KENO HILL SILVER DISTRICT MINING OPERATIONS

RECLAMATION AND CLOSURE PLAN

Version 9

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Prepared for:

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Submitted to:

YUKON WATER BOARD AND ENERGY, MINES AND RESOURCES

VERSION HISTORY

ISSUE DATE	DESCRIPTION AND REVISIONS MADE
January 2008	Water Licence Application & Mining Land Use Approval Amendment Request, Bellekeno Advanced Underground Exploration & Development, Keno Hill Silver District, Yukon, Section 2.8.2 Decommissioning and Reclamation
March 2009	Bellekeno Exploration Closure Plan Issued pursuant to Quartz Mining Land Use Approval (MLU) LQ00240 Section 127
July 2009	Preliminary Decommissioning & Reclamation Plan, Bellekeno Mine, Keno Hill Silver District Submitted as part of the Bellekeno Mine permitting process and approved under Water Licence (WL) QZ09-092
January 2011	Reclamation and Closure Plan (RCP), Bellekeno Mine, Keno Hill Silver District Updated plan issued pursuant to Quartz Mining Licence (QML) QML-0009 Section 9.2
November 2011	Bellekeno Mine, Keno Hill Silver District, Reclamation and Closure Plan Addresses review comments on the January 2011 plan to fulfill QML-0009 Section 9.2 requirements
September 2012	Preliminary Decommissioning & Reclamation Plan, Bellekeno Mine, Keno Hill Silver District, Revision 2 Submitted as part of the Lucky Queen and Onek mines WL QZ12-053-1 application (exhibit 1.10.1) Plan includes reclamation and closure measures for the Bellekeno Mine operations and infrastructure, the District Mill, Dry Stack Tailings Facility (DSTF) as well as measures for the Lucky Queen and Onek mines.
October 2014	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 3 Submitted as part an application to amend QML-0009 to include the Flame & Moth deposit and pursuant to paragraph 9.5 of QML-0009 which requires an updated RCP every two years. Update included reclamation and closure measures for the Bellekeno, Lucky Queen and Onek mine operations and infrastructure, the District Mill, DSTF Phases I-II as well as measures for closure the Flame & Moth Mine and changes made to existing facilities to accommodate development and production at Flame & Moth.
July 2015	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 4 Submitted as part of the Flame & Moth Mine WL QZ09-092-2 application (exhibit 1.10.1) Revision 4 issued as required under the QML-0009, which requires an update to the RCP every two years.
February 2018	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 5 Revision 5 issued as required under the QML-0009, which requires an update to the RCP every two years.
April 2019	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 5.1 Revision 5.1 reflects the mine plan outlined in the company's March 2017 Preliminary Economic Assessment and includes production from Bellekeno, Flame and Moth, Bermingham and Lucky Queen over an eight-year period
November 2021	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 6 Revision 6 includes the mine plan outlined in the company's April 2021 Technical Report and includes production from Bellekeno, Flame & Moth, Bermingham and Lucky Queen over an eight-year period
October 2022	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 7 Revision 7 issued pursuant to condition 7.2 of QML-0009 (November 27, 2019) and Clause 133.b) of WL QZ18-044 which require updates to the RCP every two years
November 2023	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 8 Revision 8 issued pursuant to condition 7.2 of QML-0009 and Clause 133.b) of WL QZ18-044 which require updates to the RCP every two years
August 2024	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 8.1 Revision 8.1 incorporated responses to comments received from YWB
May 2025	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 8.2 Revision 8.2 incorporated responses to comments received from FNNND and revised closure cost estimate
November 2025	Version 9 issued pursuant to condition 7.2 of QML-0009 and Clause 133.b) of WL QZ18-044 which require updates to the RCP every two years

VERSION 9 DOCUMENT REVISIONS

SECTION	SUMMARY OF CHANGES
Entire Document	Updates throughout document to improve understanding. Updated photos and figures to represent current conditions.
Version History	Table updated to reflect revision requirements of WL
Document Revisions	Table indicates areas where changes have been made to the previous revision of the Plan
Concordance Tables	QML-0009 Schedule C conditions include changes as of August 2025 Concordance to Yukon Environmental Assessment Act (YESAA) evaluation report commitments and decision document terms and conditions added
Section 1.1	Table 1-1 updated
Section 1.2	Bellekeno waste rock facilities removed from list of mine components Cemented tailing batch plant added Table acknowledging external technical support added
Section 1.3	YESAA review for expansion project added
Section 2.3	YESAA review for expansion project added Plan for collaboration with FNNND on future RCP updates expressed
Section 2.4	Updated to include current research programs and to improve readability
Section 3.1	Separated safety risks from future land use in first paragraph bullet points. Directed to concordance tables to cross-reference closure objectives and criteria raised during YESAA assessments RCP version 8.2 Table 3-2 incorporated into QML concordance table RCP version 8.2 Table 3-3 included as Table 3-2 in version 9: revised to reflect advancement on closure plan objectives
Section 3.2	New subsection added for site-specific closure objectives Placeholder section to be expanded in subsequent versions to include outcomes of engagement with stakeholders
Section 3.3	Was Section 3.2 in RCP version 8.2 text replaced
Section 3.4	Was Section 3.3 in RCP version 8.2
Section 3.5	Was Section 3.4 in RCP version 8.2 Table 3-3 (was Table 3-5 in version 8.2) updated completion criteria to reflect closure options
Section 4	Socio-Economic Description separated from Environmental Description Was section 4.7 in RCP version 8.2 Figure illustrating FNND traditional territory and settlement land parcels added
Section 5	Environmental conditions detailed descriptions, analysis and supporting data found in the 2025 Site Characterization Report included as Appendix 2
Section 6.1	Table 6-1 updated to reflect activities as of Q3 2025
Section 6.3	Mining at Bellekeno removed from mine plan Updated Life of Mine Table 6-7 updated and scheduled renamed Baseline Master Project Schedule for Operations, Decommissioning and Reclamation to conform with YG PEP terminology
Section 6.4	Use of cemented tailings as backfill added to mining methods Mining methods update for clarity and to reflect current processes Section 6.4.3 updated to reflect current conditions and future plans for N-AML WRDA at Flame & Moth.
Section 6.5	Updates to current water management systems.
Section 6.6	Updates to reflect Mill Pond and DSTF water conveyance improvements.
Section 6.7	Updated to reflect recent geotechnical investigations, construction of DSTF P2 and the current status of DSTF P1 DSTF Phase 2 subdivided into Phase 2 East and Phase 2 West
Section 6.9	Upgrades to camp facilities and improved waste management and potable water treatment systems added.

SECTION	SUMMARY OF CHANGES
Section 6.11	Updates to reflect risk management tools used such as the Trigger Action Response Plans and the Adaptive Management Plan.
Section 7.1	Description of activities on DSTF revised
Section 7.2	Description of activities at Bellekeno Mine site updated
Section 7.3	Description of progress made in the removal of special waste between 2021 and 2024 expanded on
Section 8	Requirement to notify Yukon Water Board and Director of Mineral Resource upon Temporary Closure added
Section 9	Reference to updated drawings
Section 0	Table 9-1 updated to reflect status as of Q3 2025
Section 9.1	Description of Bellekeno closure measures expanded on
Section 9.2	Section 9.2.1 Updated Section 9.2.2 Closure measures revised to reflect current knowledge Section 9.2.3 Updated to reflect changes to site and current knowledge
Section 9.3	Future N-AML WRDA at Flame & Moth added Updated to reflect current site status Section 9.4.4.2 Contouring of cover on Bermingham Southwest Pit to promote shedding of water added
Section 9.4	Directed to Project Execution Plan for further details on component reclamation Section 9.4.1 Updated to better reflect Table 3-2and Table 3-3 Section 9.4.4 status of *in situ* water treatment updated
Section 9.4.5	Revised to reflect mine infrastructure currently in place
Section 9.11	Cover Design and revegetation closure plan revised
Section 9.12	Revised to incorporate linkages to the PEP
Section 9.13	Was Section 8.14 in revision 8.2 Section 9.13.2 DSTF Risk Assessment section updated to summarize updated TARP and to incorporate 2024 Failure modes and effects analysis of Phase 2t
Section 10	Majority of this section was removed and will be included in the Project Execution Plan
Section 11	Update to agreed with EMR's January 2025 evaluation and to reflect inflation and changes to infrastructure and work packages
Appendix 1	DSTF Cover System Performance Monitoring Plan added Gap Assessment Bellekeno *In Situ* Treatment Program added Silver King In Situ Treatment Performance Memo updated Bellekeno Semi Passive Treatment Data Review and Gap Analysis Report
Appendix 2	Updated Site Characterization Report
Appendix 3	Bermingham WRSA Design Report Flame and Moth WRSA Design Report DSTF P2E Tailings Deposition Plan AKHM Monitoring Well Drilling Report DSTF P2 FMEA

WATER LICENCE QZ18-044 CONCORDANCE TABLE

CLAUSE	WATER LICENC CONDITION	WHERE ADDRESSED
133	The Licensee must update and submit to the Board exhibit 1.9.1. to 1.9.5, *Reclamation and Closure Plan: Keno District Mine Operations, Keno Hill Silver District* (RCP)and 1.9.5.1, Updated AKHM Cost Estimate Nov13_2019 in the following manner: a) the first update must be submitted on or before November 27, 2021; b) subject to paragraph (c), all subsequent updates must be submitted every two years on or before November 27th of the second year; or c) at any time an update is required by order of the Board.	This document
134(a)	Detailed reclamation schedule for the period of active closure as per Section 8.1 of the *Reclamation and Closure Planning for Quartz Mining Projects: Plan requirements and closure costing guidance – August 2013* (RCPQMP);	2025 RCP R9 PEP Table 6-3 Table 9-4 Table 11-5 Section 10
134(b)	A detailed execution strategy for the period of active closure including a personnel staffing chart as per Section 8.2 of the RCPQMP including the transportation, housing, planning, staffing and supervision requirements of the post-closure years as per Section 8.2 of the RCPQMP;	2025 RCP R9 PEP Section 10.2
134(c)	Updates on all DSTF engineered cover designs and modelling of expected cover performance, incorporating the results of ongoing research and data collection (geochemical characterization);	Section 2.3 Appendix 1.1 Appendix 1.2
134(d)	Results of reclamation research activities and a description of any revisions to the research program with rationale for those revisions;	Section 2.3
134(e)	Results of any closure planning studies or research completed since the previous RCP was submitted, account for any changes in environmental conditions arising from monitoring, any further development of the logistical execution of the plan, and must include any additional design details for closure measures that have been developed;	Section 2.3 Appendix 1
134(f)	Updated and detailed closure cost estimates for all existing and proposed work, including, but not limited to, the following: i. all changes required by this license; ii. a Microsoft Excel security costing workbook, with all supporting spreadsheets including and describing all formulas and assumptions; iii. a detailed inventory of waste rock storage sites and their capacities, as well as a survey of all P-AML and ore temporarily stored on surface on the two-year anniversary of the RCP which includes: i. location of material; and ii. tonnages and volumes; iv. a detailed cost estimate to haul and place P-AML waste rock and ore permanently underground, which includes the following details: i. equipment types and quantities; ii. productivity assumptions for the haulage equipment; iii. haulage distances to permanent disposal sites and the anticipated long- term groundwater characteristics of each site (saturated or dry); iv. a detailed cost estimate for this activity including all equipment rental and operating costs and general mine expenses including adequate supervision; and v. a demonstration of compliance with YWCB safety requirements for work inside any underground mine	Section 6.4.3 Section 6.5.3 Section 9.3.1 Section 11 2025 RCP R9 PEP Section 11 PEP
134(g)	Descriptions, preliminary designs, and installation methodology for all mine closure facilities, including: i. all mine bulkheads and ventilation raise caps; and ii. the mine pool injection system;	Appendix 3.1 Appendix 3.7

CLAUSE	WATER LICENC CONDITION	WHERE ADDRESSED
134(h)	A detailed description of water management and treatment activities planned for the post- closure years, including: i. the location of permanent mine effluents and any plans for collection, transportation, and/or treatment; ii. the installation, maintenance, or operation of any water collection or transfer systems, such as ditches, collection ponds, pumping systems, or truck haulage; iii. the operation and maintenance of any active or inactive water treatment facilities; iv. the operation and maintenance of the mine pool injection system; and v. the installation of any new water treatment facilities such as bio-reactors;	Section 9.4.5
134(i)	A detailed summary of findings or description of all planned additional kinetic testing including: i. saturated columns for backfill material at each mine; and ii. humidity cell(s) and saturated column(s) for tailings;	Section 2.3 Appendix 2
134(j)	A detailed summary of findings or detailed description of seasonal water quality objectives including: i. the development of site specific WQO for arsenic; ii. details on how water quality objectives will be developed for KV-111 (upstream of KV-21 on No Cash Creek); and iii. an update on seepage chemistry predictions or investigations.	Section 3.4.2 Section 9.4.1 Section 9.4.5 Section 9.12 Appendix 3.3

QUARTZ MINING LICENCE QML-0009, AUGUST 21, 2025 - SCHEDULE C CONCORDANCE TABLE

CLAUSE	QUARTZ MINING LICENSE SCHEDULE C CONDITION	WHERE ADDRESSED
4.1	The 2025 Reclamation and Closure Plan, as required pursuant to condition 7.2 of the License, is required to incorporate the following:	
4.1 (a)	Provide measurable closure completion criteria for all units and what monitoring /performance indicators will be used to evaluate success, including: i. a summary of how consultation on end land use objectives with the First Nation of Na-cho Nyäk Dun were incorporated into the plan ii. if development and consultation on the closure completion criteria is not yet complete, a summary of: a. proposed plan to identify and collect the necessary information to determine criteria; and b. what milestones have been achieved to-date and are projected to be completed prior to the 2027 Reclamation and Closure Plan update	Section 2.2
4.1 (b)	Develop and implement a detailed revegetation research program. Provide description on how the revegetation approach achieves end land use objectives, including: i. results for cover and revegetation trial plots to support design approach; and ii. additional investigations on potential metal uptake in vegetation, to support decision-making about closure measures, including the need for and design of covers, selection of vegetation species, and implications of mine water discharges on contamination in vegetation.	Section 2.3
4.1 (c)	Provide all available data on the performances of the Silver King in-situ treatment, including: i. results for performance data up to 2025; ii. a discussion on how the updated data potentially impacts the design and planning of in situ treatment for Bellekeno and Bermingham; and iii. a water quality comparison between the Bellekeno and Bermingham sites and the water quality at Silver King.	Section 9.4.4 Appendix 1.3 Appendix 1.4
4.1 (d)	Provide updated predictions on mine flows with depth at both Flame and Moth and Bermingham, including:	Appendix 2

CLAUSE	QUARTZ MINING LICENSE SCHEDULE C CONDITION	WHERE ADDRESSED
	i. updated water treatment plans (mine pool treatment, mill pond bioreactor) and closure strategies based on updated predictions; ii. details on the use of the mill pond as a bioreactor; and iii. assessment of groundwater wells that have been consistently dry for more than two years and/or have structural issues preventing sampling, for decommissioning and replacement to prevent gaps in monitoring network. Provide schedule for those evaluated for decommissioning and replacement.	Section 9.4
4.1 (e)	Provide updated kinetic results (inclusive of waste material produced from Flame and Moth and Birmingham mines) and demonstrate how the results have been considered and addressed.	Appendix 2 Section 3.4
4.1 (f)	Provide updated geotechnical stability analyses for the DSTF (all phases), including: i. any information gathered from the investigation into the permafrost thaw induced cracking in the DSTF Phase I and how it is being incorporated into Phase II designs and construction, and long-term stability monitoring for the DSTF iii. review of the 2012 FMEA to ensure seismic criteria meets current guidelines (e.g. Mining Dams guidelines 2014 and 2019 by the CDA).	Appendix 3.5 Appendix 3.13
4.1 (g)	Provide completed monitoring and analyses on the DSTF cover performance (inclusive of all available data), including: i. purpose/primary objective(s) of the cover; ii. detailed description of the monitoring plan for closure; iii. results of all characterization and performance monitoring programs; iv. results of all engineering evaluations of the cover; and v. an estimate of the reduction in precipitation infiltration from the area of the DSTF that was covered based on performance data to-date.	Appendix 1.1 Appendix 1.2 Appendix 1.7 Section 9.11
4.1 (i)	Provide summary of Bellekeno closure activities, including: i. details on the type of materials used for backfill and procedures used to backfill stopes; ii. results of monitoring and confirmation testing for closure activities completed to date (e.g. PAML waste rock storage facility decommissioning, etc.) iii. location of P-AML material underground, crown pillars and any stability assessment results; iv. results of hydrogeological study during mine operations; v. results and summary of all targeted campaigns of water sampling and reagent additions following the cessation of mining; vi. description of the planned sequencing for constructing, commissioning, and transitioning water treatment systems and contingencies. vii. description of permanent infrastructure requirements for delivery and mixing of reagents in the mine pool and periodic maintenance and replacement of such infrastructure; viii. description of the planned sequencing for adit closure and access requirements for long term addition of reagents	Appendix 1.5 Section 8 Section 9
4.1 (i)	Provide clarification on which specific closure concept is to be used for the following locations: (1) Bellekeno East Portal; (2) Bellekeno 625 Adit; and (3) 200 Level Vent Raise including: i. geochemistry of any rock fill material i. volume of overburden removal required; ii. location of coffer dam in engineered drawings; iii. supporting appendices reflect the chosen closure concept; and iv. signed and sealed engineered drawings.	Section 9.1.2
4.1 (j)	Submit a Project Execution Plan for implementation of the 2025 Reclamation and Closure Plan	2025 RCP R9 PEP

Table of Contents

1 INTRODUCTION 1

1.1 Overview 1
1.2 This Document 1
1.3 Permits and Authorizations 2

2 RECLAMATION AND CLOSURE PLANNING 7

2.1 Reclamation and Closure Plan Basis 7
2.2 Comprehensive Cooperation and Benefits Agreement 8
2.3 Reclamation Research 9

3 CLOSURE OBJECTIVES AND DESIGN CRITERIA 12

3.1 Design Basis 12
3.2 Advancement of Closure Objectives 16
3.3 Integration with Legacy Sites Reclamation Planning 16
3.4 Design Criteria 16
3.5 Completion Criteria for Mine Components 17

4 SOCIO-ECONOMIC DESCRIPTION 22

4.1 Land and Resource Use 24
4.2 Local Economy and Human Resources 25

5 ENVIRONMENTAL DESCRIPTION 26

6 PROJECT DESCRIPTION 27

6.1 History 27
6.2 Summary of Mining and Milling Operations 28
6.3 Mine Plan 29
6.4 Mining 34
6.5 Mine Water Management 59
6.6 Milling Operations 67
6.7 Dry Stack Tailings Facility 74
6.8 Electrical Power 80
6.9 Camp Facilities 81
6.10 Monitoring 82
6.11 Risk and Adaptive Management 82

7 PROGRESSIVE RECLAMATION 85

7.1 Dry Stack Tailings 85
7.2 Bellekeno Mine 88

7.3 Special Waste 91

8 TEMPORARY CLOSURE 92

8.1 Site Security, Monitoring and Maintenance 92
8.2 Physical Stability and Geochemical Stability 93
8.3 Reporting 93

9 FINAL RECLAMATION AND CLOSURE MEASURES 96

Disturbance area by mine component 96
9.1 Underground Workings and Openings to Surface 99
9.2 Dry Stack Tailings Facility 105
9.3 Waste Rock and Ore Storage and Overburden Areas 107
9.4 Water Management Structures and Systems 110
9.5 Mine Surface Infrastructure 127
9.6 Mill Infrastructure 129
9.7 Flat Creek Camp 135
9.8 Roads and Other Linear Features 135
9.9 Waste Materials 138
9.10 Borrow Materials Planning 140
9.11 Cover Design and Revegetation 141
9.12 Monitoring and Maintenance 144
9.13 Performance Uncertainty and Risk Management 148

10 CLOSURE IMPLEMENTATION AND PROJECT EXECUTION PLAN 151

10.1 Project Execution Plan 151
10.2 Implementation Strategy 151
10.3 Regional Framework and Financial Independence 152

11 RECLAMATION AND CLOSURE LIABILITY 153

12 REFERENCES 194

LIST OF TABLES

Table 1-1: Keno Hill Silver District mining operations overview 1
Table 1-2: List of External Technical Support 2
Table 1-3: Relevant assessment and regulatory approvals 3
Table 3-1: Fundamental Mine Reclamation and Closure Objectives (YG, 2013) 12
Table 3-2: Performance Objectives for Key Minesite Features 14
Table 3-3: AKHM Reclamation Units Completion Criteria 19
Table 5-1: Keno Hill Silver District Environmental Setting Summary 26
Table 6-1: Keno Hill Silver District Mine Operations Timeline 28
Table 6-2: Keno Hill Silver District Mining Operations Summary 29
Table 6-3: Keno Hill Silver District Mining Operations Projected Timeline 29
Table 6-4: Keno Hill Mine Operations LOM Plan for Flame & Moth and New Bermingham Mines 31
Table 6-5: Life of Mine Plan for Flame & Moth 31
Table 6-6: Life of Mine Plan for New Bermingham 31
Table 6-7: Baseline Master Project Schedule for Operations, Decommissioning and Reclamation 32
Table 6-8: District Mill Design Criteria 68
Table 6-9: Dry Stack Tailings Facility Components 74
Table 8-1: Summary of Care and Maintenance Activities and Surveillance during Temporary Cessation of Mining Activities 95
Table 9-1: Summary of Disturbance Area by Mine Component 96
Table 9-2: Underground workings and openings to surface 99
Table 9-3: Mine Water Management Summary 110
Table 9-4: Underground Mines Water Management Schedule 112
Table 9-5: Total Cadmium and Zinc Data from Untreated Bellekeno and Silver King Mine Discharges 116
Table 9-6: Dissolved Arsenic, Cadmium, and Zinc Data from Untreated New Bermingham and Silver King Mine Discharges 121
Table 9-7: Building construction style 130
Table 9-8: Keno Hill Silver District Mining Operations MDMER Surface Water Monitoring Program 145
Table 9-9: Keno Hill Silver District Mining Operations Surface Water Monitoring Program Summary 146
Table 9-10: Keno Hill Silver District Mining Operations Groundwater Water Monitoring Program Summary 147
Table 11-1: Summary Table of Estimated Closure Costs - Keno Hill Mine Operations 157
Table 11-2: Keno Hill Mine Operations Unit Rates 158
Table 11-3: General and Administration Costs 160
Table 11-4: Exploration Disturbances 161
Table 11-5: Closure Planning 162
Table 11-6: Mine Workings - Underground 163
Table 11-7: Waste Rock and Borrow Pits 170
Table 11-8: Mill & Ancillary Facilities 175
Table 11-9: Dry Stack Tailings Facility 178
Table 11-10: Waste Disposal/Remediation 180
Table 11-11: Landfill 181
Table 11-12: Roads and Trails 182
Table 11-13: Water and Solutions Management 184
Table 11-14: Interim Care and Maintenance 189
Table 11-15: Post Closure, Care, Maintenance and Monitoring 190

LIST OF FIGURES

Figure 1-1: Project Location 4
Figure 1-2: Keno Hill Silver District Mining Operations Overview 5
Figure 1-3: Site Reclamation and Decommissioning Plan Components 6
Figure 4-1-NNDFN Settlement Lands 23
Figure 6-1: Mechanized Cut and Fill Lifts with Uphole Stopes Section 34
Figure 6-2: Shanty MCF Development Shapes Example 35
Figure 6-3: (Downhole) Longhole Stoping 36
Figure 6-4: Uphole Longhole Stoping 37
Figure 6-5: Bellekeno Minesite Overview 41
Figure 6-6: Bellekeno Mine As-Built at EOM 42
Figure 6-7: Flame & Moth Mine Surface Facilities, August 2025 44
Figure 6-8: Flame & Moth P-AML Waste Rock Storage Facility, August 2025 45
Figure 6-9: Flame & Moth Plan View Showing Ore Zones 46
Figure 6-10: Flame & Moth Life of Mine Plan and As-Built (Y/E 2024) 46
Figure 6-11: New Bermingham P-AML Waste Rock Storage Facility, September 2025 50
Figure 6-12: New Bermingham Life of Mine Plan and As-Built (Y/E 2024) 50
Figure 6-13: Lucky Queen Mine Layout 53
Figure 6-14: Lucky Queen Mine As-Built March 8, 2013 54
Figure 6-15: Onek 990 Mine Layout 57
Figure 6-16: Onek As-built 30 May 2013 58
Figure 6-17: Existing Bellekeno 625 Water Treatment Process Flow Diagram 60
Figure 6-18: Flame & Moth and Mill Ponds As-Built Site Plan and Cross Sections 63
Figure 6-19: Flame & Moth Water Treatment Plant Process Flow 64
Figure 6-20: Bermingham Water Treatment Ponds As-Built 66
Figure 6-21: New Bermingham Water Treatment Plant Process Flow 67
Figure 6-22: District Mill Process Flowchart 69
Figure 6-23: Mill Infrastructure Overview 71
Figure 6-24: DSTF Phase I Plan View 76
Figure 6-25: DSTF Phase 1 Sections 77
Figure 6-26: DSTF Phase 1 Final Construction Plan with Phase 2 East Footprint 78
Figure 6-27: DSTF Phase II East Deposition Cross Section 79
Figure 9-1: Portal Closure Typical Adit Closure Design 101
Figure 9-2: Shaft/Raise to Surface Typical Concrete and Backfilled Caps 102
Figure 9-3: Bellekeno 625 *In Situ* Treatment Process Flow and Instrumentation Diagram 116
Figure 9-4: Sections and Details Concrete Cofferdam Adit Closure 118
Figure 9-5: Total and Dissolved Cadmium and Zinc Concentrations in Water Discharged from the Silver King Mine Before and During *In Situ* Treatment Pilot Test 119
Figure 9-6: Bellekeno 625 Bioreactor Design 124
Figure 9-7: Bellekeno 625 Bioreactor Design Sections 125
Figure 9-8: Roads Subject to Standard Decommissioning and Reclamation 137
Figure 9-9: Risk Assessment Process Flow Chart 149

LIST OF PHOTOS

Photo 6-1: Former Bellekeno P-AML WRSF (decommissioned and reclaimed) 39
Photo 6-2: Bellekeno N-AML waste rock used for construction of Bellekeno Haul Road 39
Photo 6-3: Bellekeno East Portal 40
Photo 6-4: Flame & Moth P-AML Pad and Mill Ore Pad 43
Photo 6-5: New Bermingham Surface Infrastructure, October 2023 48
Photo 6-6: New Bermingham Surface Infrastructure, November 2025 49
Photo 6-7: New Bermingham P-AML Waste Rock Storage Facility #1 49
Photo 6-8: Lucky Queen Portal 51
Photo 6-9: Lucky Queen Portal Pad (October 2023) 52
Photo 6-10: Onek 990 Portal Shed (October 2023) 55
Photo 6-11: Onek Mine Surface Overview 56
Photo 6-12: Flame & Moth Settling Pond and Mill Pond 62
Photo 6-13: New Bermingham Settling Pond 66
Photo 6-14: Ore Stockpile and Flame & Moth P-AML Pad 70
Photo 6-15: Fine Ore Storage, Secondary and Primary Crusher Building 72
Photo 6-16: Mill Expansion and Assay Lab 72
Photo 6-17: Mill MCC 72
Photo 6-18: Crusher MCC 72
Photo 6-19: Mill Pond November 2025 73
Photo 6-20: Electrical Substation 80
Photo 6-21: Flat Creek Camp – 2025 81
Photo 7-1: DSTF Progressive Reclamation, June 2012 86
Photo 7-2: DSTF Progressive Reclamation, August 2013 86
Photo 7-3: DSTF Progressive Reclamation, September 2016 87
Photo 7-4: DSTF Progressive Reclamation, August 2023 87
Photo 7-5: DSTF P1 and P2, August 2025 88
Photo 7-6: Bellekeno Fuel Tank Farm – 2021 90
Photo 7-7: Bellekeno Fuel Tank Farm – 2023 90
Photo 9-1: Bellekeno 625 WTP Area Overview 120
Photo 9-2: Bellekeno 625 Surface Facilities – October 2023 128
Photo 9-3: Mill Building 132
Photo 9-4: Assay Lab and Mill Extension 132
Photo 9-5: Crushing Plant – November 2023 133

LIST OF APPENDICES

Appendix 1 Reclamation Research Summary Reports

Appendix 1.1 Dry Stack Tailings Facility Cover System Performance and Monitoring Plan

Appendix 1.2 2012 DSTF Interim Reclamation and Cover Summary Report

Appendix 1.3 2025 Gap Assessment Bellekeno In Situ Treatment Program

Appendix 1.4 2016 Silver King In Situ Demonstration Test Interim Report

Appendix 1.5 Silver King In Situ Treatment Pilot – 2024 Update

Appendix 1.6 Galkeno 900 Bioreactor Performance Report

Appendix 1.7 Preliminary Assessment of Performance for WRSA Closure Cover Systems

Appendix 1.8 No Cash Creek Attenuation Study Interim Report

Appendix 1.9 Christal Creek Attenuation Study Interim Report

Appendix 2 Supporting Environmental Data

Appendix 3 Engineering Supporting Documents

Appendix 3.1 Engineering Design Package

Appendix 3.2 Typical Waste Containment Facility Design, EBA 2008

Appendix 3.3 Geochemistry Summary for Waste Rock and Tailings

Appendix 3.4 Flame & Moth Waste Rock Disposal Area Design

Appendix 3.5 DSTF Risk Assessment

Appendix 3.6 Keno Hill In Situ System Operations and Maintenance Plan

Appendix 3.7 Bioreactor Design and Operation Plan

LIST OF ACRONYMS AND ABBREVIATIONS

ACG	Access Consulting Group
AEG	Alexco Environmental Group
AKHM	Alexco Keno Hill Mining Corp.
AL	Aquatic Life
AMC	Access Mining Consultants
AMI	Adaptive Management Initiative
AMP	Adaptive Management Plan
ARD	Acid Rock Drainage
BK	Bellekeno
CCBA	Comprehensive Cooperation and Benefits Agreement
CCME	Canadian Council of Ministers of the Environment
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
COPC	Contaminates of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRF	Cemented Rock Fill
DIAND	Department of Indian Affairs and Northern Development
DSTF	Dry Stack Tailings Facility
DW	Drinking Water
ECCC	Environment and Climate Change Canada
EDI	Environmental Dynamic Inc.
EOM	End of Mine Life
EMR	Energy, Mines and Resources
EQS	Effluent Quality Standard
ERDC	Elsa Reclamation and Development Company
FMEA	Failure Modes and Effects Analysis
FNNND	First Nation of Na-Cho Nyäk Dun
GCMP	Ground Control Management Plan
INAC	Indigenous and Northern Affairs Canada
KHM	Keno Hill Mining Company Limited
KHSD	Keno Hill Silver District
LHD	Load Haul Dump
LHOS	Long Hole Open Stoping
LOM	Life of Mine
LTF	Land Treatment Facility
MAP	Map Annual Precipitation
masl	metres above sea level
mbgs	meters below ground surface
MCC	Motor Control Centre
MCF	Mechanical Cut and Fill
MDMER	Metal and Diamond Mining Effluent Regulations
MRP	Management Response Plan
MSR Plan	Monitoring, Surveillance and Reporting Plan
N-AML	Non-Acid Metal Leaching

NVP	Net Present Value
PAL	Protection of Aquatic Life
P-AML	Potentially-Acid Metal Leaching
PEP	Project Execution Plan
PFU	Polyurethane Foam
QA	Quality Assurance
QC	Quality Control
QML	Quartz Mining Licence
RCP	Reclamation and Closure Plan
RCPQMP	Reclamation and Closure Planning for Quartz Mining Projects
ROC	Registered Outfitters Concession
RTC	Registered Trapline Concession
TSS	Total Suspended Solids
TYCL	Treadwell Yukon Company Limited
UKHM	United Keno Hill Mines Limited
VTF	Valley Tailings Facility
WL	Water Licence
WQO	Water Quality Objective
WRDA	Waste Rock Disposal Area
WRSF	Waste Rock Storage Facility
WTP	Water Treatment Plant
YCSR	Yukon Contaminated Sites Regulation
YESAA	Yukon Environmental and Socio-economic Assessment Act
YESAB	Yukon Environmental and Socio-economic Assessment Board
YG	Yukon Government
YWB	Yukon Water Board

1 INTRODUCTION

1.1 OVERVIEW

This plan describes the temporary and permanent reclamation and closure activities that will be carried out to ensure that the Keno Hill Silver District (KHSD) Mining Operations are managed in a manner that provides human and environmental protection.

Alexco Keno Hill Mining Corp. (AKHM), doing business as (dba) Hecla Keno Hill, owns and operates a series of underground silver/lead/zinc mines with a centralized mill as described in Table 1-1. Alexco Resource Corp. (dba Hecla Yukon), the parent company of AKHM, was acquired by Hecla Mining Company in September 2022.

The KHSD Mining Operations are 354 km north of Whitehorse, near Keno City in the central Yukon (63° 54' 32" N, 135° 19' 18" W; NTS 105M/14 & 105M/13). Figure 1-1 shows the project location within Yukon, while Figure 1-2 shows the site on a smaller scale proximate to Keno City. The site is within the traditional territory of the First Nation of Na-Cho Nyäk Dun (FNNND).

Table 1-1: Keno Hill Silver District mining operations overview

MINES / ORE DEPOSITS	Bellekeno (production 2010 – 2013, suspended 2013 – 2020, production 2020, temporary closure 2021) Flame & Moth (development 2018, suspended 2018 – 2020, development and production 2020 - present) New Bermingham (advanced exploration 2017 – 2018, development and production 2020 - present) Lucky Queen, Onek 990 (advanced exploration 2013, not currently active)
MILL	District Mill located in Flame & Moth Mine area (Constructed 2010) Conventional floatation process producing separate lead/silver concentrate and zinc concentrate Tailings placed in Dry Stack Tailings Facility (Established 2010) or underground as backfill
WORK FORCE	~ Camp capacity of 250 employees and contractors during active mine and reclamation operations (as per Yukon Environmental and Socio-economic Assessment Act (YESAA) file # 2018-0169 Decision Document)
AIRSTRIP	Village of Mayo, YT
CAMP FACILITIES	Flat Creek camp facilities include a trailer camp, kitchen facility, welcome center, medical clinic and fitness facility
POWER	Hydro grid power Yukon Energy, diesel power backup
WATER SUPPLY AND USE	Fresh water supply from Flat Creek and adjacent well Water treatment plants at Bellekeno 625, Flame & Moth, and New Bermingham for mine effluent Process water is recycled from the Mill Pond to the mill

1.2 THIS DOCUMENT

The KHSD Mining Operations Reclamation and Closure Plan addresses the following mine components:

- underground mining activities at the Bellekeno, Flame & Moth and New Bermingham deposits, reclamation of existing disturbances at Lucky Queen and Onek 990, and for each mine all surface support infrastructure (including but not limited to miners' dry area, office trailers, storage containers, maintenance shop, cemented tailings batch plant) and portals;
- conventional flotation mill and supporting infrastructure, warehouse, coarse ore stockpile, plant services, fuel storage area, employee dry area, offices trailers, storage containers, and mill pond;

- Dry-stack tailings facility (DSTF), Phase 1 and Phase 2;
- Flame & Moth, and New Bermingham non-acid metal leaching (N-AML) waste rock disposal areas (WRDA) and potentially-acid metal leaching (P-AML) waste rock storage facilities (WRSF);
- temporary coarse ore stockpiles;
- site access roads;
- power distribution system (power poles, transformers);
- water treatment plants and facilities;
- solid waste management facilities; and
- Flat Creek Camp accommodations.

Please refer to Figure 1-3 for the location and summary of reclamation components under this RCP.

In preparation of this update to the RCP Hecla Yukon has received technical support from specialists in various fields as listed in Table 1-2.

Table 1-2: List of External Technical Support

FIELDS	SPECIALIST
Environmental Characterization	Ensero Solutions Inc.
Civil Construction	Tetra Tech
Tailings Cover Design	Okane Consultants
Bellekeno *In Situ* Treatment Gap Assessment	Core Geoscience
Closure Liability Estimation	The Mines Group Inc.

1.3 PERMITS AND AUTHORIZATIONS

The Keno Hill mining camp has a long mining history and is a brownfields site. AKHM develops mineral resources, operates the KHSD mines, and undertakes receiving environmental monitoring and mine discharge water treatment. Hecla Yukon's wholly owned subsidiary, Elsa Reclamation and Development Company Ltd. (ERDC), undertakes remediation of the historic environmental liabilities.

Activities undertaken by AKHM are authorized under a suite of project approvals. The key existing approvals required for reclamation and closure are listed in Table 1-3. Additional minor approvals will be required to implement permanent closure measures.

Table 1-3: Relevant assessment and regulatory approvals

Purpose	YESAA Approval	QUARTZ MINING ACT APPROVAL	Water Use Licence
Bellekeno Mine Production	Project #2009-0030 Decision Document	Quartz Mining Licence (QML-0009, Amendment 2, expires 2037)[1,2]	Type A Water Use Licence QZ18-044, expires 2037[3]
Onek 990 and Lucky Queen Mine Production	Project#2011-0315 Decision Document	Quartz Mining Licence (QML-0009, Amendment 2, expires 2037)[1,2]	Use of water and the deposit of waste into water is not authorized
Flame & Moth Mine Production	Project #2013-0161 Decision Document	Quartz Mining Licence (QML-0009, Amendment 2, expires 2037)[1,2]	Type A Water Use Licence QZ18-044, expires 2037[3]
New Bermingham Mine Production	Project#2017-0176 Decision Document	Quartz Mining Licence (QML-0009, Amendment 2, expires 2037)[1,2]	Type A Water Use Licence QZ18-044 issued, expires 2037[3]

Notes:

1. https://emr-ftp.gov.yk.ca/emrweb/COMM/major-mines/keno-hill/mml-keno-qml-0009-nov2019.pdf
2. QML-0009, Schedule C amended August 21, 2025, Schedule D amended January 4, 2023
3. http://www.yukonwaterboard.ca/waterline

A project to extend the life of mine and provide for power backup is currently being assessed by YESAA (YESAA Project #2025-0068). The current version (Version 9) of the RCP considers the approved scope of work listed in Table 1-3.

Figure 1-1: Project Location





Hecla YUKON

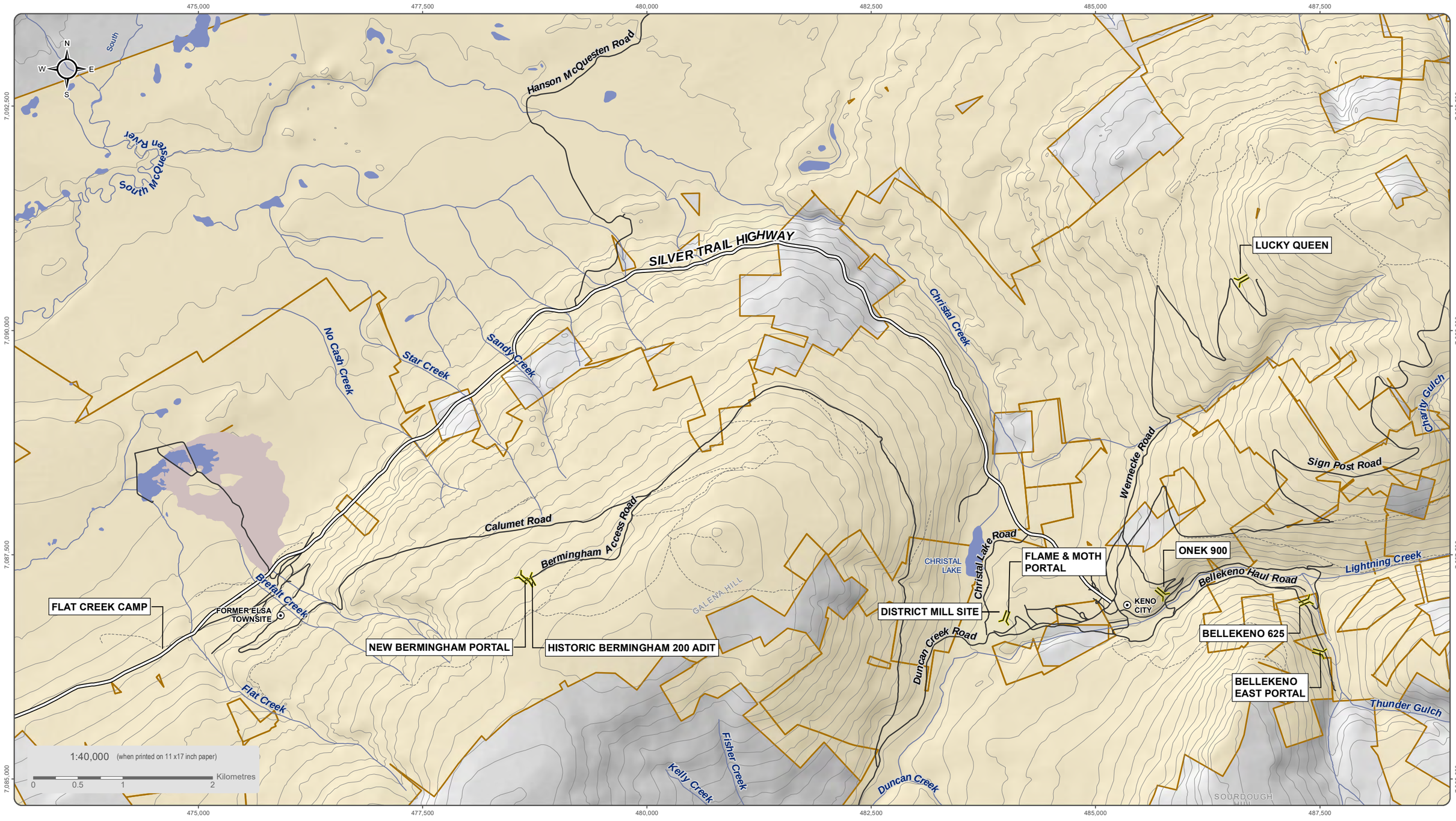
KENO HILL SILVER DISTRICT
MINING OPERATIONS

FIGURE 1-1
PROJECT LOCATION

OCTOBER 2025

D:\Project\All\Projects\ALEX-05-01\gis\mxd\Overview_Maps\Project-Location\Project_Location_ESRI_LAYERS_20170612.mxd (*Last edited by: amatlashevska; 11/01/2018/14:18 PM*)

Figure 1-2: Keno Hill Silver District Mining Operations Overview



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Datum: NAD 83; Map Projection: UTM Zone 8N

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- Adit
- AKHM/ERDC Quartz Claims
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Tailings Area
- Waterbody
- Watercourse
- Contours (100 ft intervals)

Hecla YUKON

ENSERO solutions

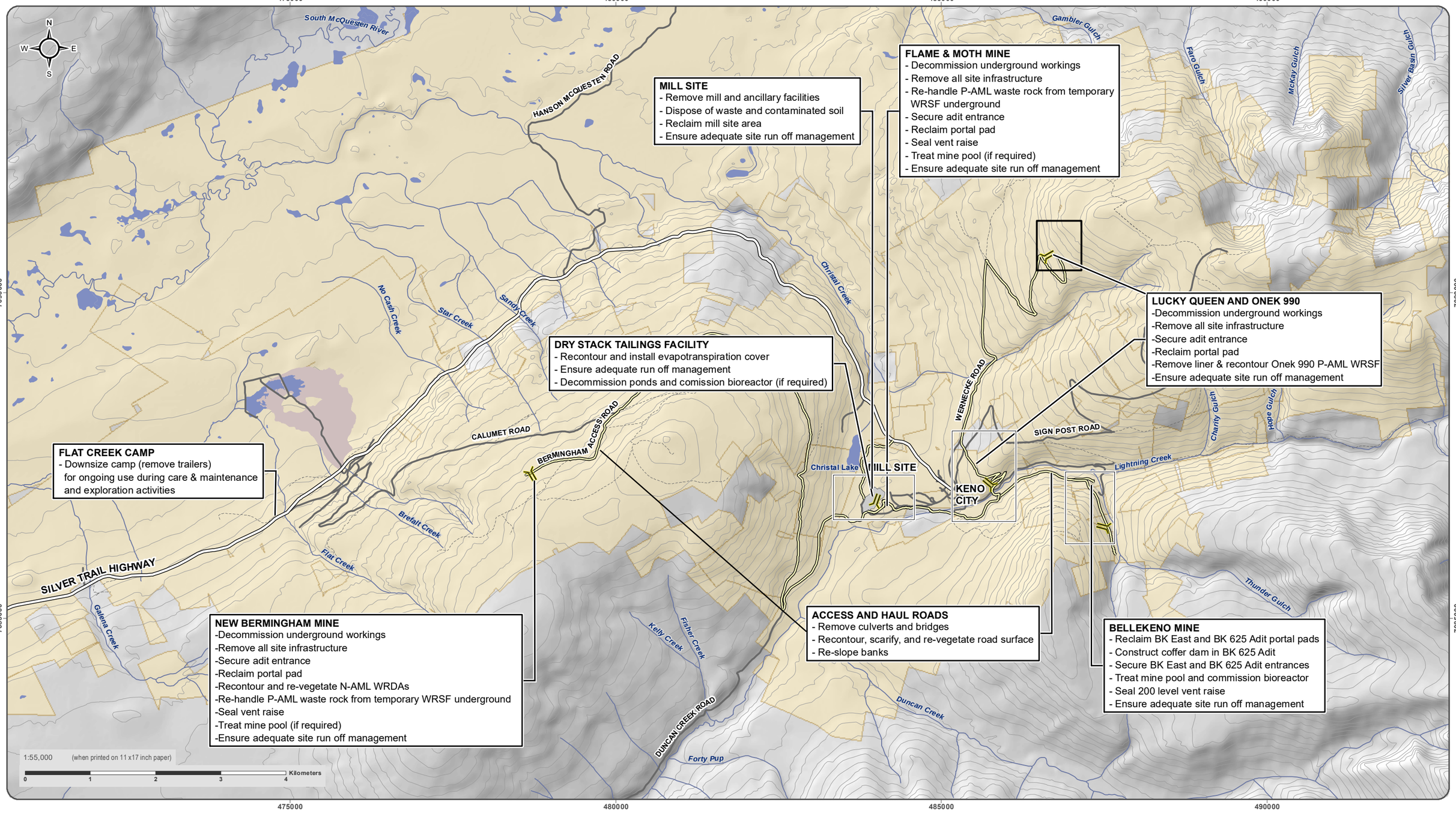
KENO HILL SILVER DISTRICT
MINING OPERATIONS

FIGURE 1-2
KENO HILL SILVER DISTRICT MINING OPERATIONS OVERVIEW

SEPTEMBER 2025

D:\Projects\AllProjects\Keno_Area_Mines\ALL-SITES\02-Map\01_Overview\01-Property Overview\01-District_Wide\Overview_20230928.mxd
(Last edited by: amattsheroka;2023-09-29/09:04 AM)

Figure 1-3: Site Reclamation and Decommissioning Plan Components



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- Adit
- KHSD Mill
- Hecla/ERDC Quartz Claims
- Waterbody
- Watercourse
- Contours (100 ft intervals)
- Silver Trail Highway
- Road
- Limited-Use Road
- Haul Road

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 1-3

SITE RECLAMATION AND DECOMMISSIONING PLAN COMPONENTS

SEPTEMBER 2025

G:\Project\All\Projects\Keno_Area_Mines\ALL SITES\02-Map\04-Closure\16-Keno Hill Reclamation Closure Plan 2021\Site_Reclamation_Plan_20230929.mxd
(Last edited by: amalia.sheyska; 2023-09-29 09:51 AM)

2 RECLAMATION AND CLOSURE PLANNING

2.1 RECLAMATION AND CLOSURE PLAN BASIS

AKHM has developed this RCP to address regulatory and government policy for mine closure. In keeping with its high standards for environmental and social responsibility, AKHM intends to implement environmentally sound and technically feasible decommissioning and reclamation measures for the mining and milling operations included in this RCP. Closure planning and implementation will be undertaken with appropriate environmental care while respecting local laws, First Nations agreements, and the public interest and ensuring that the Company's high environmental standards are achieved. Necessary environmental protection measures have been adopted in the development of this RCP to ensure that a healthy environment exists after closure.

The Yukon Department of Energy, Mines and Resources (ERM) outlined requirements to be incorporated into RCP Revision 9 in QML-0009 –Schedule C dated February 27, 2025, and the Yukon Water Board provides requirements in WL QZ18-044 Part K – Reclamation and Closure. The *Yukon Mine Site and Reclamation Closure Policy* (YG, 2006) established a foundation for mine reclamation and closure plans and financial assurance. The *Yukon Mine Site and Reclamation Closure Policy, Financial and Technical Guidelines* (YG, 2013) provide details on the procedures for calculating, reviewing and adjusting security and they provide direction on reclamation and closure objectives for key mine components. The completion criteria applied in this RCP for those key mine components is provided in Section 3.5.

In addition, principles, and approaches for reclamation planning from the *Reclamation and Closure Planning for Quartz Mining Projects, Plan requirements and closure costing guidance* (YG, 2013) are incorporated into the RCP. To achieve its purpose, the guide has the following objectives:

- Describing the context for mine closure planning in the Yukon, and the rationale for requirements to submit RCPs and liability estimates.
- Describe the principles, philosophy, and broad objectives for closure planning for Yukon mining projects.
- Describe the information expectations for RCPs and liability estimates.
- Identify key sources of additional guidance for preparing RCPs and liability estimates.

The guidance document includes methods for developing fundamental reclamation and closure objectives, methods for conducting community and regulatory engagement, reclamation and closure principles and principles for estimating liability.

The closure measures that are expressed herein are consistent with the YG reclamation and closure policy, guidelines and guidance document for mining projects and best management practices used by the mining industry today, which has in recent years developed a great deal of experience in climate change initiatives and physical stability. The overall outline and table of contents of this RCP differs slightly from the YG guidance document (YG and YWB, 2013) for purposes of report flow and site- specific mine area components but all the sections of the guidance document have been addressed.

A significant responsibility of Hecla Yukon is to develop and implement a closure plan for the historic environmental liabilities (District-Wide Closure Plan, also called the UKHM Reclamation Plan) addressing the historical mining practices in the Keno Hill Silver District. This is a public-private partnership between Alexco Resource Corp. (dba Hecla Yukon), and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)

(formerly referred to as Indigenous and Northern Affairs Canada [INAC]). The partnership provides for significant collaboration on closure objectives, applied reclamation research, and use of this information for development of the District-Wide Closure Plan.

The knowledge, science, and consultation gained from development of the District-Wide Closure Plan provides guidance for developing a Reclamation and Closure Plan for the activities associated with Hecla Yukon's subsidiary AKHM's active KHSD Mining Operations.

2.2 COMPREHENSIVE COOPERATION AND BENEFITS AGREEMENT

Since 2008, Alexco Resource Corp. and FNNND have a Comprehensive Cooperation and Benefits Agreement (CCBA) that sets out the terms of the company's remediation, mineral exploration, and development and mining at Keno Hill. It is under the terms of this agreement that Alexco Resource Corp. and FNNND have established a long-term relationship honoring the principles of economic sustainability, environmental stewardship, and self-determination of FNNND in respect to the FNNND Lands and its resources.

Hecla Yukon remains committed to:

- Maintaining a cooperative and respectful long-term relationship with the FNNND;
- Mitigating adverse impacts of its activities at Keno Hill;
- Providing business and employment opportunities related to Keno Hill's development and operation to FNNND citizens and businesses to promote their economic self-reliance;
- Establishing a role for FNNND in the assessment, permitting and environmental monitoring of Keno Hill and the promotion of environmental stewardship;
- Setting out financial provisions to enable FNNND to participate in the opportunities and benefits related to Keno Hill's development and operation; and
- Establishing a role for FNNND in the assessment, permitting and environmental monitoring of Keno Hill and the promotion of environmental stewardship.

FNNND have long been active partners in the design of the District-Wide Closure Plan as well in environmental monitoring of site operations. Engagement with the FNNND to better understand their perspectives and receive input on the design of the closure plan for the active KHSD Mining Operations is ongoing and this Plan will be updated regularly to incorporate their feedback.

Hecla Yukon continues to conduct ongoing consultation and stakeholder engagement with respect to all its activities within the Keno Hill mining camp. Consultation and engagement are conducted in a variety of forms, including:

- community meetings (Whitehorse, Mayo, Keno City),
- FNNND Chief and Council meetings,
- technical meetings with multiple stakeholders and consultants,
- site tours, and
- meetings with regulators.

The KHSD Mining Operations has been subject to four separate YESAA reviews (Table 1-3). The "Keno Hill Silver District Mining Operations Extension and Power Back-up Project" is in the Pre-submission Engagement Process under YESAA (File # 2025-0068). The Yukon Environmental and Socio-economic assessment Board (YESAB) relies on input from the public, Firsts Nations, federal, territorial and First Nations's governments along with advice from experts and academic research to evaluate projects. Advanced exploration projects leading up to the development of Bellekeno and New Bermingham mines were also reviewed under YESAA (File #s 2008-0039 and 2017-0086). The recurring issuance and renewal of the Type A water licence, and approval of plans under the QML, provide opportunities for consultation and stakeholder engagement through the submission of interventions and participation in public hearings. The KHSD Mining Operations water licence has been renewed three times since the original licence was issued (QZ09-092). Management and operating plans required under the QML are revised to reflect modifications to the activities undertaken by AKHM. Multiple plans were updated since production resumed in 2020 and further updates or new plans are underway to reflect improvements.

In addition to consultation and engagement opportunities through the assessment, licencing and plan revision process, Hecla Yukon has undertaken measures to directly speak with and receive feedback on the KHSD Mining Operations from the FNNND and Keno City residents. The focus of the consultation events and topics varies, to address the relevant issues at the time and activities within the Keno Hill mining camp, including permitting, development of the District-Wide Closure Plan or general updates on the mine development and production activities.

While this revision of the KHSD Mining Operations Reclamation and Closure Plan contains no substantial changes requiring immediate consultation, AKHM remains committed to meaningful engagement with the FNNND throughout the ongoing development of the RCP. Hecla Yukon recognizes the importance of incorporating FNNND perspectives and traditional knowledge into reclamation and closure planning. Future updates will be developed in collaboration with the FNNND, with dedicated consultation events planned to ensure their input shapes key aspects of the plan, particularly those of cultural and environmental significance to the First Nation.

To demonstrate this commitment, AKHM will:

- Establish regular meetings with FNNND representatives specifically focused on reclamation and closure planning, with additional meetings scheduled as needed.
- Conduct a collaborative priority-setting workshop with FNNND to identify and document their key concerns, values, and priorities for reclamation and closure.
- Based on these identified priorities, jointly develop measurable goals and milestones that reflect both AKHM's operational requirements and FNNND's cultural and environmental values.
- Create a formal timeline with specific deliverables and checkpoints for incorporating FNNND input into the next RCP revision.
- Provide progress updates to FNNND in monthly technical working group meetings on the advancement of these collaborative goals.
- Ensure all milestones are mutually agreed upon and formally documented to maintain alignment between AKHM and FNNND throughout the RCP development process.

2.3 RECLAMATION RESEARCH

Ongoing reclamation research and field validation of reclamation designs support site specific refinement of closure measure designs for the KHSD Mining Operations. Current research programs include:

- DSTF slope stability analyses,

- DSTF cover system design studies,
- DSTF geotechnical closure design investigations,
- assessment of New Bermingham Mine inflow rates
- natural attenuation studies,
- *in situ* treatment gap assessment at Bellekeno,
- metal uptake in vegetation investigations,
- natural revegetation rate and succession monitoring at Bellekeno Upper Laydown Yard, and
- contaminated soil and groundwater assessments at decommissioned Bellekeno facilities.

In addition, there are currently a number of reclamation activities and research programs underway as part of the ERDC District Closure Plan that will inform the closure design of the KHSD Mining Operations, including:

- *in situ* treatment at Silver King,
- reclamation performance monitoring of the legacy mines,
- revegetation monitoring of Galena Hill trials
- cover system and natural succession trials
- contaminant levels in vegetation, and
- natural attenuation studies downgradient of legacy mines.

Results from these programs will inform reclamation and closure planning decisions. Reports on the results of the reclamation research programs are included in Appendix 1. For those topics not yet reported on a brief description of the scope is provided below.

DSTF slope stability and geotechnical investigations on going and findings will be incorporated into the design basis for closure.

A revegetation research program is being carried out while the mine is in operations to determine the seed mix characteristics to be used in seeding and revegetating the covered waste rock dumps and DSTF. This program will be commensurate with research investigations carried out for waste rock dumps under the ERDC District Closure Plan and will also be sensitive to the desired level of infiltration prevention into mine facilities.

The implementation of the temporary closure of the Bellekeno Mine provides an opportunity for applied reclamation research on the *in situ* water treatment in the underground mine. Data collection during flooding and as the natural biological processes are established will provide further information on the time to establish *in situ* treatment, reagent requirements to develop the biological community (the sulphate reducing organisms), and management requirements. The Bellekeno mine provides an excellent research site as the mine waters are contained and the system for conventional lime water treatment remains in place (see Section 9.4.4).

There is an extensive program of monitoring and data collection in the Keno Hill mining camp by Hecla Yukon. These data are reported in the annual Water Licence and Quartz Mining License reports. The data programs that are particularly important to closure planning and monitoring include:

- surface water quality and hydrology,

- groundwater quality and quantity,
- waste rock geochemistry,
- tailings geochemistry; and
- meteorology.

3 CLOSURE OBJECTIVES AND DESIGN CRITERIA

3.1 DESIGN BASIS

AKHM's overall closure objective is to leave the mine site in a safe and stable condition which requires little maintenance or management in the long-term. To achieve this, each mine component is considered in terms of achieving the following at closure:

- physical stability,
- chemical stability (particularly water quality),
- minimal long-term active maintenance,
- minimal safety risks to people and wildlife, and
- future land use which considers the surrounding landscape, visual aesthetics, and traditional values.

The *Reclamation and Closure Planning for Quartz Mining Projects. Plan requirements and closure costing guidance* (YG and YWB, 2013) document provides objectives and guiding principles (Table 3-1) for the development of specific closure objectives which inform the design to attain the long-term condition. Specific design criteria for each component of the mine site as discussed in the following sections.

Table 3-1: Fundamental Mine Reclamation and Closure Objectives (YG, 2013)

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

Terms and conditions in the YESAA assessments, Water Licence and Quartz Mining License (Table 1-3) addressed in this plan as summarized in the concordance tables.

The effectiveness of closure measures implemented from this RCP will be the subject of review by regulatory agencies. Once the reclamation is complete, under the *Quartz Mining Act*, the company would be able to apply for a certificate of closure from the Yukon Government once there is agreement with their effectiveness.

Table 3-2: Performance Objectives for Key Minesite Features

EMR 2013 TECHNICAL GUIDELINE #	THEME	CLOSURE OBJECTIVE	INSTRUCTIONS FOR ACHIEVING OBJECTIVE
T-01	Water Retention and Sediment Control Structures	Ensure decommissioning of water retention and sediment control structures, and their associated infrastructure, in such a way that drainage at, and adjacent to the site, is stable in the long term.	Water treatment ponds will remain in place at the WTPs until their use for treatment is no longer required, at which time they will be decommissioned. DSTF collection and diversion structures will remain in place until their use for treatment is no longer required, at which time they will be decommissioned. Materials recovered during decommissioning (i.e., liners, sludge, sediment) will be disposed of in approved facilities. Following decommissioning the areas will be contoured and slopes stabilized with erosion barriers as required.
T-02	Watercourses	Reclaim watercourses to meet land use objectives and current DFO and YG legislation and guidelines.	The two clear span bridges (and abutments) across Lightning Creek installed for haul truck traffic will be removed. The banks will be stabilized through revegetation and strategic placement of the existing rip rap.
T-03	Water Quality	Reduce risk of introducing contamination into receiving environments. Improved loading from mine site features over time.	Promote geochemical stability of areas where waste rock will remain on surface and the DSTF. Manage water on site to meet receiving environment WQOs. Effectively manage surface water to limit deposition of deleterious substances caused by erosion. WQ bioreactor and in situ treatment to be activated at Bellekeno and if required and appropriate, at New Berm, FM.
T-04	Site Contamination	Prevent exposure to and mobilization of substances in soil that pose a risk to human health and the environment.	Conduct an environmental site assessment to locate and characterize contamination; Remediate as required to establish physical and chemical stability. Provide assessment results, restoration plans for approval and final remediation reports in accordance with YG Contaminated Sites Regulation.
T-05	Acid Rock Drainage Potential	Reduce water and oxygen ingress into materials with potential ML-ARD concerns. Reduce need for long-term active treatment.	P-AML waste rock stored on surface during operations will be placed back in the underground mine. Reduce water and oxygen ingress into mine waste materials (e.g., compaction, covering); Performance monitoring of mitigation measures for ML-ARD. Consolidate material with ML-ARD potential in appropriate containment infrastructure. Monitor where N-AML remains on surface.
T-06	Tailings Management	Promote geochemical stability in the DSTF. Ensure geotechnical stability of the DSTF.	The recontoured landform will be covered with a soil cover consisting of locally available growth medium material and revegetating with a native seed mix. Monitoring of the cover system, water management, infrastructure, geotechnical stability,

EMR 2013 TECHNICAL GUIDELINE #	THEME	CLOSURE OBJECTIVE	INSTRUCTIONS FOR ACHIEVING OBJECTIVE
			and revegetation effort. Progressive reclamation of the DSTF will occur through recontouring to design slope angle, placing growth medium, and revegetating.
T-07	Underground Workings and Openings to Surface	Reduce risk of introducing contamination into receiving environments from underground workings. Except for authorized access, prevent inadvertent or intentional underground access that may be a hazard to humans and wildlife. Mitigate risk of subsidence or changes in the topography that may result in a hazard to humans or wildlife.	Maintain treatment plant and ponds until WQ will be managed/treated to ensure compliance at discharge. Studies on-going to determine implementation techniques. Placement of rock piles and engineered caps on mine openings to block access. Ground control monitoring and maintenance - have contingency plan in place.
T-08	Terrain Hazards	Modify mine induced terrain hazards at the site to protect people and wildlife.	Monitor and maintain post closure physical site terrain hazards. Respond to developing hazards.
T-09	Mine Rock Piles	Promote geotechnical and geochemical stability in the rock piles	P-AML waste rock will be returned underground at closure. Monitor seepage and surface water quality, and geotechnical stability of rock piles and where waste rock remains in constructed features (i.e., roads, laydowns).
T-10	Roads and Other Access	Reduce risk to public safety Promote vegetation of disturbed areas Reduce risk of erosion in decommission linear infrastructure.	Scarify and add water bars (cross-ditches) on decommissioned roads. Enable public use of preexisting roads. Identify alternative future land use of roads.
T-11	Erosion Control	Upon closure disturbed lands are physically stable to reduce soil erosion, slumping and other instabilities that may impede re-vegetation, pose a risk to public safety or wildlife, or cause elevated sediment loads to enter nearby water bodies.	Monitor for erosion and maintain as necessary. Revegetate and monitor effectiveness. Slopes will be regraded for physical stability.
T-12	Re-vegetation	Promote physical stability of vegetated areas and prevent loss of wildlife habitat by re-establishing self-sustaining natural revegetation.	Conduct field trials to monitor succession to natural species. Revegetation will occur in a manner that meets EMR's Yukon *Mine Site and Reclamation Closure* Policy and that achieves the closure of objectives and reduces erosion.
T-13	Mine Infrastructure	Promote physical stability and reduce risk to public health and safety.	Remove infrastructure, buildings and equipment; and reuse or recycle materials where practical otherwise dispose of in an approved facility. Identify and remove hazardous materials to an approved facility.
T-15	Temporary Closure Site Conditions	Protect public health and safety and the environment in the event of a temporary closure	Undertake protective measures to prevent personal injury, property damage and damage to the environment.

3.2 ADVANCEMENT OF CLOSURE OBJECTIVES

AKHM is committed to advancing closure objectives through meaningful collaboration with FNNND, recognizing that successful mine closure requires the integration of Indigenous knowledge, values, and priorities throughout the planning process. Engagement with the FNNND as discussed in 2.3 will include the development of closure objectives, completion criteria and monitoring requirements for the KHSD Mining Operations as directed by FNNND priorities.

The DSTF shall be reclaimed to ensure long-term stability while enhancing the visual amenity of the site. AKHM will actively engage with the community of Keno City in the development of the DSTF cover design, incorporating community input on visual amenity objectives to ensure the final reclamation strives to align with local values and preferences.

Input from engagement with stakeholders will guide subsequent updates of this Plan.

3.3 INTEGRATION WITH LEGACY SITES RECLAMATION PLANNING

Specific closure objectives developed during workshops and meetings with stakeholders for the ERDC UKHM Reclamation Plan project apply only to the legacy sites, not current mining activities being undertaken by AKHM. However, given that we share the same watersheds with ERDC closure activities, we coordinate monitoring efforts to ensure comprehensive watershed management. This collaboration extends to sharing conceptual understanding and coordinating assessments and studies that benefit both operations. Additionally, we consider each project's reclamation and closure activities in our cumulative effects assessments, recognizing that coordinated closure planning in shared watersheds is essential for achieving long-term environmental objectives.

3.4 DESIGN CRITERIA

Design criteria for existing facilities are defined in facility design reports and summarized in Section 0. Section 9 discusses the specific design basis for each reclamation measure. Physical reclamation success directly influences physical, chemical and biological stability.

3.4.1 Physical Stability

Physical stability ensures protection against wind and water erosion, provides adequate surface drainage, and minimizes hazardous conditions, while also enabling the surface to be contoured to meet land capability objectives (Table 3-1). Physical structures such as underground openings, sedimentation and treatment ponds, spillways, surface openings and waste rock storage areas must:

- be physically stable and designed according to acceptable design criteria,
- pose minimal hazard to public and wildlife health and safety from failure or physical deterioration,
- continue to perform their intended function, and
- maintain stable land surfaces with minimal erosion.

3.4.2 Chemical Stability

Reclaimed AKHM mine sites are to achieve chemical stability by removing or controlling contamination sources such as contaminated soils, hazardous or special wastes, and acid rock drainage (Table 3-1). This approach will protect surface water and groundwater from significant adverse environmental effects and prevents harm to public and wildlife health and safety.

Water quality monitoring for both surface water and groundwater will measure chemical stability. Water quality objectives (WQOs) align with the Adaptive Management Plan (AMP) (Hecla Yukon, 2024), which undergoes annual review to evaluate indicator and threshold appropriateness. The AMP may be modified based on monitoring data trends, regulatory changes, site operations, available technology, and climate conditions. For closure design criteria specifically, surface water WQOs and monitoring stations will align with adaptive management initiative (AMI) #12 in the AMP, and groundwater WQOs and monitoring wells will align with AMI#13. (Hecla Yukon, 2024).

Wind erosion and disbursement of contamination risk is minimized by physical controls implemented during closure.

Critical monitoring aspects include short-term and long-term changes in underground mine discharge water quality, seepage and runoff from the DSTF and waste rock storage areas, and the chemistry of surface water draining from the site. Potential acid rock drainage effects through surface or ground water will be mitigated. Future waste rock and tailings facility design will complete predictive modelling of drainage water chemistry, including equilibrium and kinetic modelling to assess long-term surface and subsurface contaminant transport and stability.

Additionally, a third-party Waste Rock Audit was completed in 2025 by O'Kane Consultants. An action plan is currently being progressed to address recommendations which were identified in the audit.

3.4.3 Biological Stability

Biological stability (ecological conditions and sustainability in Table 3-1) depends on reclamation measures, end land use, and site physical and chemical characteristics. Biological stability is achieved when vegetation and wildlife habitats become stable, self-sustaining, productive, and meet the closure objectives.

3.5 COMPLETION CRITERIA FOR MINE COMPONENTS

Reclamation completion criteria will be used to assess the final reclamation obligations for the KHSD Mining Operations closure. These criteria will establish benchmarks to be used in determining when decommissioning, reclamation and monitoring programs have been completed and passive management has been implemented and maintained. The three stages of reclamation used to reach closure criteria are:

- Decommissioning – removal of structures and creation of safe geotechnical structures, removal of contaminants, implementation of water management/treatment facilities and recontouring/ revegetation.
- Rehabilitation – the return of the disturbed site to a form and productivity level that is consistent with the closure objectives. Water management/treatment facilities are in place and operational, revegetation is complete and post closure maintenance and monitoring is underway.

- Completion Criteria Conformance – monitoring and demonstration of establishment of sustainable reclamation features.

Completion criteria presented for the KHSD Mining Operations ensure that the closure measures meet overall objectives of mine site reclamation. The objectives of the completion criteria can be considered under the following three site conditions: physical stability, chemical stability, and biological stability.

Each of the Mine Area Components will reach their completion criteria at varying times in the operations and post-mining period, but all will follow the same three stages of reclamation in systematic order. In addition, adjustments to the reclamation schedule will be expected due to modifications made from new innovations in reclamation practices, seasonal climate variability and/or geotechnical setbacks. Table 3-3 provides a general overview of each Mine Area Component and the site conditions associated with meeting completion criteria.

Table 3-3: AKHM Reclamation Units Completion Criteria

RECLAMATION UNITS	COMPLETION CRITERIA CONDITIONS		
	PHYSICAL STABILITY REQUIREMENTS	CHEMICAL STABILITY REQUIREMENTS	BIOLOGICAL STABILITY REQUIREMENTS
Underground Mines and Deposits			
Bellekeno Flame & Moth New Bermingham Lucky Queen Onek 990	Monitoring of backfilled underground stopes shows stable conditions and Geotech PEng acceptance is obtained; Mine openings closure methods determined to be stabile and appropriately secured from public access.	Sites have either no direct flow from portals or Mine effluent quality requirements are met by discharge; Groundwater pathways connecting underground workings to surface represent small load contribution to receiving environment	Groundwater pathways that connect underground workings to the surface environment do not cause adverse impact to receiving environments.
Waste Rock Storage Facilities and Disposal Areas			
Areas where N-AML used for construction Flame & Moth P-AML WRSF New Bermingham P-AML WRSF New Bermingham N-AML WRDA	P-AML storage facilities decommissioned; Waste materials (i.e., liners) disposed of in approved facilities; Monitoring for geotechnically shows stable slopes; Erosion monitoring indicates no more changes.	P-AML waste rock removed from surface and disposed of in mine workings; Application of engineered closure techniques complete; Performance monitoring shows an improving trend MLARD conditions; Capture of non-compliant seepage if necessary, and treatment prior to discharge.	Safe wildlife access; Seepage and surface water runoff does not cause adverse impact to receiving environment.
Water Management Structures			
Bellekeno 635 WTP Settling Ponds Flame & Moth WTP Settling Pond New Bermingham WTP Settling Pond Mill pond	Waste materials (i.e., liners) disposed of in approved facilities; Infrastructure that impedes flow conditions removed; Monitoring for geotechnically shows stable slopes; Erosion monitoring indicates no more changes; Ponds converted to geotechnically-stable bioreactors if necessary	Removal of sludge and sediment from ponds and disposal in approved facility; Remaining surface and sub-soil does not cause adverse impact to receiving environments.	Safe wildlife access; Vegetation management shows no adverse impact to remaining structures; Ponds remaining post-closure, if necessary, to have secured access maintained.
Mine Surface Infrastructure			
Buildings Maintenance Shop Electrical Substation	Infrastructure disassembled and removed; Reuse and recycling of infrastructure if practical Infrastructure supports and foundations	Approved soil clean up goals achieved; Hazardous materials not for future use recycling elsewhere or disposed of in approved facility;	Sustainable vegetation cover; Approved soil clean up goals achieved; Surface water runoff does not cause adverse impact to receiving environment.

RECLAMATION UNITS	COMPLETION CRITERIA CONDITIONS		
	PHYSICAL STABILITY REQUIREMENTS	CHEMICAL STABILITY REQUIREMENTS	BIOLOGICAL STABILITY REQUIREMENTS
Fuel Storage Tanks and Propane Tank Laydown Yards	removed or buried and berms broken down and disposed of approved facilities.	Special waste removed and disposed of in an approved facility.	
District Mill Site			
Mill and Crushing Plant Buildings Ore Stockpile Electrical Substation Crusher and Mill Motor Control Centres Fresh Water Tank, Hazardous Materials Fuel Storage Tanks and Propane Tank Buried Infrastructure	Infrastructure disassembled and removed; Reuse and recycling of infrastructure if practical Infrastructure supports and foundations removed or buried and berms broken down and disposed of approved facilities.	Approved soil and groundwater clean up goals achieved Hazardous materials not for future use recycling elsewhere or disposed of in approved facility; Special waste removed and disposed of in an approved facility.	Sustainable vegetation cover Approved soil clean up goals achieved Surface water runoff does not cause adverse impact to receiving environment.
Dry Stack Tailing Facility			
DSTF Phase I DSTF Phase II	DSTF covered with growth medium and re-vegetated. Monitoring of erosion and mitigation if required and eventually deemed stable EOR DSTF landform geotechnically stable	DSTF geochemically stable Any seepage reporting to Christal Creek watershed will not result in an adverse impact (i.e., WQO)	Sustainable vegetation cover Safe wildlife access Metal uptake acceptable Surface water runoff does not cause adverse impact to receiving environment
Water Diversion Structures			
DSTF diversion berms	Diversion structures to remain post-closure upgraded to meet xx storm event DSTF landform geotechnically stable No significant erosion along channel banks and banks of dam structures	Capture of non-compliant seepage, Treatment evaluation of discharge for compliant seepage	Vegetation management (no adverse impact to remaining structures
Sedimentation Pond			
DSTF settling ponds	No exposed sedimentation areas No significant wind erosion Waste materials (i.e., liners) disposed of in approved facilities Removal of infrastructure that impedes flow conditions facilitate Stable surface topography of	Effluent water quality requirements as required by the Water License	Vegetation management (no adverse impact to remaining structures
Bridges and Culverts			

RECLAMATION UNITS	COMPLETION CRITERIA CONDITIONS		
	PHYSICAL STABILITY REQUIREMENTS	CHEMICAL STABILITY REQUIREMENTS	BIOLOGICAL STABILITY REQUIREMENTS
Lightning Creek Bridge Onek Bridge Culverts	Culverts from decommissioned roads removed and no surface water flow impediment; Clear span bridges and abutments removed; Monitoring of mine disturbed water course banks indicate no more changes.	Surface water runoff does not cause adverse impact to receiving environment.	Surface water runoff does not cause adverse impact to receiving environment.
Flat Creek Camp			
Accommodations Camp Wastes	Camp downsized to pre-production level; Excess infrastructure disassembled and removed; Reuse and recycling of infrastructure if practical Areas where camp buildings have been removed are stable with no significant wind or water erosion.	Approved soil clean up goals achieved; Hazardous materials not for future use recycling elsewhere or disposed of in approved facility; Special waste removed and disposed of in an approved facility.	Sustainable vegetation cover; Approved soil clean up goals achieved.
Linear Disturbances			
Haul Roads AKHM Controlled Access Roads Powerlines	Monitoring for geotechnically stability of road banks considered stable by Geotechnical Engineer Erosion monitoring indicates no more changes	Approved soil clean up goals achieved; Hazardous materials not for future use recycling elsewhere or disposed of in approved facility; Special waste removed and disposed of in an approved facility. where waste rock used monitor for ML-ARD okay	Sustainable vegetation cover; Safe wildlife access; Seepage and surface water runoff does not cause adverse impact to receiving environment; Approved soil clean up goals achieved.

4 SOCIO-ECONOMIC DESCRIPTION

The KHSD Mining Operations are within the traditional territory of the First Nation of Na-cho Nyäk Dun (FNNND) and near the communities of Keno City and Mayo. The area has been shaped by mineral development over the past hundred years. Silver and lead ore deposits were discovered on Keno Hill in the early 1900s and the area has since seen fluctuating levels of ongoing quartz and placer mining and exploration. Today, the area supports not only mineral development, but also tourism, recreation, traditional pursuits, as well as the local people.

Keno City is a small community situated at the end of the Silver Trail Highway with a population of approximately 20 permanent residents (YG, 2022). The community was originally established to support mining operations in the area and the community's population has fluctuated over the last hundred years in response to local mineral development activity. Today, Keno City comprises seasonal and full-time residences, a few small and growing businesses, the Keno City Mining Museum, and the Keno City Alpine Interpretive Centre.

The community of Mayo is located approximately 50 km from the Keno Hill mining camp. Mayo has a population of approximately 463 people (YG, 2024) and serves as a distribution and service centre for the surrounding area, supporting mineral development, tourism, and other activities. Mayo is the administrative centre for the FNNND. In addition, the community is a base for wilderness and mining tourism, canoeing, hiking, big-game hunting, and fly-in fishing.

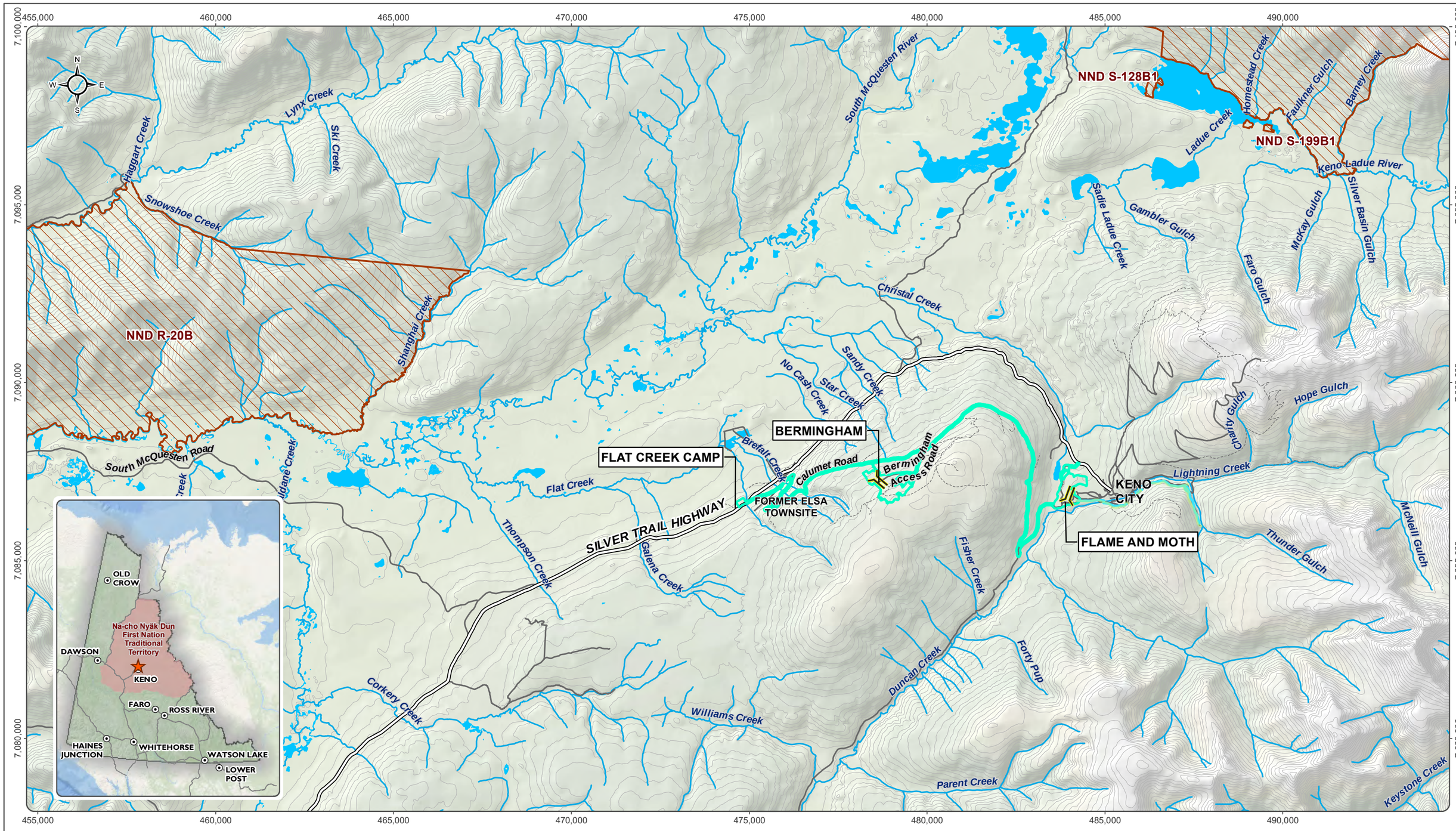
The FNNND has a membership of over 600, and about 200 of whom live in Mayo (Leaders International, 2025). As a self-governing First Nation, the FNNND can make laws on behalf of their citizens and their lands. Under the land claims agreement, the FNNND owns 4,739.68 square kilometres of settlement lands. Na-Cho Nyäk Dun First Nation Traditional Territory and Category B Settlement Land Parcels around the project are illustrated in Figure 4-1-NNDFN Settlement Lands. The FNNND has been actively involved in affairs of the Mayo community, attempting to promote a better, healthier lifestyle for its future generations and a strong economy based on its abundant natural resources (NNND Website, About Our Nation page).

Historically, the FNNND lived and trapped throughout the area surrounding Mayo. In early times, the ancestors of the FNNND lived off the land, using the abundant supply of game animals, fish, birds, and numerous plants for food and medicinal purposes. Their lifestyle required travelling throughout their traditional territory, including the KHSD area, at various times of the year, for hunting, fishing, and gathering food to survive. (NNND Website, About Our Nation page)

Na-Cho Nyäk Dun Development Corporation (NNDDC) was established in 1996. The purpose and mandate of the NNDDC are to develop economic and employment opportunities for the FNNND and its citizens. The NNDDC focuses on opportunities arising from mining, construction and property development projects within the traditional territory of the First Nation (NNND Website, NNDDC page).

Further updates about community demographics will incorporate changes considered important to the FNNND as expressed in the consultation events planned for.

Figure 4-1-NNDFN Settlement Lands



National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Adit
- Project Location
- Project Footprint
- First Nation Settlement Land, Surveyed
- Na-cho Nyäk Dun First Nation Traditional Territory
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

Hecla KENO HILL SM

ENSERO solutions

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 4-1

NA-CHO NYÄK DUN FIRST NATION SETTLEMENT LAND PARCELS AROUND THE PROJECT

MARCH 2025

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4.1 LAND AND RESOURCE USE

The regional land use in the Keno Hill mining camp area has evolved from a long history of occupation and development. Significant development activity and local population fluctuations have historically occurred in the area. As such, land and resource use was selected as a Valued Component.

The general area is utilized for several purposes by a variety of users. Regional land use has been influenced by the following activities:

- the area has been utilized by First Nations for thousands of years;
- a variety of anthropogenic activities have occurred throughout the region including both hard rock and placer mining, forestry, hunting and gathering, transportation, recreation and residential;
- the project footprint overlaps with Registered Trapline Concession (RTC) #82;
- the sites lie within Rogue River Outfitters Ltd. (Duncan, BC) Registered Outfitting Concession (ROC#7), reported to operate near the Keno Hill mining camp;
- numerous historic mining related structures exist in the general area and are of interest to local community groups and government; and
- the area is known and used for recreational pursuits and has potential for tourism development.

4.1.1 Recreation and Tourism

Recreation and tourism are important in the Keno City area and concerns have been raised by stakeholders about potential impacts on these values from mining activities in the Keno Hill mining camp.

Visitor numbers in Keno City are generally consistent with the same trends in other small communities within the Yukon (Derome & Associates, 2013). However, Keno City is emerging as an inspiring hotspot for artists, and has become the site of multi-day music and art workshops (YG, 2023b).

4.1.2 Sport/Commercial Hunting, Fishing and Trapping

Very limited sport/commercial hunting or trapping is conducted in the Keno Hill mining camp, likely because of the high level of historic and present mineral development activity and general use of the area.

There are five registered traplines summarized as follows:

1) Concession 85: Active. Minor portions including Galena Creek and Williams Creek and a small piece south of Mt. Hinton.
2) Concession 82: Activity unknown. This concession is reserved for the Mayo First Nation and covers most of the central and western study area.
3) Concession 81: Active. Only a minor portion on the western limit of the study area.
4) Concession 83: Inactive. Eastern limit of the study area, including Keno Hill, Beauvette Hill, Upper Lightning and Faith Creeks.
5) Concession 43: Intermittently Active. Marginally peripheral on the northwest corner of the study area.

The Keno Hill mining camp lies within RTC#82, which is currently unassigned (though FNNND have expressed interest in the trapline), and near RTC#83, assigned to Christine Hager. Hecla Yukon is aware of some trapping on Galena Hill, but otherwise trapping in the district is limited. Hecla Yukon personnel will continue to be instructed not to disturb trapping equipment or activities.

The Keno Hill mining camp lies within hunting outfitting concession #7, operated by Rogue River Outfitters. Hunting within the Keno Hill Mining Operations is not allowed due to employee safety concerns and its proximity to current operations.

4.2 LOCAL ECONOMY AND HUMAN RESOURCES

4.2.1 Keno City

The economy of Keno City is based on tourism and mining. In addition to the Keno City Mining Museum, which provides excellent historical perspective on the Keno Hill mining camp, a population of butterflies also exists in the region and attracts interested individuals. The Signpost Viewpoint on Keno Hill Summit also attracts numerous tourists throughout the summer months.

4.2.2 Mayo

Tourism in the Mayo area is an important industry. Accommodation, food services, recreation services (i.e., guiding and outfitting) and retail cater to tourists and provide employment for local residents. Tourist attractions in the area are linked with the history of mining around Mayo and Keno City. Camping and hiking, hunting, and fishing, and other outdoor pursuits comprise the activities undertaken by tourists in the area.

The economy of Mayo is linked to the provision of services to the people of Mayo and the surrounding areas. One third of the jobs in the community are related to government services, including First Nation and territorial administration. Placer mining and mineral exploration and development also provide an economic base for the community. In addition, construction provides considerable employment to Mayo residents.

In cooperation with industry (developers/companies), the FNNND Development Corporation is establishing a number of training, work, and apprenticeship programs in the community. The First Nation works toward participation in land and resource development in their traditional territory and employs many FNNND citizens.

4.2.3 Heritage Resources

The Keno Hill mining camp has rich historical significance and is characterized by numerous historic and heritage resources, largely related to past mineral development. As part of the UKHM Reclamation Plan, ERDC developed a district-wide heritage plan in consultation with stakeholders, including YG Heritage Resources, FNNND, the Silver Trail Tourism Association, the Binet House Museum, the Village of Mayo, Keno City Mining Museum, Keno City residents and Indigenous and Northern Affairs Canada (INAC).

Heritage resources in the Keno Hill mining camp in general are known and, in many cases, documented. The extent of new footprint associated with the KHSD Mining Operations is limited and no heritage resources are known to exist in that area. In order to mitigate potential significant effects of the project on heritage resources, Hecla Yukon implements the Heritage Resources Protection Plan developed under QML-0009.

5 ENVIRONMENTAL DESCRIPTION

The Site Characterization Plan submitted in December of 2025 can be found in Appendix 2. This document includes a description and updated information on climate and air quality, surface water, groundwater, geology and soils, geochemistry, aquatics, wildlife, vegetation and noise.

The Keno Hill mining camp lies within the Yukon Plateau – North Ecoregion, just south of the Wernecke Mountains. The terrain consists of concordant, rolling, upland areas separated by wide valleys. Alpine mountain peaks extend above the uplands locally. Many valleys include peatlands, palsas, fens and meadows of sedge tussocks. Upper slopes may be covered with scree material, with treeline occurring at 1,350 to 1,500 metres above sea level (masl). The area has been influenced by the latest glaciation but shows more subtle evidence of an earlier event as well. Table 5-1 summarizes existing environmental conditions in the project area.

Table 5-1: Keno Hill Silver District Environmental Setting Summary

CATEGORY	DESCRIPTION
Drainage Region	Stewart River drainage region
Significant Watersheds	McQuesten River, Lightning Creek and Stewart River Watershed, Mayo River
Ecoregion	Yukon Plateau (North)
Study Area Elevation	900-1350 masl
Vegetation Communities	Northern boreal forests occupy lower slopes and valley bottom; spruce, pine, and alder; grasses and sedges, mosses occupy forest floor; heavy moss and lichen growth resident as ground cover understory of shrub willow; open and forest fringe areas of willow and scrub birch, and various flowering plant species.
Wildlife Species	Moose, grizzly and black bear, caribou, beaver, wolf, lynx, marten, wolverine, western tanager, magnolia warbler, white-throated sparrow, bald eagle, furbearers, and small animals. Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed species including: Common Nighthawk (Threatened); Rusty Blackbird and Olive-Sided Flycatcher (Special Concern).
Fish Species	Bering and Beaufort Sea salmonids and freshwater species, including: Arctic grayling, Arctic char, lake trout, trout perch, lake whitefish, broad whitefish, burbot, inconnu, Arctic Cisco, Northern pike, slimy sculpin

6 PROJECT DESCRIPTION

6.1 HISTORY

The Keno Hill mining camp has a rich history of exploration and mining with 21 deposits having documented silver production in excess of 3,110 kilograms (100,000 ounces). Silver was first found in 1901 but small-scale mining only began during 1913. High silver prices at the end of the First World War led to renewed and ultimately successful exploration activity in the area. Since then, at least 65 deposits and prospects have been identified within the area. Many small silver deposits were mined independently of each other, throughout the area between 1914 and 1925.

The Treadwell Yukon Company Limited (TYCL) in 1925 consolidated a number of small mines and properties in the area. TYCL continued to be the dominant company in the mining camp until it ceased operations in 1942 upon the untimely death of its founder, Livingston Wernecke.

Keno Hill Mining Company Limited (KHM) acquired the interests formerly controlled by TYCL in 1945. KHM was reorganized in November 1947 as United Keno Hill Mines Limited (UKHM) and by 1958 UKHM had acquiring several properties, interests in properties and other companies, including the assets of Galkeno Mines Limited and Canadian Northwest Mines and Oil.

Ventures Limited (later Falconbridge Nickel Mines Limited and Falconbridge Limited) acquired a controlling interest in the UKHM in 1960 when it merged with Frobisher Limited and acquired the Conwest interest. Falconbridge Nickel Mines Ltd. Acquired 48.2% of UKHM in 1962 and assumed management control of UKHM.

UKHM ceased all production in the area in 1989 and placed the active mines on care and maintenance, but continued to conduct limited underground exploration and development at the Bellekeno and Silver King mines. On Feb 18, 2000, UKHM was granted bankruptcy protection with PricewaterhouseCoopers Inc. being court-appointed as the interim receiver and receiver-manager of UKMH in 2001.

In June 2005, Alexco Resource Corp. was selected as the preferred purchaser of the assets of UKHM, the Keno Hill mining camp, by PriceWaterhouse Coopers Inc. In February 2006, Alexco Resource Corp.'s purchase of UKHM's assets through a wholly owned subsidiary, Elsa Reclamation & Development Company Ltd. (ERDC), was approved. Under the Keno Hill Amended and Restated Subsidiary Agreement, Alexco Resource Corp. and ERDC are indemnified against all historical liability, has property access for exploration and future development, and is not required to post security against pre-existing liabilities. ERDC received a water license from the Yukon Government in November 2007, giving Alexco Resource Corp. free and clear title to surface and subsurface claims, leases, free-hold land, buildings, and equipment at the Keno Hill mining camp. Alexco Resource Corp. (dba Hecla Yukon) was acquired by Hecla Mining Company in September 2022.

Since Alexco Resource Corp. acquired the assets of the Keno Hill mining camp, the major mine development and operations milestones listed in Table 6-1 have occurred.

Table 6-1: Keno Hill Silver District Mine Operations Timeline

2006 – 2008	Alexco Resource Corp. acquires Keno Hill mining camp and begins aggressive surface exploration programs, focus on expansion of Bellekeno resource
2009	Underground development at the Bellekeno Mine
2010	Comprehensive Cooperation and Benefits Agreement signed with FNNND AKHM constructs the mill and surface facilities, and establishes the DSTF
2011	Production at Bellekeno Mine and District Mill Surface exploration at Flame & Moth begins
2012	Development and rehabilitation of Lucky Queen adit Development of new Onek 990 decline
2013	Temporary suspension of Bellekeno Mine operations and milling AKHM monitors KHSD mine sites during care and maintenance
2014 – 2020	Permitting for Flame & Moth and New Bermingham mines Continued surface exploration, advanced underground exploration decline at New Bermingham deposit Decline development at Flame & Moth and New Bermingham mines Care and maintenance and water treatment
2021	Ore production from Bellekeno and New Bermingham mines Camp, surface facilities, and mill upgrades Mine development at Flame & Moth and New Bermingham mines Temporary suspension of Bellekeno Mine operations. Continued surface exploration and water treatment
2022	Ore production at New Bermingham and Flame & Moth mines temporarily suspended Continued mine development at Flame & Moth and New Bermingham mines Continued surface exploration and water treatment
2023 - 2025	Ore production at New Bermingham and Flame & Moth mines Continued mine development at Flame & Moth and New Bermingham mines Construction of DSTF Phase 2 (P2) Construction of Cemented Tails Batch Plant Progressive reclamation of Bellekeno Mine implemented Continued surface exploration and water treatment Expansion of, and upgrades to, Flat Creek Camp Upgrades to mill, water treatment and mine surface infrastructure Improvements to Mill Pond and DSTF water conveyance infrastructure

6.2 SUMMARY OF MINING AND MILLING OPERATIONS

AKHM mine and mill operations is located on and around Galena Hill, Keno Hill and Sourdough Hill within the Keno Hill mining camp and are collectively known as the Keno Hill Silver District (KHSD) Mining Operation. Table 6-2 presents a summary of the present KHSD Mining Operations. This RCP Revision 9 incorporates the Bellekeno, Flame & Moth, and New Bermingham mines and the District Mill. This RCP also includes reclamation of existing disturbance at Lucky Queen and Onek 990 created by AKHM's activities.

Table 6-2: Keno Hill Silver District Mining Operations Summary

Mines/Ore Deposits	Bellekeno Mine (Active 2010 – 2013, and 2020 - 2021) Flame & Moth Mine, New Bermingham Mine (development and production) Lucky Queen Deposit, Onek 990 Deposit (permitted under QML but not WL)
Mining Method	Year round underground narrow vein cut and fill/long hole mining
Current Mine(s) Plan Life	9 years including initial development
Current Total Project Life	9 years construction/development/operations/progressive reclamation 2-year final decommissioning and reclamation 10 years closure monitoring and maintenance.
Ore Production Rate	400 tonnes/day (Bellekeno, Flame & Moth, New Bermingham) for a total of ~1,38 M tonnes of ore
Mine Waste Rock	796,400 tonnes of waste rock from underground development, of which 768,300 is required for structural backfill underground
Ore Mining Schedule	Ore mining for 365 days/year Milling operations 365 day/year
Mill Recovery Process	Conventional floatation process producing separate lead/silver concentrate and zinc concentrate Concentrate shipped off-site for smelting Tailings placed in DSTF or underground as backfill
Haul Roads and AKHM access roads	Bellekeno Haul Road: Road from the District Mill to Bellekeno East portal (including the Lightning Creek bridge), Bermingham Haul Road: Calumet Road from Duncan Road to the Bermingham Access Road and the Bermingham Access Road to the New Bermingham portal Christal Lake Road (from Silver Trail Highway to Duncan Creek Road) Onek Connector from Bellekeno Haul Road to Wernecke Road (including the Onek Bridge)

6.3 MINE PLAN

The KHSD Mining Operations comprise a series of small underground mines and a centralized mill (District Mill). The current LOM mine plan includes a combination of Flame & Moth, and New Bermingham operating over an additional nine-year period. Table 6-3 summarizes the mine operations schedule from 2025 through to the completion of the current Life of Mine (LOM) plan. A more detailed project schedule is included as Table 6-7.

Table 6-3: Keno Hill Silver District Mining Operations Projected Timeline

YEAR	SUMMARY OF MAIN PROJECT ACTIVITY
2025-2039	Operate New Bermingham and Flame & Moth mines
2039	Complete mining of New Bermingham
2039	Complete mining at Flame & Moth Commence closure plan activities District care and maintenance
2040+	Closure of AKHM mines for term of Water Licence

Mine operating plans are continuously reviewed and optimized depending on a variety of factors including metals prices, exchange rates, underlying operating costs (fixed and variable), ore grades, etc. As these and other factors change, both positively and negatively, ore production profiles from each of the mines will change. Depending on the various parameters, mines may come in and out of the LOM plan as factors change. Table 6-4 presents the current LOM plan that is the basis for the RCP, additional details for each mine are provided in

Consolidated Mine Plan	Total	2026 (Year 1)	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Mill Feed Tonnes	1,823,913	108,920	127,167	142,056	142,801	144,616	145,001	145,189	145,131	144,525	144,073	144,438	144,482	121,857	23,657
Waste Tonnes	1,218,265	193,402	211,108	213,098	80,112	185,361	130,591	57,046	23,600	33,864	31,889	22,162	20,249	14,490	1,293
Total Tonnes	3,042,178	302,322	338,274	355,155	222,913	329,977	275,592	202,235	168,731	178,389	175,962	166,600	164,731	136,348	24,950
Total Backfill Tonnes	1,149,803	61,418	51,680	96,365	61,271	90,121	90,485	85,626	88,960	99,346	104,215	97,236	83,495	105,408	34,174
Development (m)	22,023	3,363	3,238	3,354	1,386	3,346	2,557	1,193	561	848	630	552	462	457	77

Notes:
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered;
Tonnage are in metric units;
Quantities and schedule are subject to change based on resource development and market conditions.

Table 6-5, and Table 6-6. For the most recent ore reserves and mineral resources information, readers should refer to Hecla Mining Company's latest reserves and resources public release available on the company's website or through regulatory filings.

Table 6-4: Keno Hill Mine Operations LOM Plan for Flame & Moth and New Bermingham Mines

Consolidated Mine Plan	Total	2026 (Year 1)	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Mill Feed Tonnes	1,823,913	108,920	127,167	142,056	142,801	144,616	145,001	145,189	145,131	144,525	144,073	144,438	144,482	121,857	23,657
Waste Tonnes	1,218,265	193,402	211,108	213,098	80,112	185,361	130,591	57,046	23,600	33,864	31,889	22,162	20,249	14,490	1,293
Total Tonnes	3,042,178	302,322	338,274	355,155	222,913	329,977	275,592	202,235	168,731	178,389	175,962	166,600	164,731	136,348	24,950
Total Backfill Tonnes	1,149,803	61,418	51,680	96,365	61,271	90,121	90,485	85,626	88,960	99,346	104,215	97,236	83,495	105,408	34,174
Development (m)	22,023	3,363	3,238	3,354	1,386	3,346	2,557	1,193	561	848	630	552	462	457	77

Notes:
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered;
Tonnage are in metric units;
Quantities and schedule are subject to change based on resource development and market conditions.

Table 6-5: Life of Mine Plan for Flame & Moth

Flame & Moth	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Mill Feed Tonnes	433,961	32,661	34,977	33,759	33,184	35,524	36,058	36,009	36,068	35,662	35,815	35,676	35,658	12,910	0
Waste Tonnes	316,084	40,221	43,382	41,555	40,791	40,702	38,320	33,897	5,460	12,268	8,695	5,454	3,532	1,806	0
Total Tonnes	750,045	72,882	78,359	75,314	73,975	76,226	74,379	69,906	41,528	47,931	44,510	41,130	39,190	14,716	0
Total Backfill Tonnes	241,031	19,263	15,891	14,827	15,995	17,103	19,852	19,937	15,763	29,042	20,575	18,677	20,155	13,949	0
Development (m)	6,565	699	740	767	792	805	820	697	159	408	240	244	137	57	0

Notes:
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered;
Tonnage are in metric units;
Quantities and schedule are subject to change based on resource development and market conditions.

Table 6-6: Life of Mine Plan for New Bermingham

New Bermingham	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Mill Feed Tonnes	1,389,952	76,260	92,190	108,298	109,617	109,092	108,942	109,180	109,063	108,862	108,258	108,762	108,824	108,947	23,657
Waste Tonnes	1,218,265	193,402	211,108	213,098	80,112	185,361	130,591	57,046	23,600	33,864	31,889	22,162	20,249	14,490	1,293
Total Tonnes	2,608,217	269,661	303,297	321,396	189,729	294,453	239,534	166,226	132,663	142,726	140,147	130,924	129,073	123,438	24,950
Total Backfill Tonnes	241,031	19,263	15,891	14,827	15,995	17,103	19,852	19,937	15,763	29,042	20,575	18,677	20,155	13,949	0
Development (m)	15,458	2,664	2,498	2,587	594	2,541	1,737	496	402	440	389	308	325	400	77

Notes:
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered;
Tonnage are in metric units;
Quantities and schedule are subject to change based on resource development and market conditions.

Table 6-7: Baseline Master Project Schedule for Operations, Decommissioning and Reclamation

Phase / Activity	2026				2027				2028				2029				2030				2031				2032				2033				2034			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Mine Development/Operations/Progressive Reclamation																																			
Bellekeno Mine																																				
- Reclaim Bellekeno East Portal Site																																				
- Reclaim Bellekeno 625 Adit Site																																				
- Mine Flooding and Insitu Treatment																																				
- Bellekeno 625 Bioreactor Construction																																				
- Reclaim N-AML Facility																																				
- 200 Level Vent Raise																																				
Flame and Moth Mine																																				
- Underground Development/Operations																																				
- Underground Backfill																																				
- Portal Closure																																				
- Mine Flooding																																				
- Backhaul P-AML Underground																																				
- Reclaim N-AML Facility																																				
- Vent Raise																																				
New Bermingham Mine																																				
- Underground Development/Operations																																				
- Underground Backfill																																				
- Portal Closure																																				
- Mine Flooding																																				
- Backhaul P-AML Underground																																				
- Reclaim N-AML Facility																																				
- Vent Raise(s)																																				
Lucky Queen Mine																																				
- Portal Closure																																				
- Reclaim N-AML Facility																																				
Onek Deposit																																				
- Reclaim Unused P-AML Pad																																				
- Reclaim Onek 990 Portal Area																																				
Roads																																				
- Bellekeno Haul Road																																				
- Onek Connector																																				
- Christal Lake Road																																				
- Lucky Queen Access Road																																				
- Bermingham Mine Access Road																																				
- Other Roads and Trails																																				
Mill & Facilities																																				
- Active Milling Operations																																				
- Mill and Ancillary Facilities																																				
- Mill Pad																																				
- Ore/Tailings Pads at Mill																																				
- Runoff Collection Pond(s)																																				
- Diversion Ditches to Collection Pond																																				
Dry Stack Tailings Facility																																				
- Tailings to Phase 1																																				
- Tailings to Phase 2																																				
- Tailings to Phase 3																																				
- Progressive Reclamation																																				
- Final Cover Reclamation																																				
Camp Downsize																																				
Post Closure Site Monitoring & Maintenance																																				

Active Operations

Progressive Reclamation

Reclamation and Closure

Water Management

Table 6-8: Baseline Master Project Schedule for Operations, Decommissioning and Reclamation (Continued)

Phase / Activity	2035				2036				2037				2038				2039				2040				2041				2042 – 2050
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
	Mine Development/Operations/Progressive Reclamation																				Active Closure								Post Closure Monitoring and Maintenance
Bellekeno Mine																													
- Reclaim Bellekeno East Portal Site																													
- Reclaim Bellekeno 625 Adit Site																													
- Mine Flooding and Insitu Treatment																													
- Bellekeno 625 Bioreactor Construction																													
- Reclaim N-AML Facility																													
- 200 Level Vent Raise																													
Flame and Moth Mine																													
- Underground Development/Operations																													
- Underground Backfill																													
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Camp Downsize																													
Post Closure Site Monitoring & Maintenance																													

Active Operations

Progressive Reclamation

Reclamation and Closure

Water Management

6.4 MINING

6.4.1 Mining Methods

The KHSD Mining Operations are mined by mechanized underground mining methods of cut and fill (MCF) and longhole open stoping (LHOS) with both methods utilizing cemented rock fill (CRF), cemented tailings fill (CTF), and unconsolidated rock fill as required. The Flame & Moth and New Bermingham mines are comprised of several zones and the mine methods are selected based on zone geometries, geotechnical conditions, production rates, and other constraints.

6.4.1.1 ***Mechanized Cut and Fill***

Mechanized Cut and Fill (MCF) mining is a method of short hole mining used in a wide range of deposit geometries and will be the dominant mining method for Flame & Moth and Bermingham. In MCF method, an attack ramp is developed from the main ramp at a gradient of +/-15%. Upon reaching the orebody, an intersection is developed and a lift is developed in both directions along strike, following the geological contact of the orebody. At the end of the lens, the void is backfilled using either unconsolidated rock fill, cemented rockfill (CRF) or cemented tailings fill (CTF) with a Load Haul Dump (LHD) machine. The LHD utilizes a rammer-jammer plate (a dozer plate modified to be attached to a scoop to push waste tight to the back) to ensure that the backfill is placed tight to the back of the drift.

Once the level has been completely backfilled, the next lift above the previously mined lift is accessed by slashing down the back or the floor of the attack ramp and working off the muck pile or under cemented tailings fill. Figure 6-1 illustrates the sequence of activities with MCF mining.

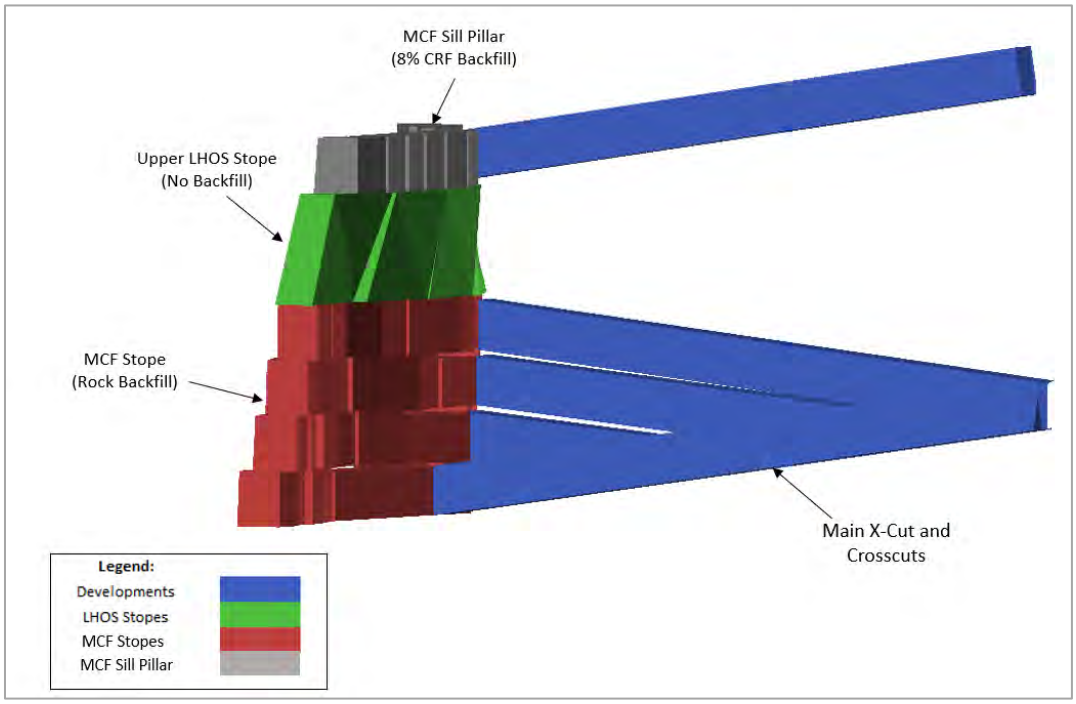


Figure 6-1: Mechanized Cut and Fill Lifts with Uphole Stopes Section

MCF drifts are on average 4.0 m high with varying widths, based on the deposit geology. For areas wider than development equipment is capable of mining or supporting, a second parallel drift is be mined beside the backfilled drift to fully extract the orebody width prior to accessing the lift above. In this situation, the first drift is to be completely backfilled with cemented rock fill or cemented tailings fill to ensure a stable wall to allow adjacent mining activity.

For the Flame & Moth and New Bermingham mines, the lifts are sequenced either bottom up or top town within each panel; however, to maximize productivity the panels are mined from the top down as they are accessed by the ramp spiraling down. As such, a pillar remains between the top lift of one panel and the bottom lift of the panel above. These pillars will be extracted using an uphole drill and blast method discussed later in this Section.

A variable width shanty-back drift profile has been used to create the MCF method minable shapes for the KHSD mines. The primary reason for implementing a shanty MCF profile is to potentially reduce dilution; however, the development and blasting practices require strong quality control in order to ensure that additional waste is not mined. The hanging wall (HW) and footwall (FW) are restricted to the following stope dip angle parameters, 90 degrees for FW and minimum 60 degrees minimum/90 maximum degrees for HW. Figure 6-2 depicts a section view of an example shanty back MCF profile versus standard vertically aligned hanging walls.

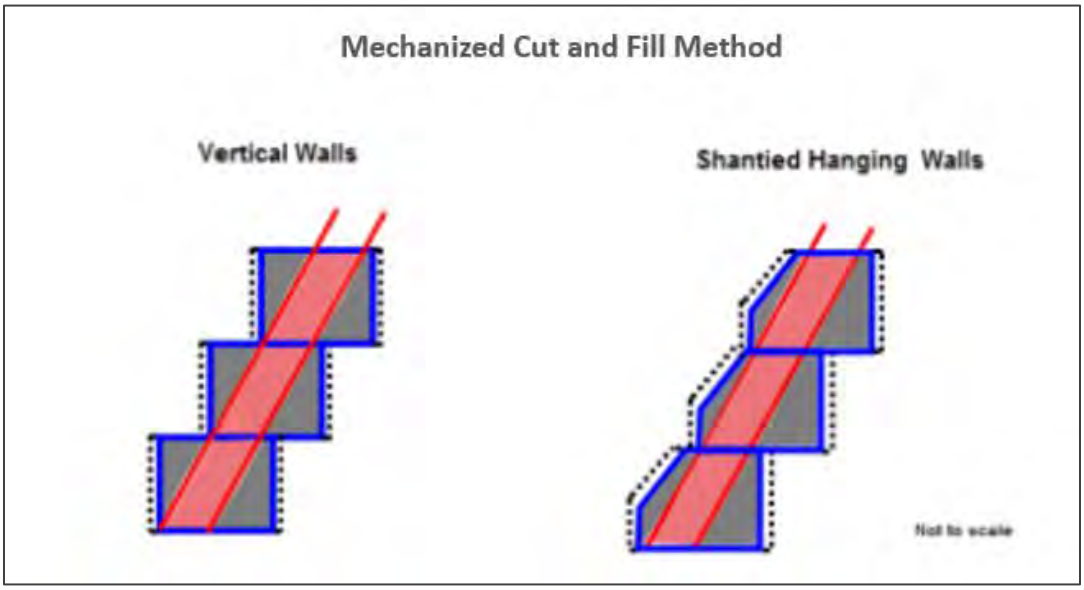


Figure 6-2: Shanty MCF Development Shapes Example

6.4.1.2 ***Long hole open stoping***

Long hole open stoping ("LHOS") is the preferred mining method when the ground conditions and the lens geometry allow. In LHOS, two drifts are developed along the strike of the orebody at a vertical spacing selected based on geotechnical constraints for that zone. After development is completed, blasting rings are drilled in parallel from the top level to the bottom level. Hole diameter and blast design follow industry best practice and are detailed in AKHM's standard operating procedures. Several rows are typically pre-loaded to minimize the loading crew's exposure to the open stope brow.

An initial slot is developed by drilling and blasting a drop raise made up of multiple holes in close spacing. Hole diameter and blast design follow industry best practice and are detailed in AKHM's standard operating

procedures. Once this initial slot has been blasted (retaining a minimum pillar below the top drift) the entire stope is blasted and mucked using a LHD. All remote mucking is carried out using a LHD equipped with a remote package.

Stope strike lengths are based on the geotechnical analysis that has been performed and is detailed in the sites' Ground Management Control Plan (Hecla Yukon, 2023b, 2023c). Typical stope lengths vary from approximately 8 m to 20 m.

Once the stope is empty, the stope is backfilled with Cemented Rock Fill (CRF) or Cemented Tailings Fill (CTF). Cemented rockfill and cemented tailings fill mix design and curing times to achieve required strengths were determined by an independent consultant and are detailed in Hecla Keno Hill GCMP and standard operating procedures. Figure 6-3 illustrates the LHOS Method. LHOS will be used in the Flame & Moth deposit at Christal and Lightning zones, as well as NE and Arctic zones of the New Bermingham deposit.

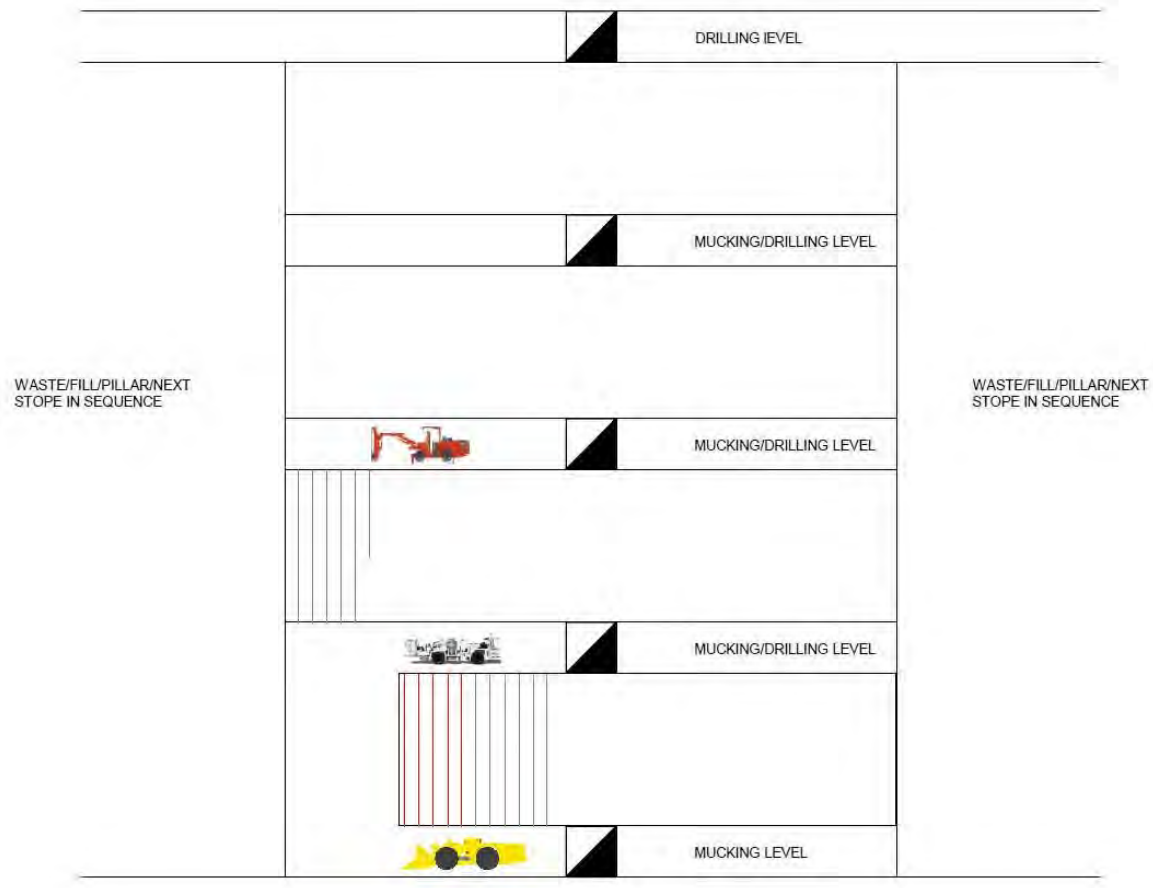


Figure 6-3: (Downhole) Longhole Stoping

A modified version of LHOS is used at the top of a MCF level to extract the sill pillar between MCF panel and the panel above, or in areas where there is no access for a top drift. Backfill mix design and curing times to achieve required strengths for the backfill pillar above the uphole stope were determined by an independent consultant and are detailed in Hecla Yukon's standard operating procedures. In uphole stoping, a series of parallel rings are drilled from the bottom drift into the back, to the limit of the lens. An inverse raise is drilled and blasted on the extremity of the stope. The longhole rings are then blasted into the void created by the raise and mucked using a remote-operated LHD. No backfill is necessary in this method. Figure 6-4 illustrates the uphole stoping method.

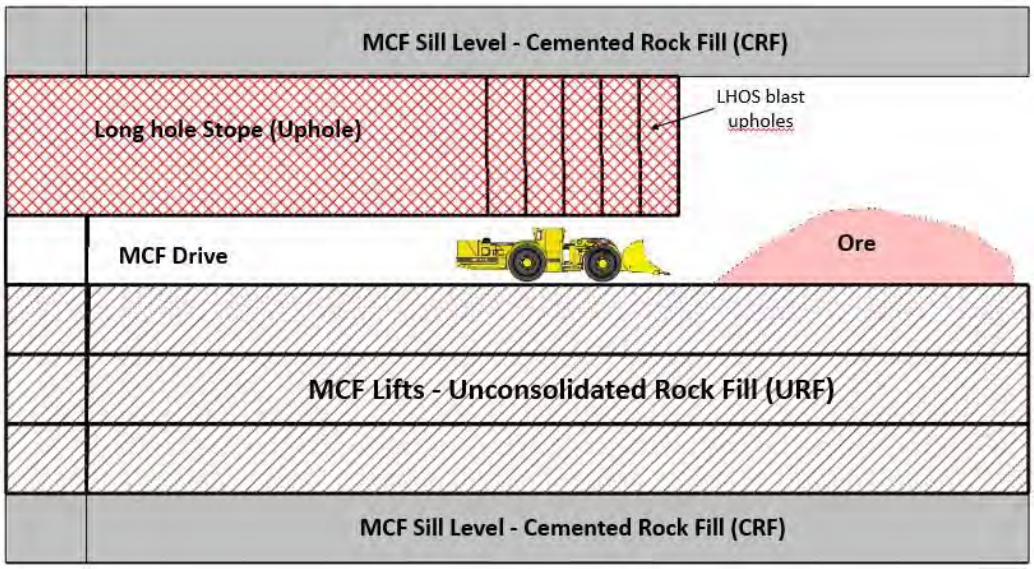


Figure 6-4: Uphole Longhole Stoping

The uphole LHOS mining method was utilized at Bellekeno Mine to extract a mostly developed panel when production resumed in 2020. Uphole LHOS will be used to extract sill pillars in the Flame & Moth and New Bermingham mines.

*6.4.1.3 **Ground Control***

The Ground Control Management (GCMP) has been developed for Flame and Moth and New Bermingham mining operations to govern the ground support methodology. The plan is updated as risks and risk mitigation strategies evolve and approved annually. The GCMP addresses underground geotechnical stability and the required ground control measures to be used to ensure safe working conditions and the long-term stability of underground infrastructure. Crown pillar thicknesses have been assessed at each mine to address potential for surface subsidence and ground classes have been defined for the development headings. Mine infrastructure has been designed to avoid areas with potential poor ground conditions, and the support is designed to provide long term stability.

In addition to the ground support designs in waste development headings, stopes are backfilled with cemented waste rock and/or filtered tailings. The combination of stope backfilling and the ground control management plan and measures addresses any concerns with long term underground stability and subsidence that needs to be considered in the RCP.

6.4.2 Backfill

Backfill materials consisting of development waste rock (N-AML and P-AML) and dry filtered cemented tailings will be placed into empty stopes by Load Haul Dump (LHD) or underground haul trucks. The mix of these materials was determined based on geotechnical requirements and characteristics of backfill materials available (Mine fill, 2021). Backfill mix design will also aim to minimize the surface environmental impact while optimizing the most efficient and cost-effective back filling sequence. Table 6-4 summarizes the amount of backfill required during the LOM Plan schedule.

Based on the planned stope geometry, mining sequence, backfill type and exposure types, appropriate factors of safety have been applied. Material samples sourced from the Flame and Moth, the mill and Bermingham were sent to independent Labouratories to determine optimal mix design to achieve these required strengths. Refer to Labouratory Test Report (Minefill, 2021) and "Strategic Engineering Review of the Hecla Kino Hill Silver District Backfill Options" (RMS, 2023) for details pertaining to required mining strengths and mix designs.

Cemented backfill will be used in longhole and cut and fill stopes. For CRF, the cement, rock and water is mixed by LHD bucket in a small sump-like cut out near the empty stope. Cement will be transported underground in bulk bags. For CTF, dry tailings are to be mixed with cement at the surface batch plant then transported to the stopes where LHDs place and compact the CTF in a similar manner to CRF.

For cut and fill stopes, the backfill will be placed using an LHD and if needed, pushed tight to the back using a rammer jammer attachment. For long hole stopes, the backfill procedures vary depending on stoping methods. For conventional downhole stopes, the backfill will be placed by dumping rockfill or cemented rockfill from the top access using LHDs or underground trucks. For pillar recovery (uphole stopes), no backfill is necessary. They will be filled with P-AML and N-AML as needed for waste management.

Where sill pillars are required, a cemented fill will be used to provide a stable back to mine up to from beneath. Extraction of the vein from the final lift requires that the pillar is self-supporting and maintains integrity while the heading is active. The quality and the placement of the fill are both important factors in this application. These materials should be placed into headings as tight to the back as possible to ensure optimal placed density. An increased cement content will be required to provide the required strength of the pillar. In areas where additional caution is required during final lift extraction, the lift will be mined using up-holes and remote mucking.

Careful preparation of the excavation where cemented fill is to be placed will be required. The floor should be cleaned prior to placement to prevent material falling from the back following mining. An appropriate lead time should be provided to allow set-up and cure for the cemented fill. Standard quality control procedures (e.g., unconfined compressive strength and slump tests) should be completed during batching and following placement of cemented tailing fill materials.

Quality assurance and quality control (QA/QC) procedures are in place to ensure backfill procedures are appropriate for short and long-term stability requirements.

6.4.2.1 ***Cemented Tailings/Waste Rock Backfill***

Cemented tailings and waste rock back fill are the preferred backfill methods. Where sill pillars are required, a cemented fill will be used to provide a stable back to mine up to from beneath. Extraction of the vein from the final lift requires that the pillar is self-supporting and maintains integrity while the heading is active. The quality and the placement of the fill are both important factors in this application. An increased cement content of between three and five percent will be required to provide the required strength of the pillar. In areas where additional caution is required during final lift extraction, the lift will be mined using up-holes and remote mucking.

Cemented tailings and cemented rockfill are the preferred backfill methods. Where sill pillars are required, a cemented fill will be used to provide a stable back to mine up to from beneath. Extraction of the vein from the final lift requires that the pillar is self-supporting and maintains integrity while the heading is active. The quality and the placement of the fill are both important factors in this application. An increased cement content will be required to achieve the required strength of the pillar. In areas where additional caution is required during final lift extraction, the lift will be mined using up-holes and remote mucking. In areas where mine personnel will not be

exposed to fill during adjacent mining or via underhand mining, uncemented waste rock can be placed in lieu of cemented tailings or cemented rock fill. Table 6-2 summarizes the amount of backfill required during the LOM Plan schedule.

6.4.3 Mine Infrastructure

*6.4.3.1 **Bellekeno Mine Infrastructure***

Surface

P-AML waste rock previously mined from the Bellekeno Mine was placed in a lined Waste Rock Storage Facility (WRSF) located south of the Bellekeno East portal (Photo 6-1). The facility was designed according to the approved generic design (EBA, 2008) Appendix 3.2.

The Bellekeno 625 waste rock dump (Photo 6-2) is a historical facility that is included in this RCP under the designation of the Bellekeno Production Unit.

A Waste Rock Disposal Area (WRDA) was proposed to be constructed along the northeast flank of Sourdough Hill. The Bellekeno WRDA was not constructed as all the N-AML waste rock generated by AKHM at the Bellekeno Mine has been used for road construction material (Photo 6-2), with a lesser amount as underground backfill. With the current LOM plan for Bellekeno, there is no scheduled requirement for construction of a Bellekeno WRDA.

All buildings and infrastructure at the Bellekeno East portal have been removed.



Photo 6-1: Former Bellekeno P-AML WRSF (decommissioned and reclaimed)



Photo 6-2: Bellekeno N-AML waste rock used for construction of Bellekeno Haul Road

Underground

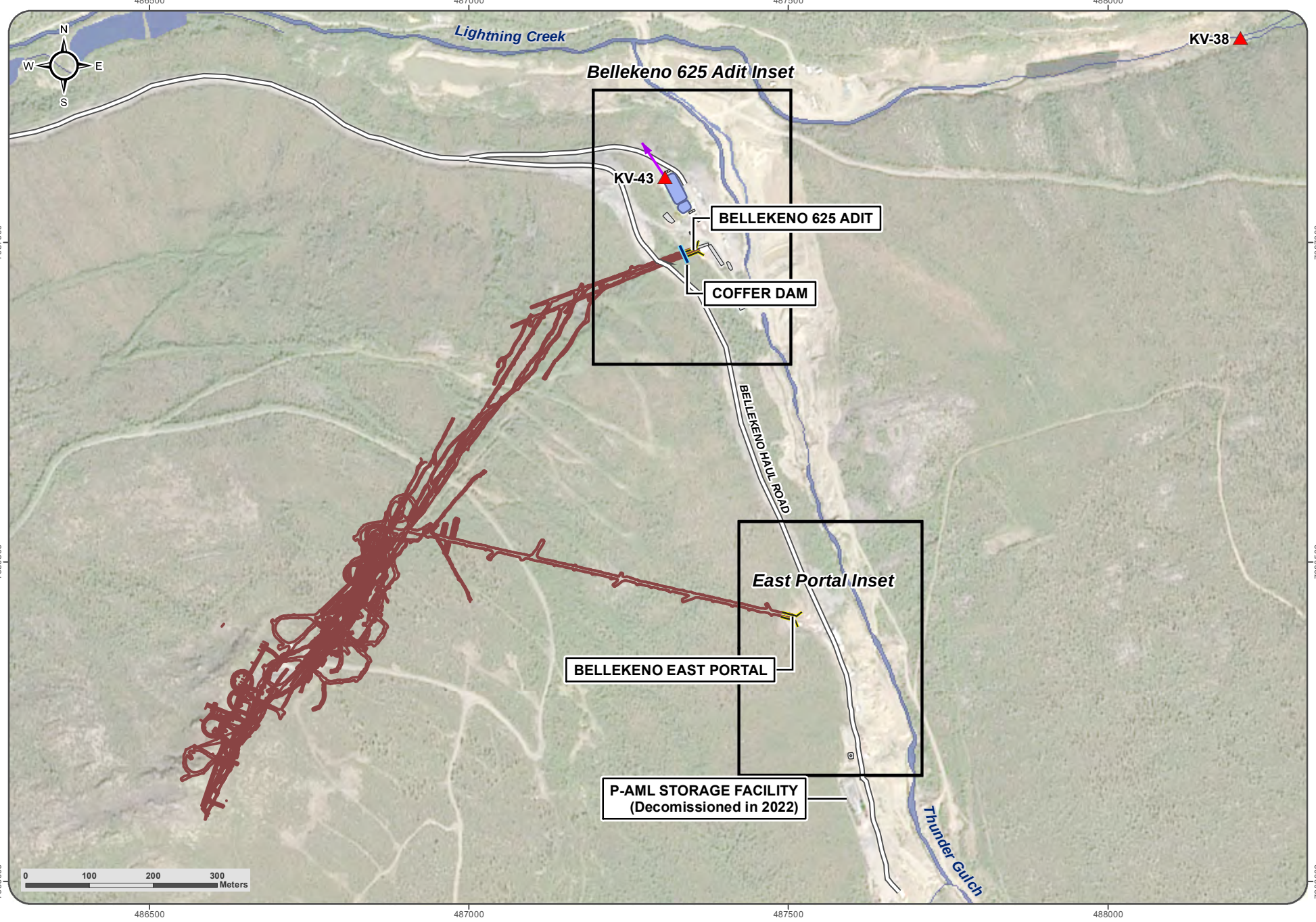
The Bellekeno Mine consists of the underground workings and surface adit entrances (Bellekeno East portal and decline and the Bellekeno 625 adit). The Bellekeno East portal is the primary ingress/egress point for the Bellekeno Mine (Photo 6-3). An as built of the Bellekeno Mine underground workings at the end of the LOM is shown in Figure 6-6. The Bellekeno 625 adit provides secondary escape and ventilation intake for the mine and discharges mining-impacted water requiring treatment for suspended solids, zinc and occasionally other metals, on a continuous basis. The 200-level vent raise is not a component of the Bellekeno mine operations (it is a historic liability not used in Bellekeno operations) but is included in the RCP given its proximity to the Bellekeno mine.

The decline collar is a multi-plate culvert 4 meters in diameter extending from the surface into the competent bedrock.

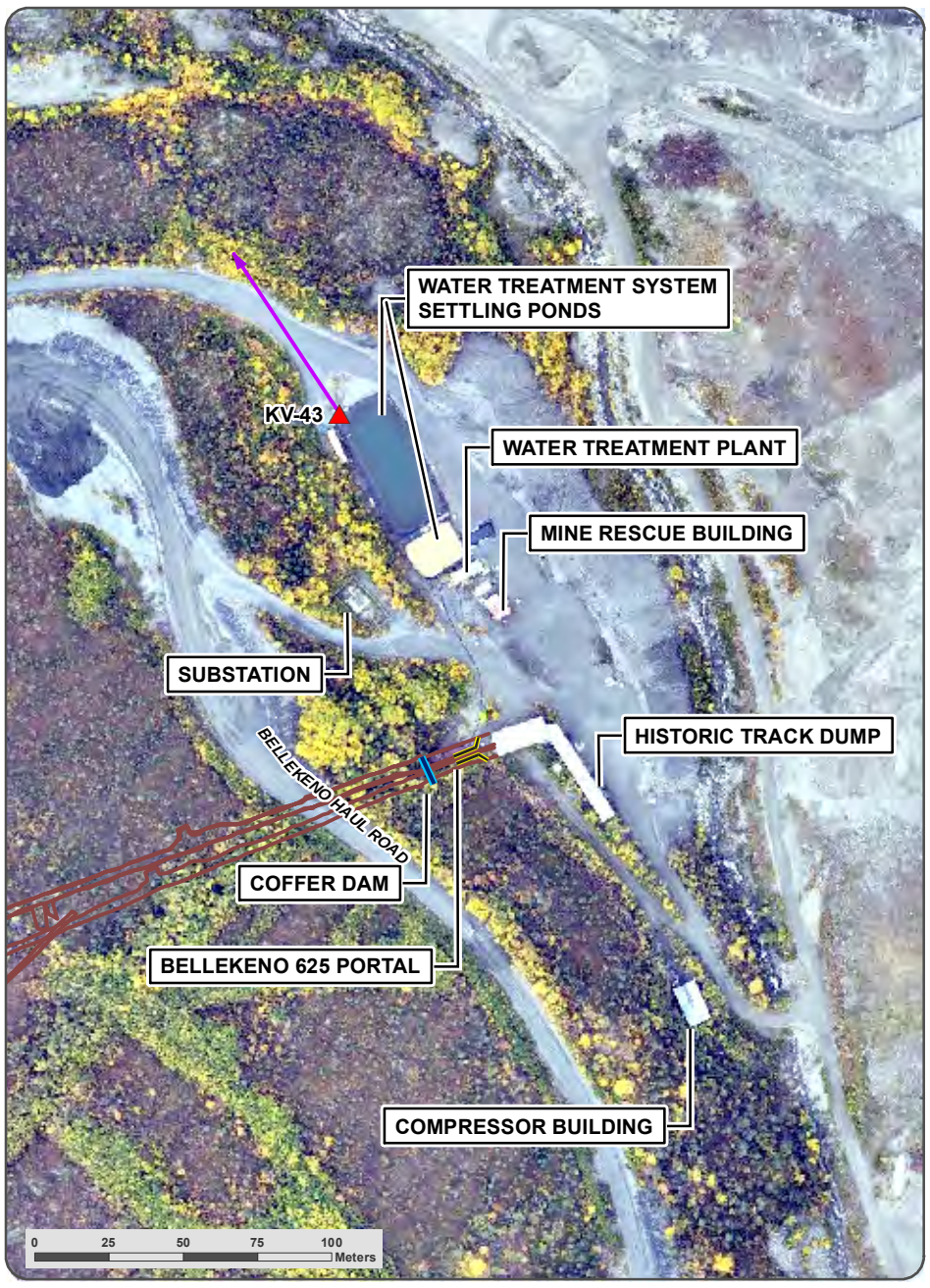


Photo 6-3: Bellekeno East Portal

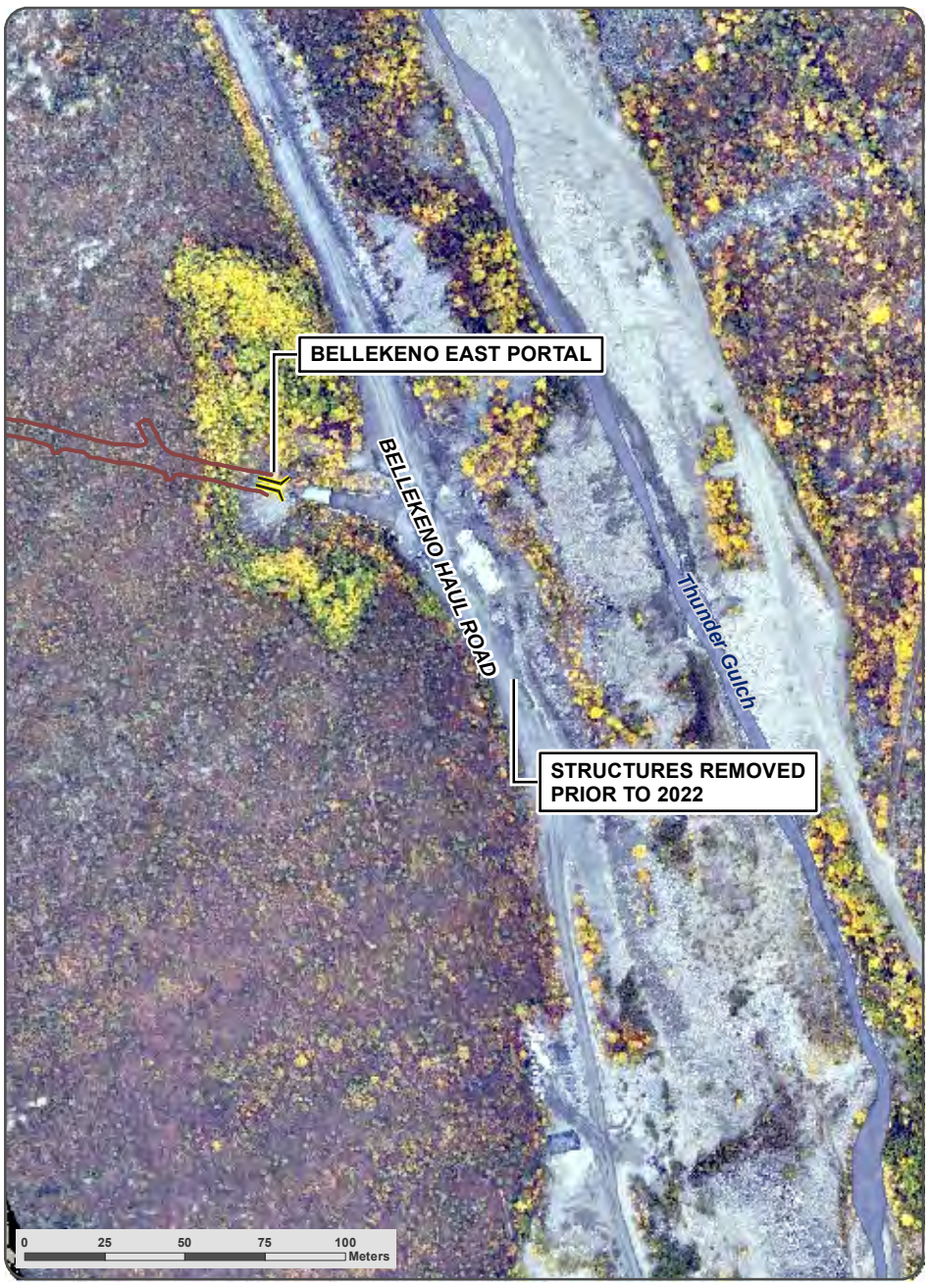
Figure 6-5: Bellekeno Minesite Overview



BELLEKENO 625 ADIT LAYOUT



EAST PORTAL LAYOUT



- Surface Water Quality Stations
- Adit
- Coffer Dam
- Building/Structure
- Pond
- Underground Workings, As-Built End of 2021
- Pipeline
- Haul Road

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on March 2025. Aerial imagery aquired on August 2017

Datum: NAD 83; Map Projection: UTM Zone 8N

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Hecla YUKON

KENO HILL SILVER DISTRICT
MINING OPERATIONS

FIGURE 6-5

BELLEKENO MINESITE OVERVIEW

MARCH 2025

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(Last edited by: amatiashevska;2025-03-13 15:26 PM)

Figure 6-6: Bellekeno Mine As-Built at EOM



Revision Comments	Approvals						HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS BELLEKENO MINE AS-BUILT AT EOM Figure 6-6			
	Name									
	Signed									
	Date						Scale:	Support:	Rev #:	Mine:
		Originator	Engineering	Geology	Mine / Ops Manager		File Path:			

6.4.3.2 ***Flame & Moth Mine Infrastructure***

Surface

The Flame & Moth Mine surface facilities sit within the District Mill area footprint and disturbance and utilizes much of the same mill infrastructure. Figure 6-7: Flame & Moth Mine Surface Facilities, August 2025 shows the location of the Flame and Moth Mine in relation to the mill. Surface infrastructure for the Flame & Moth Mine consists of a miners' office trailer and miners' dry facility, cold storage structure, water treatment plant (inside the mill) and settling pond, ore and waste handling/storing facility, explosives magazine, portal ventilation fan and heater, air compressors and a fresh air raise. The main ventilation fans and mine air heater will be located at the raise collar.

N-AML waste rock generated from development and mining at Flame & Moth will be deposited in the N-AML waste rock disposal area (WRDA) or deposited around the mill area to create extensions to laydown, storage areas and as a base for the construction of the DSTF. P-AML waste rock is deposited in a temporary P-AML waste rock storage facility constructed nearby before being backfilled underground. The lined temporary P-AML storage facility has been constructed near the portal entrance (up to 12,000 tonnes) (Photo 6-4 and Appendix 3.4). This will be used during the initial development (137,000 tonnes) after which the development schedule will enable all P-AML development rock to remain underground, and the P-AML rock stored within the temporary facility will be moved back underground as backfill. In Q3 of 2025 AKHM identified damage to the liner due to removal of the material as it was being relocated underground. The P-AML waste rock in the facility was relocated underground, clean up and testing of the area was completed, and the liner was repaired in Q4 of 2025. All P-AML waste rock will be rehandled back underground prior to closure.

The site receives explosives deliveries by truck, and the explosives are stored in licensed and permitted underground magazines.



Photo 6-4: Flame & Moth P-AML Pad and Mill Ore Pad

N-AML waste rock from the Flame & Moth Mine will be deposited in the N-AML waste rock storage facility or used for construction or backfill. Flame & Moth N-AML materials may be used within the District Mill area for construction of the portal pad and laydown area, expansion of the coarse ore stockpile, mill yard expansion,

District Mill truck access routes, and construction of the toe berm and base layer for DSTF Phase II and maintenance or construction of other infrastructure proximal to the District Mill.

Figure 6-7: Flame & Moth Mine Surface Facilities, August 2025

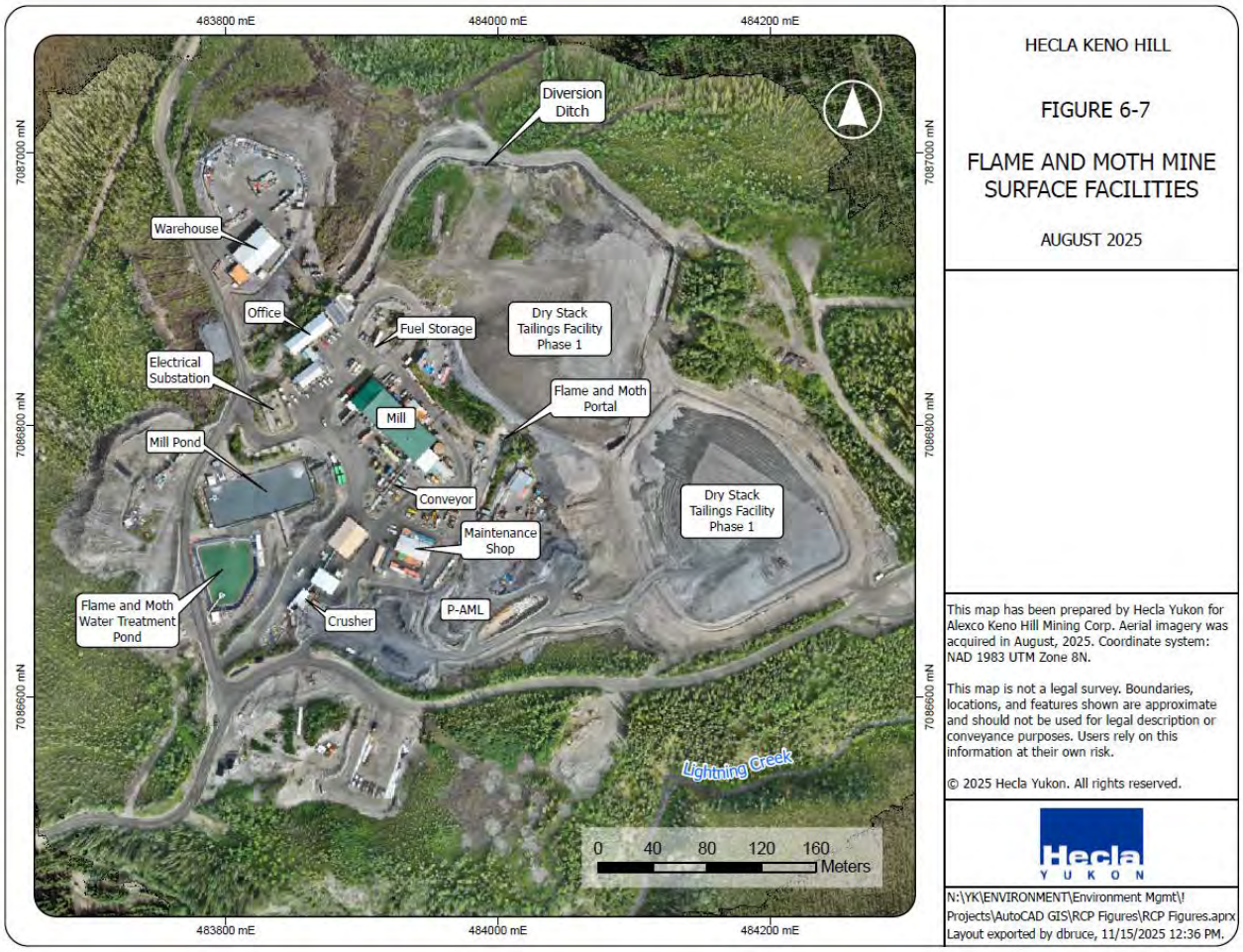


Figure 6-8: Flame & Moth P-AML Waste Rock Storage Facility, August 2025



Underground

The Flame & Moth deposit was outlined by surface exploration drilling in 2010 through 2013 with ongoing surface exploration. The location of the Flame & Moth Mine in relation to the District Mill and the ore zones is shown in Figure 6-9. The current Flame & Moth LOM Plan and As-built is shown in Figure 6-10.



Figure 6-9: Flame & Moth Plan View Showing Ore Zones

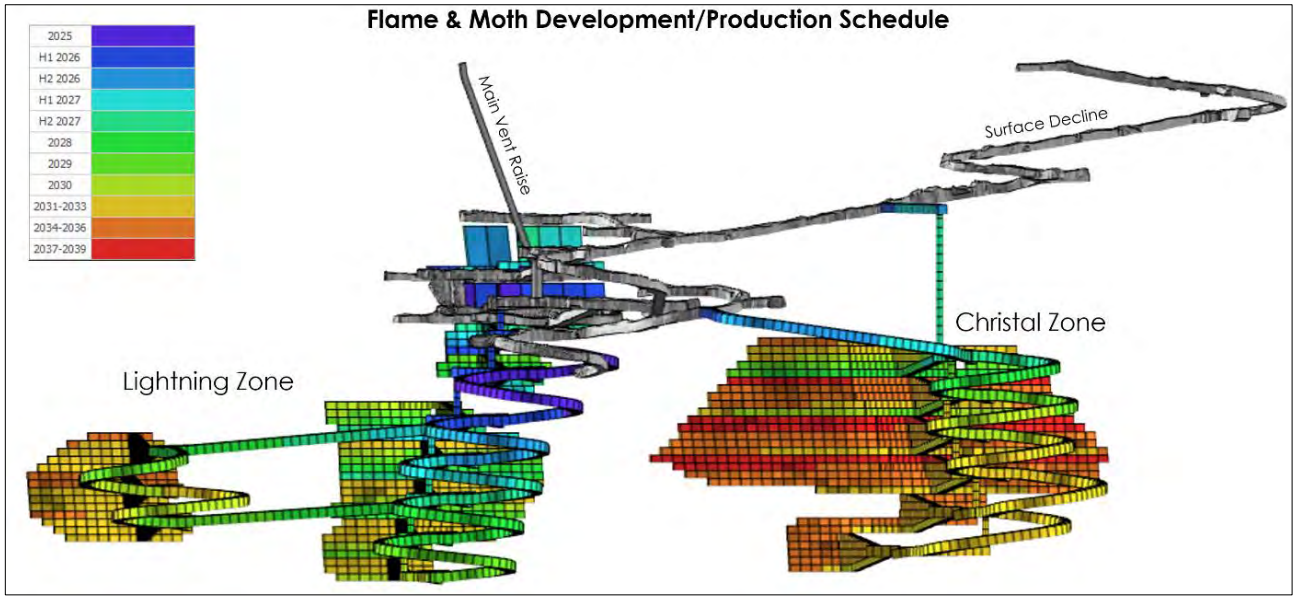


Figure 6-10: Flame & Moth Life of Mine Plan and As-Built (Y/E 2024)

6.4.3.3 ***Bermingham Mine Infrastructure***

Surface

Various surface facilities and infrastructure were installed 2017 to 2020 to support the New Bermingham underground exploration and mine development including a mine office, dry/lunchroom, maintenance shop, water treatment plant and settling pond, diesel power generation, fuel storage tanks and laydown yard. The surface infrastructure constructed for the advanced exploration decline has been expanded to facilitate development and production mine. Additional surfaces facilities and infrastructure include an administrative and technical service office (2023), additional miner's dry facilities (2023), cold storage structure, ore and P-AML waste rock handling/storing facilities, explosives magazine, portal ventilation fan and heater, air compressors and a fresh air raise. The main ventilation fans and mine air heater will be located at the raise collar. An electrical substation at Ruby and power lines to the mine.

Non-acid metal leaching (N-AML) waste rock generated from development and mining at New Bermingham is deposited in a N-AML waste rock disposal area, which is an extension to the advance exploration waste rock disposal area.

Figure 6-11 shows P-AML waste rock deposited in a P-AML waste rock storage facility constructed on top of a historic Bermingham Mine waste rock dump. The P-AML rock stored within the temporary facility is moved back underground when it can be used for backfill. N-AML waste is used for construction of portal pad and laydown area, and roads or as backfill underground.

The site receives explosives deliveries by truck and the explosives are stored in licensed and permitted underground magazines.

A view of the New Bermingham surface facilities (current and proposed) and layout is shown in Photo 6-5 and Photo 6-7. The surface infrastructure present as of October 2025 is shown in Photo 6-6.

In Q4 of 2025 a septic system was constructed at New Bermingham to reduce septic servicing requirements for the site. In 2025 a pad was established in preparation for construction of a maintenance shop in 2026.



Photo 6-5: New Bermingham Surface Infrastructure, October 2023



Photo 6-6: New Bermingham Surface Infrastructure, November 2025



Photo 6-7: New Bermingham P-AML Waste Rock Storage Facility #1



Figure 6-11: New Bermingham P-AML Waste Rock Storage Facility, September 2025

Underground

The current New Bermingham Life of Mine Plan and As-Built is shown in Figure 6-12.

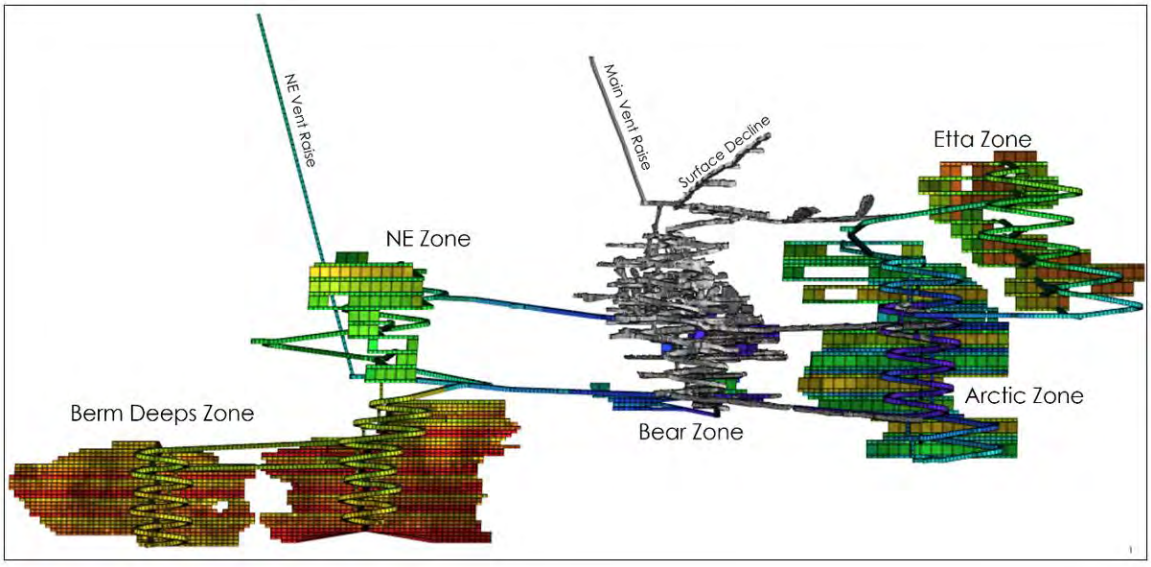


Figure 6-12: New Bermingham Life of Mine Plan and As-Built (Y/E 2024)

6.4.3.4 ***Lucky Queen***

The Lucky Queen mine adit was rehabilitated in 2011/2012 including installation of new ground support over the 1,200 metres of historic adit. This adit provides primary ingress/egress to the Lucky Queen mine, as shown in Figure 6-13.

The current status of the Lucky Queen mine includes the portal, a shop maintenance building, and an ore load out building as shown in Photo 6-8: and Photo 6-9. An unlined settling pond is in place to manage water flowing from the Lucky Queen mine. An as built of the Lucky Queen underground workings is shown in Figure 6-14.

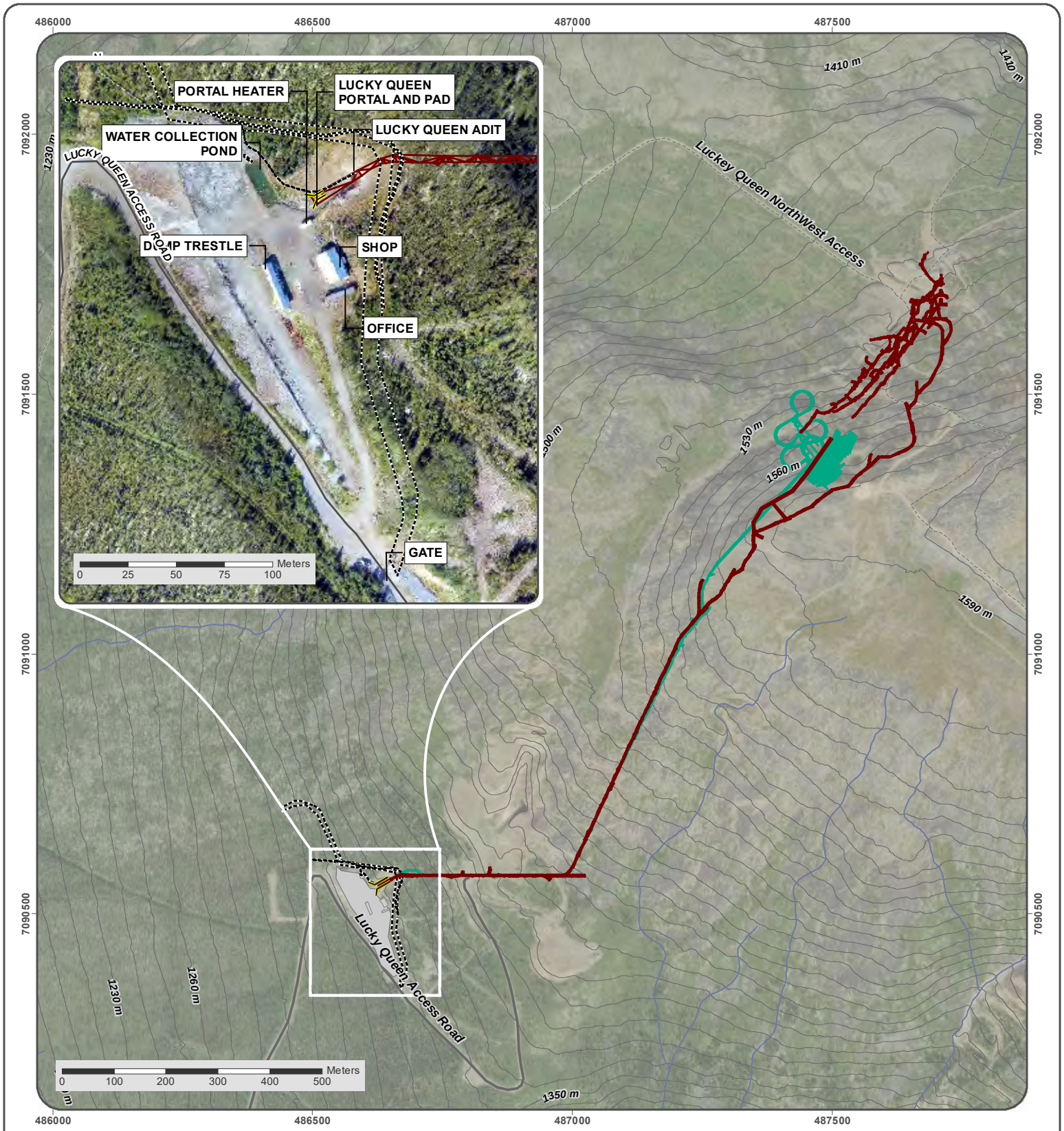


Photo 6-8: Lucky Queen Portal



Photo 6-9: Lucky Queen Portal Pad (October 2023)

Figure 6-13: Lucky Queen Mine Layout



Adit

Underground Workings, Proposed

Underground Workings, Existing

As Built Mine Features

Ditch/Pipeline

Other Road

Limited-Use Road

Satellite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on September 29 2023.

Datum: NAD 83; Projection: UTM Zone 8N

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Hecla KENO HILL

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 6-13

LUCKY QUEEN MINE LAYOUT

SEPTEMBER 2023

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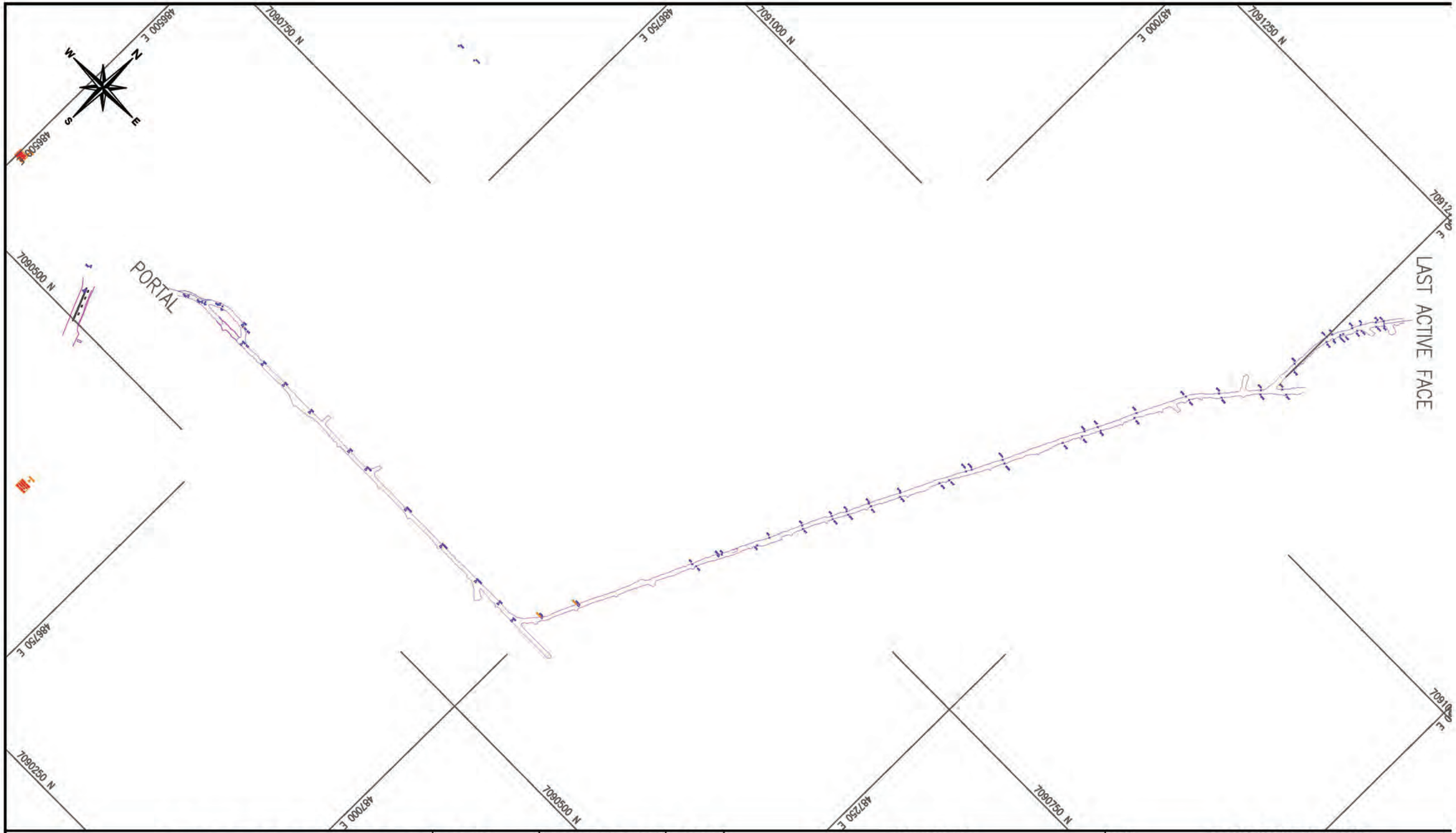
(Last edited by: amatiashevska; 2023-09-29 11:25 AM)

Figure 6-14: Lucky Queen Mine As-Built March 8, 2013



Hecla YUKON	HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS	DEPT.	APPROVED BY	DATE	COMMENTS
		SURVEY			
		ENGINEERING			
		GEOLOGY			
		ALEXCO MANAGER			
		PROCON SUPER			

TITLE: **LUCK QUEEN MINE**
Asbuilt March 8, 2013
Figure 6-14

Drawn by: DARIN BAKER	Scale: 1:2500
Date: 03/08/2013	Approval: Date:
File: C:\Users\Darin Baker\Documents\Drawing1.dwg	

6.4.3.5 ***Onek 990***

The Onek 990 deposit was developed in 2012 and currently consists of 220 meters of a primary decline. Surface facilities (office building, storage containers, and ventilation fan) have already been removed. The N-AML WRDAs, and the vent raise have not yet been constructed. The P-AML WRSF has been constructed, but no material placed in it. The Onek mine is not currently included in the Keno Hill Mine Operations LOM plan and these additional facilities would not be constructed until Onek becomes part of the LOM plan. An overview of the Onek mine is shown in Photo 6-11 and Figure 6-15. An as built of the Onek mine underground workings is shown in Figure 6-16.

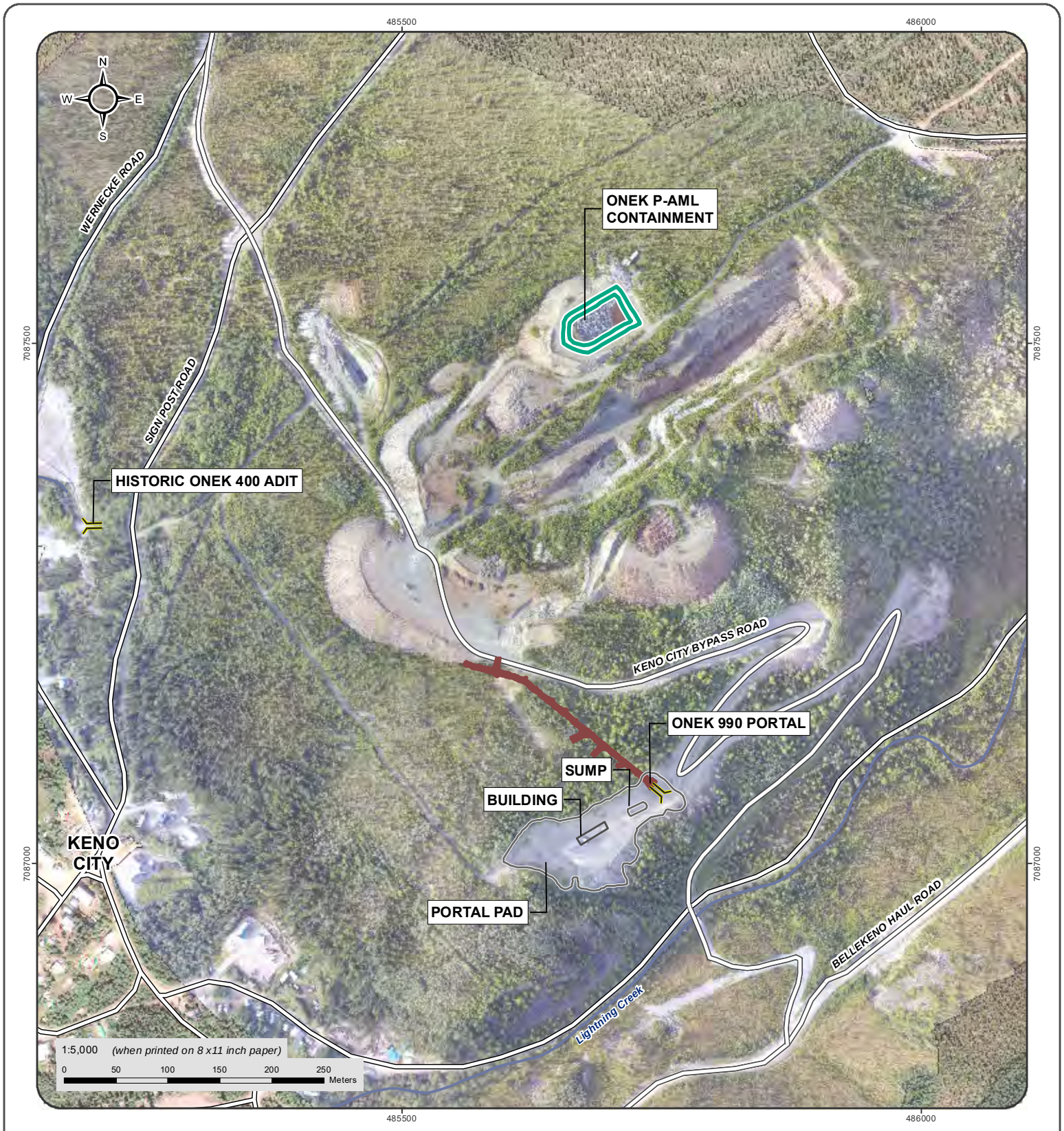


Photo 6-10: Onek 990 Portal Shed (October 2023)



Photo 6-11: Onek Mine Surface Overview

Figure 6-15: Onek 990 Mine Layout



As Built Mine Feature

Permitted To Be Completed Mine Features

Underground Workings Footprint, As-Built End of 2013

Adit

Secondary Road

Limited-Use Road

Watercourse

Aerial Imagery aquired on August 2017

Datum: NAD 83; Projection: UTM Zone 8N

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Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 6-15
ONEK 990 MINE LAYOUT

SEPTEMBER 2023

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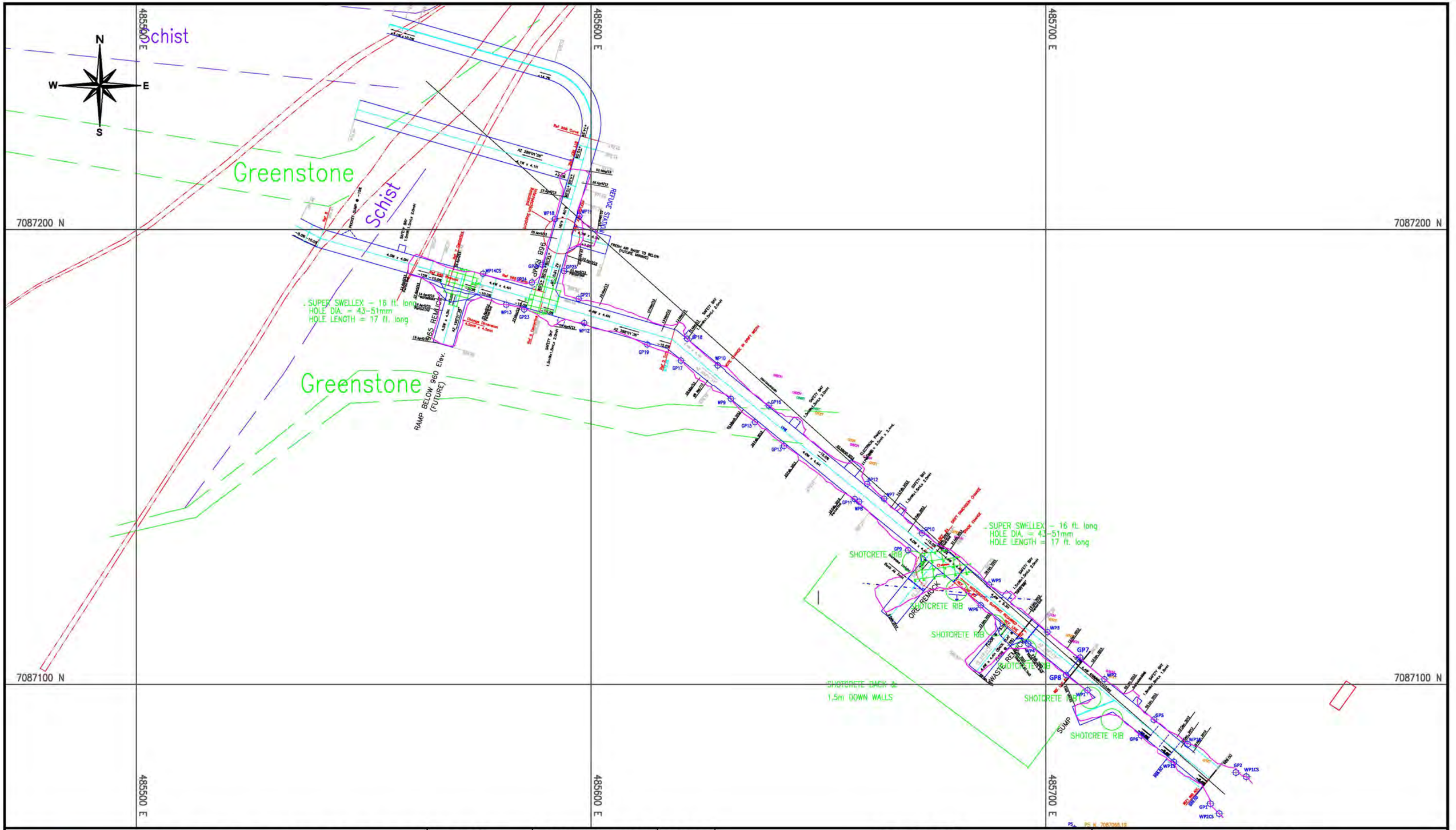
(Last edited by: amatlashevska; 2023-04-27/11:33 AM)

Figure 6-16: Onek As-built 30 May 2013



Hecla YUKON	HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS	DEPT.	APPROVED BY	DATE	COMMENTS
		SURVEY			
		ENGINEERING			
		GEOLOGY			
		ALEXCO MANAGER			
		PROCON SUPER			

TITLE: **ONEK**
ASBUILT 30 May 2013

Figure 6-16

Drawn by: DARIN BAKER | Scale: 1:750
Date: 05/30/2013 | Approval: | Date:
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6.4.4 Area Haul Road System

AKHM has constructed a series of access and haul roads to route mine traffic around the Keno City community. All traffic between Elsa and the mill facility and/or the Bellekeno Mine is routed along the Christal Lake Road and subsequently the Bellekeno haul road. The Bermingham Mine traffic uses the Bermingham access road, Calumet Road, and a section of the Duncan Creek Road (~2 km) between the mill and Calumet Road.

Heavy truck traffic from Lucky Queen will be routed along the Onek Connector to/from the Bellekeno haul road. The Onek Connector (formerly referred to at the Keno City Bypass) is approximately 2.1 km long and will be six to nine meters wide as per Yukon Workers' Compensation Health and Safety Board regulations and the identified haul road type.

6.5 MINE WATER MANAGEMENT

The Water Management Plan (Ensero & AKHM, 2020c) describes protocols for decision making on water management for each of Bellekeno, Flame & Moth and Bermingham mines.

Mass load model for No Cash Creek, Christal Creek and Lightning Creek were developed by Ensero and Interralogic, Inc./ Hatch using the GoldSim simulation framework. The load models calculated metal loadings for three phases of the project: pre-mining development, operations, and reclamation and post-closure. These load models formed the basis for the EQS defined within Water Licence QZ18-044.

The water management is focused on ensuring all water discharged from site is compliant with the EQS. The main features of water management include and are discussed in more detail in the following sections:

- Lime water treatment plants are used to remove dissolved metals from adit drainages at Flame & Moth, New Bermingham and Bellekeno.
- A breakpoint chlorination system to remove ammonia from the New Bermingham portal drainage when required.
- Water storage in ponds near each of the adits for use within the mill, and for underground development.
- Water management structures, including berms, ditches, and temporary water storage ponds, have been established to convey water around N-AML WRDA and P-AML waste rock storage facilities and direct water to appropriate locations to be discharged to ground. Any runoff from N-AML WRDA is conveyed to the environment. At Bermingham the diversion ditch is located upgradient of the Bermingham portal and diverts clean water around surface facilities to a point approximately 0.65 km uphill of the No Cash Creek headwaters. If water accumulates within the P-AML facilities this water is collected and treated at a water treatment plant prior to discharge, and
- Tailings produced is deposited in the permitted existing lined Phase 1 DSTF, has been expanded into the Phase 2 footprint in 2024. The DSTF is a lined and bermed facility that conveys any runoff from the DSTF area to the mill pond. Non-contact water is diverted from running onto the facility.
- The District Mill yard water runoff is directed into a sediment basin and then into the mill pond through a series of ditches, culverts and graded structures.

6.5.1 Bellekeno

At Bellekeno 625, mine in-flow water flows to the surface adit by gravity and then is directed into a pipeline which directs mine water into a lime-based metals precipitation water treatment plant located near the 625 adit. Bellekeno mine water treatment is primarily associated with zinc contamination. Lime slurry is mixed with underground mine water, mixed in a reactor tank to allow precipitation of zinc hydroxide sludge along with other hydroxide-based metal precipitates. The water then flows into two sequential HDPE lined ponds that have a combined storage capacity of 1,830 m^3. Figure 6-17 provides a representation of the existing Bellekeno 627 WTP process (Water Tectonics, 2024).

The water licence limits the effluent discharge rate from the mine to 864 m_3/day, or the equivalent of continuous discharge at 10 litres per second (L/s). Performance of the water treatment plant can be found in Appendix A Water Treatment Systems Performance Evaluation Report of the AKHM Water Licence QZ18-044 Annual Report.

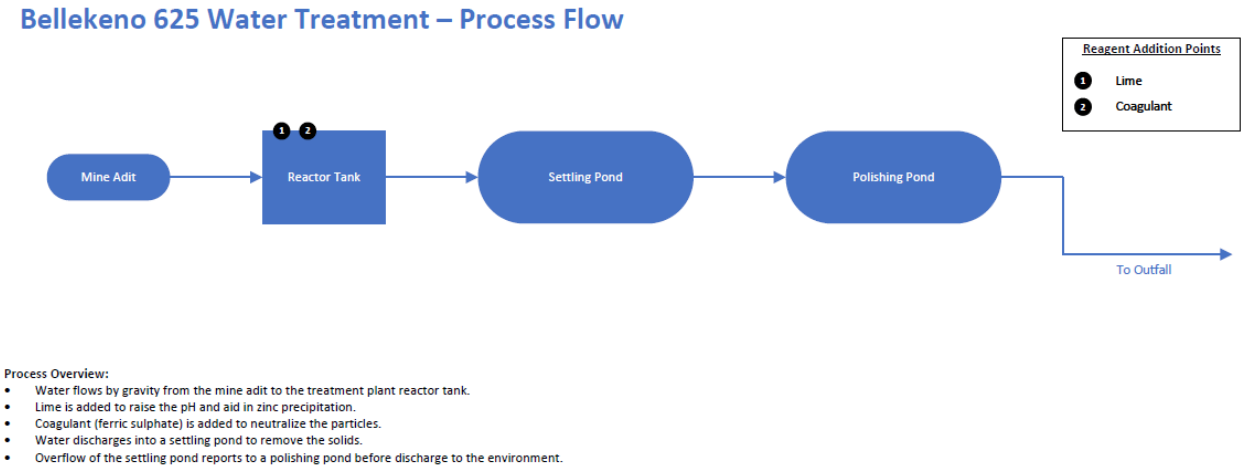


Figure 6-17: Existing Bellekeno 625 Water Treatment Process Flow Diagram

6.5.2 Flame & Moth

The Flame & Moth Mine is licenced to discharge up to 35 L/s (3,024 m3/day) to both Lightning and Christal Creek. The water encountered during the development and operation of the Flame & Moth underground workings will either be utilized in the milling process as makeup water or discharged. The milling process requires up to 81 m^3/day, while the underground development requires up to 140.1 m^3/day (includes 25% contingency) when production is at 400 tpd.

The balance of this flow will be treated in a lime water treatment plant that has been constructed in the District Mill building. The treated effluent is conveyed to the Flame & Moth settling pond and discharged via pipeline to Christal or Lightning Creeks. To date the majority of the Flame & Moth treated water has been discharged to Lightning Creek.

Performance and flow rates of the water treatment plant can be found in Appendix A Water Treatment Systems Performance Evaluation Report of the AKHM Water Licence QZ18-044 Annual Report.

The as-built pond and process flow sheet are shown in Photo 6-12. The Flame & Moth water treatment system operates as follows:

- Once primary settling of solids has occurred in the sumps, water is pumped to surface via a submersible pump in the sump through an 8" pipeline to a flash mixing tank on the clarifier. Lime and ferric are added into the flash mixing tank and mixed. The dissolved metals will begin to react with lime and form precipitates. Ferric sulphate is also added as a coagulant, and to assist with arsenic removal.
- Water flows into the lamella clarifier, which contains a series of inclined plates. Polymer is added to the stream at the beginning of the clarifier to accelerate settling of solid particles. The solids then settle on the plates and accumulate into a cone located at the bottom of the clarifier. The sludge is drawn off at the bottom, and the clarified liquid exits the top by weir. The clean clarifier overflow flows into a pipeline and is conveyed to the settling pond.
- Sludge and heavier particles from the clarifier then gravity flow into geotextile dewatering bags. The bags densify the sludge by filtering the water from the solids. The water flows into a pipeline and is conveyed to the settling pond. The sludges in the geotextile bags are disposed of in the underground mine when filled.
- Once water enters the settling pond, residence time will allow for final particle removal and polishing of the treated water.
- Water can then be decanted from the pond for discharge or reused within the Flame & Moth underground activities if required.

Updated groundwater inflow estimates for the Flame and Moth Mine were completed in 2025. SRK Consulting assessed groundwater inflow estimates for the proposed Flame & Moth underground mine as it reaches a depth of 270 meters below ground surface. Historical dewatering data from 2018-2024 showed mine water flows peaked at 260 m^3/day in early 2019, stabilized around 130 m^3/day by 2020, and recently measured approximately 950 m^3/day (11 L/s) after flow meter repairs in 2024. Using FEFLOW numerical modeling calibrated against historical data, SRK predicts maximum end-of-mine groundwater inflows of 1,900 m^3/day, with drawdowns extending 500-1000 meters from the mine affecting an area of 2.6 km^2. The model forecasts minimal impact on Lightning Creek baseflows (3% reduction upstream of Duncan Creek) but more significant reductions in Christal Creek (up to 28% at monitoring station KV-6, though likely overestimated due to Christal Lake's sustaining influence), with groundwater levels and baseflows expected to return to baseline conditions within 1-9 years after mine closure depending on location.



Photo 6-12: Flame & Moth Settling Pond and Mill Pond

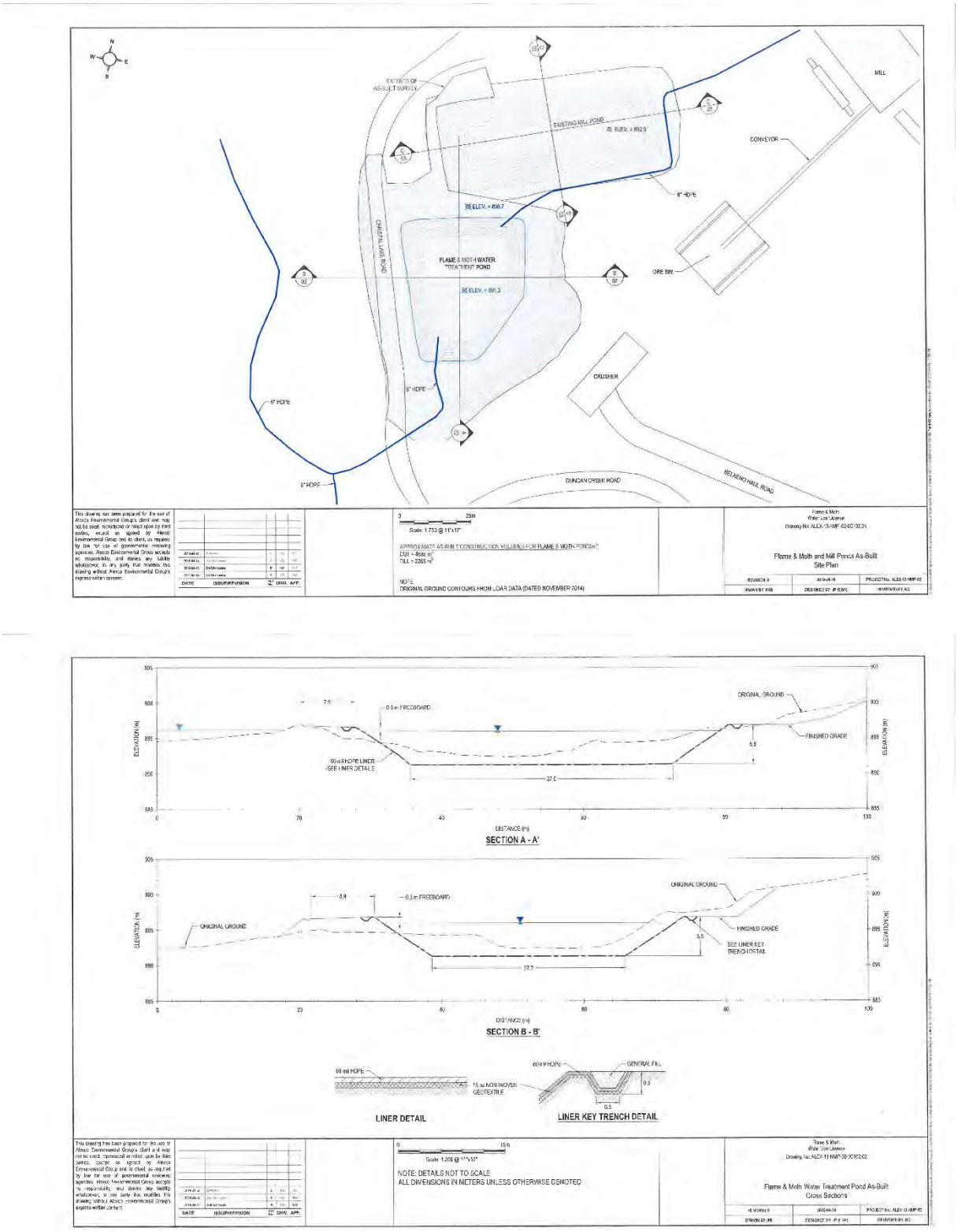


Figure 6-18: Flame & Moth and Mill Ponds As-Built Site Plan and Cross Sections

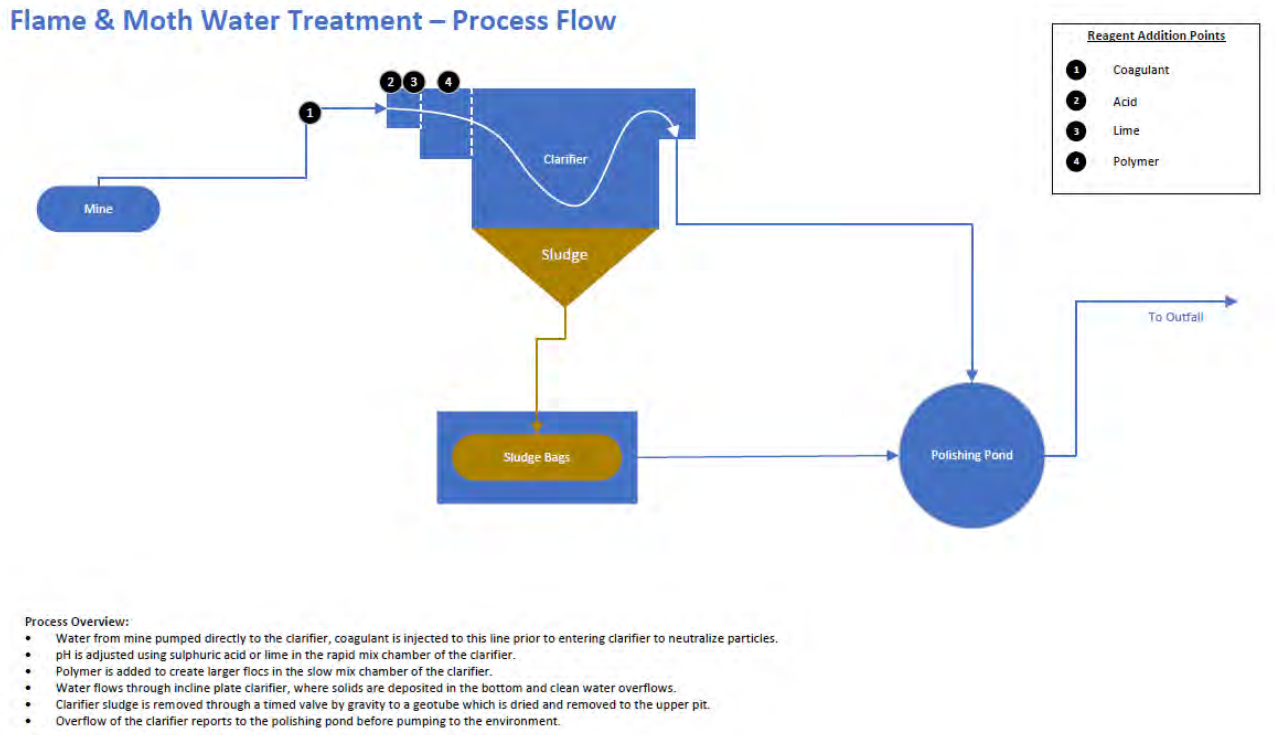


Figure 6-19: Flame & Moth Water Treatment Plant Process Flow

6.5.3 New Bermingham

The New Bermingham underground development and production require up to 140.1 m^3/day (includes a contingency of 25%) and will discharge up to 13.9 L/s (1,200 m^3/day) to the No Cash Creek catchment, following water treatment. Daily water usage during ongoing underground mine development and operation is estimated at 112.5 m^3/day when mining at an estimated maximum rate of 400 tpd. This water is used to support activities including percussion drilling, dust suppression, equipment cooling and minor use for sanitation. As part of advanced exploration, water was pumped from the face of the underground development to a series of underground sumps before being conveyed to the surface pond, which then discharged to ground.

Reused process water from the underground workings will be the primary source of water for New Bermingham. The underground water will be supplemented if needed by water sourced from the New Bermingham water treatment pond and from a groundwater source as contingency. These contingency sources may be required if water quality in the underground mine water is not suitable (e.g., high suspended solids could damage mechanical equipment) or if it is temporarily not available (e.g., during sump construction).

The New Bermingham mine requires continual dewatering, with discharge flows dependent on mine depth. It is estimated that flow rates may reach a maximum of 13.9 L/s with incoming water quality generally compliant except for some metals and potentially with elevated levels of ammonia and total suspended solids from underground mining activities. The treatment plant is located near the New Bermingham portal.

As part of mine operations at New Bermingham, a water treatment plant similar to Flame & Moth has been constructed. All of the systems and technology used in this WTP are proven technologies operating at Keno Hill or elsewhere in the industry. The system operates as follows:

- Once primary settling of solids has occurred in the sumps, water is pumped to surface via a submersible pump in the sump through a 4" pipeline line to a reactor tank. Lime and ferric sulphate are added into the reactor tank and aggressively mixed. The reactor tank provides sufficient residence time for the dissolved metals to react with lime being added to this tank. Ferrous chloride is also added as a coagulant in the clarifier. The iron addition also assists with removal of both particulate and dissolved arsenic;
- Water flows from the reactor tank into the lamella clarifier, which contains a series of inclined plates. Polymer is added to the stream at the beginning of the clarifier to accelerate settling of solid particles. The solids then settle on the plates and accumulate into a cone located at the bottom of the clarifier. The sludge is drawn off at the bottom and the clarified liquid exits the top by weir. The clean clarifier overflow flows into a pipeline and is conveyed to the settling pond;
- Sludge and heavier particles from the clarifier then gravity flow into geotextile dewatering bags. The bags densify the sludge by filtering the water from the solids. The water flows into a pipeline and is conveyed to the settling pond. The sludges in the geotextile bags are disposed of in the Bermingham SW pit once the bags have been filled. At closure the sludge in the pit will be covered with waste rock and till material;
- Once water enters the settling pond, residence time will allow for final particle removal and polishing of the treated water. The pond, its as-built pond and the process flow sheet are shown in Photo 6-13, Figure 6-22 and Figure 6-23.
- Water can then be decanted from the pond for discharge or reused within the New Bermingham underground activities, or pumped to an ammonia treatment system if required; and
- The ammonia treatment system utilizes breakpoint chlorination to convert the ammonia into nitrate, nitrogen gas and low concentrations of nitrous oxide. Sodium hypochlorite is dosed based on the ammonia concentration, and the pH is tightly controlled using sulphuric acid and pH probes. A series of reactor vessels ensure complete reaction and then the treated water flows via gravity back to the settling pond.

Improvements to the water management system underground at Bermingham were made in Q1 of 2025 with the commissioning of the North East Zone sumps, a series of 3 large sumps which promote the settling of solids prior to the water being pumped to the water treatment plant on surface. The addition of the sumps has significantly improved the quality of the water being pumped to surface for treatment and discharge.

Additionally, root cause analysis and risk assessments have identified the need for a surge pond on surface which would accept water being pumped from the underground and supply a consistent flow and quality of water to the water treatment plant. The addition of this pond would provide redundancy and ensure maintenance and upset conditions can be managed without discharging outside the EQS regulatory parameters. The surge pond is proposed to be constructed in 2026 pending authorization from the appropriate regulatory bodies.

Updated groundwater inflow estimates for the New Bermingham Mine were completed by SRK Consulting in 2025. As the mine plans to expand into new fault-isolated zones a volume-based estimation approach predicts significantly higher combined inflows of up to 42 L/s (3,600 m^3/day) at EOM above the current permitted discharge rate of 13.6 L/s. The permitting initiatives are currently underway and engineering is being initiated to manage the increased volumes for the LOM. Additional work is planned in 2026 to further advance hydrology models at New Bermingham Mine.



Photo 6-13: New Bermingham Settling Pond



Figure 6-20: Bermingham Water Treatment Ponds As-Built

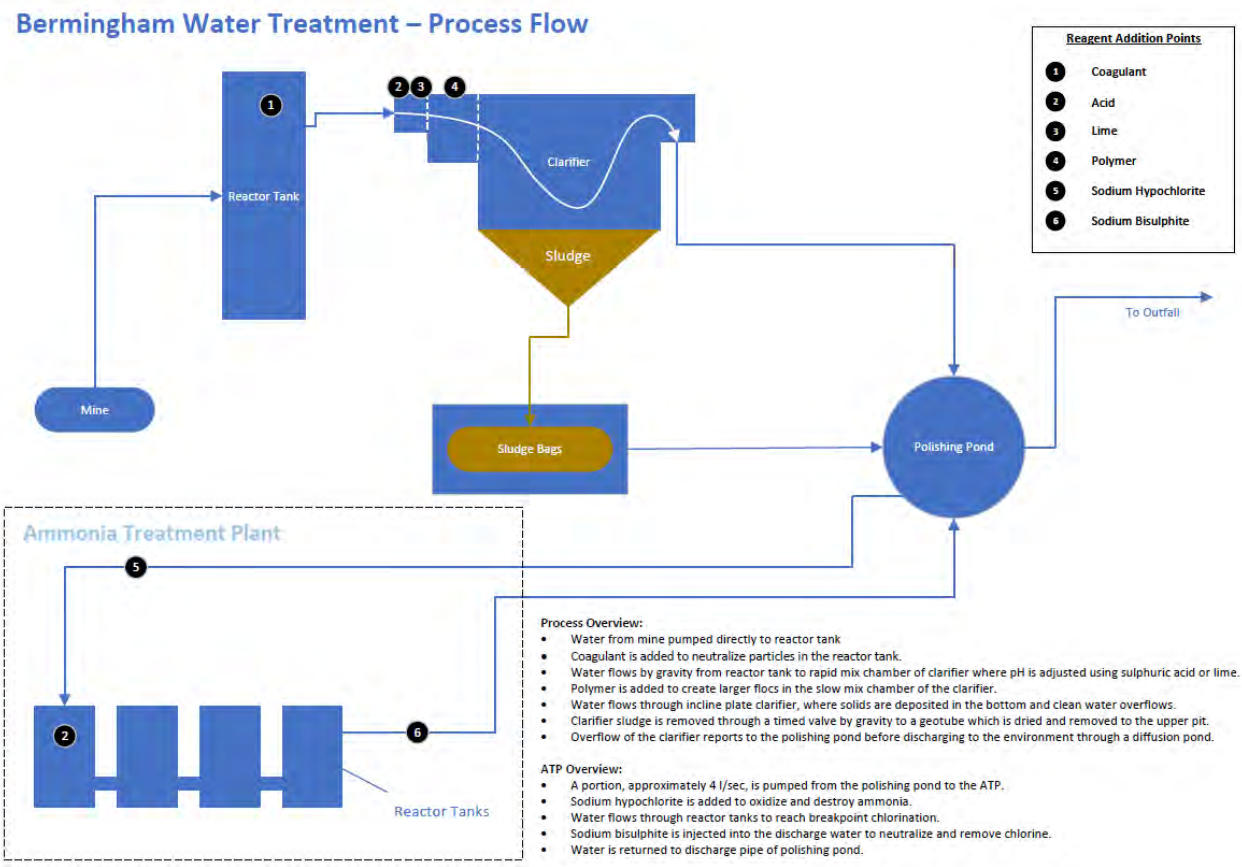


Figure 6-21: New Bermingham Water Treatment Plant Process Flow

6.6 MILLING OPERATIONS

The District Mill is a conventional differential flotation facility producing two separate metal concentrates that are shipped offsite for final processing. The mill was constructed in 2009 and 2010. The mill achieved commercial production in January 2011 using Bellekeno ore and operated until 2013. The mill was then put into Care and Maintenance, which lasted until 2021. Recommissioning of the mill commenced in 2021. In 2020 and 2021 minor modifications were made to the mill to improve throughput and recovery. In 2023, the crusher plant was reconfigured: an outdoor conveyor was relocated inside the upgraded crusher building; doors were installed on the building; and a new screen deck installed to improve maintenance and operation capabilities at cold temperatures. Infrastructure upgrades in 2024 included replacement of the process water line between the mill and Mill Pond with Arctic pipe and installation of tent ends on the fine ore tent.

6.6.1 Mill Design Criteria

Design criteria for the mill operations are summarized in Table 6-8.

Table 6-8: District Mill Design Criteria

DESCRIPTION	UNIT	VALUE
Ore Characteristics		
Specific Gravity	g/cm³	3.46
Bulk Density	t/m³	2.1
Moisture Content	%	3-5
Operating Schedule		
Crusher Plant		1 shift per day (12 h/shift)
Grinding and Flotation Plant		2 shifts per day (12 h/shift)
Annual Operating Days	day	365
Plant Availability/Utilization		
Overall Plant Feed	mt/a	146,000
Overall Plant Feed	mt/d	250 - 400
Crusher Plant Availability	%	80
Grinding and Flotation Plant Availability	%	92
Crushing Process Rate	mt/h	63.8
Grinding/Flotation Process Rate	mt/h	18.5

6.6.2 Process Overview

The Keno District Mill consists of the following process circuits;

- primary and secondary crushing circuits with a belt conveyor to transport the crushed ore to the covered fine ore stockpile,
- fine ore reclaim system feeding crushed ore from the covered fine ore stockpile,
- primary and secondary ball milling in a closed circuit with a high cyclones to produce a grinding product of 80% passing 110 µm,
- the cyclone overflow feeding to lead rougher scavenger flotation circuit to recover lead and silver minerals; the lead rougher flotation concentrate regrind followed by being upgraded in three stages of cleaner flotation,
- the zinc rougher flotation concentrate regrind followed by being upgraded in three stages of cleaner thickening and pressure filtration of the lead and zinc concentrates, and
- thickening and pressure filtration of tailings, disposed either at underground as backfill or at the surface dry stack tailings facility. The mill process flowsheet is presented in Figure 22.

Decontamination of process facilities is routinely undertaken by operations personnel of the crushing circuits, mill, and concentrate loadout area.

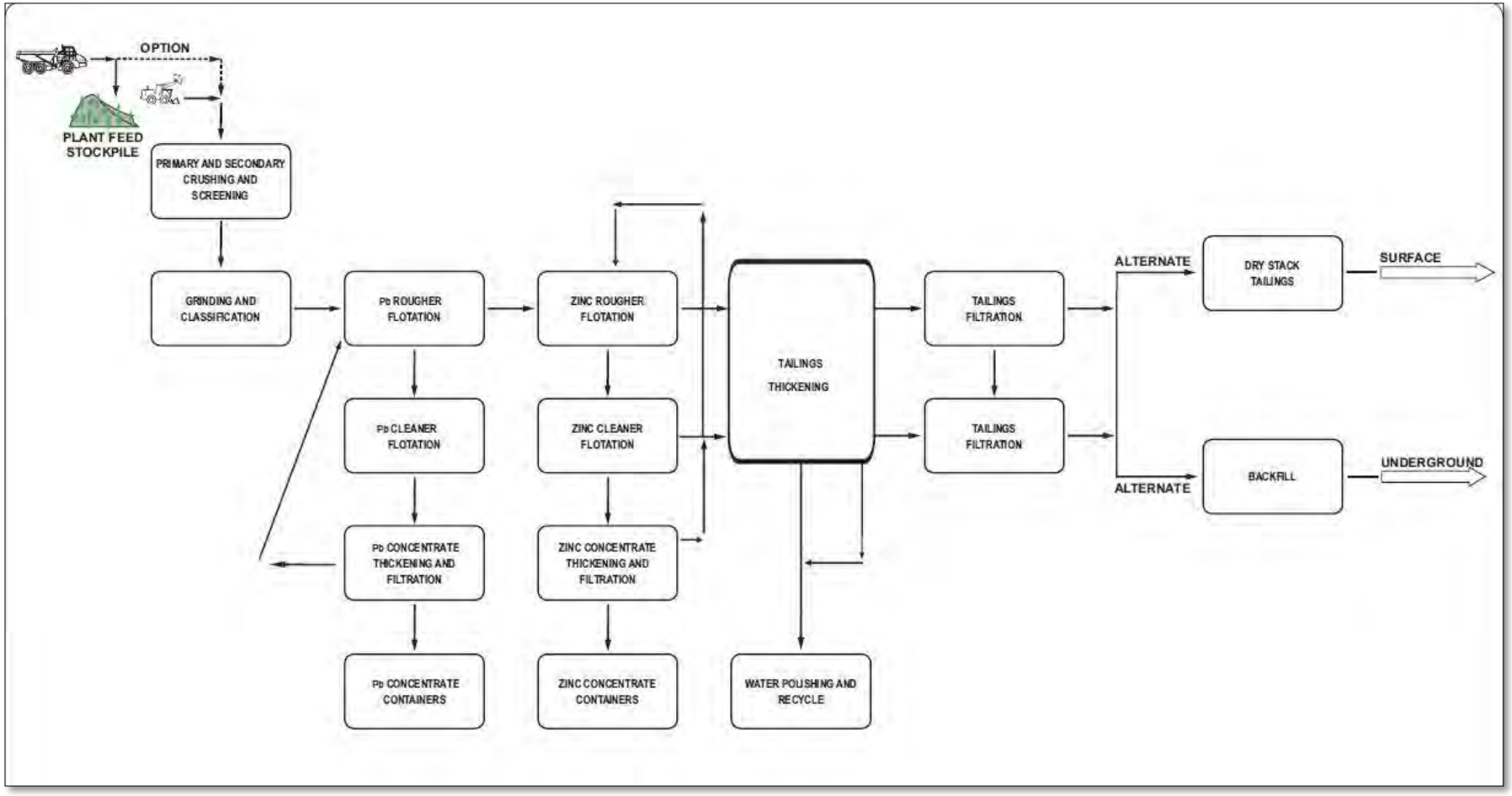


Figure 6-22: District Mill Process Flowchart

6.6.3 Ore Stockpile

Ore from the various mines is stored at the coarse ore stockpile for at the District Mill prior to being moved into the crusher/grinding facility. The coarse ore stockpile is on a 0.5-metre-thick concrete base (cemented rock fill [CRF]) pad which is covered with a layer of low-grade ore. The ore pad is surrounded by portable concrete containment blocks. The ore pad was redesigned in 2022 and a new and expanded CRF pad was laid as described in the Mill Development and Operations Plan (Hecla 2023).

Fine ore produced from the crushing plant is stored on a fine ore stockpile covered by a fabric membrane structure to isolate the ore from snow, rain, and windy conditions, as well as storage units for the crushing plant and mill spare parts inventory (Photo 6-15).



Photo 6-14: Ore Stockpile and Flame & Moth P-AML Pad

6.6.4 District Mill Infrastructure

An aerial photo showing the District Mill and Flame & Moth Mine infrastructure is provided in Figure 6-26. Infrastructure at the District Mill facility includes the mill and DSTF along with:

1) mill and administration offices,
1) warehouse,
2) maintenance shop,
3) male and female dry facilities,
4) an assay lab,
5) first aid facilities (located inside the mill office),
6) millwright shop,
7) water tank, and
8) mill pond.



Figure 6-23: Mill Infrastructure Overview

The mine geology and engineering office buildings from Bellekeno were moved to the District Mill area in 2020 to serve as an administration office. The warehouse was constructed in 2022. In Q4 of 2025 a temporary heated storage tent was erected along the Christal Lake Road for the heated storage of water and vac trucks. Improvements to a section of the DSTF water conveyance and mill pond infrastructure were completed in Q4 of 2025.

A metallurgical and assay laboratory conducts all basic test work to monitor and improve the process flowsheet metallurgy and efficiency, and to support environmental monitoring. The assay laboratory was constructed as a pre-packaged unit consisting of two retrofitted 40 ft shipping containers converted into laboratory modules. The laboratory is equipped with the necessary analytical instruments to provide all routine assays for the mine, plant, and environmental quality control monitoring. Standard analysis includes acid digestion of samples followed by analysis on an atomic absorption spectrometer and fire assay.



Photo 6-15: Fine Ore Storage, Secondary and Primary Crusher Building



Photo 6-16: Mill Expansion and Assay Lab

6.6.5 Motor Control Centres

A Motor Control Centre (MCC) for the mill building (Photo 6-17) is located immediately adjacent to the mill and contains the motor control starters and distribution for the mill equipment. The main electrical substation distributes 600 V electrical power to the mill MCC. The mill MCC is a skid mounted unit mounted on a steel support structure and has a dimension of 15.24 x 3.04 meters.

The crusher MCC (Photo 6-18) is located adjacent to the crushing plant and provides electrical distribution for the various motors located in the crushing plant. The main electrical substation distributes 600-volt electrical power directly to the crusher MCC and then individual motor starters within the MCC distribute power to the motors. It is a portable skid mounted steel insulated building with dimensions of 2.4 by 6.1 meter.



Photo 6-17: Mill MCC



Photo 6-18: Crusher MCC

6.6.6 Water Management

The mill process pond is located downgradient from the mill building and contains and manages the process water balance required for the milling operation. Thickener overflow water from inside the mill building gravity flows via an insulated pipe into the mill process pond. Process makeup water is pumped from the pond to the process water tank for makeup and recycle in the milling process.

The mill pond receives runoff from the DSTF area as discussed in Section 6.5. The mill process pond is 32 x 79 meters in dimension and was upgraded in 2025 for a total design capacity of 8,650 m^3 to accommodate a 1:50-year event. Excess volumes spill into the Flame and Moth Pond and a spill way was constructed in 2025 to safely evaluate volume from events higher than 1:200-year, including peak flows at 1:500-year.

Process water consists primarily of reclaim water from the water polishing pond, as well as tailings thickeners overflow. From the process water pond, the reclaimed water is pumped to a 7 m diameter by 7 m high process water storage tank, from where the water is dispersed to the distribution lines in the process plant. The steel water storage tank is located next to the mill building and sits on a compacted gravel pad.

Fresh water is delivered to the fresh water tank at the administrative office trailers via a water truck and the fresh water is used in eye wash stations located throughout the mill building, for reagent mixing and for pump gland water.



Photo 6-19: Mill Pond November 2025

6.7 DRY STACK TAILINGS FACILITY

6.7.1 Overview

AKHM employs Dry Stack Tailings technology for management and long-term storage of tailings. Following dewatering through plate and frame filter presses located inside the mill building, the tailings are deposited onto a storage location outside the mill building via a conveyor belt. Dewatered tailings for the DSTF are rehandled and loaded into a 30-tonne articulating haul truck and hauled from the tailings stockpile outside of the mill building to the DSTF and mechanically spread and compacted in 300 mm-high lifts to form a stacked tailings deposit.

The dewatered tailings are transported onto a liner system designed to capture any residual porewater that may leave the pile. The tailings are laid down in 0.5 metre lifts and compacted with a vibratory roller compactor. The DSTF components are summarized in Table 6-9 (TetraTech, 2023).

Table 6-9: Dry Stack Tailings Facility Components

COMPONENT	DESCRIPTION
Drainage blanket	Drainage layer located at the base of the DSTF Allows excess water from tailings stack or degrading permafrost to drain freely
Diversion berms	Diverts surface runoff away from the DSTF and mill areas
Runoff collection ditch	Collects surface water and seepage from the drainage blanket and directs it to the water collection pond via a sump
Water collection pond	Lined water retention cell with 3,500 m^3 capacity
Tailings stack	Mechanically placed and compacted tailings
Evapo-transpirative cover	0.5 m-thick vegetative cover to be placed during DSTF reclamation
Monitoring installation	Ground temperature cables. Historically there were also groundwater monitoring wells, inclinometers, and survey monuments installed in the DSTF for geotechnical and environmental monitoring.

As of September 30, 2025, approximately >342,000 dry tonnes (>190,000 m3) of tailings are stored in the DSTF and cover an area of approximately 3.3 hectares. The ultimate proposed DSTF capacity is approximately 450,000 m3 or 855,000 tonnes and will cover an area of approximately 6.5 hectares. Tailings are planned to be placed in the DSTF at a rate of approximately 11,160 tonnes (6,200 m3) per month (372 tonnes per day).

QML-0009 provides approval for up to 907,000 tonnes of dewatered tailings to be placed in the DSTF.

6.7.2 Phase I

The DSTF is developed in phases. Detailed Phase 1 design was completed in 2011 (EBA, 2011). Phase 1b was designed as an expansion to Phase 1 to accommodate the permitted tailings volume. Phase 1b design was completed in 2013 (EBA, 2013). The detailed design of the DSTF phase I is presented in Figure 6-26. Changes in mine planning led to a portion of the Phase I footprint not being constructed. An area included in the Phase I design footprint immediately north of the mill is now used as a reagent storage area, turnaround for concentrate trucks entering the mill, and a laydown yard, as shown on the existing construction plan.

6.7.3 Phase II

The Phase II expansion is located generally to the southeast of the existing Phase I. Currently, the area is mostly disturbed. The former Keno City waste transfer station and access road are adjacent on the northwest side of Phase II (Figure 25: Figure 6-25: DSTF Phase 1 Sections

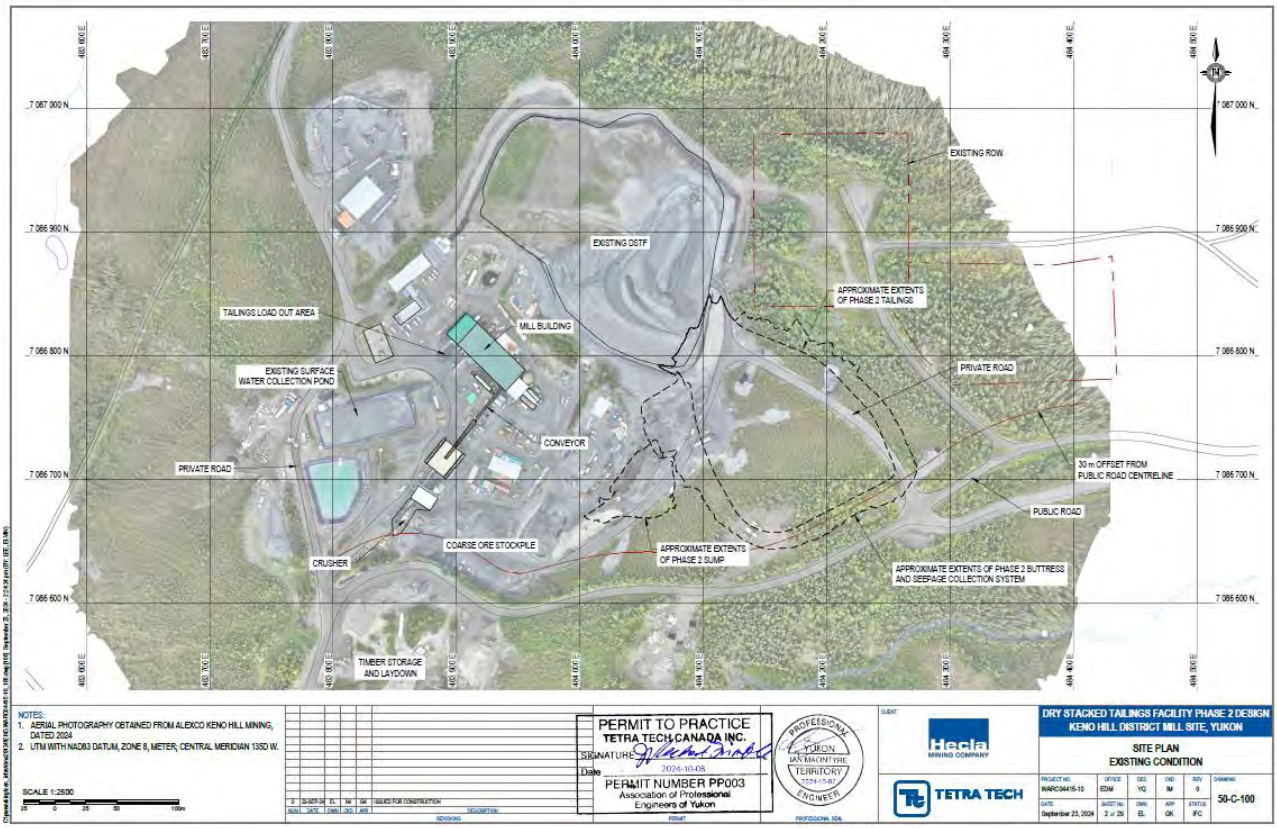


Figure 6-26).

Detailed design for Phase 2 East of the DSTF was issued in 2024 (Tetra Tech, 2024). DSTF Phase 2 East construction was completed in early 2025. Phase 2 West is currently under design and is scheduled for construction during Summer 2026.

Preliminary geotechnical investigation and design work was previously completed by Tetra Tech (Tetra Tech EBA 2015). The detailed design herein has expanded on the preliminary work completed and incorporates engineering observations and judgement of the performance of Phase 1 to date.

To aid in overall facility stability, 3.25H:1V slopes have been designed for Phase 2 East.

A toe buttress has been incorporated into the design to assist in achieving minimum factors of safety against failures through the foundation materials. This buttress will also be utilized to collect and convey surface runoff along the western slope and toe. The surface of the buttress is expected to have a gradient of approximately 2%, sloping from the north to the south. A cut/fill operation is anticipated using the local waste rock that is on site. The height of the required fill varies up to approximately 3 m in localized areas. The intention is a 2 m high buttress of waste rock along the western toe.

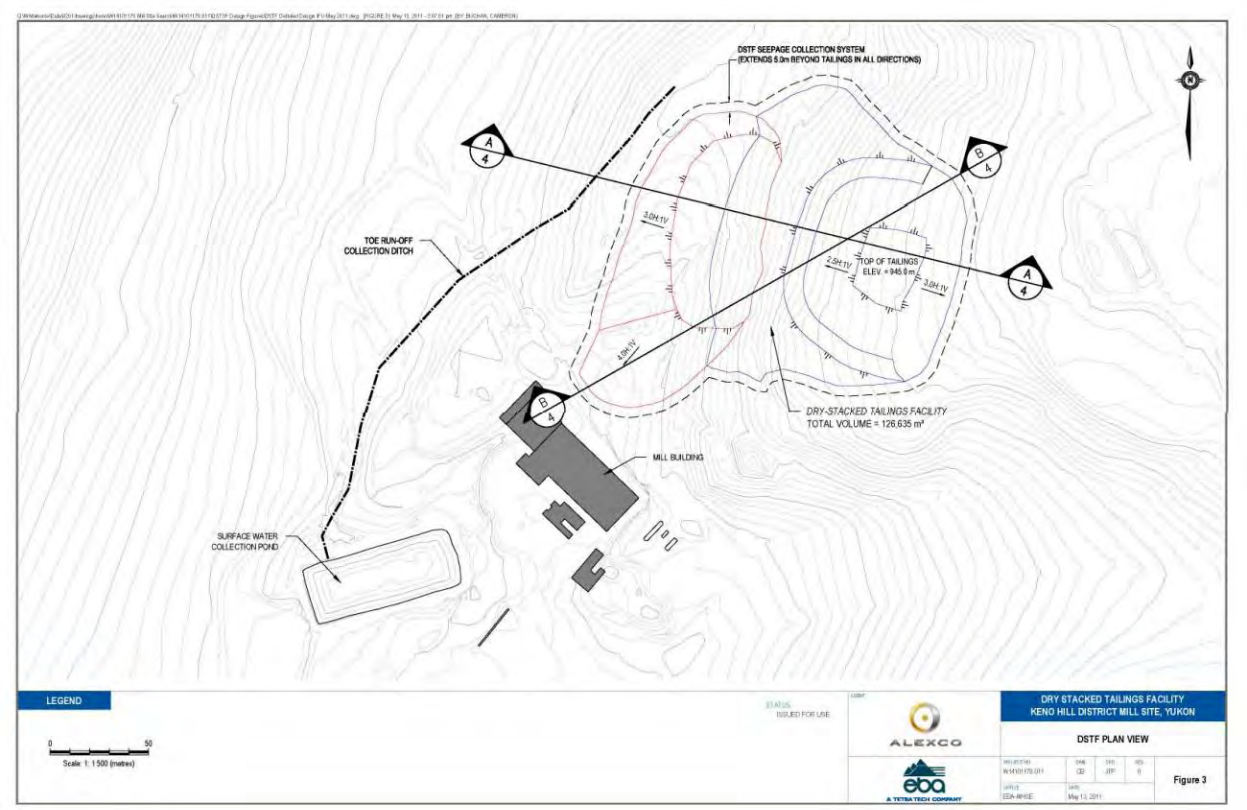


Figure 6-24: DSTF Phase I Plan View

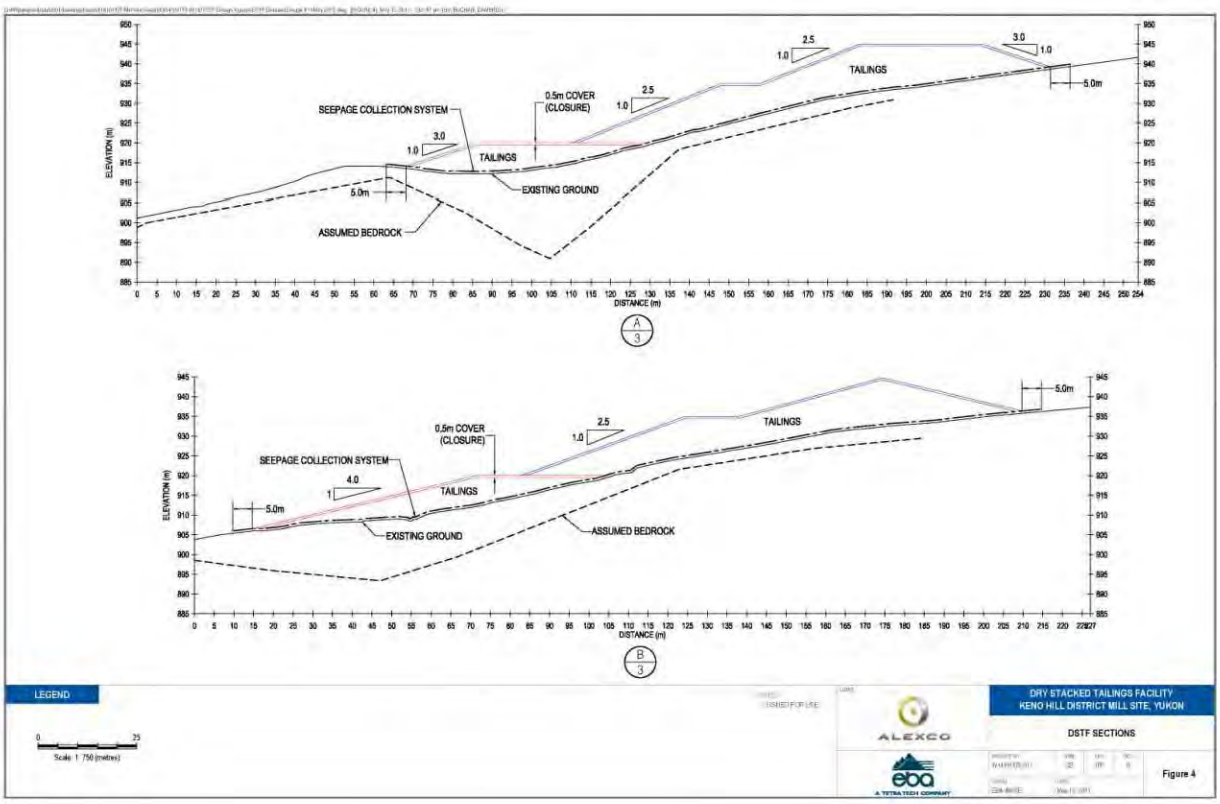


Figure 6-25: DSTF Phase 1 Sections

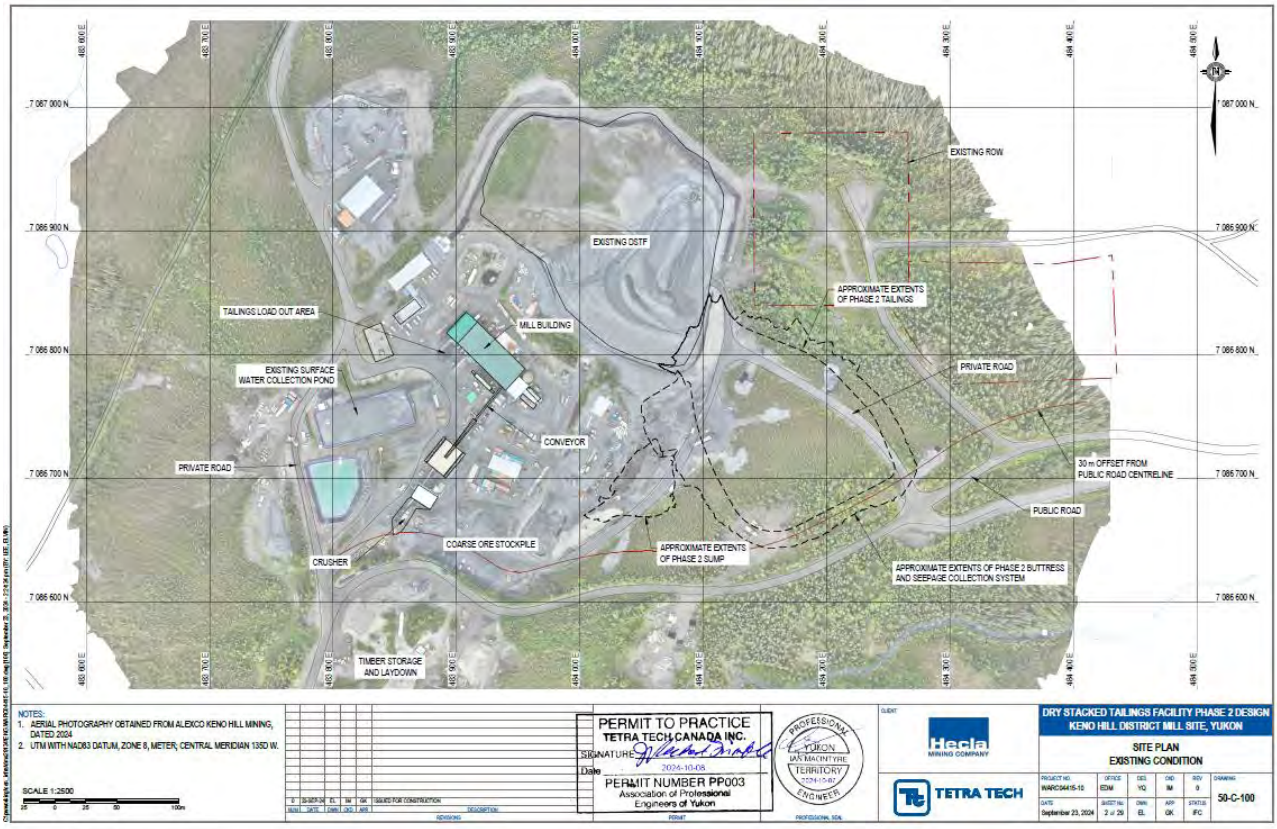
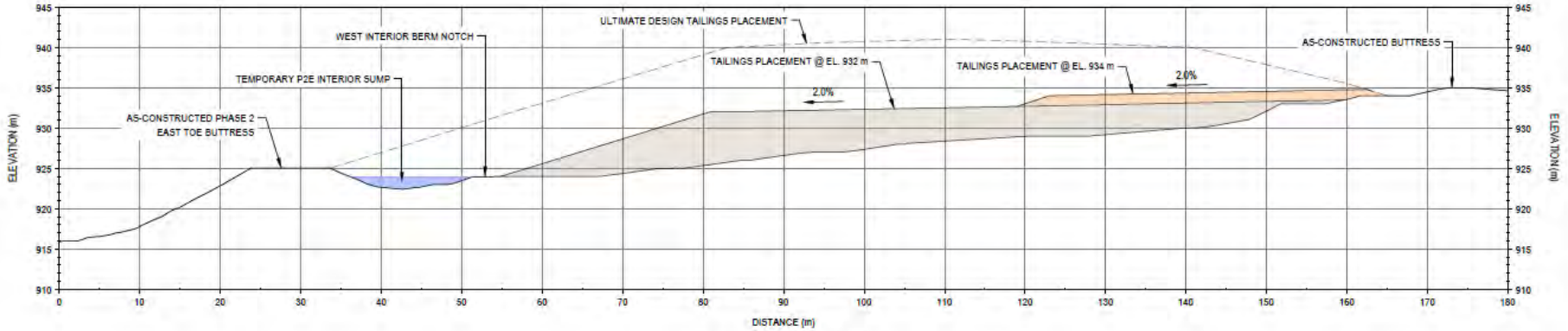
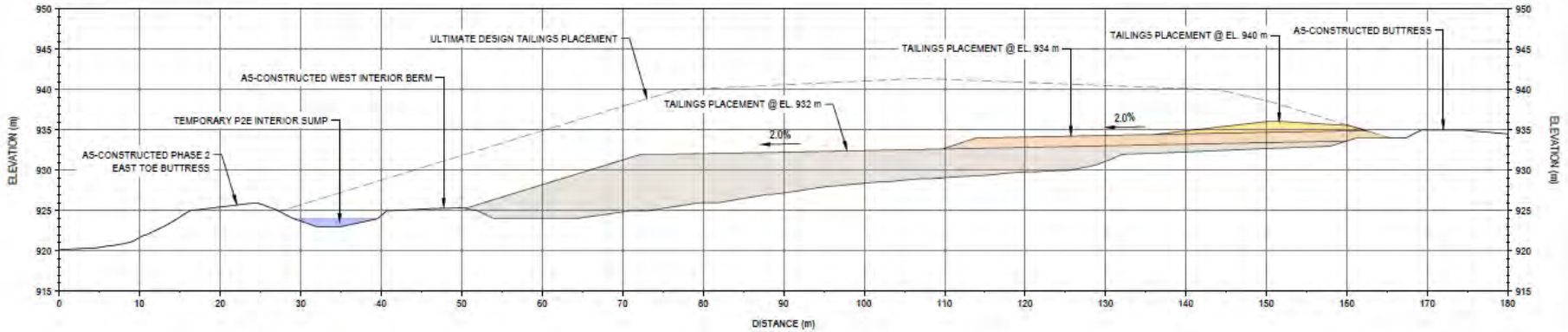


Figure 6-26: DSTF Phase 1 Final Construction Plan with Phase 2 East Footprint

Figure 6-31: DSTF Phase II East Deposition Cross Section



A 50-C-400 CROSS-SECTION
SCALE: 1:500



B 50-C-400 CROSS-SECTION
SCALE: 1:500

NUM	DATE	DWN	CKD	APP	DESCRIPTION
2	18-FEB-25	EL	IM	GK	REVISED DEPOSITION OUTSIDE SLOPE TO 3.25H:1V
1	20-DEC-24	EL	IM	GK	REVISED DEPOSITION PLAN BASED ON DECEMBER 15, 2024 PHOTOGRAMETRY SCAN
0	23-SEP-24	EL	IM	GK	ISSUED FOR CONSTRUCTION

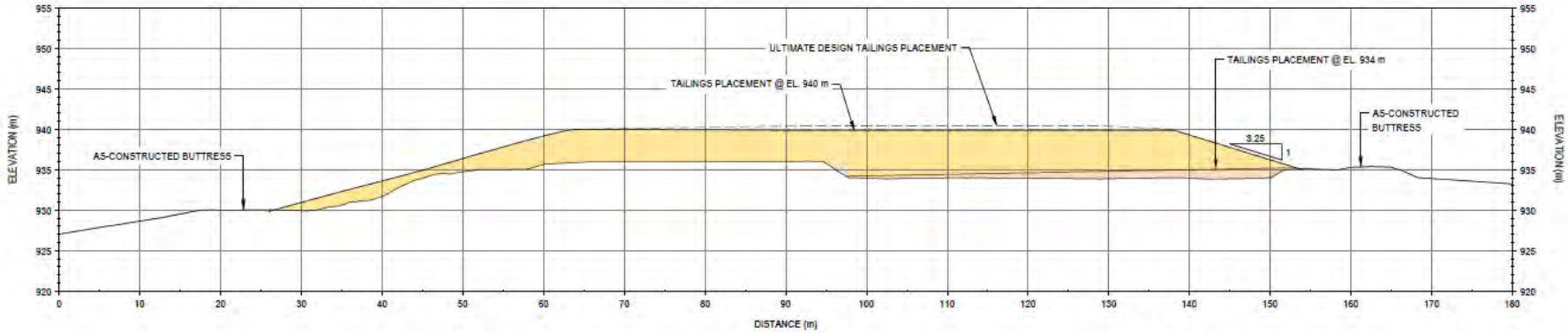
REVISIONS | PERMIT | PROFESSIONAL SEAL

CLIENT: Hecla MINING COMPANY

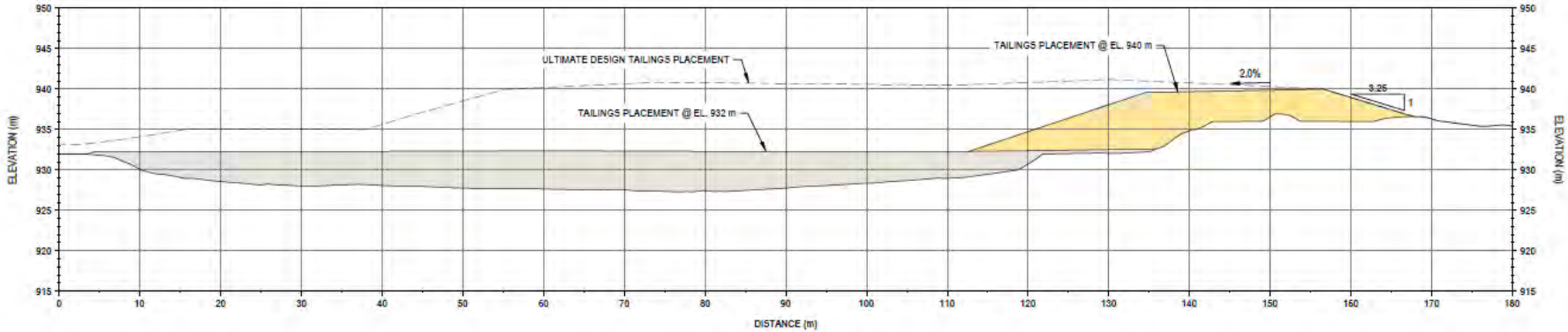
TETRA TECH

DRY STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON
DSTF PHASE 2 EAST
INITIAL TAILINGS DEPOSITION CROSS-SECTION

PROJECT NO.	OFFICE	DES.	CKD.	REV.	DRAWING
WARC04415-10	EDM	YQ	IM	2	50-C-401
DATE	SHEET No.	DWN.	APP.	STATUS	
February 18, 2025	2 of 3	EL	GK	IFC	



C (50-C-400) CROSS-SECTION
SCALE: 1:500



D (50-C-400) CROSS-SECTION
SCALE: 1:500

NUM	DATE	DWN	CKD	APP	DESCRIPTION
2	18-FEB-25	EL	IM	GK	REVISED DEPOSITION OUTSIDE SLOPE TO 3.25H:1V
1	20-DEC-24	EL	IM	GK	REVISED DEPOSITION PLAN BASED ON DECEMBER 15, 2024 PHOTOGAMETRY SCAN
0	23-SEP-24	EL	IM	GK	ISSUED FOR CONSTRUCTION

REVISIONS | PERMIT | PROFESSIONAL SEAL

CLIENT: Hecla MINING COMPANY

TETRA TECH

DRY STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON
DSTF PHASE 2 EAST
INITIAL TAILINGS DEPOSITION CROSS-SECTION

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
WARC04415-10	EDM	YQ	IM	2	50-C-402
DATE: February 18, 2025	SHEET No. 3 of 3	DWN EL	APP GK	STATUS IFC	

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6.8 ELECTRICAL POWER

The Project is supplied with electrical power from a hydroelectric plant near Mayo and connection to the Yukon wide electrical grid.

The Mayo hydro facility was expanded in 2011 which increased generation capacity from 5 megawatts to 15 megawatts. The power distribution grid was also upgraded from Pelly Crossing to Stewart Crossing during the same time. Recently the power distribution line from Mayo to McQuesten was completed in early 2021 to replace the 65 year old transmission line and to add system protection equipment.

A new 69 kV/4.16 kV 3 MVA substation was installed to deliver power to the mill facility, Flame & Moth, and associated infrastructure.

Alexco owns several substations in the area, including the Elsa substation, the Onek substation, and the Bellekeno 625 substation. Alexco also owns the transmission line connecting the latter two. Power for the Bellekeno and Flame & Moth mines is now provided exclusively by the YEC electrical distribution system.

Power for the camp is supplied from the local grid that runs through Elsa to Keno City.

Electrical power for Bermingham was initially provided by diesel-powered generators and was transferred over to YEC grid power in Q2 2021. A transmission line (via surface teck cable) connects to the Yukon grid near the Calumet Road to the site.

An electrical substation is located adjacent to the mill office/dry facility and houses a primary 69 KV – 600 V step down transformer and electrical distribution infrastructure. The substation is enclosed by a 28 m x 15.5 m fence (Photo 6-20).



Photo 6-20: Electrical Substation

6.9 CAMP FACILITIES

The currently licensed Flat Creek camp facilities include a trailer camp, kitchen facility, site sign-in/reception. The Flat Creek camp has a total capacity of 210 permanent beds. There are four refurbished houses located nearby in the townsite of Elsa with a total of 24 rooms, and an additional 38 rooms available in two modular camp buildings near the town of Keno City, which is used primarily for seasonal contract personnel for onsite projects. Two modular dormitories at Flat Creek camp were replaced with new units in Q4 2020 and a fourth modular dormitory was installed in Q2 2023. An additional dormitory will be replaced in Q2 2026. The entire capacity of the camp facilities is 272 rooms.

Hecla Yukon is licensed to withdraw water from Flat Creek and an existing groundwater well for domestic use. A water treatment facility located within the Flat Creek camp consists of 5,000 L of storage, a water softener, UV treatment, and chlorination. In 2025, the potable water treatment plant was upgraded to include redundant filter packages and redundant UV disinfection systems, enhancing treatment reliability and ensuring continuous water quality protection in the event of equipment maintenance or failure. Wastewater is treated in septic tanks and released via an absorption bed. In 2023. A containerized membrane bioreactor (MBR) sewage treatment plant was installed near the existing absorption bed to expand the Flat Creek camp system. The waste water treatment plant is scheduled upgrades in 2026, including an improved membrane system, implementation of a PLC-based monitoring system with alarms for enhanced operational control, and comprehensive operator training to ensure optimal system performance

The mine dry facilities located at the Flat Creek Camp were relocated to the New Bermingham site in 2023 and a new modular kitchen and dining facility was installed in the area where they had been located.

Commercial Dump Permits #81-012 and #81-067 are currently held from YG Environment in accordance with the *Environment Act*, Solid Waste Regulations, as well as the *Public Health and Safety Act*. The maximum volume of special wastes that can be stored on site and the location where these may be stored are restricted by these permits. Special wastes are routinely shipped off site for disposal or treatment.



Photo 6-21: Flat Creek Camp – 2025

6.10 MONITORING

The Monitoring, Surveillance and Reporting Plan (Hecla Yukon, 2023d) describes the framework used to manage the KHSD Mining Operations. The plan includes monitoring and reporting of:

- The local and receiving environment through scheduled inspections and monitoring programs;
- Effluent discharge points and treatment system performance;
- Site facilities and incorporated design measures to ensure structural stability and prevention of accidents and malfunctions;
- Remediation success; and
- Adaptive management responses.

If monitoring indicates that physical structures, treatment systems or mitigative measures are not performing then maintenance or contingency plans can be implemented following an adaptive management approach.

Prior to mine development in the KHSD, a number of monitoring programs and surveillance networks were already in place as per care and maintenance activities (Water Licence QZ17-076), advanced exploration and preliminary development activities at the Bellekeno, Flame & Moth and New Bermingham mines (Water Licence QZ18-044) as well as district-wide closure and new mine permitting studies. These programs include but are not limited to physical inspections, a water quality surveillance network, old mine workings monitoring, aquatic resources monitoring for benthic invertebrate and fisheries populations, sediment monitoring, waste rock and mine wall sampling and the Adaptive Management Plan. Monitoring, surveillance and reporting applicable to Bellekeno, Flame & Moth and New Bermingham mines are presented in the Monitoring, Surveillance and Reporting Plan (Hecla Yukon, 2023d). A revised plan was submitted to EMR on September 2023 to incorporate comments received from EMR and is currently under agency.

In 2025, a monitoring well drill program was undertaken to reestablish wells which were no longer viable to sample from due to frost heaving and operational activities. The Ensero Solutions AKHM Drilling 2025 Factual Report is available in Appendix 3.11. All wells have been replaced except for 2, BH-39 and FM-MW-01 at the Flame and Moth site. Due to constraints of the drill BH-39 was not able to be accessed due to the slope of the DSTF phase 1, this well will be established in 2026 with an alternate style of drill. FM-MW-01 was not able to be established due to excessively difficult ground conditions. This well will be reattempted to be drilled in 2026 upon investigation into drilling methods to ensure well can be established.

Multiple wells which were drilled in 2025 could not be established as they were found to be dry. An assessment will be initiated in 2026 on ground water to identify recommendations regarding ground water monitoring to ensure adequate information is collected and assessed.

AKHM provides regular monitoring data, analysis, and discussion of trends in our monthly and annual reports submitted as a condition of QZ18-044 and QML-0009.

6.11 RISK AND ADAPTIVE MANAGEMENT

AKHM implements a comprehensive risk-based adaptive management approach to ensure environmental protection throughout operations and into closure. This approach is formalized through the Adaptive

Management Plan (Hecla Yukon, 2024), which establishes systematic protocols for monitoring, assessment, and response to changing conditions.

Geochemical Risk Management

As part of the proactive risk management strategy, seepage source terms will be continuously refined as the Flame & Moth and New Bermingham mines generate waste rock and tailings. These materials undergo rigorous characterization following protocols established in the Tailings Characterization Plan and Waste Rock Management Plan. The comprehensive kinetic testing program includes:

- Humidity cell tests for waste rock classification and reactivity assessment
- Subaqueous column tests evaluating tailings behavior under saturated conditions
- Specialized testing for cemented tailings and both P-AML and N-AML waste rock categories
- Performance evaluation of cemented P-AML and N-AML waste rock materials

Preliminary kinetic test results, anticipated in 2024, will provide critical data for model calibration. These findings will be immediately integrated into updated water quality models, allowing for real-time refinement of source terms and validation of predictive assessments. This iterative process ensures that management strategies remain responsive to actual geochemical conditions rather than relying solely on initial predictions.

Geotechnical Risk Management and TARPS

The Dry Stack Tailings Facility (DSTF) and other critical infrastructure incorporate Trigger Action Response Plans (TARPs) as key components of the adaptive management framework. These TARPs establish:

- Clear monitoring thresholds and trigger levels for geotechnical parameters
- Specific response actions corresponding to each trigger level
- Decision criteria for implementing enhanced monitoring or mitigation measures
- Communication protocols for stakeholder notification

The DSTF TARP specifically addresses stability concerns through continuous monitoring of pore pressures, settlement rates, and deformation patterns. Similar risk-based approaches are applied to waste rock storage facilities, water management infrastructure, and other geotechnical structures critical to environmental performance.

Integrated Adaptive Management Framework

The Adaptive Management Plan serves as the overarching framework linking all monitoring programs, TARPs, and response protocols. This integration ensures that:

- Early warning indicators from multiple monitoring programs are evaluated collectively
- Response actions consider cumulative effects and system-wide implications
- Lessons learned are systematically incorporated into operational procedures
- Management strategies evolve based on performance data and changing site conditions

Through this comprehensive approach, the project maintains flexibility to address uncertainties while ensuring environmental objectives are consistently achieved throughout the mine life cycle and into post-closure.

7 PROGRESSIVE RECLAMATION

Progressive reclamation is implemented on an ongoing basis to fulfill the Company's commitment to maintaining site stability and reclaiming areas as soon as operationally possible, therefore reducing both financial and operational liability.

7.1 DRY STACK TAILINGS

The DSTF landform has been and will continue to be progressively constructed over the life of the facility. As construction of the facility allows, progressive reclamation has occurred through recontouring the side slopes to design slope angle, placing growth medium, and revegetating. Construction of the final closure cover system will be conducted in the snow-free period following the end of commercial milling unless there is additional milling of ore from other Production Units which may be permitted during the life of the currently active mine operations.

The seed mix used for progressive reclamation of the DSTF consists of the following:

- 40% Violet Wheatgrass,
- 13.5% Glaucous Bluegrass,
- 23.5% Sheep Fescue, and
- 23% Rocky Mountain Fescue.

The DSTF seed mix is consistent with the objective of slope stabilization and managing surface water runoff to limit erosion in the short-term and returning the site in the longer-term to an environment that meets end land use objectives.

In 2012, reclamation was initiated on DSTF Phase 1 to minimize dusting and erosion of exposed tailings slopes. The progressive reclamation activities included covering the western slope of the landform with 0.25 to 0.5 m of growth medium and seeding in four areas (block A, B, C, & D). A summary report on the progressive reclamation activities completed on the DSTF in 2012 is included in Appendix 1.1. Progressive reclamation in August 2013 included recontouring the western slope of the upper bench and north and south slopes of Phase 1, placement of a 0.5 m growth medium and seeding/fertilization.

In 2022, progressive reclamation of the DSTF was implemented to maintain site stability and control dust, with work consisting of recontouring the side slopes to the final design slope angle.



Photo 7-1: DSTF Progressive Reclamation, June 2012



Photo 7-2: DSTF Progressive Reclamation, August 2013



Photo 7-3: DSTF Progressive Reclamation, September 2016



Photo 7-4: DSTF Progressive Reclamation, August 2023



Photo 7-5: DSTF P1 and P2, August 2025

The DSTF cover system closure objectives are:

- Ensure geotechnical and geochemical stability of the DSTF.
- Effectively manage surface water runoff to limit erosion.
- Reduce water infiltration to the DSTF.
- Minimize safety risks to people and wildlife.
- Reclaim the site to meet end land use objectives.

Observations of the physical conditions of the DSTF, including progressively reclaimed areas were completed from 2013 to present. Inspection documentation indicates that the cover has been effective in limiting erosion of tailings and supporting vegetative cover as shown in Photo 7-3 and Photo 7-4. However, formally reclaimed areas on DSTF Phase 1 were reworked to ensure long-term geotechnical stability. The final geotechnical design for these areas is pending and will be implemented to meet current stability standards and requirements."

7.2 BELLEKENO MINE

Reclamation measures for the Bellekeno Mine are predicated on the fact that the static water elevation will not reach the elevation of the Bellekeno East portal and therefore this portal will not discharge water.

7.2.1 Surface Activities

The mine geology and engineering office buildings from Bellekeno were moved to the District Mill area in 2020 to serve as an administration office. The maintenance shop was relocated to New Bermingham in 2020. In 2021, the miners' office buildings with septic storage, and miners' dry were removed, and the P-AML waste rock storage facility decommissioned.

In 2021 waste in the laydown yard and at the mine portal was removed and equipment salvaged. The decommissioned fuel tank was recovered from the lined containment area with the intent of it being repurposed for use as a modified burn barrel. The liner from the P-AML facility was relocated underground, the berm breached, and site run off conveyance ditches installed.

In 2021 and 2022 approximately 600 m^3 of sludge was removed from the Bellekeno 625 Adit water treatment ponds and the adjacent decant area and relocated underground in the Bellekeno Mine.

In 2022, the Bellekeno Mine P-AML facility was decommissioned, its berm breached, and site run off conveyance ditches installed.

In 2025, 8000m^3 of placer tailings were excavated from approximately 300m south of Bellekeno East Portal. This material was hauled to Flame and Moth for a mill pond upgrade project. The discharge line and box from Bellekeno 625 water treatment system was also replaced to mitigate freezing risk during the winter.

As such the sediment ponds constructed at Bellekeno East for development of the decline will be progressively reclaimed prior to mine closure.

*7.2.1.1 **P-AML Waste Rock Storage Facility***

P-AML waste rock previously mined from the Bellekeno mine was placed in a lined temporary Waste Rock Storage Facility (WRSF) located south of the Bellekeno East portal (

Figure 6-5). The facility was designed according to the approved generic design (EBA, 2008) Appendix 3.2. At temporary closure of Bellekeno, this P-AML waste rock stored has been transported underground. The temporary WRSF liner has been removed and placed underground in 2021. Recontouring and revegetation will take place with appropriate growth media and seed mixes.

*7.2.1.2 **Fuel Tank Decommissioned***

A lined and bermed fuel tank facility locate near the Bellekeno East Portal was decommissioned (Photo 7-6 and Photo 7-7). In 2022 the tank was removed (it was salvage for potential repurpose usage on site). In 2023 the liner and associated hydrocarbon impacted soil removed and shipped off site for disposal to an approved facility.



Photo 7-6: Bellekeno Fuel Tank Farm – 2021



Photo 7-7: Bellekeno Fuel Tank Farm – 2023

7.2.1.3 ***N-AML Waste Rock Disposal Area***

A Waste Rock Disposal Area (WRDA) was proposed to be constructed along the northeast flank of Sourdough Hill, northwest of the current Bellekeno 625 waste rock storage areas. The Bellekeno WRDA has not yet been constructed because the majority of the N-AML waste rock currently generated from the Bellekeno mine has been used for road construction material with a lesser amount as underground backfill. With the current LOM plan for Bellekeno, there is no scheduled requirement for construction of a Bellekeno WRDA (see Photo 6-2:).

7.2.2 Underground Activities

In 2022, unusable inert products from the surface laydown area were disposed of in the underground workings.

The underground equipment has been removed from the underground mine which included mining equipment such as trucks, LHD's, drills, etc. Mining fleet equipment was brought to surface and either transported offsite or salvaged. The following equipment was left underground at the mine:

- Electrical cable;
- Electrical junction boxes;
- Steel piping;
- Hoses; and
- Vent tubing.

No hazardous material such as explosives, oils, lubes were left in the underground mine.

7.2.3 Progress on In Situ Mine Water Treatment

Core Geoscience Services Inc. (CoreGeo) completed a comprehensive data review and gap analysis in November of 2025 to advance the development of a semi-passive treatment system for the Bellekeno Mine. This review builds upon successful pilot projects previously implemented at other sites within the Keno Hill Silver District.

Current Status and Identified Gaps

While the engineering design for the Bellekeno bioreactor system has progressed to a conceptual stage, several critical scientific and technical gaps require resolution:

- Bellekeno mine water chemistry has not been fully characterized despite historical monitoring data availability (2009-2020)
- Laboratory and pilot-scale validation studies are absent from current plans
- The rationale for shifting from in situ underground treatment (2020 plan) to surface bioreactors (2023 plan) requires clarification
- Site-specific evaluation of sulfate-reducing bacteria populations and optimal carbon sources needs completion

CoreGeo has developed a phased approach to address identified gaps and advance the semi-passive treatment system:

- Phase 1 - Site Characterization:
    - Complete comprehensive water chemistry analysis for Bellekeno mine discharge
    - Conduct genomic characterization of native microbial populations
    - Determine site-specific hydraulic retention times
- Phase 2 - Laboratory Testing:
    - Perform batch and column tests to optimize treatment parameters
    - Evaluate locally available carbon sources to enhance system sustainability
    - Validate metal removal efficiency under cold climate conditions
- Phase 3 - Pilot Implementation:
    - Conduct on-site pilot-scale testing to verify Laboratory results
    - Monitor system performance under variable site conditions
    - Engage First Nation partners and academic institutions in research activities

The semi-passive treatment system development will remain in the research and evaluation phase until other water management solutions have been thoroughly assessed and confirmed to be non-viable. The phased approach outlined above will only be initiated once other alternatives have been exhausted or proven unsuitable for long-term closure objectives. This contingency-based approach ensures resources are focused on the most sustainable solutions while maintaining the semi-passive treatment system as a viable option. Should implementation proceed, the final design parameters will be incorporated into future RCP updates based on proven treatment performance.

7.3 SPECIAL WASTE

Commencing in 2021, AKHM initiated campaigns to remove accumulated special waste and reagents that were no longer viable for use. Between 2021 and 2024 40.6 tonnes and 68,500 litres of special waste was removed from site. The accumulated products included waste generated by KHSD Mining Operations as well as ERDC special wastes discovered/located following 2010 to 2014 waste reduction programs. The AKHM Commercial Waste Permit has been modified to reflect the smaller volume stored on site. AKHM continues to identify and remove special waste materials as part of ongoing site management activities, ensuring that hazardous materials are properly disposed of and do not accumulate on site.

8 TEMPORARY CLOSURE

In the event of a premature closure, the following monitoring and care and maintenance activities (focused on a temporary closure scenario occurring after mine start-up) will be implemented. AKHM's priority during any temporary closure scenario will be to ensure that the site remains geochemically and physically stable, secure, and safe, monitored and in compliance with applicable licences and legislation. This will include initial stabilization and on-going routine monitoring and maintenance of the site infrastructure and facilities until mining recommences, or full closure is initiated.

Table 8-1 provides a summary of the various project components and associated inspection and maintenance activities during any temporary cessation of mining activities. Hecla Yukon's ongoing care and maintenance activities in the Keno Hill mining camp are scheduled to continue beyond the next 6 years which means that there would be minimal additional costs related to a temporary closure of the KHSD Mining Operations.

8.1 SITE SECURITY, MONITORING AND MAINTENANCE

Uncontrolled access to the mine components and facilities could pose a risk to the public and to the site assets. As such, the full-time care and maintenance crew will conduct daily monitoring of all infrastructure and site elements. Equipment and vehicles will be available onsite for the staff should more intensive earthworks be required during the temporary closure period.

During temporary closure gates may be required and locked with warning signs erected at the gates and key locations around the site indicating the risks of entry. Site buildings will be locked and secured. Roads will be maintained as required.

The care and maintenance crew will be responsible for:

- Regular inspections of the site to observe and document the condition of, and any changes to: site security and public safety measures, infrastructure, mine components, etc., as well as to document potential emerging environmental or public health and safety objectives;
- Conducting routine physical monitoring activities;
- Regular water quality and flow monitoring;
- Inspection and regular maintenance of all water management and water treatment plants, the DSTF and infrastructure such as ponds, pipelines, treatment plants and access;
- Submitting inspection and monitoring reports to managers on a regular basis;
- Responding to any security/safety objectives as required; and
- Conducting routine site maintenance and basic repairs to infrastructure and works as required (snow removal, culvert, and road maintenance, building maintenance).

Site inspections and monitoring will be conducted by vehicle when seasonally possible. Some sites may be difficult to access in winter as snow removal would not be reasonable at all locations. A risk assessment will be completed to identify critical inspection items and prioritize access to those areas.

Maintenance for the DSTF components is strictly event driven maintenance and will result from inspections. The heavy equipment used for the construction and the DSTF will be utilized to maintain the DSTF.

The Company's environmental monitoring program (Ensero & AKHM 2020a, 2021a, 2021b; Hecla Yukon 2023b) and detailed design reports further commit to structural monitoring, which will continue in the event of temporary closure.

Some elements of the monitoring program (geotechnical and structural inspections and non-routine water quality and biological monitoring) will be conducted by appropriate professional personnel, and results of these inspections will be included in annual reports and other required submissions.

To limit access during temporary closure, pylons and signage will be used to warn road users, and gates will be installed, as required. Bridges will not be decommissioned during a temporary closure.

During a temporary closure road will be visually inspection for signs of instability/erosion, the road surface, ditches, and culverts will be maintained.

8.2 PHYSICAL STABILITY AND GEOCHEMICAL STABILITY

Stabilization of site works during any temporary closure will be addressed initially well in advance of any closure scenario through the Company's commitment to progressive reclamation and stabilization measures.

Site infrastructure, including primarily buildings, equipment, and machinery, will be emptied/drained of hazardous reagents and process fluids where appropriate and stabilized for temporary closure based on recommendations from mechanical and chemical suppliers, contractors, and engineers. This includes the removal of all hazardous wastes, including waste hydrocarbons, coolants, lubricants, mill reagents and process chemicals. Depending on the anticipated length of a temporary closure, mill reagents and chemicals may remain on site in a secure condition for reuse once active operations recommence. The bulk explosives inventory will be removed from site and explosives storage containers and facilities will be inspected regularly. In the event of suspended operations, the onsite water treatment plants will be maintained by the existing district care and maintenance crew.

Such temporary closure measures will be conducted to a level whereby the infrastructure and mine components are ensured to be stable in the short term (less than 5 years) and whereby mining and milling operations can be resumed in a timely manner should the decision be made to transition back into operations. This will include:

- the retention of essential equipment/assets onsite to maintain infrastructure; and
- the storage of hazardous materials (not waste) in competent primary and secondary containment ensuring compliance with applicable legislation.

8.3 REPORTING

Inspection results will be documented on a form and submitted to management on a regular basis. Reports of changes to physical status of any part of the site may warrant a follow-up investigation by managers and/or professional personnel.

Monitoring and inspection data collected will be compiled and submitted according to the required monthly and annual reporting timeframes for both the Quartz Mining and Water Licences. Documentation of any maintenance completed will be used to assess the performance of the specific component and determine whether the design, operation, or surveillance of that component must be adjusted.

Notification of temporary closure will be provided to the Yukon Water Board and the Director of Mineral Resources in accordance with conditions of QZ18-044 and QML-0009 respectively.

Table 8-1: Summary of Care and Maintenance Activities and Surveillance during Temporary Cessation of Mining Activities

Project Component	Objectives	Care & Maintenance Activities	Monitoring	Monitoring Responsibility	Monitoring Timing/ Frequency
Bellekeno Mine	Water Management	Maintain Bellekeno 625 water treatment plant and related water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
Flame & Moth Mine	Water Management	Maintain Flame & Moth water treatment plant and related water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
New Bermingham Mine	Water Management	Maintain New Bermingham water treatment plant and related water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
Waste Rock Storage	Physical stability	Runoff/Erosion/Sediment control. Progressive reclamation will occur during operations.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
			Geotechnical Inspection	Engineer	Annual
	Geochemical Stability	Remove all P-AML WRSFs and place underground Monitor WRSF & WRDA for water collection or seepage, respectively.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
Roads	Physical Stability	Grade surface and scarify, ditch and culvert maintenance.	Visual inspection periodically for signs of instability/erosion	Care & Maintenance Crew	Weekly and after heavy precipitation events
Mill	Buildings, Equipment, and Infrastructure	Secure buildings and retain necessary equipment for site maintenance.	Visual inspection for signs of instability.	Care & Maintenance Crew	Monthly
		Concentrate removed from site.			
	Physical Stability	Inspect for site stability.	Structural Inspection	Engineer	Twice Annually
		Reduce ore stockpile inventory.			
	Water Management	Maintain water treatment system and related water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
Dry Stack Tailings Facility	Physical stability	Surface water diversion structure repair/ maintenance.	Monitoring Program from DSTF Operating Plan; & QML Physical Monitoring Program	Care & Maintenance Crew	As per Monitoring Programs & QML
		Runoff/Erosion/Sediment control.			
		Dust Control.			
		Progressive reclamation will occur during operations.	Geotechnical Inspection from QML and DSTF Operating Plan	Engineer	Annual
	Geochemical Stability	Monitor for seepage and water quality.	WL Water Quality Surveillance Program; & Monitoring Program from DSTF Operating Plan	Care & Maintenance Crew	As per WL
Entire Site	Physical stability	Runoff/Erosion/Sediment control.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
		Road/culvert maintenance.			
		Progressive reclamation will occur during operations.			
	Security	Full time site care & maintenance crew will check, repair, and replace as required:	Care & Maintenance Monitoring of all infrastructure and site elements	Care & Maintenance Crew	Daily: Inspection Sheets included in Annual Reporting
		precautionary signage			
		security gates – installed to restrict access to the mill			
	Miscellaneous Infrastructure	Minimize camp size.	Care & Maintenance monitoring of all infrastructure and site elements	Care & Maintenance Crew	Daily: Inspection Sheets included in Annual Reporting
		Inspect power line			
	Reporting	Prepare and submit annual report to Yukon Water Board pursuant to WL, including details of temporary closure activities and monitoring.		AKHM	Annually
		Prepare and submit annual report to YG Mineral Resources Branch pursuant to the QML, including details of temporary closure activities and monitoring.			
		Prepare and submit quarterly monitoring reports to ECCC under MDMER.			Quarterly, Online RISS Registry

9 FINAL RECLAMATION AND CLOSURE MEASURES

This section of the Reclamation and Closure Plan provides the details on the proposed reclamation and closure measures for each mine component in the KHSD Mining Operations. The approach to each subsection is to present a brief description of each component and related facilities with reclamation and closure objectives and measures. The following mine components specific to the KHSD Mining Operations are addressed:

1) Underground Workings and Opening to Surface
    - Bellekeno Production Unit Area (Appendix 3.1, Drawings: C-2401, C-2402, B-2101, B-2102, D-2102, D-2301, D-2601)
    - Flame & Moth Production Unit Area (Appendix 3.1, Drawing: C-1401)
    - New Bermingham Mine (Appendix 3.1, Drawings: C-5401, B-5101, B-5301)
    - Onek 990 existing workings and infrastructure
    - Lucky Queen existing workings and infrastructure (Appendix 3.1, Drawings: C-3401, B-3101, B-3301)
2) Dry Stack Tailings Facility – Phases I – II (Appendix 3.1, Drawings: C-7401, 50-C-400, 50-C-401, 50-C-402)
3) Waste Rock Storage and Overburden Areas (Appendix 3.1, Appendix 3.4, Appendix 3.5, Appendix 3.7)
4) Water Management Structures and Systems (Appendix 3.1)
5) Surface Instructure and Facilities at the Mines, District Mill, and Flat Creek Camp (Appendix 3.1, Drawings: C-6401, B-6101, B-6301, C-9401, B-9101, B-9301)
6) Roads and Linear Disturbances (Appendix 3.1, Drawings: B-0301)

DISTURBANCE AREA BY MINE COMPONENT

Development of the mines in the KHSD Mining Operations progress through a life cycle referred to as the life of mine (LOM) Plan. The RCP addresses reclamation and closure cost liabilities at different times, including current disturbance, end of Year 2 and End of Mine life.

Table 9-1 summarizes the disturbance by Mine Area Component at these different stages in the LOM Plan.

Table 9-1: Summary of Disturbance Area by Mine Component

MINE COMPONENT	UNITS	AS OF Q3 2025	YEAR 2 LOM PLAN	END OF LOM PLAN
DISTRICT MILL FACILITIES				
Ore Mined/Milled	tonnes	532,153	719,141	1,834,000
Dry Stack Tailings Facility	tonnes	460,000	512,827	907,000
Dry Stack Tailings Facility Area (unreclaimed)	ha	5.8	5.8	5.5
Mill Pad area	ha	4.79	4.79	4.79
BELLEKENO				
BK East Yards/Portal/Laydown Areas	ha	2.04	2.04	2.04

MINE COMPONENT	UNITS	AS OF Q3 2025	YEAR 2 LOM PLAN	END OF LOM PLAN
BK 625 Yards/Portal/Laydown Areas	ha	1.29	1.29	1.29
N-AML WRDA	tonnes	0	0	0
N-AML WRDA	ha	0	0	0
Temporary P-AML WRSF	tonnes	0	0	0
Temporary P-AML WRSF	m^3	0	0	0
Temporary P-AML WRSF	ha	0.33	0.33	0.33
FLAME & MOTH				
Yards/Portal/Laydown Areas	ha	0	0	0
N-AML WRDA	tonnes	0	86,603	125,000
N-AML WRDA	ha	0	2.2	2.2
P-AML WRSF	tonnes	300	1500	0
P-AML WRSF	m^3	150	750	0
P-AML WRSF	Ha	0.23	0.23	0.23
NEW BERMINGHAM				
Yards/Portal/Laydown Areas	ha	19	19	19
N-AML WRDA	tonnes	130,000	190,000	190,000
N-AML WRDA	ha	3.0	5.5	5.5
P-AML WRSF	tonnes	1,900	2,000	0
P-AML WRSF	m^3	950	1,000	0
P-AML WRSF	ha	0.19	0.19	0.19
ROADS AND OTHER				
Camp Accommodations	ha	2.8	2.8	2.8
Sludge Volume	m^3	1000	2000	2000
BK Haul Road length	metres	5,661	5,661	5,661
Christal Lake Road length	metres	1,299	1,299	1,299
Onek Connector length	metres	2,060	2,060	2,060
Bermingham Access Road length	metres	1,979	1,979	1,979
Duncan Creek Bypass length	metres	0	2,400	2,400
ONEK 990 (EXISTING, NO PLANNED MINING)				
Yards/Portal/Laydown Areas	ha	0.83	0.83	0.83
N-AML WRDA	tonnes	0	0	0
N-AML WRDA	ha	0	0	0
P-AML WRSF	tonnes	0	0	0
P-AML WRSF	m^3	0	0	0
P-AML WRSF	ha	0	0	0
LUCKY QUEEN (EXISTING, NO PLANNED MINING)				
Yards/Portal/Laydown Areas	ha	0.64	0.64	0.64
N-AML WRDA	tonnes	0	0	0
N-AML WRDA	ha	0	0	0

MINE COMPONENT	UNITS	AS OF Q3 2025	YEAR 2 LOM PLAN	END OF LOM PLAN
P-AML WRSF	tonnes	0	0	0
P-AML WRSF	ha	0	0	0
P-AML WRSF	m^3	0	0	0

9.1 UNDERGROUND WORKINGS AND OPENINGS TO SURFACE

This RCP addresses the mine workings as listed in Table 9-2.

Table 9-2: Underground workings and openings to surface

BELLEKENO	FLAME & MOTH	NEW BERMINGHAM	LUCKY QUEEN	ONEK 990
Bellekeno East Portal	Flame & Moth Portal	New Bermingham Portal	Lucky Queen Portal	Onek 990 Portal
Bellekeno Mine Decline and Underground Workings	Flame & Moth Decline and Underground Workings	New Bermingham Decline and Underground Workings		
Bellekeno 625 Adit	Flame & Moth Vent Raise	New Bermingham Vent Raise		
Bellekeno 200 Vent Raise				

9.1.1 Closure Objectives

The objectives for closing the underground workings and openings to surface are to:

1) Ensure physical and geochemical stability of the site.
2) Achieve passive management and treatment of mine pools.
3) Minimize safety risks to people and wildlife (control or prevent access).
4) Reclaim the site to an aesthetically acceptable level.

9.1.2 Bellekeno Mine Closure Measures

The steps and measures required for closure of the Bellekeno Mine include:

1) Stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability. *(completed)*
2) Backfill any remaining P-AML waste rock on surface to underground. *(completed)*
3) Remove/salvage underground assets and equipment. *(completed)*
4) Remove/salvage surface facilities and infrastructure.
5) Remove any hazardous materials. *(completed*)
6) Install mine pool treatment infrastructure. *(completed*)
7) Install an appropriate cover for the portal at Bellekeno East.

The current mine pool is being managed by actively treating the 625 adit discharge. AKHM plans to transition from actively treating adit discharge to managing the discharge with the concrete coffer dam, implementing in situ mine pool treatment, and installing a passive treatment system (bioreactor). Further discussion on the closure measures associated with long-term water management at Bellekeno is presented in Section 9.4.4.

Reclamation measures for the Bellekeno East, and Bellekeno 625 adit areas are described on Drawings C-2401 and C-2402 respectively located in Appendix 3.1.

In 2026, the status of the underground workings in the Bellekeno Mine will be reviewed and compiled to provide the following information as it is related to reclamation and closure of the mine:

- Methods and material used to backfill stopes, including the location of any P-AML material.
- Location of crown pillars and any stability assessments which were performed.
- Any hydrogeological studies which were undertaken during mine operation.

For the 2027 update of the Reclamation and Closure Plan, AKHM will evaluate and advance engineering plans for Bellekeno East Portal, Bellekeno 625 Adit and 200 Level. An evaluation will be completed to confirm the current conceptual plans detailed below are appropriate to meet the objectives for closure. Engineering designs will then be advanced to address:

- geochemistry and placement of rockfill material
- removal and management of overburden material
- coffer dam design and location for closure
- design of any structures used to barricade or block entrances.

9.1.2.1 ***Bellekeno East Portal***

The Bellekeno East adit opening is planned to be blocked by inserting rock fill to protect human health and safety and prevent wildlife access (Figure 9-1). This method, in use at other northern Canadian mines, allows for movement of water and air through the opening, as well as allowing for any movement of rock walls, to prevent failure as would occur with a concrete plug for example. Reclamation measures for the Bellekeno Mine are predicated on the fact that the static water elevation will not reach the elevation of the Bellekeno East portal and therefore this portal will not discharge water. An adit decant channel will not be constructed as any water leaving the mine workings will flow via the Bellekeno 625 adit which is connected to the Bellekeno East decline.

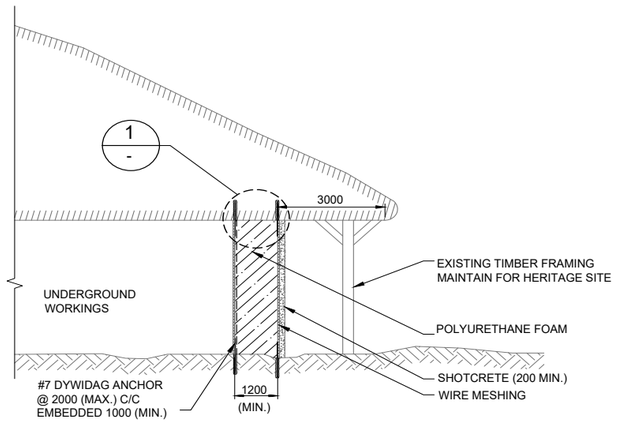
9.1.2.2 ***Bellekeno 625 Adit***

A stainless steel grate will be installed at the adit entrance to restrict access by humans or wildlife. A padlocked door within the grate will allow for access to the coffer dam for closure monitoring and maintenance as needed. Final design of the coffer dam is currently under evaluation to ensure it adequately mitigates risks.

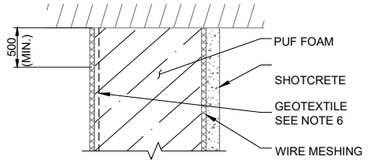
9.1.2.3 ***200 Level Vent Raise***

The 200 level vent raise is a historic vent raise to surface that connected to the 99 zone of the Bellekeno Mine. The 200 vent raise will be capped with a cement cap similar to what is used at mines elsewhere in Canada. This plug/cap will restrict physical entry and prevent air movement and possible ice plug formation at the adit. Designs for concrete slab and backfilled caps are included in Figure 9-2. Figure 9-2 also exhibits the use of Polyurethane Foam (PUF) with a concrete slab for closure, which is no longer intended to be used at closure.

Figure 9-1: Portal Closure Typical Adit Closure Design



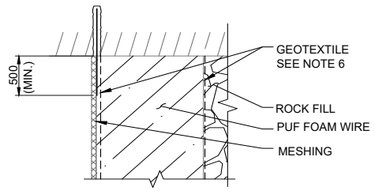
TYPICAL ADIT CLOSURE TYPE 1



1 / - DETAIL 1

1:40

SEE NOTE 7 FOR
CONSTRUCTION SEQUENCE



2 / - DETAIL 2

SEE NOTE 8 FOR
CONSTRUCTION SEQUENCE

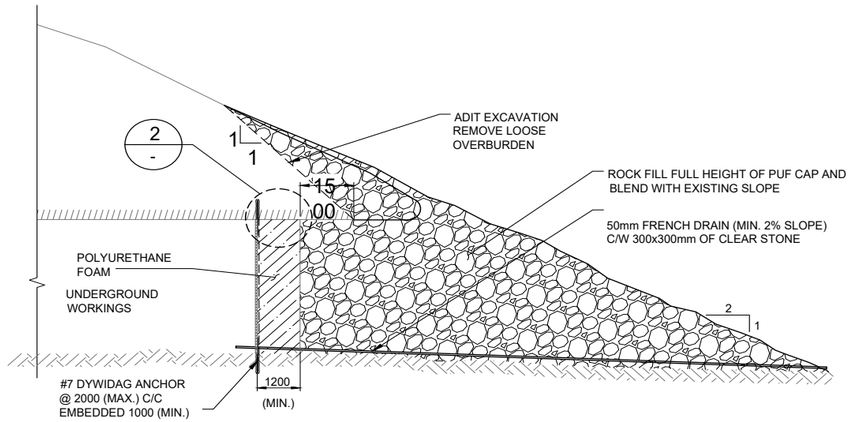
NOTES:

1. SEE DRAWING AKHM-13-01-S-0303 FOR GENERAL NOTES.
2. SEE DRAWING AKHM-13-01-S-0303 FOR CONCRETE NOTES
3. SEE DRAWING AKHM-13-01-S-0303 FOR PUF NOTES
4. VERIFY ADIT DIMENSIONS ARE CONSISTENT WITH DRAWING.

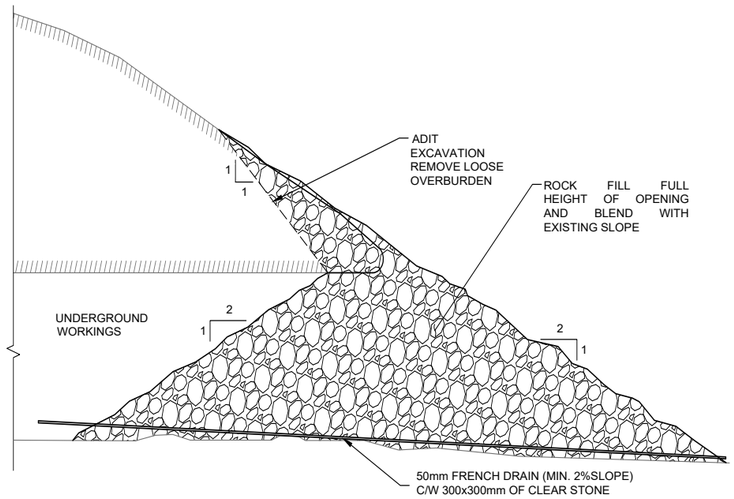
   ALL DEVIATIONS MUST BE REPORTED TO THE PROJECT ENGINEER BEFORE COMMENCING CONSTRUCTION.
5. ALL DIMENSIONS IN MILLIMETERS U.N.O.
6. GEOTEXTILE TO BE ARMTEC 835 WOVEN GEOTEXTILE OR APPROVED ALTERNATE WITH MINIMUM OVERLAP OF 300mm.
7. CONSTRUCTION SEQUENCE TYPE 1:

   7.1. INSTALL DYWIDAG ANCHORS ALONG WITH WIRE MESHING AND GEOTEXTILE ON FAR SIDE OF PUF PLUG LOCATION.
   7.2. SPRAY PUF PLUG TO DESIRED THICKNESS.
   7.3. INSTALL DYWIDAG ANCHORS ON NEAR SIDE OF PLUG.
   7.4. INSTALL WIRE MESH AND SPRAY SHOTCRETE OVER ENTIRE AREA OF THE PLUG.
8. CONSTRUCTION SEQUENCE TYPE 2:

   8.1. INSTALL DYWIDAG ANCHORS ALONG WITH WIRE MESHING AND GEOTEXTILE ON FAR SIDE OF PUF PLUG LOCATION.
   8.2. SPRAY PUF PLUG TO DESIRED THICKNESS.
   8.3. FASTEN GEOTEXTILE TO PUFAND BACKFILL TO THE FULL HEIGHT OF THE ADIT WITH ROCKFILL.



TYPICAL ADIT CLOSURE TYPE 2



TYPICAL ADIT CLOSURE TYPE 3

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-04-23	Draft For Review	0A	TT	--

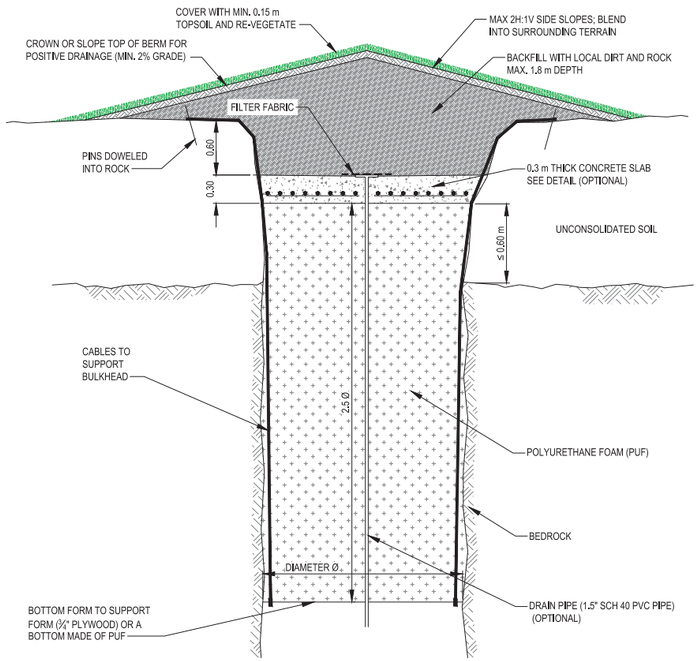
HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

AKHM-13-01-S-0301

Figure 8-1
Portal Closure
Typical Adit Closure Design

REVISION: 0A	2021-04-23	PROJECT No.: AKHM-13-01
DRAWN BY: Tetra Tech EBA	DESIGNED BY: Tetra Tech EBA	REVIEWED BY: KSW

Figure 9-2: Shaft/Raise to Surface Typical Concrete and Backfilled Caps

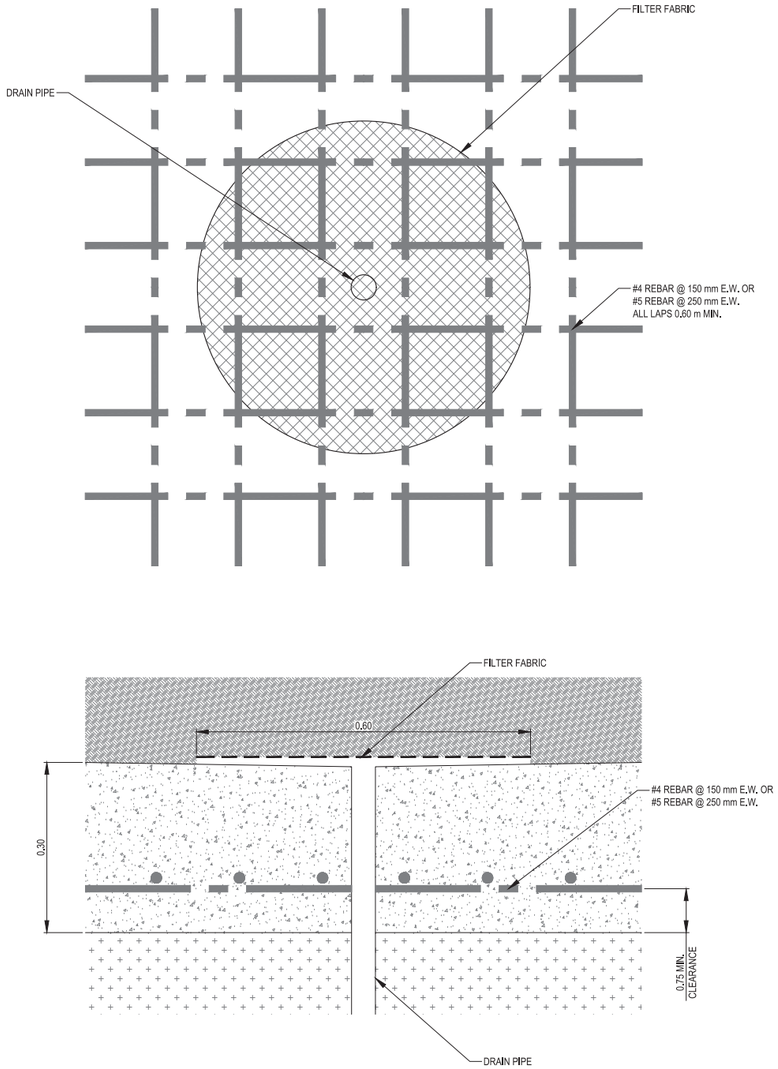


SHAFT PUF WITH CONCRETE SLAB CLOSURE

NOT TO SCALE

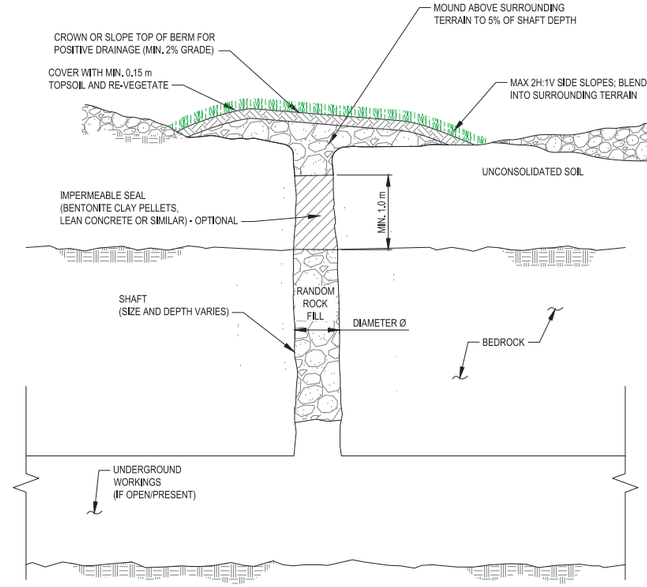
NOTES

1. Safety protocols related to working near or in the shaft should be followed during the project implementation.
2. Lower the bottom form into the shaft to the final depth of the Polyurethane foam (PUF)
3. Install drain pipe (1.5 " SC 40 PVC) extending from below the bottom form to planned top of concrete cap.
4. Place seals into the cracks between the edges of the bottom form to prevent foam from falling down the shaft.
5. Pour the mixed PUF foam onto the bottom form to form the plug.
6. Construct the 0.3 m concrete slab. Concrete slab sloped outwards to drain (2%)
7. Back fill on top of the concrete slab with local dirt and rock.
8. Concrete shall have a minimum 20 MPa compressive strength at 28 days
9. The Sub-Contractor will retain an independent testing agency recommended by the Consultant for the testing of concrete to establish that minimum strength required for concrete slab has been obtained.



CONCRETE SLAB DETAILS

NOT TO SCALE



SHAFT BACKFILL (DRY SEAL) CLOSURE

NOT TO SCALE

NOTES

1. Safety protocols related to working near or in the shaft should be followed during the project implementation.
2. Quantities will vary with shaft depth, connection to underground workings, and other conditions.
3. Mobile equipment must never operate on ground that shows signs of subsidence without taking adequate precautions.
4. Remove as practical, if present, and dispose of timber, trash, brush, topsoil and other debris in and around shaft area, prior to backfilling. Strip down to bedrock surface at collar where practical.
5. Existing steel pipe, concrete rubble (if present) should be removed or incorporated into backfill as directed by engineer.
6. Random rock fill must be:
   a. Non-acid generating rock fill
   b. Sized to contain no rocks greater than ¼ the diameter of the shaft.
7. Every effort should be made to keep all debris other than rock fill from going underground.

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-02-05	Draft for review	A	TT	--

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

Figure 8-2

Shaft/Raise to Surface
Typical Concrete Cap Design

REVISION: A	2018-02-05	PROJECT No.: AKHM-13-01
DRAWN BY: Tetra Tech EBA	DESIGNED BY: Tetra Tech EBA	REVIEWED BY: KSW

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\0-General\AKHM-13-01-S-0303-ShaftCap.dwg [last edited by: KBoldt; 2018/02/15 - 2:15 PM

9.1.3 Flame & Moth Mine Closure Measures

The steps and measures required for closure of the Flame & Moth Mine include:

1) stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability underground,
2) backfill any remaining P-AML waste rock on surface to underground,
3) remove/salvage underground assets and equipment,
4) remove/salvage surface facilities and infrastructure not included in the mill area mine area component,
5) remove any hazardous materials,
6) Recontour N-AML WRSA, scarify and revegetate;
7) install concrete cap on vent raise, and
8) install rock pile portal cover.

During operations, the Flame & Moth mine is permitted to discharge up to 35 L/s. The current static water elevation of groundwater table within the Flame & Moth deposit is ~20 metres below surface. Once active mining operations cease, it is expected that the underground workings will flood overtime from groundwater infiltration. The elevation of groundwater is expected to return to current static elevations which is below the elevation of the Flame & Moth portal (906 masl) and therefore no water is expected to discharge the Flame & Moth mine requiring any ongoing water management at closure. This assumption will be confirmed as the mine is advanced and the closure water management is updated to reflect new data collected.

Reclamation measures for the Flame & Moth Mine are described on Drawing C-1401 located in Appendix 3.1.

9.1.4 New Bermingham Mine Closure Measures

The steps and measures required for closure of the New Bermingham Mine include:

1) Stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability underground; Backfill any remaining P-AML waste rock on surface to underground;
2) Remove/salvage underground assets and equipment;
3) Remove/salvage surface facilities and infrastructure;
4) Remove any hazardous materials;
5) Recontour N-AML WRSA, scarify and revegetate;
6) Install and implement *in situ* mine pool treatment;
7) Install concrete cap on vent raise; and
8) Install rock pile portal cover.

During operations, the Bermingham mine is permitted to discharge up to 13.9 L/s. Hydrology studies and an environmental assessment are currently underway and/or planned as continued production in the Bermingham mine is expected to exceed this discharge rate in the future. Once active mining operations cease, it is expected that the underground workings will flood overtime from groundwater infiltration. For the basis of long-term water management designs, it is assumed that the flooded New Bermingham Mine will discharge out of the portal and then infiltrate into the ground. Because of this assumption, mine pool treatment is included in the water management design for the closure of the New Bermingham Mine. This assumption will be

confirmed as the mine is advanced and the closure water management is updated to reflect new data collected. The grading plan and the reclamation measures for the New Bermingham Mine are described and presented on Drawings B-5101, B-5301 and C-5401 located in Appendix 3.1.

Closure of the New Bermingham Mine will include restricting access and identifying and removing hazards and hazardous materials. Concern regarding physical stability of infrastructure at closure will be mitigated for the most part through disassembly and removal from the site, and by eliminating underground access. Additional chemical stability objectives will be associated with any soil contamination by fuel, chemicals, or other wastes in the areas around the portal and treatment system. The New Bermingham portal is expected to produce long term discharge therefore mine pool treatment is proposed.

At closure, underground equipment will be removed from the underground mine through the portal. The portal entrances will be blocked by inserting rock fill or creating a concrete plug and then laying rockfill in front of it. A french drain would penetrate through the rockfill or concrete plug to ensure drainage (Figure 9-1 Type 2 or Type 3). These measures will protect human safety and prevent wildlife access. This method, in use at other northern Canadian mines, allows for movement of water and air through the opening, as well as allowing for any movement of rock walls, to prevent failure as would occur with a concrete plug for example.

Reclamation of the portal site will include removal of the surface facilities and other buildings (e.g. explosives and cap magazine). Fuel tanks will be cleaned and removed along with liners for reuse or landfilling. Any additional debris will also be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with the Yukon Environmental Act Solid Waste Regulations. All waste petroleum products and any other special waste, as defined in the Special Waste Regulations will be disposed of in accordance with the Regulations. Any soil contamination will be documented through a final site contamination assessment. Contaminated soil will be removed and/or remediated in an approved manner. A land treatment facility is anticipated to be constructed near the Elsa Valley Tailings Facility for remediation of such soils for district closure and can be used for remediation of any hydrocarbon contamination at the Bermingham mine. The portal site would then be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence.

9.1.5 Lucky Queen Closure Measures

Only the closure measures for the existing infrastructure at Lucky Queen are included as this time since this mine is not currently licenced. The steps and measures required for closure of the Lucky Queen Mine include:

1) Stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability underground;
2) Remove/salvage underground assets and equipment;
3) Remove/salvage surface facilities and infrastructure;
4) Backfill the adit and install French drain with pipe; and
5) Remove any hazardous materials.

The Lucky Queen mine drift is currently draining groundwater at a rate of approximately 1 L/s. This water is clean groundwater that does not require treatment and meets direct effluent quality standards. The water from Lucky Queen is collected into a pipe and directs it to an unlined settling pond located outside the portal. There is no water treatment at Lucky Queen and no treatment sludges to remove from the pond.

The grading plan and the reclamation measures for the Lucky Queen mine are described and presented on Drawings S-0301, B-3101, B-3301 and C-3401 located in Appendix 3.1.

9.1.6 Onek 990 Closure Measures

The closure measures associated with the Onek mine include the following steps:

1) Remove/salvage underground assets and equipment;
2) Remove any hazardous materials;
3) Remove/salvage surface facilities and infrastructure including P-AML facility; and
4) Install rock pile portal cover at the Onek 990 portal.

The Onek mine is not expected to produce any water during operations or closure. This is evidenced by groundwater modelling presented during the environmental assessment and licensing process as well as the Onek decline development project that demonstrated no water was encountered or produced underground at Onek. Since the Onek decline was developed in September 2012 and suspended, no water has pooled at the bottom of the decline since that time, again supporting the closure design for Onek 990 that no long term water management features are required for the Onek 990 mine for closure since no water is expected to flood the underground workings and exit the Onek 990 portal.

A rock pile cover similar to Bellekeno East (Figure 9-1) will be constructed to close the Onek 990 portal face and prevent inadvertent access from wildlife or people.

The grading plan and the reclamation measures for the Onek mine are described and presented on Drawings B-4101, B-4301 and C-4401 located in Appendix 3.1.

The reclamation of the historic Onek mine and associated liabilities including the Onek 400 adit discharge is ERDC's responsibility, and it has been included in ERDC's Water Licence (QZ21-012). The previously proposed Onek 990 mine, should it be constructed in the future, would be the responsibility of AKHM although currently AKHM has no plans to proceed with Onek project currently.

9.2 DRY STACK TAILINGS FACILITY

The dry stack tailings facility (DSTF) is located adjacent to the District mill site and the most recent as-built of the facility is shown in Figure 6-23.

The DSTF cover system closure objectives are to:

1) Ensure geotechnical and geochemical stability of the DSTF;
2) Effectively manage surface water runoff to limit erosion;
3) Reduce water infiltration into the DSTF;
4) Minimize safety risks to people and wildlife; and
5) Reclaim the site to meet end land use objectives.

9.2.1 DSTF Geochemical Performance

Geochemical characterization of the tailings is being conducted as part of the Tailings Characterization Plan which was submitted in October 2020 and last updated in September of 2024 as a requirement under Water

Licence QZ18-044 and QML-0009. A humidity cell test was completed (212 week duration) for a composite sample of Bellekeno tailings produced and stored on the DSTF. The results of the kinetic testing for Bellekeno tailings are presented in Appendix 3.3. The results of this program are also included in the Annual Reporting submitted for QZ09-092. Static and kinetic testing data from Flame & Moth and New Bermingham tailings are presented in Appendix 3.3.

9.2.2 DSTF Cover

Construction of the DSTF consists of compacted 0.3 – 0.6 m tailings lifts to limit water penetration. Final closure measures will include covering the recontoured landform with a 0.5 m thick soil cover consisting of locally available growth medium material. Large organic debris (large trees and roots) will be removed from the stockpile before placing the material. The cover system is to be seeded with a revegetation mix for slope stabilization and backtracked parallel to the slope for erosion prevention.

Progressive reclamation of the DSTF has occurred through recontouring to design slope angle, placing growth medium, and revegetating. The first phase of reclamation for the DSTF was completed in June 2012 and included recontouring the western slope to 3:1, placement of a 0.5 m growth medium and seeding/fertilization (Photo 7-1). A summary report on the progressive reclamation on the DSTF completed in 2012 is included in Appendix 1.1. The second phase of progressive reclamation was completed in August 2013 (Photo 7-2) and included recontouring the north and south slopes, and upper bench of the western slope, placement of a 0.5 m growth medium and seeding/fertilization. Photo 7-3 shows the DSTF in September 2016.

Closure work for the DSTF has included annual geotechnical inspections dating back to 2011, installation of geotechnical monitoring equipment in 2024, progressive reclamation activities, and a failure modes and effects analysis completed in 2013 and updated in 2024. The physical stability of the DSTF cover system was raised as a concern during the 2022 and 2023 geotechnical inspections as inspectors observed several small piping failure exits, erosion gullies, and sloughing of the cover system material on the north slope.

A cover system performance monitoring program will begin in 2026 to evaluate key performance indicators of the DSTF cover system including the hydrological and meteorological components of the cover system water and energy balance, erosion, and vegetation. To evaluate the performance of the cover system, installation of performance monitoring instrumentation on a covered portion of Phase 1 of the DSTF landform will be completed, as well as implementation of a monitoring plan to collect cover system water balance, erosion, and vegetation information.

The performance monitoring instrumentation to be installed consists of one monitoring station installed on the existing Phase 1 DSTF cover system at a location that is field verified to be 0.5 m thick. A series of in situ soil and meteorological sensors will collect measurements needed to complete a water and energy balance and thus to estimate the net percolation and the water holding capacity of the cover system. Additional meteorological sensors will provide surface and aspect specific measurements to supplement the meteorological data collected by the District Mill meteorological station. Manual snow surveys will be completed during the winter to measure bulk densities of snow to estimate snow water equivalent for the water balance.

The performance monitoring plan includes regular inspections of the DSTF covered landform to evaluate the cover system performance in terms of erosion and vegetation. Erosion monitoring will include annual visual monitoring and remote surveys to monitor erosion features and capture landform geomorphic losses of

sediment. An erosion risk classification system will aid in tracking the progression of issues and to indicate whether repairs are necessary.

Vegetation monitoring will be completed annually for previously progressively reclaimed areas as well as the vegetation that will develop on the remainder of the Phase 1 covered area. Revegetation performance will be quantified through in situ monitoring techniques such as permanent sampling transects and quadrats within the revegetated area. Indicators such as soil properties, ground coverage, and plant diversity will be monitored. The drone photogrammetry used for erosion monitoring may also be utilized to monitor vegetation progression.

9.2.3 DSTF Surface Water Conveyance Structure

Surface water conveyance structures (closure channels) will be constructed at closure to manage potential runon and preclude erosion of the DSTF. Design of the closure channels is part of the on-going Phase 2 design of the Dry Stack Tailings Facility. Following completion and authorization of the forthcoming Phase 2 design, the surface water conveyance (closure channels) can be prepared. Design for the closure channels will be submitted separately.

As an interim measure, AKHM has added Item 9.4 Surface Water Conveyance Structures to Table 11-9 of the Closure Costs to accommodate construction of the diversion channel at the DSTF sized to manage potential non-contact flow for 500-year 24-hour storm events. Total surface area disturbance, including side slopes, for the proposed diversion channel is 0.12 hectares (7.71 w x 150 l = 1,156.2 m2; 0.11562 ha). Costs included in the Closure Cost model assume excavation of total volume of the channel followed by placement of 0.5 meter of cover soil material and ripping and seeding for revegetation. An excavator (CAT 235 or similar) will be used to excavate the channel. Cover soil placement will be performed by truck, excavator, and dozer, or similar equipment as appropriate. Ripping and seeding will be performed by a dozer (CAT D7 or similar).

If monitoring during operations indicates that treatment will be required for meteoric water after final closure, a passive bioreactor treatment system will be constructed at the site immediately down slope from the DSTF. The area at the toe of the DSTF occupied by the runoff collection pond and polishing pond during operations can be reconstructed and used for the development of a gravel infiltration gallery, ethanol-based bioreactor cell (similar to that piloted at the Galkeno 900 adit across Christal Lake and proposed for the Bellekeno mine).

Reclamation measures for the DSTF are described on Drawing C-7401 located in Appendix 3.1.

9.3 WASTE ROCK AND ORE STORAGE AND OVERBURDEN AREAS

Waste rock extracted from the deposits is characterized and managed according to the Waste Rock Management Plan. Waste rock is identified as being one of the following types: potentially acid metal leaching (P-AML) or non-acid metal leaching (N-AML).

The closure objectives for the waste rock storage facilities/disposal areas are to:

1) Ensure geotechnical and geochemical stability of the site;
2) Minimize erosion;
3) Minimize safety risks to people and wildlife, and
4) Reclaim them to an aesthetically acceptable level.

The reclamation and closure of waste rock storage facilities and disposal areas is described below in more detail. Consultation with FNNND and their technical advisors is underway to further design closure objectives.

A temporary ore stockpile exists at the New Bermingham Mine. All ore will be milled or relocated back underground with P-AML waste rock prior to closure.

Soil and organics are recovered and stockpiled for reclamation use during the construction of site infrastructure. Overburden stockpiles are discussed further in Section 9.10.2 Growth Media Sources. Upon use of the stockpiled overburden, the storage area footprint will be recontoured.

9.3.1 Bellekeno Waste Rock Storage Facilities and Disposal Areas

*9.3.1.1 **P-AML Waste Rock Storage Facilities***

At temporary closure of Bellekeno, waste rock in the Bellekeno P-AML WRSF was transported underground in 2021. The temporary P-AML WRSF liner was removed and placed underground in 2022.

Recontouring and revegetation will take place with appropriate growth media and seed mixes.

In 2026 AKHM plans to conduct an assessment of the previous P-AML WRSF to determine if further reclamation work is required prior to recontouring and revegetation of the area with the appropriate growth media and seed mixes.

*9.3.1.2 **N-AML Waste Rock Disposal Area***

The Bellekeno WRDA was not constructed because the N-AML waste rock generated from the Bellekeno Mine was used for road construction material with a lesser amount as underground backfill. With the current LOM plan for Bellekeno, there is no scheduled requirement for construction of a Bellekeno WRDA.

Bellekeno East WRDA regrading plans are described in Drawing B-2102 respectively, located in Appendix 3.1.

*9.3.1.3 **Bellekeno 625 Historic Waste Rock Dump***

Reclamation and closure of the Bellekeno 625 WRDA will include cleanup of equipment on the top surface of the WRDA, pulling back the crests with an excavator followed by scarification and revegetation of the flat surface of the WRDA. Long term road access will remain for pickup traffic to the Bellekeno 625 adit given it will drain and inspections will be required during the post closure monitoring and maintenance period.

Bellekeno 625 WRDA regrading plans are described in Drawing B-2102 respectively, located in Appendix 3.1.

9.3.2 Flame & Moth Waste Rock Storage Facilities and Disposal Areas

*9.3.2.1 **Flame & Moth P-AML Waste Rock Storage Facilities***

P-AML development rock stored in the P-AML WRSF is moved back underground when it can be used for backfill to remain underground. All P-AML waste rock will be rehandled back underground prior to closure. The liner will be removed to be backfilled underground and the area will be recontoured.

9.3.2.2 Flame & Moth N-AML Waste Rock Storage Facilities

Waste rock remaining in the N-AML WRDA at closure will be graded as described in the Flame & Moth Waste Rock Storage Area Design Report, dated August 1, 2025, located in Appendix 3.1.

9.3.3 Bermingham Waste Rock Storage Facilities and Disposal Areas

9.3.3.1 New Bermingham P-AML Waste Rock Storage Facilities

A temporary P-AML storage facility has been constructed on the historic Bermingham waste rock dump. This and a secondary P-AML WRSF (if required) will be used to store P-AML rock. The P-AML rock is moved back underground when it can be used for backfill. Thus, all P-AML waste rock will be rehandled back underground prior to closure. The liner will be removed to be backfilled underground and the area will be recontoured.

9.3.3.2 New Bermingham N-AML Waste Rock Disposal Area

Waste rock remaining in the N-AML WRDA at closure will be graded as described in the Bermingham WRSA Expansion Design, dated June 9, 2025, located in Appendix 3.1.

9.3.3.3 Bermingham Historic Waste Rock Dumps

Terrestrial reclamation of historic liabilities at the historic Bermingham Mine is under the scope of the UKHM Reclamation Plan being implemented by ERDC.

9.3.1 Lucky Queen Waste Rock Storage Facilities and Disposal Areas

9.3.1.1 P-AML Waste Rock Storage Facility

This is not yet licensed and therefore not constructed, so no reclamation is required at this time.

9.3.1.2 N-AML Waste Rock Disposal Area

The existing disturbance at Lucky Queen N-AML WRDA will be recontoured by pulling the crests back followed by scarification and revegetation of the flat surface of the WRDA. Lucky Queen area regrading plan is described in Drawings B-3101 and B-3301, located in Appendix 3.1.

9.3.1.3 Lucky Queen Historic Waste Rock Dumps

Terrestrial reclamation of historic liabilities at Lucky Queen is currently under the scope of the UKHM Reclamation Plan being implemented by ERDC.

9.3.2 Onek 990 Waste Rock Storage Facility and Disposal Areas

9.3.2.1 ***P-AML Waste Rock Storage Facility***

The Onek 990 is not currently in the KHSD Mining Operations LOM plan so no Onek P-AML or N-AML waste are included in the RCP. A P-AML WRSF was constructed on the historic Onek waste rock dump to the north of the Onek historic open pit for the purposes of advanced exploration and production at Bellekeno. Although constructed, no P-AML rock has been brought to surface. Closure of the Onek P-AML WRSF therefore includes removal of the liner and recontouring the outside containment berms followed by scarification of the surface and seeding/fertilization.

9.3.2.2 ***N-AML Waste Rock Disposal Area***

No N-AML WRDA has been constructed. Development rock from Onek 990 was used for construction of the portal area laydown yard and haul road switch backs. Onek 990 portal pad area regrading plan is described in Drawings B-4101 and B-4301, located in Appendix 3.1.

9.3.2.3 ***Onek Historic Waste Rock Dumps***

Terrestrial reclamation of historic liabilities at Onek is currently under the scope of the District Closure Plan being implemented by ERDC.

9.4 WATER MANAGEMENT STRUCTURES AND SYSTEMS

9.4.1 Closure Objectives and Design Criteria

The primary closure objectives for the water management and treatment sites are in regards to chemical stability and environmental protection, including:

- Prevent, minimize, or mitigate adverse effects on the aquatic environment by removing constituents of concern prior to discharge to the aquatic or terrestrial environment. WQOs will be consistent with AMI#1 of the AMP for flowing adits (i.e., Bellekeno 625) discharging to the aquatic environment (Hecla Yukon, 2023a).
- Minimize effects on the terrestrial environment by reducing sources of metals that could affect soil quality.
- Prevent the discharge of water to the environment that could cause human health effects.

A summary of the water management and treatment plan for each of the four mines and adits associated with the RCP is shown in Table 9-3.

Table 9-3: Mine Water Management Summary

MINE	UNITS
Bellekeno East	No water discharges from Bellekeno East Rock fill in front of adit

MINE	UNITS
Bellekeno 625	Static water levels increase resulting in discharge from the 625 adit Concrete coffer dam (non-pressurized) In situ treatment of Bellekeno mine pool as primary treatment Convert lined WTP ponds to bioreactor as contingency
Lucky Queen	Groundwater infiltration exits the Lucky Queen mine/portal No treatment required. Rock fill in front of adit
Onek	No water discharges from Onek 990 portal Rock fill in front of adit
Flame & Moth	Pre-mining static groundwater elevation is reached (20 metres below surface and portal elevation, no portal discharge) Modification of mill pond to function as bioreactor if required Rock fill in front of adit
New Bermingham	Static water levels increase resulting in discharge out of New Bermingham portal In situ treatment of New Bermingham mine pool as primary treatment Active water treatment plant will remain in place and ready for operations as a contingency measure for a period of time for the New Bermingham in situ treatment to demonstrate stability. Rock fill plug in front of adit

9.4.2 Schedule

Table 9-4: Underground Mines Water Management Schedule

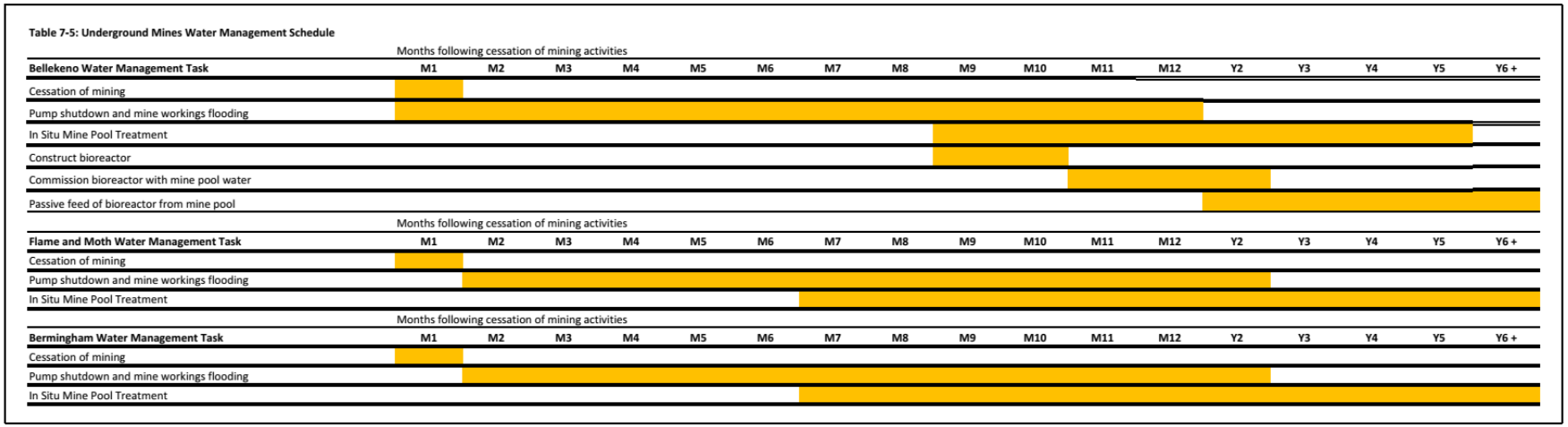


Table 7-5: Underground Mines Water Management Schedule

	Months following cessation of mining activities																
Bellekeno Water Management Task	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6 +**
Cessation of mining																	
Pump shutdown and mine workings flooding																	
In Situ Mine Pool Treatment																	
Construct bioreactor																	
Commission bioreactor with mine pool water																	
Passive feed of bioreactor from mine pool																	

	Months following cessation of mining activities																
Flame and Moth Water Management Task	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6 +**
Cessation of mining																	
Pump shutdown and mine workings flooding																	
In Situ Mine Pool Treatment																	

	Months following cessation of mining activities																
Bermingham Water Management Task	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6 +**
Cessation of mining																	
Pump shutdown and mine workings flooding																	
In Situ Mine Pool Treatment																	

9.4.3 Sludge Management

Reclamation tasks include removal of pond sludges, removal and burial of the pond liners, pipelines, rip rap discharge channels, pond recontouring, revegetation and remediation of any contaminated soils. Sludge is removed on an on-going basis during operations in accordance with the Sludge Management Plan.

At mine closure, the sludge disposed of in the Bermingham Southwest pit will be covered with waste rock and till material. The area will be contoured to promote the shedding of water.

9.4.4 Closure Water Management

9.4.4.1 ***Mill Site and Dry Stack Tailings Facility***

The mill process pond is located downgradient from the mill building and contains and manages the process water balance required for the milling operation. Thickener overflow water from inside the mill building gravity flows via a 6" yelomine pipe into the mill process pond. Process makeup water is pumped from the pond to the process water tank for makeup and recycling in the milling process. The mill process pond is 32 x 79 meters in dimension and has a capacity of 8,650 m^3. An overflow spillway is in place with a 0.4m freeboard.

Closure of the pond consists of removing and burying the HDPE liner, scarification of the side slopes and revegetation. The overflow spillway at closure allows the pond to serve as a sedimentation pond. It would capture surface water, if necessary, until revegetation is stabilized.

9.4.4.2 ***Bellekeno 625***

The Bellekeno WTP will be decommissioned, and the lined ponds and tanks used for the construction of the underground *in situ* treatment system. As a contingency treatment system, the Bellekeno treatment pond is planned to be converted into a biological treatment cell, in addition to the *in situ* treatment of the mine pool.

Without continued dewatering and pumping after closure, the static water elevation of the Bellekeno Mine will rise to and discharge from the Bellekeno 625 adit. The Bellekeno mine stopped dewatering activities on October 15, 2021 and was placed into temporary closure on December 15, 2021. The Bellekeno 625 adit began producing water on March 22, 2023, which was directed to the existing water treatment plant.

A concrete coffer dam was constructed to allow management of the underground mine water in the long term. The coffer dam is not designed to withhold water to allow flooding above the 625 elevation, but rather as a water management tool and feature that will allow consistent flow to the secondary bioreactor contingency treatment system if it is required for treatment. The design for the Bellekeno 625 adit concrete coffer dam is shown in

The size of the Bellekeno 625 adit opening is approximately 2.5 m x 2.5 m.

The water quality monitoring collected by AKHM over the life of the Bellekeno mine, which includes both periods of operation as well as several years of temporary closure and the recent data set collected following flooding and passive discharge from the 625 adit provides a sound basis for designing the *in situ* treatment reagent addition and water management requirements.

The long-term water management and treatment approach for the Bellekeno mine is summarized as follows:

- As noted above, based on the existing mine plan, the final elevation of the static water in the mine will be controlled by the Bellekeno 625 adit. Adit flows measured since passive discharge from the 625 adit began (May to October 2023) ranged from 0.3 to 3 L/3 (average 1 L/s), with the highest flow observed in spring.The coffer dam was put in place prior to the water reaching the 625 elevation.

- (Appendix 3.1, Drawing S-0302). The coffer dam was put in place prior to the water reaching the 625 elevation.
- (Appendix 3.1, Drawing S-0302). The coffer dam was put in place prior to the water reaching the 625 elevation.
- *In situ* (mine pool) treatment to reduce soluble metals (cadmium, zinc) loads using a carbon source such as molasses will be implemented as the post-closure water treatment approach. This technology is implemented at Silver King and has proven highly successful in reducing soluble metal loading. The mine pool would be accessed through the Bellekeno East decline which would not be blocked until Bellekeno 625 has been adequately decommissioned. Evidentiary information to support the expected success of the in mine pool treatment of Bellekeno 625 is included in Appendices 1.3 and 1.4 and discussed further below.
- The existing water treatment plant will remain operating in place until the *in situ* treatment has been commissioned and meets the effluent quality standards. It is expected that the *in situ* mine pool treatment will obtain acceptable discharge water quality. As a contingency, a bioreactor will be constructed and commissioned to serve as a polishing step to the mine pool primary treatment if necessary. Bioreactor conceptual design described in Drawings D-2102 and D- 2301, located in Appendix 3.1.
- Surface water diversion infrastructure (berms, ditches) will be maintained to prevent surface runoff inflows into the adit and limit erosion. Water storage ponds will be filled in and contoured to match surrounding environmental features.

The *in situ* treatment pilot at Silver King, was initiated in September 2014 and provides a robust 9-year data set for evaluation of this treatment approach. Cadmium and zinc are the primary constituents of concern for both Silver King and Bellekeno. *In situ* treatment at Silver King has demonstrated substantial and sustained removal of both metals (Figure 9-5) to below their effluent quality standards. The treatment is considered semi-passive in that periodic injections of organic carbon (e.g., molasses, alcohol) may be required to maintain treated conditions within the flooded mine workings. At Silver King, such maintenance injections occur approximately every 2 years and last for approximately one month of continuous carbon injection to the mine workings. Further details of the performance of the Silver King *in situ* treatment pilot are provided in Appendices 1.3 and 1.4.

A comparison of total cadmium and zinc concentrations in the untreated mine water discharge from Bellekeno and Silver King is presented in Table 9-5. These parameters were selected since they are the only metals in untreated mine water that routinely exceed the EQS at either mine. Data from 2023 is presented for Bellekeno when the mine began discharging following suspension of dewatering in 2021. For Silver King, two years of data collected immediately prior to the start of the *in situ* treatment pilot are presented. Median total cadmium and zinc concentrations for Bellekeno are approximately 2- and 29-fold higher than those at Silver King. The Silver King pilot demonstrated sustained treatment of total cadmium to below the Bellekeno EQS of 0.01 mg/L. Although the Silver King total cadmium concentrations prior to treatment were lower than those present in Bellekeno mine waters, comparable treated concentrations below 0.01 mg/L are expected at Bellekeno following *in situ* treatment. Although the total zinc concentrations are Bellekeno are an order of magnitude higher than those at Silver King, treatment to below the 0.5 mg/L EQS is considered feasible via *in situ* treatment. Lines of evidence to support this include:

- Longer hydraulic residence time available in the Bellekeno mine workings (200 days; Appendix 3.6) compared with Silver King (81 days; AEG, 2021) under average flow conditions, thus allowing for greater treatment to occur along the mine water flow path;

- Successful *in situ* treatment of similarly elevated zinc concentrations (7 to 19 mg/L) in the Platoro Mine (Colorado, USA) to below 0.5 mg/L (Harrington et al., 2015);
- A significant fraction of recharge to the Silver King mine comes from oxygenated Galena Creek waters (Appendix 1.2). Since *in situ* treatment relies on the development and maintenance of low oxygen conditions within the mine workings, supply of this oxygenated recharge water likely decreases the length of time over which treated conditions persist. Recharge to the Bellekeno mine is not dominated by infiltrating creek water so treated conditions may last longer than at Silver King.

Table 9-5: Total Cadmium and Zinc Data from Untreated Bellekeno and Silver King Mine Discharges

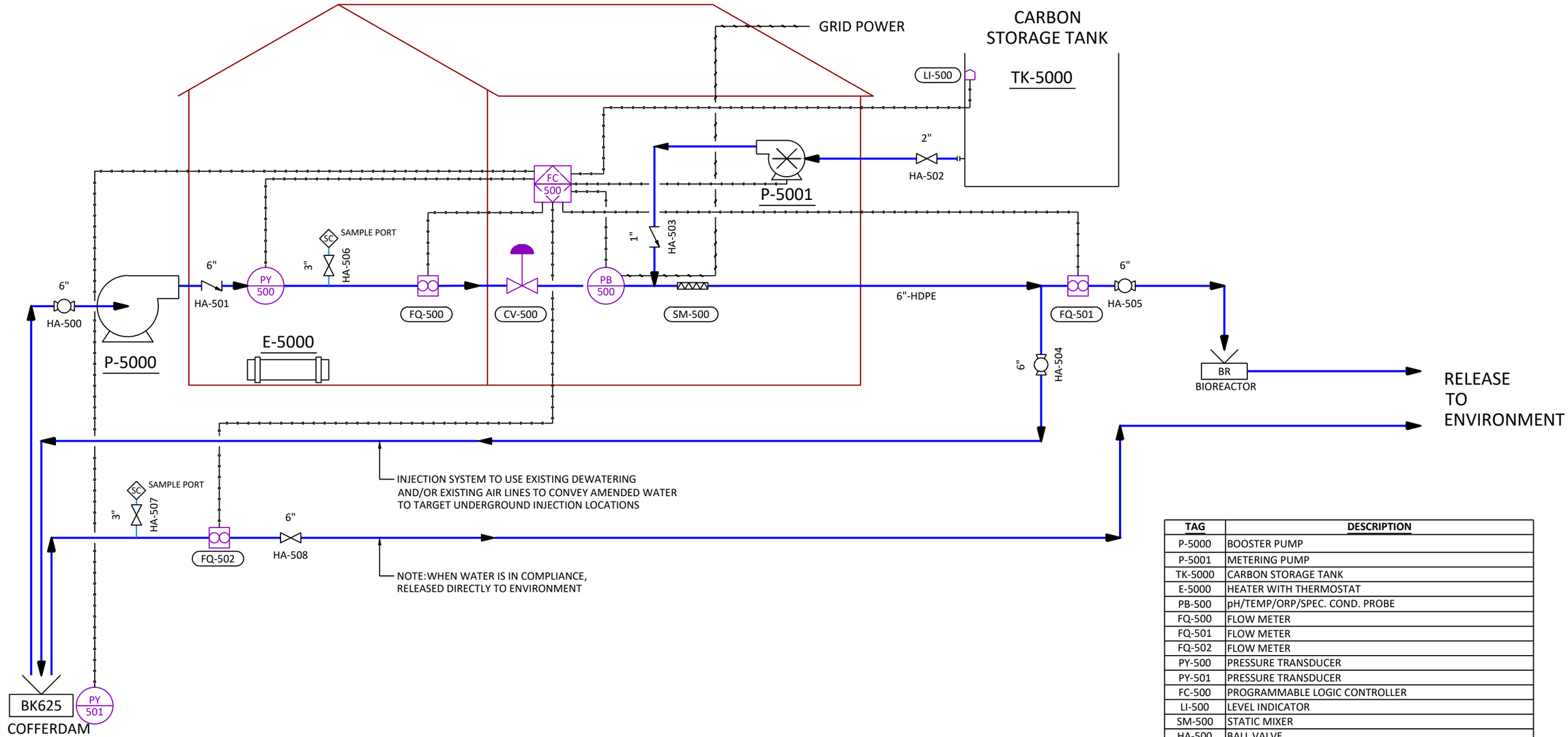
PARAMETER	TOTAL CADMIUM		TOTAL ZINC	
MINE	BELLEKENO[1]	SILVER KING[2]	BELLEKENO[1]	SILVER KING[2]
Units	mg/L	mg/L	mg/L	mg/L
EQS	0.01	0.05	0.5	0.5
Minimum	0.0122	0.00635	19.6	0.549
25th Percentile	0.0150	0.00872	21.8	0.712
Median	0.0190	0.00949	22.2	0.77
Average	0.0337	0.0101	23.2	0.772
75th Percentile	0.0242	0.0116	23.8	0.838
Maximum	0.188	0.0186	34.6	0.995
Count Exceeding EQS	19	0	19	27
Percent Exceeding EQS	100%	0%	100%	100%

[1] Bellekeno data from untreated Bellekeno 625 adit discharge (station KV-42) between May 2023 and October 2023
[2] Silver King data from untreated Silver King 100 adit discharge (station KV-13) between October 2012 and September 2014

Details regarding the *in situ* treatment system for Bellekeno can be found in Appendix 3.9. During the initial stages, a tracer will also be included with the carbon injection to evaluate residence time and the degree of mixing with the carbon source. Once treatment is attained and observed to be sustained for greater than 6 months between injection events, adit water quality will be monitored to evaluate whether a maintenance carbon injection is required. The triggers for this are provided in Appendix 3.9; however, carbon injections on an annual basis are considered a conservative case – maintenance injections with a longer frequency are expected, particularly following installation and commissioning of the bioreactor which will provide additional removal of cadmium and zinc.

In 2025 Core Geosciences reviewed available technical reports and identified gaps in information which could result in risk to successful in situ implementation at Bellekeno. The recommendations are currently being assessed to initiate progressing a work plan in 2026. The recommendations are included in the Core Geosciences Passive Treatment Bellekeno Memorandum in Appendix 1.6.

Figure 9-3: Bellekeno 625 In Situ Treatment Process Flow and Instrumentation Diagram



TAG	DESCRIPTION
P-5000	BOOSTER PUMP
P-5001	METERING PUMP
TK-5000	CARBON STORAGE TANK
E-5000	HEATER WITH THERMOSTAT
PB-500	pH/TEMP/ORP/SPEC. COND. PROBE
FQ-500	FLOW METER
FQ-501	FLOW METER
FQ-502	FLOW METER
PY-500	PRESSURE TRANSDUCER
PY-501	PRESSURE TRANSDUCER
FC-500	PROGRAMMABLE LOGIC CONTROLLER
LI-500	LEVEL INDICATOR
SM-500	STATIC MIXER
HA-500	BALL VALVE
HA-501	CHECK VALVE
HA-502	ISOLATION VALVE
HA-503	CHECK VALVE
HA-504	BALL VALVE
HA-505	BALL VALVE
HA-506	GATE VALVE
HA-507	GATE VALVE
HA-508	GATE VALVE
CV-500	THROTTLING VALVE

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-02-05	Draft for review	A	KAB	--

NOTES:

1) Treatment will be performed in treatment campaigns periodically as necessary to maintain low redox potential, and low zinc.
2) A centrifugal booster pump will be installed near the cofferdam, allowing for water to be pumped from the mine, amended with carbon, and injected back underground
3) A throttling valve will control the pump speed.
4) System's flow rate and pressure will be monitored, with carbon injection proportional to flow rate. Monitoring information of all adit discharge will be continuously monitored with datalogging field parameters: specific conductivity, temperature, ORP, pH, and pressure.
5) When in compliance, water will be released to the environment.

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Reclamation and Closure Plan
Drawing No.: AKHM-13-01-D2601

Figure 8-4

Bellekeno 625 In Situ Treatment Process Flow and Instrumentation Diagram

REVISION B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: EJL	REVIEWED BY: JMH

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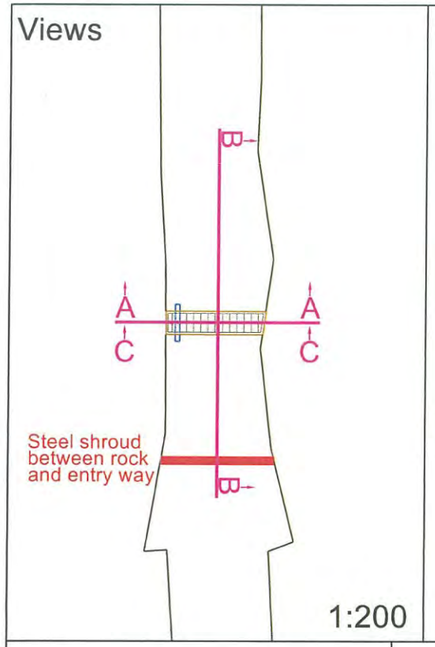
Figure 9-4: Sections and Details Concrete Cofferdam Adit Closure

Views



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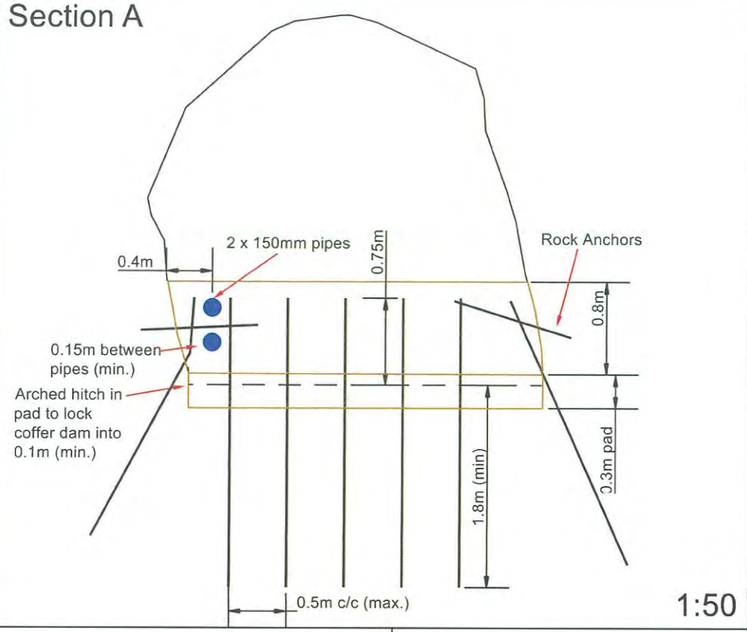
Section A



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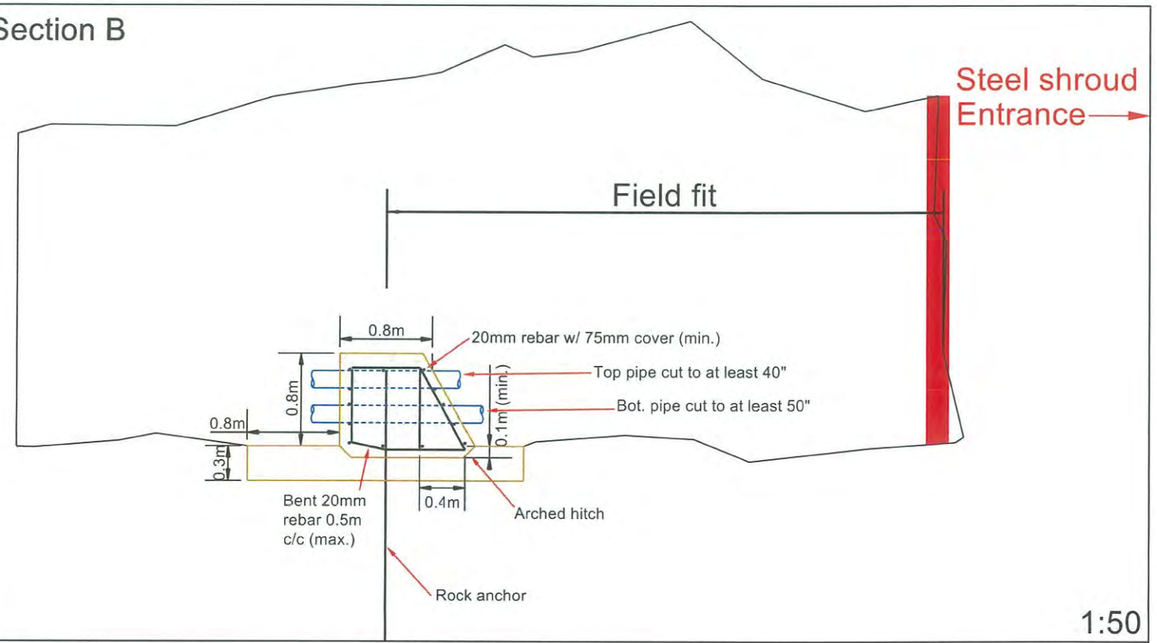

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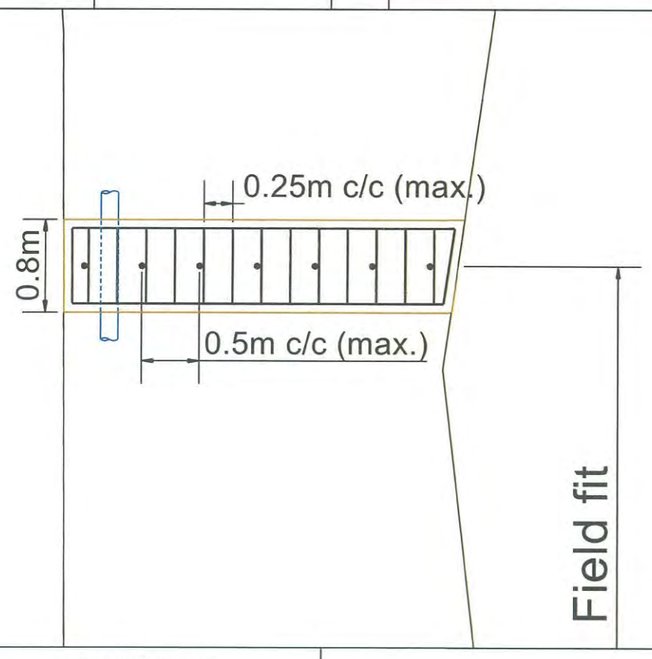
Plan



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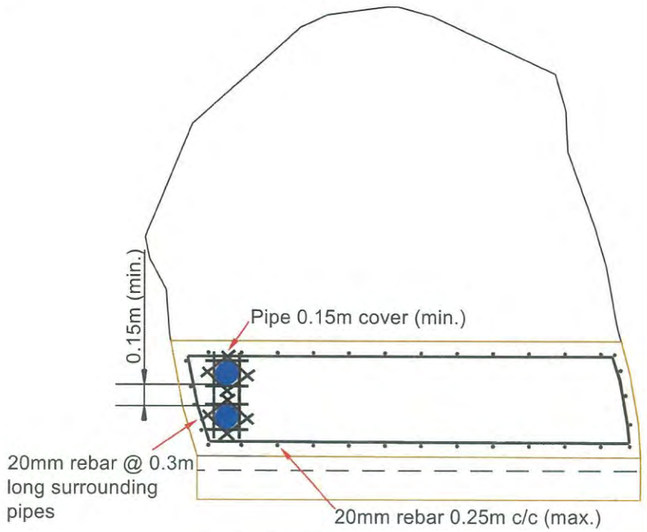

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Revision Comments							
Original Drawing by N. Toeppner	Approvals						
Changed Dam Shape and added pipe notes - B.G.	Name	bgumata	EFUEN76 J	George Oliveira	T. Branch	MR. BRADEN BUYE TERRITORY	BK COFFER DAM
	Signed				Trevor Branch		
	Date	06/09/2022	06/09/22.	Sept 16, 2022	Sept 6/22.		Scale: Varies / Dwg Z: Varies / Rev #: / Mine:Bellekeno
		Originator	Engineering	Geology	Mine Superintendent	Mine Operations Manager	File Path: C:\Users\bgumata\OneDrive - Alexco Resource Corp\Documents\DES\WK.FM\kh\Engineering\Construction\Construction Projects.duf

Hecla YUKON KENO HILL OPERATIONS

PROFESSIONAL ENGINEER YUKON TERRITORY Sept 6, 2022

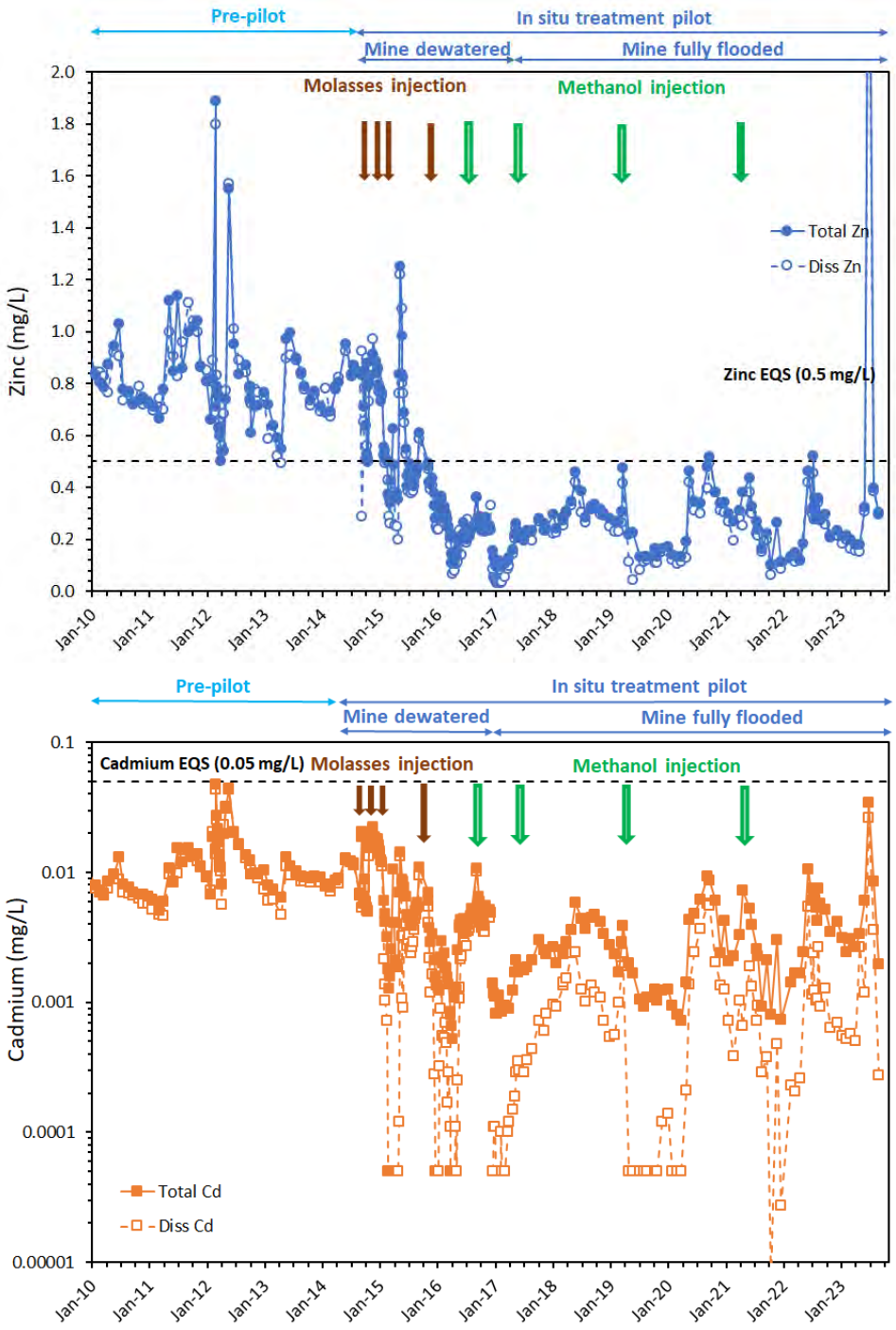


Figure 9-5: Total and Dissolved Cadmium and Zinc Concentrations in Water Discharged from the Silver King Mine Before and During *In Situ* Treatment Pilot Test

The Bellekeno 625 Water Treatment Plant (WTP) (Photo 9-1) includes a lime-addition circuit for metals removal and settling ponds for removal of suspended solids. The WTP will be left in place as a contingency measure until the biological and chemical processes that make up in situ treatment establish in the underground workings. At closure, following in situ treatment commissioning the Bellekeno 625 WTP will be shut down and decommissioned and the lined ponds and tanks will be used for the construction of the bioreactor. The equipment from the Bellekeno 625 WTP will be repurposed for the New Bermingham in situ treatment system.

Sludge from the Bellekeno 625 WTP has been disposed of into a cell on the surface of the Valley Tailings as authorized under QML-0009. The sludge from Bellekeno 625 that is stored in the Valley Tailings cell is kept separate from the sludge generated at the other treatment facilities. The sludge containment cells are not lined in order to allow water to exfiltrate from the cells.



Photo 9-1: Bellekeno 625 WTP Area Overview

Regular sludge removal to maintain pond residence time minimizes will be required periodically in accordance with the Sludge Management Plan. Sludge that builds up at Bellekeno 625 will be blended with P-AML waste rock and disposed of underground when possible.

The discharge criteria currently authorized in Water Licence QZ18-044 for the Bellekeno 625 WTP is protective of the receiving environment. The discharge criteria for the Bellekeno Mine for closure and long-term is the same as the current effluent quality levels.

*9.4.4.1 **Flame & Moth***

The Flame & Moth pond is located adjacent to the mill pond and serves as a final polishing step for effluent from the water treatment plant. The clarifier overflow water from inside the mill building gravity flows via a 6" HDPE pipe into the pond. The pond was constructed with an engineered fill embankment. The closure of the pond consists of removing and burying the HDPE liner, backfilling and recontouring the pond to limit ponding, scarification of the final surface and revegetation.

*9.4.4.2 **New Bermingham***

The mine will flood at closure due to ground water infiltration and it is expected to discharge out the portal. A N-AML rockfill adit closure with a drain will be installed at the adit entrance to restrict access by humans or

wildlife. At closure, discharge from the flooded New Bermingham Mine (currently expected to be up to 2.5 L/s) will infiltrate to ground.

The adit discharge chemistry is expected to be similar to that of the nearby historical Bermingham 200 adit, which has a median dissolved cadmium and zinc concentration of 0.073 and 2.3 mg/L. The water chemistry during New Bermingham mine development and production is reviewed regularly for both operations and to assess long-term water chemistry. A summary of dissolved arsenic, cadmium, and zinc concentrations in the untreated mine water discharge from New Bermingham and Silver King is presented in Table 9-6. These parameters were selected since they are the only metals in untreated mine water that routinely exceed the EQS at either mine at present or are expected to exceed the EQS in closure.

Table 9-6: Dissolved Arsenic, Cadmium, and Zinc Data from Untreated New Bermingham and Silver King Mine Discharges

Parameter	Dissolved arsenic		Dissolved cadmium		Dissolved zinc	
Parameter	Bermingham[1]	Silver King[2]	Bermingham[1]	Silver King[2]	Bermingham[1]	Silver King[2]
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQS	0.061	-	0.01	-	0.5	-
Minimum	0.0005	0.0013	0.00005	0.00472	0.0036	0.29
25th Percentile	0.0386	0.0306	0.000130	0.00747	0.00883	0.703
Median	0.047	0.0388	0.00093	0.00852	0.0422	0.778
Average	0.051	0.0337	0.00202	0.00880	0.132	0.746
75th Percentile	0.0623	0.0430	0.00215	0.0103	0.201	0.838
Maximum	0.106	0.0474	0.0157	0.0124	0.846	0.925
Count Exceeding EQS	30	-	7	-	8	-
Percent Exceeding EQS	28%	-	6%	-	7%	-

[1] New Bermingham data from untreated portal discharge (station KV-110) between September 2021 and October 2023
[2] Silver King data from untreated Silver King 100 adit discharge (station KV-13) between October 2012 and September 2014

9.4.4.3 ***Lucky Queen***

Surface water diversion infrastructure (berms, ditches) will be maintained as appropriate to manage runoff and limit erosion. Water storage ponds will be filled in and contoured to match surrounding environmental features.

9.4.4.4 ***Onek 990***

Surface water diversion infrastructure (berms, ditches) will be maintained as appropriate to manage surface runoff from entering the decline and limit erosion on site. Water storage ponds will be filled in and contoured to match surrounding environmental features.

9.4.5 Post Closure Water Management

9.4.5.1 ***Mill Site and Dry Stack Tailings Facility***

Post closure, if the DSTF produces seepage requiring treatment the Mill Pond could also serve as a bioreactor facility. This would be accomplished by constructing an internal berm in the existing pond to separate the Mill Pond into an equalization pond and a placer gravel filled bioreactor. The bioreactor portion would require a 2.0

m thick soil cover to act as both a frost barrier and protection for humans and wildlife. Inlet piping would allow gravity flow from the equalization pond to the bioreactor, and collection piping at the opposite end of the bioreactor would allow for discharge of the treated water. Pipe risers at the ends of the piping at both the inlet and outlet sides of the bioreactor would act as clean-out locations. Additionally, treatment amendments could be added to the bioreactor through the inlet side risers.

Bellekeno 625 Bioreactor

A preliminary design of the bioreactor at Bellekeno 625 is shown in Figure 9-6 and Figure 9-7.

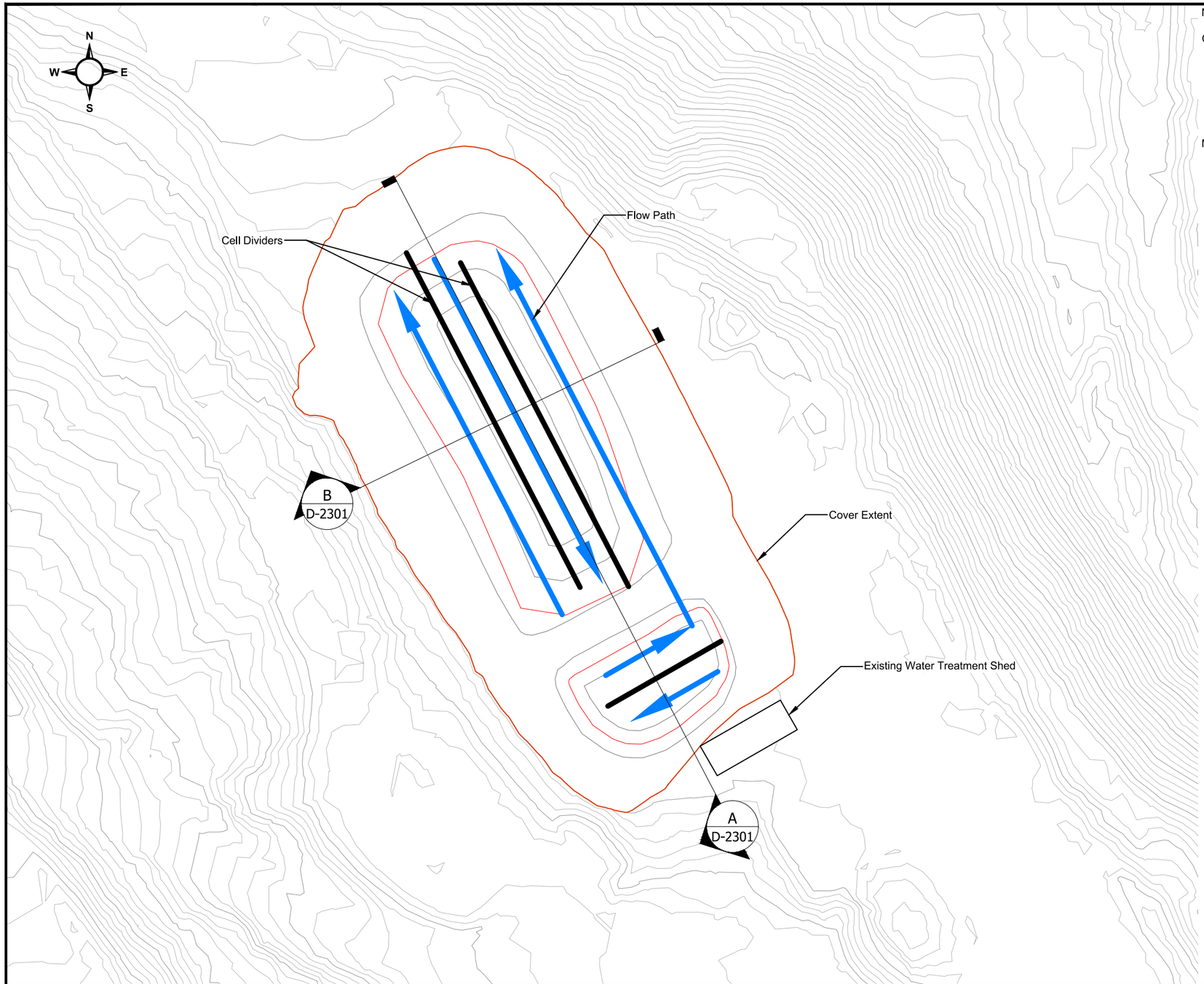
The lined ponds at Bellekeno 625 will be converted into a bioreactor and serve as a contingency treatment system. Although the *in situ* treatment of Bellekeno is expected to produce direct discharge compliant water, an additional contingency treatment system in the form of a bioreactor adds further confidence and conservatism in the water management plan for Bellekeno upon closure.

The bioreactor design and construction consists of the following steps:

- Remove (vacuum truck) remaining sludge in Bellekeno lined ponds.
- Install piping distribution system in bottom of ponds.
- Fill ponds with clean gravel sourced from placer operations located adjacent to the Bellekeno mine on Thunder Gulch.
- Install geotextile barrier over surface of gravel.
- Place 2-metre soil cover over top of geotextile.
- Recirculate mine pool water through bioreactor and commission.

A water treatment and management schedule for Bellekeno 625 is included in Table 9-4. Once in situ treatment is established within the mine workings, bioreactor construction will commence to provide treatment contingency. A bioreactor was constructed and operated from 2009-2011 at Galkeno 900 as part of the district-wide closure planning process. The results of the Galkeno 900 bioreactor performance are included in Appendix 1.5 as support for this approach in closure of the Bellekeno mine.

Figure 9-6: Bellekeno 625 Bioreactor Design



Notes:

Conceptual Design Assumptions:

1. Divide Pond 1 in to two zones with an HDPE liner divider. Two cells of approximately 6 m x 15 m
2. Divide Pond 2 in to three zones with HDPE liner dividers. Three cells of approximately 5.3 m x 42 m
3. Total Volume = 2,800 m^3
4. Porosity = 40%
5. Flowrate = 4 lps
6. Retention Time = (2800 m^3 x 0.40)/4 lps = 3.1 days

Material Quantities:

Placer Gravel Rock Substrate:	2,800 m^3
Geotextile Barrier:	1,410 m^2
Soil Cover:	4,010 m^3

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2018-02-01	Draft for review	A	KAB	–

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Reclamation and Closure Plan
Drawing No: AKHM-13-01-D-2102

Figure 9-9

Bellekeno 625
Bioreactor Design

REVISION: A	2018-02-01	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: –	REVIEWED BY: KSW

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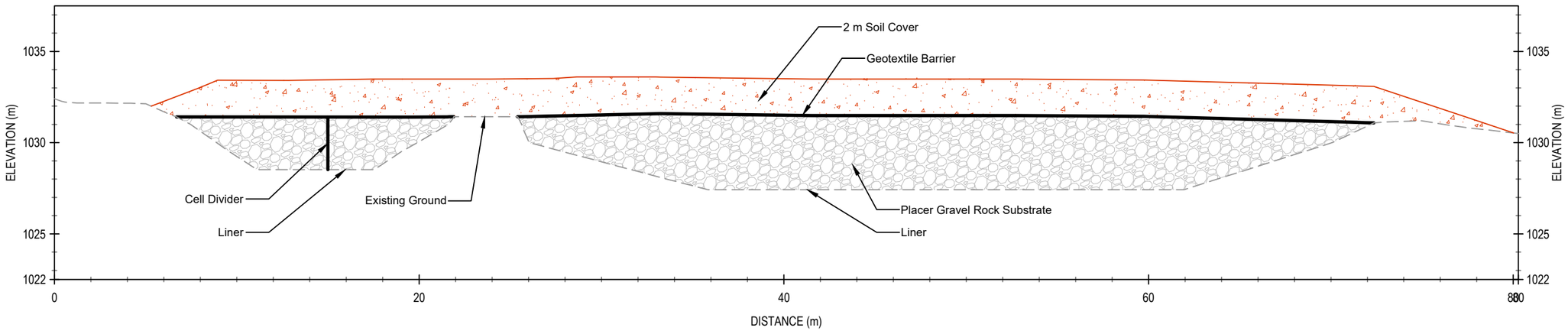
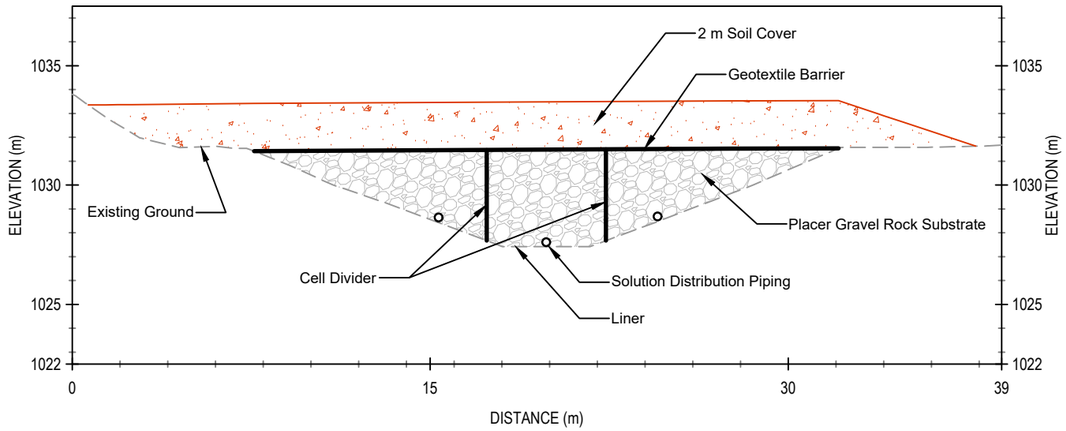
Figure 9-7: Bellekeno 625 Bioreactor Design Sections



Section A



Section B

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2022-04-22	Draft for review	C	KAB	--
2021-11-25	Draft for review	B	KAB	--
2018-02-01	Draft for review	A	KAB	--

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Reclamation and Closure Plan
Drawing No: AKHM-13-01-D-2301

Figure 9-10
Bellekeno 625
Bioreactor Design Sections

REVISION: C	2022-04-22	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: KSW

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9.4.5.2 ***New Bermingham***

The long-term water management and treatment approach for the New Bermingham Mine is summarized as follows:

- Once active treatment and pumping of the mine pool ceases, the mine workings are allowed to flood and *in situ* treatment begins. A conceptual *in situ* treatment design, similar to that currently in place at Silver King, is envisaged for the New Bermingham mine. Water from the New Bermingham portal discharge will be amended with soluble organic carbon (e.g., alcohol and/or molasses) and pumped back to the flooded workings via an injection well installed in the vent raise or a drill hole. If required, a submersible pump will recirculate water within the flooded mine workings to achieve the optimal conditions for treatment within the workings. Given the success of the Silver King *in situ* treatment pilot test (Appendices 1.3 and 1.4), the relatively low zinc and cadmium concentrations, and the infiltration of discharge to ground, *in situ* treatment is considered an appropriate closure technology for primary treatment of the New Bermingham portal discharge.
- Such injections would occur continuously over a period of a few weeks to ensure adequate carbon is delivered to the workings alongside dispersion throughout the workings. During the initial stages, a tracer will also be included with the carbon injection to evaluate residence time and the degree of mixing with the carbon source. Once treatment is attained and observed to be sustained for greater than 6 months between injection events, adit water quality will be monitored to evaluate whether a maintenance carbon injection is required. The triggers for this are anticipated to be similar to those outlined in Appendix 3.9; however, carbon injections on an annual basis are considered a conservative case – maintenance injections with a longer frequency are expected.
- Following discharge from the New Bermingham portal, the water may need pH adjustment and/or total suspended solids (TSS) control. This would be achieved via a passive aeration system (e.g., tumbling the discharge over rip rap channel) to promote equilibration with the atmosphere and raise pH via degassing of carbon dioxide. The rip rap channel would then flow into a retention pond to promote settling of TSS and further equilibration with the atmosphere, prior to discharge to the environment.
- The conceptual hydrogeologic model for the underground mine flow will be evaluated as the mine is developed by comparing predicted and actual flows. However, the key parameters for design of the *in situ* treatment and contingency planning for treatment are obtained from site data; the rate of groundwater flow through the workings, the time to flooding, and the resultant water chemistry underground. The extent of the mine workings at the time of closure will determine the location and requirement for carbon injection.
- The open (i.e., not backfilled) mine workings flooded volume at closure is approximately 46,000 m^3 as determined from MineSight. Based on the calculated post-closure, flooded workings portal discharge rate of 2.5 L/s, the hydraulic retention time on the mine workings is 213 days. This is an upper end estimate based on plug flow assumptions that will be refined during tracer injection in the early stages of *in situ* treatment. However, it is considerably longer than the 81 days calculated for Silver King under average flow conditions (AEG, 2021), suggesting that treatment of the somewhat higher cadmium and zinc concentrations expected in the New Bermingham flooded mine workings than present at Silver King will be treated to below the EQS.
- Dissolved arsenic concentrations in the discharge from the New Bermingham portal and Silver King 100 adit are comparable (Table 9-6). *In situ* treatment at Silver King did not result in arsenic removal, with dissolved arsenic concentrations that were approximately 30% higher following establishment of *in situ* treatment (Appendix 1.3), linked to reductive dissolution of arsenic-bearing iron oxyhydroxide phases within the mine workings. Nevertheless, bench-scale testing of passive aeration of the Silver King discharge demonstrated 80% removal of arsenic within 24 hours, likely due to co-precipitation with iron

that is mobilized under reducing conditions. This is analogous to the processes expected in the retention pond into which the New Bermingham post-closure discharge would report.

- The water quality monitoring data from both Bermingham, as well as the Bellekeno and Silver King *in situ* treatment will be used to refine the design, particularly the commissioning period requirements. To date, the data do not indicate any changes are required to the current plans. Site experience will be considered for updates to the RCP with respect to contingencies for treatment.
- The lime water treatment plant constructed for the mine operations phase will remain in place as a contingency measure until the *in situ* treatment system has demonstrated stability and effectiveness.

The Silver King in situ treatment is representative of what would be constructed at Bermingham. Additional details describing typical operations and maintenance of this type of system can be found in the In Situ System Operations Plan (Appendix 3.9).

9.5 MINE SURFACE INFRASTRUCTURE

The closure objectives for mine, mill and surface infrastructure are to:

1) Remove potential sources of environmental contamination;
2) Minimize erosion;
3) Minimize safety risks to people and wildlife, and
4) Reclaim the site to an aesthetically acceptable level.

9.5.1 Bellekeno Surface Infrastructure

*9.5.1.1 **Bellekeno East Surface Facilities***

All of the surface buildings at Bellekeno East portal were portable structures that have subsequently been removed and transported elsewhere on the KHSD Mining Operations.

Reclamation of the Bellekeno East portal site includes removal of the shop and other buildings (complete). Fuel tanks to be cleaned and removed along with liners for reuse or landfilling (complete). Any additional debris will also be removed for reuse or proper disposal (on going).

All solid waste will be disposed of in accordance with the Yukon Environment Act Solid Waste Regulations. All waste petroleum products and any other special waste, as defined in the Special Waste Regulations will be disposed of in accordance with the Regulations. Any soils contamination will be documented through a contamination site assessment. Contaminated soil will be removed and/or remediated in an approved manner.

The portal site would then be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence.

Compacted areas will be scarified to promote natural revegetation or selected areas will be reseeded with native vegetation.

*9.5.1.2 **Bellekeno 625 Adit Surface Facilities***

The primary facilities remaining in place at Bellekeno 625 are seen in Photo 9-2 and include:

1. historic loadout and snow shed facility,

2. compressor container,
3. ventilation fan,
4. water treatment building,
5. container storage units, and
6. electrical substation.

At closure the water treatment building will be converted to support the *in situ.* The Electrical substation will remain until power not required at Bellekeno *in situ*.



Photo 9-2: Bellekeno 625 Surface Facilities – October 2023

9.5.2 Flame & Moth Surface Infrastructure

Infrastructure at the Flame & Moth Mine consists of a miners' office trailer and miners' dry facility, water treatment plant (inside the mill) and settling pond, ore and waste handling/storing facility, portal ventilation fan and heater, and air compressors.

All of the surface buildings associated with Flame & Moth are portable structures that will be removed and transported off site for salvage at the end of the mine life.

Reclamation of the portal site will include removal of the surface facilities and other buildings.

Additional details on closure activities in this area are described in Section 9.6.

9.5.3 New Bermingham Surface Infrastructure

All of the infrastructure constructed by AKHM at the New Bermingham Mine will be removed and repurposed or disposed of. The substation at Ruby will be removed. Any additional debris will also be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with regulations under the *Yukon Environment Act* and measures described in Section 9.8.

The portal site will be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence. Compacted areas will be scarified to promote natural revegetation or selected areas will be reseeded with native vegetation.

9.5.4 Lucky Queen Surface Infrastructure

Reclamation of the Lucky Queen Portal Pad will include removal of the shop and two other existing buildings. Any additional debris will be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with regulations under the *Yukon Environment Act* and measures described in Section 9.8.

The portal pad will be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence.

Compacted areas will be scarified to promote natural revegetation or selected areas will be reseeded with native vegetation.

9.5.5 Onek 990 Surface Infrastructure

Except for a small wooden shack all buildings and facilities at Onek 990 have been removed and the area only requires minimal final recontouring and reclamation of the surface disturbance and closure of the 990 Portal. The shack and any additional debris will be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with regulations under the *Yukon Environment Act* and measures described in Section 9.8.

The portal site will be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence.

Compacted areas will be scarified to promote natural revegetation or selected areas will be reseeded with native vegetation.

9.6 MILL INFRASTRUCTURE

The closure objectives specific to the District Mill area is to:

- remove potential sources of environmental contamination,
- minimize erosion,
- minimize safety risks to people and wildlife, and
- reclaim them to an aesthetically acceptable level.

The District Mill is a conventional differential flotation facility producing two separate metal concentrates that are shipped offsite for final processing. A layout of the mill facilities is shown in Figure 9-. The buildings at the District Mill site that require removal under the closure plan are listed in Table 9-7 and can be broken into five categories:

- modular, prefabricated trailer style buildings,
- rigid, steel frame construction buildings with insulated steel wall sheeting,
- non-rigid prefabricated steel frame "fold-away" buildings,
- containerized buildings, and
- tents.

Table 9-7: Building construction style

BUILDING	MODULAR TRAILER	RIGID STEEL FRAME	FOLD-AWAY	CONTAINERIZED	TENT
Mill and mill expansion		✓			
Crusher building		✓			
Fine ore storage					✓
Assay lab				✓	
Millwright shop				✓	
Warehouse		✓			
Mine and mill offices	✓				
Electrician Shed				✓	
Maintenance shop	✓		✓	✓	
Dry facilities	✓				
Cold storage				✓	
Heated storage					✓
Composter				✓	

Reclamation measures for the Mill area are described on Drawing C-6401, and grading details are described on Drawings B-6101 and B-6301, located in Appendix 3.1.



Figure 9-11: Aerial View of Mill Site Infrastructure and Layout

9.6.1 Buildings

The modular prefabricated trailer style buildings will, wherever economically feasible, be removed from the site and sold for their salvage value. Generally, disassembly involves removing the underlying wood skirting, water, electrical and septic piping and cabling and then breaking the units into their respective prefabricated units. The individual units are then placed on axle dollies and removed from the site to be reused elsewhere following refurbishing. The remaining service piping, cabling and skirting lumber is removed and disposed of as either scrap or as salvageable material. The gravel pad beneath the trailer units will be scarified with a grader to enhance the re-establishment of natural vegetation.

In the event that it is found at the time of decommissioning that any such unit(s) cannot be removed or sold for their salvage value, then the unit(s) will be inspected for hazardous materials, the hazardous materials removed, and units demolished on site. The materials with salvage value will be removed and sold for their respective value. Non-hazardous materials that have no salvage value will be disposed of in an approved landfill site on the mine site. Combustible wastes such as lumber-based building materials will be burned, and the residue buried in the landfill site.

The rigid steel frame buildings will be dismantled on site with the support steel being sold for salvage value wherever economically feasible. Prior to disassembly, the buildings will be stripped of all non-attached equipment and materials such as shelving units, office furniture, equipment, etc. Wherever feasible, materials with salvage value will be sold for its value. Non-hazardous materials that have no salvage value will be disposed of in the approved on-site landfill area. All buildings will be inspected for hazardous materials, such as hydrocarbons, reagents, etc. Any such material will be removed and disposed of in a manner approved by regulatory authorities for the Yukon Territory. Generally, disassembly of these buildings involves removing all the steel sheet roof and wall panels and internal insulation. The steel support structure is then disassembled and where feasible sold for its salvage value either as an intact building or as high-quality steel scrap. Internal steel structures would then be removed and treated in a similar fashion.

The foldaway buildings are modular and portable structures. The buildings will be dismantled and tendered for re-sale or buried on site.

Closure measures for containerized buildings include dismantling and removal of the excess containers off site.

Tents will be dismantled and either salvaged or buried on site.

Above grade concrete footings, foundations concrete floor slabs and below grade concrete foundations will be covered by a minimum thickness of 1 m of overburden and scarified. These covered slabs will be seeded with an appropriate vegetation mix to establish vegetative growth over these areas. The specific details of each of the mill area buildings are further described in the following sections and closure measures identified.

9.6.1.1 ***Mill Building***

The Keno District Mill is a conventional differential flotation facility producing two separate metal concentrates that are shipped offsite for final processing. The mill building is a pre-engineered steel building containing all of the processing equipment used for the milling, flotation and recovery of silver, lead and zinc from KHSD Mining Operations. The mill building is 22.5 by 54 meters in dimension (Photo 9-3). In 2021 an expansion to the mill building was added between the mill and the assay lab to house the secondary grinder (Photo 9-4).



Photo 9-3: Mill Building



Photo 9-4: Assay Lab and Mill Extension

Closure measures for the mill building include decontamination (procedure described in Section 6.6.2) salvage and removal of the process equipment, dismantling of the engineered building, breaking the concrete slab to allow percolation of water, and covering of the footprint with growth media.

9.6.1.2 ***Assay Lab***

The assay lab is located immediately adjacent to the mill building and consists of 3 skid mounted trailer units separated by a wooden deck and winter roof truss (Photo 9-4). The sample prep trailer is a skid mounted trailer used for preparation of mill and underground samples. The trailer is 13.47 x 3.05 meters in dimension. The assay lab trailers consist of 2 separate skid mounted units that are joined together. The two assay trailers are 2.4 x 6.1 meters in dimension.

Closure measures for the assay lab consist of transporting the units offsite for salvage.

9.6.1.3 ***Mill Office and Dry***

The mill office and dry facility is comprised of two skid mounted trailer units and two skid mounted wash car with a wooden truss constructed over the top of the 3 units. The four office units are 3.05 x 8.3 meters in dimension and the dry/shower facility is 3.35 x 11.58 meters.

Closure measures for the mill office include dismantling the roof truss structure and removing the building from site. Since the office is a portable structure there is no demolition required.

9.6.2 Crushing Plant

Coarse ore from the Flame & Moth and New Bermingham mines is transported to a crushing plant (Photo 9-5) where the coarse ore is crushed and reduced in size to nominally 3/8". The crushing plant is a two-stage closed circuit plant containing a jaw crusher, single deck screen and cone crusher. The crushers, screen deck and conveyors. Once the material is crushed it is transported to the adjacent fine ore stockpile via a radial stacker conveyor.

The crusher retaining wall is constructed of 6 stacked sea- containers that likewise can be removed and salvaged. Decontamination of the area is described in Section 9.9.



Photo 9-5: Crushing Plant – November 2023

9.6.3 Fine Ore Stockpile

The fabric membrane structure is 11.35 meters tall, 18.3 x 24.5 meters in dimension and is supported by an aluminum support structure sitting on 4 (ea) 40' steel containers that provide containment of the fine ore. Closure measures involve removal and salvage or burial of stored parts and the dismantling and disposal of the structure.

Closure of the stockpile includes excavation and milling of any residual fine ore remaining on surface, removal and salvage of the sprung structure and sea-containers. The buried tunnel will be removed and salvaged for steel scrap value.

9.6.4 Motor Control Centres

Closure measures for the mill and crusher MCC consist of transporting the unit offsite for salvage.

9.6.5 Fresh Water Tank

The fresh water tank has a capacity of 50.26 m^3 and is 4 meters tall and 4 meters in diameter. At closure of the fresh water tank consists of dismantling and cutting up for salvage value.

9.6.6 Fuel Storage Tanks

One skid mounted double walled diesel storage tank and one skit mounted gasoline tank are located adjacent to the concentrate loadout area and are used for general fueling of mobile equipment and vehicles. The tanks each have a storage capacity of 3.78 m^3.

The diesel storage tanks are supplied by the diesel supply vendor and closure consists of returning the tanks to the supplier.

9.6.7 Propane Tank

A tire mounted portable propane storage tank sits near the mill building with a capacity of 10,000 gallons (37,854 litres) or more of propane. Propane is used at the mill for heating the mill building during winter conditions.

The propane tank is supplied by the vendor and closure consists of returning the tanks to the supplier.

9.6.8 Buried Infrastructure

All buried piping and electrical cabling will be de-energized, drained and truncated where they break surface with the buried portions left remaining in the ground. The ends of all buried piping and cable runs will be cut off at 1 m below grade with the resulting excavations backfilled. Prior to abandonment all possible piping will be drained and washed to remove its contents.

The location of all known buried piping and cabling to be left in the ground will be marked on a site plan to be submitted to regulatory authorities for future reference.

Where appropriate, surface piping will be decontaminated by flushing the respective section of pipe with water and then removing the pipe for disposal. Large diameter piping will be sold for salvage where feasible. Piping with no salvage value will be disposed of in the site landfill area.

9.6.9 Electrical Substations

The step down transformer will be removed and salvaged and the remaining equipment will be removed and either salvaged or buried. The same decommissioning measures will be applied to the Onek substation.

All above ground electrical cabling will be de-energized and removed. Ideally the cable will be recovered for its salvage value. Cable with no salvage value will be disposed of in the site landfill area.

9.7 FLAT CREEK CAMP

Employees and contractors directly related to the Keno Hill Mine Operations are housed in the Flat Creek camp as well as in four staff houses that are located in Elsa. Some personnel and camp accommodation requirements may be required in the longer term for exploration, and district-wide closure activities. Given these ongoing activities, removal and closure of the entire camp facility is not envisioned as part of the Bellekeno, Flame & Moth, and New Bermingham mines closure plan and requirement.

Closure measures include dismantling and removal of the excess trailer units off site. The expanded septic system, along with the increased freshwater supply will remain in place for continued use by the downsized camp.

Reclamation measures for the Flat Creek Camp area are described on Drawing C-9401, and grading details are described on Drawings B-9101 and B-9301, located in Appendix 3.1.

9.8 ROADS AND OTHER LINEAR FEATURES

The closure objectives for linear disturbances, including roads, other access, and transmission lines, are to:

1) achieve long term physical stability of the disturbed area,
2) enable pre-mining human and wildlife utilization of linear infrastructure, and
3) reclaim the areas such that it is aesthetically acceptable.

9.8.1 Roads

The haul roads and access roads developed for the AKHM Operations will be subject to standard road decommissioning and reclamation measures at closure. These roads are shown on Figure 9-8 and comprise the following routes:

- Bellekeno Haul Road from District Mill to Bellekeno East Portal (including the Lightning Creek bridge) and Bellekeno 625 Adit,
- Bermingham Access Road from Calumet Road to the New Bermingham Mine (including access to the portal, the P-AML pad, the vent raise, and the New Bermingham Water Treatment Plant),
- Christal Lake Road (from Silver Trail Highway to Duncan Creek Road),
- Lucky Queen Road, and
- Onek Connector from Bellekeno Haul Road to Wernecke Road (including the Onek bridge).

The roads identified for closure above range in width from six to nine meters and are either newly developed or reconstructed/upgraded from pre-existing roads. Roads required during the 10-year post-closure monitoring period will be decommissioned at closure. The requirement for road access for monitoring will be reviewed 10 years after closure and if the route is no longer needed it will be reclaimed.

Standard road decommissioning measures at closure include culvert removal, re-sloping banks and removal of safety berms to reflect the natural topography as well as provide stability. Re-grading/contouring the roads will ensure that runoff sheds off the road surface. Reclamation measures include surface scarification to encourage natural revegetation. Localized seeding with native vegetation will take place where erosion control is necessary. A typical cross-section of road reclamation is described in Drawing B-0301, located in Appendix 3.1.

Decommissioning measures will involve removal of the two clear span bridges (and abutments) across Lightning Creek. The banks will be stabilized through revegetation and strategic placement of the existing rip rap.

The public roads will remain in place post closure. The sections of public roads upgraded for mine traffic use roads will not be reclaimed or closed and include the following:

- a section of the of the Sourdough Trial incorporated into the Bellekeno Haul Road,
- a section of the Duncan Creek Road from Calumet Road to the District Mill,
- Calumet Road,
- Tower Road,
- a section of the Bermingham Access Road between Calumet Road and Tower Road, and
- in the future a section of the Wernecke Road from Keno City to Lucky Queen Road.

9.8.2 Transmission Lines

Transmission lines constructed include the District Mill, Bellekeno, New Bermingham, and, in future the Lucky Queen transmission line. All transmission lines constructed will be subject to standard decommissioning and reclamation measures at closure, including removing power poles and lines, and undertaking measures to promote natural revegetation. Any compacted areas will be scarified.

Figure 9-8: Roads Subject to Standard Decommissioning and Reclamation

Road Name	Width, m	Length, m
Bermingham Access Road	9	1979
Calumet Drive	9	7098
Christal Lake Road	6	1299
Bellekeno Haul Road	9	5661
Keno City Bypass Road	9	2060

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Chistal Lake Road
- Bellekno Haul Road
- Keno City ByPass
- Calumet Drive
- Bermingham Access Road
- Place of Interest
- Adit
- Hecla/ERDC Quartz Claims
- Tailings Area
- Waterbody
- Silver Trail Highway
- Road
- Limited-Use Road

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 8-13
ROADS SUBJECT TO STANDARD DECOMISSIONING AND RECLAMATION

OCTOBER 2023

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(Last edited by: a.radashevska;2023-10-02;10:37 AM)

9.9 WASTE MATERIALS

Measures taken to manage the generation, handling, storage, treatment, and disposal of solid, liquid, gaseous and special wastes from the mining operations will be tailored to accommodate wastes generated during closure. During operations AKHM has invested in waste management infrastructure and implemented the 5 R pollution prevention hierarchy (British Columbia Ministry of Environment, 2016). The 5 R pollution prevention hierarchy ranks the preferred approaches to waste reduction and management to maximize the recovery and value of used materials (Figure 9-).



Figure 9-12: 5 R Pollution Prevention Hierarchy

R1. Reducing waste involves purchasing materials that come in reusable, recyclable or compostable packaging; purchasing in bulk; employing inventory control measures; renting or purchasing used equipment; selling old equipment; and substituting less hazardous chemicals where possible.

R2. Reuse involves maximizing the useful life of products by conducting preventative maintenance; repairing or refurbishing products. dismantling and keeping usable parts for reuse in other products; and repurposing materials in the same form for a different use (i.e., reusing large tires and pallets for storage racks, reusing steel, and using empty totes for waste containment). Reuse activities may be undertaken either on-site or off-site.

R3. Recycle involves diverting waste to material recycling facilities (i.e., batteries, copper); and composting organic material along with paper and cardboard.

R4. Recovery of thermal energy involves utilizing waste oil to generate heat and thereby reduce the use of electrical power.

R5. Residuals management is the final step in the hierarchy and refers to compaction, incineration, on-site soil treatment, open burning, on-site burial, and off-site treatment or disposal of waste.

9.9.1 Special Wastes

During operations AKHM has reduced waste by purchasing reagents and chemical in bulk and by substituting less hazardous chemical were possible. The potential to repurpose reagents and chemicals on site to support reclamation activities will be evaluated when preparing the final RCP. Thermal heat will be recovered from used crankcase oil, used transmission fluid, used hydraulic oil by operating the waste oil burners on site until the structures where they are used are ready for decommissioning. Reagents or chemicals remaining at closure will be returned to the supplier where possible. All residual reagents, chemicals, waste petroleum products and any other special waste, as defined in the *Special Waste Regulations* will be disposed of in accordance with the Regulations.

9.9.2 Contaminated Soils

It is expected that at closure the material beneath the ore stockpiles will be processed through the mill to remove any remaining economic values as well as eliminating any potential contaminant of concern from the material. The CRF lined rehandling pads will be demolished and buried once cleaned of all metal contaminants.

Soil contamination will be documented when preparing the final RCP, through a contaminated soil site assessment. Contaminated soil would be repurposed, treated, or disposed of on-site in accordance with requirements provided in Yukon *Contaminated Sites Regulation,* or removed and treated off site at an approved facility.

At mine closure cement-based solidification/stabilization will be considered to remediate metal and PHC contaminated soil both in-situ and ex-situ. During operations, contaminated soil and gravel may be reused and transformed from a waste into a product by adding it as a portion of the aggregate needed to produce cemented rock fill (CRF) or other concrete products. AKHM is afforded the opportunity to evaluate this remedial technique because they have the infrastructure to produce and deliver cement at site.

Soil stabilization / solidification of contaminated soil will be achievable by utilizing the impacted material as a portion of the aggregate supplied to the cement batch plant, pending restrictions on the type and level of contamination and the end use. This process is used to create concrete products that solidifies and stabilizes the contaminants by adding cement to the contaminated soil. It is also used to solidify and stabilize PHC contaminated soil in place. Blending up to 10% aggregates contaminated with varying types of petroleum hydrocarbon is being tested by AKHM for strength and toxic leachate potential. Tests will be conducted on aggregates contaminated predominately with 1) oil and lubricant, and 2) diesel. The laboratory cement-based solidification testing is currently not available. The initial test results, case histories and proposed additional testing will be provided to YG Contaminated Sites for comment. A remedial plan will then be prepared by AKHM that includes this methodology. It will be incorporated into an update of the AKHM Waste Management Plan and submitted for review and approval under QML-0009 through EMR.

An application for the construction and operation of a land treatment facility (LTFs) is being prepared in accordance with requirements provided in Yukon *Contaminated Sites Regulation, Application for a Land Treatment Facility Permit*. During operations the AKHM LTFs would be for treating soil and gravel contaminated predominately by small spills of gasoline or diesel fuel. The aggregated quantity of material being treated at any given time must not exceed 3,000 m^3.

At closure use of the small LTF is expected to continue to treat soil impacted by gasoline or diesel. The treated soil will be utilized for reclamation purposes in accordance with the Yukon CSR. Final closure of the LTF will involve removing treated soil, removing the artificial liner, leveling the berms, and the area recontoured to promote

positive drainage and the site allowed to naturally reseed. The artificial liner will be buried in accordance with approved license and permit conditions.

At closure metal contaminated soil in the vicinity of the mill and mine workings will be placed underground with any remaining PAML or other waste rock. When possible, metal contaminated granular material will be utilized to create concrete products as described above.

Alternative remediation technologies, such as *in situ* bioremediation or capping, will be considered at final mine closure, when the extent of the impacts have been accessed.

9.9.3 Non-hazardous Solid Waste

All solid waste will be disposed of in accordance with the Yukon *Solid Waste Regulations*. AKHM is currently permitted to operate landfills in accordance with Commercial Dump Permit No. 81-067 for the safe disposal of demolition debris at the following sites:

- Bellekeno,
- District Mill, and
- Sign Post Portal Trench (Onek).

Authorization to operate landfills at New Bermingham and Lucky Queen will be applied for to allow the disposal of demolition materials generated from those sites. Demolition debris will be removed for reuse, salvage, recycle, or disposed of in a landfill in an approved site.

An in-vessel composter and associated equipment has been purchased. The composting of organic waste generated from the Hecla Yukon's activities in the Keno Hill mining camp provides an environmentally friendly alternative to incineration. On-site composting reduces greenhouse gas emissions and atmospheric pollutants related to the incineration of waste. At closure the composter will be removed for reuse or disposed of as demolition debris during site decommissioning.

9.10 BORROW MATERIALS PLANNING

9.10.1 Sources of Granular Materials

Granular material will be required for cover systems. Any in situ granular deposits used will be reclaimed through slope stabilization and revegetation. Granular deposits where borrow material for the reclamation of the KHSD Mining Operations include the following sources:

- placer tailings,
- fill from road cuts,
- borrow from near road sources within KHSD Mining Operations right of ways or development footprint, and
- borrow from the District Mill area.

In addition, the crusher commissioned in Q4 2023 at the District Mill is to be utilized to create granular material for construction, site maintenance (i.e. roads), and reclamation purposes.

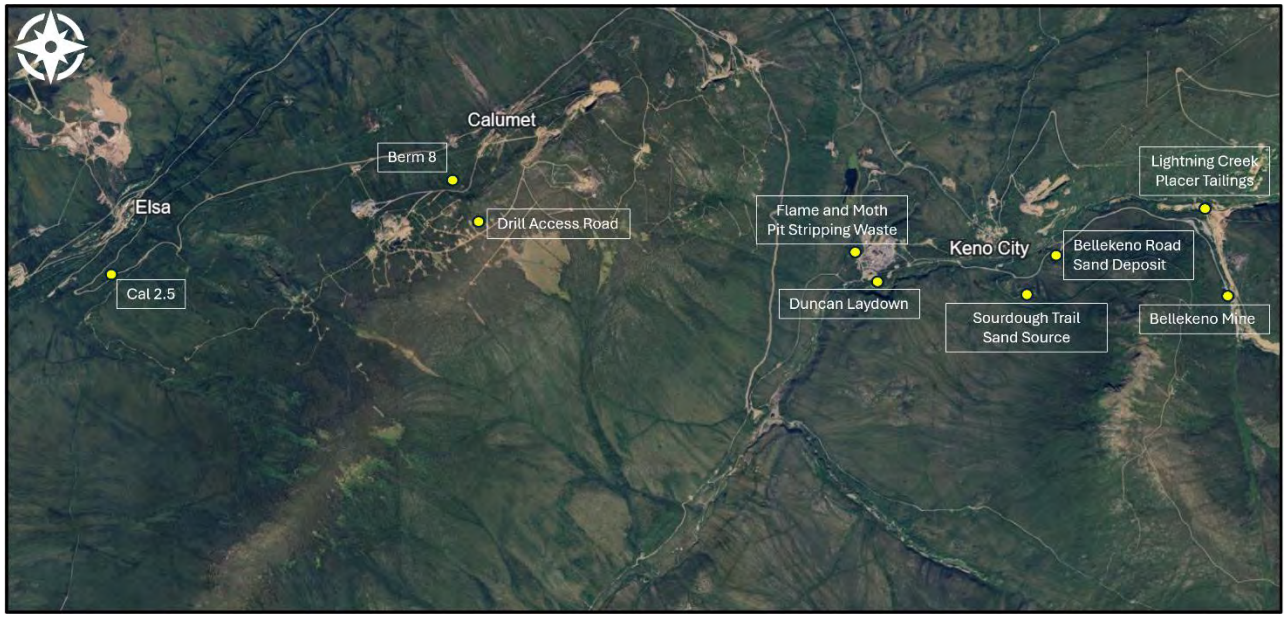

Figure 9-3: Borrow Material Sources

9.10.2 Growth Media

Overburden and organic material will be required as growth media for the cover systems. There are sites dedicated for the storage of growth media at the District Mill and New Bermingham Mine. This material is used to for DSTF cover construction and reclamation purposes. The volume of growth media stored at the District Mill stockpile was approximately 18,500 m^3 as of Q4 2024. The amount of growth media in the stockpiles increases as new material is relocated from expansion of the mill yard and the DSTF and it decreases when it is used for progressive reclamation of the DSTF.

In addition to the growth media recovered during construction, the in-vessel composter will generate organics that are planned for use in the progressive reclamation of the DSTF. Any field trials of the material documented during progressive reclamation will be considered for final closure cover design.

9.11 COVER DESIGN AND REVEGETATION

9.11.1 Cover Engineering Design Parameters

The use of growth media for revegetation will be prioritized in the following order:

1) Sufficient growth media will be identified to construct a 0.5 m soil cover over the DSTF.
2) Sufficient growth media will be identified and used to construct the soil/vegetative cover over the WRDAs containing N-AML material. The volume of material that will be required is yet to be determined as the N-AML material is used for mine backfill, road and other construction purposes over the life of the mine.
3) Sufficient growth media will be identified and used to construct the soil/vegetative cover over the waste rock storage facilities, in the case that additional facilities are required after the rehandling of P-AML to the underground. All P-AML WRSFs will be covered with growth

media, the volume of which will be determined upon design and construction of the facilities.

4) Growth media will be spread in those recontoured slopes that do not contain the necessary fines content to promote successful revegetation.
5) The growth media, if any that remains, in stockpiles will be recontoured and revegetated.

9.11.2 Revegetation Design Characteristics

A revegetation research program will be carried out while the mine is in operations to determine the seed mix characteristics to be used in seeding and revegetating the covered waste rock dumps and DSTF. This program will be commensurate with research investigations carried out for waste rock dumps under District closure and will also be sensitive to the desired level of infiltration prevention into mine facilities. Results from the ongoing testing program will inform seed mix needs.

The seed mix used on the progressive reclamation of the DSTF over two periods consisted of the following:

- 40% Violet Wheatgrass,
- 13.5% Glaucous Bluegrass,
- 23.5% Sheep Fescue, and
- 23% Rocky Mountain Fescue.

The DSTF seed mix is consistent with the objective of slope stabilization and prevention of soil erosion in the short-term and returning the site in the longer-term to an environment that closely resembles pre-mining conditions. Progressive reclamation has taken place on the DSTF and a summary report on the activities completed in 2012 are included in Appendix 1.1.

Appropriate diversions will be in place to meet erosion prevention objectives. AKHM's revegetation program includes contouring and resloping, providing growth media material where it is necessary and active fertilization and seeding.

The performance monitoring plan for the DSTF covered landform includes regular inspections to evaluate the cover system performance in terms of vegetation. Vegetation monitoring will be completed for the DSTF progressively reclaimed areas and newly covered areas, once revegetation is established. Revegetation performance will be quantified through *in situ* monitoring techniques such as permanent sampling transects and quadrats within the revegetated area. Indicators such as soil properties, ground coverage, and plant diversity will be monitored. The drone photogrammetry used for erosion monitoring may also be utilized to monitor vegetation progression.

Assessment of revegetation programs carried out as a part of the Keno Hill District closure will be carried out to ensure that Bellekeno, New Bermingham and Flame & Moth Production Unit Areas closure is commensurate with the overall plan for the district.

9.11.3 Cover System Design and Field Trials

The DSTF cover system closure objectives are to:

- Ensure geotechnical and geochemical stability of the DSTF;
- Effectively manage surface water runoff to limit erosion;

- Reduce water infiltration into the DSTF;
- Minimize safety risks to people and wildlife; and
- Reclaim the site to meet end land use objectives.

Final closure measures will include covering the recontoured landform with a 0.5 m thick soil cover consisting of locally available growth medium material and revegetating with a native seed mix. Performance monitoring instrumentation consisting of one monitoring station will be installed on a covered area of the Phase 1 DSTF at a location that is field verified to be 0.5 m thick. A series of in situ soil and meteorological sensors will collect measurements needed to complete a water and energy balance and thus to estimate the net percolation through the cover system, and the water holding capacity of the cover system. Additional meteorological sensors will provide surface and aspect specific measurements to supplement the meteorological data collected by the District Mill meteorological station. The performance monitoring program will inform upon key cover system performance indicators including the hydrological and meteorological components of the cover system water and energy balance, erosion, and vegetation.

9.11.3.1 ***Cover Modelling***

This reclamation plan does not require any covers to function as "low permeability" covers to prevent infiltration on waste rock disposal areas. There will be no reactive (P-AML) waste rock left on surface; therefore, conventional cover modelling which evaluates design and performance of covers in terms of reduction of net percolation etc. is not required for the N-AML waste rock.

9.11.3.2 ***Site Revegetation Field Trials***

The main purpose of revegetation as a closure action is to align with site closure objectives and anticipated end land use and to assist with erosion control. Erosion rates may be higher initially after construction, as the cover system stabilizes, vegetation develops, and root mass increases within the material. Over time, erosion rates are anticipated to decrease with establishment of vegetation and consolidation of cover system materials.

Vegetation performance will be assessed by monitoring vegetation in previously progressively reclaimed areas, as well as that which will develop on the remainder of the Phase 1 covered area. Revegetation performance should be quantified through *in situ* monitoring techniques such as permanent sampling transects and quadrats within the revegetated area established for repeat monitoring. The following primary performance indicators will be monitored during annual vegetation surveys to evaluate revegetation success:

- Soil sampling and testing to characterize the general soil properties of the revegetated area;
- Percent ground coverage of vegetation;
- Relative species survival and health of planted specimens; and
- Plant diversity across the revegetated area, including both planted and volunteer species.

Additional indicators that may also be monitored to evaluate vegetation performance include:

- Invasive plant species ingress and density;
- Rooting depth; and

- Vegetation tissue sampling of species consumed by humans or wildlife to assess ecotoxicity effects and bioaccumulation.

An assessment of metal uptake in vegetation in undisturbed areas adjacent to the District Mill and New Bermingham Mine was initiated in Q3 2024. Soil development, revegetation and metals uptake in vegetation of the existing cover on DSTF Phase 1 is to commence in Q2 2025. The monitoring for potential metal uptake in vegetation and soils will also be documented as part of the UKHM revegetation program. This research will provide input to the cover system design and revegetation plan for the KHSD Mining Operations.

Timely and self-sustaining establishment of vegetation is important to the reclamation. Terrestrial reclamation of mine sites requires an understanding of environmental conditions to develop prescriptions that will have a better chance of success. To date, significant reclamation research has been completed on the ecosystem mapping program at the former UKHM site to understand successional, soil, and nutrient regimes, data collection on soil metals and metals uptake by vegetation, seed collection workshops, biochar amendment trials in the valley tailings and biomass sampling while continuing to develop a clear understanding of successional relationships with disturbed soils and metals uptake. There have been revegetation test plots done on site in the past on both newly vegetated areas as well as natural revegetation of areas disturbed during historical mining activities.

Additional research in revegetation will include the collection of native plant species seeds and establishing propagules to be used for terrestrial reclamation of sites requiring revegetation. Native plants species are desirable for reclamation efforts because they are adapted to local conditions and suitable candidates for long-term restoration success. Consultation with FNNND and their technical advisors is underway as part of the research.

The analysis of field trials in various microclimate aspects and the Phase 1 DSTF vegetation will assist in establishing trajectories to enable projects to stop monitoring after certain criteria are reached. The required criteria will be established in consultation with FNNND and their technical advisors.

9.12 MONITORING AND MAINTENANCE

Monitoring, surveillance and reporting is carried out to ensure that the KHSD Mining Operations are managed in a manner that provides human and environmental protection. In addition, results of monitoring programs undertaken by ERDC as the reclamation and closure of historic liabilities is implemented also inform the environmental performance of the KHSD Mining Operations. The programs include monitoring and reporting of:

- the local and receiving environment through scheduled inspections and monitoring programs,
- effluent discharge points and treatment system performance,
- site facilities and incorporated design measures to ensure structural stability and prevention of accidents and malfunctions,
- remediation success, and
- adaptive management responses.

These programs will be tailored to assess closure measures and continue as necessary with cessation of mining. The scope of the required amendments to the existing monitoring and surveillance programs would be determined at Closure.

The following existing KHSD Mining Operations programs will continue in modified form after closure:

1) surface water quality monitoring (as per Table 9-9 and Table 9-8)

2) hydrological monitoring,
3) groundwater monitoring (as per Table 9-10),
4) physical and engineered structures monitoring (geotechnical assessment),
5) sediment, benthic and aquatic resources monitoring,
6) climate monitoring, and
7) remediation success.

Monitoring activity will be required to determine the on-going and continued success of closure measures in meeting the closure objectives for a period of 15 years. If monitoring indicates that physical structures, treatment systems or mitigative measures are not performing, then maintenance or contingency plans can be implemented following an adaptive management approach as discussed in Section 9.13.3. The adaptive management approach will be used to determine thresholds identifying when remedial actions have been triggered, and then the success of the remedial measures will need to be incorporated into the monitoring and surveillance regime.

During closure, an Environmental Monitor will continue water quality sampling at some of the monitoring stations identified in the Type A Water Licence and as required under the *Metal and Diamond Mining Effluent Regulations* (MDMER). The monitoring costs have been updated to reflect current market conditions and scarcity of local skilled labour; assumption is that the Environmental Monitor would be based out of Whitehorse for the first six months of closure and then would transition to a person based out of Mayo for the longer term. This approach is intended to align with closure objectives for local hire and FNNND's stewardship of the land.

Table 9-8: Keno Hill Silver District Mining Operations MDMER Surface Water Monitoring Program

SITE	SITE DESCRIPTIOND	DAPHNIA MAGNA LC50 48 HOUR	SEDIMENT	BENTHIC	SUB-LETHAL TOXICITY
MINE TREATMENT / EFFLUENT DISCHARGE SITES					
KV-42	Bellekeno 625 Adit	-	A	-	-
KV-43	Bellekeno 625 Settling Pond Decant	M		-	A
KV-82	Flame and Moth Mill Site Collection and Sediment Pond	-	A	-	-
KV-83	Flame and Moth Mill Treatment Plant Discharge	M		-	SA
KV-105	Flame and Moth Adit Discharge		-	-	-
KV-104L	Flame and Moth Settling Pond Decant discharge to Lightning Creek	M	A	-	SA
KV-104C	Flame and Moth Settling Pond Decant discharge to Christal Creek	M	A	-	SA
KV-114	New Bermingham Pond Decant	M			SA
MINE SURFACE WATER SURVEILLANCE SITES					
KV-6	Christal Creek @ Keno Highway	-	BA	BA	-
KV-21	No Cash Creek at Silver Trail Highway	-	A	A	-
KV-38	Lightning Creek u/s Thunder Gulch	-	A	A	-
KV-41	Lightning Creek u/s Bridge @ Keno City	-	A	A	-
KV-111	No Cash Creek above No Cash 500 Adit		A	A	

M = Monthly
A = Annually
SA = Semi-Annually / twice per year
BA = Bi-Annually (every 2 years)

Table 9-9: Keno Hill Silver District Mining Operations Surface Water Monitoring Program Summary

SITE	SITE DESCRIPTION	WATER LICENCE	INSITU MEASUREMENTS / INTERNAL ANALYSIS								EXTERNAL LAB ANALYSIS															
		QZ18-044 Monitoring Status	Level	Flow	pH	Temperature	Conductivity	Total Zn	Ammonia	Turbidity	Total Metals	Dissolved Metals	Hardness	pH	Conductivity	TSS	Alkalinity	Sulphate	Nitrate	Nitrite	Ammonia-N	DOC	Total Phosphorous	Total and Free Chlorine	PHC & Glycol	Radium 226	Acute Lethality 96 hrs LC50 RT
Mine Treatment / Effluent Discharge Sites																										
KV-42	Bellekeno 625 Adit	Existing	-	C	D	D	D	D	D	D	W	W	W	W	W	W	W	W	W	W	W	M	W		M	-	-
KV-43	Bellekeno 625 Settling Pond Decant	Existing	-	C	D	D	D	D	D	D	W	W	W	W	W	W	W	W	W	W	W	W	W			W/Q	M
KV-82	Flame and Moth Mill Site Collection and Sediment Pond	Existing	D	-	D	D	D	D	D	D	M	M	M	M	M	M	M	M	M	M	M	M	M			-	-
KV-83	Flame and Moth Mill Treatment Plant Discharge	Existing	-	C-WD	D-WD	D-WD	D-WD	D-WD	D-WD	D-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	Q-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD			W/Q	M
KV-105	Flame and Moth Adit Discharge	Existing	-	C	D-WD	D-WD	D-WD	D-WD	D-WD	D-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD			-	-
KV-104L	Flame and Moth Settling Pond Decant discharge to Lightning Cree	Existing	D	C-WD	D	D	D	D	D	D	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD			W/Q	M
KV-104C	Flame and Moth Settling Pond Decant discharge to Christal Creek	Existing	D	C-WD	D	D	D	D	D	D	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD			W/Q	M
KV-110	New Bermingham Portal	Existing	-	C-WD	D-WD	D-WD	D-WD	D-WD	D-WD	D-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	D-WD*		-	-
KV-114	New Bermingham Pond Decant	Existing	D	C-WD	D	D	D	D	D	D	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	W-WD	D-WD*		W/Q	M
Mine Surface Water Surveillance Sites																										
KV-1	South McQuesten River u/s Christal Creek	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-2	South McQuesten River @ Pumphouse	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-6	Christal Creek @ Keno Highway	Existing	-	C	M-WD	M-WD	M-WD	-	-	-	W-WD/M	W-WD/M	W-WD/M	W-WD	W-WD	W-WD	W-WD	W-WD/M	W-WD/M	W-WD/M	W-WD/M	W-WD/M	W-WD/M			-	-
KV-7	Christal Creek @ Hanson Road	Existing	-	M	M	M	M	-	-	-	M	M	M	M	M	M	M	M	M	M	M	M	M			-	-
KV-8	Christal Creek @ mouth	Existing	-	Q	M	M	M	-	-	-	M	M	M	M	M	M	M	M	-	-	-	M	M			-	-
KV-21	No Cash Creek at Silver Trail Highway	Existing	-	C	M	M	M	-	-	-	M	M	M	M	M	M	M	M	M	M	M	M	M			-	-
KV-37	Lightning Creek u/s Hope Gulch	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-38	Lightning Creek u/s Thunder Gulch	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-39	Hope Gulch u/s Lightning Creek	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-40	Charity Gulch u/s Lightning Creek	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-41	Lightning Creek u/s Bridge @ Keno City	Existing	-	C	M	M	M	-	-	-	M	M	M	M	M	M	M	M	M	M	M	M	M			-	-
KV-44	Bellekeno 625 Seep	Existing	-	Ms	Ms	Ms	Ms	Ms	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q			-	Q
KV-45	Onek 400 Adit	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-49	Hinton Creek u/s Christal Creek	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-50	Christal Creek u/s Hinton Creek	Existing	-	M-WD	M-WD	M-WD	M-WD	-	-	-	W-WD/M	W-WD/M	W-WD/M	W-WD	W-WD	W-WD	W-WD	W-WD/M	W-WD/M	W-WD/M	W-WD/M	W-WD/M	W-WD/M			-	-
KV-51	Christal Creek d/s Hinton Creek	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q			-	-
KV-52	Natural spring to Christal Lake @ Old Mackeno Pumphouse	Existing	-	M	M	M	M	-	-	-	M	M	M	M	M	M	M	M	-	-	-	M	M			-	-
KV-56	Star Creek at Silver Trail Highway	Existing	-	M	M	M	M	-	-	-	M	M	M	M	M	M	M	M	M	M	M	M	M			-	-
KV-65	Thunder Gulch u/s of Bellekeno 625	Existing	-	Q	Q	Q	Q	-	-	-	M	M	M	M	M	M	M	M	-	-	-	M	M			-	-
KV-72	South McQuesten River at McQuesten Lake	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q				Q	Q				
KV-76	Thunder Gulch d/s Bellekeno 625	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-77	Thunder Gulch u/s Bellekeno East	Existing	-	Q	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-78B	Bellekeno East Temporary Waste Rock Storage Facility	Existing	Ms	-	Ms	Ms	Ms	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-79	Christal Creek d/s MacKeno Tailings	Existing	-	-	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-80	Christal Creek u/s Mackeno Tailings	Existing	-	-	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-81	Lightning Creek Southwest of Mill Site	Existing	-	M-WD	M-WD	M-WD	M-WD	-	-	-	W-WD/M	W-WD/M	W-WD/M	W-WD	W-WD	W-WD	W-WD	W-WD/M	W-WD/M	W-WD/M	W-WD/M	W-WD/M	W-WD/M			-	-
KV-106	Flame and Moth Temporary P-AML Waste Rock Storage Facility	Existing	Q	-	Q	Q	Q	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-111	No Cash Creek above No Cash 500 Adit	Existing	-	M	M	M	M	-	-	-	M	M	M	M	M	M	M	M	M	M	M	M	M			-	-
KV-115	Bermingham P-AML Facility #1	Existing	Ms	-	Ms	Ms	Ms	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-119	Bermingham P-AML Facility #2	Pending	Ms	-	Ms	Ms	Ms	-	-	-	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-	Q	Q			-	-
KV-118	No Cash Creek at Calumet Drive	Existing	-	M	M	M	M	-	-	-	M	M	M	M	M	M	M	M	M	M	M	M	M			-	-

Pending Stations to be established

C = Continuous
C-WD = Continuous While Discharging
D = Daily
D-WD = Daily While Discharging
D-WD* = Daily While Discharging from breakpoint chlorination system
W = Weekly
W-WD = Weekly While Discharging
Petroleum Hydrocarbons** include BETX + Styrene, VPHw, LEPHw, and PAH

W/Q = Weekly migrating to quarterly to accord with monitoring frequency pursuant to MDMER
M = Monthly
Ms = Monthly (May - Oct)
M/Q = Monitoring to occur monthly for first 12 months, reverting to quarterly thereafter.
Q = Quarterly
A = Annually

Table 9-10: Keno Hill Silver District Mining Operations Groundwater Water Monitoring Program Summary

SITE	SITE DESCRIPTION	WATER LICENCE	INSITU MEASUREMENTS / INTERNAL ANALYSIS					EXTERNAL LAB ANALYSIS												
		QZ18-044 Monitoring Status	Level	Synoptic Levels	pH	Temperature	Conductivity	Total Metals	Dissolved Metals	Hardness	pH	Conductivity	TSS	Alkalinity	Sulphate	Nitrate	Nitrite	Ammonia-N	DOC	Total Phosphorous
Mine Groundwater Monitoring Wells																				
KV-84Nd	Keno City Well #1	Existing	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-85D	Keno Hill Silver Distirict Mill Site Groundwater Well #1 (PH2) Deep	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-85S	Keno Hill Silver Distirict Mill Site Groundwater Well #2 (Shallow)	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-86	Keno Hill Silver Distirict Mill Site Groundwater Well #3 (PH5)	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-87	Keno Hill Silver Distirict Mill Site Groundwater Well #4 (PH6)	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-88D	Keno Hill Silver Distirict Mill Site Groundwater Well #5 (Deep)	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-88S	Keno Hill Silver Distirict Mill Site Groundwater Well #6 (Shallow)	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-89D	Keno Hill Silver Distirict Mill Site Groundwater Well #7 (Deep)	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-89S	Keno Hill Silver Distirict Mill Site Groundwater Well #8 (Shallow)	Existing	Q		Q	Q	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV-122	Bermingham - downgradient of BH SW pit well #1	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-123	Bermingham - downgradient of BH SW pit well #2	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-124	Bermingham - upgradient of BH SW pit	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-125	Bermingham - downgradient of BH P-AML well #1	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-126	Bermingham - downgradient of BH P-AML well #2	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-127	Bermingham - upgradient of BH P-AML	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KC-MW-4	Keno City Well #3 (Well south of Onek 400 adit)	Existing	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
ON-MW-2	Keno City Well #2 (Onek Monitoring Well d/g Project Facilities)	Existing	Q	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
ON-MW-3	Keno City Well (Well south of Onek 400 adit)	Pending	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
FM-MW-01	Flame and Moth Well #1 (KAR-01)	Existing	M	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-MW-02	Flame and Moth Well #2 (KAR-02)	Existing	M	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-MW-03	Flame and Moth Well #3 (KAR-03)	Existing	M	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH39	DSTF phase 1 area	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-107	DSTF phase II expansion area	Pending	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-108	Upgradient of DSTF Phase 2 Expansion Area	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
RB-MW-1	Ruby 400 adit Monitoring Well	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
BH-MW-1	Historical Bermingham 200 adit monitoring well	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-116	Bermingham Waste Rock Disposal Area Well	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
NC-MW-1	No Cash 500	Existing	M/Q		M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-109	Lightning Creek near KV-81	Existing	M/Q	-	M/Q	M/Q	M/Q	-	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q	M/Q
KV-103	District Mill Supply Well	Existing	Q	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-84	Overburden Monitoring Well	Existing	Q	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KC-MW-1B	Bedrock Groundwater Monitoring Well	Existing	Q	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KC-MW-2	Overburden Groundwater Monitoring Well	Existing	Q	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KC-MW-3	Bedrock Groundwater Monitoring Well	Existing	Q	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ON-MW-1	Onek Monitoring Well #1 d/g Project Facilities	Existing	Q	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ON-MW-4	Bedrock monitoring well	Existing	Q	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pending Stations to be established

C = Continuous
C-WD = Continuous While Discharging
D = Daily
D-WD = Daily While Discharging
D-WD* = Daily While Discharging from breakpoint chlorination system
W = Weekly
W-WD = Weekly While Discharging
Petroleum Hydrocarbons** include BETX + Styrene, VPHw, LEPHw, and PAH

W/Q = Weekly migrating to quarterly to accord with monitoring frequency pursuant to MDMER
M = Monthly
Ms = Monthly (May - Oct)
M/Q = Monitoring to occur monthly for first 12 months, reverting to quarterly thereafter.
Q = Quarterly
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Table 6-7 shows the proposed closure monitoring schedule used as the basis for cost estimating. The schedule includes those sites that are relevant to post closure monitoring and monitored under other licenses:

- monitoring of road bank and drainage along access road,
- physical inspection of dry stack tailings facility area,
- physical inspection of the passive water treatment systems,
- physical stability of all waste rock disposal areas,
- success of revegetation measures (principally portal areas and mill pad area, DSTF),
- monitoring of cover system integrity (P-AML WRSF areas and DSTF), and
- physical inspection of impacted earthen surfaces for evidence of erosion, gullying, or sediment transport to watercourses.

The condition of permafrost beneath the WRDAs and DSTF will be monitored throughout operation and during the 15-year post closure monitoring period. The requirement for ground temperature monitoring will be reviewed 15 years after closure. An annual geotechnical inspection should be conducted on the WRDAs (if any material remains in place post-closure), DSTF and sedimentation/treatment ponds for at least five years after closure. The requirement for an annual geotechnical inspection will be reviewed five years after closure.

9.13 PERFORMANCE UNCERTAINTY AND RISK MANAGEMENT

9.13.1 Risk Assessment

Management of risk is fundamental to AKHM's business model, operations approach, and philosophy. AKHM's risk assessment system has been tailored from other well proven systems and models. It is the objective of AKHM that any major project, expansion, or undertaking should undergo a risk assessment process. The benefits of a risk assessment process include:

- Develops a risk profile for the major risks of a project;
- Provides a recognition and documentation of project uncertainties prior to commencing the project;
- Provides common understanding, objectives, and direction for projects;
- Provides the framework for an action plan to manage and reduce project risks;
- Enhances project economics; and
- Enhances employee and environmental safety.

The risk assessment process can be summarized in the following steps outlined below.

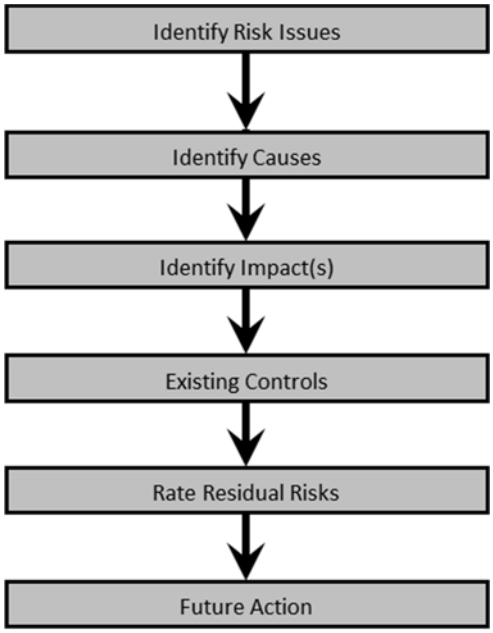

Figure 9-9: Risk Assessment Process Flow Chart

AKHM uses standard tools for risk assessments of activities. For technical risk assessments, an "FMEA" (failure modes and effects analysis) approach is used. These are conducted with appropriate technical experts to inform both the risk characterization (consequence, likelihood) as well as the mitigating measures and/or design changes. In addition, all new projects will undergo risk assessment that specifically evaluates reclamation and closure implications, ensuring that end-of-life considerations are integrated into project design from the outset. This proactive approach helps identify potential closure challenges early, allowing for design modifications that facilitate successful reclamation and reduce long-term liabilities.

9.13.2 DSTF Risk Assessment

With respect to the RCP and risks to reclamation and closure of mine area components, the long-term stability of the DSTF has been expressed by FNNND as one of the areas of consideration and concerns from a risk perspective. In response, AKHM and FNNND and respective technical consultants conducted a risk assessment specific to the DSTF and long-term performance and stability in by SRK Consulting in 2013 and again in 2024 by Tetra Tech. The results of the DSTF risk assessments are included in Appendix 3.6 and Appendix 3.12. These risks and mitigations are incorporated into both the operations and maintenance phase of the facility as well as the final reclamation and closure of the DSTF.

In addition, Trigger Action and Response Plan (TARP) has been developed and included in the Keno Hill Dry Stack Tailings Facility Operations, Maintenance and Surveillance Manual. Using a risk-based approach. The TARP effectively defines specific monitoring thresholds and corresponding actions to prevent failures and ensure safe operation.

9.13.3 Adaptive Management Plans

Adaptive management planning is a management tool designed to guide responses to unforeseen or contingency events during the lifespan of the KHSD Mining Operations. The adaptive management approach provides for assessment of mitigation measures and their effectiveness and guides the orderly implementation of responses. Since it is difficult to predict the specific environmental conditions that may arise and which require a response from management, the Adaptive Management Plan (AMP) does not necessarily provide specific detailed descriptions of responses to every situation. The AMP provides procedures that can be implemented to ensure appropriate action is taken before adverse effects are realized.

The AMP, and a Management Response Plan (MRP) developed as a result, provide possible management responses that range in level of intervention or mitigation. The AMP is laid out using a common element approach to consistently implement the AMP protocols for each Adaptive Management Initiative (AMI). An AMI is a specific condition, or event, that is anticipated to require monitoring, assessment, and management as part of the AMP. The AMP follows the Yukon Government Guidelines for developing adaptive management plans in Yukon, water-related components of quartz mining projects (Yukon Government, 2021). For each AMI a methodical approach is provided:

1) Description of the initiative - Addresses issues or information that trigger the AMP and identifies specific working site locations if applicable to event or condition;
2) Risk Narrative – Possible environmental consequences if issue not addressed;
3) Monitoring requirements and evaluation of results – Identifies the parameters to be monitored, frequency and means for of evaluating parameter;
4) Indicators, action level triggers and management response strategy– Identifies the conditions to be monitored and assessed and defines the staged thresholds when a series of management actions should be taken. Provides the series of responses to be implemented when an action is triggered including notification, evaluation, response planning, action, timelines, and reporting. Each action level incorporates the management responses required at lower levels; and
5) Reporting – Requirements for reporting results of evaluations or investigations for each event provided.

Consultation and stakeholder engagement has resulted in twelve revisions to the AMP since original application for the development of the Bellekeno Mine was submitted. The AMP will require amendments to ensure that changing site conditions are subject to appropriately responsive reclamation actions, and that closure measures can be adapted to changing conditions to achieve desired performance as the operations progress from operating or care and maintenance into closure and post-closure.

10 CLOSURE IMPLEMENTATION AND PROJECT EXECUTION PLAN

10.1 PROJECT EXECUTION PLAN

Mine decommissioning and reclamation activities, including systematic equipment and infrastructure removal, are planned to commence within the first year of closure or if temporary closure lasts more than 6 continuous years of an operating mine. A detailed Project Execution Plan (PEP) will be developed to guide the implementation of the reclamation and closure plan, which will include: a comprehensive work breakdown structure organizing activities by site operations, consultation, regulatory compliance, investigation/engineering, remediation, monitoring, and project management; detailed cost estimates and cash flow projections organized by activity and quarter; procurement strategies and construction work packages for civil earthworks, infrastructure, and technical management; project governance structure with defined roles and responsibilities; control plans for scope, schedule, and budget management; environmental and regulatory management procedures; and operation, maintenance and surveillance (OMS) plans for critical infrastructure during the closure period. Implementation schedules for water management and treatment at Bellekeno, New Bermingham, and Flame & Moth are illustrated in Table 9-4 (Section 9.4) and Table 6-7 (Section 6.3) presents the baseline master project schedule for decommissioning and reclamation.

10.2 IMPLEMENTATION STRATEGY

Closure management and monitoring of the various sites will be guided by regulatory requirements, the performance of physical structures to remain on site post closure, and AKHM's commitment to achieving long-term compliance with effluent quality standards. Upon successfully demonstrating overall closure performance through establish completion criteria for all aspects to be decommissioned, the necessity of maintaining licenses or permits will be examined. At that time, AKHM will submit a Certificate of Closure under the *Quartz Mining Act*.

The closure phase for the Bellekeno, Flame & Moth, and New Bermingham mines will begin following the completion of economic mining at each mine site. AKHM's closure activities at Lucky Queen and Onek 990 will be of existing disturbances created by AKHM's operations at these deposits. The following sections outline AKHM's strategy for managing the decommissioning and reclamation of the Bellekeno, Flame & Moth and New Bermingham mines, and the Lucky Queen and Onek 990 sites throughout the closure phase.

The KHSD Mining Operations RCP will be implemented through a coordinated approach involving AKHM site management and supervision, utilizing both specialized contractors and experienced in-house teams, along with dedicated care and maintenance personnel. This integrated approach ensures efficient execution of all decommissioning and reclamation activities. Details are provided in the PEP.

Key implementation activities include:

- systematic closure of mine components,
- organized salvage and removal of infrastructure, equipment, and reagents,
- operation and maintenance of contingency water treatment facilities,
- decommissioning of access roads, and
- reclamation, and revegetation as necessary, of disturbed areas

The activities listed above are subdivided into "Engineering Work Packages" and "Construction Work Packages" in the PEP to reflect the *Template for a Project Execution Plan* (YG 2024) prepared by the Government of Yukon.

10.3 REGIONAL FRAMEWORK AND FINANCIAL INDEPENDENCE

10.3.1 Collaborative Regional Approach

The Keno Hill Silver District is currently undergoing the reclamation and closure of historic mining operations to address their environmental liabilities. ERDC and CIRNAC have formed a strategic partnership to reclaim abandoned former United Keno Hill Mine (UKHM) mine sites.

The temporal scope of the post closure monitoring requirements of the historic liabilities is on the order of decades, and as such a sustained presence will be maintained by the parent company of AKHM for many years to come. Closure activities at the historic UKHM mines are expected to be completed prior to the commencement of AKHM closure activities, allowing for AKHM to incorporate proven efficiencies and design optimizations into AKHM's Final Reclamation and Closure Plan.

10.3.2 Independent Financial Responsibility

All cost estimates provided by AKHM assume independent execution of reclamation activities, regardless of any parallel AKHM and UKHM activities. AKHM has not factored in potential cost-sharing arrangements with adjacent projects or other actives. AKHM maintains full financial responsibility for all KHSD Mining Operations project reclamation costs, ensuring complete accountability for closure obligations resulting from their activities.

11 RECLAMATION AND CLOSURE LIABILITY

Costing of the Reclamation and Closure Plan assumes the use of third-party contractors and Yukon Government implementation. The closure cost estimate is consistent with the plan requirements and closure costing guidance as per the Yukon *Reclamation and Closure Planning for Quartz Mining Projects* (Yukon Energy, Mines and Resources, 2013). Hecla Yukon has completed a cost estimate to implement this RCP for the KHSD Mining Operations and the estimated cost to implement the reclamation and closure plan at the End Of Mine Life (EOM) is $13,510,072. The amount of security held by YG as of Q2 2025 for reclamation and closure of the KHSD Mining Operations is $14,216,711. It is important to note that not all of the liabilities included in the cost estimate have yet been realized or created. Updated costs for reclamation and closure are include in an update to the closure plan every 2 years and account for changes to facilities and as reclamation planning matures.

Closure liability cost estimate summary tables are provided below. Where possible, cost estimates were made using unit cost per volume. Where the use of unit costs proved difficult, then an estimation of equipment and labour hours were used. The unit costs and job hours were derived from AKHM's operational and professional experience and with other closure program costing estimates prepared for the Yukon Government.

The following summarizes the scope within each cost sheet. Notes of significant changes resulting from this update and the review process are included.

T1 Cost Summary: The summary table provides an overview of all costs required for the closure and reclamation of the Mine and links to the costs calculated in the other costing tables. Each individual costing table (Tables T2 to T15) is described separately.

T2 Unit Costs: This table lists the unit rates for equipment, personnel, materials, and other rates, which are used repeatedly throughout the cost estimate. Unit rates are based on input received during previous authorized review processes, updated labour rates based developed custom rates based on the configuration of the Mine and estimates based on current on-site and prospective contractors conducting similar work at Keno Hill or elsewhere in Canada. Unit rates for personnel and equipment were revised to reflect market conditions and reviewer comments.

Unit costs have been updated wherever possible throughout the Closure Costs to reflect cost quotes received from local vendors and relevant third parties. If more than one vendor quote was received for a particular parameter, received costs were averaged to produce the final rate used in the Closure Costs model. Where cost updates were not possible, an inflation adjustment of 4.04 percent (reflecting the consumer price index increase from 2023 to 2025) has been added (Statistics Canada, 2025). Costs indicated in gray highlight in Table 11-2 did not receive a vendor quote sufficiently timely and the inflation adjustment was used.

T3 General and Administrative: This task accounts for typical G&A costs that are not directly associated with individual reclamation and closure tasks. Line items include general project management during the implementation period as well as pre closure planning, light vehicles, power and heat, miscellaneous G&A expenses, employee transport, mobilization/demobilization of contractor equipment and camp accommodations. Contractor costs such as profit, and insurance are included in the specific unit rate for equipment. Rates utilized are provided by third-party contractors.

T4 Exploration Disturbances: No costs are included for this task as exploration disturbance is bonded for under the Class IV Mining Land Use Approval LQ00476 and security is held under a separate bond held by the Yukon Government.

T5 Closure Planning: Costs for closure planning include an update to the closure plan every 2 years, ongoing kinetic testing of tailings and waste rock, adaptive management plan updates, contaminated site assessment plans, reclamation research plans and passive treatment design. Costs were updated to address potential uncertainties with performance assumptions, some of which may be validated with site data over the next few years e.g., *in situ* treatment, conversion of existing ponds into bioreactors, site ongoing kinetic testing as per licence requirements, and data from the Bellekeno reclamation work.

T6 Underground Mines: Reclamation tasks for the underground mines include removal of any remaining salvageable or hazardous equipment, demolition or removal of surface buildings and facilities, removal of pond sludges and remediation of lined ponds, construction of rip-rap in portal entrances, recontouring and revegetation of yard areas and remediation of any contaminated soils. Provisions for unique underground requirements such as underground supervisor oversight and air ventilation for any underground access are included. Equipment hours for these tasks are based on experience and costs realized during active mine operations.

T7 Waste Rock Dumps: The primary tasks associated with closure and reclamation of the waste rock dumps include the recontouring of the crests, scarification of the surface of NAML waste rock storage facilities followed by revegetation. Closure of P-AML facilities at Flame & Moth and Bellekeno include backhauling remaining P- AML underground followed by liner removal and closure of the P-AML storage facility. Rock stored in the P- AML facility at New Bermingham will be required for backfill, and therefore is scheduled for rehandling and hauling underground at New Bermingham during operation. Borrow areas and coarse ore pads are included in the waste rock dumps cost category. A custom rate has been calculated for haulage and placement of cover material.

T8 Mill & Facilities: Demolition costs for the mill and surface facilities are calculated based on the assumption that no salvage value is credited against the cost of demolition. The majority of the costs for demolition is based on the amount of general and skilled labour along with the type of support equipment (crane, excavators, etc.). It is likely that significant salvage value will be realized in the facilities however no value nor credit for salvage has been included within the security estimates.

T9 DSTF: Reclamation and closure of the DSTF includes recontouring the side slopes to a 3:1 angle followed by compaction of the tailings to reduce water infiltration and then load, haul, place and spread a 0.5 m soil cover and final revegetation. The productivities associated with these tasks are based on actual performance during progressive reclamation already completed on the DSTF Phase 1.

T10 Waste Disposal and Remediation: Costs associated with this task include offsite hazardous material (i.e. unused mill reagents) disposal, the management of metal contaminated soils from the mill area, and the management of hydrocarbon contaminated soils from sources such as around the fuel storage facilities and equipment maintenance shop. It is assumed that hydrocarbon contaminated soils will be transported offsite given the minimal volume and operational requirements to manage spills as they occur and that metal contaminated soils will be managed in the same manner as P-AML waste rock.

T11 Landfills: Costs to close out the AKHM landfills are included in this sheet.

T12 Roads and Trails: Closure costs for the roads and trails account for both present and future roads on site and consider the equipment and labour costs to recontour road crests, scarify the surface and revegetate. Costs for removal of culverts are included along with standard erosion control measures.

T13 Water and Solutions Management: The scope of work and costs for this task include the decommissioning of water storage ponds which include discharge of remaining solution, removal of sludges, removal, and burial of the HDPE liners and recontouring. The Bellekeno 625 treatment pond is planned to be converted into a biological treatment cell as a contingency treatment system in addition to the *in-situ* treatment underground. This has also been included for Bermingham. Removal of pipelines and rip rap discharge channels are included in this closure task.

T14 Interim Care and Maintenance: This cost sheet provides the cost basis for 2 years of interim care and maintenance during the time period between an unanticipated shutdown (presumed to be from the company's inability to carry out operations or closure) and the time for government to initiate and implement the closure plan through third party contractors. The activities associated with this period include ongoing monitoring as per license requirements and site presence and care and maintenance activities. Costs have been increased to reflect shortage of available skilled local labour in the near term.

T15 Post Closure Compliance Monitoring and Reporting: This table includes costs for long-term monitoring and maintenance of the site over a 15-year post closure period once the active closure activities have been completed. Included therein are allowances for 15 years of annual geotechnical, reclamation, and site maintenance inspections. The geotechnical inspection can be performed and combined by the same inspector conducting the reclamation and site maintenance inspections. Costs to maintain and operate the contingency bio reactor at Bellekeno are included. Onsite management, employee transport, ongoing water treatment operating and capital replacement costs, long term funding of reclamation and closure research, monitoring and reporting, and site maintenance are also within this category. A breakdown of water treatment operating, and capital replacement costs are provided. The annual costs and full costs for each of these tasks are presented in this table, along with the Net Present Value (NPV) of the costs as they occur in the future. The NPV costs are calculated in separate tables. NPV is described further below.

Tab 16 (three tabs) NPV Calculations: YG security costing provides for discounting the future long-term monitoring and maintenance costs associated with the closure cost estimate. The discount rate used in the NPV calculation is the long-term government of Canada benchmark bond yield as of November 6, 2025.

Table 11-1 summarizes closure liability cost estimates for the current conditions (Year 0), after Year 2 of operations and at the end of mine life (EOM). Cost estimates for the separate reclamation components including site management are provided in the remaining tables.

Basis of Cost Estimate

The basis of the cost estimate for the RCP assumes the use of third-party contractors and equipment for implementation of major earthworks and terrestrial tasks. Many of the reclamation tasks may be implemented in house but the assumption of third-party contractors is consistent with the YG costing guidance document. It is also noted that the company currently owns all of the equipment that is included in the cost estimate and this equipment is currently on site and operational. For the basis of the current cost estimate, standard equipment types are included that are locally available (i.e. D-7 dozer, CAT 235 excavator).

Equipment and Personnel Rates: Labour rates are based on experience and current third-party contractor rates for similar positions. These rates are higher than the Yukon Government Fair Wage Schedule, effective February 2023. Camp costs are based on current site contract variable rates for a small camp population. Custom haul rates are based on site-specific information.

Lump Sum Values: Some costs are presented as a lump sum which could be either a one-time expenditure, repeating periodic cost or specific equipment costs. Many lump sum costs have been derived based on experience with similar tasks at other Yukon mine sites or have been developed in consultation with knowledgeable vendors.

Indirect Costs: Indirect costs are related to the planning, design, contracting, administration and or actual performance of the reclamation tasks. Indirect costs in the RCP have been included in two approaches. The YG closure costing guidance identifies several categories associated with indirect costs including reclamation research, engineering design, mobilization/demobilization, contractors' costs, permitting and assessment costs, contingencies, inflation, and government project management. Where applicable, these indirect unit costs categories have been costed individually.

In addition, a further 15% provision of direct costs is included for most items. Some items were considered to have greater uncertainty until further data is obtained. For these, the costs were increased for the specific line item, leading to a higher contingency (effectively 25%).

Table 11-1 below summarizes the costs associated with the RCP, including indirect costs.

Table 11-1: Summary Table of Estimated Closure Costs - Keno Hill Mine Operations

Description of Cost	Proposed Cost Current - AKHM 2025	Proposed Cost Year 2 - AKHM 2025	Proposed Cost EOM - AKHM 2025
Closure Implementation			
T3 General & Administration	$1,785,554	$1,785,554	$1,785,554
T4 Exploration Disturbances	$0	$0	$0
T5 Closure Planning	$170,201	$401,568	$570,416
T6 Mine Workings - Underground	$597,485	$683,126	$845,450
T7 Waste Dumps	$147,180	$557,689	$561,545
T8 Mill and Surface Facilities	$806,794	$806,794	$806,794
T9 DSTF	$230,691	$230,691	$257,833
T10 Waste Disposal/Remediation	$64,025	$64,025	$64,025
T11 Landfills	$10,713	$10,713	$10,713
T12 Roads and Trails	$158,164	$158,164	$142,402
T13 Water and Solutions Management	$295,822	$295,822	$296,124
T14 Interim Care and Maintenance	$2,041,878	$2,041,878	$2,041,878
Sub-total Direct Costs	$6,308,506	$7,036,023	$7,382,736
Indirect Costs (%)	15%	15%	15%
Indirect Costs	$946,276	$1,055,404	$1,107,410
Contingency Costs (%) [2]	26%	26%	26%
Contingency Costs	$1,626,370	$1,815,525	$1,904,041
Cost Inflation [1]	$148,723	$165,874	$174,048
Total Closure Implementation Costs	**$9,029,875**	**$10,072,826**	**$10,568,236**
T15 Long Term Monitoring and Maintenance			
Onsite Management	$174,317	$174,317	$174,317
Transport Costs	$415,423	$415,423	$415,423
Water Treatment Costs			
Active Treatment			
Capital Costs	$0	$0	$0
Capital Replacement Costs	$0	$0	$0
Operating Costs	$920,143	$920,143	$920,143
Passive Treatment			
Capital Costs	$173,093	$173,093	$173,093
Operation and Maintenance Costs	$191,187	$191,187	$191,187
Reclamation & Closure Research Plan (Post Closure)	$0	$0	$0
Monitoring & Reporting	$1,188,466	$1,188,466	$1,188,466
Sub-Total	$3,062,629	$3,062,629	$3,062,629
Sub-Total NPV	$2,447,754	$2,373,119	$2,028,852
Indirect Costs (%)	15%	15%	15%
Indirect Costs	$367,163	$355,968	$304,328
Contingency Costs (%)	30%	30%	30%
Contingency Costs	$734,326	$711,936	$608,656
Total (NPV)	$3,549,243	$3,441,023	$2,941,836
Total Financial Security (incl. Indirect Costs)	**$12,579,118**	**$13,513,849**	**$13,510,072**

[1]Cost inflation uses a rate of 2.05%, please see "T18" worksheet

[2]Contingency Cost % uses 20% on costs from tab 9, All other tabs have 18% applied

Table 11-2: Keno Hill Mine Operations Unit Rates

Equipment Rates		
Equipment	**Unit Rates**	**Per Unit**
D7 Dozer	$229	per hr
A30 Haul Truck	$218	per hr
Cat 235 Excavator	$154	per hr
Cat 235 Excavator w hammer	$218	per hr
Cat 324E Excavator (Demo)	$234	per hr
Cat 14H grader	$198	per hr
966 Loader	$136	per hr
Tractor Trailer (lowbed)	$260	per hr
Vacuum Truck	$173	per hr
30 ton Crane	$219	per hr
3 yd Underground LHD	$254	per hr
15 tonne Underground Truck	$231	per hr
Vibratory Packer	$104	per hr
Pickup Truck	$6,242	per mo

Personnel Rates		
Personnel	**Unit Rates**	**Per Unit**
General Labourer	$75	per hr
Equipment Operator	$61	per hr
Trades Labourer	$129	per hr
Site Supervisor	$1,561	per day
Design Engineer	$185	per hr
Project Manager	$1,873	per day
Site Caretaker, Operator	$1,124	per day
Field Engineer, QA/QC	$114	per hr
Environmental Monitor	$133	per hr

Revegetation Rates		**Per Unit**
Revegetation Seed Mix	$16.80	per kg
Revegetation Seed Mix - 50kg/ha	$840	per ha
Fertilizer	$2.11	per kg
Fertilizer - 250kg/ha	$528	per ha
Tree Seedlings (1,000 seedlings per ha)	$14,726	per ha
Seed/Fertilizer Application	$2,060	per ha
Erosion Barrier	$2.81	per sq.m
Revegetation cost per ha. Including application cost	**$3,427.31**	**per ha**

Contractor Unit Rates & Camp Costs	**Unit Rates**	**Per Unit**
Custom Rate A (Load, haul and place overburden cover on P-AML Waste Rock)	$5.35	per cu.m
Custom Rate B (Load, haul and dump mineralized rock stockpile in BK East Decline)	$5.50	per cu.m
Compact and Contour Cover	$2.31	per cu.m

Table 11-2: Keno Hill Mine Operations Unit Rates (continued)

Contractor Unit Rates & Camp Costs	Unit Rates	Per Unit
Excavation of Soil	$5.77	per cu.m
Supply and place Geotextile	$8.08	per cu.m
Load, haul and place soil cover	$9.23	per cu.m
Haul & Place rock cover	$9.23	per cu.m
Produce Rip-Rap	$18.17	per cu.m
Screen Rip-Rap	$5.77	per cu.m
Load and Haul and Place Rip Rap	$15.00	per cu.m
HDPE Liner Install	$13.85	per sq. m
Erosion barriers	$2.81	per sq. m
Freight run to Whitehorse	$3,558	per load
Camp Cost	$86	per day per person
Power and Heat	$6,714	per month
Employee Transport Costs	$10,837	per month

Table 11-3: General and Administration Costs

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
3.1	**Onsite Management**							
	Project Management (Pre-closure planning and organization)	Project Manager	days	65	$1,873	$121,631	$121,631	$121,631
	Project Management (on site Active Closure 9 months per year, 2 years)	Project Manager	days	260	$1,873	$486,523	$486,523	$486,523
	Site Supervisor (on site Active Closure 9 months per year, 2 years)	Site Supervisor	days	260	$1,561	$405,436	$405,436	$405,436
	Pickup truck (2 trucks, 6 months per year, 2 years)	Pickup Truck	monthly	24	$6,242	$149,815	$149,815	$149,815
	Seasonal shutdown/startup costs Y1-Y2	Unit Cost Basis	annually	2	$8,655	$17,309	$17,309	$17,309
	Sundry equipment maintenance	Unit Cost Basis	annually	2	$5,770	$11,540	$11,540	$11,540
	Power and heat (6 months per year, 2 years)	Power and Heat	monthly	12	$6,714	$80,568	$80,568	$80,568
	General Administrative expenses (6 months per year, 2 years)	Unit Cost Basis	monthly	12	$2,308	$27,695	$27,695	$27,695
	Geotechnical Inspections (included in T16)		annually	-		$0	$0	$0
	Reclamation Inspections (Active Closure 1 time)		annually	1	$11,540	$11,540	$11,540	$11,540
	Camp Costs (Average 7 people, max 18, 6 months/season, 2 seasons)	Camp Cost	man-day	2,520	$86	$216,720	$216,720	$216,720
					Sub-Total	**$1,528,775**	**$1,528,775**	**$1,528,775**
3.2	**Transport Costs**							
	Employee transport costs (7 months per year, 2 years)	Employee Transport Costs	monthly	14	$4,039	$56,544	$56,544	$56,544
	Commercial flights		monthly	14	$4,039	$56,544	$56,544	$56,544
					Sub-Total	**$113,087**	**$113,087**	**$113,087**
3.3	**Contractor/Third Party Costs**							
	Contractor Profit & Home Office Overhead	Contractor profit and insurance included in the all-in wet rates						
	Insurance							
	Bonding	Included in Indirect Costs calculated in Summary tab						
	Taxes							
	Government Bond Costs							
	Property Holding Costs							
	General freight allowance	Elsa- Whitehorse	loads	20	$3,558	$71,166	$71,166	$71,166
					Sub-Total	**$71,166**	**$71,166**	**$71,166**
3.4	**Mobilize Equipment & Fuel**							
	Heavy Equipment							
	D7 Dozer	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	A30 Haul Truck	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 235 Excavator	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 235 Excavator w hammer	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 324E Excavator (Demo)	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 14H grader	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	966 Loader	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Tractor Trailer (lowbed)	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Vacuum Truck	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	30 ton Crane	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	3 yd Underground LHD	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Vibratory Packer	Tractor Trailer (lowbed)	hrs	11	$260	$2,856	$2,856	$2,856
	15 tonne Underground Truck	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
					Sub-Total	**$34,013**	**$34,013**	**$34,013**

Table 11-3: General Administration Costs (continued)

3.5	**Demobilize Equipment**							
	Heavy Equipment							
	D7 Dozer	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	A30 Haul Truck	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 235 Excavator	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 235 Excavator w hammer	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 324E Excavator (Demo)	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Cat 14H grader	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	966 Loader	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Tractor Trailer (lowbed)	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Vacuum Truck	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	30 ton Crane	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	3 yd Underground LHD	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	15 tonne Underground Truck	Tractor Trailer (lowbed)	hrs	10	$260	$2,596	$2,596	$2,596
	Vibratory Packer	Tractor Trailer (lowbed)	hrs	11	$260	$2,856	$2,856	$2,856
	Sea Containers (supplies, mobile offices)	Other	hrs	60	$75	$4,500	$4,500	$4,500
					Sub-Total	**$38,513**	**$38,513**	**$38,513**
Total Estimated Cost for General & Administration During Closure						**$1,785,554**	**$1,785,554**	**$1,785,554**

Table 11-4: Exploration Disturbances

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
4.1	**Exploration Disturbances**										
	Exploration disturbances secured by a separate security bond				Cat 235 Excavator	hrs					
					General Labourer	hrs					
					D7 Dozer	hrs					
					Revegetation cost per ha. Including application cost	ha					
					% of Direct Costs	%					
								Sub-Total	**$0**	**$0**	**$0**
Total Estimated Cost in Reclaiming Exploration Disturbances									**$0**	**$0**	**$0**

Table 11-5: Closure Planning

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
5.1	**Reclamation & Closure Planning**							
	Update closure plan every two years	Misc.	l.s.	1	$25,964	$0	$25,964	$77,892
	Permitting and Assessment (RCP is already assessed and licensed)	Misc.	l.s.	1	$0	$0	$0	$0
	FN and Community Consultation	Misc.	l.s.	1	$15,000	$15,000	$30,000	$90,000
					Sub-Total	**$15,000**	**$55,964**	**$167,892**
5.2	**Kinetic Tailings and Waste Rock Materials Testing**							
	Field bin ARD/metal leaching studies/tests	Misc.	l.s.	5	$7,500	$37,500	$37,500	$75,000
	Humidity cells	Misc.	l.s.	3	$7,500	$22,500	$22,500	$45,000
					Sub-Total	**$60,000**	**$60,000**	**$120,000**
5.3	**Other Adaptive Management Plans Required**							
	Inclusion of additional triggers and updating of overall plan as per directives (YWB, YESAB)	Misc.	l.s.	1	$11,540	$11,540	$23,079	$20,000
					Sub-Total	**$11,540**	**$23,079**	**$20,000**
5.4	**Contaminated Site Assessment Plan**							
	Develop Plan	Misc.	l.s.	1	$8,655	$8,655	$8,655	$8,655
	Site Reporting	Misc.	l.s.	1	$11,540	$11,540	$11,540	$11,540
					Sub-Total	**$20,194**	**$20,194**	**$20,194**
5.5	**Reclamation & Closure Research Plan**							
	Research to finalize closure plan ($25K per year)	Misc.	l.s.	1	$28,849	$28,849	$173,093	$173,093
	Closure Water Management Treatment Optimization	Misc.	l.s.	1	$34,619	$0	$34,619	$34,619
					Sub-Total	**$28,849**	**$207,712**	**$207,712**
5.6	**Passive Treatment Design**							
	Design for mill pond bioreactor	Misc.	l.s.	1	$34,619	$34,619	$34,619	$34,619
					Sub-Total	**$34,619**	**$34,619**	**$34,619**
Total Estimated Cost for Closure Planning						**$170,201**	**$401,568**	**$570,416**

Table 11-6: Mine Workings - Underground

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.1	**Bellekeno East Portal and Underground**	**8.2.2.1**	**7-1, 7-2**	**1.71**							
	Remove underground equipment (already complete)				3 yd Underground LHD	hrs		$254	$0	$0	$0
					A30 Haul Truck	hrs		$218	$0	$0	$0
					Trades Labourer	hrs		$129	$0	$0	$0
					General Labourer	hrs		$75	$0	$0	$0
	Remove shop and other buildings (trailers, explosives and cap magazine, etc.)					lump sum	2	$17,309	$34,619	$34,619	$34,619
	Load/Haul and place rip rap for portal cover					cu.m.	700	$15	$10,501	$10,501	$10,501
	Screen rip rap					cu.m.	700	$6	$4,039	$4,039	$4,039
	Labour for portal barrier				General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Characterize settling ponds sediments analytical costs					unit cost	2	$346	$692	$692	$692
	Remove pond water/sediments				Vacuum Truck	hrs	8	$173	$1,385	$1,385	$1,385
					General Labourer	hrs	8	$75	$600	$600	$600
	Remove settling ponds liners to landfill				A30 Haul Truck	hrs	2	$218	$435	$435	$435
					Cat 235 Excavator	hrs	8	$154	$1,233	$1,233	$1,233
					General Labourer	hrs	8	$75	$600	$600	$600
	Clean out fuel tank residue					lump sum	1	$1,154	$1,154	$1,154	$1,154
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs	6	$154	$925	$925	$925
					A30 Haul Truck	hrs	6	$218	$1,305	$1,305	$1,305
					General Labourer	hrs	16	$75	$1,200	$1,200	$1,200
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					A30 Haul Truck	hrs	20	$218	$4,351	$4,351	$4,351
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Test area soils for contamination				Environmental Monitor	hrs	16	$133	$2,123	$2,123	$2,123
	Laboratory Analysis for soils testing					unit cost	4	$346	$1,385	$1,385	$1,385
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$154	$2,467	$2,467	$2,467
					A30 Haul Truck	hrs	16	$218	$3,481	$3,481	$3,481
	Recontour and scarify area and slopes to establish drainage		C-2401, B-2101		D7 Dozer	hrs	25	$229	$5,627	$5,627	$5,627
			C-2401, B-2101		Cat 14H grader	hrs	2	$198	$396	$396	$396
	Revegetation		C-2401	1.71 ha	Revegetation cost per ha. Including application cost	ha	1.71	$3,427	$5,861	$5,861	$5,861
	Install Signage				Misc.	lump sum	1	$577	$577	$577	$577
	Certified Underground Supervisor				Site Supervisor	days	7	$1,561	$10,924	$10,924	$10,924
	Underground safety equipment				Misc.	lump sum	1	$5,770	$5,770	$5,770	$5,770
	Engineering Design				% of Direct Costs	%	8%		$8,305	$8,305	$8,305
								Sub-Total	**$119,039**	**$119,039**	**$119,039**

Table 11-6: Mine Workings - Underground (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.2	**Bellekeno 625 Adit Area**	**7.1.3, 7.5.1.2**	**7-1**	**1.29**							
	Remove electrical substation				Misc.	lump sum	1	$17,309	$17,309	$17,309	$17,309
	Remove electrical transmission line (Keno City to BK 625)				Misc.	lump sum	1	$28,849	$28,849	$28,849	$28,849
	Remove shop/loadout facility, compressor station				Misc.	lump sum	1	$34,619	$34,619	$34,619	$34,619
	Remove ammonia treatment plant trailers				Misc.	lump sum	1	$11,540	$11,540	$11,540	$11,540
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					A30 Haul Truck	hrs	20	$218	$4,351	$4,351	$4,351
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Test area soils for contamination				Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Laboratory Analysis for soils testing					unit cost	4	$346	$1,385	$1,385	$1,385
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$154	$2,467	$2,467	$2,467
					A30 Haul Truck	hrs	16	$218	$3,481	$3,481	$3,481
	Recontour and scarify area and slopes to establish drainage		C-2402, B-2102		D7 Dozer	hrs	10	$229	$2,298	$2,298	$2,298
			C-2402, B-2102		Cat 14H grader	hrs	2	$198	$396	$396	$396
	Revegetation		C-2402	1.29 ha	Revegetation cost per ha. Including application cost	ha	1.29	$3,427	$4,421	$4,421	$4,421
	Install Signage				Misc.	lump sum	1	$577	$577	$577	$577
	Engineering Design				% of Direct Costs	%	8%		$8,913	$8,913	$8,913
								Sub-Total	**$127,751**	**$127,751**	**$127,751**
6.3	**Bellekeno 200 Level Vent Raise**	**7.1.3.1**	**7-6**								
	Engineering for Expansion foam cap		S-0303		Misc.	l.s.	1	$11,540	$11,540	$11,540	$11,540
	Expansion foam				Misc.	l.s.	1	$11,540	$11,540	$11,540	$11,540
					966 loader	hrs	12	$136	$1,627	$1,627	$1,627
					Tractor Trailer (lowbed)	hrs	48	$260	$12,463	$12,463	$12,463
					30 ton Crane	hrs	48	$219	$10,524	$10,524	$10,524
	Labour for cap				General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
					Trades Labourer	hrs	40	$129	$5,170	$5,170	$5,170
	Engineering Design				% of Direct Costs	%	8%		$3,802	$3,802	$3,802
								Sub-Total	**$59,665**	**$59,665**	**$59,665**

Table 11-6: Mine Workings - Underground (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.4	**Onek 990 Portal and Underground**	**7.1.9**									
	Remove underground equipment (no material underground after suspension)				3 yd Underground LHD	hrs					
					A30 Haul Truck	hrs					
					Trades Labourer	hrs					
					General Labourer	hrs					
	Engineering Design				% of Direct Costs	%	8%		$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**
6.5	**Onek 990 Portal Site and Infrastructure**	**7.5.4**	**7-16**	**0.35**							
	Remove shop and other buildings (already completed)				Misc.	l.s.	1	$0	$0	$0	$0
	Supply rockfill for portal barrier		S-0301		Load and Haul and Place Rip Rap	m3	700	$15	$10,501	$10,501	$10,501
					Trades Labourer	hrs	40	$129	$5,170	$5,170	$5,170
	Clean out fuel tank residue (no tank at site)				Misc.	l.s.					
	Haul fuel tank and liner for reuse or landfill (no tank at site)				Cat 235 Excavator	hrs					
					A30 Haul Truck	hrs					
					General Labourer	hrs					
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	10	$154	$1,542	$1,542	$1,542
					A30 Haul Truck	hrs	8	$218	$1,740	$1,740	$1,740
					General Labourer	hrs	20	$75	$1,500	$1,500	$1,500
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	8	$346	$2,769	$2,769	$2,769
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$154	$1,233	$2,467	$2,467
					A30 Haul Truck	hrs	16	$218	$1,740	$3,481	$3,481
	Recontour and scarify area and slopes to establish drainage		C-4401, B-4101		D7 Dozer	hrs	7	$229	$1,567	$1,567	$1,567
			C-4401, B-4101		Cat 14H grader	hrs	4	$198	$792	$792	$792
	Recontour crests of pad		C-4401, B-4101		Cat 235 Excavator	hrs	4	$154	$617	$617	$617
	Install Signage				Misc.	l.s.	1	$577	$577	$577	$577
	Remove electrical substation (not yet constructed, not part of LOM Plan)				Misc.	l.s.					
	Remove electrical transmission line (not yet constructed, not part of LOM Plan)				Misc.	l.s.					
	Characterize settling pond sediments/sludge (not yet constructed, not part of LOM Plan)				Analytical Costs	Unit Cost					
	Remove sludge from settling pond (not yet constructed, not part of LOM Plan)				Vacuum Truck	hrs					
					General Labourer	hrs					
	Remove settling ponds liners to landfill (not yet constructed, not part of LOM Plan)				A30 Haul Truck	hrs					
					General Labourer	hrs					
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$154	$1,233	$1,233	$1,233
					A30 Haul Truck	hrs	12	$218	$2,611	$2,611	$2,611
	Revegetation		C-4401	0.35 ha	Revegetation cost per ha. Including application cost	ha	0.35	$3,427	$1,200	$1,200	$1,200
	Engineering Design				% of Direct Costs	%	8%		$2,689	$2,912	$2,912
								Sub-Total	**$38,544**	**$41,740**	**$41,740**

Table 11-6: Mine Workings - Underground (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.6	**Onek 990 Vent Raise**	**7.5.4**									
	Not constructed and not licensed for production				Misc.	l.s.					
					Misc.	l.s.					
					Cat 966 loader	hrs					
					Tractor Trailer (lowbed)	hrs					
					General Labourer	hrs					
					% of Direct Costs	%	8%		$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**
6.7	**Lucky Queen Underground/Laydown Areas**	**7.1.11**	**7-18**	**0.63**							
	Remove shop and other buildings				Misc.	hrs	1	$5,770	$5,770	$5,770	$5,770
	Supply rockfill for portal barrier				Load and Haul and Place Rip Rap	m3	700	$15	$10,501	$10,501	$10,501
	Labour for portal barrier				General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Clean out fuel tank residue				Misc.	l.s.					
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs		$154	$0	$0	$0
					A30 Haul Truck	hrs		$218	$0	$0	$0
					General Labourer	hrs		$75	$0	$0	$0
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					A30 Haul Truck	hrs	20	$218	$4,351	$4,351	$4,351
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
					A30 Haul Truck	hrs	20	$218	$4,351	$4,351	$4,351
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	6	$346	$2,077	$2,077	$2,077
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$154	$2,467	$2,467	$2,467
					A30 Haul Truck	hrs	16	$218	$1,740	$3,481	$3,481
	Recontour and scarify area and slopes to establish drainage		C-3401, B-3101		D7 Dozer	hrs	6	$229	$1,384	$1,384	$1,384
			C-3401, B-3101		Cat 14H grader	hrs	1	$198	$198	$198	$198
	Recontour crests		C-3401, B-3101		Cat 235 Excavator	hrs	4	$154	$666	$666	$666
	Remove electrical substation (not yet upgraded)				Misc.	l.s.					
	Remove electrical transmission cable (not yet constructed)				Misc.	l.s.					
	Remove loadout facility				Misc.	l.s.	1	$5,770	$5,770	$5,770	$5,770
	Install Signage				Misc.	l.s.	1	$577	$577	$577	$577
	Characterize settling pond sediments/sludge				Analytical Costs	Unit Cost	2	$346	$692	$692	$692
					Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Remove sludge from settling pond				Vacuum Truck	hrs	40	$173	$1,731	$1,731	$1,731
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Remove settling ponds liners to landfill (not yet constructed)				A30 Haul Truck	hrs		$218			
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$154	$1,233	$1,233	$1,233
					A30 Haul Truck	hrs	12	$218	$2,611	$2,611	$2,611
	Revegetation		C-3401	0.63 ha	Revegetation cost per ha. Including application cost	ha	0.63	$3,427	$2,159	$2,159	$2,159
	Install Signage				Misc.	l.s.	1	$577	$577	$577	$577
	Misc. Supplies & Tools				Misc.	l.s.	1	$5,770	$5,770	$5,770	$5,770
	Engineering Design				% of Direct Costs	%	8%		$4,836	$4,967	$4,967
								Sub-Total	**$69,317**	**$71,188**	**$71,188**

Table 11-6: Mine Workings - Underground (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.8	**Lucky Queen Vent Raise**	**7.1.10**									
	Not constructed and not licensed for production				Misc.	l.s.					
					966 loader	hrs					
					Tractor Trailer (lowbed)	hrs					
					General Labourer	hrs					
					% of Direct Costs	%	8%		$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**
6.9	**Flame and Moth Underground**	**7.1.5**									
	Remove underground equipment				3 yd Underground LHD	hrs	60	$254	$3,808	$7,616	$15,232
					A30 Haul Truck	hrs	60	$218	$3,263	$6,526	$13,053
					Trades Labourer	hrs	120	$129	$3,877	$7,755	$15,509
					General Labourer	hrs	120	$75	$9,001	$9,001	$9,001
	Remove shop and other buildings (explosives and cap magazine)				Misc.	hrs	2	$5,770	$11,540	$11,540	$11,540
	Supply rockfill for portal barrier				Load and Haul and Place Rip Rap	m3	700	$15	$10,501	$10,501	$10,501
					Screen Rip-Rap	m3	700	$6	$4,039	$4,039	$4,039
					Trades Labourer	hrs	40	$129	$5,170	$5,170	$5,170
	Clean out fuel tank residue				Misc.	l.s.	1	$1,154	$1,154	$1,154	$1,154
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs	6	$154	$925	$925	$925
					A30 Haul Truck	hrs	6	$218	$1,305	$1,305	$1,305
					General Labourer	hrs	16	$75	$1,200	$1,200	$1,200
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	10	$154	$1,542	$1,542	$1,542
					A30 Haul Truck	hrs	10	$218	$2,175	$2,175	$2,175
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	8	$346	$2,769	$2,769	$2,769
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$154	$1,233	$2,467	$2,467
					A30 Haul Truck	hrs	16	$218	$1,740	$3,481	$3,481
	Recontour and scarify area and slopes to establish drainage (Incl. with Mill)		C-6401, C-6101		D7 Dozer	hrs		$229	$0	$0	$0
			C-6401, C-6101		Cat 14H grader	hrs		$198	$0	$0	$0
	Remove electrical substation (included in mill facilities)				Misc.	l.s.	1				
	Install Signage				Misc.	l.s.	1	$577	$577	$577	$577
	Characterize settling pond sediments/sludge				Analytical Costs	Unit Cost	2	$346		$692	$692
					Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Remove sludge from settling pond				Vacuum Truck	hrs	30	$173		$5,193	$5,193
					General Labourer	hrs	30	$75		$2,250	$2,250
	Remove settling ponds liners to landfill				A30 Haul Truck	hrs	4	$218		$870	$870
					General Labourer	hrs	12	$75		$900	$900
					Cat 235 Excavator	hrs	12	$154		$1,850	$1,850
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$154	$617	$1,233	$1,233
					A30 Haul Truck	hrs	12	$218		$2,611	$2,611
	Certified Underground Supervisor				Site Supervisor	days	5	$1,561	$7,803	$7,803	$7,803
	Underground safety equipment				Misc.	lump sum	1	$5,770	$5,770	$5,770	$5,770
	Misc. Supplies & Tools				Misc.	l.s.	1	$8,655	$8,655	$8,655	$8,655
	Engineering Design				% of Direct Costs	%	8%		$5,538	$6,885	$10,844
								Sub-Total	**$99,326**	**$129,578**	**$155,435**

Table 11-6: Mine Workings - Underground (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.10	**Flame and Moth Vent Raise**	**7.1.5**	**S-0303**								
	Concrete Batch (not constructed)				Misc.	m3	7	$1,731		$12,117	$12,117
					966 loader	hrs	12	$136		$1,627	$1,627
					Tractor Trailer (lowbed)	hrs	48	$260		$12,463	$12,463
	Labour for cap				Trades Labourer	hrs	40	$129		$5,170	$5,170
					General Labourer	hrs	40	$75		$3,000	$3,000
	Engineering Design				% of Direct Costs	%	8%		$0	$2,578	$2,578
								Sub-Total	**$0**	**$36,955**	**$36,955**
6.11	**Bermingham Underground Portal and Surface Site**	**7.1.7 & 7.5.3**		**7**							
	Remove underground equipment				3 yd Underground LHD	hrs	60	$254	$3,808	$7,616	$15,232
					A30 Haul Truck	hrs	60	$218	$3,263	$6,526	$13,053
					Trades Labourer	hrs	120	$129	$3,877	$7,755	$15,509
					General Labourer	hrs	120	$75	$9,001	$9,001	$9,001
	Remove electrical substation located at Ruby				Misc.	lump sum	1	$17,309	$17,309	$17,309	$17,309
	Load/Haul and place rip rap for portal cover				Load and Haul and Place Rip Rap	cu.m.	700	$15	$10,501	$10,501	$10,501
	Screen rip rap				Screen Rip-rap	cu.m.	700	$6	$4,039	$4,039	$4,039
	Labour for portal barrier				General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Remove shop and other surface facilities				Misc.	ls	1	$5,000	$5,000	$10,000	$10,000
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$154	$1,233	$1,233	$1,233
					A30 Haul Truck	hrs	12	$218	$2,611	$2,611	$2,611
	Clean out fuel tank residue				Misc.	l.s.	1	$1,154	$1,154	$1,154	$1,154
	Haul fuel tank for reuse				966 Loader	hrs	6	$136	$814	$814	$814
					Tractor Trailer (lowbed)	hrs	6	$260	$1,558	$1,558	$1,558
					General Labourer	hrs	16	$75	$1,200	$2,400	$2,400
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					A30 Haul Truck	Unit Cost	40	$346	$13,847	$13,847	$13,847
					Cat 235 Excavator	hrs	16	$154	$2,467	$2,467	$2,467
	Test area for soils for contamination				Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Laboratory analysis for soils testing					unit cost	4	$346	$1,385	$1,385	$1,385
	Haul contaminated soils to LTF				Cat 235 Excavator	hrs	16	$154	$2,467	$2,467	$2,467
					A30 Haul Truck	hrs	16	$218	$3,481	$3,481	$3,481
	Recontour and scarify area and slopes to establish drainage		C-5401, B-5101		D7 Dozer	hrs	2	$229	$403	$403	$403
			C-5401, B-5101		Cat 14H grader	hrs	3	$198	$594	$594	$594
	Revegetation		C-5401	7	Revegetation cost per ha. Including application cost	ha	7	$3,427	$23,991	$23,991	$23,991
	Install signage				Misc.	lump sum	1	$577	$577	$577	$577
	Certified Underground Supervisor				Site Supervisor	days	5	$1,561	$7,803	$7,803	$7,803
	Underground safety equipment				Misc.	lump sum	1	$5,770	$5,770	$5,770	$5,770
	Misc. Supplies & Tools				Misc.	l.s.	1	$8,655	$8,655	$8,655	$8,655
	Engineering Design				% of Direct Costs	%	8%		$10,796	$12,083	$13,725
								Sub-Total	**$154,749**	**$173,184**	**$196,723**

Table 11-6: Mine Workings - Underground (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.12	**Bermingham Vent Raise**	**7.1.7**	**S-0303**								
	Concrete Batch				Misc.	m3	7	$1,731	$12,117	$12,117	$12,117
					966 loader	hrs	12	$136	$1,627	$1,627	$1,627
					Tractor Trailer (lowbed)	hrs	48	$260	$12,463	$12,463	$12,463
	Labour for cap				Trades Labourer	hrs	40	$129	$5,170	$5,170	$5,170
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Engineering Design				% of Direct Costs	%	8%		$2,578	$2,578	$2,578
								Sub-Total	**$36,955**	**$36,955**	**$36,955**
Total Estimated Cost in Reclaiming Underground Mines									**$597,485**	**$683,126**	**$845,450**

Table 11-7: Waste Rock and Borrow Pits

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
7.1	**Bellekeno East Temporary P-AML WRSF**	**7.3.1.1**	**7-24**	**0.33**							
	Rehandle PAML underground (complete)										
					3 yd Underground LHD	hrs.		$254	$0	$0	$0
					A30 Haul Truck	hrs		$218	$0	$0	$0
					Cat 235 Excavator	hrs		$154	$0	$0	$0
					General Labourer	hrs		$75	$0	$0	$0
	Site Recontouring		C-2401, B-2101		D7 Dozer	hrs	13	$229	$2,881	$2,881	$2,881
			C-2401, B-2101		Cat 235 Excavator	hrs	9	$154	$1,410	$1,410	$1,410
	Revegetation		C-2401		Revegetation cost per ha. Including application cost	ha	0.3	$3,427	$1,131	$1,131	$1,131
	Engineering Design				% of Direct Costs	%	8%		$407	$407	$407
								Sub-Total	**$5,828**	**$5,828**	**$5,828**
7.2	**Bellekeno N-AML WRDA**	**7.3.1.2**									
	This has not been constructed and there is no plan or requirement for a Bellekeno WRDA in the LOM Plan										
								Sub-Total	**$0**	**$0**	**$0**
7.3	**Bellekeno Historic WRDAs**	**7.3.1.3**	**7-24**	**1.29**							
	Recontour crests 625 WRDA		C-2402, B-2102		Cat 235 Excavator	hrs	7	$154	$1,125	$1,125	$1,125
	Up-slope Diversion Ditch-no lining specified				Cat 235 Excavator	hrs	4	$154	$617	$617	$617
	Place soil cover (0.5m thickness)				Load, haul and place soil cover	cu.m.	-	$9	$0	$0	$0
	Revegetation (Incl. in Portal reclamation [Table 5])		C-2401, C-2402		Revegetation cost per ha. Including application cost	ha	1	$3,427	$4,421	$4,421	$4,421
	Engineering Design				% of Direct Costs	%	8%		$462	$462	$462
								Sub-Total	**$6,626**	**$6,626**	**$6,626**

Table 11-7: Waste Rock and Borrow Pits (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
7.4	**Onek P-AML WRSF**	**7.3.4**	**7-15**	**0.48**							
	Remove impounded water (no water liner not complete)				Vacuum Truck	hrs	-	$173	$0	$0	$0
					General Labourer	hrs	4	$75	$300	$300	$300
	Remove P-AML rock and place underground at Onek				D7 Dozer	hrs	-	$229	$0	$0	$0
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	2	$218	$435	$435	$435
					Cat 235 Excavator	hrs	4	$154	$617	$617	$617
					General Labourer	hrs.	8	$75	$600	$600	$600
	Recontour for drainage		C-4401, B-4101		D7 Dozer	hrs	19	$229	$4,283	$4,283	$4,283.5
	Revegetation		C-4401	0.48 ha	Revegetation cost per ha. Including application cost	ha	0.48	$3,427	$1,645	$1,645	$1,645.1
	Engineering Design				% of Direct Costs	%	8%		$591	$591	$591
								Sub-Total	**$8,472**	**$8,472**	**$8,472**
7.5	**Onek N-AML WRDA**	**7.3.4**									
	This has not been constructed and Onek is not in the current LOM plan and therefore no plan to construct an Onek N-AML WRDA					hrs			$0	$0	$0
						hrs			$0	$0	$0
						%			$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**
7.6	**Lucky Queen P-AML WRSF**	**7.3.5**									
	Not constructed and not licensed for production				Vacuum Truck	hrs					
					General Labourer	hrs					
			C-3401, B-3101		D7 Dozer	hrs					
					Custom Rate A (Load, haul and place overburden cover on P-AML Waste Rock)	cu.m.					
			C-3401		Revegetation cost per ha. Including application cost	ha					
	Engineering Design				% of Direct Costs	%	8%		$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**
7.7	**Lucky Queen N-AML WRDA**	**7.3.5**									
	Not constructed and not licensed for production		C-3401, B-3101		Cat 235 Excavator	hrs					
			C-3401		D7 Dozer	hrs					
			C-3401		Revegetation cost per ha. Including application cost	ha					
	Engineering Design				% of Direct Costs	%	8%		$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**

Table 11-7: Waste Rock and Borrow Pits (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
7.8	**Flame and Moth Temporary P-AML WRSF**	**7.3.2**		**0.23**							
	Rehandle underground										
	6000 m3 @ 7m3/hr. cycle time to underground (vol estimate based on maximum capacity assuming full)				3 yd Underground LHD	hrs.	857	$254		$217,603	$217,603
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	8	$218		$1,740	$1,740
					Cat 235 Excavator	hrs	48	$154		$7,401	$7,401
					General Labourer	hrs	24	$75		$1,800	$1,800
	Certified Underground Supervisor				Site Supervisor	days	12	$1,561	$18,727	$18,727	$18,727
	Underground safety equipment				Misc.	l.s.	1	$5,770	$5,770	$5,770	$5,770
	Site Recontouring		C-1401, B6101		D7 Dozer	hrs	9	$229	$2,000	$2,000	$2,000
	Revegetation		C-1401		Revegetation cost per ha. Including application cost	ha	0.23	$3,427	$788	$788	$788
	Engineering Design				% of Direct Costs	%	8%		$2,046	$19,187	$19,187
								Sub-Total	**$29,331**	**$275,016**	**$275,016**
7.9	**Flame and Moth N-AML WRDA**	**7.3.2**									
	All of the Flame and Moth N-AML waste is scheduled to be used for construction purposes or backfill therefore there is no N-AML WRDA					hrs					
						hrs					
						cu.m.					
						cu.m.					
					% of Direct Costs	%	8%		$0	$0	$0
7.10	**Bermingham N-AML WRDA**	**7.3.3**		**5.50**							
	Recontour crests		C-5401, B-5101		Cat 235 Excavator	hrs.	153	$154	$23,617	$23,617	$23,617
	Scarify surface		C-5401		D7 Dozer	hrs.	12	$229	$1,375	$2,751	$2,751
	Revegetation		C-5401		Revegetation cost per ha. Including application cost	ha	5.500	$3,427.31	$9,425	$18,850	$18,850
	Engineering Design				% of Direct Costs	%	8%		$2,581	$3,391	$3,391
								Sub-Total	**$36,998**	**$48,609**	**$48,609**

Table 11-7: Waste Rock and Borrow Pits (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
7.11	**Bermingham P-AML WRSF**	**7.3.3**		**0.32**							
	Rehandle underground										
	8000 m3 @ 16m3/hr. cycle time to underground (vol estimate based on maximum capacity assuming full)				3 yd Underground LHD	hrs.	500	$254		$126,935	$126,935
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	24	$218		$5,221	$5,221
					Cat 235 Excavator	hrs	48	$154		$7,401	$7,401
					General Labourer	hrs	24	$75		$1,800	$1,800
	Certified Underground Supervisor				Site Supervisor	days	12	$1,561	$18,727	$18,727	$18,727
	Underground safety equipment				Misc.	l.s.	1	$5,770	$5,770	$5,770	$5,770
	Site Recontouring		C-5401, B-5101		D7 Dozer	hrs	10	$229		$802	$2,406
	Revegetation		C-5401		Revegetation cost per ha. Including application cost	ha	0.32	$3,427		$366	$1,097
	Engineering Design				% of Direct Costs	%	8%		$1,837	$12,527	$12,702
								Sub-Total	**$26,334**	**$179,548**	**$182,058**
7.12	**Borrow Areas (2ha currently, 3ha by EOM)**	**7.8.1**		**2.00**							
	Stabilize slopes				Cat 235 Excavator	hrs	12	$154	$1,221	$1,221	$1,850
					D7 Dozer	hrs	8	$229	$1,210	$1,210	$1,834
	Revegetation				Revegetation cost per ha. Including application cost	ha	2.0	$3,427	$6,855	$6,855	$6,855
	Engineering Design				% of Direct Costs	%	8%		$696	$696	$790
								Sub-Total	**$9,983**	**$9,983**	**$11,329**

Table 11-7: Waste Rock and Borrow Pits (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
7.13	**Coarse Ore Pad**	**7.5.6**		**0.30**							
	Concrete Demolition and Burial				Cat 235 Excavator w hammer	hrs	16	$218	$3,495	$3,495	$3,495
					D7 Dozer	hrs	16	$229	$3,668	$3,668	$3,668
	Dismantle Sprung Structure over fine ore stockpile				Misc.	l.s.	1	$11,540	$11,540	$11,540	$11,540
	Haul contaminated soils/materials to DSTF or underground				Cat 235 Excavator	hrs	6	$154	$925	$925	$925
					A30 Haul Truck	hrs	6	$218	$1,305	$1,305	$1,305
	Revegetation				Revegetation cost per ha. Including application cost	ha	0.3	$3,427	$1,028	$1,028	$1,028
	Engineering Design				% of Direct Costs	%	8%		$1,647	$1,647	$1,647
								Sub-Total	**$23,608**	**$23,608**	**$23,608**
Total Estimated Cost in Reclaiming Overburden and Waste Rock Dumps									**$147,180**	**$557,689**	**$561,545**

Table 11-8: Mill & Ancillary Facilities

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
8.1	**Mill and Ancillary Facilities**	**7.5.6**									
	Remove equipment (crusher, conveyors, mill equipment, trailer units, other ancillary facilities - fine ore bin)				General Labourer	hrs	600	$75	$45,004	$45,004	$45,004
					Trades Labourer	hrs	400	$129	$51,697	$51,697	$51,697
					966 loader	hrs	150	$136	$20,342	$20,342	$20,342
					Cat 235 Excavator	hrs	35	$154	$5,396	$5,396	$5,396
					Cat 324E Excavator (Demo)	hrs	35	$234	$8,206	$8,206	$8,206
					A30 Haul Truck	hrs	20	$218	$4,351	$4,351	$4,351
					Tractor Trailer (lowbed)	hrs	150	$260	$38,946	$38,946	$38,946
	Load and return extra chemicals/reagents				General Labourer	hrs	75	$75	$5,626	$5,626	$5,626
					Misc.	l.s.	1	$11,540	$11,540	$11,540	$11,540
	Dismantle Mill Building				966 loader	hrs	70	$136	$9,493	$9,493	$9,493
					Cat 324E Excavator (Demo)	hrs	70	$234	$16,411	$16,411	$16,411
					A30 Haul Truck	hrs	30	$218	$6,526	$6,526	$6,526
					Tractor Trailer (lowbed)	hrs	90	$260	$23,368	$23,368	$23,368
					Trades Labourer	hrs	300	$129	$38,773	$38,773	$38,773
					General Labourer	hrs	1000	$75	$75,007	$75,007	$75,007
	Removal and burial of outside pipelines				General Labourer	hrs	80	$75	$6,001	$6,001	$6,001
					966 loader	hrs	40	$136	$5,425	$5,425	$5,425
	Concrete Demolition				Cat 235 Excavator w hammer	hrs	40	$218	$8,737	$8,737	$8,737
					D7 Dozer	hrs	40	$229	$9,170	$9,170	$9,170
	Elec. Substation (disconnect, remove from site)				Misc.	Unit Cost	1	$23,079	$23,079	$23,079	$23,079
	Dismantle/remove other area buildings (dry, lab, MCCs, etc.)				Misc.	Unit Cost	5	$5,770	$28,849	$28,849	$28,849
	Disconnect services				Misc.	Misc.	4	$2,308	$9,232	$9,232	$9,232
	Decommission buried infrastructure				Misc.	Misc.	1	$5,770	$5,770	$5,770	$5,770
	Dismantle/remove freshwater tank				Misc.	Misc.	1	$11,540	$11,540	$11,540	$11,540
	Remove diesel & propane Tanks (owned by vendors)										
	Disconnect services				Misc.	Misc.	2	$1,154	$2,308	$2,308	$2,308
	Crane Support				30-ton Crane	hrs	200	$219	$43,850	$43,850	$43,850
	Haul Scrap to Solid Waste Facility				Cat 235 Excavator	hrs	50	$154	$7,709	$7,709	$7,709
					A30 Haul Truck	hrs	100	$218	$21,754	$21,754	$21,754
	Misc. Supplies and Tools				Misc.	hrs	1	$5,770	$5,770	$5,770	$5,770
	Project Management & Engineering				% of Direct Costs	%	8%		$41,241	$41,241	$41,241
								Sub-Total	**$591,119**	**$591,119**	**$591,119**

Table 11-8: Mill & Ancillary Facilities (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
8.2	**Warehouse**										
	Dismantle Mill Building				966 loader	hrs	30	$136	$4,068	$4,068	$4,068
					Tractor Trailer (lowbed)	hrs	30	$260	$7,789	$7,789	$7,789
					Trades Labourer	hrs	100	$129	$12,924	$12,924	$12,924
					General Labourer	hrs	250	$75	$18,752	$18,752	$18,752
	Concrete Demolition				Cat 235 Excavator w hammer	hrs	20	$218	$4,369	$4,369	$4,369
					D7 Dozer	hrs	20	$229	$4,585	$4,585	$4,585
	Haul Scrap to Solid Waste Facility				Cat 235 Excavator	hrs	15	$154	$2,313	$2,313	$2,313
					A30 Haul Truck	hrs	10	$218	$2,175	$2,175	$2,175
	Misc. Supplies and Tools				Misc.	l.s.	1	$5,770	$5,770	$5,770	$5,770
	Engineering Design				% of Direct Costs	%	8%		$4,706	$4,706	$4,706
								Sub-Total	**$67,451**	**$67,451**	**$67,451**
8.3	**Mixing Plant**										
	Dismantle Norseman Structure (Covered Filtered Tailings Storage), Conveyor, Silo 1, Silo 2, Mixing Plant, Propane Tank, Hopper Enclosure				966 loader	hrs	40	$136	$5,425	$5,425	$5,425
					Tractor Trailer (lowbed)	hrs	40	$260	$10,386	$10,386	$10,386
					Trades Labourer	hrs	60	$129	$7,755	$7,755	$7,755
					General Labourer	hrs	100	$75	$7,501	$7,501	$7,501
	Concrete Demolition				Cat 235 Excavator w hammer	hrs	10	$218	$2,184	$2,184	$2,184
					D7 Dozer	hrs	10	$229	$2,292	$2,292	$2,292
	Haul Scrap to Solid Waste Facility				Cat 235 Excavator	hrs	30	$154	$4,626	$4,626	$4,626
					A30 Haul Truck	hrs	30	$218	$6,526	$6,526	$6,526
	Misc. Supplies and Tools				Misc.	l.s.	1	$5,770	$5,770	$5,770	$5,770
	Engineering Design				% of Direct Costs	%	8%		$3,935	$3,935	$3,935
								Sub-Total	**$56,399**	**$56,399**	**$56,399**
8.4	**Mill Pad**	**7.5.6**		**4.8**							
	Regrade embankment shoulders		C-6401, B-6101		D7 Dozer	hrs	9	$229	$2,089	$2,089	$2,089
	Haul & place soil cover (1 m aver. thickness) S.7.5.5.1		C-6401, B-6101		Load, haul and place soil cover	cu.m.	1800	$9	$16,617	$16,617	$16,617
	Recontour area to bury any footings & provide drainage, in prep for revegetation		C-6401, B-6101		D7 Dozer	hrs	94	$229	$21,447	$21,447	$21,447
	Revegetate		C-6401		Revegetation cost per ha. Including application cost	ha	4.8	$3,427	$16,417	$16,417	$16,417
	Engineering Design				% of Direct Costs	%	8%		$4,243	$4,243	$4,243
								Sub-Total	**$60,813**	**$60,813**	**$60,813**

Table 11-8: Mill & Ancillary Facilities (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
8.5	**Camp Downsize**	**7.5.7**									
	Dismantle 5 trailer units and transport to Lot 960				Misc.	l.s.	1	$28,849	$28,849	$28,849	$28,849
	Engineering Design				% of Direct Costs	%	8%		$2,164	$2,164	$2,164
								Sub-Total	**$31,013**	**$31,013**	**$31,013**
Total Estimated Cost in Reclaiming Mill and Ancillary Facilities									**$806,794**	**$806,794**	**$806,794**

Table 11-9: Dry Stack Tailings Facility

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
9.1	**DSTF - Current**	**7.2**		**5.8**							
	Recontour slopes to final design and compact				D7 Dozer	hrs	116	$229	$26,593		
					Vibratory Packer	hrs	46	$104	$4,844		
	Place soil cover and spread (0.5 m thickness)				A30 Haul Truck	hrs	290	$218	$63,088		
					Cat 235 Excavator	hrs	348	$154	$53,656		
					D7 Dozer	hrs	203	$229	$46,537		
	Revegetation				Revegetation Seed Mix - 50kg/ha	ha	5.8	$840	$4,872		
					Fertilizer - 250kg/ha	ha	5.8	$528	$3,060		
					Seed/Fertilizer Application	ha	5.8	$2,060	$11,947		
	Engineering Design				% of Direct Costs	%	8%		$16,095	$0	$0
								Sub-Total	**$230,691**		
9.2	**DSTF - Year 2**	**7.2**		**5.8**							
	Recontour slopes to final design and compact				D7 Dozer	hrs	116	$229		$26,593	
					Vibratory Packer	hrs	46	$104		$4,844	
	Place soil cover and spread (0.5 m thickness)				A30 Haul Truck	hrs	290	$218		$63,088	
					Cat 235 Excavator	hrs	348	$154		$53,656	
					D7 Dozer	hrs	203	$229		$46,537	
	Revegetation				Revegetation Seed Mix - 50kg/ha	ha	5.8	$840		$4,872	
					Fertilizer - 250kg/ha	ha	5.8	$528		$3,060	
					Seed/Fertilizer Application	ha	5.8	$2,060		$11,947	
	Engineering Design				% of Direct Costs	%	8%		$0	$16,095	$0
								Sub-Total		**$230,691**	
9.3	**DSTF - EOM**	**7.2**		**7.2**							
	Recontour slopes to final design and compact		C-7401		D7 Dozer	hrs	143	$229			$32,820
					Vibratory Packer	hrs	57	$104			$5,972
	Place soil cover and spread (0.5 m thickness)		C-7401		A30 Haul Truck	hrs	358	$218			$77,772
					Cat 235 Excavator	hrs	429	$154			$66,145
					D7 Dozer	hrs	119	$229			$27,350
	Revegetation		C-7401		Revegetation Seed Mix - 50kg/ha	ha	7.2	$840			$6,006
					Fertilizer - 250kg/ha	ha	7.2	$528			$3,772
					Seed/Fertilizer Application	ha	7.2	$2,060			$14,728
	Engineering Design				% of Direct Costs	%	8%		$0	$0	$17,592
								Sub-Total			**$252,156**

Table 11-9: Dry Stack Tailings Facility (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
9.3	**DSTF - Surface Water Conveyance Structure**	**7.2.3**		**0.12**							
	Excavate Channel				Cat 235 Excavator	hrs	4	$154			$657
	Place soil cover and spread (0.5 m thickness)				A30 Haul Truck	hrs	11	$218			$2,447
					Cat 235 Excavator	hrs	3	$154			$422
					D7 Dozer	hrs	6	$229			$1,343
	Revegetation				Revegetation Seed Mix - 50kg/ha	ha	0.12	$840			$101
					Fertilizer - 250kg/ha	ha	0.12	$528			$63
					Seed/Fertilizer Application	ha	0.12	$2,060			$247
	Engineering Design				% of Direct Costs	%	8%		$0	$0	$396
								Sub-Total			**$5,677**
Total Estimated Cost in Reclaiming DSTF									**$230,691**	**$230,691**	**$257,833**

Table 11-10: Waste Disposal/Remediation

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
10.1	**Solid Waste Disposal**	**7.6**									
10.2	**Hazardous Materials Disposal**	**7.6**									
	Consolidation of onsite materials, packaging					l.s.	1	$17,309	$17,309	$17,309	$17,309
	Off-site disposal					l.s.	1	$8,655	$8,655	$8,655	$8,655
	Engineering Design				% of Direct Costs	%	8%		$1,947	$1,947	$1,947
								Sub-Total	**$27,911**	**$27,911**	**$27,911**
10.3	**Contaminated Soils**	**7,6**									
	Test area soils for contamination				Environmental Monitor	hrs	16	$133	$2,123	$2,123	$2,123
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	40	$346	$13,847	$13,847	$13,847
	Excavation and packaging of contaminated soils				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Haul any contaminated soils to nearest Land Treatment Facility					l.s.	1	$11,540	$11,540	$11,540	$11,540
	Engineering Design				% of Direct Costs	%	8%		$2,520	$2,520	$2,520
								Sub-Total	**$36,114**	**$36,114**	**$36,114**
Total Estimated Cost in Reclaiming Waste Disposal and Remediation									**$64,025**	**$64,025**	**$64,025**

Table 11-11: Landfill

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
11.1	**Landfill Final Closure**	**7.6**		**0.33**							
	Valley Tailings Landfill is an ERDC permitted facility										
	Final Closure of AKHM landfills				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
	Site Recontouring				D7 Dozer	hrs	12	$229	$2,751	$2,751	$2,751
	Revegetation				Revegetation cost per ha. Including application cost	ha	0.3	$3,427	$1,131	$1,131	$1,131
	Engineering Design				% of Direct Costs	%	8%		$747	$747	$747
								Sub-Total	**$10,713**	**$10,713**	**$10,713**
Total Estimated Cost in Reclaiming Landfills									**$10,713**	**$10,713**	**$10,713**

Table 11-12: Roads and Trails

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (km)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
12.1	**Bellekeno East Portal to Upper Laydown**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (2 ea.)				Cat 235 Excavator	hrs	10	$154	$1,542	$1,542	$1,542
					General Labourer	hrs	10	$75	$750	$750	$750
	Re-slope banks/remove safety berms				Cat 235 Excavator	hrs	16	$154	$2,467	$2,467	$2,467
	Scarify road surface			0.5	Cat 14H grader	hrs	16	$198	$3,169	$3,169	$3,169
	Erosion barrier (50% of length)				Erosion Barrier	m2	500	$3	$1,407	$1,407	$1,407
	Engineering Design				% of Direct Costs	%	8%		$700	$700	$700
								Sub-Total	**$10,034**	**$10,034**	**$10,034**
12.2	**Bellekeno 625 Access**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (3 ea.)				Cat 235 Excavator	hrs	12	$154	$1,850	$1,850	$1,850
					General Labourer	hrs	12	$75	$900	$900	$900
	Re-slope banks/remove safety berms				Cat 235 Excavator	hrs	12	$154	$1,850	$1,850	$1,850
	Scarify road surface			0.25	Cat 14H grader	hrs	16	$198	$3,169	$3,169	$3,169
	Erosion barrier (50% of length)				Erosion Barrier	m2	250	$3	$703	$703	$703
	Engineering Design				% of Direct Costs	%	8%		$635	$635	$635
								Sub-Total	**$9,108**	**$9,108**	**$9,108**
12.3	**Bellekeno Haul Road**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (15 ea.)				Cat 235 Excavator	hrs	60	$154	$9,251	$9,251	$9,251
					General Labourer	hrs	60	$75	$4,500	$4,500	$4,500
	Re-slope banks/remove safety berms				Cat 235 Excavator	hrs	40	$154	$6,167	$6,167	$6,167
	Scarify road surface			5.7	Cat 14H grader	hrs	30	$198	$5,941	$5,941	$5,941
	Erosion barrier (50% of length)				Erosion Barrier	m2	5,700	$3	$16,038	$16,038	$16,038
	Engineering Design				% of Direct Costs	%	8%		$3,142	$3,142	$3,142
								Sub-Total	**$45,040**	**$45,040**	**$45,040**
12.4	**Keno City Bypass Road**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (5 ea.)				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					General Labourer		20	$75	$1,500	$1,500	$1,500
	Re-slope banks/remove safety berms				Cat 235 Excavator		24	$154	$3,700	$3,700	$3,700
	Scarify road surface			2.1	Cat 14H grader	hrs	16	$198	$3,169	$3,169	$3,169
	Erosion barrier (50% of length)				Erosion Barrier	hrs	12	$3	$34	$34	$34
	Remove Lightning Creek Bridge (Bellekeno)				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					Tractor Trailer (lowbed)	hrs	12	$260	$3,116	$3,116	$3,116
	Erosion barrier (50% of length)				Erosion Barrier	m2	2,100	$3	$5,909	$5,909	$5,909
	Engineering Design				% of Direct Costs	%	8%		$1,770	$1,770	$1,770
								Sub-Total	**$25,364**	**$25,364**	**$25,364**

Table 11-12: Roads and Trails (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (km)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
12.5	**Christal Lake Road**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (5 ea.)				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					General Labourer	hrs	30	$75	$2,250	$2,250	$2,250
	Re-slope banks/remove safety berms				Cat 235 Excavator	hrs	12	$154	$1,850	$1,850	$1,850
	Scarify road surface			1.3	Cat 14H grader	hrs	16	$198	$3,169	$3,169	$3,169
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,300	$3	$3,658	$3,658	$3,658
	Engineering Design				% of Direct Costs	%	8%		$1,051	$1,051	$1,051
								Sub-Total	**$15,061**	**$15,061**	**$15,061**
12.6	**Lucky Queen Haul and Access Road**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (2 ea.)				Cat 235 Excavator	hrs	40	$154	$6,167	$6,167	$6,167
					General Labourer	hrs	16	$75	$1,200	$1,200	$1,200
	Re-slope banks/remove safety berms				Cat 235 Excavator	hrs	10	$154	$1,542	$1,542	$1,542
	Scarify road surface			1.2	Cat 14H grader	hrs	12	$198	$2,376	$2,376	$2,376
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,200	$3	$3,376	$3,376	$3,376
	Engineering Design				% of Direct Costs	%	8%		$1,100	$1,100	$1,100
									$15,762	**$15,762**	**$15,762**
12.7	**Bermingham Haul and Access Road**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (2 ea.)				Cat 235 Excavator	hrs	32	$154	$4,934	$4,934	$4,934
					General Labourer	hrs	16	$75	$1,200	$1,200	$1,200
	Re-slope banks/remove safety berms				Cat 235 Excavator	hrs	10	$154	$1,542	$1,542	$1,542
	Scarify road surface			2.0	Cat 14H grader	hrs	4	$198	$792	$792	$792
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,979	$3	$5,568	$5,568	$5,568
	Engineering Design				% of Direct Costs	%	8%		$1,053	$1,053	$1,053
								Sub-Total	**$15,089**	**$15,089**	**$15,089**
12.7	**Duncan Creek Bypass**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (10 total)				Cat 235 Excavator	hrs	40	$154	$6,167	$6,167	$6,167
					General Labourer	hrs	19	$75	$1,440	$1,440	$1,440
	Re-slope banks/remove safety berms				Cat 235 Excavator	hrs	12	$154	$1,850	$1,850	$1,850
	Scarify road surface			2.4	Cat 14H grader	hrs	5	$198	$951	$951	$951
	Erosion barrier (50% of length)				Erosion Barrier	m2	2,400	$3	$6,753	$6,753	$6,753
	Engineering Design				% of Direct Costs	%	8%		$1,287	$1,287	$1,287
								Sub-Total	**$18,448**	**$18,448**	**$18,448**
12.8	**Other Roads and Trails**	**7.7**	**B-0301 & Fig 7-46**								
	Scarify road surface			3.0	Cat 14H grader	hrs	20	$198	$3,961	$3,961	$3,961
	Engineering Design				% of Direct Costs	%	8%		$297	$297	$297
								Sub-Total	**$4,258**	**$4,258**	**$4,258**
Total Estimated Cost for Roads & Trails									**$158,164**	**$158,164**	**$142,402**

Table 11-13: Water and Solutions Management

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
13.1	**Mill Runoff Collection & Process Pond**	**7.4.3**									
	Engineering Design				% of Direct Costs	%					
								Sub-Total	**$0**	**$0**	**$0**
13.2	**Diversion Ditches**										
	Recontour Diversion Ditch to Mill Pond			525	D7 Dozer	hrs	20	$229	$4,585	$4,585	$4,585
					Cat 235 Excavator	hrs	10	$154	$1,542	$1,542	$1,542
	Recontour Diversion Ditch above Mill Area			285	D7 Dozer	hrs	10	$229	$2,292	$2,292	$2,292
					Cat 235 Excavator	cu.m.	5	$154	$771	$771	$771
	Enhance Diversion Ditch above DSTF, to closure criteria			300	D7 Dozer	hrs	10	$229	$2,292	$2,292	$2,292
					Cat 235 Excavator	cu.m.	5	$154	$771	$771	$771
	Revegetate			1	Erosion barriers	m	500	$3	$1,407	$1,407	$1,407
	Engineering Design				% of Direct Costs	%	8%		$1,025	$1,025	$1,025
								Sub-Total	**$14,685**	**$14,685**	**$14,685**

Table 11-13: Water and Solutions Management (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
13.3	**Bellekeno 625 WTP - Mine Pool Treatment Transition**	**7.4.2**									
	625 Adit Coffer Dam (S.7.1.3)		S-0302								
	Underground Rehab for Coffer Dam				Misc.	lump sum	1	$11,540	$11,540	$11,540	$11,540
	Construct coffer dam				General Labourer	hrs	24	$75	$1,800	$1,800	$1,800
					Trades Labourer	hrs	24	$129	$3,102	$3,102	$3,102
	Concrete Batch				Misc.	cu.m	2	$2,019	$4,039	$4,039	$4,039
					966 loader	hrs	8	$136	$1,085	$1,085	$1,085
	Misc for concrete coffer dam (anchors, drainage pipe, etc.)				Misc.	lump sum	1	$5,770	$5,770	$5,770	$5,770
	Remove salvageable equipment				Cat 235 Excavator	hrs	16	$154	$2,467	$2,467	$2,467
					Trades Labourer	hrs	16	$129	$2,068	$2,068	$2,068
	Load & return extra reagents/chemicals				General Labourer	hrs	8	$75	$600	$600	$600
					Misc.		1	$2,308	$2,308	$2,308	$2,308
					Disposal by supplier		1	$2,000	$2,000	$2,000	$2,000
	In mine pool treatment implementation				Misc.	l.s.	1	$46,158	$46,158	$46,158	$46,158
	Characterize settling ponds sediments/sludge				Analytical Costs	Unit Cost	2	$346	$692	$692	$692
	Remove sludge from settling ponds (to underground)				Vacuum Truck	hrs		$173	$0	$0	$0
					General Labourer	hrs		$75	$0	$0	$0
	Remove settling ponds liners to landfill (liners remain in place for bioreactor)				Haul Truck D250E	hrs					
					General Labourer	hrs					
	Complete final design of bioreactor		D-2102		Misc.	lump sum	1	$11,540	$11,540	$11,540	$11,540
	Construct Bellekeno 625 bioreactor		D-2301		A30 Haul Truck	hrs	100	$218	$21,754	$21,754	$21,754
					966 loader	hrs	60	$136	$8,137	$8,137	$8,137
					Cat 235 Excavator	hrs	60	$154	$9,251	$9,251	$9,251
					General Labourer	hrs	60	$75	$4,500	$4,500	$4,500
					Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
					HDPE Liner Install	per sq. m	1,410	$14	$19,525	$19,525	$19,525
	Operate Bellekeno 625 bioreactor (included in Post Closure)				Misc.	years	10		$0	$0	$0
	Site levelling				D7 Dozer	hrs	25	$229	$5,731	$5,731	$5,731
	Scrap hauled to solid waste facility				A30 Haul Truck	hrs	8	$218	$1,740	$1,740	$1,740
					Cat 235 Excavator	hrs	12	$154	$1,850	$1,850	$1,850
	Haul BK 625 sludge from Valley Tailings to BK East UG				Cat 235 Excavator	hrs	30	$154	$4,626	$4,626	$4,626
					A30 Haul Truck	hrs	40	$218	$8,702	$8,702	$8,702
	Misc. Supplies & Tools				Misc.	l.s.	1	$8,655	$8,655	$8,655	$8,655
	Engineering Design				% of Direct Costs	%	8%		$14,303	$14,303	$14,303
								Sub-Total	**$205,003**	**$205,003**	**$205,003**

Table 11-13: Water and Solutions Management (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
13.4	**Mill Pond - Bioreactor Transition**										
	Discharge mill pond inventory (3,500 m3)				Analytical Costs	Unit Cost	6	$346	$2,077	$2,077	$2,077
					General Labourer	hrs	10	$75	$750	$750	$750
					Environmental Monitor	hrs	10	$133	$1,327	$1,327	$1,327
	Construct bioreactor in mill pond if necessary (DSTF runoff + Flame and Moth if necessary). Costs included in post closure care and maintenance (T.15.3.2)										
	Operate mill bioreactor if necessary (15 years) costs included in Care and Maintenance (T.15.3.2)										
	Construct outlet channel				Cat 235 Excavator	hrs	20	$154	$3,084	$3,084	$3,084
					D7 Dozer	hrs	20	$229	$4,585	$4,585	$4,585
					Place rip rap	cu.m.	5	$1,442	$7,212	$7,212	$7,212
					General Labourer	hrs	30	$75	$2,250	$2,250	$2,250
	Engineering Design				% of Direct Costs	%	8%		$1,596	$1,596	$1,596
								Sub-Total	**$22,882**	**$22,882**	**$22,882**

Table 11-13: Water and Solutions Management (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
13.5	**Flame and Moth Water Management**	**7.4.3**									
	Pump down collected water				General Labourer	hrs	36	$75	$2,700	$2,700	$2,700
					Pump	daily	3	$115	$346	$346	$346
	Misc. Supplies and Tools				Misc.	l.s.	1	$1,154	$1,154	$1,154	$1,154
	Characterize pond sediments/sludge				Analytical Costs	Unit Cost	2	$346	$692	$692	$692
					General Labourer	hrs	2	$75	$150	$150	$150
	Remove pond sediments/sludge (240 m3)				Vacuum Truck	hrs	16	$173	$2,769	$2,769	$2,769
					General Labourer	hrs	16	$75	$1,200	$1,200	$1,200
	Breach dyke				D7 Dozer	hrs	4	$229	$917	$917	$917
	Remove & bury HDPE liner (1620 m2)				General Labourer	hrs	40	$75	$3,000	$3,000	$3,000
					Cat 235 Excavator	hrs	12	$154	$1,850	$1,850	$1,850
					A30 Haul Truck	hrs	4	$218	$870	$870	$870
	Recontour area				D7 Dozer	hrs	30	$229	$6,877	$6,877	$6,877
			C-6401		Cat 235 Excavator	hrs	30	$154	$4,626	$4,626	$4,626
	Stabilize slopes with erosion barriers				Cat 235 Excavator	hrs	30	$154	$4,626	$4,626	$4,626
					Erosion Barrier	per sq. m	100	$3			$281
	Remove discharge pipeline				General Labourer	hrs	30	$75	$2,250	$2,250	$2,250
	Discharge pond inventory (5,000 m3)				Analytical Costs	Unit Cost	6	$346	$2,077	$2,077	$2,077
	Engineering Design				% of Direct Costs	%	8%		$2,708	$2,708	$2,708
								Sub-Total	**$38,814**	**$38,814**	**$38,814**

Table 11-13: Water and Solutions Management (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
13.6	**Bermingham Water Storage / Settling Pond**	**7.4.4**									
	Pump down collected water				General Labourer	hrs	10	$75	$750	$750	$750
					Pump	daily	6	$115	$692	$692	$692
	Misc. Supplies and Tools				Misc.	l.s.	1	$865	$865	$865	$865
	Characterize pond sediments/sludge				Analytical Costs	Unit Cost	2	$346	$692	$692	$692
					Environmental Monitor	hrs	8	$133	$1,062	$1,062	$1,062
	Remove pond sediments/sludge				Vacuum Truck	hrs	8	$173	$1,385	$1,385	$1,385
					General Labourer	hrs	12	$75	$900	$900	$900
	Remove & bury HDPE liner				General Labourer	hrs	12	$75	$900	$900	$900
					Cat 235 Excavator	hrs	8	$154	$1,233	$1,233	$1,233
					A30 Haul Truck	hrs	4	$218	$870	$870	$870
	Recontour area				D7 Dozer	hrs	8	$229	$1,834	$1,834	$1,834
	Stabilize slopes with erosion barriers				Cat 235 Excavator	hrs	8	$154	$1,233	$1,233	$1,233
					Erosion Barrier	per sq. m	200	$2.81	$563	$563	$563
	Remove discharge pipeline				General Labourer	hrs	6	$75	$450	$450	$450
	Engineering Design				% of Direct Costs	%	8%		$1,007	$1,007	$1,007
								Sub-Total	**$14,438**	**$14,438**	**$14,438**
									$295,822	**$295,822**	**$295,822**

Table 11-14: Interim Care and Maintenance

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Full Cost (24 months)
14.1	**Personnel**					
	On-site Caretaker					
	100% AKHM, no cost share with ERDC (2 people rotating, 1 week in/out)	Site Caretaker, Operator	$/day	730	$1,124	$820,234
	Extra Personnel					
	Electrician (3 days every other month)	Trades Labourer	$/hr	432	$129	$55,833
	Mechanic (3 days every other month)	Trades Labourer	$/hr	432	$129	$55,833
	Supervisor (5 days/month on site)	Site Supervisor	$/day	120	$1,561	$187,268
	Camp Costs					
	for above personnel	Camp Cost	mandays	994	$86	$85,484
	Employee Transport Costs					
	Driving in allowance (Whitehorse based)	Employee Transport Costs	monthly	6	$4,039	$24,233
	Driving in allowance (Mayo based)	Employee Transport Costs	monthly	18	$2,308	$41,542
					Sub-total Personnel	**$1,270,428**
14.2	**Equipment**					
	Small Excavator (1)	Misc.	monthly	24	$1,000	$24,000
	Small Dozer (1)	Misc.	monthly	24	$1,000	$24,000
	Small Loader (1)	Misc.	monthly	24	$1,000	$24,000
	Pick-Up Truck (1)	Misc.	monthly	24	$2,500	$60,000
	Snow Machine & ATV	Misc.	monthly	24	$350	$8,400
					Sub-total Equipment	**$140,400**
14.3	**Monitoring**					
	Water Quality Monitoring	Misc.	monthly	24	$7,756	$186,140
	Interim water treatment (active BK-625)	Misc.	monthly	24	$0	$0
	Biological Monitoring	Misc.	annually	1	$7,500	$7,500
	Geotechnical Assessments	Misc.	each	2	$18,000	$36,000
	Enhanced Groundwater/Foundation monitoring	Misc.	each	2	$18,000	$36,000
	Monitoring of piezometers and thermistors	Misc.	each	4	$4,000	$16,000
	Communications & reporting	Misc.	monthly	24	$1,200	$28,800
					Sub-total Monitoring	$**310,440**
14.4	**Miscellaneous**					
	Misc Supplies	Misc.	monthly	24	$3,462	$83,085
	Fuel (500 l/month)	Misc.	$/litre	12,000	$1.75	$21,000
	Power and heat	Power and Heat	monthly	24	$6,714	$161,136
	General Administrative expenses	Unit Cost Basis	monthly	24	$2,308	$55,390
					Sub-total Misc.	**$320,610**
					Total 2-year Interim C&M	**$2,041,878**

Table 11-15: Post Closure, Care, Maintenance and Monitoring

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Annual Cost	Full Cost	NPV Current	NPV Year 2	NPV EOM
15.1	**Onsite Monitoring**									
	Pickup trucks									
	3 days per month to complete monthly monitoring			9	$624	$5,618	$11,236			
	Sundry equipment maintenance									
	Post Closure 15 Years			9		$2,885	$25,964			
	Power and heat (na)									
	Post Closure 15 Years			9		$2,885	$25,964			
	General Administrative expenses									
	Post Closure 15 Years			9		$3,750	$33,753			
	Camp Costs/Per diem									
	Post Closure 15 Years	Unit Cost Basis	man-day	900	$86	$7,740	$77,400			
	Subtotal - Post Closure 15 Years					**$17,432**	**$174,317**	**$197,295**	**$186,583**	**$132,240**
15.2	**Transport Costs**									
	Employee transport costs									
	Post Closure 15 Years	Unit Cost Basis	Years	15		$27,695	$415,423			
	Subtotal – Post Closure 15 years						$415,423	**$52,937**	**$50,587**	**$38,668**
15.3	**Water Treatment Costs**									
15.3.1	Active Treatment (Active treatment at BK 625 & Berm for 2 year)	Misc	monthly							
	Capital Costs	Misc.	annually							
	Capital Replacement Costs	Misc.	annually							
	Operating Costs	Misc.	annually	-			$920,143	$920,143	$920,143	$920,143
15.3.2	Passive Treatment (In situ + bioreactor)									
	Capital Costs (Bellekeno & Mill Pond)	Misc.	ls	1			$126,935	$126,935	$126,935	$126,935
	Capital Costs (Bermingham)						$46,158	$46,158	$40,000	$40,000
	Operation and Maintenance Costs	Misc.	annually	15		$12,746	$191,187	$146,994	$138,295	$94,167
	Subtotal - Post Closure 15 Years						**$1,284,423**	**$1,240,230**	**$1,225,373**	**$1,181,245**

Table 11-15: Post Closure, Care, Maintenance and Monitoring (continued)

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Annual Cost	Full Cost	NPV Current	NPV Year 2	NPV EOM
15.4	**Reclamation & Closure Plan**									
	Reclamation and Closure Plan	**Misc**	annually	-	$0	$0	$0			
	Subtotal - Post Closure 15 Years						**$0**		**$0**	**$0**
15.5	**Monitoring & Reporting (Sec 7.9)**	Misc.								
15.5.1	Disbursements (non-labour/non-analytical)		annually	15		$5,231	$78,469	$62,005	$59,057	$44,104
15.5.2	Water Quality Monitoring	Misc.								
	Active Closure 2 year + Post Closure Years 1-5	Misc.	each	188		$86,547	$605,826	$526,145	$502,862	$384,745
	Post Closure Years 6-15		each	126		$36,927	$184,633	$120,908	$112,934	$72,483
15.5.3	EEM Monitoring									
	Biological Monitoring (Sediment, Benthos, Toxicity):									
	Active Closure 2 year + Post Closure Years 1-5	Misc.	annually	7	$4,000	$4,000	$40,388	$35,076	$33,524	$25,650
	Post Closure Years 6-15	Misc.	annually	8	$4,000	$4,000	$23,079	$14,856	$13,876	$8,906
	Radium- (Quarterly at 4 mines for 2 Years Active Closure)		each	32	$130	$4,160	$6,240	$3,120	$3,120	$6,240
15.5.4	Geotechnical Inspections									
	Active Closure + Post Closure Years 1-15	Misc.	annually	15		$4,231	$63,467	$49,932	$47,400	$34,556
15.5.6	Reclamation Inspections:									
	Active Closure + Post Closure Years 1-15	Misc.	annually	15		$4,231	$63,467	$49,932	$47,400	$34,556
15.5.7	Site Maintenance									
	Active Closure + Post Closure Years 1-15	Misc.	each	15		$3,577	$53,659	$43,076	$40,996	$30,445
15.5.8	Annual Inspection + report - Active and Post Closure yrs 1-15	Misc.	annually	15		$4,000	$69,237	$52,243	$49,406	$35,016
						Sub-Total	**$1,188,466**	**$957,291**	**$910,575**	**$676,700**
Total Estimated Cost for Compliance Monitoring and Reporting							**$3,062,629**	**$2,447,754**	**$2,373,119**	**$2,028,852**

Table 11-15: Post Closure, Care, Maintenance and Monitoring (continued)

B-625 & Berm Active Water Treatment	
Manpower: as per Alexco	**2,885**
Vacuum truck: every 3d for 3hrs@ $120/hr	4,154
Camp costs: 1/4 manday/d, 30d/mo @ $65/d	563
Lime: as per Alexco	2,077
Ferric chloride	
Power: as per Alexco	2,885
Maintenance of facilities: as per Alexco	692
Replacement of equipment & parts @ $4k/yr	384
WQ analyses, internal 2/week @ $200 each	1,846
Winter road access: grader 3h/week x 6mo/yr @$270/hr	1,869
Misc Supplies: consumables	231
Other (9%)	1,583
Treatment Operation at BK 625 / month	**$19,170**

Table 11-17: Resource Schedule

		Year 1 - ICM				Year 2 - ICM				Year 3 - Active Closure				Year 4 - Active Closure				Post Closure Monitoring Maintenance													
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17
	Total Hrs																													
General Labourer	3354										838.55	838.55			838.55	838.55														
Equipment Operator	8090										2022.383	2022.383			2022.383	2022.383														
Trades Labourer	2044										511	511			511	511														
Site Supervisor	2754									459	459	459		459	459	459														
Design Engineer	539										134.683	134.683			134.683	134.683														
Project Manager	2598									433	433	433		433	433	433														
Camp Labourer	0										0	0			0	0														
Site Caretaker	17520	2190	2190	2190	2190	2190	2190	2190	2190	2190			2190	2190																
Field Engineer QA/QC	0																													
Environmental Monitor	9118	259	259	259	259	259	259	259	259	200	200	200	200	200	200	200	200	774	774	774	774	774	209	296	209	296	209	296	209	296
Camp man-days/month	153	82	82	82	82	82	82	82	82	109	153	153	80	109	153	153	7	6	6	6	6	6	2	2	2	2	2	2	2	2
# Of Personnel																														
General Labourer		0	0	0	0	0	0	0	0	0	2	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment Operator		0	0	0	0	0	0	0	0	0	10	10	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trades Labourer		0	0	0	0	0	0	0	0	0	2	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Site Supervisor		0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Design Engineer		0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project Manager		0	0	0	0	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Camp Labourer		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Site Caretaker		2	2	2	2	2	2	2	2	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Field Engineer QA/QC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Environmental Monitor		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Specialist Contractors																														
Total Headcount		3	3	3	3	3	3	3	3	5	18	18	3	5	18	18	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Keno Hill Mine Operations LOM Plan & Decommissioning and Reclamation Plan

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APPENDIX 1

RECLAMATION RESEARCH SUMMARY REPORTS

APPENDIX 1.1

DRY STACK TAILINGS FACILITY COVER SYSTEM PERFORMANCE AND MONITORING PLAN

Dry Stack Tailings Facility Cover System Performance Monitoring Plan

October 22, 2025



Hecla® MINING COMPANY

okane

Integrated Mine Closure and Relinquishment Solutions

Dry Stack Tailings Facility Cover System Performance Monitoring Plan

B-778-222-RPT-001

October 22, 2025

Prepared for:

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0	DRAFT	August 8, 2025	EE/LB		
0	FINAL	October 16, 2025	EE/LB	DChristensen	Minor changes based on client feedback

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EXECUTIVE SUMMARY

Okane Consultants (Okane) has been retained by Hecla Keno Hill (Hecla) to develop a detailed performance monitoring program to understand the performance of the base case cover system for the Dry Stack Tailings Facility (DSTF) located at the Keno Hill Silver District (KHSD) site in Yukon Territory. The DSTF base case closure cover system design consists of 0.5 m of growth medium overlying the dry-stacked tailings. The growth medium is a till material that is classified as a sandy loam mixed with some organic material. Phase 1 of the DSTF has been progressively reclaimed with this growth medium, while tailings deposition continues in Phase 2. The performance monitoring program outlined herein has been designed to evaluate key performance indicators including the hydrological and meteorological components of the cover system water and energy balance, erosion, vegetation, and seepage water quality.

To evaluate the performance of the cover system, the installation of performance monitoring instrumentation on the covered portion of the DSTF landform is recommended, as well as implementation of a monitoring plan to collect cover system water balance, erosion, vegetation, and seepage water quality data. The recommended performance monitoring instrumentation consists of one monitoring station installed on the existing Phase 1 DSTF cover system at a location that is field verified to be 0.5 m thick. A series of in situ soil and meteorological sensors will collect measurements needed to complete a water and energy balance and thus to estimate the net percolation (NP) through and the water holding capacity of the cover system. Additional meteorological sensors will provide surface and aspect specific measurements to supplement the meteorological data collected by the District Mill meteorological station.

Sensor data will be recorded automatically at regular intervals and retrieved monthly for data quality assurance/quality control (QA/QC). Instrumentation inspections, maintenance, and calibrations should be performed regularly to maintain data quality and integrity. Periodic site visits are required to complete inspections and assure all systems are functioning correctly and to troubleshoot any issues that arise. Manual snow surveys are recommended to be completed monthly during the winter by Hecla personnel to measure bulk densities of snow to estimate snow water equivalent for the water balance.

The performance monitoring plan includes regular inspections of the DSTF covered landform to evaluate the cover system performance in terms of erosion, vegetation, and seepage water quality. Performance criteria for each of these monitoring categories, along with the cover system itself, are not presently defined but will be required to demonstrate to stakeholders that the cover system objectives are achieved.

Erosion monitoring will include annual visual monitoring after construction. Annual remote surveys are also recommended to monitor erosion features and capture landform geomorphic losses of sediment. An erosion risk classification system will aid in tracking the progression of issues and to indicate whether repairs are necessary.

Vegetation monitoring is recommended for the cover system revegetation trial area as well as that which will develop on the remainder of the Phase 1 covered area. Revegetation performance should be quantified through *in situ* monitoring techniques such as permanent sampling transects and quadrats within the revegetated area. Indicators such as soil properties, ground coverage, and plant diversity should be monitored according to the Yukon revegetation manual (Matheus and Omtzigt, 2013). The drone photogrammetry recommended for erosion monitoring can also be utilized to monitor vegetation progression.

A seepage water quality testing plan is provided in the event that seepage from the DSTF is observed, and for alignment with the current site program. Quarterly sampling and testing of seepage water is recommended, using CCME standard methods (CCME, 2007). Water quality results should be compared with Health Canada water quality guidelines (2012 and 2014) as well as any site-specific performance quality guidelines that are developed for KHSD.

TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 Project Objectives and Scope 1
1.2 Report Organization 1
2 BACKGROUND 3
2.1 Project Background 3
2.2 Cover System Objectives 5
2.3 Base Case Closure Design 5
3 PERFORMANCE MONITORING SYSTEM 7
3.1 Monitoring System Objectives 7
3.2 Monitoring System Location 7
3.3 In Situ Soil Monitoring System 8
3.4 Meteorological Monitoring System 8
3.5 Data Acquisition System 10
4 PERFORMANCE MONITORING PLAN 11
4.1 Soil and Meteorological Monitoring Station 11
4.2 Erosion and Vegetation Monitoring 12
4.2.1 Erosion Monitoring 12
4.2.2 Vegetation Monitoring 15
4.3 Seepage Water Quality Monitoring 16
5 CLOSURE 19
6 REFERENCES 20

Appendix A Drawings

Appendix B Monitoring and Maintenance Inspection Checklist Examples

Appendix C DSTF Weekly Visual Inspection Checklist

LIST OF TABLES

Table 4.1: Erosion observation risk classification and mitigations 14
Table 4.2: Vegetation Performance Indicator Field Sampling Methodologies 16

LIST OF FIGURES

Figure 2.1: KHSD DSTF Phase 1 and Phase 2 Final Construction Plan. 3
Figure 2.2: KHSD Monthly Mill Tailings Composite Testing, Neutralization Potential Ratio. 4

LIST OF DRAWINGS

0778-222-000 Drawing Index, Cover Sheet, Locality Map

0778-222-001 General Arrangement

0778-222-002 Instrumentation Plan

0778-222-003 Instrumented Profile

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Meaning
AEG	Alexco Environmental Group
AET	Actual evapotranspiration
AWHC	Available water holding capacity
BCMOE	British Columbia Ministry of Environment
CCME	Canadian Council of Ministers of Environment
COPC	Constituent of potential concern
CS	Campbell Scientific
DAS	Data acquisition system
DEM	Digital elevation model
DSTF	Dry Stack Tailings Facility
EOR	Engineer of Record
FMEA	Failure modes and effects analysis
GCL	Geosynthetic clay liner
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICP-OES	Inductively Coupled Plasma Optical Emission Spectroscopy
KHSD	Keno Hill Silver District Mining Operations
LEM	Landform Evolution Modelling
MAP	Mean annual precipitation
NAG	Non-acid generating
NML	Non-metal leaching
NP	Net percolation
OMS	Operations, Maintenance & Surveillance
PAG	Potentially acid generating
QA/QC	Quality assurance/quality control
RCP	Reclamation and Closure Plan
RE	Reference evapotranspiration
RH	Relative humidity
SWE	Snow water equivalent
VWC	Volumetric water content
VWP	Vibrating wire piezometer
WEPP	Water Erosion Prediction Project
WQG	Water quality guideline

1 INTRODUCTION

Hecla Keno Hill (Hecla) has begun progressive reclamation of the Dry Stack Tailings Facility (DSTF) located at the Keno Hill Silver District (KHSD) Mining Operation in Yukon Territory. The DSTF is being constructed in phases: Phase 1 is complete and is being progressively reclaimed, while tailings placement continues on Phase 2. Progressive reclamation of the DSTF involves placement of a 0.5 m thick growth medium layer composed of mixed till and organic overburden salvaged during site activities.

Hecla has retained Okane Consultants (Okane) to develop a detailed monitoring program to understand the performance of the base case cover system. The performance monitoring program outlined herein has been designed to evaluate key performance indicators including the hydrological and meteorological components of the cover system water and energy balance, erosion, vegetation, and seepage water quality.

1.1 Project Objectives and Scope

Performance monitoring is the optimal method for demonstrating to stakeholders how a cover system design is performing and to advise upon future phases of progressive reclamation. A Risk and Opportunity Workshop completed with Hecla personnel (Okane, 2025a) recommended that the DSTF Phase 1 base case cover system be monitored to determine performance in regard to net percolation (NP), integrity, and revegetation, as well as to collect data to inform upon any recommended modifications to cover system design for implementation on the DSTF Phase 2.

The objectives of the recommended monitoring components include:

- Measuring or estimating components of the water and energy balance to complete a cover system water balance;
- Estimating the available water holding capacity (AWHC) of the cover system to determine capacity to support vegetation;
- Monitoring the integrity of the cover system;
- Monitoring developments of vegetation on the cover system; and
- Monitoring seepage water quality.

1.2 Report Organization

For convenient reference, this report has been subdivided into the following sections:

- Section 2 – Background;

- Section 3 – Performance Monitoring System;
- Section 4 – Performance Monitoring Plan; and
- Section 5 – Closure

2 BACKGROUND

Okane has been providing ongoing support to Hecla for update of the Reclamation and Closure Plan (RCP) for KHSD and the DSTF. Previous work has included a Risk and Opportunity Workshop (Okane, 2025a) and an Objectives Workshop (Okane, 2025c) for the DSTF cover system. A site visit was conducted in June 2025 during which Okane inspected the DSTF and the material stockpiles intended to be used for cover system construction (Okane, 2025b).

2.1 Project Background

Keno Hill Silver District is located 450 km north of Whitehorse near Keno City in central Yukon Territory. The project includes a series of underground silver, lead, and zinc mines with a centralized mill. Tailings from the various stages of mining are taken from the mill and placed in the DSTF located adjacent to the District Mill site. The DSTF is separated into Phase 1 and Phase 2 areas (Figure 2.1); Phase 1 has been partially reclaimed, while tailings placement continues in Phase 2.

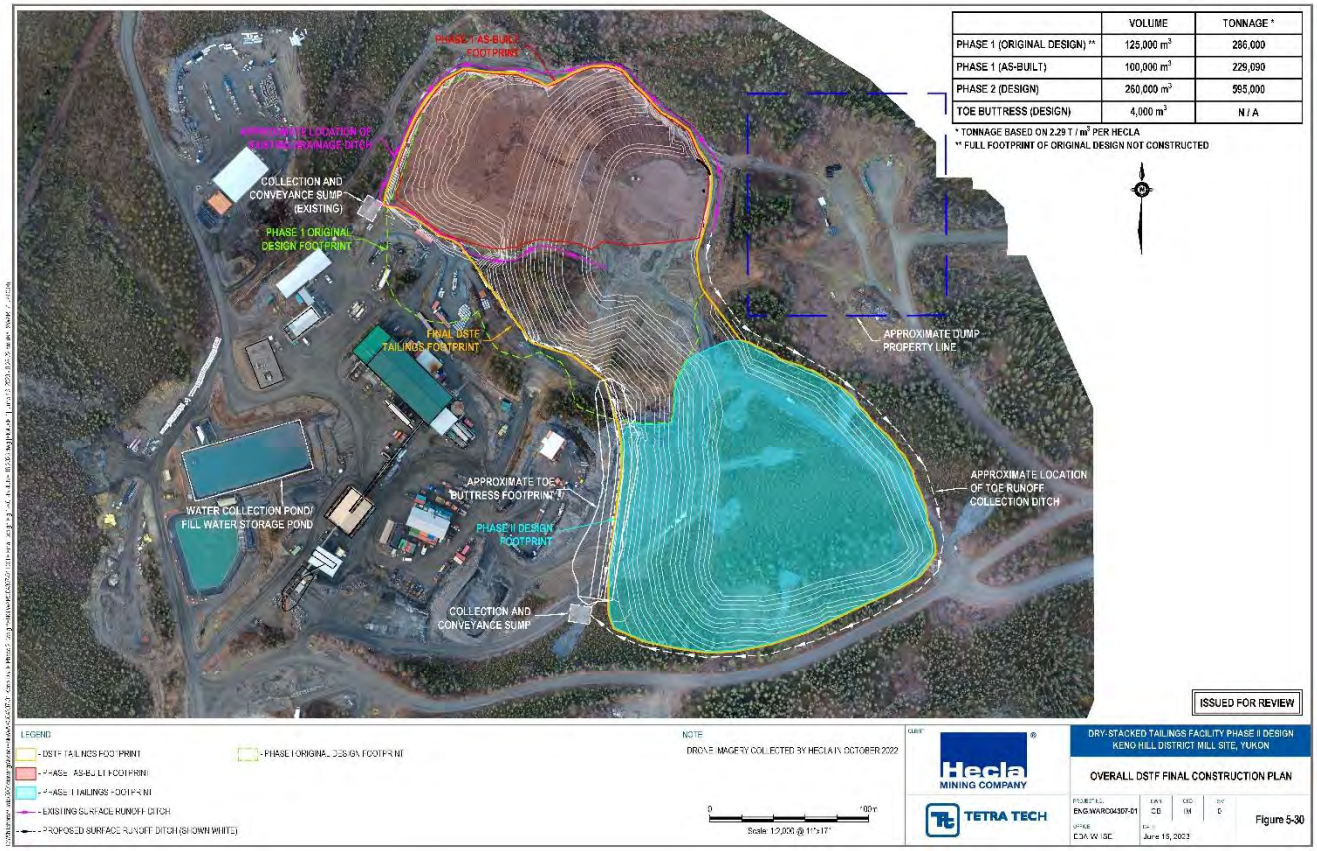

Figure 2.1: KHSD DSTF Phase 1 and Phase 2 Final Construction Plan.

Hecla Keno Hill, 2023

The majority of the tailings produced to date have been placed in Phase 1, including tailings from Bellekeno Mine. Some tailings from Flame of Moth and New Birmingham Mines were placed in Phase 1b. Phase 2 East contains tailings from Flame of Moth and New Birmingham Mines and has capacity for approximately another 18 months of tailings production. Future expansion is planned into Phase 2 West, which is currently in the design stage. Both phases of the DSTF are constructed by placing tailings in lifts over a geosynthetic clay liner (GCL) to collect seepage drainage. The lifts are compacted and roller-sealed, with a construction target of 95% of Standard Proctor density. Saturated tailings have been encountered directly above the GCL, indicating that the seepage drain may not be functioning as intended. Perimeter ditching around the DSTF is designed to collect surface water, which is to be directed to the Mill Pond in the long-term design for the facility.

The Phase 1 DSTF tailings were classified as non-acid generating (NAG) and non-metal-leaching (NML). Phase 1 tailings deposited later in landform development, and Phase 2 tailings, were classified as uncertain with respect to acid generation and had a low level of metal leaching potential. All tailings samples tested in 2024 were classified as uncertain or potentially acid generating (PAG) (Ensero Solutions, 2025). Samples of placed tailings are collected and tested for acid generating potential on a monthly basis (Figure 2.2), and additional characterization is underway, including a humidity cell testing program that began in 2024.

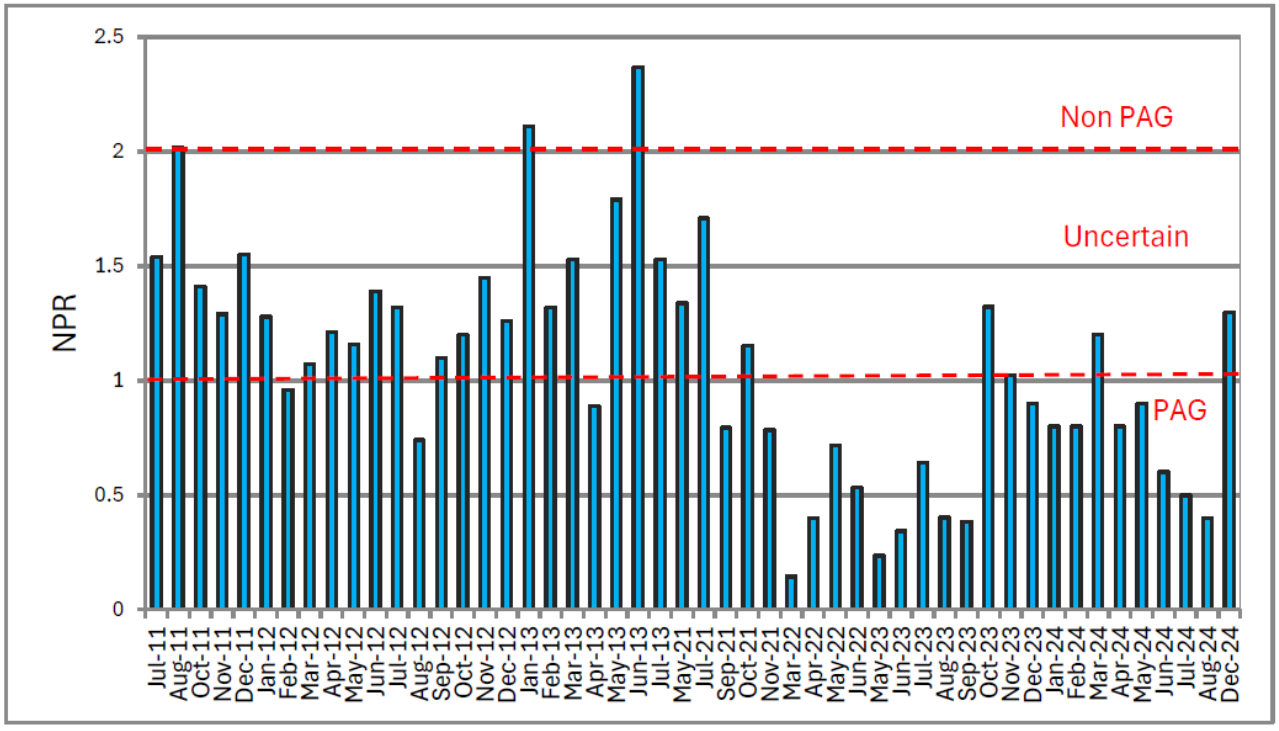

Figure 2.2: KHSD Monthly Mill Tailings Composite Testing, Neutralization Potential Ratio.

Ensero Solutions, 2025

Closure work for the DSTF has included annual geotechnical inspections completed by Tetra Tech dating back to 2011, installation of geotechnical monitoring equipment in 2024, a cover system field trial constructed in 2012 (Access Consulting Group, 2013), and a failure modes and effects analysis (FMEA) completed by SRK Consulting in 2013 (SRK, 2013) and updated by Hecla in 2024. The physical stability of the DSTF cover system was raised as a concern during the 2022 and 2023 geotechnical inspections (Tetra Tech, 2023a and 2023b), as inspectors observed several small piping failure exits, erosion gullies, and sloughing of the cover system material on the north slope. The stability issues were assessed in the 2024 FMEA, and a medium risk ranking was given to two failure modes:

- Large differential settlement in the long-term (~50 years) leading to tailings exposure on the surface from compromised covers (Likely, minor/moderate environmental consequence).
- Large precipitation event erodes through the surface cover, exposes the tailings resulting in transport of tailings into natural environment (Unlikely, moderate special considerations consequence).

2.2 Cover System Objectives

The objectives of the DSTF cover system were discussed and revised during the Cover System Objectives Workshop, attended by Hecla, Okane, and Tetra Tech personnel (Okane, 2025c). The cover system closure objectives outlined during the workshop were:

- Ensure geotechnical and geochemical stability of the DSTF.
- Effectively manage surface water runoff to limit erosion.
- Reduce water infiltration to the DSTF.
- Minimize safety risks to people and wildlife.
- Reclaim the site to meet end land use objectives.

Discussion of these objectives is ongoing, and modifications may be made in future phases of work.

2.3 Base Case Closure Design

The base case closure design for the DSTF is outlined in the KHSD RCP, developed and last submitted by Hecla in 2023 (Hecla Keno Hill, 2023). The closure cover system for the DSTF provided in the RCP is a cover system consisting of a 0.5 m thick layer of growth medium. The growth medium is composed of mixed till and organic overburden salvaged during site activities. The DSTF is to be progressively covered and reclaimed over the life of the facility. The cover system is to be seeded with a native vegetation mix for slope stabilization and backtracked parallel to the slope for erosion prevention. The material intended for cover system construction was stockpiled during construction of the mill site infrastructure and has

been classified as a sandy loam with some granular and organic material (Drawing no. 0778-222-001, Appendix A). Okane recommends removing large organic debris (large trees and roots) from the stockpile before placing the material (Okane, 2025b). The large organic debris could potentially be placed on the surface to assist with micro-topography creation for erosion control, moisture retention, and vegetation growth.

3 PERFORMANCE MONITORING SYSTEM

The proposed DSTF performance monitoring system design includes automated instrumentation to collect measurements of meteorological and in situ soil conditions required to complete a cover system water balance and energy balance. Okane has developed the performance monitoring design to utilize existing on-site monitoring equipment and capabilities where possible.

3.1 Monitoring System Objectives

The water balance method uses measured or estimated water fluxes in mm/day to solve the water balance equation (Equation 1) and estimate NP as a percentage of mean annual precipitation (MAP) for a cover system.

Equation 1: $$\boldsymbol{NP = P - AET - R - \Delta S}$$

where:

- NP = net percolation
- P = precipitation
- AET = actual evapotranspiration
- R = runoff
- ΔS = change in soil water storage

The purpose of the in situ soil and meteorological monitoring systems is to provide measurements or estimates of the components of the water balance in order to estimate the resulting NP. The performance of the cover system can then be evaluated based on the relative reduction of NP and whether it meets closure objectives and criteria, which are currently being developed for the KHSD DSTF.

3.2 Monitoring System Location

The recommended performance monitoring system consists of one instrumentation nest installed approximately one third of the distance from the top of a covered slope on the DSTF. The instrumentation will be installed at a location where the cover system has been field verified as 0.5 m thick. The proposed location (Drawing no. 0778-222-002, Appendix A) has been selected based on observations of the existing cover system constructed on Phase 1b of the DSTF during Okane's June 2025 site visit, including cover thickness field verification (Okane, 2025b). The exact location of the monitoring system will depend on approval from Hecla and may be adjusted during installation; field verification will be completed prior to installation, by test pit excavation and logging.

3.3 In Situ Soil Monitoring System

Soil monitoring sensors will be installed throughout the cover system profile and focused where most hydrologic process dynamics occur – for example, at the cover system surface and at textural interfaces. Sensor placement at the interfaces of material layers, specifically where a textural discontinuity exists, as well as at the soil-plant-atmosphere interface, allows for robust interpretation of field performance. The base case cover system is a monolithic growth medium layer, and therefore sensors will be distributed relatively uniformly throughout the cover system profile and in the top of the tailings material. Drawing no. 0778-222-003 (Appendix A) shows the general configuration and depths of the sensors. The following in situ soil monitoring instrumentation will be installed in the instrumentation nest:

- Six (6) Campbell Scientific (CS) 616 water content reflectometers (Campbell Scientific, 2020) to measure changes in volumetric water content (VWC) throughout the cover system profile.
- Six (6) CS 229 heat dissipation sensors (Campbell Scientific, 2009) to measure changes in negative pore water pressure (matric suction) throughout the cover system profile.

These sensors will collect data to be used in estimation of the ΔS component of the water balance and to provide information on cover system freezing timing and depth, water cycling, AWHC, vegetation growing season, and hydraulic gradient within the profile. The runoff component of the water balance will be estimated using the water balance method and Precipitation, ΔS, and surface material characterization data. Automated measurements from the in situ soil monitoring sensors will be taken at 4 or 6 hour intervals to allow for capture of soil water dynamics.

3.4 Meteorological Monitoring System

Local meteorological conditions will provide inputs to the actual evapotranspiration and precipitation components of the water balance and influence other metrics used to evaluate performance in regard to NP, such as subsurface soil temperatures and water content. Actual evapotranspiration can be estimated by calculating reference evapotranspiration (RE), using the Penman-Monteith method (Allen et al. 1998), with soil matric suction and soil water storage as limitations. The RE calculation requires input of air temperature, relative humidity (RH), wind speed, and net radiation data.

Data from the District Mill meteorological station will be used as inputs to precipitation and RE calculations for the water balance AET parameter and supplemented with meteorological instruments installed on the DSTF cover system. The District Mill meteorological station was initially installed in 2011 at 936 meters above sea level (masl) and relocated in 2022 to its current location at 900 masl near the Flame of Moth Portal (Drawing 0778-222-001 in Appendix A). The District Mill meteorological station has collected air temperature, RH, rainfall, wind speed, solar radiation, and barometric pressure data since 2011, with the following sensors:

- One (1) CS HMP45C212 temperature and relative humidity probe (Campbell Scientific, 2010)

- One (1) TE525M tipping bucket rain gauge (Campbell Scientific, 2024b)
- One (1) R.M. Young 05103AP-10 wind monitor (Campbell Scientific, 2004)
- One (1) SP Lite2 silicon pyranometer (Campbell Scientific, 2017b)
- One (1) CS106 barometric pressure sensor (Campbell Scientific, 2017a)

Records indicate that these sensors were last calibrated during the meteorological station relocation in 2022 (Hecla Keno Hill, 2024b). It is recommended that the sensors be sent to the instrumentation supplier for recalibration as soon as possible and be inspected or recalibrated every one to two years following, as outlined in the instrumentation manuals.

In 2024, the following sensors were added to the District Mill meteorological station to allow collection of snow depth, snow water equivalent (SWE), and net radiation data:

- One (1) SnowVUE 10 digital snow-depth sensor (Campbell Scientific, 2024a)
- One (1) CS705 snowfall adaptor (Campbell Scientific, 2022a)
- One (1) SN500SS net radiometer (Campbell Scientific, 2024c)
- One (1) GEONOR T-200B series precipitation gauge (Campbell Scientific, 2011)

It is recommended that these sensors be inspected or calibrated every six months to three years, depending on the sensor, as detailed in the instrumentation manuals.

Net radiation, snow depth, and rainfall can be surface, aspect, and elevation specific. These parameters have substantial influence on the water balance as they inform upon timing of cover system freezing, precipitation inputs, and seasonal daylength and aspect insolation differences. As such, it is recommended that net radiation, snow depth, and rainfall also be measured directly on the DSTF cover system surface to capture the different elevation and aspect. The following meteorological instrumentation is recommended for installation on the DSTF cover system:

- One (1) Kipp and Zonen NR-LITE2 sensor to measure net radiation (Campbell Scientific, 2016)
- One (1) SnowVUE10 ultrasonic sensor to measure snow depth (Campbell Scientific, 2024a)
- One (1) EML ARG314 rain gauge to measure rainfall (Campbell Scientific, 2022b)
- One (1) trail camera to monitor snowmelt timing

The meteorological sensors will be installed on a combined cover system monitoring station with the in situ soil instrumentation. Automated measurements of meteorological parameters will be taken every 60

seconds, and output in hourly and daily tables, as well as event tables for rainfall. Trail camera installation is recommended for recording snowmelt timing. Automated photographs will be taken by the trail camera once per day and stored on the camera SIM card.

3.5 Data Acquisition System

The soil and meteorological monitoring sensors will be connected to an automated data acquisition system (DAS) installed in proximity to the in situ soil instrumentation nest. The DAS will consist of a datalogger, housed in a weatherproof fibreglass enclosure, and powered by a 12V, 55Ahr rechargeable battery and a 30W or 50W solar panel. This DAS setup ensures redundancy in power sources and reduces risk for data gaps due to power loss. It is recommended that remote connection be planned for the DAS to allow offsite data downloads and troubleshooting. It is recommended that incorporation of the DAS into the existing remote communication networks on site be explored, such as incorporation into the automated DAS for the geotechnical instrumentation that was installed as part of the Phase 1 DSTF geotechnical site investigation in 2024.

4 PERFORMANCE MONITORING PLAN

Performance monitoring of the DSTF base case cover system will include collection of soil and meteorological data by the instrumentation described in Section 3, as well as regular collection of erosion, vegetation, and seepage water quality monitoring data. It is recommended that the monitoring program be executed for a minimum of three years after cover system construction, and extended monitoring be implemented as required during site operation based on the findings during the initial monitoring period. The need and frequency of monitoring post-closure will be assessed by qualified professionals. Monitoring can be incorporated into the regular inspections of the DSTF, as outlined in the KHSD Operations, Maintenance & Surveillance (OMS) Manual (Hecla Keno Hill, 2024a).

4.1 Soil and Meteorological Monitoring Station

Data collected by soil and meteorological instrumentation on Phase 1 of the DSTF will be stored in the memory of the datalogger in the soil and meteorological station DAS and is recommended to be retrieved and processed monthly. Remote connection is recommended for data retrieval, tied into an existing remote connection on site, if possible. Okane verified that cell coverage was available at the proposed monitoring station location during the June 2025 site visit (Okane, 2025b); however, a manual connection to the datalogger is available as a backup for data retrieval.

Collection and quality assurance/quality control (QA/QC) checks of collected data are recommended monthly, as this frequency of review reduces the risk of extended periods of data loss should there be any issues with the instrumentation or data collection system. Okane recommends the use of an integrated, quality-controlled database, as well as utilizing Okane's expertise in data management and interpretation, for accurate review, analysis and reporting of data. Automated data would be reduced, stored, and interpreted in a database, and raw data files would also be stored on Okane's SharePoint site. Raw data, and data files that have been QA/QC'd would be provided to Hecla, and Okane would notify Hecla if any issues with data are identified.

Periodic maintenance site visits are required to assure remote connection, data storage systems, sensors, and power systems are functioning correctly. Routine inspection of the DAS and sensor wires are recommended to be performed by Hecla personnel at least monthly and can be integrated into the regular DSTF inspections described in the OMS Manual (Hecla Keno Hill, 2024a). The station will be inspected for loose wires, damaged equipment, and the presence of insects or wildlife damage, with cleaning or repairs completed as required. An example monitoring station inspection checklist is provided in Appendix B.

Manual snowpack measurements are required to measure bulk densities of snow to estimate SWE for input into the P component of the water balance. It is recommended that one manual snow survey be completed by Hecla site personnel per month in January, February, March, April, and May to capture the accumulation, peak, and ablation phases of the snowpack to estimate bulk density and spatial and

temporal change. At minimum, one snow survey per year prior to snowmelt is required. It is recommended that one vertical and one horizontal transect on the DSTF covered surface be completed during each survey to gain data on spatial variability of snowpack height and density. Ideally, the same transects should be followed during each survey, and the locations of the survey points documented. Snow surveys will follow the process as described in the BC Snow Survey Sampling Guide (BC Hydro, 2024).

It is recommended that qualified Okane personnel perform detailed annual site inspections and field calibrations for the soil and meteorological instrumentation. Any issues identified either during monthly site inspections or during QA/QC of retrieved data can first be troubleshot remotely with assistance from Okane personnel, if requested by Hecla. Issues that cannot be addressed remotely would be troubleshot in person during the annual or scheduled site inspections. Meteorological sensors are recommended to be laboratory calibrated, and field calibrations and rotational parts replacement is recommended to be completed during annual site inspections at frequencies outlined in instrumentation manuals.

4.2 Erosion and Vegetation Monitoring

Work Area Safety Inspections are performed on the DSTF daily and reviewed monthly by Hecla personnel, according to the DSTF OMS Manual (Hecla Keno Hill, 2024a and Appendix C), to verify that tailings are placed in the DSTF in accordance with design requirements. These inspections include observations of the DSTF surface, seepage, runoff collection ditches, the area surrounding the DSTF, and monitoring instrumentation. The DSTF is also inspected monthly by a qualified geotechnical engineer and quarterly by the Engineer of Record (EOR). These inspections are focused on the operational areas of the DSTF where tailings are currently being placed and include tests for tailings characterization and density measurements. An annual geotechnical inspection is performed by the EOR to assess the condition of DSTF and accessory structures, tailings placement activities, and maintenance and surveillance activities. In addition to the DSTF visual inspections performed, it is recommended that detailed annual inspections be performed to specifically assess erosion and vegetation development on the DSTF cover system.

4.2.1 Erosion Monitoring

Erosion of cover system materials has been identified as a potential risk for the DSTF cover system performance and erosion mitigation was identified as a closure objective in the Cover System Objectives Workshop (Okane, 2025c). Erosion rates may be higher initially after construction, as the cover system stabilizes, vegetation develops, and root mass increases within the material. Over time, erosion rates are anticipated to decrease with establishment of vegetation and consolidation of cover system materials. Erosion may be further prevented through the placement of rocky materials or woody debris to create micro-topography, or other mitigation measures on the reclaimed cover system surface.

Detailed monitoring of erosion occurring on the cover system should be conducted semi-annually after construction to ensure the cover system thickness is not decreasing to a point that performance objectives cannot be met. Specific performance objectives and criteria have not yet been developed for the DSTF cover system; it is recommended that criteria for evaluating erosion be developed with stakeholders for site specific conditions and risks. Guidance for erosion criteria development can often be found in literature or inferred by experience of qualified personnel with similar materials. Once criteria have been developed, erosion modelling such as the Water Erosion Prediction Project (WEPP) or Landform Evolution Modelling (LEM) can be completed to inform on the erosion potential for the closure DSTF landform, if deemed necessary. Erosion potential is influenced by several factors including climate (precipitation), material texture and gradation, slope length and gradient, and vegetation/surface coverage.

Assessment of the intensity of erosion processes and the volumes of sediment loss typically involves field measurements and visual comparison of photographs taken from surfaces at various times. Field measurements for erosion monitoring may involve manual measurements of specific locations at set intervals, or the installation of remote cameras which take photos of the cover system surface at set intervals for visual comparison of erosional changes over a period of time. A depth gauge or other reference object may be placed in the camera's field of view for easier comparison between photographs. Manual classical photogrammetry may also be utilized, which involves taking multiple, overlapping photos of an area or erosional feature from many angles that can be converted into a 3D model. These models can be compared over a period of time to track erosional changes, similar to comparisons of 2D photographs or field measurements.

It is recommended that a detailed visual field survey/inspection of the cover system for erosional features be completed once per year during the Okane annual monitoring site visit. Personnel will walk transects through the interior of the covered area as well as the entire perimeter to complete the survey. Field erosional surveys will be completed at repeat locations to allow erosion rill or gully sizes, quantity, and depths to be tracked over time. Manual field surveys allow for the identification of changes in erosion rates over time as a result of vegetation catch or changes in precipitation volume or intensity.

Erosion monitoring will aim to identify:

- Development of erosion features, such as rills and gullies;
- Soil deposition areas;
- Sediment loading within surface water storage ponds;
- Areas of ponding water on the surface; and
- Development of crack or fauna-induced macro-structures (burrows or dens) within the cover system.

An example of an erosion inspection checklist is provided in Appendix B. An issues log will be maintained, similarly to what is done for DSTF inspections as outlined in the OMS Manual (Hecla, Keno Hill, 2024a). The issues log will note at a minimum:

- Date on which the issue was identified;
- Type of issue;
- Location of the issue; and
- Risk classification.

An erosion risk classification system will aid in tracking the progression of issues, whether that be towards requiring repairs or being resolved. The classification system provided in Table 4.1 has been designed for this program to be consistent with Hecla's existing risk classification system outlined in the OMS Manual (Hecla Keno Hill, 2024a).

Table 4.1: Erosion observation risk classification and mitigations

Risk Classification	Observation	Description and Mitigation
Minor	Rills >0.1 m depth, changes observed over two freshets following identification.	Minor risk situation or unusual condition requiring review. Continue monitoring for two additional freshets, and if no visible change, the issue is resolved, and no further monitoring required. If changes are observed the issue is raised to Moderate.
Moderate	Singular piping grows to >30 m^2 and reaches depths of >0.2 m	Moderate risk situation or potential emergency condition requiring urgent review. Repairs required during next available field season or equipment availability. Once repairs are completed, revert to Minor for continued monitoring.
High	Multiple small piping reaches >0.2 m depth over 20% of the landform	High risk situation, potential imminent failure, or failure of facility requiring immediate repairs. Once repairs are completed revert to Minor for continued monitoring.

It is also recommended that the DSTF covered landform be monitored annually using remote surveys (drone photogrammetry) for generation of digital elevation models (DEM) to quantify soil loss. The DEM can be used to monitor erosion gullies (meso-scale) while capturing landform geomorphic losses of sediment. According to the OMS Manual (Hecla Keno Hill, 2024a), drone photogrammetry is used to develop month-end surveys to calculate tailings placement volumes on the DSTF. It is recommended that erosion monitoring use data that is collected during these surveys. A ground sampling distance of 1 cm is recommended for a maximum accuracy/error of 5 cm in order to detect erosional features and sediment loss at the desired scale.

4.2.2 Vegetation Monitoring

The main purpose of revegetation as a closure action is to align with site closure objectives and anticipated end land use and to assist with erosion control. Specific performance indicators outlined in a site vegetation monitoring plan need to be able to determine success in support of the closure objectives. The short-term closure objectives for the DSTF are slope stabilization and erosion prevention, and the long-term objective is to return the site to an environment that closely resembles pre-mining conditions (Hecla Keno Hill, 2023).

The Yukon has a challenging climate for revegetation efforts, and plant growth must be monitored to evaluate success (Matheus and Omtzigt, 2013). It is recommended that vegetation performance be assessed by monitoring the vegetation in the cover system trial area constructed in 2013 (Access Consulting Group, 2013), as well as that which will develop on the remainder of the Phase 1 covered area. Revegetation performance should be quantified through *in situ* monitoring techniques such as permanent sampling transects and quadrats within the revegetated area established for repeat monitoring. As outlined in the Yukon revegetation manual (Matheus and Omtzigt, 2013), the following primary performance indicators should be monitored during annual vegetation surveys to evaluate revegetation success:

- Soil sampling and testing to characterize the general soil properties of the revegetated area;
- Percent ground coverage of vegetation;
- Relative species survival and health of planted specimens; and
- Plant diversity across the revegetated area, including both planted and volunteer species.

Additional indicators that may also be monitored to evaluate vegetation performance include:

- Invasive plant species ingress and density;
- Rooting depth; and
- Vegetation tissue sampling of species consumed by humans or wildlife to assess ecotoxicity effects and bioaccumulation.

It is recommended that the primary indicators of vegetation success be monitored at the DSTF, at minimum. An example of a vegetation inspection checklist is provided in Appendix B. Collecting the above performance indicators should be conducted in alignment with methodologies outlined in the Field Manual for Describing Yukon Ecosystems (Department of Environment, 2017). Table 4.2 provides a brief description of the sampling methodology for each performance indicator.

Table 4.2: Vegetation Performance Indicator Field Sampling Methodologies

Vegetation Performance Indicator	Description	Field Sampling Method
Soil Properties	Nutrient status and pH of soil in revegetated areas.	Using a coring tool or shovel, collect a composite sample across the trial at two depths, 0 to 15 cm and 15 to 30 cm.
Percent Cover (%)	Percentage of ground surface covered.	View the trial area vertically and assess the percentage of ground covered by vegetation.
Health	Survival and health of planted specimens.	Evaluate if planted specimens are alive and note their health on a scale from dead, dead/struggling, struggling, struggling/healthy, to healthy.
Species List	Record the species of all vegetation by stratum (trees, shrubs, and herbs).	Enter the names in full of all species observed across the trial.
Rooting Depth (cm)	Distance in cm from the ground surface to the bottom of the rooting zone.	Excavate a soil pit, generally 50 to 75 cm deep, leaving the face and sides undisturbed around the ground surface. Assess for the depth when roots are no longer present.
Invasive Species Density Distribution	Prevalence of invasive species contained within the Yukon Invasive Species Council list of invasive species in Yukon (2019).	Assess the density distribution class, from 0 to 13, of invasive species across the trial using the Range Health Guide (Government of Alberta, 2017).
Tissue Properties	Concentration of metals in vegetative tissue for assessing ecotoxicity and bioaccumulation.	Select samples of leaves that are consumed by humans or wildlife and are available within the trial area. Submit samples to an accredited laboratory for analysis to test for elements in tissue.

Adapted from Department of Environment (2017) and Matheus and Omtzigt (2013).

According to the OMS Manual (Hecla Keno Hill, 2024a), drone photogrammetry is used to develop month-end surveys to calculate tailings placement volumes on the DSTF. Vegetation on the cover system can be accounted for during data collection or data processing using either equipment or software that automatically filters out incongruous data points. It is recommended that vegetation monitoring data is also collected during these surveys.

4.3 Seepage Water Quality Monitoring

Reducing water infiltration into the DSTF was identified as a cover system objective in the Objectives Workshop (Okane, 2025c). Tailings in the DSTF Phase 1 primarily came from Bellekeno Mine and were classified as NML; however, the DSTF Phase 2 tailings composition shifted to more PAG material with higher acid rock drainage potential than the Phase 1 tailings (Hecla Keno Hill, 2024a). The reduction of NP through the cover system is anticipated to reduce the risk of mobilization of acidic oxidation products and drainage that may cause water quality issues in the future. However, there is uncertainty as to

whether NP through the cover system needs to be controlled to maintain seepage water quality, given the highly compacted nature of the DSTF landform and the presence of a liner to control seepage.

Infiltration through the DSTF is intended to be captured by the GCL for treatment prior to discharge. Uncertainties regarding the efficiency of the GCL in capturing seepage and understanding of the hydrogeological regime result in a lack of data to demonstrate that there is no transport of contaminants through the liner. The culmination of these uncertainties and challenges is that no specific seepage water quality targets or performance criteria have yet been developed, nor is there a robust understanding of whether the targets may be exceeded or how exceedances may be mitigated.

Current monitoring of the DSTF is limited to visual inspections, with no seepage observed to date at the facility toe. However, the basal liner system in the associated ditch was in disrepair for several years, potentially affecting seepage capture. The liner was recently repaired, and future inspections will help determine if seepage is occurring. Any seepage conveyed along the basal liner is intended to be directed to the Mill Pond, where water quality is monitored in accordance with permit requirements. Due to the historical liner deficiencies, there remains uncertainty regarding the proportion of captured water that is attributable to DSTF seepage.

It is understood that there is currently no method to collect seepage from the DSTF Phase 1 and that no seepage has yet been observed from the DSTF Phase 2 seepage collection system. Tetra Tech installed six vibrating wire piezometers (VWPs) in boreholes in the Phase 1 DSTF during the geotechnical site investigation in December 2024 (Tetra Tech, 2025). The VWPs will provide data on water levels within the DSTF, including potential seepage quantities. Hecla has previously noted the potential to coordinate installation of a water quality monitoring well in Phase 1 during site investigation activities for future DSTF phases.

Once seepage is observed and seepage water quality targets have been defined, a seepage water quality testing program will allow Hecla to evaluate the effectiveness of the landform in achieving seepage water quality targets in closure. A seepage monitoring plan is outlined here to allow for alignment with the current site monitoring plan. Quarterly sampling and testing of seepage water is recommended to ensure that parameters are within permit and trigger levels. Seepage samples should be collected manually by site personnel with laboratory approved materials and instructions and dispatched to an approved laboratory for testing of constituents of potential concern (COPCs) when seepage from the base of the DSTF is identified by site personnel. The following list of parameters includes general water quality COPCs that may indicate acid generation in the tailings, as well as COPCs that were listed in a 2018 ARD/ML memorandum prepared by Alexco Environmental Group (AEG) (Hecla Keno Hill, 2023):

- Electrical conductivity
- pH

- Sulfate
- Arsenic (dissolved)
- Cadmium (dissolved)
- Copper (dissolved)
- Lead (dissolved)
- Nickel (dissolved)
- Silver (dissolved)
- Zinc (dissolved)

The sample screening process requires site-specific environmental monitoring data obtained through a baseline monitoring program or by using water quality guidelines (WQGs). Because Yukon Territory does not have its own WQGs, the primary sources for WQGs in Yukon Territory are the Canadian Environmental Quality Guidelines (CCME, 2007; 2016), the Guidelines for Canadian Recreational Water Quality (Health Canada, 2012), the Guidelines for Canadian Drinking Water Quality (Health Canada, 2014), and standards from other regulatory agencies (MacDonald, 1997; 2016; BCMOE, 2012). The British Columbia Ministry of Environment (BCMOE) provides a secondary source for substances or uses not covered by the primary sources. The Yukon Guide for Developing Water Quality Objectives and Effluent Quality Standards for Quartz Mining Projects (Government of Yukon, 2021) (hereafter "the Guide") describes how these guidelines are applied in Yukon Territory. According to the Guide, COPCs should be identified for monitoring if concentrations exceed the 95th percentile of background and/or baseline concentrations in more than 5% of samples, or in more than 5% of predicted conditions for two or more months within three years, or for any period exceeding 30 days.

According to Canadian Council of Ministers of the Environment (CCME, 2011), standard methods for collecting, handling, and storing seepage water samples are provided in CCME (2007). A minimum baseline monitoring period of one year is typically recommended, with at least monthly sampling to ensure that seasonal peaks are captured. Field measurements for pH, temperature, and specific conductivity should be taken immediately after sampling to prevent changes during transport. Samples should generally be kept at 4 °C +/- 2 °C until analysed by the laboratory, avoiding freezing unless specified (Yukon Environment, 2002). Each parameter has a defined holding time, so samples should be shipped promptly to accredited laboratories certified for the required parameters. Field QA/QC measures, such as blanks, duplicates, and equipment rinsate samples, should make up 10 to 20% of total samples (CCME, 2011). The most common analytical methods for solution chemistry are ICP-MS, ICP-OES, and ICP-AES, which differ in detection limits and cost per sample. The required sample volume depends on the laboratory and analysis method; for example, ALS Global typically requires 125 to 500 mL.

5 CLOSURE

We trust information provided is satisfactory for your requirements. Please do not hesitate to contact the undersigned at (403) 819-0648 or lbarber@okaneconsultants.com for further information or questions.

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Reviewed by:

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Appendix A

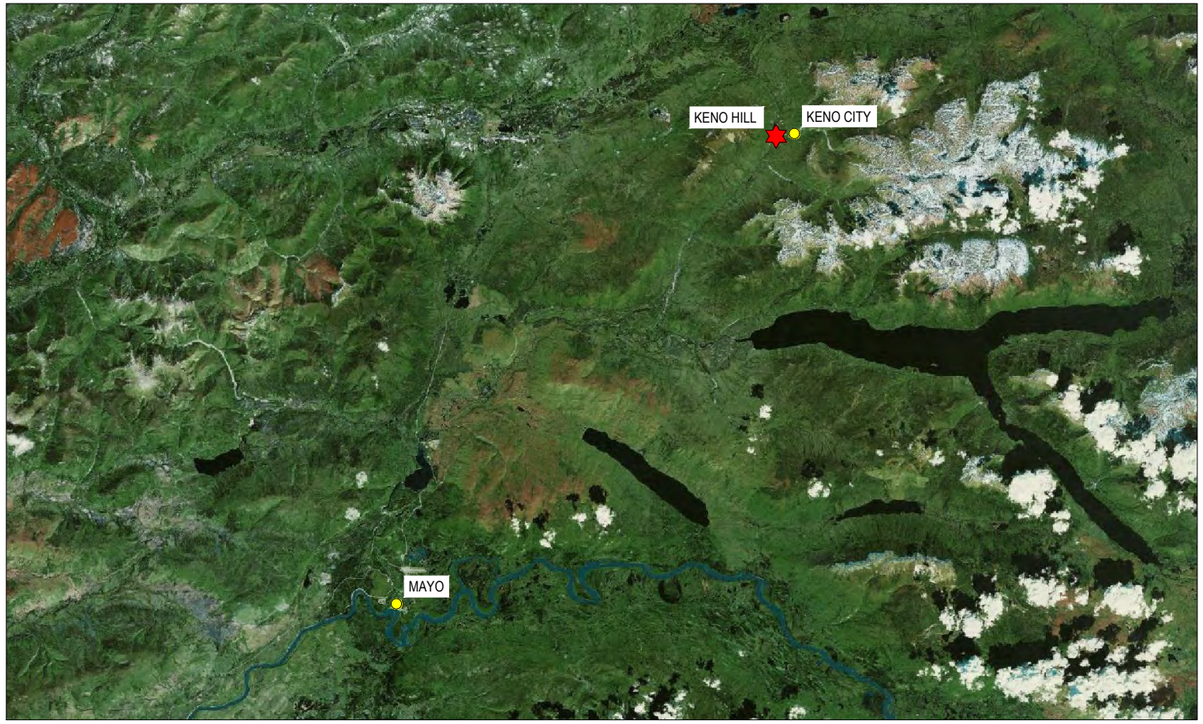
Drawings

PRELIMINARY
NOT FOR CONSTRUCTION

HECLA KENO HILL

DSTF COVER SYSTEM
INSTRUMENTATION DESIGN

DRAWING INDEX	
Sheet Number	Sheet Title
000	DRAWING INDEX, COVER SHEET, LOCALITY MAP
001	GENERAL ARRANGEMENT
002	INSTRUMENTATION PLAN
003	INSTRUMENTED PROFILE



AERIAL IMAGERY: MICROSOFT BING 2025
NOT TO SCALE

REVISION LOG	
REVISION	CHANGES
0	ISSUED FOR CLIENT REVIEW
1	UPDATED CLIENT INFORMATION

PREPARED BY:

okane

PREPARED FOR:

Hecla
KENO HILL



okane
Integrated Mine Closure and Relinquishment Solutions

PRELIMINARY
NOT FOR CONSTRUCTION

Legend/Notes

NOTE

1. ALL UNITS IN METRES U.N.O.
2. COORDINATE SYSTEM NAD83 UTM ZONE 8.
3. IMAGERY OBTAINED FROM CLIENT.

LEGEND

DISTRICT MILL WEATHER STATION ★

20 10 0 20 40 60 80 100m
SCALE 1:2000

Revision	Description	Date
1	UPDATED CLIENT INFORMATION	2025/09/12
0	ISSUED FOR CLIENT REVIEW	2025/08/15

Client/Project

Hecla KENO HILL

HECLA KENO HILL
DSTF COVER SYSTEM
INSTURMENTATION DESIGN

Drawn by: B. HAY

Designed by: OKANE

Approved by: L. BARBER, P. GEO

Drawing title

GENERAL ARRANGEMENT

Project no.	Drawing no.	Sheet	Revision
0778-222	0778-222-001	ANSI B	1

Last Saved:8/22/2025 8:46 AM
Cadfile Name:778-222-001-003 Cover System Instrumentation Design.dwg



okane
Integrated Mine Closure and Relinquishment Solutions

PRELIMINARY
NOT FOR CONSTRUCTION

Legend/Notes

NOTE

1. ALL UNITS IN METRES U.N.O.
2. COORDINATE SYSTEM NAD83 UTM ZONE 8.
3. IMAGERY OBTAINED FROM CLIENT.

LEGEND

MONITORING STATION

0 7.5 15 22.5 30 37.5 45m
SCALE 1:750

SETOUT DATA			
POINT #	EASTING	NORTHING	DESCRIPTION
1	484005.83	7086860.02	MONITORING STATION

Revision	Description	Date
1	UPDATED CLIENT INFORMATION	2025/09/12
0	ISSUED FOR CLIENT REVIEW	2025/08/15

Client/Project

Hecla KENO HILL

HECLA KENO HILL
DSTF COVER SYSTEM
INSTURMENTATION DESIGN

Drawn by: B. HAY

Designed by: OKANE

Approved by: L. BARBER, P. GEO

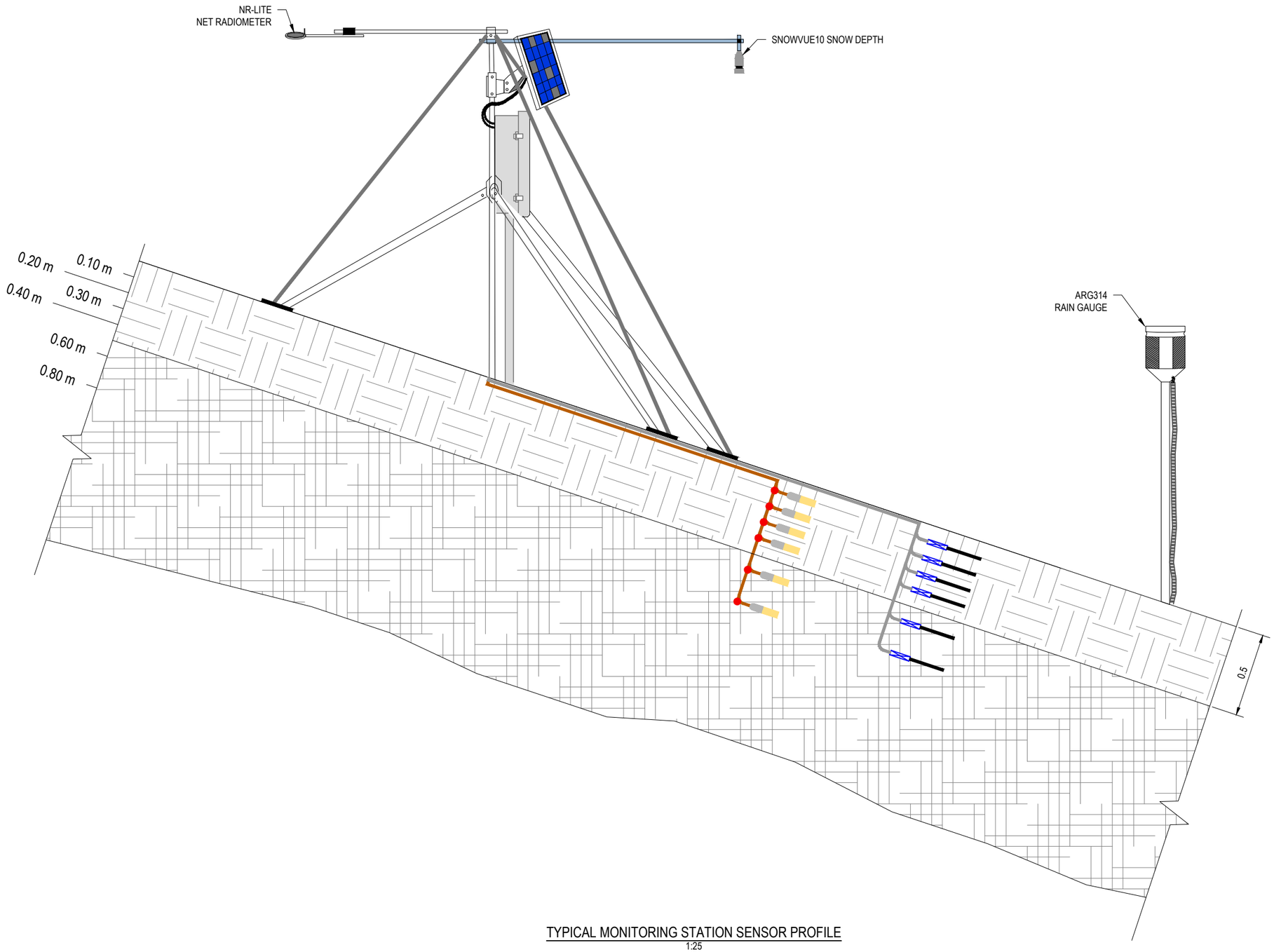
Drawing title

INSTRUMENTATION PLAN

Project no.	Drawing no.	Sheet	Revision
0778-222	0778-222-002	ANSI B	1

Last Saved:8/22/2025 8:46 AM

Cadfile Name:778-222-001-003 Cover System Instrumentation Design.dwg



TYPICAL MONITORING STATION SENSOR PROFILE
1:25

okane
Integrated Mine Closure and Relinquishment Solutions

PRELIMINARY
NOT FOR CONSTRUCTION

Legend/Notes

NOTE

1. ALL UNITS IN METRES U.N.O.
2. TRAIL CAMERA INCLUDED AT MONITORING STATION TO MONITOR SNOW MELT TIMING.

LEGEND

VOLUMETRIC WATER CONTENT (CS616)
SOIL MATRIC SUCTION (CS229)
OVERBURDEN
TAILINGS

250 0 250 500 750 1000 1250mm
SCALE 1:25

Revision	Description	Date
1	UPDATED CLIENT INFORMATION	2025/09/12
0	ISSUED FOR CLIENT REVIEW	2025/08/15

Client/Project

Hecla KENO HILL

HECLA KENO HILL
DSTF COVER SYSTEM
INSTURMENTATION DESIGN

Drawn by
B. HAY

Designed by
OKANE

Approved by
L. BARBER, P. GEO

Drawing title

INSTRUMENTED PROFILE

Project no.	Drawing no.	Sheet	Revision
0778-222	0778-222-003	ANSI B	1

Last Saved:8/22/2025 8:46 AM
Cadfile Name:778-222-001-003 Cover System Instrumentation Design.dwg

Appendix B

Monitoring and Maintenance Inspection Checklist Examples

Inspection Checklist – DSTF Monitoring Station

Personnel: _____ **Date (yyyy/mm/dd):** _____

	DSTF Station	Notes
Download and review data	☐	
Check condition of desiccant packs, replace if required	☐	
Remove debris/dust/snow from solar panel	☐	
Inspect for damage to enclosure or wires	☐	
Inspect for loose wires	☐	
Inspect enclosure for signs of moisture	☐	
Voltage of DAS station > 12 V	☐	
Photos of each panel, enclosure, and surroundings	☐	
Replace batteries in field cameras and download photos	☐	
Inspect security of mounting hardware	☐	
Remove sediment and debris from tipping bucket	☐	
Check level of tipping bucket	☐	
Clean net radiometer head	☐	

Check level of net radiometer	☐	
Check level of SnowVUE10 sensor	☐	
Remove vegetation under SnowVUE10	☐	

Inspection Checklist – Erosion Monitoring

	DSTF Cover System	Notes/Risk Classification
Across the cover system surface, note the following:		**Note if features are a new observation or are tracking changes to a known issue**
Location and size of rills or gullies	☐	
Location and size of piping exits	☐	
Location of any observed seepage	☐	
Presence of soil deposition areas	☐	
Presence of cover system cracks	☐	
Presence of animal burrows or dens in cover system	☐	
Take photos of any erosional features noted	☐	
At specified measurement locations, perform the following:		
Measure depth of erosional features	☐	
Take photos	☐	
Log Issue and Risk Classification	☐	

Inspection Checklist – Vegetation Monitoring

Personnel: _____ **Date (yyyy/mm/dd):** _____

	DSTF Reveg. Trials	DSTF Cover System	Notes
In specified transects or quadrats, perform the following:			
Collect soil samples (15 cm and 30 cm depths) for nutrient and pH testing	☐	☐	
Assess percentage of vegetation ground cover	☐	☐	
Note health of planted specimens (dead/struggling/healthy)	☐	☐	
Record species of all vegetation	☐	☐	
Measure distance (cm) from ground surface to bottom of rooting zone	☐	☐	
Note presence and density of any invasive species	☐	☐	
Collect leaf samples for trace element uptake testing	☐	☐	

Appendix C

DSTF Weekly Visual Inspection Checklist

DSTF WEEKLY VISUAL INSPECTION CHECKLIST

Date/Time: _____ Weather: _____

Inspector: _____ Temperature: _____

Description of work occurring on site:

Area	Observation	Yes/No	
DSTF Surface	Apparent slope movement?	☐ Yes, photograph and describe:	☐ No
	Erosion or gullying?	☐ Yes, photograph and describe:	☐ No
	Water flowing down tailings stack?	☐ Yes, photograph and describe:	☐ No
	Toe or face bulging?	☐ Yes, photograph and describe:	☐ No
	Depressions, sinkholes, animal burrows or tension cracks?	☐ Yes, photograph and describe:	☐ No
Seepage	Seepage areas?	☐ Yes, photograph and describe:	☐ No
	Changes in seepage rate?	☐ Yes, photograph and describe:	☐ No
	Turbidity in seepage?	☐ Yes, photograph and describe:	☐ No
Runoff Collection Ditch	Erosion of ditch berm?	☐ Yes, photograph and describe:	☐ No
	Vegetation or obstructions in ditch?	☐ Yes, photograph and describe:	☐ No
	Turbid flow?	☐ Yes, photograph and describe:	☐ No
Surrounding Area	Tailings/turbid water visible at surface or in nearby watercourses?	☐ Yes, photograph and describe:	☐ No
	Visible boils?	☐ Yes, photograph and describe:	☐ No
Monitoring Instrumentation	Damage to, or deterioration of instrumentation?	☐ Yes, photograph and describe:	☐ No

Other Comments:

For further information contact:

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Canada

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APPENDIX 1.2

2012 DSTF INTERIM RECLAMATION AND COVER SUMMARY REPORT

3 Calcite Business Centre, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3
Phone (867) 668-6463 Fax (867) 667-6680
www.accessconsulting.ca

Memorandum

To: Alexco Keno Hill Mining Corp.

From: Access Consulting Group

CC:

Date: March 20, 2013

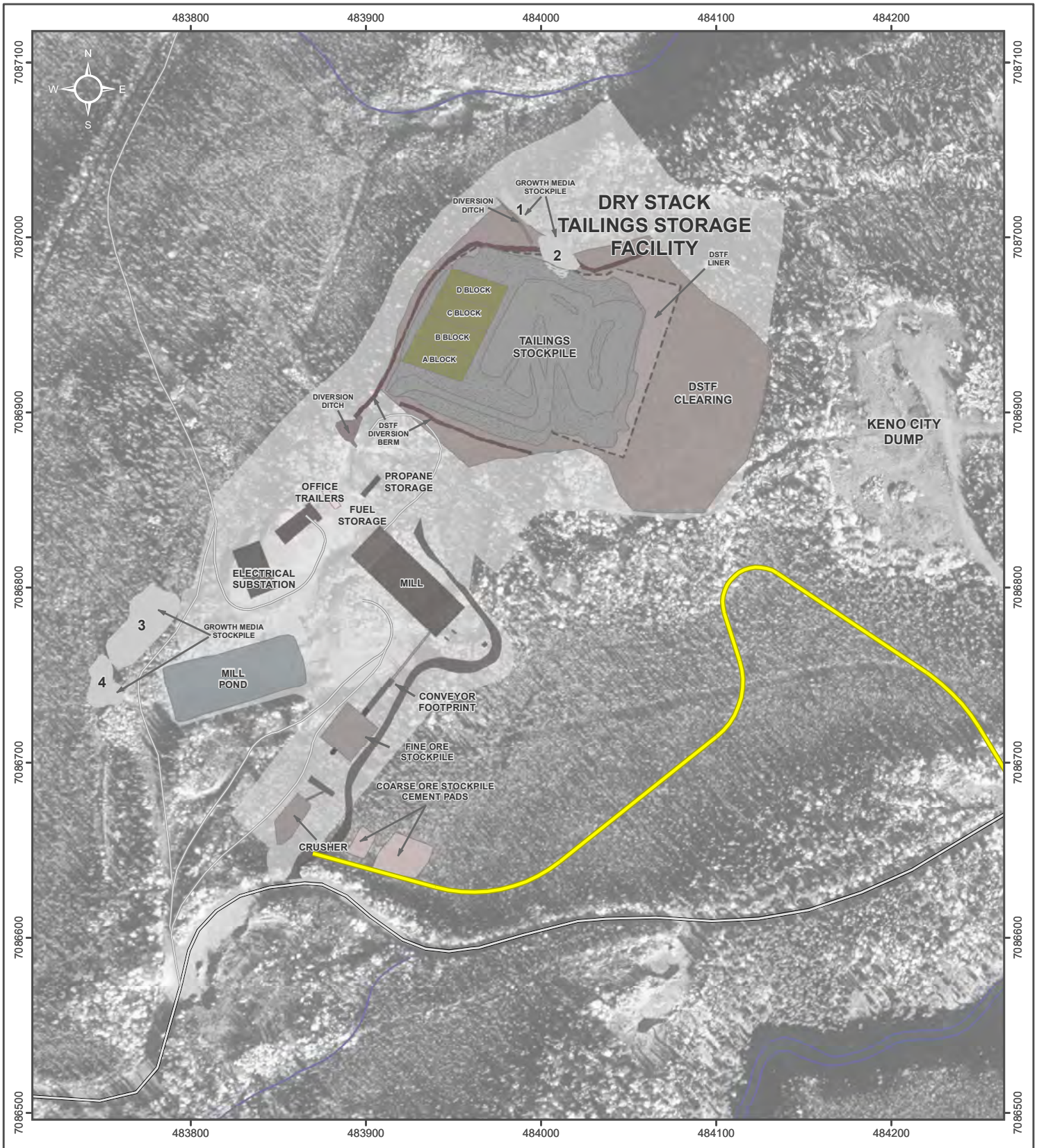
Re: 2012 Dry Stack Tailings Facility Cover Trial

Alexco Resource Corp. (Alexco) through its wholly owned subsidiary Alexco Keno Hill Mining Corp. owns and operates the Bellekeno Mine located in the Keno Hill Silver District. The Bellekeno Mine is licenced under Quartz Mining License QML-0009 and Water Use Licence QZ09-092.

Progressive reclamation of the Dry Stack Tailings Facility (DSTF), one of several mine components licenced under the authorizations above and shown in Figure 1. The reclamation was initiated during the summer of 2012 as outlined in the Reclamation and Closure Plan (Access, 2012) to prevent infiltration of meteoric water and prevention of dusting and erosion of exposed tailings slopes. The progressive reclamation included four areas (block A, B, C, & D) on the DSTF to be covered with granular material and seeded to test various cover trials.

Progressive reclamation of the DSTF is scheduled to occur after mill generated tailings are deposited, followed by recontouring of the slopes, and placement of a cover consisting of course soil and seeding with suitable vegetation. Reclamation was initiated in 2012 and on schedule with the year 2 start date (EBA 2010b). Ground surface preparation of the tailings prior to soil cover placement was not necessary (EBA 2010a) given that tailings are hauled from the mill at least once daily, and compacted with a drum packer to ensure proper compaction.

Phase I of the progressive reclamation tailings program covered an area of approximately 2,188 m^2 (~0.22 ha) which would correspond to a volume of ~547 m^3 of cover material for a cover thickness of 0.25 m. There was sufficient suitable granular material in the area of the DSTF to allow for construction of the proposed evapotranspiration cover. A conceptual evapotranspiration cover design is shown in Figure 2 and is based on the successful cover design constructed at the Brewery Creek Mine.



DSTF Cover Trial
Duncan Creek Road
Mill Access
Haul Road

1:3,000 *When printed on 8.5 by 11 inch paper*

0 50 100 150 Meters

Aerial photography flight date: July 13th 2006. Ortho-rectification produced by Challenger Geomatics Ltd. Site hydrography and contours derived from 2006 aerial imagery. Mill pond survey (Y.E.S. Sept 2010), mill structures, current DSTF footprint and roads survey (ACG, December 2011). Design data obtained from EBA.

Datum: NAD 83; Projection: UTM Zone 8N

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ALEXCO KENO HILL MINING CORP.

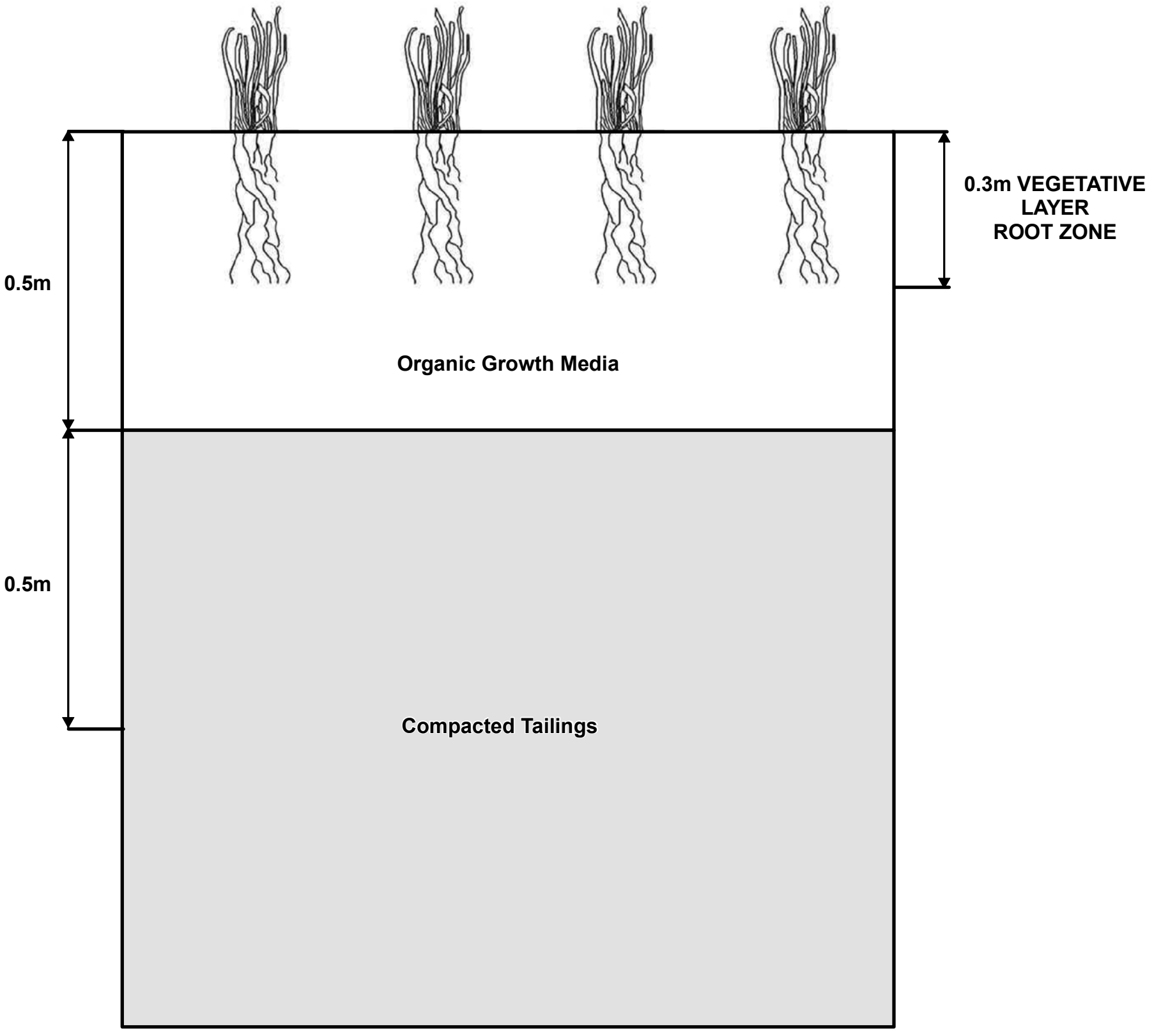
FIGURE 1
DSTF VEGETATION COVER TRIAL 2012

AKHM ACCESS

MARCH 2013

I:\ALEX-05-01\Bellekeno\GIS\mxd\Annual_Reports\2012\Groundwater_MillSite_Memo20130314.mxd
(Last edited by: jpan; 3/20/2013/09:16 AM)

CONCEPTUAL SOIL COVER DESIGN



Conceptual drawing only. Drawing is not to scale.

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ACCESS

ALEXCO KENO HILL MINING CORP.
RECLAMATION AND CLOSURE PLAN

FIGURE 2

CONCEPTUAL SOIL COVER DESIGN

DRAWN BY JP	NOVEMBER 2011	VERIFIED BY BT

I:\ALEX-05-01\Bellekeno\GIS\mxd\Closure\2011\Submitted_Nov2011\Fig6-11_Soil_Cover_System20111117.mxd
(*Last edited by: jpan;11/17/2011/12:25 PM*)

In general, there is no dominant type of cover specifically designed for cold climates; rather, the type of cover design is site specific depending on the physical and chemical characteristics of the tailings facility (SRK, 2009). The cover design in this instance is defined as a store-and-release cover, which makes use of a generally thick layer of soil to store water until it can be taken up and evapo-transpired by plants (SRK, 2009).

As stated above and in the Preliminary Engineering Design and Management Plan of the DSTF (EBA, 2010b), progressive reclamation consists of placing an evapo-transpirative cover (a minimum of 0.25 m of loosely placed gravel soil) over the surface of the compacted tailings to temporarily store runoff and allow it to evaporate or be used by plants. Analogous to the successful results realized at the Brewery Creek Mine, the Reclamation Plan includes re-vegetation of the DSTF with plants that promote soil evapo-transpiration such that pore water is released to the atmosphere reducing the net infiltration across the soil system (Tremblay et al., 2001). The performance results of those covers indicate precipitation infiltration rates between 7% – 22% with the variation related to differences in cover thickness and site topography (Access, 2010).

The four stockpiles of growth media that were set aside during development of the mill site and ancillary support buildings (for the future use as DSFT cover material) were surveyed and the volumes calculated (Table 1). To prepare for the upcoming cover program activities over the summer, samples were obtained from each pile and sent to an outside laboratory for analysis of available nutrients, metals and physical properties in late spring, 2012. Nutrient levels ranged from very low to moderate as shown in the Appendix A laboratory analysis while soil pH ranged from neutral to mildly acidic. Physical locations, soil properties, and volumes of the piles are presented below in Table 1.

Table 1 Stockpiled Growth Media for Use as DSTF Cover

Stock Pile Number	Location	Soil Type	Volume (m^3)
1	483987E, 7087017N	Loam	205.5
2	484007E, 7086993N	Loam	301.3
3	483770E, 7086777N	Sandy Loam	3102.9
4	483750E, 7086744N	Sandy Loam	615.0
		Total	4,224.7

The DSTF was constructed to the preliminary engineering design specification and as such has a slope of 3:1. The cover therefore, has a similar slope except in Block D where a small area, by design, has a steeper slope.

As discussed above, the area requiring a cover was estimated to be 2,188 m^2. Block A of the cover trial received a minimum cover thickness of 0.5 m, whereas Blocks B, C and D had a minimum cover thickness of 0.25 m. The actual thickness of the cover on the individual Blocks will vary due to the various types of surface landscaping included in the trial Blocks. The minimum total volume of material used for placement on the DSTF was calculated to be 687 m^3 using the above compacted thicknesses; however, the actual volume of growth media placed is most likely greater due to a compaction factor and the surface landscaping, where the cover was placed thicker than the minimum thickness specification. This cover material was transferred from the stock piles to the DSTF using the Volvo trucks, which have a capacity of 17 m^3 per load. It should be noted that unsuitable material such as boulders and organics were set aside and not used in the construction of the

cover. After the material was placed and profiles construction completed, the growth media was compacted by backtracking the hoe parallel to the slope which also created an irregular surface and therefore limiting the susceptibility of soil erosion. Prior to seeding, the dimensions of the individual blocks were measured (Table 2) to determine the appropriate mass of seed required per section. Cross sections of the individual block are presented in Appendix B and a photo log of the cover trial is presented in Appendix C.

Table 2 Area by Section of DSTF Cover

Block	Dimensions (m)	Area (m^2)	Minimum Cover Thickness (m)
A	15.5 m x 36 m	558	0.50
B	16.75 m x 37.5 m	628.13	0.25
C	12 m x 37.5 m	450	0.25
D	16 m x 34.5 m	552	0.25
Total	**60.25 m x ~36 m**	**2,188.13**	**0.25**

The Keno District Dry Land Seed Mix (Table 3) was selected using a blend of suitable species seeded at the Brewery Creek and Minto mine sites, which was custom mixed by Brett-Young Seeds of Alberta and was applied using a seeding rate of 35 kg/ ha. All species used in the seed mix are Yukon natives except for Sheep Fescue which is native to Eurasia; however, it resembles many tufted fine-leaved fescues in North America (Matheus and Omtzigt 2011). This species was chosen because it is closely related to the Yukon native alpine fescue (*Festuca brachyphylla*) which is an ideal native fescue to sow on acidic alpine and subalpine sites; however this seed is not currently available commercially (Matheus and Omtzigt 2011).

Table 3 Seed Mix Used on DSTF (Matheus and Omtzigt 2011)

Common Name	Botanical Name	Origin	Seeds per kg	Percent Mix (%)
Violet Wheatgrass	*Elymus alaskanus*	*native to Yukon*	330,000	40.0
Sheep Fescue	*Festuca ovina*	*not native (Eurasian)*	1,100,000	23.5
Rocky Mountain Fescue	*Festuca saximontana*	*native to Yukon*	1,430,000	23.0
Glaucous Bluegrass	*Poa glauca*	*native to Yukon*	2,907,000	13.5

Fertilizer was applied at a calculated rate of 130 kg/ha (Matheus and Omtzigt 2011). In total, 25 kg of 19-19-19 was used. Individual blocks were seeded and fertilized using a grid and track-back method, using hand held hoppers for dispersal. Seeded areas that had been constructed with a slope greater than 3:1 were raked to ensure good seed-soil contact was made and to reduce the risk of seeds washing downslope in the event of a high intensity rainfall.

A follow up site visit was conducted in August 2012 to assess the progress of the seeding program. Seedlings were present on the cover and areas where seed had been raked into the soil appeared to a higher density of seedlings.

Follow up monitoring later spring 2013 will assess winterkill and survival rates. At this time additional seeding and fertilizing application rates will be calculated. The blocks will also be inspected for signs of rill erosion and will be mitigated should any be present

REFERENCES

Access Consulting Group. 2012. Preliminary Reclamation and Closure Plan, Keno Hill Silver District Mining Operations. Prepared for Alexco Keno Hill Mining Corporation

Access Consulting Group. 2010. Brewery Creek: From Assessment and Permitting Through Production and Closure: A Post Closure Analysis of a Northern Heap Leach Mine. Prepared for Mining, petroleum Environmental Research Group

EBA Engineering Ltd., 2010a. Operation, Maintenance, and Surveillance Manual Dry Stack Tailings Facility, Keno Hill District Mill, YT. Revision 2010-1. Prepared for Alexco Hill Mining Corp. EBA File: W14101178.009

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O'Kane Consultants Inc. (editors) 2004. Design, Construction and Performance Monitoring of Cover Systems for Waste Rock and Tailings. MEND 2.21.4. Volume 4: Field Performance Monitoring and Sustainable Performance of Cover Systems. Prepared for MEND.

SRK Consulting (Canada) Inc. 2009. Mine Waste Covers in Cold Regions. Prepared for Mine Environmental Neutral Drainage Program (MEND).

Tremblay, Gilles and Hogan, Charlene, 2001. "MEND Manual Volume 4 – Prevention and Control". Mine Environment Neutral Drainage (MEND) Program.

APPENDIX A

SOIL ANALYSIS

Your Project #: ALEX-12-BELLE-02
Your C.O.C. #: 08351389

Attention: Scott Davidson
ACCESS CONSULTING GROUP
#3 Calcite
151 Industrial Road
WHITEHORSE, YT
CANADA Y1A 3C8

Report Date: 2012/05/28

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B241340
Received: 2012/05/18, 08:30

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Cation Exchange Capacity (1)	4	2012/05/25	2012/05/25	AB SOP-00009	SSMA 18.2, EPA 200.7
Conductivity (Soluble)	4	2012/05/24	2012/05/24	BBY6SOP-00029	SM-2510 B
Elements by ICPMS (total)	4	2012/05/24	2012/05/24	BBY7SOP-00001	EPA 6020A
Potassium (Available) (1)	4	2012/05/25	2012/05/25	AB SOP-00042	EPA 200.7
Nitrate-N (Available) (1)	4	2012/05/25	2012/05/25	AB SOP-00023	SM 4110-B
Phosphorus (Available by ICP) (1)	4	2012/05/25	2012/05/25	AB SOP-00042	EPA 200.7
pH (2:1 DI Water Extract)	4	2012/05/24	2012/05/24	BBY6SOP-00028	Carter, SSMA 16.2
Saturated Paste	4	2012/05/24	2012/05/24	BBY6SOP-00030	Carter SSMA 18.2.2
Total Organic Carbon LECO Method (1)	4	2012/05/25	2012/05/25	CAL SOP-00243	LECO# 203-821-170
Texture by Hydrometer (1)	4	N/A	2012/05/25	AB SOP-00030	MMFSPA Ch9
Texture Class (1)	4	N/A	2012/05/25	AB SOP-00030	MMFSPA Ch9
Total Nitrogen in Soil by LECO (1)	4	2012/05/28	2012/05/28	CAL SOP-00243	LECO# 203-821-170

* Results relate only to the items tested.

(1) This test was performed by Maxxam Calgary Environmental

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

LANOY LUANGKHAMDENG, Burnaby Project Manager
Email: LLuangkhamdeng@maxxam.ca
Phone# (604) 638-2636

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Analytics - Partial/Rush Results

Maxxam Job #: B241340
Report Date: 2012/05/28

ACCESS CONSULTING GROUP
Client Project #: ALEX-12-BELLE-02

Sampler Initials: LK

NPK (AVAILABLE)

Maxxam ID		DL5561		DL5562		DL5563	DL5564		
Sampling Date		2012/05/14 13:30		2012/05/14 13:30		2012/05/14 13:30	2012/05/14 13:30		
	Units	**WP1 (DSTF)**	**RDL**	**WP2 (DSTP)**	**RDL**	**WP3 (MILL WASTE)**	**WP4 (MILL WASTE)**	**RDL**	**QC Batch**
Nutrients									
Available (NH4F) Nitrogen (N)	mg/kg	<10(1)	10	<2.0	2.0	11(1)	<10(1)	10	5868444
Available (NH4F) Phosphorus (P)	mg/kg	10	5.0	<1.0	1.0	17	77	5.0	5867906
Available (NH4OAc) Potassium (K)	mg/kg	52	10	29	2.0	25	29	10	5867902

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		DL5561	DL5562	DL5563		DL5564		
Sampling Date		2012/05/14 13:30	2012/05/14 13:30	2012/05/14 13:30		2012/05/14 13:30		
	Units	**WP1 (DSTF)**	**WP2 (DSTP)**	**WP3 (MILL WASTE)**	**QC Batch**	**WP4 (MILL WASTE)**	**RDL**	**QC Batch**
Elements								
Cation exchange capacity	cmol+/Kg	24	13	33	5867085	13	10	5867085
Soluble Parameters								
Soluble Conductivity	uS/cm	197	2540	512	5863576	276	1.0	5863576
Saturation %	%	90.5	53.0	88.7	5863551	74.8	1.0	5863551
Physical Properties								
% sand by hydrometer	%	44	53	58	5866937	50	2.0	5866937
% silt by hydrometer	%	44	37	31	5866937	43	2.0	5866937
Clay Content	%	12	11	10	5866937	6.9	2.0	5866937
Texture	N/A	LOAM	LOAM	SANDY LOAM	5860280	SANDY LOAM	N/A	5861607

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Detection limits raised due to sample matrix.

Maxxam Analytics - Partial/Rush Results

Maxxam Job #: B241340
Report Date: 2012/05/28

ACCESS CONSULTING GROUP
Client Project #: ALEX-12-BELLE-02

Sampler Initials: LK

MISCELLANEOUS (SOIL)

Maxxam ID		DL5561		DL5562		DL5563		DL5564		
Sampling Date		2012/05/14 13:30		2012/05/14 13:30		2012/05/14 13:30		2012/05/14 13:30		
	Units	**WP1 (DSTF)**	**RDL**	**WP2 (DSTP)**	**RDL**	**WP3 (MILL WASTE)**	**RDL**	**WP4 (MILL WASTE)**	**RDL**	**QC Batch**
Misc. Inorganics										
Total Nitrogen	%	0.28	0.20	<0.20	0.20	0.25	0.20	0.23	0.20	5871016
Total Organic Carbon (C)	%	7.4(1)	0.040	2.4	0.020	5.8(1)	0.20	4.0	0.020	5867097

RDL = Reportable Detection Limit
(1) - Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam Analytics - Partial/Rush Results

Maxxam Job #: B241340
Report Date: 2012/05/28

ACCESS CONSULTING GROUP
Client Project #: ALEX-12-BELLE-02

Sampler Initials: LK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		DL5561	DL5562	DL5563	DL5564		
Sampling Date		2012/05/14 13:30	2012/05/14 13:30	2012/05/14 13:30	2012/05/14 13:30		
	Units	**WP1 (DSTF)**	**WP2 (DSTP)**	**WP3 (MILL WASTE)**	**WP4 (MILL WASTE)**	**RDL**	**QC Batch**
Physical Properties							
Soluble (2:1) pH	pH Units	5.67	6.33	7.25	5.53	0.010	5863833
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	12100	9370	9130	11500	100	5863755
Total Antimony (Sb)	mg/kg	1.10	39.5	2.01	2.32	0.10	5863755
Total Arsenic (As)	mg/kg	29.2	712	65.1	58.2	0.50	5863755
Total Barium (Ba)	mg/kg	217	182	188	289	0.10	5863755
Total Beryllium (Be)	mg/kg	<0.40	<0.40	<0.40	<0.40	0.40	5863755
Total Bismuth (Bi)	mg/kg	0.19	1.03	0.44	0.21	0.10	5863755
Total Cadmium (Cd)	mg/kg	1.17	148	2.13	2.66	0.050	5863755
Total Calcium (Ca)	mg/kg	4750	5760	10400	4050	100	5863755
Total Chromium (Cr)	mg/kg	19.0	15.9	17.2	20.5	1.0	5863755
Total Cobalt (Co)	mg/kg	7.39	11.6	9.73	9.90	0.30	5863755
Total Copper (Cu)	mg/kg	19.0	87.0	35.4	28.0	0.50	5863755
Total Iron (Fe)	mg/kg	23200	47000	23300	27600	100	5863755
Total Lead (Pb)	mg/kg	38.9	3730	50.2	134	0.10	5863755
Total Lithium (Li)	mg/kg	11.7	10.1	11.2	11.9	5.0	5863755
Total Magnesium (Mg)	mg/kg	3400	4050	4960	3790	100	5863755
Total Manganese (Mn)	mg/kg	597	7790	610	674	0.20	5863755
Total Mercury (Hg)	mg/kg	0.057	0.223	<0.050	0.062	0.050	5863755
Total Molybdenum (Mo)	mg/kg	1.20	1.66	1.63	1.50	0.10	5863755
Total Nickel (Ni)	mg/kg	15.5	20.7	22.1	21.3	0.80	5863755
Total Phosphorus (P)	mg/kg	469	511	685	659	10	5863755
Total Potassium (K)	mg/kg	494	394	402	435	100	5863755
Total Selenium (Se)	mg/kg	0.72	1.19	0.91	0.76	0.50	5863755
Total Silver (Ag)	mg/kg	0.491	29.0	0.921	1.79	0.050	5863755
Total Sodium (Na)	mg/kg	<100	<100	<100	<100	100	5863755
Total Strontium (Sr)	mg/kg	18.7	15.4	29.0	18.5	0.10	5863755
Total Thallium (Tl)	mg/kg	0.116	0.131	0.101	0.127	0.050	5863755
Total Tin (Sn)	mg/kg	0.42	11.0	0.93	0.44	0.10	5863755
Total Titanium (Ti)	mg/kg	226	197	197	238	1.0	5863755
Total Uranium (U)	mg/kg	0.609	0.643	0.835	0.706	0.050	5863755
Total Vanadium (V)	mg/kg	39.5	28.1	29.0	34.3	2.0	5863755
Total Zinc (Zn)	mg/kg	123	11800	219	251	1.0	5863755
Total Zirconium (Zr)	mg/kg	0.55	<0.50	1.32	<0.50	0.50	5863755

RDL = Reportable Detection Limit

Maxxam Analytics - Partial/Rush Results

Maxxam Job #: B241340
Report Date: 2012/05/28

ACCESS CONSULTING GROUP
Client Project #: ALEX-12-BELLE-02

Sampler Initials: LK

Package 1	1.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

General Comments

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NPK (AVAILABLE) Comments

Sample DL5561-01 Phosphorus (Available by ICP): Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample DL5563-01 Phosphorus (Available by ICP): Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample DL5564-01 Phosphorus (Available by ICP): Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample DL5561-01 Potassium (Available): Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample DL5563-01 Potassium (Available): Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample DL5564-01 Potassium (Available): Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Maxxam Analytics - Partial/Rush Results

Maxxam Job #: B241340
Report Date: 2012/05/28

ACCESS CONSULTING GROUP
Client Project #: ALEX-12-BELLE-02

Sampler Initials: LK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
5863551	Saturation %	2012/05/24			99	80 - 120	<1.0	%	0.4	30		
5863576	Soluble Conductivity	2012/05/24			111	70 - 130	<1.0	uS/cm	2.5	35		
5863755	Total Antimony (Sb)	2012/05/24	NC	75 - 125	93	75 - 125	<0.10	mg/kg			39	N/A
5863755	Total Arsenic (As)	2012/05/28	NC	75 - 125	102	75 - 125	<0.50	mg/kg	0.5	30	192	N/A
5863755	Total Barium (Ba)	2012/05/24	NC	75 - 125	97	75 - 125	<0.10	mg/kg			470	N/A
5863755	Total Beryllium (Be)	2012/05/24	104	75 - 125	106	75 - 125	<0.40	mg/kg			1.8	N/A
5863755	Total Cadmium (Cd)	2012/05/24	98	75 - 125	105	75 - 125	<0.050	mg/kg			5.0	N/A
5863755	Total Chromium (Cr)	2012/05/24	100	75 - 125	97	75 - 125	<1.0	mg/kg			72	N/A
5863755	Total Cobalt (Co)	2012/05/24	96	75 - 125	98	75 - 125	<0.30	mg/kg			25	N/A
5863755	Total Copper (Cu)	2012/05/24	NC	75 - 125	99	75 - 125	<0.50	mg/kg			367	N/A
5863755	Total Lead (Pb)	2012/05/24	NC	75 - 125	97	75 - 125	<0.10	mg/kg			274	N/A
5863755	Total Lithium (Li)	2012/05/24	95	75 - 125	96	75 - 125	<5.0	mg/kg			31	N/A
5863755	Total Manganese (Mn)	2012/05/24	NC	75 - 125	98	75 - 125	<0.20	mg/kg			1060	N/A
5863755	Total Mercury (Hg)	2012/05/24	111	75 - 125	109	75 - 125	<0.050	mg/kg			44	N/A
5863755	Total Molybdenum (Mo)	2012/05/24	98	75 - 125	88	75 - 125	<0.10	mg/kg			29	N/A
5863755	Total Nickel (Ni)	2012/05/24	88	75 - 125	95	75 - 125	<0.80	mg/kg			104	N/A
5863755	Total Selenium (Se)	2012/05/24	117	75 - 125	118	75 - 125	<0.50	mg/kg			1.3	N/A
5863755	Total Silver (Ag)	2012/05/24	83	75 - 125	89	75 - 125	<0.050	mg/kg			20	N/A
5863755	Total Strontium (Sr)	2012/05/24	NC	75 - 125	91	75 - 125	<0.10	mg/kg			417	N/A
5863755	Total Thallium (Tl)	2012/05/24	94	75 - 125	88	75 - 125	<0.050	mg/kg			43	N/A
5863755	Total Tin (Sn)	2012/05/24	NC	75 - 125	85	75 - 125	<0.10	mg/kg			33	N/A
5863755	Total Titanium (Ti)	2012/05/24	NC	75 - 125	94	75 - 125	<1.0	mg/kg			2070	N/A
5863755	Total Uranium (U)	2012/05/24	99	75 - 125	94	75 - 125	<0.050	mg/kg			2.7	N/A
5863755	Total Vanadium (V)	2012/05/24	NC	75 - 125	97	75 - 125	<2.0	mg/kg			82	N/A
5863755	Total Zinc (Zn)	2012/05/24	NC	75 - 125	115	75 - 125	<1.0	mg/kg			981	N/A
5863755	Total Aluminum (Al)	2012/05/24					<100	mg/kg				
5863755	Total Bismuth (Bi)	2012/05/24					<0.10	mg/kg				
5863755	Total Calcium (Ca)	2012/05/24					<100	mg/kg				
5863755	Total Iron (Fe)	2012/05/24					<100	mg/kg				
5863755	Total Magnesium (Mg)	2012/05/24					<100	mg/kg				
5863755	Total Phosphorus (P)	2012/05/24					<10	mg/kg				
5863755	Total Potassium (K)	2012/05/24					<100	mg/kg				
5863755	Total Sodium (Na)	2012/05/24					<100	mg/kg				
5863755	Total Zirconium (Zr)	2012/05/24					<0.50	mg/kg				
5863833	Soluble (2:1) pH	2012/05/24			101	96 - 104			0.2	20		
5866937	% sand by hydrometer	2012/05/25							17.9	35	99	75 - 125
5866937	% silt by hydrometer	2012/05/25							11.1	35	108	75 - 125
5866937	Clay Content	2012/05/25							3.3	35	85	75 - 125
5867085	Cation exchange capacity	2012/05/25							NC	35		
5867097	Total Organic Carbon (C)	2012/05/25			100	75 - 125	<0.020	%	7.7	50	108	75 - 125

Maxxam Analytics - Partial/Rush Results

Maxxam Job #: B241340
Report Date: 2012/05/28

ACCESS CONSULTING GROUP
Client Project #: ALEX-12-BELLE-02

Sampler Initials: LK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
5867902	Available (NH4OAc) Potassium (K)	2012/05/25			105	80 - 120	<2.0	mg/kg	3.4	35		
5867906	Available (NH4F) Phosphorus (P)	2012/05/25			102	80 - 120	<1.0	mg/kg	12.6	35		
5868444	Available (NH4F) Nitrogen (N)	2012/05/25	NC	80 - 120	100	90 - 110	<2.0	mg/kg	NC	35		
5871016	Total Nitrogen	2012/05/28			100	75 - 125	<0.20	%	NC	35	101	75 - 125

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Maxxam Analytics - Partial/Rush Results

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

Phone: (604) 444-4808
Fax.: (604) 444-4511
Toll-Free: 1-800-440-4808

08351389

CHAIN-OF CUSTODY RECORD AND ANALYSIS REQUEST

LAB USE ONLY — MAXXAM JOB #: B241340

ANALYSIS REQUEST

LAB USE ONLY — COC #:

COMPANY NAME: Access Consulting Group

CLIENT PROJECT NO.: ALEX-12-BELLE-02

COMPANY ADDRESS:
#3 Calcite Business Center
151 Industrial Rd.
Whitehorse, YT
Y1A 2V3

TEL.: 867-668-6463

E-MAIL:

FAX: 867-667-6680

SAMPLER NAME (PRINT): Lisa Knight

PROJECT MANAGER: Scott Davidson

LABORATORY CONTACT: Lanoy Luangkhamdeng

	FIELD SAMPLE ID	MAXXAM LAB # (LAB USE ONLY)	MATRIX: GROUNDWATER	SURFACE WATER	DRINKING WATER	SOIL	OTHER	SAMPLING: DATE DD/MM/YY	TIME	# CONTAINERS	ICP Metals	pH/EC	Texture	TOC	C:N Ration	CEC	Total N	Nutrients	Phosphorus
1	WP1 (DSTF)	DLS561				X		14/05/12	13:30	1	X	X	X	X	X	X	X	X	X
2	WP2 (DSTP)	562				X		↓	↓	1	X	X	X	X	X	X	X	X	X
3	WP3 (Mill Waste)	563				X				1	X	X	X	X	X	X	X	X	X
4	WP4 (Mill Waste)	564				X				1	X	X	X	X	X	X	X	X	X
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

B241340

TAT (Turnaround Time)
LESS THAN 5 DAY TAT MUST HAVE PRIOR APPROVAL
* Some exceptions apply - please contact laboratory

STANDARD 5 BUSINESS DAYS
RUSH 3 BUSINESS DAYS
RUSH 2 BUSINESS DAYS
URGENT 1 BUSINESS DAY
OTHER BUSINESS DAYS

PO NUMBER OR QUOTE NUMBER:

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE:

CCME
CSR
AB TIER 1
OTHER

LAB USE ONLY

ARRIVAL TEMPERATURE °C: 1, 2, 2

DUE DATE:

LOG IN CHECK:

ACCOUNTING CONTACT:

SPECIAL REPORTING OR BILLING INSTRUCTIONS:

JARS USED:

RELINQUISHED BY SAMPLER:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY 18/05/12	TIME: 08:30	RECEIVED BY: NICOLE LOCKYER
RELINQUISHED BY: Lisa Knight	DATE: DD/MM/YY	TIME:	RECEIVED BY LABORATORY:

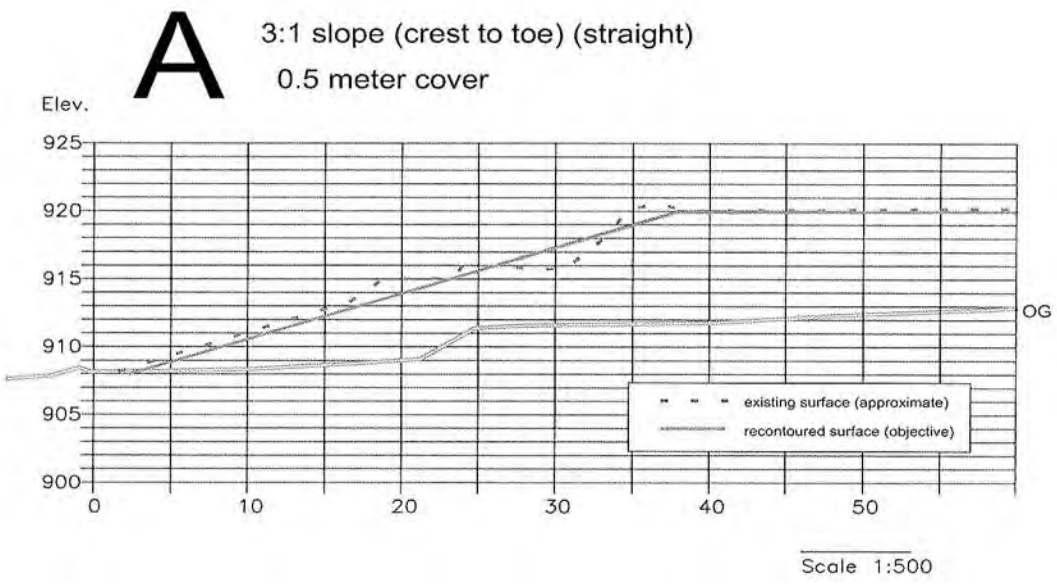
CUSTODY RECORD

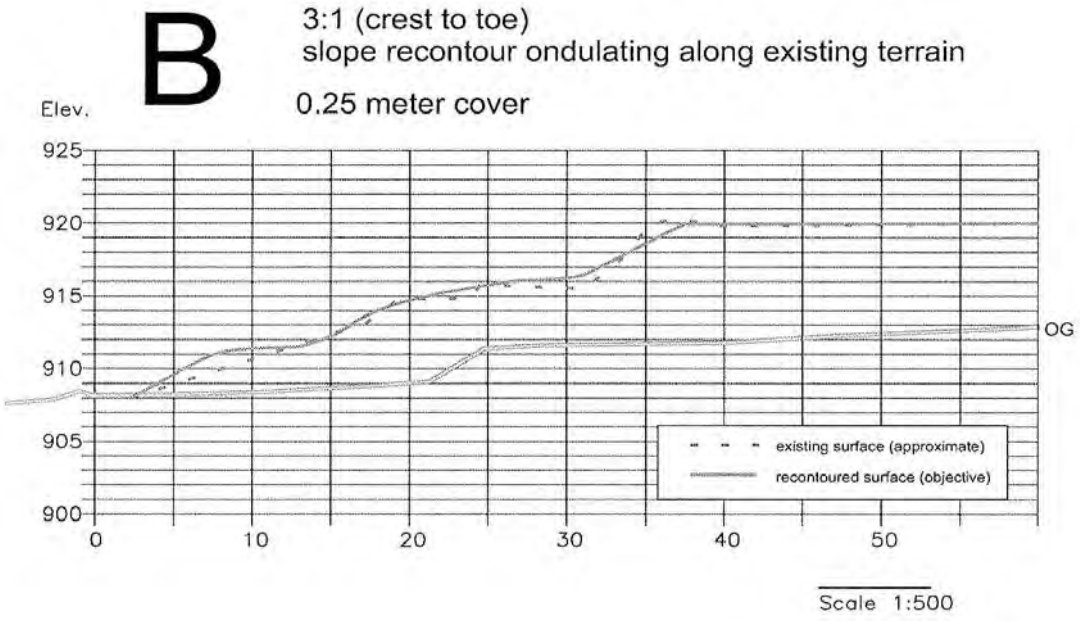
COCFORM - BC - 29970803

APPENDIX B

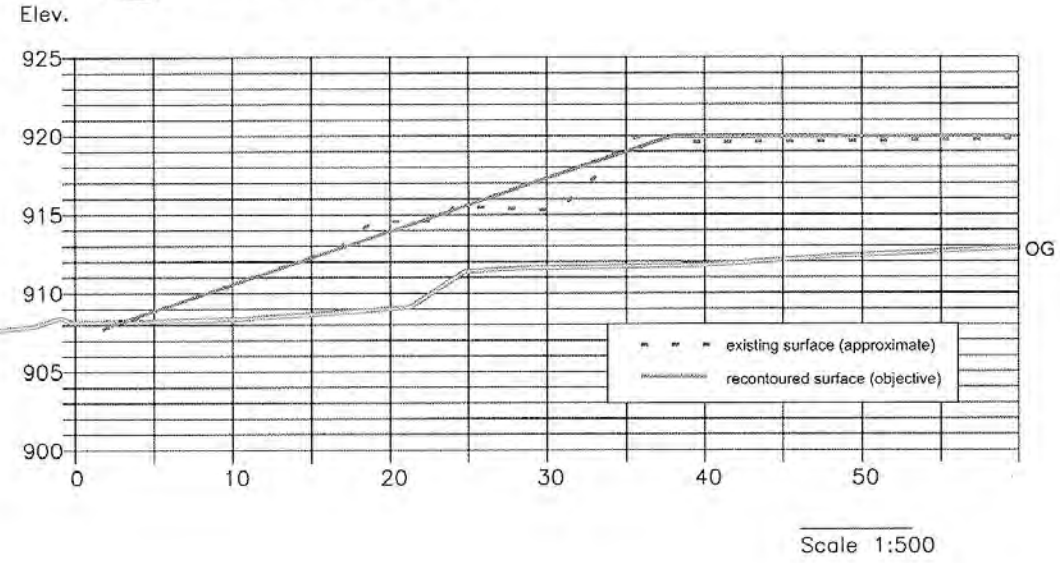
BLOCK PROFILES

DSTF Phase I Reclamation - Slope Profiles



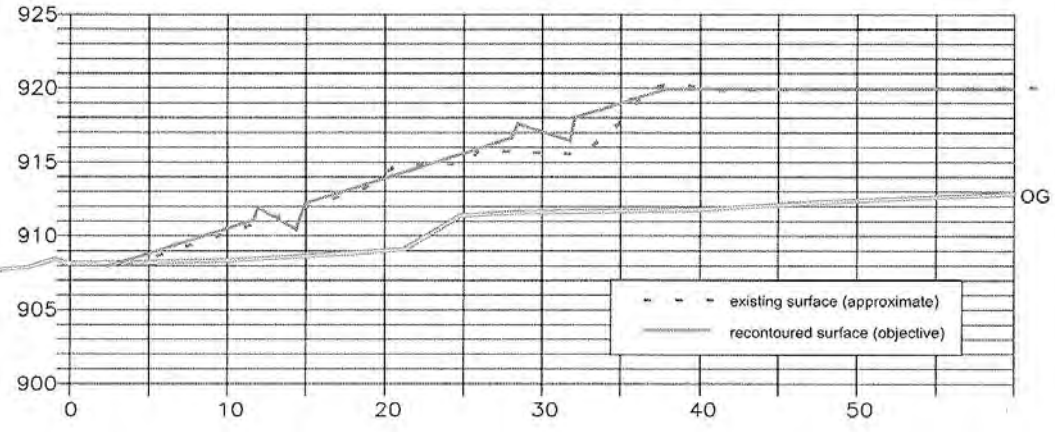


C 3:1 slope (straight)
0.25 meter cover



Scale 1:500

D 0.25 meter cover
3:1 (crest to toe)
slope with random ondulating



Section 2
Scale 1:500

APPENDIX C

PHOTO LOG



Photo 1: Growth Media Pile 1



Photo 2: Growth Media Pile 2



Photo 3: Growth Media Pile 2



Photo 4: Growth Media Pile 3



Photo 5: Growth Media Pile 4



Photo 6: Growth Media Pile 4



Photo 7: Covered DSTF toe looking north



Photo 8: Covered DSTF mid-slope looking south



Photo 9: Covered DSTF crest looking north



Photo 10: Covered DSTF crest looking south



Photo 11: Grass sprouts DSTF looking south from crest



Photo 12: Grass sprouts DSTF looking west from crest

APPENDIX 1.3

2016 SILVER KING IN SITU DEMONSTRATION TEST INTERIM REPORT

3 Calcite Business Centre, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3
Phone (867) 668-6463 Fax (867) 633-4882
www.accessconsulting.ca

Memorandum

To: Elsa Reclamation and Development Company Ltd.

From: Andrew Gault, Jim Harrington (Alexco Environmental Group)

CC: Linda Broughton, Kai Woloshyn (Alexco Environmental Group)

Date: October 24, 2016

Re: Silver King In Situ Treatment Test Update: March – August 2016

Deliverable 2016-17-033-2_07

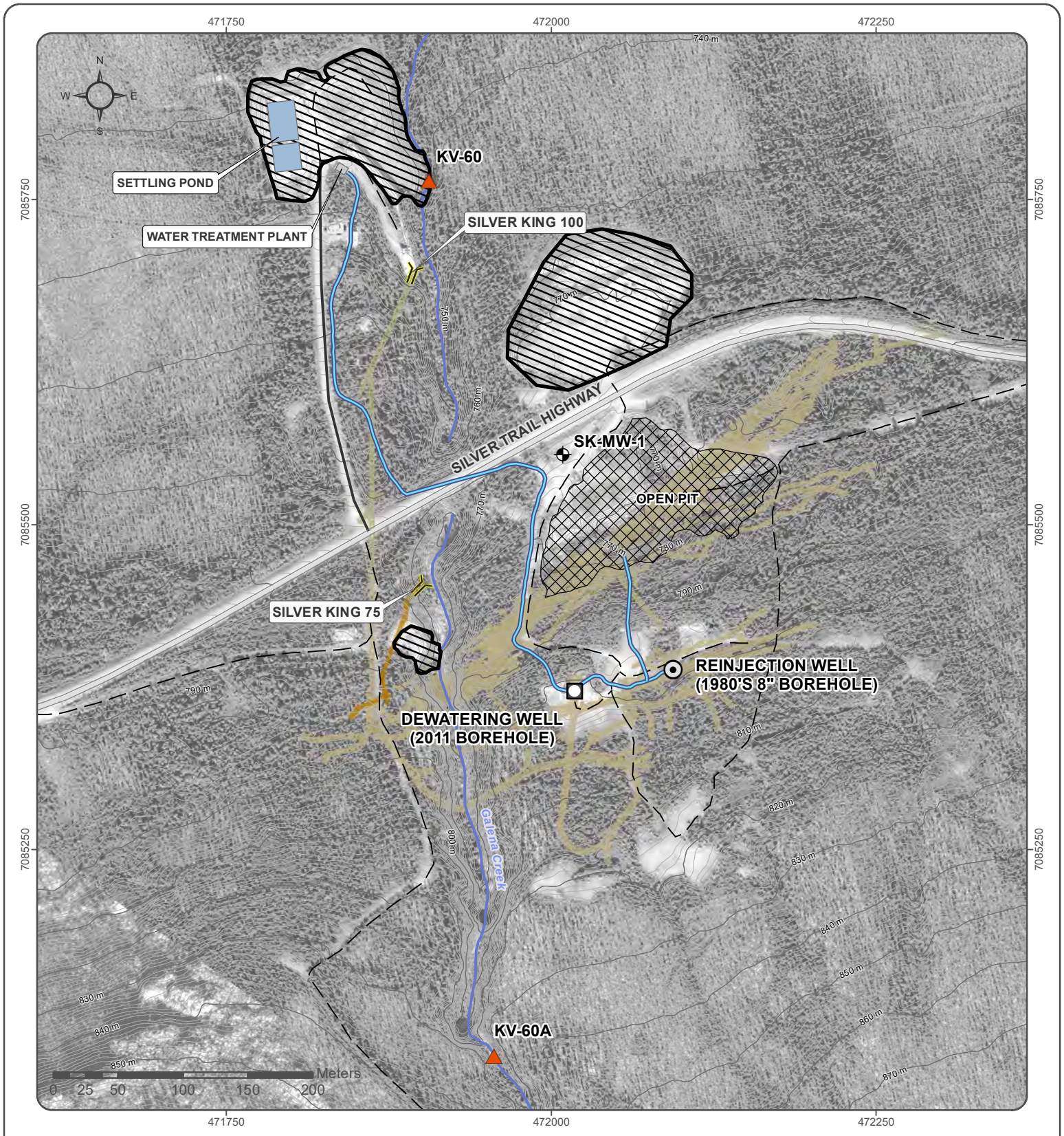
1 INTRODUCTION

This memorandum provides an overview of the work performed and results collected for the Silver King (SK) in situ treatment test between March 2016 and August 2016. It serves to provide an update to INAC on the latest results from the in situ treatment pilot test that was initiated in September 2014.

2 ACTIVITY AND RECENT DATA

2.1 SILVER KING DEWATERING AND GROUNDWATER LEVEL

An overview of the Silver King site is displayed in Figure 2-1. The groundwater level within the SK flooded workings is plotted in Figure 2-2 alongside flow rates of mine pool water pumped from the dewatering well to the SK water treatment plant (WTP) and water that is reinjected to create a recirculation loop within the flooded mine workings. The mine pool elevation varied between 728 and 738 masl for the majority of the March to August 2016 period. Overall, the dewatering rate ranged between 5 and 15 L/s, with approximately 3 L/s returned to the Silver King pit between March and the end of April, 2016. The reinjected water was amended with methanol to stimulate subsurface sulphate- and metal-reducing bacteria between January 22 and April 2, 2016.



Surface Water Station
Reinjection Well; Injection Well, n/a
Dewatering Well
Monitoring Well
Adit

Pipeline
Underground Workings (100 level)
Underground Workings (75 level)
Watercourse
Contours (1 m interval)

Silver Trail Highway
Local Road
Limited-Use Road
Buildings
Settling Pond
Open Pit
Waste Rock Dump

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on October 2016

This drawing has been prepared for the use of Alexco Environmental Group Inc.'s client and may not be used, reproduced or relied upon by third parties, except as agreed by Alexco Environmental Group Inc. and its client, as required by law or for use of governmental reviewing agencies. Alexco Environmental Group Inc. accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without Alexco Environmental Group Inc.'s express written consent.

ERDC

AEG

ELSA RECLAMATION AND DEVELOPMENT COMPANY LTD.

SILVER KING IN SITU TEST

FIGURE 2-1
SILVER KING LAYOUT

OCTOBER 2016

D:\Project\AllProjects\ALEX-05-01\gis\mxd\Studies\WaterTreatment\In-SituWaterTreatment\SilverKing_InSitu_Pipeline_Profile\SilverKing_Pipeline_Simple_20161004.mxd
(Last edited by: amatlashevska; 10/4/2016/14:34 PM)

Between March and late April 2016, the groundwater level in the SK workings was maintained at 727 – 730 masl by dewatering at 5 – 6 L/s and reinjecting back into the SK pit at ~3 L/s (Figure 2-2). The effects of freshet and the associated increased recharge rate were first observed on April 25, 2016, when the groundwater level started to increase sharply. In response to this, on May 2, 2016 the recirculation of water to the Silver King pit was suspended and the dewatering well pumping rate was increased to run at between 9 and 15 L/s to accommodate the high volumes. Since no water was being injected into the mine, methanol amendment was also suspended at this time. All dewatering flows were directed to the Silver King water treatment plant (WTP). The increased dewatering rate slowed the water level rise in the mine workings and managed to maintain the groundwater level at 731 – 735 masl between May and mid-July 2016. As such, the pilot test remained under hydraulic control, largely due to the increased pumping rate that could be achieved with the replacement pump installed in November 2015. This represents an improvement in the test conditions when compared with the freshet event of 2015 when the previous dewatering pump could not adequately maintain hydraulic control during this period of high recharge rate, leading to full flooding of the mine workings and overflow of water from the adit in the spring of 2015.

Extended precipitation in late summer and fall of 2016 also caused a spike in the recharge to the mine working, leading to a second rise in the groundwater level (735 – 739 masl) between mid-July and the end of August despite dewatering at 11 – 15 L/s. By maintaining a high rate of pumping, overflow of the adit was prevented during this period. However, on August 28, 2016 the motor in the dewatering pump failed, leading to full flooding of the workings by the end of August. During this period that water discharged from the SK100 adit it has been directed to the SK water treatment plant for secondary treatment as necessary.

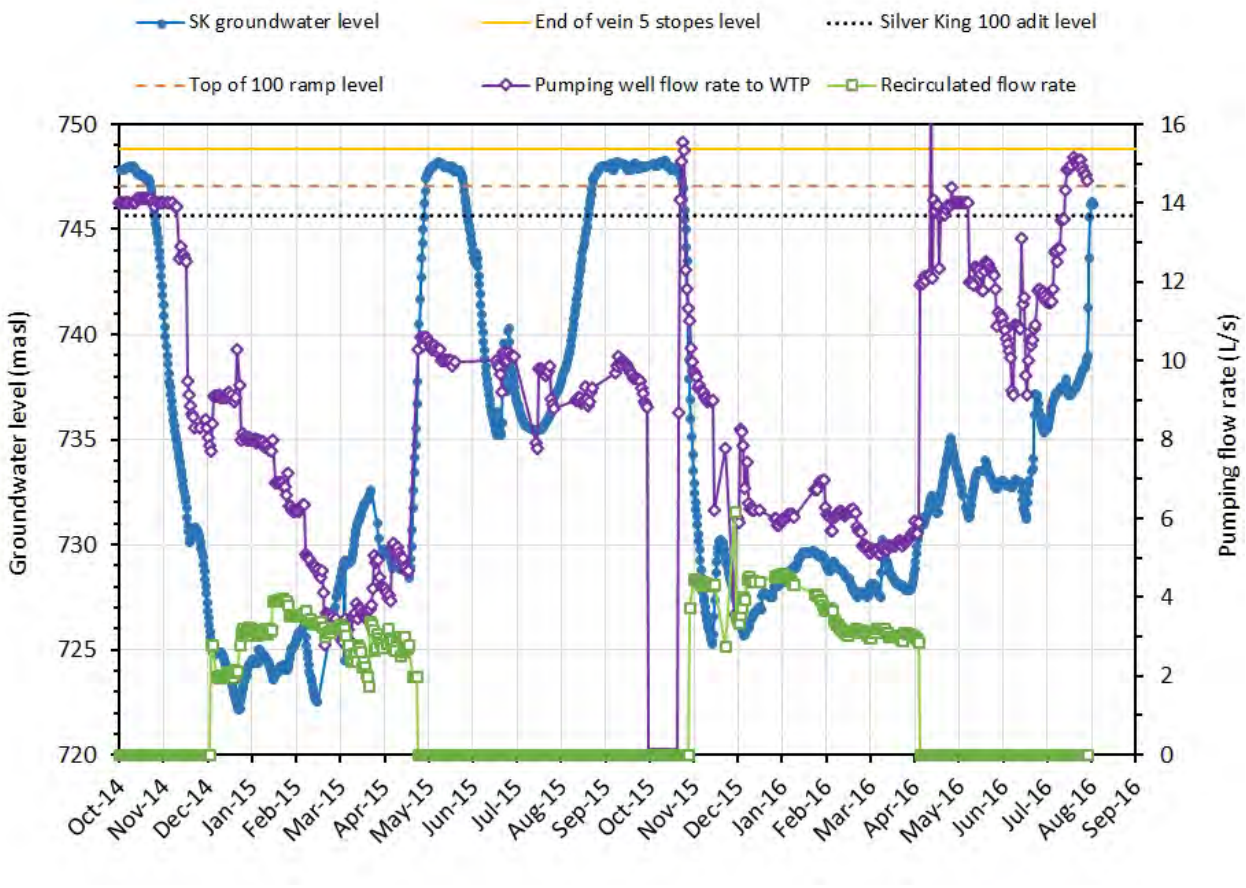


Figure 2-2: Response of groundwater level in SK mine pool during dewatering only and dewatering-recirculation phases of testing at different pumping flow rates. The level of the end of the Vein 5 stopes, top of the 100 ramp and SK100 adit are shown for reference.

2.2 SILVER KING MINE POOL GEOCHEMISTRY

Although the March to August 2016 dataset is the primary concern for this update memorandum, the full dataset collected since the start of the SK in situ treatment pilot test is displayed for selected constituents of interest in Figure 2-3 and Figure 2-4 in order to place the data in context.

A sustained rise in dissolved organic carbon (DOC) concentrations in the SK dewatering well water (SKDW; which extracts water from the base of the Vein 5 workings) was observed approximately one month after the start of methanol injection into the SK pit (which infiltrates into the Vein 1 workings). Dewatering well DOC levels peaked (16 mg/L) 3-4 weeks after methanol injection was halted and declined to pre-injection levels approximately 2 months after the end of methanol injection;

The peak in dewatering well DOC concentrations in April-May 2016 coincided with the following trends in the dewatering well water which are consistent with the onset of sulphate-reducing conditions:

- A rise in alkalinity (200 – 240 mg/L over April – June 2016 versus 146 – 160 mg/L prior to April 2016) since metal and sulphate reduction coupled to the oxidation of organic matter produces alkalinity;

- A rise in sulphide concentrations (0.02 – 0.06 mg/L versus non-detect (<0.02 mg/L) in the previous two months) and concomitant decline in sulphate levels (300 – 320 mg/L versus >390 mg/L for duration of test prior to April 2016) consistent with the transformation of dissolved sulphate to sulphide by sulphate-reducing microorganisms; and

- A fall in the total and dissolved concentrations of zinc, cadmium and thallium to their lowest concentrations observed to date as these chalcophile metals reach with the biogenic sulphide to form insoluble metal sulphide phases which precipitate out of the water column.

Following the decline in DOC concentrations to pre-injection levels, the zinc, cadmium, and thallium concentrations have slowly increased between May and August 2016. However, five months after the suspension of soluble carbon injection, the concentrations of these chalcophile metals still remain well below those present prior to the start of in situ treatment, and discharge water from the pumping well has remained below the water licence thresholds for these metals (there is no threshold criteria for thallium).

The ORP increased markedly in July-August 2016, from ~+10 mV in May 2016, likely due to the ingress of oxidizing surface waters from elevated precipitation in late summer/fall as indicated by the rising groundwater level. A similar spike in ORP was observed during the 2015 freshet event with temporarily re-flooded the mine workings. Although this likely prompted the oxidation of some reduced metal sulphide phases, the slow rise in the dissolved zinc and cadmium concentrations suggests that this process did not result in a rapid rebound in chalcophile metal concentrations. It is inferred that the longer treatment of the Vein 1 workings (Jan – April 2016 carbon injection via SK pit) increased both the treated water volume and the treated surface area within the mine pool, allowing it to effectively treat the increased metal loading from the higher rate of recharge that the mine received during freshet and the summer rainy season.

Iron and arsenic concentrations were closely correlated and exhibited spikes in March and May 2016, typically following the decline in sulphide levels following organic carbon injection. The March peak is interpreted as the onset of stronger reducing conditions in March 2016 during the methanol injection period. Influx of particulate iron and arsenic into the mine during freshet and rinsing of unsaturated surfaces as the groundwater level rose may partly explain the spike in iron and arsenic concentrations observed in May 2016. Alternatively, the dissolved sulphide produced from microbial sulphate reduction may have caused “abiotic” reductive dissolution of more recalcitrant iron (oxyhydr)oxides, releasing iron and associated arsenic to solution. However, at all times during the 2016 organic carbon injection period and the passive treatment phases since organic carbon addition ceased, arsenic concentrations have remained well below (i.e., 10% or less) the water licence discharge thresholds (there is no threshold criteria for iron).

Manganese concentration showed little change between March and August 2016, ranging between 2.1 and 2.8 mg/L with no clearly discernable trend. Temperature increased between March and August 2016, but only over a relatively narrow range (2.8 to 5.4°C).

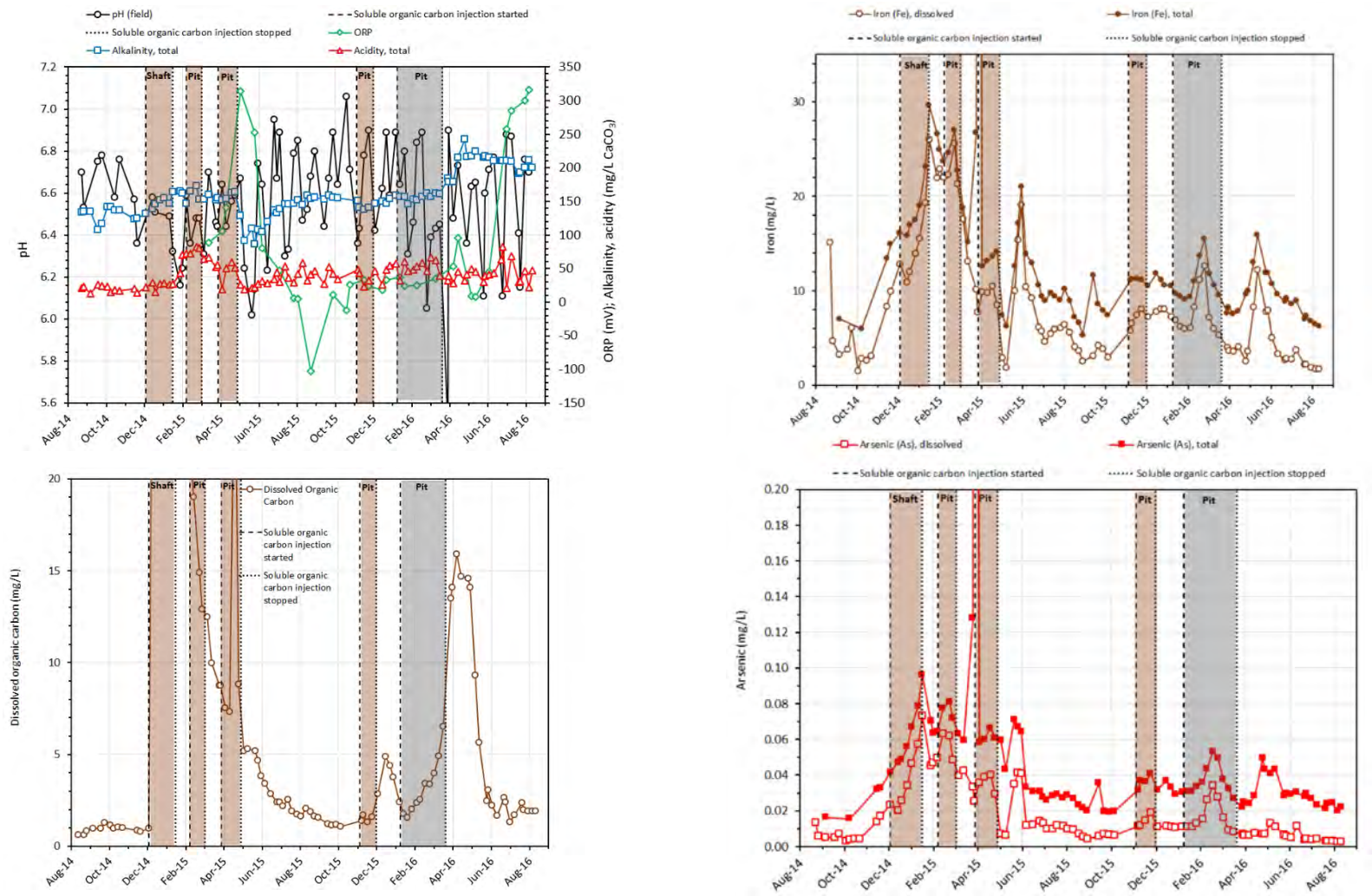


Figure 2-3: Change in selected constituents in SK mine pool water (collected via the dewatering borehole) during the dewatering and molasses amendment phases of the in situ mine pool treatment testing. The shaded areas indicate when continuous injection of molasses (brown) or methanol (grey) was ongoing with recirculation to either the shaft or pit; data collected prior to this were sampled when the mine pool was undergoing dewatering only.

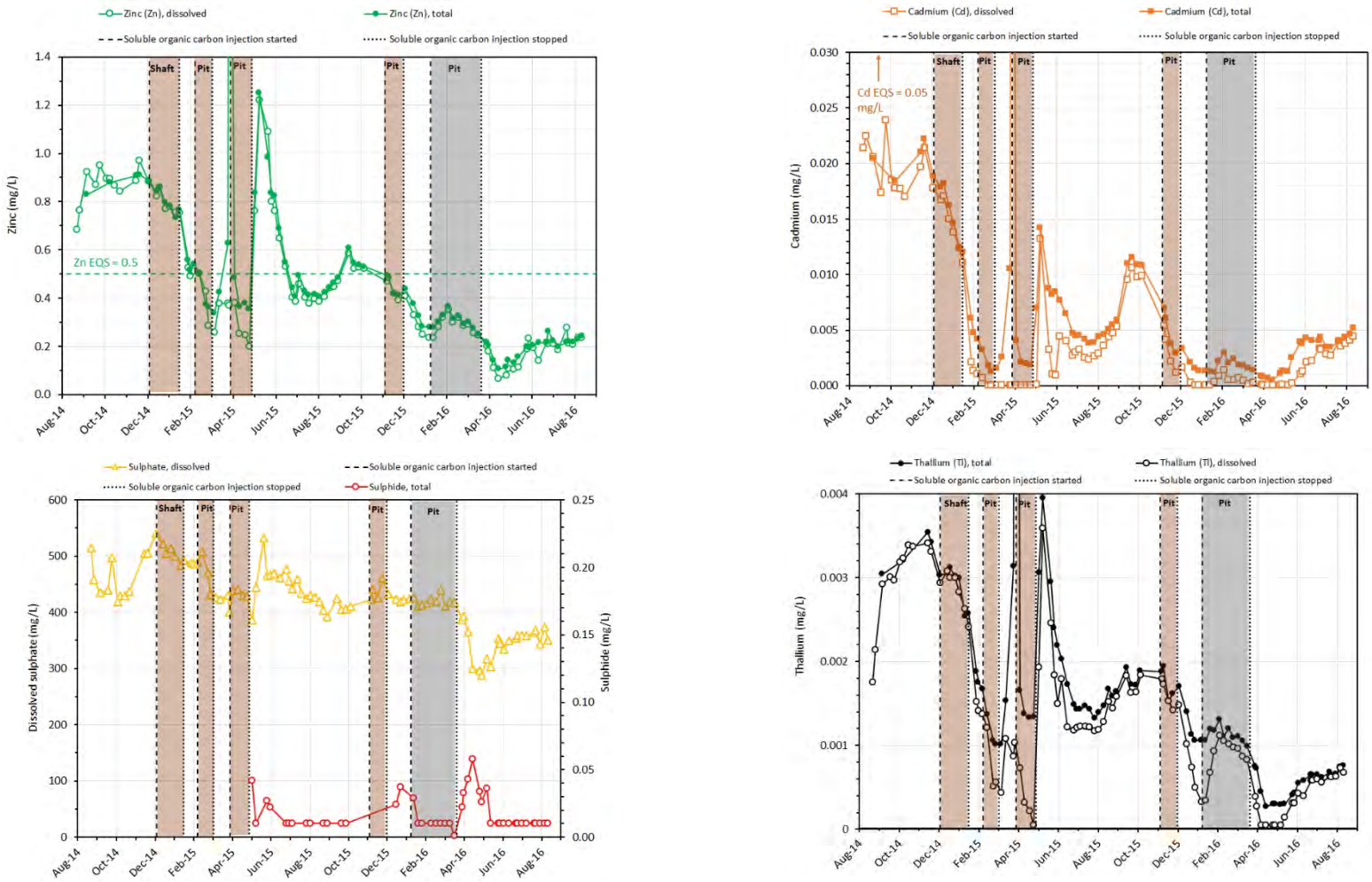


Figure 2-4: Change in zinc, cadmium, sulphur species, and thallium concentrations in SK mine pool water (collected via the 2011 dewatering borehole) during the dewatering and molasses amendment phases of the in situ mine pool treatment testing. The shaded areas indicate when continuous injection of molasses (brown) or methanol (grey) was ongoing with recirculation to either the shaft or pit; data collected prior to this were sampled when the mine pool was undergoing dewatering only. EQS = effluent quality standard.

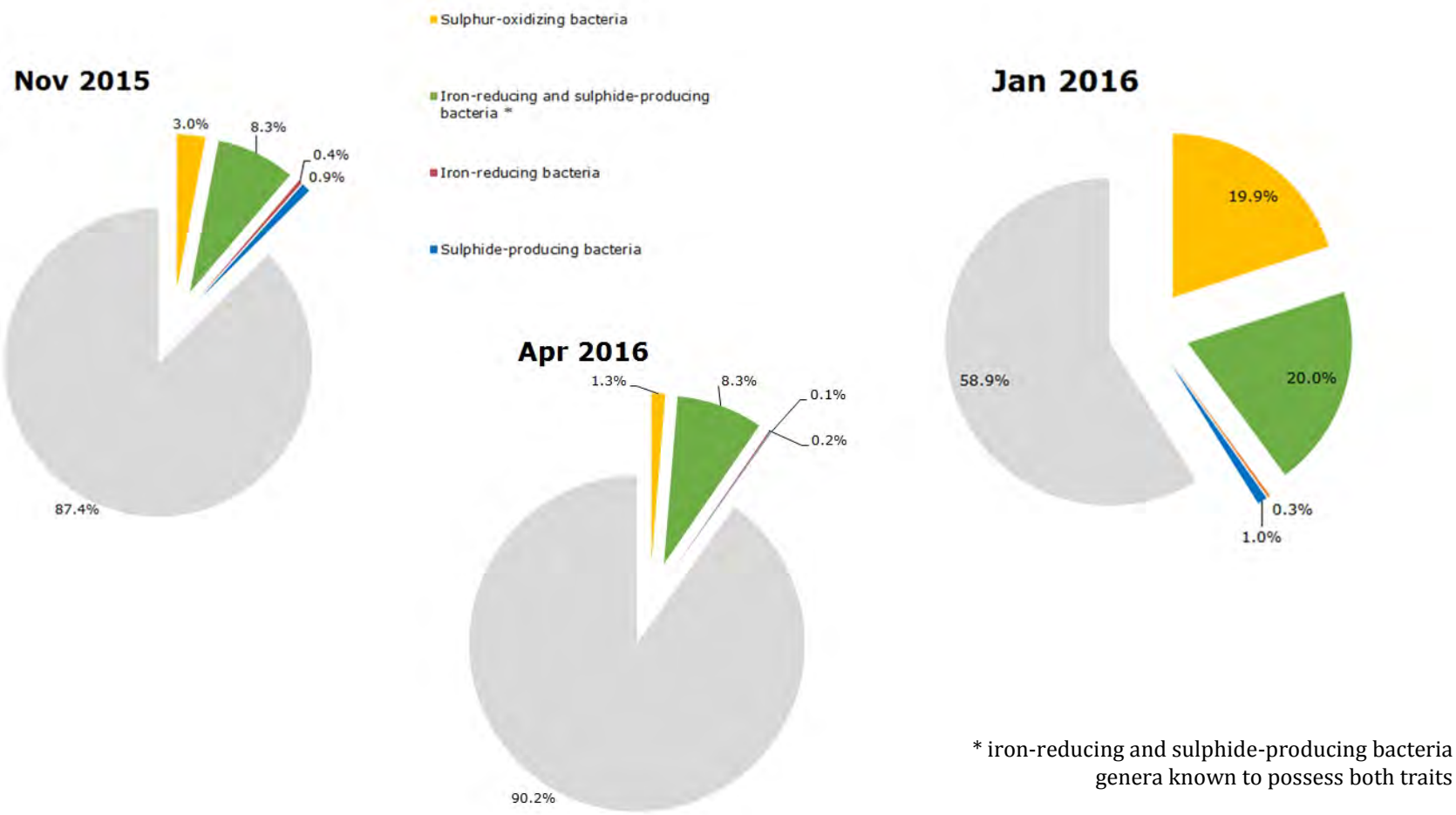
2.3 SILVER KING MINE POOL MICROBIOLOGY

Dewatering well samples were collected for microbial community profiling in April 2016. These were submitted to Contango Strategies (Saskatoon, SK) for genomic analysis. Further details regarding this analysis are reported in AEG (2016). In brief, DNA was extracted from the water samples and portions of the 16S rRNA gene, which can be used for taxonomic classification, were sequenced and matched against known microorganisms. Similar sequences (97% similarity or higher) were grouped together into operational taxonomic units (OTUs) and compared against a microbial database for classification at the genus level. Following classification, the matched genera were grouped into the following categories according to their ability to mediate redox transformations of sulphur and/or iron:

- Iron reducing bacteria (FeRB);
- Sulphur-oxidizing bacteria (SOB); and
- Sulphide-producing bacteria (SPB).

Many microorganisms are capable of both sulphide production and iron reduction; such genera were grouped together. The November 2015 and January 2016 data are also presented in order to provide some context for the April 2016 data (Figure 2-5 to Figure 2-7).

Microbes capable of sulphide production were present in the SK mine pool for all three sampling events. Although the proportion of microorganisms capable of sulphide-production appeared to have declined in the April 2016 sampling event relative to January 2016 (Figure 2-5), the inferred abundance of SPBs, which is based on most probable number measurements of heterotrophic bacteria present in each sample, increased markedly from January to April 2016 (Figure 2-7). The lower proportion of sulphide-producing bacteria in the April 2016 sample is likely exacerbated by the proliferation in methylotrophic bacteria (24% of OTUs) in the April 2016 sample, compared to the November 2016 (3% of OTUs) and January 2016 (1% of OTUs) samples. The sharp rise in methylotroph abundance is due to the methanol injection into the SK mine workings (via the SK pit) that took place from late January to early April, 2016. Of those OTUs that were most closely matched with SPBs, the majority were associated with the *Desulfosporosinus* genus in the January and April 2016 samples (Figure 2-6).



* iron-reducing and sulphide-producing bacteria genera known to possess both traits

Figure 2-5: Percentage of OTUs assigned as FeRB, SPB and SOB in SK mine pool water samples.

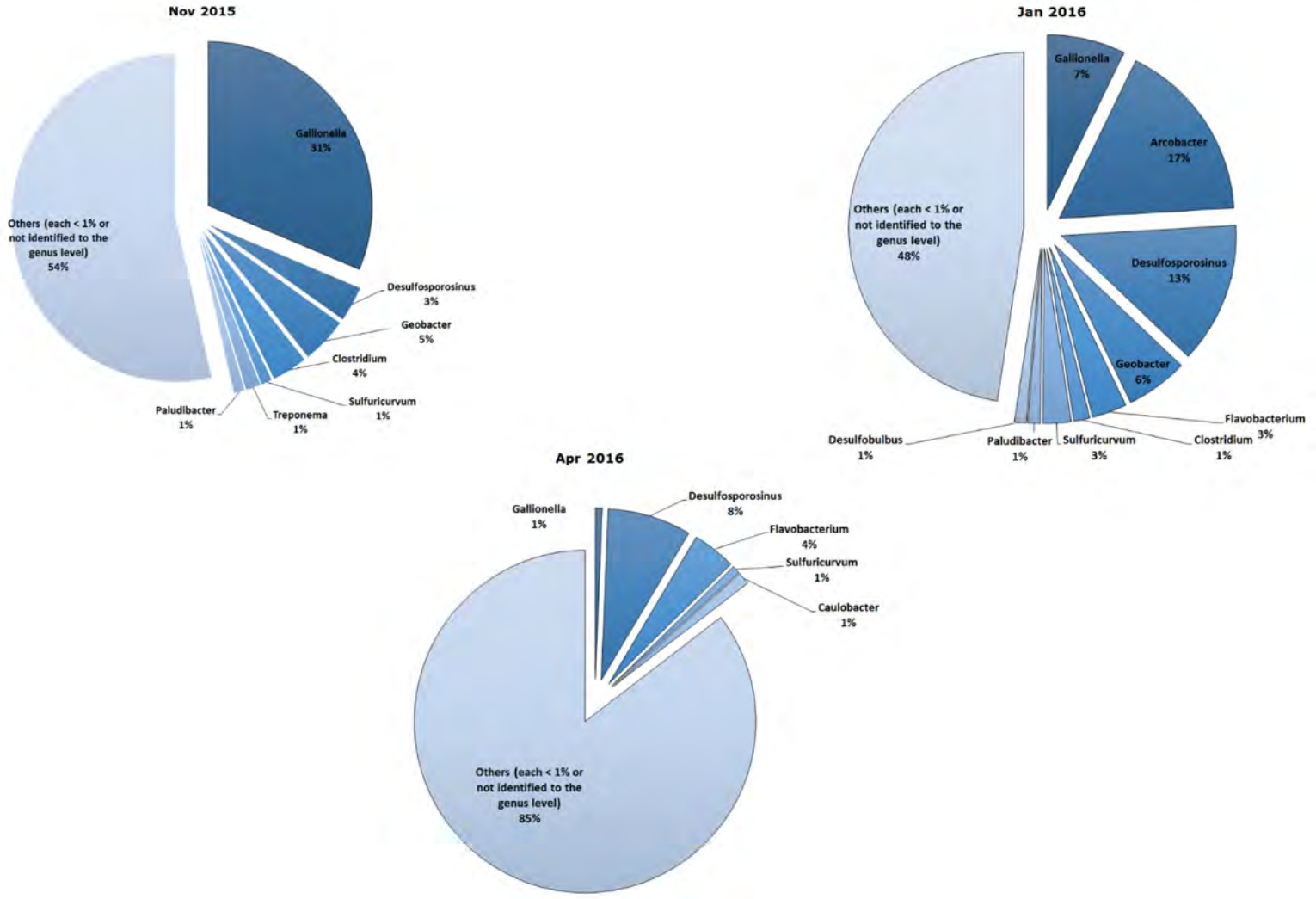


Figure 2-6: Highest percentage of organisms identified to genus level for November 2015, January 2016, and April 2016 sampling events

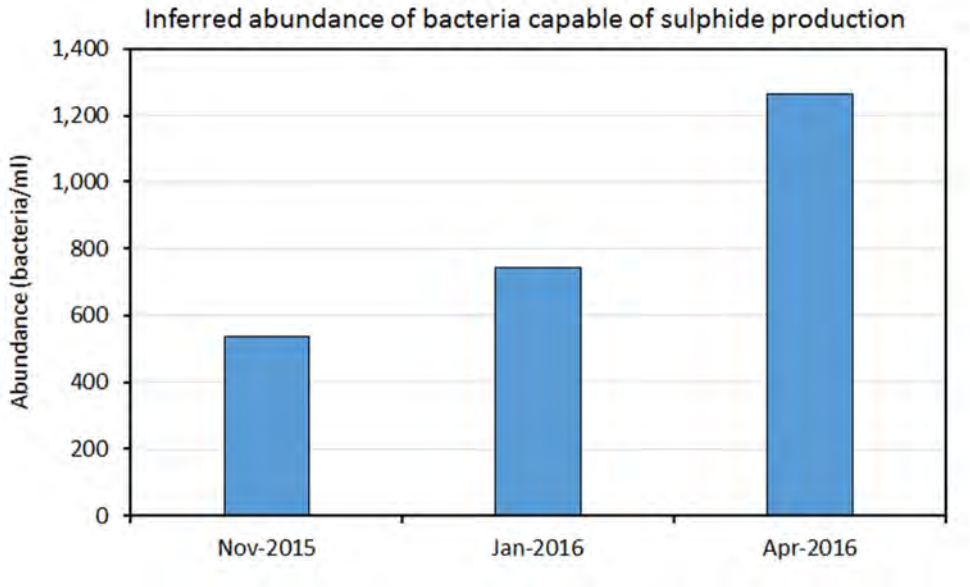


Figure 2-7: Inferred abundance of microorganisms with ability to produce sulphide determined for November 2015, January 2016, and April 2016 sampling events

2.3.1 ^{34}S-SO_4 Isotopic Analysis

The relative differences in stable isotope ratios are reported relative to a standard reference material and in delta notation:

$$\delta = [\ (R_{sample} - R_{std})/R_{std}\ ] \times 1000$$

where R_{sample} and R_{std} are the ratios of the abundance of the heavy to light isotope (^{34}S and ^{32}S, respectively) for the sample and the standard reference material (Canyon Diablo Troilite for $\delta^{34}S$), respectively. Laboratory delays have limited the amount of stable isotope data for evaluation with only samples collected between November 2015 and March 2016 available. This small sample set limits the conclusions that may be drawn from the data; however, the data collected to data are discussed below.

During microbial sulphate reduction, the ^{32}S-O bond is more easily broken than the ^{34}S-O bond. As such, the sulphate that remains during microbial sulphate reduction is expected to become progressively enriched in the ^{34}S isotope, leading to an increase in the $\delta^{34}S$-SO_4 value (i.e. become more positive). This may provide a secondary tool to indicate the development of microbially-induced sulphate reducing conditions in the SK mine pool.

The SK mine pool $\delta^{34}S$-SO_4 data (-1.6 to -3.2‰) lie within the range observed along Galena Creek (-1.2 to -1.9‰ at KV-60A and -3.4 to -3.8‰ at KV-60), and are higher than the $\delta^{34}S$-SO_4 measured in groundwater samples from SK-MW-1 (-5.6 to -6‰) (Figure 2-8). This is consistent with the δD and $\delta^{18}O$ stable isotope data that suggest the majority of the SK mine pool is supplied by Galena Creek (Section 2.4.2).

Measurable sulphide was detected in the SK mine pool between late December 2015 and January 2016 (Figure 2-4), which coincided with a rise in the $\delta^{34}S\text{-}SO_4$ ratio between January and mid February, 2016, however, the $\delta^{34}S\text{-}SO_4$ data for this period were largely within the range of values observed prior to the detection of sulphide. Furthermore, the dissolved sulphate concentration showed little change over this time, suggesting that any change in the $\delta^{34}S\text{-}SO_4$ signature was likely masked by the large sulphate pool. Further data, especially in April and May, 2016, when a marked drop in the SK mine pool dissolved sulphate concentration and concomitant rise in sulphide levels were observed, are required to evaluate the utility of $\delta^{34}S\text{-}SO_4$ measurements in identifying microbially mediated sulphate reduction in this system.

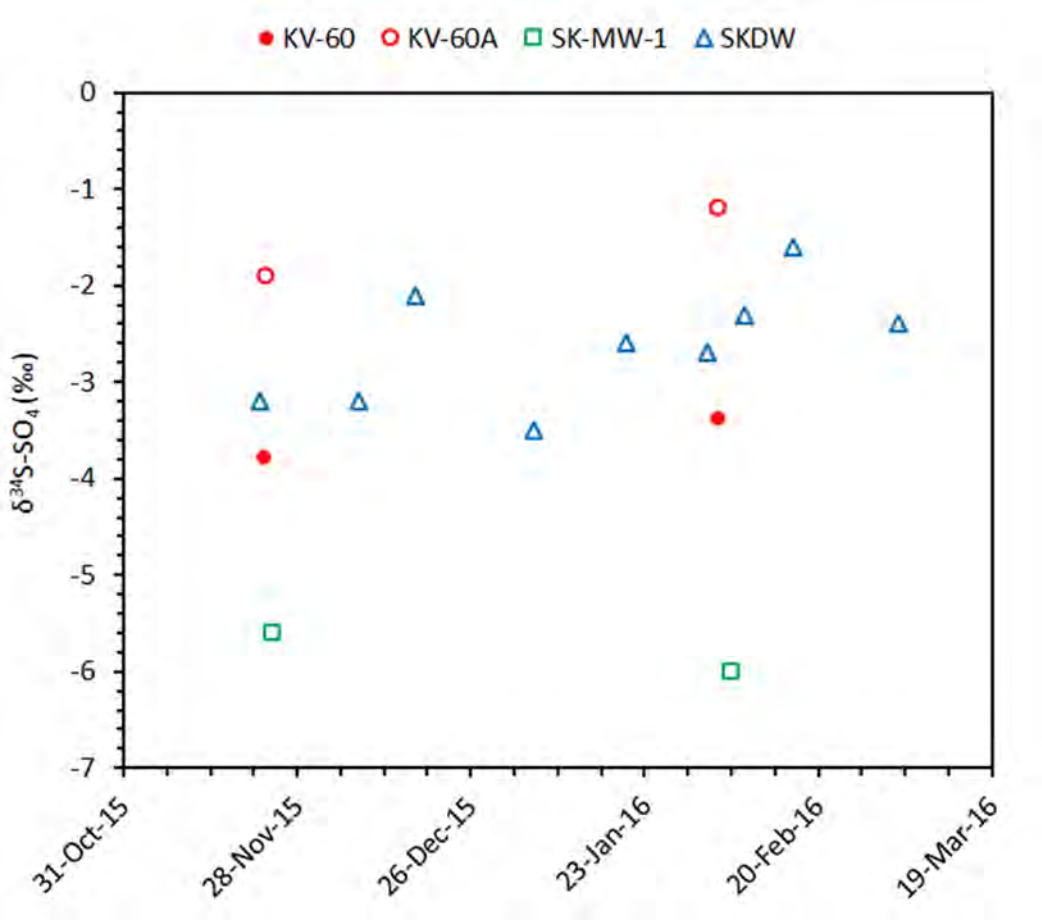


Figure 2-8: $\delta^{34}S\text{-}SO_4$ measurements from water samples collected from Galena Creek (KV-60 and KV-60A), the flooded SK mine workings (SKDW), and local groundwater (SK-MW-1).

2.4 TRACER ANALYSIS

2.4.1 Dye

Fluorescent tracer (18 L of 20% Rhodamine solution) was injected into the SK workings via the SK pit on February 24, 2016. An inline fluorimeter was placed at the mine water discharge at the treatment plant to provide high resolution data regarding the arrival of the injected dye at the dewatering well. No dye breakthrough has been detected, suggesting that either too little dye was added to the workings, or that the dye was significantly attenuated within the workings.

2.4.2 Stable Isotope (^{2}H and ^{18}O)

Samples for deuterium (^{2}H or D) and oxygen-18 (^{18}O) analyses were collected periodically from the SK dewatering well in addition to Galena Creek (KV-60A and KV-60) and the nearby groundwater monitoring well (SK-MW-1). This work is not intended to provide a quantitative measure of the precise contributions of surface and groundwater sources to the SK workings since the time and budget required for such a study are outwith the scope of the SK in situ treatment pilot test. Nevertheless, stable isotope analyses of water samples from the SK workings, and from likely recharge sources to the SK mine such as Galena Creek and local groundwater, may provide information regarding the dominant source of recharge to the flooded SK workings.

The relative differences in stable isotope ratios are reported relative to a standard reference material and in delta notation:

$$\delta = [\ (R_{sample} - R_{std})/R_{std}\ ] \times 1000$$

where R_{sample} and R_{std} are the ratios of the abundance of the heavy to light isotope for the sample and the standard reference material (standard mean ocean water for both δD and $\delta^{18}O$), respectively. Long analytical delays at the specialist laboratory responsible for the isotopic analysis have resulted in the analysis of only the March, 2016 sample in the March-August, 2016 period; further data are awaited.

Plotting of the δD and $\delta^{18}O$ data collected to date indicates that the Galena Creek samples largely share a similar isotopic signature with the global meteoric water line (GMWL; Figure 2-9), suggesting that local precipitation that ultimately feeds Galena Creek has not undergone substantive subsequent isotopic fraction (e.g. via evaporation and/or mineral-fluid interactions). The SK-MW-1 groundwater samples are generally located further right of the GMWL than the Galena Creek samples, suggesting they have experienced some evaporation and/or mineral-fluid reactions (Figure 2-9). The mine pool samples collected via the dewatering well (SKDW) plot between the Galena Creek and local groundwater data, and are closest to the Galena Creek stable isotope dataset (Figure 2-9).

Examination of temporal trends in the stable isotope data (Figure 2-10) indicates that the Galena Creek and SK flooded mine workings samples have exhibited minimal variation over the sampling period (November 2015 to March 2016); however, an increase in the δD and $\delta^{18}O$ values for the local groundwater (SK-MW-1) was

observed in the February and March, 2016 samples. Given the limited dataset available, it is unclear if this increase represents a seasonal trend.

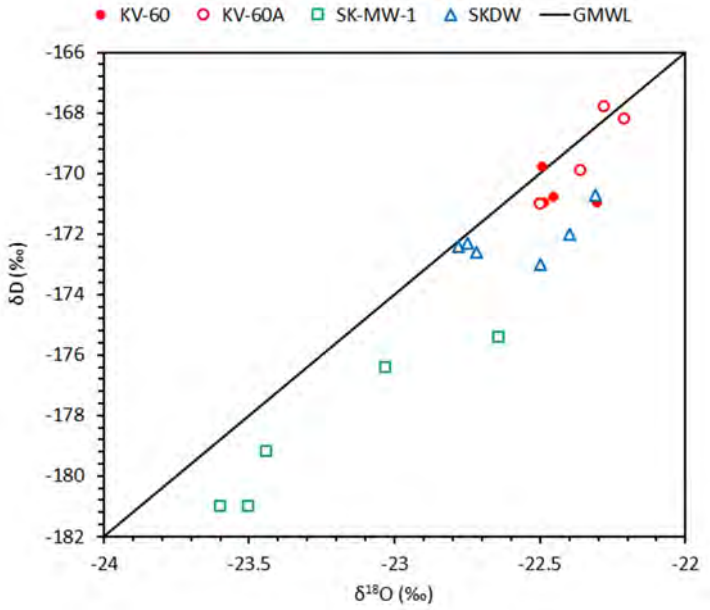


Figure 2-9: δD versus $\delta^{18}O$ plot of water samples from Galena Creek (KV-60 and KV-60A), the flooded SK mine workings (SKDW), and local groundwater (SK-MW-1).

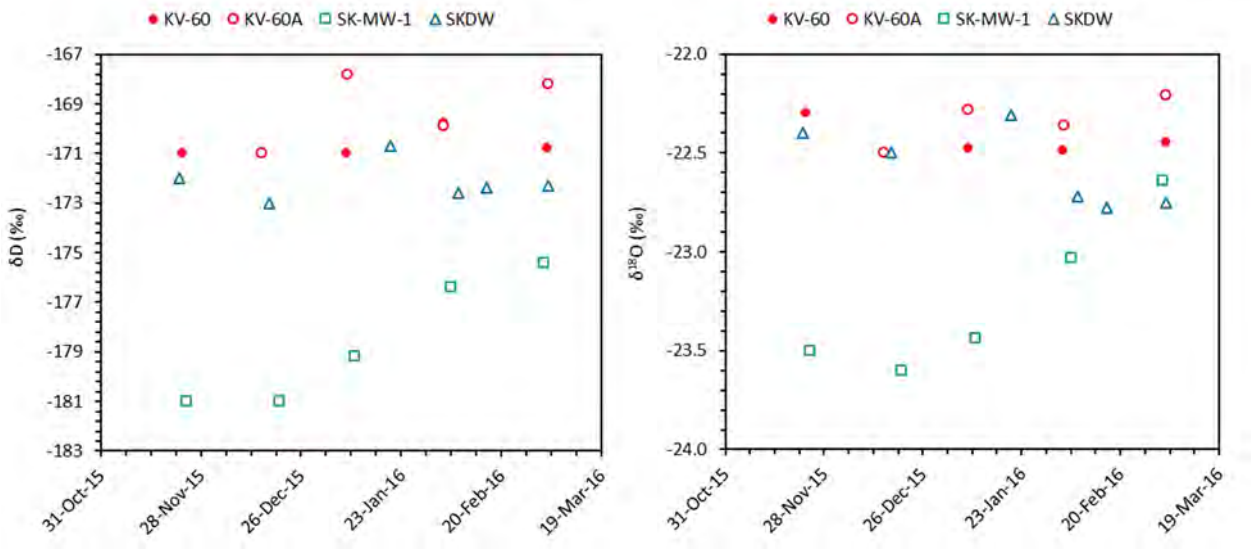


Figure 2-10: Temporal changes in hydrogen (left) and oxygen (right) isotope ratios measured in water samples collected from Galena Creek (KV-60 and KV-60A), the flooded SK mine workings (SKDW), and local groundwater (SK-MW-1).

Since the start of collection of samples for isotopic analysis (November 2015), four paired sampling events are available (collected within 5 days of each other) for evaluation (Table 2-1). In order to estimate the relative contribution of Galena Creek and local groundwater to the SK workings, a two component mixing model was assumed where KV-60A data were used for the Galena Creek endmember and SK-MW-1 for the local groundwater endmember.

Table 2-1: Stable isotope and tritium date-paired data collected to date from sampling locations at the SK site

Sample location	Date	δD	δ18O	Tritium
		‰	‰	TU
KV-60	23-Nov-15	-171	-22.3	-
SKDW	22-Nov-15	-172	-22.4	5.4
SK-MW-1	24-Nov-15	-181	-23.5	-
KV-60A	15-Dec-15	-171	-22.5	-
KV-60	15-Dec-15	-171	-22.5	-
SKDW	17-Dec-15	-173	-22.5	-
SK-MW-1	20-Dec-15	-181	-23.6	-
KV-60A	04-Feb-16	-169.9	-22.36	-
KV-60	04-Feb-16	-169.8	-22.49	-
SKDW	08-Feb-16	-172.6	-22.72	-
SK-MW-1	06-Feb-16	-176.4	-23.03	-
KV-60A	04-Mar-16	-168.2	-22.21	-
KV-60	04-Mar-16	-170.8	-22.45	-
SKDW	04-Mar-16	-172.3	-22.75	-
SK-MW-1	03-Mar-16	-175.4	-22.64	-

The proportions of each endmember were varied such that:

$$x*\delta D_{KV\text{-}60A} + (1\text{-}x)*\delta D_{SK\text{-}MW\text{-}1} = \delta D_{SKDW}$$

Where x and (1-x) denote the fractional proportion that Galena Creek (KV-60A) and local groundwater (SK-MW-1) contribute to the SK mine pool. This assumes a two component endmember system.

No KV-60A data were available for the November 2015 sampling event, so KV-60 was used instead; the use of either KV-60 or KV-60A in the mixing model returned largely similar results. The same mixing model exercise using $\delta^{18}O$ also returned similar results.

This two-component mixing model indicated that Galena Creek provided the majority of recharge in November (90%) and December (80%) 2015. This is consistent with the November 2015 SK dewatering well tritium data (Table 2-1), which indicated that 5.4 TU of tritium was present, suggesting that the mine workings had been recharged with relatively young water.

Although Galena Creek was still the predominant source of recharge in the February and March 2016 sampling events, its relative contribution had declined to 58% and 67%, respectively. While this might reflect the lower recharge that may be expected during the winter months when flow in Galena Creek is at its lowest, the increase observed in the δD and $\delta^{18}O$ SK-MW-1 data complicates this assessment since this is responsible for the higher apparent groundwater proportion of the inferred recharge from the mixing model calculation. Further data may help clarify any seasonality in waters from each sampling station and provide additional information regarding source apportionment to the flooded SK mine workings.

3 SUMMARY

- Methanol injection via the SK pit resulted in development of sulphate-reducing conditions in the SK mine pool as indicated by the fall in chalcophile metal and sulphate concentrations alongside a rise in sulphide and alkalinity levels;

- Ongoing monitoring over the 5 months following the suspension of carbon injection indicates that zinc and cadmium concentrations in the SK mine pool remain substantially lower than those present prior to in situ treatment and have exhibited only a slow rate of increase over this time;

- Microbial profiling continued to indicate the presence of bacteria with a close genetic similarity to known sulphate-reducing microorganisms, and suggested that their inferred abundance had increased over the course of the in situ treatment program; and

- Limited data precludes an in depth assessment of the stable isotope data, however, δD and $\delta^{18}O$ data suggest that Galena Creek is the principal source of recharge to the SK mine workings.

4 REFERENCES

Alexco Environmental Group (AEG) (2016) ERDC Task 033-2 Silver King In-Situ Treatment FY2015-16 Summary. Memorandum prepared for Elsa Reclamation and Development Company Ltd., April 1, 2016.

APPENDIX 1.4

SILVER KING IN SITU TREATMENT PILOT – 2025 UPDATE

Memorandum

To: Elsa Reclamation and Development Company Ltd.

From: Andrew Gault, Ensero Solutions Canada, Inc.

CC: Ryan Herbert, Ensero Solutions Canada, Inc.

Date: March 26, 2025

Deliverable: 2024-25-321-1_4

Re: *Silver King In situ Treatment Pilot – 2024 Update*

1 INTRODUCTION

In February 2006, Elsa Reclamation and Development Company Ltd. (ERDC) purchased the United Keno Hill Mine (UKHM) assets to develop and implement a reclamation plan, as well as perform ongoing environmental Care and Maintenance associated with the historical UKHM site in the Keno Hill Silver District (KHSD). In September 2022, Hecla Mining Company (Hecla) acquired Alexco Resource Corp. and its subsidiaries, including ERDC.

The pilot scale implementation of *in situ* treatment at the Silver King mine was initiated in September 2014 under ERDC. Since then, the performance of the pilot treatment system has been documented in numerous memoranda and reports, the most recent of which described the results obtained in 2023 (Ensero, 2024). This memorandum provides an overview of the work performed and results collected for the Silver King *in situ* treatment test between September 2014 and December 2024.

2 METHODS

2.1 OPERATIONS

Between September 2014 and December 2016, the Silver King mine workings were actively dewatered to maintain the static water level approximately 10 to 15 m below the top of the 100 level ramp and prevent discharge via the 100 level adit. This was to provide some control on the hydraulic residence time (HRT) within the mine workings. Such active dewatering was stopped in late December 2016, allowing the mine to return to its fully flooded conditions with discharge from the Silver King 100 (SK100) adit. The mine has remained in this fully flooded configuration since late December 2016. As a contingency during the piloting of *in situ* treatment at Silver King, all water pumped from the dewatering well during the active dewatering period, or discharged from the SK100 adit

upon re-flooding, is sent to the existing water treatment plant (WTP) to ensure compliance with the water licence (WL) QZ21-012 effluent quality standards (EQS).

Following bench-scale and full-scale testing as described in the 2023 Silver King *in situ* treatment update memorandum (Ensero, 2024), hydrogen peroxide addition was implemented at the WTP. This water treatment modification is intended to address historical sporadic elevated total suspended solids (TSS) concentrations observed in effluent from the Silver King settling pond discharge (monitoring station KV-14) which exceeded the EQS of 25 mg/L.

In addition, the Silver King settling ponds were cleaned out in fall 2024 to increase their retention capacity.

2.2 CARBON INJECTION

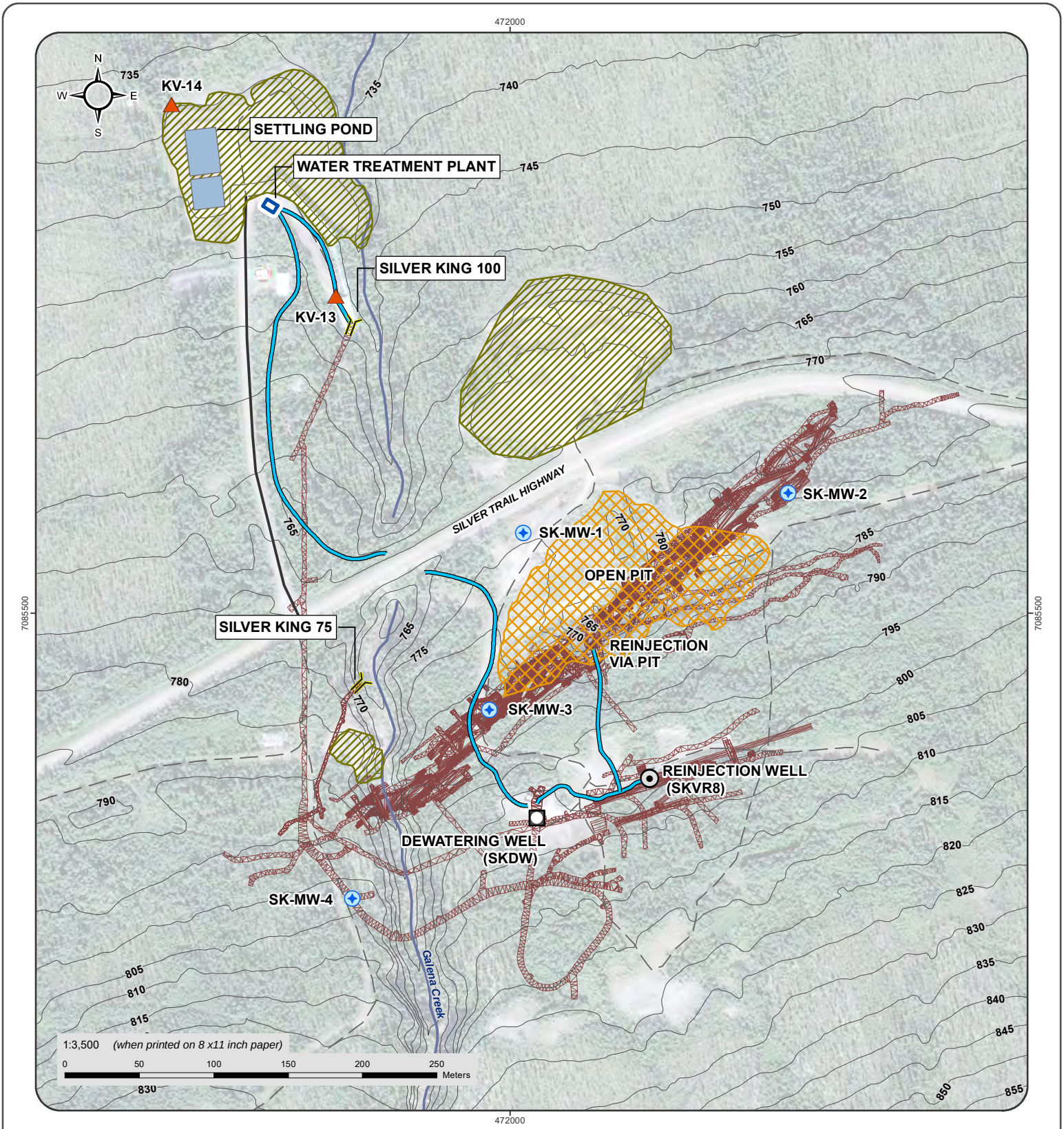
In situ treatment involves the injection of organic carbon to flooded subsurface mine workings to stimulate the activity of naturally occurring sulphate-reducing bacteria. Such microorganisms convert sulphate to sulphide, which in turn reacts with chalcophile ("sulphur-loving") elements (e.g., cadmium, zinc, copper, lead, thallium) to form insoluble sulphide minerals that precipitate within the flooded mine workings. At Silver King, this is achieved by pumping of mine water from the dewatering well location (SKDW; Figure 2-1), blending in molasses or methanol into the pumped mine water, and re-injecting via a historical borehole (SKVR8) that intersects the Vein 5 workings, or the open pit that infiltrates into the Vein 1 mine workings below (Figure 2-1). This reinjection forms a recirculation loop, helping to mix the organic carbon throughout the mine workings. A summary of the carbon injection events, which typically last three to six weeks, is summarized in Table 2-1.

No carbon injection occurred in 2024.

Table 2-1: Summary of Carbon Injection to the Silver King Mine Workings

Date of Injection	Carbon Source	Location of Injection
23 Dec 2014 - 3 Feb 2015	Molasses	SKVR8
25 Feb 2015 - 21 Mar 2015	Molasses	SK open Pit
16 Apr 2015 - 16 May 2015	Molasses	SK open Pit
19 Nov 2015 - 15 Dec 2015	Molasses	SK open Pit
22 Jan 2016 - 2 Apr 2016	Methanol	SK open Pit
18 Nov 2016 - 22 Dec 2016	Methanol	SK open Pit
22 Feb 2019 - 4 Apr 2019	Methanol	SK open Pit
16 Aug 2021 - 15 Oct 2021*	Methanol	SK open Pit
2 Sep 2023 - 4 Oct 2023	Methanol	SK open Pit

** Methanol dosing was accidentally halted between September 15 and 25, 2021.*



- Adit
- Dewatering Well
- Reinjection Well
- Monitoring Well
- Surface Water Station
- Water Treatment Shed
- Settling Pond
- Open Pit
- Waste Rock Storage Area
- Existing HDPE Pipeline
- Underground Workings (75 level)
- Contours (5m)

Satellite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on January 21 2021.

Datum: NAD 83; Projection: UTM Zone 8N

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ERDC

ELSA RECLAMATION AND DEVELOPMENT COMPANY LTD.

FIGURE 2-1
PLAN VIEW OF SILVER KING LAYOUT

JANUARY 2021

D:\Project\AllProjects\ALEX-05-01\gis\mxd\Studies\WaterTreatment\In-SituWaterTreatment\SilverKing\02-mxd\SK_Layout_20210121.mxd

2.3 WATER QUALITY MONITORING

Water quality monitoring of the Silver King system via the 100-level adit discharge and wells screened within the mine workings has demonstrated that the treatment has become established as stable and repeatable (AEG, 2019). That is to say that the target constituents, cadmium and zinc, exhibited markedly decreased concentrations following *in situ* treatment throughout the mine workings, and that such treated concentrations were maintained for prolonged periods (i.e., one year or greater) between maintenance carbon injections. Therefore, water quality monitoring of the wells drilled in the Silver King mine workings (SKDW, SK-MW-2, SK-MW-3, and SK-MW-4) was discontinued in March 2019 (SKDW, SK-MW-2, and SK-MW-3). Water quality monitoring related to the *in situ* treatment pilot continues only for the SK 100 adit discharge (station KV-13) under WL QZ21-012. This memo discusses the water quality of water discharged to the WTP via monitoring well SKDW during the dewatered phase (i.e., September 2014 to end of December 2016) or KV-13 once the was mine fully flooded (i.e., from January 2017 onwards). The water quality of SKDW, SK-MW-2, SK-MW-3, and SK-MW-4 was last reported in the 2018 Operations Update Report (AEG, 2019).

Water quality was sampled monthly. The samples collected were shipped on ice to ALS (Burnaby, BC) for analysis of:

- pH, conductivity;
- Alkalinity;
- Major anions;
- Total and dissolved metals;
- Dissolved organic carbon (until June 2019); and
- Sulphide (until January 2019).

Flow from the SK100 adit was measured regularly (typically daily) by site personnel as part of ongoing Care and Maintenance activities.

3 SILVER KING MINE DISCHARGE WATER QUALITY

This memo discusses the water quality of water discharged to the WTP via monitoring well SKDW during the dewatered phase (i.e., September 2014 to end of December 2016) or KV-13 once the mine was fully flooded (i.e., from January 2017 onwards). The water quality data from monitoring wells within the mine (SKDW, SK-MW-2, SK-MW-3, and SK-MW-4) can be found in the 2018 Operations Update Report (AEG, 2019). Water quality parameters discussed herein include dissolve organic carbon (DOC), sulphide, iron, arsenic, cadmium, and zinc. Cadmium and zinc are contaminants of concern for the Silver King Mine; however, zinc is the only contaminant in the untreated SK100 adit discharge above the EQS under WL QZ21-012. The EQS for the closure of the former United Keno Hill Mines site apply to the total phase at station KV-14 under WL QZ21-012. KV-14 is located after the settling ponds of the water treatment plant and therefore comparison to KV-13 data is conservative as further metal removal is expected in the settling ponds located between KV-13 and KV-14 (Section 3.3; AEG, 2018). Total and dissolved metal concentrations are presented; however, the focus of the discussion is on total metals.

No exceedances of the TSS EQS at station KV-14 were observed in 2024 (Figure 3-1). Indeed, the average TSS concentration at KV-14 in 2024 (6.3 mg/L) was considerably lower than the TSS average for preceding years (17 mg/L for 2015 to 2023), suggesting that addition of hydrogen peroxide as part of the WTP treatment process was effective.

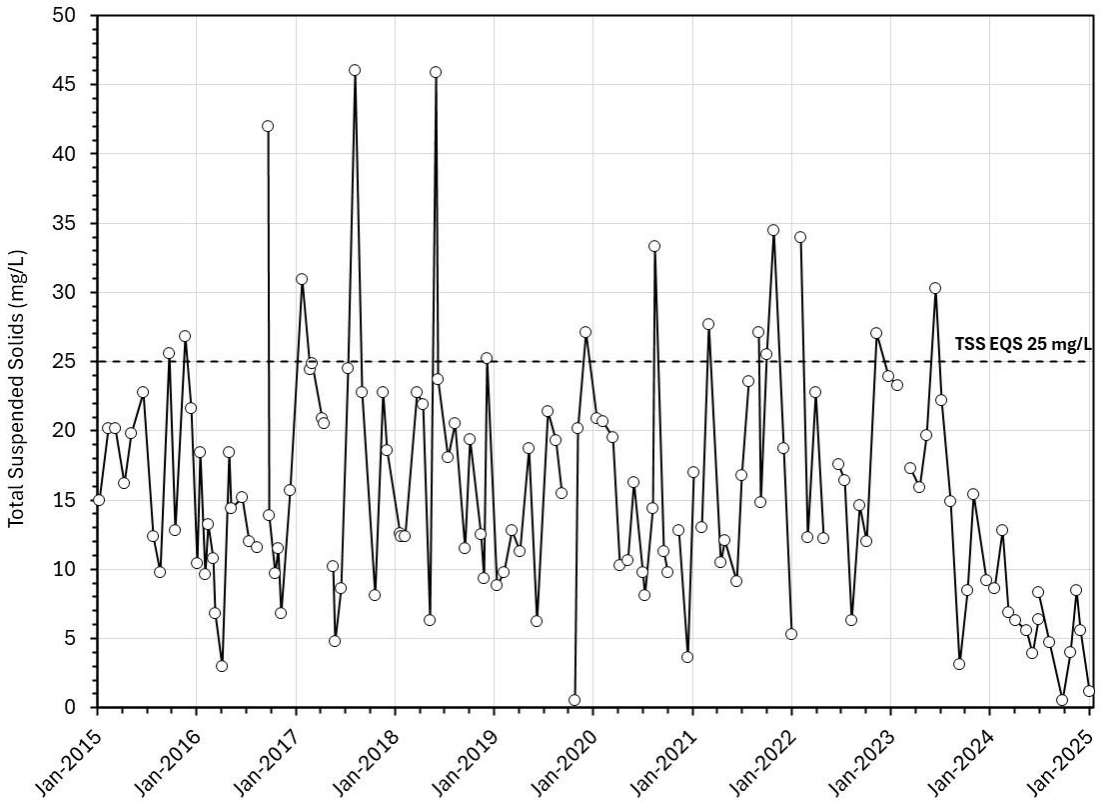


Figure 3-1: Total Suspended Solids Concentrations in Water Discharged from Silver King Settling Pond (Station KV-14)

3.1 DISSOLVED ORGANIC CARBON

Dissolved organic carbon was measured as a proxy for monitoring the addition and consumption of carbon (molasses or methanol) to the Silver King mine workings. Dissolved organic carbon concentrations generally peak after carbon injection, then gradually decrease close to baseline concentrations within one to three months of the end of carbon injection (Figure 3-2). The decrease in DOC to baseline concentrations indicates full consumption of carbon by microbes.

Regular monitoring of DOC concentrations in the SK100 adit discharge (station KV-13) ended in 2019. WL QZ21-012 only requires monitoring of DOC at station KV-14, located at the outflow of the SK settling ponds. DOC concentrations at KV-14 ranged between 0.93 and 1.8 mg/L (i.e., baseline) in 2024.

3.2 SULPHIDE

Sulphide was monitored as an indicator for the sulphidic conditions required within the mine pool to treat dissolved zinc through precipitation as an insoluble sulphide mineral. Peak sulphide concentrations correlate with carbon addition (Figure 3-3), suggesting sulphide generation as a result of microbial sulphate reduction coupled to the oxidation of organic carbon. Sulphide concentrations declined rapidly to below detection (<0.01 mg/L) within weeks

of the end of carbon addition, likely due to precipitation as metal sulphide phases (e.g., iron sulphide) within the mine workings. Regular monitoring of sulphide concentrations in the SK100 adit discharge (station KV-13) ended in 2019. WL QZ21-012, issued in April 2023, only requires monitoring of sulphide at station KV-14 and only during and following an organic carbon injection event. No carbon injection occurred at Silver King in 2024; therefore, no sulphide data were collected in 2024.

Coincident with the increase in sulphide, sulphate concentrations showed a marked and rapid decline following each carbon injection event (Figure 3-3), which provides further evidence of the development of sulphate-reducing conditions within the mine workings. The absolute decrease in sulphate concentration (approximately 100 mg/L; Figure 3-3) was greater than the concentration of sulphide detected in the water samples (peak 0.07 mg/L; Figure 3-3), suggesting that much of the sulphate was transformed into insoluble phases (e.g., iron sulphide precipitates or elemental sulphur). The average sulphate concentration in the SK100 discharge prior to the *in situ* treatment pilot (404 mg/L; October 2012 to September 2014 dataset) was greater than that observed following re-flooding under *in situ* treated conditions (366 mg/L; January 2017 to December 2024). This 10% sulphate decrease further suggests that a significant pool of reduced sulphur (such as iron sulphide phases) has been formed within the mine workings. This can act as a "redox buffer" that reacts with oxidizing recharge waters to maintain the low redox conditions in the mine workings under which the sequestered cadmium and zinc sulphides are stable.

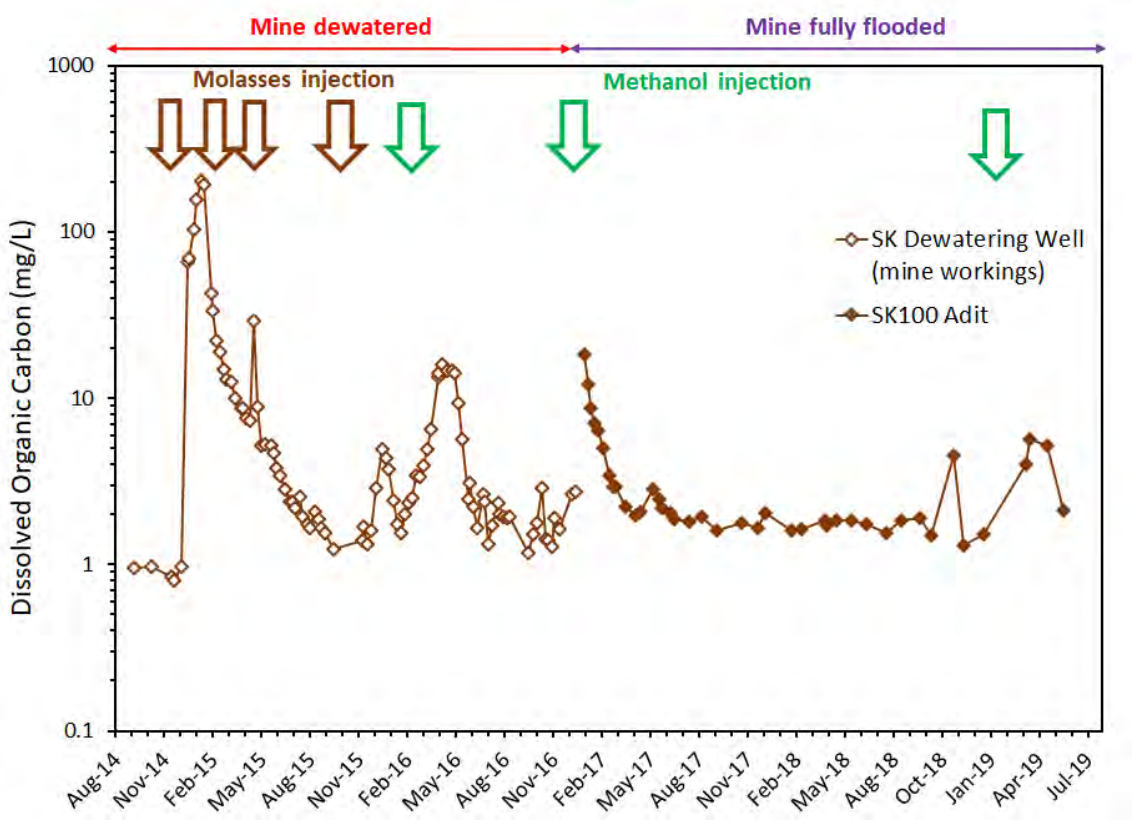


Figure 3-2: Dissolved Organic Carbon Concentrations in Water Discharged from the Silver King Mine During *In Situ* Treatment Pilot Test

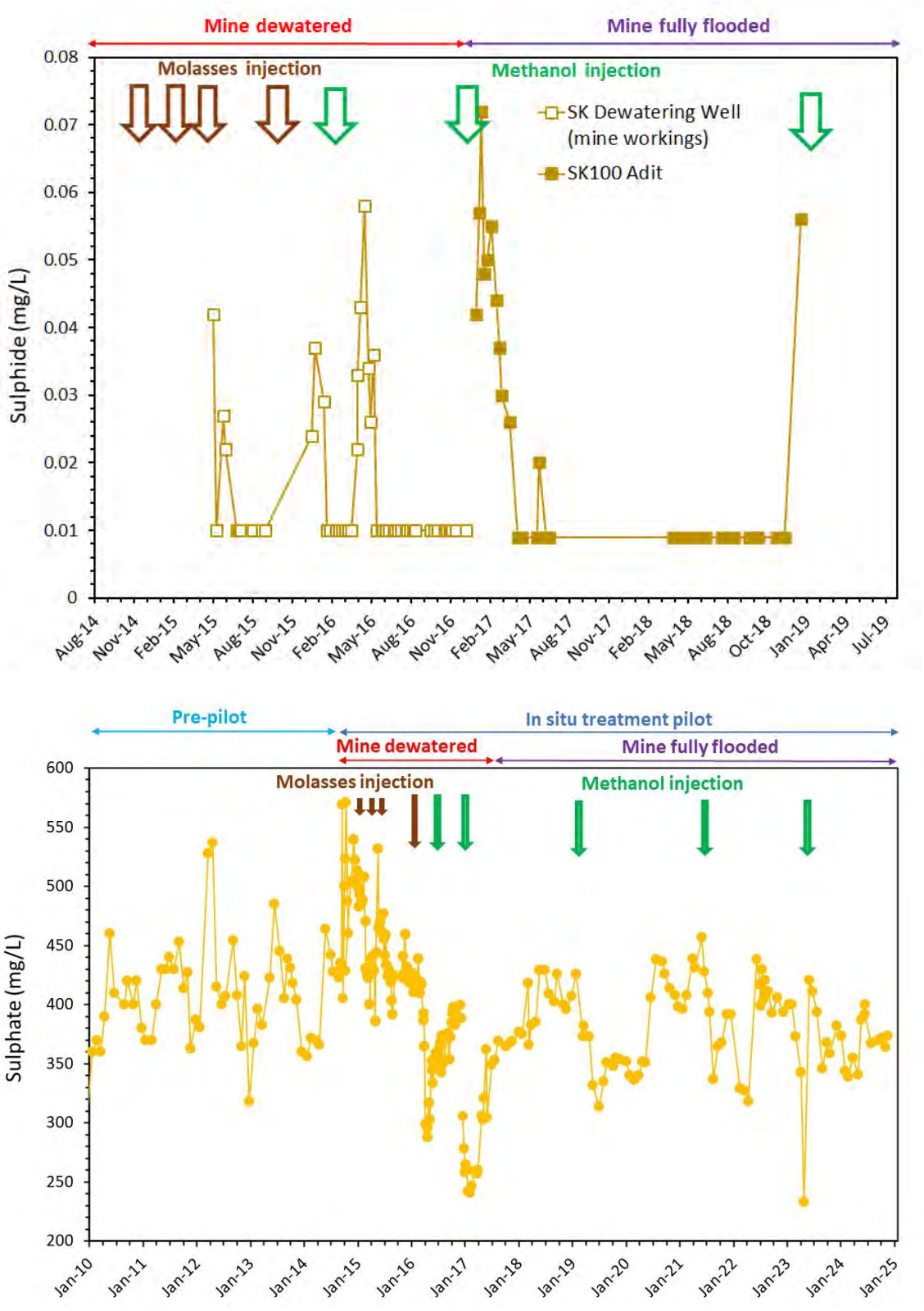


Figure 3-3: Sulphide and Sulphate Concentrations in Water Discharged from the Silver King Mine During *In Situ* Treatment Pilot Test

3.3 CADMIUM AND ZINC

Cadmium and zinc are the constituents of concern in receiving waters in the Flat Creek catchment, in which the Silver King mine is situated, and in the former UKHM site in general (Minnow, 2020). Zinc is also the only element in the SK100 adit discharge that requires treatment to meet the EQS (0.5 mg/L). The concentrations of total and dissolved cadmium and zinc in the SK100 adit discharge before and during the *in situ* treatment pilot test are presented in Figure 3-4.

Pre-pilot total cadmium and zinc concentrations (October 2012 to September 2014 dataset) averaged 0.010 and 0.77 mg/L, respectively (ranging from 0.0064 to 0.19 mg/L and 0.55 to 1.0 mg/L, respectively). Cadmium and zinc concentrations in the Silver King mine pool decreased substantially in the first year after the start of molasses addition (Figure 3-4). Total cadmium and zinc concentrations flowing out of the SK100 adit post-flooding (i.e., January 2017 onwards) averaged 0.0033 and 0.25 mg/L, respectively (ranging from 0.00072 to 0.011 mg/L and 0.092 to 0.52 mg/L, respectively). The average total cadmium and zinc concentrations observed over this period were 67% and 68% lower than those observed prior to the start of the *in situ* treatment pilot, with a maximum removal of 93% and 88% respectively.

Both cadmium and zinc concentrations generally increased in the spring, coincident with peak flow from the SK100 adit due to freshet recharge. This seasonal response has been observed throughout the *in situ* pilot and is likely related to:

- Decrease in HRT within the mine workings due to increased recharge and so less time for metals removal to occur within the workings; and

- Ingress of more oxidizing water (e.g., from higher Galena Creek contributions that flows over the mine workings and is thought to supply significant recharge to the mine) resulting in some oxidative dissolution of the biogenic sulphide minerals in which cadmium and zinc are sequestered during *in situ* treatment.

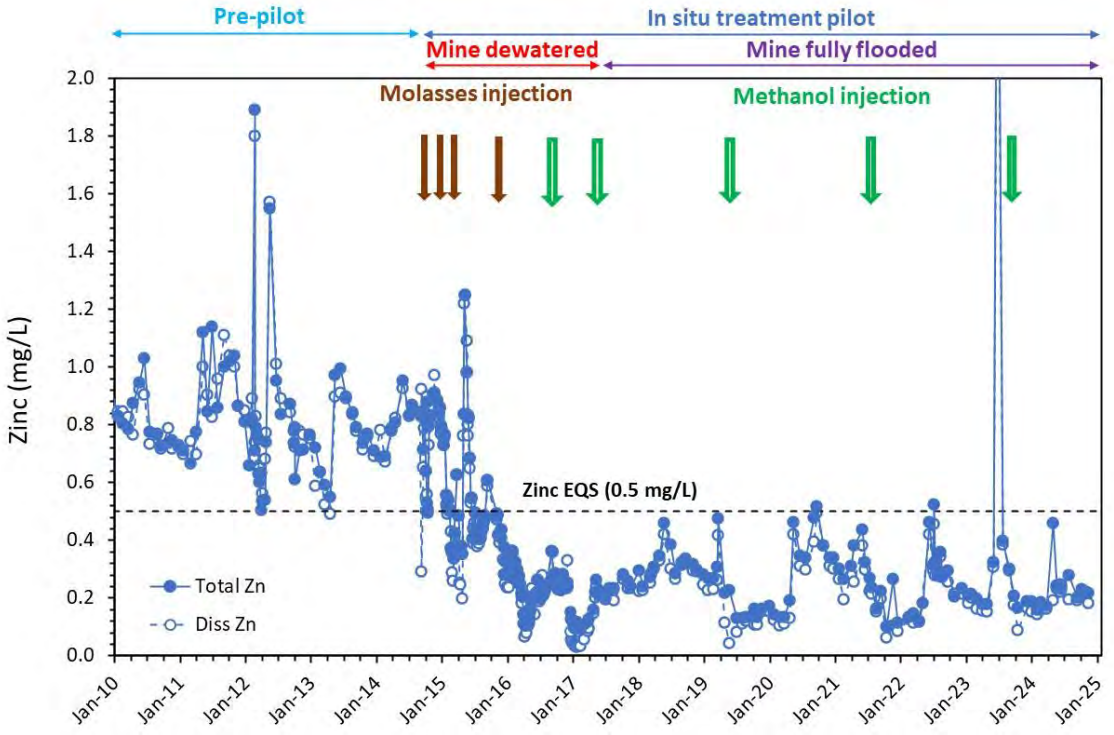
Despite the increase, cadmium and zinc concentrations were typically well below their pre-in situ treatment concentrations (Figure 3-4) and generally did not exceed the EQS. This is notable given the treated workings have experienced nine spring freshets and a particularly high flow year in 2020 since December 2015, when substantial treatment was still observed.

Both cadmium and zinc concentrations increased sharply in June 2020 (Figure 3-4), likely in response to the relatively high flows observed and associated shorter HRT within the mine workings. Zinc concentrations then abated somewhat in July and August before increasing to peak in October 2020 (Figure 3-4), again related to sustained elevated discharge during the fall (Figure 4-2). Cadmium concentrations also peaked in the fall. Concentrations of both cadmium and zinc declined through winter as flow from the SK100 adit declined and longer HRT was re-established in the workings, providing time for greater metals removal.

Water discharged from the Silver King mine, either via the dewatering well (i.e., pre-2017) or via flow from the SK100 adit has met the total zinc EQS consistently since December 2015, aside from three excursions in October 2020 (0.52 mg/L), July 2022 (0.52 mg/L), and July 2023 (3.19 mg/L) (Figure 3-4). The October 2020 and July 2022 EQS excursions were only slightly above the EQS (0.5 mg/L). The July 2023 sample was an order of magnitude higher than recent concentrations observed at KV-13, including those measured in June and August 2023, and is considered an outlier. It was not removed from the data set since dissolved zinc agreed with the total zinc value and total and

dissolved cadmium were also elevated by a similar magnitude. No marked changes in flow were observed from the SK100 adit in July 2023. Given that cadmium and zinc concentrations returned to treated baseline levels for subsequent monthly samples collected in August to December, the July 2023 result is not considered representative of conditions within the mine workings and was not considered in the statistical comparison presented above.

It should be noted that discharge from the SK100 adit continues to be routed to the existing WTP, so no EQS exceedance was observed at the compliance point (station KV-14 located at the discharge from the post-WTP settling ponds). As part of the full *in situ* treatment design the two existing settling ponds located downstream of SK100 adit will be retained. These provide ample time for oxidative precipitation of a significant portion of the dissolved iron present in the SK100 adit discharge water, producing hydrous ferric oxide (HFO). This in turn will promote further metal(loid) removal via sorption on and co-precipitation with HFO, which will settle out from the water column along with other particulate material. Indeed, settling tests performed on *in situ* treated SK100 adit water showed removal of 30% zinc and 60% cadmium following 24 hours of settling (AEG, 2018). Therefore, metals polishing by the settling ponds is expected to result in lower cadmium and zinc concentrations in the pond discharge water than those observed in the SK100 adit.



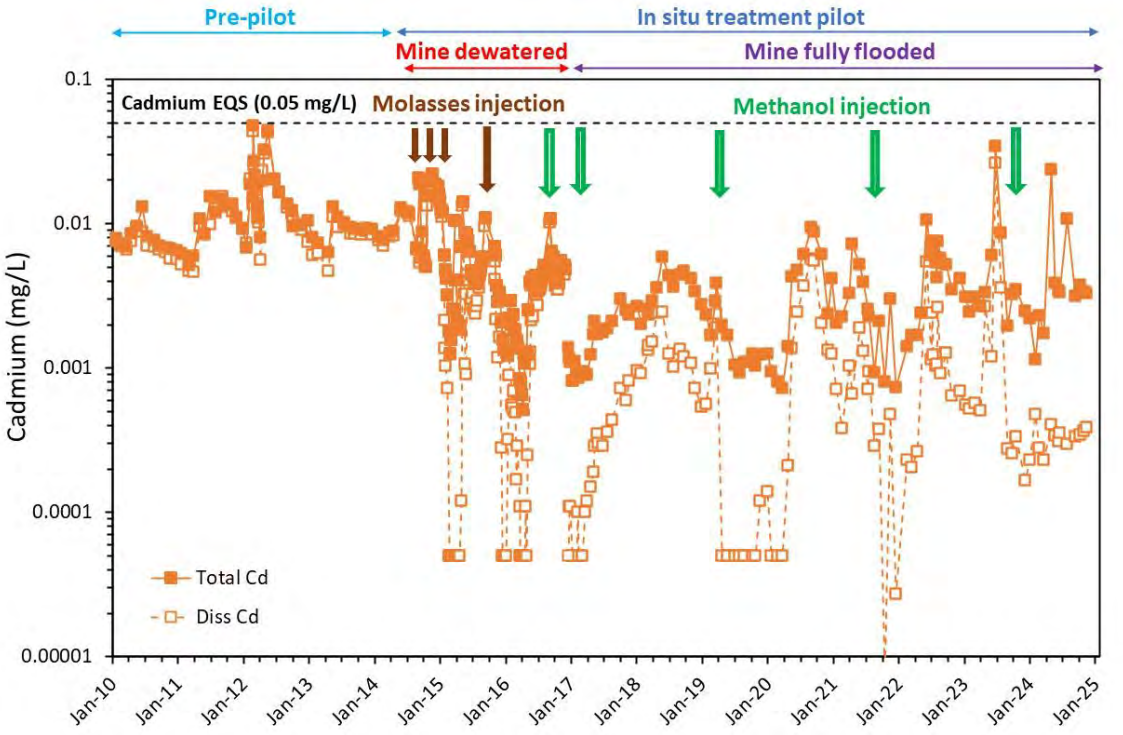


Figure 3-4: Total and Dissolved Cadmium and Zinc Concentrations in Water Discharged from the Silver King Mine Before and During *In Situ* Treatment Pilot Test

3.4 IRON AND ARSENIC

Iron-reducing conditions occur prior to and/or simultaneously with sulphate-reducing conditions which can lead to an increase in iron concentrations due to reductive dissolution of HFO. Such reductive dissolution can also cause mobilization of sorbed metals, including arsenic. Therefore, review of iron and arsenic concentrations in *in-situ* treated Silver King mine water is presented.

Pre-pilot total iron concentrations (October 2012 to September 2014 dataset) ranged from 5.9 to 32.5 mg/L with an average concentration of 16.5 mg/L and 64% in dissolved form. Total and dissolved iron concentrations generally showed a short-term increase following carbon injections (Figure 3-5). Total iron concentrations flowing out of the SK100 adit post-flooding (i.e., January 2017 onwards) remained slightly higher than pre-pilot conditions (ranged from 5.6 to 135 mg/L with an average of 20 mg/L and 58% in dissolved form).

Arsenic concentrations mirrored the trends observed for iron (Figure 3-5 and Figure 3-6). Pre-pilot total arsenic concentrations ranged from 0.016 to 0.18 mg/L with an average concentration of 0.078 mg/L and 44% in dissolved form. Total and dissolved arsenic concentrations generally increased temporarily following carbon injections, although to a lesser extent compared to iron (Figure 3-5). Total arsenic concentrations flowing out of the adit post-flooding (i.e., January 2017 onwards) were slightly higher than pre-pilot conditions (ranging from 0.032 to 0.86 mg/L with an average of 0.11 mg/L and 42% in dissolved form).

In 2024, total arsenic concentrations exhibited sporadic peaks in May and August (Figure 3-5) such that the May 2024 sample (0.86 mg/L) exceeded the total arsenic EQS (0.3 mg/L). These peaks coincided with peaks in total iron concentration and TSS concentrations – in addition to being strongly correlated to each other, total iron and total arsenic concentrations are also positively correlated with TSS (Figure 3-6). Indeed, the May 2024 TSS concentration (234 mg/L) was the highest recorded at KV-13 since 2017 and well above the average 2017 to 2024 average (37 mg/L). Dissolved arsenic concentrations showed little variation in 2024 and remained well below the EQS. It should be noted that discharge from the SK100 adit continues to be routed to the existing WTP, so no EQS exceedance was observed at the compliance point (station KV-14 located at the discharge from the post-WTP settling ponds).

Iron and arsenic mobilization under reducing conditions can be mitigated upon transition to oxidizing conditions, such as in a settling pond. Ferrous iron will rapidly oxidize and precipitate as HFO under the circumneutral pH and oxic conditions present in the Silver King settling ponds. Arsenic can also be removed from solution during this process via sorption on and co-precipitation with the HFO. This was demonstrated in bench-scale passive aeration trials using Silver King *in situ* treated water intended to simulate a discharge flow path along a rip rap lined channel from the SK100 adit and through a settling basin. Approximately 80% removal of total iron and arsenic for a 24-hour retention period was reported for this work (AEG, 2018). The 24-hour retention time is considered conservative – at the 95th percentile SK100 adit flow (12.8 L/s; 2008 to 2018 dataset) and a combined stated volume of 2,600 m^3 for both Silver King settling ponds, the residence time for plug flow conditions is 56 hours, during which time further iron and arsenic removal is anticipated. This residence time is also expected to allow for settling of suspended particulates, resulting in low levels of TSS leaving the settling ponds.

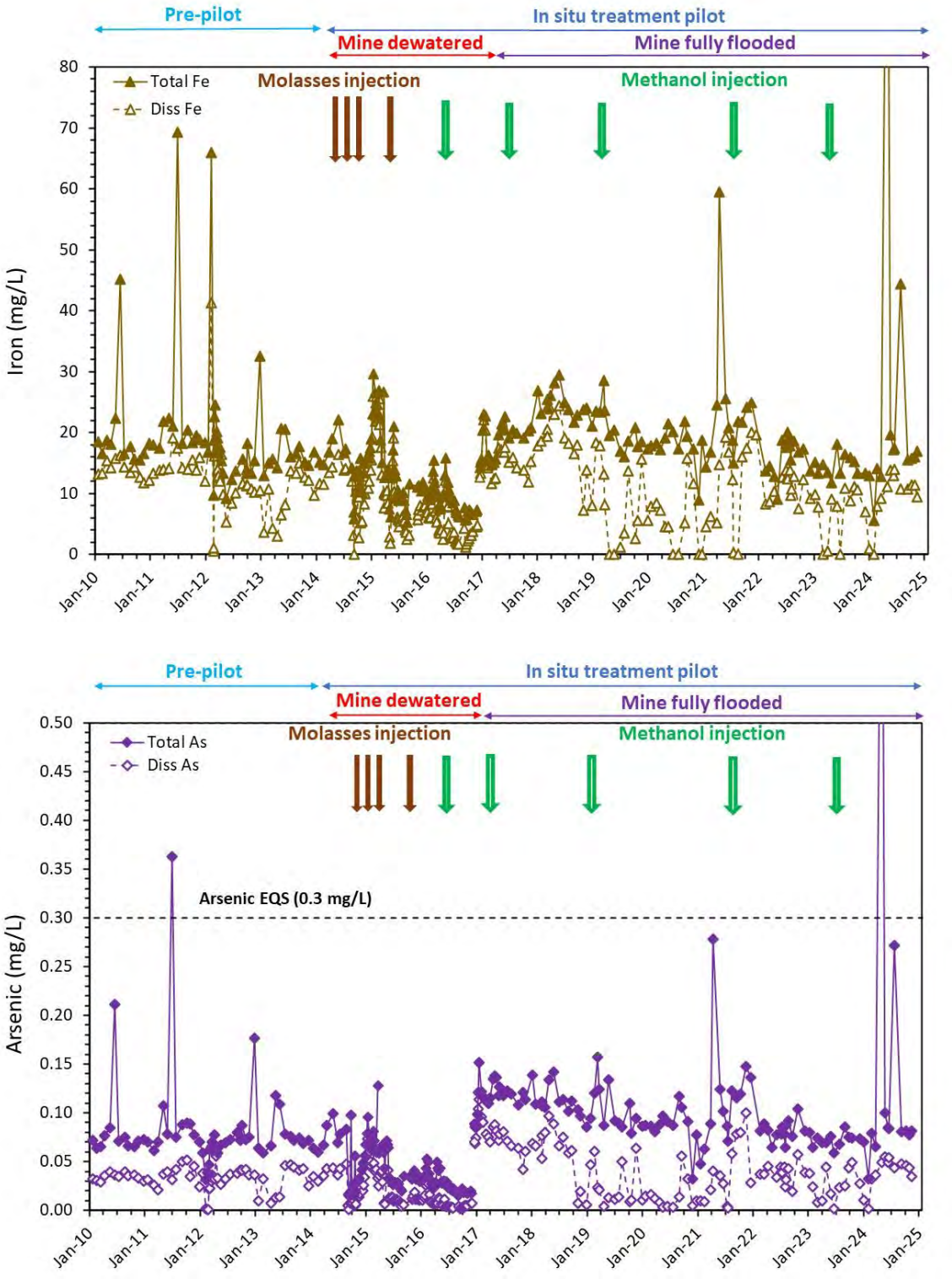


Figure 3-5: Total and Dissolved Iron and Arsenic Concentrations in Water Discharged from the Silver King Mine Before and During *In Situ* Treatment Pilot Test

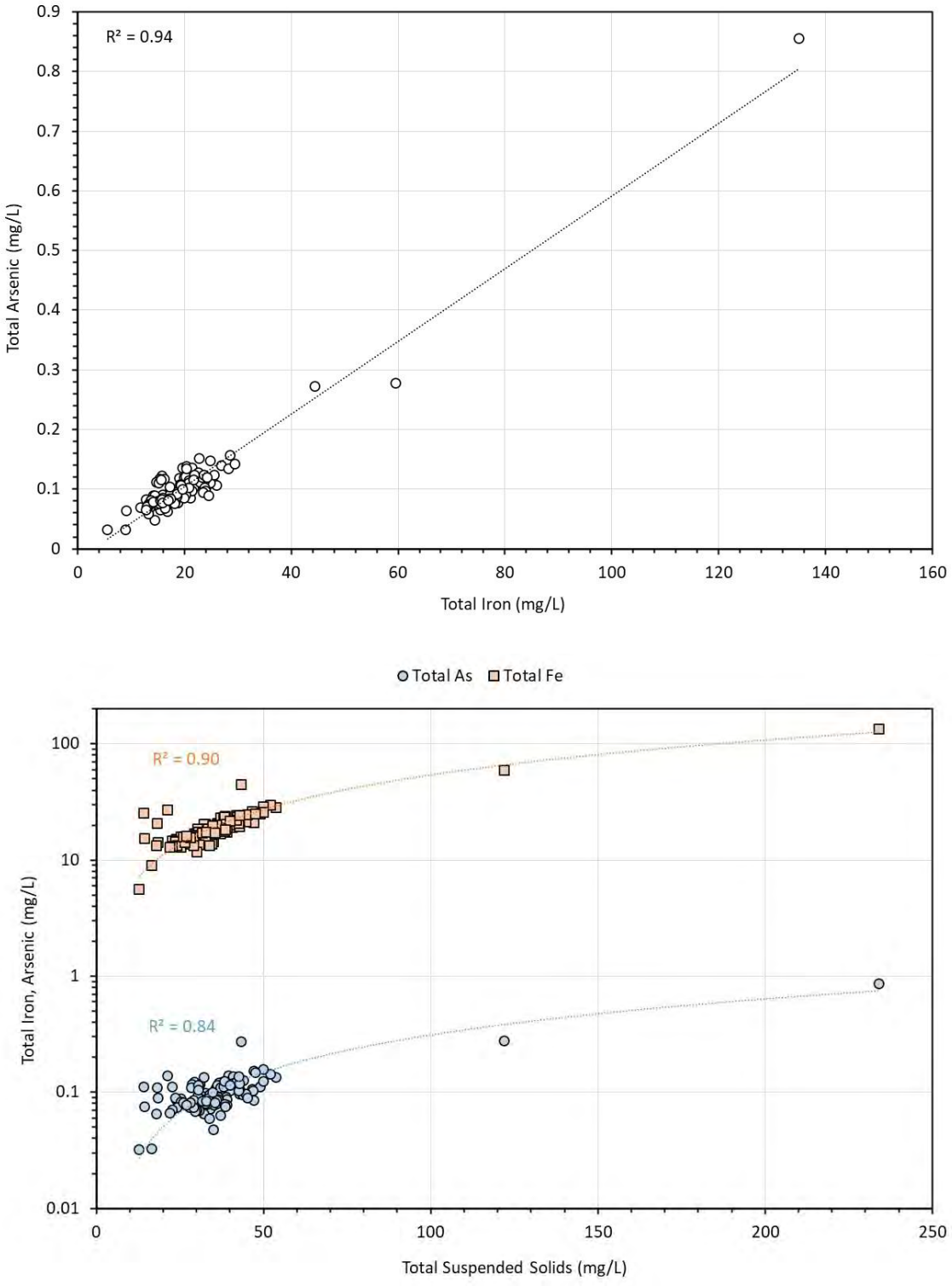


Figure 3-6: Correlation of Total Iron, Total Arsenic, and Total Suspended Solids Concentrations in Water Discharged from Silver King 100 Adit (KV-13) During *In Situ* Treatment Pilot Test (2017 – 2024)

4 SK100 ADIT FLOW

The flow recorded from the SK100 adit between 2010 and 2024 is presented in Figure 4-1. There is a data gap between September 2014 and December 2016 as the mine was actively dewatered during this time with no flow from the SK100 adit. As described in the 2020 Silver King *in situ* treatment update memorandum (Ensero, 2021a), relatively high flow was observed across the site in 2020, due in part to the large snowpack accumulated over the 2019/20 winter. This was also manifested in the SK100 adit discharge which demonstrated sustained elevated flow compared to previous years (Figure 4-1). Flows recorded in 2021 to 2024 from the SK100 adit were considerably lower than those observed in 2020 (average 6.9 and 11.5 L/s in 2021-2024 and 2020, respectively) and similar to the historical average flow (7.9 L/s for 2008 to 2019 data set; Figure 4-1 and Figure 4-2).

A feature of the higher flows observed in 2020 was that 32% of the of the daily spot flow measurements of the SK100 adit discharge exceeded the 95th percentile of the 2008 to 2018 data set (12.8 L/s). This was notable since the 12.8 L/s value was proposed as a threshold in the Operations and Maintenance Manual (OMM) for the *in situ* treatment design (Ensero, 2021b) to indicate conditions when intervention (e.g., a maintenance carbon injection) may be required. The effects of the high flow conditions on cadmium and zinc concentrations are discussed in Ensero (2021a) and summarized in Section 3.3. In contrast, only 1% of daily flow measurements of the SK100 adit discharge exceeded 12.8 L/s in between 2021 and 2024 (Figure 4-1 and Figure 4-2). These occurred during the annual peak flow conditions during spring freshet.

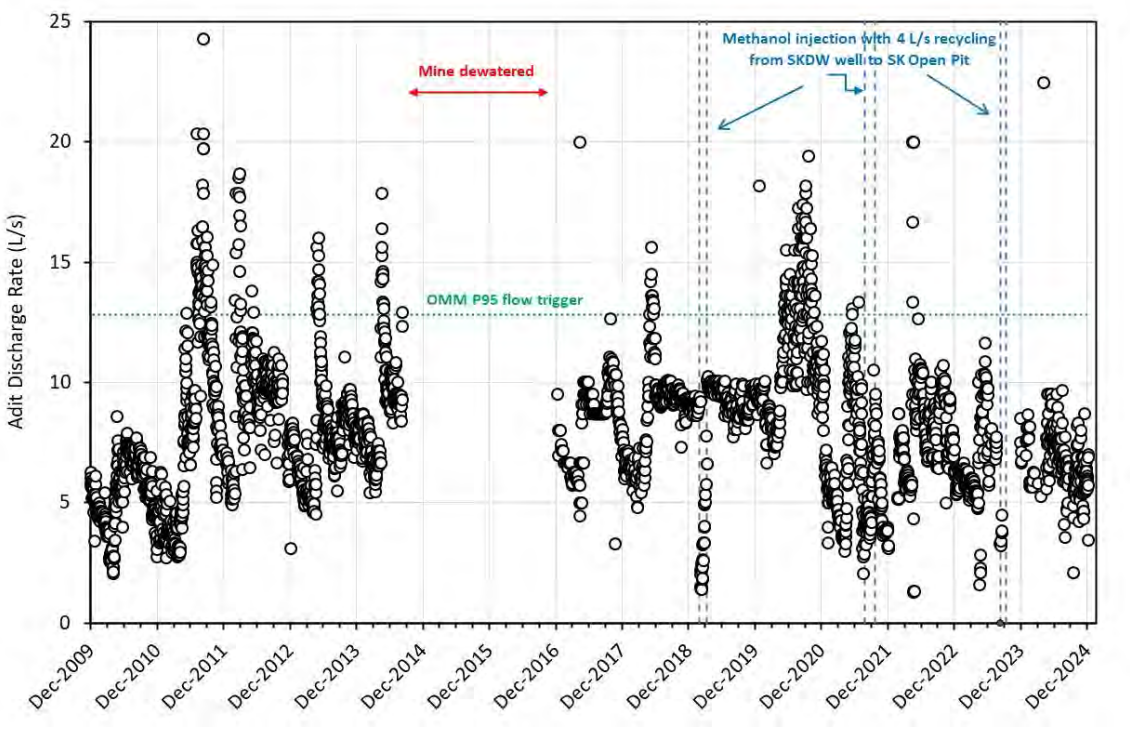


Figure 4-1: Variation in Silver King 100 Adit Discharge Flow Rate Between 2010 and 2024

Data gap indicates period when mine was dewatered and not discharging water via the 100-level adit. Dashed vertical lines bracket the methanol injection period. Dotted green horizontal line indicates 95th percentile flow trigger in In Situ Design Operations and Maintenance Manual.

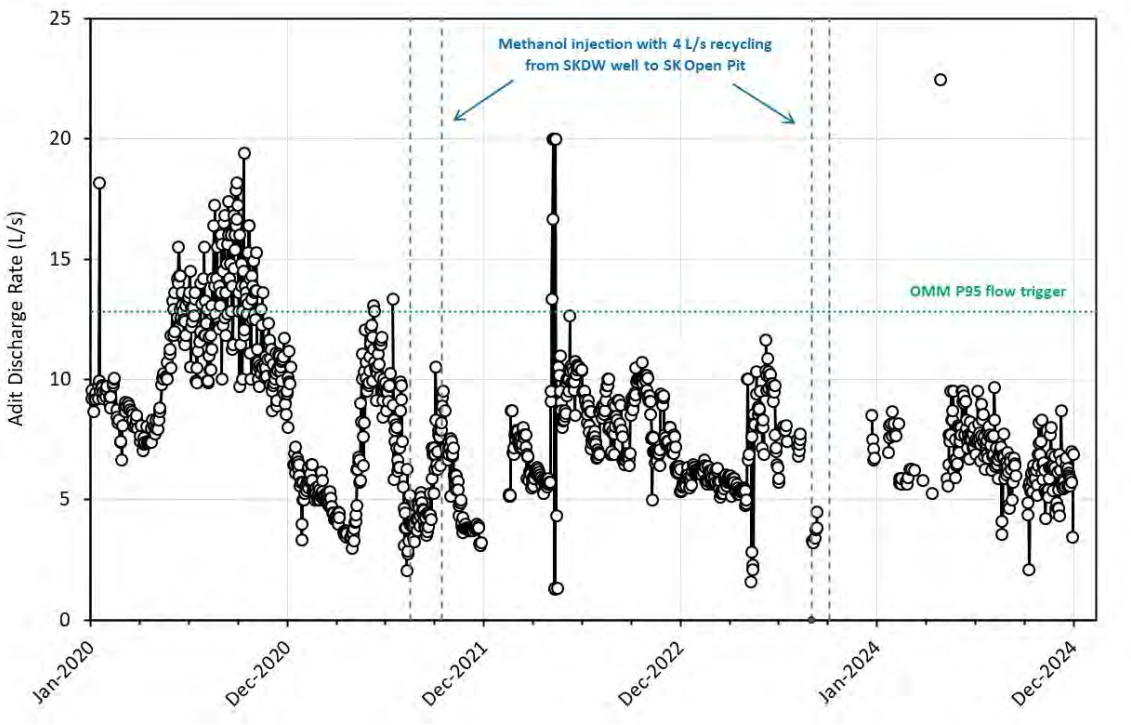


Figure 4-2: Variation in Silver King 100 Adit Discharge Flow Rate in 2020 to 2024

Dotted green horizontal line indicates 95th percentile flow trigger in In Situ Design Operations and Maintenance Manual.

5 SUMMARY

- Cadmium and zinc concentrations seasonally peak in the spring coincident with higher adit discharge due to elevated recharge to the mine workings but remained well below the pre-pilot levels and generally did not exceed the EQS of 0.05 and 0.5 mg/L, respectively. Historical data from the *in situ* pilot show that higher flow conditions are associated with higher metal concentrations, likely due to lower HRT within the workings and/or ingress of more oxidizing recharge water. That treated conditions have generally persisted through the spring period since December 2015 points to the robustness of the *in situ* treatment approach at Silver King.

- The total zinc concentration (0.52 mg/L) marginally exceeded the EQS on two occasions (October 2020 and July 2022). A third, more marked EQS exceedance observed in July 2023 is considered an outlier and not representative of mine pool conditions. The two existing settling ponds located downstream of SK100 adit will be retained as part of the full *in situ* treatment design and provide ample time for oxidative precipitation of HFO for metal(loid) polishing.

- The total arsenic concentration in the SK100 adit discharge exceeded the EQS in May 2024 (0.86 mg/L versus 0.3 mg/L EQS) owing to extremely high TSS levels (234 mg/L). The residence time of the two existing settling ponds is expected to allow for settling of arsenic-bearing particulates under the final *in situ* treatment design.

- Incorporation of hydrogen peroxide addition to WTP process appears to have lowered TSS concentrations at KV-14 compliance location in 2024.

- Flow from the SK100 adit in 2021-2024 (average 6.9 L/s) was considerably lower than the high flow conditions observed in 2020 (average 11.5 L/s) and comparable with the historical average (7.9 L/s).

-

6 RECOMMENDATIONS

- The SK100 flow should be monitored regularly during *in situ* operations and compared to the 95th percentile flow trigger to evaluate whether a carbon injection event is required to minimize the opportunity for an EQS exceedance during high flow periods. Information such as winter snowpack (and therefore potential for higher-than-average SK100 flow in spring freshet) should also inform decisions on carbon injection. Injection event triggers are discussed and summarized in the OMM for the *in situ* treatment design (Ensero, 2021b) and should be updated during final planning for full-scale *in situ* treatment implementation at Silver King.

- A biennial organic carbon injection frequency has been effective to maintain treated conditions in the Silver King mine workings since 2017. Continuance of that schedule would involve an organic carbon injection in 2025. This may be desirable if above average snowpack accumulation has occurred by March 2025 which may result in subsequent high spring SK100 adit flow with which spikes in total zinc concentration close to the EQS are associated. However, given that SK100 adit flow continues to be treated by the existing WTP, it may be instructive not to inject carbon in 2025 and further evaluate the robustness of *in situ* treatment pilot prior to its conversion to a full scale system.

- Collection of daily flow measurements at station KV-13 should continue. Consideration of logger installation to automate flow data collection (and increase its frequency) in advance of transition to full scale *in situ* treatment at Silver King (and other *in situ* treatment locations) is also recommended.

- Inclusion of KV-13 to the samples regularly analyzed for total zinc at the on-site laboratory would allow collection of a higher frequency zinc data set to inform fluctuation in treatment efficacy (likely tied to changes in flow). It could also be used to inform decisions regarding timing of maintenance carbon injections. Collection of samples for total zinc analysis on a daily, every few days, or weekly basis would be beneficial (timing dependent on budget and resourcing).

- Continued addition of hydrogen peroxide is recommended as part of the WTP process going forward. Its use should also be considered as part of the final *in situ* treatment design for Silver King (e.g., flow metered addition of peroxide to KV-13 discharge).

- Consider re-introducing analysis of DOC and sulphide as part of monthly sampling at KV-13 to ensure that such data are not missed during and following a carbon injection event (as required by WL QZ21-012).

- The *in situ* design report (Ensero, 2021b) recommends using glycerol as the carbon source since past genomic data for the Silver King *in situ* treatment pilot indicated that methanol encouraged growth of methylotrophs that do not participate in treatment reactions (i.e., there is some treatment inefficiency in terms of carbon utilization). If there is still sufficient methanol at site, it can be used for the next carbon

injection event, but evaluation of glycerol suppliers etc should be explored in advance of transitioning to the full scale *in situ* treatment system.

- Similarly, the *in situ* design report (Ensero, 2021b) recommends upgrading the carbon delivery infrastructure to draw water from monitoring borehole SK-MW-2 and injecting carbon amended water between SKDW, SKVR8, and another on-site monitoring well, SKMW-3. This arrangement will maximize the volume of treated workings and avoid using the SK open pit. Consideration should be given to this arrangement as *in situ* planning for Silver King advances.

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APPENDIX 1.5

GALKENO 900 BIOREACTOR PERFORMANCE REPORT



GALKENO 900 SULPHATE-REDUCING BIOREACTOR 2008-2011 OPERATIONS

FINAL REPORT

March 2012

Prepared for:

ELSA RECLAMATION AND DEVELOPMENT CORP.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 1

2 BACKGROUND 2

3 GALKENO 900 TREATMENT LAYOUT 4

4 BIOREACTOR OPERATIONAL SUMMARY 10

5 METALS REMOVAL MECHANISMS IN BIOREACTOR TREATMENT 12

5.1 LITERATURE REVIEW AND BACKGROUND DISCUSSION 13
5.2 DETERMINATION OF THE SULPHATE REDUCTION RATE 15
5.3 RECIRCULATION DYE TEST 16

6 BIOREACTOR PERFORMANCE 18

6.1 GENERAL PARAMETERS 18
6.2 DISSOLVED METALS 19
6.2.1 ZINC 20
6.2.1.1 MINERALOGICAL ANALYSIS OF ZINC PRECIPITATES 22
6.2.2 ANTIMONY 23
6.2.3 ARSENIC 24
6.2.4 CADMIUM 25
6.2.5 IRON 26
6.2.6 MANGANESE 27
6.2.7 NICKEL 28

7 BIOREACTOR ENGINEERING DISCUSSION 29

7.1 GENERAL BIOREACTOR DESIGN IMPROVEMENTS 29

8 DISCUSSION AND CONCLUSIONS 32

9 REFERENCES 34

LIST OF TABLES

Table 1 – Residence Time within the Bioreactor per Flow Rate 17
Table 2 - Effluent Quality Standards per Water Licence 18
Table 3 - Total vs. Dissolved Zinc per Operation Phase 20

LIST OF FIGURES

Figure 1 - Galkeno 900 Layout 4
Figure 2 - Inlet Valve 4
Figure 3 - Bioreactor Influent Sump 5
Figure 4 - Bioreactor Inlet 5
Figure 5 - Bioreactor Construction 6
Figure 6 - Bioreactor Standpipe 7
Figure 7 - Bioreactor Layout 7
Figure 8 - Bioreactor Discharge Valves 8
Figure 9 - Conceptualization of Flow Path in the Bioreactor 17
Figure 10 - Comparison of Galkeno 900 Adit pH and Bioreactor pH vs. Temp 19
Figure 11 - Zinc removal by the Galkeno 900 Bioreactor 21
Figure 12 - Antimony Removal by the Galkeno 900 Bioreactor 23
Figure 13 - Arsenic Removal by the Galkeno 900 Bioreactor 24
Figure 14 - Cadmium Removal by the Galkeno 900 Bioreactor 25
Figure 15 - Iron Removal by the Galkeno 900 Bioreactor 26
Figure 16 - Manganese Removal by the Galkeno 900 Bioreactor 27
Figure 17 - Nickel Removal by the Galkeno 900 Bioreactor 28

LIST OF APPENDICES

APPENDIX A SUMMARY REPORT ON OPTICAL AND ELECTRON MICROPROBE ANALYSIS OF GALKENO 900 BIOREACTOR AT KENO HILLS

1 EXECUTIVE SUMMARY

Alexco Environmental Group has operated a test bioreactor at the Galkeno 900 mine site since October 2008. Bioreactor technology is considered a closure option for some adit drainage sites in the Keno Hill Silver District (KHSD) and this closure pilot study has been performed to validate the effectiveness of this treatment technology with special consideration of engineering a stable bioreactor for the KHSD climate. In general, once sulphate reduction onset occurred after a commissioning period, effective treatment (significant mass reduction averaging over 90% during operational periods, and achieving discharge criteria at lower flow rates) was accomplished with a test flow rate range of 0.5-1.0 litres per second (lps). The configuration of the bioreactor was suboptimal due to the very limited footprint available near the Galkeno 900 adit, and the regulatory requirement to operate the bioreactor upstream of the lime treatment system. However, the key objectives of the study were accomplished; specifically sulphate reducing rates were determined across year-round operation, and it was demonstrated that the sulphate bioreactor technology could achieve under some operational flow rates discharge water quality standards as set under the existing water licence QZ06-074. The primary failure mode of the bioreactor was failure of the pumping systems due to power outages, which happened several times during the study, which led to freezing of the antisiphon valves and loss of water by siphoning from the bioreactor.

During the operational treatment phase at 0.5 lps, results showed removal of close to 99.8% zinc was achieved (5-6 mg/L reduced to 0.011 mg/L). During the operational treatment phase at 1.0 lps a maximum of 97.8% removal was occasionally achieved. Section 6, Bioreactor Performance, provides additional information concerning other metals that have also been substantially removed in the bioreactor at flow rates between 0.5 lps and 1.0 lps respectively. While zinc is the primary Constituent Of Concern (COC), the reduction of these other constituents will have beneficial effects in the reduction of toxicity where elevated metals have a combined toxicity more than any one metal alone. Iron and manganese, which had good removal during the recirculation phase (99% for both metals) showed a dissolution and production from the bioreactor during the reduction onset and initial through flow phases. Manganese currently passes through the reactor unchanged, while iron is still slowly releasing from the reactor. Conservative elements show less than 10% change during passage through the bioreactor, including calcium, magnesium, silica, sodium and strontium, demonstrating that dilution is not a significant factor causing metal removal in the reactor.

Mineralogical analysis was performed on materials removed from the bioreactor to identify minerals and mineral phases that had been formed in the bioreactor. The purpose of this work was to strengthen the conclusions about the ultimate fate of metals removed in the bioreactor, and to determine if the inferences about removal mechanisms are confirmed when examining the solid phases formed. The results showed that micron sized grains of ZnS were precipitated with a molar ratio of 1:1 indicating bacteriological sphalerite (ZnS) was being formed. The sphalerite formed bands which were indicative of biofilm deposition in successive layers. Some of the ZnS layers were immediately adjacent to or surrounding layers of Fe and Mn oxide or hydroxide, which is consistent with the operational phases of the bioreactor which initially had zinc removal coinciding with manganese and iron removal. When the bioreactor became anaerobic the Mn and later Fe was partially mobilized but the Zn which was removed with Mn and Fe became bacterially sequestered as ZnS. These results show that Zn removal in carbon source-fed bioreactors is predominantly performed by microbial sulfate reduction, producing predominantly a biofilm-enclosed ZnS phase.

2 BACKGROUND

A bioreactor was constructed and operated in the Keno Hill Silver District (KHSD) at the Galkeno 900 adit beginning in May 2008. The bioreactor ceased operations in late Spring 2011.. These results demonstrate the viability of sulphate reduction technology for the removal of metals, especially zinc and other metals that react with aqueous sulphide, in the KHSD.

The bioreactor solid phase substrate utilized to construct the bioreactor was coarse rock from a nearby placer mining operation. Solid organic carbon forms were not utilized to allow for the simplest assessment of metals removal due to sulphate reduction only. The organic substrate supplied to the bioreactor included dissolved organic carbon forms, with sugars, alcohols and complex carbohydrates and proteins from milk used during the growth phase of the bioreactor operation, and sugars and alcohols used during the maintenance phase. The purpose of the organic substrate was initially to support microbial growth until sulphate reduction became the predominant microbial activity in the reactor, and during the treatment phase to support microbial sulphate reduction. Sulphate reduction is a chemical transformation performed by microbes that transfers electrons from organic carbon to sulphate, causing sulphate to be reduced to sulphide. Sulphide then reacts with many dissolved metals, forming very insoluble metal precipitates. The reactor also had the potential for other reactions to occur as a result of alkalinity being generated from the oxidation of organic carbon, and such as carbonate mineral formation within the bioreactor.

The bioreactor demonstration is part of a multipurpose program to assess the potential of adding an organic substrate to mine adit water to support metals removal, whether within a constructed bioreactor, within a mine pool, or in a naturally permeable zone outside a mine such as in a naturally occurring bog or gravel bed. Conceptually, the sulphide- and carbonate-based mineral precipitation that occurs in a bioreactor is similar to what would occur in a mine pool or natural sulphate reduction zone outside of a mine pool. The sulfate reduction rate observed in the bioreactor is similar to what would be achieved in these other settings.

Alexco has extensive experience with these types of in situ sulphate reduction systems, and owns six patents and has additional patents allowed and pending for the in-situ use of organic substrates and nutrients in earthen materials to stabilize metals. Alexco's technologies and patents provide in-situ encapsulation technologies, whereby soluble toxic metals including arsenic, cadmium, nickel, selenium, and zinc are geochemically encapsulated by more benign minerals within the groundwater aquifer or within and downgradient of sources of contamination such as within a pit lake, tailings impoundment, heap leach pad, or waste storage area. One patent that is applicable to this treatment approach is US patent #5,710,361, which describes amendment of metals-containing water with a carbon source to cause precipitation of metals during flow through rock or earthen materials via sulphate reduction.

Several adit discharge locations are being considered in the Closure Option assessment process for treatment in a bioreactor (Alexco Environmental Group, 2011). At this time, Silver King 100, Bermingham 200, Ruby 400, No Cash 500, Galkeno 900, Onek 400, Sadie Ladue 600 and Keno 700 are all considered as possible locations where bioreactor technology could be employed. Galkeno 900 has water chemistry and flow characteristics that are typical of these other adits in the KHSD. This test was of sufficient scale and operated long enough to provide design information that allows for the design of either a large scale bioreactor or an in-situ reduction field at several other adit drainage locations in the KHSD. The test was operated in a lined bioreactor allowing for the performance of the technology to be assessed while still in containment, but the

results of the tests (reaction rates and stoichiometry) can be extended in the design of either a lined or an unlined system. The operation of the reactor continued through the winter season to demonstrate durability of metals removal mechanisms. During the course of the bioreactor demonstration, the conventional lime treatment system was maintained to ensure water license discharge compliance criteria were met.

3 GALKENO 900 TREATMENT LAYOUT

Figure 1 shows the piping and instrumentation setup of the bioreactor and treatment facility at Galkeno 900.

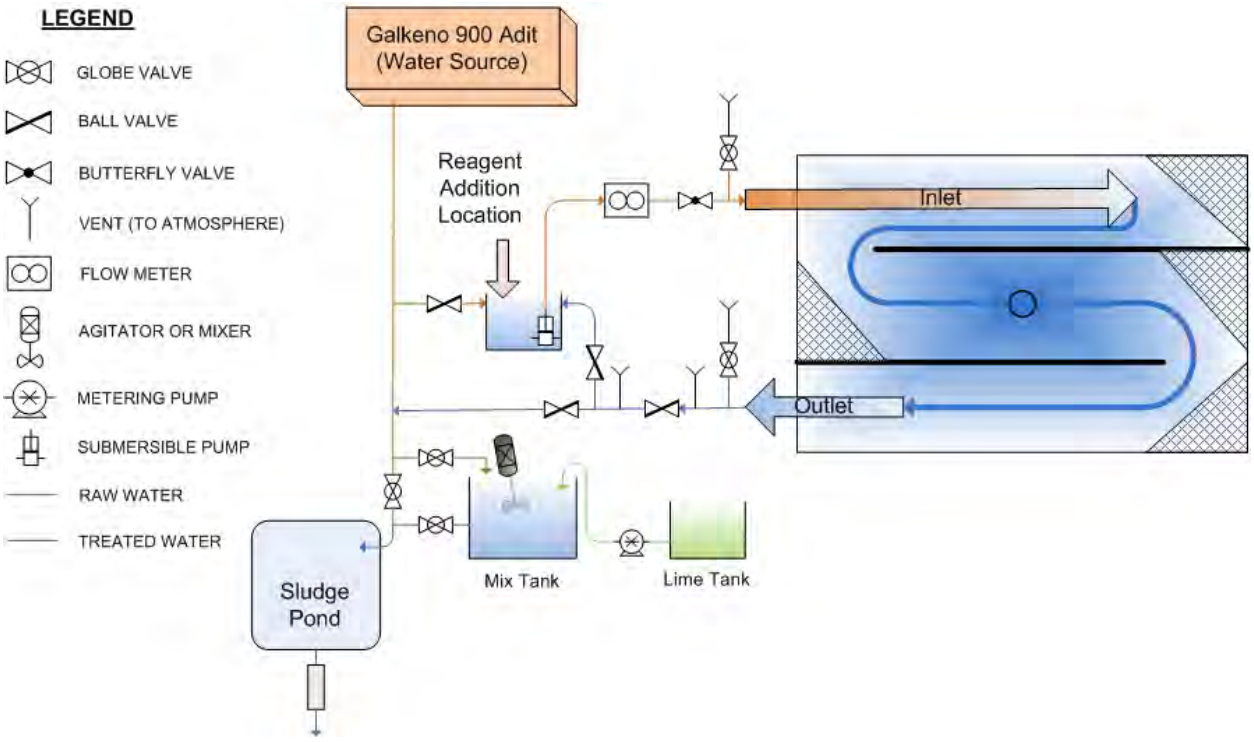

Figure 1 - Galkeno 900 Layout

Water drains from the Galkeno 900 adit at an average annual rate of 4 litres per second (lps). This water is collected in a pipe and gravity flows away from the adit. Before the bioreactor system was installed, the water traveled directly to the treatment facility where it was mechanically agitated in a mix tank and dosed with lime slurry through a metering pump. Then the water was discharged to a sludge pond where the heavier particles where allowed to settle at the bottom in the form of sludge, and clean water was decanted and released. When the bioreactor treatment system was installed, additional valves and piping were added upstream of the lime treatment system so that a portion of the untreated adit water could pass through the bioreactor system for the purposes of this study.



Figure 2 - Inlet Valve

Water is supplied to the bioreactor through an initial valve that when opened allows water to travel to the bioreactor's influent sump. Because of the harsh conditions in the Yukon, this valve, and all piping used in this setup was buried over 1 meter below surface, thereby reducing the possibility of freezing. Figure 2 shows the buried vertical pipe that contains this initial valve. In this figure, water travels downward from

the adit to the lime treatment area. Opening this valve allows water to flow into the bioreactor's inlet sump.

The bioreactor inlet sump, shown in Figure 3, has a 48 inch diameter and is also located below surface. It is accessed through a cover that allows for reagent addition and water sampling as needed. Normal operation of the bioreactor requires the frequent dosing (constant dosing up to as infrequently as every two weeks, depending on flow rates) of a carbon source such as sugar, ethanol, or methanol. These reagents are slowly added to this sump via a metering pump for the liquids, or as dry powder for the sugar. During initial start-up, and on a few other occasions, an addition of milk sugars/protein as dry milk powder was required to aid the growth of microbes in the bioreactor. These reagents were also added at this location.



Figure 3 - Bioreactor Influent Sump

Within in the bioreactor inlet sump is a 1-horsepower submersible pump. The cable seen in Figure 3, stretching from lower left to upper right, attaches to a chain allowing the pump to be removed from the mix tank for servicing and/or replacement. The discharge from this pump is shown in Figure 4.

From the bottom of Figure 4 moving toward the top is a blue datalogger attached to the black Magnetic Flowmeter (Magmeter), a throttling globe valve, and finally a vertical anti-siphon standpipe. The datalogger records and stores the flow rates from the magmeter, allowing the system's operation rate to be tracked and analyzed. The globe valve is used to adjust the flow rate into the bioreactor. The vertical anti-siphon standpipe is exposed to the atmosphere. The system is designed so that in the event of pump failure, air will be pulled into the pipe and breaks the siphon. This series of instruments and valves is also located below grade in an insulated box and can be accessed through a cover.



Figure 4 - Bioreactor Inlet

The bioreactor is roughly 90 feet by 100 feet and has a liquid-filled portion that is 10 feet deep. It was dug partially into the native ground with an excavator, and the remaining depth was created by forming a berm around the excavated area. The bermed/excavated area was lined with 0.060 inch thick HDPE liner to form a pond, and then filled with waste rock recovered from a local placer mine. Figures 5 and 6 were taken during construction of the bioreactor and Figure 7 shows the overall design.

After the pond was filled with placer oversize rock, a geofabric was laid across the bioreactor, and soil from the excavated area and hillside was used to provide a 4 foot soil cover over the bioreactor. This soil cover layer acted as an insulating layer, minimizing the amount of ice formation in the top layer of the bioreactor. When the bioreactor solids were sampled in March 2011, the ice layer was approximately 18 inches to 2 feet thick.

Water enters the bioreactor through an inlet pipe that transports water to the far side of the bioreactor (see Figure 7 for an overall view of the layout). The last half of the pipe is perforated with ¾" holes, allowing water to fill the bioreactor and flow back and forth before final release.



Figure 5 - Bioreactor Construction



Figure 6 - Bioreactor Standpipe

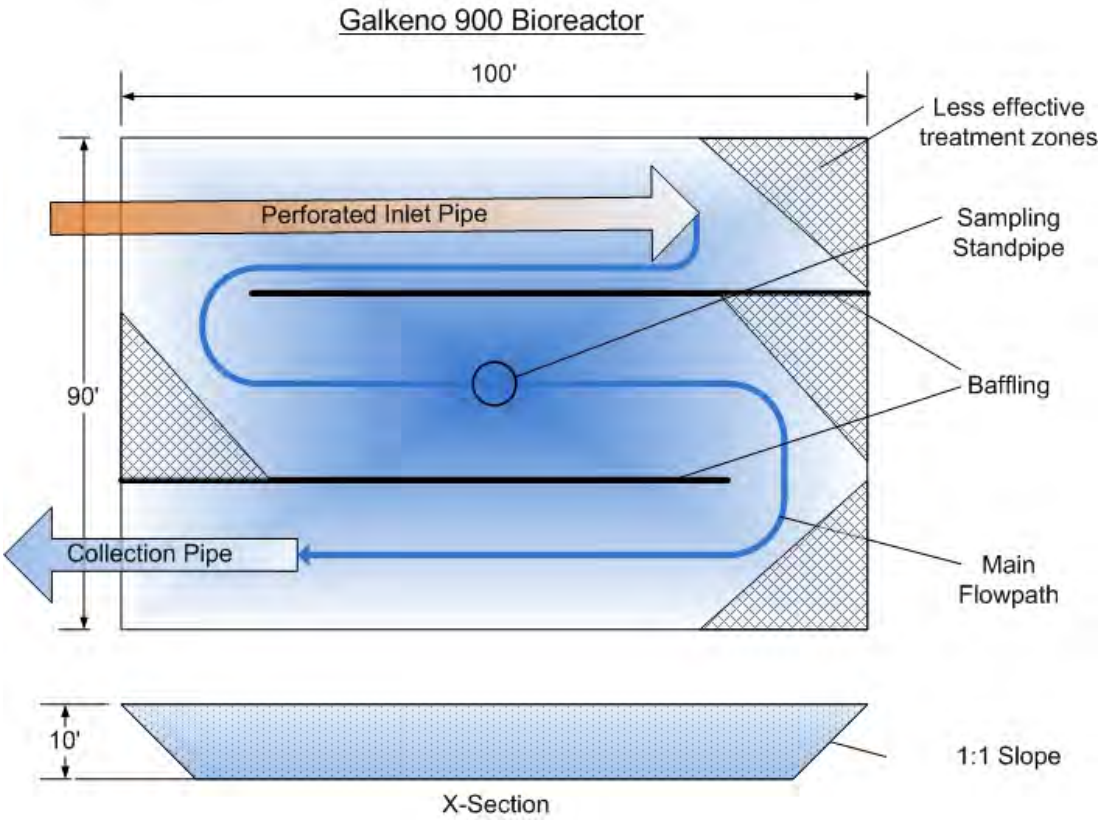

Figure 7 - Bioreactor Layout

Baffling was installed in two locations to create a torturous flow path and increase the contact time of the water with the media within the bioreactor,. This forces the water to travel a greater distance within the bioreactor before final release and to contact a greater fraction of the media. Also present at the center of the bioreactor is a sampling standpipe that can be seen in Figure 6. This allows samples to be collected and analyzed once water has passed midway through the bioreactor.

The discharge from the bioreactor is collected in a pipe and can then be either sent back to the bioreactor influent sump for recirculation or mixed with untreated adit water from the Galkeno 900 adit. This co-mingled water then passes through the lime treatment system mentioned earlier and is released into a sludge pond where heavy particulate settles and clean water is decanted and released. Figure 8 is the bioreactor discharge valve set-up. Water travels from the bioreactor on the right (not shown) and can either be sent up (as shown in the photo) to the bioreactor influent sump or to the left (as shown in the photo) to be co-mingled with adit water from the Galkeno adit. This setup is below surface grade and is accessible through a cover.



Figure 8 - Bioreactor Discharge Valves

Overall, the system was constructed to provide the operator with the maximum amount of flexibility to study the performance of a bioreactor without introducing the risk of releasing untreated water from the adit. Based on the positions of several valves, the system could be run in one of the following operation modes:

1) Bioreactor influent valve closed – collected adit water bypasses the bioreactor and is treated at the lime treatment facility.

2) Bioreactor influent valve and discharge valve closed – water pumped from the bioreactor influent sump fills the bioreactor and once filled, this mode allowed the water in the bioreactor to be continuously re-circulated. This was important to allow for the initial growth phase of the bioreactor, allowing the carbon source to be consumed in the bioreactor rather than being released from the discharge.

3) Bioreactor influent valve open and discharge valve open – untreated adit water was pumped into the bioreactor, sampled along several key locations, then discharged from the bioreactor and co-mingled with the untreated adit water where it was transferred to the lime treatment facility.

The water from the adit was a significant heat source for the bioreactor; therefore some amount of influent water from the adit was desired even during the initial growth phase of the bioreactor. In a full scale installation without the requirement of the downstream secondary treatment plant, these valving systems would not be required other than to provide a bypass from the adit if desired, and a temporary recirculation loop to allow discharged water to be sent back to the influent sump.

4 BIOREACTOR OPERATIONAL SUMMARY

Operational notes are included in this report to capture a few of the issues experienced during construction and operation of the bioreactor. The bioreactor construction began in the summer of 2008 with operation starting soon after. The following timeline outlines milestones, as well as issues, that were noted during operation:

- July-August 2008: Pond constructed and lined (see Figures 5 & 6).
- September 2008: Pond filled with oversize rock from a local placer mining operation (some small amounts of fines were present).
- October 4th, 2008: Start filling the bioreactor with untreated adit water.
- October 10th & 11th, 2008: Started recirculation of bioreactor water, added 182 kg sucrose to support microbial sulfate reduction.
- October 16th, 2008: 110 gal methanol and 1.8 kg dried milk solids added.
- October 2008: Bioreactor covered with geofabric and several feet of topsoil.
- October 2008 through May 2009: Occasional "top up" of untreated mine water to maintain full conditions in bioreactor. Make-up water averages ~ 1 m3/day or approximately 1 liter per minute average.
- January 23rd, 2009: 110 gal methanol added.
- January 2009: Determination of slow leakage rate from bioreactor ~ 1.09 m3/day.
- February 19th, 2009: Anti-siphon valve on the return recirculation line iced over, draining the bioreactor and flooding covers/box. Estimated ~135 m3 water was lost from the bioreactor through overflow of the tank.
- April 8th, 2009: Bioreactor standpipe blocked with ice – unable to sample.
- May 17th, 2009: Began adding methanol at the bioreactor influent sump at a rate of 1.0 litre per day.
- July 11th & 12th, 2009: Added 10 kg sucrose each day to jumpstart reduction, continued methanol addition at 1.0 litre per day.
- August 25th, 2009: Installed totalizer and flowmeter on the inlet to the bioreactor.

Once methanol was added at a constant rate, the bioreactor began through-flow operation. During that time, the following events occurred:

- October 8th, 2009: Initiated flow-through at a rate of 0.5 litre per second.
- December 18th, 2009: Initiated flow-through at a rate of 1.0 litre per second.
- January 7th-20th, 2010: Valve box flooded and frozen, thawed and repaired on January 20.
- February 15th, 2010: Power loss to submersible and metering pump.

- February 16th - 18th, 2010: Power loss while anti-siphon frozen which resulted in the loss of approximately half the bioreactor water volume through the sump; power restoration and line thawed; refilled bioreactor.
- August 6th, 2010: Reduced flow rate to 0.75 l/s to improve treatment.
- March 17th &18th, 2011: Return line frozen.
- May 11, 2011: cessation of active operations; bioreactor sampled for solids mineralogical analysis.

A review of the operator's log provides some important details that will guide future design. On February 19th 2009 and February 16th 2010, loss of power and a lack of continued pumping of water, which maintained heat in the bioreactor lines, resulted in ice formation in the anti-siphon valve. With the transfer pump stopped, the bioreactor siphoned water into the sump, which overflowed on the ground around the sump.

5 METALS REMOVAL MECHANISMS IN BIOREACTOR TREATMENT

The removal of metals from mine waters by bioreactors is done around the world, utilizing a variety of approaches. Doshi (2006) summarizes the many different types of bioreactors that are in operation, and discusses the relative advantages and disadvantages of these different bioreactor systems. The bioreactor utilized at Galkeno 900 is one type of reactor, where the only carbon source added to the bioreactor was added in a dissolved form semi-continuously during the operation of the bioreactor. Bioreactors are often constructed utilizing a mixture of substrates which either act as a carbon source for microbial reactions, or these substrates can act as sorptive surface for metals precipitation. However, bioreactors with solid phase carbon sources are often limited in their sulphate reduction rates by the availability of soluble organic carbon (Buccambuso et al, 2007) indicating that the constant supply of a carbon source as was done in Galkeno 900 bioreactor will tend to prevent microbial limitations on treatment.

For context of this discussion, the operation of the Galkeno 900 bioreactor can be divided into three distinct time periods. They are:

- **Recirculation Phase – Operation Mode 2 (October 2009 - July 2009):** During this period, the bioreactor was placed into service with water from the adit entering at an average rate of one litre per minute (1 lpm), which provided makeup water to replace slow leakage, and also to provide some heat from the adit water during the cold season. An initial carbon source addition consisting of (1.8 kg) milk powder and (182 kg) table sugar (sucrose) and (110 gal) methanol was added to provide an energy and nutrient source for an initial microbial growth phase. No source of microbes other than what was present on the placer rock and what is carried in the mine water was added to the bioreactor. However, researchers studying mine water and sediment at the Penn Mine Church et al (2007) showed that mine water even in an pH 4 mine drainage with high concentrations of heavy metals contained sulphate reducing bacteria and accounted for metals removal processes. The water in the bioreactor was re-circulated at a rate of one to two liters per second to mix and distribute water in the bioreactor. The water was periodically sampled to evaluate microbial growth and activity indirectly by evaluating water quality changes that could be inferred to be caused by microbial action. During this period there was incomplete formation of reducing conditions and the bioreactor likely had both aerobic and anaerobic zones. During the recirculation phase, metal concentrations were decreased over several months (discussed more below) and the removal mechanisms during this time may have included oxidative mechanisms (iron and manganese oxide formation) with metal co-precipitation on the iron and manganese oxides, carbonate mineral formation, and microbial sulphate reduction and metal sulphide precipitation.
- **Reduction Onset Phase – Operation Mode 2 (July 2009 – September 2009):** During this period, water within the bioreactor continued to be re-circulated while additional carbon sources were added at the bioreactor influent sump. This resulted in elevated carbon concentrations and the onset of more strongly sulphate-reducing conditions. During this time, the development of stronger reducing conditions were observed, characterized by greater sulphate reduction, the dissolution of manganese and iron from the reactor solid phase (likely manganese and iron oxides formed during initial bioreactor operations, as well

as structural iron and manganese minerals in the placer rocks), and greater metals removal as sulphides.

- **Operational Treatment Phase – Operation Mode 3 (October 2009 – May 2011):** An initial flow rate of 0.5 litre per second (lps) was established into the reactor, and after stable metal removal conditions were observed this flow rate was maintained for several consecutive bimonthly samples. Soon after, the flow rate was increased to one litre per second (lps) in December 2009. In August 2010, the flow rate of the bioreactor was reduced to 0.75 lps, or approximately 19% of the adit flow. This flow rate was then maintained for the remaining operation of the bioreactor.

The results displayed in this report focus primarily within the operational treatment phase. The other phases, while important, are reflective of treatment performance during the transition of the bioreactor from construction to operation.

5.1 LITERATURE REVIEW AND BACKGROUND DISCUSSION

The formation of metal precipitates in a bioreactor that has carbon sources added to or present in the solid phase of the bioreactor has been extensively studied for 30+ years. There are several different styles of bioreactors, both in terms of carbon sources and flow dynamics. Some very large bioreactors have been created to treat flows as large as 20 lps or greater, and some bioreactors are designed to treat very acidic or concentrated metal-containing mine drainage. Each bioreactor must be designed to reflect the environmental conditions, the water chemistry of the mine water being treated, and other relevant variables as discussed in this report.

To understand the processes that occur in bioreactors many studies have attempted to identify directly by examination of mineral formation or by inference from water chemistry signatures what primary mechanisms are responsible for metals removal. When complex carbon sources are added as a solid phase in the bioreactor construction (i.e., peat, straw, compost, wood chips, etc.), a broad range of mechanisms has been documented (Gusek, 2002; Doshi, 2007; Gusek et al, 2008), that include:

- Sorption of metals on organic matter.
- Precipitation of iron hydrous oxides including ferric and mixed valence minerals, which then provide mineral surfaces for sorptive removal of metals, or metals can also be co-precipitated within the iron mineral matrix.
- Precipitation of manganese oxides including manganese (IV) oxides and mixed valence (III/IV) oxides and manganese carbonates, which then provide mineral surfaces sorptive removal of metals, or metals can also be co-precipitated within the manganese mineral matrix.
- Precipitation of metal sulphides, including primary metal sulphides such as ZnS or CdS, as well as precipitation of iron sulphides such as amorphous FeS and co-precipitation of metals within the FeS matrix. Depending on the pH of the bioreactor and the availability of structural iron, a very large amount of FeS minerals can be formed by aqueous sulphide

formed by microbes reductively dissolving iron from the rock matrix, creating a "bank" of amorphous sulphide which has reactivity toward dissolved metals.

- Precipitation of some metals in their reduced forms, for example selenium reduction from a Se(VI or IV) anion to elemental selenium precipitates Se.
- Precipitation of metals as carbonate minerals. Some of the relevant metals have somewhat soluble carbonate minerals (e.g., zinc carbonate minerals including smithsonite, and hydrozincite) which are relatively more soluble than sulphides. When sulphide is not present, these minerals may provide a precipitation-removal mechanism.

Sorption of metals on organic matter is not a relevant metals removal mechanism by design in the Galkeno 900 bioreactor because only coarse rock was used as a solid substrate. The metal removal mechanisms in this reactor appear to initially relate to removal of iron and manganese during the recirculation phase, and then over time the removal mechanism transitioned to a metal sulphide removal mechanism (inferred because metals removal continued to occur when iron and manganese ceased being removed and actually increased in concentration during flow through the reactor). The precipitation and removal of metals in their reduced forms is not a significant potential mechanism for most of the metals present in Galkeno 900 adit water, with the potential exception of uranium which was only present in very low concentrations in the influent water. Consequently, the formation of sulphide from sulphate, which is a chemical reaction that is catalyzed by microbes and relies on the availability of organic carbon, is the primary performance variable that is relevant in the Galkeno 900 bioreactor performance evaluation. In typical evaluation of bioreactors where sulphate reduction/sulphide precipitation is a dominant mechanism, the Sulphate Reduction Rate (SRR) is determined as a primary design variable.

In a bioreactor with available sulphate and a soluble carbon source added, Dar et al (2007) showed that sulphate reducing bacteria (SRB) are the dominant microbe that accumulates in the bioreactor, and by inference the vast majority of the carbon consumption is performed by SRB. In their study, only a few different strains accounted for the majority of the cells present, indicating that microbes capable of utilizing the carbon source and reduce sulphate will become dominant in the bioreactor.

After the bioreactor entered stable operation, metals removal mechanisms appear to have shifted from the mixed reaction that were discussed in the prior report (Alexco Resource US Corp, 2009) to primarily a sulphide-based precipitation process. The stability of metals removed as sulphides are consequently an important consideration for the performance of the bioreactor. Jong and Perry (2004) studied the form of metals that were precipitated from solution as a result of the sulphate reduction process, and determined that arsenic, copper, iron, nickel, and zinc were primarily bound up in a sulphide phase that was also associated with residual organics, and that carbonate or hydroxide phases were relatively minor phases that held the metals removed from solution. The United States Environmental Protection Agency SITE program studied the stability of these sulphate-reducing bioreactor precipitates at the Leviathan Mine, in California. Using a series of different tests, the EPA determined that the metals in the bioreactor precipitates were below regulated total metals thresholds (California standards), the WET extraction test showed that the metals in the bioreactor did not leach above regulated soluble threshold standards, and that as defined by TCLP extraction testing the bioreactor solid materials were not hazardous.

The effectiveness of this sulphate reduction bioreactor process is sensitive to important variables including the hydraulic residence time in the bioreactor, the sulphate reduction rate, and the filtration capacity of the media.

Because the products of the sulphate reduction reaction include both sulphide and bicarbonate alkalinity, it is possible that carbonate precipitation is also an important mode of precipitation for some of the metals removed in the reactor. However, for most of the metals being removed in the bioreactor, including antimony, arsenic, cadmium, cobalt, iron, nickel, and zinc, a sulphide precipitation mechanism appears more likely because sulphide precipitates are less soluble than the carbonate precipitates of these elements. The mineralogical analysis discussed in Section 6.2.1.1 confirms that sulphide is the solid phase form of zinc precipitates formed in the bioreactor. Thus the sulphate reduction reaction is the primary reaction that we will focus on optimizing in the bioreactor operations.

5.2 DETERMINATION OF THE SULPHATE REDUCTION RATE

Microbial production of sulphide from sulphate is dependent on the presence of sufficient numbers of sulphate-reducing bacterial (SRB) cells, and the availability of organic carbon, according to the following reaction:

4 moles methanol + 3 moles sulphate → 3 moles sulphide + 4 moles bicarbonate

The rate of the reaction is nearly the same at temperatures in natural environments where the long-term temperature is around freezing (-2^{0}C to 2^{0}C) as it is in natural environments where the long-term temperature is around 20 ^{0}C when the abundance of SRB is the same (Knoblauch, Jorgensen, and Harder, 1999). This is due to the development of psychrophilic (i.e., 'cold loving") SRB. The growth rate of psychrophilic SRB is typically far slower than temperate SRB, which is reflected in the long growth period (October 2008 to August 2009) required for the Galkeno 900 bioreactor to reach maturity so that it could sufficiently treat mine water. However, once the bioreactor was competent to perform sulphate reduction (as evidenced by net sulphide concentrations leaving the reactor in the 1 to 10 µM range, indicating that there is excess aqueous sulphide created above what was required to react with the soluble and solid phase metals) then the bioreactor SRR could be assessed. (Note: it was possible to add more organic carbon to the reactor and support additional sulphate reduction, however it would result in higher dissolved sulphide which would not be required for metals precipitation, and could result in reduction of oxygen in the surface receiving streams. At the amount of sulphide precipitation that was achieved (1 to 10 µM range) dissolved oxygen consumption would be less than 1 mg/L, or less than 10% of what is normally in surface water.)

The SRR is measured in terms of mM sulphate reduced per m^3 of bioreactor substrate per day. The influent sulphate compared to the effluent sulphate is compared to determine the amount of sulphate removal. The average sulphate removal amount during the treatment phase was 128 mg/L, or 1.33 mM. With a known bioreactor volume of approximately 2,550 m^3, and a flow rate of 1 lps, the total sulphate removal per day was 115,200 mM, which yields a SRR of 45 mM/m^3/day. For comparison, artic ocean sediments have SRRs in the range of 5-40 mM/m3/day (Knoblauch, Jorgensen, and Harder, 1999), showing that the bioreactor has a similar rate as natural systems that have long term adaptation to cold environments.

The SRR calculated for the Galkeno 900 bioreactor is conservatively calculated based on dividing the amount of sulphate reduced by the volume of the entire bioreactor. However, less effective treatment zones or "dead zones" are identified in Figure 7 and were expected based on the sub-optimal configuration that was available at Galkeno 900. These areas can limit the exchange of organic carbon and therefore it is likely that minimization or elimination of these dead zones will improve the performance of the bioreactor.

5.3 RECIRCULATION DYE TEST

The volume of the bioreactor voids needed to be determined independently to assess residence time and other performance characteristics of the bioreactor. The dimensions of the reactor were measured to be approximately 100 feet by 90 feet and 10 feet in depth. Assuming an estimated porosity of 0.35, the volume was calculated to be roughly 890 m3 or approximately 235,000 gallons. Starting on August 25th, 2009, a dye test was completed to independently assess the volume in the reactor.

Roughly eight ounces of rhodamineWT dye was added to the bioreactor on August 25 2009, and water was re-circulated in the bioreactor at a rate of two litres per second. After equilibrium conditions were reached in six days, a final dye concentration of 0.25 ppm dye was measured. The volume of the bioreactor was determined by the following formula:

Volume of reactor =mass of dye added÷concentration measured

Using this formula, the volume of the bioreactor was calculated to be approximately 909 m^3, or approximately 240,000 gallons, which is consistent with the estimated volume based on the dimensions of the bioreactor and the estimated porosity of the rock.

Understanding the volume of the bioreactor is necessary to understand the potential hydraulic residence time for water passing through the reactor. At 0.5 lps, assuming the total porosity of the bioreactor is utilized, approximately 21 days of residence time is available, and at 1.0 lps, approximately 10.5 days of residence time is available. A 2 lps flow rate should result in a residence time of approximately 5.25 days.

The dye test was run under re-circulating conditions at a relatively fast rate (2 l/s). By definition, when the peak concentration of dye is measured in the effluent, 50% of the dye has passed through the reactor. The time for the peak dye to exit the bioreactor at 2 lps recirculation was determined to be approximately 1.03 days into the bioreactor operation. This much faster flow rate indicates breakthrough of the dye along flow paths that "short circuit" i.e., do not interact with the entire porosity of the bioreactor. Figure 9 shows conceptualization of flow in the bioreactor.

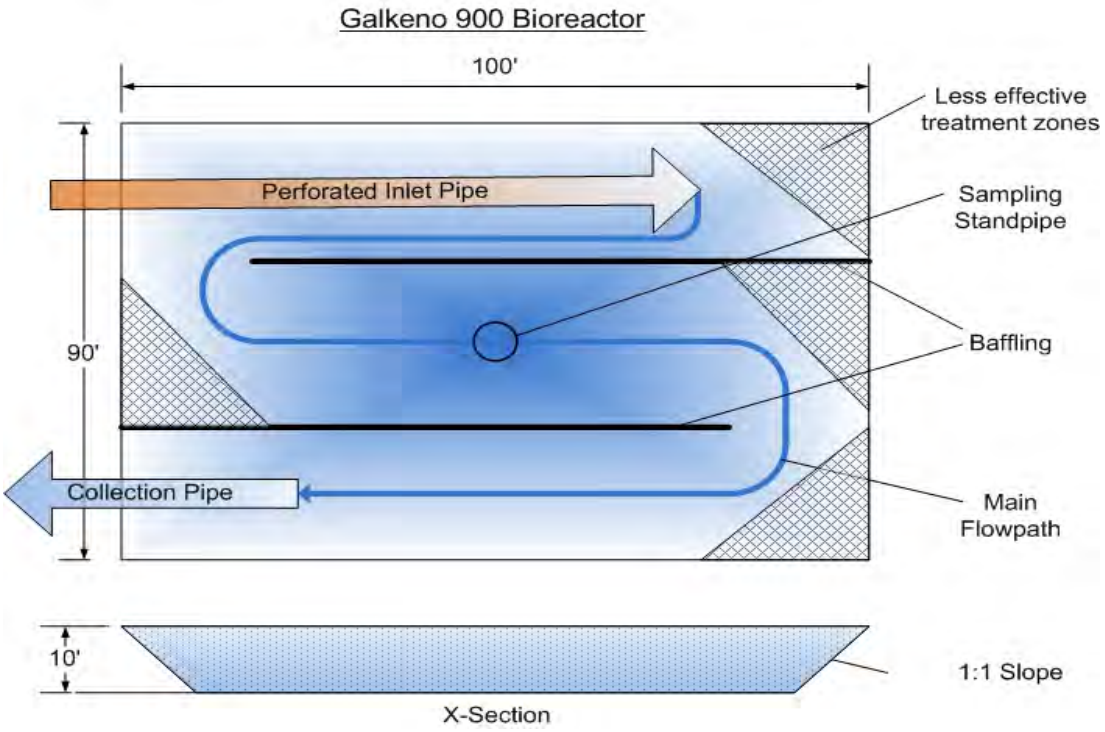

Figure 9 - Conceptualization of Flow Path in the Bioreactor

The "less effective treatment zones" are where water entering the bioreactor does not interact as much with the media and hence these zones are likely to only minimally contribute to the treatment performance. The activity in these areas is dependent on the availability of carbon sources diffusing from the actively flowing areas to support sulphate reduction. The practical residence time in the bioreactor can be estimated as two times the breakthrough time of the dye peak. This residence time corresponds to the volume of the reactor that participates in rapid exchange of influent water to the bioreactor discharge (this will be termed the "effective residence time"). (Note, in most porous media, there is a tailing phenomenon, where dye concentrations do not behave "normally" in a bell shape curve, but the second half of the curve "tails", i.e., there is a slow bleed out of dye from slower flowing zones in the reactor which increases the time required for the washout of the dye. For the design of bioreactors these less effective zones cannot be relied upon for treatment and hence the 2X dye peak is used for design purposes.)

Table 1 – Residence Time within the Bioreactor per Flow Rate

Flow Rate	Residence time (total porosity)	Residence Time (active porosity)
0.5 lps	21.0 days	9.00
1.0 lps	10.5 days	4.50
2.0 lps	5.25 days	2.25

6 BIOREACTOR PERFORMANCE

The performance of the bioreactor with respect to water chemistry is summarized in the following tables, graphs, and discussion. To better understand the treatment goals, Table 2 provides the Galkeno 900 effluent quality standards per the Conditions of Water Licence QZ06-074. In order to release water from any adit in the KHSD that is currently under the Care and Maintenance of ERDC, the water discharge must meet these standards. It is important to note that some sites such as Keno 700 do not need to meet discharge standards in order to attain aquatic standards in the receiving environment (Lightning Creek) Targeting a mass reduction goal of 90% may be more relevant for some sites of this nature.

Table 2 - Effluent Quality Standards per Water Licence

Parameter	Maximum Concentration in a Grab Sample Measured in mg/L
pH	6.5 – 9.5 pH units
Suspended Solids	25.0 mg/L
Arsenic (total)	0.50 mg/L
Cadmium (total)	0.05 mg/L
Copper (total)	0.30 mg/L
Lead (total)	0.20 mg/L
Nickel (total)	0.50 mg/L
Silver	0.10 mg/L
Zinc (total)	0.50 mg/L

6.1 GENERAL PARAMETERS

The pH of the reactor did not substantially change through the operational period, with the inflow and outflow from the reactor in the same range as the pH of the adit drainage. Figure 10 illustrates the pH of the influent and effluent from the reactor.

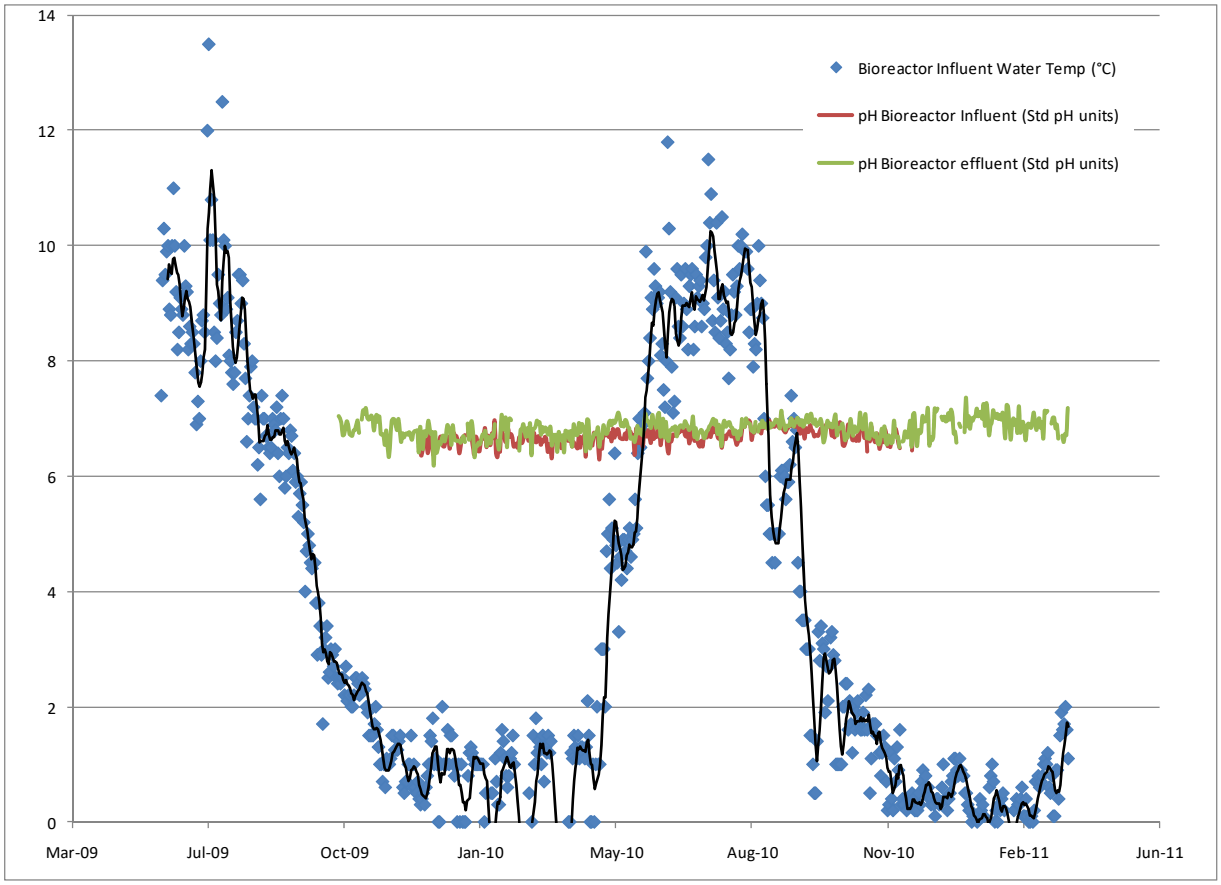

Figure 10 - Comparison of Galkeno 900 Adit pH and Bioreactor pH vs. Temp

In addition to pH, Figure 10 also displays water temperatures of the bioreactor influent water recorded during operation. Notice how the influent water temperature decreases to less than 2°C from October through April each year. This emphasizes how important it is to keep water moving through both the bioreactor and the piping systems at all times to avoid freezing.

6.2 DISSOLVED METALS

The primary metal that exceeds discharge criteria at the Galkeno 900 adit is zinc, which is true of most of the adit discharge locations in the KHSD. There are other metals that potentially contribute to the toxicity of water and this and other discharge locations, and hence the water chemistry of all dissolved metals present in the Galkeno 900 water has been evaluated.

To better understand the performance of the bioreactor during operation, several graphs have been generated that plot each constituent of concern. These graphs display the results of samples taken at the adit, midway through the bioreactor, and at the discharge from the bioreactor. Within each graph, a blue and green transparent box was added to signify flow rates during operation. Within the blue box, the average

flow rate through the bioreactor was 0.5 lps. Within the green box, the flow rate was increased to 1.0 lps and then subsequently to 0.75 lps.

6.2.1 Zinc

The concentrations of zinc in the bioreactor were approximately 90% reduced during the recirculation phase where only minor additions of water (approximately one litre per minute) was being added to the reactor. During the onset of more strongly reducing conditions in the summer of 2009, dissolved zinc concentrations were decreased to below detection limits (0.01 mg/L). After this removal was confirmed for several consecutive sampling periods, the bioreactor treatment phase was initiated at 0.5 lps in October 2009. Figure 11 illustrates the removal efficiency of the bioreactor during both treatment periods, including the 0.5 lps flow rate (blue rectangle), and the 1.0 lps flow rate (green rectangle). During the 0.5 lps time period approximately three pore volumes were exchanged (calculated on a total porosity basis) and when calculated on a reactive volume estimated by 2X the dye peak, nearly eight pore volumes would have been exchanged during this period. This shows that the treatment cannot be attributed to dilution by previously treated water.

During the 1.0 lps treatment phase, approximately six pore volumes (calculated on a total porosity basis) passed through the bioreactor prior to the loss of power and pump failure that led to the bioreactor being back-siphoned out. The loss of complete treatment that occurred after the refilling of the bioreactor is attributed to the refilling of the bioreactor with approximately half of the volume of the reactor in February 2010. However, even with this refilling, the bioreactor still removed over 95% of the zinc in the sample taken immediately after refilling. (Note: data from the period after refilling the bioreactor indicates that the removal efficiency dropped to closer to 60-80% in the period immediately after the bioreactor siphoned out and was refilled, indicating that the pipe freeze-up and refilling of the reactor has temporary negative effects for a period of a few weeks after an upset.) This rapid reactivity of the bioreactor to recover from upset conditions indicates a residual treatment phase, most likely an amorphous FeS phase, has been formed in the bioreactor, which provides for rapid reaction with soluble zinc.

The conclusions that can be reached from the bioreactor's operation, before the pump failure, are that dissolved zinc can be effectively removed at 0.5 lps flow rate with an effective residence time of nine days, or a total residence of 21 days, and the first two months of operation at 1.0 lps also effectively removed dissolved zinc. However, there was a difference between dissolved zinc removal and total zinc removal within the bioreactor at the faster flow rate. Table 3 outlines the difference between dissolved and total zinc removal during the different operational phases.

Table 3 - Total vs. Dissolved Zinc per Operation Phase

	Average total zinc concentration (mg/L)	Average dissolved zinc concentration (mg/L)	% total zinc that is dissolved
Recirculation phase	0.64	0.65	100%
Reduction onset phase	0.32	0.27	86%
0.5 lps treatment phase	0.28	0.012	4%
1.0 lps treatment phase	0.74	0.13	17%
0.75 lps treatment phase	0.29	0.018	6%

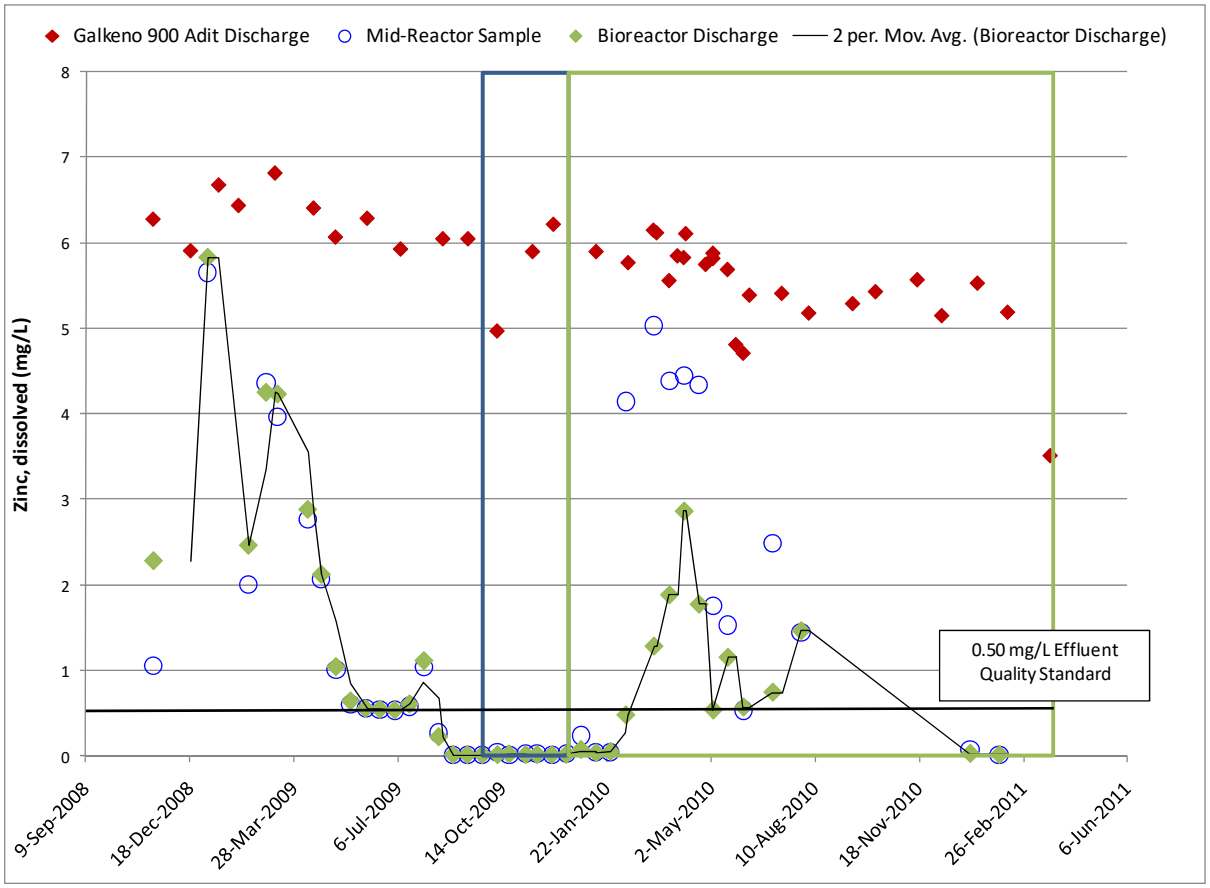

Figure 11 - Zinc removal by the Galkeno 900 Bioreactor

The difference between total and dissolved zinc is that total zinc can be filtered out, i.e., it is the particulate zinc in the bioreactor samples that has been reduced from the soluble phase and become a solid zinc phase. Because of the coarseness of the bioreactor rock (see Figure 5) the media does not act as a very good filter. This is consistent with what was observed at a bioreactor in Montana (Gammons and Frandsen, 2001), where fine ZnS particulates passed as colloids through the reactor but could be filtered out with a 0.45 µm filter. As discussed later, design of future bioreactors would include finer grained rock than coarse oversize placer rock to encourage some filtration. In addition, freshly formed sulphides are very fine particulates. In rapidly flowing systems, small or colloidal particles can remain suspended and exit the bioreactor without being agglomerated into larger particles that would drop out via gravity or by being caught in bioreactor media pore throats. Dissolved zinc averaged below the discharge treatment objective of 0.5 mg/L during both the 0.5 and 1.0 lps treatment regimes. However, the treatment objective was not achieved for total zinc for the higher flow rate (1.0 lps) regime (0.74 mg/L) except for the final two data points collected in January and February 2011. This indicates that additional residence time may be required in the bioreactor to filter the particulate materials, or a subsequent filtration treatment step could be taken in the discharge if the higher flow rate were to be used. An example of natural filtration is a wetlands or bog system, or infiltration into an underground porous aquifer. Active semi-passive or passive filtration systems such as sand filters, multimedia filters, or sedimentation ponds are other alternatives that could improve filtration.

6.2.1.1 Mineralogical Analysis of Zinc Precipitates

After decommissioning the bioreactor in the spring of 2011, samples were removed of the solids formed in the bioreactor utilizing a backhoe to dig through the cover layers into the bioreactor media. Bioreactor solids were preserved in epoxy to keep sulphide minerals stable which might be affected by exposure to oxygen. Preserved samples were evaluated with electron microprobe analysis using backscattered electrons and mapped for Mn, Fe, S, and Zn to examine elemental associations. Quantitative analysis of areas with elevated levels of zinc was further performed to determine elemental ratios, which allowed for mineralogical determination.

Micron-sized ZnS particles were found extensively within a biofilm layer on the bioreactor media. Appendix A "Summary Report on optical and electron microprobe analysis of Galkeno 900 Bioreactor at Keno Hills" shows the visual evidence of the biofilm containing the zinc sulphide materials. Consistent with the inference of the formation of iron sulphides, iron was observed coincident with the ZnS phases within the biofilms, as well as more broadly spread throughout the bioreactor materials. The atomic proportions of Zn:S of 1:1 was at a very high level of correlation (R^2 0.98) which verified the identification of sphalerite as the mineral into which zinc was being sequestered in the bioreactor.

The significance of ZnS as the storage phase for zinc in the bioreactor is that in a saturated setting it will remain stable and at a very low solubility. A buried, lined bioreactor is a feature that can readily be closed in place if desired, with no route for metals remobilization due to the physical encased (by liner and capping) structure of the reactor, and further certainty about the long term stability is provided by the very low solubility geochemical phases that the metals are stored in.

6.2.2 Antimony

Antimony concentrations declined approximately 80% during the test (0.0025 mg/L reduced to below the detection limit (0.0005 mg/L) for most of the phases of the test (See Figure 12). Antimony removal in an organic carbon-rich reducing system is typically attributed to an antimony sulphide phase, or by sorption to iron or manganese oxides, carbonates, or sulphides that are stable in reducing conditions.

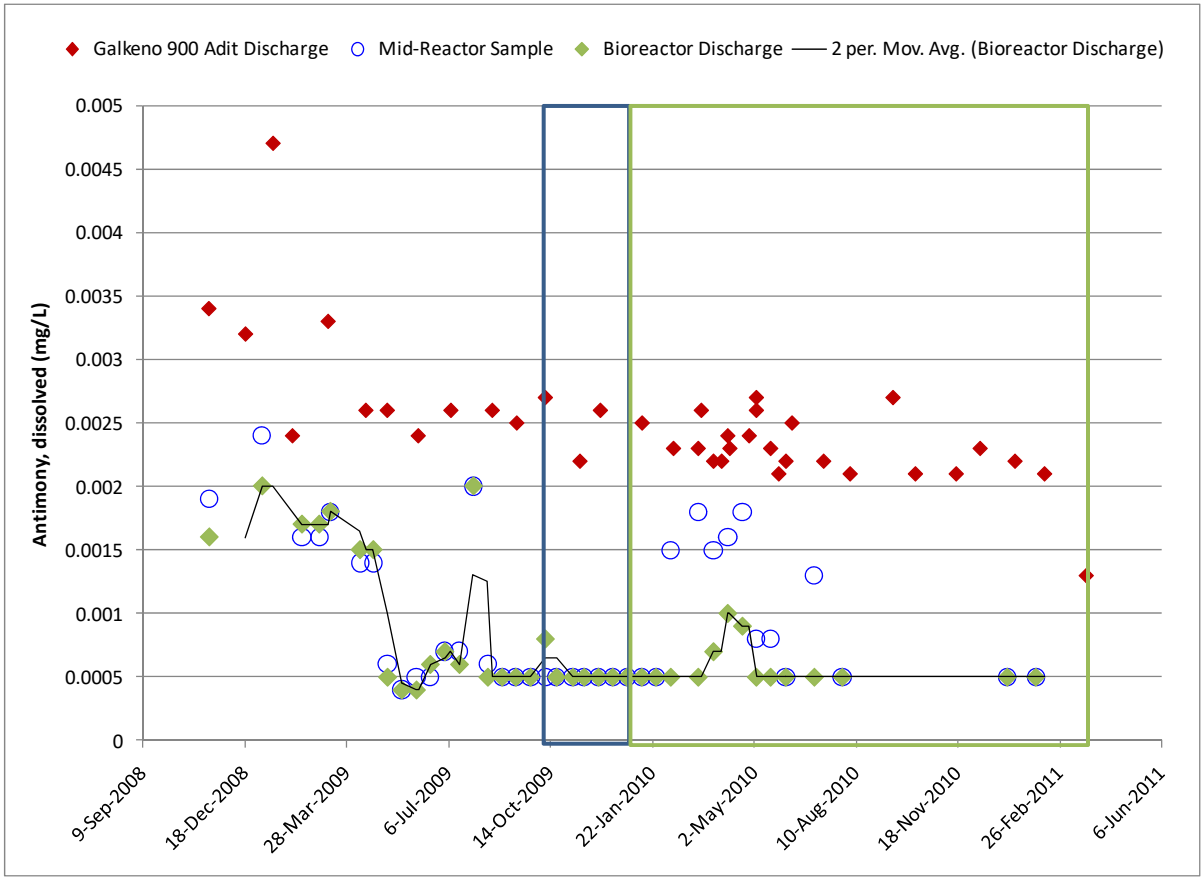

Figure 12 - Antimony Removal by the Galkeno 900 Bioreactor

6.2.3 Arsenic

Arsenic concentrations declined approximately 97% (0.068 mg/L reduced to 0.0015 mg/L average of last two months) during the recirculation phase (See Figure 13). Arsenic concentrations increased during the reduction onset phase, indicating a temporary dissolution of arsenic-bearing mineral phases during this transition period. During both treatment phases, arsenic removal increased again as sulphate reducing conditions were established. During the treatment phases, arsenic removal averaged 58% for the 0.5 lps period, and 80% during the 1.0 lps. The performance during the 0.5 lps period was likely affected by the residual washout of dissolved arsenic released during the reduction onset period, so a long term average removal would more likely be similar to the 1.0 lps performance.

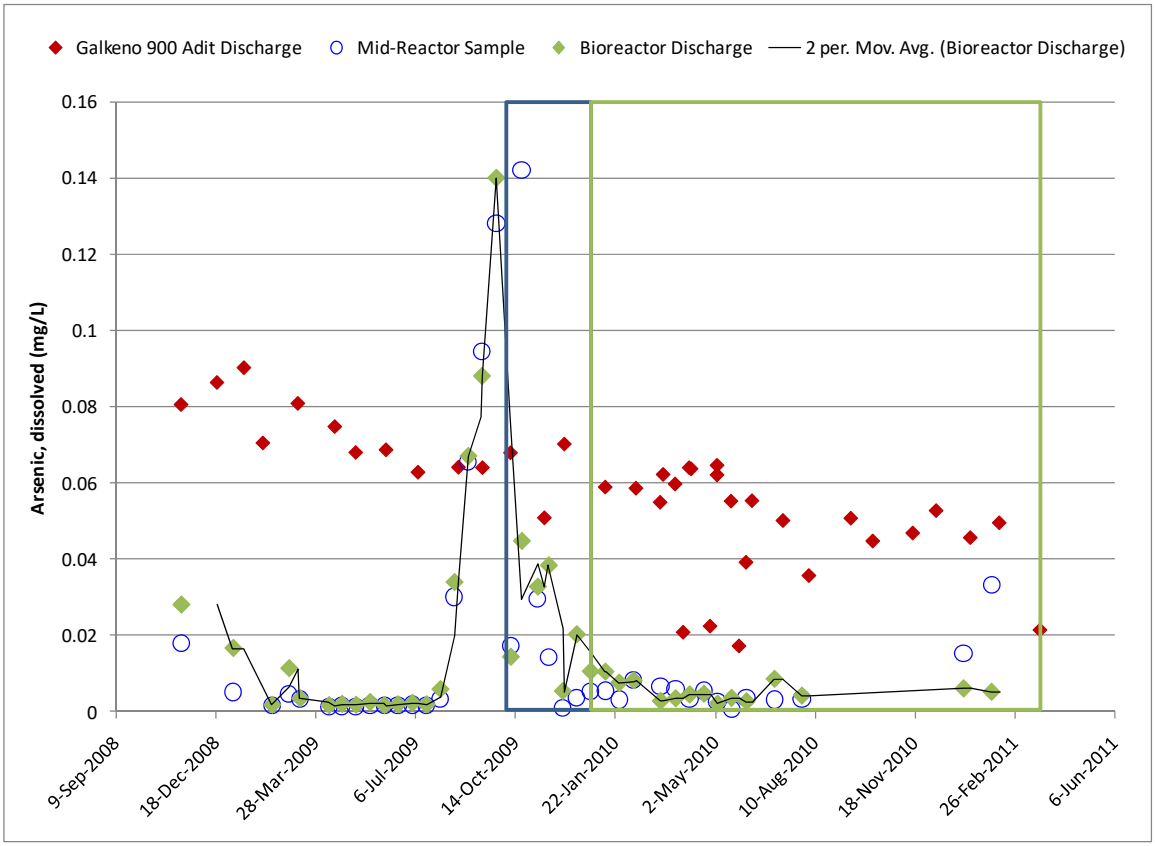

Figure 13 - Arsenic Removal by the Galkeno 900 Bioreactor

6.2.4 Cadmium

Cadmium concentrations declined approximately 60% (0.0015 mg/L reduced to 0.0005 mg/L average of last two months) during the recirculation phase (See Figure 14). After the beginning of the reduction onset phase, cadmium has been removed to below the detection limit and has remained at those levels during all the recirculation phases.

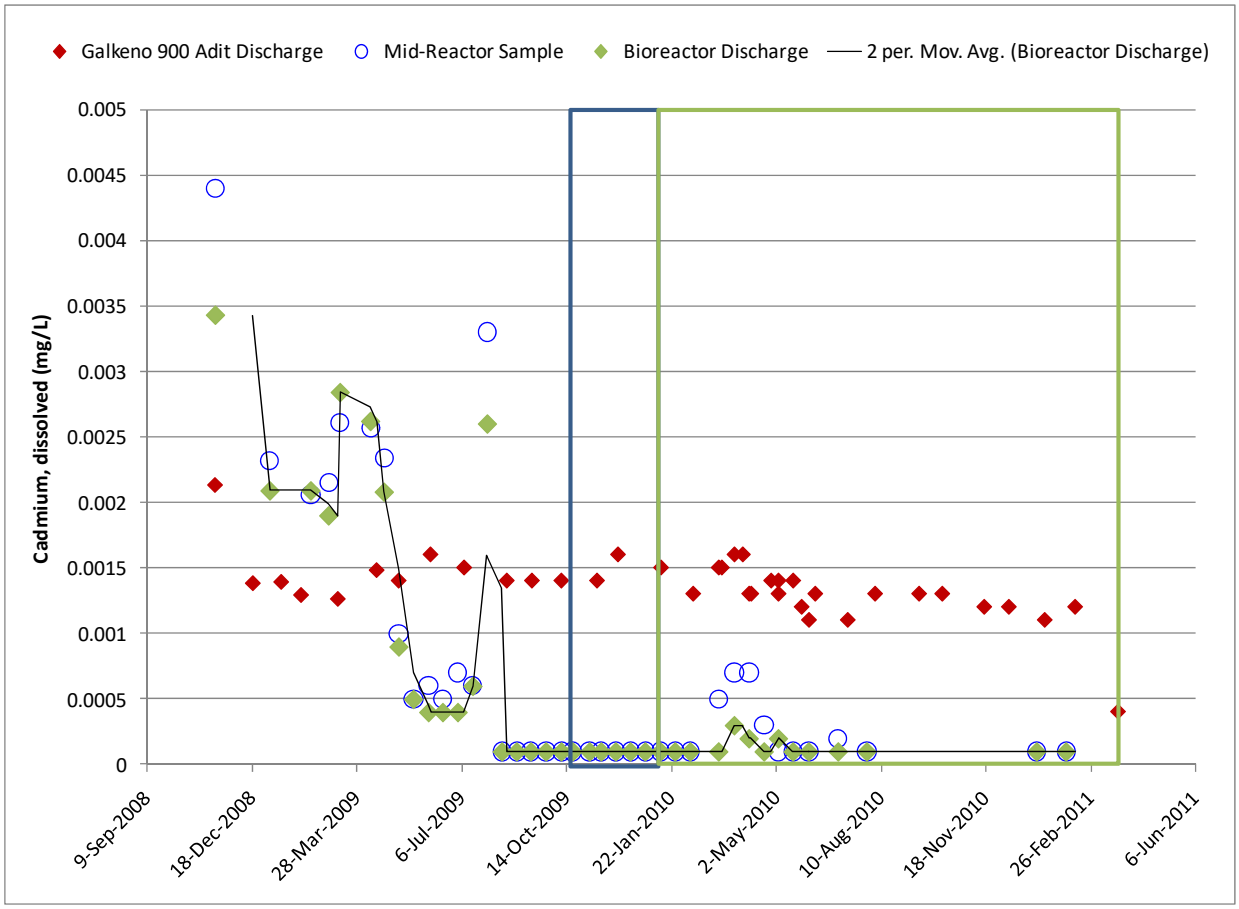

Figure 14 - Cadmium Removal by the Galkeno 900 Bioreactor

6.2.5 Iron

Iron concentrations declined approximately 97% reduction (1.75 mg/L reduced to 0.032 mg/L average of last two months) during the recirculation phase (See Figure 15). During this phase, iron appears to have been removed primarily by precipitation as an oxide. During the reduction onset phase, iron dissolved from the reactor and has been released at a rate higher than the amount entering the reactor through the recent operations.

Iron removal in the bioreactor provided sorption and co-precipitation phases for other trace metals removal during the recirculation phase. Some of the iron was likely also removed as sulphides in their initial amorphous precipitate form (operationally called Acid Volatile Sulphides or AVS). The rate of formation of this phase may be limited by the residence time provided in the bioreactor. An operational objective could include operating the reactor to create AVS.

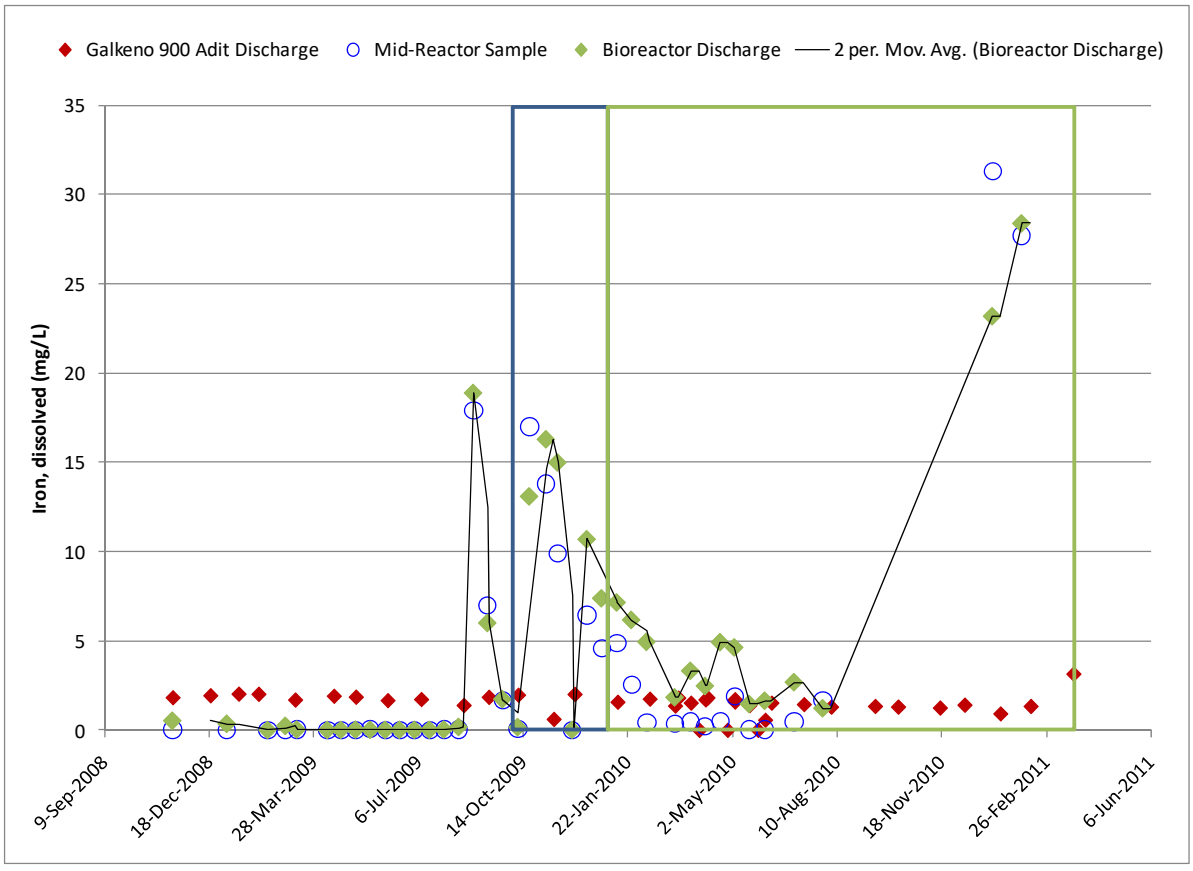

Figure 15 - Iron Removal by the Galkeno 900 Bioreactor

6.2.6 Manganese

Manganese concentrations declined approximately 98% (18 mg/L reduced to 0.25 mg/L) during the recirculation phase (See Figure 16). During the reduction onset phase, some manganese was released from the bioreactor, indicating that some of the manganese removal in the recirculation phase was as a manganese oxide. In through flow treatment phases the manganese concentrations entering the bioreactor and exiting the bioreactor were nearly the same, indicating manganese is not being removed from the reaction in the bioreactor under the more strongly reducing conditions and at the hydraulic residence times provided under the current flow regime.

Similar to iron, manganese removal in the bioreactor has important effects for other metals. Manganese carbonates and oxides that may have formed during the initial bioreactor operation phase have good sorption capacity for trace metals. Manganese precipitates may play a significant role in the removal of metals in the bioreactor.

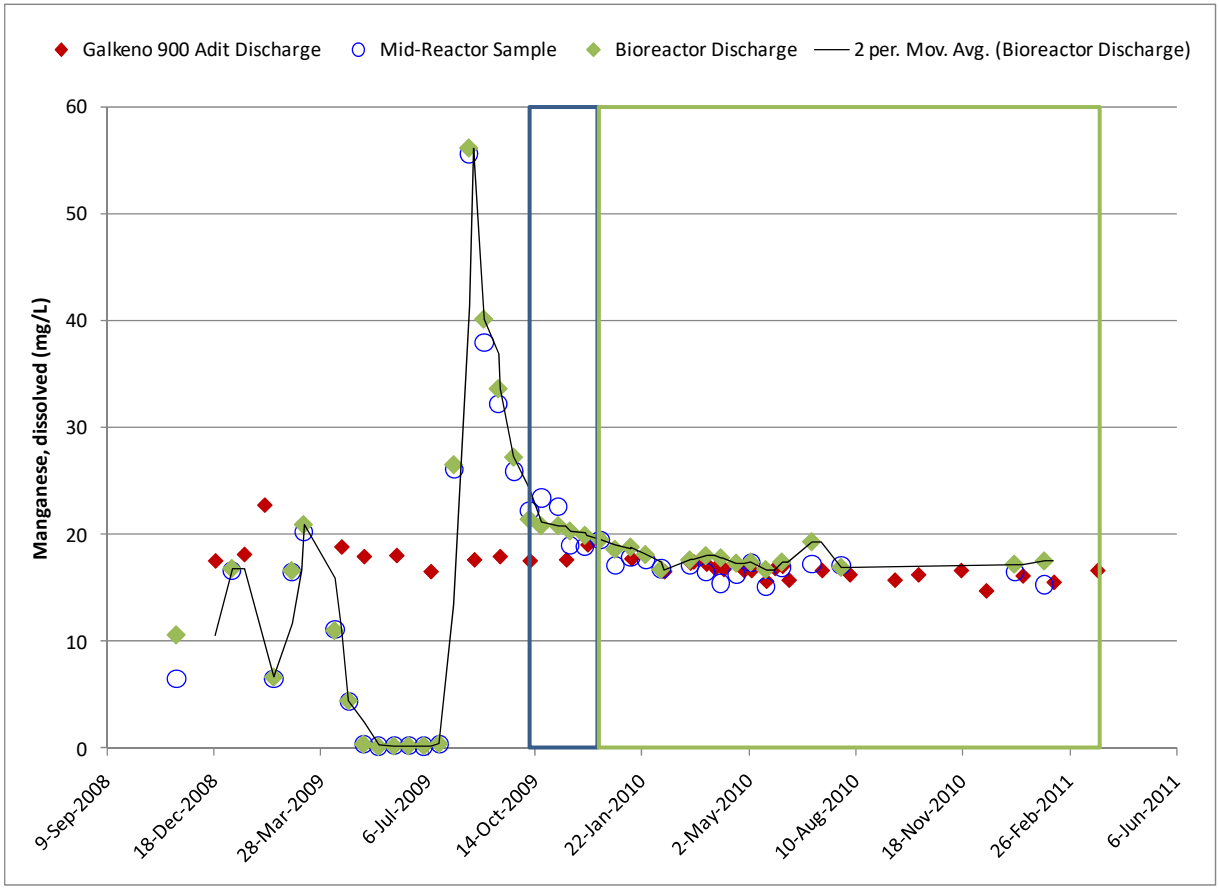

Figure 16 - Manganese Removal by the Galkeno 900 Bioreactor

6.2.7 Nickel

Nickel concentrations declined approximately 80% (0.2 mg/L reduced to 0.04 mg/L average of last two months) during the recirculation phase (See Figure 17). During the reduction onset, a portion of the nickel was returned to solution, but during the slower flow periods, the nickel concentrations decreased to detection limits. Nickel removal during the 0.5 lps was 97.5%, but declined during the 1.0 lps flow rate. The treatment capacity of the reactor appears to be more sensitive for nickel than some other metals, as the mid-reactor sample increased during the switch to the higher flow rate. If nickel removal were an objective, operation of the bioreactor at a slower flow rate appears to be beneficial. However, the transition back to 0.75 lps improved the nickel removal.

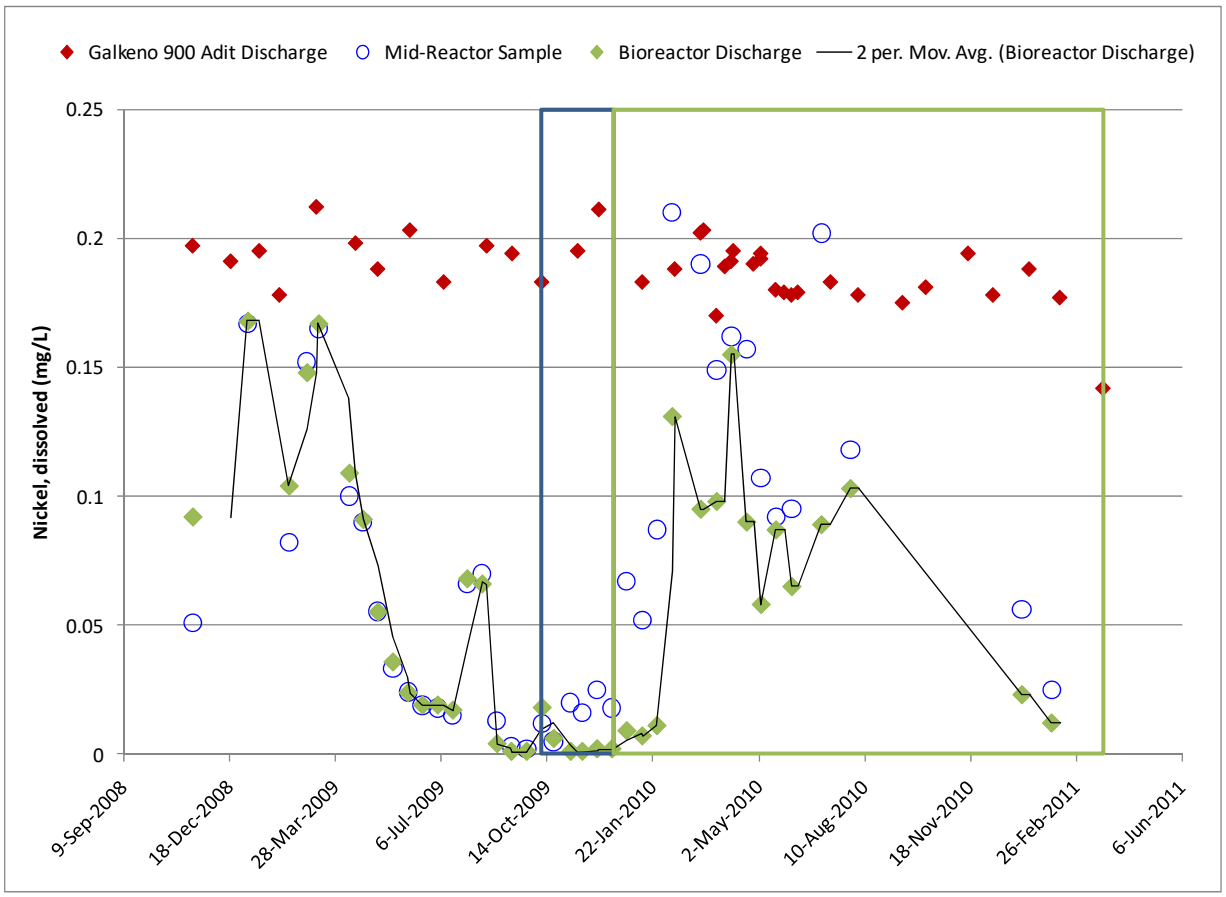

Figure 17 - Nickel Removal by the Galkeno 900 Bioreactor

7 BIOREACTOR ENGINEERING DISCUSSION

Evaluation of the metals removal obtained in the bioreactor and determination of the SRR that can be achieved in the wintertime at the 0.5 and 1.0 lps flow rates enables an evaluation of the potential scaling factor for the size of the bioreactor that could treat the entire flow from the Galkeno 900 adit. Design improvements would focus on increasing contact with all of the bioreactor, and decreasing 'dead zones'. Experience at other sites has shown an elongated rather than square bioreactor has better contact parameters and fewer dead zones. In rough parameters, the flow from the Galkeno 900 adit is approximately 4 lps and remains consistent throughout the year and with the improvements and balancing the appropriate conservatism in design an approximate scale factor of four times the volume of bioreactor media would be used to design and cost a bioreactor for a full scale at Galkeno 900.

The minimum goal of 0.5 mg/L zinc was consistently achievable during normal operation of the bioreactor as long as the system remained in operation without interruptions. As shown in the data, a pump failure and/or pipe freezing can have a detrimental effect on the water quality results. This experience has shown the improvements to the design must focus on ensuring flow at all times, not dependent on power availability, and further improvements to insulation could also achieved.

The removal of other metals was also consistently achieved with the exception of a short period when reduction onset occurred, when some metals were released with the reductive dissolution of iron and manganese.

7.1 GENERAL BIOREACTOR DESIGN IMPROVEMENTS

The following is an assessment of the Galkeno 900 design components that worked well and design components that did not work well. This information will provide the basis of design and inform the construction of future bioreactors within the district.

The following components worked well and should be repeated in future designs:

1.) **Torturous Path** - Creating a torturous path within the bioreactor using liner for baffling was needed with the Galkeno 900 design to minimize short-circuiting and increase residence time. However, the use of baffling created zones that did not provide effective treatment and these zones should be minimized or eliminated in future designs if possible. One way to do this is to create a bioreactor that is laid out as a long, gently sloping trench sections. Finding land where trenches could be constructed near adits in the Keno Hill area may be difficult in some areas.

2.) **Bioreactor Dead Zones** - As discussed earlier, approximately 60% of the media appears to be actively participating in treating the water as it passes through the bioreactor. The remaining volume is for practical purposes considered as dead zones. These dead zones can be minimized by creating longer and narrower flow paths. This design improvement should be considered for future bioreactors.

3.) **Flowing Water** - Water must be kept flowing - This is critical during the winter months in the Keno Hills district. Mine drainage and groundwater is above freezing, and the water temperature must be maintained while passing through the bioreactor. As long as the pump was working and water was continuously flowing through the bioreactor, freezing was avoided. Every freezing failure of the bioreactor was caused by power failures which lead to cessation of pumping and a loss of the heat capacity of the adit influent water. In future bioreactor designs, allowing adit water to flow via gravity through a bioreactor will eliminate the potential for pump failure and maintain flow through the bioreactor. The exact design for each bioreactor will be carefully considered to minimize power usage and prevent the potential for power interruptions to cause treatment failures.

4.) **Back-up Treatment System** – During this study, the discharge from the Galkeno 900 bioreactor was co-mingled with the untreated raw water from the adit. This combined water was then treated with a lime slurry and allowed to decant from a settling pond. It is possible to have a mobile system to treat water while the bioreactor until the discharged water meets the applicable standards or performance objectives. Once the bioreactor can demonstrate effective treatment with discharged water meeting standards, the treatment system could be removed or placed on stand-by.

The following components were sources of problems and should be eliminated or redesigned for future bioreactors in the district:

1) **Fill Material** - The fill material used in the Galkeno 900 bioreactor was too coarse. As seen in Figure 5, the material was a mixture of larger, broken rocks mixed with smaller pebbles and sand. By using a consistent fill material that is a smaller, crushed rock (between 3/8" to 2" diameters) additional surface areas will be available for bio-growth and will help avoid short circuiting.

2) **Metering Pump** - If the metering pump that provided a carbon source to the bioreactor stopped working, there was at best a limited stored carbon source available within the media. For future bioreactor designs, a limited amount of solid phase carbon source such as course sawdust or wood chips, and/or peat should be mixed with the media to provide a secondary source of carbon to sustain the bioreactor if the soluble/primary carbon source is interrupted.

3) **Pumps and Heat Trace** - As mentioned earlier, power failures were not planned for in the existing design. Inclusion of heat trace lines and backup power to pumps could have avoided the problems experienced in the Galkeno 900 bioreactor. In most cases, the location of the bioreactors could be placed in a downgradient location where power would only be required for the addition of a soluble carbon source. The carbon source could be designed to not require power by using an educator system where flow from the adit would draw in the carbon substrate by a venturi force. If utilized for backup power, a generator would be a very minimal size. The design would also consider placing the valves and controls inside the adit to minimize freezing.

Neither iron nor manganese were removed by the reactor during through flow operational phase. The natural attenuation studies in the district shows that these are readily removed in a very short distance by turbulent flow creating a natural oxidation system. This could be a designed as a cascading discharge or could be performed in a natural setting such as an existing stream.

8 DISCUSSION AND CONCLUSIONS

When continuous flow was maintained to the bioreactor at acceptable flow rates, effective treatment was maintained. At higher flow rates the transformation of metals from their dissolved forms to an insoluble form was accomplished, but the filtration efficiency of the coarse rock in the bioreactor did not filter the insoluble precipitates effectively. Full scale application of the sulphate reduction bioreactor technology appears feasible if slight design modifications are made to ensure gravity flow from the adit, avoidance of siphoning due to freezing, and improved sizing of the bioreactor media.

Evaluation of longer term bioreactor studies have been conducted at the Leviathin mine since 1997 by the US EPA. The US EPA SITE program (2006) ranked the bioreactor technology for metals treatment at the Leviathan mine using the criteria shown below. The Discussion of the Galkeno 900 bioreactor in terms of how it performed is presented relative to the same evaluation criteria.

- For Overall Protection of Human Health and the Environment, it was determined that the sulphate reducing bioreactor was effective for reducing metals concentration, and produced non-toxic and stable precipitates. A similar conclusion can be reached for the Galkeno 900 bioreactor; confirmation of stable non-toxic precipitates is underway in additional was confirmed with the mineralogical studies. , but with lower influent metals concentration in the Galkeno 900 bioreactor it is reasonable to believe similar results will be determined.

- For Compliance with Applicable or Relevant and Appropriate Requirements (ARAR), it was determined that the bioreactor generally produced compliant discharge, and with minor adjustments compliance was improved further. Similar conclusions can be stated for the Galkeno 900 bioreactor.

- For Long Term Effectiveness and Performance, it was determined that the bioreactor consistently met the applicable standards over many years, and suggested that with additional engineering a more passive (wind and/or solar powered) system appeared to be feasible. The strength of this conclusion for Galkeno 900 reactor is weakened primarily due to power and freezing issues, but these issues can be engineered in future applications to be less significant and thereby increase the long term effectiveness and performance.

- For Reduction in Toxicity, Mobility, or Volume through Treatment, it was determined that the bioreactor concentrated the metals in a stable form. Similar conclusions can be reached for the Galkeno 900 bioreactor: on average over 90% of the metals were removed from solution and filtered out of the bioreactor during operational times. Confirmation that zinc was removed in a ZnS precipitate also shows that the bioreactor created a dense, low volume precipitate; compared to zinc precipitated as metal hydroxides, ZnS is multiple times denser and therefore lower volume.

- For Short Term Effectiveness, it was determined that the bioreactor effluent was protective of human health, and that the chemicals required for bioreactor operation could be handled safely with the appropriate engineering controls. Conclusions for the Galkeno 900 bioreactor are that it had short term effectiveness when operating at lower flow rates, and

consequently that by appropriate sizing and cold weather engineering a bioreactor can have high short term effectiveness in the KHSD.

- For Implementability, it was determined that the technology is simple, could be operated with limited operator involvement, and that it was stable over a long time. For the Galkeno 900 bioreactor, the technology is very simple and required little operator involvement, and if pumping and siphoning the bioreactor could be avoided through gravity feed, the Galkeno 900 bioreactor process has a high implementability ranking.

- For Cost, it was determined that it cost approximately $15 per 1000 gallons to operate the Leviathan bioreactor. By way of comparison, the Galkeno 900 bioreactor costs are in the range of $5 per 1000 gallons. The main difference is the lower level of reagent requirements due to lower metals concentration and neutral pH at the Galkeno 900 bioreactor.

- For Community Acceptance, it was determined that the operation of the bioreactor presented minimal risk to the community, with diesel generation and transportation of chemicals to the bioreactor being the main risks. With the lower chemical usage required for a bioreactor in the neutral drainages in the KHSD, and the availability of line power the Community Acceptance criteria should be even better in the KHSD.

- For State Acceptance, it was noted that California has allowed it to be the only water treatment technology used year-round at the Leviathan Mine site. The Galkeno 900 bioreactor is currently approved for pilot scale trials on the Keno Closure program and was approved as part of the environmental assessment and water licencing ofat the Bellekeno Mine.

The bioreactor testing program is now considered complete. If desired, a subsequent study utilizing a buried trench design without the use of power could be considered for a next phase of testing to demonstrate the effectiveness of this approach for sites where power is available only by generator.

9 REFERENCES

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APPENDIX A

SUMMARY REPORT ON OPTICAL AND ELECTRON MICROPROBE ANALYSIS OF GALKENO 900 BIOREACTOR AT KENO HILLS

Summary Report on optical and electron microprobe analysis of Galkeno 900 Bioreactor at Keno Hills

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Submitted, November 25, 2011

Table of Contents

		Page Number
Table of Contents		2
List of Figures		2
Executive Summary		3
1.	Introduction	4
2.	Methodology	4
3.	Results	4
	3.1 Column Test	4
	3.2 Galkeno Bioreactor	5
4.	Discussion	8
5.	References	8

List of Figures

Figure 1: BSE images and element scans of Sample 8A FM Silt and Clay Bottom showing Mn and Zn rich coating around a lithic grain 5

Figure 2: 1B G900 BIO BSE images and element maps 5

Figure 3 GK900 Bioreactor sample. (A) Low magnification BSE image showing extensive bright bands of ZnS and Fe,(B) BSE image and element scans of area in red box in (A), (C) BSE image and element scans of area yellow box in (A) 6

Figure 4: GK900.BSE image and element scans of area in yellow box in Figure 3C Element scans along the yellow line in BSE image (A) 7

Figure 5: BioR sediment: BSE image and element maps showing the relationship of Fe and Mn, Zn and S. Plots of molar Zn:S in the ZnS rich band and Mn:Fe wt % in the Fe rich band. 8

Executive Summary

Samples of sediment from the Galkeno Bioreactor and also from a column experiment were analyzed using optical microscopy and an electron microprobe at the University of Manitoba. The first samples from the column experiment and from the Galkeno Bioreactor were oven dried in an aerobic environment prior to making polished thin sections. The second set of Galkeno Bioreactor sediments were kept in a wet anaerobic state before being sealed in epoxy resin.

Column samples contained Mn and Zn coatings on lithic grain.

The results showed that micron sized grains of ZnS were precipitated with a molar ratio of 1:1 indicating bacteriological sphalerite was being formed. The samples preserved anaerobically contained significantly more sphalerite than the first set of samples. The sphalerite formed bands indicative of biofilm deposition. Some if the ZnS layers were immediately adjacent to or surrounding layers of Fe and Mn oxide or hydroxide. This result fits with the water data from the Bioreactor. During the initiation the reactor was in an aerobic state and Mn and Fe oxides and hydroxides were deposited sequestering some Zn. When the Bioreactor became anaerobic the Mn and later Fe was mobilized but the Zn was now bacterially sequestered as ZnS. Some of this was formed on the remaining FeOOH biofilm layers.

1. Introduction

This study was initiated to investigate the form of Zn that was attenuated in column tests and in the Galkeno 900 Bioreactor. The initial set of samples had been oven dried prior to making the polished thin sections. This set consisted of duplicate thin sections (A and B) from 6 samples from the upper, middle, and lower section of four column tests (samples #3-8) and of two other samples from the bioreactor sediments (Sherriff 2011a) .

A second set of samples were obtained during the decommissioning of the Bioreactor (BioR Sed., and GK900 Sed.) These samples were sent to Vancouver Petrographics in jars as slurries. They were air dried and immediately sealed in eposxy resin to preserve minerals that might be unstable in an oxidizing environment. Two thin sections were made of sample BioR (A and B) (Sherriff 2011b).

2. Methodology

Polished thin sections were made by Vancouver Petrographics. The thin sections were examined optically to determine overall composition and delineate areas of interest. Selected areas were imaged on the electron microprobe (EMP) at the University of Manitoba using back scattered electrons (BSE) and mapped for Mn, Fe, S, and Zn. Points of further interest were the quantitatively analyzed.

The microprobe was operated at an acceleration potential of 15 kV and a beam current of 3 nA measured on the Faraday cup, with a 1 μm diameter beam. The standards for the quantitative analysis were albite (Na), olivine (Mg), andalusite (Al), diopside (Si, Ca), pyrite (S , Fe), orthopyroxene (K), sphene (Ti), spessartine (Mn), pentlandite(Ni), chalcopyrite (Cu), Gahnite (Zn), cobaltite (As), barite (Ba), chromite (Cr), and galena (Pb). The results of quantitative point analyses are given in wt. % elements with oxygen added to the Mn coating analyses to balance the cations.

3. Results

3.1 FM Column Tests

Only samples #5A FM Peat Bottom and #8A FM Silt and Clay Bottom were analyzed using the electron microprobe. Under optical microscopy thin section #5A FM Peat Bottom showed just plant fragments in a red mud whereas thin sections 8A FM Silt and Clay Bottom had lithic grains in fine grained matrix. The results from the column samples were rather ambiguous. Small areas (~1μm) in sample 5A had high Zn and S with Zn:S molar ratio of about 1:1 indicating possible precipitation of sphalerite. Sample 8A had a thin black coating of Mn and Zn around lithic grains with an average concentration is 8.1 wt. % Mn and 1.2 wt. % Zn giving an average Mn:Zn molar ratio of 3.4 (Figure 1)

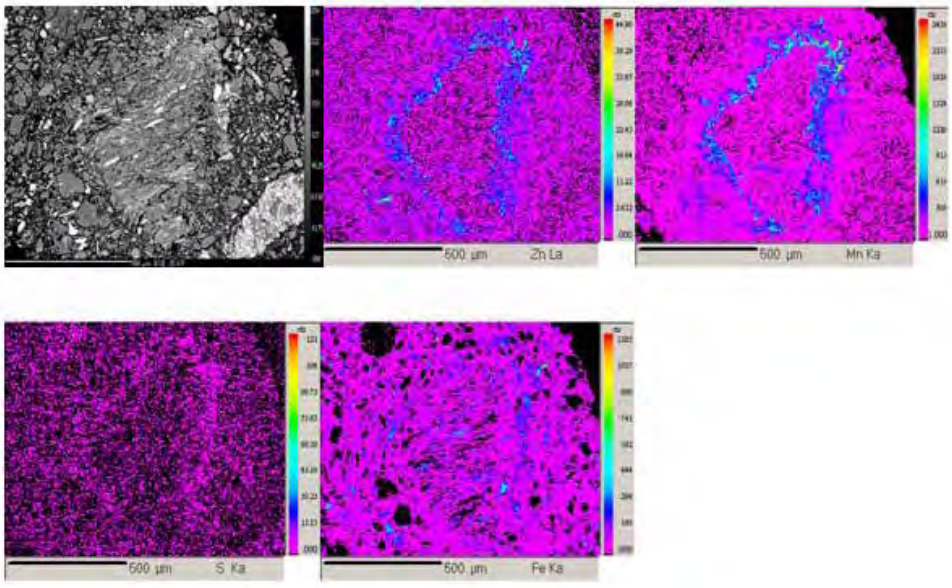

Figure 1: BSE images and element scans of Sample 8A FM Silt and Clay Bottom showing Mn and Zn rich coating around a lithic grain

3.2 Galkeno Bioreactor

The first set of Galkeno Bioreactor samples showed a few small areas that contained micron sized areas of Zn and S in a ratio of about 1:1indicating the presence of ZnS (Figure 2).

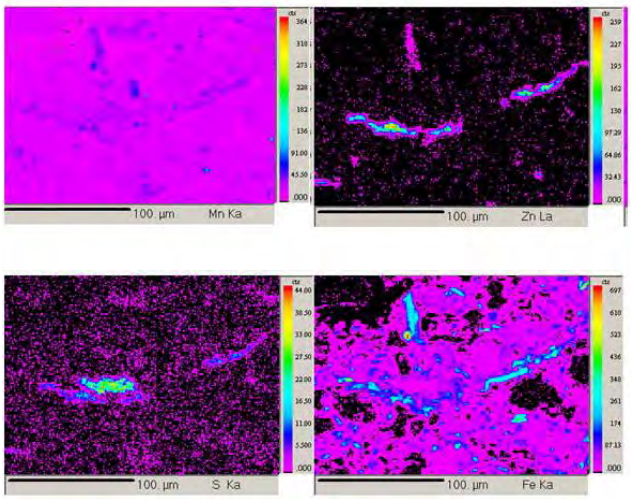

Figure 2: 1B G900 BIO BSE images and element maps

The second set of Galkena 900 samples (BioR Sediment and GK900 sediment) were kept under water and hence in an anaerobic environment until analyzed. These have a much higher concentration of micron sized ZnS grains, many of which formed bands indicating bacterial precipitation of sphalerite within a biofilm layer (Figure 3).

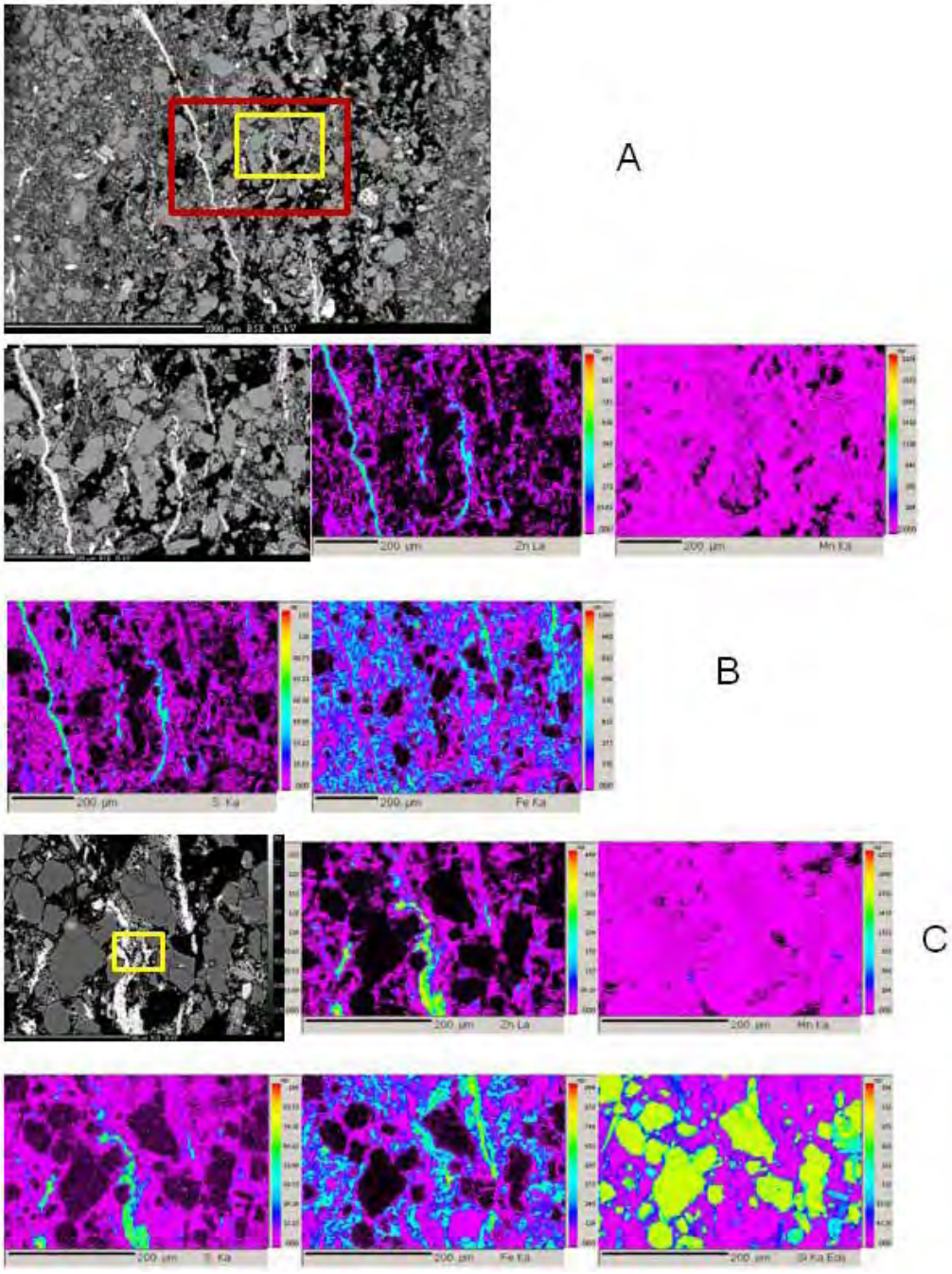

Figure 3 GK900 Bioreactor sample. (A) BSE image showing extensive bright bands of ZnS and Fe(B) BSE image and element scans of area in red box in (A) (C) BSE image and element scans of area yellow box in (A)

There were also areas containing Fe and Mn but not Zn or S (Figure 4). An elemental line scan across this area indicates regions rich in Zn and S adjacent to areas rich in Fe and Mn. Scatter plots of the quantitative analyses along the same line show that firstly Zn and S are related in atomic proportions of 1:1 (R^2 0.98) verifying the presence of sphalerite (ZnS) and secondly that Fe and Mn are precipitated together in a separate band (R^2 0.83). The concentrations of Mn are very low and there is no correlation between Fe and Zn or between Mn and Zn.

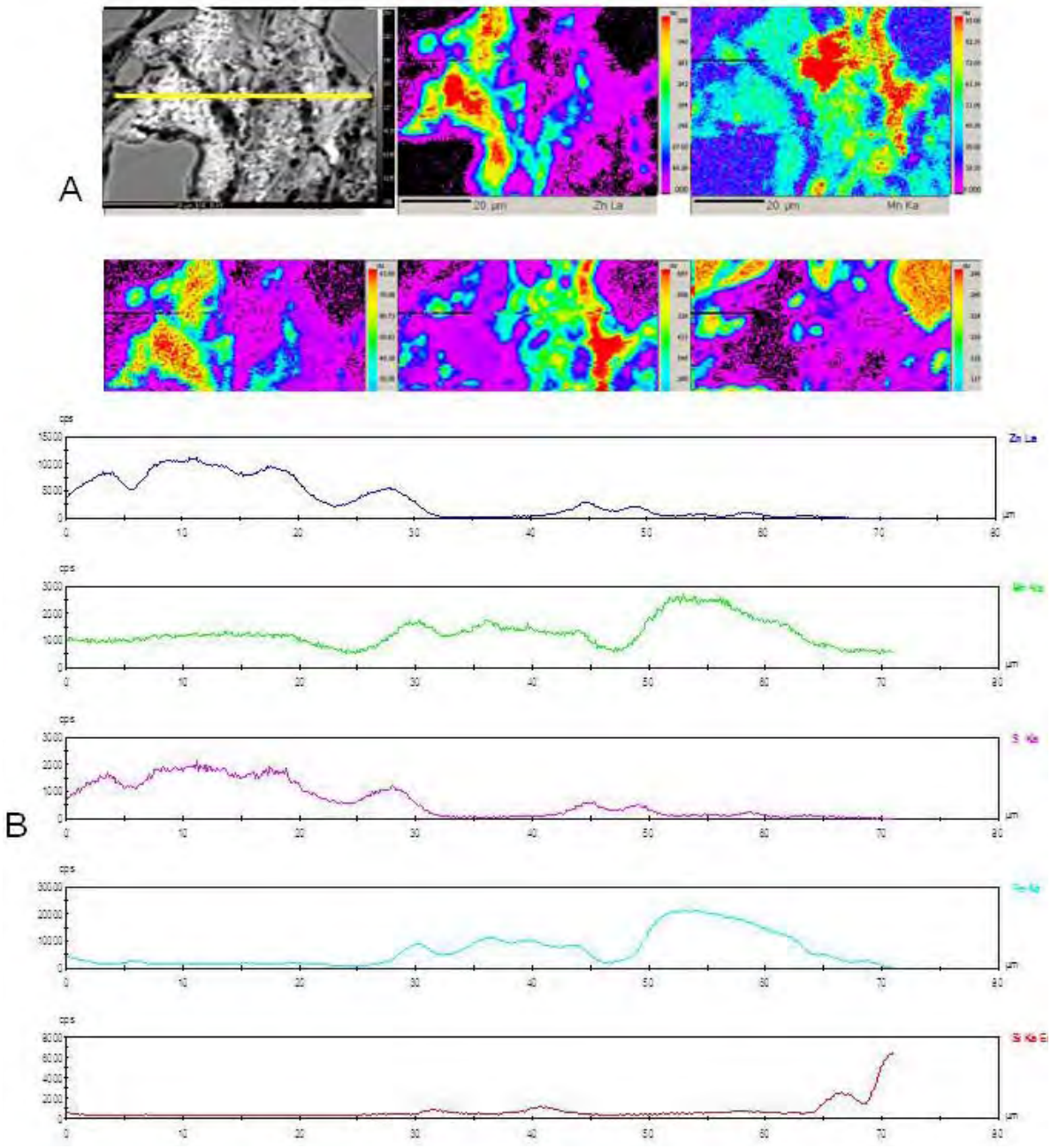

Figure 4: GK900. BSE image and element scans of area in yellow box in Figure 3 Element scans along the yellow line in BSE image (A)

In thin section BioR sediment A, a number of areas were imaged and mapped. A total of 160 points were selected within areas rich in Zn and S for quantitative analysis. In one area, two ZnS regions in the image have a thin band of Fe through the centre (Figure 5). The ZnS and Fe-rich bands were analyzed separately. A scatter plot of the concentrations of the ZnS band gives a 1:1 molar ratio of Zn to S indicating the presence of sphalerite. The Fe-rich bands have much lower concentrations of Zn and S and higher Fe and Mn. A plot of molar proportions of Zn and S indicates that there are still some grains of sphalerite in this region (Figure 5). In the Fe-rich band, there is a weak positive trend between the values of wt. % Fe and Mn (Figure 5).

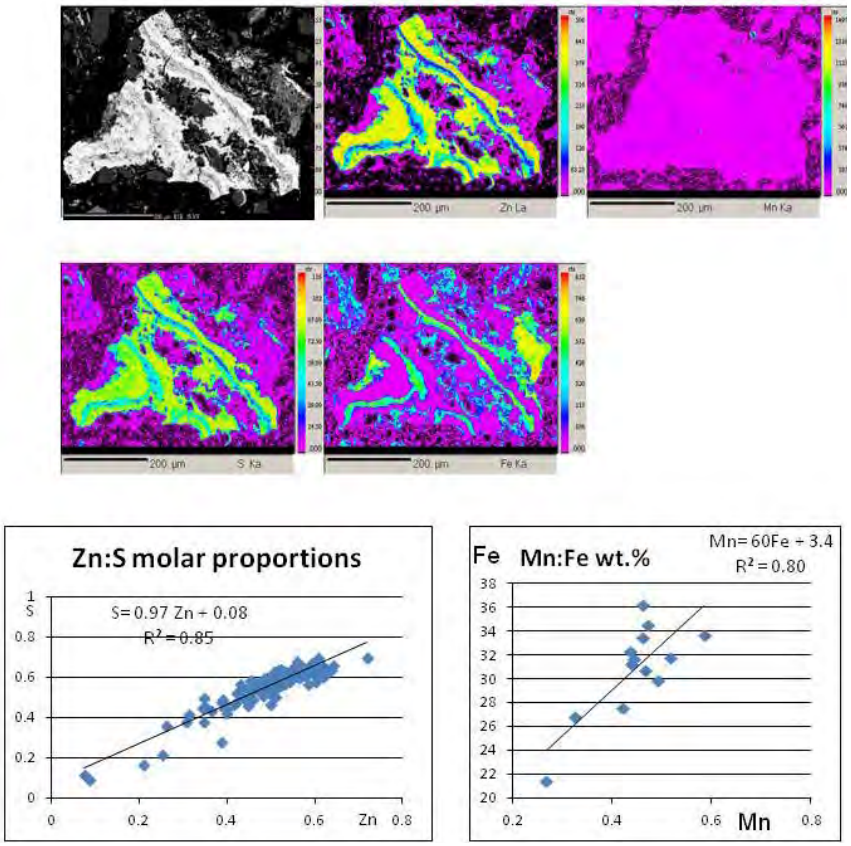

Figure 5: BioR sediment: BSE image and element maps showing the relation ship of Fe and Mn, Zn and S. Plots of molar Zn:S in the ZnS rich band and Mn:Fe wt % in the Fe rich band.

4. Discussion

The chemical analytical data from the samples GK900 and BioR Sediment can be interpreted in light of the composition of water exiting the Bioreactor (Alexco Resource US Corp. 2011). When the reactor was initially established, from September 2008 to October 2009, the environment was aerobic, Mn, Zn and Fe were removed from the adit water probably as Zn absorbed on Mn oxide and FeOOH. In October 2009 the reactor became anaerobic and there was an immediate increase in the Mn concentration in the water. This would have been due to the dissolution of the Mn oxide. For the rest of the operation of the bioreactor, Mn was not removed from the mine water. Zn was then precipitated as ZnS by sulphate reducing bacteria with residual FeOOH acting as a template for the formation of a ZnS biofilm.

5 References

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Sherriff, B.L. (2011a) Interim Report on optical and electron microprobe analysis of Keno Hills samples set 3

Sherriff, B.L. (2011b) Interim Report on optical and electron microprobe analysis of Keno Hills samples set 4

APPENDIX 1.6

BELLEKENO MINE SEMI-PASSIVE TREATMENT SYSTEM - DATA REVIEW AND GAP ANALYSIS 2025

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Memorandum

Date: November 14, 2025

To: Coralee Kirby Health, Safety & Environment Manager

From: Core Geoscience Services Inc.

Subject: Work Order #2. Bellekeno Mine Semi-Passive Treatment System Phase 1- Data Review, Gap Analysis and Recommendations

1. INTRODUCTION

Core Geoscience Services Inc. (CoreGeo) has prepared for Alexco Keno Hill Mining Corp. ("AKHM", the Client) a data review and gap analysis for consideration and development of a semi-passive treatment system implementation at the Bellekeno Mine, in alignment with current best practices, scientific research rigor and regulatory requirements for the Yukon.

CoreGeo reviewed key documentation provided by the Client to identify gaps and missing information. This review will support the development and implementation of passive or semi-passive treatment options for mine-impacted water at the Bellekeno Mine, Keno Hill Silver District, Yukon Territory (YT).

2. SCOPE OF WORK

As outlined in CoreGeo's proposal dated September 12, 2025, the following scope of work was conducted to support AKHM's advancement of the following tasks:

Task 1.1 – Data review and gap analysis

- A review of technical reports issued to date and provided by the Client,
- Identification of any gaps in information which could result in risk to a successful in situ treatment implementation.

Task 1.2 – Recommended Work Plan

- Develop recommendations for criteria for successful bioreactor implementation at the Bellekeno Mine.
- Develop recommendations for a laboratory-scale bioreactor test and a pilot scale bioreactor implementation.
- Development of recommendations for the collection of additional data which would improve the certainty of the implementation plan.
- The recommendations are expected to have a realistic application and be feasible. Resources required for execution of the recommendations shall be understood.

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- Recommendations shall be based on scientifically proven results in similar environments and climates. Where the plan requires research or experimental methods, this shall be identified with appropriate background information to understand resources and time required.
- Recommendations shall include proposed timelines for executing various phases of the testing and implementation of the semi-passive treatment system for Bellekeno Mine.

This memo outlines the preliminary identified gaps and recommendations for next steps.

3. DOCUMENTS REVIEWED

CoreGeo has completed a review of the documents supplied by the Client, looking to identify information relevant to reclamation and closure planning at Bellekeno.

1- **ERDC No Cash Commissioning Manual (22 Jul 2025);** Ensero; Prepared for: Elsa Reclamation & Development Company Ltd.
2- **RE: QZ18-044 Clause 56 – 2021 Annual Update to Bioreactor Design and Operation Plan (22 Oct 2021);** Alexco; Prepared for: Yukon Water Board Secretariat.
3- **Silver King In Situ Treatment Pilot – 2024 Update (Memo) (26 Mar 2025);** Ensero; Prepared for: Elsa Reclamation & Development Company Ltd.
4- **Keno Hill Silver District Mining Operations – Bioreactor Design and Operation Plan (Nov 2023);** Ensero, AKHM; Prepared for: Hecla Yukon.
5- **2014 Annual Water Licence Report (Water Use Licence QZ12-057) (27 Feb 2015);** Access Consulting Group; Prepared for: Yukon Water Board.
6- **Galkeno 900 Sulphate-Reducing Bioreactor 2008–2011 Operations, Final Report (Mar 2012);** Alexco; Prepared for: Elsa Reclamation & Development Company Ltd.
7- **Memorandum – QZ18-044 Water Treatment Plant Performance (31 Mar 2021);** Alexco Keno Hill Mining Corp.; Prepared for: Yukon Water Board.
8- **QZ18-044 Water Treatment Plant Performance, 2024 (28 Mar 2025);** Alexco Keno Hill Mining Corp. (Arlene Stearman); Prepared for: Yukon Water Board.
9- **Keno Hill Silver District Mining Operations – Keno Hill In Situ System Operations and Maintenance Plan (01 Oct 2020);** Ensero and AKHM; Prepared for: Alexco Keno Hill Mining Corp.
10- **Bellekeno Adit Chemistry (2021).** Hecla internal data excel file
11- **Keno Hill WQDB (13-May-2009).** Hecla internal data excel file
12- **Pilot Study of In Situ Biological Treatment at the Silver King Mine, Keno Hill, Yukon (2018).** In 11th ICARD, IMWA Report, MWD Conference 'Risk to Opportunity' (pp. 121-127).
13- **Percentage and Abundance of Known Sulphide-Producing Bacteria (17 July 2022).** Hecla internal data excel file
14- **QZ18-044 Water Treatment Plant Performance, 2023** Alexco Keno Hill Mining Corp. (Arlene Stearman); Prepared for: Yukon Water Board.

A complete list of all documents reviewed to date is presented in Appendix A.

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4. PROJECT BACKGROUND

On July 5, 2022, Hecla announced a definitive agreement to acquire all outstanding common shares of Alexco that Hecla did not already own. Hecla gained control of Alexco's key asset: the Keno Hill Silver District in Yukon, Canada, a high-grade silver district with existing infrastructure (mill, camp, highway access, hydro power).

However, reclamation plans developed prior to the acquisition, along with related information, were not always effectively transmitted, leading to some uncertainty regarding the work that has been completed and the current plans moving forward.

4.1 Bellekeno Project History

The Bellekeno underground mine was first operated by Mackeno Mines in the 1950s, accessed through adits at the 100 and 200 levels.

Mining activities resumed in 1984 with the development of the 625 level adit, which extended approximately 200 meters to intersect the "48" vein. Over time, the 625 level workings were connected to the 400 level, and the 500 level was developed. Between 1984 and 1989, ore was extracted from the 500, 625, 700, 750, and 800 levels.

In 1994, dewatering and rehabilitation of the 700 through 800 levels began via the 625 adit to support underground exploration drilling. The site was maintained until 2001, when it was officially declared abandoned. The lower Bellekeno workings were allowed to flood in 2003.

In 2008, the Bellekeno East Portal was driven as part of a new exploration initiative. This project included development of a new decline and the rehabilitation of the Bellekeno 200 portal and 625 adit for ventilation purposes. Dewatering of the lower workings likely began around 2009.

Commercial production commenced in 2011, but the mine was placed in care and maintenance in 2013. In 2015, equipment, fans, and utility lines below the 800 level were removed, allowing the workings between the 900 and 800 levels to flood. By early July 2016, groundwater had reached the 800 level (Bankers Corner), prompting renewed pumping to surface and water treatment, with treated effluent discharge resuming at that time.

In 2020, dewatering of the lower workings began once more. Mining operations resumed in the fourth quarter of 2020 and continued until the third quarter of 2021, after which the workings were again permitted to flood up to the 625 level.

4.2 Previous Passive Treatment Projects at Keno Hill Silver District

- **Galkeno 900**

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In 2008, a sulfate-reducing passive bioreactor (SRPB) was built at the Galkeno 900 adit in the Keno Hill Silver District to test the effectiveness of sulfate reduction technology for removing metals, especially zinc, from mine water. The project aimed to assess SRPB systems as a long-term water treatment option for mines in the district. Interim performance reports were completed in 2009 and 2010, with a final report issued in May 2011 for review by Aboriginal Affairs and Northern Development Canada (AANDC) and inclusion in the 2011 Annual Report. The pilot project demonstrated that SRPB technology, commonly used in warmer regions, can successfully operate year-round in Keno Hill Silver District's cold climate (as low as -40°C). The system split the Galkeno 900 adit flow: half to the bioreactor and half to a lime treatment facility, with treated water recirculated between the systems. The bioreactor was fully decommissioned after 2011, and from 2012 to 2014, all flows were redirected solely to the lime treatment circuit for final discharge.

- **Silver King**

The pilot-scale in situ treatment program at the Silver King Mine began in September 2014 under the Elsa Reclamation and Development Company Ltd. (ERDC) initiative.

The process proposed to periodically inject soluble organic carbon in Silver King underground workings to create sulfate-reducing conditions, resulting in the precipitation and removal of zinc and cadmium as metal sulfide. Genomic analyses confirmed the presence of sulfate-reducing bacteria (SRB), primarily from the *Desulfosporosinus* genus. Hydrogen peroxide dosing was also added to the Water Treatment Plant (WTP) to address occasional elevated total suspended solids (TSS) levels in effluent from the Silver King settling pond. After carbon addition, zinc and cadmium levels dropped by more than 90% and, although they gradually increased over time, remained below pre-treatment levels and applicable effluent quality standards.

From September 2014 to December 2016, the Silver King mine workings were actively dewatered to keep the static water level about 10–15 m below the top of the 100 Level ramp, preventing discharge through the 100 Level adit and maintaining control over the hydraulic residence time (HRT) within the mine. Active dewatering ceased in late December 2016, allowing the mine to return to a fully flooded condition with continuous discharge from the Silver King 100 (SK100) adit. The mine has remained in this fully flooded configuration since late December 2016. No carbon injection occurred at Silver King in 2024; therefore, no sulphide data were collected in 2024.

5. GAPS IDENTIFIED

The reviewed documents provide a strong scientific and historical foundation for designing a semi-passive (or semi active) biological water treatment system at Bellekeno. They include comprehensive reports with key technical details and engineering considerations essential for initiating an *in situ* treatment approach. Additionally, these reports are grounded in a strong foundation, drawing on the experience gained from the implementation, monitoring, and decommissioning of the Galkeno 900 bioreactors and the Silver King passive treatment project (although, based on the reports, the Silver King project has not been decommissioned but no longer appears to be monitored).

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The report tilted *Keno Hill Silver District Mining Operations Bioreactor Design and Operation Plan* (Nov 2023) addresses much of the work initially assigned to CoreGeo through work order #2. Similar to what was done at Galkeno 900, the proposed approach relies on bacterial sulfate reduction to precipitate heavy metals as metal sulfide, but instead of injecting carbon in underground mine tunnels (as it was done at Silver King), the water is pumped from bulkhead to water treatment plan and/or, after getting mixed with carbon solution, to the "bioreactor" which consists of the 2 existing ponds (including the Bellekeno 625 pond) engineered and designed to host targeted bacteria.

While the proposed Bellekeno system is referred to as a "passive bioreactor", it should be noted that the system must be considered a semi-passive biological reactor, and not a fully passive treatment system. The engineering design appears generally adequate; however, the scientific methodology could be strengthened by including site-specific characterization of impacted water, evaluation of the sulfate-reducing bacteria and substrate mixture, and supporting laboratory- and pilot-scale studies to validate the treatment process.

Specifically, Bellekeno mine impacted water has not been characterized and is not discussed in the report. Furthermore, the report does not discuss the sulfate-reducing bacteria (SRB) and substrate mixture, which are fundamental to the operation and success of such a reactor. More importantly, the scientific approach, which should include laboratory-scale and pilot-scale studies to develop and validate processes prior to full-scale implementation appears to be absent from all Bellekeno related documents reviewed by Coregeo. These stages are essential for generating site-specific data and for demonstrating the feasibility and effectiveness of the proposed treatment system.

The overall approach also lacks clarity. In 2020, the report *Keno Hill Silver District Mining Operations: Keno Hill In Situ System Operations and Maintenance Plan* outlined plans to implement *in situ* treatment within the underground tunnels at Bellekeno, similar to the method used at Silver King. In 2023, the memo *QZ18044 Water Treatment Plant Performance* states that:

"*In 2022, dissolved organic carbon (DOC), in the form of molasses, was introduced into the mine workings to facilitate microbe growth and fuel in situ treatment*".

Which means that, in 2022, the plan was still to develop the project in Bellekeno mine workings. However, by 2023, the plans had shifted towards constructing two bioreactors within the existing treatment ponds at Bellekeno. The rationale for this change, along with the supporting data that justified the transition from one approach to another, appears to be missing.

While the previously implemented passive treatment systems at the Keno Hill Mining District are well developed and have produced valuable data, the proposed project at Bellekeno could benefit from new approaches or innovations. For instance, sulfate reduction to sulfide by SRB requires a carbon source, which has traditionally been supplied in the form of molasses or alcohols (such as methanol or glycerol) since the design of the Galkeno 900 system in 2008. Exploring alternative carbon sources that are potentially available on site could offer economic benefits and make the process more genuinely passive, as importing molasses or other chemicals reduces the system's passive nature.

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The report titled *Keno Hill Silver District Mining Operations Bioreactor Design and Operation Plan* (November 2023) repeatedly describes the bioreactors as "simply a polishing process and contingency measure" for the active *in situ* water treatment facility. This characterization is insufficient to demonstrate to regulatory agencies that these semi-passive treatment systems can be effective in northern environments.

6. RECOMMENDATIONS AND NEXT STEPS

To advance the development of a semi-passive treatment system at Bellekeno, CoreGeo recommends the following actions:

- **Clarify treatment approach:** Investigate the rationale for selecting bioreactors instead of treatment within underground workings.
- **Characterize site water:** Analyze Bellekeno mine water and determine key parameters such as hydraulic retention time, water chemistry, and the presence of native SRB from underground environments.
- **Characterize native microbial population:** perform genomic characterization on samples from underground workings to identify bacterial genera (or families) known to have species capable of reducing various sulfur compounds to form sulfides
- **Compare with existing systems:** based on Bellekeno's site characteristics, conduct comparative studies between Galkeno 900, Silver King, and Bellekeno site.
- **Conduct laboratory-scale experiments:** Perform both batch and column tests to evaluate the capacity of native SRB to reduce sulfate to sulfide in cold conditions and to precipitate heavy metals as metal sulfides. Laboratory scale methodology and cost estimate is provided in Appendix B.
- **Assess local carbon sources:** Identify and test locally available carbon sources that could be harvested on-site to support bacterial growth and improve treatment efficiency, reducing dependency on imported materials.
- **Implement a pilot-scale study:** Following successful lab-scale optimization, conduct a pilot-scale experiment on site to assess how laboratory results translate under real-world conditions, including climatic, hydrological, and geological variability. Pilot scale methodology is provided in Appendix C. The methodology development and associated cost estimate assume that AKHM will provide a suitable location to host the experiment (e.g., a heated shed) and that maintenance and certain monitoring activities will be carried out by AKHM personnel.
- **Engage academic and Indigenous partners:** Use both lab-scale and pilot-scale stages as opportunities to collaborate with academic institutions and to involve First Nation partners, such as the First Nation of Nacho Nyak Dun, through student research projects (e.g., M.Sc. or Ph.D. studies) or environmental staff participation. Partnering with an academic institution and co-supervising post-secondary students can also help reduce project costs, as access to laboratory facilities and analytical services may be provided as in-kind contributions. In addition, partnerships with academic institutions will support the development of peer-reviewed publications, which can help demonstrate the scientific validity of the developed systems and strengthen their acceptance by Yukon regulatory agencies.

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- **Continue monitoring the Silver King project:** No carbon injection was conducted at Silver King in 2024; consequently, no sulfide data were collected during that period. However, analyzing how the treatment system responded to the cessation of carbon injection could provide valuable insights, particularly if an *in situ* treatment approach is developed within the underground workings at Bellekeno, similar to the Silver King system.

7. CLOSURE

If you require any additional information or clarification, please do not hesitate to contact us.

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8. APPENDICES

- **APPENDIX A:** Detailed list of Documents Reviewed.
- **APPENDIX B**: Batch test Laboratory scale experiment – Methodology.
- **APPENDIX C**: Pilot test Laboratory scale experiment – Methodology.

9. REFERENCES

Price, W.A. 2009. Prediction manual for drainage chemistry for sulphidic geologic materials. Mine Environment Neutral Drainage (MEND) Report 1.20.1. CANMET Mining and Mineral Sciences Laboratories.

APPENDIX A

Appendix A - Detailed List of Documents Reviewed

Report Name	File name on SharePoint	Author	Client	Date	Summary	Comments/Observations
ERDC No Cash Commissioning Manual	2025-07-22_ECA25YT00497_ERDC_NoCashCommissioningManual_Rev1	Ensero	Elsa Reclamation & Development Company Ltd.	July 22 2025	The report outlines an in-situ treatment plan for the No Cash Mines, adapted from the Silver King pilot project. The proposed method involves injecting dissolved organic carbon (Molasses and glycerol) into mine workings to promote microbial activity that supports sulfate-reducing conditions, aiding in the treatment of Cd and Zn. Ensero uses DOC decay to determine the amount of carbon source to inject such that 10 mg/L of residual DOC could be expected in the adit discharge under average flow conditions and hydraulic residence time (HRT). DOC delivery to the No Cash Creek both for reagent usage efficiency and to avoid any potential negative impacts of excess DOC in the creek.	"Classic" passive treatment method working in underground (as it was done at Sliver King). Water License (WL) for Bellekeno? Water chemistry at KV-20 (unclear where is KV-20 and what water chemistry it reflects, more likely No Cash 500 Adit Discharge). From Silver King experiment: keep molasses at the beginning, but trade Methanol to Glycerol for safety reason (but same goal regarding supporting bacterial growth). Injection in mine working similar to Silver King. Mine water injection is sourced at Ruby adit water quality (considered in the DOC demand as the average, require similar carbon demand to achieve sulphate-reducing conditions but also has total Cd and Zn concentrations about an order of magnitude lower than the No Cash 500 adit (average 0.0010 mg/L and 0.96 mg/L, respectively)). Passive treatment is specific to very specific to a mine site. Initial concentration of contaminants, initial DOC, HRT calculation might differ (methodology to determine each parameter is adequate). HRT is calculated with sodium chloride tracer. Solid methodology already proven in other projects. Sulfate concentration is missing (mentioned average of 445 mg/L), but used for any calculation of DOC. During freshet recharge, there is a potential increased recharge and increased HRT (so less time for metals removal to occur). We can also have more oxidizing water = potential oxidative dissolution of the biogenic sulphide minerals. These points are not discussed. General water chemistry characterisation = comparable to higher than all HMs of Bellekeno's characterisation between June 2009 and Feb 2020. **General comments:** as usual, Ensero's reports are solid reports presenting some important details and engineering pieces to start an in situ passive treatment. **But where is the science that shows it may work?** Each passive treatment must be specific to a mine site and I understand Silver king is mentioned as THE reference. BUT then, nothing is compared between Silver King and No Cash… HRT? Initial water chemistry? Native microbial population? Genomic characterisation? DOC and carbon injection? No new carbon sources investigation? We cannot implement a scale 1 project of that amplitude without scientific data that supports it… Lab scale? Pilot scale?
RE: QZ18-044 Clause 56 - 2021 Annual Update to Bioreactor Design and Operation Plan	2021_AKHM_Letter_QZ18-044_OMP_clause56	Alexco	Yukon Water Board Secretariat	22-Oct-21	Letter to the Water Board stating that Alexco will implement in situ mine water treatment in the underground at Bellekeno. Bioreactor Design and Operation Plan was to be updated next year (2022).	Is this document still relevant? Is Hecla obligated to implement an in situ water treatment?
Silver King In situ Treatment Pilot – 2024 Update (Memo)	2024_Ensero_Silver King Stakeholder Memo_ERDC_Rev_3	Ensero	Elsa Reclamation & Development Company Ltd.	26-Mar-25	A pilot in situ treatment project at the Silver King mine began in 2014 under ERDC and has been monitored through various reports, with the latest covering results up to 2023. This memorandum summarizes the work and findings from the Silver King in situ treatment test conducted between September 2014 and December 2024.	The report lacks methodology regarding the addition of hydrogen peroxide mentioned to reduce TSS (common for coagulation and flocculation, oxidation of Organic and Inorganic Compounds or oxidation dissolved metals (like Fe^{2+} to Fe^{3+})). How, where, at what concentration? "The decrease in DOC to baseline concentrations indicates full consumption of carbon by microbes". This statement is incorrect. Dissolution can be simply the cause. That does not mean there are no bacterial consumption but cannot, by itself, justify the presence of microbes. "No carbon injection occurred at Silver King in 2024; therefore, no sulphide data were collected in 2024." That will be interesting to know if the bacterial population was impacted by the lack of Carbon injection.
Keno Hill Silver District Mining Operations Bioreactor Design And Operation Plan	2023_Ensero_AKHM_Bioreactor_Design_and_Operation_Plan	Ensero, AKHM	HECLA YUKON	Nov-23	Preliminary design for the Bellekeno "bioreactor" and for the Flame & Moth "bioreactor", along with plans for its detailed design, commissioning, and future operation. In 2023, no water was flowing from the Bellekeno mine or mill site that requires treatment, making it impractical to finalize the bioreactor design beyond a conceptual stage. This design is based on a Previous Bioreactor Study: A bioreactor was constructed and operated at Galkeno 900 from 2009–2011. It is mentioned that these bioreactors are simply polishing processes and contingency measures. The existing conventional water treatment system (using lime and flocculant) will be retained during the decommissioning phase (active reclamation) of the underground treatment system. The plan is to convert the lined ponds at Bellekeno 625. What is missing to advance: underground water chemistry, time to flooding, HRT, need for secondary treatment during active reclamation. carbon source to develop the biomass. The reagent makeup and handling systems will be the same systems used for the in situ treatment underground. The carbon sources that can be used are molasses or an alcohol such as ethanol or glycerol.	This report treats about most of the work detailed in work order#2 assigned to Coregeo. While the proposed "bioreactor" does not mean the proposed system is "passive", the design is very close to what I envisioned (actually, this is an "active biological reactor that is proposed"). As no water was flowing from Bellekeno mine, no water has been characterized in the report. This is suspicious to envision a bioreactor set up, as POC and initial concentrations are the very first parameter to take into account when designing a bioreactor (with HRT and SRB/substrate mixture). The proposed bioreactor is closer to Galkeno project than Silver King. Both processes rely on bacterial sulfate reduction to precipitate HM as metal sulfide, but instead of injecting Carbon in underground mine tunnels (Silver King), the water is pumped from bulkhead to WTF and/or the "bioreactor" = the 2 existing ponds engineered and design to host targeted microbes. It is mentioned that bioreactors are simply polishing processes and contingency measures. It is safer indeed to keep the WTF during the commissioning phase (active reclamation) of the underground treatment system and keep the bioreactor as a polishing processes and contingency measures. The plan to use Bellekeno 625 pond into a bioreactor and the detailed design appears to be adequate. General notes/comments: instead of "bioreactors" why not use historical underground workings to mimic what has been achieved at Sliver King and proposed in 2025 by Ensero at No Cash? In the design, how to maintain anoxic conditions in the bioreactors (no top cover planned?) Why always use molasses or alcohol and not investigate potential carbon sources on site (e.g.: compost invasive species). Has the Bellekno water been characterized since, as well as HRT? Where would the needed inoculum/microbes (SRB? Probably depend on POC) be sourced from?

Appendix A - Detailed List of Documents Reviewed

Report Name	File name on SharePoint	Author	Client	Date	Summary	Comments/Observations
2014 Annual Water Licence Report Water Use Licence Qz12 057	ERDC QZ12-057 2014 Water Licence Annual Report-complete_Part1 (1)	Access Consulting Group.	Yukon Water Board	27 February 2015	This report fulfills the requirements of Water Use Licence QZ12-057, Clauses 16 and 17, and covers the reporting period from January 2014 to December 2014. Focus on Galkeno 900: •In 2008, a sulfate-reducing bioreactor cell was constructed at the Galkeno 900 adit to test the effectiveness of SRB technology for removing metals—especially zinc—through sulfate reduction. •The goal was to assess SRB treatment as a long-term alternative for mine sites in the district with compatible water chemistry. •Interim performance reports were completed in 2009 and 2010, with a final report issued in May 2011 for review by AANDC, supporting closure planning decisions. •The pilot demonstrated that buried pond bioreactors can operate year-round in cold climates, such as Keno Hill, where temperatures reach -40°C. •During testing, half the adit flow was directed into the bioreactor and recirculated to the lime treatment circuit; the other half went directly to the lime treatment.	In the context of this study, Not enough in this report to understand the design and results of Galkeno 900 and how this can be used for Bellekeno.
Galkeno 900 Sulphate-Reducing Bioreactor 2008-2011 Operations, Final Report	Appendix1.4 Gk 900 Sulphate Reducing Bioreactor Report_Alexco Environmental Group_2012	Alexco	Elsa Reclamation & Development Company Ltd.	Mar-12	The study, presenting Galkeno 900 bioreactor, demonstrated that year-round SRB operation is feasible in KHSD's cold climate, meeting discharge standards at lower flows. Main operational issues were due to power failures, which led to pump and valve malfunctions and water loss. Additional findings include: •Iron and manganese showed high removal during recirculation but were later partially remobilized during anaerobic operation. •Manganese now passes through unchanged; iron is slowly released. •Conservative elements like calcium and sodium showed <10% change, confirming that dilution was not a major factor in metal removal. Mineralogical analysis confirmed that zinc was removed primarily via microbial sulfate reduction, forming bacteriological sphalerite (ZnS) within biofilms. These findings support SRB bioreactors as a viable long-term treatment option for suitable KHSD sites. The bioreactor was supplied with organic substrates, such as sugars, alcohols, and milk-based compounds, to support microbial growth. During the growth phase, complex organics from milk were used, while sugars and alcohols were used in the maintenance phase. The goal was to promote microbial activity, particularly sulfate reduction, which became the primary treatment process.	Good design description, but poor methodology description regarding science. Section 7.1 General Bioreactor Design Improvements will be useful to design Bellekeno bioreactors. The reports details how they calculated HRT (=good point) but keeps presenting removal vs flow rate (L/s) which is not normal. 4 moles methanol + 3 moles sulphate = 3 moles sulphide + 4 moles bicarbonate The stoichiometry is ok for methanol, but for sugar carbon source? How was it achieved? The methodology lacks critical info (especially if we want to develop similar bioreactors at Bellekeno).
Memorandum, QZ18-044 Water Treatment Plant Performance	2021_Enserso_BK_FM_BH_WT_ System_ Performance	Alexco Keno Hill Mining Corp.	Yukon Water Board	31-Mar-21	The memo analyzes the 2021 performance of the Bellekeno, New Bermingham, and Flame & Moth water treatment plants. The Bellekeno 625 Water Treatment Plant (WTP)= pump MIW into a mix tank + lime slurry = HM precipitate and some ammonia to convert to gas. ferric chloride can be used to aid settling, but not done in 2021. The treated water then flows through two settling ponds for solids removal and further ammonia degradation before being discharged. Max flow rate of 10 L/s.	Important info for passive treatment design. At Bellekwno, in 2021, the WTF was designed for a maximum flow rate of 10 L/s. Discharge flows typically range between 0 to 5.96 L/s. The median flow in 2021 is 2.8 L/s. Initial water chemistry is not presented. After treatment, Ammonia, Zn and Pb were sporadically higher than DL. Similar info for Flame & Moth and New Bermingham in this memo, but we focus on Bellekeno for sake of time.
QZ18-044 Water Treatment Plant Performance, 2024	2024_AKHM_WTP_Performance_Memo_20240328	Alexco	Elsa Reclamation & Development Company Ltd.	Mar-25	Yearly update to water board.	Focus only on Bellekeno 625. Nothing new. All parameters are below EQS (TSS was in exceedance once, not source identified). General comments: why would Ensero want to install a bioreactor as a "polishing step", if active treatment works well?

Appendix A - Detailed List of Documents Reviewed

Report Name	File name on SharePoint	Author	Client	Date	Summary	Comments/Observations
Keno Hill Silver District Mining Operations Keno Hill In Situ System Operations And Maintenance Plan	2020_Ensero_AKHM_Keno_Hill_In_Situ_System_Ops_Maint_Plan	Ensero and AKHM	ALEXCO KENO HILL MINING CORP.	01-Oct-20	Alexco Keno Hill Mining Corp. (AKHM) plans to operate a semi-passive water treatment system at the Bellekeno Mine after mining ends. This document fulfills Clause 63.(a) of Water Licence QZ18-044, requiring an updated Operating and Maintenance Plan (OMP). The update specifically addresses the post-closure, in situ semi-passive treatment of underground mine water. Mining was expected to finish in Q1 2020. Bellekno mine = Bellekeno East portal and decline and the Bellekeno 625 adit. In situ treatment at the Bellekeno Mine is designed to create oxygen-deficient (anaerobic) conditions underground to prevent further metal oxidation and promote metal removal through sulphate reduction. This natural process is enhanced by injecting organic carbon sources (like glycerol, sugars, or starches), which are consumed by native microbes, sustaining anaerobic conditions. These microbial reactions cause dissolved metals to reprecipitate in the mine, effectively reversing the process that originally caused metal contamination. Treatment effectiveness depends on the type and concentration of carbon added, which controls the rate of sulphate reduction. Residence time for water in the mine is critical and is managed using hydraulic bulkheads to retain water underground. The system includes carbon amendment equipment that pumps circulation water, mixes it with glycerol, and injects it into three locations in the mine. A bulkhead at the portal retains water and controls discharge, while monitoring equipment at the adit tracks discharge pressure, pH, and turbidity. The Bellekeno mine post closure water treatment system includes two stages of treatment; the primary treatment in the underground workings followed by a contingency for secondary treatment at surface in the existing settling ponds. The plan: Primary treatment in underground working =An adit concrete bulkhead at 625 will collect and manage water stored in the mine and provide hydraulic retention time (HRT), as well as providing access control. A pipeline and recirculation pump to inject reagents and water recirculation to various levels of the mine. The Bellekeno mine is equipped with both air and water lines from surface to all levels throughout the mine and will be used as the recirculation and reagent addition pipeline upon closure. The discharge location of the injection pipe is planned to be in the stopes on the 850 level of the Southwest Zone. alcohol-based reagent will be utilized Secondary treatment: settling ponds at the Bellekeno 625 mine site will be retained at closure and will be converted to use as secondary treatment as a bioreactor. The existing conventional water treatment system for addition of lime and flocculant would be retained during the commissioning period (active reclamation) of the underground water treatment process. This is to provide a contingency for final polishing of effluent as steady state conditions are being established in the underground in situ treatment system. Once underground in situ treatment is established and the site enters post-closure, the existing settling ponds at Bellekeno will be converted into bioreactor systems to provide a passive final polishing step. Water quality will be monitored at both the underground outlet and the final discharge point to assess treatment effectiveness. While the mine floods and biological conditions develop, it may be necessary to retain conventional water treatment for one to two years, though reagent needs are expected to be minimal and won't significantly increase labour. Construction of the bioreactors will be phased—one pond will be converted while the other remains in use, followed by the second once underground treatment stabilizes. Timing for these conversions will depend on water flow and chemistry, with detailed plans to be included in the Reclamation and Closure Plan update due by November 27, 2021.	It is mentioned in this report that, in 2020, the want to implement in situ treatment in underground tunnels at Bellekeno. Very different from the 2023 Ensero approach. What happened between 2020 and 2023 to move from underground working to bioreactors? Process is well known, but it is first time it is mentioned that the HRT time can be managed by installation of hydraulic bulkheads to retain water underground. First time Initial MIW is described (very high level though). Table 3-1 = Zn (i)= 4mg/L on avg with a Max of 8mg/L. Mine inflo = 4L/s with a max= 6L/s. with Mine V=67,600 m3, Avg HRT = 200 days (min 130d). This report proposes 1- the primary treatment in the underground workings and 2- secondary treatment at surface in the existing settling ponds. This is based on Silver king (which has no secondary treatment). **The plan in summary**: 1=underground tunnels. lime and flocculant would be retained during the commissioning period (active reclamation) of the underground water treatment process. 2= bioreactors in existing Bellekeno pounds. Once treatment is established underground and the site moves into post closure, the setting ponds will be converted to a bioreactor treatment system. Classic use of molasses.
Bellekeno_adit_chemistry_2021	Bellekeno_adit_chemistry_2021				Excel file presenting KV-42 = Bellekeno 625 adit water chemisrty from June 2009 to Feb 2020 Type A WL QZ09-092 BK EQS and Type A WL QZ09-092 BK EQS-DM.	Type A WL QZ09-092 BK EQS= total and Type A WL QZ09-092 BK EQS-DM= Dissolved. Data from June 2009 to Feb 2020 (between 1 and 3 samples per months = 532 samples/data points). Exceedances in: •TSS (avg= 142.3mg/L when WL=25; 44% samples exceeding std. •[Ammonia]avg= 1.131 when WL=25; 2.1% samples exceeding std. •[As total]avg= 0.10114mg/L when WL= 0.1; 12.5% samples exceeding std. •[As diss] is good. •[Cd total]avg= 0.03955mg/L when WL= 0.01; 48.9% samples exceeding std. •[Cd diss]avg= 0.006466mg/L when WL= 0.01; 16% samples exceeding std. •[Cu total]avg= 0.001051mg/L when WL= 0.1; 6.1% samples exceeding std. •[Cu diss] is good. •[Pb total]avg= 0.017596mg/L when WL= 0.2; 37.5% samples exceeding std. •[Pb diss]avg= 3.45757mg/L when WL= 0.2; 0.4% samples exceeding std. •[Ag total]avg= 0.024771mg/L when WL= 0.01; 24.5% samples exceeding std. •[Ag diss] is good. •[Zn total]avg= 4.714 mg/L when WL= 0.5; 96% samples exceeding std. •[Zn diss]avg= 2.14mg/L when WL= 0.5; 74.1% samples exceeding std. •[SO4] (avg= 779mg/L) = good for sulfate reduction plans. Exceedances with some total metals but their dissolved concentrations generally remained within compliance, highlighting the role of particulates in metal transport. If total metals exceed water licence limits more often than dissolved metals, it indicates a significant portion of the metal load is particle-bound. This suggests: •High suspended sediment levels are likely contributing to metal exceedances (confirmed by the high TSS values). •Sediment and erosion control could reduce total metal concentrations. •Monitoring both total and dissolved metals is necessary to understand both current risk (dissolved) and potential transport/storage (total). Overall, these results suggest that managing particulate-bound metals and sediment control may be critical for improving water quality and achieving compliance.
Keno Hill WQDB 13-May-2009	Keno Hill WQDB 13-May-2009	Ensero and AKHM	Alexco keno hill mining corp.	01-Oct-20	Excel file from YESAB registry with water data for KV-42 from 1995	Only few data, but Zn increases drastically in 2003.
Pilot Study of In Situ Biological Treatment at the Silver King Mine, Keno Hill, Yukon. In 11th ICARD, IMWA Report, MWD Conference 'Risk to Opportunity' (pp. 121-127). 2018		Gault, A. G., Harrington, J. M., Robertson, C., Simair, M. C., & Friesen, V. P.		2018	Following carbon-injection events, Zn and Cd concentrations in mine discharge declined by more than 90%. Although metal concentrations slowly increased over time after interventions, they remained below pre-treatment levels and below effluent quality standards, indicating sustainable reduction potentials. The microbial community shifted to favour sulfate-reducing conditions, showing that SRB can be active even in cold sub-arctic mine environments. The pilot demonstrates that in situ biological treatment using indigenous SRB is feasible in a cold-climate mine setting and can substantially reduce metal loads (Zn, Cd). For closure planning at Silver King and similar sites, this offers a potentially lower-maintenance alternative to active treatment systems. The authors suggest that periodic carbon additions (e.g., annually) could maintain performance over the long term, reducing the reliance on constant active treatment.	Good peer reviewed publi that can be used to draft future similar experiments.

Appendix A - Detailed List of Documents Reviewed

Report Name	File name on SharePoint	Author	Client	Date	Summary	Comments/Observations
Percentage and Abundance of Known Sulphide-Producing Bacteria	BK_Micro_Summary			17-Jul-22	Excel file presenting genomic characterisation of native bacteria samples in Bellekeno underground working un 2022. •Most genera (e.g., Desulfocapsa, Desulfomicrobium, Desulfosporosinus, Desulfovibrio, and the families Desulfobacteraceae and Desulfobulbaceae) can reduce sulphate, thiosulphate, sulphite, and sulphur, indicating broad sulfur-reducing capability. •Partial reducers such as Desulfobacula, Desulfobulbus, and Fusibacter can reduce sulphate and thiosulphate but not all sulfur compounds. •Specialized reducers (Desulfuromonas and Geobacter) cannot reduce sulphate, thiosulphate, or sulphite but can reduce elemental sulphur. •Clostridium sensu stricto lacks sulphate reduction ability but can reduce thiosulphate, sulphite, and sulphur. •Paludibacter and Rhodoferax are confirmed to reduce sulphate, while data for other sulfur compounds are inconclusive (INA).	Most sulfur-reducing genera in the dataset possess the ability to reduce sulphate and thiosulphate, while fewer can reduce sulphite and sulphur. The genera Desulfosporosinus, Desulfovibrio, Desulfomicrobium, and related families show the widest sulfur-reduction range, highlighting their importance in sulfate-reducing environments such as mine bioreactors. This is very important data to develop SRPB at Bellekeno
QZ18 044 Water Treatment Plant Performance, 2023	2023_AKHM_WTP_Performance	Hecla, Arlene Stearman	Yukon Water Board	March 27, 2024	Important info regarding the future plans	In 2022, dissolved organic carbon (DOC), in the form of molasses, was introduced into the mine workings to facilitate microbe growth and fuel in situ treatment.

APPENDIX B

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APPENDIX B

Batch test Laboratory scale experiment - Methodology

The following laboratory scale protocol is a draft and may be reassessed.

1- Inoculum Collection

Inoculum sampling will be conducted at the mine, targeting native sulfate reducing bacterial populations from the site.

Option 1: Sediment is to be collected from the underground workings at Bellekeno, if all underground workings are not flooded and are accessible. Data collected on July 17, 2022, indicate the presence of sulfate-reducing bacteria (SRB) within the Bellekeno mine workings, suggesting the potential for *in situ* treatment processes if an adequate supply of organic carbon is available. Notably, the bacterial genera *Desulfosporosinus* and *Geobacter* were identified in the Bellekeno samples, mirroring those that were abundant in the Silver King workings during and after previous *in situ* treatment activities.

Option 2: If underground workings are flooded, sediment samples are to be collected from Christal Creek, located within the Keno Hill mining district between Keno and Mayo, Yukon, Canada. The presence of SRB in Christal Creek sediments has been previously documented in baseline studies conducted by Alexco during the remediation and maintenance of the historic mining district. Londry (2013) performed a technical assessment of microbial involvement in metal removal for Alexco's Galkeno 900 bioremediation project using molecular (DNA-based) and culture-based methods. That study confirmed the presence of SRB in sediments from several creeks across the United Keno Hill Mines area.

2- Mine Water Characterization

Mine impacted water (MIW) is to be collected from the Bellekeno 625 adit (KV-42). This site was part of a long-term monitoring program conducted by Alexco Resource Corporation, with monthly water samples collected between June 2009 to Feb 2020. More data must be reviewed and compiled to fully characterize Bellekeno MIW.

3- Waste rock characterization

Waste rock samples are to be collected from the Bellekeno site waste rock piles that were created during the excavation of the mine tunnels.

Comprehensive characterization of the waste rock, including particle size distribution, metal content, and acid mine drainage (AMD) generation potential, must be performed to evaluate its geochemical reactivity. Characterization must include: Particle size distribution, Mineralogical analysis (conducted using X-ray diffraction (XRD)) and Acid base accounting (ABA) testing should be conducted following Price (2009) guidelines.

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The sulfur content of the waste rock samples must be measured (TruSpec® Micro analyzer (St. Joseph, MI, USA)).

4- Carbon source collection and characterization

Carbon sources will be identified through a literature review and an assessment of materials available at the Keno Hill Silver District. On-site carbon sources will be collected in collaboration with the First Nation of Na-Cho Nyäk Dun as part of the community engagement component of this research project.

Various simple and complex carbon sources will be tested as carbon sources to support SRB's growth and efficiency.

Carbon Source Leach Test: Shake tests will be conducted to determine how each carbon source would impact the pH of Bioreactors.

CHN Analysis: The percentage of total carbon in each carbon source must be determined by CHN analysis.

Sorption Capacity Test: sorption capacity test for each carbon source will be conducted to determine how much sulfate/HM removal is chemical versus biological.

5- Batch test - Experimental Design and Operation

Bioreactors will be constructed using 1 L low-density polyethylene (LDPE) bottles to simulate conditions similar to an *in situ* water treatment system within underground mine tunnels. Each bioreactor will contain 200 mL of waste rock, 850 mL of mine-impacted water, 5 mL of microbial inoculum, and varying amounts of liquid carbon sources (to be determined). Deionized water is to be added to fill the remaining volume and maintain anoxic conditions.

The bioreactors will be incubated at 5 °C and monitored. All treatments will be prepared in triplicate to ensure data reliability and allow statistical comparison of the effects of different carbon sources on bacterial activity and metal removal. The experiment duration is not fixed in advance but will be concluded once total organic carbon (TOC) is fully depleted. Estimate time of the experiment is expected to be around 90 days.

It is planned to test 5 different carbon sources (2 form the literature and 3 from mine site) in triplicates so 15 batch test bioreactors total ,plus one control in triplicates)

6- Batch Bioreactor Monitoring

Throughout the experiment, multiple parameters must be monitored in both the bioreactors and control samples to assess the effects of carbon source type and concentration on SRB activity and, consequently, on Heavy metal removal.

On a weekly basis, several parameters will be followed such as the oxidation–reduction potential (ORP), pH, Dissolved Oxygen (DO), conductivity, sulfate concentration, TOC, and Total Heavy metals. The total volume that will be collected during each sampling event will be approximately 60

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mL. After each sampling, the 1 L bioreactors and control bottles will be refilled with deionized water (DIW) to the top to eliminate air pockets and maintain anoxic conditions.

7- Column Test - Experimental Design and Operation

After reviewing documentation that will allow to estimate or calculate the HRT in the Bellekeno underground workings and after selecting best carbon source from the batch test study, a duplicate column bioreactor will be constructed using acrylic cylinders. Flow rate will be calculated to mimic the HRT from underground workings and controlled by peristaltic pumps.

The operating temperature for these column bioreactors will be 5°C, to mimic average groundwater temperatures in the general region of the mine.

8- Column Bioreactors Monitoring

Effluent from each column will be sampled weekly during the first 5 weeks and biweekly from week 6 until the end of experiment (to be determined). ORP, pH, Dissolved DO, and conductivity sulfate analysis, TOC, Total Heavy metals.

9- Conclusion and reporting

A scientific report will be produced to present results and discussion from the laboratory test.

APPENDIX C

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APPENDIX C

Pilot scale bioreactors Experimental Setup

This pilot scale experimental set up will follow the Phase 2- laboratory scale experiment. This proposal will be updated based on the phase 2's conclusions and findings.

Two duplicate above-ground experimental bioreactors will be installed at Bellekeno mine site. Each bioreactor consists of a sealed 200 L polyethylene drum. To minimize headspace and maintain anoxic conditions, the outlet pipe is installed through the top cover of each drum. Effluent water from the bioreactors is collected in two separate open-top 200 L polyethylene drums.

Each bioreactor is filled with 40 L of waste rock, representing 20% (v/v) of the reactor volume to mimic underground mine workings' conditions. The waste rock is collected in equal proportions from two piles of excavated material originating from the Bellekeno tunnels.

Mine impacted water (MIW) is pumped biweekly into a 1000 L feed tank from KV-42, Bellekeno 625 adit. The feed tank is completely emptied before each refilling. MIW is then pumped from this tank into the bottom of the bioreactors, flowing upward through the waste rock bed. The flow rate is adjusted to achieve a hydraulic retention time (HRT) that needs to be determined to mimic groundwater's HRT in the underground tunnels.

The carbon source used for this pilot scale experiment will be determined by the Phase 2- laboratory scale experiment.

The carbon source's solution is continuously stirred in a 10 L glass bottle and introduced into the bottom of each bioreactor via a timer-controlled pump in order to reach to the desired carbon concentration in the bioreactor influent.

Bioreactor Monitoring and Chemical Analysis

Effluent samples are collected weekly from the 200 L collection drums after thoroughly stirring the contents. Temperature, pH, oxidation–reduction potential (ORP), and conductivity are measured in both the mine impacted water (MIW) feed tank and the liquid phase inside the bioreactors.

Samples will be taken for sulfate, TOC and Heavy metals.

Biological Sample Collection

Microorganisms within the bioreactors are collected using passive samplers, which are designed to capture microbial communities representative of the biofilms in each bioreactor and responsible for water treatment.

Each passive sampler consists of a light cotton cheesecloth bag containing a few grams of waste rock, prepared in the same composition and ratio as the material within each bioreactor. Twenty such bags are prepared and suspended at mid-depth in each bioreactor using fishing line to facilitate removal during sampling.

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Once per month, one passive sampler is retrieved from each bioreactor for microbial community analysis. Immediately after collection, the samplers are flash-frozen by immersion in liquid nitrogen and transported from the field to the laboratory, where they are stored at –80 °C until DNA extraction.

Following sampler removal, the bioreactor lids are replaced and resealed with silicone to maintain anaerobic conditions.

DNA extraction and sequencing and genomic characterization are to be sub-contracted.

APPENDIX 1.7

PRELIMINARY ASSESSMENT OF PERFORMANCE FOR WRSA CLOSURE COVER SYSTEMS

O'Kane Consultants Inc.

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

March 30, 2015

Leia Fougere
Environmental Engineer (EIT)
Access Consulting, a member of
Alexco Environmental Group
#3 Calcite Business Centre, 151 Industrial Road
Whitehorse, YT Y1A 2V3

Ms. Fougere:

Re: Keno Hill Silver District – Preliminary Assessment of Performance for Closure Cover Systems for Waste Rock Storage Areas

O'Kane Consultants Inc. (OKC) was retained by Alexco Environmental Group (AEG) in February 2015 to provide technical support related to cover system designs for closure of waste rock storage areas (WRSAs) at the Keno Hill Silver District (KHSD) in the Yukon. This report outlines the project context, objectives, and work scope, followed by preliminary estimates of hydrological performance for three different cover system types.

Project Context, Objectives, and Work Scope:

Approximately 60 WRSAs exist within the KHSD, ranging from a few thousand tonnes from exploration trenches to 1.5 M tonnes. They are located in five different drainages; namely, Flat Creek, Christal Creek, No Cash, Sadie Ladue, and Lightning Creek. Based on previous characterization work, about 25 WRSAs have been prioritized for some type of re-contouring / cover / revegetation. Of those, about 10 WRSAs merit consideration of a lower net percolation cover system on some or all of the surfaces. Waste material in the WRSAs is not considered to be net acid-generating; the primary concern is metal leaching with Zn and Cd being of greatest concern. Much of the waste material is unmineralized quartzite or greenstones; the vein structures and schists are the primary sources of metal leaching and acidity. The surrounding peat landscape provides relatively good attenuation within a short migration flowpath.

The KHSD WRSAs are >30 years old and many have vegetation established on some or all of the surfaces. This is considerable time for generation of oxidation products, but on the same hand, the pore spaces have been flushed thoroughly as a result of percolating meteoric waters. Most WRSAs have angle-of-repose slopes on steeper slopes adjacent to adits. Considering the relatively low environmental impact to surface waters or groundwater from most WRSAs, it is difficult to justify the increased footprint, disturbance, and release of stored soluble load that a very low net percolation cover system would incur.

The currently planned end land-use for the reclaimed WRSAs is natural habitat (wilderness). Given this and the geochemical conditions of the waste materials, the primary design objectives of the KHSD WRSA closure cover systems are to:

a) provide an adequate rooting zone for growth of native plants;
b) eliminate dust emissions from the waste deposits;
c) prevent direct contact between waste material and incident meteoric waters; and
d) reduce net percolation rates and thus seepage flows to the greatest extent possible.

The overall objective of OKC's work was to develop conceptual-level or indicative cover system design alternatives for closure cover systems for WRSAs at KHSD. Specifically, AEG requires preliminary estimates of hydrological performance (i.e. long-term net percolation rates) and construction costs for three difference cover system types. This information is required to support an update to the KHSD ESM Reclamation Plan. Preliminary costs for remediation of the WRSAs were submitted to AEG in a separate memorandum.

The following tasks were completed to address the above project objectives:

- Project orientation including review of pertinent background information and participation in a project planning / kickoff meeting in Vancouver on February 19, 2015;
- Development of a conceptual model of hydrological performance of a typical soil cover system for the KHSD site;
- Base case numerical simulations of cover system performance using the soil-plant-atmosphere (SPA) model VADOSE/W[1];
- Provision of technical support on various matters related to cover system design; and
- Development of indicative-level cost estimates (-20% to +30%) for cover system construction.

Conceptual Model of Cover System Performance:

A conceptual model of hydrological performance of cover systems for KHSD was developed prior to the start of SPA numerical modelling. This required consideration of the following water balance fluxes:

- precipitation (Ppt),
- potential evapotranspiration (PET),
- actual evapotranspiration (AET),
- runoff (RO),
- sublimation (Sub), and
- net percolation (NP).

The mean annual precipitation (MAP) for the KHSD and how it is influenced by elevation was previously estimated by Clearwater Consultants in 1996 (Access, 1996)[2]. Clearwater Consultants developed a linear relationship between elevation and MAP:

$$MAP = 0.27 * Elev + 190$$

[1] Geo-Slope International Ltd. 2014. GeoStudio 2012. Version 8.14.1.10087. Online. www.geo-slope.com.

[2] Access Mining Consultants Ltd., 1996a. United Keno Hill Mines Limited, Site Characterization Report, Report No. UKH96/01. Prepared for United Keno Hill Mines Limited.

where:

MAP = mean annual precipitation (mm/yr); and

Elev = elevation above sea level (masl).

OKC performed their own review of the MAP estimate and found it reasonable. Hence, the equation above was used to estimate MAP. Three elevations were simulated for this project: 750 masl, 1,000 masl, and 1,500 masl. Hence, the MAP at each elevation is estimated to be 390 mm/yr, 460 mm/yr, and 530 mm/yr, respectively.

Given the relatively high latitude of KHSD, slope aspect and angle highly influences the amount of solar energy and resultant PET applied to various areas of the site (MEND, 2012)[3]. Hence, for an exposed plateau (i.e. a flat area with no slope influences) or east- or west-facing slope (referred to hereinafter as a middle aspect), average annual PET is estimated to be 370 mm/yr with an annual range from 200 mm/yr to 1,400 mm/yr. However, PET is estimated to be 60% less on north-facing aspects and 50% more on south-facing aspects, resulting in average annual PET rates for these two aspects of 150 mm/yr and 560 mm/yr, respectively.

In general, the ratio of annual AET to precipitation ranges from 40 to 60% for study areas similar to KHSD (Kane and Yang, 2004)[4]. This results in a typical AET:PET ratio of 50 to 70%. However, it must be noted that results for north or south aspects may be outside of the general ranges.

Runoff to precipitation ratios for northern sites typically have an increasing trend with increasing latitude (Kane and Yang, 2004). A runoff rate of 0 to 20% of precipitation is expected for KHSD given the latitude at which the site is located combined with the current knowledge of locally available materials and the range of vegetation conditions.

Sublimation and redistribution of snow constitutes a significant portion of the water balance in several seasonally snow-covered areas of the Canadian North such as KHSD (Pomeroy *et al.*, 1995)[5]. Snow interception and sublimation are important hydrological processes that occur as a result of complex mass and energy exchanges. Comparing KHSD to other northern sites at a similar latitude, a sublimation rate of 25 to 35% of annual snowfall is expected (Kane and Yang, 2004). This corresponds to a sublimation rate of approximately 10 to 15% of total annual precipitation.

NP is a vital component of the water balance for northern climates. Basic water balance accounting of the estimates supplied above leaves between 5 to 50% of precipitation available for NP for a middle aspect. NP is functionally halted during the winter months due to frozen ground conditions. In general, the majority of NP at the KHSD site occurs during spring-melt. Through the summer months, NP rates are lower due to the store and release function of a vegetated soil profile. NP rates generally increase in the fall due to lower PET rates.

[3] MEND (Mine Environment Neutral Drainage). 2012. Cold regions cover system design technical guidance document. Canadian Mine Environment Neutral Drainage Program, Project 1.61.5c, March.

[4] Kane, D. and Yang, D. 2004. Northern Research Basins Water Balance. International Association of Hydrological Sciences. Oxfordshire, United Kingdom.

[5] Pomeroy, J., Hedstrom, N., and Parvianinen., J. 1995. *The Snow Mass Balance of Wolf Creek, Yukon: Effects of Snow Sublimation and Redistribution*. National Hydrology Research Center. Environment Canada: Saskatoon.

Preliminary Estimates of Cover System Performance:

Cover Systems Modelled:

Four reclamation scenarios were evaluated with SPA models (see Figure 1); namely, three cover system types as well as a 'do-nothing' scenario (i.e. bare waste rock with no revegetation effort). A description of the modelled scenarios is as follows:

- *Type 1a – Very Low Net Percolation Cover System:* 0.3 m of compacted silty-clay material underlying a 1.0 m well-graded local soil layer. Surface re-graded to promote runoff, then revegetated with native plants;
- *Type 1b – Lower Net Percolation Cover System:* 0.3 m well-graded local soil layer. Surface re-graded to promote runoff, then revegetated with native plants;
- *Type 3 – Revegetation Cover System:* direct seeding of waste rock to promote revegetation (assumes sufficient fines content to support plant growth). Scarifying and contouring of surface to promote vegetation and enhance physical stability of landform.
- *Type 4 – Bare Waste Rock Surface:* no cover system or site preparation.

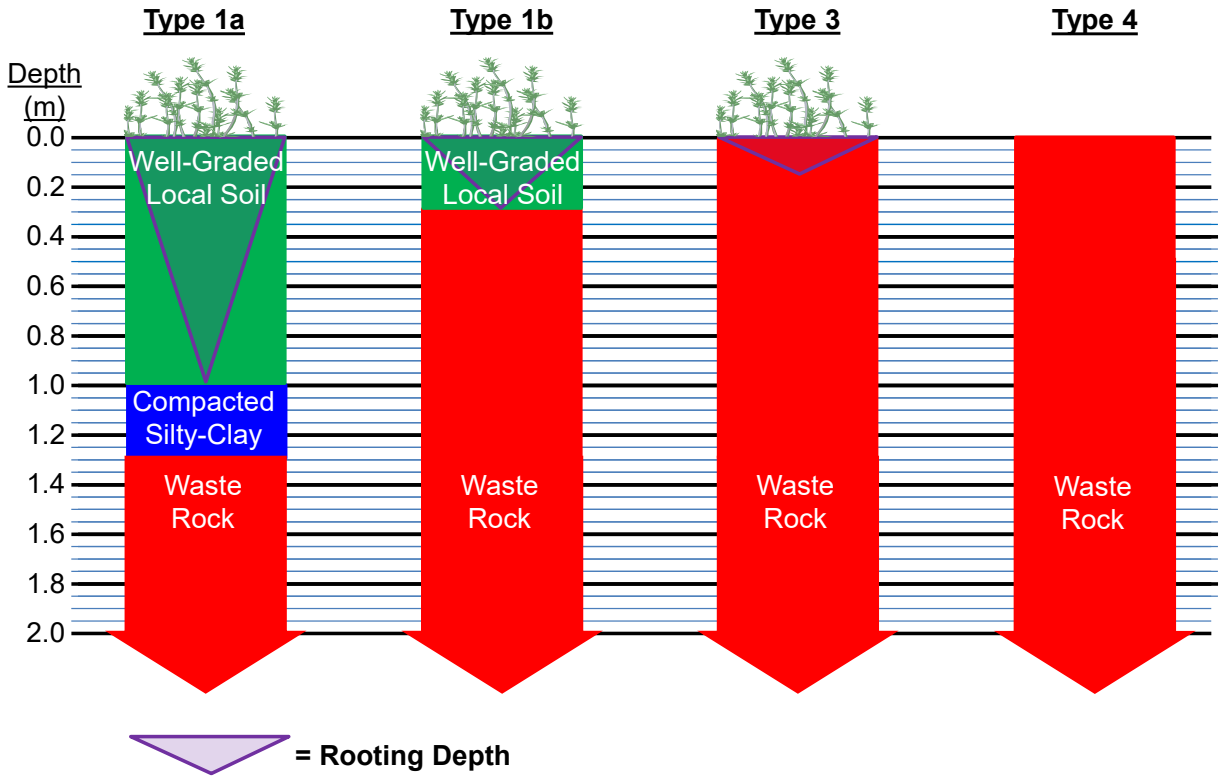


Figure 1 Schematic of four reclamation scenarios modelled for possible closure of WRSAs.

OKC was provided with particle size distribution (PSD) data for various potential borrow materials for cover system construction as well as waste rock materials. For the current SPA modelling program, OKC focused on PSD data for soil samples collected at the Husky site. OKC developed estimates of hydraulic material properties for a growth medium layer based on the following PSD, with the range of percentages for each particle size provide in parentheses:

- Gravel, cobbles, and boulders: 29% (13 to 36%);
- Sand: 32% (26 to 40%);
- Silt: 30% (18 to 40%); and
- Clay: 9% (6 to 14%).

A growth medium layer with the above average PSD is ideal for supporting plant growth as well as storing and releasing meteoric waters back to the atmosphere. However, a growth medium layer with a 39% fines content (i.e. material finer than 0.075 mm) could be susceptible to higher, and potentially unacceptable, rates of erosion and frost action, both of which could result in higher rates of net percolation. Frost action may not be an issue given the drained nature of most WRSAs and thus limited water supply in the subsurface to generate frost action. Nonetheless, some caution is required when evaluating potential borrow sources within or near the KHSD site for WRSA cover system construction; ideally, growth medium layers would consist of well-graded glacial till material with a fines content in the range of 20 to 35%.

Key Inputs and Assumptions:

The inputs into a SPA model can be divided into five categories; namely, geometry, lower and edge boundary conditions, initial conditions, material properties, and upper boundary conditions.

All the models simulated a one-metre-wide column of waste rock overlain with one of the four reclamation scenarios described above. The base of the waste rock was simulated as a unit hydraulic gradient, with the edges of the models simulated as no flow boundaries (i.e. no lateral flows) to simulate a one-dimensional (1D) system. The initial model profiles were started at a constant pressure head of -2 m. Waste rock below a depth of 1.5 m was set at a constant temperature of 2°C so that permafrost would not form in the models. It is presumed that discontinuous permafrost exists at some locations on the KHSD site, particularly at higher elevations and for north-facing slopes; hence, net percolation rates estimated by the SPA models and presented herein are conservative for areas with discontinuous permafrost.

Three materials were defined for SPA modelling; namely, waste rock, well-graded local soil, and compacted silty-clay soil. The required properties or functions for each material are as follows:

- water retention curve (WRC - suction versus volumetric water content);
- hydraulic conductivity function (k-function - suction versus hydraulic conductivity);
- thermal conductivity function (volumetric water content versus thermal conductivity); and
- volumetric specific heat function (volumetric water content versus volumetric specific heat).

Hydraulic properties (i.e. WRCs and k-functions) for each of these materials were estimated by comparing previously measured PSDs and other geotechnical properties to materials in the SoilVision[6] and OKC material databases with similar geotechnical and known hydraulic properties. The hydraulic properties from the databases were compared with those previously measured for each material and found to be similar. Each material was then defined using the van Genuchten[7] or Durner[8] method. A summary of the hydraulic properties estimated for the three materials is provided in Table 1. The thermal properties were estimated using modules included in the VADOSE/W software.

[6] SoilVision Systems Ltd., 2005. Software. SoilVision 4.23. www.soilvision.com
[7] van Genuchten, M. Th., A closed-form equation for predicting the hydraulic conductivity of unsaturated soils, Soil Sci. Soc. Am. J., 44, 892-898, 1980.
[8] Durner, W., Hydraulic conductivity estimation for soils with heterogeneous pore structure, Water Resour. Res., 32(9), 211-223, 1994.

Table 1
Summary of key properties for materials included in the SPA modelling program.

Material Type	k_{sat} (cm/s)	Porosity (m^3/m^3)	Residual VWC (m^3/m^3)	Van Genuchten or Durner parameters							
				w1	a1 (cm^{-1})	n1	m1	w2	a2 (cm^{-1})	n2	m2
Waste rock	$1.0X10^{-1}$	0.28	0.0	0.5	1.0	1.35	0.26	0.5	20	4.0	0.75
Well-graded local soil	$5.0X10^{-5}$	0.33	0.0	-	$3X10^{-4}$	1.25	0.20	-	-	-	-
Compacted silty-clay	$1.0X10^{-7}$	0.40	.0.0	-	$1X10^{-4}$	1.15	0.13	-	-	-	-

The upper boundary conditions can be divided into two parts: climate and vegetation. To define the climate for KHSD, a synthetic 80-year climate database was developed by comparing measurements from the Galena Hill weather station (also referred to as the Calumet weather station) to measurements taken at the Environment Canada weather station in Mayo, YT, between 2007 and 2012. Based on this comparison, the Mayo climate data from 1934 to 2012 were adjusted to represent conditions at Galena Hill. Climate data from Galena Hill were also compared to the Valley Tailings and Flame and Moth weather stations to determine additional variations required to account for elevation. These comparisons indicated that only precipitation needed to be varied with elevation using the linear relationship provided in the conceptual model section. Finally, potential evaporation rates were estimated for three slope aspects (i.e. north, south, and middle aspect). Table 2 provides the monthly average climate estimated for the KHSD site.

Table 2
Monthly average values for the 80-year synthetic climate database developed for the KHSD site.

Month	Temperature (°C)		RH (%)	Precipitation (mm) for each Elevation (masl)			Wind Speed (m/s)	Potential Evapotranspiration (mm) for each Aspect		
	High	Low	%	750	1,000	1,250		North	Middle	South
January	-22	-26	80	27	32	37	1.6	0	0	0
February	-16	-21	79	23	27	31	1.8	0	0	0
March	-8	-15	76	21	24	28	2.3	0	0	0
April	2	-3	73	19	23	26	2.3	0	5	10
May	10	4	64	29	34	40	2.2	30	70	100
June	16	9	70	41	49	56	1.8	40	95	140
July	17	10	73	51	60	69	1.8	40	100	150
August	14	7	77	48	56	65	1.8	30	70	105
September	7	2	79	39	46	53	1.6	10	30	50
October	-3	-5	84	34	40	46	1.6	0	0	5
November	-15	-17	85	30	35	41	1.6	0	0	0
December	-21	-24	83	28	34	39	1.0	0	0	0
Annual	*-1*	*-7*	*77*	*390*	*460*	*530*	*1.8*	*150*	*370*	*560*

Vegetation was simulated as grasses and shrubs, with each growing season starting seven days following spring-melt and ending when daily low air temperatures consistently stay below 0°C. The vegetation was simulated as having a rooting depth the thickness of the well-graded local soil layer or 0.15 cm for the bare waste rock scenario. The vegetation was estimated to have a maximum ground cover of 50%. Vegetation was assumed to have its transpiration rate limited when the suction within the growth material increased above 100 kPa. Transpiration was estimated to cease when suction conditions in the growth material increased above 1,500 kPa.

Key Modelling Results:

Tables 3 provides average annual, long-term water balance fluxes for all the model scenarios completed for this project. All modelling completed for this project used the computer modelling program VADOSE/W[9]. The estimated net percolation rates are summarized in Figure 2. It must be emphasized that the values provided in Table 3 and Figure 2 are averages; the components of the water balance will vary greatly from year-to-year, and during any given year. For example, RO averages 175 mm/yr for the Type 1a cover system at 1,000 masl, but ranges from 40 to 360 mm/yr with most of the RO occurring during spring-melt.

Practical Construction Issues for Consideration:

The current stage of this project is to provide conceptual or indicative-level design details for reclamation of the KHSD WRSAs. However, based on OKC's experience with cover system design and performance in cold regions, the following guidelines are provided for consideration as the state of the WRSA closure cover system designs progresses:

- Avoid north-facing slopes to the greatest extent possible due to higher available waters for net percolation.
- Different moisture regimes will exist on south and north slopes; therefore, use natural analogues at site to determine revegetation plans for different slope aspects.
- North slopes should be steeper than south slopes to promote additional runoff and thus reduce net percolation; however, this needs to be balanced against the potential for soil erosion.
- Drainage channels, particularly bench / lateral channels, should be avoided on north slopes to the greatest extent possible due to higher potential for glaciation (this is the formation of ice features in a drainage course as defined in MEND (2012)).
- Plateau catchments should not drain to the north to avoid potential effects of glaciation.
- Coarser-textured materials are preferred on north slopes to reduce potential for solifluction (i.e. silts and clays are more prone to solifluction due to higher water retention).

[9] Geo-Slope International Ltd. 2014. GeoStudio 2012. Version 8.14.1.10087. Online. www.geo-slope.com.

Table 3
Summary of average annual water balance fluxes for 80-year model scenarios.

Aspect	Elevation / PPT (masl / mm/yr)	Reclamation Scenario	Water Balance Flux as Percent of PPT (mm/yr in brackets)			
			Sub	RO	AET	NP
North	750 / 390	1a	5% (60)	30% (117)	33% (130)	21% (83)
		1b	16% (61)	5% (21)	33% (128)	46% (180)
		3	16% (61)	1% (4)	32% (126)	51% (199)
		4	16% (61)	1% (4)	27% (105)	56% (220)
	1,000 / 460	1a	14% (62)	38% (175)	27% (125)	21% (98)
		1b	14% (62)	4% (20)	27% (124)	55% (254)
		3	14% (62)	1% (4)	26% (122)	59% (272)
		4	13% (61)	1% (3)	22% (103)	64% (293)
	1,250 / 530	1a	12% (61)	45% (241)	22% (119)	20% (109)
		1b	12% (62)	4% (20)	22% (118)	62% (329)
		3	12% (62)	1% (4)	22% (116)	66% (347)
		4	12% (62)	1% (4)	19% (100)	69% (364)
Middle	750 / 390	1a	16% (61)	9% (35)	73% (283)	3% (12)
		1b	16% (61)	3% (10)	67% (261)	15% (58)
		3	16% (61)	1% (3)	57% (221)	27% (105)
		4	16% (61)	1% (3)	51% (199)	33% (128)
	1,000 / 460	1a	14% (62)	18% (84)	62% (285)	6% (29)
		1b	14% (62)	3% (13)	58% (269)	25% (117)
		3	14% (62)	1% (3)	50% (228)	36% (167)
		4	14% (62)	1% (3)	44% (204)	41% (191)
	1,250 / 530	1a	12% (63)	27% (141)	53% (278)	9% (48)
		1b	12% (62)	3% (15)	50% (266)	35% (186)
		3	12% (62)	1% (4)	43% (230)	44% (234)
		4	12% (62)	1% (4)	39% (206)	49% (258)
South	750 / 390	1a	16% (61)	5% (19)	78% (306)	1% (4)
		1b	16% (61)	2% (10)	73% (284)	9% (35)
		3	16% (61)	1% (3)	63% (244)	21% (82)
		4	16% (61)	1% (3)	57% (224)	26% (103)
	1,000 / 460	1a	14% (62)	10% (46)	74% (341)	2% (11)
		1b	14% (62)	2% (10)	67% (305)	18% (83)
		3	14% (62)	1% (3)	56% (257)	30% (138)
		4	14% (62)	1% (3)	51% (236)	35% (159)
	1,250 / 530	1a	12% (62)	18% (95)	67% (356)	3% (16)
		1b	12% (62)	2% (10)	61% (322)	25% (135)
		3	12% (62)	1% (4)	50% (265)	38% (199)
		4	12% (62)	1% (3)	46% (244)	42% (220)
Conceptual Model*			10% - 15%	0% - 20%	40% - 60%	5% - 50%

*Conceptual model is based on general water balances for the area; hence, more comparable to middle aspects.

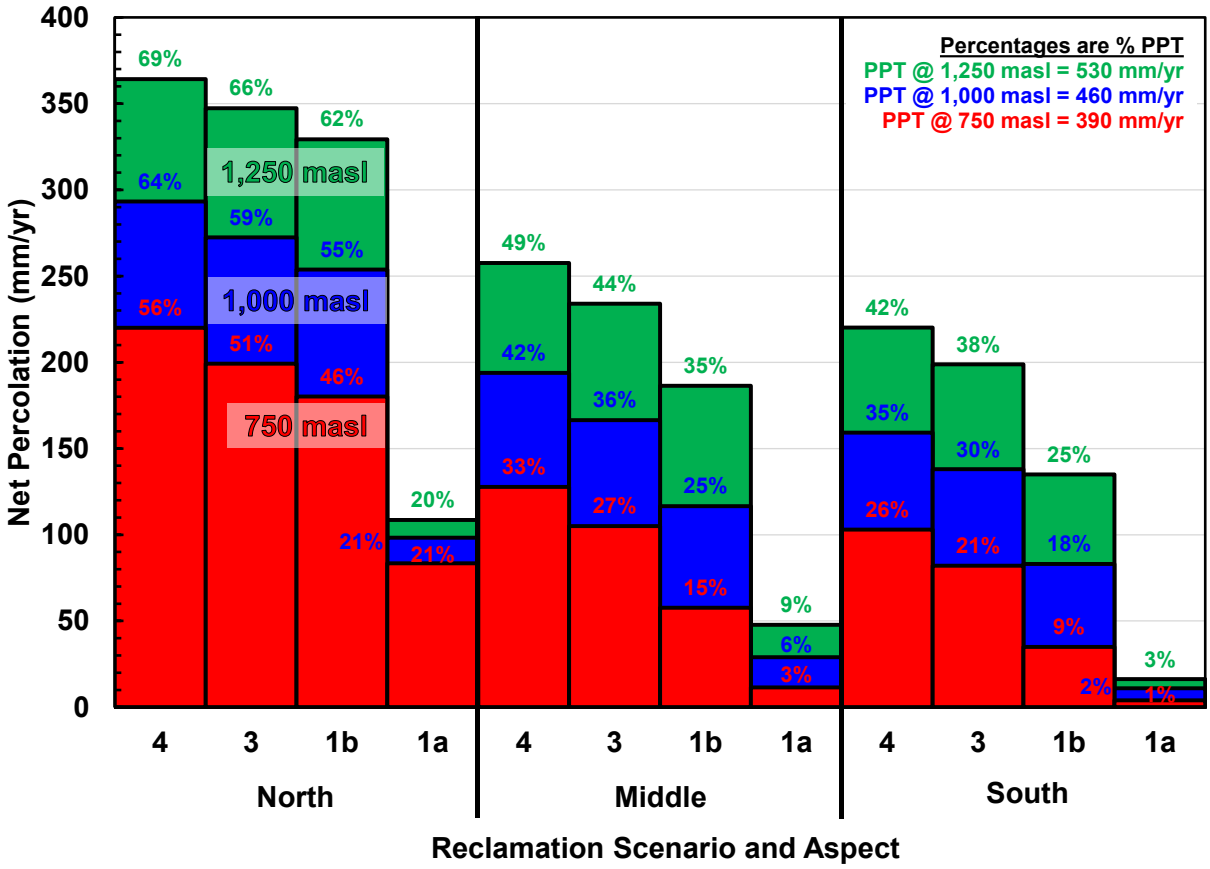


Figure 2 Annual average net percolation rates estimated for range of reclamation scenarios, elevations, and slope aspects.

The following issues should be taken into consideration when developing final landforms for larger WRSAs:

- The maximum slope recommended to support construction and long-term sustainability of a barrier layer such as a compacted silty-clay layer is 3H:1V.
- Slopes to support a simpler cover system can be steeper (e.g. range of 2H:1V to 2.5H:1V), but the potential for soil erosion to occur should be considered, which is generally a function of slope length, vegetation type and time to establishment, rainfall intensities, and texture of surface material.
- Concave slopes are preferred over linear slopes, and most definitely over a benched-landform slope profile.
- Upper slopes can be steeper and coarser-textured, while lower slopes can be flatter and finer-textured, if material availability / balancing requires this flexibility.
- A cover system profile can be thinner in upper slopes, but must be thick enough to support growth of the anticipated climax vegetation species.
- Plateau surface waters must never be allowed to discharge over the crest of a slope without a properly engineered channel.
- A common location for failure of drainage channels is where plateau channels transition to slope channels; an intermediate-slope is recommended at these locations with additional riprap protection.

Closure:

Thank you for the opportunity to assist AEG with closure planning at the KHSD site. Please do not hesitate to contact the undersigned should you have any questions or comments.

Sincerely yours,

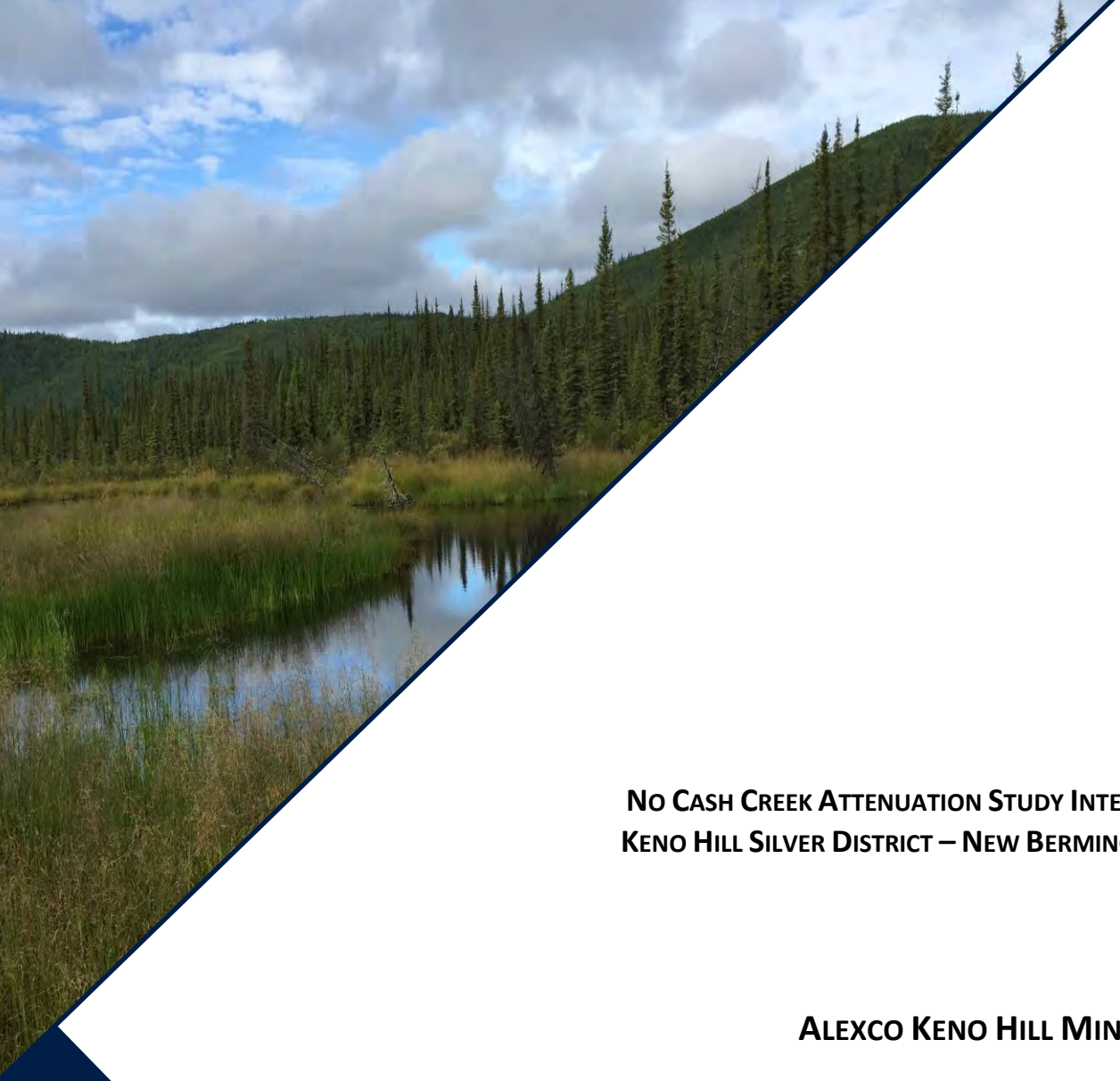


Brian Ayres, M.Sc., P.Eng.
Senior Geotechnical Engineer / Chief Operating Officer

cc: Linda Broughton – Alexco Environmental Group
Robert Shurniak and Mike O'Kane – O'Kane Consultants Inc.

APPENDIX 1.8

NO CASH CREEK ATTENUATION STUDY INTERIM REPORT



NO CASH CREEK ATTENUATION STUDY INTERIM REPORT
KENO HILL SILVER DISTRICT – NEW BERMINGHAM MINE

Prepared for:

ALEXCO KENO HILL MINING CORP.

Date:

March 6, 2025

ENSERO solutions

ENSERO SOLUTIONS CANADA, INC. SIGNATURES

Report prepared by:  3/6/2025

Collin Burelle
Scientist

Report reviewed by:  3/6/2025

Andrew Gault, PhD
Practice Lead – Geochemistry

EXECUTIVE SUMMARY

Attenuation studies previously conducted in the No Cash Creek catchment area have shown significant reduction of metals such as cadmium, manganese, and zinc along flow path from the No Cash 500 adit discharge. The decreases were attributed to various attenuation mechanism including precipitation of iron and manganese oxides/hydroxides, coprecipitation of metals, and adsorption (Interralogic, 2012). Also, water quality modelling work performed to support the New Bermingham Mine assumed natural attenuation of 50% for selected constituents (arsenic, silver, copper, nickel, lead, and ammonia) between the water treatment plant discharge location and No Cash Creek (AEG 2019) based on those previous studies.

The No Cash Creek Attenuation Study Plan (AEG, 2018) was undertaken to satisfy a recommendation issued by the Yukon Government under term 5 of the New Bermingham Mine Yukon Environmental and Socio-economic Assessment Decision Document 2017-0176. Yukon Environmental and Socio-Economic Assessment Board recommended the implementation of a study to monitor the mechanism of natural attenuation of constituents of the discharge and surface water in the No Cash Creek catchment following the initiation of the New Bermingham Mine water treatment plant. Additionally, this interim report has been prepared to satisfy Clauses 40 and 119 e) of Water Licence QZ18-044 that requires interim results to be provided as part of the annual report.

The ultimate aim of the study is to better understand the mechanism of natural attenuation along the 1,500 m proposed discharge pathway from the New Bermingham Mine discharge and headwaters of No Cash Creek to verify the assumptions made during the water quality modelling studies conducted for the No Cash Creek. This report presents the initial site characterization results along the expected flow path between the New Bermingham discharge and No Cash Creek upper catchment area.

Twenty-one surficial soil samples were collected along the discharge channel between the New Bermingham discharge location and the upper catchment area of No Cash Creek to assess the potential for natural attenuation mechanisms related to soil conditions along the flow path. The soil testing program included the determination of physical, chemical, and microbiological characteristics of the soil samples. The program also included the collection of moss samples from six sites along the discharge channel for metals analysis and the sampling of baseline surface water and groundwater water quality.

The soil samples consisted mostly of silt (twelve samples), silty loam (five), and gravel (one sample) with various proportions of clay and sand comprising the remainder of soil. The combined silt and clay contents are predicted to result in large surface areas favourable for metal adsorption or cation exchange processes with the discharged water.

The study site had a low organic matter content (median of 13.3%) that do not reflect the most favorable conditions for sorption, immobilization and attenuation of metals but will offer some level of attenuation.

The soil pHs were acidic to mildly acidic (median pH 5.4) with only one neutral soil pH reflecting an environment impacted by the weathering products of local mineralization. The soil pH conditions of the first two thirds of the channel do not constitute an optimum environment for the precipitation of oxide or hydroxides, however, the soil pH values were higher than the point zero charge pH of most clay minerals which are conducive for the retention of metals cations by variable surface charge clays.

The study site had a median soil moisture content of 48% indicative of a moderate water holding capacity favourable for the development of vegetation cover, peaty and organic-rich surficial materials along the discharge channel which will promote natural attenuation.

Results of the 2023 synoptic sampling event along the New Bermingham water treatment plant (WTP) discharge corridor, suggest little to no natural attenuation along the flow path. Water quality along the discharge corridor was similar along the flow path, however, elevated cadmium and zinc concentrations at the end of the flow path may result from influence of the Ruby 400 adit discharge. Accumulation of total metals in the sediments was likely low due to the short duration of the WTP discharge to date and the low concentrations of metals in the discharge.

Tessier sequential extractions and analysis was conducted in 2023 on three soil samples collected along the discharge channel to assess the fractionation of sequestered metals in exchangeable/sorbed phases, carbonate bound phases, easily reducible phases, organic/sulphide bound phases, and residual phases within the soil matrix. Most of the identified COPIs had a large association with the reducible phase, likely associated iron and/or manganese oxyhydroxides. Cadmium and zinc also showed some associated with the carbonate extraction fraction while copper was largely associated with the organic matter extraction step.

Microbial profiling identified the presence of microorganisms capable of mediating sulphur redox transformations, indicating the potential exists for long-term metal sequestration via sulphide mineral precipitation. The marshy and organic matter rich environment will favor the development of sulphate-reducing conditions under which chalcophile metals may be sequestered as sulphide mineral assemblages. These soil data indicate conditions favourable for natural attenuation of metal(loid)s in the treatment discharge along the proposed discharge corridor.

The moss samples had different metal contents depending on their location along the discharge channel. Vegetation material in the most downstream moss sampling site (BM-NAT-18) had the highest concentration of arsenic, cadmium, iron, manganese, copper, nickel, lead, and zinc and the vegetation located in the area closest to the New Bermingham discharge location had the lowest. The elevated metals concentrations in the BM-NAT-18 moss was likely caused by soil residue left in the sample after washing during sample preparation.

The concentration of arsenic, cadmium, copper, nickel, ammonia-N, selenium, and zinc in the New Bermingham adit discharge (station KV-110) increased during early monitoring (July 2007 to August 2018), in the second half of 2020 (June to December 2020: arsenic, ammonia-N, and selenium only), and again in 2021 (arsenic, ammonia-N, nickel and selenium only) due to mine development activities. Average concentrations for 2024 generally remained similar to 2021-2023 concentrations for these parameters; however, cadmium and zinc concentrations declined in 2024.

Surface water monitoring data indicate circumneutral pH and oxic conditions at most of the monitoring stations. The water quality at the New Bermingham WTP discharge (KV-110) was often better or comparable to the water quality at KV-118 (upper No Cash Creek at Calumet Drive) except for arsenic, nickel, selenium, and ammonia-N and lead which historically exhibit higher concentrations at KV-110 than KV-118 for the same period. This means that the WTP discharge from the New Bermingham Mine will contribute to improving water quality in upper No Cash Creek waters except during the isolated periods of seasonal peak concentrations. It was also noted that the water quality at KV-111 (No Cash Creek above the No Cash 500 adit) was largely better than KV-118 (except for copper and sulphate, which historically increase from KV-118 to downstream KV-111) suggesting that attenuation and/or dilution mechanism are occurring along the upper No Cash Creek reach.

Past water quality modelling performed for the New Bermingham Mine included a 50% attenuation term for silver, arsenic, copper, nickel, lead, and ammonia for the ~2 km flow path between the New Bermingham pond decant (KV-114) and station KV-21 on No Cash Creek. Additionally, inputs from Bermingham 200 Adit and/or Ruby 400 Adit may seasonally influence the chemistry in Upper No Cash Creek while the No Cash 500 Adit is the primary source of constituent loading to KV-21. Due to the contributions from Ruby 400 Adit into No Cash Creek, low concentrations of ammonia, lead, nickel, and silver at KV-118 and KV-111, and generally low concentrations from the WTP discharge

(KV-114), it is complicated to quantify the extent of attenuation between KV-118 and KV-111. In 2024, four years after discharge from the New Bermingham decant pond began, the decrease in arsenic and copper concentrations (of the 50% attenuation term parameters) along the flow path from Upper No Cash Creek to downstream No Cash Creek were less than that calculated from dilution alone based on the change in sodium concentrations, which is assumed to behave conservatively. The decrease in ammonia, lead, nickel, and silver concentrations were likely due to a combination of dilution and attenuation based on concentration decreases greater than observed for sodium. Additionally, ammonia and dissolved arsenic concentrations measured in the WTP discharge (KV-114) were one-three orders magnitude higher than those measured at KV-118 and KV-111, suggesting attenuation along the discharge corridor or that the New Bermingham Mine discharge does not have a significant influence on ammonia and arsenic concentrations in No Cash Creek.

Local groundwater monitoring data (historical and 2024 data) indicate sub-oxic to oxic, circumneutral pH, and low salinity groundwater. The data also show recurrent or occasional exceedances of Yukon Contaminated Sites Regulation standards for pH (RB-MW-1 and KV-116), arsenic (RB-MW-1) and cadmium (RB-MW-1 and KV-116) in site monitoring wells. . Investigation of the groundwater quality between the Ruby and No Cash monitoring wells indicate that the groundwater system is complex. Although there are many similarities between the wells for parameters such as ORP, pH, cadmium, etc. there are also large differences in other metals concentrations that cannot be ascribed to a simple geochemical process or common groundwater source. It is likely that a combination of hydrogeological processes, such as dilution, attenuation and/or oxidation/reduction, may be impacting the geochemical evolution of groundwater between New Bermingham and the No Cash 500 adit.

TABLE OF CONTENTS

EXECUTIVE SUMMARY II

TABLE OF CONTENTS V

LIST OF TABLES 1

LIST OF FIGURES 2

LIST OF APPENDICES 3

1 INTRODUCTION 4

1.1 BACKGROUND AND OBJECTIVES OF THE STUDY 4
1.2 SCOPE 4
1.3 BACKGROUND ON NATURAL ATTENUATION 5
1.4 IMPACT OF BENTONITE ON NATURAL ATTENUATION 5

2 SITE LOCATION 7

3 DATA COLLECTION AND TESTING 10

3.1 SOIL BIOGEOCHEMISTRY 10
3.1.1 Soil Sampling and Testing *10*
3.1.2 Sequential Extractions *11*
3.1.3 Soil Microbiology *12*
3.2 VEGETATION (MOSS) 12
3.3 WATER QUALITY 13
3.4 QUALITY ASSURANCE AND QUALITY CONTROL 14

4 RESULTS 17

4.1 SOIL GEOCHEMISTRY 17
4.1.1 Paste pH *17*
4.1.2 Moisture Content *18*
4.1.3 Texture *19*
4.1.4 Organic Matter Content *19*
4.1.5 Metal Content *20*
4.2 2023 SYNOPTIC SAMPLING 27
4.2.1 Water Quality *27*
4.2.2 Sediment Quality *28*
4.2.3 Sequential Extraction *28*
4.3 SOIL MICROBIOLOGY 34
4.4 VEGETATION (MOSS) 37
4.5 WATER QUALITY 40
4.5.1 Surface Water Quality *40*
4.5.2 Groundwater Water Quality *64*

5 CONCLUSIONS 75

6 NEXT STEPS 78

7 REFERENCES 79

LIST OF TABLES

Table 3-1: Description of Soil Samples 11

Table 3-2: Description of Moss Samples....13

Table 3-3: Field Duplicate 2022 Results – Analytes Detected above the PQL for KV-21 15

Table 4-1: Results of Physical and Geochemical Tests of Soil Samples 22

Table 4-2: Results of Physical and Geochemical Tests of Soil Samples 24

Table 4-3: Keno Hill Silver District Background Average Concentration of Soil (CanNorth, 2018) 26

Table 4-4:Dissolved Metals Concentrations in Water Collected Along New Bermingham Decant Pond Discharge Corridor....27

Table 4-5: Metals Concentrations in Sediment Collected Along New Bermingham Decant Pond Discharge Corridor 28

Table 4-6: Results of Tessier Sequential Extraction of Soil Sample BM-23-NAT-2 (WTP Flow Path)....31

Table 4-7: Results of Tessier Sequential Extraction of Soil Sample BM-23-NAT-3-RB (right bank background station) 32

Table 4-8: Results of Tessier Sequential Extraction of Soil Sample BM-23-NAT-4 (WTP Flow Path)....33

Table 4-9: Abundance of Bacteria Identified to the Genus Level in Transect Soil Samples 34

Table 4-10: Identification and Abundance of Known Sulphide-producing Bacteria in Soil Samples....36

Table 4-11: Results of Elemental Analysis of Moss Samples 38

Table 4-12: Dissolved Silver Statistics at Monitoring Stations, 2008-2023 Data 44

Table 4-13: Dissolved Arsenic Statistics at Monitoring Stations, 2008-2023 Data 46

Table 4-14: Dissolved Cadmium Statistics at Monitoring Stations, 2008-2023 Data 48

Table 4-15: Dissolved Copper Statistics at Monitoring Stations, 2008-2023 Data 50

Table 4-16: Dissolved Lead Statistics at Monitoring Stations, 2008-2023 Data 52

Table 4-17: Nickel at Monitoring Stations, 2008-2023 Data 54

Table 4-18: Dissolved Selenium Statistics at Monitoring Stations, 2008-2023 Data 56

Table 4-19: Dissolved Zinc Statistics at Monitoring Stations, 2008-2023 Data 58

Table 4-20: Dissolved Sulphate Statistics at Monitoring Stations, 2009-2023 Data....60

Table 4-21: Dissolved Ammonia-N Statistics at Monitoring Stations, 2014-2023 Data 61

Table 4-22: Dissolved Arsenic in Groundwater Monitoring Wells, 2013-2023 Data 69

Table 4-23: Dissolved Cadmium in Groundwater Monitoring Wells, 2013-2023 Data 69
Table 4-24: Dissolved Copper in Groundwater Monitoring Wells, 2013-2023 Data 70
Table 4-25: Dissolved Selenium in Groundwater Monitoring Wells, 2013-2023 Data 70
Table 4-26: Dissolved Sulphate in Groundwater Monitoring Wells, 2013-2023 Data 71

LIST OF FIGURES

Figure 2-1: New Bermingham Natural Attenuation Study Area 8
Figure 2-2: 2023 Synoptic Sampling Event 9
Figure 4-1: Soil Paste pH Profile Along the Discharge Channel 18
Figure 4-2: Moisture Content of Soil Along the Discharge Channel 19
Figure 4-3: Quantity of Sulphate-reducing Bacteria in Soil Samples 35
Figure 4-4: Field pH at Monitoring Stations, 2017-2023 Data 41
Figure 4-5: Field ORP at Monitoring Stations, 2017-2023 Data 42
Figure 4-6: Dissolved Silver at Monitoring Stations, 2017-2023 Data 43
Figure 4-7: Dissolved Arsenic at Monitoring Stations, 2017-2023 Data 45
Figure 4-8: Dissolved Cadmium at Monitoring Stations, 2017-2023 Data 47
Figure 4-9: Dissolved Copper at Monitoring Stations, 2017-2023 Data 49
Figure 4-10: Dissolved Lead at Monitoring Stations, 2017-2023 Data 51
Figure 4-11: Dissolved Nickel at Monitoring Stations (Total Nickel at KV-110 and KV-114), 2017-2023 Data 53
Figure 4-12: Dissolved Selenium at Monitoring Stations, 2017-2023 Data 55
Figure 4-13: Dissolved Zinc at Monitoring Stations, 2017-2023 Data 57
Figure 4-14: Dissolved Sulphate at Monitoring Stations, 2017-2023 Data 59
Figure 4-15: Dissolved Ammonia-N at Monitoring Stations, 2017-2023 Data 61
Figure 4-16: Field pH and ORP of Groundwater Monitoring Wells, 2017-2023 Data 66
Figure 4-17: Dissolved Arsenic, Cadmium, Copper, and Nickel of Groundwater Monitoring Wells, 2017-2023 Data 72
Figure 4-18: Dissolved Lead, Selenium, Silver, and Zinc of Groundwater Monitoring Wells, 2017-2023 Data 73
Figure 4-19: Dissolved Sulphate and Ammonia of Groundwater Monitoring Wells, 2017-2023 Data 74

LIST OF APPENDICES

Appendix A: Laboratory Analytical Reports – Soil and Moss Geochemical and Microbiological, and Surface Water Quality Data

1 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES OF THE STUDY

Under term 5 of the New Bermingham Mine Yukon Environmental and Socio-economic Assessment Board (YESAB) Decision Document 2017-0176, YESAB recommended the implementation of a study to monitor the mechanism(s) of natural attenuation of discharge and surface water constituents in the No Cash Creek catchment following the initiation of the New Bermingham water treatment plant (WTP) and verify the assumptions of attenuation used in modelling studies.

Past investigations on natural attenuation mechanisms in the Keno Hill Silver District (KHSD) have documented significant metal(loid) attenuation along groundwater and surface water flow paths, (AEG, 2011; Interralogic, 2010; 2012; Kwong et al., 1994; 1997; SRK, 2009). Attenuation studies conducted in the No Cash Creek catchment area have shown a modest reduction of sulphate and significant decrease of cadmium, manganese, and zinc along the flow path from the No Cash adit discharge. The authors attributed these metal reductions to various attenuation mechanisms including precipitation of iron and manganese oxides/hydroxides, co-precipitation of metals, and adsorption (Interralogic, 2012). Water quality modelling performed to support the New Bermingham mine assumed a natural attenuation rate of 50% for selected constituents (arsenic, silver, copper, nickel, lead, and ammonia) between the WTP discharge location and No Cash Creek (AEG, 2019).

The aim of the No Cash Creek Attenuation Study is to better understand the mechanism(s) of natural attenuation along the 1,500 m discharge pathway from the New Bermingham decant pond (KV-114) and headwaters of No Cash Creek (KV-111) as discussed in the study plan (AEG, 2018) and verify the assumptions of attenuation extent made in the water quality modelling studies conducted for the No Cash Creek environment (AEG, 2019).

Like elsewhere in the KHSD, it is predicted that the concentration of several metal(loid)s and constituents in the New Bermingham WTP discharge are likely to decrease due to biogeochemical processes, exchanges with soil and vegetation or mixing with groundwater and surface water along the discharge corridor. These biogeochemically driven changes may include the removal of metal(loids) and other constituents through direct precipitation, co-precipitation by various oxides/hydroxides (e.g., iron, aluminum, manganese), adsorption onto mineral and organic matter, and uptake by vegetation.

This interim report describes the physio-chemical and microbiological characteristics of the environment of the flow path between the WTP discharge location and headwaters of No Cash Creek, over which metal(loids) attenuation is assumed to occur and include baseline data collected before the discharge was initiated.

1.2 SCOPE

The scope of the study includes:

- Characterization of the site prior to WTP operation by collecting baseline data for parameters that influence or impact the flow of the discharge water and changes of its chemistry from the discharge location to No Cash Creek headwater. These baseline data include:
- Identification of physical and landcover (i.e., vegetation) characteristics of the site;
- Determination of the type, composition, geochemical and microbiological characteristics of soil along proposed flow path;

- Up to 14-years of available surface water records at the following monitoring stations: KV-18, KV-19, KV-20, KV-21, KV-110, KV-111, KV-114, and KV-118;
- Determination of existing metal content of moss along the flow path; and
- Document existing groundwater quality from wells BH-MW-1, RB-MW-1, NC-MW-1, and KV-116.
- Analysis and interpretation of data, and the assessment of attenuation mechanism to confirm the assumptions made in earlier studies; and
- Assess the potential changes of water quality along the flow path after the commissioning of the New Bermingham WTP since September 2020.

1.3 BACKGROUND ON NATURAL ATTENUATION

Natural attenuation is a combination of physical, geochemical, and/or biological processes that naturally reduce the mass, toxicity, mobility, or concentration of contaminants in soil or groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation or reduction of contaminants (EPA, 1999), and metal precipitation. Soil conditions, solution pH, redox potential, soil composition particularity the oxide and clay contents, moisture, organic matter content play significant roles in natural attenuation mechanisms.

When the solution pH is circumneutral or slightly acidic, cationic metal species can precipitate as hydroxide, oxyhydroxide, or hydroxy-sulphate minerals (Nordstrom, 1982). Under these pH conditions, dissolved metals may adsorb onto surfaces of these amorphous minerals and/or other surfaces present in the environment, such as clays and organic matter due to decreasing competition with protons, and increased hydrolysis of metal ions at circumneutral pH (Richard, 2007).

Microorganism such as sulphate-reducing bacteria (SRB) can attenuate the migration of metals in the natural environment through the precipitation of chalcophile metals as sulphide minerals following the reduction of sulphate in the presence of organic matter. Characterization of microbiological impacts on natural attenuation processes involves tools that can be used during site characterization. Genetic analyses such as molecular biological methods relying on 16S rRNA gene sequences have been used to identify microbial communities in environmental samples (Richard, 2007).

1.4 IMPACT OF BENTONITE ON NATURAL ATTENUATION

Bentonite clays are mainly composed of montmorillonite; a 2:1 structured phyllosilicate composed of one octahedral sheet located between two tetrahedral sheets. Substitutions inside the structure of lower valence ions for those with higher valance such as substitution of aluminium for silicon in the tetrahedral layer and magnesium for trivalent aluminium in the octahedral layer usually create negative electric charge on the bentonite surface. The overall negative charges on the surface attract cations and confers to clay minerals their important metal sequestration properties.

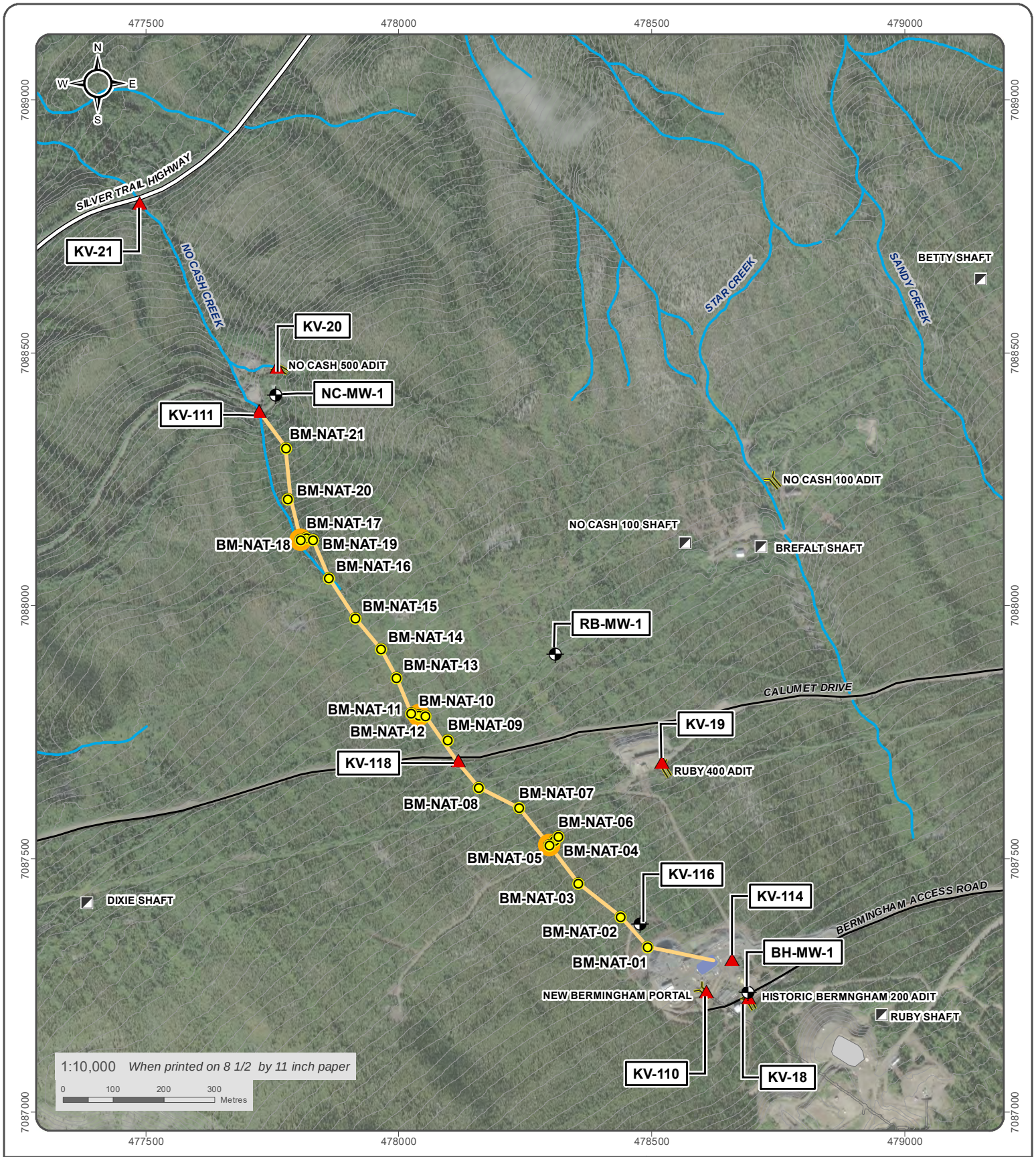
Bentonite clay was used as drilling fluid during exploration activities and bentonite particles can be found mixed with dewatering effluents from the New Bermingham portal as noted by Water Resources Branch during their site inspection in June 10 to 14, 2018 (YG, 2018). Although bentonite particles could create a physical water infiltration barrier, bentonite clay is known for its high metal adsorption capacity and effectiveness for the removal of metals (and organic contaminants) due to its structure, high specific surface area, small particle size and high cation

exchange capacity (Doulia et al., 2009; Khan et al., 2018). Several studies have tested and proved the high adsorption capacity of bentonite (natural and modified) for metals such as lead, cadmium, copper, chromium, nickel, and zinc (Doulia et al., 2009; Khan et al., 2018; Vega et al., 2005) and demonstrated its property as chemical barrier. It is thus expected that bentonite particles mixed with drilling fluids from the New Bermingham portal discharge during the exploration phase likely contributed to metal attenuation on site instead of hindering it.

2 SITE LOCATION

Figure 2-1 shows the location soil and moss sampling along the discharge channel, mine adits and current surface water and groundwater quality monition locations in the study area. The location of the discharge was selected based on engineering examination and assessment of the topography of the site to limit potential erosion of the channel during discharge and maximize constituent removal and attenuation by promoting longer interaction time between the discharge water and the underlying soils matrix and vegetation cover. By siting the discharge over low grade slopes, the precipitates formed in situ will likely remain chemically and physically stable within the discharge area. Figure 2-2 shows the location of soil and water sampling along the WTP discharge channel as part of the 2023 synoptic sampling event.

The vegetation cover within the discharge corridor is characterized by stunted white and black spruce, scrub birch, willow, and Labrador tea. The area has a thick moss cover, which persists throughout the area. The site is homogenous in terms of vegetation cover. In terms of vegetation density, vegetation becomes less dense, and a transition occurs from spruce dominated to willow and birch dominated farther down the hillside. The presence of moss/bog materials is found throughout the discharge corridor.



Location of Soil Sample Collected Sept 4th 2018

Groundwater Monitoring Station

Surface Water Quality Station

Moss Samples Collected on October 06, 2016

Adit

Shaft

Attenuation Study Line

Contours (5m interval)

Waterbody

Watercourse

Satelite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on March 07 2024.
Datum: NAD 83; Projection: UTM Zone 8N

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FIGURE 2-1

BERMINGHAM NATURAL ATTENUATION STUDY AREA

FEBRUARY 2025

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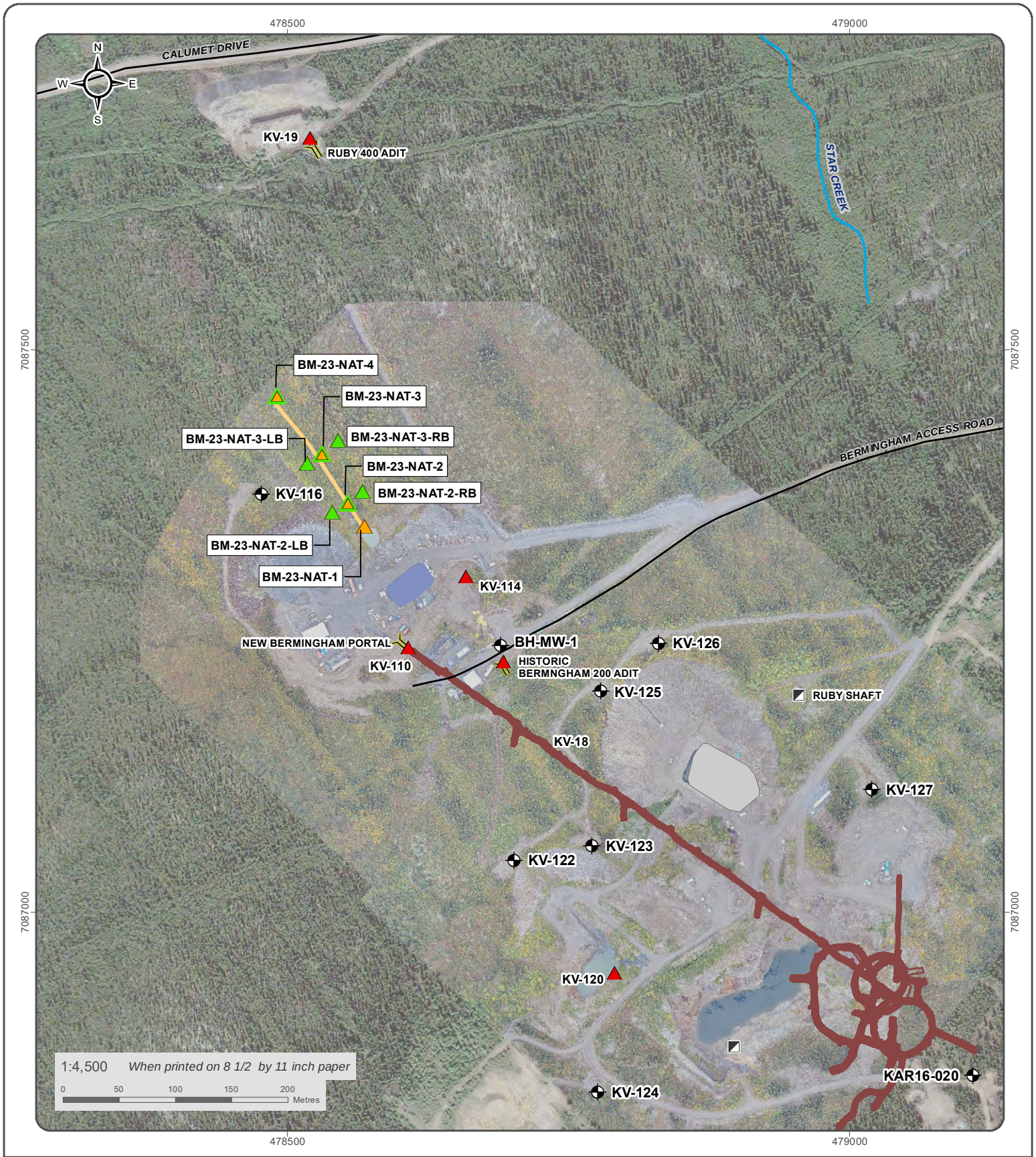

Attenuation Study Water Quality Sample

Attenuation Study Sediment Sample

Attenuation Study Water/Sediment Quality Sample

Surface Water Quality Station

Groundwater Monitoring Station

New Bermingham WTP Discharge Flow Path

Adit

Shaft

Underground Workings, As-Built 2023

Watercourse

Satelite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on March 07 2024.
Datum: NAD 83; Projection: UTM Zone 8N

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FIGURE 2-2

2023 SYNOPTIC SAMPLING EVENT

MARCH 2024

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(Last edited by: amatlashevska; 2024-03-07/15:02 PM)

3 DATA COLLECTION AND TESTING

3.1 SOIL BIOGEOCHEMISTRY

Soil characterization is a fundamental part of investing natural attenuation mechanisms at any given site. The biogeochemical processes controlling the mobility, immobilization, and bioavailability of metal(loid)s and other chemical constituents in the natural environment are in large extent controlled by the type of local soil, its composition, structure, metals and organic matter contents, microbiology, pore water chemistry, soil pH, and redox potential. Soil along the discharge corridor was investigated, sampled, and tested in order assess its potential for natural attenuation.

3.1.1 SOIL SAMPLING AND TESTING

On September 4, 2018, eighteen (18) surficial (top 30 cm) soil samples were collected for geochemical testing from the likely discharge corridor between the New Bermingham decant pond (KV-114) and headwater of No Cash Creek (KV-111). The samples were collected such that they were evenly spaced covering the entire proposed study area. Three additional samples destined for microbial profiling were also collected from the same location as well as three samples collected for geochemical soil testing. The locations of all the twenty-one (21) soil sampling sites are displayed on Figure 2-1 and a description is provided in Table 3-1.

The samples were documented in the field, placed in sealed sampling bags, and submitted to ALS Environmental (Burnaby, BC) for testing. Eighteen samples were analyzed for:

- Moisture content;
- Particle size;
- Paste pH;
- Total organic carbon (TOC); and
- *Aqua regia* digestion followed by multi-element analysis of digestate.

Three samples (BM-NAT-04, BM-NAT-10, and BM-NAT-17) were stored in sterile plastic containers and sent to Ensero's microbiology laboratory (Saskatoon, S.K.) for microbial profiling.

Each of the above analytical methods is briefly discussed below or in the results sections where appropriate.

A sequential extraction test could not be done in 2018 but was conducted on select samples in 2023 as part of a synoptic sampling event in which discharge channel from the New Bermingham WTP sedimentation pond was mapped. On September 17, 2023, seven surficial soil samples were collected from the New Bermingham decant pond discharge corridor (BM-23-NAT-2, BM-23-NAT-3, BM-23-NAT-4) and the left (BM-23-NAT-2-LB, BM-23-NAT-3-LB) and right banks (BM-23-NAT-2-RB, BM-23-NAT-3-RB), approximately 20 m perpendicular to the flow path. The locations of the seven soil sampling sites from 2023 are displayed on Figure 2-2. All seven samples were analyzed for multi-element analysis following *aqua regia* digestion. The trace element partitioning was also examined for three samples (BM-23-NAT-2, BM-23-NAT-4, BM-23-NAT-3-RB) using the Tessier et al. (1979) sequential extraction method (Section 3.1.2).

Table 3-1: Description of Soil Samples

Sample ID	Sample Type	Distance for Decant Pond (m)	Sampling Date	Type of Test
BM-NAT-01	Soil	170	4-Sep-18	Soil physical and chemical
BM-NAT-02	Soil	248.95	4-Sep-18	Soil physical and chemical
BM-NAT-03	Soil	355.95	4-Sep-18	Soil physical and chemical
BM-NAT-05	Soil	450.65	4-Sep-18	Microbial profiling
BM-NAT-04	Soil	464.95	4-Sep-18	Soil physical and chemical
BM-NAT-06	Soil	475.95	4-Sep-18	Soil physical and chemical
BM-NAT-07	Soil	545.45	4-Sep-18	Soil physical and chemical
BM-NAT-08	Soil	634.65	4-Sep-18	Soil physical and chemical
BM-NAT-09	Soil	747.5	4-Sep-18	Soil physical and chemical
BM-NAT-10	Soil	824.35	4-Sep-18	Microbial profiling
BM-NAT-11	Soil	840.75	4-Sep-18	Soil physical and chemical
BM-NAT-12	Soil	811.35	4-Sep-18	Soil physical and chemical
BM-NAT-13	Soil	918.25	4-Sep-18	Soil physical and chemical
BM-NAT-14	Soil	981.95	4-Sep-18	Soil physical and chemical
BM-NAT-15	Soil	1060.75	4-Sep-18	Soil physical and chemical
BM-NAT-16	Soil	1156.35	4-Sep-18	Soil physical and chemical
BM-NAT-17	Soil	1249.75	4-Sep-18	Microbial profiling
BM-NAT-18	Soil	1261.75	4-Sep-18	Soil physical and chemical
BM-NAT-19	Soil	1237.85	4-Sep-18	Soil physical and chemical
BM-NAT-20	Soil	1345.95	4-Sep-18	Soil physical and chemical
BM-NAT-21	Soil	1446.95	4-Sep-18	Soil physical and chemical

3.1.2 SEQUENTIAL EXTRACTIONS

Information regarding the distribution of metal(loid)s between various phases within soils and sediments provides an understanding of the relative mobility of these elements. Several extraction methods (e.g., Tessier et al., 1979; Rauret et al., 1999; Silveira et al., 2006) have been developed and used to understand the partitioning of major and trace elements in soils and sediments with the Tessier et al. (1979) sequential extraction (TSE) method being the most used. The TSE procedures uses reagents designed to extract metals from a target fraction in a stepwise fashion:

- Fraction 1 – Exchangeable: this fraction represents the weakly bound fraction which is readily remobilized via desorption by competing ions in solution.
- Fraction 2 – Bound to carbonates: this fraction represents the fraction bound to carbonate minerals.
- Fraction 3 – Bound to iron and manganese oxyhydroxides (reducible): this fraction consists of metals associated with iron and manganese oxides that may be remobilized under reducing conditions.
- Fraction 4 – Bound to organic matter (oxidizable): this fraction represents the fraction bound to organic matter such as humic and fulvic acids or sulphide minerals and could be remobilized following oxidation processes.
- Fraction 5 – Residual: this fraction represents the fraction strongly tied to mineral lattice and is relatively immobile.

Understanding the distribution of metal species in soils samples is expected to help gain an insight into natural attenuation processes occurring on site.

3.1.3 SOIL MICROBIOLOGY

Determining the presence, type, and the activity of microorganisms in soil is an important aspect in understanding of natural attenuation and metal sequestration. Various studies have shown that soil microorganisms promote the attenuation of metals and the transformation of attenuated metals into stable forms such as metal sulphides under anaerobic and organic-rich soils conditions.

Three select samples (BM-NAT-04, BM-NAT-10, and BM-NAT-17) were tested for the following:

- Microbial community profiling via 16S rRNA to identify microorganisms to the genus level, including sulphide-producing bacteria; and
- Enumeration of sulphate-reducing bacteria using quantitative polymerase chain reaction (qPCR).

The objective of these tests is to understand the structure of the microbial community, including members that may play an active role in attenuation processes that can immobilize metal(loid)s into stable mineral forms under site conditions.

In brief, DNA extracted from the soil samples and portions of the 16S rRNA gene, which can be used for taxonomic classification, were sequenced and matched against known microorganisms. Similar sequences (97% similarity or higher) were grouped together into operational taxonomic units (OTUs) and compared against a microbial database for classification at the species level.

The quantification of sulphate-reducing bacteria was performed by qPCR targeting the β-subunit of the dissimilatory sulphite reductase *dsrB* gene. The dissimilatory sulphite reductase is the primary enzyme in the dissimilatory sulphate reduction gene in sulphate-reducing prokaryotes, hence, this approach targets sulphate-reducing bacteria.

3.2 VEGETATION (MOSS)

Six (6) moss samples (BM-NAT-05-A, BM-NAT-05-B, BM-NAT-10-A, BM-NAT-10-B, BM-NAT-18-A, and BM-NAT-18-B) were collected from three locations along the likely discharge corridor between the New Bermingham decant pond (KV-114) and headwater of No Cash Creek (KV-111) (Figure 2-1). Two samples were collected at each location between October 3 and 5, 2019 and sent to the laboratory for moisture and metal content analysis of the tissue. The samples were rinsed with deionized water to remove soil/dust particles before being homogenized and digested for metal content analysis. The moisture content was determined on a pre-rinsed sample portion. A brief description of the samples is provided in Table 3-2.

Table 3-2: Description of Moss Samples

Sample ID	Sample Type	Distance from Decant Pond (m)	Sampling Date
BM-NAT-05-A	Moss	476	6-Oct-19
BM-NAT-05-B	Moss	476	6-Oct-19
BM-NAT-10-A	Moss	824	6-Oct-19
BM-NAT-10-B	Moss	824	6-Oct-19
BM-NAT-18-A	Moss	1262	6-Oct-19
BM-NAT-18-B	Moss	1262	6-Oct-19

3.3 WATER QUALITY

Seventeen years (2008 to 2024) of surface water quality (WQ) and twelve years (2013 to 2024) of groundwater records from monitoring stations set up along study area were used as background data in this study. Field parameters and total and dissolved metal(loid) concentrations were reviewed from the following operating surface monitoring stations and groundwater monitoring wells:

- KV-18 (Bermingham 200 adit; monthly sampling);
- KV-19 (Ruby 400 adit; monthly sampling);
- KV-20 (No Cash 500 adit; monthly sampling);
- KV-21 (No Cash Creek u/s Silver Trail Highway; monthly sampling);
- KV-110 (New Bermingham portal discharge; weekly sampling since July 2017);
- KV-111 (No Cash Creek above No Cash 500 adit; monthly sampling since September 2017);
- KV-114 (New Bermingham Decant Pond; weekly sampling since September 2020);
- KV-116 (New Bermingham N-AML waste rock disposal area Monitoring Well; monthly sampling since November 2020);
- KV-118 (Upper No Cash Creek at Calumet Road; monthly sampling since July 2018 with flow typically only observed in spring through fall);
- BH-MW-1 (Bermingham 200 adit Monitoring Well; monthly sampling since September 2013);
- RB-MW-1 (Ruby 400 adit Monitoring Well; monthly sampling since September 2013); and
- NC-MW-1 (No Cash 500 adit Monitoring Well; monthly sampling since November 2020).

WQ data for these monitoring sites were used to assess surface water and groundwater baseline conditions before the discharge of treated water began providing a benchmark for the assessment of water quality variation during and after the water treatment discharge started. Note that limited WQ data were available for KV-111, KV-114, and KV-118 because monitoring was recently initiated at these stations (2017 onwards for KV-111 and KV-118; 2020 onwards for KV-114). Several groundwater wells including KV-116 and NC-MW-1 were also installed in the New Bermingham area in Q4 of 2020. The location of operating surface stations and groundwater monitoring wells is shown in Figure 2-1.

As part of a synoptic sampling event on September 17, 2023, four surface water samples were collected from the New Bermingham decant pond discharge corridor (BM-23-NAT-1, BM-23-NAT-2, BM-23-NAT-3, BM-23-NAT-4). The locations of the four water quality sampling sites from the 2023 synoptic sampling event are displayed on Figure 2-2. Sampling location BM-23-NAT-1 is located at the outlet of the settling pond below the KV-114 outflow and BM-23-NAT-4 is located at the closest location before the water goes to ground. Sampling stations BM-23-NAT-2 and BM-23-NAT-3 are spaced one third and two thirds of the distance from the settling pond and to the end of the flow path, respectively.

3.4 QUALITY ASSURANCE AND QUALITY CONTROL

A standard practice quality assurance and quality control (QA/QC) program was followed to assess the accuracy and reproducibility of laboratory analytical results. Duplicate samples, methods blanks, Internal Reference Material (IRM), Certified Reference Material (CRM) and Laboratory Control Sample (LCS) were included to ensure confidence in the analytical data. Reproducibility of duplicate analyses was assessed by calculating the relative percent difference (RPD) between the lead sample and the duplicate. An RPD ≤20% was considered acceptable for sediment samples where the parameter measured value (mv) reported was >10 times the reporting detection limit (RDL). The RPD is calculated as follows:

$$RPD\ (\%) = 100\ \text{X}\ \frac{\text{ABS (Sample mv} - \text{Duplicate mv)}}{\text{Average (Sample mv, Duplicate mv)}}$$

Where:

- ABS: absolute value
- mv: measured value

The accuracy of the IRM and LCS analysis was determined by percent recovery (RP) relative to the set target value as follows:

$$RP\ (\%) = 100\ \text{X}\ \frac{\text{Sample mv}}{\text{IRM or LCS}}$$

Where:

- RP: recovery percentage
- mv: measured value

For the sediment sampling program, an IRM percentage recovery of 80-120% was considered acceptable for total carbon (TC) and IRM within the ranges set for particle size distribution (39.1 — 49.1 for sand; 32.5 — 42.5 for silt and 13.4 — 23.4 for clay) and paste pH (5.9 — 6.5) analyses were also considered acceptable. LCS percentage recoveries of 80 — 120% and 90 — 110% were considered acceptable for total inorganic carbon (TIC) and total carbon (TC), respectively, and LCS within the range set for the moisture content (90 — 110%) and paste pH (5.7 — 6.3) were also considered acceptable.

Two duplicates analysis was done for the moisture content for samples BM-NAT-09 and BM-NAT-11 and the calculated RPDs were 13% and 2.3%, respectively, indicating a good analytical reproducibility. Also, one duplicates

analysis was done for the particle size distribution for samples BM-NAT-16 and all the calculated RPDs were below the maximum RPD limit of 25% indicating a good analytical reproducibility. All method blanks included in the analysis of moisture content, TIC and TC returned values below the detection limit indicating laboratory analyses were free from contamination. Calculated RP for IRM and LCS retuned values within the set acceptable percentages and value ranges.

All method blanks included in the analysis of the moisture and metal content of moss tissue returned values below the detection limit indicating laboratory analyses were free from contamination. All CRM and LCS analyses returned values within the set acceptable percentages and value ranges. Thus, the QA/QC results show that the results of soil geochemical tests are acceptable for use in analysis and interpretation.

A collaborative QA/QC program was implemented as part of the Alexco Keno Hill Mining Corp. (AKHM) and Elsa Reclamation and Development Company Ltd. (ERDC) surface and groundwater monitoring programs. A QA/QC program ensures that sampling is done in accordance with standard practice and the results are adequate for reporting purposes. The standard QA/QC program included duplicate samples, field and trip blanks, and a QA/QC review, including all in-situ field parameters and laboratory data reviewed against the historical data managed within the project EQWin database. The laboratory also conducted their own QA/QC measures to ensure the data they provide is accurate; their results showed that the test results were acceptable for use in analysis and interpretation.

Between zero and nine field duplicates were taken during each monthly water quality sampling event throughout the KHSD. In 2024, four of these duplicates (one taken at KV-118 in May, KV-20 in June, KV-21 in September, and NC-MW-1 in July) corresponded to stations examined for this study. The RPD between the field duplicate and its corresponding sample was calculated, and if the RPD was below 25%, then the results were acceptable. If the RPD exceeded 25%, then the results were compared to the practical quantitation limit (PQL), which is calculated as the ratio of the analytical result to RDL. The PQL was met if the result was five times greater than the RDL. Both the sample and the duplicate results need to meet the PQL to be considered reliably quantifiable.

Three parameters for KV-118, one parameter for KV-20, one parameter for KV-21, and two parameters for NC-MW-1 in July 2024, showed instances of duplicate samples with an RPD >25%. Of all the parameters with an RPD > 25% for KV-118, KV-20, KV-21, and NC-MW-1, four parameters with RPD > 25% (two at KV-118, one at KV-20, one at KV-21) met the PQL and the results were considered reliably quantifiable (

). Variability in the total arsenic and lead concentrations in the KV-118 duplicate sample were marginal with a 25-28% RDP. Variability in the KV-21 and KV-20 duplicate sample was limited to one parameter each. Overall, the results of the duplicate samples show good reproducibility and are not considered variable enough to have a material effect on the data collected and its interpretation.

Table 3-3: Field Duplicate 2024 – Analytes Detected >25% RPD and Above the PQL for KV-118, KV-20, KV-21, NC-MW-1

Station	Date	Parameter	Units	DL 1	DL 2	Result 1	Result 2	RPD	PQL 1	PQL 2
KV-118	2024/May/28	As, total	mg/L	0.00010	0.00010	0.00158	0.00209	28%	15.8	20.9
KV-118	2024/May/28	Pb, total	mg/L	0.000050	0.000050	0.00466	0.00362	25%	93.2	72.4
KV-20	2024/Jun/05	Al, dissolved	mg/L	0.0010	0.0010	0.0061	0.0091	39%	6.1	9.1
KV-21	2024/Sep/05	Ag, total	mg/L	0.000010	0.000010	0.000096	0.000053	58%	9.6	5.3

Field and trip blanks were typically less than 3x the detection limit in 2024. Where analytes were detectable above this threshold, their absolute concentrations were low relative to the sample data – i.e., they are not considered high enough to have a material effect on the data collected and its interpretation.

4 RESULTS

4.1 SOIL GEOCHEMISTRY

The soil test results are discussed below, summarized in Table 4-1 to Table 4-2, and all laboratory reports are compiled in Appendix A. Soil Geochemistry results are from the 2018 sampling event, and no additional samples were taken in 2024.

4.1.1 PASTE PH

Soil pH is a crucial parameter in natural attenuation because it determines the surface charge of clays and the precipitation/dissolution behaviour of metal sinks such as metal oxyhydroxides, carbonates, and phosphates. Studies on adsorption mechanisms have shown that generally the adsorption of metal cations increases with increasing pH, while the adsorption of element anions or oxyanions increase with the decrease of pH (Stumm and Morgan, 1996).

The soil pH was determined by saturating a sub-sample with distilled water then an extract from the saturated paste was taken and its pH measured using a pH meter.

The soil pH ranged from 3.8 to 7.1 (median pH of 5.4) with only one sample having a neutral soil pH (pH = 7.1). The majority of samples (10 of the 18 sample; 56%) had an acidic or mildly acidic soil pH of <5.5 with the majority of those located in the first two thirds of the flow path; from the discharge location to mid-distance between Calumet Road and surface water station KV-111. A plot of soil pH versus distance shows a slightly increasing soil pH along the discharge channel with the samples with a soil pH ≈ or >6 located in lower end of the channel (Figure 4-1).

These acidic to mildly acidic soil pHs reflect an environment influenced by the weathering products of mineralization and/or the presence of organic acids from the local organic matter. The results of X-ray diffraction and acid-base accounting tests conducted on soils and sediment samples in previous studies had revealed the presence of sulphide minerals in sediment and soil along attenuation routes (Interralogic, 2012). The soil pH conditions of the channel, especially the first two thirds, are ones where the precipitation of oxide or hydroxides, which may co-precipitate other metal(loid)s from the discharge water, is less than optimum for low metal(loids) solubility. However, the soil pH values, especially in the lower end of the channel, were higher than the point zero charge pH of most clay minerals. Therefore, the clay fractions characterized by a variable surface charge are likely to have a net negatively charged surface favourable for the retention of metals cations under the site soil pH conditions.

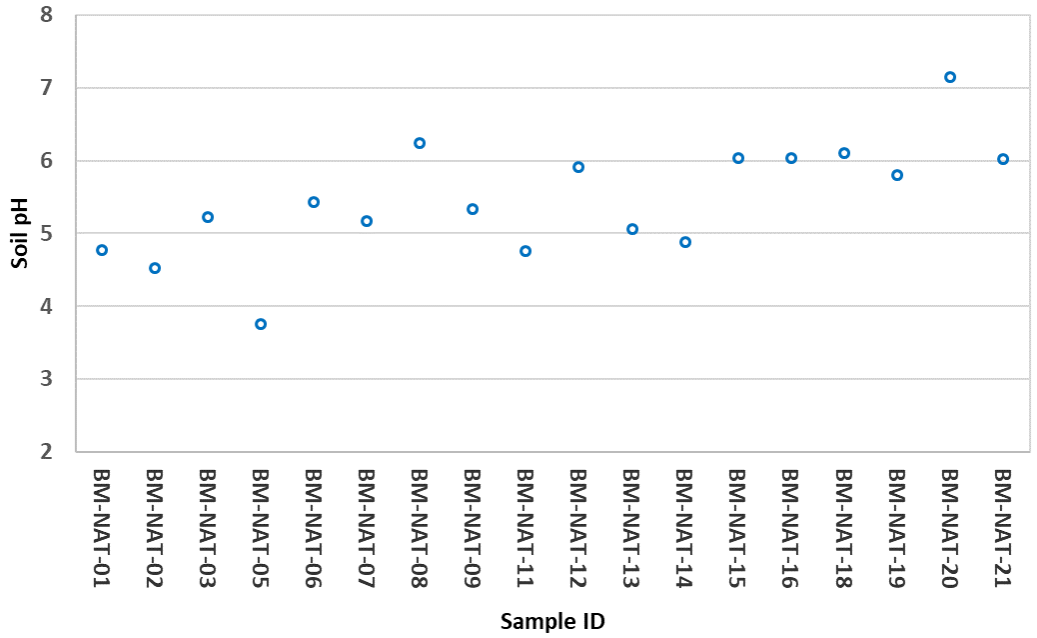


Figure 4-1: Soil Paste pH Profile Along the Discharge Channel

4.1.2 MOISTURE CONTENT

Soil moisture content analysis was determined by gravimetric method. The procedure consists of weighing a sub-sample, drying it at 105°C for a minimum of six hours then re-weighing it. Moisture content is then calculated as a percentage weight difference between the initial sample and the dried sample.

The results show that the moisture content ranged from 22.3% to 60.1% with a median of 48.3%. The majority of samples except one (BM-NAT-02) had a moisture content greater than 30%. The moisture content varied between the sampling sites; however, an increasing trend was observed in the samples collected after Calumet Road (BM-NAT-12 to BM-NAT-21; Figure 4-2). These moisture content data are indicative of moderate water holding capacity favourable for the development of the vegetation cover and peaty and organic-rich surficial material.

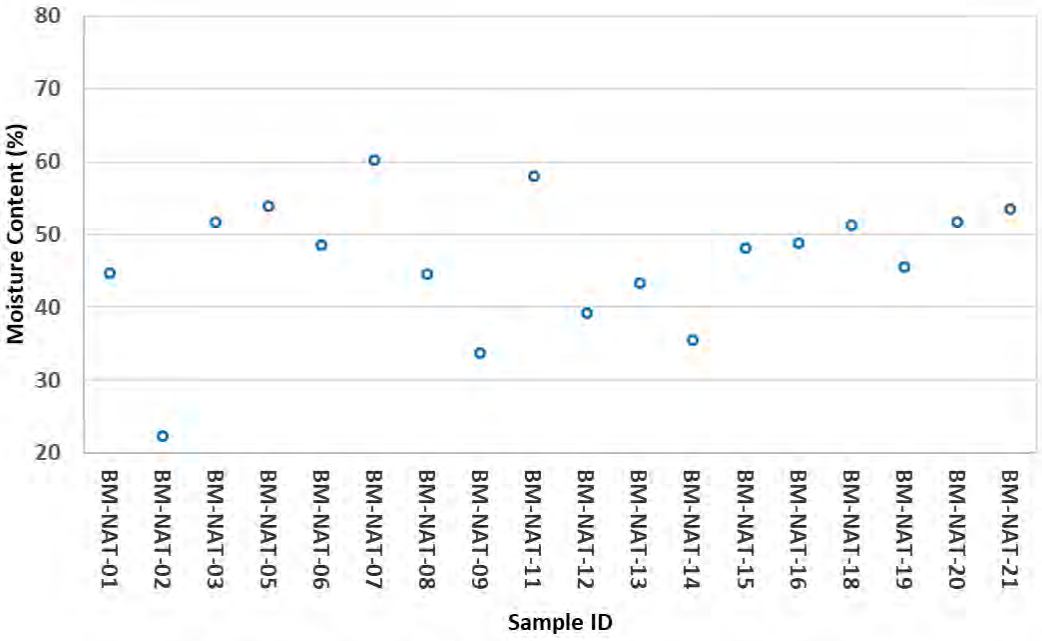


Figure 4-2: Moisture Content of Soil Along the Discharge Channel

4.1.3 TEXTURE

Soil texture was determined based on the particle size distribution. This was performed following the method developed by the United States Department of Agriculture – Natural Resources Conservation Service (Burt, 2009). During the test, dry sieving was used for coarse particles, wet sieving for sand particles, and the pipette sedimentation method for clay particles.

The results indicate that the soil samples consisted predominantly of silt with gravel dominating in BM-NAT-02 (57.1%) explaining its very low moisture content. The silt proportion ranged from 19.1% to 88.8% with a median of 80.7% and the sand content ranged from 2.3% to 27.7% with a median of 8.8%. The clay content ranged from 2.0% to 9.8% with a median of 8.3% and showed a modestly decreasing trend further away from the discharge location.

The soil texture of the majority of the samples (12 of the 18 samples) was determined to be silt, five (5) were categorized as silty loam and one (1) was sandy loam. The high proportion of silt plus clay is predicted to result in a large surface area favourable for the retention of metals through adsorption or cation exchange processes with the discharged water.

4.1.4 ORGANIC MATTER CONTENT

Like soil pH and clay contents, soil organic matter content plays a significant role in the attenuation and immobilization of metals. Organic matter occurs as a mixture of various types of organisms, biochemicals, and humic substances. These provide functional groups where metals can be adsorbed or favorable for the formation of stable complexes with free ions. Soil organic matter also provides food for the development of microorganisms and serves as electron donor in microbiologically mediated sulphate reduction reactions. It also improves the water holding capacity of soil thus increasing the water-soil exchange reactions.

The organic matter content of soil was determined by its TOC. The latter was calculated as the difference between TC and TIC. The TC was determined by ignition in a combustion analyzer where carbon in the reduced CO_2 gas is determined using a thermal conductivity detector. The TIC was determined by reacting the sample with known quantity of acetic acid then the pH of the resulting solution was measured and compared against a standard curve relating the pH to weight of carbonate.

The TOC of the soil samples was low, ranging from 2.4% to 15.5% with a 7.8% median and no particular trend was reflected in the data. The sample with the highest gravel content (BM-NAT-02) had the lowest TOC content (2.4%). These soil TOC can be translated into soil organic matter contents using a conversion factor of 1.72 assuming that 58% of organic matter is present as carbon (Pribyl, 2010). This results in an estimated soil organic matter content ranging from 4.1% to 26.7% (13.3% median). The soils samples contained a relatively low amount of organic matter which will likely impact the extent of sorption, immobilization, and attenuation of metals but will offer some level of attenuation.

4.1.5 METAL CONTENT

The metal content of the soil provides an understanding of current site conditions and offers a benchmark against which future data can be compared following WTP discharge. Baseline metal content data also provides indications of the presence of minerals that may play a key role in attenuation mechanisms. For example, the presence of elevated calcium, iron, and manganese in a sample could be an indication of the presence of carbonate phases and iron and manganese oxides known for their metal attenuation capacities. The baseline data can also reveal unusually elevated metal concentrations due to site-specific conditions (i.e., presence of weathering products from mineralization) that could otherwise be interpreted as sign of contamination.

The soil metal content was determined by *aqua regia* (3:1 mixture of hydrochloric and nitric acids) digestion followed by inductively coupled plasma – mass spectrometry (ICP-MS) analysis. Soil split samples (0.5 g) were digested with the *aqua regia* acid mix in a graphite heating block. After cooling, the digestate was diluted with deionized water and analyzed by ICP-MS. Although the aqua *regia* digestion method does not usually result in a full digestion of a soil sample, it provides a good measure of concentration of trace and major elements of potential environmental concern.

For a site-specific assessment of the metal enrichment or depletion, the average metal content of soil samples was compared to the average baseline soil metal composition of the KHSD compiled in July 2018 (CanNorth, 2018; Table 4-3). In the present case, the averages were considered significantly different only if their difference was ten times greater than the detection limit. The results of the comparative analysis are summarized as follows:

- The concentration of arsenic, calcium, copper, strontium, tin, and zirconium was higher in the KHSD baseline dataset than the study site soil samples;
- The concentration of the following constituents was elevated in the study area soil samples compared to the KHSD baseline: aluminum, barium, cadmium, cobalt, manganese, vanadium, and zinc. The concentration of constituents such as cadmium, manganese, and zinc investigated in previous attenuation studies were two, three, and four times higher in the study site samples than the baseline soil composition, respectively; and
- All other constituents were considered comparable in both datasets including several constituents related to the mineralization such as iron, silver, nickel, and selenium.

The elevated content of cadmium, manganese, and zinc in the study soil samples compared to the baseline are indicative of the greater presence of weathering products of the mineralization. The lower calcium and comparable magnesium and iron concentration with the baseline coupled with low organic matter content and mildly acidic pH indicate less than ideal environment for attenuation, but the elevated silt and manganese contents will likely play a positive role in metals attenuation on site.

Table 4-1: Results of Physical and Geochemical Tests of Soil Samples

Parameter	Lowest Detection Limit	Sample ID	BM-NAT-01	BM-NAT-02	BM-NAT-03	BM-NAT-05	BM-NAT-06	BM-NAT-07	BM-NAT-08	BM-NAT-09	BM-NAT-11
		Units	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests (Soil)											
Moisture	0.25	%	44.7	22.3	51.6	53.8	48.5	60.1	44.5	33.6	58.0
Particle Size (Soil)											
% Gravel (>2mm)	1.0	%	9.0	57.1	3.0	<1.0	2.8	2.4	<1.0	15.6	<1.0
% Sand (2.0mm — 0.063mm)	1.0	%	10.5	21.9	16.7	7.3	3.8	8.1	4.8	23.2	2.9
% Silt (0.063mm — 4um)	1.0	%	71.7	19.1	71.3	84.4	84.9	79.7	86.8	55.5	87.8
% Clay (<4um)	1.0	%	8.9	2.0	9.0	8.0	8.6	9.8	8.4	5.7	9.3
Texture		-	Silt	Sandy loam	Silt loam	Silt	Silt	Silt	Silt	Silt loam	Silt
Organic / Inorganic Carbon (Soil)											
Total Organic Carbon	0.05	%	8.13	2.37	7.62	10.3	7.82	10.2	6.41	5.98	11
Saturated Paste Extractables (Soil)											
Paste pH	0.1	pH	4.76	4.52	5.22	3.75	5.42	5.17	6.23	5.33	4.75
Total Metals (Soil)											
Aluminum (Al)	0.01	%	1.33	0.9	1.15	1.19	1.35	1.31	1.4	1.13	1.32
Antimony (Sb)	0.05	ppm	1.62	2.41	1.02	0.95	1.13	1.66	1.1	1.37	1.41
Arsenic (As)	0.1	ppm	16.3	24.8	10.2	10.6	15.1	18.2	12.8	13.6	12.1
Barium (Ba)	10	ppm	320	140	270	210	370	440	440	360	380
Beryllium (Be)	0.05	ppm	0.28	0.23	0.2	0.18	0.29	0.33	0.32	0.22	0.31
Bismuth (Bi)	0.01	ppm	0.22	0.13	0.12	0.15	0.19	0.16	0.17	0.14	0.16
Boron (B)	10	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium (Cd)	0.01	ppm	0.79	0.38	0.53	0.4	0.57	1.12	0.66	0.62	0.7
Calcium (Ca)	0.01	%	0.22	0.13	0.4	0.16	0.29	0.27	0.42	0.28	0.31
Chromium (Cr)	1.0	ppm	25	21	21	20	23	24	24	20	23

Parameter	Lowest Detection Limit	Sample ID	BM-NAT-01	BM-NAT-02	BM-NAT-03	BM-NAT-05	BM-NAT-06	BM-NAT-07	BM-NAT-08	BM-NAT-09	BM-NAT-11
		Units	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Cobalt (Co)	0.1	ppm	4.7	5.2	5.8	4.7	6.1	29.4	10.5	13.9	8.3
Copper (Cu)	0.2	ppm	15	13.9	10.5	8.9	12.1	14.4	13.9	11	13.8
Iron (Fe)	0.01	%	1.77	1.82	1.57	1.46	1.77	1.94	1.9	1.56	1.97
Lead (Pb)	0.2	ppm	28.9	18.6	14.1	15	17.5	49.3	14.1	30.9	16.5
Lithium (Li)	0.1	ppm	11.9	8.9	13.5	10.8	13.2	14.1	15.9	12.5	12.4
Magnesium (Mg)	0.01	%	0.28	0.21	0.32	0.24	0.28	0.31	0.35	0.29	0.29
Manganese (Mn)	5.0	ppm	161	223	167	131	304	1580	645	1270	546
Mercury (Hg)	0.01	ppm	0.09	0.1	0.17	0.1	0.09	0.1	0.07	0.06	0.11
Molybdenum (Mo)	0.05	ppm	0.98	1.21	0.71	0.8	0.73	0.79	0.66	0.66	0.75
Nickel (Ni)	0.2	ppm	16.6	14.9	14.5	12.3	14.9	18.5	17.9	13.6	17.2
Phosphorus (P)	10	ppm	980	590	880	880	950	880	770	600	890
Potassium (K)	0.01	%	0.04	0.03	0.04	0.04	0.04	0.05	0.04	0.04	0.04
Selenium (Se)	0.2	ppm	0.9	0.5	1	1.1	1.1	1.4	1.9	0.9	1.7
Silver (Ag)	0.01	ppm	1.55	0.46	0.52	0.48	0.78	1.11	0.34	0.72	0.42
Sodium (Na)	0.01	%	0.01	0.01	0.01	0.01	0.02	0.01	<0.01	<0.01	<0.01
Strontium (Sr)	0.2	ppm	19.4	16.3	20.5	13.2	19.5	18.1	20.7	16.9	22.1
Sulfur (S)	0.01	%	0.06	0.02	0.05	0.05	0.06	0.06	0.05	0.05	0.08
Thallium (Tl)	0.02	ppm	0.15	0.08	0.1	0.16	0.27	0.26	0.22	0.18	0.22
Tin (Sn)	0.2	ppm	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3
Titanium (Ti)	0.01	%	0.021	0.026	0.024	0.019	0.021	0.023	0.025	0.025	0.021
Uranium (U)	0.05	ppm	1.08	0.74	0.63	0.63	0.84	0.97	0.85	0.57	0.87
Vanadium (V)	1.0	ppm	36	34	30	31	39	37	39	36	36
Zinc (Zn)	2.0	ppm	129	74	72	62	78	99	104	119	89

Table 4-2: Results of Physical and Geochemical Tests of Soil Samples

Parameter	Lowest Detection Limit	Sample ID	BM-NAT-12	BM-NAT-13	BM-NAT-14	BM-NAT-15	BM-NAT-16	BM-NAT-18	BM-NAT-19	BM-NAT-20	BM-NAT-21
		Units	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests (Soil)											
Moisture	0.25	%	39.1	43.2	35.4	48.1	48.8	51.2	45.4	51.6	53.4
Particle Size (Soil)											
% Gravel (>2mm)	1.0	%	10.2	<1.0	<1.0	<1.0	<1.0	16.7	<1.0	5.8	3.4
% Sand (2.0mm — 0.063mm)	1.0	%	27.7	5.9	7.5	2.3	7.2	10.1	9.4	27.2	24.3
% Silt (0.063mm — 4um)	1.0	%	57.1	85.2	83.5	88.8	85.0	67.0	81.6	61.8	66.5
% Clay (<4um)	1.0	%	5.1	8.9	9.1	9.0	7.9	6.2	8.1	5.2	5.7
Texture		-	Silt loam	Silt	Silt	Silt	Silt	Silt	Silt	Silt loam	Silt loam
Organic / Inorganic Carbon (Soil)											
Total Organic Carbon	0.05	%	4.45	8.15	5.58	10.4	5.57	15.5	7.68	11.2	6.69
Saturated Paste Extractables (Soil)											
Paste pH	0.1	pH	5.91	5.05	4.87	6.03	6.03	6.09	5.80	7.14	6.02
Total Metals (Soil)											
Aluminum (Al)	0.01	%	1.17	1.15	1.16	1.29	1.25	1.3	1.06	1.07	1.1
Antimony (Sb)	0.05	ppm	2.36	1.17	0.78	2.14	1.41	1.11	1.18	1.24	0.91
Arsenic (As)	0.1	ppm	15.4	18.9	7.3	23.5	17.8	24.9	17.1	36.9	19.7
Barium (Ba)	10	ppm	340	300	240	400	500	480	220	320	400
Beryllium (Be)	0.05	ppm	0.36	0.3	0.2	0.32	0.32	0.5	0.27	0.51	0.3
Bismuth (Bi)	0.01	ppm	0.15	0.17	0.14	0.17	0.17	0.18	0.15	0.19	0.16
Boron (B)	10	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium (Cd)	0.01	ppm	1.17	0.34	0.24	5	2.53	1.31	4.17	6.09	0.77
Calcium (Ca)	0.01	%	0.64	0.36	0.22	0.57	0.43	0.73	0.36	1.14	0.51
Chromium (Cr)	1.0	ppm	22	21	21	23	22	20	20	22	20
Cobalt (Co)	0.1	ppm	6.2	5.9	4.7	20	91.5	14.7	9.1	11.3	15.6
Copper (Cu)	0.2	ppm	21.3	10.6	8.8	14.3	10.2	60.7	11.6	39.1	18.7

Parameter	Lowest Detection Limit	Sample ID	BM-NAT-12	BM-NAT-13	BM-NAT-14	BM-NAT-15	BM-NAT-16	BM-NAT-18	BM-NAT-19	BM-NAT-20	BM-NAT-21
		Units	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Iron (Fe)	0.01	%	1.71	1.83	1.37	2.21	2.91	2.88	2.01	2.22	2.11
Lead (Pb)	0.2	ppm	67.3	13.7	14	72.5	17.4	17.2	19.6	14.9	17
Lithium (Li)	0.1	ppm	12.2	11.5	11.8	13.6	12.6	12.6	11	11.8	12
Magnesium (Mg)	0.01	%	0.34	0.28	0.28	0.35	0.31	0.48	0.29	0.39	0.32
Manganese (Mn)	5.0	ppm	205	318	180	4890	6210	2040	683	3030	2510
Mercury (Hg)	0.01	ppm	0.09	0.08	0.09	0.11	0.07	0.06	0.05	0.06	0.17
Molybdenum (Mo)	0.05	ppm	0.66	0.75	0.4	0.95	1.41	1.21	0.85	1.24	1.06
Nickel (Ni)	0.2	ppm	16.1	13.2	11.9	20.8	18.9	26.3	17.8	43.3	19.5
Phosphorus (P)	10	ppm	800	680	560	890	720	860	680	650	740
Potassium (K)	0.01	%	0.04	0.04	0.03	0.05	0.04	0.04	0.04	0.05	0.04
Selenium (Se)	0.2	ppm	1.9	1	0.9	1	1	1.3	0.6	1.4	0.6
Silver (Ag)	0.01	ppm	1.53	0.3	0.24	1.24	0.29	0.26	0.31	0.27	0.29
Sodium (Na)	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium (Sr)	0.2	ppm	24.7	19.4	15	21.6	21.7	31.7	16.6	32.3	23.3
Sulfur (S)	0.01	%	0.1	0.06	0.05	0.05	0.05	0.06	0.03	0.07	0.04
Thallium (Tl)	0.02	ppm	0.18	0.18	0.19	0.22	0.2	0.12	0.14	0.1	0.14
Tin (Sn)	0.2	ppm	0.4	0.3	0.3	0.4	0.4	0.3	0.3	0.2	0.3
Titanium (Ti)	0.01	%	0.026	0.022	0.023	0.024	0.024	0.037	0.025	0.017	0.024
Uranium (U)	0.05	ppm	0.94	0.63	0.62	0.85	0.71	0.82	0.72	1.2	0.81
Vanadium (V)	1.0	ppm	34	43	29	38	44	63	37	34	37
Zinc (Zn)	2.0	ppm	158	69	56	486	616	112	658	2340	102

Table 4-3: Keno Hill Silver District Background Average Concentration of Soil (CanNorth, 2018)

Total Metal Concentration	Unit	Galena Hill, South McQuesten (latest data)
Aluminum (Al)	%	0.734
Antimony (Sb)	ppm	1.06
Arsenic (As)	ppm	27
Barium (Ba)	ppm	220
Beryllium (Be)	ppm	0.45
Bismuth (Bi)	ppm	0.19
Boron (B)	ppm	2.85
Cadmium (Cd)	ppm	0.71
Calcium (Ca)	%	0.882
Chromium (Cr)	ppm	14.3
Cobalt (Co)	ppm	6.34
Copper (Cu)	ppm	22.9
Iron (Fe)	%	1.85
Lead (Pb)	ppm	22.4
Lithium (Li)	ppm	14.3
Magnesium (Mg)	%	0.295
Manganese (Mn)	ppm	451
Mercury (Hg)	ppm	0.05
Molybdenum (Mo)	ppm	1.03
Nickel (Ni)	ppm	17.5
Phosphorus (P)	ppm	712
Potassium (K)	%	0.03
Selenium (Se)	ppm	0.65
Silver (Ag)	ppm	0.47
Sodium (Na)	%	0.00234
Strontium (Sr)	ppm	32.3
Thallium (Tl)	ppm	0.06
Tin (Sn)	ppm	2.19
Titanium (Ti)	%	0.0113
Uranium (U)	ppm	0.84
Vanadium (V)	ppm	23
Zinc (Zn)	ppm	77.2
Zirconium (Zr)	ppm	1.42

4.2 2023 SYNOPTIC SAMPLING

Attenuation of metals along the New Bermingham decant pond (KV-114) discharge corridor was assessed from water quality (Section 4.2.1) and sediment samples (Section 4.2.2) collected in 2023. The results of the 2023 synoptic sampling event conducted are provided in Appendix A for water quality and sediment samples, respectively. No additional synoptic sampling occurred in 2024.

4.2.1 WATER QUALITY

Water quality data (2023 synoptic sampling) along the New Bermingham decant pond (KV-114) discharge corridor from BM-23-NAT-1 to BM-23-NAT-4 are shown in Table 4-4. The water quality along the discharge corridor show similar dissolved arsenic (0.00274 to 0.00477 mg/L), copper (0.00071 to 0.0012 mg/L), lead (0.0010 to 0.0019 mg/L), nickel (0.0019 to 0.00020 mg/L), and silver (0.000013 to 0.000032 mg/L) concentrations along the flow path from BM-23-NAT-1 to BM-23-NAT-4. Dissolved arsenic (0.0025 mg/L), copper (0.00081 mg/L), lead (0.0017 mg/L), nickel (0.0032 mg/L), and silver (0.000015 mg/L) concentrations from KV-114 on September 19, 2023 were similar to the concentrations observed along the discharge corridor on September 17, 2023.

Dissolved sodium concentrations from BM-23-NAT-1 to BM-23-NAT-4 were similar along the flow path from 143 mg/L at BM-23-NAT-2 to 127 mg/L at BM-23-NAT-4, suggesting there was little to no dilution along the WTP discharge flow path. Sulphate concentrations from BM-23-NAT-1 to BM-23-NAT-4 were also similar along the flow path (140 mg/L to 173 mg/L, respectively). Thus, stable concentrations of arsenic, copper, lead, nickel, and silver concentrations and conservative ions sodium and sulphate along the flow path, suggest little to no attenuation in the discharge corridor.

Dissolved cadmium concentrations gradually increased along the flow path to BM-23-NAT-4 from 0.0000703 to 0.000394 mg/L and zinc concentrations increased an order of magnitude at BM-23-NAT-4 to 0.0274 mg/L. As sodium and sulphate ions are stable along the flow path, the increase in cadmium and zinc concentrations is likely not due to evaporation and maybe influenced by the Ruby adit (KV-19), which discharges water upgradient of the end of the flow path. Dissolved cadmium (0.000834 to 0.0015 mg/L) and zinc (0.26 to 0.34 mg/L) concentrations at KV-19 in 2023 (as measured in May and July) were higher than those observed along the discharge corridor.

Ammonia concentrations measured at BM-23-NAT-1 (7.6 mg/L) and BM-23-NAT-4 (5.2 mg/L) show a small decline in concentration.

Table 4-4:Dissolved Metals Concentrations in Water Collected Along New Bermingham Decant Pond Discharge Corridor

Station	Ag-D	As-D	Cd-D	Cu-D	Na-D	Ni-D	NH_3	Pb-D	SO4-D	Zn-D
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as N	mg/L	mg/L	mg/L
BM-23-NAT-1	0.000028	0.0040	0.000070	0.00090	142	0.0019	7.6	0.0010	140	0.0028
BM-23-NAT-2	0.000032	0.0048	0.000092	0.0011	143	0.0019	-	0.0019	140	0.0028
BM-23-NAT-3	0.000013	0.0048	0.00017	0.0012	136	0.0020	-	0.0014	144	0.0038
BM-23-NAT-4	0.000026	0.0027	0.00039	0.00071	127	0.0020	5.2	0.0012	173	0.027
% change [a]	-7	-31	460	-21	-11	0.0019	-31	14	24	879

[a] Percent change measured along the flow path at BM-23- NAT-4 from original concentration measured at BM-23- NAT-1. Negative percentage indicates a decrease in concentration.

4.2.2 SEDIMENT QUALITY

The results of the multi-element analysis following *aqua regia* digestion of sediment samples from the 2023 synoptic event are shown in Table 4-5. The bulk metal concentrations in the sediment samples show arsenic, copper, lead, nickel, and silver concentrations higher in BM-23-NAT-2 sediment samples compared to the background samples (BM-23-NAT-2-LB, BM-23-NAT-3-LB, BM-23-NAT-2-RB, BM-23-NAT-3-RB). For example, the arsenic concentration measured at BM-23-NAT-2 (167 ppm) was higher than in the background samples (19.9 to 50.3 ppm); comparatively the other downstream sediment samples were similar in concentration (28.6 and 21.9 ppm for BM-23-NAT-3 and BM-23-NAT-4, respectively) to the background samples. Copper concentrations were slightly higher at BM-23-NAT-4 compared to the background samples. Cadmium and zinc concentrations in the sediment samples along the flow path were generally within the concentrations observed in the background samples, except for BM-23-NAT-4 where concentrations were lower than in the background samples.

The relatively low metal concentrations from the WTP discharge and short period of operation (few years), it is possible that there is limited metal accumulation in the sediment and these results likely reflect heterogeneity in the sediment samples. This is also consistent with the water quality results along the flow path (Section 4.2.1), which suggest little to no attenuation in the discharge corridor.

Table 4-5: Metals Concentrations in Sediment Collected Along New Bermingham Decant Pond Discharge Corridor

Analyte	Units	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-4	BM-23-NAT-2-LB	BM-23-NAT-2-RB	BM-23-NAT-3-LB	BM-23-NAT-3-RB
Arsenic	ppm (w/w)	167	28.6	21.9	29.9	50.3	19.9	25.5
Cadmium	ppm (w/w)	17.9	2.25	0.63	16.5	37.7	5.97	60.9
Copper	ppm (w/w)	30	11.6	24.3	17.1	18.2	12.2	16.8
Lead	ppm (w/w)	477	64.5	42.4	82.7	96.0	46.8	96.5
Nickel	ppm (w/w)	53.2	16.1	16.4	18.6	20.0	16.4	19.2
Silver	ppm (w/w)	15.8	1.61	0.990	2.31	3.61	1.13	2.98
Zinc	ppm (w/w)	1065	290	98	403	1235	314	1920

4.2.3 SEQUENTIAL EXTRACTION

The results of TSE testing conducted in 2023 are summarized in Table 4-6 to Table 4-8 and the laboratory report is provided in Appendix A. The discussion herein is focused on constituents of potential interest (COPI) such as arsenic, cadmium, copper, lead, nickel, manganese, iron, selenium, silver, and zinc for samples collected at BM-23-NAT-2, BM-23-NAT-3-RB, and BM-23-NAT-4 (Figure 2-2). Values reported less than the detection limit were halved for calculations. BM-23-NAT-2 and BM-23-NAT-4 are along the New Bermingham WTP discharge flow path, while BM-23-NAT-3-RB represents background as it is located approximately 20 m perpendicular to the flow path.

The results indicate the following:

- In the sediment sample that represents the background at BM-23-NAT-3-RB, the majority of COPI were predominantly associated with the reducible, and residual phases, and to a lesser extent the organic matter and/or sulphide phase. The majority of COPI were predominantly associated with the reducible and/or organic/sulphide bound phases in the BM-23-NAT-2 sample and with the reducible, organic matter/sulphide, and/or residual phases in the downstream BM-23-NAT-4 sample.

- Many COPI were below the detection limit or at low concentrations in the exchangeable and adsorbed fraction, except for cadmium, manganese, and zinc in both the BM-23-NAT-2 and BM-23-NAT-3-RB samples and manganese in the BM-23-NAT-4 sample (most downstream of the WTP flow path).

- The carbonate phase associated concentrations of COPI were low and occasionally below detection limit (DL) for copper, iron, nickel, and silver. Cadmium and zinc had concentrations of 38% and 22%, respectively, of the total elemental concentration associated with carbonates at BM-23-NAT-2. Sedimentary cadmium and zinc associated with the carbonate phase was lower at BM-23-NAT-4 and BM-23-NAT-3-RB (7-14%). Cadmium, lead, manganese, and zinc can form or co-precipitate with carbonate minerals.

- Arsenic was predominantly associated with the easily reducible / iron oxide phases (23% - 53% for all samples) and in the residual phases (43% in BM-23-NAT-2, and 68% in BM-23-NAT-3-RB). Sedimentary arsenic in the reducible phase was lowest for the background sample BM-23-NAT-3-RB (23%) compared to both sedimentary samples collected along the Bermingham WTP discharge flow path (44%-53%).

- Cadmium was primarily found in the exchangeable phase (16% - 75%), the carbonate phase (11% - 39%) and the easily reducible phase (13% - 53%) for all samples. Sedimentary cadmium in the exchangeable phase (75%) was highest for the background sample BM-23-NAT-3-RB compared to both sedimentary samples collected along the Bermingham WTP discharge flow path (16% and 28% at BM-23-NAT-2 and BM-23-NAT-4, respectively).

- The majority of copper was sequestered in the organic matter and/or sulphide phase (55% - 79%) for all samples, with the remaining fractions being split between the easily reducible and residual phases.

- Iron was largely associated with the reducible (50% - 73%) and residual phases (14% - 42%) for all samples. Only 6%-14% of iron was found in the organic and/or sulphide bound phase.

- The lead partitioning was similar to iron in that it was largely associated with the reducible phase (65% - 77%) for all stations.

- Manganese was mostly associated with the reducible phase (34% - 82%) for all samples, and to the exchangeable and adsorbed metals fraction for BM-23-NAT-4 (44%).

- Zinc was mostly associated with the reducible phase (55% - 70%) for all samples, and to a lesser extent the organic and/or sulphide bound phases (18% - 21%) for BM-23-NAT-2 and BM-23-NAT-4 samples.

- Nickel was concentrated in the reducible phase (34% - 66%) for all samples, and in the organic /sulphide bound and residual phases for BM-23-NAT-4 and BM-23-NAT-3-RB samples (21% - 34%).

- Silver concentrations were very low to below DL in most fractions. The highest concentration measured was 7.58 mg/kg in the residual metal phase for the BM-23-NAT-2 sample (78% of the silver concentration). Other concentrations measured were less than 1.70 mg/kg. Silver was largely associated with easily reducible phase and the organic /sulphide phase for BM-23-NAT-3RB (52%) and BM-23-NAT-4 (50%), respectively.

- The bulk cadmium (largely bound in the exchangeable /adsorbed metal fraction) and zinc (largely bound in the easily reducible fraction) concentrations in the soil were highest in sediment collected at BM-23-NAT-3RB and lowest in the BM-23-NAT-4 sample. The highest bulk concentrations of arsenic, copper, iron (largely bound in the easily reducible fraction), lead, manganese, and silver were found in sediment collected BM-23-NAT-2.

These data indicate that most COPI were predominantly associated with the reducible phases in BM-23-NAT-3RB, except cadmium (predominantly associated with the exchangeable and adsorbed phase) and copper (largely sequestered in the organic and/or sulphide phase). In addition to the large association to the reducible phase, arsenic, copper, iron, nickel, and zinc in BM-23-NAT-3RB were also largely associated with residual phases; and nickel was also largely associated with the sulphide/organic phase. For BM-23-NAT-2, COPI were predominantly associated with the reducible phases, except copper (which was largely sequestered in the organic and/or sulphide phase) and silver (which was largely associated with the residual phase). In addition to the large association to the reducible phase, arsenic, cadmium, and zinc at BM-23-NAT-2 were also largely associated with carbonate (cadmium and zinc), organic/sulphide (zinc) and/or residual phases (arsenic). Similar to BM-23-NAT-2, the COPI in the BM-23-NAT-4 sample were largely bound to the reducible phase, except for copper and silver. However, there were some differences between the fraction of total concentration for BM-23-NAT-2 and BM-23-NAT-4 including higher percentage of cadmium and manganese in the exchangeable and adsorbed phase and silver in the organic/sulphide phase of BM-23-NAT-4. The easily mobilized exchangeable fraction and carbonate phases were generally low for most COPI, except cadmium (all samples) and manganese (only for BM-23-NAT-4) which were predominantly associated with the exchangeable fraction. Also, the carbonate fraction accounted for up to 39% of cadmium, 16% lead, 12% of manganese, and up to 22% of zinc and was generally a higher proportion of the total concentration in the BM-23-NAT-2 sample.

COPI in the residual phase are expected to be strongly tied to the mineral lattice and predicted to be stable in the soil matrix significantly decreasing their solubility and potential bioavailability. However, significant fractions of COPI could be remobilized if the environment becomes reducing (fraction bound to reducible phase). Given the surficial nature of the soils and the oxidizing surface waters that contact the soils in the WTP discharge flow path, such mobilization is not considered likely. Rather, the data suggest that iron/manganese oxyhydroxides are important hosts for many COPIs with carbonate (cadmium, zinc) and organic matter (copper) also key soil components that sequester COPIs.

Although no COPI attenuation was observed along the short WTP discharge corridor, the TSE data suggest that COPI sorption on and co-precipitation with iron/manganese oxyhydroxides is a viable mechanism for COPI uptake to the soils, consistent with past studies of metal sequestration in the No Cash Creek system (e.g., Interralogic, 2012).

Table 4-6: Results of Tessier Sequential Extraction of Soil Sample BM-23-NAT-2 (WTP Flow Path)

Parameter	Lowest Detection Limit	Units	BM-23-NAT-2				
			Exchangeable & Adsorbed Metals	Carbonate Metals	Easily Reducible Metals and Iron Oxides	Organic / Sulphide Bound Metals	Residual Metals
Aluminum (Al)	50	mg/kg	<50	<50	1350	1460	2040
Antimony (Sb)	0.10	mg/kg	0.86	0.96	2.99	2.59	9.12
Arsenic (As)	0.050	mg/kg	0.293	0.514	62.3	18.0	60.1
Barium (Ba)	0.50	mg/kg	7.46	28.9	49.0	12.5	10.3
Beryllium (Be)	0.20	mg/kg	<0.20	<0.20	0.40	<0.20	<0.20
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	0.050	mg/kg	4.55	11.1	9.35	3.57	0.184
Calcium (Ca)	50	mg/kg	4880	31100	5340	196	188
Chromium (Cr)	0.50	mg/kg	<0.50	<5.0	16.6	10.4	<5.0
Cobalt (Co)	0.10	mg/kg	<0.10	0.22	10.2	1.40	0.62
Copper (Cu)	0.50	mg/kg	0.70	0.69	3.60	28.8	2.48
Iron (Fe)	50	mg/kg	<50	<50	18400	3430	3440
Lead (Pb)	0.50	mg/kg	<0.50	28.0	650	123	39.6
Lithium (Li)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
Manganese (Mn)	1.0	mg/kg	59.2	474	3280	182	23.5
Molybdenum (Mo)	0.50	mg/kg	0.58	<0.50	0.91	1.41	0.74
Nickel (Ni)	0.50	mg/kg	1.93	11.1	51.1	9.77	3.5
Phosphorus (P)	50	mg/kg	<50	<50	<50	-	-
Potassium (K)	100	mg/kg	160	-	-	-	-
Selenium (Se)	0.20	mg/kg	<0.20	<0.20	0.24	1.08	<0.20
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	0.98	1.00	7.58
Sodium (Na)	100	mg/kg	640	-	-	-	-
Strontium (Sr)	0.50	mg/kg	24.3	41.8	9.41	0.68	<5.0
Thallium (Tl)	0.050	mg/kg	<0.050	<0.050	0.112	<0.050	0.056
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	<1.0	<5.0	<1.0	<1.0	11.8
Uranium (U)	0.050	mg/kg	0.323	1.14	1.32	0.333	0.146
Vanadium (V)	0.20	mg/kg	<0.20	<0.20	22.1	6.97	4.93
Zinc (Zn)	1.0	mg/kg	5.9	339	851	330	26.8

Table 4-7: Results of Tessier Sequential Extraction of Soil Sample BM-23-NAT-3-RB (right bank background station)

Parameter	Lowest Detection Limit	Units	BM-23-NAT-3-RB				
			Exchangeable & Adsorbed Metals	Carbonate Metals	Easily Reducible Metals and Iron Oxides	Organic / Sulphide Bound Metals	Residual Metals
Aluminum (Al)	50	mg/kg	<50	<50	1070	1980	3100
Antimony (Sb)	0.10	mg/kg	0.17	0.23	0.19	<0.10	0.87
Arsenic (As)	0.050	mg/kg	<0.050	0.137	2.76	0.855	8.01
Barium (Ba)	0.50	mg/kg	60.4	28.1	82.2	32.1	17.6
Beryllium (Be)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	0.050	mg/kg	76.5	11.6	13.1	0.619	0.084
Calcium (Ca)	50	mg/kg	3390	343	401	124	264
Chromium (Cr)	0.50	mg/kg	<0.50	<5.0	2.45	6.79	<5.0
Cobalt (Co)	0.10	mg/kg	<0.10	<0.10	2.92	1.04	1.25
Copper (Cu)	0.50	mg/kg	<0.50	<0.50	1.29	6.11	2.95
Iron (Fe)	50	mg/kg	<50	<50	5540	744	4680
Lead (Pb)	0.50	mg/kg	<0.50	5.04	76.7	15.4	14.2
Lithium (Li)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
Manganese (Mn)	1.0	mg/kg	10.0	38.1	512	94.7	44.6
Molybdenum (Mo)	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Nickel (Ni)	0.50	mg/kg	<0.50	<2.0	3.74	2.30	3.7
Phosphorus (P)	50	mg/kg	<50	<50	<50	-	-
Potassium (K)	100	mg/kg	<100	-	-	-	-
Selenium (Se)	0.20	mg/kg	<0.20	<0.20	<0.20	0.89	<0.20
Silver (Ag)	0.10	mg/kg	0.10	<0.10	1.70	0.57	0.40
Sodium (Na)	100	mg/kg	<100	-	-	-	-
Strontium (Sr)	0.50	mg/kg	13.9	<5.0	2.34	0.91	<5.0
Thallium (Tl)	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	<1.0	<5.0	1.6	19.7	67.6
Uranium (U)	0.050	mg/kg	<0.050	0.218	0.348	0.155	0.097
Vanadium (V)	0.20	mg/kg	<0.20	<0.20	7.22	5.61	8.00
Zinc (Zn)	1.0	mg/kg	252	330	1680	99.5	44.1

Table 4-8: Results of Tessier Sequential Extraction of Soil Sample BM-23-NAT-4 (WTP Flow Path)

Parameter	Lowest Detection Limit	Units	BM-23-NAT-4				
			Exchangeable & Adsorbed Metals	Carbonate Metals	Easily Reducible Metals and Iron Oxides	Organic / Sulphide Bound Metals	Residual Metals
Aluminum (Al)	50	mg/kg	<50	<50	994	1300	1470
Antimony (Sb)	0.10	mg/kg	0.19	0.16	0.22	0.12	0.69
Arsenic (As)	0.050	mg/kg	0.248	0.792	4.45	0.437	<5.00
Barium (Ba)	0.50	mg/kg	37.9	20.0	35.0	14.9	7.7
Beryllium (Be)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	0.050	mg/kg	0.179	0.071	0.343	<0.050	<0.050
Calcium (Ca)	50	mg/kg	2180	187	214	194	169
Chromium (Cr)	0.50	mg/kg	<0.50	<5.0	2.68	4.73	<5.0
Cobalt (Co)	0.10	mg/kg	0.29	0.24	2.76	0.87	0.74
Copper (Cu)	0.50	mg/kg	<0.50	0.68	2.84	7.88	2.82
Iron (Fe)	50	mg/kg	<50	100	4970	463	2500
Lead (Pb)	0.50	mg/kg	0.58	5.56	23.4	3.14	3.09
Lithium (Li)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
Manganese (Mn)	1.0	mg/kg	92.7	15.6	71.3	11.2	17.7
Molybdenum (Mo)	0.50	mg/kg	<0.50	<0.50	<0.50	0.69	<0.50
Nickel (Ni)	0.50	mg/kg	<0.50	<2.0	2.67	1.79	2.1
Phosphorus (P)	50	mg/kg	<50	<50	69	-	-
Potassium (K)	100	mg/kg	120	-	-	-	-
Selenium (Se)	0.20	mg/kg	<0.20	<0.20	<0.20	0.49	<0.20
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	<0.10	0.29	0.14
Sodium (Na)	100	mg/kg	170	-	-	-	-
Strontium (Sr)	0.50	mg/kg	10.6	<5.0	1.43	1.02	<5.0
Thallium (Tl)	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	<1.0	<5.0	1.4	6.9	42.4
Uranium (U)	0.050	mg/kg	<0.050	0.347	0.278	0.102	0.053
Vanadium (V)	0.20	mg/kg	<0.20	0.34	6.85	4.24	4.13
Zinc (Zn)	1.0	mg/kg	1.2	3.7	29.6	9.4	8.7

4.3 SOIL MICROBIOLOGY

BM-NAT-04, BM-NAT-10, and BM-NAT-17 were selected for microbial community profiling (2018 analysis). Bacteria identified to the genus level that comprised >1% of the OTUs in at least one sample are presented in Table 4-9. Only a single genus, *Nitrospira*, accounted for >1% of the OTUs in at least one soil sample. No additional soil microbiological analyses were conducted in 2024.

Nitrospira are widely distributed in nature and are key nitrite-oxidizing bacteria but are not capable of modifying the mobility of major and trace elements via redox transformations. Conversely, *Clostridium* (0.1% to 0.5% of OTUs in all three samples; Table 4-10) genera contain species known to cycle reduced and oxidized forms of sulphur. The presence of organisms in the soil samples with close genetic similarity to genera known to mediate sulphur redox transformations suggests there is the capacity for microbial controls on trace element mobility; for example, via sequestration as metal sulphides under sulphide-producing conditions. Members of the genera identified are either anaerobic or obligately anaerobic (i.e., can grow without oxygen) were identified in all three samples suggesting that sulphate-reducing niches are present in the shallow subsurface soil. It is important to note that 99.4% to 99.9% of the OTUs sequenced from each sample were either matched to genera of low abundance in the sample (<1%) or could not be matched to the genus level. The latter reflects the limited number of bacteria isolated in pure culture and available for database matching.

Table 4-9: Abundance of Bacteria Identified to the Genus Level in Transect Soil Samples

Genus	Percentage of Bacterial Community		
	BM-NAT-10	BM-NAT-17	BM-NAT-4
Nitrospira	0.39%	1.02%	0.14%
Others (each < 1% or not identified to the genus level)	99.61%	98.98%	99.86%

Table 4-10 presents the identification and relative abundance of sulphide-producing bacteria in the three soil samples, and Figure 4-3 compares the quantity of sulphate-reducing bacteria based on qPCR enumeration. A distinction is made between sulphate-reducing and sulphide-producing since not all bacteria produce sulphide from sulphate-reduction; however, the microbial community profiling and enumeration of sulphate-reducers appear complementary. Sequences associated with the *Clostridium* genus comprised the majority of the sulphide-producing bacteria in all three samples with BM-NAT-10 having the highest abundance. OTUs associated with the *Desulfobulbus and Desulfobulbaceae* were only identified in BM-NAT-10 and in much lower abundance than the *Clostridium* sequences. BM-NAT-10 sample had the highest proportion of sulphide-producing and sulphate-reducing bacteria (0.57% of sequenced OTUs and 343,770 gene copies per cm^3 soil, respectively). BM-NAT-04 and BM-NAT-17 returned a similar proportion of sulphide-producing bacteria (0.11% of sequenced OTUs) but BM-NAT-17 had the lowest number of sulphate-reducing bacteria (66,770 gene copies per cm^3 soil). Although a minor proportion of the microbial community, the presence of sulphide-producing bacteria in all three soils suggests the capacity exists for trace element sequestration as sulphide phases.

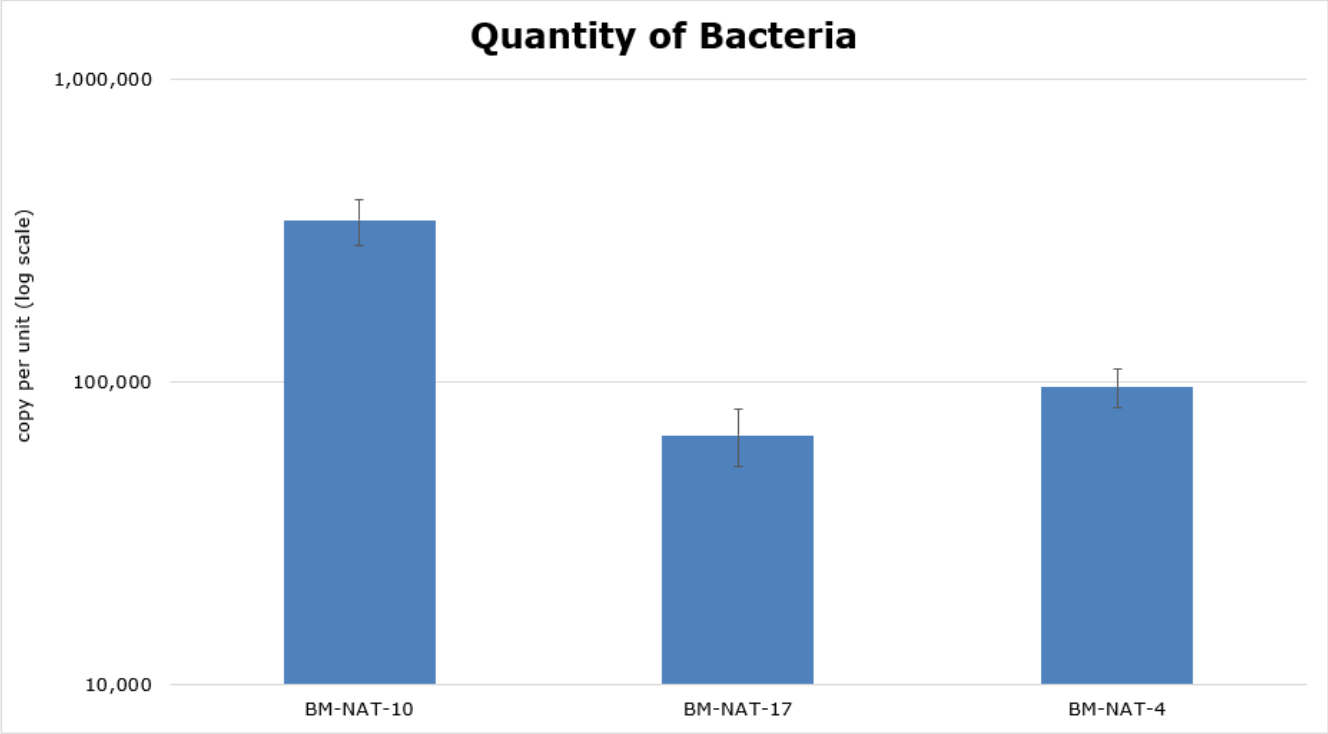


Figure 4-3: Quantity of Sulphate-reducing Bacteria in Soil Samples

Table 4-10: Identification and Abundance of Known Sulphide-producing Bacteria in Soil Samples

Genus	Can Reduce				Environment			Trait Assignment Category [1]	Percentage of Bacterial Community		
	Sulphate	Thiosulphate	Sulphite	Sulphur	Aerobic/Anaerobic Characteristics	Temperature	pH	-	BM-NAT-10	BM-NAT-17	BM-NAT-04
Desulfobulbus	Yes	Yes	Yes	No	anaerobic	mesophilic	neutrophilic	A	0.05%	-	-
Desulfobulbaceae family	Yes	Yes, some	Yes, some	Yes, some	anaerobic	mesophilic, some psychrotolerant	typically neutrophilic	A	0.01%	-	-
Clostridium_sensu_stricto	No	Yes	Yes, some	Yes, some	obligately anaerobic	mesophilic	mildly acidophilic to neutrophilic	B	0.51%	0.11%	0.11%
Total Sulphide-producing Bacteria Percentage									**0.57%**	**0.11%**	**0.11%**

[1] Trait Assignment Categories: A – most species in this genus possess these traits or abilities; B – some species in this genus possess these traits or abilities.

4.4 VEGETATION (MOSS)

The baseline total metal composition of moss collected from the likely discharge corridor is provided in Table 4-11 and laboratory reports are compiled in Appendix A, with no additional vegetation analyses having been conducted in 2024. The 2019 results of the analysis are summarized as follows:

- The two samples collected from area BM-NAT-18, the most downstream of the sampling sites had the highest metal concentrations. This was especially true for arsenic, cadmium, copper, iron, manganese, nickel, lead, and zinc. The average concentration of these constituents was 2 to 47 times higher than the sampling area with second highest concentration (BM-NAT-110). Cadmium, nickel, and zinc at BM-NAT-18 were particularly elevated compared to BM-NAT-05 and/or BM-NAT-10. The average cadmium concentration at BM-NAT-18 was 14 and 47 times higher than BM-NAT-10 and BM-NAT-05, respectively, and the average zinc concentration was 12 and 63 times higher than BM-NAT-10 and BM-NAT-05, respectively. Also, the average aluminum and iron concentration at BM-NAT-18 were nearly 3 and 5 times higher than BM-NAT-10 and 12 and 8 times higher than BM-NAT-05, respectively. These elevated metal data in BM-NAT-18 samples suggest residual soil contamination despite the washing in preparation of testing.
- BM-NAT-10 samples had the highest antimony and second highest metal concentration of arsenic, cadmium, copper, manganese, lead, and zinc and BM-NAT-05 had the lowest suggesting an increasing metal content in vegetation downstream of the proposed charge location. The disparity of concentration was not as high as between BM-NAT-18 and BM-NAT-10. The average cadmium and zinc concentration at BM-NAT-10 were only 3 and 5 times higher than BM-NAT-05, respectively.
- BM-NAT-10 samples reported the second highest iron and nickel content after BM-NAT-18.

Table 4-11: Results of Elemental Analysis of Moss Samples

Parameter	Lowest Detection Limit		BM-NAT-05		BM-NAT-10		BM-NAT-18	
		Sample ID	BM-NAT-05-A	BM-NAT-05-B	BM-NAT-10-A	BM-NAT-10-B	BM-NAT-18-A	BM-NAT-18-B
		Units	Moss	Moss	Moss	Moss	Moss	Moss
Physical Tests (Tissue)								
Moisture	0.50	%	81.2	93.6	92.1	86.5	78.3	78.9
Total Metals (Tissue)								
Aluminum (Al)-Total	2.0	mg/kg	395	601	127	97	1080	1550
Antimony (Sb)-Total	0.010	mg/kg	0.2	0.2	0.4	0.36	1.21	1.71
Arsenic (As)-Total	0.020	mg/kg	0.7	0.9	1.4	1.34	4.76	8.82
Barium (Ba)-Total	0.050	mg/kg	18.6	120	24.6	34.6	91.8	92.3
Beryllium (Be)-Total	0.010	mg/kg	0.019	0.036	<0.010	<0.010	0.101	0.140
Bismuth (Bi)-Total	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	0.026	0.021
Boron (B)-Total	1.0	mg/kg	<1.0	<1.0	1.6	5.0	6.3	6.0
Cadmium (Cd)-Total	0.0050	mg/kg	0.6	0.8	2.2	2.55	32.9	34.1
Calcium (Ca)-Total	20	mg/kg	1530	4160	5310	5500	13900	13900
Cesium (Cs)-Total	0.0050	mg/kg	0.507	0.076	0.0645	0.0499	0.736	0.494
Chromium (Cr)-Total	0.050	mg/kg	0.38	0.333	0.288	0.250	1.73	2.28
Cobalt (Co)-Total	0.020	mg/kg	0.377	1.60	0.252	0.387	1.73	2.84
Copper (Cu)-Total	0.10	mg/kg	2.1	2.1	2.7	4.6	17.2	24.4
Iron (Fe)-Total	3.0	mg/kg	314	625	365	295	1980	3030
Lead (Pb)-Total	0.020	mg/kg	10	19	24	19	28	46
Lithium (Li)-Total	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	0.71	1.01
Magnesium (Mg)-Total	2.0	mg/kg	627	1160	1250	1270	1740	1960
Manganese (Mn)-Total	0.050	mg/kg	415	350	311	918	1540	2440

Parameter	Lowest Detection Limit		BM-NAT-05		BM-NAT-10		BM-NAT-18	
		Sample ID	BM-NAT-05-A	BM-NAT-05-B	BM-NAT-10-A	BM-NAT-10-B	BM-NAT-18-A	BM-NAT-18-B
		Units	Moss	Moss	Moss	Moss	Moss	Moss
Molybdenum (Mo)-Total	0.020	mg/kg	0.073	0.102	0.043	0.067	0.247	0.356
Nickel (Ni)-Total	0.20	mg/kg	0.70	2.12	1.03	0.79	37.2	39.2
Phosphorus (P)-Total	10	mg/kg	629	524	949	893	1380	1590
Potassium (K)-Total	20	mg/kg	3090	3010	3520	2270	2190	2670
Rubidium (Rb)-Total	0.050	mg/kg	16.0	10.7	8.05	5.26	19.5	23.2
Selenium (Se)-Total	0.050	mg/kg	<0.050	0.055	<0.050	<0.050	0.306	0.468
Silver (Ag)-Total	0.0050	mg/kg	0.4	0.26	0.53	0.51	1.30	1.50
Sodium (Na)-Total	20	mg/kg	<40	182	41	<20	48	123
Strontium (Sr)-Total	0.050	mg/kg	4.8	18.1	11.00	9.1	35.8	35.1
Tellurium (Te)-Total	0.020	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Thallium (Tl)-Total	0.0020	mg/kg	0.0052	0.0247	0.0128	0.0029	0.0620	0.0821
Tin (Sn)-Total	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	0.11	0.14
Uranium (U)-Total	0.0020	mg/kg	0.0123	0.0477	0.0124	0.0087	0.306	0.534
Vanadium (V)-Total	0.10	mg/kg	0.48	0.51	0.35	0.25	2.98	4.19
Zinc (Zn)-Total	0.50	mg/kg	42	46	276	175	2740	2780
Zirconium (Zr)-Total	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.25	0.91

4.5 WATER QUALITY

4.5.1 SURFACE WATER QUALITY

The dissolved concentrations of constituents of potential interest (COPI) in surface waters sampled from KV-118 to KV-21 between 2008 and 2024 were compared with the effluent quality standards (EQS) for the New Bermingham WTP and the No Cash Creek water quality objectives (WQO). The EQS are defined in the Water Licence (QZ18-044) that came into effect on July 23, 2020 and apply specifically to station KV-114 (New Bermingham WTP decant pond), while the WQO are listed in the adaptive management plan (Hecla Yukon, 2023) and apply to the farthest downstream receiving environment station in No Cash Creek (KV-21). Although they do not apply to the untreated discharge, the EQS were also compared with data collected from the New Bermingham portal discharge (KV-110) to provide a benchmark for comparison. For hardness-, pH-, dissolved organic carbon- (DOC), and temperature-dependent constituents (e.g., ammonia, nickel, and lead), the WQO was determined on a sample-by-sample basis. The comparison of water quality results with the EQS and WQO is to:

- Identify elevated constituent concentrations in water quality data prior to the start of untreated discharge from the New Bermingham portal during advanced exploration; and
- Provide a benchmark for comparison with surface water quality data during both the advanced exploration period (July 2017 to August 2020) when untreated water discharged from the Bermingham portal and following the implementation of the WTP (September 2020 onwards).

Time series plots depicting the results for COPI are shown in Figure 4-4 through Figure 4-15 and associated summary statistics are reported in Table 4-12 through Table 4-21. Values measuring less than the detection limit were halved for statistics and plots. Dissolved arsenic was elevated above the EQS in more than 5% of the samples collected from the treated New Bermingham decant (KV-114; 7% exceedances) and the untreated New Bermingham portal (KV-110; 28% exceedances). At KV-110, these elevated concentrations mostly occurred in 2018 and from the end of September 2020 to February 2022, with fewer exceedances observed since. In 2024, only one sample collected at KV-110 had an arsenic concentration that was above the EQS (March 25, 2024). Fewer samples at KV-114 exceeded the dissolved arsenic EQS than at KV-110 since the end of September 2020 and there were no dissolved arsenic EQS exceedances measured at KV-114 since June 28, 2021. At KV-114, 11 of the 229 samples (5%) collected returned a pH greater than 9.5 and 18 of 220 samples (8%) collected returned total suspended solids (TSS) concentrations above the EQS (25 mg/L) from September 2020 (start of sampling) to December 2024.

The maximum short-term WQOs at KV-21 for dissolved cadmium and zinc were not exceeded in any of the samples collected in 2024; and no samples collected in 2024 returned 24-month rolling average concentrations greater than the long-term WQO for cadmium and zinc. There appears to have been an improvement in water quality at KV-21 in 2023 and 2024 compared to July through November 2020, and 2021 when dissolved cadmium and zinc concentrations exceeded the maximum short-term WQOs, and there were exceedances of the long term WQOs based on the 12-month rolling averages (2020 and 2021). This is likely related to in elevated cadmium and zinc concentrations from the No Cash 500 adit (KV-20) between June 2020 and February 2021, which drives concentrations observed at KV-21. There was also a slight decrease in median concentrations for both dissolved cadmium and zinc at KV-21 in 2024 (0.0098 mg/L and 1.26 mg/L, respectively) compared to 2023 (0.0135 and 1.63 mg/L, respectively). Dissolved cadmium and zinc concentrations measured at KV-21 in 2024 were within historical ranges. All other parameters with a WQO at KV-21 (ammonia, nitrate, nitrite, sulphate, dissolved arsenic, copper lead, nickel, selenium, silver, and uranium) were below their respective WQO in 2024.

4.5.1.1 FIELD PH

Field pH data indicate a generally stable neutral field pH despite a few isolated exceedances (Figure 4-4). There is no seasonality depicted in the field pH data. The field pH has remained in the Canadian Council for Ministers of the Environment (CCME) guideline range (pH 6.5 — 9.0) during the monitoring period except for a few exceedances of the lower pH limit (pH below pH 6.5) at the Bermingham 200 adit (KV-18) and the No Cash 500 adit (KV-20) occurring pre-2022, both of which stabilized to circumneutral pH in 2023. Exceedances of the lower pH limit were observed at KV-118 (Upper No Cash Creek at Calumet) in 2024. Recurrent alkaline pH at KV-114 continued into 2024, with values close to the upper EQS defined pH boundary (9.5). A decline in field pH was observed at KV-114 samples in October through December 2024. Eight of the 56 samples collected at KV-114 in 2021 had a pH that exceeded the EQS of pH 9.5, while no samples exceeded the pH EQS since December 2021. Discharge from the New Bermingham adit (KV-110) exhibited marked increases in pH in 2023 and through 2024. Overall, No Cash Creek, and the historical Ruby 400 (KV-19) and Bermingham 200 (KV-18) adit discharges typically exhibited circumneutral to mildly alkaline pH and generally remained within the Canadian Council for Ministers of the Environment (CCME) boundaries (pH 6 .5 to 9.0).

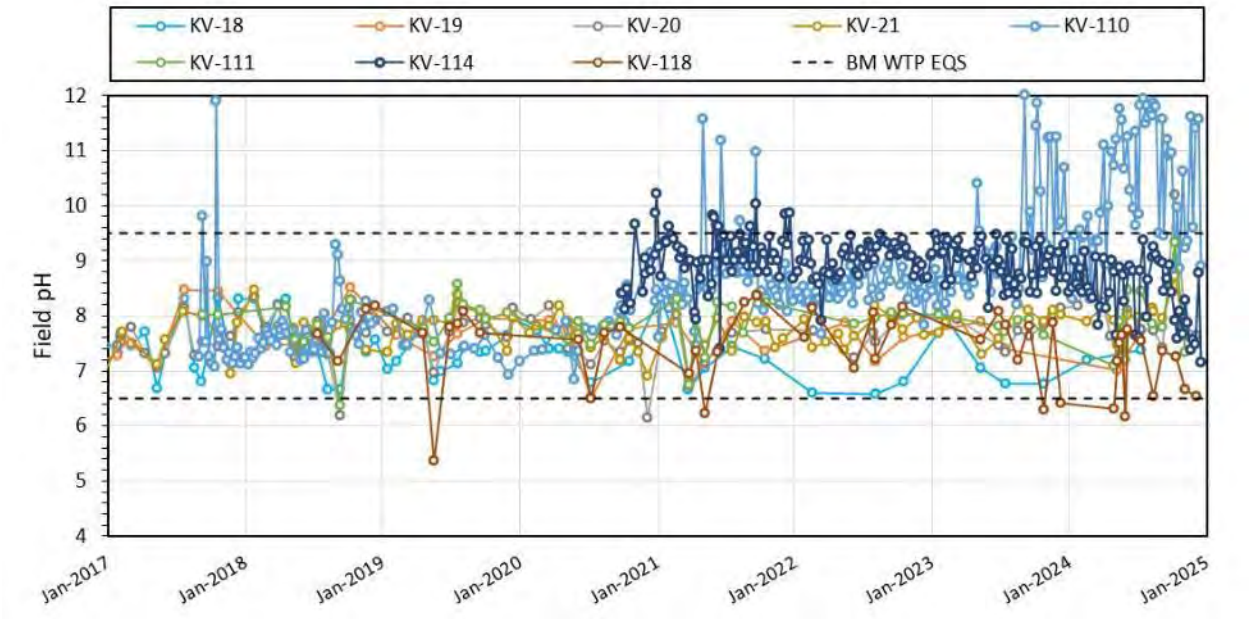


Figure 4-4: Field pH at Monitoring Stations, 2017-2024 Data

4.5.1.2 FIELD REDOX POTENTIAL

As expected, the oxidation-reduction potential (ORP) at the monitoring stations was oxidizing but large fluctuations were recurrent in the dataset (approximate range of -200 to 800 mV). The redox potential in 2024 seemed to decrease slightly from previous years, with minimum and maximum field ORP values ranging from -160 mV (KV-118) to +216 mV (KV-20). The median ORP at the monitoring stations range from +31.1 to 114 mV. No ORP measurements were taken at KV-114 or KV-110 since the start of sampling or since October 2017, respectively. All ORP measurements in 2024 continued to be largely oxidizing, and no trend is discernable at this time.

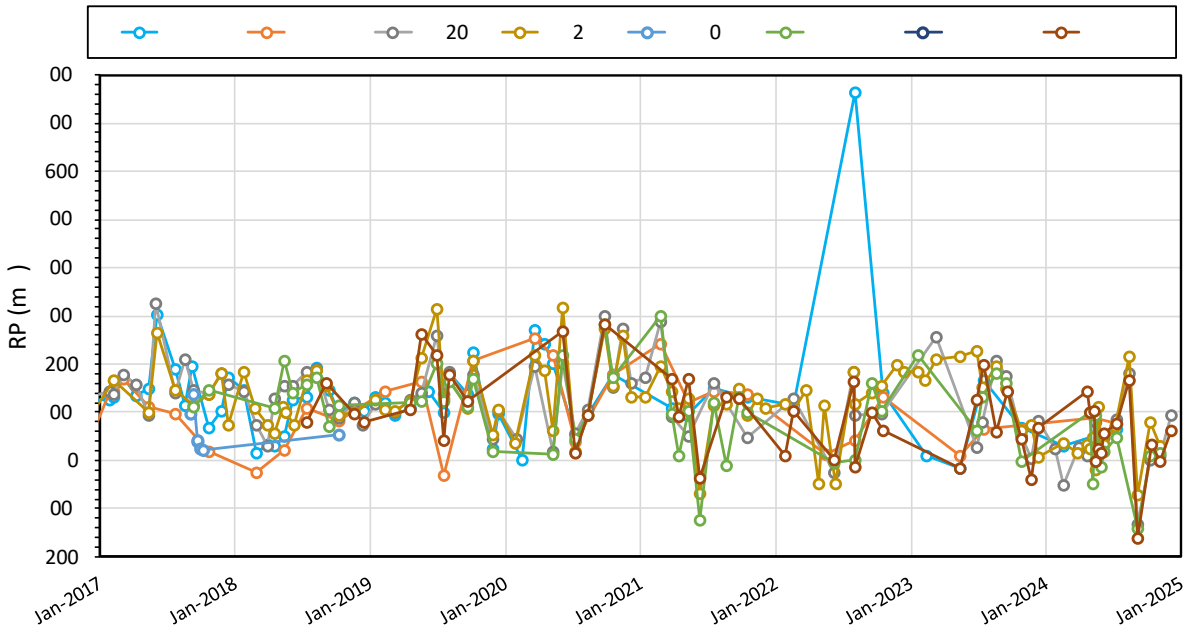


Figure 4-5: Field ORP at Monitoring Stations, 2017-2024 Data

Oxidation-reduction potential (ORP) data not available for KV-114. Therefore, site is not shown on the graph.

4.5.1.3 SILVER

The dissolved silver time series plot and statistical summary of the monitoring data are shown in Figure 4-6 and Table 4-12, respectively. Historically, and in 2024, dissolved silver concentrations in the New Bermingham portal discharge (KV-110) and in the decant pond (KV-114) mostly remained below the EQS (0.00062 mg/L), except for two exceedances at KV-114 (September 2023 and June 2024). Most of the samples taken at these points had dissolved silver concentrations below the detection limit, historically, but less so in 2023 and 2024. The dissolved silver concentrations at KV-21 were usually below the detection limit and were only above the WQO in 2% of samples, with no exceedances in 2024. Dissolved silver was regularly below the detection limit at the No Cash 500 adit (KV-20) historically, and in 2024. It was noted that elevated silver concentrations at the Historical Bermingham 200 (KV-18) and No Cash 500 (KV-20) adit monitoring stations and KV-110 (New Bermingham adit) and KV-111 (No Cash Creek upstream of No Cash 500 adit) were generally associated with summer months (April through October) and the lowest concentrations (below detection limit) during winter months reflecting release during freshet. However, a clear seasonality was only seen at KV-18 (pre-2019) and KV-21 (since 2012). KV-111 also showed a seasonality marked by peak silver concentrations during freshet (April-May) over the historical period; with all other samples below the detection limit. The higher silver concentrations were typically observed at KV-118 compared to the New Bermingham mine discharge (KV-110 pre-WTP installation and KV-114 since WTP installation in 2020), however, there has been a noted increase in dissolved silver concentrations at KV-114 in 2023 and 2024, often exceeding KV-118 concentrations. Dissolved silver concentrations in 2023 and 2024 at KV-118 may have marginally increased since pre-2022 (Figure 4-6); however, concentrations at KV-111 are the same. This may suggest that the KV-114 dissolved silver concentrations have minimal effect on dissolved silver concentrations in downstream No Cash Creek.

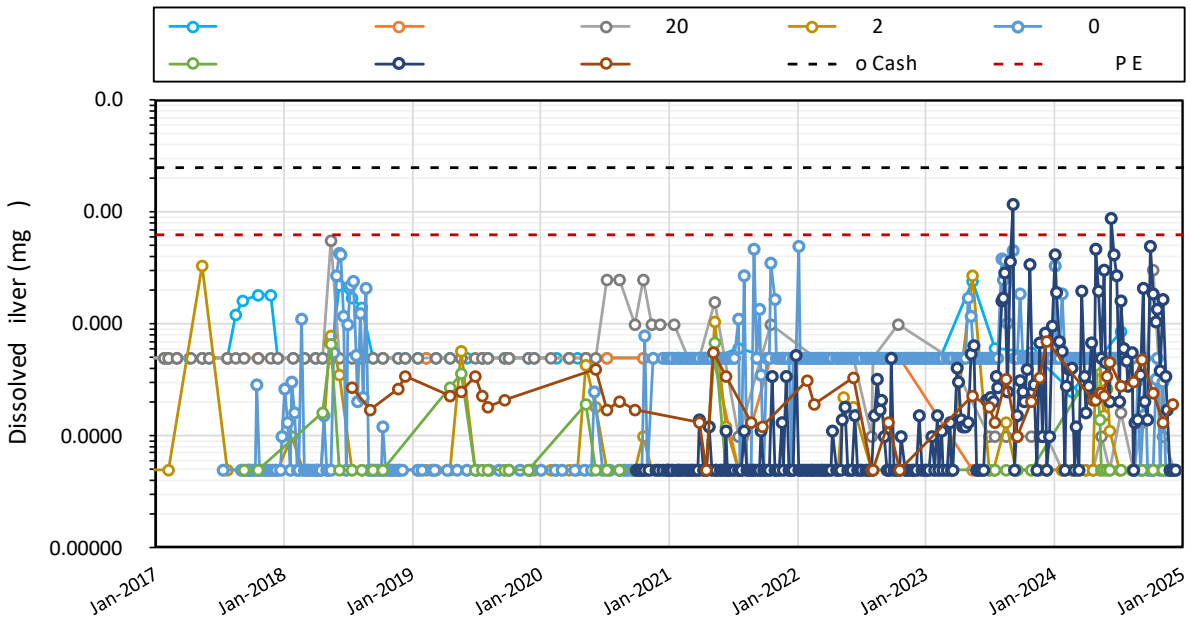


Figure 4-6: Dissolved Silver at Monitoring Stations, 2017-2024 Data

Table 4-12: Dissolved Silver Statistics at Monitoring Stations, 2008-2024 Data

Dissolved Silver (EQS= 0.00062 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.000088	0.000044	0.000057	0.000028	0.000052	0.0000097	0.000046	0.000024
Count	135	108	152	152	313	53	219	48
Minimum	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010	<0.000010
Maximum	0.00090	<0.0001	0.00056	0.00060	0.00050	0.000068	0.0012	0.000070
Count <DL	104	107	143	122	268	45	119	4
Standard Deviation	0.00013	0.000015	0.000064	0.000063	0.000075	0.000014	0.00013	0.000013
1st Quartile	0.000050	0.000050	0.000050	0.0000050	0.000010	0.000010	0.0000050	0.000017
Median	0.00010	0.000050	0.000050	0.0000050	0.00010	0.000010	0.000010	0.000023
3rd Quartile	0.000050	0.000050	0.000050	0.000049	0.00010	0.000010	0.000028	0.000031
99 Percentile	0.00074	0.000050	0.00034	0.00030	0.00043	0.000068	0.00049	0.000063
Count Over Guideline	-	-	-	3	0	-	2	-
% Over Guideline	-	-	-	2%	0%	-	1%	-

[a] KV-21 compared to WQO (0.00025 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.00062 mg/L).

4.5.1.4 ARSENIC

The dissolved arsenic time series plot and statistical summary of the monitoring data are shown in Figure 4-7 and Table 4-13, respectively. The dissolved arsenic concentrations at KV-110 were lower than the EQS during early monitoring in 2017 then increased and remained above, at, or slightly below the EQS (0.061 mg/L) until the end of 2019. Most of the samples collected in the first part of 2020 were below the EQS. The concentration then increased, surpassing the EQS in most samples collected since October 2020 to February 2022, with fewer exceedances observed since. This increase above the EQS was also observed at KV-114 (at which the EQS applies) between October 2020 and July 2021 and coincided with the increase of field pH to alkaline levels. While most dissolved arsenic concentrations measured in samples at KV-110 were above the EQS in samples throughout 2021 (80%), 2022 noted a large decrease in the number of exceedances, and the same was noted for 2023 (25% of samples exceeding) and even more so in 2024 (0.3% of samples exceeding). Dissolved arsenic concentrations measured at KV-114 from July 2021 to December 2024 were below the EQS. Over the historical period, 28% and 7% of the samples from KV-110 and KV-114 had dissolved arsenic higher than the EQS, respectively. However, these elevated arsenic concentrations from the adit discharge and decant pond did not affect the downstream stations KV-111 and KV-118 which remain well below the arsenic WQO in 2024. Low dissolved arsenic concentrations were also measured at KV-21 without ever surpassing the WQO (0.025 mg/L) in the 17-year dataset.

Elevated arsenic concentrations were noted in the historical Bermingham 200 adit discharge (KV-18). There was a slight seasonality at Bermingham 200 adit (KV-18) where discharge dissolved arsenic concentrations were generally lowest in May-June then gradually increased peaking in January-March the following year. However, this seasonal pattern was less evident in recent years (2018 to 2024), perhaps partially due to the lower sampling frequency enacted at KV-18 since mid-2020 (changed from monthly to quarterly). There is also a slight observable decrease in dissolved arsenic concentrations at KV-18 between 2021 and 2024. A similar seasonal pattern was also observed at the No Cash 500 adit (KV-20). Arsenic concentrations at KV-111, located on No Cash Creek above No Cash 500 adit, showed a different seasonal variation, marked by peak concentrations during freshet (April through May) and lowest concentration in the fall (September through October). Dissolved arsenic concentrations at Upper No Cash Creek at Calumet Drive (KV-118) have remained nearly unchanged for the last four years (except for samples collected in March and April 2021, when dissolved arsenic concentrations were almost an order of magnitude lower). Dissolved arsenic concentrations at KV-118 exhibited slightly lower concentrations in 2023 and 2024.

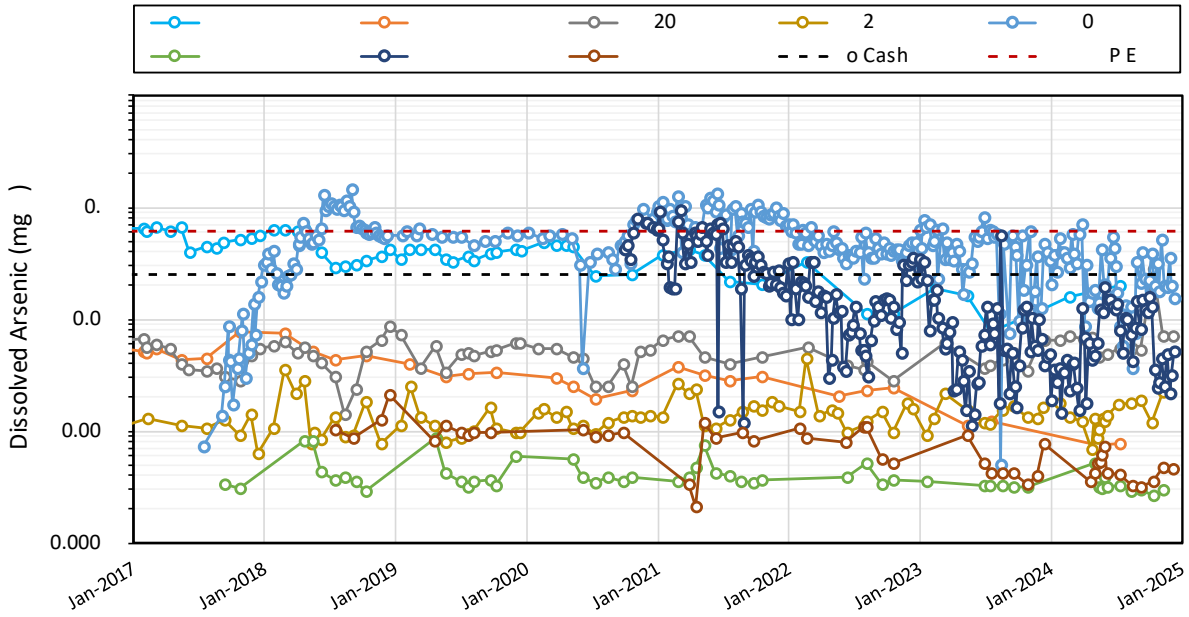


Figure 4-7: Dissolved Arsenic at Monitoring Stations, 2017-2024 Data

Table 4-13: Dissolved Arsenic Statistics at Monitoring Stations, 2008-2024 Data

Dissolved Arsenic (EQS = 0.061 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.044	0.0037	0.0048	0.0014	0.049	0.00040	0.020	0.00074
Count	135	108	152	152	313	53	219	48
Minimum	0.0074	0.00076	0.00080	0.00064	<0.0010	0.00027	0.0011	0.00021
Maximum	0.078	0.0077	0.028	0.0046	0.14	0.00087	0.093	0.0021
Count <DL	0	0	3	0	1	0	0	0
Standard Deviation	0.017	0.0012	0.0024	0.00065	0.028	0.00014	0.020	0.00035
1st Quartile	0.033	0.0030	0.0035	0.0010	0.031	0.00033	0.0052	0.00042
Median	0.045	0.0036	0.0046	0.0012	0.047	0.00036	0.013	0.00078
3rd Quartile	0.057	0.0044	0.0057	0.0015	0.063	0.00039	0.031	0.00096
99 Percentile	0.074	0.0073	0.0095	0.0042	0.13	0.00085	0.079	0.0017
Count Over Guideline	-	-	-	0	87	-	15	-
% Over Guideline	-	-	-	0%	28%	-	7%	-

[a] KV-21 compared to WQO (0.025 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.061 mg/L).

4.5.1.5 CADMIUM

The dissolved cadmium time series plot and statistical summary of the monitoring data are shown in Figure 4-8 and Table 4-14, respectively. The dissolved cadmium concentrations at KV-110 were frequently lower than the EQS (0.01 mg/L) with only eleven samples that returned cadmium concentrations higher than the EQS, two of which were in late May and June 2020, and again within the same period in 2022. There were no exceedances of the EQS at KV-110 in 2023 or 2024. Cadmium concentrations were typically one to three orders of magnitude lower than the EQS in the New Bermingham decant (KV-114) historically. Dissolved cadmium concentrations at KV-110 remained below the detection limits for the majority of 2024, except in the month of January, however concentrations remained well below the EQS. The dissolved cadmium concentrations at KV-110 were elevated during early monitoring, decreased by approximately three orders of magnitude between late 2018 through 2019, increased again in mid-2020 to 2022, and subsequently decreased between 2022 and 2024 (Figure 4-8). This behaviour reflects initial advancement of the exploration workings, a suspension of activity, then further expansion of the workings upon receipt of the water licence.

Historically, water discharged from the historical Bermingham 200 (KV-18), Ruby 400 (KV-19), and No Cash 500 (KV-20) adits consistently had elevated cadmium concentrations relative to generic Canadian water quality guidelines. KV-118, which represents the upper reach of No Cash Creek that experiences seasonal flow, returned cadmium concentrations generally higher than the New Bermingham portal discharge, and similar to KV-19 (Ruby 400 adit discharge) which may suggest an influence from the Ruby 400 adit. Compared to KV-118, lower cadmium concentrations were observed farther downstream on No Cash Creek at KV-111 (situated upstream of the No Cash 500 adit), historically, and continued throughout 2024. This is suggestive of dilution and/or cadmium attenuation in Upper No Cash Creek. Cadmium concentrations at the farthest downstream No Cash Creek station, KV-21, were approximately two orders of magnitude higher than those at KV-111 due to the contribution from the No Cash 500 adit discharge which flows into No Cash Creek between these two stations. Four samples (3%) of samples collected

at KV-21 were higher than the short-term maximum WQO (all which occurred in 2020) and 22% of the calculated 24-month rolling averages over the past three years were higher than the long-term WQO (0.0209 mg/L), all occurring in 2022. The majority of these were likely due to the sustained higher cadmium concentrations in the No Cash 500 adit (KV-20) discharge in 2020, likely related to higher flow conditions for that year.

A weak seasonal pattern characterized by peak concentrations in May through July followed by a gradual decline during the rest of the year (lowest concentrations in winter months) was observed at the Bermingham 200 adit (KV-18) and Ruby 400 adit (KV-19), with a stronger seasonal pattern noted for the No Cash 500 adit (KV-20). The seasonality observed at No Cash 500 adit was also reflected in water collected from No Cash Creek station KV-21. KV-111 also showed seasonality in which peak cadmium concentrations generally occurred during freshet (April through May) followed by a decline and lowest concentration in the summer/fall (August through October), though concentration peaks and troughs have become less prominent since 2021. The Ruby 400 adit also showed an increase in dissolved cadmium after relatively unchanged concentrations in 2019, though the concentrations stabilized in 2022.

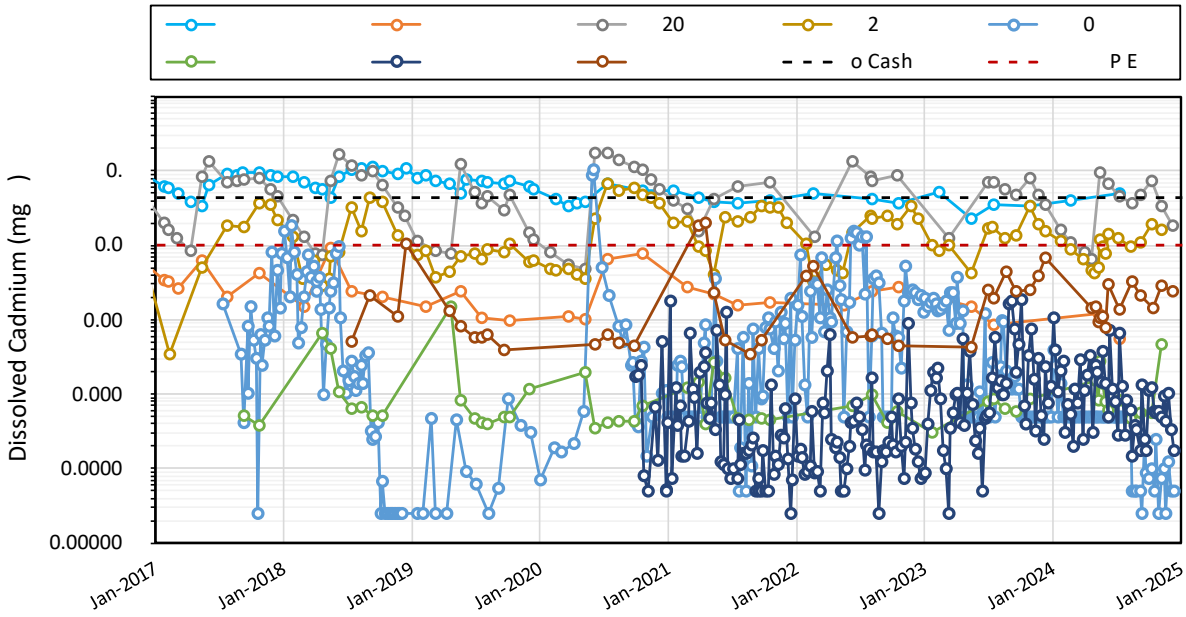


Figure 4-8: Dissolved Cadmium at Monitoring Stations, 2017-2024 Data

Table 4-14: Dissolved Cadmium Statistics at Monitoring Stations, 2008-2024 Data

Dissolved Cadmium (EQS = 0.01 mg/L)[a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.084	0.0059	0.069	0.015	0.0019	0.00013	0.00014	0.0026
Count	136	108	152	152	313	53	219	48
Minimum	0.023	0.00055	0.0049	0.00035	<0.0000050	0.000030	<0.0000050	0.00034
Maximum	0.42	0.022	0.55	0.067	0.11	0.0015	0.0019	0.020
Count <DL	0	0	0	0	120	0	41	0
Standard Deviation	0.060	0.0047	0.065	0.012	0.0082	0.00022	0.00029	0.0040
1st Quartile	0.043	0.0024	0.019	0.0062	0.00010	0.000047	0.000016	0.00057
Median	0.069	0.0039	0.057	0.010	0.00012	0.000063	0.000044	0.0012
3rd Quartile	0.098	0.0085	0.10	0.021	0.0011	0.00011	0.00012	0.0025
99 Percentile	0.32	0.022	0.25	0.057	0.016	0.0011	0.0017	0.019
Count Over Guideline	-	-	-	4	11	-	0	-
% Over Guideline	-	-	-	3%	4%	-	0%	-

[a] KV-21 compared to the short-term WQO (0.0445 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.01 mg/L).

4.5.1.6 COPPER

The dissolved copper time series plot and statistical summary of the monitoring data are shown in Figure 4-9 and Table 4-15, respectively. The dissolved copper concentrations in the New Bermingham portal discharge (KV-110) were generally lower than the EQS (0.024 mg/L) in 2017 and early 2018, then increased above the EQS on three occasions (1% of sample dataset) between March and August 2018 and finally decreased below the EQS and often below the detection limit during the remainder of the monitoring period (2019-2024). The dissolved copper concentrations in the New Bermingham decant discharge (KV-114) were also low and below the detection limit during many of the sampling events in 2022, however, concentrations exhibited an increase in 2023, with one sample (<1%) exceeding the EQS in August 2023. Dissolved copper concentrations decreased slightly in 2024 compared to 2023, with no EQS exceedances observed in 2024. The upper No Cash Creek stations KV-111 and KV-118 had overall comparable concentrations that were lower than those observed at KV-110 during 2017 to September 2018 but higher since late 2018 due to the decline of copper below the detection limit at KV-110. The No Cash Creek station KV-21 did not exhibit any WQO exceedances in 2024, with most historical exceedances (6% of samples) occurring prior to 2020. KV-18, KV-20, and KV-21 showed copper seasonality although more muted compared to dissolved cadmium. The KV-18 station historical copper concentrations were commonly below the detection limit since 2014. KV-111 also showed a weak copper seasonality marked by peak concentrations during freshet and lowest concentration in the summer/fall (August through October).

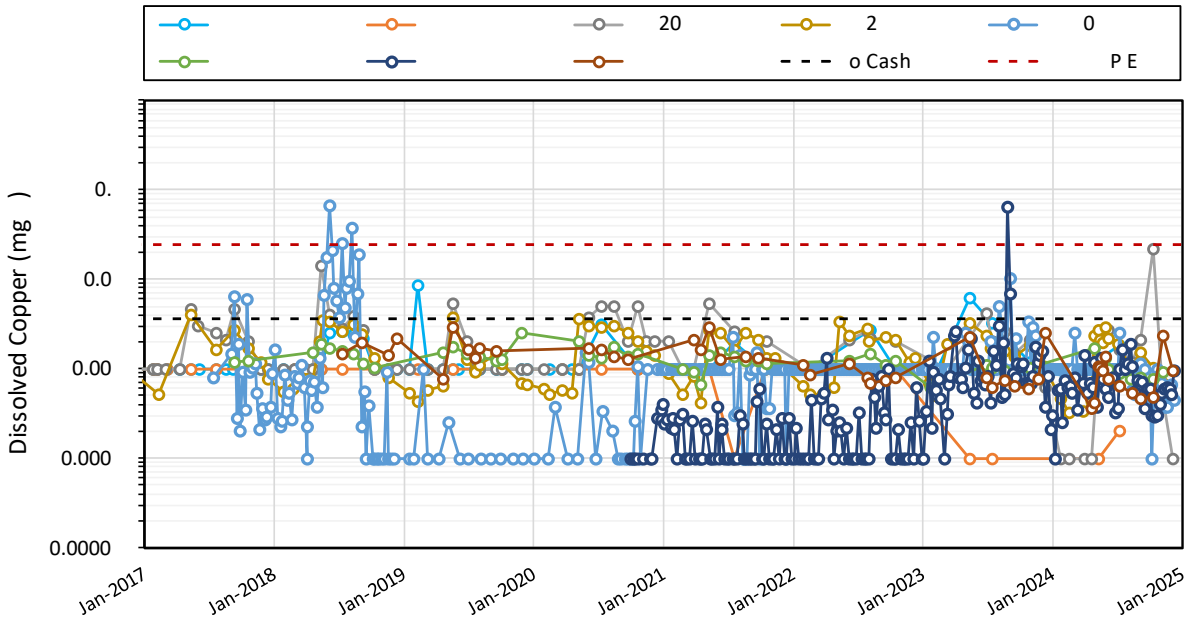


Figure 4-9: Dissolved Copper at Monitoring Stations, 2017-2024 Data

Table 4-15: Dissolved Copper Statistics at Monitoring Stations, 2008-2024 Data

Dissolved Copper (EQS = 0.024 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.0019	0.00081	0.0032	0.0017	0.0017	0.0013	0.00081	0.0013
Count	135	108	152	152	313	53	219	48
Minimum	0.000090	<0.00020	<0.00020	0.00032	<0.00020	0.00062	<0.00020	0.00036
Maximum	0.016	0.0016	0.11	0.0090	0.068	0.0025	0.064	0.0030
Count <DL	95	99	77	11	210	0	73	0
Standard Deviation	0.0024	0.00031	0.0091	0.0012	0.0050	0.00036	0.0043	0.00065
1st Quartile	0.0010	0.00050	0.0010	0.00073	0.00061	0.0010	0.00010	0.00076
Median	0.0020	0.0010	0.0017	0.0013	0.0020	0.0012	0.00031	0.0011
3rd Quartile	0.0013	0.0010	0.0030	0.0023	0.0020	0.0015	0.00070	0.0016
99 Percentile	0.012	0.0011	0.024	0.0056	0.021	0.0023	0.0029	0.0030
Count Over Guideline	-	-	-	9	3	-	1	-
% Over Guideline	-	-	-	6%	1%	-	0.5%	-

[a] KV-21 compared to short-term WQO (0.00359 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.024 mg/L).

4.5.1.7 LEAD

The dissolved lead time series plot and statistical summary of the monitoring data are shown in Figure 4-10 and Table 4-16, respectively. The dissolved lead concentrations in the New Bermingham portal discharge (KV-110) were commonly much lower than the EQS (0.048 mg/L) in 2017 and early 2018 and increased above the EQS twice between March and August 2018. The concentration then decreased significantly below the EQS until 2021, when concentrations in seven more samples were above the EQS (6% of samples over the dataset). One sample was above the EQS in 2022 (June 13), two samples were higher than the EQS in 2023 (August, September), and 9 samples were above the EQS in 2024 (18% exceedances in 2024). The dissolved lead concentrations in the New Bermingham WTP decant (KV-114) were historically below the EQS, generally by one or more orders of magnitude, however, two exceedances (4% of 2023 samples) were observed at KV-114 at roughly the same period as the exceedances observed at KV-110 in 2023. There were no exceedances for dissolved lead at KV-114 in 2024. The elevated dissolved lead concentrations from the New Bermingham portal discharge in 2018 and from the New Bermingham Pond decant from 2021 to 2024 did not affect the downstream stations KV-111 and KV-118, both exhibiting lead concentrations well below the WQO. Dissolved lead concentrations at KV-111 and KV-118 were higher than those in the discharge from the New Bermingham portal (KV-110) in 2019 and the first half of 2020. Lead concentrations generally declined between KV-118 and KV-111, often exhibiting concentrations below detection at KV-111. This is suggestive of some dilution and/or attenuation in upper No Cash Creek. Concentrations for KV-111 and KV-118 continued to be much lower than the WQO in 2024. Seasonal peak dissolved lead concentrations above the WQO were occasionally measured in the downstream No Cash Creek station KV-21 (6% of samples, hardness dependant WQO). A seasonal pattern characterized by peak concentrations in May through September followed by gradual decline during the rest of the year is observed at the Bermingham 200 adit (KV-18) and No Cash Creek KV-21 monitoring stations. Dissolved lead concentrations at the Ruby 400 adit (KV-19) and No Cash 500 adit (KV-20) remained near or below the detection limit from mid-2013 to 2024.

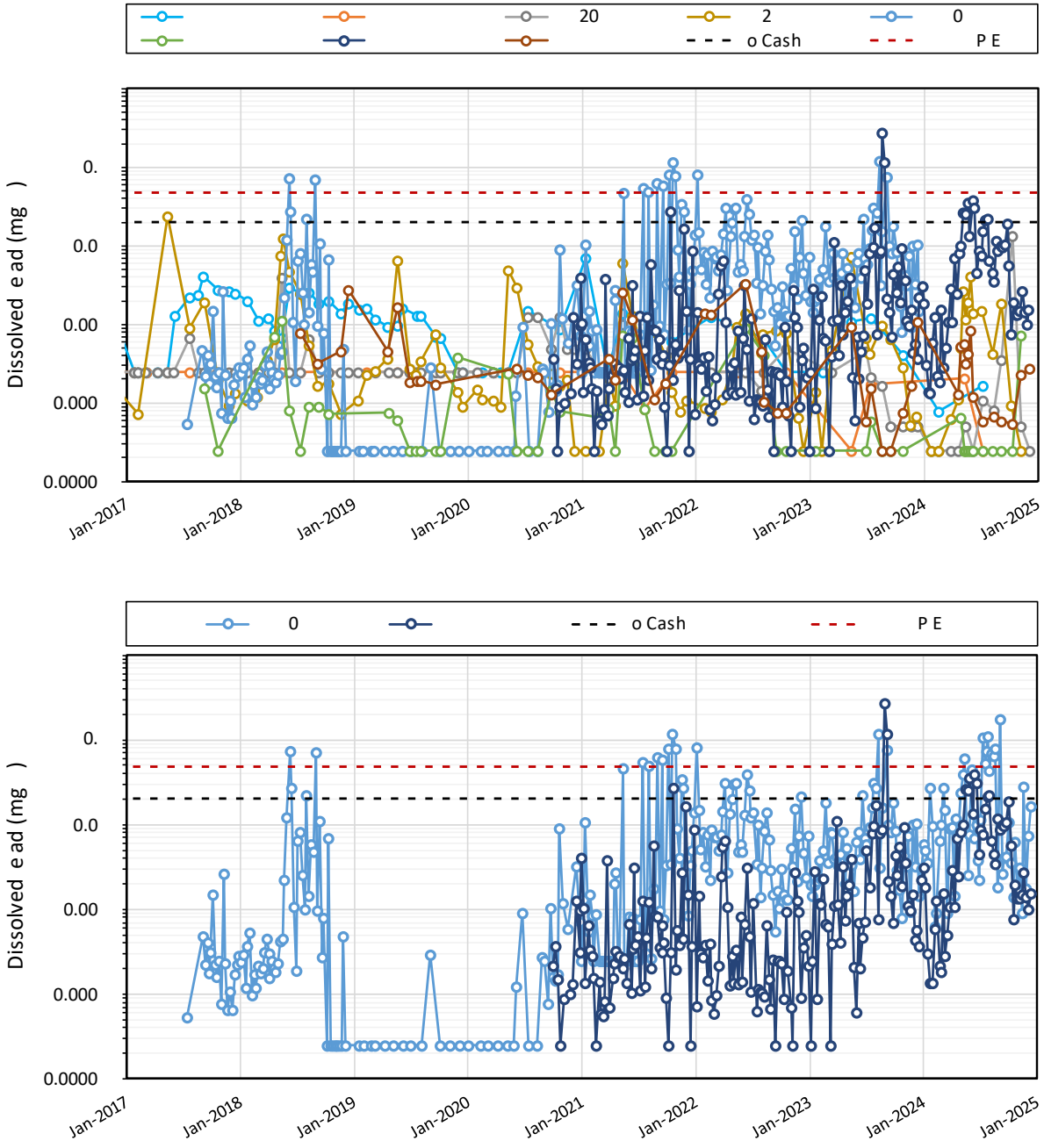


Figure 4-10: Dissolved Lead at Monitoring Stations, 2017-2024 Data

Table 4-16: Dissolved Lead Statistics at Monitoring Stations, 2008-2024 Data

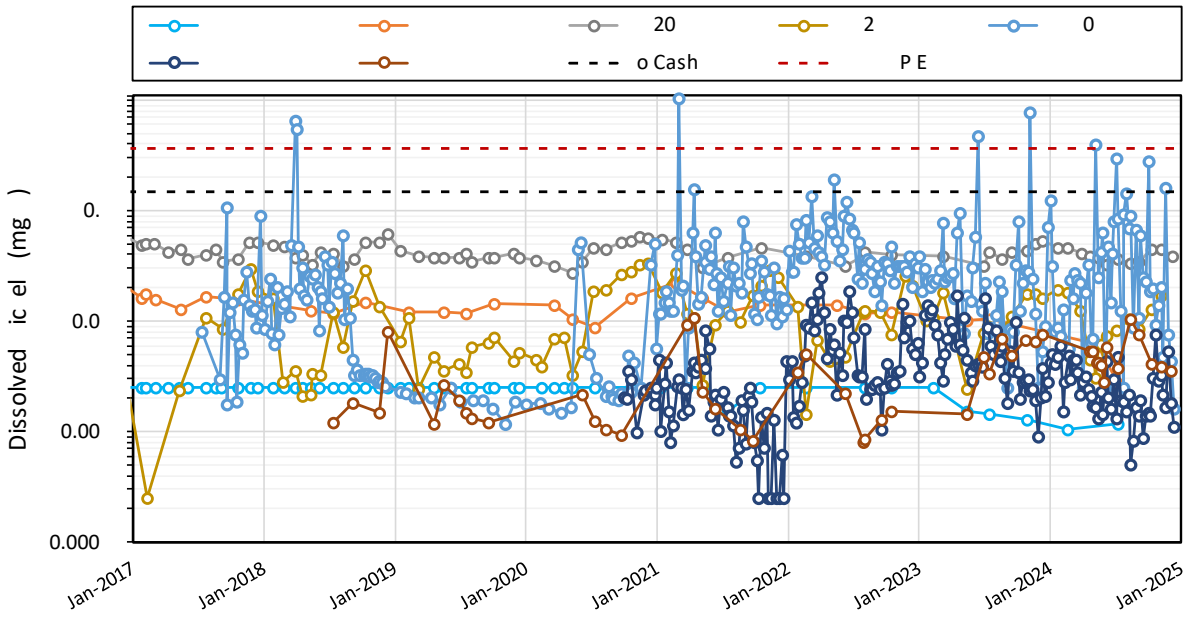
Dissolved Lead (EQS = 0.048 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.0016	0.00029	0.00053	0.0017	0.011	0.00015	0.0048	0.00054
Count	135	108	152	152	313	53	219	48
Minimum	0.000049	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Maximum	0.019	0.0054	0.013	0.028	0.18	0.0011	0.27	0.0034
Count <DL	46	92	117	18	46	30	9	2
Standard Deviation	0.0028	0.00054	0.0014	0.0042	0.022	0.00026	0.021	0.00074
1st Quartile	0.00025	0.00010	0.00025	0.00013	0.00027	0.000050	0.00021	0.00012
Median	0.00079	0.00025	0.00025	0.00032	0.0026	0.000050	0.00067	0.00022
3rd Quartile	0.0018	0.00025	0.00025	0.0010	0.0084	0.000084	0.0027	0.00053
99 Percentile	0.016	0.0018	0.0078	0.026	0.11	0.0010	0.038	0.0031
Count Over Guideline	-	-	-	9	21	-	2	-
% Over Guideline	-	-	-	6%	7%	-	1%	-

[a] KV-21 compared to WQO (hardness-dependent based on BCMOE guideline) and KV-110 and KV-114 compared to New Bermingham EQS (0.048 mg/L).

4.5.1.8 NICKEL

The dissolved nickel time series plot and statistical summary of the monitoring data are shown in Figure 4-11 and Table 4-17, respectively. Total nickel concentrations, rather than dissolved concentrations, are reported and plotted for KV-110 and KV-114 since the EQS applies to the total fraction. There was one (2% of 2024 samples) exceedance for total nickel concentrations in the New Bermingham portal discharge (KV-110) in 2024 (May). This was due to elevated particulate matter (TSS concentrations of 26 000 mg/L in May); the dissolved nickel concentration was below detection limit for the same sample. No elevated nickel concentrations were observed at the WTP decant pond (KV-114), for which concentrations were generally an order of magnitude lower than the adit discharge in 2024. Like other parameters, nickel concentrations in the New Bermingham portal discharge (KV-110) were highest in 2017 through mid 2018 and again in mid 2020 to present, with an approximate order of magnitude decrease between these periods (Figure 4-11). This behaviour reflects initial advancement of the exploration workings, a suspension of activity, then further expansion of the workings upon receipt of the Water Licence. During the WTP operation (September 2020 onwards), dissolved nickel concentrations at KV-118 (upper No Cash Creek) were comparable to those in the New Bermingham treated decant (KV-114). While this might suggest contribution from the decant, the post September 2020 KV-118 concentrations were comparable to those measured prior to the WTP operation. Indeed, during periods of elevated nickel concentrations in the Bermingham portal discharge (KV-110) prior to the WTP implementation, nickel concentrations at KV-118 were substantially lower, suggesting the discharge likely had a limited contribution to upper No Cash Creek waters. Dissolved nickel concentrations at KV-111 were lower than at KV-118 historically and in 2024, suggestive of some dilution and/or attenuation in upper No Cash Creek. Nickel concentrations were higher farther downstream at KV-21, due to the contributions from the No Cash 500 adit.

The dissolved nickel concentrations measured at the Bermingham 200 adit (KV-18) were generally below the detection limit since April 2013, with only two detectable dissolved nickel concentrations measured since then. The dissolved nickel concentration at the No Cash 500 adit (KV-20) was the highest of the three historical adits and Ruby 400 adit (KV-19) was second, slightly lower than KV-20. The latter showed a slight seasonal pattern characterized by lows in summer/fall (June through September) after which the concentration gradually increased and peaked in winter (November through December). This cyclic pattern has not been observed in recent years (since 2019). KV-111 also exhibits a seasonal trend marked by peak nickel concentrations during freshet (April through July) followed by a sharp decline and lowest concentrations typically observed in the fall to early winter (October-January). Dissolved nickel was consistently below the WQO for KV-21 in 2024.



[1] All nickel concentrations are dissolved except for KV-110 and KV-114 which are total concentrations.

Figure 4-11: Dissolved Nickel at Monitoring Stations, 2017-2024 Data

Table 4-17: Nickel at Monitoring Stations, 2008-2024 Data

Total Nickel (EQS = 0.37 mg/L) [a,b]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.0024	0.016	0.047	0.0100	0.040	0.00058	0.0041	0.0037
Count	135	108	152	152	315	53	219	48
Minimum	<0.0010	0.0028	0.0040	<0.00050	0.0012	<0.00050	<0.00050	0.00080
Maximum	0.0070	0.036	0.074	0.033	1.1	0.0019	0.025	0.011
Count <DL	95	0	0	5.0	11	23	8	0
Standard Deviation	0.00073	0.0044	0.011	0.0077	0.097	0.00039	0.0038	0.0027
1st Quartile	0.0025	0.014	0.040	0.0040	0.0082	0.00050	0.0018	0.0014
Median	0.0050	0.016	0.046	0.0079	0.020	0.00054	0.0029	0.0031
3rd Quartile	0.0025	0.018	0.054	0.014	0.034	0.00076	0.0050	0.0051
99 Percentile	0.0060	0.029	0.071	0.031	0.53	0.0018	0.018	0.011
Count Over Guideline	-	-	-	0	6	-	0	-
% Over Guideline	-	-	-	0%	2%	-	0%	-

[a] KV-21 compared to WQO (hardness-dependent based on CCME guideline) and KV-110 and KV-114 compared to New Bermingham EQS (0.37 mg/L).
[b] All nickel concentrations are dissolved except for KV-110 and KV-114 which are total concentrations.

4.5.1.9 SELENIUM

The dissolved selenium concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-12 and Table 4-18, respectively. Dissolved selenium concentrations in the Bermingham 200 (KV-18), No Cash 500 (KV-20), and Ruby 400 adits (KV-19) discharges were commonly below the detection limit (53%, 63%, and 56% of samples, respectively). The dissolved selenium concentration in the New Bermingham portal discharge (KV-110) ranged between 0.0003 and 0.007 mg/L with the highest concentrations observed between October 2017 and April 2018. The concentrations declined significantly and remained relatively stable between 0.0003 and 0.0004 mg/L between November 2018 and May 2020. The dissolved selenium concentration rose again, peaking at 0.0025 mg/L in October 2020. Such behaviour reflects changes in mining activity at the site as described for other COPIs. Selenium concentrations remained consistent throughout 2024 at KV-110, similar to concentrations found in recent years (2021 – 2023). The dissolved selenium concentration at the New Bermingham pond decant (KV-114) also exhibited a similar pattern to KV-110 for the same period. KV-110 had dissolved selenium concentrations higher than those in upper No Cash Creek (KV-118 and KV-111), and the latter consistently returned the lowest selenium concentrations (typically <0.00024 mg/L) historically, and in 2024. A spike in concentration was observed at KV-111 in early 2023 (January). Concentrations returned to historical norms by May 2023, and remained comparable to historical concentrations in 2024. Dissolved selenium concentrations at KV-118 increased in 2024, exhibiting higher concentrations than KV-110 and KV-111 towards the end of the year. This is possibly indicative of another source of selenium contributions to upper No Cash Creek. Dissolved selenium concentrations farther downstream at KV-21 were higher than those observed in upper No Cash Creek but were below the WQO (0.002 mg/L) except on one occasion in 2008 and were commonly below the detection limit (20% of samples; Table 4-18) from 2008 to 2024. Dissolved selenium also showed a seasonal pattern at KV-111 similar to other COPI.

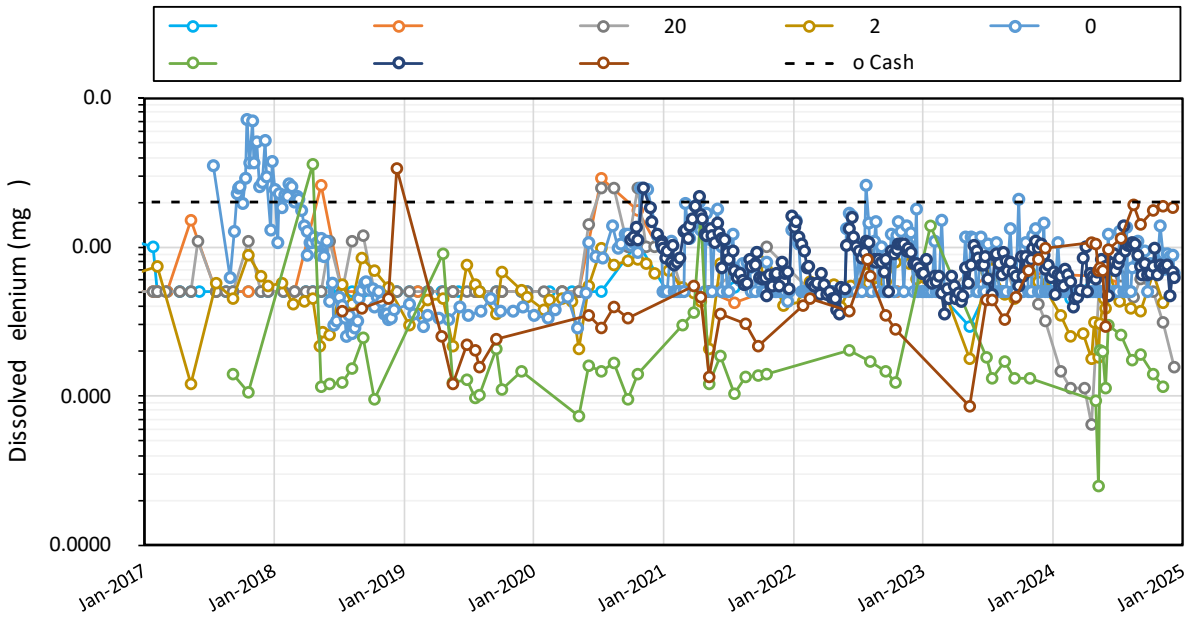


Figure 4-12: Dissolved Selenium at Monitoring Stations, 2017-2024 Data

Table 4-18: Dissolved Selenium Statistics at Monitoring Stations, 2008-2024 Data

Dissolved Selenium (WQO = 0.002 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.00078	0.00100	0.00069	0.00052	0.00096	0.00028	0.00084	0.00067
Count	135	108	152	152	313	53	219	48
Minimum	0.00029	<0.0006	0.000065	<0.0002	0.00025	<0.000050	0.00036	0.000085
Maximum	0.0015	0.0037	<0.00500	0.0032	0.0072	0.0036	0.0025	0.0034
Count <DL	71	61	95	31	120	1	1	0
Standard Deviation	0.00036	0.00084	0.00040	0.00029	0.00088	0.00055	0.00032	0.00062
1st Quartile	0.00050	0.00050	0.00050	0.00040	0.0010	0.00012	0.00063	0.00030
Median	0.0010	0.00050	0.00050	0.00045	0.0010	0.00014	0.00077	0.00044
3rd Quartile	0.0011	0.0015	0.00094	0.00064	0.0012	0.00019	0.00098	0.00082
99 Percentile	0.0015	0.0037	0.0025	0.00098	0.0049	0.0026	0.0019	0.0027
Count Over Guideline	-	-	-	1	-	-	-	-
% Over Guideline	-	-	-	1%	-	-	-	-

KV-21 compared to WQO (0.002 mg/L).

4.5.1.10 ZINC

The dissolved zinc concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-13 and Table 4-19, respectively. The dissolved zinc concentrations in the discharge from the New Bermingham portal (KV-110) and decant pond (KV-114) were regularly lower than the EQS (0.5 mg/L) with only thirteen samples (4% of the dataset, 2008-2024) above the EQS in the New Bermingham portal discharge (KV-110). No exceedances of the EQS were observed for both KV-110 and KV-114 in 2024. Dissolved zinc concentrations at KV-110 dropped more than two orders of magnitude from 0.6 mg/L in January 2018 to between 0.005 and 0.02 mg/L between late 2018 and April 2020. Dissolved zinc then increased sharply to 4.4 mg/L in June 2020 at KV-110, then decreased to concentrations generally one to two orders of magnitude lower than the EQS over the remainder of 2020 and throughout 2021. An increasing trend in zinc concentration was observed in 2022 at KV-110, with eight instances of samples exceeding the EQS (15% of all samples taken in 2022), and subsequently exhibited a decreasing trend throughout 2023, with no exceedances. In 2024, the majority of dissolved zinc concentrations measured at KV-110 were below the detection limit.

The dissolved zinc concentrations in upper No Cash Creek (KV-118) were typically higher than at KV-110 and KV-114 for the same period (2018-2024) indicating an additional source of zinc, likely from the Ruby 400 adit. Dissolved zinc concentrations downstream in No Cash Creek above the No Cash 500 adit (KV-111) were generally higher or comparable to those at KV-114 (WTP decant) for the same period and in 2024. Historically, the patterns of dissolved zinc concentrations were similar at the historical Bermingham 200 adit (KV-18), No Cash 500 adit (KV-20), and No Cash Creek (KV-21), although the concentrations were highest at KV-20. The KV-20 samples in 2024 continue to show elevated zinc concentrations (average of 6.8mg/L). Dissolved zinc concentrations in the most downstream No Cash Creek station (KV-21) were one to two orders of magnitude higher than those in upper No Cash Creek due to the input from the No Cash 500 adit, which typically exhibited the highest zinc concentrations for all stations monitored.

Dissolved zinc concentrations at KV-21 exceeded the short-term WQO (4.94 mg/L) in 3% of samples, and the 24-month rolling average of the last 3-years have exceeded the long-term WQO (2.28 mg/L) in 31% of samples. Most of the short-term exceedances occurred between July and November 2020, with no instances of exceedance in 2024, and were related to the sustained higher zinc concentrations in the No Cash 500 adit discharge in 2020, likely related to higher flow conditions for that year. This led to higher 24-month rolling average concentrations from in 2022, with no long term WQO exceedances in 2023 or 2024. A seasonal pattern characterized by peak concentrations in May-July after which the concentration gradually decreased reaching the lowest level in March-April of the following year was observed for the Bermingham 200 adit (KV-18), No Cash 500 adit (KV-20), and lower No Cash Creek (KV-21). A seasonal zinc pattern characterized by peak concentrations in April followed by a sharp decline reaching the lowest level in September-October was also observed at KV-111.

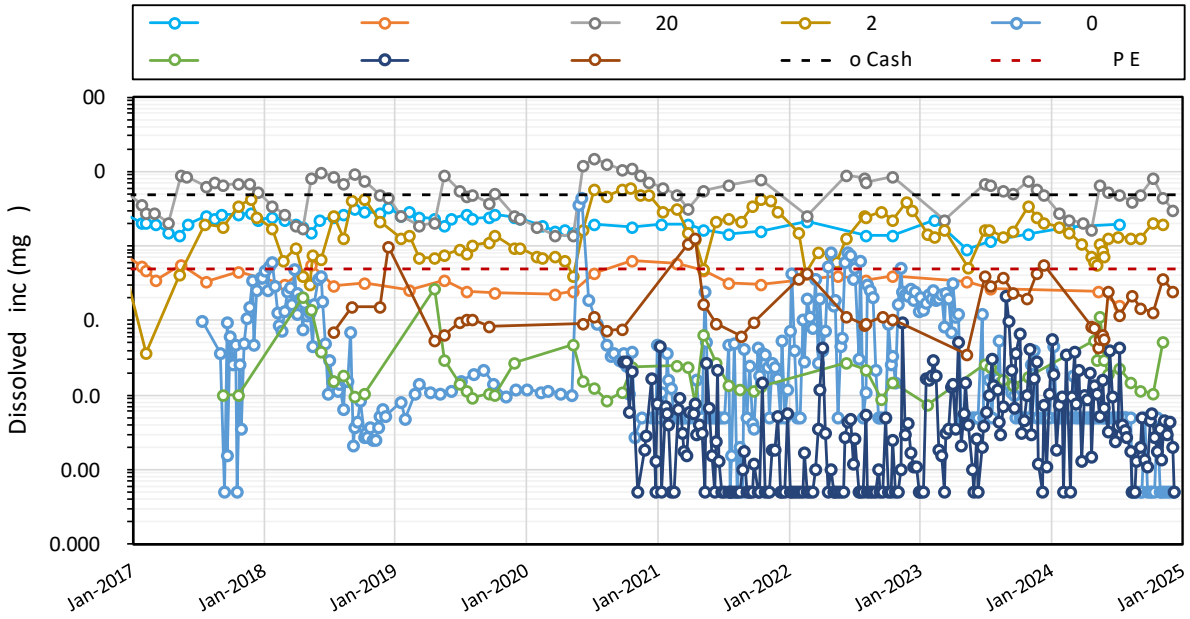


Figure 4-13: Dissolved Zinc at Monitoring Stations, 2017-2024 Data

Table 4-19: Dissolved Zinc Statistics at Monitoring Stations, 2008-2024 Data

Dissolved Zinc EQS = 0.5 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	2.4	0.61	6.8	1.8	0.10	0.033	0.0088	0.22
Count	136	109	152	152	313	53	219	48
Minimum	0.66	0.15	1.1	0.037	<0.0010	0.0075	<0.0010	0.035
Maximum	7.7	1.6	32	6.1	4.4	0.27	0.22	1.3
Count <DL	0	0	0	0	114	0	68	0
Standard Deviation	0.92	0.27	4.1	1.3	0.34	0.049	0.020	0.26
1st Quartile	1.8	0.40	3.6	0.80	0.010	0.011	0.00050	0.083
Median	2.3	0.57	6.5	1.3	0.013	0.016	0.0026	0.11
3rd Quartile	2.8	0.75	9.0	2.3	0.086	0.028	0.0075	0.25
99 Percentile	5.0	1.5	18	5.8	0.82	0.24	0.091	1.2
Count Over Guideline	-	-	-	4	13	-	0	-
% Over Guideline	-	-	-	3%	4%	-	0%	-

[a] KV-21 compared to short-term WQO (4.94 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.5 mg/L).

4.5.1.11 SULPHATE

The dissolved sulphate time series plot and statistical summary of the monitoring data are shown in Figure 4-14 and Table 4-20, respectively. The highest dissolved sulphate concentrations were observed in the No Cash 500 adit discharge (KV-20; median 452 mg/L) and downstream No Cash Creek (KV-21; median 320 mg/L). Strong seasonality was observed at both sites with concentrations highest over winter and lowest in summer. The cyclicity was most pronounced at KV-21, where concentrations declined close to an order of magnitude between the winter maxima and spring minima due to dilution from freshet. Dissolved sulphate concentrations above the short-term and long-term WQO (539 and 349 mg/L, respectively) were observed for 4% and 0% of sampling events at KV-21.

Much lower sulphate concentrations were observed at the other sites. The sulphate concentration in upper No Cash Creek at KV-118 (median 55 mg/L) and KV-111 (median 54 mg/L) were generally comparable, or slightly higher than that in the New Bermingham portal discharge (KV-110; median 49 mg/L) suggesting an additional source of sulphate along the flow path likely from the Ruby 400 adit (KV-19). Sulphate concentrations increased in upper No Cash Creek (KV-118) and KV-111 in 2024.Higher sulphate concentrations at KV-111 than KV-110 occurred more frequently over the winter months, when flowing. The sulphate concentration in the New Bermingham portal discharge rose briefly in May through June 2020 then sharply declined similarly to zinc. There was also an increasing trend in sulphate concentration at KV-110 in 2023, which continued to increase in 2024. The sulphate concentration in the New Bermingham decant pond (KV-114) was historically stable, though an increasing trend was observed in 2023 and 2024, with a new maximum sulphate concentration observed in July, 2024 (1090 mg/L). Other high concentrations of dissolved sulphate (766 mg/L and 928 mg/L) were also observed in August 2024, however lower concentrations were observed from September to December 2024. A sulphate seasonality characterized by peak concentration in April followed by a sharp decline was also observed at KV-111, although this was not observed in 2024.

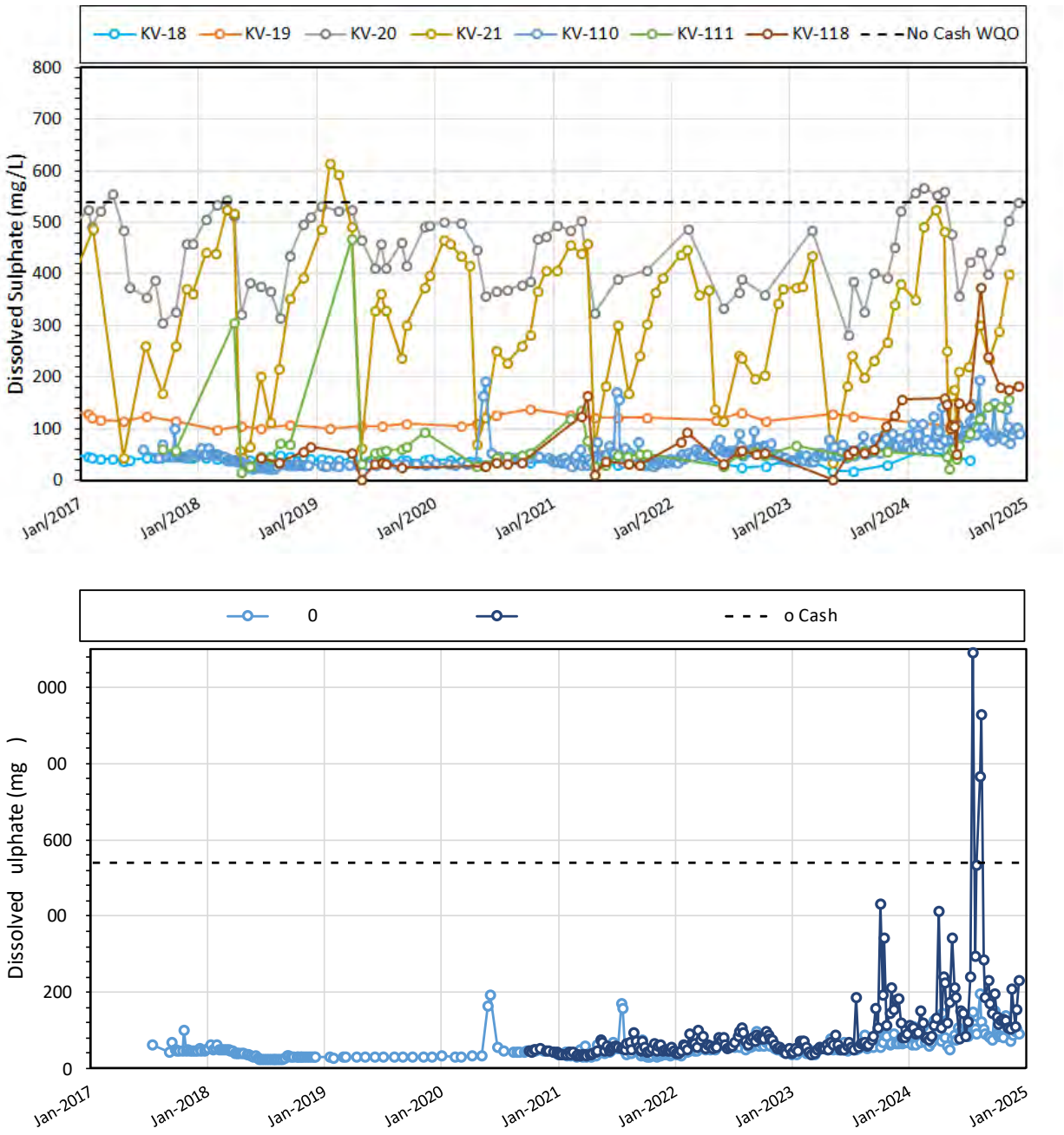


Figure 4-14: Dissolved Sulphate at Monitoring Stations, 2017-2024 Data

Table 4-20: Dissolved Sulphate Statistics at Monitoring Stations, 2009-2024 Data

Dissolved Sulfate (WQO = 539 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	41	122	445	312	56	73	101	84
Count	127	100	143	135	314	53	219	48
Minimum	19	97	130	34	22	15	32	0.89
Maximum	58	166	620	615	195	468	1,090	373
Count <DL	0	0	0	0	0	0	0	0
Standard Deviation	6.7	12	90	140	28	72	122	71
1st Quartile	38	115	378	218	37	46	50	34
Median	41	120	452	320	49	55	64	55
3rd Quartile	45	128	512	412	65	68	104	124
99 Percentile	54	152	613	588	162	383	724	310
Count Over Guideline	-	-	-	5	-	-	-	-
% Over Guideline	-	-	-	4%	-	-	-	-

[a] KV-21 compared to the short-term WQO (539 mg/L)
Dissolved sulphate monitoring began in 2009 and, therefore, data from 2009 onwards is presented.

4.5.1.12 AMMONIA

The ammonia-N time series plot and statistical summary of the 2014-2024 monitoring data are shown in Figure 4-15 and Table 4-21, respectively. Ammonia-N was commonly very low (median concentrations less than 0.02 mg/L) at all monitoring stations except in the discharge from the New Bermingham portal (KV-110) and decant pond (KV-114), which were similar. The ammonia-N concentration measured at the New Bermingham portal discharge station (KV-110) was typically orders of magnitude higher than the historical adit and No Cash Creek monitoring stations except between November 2018 and August 2020. Like most COPI, ammonia-N concentrations at KV-110 were lower than the EQS (5 mg/L) in early 2017, then increased above the EQS on five occasions between December 2017 and March 2018 and then it sharply decreased to orders of magnitude below the EQS until mid 2020. The ammonia-N concentration rose sharply in the second half of 2020 to levels close to the EQS, exceeding the EQS 10 more times in 2021, twice in 2022, 17 exceedances in 2023, and 9 exceedances in 2024 (totalling 14% of samples exceeding the EQS over the whole dataset). This reflects changes in mine activity including the use of ammonia-bearing explosives material used to develop the workings. The ammonia-N concentration at KV-114 also increased similarly to KV-110 however only surpassed the EQS (5 mg/L) on 1 occasion (2% of samples) in 2024 (5% exceedances from 2014-2024).

Stations on upper No Cash Creek (KV-111 and KV-118) returned dissolved ammonia-N concentrations comparable to KV-110 in 2019 and the first half of 2020 (when concentrations in the New Bermingham portal were lowest) but were one to two orders of magnitude lower during the periods when elevated ammonia was discharged by the New Bermingham Mine. There was an observed increase in ammonia concentrations at KV-118 in 2023 and 2024.Dissolved ammonia-N concentrations at KV-21 were below the detection limit in 57% of the samples and never increased above the temperature and pH dependent WQO.

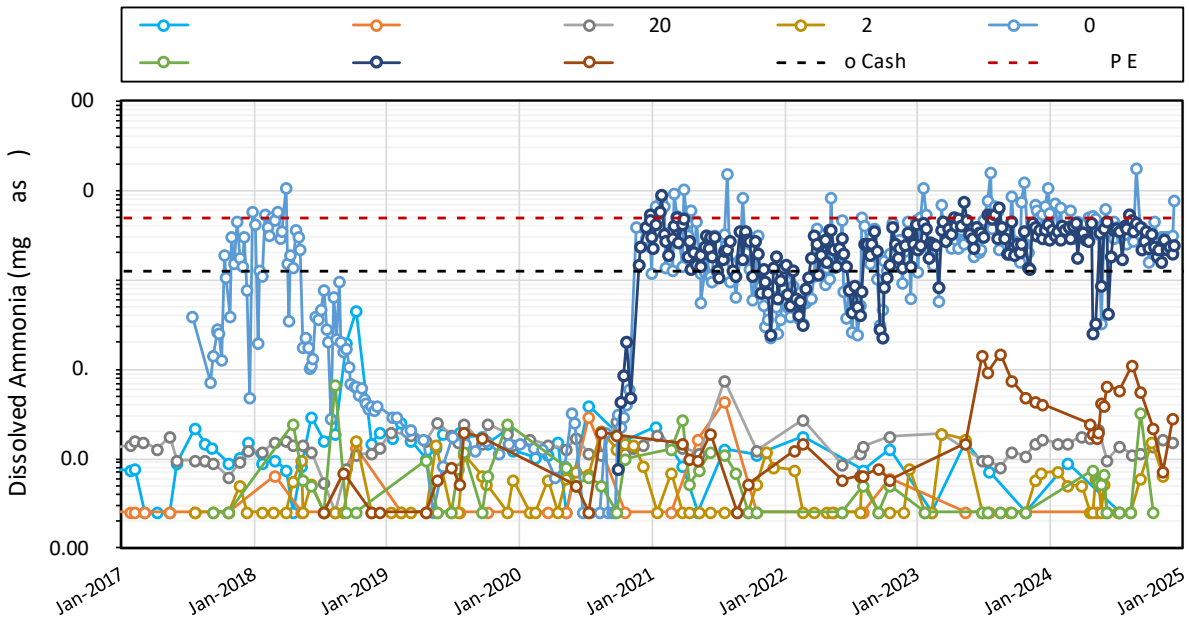


Figure 4-15: Dissolved Ammonia-N at Monitoring Stations, 2017-2024 Data

Table 4-21: Dissolved Ammonia-N Statistics at Monitoring Stations, 2014-2024 Data

Dissolved Ammonia (EQS = 5 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
Average	0.017	0.0042	0.014	0.0052	2.6	0.0079	2.7	0.028
Count	88	61	108	91	313	52	218	48
Minimum	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0078	<0.0050
Maximum	0.46	0.044	0.077	0.020	18	0.067	9.0	0.15
Count <DL	34	54	1	52	7	23	0	6
Standard Deviation	0.052	0.0066	0.0076	0.0042	2.8	0.011	1.5	0.035
1st Quartile	0.0025	0.0050	0.010	0.0025	0.39	0.0025	1.5	0.0063
Median	0.0078	0.0050	0.013	0.0050	1.9	0.0050	2.6	0.016
3rd Quartile	0.015	0.0050	0.016	0.0064	3.8	0.0076	3.6	0.039
99 Percentile	0.23	0.035	0.027	0.019	12	0.050	6.5	0.15
Count Over Guideline	-	-	-	0	43	-	11	-
% Over Guideline	-	-	-	0%	14%	-	5%	-

[a] KV-21 compared to WQO (pH and temperature-dependent based on CCME guideline) KV-110 and KV-114 compared to New Bermingham EQS (5 mg/L).
Ammonia monitoring began in 2014 and, therefore, data from 2014 onwards is shown.

4.5.1.13 SUMMARY OF WATER QUALITY ALONG ATTENUATION CORRIDOR

The analysis of background surface water quality data and trend from monitoring stations during the monitoring period indicate the following:

- Generally, circumneutral pH and oxic conditions were recorded at the surface water monitoring stations. Recent data from the New Bermingham pond decant (KV-114) show recurrent alkaline pH at the decant pond.
- A gradual increase in COPI concentrations in the New Bermingham portal discharge (KV-110) was observed from the onset of monitoring to a peak in April through July 2018. The dissolved concentrations of several COPIs (silver, copper, cadmium, nickel, selenium, zinc) declined thereafter to levels that were generally below the EQS and often below the detection limit for some parameters, reflecting changes in mining activity at the New Bermingham site.
- The New Bermingham decant pond (KV-114) 2024 water quality showed some instances of slightly elevated COPI concentrations, leading to a few exceedances of their respective EQS (ammonia, lead, silver, sulphate). It also exhibited generally alkaline pH, with a decrease in pH observed in 2024. However, these elevated concentrations were not recorded at monitoring stations downstream of the WTP discharge pond.
- In general, concentrations of many of the metal parameters and sulphate at New Bermingham portal discharge (KV-110) were below or comparable to concentrations of those parameters at downstream stations located at upper No Cash Creek (KV-118) and at No Cash Creek (KV-111) prior to implementation of the WTP. Concentrations measured in KV-114 were generally higher than KV-118 for ammonia-N, arsenic, nickel, and selenium. Concentrations measured at KV-114 were generally higher than KV-111 for ammonia-N, arsenic, nickel, lead, and selenium. Arsenic and ammonia-N concentrations remained one to three orders of magnitude higher at KV-114 and KV-110 than downstream stations. Median lead concentrations were an order of magnitude higher at KV-114 than at KV-111. Median nickel concentrations were similar in KV-114 and KV-118, though median concentrations were higher in KV-114 than KV-111. Median selenium concentrations were slightly higher at KV-114 compared to KV-111 and KV-118, however KV-118 exhibited an increase in dissolved selenium concentrations in 2024, slightly increasing median values.
- The concentration of dissolved arsenic, cadmium, lead, nickel, selenium, zinc, and sulphate measured at KV-21 were higher than those at KV-111 reflecting the input of COPI from the No Cash 500 adit discharge (KV-20). The concentration of COPI at KV-21 often mimicked that at KV-20, although generally at lower concentrations.
- The water quality of the New Bermingham portal discharge (KV-110) was generally better than at KV-118 for the same period between July 2018 to June 2020 and would have resulted in an improvement of water quality at KV-118 and probably at monitoring stations downstream of it. Since mine start-up the water quality at KV-110 has changed reflecting mining operations without noticeable impact on KV-118. While concentrations of some COPI exhibited some increasing trends (, nickel, selenium, silver, sulphate, ammonia) for KV-118 in 2024, downstream concentrations at KV-21 remained below the WQO.

4.5.1.14 ASSESSMENT OF ATTENUATION

Past water quality modelling performed for the New Bermingham mine included a 50% attenuation term for silver, arsenic, copper, nickel, lead, and ammonia (AEG, 2019). Therefore, the concentration changes of these parameters between the New Bermingham mine discharge and upper No Cash Creek form the focus of discussion herein.

It was noted that COPI concentrations at downstream No Cash Creek (KV-111) were often lower than COPI concentrations at Upper No Cash Creek (KV-118) suggesting that attenuation and/or dilution mechanisms were already occurring in this reach of No Cash Creek for arsenic, cadmium, lead, nickel, silver, and zinc. Sulphate concentrations measured at KV-111 were often higher than KV-118, suggesting there may be additional sulphate inputs along the flow path. Natural attenuation of sulphate is not anticipated in the oxic surface waters. Indeed, dissolved arsenic, cadmium, lead, nickel, silver, and zinc concentrations measured at KV-111 showed a median COPI decrease of 61-91% compared with KV-118 (when date-paired data exists for both KV-111 and KV-118) between July 2018 and September 2020 (i.e., prior to WTP operation at New Bermingham). For parameters that included a 50% attenuation term, ammonia, arsenic, lead, nickel, and silver had a median concentration decline of 48%, 62%, 87%, 61%, 74%; however, copper showed little to no decrease (12% lower). Sodium is expected to behave conservatively and has showed a median percent decrease of 29% between KV-118 and KV-111 for those same years, suggesting that there is some dilution along the flow path. Since the decrease in sodium concentrations along the flow path occurs to a lesser extent than observed for ammonia, arsenic, lead, nickel, and silver, the concentration decrease of these COPIs is likely due to attenuation from sorption or precipitation of the metal(loid)s along the flow path and oxidation and/or biological update of ammonia. Dilution along the flow path suggest that attenuation is likely less than 50% for ammonia and potentially arsenic, nickel and silver between KV-118 and KV-111.

In 2024, four years after discharge from the New Bermingham decant pond began, dissolved arsenic, cadmium, lead, nickel, silver, and zinc concentrations measured at KV-111 showed a median concentration decline of 27-92% from KV-118 (for date-paired at both KV-111 and KV-118) between March 2021 and December 2024 (i.e., when flow was observed in Upper No Cash Creek). For parameters that included a 50% attenuation term, ammonia, arsenic, copper, lead, nickel, and silver had a median concentration decrease of 68%, 27%, -29% (increases in concentrations of copper from KV-118 to KV-111), 67%, 83%, and 67%, respectively. Sodium concentrations showed a median of 55% lower concentrations post 2020 due to dilution along the flow path from Upper No Cash Creek to downstream No Cash Creek. This suggests that ammonia, cadmium, lead, nickel, selenium, silver, and zinc concentrations decreased along the flow path due to dilution and attenuation as these COPIs were removed to a greater extent than dilution alone. Attenuation after discharge from New Bermingham decant pond started is less than 50% for arsenic (27%) and copper (-29%) between KV-118 and KV-111. Sulphate concentrations continued to measure higher at KV-111 than at KV-118 post discharge from New Bermingham decant pond until October 2023. Since October 2023 KV-118 sulphate concentrations were similar or higher than measured at KV-111.

At Upper No Cash Creek (KV-118), measured ammonia, lead, nickel, and silver concentrations were often close to the detection limit (i.e., less than five times the detection limit). Ammonia, lead, nickel, and silver concentrations measured at downstream No Cash Creek (KV-111) were also often less than the detection limit or close to the detection limit (i.e., less than five time the detection limit) making it difficult to accurately quantify percent removal. Additionally, while sulphate concentrations increased or were similar at downstream No Cash Creek KV-111, other metals commonly associated with sulphate concentrations as a result of sulphide mineral oxidation (e.g., cadmium, iron, lead, zinc) did not increase or showed attenuation (i.e., concentration changes greater than dilution alone).

Many of the attenuation trends observed in previous years were also noted in 2024. It is important to note that the 50% attenuation assumed in the model applied to the ~2 km flow path between the New Bermingham pond decant (KV-114) and station KV-21 on No Cash Creek. Additionally, inputs from Bermingham 200 Adit and/or Ruby 400 Adit may seasonally influence the chemistry in Upper No Cash Creek while the No Cash 500 Adit is the primary source of constituent loading to KV-21.

Ammonia and dissolved arsenic concentrations measured at KV-114 were one to three orders magnitude higher than those measured at KV-118 and KV-111, suggesting significant attenuation or dilution, or that New Bermingham decant discharge does not reach No Cash Creek (i.e., it infiltrates to ground). Regardless, it appears that the New Bermingham mine discharge does not have a significant influence on ammonia and arsenic concentrations in No Cash Creek. Silver and copper concentrations measured at KV-114 were often less than the detection limit and lower than those measured at KV-118 until 2023, suggesting that there was not much of these COPIs to attenuate prior to Upper No Cash Creek and there was minimal contribution to No Cash Creek. Higher silver and copper concentrations observed at KV-114 in 2023 and 2024 may have resulted in higher loading of these metals at KV-118 and KV-111, and continued observation of little to no copper attenuation. However, silver does not seem to follow this trend, and concentrations are still low enough that most silver load is attenuated along the flow path. There are also potentially other sources than the New Bermingham decant contributing to the downstream water quality (e.g., Ruby 400 and/or Bermingham 200 adit discharges and/or local runoff). Lead and nickel concentrations measured at KV-114 were historically similar to those measured at KV-118 until 2022, suggesting that much of the attenuation occurred downstream of Upper No Cash Creek. However, in 2022 and 2023, KV-114 generally saw higher nickel and lead concentrations compared to KV-118, suggestive of dilution and/or attenuation of these metals along the discharge corridor. In 2024, dissolved lead concentrations at KV-114 continue to be higher than at KV-118. As noted above, attenuation was difficult to assess due to the low lead and nickel concentrations, particularly at KV-111 (57% and 43% of samples below the detection limit, respectively).

While little attenuation was observed along the short New Bermingham WTP discharge flow path in the September 2023 synoptic sampling event discussed in Section 4.2, further attenuation of WTP load may be expected in No Cash Creek owing to the presence of elevated manganese and iron concentrations. Iron and manganese precipitation is a key driver of metal attenuation observed within No Cash Creek (e.g., Interralogic, 2012) and is expected to drive polishing of metals that may reach No Cash Creek from the New Bermingham WTP discharge.

4.5.2 GROUNDWATER WATER QUALITY

The dissolved concentrations of COPI in groundwater samples collected from monitoring wells BH-MW-1 and RB-MW1 between 2013 and 2024 were compared with the Yukon Contaminated Site Regulation Schedule 3 Aquatic Life Standards (YCSR, 2002). In the absence of a YCSR standard for pH, the Federal Interim Groundwater Quality Guidelines (FIGWQG) were used for comparative purposes. The comparison of water quality results with the generic standards was aimed at identifying relatively elevated constituents, determining their background concentration to serve as a benchmark for comparison with water quality data after the New Bermingham WTP began. This comparative assessment should not be considered as a measure of compliance or lack thereof to the YCSR. The standards for hardness, pH, and temperature dependent elements were calculated for each sample using its hardness and pH data and a temperature of 10°C (as assumed in Schedule 3 of YCSR). For plotting purposes (lines on graphs), the 25th percentile hardness and 75th percentile pH observed for KV-111, the first surface water station likely to capture the groundwater discharge from the two monitoring wells, were used to create the guidelines displayed on Figure 4-16 to Figure 4-19. Recent data for NC-MW-1 and KV-116 are also included to assess the changes of groundwater quality between the upper and lower areas of the study area.

Time series plots depicting the results for COPI from 2017 to 2024 are shown in Figure 4-16 through Figure 4-19 and associated summary statistics of those exceeding guidelines are reported in Table 4-22 through Table 4-26.

The COPI which were higher or comparable to the YCSR standards (or FIGWQG for pH) in 10% of the samples in the monitoring wells were:

- Dissolved arsenic: 84% of samples over YCSR standard for RB-MW-1 only;
- pH: BH-MW-1 (two samples, 13%) and RB-MW-1 (3 samples, 7%) below lower limit.

4.5.2.1 FIELD PH, REDOX POTENTIAL, AND ELECTRICAL CONDUCTIVITY

The groundwater field pH was generally circumneutral for the four monitoring wells. The median pH values for RB-MW-1, BH-MW-1, KV-116, and NC-MW-1 were 6.96, 6.96, 7.23, and 7.32, respectively (Figure 4-16).

Historically, the ORP at the Bermingham 200 monitoring well BH-MW-1 was oxidizing and constantly above +55 mV despite the fluctuation noted between summer and winter months, though there have been no sampling events at this well since 2017 due to dewatering activities for the New Bermingham mine. The redox potential at the Ruby groundwater monitoring well RB-MW-1 was lower and fluctuated between approximately -200 mV to +100 mV since 2017, indicating more reducing conditions than observed in the Bermingham 200 monitoring well (Figure 4-16). Continued reducing conditions were observed in 2024 for RB-MW-1 (median ORP for 2024, -102 mV). The ORP at RB-MW-1 was below 0 mV since February 2017 except during the freshet of 2018 and a few instances in 2022. Redox conditions at KV-116 were oxidizing for most of the dataset (2020-2023). ORP for KV-116 in 2024 exhibited a decreasing trend to negative values (-64 mV in May 2024). The ORP at NC-MW-1 ranged from -148 to +210 mV (new maximum observed in 2023), with a median ORP of +18 mV.

The median electrical conductivity for BH-MW-1, KV-116, RB-MW-1, and NC-MW-1 were 256, 307, 415, and 1004 µS/cm, respectively, indicating low salinity (fresh) groundwater.

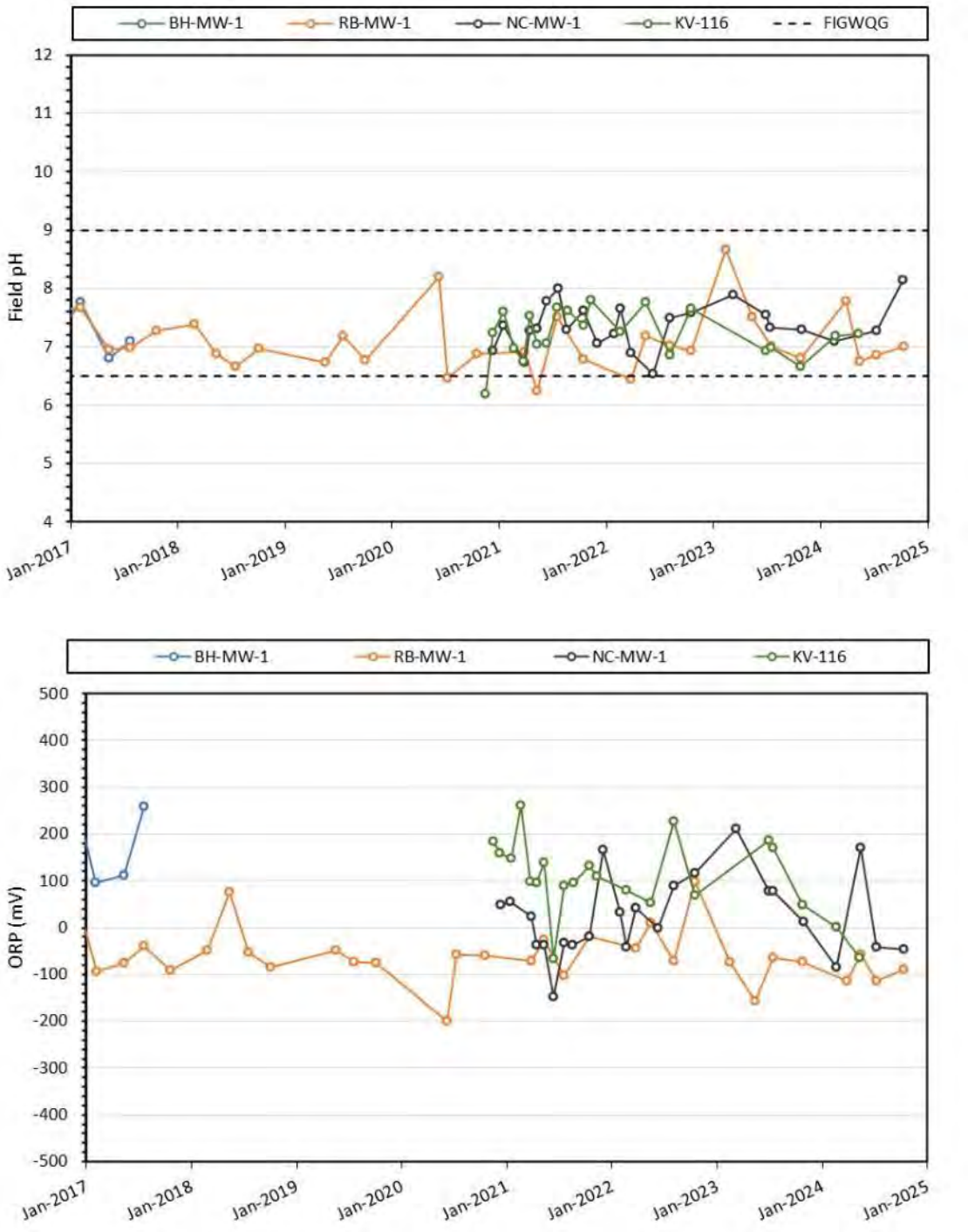


Figure 4-16: Field pH and ORP of Groundwater Monitoring Wells, 2017-2024 Data

4.5.2.2 CONSTITUENTS OF POTENTIAL INTEREST

Analysis of COPI trends revealed that arsenic and cadmium regularly or occasionally exceeded their respective YCSR standards in one or more of the monitoring wells. Dissolved arsenic and cadmium concentrations exceeded at RB-MW-1 (84% and 5% of samples, respectively) and dissolved cadmium exceeded at BH-MW-1 (6%) as shown in the statistical summary tables (Table 4-22 and Table 4-23) and Figure 4-17 below. BH-MW-1 has been dry since July 2017 due to dewatering activities and therefore no samples have been collected from this well since then.

Arsenic concentrations at RB-MW-1 were generally elevated above the YCSR standard as well as the arsenic concentrations at the Ruby adit, KV-19, since 2013. The elevated arsenic concentrations at RB-MW-1 are likely due to the reducing conditions at this monitoring well. Iron concentrations at RB-MW-1 were also elevated since 2013 and mirrored what was observed for arsenic, consistent with the reducing conditions observed at this well. At BH-MW-1, arsenic concentrations were well below the YCSR standard between 2013 and 2017 and were lower than concentrations observed at the Bermingham 200 adit. At KV-116, arsenic concentrations were approximately five times lower than the YCSR standard. Arsenic concentrations at NC-MW-1 were below the YCSR standard in all samples collected since well installation. Arsenic concentrations at this well appeared to increase through 2021 to the start of 2022; however, the concentrations appear to have stabilized in 2023 and 2024.

Cadmium concentrations at RB-MW-1 occasionally exceeded the YCSR standard since 2013. RB-MW-1 exhibited some seasonality for cadmium each year, where peak concentrations were observed in the spring and fall, while minimum concentrations were observed in the summer and winter. All exceedances of the cadmium YCSR standard at RB-MW-1 occurred during these seasonal peaks and concentrations returned below the standard during the following sampling event. This seasonal trend seemed to persist in 2024, however concentrations overall seem to be decreasing at RB-MW-1. Cadmium concentrations at KV-116 were comparable to those observed at BH-MW-1, but with more limited variation. There seemed to be an increasing trend in cadmium concentration at KV-116 in 2023, which continued into 2024 and ultimately exceeded the YCSR guideline in 2024 (one sample exceeding, 5% of samples). Cadmium concentrations at NC-MW-1 were well below the YCSR standard in all samples collected. Both the Ruby and No Cash adits also tend to exhibit seasonality for cadmium. Concentrations at these adits are markedly higher than the concentrations observed at their respective groundwater monitoring wells.

Lead concentrations at RB-MW-1 were generally higher than observed at NC-MW-1. Lead concentrations were at or below detection limit at NC-MW-1 and KV-116 in 2024. RB-MW-1 typically observed larger fluctuations in concentrations, compared to NC-MW-1, and experienced greater peak concentrations. Zinc concentrations at RB-MW-1 and NC-MW-1 were comparable. Zinc concentrations at RB-MW-1 historically exhibited the same seasonality that was observed with cadmium, with peaks in the spring/fall and minimum concentrations in the summer/winter.

Groundwater data shown on Figure 4-17 to Figure 4-19 indicate a complex groundwater system as indicated by the remarkable spatial variability of the concentration of constituents between the wells. The general similarities in ORP, pH, cadmium, and zinc concentrations between the Ruby monitoring well and NC-MW-1 and their large differences in other parameter concentrations, especially the elevated sulphate, selenium, and nickel in NC-MW-1 and elevated arsenic and ammonia in RB-MW-1 cannot be ascribed to a simple geochemical process or common groundwater source. Also, the elevated dissolved iron, nickel, and sulphate in NC-MW-1 compared to KV-116; and the higher ORP, arsenic, cadmium, and selenium compared to NC-MW-1; and their comparable lead and copper cannot be explained by attenuation, oxidation/reduction, or dilution alone. Rather a combination of these processes may be influencing the geochemical evolution of groundwater between Bermingham and the No Cash adit. Nickel and sulphate concentrations at NC-MW-1 were higher than adit and waste rock monitoring wells suggesting additional loading

along groundwater flow path toward No Cash Creek. Sulphate, cadmium, nickel, and zinc concentrations at KV-116 showed an increase in concentrations since mid- to late 2023 and will continue to be monitored for trends in future work; however, zinc concentrations generally appear to have an increasing trend since 2021.

Table 4-22: Dissolved Arsenic in Groundwater Monitoring Wells, 2013-2024 Data

Dissolved Arsenic YCSR = 0.05 mg/L	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.00017	0.068	0.0013	0.0090
Count	16	44	23	21
Minimum	<0.00010	0.00035	0.00042	0.0066
Maximum	0.00051	0.098	0.0032	0.012
Count <DL	2	0	0	0
Standard Deviation	0.00011	0.023	0.00080	0.0013
1st Quartile	0.00012	0.060	0.00077	0.0083
Median	0.00015	0.078	0.00089	0.0086
3rd Quartile	0.00021	0.083	0.0016	0.0095
Count over Guideline	0	37	0	0
% Over Guideline	0	84	0	0

Table 4-23: Dissolved Cadmium in Groundwater Monitoring Wells, 2013-2024 Data

Dissolved Cadmium YCSR = Hardness Dependent	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.00016	0.000093	0.000017	0.00018
Count	16	44	23	21
Minimum	0.000038	<0.0000050	<0.0000050	0.000080
Maximum	0.00052	0.00083	0.000080	0.0010
Count <DL	0	1	5	0
Standard Deviation	0.00012	0.00018	0.000019	0.00021
1st Quartile	0.000089	0.000013	0.0000054	0.000096
Median	0.00012	0.000024	0.0000084	0.00011
3rd Quartile	0.00019	0.000062	0.000023	0.00016
Count over Guideline	1	2	0	1
% Over Guideline	6.2	4.5	0	4.8

Table 4-24: Dissolved Copper in Groundwater Monitoring Wells, 2013-2024 Data

Dissolved Copper YCSR = Hardness Dependent	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.00022	0.00039	0.00011	0.00041
Count	16	44	23	21
Minimum	<0.00020	<0.00020	<0.00020	<0.00020
Maximum	0.00054	0.0037	0.00024	0.0010
Count <DL	8	25	21	2
Standard Deviation	0.00015	0.00066	0.000036	0.00020
1st Quartile	0.00010	0.00010	0.00010	0.00029
Median	0.00015	0.00010	0.00020	0.00040
3rd Quartile	0.00030	0.00037	0.00010	0.00047
Count over Guideline	0	0	0	0
% Over Guideline	0	0	0	0

Table 4-25: Dissolved Selenium in Groundwater Monitoring Wells, 2013-2024 Data

Dissolved Selenium YCSR = 0.01 mg/L	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.0010	0.000051	0.00021	0.00067
Count	16	44	23	21
Minimum	0.00079	<0.000050	<0.000050	0.00033
Maximum	0.0013	0.00010	0.00092	0.00098
Count <DL	0	19	1	0
Standard Deviation	0.00017	0.000018	0.00020	0.00017
1st Quartile	0.00091	0.000025	0.00010	0.00059
Median	0.0010	0.000052	0.00013	0.00066
3rd Quartile	0.0012	0.000061	0.00023	0.00080
Count over Guideline	0	0	0	0
% Over Guideline	0	0	0	0

Table 4-26: Dissolved Sulphate in Groundwater Monitoring Wells, 2013-2024 Data

Dissolved Sulphate YCSR = 1000 mg/L	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	45	117	284	70
Count	16	44	23	21
Minimum	41	74	139	37
Maximum	50	174	417	201
Count <DL	0	0	0	0
Standard Deviation	2.9	19	69	41
1st Quartile	43	103	255	47
Median	45	120	279	58
3rd Quartile	47	131	324	73
Count over Guideline	0	0	0	0
% Over Guideline	0	0	0	0

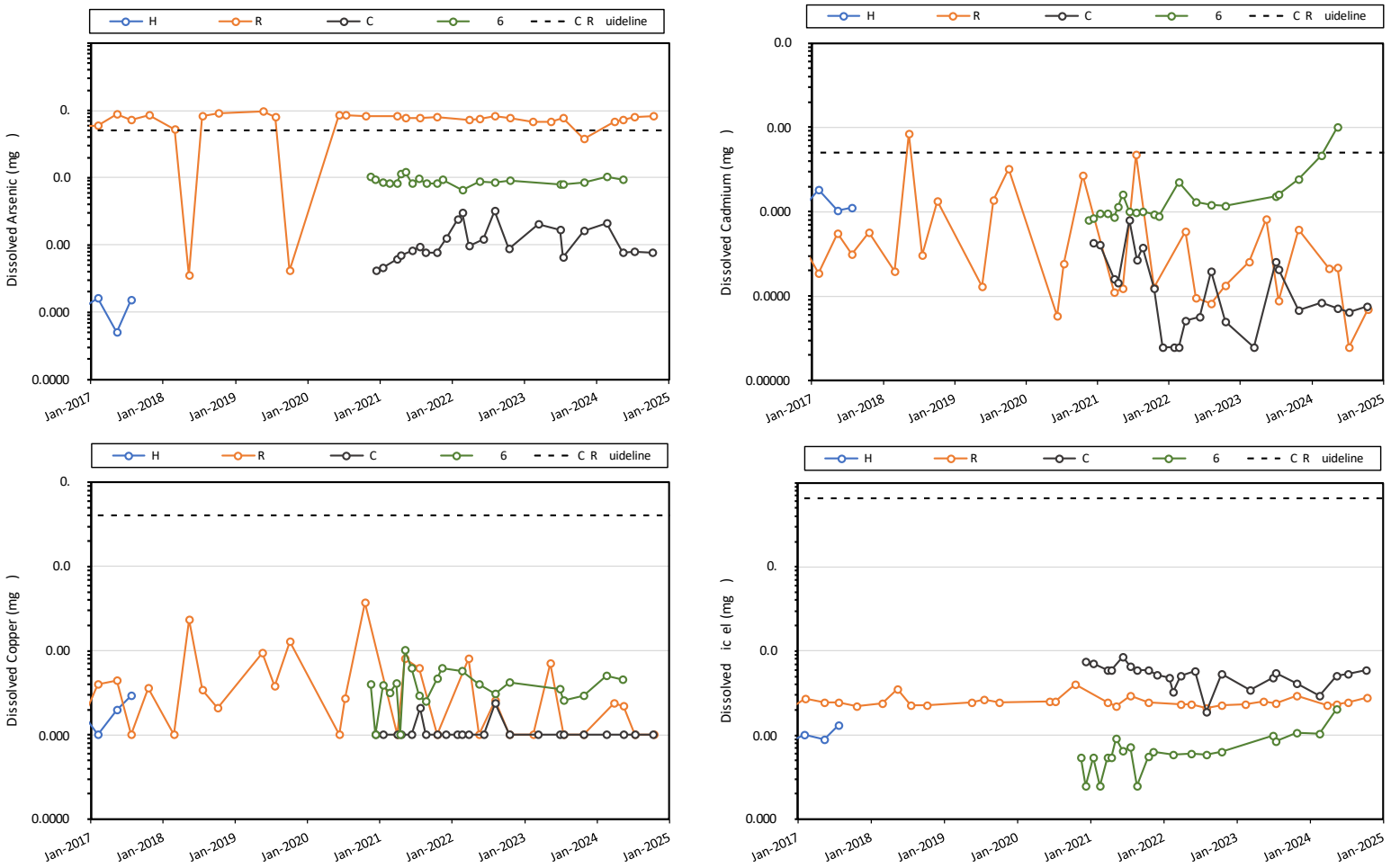


Figure 4-17: Dissolved Arsenic, Cadmium, Copper, and Nickel of Groundwater Monitoring Wells, 2017-2024 Data

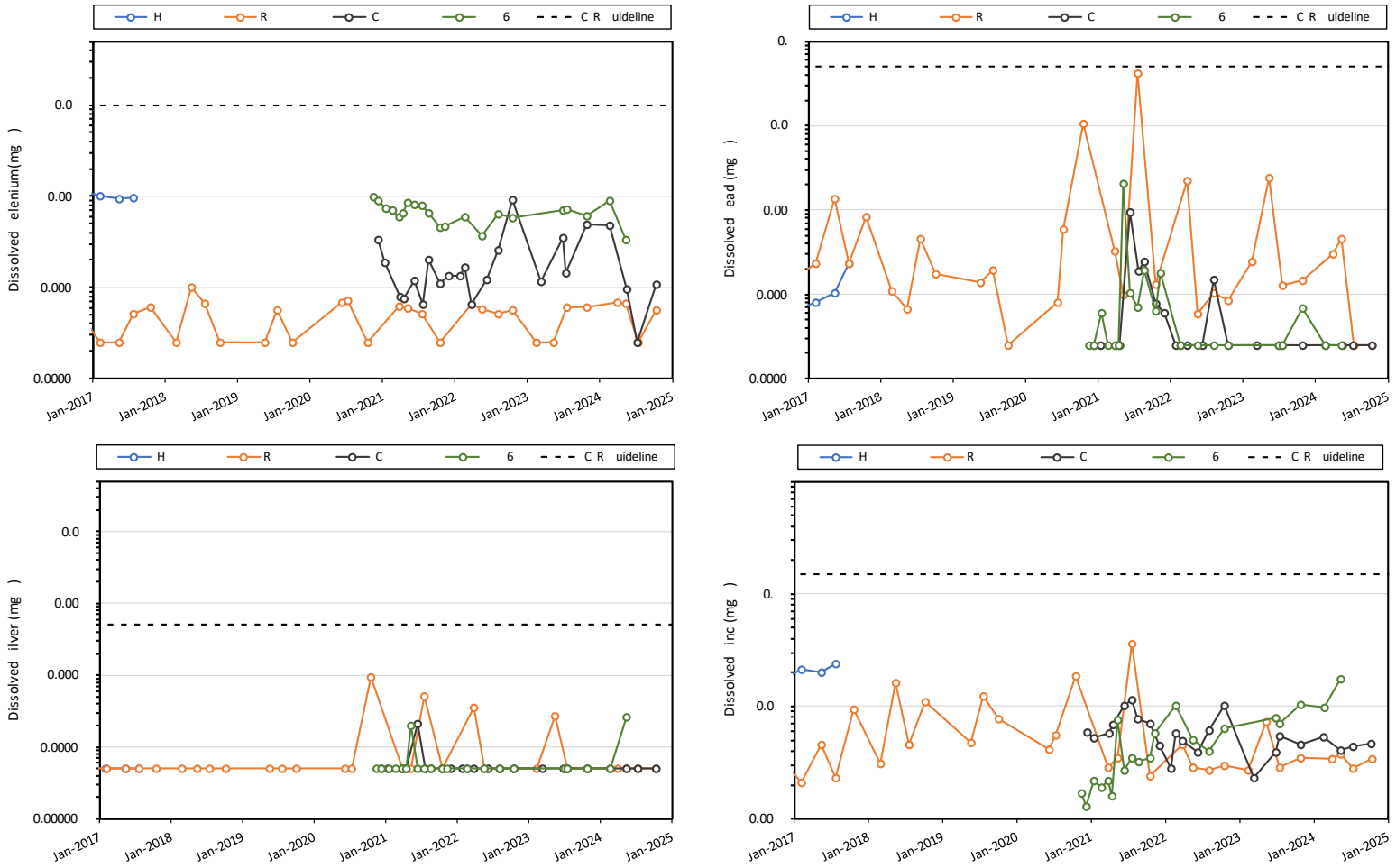


Figure 4-18: Dissolved Lead, Selenium, Silver, and Zinc of Groundwater Monitoring Wells, 2017-2024 Data

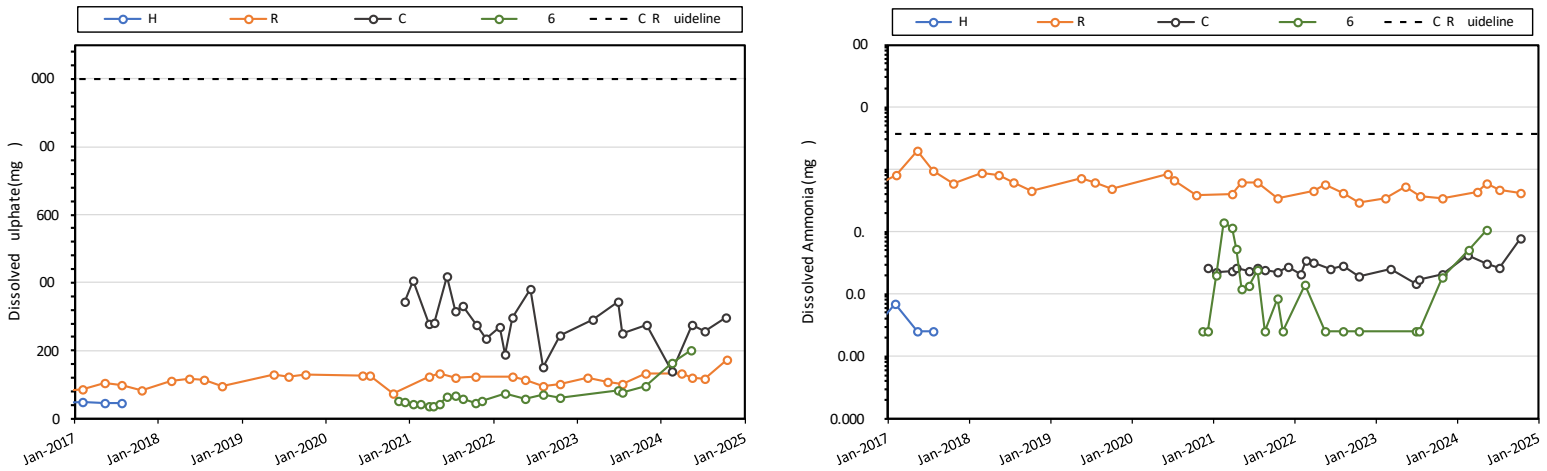


Figure 4-19: Dissolved Sulphate and Ammonia of Groundwater Monitoring Wells, 2017-2024 Data

5 CONCLUSIONS

The results of physical, geochemical, and microbiological testing conducted on surficial soil and moss samples collected from the discharge channel and surface water and groundwater monitoring data indicate the following:

- The soil samples consist mostly of silt and silt loam with a relatively low clay content (median 8.3%). The mixture of silt and clay are predicted to result in large surface areas favourable for the retention of metals through adsorption or cation exchange with the WTP discharge.

- The study site had a median soil organic matter content of 13.3% median. This low organic content along the proposed discharge channel do not create the most favorable conditions for sorption, immobilization and attenuation of metals but will offer some level of attenuation.

- The soil pHs were acidic to mildly acidic (median pH 5.4) with only one neutral soil pH reflecting an environment impacted by the weathering products of mineralization. The soil pH conditions of the first two thirds of the channel are not optimum for the precipitation of oxide or hydroxides because of the low pH. However, the soil pH values were higher that the point zero charge pH of most clay minerals which create conditions favourable for the retention of metals cations by variable surface charge clays.

- The study site had a median soil moisture content of 48.3% indicative of a moderate water holding capacity favourable for the development of vegetation cover, peaty and organic-rich surficial materials along the discharge channel which may promote natural attenuation.

- Sequential extractions were conducted in 2023 along the Bermingham WTP discharge flow path transect and perpendicular to it. Most of the identified COPIs had a large association with the reducible phase, likely associated iron and/or manganese oxyhydroxides. Cadmium and zinc also showed some associated with the carbonate-bound fraction while copper was largely associated with the organic matter extraction step.

- Microbial community profiling identified the presence of bacteria closely related to microorganisms capable of mediating sulphur redox transformations, indicating the potential exists for long-term metal sequestration via sulphide mineral precipitation. The marshy and organic matter rich environment will favor the development of sulphate-reducing conditions under which chalcophile metals may be sequestered as sulphide mineral assemblages.

- These data indicate that soil and landcover conditions along the proposed discharge corridor are favourable for natural attenuation of metal(loid)s in the treatment discharge.

- The moss samples had different metal contents depending on their location along the discharge channel. BM-NAT-18 moss samples generally had high metal concentrations especially arsenic, cadmium, iron, manganese, copper, nickel, lead, and zinc compared to other two sites likely due to contamination by residual soil left after washing. The concentration of these constituents was commonly 2- to 47-fold higher than BM-NAT-10 which had the second elevated metals concentrations. Cadmium and zinc were particularly elevated in the moss present in area BM-NAT-18 compared to others. The moss collected from BM-NAT-05 had the lowest average metal content.

- Available surface water monitoring data indicate circumneutral pH and oxic conditions at most of the monitoring stations. Although the increase of COPI concentrations at the New Bermingham portal discharge

occurred in 2020 to 2024, it did not result in exceedances compared to EQS at New Bermingham pond decant (KV-114) except for arsenic, lead, and ammonia which surpassed their EQS in 9% (one exceedance in 2023), 1% (2 exceedances in 2023), and 6% (6 exceedances in 2023) of the samples, respectively. Values for pH also surpassed the EQS to a lesser extent (16% of samples, no exceedances in 2023). Of these COPI that exhibited increases from 2020 to 2023, only ammonia exhibited one exceedance of the EQS (5.39 mg/L) in August, 2024. Additionally in 2024, one dissolved silver (0.00089 mg/L) and TSS (50.3mg/L) exceedance of the EQS was observed in June and July, respectively.

- The COPI concentrations in the New Bermingham portal discharge (KV-110) were often lower or comparable to the COPI concentrations in Upper No Cash Creek (KV-118). Ammonia concentrations have historically been one to two orders of magnitude higher at KV-110 than KV-118 since 2021. In 2024, there were observed increases at upper No Cash Creek (KV-118) for selenium, sulphate, and ammonia, at time exhibiting higher concentrations than KV-110, possibly indicating other sources of loadings for these parameters to No Cash Creek. This means that discharge from the New Bermingham Mine will generally contribute to improving COPI concentrations at downstream stations during periods where COPI concentrations were lower at New Bermingham portal discharge. It was also noted that COPI concentrations at downstream No Cash Creek (KV-111) were often lower than COPI concentrations at Upper No Cash Creek (KV-118) suggesting that attenuation and/or dilution mechanism occurred in the discharge channel both before and after discharge from the New Bermingham decant pond began. It was noted for 2024 that attenuation/dilution from upper No Cash Creek (KV-118 to downstream No Cash Creek (KV-111) was maintained for most COPI (when date-paired comparison was possible), except for dissolved copper. This is evidenced by generally lower COPI concentrations at KV-111 compared to KV-118.

- Past water quality modelling performed for the New Bermingham Mine included a 50% attenuation term for silver, arsenic, copper, nickel, lead, and ammonia for the ~2 km flow path between the New Bermingham pond decant (KV-114) and station KV-21 on No Cash Creek. Inputs from Bermingham 200 Adit and/or Ruby 400 Adit may seasonally influence the chemistry in Upper No Cash Creek while the No Cash 500 Adit is the primary source of constituent loading to KV-21. In 2024, four years after discharge from the New Bermingham decant pond began, ammonia, arsenic, copper, lead, nickel, silver, and zinc had a median concentration decrease of 68%, 27%, -29%, 67%, 83%, 67%, and 87%, respectively between Upper No Cash Creek (KV-118) and downstream No Cash Creek (KV-111). The median decrease in arsenic (27%), concentrations along the flow path from Upper No Cash Creek to downstream No Cash Creek was below that observed for sodium (55%). Copper concentrations showed a 29% increase between KV-118 and KV-111. The median decrease in ammonia (68%), cadmium (92%), lead (67%), nickel (83%), selenium (69%), silver (67%),, and zinc (87%) concentrations along the flow path were likely due to both dilution and attenuation as the concentration changes were greater than observed for sodium. Attenuation between KV-118 and KV-111 is sometimes difficult to calculate as many of the parameters such as ammonia, lead, nickel, and silver concentrations measured at downstream No Cash Creek were often less than their detection limits or close to the detection limits, making it difficult to accurately quantify percent removal. Additionally, ammonia and dissolved arsenic concentrations measured at KV-114 were one to three orders of magnitude higher than those measured at KV-118 and KV-111, suggesting that the New Bermingham Mine discharge does not have a significant influence on ammonia and arsenic concentrations in No Cash Creek. Silver and copper concentrations measured at KV-114 were often lower than those measured at KV-118 until 2023, suggesting that there was not much of these COPIs to attenuate prior to Upper No Cash Creek and there was minimal contribution to No Cash Creek. Higher silver and copper concentrations observed at KV-114 in 2023 and 2024 may have resulted in higher loading of these at KV-118 and KV-111. Lead and nickel concentrations measured at KV-114 were similar to those measured at KV-118, suggesting that much of the attenuation occurred

downstream of Upper No Cash Creek. However, KV-114 generally saw higher nickel (in 2022 and 2023) and lead (in 2022 to 2024) concentrations compared to KV-118, suggestive of dilution and/or attenuation of these metals along the discharge corridor.

- Bermingham 200 and Ruby 400 adit groundwater monitoring data since 2013 indicate sub-oxic to oxic, circumneutral pH, and low salinity groundwater. The data also show recurrent (arsenic) or occasional (cadmium and pH) exceedances of YCSR and FIGWQ standards.. Dissolved arsenic was recurrently elevated at RB-MW-1 and dissolved cadmium intermittently exceeded at RB-MW-1, BH-MW-1, and KV-116.

- Nickel and sulphate concentrations at NC-MW-1 were higher than adit and waste rock monitoring wells suggesting additional loading along groundwater flow path toward No Cash Creek. Overall, the groundwater geochemical data indicate a groundwater system characterized by cumulative effects of attenuation, dilution, and oxidation/reduction processes.

6 NEXT STEPS

The next steps in this study will involve:

- Quarterly survey New Bermingham WTP discharge pathway to confirm if overland flow or the discharge is going to ground and monitor for any glaciation of between the WTP discharge and upper No Cash Creek; and
- Continued collection of water quality data from surface stations KV-110, KV-114, KV-111, KV-118, KV-21, and groundwater monitoring wells RB-MW-1, BH-MW-1, NC-MW-1 and KV-116, to better analyze trends and attenuation along the No Cash corridor.

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APPENDIX A:

LABORATORY ANALYTICAL REPORTS – SOIL AND MOSS GEOCHEMICAL AND MICROBIOLOGICAL, AND SURFACE WATER QUALITY DATA

ALEXCO RESOURCE CORP.
ATTN: Kai Woloshyn
#3 - 151 Industrial Road
Whitehorse YT Y1A 2V3

Date Received: 07-SEP-18
Report Date: 25-SEP-18 16:21 (MT)
Version: FINAL

Client Phone: --

Certificate of Analysis

Lab Work Order #: L2160708

Project P.O. #: NOT SUBMITTED
Job Reference: BERMINGHAM NATURAL ATTENUATION STUDY
C of C Numbers: 1 of 1
Legal Site Desc:

Comments: The aqua regia metals report from ALS Minerals can be found at the end of this report.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2160708-1	L2160708-2	L2160708-3	L2160708-4	L2160708-5
Sample ID		L2160708-1	L2160708-2	L2160708-3	L2160708-4	L2160708-5
Description		Other	Other	Other	Other	Other
Sampled Date		04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18
Sampled Time		11:04	11:13	11:20	11:31	11:40
Client ID		BM-NAT-09	BM-NAT-11	BM-NAT-12	BM-NAT-13	BM-NAT-14
SOIL						
Physical Tests	Moisture (%)	33.6	58.0	39.1	43.2	35.4
Particle Size	% Gravel (>2mm) (%)	15.6	<1.0	10.2	<1.0	<1.0
	% Sand (2.0mm - 0.063mm) (%)	23.2	2.9	27.7	5.9	7.5
	% Silt (0.063mm - 4um) (%)	55.5	87.8	57.1	85.2	83.5
	% Clay (<4um) (%)	5.7	9.3	5.1	8.9	9.1
	Texture	Silt loam	Silt	Silt loam	Silt	Silt
Organic / Inorganic Carbon	Total Organic Carbon (%)	5.98	11.0	4.45	8.15	5.58
Saturated Paste Extractables	Paste pH (pH)	5.33	4.75	5.91	5.05	4.87
Total Metals	Aluminum (Al) (%)	1.13	1.32	1.17	1.15	1.16
	Antimony (Sb) (ppm)	1.37	1.41	2.36	1.17	0.78
	Arsenic (As) (ppm)	13.6	12.1	15.4	18.9	7.3
	Barium (Ba) (ppm)	360	380	340	300	240
	Beryllium (Be) (ppm)	0.22	0.31	0.36	0.30	0.20
	Bismuth (Bi) (ppm)	0.14	0.16	0.15	0.17	0.14
	Boron (B) (ppm)	<10	<10	<10	<10	<10
	Cadmium (Cd) (ppm)	0.62	0.70	1.17	0.34	0.24
	Calcium (Ca) (%)	0.28	0.31	0.64	0.36	0.22
	Cerium (Ce) (ppm)	25.3	25.2	26.8	20.7	22.0
	Cesium (Cs) (ppm)	0.69	0.85	0.73	0.77	0.77
	Chromium (Cr) (ppm)	20	23	22	21	21
	Cobalt (Co) (ppm)	13.9	8.3	6.2	5.9	4.7
	Copper (Cu) (ppm)	11.0	13.8	21.3	10.6	8.8
	Gallium (Ga) (ppm)	3.63	3.79	3.32	3.53	3.58
	Germanium (Ge) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.02	<0.02	0.02	<0.02	<0.02
	Indium (In) (ppm)	0.021	0.021	0.024	0.019	0.016
	Iron (Fe) (%)	1.56	1.97	1.71	1.83	1.37
	Lanthanum (La) (ppm)	12.5	12.3	13.4	10.5	11.2
	Lead (Pb) (ppm)	30.9	16.5	67.3	13.7	14.0
	Lithium (Li) (ppm)	12.5	12.4	12.2	11.5	11.8
	Magnesium (Mg) (%)	0.29	0.29	0.34	0.28	0.28
	Manganese (Mn) (ppm)	1270	546	205	318	180
	Mercury (Hg) (ppm)	0.06	0.11	0.09	0.08	0.09
	Molybdenum (Mo) (ppm)	0.66	0.75	0.66	0.75	0.40
	Nickel (Ni) (ppm)	13.6	17.2	16.1	13.2	11.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2160708-6	L2160708-7	L2160708-8	L2160708-9	L2160708-10
Description	Other	Other	Other	Other	Other
Sampled Date	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18
Sampled Time	11:48	11:55	12:02	12:11	12:19
Client ID	BM-NAT-15	BM-NAT-16	BM-NAT-18	BM-NAT-19	BM-NAT-20
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	48.1	48.8	51.2	45.4	51.6
Particle Size % Gravel (>2mm) (%)	<1.0	<1.0	16.7	<1.0	5.8
% Sand (2.0mm - 0.063mm) (%)	2.3	7.2	10.1	9.4	27.2
% Silt (0.063mm - 4um) (%)	88.8	85.0	67.0	81.6	61.8
% Clay (<4um) (%)	9.0	7.9	6.2	8.1	5.2
Texture	Silt	Silt	Silt	Silt	Silt loam
Organic / Inorganic Carbon Total Organic Carbon (%)	10.4	5.57	15.5	7.68	11.2
Saturated Paste Extractables Paste pH (pH)	6.03	6.03	6.09	5.80	7.14
Total Metals Aluminum (Al) (%)	1.29	1.25	1.30	1.06	1.07
Antimony (Sb) (ppm)	2.14	1.41	1.11	1.18	1.24
Arsenic (As) (ppm)	23.5	17.8	24.9	17.1	36.9
Barium (Ba) (ppm)	400	500	480	220	320
Beryllium (Be) (ppm)	0.32	0.32	0.50	0.27	0.51
Bismuth (Bi) (ppm)	0.17	0.17	0.18	0.15	0.19
Boron (B) (ppm)	<10	<10	<10	<10	<10
Cadmium (Cd) (ppm)	5.00	2.53	1.31	4.17	6.09
Calcium (Ca) (%)	0.57	0.43	0.73	0.36	1.14
Cerium (Ce) (ppm)	25.4	30.9	26.1	23.7	20.8
Cesium (Cs) (ppm)	0.84	0.75	1.12	0.66	0.68
Chromium (Cr) (ppm)	23	22	20	20	22
Cobalt (Co) (ppm)	20.0	91.5	14.7	9.1	11.3
Copper (Cu) (ppm)	14.3	10.2	60.7	11.6	39.1
Gallium (Ga) (ppm)	4.08	3.91	3.89	3.21	2.80
Germanium (Ge) (ppm)	<0.05	<0.05	0.05	<0.05	<0.05
Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
Hafnium (Hf) (ppm)	<0.02	<0.02	0.03	<0.02	0.04
Indium (In) (ppm)	0.024	0.022	0.028	0.020	0.022
Iron (Fe) (%)	2.21	2.91	2.88	2.01	2.22
Lanthanum (La) (ppm)	12.1	12.4	12.1	11.6	10.0
Lead (Pb) (ppm)	72.5	17.4	17.2	19.6	14.9
Lithium (Li) (ppm)	13.6	12.6	12.6	11.0	11.8
Magnesium (Mg) (%)	0.35	0.31	0.48	0.29	0.39
Manganese (Mn) (ppm)	4890	6210	2040	683	3030
Mercury (Hg) (ppm)	0.11	0.07	0.06	0.05	0.06
Molybdenum (Mo) (ppm)	0.95	1.41	1.21	0.85	1.24
Nickel (Ni) (ppm)	20.8	18.9	26.3	17.8	43.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2160708-11	L2160708-12	L2160708-13	L2160708-14	L2160708-15
Description	Other	Other	Other	Other	Other
Sampled Date	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18
Sampled Time	12:26	15:00	15:08	15:15	15:24
Client ID	BM-NAT-21	BM-NAT-08	BM-NAT-07	BM-NAT-06	BM-NAT-05
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	53.4	44.5	60.1	48.5	53.8
Particle Size % Gravel (>2mm) (%)	3.4	<1.0	2.4	2.8	<1.0
% Sand (2.0mm - 0.063mm) (%)	24.3	4.8	8.1	3.8	7.3
% Silt (0.063mm - 4um) (%)	66.5	86.8	79.7	84.9	84.4
% Clay (<4um) (%)	5.7	8.4	9.8	8.6	8.0
Texture	Silt loam	Silt	Silt	Silt	Silt
Organic / Inorganic Carbon Total Organic Carbon (%)	6.69	6.41	10.2	7.82	10.3
Saturated Paste Extractables Paste pH (pH)	6.02	6.23	5.17	5.42	3.75
Total Metals Aluminum (Al) (%)	1.10	1.40	1.31	1.35	1.19
Antimony (Sb) (ppm)	0.91	1.10	1.66	1.13	0.95
Arsenic (As) (ppm)	19.7	12.8	18.2	15.1	10.6
Barium (Ba) (ppm)	400	440	440	370	210
Beryllium (Be) (ppm)	0.30	0.32	0.33	0.29	0.18
Bismuth (Bi) (ppm)	0.16	0.17	0.16	0.19	0.15
Boron (B) (ppm)	<10	<10	<10	<10	<10
Cadmium (Cd) (ppm)	0.77	0.66	1.12	0.57	0.40
Calcium (Ca) (%)	0.51	0.42	0.27	0.29	0.16
Cerium (Ce) (ppm)	27.8	25.9	31.8	20.4	18.05
Cesium (Cs) (ppm)	0.73	0.82	0.90	0.92	0.88
Chromium (Cr) (ppm)	20	24	24	23	20
Cobalt (Co) (ppm)	15.6	10.5	29.4	6.1	4.7
Copper (Cu) (ppm)	18.7	13.9	14.4	12.1	8.9
Gallium (Ga) (ppm)	3.29	4.01	3.84	4.38	3.95
Germanium (Ge) (ppm)	0.05	<0.05	0.05	<0.05	<0.05
Gold (Au) (ppm)	0.04	<0.02	<0.02	<0.02	<0.02
Hafnium (Hf) (ppm)	0.02	0.02	<0.02	<0.02	<0.02
Indium (In) (ppm)	0.021	0.022	0.031	0.024	0.019
Iron (Fe) (%)	2.11	1.90	1.94	1.77	1.46
Lanthanum (La) (ppm)	12.6	13.0	14.6	10.6	9.4
Lead (Pb) (ppm)	17.0	14.1	49.3	17.5	15.0
Lithium (Li) (ppm)	12.0	15.9	14.1	13.2	10.8
Magnesium (Mg) (%)	0.32	0.35	0.31	0.28	0.24
Manganese (Mn) (ppm)	2510	645	1580	304	131
Mercury (Hg) (ppm)	0.17	0.07	0.10	0.09	0.10
Molybdenum (Mo) (ppm)	1.06	0.66	0.79	0.73	0.80
Nickel (Ni) (ppm)	19.5	17.9	18.5	14.9	12.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2160708-16	L2160708-17	L2160708-18		
	Description	Other	Other	Other		
	Sampled Date	04-SEP-18	04-SEP-18	04-SEP-18		
	Sampled Time	15:33	15:47	15:52		
	Client ID	BM-NAT-03	BM-NAT-02	BM-NAT-01		
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	51.6	22.3	44.7		
Particle Size	% Gravel (>2mm) (%)	3.0	57.1	9.0		
	% Sand (2.0mm - 0.063mm) (%)	16.7	21.9	10.5		
	% Silt (0.063mm - 4um) (%)	71.3	19.1	71.7		
	% Clay (<4um) (%)	9.0	2.0	8.9		
	Texture	Silt loam	Sandy loam	Silt		
Organic / Inorganic Carbon	Total Organic Carbon (%)	7.62	2.37	8.13		
Saturated Paste Extractables	Paste pH (pH)	5.22	4.52	4.76		
Total Metals	Aluminum (Al) (%)	1.15	0.90	1.33		
	Antimony (Sb) (ppm)	1.02	2.41	1.62		
	Arsenic (As) (ppm)	10.2	24.8	16.3		
	Barium (Ba) (ppm)	270	140	320		
	Beryllium (Be) (ppm)	0.20	0.23	0.28		
	Bismuth (Bi) (ppm)	0.12	0.13	0.22		
	Boron (B) (ppm)	<10	<10	<10		
	Cadmium (Cd) (ppm)	0.53	0.38	0.79		
	Calcium (Ca) (%)	0.40	0.13	0.22		
	Cerium (Ce) (ppm)	20.8	19.60	21.2		
	Cesium (Cs) (ppm)	0.66	0.62	0.89		
	Chromium (Cr) (ppm)	21	21	25		
	Cobalt (Co) (ppm)	5.8	5.2	4.7		
	Copper (Cu) (ppm)	10.5	13.9	15.0		
	Gallium (Ga) (ppm)	3.48	2.99	4.22		
	Germanium (Ge) (ppm)	<0.05	<0.05	<0.05		
	Gold (Au) (ppm)	<0.02	<0.02	0.02		
	Hafnium (Hf) (ppm)	<0.02	<0.02	<0.02		
	Indium (In) (ppm)	0.018	0.015	0.021		
	Iron (Fe) (%)	1.57	1.82	1.77		
	Lanthanum (La) (ppm)	10.7	10.3	11.4		
	Lead (Pb) (ppm)	14.1	18.6	28.9		
	Lithium (Li) (ppm)	13.5	8.9	11.9		
	Magnesium (Mg) (%)	0.32	0.21	0.28		
	Manganese (Mn) (ppm)	167	223	161		
	Mercury (Hg) (ppm)	0.17	0.10	0.09		
	Molybdenum (Mo) (ppm)	0.71	1.21	0.98		
	Nickel (Ni) (ppm)	14.5	14.9	16.6		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2160708-1	L2160708-2	L2160708-3	L2160708-4	L2160708-5
Sample ID		L2160708-1	L2160708-2	L2160708-3	L2160708-4	L2160708-5
Description		Other	Other	Other	Other	Other
Sampled Date		04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18
Sampled Time		11:04	11:13	11:20	11:31	11:40
Client ID		BM-NAT-09	BM-NAT-11	BM-NAT-12	BM-NAT-13	BM-NAT-14
SOIL						
Total Metals	Niobium (Nb) (ppm)	0.55	0.67	0.66	0.62	0.60
	Phosphorus (P) (ppm)	600	890	800	680	560
	Potassium (K) (%)	0.04	0.04	0.04	0.04	0.03
	Rhenium (Re) (ppm)	0.001	0.001	0.001	0.001	0.002
	Rubidium (Rb) (ppm)	4.8	9.7	7.0	7.7	6.7
	Scandium (Sc) (ppm)	2.5	2.6	2.8	2.2	2.2
	Selenium (Se) (ppm)	0.9	1.7	1.9	1.0	0.9
	Silver (Ag) (ppm)	0.72	0.42	1.53	0.30	0.24
	Sodium (Na) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Strontium (Sr) (ppm)	16.9	22.1	24.7	19.4	15.0
	Sulfur (S) (%)	0.05	0.08	0.10	0.06	0.05
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.02	0.02	0.02	0.02	0.01
	Thallium (Tl) (ppm)	0.18	0.22	0.18	0.18	0.19
	Thorium (Th) (ppm)	2.0	1.0	1.4	1.2	1.5
	Tin (Sn) (ppm)	0.3	0.3	0.4	0.3	0.3
	Titanium (Ti) (%)	0.025	0.021	0.026	0.022	0.023
	Tungsten (W) (ppm)	0.29	0.20	0.24	0.34	0.60
	Uranium (U) (ppm)	0.57	0.87	0.94	0.63	0.62
	Vanadium (V) (ppm)	36	36	34	43	29
	Yttrium (Y) (ppm)	5.25	7.79	7.81	4.21	3.76
	Zinc (Zn) (ppm)	119	89	158	69	56
	Zirconium (Zr) (ppm)	0.5	<0.5	0.5	<0.5	<0.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2160708-6 Other 04-SEP-18 11:48 BM-NAT-15	L2160708-7 Other 04-SEP-18 11:55 BM-NAT-16	L2160708-8 Other 04-SEP-18 12:02 BM-NAT-18	L2160708-9 Other 04-SEP-18 12:11 BM-NAT-19	L2160708-10 Other 04-SEP-18 12:19 BM-NAT-20
SOIL						
Total Metals	Niobium (Nb) (ppm)	0.50	0.56	0.54	0.57	0.40
	Phosphorus (P) (ppm)	890	720	860	680	650
	Potassium (K) (%)	0.05	0.04	0.04	0.04	0.05
	Rhenium (Re) (ppm)	0.001	0.001	0.001	0.001	0.005
	Rubidium (Rb) (ppm)	9.9	7.5	5.2	6.4	5.4
	Scandium (Sc) (ppm)	2.5	2.7	3.8	2.4	2.5
	Selenium (Se) (ppm)	1.0	1.0	1.3	0.6	1.4
	Silver (Ag) (ppm)	1.24	0.29	0.26	0.31	0.27
	Sodium (Na) (%)	<0.01	<0.01	<0.01	<0.01	<0.01
	Strontium (Sr) (ppm)	21.6	21.7	31.7	16.6	32.3
	Sulfur (S) (%)	0.05	0.05	0.06	0.03	0.07
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.03	0.03	0.04	0.02	0.05
	Thallium (Tl) (ppm)	0.22	0.20	0.12	0.14	0.10
	Thorium (Th) (ppm)	1.1	1.5	1.8	1.5	1.5
	Tin (Sn) (ppm)	0.4	0.4	0.3	0.3	0.2
	Titanium (Ti) (%)	0.024	0.024	0.037	0.025	0.017
	Tungsten (W) (ppm)	0.25	0.22	0.26	0.32	0.21
	Uranium (U) (ppm)	0.85	0.71	0.82	0.72	1.20
	Vanadium (V) (ppm)	38	44	63	37	34
	Yttrium (Y) (ppm)	6.05	5.47	9.02	4.95	7.22
	Zinc (Zn) (ppm)	486	616	112	658	2340
	Zirconium (Zr) (ppm)	<0.5	<0.5	0.9	<0.5	1.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2160708-11	L2160708-12	L2160708-13	L2160708-14	L2160708-15
Description	Other	Other	Other	Other	Other
Sampled Date	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18	04-SEP-18
Sampled Time	12:26	15:00	15:08	15:15	15:24
Client ID	BM-NAT-21	BM-NAT-08	BM-NAT-07	BM-NAT-06	BM-NAT-05
Grouping / **Analyte**					
SOIL					
Total Metals Niobium (Nb) (ppm)	0.53	0.60	0.53	0.51	0.45
Phosphorus (P) (ppm)	740	770	880	950	880
Potassium (K) (%)	0.04	0.04	0.05	0.04	0.04
Rhenium (Re) (ppm)	0.001	0.002	<0.001	0.001	0.001
Rubidium (Rb) (ppm)	6.2	9.2	9.6	8.2	8.0
Scandium (Sc) (ppm)	2.8	3.2	3.1	2.3	1.8
Selenium (Se) (ppm)	0.6	1.9	1.4	1.1	1.1
Silver (Ag) (ppm)	0.29	0.34	1.11	0.78	0.48
Sodium (Na) (%)	<0.01	<0.01	0.01	0.02	0.01
Strontium (Sr) (ppm)	23.3	20.7	18.1	19.5	13.2
Sulfur (S) (%)	0.04	0.05	0.06	0.06	0.05
Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
Tellurium (Te) (ppm)	0.03	0.03	0.03	0.03	0.02
Thallium (Tl) (ppm)	0.14	0.22	0.26	0.27	0.16
Thorium (Th) (ppm)	1.9	2.0	1.1	0.7	0.5
Tin (Sn) (ppm)	0.3	0.3	0.4	0.4	0.4
Titanium (Ti) (%)	0.024	0.025	0.023	0.021	0.019
Tungsten (W) (ppm)	0.19	0.22	0.30	0.29	0.32
Uranium (U) (ppm)	0.81	0.85	0.97	0.84	0.63
Vanadium (V) (ppm)	37	39	37	39	31
Yttrium (Y) (ppm)	6.51	6.63	7.40	4.29	3.04
Zinc (Zn) (ppm)	102	104	99	78	62
Zirconium (Zr) (ppm)	0.5	0.6	<0.5	<0.5	<0.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2160708-16	L2160708-17	L2160708-18		
	Description	Other	Other	Other		
	Sampled Date	04-SEP-18	04-SEP-18	04-SEP-18		
	Sampled Time	15:33	15:47	15:52		
	Client ID	BM-NAT-03	BM-NAT-02	BM-NAT-01		
Grouping	**Analyte**					
SOIL						
Total Metals	Niobium (Nb) (ppm)	0.57	0.45	0.35		
	Phosphorus (P) (ppm)	880	590	980		
	Potassium (K) (%)	0.04	0.03	0.04		
	Rhenium (Re) (ppm)	0.001	<0.001	<0.001		
	Rubidium (Rb) (ppm)	5.7	5.9	6.4		
	Scandium (Sc) (ppm)	2.1	1.6	1.3		
	Selenium (Se) (ppm)	1.0	0.5	0.9		
	Silver (Ag) (ppm)	0.52	0.46	1.55		
	Sodium (Na) (%)	0.01	0.01	0.01		
	Strontium (Sr) (ppm)	20.5	16.3	19.4		
	Sulfur (S) (%)	0.05	0.02	0.06		
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01		
	Tellurium (Te) (ppm)	0.01	0.02	0.02		
	Thallium (Tl) (ppm)	0.10	0.08	0.15		
	Thorium (Th) (ppm)	1.1	1.0	0.2		
	Tin (Sn) (ppm)	0.3	0.3	0.4		
	Titanium (Ti) (%)	0.024	0.026	0.021		
	Tungsten (W) (ppm)	0.34	0.52	0.53		
	Uranium (U) (ppm)	0.63	0.74	1.08		
	Vanadium (V) (ppm)	30	34	36		
	Yttrium (Y) (ppm)	4.15	2.87	4.40		
	Zinc (Zn) (ppm)	72	74	129		
	Zirconium (Zr) (ppm)	<0.5	<0.5	<0.5		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L2160708-10	BM-NAT-20	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2160708-13	BM-NAT-07	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2160708-18	BM-NAT-01	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2160708-6	BM-NAT-15	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2160708-9	BM-NAT-19	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217
A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.			
C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2
Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)			
C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2
The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.			
IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS
A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.			
MOISTURE-VA	Soil	Moisture content	CWS for PHC in Soil - Tier 1
This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.			
PH-PASTE-VA	Soil	pH in Soil (Paste) by Meter	Carter-CSSS / APHA 4500 H
A soil extract produced by the saturated paste extraction procedure is analyzed by pH meter.			
PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1
Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.			

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
AX	ALS MINERALS - VANCOUVER, B.C., CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 1

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

CERTIFICATE VA18228682

Project: L2160708

This report is for 18 Soil samples submitted to our lab in Vancouver, BC, Canada on 14-SEP-2018.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE SHANE STACK	ALSEV DATASUBLET	SOFTWARE DEVELOPMENT GROUP

SAMPLE PREPARATION

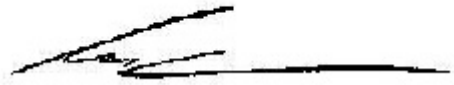
ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
SCR-41	Screen to -180um and save both

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION
ME-MS41	Ultra Trace Aqua Regia ICP-MS

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 

Colin Ramshaw, Vancouver Laboratory Manager

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

CERTIFICATE OF ANALYSIS VA18228682

Sample Description	Method	WEI-21	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	Recvd Wt.	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs
	Units	kg	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
	LOD	0.02	0.01	0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05
L2160708-1 BM-NAT-09		0.16	0.72	1.13	13.6	<0.02	<10	360	0.22	0.14	0.28	0.62	25.3	13.9	20	0.69
L2160708-2 BM-NAT-11		0.14	0.42	1.32	12.1	<0.02	<10	380	0.31	0.16	0.31	0.70	25.2	8.3	23	0.85
L2160708-3 BM-NAT-12		0.16	1.53	1.17	15.4	<0.02	<10	340	0.36	0.15	0.64	1.17	26.8	6.2	22	0.73
L2160708-4 BM-NAT-13		0.16	0.30	1.15	18.9	<0.02	<10	300	0.30	0.17	0.36	0.34	20.7	5.9	21	0.77
L2160708-5 BM-NAT-14		0.16	0.24	1.16	7.3	<0.02	<10	240	0.20	0.14	0.22	0.24	22.0	4.7	21	0.77
L2160708-6 BM-NAT-15		0.14	1.24	1.29	23.5	<0.02	<10	400	0.32	0.17	0.57	5.00	25.4	20.0	23	0.84
L2160708-7 BM-NAT-16		0.18	0.29	1.25	17.8	<0.02	<10	500	0.32	0.17	0.43	2.53	30.9	91.5	22	0.75
L2160708-8 BM-NAT-18		0.18	0.26	1.30	24.9	<0.02	<10	480	0.50	0.18	0.73	1.31	26.1	14.7	20	1.12
L2160708-9 BM-NAT-19		0.14	0.31	1.06	17.1	<0.02	<10	220	0.27	0.15	0.36	4.17	23.7	9.1	20	0.66
L2160708-10 BM-NAT-20		0.14	0.27	1.07	36.9	<0.02	<10	320	0.51	0.19	1.14	6.09	20.8	11.3	22	0.68
L2160708-11 BM-NAT-21		0.14	0.29	1.10	19.7	0.04	<10	400	0.30	0.16	0.51	0.77	27.8	15.6	20	0.73
L2160708-12 BM-NAT-08		0.16	0.34	1.40	12.8	<0.02	<10	440	0.32	0.17	0.42	0.66	25.9	10.5	24	0.82
L2160708-13 BM-NAT-07		0.18	1.11	1.31	18.2	<0.02	<10	440	0.33	0.16	0.27	1.12	31.8	29.4	24	0.90
L2160708-14 BM-NAT-06		0.14	0.78	1.35	15.1	<0.02	<10	370	0.29	0.19	0.29	0.57	20.4	6.1	23	0.92
L2160708-15 BM-NAT-05		0.14	0.48	1.19	10.6	<0.02	<10	210	0.18	0.15	0.16	0.40	18.05	4.7	20	0.88
L2160708-16 BM-NAT-03		0.16	0.52	1.15	10.2	<0.02	<10	270	0.20	0.12	0.40	0.53	20.8	5.8	21	0.66
L2160708-17 BM-NAT-02		0.16	0.46	0.90	24.8	<0.02	<10	140	0.23	0.13	0.13	0.38	19.60	5.2	21	0.62
L2160708-18 BM-NAT-01		0.14	1.55	1.33	16.3	0.02	<10	320	0.28	0.22	0.22	0.79	21.2	4.7	25	0.89

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

CERTIFICATE OF ANALYSIS VA18228682

Sample Description	Method	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb
	Units	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm
	LOD	0.2	0.01	0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05
L2160708-1 BM-NAT-09		11.0	1.56	3.63	<0.05	0.02	0.06	0.021	0.04	12.5	12.5	0.29	1270	0.66	<0.01	0.55
L2160708-2 BM-NAT-11		13.8	1.97	3.79	<0.05	<0.02	0.11	0.021	0.04	12.3	12.4	0.29	546	0.75	<0.01	0.67
L2160708-3 BM-NAT-12		21.3	1.71	3.32	<0.05	0.02	0.09	0.024	0.04	13.4	12.2	0.34	205	0.66	<0.01	0.66
L2160708-4 BM-NAT-13		10.6	1.83	3.53	<0.05	<0.02	0.08	0.019	0.04	10.5	11.5	0.28	318	0.75	<0.01	0.62
L2160708-5 BM-NAT-14		8.8	1.37	3.58	<0.05	<0.02	0.09	0.016	0.03	11.2	11.8	0.28	180	0.40	<0.01	0.60
L2160708-6 BM-NAT-15		14.3	2.21	4.08	<0.05	<0.02	0.11	0.024	0.05	12.1	13.6	0.35	4890	0.95	<0.01	0.50
L2160708-7 BM-NAT-16		10.2	2.91	3.91	<0.05	<0.02	0.07	0.022	0.04	12.4	12.6	0.31	6210	1.41	<0.01	0.56
L2160708-8 BM-NAT-18		60.7	2.88	3.89	0.05	0.03	0.06	0.028	0.04	12.1	12.6	0.48	2040	1.21	<0.01	0.54
L2160708-9 BM-NAT-19		11.6	2.01	3.21	<0.05	<0.02	0.05	0.020	0.04	11.6	11.0	0.29	683	0.85	<0.01	0.57
L2160708-10 BM-NAT-20		39.1	2.22	2.80	<0.05	0.04	0.06	0.022	0.05	10.0	11.8	0.39	3030	1.24	<0.01	0.40
L2160708-11 BM-NAT-21		18.7	2.11	3.29	0.05	0.02	0.17	0.021	0.04	12.6	12.0	0.32	2510	1.06	<0.01	0.53
L2160708-12 BM-NAT-08		13.9	1.90	4.01	<0.05	0.02	0.07	0.022	0.04	13.0	15.9	0.35	645	0.66	<0.01	0.60
L2160708-13 BM-NAT-07		14.4	1.94	3.84	0.05	<0.02	0.10	0.031	0.05	14.6	14.1	0.31	1580	0.79	0.01	0.53
L2160708-14 BM-NAT-06		12.1	1.77	4.38	<0.05	<0.02	0.09	0.024	0.04	10.6	13.2	0.28	304	0.73	0.02	0.51
L2160708-15 BM-NAT-05		8.9	1.46	3.95	<0.05	<0.02	0.10	0.019	0.04	9.4	10.8	0.24	131	0.80	0.01	0.45
L2160708-16 BM-NAT-03		10.5	1.57	3.48	<0.05	<0.02	0.17	0.018	0.04	10.7	13.5	0.32	167	0.71	0.01	0.57
L2160708-17 BM-NAT-02		13.9	1.82	2.99	<0.05	<0.02	0.10	0.015	0.03	10.3	8.9	0.21	223	1.21	0.01	0.45
L2160708-18 BM-NAT-01		15.0	1.77	4.22	<0.05	<0.02	0.09	0.021	0.04	11.4	11.9	0.28	161	0.98	0.01	0.35

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

CERTIFICATE OF ANALYSIS VA18228682

Sample Description / Method / Analyte / Units / LOD	ME-MS41 Ni ppm 0.2	ME-MS41 P ppm 10	ME-MS41 Pb ppm 0.2	ME-MS41 Rb ppm 0.1	ME-MS41 Re ppm 0.001	ME-MS41 S % 0.01	ME-MS41 Sb ppm 0.05	ME-MS41 Sc ppm 0.1	ME-MS41 Se ppm 0.2	ME-MS41 Sn ppm 0.2	ME-MS41 Sr ppm 0.2	ME-MS41 Ta ppm 0.01	ME-MS41 Te ppm 0.01	ME-MS41 Th ppm 0.2	ME-MS41 Ti % 0.005
L2160708-1 BM-NAT-09	13.6	600	30.9	4.8	0.001	0.05	1.37	2.5	0.9	0.3	16.9	<0.01	0.02	2.0	0.025
L2160708-2 BM-NAT-11	17.2	890	16.5	9.7	0.001	0.08	1.41	2.6	1.7	0.3	22.1	<0.01	0.02	1.0	0.021
L2160708-3 BM-NAT-12	16.1	800	67.3	7.0	0.001	0.10	2.36	2.8	1.9	0.4	24.7	<0.01	0.02	1.4	0.026
L2160708-4 BM-NAT-13	13.2	680	13.7	7.7	0.001	0.06	1.17	2.2	1.0	0.3	19.4	<0.01	0.02	1.2	0.022
L2160708-5 BM-NAT-14	11.9	560	14.0	6.7	0.002	0.05	0.78	2.2	0.9	0.3	15.0	<0.01	0.01	1.5	0.023
L2160708-6 BM-NAT-15	20.8	890	72.5	9.9	0.001	0.05	2.14	2.5	1.0	0.4	21.6	<0.01	0.03	1.1	0.024
L2160708-7 BM-NAT-16	18.9	720	17.4	7.5	0.001	0.05	1.41	2.7	1.0	0.4	21.7	<0.01	0.03	1.5	0.024
L2160708-8 BM-NAT-18	26.3	860	17.2	5.2	0.001	0.06	1.11	3.8	1.3	0.3	31.7	<0.01	0.04	1.8	0.037
L2160708-9 BM-NAT-19	17.8	680	19.6	6.4	0.001	0.03	1.18	2.4	0.6	0.3	16.6	<0.01	0.02	1.5	0.025
L2160708-10 BM-NAT-20	43.3	650	14.9	5.4	0.005	0.07	1.24	2.5	1.4	0.2	32.3	<0.01	0.05	1.5	0.017
L2160708-11 BM-NAT-21	19.5	740	17.0	6.2	0.001	0.04	0.91	2.8	0.6	0.3	23.3	<0.01	0.03	1.9	0.024
L2160708-12 BM-NAT-08	17.9	770	14.1	9.2	0.002	0.05	1.10	3.2	1.9	0.3	20.7	<0.01	0.03	2.0	0.025
L2160708-13 BM-NAT-07	18.5	880	49.3	9.6	<0.001	0.06	1.66	3.1	1.4	0.4	18.1	<0.01	0.03	1.1	0.023
L2160708-14 BM-NAT-06	14.9	950	17.5	8.2	0.001	0.06	1.13	2.3	1.1	0.4	19.5	<0.01	0.03	0.7	0.021
L2160708-15 BM-NAT-05	12.3	880	15.0	8.0	0.001	0.05	0.95	1.8	1.1	0.4	13.2	<0.01	0.02	0.5	0.019
L2160708-16 BM-NAT-03	14.5	880	14.1	5.7	0.001	0.05	1.02	2.1	1.0	0.3	20.5	<0.01	0.01	1.1	0.024
L2160708-17 BM-NAT-02	14.9	590	18.6	5.9	<0.001	0.02	2.41	1.6	0.5	0.3	16.3	<0.01	0.02	1.0	0.026
L2160708-18 BM-NAT-01	16.6	980	28.9	6.4	<0.001	0.06	1.62	1.3	0.9	0.4	19.4	<0.01	0.02	0.2	0.021

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

CERTIFICATE OF ANALYSIS VA18228682

Sample Description	Method	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	Tl	U	V	W	Y	Zn	Zr
	Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	LOD	0.02	0.05	1	0.05	0.05	2	0.5
L2160708-1 BM-NAT-09		0.18	0.57	36	0.29	5.25	119	0.5
L2160708-2 BM-NAT-11		0.22	0.87	36	0.20	7.79	89	<0.5
L2160708-3 BM-NAT-12		0.18	0.94	34	0.24	7.81	158	0.5
L2160708-4 BM-NAT-13		0.18	0.63	43	0.34	4.21	69	<0.5
L2160708-5 BM-NAT-14		0.19	0.62	29	0.60	3.76	56	<0.5
L2160708-6 BM-NAT-15		0.22	0.85	38	0.25	6.05	486	<0.5
L2160708-7 BM-NAT-16		0.20	0.71	44	0.22	5.47	616	<0.5
L2160708-8 BM-NAT-18		0.12	0.82	63	0.26	9.02	112	0.9
L2160708-9 BM-NAT-19		0.14	0.72	37	0.32	4.95	658	<0.5
L2160708-10 BM-NAT-20		0.10	1.20	34	0.21	7.22	2340	1.2
L2160708-11 BM-NAT-21		0.14	0.81	37	0.19	6.51	102	0.5
L2160708-12 BM-NAT-08		0.22	0.85	39	0.22	6.63	104	0.6
L2160708-13 BM-NAT-07		0.26	0.97	37	0.30	7.40	99	<0.5
L2160708-14 BM-NAT-06		0.27	0.84	39	0.29	4.29	78	<0.5
L2160708-15 BM-NAT-05		0.16	0.63	31	0.32	3.04	62	<0.5
L2160708-16 BM-NAT-03		0.10	0.63	30	0.34	4.15	72	<0.5
L2160708-17 BM-NAT-02		0.08	0.74	34	0.52	2.87	74	<0.5
L2160708-18 BM-NAT-01		0.15	1.08	36	0.53	4.40	129	<0.5

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

CERTIFICATE OF ANALYSIS VA18228682

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

LOG-22	ME-MS41	SCR-41	WEI-21

ALS Canada Ltd.

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BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

QC CERTIFICATE VA18228682

Project: L2160708

This report is for 18 Soil samples submitted to our lab in Vancouver, BC, Canada on 14-SEP-2018.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE SHANE STACK	ALSEV DATASUBLET	SOFTWARE DEVELOPMENT GROUP

SAMPLE PREPARATION

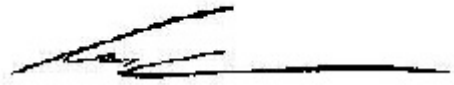
ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
SCR-41	Screen to -180um and save both

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION
ME-MS41	Ultra Trace Aqua Regia ICP-MS

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature: 

Colin Ramshaw, Vancouver Laboratory Manager

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100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

QC CERTIFICATE OF ANALYSIS VA18228682

Sample Description	Method / Analyte / Units / LOD	ME-MS41 Ag ppm 0.01	ME-MS41 Al % 0.01	ME-MS41 As ppm 0.1	ME-MS41 Au ppm 0.02	ME-MS41 B ppm 10	ME-MS41 Ba ppm 10	ME-MS41 Be ppm 0.05	ME-MS41 Bi ppm 0.01	ME-MS41 Ca % 0.01	ME-MS41 Cd ppm 0.01	ME-MS41 Ce ppm 0.02	ME-MS41 Co ppm 0.1	ME-MS41 Cr ppm 1	ME-MS41 Cs ppm 0.05	ME-MS41 Cu ppm 0.2
STANDARDS																
EMOG-17		65.0	1.50	569	0.81	<10	50	0.42	5.51	0.88	18.65	40.1	738	44	5.94	8040
Target Range - Lower Bound		59.5	1.45	505	0.77	<10	30	0.32	5.32	0.87	18.35	37.6	680	42	5.57	7780
Upper Bound		72.7	1.79	617	0.99	20	80	0.56	6.52	1.09	22.5	46.0	832	54	6.91	8960
MRGeo08		4.50	2.62	34.3	<0.02	<10	450	0.83	0.69	1.05	2.27	72.8	19.5	89	10.65	613
Target Range - Lower Bound		4.00	2.44	29.6	<0.02	<10	370	0.67	0.60	1.00	2.01	66.2	17.0	81	9.40	587
Upper Bound		4.92	3.00	36.4	0.04	20	530	0.95	0.76	1.24	2.47	81.0	21.0	102	11.60	675
OREAS 905		0.54	0.81	34.7	0.43	<10	250	1.07	6.07	0.38	0.34	80.2	14.5	17	1.19	1610
Target Range - Lower Bound		0.45	0.73	28.4	0.33	<10	200	0.78	5.16	0.29	0.30	69.7	12.4	15	1.05	1450
Upper Bound		0.58	0.91	35.0	0.45	20	300	1.08	6.32	0.38	0.38	85.3	15.4	20	1.39	1670
OREAS 920		0.09	2.35	4.9	<0.02	<10	80	0.71	0.67	0.30	0.07	72.3	14.7	41	1.89	113.5
Target Range - Lower Bound		0.07	2.18	4.2	<0.02	<10	50	0.59	0.60	0.28	0.04	64.8	13.4	37	1.84	102.0
Upper Bound		0.12	2.68	5.3	0.04	20	110	0.87	0.76	0.37	0.08	79.2	16.6	48	2.36	118.0
BLANKS																
BLANK		<0.01	<0.01	<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2
BLANK		<0.01	<0.01	<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2
Target Range - Lower Bound		<0.01	<0.01	<0.1	<0.02	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2
Upper Bound		0.02	0.02	0.2	0.04	20	20	0.10	0.02	0.02	0.02	0.04	0.2	2	0.10	0.4
DUPLICATES																
ORIGINAL		0.04	2.05	10.9	<0.02	1090	250	0.91	0.20	2.32	0.15	29.6	9.0	13	6.44	28.2
DUP		0.05	2.08	10.9	<0.02	1100	250	0.85	0.20	2.38	0.15	30.2	9.5	13	6.60	27.9
Target Range - Lower Bound		0.03	1.95	10.3	<0.02	1030	220	0.79	0.18	2.22	0.13	28.4	8.7	11	6.14	26.9
Upper Bound		0.06	2.18	11.5	0.04	1160	280	0.97	0.22	2.48	0.17	31.4	9.8	15	6.90	29.2
L2160708-17 BM-NAT-02		0.46	0.90	24.8	<0.02	<10	140	0.23	0.13	0.13	0.38	19.60	5.2	21	0.62	13.9
DUP		0.49	0.94	25.7	<0.02	<10	150	0.22	0.14	0.13	0.42	21.3	5.3	22	0.66	14.5
Target Range - Lower Bound		0.44	0.86	23.9	<0.02	<10	120	0.16	0.12	0.11	0.37	19.40	4.9	19	0.56	13.5
Upper Bound		0.51	0.98	26.6	0.04	20	170	0.29	0.15	0.15	0.43	21.5	5.6	24	0.72	14.9

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
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BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

QC CERTIFICATE OF ANALYSIS VA18228682

Sample Description	Method	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni
	Units	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
	LOD	0.01	0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05	0.2
STANDARDS																
EMOG-17		4.35	5.60	0.14	0.41	0.52	0.846	0.63	19.8	18.1	0.73	615	1020	0.15	1.56	7500
Target Range - Lower Bound		4.18	5.56	0.08	0.39	0.46	0.814	0.60	18.3	17.2	0.73	595	1015	0.15	1.32	6930
Upper Bound		5.14	6.90	0.30	0.53	0.64	1.005	0.76	22.9	21.2	0.91	739	1240	0.20	1.72	8470
MRGeo08		3.66	9.59	0.14	0.67	0.06	0.153	1.31	36.6	31.0	1.16	410	14.30	0.33	1.02	710
Target Range - Lower Bound		3.22	8.73	0.07	0.64	0.04	0.137	1.12	33.2	29.6	1.03	378	13.10	0.30	0.79	622
Upper Bound		3.96	10.80	0.29	0.83	0.10	0.179	1.40	41.0	36.4	1.29	473	16.10	0.39	1.09	760
OREAS 905		3.60	6.28	0.10	1.10	0.02	0.601	0.32	39.9	4.8	0.16	357	2.90	0.10	0.26	8.7
Target Range - Lower Bound		3.14	5.45	<0.05	1.02	<0.01	0.517	0.28	34.7	4.0	0.13	310	2.65	0.07	0.19	7.8
Upper Bound		3.86	6.77	0.22	1.29	0.04	0.643	0.36	42.9	5.2	0.19	390	3.35	0.12	0.43	10.0
OREAS 920		3.58	6.36	0.10	0.53	<0.01	0.030	0.43	36.3	20.3	1.05	508	0.34	0.02	0.33	38.0
Target Range - Lower Bound		3.26	6.12	<0.05	0.48	<0.01	0.019	0.37	33.3	19.0	0.93	454	0.26	<0.01	0.22	34.4
Upper Bound		4.00	7.60	0.22	0.63	0.02	0.043	0.47	41.1	23.4	1.15	566	0.50	0.02	0.46	42.4
BLANKS																
BLANK		<0.01	<0.05	<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2
BLANK		<0.01	<0.05	<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2
Target Range - Lower Bound		<0.01	<0.05	<0.05	<0.02	<0.01	<0.005	<0.01	<0.2	<0.1	<0.01	<5	<0.05	<0.01	<0.05	<0.2
Upper Bound		0.02	0.10	0.10	0.04	0.02	0.010	0.02	0.4	0.2	0.02	10	0.10	0.02	0.10	0.4
DUPLICATES																
ORIGINAL		2.24	6.56	0.17	0.77	0.01	0.026	1.27	16.8	132.5	1.78	435	2.77	7.58	0.29	14.5
DUP		2.28	6.54	0.14	0.74	0.01	0.026	1.29	17.0	128.5	1.83	448	2.82	7.55	0.26	14.5
Target Range - Lower Bound		2.14	6.17	0.10	0.70	<0.01	0.020	1.21	15.9	124.0	1.70	414	2.61	7.18	0.21	13.6
Upper Bound		2.38	6.93	0.21	0.81	0.02	0.032	1.35	17.9	137.0	1.91	469	2.98	7.95	0.34	15.4
L2160708-17 BM-NAT-02		1.82	2.99	<0.05	<0.02	0.10	0.015	0.03	10.3	8.9	0.21	223	1.21	0.01	0.45	14.9
DUP		1.88	3.21	<0.05	<0.02	0.05	0.014	0.04	11.1	8.6	0.22	227	1.25	0.01	0.47	15.9
Target Range - Lower Bound		1.75	2.90	<0.05	<0.02	0.06	0.009	0.02	10.0	8.2	0.19	209	1.12	<0.01	0.39	14.4
Upper Bound		1.95	3.31	0.10	0.04	0.09	0.020	0.05	11.4	9.3	0.24	241	1.34	0.02	0.53	16.4

***** See Appendix Page for comments regarding this certificate *****

ALS Canada Ltd.
2103 Dollarton Hwy
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Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

QC CERTIFICATE OF ANALYSIS VA18228682

Sample Description	Method	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl
	Units	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
	LOD	10	0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02
STANDARDS																
EMOG-17		740	6770	68.5	0.301	3.04	713	4.6	6.5	1.8	49.3	0.01	1.20	10.5	0.199	1.78
Target Range - Lower Bound		680	6510	66.5	0.287	2.90	574	4.3	5.5	1.5	47.5	<0.01	1.16	9.3	0.188	1.71
Upper Bound		850	7950	81.5	0.353	3.56	776	5.5	7.2	2.6	58.5	0.03	1.44	11.8	0.240	2.37
MRGeo08		1040	1080	146.5	0.009	0.31	3.14	7.5	0.8	3.4	76.6	0.01	0.02	21.5	0.383	0.79
Target Range - Lower Bound		900	959	132.0	0.006	0.27	2.80	6.7	0.6	2.8	72.1	<0.01	<0.01	19.1	0.338	0.64
Upper Bound		1130	1175	162.0	0.010	0.35	3.90	8.4	1.5	4.0	88.5	0.03	0.04	23.7	0.424	0.92
OREAS 905		250	16.5	18.4	<0.001	0.07	1.11	1.7	2.5	1.3	12.9	<0.01	0.08	8.8	0.020	0.11
Target Range - Lower Bound			14.4	16.3	<0.001	0.04	0.83	1.5	1.8	0.8	10.9	<0.01	0.04	7.4	0.008	0.06
Upper Bound			18.0	20.1	0.002	0.09	1.23	2.0	2.8	1.7	13.7	0.02	0.09	9.4	0.030	0.16
OREAS 920		720	20.0	23.1	<0.001	0.05	0.67	2.7	0.3	1.0	16.8	0.01	0.02	15.8	0.116	0.15
Target Range - Lower Bound			19.2	22.2	<0.001	<0.01	0.45	2.5	<0.2	0.6	15.0	<0.01	<0.01	13.6	0.106	0.09
Upper Bound			23.9	27.4	0.002	0.05	0.77	3.3	0.7	1.6	18.8	0.02	0.04	17.0	0.140	0.20
BLANKS																
BLANK		<10	<0.2	<0.1	<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02
BLANK		<10	<0.2	<0.1	<0.001	<0.01	0.06	<0.1	<0.2	<0.2	<0.2	<0.01	0.01	<0.2	<0.005	<0.02
Target Range - Lower Bound		<10	<0.2	<0.1	<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02
Upper Bound		20	0.4	0.2	0.002	0.02	0.10	0.2	0.4	0.4	0.4	0.02	0.02	0.4	0.010	0.04
DUPLICATES																
ORIGINAL		930	8.3	42.1	0.001	0.25	1.03	5.2	0.2	0.7	283	<0.01	0.03	6.1	0.105	0.20
DUP		940	8.4	42.3	0.002	0.25	1.04	5.2	0.4	0.7	279	<0.01	0.03	6.3	0.107	0.21
Target Range - Lower Bound		880	7.7	40.0	<0.001	0.23	0.91	4.8	<0.2	0.5	267	<0.01	0.02	5.7	0.096	0.17
Upper Bound		990	9.0	44.4	0.002	0.27	1.16	5.6	0.4	0.9	295	0.02	0.04	6.7	0.116	0.24
L2160708-17 BM-NAT-02		590	18.6	5.9	<0.001	0.02	2.41	1.6	0.5	0.3	16.3	<0.01	0.02	1.0	0.026	0.08
DUP		610	19.1	6.6	0.001	0.02	2.40	1.7	0.6	0.3	16.9	<0.01	0.02	1.0	0.026	0.08
Target Range - Lower Bound		560	17.7	5.8	<0.001	<0.01	2.17	1.5	0.3	<0.2	15.6	<0.01	<0.01	0.8	0.020	0.05
Upper Bound		640	20.0	6.7	0.002	0.03	2.64	1.8	0.8	0.4	17.6	0.02	0.03	1.3	0.032	0.11

***** See Appendix Page for comments regarding this certificate *****

ALS Canada Ltd.
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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

QC CERTIFICATE OF ANALYSIS VA18228682

Sample Description	Method Analyte Units LOD	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
STANDARDS							
EMOG-17		2.60	60	1.70	10.95	6870	12.9
Target Range - Lower Bound		2.57	58	1.65	10.20	6780	10.6
Upper Bound		3.25	74	2.35	12.60	8290	15.5
MRGeo08		5.55	101	2.87	19.55	779	21.5
Target Range - Lower Bound		4.93	90	2.44	17.50	708	18.1
Upper Bound		6.13	112	3.42	21.5	870	25.7
OREAS 905		2.22	6	0.58	7.10	67	42.5
Target Range - Lower Bound		1.92	4	0.41	6.32	56	39.9
Upper Bound		2.46	8	0.73	7.84	72	55.1
OREAS 920		1.94	24	0.48	16.90	105	20.4
Target Range - Lower Bound		1.89	21	0.31	15.80	93	17.6
Upper Bound		2.42	28	0.61	19.40	119	25.0
BLANKS							
BLANK		<0.05	<1	<0.05	<0.05	<2	<0.5
BLANK		<0.05	<1	<0.05	<0.05	<2	<0.5
Target Range - Lower Bound		<0.05	<1	<0.05	<0.05	<2	<0.5
Upper Bound		0.10	2	0.10	0.10	4	1.0
DUPLICATES							
ORIGINAL		1.60	61	3.89	9.21	62	33.2
DUP		1.61	62	3.79	9.00	64	32.9
Target Range - Lower Bound		1.47	57	3.50	8.60	58	30.1
Upper Bound		1.74	66	4.18	9.61	68	36.0
L2160708-17 BM-NAT-02		0.74	34	0.52	2.87	74	<0.5
DUP		0.79	36	0.40	3.09	77	<0.5
Target Range - Lower Bound		0.68	32	0.38	2.78	70	<0.5
Upper Bound		0.85	38	0.54	3.18	81	1.0

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

QC CERTIFICATE OF ANALYSIS VA18228682

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

LOG-22	ME-MS41	SCR-41	WEI-21

ALS Environmental

Chain of Custody
Canada Toll
www

L2160708-COFC

C #

Page 1 of of 1

Report To				Report Format / Distribution				Service Requested (Rush for routine analysis subject to availability)
Company:	Alexco Resource Corp.			☑ Standard ☐ Other				◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Kai Woloshyn			☑ PDF ☑ Excel ☐ Digital ☐ Fax				○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	#3 Calcite Business Centre, 151 Industrial Road			Email 1: environment@alexcoresource.com				○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Whitehorse, YT Y1A 2V3			Email 2: nichole@accessconsulting.ca				○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	867-668-6463	Fax: 867-633-4882		Email 3: amacphail@accessconsulting.ca; agault@alexcor				
Invoice To	Same as Report ? ☐ Yes	☑ No		Client / Project Information				Analysis Request
Hardcopy of Invoice with Report?	☐ Yes	☑ No		Job #: Bermingham Natural Attenuation Study				Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	Alexco Resource Corp.			PO / AFE:				
Contact:	Derek Meneghin			LSD:				
Address:	Suite 1150 - 200 Granville St. Vancouver BC V6C 1S4							
Phone:	604-633-4888	Fax: 604-633-4887		Quote #:				
Lab Work Order # (lab use only)				ALS Contact: Shane Stack	Sampler:			

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Paste pH	Moisture Content	PSA-PIPET+GRAVEL-SK	Total Organic Carbon	Aqua regia ICP-MS metals	Tessier Seq Extract ICP-MS	P	Number of Containers
1	BM-NAT-09	04-Sep-18	11:04	Other	X	X	X	X	X			1
2	BM-NAT-11	04-Sep-18	11:13	Other	X	X	X	X	X			1
3	BM-NAT-12	04-Sep-18	11:20	Other	X	X	X	X	X			1
4	BM-NAT-13	04-Sep-18	11:31	Other	X	X	X	X	X			1
5	BM-NAT-14	04-Sep-18	11:40	Other	X	X	X	X	X			1
6	BM-NAT-15	04-Sep-18	11:48	Other	X	X	X	X	X			1
7	BM-NAT-16	04-Sep-18	11:55	Other	X	X	X	X	X			1
8	BM-NAT-18	04-Sep-18	12:02	Other	X	X	X	X	X			1
9	BM-NAT-19	04-Sep-18	12:11	Other	X	X	X	X	X			1
10	BM-NAT-20	04-Sep-18	12:19	Other	X	X	X	X	X			1
11	BM-NAT-21	04-Sep-18	12:26	Other	X	X	X	X	X			1
12	BM-NAT-08	04-Sep-18	15:00	Other	X	X	X	X	X			1
13	BM-NAT-07	04-Sep-18	15:08	Other	X	X	X	X	X			1
14	BM-NAT-06	04-Sep-18	15:15	Other	X	X	X	X	X			1
15	BM-NAT-05	04-Sep-18	15:24	Other	X	X	X	X	X			1
16	BM-NAT-03	04-Sep-18	15:33	Other	X	X	X	X	X			1
17	BM-NAT-02	04-Sep-18	15:47	Other	X	X	X	X	X			1
18	BM-NAT-01	04-Sep-18	15:52	Other	X	X	X	X	X			1
19		04-Sep-18		Other	X	X	X	X	X			1
20		04-Sep-18		Other	X	X	X	X	X			1
21		04-Sep-18		Other	X	X	X	X	X			1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please contact us if further information is required for the requested anaysis (e.g., Tessier).

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Alex Zheng	Date (dd-mmm-yy): Sept 7, 2018	Time (hh-mm): 7:30	Received by: EHF	Date: 7Sep 2018	Time: 14:30	Temperature: 6.0 °C	Verified by: HA	Date: 9/11	Time: 12:40p	Observations: Yes / No ? If Yes add SIF

GENF 20.00 Front

10

Contango STRATEGIES LTD.
Forward looking. Lateral thinking.

Report To **Andrew MacPhail, Andrew Gault, Kai Woloshyn**
Alexco Resource Corp.
#3 Calcite Business Centre, 151 Industrial Road
Whitehorse, YT
Y1A 2V3

Client Phone 867-668-6463, 613-329-0085

Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A
Version	FINAL

Report #	029_1118_08A
Project P.O. #	AKHM-13-01
Project Name	Alexco
COC #	00191

Report prepared by:

Carolynn Pander, dip. BT
Technologist I

Report reviewed by:

Ainsley Stewart, dip. BT
Technologist III

Sample Summary

Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

Sample Details

Contango Sample ID	Client Sample ID	Sample Type	Date Sampled	Number of Containers	Container Type	Status Upon Received	COC#
DNA_409	BM-NAT-10	Soil	04/Sep/2018	1	Specimen cup	12 °C, Acceptable	00191
DNA_408	BM-NAT-17	Soil	04/Sep/2018	1	Specimen cup	12 °C, Acceptable	00191
DNA_407	BM-NAT-4	Soil	04/Sep/2018	1	Specimen cup	12 °C, Acceptable	00191

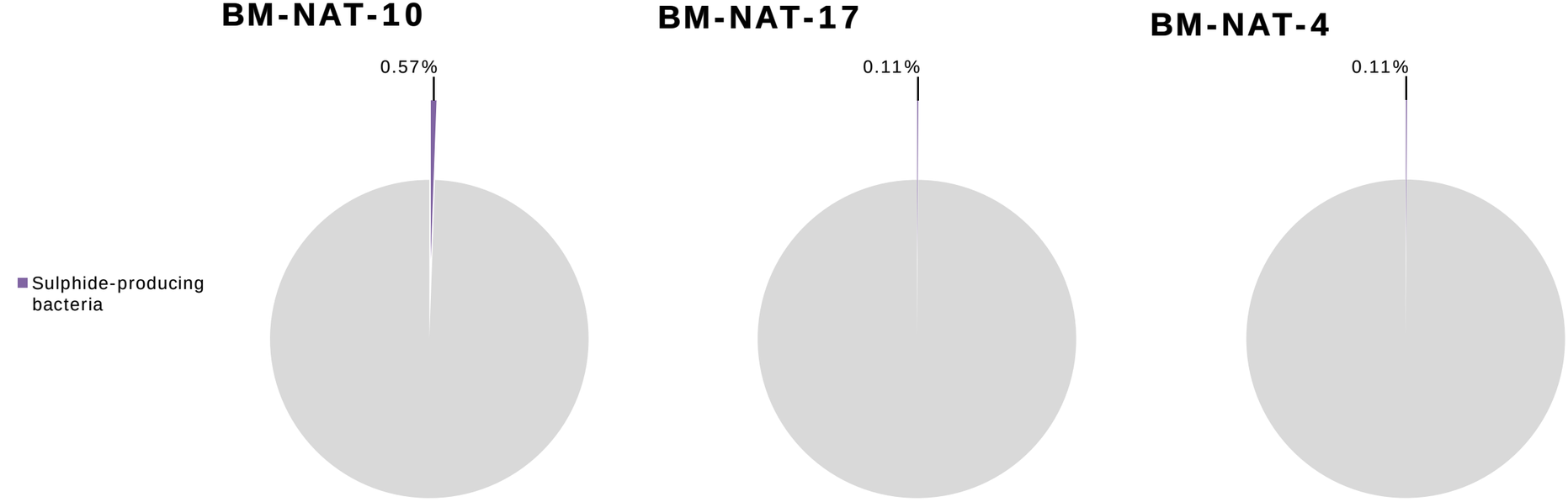
Summary of add-on analyses performed

Summary of organism populations that have genera known to possess these traits or abilities

Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

Client Sample ID	**BM-NAT-10**	**BM-NAT-17**	**BM-NAT-4**
Date Sampled	04/Sep/2018	04/Sep/2018	04/Sep/2018
Contango Sample ID	DNA_409	DNA_408	DNA_407
Sample Type	Soil	Soil	Soil
Percentage of Bacterial Community			
Sulphide-producing bacteria	0.57%	0.11%	0.11%
Other bacteria	99.43%	99.89%	99.89%

Refer to add-on analysis tabs for trait assignment categories of each genera

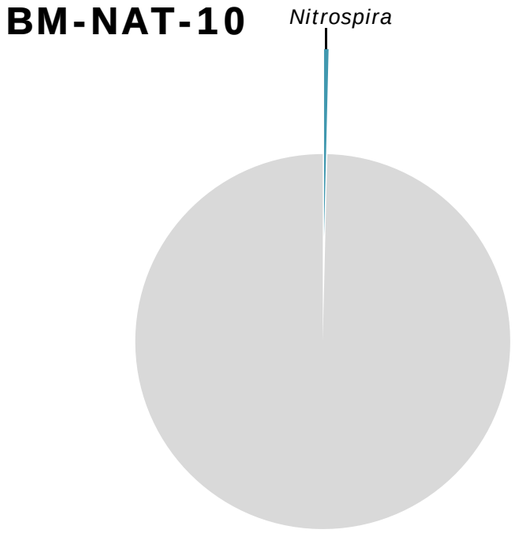


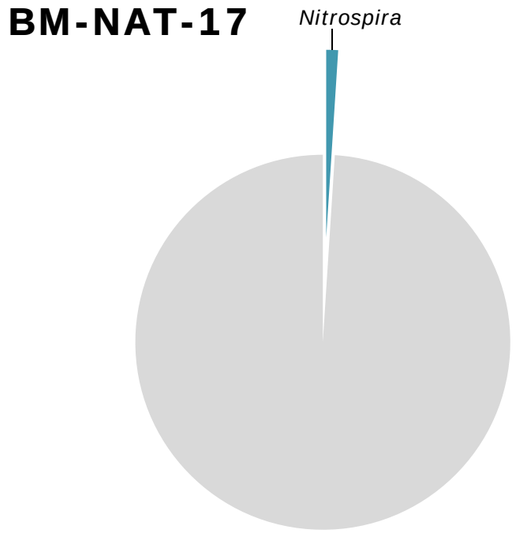
Abundant bacteria identified to the genus level

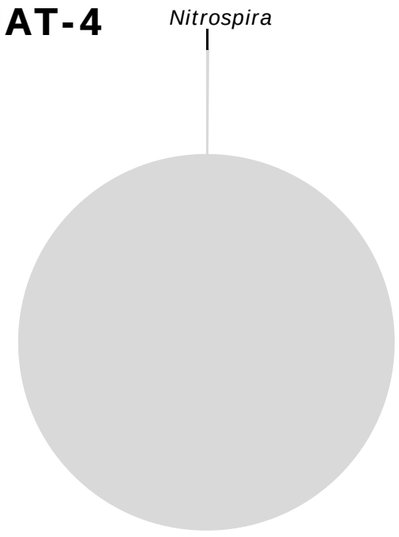
Of bacteria identified to the genus level, those with the highest percentage are provided if ≥ 1% in at least one sample.

Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

	Percentage of bacterial community		
Client Sample ID	**BM-NAT-10**	**BM-NAT-17**	**BM-NAT-4**
Date Sampled	04/Sep/2018	04/Sep/2018	04/Sep/2018
Contango Sample ID	DNA_409	DNA_408	DNA_407
Sample Type	Soil	Soil	Soil
Genus	%	%	%
Nitrospira	0.39%	1.02%	0.14%
Others (each < 1% or not identified to the genus level)	99.61%	98.98%	99.86%







Percentage of Known Sulphide-Producing Bacteria

Summary of bacterial genera or families known to have species capable of reducing various sulphur compounds to form sulphides

Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

					Percentage of bacterial community		
					BM-NAT-10	**BM-NAT-17**	**BM-NAT-4**
					04/Sep/2018	04/Sep/2018	04/Sep/2018
					DNA_409	DNA_408	DNA_407
					Soil	Soil	Soil
	Can reduce				Environment		
Genus	**Sulphate**	**Thiosulphate**	**Sulphite**	**Sulphur**	**Aerobic / Anaerobic Characteristics**	**Temperature**	**pH**
Desulfobulbus	Yes	Yes	Yes	No	anaerobic	mesophilic	neutrophilic
Desulfobulbaceae family	Yes	Yes, some	Yes, some	Yes, some	anaerobic	mesophilic, some psychrotolerant	typically neutrophilic
Clostridium_sensu_stricto	No	Yes	Yes, some	Yes, some	obligately anaerobic	mesophilic	mildly acidophilic to neutrophilic
Total SPB Percentage							

INA = Information Not Available

(+/-) represents that some species within this genus use this source as an electron donor, while some do not.

Trait Assignment Categories:

A = most species in this genus possess these traits or abilities

B = some species in this genus possess these traits or abilities

C = this trait has been noted for this genus in only a few cases or is not well documented. Further investigation may be warranted.

Percentage of Known Sulphide-Producing Bacteria

Summary of bacterial genera or families known to have species capable of reducing various sulphur compounds to form sulphides

Report Number 029_1118_08A
Project Name Alexco
P.O Number AKHM-13-01
COC Number 00191
Report To Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received 26/Sep/2018
Report Date 08/Nov/2018
Report Revision A

			Percentage of bacterial community		
			BM-NAT-10	**BM-NAT-17**	**BM-NAT-4**
			04/Sep/2018	04/Sep/2018	04/Sep/2018
			DNA_409	DNA_408	DNA_407
			Soil	Soil	Soil
Genus	**Electron donors that may be used**	**Complete Oxidizer**	**Trait Assignment Category**	%	%	%
Desulfobulbus	ethanol, formate, fumarate, H_2+acetate, lactate, malate, 1-propanol, propionate, pyruvate, succinate	No	A	0.05%	0.00%	0.00%
Desulfobulbaceae family	long chain fatty acids, alcohols	No	A	0.01%	0.00%	0.00%
Clostridium_sensu_stricto	*INA*	*INA*	B	0.51%	0.11%	0.11%
Total SPB Percentage				**0.57%**	**0.11%**	**0.11%**

Percentages of each bacterial OTU

Percentage of all bacteria in each sample. See the "Background" tab for more information.

Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

OTU IDs are specific to a given report and cannot be compared between submissions.
If you would like to compare with other submissions, please contact us.
Representative sequences for each OTU can also be provided upon request.

Client Sample ID	**BM-NAT-10**	**BM-NAT-17**	**BM-NAT-4**					
Date Sampled	04/Sep/2018	04/Sep/2018	04/Sep/2018					
Contango Sample ID	DNA_409	DNA_408	DNA_407					
Sample Type	Soil	Soil	Soil					
OTU ID	%	%	%	**Classification**				
OTU1	0.63%	0.70%	3.69%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2	2.58%	1.27%	3.61%	k__Bacteria				
OTU3	5.27%	4.09%	4.58%	k__Bacteria	p__Gemmatimonadetes			
OTU4	1.23%	0.49%	1.58%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Bradyrhizobiaceae
OTU5	2.48%	0.87%	2.18%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU6	1.01%	1.93%	3.40%	k__Bacteria	p__Proteobacteria			
OTU7	1.88%	0.48%	2.81%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU8	0.56%	0.03%	1.75%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU9	0.43%	2.03%	0.15%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU10	0.27%	0.02%	1.12%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU11	0.33%	1.99%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU12	0.43%	0.80%	0.26%	k__Bacteria	p__Actinobacteria			
OTU13	0.00%	1.59%	0.00%	k__Bacteria				
OTU14	0.42%	0.10%	1.05%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU15	0.00%	1.44%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU16	1.34%	0.01%	0.02%	k__Bacteria				
OTU17	2.93%	0.24%	0.30%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU18	0.87%	0.50%	1.04%	k__Bacteria				
OTU19	0.26%	0.26%	0.53%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU20	0.28%	0.04%	2.39%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU21	0.51%	0.08%	1.20%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU22	0.21%	1.24%	0.12%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU23	0.16%	0.00%	1.08%	k__Bacteria				
OTU24	0.22%	0.25%	0.88%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU25	1.58%	3.39%	0.25%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	

OTU ID	%	%	%	Classification				
OTU26	0.09%	0.00%	0.87%	k__Bacteria				
OTU27	0.64%	0.95%	0.02%	k__Bacteria				
OTU28	0.55%	1.44%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU29	0.81%	0.61%	0.71%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU30	0.46%	1.29%	0.07%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU31	0.50%	0.23%	1.48%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU32	0.38%	0.26%	0.91%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU33	0.38%	0.80%	0.13%	k__Bacteria	p__Nitrospirae	c__Nitrospira	o__Nitrospirales	f__Nitrospiraceae
OTU34	0.46%	0.01%	2.14%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU35	0.43%	0.01%	0.37%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU36	0.12%	0.03%	0.99%	k__Bacteria	p__Proteobacteria			
OTU37	0.79%	0.37%	1.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU38	0.47%	0.10%	0.11%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1
OTU39	0.58%	0.60%	0.20%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU40	0.31%	0.03%	0.61%	k__Bacteria	p__Proteobacteria			
OTU41	1.12%	1.36%	0.62%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU42	0.14%	0.00%	0.75%	k__Bacteria				
OTU43	0.01%	0.56%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU44	0.60%	0.40%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Acidimicrobiales	
OTU45	0.09%	0.01%	0.84%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3	
OTU46	0.13%	0.00%	0.43%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU47	0.78%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU48	1.91%	0.02%	0.05%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU49	0.03%	0.00%	0.46%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU50	0.16%	0.00%	1.55%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU51	0.01%	0.00%	0.44%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU52	0.05%	0.03%	0.74%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU53	0.08%	0.05%	0.44%	k__Bacteria	p__Actinobacteria			
OTU54	0.39%	0.56%	0.36%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7	
OTU55	0.30%	0.38%	0.35%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU56	0.38%	0.28%	0.30%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU57	0.00%	0.44%	0.00%	k__Bacteria	p__Actinobacteria			
OTU58	0.15%	0.51%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU59	0.48%	0.02%	0.66%	k__Bacteria	p__Proteobacteria			
OTU60	0.02%	0.02%	0.50%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU61	0.02%	0.35%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU62	0.01%	0.00%	0.54%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU63	0.00%	0.87%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU64	0.29%	0.03%	0.33%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		

OTU ID	%	%	%	Classification				
OTU65	0.37%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU66	0.01%	0.00%	0.57%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae
OTU67	0.41%	0.23%	0.08%	k__Bacteria				
OTU68	1.23%	0.52%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU69	0.00%	1.12%	0.00%	k__Bacteria				
OTU70	0.05%	0.00%	0.32%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU71	0.00%	0.00%	0.55%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU72	0.33%	0.71%	0.17%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU73	0.07%	0.69%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU74	0.01%	0.00%	0.31%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU75	0.58%	0.26%	0.29%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU76	0.11%	0.35%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	
OTU77	0.13%	0.41%	0.51%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU78	0.01%	0.00%	0.21%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU79	0.03%	0.44%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae
OTU80	0.15%	0.00%	0.12%	k__Bacteria	p__Gemmatimonadetes			
OTU81	0.11%	0.15%	0.21%	k__Bacteria				
OTU82	0.01%	0.00%	0.24%	k__Bacteria				
OTU83	0.50%	0.07%	0.00%	k__Bacteria	p__Actinobacteria			
OTU84	0.31%	0.21%	0.30%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU85	0.00%	0.52%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU86	0.33%	0.24%	0.13%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU87	0.00%	0.60%	0.00%	k__Bacteria	p__Actinobacteria			
OTU88	0.07%	0.16%	0.19%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU89	0.04%	0.00%	0.27%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU90	0.23%	0.08%	0.00%	k__Bacteria	p__Actinobacteria			
OTU91	0.13%	0.00%	0.17%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU92	0.00%	0.00%	0.30%	k__Bacteria				
OTU93	0.05%	0.77%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU94	0.32%	0.21%	0.12%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU95	0.84%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU96	0.09%	0.00%	0.36%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU97	0.10%	1.09%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU98	0.17%	0.40%	0.00%	k__Bacteria	p__Actinobacteria			
OTU99	0.19%	0.28%	0.13%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU100	0.23%	0.14%	0.11%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU101	0.00%	0.28%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU102	0.27%	0.42%	0.03%	k__Bacteria				
OTU103	0.25%	0.18%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		

OTU ID	%	%	%	Classification			
OTU104	0.20%	0.01%	0.76%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	
OTU105	0.23%	0.27%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales
OTU106	0.00%	0.27%	0.00%	k__Bacteria	p__Proteobacteria		
OTU107	0.02%	0.00%	0.29%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	
OTU108	0.00%	0.00%	0.27%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	
OTU109	0.01%	0.32%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	
OTU110	0.51%	0.00%	0.06%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales
OTU111	0.76%	0.60%	0.54%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis
OTU112	0.00%	0.40%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales
OTU113	0.01%	0.00%	0.33%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales
OTU114	0.12%	0.34%	0.01%	k__Bacteria	p__Actinobacteria		
OTU115	0.03%	0.07%	0.22%	k__Bacteria	p__Bacteroidetes		
OTU116	0.13%	0.14%	0.00%	k__Bacteria	p__Actinobacteria		
OTU117	0.08%	0.00%	0.17%	k__Bacteria			
OTU118	0.00%	0.29%	0.00%	k__Bacteria	p__Actinobacteria		
OTU119	0.17%	0.02%	0.21%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	
OTU120	0.06%	0.48%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	
OTU121	0.00%	0.00%	0.21%	k__Bacteria	p__Chloroflexi		
OTU122	0.14%	0.02%	0.11%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	
OTU123	0.00%	0.00%	0.19%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2
OTU124	0.01%	0.01%	0.18%	k__Bacteria	p__Planctomycetes		
OTU125	0.05%	0.01%	0.30%	k__Bacteria			g__Legionella
OTU126	0.45%	0.08%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7
OTU127	0.00%	0.00%	0.36%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2
OTU128	0.00%	0.19%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7
OTU129	0.00%	0.00%	0.14%	k__Bacteria			
OTU130	0.14%	0.14%	0.11%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales
OTU131	0.34%	0.68%	0.19%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16
OTU132	0.28%	0.04%	0.63%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales
OTU133	0.16%	0.43%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6
OTU134	0.30%	0.00%	0.06%	k__Bacteria	p__Bacteroidetes		
OTU135	0.05%	0.03%	0.17%	k__Bacteria			
OTU136	0.05%	0.23%	0.00%	k__Bacteria			
OTU137	0.00%	0.16%	0.00%	k__Bacteria	p__Actinobacteria		
OTU138	0.07%	0.10%	0.00%	k__Bacteria			
OTU139	0.08%	0.04%	0.12%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	
OTU140	0.11%	0.02%	0.63%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	
OTU141	0.00%	0.00%	0.21%	k__Bacteria	p__Proteobacteria		
OTU142	0.00%	0.41%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	

OTU ID	%	%	%	Classification				
OTU143	0.09%	0.08%	0.15%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU144	0.16%	0.42%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU145	0.17%	0.00%	0.01%	k__Bacteria				
OTU146	0.00%	0.00%	0.15%	k__Bacteria	p__candidate_division_WPS-1			
OTU147	0.05%	0.39%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU148	0.24%	0.04%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU149	0.00%	0.20%	0.00%	k__Bacteria	p__Actinobacteria			
OTU150	0.01%	0.00%	0.26%	k__Bacteria	p__Chloroflexi			
OTU151	0.24%	0.35%	0.05%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU152	0.02%	0.18%	0.03%	k__Bacteria	p__Actinobacteria			
OTU153	0.06%	0.39%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae
OTU154	0.03%	0.20%	0.04%	k__Bacteria				
OTU155	0.00%	0.16%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU156	0.09%	0.02%	0.05%	k__Bacteria	p__Actinobacteria			
OTU157	0.02%	0.00%	0.17%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU158	0.10%	0.02%	0.09%	k__Bacteria	p__Proteobacteria			
OTU159	0.00%	0.18%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU160	0.00%	0.00%	0.15%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU161	0.00%	0.00%	0.16%	k__Bacteria				
OTU162	0.02%	0.01%	0.13%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU163	0.00%	0.14%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU164	0.16%	0.20%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU165	0.03%	0.08%	0.31%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU166	0.08%	0.15%	0.22%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU167	0.20%	0.25%	0.01%	k__Bacteria	p__Gemmatimonadetes			
OTU168	0.00%	0.16%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU169	0.00%	0.28%	0.00%	k__Bacteria				
OTU170	0.08%	0.08%	0.00%	k__Bacteria				
OTU171	0.18%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Hydrogenophilales	f__Hydrogenophilaceae
OTU172	0.00%	0.00%	0.19%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU173	0.00%	0.25%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU174	0.13%	0.16%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU175	0.03%	0.01%	0.17%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU176	0.00%	0.32%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU177	0.11%	0.14%	0.02%	k__Bacteria				
OTU178	0.07%	0.06%	0.11%	k__Bacteria	p__Parcubacteria			
OTU179	0.01%	0.19%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU180	0.03%	0.08%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae
OTU181	0.10%	0.02%	0.07%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	

OTU ID	%	%	%	Classification				
OTU183	0.16%	0.11%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU184	0.13%	0.00%	0.01%	k__Bacteria				
OTU185	0.00%	0.00%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13	
OTU186	0.00%	0.00%	0.11%	k__Bacteria				
OTU187	0.22%	0.00%	0.06%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU188	0.20%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU189	0.36%	1.16%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU190	0.08%	0.10%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU191	0.03%	0.01%	0.29%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU192	0.19%	0.07%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	
OTU193	0.26%	0.03%	0.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU194	0.03%	0.08%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU195	0.00%	0.00%	0.10%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2		
OTU196	0.14%	0.03%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae
OTU197	0.25%	0.11%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	
OTU198	0.03%	0.08%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU199	0.00%	0.27%	0.00%	k__Bacteria	p__Actinobacteria			
OTU200	0.05%	0.01%	0.10%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU201	0.00%	0.00%	0.08%	k__Bacteria	p__Bacteroidetes			
OTU202	0.07%	0.07%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU203	0.00%	0.00%	0.09%	k__Bacteria	p__Gemmatimonadetes			
OTU205	0.01%	0.00%	0.10%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU206	0.10%	0.21%	0.00%	k__Bacteria				
OTU207	0.00%	0.00%	0.12%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU208	0.10%	0.23%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU209	0.31%	0.03%	0.01%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_1
OTU210	0.16%	0.10%	0.18%	k__Bacteria	p__Verrucomicrobia			
OTU211	0.06%	0.08%	0.12%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU212	0.14%	0.10%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU213	0.07%	0.08%	0.01%	k__Bacteria	p__Actinobacteria			
OTU214	0.21%	0.07%	0.31%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU215	0.09%	0.09%	0.00%	k__Bacteria	p__Actinobacteria			
OTU216	0.00%	0.00%	0.09%	k__Bacteria	p__Actinobacteria			
OTU217	0.05%	0.03%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU218	0.08%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU220	0.00%	0.08%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU221	0.00%	0.00%	0.16%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU222	0.03%	0.14%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU223	0.01%	0.11%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		

OTU ID	%	%	%	Classification					
OTU224	0.09%	0.01%	0.07%	k__Bacteria					
OTU225	0.11%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU226	0.01%	0.00%	0.22%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU227	0.02%	0.23%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU228	0.03%	0.00%	0.30%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU229	0.07%	0.21%	0.00%	k__Bacteria					
OTU230	0.23%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU231	0.06%	0.00%	0.09%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU232	0.03%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU233	0.00%	0.11%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU234	0.00%	0.08%	0.00%	k__Bacteria					
OTU235	0.09%	0.05%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU236	0.00%	0.12%	0.00%	k__Bacteria					
OTU237	0.00%	0.00%	0.07%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU238	0.06%	0.02%	0.16%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU239	0.07%	0.10%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU241	0.00%	0.00%	0.13%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales		
OTU242	0.00%	0.00%	0.12%	k__Bacteria					
OTU243	0.01%	0.00%	0.19%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU244	0.00%	0.14%	0.00%	k__Bacteria	p__Actinobacteria				
OTU245	0.00%	0.00%	0.08%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU246	0.00%	0.15%	0.00%	k__Bacteria	p__Actinobacteria				
OTU247	0.00%	0.00%	0.24%	k__Bacteria					
OTU248	0.09%	0.05%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU249	0.01%	0.16%	0.00%	k__Bacteria					
OTU250	0.08%	0.02%	0.12%	k__Bacteria					
OTU251	0.06%	0.02%	0.00%	k__Bacteria	p__Parcubacteria				
OTU252	0.13%	0.14%	0.18%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU253	0.06%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU254	0.08%	0.07%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	
OTU255	0.01%	0.00%	0.05%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU256	0.00%	0.12%	0.00%	k__Bacteria	p__Actinobacteria				
OTU257	0.09%	0.01%	0.11%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			g__Cytophaga
OTU258	0.01%	0.08%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU259	0.08%	0.03%	0.07%	k__Bacteria	p__Actinobacteria				
OTU260	0.03%	0.03%	0.07%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU261	0.04%	0.08%	0.00%	k__Bacteria					
OTU262	0.10%	0.31%	0.11%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU263	0.00%	0.00%	0.10%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			

OTU ID	%	%	%	Classification					
OTU264	0.04%	0.03%	0.15%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU265	0.01%	0.00%	0.15%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU266	0.14%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU267	0.00%	0.02%	0.11%	k__Bacteria	p__Bacteroidetes				
OTU268	0.04%	0.00%	0.06%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU269	0.02%	0.00%	0.09%	k__Bacteria	p__Armatimonadetes				
OTU270	0.00%	0.07%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU271	0.11%	0.01%	0.38%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU272	0.02%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU273	0.00%	0.14%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU274	0.00%	0.12%	0.00%	k__Bacteria					
OTU275	0.01%	0.00%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5		
OTU276	0.09%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15			
OTU277	0.02%	0.00%	0.08%	k__Bacteria	p__Actinobacteria				
OTU278	0.15%	0.22%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU279	0.08%	0.14%	0.04%	k__Bacteria	p__Actinobacteria				
OTU280	0.08%	0.06%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU281	0.34%	0.11%	0.61%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU282	0.02%	0.01%	0.14%	k__Bacteria	p__Planctomycetes				
OTU283	0.06%	0.08%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	
OTU284	0.01%	0.17%	0.00%	k__Bacteria					
OTU285	0.10%	0.05%	0.02%	k__Bacteria					
OTU286	0.00%	0.21%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU287	0.03%	0.00%	0.09%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU288	0.01%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU289	0.07%	0.04%	0.01%	k__Bacteria					
OTU290	0.12%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU291	0.00%	0.21%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		g__Schlesneria
OTU292	0.38%	0.52%	0.09%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU293	0.02%	0.02%	0.08%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU294	0.06%	0.07%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU295	0.02%	0.06%	0.00%	k__Bacteria	p__Actinobacteria				
OTU296	0.07%	0.02%	0.10%	k__Bacteria					
OTU297	0.03%	0.03%	0.08%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU298	0.00%	0.00%	0.07%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU299	0.00%	0.00%	0.13%	k__Bacteria	p__Proteobacteria				
OTU300	0.03%	0.09%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU301	0.08%	0.01%	0.21%	k__Bacteria	p__Proteobacteria				
OTU302	0.10%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			

OTU ID	%	%	%	Classification				
OTU303	0.08%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU304	0.04%	0.00%	0.11%	k__Bacteria				
OTU305	0.00%	0.08%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU306	0.00%	0.08%	0.00%	k__Bacteria				
OTU307	0.00%	0.05%	0.00%	k__Bacteria				
OTU308	0.07%	0.04%	0.02%	k__Bacteria	p__Proteobacteria			
OTU309	0.20%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU310	0.04%	0.03%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU311	0.00%	0.00%	0.11%	k__Bacteria				
OTU312	0.01%	0.07%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22	g__Gp22	
OTU313	0.03%	0.01%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU314	0.00%	0.00%	0.07%	k__Bacteria	p__Proteobacteria			
OTU315	0.08%	0.12%	0.12%	k__Bacteria				
OTU316	0.14%	0.17%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU317	0.02%	0.13%	0.00%	k__Bacteria				
OTU318	0.13%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU320	0.08%	0.04%	0.06%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis	
OTU321	0.11%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bacteriovoracaceae
OTU322	0.10%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU323	0.00%	0.00%	0.05%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU324	0.05%	0.07%	0.00%	k__Bacteria	p__Proteobacteria			g__Nitrospira
OTU325	0.05%	0.01%	0.21%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae
OTU326	0.08%	0.05%	0.00%	k__Bacteria	p__Actinobacteria			
OTU329	0.11%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU330	0.01%	0.01%	0.04%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU331	0.14%	0.02%	0.12%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU332	0.17%	0.12%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU333	0.10%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU334	0.07%	0.08%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU335	0.06%	0.05%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Microbacteriaceae
OTU336	0.11%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU337	0.05%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU338	0.02%	0.00%	0.08%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis	
OTU339	0.11%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU340	0.00%	0.06%	0.00%	k__Bacteria				
OTU341	0.01%	0.16%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU342	0.01%	0.06%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU343	0.07%	0.03%	0.00%	k__Bacteria				
OTU344	0.00%	0.06%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		

OTU ID	%	%	%	Classification				
OTU345	0.00%	0.05%	0.00%	k__Bacteria				
OTU346	0.01%	0.00%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU347	0.01%	0.00%	0.06%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU348	0.01%	0.18%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU349	0.08%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Kineosporiaceae
OTU350	0.06%	0.00%	0.00%	k__Bacteria				
OTU351	0.04%	0.07%	0.13%	k__Bacteria	p__Planctomycetes			
OTU352	0.25%	0.16%	0.26%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7	
OTU353	0.00%	0.00%	0.06%	k__Bacteria				
OTU354	0.06%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU355	0.07%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU356	0.02%	0.15%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU357	0.00%	0.06%	0.00%	k__Bacteria	p__Acidobacteria			
OTU358	0.11%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae
OTU359	0.26%	0.19%	0.12%	k__Bacteria	p__Parcubacteria			
OTU360	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU361	0.05%	0.14%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU362	0.01%	0.06%	0.00%	k__Bacteria	p__Actinobacteria			
OTU364	0.02%	0.00%	0.13%	k__Bacteria	p__Planctomycetes			
OTU365	0.10%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_1
OTU366	0.02%	0.00%	0.07%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU367	0.03%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU368	0.00%	0.00%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10		
OTU369	0.00%	0.09%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU370	0.01%	0.00%	0.10%	k__Bacteria				
OTU371	0.01%	0.07%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU372	0.18%	0.12%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU373	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU374	0.00%	0.10%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU375	0.04%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU376	0.01%	0.00%	0.06%	k__Bacteria				
OTU377	0.06%	0.01%	0.00%	k__Bacteria				
OTU378	0.25%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU379	0.00%	0.06%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU380	0.04%	0.02%	0.08%	k__Bacteria				
OTU381	0.01%	0.00%	0.08%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU382	0.05%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU383	0.00%	0.00%	0.06%	k__Bacteria	p__Actinobacteria			
OTU384	0.07%	0.05%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	

OTU ID	%	%	%	Classification					
OTU385	0.04%	0.04%	0.00%	k__Bacteria					
OTU386	0.06%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU387	0.05%	0.00%	0.00%	k__Bacteria					
OTU388	0.05%	0.00%	0.04%	k__Bacteria	p__Acidobacteria				
OTU389	0.05%	0.00%	0.07%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU390	0.00%	0.00%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU391	0.02%	0.00%	0.12%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU392	0.13%	0.17%	0.72%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU393	0.05%	0.17%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU394	0.00%	0.09%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU395	0.05%	0.14%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU396	0.06%	0.00%	0.00%	k__Bacteria					
OTU397	0.00%	0.06%	0.00%	k__Bacteria					
OTU398	0.00%	0.00%	0.06%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU399	0.00%	0.06%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU400	0.02%	0.07%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU401	0.26%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU402	0.09%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	
OTU403	0.06%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU404	0.02%	0.03%	0.00%	k__Bacteria					
OTU405	0.00%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU406	0.10%	0.23%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU407	0.04%	0.04%	0.00%	k__Bacteria					
OTU408	0.02%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU409	0.03%	0.05%	0.02%	k__Bacteria					
OTU410	0.01%	0.03%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU411	0.04%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nakamurellaceae	
OTU412	0.04%	0.03%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU413	0.05%	0.00%	0.13%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU414	0.00%	0.06%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU415	0.00%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU416	0.00%	0.00%	0.04%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU417	0.02%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			g__Clostridium
OTU418	0.08%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU419	0.04%	0.01%	0.11%	k__Bacteria	p__Proteobacteria				
OTU420	0.10%	0.04%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU421	0.01%	0.05%	0.01%	k__Bacteria					
OTU422	0.00%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU423	0.16%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				

OTU ID	%	%	%	Classification					
OTU424	0.01%	0.07%	0.01%	k__Bacteria					
OTU425	0.06%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU426	0.07%	0.09%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU427	0.01%	0.16%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU428	0.00%	0.05%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU429	0.01%	0.10%	0.01%	k__Bacteria					
OTU430	0.00%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales		
OTU431	0.01%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU432	0.08%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU434	0.01%	0.00%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU435	0.01%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU436	0.15%	0.04%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU437	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU438	0.05%	0.01%	0.00%	k__Bacteria					
OTU439	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU440	0.00%	0.00%	0.06%	k__Bacteria					
OTU441	0.04%	0.02%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU442	0.00%	0.00%	0.05%	k__Bacteria	p__candidate_division_WPS-1				
OTU443	0.00%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		g__Phenyloba
OTU444	0.06%	0.03%	0.02%	k__Bacteria					
OTU445	0.01%	0.03%	0.00%	k__Bacteria	p__Gemmatimonadetes				g__Sphingomo
OTU446	0.02%	0.02%	0.00%	k__Bacteria					
OTU447	0.02%	0.11%	0.01%	k__Bacteria	p__Acidobacteria				
OTU448	0.01%	0.00%	0.09%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15		
OTU449	0.00%	0.05%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU450	0.00%	0.06%	0.00%	k__Bacteria	p__Proteobacteria				
OTU451	0.02%	0.04%	0.00%	k__Bacteria					
OTU452	0.03%	0.00%	0.00%	k__Bacteria					
OTU453	0.01%	0.06%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae	
OTU454	0.00%	0.00%	0.05%	k__Bacteria	p__Chloroflexi	c__Ktedonobacteria			
OTU455	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU456	0.02%	0.07%	0.00%	k__Bacteria	p__Chloroflexi				
OTU458	0.00%	0.00%	0.03%	k__Bacteria					
OTU459	0.03%	0.03%	0.00%	k__Bacteria					
OTU460	0.02%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU461	0.00%	0.03%	0.00%	k__Bacteria					
OTU462	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU463	0.00%	0.00%	0.06%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU464	0.23%	0.00%	0.01%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		

OTU ID	%	%	%	Classification				
OTU465	0.00%	0.00%	0.08%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU466	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae
OTU467	0.03%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae
OTU468	0.04%	0.00%	0.07%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU469	0.04%	0.11%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU470	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU471	0.01%	0.00%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU472	0.01%	0.06%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU473	0.11%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU474	0.08%	0.06%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU475	0.03%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU476	0.00%	0.02%	0.00%	k__Bacteria				
OTU477	0.16%	0.00%	1.52%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU478	0.00%	0.04%	0.00%	k__Bacteria				
OTU479	0.05%	0.04%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU480	0.04%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU481	0.00%	0.00%	0.04%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU482	0.00%	0.00%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU483	0.03%	0.00%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU484	0.05%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU485	0.03%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1
OTU486	0.08%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae
OTU487	0.05%	0.05%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU488	0.04%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU489	0.11%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae
OTU490	0.07%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU491	0.00%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU492	0.02%	0.00%	0.04%	k__Bacteria	p__candidate_division_WPS-1			
OTU493	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU494	0.07%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU495	0.03%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU496	0.01%	0.01%	0.05%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU497	0.05%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU498	0.00%	0.00%	0.04%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU499	0.07%	0.04%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU500	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU501	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15	
OTU502	0.06%	0.08%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5	
OTU504	0.01%	0.05%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	g__Nakamurel

OTU ID	%	%	%	Classification					
OTU505	0.00%	0.00%	0.03%	k__Bacteria					
OTU506	0.04%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU507	0.09%	0.01%	0.11%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU508	0.08%	0.04%	0.00%	k__Bacteria					
OTU510	0.04%	0.04%	0.00%	k__Bacteria	p__Parcubacteria				
OTU511	0.06%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU512	0.04%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales		
OTU513	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales	f__Desulfobulbaceae	
OTU514	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU515	0.03%	0.03%	0.00%	k__Bacteria					
OTU516	0.00%	0.00%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU517	0.01%	0.05%	0.00%	k__Bacteria					
OTU518	0.01%	0.04%	0.00%	k__Bacteria					
OTU519	0.02%	0.01%	0.13%	k__Bacteria	p__candidate_division_WPS-1				
OTU520	0.00%	0.00%	0.03%	k__Bacteria					
OTU521	0.05%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU522	0.00%	0.02%	0.00%	k__Bacteria					
OTU523	0.02%	0.01%	0.00%	k__Bacteria					
OTU524	0.01%	0.00%	0.02%	k__Bacteria	p__Latescibacteria				g__Sphingomc
OTU525	0.00%	0.08%	0.00%	k__Bacteria					
OTU526	0.04%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU527	0.00%	0.00%	0.02%	k__Bacteria	p__candidate_division_WPS-2				
OTU528	0.04%	0.01%	0.03%	k__Bacteria	p__Actinobacteria				
OTU529	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU530	0.05%	0.00%	0.00%	k__Bacteria					g__Asticcacaul
OTU531	0.00%	0.07%	0.00%	k__Bacteria					
OTU532	0.19%	0.13%	0.05%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU533	0.06%	0.05%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU534	0.03%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Rhizobiaceae	
OTU535	0.04%	0.00%	0.02%	k__Bacteria	p__Proteobacteria				
OTU536	0.02%	0.00%	0.00%	k__Bacteria					g__Chthonom
OTU537	0.02%	0.02%	0.00%	k__Bacteria					
OTU538	0.02%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU539	0.00%	0.06%	0.00%	k__Bacteria					
OTU540	0.01%	0.08%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU541	0.01%	0.13%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU542	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Moraxellaceae	
OTU543	0.02%	0.02%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU545	0.00%	0.04%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU546	0.00%	0.03%	0.00%	k__Bacteria					
OTU547	0.05%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU548	0.04%	0.00%	0.00%	k__Bacteria					
OTU549	0.06%	0.05%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU550	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU551	0.01%	0.02%	0.00%	k__Bacteria					
OTU552	0.11%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Neisseriales		
OTU553	0.06%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU554	0.06%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU555	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU556	0.04%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU557	0.01%	0.04%	0.00%	k__Bacteria					
OTU558	0.02%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU559	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU560	0.01%	0.03%	0.00%	k__Bacteria	p__Planctomycetes				g__Aquicella
OTU561	0.02%	0.02%	0.04%	k__Bacteria					
OTU562	0.06%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU563	0.00%	0.00%	0.02%	k__Bacteria					g__Salinibacte
OTU564	0.00%	0.00%	0.02%	k__Bacteria					
OTU565	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU566	0.02%	0.02%	0.05%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU567	0.00%	0.03%	0.02%	k__Bacteria	p__Proteobacteria				
OTU568	0.02%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU569	0.00%	0.00%	0.04%	k__Bacteria	p__Chloroflexi				
OTU570	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales	f__Porphyromonadaceae	
OTU571	0.00%	0.00%	0.04%	k__Bacteria	p__candidate_division_WPS-2				
OTU572	0.01%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU573	0.00%	0.01%	0.06%	k__Bacteria					
OTU574	0.02%	0.05%	0.00%	k__Bacteria					
OTU575	0.00%	0.00%	0.01%	k__Bacteria					
OTU576	0.07%	0.15%	0.04%	k__Bacteria	p__Proteobacteria				
OTU577	0.01%	0.05%	0.00%	k__Bacteria	p__Acidobacteria				
OTU578	0.01%	0.03%	0.02%	k__Bacteria	p__candidate_division_WPS-2				
OTU579	0.10%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU580	0.00%	0.03%	0.00%	k__Bacteria					
OTU581	0.01%	0.00%	0.07%	k__Bacteria					
OTU582	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU583	0.00%	0.05%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU584	0.02%	0.03%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU585	0.00%	0.03%	0.00%	k__Bacteria				
OTU586	0.00%	0.00%	0.08%	k__Bacteria	p__candidate_division_\	g__WPS-2_genera_incertae_sedis		
OTU587	0.02%	0.02%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU588	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	
OTU589	0.05%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU590	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU591	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes			
OTU592	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU593	0.01%	0.02%	0.01%	k__Bacteria				
OTU594	0.01%	0.01%	0.00%	k__Bacteria				
OTU595	0.00%	0.00%	0.09%	k__Bacteria	p__Planctomycetes			
OTU596	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU597	0.00%	0.02%	0.00%	k__Bacteria				
OTU598	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU599	0.03%	0.03%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU600	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU601	0.03%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU602	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU603	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU604	0.04%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales	f__Rhodobacteraceae
OTU605	0.01%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU606	0.06%	0.02%	0.09%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU607	0.04%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU608	0.00%	0.04%	0.00%	k__Bacteria	p__Chloroflexi			
OTU609	0.03%	0.02%	0.00%	k__Bacteria				
OTU610	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU611	0.05%	0.00%	0.00%	k__Bacteria				
OTU613	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria			
OTU614	0.02%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes			
OTU615	0.00%	0.00%	0.02%	k__Bacteria				
OTU616	0.03%	0.00%	0.01%	k__Bacteria				
OTU617	0.00%	0.00%	0.02%	k__Bacteria				
OTU618	0.01%	0.00%	0.03%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU619	0.03%	0.01%	0.04%	k__Bacteria				
OTU620	0.03%	0.00%	0.02%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU621	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU622	0.01%	0.05%	0.00%	k__Bacteria				
OTU623	0.02%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae
OTU625	0.06%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae

OTU ID	%	%	%	Classification				
OTU626	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU627	0.00%	0.06%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp11	g__Gp11	
OTU629	0.01%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU630	0.00%	0.00%	0.46%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU631	0.02%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU632	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes			
OTU633	0.01%	0.04%	0.03%	k__Bacteria				
OTU634	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU635	0.04%	0.14%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU636	0.06%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU637	0.04%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU638	0.04%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU639	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU640	0.02%	0.00%	0.09%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU641	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria			
OTU642	0.01%	0.03%	0.00%	k__Bacteria				
OTU643	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU644	0.00%	0.03%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU645	0.00%	0.02%	0.00%	k__Bacteria				
OTU646	0.03%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU647	0.02%	0.00%	0.00%	k__Bacteria	p__Spirochaetes			
OTU648	0.00%	0.00%	0.04%	k__Bacteria	p__Verrucomicrobia			
OTU649	0.03%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU650	0.00%	0.00%	0.03%	k__Bacteria				
OTU651	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU652	0.00%	0.04%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	
OTU653	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia		
OTU654	0.06%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales	f__Porphyromonadaceae
OTU655	0.00%	0.00%	0.02%	k__Bacteria				
OTU656	0.00%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU657	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	g__Legionella
OTU658	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU660	0.02%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU662	0.00%	0.00%	0.03%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU663	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU664	0.04%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU665	0.02%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU666	0.04%	0.00%	0.11%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU667	0.02%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		

OTU ID	%	%	%	Classification					
OTU669	0.02%	0.03%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU670	0.04%	0.02%	0.00%	k__Bacteria					
OTU671	0.00%	0.04%	0.00%	k__Bacteria	p__Actinobacteria				
OTU672	0.00%	0.03%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU673	0.07%	0.03%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU674	0.02%	0.02%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU675	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU676	0.03%	0.03%	0.00%	k__Bacteria	p__Proteobacteria				
OTU677	0.00%	0.03%	0.00%	k__Bacteria					
OTU678	0.05%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU679	0.00%	0.01%	0.03%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU680	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp11	g__Gp11		
OTU681	0.00%	0.03%	0.00%	k__Bacteria					
OTU682	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU683	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU684	0.01%	0.01%	0.03%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU685	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU687	0.00%	0.00%	0.03%	k__Bacteria					
OTU688	0.01%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU689	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU690	0.02%	0.03%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU691	0.10%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				g__Gaiella
OTU692	0.02%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5			
OTU693	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU694	0.05%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU695	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales	f__Gallionellaceae	
OTU696	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU697	0.02%	0.00%	0.00%	k__Bacteria					
OTU698	0.04%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU699	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU700	0.01%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU701	0.02%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU702	0.00%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU703	0.00%	0.00%	0.02%	k__Bacteria					
OTU704	0.02%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU705	0.00%	0.04%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales		
OTU706	0.04%	0.02%	0.01%	k__Bacteria	p__candidate_division_WPS-2				
OTU707	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU709	0.02%	0.00%	0.01%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU710	0.01%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5		
OTU711	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU712	0.04%	0.02%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU713	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis	
OTU714	0.00%	0.04%	0.00%	k__Bacteria				
OTU715	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU716	0.03%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae
OTU717	0.04%	0.04%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU718	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU719	0.02%	0.02%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU720	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU721	0.01%	0.02%	0.00%	k__Bacteria				
OTU722	0.00%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU723	0.00%	0.02%	0.00%	k__Bacteria				
OTU724	0.02%	0.00%	0.01%	k__Bacteria	p__Actinobacteria			
OTU726	0.00%	0.03%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU727	0.03%	0.02%	0.00%	k__Bacteria				
OTU728	0.02%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU729	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU730	0.01%	0.02%	0.00%	k__Bacteria				
OTU731	0.04%	0.01%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU732	0.01%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU733	0.02%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micrococcaceae
OTU734	0.00%	0.00%	0.01%	k__Bacteria				
OTU736	0.21%	0.17%	0.23%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU737	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU738	0.01%	0.02%	0.00%	k__Bacteria	p__Chloroflexi			
OTU739	0.02%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU740	0.03%	0.06%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU742	0.00%	0.00%	0.05%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU743	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria			
OTU744	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU745	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU746	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Methylophilales	f__Methylophilaceae
OTU747	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU748	0.00%	0.00%	0.02%	k__Bacteria				
OTU749	0.00%	0.00%	0.02%	k__Bacteria				
OTU750	0.02%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU751	0.00%	0.01%	0.03%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU752	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15	
OTU753	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria			
OTU754	0.00%	0.02%	0.00%	k__Bacteria				
OTU755	0.00%	0.03%	0.00%	k__Bacteria				
OTU756	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia	o__Armatimonadales	f__Armatimonadaceae
OTU757	0.02%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU759	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU760	0.00%	0.00%	0.03%	k__Bacteria				
OTU762	0.03%	0.00%	0.00%	k__Bacteria				
OTU763	0.05%	0.07%	0.00%	k__Bacteria				
OTU765	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU766	0.00%	0.00%	0.02%	k__Bacteria				
OTU767	0.01%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Methylococcales	f__Methylococcaceae
OTU768	0.03%	0.00%	0.00%	k__Bacteria				
OTU769	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales	f__Desulfobulbaceae
OTU770	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU771	0.01%	0.02%	0.00%	k__Bacteria				
OTU772	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes			
OTU773	0.14%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU774	0.00%	0.03%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU775	0.01%	0.00%	0.00%	k__Bacteria				
OTU776	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU777	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU778	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU779	0.00%	0.01%	0.00%	k__Bacteria				
OTU780	0.00%	0.00%	0.02%	k__Bacteria				
OTU781	0.04%	0.00%	0.00%	k__Bacteria				
OTU782	0.00%	0.00%	0.01%	k__Bacteria				
OTU783	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU784	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU786	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU787	0.02%	0.04%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae
OTU788	0.00%	0.05%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU789	0.03%	0.00%	0.00%	k__Bacteria				
OTU790	0.05%	0.01%	0.03%	k__Bacteria	p__Bacteroidetes			
OTU791	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU792	0.07%	0.01%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU793	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU795	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	

OTU ID	%	%	%	Classification					
OTU797	0.02%	0.00%	0.04%	k__Bacteria					
OTU798	0.04%	0.06%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU799	0.01%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU800	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU801	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU802	0.00%	0.01%	0.00%	k__Bacteria					
OTU803	0.04%	0.00%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU804	0.00%	0.00%	0.01%	k__Bacteria					
OTU805	0.00%	0.03%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU806	0.00%	0.00%	0.02%	k__Bacteria					
OTU807	0.02%	0.04%	0.00%	k__Bacteria	p__Proteobacteria				g__Pseudomor
OTU808	0.00%	0.02%	0.00%	k__Bacteria					
OTU809	0.00%	0.00%	0.02%	k__Bacteria					
OTU810	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU811	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria				
OTU812	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU813	0.00%	0.00%	0.03%	k__Bacteria	p__Planctomycetes				
OTU814	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis			
OTU815	0.04%	0.04%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU816	0.00%	0.01%	0.00%	k__Bacteria					
OTU817	0.01%	0.01%	0.00%	k__Bacteria					
OTU818	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU819	0.04%	0.03%	0.03%	k__Bacteria					
OTU820	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU821	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU822	0.06%	0.00%	0.15%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU823	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes				
OTU824	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		g__Armatimon
OTU825	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Xanthobacteraceae	
OTU826	0.01%	0.00%	0.02%	k__Bacteria					
OTU827	0.04%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Eubacteriaceae	
OTU828	0.00%	0.02%	0.00%	k__Bacteria					
OTU830	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU831	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU832	0.01%	0.00%	0.02%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU833	0.01%	0.02%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU835	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria				
OTU836	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU837	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				

OTU ID	%	%	%	Classification					
OTU839	0.02%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU840	0.01%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU841	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU842	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			g__Mucilaginib
OTU843	0.03%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU844	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp12			
OTU845	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU846	0.00%	0.01%	0.01%	k__Bacteria					
OTU847	0.01%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU848	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU849	0.00%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU851	0.00%	0.03%	0.00%	k__Bacteria	p__Latescibacteria				
OTU852	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU853	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			g__Nakamurel
OTU854	0.00%	0.03%	0.00%	k__Bacteria					
OTU855	0.02%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU856	0.02%	0.01%	0.02%	k__Bacteria	p__Proteobacteria				
OTU857	0.03%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1	
OTU858	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU859	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU860	0.01%	0.00%	0.03%	k__Bacteria					
OTU861	0.00%	0.00%	0.01%	k__Bacteria					
OTU862	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU863	0.02%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU864	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	
OTU865	0.01%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU866	0.00%	0.02%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU867	0.01%	0.00%	0.01%	k__Bacteria					
OTU868	0.00%	0.00%	0.03%	k__Bacteria					
OTU869	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU870	0.00%	0.01%	0.00%	k__Bacteria					
OTU871	0.04%	0.04%	0.00%	k__Bacteria					
OTU872	0.01%	0.01%	0.00%	k__Bacteria					
OTU873	0.00%	0.01%	0.00%	k__Bacteria					
OTU874	0.00%	0.01%	0.00%	k__Bacteria					
OTU875	0.00%	0.02%	0.00%	k__Bacteria					
OTU876	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU877	0.00%	0.00%	0.07%	k__Bacteria	p__candidate_division_WPS-1				
OTU878	0.01%	0.01%	0.04%	k__Bacteria	p__Planctomycetes				

OTU ID	%	%	%	Classification					
OTU880	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU881	0.01%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU883	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU884	0.03%	0.05%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU886	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU887	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriacea	g__Mycobacte
OTU888	0.01%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU889	0.02%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU890	0.10%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU891	0.03%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU895	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU896	0.02%	0.01%	0.00%	k__Bacteria					
OTU897	0.02%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU899	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	
OTU900	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU901	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU902	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU903	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU905	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	
OTU906	0.00%	0.00%	0.01%	k__Bacteria					
OTU907	0.01%	0.00%	0.00%	k__Bacteria					
OTU908	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU909	0.01%	0.02%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU910	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU911	0.01%	0.05%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU912	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU913	0.04%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU914	0.00%	0.00%	0.02%	k__Bacteria					
OTU915	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU916	0.06%	0.01%	0.04%	k__Bacteria					
OTU917	0.01%	0.02%	0.00%	k__Bacteria					
OTU918	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU919	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU920	0.01%	0.01%	0.02%	k__Bacteria	p__Parcubacteria				
OTU921	0.01%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU922	0.00%	0.00%	0.03%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU923	0.02%	0.02%	0.00%	k__Bacteria					
OTU924	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU925	0.00%	0.02%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU926	0.01%	0.03%	0.00%	k__Bacteria					
OTU927	0.02%	0.03%	0.00%	k__Bacteria	p__Planctomycetes				
OTU928	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU929	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU930	0.02%	0.01%	0.00%	k__Bacteria					
OTU931	0.02%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU932	0.00%	0.02%	0.00%	k__Bacteria					
OTU933	0.01%	0.00%	0.02%	k__Bacteria	p__Planctomycetes				
OTU935	0.00%	0.01%	0.02%	k__Bacteria					
OTU936	0.00%	0.00%	0.02%	k__Bacteria					
OTU937	0.01%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU938	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis			
OTU939	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU941	0.00%	0.00%	0.02%	k__Bacteria	p__candidate_division_	WPS-1			
OTU942	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU944	0.03%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae	
OTU945	0.02%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU946	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria				
OTU947	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU948	0.03%	0.03%	0.00%	k__Bacteria					
OTU949	0.00%	0.01%	0.00%	k__Bacteria					
OTU950	0.01%	0.02%	0.00%	k__Bacteria					
OTU951	0.02%	0.04%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	
OTU952	0.00%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU953	0.03%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Hydrogenophilales		
OTU954	0.00%	0.00%	0.01%	k__Bacteria					
OTU955	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU956	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU959	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU960	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU961	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		g__Legionella
OTU962	0.02%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU963	0.02%	0.00%	0.01%	k__Bacteria					
OTU964	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU965	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU966	0.11%	0.05%	0.28%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU967	0.02%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU968	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU969	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				

OTU ID	%	%	%	Classification				
OTU970	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU971	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	f__Rhodocyclaceae
OTU973	0.00%	0.00%	0.03%	k__Bacteria				
OTU974	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU975	0.02%	0.00%	0.00%	k__Bacteria				
OTU976	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria			
OTU978	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU979	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3	
OTU980	0.02%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU981	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU982	0.04%	0.04%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU983	0.00%	0.01%	0.00%	k__Bacteria				
OTU984	0.00%	0.10%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU985	0.04%	0.03%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU986	0.03%	0.01%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU987	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU988	0.00%	0.01%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU989	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU990	0.04%	0.02%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU991	0.03%	0.02%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU992	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15	
OTU993	0.00%	0.01%	0.00%	k__Bacteria				
OTU994	0.01%	0.01%	0.01%	k__Bacteria				
OTU995	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria			
OTU996	0.05%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU997	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU998	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria			
OTU999	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1000	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales	f__Rhodobacteraceae
OTU1001	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1002	0.00%	0.00%	0.02%	k__Bacteria				
OTU1003	0.03%	0.01%	0.02%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	
OTU1004	0.01%	0.00%	0.00%	k__Bacteria				
OTU1005	0.01%	0.00%	0.02%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU1006	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1007	0.00%	0.00%	0.04%	k__Bacteria				
OTU1008	0.01%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU1009	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	
OTU1010	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	g__Mucilaginib

OTU ID	%	%	%	Classification				
OTU1011	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1012	0.00%	0.01%	0.00%	k__Bacteria				
OTU1013	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1014	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1015	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1016	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU1017	0.01%	0.01%	0.00%	k__Bacteria				
OTU1018	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes			
OTU1019	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-1			
OTU1020	0.00%	0.02%	0.00%	k__Bacteria				
OTU1021	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Rhodospirillaceae
OTU1022	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1023	0.32%	0.08%	0.09%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU1024	0.01%	0.01%	0.01%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU1025	0.01%	0.00%	0.00%	k__Bacteria				
OTU1026	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria			
OTU1027	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1028	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes			
OTU1029	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes			
OTU1030	0.01%	0.00%	0.01%	k__Bacteria				
OTU1031	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes			
OTU1034	0.02%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU1035	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes			
OTU1036	0.03%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1037	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1038	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU1039	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1040	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes			
OTU1041	0.02%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU1042	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1043	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13	
OTU1044	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU1045	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae		
OTU1047	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	
OTU1048	0.00%	0.01%	0.00%	k__Bacteria				
OTU1049	0.01%	0.03%	0.02%	k__Bacteria				
OTU1050	0.00%	0.00%	0.01%	k__Bacteria				
OTU1051	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1053	0.00%	0.02%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU1054	0.03%	0.01%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1055	0.00%	0.00%	0.00%	k__Bacteria					
OTU1056	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU1057	0.02%	0.02%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1058	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1059	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1060	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1061	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	
OTU1062	0.00%	0.01%	0.00%	k__Bacteria					
OTU1063	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1064	0.00%	0.00%	0.02%	k__Bacteria					g__Rhizobacte
OTU1065	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1067	0.01%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1068	0.01%	0.00%	0.01%	k__Bacteria	p__Chlamydiae				
OTU1069	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1070	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1071	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1072	0.00%	0.00%	0.05%	k__Bacteria	p__candidate_division_WPS-1				
OTU1074	0.01%	0.00%	0.00%	k__Bacteria					
OTU1075	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU1076	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1077	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU1078	0.00%	0.03%	0.00%	k__Bacteria					
OTU1079	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1080	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1081	0.00%	0.00%	0.01%	k__Bacteria					
OTU1083	0.00%	0.00%	0.00%	k__Bacteria					
OTU1084	0.00%	0.04%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU1085	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	
OTU1086	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1087	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1088	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae	
OTU1089	0.01%	0.00%	0.00%	k__Bacteria					
OTU1090	0.00%	0.00%	0.02%	k__Bacteria					
OTU1091	0.00%	0.01%	0.00%	k__Bacteria					
OTU1092	0.01%	0.01%	0.00%	k__Bacteria					
OTU1093	0.06%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Negativicutes	o__Selenomonadales	f__Veillonellaceae	
OTU1094	0.01%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1096	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			

OTU ID	%	%	%	Classification					
OTU1097	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1098	0.02%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1099	0.01%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1100	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1101	0.00%	0.01%	0.00%	k__Bacteria					g__Arenimona
OTU1102	0.07%	0.05%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1103	0.10%	0.06%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU1104	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1105	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				g__Mucilaginib
OTU1106	0.01%	0.00%	0.00%	k__Bacteria					
OTU1107	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU1108	0.01%	0.22%	0.00%	k__Bacteria	p__Nitrospirae	c__Nitrospira	o__Nitrospirales	f__Nitrospiraceae	
OTU1109	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1110	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1111	0.02%	0.05%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1112	0.00%	0.01%	0.00%	k__Bacteria	p__Hydrogenedentes				
OTU1113	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1114	0.09%	0.12%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU1115	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU1117	0.01%	0.05%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1118	0.04%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1119	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1121	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis			
OTU1122	0.00%	0.03%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1123	0.01%	0.00%	0.00%	k__Bacteria					
OTU1125	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1126	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU1127	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1128	0.02%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1129	0.01%	0.00%	0.01%	k__Bacteria					
OTU1130	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1131	0.01%	0.02%	0.00%	k__Bacteria					
OTU1132	0.01%	0.01%	0.00%	k__Bacteria					
OTU1133	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1134	0.01%	0.00%	0.00%	k__Bacteria					
OTU1135	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1136	0.01%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU1137	0.00%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1138	0.01%	0.01%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU1139	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1140	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1141	0.01%	0.01%	0.00%	k__Bacteria					
OTU1142	0.00%	0.00%	0.01%	k__Bacteria					
OTU1143	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_	g__Ohtaekwangia		
OTU1144	0.00%	0.02%	0.00%	k__Bacteria	p__Parcubacteria				g__Bacteriovo
OTU1145	0.01%	0.00%	0.00%	k__Bacteria					
OTU1146	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1147	0.00%	0.01%	0.00%	k__Bacteria					
OTU1148	0.01%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1149	0.02%	0.00%	0.00%	k__Bacteria					
OTU1150	0.05%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1151	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU1153	0.03%	0.00%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU1154	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1155	0.00%	0.00%	0.02%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1156	0.00%	0.00%	0.02%	k__Bacteria					
OTU1157	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU1158	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1159	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1160	0.01%	0.01%	0.03%	k__Bacteria					
OTU1161	0.01%	0.02%	0.00%	k__Bacteria					
OTU1162	0.00%	0.00%	0.01%	k__Bacteria					
OTU1163	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU1164	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1165	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1166	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1167	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1169	0.00%	0.00%	0.02%	k__Bacteria					
OTU1171	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae	
OTU1172	0.01%	0.00%	0.00%	k__Bacteria					g__Legionella
OTU1173	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1174	0.04%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1175	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1176	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU1177	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU1178	0.00%	0.00%	0.01%	k__Bacteria					
OTU1180	0.02%	0.06%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU1181	0.00%	0.02%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU1182	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU1183	0.00%	0.01%	0.00%	k__Bacteria	p__Chloroflexi			
OTU1184	0.00%	0.01%	0.00%	k__Bacteria				
OTU1185	0.01%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU1186	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1187	0.01%	0.02%	0.01%	k__Bacteria	p__Planctomycetes			
OTU1188	0.00%	0.02%	0.00%	k__Bacteria				
OTU1189	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1190	0.00%	0.01%	0.00%	k__Bacteria				
OTU1192	0.00%	0.00%	0.02%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia	o__Armatimonadales	f__Armatimonadaceae
OTU1193	0.00%	0.02%	0.00%	k__Bacteria				
OTU1194	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_\	g__WPS-1_genera_incertae_sedis		
OTU1195	0.01%	0.01%	0.00%	k__Bacteria				
OTU1196	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1197	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU1198	0.01%	0.02%	0.00%	k__Bacteria				
OTU1199	0.01%	0.00%	0.00%	k__Bacteria				
OTU1200	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1201	0.04%	0.00%	0.02%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU1202	0.00%	0.01%	0.00%	k__Bacteria				
OTU1203	0.01%	0.01%	0.00%	k__Bacteria	p__Latescibacteria			
OTU1204	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1205	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae			
OTU1206	0.00%	0.00%	0.02%	k__Bacteria	p__Actinobacteria			
OTU1207	0.00%	0.05%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU1208	0.02%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales	
OTU1209	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1210	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2		g__Legionella
OTU1212	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU1213	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU1214	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1215	0.00%	0.01%	0.01%	k__Bacteria	p__Planctomycetes			
OTU1216	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1217	0.00%	0.01%	0.00%	k__Bacteria				
OTU1218	0.01%	0.02%	0.00%	k__Bacteria				
OTU1219	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU1220	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU1221	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU1223	0.00%	0.01%	0.01%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU1224	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU1226	2.51%	0.48%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1227	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1228	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1229	0.02%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia				
OTU1230	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1231	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU1232	0.04%	0.13%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1233	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1234	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	g__Rhizobium
OTU1237	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		g__Armatimon
OTU1239	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1240	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1241	0.00%	0.00%	0.00%	k__Bacteria					
OTU1242	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1243	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis			
OTU1244	0.04%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1245	0.00%	0.03%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1246	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1247	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU1248	0.00%	0.01%	0.00%	k__Bacteria					
OTU1249	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1251	0.01%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1253	0.02%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1254	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1255	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1256	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1257	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1258	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales		
OTU1259	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1260	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1261	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1262	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1263	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1264	0.00%	0.00%	0.02%	k__Bacteria					
OTU1265	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1266	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU1267	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1268	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				

OTU ID	%	%	%	Classification						
OTU1269	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria				
OTU1271	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria					
OTU1272	0.01%	0.00%	0.02%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales			
OTU1273	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia				
OTU1274	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae					
OTU1275	0.23%	0.06%	0.18%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6			
OTU1276	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria					g__Mucilaginib
OTU1277	0.01%	0.00%	0.00%	k__Bacteria						
OTU1278	0.01%	0.00%	0.02%	k__Bacteria	p__Candidatus_Saccharibacteria					
OTU1279	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales			
OTU1280	0.04%	0.01%	0.10%	k__Bacteria						
OTU1281	0.19%	0.21%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7				
OTU1283	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes					
OTU1284	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes					
OTU1285	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria				
OTU1286	0.00%	0.01%	0.00%	k__Bacteria						
OTU1287	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria				
OTU1288	0.00%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae		
OTU1289	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales			g__Legionella
OTU1291	0.00%	0.00%	0.00%	k__Bacteria						
OTU1292	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes					
OTU1293	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis				
OTU1294	0.05%	0.03%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria				
OTU1295	0.00%	0.00%	0.00%	k__Bacteria						
OTU1296	0.00%	0.00%	0.01%	k__Bacteria						
OTU1297	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria				
OTU1298	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria				
OTU1299	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales			
OTU1300	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes					
OTU1301	0.08%	0.10%	0.13%	k__Bacteria	p__Actinobacteria	c__Actinobacteria				
OTU1302	0.00%	0.00%	0.01%	k__Bacteria						
OTU1303	0.01%	0.00%	0.00%	k__Bacteria						
OTU1304	0.00%	0.02%	0.00%	k__Bacteria						
OTU1305	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15			
OTU1306	0.00%	0.00%	0.03%	k__Bacteria						
OTU1307	0.01%	0.00%	0.00%	k__Bacteria						
OTU1308	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6			
OTU1309	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria					
OTU1310	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria				

OTU ID	%	%	%	Classification				
OTU1311	0.00%	0.00%	0.01%	k__Bacteria				
OTU1312	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1313	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU1315	0.00%	0.00%	0.00%	k__Bacteria				
OTU1316	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1317	0.01%	0.00%	0.00%	k__Bacteria				
OTU1318	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1319	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1320	0.02%	0.05%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1321	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU1322	0.00%	0.00%	0.01%	k__Bacteria				
OTU1323	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1325	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU1326	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1327	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1328	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU1329	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria			
OTU1330	0.02%	0.02%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU1331	0.00%	0.00%	0.01%	k__Bacteria				
OTU1332	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1333	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1334	0.00%	0.01%	0.00%	k__Bacteria				
OTU1335	0.10%	0.05%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1336	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1337	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1339	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1340	0.08%	0.05%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU1342	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1343	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU1344	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1345	0.00%	0.00%	0.00%	k__Bacteria				
OTU1346	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU1348	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	
OTU1349	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1350	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1351	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU1352	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes			
OTU1355	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU1356	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		

OTU ID	%	%	%	Classification				
OTU1357	0.00%	0.00%	0.00%	k__Bacteria				
OTU1358	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1360	0.09%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU1361	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1364	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5	
OTU1365	0.01%	0.01%	0.00%	k__Bacteria				
OTU1366	0.01%	0.00%	0.00%	k__Bacteria				
OTU1367	0.03%	0.04%	0.03%	k__Bacteria	p__Parcubacteria			
OTU1368	0.00%	0.01%	0.00%	k__Bacteria				
OTU1369	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU1370	0.00%	0.00%	0.01%	k__Bacteria				
OTU1371	0.00%	0.00%	0.00%	k__Bacteria				
OTU1372	0.01%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1373	0.03%	0.02%	0.00%	k__Bacteria				
OTU1374	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU1375	0.00%	0.00%	0.00%	k__Bacteria				
OTU1376	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU1378	0.03%	0.00%	0.05%	k__Bacteria	p__Proteobacteria			
OTU1379	0.01%	0.00%	0.00%	k__Bacteria				
OTU1380	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1381	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Burkholderiaceae
OTU1382	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1383	0.00%	0.00%	0.00%	k__Bacteria				
OTU1384	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1385	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU1386	0.00%	0.01%	0.00%	k__Bacteria				
OTU1387	0.02%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1388	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU1389	0.00%	0.01%	0.00%	k__Bacteria				
OTU1390	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU1391	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_	WPS-2		
OTU1392	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU1393	0.02%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU1394	0.00%	0.01%	0.00%	k__Bacteria				
OTU1395	0.01%	0.00%	0.00%	k__Bacteria				
OTU1396	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1397	0.02%	0.02%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1398	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1399	0.01%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU1400	0.09%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1402	0.01%	0.01%	0.00%	k__Bacteria				
OTU1403	0.00%	0.00%	0.00%	k__Bacteria				
OTU1404	0.01%	0.00%	0.00%	k__Bacteria				
OTU1405	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Ktedonobacteria		
OTU1406	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1407	0.00%	0.00%	0.00%	k__Bacteria				
OTU1408	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU1409	0.00%	0.01%	0.00%	k__Bacteria				
OTU1410	0.00%	0.01%	0.00%	k__Bacteria				
OTU1411	0.01%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1413	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1414	0.04%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU1415	0.01%	0.00%	0.00%	k__Bacteria				
OTU1416	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1417	0.02%	0.00%	0.00%	k__Bacteria				
OTU1418	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1	g__BRC1_genera_incertae_sedis		
OTU1419	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1			
OTU1421	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	
OTU1422	0.00%	0.00%	0.01%	k__Bacteria				
OTU1423	0.00%	0.00%	0.01%	k__Bacteria				
OTU1424	0.01%	0.00%	0.00%	k__Bacteria				
OTU1425	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1427	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1428	0.00%	0.00%	0.00%	k__Bacteria				
OTU1429	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1430	0.00%	0.00%	0.00%	k__Bacteria				
OTU1431	0.00%	0.00%	0.01%	k__Bacteria				
OTU1432	0.00%	0.00%	0.01%	k__Bacteria				
OTU1433	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU1434	0.01%	0.09%	0.02%	k__Bacteria				
OTU1435	0.02%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae
OTU1436	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17		
OTU1437	0.00%	0.01%	0.00%	k__Bacteria				
OTU1438	0.01%	0.00%	0.00%	k__Bacteria				
OTU1440	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU1441	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1442	0.01%	0.00%	0.00%	k__Bacteria				
OTU1443	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU1444	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1445	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1447	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5		
OTU1449	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1450	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1451	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU1452	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1453	0.00%	0.00%	0.00%	k__Bacteria				
OTU1454	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU1455	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU1456	0.00%	0.01%	0.00%	k__Bacteria				
OTU1457	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1458	0.00%	0.00%	0.01%	k__Bacteria				
OTU1459	0.00%	0.00%	0.01%	k__Bacteria				
OTU1461	0.00%	0.00%	0.00%	k__Bacteria				
OTU1462	0.01%	0.00%	0.00%	k__Bacteria				
OTU1463	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU1464	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1465	0.01%	0.00%	0.00%	k__Bacteria				
OTU1466	0.01%	0.00%	0.00%	k__Bacteria				
OTU1467	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1469	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1470	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU1471	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5	
OTU1472	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU1473	0.00%	0.01%	0.00%	k__Bacteria				
OTU1474	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp18	g__Gp18	
OTU1476	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU1477	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1478	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU1479	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1480	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15	
OTU1481	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1482	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1483	0.01%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU1484	0.00%	0.01%	0.00%	k__Bacteria				
OTU1485	0.08%	0.16%	0.01%	k__Bacteria	p__Parcubacteria			
OTU1486	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU1487	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification			
OTU1488	0.01%	0.01%	0.00%	k__Bacteria			
OTU1489	0.02%	0.01%	0.00%	k__Bacteria	p__Parcubacteria		
OTU1490	0.00%	0.01%	0.02%	k__Bacteria	p__candidate_division_WPS-1		
OTU1491	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria		
OTU1492	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU1493	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	
OTU1494	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17
OTU1495	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	
OTU1496	0.01%	0.00%	0.01%	k__Bacteria			
OTU1497	0.00%	0.00%	0.01%	k__Bacteria			
OTU1498	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia		
OTU1499	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	
OTU1500	0.00%	0.01%	0.00%	k__Bacteria			
OTU1501	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales
OTU1502	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	
OTU1504	0.00%	0.01%	0.00%	k__Bacteria			
OTU1505	0.00%	0.01%	0.00%	k__Bacteria			
OTU1506	0.00%	0.00%	0.00%	k__Bacteria			
OTU1507	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	
OTU1508	0.02%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	
OTU1509	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	
OTU1510	0.00%	0.00%	0.01%	k__Bacteria			
OTU1511	0.00%	0.00%	0.01%	k__Bacteria			
OTU1512	0.00%	0.01%	0.00%	k__Bacteria			
OTU1513	0.00%	0.01%	0.00%	k__Bacteria			
OTU1514	0.01%	0.03%	0.00%	k__Bacteria			
OTU1515	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria		
OTU1516	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria		
OTU1517	0.01%	0.00%	0.00%	k__Bacteria			
OTU1518	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	
OTU1519	0.02%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes		
OTU1522	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes		
OTU1523	0.00%	0.00%	0.00%	k__Bacteria			
OTU1525	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU1526	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU1527	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes		
OTU1528	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	
OTU1529	0.00%	0.02%	0.00%	k__Bacteria	p__candidate_division_WPS-1		
OTU1530	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria		

OTU ID	%	%	%	Classification			
OTU1531	0.00%	0.00%	0.00%	k__Bacteria			
OTU1532	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	
OTU1533	0.00%	0.00%	0.00%	k__Bacteria			
OTU1534	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU1535	0.10%	0.03%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	
OTU1536	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10	
OTU1537	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria		
OTU1538	0.00%	0.00%	0.04%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	
OTU1539	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes		
OTU1540	0.01%	0.00%	0.00%	k__Bacteria			
OTU1541	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	
OTU1542	0.00%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	
OTU1543	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU1544	0.00%	0.02%	0.00%	k__Bacteria			
OTU1545	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	
OTU1546	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales
OTU1547	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	
OTU1548	0.00%	0.09%	0.00%	k__Bacteria			
OTU1549	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	
OTU1551	0.00%	0.02%	0.00%	k__Bacteria			
OTU1552	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales
OTU1553	0.00%	0.00%	0.01%	k__Bacteria			
OTU1554	0.02%	0.05%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	
OTU1557	0.01%	0.00%	0.01%	k__Bacteria			
OTU1558	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales
OTU1559	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	
OTU1560	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU1561	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes		
OTU1562	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes		
OTU1564	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales
OTU1566	0.01%	0.00%	0.07%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	
OTU1567	0.00%	0.00%	0.00%	k__Bacteria			
OTU1569	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes		
OTU1570	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria		
OTU1571	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales
OTU1572	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales
OTU1573	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	
OTU1574	0.00%	0.00%	0.00%	k__Bacteria			
OTU1575	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		

OTU ID	%	%	%	Classification				
OTU1576	0.02%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU1577	0.12%	0.00%	0.04%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU1579	0.01%	0.00%	0.00%	k__Bacteria				
OTU1580	0.01%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU1581	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1582	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2		
OTU1583	0.00%	0.00%	0.00%	k__Bacteria				
OTU1584	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU1585	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae		
OTU1587	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU1588	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1589	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1590	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1591	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU1592	0.00%	0.00%	0.00%	k__Bacteria				
OTU1594	0.03%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU1595	0.08%	0.01%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU1596	0.01%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1597	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU1598	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU1599	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae
OTU1600	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU1601	0.00%	0.00%	0.00%	k__Bacteria				
OTU1602	0.01%	0.15%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1603	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1604	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis		
OTU1605	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae		
OTU1606	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU1608	0.00%	0.00%	0.00%	k__Bacteria				
OTU1610	0.00%	0.00%	0.00%	k__Bacteria				
OTU1612	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1613	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1614	0.00%	0.00%	0.00%	k__Bacteria				
OTU1615	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae
OTU1616	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU1617	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1618	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1619	0.00%	0.00%	0.00%	k__Bacteria				
OTU1621	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			

OTU ID	%	%	%	Classification					
OTU1622	0.00%	0.00%	0.00%	k__Bacteria					
OTU1624	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales		
OTU1625	0.01%	0.00%	0.00%	k__Bacteria					
OTU1626	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae	
OTU1627	0.02%	0.00%	0.00%	k__Bacteria					
OTU1628	0.00%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1629	0.00%	0.00%	0.00%	k__Bacteria					
OTU1631	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1632	0.00%	0.00%	0.00%	k__Bacteria					
OTU1634	0.00%	0.01%	0.00%	k__Bacteria					
OTU1635	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1636	0.00%	0.00%	0.00%	k__Bacteria					
OTU1637	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1638	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU1639	0.00%	0.00%	0.00%	k__Bacteria					
OTU1641	0.00%	0.00%	0.01%	k__Bacteria					
OTU1642	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1644	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1645	0.00%	0.00%	0.00%	k__Bacteria					
OTU1647	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1648	0.00%	0.00%	0.01%	k__Bacteria					
OTU1649	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1650	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			g__Mycobacte
OTU1651	0.02%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1652	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU1653	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU1654	0.01%	0.00%	0.00%	k__Bacteria					
OTU1655	0.01%	0.02%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1656	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1657	0.01%	0.00%	0.01%	k__Bacteria					
OTU1659	0.02%	0.00%	0.07%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1660	0.00%	0.00%	0.00%	k__Bacteria					
OTU1661	0.00%	0.00%	0.00%	k__Bacteria					
OTU1662	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1663	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1664	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1665	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1666	0.00%	0.03%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1667	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU1668	0.00%	0.01%	0.00%	k__Bacteria				
OTU1669	0.00%	0.00%	0.00%	k__Bacteria				
OTU1670	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1671	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU1672	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU1673	0.00%	0.00%	0.01%	k__Bacteria				
OTU1674	0.01%	0.00%	0.00%	k__Bacteria				
OTU1675	0.02%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU1676	0.00%	0.00%	0.00%	k__Bacteria				
OTU1677	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU1678	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1680	0.00%	0.00%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU1681	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia			
OTU1682	0.01%	0.00%	0.00%	k__Bacteria				
OTU1683	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1684	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1685	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1686	0.01%	0.01%	0.00%	k__Bacteria				
OTU1687	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		g__Streptomy
OTU1688	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU1689	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1690	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1691	0.00%	0.00%	0.00%	k__Bacteria				
OTU1692	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1693	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1694	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia			
OTU1696	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1697	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1698	0.02%	0.01%	0.00%	k__Bacteria				
OTU1699	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU1700	0.03%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU1701	0.01%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU1702	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae
OTU1703	0.04%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1704	0.01%	0.00%	0.00%	k__Bacteria				
OTU1705	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1706	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1707	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU1708	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			

OTU ID	%	%	%	Classification				
OTU1709	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU1710	0.00%	0.00%	0.00%	k__Bacteria				
OTU1711	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU1712	0.00%	0.00%	0.00%	k__Bacteria				
OTU1713	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1714	0.00%	0.00%	0.00%	k__Bacteria				
OTU1715	0.03%	0.05%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU1716	0.00%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU1717	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-2			
OTU1718	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU1719	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU1720	0.00%	0.04%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1722	0.01%	0.00%	0.00%	k__Bacteria				
OTU1723	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU1724	0.82%	0.07%	0.21%	k__Bacteria				
OTU1725	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae
OTU1726	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU1727	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1728	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1729	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU1730	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1732	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1733	0.00%	0.01%	0.00%	k__Bacteria	p__Chloroflexi	c__Caldilineae		
OTU1735	0.04%	0.08%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU1736	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1737	0.03%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1738	0.00%	0.00%	0.00%	k__Bacteria				
OTU1739	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU1741	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU1742	0.00%	0.00%	0.00%	k__Bacteria				
OTU1743	0.01%	0.00%	0.00%	k__Bacteria				
OTU1744	0.00%	0.00%	0.00%	k__Bacteria				
OTU1745	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1746	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1747	0.00%	0.01%	0.01%	k__Bacteria	p__Chlamydiae			
OTU1748	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1749	0.00%	0.00%	0.00%	k__Bacteria				
OTU1750	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU1751	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification				
OTU1753	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1754	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1755	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria			
OTU1756	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1757	0.00%	0.00%	0.00%	k__Bacteria				
OTU1758	0.00%	0.00%	0.00%	k__Bacteria				
OTU1759	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1760	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU1761	0.01%	0.88%	0.00%	k__Bacteria				
OTU1762	0.00%	0.00%	0.00%	k__Bacteria				
OTU1763	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU1764	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1765	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria			
OTU1766	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1767	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15	
OTU1768	0.04%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1769	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1770	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales	
OTU1771	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU1772	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Nitrosomonadales	f__Nitrosomonadaceae g__Mucilaginib
OTU1773	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU1774	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU1775	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1776	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1777	0.00%	0.00%	0.00%	k__Bacteria				
OTU1778	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1779	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU1780	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	g__Legionella
OTU1781	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU1782	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU1783	0.00%	0.09%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1784	0.00%	0.00%	0.00%	k__Bacteria				
OTU1785	0.20%	0.35%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1786	0.00%	0.00%	0.01%	k__Bacteria				
OTU1787	0.00%	0.00%	0.00%	k__Bacteria				
OTU1788	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU1789	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU1790	0.00%	0.00%	0.00%	k__Bacteria				
OTU1791	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			

OTU ID	%	%	%	Classification					
OTU1792	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1793	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU1794	0.08%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU1795	0.01%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1796	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU1797	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1798	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1799	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1800	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1801	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria				g__Aquicella
OTU1802	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1803	0.00%	0.00%	0.00%	k__Bacteria					
OTU1804	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1806	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Lachnospiraceae	
OTU1807	0.01%	0.00%	0.00%	k__Bacteria					
OTU1808	0.02%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU1809	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1811	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1812	0.00%	0.00%	0.00%	k__Bacteria					
OTU1813	0.01%	0.03%	0.00%	k__Bacteria					
OTU1814	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1815	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1816	0.00%	0.00%	0.00%	k__Bacteria					
OTU1817	0.00%	0.02%	0.00%	k__Bacteria					
OTU1818	0.00%	0.00%	0.00%	k__Bacteria					
OTU1819	0.00%	0.00%	0.00%	k__Bacteria					
OTU1820	0.03%	0.19%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1821	0.00%	0.00%	0.00%	k__Bacteria					
OTU1822	0.01%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU1823	0.00%	0.00%	0.00%	k__Bacteria					
OTU1825	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1826	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1827	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1828	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1830	0.00%	0.00%	0.00%	k__Bacteria					
OTU1831	0.36%	0.09%	0.41%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1832	0.00%	0.00%	0.00%	k__Bacteria					
OTU1833	0.05%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1834	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU1836	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales		
OTU1839	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1840	0.01%	0.01%	0.00%	k__Bacteria					
OTU1841	0.00%	0.01%	0.00%	k__Bacteria					
OTU1842	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU1843	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1846	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1847	0.00%	0.00%	0.00%	k__Bacteria					
OTU1848	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1849	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1850	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1851	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1852	0.01%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae	
OTU1854	0.01%	0.00%	0.00%	k__Bacteria					
OTU1856	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1857	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates				
OTU1858	0.00%	0.00%	0.00%	k__Bacteria					
OTU1859	0.01%	0.00%	0.00%	k__Bacteria					
OTU1860	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1861	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1862	0.02%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU1863	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				g__Legionella
OTU1864	0.01%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1865	0.02%	0.00%	0.00%	k__Bacteria					
OTU1867	0.00%	0.00%	0.00%	k__Bacteria					
OTU1868	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU1870	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				g__Brevundim
OTU1872	0.01%	0.00%	0.00%	k__Bacteria					
OTU1873	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1874	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Syntrophomonadaceae	
OTU1875	0.03%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1877	0.01%	0.00%	0.00%	k__Bacteria					
OTU1878	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5		
OTU1879	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU1880	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1881	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1				
OTU1882	0.00%	0.00%	0.00%	k__Bacteria					
OTU1883	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1884	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU1885	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU1886	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1888	0.00%	0.00%	0.00%	k__Bacteria					
OTU1889	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Phyllobacteriaceae	
OTU1890	0.00%	0.00%	0.00%	k__Bacteria					
OTU1891	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1892	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1894	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				g__Aquicella
OTU1895	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1896	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1897	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1898	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1899	0.00%	0.04%	0.00%	k__Bacteria					
OTU1900	0.02%	0.00%	0.00%	k__Bacteria					
OTU1901	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU1902	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU1903	0.02%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU1904	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1906	0.07%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1907	0.00%	0.00%	0.00%	k__Bacteria	p__SR1	g__SR1_genera_incertae_sedis			
OTU1908	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1909	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1910	0.01%	0.00%	0.00%	k__Bacteria					
OTU1911	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1912	0.00%	0.00%	0.00%	k__Bacteria					
OTU1913	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1914	0.00%	0.00%	0.00%	k__Bacteria					
OTU1915	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1916	0.00%	0.00%	0.00%	k__Bacteria					
OTU1917	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1918	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1919	0.00%	0.00%	0.00%	k__Bacteria					g__Mycobacte
OTU1920	0.00%	0.01%	0.01%	k__Bacteria					
OTU1921	0.01%	0.00%	0.00%	k__Bacteria					
OTU1923	0.00%	0.00%	0.00%	k__Bacteria					
OTU1924	0.00%	0.00%	0.00%	k__Bacteria					
OTU1925	0.04%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1926	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1927	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			

OTU ID	%	%	%	Classification					
OTU1928	0.00%	0.00%	0.00%	k__Bacteria					
OTU1929	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1930	0.02%	0.03%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU1931	0.00%	0.00%	0.00%	k__Bacteria					
OTU1932	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1933	0.00%	0.00%	0.00%	k__Bacteria					
OTU1934	0.00%	0.00%	0.00%	k__Bacteria					
OTU1935	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1936	0.00%	0.00%	0.00%	k__Bacteria					g__Nitrospira
OTU1937	0.00%	0.00%	0.00%	k__Bacteria					
OTU1938	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1939	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1940	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1942	0.00%	0.00%	0.00%	k__Bacteria					
OTU1943	0.00%	0.00%	0.00%	k__Bacteria					
OTU1944	0.01%	0.01%	0.00%	k__Bacteria					
OTU1945	0.01%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1946	0.00%	0.00%	0.00%	k__Bacteria					
OTU1947	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1948	0.00%	0.00%	0.00%	k__Bacteria					
OTU1949	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU1950	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1951	0.09%	0.11%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU1952	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1953	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1954	0.00%	0.00%	0.00%	k__Bacteria					
OTU1955	0.00%	0.00%	0.00%	k__Bacteria					
OTU1956	0.01%	0.00%	0.00%	k__Bacteria					
OTU1957	0.01%	0.00%	0.00%	k__Bacteria					
OTU1958	0.00%	0.01%	0.00%	k__Bacteria					
OTU1959	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1960	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1962	0.00%	0.00%	0.00%	k__Bacteria					
OTU1963	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2			
OTU1964	0.02%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1965	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1966	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU1967	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1968	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

OTU ID	%	%	%	Classification					
OTU1969	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	
OTU1970	0.00%	0.00%	0.01%	k__Bacteria					
OTU1971	0.00%	0.00%	0.00%	k__Bacteria					g__Paenibacill
OTU1972	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU1973	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1974	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1975	0.13%	0.24%	0.14%	k__Bacteria	p__Actinobacteria				
OTU1976	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU1977	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	
OTU1978	0.00%	0.00%	0.01%	k__Bacteria					
OTU1980	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU1981	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU1982	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1983	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15			
OTU1984	0.01%	0.00%	0.00%	k__Bacteria					
OTU1985	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		g__Chthonom
OTU1986	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1987	0.01%	0.00%	0.00%	k__Bacteria					
OTU1988	0.00%	0.00%	0.01%	k__Bacteria					
OTU1989	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1990	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1991	0.00%	0.00%	0.00%	k__Bacteria					
OTU1992	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1993	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1995	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1996	0.01%	0.01%	0.00%	k__Bacteria					
OTU1997	0.01%	0.00%	0.01%	k__Bacteria	p__Chlamydiae				
OTU1998	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1999	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU2000	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2003	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2004	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales		
OTU2005	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU2006	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2007	0.00%	0.00%	0.01%	k__Bacteria					
OTU2008	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2009	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17			
OTU2010	0.00%	0.00%	0.01%	k__Bacteria					
OTU2011	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	

OTU ID	%	%	%	Classification					
OTU2012	0.00%	0.01%	0.00%	k__Bacteria					
OTU2013	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2014	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2015	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU2016	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2017	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU2018	0.00%	0.00%	0.00%	k__Bacteria					
OTU2019	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2020	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2021	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2022	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae	g__Pseudoxan
OTU2023	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2024	0.00%	0.00%	0.00%	k__Bacteria					
OTU2025	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2026	0.00%	0.00%	0.00%	k__Bacteria					
OTU2027	0.00%	0.00%	0.00%	k__Bacteria					
OTU2028	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bdellovibrionaceae	
OTU2029	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU2030	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2031	0.00%	0.00%	0.03%	k__Bacteria	p__candidate_division_WPS-1				
OTU2032	0.00%	0.00%	0.00%	k__Bacteria					
OTU2033	0.00%	0.00%	0.00%	k__Bacteria					g__Paenibacill
OTU2034	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU2035	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2036	0.00%	0.00%	0.00%	k__Bacteria					
OTU2037	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU2039	0.01%	0.00%	0.06%	k__Bacteria					
OTU2040	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2041	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				g__Rhodanoba
OTU2042	0.00%	0.00%	0.00%	k__Bacteria					
OTU2043	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU2044	0.00%	0.00%	0.05%	k__Bacteria	p__Proteobacteria				
OTU2045	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU2046	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU2047	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU2049	0.00%	0.00%	0.00%	k__Bacteria					
OTU2050	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU2051	0.00%	0.01%	0.00%	k__Bacteria					
OTU2052	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU2053	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2055	0.00%	0.00%	0.00%	k__Bacteria				
OTU2056	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2057	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2058	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU2059	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2060	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2061	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2062	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2063	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2065	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bdellovibrionaceae
OTU2066	0.03%	0.02%	0.05%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU2067	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2068	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2069	0.00%	0.00%	0.00%	k__Bacteria				
OTU2070	0.03%	0.02%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU2072	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2073	0.06%	0.03%	0.09%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2075	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2076	0.00%	0.01%	0.01%	k__Bacteria	p__Planctomycetes			
OTU2077	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		g__Steroidoba
OTU2078	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2079	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2080	0.01%	0.00%	0.00%	k__Bacteria				
OTU2081	0.00%	0.00%	0.00%	k__Bacteria				
OTU2082	0.00%	0.00%	0.00%	k__Bacteria				
OTU2083	0.00%	0.00%	0.02%	k__Bacteria				
OTU2084	0.00%	0.00%	0.00%	k__Bacteria				
OTU2085	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2086	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2087	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2088	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2089	0.00%	0.00%	0.00%	k__Bacteria				
OTU2090	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2091	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2092	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2094	0.00%	0.00%	0.00%	k__Bacteria				
OTU2095	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae
OTU2096	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			

OTU ID	%	%	%	Classification					
OTU2097	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU2098	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2100	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2101	0.00%	0.00%	0.00%	k__Bacteria					
OTU2102	0.00%	0.00%	0.00%	k__Bacteria					
OTU2103	0.00%	0.00%	0.00%	k__Bacteria					
OTU2104	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2105	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2106	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2107	0.00%	0.00%	0.00%	k__Bacteria					
OTU2108	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2109	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU2110	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2111	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2112	0.01%	0.00%	0.00%	k__Bacteria					
OTU2113	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2115	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2116	0.03%	0.02%	0.08%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2117	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2119	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2120	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2121	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales		
OTU2122	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU2123	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU2124	0.00%	0.00%	0.00%	k__Bacteria					
OTU2125	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2126	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2127	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2128	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rickettsiales		
OTU2129	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU2130	0.00%	0.00%	0.00%	k__Bacteria					
OTU2131	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU2132	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		g__Legionella
OTU2133	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU2134	0.00%	0.00%	0.01%	k__Bacteria					
OTU2135	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2136	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				g__Flavobacte
OTU2137	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2139	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			

OTU ID	%	%	%	Classification					
OTU2140	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales		
OTU2141	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2143	0.00%	0.00%	0.00%	k__Bacteria					g__Legionella
OTU2144	0.01%	0.00%	0.03%	k__Bacteria					
OTU2145	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2146	0.00%	0.01%	0.00%	k__Bacteria					
OTU2147	0.03%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU2150	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU2151	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				g__Aquicella
OTU2152	0.02%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU2154	0.01%	0.00%	0.00%	k__Bacteria					
OTU2155	0.00%	0.01%	0.00%	k__Bacteria	p__Chloroflexi	c__Thermomicrobia	o__Sphaerobacterales		
OTU2156	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU2157	0.00%	0.00%	0.00%	k__Bacteria					
OTU2158	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2159	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	g__Rickettsia
OTU2160	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2161	0.01%	0.00%	0.02%	k__Bacteria	p__Armatimonadetes				
OTU2162	0.01%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2164	0.00%	0.00%	0.00%	k__Bacteria					
OTU2165	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2166	0.00%	0.00%	0.00%	k__Bacteria					
OTU2167	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU2169	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2170	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				g__Psychrosin
OTU2173	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Ktedonobacteria			
OTU2174	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2175	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2176	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU2177	0.03%	0.00%	0.16%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2178	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2179	0.01%	0.00%	0.00%	k__Bacteria					
OTU2180	0.00%	0.00%	0.00%	k__Bacteria					
OTU2182	0.00%	0.00%	0.00%	k__Bacteria					
OTU2183	0.00%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2184	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU2185	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU2186	0.00%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU2187	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU2188	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2189	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2190	0.02%	0.21%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU2191	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			g__Aquicella
OTU2192	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2193	0.00%	0.00%	0.00%	k__Bacteria					
OTU2194	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2195	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU2196	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU2197	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				g__Chthonom
OTU2198	0.00%	0.01%	0.00%	k__Bacteria					
OTU2199	0.05%	0.03%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2200	0.03%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2201	0.01%	0.00%	0.00%	k__Bacteria					
OTU2203	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2204	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				g__Clostridium
OTU2205	0.01%	0.00%	0.01%	k__Bacteria					
OTU2206	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU2208	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria				
OTU2209	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17			
OTU2210	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2211	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2212	0.00%	0.00%	0.00%	k__Bacteria					
OTU2213	0.02%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2214	0.00%	0.00%	0.00%	k__Bacteria					
OTU2215	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2216	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU2217	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2218	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2220	0.01%	0.00%	0.00%	k__Bacteria					
OTU2221	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2222	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2223	0.00%	0.00%	0.00%	k__Bacteria					g__Nocardioid
OTU2224	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2225	0.00%	0.00%	0.00%	k__Bacteria					
OTU2226	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Acidimicrobiales		
OTU2227	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2228	0.02%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU2230	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia				

OTU ID	%	%	%	Classification					
OTU2231	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5			
OTU2232	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2233	0.00%	0.00%	0.00%	k__Bacteria					
OTU2234	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2235	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU2236	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2237	0.01%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU2238	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2239	0.00%	0.00%	0.02%	k__Bacteria					
OTU2240	0.00%	0.00%	0.00%	k__Bacteria					
OTU2241	0.00%	0.00%	0.00%	k__Bacteria					
OTU2242	0.00%	0.01%	0.00%	k__Bacteria					
OTU2243	0.00%	0.00%	0.01%	k__Bacteria					
OTU2245	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2246	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU2247	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2248	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU2250	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2251	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2252	0.00%	0.00%	0.00%	k__Bacteria					
OTU2253	0.00%	0.00%	0.00%	k__Bacteria	p__Spirochaetes	c__Spirochaetia	o__Spirochaetales	f__Leptospiraceae	
OTU2254	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2256	0.00%	0.00%	0.00%	k__Bacteria					
OTU2257	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2258	0.02%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU2259	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU2261	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				g__Rhodobact
OTU2262	0.00%	0.00%	0.00%	k__Bacteria					
OTU2263	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp20	g__Gp20		g__Legionella
OTU2264	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2265	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2266	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2267	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU2268	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2269	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2270	0.01%	0.00%	0.00%	k__Bacteria					
OTU2271	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2273	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2274	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

OTU ID	%	%	%	Classification					
OTU2275	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2277	0.00%	0.00%	0.00%	k__Bacteria					
OTU2278	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2279	0.00%	0.00%	0.00%	k__Bacteria					
OTU2280	0.00%	0.00%	0.00%	k__Bacteria					
OTU2281	0.00%	0.00%	0.00%	k__Bacteria					g__Gaiella
OTU2282	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2283	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU2284	0.02%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU2285	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		g__Flavobacte
OTU2286	0.01%	0.00%	0.00%	k__Bacteria					
OTU2287	0.00%	0.00%	0.00%	k__Bacteria					
OTU2288	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		g__Nitrospira
OTU2289	0.00%	0.01%	0.00%	k__Bacteria					
OTU2290	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2291	0.00%	0.00%	0.00%	k__Bacteria					
OTU2292	0.00%	0.00%	0.00%	k__Bacteria					
OTU2295	0.00%	0.00%	0.00%	k__Bacteria					
OTU2296	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-1				
OTU2297	0.00%	0.00%	0.00%	k__Bacteria					
OTU2298	0.00%	0.00%	0.00%	k__Bacteria					
OTU2299	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU2300	0.01%	0.01%	0.01%	k__Bacteria					
OTU2301	0.01%	0.00%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2303	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2304	0.00%	0.00%	0.00%	k__Bacteria					
OTU2305	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2306	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2307	0.00%	0.00%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU2308	0.00%	0.00%	0.00%	k__Bacteria					
OTU2309	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2310	0.00%	0.00%	0.00%	k__Bacteria					
OTU2311	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2313	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU2314	0.00%	0.01%	0.00%	k__Bacteria					
OTU2316	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				g__Nitrosospir
OTU2317	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU2319	0.00%	0.00%	0.00%	k__Bacteria					
OTU2320	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				

OTU ID	%	%	%	Classification				
OTU2321	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2322	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae
OTU2323	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU2324	0.00%	0.00%	0.00%	k__Bacteria				
OTU2325	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU2326	0.01%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU2327	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2328	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU2329	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU2330	0.00%	0.00%	0.00%	k__Bacteria				
OTU2331	0.01%	0.00%	0.00%	k__Bacteria				
OTU2332	0.00%	0.00%	0.00%	k__Bacteria				
OTU2333	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2335	0.01%	0.00%	0.00%	k__Bacteria				
OTU2336	0.00%	0.00%	0.01%	k__Bacteria				
OTU2338	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2340	0.00%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU2341	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2342	0.00%	0.00%	0.00%	k__Bacteria				
OTU2343	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU2344	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2345	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2346	0.00%	0.01%	0.00%	k__Bacteria				
OTU2347	0.00%	0.00%	0.00%	k__Bacteria				
OTU2348	0.00%	0.00%	0.00%	k__Bacteria				
OTU2349	0.00%	0.00%	0.00%	k__Bacteria				
OTU2351	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2352	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2353	0.00%	0.00%	0.00%	k__Bacteria				
OTU2354	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU2355	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU2356	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2357	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2358	0.01%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU2359	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2360	0.00%	0.00%	0.01%	k__Bacteria				
OTU2361	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2362	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	
OTU2363	0.00%	0.01%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU2364	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2365	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU2366	0.00%	0.01%	0.00%	k__Bacteria				
OTU2367	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2368	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2369	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2370	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2372	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2373	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU2374	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2375	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2376	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2377	0.00%	0.00%	0.00%	k__Bacteria				
OTU2378	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU2379	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2380	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU2381	0.01%	0.04%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2382	0.00%	0.00%	0.00%	k__Bacteria				
OTU2383	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2384	0.00%	0.00%	0.00%	k__Bacteria				
OTU2385	0.00%	0.00%	0.00%	k__Bacteria				
OTU2386	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2387	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2388	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2389	0.00%	0.00%	0.00%	k__Bacteria				
OTU2390	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	
OTU2391	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2392	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2393	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU2394	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2395	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU2396	0.00%	0.02%	0.01%	k__Bacteria	p__Proteobacteria			
OTU2397	0.00%	0.00%	0.00%	k__Bacteria				
OTU2399	0.01%	0.00%	0.00%	k__Bacteria				
OTU2400	0.00%	0.00%	0.00%	k__Bacteria				
OTU2402	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU2403	0.00%	0.00%	0.00%	k__Bacteria				
OTU2404	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2405	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		

OTU ID	%	%	%	Classification				
OTU2407	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU2408	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU2409	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2410	0.00%	0.00%	0.00%	k__Bacteria				
OTU2411	0.00%	0.00%	0.00%	k__Bacteria				
OTU2412	0.00%	0.00%	0.00%	k__Bacteria				
OTU2413	0.00%	0.02%	0.00%	k__Bacteria				
OTU2414	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		g__Dokdonella
OTU2415	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2416	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5		
OTU2417	0.00%	0.00%	0.00%	k__Bacteria				
OTU2418	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2419	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2420	0.01%	0.00%	0.00%	k__Bacteria				
OTU2421	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU2422	0.00%	0.00%	0.01%	k__Bacteria				
OTU2423	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2424	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU2426	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2428	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU2429	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2430	0.00%	0.00%	0.00%	k__Bacteria				
OTU2431	0.00%	0.01%	0.00%	k__Bacteria				
OTU2432	0.00%	0.00%	0.00%	k__Bacteria				
OTU2433	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2434	0.00%	0.00%	0.00%	k__Bacteria				
OTU2435	0.00%	0.00%	0.00%	k__Bacteria				
OTU2436	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2437	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2438	0.00%	0.00%	0.00%	k__Bacteria				
OTU2439	0.06%	0.02%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2440	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2441	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2442	0.00%	0.00%	0.00%	k__Bacteria				
OTU2443	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae
OTU2444	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes			
OTU2445	0.00%	0.00%	0.00%	k__Bacteria				
OTU2446	0.00%	0.00%	0.00%	k__Bacteria				
OTU2447	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		

OTU ID	%	%	%	Classification				
OTU2448	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU2449	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2450	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2451	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2452	0.00%	0.02%	0.00%	k__Bacteria				
OTU2453	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU2454	0.01%	0.02%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2455	0.00%	0.00%	0.00%	k__Bacteria				
OTU2456	0.00%	0.00%	0.00%	k__Bacteria				
OTU2457	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2458	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2459	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU2460	0.01%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU2461	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU2462	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae
OTU2463	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2464	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2465	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2466	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2467	0.01%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2468	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU2470	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU2471	0.00%	0.00%	0.00%	k__Bacteria				
OTU2472	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2473	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2474	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU2475	0.00%	0.00%	0.00%	k__Bacteria				
OTU2476	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2477	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2478	0.00%	0.00%	0.00%	k__Bacteria				
OTU2480	0.00%	0.00%	0.00%	k__Bacteria				
OTU2481	0.00%	0.00%	0.00%	k__Bacteria				
OTU2482	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2483	0.00%	0.00%	0.00%	k__Bacteria				
OTU2484	0.00%	0.01%	0.00%	k__Bacteria				
OTU2485	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2486	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU2487	0.05%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2488	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			

OTU ID	%	%	%	Classification				
OTU2489	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2490	0.00%	0.00%	0.01%	k__Bacteria				
OTU2491	0.00%	0.00%	0.00%	k__Bacteria				
OTU2493	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU2494	0.00%	0.00%	0.00%	k__Bacteria				
OTU2495	0.00%	0.00%	0.00%	k__Bacteria				
OTU2496	0.00%	0.00%	0.00%	k__Bacteria				
OTU2497	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2498	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2499	0.00%	0.01%	0.00%	k__Bacteria	p__Latescibacteria			
OTU2500	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2501	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2502	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU2503	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2504	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2505	0.00%	0.00%	0.00%	k__Bacteria				
OTU2506	0.00%	0.00%	0.00%	k__Bacteria				
OTU2507	0.00%	0.01%	0.00%	k__Bacteria				
OTU2508	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae		
OTU2510	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2512	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2513	0.00%	0.00%	0.00%	k__Bacteria				
OTU2514	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2515	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	
OTU2516	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2517	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2518	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU2519	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2520	0.00%	0.00%	0.00%	k__Bacteria				
OTU2521	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2522	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2523	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2524	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU2525	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU2526	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2527	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU2528	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU2529	0.02%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU2530	0.02%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		

OTU ID	%	%	%	Classification				
OTU2531	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2532	0.00%	0.00%	0.00%	k__Bacteria				
OTU2534	0.00%	0.01%	0.00%	k__Bacteria				
OTU2536	0.00%	0.00%	0.00%	k__Bacteria				
OTU2537	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2538	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2539	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2540	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU2541	0.00%	0.00%	0.01%	k__Bacteria				
OTU2543	0.00%	0.01%	0.00%	k__Bacteria				
OTU2544	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2545	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13	
OTU2547	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2548	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2549	0.00%	0.00%	0.00%	k__Bacteria				
OTU2551	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU2552	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2553	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2554	0.00%	0.00%	0.00%	k__Bacteria				
OTU2555	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2556	0.00%	0.00%	0.00%	k__Bacteria				
OTU2557	0.00%	0.01%	0.00%	k__Bacteria				
OTU2559	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU2560	0.00%	0.00%	0.00%	k__Bacteria				
OTU2561	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2562	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae
OTU2563	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2564	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2565	0.00%	0.00%	0.00%	k__Bacteria				
OTU2566	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2567	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Saprospiraceae
OTU2569	0.00%	0.00%	0.00%	k__Bacteria				
OTU2570	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2571	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2572	0.00%	0.01%	0.00%	k__Bacteria				
OTU2574	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Thermomonosporaceae
OTU2575	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU2576	0.00%	0.00%	0.00%	k__Bacteria				
OTU2577	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			

OTU ID	%	%	%	Classification				
OTU2578	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2579	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-2			
OTU2580	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU2581	0.00%	0.00%	0.00%	k__Bacteria				
OTU2582	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2583	0.00%	0.00%	0.00%	k__Bacteria				
OTU2584	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2585	0.03%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2586	0.03%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7	
OTU2587	0.00%	0.00%	0.00%	k__Bacteria				
OTU2588	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2589	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU2590	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU2591	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae
OTU2592	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2593	0.00%	0.00%	0.00%	k__Bacteria				
OTU2596	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2597	0.00%	0.00%	0.00%	k__Bacteria	p__Spirochaetes	c__Spirochaetia	o__Spirochaetales	f__Leptospiraceae
OTU2598	0.04%	0.08%	0.13%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2599	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2600	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rickettsiales	f__Rickettsiaceae
OTU2601	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	
OTU2602	0.01%	0.00%	0.00%	k__Bacteria	p__BRC1	g__BRC1_genera_incertae_sedis		
OTU2603	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rickettsiales	
OTU2605	0.00%	0.00%	0.00%	k__Bacteria				
OTU2606	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2607	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2608	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales	
OTU2609	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2610	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2611	0.00%	0.00%	0.00%	k__Bacteria				
OTU2612	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU2613	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2615	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2617	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2618	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2619	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2620	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes		
OTU2621	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU2623	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2624	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2625	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2626	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2627	0.00%	0.00%	0.00%	k__Bacteria				
OTU2629	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	
OTU2630	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2631	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2632	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU2633	0.00%	0.00%	0.00%	k__Bacteria				
OTU2634	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae
OTU2635	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2636	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2637	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU2638	0.00%	0.00%	0.00%	k__Bacteria				
OTU2640	0.00%	0.01%	0.00%	k__Bacteria				
OTU2641	0.00%	0.00%	0.00%	k__Bacteria				
OTU2642	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2644	0.00%	0.00%	0.00%	k__Bacteria				
OTU2645	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2646	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2647	0.00%	0.00%	0.00%	k__Bacteria				
OTU2649	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2650	0.00%	0.00%	0.01%	k__Bacteria				
OTU2651	0.00%	0.04%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU2652	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2653	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2654	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2656	0.00%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2657	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2658	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2659	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae
OTU2660	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2661	0.00%	0.00%	0.00%	k__Bacteria				
OTU2662	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		g__Flavobacte
OTU2663	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			g__Gemmatim
OTU2664	0.00%	0.00%	0.00%	k__Bacteria				
OTU2665	0.00%	0.01%	0.00%	k__Bacteria				
OTU2666	0.01%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU2667	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU2668	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2669	0.03%	0.00%	0.00%	k__Bacteria				g__Ferruginiba
OTU2670	0.18%	0.01%	0.21%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU2672	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2673	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2674	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2675	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes			
OTU2676	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			g__Arthrobact
OTU2678	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2679	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis	
OTU2680	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU2681	0.00%	0.00%	0.00%	k__Bacteria				
OTU2682	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2683	0.02%	0.16%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2684	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales	
OTU2685	0.00%	0.00%	0.00%	k__Bacteria				
OTU2686	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2687	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2688	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2689	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU2690	0.00%	0.00%	0.00%	k__Bacteria				
OTU2691	0.00%	0.00%	0.04%	k__Bacteria	p__Chloroflexi			
OTU2692	0.00%	0.00%	0.00%	k__Bacteria				
OTU2693	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae			
OTU2695	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2696	0.00%	0.00%	0.00%	k__Bacteria				
OTU2698	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU2699	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2700	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU2701	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2702	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae
OTU2703	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2704	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2705	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2706	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2707	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2709	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2710	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	

OTU ID	%	%	%	Classification				
OTU2711	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2712	0.03%	0.07%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU2713	0.00%	0.00%	0.00%	k__Bacteria				
OTU2714	0.00%	0.00%	0.00%	k__Bacteria				
OTU2715	0.00%	0.01%	0.00%	k__Bacteria				
OTU2716	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU2717	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2718	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates			
OTU2720	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae
OTU2721	0.01%	0.00%	0.00%	k__Bacteria				
OTU2722	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU2724	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2725	0.01%	0.00%	0.00%	k__Bacteria				
OTU2726	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2728	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2729	0.01%	0.20%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU2731	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU2732	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2735	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2736	0.00%	0.01%	0.00%	k__Bacteria				
OTU2737	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2738	0.00%	0.00%	0.00%	k__Bacteria				
OTU2739	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU2740	0.00%	0.01%	0.00%	k__Bacteria				
OTU2741	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU2742	0.00%	0.00%	0.00%	k__Bacteria				
OTU2743	0.00%	0.00%	0.00%	k__Bacteria				
OTU2744	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae
OTU2747	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates			
OTU2748	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU2749	0.05%	0.00%	0.06%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU2750	0.00%	0.00%	0.00%	k__Bacteria				
OTU2751	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2752	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2753	0.00%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2754	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae
OTU2755	0.01%	0.00%	0.00%	k__Bacteria				
OTU2756	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU2757	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales	f__Porphyromonadaceae

OTU ID	%	%	%	Classification					
OTU2758	0.01%	0.00%	0.00%	k__Bacteria					
OTU2760	0.00%	0.01%	0.00%	k__Bacteria					
OTU2762	0.00%	0.00%	0.00%	k__Bacteria					
OTU2763	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2764	0.00%	0.00%	0.00%	k__Bacteria					
OTU2765	0.00%	0.01%	0.00%	k__Bacteria					g__Lysobacter
OTU2766	0.00%	0.00%	0.00%	k__Bacteria					
OTU2767	0.00%	0.00%	0.00%	k__Bacteria					
OTU2768	0.00%	0.00%	0.00%	k__Bacteria					
OTU2769	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2770	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2771	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2772	0.01%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2773	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2774	0.00%	0.00%	0.00%	k__Bacteria					
OTU2775	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2776	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2777	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU2779	0.00%	0.00%	0.00%	k__Bacteria					
OTU2780	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2781	0.00%	0.00%	0.00%	k__Bacteria					
OTU2782	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia			
OTU2783	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2784	0.00%	0.00%	0.00%	k__Bacteria					
OTU2785	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2786	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2787	0.00%	0.02%	0.00%	k__Bacteria					
OTU2788	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia	o__Armatimonadales	f__Armatimonadaceae	
OTU2789	0.00%	0.00%	0.00%	k__Bacteria					
OTU2790	0.00%	0.00%	0.00%	k__Bacteria					g__Turneriella
OTU2791	0.02%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2792	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2794	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2795	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU2796	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2797	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2798	0.00%	0.00%	0.03%	k__Bacteria					
OTU2799	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2801	0.00%	0.01%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU2802	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2804	0.01%	0.00%	0.01%	k__Bacteria					
OTU2805	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2806	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2807	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2808	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2809	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2811	0.00%	0.00%	0.00%	k__Bacteria					
OTU2812	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22			
OTU2813	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2814	0.00%	0.00%	0.00%	k__Bacteria					
OTU2815	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2816	0.00%	0.00%	0.00%	k__Bacteria					
OTU2817	0.00%	0.00%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU2818	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2819	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2820	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU2821	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2822	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2824	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU2826	0.00%	0.00%	0.00%	k__Bacteria					
OTU2827	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2828	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			g__Mesorhizob
OTU2829	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2830	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2831	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2832	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU2833	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU2834	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2836	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2837	0.00%	0.00%	0.00%	k__Bacteria					
OTU2839	0.00%	0.00%	0.00%	k__Bacteria					
OTU2842	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2844	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2846	0.00%	0.00%	0.00%	k__Bacteria					
OTU2847	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU2848	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2849	0.00%	0.00%	0.00%	k__Bacteria					
OTU2852	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		

OTU ID	%	%	%	Classification				
OTU2853	0.01%	0.01%	0.00%	k__Bacteria				
OTU2856	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2857	0.00%	0.00%	0.07%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2858	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2859	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU2860	0.00%	0.00%	0.00%	k__Bacteria				
OTU2861	0.00%	0.00%	0.00%	k__Bacteria				
OTU2862	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2863	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2864	0.00%	0.00%	0.00%	k__Bacteria				
OTU2865	0.00%	0.00%	0.00%	k__Bacteria				
OTU2866	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales	
OTU2867	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2868	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2869	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2870	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU2871	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2872	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2873	0.00%	0.00%	0.00%	k__Bacteria				
OTU2874	0.00%	0.00%	0.00%	k__Bacteria	p__Nitrospirae	c__Nitrospira	o__Nitrospirales	f__Nitrospiraceae
OTU2875	0.00%	0.00%	0.00%	k__Bacteria				
OTU2876	0.00%	0.00%	0.00%	k__Bacteria				
OTU2877	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2878	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae		
OTU2879	0.01%	0.00%	0.00%	k__Bacteria				
OTU2880	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2882	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2883	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2884	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2885	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2886	0.00%	0.00%	0.00%	k__Bacteria				
OTU2887	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2888	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae
OTU2890	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU2891	0.00%	0.00%	0.00%	k__Bacteria				
OTU2893	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU2895	0.00%	0.00%	0.00%	k__Bacteria				
OTU2896	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2897	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU2898	0.00%	0.06%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU2899	0.00%	0.00%	0.00%	k__Bacteria					
OTU2901	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2902	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				g__Luteolibact
OTU2903	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2907	0.00%	0.00%	0.03%	k__Bacteria					
OTU2908	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU2909	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2910	0.01%	0.00%	0.00%	k__Bacteria					
OTU2911	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU2912	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2913	0.00%	0.00%	0.00%	k__Bacteria					
OTU2914	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU2916	0.00%	0.00%	0.08%	k__Bacteria	p__Actinobacteria				
OTU2917	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU2918	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2920	0.00%	0.00%	0.01%	k__Bacteria					
OTU2921	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2922	0.00%	0.00%	0.00%	k__Bacteria					g__Acetobacte
OTU2924	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2927	0.01%	0.00%	0.00%	k__Bacteria					
OTU2928	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2930	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2931	0.00%	0.00%	0.00%	k__Bacteria					
OTU2932	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2933	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2934	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU2935	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae	
OTU2936	0.01%	0.00%	0.00%	k__Bacteria	p__Ignavibacteriae	c__Ignavibacteria			
OTU2937	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2939	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU2940	0.01%	0.00%	0.00%	k__Bacteria					
OTU2941	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2942	0.00%	0.00%	0.00%	k__Bacteria					
OTU2947	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2948	0.00%	0.00%	0.00%	k__Bacteria					
OTU2949	0.00%	0.00%	0.00%	k__Bacteria					g__Flavobacte
OTU2952	0.00%	0.00%	0.00%	k__Bacteria					
OTU2954	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			

OTU ID	%	%	%	Classification				
OTU2955	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales	f__Gallionellaceae
OTU2956	0.00%	0.00%	0.00%	k__Bacteria				
OTU2957	0.00%	0.00%	0.00%	k__Bacteria				
OTU2958	0.00%	0.00%	0.00%	k__Bacteria				
OTU2959	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2961	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU2962	0.01%	0.00%	0.00%	k__Bacteria				
OTU2963	0.00%	0.00%	0.00%	k__Bacteria				
OTU2964	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2967	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2968	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU2971	0.07%	0.08%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2972	0.00%	0.00%	0.00%	k__Bacteria				
OTU2973	0.03%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU2974	0.01%	0.00%	0.00%	k__Bacteria				
OTU2979	0.00%	0.00%	0.00%	k__Bacteria				
OTU2980	0.01%	0.00%	0.00%	k__Bacteria	p__Latescibacteria			
OTU2981	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2982	0.02%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU2984	0.01%	0.11%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2986	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2988	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2990	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU2991	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2992	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU2994	0.00%	0.00%	0.00%	k__Bacteria				
OTU3000	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		g__Turneriella
OTU3001	0.00%	0.00%	0.00%	k__Bacteria				
OTU3002	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU3004	0.00%	0.00%	0.00%	k__Bacteria				
OTU3006	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3007	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3008	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU3010	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU3012	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3014	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3015	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3017	0.00%	0.00%	0.00%	k__Bacteria				
OTU3018	0.08%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	

OTU ID	%	%	%	Classification				
OTU3020	0.00%	0.00%	0.00%	k__Bacteria				
OTU3021	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3022	0.00%	0.00%	0.00%	k__Bacteria				
OTU3023	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU3027	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3030	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU3031	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3032	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3037	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU3039	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3041	0.02%	0.04%	0.00%	k__Bacteria	p__Actinobacteria			
OTU3042	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU3043	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU3044	0.00%	0.00%	0.00%	k__Bacteria				
OTU3049	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU3050	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae
OTU3051	0.00%	0.00%	0.00%	k__Bacteria				
OTU3052	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU3053	0.05%	0.13%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU3056	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU3058	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_1
OTU3059	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU3061	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3062	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU3063	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU3065	0.00%	0.00%	0.00%	k__Bacteria				
OTU3067	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			g__Flavobacte
OTU3070	0.00%	0.00%	0.00%	k__Bacteria				
OTU3071	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Lachnospiraceae
OTU3072	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU3073	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU3074	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3075	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3076	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU3077	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		g__Legionella
OTU3079	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU3081	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3087	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU3088	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		

OTU ID	%	%	%	Classification				
OTU3089	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3090	0.00%	0.00%	0.00%	k__Bacteria				
OTU3091	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU3092	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3094	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3095	0.00%	0.00%	0.00%	k__Bacteria				
OTU3096	0.00%	0.00%	0.00%	k__Bacteria				
OTU3098	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3099	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU3100	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3102	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU3103	0.00%	0.00%	0.00%	k__Bacteria				
OTU3105	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU3106	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3107	0.01%	0.00%	0.00%	k__Bacteria				
OTU3108	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU3109	0.02%	0.04%	0.00%	k__Bacteria				
OTU3110	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU3113	0.00%	0.00%	0.00%	k__Bacteria				
OTU3114	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU3116	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10		
OTU3119	0.00%	0.00%	0.00%	k__Bacteria				
OTU3123	0.02%	0.01%	0.06%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU3124	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3125	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3126	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3129	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3130	0.00%	0.00%	0.00%	k__Bacteria				
OTU3131	0.00%	0.00%	0.00%	k__Bacteria				
OTU3133	0.02%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU3134	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU3136	0.00%	0.00%	0.00%	k__Bacteria				
OTU3137	0.00%	0.00%	0.00%	k__Bacteria				
OTU3140	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3141	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU3142	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3145	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3146	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3147	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU3148	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU3149	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3151	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3152	0.00%	0.00%	0.00%	k__Bacteria				
OTU3156	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3157	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3158	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU3159	0.00%	0.00%	0.01%	k__Bacteria				
OTU3160	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU3161	0.00%	0.00%	0.00%	k__Bacteria				
OTU3162	0.00%	0.00%	0.00%	k__Bacteria				
OTU3163	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3165	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU3166	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3167	0.00%	0.00%	0.00%	k__Bacteria				
OTU3168	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU3169	0.01%	0.00%	0.01%	k__Bacteria				
OTU3170	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3173	0.00%	0.00%	0.01%	k__Bacteria				
OTU3174	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3175	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU3176	0.00%	0.00%	0.00%	k__Bacteria				
OTU3177	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3181	0.00%	0.00%	0.00%	k__Bacteria				
OTU3182	0.00%	0.00%	0.00%	k__Bacteria				
OTU3183	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU3184	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU3186	0.00%	0.00%	0.00%	k__Bacteria				
OTU3187	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3188	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae
OTU3189	0.00%	0.00%	0.00%	k__Bacteria				
OTU3190	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU3191	0.00%	0.00%	0.00%	k__Bacteria				
OTU3192	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU3193	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU3194	0.00%	0.00%	0.00%	k__Bacteria				
OTU3195	0.00%	0.00%	0.00%	k__Bacteria				
OTU3200	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3201	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU3202	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU3204	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU3205	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3206	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU3208	0.00%	0.00%	0.00%	k__Bacteria				
OTU3209	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3210	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis	
OTU3212	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU3213	0.00%	0.00%	0.20%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU3214	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU3216	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	
OTU3218	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3219	0.00%	0.00%	0.00%	k__Bacteria				
OTU3221	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU3222	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU3223	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU3224	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3225	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes			
OTU3226	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU3227	0.00%	0.00%	0.00%	k__Bacteria				
OTU3228	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3229	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3230	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU3232	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU3233	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3234	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3235	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia			
OTU3236	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU3237	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU3238	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3239	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU3243	0.00%	0.00%	0.00%	k__Bacteria				
OTU3244	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3245	0.00%	0.00%	0.00%	k__Bacteria				
OTU3246	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU3248	0.00%	0.00%	0.00%	k__Bacteria				
OTU3249	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU3253	0.00%	0.00%	0.03%	k__Bacteria	p__Planctomycetes			
OTU3254	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU3256	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3257	0.00%	0.00%	0.00%	k__Bacteria					
OTU3258	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3260	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			g__Turneriella
OTU3262	0.00%	0.00%	0.06%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3263	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU3264	0.00%	0.00%	0.00%	k__Bacteria					
OTU3265	0.00%	0.00%	0.00%	k__Bacteria					
OTU3266	0.00%	0.00%	0.00%	k__Bacteria					
OTU3267	0.00%	0.00%	0.00%	k__Bacteria					
OTU3268	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Microbacteriaceae	
OTU3274	0.00%	0.00%	0.00%	k__Bacteria					
OTU3275	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3277	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU3278	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3279	0.00%	0.00%	0.00%	k__Bacteria					
OTU3280	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3281	0.04%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3283	0.00%	0.00%	0.00%	k__Bacteria					
OTU3288	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3291	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3292	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3293	0.00%	0.00%	0.00%	k__Bacteria					
OTU3294	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU3295	0.00%	0.00%	0.00%	k__Bacteria					
OTU3296	0.00%	0.00%	0.00%	k__Bacteria					
OTU3297	0.01%	0.00%	0.11%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3300	0.01%	0.06%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU3301	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU3303	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU3304	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		g__Bdellovibri
OTU3305	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU3310	0.00%	0.00%	0.00%	k__Bacteria					
OTU3311	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU3313	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5		
OTU3314	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3317	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU3318	0.00%	0.00%	0.00%	k__Bacteria					
OTU3319	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				

OTU ID	%	%	%	Classification				
OTU3320	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU3321	0.00%	0.02%	0.00%	k__Bacteria				
OTU3322	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU3323	0.00%	0.00%	0.00%	k__Bacteria				
OTU3326	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3328	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU3330	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU3335	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae
OTU3337	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3339	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3341	0.00%	0.00%	0.00%	k__Bacteria				
OTU3342	0.00%	0.00%	0.00%	k__Bacteria				g__Flavobacte
OTU3343	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3349	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3350	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3351	0.06%	0.17%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3352	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3353	0.38%	0.03%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU3354	0.00%	0.00%	0.00%	k__Bacteria				
OTU3355	0.00%	0.00%	0.00%	k__Bacteria				
OTU3356	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU3357	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Syntrophomonadaceae
OTU3358	0.01%	0.02%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3360	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3362	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU3363	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3364	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU3365	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU3366	0.00%	0.00%	0.00%	k__Bacteria				
OTU3367	0.00%	0.00%	0.00%	k__Bacteria				
OTU3368	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3369	0.00%	0.00%	0.00%	k__Bacteria				
OTU3370	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU3371	0.00%	0.01%	0.00%	k__Bacteria				
OTU3374	0.00%	0.00%	0.00%	k__Bacteria				
OTU3375	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3378	0.00%	0.06%	0.00%	k__Bacteria				
OTU3379	0.00%	0.00%	0.00%	k__Bacteria				
OTU3381	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		

OTU ID	%	%	%	Classification				
OTU3384	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU3385	0.00%	0.00%	0.00%	k__Bacteria				
OTU3386	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3389	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae
OTU3390	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3392	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3394	0.00%	0.00%	0.00%	k__Bacteria				
OTU3395	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3399	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13	
OTU3400	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3401	0.00%	0.00%	0.00%	k__Bacteria				
OTU3404	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3408	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU3410	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3411	0.00%	0.00%	0.00%	k__Bacteria				
OTU3412	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU3413	0.00%	0.00%	0.00%	k__Bacteria				
OTU3415	0.00%	0.00%	0.00%	k__Bacteria				
OTU3418	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3419	0.01%	0.01%	0.00%	k__Bacteria				
OTU3421	0.00%	0.00%	0.00%	k__Bacteria				
OTU3422	0.00%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3423	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp4		
OTU3424	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3425	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU3426	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3428	0.00%	0.00%	0.00%	k__Bacteria				
OTU3429	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3430	0.00%	0.00%	0.00%	k__Bacteria				
OTU3433	0.12%	0.08%	0.06%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3435	0.00%	0.00%	0.00%	k__Bacteria				
OTU3438	0.00%	0.07%	0.00%	k__Bacteria	p__Actinobacteria			
OTU3439	0.00%	0.00%	0.00%	k__Bacteria				
OTU3441	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3443	0.00%	0.00%	0.00%	k__Bacteria				
OTU3446	0.00%	0.00%	0.00%	k__Bacteria				
OTU3448	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3451	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU3453	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7	

OTU ID	%	%	%	Classification					
OTU3455	0.00%	0.01%	0.00%	k__Bacteria					g__Steroidoba
OTU3457	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3458	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3460	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3462	0.01%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3463	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3464	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU3465	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU3468	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3470	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU3471	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3473	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria				
OTU3474	0.00%	0.01%	0.00%	k__Bacteria					
OTU3475	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU3477	0.00%	0.00%	0.00%	k__Bacteria					
OTU3478	0.00%	0.00%	0.00%	k__Bacteria					
OTU3479	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3481	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3482	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3485	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3486	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp12			
OTU3487	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3488	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3489	0.00%	0.00%	0.00%	k__Bacteria					
OTU3493	0.00%	0.03%	0.00%	k__Bacteria					
OTU3494	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU3495	0.00%	0.00%	0.00%	k__Bacteria					
OTU3496	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU3497	0.01%	0.05%	0.00%	k__Bacteria					
OTU3502	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3503	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia			
OTU3505	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU3506	0.00%	0.00%	0.00%	k__Bacteria					
OTU3509	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU3510	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3512	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU3513	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp19	g__Gp19		
OTU3514	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1				
OTU3516	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		

OTU ID	%	%	%	Classification				
OTU3518	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU3519	0.03%	0.03%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU3520	0.00%	0.00%	0.00%	k__Bacteria				
OTU3521	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3524	0.00%	0.01%	0.00%	k__Bacteria				
OTU3525	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU3526	0.00%	0.00%	0.00%	k__Bacteria				
OTU3527	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	
OTU3530	0.00%	0.00%	0.00%	k__Bacteria				
OTU3531	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU3534	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU3535	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3536	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3539	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3540	0.00%	0.00%	0.00%	k__Bacteria				
OTU3541	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU3542	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3543	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3544	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU3547	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3548	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3549	0.00%	0.00%	0.00%	k__Bacteria				
OTU3550	0.00%	0.00%	0.00%	k__Bacteria				
OTU3552	0.00%	0.00%	0.00%	k__Bacteria				
OTU3555	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3556	0.00%	0.00%	0.00%	k__Bacteria				
OTU3559	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU3560	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3562	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3563	0.00%	0.00%	0.00%	k__Bacteria				
OTU3566	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3567	0.00%	0.00%	0.00%	k__Bacteria				
OTU3568	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3570	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU3571	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU3572	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3573	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU3575	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3576	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		

OTU ID	%	%	%	Classification					
OTU3577	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3579	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3580	0.01%	0.00%	0.10%	k__Bacteria					
OTU3581	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU3582	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3583	0.00%	0.00%	0.00%	k__Bacteria					
OTU3584	0.00%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			g__Methyloba
OTU3586	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3587	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU3588	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	f__Rhodocyclaceae	
OTU3589	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU3591	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3592	0.03%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU3594	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU3596	0.00%	0.00%	0.00%	k__Bacteria					
OTU3597	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3598	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3599	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3601	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3605	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3607	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3608	0.00%	0.00%	0.00%	k__Bacteria					
OTU3609	0.00%	0.00%	0.00%	k__Bacteria					
OTU3610	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU3611	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3612	0.00%	0.00%	0.00%	k__Bacteria					
OTU3613	0.00%	0.01%	0.00%	k__Bacteria					
OTU3616	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3617	0.00%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3618	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	f__Parachlamydiaceae	
OTU3621	0.00%	0.01%	0.00%	k__Bacteria					
OTU3627	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3630	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3631	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3635	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3636	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3637	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3639	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3641	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bdellovibrionaceae	

OTU ID	%	%	%	Classification				
OTU3642	0.00%	0.00%	0.00%	k__Bacteria				
OTU3647	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3648	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3649	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU3650	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU3651	0.00%	0.00%	0.00%	k__Bacteria				
OTU3654	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU3657	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3659	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU3661	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3662	0.00%	0.00%	0.00%	k__Bacteria				
OTU3663	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU3664	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3665	0.01%	0.00%	0.00%	k__Bacteria				
OTU3667	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3668	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU3669	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU3670	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3674	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3675	0.01%	0.00%	0.00%	k__Bacteria				
OTU3677	0.00%	0.00%	0.00%	k__Bacteria				
OTU3679	0.00%	0.00%	0.00%	k__Bacteria				
OTU3680	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3683	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3685	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3686	0.01%	0.00%	0.00%	k__Bacteria				
OTU3688	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3689	0.00%	0.00%	0.00%	k__Bacteria				
OTU3690	0.00%	0.00%	0.00%	k__Bacteria				
OTU3693	0.00%	0.00%	0.00%	k__Bacteria				
OTU3699	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3701	0.01%	0.00%	0.01%	k__Bacteria				
OTU3702	0.00%	0.00%	0.00%	k__Bacteria				
OTU3703	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU3704	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3705	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3708	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3709	0.00%	0.00%	0.00%	k__Bacteria				
OTU3710	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification					
OTU3711	0.00%	0.00%	0.00%	k__Bacteria					
OTU3714	0.00%	0.00%	0.00%	k__Bacteria					
OTU3718	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3721	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3722	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3723	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3726	0.00%	0.00%	0.00%	k__Bacteria					
OTU3729	0.00%	0.01%	0.00%	k__Bacteria					
OTU3730	0.00%	0.00%	0.00%	k__Bacteria					
OTU3731	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3732	0.01%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU3733	0.00%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3734	0.00%	0.00%	0.00%	k__Bacteria					
OTU3735	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU3738	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3739	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU3741	0.00%	0.00%	0.00%	k__Bacteria					
OTU3742	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU3744	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3746	0.00%	0.00%	0.00%	k__Bacteria					
OTU3747	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3748	0.00%	0.00%	0.00%	k__Bacteria					
OTU3750	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU3751	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp12			
OTU3752	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3753	0.00%	0.00%	0.00%	k__Bacteria					
OTU3754	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3755	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3756	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU3757	0.00%	0.02%	0.00%	k__Bacteria					
OTU3759	0.01%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		g__Gemmatim
OTU3760	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates				
OTU3761	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3762	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3764	0.01%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3765	0.00%	0.00%	0.00%	k__Bacteria					
OTU3766	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU3767	0.00%	0.02%	0.10%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU3768	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				

OTU ID	%	%	%	Classification				
OTU3770	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3771	0.02%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3772	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU3773	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3776	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3778	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3780	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3781	0.00%	0.00%	0.00%	k__Bacteria				
OTU3784	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU3785	0.00%	0.00%	0.00%	k__Bacteria				
OTU3789	0.00%	0.00%	0.00%	k__Bacteria				
OTU3790	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU3791	0.02%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU3792	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU3794	0.00%	0.00%	0.00%	k__Bacteria				
OTU3795	0.00%	0.00%	0.00%	k__Bacteria				
OTU3796	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3797	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	
OTU3804	0.00%	0.00%	0.00%	k__Bacteria				
OTU3805	0.00%	0.00%	0.00%	k__Bacteria				
OTU3807	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU3808	0.00%	0.00%	0.00%	k__Bacteria				
OTU3809	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU3812	0.01%	0.01%	0.00%	k__Bacteria				
OTU3813	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU3814	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22		
OTU3818	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3820	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3821	0.00%	0.00%	0.00%	k__Bacteria				
OTU3822	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU3823	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Pseudonocardiaceae
OTU3824	0.00%	0.00%	0.00%	k__Bacteria				
OTU3826	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU3833	0.00%	0.00%	0.00%	k__Bacteria				
OTU3834	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3836	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Microbacteriaceae
OTU3838	0.00%	0.00%	0.00%	k__Bacteria				
OTU3841	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3843	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		

OTU ID	%	%	%	Classification					
OTU3845	0.00%	0.05%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU3847	0.01%	0.00%	0.00%	k__Bacteria					
OTU3848	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU3849	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU3850	0.00%	0.00%	0.00%	k__Bacteria					
OTU3851	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU3852	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3853	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3855	0.00%	0.00%	0.00%	k__Bacteria					
OTU3856	0.00%	0.01%	0.00%	k__Bacteria					
OTU3857	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3858	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				g__Gemmatim
OTU3859	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3860	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3861	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3862	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU3864	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3865	0.00%	0.00%	0.00%	k__Bacteria					
OTU3866	0.00%	0.01%	0.00%	k__Bacteria					
OTU3867	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3868	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria				
OTU3870	0.00%	0.00%	0.00%	k__Bacteria					
OTU3871	0.00%	0.00%	0.00%	k__Bacteria					
OTU3872	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3875	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3877	0.00%	0.00%	0.00%	k__Bacteria					
OTU3879	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU3882	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU3883	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales		
OTU3884	0.01%	0.00%	0.00%	k__Bacteria					
OTU3886	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3888	0.00%	0.00%	0.00%	k__Bacteria					
OTU3889	0.01%	0.00%	0.00%	k__Bacteria					
OTU3890	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3892	0.00%	0.00%	0.00%	k__Bacteria					
OTU3894	0.00%	0.00%	0.00%	k__Bacteria					
OTU3896	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU3897	0.00%	0.00%	0.00%	k__Bacteria					
OTU3898	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				

OTU ID	%	%	%	Classification				
OTU3900	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3901	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU3902	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU3903	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3904	0.00%	0.00%	0.00%	k__Bacteria				
OTU3905	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3906	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU3909	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU3911	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3912	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU3913	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU3916	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU3917	0.00%	0.00%	0.00%	k__Bacteria				
OTU3918	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU3919	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU3920	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3924	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3925	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU3926	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU3929	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3930	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3933	0.02%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU3937	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3938	0.01%	0.00%	0.01%	k__Bacteria				
OTU3939	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3941	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3942	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3946	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU3947	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3948	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3951	0.00%	0.01%	0.00%	k__Bacteria				
OTU3953	0.00%	0.00%	0.00%	k__Bacteria				
OTU3955	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU3956	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3957	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU3958	0.00%	0.00%	0.00%	k__Bacteria				
OTU3959	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates			
OTU3960	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU3961	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU3962	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU3965	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			g__Bdellovibri
OTU3966	0.00%	0.00%	0.00%	k__Bacteria					
OTU3968	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3971	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU3973	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3974	0.00%	0.00%	0.00%	k__Bacteria					
OTU3975	0.00%	0.00%	0.00%	k__Bacteria					
OTU3976	0.00%	0.00%	0.00%	k__Bacteria					
OTU3977	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU3978	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3980	0.00%	0.00%	0.00%	k__Bacteria					g__Steroidoba
OTU3981	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3982	0.00%	0.00%	0.00%	k__Bacteria					
OTU3985	0.00%	0.00%	0.00%	k__Bacteria					
OTU3986	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU3987	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3990	0.01%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU3991	0.00%	0.01%	0.00%	k__Bacteria					
OTU3992	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3993	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3995	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3996	0.00%	0.00%	0.00%	k__Bacteria					
OTU3997	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU3998	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU4000	0.00%	0.00%	0.00%	k__Bacteria					
OTU4001	0.00%	0.01%	0.00%	k__Bacteria					g__Aeromicrob
OTU4002	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU4004	0.00%	0.00%	0.00%	k__Bacteria					
OTU4009	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4011	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4012	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4013	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	
OTU4014	0.00%	0.00%	0.00%	k__Bacteria					
OTU4015	0.00%	0.00%	0.00%	k__Bacteria					
OTU4017	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4018	0.00%	0.01%	0.01%	k__Bacteria					
OTU4019	0.00%	0.00%	0.00%	k__Bacteria					
OTU4020	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				

OTU ID	%	%	%	Classification				
OTU4022	0.00%	0.00%	0.00%	k__Bacteria				
OTU4023	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU4024	0.00%	0.01%	0.00%	k__Bacteria				
OTU4026	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4027	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4028	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4029	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4032	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	f__Rhodocyclaceae
OTU4034	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4035	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU4039	0.00%	0.00%	0.00%	k__Bacteria				
OTU4040	0.00%	0.00%	0.00%	k__Bacteria				
OTU4042	0.00%	0.00%	0.00%	k__Bacteria				
OTU4043	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4044	0.01%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4045	0.00%	0.00%	0.00%	k__Bacteria				
OTU4046	0.00%	0.00%	0.01%	k__Bacteria				
OTU4047	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4048	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU4049	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU4050	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15		
OTU4054	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU4057	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4058	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4059	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4060	0.00%	0.00%	0.00%	k__Bacteria				
OTU4062	0.00%	0.00%	0.00%	k__Bacteria				
OTU4063	0.00%	0.00%	0.00%	k__Bacteria				
OTU4064	0.00%	0.00%	0.00%	k__Bacteria				
OTU4065	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4068	0.00%	0.00%	0.00%	k__Bacteria				
OTU4069	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4070	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU4072	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4075	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU4077	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU4079	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4080	0.01%	0.00%	0.00%	k__Bacteria				
OTU4083	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae

OTU ID	%	%	%	Classification				
OTU4086	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU4087	0.00%	0.00%	0.00%	k__Bacteria				
OTU4088	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4094	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU4098	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4102	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU4103	0.00%	0.00%	0.00%	k__Bacteria				
OTU4104	0.00%	0.00%	0.00%	k__Bacteria				
OTU4106	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU4107	0.00%	0.00%	0.00%	k__Bacteria				
OTU4108	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU4112	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU4113	0.00%	0.00%	0.00%	k__Bacteria				
OTU4115	0.00%	0.00%	0.00%	k__Bacteria				
OTU4118	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU4120	0.00%	0.00%	0.00%	k__Bacteria				
OTU4121	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4122	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4124	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4126	0.00%	0.00%	0.00%	k__Bacteria				
OTU4128	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4130	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU4131	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4134	0.00%	0.00%	0.00%	k__Bacteria				
OTU4135	0.00%	0.00%	0.00%	k__Bacteria				
OTU4136	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU4140	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU4141	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Kineosporiaceae
OTU4142	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4143	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU4144	0.00%	0.00%	0.00%	k__Bacteria				
OTU4145	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Streptomycetaceae
OTU4146	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia		
OTU4147	0.00%	0.00%	0.00%	k__Bacteria				
OTU4152	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU4153	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4154	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU4157	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	
OTU4158	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU4159	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU4162	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU4165	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Negativicutes			
OTU4166	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU4167	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4168	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4171	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU4174	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4181	0.00%	0.00%	0.00%	k__Bacteria					
OTU4184	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae	
OTU4185	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4187	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4188	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			g__Sporosarci
OTU4189	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU4190	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4192	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4196	0.00%	0.00%	0.00%	k__Bacteria					
OTU4204	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4206	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4208	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4210	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4211	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4212	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU4214	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4215	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU4216	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4217	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4218	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU4220	0.00%	0.00%	0.00%	k__Bacteria					
OTU4224	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU4225	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4226	0.00%	0.00%	0.00%	k__Bacteria					
OTU4227	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4230	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4231	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4232	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU4233	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4235	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4237	0.00%	0.00%	0.02%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU4239	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU4241	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4242	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU4246	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4248	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp12		
OTU4249	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4253	0.00%	0.00%	0.00%	k__Bacteria				
OTU4254	0.00%	0.00%	0.00%	k__Bacteria				
OTU4256	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU4257	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU4260	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4261	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU4262	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU4263	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5	
OTU4265	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4271	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4272	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU4275	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4277	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU4278	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4281	0.03%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU4283	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4284	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4287	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		g__Staphyloco
OTU4288	0.00%	0.00%	0.00%	k__Bacteria				
OTU4289	0.00%	0.00%	0.00%	k__Bacteria				
OTU4290	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU4292	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU4293	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4295	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4296	0.00%	0.00%	0.00%	k__Bacteria				
OTU4303	0.00%	0.00%	0.00%	k__Bacteria				
OTU4305	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4306	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4310	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2		
OTU4311	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4312	0.00%	0.00%	0.00%	k__Bacteria				
OTU4313	0.00%	0.00%	0.00%	k__Bacteria				
OTU4314	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Alphaproteobacteria_incertae_sedis	

OTU ID	%	%	%	Classification				
OTU4315	0.00%	0.00%	0.00%	k__Bacteria				
OTU4316	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU4317	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU4318	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4319	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4321	0.01%	0.00%	0.01%	k__Bacteria				
OTU4322	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU4325	0.00%	0.00%	0.00%	k__Bacteria				
OTU4326	0.00%	0.00%	0.00%	k__Bacteria				
OTU4330	0.00%	0.00%	0.00%	k__Bacteria				
OTU4332	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU4333	0.00%	0.00%	0.00%	k__Bacteria				
OTU4334	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Cellulomonadaceae
OTU4335	0.00%	0.00%	0.00%	k__Bacteria				
OTU4336	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4341	0.00%	0.00%	0.00%	k__Bacteria				
OTU4343	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU4344	0.00%	0.00%	0.00%	k__Bacteria				
OTU4345	0.00%	0.00%	0.00%	k__Bacteria				
OTU4346	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria			
OTU4347	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU4348	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-2			
OTU4349	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4351	0.01%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU4352	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4353	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4355	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4356	0.05%	0.03%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4357	0.00%	0.00%	0.00%	k__Bacteria				
OTU4359	0.03%	0.06%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4360	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU4361	0.00%	0.00%	0.00%	k__Bacteria				
OTU4363	0.00%	0.00%	0.00%	k__Bacteria				
OTU4364	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10		
OTU4368	0.00%	0.00%	0.00%	k__Bacteria				
OTU4373	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4374	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Planococcaceae
OTU4375	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4376	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae		

OTU ID	%	%	%	Classification				
OTU4378	0.00%	0.00%	0.00%	k__Bacteria				
OTU4380	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4381	0.00%	0.00%	0.00%	k__Bacteria				
OTU4382	0.00%	0.00%	0.00%	k__Bacteria				
OTU4383	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU4384	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4385	0.01%	0.05%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU4386	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4389	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU4390	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4391	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1			
OTU4392	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22	g__Gp22	
OTU4394	0.00%	0.00%	0.00%	k__Bacteria				
OTU4395	0.00%	0.00%	0.00%	k__Bacteria				
OTU4396	0.00%	0.02%	0.00%	k__Bacteria				
OTU4400	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU4401	0.00%	0.00%	0.00%	k__Bacteria				
OTU4402	0.00%	0.00%	0.00%	k__Bacteria				
OTU4406	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	
OTU4410	0.00%	0.00%	0.00%	k__Bacteria				
OTU4413	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4414	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU4416	0.00%	0.00%	0.00%	k__Bacteria				
OTU4417	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU4418	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4420	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU4421	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU4424	0.00%	0.00%	0.00%	k__Bacteria				
OTU4426	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	
OTU4427	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4428	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU4430	0.00%	0.00%	0.00%	k__Bacteria				
OTU4431	0.00%	0.00%	0.00%	k__Bacteria				
OTU4432	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4433	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU4435	0.00%	0.00%	0.00%	k__Bacteria				
OTU4437	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4438	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU4443	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			

OTU ID	%	%	%	Classification				
OTU4444	0.00%	0.00%	0.00%	k__Bacteria				
OTU4445	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4446	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4447	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4450	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4452	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4453	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4454	0.01%	0.00%	0.01%	k__Bacteria				
OTU4455	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4456	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4457	0.00%	0.00%	0.00%	k__Bacteria				
OTU4458	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4460	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4461	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU4462	0.00%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU4463	0.00%	0.00%	0.00%	k__Bacteria				
OTU4464	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4466	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4467	0.00%	0.00%	0.00%	k__Bacteria				
OTU4469	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4470	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates			
OTU4472	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU4473	0.00%	0.00%	0.00%	k__Bacteria				
OTU4476	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4479	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU4480	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU4482	0.00%	0.00%	0.00%	k__Bacteria				
OTU4483	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU4485	0.00%	0.00%	0.00%	k__Bacteria				
OTU4488	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4489	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae
OTU4490	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4493	0.02%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4495	0.00%	0.00%	0.00%	k__Bacteria				
OTU4497	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4501	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU4503	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU4505	0.00%	0.00%	0.00%	k__Bacteria				
OTU4508	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		

OTU ID	%	%	%	Classification				
OTU4512	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU4513	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4514	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4516	0.00%	0.00%	0.00%	k__Bacteria				
OTU4520	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4521	0.00%	0.00%	0.00%	k__Bacteria				
OTU4522	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU4524	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4525	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes			
OTU4526	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU4527	0.00%	0.00%	0.00%	k__Bacteria				
OTU4528	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis	
OTU4529	0.06%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU4530	0.00%	0.00%	0.00%	k__Bacteria				
OTU4531	0.00%	0.00%	0.00%	k__Bacteria				
OTU4532	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU4535	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4536	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU4540	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU4544	0.00%	0.01%	0.00%	k__Bacteria				
OTU4545	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4547	0.00%	0.00%	0.00%	k__Bacteria				
OTU4550	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4551	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4552	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU4556	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1			
OTU4559	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4562	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4563	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4565	0.00%	0.00%	0.00%	k__Bacteria				
OTU4566	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4568	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae
OTU4569	0.00%	0.00%	0.00%	k__Bacteria				
OTU4573	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU4574	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4577	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1			
OTU4579	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4581	0.00%	0.00%	0.00%	k__Bacteria				
OTU4582	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			

OTU ID	%	%	%	Classification				
OTU4583	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU4585	0.00%	0.00%	0.00%	k__Bacteria				
OTU4588	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	
OTU4593	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	
OTU4594	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4595	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4598	0.00%	0.00%	0.00%	k__Bacteria				
OTU4599	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4600	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae		
OTU4601	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4602	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4604	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4607	0.00%	0.03%	0.00%	k__Bacteria	p__Nitrospirae			
OTU4608	0.00%	0.00%	0.00%	k__Bacteria				
OTU4609	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU4611	0.00%	0.00%	0.00%	k__Bacteria				
OTU4612	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4615	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4617	0.00%	0.00%	0.00%	k__Bacteria				
OTU4619	0.00%	0.00%	0.00%	k__Bacteria				
OTU4621	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4622	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4625	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4626	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4628	0.00%	0.00%	0.00%	k__Bacteria				
OTU4630	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU4636	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae
OTU4639	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4640	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU4641	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4643	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4645	0.00%	0.00%	0.00%	k__Bacteria				
OTU4647	0.00%	0.01%	0.00%	k__Bacteria	p__Spirochaetes	c__Spirochaetia	o__Spirochaetales	f__Leptospiraceae
OTU4648	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU4652	0.00%	0.00%	0.00%	k__Bacteria				
OTU4653	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4658	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4659	0.00%	0.00%	0.00%	k__Bacteria				
OTU4661	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification				
OTU4662	0.00%	0.01%	0.00%	k__Bacteria				
OTU4663	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4664	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4665	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU4666	0.01%	0.07%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU4668	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU4669	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4677	0.00%	0.00%	0.00%	k__Bacteria				
OTU4679	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU4680	0.00%	0.00%	0.00%	k__Bacteria				
OTU4681	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU4686	0.00%	0.00%	0.00%	k__Bacteria				
OTU4687	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU4688	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU4691	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4693	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4694	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4695	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU4696	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU4697	0.00%	0.00%	0.00%	k__Bacteria				
OTU4698	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4700	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4703	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae		
OTU4704	0.00%	0.00%	0.00%	k__Bacteria				
OTU4705	0.00%	0.00%	0.00%	k__Bacteria				
OTU4706	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU4707	0.03%	0.22%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU4708	0.00%	0.00%	0.00%	k__Bacteria				
OTU4710	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU4711	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU4712	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4713	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4714	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4715	0.00%	0.00%	0.00%	k__Bacteria				
OTU4718	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4720	0.00%	0.00%	0.00%	k__Bacteria				
OTU4722	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4726	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4728	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		

OTU ID	%	%	%	Classification					
OTU4730	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4731	0.00%	0.00%	0.00%	k__Bacteria					
OTU4737	0.00%	0.00%	0.00%	k__Bacteria					
OTU4740	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4743	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4747	0.00%	0.00%	0.01%	k__Bacteria					
OTU4748	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4751	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			g__Roseomona
OTU4752	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4753	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4754	0.00%	0.00%	0.00%	k__Bacteria					
OTU4757	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4760	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4762	0.00%	0.00%	0.00%	k__Bacteria					
OTU4763	0.00%	0.00%	0.06%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU4765	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia			
OTU4766	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4769	0.00%	0.00%	0.00%	k__Bacteria					
OTU4772	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU4777	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU4778	0.00%	0.00%	0.00%	k__Bacteria					
OTU4779	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU4780	0.00%	0.01%	0.00%	k__Bacteria					
OTU4782	0.00%	0.00%	0.00%	k__Bacteria					
OTU4784	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2			
OTU4785	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4789	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4792	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4796	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4797	0.00%	0.00%	0.00%	k__Bacteria					
OTU4800	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4801	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4806	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4807	0.00%	0.00%	0.00%	k__Bacteria					
OTU4812	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU4814	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae	
OTU4819	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4820	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4821	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			

OTU ID	%	%	%	Classification				
OTU4822	0.01%	0.00%	0.00%	k__Bacteria				
OTU4825	0.00%	0.00%	0.00%	k__Bacteria				
OTU4826	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4828	0.00%	0.00%	0.00%	k__Bacteria				
OTU4832	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU4835	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	
OTU4836	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4837	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4838	0.01%	0.02%	0.00%	k__Bacteria				
OTU4842	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU4850	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4854	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU4855	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4857	0.00%	0.00%	0.00%	k__Bacteria				
OTU4858	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4860	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae
OTU4863	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4864	0.00%	0.00%	0.00%	k__Bacteria				
OTU4866	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU4869	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4872	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4874	0.00%	0.00%	0.00%	k__Bacteria				
OTU4876	0.00%	0.00%	0.00%	k__Bacteria				
OTU4877	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4879	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4880	0.00%	0.01%	0.00%	k__Bacteria				
OTU4881	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU4882	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4883	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU4884	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4885	0.00%	0.00%	0.00%	k__Bacteria				
OTU4886	0.00%	0.00%	0.00%	k__Bacteria				
OTU4888	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU4889	0.00%	0.00%	0.00%	k__Bacteria				
OTU4890	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bacteriovoracaceae
OTU4892	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae
OTU4893	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae
OTU4894	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	
OTU4895	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			

OTU ID	%	%	%	Classification				
OTU4896	0.00%	0.00%	0.00%	k__Bacteria				
OTU4898	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU4899	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU4900	0.00%	0.00%	0.00%	k__Bacteria				
OTU4901	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	
OTU4902	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4903	0.00%	0.00%	0.00%	k__Bacteria				
OTU4904	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU4906	0.00%	0.00%	0.00%	k__Bacteria				
OTU4908	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU4909	0.02%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU4910	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4913	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4914	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae
OTU4916	0.00%	0.00%	0.00%	k__Bacteria				
OTU4917	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU4918	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4921	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU4924	0.00%	0.00%	0.00%	k__Bacteria				
OTU4925	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4926	0.04%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4927	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4930	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU4932	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4934	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4935	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria			
OTU4936	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU4937	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU4938	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria			
OTU4939	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU4941	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU4944	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4946	0.00%	0.00%	0.00%	k__Bacteria				
OTU4951	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4952	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4953	0.00%	0.00%	0.00%	k__Bacteria				
OTU4956	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10	g__Gp10	
OTU4959	0.00%	0.00%	0.00%	k__Bacteria				
OTU4960	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae

OTU ID	%	%	%	Classification					
OTU4961	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU4962	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4964	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU4965	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4966	0.00%	0.00%	0.00%	k__Bacteria					
OTU4967	0.01%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU4968	0.00%	0.00%	0.00%	k__Bacteria					
OTU4969	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4971	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4978	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU4979	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4980	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis			
OTU4981	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4982	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4983	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU4984	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia			g__Nocardioid
OTU4989	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU4993	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU4997	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5			
OTU4999	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5000	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU5001	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5006	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU5007	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5008	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5011	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5012	0.04%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU5013	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Paenibacillaceae_1	
OTU5014	0.00%	0.00%	0.00%	k__Bacteria					
OTU5015	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5016	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5018	0.00%	0.00%	0.00%	k__Bacteria					
OTU5019	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU5020	0.00%	0.00%	0.00%	k__Bacteria					
OTU5021	0.00%	0.00%	0.00%	k__Bacteria					
OTU5022	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5025	0.00%	0.00%	0.00%	k__Bacteria					
OTU5028	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5029	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				g__Caenimona

OTU ID	%	%	%	Classification					
OTU5030	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU5031	0.00%	0.00%	0.00%	k__Bacteria					
OTU5033	0.00%	0.01%	0.00%	k__Bacteria					
OTU5034	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5043	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU5044	0.00%	0.00%	0.00%	k__Bacteria					
OTU5047	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5049	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5050	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5054	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5055	0.00%	0.00%	0.00%	k__Bacteria					
OTU5058	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5059	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5060	0.00%	0.02%	0.00%	k__Bacteria					
OTU5061	0.00%	0.00%	0.00%	k__Bacteria					
OTU5064	0.00%	0.00%	0.00%	k__Bacteria					
OTU5068	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5071	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5073	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5075	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU5076	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5079	0.00%	0.00%	0.00%	k__Bacteria					
OTU5081	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5083	0.00%	0.00%	0.00%	k__Bacteria					
OTU5084	0.01%	0.00%	0.00%	k__Bacteria					g__Paludibacte
OTU5085	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5086	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5087	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU5092	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp18	g__Gp18		
OTU5094	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5097	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU5100	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU5101	0.00%	0.00%	0.00%	k__Bacteria					
OTU5102	0.00%	0.00%	0.00%	k__Bacteria					
OTU5103	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5104	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU5105	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU5106	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5112	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			

OTU ID	%	%	%	Classification					
OTU5113	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5120	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU5121	0.00%	0.00%	0.00%	k__Bacteria					
OTU5122	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU5125	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU5127	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU5129	0.00%	0.00%	0.00%	k__Bacteria					
OTU5131	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5132	0.00%	0.01%	0.00%	k__Bacteria					
OTU5134	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	
OTU5137	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5138	0.01%	0.00%	0.00%	k__Bacteria					
OTU5143	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5144	0.00%	0.00%	0.00%	k__Bacteria					
OTU5147	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5149	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5152	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU5155	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU5159	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15		g__Sporichthy
OTU5160	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU5162	0.00%	0.00%	0.00%	k__Bacteria					
OTU5163	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5164	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU5165	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5166	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU5169	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU5170	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales		
OTU5171	0.00%	0.00%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5172	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU5173	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	f__Parachlamydiaceae	
OTU5174	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5175	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5176	0.00%	0.00%	0.01%	k__Bacteria					
OTU5178	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5180	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5185	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU5188	0.00%	0.00%	0.00%	k__Bacteria					
OTU5190	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5191	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			

OTU ID	%	%	%	Classification					
OTU5194	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5196	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5198	0.01%	0.00%	0.12%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU5200	0.00%	0.00%	0.01%	k__Bacteria					
OTU5201	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5206	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5207	0.00%	0.00%	0.00%	k__Bacteria					
OTU5209	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales		
OTU5210	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1	g__BRC1_genera_incertae_sedis			
OTU5212	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5213	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5215	0.00%	0.00%	0.00%	k__Bacteria					
OTU5216	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5217	0.00%	0.00%	0.00%	k__Bacteria					
OTU5218	0.05%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5220	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	
OTU5221	0.00%	0.00%	0.00%	k__Bacteria					g__Steroidoba
OTU5222	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5225	0.00%	0.00%	0.00%	k__Bacteria					
OTU5228	0.00%	0.00%	0.00%	k__Bacteria					
OTU5231	0.00%	0.00%	0.00%	k__Bacteria					
OTU5233	0.02%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5237	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5241	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				g__Flavobacte
OTU5245	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5248	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU5254	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5256	0.00%	0.00%	0.00%	k__Bacteria					
OTU5258	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU5259	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5260	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5261	0.00%	0.00%	0.00%	k__Bacteria					
OTU5262	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5263	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU5265	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae	
OTU5268	0.00%	0.00%	0.00%	k__Bacteria					
OTU5269	0.00%	0.00%	0.00%	k__Bacteria					
OTU5270	0.00%	0.00%	0.00%	k__Bacteria					
OTU5271	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

OTU ID	%	%	%	Classification					
OTU5273	0.00%	0.00%	0.00%	k__Bacteria					
OTU5275	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5277	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5280	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU5281	0.00%	0.00%	0.00%	k__Bacteria					
OTU5282	0.00%	0.00%	0.00%	k__Bacteria					
OTU5284	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				g__Mycobacte
OTU5285	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU5289	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU5291	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5292	0.00%	0.00%	0.00%	k__Bacteria					
OTU5293	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU5294	0.00%	0.00%	0.00%	k__Bacteria					
OTU5295	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5296	0.00%	0.00%	0.00%	k__Bacteria					
OTU5297	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5300	0.00%	0.00%	0.00%	k__Bacteria					
OTU5302	0.03%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU5303	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5305	0.00%	0.00%	0.00%	k__Bacteria					
OTU5308	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5310	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU5311	0.00%	0.00%	0.00%	k__Bacteria					
OTU5313	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5314	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU5317	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU5318	0.00%	0.00%	0.00%	k__Bacteria					
OTU5319	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5320	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis			
OTU5321	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5324	0.00%	0.00%	0.00%	k__Bacteria					
OTU5325	0.00%	0.01%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU5328	0.00%	0.01%	0.00%	k__Bacteria					
OTU5332	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5335	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria				
OTU5338	0.00%	0.00%	0.00%	k__Bacteria					
OTU5339	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5341	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5342	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU5343	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17		
OTU5345	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU5348	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU5352	0.00%	0.00%	0.00%	k__Bacteria				
OTU5353	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU5358	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU5365	0.00%	0.00%	0.00%	k__Bacteria				
OTU5366	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5367	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU5369	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU5370	0.00%	0.00%	0.00%	k__Bacteria				
OTU5379	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU5383	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU5384	0.04%	0.01%	0.10%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU5385	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU5387	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5389	0.00%	0.00%	0.01%	k__Bacteria				
OTU5391	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-1			
OTU5393	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU5395	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU5396	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5397	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU5398	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU5399	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU5401	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5404	0.00%	0.01%	0.00%	k__Bacteria	p__BRC1			
OTU5407	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU5408	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU5409	0.00%	0.00%	0.00%	k__Bacteria				
OTU5410	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU5412	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5416	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU5418	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU5419	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5420	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU5421	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU5422	0.00%	0.00%	0.00%	k__Bacteria				
OTU5423	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU5426	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification				
OTU5427	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	f__Rhodocyclaceae
OTU5431	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU5433	0.00%	0.00%	0.00%	k__Bacteria				
OTU5435	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis		
OTU5436	0.00%	0.00%	0.00%	k__Bacteria				
OTU5438	0.00%	0.00%	0.00%	k__Bacteria				
OTU5441	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU5442	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5444	0.00%	0.00%	0.00%	k__Bacteria				
OTU5446	0.00%	0.00%	0.00%	k__Bacteria				
OTU5448	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5450	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU5452	0.00%	0.00%	0.00%	k__Bacteria				
OTU5453	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5459	0.00%	0.32%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5460	0.00%	0.00%	0.00%	k__Bacteria				
OTU5461	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU5463	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5466	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU5467	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU5475	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU5477	0.00%	0.00%	0.00%	k__Bacteria				
OTU5480	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU5483	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU5485	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5488	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Granulicella	
OTU5489	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU5491	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes			
OTU5494	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5495	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU5496	0.00%	0.00%	0.00%	k__Bacteria				
OTU5499	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU5500	0.00%	0.00%	0.00%	k__Bacteria				
OTU5502	0.00%	0.00%	0.00%	k__Bacteria				
OTU5503	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5509	0.00%	0.00%	0.00%	k__Bacteria				
OTU5512	0.00%	0.00%	0.00%	k__Bacteria				
OTU5513	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU5516	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification				
OTU5517	0.00%	0.00%	0.00%	k__Bacteria				
OTU5518	0.00%	0.00%	0.00%	k__Bacteria				
OTU5522	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5525	0.00%	0.00%	0.00%	k__Bacteria				g__Legionella
OTU5528	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU5529	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	
OTU5530	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU5534	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU5537	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5538	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU5539	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU5541	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU5543	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5544	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5545	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	
OTU5546	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU5549	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU5552	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU5557	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU5558	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU5559	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU5564	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU5567	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5568	0.00%	0.00%	0.00%	k__Bacteria				
OTU5569	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5571	0.00%	0.00%	0.00%	k__Bacteria				
OTU5572	0.00%	0.00%	0.00%	k__Bacteria				
OTU5576	0.00%	0.00%	0.00%	k__Bacteria				
OTU5580	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5588	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU5591	0.00%	0.00%	0.00%	k__Bacteria				
OTU5592	0.01%	0.00%	0.00%	k__Bacteria				
OTU5593	0.01%	0.00%	0.01%	k__Bacteria				
OTU5594	0.00%	0.00%	0.00%	k__Bacteria				
OTU5595	0.00%	0.00%	0.00%	k__Bacteria				
OTU5597	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5599	0.01%	0.01%	0.00%	k__Bacteria				
OTU5600	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU5601	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		

OTU ID	%	%	%	Classification				
OTU5606	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU5609	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU5611	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU5614	0.00%	0.00%	0.00%	k__Bacteria				
OTU5616	0.00%	0.37%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU5619	0.00%	0.00%	0.00%	k__Bacteria				
OTU5622	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU5625	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU5627	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU5630	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5633	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU5635	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5641	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU5643	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU5644	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Bradyrhizobiaceae
OTU5645	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU5646	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU5647	0.00%	0.00%	0.00%	k__Bacteria				
OTU5649	0.00%	0.00%	0.00%	k__Bacteria				
OTU5651	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5655	0.00%	0.00%	0.00%	k__Bacteria				
OTU5656	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5657	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5659	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU5660	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU5661	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU5662	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5	
OTU5663	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae
OTU5664	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5665	0.00%	0.00%	0.00%	k__Bacteria				
OTU5669	0.00%	0.01%	0.00%	k__Bacteria				
OTU5671	0.00%	0.00%	0.00%	k__Bacteria				
OTU5676	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU5679	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5680	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5681	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5682	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU5686	0.00%	0.00%	0.00%	k__Bacteria				
OTU5687	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification				
OTU5692	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU5694	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5697	0.00%	0.00%	0.00%	k__Bacteria				
OTU5699	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU5706	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU5709	0.00%	0.00%	0.00%	k__Bacteria				
OTU5714	0.00%	0.00%	0.00%	k__Bacteria				
OTU5716	0.00%	0.00%	0.00%	k__Bacteria				
OTU5728	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU5733	0.00%	0.00%	0.00%	k__Bacteria				
OTU5734	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU5735	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU5736	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Sporichthyaceae
OTU5737	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5738	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5740	0.00%	0.00%	0.00%	k__Bacteria				
OTU5743	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU5745	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5747	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU5748	0.00%	0.00%	0.00%	k__Bacteria				
OTU5751	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5752	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU5755	0.00%	0.00%	0.00%	k__Bacteria				
OTU5759	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU5762	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU5763	0.00%	0.01%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis		
OTU5765	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU5767	0.00%	0.00%	0.00%	k__Bacteria				
OTU5769	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5773	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU5774	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5775	0.00%	0.01%	0.00%	k__Bacteria				
OTU5777	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1	g__BRC1_genera_incertae_sedis		
OTU5778	0.00%	0.13%	0.00%	k__Bacteria				
OTU5782	0.00%	0.00%	0.00%	k__Bacteria				
OTU5784	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5785	0.00%	0.00%	0.00%	k__Bacteria				
OTU5788	0.00%	0.00%	0.00%	k__Bacteria				
OTU5790	0.01%	0.02%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU5791	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU5793	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5799	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU5800	0.00%	0.00%	0.00%	k__Bacteria					
OTU5803	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5805	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU5806	0.00%	0.00%	0.00%	k__Bacteria					
OTU5807	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5808	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5811	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5814	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU5816	0.00%	0.00%	0.00%	k__Bacteria					
OTU5820	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5821	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5822	0.00%	0.00%	0.00%	k__Bacteria					
OTU5823	0.08%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU5824	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU5825	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5827	0.00%	0.00%	0.00%	k__Bacteria					
OTU5828	0.02%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU5834	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5835	0.00%	0.00%	0.00%	k__Bacteria					
OTU5836	0.00%	0.01%	0.00%	k__Bacteria					
OTU5837	0.00%	0.00%	0.00%	k__Bacteria					g__Gaiella
OTU5841	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5842	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU5843	0.00%	0.00%	0.00%	k__Bacteria					
OTU5844	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5846	0.00%	0.00%	0.00%	k__Bacteria					
OTU5847	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU5849	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5850	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Propionibacteriaceae	
OTU5852	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Phyllobacteriaceae	
OTU5853	0.00%	0.00%	0.00%	k__Bacteria					g__Labrys
OTU5858	0.00%	0.00%	0.00%	k__Bacteria					
OTU5860	0.00%	0.00%	0.00%	k__Bacteria					
OTU5861	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU5862	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU5863	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				

OTU ID	%	%	%	Classification					
OTU5864	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5866	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5867	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU5868	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5869	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5870	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			g__Kribbella
OTU5873	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		g__Actinoplan
OTU5874	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5875	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5877	0.01%	0.00%	0.00%	k__Bacteria					
OTU5879	0.00%	0.00%	0.00%	k__Bacteria					
OTU5880	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5884	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5887	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5888	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5890	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5891	0.00%	0.00%	0.00%	k__Bacteria					
OTU5895	0.00%	0.00%	0.00%	k__Bacteria					
OTU5896	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp20	g__Gp20		
OTU5897	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5898	0.00%	0.00%	0.00%	k__Bacteria					
OTU5900	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales		
OTU5902	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU5904	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5911	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5916	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5923	0.00%	0.08%	0.00%	k__Bacteria					
OTU5924	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5925	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5928	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	
OTU5930	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5933	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU5934	0.05%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5937	0.00%	0.00%	0.00%	k__Bacteria					
OTU5940	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5943	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5946	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5947	0.00%	0.00%	0.00%	k__Bacteria					
OTU5949	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU5955	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU5956	0.00%	0.00%	0.00%	k__Bacteria					
OTU5957	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5958	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			g__Clostridium
OTU5960	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5964	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			g__Sulfuricella
OTU5966	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5973	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5974	0.00%	0.00%	0.00%	k__Bacteria					
OTU5975	0.00%	0.00%	0.00%	k__Bacteria					
OTU5978	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5983	0.00%	0.00%	0.00%	k__Bacteria					
OTU5984	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5985	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5987	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU5991	0.00%	0.00%	0.00%	k__Bacteria					
OTU5992	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5993	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5997	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-1				
OTU5998	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU6000	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6003	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6006	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU6008	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6011	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU6013	0.00%	0.00%	0.00%	k__Bacteria					
OTU6014	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	
OTU6015	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6016	0.00%	0.00%	0.00%	k__Bacteria					
OTU6017	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU6019	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6020	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				g__Flavobacte
OTU6021	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU6024	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU6026	0.00%	0.00%	0.00%	k__Bacteria					
OTU6028	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6029	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6032	0.00%	0.00%	0.00%	k__Bacteria					
OTU6033	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification					
OTU6037	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6038	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6042	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6047	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5			
OTU6048	0.00%	0.00%	0.00%	k__Bacteria					
OTU6052	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6054	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU6056	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6060	0.00%	0.02%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6062	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6063	0.02%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		g__Steroidoba
OTU6066	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU6068	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU6071	0.00%	0.00%	0.00%	k__Bacteria					
OTU6072	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae	
OTU6073	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6074	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU6078	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6081	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6082	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6086	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU6087	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6090	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6091	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU6093	0.00%	0.00%	0.00%	k__Bacteria					g__Cellvibrio
OTU6094	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6097	0.07%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6100	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				g__Desulfobull
OTU6104	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU6105	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU6108	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6113	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU6119	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU6120	0.04%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU6125	0.00%	0.02%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU6126	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		g__Gallionella
OTU6128	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU6135	0.00%	0.00%	0.00%	k__Bacteria					
OTU6137	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			g__Paludibacte

OTU ID	%	%	%	Classification				
OTU6144	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU6145	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU6147	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU6151	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6154	0.00%	0.00%	0.00%	k__Bacteria				
OTU6161	0.00%	0.01%	0.00%	k__Bacteria				
OTU6162	0.00%	0.01%	0.00%	k__Bacteria				
OTU6165	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6166	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU6173	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU6175	0.04%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae
OTU6176	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU6183	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU6187	0.00%	0.00%	0.00%	k__Bacteria				
OTU6188	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU6195	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6199	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6201	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU6202	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6206	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6209	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU6210	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU6211	0.00%	0.00%	0.00%	k__Bacteria				
OTU6219	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6221	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6222	0.00%	0.00%	0.00%	k__Bacteria				
OTU6228	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU6229	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU6230	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU6231	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU6233	0.00%	0.00%	0.00%	k__Bacteria				
OTU6237	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6244	0.00%	0.00%	0.00%	k__Bacteria				
OTU6250	0.00%	0.00%	0.00%	k__Bacteria				
OTU6253	0.02%	0.00%	0.06%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU6254	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU6255	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU6256	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU6258	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		

OTU ID	%	%	%	Classification				
OTU6259	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU6260	0.01%	0.02%	0.12%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU6262	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6263	0.00%	0.00%	0.00%	k__Bacteria				
OTU6268	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6270	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU6272	0.00%	0.00%	0.00%	k__Bacteria				
OTU6275	0.02%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU6276	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes			
OTU6278	0.02%	0.02%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU6280	0.00%	0.02%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3	
OTU6282	0.00%	0.00%	0.00%	k__Bacteria				
OTU6283	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU6285	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6290	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU6295	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU6300	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6306	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU6311	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU6316	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU6319	0.05%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nakamurellaceae
OTU6320	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6321	0.00%	0.00%	0.00%	k__Bacteria				
OTU6323	0.00%	0.00%	0.00%	k__Bacteria				
OTU6325	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6327	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU6328	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes		
OTU6329	0.00%	0.00%	0.00%	k__Bacteria				
OTU6331	0.00%	0.00%	0.00%	k__Bacteria				
OTU6332	0.00%	0.00%	0.00%	k__Bacteria				
OTU6333	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	
OTU6336	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU6338	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6339	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU6340	0.00%	0.00%	0.00%	k__Bacteria				
OTU6341	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6347	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU6349	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU6351	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		

OTU ID	%	%	%	Classification				
OTU6352	0.00%	0.00%	0.00%	k__Bacteria				
OTU6356	0.00%	0.05%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU6359	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU6361	0.00%	0.00%	0.00%	k__Bacteria				
OTU6362	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6364	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU6365	0.00%	0.12%	0.00%	k__Bacteria				
OTU6366	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU6367	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU6368	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6374	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6377	0.00%	0.00%	0.00%	k__Bacteria				
OTU6379	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU6386	0.00%	0.00%	0.00%	k__Bacteria				
OTU6387	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Paenibacillaceae_1
OTU6389	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU6390	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae
OTU6391	0.00%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6396	0.01%	0.01%	0.00%	k__Bacteria				
OTU6397	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU6398	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		g__Variovorax
OTU6399	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU6400	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6401	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU6407	0.00%	0.00%	0.00%	k__Bacteria				
OTU6408	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6409	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria			
OTU6418	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6421	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU6435	0.00%	0.00%	0.00%	k__Bacteria				
OTU6436	0.00%	0.00%	0.00%	k__Bacteria				
OTU6437	0.00%	0.00%	0.00%	k__Bacteria				
OTU6444	0.00%	0.01%	0.00%	k__Bacteria				
OTU6448	0.02%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae
OTU6450	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU6452	0.00%	0.00%	0.00%	k__Bacteria				
OTU6454	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU6455	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU6458	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5		

OTU ID	%	%	%	Classification			
OTU6462	0.00%	0.00%	0.00%	k__Bacteria			
OTU6463	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	
OTU6465	0.00%	0.00%	0.00%	k__Bacteria			
OTU6468	0.00%	0.01%	0.00%	k__Bacteria			
OTU6475	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes		
OTU6476	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria		
OTU6477	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	
OTU6482	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	
OTU6484	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	
OTU6486	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria		
OTU6488	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	
OTU6490	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2		
OTU6493	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales
OTU6494	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes		
OTU6495	0.00%	0.00%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales
OTU6496	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	
OTU6497	0.00%	0.00%	0.00%	k__Bacteria			
OTU6498	0.00%	0.00%	0.00%	k__Bacteria			
OTU6502	0.00%	0.00%	0.00%	k__Bacteria			
OTU6505	0.00%	0.00%	0.00%	k__Bacteria			
OTU6509	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales
OTU6510	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	
OTU6513	0.00%	0.00%	0.00%	k__Bacteria			
OTU6516	0.00%	0.00%	0.00%	k__Bacteria			
OTU6517	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6
OTU6518	0.00%	0.00%	0.00%	k__Bacteria			
OTU6519	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes		
OTU6523	0.00%	0.00%	0.00%	k__Bacteria			
OTU6525	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	
OTU6527	0.00%	0.00%	0.00%	k__Bacteria			
OTU6528	0.00%	0.00%	0.00%	k__Bacteria			
OTU6529	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales
OTU6531	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria		
OTU6536	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2		
OTU6537	0.00%	0.00%	0.00%	k__Bacteria			
OTU6541	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes		
OTU6542	0.00%	0.00%	0.00%	k__Bacteria			
OTU6544	0.00%	0.00%	0.00%	k__Bacteria			
OTU6545	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	

OTU ID	%	%	%	Classification				
OTU6548	0.08%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU6549	0.00%	0.00%	0.00%	k__Bacteria				
OTU6556	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU6557	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia		
OTU6559	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU6560	0.00%	0.00%	0.00%	k__Bacteria				
OTU6563	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU6569	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6570	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis	
OTU6572	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU6574	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU6577	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU6578	0.00%	0.00%	0.00%	k__Bacteria				
OTU6591	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae
OTU6592	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU6593	0.00%	0.00%	0.00%	k__Bacteria				
OTU6594	0.00%	0.00%	0.00%	k__Bacteria				
OTU6595	0.00%	0.00%	0.00%	k__Bacteria				
OTU6596	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU6603	0.00%	0.00%	0.00%	k__Bacteria				
OTU6606	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU6613	0.00%	0.00%	0.00%	k__Bacteria				
OTU6616	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU6619	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU6624	0.00%	0.00%	0.01%	k__Bacteria				
OTU6625	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU6626	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU6629	0.00%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU6631	0.00%	0.00%	0.00%	k__Bacteria				
OTU6638	0.04%	0.12%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU6645	0.00%	0.00%	0.00%	k__Bacteria				
OTU6646	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU6647	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU6648	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6650	0.00%	0.00%	0.00%	k__Bacteria				
OTU6651	0.00%	0.00%	0.00%	k__Bacteria				
OTU6652	0.00%	0.00%	0.00%	k__Bacteria				
OTU6658	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU6664	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae

OTU ID	%	%	%	Classification					
OTU6668	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6669	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU6676	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU6677	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6678	0.00%	0.00%	0.00%	k__Bacteria					
OTU6679	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6680	0.00%	0.00%	0.00%	k__Bacteria					
OTU6689	0.00%	0.00%	0.00%	k__Bacteria					
OTU6690	0.00%	0.00%	0.00%	k__Bacteria					
OTU6692	0.00%	0.00%	0.00%	k__Bacteria					
OTU6695	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6696	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU6702	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6705	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6706	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU6707	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU6709	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6712	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU6715	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU6716	0.00%	0.00%	0.00%	k__Bacteria					
OTU6718	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6719	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6722	0.00%	0.00%	0.00%	k__Bacteria					
OTU6730	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU6734	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU6735	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6736	0.00%	0.00%	0.00%	k__Bacteria					
OTU6737	0.00%	0.00%	0.00%	k__Bacteria					
OTU6738	0.00%	0.00%	0.00%	k__Bacteria					
OTU6739	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6740	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU6742	0.00%	0.00%	0.00%	k__Bacteria					
OTU6743	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6744	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6745	0.00%	0.01%	0.00%	k__Bacteria					
OTU6746	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp25			g__Aquicella
OTU6747	0.00%	0.00%	0.00%	k__Bacteria					
OTU6751	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6755	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU6758	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU6759	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU6761	0.00%	0.00%	0.00%	k__Bacteria				
OTU6762	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6764	0.00%	0.00%	0.00%	k__Bacteria	p__SR1			
OTU6767	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU6769	0.00%	0.00%	0.00%	k__Bacteria				
OTU6771	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU6773	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU6776	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes			
OTU6778	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6786	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU6790	0.00%	0.00%	0.00%	k__Bacteria				
OTU6795	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU6796	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU6799	0.00%	0.00%	0.00%	k__Bacteria				
OTU6801	0.00%	0.00%	0.00%	k__Bacteria				
OTU6803	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU6805	0.00%	0.00%	0.04%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU6807	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU6809	0.00%	0.00%	0.00%	k__Bacteria				
OTU6813	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU6815	0.00%	0.00%	0.00%	k__Bacteria				
OTU6816	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6817	0.00%	0.00%	0.00%	k__Bacteria				
OTU6820	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU6822	0.00%	0.00%	0.00%	k__Bacteria				
OTU6825	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU6827	0.00%	0.00%	0.00%	k__Bacteria				
OTU6829	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU6830	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU6838	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU6845	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU6846	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU6852	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU6853	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU6854	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU6855	0.00%	0.00%	0.00%	k__Bacteria				
OTU6859	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	

OTU ID	%	%	%	Classification					
OTU6860	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU6863	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales		
OTU6864	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU6867	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU6868	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6869	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6874	0.00%	0.00%	0.00%	k__Bacteria					
OTU6876	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6879	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU6880	0.00%	0.00%	0.00%	k__Bacteria					
OTU6883	0.00%	0.00%	0.00%	k__Bacteria					
OTU6890	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6893	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6895	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6896	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6898	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU6901	0.00%	0.00%	0.00%	k__Bacteria					
OTU6902	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6904	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		g__Aquicella
OTU6907	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU6911	0.00%	0.00%	0.00%	k__Bacteria					
OTU6916	0.00%	0.00%	0.00%	k__Bacteria					
OTU6919	0.00%	0.00%	0.00%	k__Bacteria					
OTU6920	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6924	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6928	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Sacchar	g__Saccharibacteria_genera_incertae_sedis			
OTU6933	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6934	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6935	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU6936	0.01%	0.00%	0.00%	k__Bacteria					
OTU6942	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU6943	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6947	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_	WPS-2			
OTU6948	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU6949	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU6968	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6973	0.00%	0.00%	0.00%	k__Bacteria					
OTU6975	0.00%	0.00%	0.00%	k__Bacteria					
OTU6980	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				

OTU ID	%	%	%	Classification				
OTU6983	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_1
OTU6985	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU6989	0.00%	0.00%	0.00%	k__Bacteria				
OTU6990	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU6991	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU6999	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU7001	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU7002	0.00%	0.00%	0.00%	k__Bacteria				
OTU7004	0.02%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Neisseriales	
OTU7005	0.00%	0.00%	0.00%	k__Bacteria				
OTU7006	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7007	0.00%	0.00%	0.00%	k__Bacteria				
OTU7008	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6		
OTU7011	0.00%	0.01%	0.00%	k__Bacteria				
OTU7012	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU7014	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU7015	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU7016	0.00%	0.00%	0.00%	k__Bacteria				
OTU7018	0.00%	0.01%	0.00%	k__Bacteria				
OTU7026	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU7027	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU7033	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU7034	0.00%	0.00%	0.00%	k__Bacteria				
OTU7044	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU7048	0.00%	0.00%	0.01%	k__Bacteria				
OTU7049	0.00%	0.00%	0.00%	k__Bacteria				
OTU7051	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU7059	0.00%	0.00%	0.00%	k__Bacteria				
OTU7062	0.00%	0.00%	0.00%	k__Bacteria				
OTU7064	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	f__Parachlamydiaceae
OTU7066	0.00%	0.00%	0.00%	k__Bacteria				
OTU7069	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU7071	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7075	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7077	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		g__Legionella
OTU7080	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU7082	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7083	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU7087	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification				
OTU7089	0.00%	0.00%	0.00%	k__Bacteria				
OTU7090	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU7094	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU7097	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU7098	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU7103	0.00%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes			
OTU7105	0.00%	0.00%	0.00%	k__Bacteria				
OTU7107	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae
OTU7111	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU7113	0.00%	0.00%	0.00%	k__Bacteria				
OTU7120	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7124	0.00%	0.00%	0.00%	k__Bacteria				
OTU7127	0.00%	0.00%	0.00%	k__Bacteria				
OTU7130	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes			
OTU7131	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7138	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU7144	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU7145	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU7146	0.02%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU7151	0.00%	0.00%	0.00%	k__Bacteria				
OTU7152	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae
OTU7156	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU7162	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU7164	0.00%	0.00%	0.00%	k__Bacteria				
OTU7165	0.00%	0.00%	0.00%	k__Bacteria				
OTU7167	0.00%	0.00%	0.00%	k__Bacteria				
OTU7175	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU7179	0.00%	0.00%	0.00%	k__Bacteria				
OTU7180	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU7181	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7184	0.00%	0.00%	0.00%	k__Bacteria				
OTU7186	0.00%	0.00%	0.00%	k__Bacteria				
OTU7188	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU7190	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7193	0.00%	0.00%	0.00%	k__Bacteria				
OTU7199	0.00%	0.00%	0.00%	k__Bacteria				
OTU7209	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU7211	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU7213	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

OTU ID	%	%	%	Classification				
OTU7215	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7219	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU7220	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7225	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU7226	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU7227	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU7228	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae
OTU7229	0.00%	0.00%	0.00%	k__Bacteria				
OTU7230	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU7237	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-1			
OTU7240	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU7241	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU7242	0.00%	0.00%	0.00%	k__Bacteria				
OTU7254	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU7255	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU7256	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU7262	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU7263	0.03%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU7264	0.00%	0.00%	0.00%	k__Bacteria				
OTU7271	0.00%	0.00%	0.00%	k__Bacteria				
OTU7274	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7277	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU7278	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU7279	0.03%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU7284	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU7286	0.05%	0.02%	0.52%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU7288	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU7291	0.00%	0.00%	0.00%	k__Bacteria				
OTU7297	0.00%	0.00%	0.00%	k__Bacteria				
OTU7300	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU7302	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU7303	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU7305	0.00%	0.00%	0.00%	k__Bacteria				
OTU7307	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7312	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7313	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU7314	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU7316	0.00%	0.00%	0.00%	k__Bacteria				
OTU7331	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU7332	0.00%	0.00%	0.00%	k__Bacteria					
OTU7333	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU7336	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU7337	0.00%	0.00%	0.00%	k__Bacteria					
OTU7338	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7340	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU7345	0.00%	0.00%	0.00%	k__Bacteria					
OTU7347	0.00%	0.00%	0.00%	k__Bacteria					
OTU7350	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Staphylococcaceae	
OTU7352	0.00%	0.00%	0.00%	k__Bacteria					
OTU7353	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	
OTU7355	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			g__Legionella
OTU7356	0.00%	0.00%	0.00%	k__Bacteria					
OTU7364	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7367	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7368	0.00%	0.00%	0.00%	k__Bacteria					
OTU7377	0.00%	0.00%	0.00%	k__Bacteria					
OTU7378	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7379	0.00%	0.00%	0.00%	k__Bacteria					
OTU7380	0.00%	0.00%	0.00%	k__Bacteria					
OTU7391	0.02%	0.01%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7392	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7399	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7400	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7402	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU7403	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU7404	0.00%	0.00%	0.00%	k__Bacteria					
OTU7409	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7414	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7415	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU7420	0.00%	0.00%	0.00%	k__Bacteria					
OTU7426	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU7429	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7433	0.00%	0.00%	0.00%	k__Bacteria					
OTU7437	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU7451	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU7455	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU7462	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU7463	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification				
OTU7470	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU7471	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	
OTU7472	0.00%	0.00%	0.00%	k__Bacteria				
OTU7474	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU7475	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU7480	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes			
OTU7487	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU7488	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7489	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU7491	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU7492	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU7497	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU7498	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU7499	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU7503	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			g__Schlesneria
OTU7507	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU7509	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	
OTU7511	0.00%	0.00%	0.00%	k__Bacteria				
OTU7512	0.00%	0.00%	0.00%	k__Bacteria				
OTU7513	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU7514	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU7519	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU7521	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU7522	0.00%	0.00%	0.00%	k__Bacteria				
OTU7523	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU7524	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU7533	0.00%	0.00%	0.00%	k__Bacteria				
OTU7535	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU7541	0.00%	0.00%	0.00%	k__Bacteria				
OTU7546	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU7554	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU7557	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU7561	0.00%	0.00%	0.00%	k__Bacteria				
OTU7563	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU7568	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU7574	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU7576	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU7579	0.08%	0.06%	0.07%	k__Bacteria	p__Gemmatimonadetes			
OTU7580	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU7582	0.00%	0.00%	0.00%	k__Bacteria					
OTU7586	0.00%	0.00%	0.00%	k__Bacteria					
OTU7588	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU7593	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7594	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU7595	0.01%	0.00%	0.03%	k__Bacteria					g__Bdellovibri
OTU7596	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU7597	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU7601	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU7603	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7607	0.00%	0.00%	0.00%	k__Bacteria					
OTU7609	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU7613	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU7614	0.00%	0.00%	0.00%	k__Bacteria					
OTU7624	0.00%	0.00%	0.00%	k__Bacteria					
OTU7627	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7629	0.03%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU7632	0.00%	0.00%	0.00%	k__Bacteria					
OTU7637	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7642	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU7644	0.00%	0.00%	0.00%	k__Bacteria					
OTU7647	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU7651	0.00%	0.00%	0.00%	k__Bacteria					
OTU7653	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7668	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU7677	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU7678	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7680	0.14%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU7683	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7687	0.00%	0.00%	0.00%	k__Bacteria					
OTU7697	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae	
OTU7703	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU7707	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU7708	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU7709	0.01%	0.00%	0.02%	k__Bacteria	p__candidate_division_WPS-1				
OTU7716	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU7722	0.00%	0.00%	0.00%	k__Bacteria					
OTU7729	0.03%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU7731	0.00%	0.00%	0.00%	k__Bacteria					

OTU ID	%	%	%	Classification			
OTU7733	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes		
OTU7745	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales
OTU7748	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes		
OTU7754	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU7755	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes		
OTU7758	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU7764	0.00%	0.10%	0.00%	k__Bacteria	p__Actinobacteria		
OTU7766	0.00%	0.00%	0.00%	k__Bacteria			
OTU7774	0.00%	0.00%	0.00%	k__Bacteria			
OTU7778	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4
OTU7780	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes		
OTU7786	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes		
OTU7792	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU7796	0.00%	0.00%	0.00%	k__Bacteria			
OTU7798	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria		
OTU7804	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16
OTU7807	0.00%	0.00%	0.00%	k__Bacteria			
OTU7812	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	
OTU7816	0.02%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	
OTU7823	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6
OTU7826	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	
OTU7834	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4
OTU7839	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae		
OTU7844	0.00%	0.00%	0.00%	k__Bacteria			
OTU7845	0.00%	0.00%	0.00%	k__Bacteria			
OTU7848	0.00%	0.00%	0.00%	k__Bacteria			
OTU7850	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales
OTU7852	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU7857	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis	
OTU7861	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	
OTU7863	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU7874	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales
OTU7876	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	
OTU7882	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales
OTU7883	0.00%	0.00%	0.00%	k__Bacteria			
OTU7885	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU7886	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales f__Opitutaceae
OTU7893	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	
OTU7894	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes		

OTU ID	%	%	%	Classification				
OTU7899	0.00%	0.00%	0.00%	k__Bacteria				
OTU7901	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1			
OTU7902	0.00%	0.00%	0.00%	k__Bacteria				
OTU7904	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU7910	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU7920	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU7926	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7931	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU7942	0.03%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU7957	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU7967	0.00%	0.00%	0.00%	k__Bacteria				
OTU7972	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU7976	0.00%	0.00%	0.00%	k__Bacteria				
OTU7980	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU7987	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU7988	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae
OTU7990	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU7993	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU7996	0.00%	0.00%	0.00%	k__Bacteria				
OTU7998	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU8001	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU8005	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU8007	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae
OTU8009	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Planococcaceae
OTU8013	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU8014	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU8020	0.01%	0.00%	0.00%	k__Bacteria				
OTU8029	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU8039	0.00%	0.00%	0.00%	k__Bacteria				
OTU8041	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU8051	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU8052	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU8053	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU8071	0.00%	0.00%	0.00%	k__Bacteria				
OTU8082	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU8086	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU8088	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales	
OTU8089	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU8100	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			

OTU ID	%	%	%	Classification				
OTU8102	0.00%	0.00%	0.00%	k__Bacteria				
OTU8105	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU8114	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU8119	0.00%	0.00%	0.00%	k__Bacteria				
OTU8122	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU8123	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	
OTU8129	0.01%	0.03%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU8146	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU8147	0.00%	0.00%	0.00%	k__Bacteria				
OTU8148	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU8150	0.00%	0.00%	0.00%	k__Bacteria				
OTU8152	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU8154	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU8160	0.00%	0.01%	0.00%	k__Bacteria				
OTU8163	0.00%	0.00%	0.00%	k__Bacteria				
OTU8169	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU8174	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU8193	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU8202	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Beijerinckiaceae
OTU8212	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU8213	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU8215	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU8233	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU8235	0.01%	0.00%	0.00%	k__Bacteria				
OTU8240	0.00%	0.00%	0.00%	k__Bacteria				
OTU8253	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17	
OTU8255	0.00%	0.00%	0.00%	k__Bacteria				
OTU8265	0.00%	0.00%	0.00%	k__Bacteria				
OTU8276	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU8284	0.00%	0.00%	0.00%	k__Bacteria				
OTU8291	0.00%	0.00%	0.00%	k__Bacteria				
OTU8303	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae
OTU8305	0.00%	0.00%	0.00%	k__Bacteria				
OTU8315	0.01%	0.01%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU8316	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU8324	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU8328	0.00%	0.00%	0.00%	k__Bacteria				
OTU8334	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	
OTU8345	0.00%	0.00%	0.00%	k__Bacteria				

OTU ID	%	%	%	Classification					
OTU8373	0.00%	0.00%	0.00%	k__Bacteria					
OTU8376	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU8386	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU8398	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU8428	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU8457	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU8460	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				g__Flavobacte
OTU8477	0.02%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU8480	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU8495	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardiaceae	
OTU8497	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU8519	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU8560	0.16%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU8566	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU8597	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU8611	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU8616	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU8621	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8622	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU8650	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU8670	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				

Diversity Results Summary

See the "Background" tab for additional information on diversity metrics.

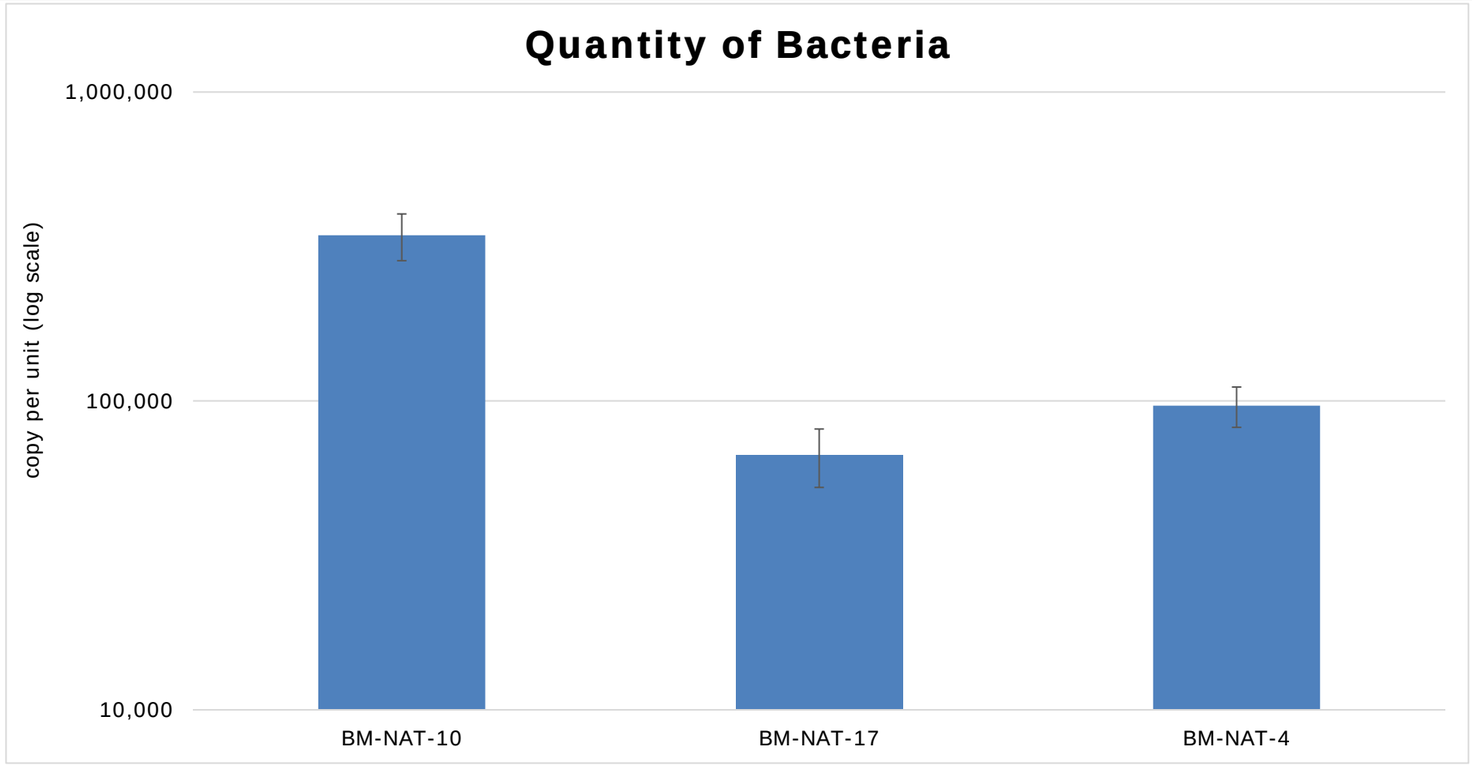
Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

Client Sample ID	**BM-NAT-10**	**BM-NAT-17**	**BM-NAT-4**
Date Sampled	04/Sep/2018	04/Sep/2018	04/Sep/2018
Contango Sample ID	DNA_409	DNA_408	DNA_407
Sample Type	Soil	Soil	Soil
Observed Number of Bacterial OTUs	3,386	3,202	2,037
Simpson Reciprocal Index	112.2	130.7	83.3

Quantification Results

Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

	Quantity of bacteria			**Standard Deviation**		
Client Sample ID	**BM-NAT-10**	**BM-NAT-17**	**BM-NAT-4**	**BM-NAT-10**	**BM-NAT-17**	**BM-NAT-4**
Date Sampled	04/Sep/2018	04/Sep/2018	04/Sep/2018	04/Sep/2018	04/Sep/2018	04/Sep/2018
Contango Sample ID	DNA_409	DNA_408	DNA_407	DNA_409	DNA_408	DNA_407
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil
Gene	copy/cm^3	copy/cm^3	copy/cm^3	copy/cm3	copy/cm3	copy/cm3
Sulphate-reducing bacteria	343,770	66,770	96,490	59,327	14,312	14,396



Methods

Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

Client Sample ID	**BM-NAT-10**	**BM-NAT-17**	**BM-NAT-4**
Date Sampled	04/Sep/2018	04/Sep/2018	04/Sep/2018
Contango Sample ID	DNA_409	DNA_408	DNA_407
Sample Type	Soil	Soil	Soil
Weight or Volume Extracted	0.200 cm^3	0.101 cm^3	0.194 cm^3
DNA Extraction Method	As per MoBIO PowerLyzer PowerSoil DNA Isolation Kit protocol		
Genetic Sequencing Target	v3/v4 16S rRNA - Bacteria		
Library Type	300 bp PE MiSeq		
Internal Controls	Passed QC		
OTU Clustering Threshold	97%		
SPB Database	SPB_00008		
Genetic Sequencing Detection Limit	0.00098%	0.00080%	0.00069%
Sulphate-reducing Bacteria Quantification	qPCR targeting dissimilatory sulphite reductase β-subunit dsrB gene		

Not for diagnostic purposes.

Definitions

Acidophilic: Microorganisms that thrive in acidic conditions (pH < 5.5)
Aerobic: Grow in the presence of oxygen
Alkaliphilic: Microorganisms that thrive in alkaline conditions (pH > 8)
Complete oxidizer: Can oxidize organic substrates completely to CO2; Incomplete oxidizers cannot and form acetate as an end produ
Facultatively Anaerobic: Can use oxygen to grow, and can also grow under anaerobic conditions
FeOB: Iron-oxidizing bacteria
FeRB: Iron-reducing bacteria
Hyperthermophilic: Microorganisms that thrive in very high temperatures (>80°C)
Mesophilic: Microorganisms that thrive in moderate temperature, typically between 15-45°C.
Microaerophilic: Require oxygen to grow, but are killed by atmospheric oxygen concentrations (typically require between 2-10%)
Neutrophilic: Microorganisms that thrive in neutral pH environments
Anaerobic: Do not require oxygen to grow, and can be killed by normal atmospheric oxygen concentrations
OTU: Operational Taxonomic Unit, which is a group of sequences that are similar based on a threshold
Phototrophic: Uses energy from light
Psychrophile or Psychrotolerant: Microorganisms that grow in cold temperatures (<15°C)
SOB: Sulphur-oxidizing bacteria; Bacteria capable of oxidizing sulphur compounds
SPB: Organisms capable of reducing various sulphur compounds (e.g., sulphate, thiosulphate, sulfite, elemental sulphur) to form sulpl
Taxonomy: The classification, identification, and naming of organisms
Thermophilic: Microorganisms that thrive in high temperatures (45°C-80°C)
Trait Assignment Category: Categorized as A or B, corresponding to whether most or some species in genus possess a given trait. Category C corresponds to undocumented or insufficient data.

Background Information

Because the same gene is sequenced for all bacteria in a sample, the relatedness can be inferred based on sequence similarity. One of the first steps of analysis is clustering similar sequences into groups which are called Operational Taxonoimc Units (OTUs). The threshold for choosing what is grouped together into an OTU is dependent on the region that is being targeted for sequencing *(Methodology tab)*.

Once sequences have been clustered together, each OTU is assigned a taxonomy classification based on similarity with sequences in a database. The taxonomy classification is therefore dependent on the database curation and on the organisms that are represented in the database. For example, if a novel bacterium is sequenced, no taxonomy will be assigned as no representative sequence would be in the database. Similarly, the level of taxonomy that is assigned (e.g., phylum, class, order, family, genus) is dependent on representative sequences in the database.

The *List of all bacteria* tab is a list of all bacteria in each sample along with their percentage, meaning the proportion of the community that a given bacteria makes up.

The diversity of each sample is also calculated (*Diversity Summary tab*). Observed Species is the total number of OTUs that was found in each sample. Simpson's Reciprocal Index is a measurement that takes into account the dominance (evenness) and overall number of species (richness) of a community.

qPCR allows us to determine the number of copies of a target gene in a sample. Different bacteria may have a different number of copies of the same gene, so the average copy number is used. The approximate number of bacteria which contain the target gene is then calculated based on the average copy number of the target gene.

ALEXCO RESOURCE CORP.
ATTN: Kai Woloshyn
#3 - 151 Industrial Road
Whitehorse YT Y1A 2V3

Date Received: 16-OCT-19
Report Date: 02-DEC-19 13:23 (MT)
Version: FINAL

Client Phone: 867-688-6463

Certificate of Analysis

Lab Work Order #: L2366434

Project P.O. #: NOT SUBMITTED
Job Reference: KENO MOSS
C of C Numbers: 1 of 1
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2366434-1 Moss 06-OCT-19 16:10 T1-A	L2366434-2 Moss 06-OCT-19 16:10 T1-B	L2366434-3 Moss 06-OCT-19 15:50 T2-A	L2366434-4 Moss 06-OCT-19 15:50 T2-B	L2366434-5 Moss 06-OCT-19 16:00 T3-A
TISSUE						
Physical Tests	% Moisture (%)	66.0	62.9	77.8	80.9	77.1
Metals	Aluminum (Al)-Total (mg/kg)	522	480	340	235	243
	Antimony (Sb)-Total (mg/kg)	32.4	27.3	14.0	6.54	3.59
	Arsenic (As)-Total (mg/kg)	40.6	29.7	11.3	5.47	5.89
	Barium (Ba)-Total (mg/kg)	94.7	67.6	21.3	38.0	84.9
	Beryllium (Be)-Total (mg/kg)	0.021	0.017	0.013	<0.010	0.025
	Bismuth (Bi)-Total (mg/kg)	0.835	0.607	0.285	0.157	0.094
	Boron (B)-Total (mg/kg)	15.9	5.9	3.5	4.5	4.0
	Cadmium (Cd)-Total (mg/kg)	35.1	26.8	13.5	6.91	4.09
	Calcium (Ca)-Total (mg/kg)	12900	7360	5160	6030	10700
	Cesium (Cs)-Total (mg/kg)	0.115	0.114	0.0967	0.0635	0.0616
	Chromium (Cr)-Total (mg/kg)	1.21	0.998	0.769	0.579	0.428
	Cobalt (Co)-Total (mg/kg)	0.739	0.655	0.395	0.282	0.282
	Copper (Cu)-Total (mg/kg)	60.3	44.4	20.8	13.6	7.55
	Iron (Fe)-Total (mg/kg)	4860	3790	1760	1190	796
	Lead (Pb)-Total (mg/kg)	4130	2890	1300	794	427
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1170	1170	1100	1390	1030
	Manganese (Mn)-Total (mg/kg)	1240	1130	498	420	226
	Molybdenum (Mo)-Total (mg/kg)	0.217	0.224	0.220	0.310	0.074
	Nickel (Ni)-Total (mg/kg)	3.07	2.17	1.63	1.11	0.99
	Phosphorus (P)-Total (mg/kg)	626	749	669	840	583
	Potassium (K)-Total (mg/kg)	1510	1740	1120	2180	1520
	Rubidium (Rb)-Total (mg/kg)	2.25	2.87	2.79	4.13	2.72
	Selenium (Se)-Total (mg/kg)	0.151	0.108	0.076	0.059	0.082
	Silver (Ag)-Total (mg/kg)	17.4	9.59	6.97	3.39	3.21
	Sodium (Na)-Total (mg/kg)	20	21	29	31	<20
	Strontium (Sr)-Total (mg/kg)	31.3	15.6	9.71	11.2	22.2
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0261	0.0222	0.0159	0.0108	0.0065
	Tin (Sn)-Total (mg/kg)	4.02	2.97	1.44	0.80	0.46
	Uranium (U)-Total (mg/kg)	0.0874	0.0709	0.0491	0.0439	0.0212
	Vanadium (V)-Total (mg/kg)	1.39	1.27	1.02	0.80	0.60
	Zinc (Zn)-Total (mg/kg)	2900	2130	1020	536	348
	Zirconium (Zr)-Total (mg/kg)	0.54	0.49	0.36	<0.20	<0.20

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2366434-6 Moss 06-OCT-19 16:00 T3-B	L2366434-7 Moss 03-OCT-19 13:35 BM-NAT-05-A	L2366434-8 Moss 03-OCT-19 13:35 BM-NAT-05-B	L2366434-9 Moss 03-OCT-19 14:16 BM-NAT-10-A	L2366434-10 Moss 03-OCT-19 14:16 BM-NAT-10-B
TISSUE						
Physical Tests	% Moisture (%)	73.4	81.2	93.6	92.1	86.5
Metals	Aluminum (Al)-Total (mg/kg)	294	395	601	127	97.1
	Antimony (Sb)-Total (mg/kg)	6.90	0.192	0.200	0.435	0.356
	Arsenic (As)-Total (mg/kg)	8.86	0.735	0.906	1.35	1.34
	Barium (Ba)-Total (mg/kg)	53.0	18.6	120	24.6	34.6
	Beryllium (Be)-Total (mg/kg)	0.011	0.019	0.036	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg)	0.151	<0.010	<0.010	<0.010	<0.010
	Boron (B)-Total (mg/kg)	4.0	<1.0	<1.0	1.6	5.0
	Cadmium (Cd)-Total (mg/kg)	6.66	0.616	0.787	2.22	2.55
	Calcium (Ca)-Total (mg/kg)	9960	1530	4160	5310	5500
	Cesium (Cs)-Total (mg/kg)	0.0901	0.507	0.0755	0.0645	0.0499
	Chromium (Cr)-Total (mg/kg)	0.621	0.379	0.333	0.288	0.250
	Cobalt (Co)-Total (mg/kg)	0.283	0.377	1.60	0.252	0.387
	Copper (Cu)-Total (mg/kg)	12.7	2.11	2.14	2.66	4.61
	Iron (Fe)-Total (mg/kg)	1260	314	625	365	295
	Lead (Pb)-Total (mg/kg)	711	10.0	19.0	24.4	19.4
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1250	627	1160	1250	1270
	Manganese (Mn)-Total (mg/kg)	213	415	350	311	918
	Molybdenum (Mo)-Total (mg/kg)	0.123	0.073	0.102	0.043	0.067
	Nickel (Ni)-Total (mg/kg)	1.03	0.70	2.12	1.03	0.79
	Phosphorus (P)-Total (mg/kg)	733	629	524	949	893
	Potassium (K)-Total (mg/kg)	1830	3090	3010	3520	2270
	Rubidium (Rb)-Total (mg/kg)	4.61	16.0	10.7	8.05	5.26
	Selenium (Se)-Total (mg/kg)	0.112	<0.050	0.055	<0.050	<0.050
	Silver (Ag)-Total (mg/kg)	2.81	0.391	0.256	0.532	0.509
	Sodium (Na)-Total (mg/kg)	23	<40 DLM	182	41	<20
	Strontium (Sr)-Total (mg/kg)	21.7	4.79	18.1	11.0	9.09
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0091	0.0052	0.0247	0.0128	0.0029
	Tin (Sn)-Total (mg/kg)	0.75	<0.10	<0.10	<0.10	<0.10
	Uranium (U)-Total (mg/kg)	0.0361	0.0123	0.0477	0.0124	0.0087
	Vanadium (V)-Total (mg/kg)	0.86	0.48	0.51	0.35	0.25
	Zinc (Zn)-Total (mg/kg)	591	41.5	46.0	276	175
	Zirconium (Zr)-Total (mg/kg)	0.23	<0.20	<0.20	<0.20	<0.20

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2366434-11	L2366434-12			
	Description	Moss	Moss			
	Sampled Date	05-OCT-19	05-OCT-19			
	Sampled Time	13:20	13:20			
	Client ID	BM-NAT-18-A	BM-NAT-18-B			
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	78.3	78.9			
Metals	Aluminum (Al)-Total (mg/kg)	1080	1550			
	Antimony (Sb)-Total (mg/kg)	1.21	1.71			
	Arsenic (As)-Total (mg/kg)	4.76	8.82			
	Barium (Ba)-Total (mg/kg)	91.8	92.3			
	Beryllium (Be)-Total (mg/kg)	0.101	0.140			
	Bismuth (Bi)-Total (mg/kg)	0.026	0.021			
	Boron (B)-Total (mg/kg)	6.3	6.0			
	Cadmium (Cd)-Total (mg/kg)	32.9	34.1			
	Calcium (Ca)-Total (mg/kg)	13900	13900			
	Cesium (Cs)-Total (mg/kg)	0.736	0.494			
	Chromium (Cr)-Total (mg/kg)	1.73	2.28			
	Cobalt (Co)-Total (mg/kg)	1.73	2.84			
	Copper (Cu)-Total (mg/kg)	17.2	24.4			
	Iron (Fe)-Total (mg/kg)	1980	3030			
	Lead (Pb)-Total (mg/kg)	28.1	45.5			
	Lithium (Li)-Total (mg/kg)	0.71	1.01			
	Magnesium (Mg)-Total (mg/kg)	1740	1960			
	Manganese (Mn)-Total (mg/kg)	1540	2440			
	Molybdenum (Mo)-Total (mg/kg)	0.247	0.356			
	Nickel (Ni)-Total (mg/kg)	37.2	39.2			
	Phosphorus (P)-Total (mg/kg)	1380	1590			
	Potassium (K)-Total (mg/kg)	2190	2670			
	Rubidium (Rb)-Total (mg/kg)	19.5	23.2			
	Selenium (Se)-Total (mg/kg)	0.306	0.468			
	Silver (Ag)-Total (mg/kg)	1.30	1.50			
	Sodium (Na)-Total (mg/kg)	48	123			
	Strontium (Sr)-Total (mg/kg)	35.8	35.1			
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020			
	Thallium (Tl)-Total (mg/kg)	0.0620	0.0821			
	Tin (Sn)-Total (mg/kg)	0.11	0.14			
	Uranium (U)-Total (mg/kg)	0.306	0.534			
	Vanadium (V)-Total (mg/kg)	2.98	4.19			
	Zinc (Zn)-Total (mg/kg)	2740	2780			
	Zirconium (Zr)-Total (mg/kg)	0.52	0.91			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Certified Reference Material	Lead (Pb)-Total	MES	L2366434-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-DRY-CCMS-N-VA	Tissue	Silver in Tissue by CRC ICPMS (DRY)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-DRY-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (DRY)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Table A2: Water Quality from 2023 Synoptic Sampling Event

Parameter	Units	BM-23-NAT-1	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-4
		17-Sep-2023	17-Sep-2023	17-Sep-2023	17-Sep-2023
Total Suspended Solids	mg/L	10.5	11.2	5.9	5.8
pH (lab)	pH units	7.92	7.97	7.89	7.14
Specific Conductance (lab)	µS/cm	1200	1190	1180	1140
Hardness (from total)	mg/L	187	-	-	202
Hardness (from dissolved)	mg/L	188	199	200	215
Alkalinity, total	mg/L	51.7	55.5	54.2	32.2
Bromide	mg/L	<0.250	<0.250	<0.250	<0.250
Chloride	mg/L	161	155	152	149
Fluoride	mg/L	0.241	0.256	0.257	0.488
Sulphate, dissolved	mg/L	140	140	144	173
Ammonia (N)	mg/L	7.57	-	-	5.22
Nitrite (N)	mg/L	0.548	0.513	0.506	0.237
Nitrate (N)	mg/L	20.7	19.9	19.1	17.0
Dissolved Organic Carbon	mg/L	-	-	-	2.84
Aluminum (Al), total	mg/L	0.114	-	-	0.0375
Antimony (Sb), total	mg/L	0.0764	-	-	0.0631
Arsenic (As), total	mg/L	0.0114	-	-	0.00541
Barium (Ba), total	mg/L	0.0477	-	-	0.0720
Beryllium (Be), total	mg/L	<0.000100	-	-	<0.000100
Bismuth (Bi), total	mg/L	<0.000050	-	-	<0.000050
Boron (B), total	mg/L	0.130	-	-	0.108
Cadmium (Cd), total	mg/L	0.000151	-	-	0.000444
Calcium (Ca), total	mg/L	66.3	-	-	71.6
Chromium (Cr), total	mg/L	0.00940	-	-	0.00528
Cobalt (Co), total	mg/L	0.00030	-	-	0.00020
Copper (Cu), total	mg/L	0.00280	-	-	0.00092
Iron (Fe), total	mg/L	2.30	-	-	0.775
Lead (Pb), total	mg/L	0.0264	-	-	0.00642
Lithium (Li), total	mg/L	0.0224	-	-	0.0221
Magnesium (Mg), total	mg/L	5.21	-	-	5.70
Manganese (Mn), total	mg/L	0.0603	-	-	0.166
Mercury (Hg), total	mg/L	<0.0000050	-	-	<0.0000050
Molybdenum (Mo), total	mg/L	0.0629	-	-	0.0504
Nickel (Ni), total	mg/L	0.00278	-	-	0.00212
Phosphorus (P), total	mg/L	<0.050	-	-	<0.050
Potassium (K), total	mg/L	20.7	-	-	17.2
Selenium (Se), total	mg/L	0.000849	-	-	0.000809
Silicon (Si), total	mg/L	6.39	-	-	5.97
Silver (Ag), total	mg/L	0.000115	-	-	0.000092
Sodium (Na), total	mg/L	136	-	-	122
Strontium (Sr), total	mg/L	0.508	-	-	0.486
Sulphur (S), total	mg/L	98.4	-	-	94.9
Thallium (Tl), total	mg/L	0.000179	-	-	0.000202
Tin (Sn), total	mg/L	0.00013	-	-	<0.00010
Titanium (Ti), total	mg/L	0.00166	-	-	0.00100

Table A2: Water Quality from 2023 Synoptic Sampling Event

Parameter	Units	BM-23-NAT-1	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-4
		17-Sep-2023	17-Sep-2023	17-Sep-2023	17-Sep-2023
Uranium (U), total	mg/L	0.000998	-	-	0.000211
Vanadium (V), total	mg/L	0.00161	-	-	<0.00050
Zinc (Zn), total	mg/L	0.0082	-	-	0.0287
Zirconium (Zr), total	mg/L	<0.00020	-	-	<0.00020
Aluminum (Al), dissolved	mg/L	0.0322	0.0391	0.0337	0.0108
Antimony (Sb), dissolved	mg/L	0.0690	0.0702	0.0676	0.0626
Arsenic (As), dissolved	mg/L	0.00398	0.00477	0.00477	0.00274
Barium (Ba), dissolved	mg/L	0.0461	0.0478	0.0492	0.0756
Beryllium (Be), dissolved	mg/L	<0.000100	<0.000100	<0.000100	<0.000100
Bismuth (Bi), dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B), dissolved	mg/L	0.130	0.130	0.122	0.116
Cadmium (Cd), dissolved	mg/L	0.0000703	0.0000924	0.000167	0.000394
Calcium (Ca), dissolved	mg/L	66.4	70.5	71.2	76.1
Chromium (Cr), dissolved	mg/L	0.00691	0.00806	0.00717	0.00469
Cobalt (Co), dissolved	mg/L	0.00022	0.00022	0.00023	0.00017
Copper (Cu), dissolved	mg/L	0.00090	0.00109	0.00124	0.00071
Iron (Fe), dissolved	mg/L	0.121	0.214	0.167	0.085
Lead (Pb), dissolved	mg/L	0.00101	0.00185	0.00142	0.00115
Lithium (Li), dissolved	mg/L	0.0233	0.0241	0.0244	0.0243
Magnesium (Mg), dissolved	mg/L	5.39	5.54	5.44	6.17
Manganese (Mn), dissolved	mg/L	0.0275	0.0321	0.0741	0.160
Mercury (Hg), dissolved	mg/L	-	-	<0.0000050	<0.0000050
Molybdenum (Mo), dissolved	mg/L	0.0600	0.0631	0.0624	0.0493
Nickel (Ni), dissolved	mg/L	0.00190	0.00190	0.00197	0.00197
Phosphorus (P), dissolved	mg/L	<0.050	<0.050	<0.050	<0.050
Potassium (K), dissolved	mg/L	21.6	21.9	20.6	18.5
Selenium (Se), dissolved	mg/L	0.000844	0.000829	0.000807	0.000791
Silicon (Si), dissolved	mg/L	5.91	6.09	6.08	6.22
Silver (Ag), dissolved	mg/L	0.000028	0.000032	0.000013	0.000026
Sodium (Na), dissolved	mg/L	142	143	136	127
Strontium (Sr), dissolved	mg/L	0.489	0.507	0.507	0.489
Sulphur (S), dissolved	mg/L	90.7	94.4	94.4	93.6
Thallium (Tl), dissolved	mg/L	0.000171	0.000176	0.000181	0.000209
Tin (Sn), dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti), dissolved	mg/L	<0.00030	0.00072	0.00031	<0.00030
Uranium (U), dissolved	mg/L	0.000887	0.000896	0.000773	0.000190
Vanadium (V), dissolved	mg/L	<0.00050	0.00073	0.00053	<0.00050
Zinc (Zn), dissolved	mg/L	0.0028	0.0028	0.0038	0.0274
Zirconium (Zr), dissolved	mg/L	<0.00030	<0.00030	<0.00030	<0.00030
Ion Balance	-	1.05	1.04	1.03	1.05
Total Anion Sum	meq/L	10.0	9.87	9.78	9.70
Total Cation Sum	meq/L	11.0	10.8	10.4	10.7

Results Summary WR2301603

Project	Bermingham Natural Attenuation Study
Report To	Accounts Payable, Alexco Keno Hill Mining Corp
Date Received	21-Dec-2023 13:15
Issue Date	16-Jan-2024 10:24
Amendment	0

Client Sample ID			BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB	BM-23-NAT-2-RB	BM-23-NAT-4
Date Sampled			17-Sep-2023	17-Sep-2023	17-Sep-2023	17-Sep-2023	17-Sep-2023	17-Sep-2023	17-Sep-2023
Time Sampled			13:00	13:40	13:50	13:55	13:10	13:15	14:00
ALS Sample ID			WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005	WR2301603-006	WR2301603-007
Analyte	Lowest Detection Limit	Units	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil
Metals (Matrix: Soil/Solid)									
Antimony	0.05	ppm (w/w)	26.2	3.53	3.17	2.84	2.89	5.38	3.62
Arsenic	0.1	ppm (w/w)	166.5	28.6	19.9	25.5	29.9	50.3	21.9
Barium	10	ppm (w/w)	130	120	170	210	190	110	150
Beryllium	0.05	ppm (w/w)	0.49	0.23	0.26	0.29	0.32	0.40	0.26
Bismuth	0.01	ppm (w/w)	0.19	0.14	0.16	0.17	0.16	0.15	0.13
Boron	10	ppm (w/w)	<10	<10	<10	<10	<10	<10	<10
Cadmium	0.01	ppm (w/w)	17.85	2.25	5.97	60.9	16.50	37.7	0.63
Cerium	0.02	ppm (w/w)	24.2	21.8	23.1	25.9	29.1	31.2	23.0
Cesium	0.05	ppm (w/w)	2.45	1.62	0.99	0.92	0.89	1.36	1.10
Chromium	1	ppm (w/w)	29	20	23	23	23	20	19
Cobalt	0.1	ppm (w/w)	11.5	6.1	6.9	7.5	11.0	6.1	7.9
Copper	0.2	ppm (w/w)	30.00	11.6	12.2	16.8	17.1	18.2	24.3
Gallium	0.05	ppm (w/w)	3.75	3.43	3.83	4.01	3.69	3.02	3.13
Germanium	0.05	ppm (w/w)	0.05	<0.05	0.05	<0.05	<0.05	0.05	<0.05
Gold	0.02	ppm (w/w)	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hafnium	0.02	ppm (w/w)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Indium	0.005	ppm (w/w)	0.036	0.018	0.021	0.023	0.022	0.022	0.018
Lanthanum	0.2	ppm (w/w)	12.6	11.1	12.0	12.9	14.5	15.9	11.7
Lead	0.2	ppm (w/w)	477	64.5	46.8	96.5	82.7	96.0	42.4
Lithium	0.1	ppm (w/w)	15.4	19.0	17.5	19.6	16.7	12.9	14.0
Manganese	5	ppm (w/w)	2230	254	236	306	594	533	263
Mercury	0.01	ppm (w/w)	0.07	0.05	0.06	0.06	0.04	0.05	0.07
Molybdenum	0.05	ppm (w/w)	3.93	1.01	1.32	0.99	1.31	1.74	1.89
Nickel	0.2	ppm (w/w)	53.2	16.1	16.4	19.2	18.6	20.00	16.4
Niobium	0.05	ppm (w/w)	0.46	0.58	0.65	0.58	0.64	0.37	0.60
Phosphorus	10	ppm (w/w)	620	670	710	770	700	800	730
Rhenium	0.001	ppm (w/w)	0.003	0.001	0.001	0.001	0.001	0.002	0.001
Rubidium	0.1	ppm (w/w)	7.5	6.7	8.4	8.1	7.4	7.1	7.1
Scandium	0.1	ppm (w/w)	2.7	2.1	2.4	2.5	2.8	1.9	2.4
Selenium	0.2	ppm (w/w)	1.2	0.7	0.9	0.8	0.9	0.7	0.6
Silver	0.01	ppm (w/w)	15.75	1.61	1.13	2.98	2.31	3.61	0.99
Strontium	0.2	ppm (w/w)	72.9	19.1	18.7	22.0	19.7	19.4	21.2
Tantalum	0.01	ppm (w/w)	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tellurium	0.01	ppm (w/w)	0.03	0.01	0.02	0.03	0.03	0.02	0.02
Thallium	0.02	ppm (w/w)	0.26	0.17	0.12	0.12	0.11	0.12	0.15
Thorium	0.2	ppm (w/w)	4.0	0.9	1.2	0.8	1.5	1.0	1.1
Tin	0.2	ppm (w/w)	3.0	0.3	0.3	0.4	0.4	0.5	0.3
Tungsten	0.05	ppm (w/w)	40.4	5.19	2.89	0.76	1.86	5.69	4.22
Uranium	0.05	ppm (w/w)	2.03	1.39	0.90	0.78	0.84	1.08	0.92
Vanadium	1	ppm (w/w)	37	32	38	38	38	27	34
Yttrium	0.05	ppm (w/w)	5.04	3.76	3.55	5.11	5.04	5.30	4.56
Zinc	2	ppm (w/w)	1065	290	314	1920	403	1235	98
Zirconium	0.5	ppm (w/w)	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Exchangeable & Adsorbed Metals (Matrix: Soil/Solid)									
Aluminum, leachable	50	mg/kg	<50			<50			<50
Antimony, leachable	0.10	mg/kg	0.86			0.17			0.19
Arsenic, leachable	0.050	mg/kg	0.293			<0.050			0.248
Barium, leachable	0.50	mg/kg	7.46			60.4			37.9
Beryllium, leachable	0.20	mg/kg	<0.20			<0.20			<0.20
Bismuth, leachable	0.20	mg/kg	<0.20			<0.20			<0.20
Cadmium, leachable	0.050	mg/kg	4.55			76.5			0.179
Calcium, leachable	50	mg/kg	4880			3390			2180
Chromium, leachable	0.50	mg/kg	<0.50			<0.50			<0.50
Cobalt, leachable	0.10	mg/kg	<0.10			<0.10			0.29
Copper, leachable	0.50	mg/kg	0.70			<0.50			<0.50
Iron, leachable	50	mg/kg	<50			<50			<50
Lead, leachable	0.50	mg/kg	<0.50			<0.50			0.58
Lithium, leachable	5.0	mg/kg	<5.0			<5.0			<5.0
Manganese, leachable	1.0	mg/kg	59.2			10.0			92.7
Molybdenum, leachable	0.50	mg/kg	0.58			<0.50			<0.50
Nickel, leachable	0.50	mg/kg	1.93			<0.50			<0.50
Phosphorus, leachable	50	mg/kg	<50			<50			<50
Potassium, leachable	100	mg/kg	160			<100			120
Selenium, leachable	0.20	mg/kg	<0.20			<0.20			<0.20
Silver, leachable	0.10	mg/kg	<0.10			0.10			<0.10
Sodium, leachable	100	mg/kg	640			<100			170
Strontium, leachable	0.50	mg/kg	24.3			13.9			10.6

Thallium, leachable	0.050	mg/kg	<0.050	<0.050	<0.050
Tin, leachable	2.0	mg/kg	<2.0	<2.0	<2.0
Titanium, leachable	1.0	mg/kg	<1.0	<1.0	<1.0
Uranium, leachable	0.050	mg/kg	0.323	<0.050	<0.050
Vanadium, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Zinc, leachable	1.0	mg/kg	5.9	252	1.2

Carbonate Metals (Matrix: Soil/Solid)

Aluminum, leachable	50	mg/kg	<50	<50	<50
Antimony, leachable	0.10	mg/kg	0.96	0.23	0.16
Arsenic, leachable	0.050	mg/kg	0.514	0.137	0.792
Barium, leachable	2.0	mg/kg	28.9	28.1	20.0
Beryllium, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Bismuth, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Cadmium, leachable	0.050	mg/kg	11.1	11.6	0.071
Calcium, leachable	50	mg/kg	31100	343	187
Chromium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Cobalt, leachable	0.10	mg/kg	0.22	<0.10	0.24
Copper, leachable	0.50	mg/kg	0.69	<0.50	0.68
Iron, leachable	50	mg/kg	<50	<50	100
Lead, leachable	0.50	mg/kg	28.0	5.04	5.56
Lithium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Manganese, leachable	5.0	mg/kg	474	38.1	15.6
Molybdenum, leachable	0.50	mg/kg	<0.50	<0.50	<0.50
Nickel, leachable	2.0	mg/kg	11.1	<2.0	<2.0
Phosphorus, leachable	50	mg/kg	<50	<50	<50
Selenium, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Silver, leachable	0.10	mg/kg	<0.10	<0.10	<0.10
Strontium, leachable	5.0	mg/kg	41.8	<5.0	<5.0
Thallium, leachable	0.050	mg/kg	<0.050	<0.050	<0.050
Tin, leachable	2.0	mg/kg	<2.0	<2.0	<2.0
Titanium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Uranium, leachable	0.050	mg/kg	1.14	0.218	0.347
Vanadium, leachable	0.20	mg/kg	<0.20	<0.20	0.34
Zinc, leachable	1.0	mg/kg	339	330	3.7

Easily Reducible Metals and Iron Oxides (Matrix: Soil/Solid)

Aluminum, leachable	50	mg/kg	1350	1070	994
Antimony, leachable	0.10	mg/kg	2.99	0.19	0.22
Arsenic, leachable	0.050	mg/kg	62.3	2.76	4.45
Barium, leachable	0.50	mg/kg	49.0	82.2	35.0
Beryllium, leachable	0.20	mg/kg	0.40	<0.20	<0.20
Bismuth, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Cadmium, leachable	0.050	mg/kg	9.35	13.1	0.343
Calcium, leachable	50	mg/kg	5340	401	214
Chromium, leachable	0.50	mg/kg	16.6	2.45	2.68
Cobalt, leachable	0.10	mg/kg	10.2	2.92	2.76
Copper, leachable	0.50	mg/kg	3.60	1.29	2.84
Iron, leachable	50	mg/kg	18400	5540	4970
Lead, leachable	0.50	mg/kg	650	76.7	23.4
Lithium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Manganese, leachable	1.0	mg/kg	3280	512	71.3
Molybdenum, leachable	0.50	mg/kg	0.91	<0.50	<0.50
Nickel, leachable	0.50	mg/kg	51.1	3.74	2.67
Phosphorus, leachable	50	mg/kg	<50	<50	69
Selenium, leachable	0.20	mg/kg	0.24	<0.20	<0.20
Silver, leachable	0.10	mg/kg	0.98	1.70	<0.10
Strontium, leachable	0.50	mg/kg	9.41	2.34	1.43
Thallium, leachable	0.050	mg/kg	0.112	<0.050	<0.050
Tin, leachable	2.0	mg/kg	<2.0	<2.0	<2.0
Titanium, leachable	1.0	mg/kg	<1.0	1.6	1.4
Uranium, leachable	0.050	mg/kg	1.32	0.348	0.278
Vanadium, leachable	0.20	mg/kg	22.1	7.22	6.85
Zinc, leachable	1.0	mg/kg	851	1680	29.6

Organic Bound Metals (Matrix: Soil/Solid)

Aluminum, leachable	50	mg/kg	1460	1980	1300
Antimony, leachable	0.10	mg/kg	2.59	<0.10	0.12
Arsenic, leachable	0.050	mg/kg	18.0	0.855	0.437
Barium, leachable	0.50	mg/kg	12.5	32.1	14.9
Beryllium, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Bismuth, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Cadmium, leachable	0.050	mg/kg	3.57	0.619	<0.050
Calcium, leachable	50	mg/kg	196	124	194
Chromium, leachable	0.50	mg/kg	10.4	6.79	4.73
Cobalt, leachable	0.10	mg/kg	1.40	1.04	0.87
Copper, leachable	0.50	mg/kg	28.8	6.11	7.88
Iron, leachable	50	mg/kg	3430	744	463
Lead, leachable	0.50	mg/kg	123	15.4	3.14
Lithium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Manganese, leachable	1.0	mg/kg	182	94.7	11.2
Molybdenum, leachable	0.50	mg/kg	1.41	<0.50	0.69
Nickel, leachable	0.50	mg/kg	9.77	2.30	1.79
Selenium, leachable	0.20	mg/kg	1.08	0.89	0.49

Silver, leachable	0.10	mg/kg	1.00	0.57	0.29
Strontium, leachable	0.50	mg/kg	0.68	0.91	1.02
Thallium, leachable	0.050	mg/kg	<0.050	<0.050	<0.050
Tin, leachable	2.0	mg/kg	<2.0	<2.0	<2.0
Titanium, leachable	1.0	mg/kg	<1.0	19.7	6.9
Uranium, leachable	0.050	mg/kg	0.333	0.155	0.102
Vanadium, leachable	0.20	mg/kg	6.97	5.61	4.24
Zinc, leachable	1.0	mg/kg	330	99.5	9.4

Residual Metals (Matrix: Soil/Solid)

Aluminum, leachable	50	mg/kg	2040	3100	1470
Antimony, leachable	0.10	mg/kg	9.12	0.87	0.69
Arsenic, leachable	5.00	mg/kg	60.1	8.01	<5.00
Barium, leachable	2.0	mg/kg	10.3	17.6	7.7
Beryllium, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Bismuth, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Cadmium, leachable	0.050	mg/kg	0.184	0.084	<0.050
Calcium, leachable	50	mg/kg	188	264	169
Chromium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Cobalt, leachable	0.10	mg/kg	0.62	1.25	0.74
Copper, leachable	0.50	mg/kg	2.48	2.95	2.82
Iron, leachable	50	mg/kg	3440	4680	2500
Lead, leachable	0.50	mg/kg	39.6	14.2	3.09
Lithium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Manganese, leachable	5.0	mg/kg	23.5	44.6	17.7
Molybdenum, leachable	0.50	mg/kg	0.74	<0.50	<0.50
Nickel, leachable	2.0	mg/kg	3.5	3.7	2.1
Selenium, leachable	0.20	mg/kg	<0.20	<0.20	<0.20
Silver, leachable	0.10	mg/kg	7.58	0.40	0.14
Strontium, leachable	5.0	mg/kg	<5.0	<5.0	<5.0
Thallium, leachable	0.050	mg/kg	0.056	<0.050	<0.050
Tin, leachable	2.0	mg/kg	<2.0	<2.0	<2.0
Titanium, leachable	5.0	mg/kg	11.8	67.6	42.4
Uranium, leachable	0.050	mg/kg	0.146	0.097	0.053
Vanadium, leachable	0.20	mg/kg	4.93	8.00	4.13
Zinc, leachable	1.0	mg/kg	26.8	44.1	8.7

CERTIFICATE OF ANALYSIS

Work Order	: **WR2301603**	Page	: 1 of 16
Client	: **Alexco Keno Hill Mining Corp**	Laboratory	: ALS Environmental - Whitehorse
Contact	: Accounts Payable	Account Manager	: Thomas Chang
Address	: #2 Calcite Business Centre - 151 Industrial Road Whitehorse YT Canada Y1A 2V3	Address	: #12 151 Industrial Road Whitehorse YT Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: Bermingham Natural Attenuation Study	Date Samples Received	: 21-Dec-2023 13:15
PO	: ----	Date Analysis Commenced	: 03-Jan-2024
C-O-C number	: ----	Issue Date	: 16-Jan-2024 10:24
Sampler	: CM		
Site	: 2022 Pricing		
Quote number	: WR22-AKHM100-004 (Keno/Hecla)		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Dan Gebert	Laboratory Analyst	Metals, Burnaby, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Metals, Burnaby, British Columbia
Paolo Obillo	Account Manager Assistant	Internal Subcontracting, North Vancouver, British Columbia

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
%	percent
mg/kg	milligrams per kilogram
ppm (w/w)	parts per million (weight/weight)

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB
					Client sampling date / time	17-Sep-2023 13:00	17-Sep-2023 13:40	17-Sep-2023 13:50	17-Sep-2023 13:55	17-Sep-2023 13:10
						WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005
						Result	Result	Result	Result	Result
Metals										
Aluminum	7429-90-5	ME-MS41/1L	0.01	%		1.07	1.18	1.35	1.40	1.30
Antimony	7440-36-0	ME-MS41/1L	0.05	ppm (w/w)		26.2	3.53	3.17	2.84	2.89
Arsenic	7440-38-2	ME-MS41/1L	0.1	ppm (w/w)		166.5	28.6	19.9	25.5	29.9
Barium	7440-39-3	ME-MS41/1L	10	ppm (w/w)		130	120	170	210	190
Beryllium	7440-41-7	ME-MS41/1L	0.05	ppm (w/w)		0.49	0.23	0.26	0.29	0.32
Bismuth	7440-69-9	ME-MS41/1L	0.01	ppm (w/w)		0.19	0.14	0.16	0.17	0.16
Boron	7440-42-8	ME-MS41/1L	10	ppm (w/w)		<10	<10	<10	<10	<10
Cadmium	7440-43-9	ME-MS41/1L	0.01	ppm (w/w)		17.85	2.25	5.97	60.9	16.50
Calcium	7440-70-2	ME-MS41/1L	0.01	%		4.38	0.35	0.32	0.40	0.36
Cerium	7440-45-1	ME-MS41/1L	0.02	ppm (w/w)		24.2	21.8	23.1	25.9	29.1
Cesium	7440-46-2	ME-MS41/1L	0.05	ppm (w/w)		2.45	1.62	0.99	0.92	0.89
Chromium	7440-47-3	ME-MS41/1L	1	ppm (w/w)		29	20	23	23	23
Cobalt	7440-48-4	ME-MS41/1L	0.1	ppm (w/w)		11.5	6.1	6.9	7.5	11.0
Copper	7440-50-8	ME-MS41/1L	0.2	ppm (w/w)		30.00	11.6	12.2	16.8	17.1
Gallium	7440-55-3	ME-MS41/1L	0.05	ppm (w/w)		3.75	3.43	3.83	4.01	3.69
Germanium	7440-56-4	ME-MS41/1L	0.05	ppm (w/w)		0.05	<0.05	0.05	<0.05	<0.05
Gold	7440-57-5	ME-MS41/1L	0.02	ppm (w/w)		0.04	<0.02	<0.02	<0.02	<0.02
Hafnium	7440-58-6	ME-MS41/1L	0.02	ppm (w/w)		0.02	<0.02	<0.02	<0.02	<0.02
Indium	7440-74-6	ME-MS41/1L	0.005	ppm (w/w)		0.036	0.018	0.021	0.023	0.022
Iron	7439-89-6	ME-MS41/1L	0.01	%		2.66	1.75	2.15	2.08	2.36
Lanthanum	7439-91-0	ME-MS41/1L	0.2	ppm (w/w)		12.6	11.1	12.0	12.9	14.5
Lead	7439-92-1	ME-MS41/1L	0.2	ppm (w/w)		477	64.5	46.8	96.5	82.7
Lithium	7439-93-2	ME-MS41/1L	0.1	ppm (w/w)		15.4	19.0	17.5	19.6	16.7
Magnesium	7439-95-4	ME-MS41/1L	0.01	%		0.29	0.30	0.34	0.34	0.35
Manganese	7439-96-5	ME-MS41/1L	5	ppm (w/w)		2230	254	236	306	594
Mercury	7439-97-6	ME-MS41/1L	0.01	ppm (w/w)		0.07	0.05	0.06	0.06	0.04
Molybdenum	7439-98-7	ME-MS41/1L	0.05	ppm (w/w)		3.93	1.01	1.32	0.99	1.31
Nickel	7440-02-0	ME-MS41/1L	0.2	ppm (w/w)		53.2	16.1	16.4	19.2	18.6
Niobium	7440-03-1	ME-MS41/1L	0.05	ppm (w/w)		0.46	0.58	0.65	0.58	0.64

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB
					Client sampling date / time	17-Sep-2023 13:00	17-Sep-2023 13:40	17-Sep-2023 13:50	17-Sep-2023 13:55	17-Sep-2023 13:10
						WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005
						Result	Result	Result	Result	Result
Metals										
Phosphorus	7723-14-0	ME-MS41/1L	10	ppm (w/w)		620	670	710	770	700
Potassium	7440-09-7	ME-MS41/1L	0.01	%		0.07	0.05	0.06	0.05	0.05
Rhenium	7440-15-5	ME-MS41/1L	0.001	ppm (w/w)		0.003	0.001	0.001	0.001	0.001
Rubidium	7440-17-7	ME-MS41/1L	0.1	ppm (w/w)		7.5	6.7	8.4	8.1	7.4
Scandium	7440-20-2	ME-MS41/1L	0.1	ppm (w/w)		2.7	2.1	2.4	2.5	2.8
Selenium	7782-49-2	ME-MS41/1L	0.2	ppm (w/w)		1.2	0.7	0.9	0.8	0.9
Silver	7440-22-4	ME-MS41/1L	0.01	ppm (w/w)		15.75	1.61	1.13	2.98	2.31
Sodium	7440-23-5	ME-MS41/1L	0.01	%		0.04	0.02	0.02	0.02	0.02
Strontium	7440-24-6	ME-MS41/1L	0.2	ppm (w/w)		72.9	19.1	18.7	22.0	19.7
Sulfur	7704-34-9	ME-MS41/1L	0.01	%		0.11	0.02	0.02	0.03	0.03
Tantalum	7440-25-7	ME-MS41/1L	0.01	ppm (w/w)		0.01	<0.01	<0.01	<0.01	<0.01
Tellurium	13494-80-9	ME-MS41/1L	0.01	ppm (w/w)		0.03	0.01	0.02	0.03	0.03
Thallium	7440-28-0	ME-MS41/1L	0.02	ppm (w/w)		0.26	0.17	0.12	0.12	0.11
Thorium	7440-29-1	ME-MS41/1L	0.2	ppm (w/w)		4.0	0.9	1.2	0.8	1.5
Tin	7440-31-5	ME-MS41/1L	0.2	ppm (w/w)		3.0	0.3	0.3	0.4	0.4
Titanium	7440-32-6	ME-MS41/1L	0.005	%		0.021	0.026	0.030	0.027	0.033
Tungsten	7440-33-7	ME-MS41/1L	0.05	ppm (w/w)		40.4	5.19	2.89	0.76	1.86
Uranium	7440-61-1	ME-MS41/1L	0.05	ppm (w/w)		2.03	1.39	0.90	0.78	0.84
Vanadium	7440-62-2	ME-MS41/1L	1	ppm (w/w)		37	32	38	38	38
Yttrium	7440-65-5	ME-MS41/1L	0.05	ppm (w/w)		5.04	3.76	3.55	5.11	5.04
Zinc	7440-66-6	ME-MS41/1L	2	ppm (w/w)		1065	290	314	1920	403
Zirconium	7440-67-7	ME-MS41/1L	0.5	ppm (w/w)		0.5	<0.5	<0.5	<0.5	<0.5
Exchangeable & Adsorbed Metals										
Aluminum, leachable	7429-90-5	E450/VA	50	mg/kg		<50	----	----	<50	----
Antimony, leachable	7440-36-0	E450/VA	0.10	mg/kg		0.86	----	----	0.17	----
Arsenic, leachable	7440-38-2	E450/VA	0.050	mg/kg		0.293	----	----	<0.050	----
Barium, leachable	7440-39-3	E450/VA	0.50	mg/kg		7.46	----	----	60.4	----
Beryllium, leachable	7440-41-7	E450/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Bismuth, leachable	7440-69-9	E450/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Cadmium, leachable	7440-43-9	E450/VA	0.050	mg/kg		4.55	----	----	76.5	----

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB
					Client sampling date / time	17-Sep-2023 13:00	17-Sep-2023 13:40	17-Sep-2023 13:50	17-Sep-2023 13:55	17-Sep-2023 13:10
						WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005
						Result	Result	Result	Result	Result
Exchangeable & Adsorbed Metals										
Calcium, leachable	7440-70-2	E450/VA	50	mg/kg		4880	----	----	3390	----
Chromium, leachable	7440-47-3	E450/VA	0.50	mg/kg		<0.50	----	----	<0.50	----
Cobalt, leachable	7440-48-4	E450/VA	0.10	mg/kg		<0.10	----	----	<0.10	----
Copper, leachable	7440-50-8	E450/VA	0.50	mg/kg		0.70	----	----	<0.50	----
Iron, leachable	7439-89-6	E450/VA	50	mg/kg		<50	----	----	<50	----
Lead, leachable	7439-92-1	E450/VA	0.50	mg/kg		<0.50	----	----	<0.50	----
Lithium, leachable	7439-93-2	E450/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Manganese, leachable	7439-96-5	E450/VA	1.0	mg/kg		59.2	----	----	10.0	----
Molybdenum, leachable	7439-98-7	E450/VA	0.50	mg/kg		0.58	----	----	<0.50	----
Nickel, leachable	7440-02-0	E450/VA	0.50	mg/kg		1.93	----	----	<0.50	----
Phosphorus, leachable	7723-14-0	E450/VA	50	mg/kg		<50	----	----	<50	----
Potassium, leachable	7440-09-7	E450/VA	100	mg/kg		160	----	----	<100	----
Selenium, leachable	7782-49-2	E450/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Silver, leachable	7440-22-4	E450/VA	0.10	mg/kg		<0.10	----	----	0.10	----
Sodium, leachable	7440-23-5	E450/VA	100	mg/kg		640	----	----	<100	----
Strontium, leachable	7440-24-6	E450/VA	0.50	mg/kg		24.3	----	----	13.9	----
Thallium, leachable	7440-28-0	E450/VA	0.050	mg/kg		<0.050	----	----	<0.050	----
Tin, leachable	7440-31-5	E450/VA	2.0	mg/kg		<2.0	----	----	<2.0	----
Titanium, leachable	7440-32-6	E450/VA	1.0	mg/kg		<1.0	----	----	<1.0	----
Uranium, leachable	7440-61-1	E450/VA	0.050	mg/kg		0.323	----	----	<0.050	----
Vanadium, leachable	7440-62-2	E450/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Zinc, leachable	7440-66-6	E450/VA	1.0	mg/kg		5.9	----	----	252	----
Carbonate Metals										
Aluminum, leachable	7429-90-5	E450A/VA	50	mg/kg		<50	----	----	<50	----
Antimony, leachable	7440-36-0	E450A/VA	0.10	mg/kg		0.96	----	----	0.23	----
Arsenic, leachable	7440-38-2	E450A/VA	0.050	mg/kg		0.514	----	----	0.137	----
Barium, leachable	7440-39-3	E450A/VA	2.0	mg/kg		28.9	----	----	28.1	----
Beryllium, leachable	7440-41-7	E450A/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Bismuth, leachable	7440-69-9	E450A/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Cadmium, leachable	7440-43-9	E450A/VA	0.050	mg/kg		11.1	----	----	11.6	----

Analytical Results

Sub-Matrix: Soil
(Matrix: Soil/Solid)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB
					Client sampling date / time	17-Sep-2023 13:00	17-Sep-2023 13:40	17-Sep-2023 13:50	17-Sep-2023 13:55	17-Sep-2023 13:10
						WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005
						Result	Result	Result	Result	Result
Carbonate Metals										
Calcium, leachable	7440-70-2	E450A/VA	50	mg/kg		31100	----	----	343	----
Chromium, leachable	7440-47-3	E450A/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Cobalt, leachable	7440-48-4	E450A/VA	0.10	mg/kg		0.22	----	----	<0.10	----
Copper, leachable	7440-50-8	E450A/VA	0.50	mg/kg		0.69	----	----	<0.50	----
Iron, leachable	7439-89-6	E450A/VA	50	mg/kg		<50	----	----	<50	----
Lead, leachable	7439-92-1	E450A/VA	0.50	mg/kg		28.0	----	----	5.04	----
Lithium, leachable	7439-93-2	E450A/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Manganese, leachable	7439-96-5	E450A/VA	5.0	mg/kg		474	----	----	38.1	----
Molybdenum, leachable	7439-98-7	E450A/VA	0.50	mg/kg		<0.50	----	----	<0.50	----
Nickel, leachable	7440-02-0	E450A/VA	2.0	mg/kg		11.1	----	----	<2.0	----
Phosphorus, leachable	7723-14-0	E450A/VA	50	mg/kg		<50	----	----	<50	----
Selenium, leachable	7782-49-2	E450A/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Silver, leachable	7440-22-4	E450A/VA	0.10	mg/kg		<0.10	----	----	<0.10	----
Strontium, leachable	7440-24-6	E450A/VA	5.0	mg/kg		41.8	----	----	<5.0	----
Thallium, leachable	7440-28-0	E450A/VA	0.050	mg/kg		<0.050	----	----	<0.050	----
Tin, leachable	7440-31-5	E450A/VA	2.0	mg/kg		<2.0	----	----	<2.0	----
Titanium, leachable	7440-32-6	E450A/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Uranium, leachable	7440-61-1	E450A/VA	0.050	mg/kg		1.14	----	----	0.218	----
Vanadium, leachable	7440-62-2	E450A/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Zinc, leachable	7440-66-6	E450A/VA	1.0	mg/kg		339	----	----	330	----
Easily Reducible Metals and Iron Oxides										
Aluminum, leachable	7429-90-5	E450B/VA	50	mg/kg		1350	----	----	1070	----
Antimony, leachable	7440-36-0	E450B/VA	0.10	mg/kg		2.99	----	----	0.19	----
Arsenic, leachable	7440-38-2	E450B/VA	0.050	mg/kg		62.3	----	----	2.76	----
Barium, leachable	7440-39-3	E450B/VA	0.50	mg/kg		49.0	----	----	82.2	----
Beryllium, leachable	7440-41-7	E450B/VA	0.20	mg/kg		0.40	----	----	<0.20	----
Bismuth, leachable	7440-69-9	E450B/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Cadmium, leachable	7440-43-9	E450B/VA	0.050	mg/kg		9.35	----	----	13.1	----
Calcium, leachable	7440-70-2	E450B/VA	50	mg/kg		5340	----	----	401	----
Chromium, leachable	7440-47-3	E450B/VA	0.50	mg/kg		16.6	----	----	2.45	----

Analytical Results

Sub-Matrix: Soil
(Matrix: Soil/Solid)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB
					Client sampling date / time	17-Sep-2023 13:00	17-Sep-2023 13:40	17-Sep-2023 13:50	17-Sep-2023 13:55	17-Sep-2023 13:10
						WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005
						Result	Result	Result	Result	Result
Easily Reducible Metals and Iron Oxides										
Cobalt, leachable	7440-48-4	E450B/VA	0.10	mg/kg		10.2	----	----	2.92	----
Copper, leachable	7440-50-8	E450B/VA	0.50	mg/kg		3.60	----	----	1.29	----
Iron, leachable	7439-89-6	E450B/VA	50	mg/kg		18400	----	----	5540	----
Lead, leachable	7439-92-1	E450B/VA	0.50	mg/kg		650	----	----	76.7	----
Lithium, leachable	7439-93-2	E450B/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Manganese, leachable	7439-96-5	E450B/VA	1.0	mg/kg		3280	----	----	512	----
Molybdenum, leachable	7439-98-7	E450B/VA	0.50	mg/kg		0.91	----	----	<0.50	----
Nickel, leachable	7440-02-0	E450B/VA	0.50	mg/kg		51.1	----	----	3.74	----
Phosphorus, leachable	7723-14-0	E450B/VA	50	mg/kg		<50	----	----	<50	----
Selenium, leachable	7782-49-2	E450B/VA	0.20	mg/kg		0.24	----	----	<0.20	----
Silver, leachable	7440-22-4	E450B/VA	0.10	mg/kg		0.98	----	----	1.70	----
Strontium, leachable	7440-24-6	E450B/VA	0.50	mg/kg		9.41	----	----	2.34	----
Thallium, leachable	7440-28-0	E450B/VA	0.050	mg/kg		0.112	----	----	<0.050	----
Tin, leachable	7440-31-5	E450B/VA	2.0	mg/kg		<2.0	----	----	<2.0	----
Titanium, leachable	7440-32-6	E450B/VA	1.0	mg/kg		<1.0	----	----	1.6	----
Uranium, leachable	7440-61-1	E450B/VA	0.050	mg/kg		1.32	----	----	0.348	----
Vanadium, leachable	7440-62-2	E450B/VA	0.20	mg/kg		22.1	----	----	7.22	----
Zinc, leachable	7440-66-6	E450B/VA	1.0	mg/kg		851	----	----	1680	----
Organic Bound Metals										
Aluminum, leachable	7429-90-5	E450C/VA	50	mg/kg		1460	----	----	1980	----
Antimony, leachable	7440-36-0	E450C/VA	0.10	mg/kg		2.59	----	----	<0.10	----
Arsenic, leachable	7440-38-2	E450C/VA	0.050	mg/kg		18.0	----	----	0.855	----
Barium, leachable	7440-39-3	E450C/VA	0.50	mg/kg		12.5	----	----	32.1	----
Beryllium, leachable	7440-41-7	E450C/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Bismuth, leachable	7440-69-9	E450C/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Cadmium, leachable	7440-43-9	E450C/VA	0.050	mg/kg		3.57	----	----	0.619	----
Calcium, leachable	7440-70-2	E450C/VA	50	mg/kg		196	----	----	124	----
Chromium, leachable	7440-47-3	E450C/VA	0.50	mg/kg		10.4	----	----	6.79	----
Cobalt, leachable	7440-48-4	E450C/VA	0.10	mg/kg		1.40	----	----	1.04	----
Copper, leachable	7440-50-8	E450C/VA	0.50	mg/kg		28.8	----	----	6.11	----

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB
					Client sampling date / time	17-Sep-2023 13:00	17-Sep-2023 13:40	17-Sep-2023 13:50	17-Sep-2023 13:55	17-Sep-2023 13:10
						WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005
						Result	Result	Result	Result	Result
Organic Bound Metals										
Iron, leachable	7439-89-6	E450C/VA	50	mg/kg		3430	----	----	744	----
Lead, leachable	7439-92-1	E450C/VA	0.50	mg/kg		123	----	----	15.4	----
Lithium, leachable	7439-93-2	E450C/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Manganese, leachable	7439-96-5	E450C/VA	1.0	mg/kg		182	----	----	94.7	----
Molybdenum, leachable	7439-98-7	E450C/VA	0.50	mg/kg		1.41	----	----	<0.50	----
Nickel, leachable	7440-02-0	E450C/VA	0.50	mg/kg		9.77	----	----	2.30	----
Selenium, leachable	7782-49-2	E450C/VA	0.20	mg/kg		1.08	----	----	0.89	----
Silver, leachable	7440-22-4	E450C/VA	0.10	mg/kg		1.00	----	----	0.57	----
Strontium, leachable	7440-24-6	E450C/VA	0.50	mg/kg		0.68	----	----	0.91	----
Thallium, leachable	7440-28-0	E450C/VA	0.050	mg/kg		<0.050	----	----	<0.050	----
Tin, leachable	7440-31-5	E450C/VA	2.0	mg/kg		<2.0	----	----	<2.0	----
Titanium, leachable	7440-32-6	E450C/VA	1.0	mg/kg		<1.0	----	----	19.7	----
Uranium, leachable	7440-61-1	E450C/VA	0.050	mg/kg		0.333	----	----	0.155	----
Vanadium, leachable	7440-62-2	E450C/VA	0.20	mg/kg		6.97	----	----	5.61	----
Zinc, leachable	7440-66-6	E450C/VA	1.0	mg/kg		330	----	----	99.5	----
Residual Metals										
Aluminum, leachable	7429-90-5	E450D/VA	50	mg/kg		2040	----	----	3100	----
Antimony, leachable	7440-36-0	E450D/VA	0.10	mg/kg		9.12	----	----	0.87	----
Arsenic, leachable	7440-38-2	E450D/VA	5.00	mg/kg		60.1	----	----	8.01	----
Barium, leachable	7440-39-3	E450D/VA	2.0	mg/kg		10.3	----	----	17.6	----
Beryllium, leachable	7440-41-7	E450D/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Bismuth, leachable	7440-69-9	E450D/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Cadmium, leachable	7440-43-9	E450D/VA	0.050	mg/kg		0.184	----	----	0.084	----
Calcium, leachable	7440-70-2	E450D/VA	50	mg/kg		188	----	----	264	----
Chromium, leachable	7440-47-3	E450D/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Cobalt, leachable	7440-48-4	E450D/VA	0.10	mg/kg		0.62	----	----	1.25	----
Copper, leachable	7440-50-8	E450D/VA	0.50	mg/kg		2.48	----	----	2.95	----
Iron, leachable	7439-89-6	E450D/VA	50	mg/kg		3440	----	----	4680	----
Lead, leachable	7439-92-1	E450D/VA	0.50	mg/kg		39.6	----	----	14.2	----
Lithium, leachable	7439-93-2	E450D/VA	5.0	mg/kg		<5.0	----	----	<5.0	----

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2	BM-23-NAT-3	BM-23-NAT-3-LB	BM-23-NAT-3-RB	BM-23-NAT-2-LB
					Client sampling date / time	17-Sep-2023 13:00	17-Sep-2023 13:40	17-Sep-2023 13:50	17-Sep-2023 13:55	17-Sep-2023 13:10
						WR2301603-001	WR2301603-002	WR2301603-003	WR2301603-004	WR2301603-005
						Result	Result	Result	Result	Result
Residual Metals										
Manganese, leachable	7439-96-5	E450D/VA	5.0	mg/kg		23.5	----	----	44.6	----
Molybdenum, leachable	7439-98-7	E450D/VA	0.50	mg/kg		0.74	----	----	<0.50	----
Nickel, leachable	7440-02-0	E450D/VA	2.0	mg/kg		3.5	----	----	3.7	----
Selenium, leachable	7782-49-2	E450D/VA	0.20	mg/kg		<0.20	----	----	<0.20	----
Silver, leachable	7440-22-4	E450D/VA	0.10	mg/kg		7.58	----	----	0.40	----
Strontium, leachable	7440-24-6	E450D/VA	5.0	mg/kg		<5.0	----	----	<5.0	----
Thallium, leachable	7440-28-0	E450D/VA	0.050	mg/kg		0.056	----	----	<0.050	----
Tin, leachable	7440-31-5	E450D/VA	2.0	mg/kg		<2.0	----	----	<2.0	----
Titanium, leachable	7440-32-6	E450D/VA	5.0	mg/kg		11.8	----	----	67.6	----
Uranium, leachable	7440-61-1	E450D/VA	0.050	mg/kg		0.146	----	----	0.097	----
Vanadium, leachable	7440-62-2	E450D/VA	0.20	mg/kg		4.93	----	----	8.00	----
Zinc, leachable	7440-66-6	E450D/VA	1.0	mg/kg		26.8	----	----	44.1	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)				Client sample ID	BM-23-NAT-2-RB	BM-23-NAT-4	----	----	----
				Client sampling date / time	17-Sep-2023 13:15	17-Sep-2023 14:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WR2301603-006	WR2301603-007	--------	--------	--------
					Result	Result	----	----	----
Metals									
Aluminum	7429-90-5	ME-MS41/1L	0.01	%	1.02	1.08	----	----	----
Antimony	7440-36-0	ME-MS41/1L	0.05	ppm (w/w)	5.38	3.62	----	----	----
Arsenic	7440-38-2	ME-MS41/1L	0.1	ppm (w/w)	50.3	21.9	----	----	----
Barium	7440-39-3	ME-MS41/1L	10	ppm (w/w)	110	150	----	----	----
Beryllium	7440-41-7	ME-MS41/1L	0.05	ppm (w/w)	0.40	0.26	----	----	----
Bismuth	7440-69-9	ME-MS41/1L	0.01	ppm (w/w)	0.15	0.13	----	----	----
Boron	7440-42-8	ME-MS41/1L	10	ppm (w/w)	<10	<10	----	----	----
Cadmium	7440-43-9	ME-MS41/1L	0.01	ppm (w/w)	37.7	0.63	----	----	----
Calcium	7440-70-2	ME-MS41/1L	0.01	%	0.35	0.33	----	----	----
Cerium	7440-45-1	ME-MS41/1L	0.02	ppm (w/w)	31.2	23.0	----	----	----
Cesium	7440-46-2	ME-MS41/1L	0.05	ppm (w/w)	1.36	1.10	----	----	----
Chromium	7440-47-3	ME-MS41/1L	1	ppm (w/w)	20	19	----	----	----
Cobalt	7440-48-4	ME-MS41/1L	0.1	ppm (w/w)	6.1	7.9	----	----	----
Copper	7440-50-8	ME-MS41/1L	0.2	ppm (w/w)	18.2	24.3	----	----	----
Gallium	7440-55-3	ME-MS41/1L	0.05	ppm (w/w)	3.02	3.13	----	----	----
Germanium	7440-56-4	ME-MS41/1L	0.05	ppm (w/w)	0.05	<0.05	----	----	----
Gold	7440-57-5	ME-MS41/1L	0.02	ppm (w/w)	<0.02	<0.02	----	----	----
Hafnium	7440-58-6	ME-MS41/1L	0.02	ppm (w/w)	<0.02	<0.02	----	----	----
Indium	7440-74-6	ME-MS41/1L	0.005	ppm (w/w)	0.022	0.018	----	----	----
Iron	7439-89-6	ME-MS41/1L	0.01	%	1.76	1.92	----	----	----
Lanthanum	7439-91-0	ME-MS41/1L	0.2	ppm (w/w)	15.9	11.7	----	----	----
Lead	7439-92-1	ME-MS41/1L	0.2	ppm (w/w)	96.0	42.4	----	----	----
Lithium	7439-93-2	ME-MS41/1L	0.1	ppm (w/w)	12.9	14.0	----	----	----
Magnesium	7439-95-4	ME-MS41/1L	0.01	%	0.26	0.32	----	----	----
Manganese	7439-96-5	ME-MS41/1L	5	ppm (w/w)	533	263	----	----	----
Mercury	7439-97-6	ME-MS41/1L	0.01	ppm (w/w)	0.05	0.07	----	----	----
Molybdenum	7439-98-7	ME-MS41/1L	0.05	ppm (w/w)	1.74	1.89	----	----	----
Nickel	7440-02-0	ME-MS41/1L	0.2	ppm (w/w)	20.00	16.4	----	----	----
Niobium	7440-03-1	ME-MS41/1L	0.05	ppm (w/w)	0.37	0.60	----	----	----
Phosphorus	7723-14-0	ME-MS41/1L	10	ppm (w/w)	800	730	----	----	----

Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	BM-23-NAT-2-RB	BM-23-NAT-4	----	----	----
					Client sampling date / time	17-Sep-2023 13:15	17-Sep-2023 14:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit		WR2301603-006	WR2301603-007	--------	--------	--------
						Result	Result	----	----	----
Metals										
Potassium	7440-09-7	ME-MS41/1L	0.01	%		0.04	0.05	----	----	----
Rhenium	7440-15-5	ME-MS41/1L	0.001	ppm (w/w)		0.002	0.001	----	----	----
Rubidium	7440-17-7	ME-MS41/1L	0.1	ppm (w/w)		7.1	7.1	----	----	----
Scandium	7440-20-2	ME-MS41/1L	0.1	ppm (w/w)		1.9	2.4	----	----	----
Selenium	7782-49-2	ME-MS41/1L	0.2	ppm (w/w)		0.7	0.6	----	----	----
Silver	7440-22-4	ME-MS41/1L	0.01	ppm (w/w)		3.61	0.99	----	----	----
Sodium	7440-23-5	ME-MS41/1L	0.01	%		0.02	0.03	----	----	----
Strontium	7440-24-6	ME-MS41/1L	0.2	ppm (w/w)		19.4	21.2	----	----	----
Sulfur	7704-34-9	ME-MS41/1L	0.01	%		0.03	0.02	----	----	----
Tantalum	7440-25-7	ME-MS41/1L	0.01	ppm (w/w)		<0.01	<0.01	----	----	----
Tellurium	13494-80-9	ME-MS41/1L	0.01	ppm (w/w)		0.02	0.02	----	----	----
Thallium	7440-28-0	ME-MS41/1L	0.02	ppm (w/w)		0.12	0.15	----	----	----
Thorium	7440-29-1	ME-MS41/1L	0.2	ppm (w/w)		1.0	1.1	----	----	----
Tin	7440-31-5	ME-MS41/1L	0.2	ppm (w/w)		0.5	0.3	----	----	----
Titanium	7440-32-6	ME-MS41/1L	0.005	%		0.019	0.031	----	----	----
Tungsten	7440-33-7	ME-MS41/1L	0.05	ppm (w/w)		5.69	4.22	----	----	----
Uranium	7440-61-1	ME-MS41/1L	0.05	ppm (w/w)		1.08	0.92	----	----	----
Vanadium	7440-62-2	ME-MS41/1L	1	ppm (w/w)		27	34	----	----	----
Yttrium	7440-65-5	ME-MS41/1L	0.05	ppm (w/w)		5.30	4.56	----	----	----
Zinc	7440-66-6	ME-MS41/1L	2	ppm (w/w)		1235	98	----	----	----
Zirconium	7440-67-7	ME-MS41/1L	0.5	ppm (w/w)		<0.5	<0.5	----	----	----
Exchangeable & Adsorbed Metals										
Aluminum, leachable	7429-90-5	E450/VA	50	mg/kg		----	<50	----	----	----
Antimony, leachable	7440-36-0	E450/VA	0.10	mg/kg		----	0.19	----	----	----
Arsenic, leachable	7440-38-2	E450/VA	0.050	mg/kg		----	0.248	----	----	----
Barium, leachable	7440-39-3	E450/VA	0.50	mg/kg		----	37.9	----	----	----
Beryllium, leachable	7440-41-7	E450/VA	0.20	mg/kg		----	<0.20	----	----	----
Bismuth, leachable	7440-69-9	E450/VA	0.20	mg/kg		----	<0.20	----	----	----
Cadmium, leachable	7440-43-9	E450/VA	0.050	mg/kg		----	0.179	----	----	----
Calcium, leachable	7440-70-2	E450/VA	50	mg/kg		----	2180	----	----	----

Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	BM-23-NAT-2-RB	BM-23-NAT-4	----	----	----
					Client sampling date / time	17-Sep-2023 13:15	17-Sep-2023 14:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit		WR2301603-006	WR2301603-007	--------	--------	--------
						Result	Result	----	----	----
Exchangeable & Adsorbed Metals										
Chromium, leachable	7440-47-3	E450/VA	0.50	mg/kg		----	<0.50	----	----	----
Cobalt, leachable	7440-48-4	E450/VA	0.10	mg/kg		----	0.29	----	----	----
Copper, leachable	7440-50-8	E450/VA	0.50	mg/kg		----	<0.50	----	----	----
Iron, leachable	7439-89-6	E450/VA	50	mg/kg		----	<50	----	----	----
Lead, leachable	7439-92-1	E450/VA	0.50	mg/kg		----	0.58	----	----	----
Lithium, leachable	7439-93-2	E450/VA	5.0	mg/kg		----	<5.0	----	----	----
Manganese, leachable	7439-96-5	E450/VA	1.0	mg/kg		----	92.7	----	----	----
Molybdenum, leachable	7439-98-7	E450/VA	0.50	mg/kg		----	<0.50	----	----	----
Nickel, leachable	7440-02-0	E450/VA	0.50	mg/kg		----	<0.50	----	----	----
Phosphorus, leachable	7723-14-0	E450/VA	50	mg/kg		----	<50	----	----	----
Potassium, leachable	7440-09-7	E450/VA	100	mg/kg		----	120	----	----	----
Selenium, leachable	7782-49-2	E450/VA	0.20	mg/kg		----	<0.20	----	----	----
Silver, leachable	7440-22-4	E450/VA	0.10	mg/kg		----	<0.10	----	----	----
Sodium, leachable	7440-23-5	E450/VA	100	mg/kg		----	170	----	----	----
Strontium, leachable	7440-24-6	E450/VA	0.50	mg/kg		----	10.6	----	----	----
Thallium, leachable	7440-28-0	E450/VA	0.050	mg/kg		----	<0.050	----	----	----
Tin, leachable	7440-31-5	E450/VA	2.0	mg/kg		----	<2.0	----	----	----
Titanium, leachable	7440-32-6	E450/VA	1.0	mg/kg		----	<1.0	----	----	----
Uranium, leachable	7440-61-1	E450/VA	0.050	mg/kg		----	<0.050	----	----	----
Vanadium, leachable	7440-62-2	E450/VA	0.20	mg/kg		----	<0.20	----	----	----
Zinc, leachable	7440-66-6	E450/VA	1.0	mg/kg		----	1.2	----	----	----
Carbonate Metals										
Aluminum, leachable	7429-90-5	E450A/VA	50	mg/kg		----	<50	----	----	----
Antimony, leachable	7440-36-0	E450A/VA	0.10	mg/kg		----	0.16	----	----	----
Arsenic, leachable	7440-38-2	E450A/VA	0.050	mg/kg		----	0.792	----	----	----
Barium, leachable	7440-39-3	E450A/VA	2.0	mg/kg		----	20.0	----	----	----
Beryllium, leachable	7440-41-7	E450A/VA	0.20	mg/kg		----	<0.20	----	----	----
Bismuth, leachable	7440-69-9	E450A/VA	0.20	mg/kg		----	<0.20	----	----	----
Cadmium, leachable	7440-43-9	E450A/VA	0.050	mg/kg		----	0.071	----	----	----
Calcium, leachable	7440-70-2	E450A/VA	50	mg/kg		----	187	----	----	----

Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	BM-23-NAT-2-RB	BM-23-NAT-4	----	----	----
					Client sampling date / time	17-Sep-2023 13:15	17-Sep-2023 14:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit		WR2301603-006	WR2301603-007	--------	--------	--------
						Result	Result	----	----	----
Carbonate Metals										
Chromium, leachable	7440-47-3	E450A/VA	5.0	mg/kg		----	<5.0	----	----	----
Cobalt, leachable	7440-48-4	E450A/VA	0.10	mg/kg		----	0.24	----	----	----
Copper, leachable	7440-50-8	E450A/VA	0.50	mg/kg		----	0.68	----	----	----
Iron, leachable	7439-89-6	E450A/VA	50	mg/kg		----	100	----	----	----
Lead, leachable	7439-92-1	E450A/VA	0.50	mg/kg		----	5.56	----	----	----
Lithium, leachable	7439-93-2	E450A/VA	5.0	mg/kg		----	<5.0	----	----	----
Manganese, leachable	7439-96-5	E450A/VA	5.0	mg/kg		----	15.6	----	----	----
Molybdenum, leachable	7439-98-7	E450A/VA	0.50	mg/kg		----	<0.50	----	----	----
Nickel, leachable	7440-02-0	E450A/VA	2.0	mg/kg		----	<2.0	----	----	----
Phosphorus, leachable	7723-14-0	E450A/VA	50	mg/kg		----	<50	----	----	----
Selenium, leachable	7782-49-2	E450A/VA	0.20	mg/kg		----	<0.20	----	----	----
Silver, leachable	7440-22-4	E450A/VA	0.10	mg/kg		----	<0.10	----	----	----
Strontium, leachable	7440-24-6	E450A/VA	5.0	mg/kg		----	<5.0	----	----	----
Thallium, leachable	7440-28-0	E450A/VA	0.050	mg/kg		----	<0.050	----	----	----
Tin, leachable	7440-31-5	E450A/VA	2.0	mg/kg		----	<2.0	----	----	----
Titanium, leachable	7440-32-6	E450A/VA	5.0	mg/kg		----	<5.0	----	----	----
Uranium, leachable	7440-61-1	E450A/VA	0.050	mg/kg		----	0.347	----	----	----
Vanadium, leachable	7440-62-2	E450A/VA	0.20	mg/kg		----	0.34	----	----	----
Zinc, leachable	7440-66-6	E450A/VA	1.0	mg/kg		----	3.7	----	----	----
Easily Reducible Metals and Iron Oxides										
Aluminum, leachable	7429-90-5	E450B/VA	50	mg/kg		----	994	----	----	----
Antimony, leachable	7440-36-0	E450B/VA	0.10	mg/kg		----	0.22	----	----	----
Arsenic, leachable	7440-38-2	E450B/VA	0.050	mg/kg		----	4.45	----	----	----
Barium, leachable	7440-39-3	E450B/VA	0.50	mg/kg		----	35.0	----	----	----
Beryllium, leachable	7440-41-7	E450B/VA	0.20	mg/kg		----	<0.20	----	----	----
Bismuth, leachable	7440-69-9	E450B/VA	0.20	mg/kg		----	<0.20	----	----	----
Cadmium, leachable	7440-43-9	E450B/VA	0.050	mg/kg		----	0.343	----	----	----
Calcium, leachable	7440-70-2	E450B/VA	50	mg/kg		----	214	----	----	----
Chromium, leachable	7440-47-3	E450B/VA	0.50	mg/kg		----	2.68	----	----	----
Cobalt, leachable	7440-48-4	E450B/VA	0.10	mg/kg		----	2.76	----	----	----

Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	BM-23-NAT-2-RB	BM-23-NAT-4	----	----	----
					Client sampling date / time	17-Sep-2023 13:15	17-Sep-2023 14:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit		WR2301603-006	WR2301603-007	--------	--------	--------
						Result	Result	----	----	----
Easily Reducible Metals and Iron Oxides										
Copper, leachable	7440-50-8	E450B/VA	0.50	mg/kg		----	2.84	----	----	----
Iron, leachable	7439-89-6	E450B/VA	50	mg/kg		----	4970	----	----	----
Lead, leachable	7439-92-1	E450B/VA	0.50	mg/kg		----	23.4	----	----	----
Lithium, leachable	7439-93-2	E450B/VA	5.0	mg/kg		----	<5.0	----	----	----
Manganese, leachable	7439-96-5	E450B/VA	1.0	mg/kg		----	71.3	----	----	----
Molybdenum, leachable	7439-98-7	E450B/VA	0.50	mg/kg		----	<0.50	----	----	----
Nickel, leachable	7440-02-0	E450B/VA	0.50	mg/kg		----	2.67	----	----	----
Phosphorus, leachable	7723-14-0	E450B/VA	50	mg/kg		----	69	----	----	----
Selenium, leachable	7782-49-2	E450B/VA	0.20	mg/kg		----	<0.20	----	----	----
Silver, leachable	7440-22-4	E450B/VA	0.10	mg/kg		----	<0.10	----	----	----
Strontium, leachable	7440-24-6	E450B/VA	0.50	mg/kg		----	1.43	----	----	----
Thallium, leachable	7440-28-0	E450B/VA	0.050	mg/kg		----	<0.050	----	----	----
Tin, leachable	7440-31-5	E450B/VA	2.0	mg/kg		----	<2.0	----	----	----
Titanium, leachable	7440-32-6	E450B/VA	1.0	mg/kg		----	1.4	----	----	----
Uranium, leachable	7440-61-1	E450B/VA	0.050	mg/kg		----	0.278	----	----	----
Vanadium, leachable	7440-62-2	E450B/VA	0.20	mg/kg		----	6.85	----	----	----
Zinc, leachable	7440-66-6	E450B/VA	1.0	mg/kg		----	29.6	----	----	----
Organic Bound Metals										
Aluminum, leachable	7429-90-5	E450C/VA	50	mg/kg		----	1300	----	----	----
Antimony, leachable	7440-36-0	E450C/VA	0.10	mg/kg		----	0.12	----	----	----
Arsenic, leachable	7440-38-2	E450C/VA	0.050	mg/kg		----	0.437	----	----	----
Barium, leachable	7440-39-3	E450C/VA	0.50	mg/kg		----	14.9	----	----	----
Beryllium, leachable	7440-41-7	E450C/VA	0.20	mg/kg		----	<0.20	----	----	----
Bismuth, leachable	7440-69-9	E450C/VA	0.20	mg/kg		----	<0.20	----	----	----
Cadmium, leachable	7440-43-9	E450C/VA	0.050	mg/kg		----	<0.050	----	----	----
Calcium, leachable	7440-70-2	E450C/VA	50	mg/kg		----	194	----	----	----
Chromium, leachable	7440-47-3	E450C/VA	0.50	mg/kg		----	4.73	----	----	----
Cobalt, leachable	7440-48-4	E450C/VA	0.10	mg/kg		----	0.87	----	----	----
Copper, leachable	7440-50-8	E450C/VA	0.50	mg/kg		----	7.88	----	----	----
Iron, leachable	7439-89-6	E450C/VA	50	mg/kg		----	463	----	----	----

Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	BM-23-NAT-2-RB	BM-23-NAT-4	----	----	----
					Client sampling date / time	17-Sep-2023 13:15	17-Sep-2023 14:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit		WR2301603-006	WR2301603-007	--------	--------	--------
						Result	Result	----	----	----
Organic Bound Metals										
Lead, leachable	7439-92-1	E450C/VA	0.50	mg/kg		----	3.14	----	----	----
Lithium, leachable	7439-93-2	E450C/VA	5.0	mg/kg		----	<5.0	----	----	----
Manganese, leachable	7439-96-5	E450C/VA	1.0	mg/kg		----	11.2	----	----	----
Molybdenum, leachable	7439-98-7	E450C/VA	0.50	mg/kg		----	0.69	----	----	----
Nickel, leachable	7440-02-0	E450C/VA	0.50	mg/kg		----	1.79	----	----	----
Selenium, leachable	7782-49-2	E450C/VA	0.20	mg/kg		----	0.49	----	----	----
Silver, leachable	7440-22-4	E450C/VA	0.10	mg/kg		----	0.29	----	----	----
Strontium, leachable	7440-24-6	E450C/VA	0.50	mg/kg		----	1.02	----	----	----
Thallium, leachable	7440-28-0	E450C/VA	0.050	mg/kg		----	<0.050	----	----	----
Tin, leachable	7440-31-5	E450C/VA	2.0	mg/kg		----	<2.0	----	----	----
Titanium, leachable	7440-32-6	E450C/VA	1.0	mg/kg		----	6.9	----	----	----
Uranium, leachable	7440-61-1	E450C/VA	0.050	mg/kg		----	0.102	----	----	----
Vanadium, leachable	7440-62-2	E450C/VA	0.20	mg/kg		----	4.24	----	----	----
Zinc, leachable	7440-66-6	E450C/VA	1.0	mg/kg		----	9.4	----	----	----
Residual Metals										
Aluminum, leachable	7429-90-5	E450D/VA	50	mg/kg		----	1470	----	----	----
Antimony, leachable	7440-36-0	E450D/VA	0.10	mg/kg		----	0.69	----	----	----
Arsenic, leachable	7440-38-2	E450D/VA	5.00	mg/kg		----	<5.00	----	----	----
Barium, leachable	7440-39-3	E450D/VA	2.0	mg/kg		----	7.7	----	----	----
Beryllium, leachable	7440-41-7	E450D/VA	0.20	mg/kg		----	<0.20	----	----	----
Bismuth, leachable	7440-69-9	E450D/VA	0.20	mg/kg		----	<0.20	----	----	----
Cadmium, leachable	7440-43-9	E450D/VA	0.050	mg/kg		----	<0.050	----	----	----
Calcium, leachable	7440-70-2	E450D/VA	50	mg/kg		----	169	----	----	----
Chromium, leachable	7440-47-3	E450D/VA	5.0	mg/kg		----	<5.0	----	----	----
Cobalt, leachable	7440-48-4	E450D/VA	0.10	mg/kg		----	0.74	----	----	----
Copper, leachable	7440-50-8	E450D/VA	0.50	mg/kg		----	2.82	----	----	----
Iron, leachable	7439-89-6	E450D/VA	50	mg/kg		----	2500	----	----	----
Lead, leachable	7439-92-1	E450D/VA	0.50	mg/kg		----	3.09	----	----	----
Lithium, leachable	7439-93-2	E450D/VA	5.0	mg/kg		----	<5.0	----	----	----
Manganese, leachable	7439-96-5	E450D/VA	5.0	mg/kg		----	17.7	----	----	----

Analytical Results

Sub-Matrix: **Soil**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	BM-23-NAT-2-RB	BM-23-NAT-4	----	----	----
					Client sampling date / time	17-Sep-2023 13:15	17-Sep-2023 14:00	----	----	----
						WR2301603-006	WR2301603-007	--------	--------	--------
						Result	Result	----	----	----
Residual Metals										
Molybdenum, leachable	7439-98-7	E450D/VA	0.50	mg/kg		----	<0.50	----	----	----
Nickel, leachable	7440-02-0	E450D/VA	2.0	mg/kg		----	2.1	----	----	----
Selenium, leachable	7782-49-2	E450D/VA	0.20	mg/kg		----	<0.20	----	----	----
Silver, leachable	7440-22-4	E450D/VA	0.10	mg/kg		----	0.14	----	----	----
Strontium, leachable	7440-24-6	E450D/VA	5.0	mg/kg		----	<5.0	----	----	----
Thallium, leachable	7440-28-0	E450D/VA	0.050	mg/kg		----	<0.050	----	----	----
Tin, leachable	7440-31-5	E450D/VA	2.0	mg/kg		----	<2.0	----	----	----
Titanium, leachable	7440-32-6	E450D/VA	5.0	mg/kg		----	42.4	----	----	----
Uranium, leachable	7440-61-1	E450D/VA	0.050	mg/kg		----	0.053	----	----	----
Vanadium, leachable	7440-62-2	E450D/VA	0.20	mg/kg		----	4.13	----	----	----
Zinc, leachable	7440-66-6	E450D/VA	1.0	mg/kg		----	8.7	----	----	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

ALS Canada Ltd.

QUALITY CONTROL REPORT

Work Order	: **WR2301603**	Page	: 1 of 17
Client	: Alexco Keno Hill Mining Corp	Laboratory	: ALS Environmental - Whitehorse
Contact	: Accounts Payable	Account Manager	: Thomas Chang
Address	: #2 Calcite Business Centre - 151 Industrial Road Whitehorse YT Canada Y1A 2V3	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	:	Telephone	: +1 867 668 6689
Project	: Bermingham Natural Attenuation Study	Date Samples Received	: 21-Dec-2023 13:15
PO	: ----	Date Analysis Commenced	: 03-Jan-2024
C-O-C number	: ----	Issue Date	: 16-Jan-2024 10:20
Sampler	: CM ----		
Site	: 2022 Pricing		
Quote number	: WR22-AKHM100-004 (Keno/Hecla)		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Dan Gebert	Laboratory Analyst	Vancouver Metals, Burnaby, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Vancouver Metals, Burnaby, British Columbia
Paolo Obillo	Account Manager Assistant	ALS Minerals (Vancouver) Internal Subcontracting, North Vancouver, British Columbia

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Exchangeable & Adsorbed Metals (QC Lot: 1293071)											
WR2301603-001	BM-23-NAT-2	Aluminum, leachable	7429-90-5	E450	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		Antimony, leachable	7440-36-0	E450	0.10	mg/kg	0.86	1.00	15.5%	30%	----
		Arsenic, leachable	7440-38-2	E450	0.050	mg/kg	0.293	0.345	0.052	Diff <2x LOR	----
		Barium, leachable	7440-39-3	E450	0.50	mg/kg	7.46	8.23	9.75%	30%	----
		Beryllium, leachable	7440-41-7	E450	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Bismuth, leachable	7440-69-9	E450	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Cadmium, leachable	7440-43-9	E450	0.050	mg/kg	4.55	2.96	42.2%	30%	DUP-H
		Calcium, leachable	7440-70-2	E450	50	mg/kg	4880	5550	12.8%	30%	----
		Chromium, leachable	7440-47-3	E450	0.50	mg/kg	<0.50	<0.50	0	Diff <2x LOR	----
		Cobalt, leachable	7440-48-4	E450	0.10	mg/kg	<0.10	0.14	0.04	Diff <2x LOR	----
		Copper, leachable	7440-50-8	E450	0.50	mg/kg	0.70	<0.50	0.20	Diff <2x LOR	----
		Iron, leachable	7439-89-6	E450	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		Lead, leachable	7439-92-1	E450	0.50	mg/kg	<0.50	<0.50	0	Diff <2x LOR	----
		Lithium, leachable	7439-93-2	E450	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Manganese, leachable	7439-96-5	E450	1.0	mg/kg	59.2	87.1	38.2%	30%	DUP-H
		Molybdenum, leachable	7439-98-7	E450	0.50	mg/kg	0.58	0.76	0.19	Diff <2x LOR	----
		Nickel, leachable	7440-02-0	E450	0.50	mg/kg	1.93	2.18	0.25	Diff <2x LOR	----
		Phosphorus, leachable	7723-14-0	E450	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		Potassium, leachable	7440-09-7	E450	100	mg/kg	160	190	20	Diff <2x LOR	----
		Selenium, leachable	7782-49-2	E450	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Silver, leachable	7440-22-4	E450	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Sodium, leachable	7440-23-5	E450	100	mg/kg	640	690	50	Diff <2x LOR	----
		Strontium, leachable	7440-24-6	E450	0.50	mg/kg	24.3	28.0	14.2%	30%	----
		Thallium, leachable	7440-28-0	E450	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Tin, leachable	7440-31-5	E450	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium, leachable	7440-32-6	E450	1.0	mg/kg	<1.0	<1.0	0	Diff <2x LOR	----
		Uranium, leachable	7440-61-1	E450	0.050	mg/kg	0.323	0.482	39.6%	30%	DUP-H
		Vanadium, leachable	7440-62-2	E450	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Zinc, leachable	7440-66-6	E450	1.0	mg/kg	5.9	7.7	27.2%	30%	----
Carbonate Metals (QC Lot: 1294464)											

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Carbonate Metals (QC Lot: 1294464) - continued											
WR2301603-001	BM-23-NAT-2	Aluminum, leachable	7429-90-5	E450A	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		Antimony, leachable	7440-36-0	E450A	0.10	mg/kg	0.96	1.08	11.9%	30%	----
		Arsenic, leachable	7440-38-2	E450A	0.050	mg/kg	0.514	0.713	32.3%	30%	DUP-H
		Barium, leachable	7440-39-3	E450A	2.0	mg/kg	28.9	29.5	1.81%	30%	----
		Beryllium, leachable	7440-41-7	E450A	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Bismuth, leachable	7440-69-9	E450A	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Cadmium, leachable	7440-43-9	E450A	0.050	mg/kg	11.1	10.9	1.45%	30%	----
		Calcium, leachable	7440-70-2	E450A	50	mg/kg	31100	31600	1.57%	30%	----
		Chromium, leachable	7440-47-3	E450A	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Cobalt, leachable	7440-48-4	E450A	0.10	mg/kg	0.22	0.33	0.11	Diff <2x LOR	----
		Copper, leachable	7440-50-8	E450A	0.50	mg/kg	0.69	<0.50	0.19	Diff <2x LOR	----
		Iron, leachable	7439-89-6	E450A	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		Lead, leachable	7439-92-1	E450A	0.50	mg/kg	28.0	28.9	3.23%	30%	----
		Lithium, leachable	7439-93-2	E450A	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Manganese, leachable	7439-96-5	E450A	5.0	mg/kg	474	536	12.3%	30%	----
		Molybdenum, leachable	7439-98-7	E450A	0.50	mg/kg	<0.50	<0.50	0	Diff <2x LOR	----
		Nickel, leachable	7440-02-0	E450A	2.0	mg/kg	11.1	12.9	1.8	Diff <2x LOR	----
		Phosphorus, leachable	7723-14-0	E450A	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		Selenium, leachable	7782-49-2	E450A	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Silver, leachable	7440-22-4	E450A	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Strontium, leachable	7440-24-6	E450A	5.0	mg/kg	41.8	42.1	0.829%	30%	----
		Thallium, leachable	7440-28-0	E450A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Tin, leachable	7440-31-5	E450A	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium, leachable	7440-32-6	E450A	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Uranium, leachable	7440-61-1	E450A	0.050	mg/kg	1.14	2.06	57.1%	30%	DUP-H
		Vanadium, leachable	7440-62-2	E450A	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Zinc, leachable	7440-66-6	E450A	1.0	mg/kg	339	337	0.661%	30%	----
Easily Reducible Metals and Iron Oxides (QC Lot: 1295492)											
WR2301603-001	BM-23-NAT-2	Aluminum, leachable	7429-90-5	E450B	50	mg/kg	1350	1300	4.28%	30%	----
		Antimony, leachable	7440-36-0	E450B	0.10	mg/kg	2.99	2.28	26.8%	30%	----
		Arsenic, leachable	7440-38-2	E450B	0.050	mg/kg	62.3	63.9	2.62%	30%	----
		Barium, leachable	7440-39-3	E450B	0.50	mg/kg	49.0	49.4	0.782%	30%	----
		Beryllium, leachable	7440-41-7	E450B	0.20	mg/kg	0.40	0.40	0.002	Diff <2x LOR	----
		Bismuth, leachable	7440-69-9	E450B	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Easily Reducible Metals and Iron Oxides (QC Lot: 1295492) - continued											
WR2301603-001	BM-23-NAT-2	Cadmium, leachable	7440-43-9	E450B	0.050	mg/kg	9.35	13.6	36.8%	30%	DUP-H
		Calcium, leachable	7440-70-2	E450B	50	mg/kg	5340	5290	0.834%	30%	----
		Chromium, leachable	7440-47-3	E450B	0.50	mg/kg	16.6	15.6	6.02%	30%	----
		Cobalt, leachable	7440-48-4	E450B	0.10	mg/kg	10.2	10.9	6.76%	30%	----
		Copper, leachable	7440-50-8	E450B	0.50	mg/kg	3.60	3.29	8.84%	30%	----
		Iron, leachable	7439-89-6	E450B	50	mg/kg	18400	17000	8.08%	30%	----
		Lead, leachable	7439-92-1	E450B	0.50	mg/kg	650	584	10.7%	30%	----
		Lithium, leachable	7439-93-2	E450B	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Manganese, leachable	7439-96-5	E450B	1.0	mg/kg	3280	3320	1.48%	30%	----
		Molybdenum, leachable	7439-98-7	E450B	0.50	mg/kg	0.91	0.78	0.12	Diff <2x LOR	----
		Nickel, leachable	7440-02-0	E450B	0.50	mg/kg	51.1	56.8	10.6%	30%	----
		Phosphorus, leachable	7723-14-0	E450B	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		Selenium, leachable	7782-49-2	E450B	0.20	mg/kg	0.24	0.26	0.02	Diff <2x LOR	----
		Silver, leachable	7440-22-4	E450B	0.10	mg/kg	0.98	0.88	10.5%	30%	----
		Strontium, leachable	7440-24-6	E450B	0.50	mg/kg	9.41	9.65	2.46%	30%	----
		Thallium, leachable	7440-28-0	E450B	0.050	mg/kg	0.112	0.142	0.031	Diff <2x LOR	----
		Tin, leachable	7440-31-5	E450B	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium, leachable	7440-32-6	E450B	1.0	mg/kg	<1.0	<1.0	0	Diff <2x LOR	----
		Uranium, leachable	7440-61-1	E450B	0.050	mg/kg	1.32	2.27	53.1%	30%	DUP-H
		Vanadium, leachable	7440-62-2	E450B	0.20	mg/kg	22.1	20.3	8.43%	30%	----
		Zinc, leachable	7440-66-6	E450B	1.0	mg/kg	851	889	4.37%	30%	----
Organic Bound Metals (QC Lot: 1296033)											
WR2301603-001	BM-23-NAT-2	Aluminum, leachable	7429-90-5	E450C	50	mg/kg	1460	2070	34.4%	30%	DUP-H
		Antimony, leachable	7440-36-0	E450C	0.10	mg/kg	2.59	6.56	86.8%	30%	DUP-H
		Arsenic, leachable	7440-38-2	E450C	0.050	mg/kg	18.0	53.5	99.2%	30%	DUP-H
		Barium, leachable	7440-39-3	E450C	0.50	mg/kg	12.5	13.2	5.00%	30%	----
		Beryllium, leachable	7440-41-7	E450C	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Bismuth, leachable	7440-69-9	E450C	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Cadmium, leachable	7440-43-9	E450C	0.050	mg/kg	3.57	3.99	11.1%	30%	----
		Calcium, leachable	7440-70-2	E450C	50	mg/kg	196	253	57	Diff <2x LOR	----
		Chromium, leachable	7440-47-3	E450C	0.50	mg/kg	10.4	16.6	46.6%	30%	DUP-H
		Cobalt, leachable	7440-48-4	E450C	0.10	mg/kg	1.40	1.88	29.8%	30%	----
		Copper, leachable	7440-50-8	E450C	0.50	mg/kg	28.8	33.0	13.5%	30%	----
		Iron, leachable	7439-89-6	E450C	50	mg/kg	3430	5040	37.9%	30%	DUP-H

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Organic Bound Metals (QC Lot: 1296033) - continued											
WR2301603-001	BM-23-NAT-2	Lead, leachable	7439-92-1	E450C	0.50	mg/kg	123	121	1.78%	30%	----
		Lithium, leachable	7439-93-2	E450C	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Manganese, leachable	7439-96-5	E450C	1.0	mg/kg	182	202	10.0%	30%	----
		Molybdenum, leachable	7439-98-7	E450C	0.50	mg/kg	1.41	# 2.78	1.37	Diff <2x LOR	DUP-H
		Nickel, leachable	7440-02-0	E450C	0.50	mg/kg	9.77	15.1	42.7%	30%	DUP-H
		Selenium, leachable	7782-49-2	E450C	0.20	mg/kg	1.08	1.66	42.2%	30%	DUP-H
		Silver, leachable	7440-22-4	E450C	0.10	mg/kg	1.00	0.62	46.5%	30%	DUP-H
		Strontium, leachable	7440-24-6	E450C	0.50	mg/kg	0.68	0.85	0.17	Diff <2x LOR	----
		Thallium, leachable	7440-28-0	E450C	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Tin, leachable	7440-31-5	E450C	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium, leachable	7440-32-6	E450C	1.0	mg/kg	<1.0	<1.0	0	Diff <2x LOR	----
		Uranium, leachable	7440-61-1	E450C	0.050	mg/kg	0.333	0.635	62.4%	30%	DUP-H
		Vanadium, leachable	7440-62-2	E450C	0.20	mg/kg	6.97	13.5	64.0%	30%	DUP-H
		Zinc, leachable	7440-66-6	E450C	1.0	mg/kg	330	344	4.14%	30%	----
Residual Metals (QC Lot: 1298134)											
WR2301603-001	BM-23-NAT-2	Aluminum, leachable	7429-90-5	E450D	50	mg/kg	2040	1530	28.3%	30%	----
		Antimony, leachable	7440-36-0	E450D	0.10	mg/kg	9.12	7.60	18.3%	30%	----
		Arsenic, leachable	7440-38-2	E450D	5.00	mg/kg	60.1	39.1	42.3%	30%	DUP-H
		Barium, leachable	7440-39-3	E450D	2.0	mg/kg	10.3	8.5	1.8	Diff <2x LOR	----
		Beryllium, leachable	7440-41-7	E450D	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Bismuth, leachable	7440-69-9	E450D	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Cadmium, leachable	7440-43-9	E450D	0.050	mg/kg	0.184	0.181	0.002	Diff <2x LOR	----
		Calcium, leachable	7440-70-2	E450D	50	mg/kg	188	145	43	Diff <2x LOR	----
		Chromium, leachable	7440-47-3	E450D	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Cobalt, leachable	7440-48-4	E450D	0.10	mg/kg	0.62	0.45	0.16	Diff <2x LOR	----
		Copper, leachable	7440-50-8	E450D	0.50	mg/kg	2.48	2.04	0.44	Diff <2x LOR	----
		Iron, leachable	7439-89-6	E450D	50	mg/kg	3440	2460	32.9%	30%	DUP-H
		Lead, leachable	7439-92-1	E450D	0.50	mg/kg	39.6	39.9	0.776%	30%	----
		Lithium, leachable	7439-93-2	E450D	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Manganese, leachable	7439-96-5	E450D	5.0	mg/kg	23.5	19.0	4.5	Diff <2x LOR	----
		Molybdenum, leachable	7439-98-7	E450D	0.50	mg/kg	0.74	<0.50	0.24	Diff <2x LOR	----
		Nickel, leachable	7440-02-0	E450D	2.0	mg/kg	3.5	2.6	0.9	Diff <2x LOR	----
		Selenium, leachable	7782-49-2	E450D	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Silver, leachable	7440-22-4	E450D	0.10	mg/kg	7.58	6.79	11.0%	30%	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Residual Metals (QC Lot: 1298134) - continued											
WR2301603-001	BM-23-NAT-2	Strontium, leachable	7440-24-6	E450D	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Thallium, leachable	7440-28-0	E450D	0.050	mg/kg	0.056	<0.050	0.006	Diff <2x LOR	----
		Tin, leachable	7440-31-5	E450D	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium, leachable	7440-32-6	E450D	5.0	mg/kg	11.8	9.8	2.0	Diff <2x LOR	----
		Uranium, leachable	7440-61-1	E450D	0.050	mg/kg	0.146	0.112	0.033	Diff <2x LOR	----
		Vanadium, leachable	7440-62-2	E450D	0.20	mg/kg	4.93	3.44	35.7%	30%	DUP-H
		Zinc, leachable	7440-66-6	E450D	1.0	mg/kg	26.8	23.0	14.9%	30%	----

Qualifiers

Qualifier	*Description*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Exchangeable & Adsorbed Metals (QCLot: 1293071)						
Aluminum, leachable	7429-90-5	E450	50	mg/kg	<50	----
Antimony, leachable	7440-36-0	E450	0.1	mg/kg	<0.10	----
Arsenic, leachable	7440-38-2	E450	0.05	mg/kg	<0.050	----
Barium, leachable	7440-39-3	E450	0.5	mg/kg	<0.50	----
Beryllium, leachable	7440-41-7	E450	0.2	mg/kg	<0.20	----
Bismuth, leachable	7440-69-9	E450	0.2	mg/kg	<0.20	----
Cadmium, leachable	7440-43-9	E450	0.05	mg/kg	<0.050	----
Calcium, leachable	7440-70-2	E450	50	mg/kg	<50	----
Chromium, leachable	7440-47-3	E450	0.5	mg/kg	<0.50	----
Cobalt, leachable	7440-48-4	E450	0.1	mg/kg	<0.10	----
Copper, leachable	7440-50-8	E450	0.5	mg/kg	<0.50	----
Iron, leachable	7439-89-6	E450	50	mg/kg	<50	----
Lead, leachable	7439-92-1	E450	0.5	mg/kg	<0.50	----
Lithium, leachable	7439-93-2	E450	5	mg/kg	<5.0	----
Manganese, leachable	7439-96-5	E450	1	mg/kg	<1.0	----
Molybdenum, leachable	7439-98-7	E450	0.5	mg/kg	<0.50	----
Nickel, leachable	7440-02-0	E450	0.5	mg/kg	<0.50	----
Phosphorus, leachable	7723-14-0	E450	50	mg/kg	<50	----
Potassium, leachable	7440-09-7	E450	100	mg/kg	<100	----
Selenium, leachable	7782-49-2	E450	0.2	mg/kg	<0.20	----
Silver, leachable	7440-22-4	E450	0.1	mg/kg	<0.10	----
Sodium, leachable	7440-23-5	E450	100	mg/kg	<100	----
Strontium, leachable	7440-24-6	E450	0.5	mg/kg	<0.50	----
Thallium, leachable	7440-28-0	E450	0.05	mg/kg	<0.050	----
Tin, leachable	7440-31-5	E450	2	mg/kg	<2.0	----
Titanium, leachable	7440-32-6	E450	1	mg/kg	<1.0	----
Uranium, leachable	7440-61-1	E450	0.05	mg/kg	<0.050	----
Vanadium, leachable	7440-62-2	E450	0.2	mg/kg	<0.20	----
Zinc, leachable	7440-66-6	E450	1	mg/kg	<1.0	----
Carbonate Metals (QCLot: 1294464)						
Aluminum, leachable	7429-90-5	E450A	50	mg/kg	<50	----
Antimony, leachable	7440-36-0	E450A	0.1	mg/kg	<0.10	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Carbonate Metals (QCLot: 1294464) - continued						
Arsenic, leachable	7440-38-2	E450A	0.05	mg/kg	<0.050	----
Barium, leachable	7440-39-3	E450A	2	mg/kg	<2.0	----
Beryllium, leachable	7440-41-7	E450A	0.2	mg/kg	<0.20	----
Bismuth, leachable	7440-69-9	E450A	0.2	mg/kg	<0.20	----
Cadmium, leachable	7440-43-9	E450A	0.05	mg/kg	<0.050	----
Calcium, leachable	7440-70-2	E450A	50	mg/kg	<50	----
Chromium, leachable	7440-47-3	E450A	5	mg/kg	<5.0	----
Cobalt, leachable	7440-48-4	E450A	0.1	mg/kg	<0.10	----
Copper, leachable	7440-50-8	E450A	0.5	mg/kg	<0.50	----
Iron, leachable	7439-89-6	E450A	50	mg/kg	<50	----
Lead, leachable	7439-92-1	E450A	0.5	mg/kg	<0.50	----
Lithium, leachable	7439-93-2	E450A	5	mg/kg	<5.0	----
Manganese, leachable	7439-96-5	E450A	5	mg/kg	<5.0	----
Molybdenum, leachable	7439-98-7	E450A	0.5	mg/kg	<0.50	----
Nickel, leachable	7440-02-0	E450A	2	mg/kg	<2.0	----
Phosphorus, leachable	7723-14-0	E450A	50	mg/kg	<50	----
Selenium, leachable	7782-49-2	E450A	0.2	mg/kg	<0.20	----
Silver, leachable	7440-22-4	E450A	0.1	mg/kg	<0.10	----
Strontium, leachable	7440-24-6	E450A	5	mg/kg	<5.0	----
Thallium, leachable	7440-28-0	E450A	0.05	mg/kg	<0.050	----
Tin, leachable	7440-31-5	E450A	2	mg/kg	<2.0	----
Titanium, leachable	7440-32-6	E450A	5	mg/kg	<5.0	----
Uranium, leachable	7440-61-1	E450A	0.05	mg/kg	<0.050	----
Vanadium, leachable	7440-62-2	E450A	0.2	mg/kg	<0.20	----
Zinc, leachable	7440-66-6	E450A	1	mg/kg	<1.0	----
Easily Reducible Metals and Iron Oxides (QCLot: 1295492)						
Aluminum, leachable	7429-90-5	E450B	50	mg/kg	<50	----
Antimony, leachable	7440-36-0	E450B	0.1	mg/kg	<0.10	----
Arsenic, leachable	7440-38-2	E450B	0.05	mg/kg	<0.050	----
Barium, leachable	7440-39-3	E450B	0.5	mg/kg	<0.50	----
Beryllium, leachable	7440-41-7	E450B	0.2	mg/kg	<0.20	----
Bismuth, leachable	7440-69-9	E450B	0.2	mg/kg	<0.20	----
Cadmium, leachable	7440-43-9	E450B	0.05	mg/kg	<0.050	----
Calcium, leachable	7440-70-2	E450B	50	mg/kg	<50	----
Chromium, leachable	7440-47-3	E450B	0.5	mg/kg	<0.50	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Easily Reducible Metals and Iron Oxides (QCLot: 1295492) - continued						
Cobalt, leachable	7440-48-4	E450B	0.1	mg/kg	<0.10	----
Copper, leachable	7440-50-8	E450B	0.5	mg/kg	<0.50	----
Iron, leachable	7439-89-6	E450B	50	mg/kg	<50	----
Lead, leachable	7439-92-1	E450B	0.5	mg/kg	<0.50	----
Lithium, leachable	7439-93-2	E450B	5	mg/kg	<5.0	----
Manganese, leachable	7439-96-5	E450B	1	mg/kg	<1.0	----
Molybdenum, leachable	7439-98-7	E450B	0.5	mg/kg	<0.50	----
Nickel, leachable	7440-02-0	E450B	0.5	mg/kg	<0.50	----
Phosphorus, leachable	7723-14-0	E450B	50	mg/kg	<50	----
Selenium, leachable	7782-49-2	E450B	0.2	mg/kg	<0.20	----
Silver, leachable	7440-22-4	E450B	0.1	mg/kg	<0.10	----
Strontium, leachable	7440-24-6	E450B	0.5	mg/kg	<0.50	----
Thallium, leachable	7440-28-0	E450B	0.05	mg/kg	<0.050	----
Tin, leachable	7440-31-5	E450B	2	mg/kg	<2.0	----
Titanium, leachable	7440-32-6	E450B	1	mg/kg	<1.0	----
Uranium, leachable	7440-61-1	E450B	0.05	mg/kg	<0.050	----
Vanadium, leachable	7440-62-2	E450B	0.2	mg/kg	<0.20	----
Zinc, leachable	7440-66-6	E450B	1	mg/kg	<1.0	----
Organic Bound Metals (QCLot: 1296033)						
Aluminum, leachable	7429-90-5	E450C	50	mg/kg	<50	----
Antimony, leachable	7440-36-0	E450C	0.1	mg/kg	<0.10	----
Arsenic, leachable	7440-38-2	E450C	0.05	mg/kg	<0.050	----
Barium, leachable	7440-39-3	E450C	0.5	mg/kg	<0.50	----
Beryllium, leachable	7440-41-7	E450C	0.2	mg/kg	<0.20	----
Bismuth, leachable	7440-69-9	E450C	0.2	mg/kg	<0.20	----
Cadmium, leachable	7440-43-9	E450C	0.05	mg/kg	<0.050	----
Calcium, leachable	7440-70-2	E450C	50	mg/kg	<50	----
Chromium, leachable	7440-47-3	E450C	0.5	mg/kg	<0.50	----
Cobalt, leachable	7440-48-4	E450C	0.1	mg/kg	<0.10	----
Copper, leachable	7440-50-8	E450C	0.5	mg/kg	<0.50	----
Iron, leachable	7439-89-6	E450C	50	mg/kg	<50	----
Lead, leachable	7439-92-1	E450C	0.5	mg/kg	<0.50	----
Lithium, leachable	7439-93-2	E450C	5	mg/kg	<5.0	----
Manganese, leachable	7439-96-5	E450C	1	mg/kg	<1.0	----
Molybdenum, leachable	7439-98-7	E450C	0.5	mg/kg	<0.50	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Organic Bound Metals (QCLot: 1296033) - continued						
Nickel, leachable	7440-02-0	E450C	0.5	mg/kg	<0.50	----
Selenium, leachable	7782-49-2	E450C	0.2	mg/kg	<0.20	----
Silver, leachable	7440-22-4	E450C	0.1	mg/kg	<0.10	----
Strontium, leachable	7440-24-6	E450C	0.5	mg/kg	<0.50	----
Thallium, leachable	7440-28-0	E450C	0.05	mg/kg	<0.050	----
Tin, leachable	7440-31-5	E450C	2	mg/kg	<2.0	----
Titanium, leachable	7440-32-6	E450C	1	mg/kg	<1.0	----
Uranium, leachable	7440-61-1	E450C	0.05	mg/kg	<0.050	----
Vanadium, leachable	7440-62-2	E450C	0.2	mg/kg	<0.20	----
Zinc, leachable	7440-66-6	E450C	1	mg/kg	<1.0	----
Residual Metals (QCLot: 1298134)						
Aluminum, leachable	7429-90-5	E450D	50	mg/kg	<50	----
Antimony, leachable	7440-36-0	E450D	0.1	mg/kg	<0.10	----
Arsenic, leachable	7440-38-2	E450D	0.5	mg/kg	<0.50	----
Barium, leachable	7440-39-3	E450D	2	mg/kg	<2.0	----
Beryllium, leachable	7440-41-7	E450D	0.2	mg/kg	<0.20	----
Bismuth, leachable	7440-69-9	E450D	0.2	mg/kg	<0.20	----
Cadmium, leachable	7440-43-9	E450D	0.05	mg/kg	<0.050	----
Calcium, leachable	7440-70-2	E450D	50	mg/kg	<50	----
Chromium, leachable	7440-47-3	E450D	5	mg/kg	<5.0	----
Cobalt, leachable	7440-48-4	E450D	0.1	mg/kg	<0.10	----
Copper, leachable	7440-50-8	E450D	0.5	mg/kg	<0.50	----
Iron, leachable	7439-89-6	E450D	50	mg/kg	<50	----
Lead, leachable	7439-92-1	E450D	0.5	mg/kg	<0.50	----
Lithium, leachable	7439-93-2	E450D	5	mg/kg	<5.0	----
Manganese, leachable	7439-96-5	E450D	5	mg/kg	<5.0	----
Molybdenum, leachable	7439-98-7	E450D	0.5	mg/kg	<0.50	----
Nickel, leachable	7440-02-0	E450D	2	mg/kg	<2.0	----
Selenium, leachable	7782-49-2	E450D	0.2	mg/kg	<0.20	----
Silver, leachable	7440-22-4	E450D	0.1	mg/kg	<0.10	----
Strontium, leachable	7440-24-6	E450D	5	mg/kg	<5.0	----
Thallium, leachable	7440-28-0	E450D	0.05	mg/kg	<0.050	----
Tin, leachable	7440-31-5	E450D	2	mg/kg	<2.0	----
Titanium, leachable	7440-32-6	E450D	5	mg/kg	<5.0	----
Uranium, leachable	7440-61-1	E450D	0.05	mg/kg	<0.050	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Residual Metals (QCLot: 1298134) - continued						
Vanadium, leachable	7440-62-2	E450D	0.2	mg/kg	<0.20	----
Zinc, leachable	7440-66-6	E450D	1	mg/kg	<1.0	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Exchangeable & Adsorbed Metals (QCLot: 1293071)									
Aluminum, leachable	7429-90-5	E450	50	mg/kg	2 mg/kg	103	70.0	130	----
Antimony, leachable	7440-36-0	E450	0.1	mg/kg	0.2 mg/kg	100	70.0	130	----
Arsenic, leachable	7440-38-2	E450	0.05	mg/kg	0.2 mg/kg	103	70.0	130	----
Barium, leachable	7440-39-3	E450	0.5	mg/kg	0.2 mg/kg	97.9	70.0	130	----
Beryllium, leachable	7440-41-7	E450	0.2	mg/kg	0.4 mg/kg	110	70.0	130	----
Bismuth, leachable	7440-69-9	E450	0.2	mg/kg	0.1 mg/kg	97.2	70.0	130	----
Cadmium, leachable	7440-43-9	E450	0.05	mg/kg	0.04 mg/kg	106	70.0	130	----
Calcium, leachable	7440-70-2	E450	50	mg/kg	40 mg/kg	111	70.0	130	----
Chromium, leachable	7440-47-3	E450	0.5	mg/kg	0.4 mg/kg	103	70.0	130	----
Cobalt, leachable	7440-48-4	E450	0.1	mg/kg	0.2 mg/kg	99.9	70.0	130	----
Copper, leachable	7440-50-8	E450	0.5	mg/kg	0.2 mg/kg	96.9	70.0	130	----
Iron, leachable	7439-89-6	E450	50	mg/kg	20 mg/kg	101	70.0	130	----
Lead, leachable	7439-92-1	E450	0.5	mg/kg	0.2 mg/kg	96.7	70.0	130	----
Lithium, leachable	7439-93-2	E450	5	mg/kg	1 mg/kg	105	70.0	130	----
Manganese, leachable	7439-96-5	E450	1	mg/kg	0.2 mg/kg	100	70.0	130	----
Molybdenum, leachable	7439-98-7	E450	0.5	mg/kg	0.2 mg/kg	107	70.0	130	----
Nickel, leachable	7440-02-0	E450	0.5	mg/kg	0.4 mg/kg	98.6	70.0	130	----
Phosphorus, leachable	7723-14-0	E450	50	mg/kg	100 mg/kg	113	70.0	130	----
Potassium, leachable	7440-09-7	E450	100	mg/kg	40 mg/kg	103	70.0	130	----
Selenium, leachable	7782-49-2	E450	0.2	mg/kg	0.4 mg/kg	101	70.0	130	----
Silver, leachable	7440-22-4	E450	0.1	mg/kg	0.04 mg/kg	104	70.0	130	----
Sodium, leachable	7440-23-5	E450	100	mg/kg	20 mg/kg	109	70.0	130	----
Strontium, leachable	7440-24-6	E450	0.5	mg/kg	0.2 mg/kg	105	70.0	130	----
Thallium, leachable	7440-28-0	E450	0.05	mg/kg	0.04 mg/kg	102	70.0	130	----
Tin, leachable	7440-31-5	E450	2	mg/kg	0.2 mg/kg	103	70.0	130	----
Titanium, leachable	7440-32-6	E450	1	mg/kg	0.4 mg/kg	110	70.0	130	----
Uranium, leachable	7440-61-1	E450	0.05	mg/kg	0.04 mg/kg	102	70.0	130	----
Vanadium, leachable	7440-62-2	E450	0.2	mg/kg	1 mg/kg	106	70.0	130	----
Zinc, leachable	7440-66-6	E450	1	mg/kg	4 mg/kg	95.9	70.0	130	----
Carbonate Metals (QCLot: 1294464)									
Aluminum, leachable	7429-90-5	E450A	50	mg/kg	2 mg/kg	106	70.0	130	----
Antimony, leachable	7440-36-0	E450A	0.1	mg/kg	0.2 mg/kg	107	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Carbonate Metals (QCLot: 1294464) - continued									
Arsenic, leachable	7440-38-2	E450A	0.05	mg/kg	0.2 mg/kg	98.3	70.0	130	----
Barium, leachable	7440-39-3	E450A	2	mg/kg	0.2 mg/kg	106	70.0	130	----
Beryllium, leachable	7440-41-7	E450A	0.2	mg/kg	0.4 mg/kg	93.4	70.0	130	----
Bismuth, leachable	7440-69-9	E450A	0.2	mg/kg	0.1 mg/kg	96.0	70.0	130	----
Cadmium, leachable	7440-43-9	E450A	0.05	mg/kg	0.04 mg/kg	98.2	70.0	130	----
Calcium, leachable	7440-70-2	E450A	50	mg/kg	40 mg/kg	97.7	70.0	130	----
Chromium, leachable	7440-47-3	E450A	5	mg/kg	0.4 mg/kg	101	70.0	130	----
Cobalt, leachable	7440-48-4	E450A	0.1	mg/kg	0.2 mg/kg	96.3	70.0	130	----
Copper, leachable	7440-50-8	E450A	0.5	mg/kg	0.2 mg/kg	93.0	70.0	130	----
Iron, leachable	7439-89-6	E450A	50	mg/kg	20 mg/kg	97.2	70.0	130	----
Lead, leachable	7439-92-1	E450A	0.5	mg/kg	0.2 mg/kg	98.0	70.0	130	----
Lithium, leachable	7439-93-2	E450A	5	mg/kg	1 mg/kg	94.8	70.0	130	----
Manganese, leachable	7439-96-5	E450A	5	mg/kg	0.2 mg/kg	102	70.0	130	----
Molybdenum, leachable	7439-98-7	E450A	0.5	mg/kg	0.2 mg/kg	104	70.0	130	----
Nickel, leachable	7440-02-0	E450A	2	mg/kg	0.4 mg/kg	93.6	70.0	130	----
Phosphorus, leachable	7723-14-0	E450A	50	mg/kg	100 mg/kg	108	70.0	130	----
Selenium, leachable	7782-49-2	E450A	0.2	mg/kg	0.4 mg/kg	99.5	70.0	130	----
Silver, leachable	7440-22-4	E450A	0.1	mg/kg	0.04 mg/kg	101	70.0	130	----
Strontium, leachable	7440-24-6	E450A	5	mg/kg	0.2 mg/kg	108	70.0	130	----
Thallium, leachable	7440-28-0	E450A	0.05	mg/kg	0.04 mg/kg	92.9	70.0	130	----
Tin, leachable	7440-31-5	E450A	2	mg/kg	0.2 mg/kg	101	70.0	130	----
Titanium, leachable	7440-32-6	E450A	5	mg/kg	0.4 mg/kg	100	70.0	130	----
Uranium, leachable	7440-61-1	E450A	0.05	mg/kg	0.04 mg/kg	102	70.0	130	----
Vanadium, leachable	7440-62-2	E450A	0.2	mg/kg	1 mg/kg	99.5	70.0	130	----
Zinc, leachable	7440-66-6	E450A	1	mg/kg	4 mg/kg	99.6	70.0	130	----
Easily Reducible Metals and Iron Oxides (QCLot: 1295492)									
Aluminum, leachable	7429-90-5	E450B	50	mg/kg	2 mg/kg	101	70.0	130	----
Antimony, leachable	7440-36-0	E450B	0.1	mg/kg	0.2 mg/kg	98.1	70.0	130	----
Arsenic, leachable	7440-38-2	E450B	0.05	mg/kg	0.2 mg/kg	102	70.0	130	----
Barium, leachable	7440-39-3	E450B	0.5	mg/kg	0.2 mg/kg	97.3	70.0	130	----
Beryllium, leachable	7440-41-7	E450B	0.2	mg/kg	0.4 mg/kg	97.8	70.0	130	----
Bismuth, leachable	7440-69-9	E450B	0.2	mg/kg	0.1 mg/kg	97.5	70.0	130	----
Cadmium, leachable	7440-43-9	E450B	0.05	mg/kg	0.04 mg/kg	97.8	70.0	130	----
Calcium, leachable	7440-70-2	E450B	50	mg/kg	40 mg/kg	96.8	70.0	130	----
Chromium, leachable	7440-47-3	E450B	0.5	mg/kg	0.4 mg/kg	98.4	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Easily Reducible Metals and Iron Oxides (QCLot: 1295492) - continued									
Cobalt, leachable	7440-48-4	E450B	0.1	mg/kg	0.2 mg/kg	99.4	70.0	130	----
Copper, leachable	7440-50-8	E450B	0.5	mg/kg	0.2 mg/kg	97.5	70.0	130	----
Iron, leachable	7439-89-6	E450B	50	mg/kg	20 mg/kg	96.8	70.0	130	----
Lead, leachable	7439-92-1	E450B	0.5	mg/kg	0.2 mg/kg	97.8	70.0	130	----
Lithium, leachable	7439-93-2	E450B	5	mg/kg	1 mg/kg	97.8	70.0	130	----
Manganese, leachable	7439-96-5	E450B	1	mg/kg	0.2 mg/kg	98.4	70.0	130	----
Molybdenum, leachable	7439-98-7	E450B	0.5	mg/kg	0.2 mg/kg	98.2	70.0	130	----
Nickel, leachable	7440-02-0	E450B	0.5	mg/kg	0.4 mg/kg	98.8	70.0	130	----
Phosphorus, leachable	7723-14-0	E450B	50	mg/kg	100 mg/kg	104	70.0	130	----
Selenium, leachable	7782-49-2	E450B	0.2	mg/kg	0.4 mg/kg	100	70.0	130	----
Silver, leachable	7440-22-4	E450B	0.1	mg/kg	0.04 mg/kg	100	70.0	130	----
Strontium, leachable	7440-24-6	E450B	0.5	mg/kg	0.2 mg/kg	99.2	70.0	130	----
Thallium, leachable	7440-28-0	E450B	0.05	mg/kg	0.04 mg/kg	95.1	70.0	130	----
Tin, leachable	7440-31-5	E450B	2	mg/kg	0.2 mg/kg	96.6	70.0	130	----
Titanium, leachable	7440-32-6	E450B	1	mg/kg	0.4 mg/kg	96.1	70.0	130	----
Uranium, leachable	7440-61-1	E450B	0.05	mg/kg	0.04 mg/kg	96.9	70.0	130	----
Vanadium, leachable	7440-62-2	E450B	0.2	mg/kg	1 mg/kg	96.9	70.0	130	----
Zinc, leachable	7440-66-6	E450B	1	mg/kg	4 mg/kg	102	70.0	130	----
Organic Bound Metals (QCLot: 1296033)									
Aluminum, leachable	7429-90-5	E450C	50	mg/kg	2 mg/kg	92.5	70.0	130	----
Antimony, leachable	7440-36-0	E450C	0.1	mg/kg	0.2 mg/kg	96.7	70.0	130	----
Arsenic, leachable	7440-38-2	E450C	0.05	mg/kg	0.2 mg/kg	95.5	70.0	130	----
Barium, leachable	7440-39-3	E450C	0.5	mg/kg	0.2 mg/kg	97.7	70.0	130	----
Beryllium, leachable	7440-41-7	E450C	0.2	mg/kg	0.4 mg/kg	94.1	70.0	130	----
Bismuth, leachable	7440-69-9	E450C	0.2	mg/kg	0.1 mg/kg	97.7	70.0	130	----
Cadmium, leachable	7440-43-9	E450C	0.05	mg/kg	0.04 mg/kg	95.4	70.0	130	----
Calcium, leachable	7440-70-2	E450C	50	mg/kg	40 mg/kg	95.8	70.0	130	----
Chromium, leachable	7440-47-3	E450C	0.5	mg/kg	0.4 mg/kg	97.4	70.0	130	----
Cobalt, leachable	7440-48-4	E450C	0.1	mg/kg	0.2 mg/kg	96.9	70.0	130	----
Copper, leachable	7440-50-8	E450C	0.5	mg/kg	0.2 mg/kg	95.7	70.0	130	----
Iron, leachable	7439-89-6	E450C	50	mg/kg	20 mg/kg	97.7	70.0	130	----
Lead, leachable	7439-92-1	E450C	0.5	mg/kg	0.2 mg/kg	98.1	70.0	130	----
Lithium, leachable	7439-93-2	E450C	5	mg/kg	1 mg/kg	95.9	70.0	130	----
Manganese, leachable	7439-96-5	E450C	1	mg/kg	0.2 mg/kg	96.1	70.0	130	----
Molybdenum, leachable	7439-98-7	E450C	0.5	mg/kg	0.2 mg/kg	98.3	70.0	130	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report: Spike Concentration	Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Organic Bound Metals (QCLot: 1296033) - continued									
Nickel, leachable	7440-02-0	E450C	0.5	mg/kg	0.4 mg/kg	98.1	70.0	130	----
Selenium, leachable	7782-49-2	E450C	0.2	mg/kg	0.4 mg/kg	100	70.0	130	----
Silver, leachable	7440-22-4	E450C	0.1	mg/kg	0.04 mg/kg	96.8	70.0	130	----
Strontium, leachable	7440-24-6	E450C	0.5	mg/kg	0.2 mg/kg	97.0	70.0	130	----
Thallium, leachable	7440-28-0	E450C	0.05	mg/kg	0.04 mg/kg	94.9	70.0	130	----
Tin, leachable	7440-31-5	E450C	2	mg/kg	0.2 mg/kg	96.1	70.0	130	----
Titanium, leachable	7440-32-6	E450C	1	mg/kg	0.4 mg/kg	98.6	70.0	130	----
Uranium, leachable	7440-61-1	E450C	0.05	mg/kg	0.04 mg/kg	97.3	70.0	130	----
Vanadium, leachable	7440-62-2	E450C	0.2	mg/kg	1 mg/kg	96.2	70.0	130	----
Zinc, leachable	7440-66-6	E450C	1	mg/kg	4 mg/kg	98.8	70.0	130	----
Residual Metals (QCLot: 1298134)									
Aluminum, leachable	7429-90-5	E450D	50	mg/kg	2 mg/kg	96.1	70.0	130	----
Antimony, leachable	7440-36-0	E450D	0.1	mg/kg	0.2 mg/kg	94.7	70.0	130	----
Arsenic, leachable	7440-38-2	E450D	0.5	mg/kg	0.2 mg/kg	98.1	70.0	130	----
Barium, leachable	7440-39-3	E450D	2	mg/kg	0.2 mg/kg	99.6	70.0	130	----
Beryllium, leachable	7440-41-7	E450D	0.2	mg/kg	0.4 mg/kg	101	70.0	130	----
Bismuth, leachable	7440-69-9	E450D	0.2	mg/kg	0.1 mg/kg	102	70.0	130	----
Cadmium, leachable	7440-43-9	E450D	0.05	mg/kg	0.04 mg/kg	102	70.0	130	----
Calcium, leachable	7440-70-2	E450D	50	mg/kg	40 mg/kg	101	70.0	130	----
Chromium, leachable	7440-47-3	E450D	5	mg/kg	0.4 mg/kg	102	70.0	130	----
Cobalt, leachable	7440-48-4	E450D	0.1	mg/kg	0.2 mg/kg	98.8	70.0	130	----
Copper, leachable	7440-50-8	E450D	0.5	mg/kg	0.2 mg/kg	97.9	70.0	130	----
Iron, leachable	7439-89-6	E450D	50	mg/kg	20 mg/kg	97.5	70.0	130	----
Lead, leachable	7439-92-1	E450D	0.5	mg/kg	0.2 mg/kg	101	70.0	130	----
Lithium, leachable	7439-93-2	E450D	5	mg/kg	1 mg/kg	102	70.0	130	----
Manganese, leachable	7439-96-5	E450D	5	mg/kg	0.2 mg/kg	100	70.0	130	----
Molybdenum, leachable	7439-98-7	E450D	0.5	mg/kg	0.2 mg/kg	96.5	70.0	130	----
Nickel, leachable	7440-02-0	E450D	2	mg/kg	0.4 mg/kg	100	70.0	130	----
Selenium, leachable	7782-49-2	E450D	0.2	mg/kg	0.4 mg/kg	101	70.0	130	----
Silver, leachable	7440-22-4	E450D	0.1	mg/kg	0.04 mg/kg	93.9	70.0	130	----
Strontium, leachable	7440-24-6	E450D	5	mg/kg	0.2 mg/kg	96.1	70.0	130	----
Thallium, leachable	7440-28-0	E450D	0.05	mg/kg	0.04 mg/kg	98.2	70.0	130	----
Tin, leachable	7440-31-5	E450D	2	mg/kg	0.2 mg/kg	96.2	70.0	130	----
Titanium, leachable	7440-32-6	E450D	5	mg/kg	0.4 mg/kg	99.3	70.0	130	----
Uranium, leachable	7440-61-1	E450D	0.05	mg/kg	0.04 mg/kg	103	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Residual Metals (QCLot: 1298134) - continued									
Vanadium, leachable	7440-62-2	E450D	0.2	mg/kg	1 mg/kg	98.3	70.0	130	----
Zinc, leachable	7440-66-6	E450D	1	mg/kg	4 mg/kg	99.9	70.0	130	----

ALS Canada Ltd.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2301603**	Page	: 1 of 12
Client	: **Alexco Keno Hill Mining Corp**	Laboratory	: ALS Environmental - Whitehorse
Contact	: Accounts Payable	Account Manager	: Thomas Chang
Address	: #2 Calcite Business Centre - 151 Industrial Road Whitehorse YT Canada Y1A 2V3	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: Bermingham Natural Attenuation Study	Date Samples Received	: 21-Dec-2023 13:15
PO	: ----	Issue Date	: 16-Jan-2024 10:18
C-O-C number	: ----		
Sampler	: CM		
Site	: 2022 Pricing		
Quote number	: WR22-AKHM100-004 (Keno/Hecla)		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- Duplicate outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Duplicate (DUP) RPDs								
Exchangeable & Adsorbed Metals	WR2301603-001	BM-23-NAT-2	Cadmium, leachable	7440-43-9	E450	42.2 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Exchangeable & Adsorbed Metals	WR2301603-001	BM-23-NAT-2	Manganese, leachable	7439-96-5	E450	38.2 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Exchangeable & Adsorbed Metals	WR2301603-001	BM-23-NAT-2	Uranium, leachable	7440-61-1	E450	39.6 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Carbonate Metals	WR2301603-001	BM-23-NAT-2	Arsenic, leachable	7440-38-2	E450A	32.3 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Carbonate Metals	WR2301603-001	BM-23-NAT-2	Uranium, leachable	7440-61-1	E450A	57.1 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Easily Reducible Metals and Iron Oxides	WR2301603-001	BM-23-NAT-2	Cadmium, leachable	7440-43-9	E450B	36.8 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Easily Reducible Metals and Iron Oxides	WR2301603-001	BM-23-NAT-2	Uranium, leachable	7440-61-1	E450B	53.1 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Aluminum, leachable	7429-90-5	E450C	34.4 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Antimony, leachable	7440-36-0	E450C	86.8 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Arsenic, leachable	7440-38-2	E450C	99.2 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Chromium, leachable	7440-47-3	E450C	46.6 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Iron, leachable	7439-89-6	E450C	37.9 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Molybdenum, leachable	7439-98-7	E450C	1.37 % DUP-H	Diff <2x LOR	Low Level DUP DQO exceeded (difference > 2 LOR).
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Nickel, leachable	7440-02-0	E450C	42.7 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Selenium, leachable	7782-49-2	E450C	42.2 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Silver, leachable	7440-22-4	E450C	46.5 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Uranium, leachable	7440-61-1	E450C	62.4 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Organic Bound Metals	WR2301603-001	BM-23-NAT-2	Vanadium, leachable	7440-62-2	E450C	64.0 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Duplicate (DUP) RPDs - Continued								
Residual Metals	WR2301603-001	BM-23-NAT-2	Arsenic, leachable	7440-38-2	E450D	42.3 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Residual Metals	WR2301603-001	BM-23-NAT-2	Iron, leachable	7439-89-6	E450D	32.9 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Residual Metals	WR2301603-001	BM-23-NAT-2	Vanadium, leachable	7440-62-2	E450D	35.7 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.

Result Qualifiers

Qualifier	*Description*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method / Container / Client Sample ID(s)	*Method*	*Sampling Date*	*Extraction / Preparation*				*Analysis*			
			Preparation Date	*Holding Times* Rec	*Holding Times* Actual	*Eval*	*Analysis Date*	*Holding Times* Rec	*Holding Times* Actual	*Eval*
Carbonate Metals : Metals by CRC ICPMS (Tessier Extraction #2)										
Glass soil jar/Teflon lined cap BM-23-NAT-2	E450A	17-Sep-2023	04-Jan-2024	180 days	109 days	✓	05-Jan-2024	180 days	110 days	✓
Carbonate Metals : Metals by CRC ICPMS (Tessier Extraction #2)										
Glass soil jar/Teflon lined cap BM-23-NAT-3-RB	E450A	17-Sep-2023	04-Jan-2024	180 days	109 days	✓	05-Jan-2024	180 days	110 days	✓
Carbonate Metals : Metals by CRC ICPMS (Tessier Extraction #2)										
Glass soil jar/Teflon lined cap BM-23-NAT-4	E450A	17-Sep-2023	04-Jan-2024	180 days	109 days	✓	05-Jan-2024	180 days	110 days	✓
Easily Reducible Metals and Iron Oxides : Metals by CRC ICPMS (Tessier Extraction #3)										
Glass soil jar/Teflon lined cap BM-23-NAT-2	E450B	17-Sep-2023	05-Jan-2024	180 days	110 days	✓	08-Jan-2024	180 days	113 days	✓
Easily Reducible Metals and Iron Oxides : Metals by CRC ICPMS (Tessier Extraction #3)										
Glass soil jar/Teflon lined cap BM-23-NAT-3-RB	E450B	17-Sep-2023	05-Jan-2024	180 days	110 days	✓	08-Jan-2024	180 days	113 days	✓
Easily Reducible Metals and Iron Oxides : Metals by CRC ICPMS (Tessier Extraction #3)										
Glass soil jar/Teflon lined cap BM-23-NAT-4	E450B	17-Sep-2023	05-Jan-2024	180 days	110 days	✓	08-Jan-2024	180 days	113 days	✓
Exchangeable & Adsorbed Metals : Metals by CRC ICPMS (Tessier Extraction #1)										
Glass soil jar/Teflon lined cap BM-23-NAT-2	E450	17-Sep-2023	03-Jan-2024	180 days	108 days	✓	05-Jan-2024	180 days	110 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Exchangeable & Adsorbed Metals : Metals by CRC ICPMS (Tessier Extraction #1)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-3-RB	E450	17-Sep-2023	03-Jan-2024	180 days	108 days	✓	05-Jan-2024	180 days	110 days	✓
Exchangeable & Adsorbed Metals : Metals by CRC ICPMS (Tessier Extraction #1)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-4	E450	17-Sep-2023	03-Jan-2024	180 days	108 days	✓	05-Jan-2024	180 days	110 days	✓
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
LDPE bag										
BM-23-NAT-2	ME-MS41	17-Sep-2023	----	----	----		12-Jan-2024	----	117 days	
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
LDPE bag										
BM-23-NAT-2-LB	ME-MS41	17-Sep-2023	----	----	----		12-Jan-2024	----	117 days	
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
LDPE bag										
BM-23-NAT-2-RB	ME-MS41	17-Sep-2023	----	----	----		12-Jan-2024	----	117 days	
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
LDPE bag										
BM-23-NAT-3	ME-MS41	17-Sep-2023	----	----	----		12-Jan-2024	----	117 days	
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
LDPE bag										
BM-23-NAT-3-LB	ME-MS41	17-Sep-2023	----	----	----		12-Jan-2024	----	117 days	
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
LDPE bag										
BM-23-NAT-3-RB	ME-MS41	17-Sep-2023	----	----	----		12-Jan-2024	----	117 days	
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
LDPE bag										
BM-23-NAT-4	ME-MS41	17-Sep-2023	----	----	----		12-Jan-2024	----	117 days	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method / Container / Client Sample ID(s)	*Method*	*Sampling Date*	*Extraction / Preparation*				*Analysis*			
			Preparation Date	*Holding Times*		*Eval*	*Analysis Date*	*Holding Times*		*Eval*
				Rec	*Actual*			*Rec*	*Actual*	
Organic Bound Metals : Metals by CRC ICPMS (Tessier Extraction #4)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-2	E450C	17-Sep-2023	06-Jan-2024	180 days	111 days	✓	09-Jan-2024	180 days	114 days	✓
Organic Bound Metals : Metals by CRC ICPMS (Tessier Extraction #4)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-3-RB	E450C	17-Sep-2023	06-Jan-2024	180 days	111 days	✓	09-Jan-2024	180 days	114 days	✓
Organic Bound Metals : Metals by CRC ICPMS (Tessier Extraction #4)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-4	E450C	17-Sep-2023	06-Jan-2024	180 days	111 days	✓	09-Jan-2024	180 days	114 days	✓
Residual Metals : Metals by CRC ICPMS (Tessier Extraction RM)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-2	E450D	17-Sep-2023	09-Jan-2024	180 days	114 days	✓	10-Jan-2024	180 days	115 days	✓
Residual Metals : Metals by CRC ICPMS (Tessier Extraction RM)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-3-RB	E450D	17-Sep-2023	09-Jan-2024	180 days	114 days	✓	10-Jan-2024	180 days	115 days	✓
Residual Metals : Metals by CRC ICPMS (Tessier Extraction RM)										
Glass soil jar/Teflon lined cap										
BM-23-NAT-4	E450D	17-Sep-2023	09-Jan-2024	180 days	114 days	✓	10-Jan-2024	180 days	115 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Metals by CRC ICPMS (Tessier Extraction #1)	E450	1293071	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #2)	E450A	1294464	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #3)	E450B	1295492	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #4)	E450C	1296033	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction RM)	E450D	1298134	1	3	33.3	5.0	✓
Laboratory Control Samples (LCS)							
Metals by CRC ICPMS (Tessier Extraction #1)	E450	1293071	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #2)	E450A	1294464	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #3)	E450B	1295492	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #4)	E450C	1296033	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction RM)	E450D	1298134	1	3	33.3	5.0	✓
Method Blanks (MB)							
Metals by CRC ICPMS (Tessier Extraction #1)	E450	1293071	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #2)	E450A	1294464	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #3)	E450B	1295492	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction #4)	E450C	1296033	1	3	33.3	5.0	✓
Metals by CRC ICPMS (Tessier Extraction RM)	E450D	1298134	1	3	33.3	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by “mod”).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Metals by CRC ICPMS (Tessier Extraction #1)	E450 ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B (mod)	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by Collision/Reaction Cell ICPMS. Note: For Extraction #1, the extraction solution is 1M Magnesium Chloride and is intended to extract the "Exchangeable and Adsorbed" metals.
Metals by CRC ICPMS (Tessier Extraction #2)	E450A ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B (mod)	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by collision cell ICPMS. Note: For Extraction #2, the extraction solution is 1M Sodium Acetate adjusted to pH 5 and is intended to extract the "Carbonate" metals.
Metals by CRC ICPMS (Tessier Extraction #3)	E450B ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B (mod)	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by CRC ICPMS.Note: For Extraction #3, the extraction solution is 0.1 M Hydroxylamine Hydro- Chloride in 25% v/v Acetic Acid and is intended to extract the Easily Reducible Metals and Iron Oxides.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Metals by CRC ICPMS (Tessier Extraction #4)	E450C ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B (mod)	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by Collision Reaction Cell ICPMS. Note: For Extraction #4, the extraction solution is 0.02 M Nitric Acid followed by 3.2M Ammonium Acetate and is intended to extract the Organic Bound metals.
Metals by CRC ICPMS (Tessier Extraction RM)	E450D ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B (mod)	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with up to 6 different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by CRC ICPMS. Note: For the Tessier "RM" Extraction, the extraction solution is 50/50 mix of 1:1 Nitric Acid along with 1:1 Hydrochloric Acid, and is hot block digested as per the BC SALM procedure. This is intended to extract the Residual metals.
51 Elements by Aqua Regia digestion and ICP-AES/MS	ME-MS41 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals ME-MS41	A prepared sample is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by ICP-AES. Samples are then analyzed by ICP-MS for the remaining suite of elements.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Extraction of Metals for CRC ICPMS (Tessier - EA)	EP450 ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by Collision/Reaction Cell ICPMS. Note: For Extraction #1, the extraction solution is 1M Magnesium Chloride and is intended to extract the "Exchangeable and Adsorbed" metals.
Extraction of Metals for CRC ICPMS (Tessier - CM)	EP450A ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by collision cell ICPMS. Note: For Extraction #2, the extraction solution is 1M Sodium Acetate adjusted to pH 5 and is intended to extract the "Carbonate" metals.
Extraction of Metals for CRC ICPMS (Tessier-FEO)	EP450B ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B	This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by CRC ICPMS.Note: For Extraction #3, the extraction solution is 0.1 M Hydroxylamine Hydro- Chloride in 25% v/v Acetic Acid and is intended to extract the Easily Reducible Metals and Iron Oxides.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Extraction of Metals for CRC ICPMS (Tessier - OB)	EP450C ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B	"This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by Collision Reaction Cell ICPMS. Note: For Extraction #4, the extraction solution is 0.02 M Nitric Acid followed by 3.2M Ammonium Acetate and is intended to extract the Organic Bound metals.
Extraction of Metals for CRC ICPMS (Tessier - RM)	EP450D ALS Environmental - Vancouver	Soil/Solid	Tessier Extraction 1979/EPA 6020B	"This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with up to 6 different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by CRC ICPMS. Note: For the Tessier "RM" Extraction, the extraction solution is 50/50 mix of 1:1 Nitric Acid along with 1:1 Hydrochloric Acid, and is hot block digested as per the BC SALM procedure. This is intended to extract the □Residual□ metals.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

1603

COC Number:

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Hecla Keno Hill
Contact:	Environment Department
Phone:	867-995-3113 X5960
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Road
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	
Company:	Alexco Keno Hill Mining: YK-AccountsPayable@hecla.com; yk-environment@hecla.com
Contact:	

Report Format / Distribution

Select Report Format:
Quality Control (QC) Report with Report

Select Distribution:

Email 1 or Fax	yk-environment@hecla.com
Email 2	Ebusby@ensero.com
Email 3	Agault@ensero.com

Invoice Distribution

Select Invoice Distribution:	
Email 1 or Fax	YK-AccountsPayable@hecla.com
Email 2	yk-environment@hecla.com

Project Information

ALS Account # / Quote #:	
Job #:	Bermingham Natural Attenuation Study
PO / AFE:	ECA23YT00259
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: Jesse McCord **Sampler:** Christina MacNeil

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] x

PRIORITY (Business Days): 4 day [P4]; 3 day [P3]; 2 day [P2]

EMERGENCY: 1 Business day [E1]; Same Day, Weekend or Statutory holiday [E0]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Aqua regia metals with ultra-trace ICP-MS analysis	Tessier sequential extraction				Number of Containers
					P	F/P		F/P	P	
	BM-23-NAT-2	17-Sep-23	13:00	Soil	R	R				1
	BM-23-NAT-3	17-Sep-23	13:40	Soil	R					1
	BM-23-NAT-3-LB	17-Sep-23	13:50	Soil	R					1
	BM-23-NAT-3-RB	17-Sep-23	13:55	Soil	R	R				1
	BM-23-NAT-2-LB	17-Sep-23	13:10	Soil	R					1
	BM-23-NAT-2-RB	17-Sep-23	13:15	Soil	R					1
	BM-23-NAT-4	17-Sep-23	14:00	Soil	R	R				1

Environmental Division
Whitehorse
Work Order Reference
WR2301603

Telephone : +1 867 668 8889

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

Are samples for human drinking water use?

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Yukon EQWin and ACC200 digital formats.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
7°C	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Xena King	21-Dec-23	Time: 12:30	Received by:	Date: 21 Dec 2021	Time: 115	Received by:	Date:	Time:

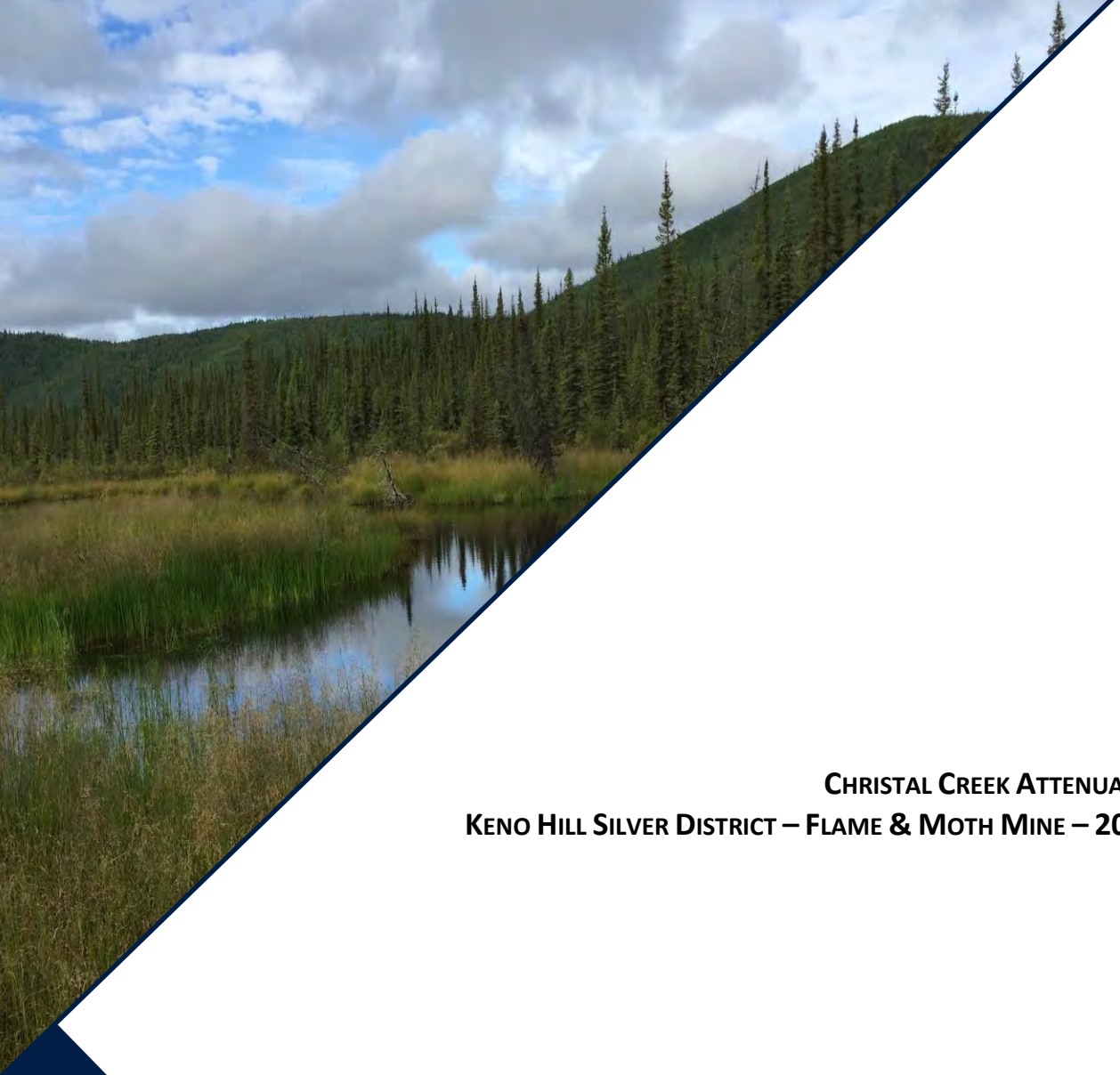
REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX 1.9

CHRISTAL CREEK ATTENUATION STUDY INTERIM REPORT



CHRISTAL CREEK ATTENUATION STUDY
KENO HILL SILVER DISTRICT – FLAME & MOTH MINE – 2024 UPDATE

Prepared for:

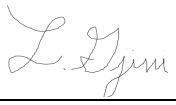
ALEXCO KENO HILL MINING CORP.

Date:

March 2025

ENSERO solutions

ENSERO SOLUTIONS CANADA, INC. SIGNATURES

Report prepared by:  3/4/2025

Luke Gjini, M.Sc.
Water Quality Scientist

Report reviewed by:  3/4/2025

Andrew Gault, Ph.D
Practice Lead Geochemistry

EXECUTIVE SUMMARY

Under Water Licence QZ18-044, the water treatment plant (WTP) at the Flame & Moth Mine is permitted to discharge to Lighting Creek (KV-104L) and Christal Creek (KV-104C). A requirement of the Water Licence was the development of an attenuation plan study to demonstrate the potential sequestration of constituents of potential interest (e.g., arsenic, cadmium, nickel, and zinc) between the WTP discharge and Christal Creek, which was assumed as part of the water quality modelling for the Project. This report presents the initial site characterization results along the expected flow path between the WTP discharge and Christal Creek.

Fifteen surficial soil and six moss samples were collected from three transects along the proposed discharge corridor between the Flame & Moth discharge diffuser and Christal Creek edge to assess the potential for natural attenuation mechanisms related to soil conditions along the flow path and current metal content of vegetation. The soil testing program included the determination of physical, chemical, and microbiological characteristics of the soil samples and the moss testing consisted of elemental metal analysis.

The soil samples consisted mostly of silt loam (11 samples), silt (two samples), sandy loam (one sample), and loam (one sample) with clay comprising the remainder (average 11% to 15% for the three transects). The high silt and clay content are predicted to result in large surface areas favourable for the retention of metals through adsorption or cation exchange processes with the discharged water.

The soil pHs were neutral (pH 6.0-6.7) reflecting an environment where the solubility of several metal(loid)s, especially iron and aluminum, is at their lowest resulting in the precipitation of metal oxyhydroxides which may co-precipitate or adsorb trace metal(loid)s from the discharge water. Also, under these buffered soil pH values, soil particles (e.g., clay fractions) with a pH-dependent surface charge will likely have a net negatively charged surface favourable for the adsorption of metal cations.

The study site soils had a median moisture content of 52% indicative of a moderate water holding capacity favourable for the development of vegetation cover, peaty, and organic-rich surficial material along the discharge channel. The median total organic carbon of the soil samples ranged from 8.6% to 13%, which translates to a median soil organic matter content ranging from 14.7% to 22.4%. The soil contained a substantial amount of organic matter that will likely create conditions favourable for metal sorption, immobilization, and attenuation.

Sequential extraction analyses indicated that several constituents of potential interest (COPI) were predominantly associated with the residual and reducible phases along transect-1, and with the organic matter and/or sulphide, reducible, and residual phases along transect-2. Along transect-3, the COPI were associated with organic matter and/or sulphide phases and the remaining to either the residual or reducible phases. There was a preferential fractionation of COPI into organic matter and/or sulphide phase in the sample from transect-3 likely due to the elevated organic matter content (25%). The exchangeable and carbonate fractions of the sequential extraction contained the lowest proportions of COPI, except cadmium which was predominantly found in the exchangeable fraction. The carbonate fraction also accounted for up to 11% of cadmium and lead, 14% of manganese and up to 17% of zinc mostly along transect-3.

Large concentrations of COPI are expected to be strongly tied to the mineral lattice and predicted to be stable in the soil matrix significantly decreasing their solubility and potential bioavailability. Significant fractions of COPI could be remobilized should the environment become iron-reducing (fraction bound to reducible phase). However, the predicted reducing environmental conditions caused by the marshy and high organic matter content will favor the uptake, fixation, or precipitation of metal(loid)s by sulphides favored under progressively reducing conditions.

These soil data indicate that soil and landcover conditions along the proposed discharge corridor are favorable for natural attenuation of metal(loid)s in the treatment discharge.

The moss samples had different metal contents depending on their location along the expected discharge channel. Vegetation material with highest arsenic, antimony, cadmium, iron, manganese, copper, nickel, lead, and zinc concentrations were those collected from transect-1 and the samples from transect-3 had the lowest concentrations.

Surface water quality monitoring data showed frequent or occasionally elevated concentrations of sulphate, arsenic, cadmium, copper, iron, lead, manganese, nickel, and zinc above their respective generic Canadian water quality guidelines at stations along Christal Creek. Additionally, pH below pH 6.5 was occasionally observed at KV-6, KV-49, KV-50, and KV-51. Aside from the further decline of sulphate, cadmium, iron, and zinc along Hinton creek (at KV-49), recent increases of arsenic, cadmium, and iron at Christal Creek upstream of Flame & Moth discharge location (KV-117), and recent decline of arsenic, manganese, iron, nickel, and zinc at the seep (KV-121) observed in late 2024, no other major changes of water quality occurred in 2024 compared to previous years. No discharge from the Flame & Moth WTP to Christal Creek occurred in 2024 (i.e., all WTP discharge was directed to Lightning Creek). The discharge from the Flame & Moth WTP to Christal Creek (KV-104C) that occurred twice in May 2021 for 10 days did not have any impact on the water quality at the monitoring stations. The water quality data from the groundwater seep KV-121 suggests possible contribution of constituents from the seep to Christal Creek, although other undefined sources could be contributing additional metal loadings.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **II**

TABLE OF CONTENTS ..... **IV**

LIST OF TABLES ..... **VI**

LIST OF FIGURES ..... **VII**

LIST OF APPENDICES ..... **VII**

LIST OF ACRONYMS AND ABBREVIATIONS ..... **VIII**

1 INTRODUCTION **1**

1.1 BACKGROUND AND OBJECTIVES OF THE STUDY 1
1.2 SCOPE 1
1.3 BACKGROUND ON NATURAL ATTENUATION 2

2 SITE LOCATION **3**

3 DATA COLLECTION AND TESTING **5**

3.1 SOIL BIOGEOCHEMISTRY 5
3.1.1 Soil Sampling and Testing *5*
3.1.2 Sequential Extraction *6*
3.1.3 Soil Microbiology *6*
3.2 VEGETATION (MOSS) 7
3.3 WATER QUALITY 8
3.4 QUALITY ASSURANCE AND QUALITY CONTROL 8

4 RESULTS **10**

4.1 SOIL GEOCHEMISTRY 10
4.1.1 Paste pH *10*
4.1.2 Moisture Content *10*
4.1.3 Texture *10*
4.1.4 Organic Matter Content *11*
4.1.5 Metal Content *11*
4.2 SEQUENTIAL EXTRACTION 20
4.3 SOIL MICROBIOLOGY 25
4.4 VEGETATION 28
4.5 WATER QUALITY 29
4.5.1 Field pH *29*
4.5.2 Field Redox Potential *30*
4.5.3 Arsenic *31*
4.5.4 Antimony *33*
4.5.5 Cadmium *34*
4.5.6 Manganese *36*
4.5.7 Iron *37*

4.5.8 Zinc 39
4.5.9 Sulphate 40
4.5.10 Copper 42
4.5.11 Lead 43
4.5.12 Nickel 45
4.5.13 Seep KV-121 46

5 CONCLUSIONS 48

6 NEXT STEPS 50

7 REFERENCES 51

LIST OF TABLES

Table 3-1: Description of Soil Samples 6

Table 3-2: Description of Moss Samples 7

Table 4-1: Results of Soil Geochemical Tests of Soil Samples Along Transect-1 13

Table 4-2: Results of Soil Geochemical Tests of Soil Samples Along Transect-2 15

Table 4-3: Results of Soil Geochemical Tests of Soil Samples Along Transect-3 17

Table 4-4: Keno Hill Silver District Background Average Concentration of Soil (CanNorth, 2018) 19

Table 4-5: Results of Tessier Sequential Extraction of Soil Sample Along Transect-1 22

Table 4-6: Results of Tessier Sequential Extraction of Soil Sample Along Transect-2 23

Table 4-7: Results of Tessier Sequential Extraction of Soil Sample Along Transect-3 24

Table 4-8: Abundance of Bacteria Identified to the Genus Level in Transect Soil Samples 25

Table 4-9: Identification and Abundance of Known Sulphide-producing Bacteria in Transect Soil Samples 27

Table 4-10: Results of Elemental Analysis Tests of Moss Samples 28

Table 4-11: Total Arsenic Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 32

Table 4-12: Total Antimony Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 34

Table 4-13: Total Cadmium Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117 and KV-6, 2008-2023 Data 35

Table 4-14: Dissolved Manganese Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 37

Table 4-15: Total Iron Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 38

Table 4-16: Dissolved Zinc Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 40

Table 4-17: Dissolved Sulphate Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 41

Table 4-18 : Dissolved Copper Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 43

Table 4-19: Total Lead Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 44

Table 4-20: Total Nickel Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 46

Table 4-21: Summary of Main Constituents of Interest at KV-121, 2019-2023 Data 47

LIST OF FIGURES

Figure 2-1: Christal Creek Attenuation Study Area 4

Figure 4-1: Quantity of Sulphate-Reducing Bacteria in Transect Soil Samples 26

Figure 4-2: Field pH at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 30

Figure 4-3: Field ORP at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2011-2023 Data 31

Figure 4-4: Total Arsenic at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 32

Figure 4-5: Total Antimony at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 33

Figure 4-6: Total Cadmium at Monitoring Stations KV-49, KV-50, KV-51, KV-117 and KV-6, 2008-2023 Data 35

Figure 4-7: Dissolved Manganese at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 36

Figure 4-8: Total Iron at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 38

Figure 4-9: Dissolved Zinc at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 39

Figure 4-10: Dissolved Sulphate at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 41

Figure 4-11: Dissolved Copper at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 42

Figure 4-12: Total Lead at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 44

Figure 4-13: Total Nickel at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2023 Data 45

LIST OF APPENDICES

Appendix A: Laboratory Reports Geochemical and Microbiological Data of Soil and Moss
Appendix B: Surface and Seep Water Quality
Appendix C: Water Quality Comparative Plots

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Description
ABS	Absolute Value
ACG	Access Consulting Group
AEG	Alexco Environmental Group Inc.
AKHM	Alexco Keno Hill Mining Corp.
B.C	British Columbia
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
CCME	Canadian Council of Ministers of the Environment
COPI	Constituents of Potential Interest
CRM	Certified Reference Material
DL	Detection Limit
EC	Environment Canada
IRM	Internal Reference Material
KHSD	Keno Hill Silver District
LCS	Laboratory Control Sample
MV	Measured Value
QAQC	Quality Assessment and Quality Control
qPCR	quantitative Polymerase Chain Reaction
RP	Recovery Percentage
RPD	Relative Percent Difference
TC	Total Carbon
TIC	Total Inorganic Carbon
TOC	Total Organic Carbon
TSE	Tessier Sequential Extraction
OTU	Operational Taxonomic Units
WQ	Water Quality
WTP	Water Treatment Plant
WRB	Water Research Branch
YG	Yukon Government

1 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES OF THE STUDY

Under Water Licence QZ18-044, the water treatment plant (WTP) at the Flame & Moth mine is permitted to discharge to Lighting Creek (KV-104L) and Christal Creek (KV-104C) with a few conditions to be satisfied. These conditions include the completion and submission of the findings of a Christal Creek Attenuation Study to confirm the assumption made in the modeling study of the impact of the WTP discharge water quality on the Christal Creek environment (AEG, 2016) and satisfy the requirements of the Water Licence.

Past investigations on natural attenuation mechanisms in the Keno Hill Silver District (KHSD) have documented significant metal(loid) attenuation along mine discharge flow paths (e.g., ITL, 2013). The water quality modeling performed to support the Flame & Moth Project assumed natural attenuation for selected constituents (arsenic, cadmium, nickel, and zinc) between the WTP discharge diffuser location and the Christal Creek receiving environment (AEG, 2016).

Like elsewhere in the KHSD, it is predicted that the concentration of some metal(loid)s and constituents in the WTP discharge are likely to decrease due to biogeochemical processes and interaction with soil and vegetation cover or mixing with groundwater and surface water along the flow path from the WTP discharge diffuser location to Christal Creek. The geochemically driven changes may include the removal of metals and constituents through direct precipitation, co-precipitation with other major metals (e.g., iron, aluminum), and adsorption on mineral and organic surfaces.

This sixth interim report describes the physio-chemical and microbiological characteristics of the expected flow path between the WTP diffuser location and Christal Creek, over which metal(loid) attenuation is assumed to occur, in accordance with the Christal Creek Attenuation Study Plan (AEG, 2018a). It also examines potential changes to water quality due to the temporary discharge from the Flame & Moth WTP (KV-104C) that occurred on April 30 to May 7 and May 15 to May 17, 2021. The Flame & Moth WTP did not discharge to Christal Creek between 2022 and 2024. This report is an update to the 2023 attenuation report (Ensero, 2024) and includes additional water quality data from surface and groundwater monitoring stations collected in 2024. All the sections pertaining to the soil and vegetation assessment have remained unchanged from the 2020 attenuation study report (Ensero, 2021) as no new soil or vegetation data was collected between 2021 to 2024.

1.2 SCOPE

The scope of the study includes the characterization of the site prior to operation by collecting baseline data for parameters that influence or impact the flow of the discharge water and changes its chemistry from the WTP diffuser location to the Christal Creek receiving environment. These baseline data include:

- Identification of physical and landcover (i.e., vegetation) characteristics of the site;
- Determination of the type, composition, geochemical and microbiological characteristics of soil along proposed flow path;
- Determination of baseline metal content of moss along the expected flow path;
- 16-year baseline surface water records at the following monitoring stations: KV-6, KV-49, KV-50, and KV-51 and four years of water quality at station KV-117;
- Collection of baseline water quality data at groundwater seep KV-121; and
- Analysis and interpretation of data, and the assessment of attenuation mechanism(s) to confirm the assumptions made in earlier studies.

Once discharge from the WTP to Christal Creek is initiated and sustained, the study will also document any physical and geochemical changes that occur along the discharge flow path between the discharge point and Christal Creek. This will include weekly collection of water quality data at sites KV-104, KV-6, and KV-50, and monthly collection at KV-117 (Figure 2-1).

1.3 BACKGROUND ON NATURAL ATTENUATION

Natural attenuation is a combination of physical, chemical, and/or biological processes that naturally reduce the mass, toxicity, mobility, or concentration of contaminants in soil or groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation or reduction of contaminants (USEPA, 1999), and metal precipitation. Soil conditions, solution pH, redox potential, soil composition (particularity the oxide and clay content), moisture, organic matter content play significant roles in natural attenuation mechanisms.

When the solution pH is circum-neutral or slightly acidic, cationic metal species precipitate as aluminum and iron hydroxide, oxyhydroxide, or hydroxy-sulphate minerals (Nordstrom, 1982). Under these pH conditions, dissolved metals may adsorb onto surfaces of these amorphous and minerals and/or other surfaces present in the environment, such as organic matter due to decreasing competition with protons, and increased hydrolysis of metal ions at circum-neutral pH (Richard, 2007).

Microorganism such as sulphate-reducing bacteria can attenuate the migration of metals in the natural environment through the precipitation of chalcophile metals as sulphide minerals following the reduction of sulphate in the presence of organic matter. Characterization of microbiological impacts on natural attenuation processes involves tools that can be used during site characterization. Genetic analyses such as molecular biological methods relying on 16S rDNA sequences have been used to identify microbial communities in environmental samples (Richard, 2007).

2 SITE LOCATION

Figure 2-1 shows the location of the District Mill, Flame & Moth WTP and pond, discharge diffuser location, current surface water quality, groundwater, soil and moss sampling locations, and various other mine components and water management structures. The location of the discharge diffuser was selected based on engineering examination and assessment of the topography of the site to limit potential erosion of the channel during discharge and maximize constituent removal and attenuation by promoting longer interaction time between the discharge water and the underlying soils matrix and vegetation cover. By siting the discharge over low grade slopes, the precipitates formed in situ will likely remain chemically and physically stable within the discharge area.

The vegetative cover within the discharge location of the diffuser is characterized by stunted white and black spruce, scrub birch, willow, and Labrador tea. The area has a thick moss cover, which persists throughout the area. All three sampling transects were similar in terms of vegetative cover. In terms of vegetation density, transect-1 and transect-2 were similar, whereas transect-3 becomes less dense, and a transition occurs from spruce dominated to willow and birch dominated farther down the hillside. The presence of moss/bog materials is found throughout the transects.



Active Surface Water Quality Stations
Attenuation Study Transect
Pipeline
Existing Diversion Ditch

Current DSTF
Pond
Mine Feature Footprint
Watercourse
Waterbody

Satellite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2025
Drone imagery provided by client, 2022

Datum: NAD 83; Projection: UTM Zone 8N

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HECLA KENO HILL

FIGURE 2-1

CHRISTAL CREEK ATTENUATION STUDY AREA

FEBRUARY 2025

D:\Project\All\Projects\Keno_Area_Mines\ALL-SITES\02-Map\04-Studies\Attenuation_Study\Attenuation_Study_Transects_WM_Hecla_20202004.mxd

3 DATA COLLECTION AND TESTING

3.1 SOIL BIOGEOCHEMISTRY

Local soil characterization is a crucial part of investing natural attenuation processes at any given site. The geochemical processes controlling the mobility or immobilization of metal(loid)s and other chemical constituents in the natural environment are in large extent controlled by the type of local soil, its composition, structure, metals and organic matter contents, pore water chemistry, soil pH and redox potential. Soil along the discharge corridor was investigated, sampled, and tested to assess its potential for natural attenuation.

3.1.1 SOIL SAMPLING AND TESTING

On July 5, 2018, fifteen surficial (top 30 cm) soil samples were collected from the anticipated discharge corridor between the WTP diffuser and Christal Creek. A transect sampling procedure was followed and five samples were collected from each of three transects evenly spaced along the proposed corridor. The samples were evenly spaced within each transect such they covered the entire transect. The locations of the soil sampling sites are displayed on Figure 2-1 and a brief description of the samples is provided in Table 3-1.

The samples were documented in the field, placed in sealed sampling bags, and submitted to ALS Environmental (Burnaby, B.C.) for testing. All the 15 samples were analyzed for:

- Moisture content;
- Particle size;
- Paste pH;
- Total organic carbon (TOC); and
- Aqua regia digestion followed by multi-element analysis of digestate.

Three selected samples (T1-D, T2-F, and T3-B) were submitted for sequential extraction using the method of Tessier et al. (1979). The selection was made such to capture the range of (i.e., minimum, median and maximum) cadmium and zinc concentrations (the primary constituents of interest for Flame & Moth discharge), total organic and clay contents.

Additionally, three samples (T1-C, T2-C and T3-C), one from the centre of each transect, were collected, stored in sterile plastic containers, and sent to Ensero's microbiology laboratory (Saskatoon, S.K.) for microbial profiling.

Each of the above analytical methods is briefly discussed below or in the results sections where appropriate.

Table 3-1: Description of Soil Samples

Sample ID	Sample Type	Sampling Location	Sampling Date
T1-A	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T1-B	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T1-D	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T1-E	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T1-F	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T2-A	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T2-B	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T2-D	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T2-E	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T2-F	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T3-A	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T3-B	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T3-D	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T3-E	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18
T3-F	Soil	Discharge Corridor, Flame & Moth Mine	5-Jul-18

3.1.2 SEQUENTIAL EXTRACTION

Information regarding the distribution of metal(loid)s between various phases within soils and sediments provides an understanding of the relative mobility of these elements. Several extraction methods (e.g., Tessier et al., 1979; Rauret et al., 1999; Silveira et al., 2006) have been developed and used to understand the partitioning of major and trace elements in soils and sediments with the Tessier et al. (1979) sequential extraction (TSE) method being the most used. The TSE procedures uses reagents designed to extract metals from a target fraction in a stepwise fashion:

- Fraction 1 – Exchangeable: this fraction represents the weakly bound fraction which is readily remobilized via desorption by competing ions in solution.
- Fraction 2 – Bound to carbonates: this fraction represents the fraction bound to carbonate minerals.
- Fraction 3 – Bound to iron and manganese oxyhydroxides (reducible): this fraction consists of metals associated with iron and manganese oxides that may be remobilized under reducing conditions.
- Fraction 4 – Bound to organic matter (oxidizable): this fraction represents the fraction bound to organic matter such as humic and fulvic acids or sulphide minerals and could be remobilized following oxidation processes.
- Fraction 5 – Residual: this fraction represents the fraction strongly tied to mineral lattice and is relatively immobile.
- Understanding the distribution of metal species in soils samples is expected to help gain an insight into natural attenuation processes occurring on site.

3.1.3 SOIL MICROBIOLOGY

Determining the presence, type, and the activity of microorganisms in soil is an important factor in understanding of natural attenuation and metal sequestration. Various studies have shown that soil microorganisms promote the attenuation of

metals and the transformation of attenuated metals into stable forms such as metal sulphides under anaerobic and organic-rich soils conditions.

The three selected samples were tested for the following:

- Microbial community profiling via 16S rRNA to identify microorganisms to the genus level, including sulphide-producing bacteria; and
- Enumeration of sulphate-reducing bacteria using quantitative polymerase chain reaction (qPCR).

The objective of these tests is to understand the structure of the microbial community, including members that may play an active role in attenuation processes that can immobilize metal(loid)s into stable mineral forms under site conditions, and provide further evidence for the biogeochemical processes in natural attenuation.

In brief, DNA extracted from the soil samples and portions of the 16S rRNA gene, which can be used for taxonomic classification, were sequenced and matched against known microorganisms. Similar sequences (97% similarity or higher) were grouped together into operational taxonomic units (OTUs) and compared against a microbial database for classification at the species level.

The quantification of sulphate-reducing bacteria was performed by qPCR targeting the β-subunit of the dissimilatory sulphite reductase *dsrB* gene. The dissimilatory sulphite reductase is the primary enzyme in the dissimilatory sulphate reduction gene in sulphate-reducing prokaryotes, hence, this approach targets sulphate-reducing bacteria.

3.2 VEGETATION (MOSS)

Six moss samples (T1-A, T1-B, T2-A, T2-B, T3-A, and T3-B) were collected from two locations along each of the three soil sampling transects (T1, T2, and T3) in October 2019 and sent to the laboratory for moisture and metal content analysis of the tissue. The samples were rinsed with deionized water to remove any attached soil/dust particles (or before being homogenized and digested for metal content analysis). The moisture content was determined on a pre-rinsed sample portion. A brief description of the samples is provided in Table 3-2.

Table 3-2: Description of Moss Samples

Sample ID	Sample Type	Sampling Location	Sampling Date
T1-A	Moss	Discharge Corridor, Flame & Moth Mine	6-Oct-19
T1-B	Moss	Discharge Corridor, Flame & Moth Mine	6-Oct-19
T2-A	Moss	Discharge Corridor, Flame & Moth Mine	6-Oct-19
T2-B	Moss	Discharge Corridor, Flame & Moth Mine	6-Oct-19
T3-A	Moss	Discharge Corridor, Flame & Moth Mine	6-Oct-19
T3-B	Moss	Discharge Corridor, Flame & Moth Mine	6-Oct-19

3.3 WATER QUALITY

Seventeen years (2008 to 2024) of surface water quality (WQ) records from monitoring stations set up along Christal Creek, upstream and downstream of Christal Lake, are used as background data in this study. Additionally, in February 2019, a new background station (KV-117) was established upstream of the proposed channel discharge point along Christal Creek to serve as a background station and capture surface water that will not be affected by the WTP discharge.

Field parameters and total and dissolved metal(loid) concentrations were reviewed from the following monitoring stations:

- KV-49 (Hinton Creek upstream of Christal Creek);
- KV-50 (Christal Creek upstream of Hinton Creek);
- KV-51 (Christal Creek downstream of Hinton Creek and upstream of Christal Lake);
- KV-6 (Christal Creek downstream of Christal Lake); and
- KV-117 (Christal Creek upstream of proposed channel discharge point).

These sites were used to assess surface water conditions before the discharge of treated water begins providing a benchmark for the assessment of water quality variation during and after the water treatment discharge. Upper Christal Creek monitoring stations includes KV-49, KV-50, and KV-51 prior to the entrance to Christal Lake and KV-117 upstream of WTP discharge point. The outflow of Christal Lake is monitored at KV-6. Additionally, WQ data collection from Christal groundwater seep KV-121, a seep located upstream of KV-50 which provides a source of sulphate and metal loads to Christal Creek was initiated in February 2019. Six years of WQ monitoring data from station KV-121 are also provided.

The location of monitoring stations is shown in Figure 2-1 and detailed description are provided in AEG (2018b) and ACG (2013).

3.4 QUALITY ASSURANCE AND QUALITY CONTROL

A standard practice quality assurance and quality control (QA/QC) program was followed to assess the accuracy and reproducibility of laboratory analytical results. Duplicate samples, methods blanks, Internal Reference Material (IRM), Certified Reference Material (CRM), and Laboratory Control Sample (LCS) were included in the analysis and were adequate. The reproducibility of the duplicate analyses was assessed by calculating the relative percent difference (RPD) between the lead sample and the duplicate. An RPD ≤20% was considered acceptable where the parameter measured value (mv) reported was >10 times the reporting detection limit (RDL). The RPD is calculated as follows:

$$RPD\ (\%) = 100\ \mathrm{X}\ \frac{\mathrm{ABS\ (Sample\ mv - Duplicate\ mv)}}{\mathrm{Average\ (Sample\ mv, Duplicate\ mv)}}$$

Where:

- ABS: absolute value
- mv: measured value

The accuracy of the IRM and LCS analysis was determined by percent recovery (RP) relative to the set target value as follows:

$$RP\ (\%) = 100\ \mathrm{X}\ \frac{\mathrm{Sample\ mv}}{\mathrm{IRM\ or\ LCS}}$$

Where:

- RP: recovery percentage
- mv: measured value

An IRM percentage recovery of 80-120% was considered acceptable for total carbon (TC) and total inorganic carbon (TIC) and IRM within the ranges set for particle size distribution (39.1-49.1 for sand; 32.5-42.5 for silt and 13.4-23.4 for clay) and paste pH (5.88-6.48) analyses were also considered acceptable. LCS percentage recoveries of 80-120% and 90-110% were considered acceptable for TIC and TC, respectively, and LCS within the range set for the moisture content (90-110%) and paste pH (5.7-6.3) were also considered acceptable.

One duplicate analysis was done for the moisture content for sample T3-F and the calculated RPD was 0.4% indicating a good analytical reproducibility. All method blanks included in the analysis of moisture content. TIC and TC returned values below the detection limit indicating laboratory analyses free from contamination. All calculated RP for IRM and LCS returned values within the set acceptable percentages and value ranges.

One duplicate analysis was done for the metal content of moss sample T3-B and the RPD calculated for the metals ranged between 0.2% to 30% within the targeted RPD of 40% indicating a good analytical reproducibility. All method blanks included in the analysis of moisture and metal content of moss tissue also returned values below the detection limit indicating laboratory analyses free from contamination. All CRM and LCS returned values within the set acceptable percentages and value ranges.

All the QA/QC results above show that the results of soil and vegetation tissue geochemical test are acceptable for use in analysis and interpretation.

4 RESULTS

4.1 SOIL GEOCHEMISTRY

The soil test results are discussed below, summarized in Table 4-1 to Table 4-3, and all laboratory reports are compiled in Appendix A.

4.1.1 PASTE PH

Soil pH is a crucial parameter in natural attenuation because it determines the surface charge of clays and the precipitation/dissolution behaviour of metal sinks such as metal oxyhydroxides, carbonates and phosphates. Studies on adsorption mechanisms have shown that generally the adsorption of metal cations increases with increasing pH, while the adsorption of element anions or oxyanions increase with the decrease of pH (Stumm and Morgan, 1996).

The soil pH was determined by saturating a sub-sample with distilled water then an extract from the saturated paste was taken and its pH measured using a pH meter.

Most samples had neutral soil pH (6.0 to 6.7) except two samples that had mildly acidic soil pH of 5.4 and 5.5. The median soil pH was 6.3, 6.2, and 6.5 for transect-1, transect-2, and transect-3, respectively, and the site wide average pH was 6.4. These buffered soil pHs reflect an environment where the solubility of several metal(loid)s, especially iron and aluminum, is at the lowest level leading to their precipitation as oxide or hydroxides, which may co-precipitate other metal(loid)s from the discharge water. These soil pH values are also higher that the point zero charge pH of most clay minerals, therefore clay fractions characterized by a variable surface charge are likely to have a net negatively charged surface favourable for the retention of metals cations under the site soil pH conditions.

4.1.2 MOISTURE CONTENT

Soil moisture content analysis was determined by gravimetric method. The procedure consists of weighing a sub-sample, drying it at 105°C for a minimum of six hours, then re-weighing it. Moisture content is then calculated as a percentage weight difference between the initial sample and the dried sample.

The results show that the moisture content ranged from 29.1% to 79.1% along transect-1, 25.8% to 76.4% along transect-2 and 18.6% to 71.9% along transect-3 with a study site median of 52.2%. The median moisture contents along the transects were 55.1% along transect-1, 59.4% along transect-2, and 48.5% along transect-3. These data are indicative of a moderate water holding capacity favourable for the development of the vegetation cover and peaty and organic-rich surficial material along the discharge channel.

4.1.3 TEXTURE

Soil texture was determined based on the particle size distribution. This was performed following the method developed by the United States Department of Agriculture – Natural Resources Conservation Service (Burt, 2009). During the test, dry sieving was used for coarse particles, wet sieving for sand particles, and the pipette sedimentation method for clay particles.

The results indicate that the soil samples consisted predominantly of silt and sand. The silt proportion ranged from 46.6% to 82.7 % along transect-1 with a median of 47.6%; from 35.9% to 75.7% along transect-2 with a median of 64.2%; and from 35.7% to 88.1% along transect-3 with a median of 66.9%. The sand content ranged from 0.05% to 37.5% in the samples from transect-1 with a median of 33.0%; from 1.9% to 41.3% in the samples from transect-2 with a median of 23.9%; and from

1.1% to 41.6 % in the samples from transect-3 with a median of 11.8 %. The median clay contents were 9.7%, 7.2%, and 10.0 % along transect-1, transect-2, and transect-3, respectively.

The soil texture of the majority of the samples (11 of the 15 samples) was determined to be silt loam. Two samples from transects-1 and 3 were categorized as silt, one sample from transect-3 as loam, and one sample from transect-2 as sandy loam. It was noted that the samples collected from transect-3 had on average a higher clay fraction than transects 1 and 2. The high proportion of silt and clay is predicted to result in a large surface area favourable for the retention of metals through adsorption or cation exchange processes with the discharged water.

4.1.4 ORGANIC MATTER CONTENT

Like soil pH and clay content, soil organic matter content significantly influences the attenuation and immobilization of metals. Organic matter occurs as a mixture of various types of organisms, biochemicals, and humic substances. These provide functional groups where metals can be adsorbed or favor the formation of stable complexes with free ions. Soil organic matter also provides food for the development of microorganisms and serves as electron donor in microbiologically mediated sulphate-reduction reactions. It also improves the water holding capacity of soil thus increasing the water-soil exchange reactions.

The organic matter content of soil was determined by its TOC. The latter was calculated as the difference between TC and TIC. The TC was determined by ignition in a combustion analyzer where carbon in the reduced CO_2 gas is determined using a thermal conductivity detector. The TIC is determined by reacting the sample with known quality of acetic acid then the pH of the resulting solution is measured and compared against a standard curve relating the pH to weight of carbonate.

The TOC of the soil samples ranged from 2.3% to 37.8% (13.0% median) along transect-1, from 4.8% to 33.2% (8.6% median) along transect-2, and from 1.2% to 25.0% (12.8% median) along transect-3. These soil TOC can be translated into soil organic matter contents using a conversion factor of 1.72 assuming that 58% of organic matter is present as carbon (Pribyl, 2010). This results in an estimated soil organic matter content ranging from 4.0% to 65.0% (22.4% median) along transect-1, from 8.2% to 57.1% (14.7% median) along transect-2, and from 2.0% to 43.0% (22.0% median) along transect-3. In general, the soils sampled contained a significant amount of organic matter that will likely create conditions favourable for sorption, immobilization, and attenuation of metals.

4.1.5 METAL CONTENT

The metal content of the soils provides an understanding of current site conditions and offers a benchmark against which future data can be compared following the start of WTP discharge to Christal Creek. The baseline metal content data also provides indications of the presence of minerals that may play a key role in attenuation mechanisms. For example, the presence of elevated calcium, iron, and manganese in a sample could be an indication of the presence of carbonate phases and iron and manganese oxides known for their metal attenuation capacities. The baseline data can also reveal unusually elevated metal concentration due to site-specific conditions (i.e., presence of weathering products from mineralization) that could otherwise be interpreted as sign of contamination.

The soil metal content was determined by *aqua regia* (3:1 mixture of hydrochloric and nitric acids) digestion followed by inductively coupled plasma – mass spectrometry (ICP-MS). Soil split samples (0.5 g) were digested with the *aqua regia* acid mix in a graphite heating block. After cooling, the digestate was diluted with deionized water and analyzed by ICP-MS. Although the *aqua regia* digestion method does not usually result in a full digestion of a soil sample, it provides a good measure of concentration of major and trace elements of potential environmental concern.

For a site-specific assessment of the metal enrichment or depletion, the average metal content of soil samples from the attenuation study site were compared to the average baseline soil metal composition of the KHSD compiled in July 2018 (CanNorth, 2018; Table 4-4). In the present case, the averages were considered significantly different only if their difference was ten times greater than the detection limit. The results of the comparative analysis are summarized as follows:

- The concentration of lithium, tin, and uranium was higher in the KHSD baseline dataset than the study site soil samples;
- The concentration of the following constituents was elevated in the study site soil samples compared to the KHSD baseline: aluminum, arsenic, calcium, cadmium, cobalt, copper, iron, lead, magnesium, manganese, nickel, phosphorus, potassium, molybdenum, strontium, sodium, vanadium, and zinc; and
- All other constituents were considered comparable in both datasets.
- The elevated content of the several metal(loids)/constituents in the soil samples compared to the baseline may be due to the contribution of localized mineralization.

Table 4-1: Results of Soil Geochemical Tests of Soil Samples Along Transect-1

Parameter	Lowest Detection Limit		Transect-1				
		Sample ID	T1-A	T1-B	T1-D	T1-E	T1-F
		Units	Soil	Soil	Soil	Soil	Soil
Physical Tests (Soil)							
Moisture	0.3	%	70.3	55.1	29.1	35.5	79.1
Particle Size (Soil)							
% Gravel (>2 mm)	1	%	4.4	8.5	5.7	12.8	0.5
% Sand (2.0 mm – 0.063 mm)	1	%	34.7	31.4	37.5	33.0	0.5
% Silt (0.063 mm – 4 µm)	1	%	47.6	52.4	47.1	46.6	82.7
% Clay (<4 µm)	1	%	13.4	7.6	9.7	7.7	16.4
Texture		-	Silt loam	Silt loam	Silt loam	Silt loam	Silt
Organic / Inorganic Carbon (Soil)							
Total Organic Carbon	0.1	%	20.6	13.0	2.3	4.9	37.8
Saturated Paste Extractables (Soil)							
Paste pH	0.1	pH	6.04	6.30	5.40	6.54	6.72
Total Metals (Soil)							
Aluminum (Al)	0.01	%	0.87	1.18	1.18	1.24	0.16
Antimony (Sb)	0.05	ppm	1.07	0.79	1.20	0.81	1.65
Arsenic (As)	0.10	ppm	94.2	17.6	47.1	10.0	14.0
Barium (Ba)	10.00	ppm	370	310	230	260	270
Beryllium (Be)	0.05	ppm	0.260	0.320	0.390	0.310	0.070
Bismuth (Bi)	0.01	ppm	0.150	0.490	0.220	0.190	0.050
Boron (B)	10.00	ppm	<10	<10	<10	<10	<10
Cadmium (Cd)	0.01	ppm	1.72	0.79	1.06	0.69	1.48
Calcium (Ca)	0.01	%	1.98	0.8	0.5	0.7	4.1
Chromium (Cr)	1.00	ppm	18	24.0	23.0	26.0	9.0
Cobalt (Co)	0.10	ppm	15.9	8.5	9.5	6.4	4.1

Parameter	Lowest Detection Limit	Sample ID	Transect-1				
			T1-A	T1-B	T1-D	T1-E	T1-F
		Units	Soil	Soil	Soil	Soil	Soil
Copper (Cu)	0.20	ppm	55.5	123.5	35.0	34.4	25.3
Iron (Fe)	0.01	%	3.78	2.4	2.6	2.0	2.7
Lead (Pb)	0.2	ppm	87.9	96.4	230.0	23.8	86.6
Lithium (Li)	0.1	ppm	6.9	12.3	13.9	14.1	0.7
Magnesium (Mg)	0.01	%	0.4	0.5	0.5	0.5	0.2
Manganese (Mn)	5	ppm	1350	627.0	163.0	354.0	1040.0
Mercury (Hg)	0.01	ppm	0.06	0.1	0.1	0.0	0.1
Molybdenum (Mo)	0.05	ppm	2.42	0.7	1.3	0.7	1.3
Nickel (Ni)	0.2	ppm	20	19.4	25.5	19.9	9.9
Phosphorus (P)	10.00	ppm	1260	740.0	820.0	850.0	720.0
Potassium (K)	0.01	%	0.1	0.2	0.1	0.2	0.0
Selenium (Se)	0.2	ppm	1.20	0.90	1.00	0.60	0.40
Silver (Ag)	0.01	ppm	0.430	0.400	0.410	0.310	0.980
Sodium (Na)	0.01	%	0.030	0.030	0.020	0.030	<0.01
Strontium (Sr)	0.2	ppm	60.2	33.4	23.5	29.1	90.5
Sulfur (S)	0.01	%	0.180	0.070	0.050	0.050	0.200
Thallium (Tl)	0.02	ppm	0.09	0.12	0.14	0.13	0.03
Tin (Sn)	0.20	ppm	0.3	0.3	0.3	0.3	0.9
Titanium (Ti)	0.005	%	0.020	0.042	0.045	0.052	<0.005
Uranium (U)	0.05	ppm	0.73	1.01	1.00	0.65	0.18
Vanadium (V)	1.00	ppm	31.00	38.00	39.00	40.00	4.00
Zinc (Zn)	2.00	ppm	148	161	152	114	184

Table 4-2: Results of Soil Geochemical Tests of Soil Samples Along Transect-2

Parameter	Lowest Detection Limit		Transect-2				
		Sample ID	T2-A	T2-B	T2-D	T2-E	T2-F
		Units	Soil	Soil	Soil	Soil	Soil
Physical Tests (Soil)							
Moisture	0.3	%	25.8	76.4	59.4	76.2	52.2
Particle Size (Soil)							
% Gravel (>2 mm)	1	%	16.9	0.5	5.7	0.5	5.2
% Sand (2.0 mm – 0.063 mm)	1	%	41.3	1.9	36.3	4.8	23.9
% Silt (0.063 mm – 4 µm)	1	%	35.9	75.7	50.8	74.0	64.2
% Clay (<4 µm)	1	%	5.8	22.4	7.2	21.2	6.7
Texture		-	Sandy loam	Silt loam	Silt loam	Silt loam	Silt loam
Organic / Inorganic Carbon (Soil)							
Total Organic Carbon	0.1	%	4.8	33.2	6.68	22.7	8.6
Saturated Paste Extractables (Soil)							
Paste pH	0.1	pH	6.17	6.61	5.51	6.01	6.59
Total Metals (Soil)							
Aluminum (Al)	0.01	%	1.36	0.71	1.07	0.98	1.35
Antimony (Sb)	0.05	ppm	0.56	1.03	0.78	0.98	0.95
Arsenic (As)	0.10	ppm	22.3	12.1	18.3	18.4	28.6
Barium (Ba)	10.00	ppm	170	250	240	290	250
Beryllium (Be)	0.05	ppm	0.240	0.230	0.310	0.310	0.370
Bismuth (Bi)	0.01	ppm	0.090	0.120	0.170	0.180	0.180
Boron (B)	10.00	ppm	<10	<10	<10	<10	<10
Cadmium (Cd)	0.01	ppm	0.57	1.05	1.95	0.89	0.46
Calcium (Ca)	0.01	%	0.6	3.15	0.85	2.5	0.8
Chromium (Cr)	1.00	ppm	34.0	14	23	18.0	29.0
Cobalt (Co)	0.10	ppm	9.4	3.9	6.2	6.1	9.4
Copper (Cu)	0.20	ppm	22.9	44.2	15.7	34.8	26.6

Parameter	Lowest Detection Limit		Transect-2				
		Sample ID	T2-A	T2-B	T2-D	T2-E	T2-F
		Units	Soil	Soil	Soil	Soil	Soil
Iron (Fe)	0.01	%	2.5	1.56	2.41	2.1	3.1
Lead (Pb)	0.2	ppm	46.1	38.7	80.8	28.1	25.7
Lithium (Li)	0.1	ppm	17.3	6.6	11.8	9.8	15.6
Magnesium (Mg)	0.01	%	0.9	0.46	0.41	0.5	0.5
Manganese (Mn)	5	ppm	542.0	398	315	321.0	377.0
Mercury (Hg)	0.01	ppm	0.1	0.08	0.06	0.1	0.1
Molybdenum (Mo)	0.05	ppm	1.1	0.85	1.23	1.2	1.8
Nickel (Ni)	0.2	ppm	26.8	17.4	16.4	20.0	24.8
Phosphorus (P)	10.00	ppm	560.0	840	710	880.0	770.0
Potassium (K)	0.01	%	0.2	0.11	0.21	0.2	0.2
Selenium (Se)	0.2	ppm	<0.2	0.70	0.50	0.50	0.40
Silver (Ag)	0.01	ppm	0.170	0.530	0.280	0.420	0.280
Sodium (Na)	0.01	%	0.020	0.020	0.030	0.020	0.030
Strontium (Sr)	0.2	ppm	18.3	75.5	33.1	64.6	30.6
Sulfur (S)	0.01	%	0.020	0.160	0.080	0.140	0.040
Thallium (Tl)	0.02	ppm	0.09	0.08	0.11	0.12	0.15
Tin (Sn)	0.20	ppm	0.4	0.2	0.3	0.3	0.5
Titanium (Ti)	0.005	%	0.098	0.012	0.027	0.013	0.036
Uranium (U)	0.05	ppm	0.46	0.46	0.53	0.52	0.46
Vanadium (V)	1.00	ppm	57.00	19.00	35.00	27.00	43.00
Zinc (Zn)	2.00	ppm	177	204	175	178	121

Table 4-3: Results of Soil Geochemical Tests of Soil Samples Along Transect-3

Parameter	Lowest Detection Limit		Transect-3				
		Sample ID	T3-A	T3-B	T3-D	T3-E	T3-F
		Units	Soil	Soil	Soil	Soil	Soil
Physical Tests (Soil)							
Moisture	0.3	%	48.5	71.9	48.2	49.1	18.6
Particle Size (Soil)							
% Gravel (>2 mm)	1	%	9.3	0.5	0.5	0.5	24.9
% Sand (2.0 mm – 0.063 mm)	1	%	41.6	1.1	11.8	5.7	31.2
% Silt (0.063 mm – 4 µm)	1	%	39.1	69.3	66.9	88.1	35.7
% Clay (<4 µm)	1	%	10.0	29.5	21.2	6.2	8.3
Texture		-	Loam	Silt loam	Silt loam	Silt	Silt loam / loam
Organic / Inorganic Carbon (Soil)							
Total Organic Carbon	0.1	%	1.4	25.0	19.8	12.8	1.15
Saturated Paste Extractables (Soil)							
Paste pH	0.1	pH	6.70	6.49	6.72	6.41	6.35
Total Metals (Soil)							
Aluminum (Al)	0.01	%	1.39	1.06	1.11	1.37	1.21
Antimony (Sb)	0.05	ppm	1.28	1.13	1.37	1.02	1.18
Arsenic (As)	0.10	ppm	37.0	25.6	80.7	59.1	35
Barium (Ba)	10.00	ppm	310	340	410	360	240
Beryllium (Be)	0.05	ppm	0.410	0.380	0.390	0.380	0.360
Bismuth (Bi)	0.01	ppm	0.280	0.200	0.220	0.240	0.230
Boron (B)	10.00	ppm	<10	10	10	10	<10
Cadmium (Cd)	0.01	ppm	2.14	38.50	14.65	1.15	1.08
Calcium (Ca)	0.01	%	0.8	2.5	1.9	1.3	0.44
Chromium (Cr)	1.00	ppm	28.0	19.0	21.0	27	26
Cobalt (Co)	0.10	ppm	11.1	7.8	19.2	10.5	12
Copper (Cu)	0.20	ppm	50.2	50.3	37.6	27.7	44.9

Parameter	Lowest Detection Limit	Sample ID	Transect-3				
			T3-A	T3-B	T3-D	T3-E	T3-F
		Units	Soil	Soil	Soil	Soil	Soil
Iron (Fe)	0.01	%	3.0	2.2	4.5	3.63	2.98
Lead (Pb)	0.2	ppm	40.9	22.4	21.7	58	22.9
Lithium (Li)	0.1	ppm	15.1	9.6	10.4	12.7	14.1
Magnesium (Mg)	0.01	%	0.5	0.5	0.5	0.48	0.47
Manganese (Mn)	5	ppm	414.0	692.0	1880.0	810	513
Mercury (Hg)	0.01	ppm	0.1	0.1	0.1	0.07	0.05
Molybdenum (Mo)	0.05	ppm	1.7	1.3	2.4	1.62	1.75
Nickel (Ni)	0.2	ppm	32.9	25.3	25.8	24	33.7
Phosphorus (P)	10.00	ppm	850.0	940.0	1120.0	900	880
Potassium (K)	0.01	%	0.2	0.2	0.2	0.22	0.18
Selenium (Se)	0.2	ppm	0.50	0.80	1.10	0.70	0.70
Silver (Ag)	0.01	ppm	0.380	0.290	0.310	0.290	0.390
Sodium (Na)	0.01	%	0.030	0.020	0.030	0.030	0.020
Strontium (Sr)	0.2	ppm	32.4	64.4	54.6	43	22.3
Sulfur (S)	0.01	%	0.050	0.180	0.250	0.110	0.020
Thallium (Tl)	0.02	ppm	0.18	0.12	0.13	0.16	0.15
Tin (Sn)	0.20	ppm	0.5	0.3	0.3	0.4	0.4
Titanium (Ti)	0.005	%	0.034	0.013	0.015	0.024	0.047
Uranium (U)	0.05	ppm	0.63	0.71	0.94	1.17	0.55
Vanadium (V)	1.00	ppm	44.00	28.00	35.00	44.00	40.00
Zinc (Zn)	2.00	ppm	435	4870	2660	307	142

Table 4-4: Keno Hill Silver District Background Average Concentration of Soil (CanNorth, 2018)

Total Metal Concentration	Unit	Galena Hill, South McQuesten (latest data)
Aluminum (Al)	%	0.734
Antimony (Sb)	ppm	1.06
Arsenic (As)	ppm	27
Barium (Ba)	ppm	220
Beryllium (Be)	ppm	0.45
Bismuth (Bi)	ppm	0.19
Boron (B)	ppm	2.85
Cadmium (Cd)	ppm	0.71
Calcium (Ca)	%	0.882
Chromium (Cr)	ppm	14.3
Cobalt (Co)	ppm	6.34
Copper (Cu)	ppm	22.9
Iron (Fe)	%	1.85
Lead (Pb)	ppm	22.4
Lithium (Li)	ppm	14.3
Magnesium (Mg)	%	0.295
Manganese (Mn)	ppm	451
Mercury (Hg)	ppm	0.05
Molybdenum (Mo)	ppm	1.03
Nickel (Ni)	ppm	17.5
Phosphorus (P)	ppm	712
Potassium (K)	%	0.03
Selenium (Se)	ppm	0.65
Silver (Ag)	ppm	0.47
Sodium (Na)	%	0.00234
Strontium (Sr)	ppm	32.3
Thallium (Tl)	ppm	0.06
Tin (Sn)	ppm	2.19
Titanium (Ti)	%	0.0113
Uranium (U)	ppm	0.84
Vanadium (V)	ppm	23
Zinc (Zn)	ppm	77.2
Zirconium (Zr)	ppm	1.42

4.2 SEQUENTIAL EXTRACTION

The results of TSE testing are summarized in Table 4-5 to Table 4-7 and the laboratory report is provided in Appendix A. The discussion herein is focused on constituents of potential interest (COPI) such as arsenic, cadmium, copper, lead, nickel, manganese, iron, silver, and zinc.

The results indicate the following:

- COPI were predominantly associated with the residual and reducible phases in the transect-1 sample and with the organic matter and/or sulphide, residual, and reducible phases in the transect-2 and 3 samples.
- Except for cadmium and manganese (and zinc in transect-3), COPI were below the detection limit or at low concentrations in the exchangeable and adsorbed fraction.
- The carbonate phase associated concentrations of COPI were low to below the detection limit (DL) for arsenic, copper, iron, nickel, and silver. Cadmium, lead, manganese, and zinc had concentration up to 16.5% of the total elemental concentration associated with carbonates, consistent with the ability of these elements to form or co-precipitate with carbonate minerals.
- Arsenic was predominantly associated with the residual phase in transect-1 and 2 (73 to 85%) and in the organic matter and/or sulphide phase in transect-3 (67%).
- Cadmium was primarily found with the exchangeable phase (53-66%) and partly tied to the reducible phase (15 to 26%). Some cadmium (up to 11%) was also associated with the carbonate fraction.
- The majority of copper was sequestered in the organic matter and/or sulphide phase (55 to 87%) and the remaining in the residual fraction.
- Iron was largely associated with the residual phase in transect-1 and 2 (64 to 74%) with the remainder bound to the reducible (transect-1) or organic matter and sulphide phase (transect-2). Only 28% of iron was bound to the residual phase in transect-3, while of the majority (61%) was associated with the organic matter and sulphide phase.
- The lead partitioning pattern was somewhat similar to iron – associated with the residual and reducible or residual and organic matter and/or sulphide phases in transect-1 and 2. A minor proportion of lead was bound to the residual phase (20%) in transect-3 while of the majority (69%) was associated with the organic matter and/or sulphide phase.
- Manganese and zinc were mostly associated with the residual and easily reducible phases in transect-1 and 2. In transect-3, 52% and 34% of manganese and zinc, respectively, were associated with the reducible phase and 23% and 26% were bound to the organic matter and/or sulphide phase, respectively.
- Nickel was concentrated in the residual and reducible phases in transect-1, and in the organic matter and/or sulphide and residual phases in transect-2 and 3.
- Silver concentrations were very low to below DL in most fractions. The highest concentrations measured were 0.19 to 0.22 mg/kg and associated with the residual phases.

These data indicate that most COPI were predominantly associated with the residual and reducible phases in transect-1, with the organic matter and/or sulphide and residual phases or the organic matter and reducible phases in transect-2. In transect-3, the COPI were largely bound to the organic matter and/or sulphide phase and the remainder to either the residual or reducible phase. The preferential fractionation of COPI into organic matter and/or sulphide phase in the sample from transect-3 and in lesser extent in transect-2 are likely due to the elevated organic matter content (25% and 8.7%, respectively) and presence of sulphide minerals. The easily mobilized exchangeable fraction and carbonate phases contained the lowest proportion of COPI, except cadmium which was predominantly associated with the exchangeable fraction. Also, the carbonate fraction accounted for up to 11% of cadmium and lead, 14% of manganese, and up to 17% of zinc mostly along transect-3.

Large concentrations of COPI are expected to be strongly tied to the mineral lattice (i.e., residual phase) and predicted to be stable in the soil matrix significantly decreasing their solubility and potential bioavailability. However, significant fractions of COPI could be remobilized once the environment become reducing (fraction bound to reducible phase) or strongly oxidizing. However, the predicted reducing environmental conditions caused by the boggy/marshy and elevated organic matter content environment, and the precipitation of sulphides favored under reducing conditions will likely prevent the release of COPI by scavenging and precipitating these metal(loid)s.

Table 4-5: Results of Tessier Sequential Extraction of Soil Sample Along Transect-1

Parameter	Lowest Detection Limit	Units	T1-D				
			Exchangeable & Adsorbed Metals	Carbonate Metals	Easily Reducible Metals and Iron Oxides	Organic / Sulphide Bound Metals	Residual Metals
Aluminum (Al)	50	mg/kg	<50	57	1050	1160	9990
Antimony (Sb)	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	1.24
Arsenic (As)	0.050	mg/kg	0.086	0.326	7.85	0.317	47.6
Barium (Ba)	0.50	mg/kg	41.0	25.2	47.1	15.7	67.9
Beryllium (Be)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	0.050	mg/kg	0.659	0.107	0.298	0.066	<0.050
Calcium (Ca)	50	mg/kg	1490	140	301	346	2090
Chromium (Cr)	0.50	mg/kg	<0.50	<5.0	1.89	4.63	17.3
Cobalt (Co)	0.10	mg/kg	1.18	0.31	2.86	0.92	4.46
Copper (Cu)	0.50	mg/kg	<0.50	1.51	4.94	23.7	12.7
Iron (Fe)	50	mg/kg	<50	145	6570	660	20700
Lead (Pb)	0.50	mg/kg	1.92	3.66	16.6	3.87	8.47
Lithium (Li)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	12.4
Manganese (Mn)	1.0	mg/kg	18.9	<5.0	21.3	8.4	105
Molybdenum (Mo)	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	1.26
Nickel (Ni)	0.50	mg/kg	2.85	<2.0	7.44	3.41	13.3
Phosphorus (P)	50	mg/kg	<50	<50	<50	–	–
Potassium (K)	100	mg/kg	<100	–	–	–	–
Selenium (Se)	0.20	mg/kg	<0.20	<0.20	0.26	1.06	<0.20
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	0.12	<0.10	0.22
Sodium (Na)	100	mg/kg	<100	–	–	–	–
Strontium (Sr)	0.50	mg/kg	3.76	<5.0	1.66	1.72	13.8
Thallium (Tl)	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	0.113
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	<1.0	<5.0	<2.0	45.0	315
Uranium (U)	0.050	mg/kg	<0.050	0.355	0.279	0.164	0.346
Vanadium (V)	0.20	mg/kg	<0.20	<0.20	5.67	5.00	29.8
Zinc (Zn)	1.0	mg/kg	11.7	5.7	54.4	20.6	58.9

Table 4-6: Results of Tessier Sequential Extraction of Soil Sample Along Transect-2

Parameter	Lowest Detection Limit	Units	T2-F				
			Exchangeable & Adsorbed Metals	Carbonate Metals	Easily Reducible Metals and Iron Oxides	Organic / Sulphide Bound Metals	Residual Metals
Aluminum (Al)	50	mg/kg	<50	<50	485	2450	6120
Antimony (Sb)	0.10	mg/kg	<0.10	<0.10	<0.10	0.18	0.83
Arsenic (As)	0.050	mg/kg	<0.050	0.254	2.65	3.83	18.4
Barium (Ba)	0.50	mg/kg	52.8	16.1	46.7	36.1	43.6
Beryllium (Be)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	0.050	mg/kg	0.452	0.094	0.226	0.088	<0.050
Calcium (Ca)	50	mg/kg	8980	1420	1660	851	771
Chromium (Cr)	0.50	mg/kg	<0.50	<5.0	0.51	6.32	10.6
Cobalt (Co)	0.10	mg/kg	<0.10	0.15	1.67	2.51	2.96
Copper (Cu)	0.50	mg/kg	<0.50	<0.50	0.95	17.7	8.42
Iron (Fe)	50	mg/kg	<50	<50	2720	4900	13600
Lead (Pb)	0.50	mg/kg	<0.50	1.04	6.84	9.17	10.6
Lithium (Li)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	8.8
Manganese (Mn)	1.0	mg/kg	12.0	33.8	125	29.7	77.8
Molybdenum (Mo)	0.50	mg/kg	<0.50	<0.50	<0.50	0.50	0.76
Nickel (Ni)	0.50	mg/kg	<0.50	<2.0	2.95	9.02	9.0
Phosphorus (P)	50	mg/kg	<50	<50	<50	–	–
Potassium (K)	100	mg/kg	<100	–	–	–	–
Selenium (Se)	0.20	mg/kg	<0.20	<0.20	<0.20	0.39	<0.20
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	<0.10	0.15	0.19
Sodium (Na)	100	mg/kg	<100	–	–	–	–
Strontium (Sr)	0.50	mg/kg	21.4	<5.0	4.14	3.41	5.6
Thallium (Tl)	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	0.068
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	<1.0	<5.0	1.4	87.5	167
Uranium (U)	0.050	mg/kg	<0.050	<0.050	0.082	0.131	0.180
Vanadium (V)	0.20	mg/kg	<0.20	<0.20	1.39	7.71	19.6
Zinc (Zn)	1.0	mg/kg	5.1	7.2	59.6	34.6	37.5

Table 4-7: Results of Tessier Sequential Extraction of Soil Sample Along Transect-3

Parameter	Lowest Detection Limit	Units	T3-B				
			Exchangeable & Adsorbed Metals	Carbonate Metals	Easily Reducible Metals and Iron Oxides	Organic / Sulphide Bound Metals	Residual Metals
Aluminum (Al)	50	mg/kg	<50	<50	316	3030	3930
Antimony (Sb)	0.10	mg/kg	<0.10	<0.10	<0.10	0.63	0.44
Arsenic (As)	0.050	mg/kg	<0.050	0.127	4.22	13.0	2.21
Barium (Ba)	0.50	mg/kg	66.5	20.0	52.2	98.2	39.3
Beryllium (Be)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	0.050	mg/kg	18.3	3.12	4.02	2.16	0.067
Calcium (Ca)	50	mg/kg	15200	3420	4200	2820	397
Chromium (Cr)	0.50	mg/kg	<0.50	<5.0	<0.50	6.25	6.7
Cobalt (Co)	0.10	mg/kg	<0.10	0.13	1.20	3.14	1.02
Copper (Cu)	0.50	mg/kg	<0.50	<0.50	1.30	28.8	3.18
Iron (Fe)	50	mg/kg	<50	<50	1750	9490	4340
Lead (Pb)	0.50	mg/kg	<0.50	<0.50	1.65	9.82	2.81
Lithium (Li)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
Manganese (Mn)	1.0	mg/kg	22.1	64.4	243	109	30.8
Molybdenum (Mo)	0.50	mg/kg	<0.50	<0.50	<0.50	0.65	<0.50
Nickel (Ni)	0.50	mg/kg	0.65	<2.0	2.15	13.4	4.1
Phosphorus (P)	50	mg/kg	<50	<50	87	–	–
Potassium (K)	100	mg/kg	<100	–	–	–	–
Selenium (Se)	0.20	mg/kg	<0.20	<0.20	<0.20	0.70	<0.20
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	0.20
Sodium (Na)	100	mg/kg	<100	–	–	–	–
Strontium (Sr)	0.50	mg/kg	35.2	6.7	8.93	8.14	<5.0
Thallium (Tl)	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	0.068
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	<1.0	<5.0	1.3	29.3	121
Uranium (U)	0.050	mg/kg	<0.050	<0.050	0.189	0.411	0.131
Vanadium (V)	0.20	mg/kg	<0.20	<0.20	0.74	8.54	10.8
Zinc (Zn)	1.0	mg/kg	1140	827	1710	1290	45.0

4.3 SOIL MICROBIOLOGY

Three soil samples were selected for microbial community profiling – one from the centre of each transect (T1-C, T2-C, and T3-C). Bacteria identified to the genus level that comprised >1% of the OTUs in at least one sample are presented in Table 4-8. Species belonging to the *Arthrobacter* and *Flavobacterium* genera, which comprised 0.2% to 1.5% of gene sequences extracted from soil samples, are commonly found in soil and freshwater samples but are not thought to be capable of modifying the mobility of major and trace elements via redox transformations. Conversely, members of the *Gallionella* (1.3% of OTUs extracted from the transect-1 sample) and *Albidiferax* (0.2% to 1.5% of OTUs in soil samples) genera are capable of iron oxidation and iron reduction, respectively. Similarly, *Clostridium* (0.2% to 1.1% of OTUs in all three samples) and *Sulfuricurvum* (2.1% of OTUs extracted from transect-1 sample) genera contain species known to cycle reduced and oxidized forms of sulphur. The presence of organisms in the soil samples with close genetic similarity to genera known to mediate iron and sulphur redox transformations suggests there is the capacity for microbial controls on trace element mobility, for example via sequestration as metal sulphides under sulphide-producing conditions or sorption/co-precipitation with iron oxyhydroxides mediated by iron-oxidizing microorganisms. Members of the major genera identified are either aerobic or facultatively anaerobic (i.e., can grow with or without oxygen), except for C*lostridum*, which were identified in all three samples and are obligate anaerobes, suggesting that reducing niches are present in the shallow subsurface sampled at all three sites. It is important to note that 93% to 98% of the OTUs sequenced from each sample were either matched to genera of low abundance in the sample (<1%) or could not be matched to the genus level. The latter reflects the limited number of bacteria isolated in pure culture and available for database matching.

Table 4-8: Abundance of Bacteria Identified to the Genus Level in Transect Soil Samples

Genus	Percentage of Bacterial Community		
	T1-C	T2-C	T3-C
Albidiferax	1.5%	0.2%	0.2%
Arthrobacter	0.5%	1.7%	0.2%
Clostridium_sensu_stricto	1.1%	0.5%	0.2%
Flavobacterium	0.2%	-	1.4%
Gallionella	1.3%	-	-
Sulfuricurvum	2.1%	-	-
Others (each < 1% or not identified to the genus level)	93.2%	97.5%	98.1%

Table 4-9 presents the identification and relative abundance of sulphide-producing bacteria in the transect soil samples, while Figure 4-1 compares the quantity of sulphate-reducing bacteria based on qPCR enumeration. A distinction is made between sulphate-reducing and sulphide-producing since not all bacteria produce sulphide from sulphate-reduction; however, the microbial community profiling and enumeration of sulphate-reducers appear complementary. Sequences associated with the *Clostridium* genus comprised the majority of the sulphide-producing bacteria in all three samples. OTUs associated with the *Desulfosporosinus* were also identified in all three samples, albeit at lower abundance than the *Clostridium* sequences. Sample T1-C had the highest proportion of sulphide-producing bacteria (1.3% of sequenced OTUs) and also had the highest number of sulphate-reducing bacteria (4.8 million gene copies per cm^3 soil). Sample T3-C returned the lowest proportion of sulphide-producing bacteria (0.23% of sequenced OTUs) and also had the lowest number of sulphate-reducing bacteria (0.1 million gene copies per cm^3 soil). Although a minor proportion of the microbial community, the presence of sulphide-producing bacteria in all three soils suggests the capacity exists in these soils for trace element sequestration as sulphide phases.

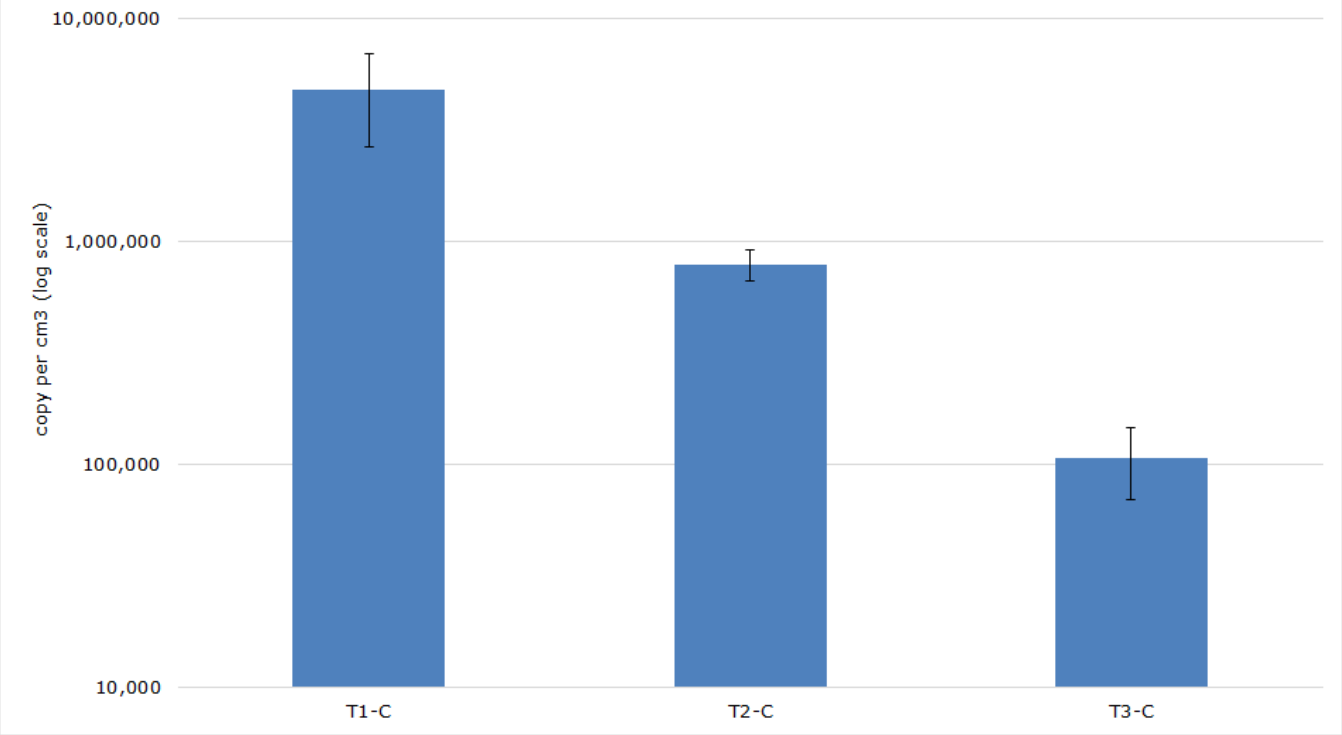

Figure 4-1: Quantity of Sulphate-Reducing Bacteria in Transect Soil Samples

Table 4-9: Identification and Abundance of Known Sulphide-producing Bacteria in Transect Soil Samples

Genus	Can Reduce				Environment			Trait Assignment Category [1]	Percentage of Bacterial Community		
	Sulphate	Thiosulphate	Sulphite	Sulphur	Aerobe / Anaerobe Characteristics	Temperature	pH		T1-C	T2-C	T3-C
Desulfosporosinus	Yes	Yes	Yes	Yes	anaerobic	mesophilic, some psychrotolerant	neutrophilic	A	0.15%	0.02%	0.07%
Sulfurospirillum	No	Yes	Yes	Yes	microaerophilic	mesophilic, some psychrotolerant	neutrophilic	A	0.01%	-	-
Clostridium_sensu_stricto	No	Yes	Yes, some	Yes, some	obligately anaerobic	mesophilic	mildly acidophilic to neutrophilic (4.0-8.5)	B	1.10%	0.54%	0.16%
Geobacter	No	No	No	Yes	anaerobic	mesophilic	neutrophilic	B	0.04%	-	-
Total Sulphide-producing Bacteria Percentage									**1.30%**	**0.55%**	**0.23%**

[1] Trait Assignment Categories: A – most species in this genus possess these traits or abilities; B – some species in this genus possess these traits or abilities; C – this trait has been noted for this genus in only a few cases or is not well documented. Further investigation may be warranted.

4.4 VEGETATION

The baseline total metal composition of moss collected from the proposed discharge corridor is provided in Table 4-10 and laboratory reports are compiled in Appendix A. The results of the analysis are summarized as follows:

- Transect T-1 generally had the highest metal concentrations. This was especially true for arsenic, antimony, cadmium, iron, manganese, copper, nickel, lead, and zinc. The concentration of these constituents was commonly at least two to three times higher than the transect with second highest concentration (T-2);
- Transect-2 had the second highest metal concentration and transect T-3 had the lowest suggesting a decreasing metal content in vegetation downstream of the proposed diffuser location; and
- Transect-3 had the lowest moisture content and T-2 the highest.

Table 4-10: Results of Elemental Analysis Tests of Moss Samples

Parameter	Lowest Detection Limit		Transect-1		Transect-2		Transect-3	
		Sample ID	T1-A	T1-B	T2-A	T2-B	T3-A	T3-B
		Units	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests (Tissue)								
Moisture	0.50	%	66.0	62.9	77.8	80.9	77.1	73.4
Total Metals (Tissue)								
Aluminum (Al)-Total	2.0	mg/kg	522	480	340	235	243	294
Antimony (Sb)-Total	0.010	mg/kg	32.4	27.3	14.0	6.54	3.59	6.90
Arsenic (As)-Total	0.020	mg/kg	40.6	29.7	11.3	5.47	5.89	8.86
Barium (Ba)-Total	0.050	mg/kg	94.7	67.6	21.3	38.0	84.9	53.0
Beryllium (Be)-Total	0.010	mg/kg	0.021	0.017	0.013	<0.010	0.025	0.011
Bismuth (Bi)-Total	0.010	mg/kg	0.835	0.607	0.285	0.157	0.094	0.151
Boron (B)-Total	1.0	mg/kg	15.9	5.9	3.5	4.5	4.0	4.0
Cadmium (Cd)-Total	0.0050	mg/kg	35.1	26.8	13.5	6.91	4.09	6.66
Calcium (Ca)-Total	20	mg/kg	12900	7360	5160	6030	10700	9960
Cesium (Cs)-Total	0.0050	mg/kg	0.115	0.114	0.0967	0.0635	0.0616	0.0901
Chromium (Cr)-Total	0.050	mg/kg	1.21	0.998	0.769	0.579	0.428	0.621
Cobalt (Co)-Total	0.020	mg/kg	0.739	0.655	0.395	0.282	0.282	0.283
Copper (Cu)-Total	0.10	mg/kg	60.3	44.4	20.8	13.6	7.55	12.7
Iron (Fe)-Total	3.0	mg/kg	4860	3790	1760	1190	796	1260
Lead (Pb)-Total	0.020	mg/kg	4130	2890	1300	794	427	711
Lithium (Li)-Total	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	2.0	mg/kg	1170	1170	1100	1390	1030	1250
Manganese (Mn)-Total	0.050	mg/kg	1240	1130	498	420	226	213
Molybdenum (Mo)-Total	0.020	mg/kg	0.217	0.224	0.220	0.310	0.074	0.123
Nickel (Ni)-Total	0.20	mg/kg	3.07	2.17	1.63	1.11	0.99	1.03
Phosphorus (P)-Total	10	mg/kg	626	749	669	840	583	733
Potassium (K)-Total	20	mg/kg	1510	1740	1120	2180	1520	1830
Rubidium (Rb)-Total	0.050	mg/kg	2.25	2.87	2.79	4.13	2.72	4.61

Parameter	Lowest Detection Limit		Transect-1		Transect-2		Transect-3	
		Sample ID	T1-A	T1-B	T2-A	T2-B	T3-A	T3-B
		Units	Soil	Soil	Soil	Soil	Soil	Soil
Selenium (Se)-Total	0.050	mg/kg	0.151	0.108	0.076	0.059	0.082	0.112
Silver (Ag)-Total	0.0050	mg/kg	17.4	9.59	6.97	3.39	3.21	2.81
Sodium (Na)-Total	20	mg/kg	20	21	29	31	<20	23
Strontium (Sr)-Total	0.050	mg/kg	31.3	15.6	9.71	11.2	22.2	21.7
Tellurium (Te)-Total	0.020	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Thallium (Tl)-Total	0.0020	mg/kg	0.0261	0.0222	0.0159	0.0108	0.0065	0.0091
Tin (Sn)-Total	0.10	mg/kg	4.02	2.97	1.44	0.80	0.46	0.75
Uranium (U)-Total	0.0020	mg/kg	0.0874	0.0709	0.0491	0.0439	0.0212	0.0361
Vanadium (V)-Total	0.10	mg/kg	1.39	1.27	1.02	0.80	0.60	0.86
Zinc (Zn)-Total	0.50	mg/kg	2900	2130	1020	536	348	591
Zirconium (Zr)-Total	0.20	mg/kg	0.54	0.49	0.36	<0.22	<0.22	0.23

4.5 WATER QUALITY

The concentrations of COPI in surface waters sampled between 2008 and 2024 were compared with the most recently updated guideline from Canadian Council of Ministers of the Environment (CCME) or the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) Water Quality Guidelines for the Protection of Fresh Water Aquatic Life (WQ FWAL). CCME guidelines were employed as the default guideline for comparison. BC ENV guidelines were used where there is no CCME guideline (sulphate, antimony) or for COPIs for which the BC ENV guideline was issued much more recently than the CCME guideline (copper, lead, nickel). Total concentrations are presented except where the water quality guideline specifies that the dissolved fraction be used (copper, lead, manganese, nickel, and zinc). The comparison of water quality results with the generic guidelines was completed to identify relatively elevated constituents, determine their background concentration, and serve as a benchmark for comparison with surface water quality data after the start of water treatment discharge. This comparative assessment should not be considered as a measure of compliance (or lack thereof) to these guidelines. The guidelines for hardness, dissolved organic carbon (DOC), and pH-dependent elements were calculated for each sample using its hardness, DOC, and pH and the number of exceedances is reported in Table 4-11 to Table 4-17. For plotting purposes (lines on graphs), the average of the 25th percentile hardness and DOC, and 75th percentile pH observed for KV-6, KV-49, KV-50, KV-51, and KV-117 was used to create the guideline displayed on the figures.

Time series plots depicting the results for COPI are shown in Figure 4-2 through Figure 4-10, associated summary statistics are reported in Table 4-11 through Table 4-17, and all laboratory results are compiled in Appendix B. The COPI which constantly or occasionally exceeded the guidelines included sulphate, arsenic, cadmium, copper, iron, lead, manganese, and zinc, while measurements lower than the minimum guideline for pH were occasionally observed for field pH.

4.5.1 FIELD PH

Aside from four field pH measurements below pH 6.5 along Hinton Creek (KV-49), two at KV-51, and one each at KV-50 and KV-6, the field pH has remained in the CCME FWAL range (pH 6.5-9.0) during the monitoring period. Although there were periods of high and low pH measurements, no clear seasonality was observed in the field pH data. Monitoring station KV-6, located downstream of Christal Lake, generally had the highest field pH (median field pH 7.59) followed by KV-51 (median field pH 7.23; Figure 4-2). There was a noticeable large variation of pH at KV-50 in 2021 not seen since 2012; however, this

variation was not observed between 2022 or 2024. On May 16, 2021, the pH at KV-50 increased to 8.2, which is similar to the pH measured on September 3, 2012 (8.58). This coincided with the most recent discharge from the Flame & Moth WTP.

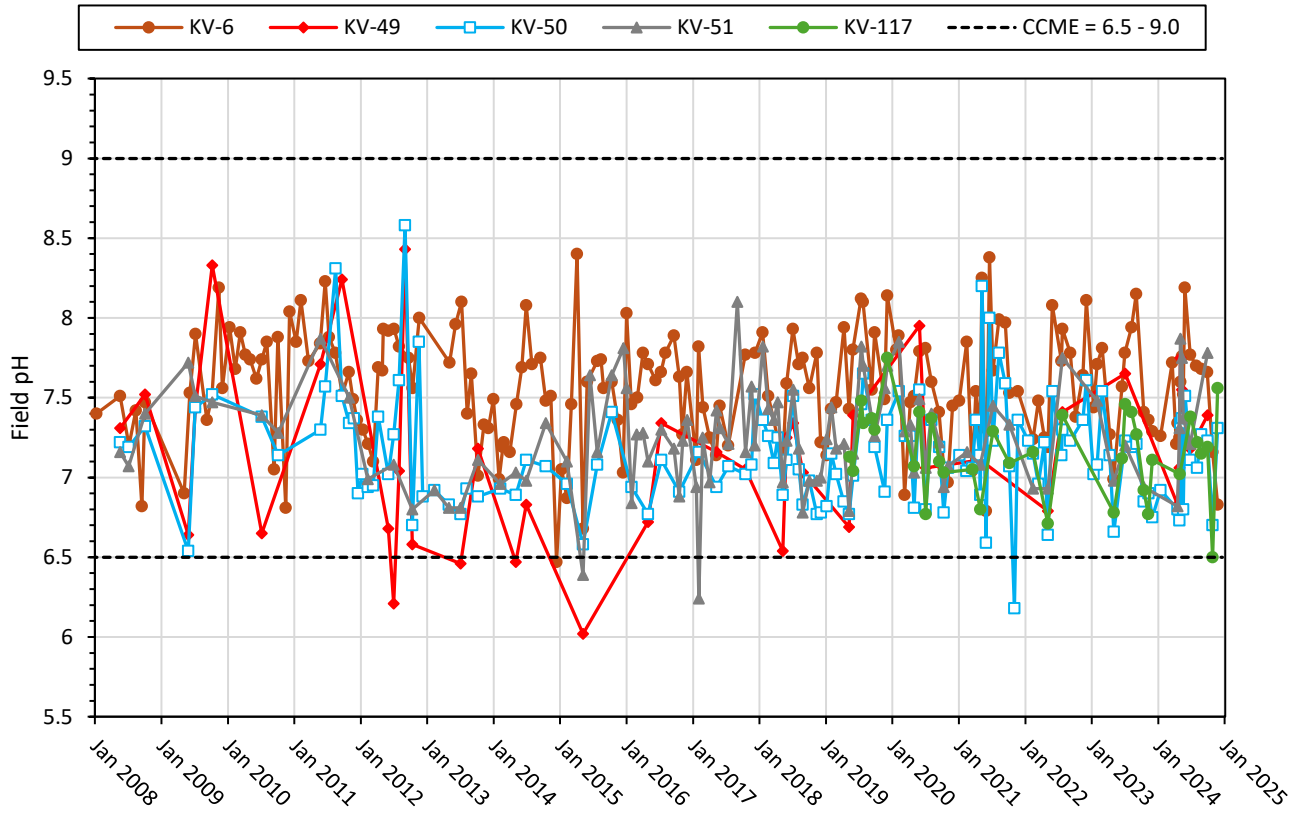

Figure 4-2: Field pH at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

4.5.2 FIELD REDOX POTENTIAL

As expected, the oxidation-reduction potential (ORP) at the monitoring stations was generally oxidizing but large fluctuations were recurrent in the data (Figure 4-3). The redox potential was largely positive with median field ORP at each station ranging between +9.9 and +104.6 mV. However, periodic negative ORP measurements were also observed during several sampling events in multiple years.

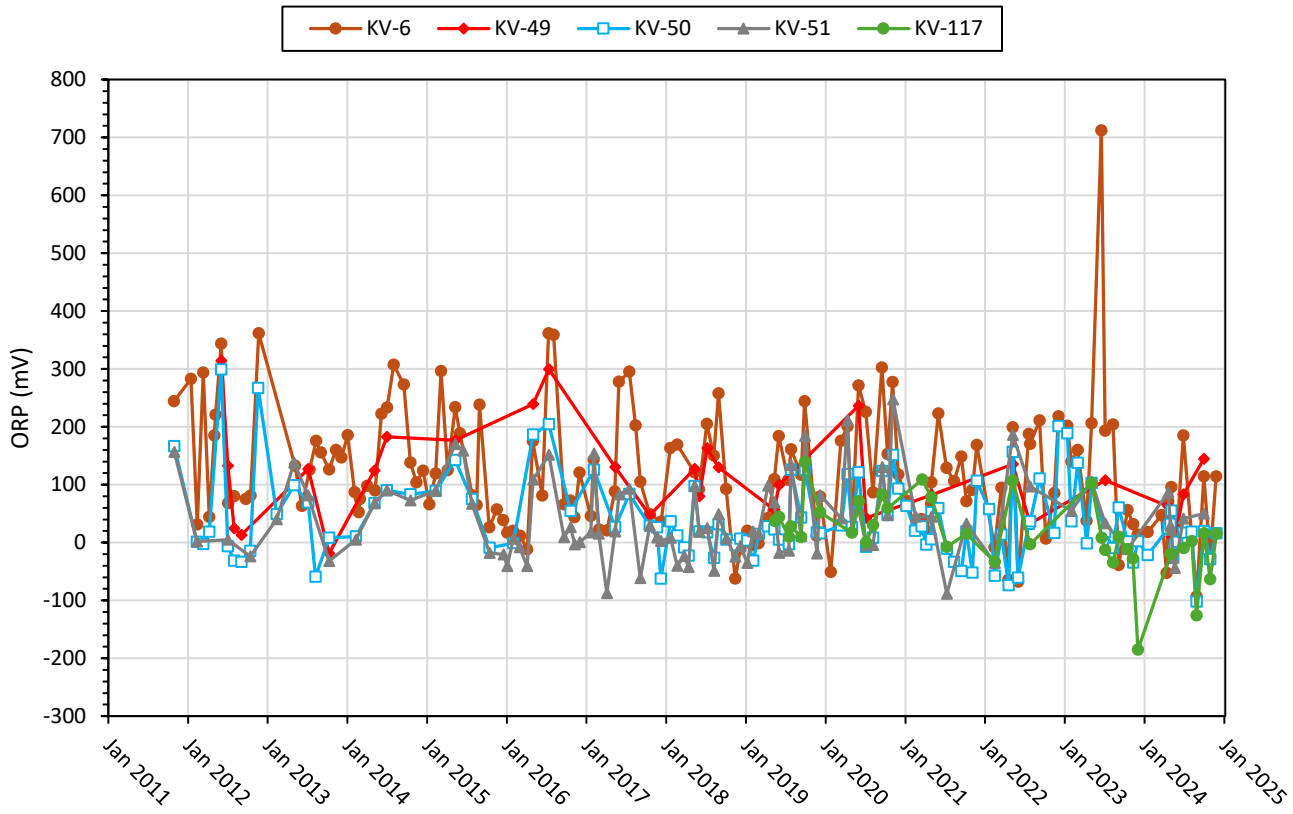

Figure 4-3: Field ORP at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2011-2024 Data

4.5.3 ARSENIC

The total arsenic time series plot and statistical summary of the monitoring data are shown in Figure 4-4 and Table 4-11, respectively. KV-50, KV-51, and the background station KV-117 generally had the highest total arsenic concentrations, which exceeded the CCME guideline (0.005 mg/L) for more than 90% of samples collected at each station. Total arsenic concentrations for KV-50 and KV-51 were generally comparable, while KV-117 showed higher seasonal variation resulting in additional concentrations below the CCME guideline during freshet. Total arsenic concentrations measured at KV-117 in November and December 2024 were higher than previously measured, and are linked to higher concentrations of TSS in these samples (74.4 and 211 mg/L, respectively). The November and December 2024 arsenic concentrations at KV-117 comprised largely of a particulate fraction (2-4% dissolved).. The lowest arsenic concentrations were measured at KV-49, with no exceedances of the CCME guideline observed during the monitoring period. KV-6 had total arsenic concentrations that were typically comparable to or higher than the guideline (71.4% of samples exceeding; Table 4-11). Most exceedances occurred in May during freshet and a weak seasonality has been observed in the data since 2013.

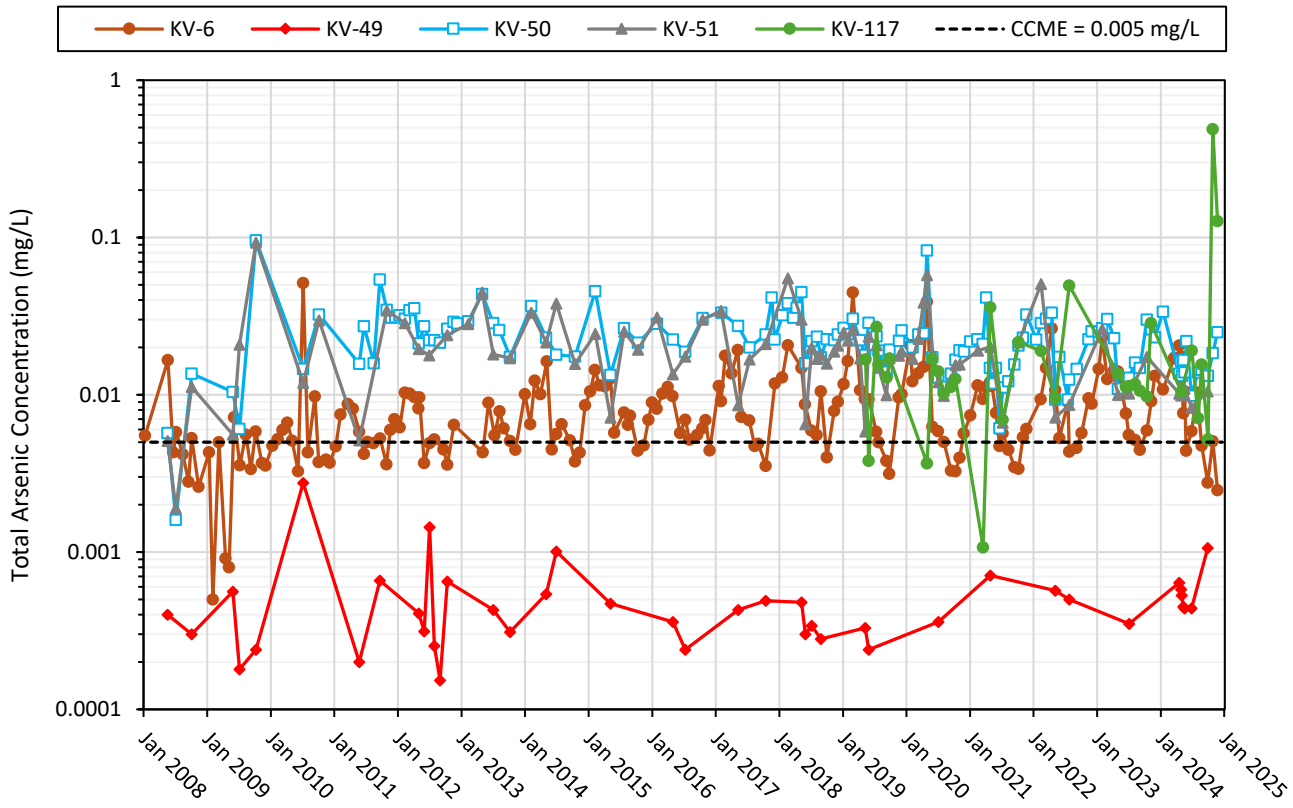

Figure 4-4: Total Arsenic at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-11: Total Arsenic Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Arsenic (mg/L); CCME = 0.005 mg/L					
Average	0.000522	0.0236	0.0203	0.00845	0.0326
Count	41	134	83	196	33
Minimum	0.000153	0.00160	0.00190	0.000500	0.00107
Maximum	0.00275	0.0960	0.0930	0.0513	0.488
Count <DL	0	0	0	0	0
Standard Deviation	0.000435	0.0121	0.0136	0.00637	0.0846
1st Quartile	0.000310	0.0159	0.0111	0.00475	0.0102
Median	0.000430	0.0223	0.0178	0.00645	0.0129
3rd Quartile	0.000560	0.0286	0.0242	0.0103	0.0190
Count over Guideline	0	133	82	140	30
% Over Guideline	0	99.3	98.8	71.4	90.9

4.5.4 ANTIMONY

The total antimony time series plot and statistical summary of the monitoring data are shown in Figure 4-5 and Table 4-12, respectively. Total antimony concentrations were low, and no exceedances of the BC ENV guideline (0.074 mg/L) were documented. The concentrations were generally comparable at the five monitoring stations (medians ranging from 0.00015 to 0.00037 mg/L), with slightly higher antimony concentrations measured at KV-6 compared to KV-49, KV-50, and KV-51 since 2013. Most total antimony concentrations that were below the detection limit were observed at KV-50 and KV-51 between 2019 and 2021. The total antimony concentrations at KV-49 were relatively stable between 2008 and 2024.

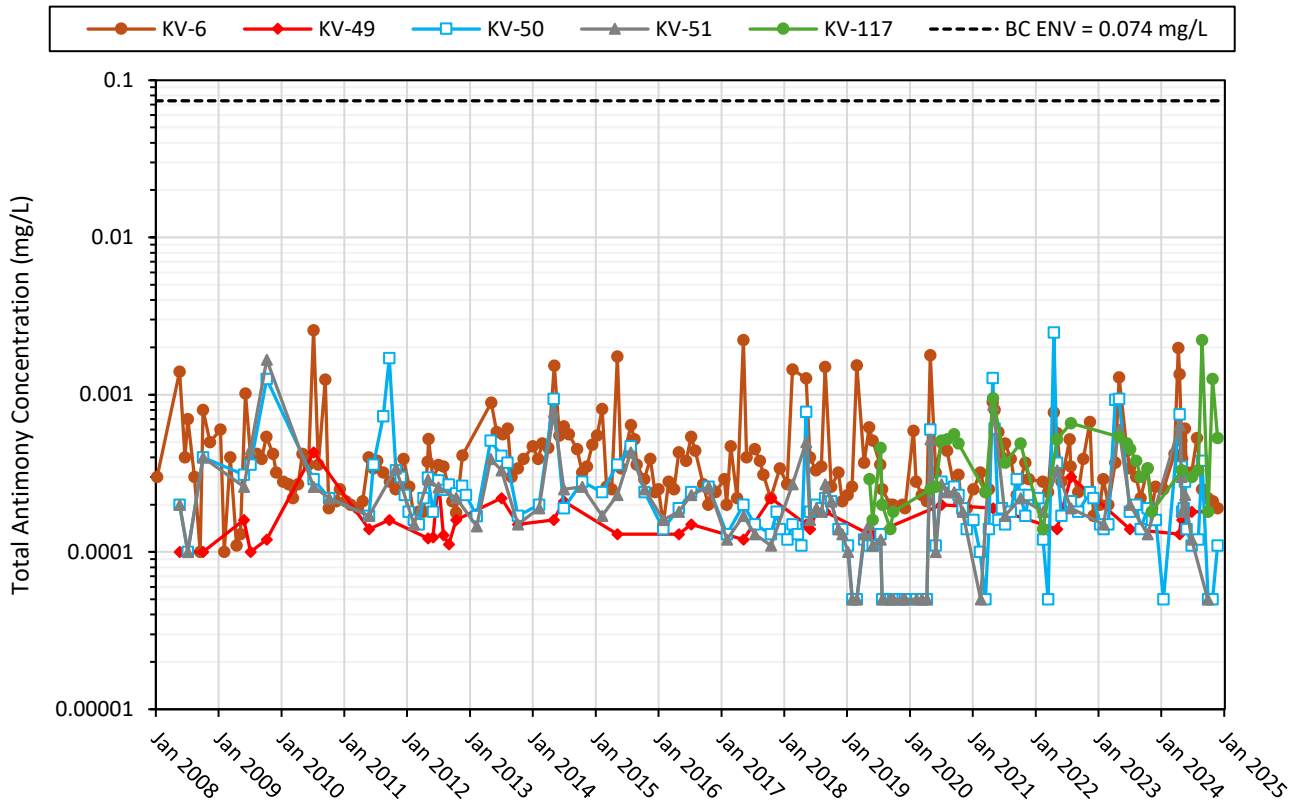

Figure 4-5: Total Antimony at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-12: Total Antimony Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Antimony (mg/L); BC ENV = 0.074 mg/L					
Average	0.000165	0.000270	0.000237	0.000449	0.000460
Count	41	134	83	196	33
Minimum	<0.000200	<0.000100	<0.000100	<0.000200	0.000140
Maximum	0.000430	0.00249	0.00167	0.00257	0.00223
Count <DL	2	16	13	2	0
Standard Deviation	0.0000610	0.000314	0.000222	0.000378	0.000390
1st Quartile	0.000130	0.000140	0.000130	0.000250	0.000250
Median	0.000150	0.000190	0.000180	0.000340	0.000370
3rd Quartile	0.000180	0.000267	0.000260	0.000483	0.000520
Count over Guideline	0	0	0	0	0
% Over Guideline	0	0	0	0	0

4.5.5 CADMIUM

The total cadmium plot and statistical summary of the monitoring data are shown in Figure 4-6 and Table 4-13, respectively. Total cadmium concentrations regularly exceeded the CCME guideline at monitoring stations KV-6 (99.5% of samples), KV-49 (43.9%), and KV-117 (66.7%) while only sporadic exceedances were noted at KV-50 and KV-51 (20.1% and 19.3%, respectively). The median cadmium concentrations at KV-49, KV-50, KV-51, and KV-117 were comparable (median = 0.000200 to 0.000375 mg/L), while KV-6 concentrations were consistently higher (median 0.00114 mg/L). Total cadmium concentrations at KV-117 were generally higher than at KV-50 since mid-2020 with the highest concentration measured in December 2024 (0.00344 mg/L), which may be related to elevated TSS concentrations in the sample. KV-50 has demonstrated visible seasonality since 2018 that is generally characterized by peak concentration during spring freshet (mid-April to May). Total cadmium concentrations at KV-49 have declined since 2014.

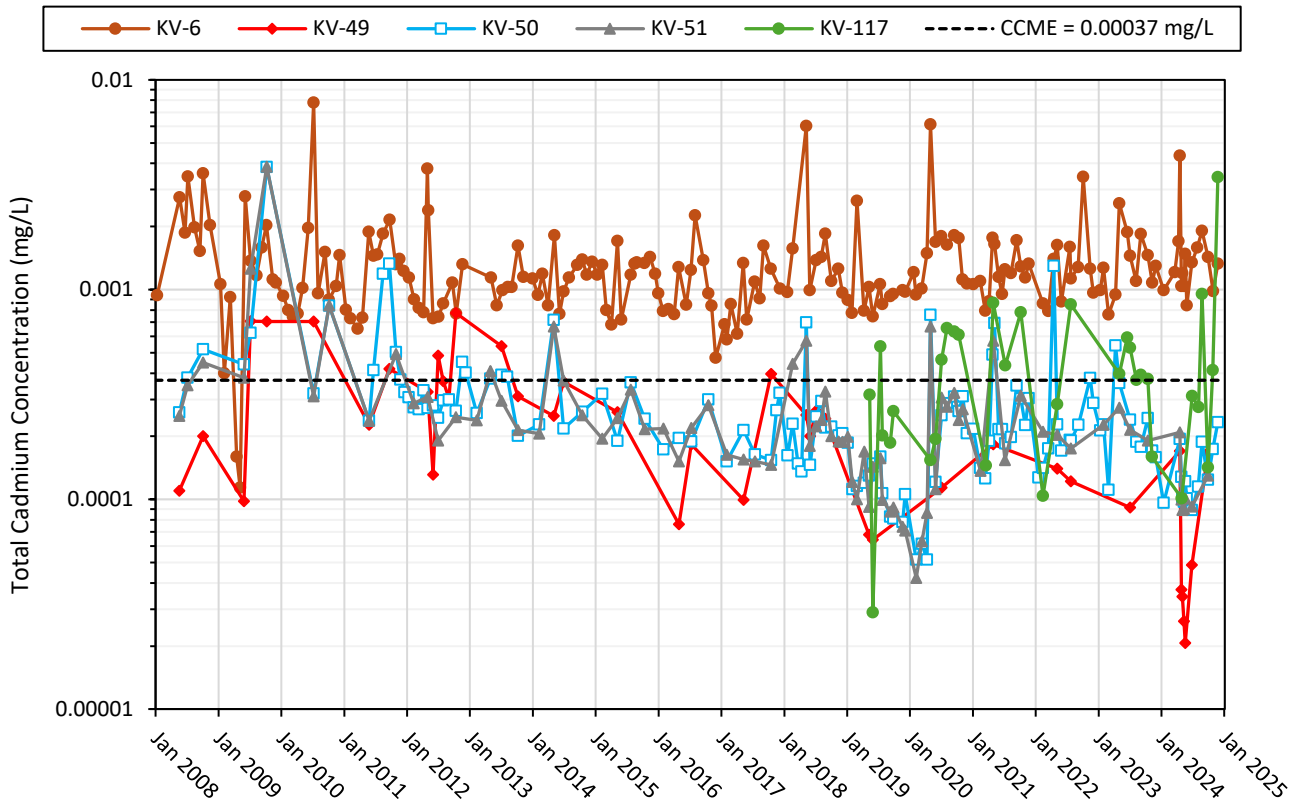

Figure 4-6: Total Cadmium at Monitoring Stations KV-49, KV-50, KV-51, KV-117 and KV-6, 2008-2024 Data

Table 4-13: Total Cadmium Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117 and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Cadmium (mg/L); CCME guideline is hardness dependent					
Average	0.000251	0.000300	0.000294	0.00136	0.000490
Count	41	134	83	196	33
Minimum	0.0000207	0.0000516	0.0000423	0.000114	0.0000289
Maximum	0.000774	0.00384	0.00385	0.00779	0.00344
Count <DL	0	0	0	0	0
Standard Deviation	0.000202	0.000372	0.000436	0.000893	0.000582
1st Quartile	0.0000994	0.000159	0.000149	0.000928	0.000194
Median	0.000200	0.000224	0.000214	0.00114	0.000375
3rd Quartile	0.000325	0.000309	0.000301	0.00146	0.000590
Count over Guideline	18	27	16	195	22
% Over Guideline	43.9	20.1	19.3	99.5	66.7

4.5.6 MANGANESE

The dissolved manganese time series plot and statistical summary of the monitoring data are shown in Figure 4-7 and Table 4-14, respectively. Dissolved manganese concentrations were higher than the CCME guideline in most of the samples at monitoring stations KV-50, KV-51, KV-6, and KV-117 (90.2%, 78.0%, 63.2%, and 67.6% of samples, respectively). KV-50 and KV-51 shared similar trends and had the highest median concentrations (1.59 and 1.42 mg/L, respectively). KV-117 had dissolved manganese concentrations generally comparable to KV-50 (and KV-51) for the same period, but the concentrations were slightly lower during freshet (April and May). The lowest concentrations were measured at KV-49 (median = 0.00674 mg/L) with no exceedances of the CCME guideline. Dissolved manganese concentrations at KV-6 were also lower than at KV-50 and KV-51, with results showing a cyclic pattern characterized by lows in summer (e.g., June-August) after which the concentration gradually increased and peaked in winter (e.g., November-December), then declined thereafter.

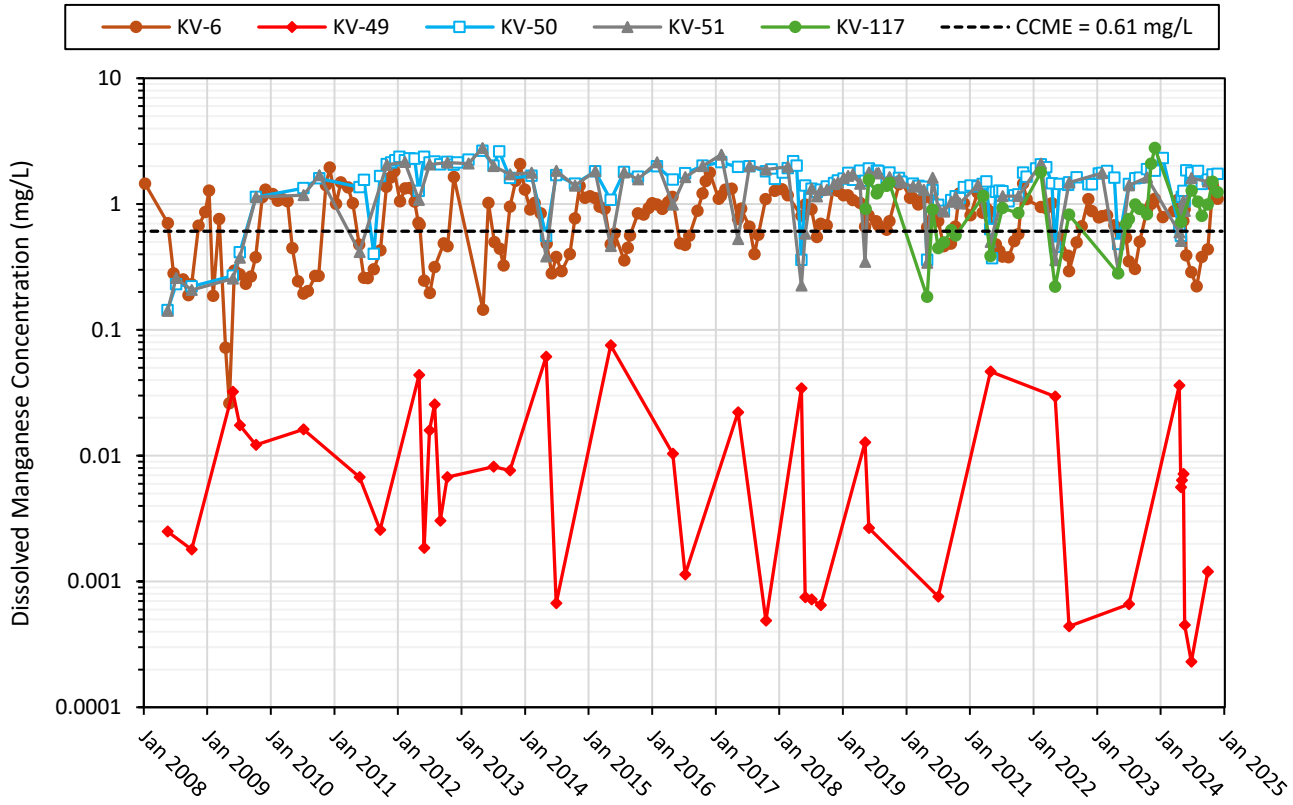

Figure 4-7: Dissolved Manganese at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-14: Dissolved Manganese Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Manganese (mg/L); CCME guideline is pH and hardness dependent					
Average	0.0137	1.53	1.31	0.805	1.00
Count	41	134	83	198	34
Minimum	0.000230	0.143	0.142	0.0260	0.183
Maximum	0.0754	2.65	2.78	2.08	2.78
Count <DL	1	0	0	0	0
Standard Deviation	0.0180	0.531	0.613	0.411	0.541
1st Quartile	0.00114	1.29	0.926	0.465	0.699
Median	0.00674	1.59	1.42	0.813	0.913
3rd Quartile	0.0175	1.86	1.76	1.09	1.27
Count over Guideline*	0	119	64	117	23
% Over Guideline**	0	90.2	78.0	63.2	67.6

**determined for sample subset for which pH and hardness were available to calculate the guideline*
***percentage exceedance based on number of samples for which pH and hardness were available to calculate the guideline (i.e., not the total count of samples)*

4.5.7 IRON

The total iron concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-8 and Table 4-15, respectively. KV-50, KV-51, and KV-117 returned similar median total iron concentrations (3.46, 3.02, and 2.54 mg/L, respectively), with measurements higher than the CCME guideline (0.3 mg/L) for all (KV-50 and KV-51; 100%) or most (KV-117; 97.0%) of the samples collected. The highest total iron concentrations were measured in November and December 2024 at KV-117, which were coincident with the relatively high concentrations of TSS in both samples. The November and December 2024 iron concentrations at KV-117 comprised largely of a particulate fraction (<1-6% dissolved). Lower total iron concentrations were observed at KV-6 (median 0.481 mg/L) and KV-49 (median 0.056 mg/L). The total iron concentration measured at KV-6 and KV-49 exceeded the CCME guideline in 71.9% and 9.8% of samples, respectively. Additionally, total iron concentrations at KV-49 appear to have declined from 2014 onwards. Slight seasonal patterns are observable at KV-49, with minimum concentrations typically measured during summer months.

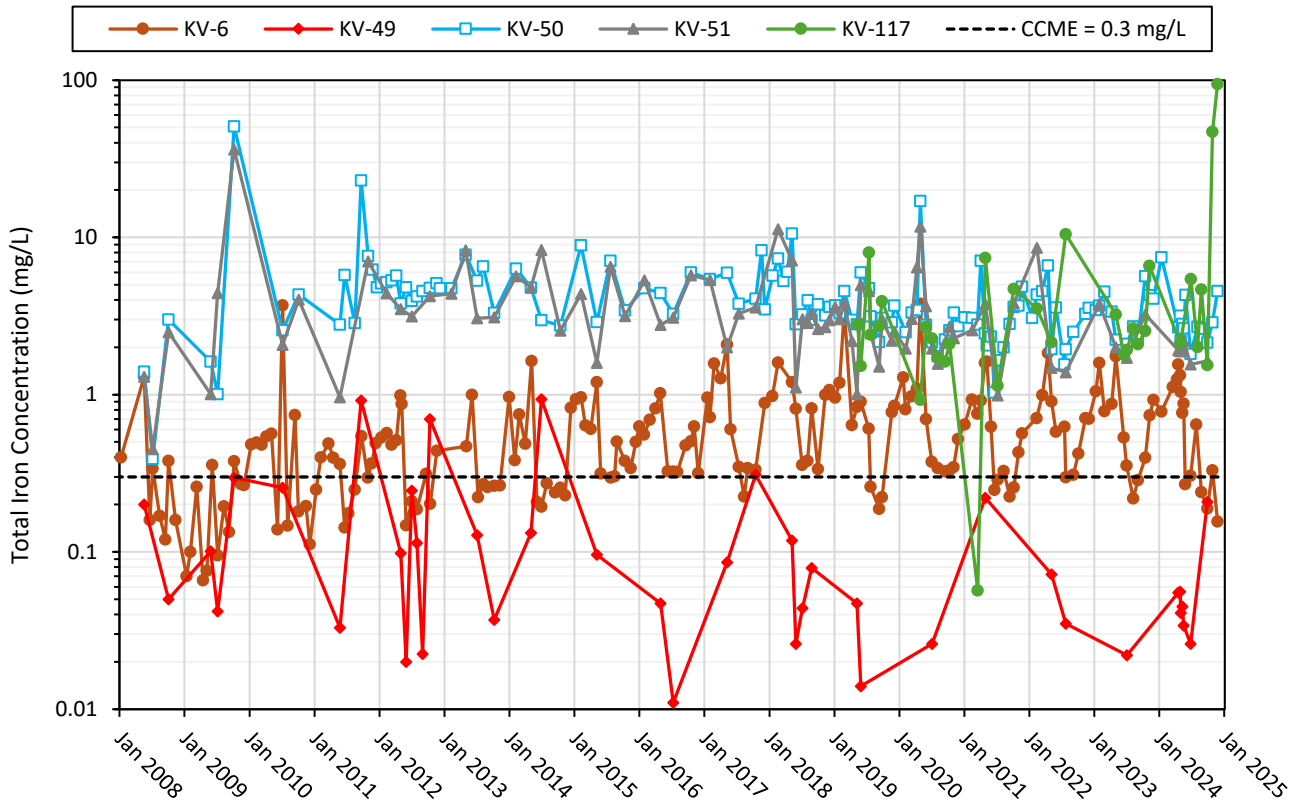

Figure 4-8: Total Iron at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-15: Total Iron Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Iron (mg/L); CCME = 0.3 mg/L					
Average	0.148	4.46	3.83	0.628	7.27
Count	41	134	83	196	33
Minimum	0.011	0.390	0.450	0.066	0.057
Maximum	0.934	50.8	36.3	3.79	94.2
Count <DL	0	0	0	0	0
Standard Deviation	0.217	4.81	4.21	0.55	17.5
1st Quartile	0.035	2.76	2	0.273	1.93
Median	0.056	3.46	3.02	0.481	2.54
3rd Quartile	0.132	4.81	4.31	0.829	4.67
Count over Guideline	4	134	83	141	32
% Over Guideline	9.8	100	100	71.9	97.0

4.5.8 ZINC

The dissolved zinc concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-9 and Table 4-16, respectively. The temporal patterns of dissolved zinc concentrations were similar for KV-50 and KV-51 (median = 0.200 and 0.178 mg/L, respectively), with lower concentrations measured during freshet. The majority of samples collected at KV-50 and KV-51 (88.8% and 80.0%, respectively) returned zinc concentrations above the CCME guideline. Sampling at KV-6 and KV-117 returned 91.0% and 63.6% of results higher than the dissolved zinc CCME guideline, respectively. Dissolved zinc concentrations at KV-117 generally exhibited a similar pattern to those of KV-50 (and KV-51) for the same period, with lower concentrations noted during freshet. The lowest dissolved zinc concentrations were measured at KV-49, with no exceedances of the pH, hardness, and DOC dependent CCME guideline noted. Dissolved zinc concentrations at KV-49 appear to have declined since 2014. Dissolved zinc concentrations at KV-6 were generally within the same range as KV-50 and KV-51 and have demonstrated consistent measurements with some variation attributable to seasonality since 2008.

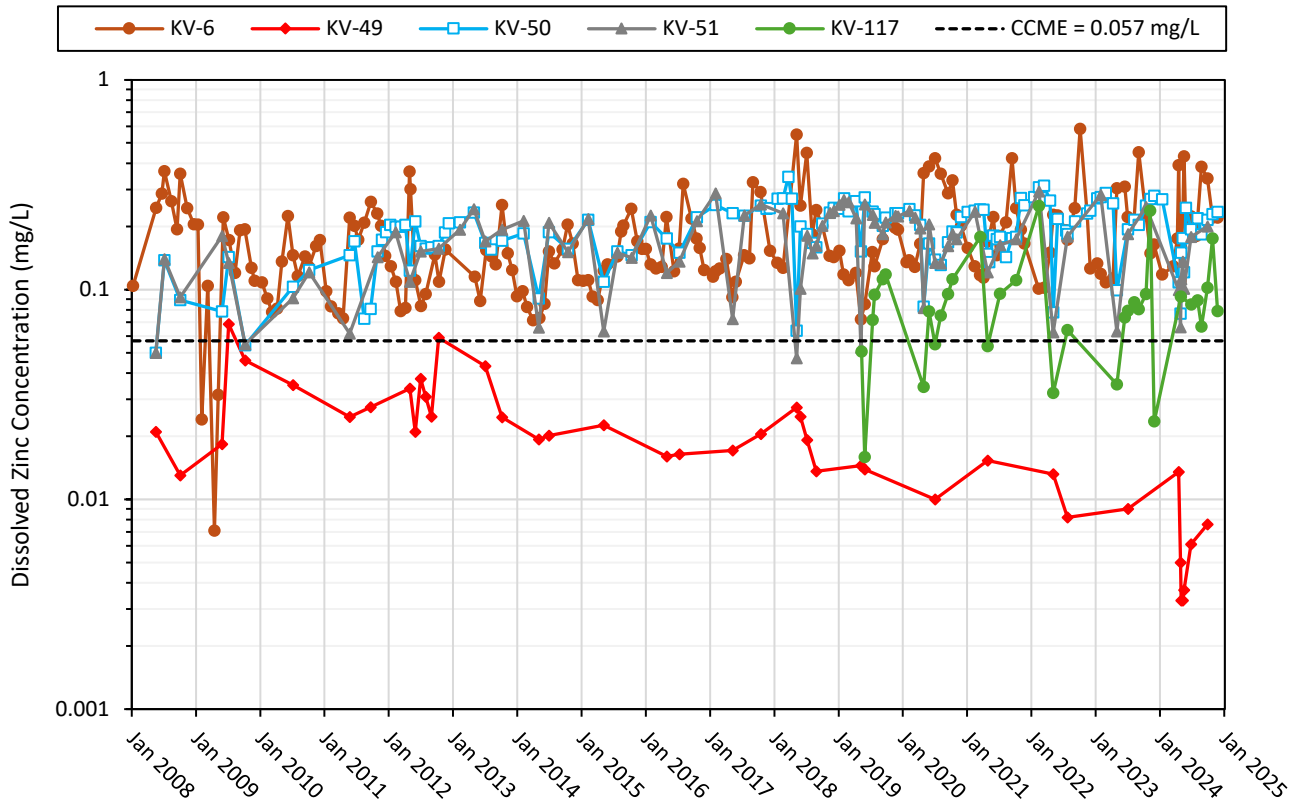

Figure 4-9: Dissolved Zinc at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-16: Dissolved Zinc Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Zinc (mg/L); CCME guideline is pH, hardness, and DOC dependent					
Average	0.0213	0.194	0.168	0.179	0.0911
Count	41	134	83	198	34
Minimum	0.0033	0.0500	0.0471	0.00710	0.0159
Maximum	0.0684	0.344	0.294	0.583	0.25
Count <DL	0	0	0	0	0
Standard Deviation	0.0142	0.0593	0.0647	0.0926	0.0525
1st Quartile	0.0132	0.156	0.121	0.118	0.0646
Median	0.0192	0.200	0.178	0.155	0.0828
3rd Quartile	0.0248	0.236	0.220	0.220	0.100
Count over Guideline*	0	111	60	152	21
% Over Guideline**	0	88.8	80.0	91.0	63.6

** determined for sample subset for which pH, DOC, and hardness were available to calculate the guideline*
***percentage exceedance based on number of samples for which pH, DOC, and hardness were available to calculate the guideline (i.e., not the total count of samples)*

4.5.9 SULPHATE

The dissolved sulphate time series plot and statistical summary of the monitoring data are shown in Figure 4-10 and Table 4-17, respectively. KV-50 and KV-51 had similar concentrations between 2010 and 2024 with 29.9% and 25.0% of all samples above the hardness dependent BC ENV guideline, respectively. The sulphate concentration measured at both these stations declined since mid-2018, resulting in fewer recent exceedances. Due to this decline, dissolved sulphate measured at KV-6 was generally comparable to KV-50 and KV-51 since mid-2018 with sulphate concentrations at all three stations typically below the applicable BC ENV guideline. The lowest sulphate concentrations were measured at KV-49 and KV-117 (median = 150 mg/L and 130 mg/L, respectively) with only one guideline exceedance observed at KV-49 during the monitoring period. Dissolved sulphate concentrations at KV-49 appear to have declined since 2014. Sulphate concentrations at KV-117 were distinctly lower compared to KV-50, indicating additional sulphate loading along the flow path.

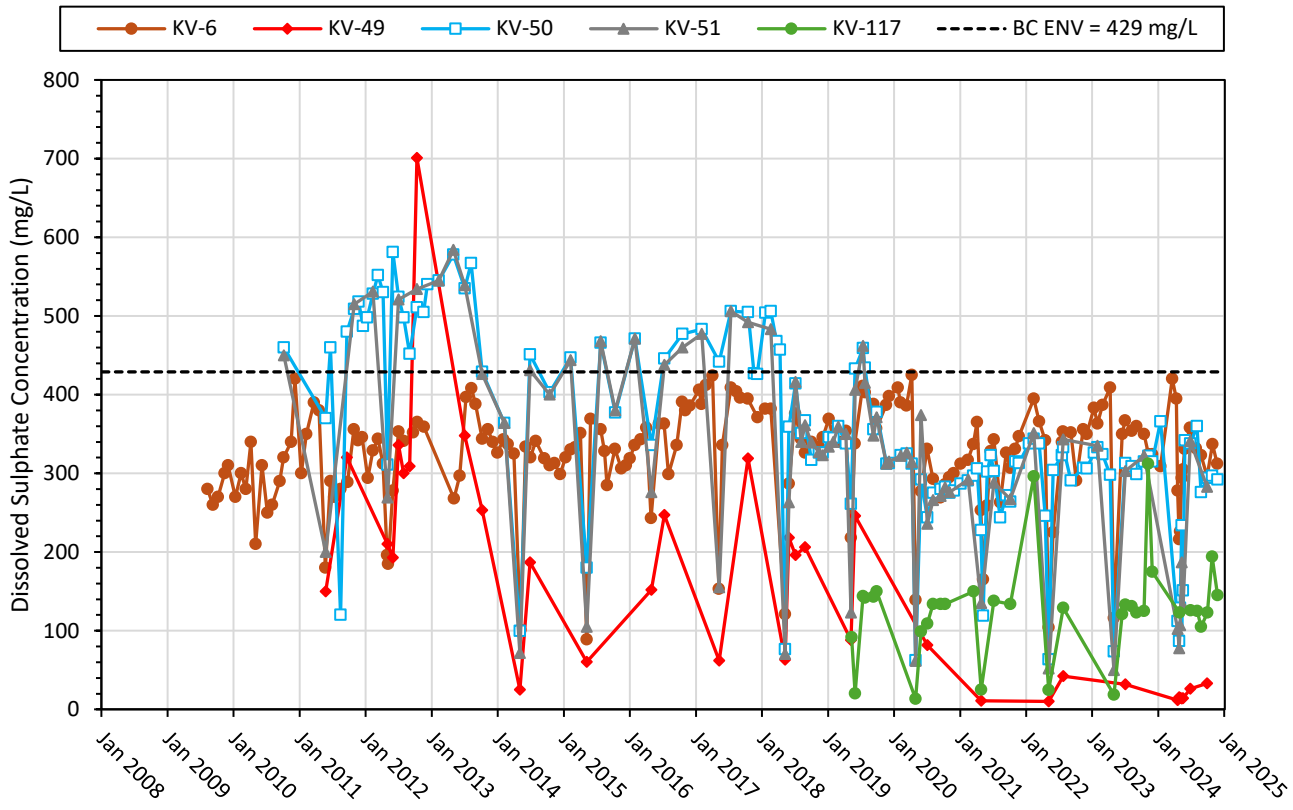

Figure 4-10: Dissolved Sulphate at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-17: Dissolved Sulphate Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Sulphate (mg/L); BC ENV guideline is hardness dependent					
Average	157	352	326	323	126
Count	35	127	76	182	34
Minimum	10.1	62.4	49.9	88.7	13.4
Maximum	701	581	584	425	312
Count <DL	0	0	0	0	0
Standard Deviation	150	119	136	64.7	63.2
1st Quartile	29	296	269	296	112
Median	150	333	337	336	130
3rd Quartile	247	452	427	360	143
Count over Guideline	1	38	19	0	0
% Over Guideline	2.9	29.9	25.0	0	0

4.5.10 COPPER

The dissolved copper concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-11 and Table 4-18, respectively. All stations except KV-49 had dissolved copper concentrations below the detection limit in more than 25% of their samples, and all stations showed a clear seasonality characterized by peak copper concentrations measured during spring freshet. The highest median concentration was observed at KV-49 (0.00115 mg/L), followed by KV-6 (0.000330 mg/L), KV-117 (0.000245 mg/L), and KV-51 (0.000197 mg/L). Although KV-50 had the lowest observed median concentration (0.000100 mg/L), the maximum concentration (0.00300 mg/L) was comparable to the maximums at KV-51 and KV-117 (0.00300 and 0.00251 mg/L, respectively). For all three stations, the maximum concentrations were measured during freshet. KV-6 also returned a dissolved copper concentration trend similar to KV-50 and KV-51 (comparable peak concentrations); however, post-freshet concentrations (July to December) were typically higher at KV-6. The highest number of exceedances were observed along Hinton creek (KV-49; 27.3% of samples exceeding the BC ENV guideline).

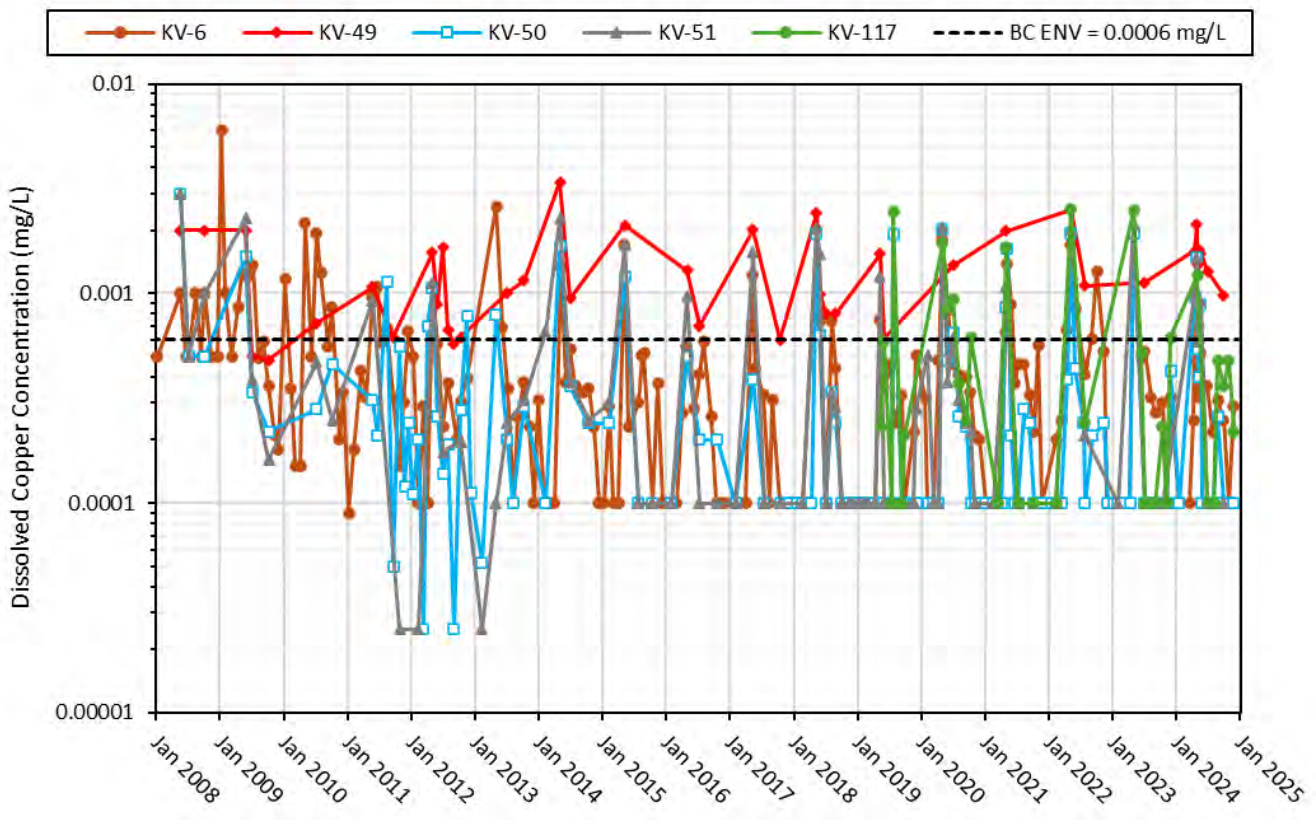

Figure 4-11: Dissolved Copper at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-18: Dissolved Copper Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Copper (mg/L); BC ENV guideline is based on a biotic ligand model, dependent on hardness, DOC, pH, and temperature					
Average	0.00133	0.000361	0.000519	0.000484	0.000602
Count	41	134	83	198	34
Minimum	0.00048	<0.000050	<0.000050	0.00009	<0.00020
Maximum	0.00341	0.00300	0.00300	0.00600	0.00251
Count <DL	0	69	40	58	12
Standard Deviation	0.000662	0.000509	0.000672	0.000592	0.00073
1st Quartile	0.000800	0.000100	0.000100	0.000100	0.000100
Median	0.00115	0.000100	0.000197	0.000330	0.000245
3rd Quartile	0.00167	0.000355	0.000640	0.000530	0.000620
Count over Guideline*	9	11	5	5	5
% Over Guideline**	27.3	8.8	6.7	3.0	15.2

** determined for sample subset for which pH, DOC and hardness were available to calculate the guideline*
***percentage exceedance based on number of samples for which pH, DOC, and hardness were available to calculate the guideline (i.e., not the total count of samples)*

4.5.11 LEAD

The dissolved lead concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-12 and Table 4-19, respectively. In previous years, total lead concentrations were compared to the CCME guideline; however, a more recent guideline for dissolved lead was provided by BC ENV in August 2024 and was therefore used for screening lead concentrations in Christal Creek. KV-50 and KV-51 had relatively low lead concentrations (median 0.000025 and 0.000067 mg/L, respectively), while the median concentration at KV-6 was an order of magnitude higher (0.000446 mg/L). In recent years, dissolved lead concentrations at KV-6 peak during freshet, with 1.7% of samples exceeding the BC ENV guideline over the historical period. No dissolved lead guideline exceedances were observed at the other four stations. Monitoring station KV-49 often had the lowest or similar dissolved lead concentrations among the stations in recent years. Monitoring station KV-117 often had similar or slightly higher dissolved lead concentrations compared to downstream stations KV-50 and KV-51. Dissolved lead concentrations at all Christal Creek stations (KV-6, KV-50, KV-51, and KV-117) typically peak with freshet (April or May).

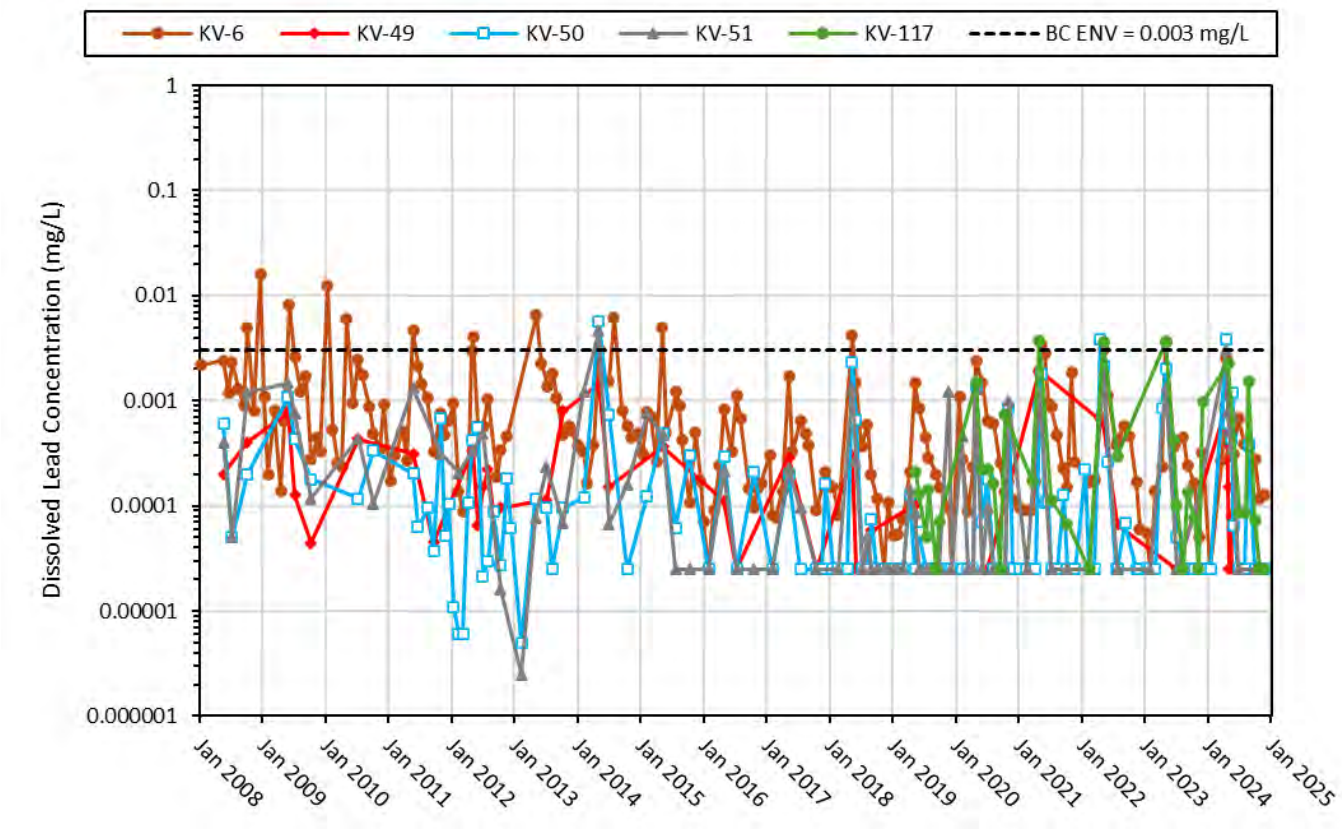

Figure 4-12: Dissolved Lead at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-19: Dissolved Lead Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Lead (mg/L); BC ENV guideline is hardness and DOC dependent					
Average	0.00027	0.00031	0.00039	0.0010	0.00062
Count	41	134	83	198	34
Minimum	<0.000050	0.0000050	<0.0000050	<0.000050	<0.000050
Maximum	0.00193	0.00568	0.00464	0.0159	0.00377
Count <DL	11	64	39	5	7
Standard Deviation	0.000398	0.000764	0.000718	0.00185	0.00109
1st Quartile	0.000050	0.000025	0.000025	0.000175	0.000068
Median	0.000112	0.000025	0.000067	0.000446	0.000133
3rd Quartile	0.000313	0.0001945	0.000449	0.00105	0.000392
Count over Guideline*	0	0	0	3	0
% Over Guideline**	0	0	0	1.7	0

** determined for sample subset for which pH, DOC and hardness were available to calculate the guideline*

***percentage exceedance based on number of samples for which pH, DOC, and hardness were available to calculate the guideline (i.e., not the total count of samples)*

4.5.12 NICKEL

The dissolved nickel concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-13 and Table 4-20, respectively. In previous years, total nickel concentrations were compared to the CCME guideline; however, a more recent guideline for dissolved nickel was issued by BC ENV in 2024 and was therefore used for screening nickel concentrations in Christal Creek. KV-50 and KV-51 returned the highest and similar dissolved nickel concentrations (median 0.0103 and 0.00951 mg/L, respectively) with 25.6% and 18.9% of samples exceeding the guideline. For dissolved nickel concentrations at background station KV-117, 6.1% of samples also exceeded the guideline at this station, with lower concentrations then KV-50 and KV-51 typically observed (median 0.00473 mg/L). Dissolved nickel concentrations at KV-49 and KV-6 were low, and no exceedances of the BC ENV guideline were recorded in the 2008-2024 dataset. Monitoring station KV-49 had the lowest dissolved nickel concentrations among the stations since 2010. Dissolved lead concentrations at KV-50 and KV-51 typically showed seasonal lows with freshet (April or May). Weaker seasonality in dissolved lead concentrations was observed at KV-117, with seasonal lows also coincident with freshet.

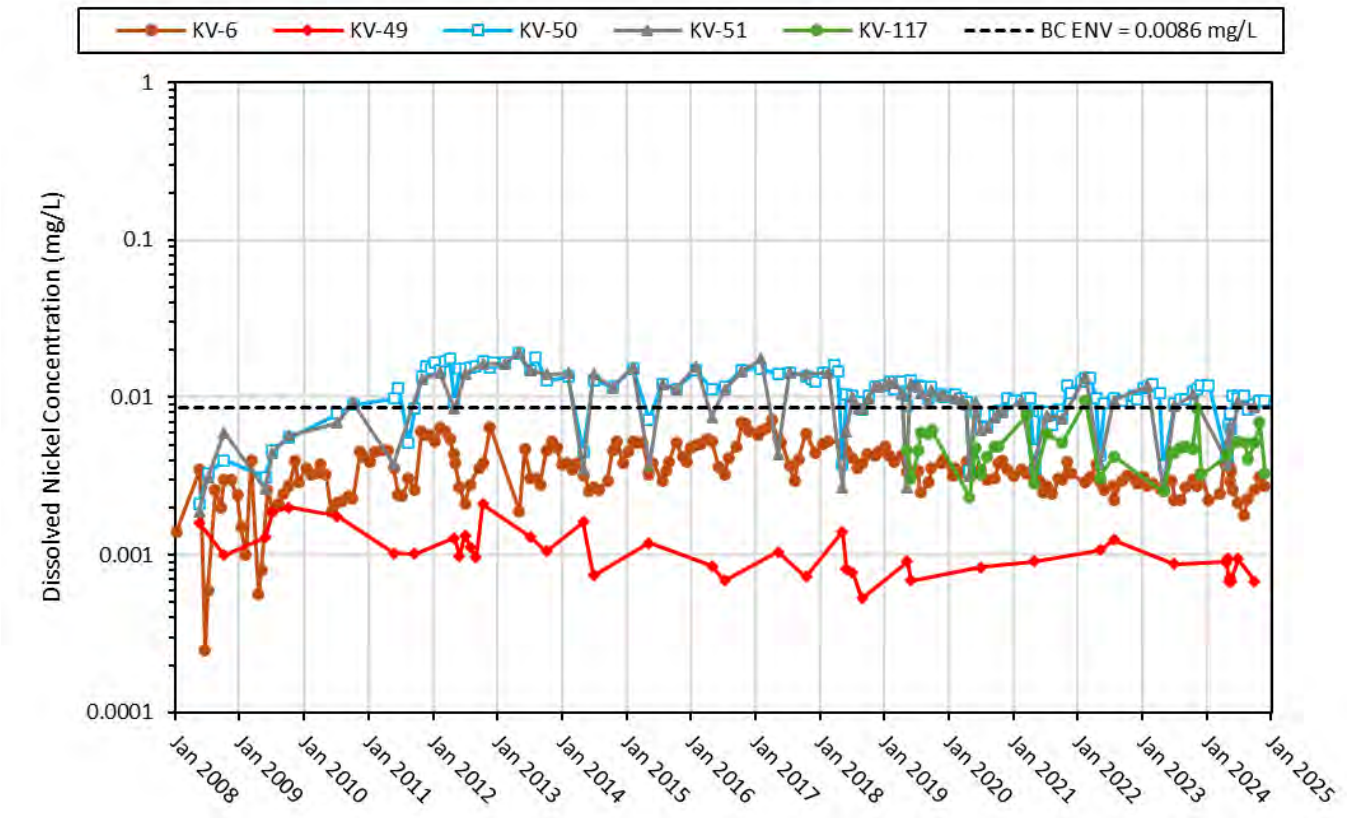

Figure 4-13: Dissolved Nickel at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

Table 4-20: Dissolved Nickel Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2024 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Nickel (mg/L); BC ENV guideline is based on a biotic ligand model, dependent on hardness, DOC, pH, and temperature					
Average	0.00108	0.0106	0.00939	0.00358	0.00485
Count	41	134	83	198	34
Minimum	0.000530	0.00210	0.00190	<0.00050	0.00232
Maximum	0.00210	0.0189	0.0193	0.00719	0.00954
Count <DL	0	0	0	1	0
Standard Deviation	0.000382	0.00365	0.00415	0.00124	0.00161
1st Quartile	0.000820	0.00843	0.00617	0.00275	0.00409
Median	0.000992	0.0103	0.00951	0.00341	0.00473
3rd Quartile	0.00128	0.0129	0.0122	0.00431	0.00528
Count over Guideline*	0	32	14	0	2
% Over Guideline**	0	25.6	18.9	0	6.1

** determined for sample subset for which pH, DOC and hardness were available to calculate the guideline*
***percentage exceedance based on number of samples for which pH, DOC, and hardness were available to calculate the guideline (i.e., not the total count of samples)*

4.5.13 SEEP KV-121

The monitoring of this natural seep began in February 2019 to comply with recommendations #1 and #5 of the Water Resources Branch (WRB) as reported in the Water Licence Audit conducted in June 2018 (WRB, 2018). These recommendations stipulate that the seep should be added to the water quality monitoring program, monitored regularly, and included in this study. The seep was sampled monthly for dissolved and total metals since February 10, 2019 and a statistical summary of water quality data for parameters of interest is shown in Table 4-21.

Dissolved element concentrations generally accounted for most of their counterpart total concentrations, indicating that most elements were transported as dissolved species. The exceptions were aluminum, antimony, cadmium, copper, and lead, where the dissolved concentrations represented less than 50% of the total concentration in more than 10% of the samples. Dissolved aluminum, copper, and lead also comprised less than 50% of their counterpart total concentrations in a majority of samples since monitoring began (57% to 75% of samples). Fluctuations of sulphate and metal(loid)s concentrations occurred at the seep and little seasonality was observed for most parameters of interest. Some muted seasonality in total antimony, cadmium, and dissolved copper concentrations was observed with peak concentrations typically in May during freshet.

The six-year dataset at KV-121 was plotted with KV-117 and KV-50 to determine how the water quality of the seep compared to the background (KV-117) and the downstream stations (KV-50) and to assess its potential contribution to Christal Creek. All comparative plots are compiled in Appendix C. The visual comparison shows that:

- Concentrations of sulphate, total arsenic and nickel, and dissolved zinc at KV-121 were comparable with the data collected at KV-50 until February 2020 after which they diverged such that concentrations at KV-121 tended to be higher.

- The dissolved copper at KV-50 varied, with many results below the detection limit and other results similar in concentration to background station KV-117 and the seep KV-121. Additionally, the peak dissolved copper concentrations at KV-50 and KV-117 were comparable and higher than those at KV-121.
- Total iron and dissolved manganese concentrations at KV-50 and KV-121 were generally comparable until late 2024, where concentrations at KV-121 were lower compared to the 2019 to 2023 dataset. Concentration decreases in late 2024 at KV-121 were also observed for total arsenic, total nickel, and dissolved zinc. This may be correlated with higher dissolved oxygen values measured at KV-121 in late 2024 and the potential onset of oxidizing conditions.
- Total concentrations of lead, cadmium, and antimony at the seep KV-121 were generally lower than those at the background station KV-117. Field pH and ORP were comparable, but sulphate, arsenic, manganese, nickel, and zinc were typically higher at KV-121 than KV-117 (Appendix C). However, recent measurements show a sharp decline in KV-121 concentrations; future monitoring is required to determine whether this decline is sustained over time.

The data above suggest that the groundwater seep may be occasionally impacting the concentrations of some metals and metalloids in Christal Creek. This may be particularly true for sulphate, zinc, arsenic, nickel, and manganese as the concentrations of these constituents were typically higher in the seep (KV-121) than in the upstream background station (KV-117). However, other unidentified sources of metals could be present along the water course between KV-117 and KV-50. The discharge from this seep will continue to be monitored.

Table 4-21: Summary of Main Constituents of Interest at KV-121, 2019-2024 Data

Parameter	Field pH	Sulphate	Arsenic	Antimony	Cadmium	Copper	Manganese	Nickel	Iron	Zinc
Unit	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Average	7.12	353	0.0343	0.000171	0.000373	0.000224	1.62	0.0148	3.82	0.332
Count	52	51	51	51	51	51	51	51	51	51
Minimum	6.45	115	0.000810	<0.00010	0.0000649	<0.00020	0.00200	0.000640	0.0610	0.0282
Maximum	8.44	554	0.118	0.00246	0.00457	0.00183	3.21	0.0303	14.2	0.647
Count <DL	0	0	0	37	0	29	0	0	0	0
Standard Deviation	0.400	114	0.0211	0.000413	0.000850	0.000269	0.860	0.00757	2.39	0.166
1st Quartile	6.87	254	0.0196	0.0000500	0.000110	0.000100	0.878	0.0100	2.44	0.213
Median	7.03	358	0.0303	0.000100	0.000139	0.000200	1.73	0.0134	3.63	0.326
3rd Quartile	7.36	452	0.0458	0.000110	0.000178	0.000250	2.29	0.0199	5.14	0.431

** Arsenic, antimony, cadmium, iron, and nickel concentrations are total*
Sulphate, copper, manganese, and zinc concentrations are dissolved

5 CONCLUSIONS

The results of physical, chemical, and microbiological testing conducted on surficial soil and moss samples collected from three transects along the proposed discharge corridor between the Flame & Moth discharge diffuser and Christal Creek indicate the following:

- The soil samples consist mostly of silt loam with a significant clay content (up to 15% on average). The high silt and clay contents are predicted to create large surface areas favourable for the retention of metals through adsorption or cation exchange with the discharged water;
- The soil pHs were neutral (pH 6.0 to 6.7) reflecting an environment where low mobility of several metal(loid)s is anticipated due to the precipitation of oxide or hydroxides (iron and aluminum) that may also co-precipitate other metal(loid)s from the discharge water. Under the buffered soil pH conditions, soil particles such as clay with a pH-dependent surface charge will be net negatively charged creating conditions favourable for the adsorption of metal cations;
- The study site had a median soil moisture content of 52% indicative of a moderate water holding capacity favourable for the development of vegetation cover, peaty, and organic-rich surficial materials along the discharge channel which may promote natural attenuation. The median soil organic matter content ranged from 14.7% to 22.4%. The soil along the proposed discharge channel contains a significant amount of organic matter that will likely create favourable conditions for metal sorption, immobilization, and attenuation;
- The majority of COPI were predominantly associated at varying proportions with the residual, reducible, and organic matter/sulphide soil compartments. Although the exchangeable fraction and carbonate phases contained the lowest fractions of COPI, cadmium was predominantly tied to the exchangeable phase. Carbonate minerals also hosted up to 17% of the cadmium, lead, manganese, and zinc in the soils, suggesting metal removal via precipitation (or co-precipitation with) as carbonate phases may also assist natural attenuation;
- The largest concentrations of COPI in the soils were often associated with the residual phase, indicating this portion of the metal inventory is strongly tied to the mineral lattice and predicted to be stable in the soil matrix significantly decreasing their solubility and potential bioavailability. Although the proportion of COPI associated with the reducible soil fraction could be remobilized following the development of iron-reducing conditions, the marshy and organic matter rich environment lends itself to the subsequent development of sulphate-reducing conditions under which previously mobilized chalcophile metals may be re-sequestered as sulphide mineral assemblages;
- Microbial community profiling identified the presence of bacteria closely related to microorganisms capable of mediating iron and sulphur redox transformations, indicating the microbial potential exists for long term metal sequestration via sulphide mineral precipitation;
- These data indicate that soil and landcover conditions along the proposed discharge corridor are favourable for natural attenuation of metal(loid)s in the treatment discharge;
- Transect T-1 generally had the highest metal concentrations especially arsenic, antimony, cadmium, iron, manganese, copper, nickel, lead, and zinc. The concentration of these constituents was commonly at least two- to three-fold higher than the transect-2. Transect-3 had the lowest suggesting a decreasing metal content in vegetation downstream along the proposed discharge channel; and
- The 2008 to 2024 surface water quality data showed that the concentrations of sulphate, arsenic, cadmium, copper, iron, lead, manganese, nickel, and zinc were frequently or occasionally above their respective guidelines along Christal Creek, while pH below pH 6.5 was occasionally observed at KV-6, KV-49, KV-50, and KV-51.
- Aside from the further decline of sulphate, cadmium, iron, and zinc at KV-49 and recent decline of arsenic, manganese, iron, nickel, and zinc at KV-121 in late 2024, no other major changes of water quality occurred in 2024 compared to previous years.

- The temporary discharge from the Flame & Moth WTP (KV-104C) that occurred on May 1-7 and 15-17, 2021 did not have any discernable impact on the water quality at KV-50, because the water quality at this station overall mirrored the water quality of the background station (KV-117). However, higher concentrations of zinc, manganese, arsenic were found at KV-50 compared to KV-117. This was noted before and after the WTP discharge had occurred suggesting some metal loading not related to the WTP discharge along the flow path between the background station and Hinton Creek. Seep KV-121 could be one source of such metal loading.

6 NEXT STEPS

The next steps in this study will involve:

- Continue to collect water quality data from existing locations;
- Install drive-point piezometers along flow path if discharge from the Flame & Moth treatment plant to Christal Creek occurs;
- Additional characterization of the topography and landcover along the discharge corridor if discharge to Christal Creek starts including monitoring for any glaciation of discharge between the diffuser and Christal Creek; and
- Assess the natural attenuation after the discharge has begun and been sustained.

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APPENDIX A:

LABORATORY REPORTS

GEOCHEMICAL AND MICROBIOLOGICAL DATA OF SOIL AND MOSS

ALEXCO RESOURCE CORP.
ATTN: Kai Woloshyn
#3 - 151 Industrial Road
Whitehorse YT Y1A 2V3

Date Received: 12-JUL-18
Report Date: 18-OCT-18 16:36 (MT)
Version: FINAL REV. 3

Client Phone: --

Certificate of Analysis

Lab Work Order #: L2128495

Project P.O. #: 18965
Job Reference: NATURAL ATTENUATION STUDY
C of C Numbers: 1 of 1
Legal Site Desc:

Comments: 18-OCT-2018 This report has been revised to add additional Tessier metals testing to samples 3, 10, and 12 as requested.

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-1	L2128495-2	L2128495-3	L2128495-4	L2128495-5
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:00	13:10	13:20	13:30	13:40
Client ID	T1-A	T1-B	T1-D	T1-E	T1-F
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	70.3	55.1	29.1	35.5	79.1
Particle Size % Gravel (>2mm) (%)	4.4	8.5	5.7	12.8	<1.0
% Sand (2.0mm - 0.063mm) (%)	34.7	31.4	37.5	33.0	<1.0
% Silt (0.063mm - 4um) (%)	47.6	52.4	47.1	46.6	82.7
% Clay (<4um) (%)	13.4	7.6	9.7	7.7	16.4
Texture	Silt loam	Silt loam	Silt loam	Silt loam	Silt
Organic / Inorganic Carbon Total Organic Carbon (%)	20.6	13.0	2.31	4.92	37.8
Saturated Paste Extractables Paste pH (pH)	6.04	6.30	5.40	6.54	6.72
Total Metals Aluminum (Al) (%)	0.87	1.18	1.18	1.24	0.16
Antimony (Sb) (ppm)	1.07	0.79	1.20	0.81	1.65
Arsenic (As) (ppm)	94.2	17.6	47.1	10.0	14.0
Barium (Ba) (ppm)	370	310	230	260	270
Beryllium (Be) (ppm)	0.26	0.32	0.39	0.31	0.07
Bismuth (Bi) (ppm)	0.15	0.49	0.22	0.19	0.05
Boron (B) (ppm)	<10	<10	<10	<10	10
Cadmium (Cd) (ppm)	1.72	0.79	1.06	0.69	1.48
Calcium (Ca) (%)	1.98	0.81	0.46	0.65	4.12
Cerium (Ce) (ppm)	14.45	25.3	33.6	30.8	1.85
Cesium (Cs) (ppm)	0.46	0.60	0.75	0.65	0.11
Chromium (Cr) (ppm)	18	24	23	26	9
Cobalt (Co) (ppm)	15.9	8.5	9.5	6.4	4.1
Copper (Cu) (ppm)	55.5	123.5	35.0	34.4	25.3
Gallium (Ga) (ppm)	2.73	3.39	3.47	3.58	0.68
Germanium (Ge) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
Hafnium (Hf) (ppm)	0.04	0.04	0.08	0.05	0.02
Indium (In) (ppm)	0.025	0.067	0.035	0.028	0.058
Iron (Fe) (%)	3.78	2.44	2.62	2.02	2.68
Lanthanum (La) (ppm)	7.1	12.7	16.9	15.3	1.1
Lead (Pb) (ppm)	87.9	96.4	230	23.8	86.6
Lithium (Li) (ppm)	6.9	12.3	13.9	14.1	0.7
Magnesium (Mg) (%)	0.40	0.46	0.46	0.48	0.24
Manganese (Mn) (ppm)	1350	627	163	354	1040
Mercury (Hg) (ppm)	0.06	0.14	0.05	0.04	0.10
Molybdenum (Mo) (ppm)	2.42	0.74	1.34	0.74	1.26
Nickel (Ni) (ppm)	20.0	19.4	25.5	19.9	9.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-6	L2128495-7	L2128495-8	L2128495-9	L2128495-10
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:50	14:00	14:10	14:20	14:30
Client ID	T2-A	T2-B	T2-D	T2-E	T2-F
Grouping / **Analyte**					
SOIL					
Physical Tests Moisture (%)	25.8	76.4	59.4	76.2	52.2
Particle Size % Gravel (>2mm) (%)	16.9	<1.0	5.7	<1.0	5.2
% Sand (2.0mm - 0.063mm) (%)	41.3	1.9	36.3	4.8	23.9
% Silt (0.063mm - 4um) (%)	35.9	75.7	50.8	74.0	64.2
% Clay (<4um) (%)	5.8	22.4	7.2	21.2	6.7
Texture	Sandy loam	Silt loam	Silt loam	Silt loam	Silt loam
Organic / Inorganic Carbon Total Organic Carbon (%)	4.77	33.2	6.68	22.7	8.56
Saturated Paste Extractables Paste pH (pH)	6.17	6.61	5.51	6.01	6.59
Total Metals Aluminum (Al) (%)	1.36	0.71	1.07	0.98	1.35
Antimony (Sb) (ppm)	0.56	1.03	0.78	0.98	0.95
Arsenic (As) (ppm)	22.3	12.1	18.3	18.4	28.6
Barium (Ba) (ppm)	170	250	240	290	250
Beryllium (Be) (ppm)	0.24	0.23	0.31	0.31	0.37
Bismuth (Bi) (ppm)	0.09	0.12	0.17	0.18	0.18
Boron (B) (ppm)	<10	10	<10	10	<10
Cadmium (Cd) (ppm)	0.57	1.05	1.95	0.89	0.46
Calcium (Ca) (%)	0.63	3.15	0.85	2.53	0.80
Cerium (Ce) (ppm)	31.3	9.24	23.6	13.10	25.5
Cesium (Cs) (ppm)	0.32	0.43	0.57	0.60	0.68
Chromium (Cr) (ppm)	34	14	23	18	29
Cobalt (Co) (ppm)	9.4	3.9	6.2	6.1	9.4
Copper (Cu) (ppm)	22.9	44.2	15.7	34.8	26.6
Gallium (Ga) (ppm)	4.22	1.84	3.33	2.68	3.86
Germanium (Ge) (ppm)	<0.05	<0.05	<0.05	<0.05	<0.05
Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
Hafnium (Hf) (ppm)	0.09	0.04	0.05	0.06	0.05
Indium (In) (ppm)	0.016	0.037	0.030	0.032	0.030
Iron (Fe) (%)	2.52	1.56	2.41	2.08	3.12
Lanthanum (La) (ppm)	17.4	5.3	12.1	7.1	13.2
Lead (Pb) (ppm)	46.1	38.7	80.8	28.1	25.7
Lithium (Li) (ppm)	17.3	6.6	11.8	9.8	15.6
Magnesium (Mg) (%)	0.85	0.46	0.41	0.49	0.50
Manganese (Mn) (ppm)	542	398	315	321	377
Mercury (Hg) (ppm)	0.06	0.08	0.06	0.06	0.05
Molybdenum (Mo) (ppm)	1.13	0.85	1.23	1.23	1.81
Nickel (Ni) (ppm)	26.8	17.4	16.4	20.0	24.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2128495-11	L2128495-12	L2128495-13	L2128495-14	L2128495-15
	Description	Other	Other	Other	Other	Other
	Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
	Sampled Time	14:40	14:50	15:00	15:10	15:20
	Client ID	T3-A	T3-B	T3-D	T3-E	T3-F
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	48.5	71.9	48.2	49.1	18.6
Particle Size	% Gravel (>2mm) (%)	9.3	<1.0	<1.0	<1.0	24.9
	% Sand (2.0mm - 0.063mm) (%)	41.6	1.1	11.8	5.7	31.2
	% Silt (0.063mm - 4um) (%)	39.1	69.3	66.9	88.1	35.7
	% Clay (<4um) (%)	10.0	29.5	21.2	6.2	8.3
	Texture	Loam	Silt loam	Silt loam	Silt	Silt loam / Loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	1.44	25.0	19.8	12.8	1.15
Saturated Paste Extractables	Paste pH (pH)	6.70	6.49	6.72	6.41	6.35
Total Metals	Aluminum (Al) (%)	1.39	1.06	1.11	1.37	1.21
	Antimony (Sb) (ppm)	1.28	1.13	1.37	1.02	1.18
	Arsenic (As) (ppm)	37.0	25.6	80.7	59.1	35.0
	Barium (Ba) (ppm)	310	340	410	360	240
	Beryllium (Be) (ppm)	0.41	0.38	0.39	0.38	0.36
	Bismuth (Bi) (ppm)	0.28	0.20	0.22	0.24	0.23
	Boron (B) (ppm)	<10	10	10	10	<10
	Cadmium (Cd) (ppm)	2.14	38.5	14.65	1.15	1.08
	Calcium (Ca) (%)	0.83	2.51	1.87	1.30	0.44
	Cerium (Ce) (ppm)	32.8	12.65	18.35	27.0	35.4
	Cesium (Cs) (ppm)	0.84	0.74	0.68	0.85	0.71
	Chromium (Cr) (ppm)	28	19	21	27	26
	Cobalt (Co) (ppm)	11.1	7.8	19.2	10.5	12.0
	Copper (Cu) (ppm)	50.2	50.3	37.6	27.7	44.9
	Gallium (Ga) (ppm)	4.01	2.86	3.05	3.84	3.52
	Germanium (Ge) (ppm)	<0.05	<0.05	<0.05	<0.05	0.05
	Gold (Au) (ppm)	<0.02	<0.02	<0.02	<0.02	<0.02
	Hafnium (Hf) (ppm)	0.08	0.05	0.05	0.04	0.09
	Indium (In) (ppm)	0.043	0.031	0.031	0.040	0.038
	Iron (Fe) (%)	3.03	2.22	4.51	3.63	2.98
	Lanthanum (La) (ppm)	16.2	7.1	8.9	13.8	17.9
	Lead (Pb) (ppm)	40.9	22.4	21.7	58.0	22.9
	Lithium (Li) (ppm)	15.1	9.6	10.4	12.7	14.1
	Magnesium (Mg) (%)	0.52	0.49	0.45	0.48	0.47
	Manganese (Mn) (ppm)	414	692	1880	810	513
	Mercury (Hg) (ppm)	0.07	0.07	0.06	0.07	0.05
	Molybdenum (Mo) (ppm)	1.73	1.26	2.41	1.62	1.75
	Nickel (Ni) (ppm)	32.9	25.3	25.8	24.0	33.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2128495-1	L2128495-2	L2128495-3	L2128495-4	L2128495-5
	Description	Other	Other	Other	Other	Other
	Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
	Sampled Time	13:00	13:10	13:20	13:30	13:40
	Client ID	T1-A	T1-B	T1-D	T1-E	T1-F
Grouping	**Analyte**					
SOIL						
Total Metals	Niobium (Nb) (ppm)	0.51	0.72	0.91	0.82	0.11
	Phosphorus (P) (ppm)	1260	740	820	850	720
	Potassium (K) (%)	0.10	0.16	0.14	0.16	0.04
	Rhenium (Re) (ppm)	0.001	0.001	0.001	<0.001	0.002
	Rubidium (Rb) (ppm)	6.2	9.7	11.2	10.3	1.4
	Scandium (Sc) (ppm)	1.8	3.1	3.6	3.4	0.2
	Selenium (Se) (ppm)	1.2	0.9	1.0	0.6	0.4
	Silver (Ag) (ppm)	0.43	0.40	0.41	0.31	0.98
	Sodium (Na) (%)	0.03	0.03	0.02	0.03	<0.01
	Strontium (Sr) (ppm)	60.2	33.4	23.5	29.1	90.5
	Sulfur (S) (%)	0.18	0.07	0.05	0.05	0.20
	Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
	Tellurium (Te) (ppm)	0.03	0.04	0.03	0.02	<0.01
	Thallium (Tl) (ppm)	0.09	0.12	0.14	0.13	0.03
	Thorium (Th) (ppm)	0.7	2.7	4.9	3.6	<0.2
	Tin (Sn) (ppm)	0.3	0.3	0.3	0.3	0.9
	Titanium (Ti) (%)	0.020	0.042	0.045	0.052	<0.005
	Tungsten (W) (ppm)	0.14	0.12	0.21	0.15	0.27
	Uranium (U) (ppm)	0.73	1.01	1.00	0.65	0.18
	Vanadium (V) (ppm)	31	38	39	40	4
	Yttrium (Y) (ppm)	5.93	6.50	8.35	7.12	1.18
	Zinc (Zn) (ppm)	148	161	152	114	184
	Zirconium (Zr) (ppm)	1.5	1.6	3.5	2.0	0.6
Exchangeable & Adsorbed Metals	Aluminum (Al)-Leachable (mg/kg)			<50		
	Antimony (Sb)-Leachable (mg/kg)			<0.10		
	Arsenic (As)-Leachable (mg/kg)			0.086		
	Barium (Ba)-Leachable (mg/kg)			41.0		
	Beryllium (Be)-Leachable (mg/kg)			<0.20		
	Bismuth (Bi)-Leachable (mg/kg)			<0.20		
	Cadmium (Cd)-Leachable (mg/kg)			0.659		
	Calcium (Ca)-Leachable (mg/kg)			1490		
	Chromium (Cr)-Leachable (mg/kg)			<0.50		
	Cobalt (Co)-Leachable (mg/kg)			1.18		
	Copper (Cu)-Leachable (mg/kg)			<0.50		
	Iron (Fe)-Leachable (mg/kg)			<50		
	Lead (Pb)-Leachable (mg/kg)			1.92		
	Lithium (Li)-Leachable (mg/kg)			<5.0		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-6	L2128495-7	L2128495-8	L2128495-9	L2128495-10
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:50	14:00	14:10	14:20	14:30
Client ID	T2-A	T2-B	T2-D	T2-E	T2-F
Grouping / **Analyte**					
SOIL					
Total Metals Niobium (Nb) (ppm)	1.22	0.35	0.75	0.46	0.72
Phosphorus (P) (ppm)	560	840	710	880	770
Potassium (K) (%)	0.16	0.11	0.21	0.16	0.23
Rhenium (Re) (ppm)	0.001	0.001	0.001	0.001	0.001
Rubidium (Rb) (ppm)	9.2	7.8	12.6	12.8	13.3
Scandium (Sc) (ppm)	2.9	1.1	2.5	1.9	3.2
Selenium (Se) (ppm)	<0.2	0.7	0.5	0.5	0.4
Silver (Ag) (ppm)	0.17	0.53	0.28	0.42	0.28
Sodium (Na) (%)	0.02	0.02	0.03	0.02	0.03
Strontium (Sr) (ppm)	18.3	75.5	33.1	64.6	30.6
Sulfur (S) (%)	0.02	0.16	0.08	0.14	0.04
Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
Tellurium (Te) (ppm)	0.01	0.02	0.02	0.02	0.02
Thallium (Tl) (ppm)	0.09	0.08	0.11	0.12	0.15
Thorium (Th) (ppm)	4.3	0.5	2.7	1.1	3.0
Tin (Sn) (ppm)	0.4	0.2	0.3	0.3	0.5
Titanium (Ti) (%)	0.098	0.012	0.027	0.013	0.036
Tungsten (W) (ppm)	0.11	0.08	0.16	0.17	0.13
Uranium (U) (ppm)	0.46	0.46	0.53	0.52	0.46
Vanadium (V) (ppm)	57	19	35	27	43
Yttrium (Y) (ppm)	6.16	4.50	4.48	4.52	5.70
Zinc (Zn) (ppm)	177	204	175	178	121
Zirconium (Zr) (ppm)	2.9	1.4	2.0	2.0	2.0
Exchangeable & Adsorbed Metals Aluminum (Al)-Leachable (mg/kg)					<50
Antimony (Sb)-Leachable (mg/kg)					<0.10
Arsenic (As)-Leachable (mg/kg)					<0.050
Barium (Ba)-Leachable (mg/kg)					52.8
Beryllium (Be)-Leachable (mg/kg)					<0.20
Bismuth (Bi)-Leachable (mg/kg)					<0.20
Cadmium (Cd)-Leachable (mg/kg)					0.452
Calcium (Ca)-Leachable (mg/kg)					8980
Chromium (Cr)-Leachable (mg/kg)					<0.50
Cobalt (Co)-Leachable (mg/kg)					<0.10
Copper (Cu)-Leachable (mg/kg)					<0.50
Iron (Fe)-Leachable (mg/kg)					<50
Lead (Pb)-Leachable (mg/kg)					<0.50
Lithium (Li)-Leachable (mg/kg)					<5.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-11	L2128495-12	L2128495-13	L2128495-14	L2128495-15
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	14:40	14:50	15:00	15:10	15:20
Client ID	T3-A	T3-B	T3-D	T3-E	T3-F
Grouping / **Analyte**					
SOIL					
Total Metals Niobium (Nb) (ppm)	0.82	0.43	0.50	0.73	0.62
Phosphorus (P) (ppm)	850	940	1120	900	880
Potassium (K) (%)	0.24	0.18	0.17	0.22	0.18
Rhenium (Re) (ppm)	0.001	0.001	0.001	0.001	<0.001
Rubidium (Rb) (ppm)	13.9	11.6	11.1	13.8	10.8
Scandium (Sc) (ppm)	4.1	1.9	2.4	3.3	3.8
Selenium (Se) (ppm)	0.5	0.8	1.1	0.7	0.7
Silver (Ag) (ppm)	0.38	0.29	0.31	0.29	0.39
Sodium (Na) (%)	0.03	0.02	0.03	0.03	0.02
Strontium (Sr) (ppm)	32.4	64.4	54.6	43.0	22.3
Sulfur (S) (%)	0.05	0.18	0.25	0.11	0.02
Tantalum (Ta) (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01
Tellurium (Te) (ppm)	0.02	0.03	0.04	0.04	0.03
Thallium (Tl) (ppm)	0.18	0.12	0.13	0.16	0.15
Thorium (Th) (ppm)	4.1	0.9	1.2	2.2	5.1
Tin (Sn) (ppm)	0.5	0.3	0.3	0.4	0.4
Titanium (Ti) (%)	0.034	0.013	0.015	0.024	0.047
Tungsten (W) (ppm)	0.18	0.10	0.11	0.14	0.77
Uranium (U) (ppm)	0.63	0.71	0.94	1.17	0.55
Vanadium (V) (ppm)	44	28	35	44	40
Yttrium (Y) (ppm)	8.83	5.21	6.26	6.58	9.16
Zinc (Zn) (ppm)	435	4870	2660	307	142
Zirconium (Zr) (ppm)	3.1	1.9	1.6	1.7	4.7
Exchangeable & Adsorbed Metals Aluminum (Al)-Leachable (mg/kg)		<50			
Antimony (Sb)-Leachable (mg/kg)		<0.10			
Arsenic (As)-Leachable (mg/kg)		<0.050			
Barium (Ba)-Leachable (mg/kg)		66.5			
Beryllium (Be)-Leachable (mg/kg)		<0.20			
Bismuth (Bi)-Leachable (mg/kg)		<0.20			
Cadmium (Cd)-Leachable (mg/kg)		18.3			
Calcium (Ca)-Leachable (mg/kg)		15200			
Chromium (Cr)-Leachable (mg/kg)		<0.50			
Cobalt (Co)-Leachable (mg/kg)		<0.10			
Copper (Cu)-Leachable (mg/kg)		<0.50			
Iron (Fe)-Leachable (mg/kg)		<50			
Lead (Pb)-Leachable (mg/kg)		<0.50			
Lithium (Li)-Leachable (mg/kg)		<5.0			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-1	L2128495-2	L2128495-3	L2128495-4	L2128495-5
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:00	13:10	13:20	13:30	13:40
Client ID	T1-A	T1-B	T1-D	T1-E	T1-F
Grouping / **Analyte**					
SOIL					
Exchangeable & Adsorbed Metals					
Manganese (Mn)-Leachable (mg/kg)			18.9		
Molybdenum (Mo)-Leachable (mg/kg)			<0.50		
Nickel (Ni)-Leachable (mg/kg)			2.85		
Phosphorus (P)-Leachable (mg/kg)			<50		
Potassium (K)-Leachable (mg/kg)			<100		
Selenium (Se)-Leachable (mg/kg)			<0.20		
Silver (Ag)-Leachable (mg/kg)			<0.10		
Sodium (Na)-Leachable (mg/kg)			<100		
Strontium (Sr)-Leachable (mg/kg)			3.76		
Thallium (Tl)-Leachable (mg/kg)			<0.050		
Tin (Sn)-Leachable (mg/kg)			<2.0		
Titanium (Ti)-Leachable (mg/kg)			<1.0		
Uranium (U)-Leachable (mg/kg)			<0.050		
Vanadium (V)-Leachable (mg/kg)			<0.20		
Zinc (Zn)-Leachable (mg/kg)			11.7		
Carbonate Metals					
Aluminum (Al)-Leachable (mg/kg)			57		
Antimony (Sb)-Leachable (mg/kg)			<0.10		
Arsenic (As)-Leachable (mg/kg)			0.326		
Barium (Ba)-Leachable (mg/kg)			25.2		
Beryllium (Be)-Leachable (mg/kg)			<0.20		
Bismuth (Bi)-Leachable (mg/kg)			<0.20		
Cadmium (Cd)-Leachable (mg/kg)			0.107		
Calcium (Ca)-Leachable (mg/kg)			140		
Chromium (Cr)-Leachable (mg/kg)			<5.0		
Cobalt (Co)-Leachable (mg/kg)			0.31		
Copper (Cu)-Leachable (mg/kg)			1.51		
Iron (Fe)-Leachable (mg/kg)			145		
Lead (Pb)-Leachable (mg/kg)			3.66		
Lithium (Li)-Leachable (mg/kg)			<5.0		
Manganese (Mn)-Leachable (mg/kg)			<5.0		
Molybdenum (Mo)-Leachable (mg/kg)			<0.50		
Nickel (Ni)-Leachable (mg/kg)			<2.0		
Phosphorus (P)-Leachable (mg/kg)			<50		
Selenium (Se)-Leachable (mg/kg)			<0.20		
Silver (Ag)-Leachable (mg/kg)			<0.10		
Strontium (Sr)-Leachable (mg/kg)			<5.0		
Thallium (Tl)-Leachable (mg/kg)			<0.050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-6	L2128495-7	L2128495-8	L2128495-9	L2128495-10
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:50	14:00	14:10	14:20	14:30
Client ID	T2-A	T2-B	T2-D	T2-E	T2-F
Grouping / **Analyte**					
SOIL					
Exchangeable & Adsorbed Metals					
Manganese (Mn)-Leachable (mg/kg)					12.0
Molybdenum (Mo)-Leachable (mg/kg)					<0.50
Nickel (Ni)-Leachable (mg/kg)					<0.50
Phosphorus (P)-Leachable (mg/kg)					<50
Potassium (K)-Leachable (mg/kg)					<100
Selenium (Se)-Leachable (mg/kg)					<0.20
Silver (Ag)-Leachable (mg/kg)					<0.10
Sodium (Na)-Leachable (mg/kg)					<100
Strontium (Sr)-Leachable (mg/kg)					21.4
Thallium (Tl)-Leachable (mg/kg)					<0.050
Tin (Sn)-Leachable (mg/kg)					<2.0
Titanium (Ti)-Leachable (mg/kg)					<1.0
Uranium (U)-Leachable (mg/kg)					<0.050
Vanadium (V)-Leachable (mg/kg)					<0.20
Zinc (Zn)-Leachable (mg/kg)					5.1
Carbonate Metals					
Aluminum (Al)-Leachable (mg/kg)					<50
Antimony (Sb)-Leachable (mg/kg)					<0.10
Arsenic (As)-Leachable (mg/kg)					0.254
Barium (Ba)-Leachable (mg/kg)					16.1
Beryllium (Be)-Leachable (mg/kg)					<0.20
Bismuth (Bi)-Leachable (mg/kg)					<0.20
Cadmium (Cd)-Leachable (mg/kg)					0.094
Calcium (Ca)-Leachable (mg/kg)					1420
Chromium (Cr)-Leachable (mg/kg)					<5.0
Cobalt (Co)-Leachable (mg/kg)					0.15
Copper (Cu)-Leachable (mg/kg)					<0.50
Iron (Fe)-Leachable (mg/kg)					<50
Lead (Pb)-Leachable (mg/kg)					1.04
Lithium (Li)-Leachable (mg/kg)					<5.0
Manganese (Mn)-Leachable (mg/kg)					33.8
Molybdenum (Mo)-Leachable (mg/kg)					<0.50
Nickel (Ni)-Leachable (mg/kg)					<2.0
Phosphorus (P)-Leachable (mg/kg)					<50
Selenium (Se)-Leachable (mg/kg)					<0.20
Silver (Ag)-Leachable (mg/kg)					<0.10
Strontium (Sr)-Leachable (mg/kg)					<5.0
Thallium (Tl)-Leachable (mg/kg)					<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-11	L2128495-12	L2128495-13	L2128495-14	L2128495-15
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	14:40	14:50	15:00	15:10	15:20
Client ID	T3-A	T3-B	T3-D	T3-E	T3-F
Grouping / **Analyte**					
SOIL					
Exchangeable & Adsorbed Metals					
Manganese (Mn)-Leachable (mg/kg)		22.1			
Molybdenum (Mo)-Leachable (mg/kg)		<0.50			
Nickel (Ni)-Leachable (mg/kg)		0.65			
Phosphorus (P)-Leachable (mg/kg)		<50			
Potassium (K)-Leachable (mg/kg)		<100			
Selenium (Se)-Leachable (mg/kg)		<0.20			
Silver (Ag)-Leachable (mg/kg)		<0.10			
Sodium (Na)-Leachable (mg/kg)		<100			
Strontium (Sr)-Leachable (mg/kg)		35.2			
Thallium (Tl)-Leachable (mg/kg)		<0.050			
Tin (Sn)-Leachable (mg/kg)		<2.0			
Titanium (Ti)-Leachable (mg/kg)		<1.0			
Uranium (U)-Leachable (mg/kg)		<0.050			
Vanadium (V)-Leachable (mg/kg)		<0.20			
Zinc (Zn)-Leachable (mg/kg)		1140			
Carbonate Metals					
Aluminum (Al)-Leachable (mg/kg)		<50			
Antimony (Sb)-Leachable (mg/kg)		<0.10			
Arsenic (As)-Leachable (mg/kg)		0.127			
Barium (Ba)-Leachable (mg/kg)		20.0			
Beryllium (Be)-Leachable (mg/kg)		<0.20			
Bismuth (Bi)-Leachable (mg/kg)		<0.20			
Cadmium (Cd)-Leachable (mg/kg)		3.12			
Calcium (Ca)-Leachable (mg/kg)		3420			
Chromium (Cr)-Leachable (mg/kg)		<5.0			
Cobalt (Co)-Leachable (mg/kg)		0.13			
Copper (Cu)-Leachable (mg/kg)		<0.50			
Iron (Fe)-Leachable (mg/kg)		<50			
Lead (Pb)-Leachable (mg/kg)		<0.50			
Lithium (Li)-Leachable (mg/kg)		<5.0			
Manganese (Mn)-Leachable (mg/kg)		64.4			
Molybdenum (Mo)-Leachable (mg/kg)		<0.50			
Nickel (Ni)-Leachable (mg/kg)		<2.0			
Phosphorus (P)-Leachable (mg/kg)		<50			
Selenium (Se)-Leachable (mg/kg)		<0.20			
Silver (Ag)-Leachable (mg/kg)		<0.10			
Strontium (Sr)-Leachable (mg/kg)		6.7			
Thallium (Tl)-Leachable (mg/kg)		<0.050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-1	L2128495-2	L2128495-3	L2128495-4	L2128495-5
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:00	13:10	13:20	13:30	13:40
Client ID	T1-A	T1-B	T1-D	T1-E	T1-F
Grouping	**Analyte**					
SOIL					
Carbonate Metals	Tin (Sn)-Leachable (mg/kg)		<2.0		
	Titanium (Ti)-Leachable (mg/kg)		<5.0		
	Uranium (U)-Leachable (mg/kg)		0.355		
	Vanadium (V)-Leachable (mg/kg)		<0.20		
	Zinc (Zn)-Leachable (mg/kg)		5.7		
Easily Reducible Metals and Iron Oxides	Aluminum (Al)-Leachable (mg/kg)		1050		
	Antimony (Sb)-Leachable (mg/kg)		<0.10		
	Arsenic (As)-Leachable (mg/kg)		7.85		
	Barium (Ba)-Leachable (mg/kg)		47.1		
	Beryllium (Be)-Leachable (mg/kg)		<0.20		
	Bismuth (Bi)-Leachable (mg/kg)		<0.20		
	Cadmium (Cd)-Leachable (mg/kg)		0.298		
	Calcium (Ca)-Leachable (mg/kg)		301		
	Chromium (Cr)-Leachable (mg/kg)		1.89		
	Cobalt (Co)-Leachable (mg/kg)		2.86		
	Copper (Cu)-Leachable (mg/kg)		4.94		
	Iron (Fe)-Leachable (mg/kg)		6570		
	Lead (Pb)-Leachable (mg/kg)		16.6		
	Lithium (Li)-Leachable (mg/kg)		<5.0		
	Manganese (Mn)-Leachable (mg/kg)		21.3		
	Molybdenum (Mo)-Leachable (mg/kg)		<0.50		
	Nickel (Ni)-Leachable (mg/kg)		7.44		
	Phosphorus (P)-Leachable (mg/kg)		<50		
	Selenium (Se)-Leachable (mg/kg)		0.26		
	Silver (Ag)-Leachable (mg/kg)		0.12		
	Strontium (Sr)-Leachable (mg/kg)		1.66		
	Thallium (Tl)-Leachable (mg/kg)		<0.050		
	Tin (Sn)-Leachable (mg/kg)		<2.0		
	Titanium (Ti)-Leachable (mg/kg)		<2.0 DLM		
	Uranium (U)-Leachable (mg/kg)		0.279		
	Vanadium (V)-Leachable (mg/kg)		5.67		
	Zinc (Zn)-Leachable (mg/kg)		54.4		
Organic Bound Metals	Aluminum (Al)-Leachable (mg/kg)		1160		
	Antimony (Sb)-Leachable (mg/kg)		<0.10		
	Arsenic (As)-Leachable (mg/kg)		0.317		
	Barium (Ba)-Leachable (mg/kg)		15.7		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-6	L2128495-7	L2128495-8	L2128495-9	L2128495-10
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:50	14:00	14:10	14:20	14:30
Client ID	T2-A	T2-B	T2-D	T2-E	T2-F
Grouping / **Analyte**					
SOIL					
Carbonate Metals Tin (Sn)-Leachable (mg/kg)					<2.0
Titanium (Ti)-Leachable (mg/kg)					<5.0
Uranium (U)-Leachable (mg/kg)					<0.050
Vanadium (V)-Leachable (mg/kg)					<0.20
Zinc (Zn)-Leachable (mg/kg)					7.2
Easily Reducible Metals and Iron Oxides Aluminum (Al)-Leachable (mg/kg)					485
Antimony (Sb)-Leachable (mg/kg)					<0.10
Arsenic (As)-Leachable (mg/kg)					2.65
Barium (Ba)-Leachable (mg/kg)					46.7
Beryllium (Be)-Leachable (mg/kg)					<0.20
Bismuth (Bi)-Leachable (mg/kg)					<0.20
Cadmium (Cd)-Leachable (mg/kg)					0.226
Calcium (Ca)-Leachable (mg/kg)					1660
Chromium (Cr)-Leachable (mg/kg)					0.51
Cobalt (Co)-Leachable (mg/kg)					1.67
Copper (Cu)-Leachable (mg/kg)					0.95
Iron (Fe)-Leachable (mg/kg)					2720
Lead (Pb)-Leachable (mg/kg)					6.84
Lithium (Li)-Leachable (mg/kg)					<5.0
Manganese (Mn)-Leachable (mg/kg)					125
Molybdenum (Mo)-Leachable (mg/kg)					<0.50
Nickel (Ni)-Leachable (mg/kg)					2.95
Phosphorus (P)-Leachable (mg/kg)					<50
Selenium (Se)-Leachable (mg/kg)					<0.20
Silver (Ag)-Leachable (mg/kg)					<0.10
Strontium (Sr)-Leachable (mg/kg)					4.14
Thallium (Tl)-Leachable (mg/kg)					<0.050
Tin (Sn)-Leachable (mg/kg)					<2.0
Titanium (Ti)-Leachable (mg/kg)					1.4
Uranium (U)-Leachable (mg/kg)					0.082
Vanadium (V)-Leachable (mg/kg)					1.39
Zinc (Zn)-Leachable (mg/kg)					59.6
Organic Bound Metals Aluminum (Al)-Leachable (mg/kg)					2450
Antimony (Sb)-Leachable (mg/kg)					0.18
Arsenic (As)-Leachable (mg/kg)					3.83
Barium (Ba)-Leachable (mg/kg)					36.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-11	L2128495-12	L2128495-13	L2128495-14	L2128495-15
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	14:40	14:50	15:00	15:10	15:20
Client ID	T3-A	T3-B	T3-D	T3-E	T3-F
Grouping / **Analyte**					
SOIL					
Carbonate Metals Tin (Sn)-Leachable (mg/kg)		<2.0			
Titanium (Ti)-Leachable (mg/kg)		<5.0			
Uranium (U)-Leachable (mg/kg)		<0.050			
Vanadium (V)-Leachable (mg/kg)		<0.20			
Zinc (Zn)-Leachable (mg/kg)		827			
Easily Reducible Metals and Iron Oxides Aluminum (Al)-Leachable (mg/kg)		316			
Antimony (Sb)-Leachable (mg/kg)		<0.10			
Arsenic (As)-Leachable (mg/kg)		4.22			
Barium (Ba)-Leachable (mg/kg)		52.2			
Beryllium (Be)-Leachable (mg/kg)		<0.20			
Bismuth (Bi)-Leachable (mg/kg)		<0.20			
Cadmium (Cd)-Leachable (mg/kg)		4.02			
Calcium (Ca)-Leachable (mg/kg)		4200			
Chromium (Cr)-Leachable (mg/kg)		<0.50			
Cobalt (Co)-Leachable (mg/kg)		1.20			
Copper (Cu)-Leachable (mg/kg)		1.30			
Iron (Fe)-Leachable (mg/kg)		1750			
Lead (Pb)-Leachable (mg/kg)		1.65			
Lithium (Li)-Leachable (mg/kg)		<5.0			
Manganese (Mn)-Leachable (mg/kg)		243			
Molybdenum (Mo)-Leachable (mg/kg)		<0.50			
Nickel (Ni)-Leachable (mg/kg)		2.15			
Phosphorus (P)-Leachable (mg/kg)		87			
Selenium (Se)-Leachable (mg/kg)		<0.20			
Silver (Ag)-Leachable (mg/kg)		<0.10			
Strontium (Sr)-Leachable (mg/kg)		8.93			
Thallium (Tl)-Leachable (mg/kg)		<0.050			
Tin (Sn)-Leachable (mg/kg)		<2.0			
Titanium (Ti)-Leachable (mg/kg)		1.3			
Uranium (U)-Leachable (mg/kg)		0.189			
Vanadium (V)-Leachable (mg/kg)		0.74			
Zinc (Zn)-Leachable (mg/kg)		1710			
Organic Bound Metals Aluminum (Al)-Leachable (mg/kg)		3030			
Antimony (Sb)-Leachable (mg/kg)		0.63			
Arsenic (As)-Leachable (mg/kg)		13.0			
Barium (Ba)-Leachable (mg/kg)		98.2			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-1	L2128495-2	L2128495-3	L2128495-4	L2128495-5
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:00	13:10	13:20	13:30	13:40
Client ID	T1-A	T1-B	T1-D	T1-E	T1-F
Grouping / **Analyte**					
SOIL					
Organic Bound Metals Beryllium (Be)-Leachable (mg/kg)			<0.20		
Bismuth (Bi)-Leachable (mg/kg)			<0.20		
Cadmium (Cd)-Leachable (mg/kg)			0.066		
Calcium (Ca)-Leachable (mg/kg)			346		
Chromium (Cr)-Leachable (mg/kg)			4.63		
Cobalt (Co)-Leachable (mg/kg)			0.92		
Copper (Cu)-Leachable (mg/kg)			23.7		
Iron (Fe)-Leachable (mg/kg)			660		
Lead (Pb)-Leachable (mg/kg)			3.87		
Lithium (Li)-Leachable (mg/kg)			<5.0		
Manganese (Mn)-Leachable (mg/kg)			8.4		
Molybdenum (Mo)-Leachable (mg/kg)			<0.50		
Nickel (Ni)-Leachable (mg/kg)			3.41		
Selenium (Se)-Leachable (mg/kg)			1.06		
Silver (Ag)-Leachable (mg/kg)			<0.10		
Strontium (Sr)-Leachable (mg/kg)			1.72		
Thallium (Tl)-Leachable (mg/kg)			<0.050		
Tin (Sn)-Leachable (mg/kg)			<2.0		
Titanium (Ti)-Leachable (mg/kg)			45.0		
Uranium (U)-Leachable (mg/kg)			0.164		
Vanadium (V)-Leachable (mg/kg)			5.00		
Zinc (Zn)-Leachable (mg/kg)			20.6		
Residual Metals Aluminum (Al)-Leachable (mg/kg)			9990		
Antimony (Sb)-Leachable (mg/kg)			1.24		
Arsenic (As)-Leachable (mg/kg)			47.6		
Barium (Ba)-Leachable (mg/kg)			67.9		
Beryllium (Be)-Leachable (mg/kg)			<0.20		
Bismuth (Bi)-Leachable (mg/kg)			<0.20		
Cadmium (Cd)-Leachable (mg/kg)			<0.050		
Calcium (Ca)-Leachable (mg/kg)			2090		
Chromium (Cr)-Leachable (mg/kg)			17.3		
Cobalt (Co)-Leachable (mg/kg)			4.46		
Copper (Cu)-Leachable (mg/kg)			12.7		
Iron (Fe)-Leachable (mg/kg)			20700		
Lead (Pb)-Leachable (mg/kg)			8.47		
Lithium (Li)-Leachable (mg/kg)			12.4		
Manganese (Mn)-Leachable (mg/kg)			105		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-6	L2128495-7	L2128495-8	L2128495-9	L2128495-10
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:50	14:00	14:10	14:20	14:30
Client ID	T2-A	T2-B	T2-D	T2-E	T2-F
Grouping / **Analyte**					
SOIL					
Organic Bound Metals Beryllium (Be)-Leachable (mg/kg)					<0.20
Bismuth (Bi)-Leachable (mg/kg)					<0.20
Cadmium (Cd)-Leachable (mg/kg)					0.088
Calcium (Ca)-Leachable (mg/kg)					851
Chromium (Cr)-Leachable (mg/kg)					6.32
Cobalt (Co)-Leachable (mg/kg)					2.51
Copper (Cu)-Leachable (mg/kg)					17.7
Iron (Fe)-Leachable (mg/kg)					4900
Lead (Pb)-Leachable (mg/kg)					9.17
Lithium (Li)-Leachable (mg/kg)					<5.0
Manganese (Mn)-Leachable (mg/kg)					29.7
Molybdenum (Mo)-Leachable (mg/kg)					0.50
Nickel (Ni)-Leachable (mg/kg)					9.02
Selenium (Se)-Leachable (mg/kg)					0.39
Silver (Ag)-Leachable (mg/kg)					0.15
Strontium (Sr)-Leachable (mg/kg)					3.41
Thallium (Tl)-Leachable (mg/kg)					<0.050
Tin (Sn)-Leachable (mg/kg)					<2.0
Titanium (Ti)-Leachable (mg/kg)					87.5
Uranium (U)-Leachable (mg/kg)					0.131
Vanadium (V)-Leachable (mg/kg)					7.71
Zinc (Zn)-Leachable (mg/kg)					34.6
Residual Metals Aluminum (Al)-Leachable (mg/kg)					6120
Antimony (Sb)-Leachable (mg/kg)					0.83
Arsenic (As)-Leachable (mg/kg)					18.4
Barium (Ba)-Leachable (mg/kg)					43.6
Beryllium (Be)-Leachable (mg/kg)					<0.20
Bismuth (Bi)-Leachable (mg/kg)					<0.20
Cadmium (Cd)-Leachable (mg/kg)					<0.050
Calcium (Ca)-Leachable (mg/kg)					771
Chromium (Cr)-Leachable (mg/kg)					10.6
Cobalt (Co)-Leachable (mg/kg)					2.96
Copper (Cu)-Leachable (mg/kg)					8.42
Iron (Fe)-Leachable (mg/kg)					13600
Lead (Pb)-Leachable (mg/kg)					10.6
Lithium (Li)-Leachable (mg/kg)					8.8
Manganese (Mn)-Leachable (mg/kg)					77.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-11	L2128495-12	L2128495-13	L2128495-14	L2128495-15
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	14:40	14:50	15:00	15:10	15:20
Client ID	T3-A	T3-B	T3-D	T3-E	T3-F
Grouping / **Analyte**					
SOIL					
Organic Bound Metals Beryllium (Be)-Leachable (mg/kg)		<0.20			
Bismuth (Bi)-Leachable (mg/kg)		<0.20			
Cadmium (Cd)-Leachable (mg/kg)		2.16			
Calcium (Ca)-Leachable (mg/kg)		2820			
Chromium (Cr)-Leachable (mg/kg)		6.25			
Cobalt (Co)-Leachable (mg/kg)		3.14			
Copper (Cu)-Leachable (mg/kg)		28.8			
Iron (Fe)-Leachable (mg/kg)		9490			
Lead (Pb)-Leachable (mg/kg)		9.82			
Lithium (Li)-Leachable (mg/kg)		<5.0			
Manganese (Mn)-Leachable (mg/kg)		109			
Molybdenum (Mo)-Leachable (mg/kg)		0.65			
Nickel (Ni)-Leachable (mg/kg)		13.4			
Selenium (Se)-Leachable (mg/kg)		0.70			
Silver (Ag)-Leachable (mg/kg)		<0.10			
Strontium (Sr)-Leachable (mg/kg)		8.14			
Thallium (Tl)-Leachable (mg/kg)		<0.050			
Tin (Sn)-Leachable (mg/kg)		<2.0			
Titanium (Ti)-Leachable (mg/kg)		29.3			
Uranium (U)-Leachable (mg/kg)		0.411			
Vanadium (V)-Leachable (mg/kg)		8.54			
Zinc (Zn)-Leachable (mg/kg)		1290			
Residual Metals Aluminum (Al)-Leachable (mg/kg)		3930			
Antimony (Sb)-Leachable (mg/kg)		0.44			
Arsenic (As)-Leachable (mg/kg)		2.21			
Barium (Ba)-Leachable (mg/kg)		39.3			
Beryllium (Be)-Leachable (mg/kg)		<0.20			
Bismuth (Bi)-Leachable (mg/kg)		<0.20			
Cadmium (Cd)-Leachable (mg/kg)		0.067			
Calcium (Ca)-Leachable (mg/kg)		397			
Chromium (Cr)-Leachable (mg/kg)		6.7			
Cobalt (Co)-Leachable (mg/kg)		1.02			
Copper (Cu)-Leachable (mg/kg)		3.18			
Iron (Fe)-Leachable (mg/kg)		4340			
Lead (Pb)-Leachable (mg/kg)		2.81			
Lithium (Li)-Leachable (mg/kg)		<5.0			
Manganese (Mn)-Leachable (mg/kg)		30.8			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-1	L2128495-2	L2128495-3	L2128495-4	L2128495-5
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:00	13:10	13:20	13:30	13:40
Client ID	T1-A	T1-B	T1-D	T1-E	T1-F
Grouping / **Analyte**					
SOIL					
Residual Metals Molybdenum (Mo)-Leachable (mg/kg)			1.26		
Nickel (Ni)-Leachable (mg/kg)			13.3		
Selenium (Se)-Leachable (mg/kg)			<0.20		
Silver (Ag)-Leachable (mg/kg)			0.22		
Strontium (Sr)-Leachable (mg/kg)			13.8		
Thallium (Tl)-Leachable (mg/kg)			0.113		
Tin (Sn)-Leachable (mg/kg)			<2.0		
Titanium (Ti)-Leachable (mg/kg)			315		
Uranium (U)-Leachable (mg/kg)			0.346		
Vanadium (V)-Leachable (mg/kg)			29.8		
Zinc (Zn)-Leachable (mg/kg)			58.9		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-6	L2128495-7	L2128495-8	L2128495-9	L2128495-10
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	13:50	14:00	14:10	14:20	14:30
Client ID	T2-A	T2-B	T2-D	T2-E	T2-F
Grouping / **Analyte**					
SOIL					
Residual Metals Molybdenum (Mo)-Leachable (mg/kg)					0.76
Nickel (Ni)-Leachable (mg/kg)					9.0
Selenium (Se)-Leachable (mg/kg)					<0.20
Silver (Ag)-Leachable (mg/kg)					0.19
Strontium (Sr)-Leachable (mg/kg)					5.6
Thallium (Tl)-Leachable (mg/kg)					0.068
Tin (Sn)-Leachable (mg/kg)					<2.0
Titanium (Ti)-Leachable (mg/kg)					167
Uranium (U)-Leachable (mg/kg)					0.180
Vanadium (V)-Leachable (mg/kg)					19.6
Zinc (Zn)-Leachable (mg/kg)					37.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2128495-11	L2128495-12	L2128495-13	L2128495-14	L2128495-15
Description	Other	Other	Other	Other	Other
Sampled Date	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18	05-JUL-18
Sampled Time	14:40	14:50	15:00	15:10	15:20
Client ID	T3-A	T3-B	T3-D	T3-E	T3-F
Grouping / **Analyte**					
SOIL					
Residual Metals Molybdenum (Mo)-Leachable (mg/kg)		<0.50			
Nickel (Ni)-Leachable (mg/kg)		4.1			
Selenium (Se)-Leachable (mg/kg)		<0.20			
Silver (Ag)-Leachable (mg/kg)		0.20			
Strontium (Sr)-Leachable (mg/kg)		<5.0			
Thallium (Tl)-Leachable (mg/kg)		0.068			
Tin (Sn)-Leachable (mg/kg)		<2.0			
Titanium (Ti)-Leachable (mg/kg)		121			
Uranium (U)-Leachable (mg/kg)		0.131			
Vanadium (V)-Leachable (mg/kg)		10.8			
Zinc (Zn)-Leachable (mg/kg)		45.0			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L2128495-10	T2-F	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2128495-5	T1-F	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2128495-7	T2-B	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2128495-8	T2-D	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2128495-9	T2-E	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
ME-MS41-AX	Soil	Aqua Regia ICPMS	Aqua Regia ICPMS

A prepared sample (0.50 g) is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by inductively coupled plasma-atomic emission spectrometry. Following this analysis, the results are reviewed for high concentrations of bismuth, mercury, molybdenum, silver and tungsten and diluted accordingly. Samples are then analysed by ICP-MS for the remaining suite of elements. The analytical results are corrected for inter-element spectral interferences.

MET-TESS-CM-CCMS-VA	Soil	METALS BY CCMS (TESSIER EXTRACTION #2)	Tessier Extraction 1979/EPA 6020A

This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Note: For Extraction #2, the extraction solution is 1M Sodium Acetate adjusted to pH 5 and is intended to extract the "Carbonate" metals.

MET-TESS-EA-CCMS-VA	Soil	METALS BY CCMS (TESSIER EXTRACTION #1)	Tessier Extraction 1979/EPA 6020A

This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Note: For Extraction #1, the extraction solution is 1M Magnesium Chloride and is intended to extract the "Exchangeable and Adsorbed" metals.

MET-TESS-FEO-CCMS-VA	Soil	METALS BY CCMS (TESSIER EXTRACTION #3)	Tessier Extraction 1979/EPA 6020A

This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Note: For Extraction #3, the extraction solution is 0.1 M Hydroxylamine Hydro› Chloride in 25% v/v Acetic Acid and is intended to extract the fiEasily Reducible Metals and Iron Oxidesfl.

MET-TESS-OB-CCMS-VA	Soil	METALS BY CCMS (TESSIER EXTRACTION #4)	Tessier Extraction 1979/EPA 6020A

Reference Information

"This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with 5 or 6 (if a pre-liminary water extraction is included) different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Note: For Extraction #4, the extraction solution is 0.02 M Nitric Acid followed by 3.2M Ammonium Acetate and is intended to extract the fiOrganic Boundfl metals.

MET-TESS-RM-CCMS-VA Soil METALS BY CCMS (TESSIER RM EXTRACTION) Tessier Extraction 1979/EPA 6020A

"This analysis is modified from the extraction procedure outlined in the "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals" Analytical Chemistry, (A. Tessier, P.G.C. Campbell, and M. Bisson, June 1979). Initially, the sample is manually homogenized, dried at <60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed for extraction. In summary, the sample is sequentially extracted with up to 6 different extraction solutions. The extract is then centrifuged for 30 minutes and the supernatant is subsequently removed and analysed. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Note: For the Tessier "RM" Extraction, the extraction solution is 50/50 mix of 1:1 Nitric Acid along with 1:1 Hydrochloric Acid, and is hot block digested as per the BC SALM procedure. This is intended to extract the fiResidualfl metals.

MOISTURE-VA Soil Moisture content CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PH-PASTE-VA Soil pH in Soil (Paste) by Meter Carter-CSSS / APHA 4500 H

A soil extract produced by the saturated paste extraction procedure is analyzed by pH meter.

PSA-PIPET+GRAVEL-SK Soil Particle size - Sieve and Pipette SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
AX	ALS MINERALS - VANCOUVER, B.C., CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 1

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
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Finalized Date: 25-JUL-2018
Account: APN

CERTIFICATE VA18171352

Project: L2128495

This report is for 15 Other samples submitted to our lab in Vancouver, BC, Canada on 16-JUL-2018.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE SHANE STACK	ALSEV DATASUBLET	SOFTWARE DEVELOPMENT GROUP

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
CRU-31	Fine crushing - 70% <2mm
SPL-21	Split sample - riffle splitter
PUL-31	Pulverize split to 85% <75 um

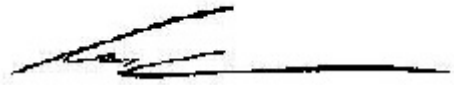
ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION
ME-MS41	Ultra Trace Aqua Regia ICP-MS

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:



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To: **ALS ENVIRONMENTAL**
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Finalized Date: 25-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

Sample Description	Method	WEI-21	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	Recvd Wt.	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs
	Units	kg	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
	LOD	0.02	0.01	0.01	0.1	0.02	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05
L2128495-1 T1-A		0.18	0.43	0.87	94.2	<0.02	<10	370	0.26	0.15	1.98	1.72	14.45	15.9	18	0.46
L2128495-2 T1-B		0.18	0.40	1.18	17.6	<0.02	<10	310	0.32	0.49	0.81	0.79	25.3	8.5	24	0.60
L2128495-3 T1-D		0.22	0.41	1.18	47.1	<0.02	<10	230	0.39	0.22	0.46	1.06	33.6	9.5	23	0.75
L2128495-4 T1-E		0.18	0.31	1.24	10.0	<0.02	<10	260	0.31	0.19	0.65	0.69	30.8	6.4	26	0.65
L2128495-5 T1-F		0.14	0.98	0.16	14.0	<0.02	10	270	0.07	0.05	4.12	1.48	1.85	4.1	9	0.11
L2128495-6 T2-A		0.20	0.17	1.36	22.3	<0.02	<10	170	0.24	0.09	0.63	0.57	31.3	9.4	34	0.32
L2128495-7 T2-B		0.16	0.53	0.71	12.1	<0.02	10	250	0.23	0.12	3.15	1.05	9.24	3.9	14	0.43
L2128495-8 T2-D		0.16	0.28	1.07	18.3	<0.02	<10	240	0.31	0.17	0.85	1.95	23.6	6.2	23	0.57
L2128495-9 T2-E		0.14	0.42	0.98	18.4	<0.02	10	290	0.31	0.18	2.53	0.89	13.10	6.1	18	0.60
L2128495-10 T2-F		0.16	0.28	1.35	28.6	<0.02	<10	250	0.37	0.18	0.80	0.46	25.5	9.4	29	0.68
L2128495-11 T3-A		0.20	0.38	1.39	37.0	<0.02	<10	310	0.41	0.28	0.83	2.14	32.8	11.1	28	0.84
L2128495-12 T3-B		0.14	0.29	1.06	25.6	<0.02	10	340	0.38	0.20	2.51	38.5	12.65	7.8	19	0.74
L2128495-13 T2-D		0.16	0.31	1.11	80.7	<0.02	10	410	0.39	0.22	1.87	14.65	18.35	19.2	21	0.68
L2128495-14 T2-E		0.16	0.29	1.37	59.1	<0.02	10	360	0.38	0.24	1.30	1.15	27.0	10.5	27	0.85
L2128495-15 T2-F		0.24	0.39	1.21	35.0	<0.02	<10	240	0.36	0.23	0.44	1.08	35.4	12.0	26	0.71

***** See Appendix Page for comments regarding this certificate *****

ALS Canada Ltd.
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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

Sample Description	Method	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb
	Units	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm
	LOD	0.2	0.01	0.05	0.05	0.02	0.01	0.005	0.01	0.2	0.1	0.01	5	0.05	0.01	0.05
L2128495-1 T1-A		55.5	3.78	2.73	<0.05	0.04	0.06	0.025	0.10	7.1	6.9	0.40	1350	2.42	0.03	0.51
L2128495-2 T1-B		123.5	2.44	3.39	<0.05	0.04	0.14	0.067	0.16	12.7	12.3	0.46	627	0.74	0.03	0.72
L2128495-3 T1-D		35.0	2.62	3.47	<0.05	0.08	0.05	0.035	0.14	16.9	13.9	0.46	163	1.34	0.02	0.91
L2128495-4 T1-E		34.4	2.02	3.58	<0.05	0.05	0.04	0.028	0.16	15.3	14.1	0.48	354	0.74	0.03	0.82
L2128495-5 T1-F		25.3	2.68	0.68	<0.05	0.02	0.10	0.058	0.04	1.1	0.7	0.24	1040	1.26	<0.01	0.11
L2128495-6 T2-A		22.9	2.52	4.22	<0.05	0.09	0.06	0.016	0.16	17.4	17.3	0.85	542	1.13	0.02	1.22
L2128495-7 T2-B		44.2	1.56	1.84	<0.05	0.04	0.08	0.037	0.11	5.3	6.6	0.46	398	0.85	0.02	0.35
L2128495-8 T2-D		15.7	2.41	3.33	<0.05	0.05	0.06	0.030	0.21	12.1	11.8	0.41	315	1.23	0.03	0.75
L2128495-9 T2-E		34.8	2.08	2.68	<0.05	0.06	0.06	0.032	0.16	7.1	9.8	0.49	321	1.23	0.02	0.46
L2128495-10 T2-F		26.6	3.12	3.86	<0.05	0.05	0.05	0.030	0.23	13.2	15.6	0.50	377	1.81	0.03	0.72
L2128495-11 T3-A		50.2	3.03	4.01	<0.05	0.08	0.07	0.043	0.24	16.2	15.1	0.52	414	1.73	0.03	0.82
L2128495-12 T3-B		50.3	2.22	2.86	<0.05	0.05	0.07	0.031	0.18	7.1	9.6	0.49	692	1.26	0.02	0.43
L2128495-13 T2-D		37.6	4.51	3.05	<0.05	0.05	0.06	0.031	0.17	8.9	10.4	0.45	1880	2.41	0.03	0.50
L2128495-14 T2-E		27.7	3.63	3.84	<0.05	0.04	0.07	0.040	0.22	13.8	12.7	0.48	810	1.62	0.03	0.73
L2128495-15 T2-F		44.9	2.98	3.52	0.05	0.09	0.05	0.038	0.18	17.9	14.1	0.47	513	1.75	0.02	0.62

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

Sample Description	Method	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41	ME-MS41
	Analyte	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti
	Units	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
	LOD	0.2	10	0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005
L2128495-1 T1-A		20.0	1260	87.9	6.2	0.001	0.18	1.07	1.8	1.2	0.3	60.2	<0.01	0.03	0.7	0.020
L2128495-2 T1-B		19.4	740	96.4	9.7	0.001	0.07	0.79	3.1	0.9	0.3	33.4	<0.01	0.04	2.7	0.042
L2128495-3 T1-D		25.5	820	230	11.2	0.001	0.05	1.20	3.6	1.0	0.3	23.5	<0.01	0.03	4.9	0.045
L2128495-4 T1-E		19.9	850	23.8	10.3	<0.001	0.05	0.81	3.4	0.6	0.3	29.1	<0.01	0.02	3.6	0.052
L2128495-5 T1-F		9.9	720	86.6	1.4	0.002	0.20	1.65	0.2	0.4	0.9	90.5	<0.01	<0.01	<0.2	<0.005
L2128495-6 T2-A		26.8	560	46.1	9.2	0.001	0.02	0.56	2.9	<0.2	0.4	18.3	<0.01	0.01	4.3	0.098
L2128495-7 T2-B		17.4	840	38.7	7.8	0.001	0.16	1.03	1.1	0.7	0.2	75.5	<0.01	0.02	0.5	0.012
L2128495-8 T2-D		16.4	710	80.8	12.6	0.001	0.08	0.78	2.5	0.5	0.3	33.1	<0.01	0.02	2.7	0.027
L2128495-9 T2-E		20.0	880	28.1	12.8	0.001	0.14	0.98	1.9	0.5	0.3	64.6	<0.01	0.02	1.1	0.013
L2128495-10 T2-F		24.8	770	25.7	13.3	0.001	0.04	0.95	3.2	0.4	0.5	30.6	<0.01	0.02	3.0	0.036
L2128495-11 T3-A		32.9	850	40.9	13.9	0.001	0.05	1.28	4.1	0.5	0.5	32.4	<0.01	0.02	4.1	0.034
L2128495-12 T3-B		25.3	940	22.4	11.6	0.001	0.18	1.13	1.9	0.8	0.3	64.4	<0.01	0.03	0.9	0.013
L2128495-13 T2-D		25.8	1120	21.7	11.1	0.001	0.25	1.37	2.4	1.1	0.3	54.6	<0.01	0.04	1.2	0.015
L2128495-14 T2-E		24.0	900	58.0	13.8	0.001	0.11	1.02	3.3	0.7	0.4	43.0	<0.01	0.04	2.2	0.024
L2128495-15 T2-F		33.7	880	22.9	10.8	<0.001	0.02	1.18	3.8	0.7	0.4	22.3	<0.01	0.03	5.1	0.047

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

Sample Description	Method / Analyte / Units / LOD	ME-MS41 Tl ppm 0.02	ME-MS41 U ppm 0.05	ME-MS41 V ppm 1	ME-MS41 W ppm 0.05	ME-MS41 Y ppm 0.05	ME-MS41 Zn ppm 2	ME-MS41 Zr ppm 0.5
L2128495-1 T1-A		0.09	0.73	31	0.14	5.93	148	1.5
L2128495-2 T1-B		0.12	1.01	38	0.12	6.50	161	1.6
L2128495-3 T1-D		0.14	1.00	39	0.21	8.35	152	3.5
L2128495-4 T1-E		0.13	0.65	40	0.15	7.12	114	2.0
L2128495-5 T1-F		0.03	0.18	4	0.27	1.18	184	0.6
L2128495-6 T2-A		0.09	0.46	57	0.11	6.16	177	2.9
L2128495-7 T2-B		0.08	0.46	19	0.08	4.50	204	1.4
L2128495-8 T2-D		0.11	0.53	35	0.16	4.48	175	2.0
L2128495-9 T2-E		0.12	0.52	27	0.17	4.52	178	2.0
L2128495-10 T2-F		0.15	0.46	43	0.13	5.70	121	2.0
L2128495-11 T3-A		0.18	0.63	44	0.18	8.83	435	3.1
L2128495-12 T3-B		0.12	0.71	28	0.10	5.21	4870	1.9
L2128495-13 T2-D		0.13	0.94	35	0.11	6.26	2660	1.6
L2128495-14 T2-E		0.16	1.17	44	0.14	6.58	307	1.7
L2128495-15 T2-F		0.15	0.55	40	0.77	9.16	142	4.7

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 25-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Applies to Method: Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).
ME-MS41

LABORATORY ADDRESSES

Applies to Method: Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

CRU-31	LOG-22	ME-MS41	PUL-31
SPL-21	WEI-21		

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L2128495-COFC

COC #

Page 1 of of 1

Report To				Report Format / Distribution				Service Requested (Rush for routine analysis subject to availability)
Company:	Alexco Resource Corp.			☑ Standard	☐ Other			◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Kai Woloshyn			☑ PDF	☑ Excel	☐ Digital	☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	#3 Calcite Business Centre, 151 Industrial Road			Email 1:	environment@alexcoresource.com			○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Whitehorse, YT Y1A 2V3			Email 2:	nichole@accessconsulting.ca			○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	867-668-6463	Fax:	867-633-4882	Email 3:	amacphail@accessconsulting.ca; agault@alexcor			
Invoice To	Same as Report ?	☐ Yes	☑ No	Client / Project Information				Analysis Request
Hardcopy of Invoice with Report?		☐ Yes	☑ No	Job #:	Natural Attenuation Study			Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	Alexco Resource Corp.			PO / AFE:	PO18965			
Contact:	Derek Meneghin			LSD:				
Address:	Suite 1150 - 200 Granville St. Vancouver BC V6C 1S4							
Phone:	604-633-4888	Fax:	604-633-4887	Quote #:				

Lab Work Order # (lab use only)

ALS Contact: Shane Stack

Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Paste pH	Moisture Content	Particle size	Total Organic Carbon	Aqua regia ICP-MS metals	Tessier Seq Extract ICP-MS								P	Number of Containers
1	T1-A	05-Jul-18	13:00	Other	X	X	X	X	X										1
2	T1-B	05-Jul-18	13:10	Other	X	X	X	X	X										1
3	T1-D	05-Jul-18	13:20	Other	X	X	X	X	X										1
4	T1-E	05-Jul-18	13:30	Other	X	X	X	X	X										1
5	T1-F	05-Jul-18	13:40	Other	X	X	X	X	X										1
6	T2-A	05-Jul-18	13:50	Other	X	X	X	X	X										1
7	T2-B	05-Jul-18	14:00	Other	X	X	X	X	X										1
8	T2-D	05-Jul-18	14:10	Other	X	X	X	X	X										1
9	T2-E	05-Jul-18	14:20	Other	X	X	X	X	X										1
10	T2-F	05-Jul-18	14:30	Other	X	X	X	X	X										1
11	T3-A	05-Jul-18	14:40	Other	X	X	X	X	X										1
12	T3-B	05-Jul-18	14:50	Other	X	X	X	X	X										1
13	T3-D	05-Jul-18	15:00	Other	X	X	X	X	X										1
14	T3-E	05-Jul-18	15:10	Other	X	X	X	X	X										1
15	T3-F	05-Jul-18	15:20	Other	X	X	X	X	X										1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please contact us if further information is required for the requested anaysis (e.g., Tessier).

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Sonny Parker	Date (dd-mmm-yy): 12-Jul-18	Time (hh-mm): 13:00	Received by: EHF	Date: 12 Jul 2018	Time: 13:30	Temperature: 5.6 °C	Verified by: HA	Date: 7/13	Time: 3:35p	Observations: Yes / No ? If Yes add SIF

8

GENF 20.00 Front

ALEXCO RESOURCE CORP.
ATTN: Kai Woloshyn
#3 - 151 Industrial Road
Whitehorse YT Y1A 2V3

Date Received: 13-FEB-19
Report Date: 20-FEB-19 17:59 (MT)
Version: FINAL

Client Phone: --

Certificate of Analysis

Lab Work Order #: L2232039

Project P.O. #:	21153
Job Reference:	TYPE A WL
C of C Numbers:	1 of 1
Legal Site Desc:	Keno Quarterly

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2232039-1	L2232039-2			
	Description	Surface Water	Surface Water			
	Sampled Date	10-FEB-19	10-FEB-19			
	Sampled Time	14:01	14:10			
	Client ID	KV-121	KV-SEEP			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	634	630			
	Hardness (as CaCO3) (mg/L)	347	345			
	Hardness (from Totals) (mg/L)	337	339			
	pH (pH)	7.55	7.55			
	Total Suspended Solids (mg/L)	25.5	15.1			
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	111	108			
	Ammonia, Total (as N) (mg/L)	0.0076	0.0052			
	Bromide (Br) (mg/L)	<0.25 DLDS	<0.25 DLDS			
	Chloride (Cl) (mg/L)	<2.5 DLDS	<2.5 DLDS			
	Fluoride (F) (mg/L)	0.14	0.12			
	Nitrate (as N) (mg/L)	0.290	0.293			
	Nitrite (as N) (mg/L)	<0.0050 DLDS	<0.0050 DLDS			
	Sulfate (SO4) (mg/L)	245	233			
	Anion Sum (meq/L)	7.35	7.05			
	Cation Sum (meq/L)	7.09	7.05			
	Cation - Anion Balance (%)	-1.8	0.0			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	0.71	0.73			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0981	<0.0030			
	Antimony (Sb)-Total (mg/L)	0.00011	<0.00010			
	Arsenic (As)-Total (mg/L)	0.0383	0.00841			
	Barium (Ba)-Total (mg/L)	0.0256	0.0178			
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Total (mg/L)	0.000363	0.000145			
	Calcium (Ca)-Total (mg/L)	97.7	99.9			
	Chromium (Cr)-Total (mg/L)	0.00029	<0.00010			
	Cobalt (Co)-Total (mg/L)	0.00286	0.00175			
	Copper (Cu)-Total (mg/L)	0.00143	<0.00050			
	Iron (Fe)-Total (mg/L)	3.29	0.805			
	Lead (Pb)-Total (mg/L)	0.000556	<0.000050			
	Lithium (Li)-Total (mg/L)	0.0128	0.0118			
	Magnesium (Mg)-Total (mg/L)	22.7	21.8			
	Manganese (Mn)-Total (mg/L)	0.563	0.378			
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.000125	0.000077			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2232039-1	L2232039-2			
	Description	Surface Water	Surface Water			
	Sampled Date	10-FEB-19	10-FEB-19			
	Sampled Time	14:01	14:10			
	Client ID	KV-121	KV-SEEP			
Grouping	**Analyte**					
WATER						
Total Metals	Nickel (Ni)-Total (mg/L)	0.00675	0.00399			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	0.39	0.37			
	Selenium (Se)-Total (mg/L)	0.000935	0.000925			
	Silicon (Si)-Total (mg/L)	3.79	3.46			
	Silver (Ag)-Total (mg/L)	0.000019	<0.000010			
	Sodium (Na)-Total (mg/L)	1.66	1.61			
	Strontium (Sr)-Total (mg/L)	0.205	0.203			
	Sulfur (S)-Total (mg/L)	87.6	84.0			
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000014			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00315	<0.00030			
	Uranium (U)-Total (mg/L)	0.00307	0.00278			
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	0.154	0.0956			
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	<0.0010			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00942	0.00868			
	Barium (Ba)-Dissolved (mg/L)	0.0168	0.0171			
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	0.000134	0.000132			
	Calcium (Ca)-Dissolved (mg/L)	102	102			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	0.00205	0.00195			
	Copper (Cu)-Dissolved (mg/L)	0.00030	0.00025			
	Iron (Fe)-Dissolved (mg/L)	0.928	0.875			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0126	0.0127			
	Magnesium (Mg)-Dissolved (mg/L)	22.7	22.2			
	Manganese (Mn)-Dissolved (mg/L)	0.463	0.442			
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.000076	0.000082			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2232039-1	L2232039-2			
	Description	Surface Water	Surface Water			
	Sampled Date	10-FEB-19	10-FEB-19			
	Sampled Time	14:01	14:10			
	Client ID	KV-121	KV-SEEP			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.00481	0.00458			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	0.40	0.38			
	Selenium (Se)-Dissolved (mg/L)	0.000896	0.000879			
	Silicon (Si)-Dissolved (mg/L)	3.59	3.38			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	1.73	1.67			
	Strontium (Sr)-Dissolved (mg/L)	0.208	0.217			
	Sulfur (S)-Dissolved (mg/L)	88.9	83.2			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00268	0.00262			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.108	0.105			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2232039-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L2232039-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L2232039-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2232039-1, -2
Matrix Spike	Arsenic (As)-Total	MS-B	L2232039-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L2232039-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2232039-1, -2
Matrix Spike	Iron (Fe)-Total	MS-B	L2232039-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2232039-1, -2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2232039-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2232039-1, -2
Matrix Spike	Sulfur (S)-Total	MS-B	L2232039-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

Reference Information

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

VIC100-T-HARDNESS-VA	Water	Hardness from Total Metals	APHA 2340B

Custom Calculation for Hardness. Client is requesting when Total Metals are run, only Total metals are used for hardness calculation.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical
Canada Toll Free: 1 800
www.alsglobal.com

L2232039-COFC

Page 1 of 1

Report To		Report Format / Distribution	
Company:	Alexco Resource Corp.		
Contact:	Kai Woloshyn		
Address:	#3 Calcite Business Centre, 151 Industrial Road	Email 1:	environment@alexcoresource.com
	Whitehorse, YT Y1A 2V3	Email 2:	nichole@accessconsulting.ca
Phone:	867-668-6463 Fax: 867-633-4882	Email 3:	amacphail@accessconsulting.ca
Invoice To	Same as Report ?	**Client / Project Information**	
Hardcopy of Invoice with Report?		Job #:	Type A WL
Company:	Alexco Resource Corp.	PO / AFE:	PO21153
Contact:	Derek Meneghin	LSD:	Keno Quarterly
Address:	Suite 1150 - 200 Granville St. Vancouver BC V6C 1S4		
Phone:	604-633-4888 Fax: 604-633-4887	Quote #:	
Lab Work Order # (lab use only)		ALS Contact:	Ariel Tang
		Sampler:	kn

Service Requested (Rush for routine analysis subject to availability)

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P	F/P	P	F/P						F/P	P	P	P	P	Number of Containers
					[redacted]	VIC100-MET-D-LOW-VA	[redacted]	VIC100-MET-D-HIGH-VA + Hg	VIC100-GEN-A	VIC100-GEN-B	VIC100-GEN-C	VIC100-GEN-D	VIC100-GEN-E	DOC	Ammonia	TKN	Ammonia + TKN	Radium (for Collins)	
	KV-121 (LP)	10-2-2019	14:01	Surface Water	X	X					X			X	X				5
	KV-Seep (LQS)	10-2-2019	14:10	Surface Water	X	X					X			X	X				5

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Yukon EQWin and ACC200 digital formats. General A: pH, EC, TSS (low) **General B:** pH, EC, TSS (low), anions-all
General C: pH, EC, TSS (low), anions-all, ion balance, alkalinity **General D:** pH, EC, TSS (low), SO4, ion balance, alkalinity **General E:** pH, EC, TSS (low), SO4, ion balance

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)			SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Obse Observations: Yes / Yes / No ? If Ye If Yes add SIF
Kyle Nault	13-2-2019		[redacted]	Feb 13/19	09:35	4/2 °C	ZZ	Feb 14, 2019	1:16 pm	

GENF 20.00 Front

7°C

Contango STRATEGIES LTD.

Forward looking. Lateral thinking.

Report To **Andrew MacPhail, Andrew Gault, Kai Woloshyn**
Alexco Resource Corp.
3 Calcite Business Centre, 151 Industrial Road
Whitehores, YT
Y1A 2V3

Client Phone 867-668-6463, 613-329-0085

Date Samples Received	16-Jul-2018
Report Date	27-Aug-2018
Report Revision	A
Version	FINAL

Report #	029_0818_07A
Project P.O. #	AKHM-13-01
Project Name	Alexco
COC #	00167

Report prepared by:

Anna Ly, dip. BT, BSc
Technologist I

Report reviewed by:

Ainsley Stewart, dip. BT
Technologist III

Sample Summary

Report Number	029_0818_07A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00167
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	16-Jul-2018
Report Date	27-Aug-2018
Report Revision	A

Sample Details

Contango Sample ID	Client Sample ID	Sample Type	Date Sampled	Number of Containers
DNA_195	T1-C	soil	05-Jul-2018	1
DNA_194	T2-C	soil	05-Jul-2018	1
DNA_193	T3-C	soil	05-Jul-2018	1

Container Type	Status Upon Received	COC#
100 mL specimen cup	20 to 21°C, acceptable	00167
100 mL specimen cup	20 to 21°C, acceptable	00167
100 mL specimen cup	20 to 21°C, acceptable	00167

Methods

Report Number	029_0818_07A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00167
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	16-Jul-2018
Report Date	27-Aug-2018
Report Revision	A

Client Sample ID	**T1-C**	**T2-C**	**T3-C**
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018
Contango Sample ID	DNA_195	DNA_194	DNA_193
Sample Type	soil	soil	soil
Weight or Volume Extracted	0.293 g	0.291 g	0.282 g
DNA Extraction Method	As per MoBIO PowerLyzer PowerSoil DNA Isolation Kit protocol		
Genetic Sequencing Target	v3/v4 16S rRNA - Bacteria		
Library Type	300 bp PE MiSeq		
Internal Controls	Passed QC		
OTU Clustering Threshold	97%		
SPB Database	SPB_00008		
Genetic Sequencing Detection Limit	0.0012%	0.0016%	0.0020%
Sulphate-reducing Bacteria Quantification	qPCR targeting dissimilatory sulfite reductase subunit B *dsrB* gene		

Not for diagnostic purposes.

Summary of add-on analyses performed

Summary of organism populations that have genera known to possess these traits or abilities

Report Number	029_0818_07A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00167
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	16-Jul-2018
Report Date	27-Aug-2018
Report Revision	A

Client Sample ID	**T1-C**	**T2-C**	**T3-C**
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018
Contango Sample ID	DNA_195	DNA_194	DNA_193
Sample Type	soil	soil	soil
Percentage of Bacterial Community			
Sulphide-producing bacteria	1.30%	0.55%	0.23%
Other bacteria	98.70%	99.45%	99.77%

Refer to add-on analysis tabs for trait assignment categories of each genera

Abundant bacteria identified to the genus level

Of bacteria identified to the genus level, those with the highest percentage are provided if ≥ 1% in at least one samp

Report Number	029_0818_07A
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P.O Number	AKHM-13-01
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Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	16-Jul-2018
Report Date	27-Aug-2018
Report Revision	A

	Percentage of bacterial community		
Client Sample ID	**T1-C**	**T2-C**	**T3-C**
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018
Contango Sample ID	DNA_195	DNA_194	DNA_193
Sample Type	soil	soil	soil
Genus	%	%	%
Albidiferax	1.53%	0.22%	0.17%
Arthrobacter	0.50%	1.74%	0.19%
Clostridium_sensu_stricto	1.10%	0.54%	0.16%
Flavobacterium	0.24%	0.00%	1.41%
Gallionella	1.33%	0.00%	0.00%
Sulfuricurvum	2.08%	0.00%	0.00%
Others (each < 1% or not identified to the genus level)	93.21%	97.50%	98.07%

Percentage of Known Sulphide-Producing Bacteria

Summary of bacterial genera or families known to have species capable of reducing various sulphur compounds to form sulphides

Report Number 029_0818_07A
Project Name Alexco
P.O Number AKHM-13-01
COC Number 00167
Report To Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received 16-Jul-2018
Report Date 27-Aug-2018
Report Revision A

											Percentage of bacterial community			
											T1-C	T2-C	T3-C	Client Sample ID
											05-Jul-2018	05-Jul-2018	05-Jul-2018	Date Sampled
											DNA_195	DNA_194	DNA_193	Contango Sample ID
	Can reduce				Environment						soil	soil	soil	Sample Type
Genus	Sulphate	Thiosulphate	Sulphite	Sulphur	Aerobic / Anaerobic Characteristics	Temperature	pH	Electron donors that may be used	Complete Oxidizer	Trait Assignment Category	%	%	%	Unit
Desulfomonile	Yes	Yes	Yes	No	anaerobic	mesophilic	neutrophilic	acetate, benzoate, butyrate, formate, lactate, pyruvate, H_2/CO_2, malate, methoxylated aromatic acids	Yes	A	0.002%	0.000%	0.000%	
Desulfosporosinus	Yes	Yes	Yes	Yes	anaerobic	mesophilic, some psychrotolerant	neutrophilic	butyrate, caprate, caproate, caprylate, ethanol, formate, fumarate, glycerol, H_2, H_2+acetate, lactate, malate, methanol, propanol, pyruvate, syringate, 3,4,5-Trimethoxybenzoate	No	A	0.15%	0.02%	0.07%	
Sulfurospirillum	No	Yes	Yes	Yes	microaerophilic	mesophilic, some psychrotolerant	neutrophilic	formate, fumarate, glutarate, hydrogen, alpha-ketoglutarate, lactate, malate, pyruvate, succinate	No	A	0.01%	0.0000%	0.0000%	
Clostridium_sensu_stricto	No	Yes	Yes, some	Yes, some	obligately anaerobic	mesophilic	mildly acidophilic to neutrophilic (4.0-8.5)	*INA*	*INA*	B	1.10%	0.54%	0.16%	
Geobacter	No	No	No	Yes	anaerobic	mesophilic	neutrophilic	acetate	Yes	B	0.04%	0.0000%	0.0000%	
Total SPB Percentage											**1.30%**	**0.55%**	**0.23%**	

INA = Information Not Available

(+/-) represents that some species within this genus use this source as an electron donor, while some do not.

Trait Assignment Categories:
A = most species in this genus possess these traits or abilities
B = some species in this genus possess these traits or abilities
C = this trait has been noted for this genus in only a few cases or is not well documented. Further investigation may be warranted.

Definitions

Acidophilic: Microorganisms that thrive in acidic conditions (pH < 5.5)
Aerobic: Grow in the presence of oxygen
Alkaliphilic: Microorganisms that thrive in alkaline conditions (pH > 8)
Complete oxidizer: Can oxidize organic substrates completely to CO2; Incomplete oxidizers cannot and form acetate as an end product.
Facultatively Anaerobic: Can use oxygen to grow, and can also grow under anaerobic conditions
FeOB: Iron-oxidizing bacteria
FeRB: Iron-reducing bacteria
Hyperthermophilic: Microorganisms that thrive in very high temperatures (>80°C)
Mesophilic: Microorganisms that thrive in moderate temperature, typically between 15-45°C.
Microaerophilic: Require oxygen to grow, but are killed by atmospheric oxygen concentrations (typically require between 2-10%)
Neutrophilic: Microorganisms that thrive in neutral pH environments
Anaerobic: Do not require oxygen to grow, and can be killed by normal atmospheric oxygen concentrations
OTU: Operational Taxonomic Unit, which is a group of sequences that are similar based on a threshold
Phototrophic: Uses energy from light
Psychrophile or Psychrotolerant: Microorganisms that grow in cold temperatures (<15°C)
SOB: Sulphur-oxidizing bacteria; Bacteria capable of oxidizing sulphur compounds
SPB: Organisms capable of reducing various sulphur compounds (e.g., sulphate, thiosulphate, sulfite, elemental sulphur) to form sulphide
Taxonomy: The classification, identification, and naming of organisms
Thermophilic: Microorganisms that thrive in high temperatures (45°C-80°C)
Trait Assignment Category: Categorized as A or B, corresponding to whether most or some species in genus possess a given trait. Category C corresponds to undocumented or insufficient data.

Background Information

Because the same gene is sequenced for all bacteria in a sample, the relatedness can be inferred based on sequence similarity. One of the first steps of analysis is clustering similar sequences into groups which are called Operational Taxonoimc Units (OTUs). The threshold for choosing what is grouped together into an OTU is dependent on the region that is being targeted for sequencing *(Methodology tab*).

Once sequences have been clustered together, each OTU is assigned a taxonomy classification based on similarity with sequences in a database. The taxonomy classification is therefore dependent on the database curation and on the organisms that are represented in the database. For example, if a novel bacterium is sequenced, no taxonomy will be assigned as no representative sequence would be in the database. Similarly, the level of taxonomy that is assigned (e.g., phylum, class, order, family, genus) is dependent on representative sequences in the database.

The *List of all bacteria* tab is a list of all bacteria in each sample along with their percentage, meaning the proportion of the community that a given bacteria makes up.

The diversity of each sample is also calculated (*Diversity Summary tab*). Observed Species is the total number of OTUs that was found in each sample. Simpson's Reciprocal Index is a measurement that takes into account the dominance (evenness) and overall number of species (richness) of a community.

Quantification Results

qPCR results based on average gene copy number. See the "Background" tab for more information.

Report Number	029_0818_07A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00167
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Report Date	27-Aug-2018
Report Revision	A

	Gene Copy Number		
Client Sample ID	**T1-C**	**T2-C**	**T3-C**
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018
Contango Sample ID	DNA_195	DNA_194	DNA_193
Sample Type	soil	soil	soil
Gene	copy/cm^3	copy/cm^3	copy/cm^3
Sulphate-reducing bacteria	4,816,820	793,274	107,427

Standard Deviation		
T1-C	**T2-C**	**T3-C**
05-Jul-2018	05-Jul-2018	05-Jul-2018
DNA_195	DNA_194	DNA_193
soil	soil	soil
copy/cm^3	copy/cm^3	copy/cm^3
2,152,762	131,108	38,456

Percentages of each bacterial OTU

Percentage of all bacteria in each sample. See the "Background" tab for more information.

Report Number	029_0818_07A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00167
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	16-Jul-2018
Report Date	27-Aug-2018
Report Revision	A

OTU IDs are specific to a given report and cannot be compared between submissions.
If you would like to compare with other submissions, please contact us.
Representative sequences for each OTU can also be provided upon request.

Client Sample ID	**T1-C**	**T2-C**	**T3-C**						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	**Classification**					
OTU1	0.44%	5.32%	0.23%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Bradyrhizobiaceae	
OTU2	0.00%	0.00%	4.34%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU3	0.05%	4.41%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU4	0.72%	0.76%	0.41%	k__Bacteria	p__Actinobacteria				
OTU5	0.64%	2.01%	0.46%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Acidimicrobiales		
OTU6	0.93%	0.58%	0.86%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU7	2.08%	2.97%	3.92%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU8	0.50%	1.74%	0.19%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micrococcaceae	g__Arthrobacter
OTU9	1.43%	0.00%	0.11%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU10	0.18%	1.68%	0.21%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU11	0.38%	0.21%	1.42%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU12	0.37%	2.43%	0.75%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU13	2.08%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Epsilonproteobacteria	o__Campylobacterales	f__Helicobacteraceae	g__Sulfuricurvum
OTU14	0.47%	0.54%	0.15%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1	g__Clostridium_sensu_stricto
OTU15	1.32%	0.06%	0.41%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU16	0.12%	1.83%	0.54%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU17	0.06%	0.50%	0.58%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU18	0.92%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	
OTU19	0.29%	0.98%	0.63%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU20	0.33%	0.61%	0.42%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nakamurellaceae	g__Nakamurella
OTU21	0.68%	0.00%	0.06%	k__Bacteria	p__Actinobacteria				
OTU22	0.17%	0.25%	0.71%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU23	0.87%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU24	0.78%	1.15%	2.04%	k__Bacteria	p__Gemmatimonadetes				
OTU25	0.54%	0.00%	0.00%	k__Bacteria					
OTU26	0.14%	0.44%	1.63%	k__Bacteria					
OTU27	0.29%	0.99%	0.12%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU28	1.01%	1.37%	2.19%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU29	0.15%	0.37%	0.34%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae	g__Gaiella
OTU30	0.78%	0.31%	0.98%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU31	0.40%	0.05%	1.21%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU32	0.10%	0.26%	0.99%	k__Bacteria	p__Proteobacteria				
OTU33	0.11%	1.21%	0.30%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU34	0.04%	0.09%	0.81%	k__Bacteria	p__Actinobacteria				
OTU35	0.40%	0.58%	0.54%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU36	1.19%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU37	0.51%	0.12%	0.05%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU38	0.23%	1.02%	0.35%	k__Bacteria	p__Actinobacteria				
OTU39	0.25%	0.44%	0.11%	k__Bacteria					
OTU40	0.43%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU41	0.17%	0.05%	1.60%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU42	0.49%	0.00%	0.01%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1	g__Clostridium_sensu_stricto
OTU43	0.16%	0.24%	0.99%	k__Bacteria	p__Nitrospirae	c__Nitrospira	o__Nitrospirales	f__Nitrospiraceae	g__Nitrospira
OTU44	0.07%	0.01%	0.44%	k__Bacteria					
OTU45	0.57%	0.77%	0.85%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU46	0.05%	0.33%	0.31%	k__Bacteria	p__Actinobacteria				
OTU47	0.04%	0.28%	0.46%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU48	0.22%	0.00%	0.51%	k__Bacteria	p__Proteobacteria				
OTU49	0.05%	0.14%	0.35%	k__Bacteria	p__Actinobacteria				
OTU50	0.52%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales	f__Gallionellaceae	g__Gallionella
OTU51	0.36%	0.35%	0.87%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU52	0.03%	0.22%	0.70%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	
OTU53	0.27%	0.19%	0.43%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU54	1.53%	0.22%	0.17%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	g__Albidiferax
OTU55	0.12%	0.69%	0.19%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU56	0.81%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales	f__Gallionellaceae	g__Gallionella
OTU57	0.02%	0.44%	0.00%	k__Bacteria	p__Actinobacteria				
OTU58	0.45%	0.24%	0.18%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU59	0.20%	0.08%	0.88%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU60	0.12%	0.27%	0.32%	k__Bacteria					
OTU61	0.33%	0.35%	0.29%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU62	0.24%	0.60%	0.75%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU63	0.46%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Hydrogenophilales	f__Hydrogenophilaceae	g__Sulfuricella
OTU64	0.91%	0.95%	0.36%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU65	0.02%	0.45%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU66	0.05%	0.39%	0.20%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU67	0.30%	0.26%	0.56%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU68	2.27%	0.24%	0.46%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU69	0.25%	0.00%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU70	0.37%	0.49%	0.81%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU71	0.06%	0.19%	0.43%	k__Bacteria	p__Actinobacteria				
OTU73	0.00%	0.16%	0.39%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU74	0.22%	0.76%	0.73%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU75	0.02%	0.00%	0.31%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU76	0.36%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU77	0.28%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales		
OTU78	0.10%	0.77%	0.10%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae	g__Pseudomonas
OTU79	0.04%	0.01%	0.21%	k__Bacteria					
OTU80	0.47%	0.06%	0.36%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU81	0.32%	0.09%	0.64%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU82	0.01%	0.34%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU83	0.27%	0.17%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU84	0.11%	0.03%	0.25%	k__Bacteria	p__Actinobacteria				
OTU85	0.05%	0.12%	0.13%	k__Bacteria	p__Actinobacteria				
OTU86	0.04%	0.02%	0.41%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae	g__Gaiella
OTU87	0.18%	0.00%	0.00%	k__Bacteria					
OTU88	0.05%	0.05%	0.47%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU89	0.31%	0.08%	1.35%	k__Bacteria					
OTU90	0.00%	0.30%	0.02%	k__Bacteria					
OTU91	0.36%	0.00%	0.35%	k__Bacteria	p__Proteobacteria				
OTU92	0.37%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU93	0.03%	0.01%	0.59%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU94	0.22%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU95	0.04%	0.03%	0.35%	k__Bacteria					
OTU96	0.06%	0.03%	0.17%	k__Bacteria	p__Actinobacteria				
OTU97	0.18%	0.01%	0.31%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU98	0.14%	0.46%	0.31%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU99	0.02%	0.48%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU100	0.06%	0.48%	0.13%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU101	0.15%	0.03%	0.37%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	g__Caulobacter
OTU102	0.18%	0.10%	0.92%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU103	0.17%	0.00%	0.02%	k__Bacteria					
OTU104	0.02%	0.24%	0.12%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU105	0.17%	0.19%	0.44%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU106	0.09%	0.18%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU107	0.06%	0.01%	0.35%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU108	0.18%	0.01%	0.70%	k__Bacteria					
OTU109	0.22%	0.00%	0.00%	k__Bacteria	p__Aminicenantes				
OTU110	0.24%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU111	0.17%	0.00%	0.00%	k__Bacteria					
OTU112	0.35%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU113	0.08%	0.45%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae	g__Mycobacterium
OTU114	0.27%	0.06%	0.37%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	g__Polaromonas
OTU115	0.08%	0.11%	0.64%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU116	0.09%	0.06%	0.28%	k__Bacteria					
OTU117	0.21%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU118	1.04%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes				
OTU120	0.01%	0.78%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU121	0.45%	0.23%	0.37%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU122	0.24%	0.22%	0.21%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	
OTU123	0.05%	0.09%	0.29%	k__Bacteria					
OTU124	0.16%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU125	0.28%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU126	0.00%	0.00%	0.45%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU127	0.59%	0.04%	0.10%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU128	0.03%	0.15%	0.04%	k__Bacteria	p__Actinobacteria				
OTU129	0.23%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU130	0.03%	0.03%	0.33%	k__Bacteria	p__Gemmatimonadetes				
OTU131	0.07%	0.03%	0.24%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU132	0.00%	0.00%	0.34%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU133	0.07%	0.27%	0.14%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU134	0.22%	0.20%	0.29%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU135	0.30%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales	f__Porphyromonadaceae	g__Paludibacter
OTU136	0.05%	0.03%	0.49%	k__Bacteria	p__Actinobacteria				
OTU137	0.01%	0.32%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU138	0.13%	0.01%	0.08%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU139	0.04%	0.04%	0.25%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU140	0.14%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU141	0.31%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia			
OTU142	0.08%	0.16%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Rhizobiaceae	g__Rhizobium
OTU143	0.02%	0.06%	0.08%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU144	0.15%	0.49%	0.08%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU145	0.29%	0.00%	0.09%	k__Bacteria	p__Proteobacteria				
OTU146	0.01%	0.00%	0.27%	k__Bacteria					
OTU147	0.02%	0.19%	0.04%	k__Bacteria					
OTU148	0.12%	0.08%	0.01%	k__Bacteria					
OTU149	0.13%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU150	0.05%	0.07%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Phyllobacteriaceae	
OTU151	0.06%	0.25%	0.21%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU152	0.35%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU153	0.31%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU154	0.04%	0.17%	0.04%	k__Bacteria	p__Proteobacteria				
OTU155	0.00%	0.04%	0.10%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU156	0.01%	0.00%	0.27%	k__Bacteria					
OTU157	0.01%	0.03%	0.21%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU158	0.06%	0.16%	0.19%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU159	0.12%	0.21%	0.01%	k__Bacteria	p__Actinobacteria				
OTU160	0.00%	0.01%	0.17%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU161	0.17%	0.10%	0.31%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	
OTU162	0.22%	0.26%	0.22%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU163	0.02%	0.32%	0.05%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU164	0.00%	0.24%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU165	0.08%	0.07%	0.15%	k__Bacteria					
OTU167	0.18%	0.23%	0.08%	k__Bacteria					
OTU168	0.24%	0.49%	0.10%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Kineosporiaceae	
OTU169	0.12%	0.11%	0.21%	k__Bacteria					
OTU170	0.09%	0.49%	0.25%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU171	0.17%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU172	0.02%	0.02%	0.15%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU173	0.11%	0.05%	0.06%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU174	0.00%	0.26%	0.10%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU175	0.19%	0.11%	0.35%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU176	0.17%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU177	0.11%	0.15%	0.08%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Microbacteriaceae	g__Salinibacterium
OTU178	0.14%	0.00%	0.15%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU179	0.20%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales	f__Porphyromonadaceae	g__Paludibacter
OTU180	0.18%	0.07%	0.26%	k__Bacteria	p__Gemmatimonadetes				
OTU181	0.04%	0.26%	0.05%	k__Bacteria					
OTU182	0.15%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU183	0.09%	0.01%	0.48%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU184	0.01%	0.18%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU185	0.07%	0.10%	0.07%	k__Bacteria	p__Proteobacteria				
OTU186	0.12%	0.50%	0.24%	k__Bacteria	p__Actinobacteria				
OTU187	0.03%	0.15%	0.12%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU188	0.08%	0.25%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU189	0.14%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	g__Saccharofermentans
OTU190	0.31%	0.41%	0.21%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU191	0.11%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU192	0.09%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU193	0.04%	0.06%	0.05%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU194	0.06%	0.02%	0.10%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU195	0.53%	0.35%	0.15%	k__Bacteria	p__Parcubacteria				
OTU196	0.02%	0.03%	0.07%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU197	0.01%	0.00%	0.17%	k__Bacteria	p__Actinobacteria				
OTU198	0.19%	0.07%	0.05%	k__Bacteria	p__Proteobacteria				
OTU199	0.11%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Burkholderiales_incertae_sedis	
OTU200	0.07%	0.05%	0.07%	k__Bacteria					
OTU201	0.02%	0.07%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU202	0.15%	0.00%	0.06%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Acidimicrobiales	f__Acidimicrobiaceae	
OTU203	0.10%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU204	0.11%	0.02%	0.52%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU205	0.01%	0.08%	0.20%	k__Bacteria	p__Actinobacteria				
OTU206	0.09%	0.15%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU207	0.02%	0.12%	0.02%	k__Bacteria	p__Planctomycetes				
OTU208	0.05%	0.09%	0.11%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU209	0.00%	0.14%	0.00%	k__Bacteria					
OTU210	0.10%	0.08%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU211	0.02%	0.16%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU212	0.00%	0.12%	0.00%	k__Bacteria	p__Proteobacteria				
OTU213	0.11%	0.00%	0.11%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU214	0.05%	0.07%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Cryptosporangiaceae	g__Cryptosporangium
OTU215	0.09%	0.01%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU216	0.19%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU217	0.10%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Methylophilales	f__Methylophilaceae	
OTU218	0.03%	0.12%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU219	0.22%	0.01%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU220	0.01%	0.18%	0.05%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU221	0.00%	0.19%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU222	0.14%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1	g__Clostridium_sensu_stricto
OTU223	0.19%	0.03%	0.07%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU224	0.01%	0.00%	0.17%	k__Bacteria					
OTU225	0.13%	0.01%	0.01%	k__Bacteria	p__Proteobacteria				
OTU226	0.12%	0.13%	0.15%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU227	0.10%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	
OTU228	0.00%	0.13%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU229	0.10%	0.00%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU230	0.00%	0.00%	0.15%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales		
OTU231	0.04%	0.29%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU232	0.01%	0.19%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU233	0.02%	0.14%	0.08%	k__Bacteria	p__Actinobacteria				
OTU234	0.01%	0.11%	0.03%	k__Bacteria	p__Actinobacteria				
OTU235	0.16%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU236	0.02%	0.03%	0.25%	k__Bacteria	p__Actinobacteria				
OTU237	0.12%	0.01%	0.07%	k__Bacteria					
OTU238	0.01%	0.18%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU239	0.06%	0.02%	0.04%	k__Bacteria	p__Actinobacteria				
OTU240	0.02%	0.00%	0.12%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Moraxellaceae	
OTU241	0.00%	0.16%	0.00%	k__Bacteria	p__Proteobacteria				
OTU242	0.07%	0.00%	0.00%	k__Bacteria					
OTU243	0.08%	0.00%	0.00%	k__Bacteria					
OTU244	0.00%	0.10%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU245	0.01%	0.08%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU246	0.02%	0.06%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU247	0.05%	0.01%	0.02%	k__Bacteria					
OTU248	0.16%	0.00%	0.00%	k__Bacteria					
OTU249	0.01%	0.21%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU250	0.04%	0.12%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	g__Nocardioides
OTU251	0.01%	0.00%	0.16%	k__Bacteria	p__Actinobacteria				
OTU252	0.10%	0.00%	0.00%	k__Bacteria					
OTU253	0.06%	0.00%	0.00%	k__Bacteria					
OTU254	0.00%	0.20%	0.02%	k__Bacteria	p__Actinobacteria				
OTU255	0.09%	0.02%	0.06%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Methylococcales	f__Methylococcaceae	
OTU256	0.00%	0.00%	0.11%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU257	0.02%	0.01%	0.18%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU258	0.08%	0.06%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU259	0.00%	0.09%	0.03%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU260	0.20%	0.03%	0.09%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU261	0.14%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU262	0.01%	0.12%	0.00%	k__Bacteria	p__Planctomycetes				
OTU263	0.06%	0.22%	0.09%	k__Bacteria	p__Actinobacteria				
OTU264	0.12%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU265	0.05%	0.00%	0.05%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU266	0.15%	0.21%	0.04%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU268	0.00%	0.05%	0.23%	k__Bacteria	p__Bacteroidetes				
OTU269	0.03%	0.00%	0.18%	k__Bacteria	p__Proteobacteria				
OTU270	0.02%	0.00%	0.08%	k__Bacteria	p__Proteobacteria				
OTU271	0.11%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU272	0.16%	0.01%	0.12%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU273	0.00%	0.00%	0.13%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU274	0.02%	0.16%	0.07%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU275	0.04%	0.04%	0.05%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU276	0.03%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes				
OTU277	0.21%	0.08%	0.08%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU278	0.09%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU279	0.08%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU280	0.10%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU281	0.04%	0.20%	0.04%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU282	0.03%	0.09%	0.12%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU283	0.10%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU284	0.04%	0.06%	0.01%	k__Bacteria	p__Planctomycetes				
OTU285	0.02%	0.03%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU286	0.14%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU287	0.09%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU288	0.13%	0.17%	0.23%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU289	0.12%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU290	0.23%	0.01%	0.02%	k__Bacteria	p__Firmicutes	c__Negativicutes	o__Selenomonadales	f__Veillonellaceae	
OTU291	0.03%	0.12%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU292	0.06%	0.00%	0.04%	k__Bacteria	p__Proteobacteria				
OTU293	0.45%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU294	0.39%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales		
OTU295	0.04%	0.08%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU296	0.02%	0.00%	0.18%	k__Bacteria	p__Actinobacteria				
OTU297	0.08%	0.01%	0.09%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU298	0.04%	0.00%	0.16%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU299	0.32%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Gallionellales		
OTU300	0.00%	0.00%	0.14%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU301	0.04%	0.08%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU302	0.15%	0.02%	0.07%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_1	g__Desulfosporosinus
OTU303	0.05%	0.12%	0.07%	k__Bacteria	p__Planctomycetes				
OTU304	0.01%	0.09%	0.11%	k__Bacteria	p__Proteobacteria				
OTU305	0.07%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU306	0.00%	0.04%	0.02%	k__Bacteria	p__Proteobacteria				
OTU307	0.01%	0.03%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp11	g__Gp11		
OTU308	0.01%	0.16%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU309	0.09%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU310	0.02%	0.13%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Xanthobacteraceae	g__Labrys
OTU311	0.04%	0.35%	0.10%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU312	0.03%	0.05%	0.08%	k__Bacteria					
OTU313	0.01%	0.00%	0.15%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU314	0.00%	0.09%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU316	0.06%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales		
OTU317	0.02%	0.04%	0.01%	k__Bacteria					
OTU318	0.09%	0.03%	0.08%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU319	0.03%	0.01%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	g__Marmoricola
OTU320	0.07%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU321	0.06%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU322	0.02%	0.07%	0.00%	k__Bacteria	p__Proteobacteria				
OTU323	0.23%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU324	0.14%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU325	0.08%	0.15%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU326	0.12%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU327	0.00%	0.04%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU328	0.17%	0.00%	0.05%	k__Bacteria					
OTU329	0.10%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales	f__Porphyromonadaceae	g__Paludibacter
OTU330	0.07%	0.02%	0.09%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU331	0.04%	0.02%	0.14%	k__Bacteria	p__Actinobacteria				
OTU332	0.09%	0.00%	0.02%	k__Bacteria					
OTU333	0.07%	0.24%	0.10%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU334	0.09%	0.04%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU335	0.06%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU336	0.00%	0.05%	0.02%	k__Bacteria	p__Actinobacteria				
OTU337	0.04%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU338	0.04%	0.00%	0.00%	k__Bacteria					
OTU339	0.04%	0.00%	0.00%	k__Bacteria					
OTU340	0.07%	0.07%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU341	0.00%	0.00%	0.10%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae	g__Nevskia
OTU342	0.10%	0.04%	0.03%	k__Bacteria	p__Actinobacteria				
OTU343	0.01%	0.10%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae	
OTU344	0.02%	0.06%	0.05%	k__Bacteria	p__candidate_division_WPS-2				
OTU345	0.15%	0.06%	0.41%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU346	0.02%	0.00%	0.09%	k__Bacteria					
OTU347	0.03%	0.00%	0.08%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU348	0.06%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15			
OTU349	0.02%	0.01%	0.04%	k__Bacteria	p__Proteobacteria				
OTU350	0.01%	0.02%	0.12%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU351	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU352	0.09%	0.01%	0.06%	k__Bacteria					
OTU353	0.03%	0.00%	0.07%	k__Bacteria					
OTU354	0.03%	0.00%	0.14%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU355	0.07%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU356	0.15%	0.00%	0.06%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU357	0.00%	0.06%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU358	0.20%	0.05%	0.07%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU359	0.10%	0.06%	0.10%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU360	0.07%	0.07%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU361	0.05%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU362	0.00%	0.00%	0.09%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU363	0.05%	0.00%	0.07%	k__Bacteria	p__Actinobacteria				
OTU364	0.00%	0.04%	0.03%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU365	0.20%	0.03%	0.01%	k__Bacteria	p__Proteobacteria				
OTU366	0.09%	0.18%	0.18%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU367	0.03%	0.17%	0.06%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU368	0.02%	0.03%	0.06%	k__Bacteria	p__Proteobacteria				
OTU369	0.07%	0.08%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU370	0.06%	0.03%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU371	0.13%	0.01%	0.11%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU372	0.12%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Hydrogenophilales	f__Hydrogenophilaceae	g__Thiobacillus
OTU373	0.13%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales		

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU374	0.07%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU375	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU376	0.01%	0.05%	0.05%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU377	0.01%	0.00%	0.10%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU378	0.04%	0.14%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU379	0.04%	0.00%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis		
OTU380	0.03%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		
OTU381	0.04%	0.00%	0.12%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU382	0.06%	0.05%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU383	0.01%	0.11%	0.04%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU384	0.03%	0.00%	0.10%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU385	0.01%	0.00%	0.10%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU386	0.02%	0.11%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU388	0.05%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp18	g__Gp18	
OTU389	0.03%	0.12%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU390	0.02%	0.13%	0.03%	k__Bacteria	p__Bacteroidetes			
OTU391	0.00%	0.06%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU392	0.01%	0.08%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU393	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU394	0.09%	0.02%	0.07%	k__Bacteria	p__Bacteroidetes			
OTU395	0.03%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU396	0.07%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales	
OTU397	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU398	0.01%	0.06%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU399	0.02%	0.03%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU400	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1	
OTU401	0.05%	0.06%	0.05%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU402	0.03%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU403	0.00%	0.00%	0.06%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU404	0.04%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU405	0.05%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU406	0.00%	0.05%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU408	0.04%	0.10%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU410	0.00%	0.05%	0.00%	k__Bacteria				
OTU411	0.09%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU412	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU413	0.00%	0.05%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU414	0.03%	0.06%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU415	0.04%	0.00%	0.00%	k__Bacteria				
OTU416	0.00%	0.04%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU417	0.04%	0.11%	0.05%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU418	0.06%	0.01%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU419	0.05%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU420	0.00%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7	
OTU421	0.04%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU422	0.01%	0.02%	0.09%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales	
OTU423	0.05%	0.12%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU424	0.04%	0.10%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7		
OTU425	0.02%	0.07%	0.08%	k__Bacteria				
OTU426	0.22%	0.12%	0.20%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU427	0.02%	0.00%	0.05%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU428	0.05%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU429	0.01%	0.13%	0.00%	k__Bacteria				
OTU430	0.00%	0.06%	0.00%	k__Bacteria				
OTU431	0.02%	0.03%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU432	0.10%	0.07%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU433	0.03%	0.03%	0.08%	k__Bacteria	p__Verrucomicrobia			
OTU434	0.11%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU436	0.03%	0.05%	0.06%	k__Bacteria				
OTU437	0.05%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae
OTU438	0.01%	0.01%	0.01%	k__Bacteria				
OTU439	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis		
OTU440	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU441	0.02%	0.03%	0.09%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU442	0.04%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU443	0.03%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU444	0.02%	0.09%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU445	0.03%	0.13%	0.02%	k__Bacteria	p__Proteobacteria				
OTU446	0.00%	0.00%	0.03%	k__Bacteria					
OTU447	0.00%	0.00%	0.07%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU448	0.01%	0.01%	0.09%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU449	0.08%	0.01%	0.08%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU450	0.04%	0.00%	0.06%	k__Bacteria					
OTU451	0.03%	0.01%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU453	0.07%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU454	0.00%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU455	0.14%	0.27%	0.12%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU456	0.02%	0.00%	0.06%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU457	0.05%	0.00%	0.00%	k__Bacteria					
OTU458	0.05%	0.00%	0.00%	k__Bacteria					
OTU459	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU460	0.04%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU461	0.01%	0.03%	0.02%	k__Bacteria					
OTU462	0.02%	0.01%	0.03%	k__Bacteria					
OTU463	0.02%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp11	g__Gp11		
OTU464	0.02%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU465	0.05%	0.01%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU466	0.02%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU467	0.02%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU468	0.03%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU469	0.04%	0.04%	0.06%	k__Bacteria					
OTU470	0.09%	0.01%	0.07%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	g__Luteolibacter
OTU471	0.03%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae	
OTU472	0.09%	0.22%	0.14%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU473	0.05%	0.03%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	g__Nocardioides
OTU474	0.03%	0.06%	0.11%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU475	0.00%	0.03%	0.00%	k__Bacteria	p__Parcubacteria				
OTU476	0.06%	0.00%	0.01%	k__Bacteria	p__Parcubacteria				
OTU477	0.06%	0.10%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU478	0.11%	0.04%	0.01%	k__Bacteria	p__Parcubacteria				
OTU479	0.00%	0.04%	0.04%	k__Bacteria	p__Planctomycetes				
OTU480	0.00%	0.05%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU481	0.08%	0.05%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae	
OTU482	0.07%	0.34%	0.13%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU483	0.10%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU484	0.04%	0.05%	0.02%	k__Bacteria					
OTU485	0.01%	0.04%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU486	0.07%	0.00%	0.00%	k__Bacteria					
OTU487	0.02%	0.05%	0.08%	k__Bacteria					
OTU488	0.10%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU489	0.07%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU490	0.00%	0.05%	0.01%	k__Bacteria					
OTU491	0.04%	0.00%	0.01%	k__Bacteria					
OTU492	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU493	0.02%	0.02%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU494	0.03%	0.00%	0.02%	k__Bacteria	p__Actinobacteria				
OTU495	0.02%	0.01%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5		
OTU496	0.02%	0.02%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU497	0.03%	0.06%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU498	0.00%	0.03%	0.05%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU499	0.00%	0.03%	0.02%	k__Bacteria					
OTU500	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU501	0.02%	0.00%	0.01%	k__Bacteria					
OTU503	0.04%	0.06%	0.10%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU504	0.02%	0.02%	0.04%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU505	0.08%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU506	0.08%	0.18%	0.32%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU507	0.06%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU508	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU509	0.09%	0.06%	0.04%	k__Bacteria	p__Parcubacteria				
OTU510	0.05%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU511	0.04%	0.00%	0.11%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU513	0.01%	0.00%	0.00%	k__Bacteria					
OTU514	0.02%	0.02%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU515	0.01%	0.01%	0.04%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU516	0.02%	0.00%	0.14%	k__Bacteria					
OTU517	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU518	0.03%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU519	0.02%	0.00%	0.00%	k__Bacteria					
OTU521	0.01%	0.02%	0.09%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU522	0.05%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU523	0.00%	0.00%	0.09%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU524	0.00%	0.00%	0.08%	k__Bacteria	p__Actinobacteria				
OTU525	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU526	0.01%	0.04%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU527	0.00%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU528	0.02%	0.05%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Phyllobacteriaceae	g__Mesorhizobium
OTU529	0.00%	0.00%	0.02%	k__Bacteria	p__Chloroflexi	c__Caldilineae			
OTU530	0.04%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU531	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU532	0.07%	0.07%	0.16%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU533	0.04%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU534	0.02%	0.01%	0.07%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU535	0.03%	0.02%	0.03%	k__Bacteria					
OTU536	0.00%	0.00%	0.02%	k__Bacteria	p__Armatimonadetes	c__Fimbriimonadia			
OTU538	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU539	0.01%	0.00%	0.05%	k__Bacteria	p__Actinobacteria				
OTU540	0.03%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU541	0.04%	0.01%	0.04%	k__Bacteria	p__Chloroflexi				
OTU542	0.03%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Negativicutes			
OTU543	0.00%	0.06%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Burkholderiaceae	
OTU544	0.03%	0.05%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU545	0.01%	0.04%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU546	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU547	0.02%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU548	0.09%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU549	0.06%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU550	0.06%	0.03%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	g__Opitutus
OTU551	0.01%	0.04%	0.01%	k__Bacteria	p__Verrucomicrobia				
OTU552	0.02%	0.00%	0.00%	k__Bacteria					
OTU553	0.04%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU556	0.05%	0.00%	0.08%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU558	0.01%	0.02%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU559	0.04%	0.02%	0.01%	k__Bacteria					
OTU560	0.02%	0.03%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU561	0.15%	0.01%	0.05%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU562	0.06%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae	
OTU563	0.01%	0.03%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU564	0.03%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU565	0.03%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Propionibacteriaceae	
OTU566	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU567	0.02%	0.00%	0.00%	k__Bacteria					
OTU568	0.00%	0.08%	0.00%	k__Bacteria	p__Parcubacteria				
OTU569	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU570	0.09%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	
OTU571	0.01%	0.08%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU572	0.05%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU573	0.00%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU574	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU575	0.02%	0.00%	0.01%	k__Bacteria					
OTU576	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria				
OTU577	0.01%	0.00%	0.00%	k__Bacteria					
OTU578	0.01%	0.03%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU579	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU580	0.02%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU581	0.03%	0.00%	0.02%	k__Bacteria	p__Gemmatimonadetes				
OTU582	0.05%	0.10%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU583	0.00%	0.02%	0.02%	k__Bacteria					
OTU584	0.03%	0.07%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	g__Sphingomonas
OTU585	0.03%	0.02%	0.05%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU587	0.01%	0.08%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU588	0.04%	0.03%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22	g__Gp22		
OTU589	0.02%	0.02%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU590	0.06%	0.00%	0.00%	k__Bacteria					
OTU591	0.02%	0.04%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU592	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Bradyrhizobiaceae	g__Bosea
OTU593	0.02%	0.02%	0.06%	k__Bacteria					
OTU594	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae	
OTU595	0.00%	0.00%	0.06%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU596	0.01%	0.00%	0.06%	k__Bacteria					
OTU599	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU600	0.00%	0.03%	0.01%	k__Bacteria	p__Planctomycetes				
OTU601	0.01%	0.05%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5		
OTU602	0.00%	0.06%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU603	0.00%	0.04%	0.02%	k__Bacteria					
OTU604	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU605	0.00%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU606	0.05%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU607	0.08%	0.10%	0.06%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae	g__Rhizobacter
OTU608	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU609	0.02%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU610	0.02%	0.00%	0.00%	k__Bacteria					
OTU611	0.00%	0.00%	0.02%	k__Bacteria	p__Gemmatimonadetes				
OTU612	0.02%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Lachnospiraceae	g__Clostridium_XlVa
OTU613	0.02%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU614	0.01%	0.09%	0.02%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU615	0.03%	0.00%	0.02%	k__Bacteria					
OTU616	0.05%	0.02%	0.01%	k__Bacteria	p__candidate_division_WPS-2				
OTU617	0.02%	0.00%	0.03%	k__Bacteria					
OTU618	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU619	0.06%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU620	0.05%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU621	0.01%	0.05%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU622	0.01%	0.02%	0.03%	k__Bacteria	p__Actinobacteria				
OTU623	0.04%	0.00%	0.01%	k__Bacteria					
OTU624	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU625	0.04%	0.00%	0.00%	k__Bacteria					
OTU626	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU627	0.05%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae	g__Steroidobacter
OTU628	0.01%	0.00%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU629	0.12%	0.45%	0.21%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU630	0.03%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU631	0.03%	0.03%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU632	0.01%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU633	0.03%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes				
OTU634	0.00%	0.06%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU635	0.01%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU636	0.02%	0.01%	0.03%	k__Bacteria					
OTU637	0.06%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU638	0.01%	0.07%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU639	0.02%	0.00%	0.00%	k__Bacteria					
OTU640	0.03%	0.01%	0.19%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU641	0.02%	0.00%	0.00%	k__Bacteria					
OTU642	0.02%	0.00%	0.00%	k__Bacteria					
OTU643	0.02%	0.00%	0.00%	k__Bacteria					
OTU644	0.00%	0.00%	0.01%	k__Bacteria					
OTU645	0.07%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU646	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU647	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU648	0.02%	0.14%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU649	0.00%	0.04%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU650	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU651	0.01%	0.03%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	g__Flavitalea
OTU652	0.13%	0.09%	0.10%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae	g__Gaiella
OTU653	0.02%	0.00%	0.00%	k__Bacteria					
OTU654	0.02%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU655	0.04%	0.03%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU656	0.00%	0.05%	0.00%	k__Bacteria					
OTU657	0.00%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU658	0.04%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU659	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU660	0.00%	0.02%	0.00%	k__Bacteria					
OTU661	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU662	0.06%	0.04%	0.11%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU663	0.01%	0.02%	0.01%	k__Bacteria	p__Acidobacteria				
OTU664	0.03%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales		
OTU665	0.03%	0.01%	0.02%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU666	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU667	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU668	0.03%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU669	0.02%	0.04%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU670	0.01%	0.02%	0.00%	k__Bacteria	p__Planctomycetes				
OTU671	0.16%	0.19%	0.27%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU672	0.04%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17			
OTU673	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU674	0.00%	0.05%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU675	0.02%	0.05%	0.06%	k__Bacteria					
OTU676	0.03%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU677	0.00%	0.00%	0.03%	k__Bacteria	p__Actinobacteria				
OTU678	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU680	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU681	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU682	0.01%	0.08%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU685	0.05%	0.19%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU686	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU687	0.03%	0.02%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU689	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU690	0.01%	0.01%	0.02%	k__Bacteria	p__Verrucomicrobia				
OTU691	0.00%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU692	0.01%	0.04%	0.01%	k__Bacteria	p__Planctomycetes				
OTU693	0.05%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU694	0.03%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU695	0.05%	0.02%	0.05%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU696	0.01%	0.02%	0.01%	k__Bacteria	p__Actinobacteria				
OTU697	0.02%	0.03%	0.05%	k__Bacteria	p__Acidobacteria				
OTU698	0.02%	0.02%	0.01%	k__Bacteria					
OTU699	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU700	0.02%	0.03%	0.01%	k__Bacteria	p__Chloroflexi				
OTU702	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU703	0.00%	0.01%	0.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	
OTU704	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU705	0.01%	0.01%	0.02%	k__Bacteria					
OTU706	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Propionibacteriaceae	
OTU707	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU708	0.02%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU709	0.06%	0.00%	0.03%	k__Bacteria	p__Planctomycetes				
OTU710	0.00%	0.03%	0.01%	k__Bacteria					
OTU711	0.02%	0.00%	0.00%	k__Bacteria					
OTU712	0.01%	0.05%	0.02%	k__Bacteria	p__Actinobacteria				
OTU713	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU714	0.11%	0.07%	0.09%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU715	0.00%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU716	0.01%	0.03%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU717	0.01%	0.04%	0.02%	k__Bacteria	p__Actinobacteria				
OTU718	0.00%	0.06%	0.00%	k__Bacteria	p__Actinobacteria				
OTU719	0.02%	0.03%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU720	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU721	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales	f__Rhodobacteraceae	
OTU722	0.00%	0.02%	0.00%	k__Bacteria					
OTU723	0.00%	0.00%	0.02%	k__Bacteria					
OTU724	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU725	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales		
OTU726	0.00%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU727	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU729	0.02%	0.00%	0.00%	k__Bacteria					
OTU730	0.01%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU731	0.02%	0.00%	0.00%	k__Bacteria					
OTU732	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU733	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU734	0.04%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU735	0.00%	0.04%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU736	0.00%	0.00%	0.02%	k__Bacteria					
OTU737	0.00%	0.02%	0.00%	k__Bacteria					
OTU738	0.01%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU739	0.04%	0.00%	0.00%	k__Bacteria					
OTU740	0.00%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU741	0.01%	0.02%	0.09%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU742	0.03%	0.01%	0.01%	k__Bacteria					
OTU743	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU744	0.03%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU745	0.03%	0.03%	0.04%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU746	0.02%	0.00%	0.03%	k__Bacteria	p__Actinobacteria				
OTU747	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU748	0.02%	0.00%	0.03%	k__Bacteria	p__Proteobacteria				
OTU749	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU750	0.00%	0.00%	0.04%	k__Bacteria					
OTU752	0.02%	0.25%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU753	0.01%	0.00%	0.00%	k__Bacteria					
OTU754	0.01%	0.00%	0.00%	k__Bacteria					
OTU755	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp25			
OTU757	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU758	0.01%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU759	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU760	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU761	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	g__Mucilaginibacter
OTU762	0.00%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU763	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU764	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU765	0.00%	0.02%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU766	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU767	0.03%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU768	0.01%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU769	0.00%	0.07%	0.01%	k__Bacteria	p__Planctomycetes				
OTU770	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU771	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU773	0.00%	0.02%	0.00%	k__Bacteria					
OTU774	0.02%	0.00%	0.00%	k__Bacteria					
OTU775	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU776	0.03%	0.09%	0.07%	k__Bacteria	p__Proteobacteria			
OTU777	0.01%	0.01%	0.02%	k__Bacteria				
OTU778	0.04%	0.03%	0.02%	k__Bacteria				
OTU779	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU780	0.00%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	
OTU781	0.00%	0.01%	0.02%	k__Bacteria				
OTU782	0.02%	0.03%	0.20%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU783	0.02%	0.01%	0.03%	k__Bacteria				
OTU784	0.02%	0.01%	0.02%	k__Bacteria				
OTU785	0.00%	0.00%	0.01%	k__Bacteria				
OTU786	0.01%	0.00%	0.00%	k__Bacteria				
OTU788	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15	
OTU789	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU790	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU791	0.03%	0.01%	0.03%	k__Bacteria	p__Gemmatimonadetes			
OTU792	0.00%	0.04%	0.01%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	
OTU793	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU794	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU795	0.01%	0.00%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU796	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU797	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU798	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5		
OTU799	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU800	0.01%	0.00%	0.00%	k__Bacteria				
OTU801	0.01%	0.02%	0.02%	k__Bacteria	p__Bacteroidetes			
OTU802	0.02%	0.02%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU804	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales	f__Rhodobacteraceae
OTU805	0.00%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU806	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Planococcaceae
OTU807	0.09%	0.06%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU808	0.01%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU809	0.01%	0.00%	0.01%	k__Bacteria				
OTU811	0.01%	0.01%	0.03%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU812	0.00%	0.01%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU813	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU814	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU815	0.00%	0.04%	0.00%	k__Bacteria	p__Planctomycetes			
OTU816	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	
OTU817	0.01%	0.00%	0.00%	k__Bacteria				
OTU820	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU821	0.01%	0.00%	0.00%	k__Bacteria				
OTU822	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU823	0.03%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU824	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU825	0.04%	0.53%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU826	0.01%	0.00%	0.01%	k__Bacteria				
OTU827	0.01%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes			
OTU828	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15	
OTU829	0.03%	0.00%	0.00%	k__Bacteria	p__Aminicenantes			
OTU830	0.05%	0.00%	0.00%	k__Bacteria	p__Ignavibacteriae	c__Ignavibacteria		
OTU831	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU832	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU833	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU834	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Geodermatophilaceae
OTU835	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales	f__Syntrophaceae
OTU836	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU837	0.04%	0.02%	0.01%	k__Bacteria	p__Proteobacteria			
OTU838	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU839	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU840	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU841	0.02%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU842	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU843	0.02%	0.00%	0.00%	k__Bacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU844	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	g__Roseomonas
OTU845	0.00%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU846	0.02%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Pseudonocardiaceae	g__Pseudonocardia
OTU848	0.00%	0.02%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU849	0.03%	0.03%	0.01%	k__Bacteria					
OTU850	0.01%	0.02%	0.02%	k__Bacteria	p__Actinobacteria				
OTU851	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes				
OTU852	0.02%	0.06%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU853	0.01%	0.03%	0.00%	k__Bacteria	p__Planctomycetes				
OTU854	0.00%	0.02%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU855	0.07%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bacteriovoracaceae	g__Bacteriovorax
OTU856	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes				
OTU857	0.03%	0.11%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU858	0.06%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	g__Janthinobacterium
OTU859	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU860	0.01%	0.06%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU861	0.02%	0.01%	0.00%	k__Bacteria					
OTU862	0.01%	0.00%	0.01%	k__Bacteria					
OTU863	0.01%	0.00%	0.01%	k__Bacteria					
OTU864	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU865	0.00%	0.02%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU866	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU867	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU868	0.04%	0.00%	0.02%	k__Bacteria					
OTU869	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU870	0.03%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales	f__Anaerolineaceae	
OTU871	0.02%	0.01%	0.04%	k__Bacteria	p__Actinobacteria				
OTU872	0.02%	0.01%	0.02%	k__Bacteria	p__Planctomycetes				
OTU873	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria				
OTU874	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU877	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Rhizobiaceae	g__Rhizobium
OTU878	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2			
OTU879	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Hyphomonadaceae	g__Hyphomonas
OTU880	0.01%	0.03%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU881	0.02%	0.00%	0.00%	k__Bacteria					
OTU882	0.03%	0.00%	0.06%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU883	0.02%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU884	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU885	0.01%	0.04%	0.02%	k__Bacteria					
OTU886	0.00%	0.03%	0.00%	k__Bacteria					
OTU887	0.03%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU888	0.03%	0.02%	0.00%	k__Bacteria					
OTU889	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU890	0.04%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU891	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU892	0.02%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU894	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU895	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU896	0.02%	0.02%	0.06%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU897	0.00%	0.08%	0.03%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU898	0.01%	0.00%	0.00%	k__Bacteria					
OTU899	0.01%	0.02%	0.02%	k__Bacteria					
OTU900	0.00%	0.10%	0.01%	k__Bacteria	p__Proteobacteria				
OTU901	0.07%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU902	0.03%	0.00%	0.00%	k__Bacteria					
OTU903	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU904	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU905	0.00%	0.06%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU906	0.02%	0.03%	0.14%	k__Bacteria					
OTU907	0.09%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU908	0.01%	0.00%	0.00%	k__Bacteria					
OTU909	0.00%	0.02%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU910	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU911	0.09%	0.02%	0.14%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU912	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU913	0.01%	0.02%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU914	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU915	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae				
OTU916	0.01%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU917	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria				
OTU918	0.02%	0.03%	0.04%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU919	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae	
OTU920	0.02%	0.02%	0.03%	k__Bacteria					
OTU921	0.00%	0.02%	0.00%	k__Bacteria	p__Planctomycetes				
OTU922	0.02%	0.00%	0.00%	k__Bacteria					
OTU923	0.01%	0.03%	0.06%	k__Bacteria					
OTU924	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae	g__Geothrix
OTU926	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria				
OTU927	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU928	0.02%	0.02%	0.02%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	g__Gemmatimonas
OTU930	0.01%	0.04%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU931	0.01%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU932	0.02%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU933	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU934	0.08%	0.13%	0.19%	k__Bacteria	p__Actinobacteria				
OTU936	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU937	0.01%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU938	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10	g__Gp10		
OTU939	0.00%	0.01%	0.01%	k__Bacteria	p__Planctomycetes				
OTU941	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU942	0.00%	0.00%	0.04%	k__Bacteria	p__Proteobacteria				
OTU943	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU944	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU945	0.01%	0.06%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU946	0.07%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU947	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU948	0.03%	0.00%	0.00%	k__Bacteria					
OTU949	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17			
OTU950	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	
OTU951	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU952	0.00%	0.00%	0.00%	k__Bacteria					
OTU953	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU955	0.02%	0.00%	0.00%	k__Bacteria					
OTU956	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU957	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU958	0.00%	0.01%	0.02%	k__Bacteria					
OTU959	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU960	0.01%	0.00%	0.00%	k__Bacteria					
OTU963	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU964	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU965	0.00%	0.02%	0.00%	k__Bacteria					
OTU966	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU967	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU968	0.00%	0.00%	0.00%	k__Bacteria					
OTU969	0.02%	0.00%	0.00%	k__Bacteria					
OTU970	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU971	0.01%	0.03%	0.01%	k__Bacteria					
OTU972	0.00%	0.02%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU973	0.01%	0.00%	0.01%	k__Bacteria					
OTU974	0.02%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU975	0.01%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU976	0.02%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	g__Brevundimonas
OTU977	0.03%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU978	0.01%	0.00%	0.01%	k__Bacteria					
OTU979	0.00%	0.00%	0.01%	k__Bacteria	p__Chloroflexi	c__Caldilineae			
OTU981	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU982	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU983	0.00%	0.00%	0.00%	k__Bacteria					
OTU984	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU985	0.00%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU987	0.01%	0.02%	0.01%	k__Bacteria					
OTU988	0.00%	0.01%	0.05%	k__Bacteria	p__Actinobacteria				
OTU990	0.00%	0.01%	0.01%	k__Bacteria					
OTU991	0.01%	0.05%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU993	0.03%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU994	0.02%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU995	0.01%	0.00%	0.00%	k__Bacteria					
OTU997	0.02%	0.00%	0.00%	k__Bacteria					
OTU998	0.00%	0.02%	0.01%	k__Bacteria	p__BRC1				
OTU999	0.00%	0.00%	0.02%	k__Bacteria					
OTU1000	0.02%	0.01%	0.01%	k__Bacteria	p__Gemmatimonadetes				
OTU1001	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU1003	0.02%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1004	0.02%	0.00%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU1006	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria				
OTU1007	0.05%	0.00%	0.02%	k__Bacteria	p__Proteobacteria				
OTU1008	0.06%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU1009	0.00%	0.02%	0.00%	k__Bacteria					
OTU1010	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1011	0.01%	0.00%	0.00%	k__Bacteria					
OTU1012	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU1013	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1014	0.01%	0.02%	0.01%	k__Bacteria					
OTU1015	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1016	0.00%	0.03%	0.02%	k__Bacteria	p__Gemmatimonadetes				
OTU1017	0.00%	0.01%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU1018	0.01%	0.00%	0.00%	k__Bacteria					
OTU1019	0.04%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1020	0.01%	0.00%	0.01%	k__Bacteria					
OTU1022	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp18	g__Gp18		
OTU1023	0.01%	0.00%	0.00%	k__Bacteria					
OTU1024	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1025	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Propionibacteriaceae	
OTU1026	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1028	0.02%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	g__Nocardioides
OTU1029	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1030	0.01%	0.02%	0.02%	k__Bacteria					
OTU1031	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1032	0.01%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1033	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1035	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1036	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU1037	0.02%	0.00%	0.00%	k__Bacteria					
OTU1038	0.00%	0.01%	0.00%	k__Bacteria					
OTU1039	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1040	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1041	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1042	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1043	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	
OTU1044	0.00%	0.09%	0.01%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales		
OTU1045	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1046	0.00%	0.01%	0.00%	k__Bacteria					
OTU1047	0.01%	0.08%	0.07%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1048	0.03%	0.00%	0.01%	k__Bacteria					
OTU1049	0.06%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1050	0.03%	0.02%	0.06%	k__Bacteria					
OTU1051	0.01%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1052	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1053	0.00%	0.01%	0.03%	k__Bacteria	p__Latescibacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1054	0.00%	0.03%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15		
OTU1055	0.01%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1056	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1057	0.03%	0.00%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU1058	0.00%	0.03%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1059	0.00%	0.00%	0.02%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1060	0.00%	0.00%	0.00%	k__Bacteria					
OTU1061	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1062	0.02%	0.00%	0.00%	k__Bacteria					
OTU1063	0.01%	0.00%	0.00%	k__Bacteria					
OTU1064	0.03%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	
OTU1065	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU1066	0.04%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU1067	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1068	0.01%	0.02%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1069	0.00%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1070	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU1071	0.01%	0.04%	0.01%	k__Bacteria	p__Acidobacteria				
OTU1072	0.00%	0.01%	0.00%	k__Bacteria					
OTU1073	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1074	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1075	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	
OTU1076	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1077	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU1078	0.00%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU1079	0.00%	0.03%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1080	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1081	0.02%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1082	0.02%	0.02%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1083	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU1084	0.02%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU1085	0.00%	0.04%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1086	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1087	0.01%	0.00%	0.00%	k__Bacteria					
OTU1088	0.01%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Cytophaga
OTU1089	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1090	0.00%	0.00%	0.01%	k__Bacteria					
OTU1091	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1092	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1093	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU1094	0.01%	0.00%	0.00%	k__Bacteria					
OTU1095	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU1096	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1097	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1098	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes				
OTU1099	0.02%	0.00%	0.00%	k__Bacteria					
OTU1100	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis	g__Ohtaekwangia		
OTU1101	0.00%	0.03%	0.02%	k__Bacteria	p__Armatimonadetes				
OTU1102	0.02%	0.00%	0.03%	k__Bacteria					
OTU1104	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1105	0.01%	0.01%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1106	0.05%	0.00%	0.04%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Eubacteriaceae	g__Acetobacterium
OTU1107	0.00%	0.00%	0.00%	k__Bacteria					
OTU1108	0.01%	0.01%	0.01%	k__Bacteria					
OTU1109	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1110	0.01%	0.00%	0.00%	k__Bacteria					
OTU1111	0.00%	0.01%	0.01%	k__Bacteria					
OTU1112	0.04%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp2			
OTU1113	0.00%	0.02%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1114	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1115	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1116	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1117	0.01%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1119	0.01%	0.00%	0.00%	k__Bacteria					
OTU1120	0.00%	0.00%	0.01%	k__Bacteria					
OTU1121	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU1122	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU1123	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1124	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1125	0.01%	0.00%	0.01%	k__Bacteria					
OTU1126	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia			
OTU1127	0.01%	0.00%	0.00%	k__Bacteria					
OTU1128	0.00%	0.01%	0.02%	k__Bacteria	p__Proteobacteria				
OTU1129	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU1130	0.02%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1131	0.02%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU1132	0.01%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1133	0.01%	0.00%	0.00%	k__Bacteria					
OTU1134	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU1135	0.01%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1136	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bdellovibrionaceae	g__Bdellovibrio
OTU1137	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1140	0.00%	0.00%	0.00%	k__Bacteria					
OTU1141	0.00%	0.02%	0.01%	k__Bacteria					
OTU1142	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU1143	0.00%	0.02%	0.00%	k__Bacteria					
OTU1144	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1145	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU1146	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1147	0.01%	0.02%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU1148	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU1149	0.01%	0.00%	0.00%	k__Bacteria					
OTU1150	0.00%	0.01%	0.00%	k__Bacteria					
OTU1151	0.10%	0.04%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales	f__Rhodobacteraceae	
OTU1152	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU1153	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU1154	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1156	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1157	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1158	0.01%	0.02%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1159	0.01%	0.01%	0.01%	k__Bacteria					
OTU1160	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU1161	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU1162	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1163	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1164	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1165	0.00%	0.01%	0.02%	k__Bacteria	p__Bacteroidetes				
OTU1166	0.04%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	g__Sphingomonas
OTU1167	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU1168	0.01%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1169	0.00%	0.00%	0.00%	k__Bacteria					
OTU1170	0.01%	0.03%	0.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU1172	0.01%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU1173	0.07%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes				
OTU1174	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU1175	0.04%	0.04%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU1176	0.00%	0.01%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU1177	0.00%	0.00%	0.01%	k__Bacteria					
OTU1178	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1179	0.01%	0.00%	0.01%	k__Bacteria					
OTU1180	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1181	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1182	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU1183	0.00%	0.02%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1184	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1185	0.00%	0.01%	0.04%	k__Bacteria	p__Actinobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1186	0.00%	0.01%	0.01%	k__Bacteria					
OTU1187	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1188	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU1189	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales		
OTU1190	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Alphaproteobacteria_incertae_sedis	g__Rhizomicrobium	
OTU1191	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1192	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1193	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1194	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1195	0.01%	0.00%	0.00%	k__Bacteria					
OTU1196	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1197	0.00%	0.03%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1198	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU1199	0.01%	0.02%	0.02%	k__Bacteria					
OTU1200	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1202	0.03%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU1203	0.00%	0.03%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU1204	0.01%	0.00%	0.00%	k__Bacteria					
OTU1205	0.13%	0.06%	0.05%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales		
OTU1206	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1207	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU1208	0.00%	0.00%	0.01%	k__Bacteria					
OTU1209	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1210	0.00%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1211	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1213	0.01%	0.03%	0.01%	k__Bacteria	p__Planctomycetes				
OTU1214	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1215	0.00%	0.00%	0.00%	k__Bacteria					
OTU1216	0.00%	0.00%	0.00%	k__Bacteria					
OTU1217	0.01%	0.00%	0.00%	k__Bacteria					
OTU1218	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU1219	0.00%	0.00%	0.00%	k__Bacteria					
OTU1220	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU1221	0.01%	0.00%	0.12%	k__Bacteria	p__Proteobacteria				
OTU1222	0.03%	0.00%	0.00%	k__Bacteria					
OTU1223	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU1224	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU1225	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU1226	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1227	0.00%	0.01%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1228	0.00%	0.00%	0.01%	k__Bacteria					
OTU1230	0.02%	0.00%	0.00%	k__Bacteria					
OTU1231	0.01%	0.00%	0.00%	k__Bacteria					
OTU1232	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU1233	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1234	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1235	0.03%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU1236	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1237	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	g__Legionella
OTU1238	0.00%	0.00%	0.01%	k__Bacteria	p__Ignavibacteriae	c__Ignavibacteria	o__Ignavibacteriales	f__Ignavibacteriaceae	g__Ignavibacterium
OTU1239	0.00%	0.00%	0.00%	k__Bacteria					
OTU1240	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1241	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU1242	0.01%	0.05%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1243	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1244	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1245	0.00%	0.00%	0.00%	k__Bacteria					
OTU1246	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1247	0.00%	0.03%	0.01%	k__Bacteria					
OTU1248	0.00%	0.00%	0.00%	k__Bacteria					
OTU1249	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1250	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales		
OTU1251	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1252	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU1253	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1254	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1255	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1256	0.11%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU1257	0.00%	0.03%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1258	0.00%	0.00%	0.00%	k__Bacteria					
OTU1260	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1261	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1262	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1263	0.00%	0.01%	0.00%	k__Bacteria					
OTU1264	0.01%	0.00%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1265	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1266	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Cryomorphaceae	g__Fluviicola
OTU1267	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1268	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales	f__Anaerolineaceae	
OTU1269	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1270	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1271	0.00%	0.02%	0.00%	k__Bacteria	p__Chloroflexi	c__Caldilineae			
OTU1272	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1273	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1274	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1275	0.01%	0.00%	0.00%	k__Bacteria					
OTU1276	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1278	0.00%	0.00%	0.00%	k__Bacteria					
OTU1279	0.02%	0.10%	0.07%	k__Bacteria					
OTU1280	0.01%	0.00%	0.00%	k__Bacteria					
OTU1281	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU1282	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1283	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1284	0.02%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU1285	0.01%	0.00%	0.00%	k__Bacteria					
OTU1286	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria				
OTU1287	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1288	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1289	0.01%	0.00%	0.00%	k__Bacteria					
OTU1290	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1291	0.01%	0.04%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU1292	0.00%	0.01%	0.00%	k__Bacteria					
OTU1293	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1295	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales		
OTU1296	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1297	0.02%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1298	0.00%	0.00%	0.00%	k__Bacteria					
OTU1299	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1300	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1301	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU1302	0.00%	0.00%	0.00%	k__Bacteria					
OTU1303	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU1304	0.10%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1305	0.00%	0.01%	0.00%	k__Bacteria					
OTU1306	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1307	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1308	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1309	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1310	0.00%	0.00%	0.00%	k__Bacteria					
OTU1311	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1313	0.00%	0.00%	0.00%	k__Bacteria					
OTU1314	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1315	0.00%	0.01%	0.00%	k__Bacteria					
OTU1316	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1317	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1318	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1319	0.01%	0.00%	0.00%	k__Bacteria					
OTU1320	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU1321	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1322	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1323	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1324	0.00%	0.01%	0.01%	k__Bacteria					
OTU1326	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU1327	0.00%	0.00%	0.01%	k__Bacteria					
OTU1328	0.00%	0.00%	0.00%	k__Bacteria					
OTU1329	0.05%	0.00%	0.00%	k__Bacteria					
OTU1330	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1331	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU1332	0.02%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1333	0.00%	0.00%	0.00%	k__Bacteria					
OTU1334	0.00%	0.01%	0.00%	k__Bacteria					
OTU1335	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1336	0.01%	0.00%	0.00%	k__Bacteria					
OTU1337	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1338	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1339	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1340	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU1341	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1342	0.00%	0.02%	0.00%	k__Bacteria					
OTU1343	0.05%	0.00%	0.53%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU1344	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1345	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1346	0.02%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1347	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1348	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1349	0.10%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1350	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU1351	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU1352	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1353	0.01%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1354	0.00%	0.00%	0.00%	k__Bacteria					
OTU1356	0.03%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes				
OTU1357	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1358	0.00%	0.00%	0.00%	k__Bacteria					
OTU1359	0.02%	0.00%	0.00%	k__Bacteria					
OTU1360	0.00%	0.00%	0.00%	k__Bacteria					
OTU1361	0.02%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Pseudonocardiaceae	
OTU1362	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1363	0.01%	0.00%	0.01%	k__Bacteria					
OTU1364	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1365	0.00%	0.00%	0.00%	k__Bacteria					
OTU1366	0.00%	0.02%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1367	0.00%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1368	0.00%	0.02%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Bacillaceae_1	g__Bacillus
OTU1369	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales		
OTU1370	0.01%	0.00%	0.02%	k__Bacteria	p__Gemmatimonadetes				
OTU1371	0.00%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1372	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1373	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1374	0.02%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Streptomycetaceae	g__Streptomyces
OTU1375	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1376	0.01%	0.00%	0.00%	k__Bacteria					
OTU1377	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1378	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1379	0.00%	0.00%	0.00%	k__Bacteria					
OTU1380	0.00%	0.09%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1382	0.00%	0.01%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1383	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1384	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU1386	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU1387	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU1388	0.01%	0.03%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae		
OTU1389	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1391	0.00%	0.00%	0.00%	k__Bacteria				
OTU1392	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria			
OTU1394	0.00%	0.00%	0.00%	k__Bacteria				
OTU1395	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Negativicutes	o__Selenomonadales	f__Veillonellaceae
OTU1396	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Methylococcales	
OTU1397	0.00%	0.00%	0.01%	k__Bacteria				
OTU1398	0.03%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU1399	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU1400	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU1401	0.01%	0.00%	0.00%	k__Bacteria				
OTU1402	0.00%	0.00%	0.02%	k__Bacteria				
OTU1404	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU1405	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15		
OTU1406	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1407	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU1408	0.02%	0.00%	0.00%	k__Bacteria				
OTU1409	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU1410	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU1411	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1412	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU1413	0.01%	0.00%	0.00%	k__Bacteria				
OTU1414	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU1415	0.00%	0.02%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU1416	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1417	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1418	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU1419	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU1421	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU1422	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU1423	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU1425	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1426	0.00%	0.00%	0.00%	k__Bacteria				
OTU1427	0.01%	0.00%	0.00%	k__Bacteria				
OTU1428	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU1429	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU1430	0.00%	0.00%	0.00%	k__Bacteria				
OTU1431	0.01%	0.00%	0.00%	k__Bacteria				
OTU1432	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1433	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1434	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1435	0.01%	0.00%	0.00%	k__Bacteria				
OTU1436	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU1437	0.00%	0.00%	0.03%	k__Bacteria	p__Acidobacteria			
OTU1438	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU1439	0.04%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU1440	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU1441	0.01%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU1442	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales	
OTU1443	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1444	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU1445	0.00%	0.01%	0.08%	k__Bacteria	p__Actinobacteria			
OTU1446	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1447	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU1448	0.00%	0.00%	0.00%	k__Bacteria				
OTU1449	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU1450	0.02%	0.00%	0.00%	k__Bacteria				
OTU1451	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes			
OTU1452	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU1453	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1454	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1455	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1456	0.01%	0.00%	0.00%	k__Bacteria					
OTU1457	0.02%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU1458	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	g__Nocardioides
OTU1459	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1460	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1461	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU1462	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1463	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5			
OTU1464	0.01%	0.00%	0.00%	k__Bacteria					
OTU1466	0.00%	0.00%	0.02%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU1467	0.01%	0.00%	0.02%	k__Bacteria	p__Gemmatimonadetes				
OTU1468	0.00%	0.00%	0.00%	k__Bacteria					
OTU1469	0.00%	0.02%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1470	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	g__Legionella
OTU1471	0.01%	0.01%	0.03%	k__Bacteria	p__Acidobacteria				
OTU1473	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1474	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia	o__Armatimonadales		
OTU1475	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU1476	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU1477	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1478	0.01%	0.00%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU1479	0.02%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1480	0.00%	0.00%	0.00%	k__Bacteria					
OTU1481	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1483	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1484	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU1485	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1486	0.00%	0.00%	0.00%	k__Bacteria					
OTU1487	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU1488	0.00%	0.00%	0.00%	k__Bacteria					
OTU1490	0.00%	0.00%	0.00%	k__Bacteria					
OTU1491	0.01%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1492	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1493	0.00%	0.03%	0.01%	k__Bacteria					
OTU1494	0.09%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1495	0.00%	0.00%	0.00%	k__Bacteria					
OTU1496	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1497	0.03%	0.00%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1498	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1499	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1500	0.00%	0.00%	0.00%	k__Bacteria					
OTU1501	0.02%	0.00%	0.00%	k__Bacteria					
OTU1503	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1505	0.00%	0.00%	0.00%	k__Bacteria					
OTU1506	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1507	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1508	0.03%	0.02%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1509	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1510	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1511	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-2				
OTU1512	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU1513	0.00%	0.02%	0.00%	k__Bacteria					
OTU1514	0.00%	0.00%	0.00%	k__Bacteria					
OTU1515	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1516	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1518	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU1519	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1520	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1522	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU1523	0.00%	0.08%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU1524	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1525	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1526	0.01%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1527	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1528	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1529	0.01%	0.00%	0.01%	k__Bacteria					
OTU1530	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU1533	0.01%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1535	0.00%	0.00%	0.00%	k__Bacteria					
OTU1536	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU1537	0.01%	0.00%	0.00%	k__Bacteria					
OTU1538	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1539	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1540	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1542	0.00%	0.01%	0.00%	k__Bacteria					
OTU1543	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU1544	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1545	0.01%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU1546	0.01%	0.00%	0.00%	k__Bacteria					
OTU1547	0.01%	0.00%	0.00%	k__Bacteria	p__Fibrobacteres	c__Fibrobacteria			
OTU1548	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1549	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU1550	0.01%	0.04%	0.10%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU1551	0.00%	0.01%	0.01%	k__Bacteria					
OTU1552	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia				
OTU1553	0.00%	0.00%	0.00%	k__Bacteria					
OTU1554	0.01%	0.00%	0.00%	k__Bacteria					
OTU1555	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1556	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1557	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU1558	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1559	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU1560	0.00%	0.00%	0.00%	k__Bacteria					
OTU1561	0.02%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-2				
OTU1563	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1564	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1565	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1566	0.00%	0.01%	0.00%	k__Bacteria					
OTU1567	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1569	0.01%	0.00%	0.01%	k__Bacteria					
OTU1570	0.00%	0.00%	0.01%	k__Bacteria					
OTU1571	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1572	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1573	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1574	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria				
OTU1575	0.01%	0.00%	0.05%	k__Bacteria					
OTU1576	0.00%	0.00%	0.00%	k__Bacteria					
OTU1577	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bdellovibrionaceae	g__Bdellovibrio
OTU1578	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU1581	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1582	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1583	0.01%	0.00%	0.00%	k__Bacteria					
OTU1585	0.03%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU1586	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1587	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU1588	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1589	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU1590	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales		
OTU1591	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1592	0.01%	0.00%	0.00%	k__Bacteria					
OTU1594	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1595	0.00%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1596	0.00%	0.00%	0.00%	k__Bacteria					
OTU1597	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1598	0.00%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1599	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1600	0.00%	0.00%	0.01%	k__Bacteria					
OTU1602	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU1604	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1605	0.02%	0.00%	0.00%	k__Bacteria					
OTU1606	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1607	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU1608	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1609	0.00%	0.00%	0.00%	k__Bacteria					
OTU1611	0.00%	0.00%	0.01%	k__Bacteria					
OTU1612	0.01%	0.04%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU1613	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1614	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1615	0.00%	0.00%	0.00%	k__Bacteria					
OTU1616	0.00%	0.00%	0.00%	k__Bacteria					
OTU1617	0.00%	0.01%	0.00%	k__Bacteria					
OTU1619	0.01%	0.00%	0.00%	k__Bacteria					
OTU1620	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1621	0.01%	0.03%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1622	0.00%	0.00%	0.00%	k__Bacteria					
OTU1623	0.00%	0.02%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1624	0.00%	0.00%	0.00%	k__Bacteria					
OTU1625	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria				
OTU1627	0.00%	0.01%	0.00%	k__Bacteria					
OTU1630	0.07%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Negativicutes	o__Selenomonadales	f__Veillonellaceae	
OTU1631	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1632	0.00%	0.00%	0.00%	k__Bacteria					
OTU1633	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1634	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1635	0.00%	0.00%	0.01%	k__Bacteria					
OTU1636	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1637	0.02%	0.00%	0.00%	k__Bacteria					
OTU1641	0.01%	0.00%	0.00%	k__Bacteria					
OTU1642	0.01%	0.02%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1643	0.01%	0.00%	0.01%	k__Bacteria					
OTU1644	0.01%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1645	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1646	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU1648	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1649	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1650	0.00%	0.02%	0.00%	k__Bacteria					
OTU1651	0.00%	0.00%	0.00%	k__Bacteria					
OTU1652	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae	
OTU1654	0.04%	0.04%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1656	0.01%	0.00%	0.02%	k__Bacteria					
OTU1657	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1658	0.01%	0.00%	0.00%	k__Bacteria					
OTU1659	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1660	0.02%	0.00%	0.01%	k__Bacteria	p__Acidobacteria				
OTU1661	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	g__Gemmatimonas
OTU1662	0.00%	0.01%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1663	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU1665	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1667	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1668	0.00%	0.00%	0.00%	k__Bacteria					
OTU1670	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1671	0.00%	0.00%	0.01%	k__Bacteria					
OTU1673	0.02%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1674	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1675	0.00%	0.02%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1676	0.00%	0.00%	0.00%	k__Bacteria					
OTU1677	0.02%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1678	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1679	0.04%	0.99%	0.17%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU1680	0.02%	0.00%	0.03%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU1681	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU1682	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1683	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1684	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1685	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU1686	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU1687	0.01%	0.00%	0.00%	k__Bacteria					
OTU1689	0.02%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1690	0.00%	0.01%	0.00%	k__Bacteria					
OTU1692	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1693	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Paenibacillaceae_1	g__Cohnella
OTU1694	0.01%	0.00%	0.00%	k__Bacteria					
OTU1695	0.00%	0.00%	0.00%	k__Bacteria					
OTU1696	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1697	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1	g__Gp1		
OTU1698	0.01%	0.00%	0.00%	k__Bacteria	p__Spirochaetes				
OTU1699	0.00%	0.00%	0.00%	k__Bacteria					
OTU1700	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1701	0.00%	0.01%	0.00%	k__Bacteria					
OTU1702	0.01%	0.01%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	g__Schlesneria
OTU1703	0.00%	0.00%	0.00%	k__Bacteria					
OTU1704	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1705	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU1706	0.02%	0.06%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1707	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1708	0.00%	0.00%	0.00%	k__Bacteria					
OTU1709	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1710	0.00%	0.00%	0.01%	k__Bacteria					
OTU1711	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1712	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1713	0.02%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU1714	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1715	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1716	0.03%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1717	0.01%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU1718	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1719	0.00%	0.00%	0.00%	k__Bacteria					
OTU1721	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1722	0.00%	0.01%	0.02%	k__Bacteria					
OTU1723	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales	f__Syntrophobacteraceae	
OTU1724	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1725	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	
OTU1726	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1728	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU1729	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1731	0.00%	0.00%	0.00%	k__Bacteria					
OTU1733	0.00%	0.00%	0.01%	k__Bacteria					
OTU1734	0.01%	0.00%	0.00%	k__Bacteria					
OTU1735	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1736	0.02%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1737	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU1738	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU1739	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU1742	0.00%	0.00%	0.00%	k__Bacteria					
OTU1743	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1744	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1746	0.00%	0.00%	0.00%	k__Bacteria					
OTU1747	0.00%	0.00%	0.00%	k__Bacteria					
OTU1748	0.00%	0.00%	0.00%	k__Bacteria					
OTU1749	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1750	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1751	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	
OTU1752	0.02%	0.02%	0.01%	k__Bacteria					
OTU1753	0.00%	0.00%	0.00%	k__Bacteria					
OTU1757	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1759	0.03%	0.01%	0.02%	k__Bacteria					
OTU1760	0.02%	0.02%	0.01%	k__Bacteria					
OTU1761	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1762	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1763	0.00%	0.00%	0.00%	k__Bacteria					
OTU1764	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU1765	0.00%	0.01%	0.00%	k__Bacteria					
OTU1766	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1767	0.00%	0.00%	0.00%	k__Bacteria					
OTU1768	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1769	0.04%	0.02%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	g__Phenylobacterium
OTU1770	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU1771	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1773	0.01%	0.00%	0.00%	k__Bacteria					
OTU1774	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria				
OTU1775	0.00%	0.01%	0.00%	k__Bacteria					
OTU1776	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1777	0.00%	0.00%	0.00%	k__Bacteria					
OTU1778	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1780	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1781	0.00%	0.01%	0.00%	k__Bacteria					
OTU1782	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1783	0.00%	0.01%	0.00%	k__Bacteria					
OTU1784	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU1785	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1786	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1787	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU1789	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1790	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1791	0.00%	0.00%	0.00%	k__Bacteria					
OTU1792	0.00%	0.00%	0.00%	k__Bacteria					
OTU1793	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU1794	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1795	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1797	0.00%	0.00%	0.00%	k__Bacteria					
OTU1798	0.00%	0.00%	0.00%	k__Bacteria					
OTU1799	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU1800	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1801	0.01%	0.00%	0.01%	k__Bacteria					
OTU1802	0.00%	0.02%	0.00%	k__Bacteria					
OTU1803	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria				
OTU1804	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1805	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1806	0.00%	0.00%	0.00%	k__Bacteria					
OTU1808	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1809	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1810	0.00%	0.00%	0.00%	k__Bacteria					
OTU1811	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU1812	0.01%	0.01%	0.00%	k__Bacteria					
OTU1813	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1814	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1815	0.00%	0.00%	0.00%	k__Bacteria					
OTU1817	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1818	0.01%	0.00%	0.01%	k__Bacteria					
OTU1819	0.02%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1820	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1821	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU1822	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1823	0.01%	0.00%	0.00%	k__Bacteria					
OTU1824	0.00%	0.00%	0.02%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1825	0.00%	0.00%	0.00%	k__Bacteria					
OTU1826	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU1827	0.01%	0.00%	0.00%	k__Bacteria					
OTU1828	0.00%	0.01%	0.00%	k__Bacteria	p__BRC1				
OTU1829	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU1830	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1831	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1832	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Chloroflexia			
OTU1833	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1834	0.01%	0.00%	0.00%	k__Bacteria					
OTU1835	0.00%	0.00%	0.00%	k__Bacteria					
OTU1836	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1837	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1839	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	g__Sphingobium
OTU1840	0.00%	0.00%	0.00%	k__Bacteria					
OTU1841	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1842	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU1843	0.00%	0.00%	0.00%	k__Bacteria					
OTU1844	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1845	0.01%	0.00%	0.00%	k__Bacteria					
OTU1846	0.01%	0.00%	0.01%	k__Bacteria					
OTU1848	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU1849	0.00%	0.02%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU1850	0.01%	0.00%	0.00%	k__Bacteria					
OTU1851	0.00%	0.00%	0.00%	k__Bacteria					
OTU1852	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU1854	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1855	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Alphaproteobacteria_incertae_sedis		
OTU1858	0.00%	0.00%	0.01%	k__Bacteria					
OTU1859	0.00%	0.01%	0.00%	k__Bacteria					
OTU1860	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1861	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1862	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1863	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU1865	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU1867	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1868	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1869	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1871	0.00%	0.00%	0.00%	k__Bacteria					
OTU1872	0.00%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU1873	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1874	0.00%	0.02%	0.01%	k__Bacteria					
OTU1875	0.00%	0.00%	0.00%	k__Bacteria					
OTU1877	0.00%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1878	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU1879	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU1880	0.01%	0.00%	0.00%	k__Bacteria					
OTU1882	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae				
OTU1883	0.01%	0.00%	0.00%	k__Bacteria					
OTU1884	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Epsilonproteobacteria			
OTU1885	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Caldilineae			
OTU1886	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1887	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU1888	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU1889	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1890	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp25			
OTU1891	0.01%	0.00%	0.00%	k__Bacteria					
OTU1892	0.00%	0.00%	0.01%	k__Bacteria					
OTU1893	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU1894	0.00%	0.00%	0.01%	k__Bacteria					
OTU1895	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1897	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1898	0.02%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU1899	0.00%	0.00%	0.00%	k__Bacteria					
OTU1902	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1903	0.01%	0.00%	0.00%	k__Bacteria					
OTU1904	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	f__Rhodocyclaceae	
OTU1906	0.01%	0.00%	0.01%	k__Bacteria					
OTU1907	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU1910	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU1911	0.07%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU1912	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1913	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp12			
OTU1914	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1915	0.00%	0.00%	0.00%	k__Bacteria					
OTU1917	0.00%	0.00%	0.00%	k__Bacteria					
OTU1918	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU1919	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1920	0.01%	0.00%	0.00%	k__Bacteria					
OTU1922	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1924	0.00%	0.01%	0.00%	k__Bacteria					
OTU1925	0.00%	0.02%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1926	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU1927	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1928	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU1929	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU1930	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1931	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1932	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1933	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU1934	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1935	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1936	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1937	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU1938	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1939	0.01%	0.00%	0.00%	k__Bacteria					
OTU1940	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1941	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia			
OTU1942	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU1943	0.00%	0.00%	0.00%	k__Bacteria					
OTU1944	0.00%	0.00%	0.00%	k__Bacteria					
OTU1945	0.01%	0.05%	0.03%	k__Bacteria	p__Actinobacteria				
OTU1946	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU1948	0.01%	0.00%	0.02%	k__Bacteria					
OTU1949	0.01%	0.00%	0.00%	k__Bacteria					
OTU1950	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU1951	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1952	0.00%	0.00%	0.00%	k__Bacteria	p__Nitrospirae	c__Nitrospira			
OTU1953	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU1955	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	g__Mucilaginibacter
OTU1956	0.00%	0.00%	0.00%	k__Bacteria					
OTU1957	0.00%	0.00%	0.00%	k__Bacteria					
OTU1958	0.12%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU1959	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU1960	0.00%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU1961	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU1962	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria				
OTU1964	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1965	0.00%	0.01%	0.00%	k__Bacteria					
OTU1966	0.00%	0.01%	0.00%	k__Bacteria					
OTU1967	0.00%	0.00%	0.00%	k__Bacteria					
OTU1968	0.01%	0.04%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1969	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU1970	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU1971	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU1972	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1973	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU1974	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU1975	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU1976	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	g__Luteibacter
OTU1978	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU1979	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU1980	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU1981	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1982	0.02%	0.00%	0.00%	k__Bacteria					
OTU1983	0.06%	0.06%	0.08%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU1984	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU1986	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1987	0.00%	0.00%	0.02%	k__Bacteria					
OTU1988	0.01%	0.02%	0.04%	k__Bacteria	p__Actinobacteria				
OTU1989	0.05%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Demequinaceae	g__Demequina
OTU1990	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU1991	0.00%	0.00%	0.00%	k__Bacteria					
OTU1993	0.00%	0.00%	0.00%	k__Bacteria					
OTU1994	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU1995	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU1996	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU1997	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU1998	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU1999	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2000	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU2001	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2002	0.01%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU2003	0.00%	0.00%	0.00%	k__Bacteria					
OTU2004	0.01%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia				
OTU2005	0.00%	0.00%	0.00%	k__Bacteria					
OTU2006	0.01%	0.00%	0.00%	k__Bacteria					
OTU2007	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2008	0.01%	0.00%	0.00%	k__Bacteria					
OTU2009	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales		
OTU2011	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU2012	0.01%	0.00%	0.00%	k__Bacteria					
OTU2013	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2014	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU2015	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2016	0.00%	0.00%	0.01%	k__Bacteria					
OTU2018	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15	g__Gp15		
OTU2019	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU2020	0.01%	0.00%	0.02%	k__Bacteria					
OTU2022	0.00%	0.00%	0.00%	k__Bacteria					
OTU2023	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU2024	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU2026	0.00%	0.00%	0.00%	k__Bacteria					
OTU2027	0.01%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	
OTU2028	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2029	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2030	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU2032	0.02%	0.07%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU2033	0.00%	0.00%	0.00%	k__Bacteria					
OTU2034	0.01%	0.00%	0.00%	k__Bacteria					
OTU2036	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2037	0.00%	0.00%	0.00%	k__Bacteria					
OTU2038	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU2039	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU2041	0.01%	0.00%	0.00%	k__Bacteria					
OTU2042	0.00%	0.00%	0.00%	k__Bacteria					
OTU2043	0.01%	0.00%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2044	0.00%	0.03%	0.01%	k__Bacteria					
OTU2045	0.00%	0.00%	0.00%	k__Bacteria					
OTU2046	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU2047	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2048	0.00%	0.00%	0.00%	k__Bacteria					
OTU2049	0.01%	0.00%	0.00%	k__Bacteria					
OTU2050	0.00%	0.01%	0.00%	k__Bacteria					
OTU2051	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2052	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2053	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae	
OTU2056	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2057	0.01%	0.00%	0.00%	k__Bacteria					
OTU2058	0.00%	0.01%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2059	0.01%	0.00%	0.00%	k__Bacteria					
OTU2060	0.00%	0.00%	0.05%	k__Bacteria	p__Actinobacteria				
OTU2061	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2062	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2064	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU2065	0.01%	0.00%	0.00%	k__Bacteria					
OTU2066	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU2067	0.00%	0.00%	0.01%	k__Bacteria					
OTU2068	0.01%	0.00%	0.01%	k__Bacteria					
OTU2069	0.01%	0.02%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU2070	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2071	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2072	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU2075	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2077	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2078	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2079	0.00%	0.00%	0.00%	k__Bacteria					
OTU2080	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2081	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2082	0.01%	0.00%	0.00%	k__Bacteria					
OTU2084	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Microbacteriaceae	
OTU2085	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae	
OTU2086	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2087	0.00%	0.00%	0.00%	k__Bacteria					
OTU2088	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU2089	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2090	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU2092	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae				
OTU2093	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria				
OTU2094	0.00%	0.00%	0.01%	k__Bacteria	p__Spirochaetes	c__Spirochaetia	o__Spirochaetales	f__Leptospiraceae	g__Turneriella
OTU2095	0.01%	0.01%	0.07%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU2096	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU2097	0.00%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2098	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU2099	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU2100	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU2101	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU2102	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2103	0.00%	0.00%	0.00%	k__Bacteria					
OTU2104	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2105	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2106	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2107	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2108	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU2109	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2110	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU2111	0.01%	0.02%	0.03%	k__Bacteria	p__Bacteroidetes				
OTU2112	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU2113	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2114	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2116	0.00%	0.00%	0.00%	k__Bacteria					
OTU2117	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU2119	0.00%	0.00%	0.00%	k__Bacteria					
OTU2120	0.00%	0.02%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2121	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2123	0.01%	0.02%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2124	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2125	0.03%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2126	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2127	0.00%	0.00%	0.00%	k__Bacteria					
OTU2128	0.01%	0.00%	0.00%	k__Bacteria					
OTU2129	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2131	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2132	0.00%	0.00%	0.00%	k__Bacteria					
OTU2133	0.02%	0.00%	0.00%	k__Bacteria					
OTU2134	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2135	0.01%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU2136	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Epsilonproteobacteria	o__Campylobacterales	f__Campylobacteraceae	g__Sulfurospirillum
OTU2137	0.01%	0.00%	0.00%	k__Bacteria					
OTU2138	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2139	0.00%	0.00%	0.00%	k__Bacteria					
OTU2140	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2141	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU2142	0.00%	0.00%	0.00%	k__Bacteria					
OTU2143	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU2144	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU2145	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	g__Aquicella
OTU2146	0.00%	0.00%	0.00%	k__Bacteria					
OTU2149	0.00%	0.01%	0.00%	k__Bacteria					
OTU2151	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU2152	0.02%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2153	0.00%	0.00%	0.01%	k__Bacteria					
OTU2154	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2155	0.00%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes				
OTU2156	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2157	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	g__Aquicella
OTU2158	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales	f__Rhodobacteraceae	
OTU2159	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2160	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2161	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU2162	0.00%	0.00%	0.00%	k__Bacteria					
OTU2164	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2165	0.01%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes				
OTU2166	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2167	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	g__Mucilaginibacter
OTU2169	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2170	0.01%	0.00%	0.02%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU2171	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2172	0.00%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2173	0.01%	0.01%	0.00%	k__Bacteria					
OTU2174	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2175	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2177	0.07%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2178	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2179	0.00%	0.01%	0.00%	k__Bacteria					
OTU2180	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU2181	0.00%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU2182	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2183	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2184	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU2185	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae	g__Mycobacterium
OTU2186	0.17%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU2187	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2188	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales		
OTU2189	0.00%	0.00%	0.00%	k__Bacteria					
OTU2190	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU2191	0.00%	0.00%	0.00%	k__Bacteria					
OTU2192	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU2193	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2194	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2198	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU2199	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2200	0.01%	0.00%	0.00%	k__Bacteria					
OTU2201	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2202	0.00%	0.00%	0.00%	k__Bacteria					
OTU2203	0.00%	0.01%	0.00%	k__Bacteria					
OTU2204	0.02%	0.00%	0.06%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU2205	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2207	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2208	0.01%	0.00%	0.00%	k__Bacteria					
OTU2209	0.01%	0.07%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU2210	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2211	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU2212	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2214	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2215	0.00%	0.00%	0.00%	k__Bacteria					
OTU2216	0.01%	0.07%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2217	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales	f__Syntrophaceae	g__Desulfomonile
OTU2218	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	g__Legionella
OTU2219	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria				
OTU2220	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2221	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU2222	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2223	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2224	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2225	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2226	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2227	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales		
OTU2231	0.01%	0.01%	0.00%	k__Bacteria					
OTU2232	0.06%	0.00%	0.07%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2233	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	g__Sphingopyxis
OTU2234	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU2235	0.00%	0.00%	0.01%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU2236	0.01%	0.01%	0.01%	k__Bacteria					
OTU2237	0.00%	0.01%	0.00%	k__Bacteria					
OTU2238	0.08%	0.08%	0.03%	k__Bacteria					
OTU2239	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2240	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2243	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2245	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2246	0.00%	0.00%	0.00%	k__Bacteria					
OTU2247	0.01%	0.00%	0.02%	k__Bacteria	p__Latescibacteria				
OTU2248	0.00%	0.00%	0.00%	k__Bacteria					
OTU2249	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2250	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU2251	0.00%	0.00%	0.00%	k__Bacteria					
OTU2252	0.01%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2254	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2255	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2256	0.00%	0.00%	0.00%	k__Bacteria					
OTU2257	0.00%	0.00%	0.00%	k__Bacteria					
OTU2258	0.01%	0.05%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2259	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2260	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2261	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2262	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU2263	0.01%	0.02%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2264	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	
OTU2265	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2267	0.02%	0.03%	0.02%	k__Bacteria	p__Planctomycetes			
OTU2268	0.00%	0.00%	0.01%	k__Bacteria				
OTU2270	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2271	0.00%	0.01%	0.00%	k__Bacteria				
OTU2272	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae
OTU2274	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2275	0.00%	0.00%	0.00%	k__Bacteria				
OTU2276	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2277	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU2278	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2279	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2280	0.01%	0.00%	0.00%	k__Bacteria				
OTU2281	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2282	0.00%	0.00%	0.00%	k__Bacteria				
OTU2283	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis		
OTU2284	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU2285	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_1
OTU2286	0.00%	0.00%	0.00%	k__Bacteria				
OTU2287	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2288	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU2289	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2290	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae			
OTU2291	0.00%	0.00%	0.00%	k__Bacteria				
OTU2292	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria			
OTU2293	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2294	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis		
OTU2296	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2297	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2298	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2300	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2301	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2302	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2303	0.00%	0.00%	0.00%	k__Bacteria				
OTU2304	0.00%	0.00%	0.00%	k__Bacteria				
OTU2305	0.00%	0.00%	0.00%	k__Bacteria				
OTU2306	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2307	0.04%	0.05%	0.05%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2308	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2309	0.00%	0.00%	0.00%	k__Bacteria				
OTU2310	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria			
OTU2311	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU2312	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2313	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU2314	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2315	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU2316	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2317	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU2318	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2319	0.00%	0.02%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU2320	0.02%	0.00%	0.00%	k__Bacteria				
OTU2321	0.00%	0.02%	0.00%	k__Bacteria				
OTU2322	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2323	0.00%	0.00%	0.00%	k__Bacteria				
OTU2324	0.00%	0.01%	0.00%	k__Bacteria				
OTU2325	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU2326	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2327	0.03%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2328	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2329	0.01%	0.00%	0.03%	k__Bacteria				
OTU2330	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales	f__Geobacteraceae	g__Geobacter

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2331	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2332	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU2334	0.01%	0.00%	0.00%	k__Bacteria					
OTU2335	0.02%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2336	0.00%	0.01%	0.01%	k__Bacteria					
OTU2337	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	
OTU2338	0.00%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU2339	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU2340	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2341	0.00%	0.00%	0.01%	k__Bacteria					
OTU2342	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria				
OTU2343	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2344	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2345	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	g__Aquicella
OTU2346	0.00%	0.00%	0.00%	k__Bacteria					
OTU2347	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2348	0.00%	0.00%	0.00%	k__Bacteria					
OTU2349	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU2350	0.00%	0.00%	0.00%	k__Bacteria					
OTU2351	0.00%	0.00%	0.00%	k__Bacteria					
OTU2352	0.00%	0.01%	0.00%	k__Bacteria					
OTU2354	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2356	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU2357	0.00%	0.01%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU2358	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU2359	0.00%	0.01%	0.00%	k__Bacteria					
OTU2360	0.01%	0.00%	0.00%	k__Bacteria					
OTU2361	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2	g__WPS-2_genera_incertae_sedis			
OTU2362	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2363	0.01%	0.03%	0.02%	k__Bacteria					
OTU2364	0.00%	0.00%	0.00%	k__Bacteria					
OTU2365	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU2366	0.00%	0.01%	0.00%	k__Bacteria					
OTU2367	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	
OTU2368	0.00%	0.00%	0.00%	k__Bacteria					
OTU2370	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2371	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2373	0.00%	0.00%	0.00%	k__Bacteria					
OTU2374	0.01%	0.00%	0.00%	k__Bacteria					
OTU2375	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2376	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU2377	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2378	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU2379	0.00%	0.00%	0.01%	k__Bacteria					
OTU2380	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2381	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2382	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2383	0.00%	0.03%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU2384	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2385	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2387	0.00%	0.12%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2388	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU2389	0.01%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU2390	0.00%	0.00%	0.00%	k__Bacteria					
OTU2391	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU2392	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2393	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2394	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2395	0.01%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU2396	0.00%	0.00%	0.01%	k__Bacteria					
OTU2398	0.00%	0.01%	0.00%	k__Bacteria					
OTU2399	0.00%	0.00%	0.00%	k__Bacteria					
OTU2400	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU2402	0.00%	0.00%	0.00%	k__Bacteria				
OTU2405	0.01%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2406	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	
OTU2409	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2410	0.00%	0.00%	0.00%	k__Bacteria				
OTU2411	0.02%	0.00%	0.00%	k__Bacteria				
OTU2412	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2414	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2415	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU2417	0.00%	0.00%	0.01%	k__Bacteria				
OTU2419	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2420	0.00%	0.00%	0.00%	k__Bacteria				
OTU2421	0.01%	0.03%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU2422	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU2423	0.00%	0.00%	0.00%	k__Bacteria				
OTU2424	0.02%	0.03%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2427	0.00%	0.00%	0.00%	k__Bacteria				
OTU2428	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2429	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU2430	0.00%	0.00%	0.00%	k__Bacteria				
OTU2431	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2432	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis		
OTU2434	0.00%	0.00%	0.00%	k__Bacteria				
OTU2435	0.00%	0.00%	0.00%	k__Bacteria				
OTU2437	0.01%	0.00%	0.01%	k__Bacteria				
OTU2438	0.01%	0.01%	0.00%	k__Bacteria				
OTU2440	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU2441	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU2443	0.01%	0.00%	0.11%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU2444	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2447	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2449	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2450	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4	
OTU2451	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2452	0.00%	0.01%	0.00%	k__Bacteria				
OTU2454	0.04%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7	
OTU2456	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2457	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU2459	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU2460	0.01%	0.00%	0.00%	k__Bacteria				
OTU2461	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU2462	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2		
OTU2466	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU2469	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2470	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2472	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2473	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15		
OTU2474	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2476	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2478	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU2480	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU2481	0.01%	0.00%	0.00%	k__Bacteria				
OTU2482	0.00%	0.01%	0.00%	k__Bacteria				
OTU2483	0.00%	0.07%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU2484	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU2486	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2489	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2490	0.01%	0.04%	0.03%	k__Bacteria	p__Actinobacteria			
OTU2493	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2494	0.00%	0.01%	0.00%	k__Bacteria	p__Chloroflexi	c__Caldilineae		
OTU2495	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales	
OTU2496	0.00%	0.00%	0.00%	k__Bacteria				
OTU2499	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2501	0.04%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU2503	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2505	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU2508	0.00%	0.00%	0.00%	k__Bacteria					
OTU2509	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2510	0.00%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2512	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU2513	0.00%	0.00%	0.00%	k__Bacteria					
OTU2514	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU2515	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU2516	0.21%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2517	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU2518	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2519	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU2521	0.00%	0.00%	0.00%	k__Bacteria					
OTU2522	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2524	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10	g__Gp10		
OTU2525	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU2528	0.00%	0.00%	0.00%	k__Bacteria					
OTU2529	0.04%	0.11%	0.01%	k__Bacteria	p__Actinobacteria				
OTU2530	0.00%	0.00%	0.00%	k__Bacteria					
OTU2531	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU2532	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2534	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2535	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17			
OTU2536	0.00%	0.01%	0.00%	k__Bacteria					
OTU2539	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2541	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2544	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2547	0.00%	0.00%	0.00%	k__Bacteria					
OTU2548	0.00%	0.00%	0.00%	k__Bacteria					
OTU2549	0.11%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU2552	0.00%	0.00%	0.00%	k__Bacteria					
OTU2554	0.00%	0.02%	0.01%	k__Bacteria					
OTU2555	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2556	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU2557	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2558	0.00%	0.01%	0.00%	k__Bacteria					
OTU2559	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2560	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis	g__Ohtaekwangia		
OTU2561	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU2562	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2563	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU2565	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU2566	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2	g__WPS-2_genera_incertae_sedis			
OTU2569	0.01%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU2570	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2574	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU2575	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2576	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU2579	0.00%	0.00%	0.00%	k__Bacteria					
OTU2580	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2582	0.00%	0.00%	0.00%	k__Bacteria					
OTU2584	0.02%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2585	0.11%	0.20%	0.17%	k__Bacteria	p__Actinobacteria				
OTU2587	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Dyadobacter
OTU2589	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2591	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2592	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2594	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2596	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU2597	0.00%	0.00%	0.00%	k__Bacteria					
OTU2600	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2601	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2602	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22			
OTU2603	0.01%	0.00%	0.00%	k__Bacteria					
OTU2604	0.00%	0.00%	0.01%	k__Bacteria					
OTU2605	0.00%	0.00%	0.00%	k__Bacteria					
OTU2606	0.00%	0.00%	0.00%	k__Bacteria					
OTU2610	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2611	0.00%	0.00%	0.00%	k__Bacteria					
OTU2614	0.00%	0.00%	0.02%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU2616	0.00%	0.00%	0.00%	k__Bacteria					
OTU2617	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales	f__Syntrophaceae	
OTU2618	0.01%	0.01%	0.01%	k__Bacteria	p__Chlamydiae				
OTU2619	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2620	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2621	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2623	0.01%	0.00%	0.00%	k__Bacteria					
OTU2625	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU2627	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU2628	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2630	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU2631	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2632	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU2633	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU2634	0.00%	0.00%	0.00%	k__Bacteria					
OTU2635	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Cryomorphaceae	
OTU2639	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2641	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2642	0.01%	0.01%	0.02%	k__Bacteria	p__Actinobacteria				
OTU2643	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU2644	0.00%	0.02%	0.00%	k__Bacteria					
OTU2649	0.00%	0.00%	0.00%	k__Bacteria					
OTU2650	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU2651	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU2653	0.02%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU2655	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2656	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Acidimicrobiales	f__Iamiaceae	g__Iamia
OTU2657	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae	g__Pseudomonas
OTU2658	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2660	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU2662	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU2663	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22			
OTU2664	0.05%	0.01%	0.01%	k__Bacteria	p__Proteobacteria				
OTU2666	0.00%	0.00%	0.00%	k__Bacteria					
OTU2667	0.01%	0.02%	0.01%	k__Bacteria	p__Parcubacteria				
OTU2668	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2669	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2670	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU2671	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU2673	0.12%	0.00%	0.03%	k__Bacteria					
OTU2675	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2676	0.00%	0.00%	0.00%	k__Bacteria					
OTU2677	0.01%	0.01%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2678	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2679	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2680	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2683	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU2684	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2685	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2686	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2688	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2691	0.00%	0.00%	0.00%	k__Bacteria					
OTU2692	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU2693	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2694	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales		
OTU2695	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2696	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2697	0.01%	0.00%	0.01%	k__Bacteria					
OTU2699	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2700	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2703	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU2705	0.00%	0.00%	0.00%	k__Bacteria					
OTU2706	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU2707	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2708	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2709	0.00%	0.00%	0.00%	k__Bacteria					
OTU2710	0.00%	0.00%	0.00%	k__Bacteria					
OTU2711	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2716	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2717	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2718	0.01%	0.00%	0.00%	k__Bacteria					
OTU2719	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU2720	0.00%	0.00%	0.01%	k__Bacteria					
OTU2721	0.02%	0.03%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2723	0.00%	0.00%	0.00%	k__Bacteria					
OTU2724	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU2725	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2726	0.00%	0.00%	0.00%	k__Bacteria					
OTU2727	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2733	0.00%	0.00%	0.00%	k__Bacteria					
OTU2734	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2736	0.02%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU2739	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1	g__Clostridium_sensu_stricto
OTU2742	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2744	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2747	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU2748	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU2750	0.00%	0.00%	0.00%	k__Bacteria					
OTU2751	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	
OTU2752	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1	g__BRC1_genera_incertae_sedis			
OTU2754	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2755	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2756	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU2757	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2758	0.04%	0.24%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2759	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2761	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU2763	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU2765	0.01%	0.00%	0.00%	k__Bacteria					
OTU2769	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU2770	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU2771	0.00%	0.00%	0.00%	k__Bacteria					
OTU2772	0.01%	0.00%	0.00%	k__Bacteria					
OTU2774	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2777	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU2779	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2780	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2782	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22			
OTU2783	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU2784	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2785	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2786	0.02%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU2787	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2788	0.00%	0.00%	0.00%	k__Bacteria					
OTU2789	0.00%	0.00%	0.01%	k__Bacteria					
OTU2791	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2793	0.01%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2794	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU2797	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2798	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Dyadobacter
OTU2799	0.05%	0.03%	0.18%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2805	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU2806	0.00%	0.01%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU2810	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU2811	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU2812	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU2815	0.00%	0.00%	0.01%	k__Bacteria					
OTU2816	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2818	0.01%	0.00%	0.00%	k__Bacteria					
OTU2821	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2822	0.05%	0.01%	0.07%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU2823	0.00%	0.00%	0.00%	k__Bacteria					
OTU2824	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU2825	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU2826	0.00%	0.00%	0.00%	k__Bacteria					
OTU2828	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2831	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU2832	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2834	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU2835	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2836	0.00%	0.00%	0.00%	k__Bacteria					
OTU2838	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2842	0.00%	0.00%	0.00%	k__Bacteria					
OTU2844	0.00%	0.00%	0.00%	k__Bacteria					
OTU2845	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2846	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2848	0.01%	0.00%	0.00%	k__Bacteria					
OTU2850	0.01%	0.00%	0.00%	k__Bacteria					
OTU2852	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU2855	0.00%	0.00%	0.00%	k__Bacteria					
OTU2856	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2857	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU2861	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU2862	0.00%	0.00%	0.00%	k__Bacteria					
OTU2863	0.00%	0.00%	0.01%	k__Bacteria					
OTU2866	0.03%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Acidimicrobiales	f__Acidimicrobiaceae	
OTU2867	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2868	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2869	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2870	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2871	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU2872	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU2873	0.00%	0.00%	0.00%	k__Bacteria					
OTU2877	0.01%	0.00%	0.00%	k__Bacteria					
OTU2879	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU2880	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU2882	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2883	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU2885	0.00%	0.00%	0.01%	k__Bacteria					
OTU2886	0.00%	0.01%	0.07%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2887	0.00%	0.00%	0.02%	k__Bacteria					
OTU2888	0.01%	0.01%	0.01%	k__Bacteria					
OTU2889	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU2890	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU2892	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU2893	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria				
OTU2895	0.00%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU2896	0.01%	0.00%	0.00%	k__Bacteria					
OTU2897	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2899	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU2900	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2901	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2903	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae		
OTU2905	0.01%	0.03%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU2906	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2909	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2911	0.00%	0.00%	0.00%	k__Bacteria				
OTU2912	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU2913	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2916	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2917	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU2918	0.00%	0.01%	0.00%	k__Bacteria				
OTU2919	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2920	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2921	0.00%	0.01%	0.00%	k__Bacteria				
OTU2923	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU2924	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2925	0.00%	0.01%	0.00%	k__Bacteria				
OTU2926	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU2928	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2930	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2931	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2932	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2935	0.00%	0.00%	0.00%	k__Bacteria				
OTU2938	0.00%	0.01%	0.00%	k__Bacteria				
OTU2939	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2940	0.00%	0.01%	0.01%	k__Bacteria				
OTU2941	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU2942	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2944	0.00%	0.00%	0.00%	k__Bacteria				
OTU2945	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	
OTU2946	0.00%	0.00%	0.00%	k__Bacteria				
OTU2947	0.06%	0.37%	0.18%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2950	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2951	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU2952	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU2953	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU2954	0.00%	0.00%	0.00%	k__Bacteria				
OTU2956	0.01%	0.02%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2957	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2959	0.00%	0.01%	0.00%	k__Bacteria				
OTU2960	0.00%	0.01%	0.00%	k__Bacteria				
OTU2961	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU2964	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU2966	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2967	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU2969	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	
OTU2970	0.05%	0.13%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU2971	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU2972	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2974	0.00%	0.00%	0.00%	k__Bacteria				
OTU2975	0.00%	0.01%	0.00%	k__Bacteria				
OTU2976	0.00%	0.01%	0.00%	k__Bacteria				
OTU2979	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU2980	0.01%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU2981	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU2983	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU2984	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU2985	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	
OTU2986	0.10%	0.41%	0.26%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU2987	0.00%	0.00%	0.16%	k__Bacteria	p__Actinobacteria			
OTU2988	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU2990	0.00%	0.01%	0.01%	k__Bacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU2992	0.02%	0.06%	0.06%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU2994	0.00%	0.00%	0.00%	k__Bacteria					
OTU2995	0.00%	0.00%	0.07%	k__Bacteria	p__Actinobacteria				
OTU2996	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU2999	0.00%	0.00%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3000	0.04%	0.03%	0.05%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3002	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3003	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3004	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3006	0.00%	0.00%	0.00%	k__Bacteria					
OTU3007	0.02%	0.02%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3008	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU3009	0.00%	0.00%	0.00%	k__Bacteria					
OTU3010	0.00%	0.00%	0.00%	k__Bacteria					
OTU3011	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3014	0.00%	0.00%	0.00%	k__Bacteria					
OTU3015	0.00%	0.00%	0.00%	k__Bacteria					
OTU3016	0.00%	0.00%	0.00%	k__Bacteria					
OTU3017	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3018	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3020	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales		
OTU3021	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3022	0.00%	0.00%	0.00%	k__Bacteria					
OTU3023	0.00%	0.00%	0.00%	k__Bacteria					
OTU3024	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3025	0.00%	0.00%	0.01%	k__Bacteria					
OTU3029	0.02%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU3030	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3031	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3032	0.00%	0.00%	0.01%	k__Bacteria					
OTU3034	0.00%	0.04%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU3036	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU3037	0.00%	0.01%	0.00%	k__Bacteria					
OTU3038	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3039	0.00%	0.00%	0.00%	k__Bacteria					
OTU3040	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3044	0.00%	0.00%	0.00%	k__Bacteria					
OTU3045	0.00%	0.00%	0.00%	k__Bacteria					
OTU3047	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3051	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3052	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli			
OTU3053	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3054	0.00%	0.00%	0.01%	k__Bacteria	p__Latescibacteria				
OTU3056	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Streptomycetaceae	g__Streptomyces
OTU3057	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU3058	0.01%	0.00%	0.04%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3059	0.05%	0.03%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU3062	0.00%	0.00%	0.01%	k__Bacteria					
OTU3064	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3065	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU3066	0.00%	0.00%	0.00%	k__Bacteria					
OTU3067	0.09%	0.05%	0.03%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	g__Opitutus
OTU3068	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3069	0.02%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU3071	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3073	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU3074	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU3075	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales		
OTU3076	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3077	0.01%	0.00%	0.00%	k__Bacteria					
OTU3079	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3080	0.00%	0.00%	0.02%	k__Bacteria					
OTU3081	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3082	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3083	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3084	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3085	0.00%	0.00%	0.00%	k__Bacteria					
OTU3086	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3087	0.00%	0.00%	0.00%	k__Bacteria					
OTU3088	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU3089	0.00%	0.00%	0.00%	k__Bacteria					
OTU3090	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU3091	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3092	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU3096	0.00%	0.00%	0.00%	k__Bacteria					
OTU3098	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3100	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU3101	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU3102	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3103	0.04%	0.02%	0.01%	k__Bacteria					
OTU3105	0.00%	0.00%	0.00%	k__Bacteria					
OTU3106	0.17%	0.09%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU3107	0.17%	0.00%	0.00%	k__Bacteria					
OTU3109	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22			
OTU3110	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3112	0.00%	0.00%	0.00%	k__Bacteria					
OTU3115	0.00%	0.00%	0.00%	k__Bacteria					
OTU3116	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3117	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3118	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3120	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3122	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU3127	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3128	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3129	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU3132	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU3135	0.01%	0.00%	0.00%	k__Bacteria	p__Ignavibacteriae				
OTU3136	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU3137	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3139	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3141	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU3143	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU3147	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia			
OTU3148	0.02%	0.04%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU3149	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU3152	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae	
OTU3154	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU3156	0.01%	0.00%	0.00%	k__Bacteria					
OTU3160	0.00%	0.00%	0.00%	k__Bacteria					
OTU3161	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU3162	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU3163	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU3165	0.00%	0.00%	0.00%	k__Bacteria					
OTU3171	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3172	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3173	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3175	0.03%	0.00%	0.00%	k__Bacteria					
OTU3177	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1				
OTU3178	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3179	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU3180	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU3181	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3182	0.00%	0.00%	0.00%	k__Bacteria					
OTU3183	0.01%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3184	0.02%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3185	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3188	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3190	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3191	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3194	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU3196	0.00%	0.00%	0.00%	k__Bacteria					
OTU3201	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Paenibacillaceae_1	g__Paenibacillus
OTU3203	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3204	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU3205	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU3206	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3207	0.00%	0.00%	0.00%	k__Bacteria					
OTU3209	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU3210	0.00%	0.01%	0.00%	k__Bacteria					
OTU3212	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3213	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3214	0.00%	0.01%	0.00%	k__Bacteria					
OTU3215	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3216	0.01%	0.03%	0.01%	k__Bacteria					
OTU3217	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3219	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3220	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU3225	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5			
OTU3227	0.00%	0.02%	0.01%	k__Bacteria					
OTU3228	0.00%	0.01%	0.00%	k__Bacteria					
OTU3229	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU3230	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU3233	0.01%	0.02%	0.06%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU3235	0.05%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU3237	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Pseudonocardiaceae	
OTU3238	0.01%	0.02%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU3242	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU3244	0.00%	0.00%	0.00%	k__Bacteria					
OTU3246	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3249	0.00%	0.00%	0.00%	k__Bacteria					
OTU3251	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales		
OTU3252	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3253	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3254	0.01%	0.00%	0.00%	k__Bacteria					
OTU3257	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU3259	0.00%	0.00%	0.00%	k__Bacteria					
OTU3261	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3262	0.01%	0.00%	0.00%	k__Bacteria					
OTU3264	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3265	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU3266	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU3267	0.00%	0.01%	0.00%	k__Bacteria					
OTU3269	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU3270	0.00%	0.01%	0.00%	k__Bacteria					
OTU3271	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU3272	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU3274	0.02%	0.03%	0.05%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3275	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3276	0.00%	0.00%	0.00%	k__Bacteria					
OTU3278	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3279	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3280	0.00%	0.00%	0.00%	k__Bacteria					
OTU3281	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU3291	0.01%	0.00%	0.00%	k__Bacteria					
OTU3292	0.00%	0.01%	0.00%	k__Bacteria					
OTU3294	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3296	0.00%	0.00%	0.00%	k__Bacteria					
OTU3297	0.00%	0.00%	0.00%	k__Bacteria					
OTU3298	0.01%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3299	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3301	0.01%	0.00%	0.00%	k__Bacteria					
OTU3305	0.00%	0.00%	0.00%	k__Bacteria					
OTU3309	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Clostridiaceae_1	g__Clostridium_sensu_stricto
OTU3310	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes			
OTU3319	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU3321	0.01%	0.00%	0.00%	k__Bacteria					
OTU3323	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3325	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU3327	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU3328	0.00%	0.00%	0.01%	k__Bacteria					
OTU3331	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU3332	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3335	0.00%	0.00%	0.00%	k__Bacteria					
OTU3343	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU3345	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3348	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU3349	0.00%	0.00%	0.00%	k__Bacteria					
OTU3350	0.01%	0.00%	0.00%	k__Bacteria					
OTU3351	0.03%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU3354	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Methylobacteriaceae	g__Methylobacterium
OTU3355	0.00%	0.00%	0.00%	k__Bacteria					
OTU3356	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU3357	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3358	0.00%	0.00%	0.00%	k__Bacteria					
OTU3359	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3360	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU3362	0.00%	0.00%	0.00%	k__Bacteria					
OTU3363	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3366	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3367	0.00%	0.00%	0.00%	k__Bacteria					
OTU3368	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	g__Nocardioides
OTU3370	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3371	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3372	0.01%	0.02%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3373	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3375	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3376	0.00%	0.00%	0.00%	k__Bacteria					
OTU3377	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales	f__Rhodobacteraceae	
OTU3379	0.01%	0.00%	0.00%	k__Bacteria					
OTU3380	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3381	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3382	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3383	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3384	0.00%	0.00%	0.00%	k__Bacteria					
OTU3385	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3386	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3389	0.00%	0.00%	0.00%	k__Bacteria					
OTU3390	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3391	0.00%	0.00%	0.00%	k__Bacteria					
OTU3393	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3395	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3396	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3398	0.00%	0.00%	0.00%	k__Bacteria					
OTU3400	0.01%	0.01%	0.00%	k__Bacteria					
OTU3402	0.00%	0.00%	0.00%	k__Bacteria					
OTU3403	0.01%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU3406	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU3407	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3409	0.00%	0.03%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3412	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU3413	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3414	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3415	0.00%	0.03%	0.00%	k__Bacteria					
OTU3417	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3418	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3419	0.00%	0.01%	0.00%	k__Bacteria					
OTU3420	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU3421	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3425	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae	g__Chthonomonas/Armatimonadetes_gp3
OTU3427	0.00%	0.02%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3429	0.01%	0.00%	0.00%	k__Bacteria					
OTU3431	0.01%	0.00%	0.00%	k__Bacteria					
OTU3432	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae	g__Chthonomonas/Armatimonadetes_gp3
OTU3434	0.00%	0.00%	0.00%	k__Bacteria					
OTU3435	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1			
OTU3436	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3437	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3438	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3440	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU3441	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU3443	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU3446	0.02%	0.02%	0.01%	k__Bacteria					
OTU3447	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU3449	0.00%	0.01%	0.00%	k__Bacteria					
OTU3452	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3453	0.01%	0.03%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3454	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU3456	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU3461	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3464	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3465	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU3466	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3467	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	g__Legionella
OTU3468	0.00%	0.03%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU3469	0.00%	0.01%	0.00%	k__Bacteria					
OTU3470	0.00%	0.01%	0.00%	k__Bacteria					
OTU3471	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3472	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3473	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria				
OTU3475	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3476	0.00%	0.01%	0.01%	k__Bacteria					
OTU3477	0.00%	0.00%	0.00%	k__Bacteria					
OTU3478	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3479	0.00%	0.00%	0.00%	k__Bacteria					
OTU3481	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3487	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	f__Polyangiaceae	
OTU3491	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3496	0.01%	0.00%	0.00%	k__Bacteria					
OTU3497	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis	g__Ohtaekwangia		
OTU3499	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU3502	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU3503	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3505	0.00%	0.00%	0.00%	k__Bacteria					
OTU3507	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia			
OTU3508	0.00%	0.00%	0.00%	k__Bacteria					
OTU3509	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17			
OTU3510	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU3511	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3512	0.01%	0.00%	0.00%	k__Bacteria					
OTU3515	0.00%	0.00%	0.00%	k__Bacteria					
OTU3517	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU3518	0.01%	0.00%	0.00%	k__Bacteria	p__Microgenomates				
OTU3520	0.03%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU3521	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU3522	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3523	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3525	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp18			
OTU3526	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3527	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3530	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3533	0.00%	0.00%	0.00%	k__Bacteria					
OTU3538	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3540	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU3544	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU3545	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3547	0.00%	0.00%	0.00%	k__Bacteria					
OTU3548	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3549	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes				
OTU3550	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria				
OTU3551	0.00%	0.00%	0.01%	k__Bacteria					
OTU3556	0.00%	0.00%	0.01%	k__Bacteria					
OTU3558	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU3559	0.00%	0.00%	0.00%	k__Bacteria					
OTU3560	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU3563	0.01%	0.00%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU3565	0.00%	0.00%	0.00%	k__Bacteria					
OTU3566	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU3567	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU3568	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3569	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3571	0.07%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU3572	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3575	0.00%	0.00%	0.00%	k__Bacteria					
OTU3576	0.00%	0.00%	0.02%	k__Bacteria					
OTU3577	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bacteriovoracaceae	
OTU3578	0.00%	0.00%	0.06%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU3579	0.00%	0.00%	0.01%	k__Bacteria					
OTU3580	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3581	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3583	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_2	
OTU3584	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU3585	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales		
OTU3586	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU3587	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3589	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3590	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales		
OTU3592	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3593	0.00%	0.00%	0.00%	k__Bacteria					
OTU3595	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3596	0.00%	0.00%	0.00%	k__Bacteria					
OTU3597	0.00%	0.00%	0.00%	k__Bacteria					
OTU3598	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU3599	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3600	0.00%	0.00%	0.00%	k__Bacteria					
OTU3601	0.03%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	
OTU3602	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3606	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3607	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	g__Legionella
OTU3608	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU3609	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3610	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU3613	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU3614	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU3615	0.00%	0.00%	0.00%	k__Bacteria					
OTU3616	0.03%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3617	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU3620	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3621	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3623	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU3625	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3626	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU3627	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	g__Luteolibacter
OTU3631	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3633	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3634	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3635	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3636	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales		
OTU3639	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU3640	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3641	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3642	0.01%	0.00%	0.00%	k__Bacteria					
OTU3643	0.02%	0.05%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Beijerinckiaceae	
OTU3644	0.00%	0.00%	0.00%	k__Bacteria					
OTU3645	0.00%	0.00%	0.00%	k__Bacteria					
OTU3646	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3647	0.00%	0.00%	0.00%	k__Bacteria					
OTU3649	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Caldilineae			
OTU3652	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3655	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU3656	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp22			
OTU3657	0.02%	0.00%	0.03%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU3661	0.00%	0.00%	0.00%	k__Bacteria					
OTU3664	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3665	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU3666	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3667	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU3674	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU3675	0.01%	0.00%	0.00%	k__Bacteria					
OTU3676	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3679	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU3680	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU3683	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU3685	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3691	0.00%	0.00%	0.00%	k__Bacteria					
OTU3693	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU3697	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales		
OTU3700	0.00%	0.00%	0.00%	k__Bacteria					
OTU3704	0.00%	0.00%	0.00%	k__Bacteria					
OTU3705	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU3706	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU3707	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3708	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU3709	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3710	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3717	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3718	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3720	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3721	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia	o__Armatimonadales	f__Armatimonadaceae	g__Armatimonas/Armatimonadetes_gp1
OTU3722	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU3723	0.01%	0.01%	0.00%	k__Bacteria					
OTU3725	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3726	0.00%	0.00%	0.00%	k__Bacteria					
OTU3727	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	g__Flavobacterium
OTU3731	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bacteriovoracaceae	
OTU3732	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU3735	0.00%	0.00%	0.00%	k__Bacteria					
OTU3737	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU3738	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	g__Opitutus
OTU3742	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU3746	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales		
OTU3747	0.01%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3749	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU3751	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU3752	0.00%	0.00%	0.00%	k__Bacteria					
OTU3755	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Negativicutes			
OTU3756	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae	
OTU3758	0.00%	0.00%	0.00%	k__Bacteria					
OTU3759	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3762	0.01%	0.00%	0.00%	k__Bacteria					
OTU3765	0.00%	0.00%	0.00%	k__Bacteria					
OTU3767	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3768	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3771	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3772	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3773	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU3774	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU3775	0.01%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU3776	0.00%	0.00%	0.00%	k__Bacteria					
OTU3777	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU3778	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU3781	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae				
OTU3783	0.02%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU3784	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3785	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3787	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU3788	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3789	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU3790	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3792	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3793	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU3795	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	g__Rhodanobacter
OTU3796	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3798	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5		
OTU3800	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3801	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3802	0.00%	0.00%	0.00%	k__Bacteria					
OTU3804	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3806	0.00%	0.01%	0.02%	k__Bacteria					
OTU3807	0.00%	0.02%	0.00%	k__Bacteria					
OTU3808	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU3809	0.00%	0.00%	0.02%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU3810	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	g__Aquicella
OTU3813	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU3816	0.01%	0.02%	0.01%	k__Bacteria	p__Actinobacteria				
OTU3818	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3819	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales		
OTU3820	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU3821	0.00%	0.02%	0.00%	k__Bacteria	p__Planctomycetes				
OTU3823	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU3824	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU3826	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3828	0.00%	0.00%	0.00%	k__Bacteria					
OTU3832	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3833	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales		
OTU3835	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU3838	0.00%	0.00%	0.00%	k__Bacteria					
OTU3841	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3843	0.01%	0.02%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU3845	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU3847	0.00%	0.00%	0.00%	k__Bacteria					
OTU3851	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU3852	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU3860	0.00%	0.00%	0.00%	k__Bacteria					
OTU3861	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	g__Pedobacter

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU3862	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3864	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	
OTU3865	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3867	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Caldilineae		
OTU3870	0.00%	0.00%	0.00%	k__Bacteria				
OTU3871	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3872	0.00%	0.00%	0.00%	k__Bacteria				
OTU3876	0.03%	0.09%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU3877	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3879	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3881	0.00%	0.00%	0.00%	k__Bacteria	p__Hydrogenedentes			
OTU3883	0.00%	0.00%	0.00%	k__Bacteria				
OTU3884	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae
OTU3885	0.01%	0.00%	0.00%	k__Bacteria				
OTU3886	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp20	g__Gp20	
OTU3889	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3891	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3892	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3893	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3898	0.00%	0.00%	0.00%	k__Bacteria				
OTU3899	0.00%	0.00%	0.00%	k__Bacteria				
OTU3901	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales	
OTU3902	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	
OTU3903	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU3904	0.00%	0.00%	0.00%	k__Bacteria				
OTU3905	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU3906	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3908	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13	
OTU3910	0.00%	0.00%	0.00%	k__Bacteria				
OTU3911	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU3913	0.01%	0.00%	0.00%	k__Bacteria				
OTU3914	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria		
OTU3916	0.01%	0.00%	0.00%	k__Bacteria				
OTU3918	0.01%	0.00%	0.00%	k__Bacteria				
OTU3919	0.00%	0.00%	0.00%	k__Bacteria				
OTU3920	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU3924	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae
OTU3925	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3928	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3929	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU3930	0.00%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes			
OTU3931	0.00%	0.00%	0.01%	k__Bacteria				
OTU3932	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU3936	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria		
OTU3937	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU3938	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	
OTU3939	0.00%	0.00%	0.01%	k__Bacteria				
OTU3942	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3944	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4		
OTU3946	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria			
OTU3947	0.01%	0.00%	0.03%	k__Bacteria				
OTU3948	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia			
OTU3951	0.00%	0.00%	0.01%	k__Bacteria				
OTU3952	0.00%	0.00%	0.00%	k__Bacteria				
OTU3953	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU3955	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria			
OTU3956	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria			
OTU3958	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae
OTU3959	0.00%	0.00%	0.00%	k__Bacteria				
OTU3960	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3961	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU3962	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU3963	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU3964	0.00%	0.00%	0.01%	k__Bacteria					
OTU3966	0.00%	0.00%	0.00%	k__Bacteria					
OTU3967	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU3968	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU3971	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3972	0.00%	0.00%	0.01%	k__Bacteria					
OTU3974	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU3975	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Neisseriales	f__Neisseriaceae	g__Iodobacter
OTU3976	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU3977	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	g__Roseimicrobium
OTU3978	0.00%	0.00%	0.00%	k__Bacteria					
OTU3980	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU3983	0.01%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU3984	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU3985	0.01%	0.00%	0.00%	k__Bacteria					
OTU3986	0.00%	0.00%	0.00%	k__Bacteria					
OTU3988	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3989	0.00%	0.00%	0.00%	k__Bacteria					
OTU3994	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU3996	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU3998	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4001	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4002	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4003	0.01%	0.00%	0.00%	k__Bacteria					
OTU4005	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU4006	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4008	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4010	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4012	0.00%	0.00%	0.00%	k__Bacteria					
OTU4013	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU4015	0.00%	0.00%	0.00%	k__Bacteria					
OTU4016	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4017	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4019	0.00%	0.00%	0.00%	k__Bacteria					
OTU4020	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4021	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU4023	0.00%	0.00%	0.00%	k__Bacteria					
OTU4025	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4026	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4028	0.02%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4029	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4030	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	
OTU4031	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU4034	0.03%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4039	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4040	0.15%	0.24%	0.16%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4044	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU4045	0.03%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU4047	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Hydrogenophilales		
OTU4050	0.01%	0.00%	0.00%	k__Bacteria					
OTU4056	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4059	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4060	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4062	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU4069	0.00%	0.00%	0.00%	k__Bacteria					
OTU4070	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4071	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Runella
OTU4072	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales		
OTU4073	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4077	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4079	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Saprospiraceae	g__Haliscomenobacter
OTU4081	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4082	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfovibrionales		

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU4083	0.00%	0.00%	0.00%	k__Bacteria				
OTU4085	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4089	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision5		
OTU4091	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4092	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4093	0.01%	0.00%	0.00%	k__Bacteria				
OTU4094	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16		
OTU4095	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae		
OTU4096	0.00%	0.00%	0.00%	k__Bacteria				
OTU4097	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4098	0.00%	0.00%	0.00%	k__Bacteria				
OTU4100	0.00%	0.01%	0.00%	k__Bacteria	p__Chloroflexi			
OTU4101	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4102	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5		
OTU4103	0.00%	0.00%	0.00%	k__Bacteria				
OTU4104	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4105	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4106	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Microbacteriaceae
OTU4107	0.00%	0.00%	0.00%	k__Bacteria				
OTU4109	0.01%	0.00%	0.00%	k__Bacteria				
OTU4110	0.00%	0.00%	0.00%	k__Bacteria				
OTU4112	0.00%	0.00%	0.00%	k__Bacteria				
OTU4114	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae		
OTU4117	0.00%	0.00%	0.00%	k__Bacteria				
OTU4125	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU4126	0.00%	0.00%	0.00%	k__Bacteria				
OTU4129	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	
OTU4134	0.01%	0.00%	0.00%	k__Bacteria				
OTU4135	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU4136	0.01%	0.01%	0.02%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4137	0.00%	0.00%	0.00%	k__Bacteria				
OTU4139	0.00%	0.00%	0.00%	k__Bacteria				
OTU4141	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4142	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4145	0.01%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis		
OTU4146	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4151	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4153	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4155	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	
OTU4157	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4158	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4159	0.00%	0.00%	0.00%	k__Bacteria				
OTU4163	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Methylococcales	f__Methylococcaceae
OTU4164	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4165	0.00%	0.00%	0.00%	k__Bacteria				
OTU4166	0.01%	0.00%	0.00%	k__Bacteria				
OTU4167	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU4169	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis		
OTU4170	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4171	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU4173	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis		
OTU4174	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4181	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4185	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Microbacteriaceae
OTU4187	0.01%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU4196	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU4197	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4199	0.00%	0.00%	0.00%	k__Bacteria				
OTU4201	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4202	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4204	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales	
OTU4207	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU4208	0.00%	0.00%	0.00%	k__Bacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU4216	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4217	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4222	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4225	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU4229	0.00%	0.00%	0.00%	k__Bacteria					
OTU4231	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodobacterales		
OTU4234	0.12%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4235	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp2			
OTU4236	0.00%	0.00%	0.00%	k__Bacteria					
OTU4237	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU4241	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4245	0.00%	0.00%	0.00%	k__Bacteria					
OTU4246	0.00%	0.00%	0.00%	k__Bacteria					
OTU4247	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4250	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4252	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU4253	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Chloroflexia	o__Chloroflexales	f__Oscillochloridaceae	g__Oscillochloris
OTU4255	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4256	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4257	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU4259	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU4260	0.01%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU4268	0.01%	0.00%	0.01%	k__Bacteria	p__Chloroflexi				
OTU4271	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU4272	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU4274	0.00%	0.00%	0.01%	k__Bacteria					
OTU4275	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1				
OTU4276	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4278	0.00%	0.00%	0.00%	k__Bacteria					
OTU4280	0.00%	0.00%	0.00%	k__Bacteria					
OTU4283	0.00%	0.00%	0.01%	k__Bacteria					
OTU4284	0.00%	0.00%	0.00%	k__Bacteria					
OTU4288	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU4290	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4291	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4292	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4293	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4297	0.09%	0.00%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4299	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU4300	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4301	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU4302	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rickettsiales	f__Rickettsiaceae	g__Rickettsia
OTU4303	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4306	0.00%	0.00%	0.01%	k__Bacteria					
OTU4308	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU4311	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Propionibacteriaceae	
OTU4312	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4313	0.00%	0.02%	0.02%	k__Bacteria					
OTU4314	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4315	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4317	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4319	0.00%	0.00%	0.00%	k__Bacteria					
OTU4321	0.01%	0.02%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4322	0.00%	0.00%	0.00%	k__Bacteria					
OTU4323	0.00%	0.00%	0.00%	k__Bacteria					
OTU4324	0.00%	0.00%	0.00%	k__Bacteria					
OTU4325	0.00%	0.00%	0.00%	k__Bacteria					
OTU4327	0.00%	0.00%	0.01%	k__Bacteria					
OTU4328	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU4329	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1	g__BRC1_genera_incertae_sedis			
OTU4330	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU4341	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4345	0.01%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU4347	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4349	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4351	0.00%	0.00%	0.01%	k__Bacteria					
OTU4352	0.03%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4353	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU4359	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU4360	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU4361	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU4362	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4364	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Dyadobacter
OTU4365	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU4366	0.00%	0.00%	0.00%	k__Bacteria					
OTU4367	0.00%	0.00%	0.00%	k__Bacteria					
OTU4370	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4372	0.01%	0.00%	0.00%	k__Bacteria					
OTU4375	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4377	0.00%	0.00%	0.00%	k__Bacteria					
OTU4379	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4381	0.00%	0.00%	0.00%	k__Bacteria					
OTU4383	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4384	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU4385	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4387	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU4390	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4393	0.00%	0.00%	0.00%	k__Bacteria					
OTU4395	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4399	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4401	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4402	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4403	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4405	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4407	0.00%	0.00%	0.00%	k__Bacteria					
OTU4409	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU4410	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4411	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4412	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU4413	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4415	0.00%	0.00%	0.02%	k__Bacteria					
OTU4416	0.00%	0.01%	0.01%	k__Bacteria	p__candidate_division_WPS-2				
OTU4417	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4420	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU4421	0.00%	0.00%	0.01%	k__Bacteria					
OTU4422	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales	f__Sphingomonadaceae	
OTU4423	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4427	0.00%	0.00%	0.00%	k__Bacteria					
OTU4428	0.00%	0.00%	0.00%	k__Bacteria					
OTU4431	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4432	0.00%	0.00%	0.00%	k__Bacteria					
OTU4433	0.01%	0.02%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4434	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4435	0.00%	0.00%	0.00%	k__Bacteria					
OTU4438	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4445	0.00%	0.00%	0.00%	k__Bacteria	p__Ignavibacteriae	c__Ignavibacteria			
OTU4448	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU4449	0.00%	0.00%	0.01%	k__Bacteria					
OTU4453	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4455	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4462	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4463	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU4465	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU4466	0.01%	0.00%	0.00%	k__Bacteria					
OTU4467	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU4470	0.00%	0.00%	0.01%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU4474	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU4475	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU4477	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4478	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU4481	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp15			
OTU4484	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Coxiellaceae	g__Aquicella
OTU4485	0.01%	0.00%	0.00%	k__Bacteria					
OTU4490	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4492	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU4494	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU4497	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU4498	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU4499	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4501	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4503	0.02%	0.00%	0.00%	k__Bacteria					
OTU4507	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4509	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU4512	0.00%	0.00%	0.00%	k__Bacteria					
OTU4516	0.00%	0.00%	0.00%	k__Bacteria					
OTU4517	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4518	0.00%	0.00%	0.00%	k__Bacteria					
OTU4519	0.01%	0.00%	0.00%	k__Bacteria					
OTU4520	0.01%	0.00%	0.00%	k__Bacteria					
OTU4521	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp18	g__Gp18		
OTU4522	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU4524	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4527	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales	f__Verrucomicrobiaceae	
OTU4528	0.02%	0.01%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU4529	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	
OTU4530	0.00%	0.00%	0.00%	k__Bacteria					
OTU4532	0.00%	0.00%	0.00%	k__Bacteria					
OTU4534	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfobacterales		
OTU4537	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4539	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae	g__Rhizocola
OTU4540	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU4542	0.00%	0.00%	0.01%	k__Bacteria					
OTU4543	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU4547	0.00%	0.00%	0.00%	k__Bacteria					
OTU4548	0.00%	0.00%	0.01%	k__Bacteria					
OTU4549	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU4550	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4551	0.00%	0.00%	0.00%	k__Bacteria					
OTU4553	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4556	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Peptococcaceae_1	
OTU4557	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4558	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU4560	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4562	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4564	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU4566	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4567	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU4571	0.01%	0.02%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU4572	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU4573	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4574	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4575	0.01%	0.04%	0.06%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU4577	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4578	0.00%	0.00%	0.00%	k__Bacteria					
OTU4579	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4580	0.00%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU4584	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4585	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU4587	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU4588	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU4589	0.00%	0.00%	0.00%	k__Bacteria				
OTU4591	0.01%	0.03%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU4594	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae
OTU4597	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU4598	0.00%	0.00%	0.00%	k__Bacteria				
OTU4602	0.00%	0.00%	0.00%	k__Bacteria				
OTU4605	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU4607	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4612	0.00%	0.00%	0.00%	k__Bacteria				
OTU4616	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4617	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU4618	0.01%	0.00%	0.01%	k__Bacteria				
OTU4621	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU4623	0.00%	0.01%	0.03%	k__Bacteria				
OTU4624	0.00%	0.00%	0.00%	k__Bacteria				
OTU4625	0.00%	0.00%	0.00%	k__Bacteria				
OTU4626	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4630	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4632	0.00%	0.00%	0.00%	k__Bacteria				
OTU4633	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU4634	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU4635	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	
OTU4637	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes			
OTU4638	0.00%	0.00%	0.00%	k__Bacteria				
OTU4639	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU4640	0.00%	0.00%	0.00%	k__Bacteria				
OTU4641	0.00%	0.01%	0.00%	k__Bacteria				
OTU4643	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU4644	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU4648	0.00%	0.00%	0.00%	k__Bacteria				
OTU4649	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4652	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU4653	0.00%	0.01%	0.00%	k__Bacteria				
OTU4654	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU4655	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU4656	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4657	0.00%	0.00%	0.00%	k__Bacteria				
OTU4658	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria			
OTU4660	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4663	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2	
OTU4668	0.00%	0.00%	0.00%	k__Bacteria				
OTU4669	0.00%	0.00%	0.00%	k__Bacteria				
OTU4670	0.00%	0.01%	0.00%	k__Bacteria				
OTU4672	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU4673	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4675	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU4676	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4677	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae
OTU4679	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4681	0.00%	0.00%	0.00%	k__Bacteria				
OTU4683	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU4684	0.00%	0.00%	0.00%	k__Bacteria				
OTU4686	0.00%	0.00%	0.00%	k__Bacteria				
OTU4688	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU4689	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU4691	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU4694	0.00%	0.00%	0.00%	k__Bacteria				
OTU4696	0.02%	0.01%	0.01%	k__Bacteria	p__candidate_division_WPS-1			
OTU4699	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes			
OTU4702	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU4703	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia		
OTU4704	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU4709	0.04%	0.08%	0.07%	k__Bacteria					
OTU4710	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU4711	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4713	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU4718	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4719	0.00%	0.00%	0.00%	k__Bacteria					
OTU4720	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU4721	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4728	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU4729	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU4730	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4731	0.02%	0.03%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU4737	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4740	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4744	0.00%	0.00%	0.00%	k__Bacteria					
OTU4746	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	g__Legionella
OTU4747	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4748	0.00%	0.00%	0.00%	k__Bacteria					
OTU4750	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU4753	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU4758	0.00%	0.00%	0.00%	k__Bacteria					
OTU4759	0.00%	0.00%	0.00%	k__Bacteria					
OTU4763	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU4768	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU4770	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU4774	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4775	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4776	0.00%	0.00%	0.00%	k__Bacteria					
OTU4778	0.00%	0.00%	0.01%	k__Bacteria					
OTU4781	0.00%	0.00%	0.00%	k__Bacteria					
OTU4783	0.00%	0.00%	0.01%	k__Bacteria					
OTU4785	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae				
OTU4786	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4787	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU4790	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5			
OTU4791	0.01%	0.01%	0.03%	k__Bacteria					
OTU4792	0.00%	0.00%	0.00%	k__Bacteria					
OTU4794	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU4795	0.00%	0.01%	0.00%	k__Bacteria					
OTU4797	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU4798	0.00%	0.00%	0.00%	k__Bacteria					
OTU4799	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU4803	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4804	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4805	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Kineosporiaceae	g__Quadrisphaera
OTU4806	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4807	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4808	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU4811	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4812	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4814	0.01%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU4815	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4818	0.00%	0.00%	0.00%	k__Bacteria					
OTU4819	0.00%	0.00%	0.00%	k__Bacteria					
OTU4824	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU4826	0.00%	0.00%	0.00%	k__Bacteria					
OTU4828	0.00%	0.00%	0.00%	k__Bacteria					
OTU4829	0.00%	0.00%	0.00%	k__Bacteria					
OTU4830	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU4832	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4833	0.01%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU4836	0.03%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU4837	0.02%	0.01%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU4839	0.00%	0.00%	0.00%	k__Bacteria					
OTU4840	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4842	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4844	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	g__Arenimonas
OTU4846	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU4851	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU4852	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU4854	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU4856	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4857	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU4859	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU4860	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4862	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU4865	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4867	0.00%	0.00%	0.00%	k__Bacteria					
OTU4870	0.04%	0.00%	0.01%	k__Bacteria					
OTU4873	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU4876	0.00%	0.00%	0.00%	k__Bacteria					
OTU4878	0.00%	0.00%	0.00%	k__Bacteria					
OTU4879	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae				
OTU4881	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4882	0.00%	0.01%	0.00%	k__Bacteria					
OTU4884	0.00%	0.00%	0.00%	k__Bacteria					
OTU4885	0.01%	0.13%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU4889	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4891	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4892	0.00%	0.00%	0.00%	k__Bacteria					
OTU4893	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4894	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4895	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU4897	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4898	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4899	0.00%	0.00%	0.00%	k__Bacteria					
OTU4902	0.00%	0.00%	0.00%	k__Bacteria					
OTU4903	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4907	0.03%	0.13%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4910	0.00%	0.00%	0.00%	k__Bacteria					
OTU4912	0.00%	0.00%	0.00%	k__Bacteria					
OTU4914	0.00%	0.00%	0.00%	k__Bacteria					
OTU4918	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales	f__Rhodocyclaceae	
OTU4919	0.01%	0.00%	0.00%	k__Bacteria					
OTU4920	0.17%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4921	0.00%	0.00%	0.00%	k__Bacteria					
OTU4923	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Acidimicrobiales		
OTU4927	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU4929	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU4931	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4932	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU4933	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU4937	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp2			
OTU4938	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU4939	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4941	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU4943	0.01%	0.00%	0.00%	k__Bacteria	p__SR1	g__SR1_genera_incertae_sedis			
OTU4946	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4948	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU4951	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU4956	0.00%	0.00%	0.00%	k__Bacteria					
OTU4957	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU4958	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU4960	0.00%	0.00%	0.01%	k__Bacteria					
OTU4961	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU4962	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU4964	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU4967	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4970	0.00%	0.00%	0.00%	k__Bacteria					
OTU4971	0.00%	0.00%	0.00%	k__Bacteria					
OTU4973	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria				
OTU4974	0.00%	0.00%	0.00%	k__Bacteria					
OTU4976	0.00%	0.00%	0.00%	k__Bacteria					
OTU4979	0.00%	0.00%	0.00%	k__Bacteria	p__Elusimicrobia				
OTU4984	0.00%	0.00%	0.00%	k__Bacteria					
OTU4985	0.00%	0.00%	0.00%	k__Bacteria					
OTU4987	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU4990	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU4992	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU4993	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU4997	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5001	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU5002	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5005	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU5006	0.00%	0.00%	0.00%	k__Bacteria					
OTU5007	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5008	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5009	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia	o__Armatimonadales	f__Armatimonadaceae	g__Armatimonas/Armatimonadetes_gp1
OTU5011	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5012	0.00%	0.00%	0.00%	k__Bacteria					
OTU5014	0.00%	0.00%	0.00%	k__Bacteria					
OTU5019	0.00%	0.00%	0.00%	k__Bacteria					
OTU5021	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU5029	0.01%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU5030	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5032	0.00%	0.00%	0.00%	k__Bacteria					
OTU5033	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU5034	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU5035	0.10%	0.02%	0.01%	k__Bacteria					
OTU5037	0.03%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU5039	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU5043	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5052	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales	f__Acetobacteraceae	g__Roseomonas
OTU5056	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis			
OTU5061	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU5064	0.00%	0.00%	0.00%	k__Bacteria					
OTU5067	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5070	0.01%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5075	0.05%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU5079	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	g__Devosia
OTU5080	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU5081	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales		
OTU5086	0.01%	0.00%	0.00%	k__Bacteria					
OTU5087	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU5092	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5094	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU5098	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5099	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU5100	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU5101	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU5102	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5103	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5104	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5107	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5111	0.00%	0.00%	0.00%	k__Bacteria					
OTU5113	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU5114	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5115	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5116	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU5118	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales		
OTU5119	0.00%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5120	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU5124	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU5126	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5127	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5128	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	g__Schlesneria
OTU5129	0.00%	0.00%	0.00%	k__Bacteria					
OTU5131	0.00%	0.01%	0.00%	k__Bacteria					
OTU5132	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5133	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5134	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5137	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5138	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU5140	0.00%	0.00%	0.00%	k__Bacteria					
OTU5141	0.01%	0.04%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5142	0.01%	0.08%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5144	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5147	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae	g__Pseudomonas
OTU5148	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5150	0.02%	0.04%	0.01%	k__Bacteria	p__Actinobacteria				
OTU5153	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5155	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5157	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5159	0.00%	0.01%	0.00%	k__Bacteria					
OTU5162	0.01%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5165	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5168	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-2				
OTU5169	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU5172	0.00%	0.01%	0.00%	k__Bacteria	p__BRC1				
OTU5175	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5179	0.00%	0.00%	0.00%	k__Bacteria					
OTU5181	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU5182	0.00%	0.00%	0.00%	k__Bacteria					
OTU5185	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5186	0.02%	0.13%	0.02%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU5189	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5192	0.00%	0.00%	0.00%	k__Bacteria					
OTU5195	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5197	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU5200	0.00%	0.00%	0.00%	k__Bacteria					
OTU5202	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5203	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU5204	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5205	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5207	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU5209	0.00%	0.00%	0.00%	k__Bacteria					
OTU5212	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5213	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	g__Gemmatimonas
OTU5215	0.00%	0.00%	0.00%	k__Bacteria					
OTU5218	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5220	0.00%	0.00%	0.00%	k__Bacteria					
OTU5221	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates				
OTU5222	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU5224	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5225	0.00%	0.00%	0.00%	k__Bacteria					
OTU5228	0.02%	0.00%	0.04%	k__Bacteria					
OTU5229	0.01%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5230	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5231	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5236	0.00%	0.00%	0.00%	k__Bacteria					
OTU5241	0.00%	0.00%	0.00%	k__Bacteria					
OTU5243	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU5244	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5245	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5246	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5247	0.03%	0.00%	0.02%	k__Bacteria	p__Actinobacteria				
OTU5248	0.00%	0.00%	0.00%	k__Bacteria					
OTU5252	0.01%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5253	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU5260	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1				
OTU5261	0.00%	0.00%	0.00%	k__Bacteria					
OTU5265	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5266	0.00%	0.00%	0.00%	k__Bacteria					
OTU5274	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5277	0.00%	0.00%	0.00%	k__Bacteria					
OTU5278	0.00%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes				
OTU5280	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5281	0.00%	0.00%	0.01%	k__Bacteria					
OTU5285	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5293	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5299	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	g__Armatimonadetes_gp5			
OTU5302	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Sphingomonadales		
OTU5305	0.00%	0.00%	0.00%	k__Bacteria					
OTU5309	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates				
OTU5310	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU5313	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU5314	0.00%	0.00%	0.00%	k__Bacteria					
OTU5318	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU5319	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5322	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU5324	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5325	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5326	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5327	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5328	0.00%	0.00%	0.00%	k__Bacteria					
OTU5331	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5332	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5334	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU5336	0.00%	0.00%	0.00%	k__Bacteria					
OTU5345	0.00%	0.00%	0.00%	k__Bacteria					
OTU5347	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5350	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU5352	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5354	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5357	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5359	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU5362	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU5364	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5365	0.00%	0.00%	0.00%	k__Bacteria					
OTU5366	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU5367	0.00%	0.01%	0.01%	k__Bacteria					
OTU5368	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU5369	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5371	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5372	0.00%	0.00%	0.00%	k__Bacteria					
OTU5373	0.01%	0.03%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5375	0.00%	0.00%	0.00%	k__Bacteria					
OTU5376	0.01%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU5379	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae	g__Steroidobacter
OTU5383	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5385	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5388	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU5390	0.00%	0.00%	0.00%	k__Bacteria					
OTU5393	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Paenibacillaceae_1	g__Paenibacillus
OTU5396	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU5398	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis		
OTU5400	0.00%	0.00%	0.00%	k__Bacteria				
OTU5401	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU5402	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU5403	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes		
OTU5404	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5407	0.00%	0.00%	0.00%	k__Bacteria	p__Spirochaetes			
OTU5412	0.01%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU5415	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5422	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5424	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU5426	0.00%	0.01%	0.00%	k__Bacteria				
OTU5427	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates			
OTU5430	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU5432	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5433	0.00%	0.02%	0.00%	k__Bacteria				
OTU5434	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis		
OTU5441	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria		
OTU5442	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5444	0.00%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU5446	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5447	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5450	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia		
OTU5452	0.00%	0.00%	0.00%	k__Bacteria				
OTU5456	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales	
OTU5458	0.00%	0.01%	0.00%	k__Bacteria				
OTU5459	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes			
OTU5460	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5461	0.00%	0.00%	0.00%	k__Bacteria				
OTU5463	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU5465	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU5469	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis		
OTU5472	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU5473	0.00%	0.00%	0.00%	k__Bacteria				
OTU5474	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5476	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1			
OTU5477	0.00%	0.01%	0.00%	k__Bacteria				
OTU5478	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU5479	0.00%	0.01%	0.01%	k__Bacteria				
OTU5482	0.01%	0.02%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU5483	0.00%	0.00%	0.00%	k__Bacteria				
OTU5484	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria		
OTU5486	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Bacillaceae_1
OTU5488	0.00%	0.00%	0.00%	k__Bacteria				
OTU5489	0.00%	0.00%	0.00%	k__Bacteria				
OTU5494	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU5497	0.00%	0.00%	0.00%	k__Bacteria				
OTU5499	0.00%	0.01%	0.00%	k__Bacteria				
OTU5500	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5501	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU5502	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU5504	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2			
OTU5505	0.00%	0.00%	0.00%	k__Bacteria				
OTU5506	0.00%	0.00%	0.00%	k__Bacteria				
OTU5507	0.00%	0.00%	0.00%	k__Bacteria				
OTU5512	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Sinobacteraceae
OTU5513	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU5514	0.01%	0.02%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6	
OTU5517	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU5519	0.00%	0.00%	0.00%	k__Bacteria				
OTU5521	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU5525	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU5527	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU5528	0.00%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5529	0.00%	0.00%	0.00%	k__Bacteria					
OTU5532	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1				
OTU5533	0.00%	0.00%	0.00%	k__Bacteria					
OTU5537	0.00%	0.00%	0.00%	k__Bacteria					
OTU5538	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5540	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5542	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5544	0.00%	0.00%	0.00%	k__Bacteria					
OTU5548	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU5550	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU5553	0.00%	0.01%	0.00%	k__Bacteria					
OTU5554	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU5556	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5559	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5561	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5562	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5566	0.00%	0.00%	0.00%	k__Bacteria					
OTU5567	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU5570	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5571	0.00%	0.00%	0.00%	k__Bacteria					
OTU5572	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales		
OTU5574	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5578	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU5584	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates	g__Microgenomates_genera_incertae_sedis			
OTU5587	0.01%	0.00%	0.00%	k__Bacteria					
OTU5591	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5598	0.00%	0.00%	0.00%	k__Bacteria					
OTU5600	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3	g__Gp3		
OTU5602	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU5603	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes				
OTU5609	0.00%	0.00%	0.00%	k__Bacteria					
OTU5610	0.00%	0.00%	0.00%	k__Bacteria					
OTU5611	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU5612	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU5614	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5615	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5616	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU5621	0.00%	0.00%	0.00%	k__Bacteria					
OTU5625	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5626	0.00%	0.00%	0.00%	k__Bacteria					
OTU5627	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5629	0.00%	0.00%	0.00%	k__Bacteria					
OTU5630	0.01%	0.04%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae	g__Gaiella
OTU5632	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5634	0.00%	0.00%	0.00%	k__Bacteria					
OTU5635	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5638	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5640	0.00%	0.00%	0.00%	k__Bacteria					
OTU5642	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5644	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU5645	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5646	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU5647	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales	f__Holophagaceae	
OTU5649	0.00%	0.00%	0.00%	k__Bacteria					
OTU5651	0.00%	0.00%	0.00%	k__Bacteria					
OTU5652	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5653	0.00%	0.00%	0.00%	k__Bacteria					
OTU5662	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5664	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5667	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU5676	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5678	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU5681	0.00%	0.00%	0.00%	k__Bacteria					
OTU5683	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5684	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5689	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU5691	0.03%	0.01%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae	
OTU5692	0.01%	0.00%	0.00%	k__Bacteria					
OTU5693	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5699	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5700	0.00%	0.00%	0.00%	k__Bacteria					
OTU5703	0.00%	0.00%	0.00%	k__Bacteria					
OTU5704	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU5705	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5711	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5715	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5718	0.02%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5720	0.00%	0.00%	0.00%	k__Bacteria					
OTU5721	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales		
OTU5724	0.01%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae			
OTU5725	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU5730	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5732	0.00%	0.00%	0.00%	k__Bacteria					
OTU5734	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5735	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Hymenobacter
OTU5736	0.00%	0.00%	0.00%	k__Bacteria					
OTU5737	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5739	0.00%	0.00%	0.00%	k__Bacteria	p__SR1	g__SR1_genera_incertae_sedis			
OTU5743	0.00%	0.00%	0.00%	k__Bacteria					
OTU5744	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5745	0.00%	0.00%	0.00%	k__Bacteria					
OTU5747	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes	o__Chthonomonadales	f__Chthonomonadaceae	g__Chthonomonas/Armatimonadetes_gp3
OTU5751	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Xanthobacteraceae	g__Labrys
OTU5755	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5759	0.00%	0.00%	0.00%	k__Bacteria					
OTU5763	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5764	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU5767	0.00%	0.00%	0.00%	k__Bacteria					
OTU5770	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU5772	0.00%	0.00%	0.00%	k__Bacteria					
OTU5773	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5775	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU5779	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5781	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5784	0.00%	0.00%	0.00%	k__Bacteria					
OTU5786	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5789	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5790	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5794	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5795	0.00%	0.00%	0.00%	k__Bacteria					
OTU5796	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU5800	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae	
OTU5802	0.01%	0.00%	0.00%	k__Bacteria					
OTU5807	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5808	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU5809	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5810	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU5812	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5814	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5822	0.00%	0.01%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU5825	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU5826	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU5829	0.04%	0.15%	0.15%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU5834	0.00%	0.00%	0.00%	k__Bacteria					
OTU5835	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU5836	0.00%	0.01%	0.00%	k__Bacteria					
OTU5839	0.00%	0.00%	0.00%	k__Bacteria					
OTU5844	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU5846	0.00%	0.00%	0.00%	k__Bacteria					
OTU5849	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5854	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5861	0.00%	0.00%	0.00%	k__Bacteria					
OTU5864	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5868	0.00%	0.00%	0.00%	k__Bacteria					
OTU5869	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Negativicutes	o__Selenomonadales	f__Veillonellaceae	
OTU5871	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU5873	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5874	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU5875	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU5876	0.00%	0.00%	0.00%	k__Bacteria					
OTU5881	0.00%	0.00%	0.02%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU5883	0.00%	0.00%	0.00%	k__Bacteria					
OTU5884	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU5888	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU5889	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU5893	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia				
OTU5895	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU5896	0.00%	0.00%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU5899	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU5900	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU5901	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU5904	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU5907	0.00%	0.00%	0.00%	k__Bacteria					
OTU5908	0.00%	0.00%	0.00%	k__Bacteria					
OTU5909	0.00%	0.00%	0.00%	k__Bacteria					
OTU5910	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5913	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Xanthomonadales	f__Xanthomonadaceae	g__Pseudoxanthomonas
OTU5914	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Mycobacteriaceae	
OTU5919	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU5921	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU5924	0.00%	0.00%	0.00%	k__Bacteria					
OTU5929	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp18	g__Gp18		
OTU5934	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU5935	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales		
OTU5936	0.11%	0.13%	0.07%	k__Bacteria					
OTU5940	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU5942	0.00%	0.00%	0.00%	k__Bacteria					
OTU5948	0.24%	0.15%	0.13%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5953	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU5954	0.00%	0.00%	0.00%	k__Bacteria					
OTU5956	0.00%	0.00%	0.00%	k__Bacteria					
OTU5966	0.01%	0.00%	0.00%	k__Bacteria					
OTU5976	0.00%	0.00%	0.00%	k__Bacteria					
OTU5978	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5980	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU5981	0.03%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU5985	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidia	o__Bacteroidales		
OTU5986	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU5987	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU5988	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU5989	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU5994	0.00%	0.00%	0.00%	k__Bacteria					
OTU5997	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6002	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6003	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU6007	0.00%	0.03%	0.01%	k__Bacteria	p__Proteobacteria				
OTU6008	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6011	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU6013	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU6014	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6017	0.00%	0.00%	0.00%	k__Bacteria					
OTU6020	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU6027	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU6028	0.00%	0.00%	0.00%	k__Bacteria	p__Spirochaetes				
OTU6032	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes				
OTU6039	0.00%	0.00%	0.00%	k__Bacteria					
OTU6041	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6042	0.01%	0.00%	0.02%	k__Bacteria	p__Actinobacteria				
OTU6044	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6046	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6058	0.00%	0.01%	0.00%	k__Bacteria					
OTU6061	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp19	g__Gp19		
OTU6063	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6067	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6072	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU6073	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6075	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU6082	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6085	0.00%	0.00%	0.00%	k__Bacteria					
OTU6087	0.00%	0.00%	0.00%	k__Bacteria					
OTU6089	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU6090	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU6093	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU6096	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU6098	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6099	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6102	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU6107	0.00%	0.00%	0.00%	k__Bacteria					
OTU6111	0.00%	0.00%	0.00%	k__Bacteria					
OTU6115	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Propionibacteriaceae	
OTU6119	0.00%	0.00%	0.00%	k__Bacteria					
OTU6120	0.00%	0.00%	0.01%	k__Bacteria					
OTU6124	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU6125	0.00%	0.03%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU6126	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Planococcaceae	g__Sporosarcina
OTU6128	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU6132	0.57%	0.09%	0.28%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Intrasporangiaceae	
OTU6134	0.00%	0.00%	0.01%	k__Bacteria					
OTU6136	0.01%	0.34%	0.15%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU6137	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU6138	0.00%	0.00%	0.00%	k__Bacteria					
OTU6142	0.00%	0.01%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU6146	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6147	0.00%	0.00%	0.00%	k__Bacteria					
OTU6149	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp5	g__Gp5		
OTU6150	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6152	0.00%	0.00%	0.00%	k__Bacteria					
OTU6155	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU6158	0.00%	0.00%	0.00%	k__Bacteria					
OTU6159	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU6161	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6163	0.00%	0.00%	0.00%	k__Bacteria					
OTU6164	0.00%	0.00%	0.00%	k__Bacteria					
OTU6165	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6167	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU6168	0.00%	0.00%	0.00%	k__Bacteria					
OTU6169	0.00%	0.00%	0.00%	k__Bacteria					
OTU6170	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU6173	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria				
OTU6176	0.00%	0.00%	0.00%	k__Bacteria					
OTU6177	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU6179	0.00%	0.00%	0.00%	k__Bacteria					
OTU6183	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6184	0.02%	0.01%	0.01%	k__Bacteria					
OTU6188	0.00%	0.00%	0.01%	k__Bacteria	p__Actinobacteria				
OTU6190	0.00%	0.01%	0.01%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6196	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria				
OTU6198	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6199	0.00%	0.00%	0.00%	k__Bacteria					
OTU6200	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6201	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6207	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6208	0.01%	0.03%	0.01%	k__Bacteria	p__Verrucomicrobia				
OTU6211	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6214	0.00%	0.00%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6215	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU6219	0.00%	0.00%	0.01%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU6220	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Bacteroidetes_incertae_sedis	g__Ohtaekwangia		
OTU6227	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6228	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU6230	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6231	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6234	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU6248	0.00%	0.00%	0.00%	k__Bacteria					
OTU6249	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6250	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	f__Paenibacillaceae_1	g__Cohnella
OTU6251	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU6253	0.00%	0.00%	0.00%	k__Bacteria					
OTU6254	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU6256	0.00%	0.00%	0.00%	k__Bacteria					
OTU6257	0.00%	0.00%	0.00%	k__Bacteria					
OTU6258	0.00%	0.00%	0.00%	k__Bacteria					
OTU6260	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6261	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU6264	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6265	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6270	0.28%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU6272	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6274	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6277	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6278	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Streptosporangiaceae	
OTU6279	0.01%	0.00%	0.00%	k__Bacteria	p__Latescibacteria	g__Latescibacteria_genera_incertae_sedis			
OTU6280	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU6281	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	g__Gemmatimonas
OTU6285	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU6286	0.00%	0.00%	0.00%	k__Bacteria					
OTU6295	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6298	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU6300	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU6301	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU6302	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6304	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU6307	0.00%	0.05%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6308	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6309	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6310	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales		
OTU6311	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6315	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU6316	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6320	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6322	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU6324	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6327	0.02%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6329	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				

Client Sample ID	T1-C	T2-C	T3-C				
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018				
Contango Sample ID	DNA_195	DNA_194	DNA_193				
Sample Type	soil	soil	soil				
OTU ID	%	%	%	Classification			
OTU6333	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria		
OTU6334	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales
OTU6335	0.00%	0.01%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis	
OTU6336	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes		
OTU6338	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13
OTU6340	0.00%	0.01%	0.00%	k__Bacteria			
OTU6345	0.00%	0.00%	0.00%	k__Bacteria			
OTU6347	0.00%	0.01%	0.00%	k__Bacteria			
OTU6348	0.00%	0.00%	0.00%	k__Bacteria			
OTU6350	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2
OTU6351	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	
OTU6357	0.00%	0.00%	0.00%	k__Bacteria			
OTU6359	0.00%	0.00%	0.00%	k__Bacteria			
OTU6360	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU6361	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Rhodocyclales
OTU6362	0.00%	0.01%	0.00%	k__Bacteria			
OTU6364	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes		
OTU6365	0.00%	0.00%	0.00%	k__Bacteria			
OTU6366	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU6367	0.00%	0.00%	0.00%	k__Bacteria			
OTU6369	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	
OTU6371	0.00%	0.00%	0.00%	k__Bacteria			
OTU6374	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	
OTU6376	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae		
OTU6377	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	
OTU6379	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1		
OTU6381	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	
OTU6388	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes		
OTU6390	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	
OTU6393	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	
OTU6394	0.00%	0.02%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	
OTU6396	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16
OTU6398	0.00%	0.00%	0.00%	k__Bacteria			
OTU6399	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7
OTU6400	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4
OTU6401	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	
OTU6402	0.00%	0.01%	0.00%	k__Bacteria			
OTU6404	0.00%	0.02%	0.01%	k__Bacteria			
OTU6406	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6
OTU6410	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria		
OTU6411	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	
OTU6412	0.00%	0.00%	0.00%	k__Bacteria			
OTU6413	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria		
OTU6417	0.00%	0.00%	0.00%	k__Bacteria			
OTU6418	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	
OTU6422	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria		
OTU6423	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	
OTU6425	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria		
OTU6431	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales
OTU6434	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	
OTU6435	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria		
OTU6436	0.00%	0.00%	0.00%	k__Bacteria			
OTU6437	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6
OTU6440	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2		
OTU6441	0.00%	0.00%	0.00%	k__Bacteria			
OTU6443	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria		
OTU6445	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	
OTU6446	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia		
OTU6449	0.00%	0.00%	0.01%	k__Bacteria			
OTU6451	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	
OTU6452	0.02%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6
OTU6456	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes		
OTU6460	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU6468	0.00%	0.00%	0.00%	k__Bacteria					
OTU6469	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6472	0.00%	0.01%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp2	g__Gp2		
OTU6473	0.00%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	g__Gemmatimonas
OTU6477	0.02%	0.06%	0.08%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6479	0.01%	0.03%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6480	0.00%	0.00%	0.00%	k__Bacteria					
OTU6484	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6487	0.00%	0.00%	0.00%	k__Bacteria					
OTU6490	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU6491	0.00%	0.00%	0.00%	k__Bacteria					
OTU6497	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU6501	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6502	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU6503	0.00%	0.00%	0.00%	k__Bacteria					
OTU6505	0.00%	0.00%	0.00%	k__Bacteria					
OTU6506	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales		
OTU6510	0.01%	0.00%	0.00%	k__Bacteria					
OTU6511	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU6522	0.03%	0.01%	0.00%	k__Bacteria					
OTU6523	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6524	0.00%	0.00%	0.00%	k__Bacteria					
OTU6526	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6528	0.01%	0.00%	0.00%	k__Bacteria					
OTU6535	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6537	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17			
OTU6542	0.00%	0.00%	0.00%	k__Bacteria					
OTU6547	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU6550	0.00%	0.00%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6553	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6559	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6562	0.00%	0.00%	0.00%	k__Bacteria	p__BRC1				
OTU6569	0.00%	0.00%	0.00%	k__Bacteria					
OTU6570	0.00%	0.00%	0.00%	k__Bacteria					
OTU6571	0.00%	0.00%	0.00%	k__Bacteria					
OTU6572	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6573	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6574	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia			
OTU6575	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU6578	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6586	0.10%	0.00%	0.04%	k__Bacteria					
OTU6590	0.00%	0.00%	0.00%	k__Bacteria					
OTU6593	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU6595	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6597	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU6599	0.01%	0.01%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU6606	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU6609	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Syntrophobacterales	f__Syntrophaceae	
OTU6611	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU6613	0.00%	0.00%	0.00%	k__Bacteria					
OTU6621	0.00%	0.00%	0.00%	k__Bacteria					
OTU6623	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6629	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU6631	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU6633	0.00%	0.00%	0.00%	k__Bacteria	p__Microgenomates				
OTU6635	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU6636	0.03%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU6637	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6640	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU6646	0.00%	0.05%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6648	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6650	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia			
OTU6653	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU6654	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU6658	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU6660	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU6661	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU6663	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU6665	0.00%	0.01%	0.00%	k__Bacteria	p__candidate_division_WPS-1				
OTU6666	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6670	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Dyadobacter
OTU6676	0.00%	0.00%	0.00%	k__Bacteria					
OTU6680	0.00%	0.01%	0.00%	k__Bacteria					
OTU6681	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU6686	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU6690	0.06%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6692	0.01%	0.00%	0.06%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU6694	0.00%	0.00%	0.00%	k__Bacteria					
OTU6696	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6697	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10	g__Gp10		
OTU6700	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU6701	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU6704	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi	c__Anaerolineae	o__Anaerolineales		
OTU6705	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6713	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6717	0.00%	0.00%	0.00%	k__Bacteria					
OTU6720	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6729	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU6730	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU6736	0.05%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Desulfuromonadales		
OTU6739	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU6742	0.00%	0.00%	0.00%	k__Bacteria					
OTU6743	0.01%	0.01%	0.02%	k__Bacteria	p__Actinobacteria				
OTU6746	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6749	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	g__Planctopirus
OTU6758	0.00%	0.00%	0.00%	k__Bacteria					
OTU6760	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU6765	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU6768	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6769	0.00%	0.00%	0.00%	k__Bacteria					
OTU6770	0.01%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes	c__Armatimonadia	o__Armatimonadales	f__Armatimonadaceae	g__Armatimonas/Armatimonadetes_gp1
OTU6776	0.01%	0.00%	0.00%	k__Bacteria					
OTU6777	0.00%	0.00%	0.00%	k__Bacteria	p__Armatimonadetes				
OTU6781	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6782	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6786	0.00%	0.00%	0.00%	k__Bacteria					
OTU6787	0.00%	0.00%	0.00%	k__Bacteria					
OTU6788	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6796	0.00%	0.00%	0.00%	k__Bacteria					
OTU6797	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU6799	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU6802	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU6803	0.00%	0.00%	0.00%	k__Bacteria					
OTU6814	0.00%	0.02%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU6816	0.00%	0.01%	0.00%	k__Bacteria					
OTU6818	0.00%	0.00%	0.00%	k__Bacteria					
OTU6821	0.00%	0.00%	0.00%	k__Bacteria					
OTU6823	0.00%	0.02%	0.02%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU6824	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU6830	0.00%	0.00%	0.00%	k__Bacteria					
OTU6836	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU6844	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU6845	0.00%	0.00%	0.00%	k__Bacteria					
OTU6848	0.00%	0.00%	0.00%	k__Bacteria					
OTU6849	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU6850	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU6852	0.01%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU6856	0.08%	0.00%	0.00%	k__Bacteria					
OTU6857	0.00%	0.00%	0.00%	k__Bacteria					
OTU6858	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6867	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU6869	0.00%	0.00%	0.00%	k__Bacteria					
OTU6871	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU6881	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU6892	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nakamurellaceae	g__Nakamurella
OTU6898	0.00%	0.00%	0.00%	k__Bacteria					
OTU6900	0.01%	0.00%	0.01%	k__Bacteria	p__Gemmatimonadetes				
OTU6901	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6902	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6905	0.00%	0.01%	0.00%	k__Bacteria					
OTU6906	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6910	0.00%	0.00%	0.00%	k__Bacteria					
OTU6913	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU6919	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU6920	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU6927	0.04%	0.02%	0.06%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU6930	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU6932	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6943	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU6944	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU6950	0.00%	0.00%	0.00%	k__Bacteria					
OTU6955	0.00%	0.00%	0.00%	k__Bacteria					
OTU6958	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU6962	0.00%	0.00%	0.00%	k__Bacteria					
OTU6963	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU6964	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU6965	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU6966	0.00%	0.01%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales		
OTU6974	0.00%	0.00%	0.00%	k__Bacteria					
OTU6975	0.00%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU6978	0.00%	0.00%	0.00%	k__Bacteria					
OTU6979	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU6989	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU6993	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU6994	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU6997	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU6998	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU6999	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7003	0.01%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7006	0.01%	0.07%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU7010	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7014	0.00%	0.00%	0.00%	k__Bacteria					
OTU7015	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7016	0.01%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU7023	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7025	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU7026	0.01%	0.00%	0.03%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU7028	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes				
OTU7033	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7035	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7039	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU7051	0.00%	0.00%	0.00%	k__Bacteria					
OTU7056	0.00%	0.00%	0.00%	k__Bacteria					
OTU7057	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU7060	0.00%	0.00%	0.00%	k__Bacteria					
OTU7065	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU7071	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi				
OTU7080	0.10%	0.00%	0.21%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU7085	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU7086	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7088	0.00%	0.00%	0.00%	k__Bacteria					
OTU7090	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU7091	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7092	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU7094	0.00%	0.00%	0.00%	k__Bacteria					
OTU7095	0.00%	0.00%	0.00%	k__Bacteria					
OTU7098	0.02%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6			
OTU7100	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7101	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7102	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7107	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU7108	0.00%	0.01%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU7111	0.00%	0.00%	0.00%	k__Bacteria					
OTU7113	0.00%	0.00%	0.00%	k__Bacteria					
OTU7115	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7117	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales		
OTU7120	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU7123	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3	g__Subdivision3_genera_incertae_sedis		
OTU7126	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU7129	0.00%	0.00%	0.01%	k__Bacteria					
OTU7132	0.00%	0.00%	0.00%	k__Bacteria					
OTU7136	0.00%	0.00%	0.00%	k__Bacteria					
OTU7143	0.02%	0.03%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Solirubrobacterales		
OTU7145	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU7158	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU7165	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Cytophagia	o__Cytophagales	f__Cytophagaceae	g__Dyadobacter
OTU7171	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7173	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7175	0.01%	0.01%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU7177	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU7179	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU7182	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7185	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU7188	0.01%	0.00%	0.04%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU7190	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU7196	0.00%	0.00%	0.00%	k__Bacteria					
OTU7205	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7206	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU7209	0.01%	0.02%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU7210	0.00%	0.00%	0.00%	k__Bacteria					
OTU7212	0.00%	0.00%	0.00%	k__Bacteria					
OTU7215	0.00%	0.00%	0.00%	k__Bacteria					
OTU7220	0.04%	0.03%	0.04%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU7225	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7229	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU7235	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU7236	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU7238	0.00%	0.00%	0.00%	k__Bacteria					
OTU7248	0.00%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU7252	0.00%	0.00%	0.00%	k__Bacteria					
OTU7256	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU7259	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU7268	0.03%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		
OTU7272	0.00%	0.00%	0.00%	k__Bacteria					
OTU7280	0.00%	0.00%	0.00%	k__Bacteria					
OTU7284	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU7286	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7295	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU7296	0.00%	0.00%	0.00%	k__Bacteria					
OTU7297	0.00%	0.01%	0.03%	k__Bacteria					
OTU7302	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7304	0.00%	0.00%	0.00%	k__Bacteria					

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU7306	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7318	0.01%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU7320	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU7321	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7323	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU7326	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7330	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7331	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7335	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU7336	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU7342	0.00%	0.00%	0.00%	k__Bacteria					
OTU7344	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	f__Pseudomonadaceae	g__Cellvibrio
OTU7347	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU7348	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU7353	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Rhizobiaceae	g__Kaistia
OTU7360	0.00%	0.00%	0.00%	k__Bacteria					
OTU7361	0.00%	0.04%	0.02%	k__Bacteria	p__candidate_division_WPS-2				
OTU7365	0.03%	0.06%	0.05%	k__Bacteria					
OTU7369	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU7379	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7382	0.00%	0.00%	0.00%	k__Bacteria					
OTU7384	0.01%	0.15%	0.03%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU7386	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU7389	0.00%	0.00%	0.00%	k__Bacteria					
OTU7390	0.00%	0.00%	0.00%	k__Bacteria					
OTU7395	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Holophagae	o__Holophagales		
OTU7397	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7399	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria				
OTU7400	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7401	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU7411	0.00%	0.00%	0.00%	k__Bacteria					
OTU7413	0.00%	0.00%	0.01%	k__Bacteria	p__Armatimonadetes	c__Chthonomonadetes			
OTU7414	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU7419	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia	o__Clostridiales	f__Ruminococcaceae	
OTU7422	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13			
OTU7425	0.00%	0.00%	0.00%	k__Bacteria					
OTU7430	0.00%	0.00%	0.00%	k__Bacteria					
OTU7436	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU7445	0.00%	0.00%	0.00%	k__Bacteria					
OTU7462	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7470	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7483	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7484	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU7487	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU7489	0.00%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU7490	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU7498	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU7499	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU7508	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7515	0.00%	0.02%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU7516	0.00%	0.02%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7519	0.01%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7521	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU7524	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7529	0.00%	0.01%	0.01%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU7530	0.00%	0.00%	0.00%	k__Bacteria					
OTU7531	0.00%	0.07%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU7536	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU7537	0.00%	0.00%	0.00%	k__Bacteria					
OTU7540	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU7542	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Flavobacteriia	o__Flavobacteriales	f__Flavobacteriaceae	
OTU7543	0.00%	0.00%	0.00%	k__Bacteria					
OTU7544	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales		

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU7550	0.00%	0.00%	0.00%	k__Bacteria					
OTU7551	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Micromonosporaceae	
OTU7560	0.00%	0.00%	0.01%	k__Bacteria	p__candidate_division_WPS-1				
OTU7563	0.00%	0.00%	0.00%	k__Bacteria					
OTU7564	0.00%	0.00%	0.01%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU7566	0.00%	0.00%	0.00%	k__Bacteria					
OTU7570	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU7573	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU7576	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Clostridia			
OTU7577	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	
OTU7580	0.01%	0.00%	0.00%	k__Bacteria	p__candidate_division_WPS-2				
OTU7582	0.00%	0.00%	0.00%	k__Bacteria					
OTU7584	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7595	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU7597	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU7599	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU7601	0.01%	0.00%	0.00%	k__Bacteria					
OTU7603	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU7614	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes				
OTU7617	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU7618	0.00%	0.07%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7619	0.00%	0.00%	0.00%	k__Bacteria					
OTU7620	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7622	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7623	0.00%	0.00%	0.00%	k__Bacteria					
OTU7629	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7643	0.01%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16		
OTU7644	0.00%	0.00%	0.00%	k__Bacteria					
OTU7649	0.00%	0.01%	0.00%	k__Bacteria					
OTU7650	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7653	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7656	0.04%	0.09%	0.29%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU7657	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU7662	0.00%	0.00%	0.00%	k__Bacteria					
OTU7663	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7666	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU7670	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU7674	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7676	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4	g__Gp4		
OTU7679	0.00%	0.01%	0.01%	k__Bacteria					
OTU7682	0.00%	0.00%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU7684	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7685	0.00%	0.00%	0.01%	k__Bacteria	p__Planctomycetes	c__Planctomycetia			
OTU7690	0.00%	0.00%	0.00%	k__Bacteria					
OTU7692	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7695	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU7697	0.00%	0.00%	0.00%	k__Bacteria					
OTU7700	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU7703	0.00%	0.01%	0.01%	k__Bacteria	p__Parcubacteria				
OTU7708	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU7711	0.05%	0.04%	0.15%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU7724	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7726	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria				
OTU7727	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7729	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp13	g__Gp13		
OTU7730	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU7734	0.01%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU7737	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU7747	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Legionellales	f__Legionellaceae	g__Legionella
OTU7750	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU7755	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU7759	0.00%	0.00%	0.00%	k__Bacteria					
OTU7761	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		

Client Sample ID	T1-C	T2-C	T3-C					
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018					
Contango Sample ID	DNA_195	DNA_194	DNA_193					
Sample Type	soil	soil	soil					
OTU ID	%	%	%	Classification				
OTU7764	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7768	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU7776	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU7779	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU7783	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae		
OTU7788	0.00%	0.00%	0.00%	k__Bacteria				
OTU7792	0.00%	0.01%	0.00%	k__Bacteria				
OTU7793	0.00%	0.01%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae
OTU7794	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7796	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU7797	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria			
OTU7801	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7803	0.00%	0.00%	0.00%	k__Bacteria				
OTU7809	0.00%	0.00%	0.00%	k__Bacteria				
OTU7812	0.00%	0.00%	0.00%	k__Bacteria	p__Firmicutes	c__Bacilli	o__Bacillales	
OTU7814	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3		
OTU7815	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7817	0.00%	0.00%	0.00%	k__Bacteria				
OTU7818	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia			
OTU7820	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7822	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	
OTU7823	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU7825	0.00%	0.00%	0.00%	k__Bacteria				
OTU7827	0.00%	0.00%	0.00%	k__Bacteria				
OTU7841	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU7842	0.01%	0.00%	0.00%	k__Bacteria				
OTU7843	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis	
OTU7845	0.00%	0.00%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU7847	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU7848	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Comamonadaceae
OTU7850	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU7851	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae
OTU7866	0.01%	0.00%	0.00%	k__Bacteria				
OTU7872	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia		
OTU7874	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU7875	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria	o__Burkholderiales	f__Oxalobacteraceae
OTU7876	0.01%	0.00%	0.00%	k__Bacteria				
OTU7877	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU7881	0.00%	0.01%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria		
OTU7888	0.00%	0.00%	0.00%	k__Bacteria				
OTU7892	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria		
OTU7899	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp1		
OTU7909	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria	o__Pseudomonadales	
OTU7911	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes			
OTU7925	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16	g__Gp16	
OTU7926	0.00%	0.00%	0.00%	k__Bacteria				
OTU7931	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria			
OTU7947	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae			
OTU7948	0.00%	0.00%	0.01%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia		
OTU7974	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria			
OTU7981	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	
OTU7982	0.00%	0.00%	0.00%	k__Bacteria				
OTU7985	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU7996	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria			
OTU7997	0.00%	0.00%	0.00%	k__Bacteria	p__Chloroflexi			
OTU8006	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae	o__Opitutales	f__Opitutaceae
OTU8017	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			
OTU8019	0.00%	0.00%	0.01%	k__Bacteria				
OTU8035	0.00%	0.00%	0.00%	k__Bacteria				
OTU8039	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3		
OTU8045	0.00%	0.00%	0.00%	k__Bacteria				
OTU8058	0.00%	0.00%	0.00%	k__Bacteria				
OTU8064	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes			

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU8074	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU8075	0.00%	0.00%	0.00%	k__Bacteria					
OTU8077	0.00%	0.01%	0.01%	k__Bacteria	p__Gemmatimonadetes				
OTU8079	0.00%	0.00%	0.00%	k__Bacteria					
OTU8080	0.00%	0.00%	0.00%	k__Bacteria					
OTU8083	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU8087	0.01%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhodospirillales		
OTU8091	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU8097	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			
OTU8098	0.00%	0.00%	0.00%	k__Bacteria					
OTU8099	0.00%	0.00%	0.00%	k__Bacteria					
OTU8102	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU8103	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU8111	0.00%	0.00%	0.00%	k__Bacteria	p__Nitrospirae				
OTU8114	0.00%	0.00%	0.00%	k__Bacteria					
OTU8125	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp10			
OTU8128	0.00%	0.00%	0.01%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU8133	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Sphingobacteriaceae	g__Mucilaginibacter
OTU8135	0.00%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU8137	0.00%	0.00%	0.00%	k__Bacteria					
OTU8139	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				
OTU8143	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales		
OTU8145	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU8147	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU8155	0.00%	0.04%	0.00%	k__Bacteria					
OTU8157	0.02%	0.09%	0.02%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp16			
OTU8158	0.00%	0.00%	0.00%	k__Bacteria					
OTU8168	0.00%	0.00%	0.00%	k__Bacteria					
OTU8174	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU8176	0.01%	0.02%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales		
OTU8184	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU8194	0.00%	0.00%	0.01%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU8200	0.00%	0.01%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU8202	0.00%	0.01%	0.00%	k__Bacteria	p__Actinobacteria				
OTU8209	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria	g__Parcubacteria_genera_incertae_sedis			
OTU8230	0.01%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Opitutae			
OTU8232	0.00%	0.00%	0.00%	k__Bacteria					
OTU8236	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU8237	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae	o__Verrucomicrobiales		
OTU8239	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU8240	0.01%	0.00%	0.02%	k__Bacteria	p__Proteobacteria	c__Betaproteobacteria			
OTU8241	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8253	0.02%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8257	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia			
OTU8263	0.00%	0.00%	0.00%	k__Bacteria					
OTU8281	0.01%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU8286	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Verrucomicrobiae			
OTU8299	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8330	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU8332	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8333	0.00%	0.00%	0.00%	k__Bacteria					
OTU8334	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU8336	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Bdellovibrionales	f__Bdellovibrionaceae	g__Bdellovibrio
OTU8338	0.01%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU8339	0.00%	0.00%	0.00%	k__Bacteria					
OTU8344	0.00%	0.00%	0.00%	k__Bacteria					
OTU8357	0.00%	0.00%	0.00%	k__Bacteria					
OTU8377	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU8386	0.00%	0.00%	0.00%	k__Bacteria	p__Latescibacteria				
OTU8388	0.00%	0.00%	0.00%	k__Bacteria					
OTU8442	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU8445	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU8447	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae				

Client Sample ID	T1-C	T2-C	T3-C						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	Classification					
OTU8448	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU8479	0.00%	0.00%	0.00%	k__Bacteria					
OTU8486	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8505	0.01%	0.00%	0.05%	k__Bacteria					
OTU8507	0.00%	0.00%	0.00%	k__Bacteria	p__Hydrogenedentes				
OTU8523	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU8524	0.00%	0.00%	0.00%	k__Bacteria					
OTU8525	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales		
OTU8527	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Subdivision3			
OTU8533	0.00%	0.04%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp17	g__Gp17		
OTU8538	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU8546	0.00%	0.00%	0.07%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Caulobacterales	f__Caulobacteraceae	
OTU8551	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Kineosporiaceae	
OTU8556	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU8560	0.00%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7			
OTU8562	0.00%	0.00%	0.00%	k__Bacteria					
OTU8573	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU8589	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU8605	0.01%	0.00%	0.04%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU8612	0.00%	0.00%	0.00%	k__Bacteria					
OTU8615	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria				
OTU8616	0.01%	0.01%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria	g__Saccharibacteria_genera_incertae_sedis			
OTU8620	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		
OTU8622	0.00%	0.00%	0.00%	k__Bacteria					
OTU8631	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria			
OTU8640	0.00%	0.00%	0.00%	k__Bacteria					
OTU8641	0.00%	0.00%	0.00%	k__Bacteria					
OTU8648	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia	o__Chlamydiales		
OTU8653	0.00%	0.00%	0.00%	k__Bacteria					
OTU8658	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU8660	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia				
OTU8664	0.00%	0.01%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU8673	0.00%	0.00%	0.00%	k__Bacteria					
OTU8674	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes	c__Planctomycetia	o__Planctomycetales	f__Planctomycetaceae	
OTU8676	0.00%	0.00%	0.00%	k__Bacteria					
OTU8680	0.00%	0.00%	0.00%	k__Bacteria	p__Planctomycetes				
OTU8683	0.00%	0.00%	0.00%	k__Bacteria	p__Parcubacteria				
OTU8692	0.00%	0.02%	0.03%	k__Bacteria	p__Bacteroidetes	c__Sphingobacteriia	o__Sphingobacteriales	f__Chitinophagaceae	
OTU8704	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales	f__Hyphomicrobiaceae	g__Hyphomicrobium
OTU8705	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Gammaproteobacteria			
OTU8725	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp3			
OTU8736	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8742	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU8753	0.00%	0.01%	0.00%	k__Bacteria	p__Planctomycetes				
OTU8754	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria			
OTU8758	0.00%	0.00%	0.00%	k__Bacteria	p__Candidatus_Saccharibacteria				
OTU8765	0.00%	0.00%	0.00%	k__Bacteria	p__Chlamydiae	c__Chlamydiia			
OTU8770	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU8780	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU8784	0.00%	0.00%	0.00%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria	g__Spartobacteria_genera_incertae_sedis		
OTU8786	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8787	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria			
OTU8795	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes	o__Gemmatimonadales	f__Gemmatimonadaceae	g__Gemmatimonas
OTU8810	0.00%	0.01%	0.00%	k__Bacteria					
OTU8828	0.00%	0.00%	0.00%	k__Bacteria					
OTU8843	0.00%	0.00%	0.00%	k__Bacteria	p__Bacteroidetes				
OTU8844	0.00%	0.00%	0.00%	k__Bacteria					
OTU8845	0.00%	0.00%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp4			
OTU8866	0.01%	0.00%	0.01%	k__Bacteria	p__Proteobacteria				
OTU8882	0.00%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU8894	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU8942	0.01%	0.00%	0.00%	k__Bacteria	p__Gemmatimonadetes	c__Gemmatimonadetes			
OTU8946	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Deltaproteobacteria	o__Myxococcales		

Client Sample ID	**T1-C**	**T2-C**	**T3-C**						
Date Sampled	05-Jul-2018	05-Jul-2018	05-Jul-2018						
Contango Sample ID	DNA_195	DNA_194	DNA_193						
Sample Type	soil	soil	soil						
OTU ID	%	%	%	**Classification**					
OTU9004	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Actinomycetales	f__Nocardioidaceae	
OTU9022	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria				
OTU9035	0.01%	0.01%	0.01%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp6	g__Gp6		
OTU9046	0.00%	0.00%	0.00%	k__Bacteria	p__Actinobacteria	c__Actinobacteria	o__Gaiellales	f__Gaiellaceae	g__Gaiella
OTU9066	0.01%	0.02%	0.00%	k__Bacteria	p__Acidobacteria	c__Acidobacteria_Gp7	g__Gp7		
OTU9153	0.00%	0.00%	0.00%	k__Bacteria	p__Proteobacteria	c__Alphaproteobacteria	o__Rhizobiales		
OTU9158	0.00%	0.00%	0.00%	k__Bacteria					
OTU9161	0.01%	0.07%	0.01%	k__Bacteria	p__Verrucomicrobia	c__Spartobacteria			

ALEXCO RESOURCE CORP.
ATTN: Kai Woloshyn
#3 - 151 Industrial Road
Whitehorse YT Y1A 2V3

Date Received: 16-OCT-19
Report Date: 02-DEC-19 13:23 (MT)
Version: FINAL

Client Phone: 867-688-6463

Certificate of Analysis

Lab Work Order #: L2366434

Project P.O. #: NOT SUBMITTED
Job Reference: KENO MOSS
C of C Numbers: 1 of 1
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2366434-1 Moss 06-OCT-19 16:10 T1-A	L2366434-2 Moss 06-OCT-19 16:10 T1-B	L2366434-3 Moss 06-OCT-19 15:50 T2-A	L2366434-4 Moss 06-OCT-19 15:50 T2-B	L2366434-5 Moss 06-OCT-19 16:00 T3-A
TISSUE						
Physical Tests	% Moisture (%)	66.0	62.9	77.8	80.9	77.1
Metals	Aluminum (Al)-Total (mg/kg)	522	480	340	235	243
	Antimony (Sb)-Total (mg/kg)	32.4	27.3	14.0	6.54	3.59
	Arsenic (As)-Total (mg/kg)	40.6	29.7	11.3	5.47	5.89
	Barium (Ba)-Total (mg/kg)	94.7	67.6	21.3	38.0	84.9
	Beryllium (Be)-Total (mg/kg)	0.021	0.017	0.013	<0.010	0.025
	Bismuth (Bi)-Total (mg/kg)	0.835	0.607	0.285	0.157	0.094
	Boron (B)-Total (mg/kg)	15.9	5.9	3.5	4.5	4.0
	Cadmium (Cd)-Total (mg/kg)	35.1	26.8	13.5	6.91	4.09
	Calcium (Ca)-Total (mg/kg)	12900	7360	5160	6030	10700
	Cesium (Cs)-Total (mg/kg)	0.115	0.114	0.0967	0.0635	0.0616
	Chromium (Cr)-Total (mg/kg)	1.21	0.998	0.769	0.579	0.428
	Cobalt (Co)-Total (mg/kg)	0.739	0.655	0.395	0.282	0.282
	Copper (Cu)-Total (mg/kg)	60.3	44.4	20.8	13.6	7.55
	Iron (Fe)-Total (mg/kg)	4860	3790	1760	1190	796
	Lead (Pb)-Total (mg/kg)	4130	2890	1300	794	427
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1170	1170	1100	1390	1030
	Manganese (Mn)-Total (mg/kg)	1240	1130	498	420	226
	Molybdenum (Mo)-Total (mg/kg)	0.217	0.224	0.220	0.310	0.074
	Nickel (Ni)-Total (mg/kg)	3.07	2.17	1.63	1.11	0.99
	Phosphorus (P)-Total (mg/kg)	626	749	669	840	583
	Potassium (K)-Total (mg/kg)	1510	1740	1120	2180	1520
	Rubidium (Rb)-Total (mg/kg)	2.25	2.87	2.79	4.13	2.72
	Selenium (Se)-Total (mg/kg)	0.151	0.108	0.076	0.059	0.082
	Silver (Ag)-Total (mg/kg)	17.4	9.59	6.97	3.39	3.21
	Sodium (Na)-Total (mg/kg)	20	21	29	31	<20
	Strontium (Sr)-Total (mg/kg)	31.3	15.6	9.71	11.2	22.2
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0261	0.0222	0.0159	0.0108	0.0065
	Tin (Sn)-Total (mg/kg)	4.02	2.97	1.44	0.80	0.46
	Uranium (U)-Total (mg/kg)	0.0874	0.0709	0.0491	0.0439	0.0212
	Vanadium (V)-Total (mg/kg)	1.39	1.27	1.02	0.80	0.60
	Zinc (Zn)-Total (mg/kg)	2900	2130	1020	536	348
	Zirconium (Zr)-Total (mg/kg)	0.54	0.49	0.36	<0.20	<0.20

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2366434-6 Moss 06-OCT-19 16:00 T3-B	L2366434-7 Moss 03-OCT-19 13:35 BM-NAT-05-A	L2366434-8 Moss 03-OCT-19 13:35 BM-NAT-05-B	L2366434-9 Moss 03-OCT-19 14:16 BM-NAT-10-A	L2366434-10 Moss 03-OCT-19 14:16 BM-NAT-10-B
TISSUE						
Physical Tests	% Moisture (%)	73.4	81.2	93.6	92.1	86.5
Metals	Aluminum (Al)-Total (mg/kg)	294	395	601	127	97.1
	Antimony (Sb)-Total (mg/kg)	6.90	0.192	0.200	0.435	0.356
	Arsenic (As)-Total (mg/kg)	8.86	0.735	0.906	1.35	1.34
	Barium (Ba)-Total (mg/kg)	53.0	18.6	120	24.6	34.6
	Beryllium (Be)-Total (mg/kg)	0.011	0.019	0.036	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg)	0.151	<0.010	<0.010	<0.010	<0.010
	Boron (B)-Total (mg/kg)	4.0	<1.0	<1.0	1.6	5.0
	Cadmium (Cd)-Total (mg/kg)	6.66	0.616	0.787	2.22	2.55
	Calcium (Ca)-Total (mg/kg)	9960	1530	4160	5310	5500
	Cesium (Cs)-Total (mg/kg)	0.0901	0.507	0.0755	0.0645	0.0499
	Chromium (Cr)-Total (mg/kg)	0.621	0.379	0.333	0.288	0.250
	Cobalt (Co)-Total (mg/kg)	0.283	0.377	1.60	0.252	0.387
	Copper (Cu)-Total (mg/kg)	12.7	2.11	2.14	2.66	4.61
	Iron (Fe)-Total (mg/kg)	1260	314	625	365	295
	Lead (Pb)-Total (mg/kg)	711	10.0	19.0	24.4	19.4
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	1250	627	1160	1250	1270
	Manganese (Mn)-Total (mg/kg)	213	415	350	311	918
	Molybdenum (Mo)-Total (mg/kg)	0.123	0.073	0.102	0.043	0.067
	Nickel (Ni)-Total (mg/kg)	1.03	0.70	2.12	1.03	0.79
	Phosphorus (P)-Total (mg/kg)	733	629	524	949	893
	Potassium (K)-Total (mg/kg)	1830	3090	3010	3520	2270
	Rubidium (Rb)-Total (mg/kg)	4.61	16.0	10.7	8.05	5.26
	Selenium (Se)-Total (mg/kg)	0.112	<0.050	0.055	<0.050	<0.050
	Silver (Ag)-Total (mg/kg)	2.81	0.391	0.256	0.532	0.509
	Sodium (Na)-Total (mg/kg)	23	<40 DLM	182	41	<20
	Strontium (Sr)-Total (mg/kg)	21.7	4.79	18.1	11.0	9.09
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Thallium (Tl)-Total (mg/kg)	0.0091	0.0052	0.0247	0.0128	0.0029
	Tin (Sn)-Total (mg/kg)	0.75	<0.10	<0.10	<0.10	<0.10
	Uranium (U)-Total (mg/kg)	0.0361	0.0123	0.0477	0.0124	0.0087
	Vanadium (V)-Total (mg/kg)	0.86	0.48	0.51	0.35	0.25
	Zinc (Zn)-Total (mg/kg)	591	41.5	46.0	276	175
	Zirconium (Zr)-Total (mg/kg)	0.23	<0.20	<0.20	<0.20	<0.20

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2366434-11	L2366434-12			
	Description	Moss	Moss			
	Sampled Date	05-OCT-19	05-OCT-19			
	Sampled Time	13:20	13:20			
	Client ID	BM-NAT-18-A	BM-NAT-18-B			
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	78.3	78.9			
Metals	Aluminum (Al)-Total (mg/kg)	1080	1550			
	Antimony (Sb)-Total (mg/kg)	1.21	1.71			
	Arsenic (As)-Total (mg/kg)	4.76	8.82			
	Barium (Ba)-Total (mg/kg)	91.8	92.3			
	Beryllium (Be)-Total (mg/kg)	0.101	0.140			
	Bismuth (Bi)-Total (mg/kg)	0.026	0.021			
	Boron (B)-Total (mg/kg)	6.3	6.0			
	Cadmium (Cd)-Total (mg/kg)	32.9	34.1			
	Calcium (Ca)-Total (mg/kg)	13900	13900			
	Cesium (Cs)-Total (mg/kg)	0.736	0.494			
	Chromium (Cr)-Total (mg/kg)	1.73	2.28			
	Cobalt (Co)-Total (mg/kg)	1.73	2.84			
	Copper (Cu)-Total (mg/kg)	17.2	24.4			
	Iron (Fe)-Total (mg/kg)	1980	3030			
	Lead (Pb)-Total (mg/kg)	28.1	45.5			
	Lithium (Li)-Total (mg/kg)	0.71	1.01			
	Magnesium (Mg)-Total (mg/kg)	1740	1960			
	Manganese (Mn)-Total (mg/kg)	1540	2440			
	Molybdenum (Mo)-Total (mg/kg)	0.247	0.356			
	Nickel (Ni)-Total (mg/kg)	37.2	39.2			
	Phosphorus (P)-Total (mg/kg)	1380	1590			
	Potassium (K)-Total (mg/kg)	2190	2670			
	Rubidium (Rb)-Total (mg/kg)	19.5	23.2			
	Selenium (Se)-Total (mg/kg)	0.306	0.468			
	Silver (Ag)-Total (mg/kg)	1.30	1.50			
	Sodium (Na)-Total (mg/kg)	48	123			
	Strontium (Sr)-Total (mg/kg)	35.8	35.1			
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020			
	Thallium (Tl)-Total (mg/kg)	0.0620	0.0821			
	Tin (Sn)-Total (mg/kg)	0.11	0.14			
	Uranium (U)-Total (mg/kg)	0.306	0.534			
	Vanadium (V)-Total (mg/kg)	2.98	4.19			
	Zinc (Zn)-Total (mg/kg)	2740	2780			
	Zirconium (Zr)-Total (mg/kg)	0.52	0.91			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Certified Reference Material	Lead (Pb)-Total	MES	L2366434-1, -10, -11, -12, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-DRY-CCMS-N-VA	Tissue	Silver in Tissue by CRC ICPMS (DRY)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-DRY-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (DRY)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1 of 1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

APPENDIX B:

SURFACE AND SEEP WATER QUALITY

Station	Description	Sample Date	Sample Comments	Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME-Aquatic							6.5 - 9	6.5 - 9				6.5							120	0.12			*		0.06	3.0			*			0.005					1.5	*			0.001	
BC-ENV Aquatic Life																					*								*		0.074											0.004
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008				6	7.4	7.87		731	0.1					449						429		7.51					0.053	0.1	0.0003	0.0055	0.08	<0.0001	<0.0005	0.002	0.00094	0.00037	133	<0.0005	0.0004	
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008				41	7.51	7.74		457	3					233						429		4.58					0.45	0.1	0.0014	0.0166	0.05	<0.0001	<0.0005	<0.002	0.00275	0.000320	72.3	0.0014	0.0014	
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008				5		7.96		702						381						429		2.10					0.034	0.1	0.0004	0.0043	0.062	<0.0001	<0.0005	0.003	0.00187	0.00037	117	<0.0005	0.0001	
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008		129.6		9	7.2	7.98		660	8.5					351						429		5.99					0.077	0.1	0.0007	0.0058	0.061	<0.0001	<0.0005	0.006	0.00346	0.00037	116	0.0006	0.0003	
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008		119.385		10	7.42	7.85		601	7					320						429		4.08					0.023	0.1	0.0003	0.0042	0.055	<0.0001	<0.0005	0.003	0.00198	0.00037	97.3	0.0005	0.0002	
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008		80.18		11	6.82	7.87		635	6					396						429		17.5					0.012	0.1	<0.0002	0.0028	0.05	<0.00004	<0.0001	<0.005	0.00153	0.00037	106	0.0006	0.00016	
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008		160.71		20	7.47	7.7		594	5					349						429		4.27				4	0.074	0.1	0.0008	0.0053	0.056	<0.00004	<0.0001	<0.005	0.00359	0.00037	104	0.0005	0.00048	
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008				<2		7.87		665						339						429		2.58				1.6	0.025	0.1	0.0005	0.0026	0.071	<0.00004	<0.0001	<0.005	0.00203	0.00037	111	0.0004	0.00042	
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008	Total metals results greatly elevated due to TSS contamination (creek bottom disturbed); results removed from database as non-representative.			~		7.88		703					~	392						429		2.52				1.4	~	0.1	~	~	~	~	~	~	~	0.00037	~	~	~
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009				<2		7.74		816						451						429		3.47				1.7	0.01	0.1	0.0006	0.0043	0.093	<0.0001	<0.0005	0.004	0.00106	0.00037	147	0.0007	0.0005	
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009				26		7.75		631						405						429		3.39					0.042	0.1	<0.0002	0.0005	0.02	<0.00004	<0.0001	<0.005	0.0004	0.00037	128	0.0007	0.00016	
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009				<5		7.58		803						368						429		5.01					0.012	0.1	0.0004	0.005	0.053	<0.00004	<0.0001	<0.005	0.00092	0.00037	124	0.0004	0.0003	
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009				<4		8.1		510					251	255						429		1.52					0.0473	0.1	0.00011	0.00091	0.0348	<0.00001	<0.000005	<0.05	0.00016	0.000340	87.5	0.0011	0.000137	
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009				2	6.9	7.6		36	2.8				19.4	19.9						128		18.9					0.0492	0.1	0.00013	0.0008	0.00689	<0.00001	<0.000005	<0.05	0.000114	0.00004	5.92	0.0002	0.000043	
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009		124.365		18	7.53	7.9		530	16				262	270						429		1.58					0.0379	0.1	0.00102	0.00719	0.0486	<0.00001	0.000032	<0.05	0.00278	0.000353	83.1	0.0002	0.000252	
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009		101.233		2	7.9	8.1		710	9.6				379	398						429		1.11					0.0055	0.1	0.00039	0.00356	0.0608	<0.00001	<0.000005	<0.05	0.00137	0.00037	117	0.0001	0.000098	
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009				6		8.1		813					457	451					280	429		1.52					0.0106	0.1	0.00042	0.00558	0.0616	<0.00001	<0.000005	<0.05	0.00117	0.00037	142	<0.0001	0.000149	
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009		102.54		1	7.36	7.9		756	7.2				448	422					260	429		4.60					0.0081	0.1	0.00039	0.00338	0.0586	<0.00001	<0.000005	<0.05	0.00159	0.00037	141	0.0003	0.000105	
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009		33.155		4	7.51	8		801	2.1				428	423					270	429		4.94					0.0241	0.1	0.00054	0.00584	0.0581	<0.00001	<0.000005	<0.05	0.00203	0.00037	135	0.0003	0.000486	
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009				2	8.19	7.9		872	0.1				449	462					300	429		1.23					0.0131	0.1	0.00042	0.00369	0.0591	<0.00001	0.000007	<0.05	0.00112	0.00037	140	0.0005	0.00131	
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009				1	7.56	7.8		845	0.1				463	457					310	429		5.20					0.0085	0.1	0.00032	0.00355	0.0671	<0.00001	<0.000005	<0.05	0.00108	0.00037	150	0.0004	0.00114	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010				2	7.94	7.8		851	0.5				474	490					270	429		2.10					0.0076	0.1	0.00028	0.00474	0.0635	<0.00001	<0.000005	<0.05	0.000934	0.00037	149	0.0003	0.00131	
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010				2	7.68	8		860	1				481	500					300	429		3.66					0.0069	0.1	0.00027	0.00523	0.0624	<0.00001	<0.000005	<0.05	0.0008	0.00037	153	0.0003	0.00137	
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010				2	7.91	7.9		883	0.2				527	512					280	429		2.31				0.8	0.0094	0.1	0.00022	0.00597	0.0594	<0.00001	<0.000005	<0.05	0.000744	0.00037	168	0.0003	0.00133	
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010				2	7.77	7.9		853	0.2				503	522					340	429		3.18					0.0135	0.1	0.00027	0.00664	0.0574	<0.00001	<0.000005	<0.05	0.00077	0.00037	161	0.0002	0.00155	
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010		71.19		2	7.74	7.9		555	2.3				276	276					210	429		2.87					0.0373	0.1	0.00042	0.00511	0.0429	<0.00001	<0.000005	<0.05	0.00102	0.000368	87.5	0.0003	0.000795	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010				1	7.62	8.1		784	10.6				390	423					310	429		1.94					0.0091	0.1	0.00036	0.00327	0.0483	<0.00001	<0.000005	<0.05	0.00197	0.00037	118	0.0003	0.000151	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010		94.01815		3	7.74	7.93		749	13.5				404	410					250	429		1.18					0.26	0.1	0.00257	0.0513	0.0739	0.00001	0.000016	<0.05	0.00779	0.00037	127	0.0009	0.00156	
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010		61.129433		2	7.85	8.03		765	14				434	456					260	429	0.06	0.889					0.0097	0.1	0.00036	0.00431	0.0509	<0.00001	0.000053	<0.05	0.00096	0.00037	133	0.0004	0.000128	
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010		141.375		6	7.05	8.02		787	4.2				424	439	120				290	429	<0.005	12.0	<0.005	0.07		2	0.0231	0.1	0.00125	0.00976	0.0494	<0.00001	<0.000005	<0.05	0.00151	0.00037	131	0.0006	0.000284	
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010		94.041		2	7.88	7.97		796	1				429	429	120				320	429	0.01	2.32	<0.005	0.13		2.4	0.0049	0.1	0.00019	0.00374	0.0458	<0.00001	<0.000005	<0.05	0.000895	0.00037	133	0.0003	0.000268	
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010	no flow taken - ice			1	6.81	7.87		856	0.1				495	510	130				340	429	0.012	29.2	<0.005	0.18		1.1	0.0062	0.1	0.00021	0.00387	0.0541	<0.00001	<0.000005	<0.05	0.00104	0.00037	158	0.0003	0.00139	
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010	no flow taken - ice			5	8.04	7.78		955	0.1				518	525	150				420	429	0.047	1.73	<0.005	0.23		3.5	0.0083	0.1	0.00025	0.0037	0.0687	<0.00001	<0.000005	<0.05	0.00146	0.00037	162	0.0002	0.00133	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011	no flow taken - ice.			2	7.85	7.59		854	0				481	475	130				300	429	0.046	2.70	<0.005	0.24		0.7	0.0044	0.1	0.00021	0.00471	0.0602	<0.00001	<0.000005	<0.05	0.000802	0.00037	150	0.0006	0.00124	
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011	no flow taken.			1	8.11	7.82		940	0				502	485	130				350	429	0.14	1.49	<0.005	0.23		1.5	0.0062	0.1	0.0002	0.00749	0.0603	<0.00001	<0.000005	<0.05	0.00073	0.00037	161	0.0003	0.00165	
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011	no flow taken -ice. Spent 1/2 hr trying to find water. Auger, axed			2	7.73	7.61		920	0.5				573	544	140				390	429	0.1	3.40	<0.005	0.22		1.3	0.0097	0.1	0.00019	0.00873	0.0632	<0.00001	<0.000005	<0.05	0.000651	0.00037	183	0.0004	0.00166	
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011	pH on multimeter not working. No flow taken - ice			1		7.69		955	0.8				564	566	130				380	429	0.089	3.64	<0.005	0.26		1.2	0.0092	0.1	0.00021	0.00817	0.0578	<0.00001	<0.000005	<0.05	0.000735	0.00037	180	0.0005	0.0016	
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011		135.975		3	7.84	7.78		581	12.1				303	304	85				180	429		1.05				8.6	0.0247	0.1	0.0004	0.00583	0.0365	<0.00001	<0.000005	<0.05	0.00189	0.00037	99.6	0.0003	0.000347	
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011		79.95		1	8.23	7.98		829	10.5				470	464	100				290	429	0.018	0.492				<0.5	0.0078	0.1	0.00034	0.00421	0.0552	<0.00001	<0.000005	<0.05	0.00145	0.00037	146	0.0002	0.000161	
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011	flows by Marsh McB	90.96		2	7.88	7.8	730	748	12.8				407	418	91				270	429	0.043	0.909	<0.005	<0.2		4.5	0.0103	0.1	0.00038	0.00503	0.0442	<0.00001	<0.000005	<0.05	0.00147	0.00037	127	0.0003	0.000208	
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011	flows with Marsh McB. no staff gauge	127		2	7.78	7.81	772	788	8.1				444	441	110				280	429		1.64				5	0.0185	0.1	0.00032	0.00492	0.0382	<0.00001	<0.000005	<0.05	0.00185	0.00037	138	0.0003	0.000338	
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011	flows with Marsh McB	127.0575		1	7.52	8.09	842	848	4.4				447	451	120				289	429	0.009	3.99	<0.005	0.1		1.9	0.0106	0.1	0.00028	0.00527	0.0433	<0.00001	<0.000005	<0.05	0.00215	0.00037	141	0.0003	0.000439	
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011		88		1	7.66	7.55	970	929	0.4	10.56	75	244.4	511	527	120				356	429	0.063	4.03	<0.05	<0.2	0.3	0.8	0.0046	0.1	0.00025	0.00361	0.053	<0.00001	<0.000005	<0.05	0.00132	0.00037	159	<0.0001	0.00243	
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011	Salt Slug; field conductivity not entered, probe malfunction in cold	74.8		2.7	7.49	7.9		896	0.1	9.64	65.8		497	493	133				342	429	0.035	6.11	<0.005	0.177	0.269	1.7	0.0096	0.1	0.00032	0.00597	0.0585	<0.00001	<0.000005	<0.05	0.0014	0.00037	153	0.0002	0.00242	
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011	Salt Slug	107.2		4.2	7.36	7.64	913	906	-0.1	12.78	87.3		505	506	138				346	429	0.18	8.30	<0.005	0.234	1.2	2.1	0.011	0.1	0.00039	0.007	0.0643	<0.00001	<0.000005	<0.05	0.00123	0.00037	159	0.0009	0.00234	
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012	Condition not condusive to measure flow.			2.1	7.3	7.59	829.1	867	0	11.1	76	282.6	468	458	130				294	429	0.11	9.53	<0.005	0.246	0.278	0.78	0.0198	0.1	0.00026	0.00621	0.0616	<0.00001	<0.000005	<0.05	0.00114	0.00037	149	0.0006	0.00187	
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012	Salt Slug, non-ideal result, caution	77.2		1.3	7.21	8.04	926.8	919	-0.1	12.63	86.4	30.9	525	545	139				329	429	0.13	11.7	<0.005	0.228	0.197	1.08	0.003	0.1	0.00017	0.0103	0.0572	<0.00001	<0.000005	<0.05	0.000898	0.00037	167	<0.0001	0.0023	
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012	Salt Slug	77.3		1.1	7.1	8.16	937.5	914	-0.1	13.14	90	293.4	518	537	135				344	429	0.12	15.1	<0.05	0.27	<0.20	1.57	0.0038	0.1	0.00018	0.0102	0.0585	<0.00001	<0.000005	<0.05	0.000818	0.00037	163	0.0001	0.00213	
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012	Salt Slug	61.7		1.8	7.69	7.77	1022	927	0.1	13.55	93.1	44.4	483	502	131				312	429	0.12	3.86	<0.005	0.259	0.144	0.9	0.009	0.1	0.00018	0.00967	0.0551	<0.00001	<0.000005	<0.05	0.000779	0.00037	151	<0.0001	0.00219	
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012	slow meandering flow. Installed Staff gauge, reading @14:12	147.0	0.345	2.8	7.67	7.62	526.0	527	1.9	12.53	90.50	185.00	271	268	66.4		<0.50		196	429	0.036	3.48	<0.050	1.06	0.108	10.4	0.0412	0.1	0.000375	0.00819	0.0378	0.00001	<0.0000050	<0.050	0.00378	0.000363	86.7	0.00017	0.00145	
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012	No ice over the water.	104.7	0.320	3.2	7.93	7.75	507.0	539	2.3	13.33	96.80	220.70	281	288	76.2		1.1		185	429	0.032	1.86	<0.050	<0.050	0.466	8.55	0.0287	0.1	0.000522	0.00961	0.0417	<0.000010	<0.0000050	<0.050	0.00239	0.00037	88.4	0.00018	0.00124	
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	Creek bed rusty.	88.65	0.29	<1.0	7.92	7.97	830	759	11	14.7	134	343.5	365	364	98.3		1.2		278	429	0.025	0.952	<0.050	<0.20	0.28	3.95	0.00723	0.1	0.000286	0.00369	0.0465	<0.000010	<0.0000050	<0.050	0.000729	0.00037	112	0.00019	0.000225	
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012	water clear; rocky bottom-reddish; flow from below culvert	85.35	0.29	1.9	7.93	8.06	875	883	13.1	10.89	104.4	68	545	459	96.3		1.3		353	429	0.059	0.793	<0.050	<0.20	0.22	2.55	0.00787	0.1	0.000358	0.00492	0.0451	<0.000010	<0.0000050	<0.050	0.000742	0.00037	171	<0.00010	0.000224	
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012	testing functionality of flow meter	104.69	0.315																	128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012		91	0.34	1	7.82	8.02	960	866	12.9	10.99	104.3	80.2	502	420	106		1		341	429	0.028	1.03	<0.050	<0.20	0.3	2.86	0.00724	0.1	0.000349	0.00521	0.0462	<0.000010	<0.0000050	<0.050	0.00086	0.00037	157	<0.00010	0.000257	
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012		89.1	0.445	1.5	7.75	8.09	1030	921	5.6	11.12	88.9	75.2	492	527	123		1.2		352	429	0.012	2.14	<0.050	<0.20	0.23	2.81	0.00713	0.1	0.00021	0.00449	0.0478	<0.000010	<0.0000050	<0.050	0.00108	0.00037	155	<0.00010	0.000691	
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012	Sampled with Kim Winnecky & Jossee Tremblay (NND). Returned Oct 16 to measure flows when data logger downloaded & winterized.			<1.0	7.56	8.03	1056	941	0.6	11.86	83.2	81.1	498	494	124		1.2		365	429	0.036	4.99	<0.050	0.22	<0.20	2	0.00447	0.1	0.000178	0.0036	0.0495	<0.000010	<0.0000050	<0.050	0.000769	0.00037	160	0.00026	0.000644	
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012	Returned to measure flows when data logger downloaded & winterized.	76.18																		128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012	Took samples between 2 ice layers.YSI conductivity not working properly , flow reading not possible.			2.8	8	8.06		928	0.1	12	82	361.3	526	513	140		1.8		359	429	0.057	1.90	<0.050	0.32	<0.20	1.35	0.0148	0.1	0.000411	0.00645	0.0687	<0.000010	0.000008	<0.050	0.00132	0.00037	165	0.00013	0.00194	
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012	Ice too thick to get to water with ice auger.																			128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013	Over 150 cm of ice. Could not find water.																			128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013	No water found. Frozen to the ground.																			128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	14-Mar-2013	Could not find water. Ice too thick for ice auger or frozen to the ground.																			128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	05-Apr-2013	Sampled turbid overflow that appears to be affected by road proximity. Non-representative results removed.																			128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2013	Ice over 1.5 meter deep. Water flowing between ice layer Cannot slug.			7.2	7.72	7.64	579.5	610	0	12.56	85.6	132.6	317	309	39.1		7.55	0.033	268	429	0.0112	3.63	0.0011	0.0381	0.917	14.8	0.221	0.1	0.00089	0.00431	0.0416	<0.00010	<0.00050	<0.010	0.00114	0.00037	92.0	0.00061	0.00041	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2013	Water turbid. Staff gauge reading at 13:47.	122.62	0.558	16.2	7.96	7.98	676	693	11.5	10.42	96	63.2	378	393	82.4		0.84	0.117	297	429	0.0186	0.837	<0.0010	0.0676	0.267	7.40	0.172	0.1	0.00058	0.00890	0.0503	<0.00010	<0.00050	<0.010	0.000842	0.00037	121	0.00057	0.00126	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jul-2013	Algae on bottom.	81.948		1.6	8.1	7.99	801	870	11.2	10.81	98.8	125.6	532	514	113		<5.0	<0.20	397	429	0.0087	0.625	<0.010	0.096	0.138	2.71	0.0184	0.1	0.00056	0.00552	0.0442	<0.00010	<0.00050	<0.010	0.000994	0.00037	166	0.00015	0.00042	
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2013		107.92		1.6	7.4	7.85	823	893	8.7	11.63	100.1	175.5	529	521	116		<5.0	0.21	408	429	<0.0050	3.73	<0.01	0.136	0.129	1.64	0.0278	0.1	0.00061	0.00785	0.0535	<0.00010	<0.00050	<0.010	0.00103	0.00037	162	0.00017	0.00038	
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2013		87.213	0.535	<1.0	7.65	7.67	891	843	6.2	12.4	101.6	155.6	518	523	116		<5.0	0.25	388	429	<0.0050	2.56	<0.010	0.145	0.110	2.04	0.0122	0.1	0.00030	0.00611	0.0484	<0.00010	<0.00050	<0.010	0.00103	0.00037	159	<0.00010	0.00031	
KV-6	Christal Creek u/s Silver Trail Highway	11-Sep-2013		91.5	0.189																	128		0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	10-Oct-2013		92.7		9.2	7.01	7.88	848.8	716	1	13.7	98.2	126.4	465	472	126		<2.5	0.21	344	429	0.0096	17.1	<0.0050	0.159	0.113	2.49	0.0220	0.1	0.00034	0.00510	0.0444	<0.00010	<0.00050	<0.010	0.00162	0.00037	146	0.00019	0.00103	
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2013	salt slug tried, short disatance and large bend/pool. May not be accurate. Water is clear, 100% ice covered. Flow measurements at 11:12.	80.2		1.2	7.33	7.31	805.1	718	-0.1	11.47	78.9	159.9	490	501	139		<2.5	0.19	356	429	0.0552	8.89	<0.0050	0.238	0.078	1.43	0.0163	0.1	0.00039	0.00447	0.0588	<0.00010	<0.00050	<0.010	0.00115	0.00037	153	0.00015	0.00171	
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2013	Water slightly brown and turbid (possibly slightly stirred up from making hole). TSS elevated and non-representative total metals results removed. 100% ice cover. No suitable place for salt slug due to overflow.					7.31	7.87	883.4

Station	Description	Sample Date	Sample Comments	Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014		99.67	0.18	1.4	8.08	7.85	796	722	11.7	10.95	102	233.3	452	457	106		0.97	0.120	320	429	0.0110	0.629	<0.0010	0.107	0.219	3.66	0.0219	0.1	0.00063	0.00564	0.0385	<0.00010	<0.00050	<0.010	0.000981	0.00037	141	0.00017	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014		63.01	0.162	6.2	7.71	7.74	829	796	7	11.3	93.2	307.1	492	501	116		1.26	0.129	341	429	0.0063	2.10	<0.0010	0.131	0.134	2.20	0.0314	0.1	0.00056	0.00649	0.0456	<0.00010	<0.00050	<0.010	0.00114	0.00037	151	0.00012	0.00034
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014		110.1515	0.202	<1.0	7.75	7.96	809	758	5.6	13.08	106	272.9	459	470	128		1.50	0.117	319	429	0.0050	2.14	<0.0010	0.132	0.141	2.42	0.0142	0.1	0.00045	0.00514	0.0425	<0.00010	<0.00050	<0.010	0.00131	0.00037	143	0.00012	0.00046
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	Ice affected stage	102.2	0.205	<1.0	7.48	7.88	757.5	826	0.3	13.67	96	138.4	475	466	140		1.61	0.125	310	429	0.0244	6.14	<0.0010	0.221	0.108	2.05	0.0161	0.1	0.00032	0.00377	0.0511	<0.00010	<0.00050	<0.010	0.00139	0.00037	147	0.00014	0.00151
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014	Glacier from road to Staff Gauge (frozen at 0.360m)	80.1		2.8	7.51	7.15	827.8	837	-0.1	11.48	77.8	104	479	477	149		1.76	0.135	313	429	0.0511	5.88	<0.0010	0.262	0.153	1.03	0.0184	0.1	0.00035	0.00428	0.0587	<0.00010	<0.00050	<0.010	0.00118	0.00037	148	0.00028	0.00182
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014				5.6	6.47	7.57	814.2	835	0	13.69	95.5	124.1	446	444	138		2.63	0.134	299	429	0.0619	64.3	0.0053	0.317	0.107	1.01	0.0515	0.005	0.00048	0.00857	0.0631	<0.00010	<0.00050	<0.010	0.00136	0.00037	138	0.00026	0.00182
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015	water clear; 100% ice covered ~1m thick	104.3		5.0	7.05	7.53	824	828	0	13.99	96.7	66	476	479	138		1.64	0.138	320	429	0.0666	16.9	<0.0010	0.319	0.108	0.84	0.0441	0.1	0.00055	0.0105	0.0597	<0.00010	<0.00050	<0.010	0.00118	0.00037	149	0.00016	0.00195
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015				5.2	6.87	7.30	850.9	892	0.1	12.87	88.5	119.4	474	476	143		1.44	0.138	330	429	0.0676	25.4	0.0011	0.319	0.114	1.30	0.0415	0.1	0.00081	0.0144	0.0603	<0.00010	<0.00050	<0.010	0.00131	0.00037	148	0.00019	0.00217
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015	strong odour, marshy.	69.8		2.0	7.46	7.93	855	819	0	4.04	27.9	296.3	507	500	135		1.41	0.142	333	429	0.0738	6.60	0.0012	0.318	0.121	0.88	0.0184	0.1	0.00026	0.0115	0.0542	<0.00010	<0.00050	<0.010	0.000798	0.00037	159	0.00014	0.00204
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015		55.8		3.0	8.4	7.51	916	833	0.2	14.8	103.5	125.4	512	517	143		1.45	0.156	351	429	0.0727	0.759	0.0011	0.319	0.131	1.20	0.0133	0.1	0.00025	0.0113	0.0540	<0.00010	<0.00050	<0.010	0.000682	0.00037	163	<0.00010	0.00195
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015	No staff gauge reading	324		9.8	6.68	7.36	294.9	269	2.2	12.08	88.1	234.1	138	146	41.6		0.51	0.066	88.7	309	0.0430	33.0	<0.0010	0.0515	0.732	17.3	0.237	0.1	0.00175	0.0127	0.0359	<0.00010	<0.000050	<0.010	0.00171	0.000207	44.1	0.00048	0.00137
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015		105.9	0.245	2.2	7.6	7.83		895	6.2	9.8	89	188.5	525	527	121		1.10	0.145	369	429	0.0148	2.88	<0.0010	0.160	0.179	2.69	0.0132	0.1	0.00034	0.00574	0.0538	<0.00010	<0.000050	<0.010	0.000719	0.00037	167	<0.00010	0.00069
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015		100.0	0.256	3.6	7.73	8.00	756	845	12.4	10.76	100.8	81.7	480	494	123		1.31	0.147	356	429	0.0073	1.32	<0.0010	0.123	0.119	2.70	0.0337	0.1	0.00064	0.00770	0.0471	<0.00010	<0.000050	<0.010	0.00118	0.00037	150	0.00012	0.00048
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015		125.1		3.2	7.74	7.51	679.1	753	10.6	11.77	106.2	64.9	473	484	124		1.37	0.139	328	429	<0.0050	1.48	<0.0010	0.101	0.172	3.26	0.0257	0.1	0.00052	0.00645	0.0401	<0.00010	<0.000050	<0.010	0.00133	0.00037	149	<0.00010	0.00057
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015		138.2	0.297	3.4	7.56	7.82	632	692	6.1	12.5	111	238.3	430	423	117		1.29	0.124	285	429	<0.0050	3.18	<0.0010	0.110	0.180	4.61	0.0517	0.1	0.00036	0.00735	0.0393	<0.00010	<0.000050	<0.010	0.00135	0.00037	136	0.00011	0.00096
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015		134.5	0.298																128		0.616						No pH													
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015	ORP drifting	91.8	0.254	1.3	7.6	7.98	790.3	867	1	13.37	94.7	26.1	494	498	130		1.48	0.135	331	429	0.0191	4.40	<0.0010	0.221	0.100	1.74	0.0146	0.1	0.00029	0.00440	0.0491	<0.00010	<0.000050	<0.010	0.00134	0.00037	156	0.00011	0.00201
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015	Dumped salt slug above a spot that widened out might not be accurate	147.3		6.6	7.36	7.56	793.3	749	0.1	10.23	69.9	57	467	471	143		2.07	0.109	306	429	0.0399	8.23	<0.0010	0.310	0.158	1.33	0.0246	0.1	0.00039	0.00477	0.0614	<0.00010	<0.000050	<0.010	0.00143	0.00037	143	0.00028	0.00176
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015	WQ collected on 17 Dec 2015 but YSI was not working so insitu collected by A.MacPhail 18 Dec during flow metering			1.8		7.70		754					461	462	138		2.03	0.115	310	429	0.0452	3.80	<0.0010	0.325	0.082	1.05	0.0165	0.1	0.00024	0.00694	0.0683	<0.00010	<0.000050	<0.010	0.00119	0.00037	141	0.00010	0.00184
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015	WQ collected on 17 Dec 2015 but YSI was not working so insitu collected by A.MacPhail 18 Dec during flow metering	142.2			7.03		828.7		0	10.7	83	38.6								128		17.7						0.1												No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016		129.6		4.2	8.03	7.44	669.5	773	0	13.6	105	17.2	517	504	140		1.81	0.119	319	429	0.0638	1.79	0.0010	0.323	0.161	0.98	0.0141	0.1	0.00025	0.00895	0.0695	<0.00010	<0.000050	<0.010	0.000959	0.00037	161	0.00011	0.00227
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016		66.5		<1.0	7.46	7.82	844.6	780	0	12.77	87.9	20	460	462	138		1.48	0.146	336	429	0.0709	6.60	<0.0010	0.306	0.136	0.94	0.0056	0.1	0.00015	0.00817	0.0538	<0.00010	<0.000050	<0.010	0.000790	0.00037	143	<0.00010	0.00227
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016		86.1		1.8	7.5	7.64	764.3	800	0.8	10.6	83.5	11.4	513	497	139		1.52	0.174	343	429	0.0640	5.63	<0.0010	0.300	0.138	0.81	0.0154	0.1	0.00028	0.0102	0.0529	<0.00010	<0.000050	<0.010	0.000808	0.00037	163	0.00014	0.00231
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016		71.3		2.4	7.78	7.63	808.4	867	0.5	12.21	94.5	-11.8	545	546	152		1.52	0.175	358	429	0.0624	3.04	<0.0010	0.284	0.200	1.26	0.0178	0.1	0.00025	0.0112	0.0522	<0.00010	<0.000050	<0.010	0.000764	0.00037	174	<0.00010	0.00231
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016		169.5	0.265	3.6	7.71	7.78	585.1	652	6.7	10.9	106.2	175.2	348	370	96.3		0.90	0.135	243	429	0.0242	2.15	<0.0010	0.130	0.235	5.48	0.0369	0.1	0.00043	0.00981	0.0520	<0.00010	<0.000050	<0.010	0.00128	0.00037	112	0.00013	0.00245
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016	SG 0.215 @10:25.	103.5	0.215	1.8	7.61	7.86	877	865	9.6	9.99	96.7	81.1	521	525	113		1.10	0.161	363	429	0.0073	2.15	<0.0010	0.126	0.145	2.52	0.0164	0.1	0.00038	0.00571	0.0482	<0.00010	<0.000050	<0.010	0.000848	0.00037	164	<0.00010	0.00089
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016	Water is clear something D/S of site is causing turbidity at KV-7 & KV-8	98.1	0.226	3.8	7.66	7.99	832	874	15.4	8.8	96	361.6	503	507	111		1.17	0.158	363	429	0.0070	1.23	<0.0010	0.101	0.187	2.99	0.0306	0.1	0.00054	0.00695	0.0461	<0.00010	<0.000050	<0.010	0.00124	0.00037	158	0.00015	0.00059
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016	DO probe may need to be replaced, varies wildy from day to day	180.3	0.294	2.8	7.78	7.93	769	771	10.6	10.3	103	358.7	450	455	109		1.05	0.149	299	429	<0.0050	1.35	<0.0010	0.0664	0.172	4.72	0.0357	0.1	0.00044	0.00518	0.0347	<0.00010	<0.000050	<0.010	0.00226	0.00037	142	0.00012	0.00078
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016		112	0.248	2.0	7.89	7.94	784.1	852	2.2	11.83	86.1	65.7	487	485	122		1.21	0.162	336	429	<0.0050	2.05	<0.0010	0.134	0.127	3.09	0.0223	0.1	0.00027	0.00555	0.0432	<0.00010	<0.000050	<0.010	0.00138	0.00037	155	<0.00010	0.00132
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016		93.7	0.314	1.8	7.63	7.75	833.4	910	0	9.57	72.5	72.4	530	569	137	<0.25	<2.5	0.16	391	429	0.0419	4.46	<0.0050	0.230	0.123	1.22	0.0105	0.1	0.00020	0.00613	0.0539	<0.00010	<0.000050	<0.010	0.000959	0.00037	164	<0.00010	0.00312
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	DO probe measurement suspect	86.7		2.1	7.27	7.87	933.5	875	0	11.19	77	43.4	514	549	137	<0.25	<2.5	0.17	380	429	0.0664	10.2	<0.0050	0.235	0.121	0.99	0.0286	0.1	0.00025	0.00691	0.0564	<0.00010	<0.000050	<0.010	0.000838	0.00037	162	<0.00010	0.00344
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	Entire staff gauge is under ice, overflow backed up from highway, could not find second location with flowing water, conditions not suitable for salt slug			1.5	7.66	7.79	729	909	-0.1	8.28	63.1	120.7	547	551	137	<0.25	<2.5	0.13	386	429	0.125	4.17	<0.0050	0.263	0.236	1.32	0.0145	0.1	0.00024	0.00444	0.0677	<0.00010	<0.000050	<0.010	0.000474	0.00037	170	0.00012	0.00318
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	sampled and discharge measured ~150 u/s from normal site as road glacier ice too built up on creek to find water. Could not find hydro station, covered in ice.	83.3		2.9	7.11	7.66	846.5	884	0.1	10.14	78.5	46	540	554	130	<0.25	<2.5	0.15	406	429	0.0674	14.6	<0.0050	0.301	0.115	0.88	0.0253	0.1	0.00029	0.0114	0.0585	<0.00010	<0.000050	<0.010	0.000684	0.00037	172	<0.00010	0.00278
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017		86.3		3.2	7.82	7.82	734.9	934	-0.3	4.62	37.7	143.2	456	575	137	<0.25	<2.5	0.15	388	429	0.0731	2.89	<0.0050	0.289	0.117	1.13	0.0052	0.1	0.00020	0.00910	0.0513	<0.00010	<0.000050	<0.010	0.000579	0.00037	144	<0.00010	0.00245
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	Sampled u/s of normal site due to overflow from above road	75.8		3.4	7.44	7.65	992	929	-0.5	12.53	95.4	22.4	555	540	144	<0.25	<2.5	0.15	412	429	0.0748	6.91	<0.0050	0.286	0.132	0.91	0.0480	0.1	0.00047	0.0177	0.0622	<0.00010	<0.000050	<0.010	0.000853	0.00037	175	0.00017	0.00343
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017		64.9		3.8	7.25	7.62	1058	963	0	12.28	95.2	20.8	592	540	139	<0.25	<2.5	0.17	424	429	0.0740	10.7	<0.0050	0.260	0.129	0.89	0.0173	0.1	0.00022	0.0137	0.0542	<0.00010	<0.000050	<0.010	0.000617	0.00037	187	<0.00010	0.00361
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	Unable to connect to logger, no winterization. Creek still under ice with a few openings.	243.6		11.4	7.14	7.48	485.1	409	2	10.09	81.6	88.4	206	194	47.1	<0.050	<0.50	0.097	153	429	0.115	11.6	<0.0010	0.0673	0.622	15.9	0.275	0.1	0.00223	0.0193	0.0432	<0.00010	<0.000050	<0.010	0.00134	0.000289	65.8	<0.00060	0.00246
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017		88.3	0.309	3.4	7.45	7.99	778	812	8.1	10.15	96.2	278	460	430	112		1.00	0.142	336	429	0.0151	3.49	<0.0010	0.145	0.237	5.70	0.0309	0.1	0.00040	0.00723	0.0508	<0.00010	<0.000050	<0.010	0.000720	0.00037	147	0.00020	0.00141
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017		91.5	0.3	4.4	7.2	8.08	815	914	15.9	9.2	102.9	295.5	510	538	121	<0.25	<2.5	0.14	409	429	0.0116	3.39	<0.0050	0.118	0.171	2.51	0.0235	0.1	0.00045	0.00688	0.0446	<0.00010	<0.000050	<0.010	0.00109	0.00037	159	<0.00010	0.00079
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	Levelogger downloaded. Field pH suspect, removed.	198	0.278	1.5		8.12	729.4	934	7.7	10.2	95.4	202.3	542	473	120	<0.25	<2.5	0.14	404	429	<0.0050	0.782	<0.0050	0.118	0.068	2.26	0.0111	0.1	0.00038	0.00472	0.0499	<0.00010	<0.000050	<0.010	0.000908	0.00037	168	0.00011	0.00046
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	field pH probe malfunction	93.4	0.311	1.5		7.97	984	883	4	11.38	97.3	105.2	505	521	119	<0.25	<2.5	0.14	396	429	<0.0050	1.47	<0.0050	0.128	0.094	2.77	0.0169	0.1	0.00031	0.00489	0.0424	<0.00010	<0.000050	<0.010	0.00162	0.00037	157	<0.00010	0.00074
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	Too cold for salt slug calibration	93.8		1.5	7.77	8.04	947.1	904	0.1	10.78	84.2	48.8	465	482	130	<0.050	1.22	0.165	395	429	0.0274	3.21	<0.0010	0.223	0.108	1.37	0.0082	0.1	0.00022	0.00353	0.0482	<0.00010	<0.000050	<0.010	0.00126	0.00037	141	<0.00010	0.00222
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017	Samped at gauge station and from overflow as site frozen to ground. Results removed as non-representative overflow sample.																		128		0.616						No pH												No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	No flow measurements, significant overflow causing water to flow in layers.			5.1	7.78	7.94	820.6	852	0.0	11.10	85	36.2	515	493	140	<0.25	<2.5	0.15	371	429	0.0737	3.17	<0.0050	0.237	0.131	0.85	0.0404	0.1	0.00034	0.0118	0.0641	<0.00010	<0.000050	<0.010	0.00101	0.00037	160	0.00012	0.00240
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	Overflow at site, station completely under ice, no flow.			2.8	7.91	7.73		883	-0.1	8.87	68.3	163.1	563	542	142	<0.25	<2.5	0.15	382	429	0.0788	2.35	<0.0050	0.254	0.127	0.96	0.0151	0.1	0.00027	0.0129	0.0678	<0.00010	<0.000050	<0.010	0.000974	0.00037	178	0.00010	0.00260
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	thick overflow ice. Drilled into overflow and sampled it. Sample shows salt contamination, Na & Cl results removed.			11.2	7.51	7.88	822.6	982	0.1	9.7	75	169	527	497	148	<0.25		0.15	382	429	0.0732	5.83	<0.0050	0.253	0.287	1.29	0.129	0.1	0.00145	0.0207	0.0630	<0.00010	<0.000050	<0.010	0.00157	0.00037	169	0.00175	0.00253
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018	drilled to bottom of auger, ice too thick																		128		0.616						No pH												No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018	Frozen too deep																		128		0.616						No pH												No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	Still significant ice cover on the creek	366.1		14.8	7.1	7.60	329	344	0.0	10.46	79.3	121.5	161	179	42.4	<0.050	0.67	0.075	121	309	0.0318	15.1	0.0011	0.0398	0.703	20.1	0.187	0.1	0.00127	0.0148	0.0322	<0.00010	<0.000050	<0.010	0.00603	0.000235	52.0	0.00045	0.00165
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	Real time readings for dewinterizing: in w/ condom = 16:39:58, out w/ condom = 16:40:54, out w/out = 16:43:11, back in = 16:46:20	122.4	0.351	4.0	7.59	8.07	610.9	690	10.1	9.32	92.6	92.1	376	372	94.3	<0.050	0.87	0.133	287	429	0.0268	2.16	<0.0010	0.100	0.260	6.23	0.0423	0.1	0.00040	0.00869	0.0482	<0.00010	<0.000050	<0.010	0.000994	0.00037	119	0.00018	0.00145
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018		107.1	0.335	2.5	7.93	7.94	885.0	865	11.9	9.80	101.0	204.8	500	487	122	<0.050	1.05	0.175	376	429	0.0122	0.869	<0.0010	0.0923	0.138	2.76	0.0118	0.1	0.00033	0.00593	0.0486	<0.00010	<0.000050	<0.010	0.00138	0.00037	156	<0.00010	0.00082
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018		161.7	0.381	2.8	7.71	8.16	657	766	9.7	10.32	90.7	150.1	425	403	109	<0.050	1.06	0.155	344	429	0.0083	1.70	<0.0010	0.0847	0.200	5.07	0.0319	0.1	0.00035	0.00555	0.0383	<0.00010	<0.000050	<0.010	0.00143	0.00037	131	0.00016	0.00087
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018		112.4	0.359	1.0	7.75	8.12	808.1	843	2.2	10.43	83.6	257.8	460	485	129	<0.050	1.15	0.144	326	429	<0.0050	2.82	<0.0010	0.116	0.132	2.90	0.0473	0.1	0.00150	0.0105	0.0445	<0.00010	<0.000050	<0.010	0.00185	0.00037	141	0.00014	0.00105
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018		71.8	0.307	1.5	7.56	8.12	837.9	843	0.1	11.13	76.8	92.4	469	428	140	<0.25	<2.5	0.13	340	429	0.0122	5.20	<0.0050	0.304	0.132	1.09	0.0156	0.1	0.00026	0.00401	0.0541	<0.00010	<0.000050	<0.010	0.00110	0.00037	144	0.00012	0.00150
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	Ice layers may affect flow. Distance between holes relatively large.	110.7		8.0	7.78	8.09	802.5	834	-0.4	10.82	82.6	-62.50	454	466	141	<0.050	1.33	0.146	334	429	0.0639	3.17	<0.0010	0.266	0.150	0.98	0.0556	0.1	0.00032	0.00791	0.0582	<0.00010	<0.000050	<0.010	0.00126	0.00037	140	0.00014	0.00201
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	Channel has lots of bends. Flow measurement Trial #2 omitted, SPC jumped to ~5500 us/cm. Flow based only on Trial #1.	95.1		4.4	7.22	8.13	775.2	888	-0.3	10.59	83.5	-10.6	447	473	136	<0.25	<2.5	0.14	346	429	0.0710	11.5	<0.0050	0.253	0.168	1.12	0.0219	0.1	0.00021	0.00902	0.0573	<0.00010	<0.000050	<0.010	0.000966	0.00037	139	0.00012	0.00181
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	ORP slow to stabalize	80.9		5.1	7.14	8.10	844.8	878	-0.5	11.40	85.4	20.4	470	544	138	<0.25	<2.5	0.16	369	429	0.0721	13.8	<0.0050	0.282	0.132	1.18	0.0205	0.1	0.00023	0.0117	0.0570	<0.00010	<0.000050	<0.010	0.000894	0.00037	145	<0.00010	0.00191
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	Use discharge/flow with caution, suspect data - a lot of noise on both curves, to be checked in Aquarius	73.9		7.7	7.43	7.55	893.5	897	-0.5	11.95	89.0	-4.6	477	529	140	<0.25	6.5	0.15	344	429	0.0853	7.07	<0.0050	0.284	0.191	0.81	0.0336	0.1	0.00026	0.0164	0.0557	<0.00010	<0.000050	<0.010	0.000774	0.00037	149	0.00012	0.00174
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019		61.1		26.2	7.47	7.64	879	872	-0.7	9.62	71.8	-1.6	456	481	134	<0.25	<2.5	0.17	340	429	0.0690	6.45	<0.0050	0.269	0.198	0.77	0.311	0.1	0.00154	0.0447	0.0661	<0.00010	<0.000050	<0.010	0.00265	0.00037	145	0.00076	0.00220
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2019	Questionable flow path with meanders.	64.3		2.8	7.94	8.02	803.9	893	0.6	11.30	78.8	41

Station	Description	Sample Date	Sample Comments	Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	LL and Baro downloaded. Benthics and sediment collected.	121.4	0.295	2.3	7.41	8.16	685.3	729	4.2	12.14	93.9	302.4	385	411	126	<0.050	1.24	0.124	269	429	0.0189	5.23	<0.0010	0.248	0.108	2.91	0.0273	0.1	0.00026	0.00330	0.0568	<0.000100	<0.000050	<0.010	0.00182	0.00037	118	<0.00010	0.00078
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	baro and WL logger downloaded. BL off by 3 hours, WL off by 20 min	85.2		3.4	7.06	7.91	779.0	787	0.0	13.18	90.4	153.1	421	400	129	<0.250	<2.50	0.109	286	429	0.0438	16.5	<0.0050	0.326	0.159	3.14	0.0358	0.1	0.00031	0.00327	0.0602	<0.000100	<0.000050	<0.010	0.00176	0.00037	128	0.00011	0.00134
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	staff guage frozen	136.8		3.0	6.97	8.07	783.8	774	-0.1	14.73	100.6	277.4	416	510	132	<0.250	<2.50	0.126	295	429	0.0652	20.4	<0.0050	0.347	0.141	1.90	0.0236	0.1	0.00018	0.00398	0.0566	<0.000100	<0.000050	<0.010	0.00112	0.00037	129	<0.00010	0.00185
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	Ice at staff gauge end.	129.6		1.6	7.45	8.18	747.7	777	0.0	13.00	89.5	117.6	443	470	131	<0.250	<2.50	0.124	300	429	0.0587	6.75	<0.0050	0.346		1.94	0.0153	0.1	0.00019	0.00568	0.0633	<0.000100	<0.000050	<0.010	0.00107	0.00037	137	0.00012	0.00157
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	Jumping SPC at peak.	107.6		3.5	7.48	7.70	690.4	794	0.0	12.74	87.3	72.2	497	507	130	<0.250	<2.50	0.125	312	429	0.0580	6.30	<0.0050	0.339		1.47	0.0234	0.1	0.00025	0.00740	0.0580	<0.000100	<0.000050	<0.010	0.00106	0.00037	159	<0.00010	0.00137
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	No flow test done to limit exposure.			3.7	7.85	8.01	787.7	865	0.0	12.53	86.0	25.3	477	474	183	<0.250	<2.50	0.123	317	429	0.0777	2.70	<0.0050	0.315		1.27	0.0365	0.1	0.00032	0.0115	0.0569	<0.000100	<0.000050	<0.010	0.00110	0.00037	150	0.00013	0.00188
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	Overflow layer, water flowing back into hole	84.3		5.1	7.04	7.70	702.9	809	0.0	13.20	90.2	40.4	445	453	127	<0.250	<2.50	0.157	337	429	0.0602	17.3	<0.0050	0.332		0.97	0.0332	0.1	0.00024	0.00943	0.0512	<0.000100	<0.000050	<0.010	0.000794	0.00037	142	<0.00010	0.00131
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021		75.4		6.6	7.54	7.81	788.9	853	0.1	13.21	90.6	19.9	475	482	126	<0.250	<2.50	0.147	365	429	0.0671	5.44	<0.0050	0.325		1.22	0.0623	0.1	0.00025	0.0112	0.0567	<0.000100	<0.000050	<0.010	0.000879	0.00037	151	0.00015	0.00157
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	no flow test initially, just sampled with site effluent discharge			11.5	7.31	7.38	584.6	649	0.3	14.03	97.2	67.0	346	344	83.5	<0.050	3.25	0.093	253	429	0.0527	9.08	0.0044	0.276		7.79	0.282	0.1	0.00090	0.0120	0.0544	<0.000100	<0.000050	<0.010	0.00177	0.00037	112	0.00054	0.00207
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021	Samples taken on May 5, 2021 due to KV-104C discharge	202.8			7.39		480.5		0.3	13.65	94.1	103.9							128			7.55						0.1										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021				25.9	8.25	7.84	460.3	453	4.0				220	222	61.9	<0.050	0.73	0.075	165	429	0.0305	0.781	0.0020	0.155		11.7	0.449	0.1	0.00080	0.0114	0.0515	<0.000100	<0.000050	<0.010	0.00165	0.000305	70.0	0.00118	0.00169
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	Steep sides, slight undercut, midsection done, staff gauge hard to read.	92.9	0.22	6.2	6.79	7.98	662.9	670	10.0	11.23	49.7	222.9	367	334	103	<0.050	1.03	0.120	259	429	0.0216	13.7	<0.0010	0.156		5.69	0.0920	0.1	0.00058	0.00767	0.0510	<0.000100	<0.000050	<0.010	0.00115	0.00037	116	<0.00050	0.00066
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021				12.5	8.38	7.91	714.2	804	12.3				436	435	119	<0.250	<2.50	0.125	328	429	0.0202	0.309	<0.0050	0.170		3.01	0.0178	0.1	0.00040	0.00473	0.0577	<0.000100	<0.000050	<0.010	0.000953	0.00037	135	<0.00050	0.00046
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	No flow measurment, not good for midsection			2.8	7.67	8.13	693.5	818	8.6	9.97	85.8	129.1	480	422	119	<0.050	1.15	0.143	343	429	0.0190	2.03	<0.0010	0.164		2.63	0.0228	0.1	0.00049	0.00568	0.0592	<0.000100	<0.000050	<0.010	0.00125	0.00037	150	<0.00050	0.00049
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	not ideal for measuring flow, d/s flowing in grass and u/s bend with roots and rocks.	86.5	0.138	1.9	7.99	7.98	600.4	724	6.5	10.69	87.8	105.9	391	374	114	<0.050	1.13	0.108	263	429	0.0090	1.15	<0.0010	0.155		4.25	0.0227	0.1	0.00039	0.00447	0.0508	<0.000100	<0.000050	<0.010	0.00120	0.00037	121	<0.00050	0.00039
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	Survey, winterize	127.9	0.152	2.1	7.97	8.19	765.0	782	1.9	11.91	86.6	148.6	440	466	134	<0.250	<2.50	0.135	326	429	0.0073	1.75	<0.0050	0.155		2.38	0.0096	0.1	0.00023	0.00347	0.0535	<0.000100	<0.000050	<0.010	0.00172	0.00037	138	0.00058	0.00038
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021		82.9	0.125	1.4	7.53	7.84	706.1	803	0.7	13.82	101.3	71.1	463	415	129	<0.250	<2.50	0.138	307	429	0.0249	5.30	<0.0050	0.250		2.36	0.0122	0.1	0.00029	0.00339	0.0532	<0.000100	<0.000050	<0.010	0.00129	0.00037	144	<0.00050	0.00100
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	pH 2.60 removed, probe failure	84.2		2.9		7.51	815.6	834	-0.1	9.95	67.9	91.0	473	490	139	<0.250	<2.50	0.139	331	429	0.0774	5.88	<0.0050	0.307		2.37	0.0257	0.1	0.00037	0.00537	0.0606	<0.000100	<0.000050	<0.010	0.00114	0.00037	151	<0.00050	0.00156
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	one flow measurement, YSI failed on second	91.7		4.4	7.54	7.61	729.8	855	0.0	9.84	67.6	168.4	457	491	134	<0.250	<2.50	0.154	347	429	0.0715	5.49	<0.0050	0.280		3.19	0.0242	0.1	0.00029	0.00608	0.0699	<0.000100	<0.000050	<0.010	0.00133	0.00037	141	<0.00050	0.00153
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022	could not locate water, drilled several holes and only found mud																		128			0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022		65.4		4.2	7.24	8.00	800.1	954	-0.2	13.19	90.9	-8.3	534	499	138	<0.250	<2.50	0.173	395	429	0.0676	10.9	<0.0050	0.268		1.91	0.0241	0.1	0.00028	0.00935	0.0607	<0.000100	<0.000050	<0.010	0.000858	0.00037	170	<0.00050	0.00119
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022				10.2	7.48	7.70	972.0	925	0.2	14.30	99.2	94.9	501	500	142	<0.050	1.34	0.157	366	429	0.0771	6.19	0.0022	0.275		1.26	0.0245	0.1	0.00024	0.0148	0.0594	<0.000100	<0.000050	<0.010	0.000790	0.00037	157	<0.00050	0.00128
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	Ice covered	65.7		7.9	7.25	7.99	848.0	851	0.7	12.31	85.3	-64.8	509	485	125	<0.250	4.38	0.116	342	429	0.0892	10.1	<0.0050	0.251		3.57	0.128	0.1	0.00077	0.0264	0.0580	<0.000100	<0.000050	<0.010	0.00140	0.00037	160	<0.00050	0.00182
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	2x salt slug, SG under ice, de-winterized logger	246.3		8.0	7.19	7.84	335.6	338	1.6	11.56	82.9	199.1	158	163	53.1	<0.050	1.04	0.071	104	309	0.0177	10.7	<0.0010	0.0609		18.8	0.100	0.1	0.00057	0.0107	0.0297	<0.000100	<0.000050	<0.010	0.00163	0.000232	50.4	<0.00050	0.00105
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	Midsection flow measurement, surveyed	124.8	0.168	1.8	8.08	8.01	556.5	586	8.1	9.90	84.1	-67.9	298	299	80.7	<0.050	0.73	0.108	225	429	0.0278	0.829	<0.0010	0.126		6.41	0.0318	0.1	0.00028	0.00531	0.0440	<0.000100	<0.000050	<0.010	0.000876	0.00037	96.0	<0.00050	0.00072
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	DO suspect, omitted	98.5	0.049	6.6	7.73	8.19	799.0	787	8.1			187.6	447	428	116	<0.250	<2.50	0.141	340	429	0.0176	1.84	<0.0050	0.148		3.87	0.0631	0.1	0.00052	0.00897	0.0638	<0.000100	<0.000050	<0.010	0.00160	0.00037	139	<0.00050	0.00061
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022		83.2		1.9	7.93	8.12	721.0	836	9.4	11.13	97.6	170.4	460	465	109	<0.250	<2.50	<0.100	353	429	0.0120	1.05	<0.0050	0.156		3.18	0.0234	0.1	0.00035	0.00434	0.0596	<0.000100	<0.000050	<0.010	0.00113	0.00037	143	<0.00050	0.00039
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022		105.8		<1.0	7.78	8.21	709.7	797	6.4	10.72	87.2	211.2	433	428	110	<0.250	<2.50	0.107	352	429	0.0057	1.88	<0.0050	0.151		3.34	0.0484	0.1	0.00024	0.00460	0.0584	<0.000100	<0.000050	<0.010	0.00128	0.00037	134	<0.00050	0.00070
KV-6	Christal Creek u/s Silver Trail Highway	14-Oct-2022	Could not measure flow, lots of pooling. logger pulled@ 14:25 to ensure winterized. dl logger and baro. Direct read does not have cap		0.239	4.1	7.38	8.30	647.9	748	-0.2	10.60	72.1	6.4	384	416	116	<0.250	<2.50	<0.100	291	429	0.0297	7.93	<0.0050	0.254		4.91	0.0486	0.1	0.00039	0.00570	0.0546	<0.000100	<0.000050	<0.010	0.00345	0.00037	117	<0.00050	0.00094
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	SPC jumping. No flow measurement, stream glaciated.			4.2	7.64	7.64		887	0.0	12.01	82.8	85.2	472	479	132	<0.250	11.8	0.118	356	429	0.0750	4.36	<0.0050	0.277		2.04	0.0435	0.1	0.00067	0.00951	0.0667	<0.000100	0.000070	<0.010	0.00126	0.00037	146	0.00174	0.00144
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2022				2.7	8.11	8.19	837.3	842	-0.2	11.05	75.6	218.3	432	440	124	<0.250	<2.50	0.129	350	429	0.0743	1.49	<0.0050	0.293		2.26	0.0137	0.1	0.00017	0.00878	0.0575	<0.000100	<0.000050	<0.010	0.000967	0.00037	135	<0.00050	0.00143
KV-6	Christal Creek u/s Silver Trail Highway	21-Jan-2023	No flow, glaciated			2.1	7.44	7.93	894.3	860	0.1	15.10	104.1	201.6	463	512	127	<0.250	<2.50	0.114	383	429	0.0693	6.85	<0.0050	0.283		1.53	0.0215	0.1	0.00020	0.0146	0.0546	<0.000100	<0.000050	<0.010	0.000995	0.00037	147	<0.00050	0.00133
KV-6	Christal Creek u/s Silver Trail Highway	09-Feb-2023	Low flow			3.1	7.71	8.05	878.9	839	-0.2	12.74	87.1	140.0	513	478	137	<0.250	<2.50	0.102	363	429	0.0775	3.72	<0.0050	0.286		1.93	0.0406	0.1	0.00029	0.0230	0.0601	<0.000100	<0.000050	<0.010	0.00127	0.00037	164	<0.00050	0.00147
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2023	Too shallow upstream for measuring flow			15.6	7.81	8.11	902.0	898	-0.3	11.76	80.0	160.0	481	488	136	<0.250	<2.50	0.115	387	429	0.0843	2.95	<0.0050	0.288		1.81	0.0122	0.1	0.00020	0.0126	0.0555	<0.000100	<0.000050	<0.010	0.000762	0.00037	152	0.00053	0.00125
KV-6	Christal Creek u/s Silver Trail Highway	20-Apr-2023	Low flow - no measurement, glaciation			3.5	7.27	8.05	959	953	0.2	13.79	45.5	37.5	494	487	130		6.50		409	429	0.0675	10.0	<0.0050	0.280		1.70	0.0189	0.1	0.00037	0.0144	0.0527	<0.000100	<0.000050	<0.010	0.000946	0.00037	158	<0.00050	0.00114
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2023	Flooded banks, no flow measurement. DO probe not working		0.304	23.7	6.99	7.37	333.9	328	0.7			205.9	159	154	38.3		1.90		116	309	0.0499	18.3	0.0034	0.151		19.2	0.460	0.1	0.00129	0.0141	0.0462	<0.000100	<0.000050	<0.010	0.00258	0.000233	52.0	0.00079	0.00135
KV-6	Christal Creek u/s Silver Trail Highway	27-Jun-2023	DL SG, survey, de-winter, slightly turbid, SG almost out of water	121.1	0.04	3.4	7.57	7.93	828.0	838	11.1	9.09	82.9	712.1	475	472	119		<2.50		350	429	0.0081	2.10	<0.0050	0.112		3.22	0.0501	0.1	0.00044	0.00762	0.0575	<0.000100	<0.000050	<0.010	0.00188	0.00037	151	<0.00050	0.00065
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2023	Will return to download logger. Swoffer flow measurement.	79.8	0.028	3.6	7.78	8.06	795.0	848	11.0	10.14	92.1	193.2	456	462	112		<2.50		367	429	0.0111	1.31	<0.0050	0.120		3.14	0.0364	0.1	0.00034	0.00556	0.0653	<0.000100	<0.000050	<0.010	0.00145	0.00037	139	<0.00050	0.00039
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2023		100.4		3.4	7.94	8.05	835.0	882	9.3	10.87	96.1	204.0	472	478	119		<2.50		354	429	0.0068	1.04	<0.0050	0.122		3.13	0.0112	0.1	0.00030	0.00515	0.0530	<0.000100	<0.000050	<0.010	0.00110	0.00037	148	<0.00050	0.00028
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2023	Surveyed SG.	81.6	0.03	5.8	8.15	8.25	900.0	912	4.4	12.91	99.7	-39.2	490	499	124	<0.250	<2.50	0.145	360	429	0.0096	0.948	<0.0050	0.164		2.81	0.0155	0.1	0.00022	0.00447	0.0482	<0.000100	<0.000050	<0.010	0.00184	0.00037	153	<0.00050	0.00033
KV-6	Christal Creek u/s Silver Trail Highway	25-Oct-2023	Overflow no flow done			3.9	7.41	8.11	888	898	0	12.14	82.8	56.1	479	496	147		<2.50		350	429	0.0726	7.40	<0.0050	0.259		2.67	0.0328	0.1	0.00034	0.00593	0.0635	<0.000100	<0.000050	<0.010	0.00146	0.00037	147	<0.00050	0.00071
KV-6	Christal Creek u/s Silver Trail Highway	20-Nov-2023				5.0	7.36	8.06	872	871	0	16.37	111	31.7	475	464	138	<0.250	<2.50	0.104	324	429	0.0828	8.30	<0.0050	0.268		2.19	0.0242	0.1	0.00019	0.00912	0.0673	<0.000100	<0.000050	<0.010	0.00108	0.00037	145	<0.00050	0.00133
KV-6	Christal Creek u/s Silver Trail Highway	10-Dec-2023		71		4.6	7.29	8.01	847.0	880	0.0	13.99	96.0	13.7	463	488	141	<0.250	<2.50	0.104	324	429	0.0911	9.75	<0.0050	0.243		2.31	0.0467	0.1	0.00026	0.0132	0.0678	<0.000100	<0.000050	<0.010	0.00130	0.00037	143	<0.00050	0.00148
KV-6	Christal Creek u/s Silver Trail Highway	25-Jan-2024	Unable to locate flow ds. Significant ice coverage. LL downloaded, unable to connect to Baro			2.6	7.26	7.67	830	831	0	11.33	78.2	17.8	484	438	141	<0.250	<2.50	<0.100	309	429	0.0567	10.4	<0.0050	0.254		1.26	0.0228	0.1	0.00025	0.0108	0.0678	<0.000100	<0.000050	<0.010	0.000993	0.00037	149	<0.00050	0.00101
KV-6	Christal Creek u/s Silver Trail Highway	16-Feb-2024	Frozen. Drilled a hole and hit slush, creek frozen to bottom																		128			0.616						No pH										No Hardness		
KV-6	Christal Creek u/s Silver Trail Highway	29-Mar-2024	No section long enough for flow measurement without overflow. Baro would not connect via Bluetooth. Maxed out auger and poked through bottom of hole.			3.7	7.72	7.95	986	991	0.2	13.23	91.7	47.3	584	564	144	<0.250	<2.50	0.139	420	429	0.0791	3.57	<0.0050	0.233		1.11	0.0416	0.1	0.00042	0.0172	0.0562	<0.000100	<0.000050	<0.010	0.00121	0.00037	184	<0.00050	0.00086
KV-6	Christal Creek u/s Silver Trail Highway	21-Apr-2024	Lots of ice, but good flow underneath. Auger hole from last month was not frozen over	82.7		11.6	7.21	8.03	996	972	0.5	13.32	93.2	-52.5	492	495	130	<0.250	2.75	<0.100	395	429	0.0832	11.2	<0.0050	0.161		4.45	0.0637	0.1	0.00198	0.0168	0.0538	<0.000100	<0.000050	<0.010	0.00170	0.00037	156	<0.00050	0.00189
KV-6	Christal Creek u/s Silver Trail Highway	28-Apr-2024	Mostly ice covered with few open spots. Unable to connect with baro logger	158.6		31.0	7.34	7.94	702	700	1.7	11.30	81.3	70.7	364	358	95.2	<0.250	<2.50	<0.100	278	429	0.0545	7.54	<0.0050	0.0852		9.45	0.180	0.1	0.00135	0.0206	0.0489	<0.000100	<0.000050	<0.010	0.00436	0.00037	118	<0.00050	0.00189
KV-6	Christal Creek u/s Silver Trail Highway	08-May-2024	Clear water. Too much ice for midsection but some open sections. Ice partially melted around staff gauge enough to get rough water level measurement. Could not connect to baro logger	142	0.005	20.1	7.25	8.05	677	697	2.4	12.80	93.9	49.6	334	364	85.0	<0.250	<2.50	<0.100	216	429	0.0638	8.75	<0.0050	0.0986		7.75	0.120	0.1	0.00051	0.0176	0.0520	<0.000100	<0.000050	<0.010	0.00104	0.00037	106	<0.00050	0.00216
KV-6	Christal Creek u/s Silver Trail Highway	13-May-2024	Did flow mid section d/s of staff gauge, 50 m u/s from road - only suitable section.Dewinterised levelogger at 14:00, could not connect to barologger. Started snowing halfway through flow measurement.	78.05		10.3	7.60	8.16	807.1	804	4.3	~	~	95.9	416	398	107	<0.250	<2.50	<0.100	226	429	0.0685	3.35	<0.0050	0.117		5.13	0.0701	0.1	0.00039	0.0127	0.0522	<0.000100	<0.000050	<0.010	0.00120	0.00037	134	<0.00050	0.00184
KV-6	Christal Creek u/s Silver Trail Highway	22-May-2024	SG approx 5.1 cm out of water. Midsection flow measurement. Some snow on banks but channel is thawed. Logger download. Found base plate of wading rod. Unable to connect to baro.	110.6	-0.051	5.8	7.76	8.11	718	747	3.7	11.20	85.0	20.3	405	389	104	<0.250	<2.50	<0.100	294	429	0.0378	2.44	<0.0050	0.148		3.75	0.0438	0.1	0.00033	0.00763	0.0514	<0.000100	<0.000050	<0.010	0.00104	0.00037	130	<0.00050	0.00108
KV-6	Christal Creek u/s Silver Trail Highway	29-May-2024	Water clear, stage is down from 2 weeks ago. No ice present, stage is below staff gauge.	121.6	-0.05	11.4	7.52	7.88	783	773	7.4	10.58	87.9	31.5	412	402	105	<0.250	<2.50	<0.100	305	429	0.0163	3.14	<0.0050	0.104		5.50	0.0700	0.1	0.00061	0.0105	0.0508	<0.000100	<0.000050	<0.010	0.00148	0.00037	131	<0.00050	0.00106
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2024	SG out of water by about 20 cm. Downloaded logger. Midsection flow measurement. Surveyed. Could not connect to baro. Muddy stream bottom noted during midsection.	101		1.5	8.19	8.40	814	835	10	12.25	109.1	9.7	464	448	125	<0.250	<2.50	<0.100	331	429	0.0113	0.559	<0.0050	0.145		3.11	0.0084	0.1	0.00029	0.00441	0.0561	<0.000100	<0.000050	<0.010	0.000841	0.00037	147	<0.00050	0.00035
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2024	Site good, new sg looks good, see sg offset from survey earlier today	78	0.342	2.5	7.77	8.33	867	888	9.9	10.51	93.2	185.1	461	463	131		<2.50		358	429	0.0087	1.46	<0.0050	0.134		3.05	0.0227	0.1	0.00032	0.00586	0.0552	<0.000100	<0.000050	<0.010	0.00135	0.00037	138	<0.00050	0.00027
KV-6	Christal Creek u/s Silver Trail Highway	08-Aug-2024	Aquatics: Benthics, sediment, fishing.	64		6.1	7.70	8.32	805	867	7.4	10.98	91.7		462	467	130	<0.250	<2.50	<0.100	332	429	0.0155	2.08	<0.0050	0.154		1.96	0.0729	0.1	0.00053	0.0103	0.0702	<0.000100	<0.000050	<0.010	0.00159	0.00037	139	<0.00050	0.00032
KV-6	Christal Creek u/s Silver Trail Highway	05-Sep-2024	Logger winterized	86.7	0.354	1.7	7.68	8.20	1009	855	5.6	10.45	83.3	-93.2	473	431	128	<0.250	2.78	0.108	323	429	0.0135	2.51	<0.0050	0.147		2.01	0.0154	0.1	0.00025	0.00475	0.0515	<0.000100	<0.000050	<0.010	0.00191	0.00037	146	<0.00050	0.00025
KV-6	Christal Creek u/s Silver Trail Highway	09-Oct-2024	Winterized logger, retrieved dropped logger	76.4	0.345	<1.0	7.66	8.12	942	785	1.6	12.42	88.6	114.5	440	435	133		<2.50		296	429	0.0198	3.65	<0.0050	0.175		2.73	0.0074	0.1	0.00022	0.00277	0.0517	<0.000100	<0.000050	<0.010	0.00143	0.00037	134	<0.00050	0.00032
KV-6	Christal Creek u/s Silver Trail Highway	07-Nov-2024	Winterized levelogger. Frozen over. Ice 3 inches thick. Discharge collected Nov 22			2.2	7.16	8.05	881	880	0	13.20	90.8	-25.3	470	446	146	<0.250	2.62	0.132	337	429	0.0652	13.1	<0.0050	0.201		1.06	0.0270	0.1	0.00021	0.00507	0.0567	<0.000100	<0.000050	<0.010	0.000982	0.00037	146	<0.00050	0.00096
KV-6	Christal Cre

Station	Description	Sample Date	Sample Comments	Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011	dry	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012	dry	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012	No water observed	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012	No water observed	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012	No water observed	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	braided, iced over - no flow measurements; no YSI for insitu			<1.0		6.91		506					252	253	9.83		<0.50		210	429		23.4				13.9	0.0516	0.1	0.000122	0.000407	0.0755	<0.000010	<0.0000050	<0.050	0.000325	0.000341	83.1	<0.00010	0.000133	
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	High water flowing through bushes.	6.741		<1.0	6.68	6.75	540.6	492	1.8	15.7	113	314.3	219	213	6.34		0.57		193	429		34.1				5.51	0.0218	0.1	0.000124	0.000313	0.0441	0.00001	<0.0000050	<0.050	0.000131	0.000304	70.9	<0.00010	0.0000366	
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012	water clear; flow measurement not possible; dispersed throughout moss and water holes; flow not observed; no continuous channel			3.2	6.21	6.88	572.8	702	6.5	5.56	45.3	132.6	386	371	11.9		<0.50		336	429		68.6				7.44	0.0402	0.005	0.000288	0.00144	0.0497	0.000011	<0.0000050	<0.050	0.000485	0.00037	126	0.00017	0.000121	
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012	Flow measurement not possible. Tiny flow through moss but mainly puddles of water.			25.2	7.04	7.04	760	670	8	6	51	24.6	360	359	14.2		<0.50		300	429		9.01				5.65	0.0197	0.1	0.000128	0.000253	0.0438	<0.000010	<0.0000050	<0.050	0.000366	0.00037	117	<0.00010	0.000064	
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012	No Flow measurement possible.Too wide + flowing through moss and willows. Flow higher than August flow. Rain the day before.			2.9	8.43	7.43	570.3	712	1.8	11.94	85.8	12.9	336	360	15.3		0.71		309	429		0.622				5.42	0.0111	0.1	0.000112	0.000153	0.0323	<0.000010	<0.0000050	<0.050	0.000304	0.00037	107	<0.00010	0.000033	
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012	ORP not taken as it was unstable, flow unsuitable for salt slug or metering			5.3	6.58	7.24	1325	1270	-0.1	6.29	43.3		745	743	29.7		<0.50		701	429		49.9				3.26	0.0686	0.1	0.00016	0.00065	0.0685	<0.000050	<0.000025	<0.25	0.000774	0.00037	241	<0.00050	0.000394	
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012	No water observed.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012	No water obseved. Seems to be frozen to the ground.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013	No water found. Frozen to the ground.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	03-May-2013	Frozen to the ground.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013	Puddles of water. May be a tiny flow through mosses but hard to tell. Saturated moss.Cannot get a flow reading.			1.8	6.46	6.85	606.7	671	7	5.02	41.5	127.3	361	370	15.0		<0.50	0.022	348	429		37.0	<0.0010	<0.0050		6.46	0.0406	0.005	0.00022	0.00043	0.0553	<0.00010	<0.00050	<0.010	0.000539	0.00037	117	0.00019	0.00010	
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	Very little flow.			<1.0	7.18	7.97	556.2	494	0	11.98	82.9	-19	284	290	18.9		<0.50	0.031	253	429		12.6	<0.0010	0.337		6.47	0.0194	0.1	0.00015	0.00031	0.0264	<0.00010	<0.00050	<0.010	0.000310	0.00037	90.8	0.00013	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014	frozen to the ground, no water found.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	06-May-2014	Cannot get flow, water running thhrough branches in different channels.			3.3	6.47	6.76		82.1	0.6	13.72	96.4	124.6	42.2	42.6	11.3		<0.50	0.054	25.0	218		61.2	<0.0010	0.0171		28.2	0.178	0.005	0.00016	0.00054	0.0217	<0.00010	<0.00050	<0.010	0.000250	0.00007745	14.1	0.00036	0.00023	
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014	Puddles of water flowing through mosses; cannot measure flow. Water is clear.			1.8	6.83	7.06	432	383	5.5	6.12	49.1	182.5	210	223	20.1		<0.50	0.035	187	429		17.8	<0.0010	<0.0050		7.32	0.0961	0.1	0.00021	0.00101	0.0418	<0.00010	<0.00050	<0.010	0.000364	0.000293	68.8	0.00024	0.00016	
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014	Frozen to the gound.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015	No water observed, frozen to the ground.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	12-May-2015	Could not meter very braided and could not run salt dilution			11.0	6.02	6.57	174.6	156	0.9	13.48	94.8	176.5	75.7	75.3	8.5		<0.50	0.057	60.3	218		168	<0.0010	0.0055		22.4	0.149	0.005	0.00013	0.00047	0.0384	<0.00010	<0.000050	<0.010	0.000261	0.0001258	25.5	0.00035	0.00027	
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015	No flowing water, only stagnant, did not sample or gauge flow																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015	No moving water present																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016	Searched extensively, no water found	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	Multiple channels, no flow conducted.			<1.0	6.72	6.80	328.8	364	0.2	13.2	101	239	189	193	9.7		<0.50	0.036	152	429		35.6	<0.0010	0.0614		13.4	0.0580	0.1	0.00013	0.00036	0.0570	<0.00010	<0.000050	<0.010	0.0000761	0.000269	63.7	<0.00020	0.00011	
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016	No way to accurately gauge flow, no flow conducted			4.0	7.34	7.19	543.7	555	7.6	10.2	95	299.7	303	305	32.4		<0.50	0.049	247	429		4.67	<0.0010	0.0770		5.91	0.0129	0.1	0.00015	0.00024	0.0411	<0.00010	<0.000050	<0.010	0.000183	0.00037	98.8	<0.00010	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016	Site frozen to ground	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017	Frozen. Chipped around area, no water found.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	Conditions not conducive to measuring flow, water spread out and flowing through willows and moss.			<1.0	7.16	6.55	191.5	160	0.5	11.41	89	130.4	75.6	73.7	8.1	<0.050	<0.50	0.044	61.9	218		12.6	<0.0010	0.0122		18.9	0.157	0.1	0.00012	0.00043	0.0316	<0.00010	<0.000050	<0.010	0.0000994	0.0001257	25.0	<0.00050	0.00019	
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017	Wet moss but not enough water to sample.	0																		128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017				6.8	7.05	7.55	733.5	681	-0.3	5.00	38.6	47.4	360	360	57.3	<0.050	0.15	0.036	319	429		16.9	<0.0010	0.823		5.59	0.0613	0.1	0.00022	0.00049	0.0413	<0.00010	<0.000050	<0.010	0.000396	0.00037	112	0.00094	0.00013	
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018	Dry, frozen with overflow ice																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	No flow measurements, water running through willows (very braided)			<1.0	6.54	6.64	163.8	172	0.0	11.89	90.4	127.4	81.8	78.2	6.7	<0.050	<0.50	0.058	63.3	309		54.7	<0.0010	0.0112		26.8	0.194	0.1	0.00015	0.00048	0.0288	<0.00010	<0.000050	<0.010	0.000253	0.0001341	27.6	0.00039	0.00019	
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	Lots of water running through willow no defined channel, not possible to measure flow.			<1.0	7.25	7.01	400.1	454	1.1	11.10	88.0	80.1	225	227	8.7	<0.050	<0.50	0.032	218	429	<0.0050	9.75	<0.0010	0.0356		7.89	0.0407	0.1	0.00014	0.00030	0.0696	<0.00010	<0.000050	<0.010	0.000200	0.000311	74.6	0.00013	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	No flow water very stagnant, willows enchroaching. DO seems to be working, probe in vertical position. Forgot temp, probably quite a bit higher than KV-50			<1.0	7.34	7.52	468	463		6.20	54.0	163.4	231	220	31.7	<0.050	<0.50	0.038	196	429		8.69	<0.0010	<0.0050		6.84	0.132	0.1	0.00018	0.00034	0.0549	<0.00010	<0.000050	<0.010	0.000264	0.000318	73.4	0.00023	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	Unable to measure flow. No good across channel for MMB flow meter and not flowing quick enough. Looks like water is sitting still			5.5	7.03	7.65	492.5	517	1.1	9.22	71.9	129.8	245	266	43.7	<0.050	<0.50	0.048	206	429	<0.0050	16.2	<0.0010	0.204		6.10	0.0178	0.1	0.00018	0.00028	0.0515	<0.00010	<0.000050	<0.010	0.000242	0.000333	78.0	<0.00010	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018	Frozen solid, no flowing water.																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019	Frozen, dry																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	no discharge measurement. Water is dispersed everywhere.			1.2	6.69	7.01	213.2	227	1.1	11.67	80.2	56.7	100	118	8.3	<0.050	<0.50	0.044	87.9	309		35.3	<0.0010	0.0344		14.3	0.0943	0.1	0.00013	0.00033	0.0316	<0.00010	<0.000050	<0.010	0.0000678	0.000158	33.1	0.00020	0.00012	
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	Site not suitable for measuring flow. Surrounded by tall grass/willows and not visibly flowing.			1.7	7.39	7.24	513.9	551	1.3	8.38	59.5	99.8	265	259	25.2	<0.050	<0.50	0.036	246	429	<0.0050	6.95	0.0012	0.134		6.36	0.0125	0.1	0.00013	0.00024	0.0370	<0.00010	<0.000050	<0.010	0.0000642	0.000356	84.2	<0.00010	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019	Dry - soil wet but no stream flow.																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019	no sample - too many willows. Water is stagnant - see photos																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020	frozen dry																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	07-May-2020	No sample taken - creek is dry or cannot be found under the ice and snow																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020	Found flowing did not take sample - only insitu - very braided.				7.95		200.3		2.5	11.09	81.3	236.6								128		1.74						0.1								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020				22.9	7.06	7.37	249.4	259	4.6	8.59	66.9	42.7	131	142	39.2	<0.050	<0.50	0.062	81.7	309		11.3	<0.0010	<0.0050		11.8	0.0323	0.1	0.00020	0.00036	0.0323	<0.000100	<0.000050	<0.010	0.000114	0.000198	42.0	0.00012	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020	frozen																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021	Frozen																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	07-May-2021				2.6	7.11	6.38	60.4	58.3	0.2	14.44	99.5	82.0	28.7	28.7	12.2		<0.50		10.8	128	0.0095	14.5				22.5	0.236	0.1	0.00019	0.00071	0.0155	<0.000100	<0.000050	<0.010	0.000183	0.00005624	9.35	<0.00050	0.00017	
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021	Dry																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021	Frozen, see pictures																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022	Dry/Frozen																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	15-May-2022	no flow measurement			3.0	6.79	7.50	86.2	84.8	0.3	12.74	88.0	135.6	46.1	43.4	29.0		<0.50		10.1	218	0.0074	30.0				24.8	0.104	0.1	0.00014	0.00057	0.0209	<0.000100	<0.000050	<0.010	0.000140	0.00008334	14.6	<0.00050	0.00012	
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022				<1.0	7.41	7.98	205.7	238	5.9	9.31	74.9	32.9	121	118	76.6		<0.50		42.3	309	0.0184	4.55				8.63	0.0248	0.1	0.00030	0.00050	0.0550	<0.000100	<0.000050	<0.010	0.000122	0.000186	37.9	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022	Seep is dry/frozen																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	09-Feb-2023	Dry																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	12-May-2023	could not locate water																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	14-Jul-2023	Peservative lost from dissolved nutrients bottle (small spill). Ysi unit C. No flow at site.			<1.0	7.65	7.84	211.7	211	6.4	4.06	33.4	107.8	116	113	79.7		<0.50		31.8	309		2.52				9.31	0.0204	0.1	0.00014	0.00035	0.0576	<0.000100	<0.000050	<0.010	0.0000914	0.000179	36.4	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	25-Oct-2023	Dry																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	16-Feb-2024	Creek was dry																			128		0.616						No pH								No Hardness				
KV-49	Hinton Creek upstream Christal Creek	28-Apr-2024	Small very clear stream. Possibly runoff, but continuous through low willows.			1.6	6.83	7.27	67	70.1	0.3	12.74	87.8	62.4	36.0	35.3	17.0	<0.050	<0.50	0.020	11.8	218	0.0076	27.4	<0.0010	<0.0050		22.5	0.0578	0.1	0.00013	0.00064	0.0174	<0.000100	<0.000050	<0.010	0.000170	0.00006788	11.1	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	08-May-2024	Very clear water in shallow stream. Sampled at old pink flag			<1.0	7.06	7.73	135.7	115	0.5	14.24	99.2	37.6	56.1	58.7	38.7	<0.050	<0.50	0.056	15.4	218	0.0080	15.9	0.0014	0.183		21.2	0.0709	0.1	0.00017	0.00058	0.0272	<0.000100	<0.000050	<0.010	0.0000372	0.00009809	16.9	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	13-May-2024	Flowing clear for now, looks ephemeral may dry up by next visit			<1.0	7.75	8.04	186.9	181	1.0	~	~	10.4	90.1	86.4	68.1	<0.050	<0.50	0.052	14.5	309	0.0054	3.12	<0.0010	0.210		12.4	0.0298	0.1	0.00016	0.00053	0.0361	<0.000100	<0.000050	<0.010	0.0000344	0.0001454	27.4	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	22-May-2024	Lots of channels and pools. Not suitable for flow. Sampled in section with flowing/moving water. Water is clear. Shallow with leafy creek bottom.			<1.0	7.55	7.83	133.1	135	1.4	10.37	73.9	28.7	69.3	66.7	52.0	<0.050	<0.50	0.070	13.7	218	<0.0050	4.77	<0.0010	0.169		12.0	0.0320	0.1	0.00018	0.00045	0.0307	<0.000100	<0.000050	<0.010	0.0000263	0.0001169	21.4	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	29-May-2024	Flowing low and clear, ephemeral			<1.0	7.36	7.59	152.3	134	1.3	11.80	84.1	5.8	69.3	67.8	49.8	<0.050	<0.50	0.061	14.2	218	0.0060	7.44	<0.0010	0.129		13.8	0.0370	0.1	0.00017	0.00044	0.0314	<0.000100	<0.000050	<0.010	0.0000207	0.0001169	21.2	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	07-Jul-2024	Stagnant marsh, no visibly flowing water.			<1.0	7.18	8.13	209.1	198	5.8	4.54	36.3	83.2	101	97.9	75.0		<0.50		26.1	309		7.79				12.8	0.0220	0.1	0.00018	0.00044	0.0488	<0.000100	<0.000050	<0.010	0.0000486	0.0001598	30.3	<0.00050	<0.00010	
KV-49	Hinton Creek upstream Christal Creek	09-Oct-2024	Thick ice on top of nearly stagnant water. Will be frozen to bottom next month			3.0	7.39	8.07	312.2	264	0.1	7.57	52.0	144.9	133	132	104		<0.50		33.2	309		7.68				10.6	0.0528	0.1	0.00018	0.00106	0.0547	<0.000100	<0.000050	<0.010	0.000167	0.000201	40.1	<0.00050	<0.00010	
KV-50	Christal Creek upstream Hinton Creek	18-May-2008				13	7.22	7.33		209	0					100						309		11.5					0.31	0.1	0.0002	0.0057	0.022	<0.0001	<0.0005	<0.002	0.00026	0.000158	31	0.0012	0.0008	
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008				3	7.19	7.86		753	5					410						429		8.12					<0.005	0.1	<0.0002	0.0016	0.036	<0.0001	<0.0005	0.003	0.00038	0.00037	123	<0.0005	0.0009	
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008				17	7.32	7.38		471	1					287						429		8.37					0.612	0.1	0.0004	0.0136	0.05	<0.00004	<0.0001	<0.005	0.00052	0.00037	85.3	0.0012	0.00197	
KV-50	Christal Creek upstream Hinton Creek	28-May-2009				25	6.54	7.7		430	5				206	210						429		36.2					0.134	0.1	0.00031	0.0104	0.0327	0.00001	<0.000005	<0.05	0.00044	0.000289	63.9	0.0005	0.00131	
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009				13	7.44	7.9		890	3.6				492	489						429		5.12					0.115	0.1	0.00036	0.00607	0.0466	<0.00001	<0.000005	<0.05	0.000623	0.00037	154	0.0003	0.00169	
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009				2900	7.52	7.5		981	1				617	523						429		5.29					7.95	0.1	0.00126	0.096	0.264	0.00088	0.000035	<0.05	0.00384	0.00037	198	0.016	0.0294	
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010				14	7.38	7.62		904	7.5				501	549						429		4.29					0.0665	0.1	0.00029	0.0146	0.0293	<0.00001	<0.000005	<0.05	0.00032	0.00037	158	0.0004	0.00493	
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010		10		63	7.14	7.61		932	0.3				515	520	110				460	429		13.4				1.2	0.237	0.1	0.00022	0.0323	0.0635	0.00002	0.000006	<0.05	0.000839	0.00037	163	0.0007	0.00892	
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011	no water found																			128		0.616						No pH								No Hardness				
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011	no sample; ice axed but water not found																			128		0.616						No pH								No Hardness				
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011	axing attempted. Water not found																			128		0.616						No pH								No Hardness				

Station	Description	Sample Date	Sample Comments	Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-50	Christal Creek upstream Hinton Creek	26-May-2011	widely dispersed flow. Flow not taken			9	7.3	7.65		891	5.7				455	503	110				370	429		5.96				3.7	0.022	0.1	0.00017	0.0157	0.0267	<0.00001	<0.000005	<0.05	0.000237	0.00037	145	0.0003	0.00473
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	flow not taken. Dispersed			20	7.57	7.68		1090	3				665	636	120				460	429		3.99				2.3	0.145	0.1	0.00036	0.0272	0.0354	<0.00001	0.000006	<0.05	0.000413	0.00037	211	0.0005	0.00702
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011	not visited. No helper/lack of time																			128		0.616						No pH										No Hardness		
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011	flow est 20 l/s	2		<1	8.31	7.31	395	401	3				192	208	84				120	429		0.739				7.9	0.742	0.1	0.00073	0.0159	0.0568	0.00003	<0.00002	<0.05	0.00119	0.000272	59.7	0.0015	0.00291
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011	most turbid DC has seen water here. flows with Marsh McB	31.4265		1300	7.51	7.72	1417	1090	1.9				606	586	120				480	429		5.02				1.5	7.96	0.1	0.00171	0.0541	0.181	0.00023	0.00019	<0.05	0.00133	0.00037	192	0.0135	0.0155
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011		34		97	7.34	7.27	1229	1160	0.1	8.46	58.6	166.4	657	645	120				509	429		8.62				1.8	0.72	0.1	0.00033	0.0347	0.0424	0.00004	<0.000005	<0.05	0.000503	0.00037	208	0.0014	0.0107
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011	Salt Slug; Conductivity probe malfunction in cold	34.6		29.8	7.37	7.28		1160	0	9.2	63.3		703	671	118				518	429		8.11				0.89	0.245	0.1	0.0003	0.0309	0.0307	0.00001	0.000013	<0.05	0.000372	0.00037	224	0.0006	0.00995
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011	Conditions not condusive to measuring flow			15.3	6.9	7.6	1182	1140	0.1	9.32	64.1		663	647	115				487	429		23.7				0.9	0.083	0.1	0.00023	0.0312	0.0222	<0.00001	<0.000005	<0.05	0.000324	0.00037	209	0.0001	0.00993
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012	Salt slug.	28.3		18.2	7.02	7.38	1121	1160	0.1	8.5	58		662	696	115				498	429		18.0				1.15	0.0407	0.1	0.00018	0.032	0.0224	0.00001	<0.000005	<0.05	0.000307	0.00037	212	<0.0001	0.00922
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012	Condition not condusive to measure flow.			14.7	6.94	7.86	1195	1180	0.1	9.89	68.2	1.3	655	687	119				528	429		21.6				<0.50	0.028	0.1	0.00016	0.0304	0.0225	<0.00001	<0.000005	<0.05	0.000275	0.00037	209	<0.0001	0.0096
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012	Salt Slug	21.2		10.6	6.95	7.83	1218	1180	0	10.47	72.2	-2.6	690	660	118				552	429		21.3				0.53	0.0326	0.1	0.00015	0.0345	0.0224	<0.00001	<0.000005	<0.05	0.000269	0.00037	218	0.0001	0.0101
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012	Salt Slug	19.5		12.7	7.38	7.47	1313	1200	0.5	10.07	70.1	18.6	667	685	116				530	429		7.60				<0.50	0.0304	0.1	0.00022	0.0355	0.0231	<0.00001	<0.000005	<0.05	0.000331	0.00037	211	0.0002	0.0106
KV-50	Christal Creek upstream Hinton Creek	03-May-2012	no YSI for insitu	38.9		30.8		7.46		698	1.0				370	363	72		0.61		311	429		6.07				10.5	0.119	0.1	0.000297	0.0212	0.0243	0.000016	0.000011	<0.050	0.000273	0.00037	116	0.00025	0.00564
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012	Red mud in creek bed.	28.525		21.7	7.02	7.74	1364	1210	3.2	11.8	89	299.1	621	608	111		0.95		581	429		13.9				0.96	0.0978	0.1	0.00018	0.0273	0.0289	<0.000050	<0.000025	<0.25	0.00028	0.00037	189	<0.00050	0.00957
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012	water turbid but less than KV-51; orange mud; foam	32.23		18.2	7.27	7.68	1134	1110	4.1	10.15	78.2	-6.3	651	648	111		0.82		524	429		7.27				1.06	0.0927	0.1	0.000285	0.0222	0.0286	0.000013	0.0000078	<0.050	0.000245	0.00037	206	0.00023	0.00868
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012	Water turbid, creek bed reddish. Lots of branches making flow reading difficult.	38.24		19.3	7.61	7.52	1164	1100	4.9	10.64	83.7	-31.5	666	648	113		0.76		498	429		3.12				1.49	0.0996	0.1	0.000248	0.0222	0.0293	<0.000010	<0.0000050	<0.050	0.000296	0.00037	211	0.0002	0.00895
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012	Water turbid + red mud on creek bed.	28.8		20	8.58	7.81	1278	1080	2	9.91	72	-33.4	559	582	112		1.2		452	429		0.438				1.47	0.115	0.1	0.000268	0.0214	0.0266	<0.000010	<0.0000050	<0.050	0.0003	0.00037	178	0.00018	0.00816
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012	Flow measurements at 11:41.	27.8387		20	6.7	7.75	1195	1130	0.2	8.16	55.5	-14.7	629	623	109		1.5		511	429		37.2				1.12	0.0754	0.1	0.000236	0.0263	0.0275	<0.000010	<0.0000050	<0.050	0.000264	0.00037	203	0.00016	0.00904
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012	YSI conductivity not working, flow reading not possible.			14.2	7.85	7.82	1072	1100	2.4	1.8	75	267	614	626	114		<0.50		505	429		2.21				0.73	0.0615	0.1	0.000264	0.0291	0.0264	<0.000010	<0.0000050	<0.050	0.000452	0.00037	193	<0.00010	0.00887
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012	Got pH in Lab at the end of the day. ORP probe not working. Salt slug discharge measurement not available - meter error.			14.2	6.88	7.77	983	1100	0.28	9.51	65.8		595	585	114		<0.50		540	429		24.4				0.92	0.0457	0.1	0.00023	0.0284	0.0255	<0.000010	<0.0000050	<0.050	0.000402	0.00037	187	<0.00010	0.00897
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013		19.82		17.3	6.92	7.96	1036	1120	0.1	9.63	67.3	49.2	617	612	114		0.92		545	429		22.6				0.77	0.0225	0.1	0.000169	0.0293	0.0226	<0.000010	<0.0000050	<0.050	0.000258	0.00037	195	0.0001	0.0094
KV-50	Christal Creek upstream Hinton Creek	03-May-2013	Cannot salt slug, too many pools + debris.			32.4	6.83	7.78	1294	1180	0.2	10.49	72.7	99	712	712	129		<5.0	0.33	578	429		27.6	<0.010	0.100		0.80	0.450	0.1	0.00051	0.0436	0.0318	<0.00010	<0.00050	<0.010	0.000377	0.00037	225	0.00088	0.0113
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013	Water little turbid.	28.238		19.4	6.77	7.79	892	1090	4.5	9.28	71.8	69	647	640	123		<5.0	<0.20	535	429		22.2	<0.010	0.116		1.44	0.323	0.1	0.00041	0.0286	0.0349	<0.00010	<0.00050	<0.010	0.000392	0.00037	199	0.00063	0.00891
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013	water clear, orange/brown sediments, brown/green algae on surface.			10.4	6.93	7.23	1184	1100	4.1	6.25	48.5	-59.2	649	663	102		<5.0	0.31	567	429		15.9	<0.010	<0.050		0.90	0.150	0.1	0.00037	0.0258	0.0247	<0.00010	<0.00050	<0.010	0.000385	0.00037	206	0.00036	0.0104
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013	Water clear, Orange/brown precipitate.	30.43		5.4	6.88	7.75	924.7	529	0.4	10.63	74.6	8.4	563	557	113		<5.0	0.23	429	429		24.2	<0.010	0.126		2.05	0.104	0.1	0.00017	0.0174	0.0222	<0.00010	<0.00050	<0.010	0.000201	0.00037	174	0.00022	0.00779
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014	Slug failed at the end, YSI froze.Too cold. Water little turbid, orange muck in creek bed. Lots of branches+ de bris in creek.All samples preserved+filtered in lab.			28.6	6.93	7.49	929.6	749	-0.1	7.81	53.5	10.6	503	518	107		0.80	0.246	364	429		22.3	<0.0010	0.0916		1.27	0.251	0.1	0.00020	0.0367	0.0253	<0.00010	<0.00050	<0.010	0.000228	0.00037	160	0.00046	0.00743
KV-50	Christal Creek upstream Hinton Creek	06-May-2014	Water orange, turbid, lots of branches in water, may affect flow reading.	21.9		43.9	6.89	7.39		292	1.2	11.31	80.8	68.1	148	148	44.4		1.21	0.093	99.7	309		22.1	<0.0010	0.0125		17.7	0.981	0.1	0.00094	0.0231	0.0432	<0.00010	<0.00050	<0.010	0.000718	0.000219	45.4	0.00179	0.00330
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014	Orange mud on bottom. Water little turbid.	27.6		7.6	7.11	7.21	893	874	3.3	9.36	70.7	90.5	574	592	130		<5.0	0.26	451	429		11.2	<0.010	0.121		1.95	0.0558	0.1	0.00019	0.0180	0.0264	<0.00010	<0.00050	<0.010	0.000218	0.00037	178	0.00012	0.00729
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014	95% open water. Red/orange sediments on bottom.	35.2		8.0	7.07	7.60	816.4	986	0.3	10.05	71.1	83.1	523	536	131		3.3	0.17	403	429		15.8	<0.0050	0.143		1.53	0.0759	0.1	0.00028	0.0175	0.0282	<0.00010	<0.00050	<0.010	0.000262	0.00037	163	0.00020	0.00627
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015	water not oily like KV-51 downstream; lots of particulates in water.	21		48.6	6.96	7.14	996	1080	0	9.77	67.5	89.5	556	578	123		<1.0	0.219	447	429		20.8	<0.0020	0.104		0.99	0.430	0.1	0.00024	0.0455	0.0346	<0.00010	<0.00050	<0.010	0.000319	0.00037	174	0.00082	0.00881
KV-50	Christal Creek upstream Hinton Creek	12-May-2015		37.2		7.8	6.58	7.11	506.8	458	3.2	9.97	74.9	142.3	245	253	63.2		<0.50	0.112	180	429		38.3	<0.0010	0.0385		14.5	0.316	0.1	0.00036	0.0134	0.0342	<0.00010	<0.00050	<0.010	0.000190	0.000333	77.3	0.00058	0.00397
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015		28.6		66.0	7.08	7.35	844	1030	4.7	8.1	70	75.4	593	605	125		<1.0	0.250	466	429		10.7	<0.0020	0.100		1.51	1.60	0.1	0.00047	0.0265	0.0809	<0.00010	<0.00050	<0.010	0.000361	0.00037	188	0.00252	0.00860
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015	ORP value suspect, water is clear some ice on banks	36.3		17.5	7.41	7.65	867.7	852	0.6	9.6	67	-9.2	513	526	122		0.85	0.206	377	429		7.04	<0.0010	0.122		1.17	0.272	0.1	0.00024	0.0214	0.0335	<0.00010	<0.00050	<0.010	0.000242	0.00037	164	0.00047	0.00669
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016		24.7		26.4	6.94	7.32	1038	926	0.1	7.75	53.5	-0.7	579	605	108		<1.0	0.203	471	429		21.6	<0.0020	0.091		0.65	0.169	0.1	0.00014	0.0283	0.0271	<0.00010	<0.00050	<0.010	0.000173	0.00037	184	0.00039	0.00850
KV-50	Christal Creek upstream Hinton Creek	04-May-2016	Water is clear, moderate to low flow.	28.5		18.0	6.77	7.19	818.5	902	1.5	9.2	74	186.4	518	554	97.4		<1.0	0.168	336	429		28.4	<0.0020	0.073		4.65	0.211	0.1	0.00019	0.0224	0.0311	<0.00010	<0.00050	<0.010	0.000196	0.00037	165	<0.00050	0.00679
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016	Water is slightly turbid, moderate flow	33.1		19.2	7.11	7.31	971	1020	6.9	8.8	80	204.3	568	601	112		0.53	0.227	446	429		8.37	<0.0010	0.0826		1.85	0.257	0.1	0.00024	0.0187	0.0354	<0.00010	<0.00050	<0.010	0.000189	0.00037	179	0.00047	0.00707
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016		43.3		35.6	6.91	7.27	922	988	-0.2	7.28	55.6	54.4	596	616	111	<0.25	<2.5	0.21	477	429		23.4	<0.0050	0.100		1.35	0.430	0.1	0.00026	0.0307	0.0366	<0.00010	<0.00050	<0.010	0.000300	0.00037	188	0.00074	0.00947
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	DO suspect (124% & 16.28 mg/L) and removed	21.3		15.8	7.16	7.71	824.8	1050	-0.1			125.9	609	638	115	<0.25	<2.5	0.24	483	429		13.1	<0.0050	0.089		0.80	0.105	0.1	0.00013	0.0332	0.0276	<0.00010	<0.00050	<0.010	0.000152	0.00037	192	<0.00050	0.00985
KV-50	Christal Creek upstream Hinton Creek	15-May-2017		22.3		28.1	6.94	7.58	1113	946	1.2	7.48	59.3	26.7	545	537	94	<0.25	<2.5	0.19	442	429		19.7	<0.0050	0.096		5.17	0.349	0.1	0.00020	0.0274	0.0357	<0.00010	<0.00050	<0.010	0.000214	0.00037	171	<0.00060	0.00921
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017		31.4		13.4	7.07	7.66	958	1030	4.6	7.69	66.8	83.9	591	596	115	<0.25	<2.5	0.21	506	429		11.0	<0.0050	0.112		1.74	0.0976	0.1	0.00015	0.0200	0.0307	<0.00010	<0.00050	<0.010	0.000164	0.00037	184	0.00016	0.00842
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	Too cold for salt slug calibration	30		7.6	7.02	7.69	1054.0	976	0.0	6.62	51.3	29.1	592	576	115	<0.25	0.69	0.25	505	429		18.1	<0.0050	0.105		1.17	0.0539	0.1	0.00013	0.0242	0.0235	<0.00010	<0.00050	<0.010	0.000154	0.00037	187	0.00011	0.00821
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017		26.1		17.5	7.08	7.39	920.8	929	0.0	9.0	70	26.2	584	560	108	<0.050	0.52	0.244	427	429	0.0462	15.8	<0.0010	0.115		0.78	0.282	0.1	0.00018	0.0415	0.0316	<0.00010	<0.00050	<0.010	0.000266	0.00037	183	0.00052	0.00847
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	Ammonia analysed from DOC filtered bottle, result is total dissolved.	30.5		8.8	7.52	7.78	858.0	891	0.2	8.40	65	-62.6	513	495	112	<0.25	<2.5	0.22	426	429	0.0598	5.65	<0.0050	0.120		1.10	0.0229	0.1	0.00014	0.0224	0.0233	<0.00010	<0.00050	<0.010	0.000322	0.00037	162	<0.00010	0.00741
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018		12.1		15.1	7.36	7.40		1010	-0.3	7.12	54	36.3	650	581	110	<0.25	<2.5	0.25	504	429	0.0240	8.30	<0.0050	0.103		0.72	0.0858	0.1	0.00012	0.0320	0.0232	<0.00010	<0.00050	<0.010	0.000162	0.00037	212	0.00024	0.00854
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018		18.8		58.1	7.26	7.67	943.2	1050	0.2	8.3	64	12.1	582	583	114	<0.25	<2.5	0.24	506	429	0.0261	10.3	<0.0050	0.099	0.142	0.97	0.408	0.1	0.00015	0.0382	0.0304	<0.00010	<0.00050	<0.010	0.000229	0.00037	189	0.00066	0.00919
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018		14.3		16.4	7.09	8.09	912.7	1040	0	7.3	55	-8.5	567	624	118	<0.25	<2.5	0.25	468	429	0.0244	15.4	<0.0050	0.071		1.22	0.134	0.1	0.00013	0.0309	0.0215	<0.00010	<0.00050	<0.010	0.000148	0.00037	179	0.00136	0.00861
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018		14.4		45.0	7.25	7.94	915.4	1040	0.1	7.1	55	-22.5	537	600	128	<0.25	<2.5	0.27	457	429	0.0426	10.6	<0.0050	0.062		1.17	0.173	0.1	0.00011	0.0358	0.0271	<0.00010	<0.00050	<0.010	0.000136	0.00037	169	0.00040	0.00888
KV-50	Christal Creek upstream Hinton Creek	15-May-2018		85.9		156	6.89	7.65	230.6	244	0.3	10.27	78.4	97.2	123	118	39.8	<0.050	<0.50	0.083	76.3	309	0.0123	23.9	<0.0010	0.0083	0.740	24.0	1.36	0.1	0.00078	0.0450	0.0555	<0.00010	<0.00050	<0.010	0.000699	0.000188	36.9	0.00296	0.00415
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018		85.4		7.4	7.11	8.04	696.3	773	1.1	8.29	65.7	19.3	430	447	98.4	<0.25	<2.5	0.20	359	429	0.0331	13.4	<0.0050	0.099		4.33	0.0478	0.1	0.00018	0.0159	0.0264	<0.00010	<0.00050	<0.010	0.000146	0.00037	133	0.00028	0.00539
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	DO stable, then erratic, then stable again at 70%.	36.7		15.1	7.51	7.93	937.0	920	8.8	8.30	70.0	17.50	490	495	121	<0.25	<2.5	0.21	414	429	0.0279	2.88	<0.0050	0.149	0.150	1.70	0.0821	0.1	0.00020	0.0219	0.0318	<0.00010	<0.00050	<0.010	0.000248	0.00037	147	0.00023	0.00637
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	total metals missing preservatives, preserved in lab later	48.7		16.0	7.05	8.00	766.3	900	2.1	7.82	56.8	-26.6	491	467	118	<0.050	0.78	0.208	351	429	0.0341	14.2	<0.0010	0.195		2.76	0.200	0.1	0.00019	0.0234	0.0334	<0.00010	<0.00050	<0.010	0.000294	0.00037	151	0.00039	0.00597
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	Sampled and flow measured 20 m u/s of flagging. Discharge suspect due to high RPD and poor helper field note recording in Sep.	48.1		13.9	6.83	7.86	877.1	915	2.0	7.67	61.2	31.7	520	521	126	<0.050	0.68	0.205	367	429	0.0361	23.8	<0.0010	0.224		1.84	0.135	0.1	0.00022	0.0173	0.0322	<0.00010	<0.00050	<0.010	0.000220	0.00037	162	0.00027	0.00538
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	Salt slug. Sampled at flagging. Ice on top of stream.	30.4		9.5	6.98	7.76	800.3	788	0.3	8.35	57.9	5.0	466	408	109	<0.25	<2.5	0.20	317	429	0.0448	19.4	<0.0050	0.327	0.121	0.78	0.147	0.1	0.00021	0.0225	0.0295	<0.00010	<0.00050	<0.010	0.000222	0.00037	145	0.00027	0.00656
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	Semi open, some mud disturbed at u/s sample site prior to salt and insitu reading	23.7		9.8	6.77	7.87	744.8	780	-0.2	8.19	62.6	-4.60	424	429	110	<0.050	<0.50	0.231	326	429	0.0703	32.2	<0.0010	0.208		0.99	0.0707	0.1	0.00014	0.0222	0.0228	<0.00010	<0.00050	<0.010	0.000202	0.00037	132	0.00017	0.00646
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	Slight u/s blockage from ice, corrected maybe. Short discharge distance for salt.	23.5		9.6	6.78	7.99	719.3	813	-0.3	8.01	63.1	6.40	388	447	113	<0.25	<2.5	0.23	326	429	0.0615	31.5	<0.0050	0.159		0.71	0.0842	0.1	0.00014	0.0242	0.0233	<0.00010	<0.00050	<0.010	0.000207	0.00037	121	0.00017	0.00641
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	shallow, good flow. Initially covered with thin ice.	16.7		12.5	6.82	7.99	792.3	821	-0.5	8.11	60.8	3.60	438	440	112	<0.25	<2.5	0.26	346	429	0.0674	28.7	<0.0050	0.102		1.00	0.0620	0.1	0.00011	0.0266	0.0232	<0.00010	<0.00050	<0.010	0.000186	0.00037	137	0.00014	0.00694
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	Flow data lost			12.5	7.15	7.45	833.0	808	0.0	8.14	66.9	-31.5	444	437	114	<0.25	<2.5	0.27	345	429	0.0690	13.5	<0.0050	0.090	0.098	0.83	0.0252	0.1	<0.00010	0.0243	0.0225	<0.00010	<0.00050	<0.010	0.000112	0.00037	139	<0.00010	0.00698
KV-50	Christal Creek upstream Hinton Creek	06-Mar-2019	shallow; flow apparent	11.7		18.2	7.02	7.45	872.7	861	-0.6	5.79	43.4	14.9	463	454	115	<0.25	<2.5	0.28	360	429	0.0277	18.1	<0.0050	0.080		1.04	0.127	0.1	<0.00010	0.0304	0.0206	<0.00010	<0.00050	<0.010	0.000116	0.00037	147	0.00023	0.00682
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2019		12.8		5.8	6.85	7.66	763	833	-0.3	8.58	58.3	28.1	443	475	114	<0.25	<2.5	0.28	338	429	0.0496	26.8	<0.0050	0.057		1.08	0.0455	0.1	0.00012	0.0222	0.0223	<0.00010	<0.00050	<0.010	0.000120	0.00037	140	0.00012	0.00711
KV-50	Christal Creek upstream Hinton Creek	16-May-2019		17.0		7.9	6.77	7.78	642.5	695	2.4	8.68	63.6	22.6	363	404	89.0	<0.050	<0.50	0.222	261	429	0.0419	26.4	<0.0010	0.0451	0.160	2.53	0.0275	0.1	0.00011	0.0179	0.0213	<0.00010	<0.00050	<0.010	0.000130	0.00037	114	0.00011	0.00449
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2019		19.0		14.9	7.01	7.36	962.0	1020	2.9	6.76	50.2	5.1	560	549	114	<0.25	<2.5	0.20	433	429	0.0328	14.6	<0.0050	0.083		1.26	0.0760	0.1	0.00011	0.0287	0.0247	<0.00010	<0.00050	<0.010	0.000148	0.00037	175	0.00018	0.00793
KV-50	Christal Creek upstream Hinton Creek	22-Jul-2019		20.3		16.7	7.46	7.77	930.0	978	2.3	8.16	59.6	-3.3	550	532	118	<0.25	<2.5	0.23	459	429	0.0728	5.45	<0.0050	0.142	0.182	1.50	0.285	0.1	0.00013	0.0235	0.0363

Station	Description	Sample Date	Sample Comments	Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021				3.1	8.00	7.61	712.5	791	9.7				419	415	113	<0.250	<2.50	0.207	323	429	0.0708	0.878	<0.0050	0.173		1.32	0.0081	0.1	0.00019	0.00612	0.0253	<0.000100	<0.000050	<0.010	0.000216	0.00037	131	<0.00050	0.00469
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021		23.2		2.9	7.23	7.91	640.2	751	7.3	8.77	72.4	-10.7	418	380	117	<0.050	0.74	0.240	303	429	0.0412	6.15	<0.0010	0.182		1.30	0.0103	0.1	0.00015	0.0111	0.0268	<0.000100	<0.000050	<0.010	0.000185	0.00037	131	<0.00050	0.00488
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	mid section flow measurement.	28.1		3.7	7.78	7.50	661.6	683	4.4	9.17	71.6	-33.3	353	350	113	<0.050	<0.50	0.197	244	429	0.0365	2.20	<0.0010	0.109		2.89	0.0282	0.1	0.00018	0.0122	0.0287	<0.000100	<0.000050	<0.010	0.000198	0.00037	110	<0.00050	0.00405
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021				7.9	7.59	7.85	631.8	687	0.2	9.65	67.8	-49.4	369	381	122	<0.050	0.59	0.216	272	429	0.0486	4.81	<0.0010	0.115		1.69	0.112	0.1	0.00029	0.0156	0.0330	<0.000100	<0.000050	<0.010	0.000349	0.00037	116	<0.00050	0.00476
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021		19.0		10.4	7.07	7.31	624.5	706	0.1	10.54	68.3	19.0	387	357	112	<0.050	0.57	0.244	264	429	0.0661	16.0	<0.0010	0.107		2.18	0.0812	0.1	0.00023	0.0206	0.0283	<0.000100	<0.000050	<0.010	0.000303	0.00037	121	<0.00050	0.00481
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021		15.9		10.6	6.18	7.30	767.2	774	0.0	7.69	53.4	-51.9	433	444	118	<0.050	0.65	0.251	315	429	0.0986	125	<0.0010	0.120		1.18	0.0617	0.005	0.00017	0.0231	0.0268	<0.000100	<0.000050	<0.010	0.000226	0.00037	141	<0.00050	0.00668
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	not ideal for flow measurement, creek full of slush			13.6	7.36	7.60	662.9	775	0.0	9.11	63.9	106.5	395	428	116	<0.250	<2.50	0.231	313	429	0.0803	8.30	<0.0050	0.147		1.29	0.105	0.1	0.00023	0.0323	0.0314	<0.000100	<0.000050	<0.010	0.000304	0.00037	124	<0.00050	0.00702
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022		15.7		6.6	7.23	7.39	772.6	826	0.4	10.48	72.5	57.7	456	432	114	<0.250	<2.50	0.290	338	429	0.0780	10.8	<0.0050	0.101		0.82	0.0106	0.1	0.00022	0.0224	0.0237	<0.000100	<0.000050	<0.010	0.000127	0.00037	145	<0.00050	0.00737
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022				16.5	7.15	7.47	285.5	802	-0.1	10.95	75.1	-57.4	451	467	119	<0.250	<2.50	0.292	344	429	0.0872	13.5	<0.0050	0.0895		1.06	0.0640	0.1	0.00012	0.0285	0.0254	<0.000100	<0.000050	<0.010	0.000141	0.00037	142	<0.00050	0.00812
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022		8.2		6.0	6.96	7.27	866.6	825	0.0	10.45	71.7	13.9	497	426	119	<0.050	<0.50	0.300	338	429	0.0970	20.8	<0.0010	0.0538		0.92	0.0122	0.1	<0.00010	0.0304	0.0271	<0.000100	<0.000050	<0.010	0.000175	0.00037	159	<0.00050	0.00882
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	low water levels	11.2		24.0	7.22	7.66	663.5	669	0.1	10.59	71.8	-74.0	344	332	86.2	<0.050	9.65	0.212	246	429	0.0765	11.4	0.0011	0.0596		3.65	0.744	0.1	0.00249	0.0332	0.0543	<0.000100	0.000056	<0.010	0.00130	0.00037	108	0.00120	0.00669
KV-50	Christal Creek upstream Hinton Creek	15-May-2022		44.8		6.5	6.64	7.67	226.3	229	4.0	9.93	76.0	156.4	112	108	38.7	<0.050	2.56	0.094	63.7	309	0.0185	31.2	<0.0010	0.0159		22.2	0.113	0.1	0.00037	0.00931	0.0208	<0.000100	<0.000050	<0.010	0.000228	0.000174	34.9	<0.00050	0.00201
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022		23.3		9.5	7.54	8.07	696.4	729	3.8	8.40	63.9	-60.5	376	377	89.8	<0.250	<2.50	0.198	304	429	0.0325	4.01	<0.0050	0.0587		4.30	0.0296	0.1	0.00017	0.0174	0.0255	<0.000100	<0.000050	<0.010	0.000171	0.00037	123	<0.00050	0.00566
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022		21.3	0.34	3.5	7.14	8.09	757.1	778	5.7	8.73	71.5	32.4	437	425	117	<0.250	<2.50	0.232	323	429	0.0394	8.60	<0.0050	0.0434		2.51	0.0156	0.1	0.00021	0.00934	0.0312	<0.000100	<0.000050	<0.010	0.000192	0.00037	140	0.00082	0.00561
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022		13.7		2.4	7.30	8.03	718.3	837	6.3	10.57	86.1	36.6	455	453	119	<0.250	<2.50	0.245	333	429	0.0460	5.68	<0.0050	0.0468		2.45	0.0263	0.1	0.00021	0.0125	0.0293	<0.000100	<0.000050	<0.010	0.000191	0.00037	146	<0.00050	0.00566
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022		25.5		11.1	7.23	8.09	629.1	723	0.7	9.07	63.9	110.6	407	402	112	<0.250	<2.50	0.179	291	429	0.0748	10.6	<0.0050	0.0701		3.13	0.298	0.1	0.00018	0.0146	0.0821	<0.000100	<0.000050	<0.010	0.000227	0.00037	130	<0.00050	0.00561
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022	Creek frozen to bottom, cannot find any open water																		128		0.616							No pH										No Hardness		
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	Normal flow, ice covered stream, water shallow and orange.	23		7.0	7.36	7.38	751.6	753	0.2	7.96	66.8	16.6	386	386	110	<0.250	<2.50	0.200	307	429	0.0777	8.16	<0.0050	0.179		1.37	0.0709	0.1	0.00024	0.0225	0.0302	<0.000100	<0.000050	<0.010	0.000379	0.00037	120	<0.00050	0.00635
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022		19		10.2	7.61	8.15	787.5	756	-0.2	8.41	58.1	201.3	354	382	106	<0.250	<2.50	0.213	306	429	0.115	4.67	<0.0050	0.191		1.42	0.0677	0.1	0.00022	0.0253	0.0330	<0.000100	<0.000050	<0.010	0.000288	0.00037	110	<0.00050	0.00630
KV-50	Christal Creek upstream Hinton Creek	21-Jan-2023	Creek slushy, no flow			3.0	7.02	7.71	763.5	759	0.0	10.70	73.4	188.6	390	426	111	<0.250	<2.50	0.282	326	429	0.0891	18.1	<0.0050	0.104		1.09	0.0172	0.1	0.00015	0.0252	0.0230	<0.000100	<0.000050	<0.010	0.000213	0.00037	126	<0.00050	0.00665
KV-50	Christal Creek upstream Hinton Creek	09-Feb-2023		11.9		4.7	7.08	7.84	805.3	772	-0.2	9.43	64.5	36.5	407	400	112	<0.250	<2.50	0.237	333	429	0.105	15.8	<0.0050	0.0899		1.62	0.0098	0.1	0.00014	0.0265	0.0244	<0.000100	<0.000050	<0.010	0.000228	0.00037	130	<0.00050	0.00735
KV-50	Christal Creek upstream Hinton Creek	10-Mar-2023	only one salt flow done	11.1		6.3	7.54	7.88	782.5	779	-0.3	9.23	62.8	137.9	405	394	113	<0.250	<2.50	0.280	324	429	0.0898	5.49	<0.0050	0.0619		1.37	0.0228	0.1	0.00015	0.0303	0.0240	<0.000100	<0.000050	<0.010	0.000111	0.00037	129	<0.00050	0.00734
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2023	Sample only, glaciation layers			6.9	7.14	7.81	766	777	0	12.31	85.7	-1.7	364	356	104	<0.250	~	0.226	298	429	0.0915	13.8	<0.0050	0.0682		1.38	0.0683	0.1	0.00093	0.0229	0.0311	<0.000100	<0.000050	<0.010	0.000541	0.00037	115	<0.00050	0.00687
KV-50	Christal Creek upstream Hinton Creek	12-May-2023	Flooded vegetation, no flow measurement			12.3	6.66	7.27	266.3	257	1.1	13.09	93.2	103	113	110	34.2		8.53		73.5	309	0.0563	37.9	0.0187	0.526		21.1	0.258	0.1	0.00094	0.0109	0.0300	<0.000100	<0.000050	<0.010	0.000359	0.000175	35.6	<0.00050	0.00190
KV-50	Christal Creek upstream Hinton Creek	14-Jul-2023		20.9		4.2	7.23	7.96	629.5	786	3.1	8.81	65.8	18.3	457	420	120		<0.50		313	429	0.0412	8.65	<0.0010	0.0590		1.76	0.0197	0.1	0.00018	0.0128	0.0308	<0.000100	<0.000050	<0.010	0.000240	0.00037	147	<0.00050	0.00546
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2023	Salt flow instead of xs b/c channel width is quite small and edge effects negatively affect ADV significantly. Needed more salt.	16.5		5.0	7.19	7.85	763.5	781	2.3	9.05	66.1	-9.7	416	419	116		<2.50		309	429	0.0518	10.1	<0.0050	0.0588		2.96	0.0261	0.1	0.00020	0.0160	0.0282	<0.000100	<0.000050	<0.010	0.000188	0.00037	134	<0.00050	0.00588
KV-50	Christal Creek upstream Hinton Creek	14-Sep-2023	Will return for flow measurement. Surveyed KV-51			3.8	7.21	8.18	790.7	789	4.3	10.16	78.4	60.4	414	423	117	<0.250	<2.50	0.240	299	429	0.0443	8.21	<0.0050	0.0518		1.77	0.0215	0.1	0.00014	0.0148	0.0260	<0.000100	<0.000050	<0.010	0.000178	0.00037	132	<0.00050	0.00581
KV-50	Christal Creek upstream Hinton Creek	25-Oct-2023	Glaciated with over flow			26.2	6.85	7.65	808	817	0	3.85	26.4	2	416	455	121		<2.50		315	429	0.0767	26.8	<0.0050	0.0654		1.72	0.210	0.1	0.00019	0.0300	0.0296	<0.000100	<0.000050	<0.010	0.000244	0.00037	130	<0.00050	0.00723
KV-50	Christal Creek upstream Hinton Creek	20-Nov-2023	Standing water on top of ice above flowing water. Unable to guarantee salt mixture enters flowing portion			6.4	6.9	7.70	796	830	0	7.24	49.6	-34.6	439	428	121	<0.250	<2.50	0.268	322	429	0.0842	23.9	<0.0050	0.0719		1.90	0.0506	0.1	0.00016	0.0260	0.0290	<0.000100	<0.000050	<0.010	0.000171	0.00037	138	<0.00050	0.00739
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2023	Salt gauge conducted but results were not good.			6.9	6.75	7.71	753.0	812	0.0	5.83	41.8	2.2	413	431	113	<0.250	<2.50	0.199	315	429	0.0958	33.8	<0.0050	0.0710		2.09	0.0241	0.1	0.00016	0.0232	0.0309	<0.000100	<0.000050	<0.010	0.000159	0.00037	130	<0.00050	0.00736
KV-50	Christal Creek upstream Hinton Creek	25-Jan-2024	Not enough flow to clear auger hole. Ice nearly frozen to bottom			61.5	6.92	7.17	865	853	0	4.13	28.3	-21.7	458	434	122	<0.250	<2.50	0.234	366	429	0.0788	22.8	<0.0050	0.0564		1.22	0.0389	0.1	<0.00010	0.0337	0.0340	<0.000100	<0.000050	<0.010	0.0000965	0.00037	146	<0.00050	0.00789
KV-50	Christal Creek upstream Hinton Creek	16-Feb-2024	could not locate running water due to glaciation																		128		0.616							No pH										No Hardness		
KV-50	Christal Creek upstream Hinton Creek	29-Mar-2024	Glaciated																		128		0.616							No pH										No Hardness		
KV-50	Christal Creek upstream Hinton Creek	21-Apr-2024	6ft plus of ice, orange overflow water on top. Very rotten ice, likely melted by next month																		128		0.616							No pH										No Hardness		
KV-50	Christal Creek upstream Hinton Creek	28-Apr-2024	Very flooded area with lots of channels. Lots of water everywhere, unable to conduct flow measurement. Possibly influenced by snowmelt.			10.2	6.80	7.78		343	0.4	9.92	68.6	24.8	160	159	50.7	<0.050	4.04	0.110	112	309	0.0144	29.1	0.0011	0.0460		14.6	0.180	0.1	0.00075	0.0136	0.0242	<0.000100	<0.000050	<0.010	0.000194	0.000234	50.1	<0.00050	0.00250
KV-50	Christal Creek upstream Hinton Creek	08-May-2024		26.9		12.1	6.73	7.72	289.3	286	0.7	11.70	81.7	32.2	126	135	47.5	<0.050	0.77	0.130	86.7	309	0.0133	33.3	<0.0010	0.0146		16.9	0.221	0.1	0.00035	0.0164	0.0206	<0.000100	<0.000050	<0.010	0.000128	0.000192	39.0	<0.00050	0.00254
KV-50	Christal Creek upstream Hinton Creek	13-May-2024	Very orange nasty water, residue on willows all around creek. Water flowing low and clear, some ice on banks.	16.1		3.4	7.34	7.97	531.3	522	2.2	~	~	55.0	259	253	76.6	<0.050	1.00	0.136	129	429	0.0324	7.23	<0.0010	0.0170		7.22	0.0203	0.1	0.00018	0.0132	0.0207	<0.000100	<0.000050	<0.010	0.000102	0.000349	82.6	<0.00050	0.00382
KV-50	Christal Creek upstream Hinton Creek	22-May-2024	Metallic odour, orange precipitate in water. Lots of orange precipitate in creek and area. Soft creek bottom due to precipitate build up. Midsection flow measurement.	15.4		6.1	7.37	8.05	615	622	2.1	8.81	64.1	-24.2	321	302	87.8	<0.050	1.28	0.200	234	429	0.0562	6.81	<0.0010	0.0527		5.09	0.0380	0.1	0.00019	0.0166	0.0252	<0.000100	<0.000050	<0.010	0.0000975	0.00037	103	<0.00050	0.00470
KV-50	Christal Creek upstream Hinton Creek	29-May-2024	Orange precipitate on creek bed and surrounding veg.	13.9		6.3	6.8	7.41	475.7	456	2.5	9.14	67.2	-2.6	234	219	71.7	<0.050	2.03	0.163	151	429	0.0465	24.4	<0.0010	0.0289		9.36	0.0663	0.1	0.00028	0.0139	0.0257	<0.000100	<0.000050	<0.010	0.000122	0.000321	74.1	<0.00050	0.00369
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2024	Midsection flow measurement. Lots of orange deposit on creek bottom, which sometimes interfered with measuring flow.	9		9.6	7.51	8.35	803	819	1.7	11.8	85.3	1.4	450	428	114	<0.250	<2.50	0.208	342	429	0.0719	5.10	<0.0050	0.0426		2.87	0.0162	0.1	0.00014	0.0219	0.0259	<0.000100	<0.000050	<0.010	0.000101	0.00037	144	<0.00050	0.00703
KV-50	Christal Creek upstream Hinton Creek	07-Jul-2024	Same sediment issue with flow meter as kv51. Could not do salt, longest stretch without a large eddie or pool was ~1m.			2.1	7.11	8.19	838	861	8.1	8.63	73.2	17.0	451	428	121		<2.50		338	429	0.0228	7.61	<0.0050	0.0442		2.28	0.0126	0.1	0.00011	0.00984	0.0263	<0.000100	<0.000050	<0.010	0.0000889	0.00037	140	<0.00050	0.00590
KV-50	Christal Creek upstream Hinton Creek	14-Aug-2024	Bottom too soft for midsection flow, every movement stirred up sediment that settles on sensor. Salt slug - 150 g was good mass, ysi was not logging for first 150 so only have 1 usable salt flow. Last salt would not come down to bl.	8.7		5.9	7.06	8.07	1039	863	5.9	8.16	65.6	18.4	455	448	124	<0.250	<2.50	0.236	360	429	0.0279	10.2	<0.0050	0.0514		1.83	0.0211	0.1	0.00012	0.0139	0.0257	<0.000100	<0.000050	<0.010	0.000115	0.00037	146	<0.00050	0.00645
KV-50	Christal Creek upstream Hinton Creek	05-Sep-2024	Bottom too soft for midsection flow, water too slow for salt flow			6.9	7.27	8.02	902	750	4.8	8.15	63.5	-101.8	412	371	117	<0.250	5.85	0.202	276	429	0.0467	6.86	<0.0050	0.0510		2.63	0.0882	0.1	0.00038	0.0144	0.0293	<0.000100	<0.000050	<0.010	0.000188	0.00037	131	<0.00050	0.00510
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2024	Creek partially frozen over, broke ice to do mid section flow measurement	7.1		6.0	7.23	8.00	901	778	0.4	9.35	64.9	19.6	411	407	117		<2.50		294	429	0.0834	10.8	<0.0050	0.0705		1.89	0.0108	0.1	<0.00010	0.0132	0.0217	<0.000100	<0.000050	<0.010	0.000124	0.00037	129	<0.00050	0.00575
KV-50	Christal Creek upstream Hinton Creek	06-Nov-2024	Discharge collected Nov 21			6.7	6.70	7.58	870	780	0.1	11.35	75.8	-28.8	405	397	116	<0.250	<2.50	0.249	297	429	0.0898	37.6	<0.0050	0.0818		0.73	0.0185	0.1	<0.00010	0.0184	0.0236	<0.000100	<0.000050	<0.010	0.000174	0.00037	129	<0.00050	0.00590
KV-50	Christal Creek upstream Hinton Creek	21-Nov-2024		9.9																	128		0.616							No pH										No Hardness		
KV-50	Christal Creek upstream Hinton Creek	05-Dec-2024		8.9		6.4	7.31	7.24	946	766	0.1	5.79	40.1	16.1	406	391	116	<0.250	<2.50	0.202	292	429	0.100	9.23	<0.0050	0.0636		0.97	0.0293	0.1	0.00011	0.0250	0.0270	<0.000020	<0.000050	<0.010	0.000233	0.00037	128	<0.00050	0.00622
KV-51	Christal Creek d/s Hinton Creek	18-May-2008				10	7.16	7.28		214	0					100					309		13.1					0.306	0.1	0.0002	0.0051	0.024	<0.0001	<0.0005	<0.002	0.00025	0.000158	32.7	0.0011	0.0007
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008				<3	7.07	7.82		751	5					407					429		10.7					0.006	0.1	<0.0002	0.0019	0.035	<0.0001	<0.0005	0.003	0.00035	0.00037	120	<0.0005	0.0009
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008				31	7.4	7.31		447	1					260					429		6.96					0.529	0.1	0.0004	0.0112	0.048	<0.00004	<0.0001	<0.005	0.00045	0.000350	78.2	0.0011	0.00171
KV-51	Christal Creek d/s Hinton Creek	28-May-2009				8	7.72	7.4		230	3.5				109	112					309		2.72					0.156	0.1	0.00026	0.00559	0.0396	0.00001	0.00002	<0.05	0.000381	0.000170	33.9	0.0006	0.000767
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009				15	7.51	7.9		900	3.5				507	494					429		4.40					0.289	0.1	0.00045	0.0208	0.0678	0.00003	0.00001	<0.05	0.00126	0.00037	160	0.0005	0.00277
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009				2100	7.47	7.5		996	1				617	533					429		5.93					5.96	0.1	0.00167	0.093	0.232	0.00069	0.000127	<0.05	0.00385	0.00037	199	0.0121	0.0244
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010				10	7.39	7.7		931	7.8				511	531					429		4.10					0.0572	0.1	0.00026	0.0119	0.029	<0.00001	<0.000005	<0.05	0.00031	0.00037	163	0.0004	0.0044
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010		10		66	7.28	7.62		950	0.2				531	537	110				450	429	0.035	9.81	<0.005	0.08		1.3	0.273	0.1	0.00022	0.0297	0.0582	0.00002	0.00001	<0.05	0.000843	0.00037	169	0.0008	0.0087
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011	no water found																		128		0.616							No pH										No Hardness		
KV-51	Christal Creek d/s Hinton Creek	26-May-2011	widely dispersed flow. Flow not taken			5	7.87	7.33		528	4.1				271	265	35				200	429	0.017	1.84	<0.005	0.1		7	0.0412	0.1	0.00017	0.00513	0.0414	<0.00001	<0.000005	<0.05	0.000237	0.000363	88.5	0.0004	0.00158
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011	not visited. No helper/lack of time																		128		0.616							No pH										No Hardness		
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011	Very cloudy water (grey)	35.26		83	7.5	7.34	1235	1160	0.7	9.39	64.8	156.8	665	651	120				515	429	0.067	5.67	0.05	0.7		1.2	0.641	0.1	0.00034	0.0343	0.0398	0.00003	<0.000005	<0.05	0.000494	0.00037	209	0.0012	0.0106
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012	Salt Slug	23.1		11	6.99	7.88	1196	1170	0.1	11.15	76.9	1.8	630	687	119				531	429	0.055	19.3	0.005	0.06		<0.50	0.0184	0.1	0.00015	0.0286	0.0232	<0.00001	<0.000005	<0.05	0.000287	0.00037	200	<0.0001	0.00963
KV-51	Christal Creek d/s Hinton Creek	03-May-2012	snowing lightly; no YSI for insitu	41.2		33		7.33		652	1.0				345	347	64.3		<0.50		269	429	0.0054	8.18	<0.050	0.56		10.8	0.129	0.1	0.000289	0.0195	0.0304	0.000014	<0.0000050	<0.050	0.000308	0.00037	109	0.00027	0.00489
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2012	showers; water high & turbid; orange mud transported by water; muddy bottom	31.60		14.4	7.08	7.61	1231	1110	3.4	10.45	78.8	5.1	657	648	111		0.74		521	429	0.19	11.9	<0.050	0.21		1.36	0.0801	0.1	0.000258	0.0178	0.027	<0.000010	<0.0000050	<0.050	0.000191	0.00037	208	0.00017	0.00835
KV-51	Christal Creek d/s Hinton Creek	14-Oct-2012	Sludge in creek bed making metering difficult. Wading rod keeps sinking. Avg'd Salt slug & Flow reading.	35.13		18.5	6.8	7.67	1195	1140	0.1	10.78	74.3	-23.6	620	642	108		0.9		534	429	0.059	29.8	<0.050	<0.20		0.86	0.0653	0.1	0.000221	0.024	0.0282	<0.000010	<0.0000050	<0.050	0.000247	0.00037	198	0.00012	0.00913
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2013		24.91		9.4	6.92	7.78	1044	1130	0.1	10.13	70.6	40.2	622	588	113		0.9		545	429	0.039	22.6	<0.0050	0.08		<0.50	0.019	0.1	0.000146	0.0281	0.0212	<0.000010	<0.0000050	<0.050	0.000238	0.00037	197	<0.00010	0.00918
KV-51	Christal Creek d/s Hinton Creek	03-May-2013	Cannot salt slug, too many pools + debris.			39.6	6.81	7.77	1017	1190	0.1	10.39	71.5	138.4	731	719	128		<5.0	0.30	584	429	0.0298	29.2	<0.010	0.096		0.92	0.531

Station	Description	Sample Date	Sample Comments	Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015	discharge only, no sample	34.5			7.81		939.2		0.1	9.7	16	-20.7								128		2.93						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016	ORP fluxuating up and down.	37			7.56		586.4		0	8.4	65	-40.9								128		5.24						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016		25.3		1.8	6.84	7.14	1039	897	0.1	7.69	54.7	6.9	620	638	108		<1.0	0.203	471	429	0.0545	27.2	<0.0020	0.090	0.156	0.72	0.265	0.1	0.00016	0.0310	0.0302	<0.00010	<0.000050	<0.010	0.000218	0.00037	197	0.00055	0.00929
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016	No sample, just flow	25.8			7.27		920		0.7	9.98	79.4	-8.2								128		9.62						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016		19.2			7.28		952		1.5	10.06	80	-40.7								128		8.80						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	04-May-2016		47	0.451	11.8	7.1	7.18	605	656	0.7	11.5	89	108.9	361	384	58.3		<0.50	0.126	276	429	0.0297	14.2	0.0010	0.0651	0.321	8.90	0.210	0.1	0.00018	0.0135	0.0437	<0.00010	<0.000050	<0.010	0.000152	0.00037	117	<0.00040	0.00374
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016		46.7	0.406																	128		0.616						No pH										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016	Water is slightly turbid	41.4	0.461	22.0	7.3	7.39	956	986	7.9	9.8	91	151.6	577	594	108		<0.50	0.215	438	429	0.0363	5.00	<0.0010	0.0813	0.143	2.16	0.259	0.1	0.00023	0.0175	0.0377	<0.00010	<0.000050	<0.010	0.000219	0.00037	182	0.00047	0.00681
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016		78.9	0.513																	128		0.616						No pH										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016		53.2	0.428		7.18		903		2.4	8.86	65.1	9.4								128		10.3						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	DO calibrated on site; SG encased in ice, no reading taken.	41.5		34.4	6.88	7.28	905	995	0.4	8.36	64.6	26.6	594	615	111	<0.25	<2.5	0.21	460	429	0.0669	24.2	<0.0050	0.095	0.177	1.21	0.416	0.1	0.00026	0.0301	0.0373	<0.00010	<0.000050	<0.010	0.000281	0.00037	188	0.00069	0.00943
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016	No sample, in-situ and discharge. DO probe measurement suspect	29.7			7.23		1025		0.3	7.06	48.8	-3.4								128		10.9						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016	Low confidence in discharge result, poor dilution performance.	37.1			7.36		878.2		0.1	8.03	60	0.9								128		8.23						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017	Flow only. Downloaded logger	25.3			6.94		938.6		0	9.38	72.6	17.7								128		21.8						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	DO not functioning properly	27.3		16.2	6.24	7.74	872.2	1060	0.1			154	686	734	105	<0.25	<2.5	0.22	477	429	0.0799	108	<0.0050	0.089	0.209	0.90	0.0714	0.005	0.00012	0.0342	0.0298	<0.00010	<0.000050	<0.010	0.000163	0.00037	216	<0.00040	0.0109
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017	First run discharge would not come back down to baseline.	23.4			7.25		1133		-0.2	9.87	74.6	15.2								128		10.7						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017		19.4			6.97		1240		0.1	10	77.3	-87.2								128		20.2						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	15-May-2017		152.5	0.599	10.9	7.42	7.23	451.5	387	0.6	10.54	82.2	19.2	193	188	29.9	<0.050	<0.50	0.092	155	429	0.0183	6.88	<0.0010	0.0225	0.484	15.6	0.334	0.1	0.00017	0.00859	0.0356	<0.00010	<0.000050	<0.010	0.000155	0.000274	60.9	<0.00070	0.00261
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017	Surveyed. Downloaded flow. Gauge difficult to read.	34.3	0.365		7.31		996		4	9	77.7	83.3								128		6.68						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017		32.4	0.351	10.2	7.21	7.56	970	1070	5.4	8.6	76.3	93	591	604	113	<0.25	<2.5	0.22	506	429	0.0328	7.51	<0.0050	0.101	0.114	1.73	0.0985	0.1	0.00013	0.0168	0.0303	<0.00010	<0.000050	<0.010	0.000152	0.00037	184	0.00016	0.00835
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017		93.2	0.306																	128		0.616						No pH										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017	Monitored for flow and insitu only.	31.8	0.346		8.1		1158		2.2	8.62	71.2	-61.1								128		1.27						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	Too cold for salt slug calibration	29.6		9.8	7.16	7.83	1046.0	979	0.1	7.40	57.6	29.7	556	537	114	<0.25	0.67	0.24	492	429	0.0525	13.0	<0.0050	0.106		0.84	0.0531	0.1	0.00011	0.0210	0.0228	<0.00010	<0.000050	<0.010	0.000146	0.00037	175	<0.00010	0.00789
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017		28.4			7.57		931.6		0.0	7.9	61	8.8								128		5.12						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017	Discharge data collected was not reproducable due to errors in the field and removed. RPD was too high. Conductivity affected by u/s salt slug and removed.				7.2				0.1	10.6	81	3.1								128		11.9						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018		11.8			7.82				-0.2	8.37	63.2	8.4								128		2.89						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	thick ice. Drilled into water layer with no discernable flow.			123	7.43	7.67	914.4	1040	0.1	9.1	71	-40	580	562	113	<0.25	<2.5	0.23	483	429	0.0289	7.01	<0.0050	0.092	0.187	1.14	0.832	0.1	0.00027	0.0550	0.0446	<0.00010	<0.000050	<0.010	0.000443	0.00037	188	0.00148	0.00963
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018	shallow water with muddy substrate. No sample	16.1			7.36		912		0	8.4	63	-23.1								128		8.30						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018	Muddy substrate with shallow water.	14.4			7.47		924.6		0	8	62	-42.4								128		6.45						0.1										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	Significant ice cover, very turbid (dark orange/brown water)	171		80.3	6.97	7.40	201.4	212	0.1	11.02	84.1	97.7	103	100	25.0	<0.050	<0.50	0.071	70.6	309	0.0122	20.2	<0.0010	0.0098	0.852	24.8	1.03	0.1	0.00050	0.0300	0.0461	<0.00010	<0.000050	<0.010	0.000571	0.000162	31.8	0.00178	0.00260
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	Real time readings for dewinterizing: in w/ condom = 8:19:48, out w/ condom = 8:20:48, out w/out = 8:25:39, back in = 8:28:14	197.4	0.525	4.7	7.23	7.73	529.3	584	0.8	10.11	79.3	18.6	304	335	44.3	<0.050	<0.50	0.101	263	429	0.0135	10.5	<0.0010	0.0679		6.33	0.0462	0.1	0.00016	0.00649	0.0507	<0.00010	<0.000050	<0.010	0.000180	0.00037	96.4	0.00026	0.00216
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	DOC preserved later. TOT metals preserved in sulphuric then rinsed and preserved in nitric. Skeptical of DO value even though it makes sense.	40.7	0.3585	9.9	7.55	7.50	942.0	913	3.7	8.40	70.0	25.30	502	496	112	<0.25	<2.5	0.20	416	429	0.0250	3.95	<0.0050	0.141	0.122	1.72	0.0823	0.1	0.00019	0.0199	0.0308	<0.00010	<0.000050	<0.010	0.000223	0.00037	153	0.00018	0.00620
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018		43.1		11.1	7.18	7.98	740.1	859	2.0	9.19	66.8	-48.7	477	446	112	<0.050	0.74	0.190	340	429	0.0294	10.6	<0.0010	0.187		3.46	0.131	0.1	0.00018	0.0169	0.0334	<0.00010	<0.000050	<0.010	0.000239	0.00037	147	0.00031	0.00534
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	Water is turbid	59.5	0.402	15.0	6.78	7.80	868.4	909	1.6	7.95	62.9	48.8	509	519	125	<0.050	0.70	0.200	361	429	0.0317	27.6	<0.0010	0.225		1.92	0.173	0.1	0.00027	0.0180	0.0321	<0.00010	<0.000050	<0.010	0.000327	0.00037	158	0.00041	0.00530
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	Surface frozen, had to salt slug.	28.9		6.3	6.98	7.52	793.5	786	0.2	8.39	57.9	7.1	462	416	107	<0.25	<2.5	0.22	339	429	0.0425	19.6	<0.0050	0.404	0.166	0.70	0.0585	0.1	0.00021	0.0158	0.0265	<0.00010	<0.000050	<0.010	0.000200	0.00037	145	0.00014	0.00632
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	Relatively short distance for flow	25.3		7.9	6.98	7.95	745.5	778	0.0	9.29	71.5	-24.2	415	405	111	<0.050	<0.50	0.231	327	429	0.0628	19.9	<0.0010	0.211		0.84	0.0598	0.1	0.00014	0.0188	0.0224	<0.00010	<0.000050	<0.010	0.000189	0.00037	129	0.00013	0.00623
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018		23.2		6.5	7.00	7.94	719.9	817	-0.3	9.04	71.2	-5.6	411	431	111	<0.25	<2.5	0.23	323	429	0.0576	19.0	<0.0050	0.156		0.83	0.0504	0.1	0.00013	0.0206	0.0221	<0.00010	<0.000050	<0.010	0.000188	0.00037	129	0.00015	0.00631
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	water shallow, short flow distance	16.7		10.9	7.24	8.00	791.9	826	-0.4	9.21	69.2	-35.0	441	446	113	<0.25	<2.5	0.25	334	429	0.0650	10.9	<0.0050	0.104		0.75	0.0672	0.1	0.00010	0.0249	0.0230	<0.00010	<0.000050	<0.010	0.000199	0.00037	138	0.00016	0.00701
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	Flow data lost			6.9	7.44	7.56	829.7	804	0.0	9.90	68.1	19.2	439	428	113	<0.25	<2.5	0.28	340	429	0.0613	6.91	<0.0050	0.088	0.092	0.73	0.0225	0.1	<0.00010	0.0221	0.0213	<0.00010	<0.000050	<0.010	0.000121	0.00037	138	<0.00010	0.00677
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	short distance for flow, neutral pressure. Water not displaying much signs for flow, probably just slow or calm.	11.6		7.9	7.18	7.51	875.7	863	-0.6	5.84	43.8	15.6	460	500	117	<0.25	<2.5	0.28	359	429	0.0269	12.6	<0.0050	0.082		0.99	0.0694	0.1	<0.00010	0.0260	0.0185	<0.00010	<0.000050	<0.010	0.000100	0.00037	146	0.00014	0.00672
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	YSI parameters slowly drifting, taking long to stabalize.	14.6		4.0	7.21	7.72	777.9	852	-0.3	10.12	68.5	98.7	451	434	111	<0.25	<2.5	0.26	350	429	0.0411	11.7	<0.0050	0.081		1.79	0.0367	0.1	0.00013	0.0170	0.0329	<0.00010	<0.000050	<0.010	0.000169	0.00037	141	0.00033	0.00619
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	Not enough salt for slug.	92.7	0.532	6.6	6.79	7.17	307.8	330	2.1	11.16	81.0	69.5	155	170	26.3	<0.050	<0.50	0.084	123	309	0.0217	25.8	<0.0010	0.0347	0.440	12.3	0.109	0.1	0.00015	0.00584	0.0316	<0.00010	<0.000050	<0.010	0.0000921	0.000228	50.1	0.00031	0.00127
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	Staff gauge rusting. Hard to read values below 0.4 m. Surveyed/dewinterized logger.	17.5	0.282	12.6	7.15	7.47	907.0	992	1.8	7.20	55.8	-18.0	528	515	108	<0.25	<2.5	0.20	406	429	0.0325	11.6	<0.0050	0.082		1.41	0.0548	0.1	0.00011	0.0234	0.0262	<0.00010	<0.000050	<0.010	0.000143	0.00037	167	0.00017	0.00712
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	Orange slime on plants. Not best path for salt slug. Bends and eddys. Needs new staff gauge.	18.2	0.368	16.9	7.82	7.87	932.0	983	2.8	7.70	57.2	-13.9	556	533	115	<0.25	<2.5	0.25	462	429	0.0707	2.29	<0.0050	0.131	0.188	1.34	0.263	0.1	0.00012	0.0207	0.0351	<0.00010	<0.000050	<0.010	0.000157	0.00037	176	0.00057	0.00759
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	orange precipitate. Took 2nd run of flow and ignored first. RPD was 37% and 2nd run matched KV-50 closer	14.1			4.6	7.70	8.11	883.0	922	4.2	9.90	76.4	133.6	505	512	118	<0.25	<2.5	0.23	415	429	0.0473	2.69	<0.0050	0.145		2.14	0.0297	0.1	<0.00010	0.0149	0.0243	<0.00010	<0.000050	<0.010	0.0000996	0.00037	159	<0.00010	0.00633
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019		14.4			1.5	7.37	7.84	779.5	792	3.2	9.56	71.8	11.6	455	447	117	<0.25	<2.5	0.23	348	429	0.0483	6.22	<0.0050	0.119		1.32	0.0077	0.1	<0.00010	0.00996	0.0213	<0.00010	<0.000050	<0.010	0.0000876	0.00037	144	<0.00010	0.00575
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	No flow. > 1 inch of ice on the creek. We do not have salt for the site.				6.8	7.26	7.51	858.1	862	-0.1	9.12	62.5	184.3	499	486	124	<0.25	<2.5	0.29	371	429	0.0290	10.4	<0.0050	0.114	0.121	1.44	0.0251	0.1	<0.00010	0.0171	0.0224	<0.00010	<0.000050	<0.010	0.0000914	0.00037	157	<0.00010	0.00643
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019		14.1			2.5	7.56	7.31	767.8	760	0.5	9.49	68.9	-18.8	423	426	121	<0.050	0.53	0.260	312	429	0.0705	5.03	<0.0010	0.131		1.02	0.0088	0.1	<0.00010	0.0177	0.0210	<0.00010	<0.000050	<0.010	0.0000740	0.00037	130	<0.00010	0.00644
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019		13.0			4.0	7.70	7.62	760.9	782	0.1	10.69	73.2	82.2	414	403	120	<0.25	<2.5	0.31	315	429	0.0603	3.77	<0.0050	0.127		1.35	0.0103	0.1	<0.00010	0.0188	0.0216	<0.00010	<0.000050	<0.010	0.0000711	0.00037	127	0.00011	0.00602
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020	Site is inaccessable without snowshoes. Too much snow.																			128		0.616						No pH										No Hardness			
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	No flow measurement. Temp outside is -40C.				7.3	7.85	8.05	789.9	788	-0.1	~	~	~	376	401	121	<0.25	<2.5	0.30	322	429	0.0357	2.70	<0.0050	0.070	0.089	0.92	<0.0030	0.1	<0.00010	0.0169	0.0162	<0.00010	<0.000050	<0.010	0.0000423	0.00037	116	<0.00010	0.00534
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	Conditions not conducive to measuring flow. SG covered in ice and snow.				4.2	7.29	7.45	797.0	817	0.1	12.53	86.3	42.2	428	431	124	<0.25	<2.5	0.29	326	429	0.0575	9.67	<0.0050	0.062		1.09	0.0050	0.1	<0.00010	0.0227	0.0203	<0.00010	<0.000050	<0.010	0.0000632	0.00037	132	<0.00010	0.00540
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	not ideal for flow test. Flow almost stagnant, creek meandering				12.4	7.33	7.76	762.7	773	0	9.03	62.2	211.7	402	385	117	<0.25	<2.5	0.28	314	429	0.0472	8.89	<0.0050	0.064		1.16	0.0255	0.1	<0.00010	0.0385	0.0198	<0.00010	<0.000050	<0.010	0.0000864	0.00037	125	0.00010	0.00521
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	DO will not calibrate, membrane needs replacement. Logger not downloaded - no flow water poolingand flowing through willows (see photos)		0.635	146	7.03	7.02	165.2	201	0.1	13.63	93.4	23.5	104	93.5	27.9	<0.050	<0.50	0.068	61.6	309	0.0179	17.6	<0.0010	0.0323	0.992	32.3	0.816	0.1	0.00052	0.0577	0.0435	<0.00010	<0.000050	<0.010	0.000667	0.0001637	31.3	0.00147	0.00341
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020		20.0	0.324	5.1	7.49	7.37	804.1	845	3.9	7.91	60.3	59.0	485	465	99.9	<0.250	<2.50	0.230	374	429	0.0277	4.46	<0.0050	0.156		4.77	0.0311	0.1	0.00010	0.0183	0.0264	<0.000100	<0.000050	<0.010	0.000112	0.00037	154	<0.00010	0.00631
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020		32.1	0.429	27.4	7.06	7.55	629.3	644	3.3	8.97	66.9	-4.6	368	360	100	<0.050	0.66	0.179	236	429	0.0244	12.6	<0.0010	0.200	0.238	5.68	0.0818	0.1	0.00027	0.0120	0.0347	<0.000100	<0.000050	<0.010	0.000306	0.00037	115	0.00017	0.00352
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020		32.1	0.449	3.6	7.40	7.57	653.1	712	3.5	9.67	73.0	-4.0	392	391	114	<0.050	0.58	0.201	266	429	0.0383	5.66	<0.0010	0.290		2.20	0.0478	0.1	0.00024	0.00987	0.0328	<0.000100	<0.000050	<0.010	0.000277	0.00037	122	<0.00010	0.00367
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	Levellogger downloaded. Benthics and sediment collected.	44.9	0.431	8.4	7.22	8.10	679.6	718	0.4	11.69	80.9	130.7	396	398	120	<0.050	0.61	0.193	271	429	0.0397	11.1	<0.0010	0.455		2.35	0.0761	0.1	0.00024	0.0125	0.0322	<0.000100	<0.000050	<0.010	0.000322	0.00037	125	0.00016	0.00417
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	WL downloaded, off by 8 mins			8.8	6.94	7.65	758.0	765	0.1	9.21	63.3	47.4	419	388	117	<0.250	<2.50	0.186	282	429	0.0446	21.6	<0.0050	0.384	0.140	2.26	0.0857	0.1	0.00022	0.0154	0.0304	<0.000100	<0.000050	<0.010	0.000239	0.00037	131	0.00013	0.00486
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	Flow not measured - corners u/s and d/s too sharp and not enough flow, too many willows.Staff gauge frozen.			14.5	7.07	7.84	727.1	725	0.2	10.71	73.7	247.4	382	380	116	<0.250	<2.50	0.199	276	429	0.0545	15.9	<0.0050	0.430		1.19	0.0507	0.1	0.00018	0.0156	0.0267	<0.000100	<0.000050	<0.010	0.000269	0.00037	119	0.00012	0.00484
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	Thin layer of ice, hollow, thin layer of ice to water. Slow flow.			1.8	7.16	8.12	624.3	742	2.0	8.65	63.5	44.8	424	421	115	<0.250	<2.50	0.228	292	429	0.0543	11.1	<0.0050	0.139		1.53	0.0186	0.1	<0.00010	0.0191	0.0217	<0.000100	<0.000050	<0.010	0.000137	0.00037	133	<0.00010	0.00579
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	Orange turbid water, staff gauge Downloaded, not ideal for flow measurement			15.6	7.08	6.93	395.3	373	1.1	12.49	88.2	44.7	182	184	42.9	<0.050	2.77	0.076	135	429	0.0293	14.4	0.0056	0.246		16.6	0.218	0.1	0.00086	0.0202	0.0386	<0.000100	<0.000050	<0.010	0.000570	0.000261	54.3	<0.00050	0.00240
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021		28.4	0.321	<1.0	7.45	7.78	627.1	733	7.9	9.78	84.6	-88.2	415	374	115	<0.050	0.72	0.237	288	429	0.0191	3.54	<0.0010	0.177		1.32	0.0052	0.1	0.00017	0.00664	0.0256	<0.000100	<0.000050	<0.010	0.000154	0.00037	130	<0.00050	0.00450
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	Half frozen, muddy bottom. Loggers winterized and downloaded. Surveyed.	27.1	0.375	12.3	7.33	7.36	636.7	714	0.0	10.47	74.5	32.9	386	368	112	<0.050	0.58	0.245	267	429	0.0511	8.89	<0.0010	0.108		2.34	0.0893	0.1	0.00022	0.0215	0.0282	<0.000100	<0.000050	<0.010	0.000312	0.00037	121	<0.00050	0.00477
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	tried one salt slug, water barely flowing			24.2	6.93	7.59	426.8	821	-0.2	10.93	74.3	-35.1	450	489	119	<0.250	6.56	0.299	351	429	0.0837	22.3	<0.0050	0.130		1.08	0.108	0.1	0.00018	0.0506	0.0291	<0.000100	<0.000050	<0.010	0.000210	0.00037	140	<0.00050	0.00834
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	2x salt slug, creek super turbid, logger de-winterized	52.1	0.422	6.0	6.93	7.66	197.2	199	3.2	10.90	81.8	185.9	94.6	93.3	36.4	<0.050	1.96	0.087	51.9	309	0.0156	17.1	<0.0010	0.0330		22.7	0.102	0.1	0.00033	0.00718	0.0201	<0.000100	<0.000050	<0.010	0.000203	0.0001514	29.6	<0.00050	0.00156
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022		32.5	0.335	2.6	7.75	8.09	716.8	840	6.2	10.00	82.1	96.7	448	467	119	<0.250	<2.50	0.242	343	429	0.0387	2.04	<0.0050

				Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
Station	Description	Sample Date	Sample Comments	L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-51	Christal Creek d/s Hinton Creek	22-May-2024	Metallic odour, orange dust and color water. Impossible to accurately read staff gauge clearly. Orange precipate and overall weathering on SG, numbers blurred. Orange dust and precipatate in water and surrounding area. Dust kicked up from stepping around site. Downloaded SH. Could not find a baro. Midsection flow measurement.	12.1	0.305	3.1	7.75	8.00	509	525	2.0	9.75	70.4	-26.4	261	259	79.8	<0.050	0.96	0.173	187	429	0.0440	2.87	<0.0010	0.0684		6.01	0.0280	0.1	0.00018	0.0108	0.0251	<0.000100	<0.000050	<0.010	0.0000900	0.000351	83.4	<0.00050	0.00366
KV-51	Christal Creek d/s Hinton Creek	29-May-2024	Orange residue on trees, no ice present. Very slow flow.	24.1	0.375	4.1	7.37	7.46	433.4	414	2.1	10.16	74.4	-44.1	209	199	69.0	<0.050	1.52	0.148	132	429	0.0399	6.81	<0.0010	0.0377		10.0	0.0529	0.1	0.00023	0.0109	0.0252	<0.000100	<0.000050	<0.010	0.000101	0.000292	65.7	<0.00050	0.00302
KV-51	Christal Creek d/s Hinton Creek	07-Jul-2024	Ground is too soft for midsection flow measurement, due to sediment being stirred up. Went u/s where it narrows and did salt slug, data not good - discarded. Surveyed. Direct read needs cap. Willows at site need to be cleared. Could not download. Logger covered in sediment.		0.26	2.8	7.21	8.18	822	841	9.3	7.70	67.4	41.7	441	438	117		<2.50		341	429	0.0235	5.50	<0.0050	0.0421		2.38	0.0121	0.1	0.00012	0.00826	0.0269	<0.000100	<0.000050	<0.010	0.0000924	0.00037	141	<0.00050	0.00558
KV-51	Christal Creek d/s Hinton Creek	09-Oct-2024	Winterized logger, surveyed staff gauge. Logger was starting to freeze into stilling well	14.9	0.33	4.8	7.78	7.68	894	730	0.6	11.10	77.9	49.9	422	404	116		<2.50		283	429	0.0679	3.01	<0.0050	0.0743		1.43	0.0103	0.1	<0.00010	0.0105	0.0231	<0.000100	<0.000050	<0.010	0.000130	0.00037	135	<0.00050	0.00520
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	No flow measurements due to ice blockages and willows.			56.8	7.13	7.73	307.1	319	1.8	8.01	57.9	37.00	169	170	67.7	<0.050	<0.50	0.171	91.7	309	0.0788	12.1	<0.0010	0.0119		3.49	0.319	0.1	0.00029	0.0168	0.0411	<0.00010	<0.000050	<0.010	0.000315	0.000245	51.9	0.00050	0.00233
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	Site not suitable for flow. Site is in patchy grass and not visibly flowing			11.3	7.04	7.38	318.8	199	1.5	1.26	9.0	44.2	104	108	76.9	<0.050	<0.50	0.080	20.4	309	0.0092	15.3	0.0013	<0.0050		16.2	0.0227	0.1	0.00016	0.00381	0.0354	<0.00010	<0.000050	<0.010	0.0000289	0.000164	29.8	0.00011	0.00572
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	Too vegetated and overall poor conditions to conduct salt slug			87.1	7.48	8.04	385.5	450	5.8	10.28	82.7	9.7	225	211	83.5	<0.050	<0.50	0.222	144	429	0.330	3.91	<0.0010	0.0131		2.28	1.97	0.1	0.00046	0.0270	0.129	<0.00010	<0.000050	<0.010	0.000537	0.000311	67.6	0.00326	0.00591
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	orange precipitate. No flow test done. Very willowy and blocked up slightly			10.8	7.34	8.10	412.8	441	7.0	9.99	82.2	27.9	221	224	88.3	<0.050	<0.50	0.236	142	429	0.168	4.90	<0.0010	0.0103	0.279	2.98	0.119	0.1	0.00020	0.0156	0.0494	<0.00010	<0.000050	<0.010	0.000202	0.000306	66.8	0.00021	0.00431
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019		2.7		10.4	7.37	7.91	425.3	429	3.1	10.61	79.2	9.5	228	234	89.4	<0.050	<0.50	0.230	143	429	0.154	6.27	<0.0010	0.0183	0.277	2.18	0.0483	0.1	0.00014	0.0129	0.0469	<0.00010	<0.000050	<0.010	0.000186	0.000314	70.1	0.00016	0.00455
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	Ice layer - could not measure flow			13.1	7.30	7.85	453.2	437	-0.1	10.62	72.4	138.6	241	234	90.9	<0.050	<0.50	0.228	150	429	0.163	9.53	<0.0010	0.0205		1.89	0.202	0.1	0.00018	0.0170	0.0550	<0.00010	<0.000050	<0.010	0.000263	0.000329	72.8	0.00040	0.00464
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019	Dry																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019	overflow slush, no sample taken				7.75		147.8		0.1	10.25	70.3	52.3							128		3.36						0.1								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020	Too much snow to access site. Need snowshoes to break initial trail.																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020	frozen/dry																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020	Frozen																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020	frozen																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	DO will not calibrate, membrane needs replacement. No flow, conditions were not conducive. Flowing everywhere and through willows.			2.7	7.07	7.03	79.0	81.5	0.1	13.62	93.7	16.8	44.4	42.1	19.8	<0.050	<0.50	0.038	13.4	218	0.0113	16.0	<0.0010	<0.0050		33.9	0.124	0.1	0.00025	0.00367	0.0179	<0.00010	<0.000050	<0.010	0.000154	0.00008078	13.2	0.00024	0.00078
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	No flow measurement.			14.6	7.41	7.48	333.0	349	6.6	9.17	75.0	71.3	176	170	82.4	<0.050	<0.50	0.181	99.1	309	0.105	4.31	<0.0010	0.0114	0.386	9.95	0.111	0.1	0.00026	0.0169	0.0467	<0.000100	<0.000050	<0.010	0.000194	0.000253	53.2	0.00028	0.00319
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020				19.5	6.77	7.65	377.7	401	4.7	9.68	75.5	0.2	207	189	89.1	<0.050	<0.50	0.154	109	429	0.0384	21.9	<0.0010	0.0360		7.93	0.339	0.1	0.00051	0.0141	0.0534	<0.000100	<0.000050	<0.010	0.000464	0.000290	62.9	0.00060	0.00196
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020				16.6	7.37	7.77	410.8	453	3.9	10.57	81.4	29.8	242	226	105	<0.050	<0.50	0.174	134	429	0.0633	5.87	<0.0010	0.0520	0.165	2.78	0.279	0.1	0.00052	0.0102	0.0544	<0.000100	<0.000050	<0.010	0.000656	0.000330	74.4	0.00048	0.00254
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020				14.5	7.10	8.09	427.7	453	1.3	10.43	75.2	82.5	228	243	100	<0.050	<0.50	0.188	134	429	0.0737	13.5	<0.0010	0.0870	0.211	2.48	0.0900	0.1	0.00056	0.0112	0.0435	<0.000100	<0.000050	<0.010	0.000632	0.000314	72.8	0.00017	0.00258
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	water disturbed a little to clear ice.			6.5	7.03	7.83	452.5	444	0.0	11.13	76.3	59.5	220	217	88.9	<0.050	<0.50	0.189	134	429	0.0858	17.7	0.0010	0.0466		2.96	0.150	0.1	0.00049	0.0126	0.0446	<0.000100	<0.000050	<0.010	0.000610	0.000305	68.1	0.00038	0.00268
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020	frozen.																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	Overflow on ice, main channel flooded/frozen, no flow measurement. No filtering done - bottle damaged in transit			<3.0	7.05	8.02	379.0	466	0.6	10.06	70.2	109.0	228	249	87.9	<0.050	0.58	0.265	150	429	0.138	16.1	<0.0010	0.0174		0.70	<0.0030	0.1	0.00024	0.00107	0.0331	<0.000100	<0.000050	<0.010	0.000145	0.000314	69.9	<0.00010	0.00371
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	Unseen flow due to ice conditions, and collapesed ice. Not able to measure flow. Orange turbid water			87.1	6.80	6.70	124.2	118	0.7	13.58	94.8	78.0	57.6	57.2	29.2	<0.050	0.98	0.064	25.0	218	0.0534	28.4	<0.0010	0.0147		21.4	0.847	0.1	0.00095	0.0360	0.0464	<0.000100	<0.000050	<0.010	0.000865	0.0001003	17.2	0.00153	0.00240
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	no flow measurement			3.2	7.29	7.57	372.3	436	7.9	9.67	81.8	-7.6	226	232	87.8	<0.050	<0.50	0.204	138	429	0.0730	5.11	<0.0010	0.0112		1.78	0.0191	0.1	0.00037	0.00694	0.0382	<0.000100	<0.000050	<0.010	0.000436	0.000312	69.2	<0.00050	0.00339
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021				33.5	7.09	7.45	394.6	446	0.2	11.77	82.7	15.2	220	224	87.7	<0.050	<0.50	0.215	134	429	0.128	15.2	<0.0010	0.0338		2.33	0.382	0.1	0.00049	0.0216	0.0502	<0.000100	<0.000050	<0.010	0.000779	0.000305	67.2	0.00068	0.00368
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	Low flow, sample only			4.5	7.16	7.79	287.9	712	-0.2	9.29	66.7	-33.6	360	363	105	<0.250	<2.50	0.265	296	429	0.117	13.1	0.0050	0.0408		0.92	0.0066	0.1	0.00014	0.0190	0.0284	<0.000100	<0.000050	<0.010	0.000104	0.00037	114	<0.00050	0.00666
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	still under ice/snow			8.8	6.71	7.61	126.8	122	4.0	9.48	72.8	106.4	60.4	62.8	32.6	<0.050	<0.50	0.072	24.7	218	0.0101	26.6	<0.0010	0.0065		22.4	0.255	0.1	0.00052	0.00946	0.0293	<0.000100	<0.000050	<0.010	0.000284	0.0001043	18.0	0.00054	0.00112
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	super flooded, no flow, in the veg.			289	7.39	7.64	404.7	451	6.6	11.15	91.3	-3.4	214	217	99.8	<0.050	<0.50	0.175	129	429	0.0897	4.51	0.0021	0.0249		3.92	0.708	0.1	0.00066	0.0494	0.0702	<0.000100	<0.000050	<0.010	0.000849	0.000298	64.6	0.00124	0.00420
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022	Frozen																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	09-Feb-2023	Frozen																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	12-May-2023	No flow measurement			27.4	6.78	6.06	96.5	25.9	1.2	12.65	89.7	103	50.1	49.0	5.0		<0.50		18.6	218	0.0377	28.5	<0.0010	0.0106		24.7	0.595	0.1	0.00054	0.0136	0.0385	<0.000100	<0.000050	<0.010	0.000396	0.00008930	15.2	0.00100	0.00151
KV-117	Christal Creek u/s Flame & Moth discharge	27-Jun-2023				4.3	7.12	7.14	422.1	422	6.1	9.90	80.0	8.4	221	215	74.4		<0.50		121	429	0.0824	8.72	<0.0010	0.0208		4.59	0.0606	0.1	0.00049	0.0112	0.0445	<0.000100	<0.000050	<0.010	0.000590	0.000306	68.3	<0.00050	0.00248
KV-117	Christal Creek u/s Flame & Moth discharge	14-Jul-2023				7.6	7.46	8.09	389.6	449	5.0	10.56	82.9	-12.7	234	232	97.5		<0.50		133	429	0.0970	4.37	<0.0010	0.0170		2.46	0.111	0.1	0.00045	0.0114	0.0531	<0.000100	<0.000050	<0.010	0.000529	0.000321	72.4	<0.00050	0.00314
KV-117	Christal Creek u/s Flame & Moth discharge	19-Aug-2023				40.5	7.41	7.86	424.4	433	2.9	10.86	80.7	-34.7	215	221	92.3		<0.50		131	429	0.115	5.81	0.0010	0.0200		3.11	0.159	0.1	0.00038	0.0117	0.0543	<0.000100	<0.000050	<0.010	0.000371	0.000299	66.3	<0.00050	0.00354
KV-117	Christal Creek u/s Flame & Moth discharge	14-Sep-2023				4.8	7.27	7.98	426.0	422	4.1	11.61	89.0	9.9	200	192	97.6		<0.50		123	429	0.119	7.27	0.0018	0.0278		2.95	0.0450	0.1	0.00030	0.0106	0.0394	<0.000100	<0.000050	<0.010	0.000393	0.000282	60.3	<0.00050	0.00314
KV-117	Christal Creek u/s Flame & Moth discharge	25-Oct-2023	sample only site			7.4	6.92	7.72	425.9	431	0	4.68	32.2	-11.3	220	201	93.0		<0.50		125	429	0.133	22.8	<0.0010	0.0218		2.36	0.0552	0.1	0.00034	0.00975	0.0401	<0.000100	<0.000050	<0.010	0.000375	0.000305	67.8	<0.00050	0.00301
KV-117	Christal Creek u/s Flame & Moth discharge	18-Nov-2023				14.0	6.77	7.72	804	807	0	3.49	23.9	-27.5	428	414	116	<0.250	<2.50	0.250	312	429	0.118	32.2	<0.0050	<0.0250		1.81	0.0398	0.1	0.00018	0.0285	0.0357	<0.000100	<0.000050	<0.010	0.000160	0.00037	136	<0.00050	0.00713
KV-117	Christal Creek u/s Flame & Moth discharge	11-Dec-2023	Maxed out auger but was able to chip to bottom, bring an auger extension next trip. Turbid and had sulfur swamp odor. Sample shows evidence of sediment contamination (TSS = 901 mg/L); TSS, total metals, Cl, Na-D and K-D results non-representative and removed.				7.11	7.75	575	600	0.1	1.38	9	-185		305	138				175	429	0.0442	14.6	<0.0010	0.0301				0.1								0.00037			
KV-117	Christal Creek u/s Flame & Moth discharge	25-Jan-2024	Overflow sample KV-117-OF																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	16-Feb-2024	could not locate water, area heavily glaciated																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	29-Mar-2024	Glaciated																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	21-Apr-2024	Frozen to bottom, 12 ft of ice																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	10-May-2024	Large glacier at sample point on map. Sampled below glacier above KV-121. Some orange precipitate on bottom. Clear water.			<1.0	7.02	7.88	399.3	384	0.5	~	~	-20.0	185	184	64.5		0.73		123	429	0.0284	17.4	<0.0010	0.0075		15.2	0.0482	0.1	0.00033	0.0104	0.0252	<0.000100	<0.000050	<0.010	0.000101	0.000264	57.4	<0.00050	0.00257
KV-117	Christal Creek u/s Flame & Moth discharge	08-Jun-2024	Walked to gps point and could not find a seep. Lots of unthawed snow/ice on ground and some pools of water (suspected melt).																		128		0.616						No pH								No Hardness			
KV-117	Christal Creek u/s Flame & Moth discharge	09-Jul-2024	Site looks old, willows should be cleared. Set did not have a syringe, triple rinsed 121's			188	7.38	7.97	433.5	432	4.4	9.88	76.1	-9.6	214	204	91.9		0.96		126	429	0.110	5.51	0.0027	0.0372		2.96	0.175	0.1	0.00030	0.0191	0.0514	<0.000100	<0.000050	<0.010	0.000311	0.000298	63.6	<0.00050	0.00374
KV-117	Christal Creek u/s Flame & Moth discharge	15-Aug-2024	No visible changes, willows should be cleared. Kind of smells like an outhouse			7.1	7.22	8.10	519	418	2.4	9.40	68.8	2.4	200	204	92.2		2.60		125	429	0.0907	9.37				2.06	0.0961	0.1	0.00033	0.00711	0.0427	<0.000100	<0.000050	<0.010	0.000276	0.000282	60.7	<0.00050	0.00319
KV-117	Christal Creek u/s Flame & Moth discharge	05-Sep-2024	Site good no change, slightly turbid, flow not monitored			35.6	7.15	8.09	422.1	437	5.2	9.24	73.1	-126.1	226	199	98.8	0.136	13.7	0.181	105	429	0.101	8.76	0.0018	0.0619		3.86	1.11	0.1	0.00223	0.0156	0.0864	<0.000100	0.000056	<0.010	0.000954	0.000312	68.8	0.00203	0.00312
KV-117	Christal Creek u/s Flame & Moth discharge	10-Oct-2024	Orange, ice forming			3.0	7.19	8.02	501	435	0.4	11.00	76.9	15.9	212	215	94.3		0.90		123	429	0.194	11.9	<0.0010	0.0364		3.08	0.0225	0.1	0.00018	0.00520	0.0387	<0.000100	<0.000050	<0.010	0.000142	0.000296	64.0	<0.00050	0.00292
KV-117	Christal Creek u/s Flame & Moth discharge	06-Nov-2024	Water was turbid and orange, pressure was released cutting through the ice.			74.4	6.50	7.45	1356	566	0	14.73	101.2	-63.2	299	295	100	<0.050	0.76	0.269	194	429	0.133	60.0	<0.0010	0.0209		1.55	0.210	0.1	0.00126	0.488	0.0497	<0.000100	<0.000050	<0.010	0.000414	0.00037	93.7	<0.00050	0.00606
KV-117	Christal Creek u/s Flame & Moth discharge	05-Dec-2024	Covered in overflow and slush. orange particles floating in the water and the water is orange			211	7.56	7.35	540	468	0	7.69	52.9	15.6	247	232	99.1	<0.050	0.65	0.181	145	429	0.0333	5.24	<0.0010	<0.0050		1.86	0.196	0.1	0.00053	0.127	0.160	0.000035	<0.000050	<0.010	0.00344	0.000336	75.4	0.00076	0.00540
KV-121	Christal Seep	10-Feb-2019	SPC moving around (1024-750) depending on placement, taking time to stabilize.			25.5	6.97	7.55	1032	634	0.1	3.83	26.6	-12.7	337	347	111	<0.25	<2.5	0.14	245	429	0.0076	20.2	<0.0050	0.290		0.71	0.0981	0.1	0.00011	0.0383	0.0256	<0.00010	<0.000050	<0.010	0.000363	0.00037	97.7	0.00029	0.00286
KV-121	Christal Seep	12-Feb-2019	No sample taken, revisit for flow measurements. Good flow, mix in 3/4 bucket, mud disturbed when poured. Slightly d/s from original sampling site.	12.9			7.13		845.8		0.1	5.59	38.9	-97.0							128		14.0						0.1								No Hardness			
KV-121	Christal Seep	06-Mar-2019	flowing well	11.6		11.3	6.99	7.27	869.9	863	-0.6	4.36	32.9	10.4	420	471	117	<0.25	<2.5	0.26	361	429	0.0283	19.4	<0.0050	0.067		1.67	0.0259	0.1	<0.00010	0.0269	0.0188	<0.00010	<0.000050	<0.010	0.0000812	0.00037	132	0.00025	0.00611
KV-121	Christal Seep	18-Apr-2019	u/s: multiple outlets of the same seep collecting into one stream, with another stream (christal?) coming in from the south. Orange sludge with gray sediment.	12.7		4.9	6.88	7.60	759.7	833	-0.3	6.58	44.5	28.6	440	443	112	<0.25	<2.5	0.28	333	429	0.0540	25.0	<0.0050	0.049		1.19	0.0191	0.1	0.00011	0.0256	0.0231	<0.00010	<0.000050	<0.010	0.0000855	0.00037	139	<0.00010	0.00740
KV-121	Christal Seep	19-May-2019	SPC fluctuating. Many seeps at site too short for salt slug; salt slug starts where seeps combine and is measured down christal creek.	18.1		8.7	6.82	7.86	942.0	1070	1.2	3.61	25.7	4.80	634	652	154	<0.25	<2.5	0.34	458	429	0.0535	26.0	<0.0050	0.058		1.12	0.0031	0.1	<0.00010	0.0308	0.0112	<0.00010	<0.000050	<0.010	0.000150	0.00037	202	<0.00010	0.0106
KV-121	Christal Seep	07-Jun-2019	Many seeps at site, conjoin into 1 which flow into Christal Creek. From left to right 4 seeps identified and YSI for SPC/pH/ORP:1)721.9/6.97/64.7; 2) 626.2/7.09/52.4; 3) 643.3/7.01/66.5; 4) 609.7;7.01;71.1	30.4		2.9	7.05	7.36	881.9	902	1.3	6.20	44.3	12.5	527	443	124	<0.25	<2.5	0.14	384	429	0.0100	15.2	<0.0050	0.300		1.12	<0.0030	0.1	<0.00010	0.0180	0.0186	<0.00010	<0.000050	<0.010	0.000182	0.00037	155	<0.00010	0.00562
KV-121	Christal Seep	22-Jul-2019	Salt slug d/s (0.0171 m3/s) and u/s (0.0103 m3/s) of site. SPC jumping a bit.	6.8		6.3	7.55	8.04	1112	1110	0.9	4.31	30.9	42.5	604	618	135	<0.25	<2.5	0.23	523	429	0.0190	4.97	<0.0050	0.175		1.22	0.0055	0.1	<0.00010	0.0356	0.0158	<0.00010	<0.000050	<0.010	0.000122	0.00037	189	<0.00010	0.00853
KV-121	Christal Seep	01-Aug-2019	Flow measured d/s.	11.7		7.1	7.46	8.21	1079	1120	1.4	4.80	34.5	94.6	637	637	139	<0.25	<2.5	0.28	536	429	0.0206	5.87	<0.0050	0.129		2.37	<0.0030	0.1	<0.00010	0.0430	0.0140	<0.00010	<0.000050	<0.010	0.000128	0.00037	202	0.00013	0.0100
KV-121	Christal Seep	17-Sep-2019	Took two sets of additional insitu readings nearby; both are u/s of KV-121.	11.3		<1.0	7.38	7.60	688.7	584	1.5	8.31	60.0	75.0	345	323	111	<0.050	0.87	0.082	215	429	0.0106	6.99	<0.0010	0.416		1.11	<0.0030	0.1	<0.00010	0.00676	0.0167	<0.00010	<0.000050	<0.010	0.000121	0.00037	98.0	0.00012	0.00157
KV-121	Christal Seep	04-Oct-2019	No flow measurements			11.4	7.10	7.72	853.0	749	0.4	7.71	53.5	129.5	491	483	110	<0.25	<2.5	0.26	375	429	0.0863	14.6	<0.0050	<0.025		1.51	0.0364	0.1	<0.00010	0.0225	0.0297	<0.00010	<0.000050	<0.010	0.0000847	0.00037	158	0.00017	0.00772
KV-121	Christal Seep	28-Nov-2019		16.7		3.7	7.22	7.07	767.6	749	0.6	6.30	44.3	14.7	427	432	120	<0.050	<0.50	0.259	306	429	0.0715	10.9	<0.0010	0.127		0.98	0.0136	0.1	<0.00010	0.0251	0.0219	<0.00010	<0.000050	<0.010	0.0000763	0.00037	132	<0.00010	0.00633
KV-121	Christal Seep	14-Dec-2019				2.6	7.96	8.02	755.3	674	0.7	7.70	54.3	-42.3	417	399	123	<0.25	<2.5	0.19	253	429	0.0253	1.98	<0.0050	0.293		1.13	<0.0030	0.1	<0.00010	0.0228	0.0147	<0.00010	<0.000050	<0.010	0.000104	0.00037	126	<0.00010	0.00420
KV-121	Christal Seep	31-Jan-2020	Too much snow to access site. Need snowshoes to break initial trail.																		128		0.616						No pH								No Hardness			
KV-121	Christal Seep	15-Feb-2020	no flow not suitable			42.0	7.77	7.99	905.1	864	-0.1	~	~	~

				Discharge (Flow)	Staff Gauge Water Level	Total Suspended Solids	pH (field)	pH (lab)	Specific Conductance (field)	Specific Conductance (lab)	Temperature (field)	Dissolved Oxygen (field)	Dissolved Oxygen (field)	ORP (field)	Hardness (from total)	Hardness (from dissolved)	Alkalinity, total	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-ENV	Ammonia (N)	Calc. Total Ammonia-N CCME PAL	Nitrite (N)	Nitrate (N)	Total Kjeldahl Nitrogen	Dissolved Organic Carbon	Aluminum (Al), total	Calculated Al-T CCME PAL	Antimony (Sb), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Bismuth (Bi), total	Boron (B), total	Cadmium (Cd), total	Calculated Cd-T CCME PAL	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total
Station	**Description**	**Sample Date**	**Sample Comments**	L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-121	Christal Seep	17-Apr-2020				6.0	7.23	7.81	885.2	894	0.2	3.43	23.9	199.4	528	482	156	<0.25	<2.5	0.39	359	429	0.0279	11.0	<0.0050	0.049		0.89	0.0053	0.1	<0.00010	0.0465	0.0100	<0.00010	<0.000050	<0.010	0.0000720	0.00037	170	<0.00010	0.00773
KV-121	Christal Seep	07-May-2020	DO will not calibrate, membrane needs replacement. No flow at this site. Conditions for flow were not good, too much pooling. Sampled where two seeps join.			<1.0	6.92	7.26	936.7	342	0.4	1.90	13.3	7.7	150	147	40.1	<0.050	1.08	0.084	115	309	0.0083	22.1	<0.0010	0.0218		17.3	0.0147	0.1	0.00068	0.00788	0.0201	<0.00010	<0.000050	<0.010	0.00345	0.000222	44.2	<0.00010	0.00112
KV-121	Christal Seep	07-Jun-2020				4.8	7.27	7.18	988.0	989	1.0	3.66	25.8	42.1	537	558	134	<0.250	<2.50	0.314	447	429	0.0264	9.39	<0.0050	0.186		1.17	<0.0030	0.1	<0.00010	0.0407	0.0166	<0.000100	<0.000050	<0.010	0.000128	0.00037	165	<0.00010	0.00848
KV-121	Christal Seep	11-Jul-2020				7.3	6.62	7.29	912.0	1090	2.1	6.74	49.6	13.5	627	592	136	<0.250	<2.50	0.293	496	429	0.0240	38.2	<0.0050	0.199		8.49	<0.0030	0.1	<0.00010	0.0446	0.0185	<0.000100	<0.000050	<0.010	0.000184	0.00037	193	<0.00010	0.00962
KV-121	Christal Seep	12-Aug-2020				7.1	7.14	7.19	794.5	1060	1.6	8.50	61.6	45.3	605	503	139	<0.250	<2.50	0.306	465	429	0.0311	12.0	<0.0050	0.272		0.81	0.0037	0.1	<0.00010	0.0456	0.0182	<0.000100	<0.000050	<0.010	0.000158	0.00037	196	<0.00010	0.00854
KV-121	Christal Seep	23-Sep-2020				2.3	6.90	8.12	891.7	953	1.0	5.62	40.3	63.5	493	564	170	<0.050	1.05	0.262	382	429	0.0267	22.0	0.0013	0.393		1.28	<0.0030	0.1	<0.00010	0.0256	0.0211	<0.000100	<0.000050	<0.010	0.000162	0.00037	152	<0.00010	0.00567
KV-121	Christal Seep	18-Oct-2020				5.1	6.76	7.84	949.0	977	0.5	6.27	43.6	20.3	536	592	153	<0.250	<2.50	0.269	427	429	0.0200	31.6	<0.0050	0.272		1.19	<0.0030	0.1	<0.00010	0.0374	0.0163	<0.000100	<0.000050	<0.010	0.000133	0.00037	169	0.00015	0.00819
KV-121	Christal Seep	11-Nov-2020	Flow not measured. No ice on stream.			1.5	6.95	7.28	959.0	709	0.4	6.80	48.0	105.1	369	393	134	<0.250	<2.50	<0.100	245	429	0.0075	20.6	<0.0050	1.01		1.53	<0.0030	0.1	<0.00010	0.0117	0.0238	<0.000100	<0.000050	<0.010	0.000181	0.00037	109	<0.00010	0.00242
KV-121	Christal Seep	24-Mar-2021	No flow measurement, condtions not ideal. ORP slow to climb			<1.0	6.95	8.09	571.7	675	0.6	8.13	58.2	27.1	347	351	121	<0.250	<2.50	0.132	242	429	0.0066	20.3	<0.0050	0.304		1.30	0.0035	0.1	<0.00010	0.0130	0.0177	<0.000100	<0.000050	<0.010	0.000162	0.00037	102	<0.00010	0.00244
KV-121	Christal Seep	07-May-2021				2.2	6.64	7.19	935.4	864	0.8	10.52	73.1	63.4	433	444	59.6	<0.050	10.8	0.134	378	429	0.0159	40.7	0.0342	1.07		6.11	0.0085	0.1	0.00246	0.0186	0.0880	<0.000100	<0.000050	<0.010	0.00282	0.00037	127	<0.00050	0.00322
KV-121	Christal Seep	16-Jul-2021				8.7	7.07	7.55	700.4	714	1.9	8.01	22.8	-17.0	519	341	124	<0.050	0.95	0.243	258	429	0.0112	13.8	<0.0010	0.232		0.70	0.0056	0.1	0.00026	0.0262	0.0144	<0.000100	<0.000050	<0.010	0.000121	0.00037	162	<0.00050	0.00514
KV-121	Christal Seep	15-Oct-2021				19.3	6.97	6.89	908.5	1190	0.1	4.49	35.0	8.6	685	691	152	<0.250	<2.50	0.346	554	429	0.0363	20.2	<0.0050	<0.0250		1.14	0.0048	0.1	<0.00010	0.0620	0.00836	<0.000100	<0.000050	<0.010	0.0000729	0.00037	221	<0.00050	0.0143
KV-121	Christal Seep	22-Feb-2022	sample only			8.2	6.88	8.12	934.5	982	-0.2	6.12	43.1	-49.8	545	585	153	<0.250	<2.50	0.378	394	429	0.0330	25.0	<0.0050	0.160		0.88	0.0055	0.1	0.00016	0.0472	0.0125	<0.000100	<0.000050	<0.010	0.000120	0.00037	170	<0.00050	0.0106
KV-121	Christal Seep	15-May-2022				10.8	6.45	8.19	925.0	808	1.4	3.72	26.5	164.6	455	498	110	<0.250	<2.50	0.245	335	429	0.0272	59.9	<0.0050	<0.0250		4.57	0.0136	0.005	0.00017	0.0475	0.00932	<0.000100	<0.000050	<0.010	0.000285	0.00037	145	<0.00050	0.0104
KV-121	Christal Seep	09-Jun-2022				3.5	6.97	8.17	1275	537	1.7	1.95	14.0	-66.8	510	504	107	<0.050	1.71	0.114	180	429	0.0325	17.7	<0.0010	0.409		2.05	<0.0030	0.1	<0.00010	0.0422	0.0198	<0.000100	<0.000050	<0.010	0.000117	0.00037	155	<0.00050	0.0105
KV-121	Christal Seep	03-Aug-2022	seep, no flow			9.6	7.00	7.79	1244	931	2.0	7.06	51.4	57.5	482	495	154	<0.250	<2.50	0.178	372	429	0.0133	16.1	<0.0050	0.149		1.24	0.0065	0.1	<0.00010	0.0200	0.0269	<0.000100	<0.000050	<0.010	0.000920	0.00037	146	<0.00050	0.00615
KV-121	Christal Seep	16-Oct-2022	Sample only, creek mostly frozen, bottom stirred up from breaking ice			10.2	8.06	7.78	584	1140	-0.1	9.36	64.2	129.5	678	758	144	<0.250	<2.50	0.268	549	429	0.0316	1.67	<0.0050	0.0668		0.92	0.0118	0.1	<0.00010	0.0690	0.0107	<0.000100	<0.000050	<0.010	0.000166	0.00037	217	<0.00050	0.0139
KV-121	Christal Seep	09-Feb-2023				6.0	7.65	7.87	833.3	870	0.3	6.10	42.9	15.3	455	442	135	<0.250	<2.50	0.268	358	429	0.0342	4.16	<0.0050	0.184		1.13	0.0040	0.1	0.00015	0.0353	0.0145	<0.000100	<0.000050	<0.010	0.000134	0.00037	142	<0.00050	0.00838
KV-121	Christal Seep	20-Apr-2023	Sample only, very shallow/orange, hard to not stir up			8.3	6.74	7.54	1066	1090	0.1	0.99	6.8	29.8	645	608	148	<0.250	<2.50	0.299	508	429	0.0399	34.3	<0.0050	<0.0250		0.67	<0.0030	0.1	<0.00010	0.0735	0.00774	<0.000100	<0.000050	<0.010	0.0000700	0.00037	210	<0.00050	0.0149
KV-121	Christal Seep	12-May-2023	May have sampled meltwater. No flow measurement.			1.8	6.70	7.44	455.9	604	0.2	13.30	91.6	105	248	360	78.9		16.0		192	429	0.121	37.2	0.0491	1.16		2.24	0.0076	0.1	0.00174	0.0125	0.0261	<0.000100	<0.000050	<0.010	0.000739	0.000337	77.3	<0.00050	0.00330
KV-121	Christal Seep	27-Jun-2023				5.7	6.97	7.25	1257	1190	4.0	4.42	34.4	72.0	717	743	141		<2.50		534	429	0.0231	14.6	<0.0050	0.0805		0.89	<0.0030	0.1	<0.00010	0.0453	0.0120	<0.000100	<0.000050	<0.010	0.0000943	0.00037	233	<0.00050	0.0122
KV-121	Christal Seep	14-Jul-2023				2.6	7.35	8.00	747.6	890	1.5	7.14	51.3	-2.7	501	472	138		<2.50		343	429	0.0072	7.49	<0.0050	0.289		0.77	<0.0030	0.1	<0.00010	0.0216	0.0222	<0.000100	<0.000050	<0.010	0.000139	0.00037	154	<0.00050	0.00512
KV-121	Christal Seep	19-Aug-2023				7.5	6.96	7.79	1028	930	1.3	4.72	33.8	-3.2	483	504	135		<2.50		374	429	0.0144	18.7	<0.0050	0.242		0.93	<0.0030	0.1	<0.00010	0.0255	0.0173	<0.000100	<0.000050	<0.010	0.000147	0.00037	151	<0.00050	0.00591
KV-121	Christal Seep	14-Sep-2023				3.2	7.09	7.99	1041	856	1.3	3.22	23.3	57.4	442	450	134		<2.50		349	429	0.0132	13.8	<0.0050	0.238		1.27	<0.0030	0.1	<0.00010	0.0257	0.0150	<0.000100	<0.000050	<0.010	0.000151	0.00037	137	<0.00050	0.00576
KV-121	Christal Seep	26-Oct-2023	Sample only			3.2	6.81	7.75	1238	699	0	1.59	10.9	14	387	382	112		0.67		241	429	0.0143	29.4	<0.0010	0.179		1.10	<0.0030	0.1	0.00018	0.0191	0.0178	<0.000100	<0.000050	<0.010	0.000144	0.00037	121	<0.00050	0.00521
KV-121	Christal Seep	18-Nov-2023				5.6	6.8	7.83	1177	611	2.3	1.07	8	-41.3	311	316	110	<0.050	1.01	0.190	205	429	0.0156	24.8	<0.0010	0.218		1.13	<0.0030	0.1	0.00019	0.0117	0.0181	<0.000100	<0.000050	<0.010	0.000152	0.00037	92.5	<0.00050	0.00304
KV-121	Christal Seep	11-Dec-2023				9.5	6.85	7.54	705	712	0	2.03	14	-75.9	380	367	99.6		<0.50		273	429	0.144	26.8	<0.0010	0.0130			0.0494	0.1	0.00020	0.0267	0.0411	<0.000100	<0.000050	<0.010	0.000199	0.00037	120	<0.00050	0.00708
KV-121	Christal Seep	25-Jan-2024				4.3	7.47	7.55	905	1060	0.1	6.00	41.6	-34.1	620	612	144		<2.50		463	429	0.0288	6.39	<0.0050	0.0852			0.0043	0.1	<0.00010	0.0495	0.0167	<0.000100	<0.000050	<0.010	0.000174	0.00037	200	<0.00050	0.0104
KV-121	Christal Seep	16-Feb-2024	seeps barely flowing, sampled collection pond			6.2	7.38	8.26	1236	1090	0.2	1.05	7.6	-151.7	646	637	151		<2.50		507	429	0.0361	7.79	0.0080	<0.0250		0.77	0.0034	0.1	<0.00010	0.0709	0.00738	<0.000100	<0.000050	<0.010	0.0000780	0.00037	210	<0.00050	0.0157
KV-121	Christal Seep	29-Mar-2024	Glaciated																		128			0.616						No pH								No Hardness			
KV-121	Christal Seep	21-Apr-2024	Muddy pool when first broke through but settled out nicely			27.0	8.44	7.76		1040	3.8	14.78	112.2	-225	530	542	134	<0.250	2.53	0.219	425	429	0.0375	0.518	<0.0050	<0.0250		0.96	0.0394	0.1	<0.00010	0.118	0.0158	<0.000100	<0.000050	<0.010	0.000317	0.00037	171	<0.00050	0.0152
KV-121	Christal Seep	10-May-2024	Light orange colour on bottom, clear water. Sampled from old auger hole near orange stain.			3.0	7.58	8.04	1095	754	0.8	~	~	-95.5	392	410	105		3.01		273	429	0.0223	4.68	<0.0050	0.0277		6.57	0.0045	0.1	0.00021	0.0154	0.00922	<0.000100	<0.000050	<0.010	0.000148	0.00037	126	<0.00050	0.00626
KV-121	Christal Seep	08-Jun-2024	Sampled by tree before seep enters Christal. Lots of precipitate on seep bottom. Difficult not to stir up while sampling.			1.5	7.63	8.37	848	652	1.5	9.04	65.4	-68.7	343	340	122	<0.050	1.74	0.140	228	429	0.0061	3.94	<0.0010	0.336		0.82	<0.0030	0.1	<0.00010	0.00836	0.0143	<0.000100	<0.000050	<0.010	0.000121	0.00037	102	<0.00050	0.00200
KV-121	Christal Seep	09-Jul-2024	Sampled before seep flows into Christal, even drawing water up with syringe disturbed bottom, tried to not disturb while sampling but very hard			8.5	7.06	8.30	1146	1150	0.5	2.30	16.2	-46.5	614	614	138		<2.50		496	429	0.0280	15.9	<0.0050	0.0585		0.60	<0.0030	0.1	<0.00010	0.0562	0.0107	<0.000100	<0.000050	<0.010	0.0000873	0.00037	196	<0.00050	0.0135
KV-121	Christal Seep	15-Aug-2024	Site looks good, no visible change			5.8	6.75	7.79	1263	1040	0.4	4.07	28.4	75.1	588	573	143		<2.50		468	429	0.0267	32.6				<0.50	<0.0030	0.1	<0.00010	0.0496	0.0103	<0.000100	<0.000050	<0.010	0.000126	0.00037	190	<0.00050	0.0118
KV-121	Christal Seep	05-Sep-2024	Sample only, site is good no change. Flow not monitored.			4.5	6.83	7.91	1416	863	0.6	1.51	10.8	-159.6	521	520	129	<0.250	<2.50	0.228	336	429	0.0388	26.7	<0.0050	0.123		<0.50	<0.0030	0.1	<0.00010	0.0303	0.0118	<0.000100	<0.000050	<0.010	0.000115	0.00037	166	<0.00050	0.00811
KV-121	Christal Seep	13-Oct-2024				8.8	7.60	7.69	391.5	694	1.5	9.10	65.4	91.7	313	361	111		0.77		255	429	0.0115	4.22	<0.0010	0.166		0.67	0.0038	0.1	<0.00010	0.0454	0.0207	<0.000100	<0.000050	<0.010	0.000148	0.00037	92.8	<0.00050	0.00424
KV-121	Christal Seep	06-Nov-2024	Open spots but mostly frozen over.			9.2	6.47	7.69	618	561	0.6	9.21	64.4	9.7	279	276	111	<0.050	2.88	0.077	177	429	0.0080	61.2	<0.0010	0.490		0.75	0.113	0.005	0.00024	0.0136	0.0712	<0.000100	<0.000050	<0.010	0.00457	0.00037	79.6	<0.00050	0.00195
KV-121	Christal Seep	05-Dec-2024				2.6	7.13	7.39	680	556	0.5	7.34	51.3	52.3	285	280	106	<0.050	2.93	0.063	177	429	0.0311	13.5	<0.0010	0.494		0.84	0.0066	0.1	<0.00010	0.00081	0.0210	<0.000020	<0.000050	<0.010	0.000297	0.00037	80.3	<0.00050	<0.00010
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021		8.98			9.19		1832		1.4										128		0.125						0.1								No Hardness			
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021		8.53		11.7	9.27	7.72	1815	1340	2.5				712	679	33.0	<0.250	33.7	<0.100	662	429	2.51	0.0983	0.212	3.61		2.54	0.0071	0.1	0.0102	0.0117	0.0215	<0.000100	<0.000050	0.034	0.000221	0.00037	194	0.00620	0.00044
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021		5.23		2.6	9.32	7.95	1133	1160	3.1				601	600	34.4	<0.250	6.99	<0.100	580	429	3.25	0.0858	0.277	4.94		1.59	0.0153	0.1	0.0107	0.0130	0.0138	<0.000100	<0.000050	0.040	0.000164	0.00037	164	0.00216	0.00022

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCME-Aquatic					0.3					0.000026	0.073				0.001		0.00025				0.0008				0.015												
BC-ENV Aquatic Life															0.002																						
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008		<0.001	0.4	0.0082	0.014	23	1.41		<0.001	0.0022		0.5	0.0009	4.3	<0.0001	1.6	0.269	96.6	<0.00005	<0.001	0.008	0.0044	0.0002	0.132	<0.001	<0.005	<0.0002	0.0031	0.077	<0.0001	<0.0005	<0.002	0.0005	140	<0.0005
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008		0.004	1.3	0.0709	0.007	11.2	1.04		<0.001	0.0044		0.6	0.0007	2.35	0.00107	0.8	0.142	56.2	<0.00005	<0.001	0.0209	0.0018	0.0012	0.319	<0.001	0.047		0.0026	0.04	<0.0001	<0.0005	<0.002	0.00145	74	0.0005
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008		<0.001	0.16	0.0084	0.01	20.9	0.311		<0.001	0.0035		<0.4	0.0012	1.95	0.00036	1.4	0.241	90.2	<0.00005	<0.001	0.0086	0.0046	0.0002	0.308	<0.001	0.011	0.001	0.0023	0.063	<0.0001	<0.0005	<0.002	0.00194	118	<0.0005
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008		0.002	0.34	0.0442	0.01	21.2	0.372		<0.001	0.0014	0.014	<0.4	0.0008	2.06	0.00014	1.3	0.207	89.7	<0.00005	<0.001	0.0045	0.0038	0.0004	0.444	<0.001	0.01	0.001	0.0027	0.056	<0.0001	<0.0005	<0.002	0.00286	107	<0.0005
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008		0.002	0.17	0.0033	0.009	17.6	0.261		<0.001	0.0028		<0.4	0.0006	2.45	0.00002	1.1	0.202	72.6	<0.00005	<0.001	0.0061	0.0026	0.0002	0.272	<0.001	0.018	0.001	0.0037	0.055	<0.0001	<0.0005	<0.002	0.00194	98.4	<0.0005
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008		<0.001	0.12	0.0036	0.008	19.1	0.207		0.00011	0.002	0.03	0.32	0.0006	2.81	<0.00001	1.2	0.182		<0.00001	<0.0001	0.0008	0.0032	0.00012	0.196	<0.0001	0.006	0.0008	0.0024	0.052	<0.00004		<0.004	0.00157	127	0.0009
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008		0.002	0.38	0.027	0.007	18.5	0.338		0.00019	0.003	<0.01	0.3	0.001	3.07	0.00013	1.28	0.183		<0.00001	<0.0001	0.0021	0.0029	0.00021	0.428	<0.0001	0.031	0.001	0.002	0.049	<0.00004		<0.004	0.0028	108	0.0008
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008		0.003	0.16	0.0101	0.008	21.7	0.701		0.0001	0.003	<0.01	0.4	0.0009	3.75	0.0002	1.36	0.204		<0.00001	<0.0001	0.0015	0.0035	0.0001	0.234		<0.005	0.0011	0.0016	0.065	<0.00004		<0.004	0.00184	101	0.0004
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008	Total metals results greatly elevated due to TSS contamination (creek bottom disturbed); results removed from database as non-representative.	~	~	~	~	~	~		~	~		~	~	~	~	~	~	~		~	~	~	~	~	~		<0.005	0.0014	0.004	0.077	<0.0001	<0.0005	<0.002	0.00093	121	<0.0005
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009		0.002	0.07	0.0044	0.014	26.4	1.39		<0.001	0.0038		0.8	0.0015	4.79	0.00002	3.4	0.286	101	<0.00005	<0.001	0.0078	0.0053	0.0001	0.203	<0.001	0.015	0.0009	0.0042	0.08	<0.0001	<0.0005	0.005	0.0003	137	<0.0005
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009		0.002	0.1	0.0005	0.008	14	0.173		0.00106	0.001	<0.01	0.7	<0.0006	3.71	<0.00001	2.53	0.205	39.8	<0.00001	<0.0001	0.0018	0.002	0.00014	0.025	<0.0001	<0.005	0.0009	0.0004	0.018	<0.00004	<0.0001	<0.004	0.00037	136	0.0005
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009		<0.001	0.26	0.0126	0.01	22.5	0.661		0.00012	0.003	0.014	0.4	0.0006	3.7	<0.00001	1.39	0.205	88.1	<0.00001	<0.0001	0.0006	0.0039	0.00009	0.115	<0.0001	<0.005	0.0013	0.003	0.066	<0.00004	<0.0001	<0.004	0.00036	113	0.0005
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009		0.00138	0.066	0.00114	0.011	7.94	0.0765	0.00001	0.00074	0.00065	0.005	0.59	0.00018	3.45	<0.000005	4.98	0.173	37	0.000003	<0.00001	<0.0005	0.00125	<0.0002	0.0107	<0.0001	0.008	0.00011	0.00069	0.034	<0.00001	<0.000005	<0.05	0.000126	89.1	0.0014
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009		0.00128	0.076	0.000947	<0.0005	1.12	0.0281	<0.00001	0.00005	0.00093	0.016	0.44	<0.00004	0.514	0.000017	0.09	0.0119	<3	<0.000002	<0.00001	0.001	0.000052	<0.0002	0.0327	<0.0001	0.03	0.00014	0.00061	0.00629	<0.00001	<0.000005	<0.05	0.000102	6.1	0.0002
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009		0.00132	0.358	0.0449	0.007	13.2	0.4	<0.00001	0.0002	0.00264	0.014	0.37	0.00056	1.93	0.000063	0.94	0.148	62	0.00001	<0.00001	0.0012	0.00243	<0.0002	0.254	<0.0001	0.0211	0.00081	0.00384	0.0484	<0.00001	0.000021	<0.05	0.00226	85.5	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009		0.00053	0.095	0.0187	0.0082	21.5	0.216	<0.00001	0.00019	0.0017	0.005	0.19	0.00088	1.88	<0.000005	1.4	0.213	93	0.000003	<0.00001	<0.0005	0.00421	<0.0002	0.155	<0.0001	0.0062	0.0004	0.00279	0.0599	<0.00001	<0.000005	<0.05	0.00127	123	0.0002
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009		0.00043	0.195	0.0155	0.0115	25.1	0.304		0.00024	0.00227		0.25	0.00082	2.56	0.000007	1.56	0.241	116	<0.000002	<0.00001	<0.0005	0.00477	<0.0002	0.141	<0.0001	0.0083	0.00031	0.00293	0.0595	<0.00001	<0.000005	<0.05	0.000784	140	0.0002
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009		0.00035	0.134	0.00567	0.0094	23.3	0.273	<0.00001	0.00024	0.00218	0.005	0.35	0.00081	3.42	0.000151	1.44	0.227	117	0.000002	<0.00001	0.0006	0.00449	<0.0002	0.191	<0.0001	0.0091	0.00029	0.00262	0.0573	<0.00001	<0.000005	<0.05	0.00131	132	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009		0.00067	0.378	0.0472	0.0111	22.2	0.488		0.00052	0.003		0.33	0.00085	4.01	0.000014	1.38	0.224	111	0.000006	<0.00001	<0.0005	0.00426	<0.0002	0.219	<0.0001	0.0019	0.00036	0.00188	0.0553	<0.00001	<0.000005	<0.05	0.00141	133	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009		0.00048	0.271	0.0107	0.0145	23.9	1.15	0.00002	0.00049	0.00409	0.004	0.38	0.00085	4.01	0.000008	1.46	0.241	115	0.000003	<0.00001	<0.0005	0.00428	<0.0002	0.138	<0.0001	0.0027	0.00035	0.00185	0.0577	<0.00001	<0.000005	<0.05	0.00087	146	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009		0.00038	0.266	0.00491	0.0131	21.8	1.33	<0.00001	0.00038	0.00301	0.006	0.41	0.00096	3.66	<0.000005	1.3	0.245	124	0.000003	<0.00001	<0.0005	0.00389	<0.0002	0.118	<0.0001	0.0019	0.00027	0.00206	0.0659	<0.00001	<0.000005	<0.05	0.000712	148	0.0002
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010		0.00033	0.482	0.00515	0.0134	24.8	1.17		0.00019	0.00317		0.42	0.00099	4.49	0.000031	1.53	0.234	122	0.000002	<0.00001	<0.0005	0.00423	<0.0002	0.107	<0.0001	0.0624	0.00038	0.0033	0.0679	<0.00001	0.000014	<0.05	0.000407	155	0.0008
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010		0.00033	0.496	0.0136	0.0143	24.3	1.11	<0.00001	0.00021	0.0034	0.006	0.42	0.00099	4.29	0.00003	1.53	0.239	127	0.000003	<0.00001	<0.0005	0.00445	<0.0002	0.101	<0.0001	0.0112	0.00019	0.00285	0.0587	<0.00001	<0.000005	<0.05	0.000291	159	0.0007
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010		0.00027	0.481	0.00476	0.015	25.9	1.15	0.00001	0.00021	0.00351	0.009	0.47	0.001	4.34	0.000011	1.67	0.264	137	<0.000002	<0.00001	0.0008	0.00456	<0.0002	0.0887	<0.0001	0.0018	0.00019	0.00307	0.0569	<0.00001	<0.000005	<0.05	0.000232	165	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010		0.00067	0.543	0.00541	0.0151	24.7	1.03	<0.00001	0.00021	0.00405	0.009	0.47	0.00093	3.5	<0.000005	1.57	0.252	133	0.000005	0.00009	<0.0005	0.00425	<0.0002	0.0985	<0.0001	0.0037	0.00022	0.00333	0.0576	<0.00001	<0.000005	<0.05	0.000154	167	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010		0.00094	0.564	0.00816	0.0074	13.9	0.45		0.00022	0.00295		0.44	0.00061	2.3	0.000014	0.91	0.153	71	0.000003	<0.00001	0.0018	0.00228	<0.0002	0.133	<0.0001	0.0668	0.00046	0.00405	0.0441	<0.00001	<0.000005	<0.05	0.000908	87.4	0.0012
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010		0.00055	0.139	0.00543	0.0122	23.2	0.275	<0.00001	0.00028	0.00209	0.007	0.21	0.00077	2.19	<0.000005	1.42	0.215	119	<0.000002	<0.00001	<0.0005	0.00366	<0.0002	0.239	<0.0001	0.0047	0.00035	0.00216	0.0496	<0.00001	<0.000005	<0.05	0.00184	134	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010		0.00507	3.7	0.312	0.0118	21.1	1.42	<0.00001	0.00028	0.00457	0.071	0.2	0.0008	2.7	0.00153	1.21	0.227	104	0.000127	0.00004	0.01	0.00334	0.0009	0.452	<0.0001	0.0166	0.0004	0.00309	0.0454	<0.00001	<0.000005	<0.05	0.00106	127	0.0006
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010		0.00046	0.147	0.00489	0.0128	24.6	0.216	<0.00001	0.00027	0.00204	0.007	0.23	0.00079	2.66	0.000017	1.47	0.234	121	0.000002	<0.00001	<0.0005	0.00406	<0.0002	0.124	<0.0001	0.0111	0.00034	0.00327	0.0492	<0.00001	0.000007	<0.05	0.000832	143	0.0004
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010		0.00071	0.741	0.0331	0.0123	23.6	0.386	<0.00001	0.00021	0.00265	0.014	0.36	0.00079	3.14	0.000027	1.48	0.22	115	0.000009	<0.00001	0.001	0.00352	<0.0002	0.177	<0.0001	0.0046	0.0002	0.0026	0.0449	<0.00001	<0.000005	<0.05	0.000788	138	0.0005
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010		0.00026	0.181	0.00231	0.0131	23.5	0.293	<0.00001	0.00019	0.00247		0.34	0.00083	3.32	0.000007	1.41	0.224	122	<0.000002	<0.00001	<0.0005	0.00389	<0.0002	0.146	<0.0001	0.0054	0.00015	0.00217	0.0467	<0.00001	<0.000005	<0.05	0.000764	134	0.0004
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010	no flow taken - ice	0.00027	0.196	0.00506	0.0144	24.3	1.42	<0.00001	0.00019	0.00439	0.005	0.42	0.00086	4.5	0.00002	1.53	0.24	121	<0.000002	0.00002	<0.0005	0.00396	<0.0002	0.166	<0.0001	0.0024	0.00017	0.00241	0.0534	<0.00001	0.000005	<0.05	0.000778	162	0.0005
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010	no flow taken - ice	0.00055	0.112	0.00522	0.0178	27.6	1.91	0.00002	0.00021	0.00428	0.015	1.31	0.00088	4.71	<0.000005	1.64	0.278	140	0.000003	<0.00001	<0.0005	0.00408	<0.0002	0.179	<0.0001	0.0015	0.00021	0.00254	0.0658	<0.00001	<0.000005	<0.05	0.000655	164	0.0002
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011	no flow taken - ice.	0.00023	0.249	0.00663	0.0136	25.5	1.05	<0.00001	0.00018	0.00419	0.007	0.42	0.00096	4.23	0.000016	1.61	0.245	125	0.000002	0.00001	<0.0005	0.0046	<0.0002	0.123	0.0004	0.0015	0.00016	0.00174	0.0574	<0.00001	<0.000005	<0.05	0.000101	149	0.0007
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011	no flow taken.	0.00014	0.4	0.00795	0.0163	24.2	1.37	<0.00001	0.00017	0.00433	0.005	0.43	0.00082	3.75	<0.000005	1.48	0.265	122	0.000003	<0.00001	<0.0005	0.00449	<0.0002	0.101	<0.0001	0.0045	0.00016	0.00271	0.0581	<0.00001	<0.000005	<0.05	0.000101	151	0.0004
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011	no flow taken -ice. Spent 1/2 hr trying to find water. Auger, axed	0.00029	0.489	0.00378	0.0158	28	1.35	<0.00001	0.00019	0.00474	0.01	0.48	0.00088	4.82	0.00001	1.69	0.268	139	<0.000002	<0.00001	<0.0005	0.00485	<0.0002	0.103	<0.0001	0.003	0.00019	0.00366	0.064	<0.00001	<0.000005	<0.05	0.000215	173	0.0005
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011	pH on multimeter not working. No flow taken - ice	0.00041	0.398	0.00488	0.0159	28.1	1.08	<0.00001	0.00017	0.00471	0.01	0.51	0.00087	4.59	<0.000005	1.7	0.274	140	<0.000002	<0.00001	<0.0005	0.00494	<0.0002	0.104	<0.0001	0.0031	0.00017	0.00338	0.057	<0.00001	<0.000005	<0.05	0.000171	182	0.0004
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011		0.00108	0.362	0.00814	0.0078	13.2	0.404	<0.00001	0.00037	0.00276	0.012	0.51	0.00066	2.92	0.00002	0.95	0.163	74	0.000003	<0.00001	<0.0005	0.0021	<0.0002	0.19	<0.0001	0.0207	0.00041	0.00481	0.0373	<0.00001	<0.000005	<0.05	0.00176	98.5	0.0004
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011		0.00037	0.143	0.00441	0.0118	25.5	0.288	<0.00001	0.00024	0.00213	0.005	0.21	0.00078	2.16	0.000013	1.57	0.254	135	0.000008	<0.00001	<0.0005	0.00432	<0.0002	0.207	<0.0001	0.0096	0.00032	0.00313	0.0523	<0.00001	<0.000005	<0.05	0.00126	145	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011	flows by Marsh McB	0.00056	0.176	0.00604	0.0103	22.1	0.281	<0.00001	0.00031	0.00244	0.008	0.17	0.00066	2.32	0.000007	1.43	0.218	108	0.000002	<0.00001	<0.0005	0.00364	<0.0002	0.183	<0.0001	0.0062	0.00036	0.00375	0.0455	<0.00001	<0.000005	<0.05	0.00116	131	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011	flows with Marsh McB. no staff gauge	0.00065	0.249	0.00846	0.0121	24.3	0.344	<0.00001	0.00024	0.00324	0.008	0.32	0.00074	3.2	0.000029	1.54	0.223	117	0.000003	<0.00001	<0.0005	0.00402	<0.0002	0.226	<0.0001	0.0087	0.00028	0.00322	0.0386	<0.00001	<0.000005	<0.05	0.0016	137	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011	flows with Marsh McB	0.00039	0.544	0.00411	0.0135	23.1	0.441	<0.00001	0.00035	0.00263	0.007	0.41	0.00077	3.4	0.000026	1.41	0.235	116	<0.000002	0.00018	<0.0005	0.00454	<0.0002	0.275	<0.0001	0.0048	0.00025	0.00318	0.045	<0.00001	<0.000005	<0.05	0.00166	144	0.0003
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011		0.00026	0.297	0.00243	0.0175	27.7	1.32	<0.00001	0.00023	0.0055	0.006	0.43	0.00082	4	0.00002	1.63	0.271	143	<0.000002	0.00013	<0.0005	0.00415	<0.0002	0.218	<0.0001	0.0031	0.00022	0.00201	0.0456	<0.00001	<0.000005	<0.05	0.00101	164	<0.0001
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011	Salt Slug; field conductivity not entered, probe malfunction in cold	0.00067	0.366	0.0155	0.0158	28.2	1.64	<0.00001	0.0002	0.00606	0.008	0.47	0.00096	4.1	<0.000005	1.77	0.256	131	0.000003	0.00055	<0.0005	0.0046	<0.0002	0.219	<0.0001	0.0016	0.00023	0.00289	0.0559	<0.00001	<0.000005	<0.05	0.000769	153	0.0001
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011	Salt Slug	0.00248	0.492	0.00752	0.0156	26.1	1.84	<0.00001	0.0002	0.00643	0.007	0.61	0.00094	4.1	0.00001	1.87	0.26	122	0.00001	0.00013	<0.0005	0.0039	<0.0002	0.175	<0.0001	0.0013	0.00022	0.00363	0.0625	<0.00001	<0.000005	<0.05	0.000517	159	0.0002
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012	Condition not condusive to measure flow.	0.00122	0.535	0.016	0.0146	23.2	1.06	<0.00001	0.00019	0.00528	0.024	0.46	0.00111	4.3	0.000011	2.43	0.244	138	0.000003	0.0005	<0.0005	0.00411	<0.0002	0.149	<0.0001	0.0051	0.00023	0.00273	0.054	<0.00001	0.000025	<0.05	0.000203	142	0.0023
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012	Salt Slug, non-ideal result, caution	0.00019	0.571	0.0039	0.0166	26.1	1.33	<0.000010	0.00016	0.00597	0.012	0.47	0.00091	4.3	<0.000005	1.6	0.244	131	0.000002	<0.0002	<0.0005	0.00419	<0.0002	0.139	<0.0001	0.0035	0.00015	0.00446	0.0568	<0.00001	<0.000005	<0.05	0.000212	172	<0.0001
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012	Salt Slug	0.00024	0.48	0.00362	0.018	26.8	1.25	<0.000010	0.00015	0.00556	0.014	0.5	0.00096	4.2	0.000008	1.7	0.248	143	0.000004	<0.0002	<0.0005	0.00335	<0.0002	0.119	<0.0001	0.0008	0.00018	0.00442	0.0631	<0.00001	<0.000005	<0.05	0.000104	169	<0.0001
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012	Salt Slug	0.00022	0.514	0.00306	0.0175	25.5	1.07	<0.00001	0.00018	0.00611	0.008	0.43	0.00089	3.8	<0.000005	1.57	0.25	131	0.000003	<0.0002	<0.0005	0.00392	<0.0002	0.117	<0.0001	0.001	0.00017	0.00423	0.0547	<0.00001	<0.000005	<0.05	0.000081	159	<0.0001
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012	slow meandering flow. Installed Staff gauge, reading @14:12	0.00124	0.991	0.0135	0.00789	13.2	0.703	<0.000010	0.000189	0.00435	0.0172	0.538	0.000553	2.47	0.000041	0.895	0.143	66	0.000005	<0.00020	0.00118	0.00171	<0.00020	0.364	<0.00010	0.0254	0.000265	0.00535	0.0366	<0.000010	<0.0000050	<0.050	0.00321	85.1	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012	No ice over the water.	0.00143	0.872	0.0225	0.00773	14.8	0.719	<0.000010	0.000329	0.0044	0.0156	0.551	0.000515	2.68	0.000063	1.02	0.15	70	0.000006	<0.00020	0.00071	0.0021	<0.00020	0.318	0.00013	0.0215	0.00035	0.00509	0.0406	<0.000010	<0.0000050	<0.050	0.00183	91.1	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	Creek bed rusty.	0.00075	0.148	0.00336	0.0118	20.6	0.25	<0.000010	0.00024	0.00294	0.0138	0.332	0.000875	2.04	0.0000102	1.75	0.211	106	<0.0000020	<0.00020	0.00328	0.00378	<0.00020	0.123	<0.00010	0.003	0.000262	0.00257	0.0457	<0.000010	<0.0000050	<0.050	0.000608	111	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012	water clear; rocky bottom-reddish; flow from below culvert	0.000872	0.21	0.00559	0.0173	28.5	0.247	<0.000010	0.000286	0.0021	0.013	0.183	0.000758	2.46	0.0000086	1.75	0.255	152	0.0000026	<0.00020	<0.00050	0.00369	<0.00020	0.0992	<0.00010	0.00666	0.000292	0.00308	0.0427	<0.000010	<0.0000050	<0.050	0.000515	144	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012	testing functionality of flow meter																																		
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012		0.000408	0.187	0.0048	0.0172	26.6	0.343	<0.000010	0.000335	0.00284	0.0023	0.24	0.000745	2.62	0.00001	1.64	0.265	133	<0.0000020	<0.00020	<0.00050	0.00361	<0.00020	0.105	<0.00010	0.00354	0.000303	0.00368	0.0456	<0.000010	<0.0000050	<0.050	0.000612	125	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012		0.000277	0.314	0.00189	0.0175	25.6	0.517	<0.000010	0.000215	0.0041	0.0023	0.387	0.000848	3.11	<0.0000050	1.53	0.274	140	<0.0000020	<0.00020	<0.00050	0.00401	<0.00020	0.163	<0.00010	0.00198	0.000201	0.00252	0.0457	<0.000010	<0.0000050	<0.050	0.00065	169	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012	Sampled with Kim Winnecky & Jossee Tremblay (NND). Returned Oct 16 to measure flows when data logger downloaded & winterized.	0.000413	0.202	0.0027	0.017	24	0.449	<0.000010	0.000195	0.00345	0.0044	0.407	0.000855	4.07	0.000005	1.45	0.27	144	0.000002	0.00035	<0.00050	0.00393	<0.00020	0.0988	<0.00010	0.00152	0.000178	0.00242	0.0484	<0.000010	<0.0000050	<0.050	0.000684	155	0.00013
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012	Returned to measure flows when data logger downloaded & winterized.																																		
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012	Took samples between 2 ice layers.YSI conductivity not working properly , flow reading not possible.	0.00119	0.441	0.0233	0.0157	27.5	1.69	<0.000010	0.00021	0.00677	0.0058	0.438	0.00101	4.2	0.000046	1.77	0.262	127	0.000007	<0.00020	<0.00050	0.00465	0.00022	0.173	<0.00010	0.00137	0.00025	0.00216	0.0662	<0.000010	<0.0000050	<0.050	0.000627	159	0.00011
KV-6	Christal Creek u/s

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014		0.00069	0.194	0.00964	0.0112	24.4	0.412	<0.000010	0.000257	0.00289	<0.050	0.19	0.00083	2.57	0.000069	1.37	0.226	112	<0.000010	<0.00010	<0.010	0.00378	<0.0010	0.163	<0.00080	0.0064	0.00045	0.00402	0.0381	<0.00010	<0.00050	<0.010	0.000773	142	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014		0.00063	0.273	0.0135	0.0131	27.9	0.347	<0.000010	0.000204	0.00274	<0.050	0.23	0.00088	2.83	0.000098	1.50	0.266	117	<0.000010	<0.00010	<0.010	0.00407	<0.0010	0.151	<0.00080	0.0037	0.00035	0.00389	0.0452	<0.00010	<0.00050	<0.010	0.000726	154	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014		0.00082	0.239	0.0106	0.0112	25.1	0.437	<0.000010	0.000197	0.00325	<0.050	0.38	0.00087	3.37	0.000040	1.50	0.229	107	<0.000010	<0.00010	<0.010	0.00373	<0.0010	0.168	<0.00080	0.0041	0.00027	0.00289	0.0411	<0.00010	<0.00050	<0.010	0.000932	146	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	Ice affected stage	0.00108	0.256	0.00514	0.0132	26.2	0.856	<0.000010	0.000199	0.00505	<0.050	0.39	0.00105	3.85	0.000025	1.65	0.246	110	<0.000010	0.00019	<0.010	0.00387	<0.0010	0.213	<0.00080	0.0040	0.00023	0.00223	0.0489	<0.00010	<0.00050	<0.010	0.00101	145	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014	Glacier from road to Staff Gauge (frozen at 0.360m)	0.00079	0.229	0.00994	0.0142	26.3	1.45	<0.000010	0.000205	0.00556	<0.050	0.47	0.00100	4.20	0.000057	1.75	0.244	110	<0.000010	<0.00010	<0.010	0.00411	<0.0010	0.171	<0.00080	0.0024	0.00020	0.00233	0.0576	<0.00010	<0.00050	<0.010	0.000720	149	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014		0.00111	0.826	0.0180	0.0139	24.9	1.22	<0.000010	0.000198	0.00433	<0.050	0.36	0.00119	4.08	0.000180	1.45	0.245	101	<0.000010	<0.00010	<0.010	0.00383	<0.0010	0.145	<0.00080	0.0016	0.00019	0.00373	0.0607	<0.00010	<0.00050	<0.010	0.000234	137	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015	water clear; 100% ice covered ~1m thick	<0.00050	0.938	0.0134	0.0126	25.2	1.21	<0.000010	0.000191	0.00487	<0.050	0.46	0.00109	4.27	0.000134	1.57	0.241	108	<0.000010	<0.00010	<0.010	0.00350	<0.0010	0.138	<0.00080	0.0011	0.00019	0.00524	0.0571	<0.00010	<0.00050	<0.010	0.000090	150	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015		0.00064	0.963	0.0246	0.0145	25.4	1.17	<0.000010	0.000204	0.00556	<0.050	0.43	0.00110	3.98	0.000188	1.53	0.256	113	<0.000010	<0.00010	<0.010	0.00424	<0.0010	0.148	<0.00080	0.0022	0.00022	0.00596	0.0591	<0.00010	<0.00050	<0.010	0.000102	149	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015	strong odour, marshy.	<0.00050	0.636	0.00552	0.0157	26.4	0.999	<0.000010	0.000190	0.00549	<0.050	0.45	0.00114	4.13	0.000065	1.61	0.256	122	<0.000010	<0.00010	<0.010	0.00432	<0.0010	0.121	<0.00080	0.0027	0.00020	0.00603	0.0552	<0.00010	<0.00050	<0.010	0.000120	157	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015		<0.00050	0.606	0.00368	0.0159	25.3	0.950	<0.0000050	0.000179	0.00537	<0.050	0.44	0.00107	4.10	0.000018	1.61	0.265	118	<0.000010	<0.00010	0.00050	0.00435	<0.00050	0.117	<0.00080	0.0021	0.00022	0.00603	0.0525	<0.00010	<0.00050	<0.010	0.0000979	166	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015	No staff gauge reading	0.00322	1.20	0.0426	0.0039	6.67	0.570	0.0000268	0.000202	0.00386	<0.050	0.72	0.000336	1.94	0.000487	0.548	0.0787	32.1	<0.000010	<0.00010	<0.0090	0.000723	0.00063	0.169	<0.00030	0.0545	0.00037	0.00543	0.0317	<0.00010	<0.000050	<0.010	0.000678	47.1	0.00014
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015		<0.00050	0.316	0.00502	0.0168	25.9	0.614	<0.0000050	0.000422	0.00416	<0.050	0.36	0.000809	3.18	0.000035	1.58	0.263	127	<0.000010	<0.00010	<0.00090	0.00448	<0.00050	0.141	<0.00030	0.0018	0.00029	0.00319	0.0534	<0.00010	<0.000050	<0.010	0.000512	169	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015		0.00071	0.297	0.0142	0.0161	25.6	0.413	<0.0000050	0.000310	0.00335	<0.050	0.30	0.000862	3.09	0.000111	1.52	0.265	128	<0.000010	<0.00010	<0.0012	0.00413	<0.00050	0.171	<0.00030	0.0023	0.00043	0.00405	0.0446	<0.00010	<0.000050	<0.010	0.000686	155	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015		0.00110	0.302	0.00852	0.0141	24.5	0.492	<0.0000050	0.000267	0.00370	<0.050	0.37	0.000808	3.51	0.000067	1.50	0.231	116	<0.000010	<0.00010	<0.00090	0.00353	<0.00050	0.199	<0.00030	0.0068	0.00032	0.00415	0.0400	<0.00010	<0.000050	<0.010	0.00107	153	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015		0.00074	0.504	0.00641	0.0120	22.2	0.602	<0.0000050	0.000223	0.00422	<0.050	0.36	0.000807	3.46	0.000039	1.36	0.210	103	<0.000010	<0.00010	0.00096	0.00306	<0.00050	0.212	<0.00030	0.0129	0.00028	0.00387	0.0386	<0.00010	<0.000050	<0.010	0.00106	134	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015																																			
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015	ORP drifting	<0.00050	0.380	0.00298	0.0152	25.7	0.869	<0.0000050	0.000234	0.00527	<0.050	0.35	0.00105	3.89	0.000030	1.65	0.246	114	<0.000010	<0.00010	0.00040	0.00382	<0.00050	0.250	<0.00030	0.0016	0.00021	0.00234	0.0494	<0.00010	<0.000050	<0.010	0.00112	157	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015	Dumped salt slug above a spot that widened out might not be accurate	0.00148	0.342	0.0110	0.0119	26.7	0.866	<0.0000050	0.000196	0.00447	<0.050	0.58	0.00144	3.98	0.000049	1.83	0.232	99.2	<0.000010	<0.00010	<0.0012	0.00454	<0.00050	0.182	<0.00030	0.0014	0.00019	0.00245	0.0604	<0.00010	<0.000050	<0.010	0.00117	145	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015	WQ collected on 17 Dec 2015 but YSI was not working so insitu collected by A.MacPhail 18 Dec during flow metering	<0.00050	0.500	0.00285	0.0121	26.4	0.981	<0.0000050	0.000179	0.00417	<0.050	0.40	0.00143	3.91	0.000019	1.68	0.236	112	<0.000010	<0.00010	0.00048	0.00412	<0.00050	0.167	<0.00030	<0.0010	0.00017	0.00410	0.0666	<0.00010	<0.000050	<0.010	0.000691	142	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015	WQ collected on 17 Dec 2015 but YSI was not working so insitu collected by A.MacPhail 18 Dec during flow metering																																		
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016		0.00050	0.629	0.00263	0.0146	28.1	1.06	<0.0000050	0.000277	0.00514	<0.050	0.53	0.00147	4.33	0.000022	1.83	0.261	116	<0.000010	<0.00010	0.00039	0.00473	<0.00050	0.168	<0.00030	<0.0010	0.00018	0.00530	0.0669	<0.00010	<0.000050	<0.010	0.000333	159	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016		<0.00050	0.557	0.00129	0.0166	24.9	1.02	<0.0000050	0.000193	0.00523	<0.050	0.58	0.00112	3.94	<0.000010	1.65	0.237	112	<0.000010	<0.00010	<0.00030	0.00410	<0.00050	0.139	<0.00030	<0.0010	0.00013	0.00491	0.0531	<0.00010	<0.000050	<0.010	0.000456	145	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016		<0.00050	0.693	0.00411	0.0151	25.7	0.974	<0.0000050	0.000192	0.00561	<0.050	0.42	0.00114	4.11	0.000043	1.61	0.264	118	<0.000010	<0.00010	0.00043	0.00432	<0.00050	0.141	<0.00030	<0.0010	0.00013	0.00570	0.0513	<0.00010	<0.000050	<0.010	0.000357	159	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016		<0.00050	0.817	0.00263	0.0173	26.9	1.01	<0.0000050	0.000205	0.00553	<0.050	0.51	0.00109	4.19	0.000021	1.75	0.260	118	<0.000010	<0.00010	0.00051	0.00426	<0.00050	0.131	<0.00030	0.0012	0.00016	0.00620	0.0521	<0.00010	<0.000050	<0.010	0.000261	175	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016		0.00090	1.02	0.00871	0.0102	16.5	1.14	<0.0000050	0.000276	0.00552	<0.050	0.51	0.000588	2.97	0.000067	1.04	0.179	79.6	<0.000010	<0.00010	0.00088	0.00246	<0.00050	0.232	<0.00030	0.0047	0.00028	0.00434	0.0519	<0.00010	<0.000050	<0.010	0.000974	119	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016	SG 0.215 @10:25.	<0.00050	0.326	0.00489	0.0167	26.9	0.539	<0.0000050	0.000307	0.00403	<0.050	0.30	0.000977	2.90	0.000047	1.62	0.260	123	<0.000010	<0.00010	0.00044	0.00393	<0.00050	0.134	<0.00030	0.0018	0.00027	0.00314	0.0473	<0.00010	<0.000050	<0.010	0.000652	166	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016	Water is clear something D/S of site is causing turbidity at KV-7 & KV-8	0.00076	0.325	0.0108	0.0154	26.5	0.526	<0.0000050	0.000310	0.00353	<0.050	0.21	0.000923	3.14	0.000083	1.53	0.266	125	<0.000010	<0.00010	0.00079	0.00379	<0.00050	0.176	<0.00030	0.0037	0.00037	0.00413	0.0453	<0.00010	<0.000050	<0.010	0.000837	159	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016	DO probe may need to be replaced, varies wildy from day to day	0.00099	0.323	0.0171	0.0134	23.2	0.618	<0.0000050	0.000248	0.00447	<0.050	0.28	0.000825	3.24	0.000145	1.29	0.229	106	<0.000010	<0.00010	0.00080	0.00291	<0.00050	0.330	<0.00030	0.0091	0.00027	0.00293	0.0342	<0.00010	<0.000050	<0.010	0.00198	144	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016		0.00080	0.476	0.00234	0.0160	24.3	0.909	<0.0000050	0.000260	0.00530	<0.050	0.40	0.000897	3.59	0.000018	1.59	0.257	126	<0.000010	<0.00010	0.00057	0.00395	<0.00050	0.229	<0.00030	0.0029	0.00019	0.00267	0.0435	<0.00010	<0.000050	<0.010	0.00109	152	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016		<0.00050	0.505	0.00471	0.0197	29.2	1.35	<0.0000050	0.000239	0.00733	<0.050	0.41	0.000915	4.11	<0.000010	1.73	0.275	135	<0.000010	<0.00010	<0.00030	0.00445	<0.00050	0.185	<0.00030	0.0011	0.00014	0.00317	0.0503	<0.00010	<0.000050	<0.010	0.000705	178	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	DO probe measurement suspect	<0.00050	0.629	0.00486	0.0186	26.4	1.66	<0.0000050	0.000212	0.00721	<0.050	0.46	0.000965	4.15	0.000037	1.74	0.265	123	<0.000010	<0.00010	0.00081	0.00463	<0.00050	0.169	<0.00030	<0.0010	0.00015	0.00379	0.0561	<0.00010	<0.000050	<0.010	0.000346	173	0.00017
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	Entire staff gauge is under ice, overflow backed up from highway, could not find second location with flowing water, conditions not suitable for salt slug	0.00059	0.317	0.00354	0.0179	29.8	1.85	<0.0000050	0.000256	0.00652	<0.050	0.49	0.00106	4.44	0.000014	1.78	0.276	128	<0.000010	<0.00010	0.00050	0.00443	<0.00050	0.134	<0.00030	0.0010	0.00014	0.00277	0.0667	<0.00010	<0.000050	<0.010	0.000213	174	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	sampled and discharge measured ~150 u/s from normal site as road glacier ice too built up on creek to find water. Could not find hydro station, covered in ice.	<0.00050	0.959	0.00571	0.0164	26.8	1.18	<0.0000050	<0.00030	0.00604	<0.050	0.42	0.00101	4.05	0.000043	1.66	0.276	131	<0.000010	<0.00010	0.00072	0.00489	<0.00050	0.125	<0.00030	0.0018	0.00018	0.00732	0.0609	<0.00010	<0.000050	<0.010	0.000290	176	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017		0.00061	0.720	0.00439	0.0153	23.2	0.968	<0.0000050	0.000188	0.00539	<0.050	0.37	0.000926	3.52	<0.000010	1.45	0.236	118	<0.000010	<0.00010	<0.00030	0.00469	<0.00050	0.106	<0.00030	<0.0010	0.00018	0.00734	0.0616	<0.00010	<0.000050	<0.010	0.000109	183	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	Sampled u/s of normal site due to overflow from above road	0.00052	1.58	0.0152	0.0181	28.6	1.38	<0.0000050	0.000228	0.00712	<0.050	0.47	0.00116	4.40	0.000147	2.26	0.279	145	<0.000010	<0.00010	0.00165	0.00515	<0.00050	0.151	<0.00030	0.0015	0.00014	0.00815	0.0584	<0.00010	<0.000050	<0.010	0.000128	169	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017		<0.00050	1.27	0.00420	0.0183	30.2	1.43	<0.0000050	0.000242	0.00770	<0.050	0.46	0.00102	4.12	0.000018	1.75	0.301	150	<0.000010	<0.00010	0.00052	0.00529	<0.00050	0.149	<0.00030	<0.0010	0.00016	0.00919	0.0511	<0.00010	<0.000050	<0.010	0.000163	169	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	Unable to connect to logger, no winterization. Creek still under ice with a few openings.	0.00324	2.08	0.0785	0.0069	10.1	1.02	0.0000093	0.000313	0.00653	<0.050	0.61	0.000401	2.58	0.00136	0.747	0.119	53.9	<0.000010	<0.00010	<0.0060	0.00161	0.00080	0.148	<0.00030	0.0781	0.00026	0.00672	0.0333	<0.00010	<0.000050	<0.010	0.000379	63.3	0.00016
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017		0.00064	0.604	0.00541	0.0131	22.7	0.916	<0.0000050	0.000305	0.00541	<0.050	0.46	0.000797	3.27	0.000027	1.36	0.237	120	<0.000010	<0.00010	0.00086	0.00410	<0.00050	0.114	<0.00030	0.0028	0.00031	0.00286	0.0498	<0.00010	<0.000050	<0.010	0.000514	136	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017		0.00078	0.348	0.0115	0.0141	27.6	0.735	<0.0000050	0.000290	0.00393	<0.050	0.21	0.000779	2.95	0.000033	1.59	0.263	134	<0.000010	<0.00010	0.00056	0.00533	<0.00050	0.165	<0.00030	0.0034	0.00036	0.00379	0.0438	<0.00010	<0.000050	<0.010	0.000750	168	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	Levelogger downloaded. Field pH suspect, removed.	<0.00050	0.225	0.00296	0.0176	29.4	0.431	<0.0000050	0.000194	0.00318	<0.050	0.25	0.000925	2.86	0.000022	1.60	0.292	150	<0.000010	<0.00010	<0.00030	0.00551	<0.00050	0.143	<0.00030	0.0017	0.00022	0.00310	0.0464	<0.00010	<0.000050	<0.010	0.000687	144	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	field pH probe malfunction	0.00052	0.342	0.00566	0.0163	27.2	0.620	<0.0000050	0.000180	0.00408	<0.050	0.41	0.000750	3.08	0.000093	1.57	0.270	140	<0.000010	<0.00010	<0.00090	0.00452	<0.00050	0.352	<0.00030	0.0033	0.00021	0.00287	0.0424	<0.00010	<0.000050	<0.010	0.00126	163	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	Too cold for salt slug calibration	<0.00050	0.333	0.00254	0.0146	27.3	1.12	<0.0000050	0.000154	0.00592	<0.050	0.40	0.000916	4.02	0.000014	1.69	0.265	145	<0.000010	<0.00010	<0.00030	0.00454	<0.00050	0.286	<0.00030	0.0011	0.00016	0.00211	0.0504	<0.00010	<0.000050	<0.010	0.00104	148	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017	Samped at gauge station and from overflow as site frozen to ground. Results removed as non-representative overflow sample.																																		
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	No flow measurements, significant overflow causing water to flow in layers.	0.00056	0.884	0.00985	0.0143	27.9	1.42	<0.0000050	0.000260	0.00515	<0.050	0.42	0.00116	4.51	0.000107	2.09	0.291	140	0.000011	<0.00010	0.00045	0.00550	<0.00050	0.172	<0.00030	<0.0010	0.00016	0.00561	0.0590	<0.00010	<0.000050	<0.010	0.000353	155	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	Overflow at site, station completely under ice, no flow.	<0.00050	0.982	0.00692	0.0153	28.9	1.48	<0.0000050	0.000226	0.00549	<0.050	0.47	0.00117	4.65	0.000034	1.81	0.292	138	<0.000010	<0.00010	<0.00030	0.00550	<0.00050	0.144	<0.00030	<0.0010	0.00015	0.00717	0.0622	<0.00010	<0.000050	<0.010	0.000288	172	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	thick overflow ice. Drilled into overflow and sampled it. Sample shows salt contamination, Na & Cl results removed.	0.00237	1.60	0.0405	0.0176	25.9	1.26	<0.0000050	0.000267	0.00667	<0.050	0.50	0.000959	4.35	0.000374		0.268	138	<0.000010	<0.00010	0.00339	0.00549	<0.00050	0.170	<0.00030	<0.0010	0.00028	0.00294	0.0605	<0.00010	<0.000050	<0.010	0.000426	155	0.00015
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018	drilled to bottom of auger, ice too thick																																		
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018	Frozen too deep																																		
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	Still significant ice cover on the creek	0.00320	1.20	0.0732	0.0039	7.50	0.885	0.0000087	0.000226	0.00529	0.052	0.72	0.000370	2.00	0.000520	0.670	0.0948	44.1	<0.000010	<0.00010	0.00474	0.00101	0.00069	0.604	<0.00030	0.0598	0.00031	0.00455	0.0301	<0.00010	<0.000050	<0.010	0.00469	57.2	0.00014
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	Real time readings for dewinterizing: in w/ condom = 16:39:58, out w/ condom = 16:40:54, out w/out = 16:43:11, back in = 16:46:20	0.00087	0.815	0.00673	0.0109	19.1	1.01	<0.0000050	0.000243	0.00484	<0.050	0.44	0.000723	3.12	0.000042	1.16	0.212	95.8	<0.000010	<0.00010	0.00090	0.00323	<0.0010	0.253	<0.00030	0.0084	0.00031	0.00481	0.0479	<0.00010	<0.000050	<0.010	0.000849	119	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018		<0.00050	0.357	0.00422	0.0159	27.1	1.02	<0.0000050	0.000277	0.00461	<0.050	0.27	0.000801	3.05	0.000015	1.66	0.276	146	<0.000010	<0.00010	<0.00060	0.00483	<0.00050	0.505	<0.00030	0.0020	0.00028	0.00293	0.0467	<0.00010	<0.000050	<0.010	0.00108	155	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018		0.00085	0.380	0.00638	0.0117	23.7	0.632	<0.0000050	0.000188	0.00365	<0.050	0.20	0.000660	2.83	0.000066	1.46	0.227	104	<0.000010	<0.00010	<0.00090	0.00345	<0.00050	0.217	<0.00030	0.0086	0.00026	0.00306	0.0351	<0.00010	<0.000050	<0.010	0.000957	125	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018		0.00099	0.817	0.0375	0.0121	26.4	0.944	<0.0000050	0.000211	0.00428	<0.050	0.29	0.00103	3.14	0.00158	1.50	0.235	118	<0.000010	<0.00010	0.00116	0.00444	<0.00050	0.288	<0.00030	0.0026	0.00019	0.00212	0.0450	<0.00010	<0.000050	<0.010	0.00101	150	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018		0.00083	0.337	0.00560	0.0147	26.6	0.682	<0.0000050	0.000201	0.00494	<0.050	0.41	0.00108	3.71	0.000023	1.87	0.262	122	<0.000010	<0.00010	0.00044	0.00502	<0.00050	0.214	<0.00030	<0.0010	0.00015	0.00189	0.0496	<0.00010	<0.000050	<0.010	0.000811	129	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	Ice layers may affect flow. Distance between holes relatively large.	0.00056	1.00	0.0106	0.0124	25.3	1.53	<0.0000050	0.000243	0.00449	<0.050	0.39	0.00124	4.25	0.000080	1.73	0.246	121	<0.000010	<0.00010	<0.0024	0.00461	<0.00050	0.159	<0.00030	<0.0010	0.00014	0.00293	0.0577	<0.00010	<0.000050	<0.010	0.000128	148	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	Channel has lots of bends. Flow measurement Trial #2 omitted, SPC jumped to ~5500 us/cm. Flow based only on Trial #1.	<0.00050	1.07	0.00419	0.0123	24.2	1.23	<0.0000050	0.000212	0.00446	<0.050	0.40	0.00123	4.17	0.000025	3.18	0.250	126	<0.000010	<0.00010	0.00059	0.00439	<0.00050	0.149	<0.00030	0.0015	0.00016	0.00539	0.0622	<0.00010	<0.000050	<0.010	0.000291	148	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	ORP slow to stabalize	<0.00050	0.960	0.00743	0.0138	26.3	1.02	<0.0000050	0.000223	0.00444	<0.050	0.41	0.00107	3.96	0.000037	1.77	0.244	117	<0.000010	<0.00010	<0.00090	0.00478	<0.00050	0.140	<0.00030	<0.0010	0.00016	0.00737	0.0645	<0.00010	<0.000050	<0.010	0.000180	168	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	Use discharge/flow with caution, suspect data - a lot of noise on both curves, to be checked in Aquarius	0.00086	1.19	0.00857	0.0135	25.4	1.14	<0.0000050	0.000240	0.00429	<0.050	0.41	0.000999	4.31	0.000046	2.17	0.253	129	<0.000010	<0.00010	<0.0012	0.00498	<0.00050	0.121	<0.00030	0.0034	0.00017	0.00951	0.0634	<0.00010	<0.000050	<0.010	0.000229	167	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019		0.00282	3.46	0.0637	0.0133	23.0	1.38	0.0000054	0.000252	0.00556	<0.050	0.46	0.00119	4.68	0.000493	2.22	0.272	132	<0.000010	<0.00010	0.00900	0.00534	0.00093	0.216	<0.00030	<0.0010	0.00017	0.00962	0.0540	<0.00010	<0.000050	<0.010	0.000273

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	LL and Baro downloaded. Benthics and sediment collected.	0.00054	0.326	0.00250	0.0100	22.0	0.483	<0.0000050	0.000231	0.00330	<0.050	0.339	0.00126	3.32	0.000010	1.60	0.238	99.1	<0.000010	<0.00010	0.00090	0.00363	<0.00050	0.316	<0.00020	0.0042	0.00023	0.00175	0.0569	<0.000100	<0.000050	<0.010	0.00157	125	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	baro and WL logger downloaded. BL off by 3 hours, WL off by 20 min	0.00051	0.331	0.00583	0.0102	25.0	0.726	<0.0000050	0.000199	0.00395	<0.050	0.378	0.00123	3.84	0.000014	1.79	0.240	102	<0.000010	<0.00010	0.00070	0.00355	<0.00050	0.328	<0.00020	0.0026	0.00022	0.00154	0.0580	<0.000100	<0.000050	<0.010	0.00163	123	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	staff guage frozen	<0.00050	0.346	0.00354	0.0099	22.9	1.19	<0.0000050	0.000194	0.00355	<0.050	0.378	0.00138	3.99	0.000021	1.69	0.225	103	<0.000010	<0.00010	0.00062	0.00383	<0.00050	0.213	<0.00020	0.0016	0.00018	0.00294	0.0687	<0.000100	<0.000050	<0.010	0.00102	158	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	Ice at staff gauge end.	<0.00050	0.523	0.00379	0.0101	24.8	0.943	<0.0000050	0.000182	0.00314	<0.050	0.402	0.00161	4.23	0.000015	2.23	0.237	105	<0.000010	<0.00010	<0.00060	0.00365	<0.00050	0.180	<0.00020	0.0016	0.00017	0.00421	0.0742	<0.000100	<0.000050	<0.010	0.000725	144	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	Jumping SPC at peak.	<0.00050	0.647	0.00530	0.0119	24.3	0.817	<0.0000050	0.000205	0.00312	<0.050	0.435	0.00161	4.41	0.000030	1.73	0.252	118	<0.000010	<0.00010	0.00070	0.00390	<0.00050	0.160	<0.00020	0.0013	0.00018	0.00524	0.0610	<0.000100	<0.000050	<0.010	0.000575	158	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	No flow test done to limit exposure.	<0.00050	0.933	0.0130	0.0116	24.9	1.14	<0.0000050	0.000268	0.00383	<0.050	0.492	0.00161	4.29	0.000056	1.79	0.254	115	<0.000010	<0.00010	0.00090	0.00431	<0.00050	0.134	<0.00020	<0.0010	0.00018	0.00575	0.0584	<0.000100	<0.000050	<0.010	0.000319	149	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	Overflow layer, water flowing back into hole	<0.00050	0.755	0.00573	0.0112	21.9	0.783	<0.0000050	0.000204	0.00317	<0.050	0.430	0.00130	4.02	0.000027	1.54	0.262	117	<0.000010	<0.00010	0.00111	0.00380	<0.00050	0.116	<0.00020	0.0022	0.00018	0.00570	0.0550	<0.000100	<0.000050	<0.010	0.000286	143	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021		0.00052	0.918	0.00579	0.0127	23.7	0.945	<0.0000050	0.000227	0.00372	<0.050	0.456	0.00128	3.92	0.000026	1.56	0.268	118	<0.000010	<0.00010	0.00178	0.00440	<0.00050	0.129	<0.00020	<0.0010	0.00017	0.00670	0.0553	<0.000100	<0.000050	<0.010	0.000397	154	<0.00010
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	no flow test initially, just sampled with site effluent discharge	0.00240	1.59	0.0169	0.0088	16.2	0.912	<0.0000050	0.000283	0.00418	<0.050	1.15	0.000742	3.16	0.000194	2.94	0.200	88.8	<0.000010	<0.00010	0.00854	0.00225	0.00090	0.209	<0.00020	0.0084	0.00056	0.00472	0.0445	<0.000100	<0.000050	<0.010	0.00123	111	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021	Samples taken on May 5, 2021 due to KV-104C discharge																																			
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021		0.00391	1.62	0.0306	0.0071	11.1	0.739	0.0000057	0.000301	0.00463	<0.050	0.542	0.000681	2.92	0.000349	0.956	0.136	55.0	<0.000010	<0.00010	<0.0150	0.00185	0.00147	0.226	<0.00020	0.0402	0.00032	0.00406	0.0383	<0.000100	<0.000050	<0.010	0.000715	70.2	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	Steep sides, slight undercut, midsection done, staff gauge hard to read.	0.00121	0.625	0.0116	0.0100	18.9	0.510	<0.0000050	0.000374	0.00307	<0.050	0.440	0.00109	2.75	0.000104	1.36	0.204	95.5	<0.000010	<0.00010	<0.00300	0.00348	0.00068	0.231	<0.00020	0.0119	0.00042	0.00371	0.0509	<0.000100	<0.000050	<0.010	0.000899	108	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021		0.00073	0.248	0.00487	0.0144	23.9	0.454	<0.0000050	0.000304	0.00286	<0.050	0.386	0.00120	3.13	0.000012	1.96	0.245	115	<0.000010	<0.00010	0.00066	0.00452	<0.00050	0.163	<0.00020	0.0026	0.00032	0.00294	0.0554	<0.000100	<0.000050	<0.010	0.000746	137	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	No flow measurment, not good for midsection	0.00065	0.287	0.00928	0.0119	25.6	0.453	<0.0000050	0.000425	0.00289	<0.050	0.301	0.00115	2.68	0.000083	1.74	0.257	118	<0.000010	<0.00010	0.00079	0.00445	<0.00050	0.191	<0.00020	0.0027	0.00031	0.00277	0.0534	<0.000100	<0.000050	<0.010	0.000811	128	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	not ideal for measuring flow, d/s flowing in grass and u/s bend with roots and rocks.	0.00061	0.327	0.0127	0.0097	21.7	0.393	<0.0000050	0.000277	0.00256	<0.050	0.238	0.00107	2.97	0.000239	1.45	0.226	93.6	<0.000010	<0.00010	0.00060	0.00370	<0.00050	0.236	<0.00020	0.0048	0.00027	0.00251	0.0494	<0.000100	<0.000050	<0.010	0.000989	115	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	Survey, winterize	<0.00050	0.225	0.00227	0.0115	23.1	0.502	<0.0000050	0.000244	0.00320	<0.050	0.476	0.00102	3.66	0.000010	1.68	0.265	122	<0.000010	<0.00010	<0.00030	0.00420	<0.00050	0.407	<0.00020	0.0031	0.00018	0.00220	0.0579	<0.000100	<0.000050	<0.010	0.00164	145	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021		<0.00050	0.257	0.00439	0.0122	25.1	0.609	<0.0000050	0.000198	0.00336	<0.050	0.331	0.00124	3.78	0.000056	1.58	0.245	112	<0.000010	<0.00010	0.00043	0.00450	<0.00050	0.246	<0.00020	0.0017	0.00018	0.00182	0.0493	<0.000100	<0.000050	<0.010	0.000944	129	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	pH 2.60 removed, probe failure	0.00096	0.430	0.0212	0.0130	23.4	1.38	<0.0000050	0.000244	0.00391	<0.050	0.543	0.00116	4.30	0.000055	1.98	0.261	117	<0.000010	<0.00010	0.00078	0.00442	<0.00050	0.200	<0.00020	0.0019	0.00019	0.00293	0.0666	<0.000100	<0.000050	<0.010	0.000852	152	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	one flow measurement, YSI failed on second	0.00089	0.568	0.00848	0.0100	25.4	1.10	<0.0000050	0.000196	0.00380	<0.050	0.727	0.00126	4.19	0.000013	2.37	0.254	124	<0.000010	<0.00010	<0.00090	0.00434	<0.00050	0.185	<0.00020	0.0021	0.00015	0.00328	0.0590	<0.000100	<0.000050	<0.010	0.000843	155	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022	could not locate water, drilled several holes and only found mud																																			
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022		<0.00050	0.709	0.00596	0.0128	26.6	0.990	<0.0000050	0.000244	0.00325	<0.050	0.554	0.00141	4.58	0.000028	1.88	0.300	128	<0.000010	<0.00010	<0.00090	0.00516	<0.00050	0.111	<0.00020	0.0024	0.00015	0.00457	0.0572	<0.000100	<0.000050	<0.010	0.000390	156	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022		<0.00050	0.993	0.00806	0.0136	26.4	1.01	<0.0000050	0.000234	0.00327	<0.050	0.507	0.00124	4.33	0.000038	1.72	0.265	125	<0.000010	<0.00010	0.00075	0.00486	<0.00050	0.116	<0.00020	0.0011	0.00016	0.00812	0.0551	<0.000100	<0.000050	<0.010	0.000222	158	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	Ice covered	0.00162	1.84	0.0249	0.0152	26.5	1.11	<0.0000050	0.000302	0.00453	<0.050	1.09	0.00124	4.47	0.000145	3.53	0.268	120	<0.000010	<0.00010	0.00318	0.00459	<0.00050	0.185	<0.00020	0.0044	0.00037	0.00959	0.0514	<0.000100	<0.000050	<0.010	0.000451	155	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	2x salt slug, SG under ice, de-winterized logger	0.00238	0.908	0.0211	0.0039	7.83	0.529	0.0000056	0.000191	0.00311	<0.050	0.646	0.000409	2.18	0.000422	0.965	0.0897	39.3	<0.000010	<0.00010	0.00204	0.00110	<0.00050	0.238	<0.00020	0.0282	0.00029	0.00521	0.0274	<0.000100	<0.000050	<0.010	0.00116	51.6	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	Midsection flow measurement, surveyed	0.00091	0.582	0.00350	0.0080	14.3	0.514	<0.0000050	0.000305	0.00262	<0.050	0.349	0.000818	2.60	0.000013	1.09	0.174	79.4	<0.000010	<0.00010	0.00082	0.00277	<0.00050	0.230	<0.00020	0.0108	0.00025	0.00371	0.0432	<0.000100	<0.000050	<0.010	0.000799	96.4	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	DO suspect, omitted	0.00098	0.626	0.0150	0.0096	24.3	0.489	<0.0000050	0.000261	0.00290	<0.050	0.264	0.00116	2.97	0.000074	1.75	0.249	118	<0.000010	<0.00010	0.00179	0.00437	<0.00050	0.245	<0.00020	0.0026	0.00031	0.00301	0.0534	<0.000100	<0.000050	<0.010	0.000598	131	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022		0.00055	0.298	0.00550	0.0104	25.1	0.331	<0.0000050	0.000282	0.00232	<0.050	0.265	0.00125	2.86	0.000016	1.75	0.267	126	<0.000010	<0.00010	<0.00090	0.00400	<0.00050	0.196	<0.00020	0.0036	0.00026	0.00243	0.0570	<0.000100	<0.000050	<0.010	0.000840	145	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022		<0.00050	0.309	0.00209	0.0100	24.0	0.494	<0.0000050	0.000306	0.00304	<0.050	0.421	0.00104	2.80	0.000014	1.62	0.246	116	<0.000010	<0.00010	0.00058	0.00385	<0.00050	0.276	<0.00020	1.89	0.00022	0.00272	0.547	<0.000100	<0.000050	<0.010	0.00112	132	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	14-Oct-2022	Could not measure flow, lots of pooling. logger pulled@ 14:25 to ensure winterized. dl logger and baro. Direct read does not have cap	0.00079	0.422	0.00861	0.0079	22.3	0.731	<0.0000050	0.000246	0.00331	<0.050	0.456	0.00118	3.89	0.000058	1.59	0.231	109	<0.000010	<0.00010	0.00123	0.00361	<0.00050	0.603	<0.00020	0.0072	0.00028	0.00253	0.0458	<0.000100	<0.000050	<0.010	0.00294	129	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	SPC jumping. No flow measurement, stream glaciated.	0.00186	0.709	0.00951	0.0120	26.0	1.14	<0.0000050	0.000240	0.00356	<0.050	0.605	0.00124	4.37	0.000057	9.00	0.249	125	<0.000010	<0.00010	0.00132	0.00408	<0.00050	0.276	<0.00020	0.0020	0.00019	0.00520	0.0632	<0.000100	<0.000050	<0.010	0.000570	148	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2022		<0.00050	0.702	0.00278	0.0106	23.1	0.899	<0.0000050	0.000245	0.00311	<0.050	0.477	0.00112	4.14	<0.000010	1.61	0.246	117	<0.000010	<0.00010	0.00050	0.00376	<0.00050	0.128	<0.00020	<0.0010	0.00016	0.00514	0.0587	<0.000100	<0.000050	<0.010	0.000166	139	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	21-Jan-2023	No flow, glaciated	<0.00050	1.05	0.00517	0.0116	23.4	0.772	<0.0000050	0.000273	0.00306	<0.050	0.527	0.00112	4.10	0.000015	1.79	0.265	125	<0.000010	<0.00010	0.00071	0.00412	<0.00050	0.149	<0.00020	0.0016	0.00015	0.00726	0.0550	<0.000100	<0.000050	<0.010	0.000173	163	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	09-Feb-2023	Low flow	0.00061	1.59	0.0130	0.0128	25.2	0.966	<0.0000050	0.000222	0.00324	<0.050	0.530	0.00139	4.41	0.000034	1.72	0.249	128	<0.000010	<0.00010	0.00165	0.00445	<0.00050	0.153	<0.00020	<0.0010	0.00015	0.00752	0.0549	<0.000100	<0.000050	<0.010	0.0000475	152	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2023	Too shallow upstream for measuring flow	<0.00050	0.784	0.00333	0.0118	24.6	0.812	<0.0000050	0.000237	0.00299	<0.050	0.581	0.00111	4.41	0.000023	1.61	0.255	135	<0.000010	<0.00010	0.00051	0.00434	<0.00050	0.114	<0.00020	<0.0010	0.00016	0.00830	0.0569	<0.000100	<0.000050	<0.010	0.000178	155	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	20-Apr-2023	Low flow - no measurement, glaciation	0.00055	0.873	0.00964	0.0123	24.2	0.734	<0.0000050	0.000236	0.00312	0.0095	0.642	0.00115	4.06	0.000019	4.24	0.272	137	<0.000010	<0.00010	0.00074	0.00424	<0.00050	0.141	<0.00020	0.0015	0.00025	0.00741	0.0498	<0.000100	<0.000050	<0.010	0.000200	156	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2023	Flooded banks, no flow measurement. DO probe not working	0.00362	1.76	0.0403	0.0044	7.09	0.628	0.0000081	0.000266	0.00349	0.0429	0.802	0.000316	2.39	0.000577	1.75	0.0901	40.8	<0.000010	<0.00010	0.0134	0.000710	0.00139	0.311	0.00026	0.0506	0.00038	0.00471	0.0311	<0.000100	<0.000050	<0.010	0.000172	49.5	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	27-Jun-2023	DL SG, survey, de-winter, slightly turbid, SG almost out of water	0.00089	0.535	0.0104	0.0130	23.9	0.584	<0.0000050	0.000378	0.00344	0.0082	0.281	0.00105	2.65	0.000063	1.71	0.263	127	<0.000010	0.00018	0.00145	0.00420	<0.00050	0.317	<0.00020	0.0048	0.00030	0.00328	0.0578	<0.000100	<0.000050	<0.010	0.00143	147	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2023	Will return to download logger. Swoffer flow measurement.	0.00059	0.354	0.00513	0.0103	26.5	0.370	<0.0000050	0.000406	0.00238	0.0086	0.238	0.00110	2.87	0.000048	1.69	0.263	138	<0.000010	<0.00010	0.00081	0.00367	<0.00050	0.231	<0.00020	0.0101	0.00031	0.00306	0.0601	<0.000100	<0.000050	<0.010	0.00114	144	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2023		<0.00050	0.219	0.00213	0.0119	25.0	0.322	<0.0000050	0.000364	0.00226	0.0079	0.367	0.00101	3.47	<0.000010	1.75	0.272	124	<0.000010	<0.00010	0.00035	0.00418	<0.00050	0.219	<0.00020	0.0039	0.00028	0.00386	0.0568	<0.000100	<0.000050	<0.010	0.000995	149	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2023	Surveyed SG.	<0.00050	0.286	0.00248	0.0137	26.3	0.495	<0.0000050	0.000247	0.00270	<0.050	0.517	0.000892	3.48	0.000015	1.84	0.263	142	<0.000010	<0.00010	0.00070	0.00421	<0.00050	0.455	<0.00020	0.0023	0.00019	0.00288	0.0479	<0.000100	<0.000050	<0.010	0.00154	157	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	25-Oct-2023	Overflow no flow done	0.00052	0.397	0.00765	0.0114	27.2	0.901	<0.0000050	0.000251	0.00328	0.0051	0.508	0.00125	4.68	0.000320	1.82	0.259	122	<0.000010	<0.00010	0.00114	0.00450	<0.00050	0.265	<0.00020	0.0012	0.00017	0.00239	0.0632	<0.000100	<0.000050	<0.010	0.000766	157	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	20-Nov-2023		<0.00050	0.740	0.00293	0.0114	27.5	1.08	<0.0000050	0.000210	0.00288	<0.050	0.469	0.00137	4.71	0.000039	1.77	0.261	124	<0.000010	<0.00010	0.00073	0.00457	<0.00050	0.166	<0.00020	<0.0010	0.00013	0.00469	0.0665	<0.000100	<0.000050	<0.010	0.000148	143	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	10-Dec-2023		0.00054	0.927	0.00477	0.0109	25.7	1.03	<0.0000050	0.000248	0.00320	<0.050	0.492	0.00125	4.70	0.000085	1.78	0.257	118	<0.000010	<0.00010	0.00101	0.00471	<0.00050	0.192	<0.00020	0.0018	0.00016	0.00771	0.0723	<0.000100	<0.000050	<0.010	0.000522	149	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	25-Jan-2024	Unable to locate flow ds. Significant ice coverage. LL downloaded, unable to connect to Baro	<0.00050	0.781	0.00574	0.0116	27.2	0.883	<0.0000050	0.000217	0.00271	<0.050	0.437	0.00133	4.40	0.000029	1.73	0.263	119	<0.000010	<0.00010	<0.00090	0.00519	<0.00050	0.144	<0.00020	<0.0010	0.00012	0.00449	0.0646	<0.000100	<0.000050	<0.010	0.000106	135	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	16-Feb-2024	Frozen. Drilled a hole and hit slush, creek frozen to bottom																																			
KV-6	Christal Creek u/s Silver Trail Highway	29-Mar-2024	No section long enough for flow measurement without overflow. Baro would not connect via Bluetooth. Maxed out auger and poked through bottom of hole.	0.00052	1.12	0.0105	0.0163	30.3	0.956	<0.0000050	0.000243	0.00272	<0.050	0.643	0.00111	4.86	0.000083	2.16	0.274	146	<0.000010	<0.00010	0.00101	0.00474	<0.00050	0.157	<0.00020	<0.0010	0.00020	0.0104	0.0560	<0.000100	<0.000050	<0.010	0.000354	178	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	21-Apr-2024	Lots of ice, but good flow underneath. Auger hole from last month was not frozen over	0.00078	1.25	0.0140	0.0143	24.8	1.12	<0.0000050	0.000287	0.00417	<0.050	0.996	0.000863	4.15	0.000073	2.18	0.266	142	<0.000010	<0.00010	<0.00180	0.00400	<0.00050	0.197	<0.00020	0.0019	0.00036	0.00996	0.0492	<0.000100	<0.000050	<0.010	0.000937	159	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	28-Apr-2024	Mostly ice covered with few open spots. Unable to connect with baro logger	0.00184	1.56	0.0357	0.0094	16.9	1.11	<0.0000050	0.000253	0.00441	<0.050	1.02	0.000596	3.31	0.000285	1.48	0.191	96.9	<0.000010	<0.00010	<0.00510	0.00278	0.00059	0.436	<0.00020	0.0067	0.00037	0.00945	0.0425	<0.000100	<0.000050	<0.010	0.00307	115	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	08-May-2024	Clear water. Too much ice for midsection but some open sections. Ice partially melted around staff gauge enough to get rough water level measurement. Could not connect to baro logger	0.00124	1.33	0.0126	0.0084	16.8	0.982	<0.0000050	0.000332	0.00463	<0.050	0.836	0.000610	3.33	0.000125	1.24	0.186	98.8	<0.000010	<0.00010	<0.00300	0.00277	<0.00050	0.145	<0.00020	0.0063	0.00024	0.00789	0.0476	<0.000100	<0.000050	<0.010	0.000424	117	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	13-May-2024	Did flow mid section d/s of staff gauge, 50 m u/s from road - only suitable section.Dewinterised levelogger at 14:00, could not connect to barologger. Started snowing halfway through flow measurement.	0.00081	1.04	0.00734	0.0119	19.8	0.989	<0.0000050	0.000294	0.00421	<0.050	0.798	0.000740	3.68	0.000076	1.44	0.217	110	<0.000010	<0.00010	<0.00300	0.00371	<0.00050	0.187	<0.00020	0.0052	0.00025	0.00461	0.0488	<0.000100	<0.000050	<0.010	0.000581	129	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	22-May-2024	SG approx 5.1 cm out of water. Midsection flow measurement. Some snow on banks but channel is thawed. Logger download. Found base plate of wading rod. Unable to connect to baro.	0.00056	0.767	0.00404	0.0104	19.6	0.739	<0.0000050	0.000264	0.00328	<0.050	0.664	0.000968	3.58	0.000111	1.47	0.218	107	<0.000010	<0.00010	<0.00150	0.00375	<0.00050	0.229	<0.00020	0.0029	0.00023	0.00318	0.0475	<0.000100	<0.000050	<0.010	0.000781	123	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	29-May-2024	Water clear, stage is down from 2 weeks ago. No ice present, stage is below staff gauge.	0.00106	0.877	0.0184	0.0112	20.5	0.991	<0.0000050	0.000324	0.00394	<0.050	0.664	0.000595	3.08	0.000123	1.57	0.221	117	<0.000010	<0.00010	<0.00240	0.00335	<0.00050	0.502	<0.00020	0.0062	0.00029	0.00334	0.0460	<0.000100	<0.000050	<0.010	0.000960	130	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2024	SG out of water by about 20 cm. Downloaded logger. Midsection flow measurement. Surveyed. Could not connect to baro. Muddy stream bottom noted during midsection.	<0.00050	0.269	0.00193	0.0111	23.5	0.392	<0.0000050	0.000277	0.00241	<0.050	0.477	0.000998	2.80	<0.000010	1.66	0.247	111	<0.000010	<0.00010	<0.00030	0.00488	<0.00050	0.214	<0.00020	0.0023	0.00027	0.00240	0.0563	<0.000100	<0.000050	<0.010	0.000774	140	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2024	Site good, new sg looks good, see sg offset from survey earlier today	0.00051	0.306	0.00589	0.0110	28.3	0.318	<0.0000050	0.000294	0.00238	0.0079	0.243	0.000947	3.18	0.000032	1.69	0.262	129	<0.000010	<0.00010	<0.00060	0.00597	<0.00050	0.247	<0.00020	0.0031	0.00026	0.00352	0.0573	<0.000100	<0.000050	<0.010	0.00106	144	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	08-Aug-2024	Aquatics: Benthics, sediment, fishing.	0.00082	0.645	0.0170	0.0113	28.0	0.286	<0.0000050	0.000288	0.00228	<0.050	0.298	0.00114	3.75	0.000097	1.79	0.250	128	<0.000010	<0.00010	0.00224	0.00563	<0.00050	0.231	<0.00020	<0.0010	0.00029	0.00410	0.0574	<0.000100	<0.000050	<0.010	0.000517	143	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	05-Sep-2024	Logger winterized	<0.00050	0.240	0.00245	0.0120	26.4	0.438	<0.0000050	0.000218	0.00254	<0.050	0.378	0.000938	3.81	0.000015	1.93	0.249	122	<0.000010	<0.00010	<0.00030	0.00465	<0.00050	0.406	<0.00020	0.0026	0.00019	0.00302	0.0465	<0.000100	<0.000050	<0.010	0.00139	134	<0.00050
KV-6	Christal Creek u/s Silver Trail Highway	09-Oct-2024	Winterized logger, retrieved dropped logger	<0.00050	0.189	0.00218	0.0112	25.7	0.470	<0.0000050	0.000205	0.00275	0.0029	0.347	0.00

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011	dry																																		
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012	dry																																		
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012	No water observed																																		
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012	No water observed																																		
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012	No water observed																																		
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	braided, iced over - no flow measurements; no YSI for insitu	0.00154	0.0984	0.000419	0.00182	10.8	0.0437	<0.000010	<0.000050	0.0013	0.0169	0.585	0.000123	1.59	0.00001	0.774	0.155	81	<0.0000020	<0.00020	<0.00050	0.00002	<0.00020	0.0333	0.00011	0.0502	0.000114	0.000443	0.0764	<0.000010	<0.0000050	<0.050	0.000298	83.6	0.00011
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	High water flowing through bushes.	0.000874	0.02	0.000469	0.002	10.3	0.00272	<0.000010	<0.000050	0.000888	0.0044	0.196	0.000254	1.79	0.0000131	0.785	0.14	83	<0.0000020	<0.00020	<0.00050	0.0000086	<0.00020	0.0212	<0.00010	0.0208	0.000123	0.000309	0.0421	<0.000010	<0.0000050	<0.050	0.000113	68.2	<0.00010
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012	water clear; flow measurement not possible; dispersed throughout moss and water holes; flow not observed; no continuous channel	0.00149	0.246	0.00806	0.0017	17.7	0.0311	<0.000010	<0.000050	0.00161	0.0197	0.077	0.000098	3.38	0.0000329	1.21	0.217	134	0.0000028	<0.00020	0.00106	0.0000153	<0.00020	0.0499	<0.00010	0.0181	0.000116	0.000264	0.0478	<0.000010	<0.0000050	<0.050	0.000373	122	<0.00010
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012	Flow measurement not possible. Tiny flow through moss but mainly puddles of water.	0.00103	0.114	0.00125	0.00147	16.6	0.00518	<0.000010	<0.000050	0.00126	0.0029	<0.050	0.000109	2.94	0.000008	1.16	0.22	118	<0.0000020	<0.00020	<0.00050	0.000012	<0.00020	0.0348	<0.00010	0.0147	0.000135	0.00023	0.0425	<0.000010	<0.0000050	<0.050	0.000335	116	<0.00010
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012	No Flow measurement possible.Too wide + flowing through moss and willows. Flow higher than August flow. Rain the day before.	0.000595	0.0225	0.000176	0.00125	16.9	0.00396	<0.000010	<0.000050	0.000825	0.0041	0.13	0.000103	2.72	<0.0000050	1.2	0.2	120	<0.0000020	<0.00020	<0.00050	0.000004	<0.00020	0.0234	<0.00010	0.0101	0.000109	0.00014	0.0332	<0.000010	<0.0000050	<0.050	0.000294	115	<0.00010
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012	ORP not taken as it was unstable, flow unsuitable for salt slug or metering	0.00145	0.699	0.00747	<0.0025	34.8	0.0632	<0.000050	0.00096	0.00255	0.014	0.26	<0.00020	3.87	<0.000025	1.96	0.43	271	<0.000010	<0.0010	<0.0025	0.000035	<0.0010	0.0585	<0.00050	0.0096	0.00014	<0.00010	0.0585	<0.000050	<0.000025	<0.25	0.000615	238	<0.00050
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012	No water observed.																																		
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012	No water obseved. Seems to be frozen to the ground.																																		
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013	No water found. Frozen to the ground.																																		
KV-49	Hinton Creek upstream Christal Creek	03-May-2013	Frozen to the ground.																																		
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013	Puddles of water. May be a tiny flow through mosses but hard to tell. Saturated moss.Cannot get a flow reading.	0.00186	0.128	0.00127	0.00178	16.8	0.0204	<0.000010	<0.000050	0.00144	<0.050	<0.10	<0.00010	2.76	<0.000010	0.936	0.220	113	<0.000010	0.00012	<0.010	<0.000010	<0.0010	0.0458	<0.00080	0.0207	0.00013	0.00024	0.0560	<0.00010	<0.00050	<0.010	0.000533	120	<0.00010
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	Very little flow.	0.00084	0.037	0.000327	0.00073	13.9	0.00474	<0.000010	<0.000050	0.00152	<0.050	<0.10	0.00012	3.40	<0.000010	0.901	0.152	82.5	<0.000010	<0.00010	<0.010	<0.000010	<0.0010	0.0224	<0.00080	0.0193	0.00013	0.00020	0.0268	<0.00010	<0.00050	<0.010	0.000325	92.6	0.00010
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014	frozen to the ground, no water found.																																		
KV-49	Hinton Creek upstream Christal Creek	06-May-2014	Cannot get flow, water running thhrough branches in different channels.	0.00344	0.132	0.00103	0.00100	1.72	0.0594	0.000013	<0.000050	0.00158	<0.050	0.48	0.00015	1.48	0.000055	0.309	0.0263	8.03	<0.000010	<0.00010	<0.010	0.000038	<0.0010	0.0185	<0.00080	0.176	0.00016	0.00053	0.0220	<0.00010	<0.00050	<0.010	0.000242	14.2	0.00037
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014	Puddles of water flowing through mosses; cannot measure flow. Water is clear.	0.00167	0.934	0.00261	0.00177	9.18	0.0213	<0.000010	<0.000050	0.00102	<0.050	<0.10	0.00015	2.44	0.000020	0.778	0.126	60.5	<0.000010	<0.00010	<0.010	0.000018	<0.0010	0.0258	<0.00080	0.0196	0.00013	0.00018	0.0390	<0.00010	<0.00050	<0.010	0.000268	73.5	<0.00010
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014	Frozen to the gound.																																		
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015	No water observed, frozen to the ground.																																		
KV-49	Hinton Creek upstream Christal Creek	12-May-2015	Could not meter very braided and could not run salt dilution	0.00225	0.096	0.000469	0.0019	2.94	0.0787	0.0000305	<0.000050	0.00126	<0.050	0.52	0.000105	1.23	0.000054	0.345	0.0533	21.8	<0.000010	<0.00010	0.00103	0.000025	<0.00050	0.0224	<0.00030	0.137	0.00011	0.00041	0.0372	<0.00010	<0.000050	<0.010	0.000230	25.3	0.00028
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015	No flowing water, only stagnant, did not sample or gauge flow																																		
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015	No moving water present																																		
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016	Searched extensively, no water found																																		
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	Multiple channels, no flow conducted.	0.00140	0.047	0.000126	0.0030	7.19	0.0113	0.0000051	<0.000050	0.00095	<0.050	0.27	0.000132	1.79	0.000014	0.547	0.108	52.2	<0.000010	<0.00010	0.00045	0.000013	<0.00050	0.0162	<0.00030	0.0527	0.00011	0.00032	0.0562	<0.00010	<0.000050	<0.010	0.0000760	65.2	0.00012
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016	No way to accurately gauge flow, no flow conducted	0.00074	0.011	<0.000050	0.0014	13.6	0.00123	<0.0000050	<0.000050	0.00069	<0.050	<0.10	0.000275	2.80	<0.000010	0.880	0.174	87.4	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	0.0169	<0.00030	0.0114	0.00013	0.00021	0.0420	<0.00010	<0.000050	<0.010	0.000182	99.5	<0.00010
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016	Site frozen to ground																																		
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017	Frozen. Chipped around area, no water found.																																		
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	Conditions not conducive to measuring flow, water spread out and flowing through willows and moss.	0.00212	0.086	0.000255	0.0021	3.22	0.0235	0.0000102	<0.000050	0.00114	<0.050	0.28	0.000184	1.41	0.000034	0.400	0.0524	20.8	<0.000010	<0.00010	0.00117	0.000026	<0.00050	0.0180	<0.00030	0.150	0.00011	0.00033	0.0314	<0.00010	<0.000050	<0.010	0.000118	24.3	0.00025
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017	Wet moss but not enough water to sample.																																		
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017		0.00109	0.310	0.000827	<0.0010	19.4	0.0182	<0.000025	0.000099	0.00095	<0.050	<0.10	0.000170	3.69	<0.000010	1.22	0.217	115	<0.000010	<0.00010	<0.0012	0.000018	<0.00050	0.0260	<0.00030	0.0093	0.00018	0.00018	0.0389	<0.00010	<0.000050	<0.010	0.000329	113	<0.00010
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018	Dry, frozen with overflow ice																																		
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	No flow measurements, water running through willows (very braided)	0.00267	0.118	0.000335	0.0026	3.14	0.0376	0.0000108	<0.000050	0.00134	<0.050	0.42	0.000124	1.53	0.000038	0.443	0.0548	21.7	<0.000010	<0.00010	0.00188	0.000031	<0.00050	0.0286	<0.00030	0.172	0.00013	0.00043	0.0295	<0.00010	<0.000050	<0.010	0.000236	26.5	0.00021
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	Lots of water running through willow no defined channel, not possible to measure flow.	0.00115	0.026	0.000117	0.0026	9.45	0.00130	<0.0000050	<0.000050	0.00100	<0.050	0.19	0.000337	1.89	<0.000010	0.678	0.159	72.7	<0.000010	<0.00010	<0.00039	<0.000010	<0.00050	0.0251	<0.00030	0.0321	0.00012	0.00020	0.0661	<0.00010	<0.000050	<0.010	0.000202	75.1	0.00013
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	No flow water very stagnant, willows enchroaching. DO seems to be working, probe in vertical position. Forgot temp, probably quite a bit higher than KV-50	0.00103	0.044	0.000269	0.0017	11.5	0.00293	<0.0000050	0.000070	0.00104	<0.050	<0.10	0.000126	2.53	<0.000010	0.870	0.146	70.7	<0.000010	<0.00010	0.00042	0.000012	0.00052	0.0306	0.00147	0.0137	0.00017	0.00020	0.0538	<0.00010	<0.000050	<0.010	0.000235	70.8	<0.00010
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	Unable to measure flow. No good across channel for MMB flow meter and not flowing quick enough. Looks like water is sitting still	0.00080	0.079	0.000192	0.0014	12.2	0.00388	<0.0000050	0.000094	0.00072	<0.050	0.11	0.000145	2.70	<0.000010	0.862	0.148	74.1	<0.000010	<0.00010	0.00031	0.000019	<0.00050	0.0144	<0.00030	0.0104	0.00014	0.00016	0.0441	<0.00010	<0.000050	<0.010	0.000218	82.2	<0.00010
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018	Frozen solid, no flowing water.																																		
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019	Frozen, dry																																		
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	no discharge measurement. Water is dispersed everywhere.	0.00161	0.047	0.000134	0.0027	4.29	0.0135	0.0000060	<0.000050	0.00089	<0.050	0.20	0.000231	1.64	0.000017	0.451	0.0692	31.7	<0.000010	<0.00010	<0.00090	0.000019	<0.00050	0.0145	<0.00030	0.0896	0.00012	0.00030	0.0309	<0.00010	<0.000050	<0.010	0.0000646	39.9	0.00020
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	Site not suitable for measuring flow. Surrounded by tall grass/willows and not visibly flowing.	0.00074	0.014	<0.000050	0.0019	13.2	0.00138	<0.0000050	0.000064	0.00092	<0.050	<0.10	0.000220	2.52	<0.000010	0.941	0.167	93.3	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	0.0137	<0.00030	0.0120	0.00013	0.00019	0.0420	<0.00010	<0.000050	<0.010	0.0000655	83.2	<0.00010
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019	Dry - soil wet but no stream flow.																																		
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019	no sample - too many willows. Water is stagnant - see photos																																		
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020	frozen dry																																		
KV-49	Hinton Creek upstream Christal Creek	07-May-2020	No sample taken - creek is dry or cannot be found under the ice and snow																																		
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020	Found flowing did not take sample - only insitu - very braided.																																		
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020		0.00988	0.026	<0.000050	0.0012	6.29	0.00138	<0.0000050	0.000087	0.00108	<0.050	<0.100	0.000233	2.54	<0.000010	0.512	0.0775	27.5	<0.000010	<0.00010	<0.00030	0.000016	<0.00050	0.0111	<0.00020	0.0286	0.00018	0.00030	0.0307	<0.000100	<0.000050	<0.010	0.000118	46.5	0.00025
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020	frozen																																		
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021	Frozen																																		
KV-49	Hinton Creek upstream Christal Creek	07-May-2021		0.00222	0.221	0.00542	<0.0010	1.31	0.0494	0.0000064	0.000082	0.00102	<0.050	0.738	0.000111	1.09	0.000156	0.188	0.0187	3.42	<0.000010	<0.00010	<0.00630	0.000040	0.00067	0.0192	0.00021	0.0937	0.00012	0.00049	0.0126	<0.000100	<0.000050	<0.010	0.000150	9.27	<0.00050
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021	Dry																																		
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021	Frozen, see pictures																																		
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022	Dry/Frozen																																		
KV-49	Hinton Creek upstream Christal Creek	15-May-2022	no flow measurement	0.00272	0.072	0.000458	0.0013	2.34	0.0318	0.0000096	0.000082	0.00109	<0.050	0.393	0.000214	1.76	0.000034	0.344	0.0316	3.99	<0.000010	<0.00010	0.00070	0.000043	<0.00050	0.0128	0.00023	0.0942	0.00015	0.00054	0.0198	<0.000100	<0.000050	<0.010	0.000128	13.7	<0.00050
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022		0.00157	0.035	0.00113	<0.0010	6.45	0.00383	<0.0000050	0.000152	0.00093	<0.050	<0.100	0.000156	3.20	<0.000010	0.655	0.0836	14.4	<0.000010	<0.00010	<0.00060	0.000031	<0.00050	0.0129	<0.00020	0.0152	0.00016	0.00029	0.0524	<0.000100	<0.000050	<0.010	0.000101	36.9	<0.00050
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022	Seep is dry/frozen																																		
KV-49	Hinton Creek upstream Christal Creek	09-Feb-2023	Dry																																		
KV-49	Hinton Creek upstream Christal Creek	12-May-2023	could not locate water																																		
KV-49	Hinton Creek upstream Christal Creek	14-Jul-2023	Peservative lost from dissolved nutrients bottle (small spill). Ysi unit C. No flow at site.	0.00109	0.022	0.000063	<0.0010	6.17	0.00093	<0.0000050	0.000125	0.00088	0.0029	<0.100	0.000205	3.34	<0.000010	0.500	0.0796	11.4	<0.000010	<0.00010	<0.00030	0.000026	<0.00050	0.0083	<0.00020	0.0203	0.00015	0.00033	0.0579	<0.000100	<0.000050	<0.010	0.0000913	35.3	<0.00050
KV-49	Hinton Creek upstream Christal Creek	25-Oct-2023	Dry																																		
KV-49	Hinton Creek upstream Christal Creek	16-Feb-2024	Creek was dry																																		
KV-49	Hinton Creek upstream Christal Creek	28-Apr-2024	Small very clear stream. Possibly runoff, but continuous through low willows.	0.00168	0.055	0.00109	<0.0010	2.00	0.0366	0.0000071	0.000051	0.00085	<0.050	0.845	0.000144	1.12	0.000030	0.289	0.0238	3.96	<0.000010	<0.00010	0.00039	0.000030	<0.00050	0.0132	<0.00020	0.0541	0.00012	0.00064	0.0175	<0.000100	<0.000050	<0.010	0.000158	10.8	<0.00050
KV-49	Hinton Creek upstream Christal Creek	08-May-2024	Very clear water in shallow stream. Sampled at old pink flag	0.00241	0.056	0.000179	<0.0010	3.37	0.00616	<0.0000050	0.000090	0.00102	<0.050	0.332	0.000411	2.53	0.000031	0.464	0.0395	5.49	<0.000010	<0.00010	0.00059	0.000042	<0.00050	0.0050	<0.00020	0.0643	0.00016	0.00050	0.0263	<0.000100	<0.000050	<0.010	0.0000260	18.0	<0.00050
KV-49	Hinton Creek upstream Christal Creek	13-May-2024	Flowing clear for now, looks ephemeral may dry up by next visit	0.00145	0.041	0.000080	0.0013	5.26	0.00714	<0.0000050	0.000133	0.00076	<0.050	0.285	0.000494	2.79	<0.000010	0.523	0.0592	6.80	<0.000010	<0.00010	0.00030	0.000157	<0.00050	0.0034	<0.00020	0.0249	0.00016	0.00044	0.0354	<0.000100	<0.000050	<0.010	0.0000218	26.2	<0.00050
KV-49	Hinton Creek upstream Christal Creek	22-May-2024	Lots of channels and pools. Not suitable for flow. Sampled in section with flowing/moving water. Water is clear. Shallow with leafy creek bottom.	0.00162	0.045	0.000080	0.0011	3.85	0.00586	<0.0000050	0.000142	0.00070	<0.050	0.124	0.000355	2.70	<0.000010	0.451	0.0474	4.35	<0.000010	<0.00010	0.00041	0.000045	<0.00050	0.0032	<0.00020	0.0320	0.00018	0.00046	0.0303	<0.000100	<0.000050	<0.010	0.0000213	20.3	<0.00050
KV-49	Hinton Creek upstream Christal Creek	29-May-2024	Flowing low and clear, ephemeral	0.00174	0.034	<0.000050	<0.0010	3.98	0.00050	<0.0000050	0.000146	0.00083	<0.050	<0.100	0.000355	2.53	<0.000010	0.447	0.0464	5.52	<0.000010	<0.00010	0.00032	0.000035	<0.00050	0.0039	<0.00020	0.0353	0.00017	0.00040	0.0306	<0.000100	<0.000050	<0.010	0.0000274	20.9	<0.00050
KV-49	Hinton Creek upstream Christal Creek	07-Jul-2024	Stagnant marsh, no visibly flowing water.	0.00125	0.026	<0.000050	<0.0010	6.13	0.00024	<0.0000050	0.000150	0.00092	0.0045	<0.100	0.000183	3.26	<0.000010	0.459	0.0722	9.01	<0.000010	<0.00010	<0.00030	0.000035	<0.00050	0.0058	<0.00020	0.0217	0.00017	0.00034	0.0527	<0.000100	<0.000050	<0.010	0.0000568	29.8	<0.00050
KV-49	Hinton Creek upstream Christal Creek	09-Oct-2024	Thick ice on top of nearly stagnant water. Will be frozen to bottom next month	0.00121	0.208	0.00107	<0.0010	8.06	0.00876	<0.0000050	0.000152	0.00085	0.0054	<0.050	0.000179	3.94	0.000010	0.586	0.0935	12.0	<0.000010	<0.00010	0.00161	0.000102	<0.00050	0.0112	<0.00020	0.0140	0.00017	0.00033	0.0544	<0.000100	<0.000050	<0.010	0.000136	40.9	<0.00050
KV-50	Christal Creek upstream Hinton Creek	18-May-2008		0.003	1.4	0.0006	0.004	5.8	0.168		<0.001	0.0028		<0.4	<0.0002	2.31	0.00004	0.5	0.067	20.4	<0.00005	<0.001	0.0125	0.0006	0.0006	0.061	<0.001	0.135		0.0017	0.019	<0.0001	<0.0005	<0.002	0.00016	32	0.0005
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008		<0.001	0.39	<0.0001	0.016	24.8	0.238		<0.001	0.0071		<0.4	0.0006	3.77	<0.00001	1.4	0.259	96.9	<0.00005	<0.001	0.0105	0.0037	<0.0001	0.148	<0.001	0.006	0.0012	0.0013	0.035	<0.0001	<0.0005	<0.002	0.0003	122	<0.0005
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008		0.004	3.01	0.002	0.009	16.7	0.302		0.00023	0.006	0.035	0.4	0.0007	4.68	0.00004	1.15	0.165		0.00003	<0.0001	0.0152	0.0022	0.0014	0.133	0.0005	0.033	0.0008	0.0022	0.03	<0.00004		<0.004	0.00028	87.1	0.0005
KV-50	Christal Creek upstream Hinton Creek	28-May-2009		0.00184	1.62	0.00112	0.0077	11.2	0.293	<0.00001	0.00019	0.00391	0.027	0.26	0.00034	2.94	0.000008	0.7	0.12	49	0.000014	<0.00001	0.0043	0.0017	0.0003	0.0885	0.0002	0.0465	0.00024	0.00338	0.0276	<0.00001	0.000008	<0.05	0.000279	65.5	0.0002
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009		0.00117	1.01	0.00115	0.0172	26.1	0.413	<0.00001	0.0002	0.00532	0.014	0.38	0.0004	4.28	0.00001	1.42	0.266	117	0.000014	<0.00001	0.0031	0.00553	0.0002	0.147	<0.0001	0.0039	0.00033	0.00311	0.0414	<0.00001	<0.000005	<0.05	0.000505	154	0.0002
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009		0.0668	50.8	0.119	0.0368	29.9	2.94		0.00197	0.0689		0.97	0.00041	14.5	0.000036	1.29	0.305	133	0.0002	0.00004	0.25	0.00608	0.0365	0.669	0.0022	0.0122	0.00061	0.0189	0.0277	<0.00001	<0.000005	<0.05	0.000023	171	0.0003
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010		0.00093	2.57	0.00109	0.024	25.9	1.32	<0.00001	0.00022	0.00776	0.019	0.34	0.00025	3.84	0.000006	1.26	0.267	143	0.000012	<0.00001	0.0022	0.00184	0.0002	0.106	<0.0001	0.0036	0.00023	0.0121	0.0257	<0.00001	<0.000005	<0.05	0.000206	175	0.0004
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010		0.00474	4.32	0.00319	0.0236	25.9	1.66	<0.00001	0.00037	0.0137		0.39	0.00021	4.17	0.000009	1.43	0.248	156	0.000032	<0.00001	0.0101	0.00412	0.0011	0.256	<0.0001	0.0049	0.00017	0.0135	0.021	<0.00001	<0.000005	<0.05	0.00015	166	0.0003
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011	no water found																																		
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011	no sample; ice axed but water not found																																		
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011	axing attempted. Water not found																																		

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-50	Christal Creek upstream Hinton Creek	26-May-2011	widely dispersed flow. Flow not taken	0.00047	2.79	0.000573	0.0185	22.5	1.23	<0.00001	0.00017	0.00848	0.014	0.35	0.00017	4.03	0.000007	1.19	0.217	136	0.000007	<0.00001	0.0007	0.00176	<0.0002	0.133	<0.0001	0.0075	0.00017	0.0148	0.0284	<0.00001	<0.000005	<0.05	0.000215	159	0.0003
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	flow not taken. Dispersed	0.00186	5.77	0.00198	0.0235	33.9	1.69	<0.00001	0.00018	0.0125	0.06	0.43	0.00035	5.27	0.000018	2.31	0.306	187	0.000018	0.00001	0.0062	0.00301	0.0005	0.196	<0.0001	0.0015	0.00019	0.0131	0.0284	<0.00001	<0.000005	<0.05	0.000283	201	0.0002
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011	not visited. No helper/lack of time																																			
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011	flow est 20 l/s	0.0036	2.86	0.00208	0.0084	10.5	0.425	<0.00001	0.00036	0.0069	0.06	<0.3	0.00093	5.1	0.000039	1	0.148	<50	0.00005	<0.0002	0.019	0.00042	0.0017	0.078	0.0002	0.0274	0.00064	0.0124	0.0385	<0.00001	<0.000005	<0.05	0.000806	65.2	0.0003
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011	most turbid DC has seen water here. flows with Marsh McB	0.0331	23	0.0327	0.0363	30.4	2.15	0.00003	0.00177	0.0313	0.44	1.2	0.00071	14.1	0.000484	1.7	0.295	152	0.000116	0.0003	0.192	0.00353	0.02	0.261	0.0012	0.0036	0.00038	0.0189	0.0254	<0.00001	<0.000005	<0.05	0.000016	190	0.0002
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011		0.00523	7.6	0.00758	0.0243	33.8	2.2	<0.00001	0.0003	0.0178	0.09	0.47	0.00027	5.1	0.000006	1.71	0.308	194	0.000027	0.00028	0.0201	0.00243	0.0022	0.205	<0.0001	0.0596	0.00024	0.0281	0.0205	<0.00001	<0.000005	<0.05	0.000108	204	0.0001
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011	Salt Slug; Conductivity probe malfunction in cold	0.00227	6.25	0.00218	0.033	34.7	2.14	<0.000020	0.00029	0.0169	0.045	0.47	0.00027	5	0.000033	1.71	0.299	187	0.00002	0.00006	0.0076	0.00244	0.0008	0.19	<0.0001	0.0016	0.00019	0.0251	0.021	<0.00001	<0.000005	<0.05	0.000154	211	0.0002
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011	Conditions not condusive to measuring flow	0.00094	4.82	0.00222	0.0339	34.3	2.46	<0.00001	0.00025	0.0173	0.017	0.4	0.00029	4.3	0.000016	1.72	0.31	189	0.000018	<0.00001	0.0024	0.00217	<0.0002	0.204	<0.0001	0.001	0.00019	0.0242	0.0223	<0.00001	<0.000005	<0.05	0.000196	209	<0.0001
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012	Salt slug.	0.00053	5.09	0.000535	0.0343	32.2	2.21	<0.00001	0.00023	0.0157	0.029	0.4	0.00031	4.9	<0.000005	1.52	0.291	227	0.000015	<0.0002	0.0017	0.00202	<0.0002	0.193	<0.0001	0.001	0.00016	0.0283	0.0211	<0.00001	<0.000005	<0.05	0.000212	220	<0.0001
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012	Condition not condusive to measure flow.	0.0004	5.18	0.000878	0.0332	32.1	2.22	<0.00001	0.00021	0.0164	0.023	0.4	0.00026	4.1	<0.000005	1.52	0.293	185	0.000016	<0.0002	0.001	0.00214	<0.0002	0.202	<0.0001	0.0015	0.00012	0.0244	0.0213	<0.00001	<0.000005	<0.05	0.0002	220	<0.0001
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012	Salt Slug	0.00049	5.33	0.00066	0.035	35.6	2.4	<0.000010	0.00021	0.017	0.032	0.45	0.00022	4.5	<0.000005	1.78	0.291	218	0.000014	<0.0002	0.0015	0.00167	<0.0002	0.211	<0.0001	0.0007	0.00012	0.0271	0.0209	<0.00001	<0.000005	<0.05	0.000182	210	<0.0001
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012	Salt Slug	0.00157	5.71	0.00498	0.0345	34.1	2.38	<0.00001	0.00018	0.0191	0.028	0.54	0.00021	4.3	<0.000005	1.89	0.294	204	0.000013	<0.0002	0.0009	0.00199	<0.0002	0.219	<0.0001	0.0014	0.00014	0.0265	0.0208	<0.00001	<0.000005	<0.05	0.000244	218	<0.0001
KV-50	Christal Creek upstream Hinton Creek	03-May-2012	no YSI for insitu	0.0211	3.8	0.00365	0.0151	19.1	1.31	0.00001	0.000225	0.0104	0.0477	0.445	0.00009	2.94	0.000017	1.14	0.168	105	0.000014	0.00126	0.00394	0.00115	0.00037	0.135	0.00018	0.0241	0.000224	0.0159	0.0195	<0.000010	<0.0000050	<0.050	0.000149	115	<0.00010
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012	Red mud in creek bed.	0.00131	4.81	0.00152	0.0357	36.3	2.47	<0.000050	<0.00025	0.0166	0.027	0.4	0.00031	3.8	<0.000025	1.87	0.317	210	0.000014	<0.0010	0.0041	0.00255	<0.0010	0.226	<0.00050	0.005	0.00018	0.0226	0.0222	<0.000050	<0.000025	<0.25	0.00015	185	<0.00050
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012	water turbid but less than KV-51; orange mud; foam	0.00113	3.94	0.000947	0.0332	33.1	2.15	<0.000010	0.000296	0.0152	0.032	0.375	0.000323	4.85	0.0000179	1.82	0.297	185	0.0000133	<0.00020	0.0032	0.00221	0.00032	0.169	<0.00010	0.00156	0.000236	0.0169	0.026	0.000011	<0.0000050	<0.050	0.0000934	204	<0.00010
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012	Water turbid, creek bed reddish. Lots of branches making flow reading difficult.	0.00105	4.22	0.00114	0.0329	33.5	2.18	<0.000010	0.000241	0.0163	0.019	0.375	0.000438	5.04	0.000005	1.69	0.314	190	0.000017	<0.00020	0.00364	0.00217	0.00031	0.17	<0.00010	0.00295	0.000212	0.0163	0.0249	<0.000010	<0.0000050	<0.050	0.000107	205	<0.00010
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012	Water turbid + red mud on creek bed.	0.000881	4.55	0.00137	0.0301	27.7	1.84	<0.000010	0.000243	0.0144	0.0174	0.333	0.000299	3.9	0.00001	1.39	0.29	165	0.000013	<0.00020	0.0024	0.00193	<0.00020	0.159	<0.00010	0.00831	0.00024	0.018	0.0245	<0.000010	<0.0000050	<0.050	0.000162	182	<0.00010
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012	Flow measurements at 11:41.	0.00109	4.77	0.000875	0.0344	29.9	2.15	<0.000010	0.000347	0.0169	0.0186	0.394	0.000283	4.65	<0.0000050	1.47	0.31	211	0.000016	<0.00020	0.00331	0.00226	<0.00020	0.169	<0.00010	0.00215	0.00021	0.0182	0.0234	<0.000010	<0.0000050	<0.050	0.000099	199	<0.00010
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012	YSI conductivity not working, flow reading not possible.	0.00138	5.11	0.00106	0.0299	31.9	2.08	<0.000010	0.000243	0.0161	0.0203	0.479	0.000307	3.96	<0.0000050	1.76	0.288	189	0.000021	<0.00020	0.00246	0.00238	<0.00020	0.201	<0.00010	0.0021	0.000235	0.021	0.0232	<0.000010	<0.0000050	<0.050	0.000287	199	<0.00010
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012	Got pH in Lab at the end of the day. ORP probe not working. Salt slug discharge measurement not available - meter error.	0.00068	4.76	0.00289	0.0295	31	2.07	<0.000010	0.00022	0.0165	0.0172	0.419	0.00031	3.77	0.000011	1.62	0.3	196	0.000018	<0.00020	0.00151	0.00267	<0.00020	0.206	0.00014	0.00183	0.000172	0.021	0.0225	<0.000010	<0.0000050	<0.050	0.000263	184	<0.00010
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013		0.00034	4.74	0.00058	0.0362	31.5	2.23	<0.000010	0.00022	0.0165	0.0141	0.389	0.000289	4.33	<0.0000050	1.59	0.31	177	0.000013	<0.00020	0.00097	0.00208	<0.00020	0.208	<0.00010	0.00165	0.000131	0.0224	0.0202	<0.000010	<0.0000050	<0.050	0.000182	192	<0.00010
KV-50	Christal Creek upstream Hinton Creek	03-May-2013	Cannot salt slug, too many pools + debris.	0.00199	7.76	0.00768	0.0493	36.1	2.87	<0.000010	0.000325	0.0212	<0.050	0.53	0.00018	5.31	0.000097	1.71	0.372	197	0.000028	<0.00010	0.013	0.00282	0.0012	0.271	<0.00080	0.0023	0.00019	0.0228	0.0208	<0.00010	<0.00050	<0.010	0.000189	226	<0.00010
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013	Water little turbid.	0.00190	5.32	0.00317	0.0315	36.4	2.23	<0.000010	0.000249	0.0171	<0.050	0.47	0.00031	4.93	0.000032	1.91	0.308	174	0.000021	<0.00010	0.013	0.00337	<0.0010	0.201	<0.00080	0.0016	0.00022	0.0147	0.0255	<0.00010	<0.00050	<0.010	0.000167	197	<0.00010
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013	water clear, orange/brown sediments, brown/green algae on surface.	0.00081	6.55	0.000944	0.0357	32.5	2.60	<0.000010	0.000324	0.0185	<0.050	0.40	<0.00010	5.13	0.000011	1.30	0.300	181	0.000018	<0.00010	<0.010	0.000525	<0.0010	0.172	<0.00080	0.0034	0.00031	0.0204	0.0215	<0.00010	<0.00050	<0.010	0.000082	211	0.00024
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013	Water clear, Orange/brown precipitate.	0.00074	3.31	0.000388	0.0254	30.9	1.84	<0.000010	0.000150	0.0151	<0.050	0.35	0.00036	4.25	<0.000010	1.62	0.246	140	<0.000010	<0.00010	<0.010	0.00203	<0.0010	0.198	<0.00080	0.0107	0.00013	0.0145	0.0181	<0.00010	<0.00050	<0.010	0.000143	173	<0.00010
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014	Slug failed at the end, YSI froze.Too cold. Water little turbid, orange muck in creek bed. Lots of branches+ de bris in creek.All samples preserved+filtered in lab.	0.00120	6.32	0.00103	0.0250	25.2	1.69	<0.000010	0.000211	0.0144	<0.050	0.40	0.00030	4.74	0.000018	1.59	0.227	127	0.000015	<0.00010	<0.010	0.00169	<0.0010	0.198	<0.00080	0.0011	0.00012	0.0221	0.0179	<0.00010	<0.00050	<0.010	0.000127	165	<0.00010
KV-50	Christal Creek upstream Hinton Creek	06-May-2014	Water orange, turbid, lots of branches in water, may affect flow reading.	0.00657	4.80	0.0287	0.00659	8.54	0.606	0.000012	0.000304	0.00744	0.064	0.84	0.00017	3.39	0.000303	0.770	0.0742	32.3	0.000027	0.00012	0.034	0.000458	0.0029	0.134	<0.00080	0.0294	0.00051	0.00793	0.0221	<0.00010	<0.00050	<0.010	0.000316	45.5	<0.00010
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014	Orange mud on bottom. Water little turbid.	0.00068	2.97	0.000829	0.0218	31.5	1.73	<0.000010	0.000186	0.0139	<0.050	0.36	0.00034	4.16	<0.000010	1.58	0.271	148	<0.000010	<0.00010	<0.010	0.00198	<0.0010	0.199	<0.00080	0.0079	0.00014	0.0144	0.0243	<0.00010	<0.00050	<0.010	0.000155	185	<0.00010
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014	95% open water. Red/orange sediments on bottom.	0.00065	2.75	0.00102	0.0221	28.1	1.45	<0.000010	0.000211	0.0119	<0.050	0.38	0.00072	4.09	<0.000010	1.61	0.257	131	0.000013	<0.00010	<0.010	0.00272	<0.0010	0.158	<0.00080	0.0049	0.00021	0.0148	0.0265	<0.00010	<0.00050	<0.010	0.000190	167	<0.00010
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015	water not oily like KV-51 downstream; lots of particulates in water.	<0.0040	8.93	0.00227	0.0280	29.5	1.98	<0.000010	0.000245	0.0175	0.061	0.43	0.00047	4.62	0.000028	1.49	0.259	147	0.000018	<0.00010	0.016	0.00211	0.0012	0.249	<0.00080	0.0025	0.00011	0.0172	0.0226	<0.00010	<0.00050	<0.010	0.000147	181	<0.00010
KV-50	Christal Creek upstream Hinton Creek	12-May-2015		0.00227	2.90	0.00202	0.0120	12.7	1.06	0.0000231	0.000229	0.00793	<0.050	0.58	0.000216	2.69	0.000037	0.663	0.122	64.4	0.000015	<0.00010	0.00775	0.000839	0.00087	0.113	<0.00030	0.0236	0.00031	0.00877	0.0253	<0.00010	<0.00050	<0.010	0.000165	80.0	<0.00010
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015		0.00541	7.09	0.00468	0.0325	30.0	1.86	0.0000089	0.000464	0.0161	0.082	0.56	0.000410	6.61	0.000086	1.58	0.286	150	0.000040	0.00012	0.0406	0.00258	0.00403	0.191	<0.00030	0.0037	0.00018	0.0179	0.0397	<0.00010	<0.00050	<0.010	0.0000595	192	<0.00010
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015	ORP value suspect, water is clear some ice on banks	0.00152	3.43	0.00115	0.0257	25.5	1.67	<0.0000050	0.000308	0.0122	<0.050	0.40	0.000516	4.29	0.000017	1.54	0.255	123	0.000016	<0.00010	0.00730	0.00211	0.00074	0.170	<0.00030	0.0032	0.00017	0.0171	0.0267	<0.00010	<0.00050	<0.010	0.0000955	168	<0.00010
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016		0.00102	4.75	0.000825	0.0343	29.4	1.99	<0.0000050	0.000202	0.0156	<0.050	0.37	0.000443	4.47	0.000012	1.54	0.249	147	0.000014	<0.00010	0.00594	0.00225	0.00066	0.217	<0.00030	0.0011	<0.00010	0.0223	0.0225	<0.00010	<0.00050	<0.010	0.0000915	193	<0.00010
KV-50	Christal Creek upstream Hinton Creek	04-May-2016	Water is clear, moderate to low flow.	0.00130	4.43	0.00123	0.0258	25.6	1.64	<0.0000050	0.000228	0.0122	<0.050	0.36	0.000340	3.90	0.000017	1.25	0.227	126	0.000011	<0.00010	0.00598	0.00185	0.00060	0.183	<0.00030	0.0087	0.00013	0.0185	0.0251	<0.00010	<0.00050	<0.010	0.000122	177	<0.00010
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016	Water is slightly turbid, moderate flow	0.00137	3.26	0.00117	0.0256	29.5	1.71	<0.0000050	0.000293	0.0125	<0.050	0.37	0.000397	4.18	0.000016	1.54	0.271	153	0.000011	<0.00010	0.00795	0.00255	0.00071	0.160	<0.00030	0.0028	0.00016	0.0128	0.0310	<0.00010	<0.00050	<0.010	0.0000676	190	<0.00010
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016		0.00210	5.99	0.00189	0.0316	30.8	2.04	0.0000056	0.000312	0.0166	<0.050	0.51	0.000321	5.44	0.000022	1.59	0.280	162	0.000022	<0.00010	0.0132	0.00268	0.00119	0.233	<0.00030	0.0026	0.00014	0.0251	0.0260	<0.00010	<0.00050	<0.010	0.000133	194	<0.00010
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	DO suspect (124% & 16.28 mg/L) and removed	0.00090	5.42	0.000409	0.0328	31.6	2.27	<0.0000050	0.000238	0.0164	<0.050	0.44	0.000332	4.65	0.000013	1.65	0.287	167	0.000016	<0.00010	0.00338	0.00236	<0.00050	0.254	<0.00030	0.0028	<0.00010	0.0246	0.0243	<0.00010	<0.00050	<0.010	0.000100	205	<0.00010
KV-50	Christal Creek upstream Hinton Creek	15-May-2017		0.00173	5.95	0.00165	0.0278	28.8	2.07	<0.0000050	0.000264	0.0160	<0.050	0.51	0.000249	4.16	0.000044	1.34	0.255	151	<0.000010	<0.00010	<0.012	0.00202	0.00112	0.253	<0.00030	0.0083	<0.00010	0.0197	0.0251	<0.00010	<0.00050	<0.010	0.000115	168	<0.00010
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017		0.00072	3.78	0.000522	0.0305	31.8	1.99	<0.0000050	0.000213	0.0149	<0.050	0.39	0.000305	4.48	<0.000010	1.73	0.290	176	0.000013	<0.00010	0.00299	0.00318	<0.00050	0.243	<0.00030	0.0026	<0.00010	0.0132	0.0272	<0.00010	<0.00050	<0.010	0.000105	185	<0.00010
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	Too cold for salt slug calibration	<0.00050	4.08	0.000255	0.0317	30.0	1.95	<0.0000050	0.000200	0.0148	<0.050	0.43	0.000370	4.52	<0.000010	1.71	0.314	183	0.000012	<0.00010	0.00162	0.00284	<0.00050	0.264	<0.00030	0.0035	<0.00010	0.0204	0.0215	<0.00010	<0.00050	<0.010	0.000110	184	<0.00010
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017		0.00128	8.27	0.00103	0.0257	30.9	2.00	<0.0000050	0.000261	0.0151	<0.050	0.44	0.000443	4.84	0.000017	1.69	0.281	161	0.000020	<0.00010	0.0103	0.00251	0.00082	0.278	<0.00030	0.0016	<0.00010	0.0173	0.0229	<0.00010	<0.00050	<0.010	0.000111	175	<0.00010
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	Ammonia analysed from DOC filtered bottle, result is total dissolved.	<0.00050	3.48	0.000164	0.0240	26.5	1.68	<0.0000050	0.000189	0.0133	<0.050	0.35	0.000434	4.32	<0.000010	1.57	0.273	154	0.000014	<0.00010	0.00042	0.00247	<0.00050	0.253	<0.00030	<0.0010	<0.00010	0.0179	0.0219	<0.00010	<0.00050	<0.010	0.000168	156	<0.00010
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018		0.00087	5.71	0.000358	0.0295	29.5	1.98	<0.0000050	0.000249	0.0159	<0.050	0.41	0.000479	4.74	<0.000010	1.62	0.310	186	0.000011	<0.00010	0.00265	0.00257	<0.00050	0.292	<0.00030	0.0012	<0.00010	0.0197	0.0202	<0.00010	<0.00050	<0.010	0.0000997	187	0.00018
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018		0.00169	7.35	0.00139	0.0335	26.7	1.95	<0.0000050	0.000240	0.0170	<0.050	0.48	0.000335	4.99	0.000020	1.64	0.283	169	0.000015	<0.00010	0.017	0.00239	0.00131	0.306	<0.00030	<0.0010	<0.00010	0.0191	0.0181	<0.00010	<0.00010	<0.010	0.0000849	184	<0.00010
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018		0.00082	5.29	0.000695	0.0282	29.3	1.91	<0.0000050	0.000187	0.0170	<0.050	0.46	0.000323	4.77	0.000010	1.74	0.287	173	0.000012	<0.00010	0.00463	0.00212	<0.00050	0.305	<0.00030	<0.0010	<0.00010	0.0241	0.0207	<0.00010	<0.00050	<0.010	0.0000987	201	0.00020
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018		0.00073	6.05	0.000687	0.0299	27.8	2.03	<0.0000050	0.000216	0.0158	<0.050	0.47	0.000211	5.07	0.000011	1.83	0.285	166	0.000018	<0.00010	0.00599	0.00220	0.00054	0.317	<0.00030	<0.0010	<0.00010	0.0220	0.0217	<0.00010	<0.00050	<0.010	0.0000661	191	<0.00010
KV-50	Christal Creek upstream Hinton Creek	15-May-2018		0.00785	10.6	0.0178	0.0065	7.63	0.626	0.0000105	0.000442	0.00964	0.140	0.76	0.000243	3.52	0.000192	0.682	0.0729	25.0	0.000031	<0.00010	0.0379	0.000692	0.00385	0.170	0.00040	0.0426	0.00032	0.00463	0.0169	<0.00010	<0.00050	<0.010	0.000143	35.8	<0.00010
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018		0.00072	2.80	0.000541	0.0195	23.7	1.33	<0.0000050	0.000225	0.0101	<0.050	0.37	0.000515	3.85	<0.000010	1.30	0.231	121	<0.000010	<0.00010	<0.0015	0.00172	<0.0010	0.179	<0.00030	0.0093	0.00037	0.0136	0.0274	<0.00010	<0.00050	<0.010	0.000172	139	0.00027
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	DO stable, then erratic, then stable again at 70%.	0.00071	3.24	0.000519	0.0230	29.6	1.53	<0.0000050	0.000228	0.0116	<0.050	0.37	0.000488	4.45	<0.000010	2.16	0.278	145	0.000013	<0.00010	0.00266	0.00390	0.00055	0.215	<0.00030	0.0014	0.00016	0.0152	0.0302	<0.00010	<0.00050	<0.010	0.000133	154	<0.00010
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	total metals missing preservatives, preserved in lab later	0.00122	3.98	0.000902	0.0209	27.6	1.40	<0.0000050	0.000258	0.0110	<0.050	0.35	0.000496	4.32	0.000012	1.89	0.262	127	0.000017	<0.00010	0.00621	0.00321	0.00063	0.196	<0.00030	0.0045	0.00014	0.0148	0.0278	<0.00010	<0.00050	<0.010	0.000154	146	<0.00010
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	Sampled and flow measured 20 m u/s of flagging. Discharge suspect due to high RPD and poor helper field note recording in Sep.	0.00080	2.99	0.000701	0.0213	28.3	1.32	<0.0000050	0.000235	0.00950	<0.050	0.38	0.000881	4.26	0.000013	1.68	0.273	135	0.000014	<0.00010	<0.0039	0.00390	<0.00050	0.177	<0.00030	0.0027	0.00014	0.0121	0.0294	<0.00010	<0.00050	<0.010	0.000117	161	<0.00010
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	Salt slug. Sampled at flagging. Ice on top of stream.	0.00067	3.75	0.000655	0.0227	25.2	1.55	<0.0000050	0.000220	0.0114	<0.050	0.40	0.000533	4.42	<0.000010	1.63	0.248	118	0.000021	<0.00010	0.00505	0.00234	<0.00050	0.215	<0.00030	<0.0020	0.00014	0.0131	0.0233	<0.00010	<0.00050	<0.010	0.000117	126	<0.00010
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	Semi open, some mud disturbed at u/s sample site prior to salt and insitu reading	<0.00050	3.19	0.000374	0.0214	22.8	1.48	<0.0000050	0.000185	0.0117	<0.050	0.34	0.000401	4.63	<0.000010	1.58	0.220	116	0.000020	<0.00010	<0.0021	0.00190	<0.00050	0.230	<0.00030	0.0012	<0.00010	0.0154	0.0214	<0.00010	<0.00050	<0.010	0.000107	133	<0.00010
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	Slight u/s blockage from ice, corrected maybe. Short discharge distance for salt.	<0.00050	3.61	0.000659	0.0209	20.7	1.41	<0.0000050	0.000196	0.0116	<0.050	0.35	0.000353	4.31	<0.000010	1.59	0.213	116	0.000018	<0.00010	0.00267	0.00176	<0.00050	0.220	<0.00030	0.0015	<0.00010	0.0181	0.0239	<0.00010	<0.00050	<0.010	0.000157	142	<0.00010
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	shallow, good flow. Initially covered with thin ice.	<0.00050	3.70	0.000323	0.0246	23.3	1.67	<0.0000050	0.000206	0.0123	<0.050	0.35	0.000344	4.30	<0.000010	1.60	0.216	115	0.000019	<0.00010	0.00220	0.00167	<0.00050	0.276	<0.00030	<0.0010	<0.00010	0.0183	0.0198	<0.00010	<0.00050	<0.010	0.0000866	138	<0.00010
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	Flow data lost	<0.00050	3.29	0.000253	0.0232	23.5	1.77	<0.0000050	0.000171	0.0126	<0.050	0.36	0.000308	4.48	<0.000010	1.63	0.212	118

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021		0.00076	1.03	0.00358	0.0271	22.3	1.24	<0.0000050	0.000158	0.00842	<0.050	0.559	0.000500	4.28	<0.000010	2.22	0.229	110	0.000012	<0.00010	<0.00060	0.00169	<0.00050	0.185	<0.00020	0.0018	0.00012	0.00375	0.0247	<0.000100	<0.000050	<0.010	0.000128	130	<0.00050
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021		<0.00050	1.65	0.000248	0.0195	22.0	1.32	<0.0000050	0.000192	0.00840	<0.050	0.386	0.000402	4.41	<0.000010	1.69	0.222	108	0.000016	<0.00010	0.00047	0.00144	<0.00050	0.173	<0.00020	<0.0010	0.00013	0.00617	0.0251	<0.000100	<0.000050	<0.010	0.000126	116	<0.00050
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	mid section flow measurement.	<0.00050	2.00	0.000140	0.0175	19.1	1.11	<0.0000050	0.000198	0.00705	<0.050	0.285	0.000715	4.10	<0.000010	1.40	0.214	85.9	0.000013	<0.00010	0.00040	0.00115	<0.00050	0.159	<0.00020	0.0050	0.00017	0.00939	0.0282	<0.000100	<0.000050	<0.010	0.000141	110	<0.00050
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021		0.00091	2.82	0.00259	0.0175	19.3	1.18	<0.0000050	0.000307	0.00857	<0.050	0.350	0.000558	4.32	0.000017	1.55	0.233	98.8	0.000016	<0.00010	0.00288	0.00172	<0.00050	0.181	<0.00020	0.0039	0.00022	0.0108	0.0295	<0.000100	<0.000050	<0.010	0.000220	120	<0.00050
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021		0.00051	3.61	0.000589	0.0188	20.7	1.27	<0.0000050	0.000213	0.00874	<0.050	0.318	0.000274	4.54	<0.000010	1.44	0.215	96.7	0.000017	<0.00010	0.00212	0.00148	<0.00050	0.185	<0.00020	0.0038	0.00017	0.0104	0.0229	<0.000100	<0.000050	<0.010	0.000162	112	<0.00050
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021		<0.00050	3.69	0.000478	0.0242	19.7	1.65	<0.0000050	0.000202	0.0114	<0.050	0.381	0.000136	4.95	<0.000010	1.59	0.218	112	0.000021	<0.00010	0.00208	0.00144	<0.00050	0.270	<0.00020	0.0011	0.00014	0.0182	0.0257	<0.000100	<0.000050	<0.010	0.000159	139	<0.00050
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	not ideal for flow measurement, creek full of slush	0.00068	4.85	0.000722	0.0196	20.8	1.64	<0.0000050	0.000204	0.0115	<0.050	0.386	0.000230	4.69	0.000078	1.84	0.211	108	0.000023	<0.00010	0.00352	0.00142	<0.00050	0.270	<0.00020	0.0012	0.00013	0.0180	0.0226	<0.000100	<0.000050	<0.010	0.000172	136	<0.00050
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022		<0.00050	3.07	0.000209	0.0236	22.7	1.87	<0.0000050	0.000203	0.0129	<0.050	0.390	0.000165	4.82	<0.000010	1.71	0.233	111	0.000016	<0.00010	<0.00030	0.00125	<0.00050	0.282	<0.00020	0.0022	0.00011	0.0201	0.0211	<0.000100	<0.000050	<0.010	0.000100	136	<0.00050
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022		<0.00050	4.32	0.000372	0.0247	23.5	2.04	<0.0000050	0.000236	0.0141	<0.050	0.398	0.000168	5.12	<0.000010	1.60	0.239	116	0.000023	<0.00010	0.00224	0.00135	0.00058	0.301	<0.00020	0.0012	<0.00010	0.0209	0.0262	<0.000100	<0.000050	<0.010	0.0000750	147	<0.00050
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022		<0.00050	4.56	0.000069	0.0270	24.2	2.20	<0.0000050	0.000210	0.0146	<0.050	0.420	0.000108	5.20	<0.000010	1.67	0.241	123	0.000024	<0.00010	0.00061	0.00128	<0.00050	0.329	<0.00020	0.0012	<0.00010	0.0254	0.0244	<0.000100	<0.000050	<0.010	0.000111	135	<0.00050
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	low water levels	0.00477	6.64	0.106	0.0187	18.0	1.49	<0.0000050	0.000431	0.0120	0.077	0.922	0.000207	4.61	0.000874	6.06	0.178	82.6	0.000034	0.00018	0.0138	0.000918	0.00209	0.335	0.00036	0.0040	0.00106	0.0170	0.0364	<0.000100	<0.000050	<0.010	0.000726	104	<0.00050
KV-50	Christal Creek upstream Hinton Creek	15-May-2022		0.00242	1.94	0.00625	0.0054	6.07	0.491	0.0000069	0.000157	0.00474	<0.050	0.467	0.000087	2.14	0.000071	1.89	0.0634	24.2	0.000010	<0.00010	0.00189	0.000277	<0.00050	0.0864	<0.00020	0.0474	0.00030	0.00528	0.0184	<0.000100	<0.000050	<0.010	0.000151	33.7	<0.00050
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022		0.00061	3.58	0.000633	0.0186	16.7	1.40	<0.0000050	0.000187	0.00932	<0.050	0.273	0.000454	3.98	<0.000010	1.08	0.198	103	0.000010	<0.00010	0.00076	0.000922	<0.00050	0.220	<0.00020	0.0092	0.00014	0.0142	0.0239	<0.000100	<0.000050	<0.010	0.000145	123	<0.00050
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022		<0.00050	1.56	0.000273	0.0195	21.2	1.45	<0.0000050	0.000212	0.0100	<0.050	0.294	0.000312	4.50	<0.000010	1.39	0.234	114	0.000014	<0.00010	<0.00060	0.00128	<0.00050	0.190	<0.00020	0.0020	0.00018	0.00520	0.0262	<0.000100	<0.000050	<0.010	0.000134	134	<0.00050
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022		<0.00050	1.94	0.000310	0.0243	21.9	1.48	<0.0000050	0.000204	0.0102	<0.050	0.347	0.000332	4.96	<0.000010	1.52	0.244	120	0.000017	<0.00010	<0.00090	0.00132	<0.00050	0.200	<0.00020	0.0016	0.00017	0.00753	0.0277	<0.000100	<0.000050	<0.010	0.000135	146	<0.00050
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022		0.00051	2.51	0.000597	0.0210	20.0	1.45	<0.0000050	0.000212	0.0101	<0.050	0.328	0.000208	4.71	<0.000010	1.36	0.206	98.7	0.000016	<0.00010	0.00088	0.00105	<0.00050	0.209	0.00021	0.0090	0.00016	0.0131	0.0253	<0.000100	<0.000050	<0.010	0.000158	127	<0.00050
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022	Creek frozen to bottom, cannot find any open water																																			
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	Normal flow, ice covered stream, water shallow and orange.	<0.00050	3.27	0.000412	0.0201	20.9	1.48	<0.0000050	0.000207	0.0108	<0.050	0.352	0.000481	4.58	<0.000010	1.66	0.213	104	0.000022	<0.00010	0.00222	0.00136	<0.00050	0.247	<0.00020	0.0025	0.00020	0.0185	0.0278	<0.000100	<0.000050	<0.010	0.000282	120	<0.00050
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022		<0.00050	3.56	0.000527	0.0184	19.2	1.51	<0.0000050	0.000232	0.0105	<0.050	0.347	0.000269	4.80	<0.000010	3.53	0.210	100	0.000016	<0.00010	0.00192	0.00121	<0.00050	0.233	<0.00020	<0.0010	0.00020	0.0204	0.0305	<0.000100	<0.000050	<0.010	0.000137	122	<0.00050
KV-50	Christal Creek upstream Hinton Creek	21-Jan-2023	Creek slushy, no flow	<0.00050	3.45	0.000132	0.0215	18.4	1.63	<0.0000050	0.000234	0.0112	<0.050	0.340	0.000146	4.78	<0.000010	2.05	0.212	101	0.000022	<0.00010	0.00052	0.00114	<0.00050	0.287	<0.00020	0.0014	0.00014	0.0200	0.0232	<0.000100	<0.000050	<0.010	0.0000887	137	<0.00050
KV-50	Christal Creek upstream Hinton Creek	09-Feb-2023		<0.00050	3.68	0.000105	0.0240	20.1	1.81	<0.0000050	0.000213	0.0122	<0.050	0.400	0.000177	4.88	<0.000010	1.59	0.219	111	0.000023	<0.00010	<0.00030	0.00111	<0.00050	0.285	<0.00020	0.0014	0.00012	0.0209	0.0227	<0.000100	<0.000050	<0.010	0.0000719	128	<0.00050
KV-50	Christal Creek upstream Hinton Creek	10-Mar-2023	only one salt flow done	0.00052	4.51	0.000340	0.0214	20.2	1.76	<0.0000050	0.000181	0.0122	<0.050	0.403	0.000105	5.07	<0.000010	1.70	0.210	115	0.000018	<0.00010	0.00078	0.00105	<0.00050	0.283	<0.00020	<0.0010	0.00010	0.0191	0.0244	<0.000100	<0.000050	<0.010	0.0000933	124	<0.00050
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2023	Sample only, glaciation layers	0.00062	3.37	0.0154	0.0195	18.6	1.73	<0.0000050	0.000257	0.0114	<0.050	0.548	0.000156	4.28	0.000048	~	0.196	101	0.000020	<0.00010	0.00159	0.000931	<0.00050	0.290	<0.00020	0.0018	0.00070	0.0181	0.0302	<0.000100	<0.000050	<0.010	0.000343	113	<0.00050
KV-50	Christal Creek upstream Hinton Creek	12-May-2023	Flooded vegetation, no flow measurement	0.00248	2.23	0.00631	0.0052	5.93	0.476	0.0000069	0.000164	0.00394	0.0341	0.935	0.000160	2.14	0.000088	6.40	0.0697	25.8	0.000010	<0.00010	0.00628	0.000222	0.00066	0.0943	0.00022	0.0603	0.00078	0.00458	0.0233	<0.000100	<0.000050	<0.010	0.000270	33.9	<0.00050
KV-50	Christal Creek upstream Hinton Creek	14-Jul-2023		<0.00050	2.10	0.000231	0.0211	21.8	1.43	<0.0000050	0.000200	0.00919	0.0072	0.307	0.000338	4.67	<0.000010	1.53	0.229	117	0.000011	<0.00010	0.00070	0.00132	<0.00050	0.190	<0.00020	0.0015	0.00018	0.00968	0.0303	<0.000100	<0.000050	<0.010	0.000140	134	<0.00050
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2023	Salt flow instead of xs b/c channel width is quite small and edge effects negatively affect ADV significantly. Needed more salt.	<0.00050	2.71	0.000369	0.0207	19.7	1.62	<0.0000050	0.000208	0.00997	0.0070	0.331	0.000212	4.84	<0.000010	1.52	0.230	106	0.000013	<0.00010	0.00090	0.00126	<0.00050	0.210	<0.00020	0.0022	0.00014	0.0120	0.0284	<0.000100	<0.000050	<0.010	0.000126	134	<0.00050
KV-50	Christal Creek upstream Hinton Creek	14-Sep-2023	Will return for flow measurement. Surveyed KV-51	<0.00050	2.32	0.000657	0.0238	20.5	1.53	<0.0000050	0.000180	0.00989	<0.050	0.373	0.000182	4.74	<0.000010	1.58	0.212	113	0.000017	<0.00010	<0.00090	0.00119	<0.00050	0.208	<0.00020	0.0025	0.00012	0.00850	0.0246	<0.000100	<0.000050	<0.010	0.000117	135	<0.00050
KV-50	Christal Creek upstream Hinton Creek	25-Oct-2023	Glaciated with over flow	0.00099	5.66	0.00130	0.0234	22.1	1.76	<0.0000050	0.000191	0.0119	0.0316	0.386	0.000210	5.54	0.000015	1.50	0.218	112	0.000018	<0.00010	0.00722	0.00132	0.00067	0.293	<0.00020	0.0025	<0.00010	0.0165	0.0236	<0.000100	<0.000050	<0.010	0.000105	148	<0.00050
KV-50	Christal Creek upstream Hinton Creek	20-Nov-2023	Standing water on top of ice above flowing water. Unable to guarantee salt mixture enters flowing portion	<0.00050	4.29	0.000421	0.0252	23.0	1.96	<0.0000050	0.000171	0.0118	<0.050	0.361	0.000212	5.35	<0.000010	1.56	0.227	118	0.000011	<0.00010	0.00177	0.00126	<0.00050	0.279	<0.00020	0.0017	<0.00010	0.0157	0.0282	<0.000100	<0.000050	<0.010	0.0000943	135	<0.00050
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2023	Salt gauge conducted but results were not good.	0.00103	4.08	0.000376	0.0236	21.5	1.78	<0.0000050	0.000164	0.0121	<0.050	0.660	0.000172	5.39	<0.000010	2.49	0.219	114	0.000015	<0.00010	0.00082	0.00119	<0.00050	0.284	<0.00020	0.0075	0.00011	0.0177	0.0298	<0.000100	<0.000050	<0.010	0.000109	136	<0.00050
KV-50	Christal Creek upstream Hinton Creek	25-Jan-2024	Not enough flow to clear auger hole. Ice nearly frozen to bottom	<0.00050	7.46	0.000466	0.0258	22.7	2.35	<0.0000050	0.000176	0.0127	<0.050	0.352	0.000136	4.93	<0.000010	1.50	0.224	120	<0.000010	<0.00010	<0.00120	0.00128	<0.00050	0.292	<0.00020	0.0030	<0.00010	0.0213	0.0327	<0.000100	<0.000050	<0.010	0.0000411	138	<0.00050
KV-50	Christal Creek upstream Hinton Creek	16-Feb-2024	could not locate running water due to glaciation																																			
KV-50	Christal Creek upstream Hinton Creek	29-Mar-2024	Glaciated																																			
KV-50	Christal Creek upstream Hinton Creek	21-Apr-2024	6ft plus of ice, orange overflow water on top. Very rotten ice, likely melted by next month																																			
KV-50	Christal Creek upstream Hinton Creek	28-Apr-2024	Very flooded area with lots of channels. Lots of water everywhere, unable to conduct flow measurement. Possibly influenced by snowmelt.	0.00155	2.68	0.00944	0.0084	8.61	0.662	<0.0000050	0.000158	0.00479	<0.050	0.870	0.000113	2.68	0.000112	2.31	0.0910	38.3	<0.000010	<0.00010	0.00543	0.000290	0.00057	0.118	0.00041	0.0177	0.00061	0.00719	0.0202	<0.000100	<0.000050	<0.010	0.000128	49.3	<0.00050
KV-50	Christal Creek upstream Hinton Creek	08-May-2024		0.00216	3.17	0.00320	0.0070	6.98	0.588	<0.0000050	0.000192	0.00502	<0.050	0.475	0.000150	2.93	0.000067	0.918	0.0758	29.8	<0.000010	<0.00010	0.00573	0.000313	0.00051	0.0911	0.00027	0.0675	0.00026	0.00610	0.0158	<0.000100	<0.000050	<0.010	0.0000646	42.6	<0.00050
KV-50	Christal Creek upstream Hinton Creek	13-May-2024	Very orange nasty water, residue on willows all around creek. Water flowing low and clear, some ice on banks.	0.00063	2.20	0.00122	0.0150	12.9	1.07	<0.0000050	0.000156	0.00674	<0.050	0.452	0.000097	3.48	0.000012	1.34	0.129	62.2	<0.000010	<0.00010	0.00040	0.000563	<0.00050	0.148	<0.00020	0.0081	0.00017	0.0121	0.0206	<0.000100	<0.000050	<0.010	0.0000876	79.5	<0.00050
KV-50	Christal Creek upstream Hinton Creek	22-May-2024	Metallic odour, orange precipitate in water. Lots of orange precipitate in creek and area. Soft creek bottom due to precipitate build up. Midsection flow measurement.	0.00055	2.82	0.00114	0.0180	15.5	1.28	<0.0000050	0.000217	0.00837	<0.050	0.387	0.000135	4.23	0.000013	1.66	0.169	80.8	<0.000010	<0.00010	<0.00090	0.000708	<0.00050	0.179	<0.00020	0.0074	0.00019	0.0127	0.0236	<0.000100	<0.000050	<0.010	0.0000872	94.2	<0.00050
KV-50	Christal Creek upstream Hinton Creek	29-May-2024	Orange precipitate on creek bed and surrounding veg.	0.00121	2.64	0.00299	0.0121	12.0	1.09	<0.0000050	0.000217	0.00658	<0.050	0.319	0.000116	3.73	0.000034	1.62	0.124	57.5	<0.000010	<0.00010	0.00122	0.000507	<0.00050	0.135	<0.00020	0.0210	0.00024	0.0103	0.0236	<0.000100	<0.000050	<0.010	0.0000850	68.9	<0.00050
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2024	Midsection flow measurement. Lots of orange deposit on creek bottom, which sometimes interfered with measuring flow.	<0.00050	4.31	0.000436	0.0245	21.9	2.17	<0.0000050	0.000199	0.0113	<0.050	0.371	0.000126	4.70	<0.000010	1.70	0.225	126	<0.000010	<0.00010	<0.00060	0.00106	<0.00050	0.259	<0.00020	0.0038	0.00012	0.0173	0.0246	<0.000100	<0.000050	<0.010	0.0000648	136	<0.00050
KV-50	Christal Creek upstream Hinton Creek	07-Jul-2024	Same sediment issue with flow meter as kv51. Could not do salt, longest stretch without a large eddie or pool was ~1m.	<0.00050	1.81	0.000216	0.0218	24.6	1.81	<0.0000050	0.000177	0.0105	0.0082	0.312	0.000160	4.69	<0.000010	1.50	0.231	122	<0.000010	<0.00010	<0.00030	0.00122	<0.00050	0.209	<0.00020	0.0012	<0.00010	0.00633	0.0267	<0.000100	<0.000050	<0.010	0.0000686	135	<0.00050
KV-50	Christal Creek upstream Hinton Creek	14-Aug-2024	Bottom too soft for midsection flow, every movement stirred up sediment that settles on sensor. Salt slug - 150 g was good mass, ysi was not logging for first 150 so only have 1 usable salt flow. Last salt would not come down to bl.	<0.00050	2.70	0.000555	0.0232	22.0	1.81	<0.0000050	0.000190	0.0103	<0.050	0.339	0.000148	4.70	<0.000010	1.54	0.226	124	0.000011	<0.00010	<0.00060	0.00122	<0.00050	0.220	<0.00020	0.0024	0.00010	0.00892	0.0262	<0.000100	<0.000050	<0.010	0.0000911	143	<0.00050
KV-50	Christal Creek upstream Hinton Creek	05-Sep-2024	Bottom too soft for midsection flow, water too slow for salt flow	0.00071	2.63	0.00976	0.0212	20.6	1.52	<0.0000050	0.000193	0.00892	<0.050	0.429	0.000190	4.78	0.000150	1.85	0.216	104	0.000014	<0.00010	0.00292	0.000948	<0.00050	0.199	<0.00020	0.0049	0.00019	0.00784	0.0255	<0.000100	<0.000050	<0.010	0.000113	117	<0.00050
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2024	Creek partially frozen over, broke ice to do mid section flow measurement	<0.00050	2.14	0.000145	0.0222	21.7	1.66	<0.0000050	0.000189	0.00950	0.0052	0.325	0.000225	4.87	<0.000010	1.52	0.213	112	0.000013	<0.00010	<0.00030	0.00104	<0.00050	0.219	<0.00020	0.0020	<0.00010	0.0112	0.0219	<0.000100	<0.000050	<0.010	0.0000982	130	<0.00050
KV-50	Christal Creek upstream Hinton Creek	06-Nov-2024	Discharge collected Nov 21	<0.00050	2.88	0.000269	0.0218	20.1	1.61	<0.0000050	0.000158	0.00971	<0.050	0.344	0.000164	5.11	<0.000010	1.43	0.214	105	0.000019	<0.00010	<0.00060	0.00100	<0.00050	0.231	<0.00020	0.0023	<0.00010	0.0146	0.0241	<0.000100	<0.000050	<0.010	0.000142	125	<0.00050
KV-50	Christal Creek upstream Hinton Creek	21-Nov-2024																																				
KV-50	Christal Creek upstream Hinton Creek	05-Dec-2024		<0.00050	4.55	0.000416	0.0215	20.9	1.88	<0.0000050	0.000171	0.0100	<0.050	0.364	0.000193	5.01	<0.000010	1.50	0.207	104	0.000018	<0.00010	<0.00090	0.000936	<0.00050	0.252	<0.00020	0.0017	<0.00010	0.0168	0.0252	<0.000020	<0.000050	<0.010	0.000128	125	<0.00050
KV-51	Christal Creek d/s Hinton Creek	18-May-2008		0.003	1.3	0.0006	0.005	6.1	0.166		<0.001	0.0028		<0.4	<0.0002	2.42	0.00004	0.5	0.07	21.9	<0.00005	<0.001	0.008	0.0006	0.0005	0.06	<0.001	0.143		0.0014	0.019	<0.0001	<0.0005	<0.002	0.00015	32.2	0.0005
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008		<0.001	0.45	<0.0001	0.017	24.2	0.245		<0.001	0.0069		0.6	0.0003	3.78	<0.00001	1.6	0.264	94.9	<0.00005	<0.001	0.0101	0.0037	<0.0001	0.154	<0.001	0.006	0.0015	0.0017	0.036	<0.0001	<0.0005	<0.002	0.00037	122	0.0005
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008		0.004	2.5	0.0017	0.009	15.2	0.261		0.00022	0.005	0.032	0.3	0.0007	4.55	<0.00001	1.07	0.15		0.00002	<0.0001	0.012	0.0019	0.00116	0.114	0.0002	0.045	0.0012	0.0022	0.033	<0.00004		<0.004	0.00026	78.9	0.0007
KV-51	Christal Creek d/s Hinton Creek	28-May-2009		0.002	1.01	0.000889	0.0038	5.99	0.171	<0.00001	0.00011	0.00265	0.028	0.32	0.00018	1.89	0.000017	0.44	0.0661	28	0.000009	<0.00001	0.0024	0.000721	0.0002	0.0547	0.0002	0.117	0.0002	0.00167	0.0355	<0.00001	<0.000005	<0.05	0.000405	35.1	0.0003
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009		0.0029	4.43	0.00297	0.0158	26	0.569	<0.00001	0.00022	0.00696	0.058	0.44	0.00041	4.57	0.000024	1.48	0.268	129	0.000024	<0.00001	0.0099	0.00524	0.0008	0.195	<0.0001	0.0066	0.00031	0.0026	0.0484	<0.00001	<0.000005	<0.05	0.000512	156	0.0002
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009		0.0829	36.3	0.1	0.0331	29.2	2.57		0.00256	0.055		0.83	0.00045	11	0.000131	1.32	0.293	145	0.000165	0.00006	0.201	0.00505	0.0278	0.551	0.0022	0.0077	0.00062	0.018	0.0288	<0.00001	<0.000005	<0.05	0.000026	173	0.0003
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010		0.00078	2.07	0.000586	0.0214	25.5	1.19	0.00001	0.0002	0.00725	0.015	0.31	0.00024	3.79	<0.000005	1.32	0.269	148	0.00001	<0.00001	0.0027	0.00168	<0.0002	0.096	<0.0001	0.0057	0.00024	0.00931	0.0267	<0.00001	<0.000005	<0.05	0.000212	170	0.0003
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010		0.00486	4.03	0.00355	0.0246	26.5	1.7	<0.00001	0.00036	0.0143		0.39	0.00024	4.3	0.000015	1.43	0.256	157	0.000033	<0.00001	0.0094	0.00411	0.0012	0.246	<0.0001	0.0036	0.00015	0.0126	0.0207	<0.00001	<0.000005	<0.05	0.000069	171	0.0004
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011	no water found																																			
KV-51	Christal Creek d/s Hinton Creek	26-May-2011	widely dispersed flow. Flow not taken	0.0009	0.961	0.000324	0.007	12.2	0.422	<0.00001	0.00007	0.00347	0.014	0.26	0.0002	2.6	0.000022	0.81	0.146	84	0.000003	<0.00001	0.0006	0.000597	<0.0002	0.0599	<0.0001	0.0306	0.00015	0.00424	0.0404	<0.00001	<0.000005	<0.05	0.000231	85.3	0.0003
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011	not visited. No helper/lack of time																																			
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011	Very cloudy water (grey)	0.00511	7.04	0.00595	0.0247	34.8	2.24	<0.00001	0.00034	0.0176	0.079	0.46	0.00027	5.1	0.000008	1.75	0.312	200	0.000024	0.00009	0.0188	0.00249	0.0021	0.2	<0.0001	0.0034	0.00022	0.0263	0.0206	<0.00001	<0.000005	<0.05	0.000068	207	<0.0001
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012	Salt Slug	0.00033	4.41	0.000376	0.0354	31.9	2.22	<0.00001	0.00022	0.0167	0.023	0.4	0.00025	3.9	<0.000005	1.49	0.31	188	0.000013	<0.0002	0.0011	0.00231	<0.0002	0.202	<0.0001	0.0009	0.00013	0.022	0.0213	<0.00001	<0.000005	<0.05	0.000199	224	<0.0001
KV-51	Christal Creek d/s Hinton Creek	03-May-2012	snowing lightly; no YSI for insitu	0.00246	3.5	0.00259	0.0133	17.7	1.13	<0.0000010	0.000198	0.00961	0.0471	0.458	0.000175	2.73	0.000019	1.09	0.165	101	0.000012	<0.00020	0.00454	0.00103	0.0004	0.127	0.00023	0.0259	0.000212	0.0126	0.0255	<0.000010	<0.0000050

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015	discharge only, no sample																																		
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016	ORP fluxuating up and down.																																		
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016		0.00126	5.33	0.00101	0.0355	31.3	2.15	<0.0000050	0.000239	0.0169	<0.050	0.40	0.000467	4.96	0.000016	1.64	0.278	157	0.000017	<0.00010	0.00821	0.00241	0.00091	0.238	<0.00030	0.0010	<0.00010	0.0214	0.0234	<0.00010	<0.000050	<0.010	0.0000995	202	<0.00010
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016	No sample, just flow																																		
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016																																			
KV-51	Christal Creek d/s Hinton Creek	04-May-2016		0.00287	2.78	0.000967	0.0146	16.9	0.888	<0.0000050	0.000156	0.00720	<0.050	0.33	0.000224	3.00	0.000019	0.903	0.171	90.1	<0.000010	<0.00010	0.00571	0.000987	0.00060	0.109	<0.00030	0.0335	0.00012	0.0113	0.0440	<0.00010	<0.000050	<0.010	0.000111	124	<0.00010
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016																																			
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016	Water is slightly turbid	0.00150	3.09	0.00124	0.0250	29.5	1.65	<0.0000050	0.000284	0.0120	<0.050	0.34	0.000416	4.20	0.000019	1.53	0.273	156	0.000014	<0.00010	0.00769	0.00238	0.00077	0.154	<0.00030	0.0029	0.00015	0.0102	0.0323	<0.00010	<0.000050	<0.010	0.0000593	188	<0.00010
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016																																			
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016																																			
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	DO calibrated on site; SG encased in ice, no reading taken.	0.00232	5.73	0.00192	0.0318	30.4	2.08	<0.0000050	0.000316	0.0167	<0.050	0.48	0.000409	5.33	0.000027	1.68	0.279	162	0.000032	<0.00010	0.0125	0.00265	0.00112	0.235	<0.00030	0.0024	0.00013	0.0227	0.0257	<0.00010	<0.000050	<0.010	0.000107	194	<0.00010
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016	No sample, in-situ and discharge. DO probe measurement suspect																																		
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016	Low confidence in discharge result, poor dilution performance.																																		
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017	Flow only. Downloaded logger																																		
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	DO not functioning properly	<0.00050	5.35	0.000353	0.0374	35.5	2.57	<0.0000050	0.000278	0.0181	<0.050	0.46	0.000345	5.12	<0.000010	1.84	0.330	186	0.000015	<0.00010	0.00204	0.00268	<0.00050	0.281	<0.00030	0.0040	<0.00010	0.0256	0.0277	<0.00010	<0.000050	<0.010	0.000107	235	<0.00010
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017	First run discharge would not come back down to baseline.																																		
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017																																			
KV-51	Christal Creek d/s Hinton Creek	15-May-2017		0.00257	2.00	0.00121	0.0088	9.82	0.552	0.0000085	0.000118	0.00529	<0.050	0.36	0.000214	2.27	0.000040	0.645	0.106	56.6	<0.000010	<0.00010	0.00849	0.000558	0.00087	0.0843	<0.00030	0.114	0.00011	0.00493	0.0286	<0.00010	<0.000050	<0.010	0.0000940	59.8	0.00020
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017	Surveyed. Downloaded flow. Gauge difficult to read.																																		
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017		0.00060	3.28	0.000434	0.0293	31.8	2.00	<0.0000050	0.000227	0.0151	<0.050	0.37	0.000296	4.32	<0.000010	1.62	0.297	175	0.000012	<0.00010	0.00245	0.00313	<0.00050	0.239	<0.00030	0.0027	<0.00010	0.0114	0.0274	<0.00010	<0.000050	<0.010	0.0000939	188	<0.00010
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017																																			
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017	Monitored for flow and insitu only.																																		
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	Too cold for salt slug calibration	0.00101	3.58	0.000228	0.0287	29.0	1.85	<0.0000050	0.000190	0.0141	<0.050	0.42	0.000390	4.44	<0.000010	1.61	0.301	180	0.000011	<0.00010	0.00123	0.00273	<0.00050	0.254	<0.00030	0.0028	<0.00010	0.0185	0.0217	<0.00010	<0.000050	<0.010	0.000107	166	<0.00010
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017																																			
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017	Discharge data collected was not reproducable due to errors in the field and removed. RPD was too high. Conductivity affected by u/s salt slug and removed.																																		
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018																																			
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	thick ice. Drilled into water layer with no discernable flow.	0.00318	11.3	0.00259	0.0334	26.9	1.95	<0.0000050	0.000293	0.0184	0.089	0.54	0.000350	5.88	0.000045	1.64	0.279	171	0.000023	<0.00010	0.035	0.00246	0.00226	0.340	0.00040	<0.0010	<0.00010	0.0133	0.0187	<0.00010	<0.000050	<0.010	0.0000394	175	<0.00010
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018	shallow water with muddy substrate. No sample																																		
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018	Muddy substrate with shallow water.																																		
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	Significant ice cover, very turbid (dark orange/brown water)	0.00596	7.13	0.00979	0.0049	5.81	0.353	0.0000120	0.000212	0.00624	0.107	0.64	0.000210	2.97	0.000115	0.602	0.0639	24.2	0.000020	<0.00010	0.0262	0.000432	0.00261	0.120	0.00038	0.0988	0.00023	0.00251	0.0214	<0.00010	<0.000050	<0.010	0.000164	31.6	0.00019
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	Real time readings for dewinterizing: in w/ condom = 8:19:48, out w/ condom = 8:20:48, out w/out = 8:25:39, back in = 8:28:14	0.00092	1.11	0.000314	0.0090	15.3	0.509	<0.0000050	0.000096	0.00460	<0.050	0.26	0.000426	2.69	<0.000010	0.928	0.184	92.7	<0.000010	<0.00010	<0.00090	0.000670	<0.0010	0.0866	<0.00030	0.0245	0.00014	0.00535	0.0574	<0.00010	<0.000050	<0.010	0.000243	107	0.00012
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	DOC preserved later. TOT metals preserved in sulphuric then rinsed and preserved in nitric. Skeptical of DO value even though it makes sense.	0.00067	3.02	0.000513	0.0234	28.7	1.46	<0.0000050	0.000220	0.0113	<0.050	0.36	0.000483	4.40	<0.000010	2.02	0.279	145	0.000012	<0.00010	0.00267	0.00392	0.00054	0.208	<0.00030	0.0015	0.00015	0.0135	0.0293	<0.00010	<0.000050	<0.010	0.000119	153	<0.00010
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018		0.00100	2.86	0.000617	0.0196	26.5	1.27	<0.0000050	0.000206	0.00906	<0.050	0.31	0.000461	4.06	0.000011	1.83	0.251	122	0.000014	<0.00010	<0.0060	0.00292	<0.00050	0.174	<0.00030	0.0039	0.00015	0.0112	0.0292	<0.00010	<0.000050	<0.010	0.000155	139	<0.00010
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	Water is turbid	0.00148	3.27	0.00360	0.0206	28.1	1.26	<0.0000050	0.000221	0.00965	<0.050	0.45	0.000885	4.25	0.000027	1.77	0.269	131	0.000014	<0.00010	0.00503	0.00376	0.00051	0.186	<0.00030	0.0023	0.00015	0.0109	0.0297	<0.00010	<0.000050	<0.010	0.000102	159	<0.00010
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	Surface frozen, had to salt slug.	0.00054	2.61	0.00125	0.0224	24.1	1.49	<0.0000050	0.000209	0.0112	<0.050	0.39	0.000550	4.38	<0.000010	1.61	0.241	120	0.000018	<0.00010	0.00216	0.00227	<0.00050	0.203	<0.00030	<0.0020	0.00014	0.0108	0.0240	<0.00010	<0.000050	<0.010	0.0000986	130	<0.00010
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	Relatively short distance for flow	<0.00050	2.69	0.000298	0.0219	22.8	1.47	<0.0000050	0.000198	0.0113	<0.050	0.33	0.000391	4.53	<0.000010	1.61	0.220	118	0.000019	<0.00010	<0.0021	0.00185	<0.00050	0.221	<0.00030	<0.0010	<0.00010	0.0120	0.0211	<0.00010	<0.000050	<0.010	0.000119	126	<0.00010
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018		<0.00050	2.98	0.000569	0.0215	21.5	1.39	<0.0000050	0.000180	0.0114	<0.050	0.37	0.000412	4.41	<0.000010	1.61	0.220	119	0.000020	<0.00010	0.00159	0.00178	<0.00050	0.221	<0.00030	0.0012	<0.00010	0.0161	0.0232	<0.00010	<0.000050	<0.010	0.000150	134	<0.00010
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	water shallow, short flow distance	<0.00050	3.61	0.000318	0.0249	23.1	1.63	<0.0000050	0.000223	0.0124	<0.050	0.35	0.000346	4.49	<0.000010	1.62	0.207	115	0.000016	<0.00010	0.00245	0.00163	<0.00050	0.269	<0.00030	<0.0010	<0.00010	0.0171	0.0205	<0.00010	<0.000050	<0.010	0.0000968	139	0.00011
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	Flow data lost	<0.00050	3.02	0.000116	0.0227	22.9	1.77	<0.0000050	0.000239	0.0124	<0.050	0.35	0.000285	4.43	<0.000010	1.59	0.213	117	0.000015	<0.00010	0.00066	0.00146	<0.00050	0.252	<0.00030	<0.0010	<0.00010	0.0192	0.0214	<0.00010	<0.000050	<0.010	0.0000758	134	<0.00010
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	short distance for flow, neutral pressure. Water not displaying much signs for flow, probably just slow or calm.	<0.00050	3.81	0.000341	0.0242	23.0	1.78	<0.0000050	0.000186	0.0125	<0.050	0.39	0.000271	4.72	<0.000010	1.65	0.235	139	<0.000010	<0.00010	0.00218	0.00164	<0.00050	0.251	<0.00030	<0.0010	<0.00010	0.0230	0.0182	<0.00010	<0.000050	<0.010	0.0000616	157	<0.00010
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	YSI parameters slowly drifting, taking long to stabalize.	<0.00050	2.19	0.00114	0.0196	23.8	1.56	<0.0000050	0.000179	0.0108	<0.050	0.44	0.000186	3.83	<0.000010	1.51	0.234	126	<0.000010	<0.00010	<0.00090	0.00118	<0.00050	0.223	<0.00030	0.0014	<0.00010	0.0147	0.0312	<0.00010	<0.000050	<0.010	0.000130	136	<0.00010
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	Not enough salt for slug.	0.00146	1.01	0.000320	0.0060	7.16	0.306	0.0000063	0.000140	0.00277	<0.050	0.26	0.000216	1.99	0.000016	0.580	0.0913	43.9	<0.000010	<0.00010	<0.0021	0.000238	<0.00050	0.0542	<0.00030	0.0675	0.00011	0.00264	0.0286	<0.00010	<0.000050	<0.010	0.0000664	56.1	0.00014
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	Staff gauge rusting. Hard to read values below 0.4 m. Surveyed/dewinterized logger.	<0.00050	4.97	0.000347	0.0247	27.1	1.91	<0.0000050	0.000179	0.0128	<0.050	0.35	0.000230	4.34	<0.000010	1.60	0.259	171	0.000012	<0.00010	<0.0018	0.00144	<0.00050	0.261	<0.00030	0.0018	<0.00010	0.0160	0.0255	<0.00010	<0.000050	<0.010	0.0000909	163	<0.00010
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	Orange slime on plants. Not best path for salt slug. Bends and eddys. Needs new staff gauge.	0.00096	4.55	0.000729	0.0254	28.5	1.97	0.0000051	0.000232	0.0131	<0.050	0.39	0.000305	4.71	0.000013	1.63	0.284	157	0.000011	<0.00010	0.00719	0.00208	0.00081	0.248	<0.00030	0.0082	<0.00010	0.0161	0.0245	<0.00010	<0.000050	<0.010	0.0000706	170	<0.00010
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	orange precipitate. Took 2nd run of flow and ignored first. RPD was 37% and 2nd run matched KV-50 closer	<0.00050	2.46	0.000124	0.0227	26.2	1.70	<0.0000050	0.000197	0.0110	<0.050	0.36	0.000295	3.94	<0.000010	1.58	0.260	141	0.000013	<0.00010	0.00080	0.00196	<0.00050	0.212	<0.00030	0.0010	<0.00010	0.0114	0.0228	<0.00010	<0.000050	<0.010	0.0000863	164	<0.00010
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019		<0.00050	1.51	0.000067	0.0233	23.2	1.57	<0.0000050	0.000262	0.00989	<0.050	0.38	0.000293	4.14	<0.000010	1.62	0.228	119	0.000011	<0.00010	<0.00030	0.00151	<0.00050	0.193	<0.00030	0.0014	<0.00010	0.00735	0.0207	<0.00010	<0.000050	<0.010	0.0000666	141	<0.00010
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	No flow. > 1 inch of ice on the creek. We do not have salt for the site.	<0.00050	3.01	0.000171	0.0256	25.7	1.71	<0.0000050	0.000202	0.0112	<0.050	0.40	0.000303	4.27	<0.000010	1.72	0.235	137	0.000010	<0.00010	0.00078	0.00162	<0.00050	0.227	<0.00030	0.0018	<0.00010	0.00854	0.0190	<0.00010	<0.000050	<0.010	0.0000743	155	<0.00010
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019		<0.00050	2.20	0.000058	0.0223	23.9	1.64	<0.0000050	0.000253	0.0109	<0.050	0.39	0.000269	4.57	<0.000010	1.79	0.213	117	0.000012	<0.00010	<0.00030	0.00139	<0.00050	0.233	<0.00030	<0.0010	<0.00010	0.0120	0.0203	<0.00010	<0.000050	<0.010	0.0000517	133	<0.00010
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019		<0.00050	2.52	0.000073	0.0228	23.4	1.48	<0.0000050	0.000287	0.0101	<0.050	0.37	0.000340	4.36	<0.000010	1.75	0.219	110	0.000012	<0.00010	0.00063	0.00143	<0.00050	0.208	<0.00030	<0.0010	<0.00010	0.0147	0.0219	<0.00010	<0.000050	<0.010	0.0000505	123	<0.00010
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020	Site is inaccessable without snowshoes. Too much snow.																																		
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	No flow measurement. Temp outside is -40C.	<0.00050	1.96	0.000059	0.0210	20.8	1.35	<0.0000050	0.000167	0.00949	<0.050	0.34	0.000193	3.78	<0.000010	1.59	0.198	104	<0.000010	<0.00010	<0.00030	0.00118	<0.00050	0.222	<0.00030	<0.0010	<0.00010	0.0152	0.0170	<0.00010	<0.000050	<0.010	0.0000525	126	<0.00010
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	Conditions not conducive to measuring flow. SG covered in ice and snow.	<0.00050	3.03	0.000106	0.0213	23.6	1.46	<0.0000050	0.000149	0.0104	<0.050	0.40	0.000144	4.23	<0.000010	1.68	0.213	114	<0.000010	<0.00010	<0.00030	0.00117	<0.00050	0.242	<0.00030	<0.0010	<0.00010	0.0107	0.0210	<0.00010	<0.000050	<0.010	0.0000349	135	<0.00010
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	not ideal for flow test. Flow almost stagnant, creek meandering	<0.00050	6.44	0.000221	0.0218	22.1	1.38	<0.0000050	0.000142	0.00980	<0.050	0.42	0.000161	4.25	<0.000010	1.71	0.196	111	<0.000010	<0.00010	0.00078	0.00102	<0.00050	0.207	<0.00030	<0.0010	<0.00010	0.0165	0.0185	<0.00010	<0.000050	<0.010	0.0000468	120	<0.00010
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	DO will not calibrate, membrane needs replacement. Logger not downloaded - no flow water poolingand flowing through willows (see photos)	0.00517	11.7	0.00618	0.0048	6.17	0.604	<0.0000050	0.000308	0.00700	0.119	1.03	0.000277	3.03	0.000092	0.652	0.0610	20.8	0.000027	<0.00010	0.0239	0.000471	0.00213	0.171	0.00041	0.0558	0.00026	0.00380	0.0179	<0.00010	<0.000050	<0.010	0.000217	28.3	0.00015
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020		0.00074	3.65	0.000180	0.0234	24.3	1.72	<0.0000050	0.000513	0.00985	<0.050	0.416	0.000355	3.85	<0.000010	1.53	0.237	141	<0.000010	<0.00010	0.00067	0.00128	<0.00050	0.215	<0.00020	0.0076	<0.00010	0.0151	0.0243	<0.000100	<0.000050	<0.010	0.0000843	148	<0.00010
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020		0.00110	1.96	0.00115	0.0148	19.4	0.948	<0.0000050	0.000192	0.00660	0.090	0.326	0.000889	3.97	0.000011	1.46	0.201	86.8	0.000013	<0.00010	0.00200	0.00143	<0.00050	0.140	<0.00020	0.0122	0.00024	0.00807	0.0303	<0.000100	<0.000050	<0.010	0.000212	112	<0.00010
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020		0.00051	1.57	0.000259	0.0167	21.3	0.919	<0.0000050	0.000204	0.00707	<0.050	0.312	0.00111	4.33	<0.000010	1.57	0.234	92.0	0.000012	<0.00010	0.00122	0.00223	<0.00050	0.140	<0.00020	0.0044	0.00023	0.00640	0.0312	<0.000100	<0.000050	<0.010	0.000200	123	<0.00010
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	Levellogger downloaded. Benthics and sediment collected.	0.00056	2.14	0.000390	0.0190	20.4	0.896	<0.0000050	0.000377	0.00757	<0.050	0.361	0.00112	4.35	<0.000010	1.70	0.239	95.8	0.000016	<0.00010	0.00208	0.00259	<0.00050	0.160	<0.00020	0.0039	0.00020	0.00728	0.0298	<0.000100	<0.000050	<0.010	0.000209	122	<0.00010
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	WL downloaded, off by 8 mins	0.00062	2.70	0.000436	0.0184	22.5	1.23	<0.0000050	0.000158	0.00868	<0.050	0.358	0.000674	4.42	<0.000010	1.82	0.242	100	<0.000010	<0.00010	0.00259	0.00229	<0.00050	0.193	<0.00020	0.0019	0.00017	0.00795	0.0278	<0.000100	<0.000050	<0.010	0.000139	121	<0.00010
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	Flow not measured - corners u/s and d/s too sharp and not enough flow, too many willows.Staff gauge frozen.	<0.00050	2.29	0.000364	0.0162	20.8	1.23	<0.0000050	0.000163	0.00873	<0.050	0.365	0.000657	4.25	<0.000010	2.15	0.210	95.5	0.000018	<0.00010	0.00203	0.00259	<0.00050	0.202	<0.00020	<0.0010	0.00016	0.00761	0.0270	<0.000100	<0.000050	<0.010	0.000145	117	<0.00010
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	Thin layer of ice, hollow, thin layer of ice to water. Slow flow.	<0.00050	2.57	0.00204	0.0210	22.3	1.56	<0.0000050	0.000168	0.00984	<0.050	0.389	0.000539	4.62	<0.000010	1.78	0.216	110	0.000013	<0.00010	0.00064	0.00168	<0.00050	0.231	<0.00020	<0.0010	<0.00010	0.0155	0.0215	<0.000100	<0.000050	<0.010	0.000103	133	<0.00010
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	Orange turbid water, staff gauge Downloaded, not ideal for flow measurement	0.00204	3.76	0.00539	0.0068	11.2	0.564	0.0000062	0.000139	0.00446	0.056	1.05	0.000201	2.47	0.000086	2.76	0.112	46.7	0.000013	<0.00010	<0.00630	0.000470	0.00068	0.146	<0.00020	0.0278	0.00070	0.00584	0.0309	<0.000100	<0.000050	<0.010	0.000402	54.9	<0.00050
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021		<0.00050	0.988	0.000271	0.0193	21.9	1.23	<0.0000050	0.000201	0.00795	<0.050	0.389	0.000461	4.38	<0.000010	1.75	0.216	106	0.000048	<0.00010	<0.00030	0.00149	<0.00050	0.158	<0.00020	0.0012	0.00012	0.00353	0.0242	<0.000100	<0.000050	<0.010	0.000125	114	<0.00050
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	Half frozen, muddy bottom. Loggers winterized and downloaded. Surveyed.	0.00057	3.81	0.000710	0.0182	20.4	1.27	<0.0000050	0.000210	0.00865	<0.050	0.340	0.000286	4.70	<0.000010	1.44	0.222	102	0.000014	<0.00010	0.00218	0.00149	<0.00050	0.189	<0.00020	0.0031	0.00016	0.00790	0.0222	<0.000100	<0.000050	<0.010	0.000142	116	<0.00050
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	tried one salt slug, water barely flowing	0.00056	8.60	0.00108	0.0249	24.3	2.06	<0.0000050	0.000232	0.0146	<0.050	0.409	0.000172	5.36	0.000013	5.14	0.235	117	0.000023	<0.00010	0.00364	0.00144	0.00059	0.323	<0.00020	0.0010	<0.00010	0.0155	0.0280	<0.000100	<0.000050	<0.010	0.0000995	154	<0.00050
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	2x salt slug, creek super turbid, logger de-winterized	0.00244	1.48	0.00538	0.0043	5.02	0.378	0.0000064	0.000122	0.00396	<0.050	0.448	0.000083	2.12	0.000063	1.42	0.0566	19.4	<0.000010	<0.00010	0.00154	0.000222	<0.00050	0.0685	<0.00020	0.0607	0.00026	0.00394	0.0180	<0.000100	<0.000050	<0.010	0.000143	29.1	<0.00050
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022		<0.00050	1.39	0.000211	0.0254	21.4	1.41	<0.0000050	0.000210	0.00988	<0.050	0.333	0.000340	4.79	<0.000010	1.46	0.259	119	0.000016	<0.00010	<0.00060	0.00130	<0.00050	0.191	<0.00020	0.0015	0.00016	0.00507	0.0273	<0.000100	<0.000050	<0.010	0.000135	151	<0.00050
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2022	Logger frozen in staff gauge, maybe not winterized. Creek frozen to bottom. Surveyed and dl logger. SG frozen @ 0.575 m																																		
KV-51	Christal Creek d/s Hinton Creek	09-Feb-2023		<0.00050	3.77	0.000208	0.0253	20.3	1.80	<0.0000050	0.000205	0.0121	<0.050	0.377	0.000139	4.91	<0.000010	1.58	0.223	107	0.000023	<0.00010	<0.00090	0.00114	<0.00050	0.284	<0.00020	0.0011	0.00012	0.0184	0.0230	<0.000100	<0.000050	<0.010	0.0000679	133	<0.00050
KV-51	Christal Creek d/s Hinton Creek	12-May-2023	High water - flooded vegetation. DO probe not working	0.00272	2.00	0.00416	0.0034	4.48	0.342	0.0000121	0.000118	0.00318	0.0324	0.745	0.000168	2.09	0.000076	4.32	0.0474	17.0	<0.000010	<0.00010	<0.00690	0.000160	0.00061	0.0750	0.00024	0.0901	0.00052	0.00268	0.0196	<0.000100	<0.000050	<0.010	0.000186	24.9	<0.00050
KV-51	Christal Creek d/s Hinton Creek	14-Jul-2023		<0.00050	1.72	0.000218	0.0225	22.1	1.51	<0.0000050	0.000243

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-51	Christal Creek d/s Hinton Creek	22-May-2024	Metallic odour, orange dust and color water. Impossible to accurately read staff gauge clearly. Orange precipate and overall weathering on SG, numbers blurred. Orange dust and precipatate in water and surrounding area. Dust kicked up from stepping around site. Downloaded SH. Could not find a baro. Midsection flow measurement.	0.00075	1.89	0.000730	0.0139	12.8	1.05	<0.0000050	0.000181	0.00661	<0.050	0.335	0.000200	3.87	0.000010	1.31	0.138	63.7	<0.000010	<0.00010	<0.00060	0.000582	<0.00050	0.135	<0.00020	0.0130	0.00017	0.00849	0.0243	<0.000100	<0.000050	<0.010	0.0000780	81.2	<0.00050
KV-51	Christal Creek d/s Hinton Creek	29-May-2024	Orange residue on trees, no ice present. Very slow flow.	0.00121	2.20	0.00173	0.0101	11.0	0.936	<0.0000050	0.000216	0.00570	<0.050	0.281	0.000232	3.42	0.000020	1.37	0.112	47.5	<0.000010	<0.00010	0.00108	0.000431	<0.00050	0.112	<0.00020	0.0202	0.00022	0.00794	0.0241	<0.000100	<0.000050	<0.010	0.0000693	63.2	<0.00050
KV-51	Christal Creek d/s Hinton Creek	07-Jul-2024	Ground is too soft for midsection flow measurement, due to sediment being stirred up. Went u/s where it narrows and did salt slug, data not good - discarded. Surveyed. Direct read needs cap. Willows at site need to be cleared. Could not download. Logger covered in sediment.	<0.00050	1.56	0.000260	0.0243	21.7	1.66	<0.0000050	0.000183	0.00964	0.0068	0.383	0.000135	4.62	<0.000010	1.69	0.241	123	0.000011	<0.00010	<0.00060	0.00120	<0.00050	0.189	<0.00020	0.0014	0.00012	0.00418	0.0275	<0.000100	<0.000050	<0.010	0.0000671	140	<0.00050
KV-51	Christal Creek d/s Hinton Creek	09-Oct-2024	Winterized logger, surveyed staff gauge. Logger was starting to freeze into stilling well	<0.00050	1.64	0.000247	0.0183	20.5	1.49	<0.0000050	0.000159	0.00896	0.0060	0.338	0.000229	4.46	<0.000010	1.53	0.211	99.3	0.000011	<0.00010	<0.00030	0.000996	<0.00050	0.198	<0.00020	0.0015	<0.00010	0.00757	0.0225	<0.000100	<0.000050	<0.010	0.0000953	127	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	No flow measurements due to ice blockages and willows.	0.00126	2.79	0.00131	0.0080	9.48	0.797	<0.0000050	0.000302	0.00420	<0.050	0.46	0.000101	3.68	0.000023	0.995	0.125	30.6	0.000027	<0.00010	0.00994	0.000187	0.00087	0.0594	<0.00030	0.0030	0.00012	0.00541	0.0336	<0.00010	<0.000050	<0.010	0.0000107	51.3	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	Site not suitable for flow. Site is in patchy grass and not visibly flowing	0.00075	1.52	0.000573	0.0026	7.15	1.20	0.0000052	0.000221	0.00311	<0.050	0.38	0.000117	2.64	<0.000010	0.681	0.0731	11.1	<0.000010	<0.00010	0.00046	0.000161	<0.00050	0.0245	<0.00030	0.0130	0.00019	0.00296	0.0427	<0.00010	<0.000050	<0.010	0.0000179	31.1	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	Too vegetated and overall poor conditions to conduct salt slug	0.00671	8.02	0.00436	0.0133	13.6	1.38	<0.0000050	0.000520	0.0101	0.144	0.56	0.000229	8.54	0.000072	1.60	0.153	48.5	0.000054	0.00073	0.0552	0.000353	0.00509	0.132	0.00046	0.0033	0.00021	0.0160	0.0435	<0.00010	<0.000050	<0.010	0.0000976	62.9	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	orange precipitate. No flow test done. Very willowy and blocked up slightly	0.00059	2.41	0.000414	0.0113	13.1	1.29	<0.0000050	0.000346	0.00614	<0.050	0.29	0.000052	4.83	<0.000010	1.31	0.157	47.0	0.000044	<0.00010	0.00405	0.000150	<0.00050	0.103	<0.00030	0.0038	0.00016	0.0124	0.0436	<0.00010	<0.000050	<0.010	0.000120	67.9	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019		<0.00050	2.73	0.000236	0.0118	12.8	1.46	<0.0000050	0.000389	0.00635	<0.050	0.29	0.000058	4.79	<0.000010	1.30	0.156	48.8	0.000037	<0.00010	0.00139	0.000145	<0.00050	0.122	<0.00030	0.0020	0.00013	0.00900	0.0451	<0.00010	<0.000050	<0.010	0.0000143	72.0	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	Ice layer - could not measure flow	0.00087	3.93	0.000862	0.0121	14.5	1.45	<0.0000050	0.000315	0.00685	<0.050	0.32	0.000062	5.16	0.000017	1.37	0.158	52.0	0.000036	0.00012	0.00651	0.000153	0.00084	0.131	<0.00030	0.0024	0.00011	0.00747	0.0461	<0.00010	<0.000050	<0.010	0.000169	71.4	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019	Dry																																			
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019	overflow slush, no sample taken																																			
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020	Too much snow to access site. Need snowshoes to break initial trail.																																			
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020	frozen/dry																																			
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020	Frozen																																			
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020	frozen																																			
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	DO will not calibrate, membrane needs replacement. No flow, conditions were not conducive. Flowing everywhere and through willows.	0.00192	0.929	0.00300	0.0014	2.75	0.180	<0.0000050	0.000120	0.00235	<0.050	0.77	0.000110	1.45	0.000043	0.266	0.0315	4.64	<0.000010	<0.00010	<0.0033	0.000040	<0.00050	0.0383	<0.00030	0.0519	0.00024	0.00219	0.0162	<0.00010	<0.000050	<0.010	0.000129	12.3	0.00014
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	No flow measurement.	0.00130	2.70	0.000751	0.0082	10.5	0.923	<0.0000050	0.000367	0.00522	<0.050	0.260	0.000127	4.19	0.000012	1.02	0.124	35.4	0.000028	<0.00010	0.00323	0.000135	<0.00050	0.0863	<0.00020	0.0122	0.00024	0.0131	0.0414	<0.000100	<0.000050	<0.010	0.000147	51.0	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020		0.00199	2.28	0.00136	0.0081	12.1	0.496	<0.0000050	0.000274	0.00440	<0.050	0.231	0.00133	4.59	0.000021	1.11	0.161	39.9	0.000026	<0.00010	0.00940	0.000340	0.00094	0.0658	0.00022	0.0180	0.00040	0.00613	0.0388	<0.000100	<0.000050	<0.010	0.000302	57.9	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020		0.00114	1.72	0.00118	0.0102	13.7	0.563	<0.0000050	0.000322	0.00530	<0.050	0.282	0.00147	5.15	0.000016	1.28	0.205	45.8	0.000033	<0.00010	<0.00810	0.000561	0.00084	0.0904	<0.00020	0.0057	0.00050	0.00611	0.0415	<0.000100	<0.000050	<0.010	0.000410	70.4	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020		0.00084	1.62	0.000687	0.0110	11.2	0.520	<0.0000050	0.000638	0.00505	<0.050	0.271	0.00153	4.72	<0.000010	1.20	0.204	49.4	0.000032	<0.00010	0.00296	0.000561	<0.00050	0.0946	<0.00020	0.0047	0.00046	0.00665	0.0405	<0.000100	<0.000050	<0.010	0.000447	74.0	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	water disturbed a little to clear ice.	0.00096	2.10	0.000910	0.0095	12.3	0.564	<0.0000050	0.000247	0.00563	<0.050	0.269	0.000626	5.04	<0.000010	1.23	0.179	45.7	0.000026	<0.00010	<0.00510	0.000327	<0.00050	0.114	<0.00020	0.0042	0.00045	0.00527	0.0394	<0.000100	<0.000050	<0.010	0.000408	67.2	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020	frozen.																																			
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	Overflow on ice, main channel flooded/frozen, no flow measurement. No filtering done - bottle damaged in transit	<0.00050	0.057	0.00473	0.0142	12.9	1.05	<0.0000050	0.000211	0.00709	<0.050	0.349	<0.000050	5.12	0.000035	1.74	0.151	50.2	0.000033	<0.00010	<0.00030	0.000079	<0.00050	0.159	<0.00020	<0.0010	0.00022	0.00093	0.0391	<0.000100	<0.000050	<0.010	0.000151	76.6	<0.00010
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	Unseen flow due to ice conditions, and collapesed ice. Not able to measure flow. Orange turbid water	0.00548	7.42	0.0331	0.0033	3.56	0.459	0.0000083	0.000391	0.00574	0.122	0.862	0.000182	2.92	0.000392	0.821	0.0430	8.97	0.000041	<0.00010	0.0218	0.000148	0.00227	0.106	0.00033	0.0423	0.00032	0.00354	0.0228	<0.000100	<0.000050	<0.010	0.000206	17.1	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	no flow measurement	0.00052	1.14	0.000926	0.0118	12.8	0.942	<0.0000050	0.000274	0.00585	<0.050	0.324	0.000052	5.17	<0.000010	1.32	0.159	46.6	0.000043	<0.00010	0.00063	0.000120	<0.00050	0.0997	<0.00020	0.0010	0.00034	0.00336	0.0378	<0.000100	<0.000050	<0.010	0.000311	72.1	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021		0.00165	4.70	0.00210	0.0115	12.7	0.895	<0.0000050	0.000303	0.00684	<0.050	0.310	0.000214	5.65	0.000024	1.24	0.166	46.3	0.000042	<0.00010	0.0101	0.000239	0.00114	0.133	<0.00020	0.0044	0.00035	0.00693	0.0343	<0.000100	<0.000050	<0.010	0.000395	69.0	0.00086
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	Low flow, sample only	<0.00050	3.53	0.000071	0.0224	18.2	1.73	<0.0000050	0.000245	0.00958	<0.050	0.370	<0.000050	5.33	<0.000010	1.45	0.196	103	0.000027	<0.00010	<0.00030	0.000402	<0.00050	0.236	<0.00020	0.0016	0.00012	0.0175	0.0285	<0.000100	<0.000050	<0.010	0.0000825	115	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	still under ice/snow	0.00338	2.15	0.0140	0.0028	3.75	0.252	0.0000075	0.000206	0.00378	0.053	0.410	0.000185	2.30	0.000168	0.466	0.0467	8.72	<0.000010	<0.00010	<0.00690	0.000064	0.00073	0.0459	0.00026	0.0552	0.00036	0.00342	0.0226	<0.000100	<0.000050	<0.010	0.000131	18.7	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	super flooded, no flow, in the veg.	0.00309	10.5	0.00698	0.0109	12.7	1.08	0.0000052	0.000439	0.00760	0.112	0.335	0.000612	6.51	0.000070	1.36	0.182	44.1	0.000053	<0.00010	0.0190	0.000345	0.00210	0.131	<0.00020	0.0038	0.00035	0.00793	0.0429	<0.000100	<0.000050	<0.010	0.000274	68.3	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022	Frozen																																			
KV-117	Christal Creek u/s Flame & Moth discharge	09-Feb-2023	Frozen																																			
KV-117	Christal Creek u/s Flame & Moth discharge	12-May-2023	No flow measurement	0.00408	3.24	0.0130	0.0028	2.94	0.309	0.0000093	0.000262	0.00376	0.0548	0.513	0.000157	2.44	0.000142	0.508	0.0404	6.45	0.000019	<0.00010	0.0132	0.000107	0.00146	0.0542	0.00039	0.0901	0.00030	0.00323	0.0230	<0.000100	<0.000050	<0.010	0.000177	14.9	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	27-Jun-2023		0.00080	1.79	0.00113	0.0104	12.2	0.683	<0.0000050	0.000312	0.00487	0.0207	0.273	0.000666	4.37	0.000010	1.38	0.177	43.9	0.000022	<0.00010	0.00160	0.000360	<0.00050	0.0753	<0.00020	0.0068	0.00043	0.00784	0.0423	<0.000100	<0.000050	<0.010	0.000478	65.5	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	14-Jul-2023		0.00059	1.93	0.000951	0.0114	13.0	0.876	<0.0000050	0.000337	0.00511	0.0216	0.299	0.000539	5.30	<0.000010	1.54	0.179	49.6	0.000026	<0.00010	0.00330	0.000363	<0.00050	0.0849	<0.00020	0.0030	0.00037	0.00637	0.0502	<0.000100	<0.000050	<0.010	0.000352	72.3	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	19-Aug-2023		0.00085	2.64	0.00128	0.0106	12.0	0.999	<0.0000050	0.000330	0.00549	0.0228	0.297	0.000119	5.34	0.000014	1.36	0.166	44.4	0.000028	<0.00010	0.00442	0.000222	0.00058	0.0957	<0.00020	0.0025	0.00031	0.00645	0.0471	<0.000100	<0.000050	<0.010	0.000254	68.4	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	14-Sep-2023		<0.00050	2.09	0.00108	0.0099	11.9	0.943	<0.0000050	0.000290	0.00512	<0.050	0.302	0.000071	4.90	<0.000010	1.38	0.150	42.8	0.000029	<0.00010	0.00133	0.000174	<0.00050	0.0869	<0.00020	0.0028	0.00027	0.00634	0.0384	<0.000100	<0.000050	<0.010	0.000292	58.6	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	25-Oct-2023	sample only site	0.00059	2.54	0.000776	0.0112	12.2	0.871	<0.0000050	0.000220	0.00490	0.0109	0.319	0.000064	5.56	<0.000010	1.29	0.160	48.0	0.000027	<0.00010	0.00149	0.000125	<0.00050	0.0998	<0.00020	0.0074	0.00024	0.00629	0.0388	<0.000100	<0.000050	<0.010	0.000329	59.5	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	18-Nov-2023		<0.00050	6.59	0.000381	0.0254	21.4	2.18	<0.0000050	0.000216	0.00903	<0.050	0.341	0.000055	5.54	<0.000010	1.33	0.220	111	0.000010	<0.00010	0.00131	0.000520	<0.00050	0.249	<0.00020	0.0054	0.00011	0.0244	0.0358	<0.000100	<0.000050	<0.010	0.000108	131	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	11-Dec-2023	Maxed out auger but was able to chip to bottom, bring an auger extension next trip. Turbid and had sulfur swamp odor. Sample shows evidence of sediment contamination (TSS = 901 mg/L); TSS, total metals, Cl, Na-D and K-D results non-representative and removed.																										0.0113	0.00017	0.00522	0.111	<0.000100	<0.000050	<0.010	0.0000174	90.9	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	25-Jan-2024	Overflow sample KV-117-OF																																			
KV-117	Christal Creek u/s Flame & Moth discharge	16-Feb-2024	could not locate water, area heavily glaciated																																			
KV-117	Christal Creek u/s Flame & Moth discharge	29-Mar-2024	Glaciated																																			
KV-117	Christal Creek u/s Flame & Moth discharge	21-Apr-2024	Frozen to bottom, 12 ft of ice																																			
KV-117	Christal Creek u/s Flame & Moth discharge	10-May-2024	Large glacier at sample point on map. Sampled below glacier above KV-121. Some orange precipitate on bottom. Clear water.	0.00138	2.13	0.00365	0.0102	10.2	0.727	<0.0000050	0.000208	0.00436	0.0224	0.439	0.000134	3.18	0.000033	1.02	0.108	43.5	<0.000010	<0.00010	0.00121	0.000208	<0.00050	0.0948	<0.00020	0.0279	0.00030	0.00965	0.0241	<0.000100	<0.000050	<0.010	0.0000815	57.0	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	08-Jun-2024	Walked to gps point and could not find a seep. Lots of unthawed snow/ice on ground and some pools of water (suspected melt).																																			
KV-117	Christal Creek u/s Flame & Moth discharge	09-Jul-2024	Site looks old, willows should be cleared. Set did not have a syringe, triple rinsed 121's	0.00089	5.43	0.00265	0.0104	13.5	1.24	<0.0000050	0.000315	0.00624	0.0424	0.273	0.000082	5.27	0.000028	1.43	0.150	42.8	0.000022	<0.00010	0.00489	0.000167	0.00058	0.106	<0.00020	0.0042	0.00021	0.00770	0.0453	<0.000100	<0.000050	<0.010	0.000134	59.1	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	15-Aug-2024	No visible changes, willows should be cleared. Kind of smells like an outhouse	<0.00050	2.01	0.00506	0.0107	11.8	1.02	<0.0000050	0.000269	0.00531	<0.050	0.319	0.000063	4.99	0.000045	1.52	0.154	42.4	0.000021	<0.00010	0.00294	0.000161	<0.00050	0.102	<0.00020	0.0024	0.00026	0.00377	0.0415	<0.000100	<0.000050	<0.010	0.0000372	61.9	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	05-Sep-2024	Site good no change, slightly turbid, flow not monitored	0.00518	4.67	0.0896	0.0119	13.1	1.00	0.0000084	0.000530	0.00660	0.075	0.646	0.000198	6.02	0.00135	2.54	0.184	37.7	0.000048	0.00018	0.0294	0.000262	0.00318	0.156	0.00034	0.0079	0.00062	0.00367	0.0463	<0.000100	<0.000050	<0.010	0.000162	59.7	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	10-Oct-2024	Orange, ice forming	<0.00050	1.54	0.000471	0.0102	12.7	0.953	<0.0000050	0.000262	0.00509	0.0096	0.262	0.000054	4.82	<0.000010	1.38	0.162	42.2	0.000029	<0.00010	<0.00100	0.000136	<0.00050	0.0953	<0.00020	0.0032	0.00017	0.00406	0.0392	<0.000100	<0.000050	<0.010	0.000125	63.7	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	06-Nov-2024	Water was turbid and orange, pressure was released cutting through the ice.	0.00096	47.0	0.00220	0.0178	15.7	1.52	<0.0000050	0.000637	0.00930	0.454	0.578	0.000050	7.12	0.000031	1.74	0.181	71.8	0.000040	<0.00010	<0.00240	0.00111	<0.00050	0.385	<0.00020	0.0024	0.00013	0.0172	0.0298	<0.000100	<0.000050	<0.010	0.000107	91.9	<0.00050
KV-117	Christal Creek u/s Flame & Moth discharge	05-Dec-2024	Covered in overflow and slush. orange particles floating in the water and the water is orange	0.00174	94.2	0.00770	0.0120	14.2	1.52	0.0000055	0.000417	0.00773	0.319	0.573	0.000256	8.79	0.000075	1.93	0.192	51.5	0.000026	<0.00010	0.00369	0.000279	0.00142	0.342	0.00080	0.0020	0.00014	0.00308	0.0514	<0.000020	<0.000050	<0.010	0.000147	70.3	<0.00050
KV-121	Christal Seep	10-Feb-2019	SPC moving around (1024-750) depending on placement, taking time to stabilize.	0.00143	3.29	0.000556	0.0128	22.7	0.563	<0.0000050	0.000125	0.00675	<0.050	0.39	0.000935	3.79	0.000019	1.66	0.205	87.6	<0.000010	<0.00010	0.00315	0.00307	<0.00050	0.154	<0.00030	<0.0010	<0.00010	0.00942	0.0168	<0.00010	<0.000050	<0.010	0.000134	102	<0.00010
KV-121	Christal Seep	12-Feb-2019	No sample taken, revisit for flow measurements. Good flow, mix in 3/4 bucket, mud disturbed when poured. Slightly d/s from original sampling site.																																			
KV-121	Christal Seep	06-Mar-2019	flowing well	<0.00050	3.78	0.000220	0.0228	21.7	1.38	<0.0000050	0.000174	0.0112	<0.050	0.39	0.000274	4.45	<0.000010	1.65	0.215	126	0.000010	<0.00010	<0.0012	0.00157	<0.00050	0.242	<0.00030	0.0012	<0.00010	0.0287	0.0184	<0.00010	<0.000050	<0.010	0.0000619	148	0.00019
KV-121	Christal Seep	18-Apr-2019	u/s: multiple outlets of the same seep collecting into one stream, with another stream (christal?) coming in from the south. Orange sludge with gray sediment.	<0.00050	3.43	0.000918	0.0233	23.0	1.85	<0.0000050	0.000207	0.0122	<0.050	0.41	0.000166	4.32	<0.000010	1.50	0.210	123	0.000013	<0.00010	<0.00060	0.00113	<0.00050	0.257	<0.00030	0.0011	<0.00010	0.0250	0.0219	<0.00010	<0.000050	<0.010	0.0000767	138	0.00025
KV-121	Christal Seep	19-May-2019	SPC fluctuating. Many seeps at site too short for salt slug; salt slug starts where seeps combine and is measured down christal creek.	<0.00050	2.66	<0.000050	0.0272	31.8	2.35	<0.0000050	0.000180	0.0216	<0.050	0.50	0.000169	4.08	<0.000010	2.07	0.310	164	0.000018	<0.00010	<0.00030	0.00257	<0.00050	0.420	<0.00030	<0.0010	<0.00010	0.0399	0.0110	<0.00010	<0.000050	<0.010	0.000144	208	<0.00010
KV-121	Christal Seep	07-Jun-2019	Many seeps at site, conjoin into 1 which flow into Christal Creek. From left to right 4 seeps identified and YSI for SPC/pH/ORP:1)721.9/6.97/64.7; 2) 626.2/7.09/52.4; 3) 643.3/7.01/66.5; 4) 609.7;7.01;71.1	<0.00050	1.97	<0.000050	0.0177	34.3	1.18	<0.0000050	0.000084	0.0123	<0.050	0.41	0.000742	3.91	<0.000010	2.35	0.290	145	<0.000010	<0.00010	<0.00030	0.00346	<0.00050	0.258	<0.00030	<0.0010	<0.00010	0.00795	0.0203	<0.00010	<0.000050	<0.010	0.000173	131	<0.00010
KV-121	Christal Seep	22-Jul-2019	Salt slug d/s (0.0171 m3/s) and u/s (0.0103 m3/s) of site. SPC jumping a bit.	<0.00050	3.95	<0.000050	0.0260	31.9	1.71	<0.0000050	0.000122	0.0181	<0.050	0.39	0.000442	4.01	<0.000010	1.82	0.300	174	0.000012	<0.00010	<0.00030	0.00305	<0.00050	0.371	<0.00030	<0.0010	<0.00010	0.0351	0.0157	<0.00010	<0.000050	<0.010	0.000121	193	<0.00010
KV-121	Christal Seep	01-Aug-2019	Flow measured d/s.	<0.00050	4.93	<0.000050	0.0296	32.1	1.99	<0.0000050	0.000152	0.0208	<0.050	0.40	0.000427	4.30	<0.000010	1.76	0.292	181	<0.000010	<0.00010	<0.00030	0.00287	<0.00050	0.387	<0.00030	<0.0010	<0.00010	0.0395	0.0146	<0.00010	<0.000050	<0.010	0.000119	204	<0.00010
KV-121	Christal Seep	17-Sep-2019	Took two sets of additional insitu readings nearby; both are u/s of KV-121.	<0.00050	0.703	<0.000050	0.0116	24.3	0.324	<0.0000050	0.000102	0.00351	<0.050	0.36	0.000972	3.68	<0.000010	1.94	0.216	87.0	<0.000010	<0.00010	<0.00030	0.00268	<0.00050	0.0878	<0.00030	<0.0010	<0.00010	0.00519	0.0165	<0.00010	<0.000050	<0.010	0.000129	91.3	<0.00010
KV-121	Christal Seep	04-Oct-2019	No flow measurements	<0.00050	5.14	0.000207	0.0285	23.6	2.21	<0.0000050	0.000247	0.0111	<0.050	0.35	<0.000050	4.93	0.000012	1.37	0.231	142	0.000013	<0.00010	0.00100	0.000449	<0.00050	0.220	<0.00030	0.0025	<0.00010	0.0152	0.0287	<0.00010	<0.000050	<0.010	0.0000398	157	<0.00010
KV-121	Christal Seep	28-Nov-2019		<0.00050	3.57	0.000066	0.0243	23.4	1.59	<0.0000050	0.000173	0.0107	<0.050	0.35	0.000253	4.41	<0.000010	1.69	0.209	113	0.000012	<0.00010	0.00035	0.00135	<0.00050	0.234	<0.00030	0.0012	<0.00010	0.0223	0.0214	<0.00010	<0.000050	<0.010	0.0000438	134	<0.00010
KV-121	Christal Seep	14-Dec-2019		<0.00050	1.89	<0.000050	0.0162	24.9	0.930	<0.0000050	0.000132	0.00877	<0.050	0.37	0.000641	3.86	<0.000010	1.98	0.207	95.3	<0.000010	<0.00010	<0.00030	0.00226	<0.00050	0.187	<0.00030

Station	Description	Sample Date	Sample Comments	Copper (Cu), total	Iron (Fe), total	Lead (Pb), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Phosphorus (P), total	Potassium (K), total	Selenium (Se), total	Silicon (Si), total	Silver (Ag), total	Sodium (Na), total	Strontium (Sr), total	Sulphur (S), total	Thallium (Tl), total	Tin (Sn), total	Titanium (Ti), total	Uranium (U), total	Vanadium (V), total	Zinc (Zn), total	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calcium (Ca), dissolved	Chromium (Cr), dissolved
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
KV-121	Christal Seep	17-Apr-2020		<0.00050	3.63	0.000115	0.0264	25.4	1.70	<0.0000050	0.000217	0.0161	<0.050	0.41	0.000214	3.82	<0.000010	2.09	0.218	129	0.000016	<0.00010	<0.00030	0.00211	<0.00050	0.314	<0.00030	0.0011	<0.00010	0.0455	0.0100	<0.00010	<0.000050	<0.010	0.0000656	149	<0.00010
KV-121	Christal Seep	07-May-2020	DO will not calibrate, membrane needs replacement. No flow at this site. Conditions for flow were not good, too much pooling. Sampled where two seeps join.	0.00200	0.554	0.000935	0.0048	9.53	0.237	<0.0000050	0.000096	0.00301	<0.050	1.40	0.000206	1.55	0.000042	1.43	0.0775	37.2	<0.000010	<0.00010	<0.00030	0.000397	<0.00050	0.626	<0.00030	0.0146	0.00063	0.00863	0.0190	<0.00010	<0.000050	<0.010	0.00296	43.0	<0.00010
KV-121	Christal Seep	07-Jun-2020		<0.00050	3.87	<0.000050	0.0241	30.1	1.78	<0.0000050	0.000164	0.0170	<0.050	0.404	0.000288	4.18	<0.000010	2.02	0.276	164	0.000010	<0.00010	<0.00030	0.00259	<0.00050	0.373	<0.00020	<0.0010	<0.00010	0.0395	0.0170	<0.000100	<0.000050	<0.010	0.000122	174	<0.00010
KV-121	Christal Seep	11-Jul-2020		<0.00050	4.42	<0.000050	0.0290	35.4	2.10	<0.0000050	0.000194	0.0197	<0.050	0.424	0.000558	4.28	<0.000010	1.92	0.296	185	0.000014	<0.00010	<0.00030	0.00294	<0.00050	0.380	<0.00020	0.0012	<0.00010	0.0402	0.0171	<0.000100	<0.000050	<0.010	0.000180	187	<0.00010
KV-121	Christal Seep	12-Aug-2020		<0.00050	4.52	<0.000050	0.0272	28.2	1.75	<0.0000050	0.000158	0.0173	<0.050	0.379	0.000711	4.26	<0.000010	1.80	0.298	156	0.000011	<0.00010	<0.00030	0.00377	<0.00050	0.346	<0.00020	0.0017	<0.00010	0.0278	0.0229	<0.000100	<0.000050	<0.010	0.000175	154	<0.00010
KV-121	Christal Seep	23-Sep-2020		<0.00050	2.60	<0.000050	0.0203	27.6	1.20	<0.0000050	0.000106	0.0117	<0.050	0.406	0.00108	3.94	<0.000010	2.32	0.269	130	0.000010	<0.00010	<0.00030	0.00544	<0.00050	0.256	<0.00020	<0.0010	<0.00010	0.0386	0.0171	<0.000100	<0.000050	<0.010	0.000137	180	<0.00010
KV-121	Christal Seep	18-Oct-2020		<0.00050	3.60	<0.000050	0.0250	27.3	1.66	<0.0000050	0.000158	0.0167	<0.050	0.403	0.000692	4.60	<0.000010	1.91	0.271	147	<0.000010	<0.00010	<0.00030	0.00465	<0.00050	0.341	<0.00020	<0.0010	<0.00010	0.0436	0.0157	<0.000100	<0.000050	<0.010	0.000132	191	<0.00010
KV-121	Christal Seep	11-Nov-2020	Flow not measured. No ice on stream.	<0.00050	1.15	0.000073	0.0111	23.4	0.543	<0.0000050	0.000086	0.00539	<0.050	0.393	0.00148	3.55	<0.000010	2.49	0.216	86.3	<0.000010	<0.00010	<0.00030	0.00498	<0.00050	0.131	<0.00020	<0.0010	<0.00010	0.0135	0.0230	<0.000100	<0.000050	<0.010	0.000149	119	<0.00010
KV-121	Christal Seep	24-Mar-2021	No flow measurement, condtions not ideal. ORP slow to climb	<0.00050	1.20	0.000213	0.0114	22.4	0.516	<0.0000050	0.000103	0.00525	<0.050	0.369	0.00118	3.56	<0.000010	2.68	0.202	84.4	<0.000010	<0.00010	<0.00030	0.00269	<0.00050	0.124	<0.00020	<0.0010	<0.00010	0.0120	0.0179	<0.000100	<0.000050	<0.010	0.000139	102	<0.00010
KV-121	Christal Seep	07-May-2021		0.00064	1.54	0.00945	0.0146	28.1	0.683	<0.0000050	0.000067	0.00696	<0.050	2.65	0.000128	3.69	0.000078	9.30	0.243	148	<0.000010	<0.00010	<0.00030	0.000840	<0.00050	0.521	<0.00020	0.0030	0.00235	0.0170	0.0950	<0.000100	<0.000050	<0.010	0.00287	130	<0.00050
KV-121	Christal Seep	16-Jul-2021		<0.00050	3.00	0.00209	0.0228	27.8	1.33	<0.0000050	0.000106	0.0114	<0.050	0.460	0.000510	3.86	<0.000010	2.03	0.244	123	<0.000010	<0.00010	<0.00030	0.00257	<0.00050	0.234	<0.00020	0.0016	<0.00010	0.0203	0.0193	<0.000100	<0.000050	<0.010	0.000123	99.6	<0.00050
KV-121	Christal Seep	15-Oct-2021		<0.00050	6.87	<0.000050	0.0398	32.4	2.93	<0.0000050	0.000157	0.0291	<0.050	0.421	<0.000050	4.76	<0.000010	1.63	0.315	190	0.000023	<0.00010	<0.00030	0.00263	<0.00050	0.627	<0.00020	0.0029	<0.00010	0.0592	0.00843	<0.000100	<0.000050	<0.010	0.0000827	224	<0.00050
KV-121	Christal Seep	22-Feb-2022	sample only	<0.00050	5.18	0.00258	0.0284	29.2	2.08	<0.0000050	0.000216	0.0208	<0.050	0.464	0.000284	5.23	0.000038	2.27	0.261	159	0.000022	<0.00010	<0.00030	0.00309	<0.00050	0.431	<0.00020	<0.0010	<0.00010	0.0464	0.0130	<0.000100	<0.000050	<0.010	0.000114	183	<0.00050
KV-121	Christal Seep	15-May-2022		0.00050	5.14	0.000824	0.0240	22.6	2.16	<0.0000050	0.000146	0.0207	<0.050	0.556	0.000052	3.92	0.000019	1.69	0.223	133	0.000016	<0.00010	0.00032	0.00190	<0.00050	0.469	<0.00020	0.0028	0.00018	0.0436	0.00943	<0.000100	<0.000050	<0.010	0.000250	157	<0.00050
KV-121	Christal Seep	09-Jun-2022		<0.00050	5.60	0.000063	0.0217	29.9	2.32	<0.0000050	0.000207	0.0195	<0.050	0.466	0.000268	5.04	<0.000010	1.85	0.260	144	0.000026	<0.00010	<0.00030	0.00322	<0.00050	0.382	<0.00020	0.0011	<0.00010	0.0391	0.0189	<0.000100	<0.000050	<0.010	0.000112	154	<0.00050
KV-121	Christal Seep	03-Aug-2022	seep, no flow	<0.00050	2.49	0.000970	0.0206	28.6	1.48	<0.0000050	0.000217	0.0136	<0.050	0.360	0.000563	4.73	<0.000010	1.95	0.258	135	0.000010	<0.00010	<0.00030	0.00432	<0.00050	0.293	<0.00020	0.0016	<0.00010	0.0175	0.0212	<0.000100	<0.000050	<0.010	0.000292	154	<0.00050
KV-121	Christal Seep	16-Oct-2022	Sample only, creek mostly frozen, bottom stirred up from breaking ice	<0.00050	6.92	0.000072	0.0341	33.2	2.94	<0.0000050	0.000154	0.0284	<0.050	0.419	0.000156	4.71	<0.000010	1.95	0.291	190	0.000021	<0.00010	0.00032	0.00286	<0.00050	0.602	<0.00020	0.0082	<0.00010	0.0564	0.00975	<0.000100	<0.000050	<0.010	0.000141	249	<0.00050
KV-121	Christal Seep	09-Feb-2023		<0.00050	4.40	0.000203	0.0249	24.3	1.79	<0.0000050	0.000122	0.0158	<0.050	0.508	0.000417	4.85	<0.000010	2.11	0.231	121	0.000018	<0.00010	<0.00030	0.00302	<0.00050	0.342	<0.00020	<0.0010	0.00014	0.0281	0.0141	<0.000100	<0.000050	<0.010	0.000129	138	<0.00050
KV-121	Christal Seep	20-Apr-2023	Sample only, very shallow/orange, hard to not stir up	<0.00050	7.77	<0.000050	0.0345	29.3	3.03	<0.0000050	0.000179	0.0299	<0.050	0.442	0.000057	4.91	<0.000010	1.73	0.290	184	0.000028	<0.00010	<0.00030	0.00236	<0.00050	0.640	<0.00020	0.0014	<0.00010	0.0647	0.00747	<0.000100	<0.000050	<0.010	0.0000648	197	<0.00050
KV-121	Christal Seep	12-May-2023	May have sampled meltwater. No flow measurement.	0.00141	1.58	0.000413	0.0103	13.4	0.782	<0.0000050	0.000107	0.00713	0.0101	1.68	0.000285	2.77	0.000034	13.8	0.129	58.1	<0.000010	<0.00010	<0.00030	0.000967	<0.00050	0.307	<0.00020	0.0017	0.00021	0.0242	0.0128	<0.000100	<0.000050	<0.010	0.000133	113	<0.00050
KV-121	Christal Seep	27-Jun-2023		<0.00050	5.74	<0.000050	0.0338	32.8	2.43	<0.0000050	0.000136	0.0252	0.0021	0.418	0.000245	4.44	<0.000010	1.56	0.342	210	0.000020	<0.00010	<0.00030	0.00343	<0.00050	0.481	<0.00020	0.0015	<0.00010	0.0510	0.0125	<0.000100	<0.000050	<0.010	0.000102	238	<0.00050
KV-121	Christal Seep	14-Jul-2023		<0.00050	2.39	0.000065	0.0192	28.4	1.09	<0.0000050	0.000097	0.0106	<0.0020	0.438	0.000959	4.22	<0.000010	2.71	0.261	130	<0.000010	<0.00010	<0.00030	0.00506	<0.00050	0.228	<0.00020	0.0012	<0.00010	0.0159	0.0237	<0.000100	<0.000050	<0.010	0.000161	143	<0.00050
KV-121	Christal Seep	19-Aug-2023		<0.00050	2.73	<0.000050	0.0197	25.8	1.32	0.0000568	0.000101	0.0120	<0.0020	0.386	0.000831	4.14	<0.000010	2.24	0.264	126	<0.000010	<0.00010	<0.00030	0.00378	<0.00050	0.254	<0.00020	<0.0010	<0.00010	0.0280	0.0174	<0.000100	<0.000050	<0.010	0.000140	158	<0.00050
KV-121	Christal Seep	14-Sep-2023		<0.00050	2.61	<0.000050	0.0187	24.2	1.29	<0.0000050	0.000098	0.0120	<0.050	0.389	0.000712	3.99	<0.000010	2.07	0.234	125	<0.000010	<0.00010	<0.00030	0.00314	<0.00050	0.270	<0.00020	0.0010	<0.00010	0.0268	0.0148	<0.000100	<0.000050	<0.010	0.000135	142	<0.00050
KV-121	Christal Seep	26-Oct-2023	Sample only	<0.00050	2.70	0.000163	0.0179	20.7	1.14	<0.0000050	0.000082	0.0103	<0.0020	0.367	0.000726	4.32	<0.000010	1.69	0.204	103	0.000010	<0.00010	<0.00030	0.00250	<0.00050	0.216	<0.00020	<0.0010	<0.00010	0.0154	0.0162	<0.000100	<0.000050	<0.010	0.000122	120	<0.00050
KV-121	Christal Seep	18-Nov-2023		0.00124	1.62	0.000098	0.0142	19.4	0.697	<0.0000050	0.000084	0.00655	<0.050	0.470	0.000802	3.98	<0.000010	1.69	0.178	73.5	<0.000010	<0.00010	<0.00030	0.00229	<0.00050	0.149	<0.00020	<0.0010	<0.00010	0.00909	0.0176	<0.000100	<0.000050	<0.010	0.000120	94.4	<0.00050
KV-121	Christal Seep	11-Dec-2023		<0.00050	6.16	0.000442	0.0225	19.6	1.85	<0.0000050	0.000233	0.00969	<0.050	0.367	<0.000050	5.78	<0.000010	1.50	0.210	104	0.000015	<0.00010	0.00121	0.000406	<0.00050	0.250	<0.00020	0.0178	0.00015	0.0217	0.0360	<0.000100	<0.000050	<0.010	0.000133	117	<0.00050
KV-121	Christal Seep	25-Jan-2024		<0.00050	5.35	0.000195	0.0324	29.3	2.21	<0.0000050	0.000140	0.0200	<0.050	0.523	0.000464	5.59	<0.000010	2.22	0.302	170	0.000017	<0.00010	0.00058	0.00264	<0.00050	0.433	<0.00020	0.0013	<0.00010	0.0441	0.0165	<0.000100	<0.000050	<0.010	0.000158	193	<0.00050
KV-121	Christal Seep	16-Feb-2024	seeps barely flowing, sampled collection pond	<0.00050	7.55	0.000477	0.0361	29.6	3.26	<0.0000050	0.000179	0.0303	0.0028	0.402	<0.000050	5.07	0.000024	1.52	0.293	180	0.000028	<0.00010	<0.00060	0.00246	<0.00050	0.654	<0.00020	0.0012	<0.00010	0.0573	0.00683	<0.000100	<0.000050	<0.010	0.0000589	208	<0.00050
KV-121	Christal Seep	29-Mar-2024	Glaciated																																		
KV-121	Christal Seep	21-Apr-2024	Muddy pool when first broke through but settled out nicely	0.00069	14.2	0.00176	0.0317	24.9	3.13	<0.0000050	0.000196	0.0272	<0.050	0.423	<0.000050	5.47	0.000045	2.07	0.242	158	0.000029	<0.00010	<0.00090	0.00234	<0.00050	0.615	<0.00020	<0.0010	<0.00010	0.0447	0.00853	<0.000100	<0.000050	<0.010	0.000128	176	<0.00050
KV-121	Christal Seep	10-May-2024	Light orange colour on bottom, clear water. Sampled from old auger hole near orange stain.	0.00052	2.56	0.000669	0.0226	18.8	1.44	<0.0000050	0.000091	0.0134	0.0075	0.547	<0.000050	3.96	0.000044	2.62	0.186	116	0.000012	<0.00010	<0.00030	0.00149	<0.00050	0.364	<0.00020	0.0018	0.00013	0.0201	0.00839	<0.000100	<0.000050	<0.010	0.000124	132	<0.00050
KV-121	Christal Seep	08-Jun-2024	Sampled by tree before seep enters Christal. Lots of precipitate on seep bottom. Difficult not to stir up while sampling.	<0.00050	0.930	<0.000050	0.0134	21.5	0.417	<0.0000050	0.000059	0.00432	<0.050	0.397	0.000789	3.84	<0.000010	2.14	0.185	83.7	<0.000010	<0.00010	<0.00030	0.00294	<0.00050	0.107	<0.00020	<0.0010	<0.00010	0.00935	0.0144	<0.000100	<0.000050	<0.010	0.000131	101	<0.00050
KV-121	Christal Seep	09-Jul-2024	Sampled before seep flows into Christal, even drawing water up with syringe disturbed bottom, tried to not disturb while sampling but very hard	<0.00050	6.67	0.000082	0.0312	30.3	3.02	<0.0000050	0.000147	0.0272	<0.050	0.386	0.000256	4.77	<0.000010	1.52	0.266	170	0.000018	<0.00010	<0.00030	0.00246	<0.00050	0.553	<0.00020	<0.0010	<0.00010	0.0578	0.0111	<0.000100	<0.000050	<0.010	0.0000994	190	<0.00050
KV-121	Christal Seep	15-Aug-2024	Site looks good, no visible change	<0.00050	5.26	0.000132	0.0295	27.6	2.47	<0.0000050	0.000132	0.0235	<0.050	0.408	0.000263	4.59	<0.000010	1.63	0.263	156	0.000020	<0.00010	<0.00030	0.00260	<0.00050	0.490	<0.00020	0.0018	<0.00010	0.0466	0.0111	<0.000100	<0.000050	<0.010	0.000132	184	<0.00050
KV-121	Christal Seep	05-Sep-2024	Sample only, site is good no change. Flow not monitored.	<0.00050	3.68	<0.000050	0.0271	25.9	1.88	<0.0000050	0.000104	0.0161	<0.050	0.362	0.000467	4.81	<0.000010	1.72	0.235	138	0.000015	<0.00010	<0.00030	0.00209	<0.00050	0.346	<0.00020	0.0014	<0.00010	0.0330	0.00980	<0.000100	<0.000050	<0.010	0.0000866	166	<0.00050
KV-121	Christal Seep	13-Oct-2024		<0.00050	4.06	0.000509	0.0129	19.7	0.939	<0.0000050	0.000106	0.00804	0.0041	0.305	0.000926	3.93	<0.000010	1.45	0.181	76.2	0.000012	<0.00010	<0.00030	0.00190	<0.00050	0.180	<0.00020	<0.0010	<0.00010	0.0236	0.0168	<0.000100	<0.000050	<0.010	0.000110	110	<0.00050
KV-121	Christal Seep	06-Nov-2024	Open spots but mostly frozen over.	0.0103	1.68	0.00182	0.0084	19.4	1.22	<0.0000050	0.000237	0.0125	0.052	0.445	0.00135	3.98	0.000184	2.42	0.185	61.2	<0.000010	<0.00010	0.00273	0.00322	0.00051	0.248	<0.00020	<0.0010	<0.00010	0.00024	0.0180	<0.000100	<0.000050	<0.010	0.000155	78.9	<0.00050
KV-121	Christal Seep	05-Dec-2024		0.00084	0.061	0.000163	0.0078	20.5	0.0323	<0.0000050	<0.000050	0.00064	<0.050	0.440	0.00117	3.76	0.000011	2.59	0.190	63.1	<0.000010	<0.00010	<0.00030	0.00176	<0.00050	0.0376	<0.00020	<0.0010	<0.00010	0.00030	0.0198	<0.000020	<0.000050	<0.010	0.000186	80.6	<0.00050
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021																																			
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021		0.00102	0.010	0.00625	0.0176	55.3	0.131	<0.0000050	0.00681	0.00407	<0.050	4.85	0.000356	5.80	0.000017	26.9	0.692	252	0.000057	<0.00010	<0.00060	0.00872	0.00220	0.0133	<0.00020	0.0026	0.0106	0.0115	0.0220	<0.000100	<0.000050	0.030	0.000133	182	0.00597
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021		<0.00050	0.020	0.00560	0.0184	46.5	0.0488	<0.0000050	0.00420	0.00288	<0.050	3.03	0.000320	5.85	0.000016	10.9	0.597	200	0.000054	<0.00010	<0.00030	0.00857	0.00205	0.0094	<0.00020	0.0048	0.0105	0.0128	0.0135	<0.000100	<0.000050	0.039	0.000152	163	0.00216

Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
CCME-Aquatic												*																		*					
BC-ENV Aquatic Life					*			*								*																			
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008		0.0004	<0.001		0.16	0.0022	0.00200	0.01	24.3	1.45	0.77		<0.001	0.0014			0.6	0.0009	4.36	<0.0001	1.6	0.239	100	<0.00005	<0.001	0.0054	0.0047	0.0002	0.104	0.044					
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008		0.0009	0.001		0.24	0.0024	0.00174	0.006	11.7	0.702	0.64		<0.001	0.0035			0.5	0.0004	1.9	0.00001	0.8	0.142	56	<0.00005	<0.001	0.0064	0.0017	0.0001	0.245	0.024					
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008		0.0002	<0.001		0.05	0.0012	0.00193	0.009	21.1	0.281			<0.001	<0.0005			<0.4	0.0009	2.03	0.00008	1.2	0.21	91.4	<0.00005	<0.001	0.003	0.0044	0.0001	0.287	0.027					
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008		0.0002	<0.001		0.07	0.0023	0.00190	0.008	20.3	0.248	0.86		<0.001	0.0006			<0.4	0.0006	2.05	<0.00001	1.4	0.208	86	<0.00005	<0.001	0.0024	0.0034	0.0001	0.366	0.046					
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008		0.0002	0.001		0.08	0.0013	0.00186	0.008	18	0.251	0.71		<0.001	0.0026			<0.4	0.0006	2.54	<0.00001	1.3	0.189	74.7	<0.00005	<0.001	0.0065	0.0026	0.0001	0.264	0.035					
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008		0.00025	<0.001		0.06	0.0009	0.00195	0.007	19	0.188	0.94		0.00014	0.002		<0.01	0.34	0.0014	2.77	<0.00001	1.27	0.185		<0.00001	<0.0001	0.0003	0.0033	0.00022	0.194	0.070	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008		0.00037	0.001	0.0016	0.152	0.0049	0.00552	0.006	19.3	0.23	0.71		0.00016	0.003	0.0102	<0.01	0.4	<0.0006	3.07	<0.00001	1.3	0.17		<0.00001	<0.0001	0.0011	0.0026	0.00021	0.357	0.103	0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008		0.00051	<0.001		0.042	0.0008	0.00342	0.008	20.8	0.67			0.00008	0.003		<0.01	0.3	0.0011	3.46	<0.00001	1.4	0.201		<0.00001	0.0008	0.0005	0.0034	<0.00004	0.244	0.050	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008	Total metals results greatly elevated due to TSS contamination (creek bottom disturbed); results removed from database as non-representative.	0.0004	<0.001		<0.01	0.0159	0.00330	0.009	21.9	0.859			<0.001	0.0024			0.4	0.0013	3.93	0.00001	1.5	0.216	82.2		<0.001	0.0028	0.0043	0.0009	0.205	0.054					
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009		0.0005	0.006		0.03	0.0011	0.00375	0.012	26.5	1.28			0.001	0.0015			0.8	0.0014	4.54	<0.00001	3.7	0.239	94.7	<0.00005	<0.001	0.0076	0.0048	0.0002	0.204	0.067					
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009		0.00012	0.001		<0.01	0.0002	0.00196	0.008	15.6	0.186			0.00114	0.001		<0.01	0.6	<0.0006	3.94	<0.00001	2.5	0.211	47.7	<0.00001	<0.0001	0.0004	0.0021	0.00006	0.024	0.033	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009		0.00041	<0.001		0.11	0.0008	0.00192	0.012	20.8	0.757			0.00013	0.004		<0.01	0.4	0.0012	3.4	<0.00001	1.3	0.266	82.2	<0.00001	<0.0001	0.0004	0.0049	0.00006	0.104	0.035	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009		0.000098	0.00086		0.014	0.00014	0.00177	0.0114	7.92	0.0722		<0.00001	0.00076	0.00056		0.002	0.58	0.00019	3.4	<0.000005	5.07	0.176	38	<0.000002	<0.00001	<0.0005	0.00127	<0.0002	0.0071	0.016	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009		0.000028	0.00124		0.053	0.000639	0.00103	<0.0005	1.14	0.026	0.23	<0.00001	0.00005	0.0008		0.009	0.44	<0.00004	0.51	0.000012	0.1	0.0119	<3	<0.000002	<0.00001	<0.0005	0.000055	0.0003	0.0315	0.005	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009		0.000176	0.00121		0.152	0.00823	0.00179	0.0069	13.7	0.296	0.64	<0.00001	0.00023	0.00261		0.008	0.42	0.00057	1.89	0.000043	1	0.154	63	0.000004	0.00003	0.0007	0.00238	<0.0002	0.221	0.027	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009		0.000129	0.00137		0.057	0.0026	0.00195	0.0085	22.2	0.276	0.46	<0.00001	0.0002	0.0019		0.005	0.28	0.00094	2.23	0.000012	1.61	0.215	102	0.000002	0.00002	<0.0005	0.00414	<0.0002	0.172	0.029	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009		0.0001	0.00049		0.053	0.00121	0.00200	0.0119	24.6	0.232			0.00027	0.00212			0.26	0.00078	2.71	<0.000005	1.54	0.239	115	<0.000002	0.00006	<0.0005	0.00475	<0.0002	0.12	0.025	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009		0.000128	0.00059		0.068	0.0017	0.00197	0.009	22.4	0.265	0.77	0.00001	0.00023	0.00246		0.004	0.33	0.00077	3.4	0.000006	1.45	0.227	107	<0.000002	<0.00001	<0.0005	0.00441	<0.0002	0.192	0.046	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009		0.000421	0.00036		0.045	0.000277	0.00197	0.0112	22.1	0.377	0.77	<0.00001	0.00053	0.00276		0.004	0.33	0.00072	3.37	<0.000005	1.37	0.225	108	<0.000002	<0.00001	<0.0005	0.00432	<0.0002	0.194	0.040	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009		0.00129	0.00021		0.089	0.000447	0.00201	0.0146	23.9	1.13	0.3	0.00001	0.00051	0.00401		0.003	0.4	0.00086	4.15	<0.000005	1.45	0.243	119	<0.000002	<0.00001	<0.0005	0.00425	<0.0002	0.127	0.024	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009		0.00107	0.00018		0.093	0.000326	0.00201	0.013	21.3	1.3	0.65	<0.00001	0.00037	0.00289		0.005	0.41	0.00095	3.55	<0.000005	1.26	0.241	122	<0.000002	<0.00001	<0.0005	0.00379	<0.0002	0.11	0.039	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010		0.00135	0.00117		0.318	0.0126	0.00204	0.0137	25.3	1.2	0.48		0.00026	0.00355			0.48	0.00101	4.54	0.000094	1.58	0.251	129	0.000005	0.00013	0.0032	0.00431	<0.0002	0.108	0.028	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010		0.00125	0.00035		0.191	0.000535	0.00205	0.0143	25.1	1.06	0.65	<0.00001	0.0002	0.00323		0.005	0.43	0.00087	4.21	<0.000005	1.6	0.233	124	<0.000002	0.00001	<0.0005	0.00446	<0.0002	0.0905	0.035	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010		0.00126	0.00015	0.0005	0.153	0.000257	0.00262	0.0154	24.5	1.09	0.48	<0.00001	0.00021	0.00329	0.0112	0.002	0.45	0.00093	4.32	<0.000005	1.59	0.255	130	<0.000002	0.00001	<0.0005	0.00441	<0.0002	0.078	0.043	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010		0.00151	0.00015		0.176	0.000235	0.00206	0.0157	25.8	1.05	0.48	<0.00001	0.0002	0.00375		0.003	0.46	0.00091	4.16	<0.000005	1.63	0.255	138	<0.000002	<0.00001	<0.0005	0.00433	<0.0002	0.0811	0.033	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010		0.000851	0.00216		0.521	0.00595	0.00180	0.0072	14	0.445	0.56		0.00023	0.00322			0.49	0.00061	2.32	0.000013	1.15	0.153	72	0.000004	0.00003	0.0022	0.0023	<0.0002	0.136	0.024	0.0002				
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010		0.000131	0.0005		0.045	0.000948	0.00197	0.0123	21.7	0.242	0.65	<0.00001	0.00029	0.00189		0.003	0.2	0.00078	2.16	<0.000005	1.34	0.231	111	<0.000002	<0.00001	<0.0005	0.00384	<0.0002	0.224	0.037	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010		0.000135	0.00195		0.085	0.00245	0.00196	0.0113	22.7	0.194	0.65	0.00001	0.00024	0.00216		0.009	0.26	0.00072	2.51	0.000007	1.44	0.217	107	0.000002	0.00007	<0.0005	0.00325	<0.0002	0.146	0.033	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010		0.000113	0.00125	0.0017	0.076	0.00174	0.00486	0.0125	24.3	0.203	0.48	<0.00001	0.00027	0.00221	0.0117	0.007	0.27	0.00079	3.16	0.000009	1.55	0.216	119	<0.000002	0.00006	0.0006	0.00345	<0.0002	0.116	0.074	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010		0.000179	0.00056	0.0005	0.059	0.000871	0.00406	0.0123	23.1	0.268	0.93	<0.00001	0.00019	0.00237	0.0117	0.005	0.36	0.00079	3.33	0.000007	1.41	0.21	109	<0.000002	0.00002	<0.0005	0.00363	<0.0002	0.144	0.125	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010		0.00026	0.00086	0.0013	0.064	0.000489	0.00443	0.0132	22.9	0.267	0.48		0.0002	0.00227	0.0108		0.33	0.00082	3.69	<0.000005	1.43	0.221	111	<0.000002	0.00002	<0.0005	0.00353	<0.0002	0.128	0.068	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010	no flow taken - ice	0.00136	0.0002	0.0002	0.06	0.000343	0.00308	0.0143	25.5	1.41	1.0	<0.00001	0.00019	0.00449	0.0133	0.003	0.44	0.00083	4.53	<0.000005	1.63	0.24	121	<0.000002	0.00002	<0.0005	0.00406	<0.0002	0.161	0.120	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010	no flow taken - ice	0.00131	0.00034	0.0021	0.025	0.000924	0.00559	0.017	28.3	1.95	0.48	<0.00001	0.00021	0.00423	0.0133	0.008	1.27	0.00087	4.63	0.000008	1.7	0.272	140	<0.000002	<0.00001	<0.0005	0.00402	0.0003	0.172	0.070	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011	no flow taken - ice.	0.0012	0.00009	0.0004	0.016	0.000171	0.00241	0.0137	25.1	1	0.48	0.00002	0.00016	0.00393	0.0105	0.004	0.41	0.00093	4.03	0.000025	1.61	0.239	121	0.000002	0.00001	<0.0005	0.0045	<0.0002	0.0982	0.043	0.0004				
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011	no flow taken.	0.00168	0.00018	0.001	0.029	0.000306	0.00358	0.0156	26.1	1.48	0.3	<0.00001	0.00021	0.00451	0.0105	0.008	0.5	0.00084	3.48	0.000011	1.6	0.252	134	0.000002	<0.00001	<0.0005	0.00421	<0.0002	0.0831	0.047	0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011	no flow taken -ice. Spent 1/2 hr trying to find water. Auger, axed	0.00161	0.00043	0.0006	0.123	0.000517	0.00336	0.0162	27.3	1.35	0.65	<0.00001	0.00018	0.00462	0.0128	0.005	0.55	0.00089	4.34	<0.000005	1.71	0.271	139	<0.000002	<0.00001	<0.0005	0.00486	<0.0002	0.0769	0.060	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011	pH on multimeter not working. No flow taken - ice	0.00151	0.00032		0.095	0.000271	0.00322	0.0163	27.1	1.01		<0.00001	0.00017	0.00462		0.012	0.53	0.00085	4.46	<0.000005	1.64	0.269	137	<0.000002	<0.00001	<0.0005	0.00501	<0.0002	0.0729	0.060	0.0002				
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011		0.000431	0.00096	0.0051	0.277	0.00465	0.00794	0.0082	14.1	0.476	0.46	<0.00001	0.00021	0.00354	0.0124	0.008	0.47	0.0004	2.61	0.000018	0.97	0.16	77	<0.000002	0.00002	0.0005	0.00238	<0.0002	0.22	0.091	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011		0.000141	0.00108	0.0004	0.059	0.00216	0.00201	0.0115	25.1	0.258	0.3	<0.00001	0.00026	0.00239	0.0088	0.006	0.25	0.00078	2.14	0.000012	1.63	0.245	122	0.000007	0.00011	<0.0005	0.00429	<0.0002	0.201	0.030	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011	flows by Marsh McB	0.00017	0.00058	0.0027	0.056	0.00143	0.00609	0.0098	21.9	0.257	0.48	<0.00001	0.00029	0.00236	0.0121	0.004	0.19	0.00064	2.44	0.000006	1.41	0.212	110	<0.000002	0.00001	<0.0005	0.00381	<0.0002	0.173	0.088	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011	flows with Marsh McB. no staff gauge	0.000307	0.00068	0.0027	0.081	0.00105	0.00650	0.0118	23.9	0.303	0.48		0.00025	0.00304	0.013	0.006	0.34	0.00069	3.1	<0.000005	1.51	0.229	117	<0.000002	0.00001	<0.0005	0.00392	<0.0002	0.208	0.099	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011	flows with Marsh McB	0.00037	0.00032	0.0008	0.072	0.000328	0.00397	0.0139	22.1	0.428	0.77	<0.00001	0.0004	0.00259	0.0115	0.007	0.41	0.0008	3.3	<0.000005	1.36	0.247	116	<0.000002	0.0001	<0.0005	0.0046	<0.0002	0.262	0.083	0.0002				
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011		0.00261	0.00015	0.0004	0.124	0.000755	0.00262	0.0174	28.8	1.37	0.65	<0.00001	0.00022	0.00607	0.0123	0.004	0.4	0.00092	4.1	<0.000005	1.77	0.259	141	<0.000002	0.00006	<0.0005	0.00436	<0.0002	0.23	0.053	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011	Salt Slug; field conductivity not entered, probe malfunction in cold	0.00236	0.0003	0.0007	0.067	0.000474	0.00383	0.0154	27.2	1.62	0.77	<0.00001	0.00018	0.00582	0.0125	0.005	0.48	0.0009	3.9	<0.000005	1.71	0.25	129	<0.000002	0.00052	<0.0005	0.00459	<0.0002	0.201	0.082	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011	Salt Slug	0.00225	0.00066	0.0007	0.163	0.00064	0.00429	0.0153	26.5	1.82	0.77	<0.00001	0.00018	0.00582	0.0131	0.003	0.62	0.00096	4.3	<0.000005	1.8	0.259	129	<0.000002	0.00007	<0.0005	0.00386	<0.0002	0.145	0.099	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012	Condition not condusive to measure flow.	0.00191	0.0005	0.0003	0.105	0.000947	0.00252	0.0147	24.8	1.05	0.77	<0.00001	0.00017	0.00522	0.0115	0.006	0.43	0.00106	3.8	0.000006	1.86	0.235	124	<0.000002	<0.0002	<0.0005	0.00422	<0.0002	0.129	0.070	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012	Salt Slug, non-ideal result, caution	0.00247	0.0001	0.0003	0.149	0.000139	0.00305	0.0171	27.8	1.33	0.93	<0.00001	0.00016	0.00643	0.0138	0.007	0.5	0.0009	4.5	<0.000005	1.73	0.26	136	<0.000002	<0.0002	<0.0005	0.00452	<0.0002	0.109	0.086	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012	Salt Slug	0.00234	0.00029	0.0004	0.131	0.000088	0.00370	0.019	27.9	1.34	0.93	<0.00001	0.00018	0.0061	0.0139	0.007	0.53	0.00104	4.4	<0.000005	1.83	0.286	147	<0.000002	<0.0002	<0.0005	0.00511	<0.0002	0.079	0.109	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012	Salt Slug	0.00207	0.0001	0.0004	0.133	0.000104	0.00277	0.0168	25.5	1.04	0.65	<0.000010	0.00015	0.00549	0.0117	0.006	0.45	0.00094	4	<0.000005	1.57	0.248	134	<0.000002	<0.0002	<0.0005	0.00406	<0.0002	0.0817	0.054	<0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012	slow meandering flow. Installed Staff gauge, reading @14:12	0.00144	0.00106	0.0049	0.641	0.00296	0.00852	0.0075	13.6	0.707	0.56	<0.000010	0.000137	0.0044	0.012	0.0125	0.553	0.000471	2.39	0.000007	0.945	0.144	68	0.000002	<0.00020	<0.00050	0.0018	<0.00020	0.365	0.100	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012	No ice over the water.	0.00122	0.00108	0.0049	0.504	0.00409	0.00782	0.008	14.6	0.685	0.43	<0.000010	0.000205	0.00384	0.0123	0.0103	0.553	0.000587	2.8	0.000006	1.01	0.151	75	0.000003	<0.00020	<0.00050	0.00188	<0.00020	0.301	0.080	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	Creek bed rusty.	0.000203	0.000572	0.0025	0.0336	0.000581	0.00553	0.0116	21	0.245	0.46	<0.000010	0.000238	0.00271	0.0105	0.0052	0.303	0.000818	2.03	<0.0000050	1.76	0.207	112	<0.0000020	<0.00020	<0.00050	0.00369	<0.00020	0.111	0.074	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012	water clear; rocky bottom-reddish; flow from below culvert	0.000159	0.000232	0.0016	0.0417	0.000569	0.00464	0.0168	24.3	0.196	0.48	<0.000010	0.000617	0.0021	0.0114	0.0076	0.16	0.000771	1.83	<0.0000050	1.47	0.243	128	<0.0000020	<0.00020	<0.00050	0.00363	<0.00020	0.0835	0.067	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012	testing functionality of flow meter						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012		0.000207	0.000373	0.0017	0.0518	0.00104	0.00483	0.017	26.1	0.315	0.48	<0.000010	0.000243	0.00281	0.011	<0.0020	0.259	0.000609	2.04	<0.0000050	1.61	0.254	132	<0.0000020	<0.00020	<0.00050	0.00356	<0.00020	0.0952	0.077	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012		0.000666	0.000203	0.0014	0.0639	0.000189	0.00499	0.0167	25.8	0.487	0.48	<0.000010	0.000217	0.00359	0.0134	<0.0020	0.381	0.00083	3.5	<0.0000050	1.57	0.265	136	<0.0000020	<0.00020	<0.00050	0.00369	<0.00020	0.147	0.081	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012	Sampled with Kim Winnecky & Jossee Tremblay (NND). Returned Oct 16 to measure flows when data logger downloaded & winterized.	0.000644	0.000308	0.0009	0.059	0.000336	0.00416	0.0171	25.8	0.462	0.65	<0.000010	0.000159	0.00386	0.0125	<0.0020	0.404	0.000855	3.99	<0.0000050	1.55	0.27	152	<0.0000020	<0.00020	<0.00050	0.00405	<0.00020	0.109	0.082	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012	Returned to measure flows when data logger downloaded & winterized.						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012	Took samples between 2 ice layers.YSI conductivity not working properly , flow reading not possible.	0.00181	0.000392	0.0008	0.111	0.000454	0.00342	0.0162	28.4	1.64	0.48	<0.000010	0.000244	0.0065	0.0113	<0.0020	0.44	0.00105	4.09	<0.0000050	1.84	0.263	133	0.000002	<0.00020	<0.00050	0.00461	<0.00020	0.155	0.049	<0.00010				
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012	Ice too thick to get to water with ice auger.						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013	Over 150 cm of ice. Could not find water.						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013	No water found. Frozen to the ground.						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	14-Mar-2013	Could not find water. Ice too thick for ice auger or frozen to the ground.						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	05-Apr-2013	Sampled turbid overflow that appears to be affected by road proximity. Non-representative results removed.						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2013	Ice over 1.5 meter deep. Water flowing between ice layer Cannot slug.	0.00020	0.00261	0.0074	0.028	0.00647	0.01053	0.00817	20.7	0.144	0.61	<0.000010	0.000116	0.0019	0.0161	<0.050	2.74	0.00023	2.37	0.000027	1.90	0.174	86.5	<0.000010	0.00013	<0.010	0.000566	<0.0010	0.115	0.126	<0.00080	6.57	6.34	0.98
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2013	Water turbid. Staff gauge reading at 13:47.	0.00109	0.00069	0.0047	0.242	0.00224	0.00776	0.00969	18.7	1.02	0.46	<0.000010	0.000335	0.0047	0.0139	<0.050	0.50	0.00050	2.74	<0.000010	1.11	0.200	93.7	<0.000010	<0.00010	<0.010	0.00285	<0.0010	0.0882	0.099	<0.00080	7.87	7.97	1.01
KV-6	Christal Creek u/s Silver Trail Highway	12-Jul-2013	Algae on bottom.	0.00038	0.00035	0.0019	0.068	0.00138	0.00490	0.0136	27.0	0.497	0.3	<0.000010	0.000312	0.00304	0.0122	<0.050	0.18	0.00082	2.44	<0.000010	1.54	0.279	128	<0.000010	<0.00010	<0.010	0.00478	<0.0010	0.154	0.060	<0.00080	10.5	10.4	0.99
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2013		0.00032	<0.00020	0.0006	0.055	0.00180	0.00379	0.0144	30.3	0.441	0.77	<0.000010	0.000272	0.00308	0.0132	<0.050	0.30	0.00102	3.01	<0.000010	1.68	0.280	130	<0.000010	<0.00010	<0.010	0.00555	<0.0010	0.144	0.087	<0.

Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014		0.00033	0.00054	0.0026	0.058	0.00151	0.00558	0.0112	24.7	0.379	0.3	<0.000010	0.000242	0.00269	0.012	<0.050	0.18	0.00083	2.55	<0.000010	1.37	0.220	111	<0.000010	<0.00010	<0.010	0.00371	<0.0010	0.152	0.069	<0.00080	8.82	9.22	1.02
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014		0.00027	0.00036	0.0011	0.070	0.00621	0.00438	0.0132	28.1	0.292	0.65	<0.000010	0.000203	0.0026	0.0125	<0.050	0.24	0.00087	2.79	<0.000010	1.53	0.262	117	<0.000010	<0.00010	<0.010	0.00408	<0.0010	0.133	0.076	<0.00080	9.47	10.1	1.03
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014		0.00039	0.00034	0.0012	0.043	0.000808	0.00454	0.0108	25.3	0.398	0.48	<0.000010	0.000188	0.00297	0.0119	<0.050	0.37	0.00094	3.38	<0.000010	1.45	0.222	109	<0.000010	<0.00010	<0.010	0.00359	<0.0010	0.155	0.076	<0.00080	9.26	9.48	1.01
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	Ice affected stage	0.00138	0.00035	0.0008	0.063	0.000569	0.00416	0.0122	25.2	0.769	0.77	<0.000010	0.000163	0.00464	0.012	<0.050	0.37	0.00103	3.74	<0.000010	1.57	0.235	106	<0.000010	<0.00010	<0.010	0.00373	<0.0010	0.204	0.089	<0.00080	9.31	9.42	1.01
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014	Glacier from road to Staff Gauge (frozen at 0.360m)	0.00169	0.00023	0.0004	0.048	0.000445	0.00294	0.0131	25.6	1.39	0.77	<0.000010	0.000191	0.00524	0.0117	<0.050	0.42	0.00108	4.08	<0.000010	1.62	0.238	109	<0.000010	<0.00010	<0.010	0.00397	<0.0010	0.166	0.066	<0.00080	9.55	9.68	1.01
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014		0.00162	<0.00020	0.0002	0.345	0.000485	0.00286	0.0131	24.8	1.12	1.2	<0.000010	0.000177	0.00386	0.0118	<0.050	0.38	0.00120	3.93	<0.000010	1.46	0.237	99.3	<0.000010	<0.00010	<0.010	0.00371	<0.0010	0.111	0.149	<0.00080	9.07	9.02	1
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015	water clear; 100% ice covered ~1m thick	0.00185	<0.00020	0.0002	0.418	0.000307	0.00265	0.0121	25.4	1.15	0.93	<0.000010	0.000169	0.00449	0.0123	<0.050	0.42	0.00118	4.21	<0.000010	1.57	0.237	106	<0.000010	<0.00010	<0.010	0.00336	<0.0010	0.110	0.088	<0.00080	9.51	9.72	1.01
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015		0.00207	0.00029	0.0002	0.309	0.000775	0.00331	0.0143	25.2	1.11	1.0	<0.000010	0.000186	0.00524	0.0125	<0.050	0.42	0.00114	3.94	<0.000010	1.61	0.255	110	<0.000010	0.00019	<0.010	0.00420	<0.0010	0.111	0.122	<0.00080	9.79	9.65	0.99
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015	strong odour, marshy.	0.00192	<0.00020	0.0003	0.177	0.000691	0.00274	0.0151	25.9	0.952	0.77	<0.000010	0.000211	0.00518	0.0123	<0.050	0.45	0.00112	3.97	<0.000010	1.69	0.246	116	<0.000010	<0.00010	<0.010	0.00412	<0.0010	0.0924	0.064	<0.00080	9.69	10.1	1.02
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015		0.00186	<0.00020	0.0009	0.245	0.000260	0.00322	0.0149	25.2	0.912	0.3	<0.0000050	0.000161	0.00519	0.0089	<0.050	0.48	0.00127	4.01	<0.000010	1.67	0.256	113	<0.000010	<0.00010	<0.00030	0.00417	<0.00050	0.0891	0.042	<0.00080	10.2	10.5	1.01
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015	No staff gauge reading	0.00112	0.0017	0.00190	0.446	0.00490	0.00972	0.0037	6.97	0.477	0.73	0.0000138	0.000175	0.00322	0.00620	<0.050	0.71	0.000320	1.69	0.000019	0.541	0.0794	32.0	<0.000010	<0.00010	0.00052	0.000680	<0.00050	0.123	0.154	<0.00030	2.70	3.02	1.06
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015		0.00062	0.00023	0.0012	0.063	0.000503	0.00488	0.0172	25.8	0.58	0.65	<0.0000050	0.000378	0.00385	0.0136	<0.050	0.33	0.000863	3.14	<0.000010	1.53	0.263	117	<0.000010	<0.00010	<0.00030	0.00448	<0.00050	0.132	0.090	<0.00030	10.2	10.6	1.02
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015		0.00034	0.0003	0.00140	0.054	0.00123	0.00486	0.0157	26.0	0.356	0.65	<0.0000050	0.000295	0.00295	0.01260	<0.050	0.29	0.000776	3.02	<0.000010	1.44	0.260	125	<0.000010	<0.00010	<0.00030	0.00399	<0.00050	0.144	0.081	<0.00030	9.91	9.95	1
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015		0.00053	0.00051	0.0017	0.066	0.000909	0.00533	0.0134	24.8	0.447	0.65	<0.0000050	0.000233	0.00343	0.0128	<0.050	0.35	0.000815	3.46	<0.000010	1.48	0.229	113	<0.000010	<0.00010	<0.00030	0.00343	<0.00050	0.189	0.086	<0.00030	9.34	9.77	1.02
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015		0.00087	0.00052	0.002	0.089	0.000421	0.00618	0.0121	21.6	0.561	0.65	<0.0000050	0.000191	0.00388	0.0123	<0.050	0.35	0.000806	3.33	<0.000010	1.37	0.206	102	<0.000010	<0.00010	<0.00030	0.00286	<0.00050	0.202	0.115	<0.00030	8.31	8.54	1.01
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015							0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015	ORP drifting	0.00191	<0.00020	0.0008	0.066	0.000108	0.00388	0.0144	25.8	0.842	0.65	<0.0000050	0.000174	0.00519	0.0124	<0.050	0.37	0.00114	3.85	<0.000010	1.61	0.245	110	<0.000010	<0.00010	<0.00030	0.00355	<0.00050	0.243	0.075	<0.00030	9.55	10.1	1.03
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015	Dumped salt slug above a spot that widened out might not be accurate	0.00164	0.00037	0.0005	0.089	0.000501	0.00334	0.0113	26.3	0.822	0.77	<0.0000050	0.000167	0.00419	0.012	<0.050	0.41	0.00154	3.96	<0.000010	1.65	0.229	99.2	<0.000010	<0.00010	<0.00030	0.00439	<0.00050	0.170	0.082	<0.00030	9.30	9.55	1.01
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015	WQ collected on 17 Dec 2015 but YSI was not working so insitu collected by A.MacPhail 18 Dec during flow metering	0.00170	<0.00020		0.217	0.000175	0.00295	0.0123	26.0	0.93		<0.0000050	0.000176	0.00387		<0.050	0.39	0.00142	3.89	<0.000010	1.60	0.228	110	<0.000010	<0.00010	<0.00030	0.00397	<0.00050	0.156	0.057	<0.00030	9.30	9.37	1
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015	WQ collected on 17 Dec 2015 but YSI was not working so insitu collected by A.MacPhail 18 Dec during flow metering						0.00075																						0.004				
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016		0.00210	<0.00020	0.0006	0.233	0.000071	0.00290	0.0141	26.1	1.01	0.48	<0.0000050	0.000179	0.00477	0.0107	<0.050	0.44	0.00144	4.18	<0.000010	1.74	0.257	112	<0.000010	<0.00010	<0.00030	0.00451	<0.00050	0.156	0.042	<0.00030	9.51	10.2	1.04
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016		0.00216	<0.00020	0.0004	0.208	<0.000050	0.00278	0.0157	24.3	0.987	0.77	<0.0000050	0.000176	0.00495	0.0114	<0.050	0.42	0.00114	3.88	<0.000010	1.59	0.227	110	<0.000010	<0.00010	<0.00030	0.00391	<0.00050	0.132	0.066	<0.00030	9.82	9.36	0.98
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016		0.00212	<0.00020	0.0003	0.285	0.000091	0.00262	0.0156	24.5	0.913	0.77	<0.0000050	0.000181	0.00511	0.0121	<0.050	0.39	0.00108	3.85	<0.000010	1.51	0.244	110	<0.000010	<0.00010	<0.00030	0.00408	<0.00050	0.126	0.060	<0.00030	9.99	10.1	1
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016		0.00236	0.00027	0.0007	0.354	0.000244	0.00331	0.0178	26.6	1.03	0.48	<0.0000050	0.000189	0.00541	0.0127	<0.050	0.53	0.00107	4.01	<0.000010	1.78	0.258	113	<0.000010	<0.00010	<0.00030	0.00417	<0.00050	0.128	0.057	<0.00030	10.6	11.1	1.02
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016		0.00241	0.00056	0.0028	0.282	0.000820	0.00657	0.0107	17.3	1.14	0.61	<0.0000050	0.000262	0.00525	0.0117	<0.050	0.50	0.000619	3.03	<0.000010	1.06	0.183	81.9	<0.000010	<0.00010	<0.00030	0.00251	<0.00050	0.222	0.101	<0.00030	7.02	7.51	1.03
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016	SG 0.215 @10:25.	0.00078	0.00028	0.0011	0.052	0.000333	0.00472	0.0164	26.7	0.485	0.65	<0.0000050	0.000280	0.00361	0.0134	<0.050	0.24	0.00110	2.88	<0.000010	1.53	0.255	123	<0.000010	<0.00010	<0.00030	0.00378	<0.00050	0.122	0.087	<0.00030	9.87	10.6	1.03
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016	Water is clear something D/S of site is causing turbidity at KV-7 & KV-8	0.00048	0.00041	0.0015	0.062	0.00112	0.00515	0.0149	26.7	0.472	0.65	<0.0000050	0.000273	0.00323	0.0132	<0.050	0.18	0.000893	3.10	<0.000010	1.51	0.255	124	<0.000010	<0.00010	<0.00030	0.00356	<0.00050	0.157	0.089	<0.00030	9.81	10.2	1.02
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016	DO probe may need to be replaced, varies wildy from day to day	0.00069	0.00059	0.0026	0.061	0.000673	0.00636	0.0131	23.3	0.558	0.48	<0.0000050	0.000232	0.0041	0.0131	<0.050	0.27	0.000822	3.21	<0.000010	1.26	0.228	102	<0.000010	<0.00010	<0.00030	0.00286	<0.00050	0.319	0.097	<0.00030	8.44	9.19	1.04
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016		0.00125	0.00026	0.0017	0.051	0.000145	0.00518	0.0159	25.4	0.879	0.48	<0.0000050	0.000229	0.0049	0.0125	<0.050	0.40	0.000829	3.67	<0.000010	1.55	0.251	125	<0.000010	<0.00010	<0.00030	0.00374	<0.00050	0.218	0.075	<0.00030	9.49	9.81	1.02
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016		0.00295	<0.00020	0.0006	0.182	0.000097	0.00325	0.0178	30.5	1.21	0.65	<0.0000050	0.000206	0.00695	0.0136	<0.050	0.46	0.00102	4.13	<0.000010	1.63	0.266	130	<0.000010	<0.00010	<0.00030	0.00427	<0.00050	0.175	0.064	<0.00030	10.9	11.5	1.03
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	DO probe measurement suspect	0.00316	<0.00020	0.0003	0.271	0.000146	0.00292	0.0179	28.6	1.52	0.77	<0.0000050	0.000207	0.00677	0.0138	<0.050	0.46	0.000880	4.17	<0.000010	1.64	0.256	124	<0.000010	<0.00010	<0.00030	0.00441	<0.00050	0.158	0.079	<0.00030	10.7	11.1	1.02
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	Entire staff gauge is under ice, overflow backed up from highway, could not find second location with flowing water, conditions not suitable for salt slug	0.00312	<0.00020	0.0006	0.123	0.000163	0.00339	0.0166	28.3	1.78	0.65	<0.0000050	0.000225	0.00615	0.0132	<0.050	0.46	0.00105	4.21	<0.000010	1.71	0.272	126	<0.000010	<0.00010	<0.00030	0.00431	<0.00050	0.124	0.064	<0.00030	10.8	11.2	1.02
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	sampled and discharge measured ~150 u/s from normal site as road glacier ice too built up on creek to find water. Could not find hydro station, covered in ice.	0.00266	<0.00020	0.0002	0.574	0.000306	0.00275	0.0179	27.8	1.1	0.93	<0.0000050	0.000209	0.00579	0.0141	<0.050	0.43	0.00104	3.99	<0.000010	1.55	0.268	125	<0.000010	<0.00010	<0.00030	0.00485	<0.00050	0.115	0.086	<0.00030	11.1	11.2	1.01
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017		0.00291	<0.00020	0.0006	0.512	0.000081	0.00313	0.0179	28.7	1.16	0.48	<0.0000050	0.000202	0.00611	0.0131	<0.050	0.46	0.00109	4.30	<0.000010	1.73	0.276	139	<0.000010	<0.00010	<0.00030	0.00538	<0.00050	0.122	0.053	<0.00030	10.8	11.7	1.04
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	Sampled u/s of normal site due to overflow from above road	0.00322	<0.00020	0.0003	0.672	0.000077	0.00280	0.0207	28.4	1.3	0.77	<0.0000050	0.000201	0.00633	0.0132	<0.050	0.44	0.00105	4.01	<0.000010	2.28	0.277	141	<0.000010	<0.00010	<0.00030	0.00478	<0.00050	0.126	0.066	<0.00030	11.5	11.0	0.98
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017		0.00343	<0.00020	0.0003	0.734	0.000140	0.00276	0.0190	28.6	1.32	0.77	<0.0000050	0.000230	0.00719	0.0136	<0.050	0.45	0.00139	3.83	<0.000010	1.76	0.291	149	<0.000010	<0.00010	<0.00030	0.00517	<0.00050	0.140	0.077	<0.00030	11.6	11.0	0.97
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	Unable to connect to logger, no winterization. Creek still under ice with a few openings.	0.00189	0.00122	0.0039	0.613	0.00171	0.00989	0.0060	8.62	0.757	0.73	<0.0000050	0.000238	0.00547	0.009	<0.050	0.55	0.000300	1.95	0.000014	0.681	0.0993	45.5	<0.000010	<0.00010	0.00082	0.00123	<0.00050	0.0920	0.134	<0.00030	4.14	3.99	0.98
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017		0.00135	0.00044	0.0022	0.074	0.000326	0.00692	0.0132	22.1	0.917	0.77	<0.0000050	0.000279	0.0052	0.013	<0.050	0.45	0.000771	2.97	<0.000010	1.44	0.237	111	<0.000010	<0.00010	<0.00030	0.00398	<0.00050	0.109	0.137	<0.00030	9.27	8.71	0.97
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017		0.00064	0.00033	0.0007	0.055	0.000635	0.00471	0.0172	28.6	0.66	0.93	<0.0000050	0.000268	0.0037	0.0141	<0.050	0.22	0.000773	3.03	<0.000010	1.50	0.266	137	<0.000010	<0.00010	<0.00030	0.00448	<0.00050	0.146	0.121	<0.00030	10.9	10.9	1
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	Levelogger downloaded. Field pH suspect, removed.	0.00042	<0.00020		0.060	0.000480	0.00439	0.0155	27.5	0.398		<0.0000050	0.000164	0.00293		<0.050	0.26	0.000782	2.51	<0.000010	1.57	0.255	132	<0.000010	<0.00010	<0.00030	0.00476	<0.00050	0.141	0.055	<0.00030	10.8	9.54	0.94
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	field pH probe malfunction	0.00067	0.00031		0.093	0.000377	0.00496	0.0155	27.8	0.567		<0.0000050	0.000160	0.00404		<0.050	0.43	0.000927	3.14	<0.000010	1.57	0.257	146	<0.000010	<0.00010	<0.00030	0.00436	<0.00050	0.325	0.067	<0.00030	10.6	10.5	0.99
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	Too cold for salt slug calibration	0.00219	<0.00020	0.0007	0.103	0.000090	0.00341	0.0159	27.5	1.09	0.48	<0.0000050	0.000146	0.00589	0.0114	<0.050	0.40	0.00103	4.00	<0.000010	1.67	0.284	141	<0.000010	<0.00010	<0.00030	0.00482	<0.00050	0.292	0.060	<0.00030	10.9	9.77	0.95
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017	Samped at gauge station and from overflow as site frozen to ground. Results removed as non-representative overflow sample.						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	No flow measurements, significant overflow causing water to flow in layers.	0.00224	<0.00020	0.0004	0.331	0.000212	0.00268	0.0136	26.0	1.27	0.48	<0.0000050	0.000205	0.00441	0.0113	<0.050	0.38	0.00105	4.07	<0.000010	1.93	0.274	135	<0.000010	<0.00010	<0.00030	0.00522	<0.00050	0.153	0.049	<0.00030	10.6	10.0	0.97
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	Overflow at site, station completely under ice, no flow.	0.00243	<0.00020	0.0005	0.402	0.000152	0.00287	0.0161	27.3	1.31	0.48	<0.0000050	0.000196	0.00502	0.0119	<0.050	0.45	0.00111	4.31	<0.000010	1.76	0.275	127	<0.000010	<0.00010	<0.00030	0.00509	<0.00050	0.134	0.046	<0.00030	10.8	11.0	1.01
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	thick overflow ice. Drilled into overflow and sampled it. Sample shows salt contamination, Na & Cl results removed.	0.00232	<0.00020	0.0005	0.035	0.000082	0.00333	0.0163	26.8	1.17	0.77	<0.0000050	0.000210	0.00529	0.0123	<0.050	0.43	0.00105	4.30	<0.000010		0.294	137	<0.000010	<0.00010	<0.00030	0.00493	<0.00050	0.127	0.072	<0.00030	11.2	10.4	0.96
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018	drilled to bottom of auger, ice too thick						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018	Frozen too deep						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	Still significant ice cover on the creek	0.00149	0.00202	0.0046	0.431	0.00414	0.01097	0.0048	8.65	0.805	0.73	<0.0000050	0.000196	0.0051	0.0094	<0.050	0.73	0.000289	1.89	0.000020	0.696	0.0975	44.8	<0.000010	<0.00010	0.00066	0.000896	<0.00050	0.548	0.140	<0.00030	3.40	3.69	1.04
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	Real time readings for dewinterizing: in w/ condom = 16:39:58, out w/ condom = 16:40:54, out w/out = 16:43:11, back in = 16:46:20	0.00141	0.00074	0.0028	0.357	0.00148	0.00702	0.0106	18.2	0.989	0.61	<0.0000050	0.000234	0.00465	0.012	<0.050	0.46	0.000699	2.80	<0.000010	1.21	0.209	84.3	<0.000010	<0.00010	<0.00030	0.00329	<0.00050	0.251	0.118	<0.00030	7.91	7.56	0.98
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018		0.00072	<0.00020	0.0017	0.059	0.000364	0.00490	0.0149	24.2	0.906	0.48	<0.0000050	0.000277	0.00411	0.0121	<0.050	0.27	0.000752	2.81	<0.000010	1.52	0.271	132	<0.000010	<0.00010	<0.00030	0.00472	<0.00050	0.448	0.069	<0.00030	10.3	9.86	0.98
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018		0.00074	0.00074	0.0026	0.099	0.000594	0.00643	0.0112	21.8	0.544	0.65	<0.0000050	0.000184	0.00355	0.0122	<0.050	0.23	0.000766	2.80	<0.000010	1.48	0.212	105	<0.000010	<0.00010	<0.00030	0.00354	<0.00050	0.183	0.105	<0.00030	9.39	8.16	0.93
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018		0.00080	0.00044	0.0015	0.045	0.000198	0.00502	0.0123	26.7	0.695	0.48	<0.0000050	0.000226	0.00383	0.0126	<0.050	0.32	0.000947	2.92	<0.000010	1.54	0.250	112	<0.000010	<0.00010	<0.00030	0.00445	<0.00050	0.239	0.082	<0.00030	9.41	9.80	1.02
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018		0.00131	<0.00020	0.0005	0.067	0.000118	0.00295	0.0120	25.7	0.677	0.65	<0.0000050	0.000157	0.00438	0.0105	<0.050	0.38	0.00116	3.81	<0.000010	1.68	0.216	126	<0.000010	<0.00010	<0.00030	0.00446	<0.00050	0.201	0.065	<0.00030	9.90	8.68	0.93
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	Ice layers may affect flow. Distance between holes relatively large.	0.00188	<0.00020	0.0005	0.243	<0.000050	0.00285	0.0133	23.5	1.44	0.48	<0.0000050	0.000226	0.00432	0.0108	<0.050	0.41	0.00118	3.94	<0.000010	1.75	0.251	115	<0.000010	<0.00010	<0.00030	0.00444	<0.00050	0.145	0.052	<0.00030	9.85	9.47	0.98
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	Channel has lots of bends. Flow measurement Trial #2 omitted, SPC jumped to ~5500 us/cm. Flow based only on Trial #1.	0.00183	<0.00020	0.0003	0.650	0.000108	0.00306	0.0128	25.0	1.27	0.93	<0.0000050	0.000226	0.00451	0.0121	<0.050	0.43	0.00118	4.12	<0.000010	3.03	0.271	120	<0.000010	<0.00010	<0.00030	0.00458	<0.00050	0.143	0.086	<0.00030	9.95	9.68	0.99
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	ORP slow to stabalize	0.00223	<0.00020	0.0003	0.440	0.000052	0.00320	0.0144	30.4	1.17	0.93	<0.0000050	0.000299	0.0049	0.0139	<0.050	0.52	0.00122	4.63	<0.000010	2.02	0.300	135	<0.000010	<0.00010	<0.00030	0.00535	<0.00050	0.153	0.094	<0.00030	10.5	11.0	1.03
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	Use discharge/flow with caution, suspect data - a lot of noise on both curves, to be checked in Aquarius	0.00179	<0.00020	0.0003	0.539	0.000054	0.00263	0.0142	27.2	1.17	0.77	<0.0000050	0.000224	0.00431	0.013	<0.050	0.47	0.00130	4.46	<0.000010	2.55	0.273	131	<0.000010	<0.00010	<0.00030	0.00542	<0.00050	0.118	0.064	<0.00030	10.2	10.8	1.03
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019		0.00161	<0.00020	0.0003	0.290	0.000075	0.00253	0.0136	25.3	1.07	0.77	<0.0000050	0.000215	0.00388	0.0117	<0.050	0.43	0.00122	4.14	<0.000010	3.32	0.247	123	<0.000010	<0.00010	<0.00030	0.00483	<0.00050	0.111	0.061	<0.00030	9.79	9.83	1
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2019	Questionable flow path with meanders.	0.00171	<0.00020	0.0008	0.215	0.000208	0.00332	0.0119	25.0	1.02	0.48	<0.0000050	0.000216	0.00431	0.011	<0.050	0.53	0.00116	3.58	<0.000010	1.65	0.254	123	<0.000010	<0.00010	<0.00030	0.00466	<0.00050	0.120	0.051	<0.00030	10.1	9.94	0.99
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2019		0.00100	0.00075	0.0035	0.250	0.00150	0.00823	0.0078	14.9	0.66	0.71	<0.0000050	0.000157	0.00337	0.0116	<0.050

Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	LL and Baro downloaded. Benthics and sediment collected.	0.00069	0.0004	0.00110	0.046	0.000254	0.00485	0.0099	23.9	0.484	0.77	<0.0000050	0.000207	0.00304	0.01120	<0.050	0.363	0.00114	3.27	<0.000010	1.56	0.227	97.2	<0.000010	<0.00010	<0.00030	0.00356	<0.00050	0.288	0.108	<0.00030	8.17	8.42	1.02
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	baro and WL logger downloaded. BL off by 3 hours, WL off by 20 min	0.00128	0.00034	0.0007	0.050	0.000135	0.00502	0.0108	22.2	0.66	0.93	<0.0000050	0.000206	0.00382	0.011	<0.050	0.392	0.00150	4.00	<0.000010	1.69	0.234	108	<0.000010	<0.00010	<0.00030	0.00378	<0.00050	0.332	0.148	<0.00030	8.59	8.11	1.03
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	staff guage frozen	0.00206	0.00021	0.0004	0.092	0.000170	0.00408	0.0126	27.9	1.21	1.0	<0.0000050	0.000244	0.00396	0.0134	<0.050	0.485	0.00193	4.68	<0.000010	1.92	0.259	122	<0.000010	<0.00010	<0.00030	0.00427	<0.00050	0.227	0.130	<0.00030	8.87	10.4	1.08
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	Ice at staff gauge end.	0.00172	0.0002	0.00070	0.231	0.000115	0.00405	0.0113	27.0	1.01	0.77	<0.0000050	0.000206	0.00348	0.01210	<0.050	0.468	0.00186	4.62	<0.000010	2.15	0.248	126	<0.000010	<0.00010	<0.00030	0.00404	<0.00050	0.201	0.089	<0.00030	8.90	9.57	1.04
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	Jumping SPC at peak.	0.00142	<0.00020	0.0006	0.272	0.000096	0.00357	0.0128	27.3	0.814	0.77	<0.0000050	0.000193	0.00318	0.0127	<0.050	0.465	0.00178	4.60	<0.000010	1.94	0.273	127	<0.000010	<0.00010	<0.00030	0.00443	<0.00050	0.158	0.078	<0.00030	9.12	10.3	1.06
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	No flow test done to limit exposure.	0.00181	<0.00020	0.0007	0.264	0.000092	0.00327	0.0132	24.8	1.23	0.48	<0.0000050	0.000249	0.00352	0.0109	<0.050	0.531	0.00163	4.20	<0.000010	1.88	0.262	117	<0.000010	<0.00010	<0.00030	0.00440	<0.00050	0.129	0.054	<0.00030	10.3	9.63	1.03
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	Overflow layer, water flowing back into hole	0.00139	<0.00020	0.0002	0.343	0.000090	0.00282	0.0128	23.2	0.85	1.0	<0.0000050	0.000206	0.00333	0.0117	<0.050	0.452	0.00128	3.90	<0.000010	1.70	0.273	120	<0.000010	<0.00010	<0.00030	0.00435	<0.00050	0.117	0.094	<0.00030	9.59	9.18	1.02
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021		0.00149	<0.00020	0.0005	0.390	0.000166	0.00321	0.0126	23.7	0.925	0.77	<0.0000050	0.000220	0.00337	0.0119	<0.050	0.490	0.00150	4.13	<0.000010	1.75	0.256	122	<0.000010	<0.00010	<0.00030	0.00432	<0.00050	0.114	0.069	<0.00030	10.1	9.78	1.02
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	no flow test initially, just sampled with site effluent discharge	0.00160	0.00065	0.0026	0.361	0.00190	0.00775	0.0085	16.3	0.866	0.71	<0.0000050	0.000233	0.00305	0.0114	<0.050	1.15	0.000644	2.68	0.000011	3.04	0.194	81.8	<0.000010	<0.00010	<0.00030	0.00213	<0.00050	0.169	0.151	<0.00030	7.05	7.10	1.00
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021	Samples taken on May 5, 2021 due to KV-104C discharge						0.00075																						0.003				
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021		0.00122	0.00138	0.0075	0.452	0.00342	0.00869	0.0067	11.4	0.662	0.27	<0.0000050	0.000201	0.00324	0.0146	<0.050	0.526	0.000571	2.38	0.000015	0.997	0.140	52.5	<0.000010	<0.00010	0.00043	0.00174	<0.00050	0.181	0.060	<0.00030	4.71	4.55	1.02
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	Steep sides, slight undercut, midsection done, staff gauge hard to read.	0.00058	0.00089	0.0009	0.199	0.00284	0.00655	0.0098	15.6	0.478	0.94	<0.0000050	0.000352	0.00295	0.0097	<0.050	0.434	0.00104	2.65	<0.000010	1.37	0.210	82.6	<0.000010	<0.00010	<0.00060	0.00350	<0.00050	0.222	0.198	<0.00030	7.50	6.78	1.05
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021		0.00041	0.00037	0.0026	0.059	0.000941	0.00500	0.0106	22.5	0.423	0.3	<0.0000050	0.000310	0.00252	0.0097	<0.050	0.249	0.00105	2.99	<0.000010	1.56	0.247	111	<0.000010	<0.00010	<0.00030	0.00405	<0.00050	0.146	0.061	<0.00030	9.22	8.78	1.02
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	No flow measurment, not good for midsection	0.00038	0.00046	0.0013	0.062	0.000874	0.00463	0.0111	24.8	0.381	0.65	<0.0000050	0.000367	0.00272	0.0111	<0.050	0.299	0.00114	2.88	<0.000010	1.74	0.237	119	<0.000010	<0.00010	<0.00030	0.00442	<0.00050	0.180	0.084	<0.00030	9.57	8.53	1.06
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	not ideal for measuring flow, d/s flowing in grass and u/s bend with roots and rocks.	0.00037	0.00046	0.0026	0.066	0.000479	0.00578	0.0088	21.0	0.377	0.46	<0.0000050	0.000259	0.00245	0.0109	<0.050	0.261	0.00111	3.08	<0.000010	1.50	0.216	90.9	<0.000010	<0.00010	<0.00030	0.00346	<0.00050	0.209	0.074	<0.00030	7.80	7.56	1.02
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	Survey, winterize	0.00040	0.00033	0.0014	0.050	0.000228	0.00449	0.0119	25.2	0.507	0.48	<0.0000050	0.000338	0.00305	0.0113	<0.050	0.502	0.00128	3.84	<0.000010	1.90	0.268	130	<0.000010	<0.00010	<0.00030	0.00406	<0.00050	0.422	0.063	<0.00030	9.48	9.44	1.00
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021		0.00095	0.00022	0.001	0.060	0.000150	0.00437	0.0110	22.6	0.575	0.77	<0.0000050	0.000188	0.003	0.0109	<0.050	0.315	0.00123	3.69	<0.000010	1.58	0.229	100	<0.000010	<0.00010	<0.00030	0.00395	<0.00050	0.244	0.090	<0.00030	8.99	8.40	1.03
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	pH 2.60 removed, probe failure	0.00176	0.00057		0.122	0.00185	0.00453	0.0113	26.9	1.45		<0.0000050	0.000235	0.00394		<0.050	0.617	0.00123	4.33	<0.000010	2.24	0.279	113	<0.000010	<0.00010	<0.00030	0.00462	<0.00050	0.193	0.092	<0.00030	9.70	9.98	1.01
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	one flow measurement, YSI failed on second	0.00152	<0.00020	0.0013	0.215	0.000260	0.00528	0.0117	25.2	1.09	0.77	<0.0000050	0.000209	0.00329	0.0132	<0.050	0.423	0.00129	4.40	<0.000010	1.81	0.256	120	<0.000010	<0.00010	<0.00030	0.00405	<0.00050	0.166	0.101	<0.00030	9.93	9.95	1.00
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022	could not locate water, drilled several holes and only found mud						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022		0.00113	0.0002	0.00060	0.258	0.000170	0.00407	0.0123	26.6	0.943	0.93	<0.0000050	0.000213	0.00288	0.01300	<0.050	0.622	0.00124	4.37	<0.000010	1.79	0.286	122	<0.000010	<0.00010	<0.00030	0.00485	<0.00050	0.101	0.105	<0.00030	11.0	10.1	1.04
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022		0.00121	0.00025	0.0005	0.453	0.000176	0.00329	0.0137	25.7	0.921	0.77	<0.0000050	0.000240	0.00315	0.0124	<0.050	0.562	0.00137	4.32	<0.000010	1.85	0.277	130	<0.000010	<0.00010	<0.00030	0.00506	<0.00050	0.102	0.073	<0.00030	10.5	10.2	1.01
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	Ice covered	0.00154	0.00067	0.0011	0.479	0.000698	0.00558	0.0136	23.7	1.01	0.77	<0.0000050	0.000256	0.00375	0.0133	<0.050	1.03	0.000989	3.78	<0.000010	3.31	0.248	116	<0.000010	<0.00010	<0.00030	0.00400	<0.00050	0.150	0.133	<0.00030	9.77	9.92	1.01
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	2x salt slug, SG under ice, de-winterized logger	0.00089	0.0017	0.00470	0.451	0.00308	0.01038	0.0041	8.32	0.477	0.7	<0.0000050	0.000160	0.00292	0.00910	<0.050	0.631	0.000371	1.88	0.000015	0.910	0.0916	37.1	<0.000010	<0.00010	0.00035	0.000973	<0.00050	0.227	0.116	<0.00030	3.26	3.36	1.02
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	Midsection flow measurement, surveyed	0.00066	0.00085	0.0042	0.316	0.00114	0.00680	0.0077	14.2	0.538	0.27	<0.0000050	0.000246	0.0026	0.0111	<0.050	0.347	0.000648	2.50	<0.000010	1.08	0.178	75.2	<0.000010	<0.00010	<0.00030	0.00270	<0.00050	0.226	0.065	<0.00030	6.33	6.08	1.02
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	DO suspect, omitted	0.00041	0.00046	0.002	0.034	0.000382	0.00567	0.0099	24.6	0.388	0.65	<0.0000050	0.000263	0.00274	0.012	<0.050	0.264	0.00111	2.90	<0.000010	1.63	0.234	117	<0.000010	<0.00010	<0.00030	0.00398	<0.00050	0.192	0.093	<0.00030	9.42	8.66	1.04
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022		0.00032	0.00041	0.0019	0.053	0.000429	0.00521	0.0092	25.1	0.292	0.48	<0.0000050	0.000273	0.00223	0.012	<0.050	0.248	0.00111	2.43	<0.000010	1.67	0.277	118	<0.000010	<0.00010	<0.00030	0.00384	<0.00050	0.173	0.073	<0.00030	9.54	9.40	1.01
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022		0.00075	0.00061	0.0018	0.070	0.000577	0.00525	0.0200	23.9	0.494	0.48	<0.0000050	0.000370	0.00293	0.0116	<0.050	0.438	0.000986	3.10	<0.000010	1.64	0.257	113	<0.000010	<0.00010	0.00102	0.00350	0.00061	0.244	0.084	0.00145	9.54	8.87	1.04
KV-6	Christal Creek u/s Silver Trail Highway	14-Oct-2022	Could not measure flow, lots of pooling. logger pulled@ 14:25 to ensure winterized. dl logger and baro. Direct read does not have cap	0.00084	0.00128	0.0017	0.077	0.000460	0.00636	0.0090	22.9	0.662	0.77	<0.0000050	0.000239	0.0032	0.0122	<0.050	0.440	0.000934	3.59	<0.000010	1.66	0.238	103	<0.000010	<0.00010	<0.00030	0.00336	<0.00050	0.583	0.136	<0.00030	8.39	8.45	1.00
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	SPC jumping. No flow measurement, stream glaciated.	0.00130	0.00053	0.0009	0.279	0.000166	0.00418	0.0112	26.5	1.09	0.65	<0.0000050	0.000235	0.00314	0.0121	<0.050	0.513	0.00135	4.76	<0.000010	15.1	0.264	128	<0.000010	<0.00010	<0.00030	0.00413	<0.00050	0.231	0.078	<0.00030	10.4	10.3	1.00
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2022		0.00136	<0.00020	0.0014	0.291	0.000060	0.00432	0.0111	22.6	0.878	0.3	<0.0000050	0.000260	0.00286	0.0103	<0.050	0.469	0.00112	4.18	<0.000010	1.64	0.256	114	<0.000010	<0.00010	<0.00030	0.00384	<0.00050	0.126	0.055	<0.00030	9.79	8.93	0.95
KV-6	Christal Creek u/s Silver Trail Highway	21-Jan-2023	No flow, glaciated	0.00131	<0.00020	0.0006	0.323	0.000055	0.00365	0.0112	25.4	0.781	0.77	<0.0000050	0.000264	0.00311	0.0129	<0.050	0.536	0.00111	4.00	<0.000010	1.68	0.266	128	<0.000010	<0.00010	<0.00030	0.00379	<0.00050	0.133	0.082	<0.00030	10.5	10.4	1.00
KV-6	Christal Creek u/s Silver Trail Highway	09-Feb-2023	Low flow	0.00121	<0.00020	0.0009	0.285	<0.000050	0.00406	0.0125	23.8	0.8	0.65	<0.0000050	0.000203	0.00273	0.0119	<0.050	0.512	0.00126	3.98	<0.000010	1.63	0.257	113	<0.000010	0.00013	<0.00030	0.00442	<0.00050	0.119	0.072	<0.00030	10.3	9.67	0.97
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2023	Too shallow upstream for measuring flow	0.00125	<0.00020	0.001	0.428	0.000140	0.00394	0.0126	24.4	0.812	0.48	<0.0000050	0.000214	0.00285	0.0117	<0.050	0.563	0.00130	4.40	<0.000010	1.61	0.266	135	<0.000010	<0.00010	<0.00030	0.00455	<0.00050	0.108	0.065	<0.00030	10.8	9.88	0.96
KV-6	Christal Creek u/s Silver Trail Highway	20-Apr-2023	Low flow - no measurement, glaciation	0.00108	<0.00020	0.0005	0.376	0.000237	0.00382	0.0127	23.7	0.674	0.77	<0.0000050	0.000222	0.00263	0.0126	<0.050	0.614	0.00117	4.13	<0.000010	4.64	0.261	134	<0.000010	<0.00010	<0.00030	0.00422	<0.00050	0.113	0.098	<0.00030	11.3	10.0	0.94
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2023	Flooded banks, no flow measurement. DO probe not working	0.00096	0.00191	0.0036	0.484	0.00360	0.01037	0.0037	7.37	0.487	0.75	0.0000056	0.000224	0.00254	0.0078	<0.050	0.813	0.000330	1.85	0.000020	1.78	0.0892	39.6	<0.000010	<0.00010	0.00074	0.000558	<0.00050	0.304	0.131	<0.00030	3.24	3.23	1.00
KV-6	Christal Creek u/s Silver Trail Highway	27-Jun-2023	DL SG, survey, de-winter, slightly turbid, SG almost out of water	0.00052	0.00049	0.0014	0.067	0.000368	0.00526	0.0127	25.5	0.538	0.65	<0.0000050	0.000355	0.00296	0.0127	<0.050	0.270	0.000996	2.74	<0.000010	1.76	0.265	122	<0.000010	<0.00010	<0.00030	0.00393	<0.00050	0.309	0.099	<0.00030	9.67	9.55	0.99
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2023	Will return to download logger. Swoffer flow measurement.	0.00032	0.00053	0.0017	0.058	0.000411	0.00517	0.0122	24.8	0.349	0.48	<0.0000050	0.000416	0.00222	0.0122	<0.050	0.253	0.00112	2.94	<0.000010	1.82	0.260	134	<0.000010	<0.00010	<0.00030	0.00428	<0.00050	0.222	0.082	<0.00030	9.89	9.33	0.97
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2023		0.00026	0.00032	0.0019	0.071	0.000448	0.00520	0.0118	25.8	0.304	0.48	<0.0000050	0.000289	0.00222	0.0122	<0.050	0.364	0.00102	3.31	<0.000010	1.69	0.260	118	0.000010	<0.00010	<0.00030	0.00403	<0.00050	0.214	0.072	<0.00030	9.76	9.66	0.99
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2023	Surveyed SG.	0.00030	0.00027	0.0018	0.074	0.000243	0.00497	0.0126	26.0	0.501	0.3	<0.0000050	0.000264	0.00267	0.0119	<0.050	0.532	0.000944	3.39	<0.000010	1.85	0.276	136	<0.000010	<0.00010	<0.00030	0.00389	<0.00050	0.452	0.059	<0.00030	9.99	10.1	1.01
KV-6	Christal Creek u/s Silver Trail Highway	25-Oct-2023	Overflow no flow done	0.00060	0.0003	0.00100	0.081	0.000163	0.00483	0.0108	25.3	0.898	0.77	<0.0000050	0.000213	0.00301	0.01310	<0.050	0.484	0.00112	4.31	<0.000010	1.79	0.256	118	<0.000010	<0.00010	<0.00030	0.00426	<0.00050	0.226	0.104	<0.00030	10.2	10.0	0.99
KV-6	Christal Creek u/s Silver Trail Highway	20-Nov-2023		0.00121	<0.00020	0.0008	0.133	0.000050	0.00430	0.0113	26.1	1	0.77	<0.0000050	0.000222	0.00274	0.0122	<0.050	0.465	0.00124	4.48	<0.000010	1.72	0.257	119	<0.000010	<0.00010	<0.00030	0.00459	<0.00050	0.149	0.100	<0.00030	9.53	9.42	0.99
KV-6	Christal Creek u/s Silver Trail Highway	10-Dec-2023		0.00154	0.00032	0.0007	0.496	0.000323	0.00447	0.0115	28.1	1.1	0.77	<0.0000050	0.000222	0.0033	0.0129	<0.050	0.523	0.00120	4.57	<0.000010	1.90	0.265	114	<0.000010	<0.00010	<0.00030	0.00486	<0.00050	0.164	0.109	<0.00030	9.59	9.91	1.02
KV-6	Christal Creek u/s Silver Trail Highway	25-Jan-2024	Unable to locate flow ds. Significant ice coverage. LL downloaded, unable to connect to Baro	0.00089	<0.00020	0.0004	0.143	<0.000050	0.00320	0.0103	24.5	0.785	0.77	<0.0000050	0.000195	0.00223	0.0113	<0.050	0.419	0.00126	4.22	<0.000010	1.62	0.241	106	<0.000010	<0.00010	<0.00030	0.00474	<0.00050	0.118	0.087	<0.00030	9.27	8.87	0.98
KV-6	Christal Creek u/s Silver Trail Highway	16-Feb-2024	Frozen. Drilled a hole and hit slush, creek frozen to bottom						0.00075																						0.002				
KV-6	Christal Creek u/s Silver Trail Highway	29-Mar-2024	No section long enough for flow measurement without overflow. Baro would not connect via Bluetooth. Maxed out auger and poked through bottom of hole.	0.00077	<0.00020	0.0005	0.559	0.000268	0.00310	0.0160	29.1	0.877	0.65	<0.0000050	0.000221	0.00243	0.0132	<0.050	0.617	0.00114	4.60	<0.000010	2.10	0.265	139	<0.000010	<0.00010	<0.00030	0.00418	<0.00050	0.129	0.057	<0.00030	11.6	11.4	0.99
KV-6	Christal Creek u/s Silver Trail Highway	21-Apr-2024	Lots of ice, but good flow underneath. Auger hole from last month was not frozen over	0.00174	0.00025	0.0013	0.614	0.000862	0.00628	0.0148	23.9	1.08	0.93	<0.0000050	0.000242	0.00384	0.0139	<0.050	0.976	0.000831	4.02	<0.000010	2.30	0.270	137	<0.000010	<0.00010	<0.00030	0.00387	<0.00050	0.175	0.151	<0.00030	10.9	10.1	0.96
KV-6	Christal Creek u/s Silver Trail Highway	28-Apr-2024	Mostly ice covered with few open spots. Unable to connect with baro logger	0.00149	0.00069	0.0032	0.528	0.00254	0.00863	0.0091	17.1	1.03	0.71	<0.0000050	0.000201	0.00369	0.0125	<0.050	1.04	0.000594	2.98	0.000014	1.51	0.191	95.1	<0.000010	<0.00010	<0.00030	0.00265	<0.00050	0.391	0.165	<0.00030	7.70	7.31	0.97
KV-6	Christal Creek u/s Silver Trail Highway	08-May-2024	Clear water. Too much ice for midsection but some open sections. Ice partially melted around staff gauge enough to get rough water level measurement. Could not connect to baro logger	0.00181	0.00048	0.0024	0.382	0.00118	0.00782	0.0088	17.4	0.966	0.71	<0.0000050	0.000302	0.00389	0.0118	<0.050	0.824	0.000580	2.81	<0.000010	1.21	0.192	88.8	<0.000010	<0.00010	<0.00030	0.00257	<0.00050	0.110	0.167	<0.00030	6.20	7.40	1.09
KV-6	Christal Creek u/s Silver Trail Highway	13-May-2024	Did flow mid section d/s of staff gauge, 50 m u/s from road - only suitable section.Dewinterised levelogger at 14:00, could not connect to barologger. Started snowing halfway through flow measurement.	0.00164	0.00032	0.0023	0.155	0.000394	0.00645	0.0098	18.5	0.962	0.61	<0.0000050	0.000304	0.00376	0.012	<0.050	0.717	0.000823	3.47	<0.000010	1.40	0.226	114	<0.000010	<0.00010	<0.00060	0.00361	<0.00050	0.159	0.116	<0.00030	6.85	8.09	1.08
KV-6	Christal Creek u/s Silver Trail Highway	22-May-2024	SG approx 5.1 cm out of water. Midsection flow measurement. Some snow on banks but channel is thawed. Logger download. Found base plate of wading rod. Unable to connect to baro.	0.00097	0.00032	0.0019	0.151	0.000305	0.00546	0.0098	20.0	0.734	0.46	<0.0000050	0.000249	0.00298	0.011	<0.050	0.582	0.000744	3.10	<0.000010	1.36	0.204	94.5	<0.000010	<0.00010	<0.00030	0.00365	<0.00050	0.214	0.088	<0.00030	8.21	7.90	0.98
KV-6	Christal Creek u/s Silver Trail Highway	29-May-2024	Water clear, stage is down from 2 weeks ago. No ice present, stage is below staff gauge.	0.00092	0.00052	0.0023	0.126	0.000692	0.00670	0.0106	18.8	0.906	0.77	<0.0000050	0.000297	0.00345	0.0123	<0.050	0.613	0.000634	2.70	<0.000010	1.42	0.218	100	<0.000010	<0.00010	<0.00030	0.00311	<0.00050	0.431	0.127	<0.00030	8.46	8.16	0.98
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2024	SG out of water by about 20 cm. Downloaded logger. Midsection flow measurement. Surveyed. Could not connect to baro. Muddy stream bottom noted during midsection.	0.00034	0.00037	0.0023	0.058	0.000315	0.00511	0.0109	23.9	0.391	0.3	<0.0000050	0.000315	0.00261	0.011	<0.050	0.489	0.000991	2.88	<0.000010	1.61	0.250	109	<0.000010	<0.00010	<0.00030	0.00505	<0.00050	0.215	0.062	<0.00030	9.40	9.06	0.98
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2024	Site good, new sg looks good, see sg offset from survey earlier today	0.00023	0.00036	0.0016	0.096	0.000673	0.00510	0.0119	25.2	0.287	0.48	<0.0000050	0.000328	0.00215	0.0121	<0.050	0.258	0.00110	2.93	<0.000010	1.79	0.260	121	<0.000010	<0.00010	<0.00030	0.00535	<0.00050	0.223	0.082	<0.00030	10.1	9.36	0.96
KV-6	Christal Creek u/s Silver Trail Highway	08-Aug-2024	Aquatics: Benthics, sediment, fishing.	0.00019	0.00022	0.001	0.062	0.000391	0.00407	0.0118	26.8	0.221	0.65	<0.0000050	0.000232	0.00178	0.0116	<0.050	0.323	0.00115	3.48	<0.000010	1.88	0.255	117	<0.000010	<0.00010	<0.00030	0.00538	<0.00050	0.180	0.073	<0.00020	9.52	9.45	1.00
KV-6	Christal Creek u/s Silver Trail Highway	05-Sep-2024	Logger winterized	0.00019	0.00031	0.001	0.084	0.000368	0.00405	0.0109	23.5	0.379	0.65	<0.0000050	0.000208	0.00229	0.0109	<0.050	0.376	0.000852	3.52	<0.000010	1.62	0.241	112	<0.000010	<0.00010	<0.00030	0.00447	<0.00050	0.385	0.075	<0.00020	9.38	8.73	0.96
KV-6	Christal Creek u/s Silver Trail Highway	09-Oct-2024	Winterized logger, retrieved dropped logger	0.00030	0.00025	0.0013	0.067	0.000278	0.00475	0.0096	23.7	0.436	0.65	<0.0000050	0.000212	0.0026	0.0115	<0.050	0.335	0.00105	3.52	<0.000010	1.60	0.235	106	<0.000010	<0.00010	<0.00030	0.00488	<0.00050	0.338	0.086	<0.00020	8.83	8.79	1.00
KV-6	Christal Creek u/s Silver Trail Highway	07-Nov-2024	Winterized levelogger. Frozen over. Ice 3 inches thick. Discharge collected Nov 22	0.00092	<0.00020	0.0003	0.118	0.000116	0.00294	0.0119	25.8	1.4	0.93	<0.0000050	0.000192	0.00314	0.0115	<0.050	0.420	0.00111	4.26	<0.000010	1.88	0.248	111	<0.000010	<0.00010	<0.00030	0.00491	<0.00050	0.220

Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011	dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012	dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012	No water observed						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012	No water observed						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012	No water observed						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	braided, iced over - no flow measurements; no YSI for insitu	0.000131	0.00157		0.0921	0.00034	0.00977	0.00263	10.7	0.0438		<0.000010	<0.000050	0.00128		0.0125	0.598	0.000186	1.53	0.000008	0.763	0.158	82	<0.0000020	<0.00020	0.00055	0.000018	<0.00020	0.0337	0.196	0.00011			
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	High water flowing through bushes.	0.0000413	0.000886	0.0007	0.0139	0.0000653	0.00585	0.00215	10.4	0.00185	0.89	<0.000010	0.000055	0.000992	0.0065	0.0047	0.191	0.000259	1.73	<0.0000050	0.81	0.138	84	<0.0000020	<0.00020	<0.00050	0.0000057	<0.00020	0.021	0.139	<0.00010			
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012	water clear; flow measurement not possible; dispersed throughout moss and water holes; flow not observed; no continuous channel	0.0000906	0.00167	0.0004	0.04	0.000149	0.00769	0.00154	16.3	0.0159	0.94	<0.000010	<0.000050	0.00133	0.0105	0.0104	<0.050	0.000102	3.15	<0.0000050	1.05	0.218	120	<0.0000020	0.00072	<0.00050	0.0000092	<0.00020	0.0376	0.307	<0.00010			
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012	Flow measurement not possible. Tiny flow through moss but mainly puddles of water.	0.000195	0.000673	0.0013	0.23	0.00022	0.00663	0.00159	16.6	0.0256	0.94	<0.000010	0.000074	0.00113	0.0106	<0.0020	<0.050	0.000103	2.88	<0.0000050	1.14	0.214	118	<0.0000020	<0.00020	<0.00050	0.000012	<0.00020	0.0308	0.172	<0.00010			
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012	No Flow measurement possible.Too wide + flowing through moss and willows. Flow higher than August flow. Rain the day before.	0.000032	0.000571	0.0038	0.0142	0.000086	0.00649	0.00113	17.4	0.00304	0.29	<0.000010	<0.000050	0.000959	0.0102	<0.0020	0.158	0.000101	2.87	<0.0000050	1.24	0.211	128	<0.0000020	<0.00020	<0.00050	0.000006	<0.00020	0.0248	0.070	<0.00010			
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012	ORP not taken as it was unstable, flow unsuitable for salt slug or metering	0.000053	0.00062	0.0003	0.015	0.000096	0.00539	<0.0025	36.3	0.00676	1.4	<0.000050	<0.00025	0.0021	0.0197	<0.010	<0.25	<0.00020	3.85	<0.000025	1.65	0.411	282	<0.000010	<0.0010	<0.0025	0.000041	<0.0010	0.059	0.222	<0.00050			
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012	No water observed.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012	No water obseved. Seems to be frozen to the ground.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013	No water found. Frozen to the ground.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	03-May-2013	Frozen to the ground.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013	Puddles of water. May be a tiny flow through mosses but hard to tell. Saturated moss.Cannot get a flow reading.	<0.00010	0.00101	0.0005	0.037	0.000114	0.00715	0.00162	17.1	0.00817	1.0	<0.000010	<0.000050	0.00131	0.0105	<0.050	<0.10	<0.00010	2.77	<0.000010	0.897	0.208	114	<0.000010	<0.00010	<0.010	<0.000010	<0.0010	0.0432	0.290	<0.00080	7.55	7.43	0.99
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	Very little flow.	<0.00010	0.00115	0.0018	0.036	0.000797	0.00679	0.00079	14.2	0.00765	0.76	<0.000010	0.000222	0.00106	0.0093	<0.050	<0.10	0.00012	3.45	<0.000010	0.946	0.146	82.7	<0.000010	<0.00010	<0.010	<0.000010	<0.0010	0.0246	0.132	<0.00080	5.67	5.83	1.01
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014	frozen to the ground, no water found.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	06-May-2014	Cannot get flow, water running thhrough branches in different channels.	0.00023	0.00341	0.0009	0.126	0.00142	0.00960	0.00121	1.72	0.0614	0.33	0.000011	<0.000050	0.00162	0.0037	<0.050	0.50	0.00013	1.53	0.000031	0.314	0.0264	8.31	<0.000010	<0.00010	<0.010	0.000033	<0.0010	0.0193	0.062	<0.00080	0.75	0.91	1.09
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014	Puddles of water flowing through mosses; cannot measure flow. Water is clear.	<0.00010	0.00095	0.0012	0.017	0.000152	0.00684	0.00102	9.56	0.000673	0.83	<0.000010	<0.000050	0.00074	0.0071	<0.050	<0.10	0.00012	2.41	<0.000010	0.691	0.127	63.2	<0.000010	<0.00010	<0.010	<0.000010	<0.0010	0.0201	0.144	<0.00080	4.30	4.49	1.02
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014	Frozen to the gound.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015	No water observed, frozen to the ground.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	12-May-2015	Could not meter very braided and could not run salt dilution	0.00025	0.00211	0.0004	0.086	0.000364	0.00963	0.0018	2.93	0.0754	0.48	0.0000194	<0.000050	0.00119	0.0038	<0.050	0.53	0.000105	1.22	0.000018	0.333	0.0507	21.2	<0.000010	<0.00010	0.00086	0.000019	<0.00050	0.0226	0.105	<0.00030	1.43	1.56	1.04
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015	No flowing water, only stagnant, did not sample or gauge flow						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015	No moving water present						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016	Searched extensively, no water found						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	Multiple channels, no flow conducted.	0.00011	0.00129	0.0017	0.045	0.000112	0.00905	0.0031	7.34	0.0104	0.84	0.0000055	<0.000050	0.00085	0.0071	<0.050	0.29	0.000162	1.78	<0.000010	0.537	0.108	51.2	<0.000010	<0.00010	0.00043	0.000012	<0.00050	0.0160	0.175	<0.00030	3.36	3.90	1.07
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016	No way to accurately gauge flow, no flow conducted	<0.00010	0.0007	0.00200	<0.010	<0.000050	0.00655	<0.0010	13.8	0.00114	0.71	<0.0000050	<0.000050	0.00069	0.00970	<0.050	<0.10	0.000264	2.85	<0.000010	0.894	0.172	88.7	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	0.0164	0.118	<0.00030	5.80	6.14	1.03
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016	Site frozen to ground						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017	Frozen. Chipped around area, no water found.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	Conditions not conducive to measuring flow, water spread out and flowing through willows and moss.	0.00018	0.00201	0.0036	0.075	0.000286	0.00879	0.0021	3.16	0.0221	0.49	0.0000088	<0.000050	0.00105	0.0059	<0.050	0.27	0.000203	1.39	0.000017	0.383	0.0507	19.9	<0.000010	<0.00010	0.00108	0.000023	<0.00050	0.0171	0.056	<0.00030	1.45	1.52	1.02
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017	Wet moss but not enough water to sample.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017		<0.00010	0.0006	0.00130	0.011	<0.000050	0.00660	<0.0010	19.0	0.00049	0.86	<0.0000050	0.000060	0.00073	0.01070	<0.050	<0.10	0.000155	3.52	<0.000010	1.14	0.234	110	<0.000010	<0.00010	<0.00030	0.000014	<0.00050	0.0205	0.170	<0.00030	7.86	7.25	0.96
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018	Dry, frozen with overflow ice						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	No flow measurements, water running through willows (very braided)	0.00019	0.00242	0.0013	0.097	0.000301	0.01065	0.0025	2.92	0.0344	0.56	0.0000108	<0.000050	0.00141	0.0047	<0.050	0.37	0.000116	1.45	0.000024	0.408	0.0521	20.5	<0.000010	<0.00010	0.00114	0.000032	<0.00050	0.0274	0.107	<0.00030	1.46	1.62	1.05
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	Lots of water running through willow no defined channel, not possible to measure flow.	<0.00010	0.00099	0.0024	0.013	<0.000050	0.00713	0.0025	9.49	0.00075	0.64	<0.0000050	<0.000050	0.00082	0.0082	<0.050	0.18	0.000343	1.81	<0.000010	0.641	0.163	67.9	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	0.0248	0.107	<0.00030	4.72	4.57	0.98
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	No flow water very stagnant, willows enchroaching. DO seems to be working, probe in vertical position. Forgot temp, probably quite a bit higher than KV-50	<0.00010	0.0008		0.011	<0.000050	0.00659	0.0016	10.5	0.00072	0.64	<0.0000050	0.000053	0.00078		<0.050	<0.10	0.000123	2.29	<0.000010	0.844	0.153	65.3	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	0.0192	0.091	<0.00030	4.72	4.43	0.97
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	Unable to measure flow. No good across channel for MMB flow meter and not flowing quick enough. Looks like water is sitting still	<0.00010	0.0008	0.00140	<0.010	0.000058	0.00647	0.0012	14.9	0.00065	0.83	<0.0000050	0.000085	0.00053	0.00830	<0.050	0.14	0.000140	2.61	<0.000010	0.833	0.158	66.7	<0.000010	<0.00010	<0.00030	0.000018	<0.00050	0.0136	0.135	<0.00030	5.17	5.37	1.02
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018	Frozen solid, no flowing water.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019	Frozen, dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	no discharge measurement. Water is dispersed everywhere.	0.00012	0.00154	0.0015	0.037	0.000103	0.00842	0.0027	4.41	0.0128	0.67	<0.0000050	<0.000050	0.00091	0.005	<0.050	0.20	0.000239	1.51	<0.000010	0.442	0.0824	27.9	<0.000010	<0.00010	0.00067	0.000021	<0.00050	0.0145	0.115	<0.00030	2.00	2.39	1.09
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	Site not suitable for measuring flow. Surrounded by tall grass/willows and not visibly flowing.	<0.00010	0.00061	0.0023	0.016	<0.000050	0.00657	0.0019	12.4	0.00266	0.64	<0.0000050	0.000074	0.00069	0.0088	<0.050	<0.10	0.000224	2.34	<0.000010	0.839	0.168	85.8	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	0.0139	0.100	<0.00030	5.63	5.21	0.96
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019	Dry - soil wet but no stream flow.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019	no sample - too many willows. Water is stagnant - see photos						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020	frozen dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	07-May-2020	No sample taken - creek is dry or cannot be found under the ice and snow						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020	Found flowing did not take sample - only insitu - very braided.						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020		<0.00010	0.00136	0.0024	0.023	<0.000050	0.00794	0.0011	6.26	0.00076	0.66	<0.0000050	0.000084	0.00084	0.0062	<0.050	<0.100	0.000185	2.48	<0.000010	0.500	0.0887	25.7	<0.000010	<0.00010	<0.00030	0.000020	<0.00050	0.0100	0.094	<0.00030	2.49	2.87	1.07
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020	frozen						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021	Frozen						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	07-May-2021		0.00010	0.00198	0.0028	0.090	0.00193	0.00785	<0.0010	1.36	0.0467	0.38	<0.0000050	0.000066	0.00091	0.0049	<0.050	0.740	0.000112	0.830	0.000024	0.197	0.0185	3.34	<0.000010	<0.00010	0.00129	0.000033	<0.00050	0.0153	0.026	<0.00030	0.47	0.62	1.14
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021	Dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021	Frozen, see pictures						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022	Dry/Frozen						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	15-May-2022	no flow measurement	0.00010	0.0025	0.00170	0.081	0.000616	0.00902	<0.0010	2.23	0.0295	0.35	<0.0000050	0.000092	0.00108	0.00440	<0.050	0.362	0.000180	1.57	0.000021	0.322	0.0284	3.19	<0.000010	<0.00010	0.00069	0.000041	<0.00050	0.0132	0.050	<0.00030	0.79	0.90	1.07
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022		<0.00010	0.00109	0.0026	0.014	0.000066	0.00649	<0.0010	6.38	0.00044	0.53	<0.0000050	0.000130	0.00125	0.0058	<0.050	<0.100	0.000166	2.84	<0.000010	0.536	0.0861	13.4	<0.000010	<0.00010	<0.00030	0.000028	<0.00050	0.0082	0.053	<0.00030	2.41	2.39	1.00
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022	Seep is dry/frozen						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	09-Feb-2023	Dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	12-May-2023	could not locate water						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	14-Jul-2023	Peservative lost from dissolved nutrients bottle (small spill). Ysi unit C. No flow at site.	<0.00010	0.00113	0.0036	0.020	<0.000050	0.00669	<0.0010	6.08	0.00066	0.47	<0.0000050	0.000129	0.00088	0.0068	<0.050	<0.100	0.000241	3.48	<0.000010	0.512	0.0783	11.0	<0.000010	<0.00010	<0.00030	0.000032	<0.00050	0.0090	0.043	<0.00030	2.25	2.29	1.01
KV-49	Hinton Creek upstream Christal Creek	25-Oct-2023	Dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	16-Feb-2024	Creek was dry						0.00075																						0.002				
KV-49	Hinton Creek upstream Christal Creek	28-Apr-2024	Small very clear stream. Possibly runoff, but continuous through low willows.	<0.00010	0.0016	0.00180	0.051	0.000916	0.00821	<0.0010	2.03	0.0361	0.35	0.0000063	<0.000050	0.0009	0.00400	<0.050	0.859	0.000132	1.10	0.000017	0.301	0.0234	4.08	<0.000010	<0.00010	0.00031	0.000027	<0.00050	0.0135	0.039	<0.00030	0.59	0.75	1.12
KV-49	Hinton Creek upstream Christal Creek	08-May-2024	Very clear water in shallow stream. Sampled at old pink flag	<0.00010	0.00215	0.0031	0.046	0.000149	0.00888	<0.0010	3.35	0.00562	0.49	0.0000063	0.000080	0.00095	0.0053	<0.050	0.331	0.000387	2.20	0.000023	0.420	0.0416	4.61	<0.000010	<0.00010	0.00064	0.000037	<0.00050	0.0050	0.052	<0.00030	1.11	1.21	1.04
KV-49	Hinton Creek upstream Christal Creek	13-May-2024	Flowing clear for now, looks ephemeral may dry up by next visit	<0.00010	0.00137	0.0047	0.028	<0.000050	0.00732	0.0010	5.10	0.00637	0.35	<0.0000050	0.000128	0.00068	0.0079	<0.050	0.259	0.000530	2.70	<0.000010	0.480	0.0612	6.93	<0.000010	<0.00010	0.00030	0.000156	<0.00050	0.0033	0.034	<0.00030	1.68	1.76	1.02
KV-49	Hinton Creek upstream Christal Creek	22-May-2024	Lots of channels and pools. Not suitable for flow. Sampled in section with flowing/moving water. Water is clear. Shallow with leafy creek bottom.	<0.00010	0.00162	0.0036	0.039	0.000082	0.00681	<0.0010	3.89	0.00716	0.39	<0.0000050	0.000134	0.00072	0.0058	<0.050	0.129	0.000340	2.59	<0.000010	0.436	0.0481	3.99	<0.000010	<0.00010	0.00033	0.000045	<0.00050	0.0033	0.031	<0.00030	1.34	1.36	1.01
KV-49	Hinton Creek upstream Christal Creek	29-May-2024	Flowing low and clear, ephemeral	<0.00010	0.00155	0.0034	0.030	<0.000050	0.00734	<0.0010	3.78	0.00045	0.43	<0.0000050	0.000146	0.00068	0.0054	<0.050	<0.100	0.000246	2.41	<0.000010	0.416	0.0471	4.60	<0.000010	<0.00010	0.00033	0.000037	<0.00050	0.0037	0.039	<0.00030	1.30	1.38	1.03
KV-49	Hinton Creek upstream Christal Creek	07-Jul-2024	Stagnant marsh, no visibly flowing water.	<0.00010	0.00128	0.0027	0.022	<0.000050	0.00764	<0.0010	5.71	0.00023	0.56	<0.0000050	0.000148	0.00094	0.0055	<0.050	<0.100	0.000207	3.07	<0.000010	0.496	0.0718	8.70	<0.000010	<0.00010	<0.00030	0.000036	<0.00050	0.0061	0.062	<0.00030	2.04	1.98	0.99
KV-49	Hinton Creek upstream Christal Creek	09-Oct-2024	Thick ice on top of nearly stagnant water. Will be frozen to bottom next month	<0.00010	0.00098	0.0032	0.017	<0.000050	0.00739	<0.0010	7.34	0.0012	0.57	<0.0000050	0.000138	0.00068	0.0068	<0.050	<0.050	0.000188	3.52	<0.000010	0.536	0.0933	11.4	<0.000010	<0.00010	<0.00030	0.000104	<0.00050	0.0076	0.064	<0.00020	2.77	2.67	0.98
KV-50	Christal Creek upstream Hinton Creek	18-May-2008		0.0005	0.003		0.38	0.0006	0.00145	0.003	5.9	0.143	0.61		<0.001	0.0021			<0.4	<0.0002	2.1	<0.00001	0.5	0.059	21.1	<0.00005	<0.001	0.0016	0.0005	0.0002	0.05	0.014				
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008		0.0009	<0.001		0.23	<0.0001	0.00196	0.015	25.5	0.231	0.93		<0.001	0.0033			<0.4	<0.0002	4.05	<0.00001	1.4	0.247	96	<0.00005	<0.001	0.0029	0.0038	<0.0001	0.138	0.052				
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008		0.00118	<0.001		0.32	0.0002	0.00182	0.008	16.9	0.221	0.64		0.00016	0.004		<0.01	0.3	<0.0006	3.91	<0.00001	1.1	0.144		<0.00001	<0.0001	0.0007	0.002	0.0001	0.089	0.034	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	28-May-2009		0.000973	0.0015		0.509	0.00108	0.00170	0.008	11.4	0.27	0.88	<0.00001	0.0002	0.00314		0.008	0.27	0.00035	2.73	0.00001	1.98	0.121	50	0.000008	0.00004	<0.0005	0.00169	<0.0002	0.0786	0.048	0.0001			
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009		0.0015	0.00034		0.364	0.000431	0.00204	0.0184	25.5	0.412	0.77	<0.00001	0.00035	0.00463		0.004	0.39	0.00039	3.95	<0.000005	1.41	0.267	115	0.00001	<0.00001	<0.0005	0.00558	<0.0002	0.143	0.043	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009		0.00423	0.00022		2.97	0.00018	0.00206	0.0252	23.5	1.14	0.77	<0.00001	0.00113	0.00556		0.007	0.38	0.00026	4.72	<0.000005	1.25	0.246	140	<0.000002	<0.00001	<0.0005	0.002	<0.0002	0.0543	0.040	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010		0.00505	0.00028		1.84	0.000118	0.00206	0.0239	27.4	1.34	0.77	<0.00001	0.00023	0.00785		0.006	0.37	0.00025	4.18	<0.000005	1.41	0.258	150	0.000002	<0.00001	<0.0005	0.00184	<0.0002	0.103	0.045	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010		0.00585	0.00046	0.0003	2.15	0.000336	0.00322	0.0266	25.3	1.6	0.93		0.00025	0.00902	0.0134		0.39	0.00018	4.45	0.000012	1.39	0.252	153	<0.000002	<0.00001	<0.0005	0.0022	<0.0002	0.124	0.095	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011	no water found						0.00075																						0.002				
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011	no sample; ice axed but water not found						0.00075																						0.002				
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011	axing attempted. Water not found						0.00075																						0.002				

				Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
Station	**Description**	**Sample Date**	**Sample Comments**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-50	Christal Creek upstream Hinton Creek	26-May-2011	widely dispersed flow. Flow not taken	0.00548	0.00031	0.0012	2.58	0.000204	0.00573	0.0203	25.6	1.36	0.77	<0.00001	0.00018	0.00982	0.0138	0.009	0.36	0.00018	4.32	<0.000005	1.38	0.235	142	0.00001	0.00001	<0.0005	0.00202	<0.0002	0.146	0.130	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	flow not taken. Dispersed	0.00645	0.00021	0.001	2.49	0.000063	0.00450	0.0246	32.7	1.55	0.65	<0.00001	0.00018	0.0115	0.0159	0.003	0.38	0.00032	4.71	<0.000005	2.26	0.321	169	0.000011	<0.00001	<0.0005	0.00318	<0.0002	0.17	0.086	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011	not visited. No helper/lack of time						0.00075																						0.002				
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011	flow est 20 l/s	0.00223	0.00114	0.0051	1.14	0.000096	0.00701	0.0084	11	0.401	0.27		0.00028	0.00518	0.0108	0.01	0.25	0.00097	4.6	<0.000005	1.05	0.163	43	0.000034	<0.00001	<0.0005	0.00037	<0.0002	0.0726	0.048	0.0001			
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011	most turbid DC has seen water here. flows with Marsh McB	0.00623	0.00005	0.0006	2.29	0.000037	0.00362	0.0287	26.8	1.67	0.77	<0.00001	0.00076	0.00854	0.0145	0.007	0.4	0.00052	4.2	<0.000005	1.46	0.281	166	<0.000002	0.00001	<0.0005	0.0027	<0.0002	0.0809	0.076	0.0004			
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011		0.00915	0.00056	0.0006	4.72	0.000673	0.00397	0.0324	32.9	2.07	0.77	<0.00001	0.00025	0.0136	0.0164	0.016	0.4	0.00025	4.2	<0.000005	1.67	0.306	186	0.000003	0.00006	0.0017	0.00229	<0.0002	0.152	0.094	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011	Salt Slug; Conductivity probe malfunction in cold	0.00941	0.00012	0.0003	4.38	0.000052	0.00276	0.034	35	2.14	0.86	<0.000020	0.00025	0.0158	0.0165	0.012	0.42	0.00025	4.4	<0.000005	1.73	0.297	190	0.000002	0.00005	<0.0005	0.00235	<0.0002	0.173	0.070	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011	Conditions not condusive to measuring flow	0.00913	0.00024	0.0002	3.85	0.000106	0.00278	0.0353	30.5	2.23	1.0	<0.000010	0.00025	0.0152	0.0167	<0.002	0.4	0.00034	4	<0.000005	1.61	0.314	177	0.000004	<0.00001	<0.0005	0.00209	<0.0002	0.188	0.103	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012	Salt slug.	0.00973	0.00011	0.0002	4.19	0.000011	0.00315	0.0333	35.5	2.37	1.2	<0.00001	0.00026	0.0166	0.0178	0.009	0.44	0.00034	4.8	<0.000005	1.61	0.302	233	0.000006	<0.0002	<0.0005	0.00218	<0.0002	0.203	0.103	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012	Condition not condusive to measure flow.	0.00914	0.0002	0.0002	3.8	0.000006	0.00206	0.0355	33.4	2.23	1.2	<0.00001	0.0002	0.015	0.0175	0.009	0.44	0.00023	4.6	<0.000005	1.6	0.304	212	0.000009	<0.0002	<0.0005	0.00184	<0.0002	0.199	0.079	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012	Salt Slug	0.00985	<0.00005	0.0002	4.34	0.000006	0.00212	0.0334	33	2.3	1.0	<0.00001	0.00019	0.0169	0.0168	0.009	0.41	0.00022	4.3	<0.000005	1.64	0.297	199	0.000008	<0.0002	<0.0005	0.00229	<0.0002	0.199	0.080	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012	Salt Slug	0.0101	0.0007	0.0002	4.16	0.000108	0.00206	0.0355	34.1	2.29	0.86	<0.00001	0.00018	0.0176	0.0166	0.009	0.54	0.0002	4.4	<0.000005	1.89	0.284	203	0.000008	<0.0002	<0.0005	0.002	<0.0002	0.203	0.055	<0.0001			
KV-50	Christal Creek upstream Hinton Creek	03-May-2012	no YSI for insitu	0.00517	0.00106		2.56	0.000425	0.00914	0.0177	18.5	1.27		<0.000010	0.000181	0.00943		0.0154	0.422	0.000174	2.8	<0.0000050	1.1	0.169	106	0.000007	<0.00020	<0.00050	0.00112	<0.00020	0.123	0.158	0.00011			
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012	Red mud in creek bed.	0.00885	0.00026	0.0002	3.7	0.000556	0.00287	0.0319	35.7	2.37	1.0	<0.000050	<0.00025	0.0151	0.0156	<0.010	0.39	0.00024	3.6	<0.000025	1.84	0.285	192	<0.000010	<0.0010	<0.0025	0.00221	0.0011	0.211	0.095	<0.00050			
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012	water turbid but less than KV-51; orange mud; foam	0.00869	0.000139	0.0003	2.82	0.0000215	0.00302	0.0335	33.3	2.14	0.77	<0.000010	0.000236	0.0151	0.0162	0.0145	0.377	0.000294	4.52	<0.0000050	1.83	0.301	186	0.0000025	<0.00020	<0.00050	0.00218	<0.00020	0.161	0.081	<0.00010			
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012	Water turbid, creek bed reddish. Lots of branches making flow reading difficult.	0.00864	0.000191	0.0007	2.83	0.00003	0.00360	0.0315	33.4	2.17	0.65	<0.000010	0.000232	0.0154	0.0156	<0.0020	0.365	0.000363	4.64	<0.0000050	1.68	0.295	189	0.000003	<0.00020	<0.00050	0.00203	<0.00020	0.157	0.070	<0.00010			
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012	Water turbid + red mud on creek bed.	0.00886	<0.000050	0.0011	3.2	0.000088	0.00358	0.0305	30.8	2.06	0.21	<0.000010	0.000277	0.0157	0.0076	0.0031	0.413	0.000319	4.24	<0.0000050	1.61	0.303	183	0.000004	<0.00020	<0.00050	0.00209	<0.00020	0.159	0.046	<0.00010			
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012	Flow measurements at 11:41.	0.00913	0.000278	0.0002	3.21	0.000027	0.00311	0.0331	30.8	2.16	1.2	<0.000010	0.00025	0.017	0.0163	<0.0020	0.384	0.000247	4.48	<0.0000050	1.57	0.305	209	0.000008	0.00032	<0.00050	0.00223	<0.00020	0.161	0.132	<0.00010			
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012	YSI conductivity not working, flow reading not possible.	0.00861	0.000777	0.0004	3.45	0.000184	0.00250	0.0305	31.3	2.05	0.48	<0.000010	0.000273	0.0156	0.0137	0.0049	0.541	0.000289	4.33	<0.0000050	1.74	0.288	186	0.000008	<0.00020	<0.00050	0.00237	<0.00020	0.187	0.044	<0.00010			
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012	Got pH in Lab at the end of the day. ORP probe not working. Salt slug discharge measurement not available - meter error.	0.00919	0.000112	0.0002	3.76	0.000062	0.00281	0.0313	30.2	2.14	1.0	<0.000010	0.000207	0.0168	0.0151	<0.0020	0.375	0.000351	3.75	<0.0000050	1.64	0.296	170	0.000009	<0.00020	<0.00050	0.00247	<0.00020	0.207	0.105	0.00019	14	12	
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013		0.00964	0.000052	0.0002	3.73	0.000005	0.00257	0.0344	32	2.25	1.0	<0.000010	0.000224	0.0168	0.0157	<0.0020	0.377	0.000263	4.5	<0.0000050	1.57	0.29	173	0.000008	<0.00020	<0.00050	0.00202	<0.00020	0.209	0.095	<0.00010	14	13	
KV-50	Christal Creek upstream Hinton Creek	03-May-2013	Cannot salt slug, too many pools + debris.	0.0103	0.00079	0.0002	3.98	0.000118	0.00262	0.0362	35.9	2.65	1.2	<0.000010	0.000203	0.0189	0.0183	<0.050	0.45	0.00017	4.35	<0.000010	1.67	0.302	193	<0.000010	0.00012	<0.010	0.00207	<0.0010	0.233	0.104	<0.00080	14.6	14.6	1
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013	Water little turbid.	0.00784	0.0002	0.00020	2.27	0.000097	0.00354	0.0296	35.7	2.02	1.0	<0.000010	0.000199	0.0149	0.01670	<0.050	0.39	0.00029	4.29	<0.000010	1.79	0.297	168	<0.000010	<0.00010	<0.010	0.00303	<0.0010	0.167	0.137	<0.00080	13.6	13.1	0.98
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013	water clear, orange/brown sediments, brown/green algae on surface.	0.0104	<0.00020	0.0002	5.28	<0.000050	0.00278	0.0351	32.8	2.62	1.0	<0.000010	0.000317	0.0181	0.017	<0.050	0.38	<0.00010	4.91	<0.000010	1.33	0.300	178	<0.000010	<0.00010	<0.010	0.000481	<0.0010	0.155	0.100	<0.00080	13.9	13.7	0.99
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013	Water clear, Orange/brown precipitate.	0.00655	0.00029	0.0004	2.79	0.000095	0.00425	0.0255	30.5	1.61	1.0	<0.000010	0.000161	0.0128	0.0147	<0.050	0.35	0.00036	4.00	<0.000010	1.55	0.226	134	<0.000010	<0.00010	<0.010	0.00184	<0.0010	0.171	0.145	<0.00080	11.2	11.4	1.01
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014	Slug failed at the end, YSI froze.Too cold. Water little turbid, orange muck in creek bed. Lots of branches+ de bris in creek.All samples preserved+filtered in lab.	0.00709	<0.00020	0.0002	3.04	0.000121	0.00332	0.0263	25.9	1.68	1.0	<0.000010	0.000167	0.0135	0.0135	<0.050	0.40	0.00030	4.36	<0.000010	1.63	0.239	127	<0.000010	<0.00010	<0.010	0.00164	<0.0010	0.185	0.115	<0.00080	9.77	10.7	1.04
KV-50	Christal Creek upstream Hinton Creek	06-May-2014	Water orange, turbid, lots of branches in water, may affect flow reading.	0.00221	0.00169	0.0028	1.02	0.00568	0.00986	0.00602	8.27	0.558	0.71	<0.000010	0.000132	0.00454	0.0069	<0.050	0.64	<0.00010	1.79	0.000011	0.755	0.0749	32.4	<0.000010	<0.00010	<0.010	0.000352	<0.0010	0.0907	0.132	<0.00080	3.00	3.08	1.01
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014	Orange mud on bottom. Water little turbid.	0.00685	0.00036	0.0005	2.51	0.000748	0.00414	0.0219	31.7	1.69	0.93	<0.000010	0.000161	0.0129	0.0154	<0.050	0.37	0.00030	4.16	<0.000010	1.50	0.262	147	<0.000010	<0.00010	<0.010	0.00196	<0.0010	0.188	0.118	<0.00080	12.0	12.1	1
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014	95% open water. Red/orange sediments on bottom.	0.00621	0.00024	0.0004	2.27	<0.000050	0.00365	0.0213	29.0	1.45	0.93	<0.000010	0.000187	0.0116	0.0139	<0.050	0.37	0.00075	4.10	<0.000010	1.58	0.259	131	<0.000010	<0.00010	<0.010	0.00271	<0.0010	0.156	0.110	<0.00080	11.1	11.0	0.99
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015	water not oily like KV-51 downstream; lots of particulates in water.	0.00767	0.00024	0.0002	2.83	0.000124	0.00292	0.0284	30.5	1.82	1.0	<0.000010	0.000158	0.0153	0.0149	<0.050	0.40	0.00043	4.05	<0.000010	1.67	0.267	148	<0.000010	<0.00010	<0.010	0.00188	<0.0010	0.215	0.101	<0.00080	11.8	11.9	1
KV-50	Christal Creek upstream Hinton Creek	12-May-2015		0.00367	0.0012	0.00150	1.48	0.000489	0.00998	0.0118	13.0	1.08	0.88	0.0000100	0.000179	0.00726	0.00860	<0.050	0.59	0.00224	2.26	<0.000010	0.673	0.123	64.8	<0.000010	<0.00010	0.00032	0.000782	<0.00050	0.109	0.261	<0.00030	5.02	5.23	1.02
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015		0.00714	<0.00020	0.0004	2.89	0.000062	0.00363	0.0307	30.2	1.8	0.93	<0.0000050	0.000282	0.0122	0.0156	<0.050	0.35	0.000320	4.12	<0.000010	1.56	0.288	150	<0.000010	<0.00010	<0.00030	0.00239	<0.00050	0.152	0.109	<0.00030	12.2	12.4	1.01
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015	ORP value suspect, water is clear some ice on banks	0.00637	<0.00020	0.0004	2.40	0.000301	0.00318	0.0241	25.9	1.65	0.77	<0.0000050	0.000244	0.0113	0.0131	<0.050	0.35	0.000507	3.95	<0.000010	1.56	0.244	120	<0.000010	<0.00010	<0.00030	0.00218	<0.00050	0.146	0.075	<0.00030	10.3	10.8	1.02
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016		0.00833	<0.00020	0.0002	3.43	<0.000050	0.00235	0.0344	30.0	1.99	1.0	<0.0000050	0.000182	0.0149	0.0155	<0.050	0.35	0.000476	4.29	<0.000010	1.53	0.258	151	<0.000010	<0.00010	<0.00030	0.00219	<0.00050	0.210	0.087	<0.00030	12.0	12.4	1.02
KV-50	Christal Creek upstream Hinton Creek	04-May-2016	Water is clear, moderate to low flow.	0.00624	0.0005	0.00070	3.60	0.000298	0.00647	0.0260	27.5	1.56	1.0	<0.0000050	0.000191	0.0113	0.01520	<0.050	0.38	0.000386	3.77	<0.000010	1.21	0.230	129	<0.000010	<0.00010	<0.00030	0.00186	<0.00050	0.175	0.219	<0.00030	8.95	11.4	1.12
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016	Water is slightly turbid, moderate flow	0.00691	0.0002	0.00050	1.76	<0.000050	0.00403	0.0275	31.0	1.75	0.93	<0.0000050	0.000251	0.0118	0.01560	<0.050	0.36	0.000413	4.02	<0.000010	1.63	0.282	158	<0.000010	<0.00010	<0.00030	0.00258	<0.00050	0.150	0.115	<0.00030	11.6	12.3	1.03
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016		0.00891	0.0002	0.00020	4.47	0.000208	0.00342	0.0304	32.0	2.02	1.0	<0.0000050	0.000247	0.015	0.01600	<0.050	0.45	0.000331	4.37	<0.000010	1.64	0.274	158	<0.000010	<0.00010	<0.00030	0.00250	<0.00050	0.221	0.120	<0.00030	12.2	12.7	1.02
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	DO suspect (124% & 16.28 mg/L) and removed	0.00920	<0.00020	0.0002	4.30	<0.000050	0.00262	0.0296	31.0	2.15	0.93	<0.0000050	0.000212	0.0152	0.0161	<0.050	0.40	0.000314	4.48	<0.000010	1.54	0.283	169	<0.000010	<0.00010	<0.00030	0.00221	<0.00050	0.253	0.079	<0.00030	12.4	13.2	1.03
KV-50	Christal Creek upstream Hinton Creek	15-May-2017		0.00832	0.00039	0.001	4.08	0.000198	0.00683	0.0270	28.5	1.97	1.0	<0.0000050	0.000206	0.014	0.015	<0.050	0.45	0.000199	3.58	<0.000010	1.29	0.249	149	<0.000010	<0.00010	<0.00030	0.00190	<0.00050	0.231	0.199	<0.00030	11.1	11.1	1
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017		0.00814	<0.00020	0.0004	2.32	<0.000050	0.00390	0.0304	32.4	1.99	0.93	<0.0000050	0.000197	0.0144	0.0155	<0.050	0.37	0.000307	4.17	<0.000010	1.68	0.289	171	<0.000010	<0.00010	<0.00030	0.00310	<0.00050	0.225	0.116	<0.00030	12.8	12.2	0.97
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	Too cold for salt slug calibration	0.00766	<0.00020	0.0003	3.19	<0.000050	0.00318	0.0295	28.2	1.82	1.0	<0.0000050	0.000190	0.0136	0.0149	<0.050	0.40	0.000322	4.15	<0.000010	1.60	0.317	175	<0.000010	<0.00010	<0.00030	0.00288	<0.00050	0.251	0.103	<0.00030	12.8	11.8	0.96
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017		0.00746	<0.00020	0.0002	3.16	<0.000050	0.00258	0.0247	29.6	1.88	0.93	<0.0000050	0.000181	0.013	0.0143	<0.050	0.39	0.000396	4.24	<0.000010	1.62	0.270	160	<0.000010	<0.00010	<0.00030	0.00232	<0.00050	0.243	0.084	<0.00030	11.1	11.5	1.02
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	Ammonia analysed from DOC filtered bottle, result is total dissolved.	0.00698	<0.00020	0.0005	2.79	0.000163	0.00306	0.0235	25.3	1.58	0.77	<0.0000050	0.000170	0.0125	0.0121	<0.050	0.33	0.000402	4.08	<0.000010	1.59	0.265	151	0.000011	<0.00010	<0.00030	0.00234	<0.00050	0.244	0.067	<0.00030	11.1	10.2	0.96
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018		0.00818	<0.00020	0.0002	3.49	<0.000050	0.00248	0.0304	27.8	1.78	0.77	<0.0000050	0.000193	0.0144	0.0143	<0.050	0.38	0.000437	3.93	<0.000010	1.47	0.260	160	<0.000010	<0.00010	<0.00030	0.00224	<0.00050	0.271	0.065	<0.00030	12.7	12.0	0.97
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018		0.00780	<0.00020	0.0003	3.35	<0.000050	0.00289	0.0319	29.9	1.92	0.77	<0.0000050	0.00019	0.0144	0.0146	<0.050	0.39	0.000320	4.32	<0.000010	1.61	0.286	170	<0.000010	<0.00010	<0.00030	0.00190	<0.00050	0.272	0.079	<0.00030	12.8	12.0	0.97
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018		0.00918	<0.00020	0.0003	4.07	<0.000050	0.00325	0.0289	29.6	2.18	0.93	<0.0000050	0.000189	0.0162	0.016	<0.050	0.47	0.000237	4.48	<0.000010	1.89	0.290	154	<0.000010	<0.00010	<0.00030	0.00208	<0.00050	0.344	0.099	<0.00030	12.1	12.9	1.03
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018		0.00834	<0.00020	0.0003	2.97	<0.000050	0.00318	0.0315	29.6	2.02	0.77	<0.0000050	0.000215	0.0147	0.0151	<0.050	0.46	0.000243	4.75	<0.000010	1.87	0.275	167	0.000012	<0.00010	<0.00030	0.00208	<0.00050	0.271	0.086	<0.00030	12.1	12.3	1.01
KV-50	Christal Creek upstream Hinton Creek	15-May-2018		0.00146	0.00193	0.0029	0.758	0.00231	0.01099	0.0049	6.84	0.359	0.65	<0.0000050	0.000149	0.00379	0.007	<0.050	0.61	0.000130	1.55	0.000014	0.587	0.0651	24.2	<0.000010	<0.00010	0.00065	0.000321	<0.00050	0.0636	0.118	<0.00030	2.39	2.45	1.01
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018		0.00580	0.00063	0.0011	2.30	0.000661	0.00606	0.0189	24.2	1.4	0.93	<0.0000050	0.000202	0.0104	0.0126	<0.050	0.40	0.000568	3.37	<0.000010	1.41	0.235	94.9	<0.000010	<0.00010	<0.00030	0.00186	<0.00050	0.200	0.162	<0.00030	9.45	9.18	0.98
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	DO stable, then erratic, then stable again at 70%.	0.00570	<0.00020	0.0007	2.16	<0.000050	0.00383	0.0231	26.8	1.32	0.77	<0.0000050	0.000200	0.0102	0.0124	<0.050	0.35	0.000440	3.98	<0.000010	1.98	0.278	138	<0.000010	<0.00010	<0.00030	0.00421	<0.00050	0.184	0.080	<0.00030	11.1	10.2	0.96
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	total metals missing preservatives, preserved in lab later	0.00544	0.00034	0.0006	2.31	<0.000050	0.00485	0.0199	25.2	1.25	0.93	<0.0000050	0.000194	0.00935	0.0126	<0.050	0.34	0.000494	4.00	<0.000010	1.85	0.247	123	<0.000010	<0.00010	<0.00030	0.00316	<0.00050	0.167	0.142	<0.00030	9.71	9.61	0.99
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	Sampled and flow measured 20 m u/s of flagging. Discharge suspect due to high RPD and poor helper field note recording in Sep.	0.00503	0.00024	0.0003	1.87	0.000075	0.00402	0.0206	28.9	1.3	1.0	<0.0000050	0.000205	0.00845	0.0138	<0.050	0.37	0.000923	3.84	<0.000010	1.66	0.278	128	<0.000010	<0.00010	<0.00030	0.00359	<0.00050	0.159	0.144	<0.00030	10.2	10.6	1.02
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	Salt slug. Sampled at flagging. Ice on top of stream.	0.00572	<0.00020	0.0002	1.90	<0.000050	0.00246	0.0186	22.8	1.38	1.0	<0.0000050	0.000175	0.0102	0.0106	<0.050	0.33	0.000603	4.45	<0.000010	1.60	0.213	126	0.000010	<0.00010	<0.00030	0.00237	<0.00050	0.206	0.091	<0.00030	8.80	8.40	0.98
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	Semi open, some mud disturbed at u/s sample site prior to salt and insitu reading	0.00631	<0.00020	0.0002	2.05	<0.000050	0.00281	0.0222	23.2	1.47	1.0	<0.0000050	0.000192	0.0117	0.0113	<0.050	0.39	0.000385	4.02	<0.000010	1.71	0.216	111	0.000016	<0.00010	<0.00030	0.00184	<0.00050	0.233	0.118	<0.00030	9.02	8.82	0.99
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	Slight u/s blockage from ice, corrected maybe. Short discharge distance for salt.	0.00663	<0.00020	0.0002	2.60	<0.000050	0.00239	0.0222	22.7	1.54	1.0	<0.0000050	0.000175	0.0118	0.0117	<0.050	0.39	0.000333	4.28	<0.000010	1.99	0.226	108	0.000016	<0.00010	<0.00030	0.00189	<0.00050	0.245	0.103	<0.00030	9.06	9.24	1.01
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	shallow, good flow. Initially covered with thin ice.	0.00673	<0.00020	0.0002	2.55	<0.000050	0.00284	0.0225	23.5	1.59	1.0	<0.0000050	0.000210	0.0119	0.0116	<0.050	0.37	0.000366	4.35	<0.000010	1.59	0.227	117	0.000014	<0.00010	<0.00030	0.00158	<0.00050	0.243	0.114	<0.00030	9.46	9.08	0.98
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	Flow data lost	0.00712	<0.00020	0.0002	2.89	<0.000050	0.00258	0.0218	24.1	1.76	0.93	<0.0000050	0.000178	0.0127	0.0112	<0.050	0.38	0.000314	4.44	<0.000010	1.59	0.215	114	0.000012	<0.00010	<0.00030	0.00143	<0.00050	0.272	0.081	<0.00030	9.48	9.04	0.98
KV-50	Christal Creek upstream Hinton Creek	06-Mar-2019	shallow; flow apparent	0.00620	<0.00020	0.0002	2.70	<0.000050	0.00292	0.0243	23.8	1.55	1.0	<0.0000050	0.000172	0.0112	0.0118	<0.050	0.38	0.000268	4.44	<0.000010	1.63	0.220	121	<0.000010	<0.00010	<0.00030	0.00147	<0.00050	0.236	0.099	<0.00030	9.81	9.36	0.98
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2019		0.00707	<0.00020	0.0002	2.42	0.000128	0.00301	0.0240	24.3	1.84	1.0	<0.0000050	0.000221	0.0126	0.0124	<0.050	0.41	0.000187	4.02	<0.000010	1.62	0.221	125	0.000011	<0.00010	<0.00030	0.00130	<0.00050	0.264	0.115	<0.00030	9.34	9.79	1.02
KV-50	Christal Creek upstream Hinton Creek	16-May-2019		0.00412	<0.00020	0.0004	0.020	<0.000050	0.00450	0.0172	20.1	1

Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021		0.00466	<0.00020	0.0009	0.432	0.000110	0.00324	0.0192	21.9	1.28	0.48	<0.0000050	0.000149	0.00812	0.0093	<0.050	0.346	0.000458	4.14	<0.000010	1.61	0.233	108	0.000011	<0.00010	<0.00030	0.00152	<0.00050	0.174	0.049	<0.00030	9.01	8.44	1.03
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021		0.00462	<0.00020	0.0004	0.973	<0.000050	0.00315	0.0186	22.0	1.26	0.86	<0.0000050	0.000152	0.00811	0.0099	<0.050	0.356	0.000366	4.48	<0.000010	1.63	0.209	104	0.000015	<0.00010	<0.00030	0.00154	<0.00050	0.178	0.087	<0.00030	8.69	7.77	1.06
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	mid section flow measurement.	0.00405	0.00028	0.0015	1.42	<0.000050	0.00467	0.0162	18.3	1.05	0.46	<0.0000050	0.000203	0.00669	0.0095	<0.050	0.307	0.000860	4.28	<0.000010	1.45	0.212	84.1	0.000011	<0.00010	<0.00030	0.00108	<0.00050	0.143	0.070	<0.00030	7.36	7.16	1.01
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021		0.00475	0.00024	0.0008	1.81	0.000127	0.00361	0.0180	19.8	1.17	0.61	<0.0000050	0.000222	0.0083	0.0097	<0.050	0.359	0.000597	4.12	<0.000010	1.58	0.234	91.5	0.000013	<0.00010	<0.00030	0.00175	<0.00050	0.176	0.072	<0.00030	8.14	7.81	1.02
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021		0.00440	<0.00020	0.0005	1.56	<0.000050	0.00406	0.0176	18.9	1.19	0.86	<0.0000050	0.000172	0.00757	0.0097	<0.050	0.311	0.000269	4.39	<0.000010	1.47	0.204	87.5	0.000013	<0.00010	<0.00030	0.00129	<0.00050	0.178	0.114	<0.00030	7.77	7.32	1.03
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021		0.00734	<0.00020	0.0002	2.74	<0.000050	0.00310	0.0208	23.6	1.78	1.1	<0.0000050	0.000194	0.0119	0.0118	<0.050	0.444	0.000227	4.80	<0.000010	1.86	0.244	109	0.000018	<0.00010	<0.00030	0.00146	<0.00050	0.273	0.158	<0.00030	8.96	9.15	1.01
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	not ideal for flow measurement, creek full of slush	0.00670	<0.00020	0.0004	2.58	<0.000050	0.00322	0.0219	21.4	1.65	0.77	<0.0000050	0.000191	0.0107	0.0109	<0.050	0.366	0.000288	4.73	<0.000010	1.70	0.217	106	0.000017	0.00020	<0.00030	0.00136	<0.00050	0.252	0.081	<0.00030	8.86	8.80	1.00
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022		0.00717	<0.00020	0.0002	2.71	0.000220	0.00256	0.0217	22.4	1.91	0.93	<0.0000050	0.000186	0.0126	0.011	<0.050	0.377	0.000139	4.81	<0.000010	1.59	0.220	118	0.000014	<0.00010	<0.00030	0.00121	<0.00050	0.276	0.076	<0.00030	9.34	8.89	1.02
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022		0.00786	<0.00020	0.0003	2.89	<0.000050	0.00297	0.0243	24.2	2.06	0.93	<0.0000050	0.000194	0.0134	0.012	<0.050	0.379	0.000147	4.91	<0.000010	1.56	0.226	114	0.000021	<0.00010	<0.00030	0.00111	<0.00050	0.307	0.089	<0.00030	9.56	9.60	1.00
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022		0.00808	<0.00020	0.0002	3.60	<0.000050	0.00270	0.0244	21.7	1.96	1.0	<0.0000050	0.000193	0.0134	0.0111	<0.050	0.389	0.000078	4.82	<0.000010	1.59	0.223	119	0.000018	<0.00010	<0.00030	0.00118	<0.00050	0.313	0.099	<0.00030	9.43	8.82	1.03
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	low water levels	0.00602	0.00039	0.0011	3.00	0.00380	0.00521	0.0165	17.5	1.46	0.86	0.0000063	0.000280	0.00989	0.0095	<0.050	0.819	0.000082	3.47	0.000013	5.71	0.168	84.3	0.000016	<0.00010	<0.00030	0.000782	<0.00050	0.266	0.116	<0.00030	7.13	7.07	1.00
KV-50	Christal Creek upstream Hinton Creek	15-May-2022		0.00182	0.00194	0.0018	1.06	0.00215	0.01036	0.0050	5.87	0.456	0.64	<0.0000050	0.000135	0.00431	0.0055	<0.050	0.443	0.000087	1.84	0.000014	1.71	0.0644	22.0	<0.000010	<0.00010	0.00051	0.000216	<0.00050	0.0778	0.132	<0.00030	2.18	2.31	1.03
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022		0.00563	0.00044	0.0018	2.91	0.000266	0.00582	0.0180	16.9	1.44	0.71	<0.0000050	0.000179	0.00916	0.0111	<0.050	0.270	0.000420	3.79	<0.000010	1.07	0.203	96.2	<0.000010	<0.00010	<0.00030	0.000920	<0.00050	0.217	0.108	<0.00030	8.14	7.75	1.02
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022		0.00535	0.00024	0.0007	0.930	<0.000050	0.00453	0.0211	21.9	1.42	0.93	<0.0000050	0.000177	0.00951	0.0114	<0.050	0.296	0.000295	4.66	<0.000010	1.37	0.221	114	0.000016	<0.00010	<0.00030	0.00116	<0.00050	0.191	0.127	<0.00030	9.08	8.65	1.02
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022		0.00547	<0.00020	0.0008	1.06	<0.000050	0.00453	0.0211	21.4	1.48	0.77	<0.0000050	0.000204	0.00986	0.012	<0.050	0.323	0.000329	4.39	<0.000010	1.47	0.251	111	0.000015	<0.00010	<0.00030	0.00122	<0.00050	0.184	0.110	<0.00030	9.33	9.22	1.01
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022		0.00566	0.00021	0.0009	1.97	0.000068	0.00501	0.0187	20.5	1.63	0.93	<0.0000050	0.000226	0.00958	0.0111	<0.050	0.324	0.000175	4.48	<0.000010	1.46	0.228	97.7	0.000015	<0.00010	<0.00030	0.000958	<0.00050	0.211	0.129	<0.00030	8.31	8.24	1.00
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022	Creek frozen to bottom, cannot find any open water						0.00075																							0.002			
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	Normal flow, ice covered stream, water shallow and orange.	0.00593	0.00024	0.0005	2.36	<0.000050	0.00325	0.0186	20.9	1.43	0.71	<0.0000050	0.000178	0.0103	0.01	<0.050	0.345	0.000458	4.77	<0.000010	1.67	0.216	105	0.000016	<0.00010	<0.00030	0.00135	<0.00050	0.230	0.081	<0.00030	8.61	7.94	0.96
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022		0.00599	<0.00020	0.0006	2.59	<0.000050	0.00330	0.0207	18.7	1.43	0.61	<0.0000050	0.000220	0.00978	0.0096	<0.050	0.342	0.000248	4.72	<0.000010	4.63	0.224	99.8	0.000015	<0.00010	<0.00030	0.00122	<0.00050	0.238	0.066	<0.00030	8.51	8.00	0.97
KV-50	Christal Creek upstream Hinton Creek	21-Jan-2023	Creek slushy, no flow	0.00681	<0.00020	0.0002	2.50	<0.000050	0.00295	0.0218	20.4	1.74	1.0	<0.0000050	0.000238	0.0115	0.0111	<0.050	0.359	0.000157	4.88	<0.000010	2.07	0.222	109	0.000020	<0.00010	<0.00030	0.00108	<0.00050	0.272	0.100	<0.00030	9.03	8.78	0.99
KV-50	Christal Creek upstream Hinton Creek	09-Feb-2023		0.00703	<0.00020	0.0004	2.80	<0.000050	0.00357	0.0245	19.6	1.76	0.93	<0.0000050	0.000187	0.0116	0.0106	<0.050	0.354	0.000143	4.45	<0.000010	1.53	0.216	98.4	0.000022	<0.00010	<0.00030	0.00112	<0.00050	0.276	0.112	<0.00030	9.19	8.26	0.95
KV-50	Christal Creek upstream Hinton Creek	10-Mar-2023	only one salt flow done	0.00732	<0.00020	0.0006	2.41	<0.000050	0.00326	0.0221	20.6	1.83	0.71	<0.0000050	0.000175	0.0122	0.0099	<0.050	0.401	0.000138	4.71	<0.000010	1.69	0.208	108	0.000017	0.00014	<0.00030	0.00103	<0.00050	0.289	0.071	<0.00030	9.02	8.13	0.95
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2023	Sample only, glaciation layers	0.00654	<0.00020	0.0004	2.44	0.000856	0.00321	0.0201	18.0	1.62	0.86	<0.0000050	0.000256	0.0106	0.0094	<0.050	0.508	0.000136	4.33	<0.000010	~	0.195	97.5	0.000017	<0.00010	<0.00030	0.000890	<0.00050	0.257	0.090	<0.00030	8.79	7.74	0.94
KV-50	Christal Creek upstream Hinton Creek	12-May-2023	Flooded vegetation, no flow measurement	0.00168	0.00195	0.0019	0.868	0.00200	0.01013	0.0048	6.16	0.479	0.67	0.0000073	0.000126	0.00368	0.0055	<0.050	0.959	0.000148	1.83	0.000024	6.90	0.0681	25.0	<0.000010	<0.00010	<0.00090	0.000176	<0.00050	0.0993	0.129	<0.00030	2.49	2.58	1.02
KV-50	Christal Creek upstream Hinton Creek	14-Jul-2023		0.00533	<0.00020	0.0005	1.57	0.000051	0.00376	0.0220	20.7	1.44	0.93	<0.0000050	0.000216	0.00912	0.011	<0.050	0.324	0.000479	4.74	<0.000010	1.64	0.227	116	0.000013	<0.00010	<0.00030	0.00154	<0.00050	0.194	0.102	<0.00030	8.92	8.59	0.98
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2023	Salt flow instead of xs b/c channel width is quite small and edge effects negatively affect ADV significantly. Needed more salt.	0.00578	<0.00020	0.0008	1.89	<0.000050	0.00491	0.0210	20.5	1.6	0.93	<0.0000050	0.000168	0.00981	0.0115	<0.050	0.323	0.000220	4.76	<0.000010	1.50	0.221	105	0.000012	<0.00010	<0.00030	0.00122	<0.00050	0.215	0.130	<0.00030	8.76	8.58	0.99
KV-50	Christal Creek upstream Hinton Creek	14-Sep-2023	Will return for flow measurement. Surveyed KV-51	0.00575	<0.00020	0.0005	1.22	<0.000050	0.00378	0.0234	20.8	1.62	0.93	<0.0000050	0.000293	0.00972	0.0111	<0.050	0.377	0.000165	4.71	<0.000010	1.60	0.220	109	0.000015	<0.00010	<0.00030	0.00111	<0.00050	0.203	0.104	<0.00030	8.58	8.64	1.00
KV-50	Christal Creek upstream Hinton Creek	25-Oct-2023	Glaciated with over flow	0.00659	<0.00020	0.0003	3.18	<0.000050	0.00378	0.0244	20.8	1.89	1.0	<0.0000050	0.000153	0.0109	0.0121	<0.050	0.384	0.000148	5.04	<0.000010	1.49	0.224	110	<0.000010	<0.00010	<0.00030	0.00113	<0.00050	0.251	0.138	<0.00030	8.99	9.37	1.02
KV-50	Christal Creek upstream Hinton Creek	20-Nov-2023	Standing water on top of ice above flowing water. Unable to guarantee salt mixture enters flowing portion	0.00702	<0.00020	0.0003	2.25	<0.000050	0.00393	0.0238	22.2	1.86	1.0	<0.0000050	0.000244	0.0112	0.0114	<0.050	0.368	0.000202	5.14	<0.000010	1.54	0.227	113	0.000011	<0.00010	<0.00030	0.00124	<0.00050	0.270	0.138	<0.00030	9.14	8.80	0.98
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2023	Salt gauge conducted but results were not good.	0.00729	0.00043	0.0003	2.99	<0.000050	0.00413	0.0236	22.2	1.84	1.0	<0.0000050	0.000162	0.012	0.0116	<0.050	0.434	0.000163	4.84	<0.000010	1.95	0.224	106	0.000014	<0.00010	<0.00030	0.00116	<0.00050	0.280	0.162	<0.00030	8.83	8.90	1.00
KV-50	Christal Creek upstream Hinton Creek	25-Jan-2024	Not enough flow to clear auger hole. Ice nearly frozen to bottom	0.00747	<0.00020	0.0002	5.30	<0.000050	0.00314	0.0237	21.6	2.32	1.0	<0.0000050	0.000162	0.012	0.0114	<0.050	0.349	0.000128	4.79	<0.000010	1.46	0.219	111	<0.000010	<0.00010	<0.00030	0.00118	<0.00050	0.269	0.114	<0.00030	10.1	9.02	0.94
KV-50	Christal Creek upstream Hinton Creek	16-Feb-2024	could not locate running water due to glaciation						0.00075																							0.002			
KV-50	Christal Creek upstream Hinton Creek	29-Mar-2024	Glaciated						0.00075																							0.002			
KV-50	Christal Creek upstream Hinton Creek	21-Apr-2024	6ft plus of ice, orange overflow water on top. Very rotten ice, likely melted by next month						0.00075																							0.002			
KV-50	Christal Creek upstream Hinton Creek	28-Apr-2024	Very flooded area with lots of channels. Lots of water everywhere, unable to conduct flow measurement. Possibly influenced by snowmelt.	0.00230	0.00096	0.002	1.14	0.00384	0.00907	0.0081	8.73	0.658	0.75	<0.0000050	0.000130	0.00436	0.0065	<0.050	0.878	0.000082	2.27	0.000030	2.35	0.0895	36.9	<0.000010	<0.00010	0.00038	0.000253	<0.00050	0.108	0.141	<0.00030	3.47	3.37	0.99
KV-50	Christal Creek upstream Hinton Creek	08-May-2024		0.00198	0.00148	0.0019	0.962	0.000892	0.00944	0.0068	7.05	0.559	0.73	<0.0000050	0.000143	0.00418	0.0059	<0.050	0.453	0.000140	2.40	0.000018	0.901	0.0789	26.2	<0.000010	<0.00010	0.00090	0.000230	<0.00050	0.0768	0.136	<0.00030	2.78	2.82	1.01
KV-50	Christal Creek upstream Hinton Creek	13-May-2024	Very orange nasty water, residue on willows all around creek. Water flowing low and clear, some ice on banks.	0.00374	0.00054	0.0024	1.89	0.000601	0.00698	0.0124	13.2	1.14	0.64	<0.0000050	0.000149	0.00671	0.0089	<0.050	0.439	0.000084	3.39	<0.000010	1.39	0.137	63.7	<0.000010	<0.00010	<0.00030	0.000547	<0.00050	0.150	0.107	<0.00030	4.25	5.24	1.10
KV-50	Christal Creek upstream Hinton Creek	22-May-2024	Metallic odour, orange precipitate in water. Lots of orange precipitate in creek and area. Soft creek bottom due to precipitate build up. Midsection flow measurement.	0.00450	0.0004	0.00180	2.09	0.000439	0.00605	0.0167	16.2	1.27	0.71	<0.0000050	0.000197	0.00792	0.00940	<0.050	0.350	0.000114	3.84	<0.000010	1.53	0.161	72.4	<0.000010	<0.00010	<0.00030	0.000736	<0.00050	0.176	0.107	<0.00030	6.68	6.24	0.97
KV-50	Christal Creek upstream Hinton Creek	29-May-2024	Orange precipitate on creek bed and surrounding veg.	0.00360	0.00088	0.0014	1.83	0.00119	0.00773	0.0113	11.4	1.05	0.83	<0.0000050	0.000213	0.00629	0.0073	<0.050	0.315	0.000139	3.21	<0.000010	1.53	0.124	47.7	<0.000010	<0.00010	<0.00030	0.000463	<0.00050	0.121	0.160	<0.00030	4.64	4.56	0.99
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2024	Midsection flow measurement. Lots of orange deposit on creek bottom, which sometimes interfered with measuring flow.	0.00642	<0.00020	0.0012	3.30	0.000065	0.00486	0.0229	21.4	1.85	0.77	<0.0000050	0.000226	0.0103	0.0115	<0.050	0.342	0.000109	4.70	<0.000010	1.58	0.216	118	<0.000010	<0.00010	<0.00030	0.00110	<0.00050	0.245	0.099	<0.00030	9.41	8.82	0.97
KV-50	Christal Creek upstream Hinton Creek	07-Jul-2024	Same sediment issue with flow meter as kv51. Could not do salt, longest stretch without a large eddie or pool was ~1m.	0.00572	<0.00020	0.0006	1.05	<0.000050	0.00432	0.0246	22.0	1.77	0.93	<0.0000050	0.000174	0.00986	0.0114	<0.050	0.339	0.000128	4.43	<0.000010	1.58	0.226	117	<0.000010	<0.00010	<0.00030	0.00114	<0.00050	0.194	0.125	<0.00030	9.46	8.73	0.96
KV-50	Christal Creek upstream Hinton Creek	14-Aug-2024	Bottom too soft for midsection flow, every movement stirred up sediment that settles on sensor. Salt slug - 150 g was good mass, ysi was not logging for first 150 so only have 1 usable salt flow. Last salt would not come down to bl.	0.00649	<0.00020	0.0004	1.68	<0.000050	0.00389	0.0224	22.0	1.83	0.93	<0.0000050	0.000165	0.0102	0.0118	<0.050	0.366	0.000183	4.87	<0.000010	1.45	0.230	129	<0.000010	<0.00010	<0.00030	0.00116	<0.00050	0.219	0.119	<0.00020	9.99	9.15	0.96
KV-50	Christal Creek upstream Hinton Creek	05-Sep-2024	Bottom too soft for midsection flow, water too slow for salt flow	0.00484	0.00026	0.0008	1.18	0.000380	0.00451	0.0183	19.2	1.44	0.71	<0.0000050	0.000171	0.00843	0.0101	<0.050	0.469	0.000158	4.20	<0.000010	1.66	0.216	92.1	<0.000010	<0.00010	<0.00030	0.000927	<0.00050	0.183	0.109	<0.00020	8.26	7.60	0.96
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2024	Creek partially frozen over, broke ice to do mid section flow measurement	0.00555	<0.00020	0.0006	1.56	<0.000050	0.00388	0.0199	20.1	1.56	0.93	<0.0000050	0.000181	0.009	0.0108	<0.050	0.328	0.000225	4.47	<0.000010	1.42	0.214	102	0.000013	<0.00010	<0.00030	0.00107	<0.00050	0.215	0.105	<0.00020	8.46	8.34	0.99
KV-50	Christal Creek upstream Hinton Creek	06-Nov-2024	Discharge collected Nov 21	0.00605	<0.00020	0.0002	2.05	<0.000050	0.00237	0.0217	20.6	1.71	1.0	<0.0000050	0.000145	0.00957	0.0105	<0.050	0.355	0.000167	4.82	<0.000010	1.41	0.211	98.7	0.000015	<0.00010	<0.00030	0.000946	<0.00050	0.229	0.111	<0.00020	8.52	8.15	0.98
KV-50	Christal Creek upstream Hinton Creek	21-Nov-2024							0.00075																							0.002			
KV-50	Christal Creek upstream Hinton Creek	05-Dec-2024		0.00605	<0.00020	0.0003	2.68	<0.000050	0.00273	0.0224	19.1	1.73	0.71	<0.0000050	0.000164	0.00955	0.01	<0.050	0.409	0.000163	4.90	<0.000010	1.52	0.208	99.6	0.000016	<0.00010	<0.00030	0.000887	<0.00050	0.234	0.074	<0.00030	8.41	8.06	0.98
KV-51	Christal Creek d/s Hinton Creek	18-May-2008		0.0006	0.003		0.42	0.0004	0.00145	0.004	6.1	0.142	0.61		<0.001	0.0019			<0.4	<0.0002	2.1	<0.00001	0.5	0.062	21.4	<0.00005	<0.001	0.0016	0.0006	0.0002	0.05	0.014				
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008		0.0009	<0.001		0.32	<0.0001	0.00196	0.015	24.8	0.258	0.93		<0.001	0.0031			<0.4	0.0003	4.07	<0.00001	1.4	0.248	94.3	<0.00005	<0.001	0.0028	0.0036	<0.0001	0.14	0.058				
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008		0.00113	0.001		0.316	0.0012	0.00178	0.008	15.4	0.208	0.64		0.00015	0.006		<0.01	0.3	<0.0006	3.86	<0.00001	1	0.137		<0.00001	<0.0001	0.001	0.0018	0.00015	0.092	0.029	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	28-May-2009		0.000637	0.00228		0.26	0.00148	0.00149	0.0039	6.06	0.256	0.47	<0.00001	0.00015	0.00262		0.016	0.36	0.00021	1.83	0.000013	0.52	0.0674	27	0.000005	<0.00001	0.0009	0.0007	<0.0002	0.18	0.010	0.0002			
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009		0.00134	0.00039		0.267	0.000755	0.00204	0.0169	25.2	0.375	0.77	<0.00001	0.00025	0.00448		0.008	0.37	0.00038	3.94	<0.000005	1.4	0.275	121	0.000009	<0.00001	<0.0005	0.00504	<0.0002	0.134	0.040	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009		0.00434	0.00016		2.78	0.000118	0.00206	0.022	24.6	1.14	0.77	<0.00001	0.00118	0.00572		0.002	0.37	0.00026	4.54	<0.000005	1.33	0.246	149	<0.000002	<0.00001	<0.0005	0.00195	<0.0002	0.0548	0.042	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010		0.00445	0.00047		1.37	0.000441	0.00206	0.0214	26	1.18	0.77	0.00001	0.00021	0.00692		0.008	0.34	0.00023	4.1	<0.000005	1.38	0.264	143	0.000002	<0.00001	<0.0005	0.00171	<0.0002	0.0911	0.044	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010		0.00608	0.00025	0.0004	1.89	0.000106	0.00336	0.027	26.4	1.69	0.77		0.00024	0.00932			0.37	0.00018	4.49	<0.000005	1.43	0.259	159	<0.000002	<0.00001	<0.0005	0.00247	<0.0002	0.121	0.087	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011	no water found						0.00075																							0.002			
KV-51	Christal Creek d/s Hinton Creek	26-May-2011	widely dispersed flow. Flow not taken	0.00165	0.00093	0.0039	0.724	0.00132	0.00693	0.0071	12.6	0.415	0.43	<0.00001	0.00008	0.00379	0.0104	0.007	0.25	0.00019	2.41	0.00001	0.85	0.146	80	0.000003	<0.00001	<0.0005	0.000662	<0.0002	0.0616	0.071	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011	not visited. No helper/lack of time						0.00075																							0.002			
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011	Very cloudy water (grey)	0.00884	<0.00005	0.0005	4.06	0.000312	0.00322	0.0317	32.7	2.05	0.77	<0.00001	0.00027	0.013	0.0158	0.01	0.38	0.00027	4.2	<0.000005	1.63	0.304	186	<0.000002	0.00006	<0.0005	0.00233	<0.0002	0.143	0.071	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012	Salt Slug	0.00878	<0.00005	0.0002	3.42	0.000207	0.00206	0.036	31.2	2.16	1.2	<0.00001	0.00019	0.0145	0.0174	0.008	0.42	0.00023	4.5	<0.000005	1.49	0.297	204	0.000011	<0.0002	<0.0005	0.00186	<0.0002	0.188	0.075	<0.0001			
KV-51	Christal Creek d/s Hinton Creek	03-May-2012	snowing lightly; no YSI for insitu	0.00456	0.00112		2.12	0.00034	0.00918	0.0152	17.8	1.08		<0.000010	0.000143	0.00853		0.0156	0.446	0.0001	2.58	0.000006	1.07	0.164	103	0.000003	<0.00020	<0.00050	0.000968	<0.00020	0.109	0.170	<0.00010			
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2012	showers; water high & turbid; orange mud transported by water; muddy bottom	0.0082	0.000176	0.0003	2.32	0.000486	0.00344	0.0319	32.3	2.06	0.93	<0.000010	0.00024	0.0141	0.0166	0.0119	0.361	0.00032	4.65	<0.0000050	1.79	0.299	179	0.0000038	<0.00020	<0.00050	0.00223	<0.00020	0.152	0.104	<0.00010			
KV-51	Christal Creek d/s Hinton Creek	14-Oct-2012	Sludge in creek bed making metering difficult. Wading rod keeps sinking. Avg'd Salt slug & Flow reading.	0.00904	0.000197	0.0002	2.81	0.000016	0.00272	0.033	31	2.14	1.0	<0.000010	0.000216	0.0164	0.0166	0.0046	0.382	0.000209	4.51	<0.0000050	1.56	0.304	210	0.00001	<0.00020	<0.00050	0.00216	<0.00020	0.157	0.109	<0.00010			
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2013		0.009	<0.000050	0.0002	3.48	<0.0000050	0

Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015	discharge only, no sample						0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016	ORP fluxuating up and down.						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016		0.00891	<0.00020	0.0002	3.16	<0.000050	0.00248	0.0352	32.1	2.15	1.0	<0.0000050	0.000178	0.0159	0.0165	<0.050	0.36	0.000491	4.56	<0.000010	1.65	0.275	161	<0.000010	<0.00010	<0.00030	0.00234	<0.00050	0.226	0.099	<0.00030	12.0	13.1	1.04
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016	No sample, just flow						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016							0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	04-May-2016		0.00399	0.00098	0.0022	1.82	0.000215	0.00849	0.0155	17.9	0.992	0.86	<0.0000050	0.000131	0.0075	0.0123	<0.050	0.33	0.000235	2.82	<0.000010	1.03	0.173	92.4	<0.000010	<0.00010	0.00031	0.000982	<0.00050	0.120	0.209	<0.00030	6.91	7.87	1.06
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016							0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016	Water is slightly turbid	0.00642	<0.00020	0.0007	1.35	<0.000050	0.00436	0.0255	30.3	1.64	0.77	<0.0000050	0.000253	0.0112	0.0153	<0.050	0.33	0.000361	3.92	<0.000010	1.53	0.280	157	<0.000010	<0.00010	<0.00030	0.00236	<0.00050	0.136	0.105	<0.00030	11.3	12.1	1.03
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016							0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016							0.00075																						0.004				
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	DO calibrated on site; SG encased in ice, no reading taken.	0.00870	<0.00020	0.0002	3.93	<0.000050	0.00324	0.0308	31.9	2	1.0	<0.0000050	0.000241	0.0147	0.016	<0.050	0.41	0.000343	4.35	<0.000010	1.56	0.276	157	<0.000010	<0.00010	<0.00030	0.00250	<0.00050	0.212	0.117	<0.00030	11.8	12.7	1.04
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016	No sample, in-situ and discharge. DO probe measurement suspect						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016	Low confidence in discharge result, poor dilution performance.						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017	Flow only. Downloaded logger						0.00075																						0.004				
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	DO not functioning properly	0.0106	<0.00020	0.0002	4.37	<0.000050	0.00278	0.0334	35.5	2.47	1.4	<0.0000050	0.000240	0.0176	0.0192	<0.050	0.46	0.000339	5.16	<0.000010	1.79	0.320	190	<0.000010	<0.00010	<0.00030	0.00250	<0.00050	0.288	0.142	<0.00030	12.1	15.1	1.11
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017	First run discharge would not come back down to baseline.						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017							0.00075																						0.004				
KV-51	Christal Creek d/s Hinton Creek	15-May-2017		0.00226	0.00157	0.0054	1.01	0.000227	0.00973	0.0085	9.41	0.526	0.62	0.0000053	0.000070	0.0044	0.0105	<0.050	0.31	0.000167	1.90	0.000014	0.611	0.100	51.4	<0.000010	<0.00010	<0.00090	0.000489	<0.00050	0.0724	0.102	<0.00030	3.83	3.88	1.01
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017	Surveyed. Downloaded flow. Gauge difficult to read.						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017		0.00818	<0.00020	0.0005	2.04	0.000096	0.00389	0.0309	32.9	2	0.93	<0.0000050	0.000209	0.0143	0.0155	<0.050	0.36	0.000296	4.16	<0.000010	1.67	0.289	173	<0.000010	<0.00010	<0.00030	0.00308	<0.00050	0.226	0.103	<0.00030	12.8	12.3	0.98
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017							0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017	Monitored for flow and insitu only.						0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	Too cold for salt slug calibration	0.00793	<0.00020	0.0002	2.67	<0.000050	0.00268	0.0275	29.5	1.88	0.93	<0.0000050	0.000167	0.0141	0.0136	<0.050	0.43	0.000345	4.08	<0.000010	1.65	0.293	170	<0.000010	<0.00010	<0.00030	0.00258	<0.00050	0.255	0.081	<0.00030	12.6	11.0	0.94
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017							0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017	Discharge data collected was not reproducable due to errors in the field and removed. RPD was too high. Conductivity affected by u/s salt slug and removed.						0.00075																						0.004				
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018							0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	thick ice. Drilled into water layer with no discernable flow.	0.00808	<0.00020	0.0004	2.52	<0.000050	0.00314	0.0300	30.0	1.98	0.77	<0.0000050	0.000135	0.0144	0.0139	<0.050	0.40	0.000301	4.04	<0.000010	1.59	0.289	164	<0.000010	<0.00010	<0.00030	0.00204	<0.00050	0.231	0.073	<0.00030	12.3	11.5	0.96
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018	shallow water with muddy substrate. No sample						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018	Muddy substrate with shallow water.						0.00075																						0.003				
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	Significant ice cover, very turbid (dark orange/brown water)	0.00096	0.00206	0.0031	0.447	0.00130	0.01078	0.0038	5.12	0.225	0.65	0.0000062	0.000090	0.00267	0.0069	<0.050	0.51	0.000124	1.52	0.000030	0.507	0.0590	22.8	<0.000010	<0.00010	<0.00090	0.000189	<0.00050	0.0471	0.095	<0.00030	1.97	2.08	1.03
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	Real time readings for dewinterizing: in w/ condom = 8:19:48, out w/ condom = 8:20:48, out w/out = 8:25:39, back in = 8:28:14	0.00248	0.00155	0.0019	0.964	0.000274	0.00692	0.0095	16.3	0.58	0.86	<0.0000050	0.000199	0.00614	0.0105	<0.050	0.32	0.000403	2.47	<0.000010	1.09	0.199	75.4	<0.000010	<0.00010	<0.00030	0.000735	<0.00050	0.101	0.144	<0.00030	6.37	6.84	1.04
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	DOC preserved later. TOT metals preserved in sulphuric then rinsed and preserved in nitric. Skeptical of DO value even though it makes sense.	0.00564	<0.00020	0.0007	1.87	<0.000050	0.00385	0.0227	27.4	1.33	0.65	<0.0000050	0.000194	0.0101	0.0124	<0.050	0.36	0.000405	3.91	<0.000010	1.99	0.271	137	<0.000010	<0.00010	<0.00030	0.00400	<0.00050	0.181	0.078	<0.00030	10.9	10.2	0.96
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018		0.00489	0.00034	0.001	1.81	0.000051	0.00540	0.0184	23.8	1.15	0.93	<0.0000050	0.000177	0.0085	0.0123	<0.050	0.31	0.000522	3.91	<0.000010	1.74	0.238	116	<0.000010	<0.00010	<0.00030	0.00295	<0.00050	0.149	0.140	<0.00030	9.34	9.14	0.99
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	Water is turbid	0.00507	0.00029	0.0003	1.68	<0.000050	0.00410	0.0204	29.6	1.29	1.0	<0.0000050	0.000196	0.00857	0.0137	<0.050	0.39	0.000908	3.89	<0.000010	1.73	0.275	125	<0.000010	<0.00010	<0.00030	0.00353	<0.00050	0.162	0.153	<0.00030	10.1	10.6	1.03
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	Surface frozen, had to salt slug.	0.00556	<0.00020	0.0002	1.55	<0.000050	0.00234	0.0184	22.4	1.3	1.0	<0.0000050	0.000178	0.00993	0.0108	<0.050	0.32	0.000794	4.59	<0.000010	1.61	0.216	132	0.000011	<0.00010	<0.00030	0.00222	<0.00050	0.201	0.087	<0.00030	9.22	8.53	0.96
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	Relatively short distance for flow	0.00620	<0.00020	0.0002	1.53	<0.000050	0.00255	0.0218	21.7	1.44	1.0	<0.0000050	0.000169	0.0116	0.0106	<0.050	0.35	0.000396	4.05	<0.000010	1.60	0.215	112	0.000015	<0.00010	<0.00030	0.00180	<0.00050	0.232	0.094	<0.00030	9.05	8.32	0.96
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018		0.00647	<0.00020	0.0002	2.18	<0.000050	0.00257	0.0213	23.3	1.48	1.0	<0.0000050	0.000165	0.0117	0.0112	<0.050	0.37	0.000369	4.37	<0.000010	1.64	0.219	113	0.000016	<0.00010	<0.00030	0.00178	<0.00050	0.237	0.092	<0.00030	8.98	8.88	0.99
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	water shallow, short flow distance	0.00695	<0.00020	0.0002	2.31	<0.000050	0.00246	0.0227	23.8	1.61	0.93	<0.0000050	0.000933	0.0121	0.0113	<0.050	0.37	0.000309	4.46	<0.000010	1.61	0.222	121	0.000015	<0.00010	<0.00030	0.00162	<0.00050	0.254	0.072	<0.00030	9.24	9.18	1
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	Flow data lost	0.00692	<0.00020	0.0003	2.41	<0.000050	0.00240	0.0220	23.0	1.68	0.77	<0.0000050	0.000184	0.0124	0.0106	<0.050	0.37	0.000293	4.37	<0.000010	1.55	0.217	115	0.000012	<0.00010	<0.00030	0.00144	<0.00050	0.267	0.061	<0.00030	9.36	8.83	0.97
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	short distance for flow, neutral pressure. Water not displaying much signs for flow, probably just slow or calm.	0.00689	<0.00020	0.0003	2.64	<0.000050	0.00291	0.0261	26.3	1.72	0.93	<0.0000050	0.000162	0.0124	0.0128	<0.050	0.42	0.000280	4.74	<0.000010	1.85	0.229	134	<0.000010	<0.00010	<0.00030	0.00156	<0.00050	0.261	0.085	<0.00030	9.83	10.3	1.02
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	YSI parameters slowly drifting, taking long to stabalize.	0.00604	<0.00020	0.0005	1.71	0.000143	0.00382	0.0179	22.8	1.45	0.93	<0.0000050	0.000151	0.0104	0.0114	<0.050	0.43	0.000149	3.53	<0.000010	1.47	0.212	118	<0.000010	<0.00010	<0.00030	0.00110	<0.00050	0.219	0.105	<0.00030	9.54	8.91	0.97
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	Not enough salt for slug.	0.00114	0.00121	0.0017	0.353	0.000087	0.00843	0.0056	7.34	0.347	0.75	<0.0000050	0.000064	0.00267	0.0064	<0.050	0.25	0.000225	1.87	<0.000010	0.585	0.107	40.6	<0.000010	<0.00010	<0.00090	0.000215	<0.00050	0.0527	0.142	<0.00030	3.09	3.48	1.06
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	Staff gauge rusting. Hard to read values below 0.4 m. Surveyed/dewinterized logger.	0.00726	<0.00020	0.0004	3.31	<0.000050	0.00350	0.0236	26.6	1.79	0.93	<0.0000050	0.000163	0.0122	0.0133	<0.050	0.32	0.000260	4.07	<0.000010	1.54	0.262	164	<0.000010	<0.00010	<0.00030	0.00154	<0.00050	0.255	0.100	<0.00030	10.6	10.6	1
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	Orange slime on plants. Not best path for salt slug. Bends and eddys. Needs new staff gauge.	0.00693	<0.00020	0.0007	3.05	<0.000050	0.00341	0.0251	26.4	1.75	0.48	<0.0000050	0.000146	0.0117	0.0123	<0.050	0.35	0.000248	4.08	<0.000010	1.51	0.263	143	<0.000010	<0.00010	<0.00030	0.00188	<0.00050	0.227	0.057	<0.00030	11.9	11.0	0.96
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	orange precipitate. Took 2nd run of flow and ignored first. RPD was 37% and 2nd run matched KV-50 closer	0.00638	<0.00020	0.001	1.79	<0.000050	0.00434	0.0242	24.6	1.76	0.65	<0.0000050	0.000187	0.0107	0.0128	<0.050	0.33	0.000348	4.14	<0.000010	1.55	0.272	141	0.000011	<0.00010	<0.00030	0.00187	<0.00050	0.208	0.075	<0.00030	11.0	10.5	0.97
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019		0.00542	<0.00020	0.0005	1.03	<0.000050	0.00329	0.0234	23.2	1.49	0.77	<0.0000050	0.000182	0.00916	0.0114	<0.050	0.35	0.000264	4.01	<0.000010	1.54	0.229	115	0.000011	<0.00010	<0.00030	0.00151	<0.00050	0.184	0.081	<0.00030	9.61	9.13	0.97
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	No flow. > 1 inch of ice on the creek. We do not have salt for the site.	0.00627	<0.00020	0.0004	1.49	<0.000050	0.00350	0.0236	23.9	1.64	0.77	<0.0000050	0.000188	0.0111	0.0125	<0.050	0.34	0.000263	4.24	<0.000010	1.58	0.237	122	<0.000010	<0.00010	<0.00030	0.00155	<0.00050	0.209	0.092	<0.00030	10.2	9.94	0.99
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019		0.00602	<0.00020	0.0004	1.28	0.00123	0.00285	0.0238	22.8	1.58	0.65	<0.0000050	0.000149	0.0102	0.0104	<0.050	0.37	0.000264	4.12	<0.000010	1.84	0.216	112	0.000012	<0.00010	<0.00030	0.00128	<0.00050	0.225	0.063	<0.00030	8.94	8.74	0.99
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019		0.00607	0.00028	0.0007	1.60	<0.000050	0.00326	0.0220	22.9	1.48	0.65	<0.0000050	0.000253	0.0102	0.0098	<0.050	0.43	0.000289	4.40	<0.000010	1.83	0.210	103	0.000010	<0.00010	<0.00030	0.00136	<0.00050	0.223	0.063	<0.00030	8.98	8.29	0.96
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020	Site is inaccessable without snowshoes. Too much snow.						0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	No flow measurement. Temp outside is -40C.	0.00547	0.00051	0.0005	1.67	0.000456	0.00267	0.0225	21.1	1.38	0.48	<0.0000050	0.000173	0.00995	0.0092	<0.050	0.46	0.000193	4.10	<0.000010	1.82	0.214	111	<0.000010	<0.00010	<0.00030	0.00123	<0.00050	0.237	0.048	<0.00030	9.15	8.25	0.95
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	Conditions not conducive to measuring flow. SG covered in ice and snow.	0.00534	<0.00020	0.0003	0.870	<0.000050	0.00296	0.0224	22.6	1.4	0.77	<0.0000050	0.000129	0.00976	0.011	<0.050	0.42	0.000137	3.72	<0.000010	1.63	0.215	104	<0.000010	<0.00010	<0.00030	0.00109	<0.00050	0.220	0.081	<0.00030	9.29	8.80	0.97
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	not ideal for flow test. Flow almost stagnant, creek meandering	0.00487	<0.00020	0.0004	2.08	<0.000050	0.00298	0.0207	20.8	1.3	0.71	<0.0000050	0.000128	0.00905	0.0099	<0.050	0.39	0.000113	3.93	<0.000010	1.63	0.195	107	<0.000010	<0.00010	<0.00030	0.00101	<0.00050	0.196	0.077	<0.00030	8.88	7.95	0.94
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	DO will not calibrate, membrane needs replacement. Logger not downloaded - no flow water poolingand flowing through willows (see photos)	0.00135	0.00207	0.0034	0.774	0.00128	0.01202	0.0036	5.53	0.342	0.59	<0.0000050	0.000108	0.0032	0.007	<0.050	0.95	0.000138	1.50	0.000018	0.604	0.0543	20.6	<0.000010	<0.00010	0.00056	0.000172	<0.00050	0.0816	0.085	<0.00030	1.85	1.98	1.03
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020		0.00596	0.00038	0.0019	2.96	<0.000050	0.00642	0.0207	23.2	1.62	0.77	<0.0000050	0.000167	0.00934	0.0134	<0.050	0.296	0.000252	3.61	<0.000010	1.35	0.238	124	<0.000010	<0.00010	<0.00030	0.00118	<0.00050	0.205	0.123	<0.00030	9.83	9.65	1.01
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020		0.00335	0.00062	0.0014	1.19	0.000095	0.00665	0.0142	19.4	0.924	0.86	<0.0000050	0.000195	0.0062	0.0107	<0.050	0.261	0.000754	3.72	<0.000010	1.46	0.216	81.8	0.000010	<0.00010	<0.00030	0.00140	<0.00050	0.134	0.170	<0.00030	6.96	7.42	1.03
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020		0.00351	0.00031	0.0008	0.903	<0.000050	0.00416	0.0169	20.2	0.871	0.71	<0.0000050	0.000205	0.00649	0.0104	<0.050	0.300	0.00126	4.12	<0.000010	1.53	0.236	95.5	0.000012	<0.00010	<0.00030	0.00207	<0.00050	0.133	0.096	<0.00030	7.87	8.01	1.01
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	Levellogger downloaded. Benthics and sediment collected.	0.00413	0.00024	0.0007	1.30	<0.000050	0.00432	0.0172	22.8	1.04	0.86	<0.0000050	0.000190	0.00743	0.0107	<0.050	0.341	0.00104	4.18	<0.000010	1.68	0.231	92.4	0.000010	<0.00010	<0.00030	0.00274	<0.00050	0.161	0.116	<0.00030	8.09	8.20	1.01
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	WL downloaded, off by 8 mins	0.00459	0.00022	0.0004	1.28	<0.000050	0.00421	0.0193	20.7	1.14	0.94	<0.0000050	0.000166	0.00804	0.0105	<0.050	0.376	0.000853	4.40	<0.000010	1.75	0.228	104	<0.000010	<0.00010	<0.00030	0.00247	<0.00050	0.184	0.139	<0.00030	8.28	7.92	1.02
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	Flow not measured - corners u/s and d/s too sharp and not enough flow, too many willows.Staff gauge frozen.	0.00440	<0.00020	0.0003	0.866	0.00102	0.00301	0.0169	21.3	1.01	0.86	<0.0000050	0.000184	0.0081	0.01	<0.050	0.376	0.000658	4.19	<0.000010	1.91	0.203	93.5	0.000013	<0.00010	<0.00030	0.00238	<0.00050	0.174	0.095	<0.00030	8.13	7.76	1.02
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	Thin layer of ice, hollow, thin layer of ice to water. Slow flow.	0.00558	<0.00020	0.0004	1.84	<0.000050	0.00350	0.0213	21.6	1.42	0.93	<0.0000050	0.000161	0.00951	0.011	<0.050	0.408	0.000520	4.23	<0.000010	1.68	0.228	106	0.000010	<0.00010	<0.00030	0.00163	<0.00050	0.235	0.103	<0.00030	8.40	8.62	1.01
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	Orange turbid water, staff gauge Downloaded, not ideal for flow measurement	0.00186	0.00108	0.0037	0.928	0.00120	0.01000	0.0067	11.3	0.501	0.73	<0.0000050	0.000115	0.00368	0.0086	<0.050	1.07	0.000156	2.08	0.000016	2.90	0.104	44.7	<0.000010	<0.00010	0.00034	0.000390	<0.00050	0.121	0.136	<0.00030	3.77	3.88	1.01
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021		0.00427	<0.00020	0.0005	0.612	<0.000050	0.00317	0.0183	21.6	1.16	0.71	<0.0000050	0.000172	0.00766	0.0095	<0.050	0.353	0.000378	4.46	<0.000010	1.66	0.200	97.6	0.000015	<0.00010	<0.00030	0.00148	<0.00050	0.163	0.072	<0.00030	8.34	7.62	1.05
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	Half frozen, muddy bottom. Loggers winterized and downloaded. Surveyed.	0.00429	<0.00020	0.0008	1.19	<0.000050	0.00424	0.0177	19.1	1.16	0.71	<0.0000050	0.000170	0.0074	0.0099	<0.050	0.324	0.000260	4.46	<0.000010	1.43	0.205	89.7	<0.000010	<0.00010	<0.00030	0.00128	<0.00050	0.174	0.098	<0.00030	7.83	7.52	1.02
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	tried one salt slug, water barely flowing	0.00811	<0.00020	0.0002	1.85	<0.000050	0.00303	0.0258	25.3	2.1	1.0	<0.0000050	0.000183	0.0136	0.0127	<0.050	0.397	0.000186	4.85	<0.000010	16.3	0.237	113	0.000022	<0.00010	0.00032	0.00128	<0.00050	0.294	0.108	<0.00030	9.90	10.6	1.03
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	2x salt slug, creek super turbid, logger de-winterized	0.00140	0.00203	0.0029	0.820	0.00194	0.01015	0.0041	5.01	0.357	0.59	<0.0000050	0.000113	0.00374	0.0061	<0.050	0.433	0.000116	1.80	0.000015	1.35	0.0560	17.9	<0.000010	<0.00010	0.00058	0.000172	<0.00050	0.0625	0.091	<0.00030	1.87	1.99	1.03
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022		0.00537	0.00021	0.0012	0.774	<0.000050	0.00441	0.0212	21.9	1.48	0.48	<0.0000050	0.000192	0.00962	0.0118	<0.050	0.317	0.000364	4.35	<0.000010	1.41	0.260	111	0.000013	<0.00010	<0.00030	0.00124	<0.00050	0.179	0.074	<0.00030	9.54	9.50	1.00
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2022	Logger frozen in staff gauge, maybe not winterized. Creek frozen to bottom. Surveyed and dl logger. SG frozen @ 0.575 m						0.00075																						0.002				
KV-51	Christal Creek d/s Hinton Creek	09-Feb-2023		0.00715	<0.00020	0.0007	2.44	<0.000050	0.00370	0.0249	20.7	1.76	0.77	<0.0000050	0.000187	0.0119	0.0107	<0.050	0.363	0.000170	4.82	<0.000010	1.54	0.222	106	0.000020	<0.00010	<0.00030	0.00109	<0.00050	0.283	0.083	<0.00030	9.27	8.58	0.96
KV-51	Christal Creek d/s Hinton Creek	12-May-2023	High water - flooded vegetation. DO probe not working	0.00106	0.00214	0.003	0.536	0.00134	0.01026	0.0033	4.11	0.301	0.59	0.0000094	0.000086	0.00264	0.0062	<0.050	0.730	0.000144	1.78	0.000026	4.26	0.0487	16.2	<0.000010	<0.00010	0.00079	0.000121	<0.00050	0.0633	0.075	<0.00030	1.78	1.83	1.01
KV-51	Christal Creek d/s Hinton Creek	14-Jul-2023		0.00514	<0.00020	0.0004	1.22	<0.000050	0.00342	0.0213	20.5	1.41	0.93	<0.0000050	0.000201	0.00881	0.0109	<0.050	0.322	0.000403	4.61	<0.000010	1.63	0.229	108	0.000010	<0.00010	<0.00030	0.00150	<0.00050	0.184	0.098	<0.00030	8.67	8.50	0.99
KV-51	Christal Creek d/s Hinton Creek	25-O

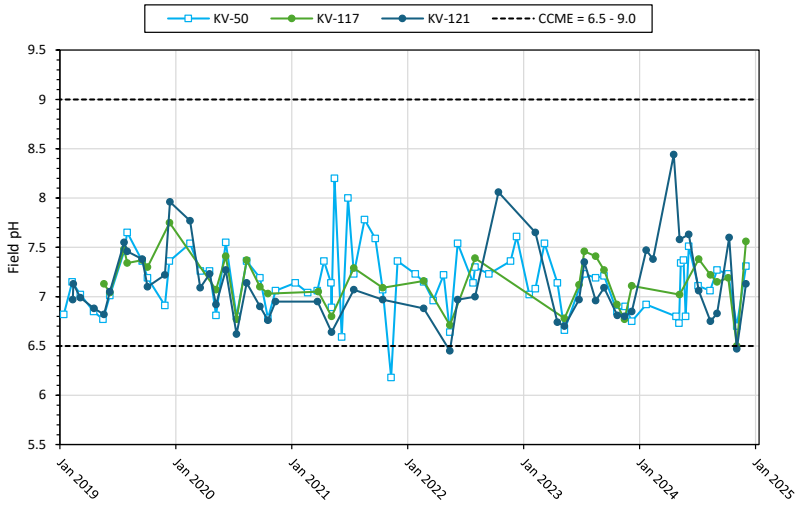
Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-51	Christal Creek d/s Hinton Creek	22-May-2024	Metallic odour, orange dust and color water. Impossible to accurately read staff gauge clearly. Orange precipate and overall weathering on SG, numbers blurred. Orange dust and precipatate in water and surrounding area. Dust kicked up from stepping around site. Downloaded SH. Could not find a baro. Midsection flow measurement.	0.00344	0.00073	0.0031	1.42	0.000346	0.00638	0.0136	13.6	1.06	0.43	<0.0000050	0.000171	0.00652	0.0094	<0.050	0.311	0.000165	3.52	<0.000010	1.30	0.137	57.4	<0.000010	<0.00010	<0.00030	0.000589	<0.00050	0.136	0.073	<0.00030	5.53	5.33	0.98
KV-51	Christal Creek d/s Hinton Creek	29-May-2024	Orange residue on trees, no ice present. Very slow flow.	0.00291	0.00092	0.0033	1.42	0.000743	0.00783	0.0096	10.1	0.879	0.62	<0.0000050	0.000197	0.00524	0.0085	<0.050	0.270	0.000169	3.08	<0.000010	1.27	0.114	40.5	<0.000010	<0.00010	<0.00030	0.000394	<0.00050	0.101	0.094	<0.00030	4.18	4.14	1.00
KV-51	Christal Creek d/s Hinton Creek	07-Jul-2024	Ground is too soft for midsection flow measurement, due to sediment being stirred up. Went u/s where it narrows and did salt slug, data not good - discarded. Surveyed. Direct read needs cap. Willows at site need to be cleared. Could not download. Logger covered in sediment.	0.00531	<0.00020	0.0007	0.597	<0.000050	0.00444	0.0249	21.6	1.61	0.93	<0.0000050	0.000187	0.00938	0.0117	<0.050	0.324	0.000141	4.66	<0.000010	1.55	0.236	120	0.000013	0.00012	<0.00030	0.00114	<0.00050	0.178	0.117	<0.00030	9.44	8.92	0.97
KV-51	Christal Creek d/s Hinton Creek	09-Oct-2024	Winterized logger, surveyed staff gauge. Logger was starting to freeze into stilling well	0.00511	<0.00020	0.0008	0.936	<0.000050	0.00335	0.0199	21.0	1.51	0.48	<0.0000050	0.000169	0.00875	0.0098	<0.050	0.310	0.000236	4.43	<0.000010	1.54	0.216	108	0.000013	<0.00010	<0.00030	0.000950	<0.00050	0.200	0.060	<0.00030	8.22	8.24	1.00
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	No flow measurements due to ice blockages and willows.	0.00206	0.00023	0.0008	0.591	0.000213	0.00441	0.0083	10.2	0.914	0.7	<0.0000050	0.000070	0.0046	0.0053	<0.050	0.45	0.000081	3.42	<0.000010	1.01	0.114	30.6	<0.000010	<0.00010	<0.00030	0.000159	<0.00050	0.0507	0.065	<0.00030	3.27	3.52	1.04
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	Site not suitable for flow. Site is in patchy grass and not visibly flowing	0.00692	0.00059	0.0029	0.993	0.000132	0.00881	0.0026	7.40	1.55	0.65	<0.0000050	0.000283	0.00306	0.006	<0.050	0.64	0.000110	2.45	<0.000010	0.742	0.0811	7.35	<0.000010	<0.00010	<0.00030	0.000197	<0.00050	0.0159	0.084	<0.00030	1.96	2.32	1.08
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	Too vegetated and overall poor conditions to conduct salt slug	0.00396	<0.00020	0.0009	2.30	0.000051	0.00371	0.0103	13.2	1.21	0.64	<0.0000050	0.000375	0.00465	0.0061	<0.050	0.29	<0.000050	5.07	<0.000010	1.33	0.152	48.7	<0.000010	<0.00010	<0.00030	0.000148	<0.00050	0.0715	0.051	<0.00030	4.67	4.48	0.98
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	orange precipitate. No flow test done. Very willowy and blocked up slightly	0.00417	0.00246	0.001	1.41	0.000144	0.00431	0.0112	13.2	1.29	0.64	<0.0000050	0.000315	0.00596	0.0066	<0.050	0.28	<0.000050	5.17	<0.000010	1.33	0.159	51.0	0.000034	<0.00010	<0.00030	0.000148	<0.00050	0.0946	0.067	<0.00030	4.74	4.68	0.99
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019		0.00430	<0.00020	0.0008	1.85	<0.000050	0.00371	0.0126	13.1	1.39	0.64	<0.0000050	0.000321	0.00585	0.0066	<0.050	0.29	0.000087	4.71	<0.000010	1.33	0.157	47.6	0.000038	<0.00010	<0.00030	0.000144	<0.00050	0.112	0.060	<0.00030	4.77	4.90	1.01
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	Ice layer - could not measure flow	0.00441	0.00021	0.0006	1.73	0.000071	0.00344	0.0115	13.4	1.47	0.64	<0.0000050	0.000246	0.00616	0.0065	<0.050	0.28	<0.000050	4.71	<0.000010	1.30	0.149	44.7	0.000028	0.00039	<0.00030	0.000133	<0.00050	0.118	0.060	<0.00030	4.95	4.89	0.99
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019	Dry						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019	overflow slush, no sample taken						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020	Too much snow to access site. Need snowshoes to break initial trail.						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020	frozen/dry						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020	Frozen						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020	frozen						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	DO will not calibrate, membrane needs replacement. No flow, conditions were not conducive. Flowing everywhere and through willows.	0.00078	0.00174	0.0028	0.462	0.00147	0.01013	0.0014	2.77	0.183	0.38	<0.0000050	0.000072	0.00232	0.0054	<0.050	0.75	0.000061	1.35	0.000018	0.272	0.0295	5.26	<0.000010	<0.00010	0.00063	0.000038	<0.00050	0.0343	0.038	<0.00030	0.68	0.91	1.15
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	No flow measurement.	0.00294	0.00085	0.0033	1.64	0.000223	0.00756	0.0076	10.4	0.9	0.6	<0.0000050	0.000284	0.00475	0.0078	<0.050	0.220	0.000104	3.83	<0.000010	1.03	0.127	32.4	0.000023	<0.00010	<0.00030	0.000115	<0.00050	0.0787	0.079	<0.00030	3.72	3.61	1.02
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020		0.00153	0.00094	0.0011	0.653	0.000222	0.00688	0.0070	10.8	0.446	0.79	<0.0000050	0.000252	0.00327	0.0062	<0.050	0.151	0.00115	3.98	<0.000010	1.05	0.149	37.1	0.000016	<0.00010	<0.00030	0.000322	<0.00050	0.0549	0.134	<0.00030	4.07	3.91	1.02
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020		0.00206	0.00037	0.001	0.610	0.000165	0.00417	0.0093	12.3	0.493	0.64	<0.0000050	0.000303	0.00418	0.0066	<0.050	0.225	0.00145	4.22	<0.000010	1.18	0.199	44.7	0.000023	<0.00010	<0.00030	0.000477	<0.00050	0.0752	0.064	<0.00030	4.90	4.66	1.03
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020		0.00257	0.00025	0.0006	0.900	<0.000050	0.00399	0.0104	14.1	0.618	0.76	<0.0000050	0.000266	0.00489	0.0069	<0.050	0.276	0.00140	4.48	<0.000010	1.27	0.196	46.3	0.000027	<0.00010	<0.00030	0.000563	<0.00050	0.0952	0.082	<0.00030	4.80	5.03	1.02
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	water disturbed a little to clear ice.	0.00250	0.00062	0.0006	0.732	0.000732	0.00427	0.0102	11.9	0.563	0.83	<0.0000050	0.000218	0.00489	0.0063	<0.050	0.311	0.000573	4.44	<0.000010	1.27	0.180	44.9	0.000026	<0.00010	<0.00030	0.000304	<0.00050	0.112	0.083	<0.00030	4.59	4.46	1.01
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020	frozen.						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	Overflow on ice, main channel flooded/frozen, no flow measurement. No filtering done - bottle damaged in transit	0.00394	<0.00020	0.0002	<0.010	0.000173	0.00210	0.0154	14.1	1.16	0.76	<0.0000050	0.000228	0.00775	0.0066	<0.050	0.380	<0.000050	5.60	<0.000010	1.87	0.169	56.9	0.000036	<0.00010	<0.00030	0.000088	<0.00050	0.178	0.053	<0.00030	4.91	5.13	1.02
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	Unseen flow due to ice conditions, and collapesed ice. Not able to measure flow. Orange turbid water	0.00123	0.00165	0.0019	0.831	0.00377	0.00887	0.0022	3.52	0.386	0.49	<0.0000050	0.000144	0.00283	0.0043	<0.050	0.841	0.000094	1.52	0.000019	0.880	0.0409	8.34	0.000011	<0.00010	0.00050	0.000047	<0.00050	0.0537	0.062	<0.00030	1.14	1.26	1.05
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	no flow measurement	0.00319	<0.00020	0.0006	0.533	0.000113	0.00333	0.0121	12.7	0.928	0.64	<0.0000050	0.000255	0.00586	0.0064	<0.050	0.313	<0.000050	5.10	<0.000010	1.35	0.167	47.1	0.000037	<0.00010	<0.00030	0.000131	<0.00050	0.0955	0.059	<0.00030	4.64	4.77	1.01
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021		0.00313	<0.00020	0.0006	1.09	0.000067	0.00380	0.0111	12.7	0.846	0.76	<0.0000050	0.000274	0.0052	0.0064	<0.050	0.289	0.000207	5.02	<0.000010	1.23	0.166	45.8	0.000029	<0.00010	<0.00030	0.000188	<0.00050	0.111	0.074	<0.00030	4.56	4.63	1.01
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	Low flow, sample only	0.00671	<0.00020	0.0003	3.05	<0.000050	0.00261	0.0230	18.5	1.79	0.86	<0.0000050	0.000201	0.00954	0.0094	<0.050	0.364	<0.000050	5.07	<0.000010	1.50	0.195	98.2	0.000022	<0.00010	<0.00030	0.000365	<0.00050	0.250	0.077	<0.00030	8.28	7.52	1.05
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	still under ice/snow	0.00073	0.00251	0.0017	0.818	0.00360	0.00927	0.0028	3.91	0.22	0.49	<0.0000050	0.000180	0.00308	0.0044	<0.050	0.413	0.000213	1.83	0.000041	0.487	0.0456	8.55	<0.000010	<0.00010	0.00087	0.000048	<0.00050	0.0321	0.075	<0.00030	1.17	1.33	1.06
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	super flooded, no flow, in the veg.	0.00250	0.00024	0.0014	1.42	0.000298	0.00493	0.0103	11.3	0.822	0.64	<0.0000050	0.000330	0.00424	0.0068	<0.050	0.268	0.000484	4.83	<0.000010	1.28	0.172	43.0	0.000024	<0.00010	<0.00030	0.000261	<0.00050	0.0640	0.069	<0.00030	4.69	4.49	1.02
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022	Frozen						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	09-Feb-2023	Frozen						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	12-May-2023	No flow measurement	0.00096	0.00248	0.0018	0.777	0.00360	0.00924	0.0021	2.87	0.28	0.35	0.0000085	0.000252	0.00254	0.0045	<0.050	0.466	0.000138	1.66	0.000020	0.475	0.0392	6.33	<0.000010	<0.00010	<0.00090	0.000055	<0.00050	0.0353	0.056	0.00032	0.49	1.06	1.37
KV-117	Christal Creek u/s Flame & Moth discharge	27-Jun-2023		0.00230	0.00052	0.0011	1.11	0.000423	0.00534	0.0098	12.4	0.692	0.76	<0.0000050	0.000289	0.00443	0.0067	<0.050	0.271	0.000624	4.64	<0.000010	1.30	0.174	40.8	0.000021	<0.00010	<0.00030	0.000327	<0.00050	0.0736	0.091	<0.00030	4.01	4.42	1.05
KV-117	Christal Creek u/s Flame & Moth discharge	14-Jul-2023		0.00283	<0.00020	0.0009	0.893	0.000103	0.00394	0.0112	12.5	0.759	0.64	<0.0000050	0.000312	0.00445	0.0066	<0.050	0.283	0.000447	4.58	<0.000010	1.36	0.182	47.6	0.000024	<0.00010	<0.00030	0.000330	<0.00050	0.0792	0.058	<0.00030	4.72	4.77	1.01
KV-117	Christal Creek u/s Flame & Moth discharge	19-Aug-2023		0.00318	<0.00020	0.0011	1.27	<0.000050	0.00440	0.0106	12.3	0.992	0.64	<0.0000050	0.000612	0.00482	0.0066	<0.050	0.283	0.000079	5.01	<0.000010	1.35	0.165	42.4	0.000020	<0.00010	<0.00030	0.000184	<0.00050	0.0871	0.063	<0.00030	4.57	4.58	1.00
KV-117	Christal Creek u/s Flame & Moth discharge	14-Sep-2023		0.00307	<0.00020	0.0009	1.08	0.000134	0.00415	0.0097	11.2	0.913	0.62	<0.0000050	0.000292	0.00485	0.0058	<0.050	0.305	0.000057	4.51	<0.000010	1.40	0.149	41.5	0.000028	<0.00010	<0.00030	0.000164	<0.00050	0.0806	0.061	<0.00030	4.51	4.00	0.94
KV-117	Christal Creek u/s Flame & Moth discharge	25-Oct-2023	sample only site	0.00297	0.00023	0.0004	1.68	0.000074	0.00374	0.0112	12.8	0.826	0.83	<0.0000050	0.000193	0.00472	0.0058	<0.050	0.334	<0.000050	5.31	<0.000010	1.36	0.148	42.3	0.000024	<0.00010	<0.00030	0.000116	<0.00050	0.0950	0.077	<0.00030	4.47	4.19	0.97
KV-117	Christal Creek u/s Flame & Moth discharge	18-Nov-2023		0.00673	<0.00020	0.0003	5.60	<0.000050	0.00381	0.0245	21.2	2.09	1.0	<0.0000050	0.000210	0.00851	0.0111	<0.050	0.343	<0.000050	5.36	<0.000010	1.33	0.223	110	<0.000010	<0.00010	<0.00030	0.000508	<0.00050	0.238	0.151	<0.00030	8.83	8.64	0.99
KV-117	Christal Creek u/s Flame & Moth discharge	11-Dec-2023	Maxed out auger but was able to chip to bottom, bring an auger extension next trip. Turbid and had sulfur swamp odor. Sample shows evidence of sediment contamination (TSS = 901 mg/L); TSS, total metals, Cl, Na-D and K-D results non-representative and removed.	0.00727	0.00062		6.44	0.000976	0.00184	0.0113	19.0	2.78	0.86	<0.0000050	0.000178	0.00322		<0.050		0.000076	6.67	<0.000010		0.222	61.8	<0.000010	<0.00010	<0.00030	0.000211	<0.00050	0.0235	0.043	<0.00030	6.48	6.69	1.02
KV-117	Christal Creek u/s Flame & Moth discharge	25-Jan-2024	Overflow sample KV-117-OF						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	16-Feb-2024	could not locate water, area heavily glaciated						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	29-Mar-2024	Glaciated						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	21-Apr-2024	Frozen to bottom, 12 ft of ice						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	10-May-2024	Large glacier at sample point on map. Sampled below glacier above KV-121. Some orange precipitate on bottom. Clear water.	0.00252	0.00122	0.0031	1.89	0.00226	0.00955	0.0102	10.1	0.72	0.79	<0.0000050	0.000187	0.00435	0.008	<0.050	0.438	0.000102	3.03	<0.000010	1.01	0.109	42.2	<0.000010	<0.00010	0.00050	0.000273	<0.00050	0.0927	0.138	<0.00030	3.87	3.83	0.99
KV-117	Christal Creek u/s Flame & Moth discharge	08-Jun-2024	Walked to gps point and could not find a seep. Lots of unthawed snow/ice on ground and some pools of water (suspected melt).						0.00075																							0.002			
KV-117	Christal Creek u/s Flame & Moth discharge	09-Jul-2024	Site looks old, willows should be cleared. Set did not have a syringe, triple rinsed 121's	0.00357	<0.00020	0.001	2.64	0.000087	0.00421	0.0100	13.6	1.28	0.64	<0.0000050	0.000280	0.0053	0.0061	<0.050	0.265	<0.000050	5.00	<0.000010	1.39	0.152	43.3	0.000015	<0.00010	<0.00030	0.000141	<0.00050	0.0849	0.059	<0.00030	4.49	4.29	0.98
KV-117	Christal Creek u/s Flame & Moth discharge	15-Aug-2024	No visible changes, willows should be cleared. Kind of smells like an outhouse	0.00322	<0.00020	0.0006	0.524	0.000086	0.00350	0.0108	11.9	1.04	0.76	<0.0000050	0.000260	0.0052	0.0058	<0.050	0.323	<0.000050	4.90	<0.000010	1.41	0.155	43.9	0.000017	<0.00010	<0.00030	0.000144	<0.00050	0.0887	0.058	<0.00020	4.52	4.20	0.96
KV-117	Christal Creek u/s Flame & Moth discharge	05-Sep-2024	Site good no change, slightly turbid, flow not monitored	0.00228	0.00048	0.001	0.732	0.00155	0.00480	0.0092	12.2	0.805	0.73	<0.0000050	0.000270	0.00406	0.0061	<0.050	0.565	0.000095	4.31	0.000012	2.45	0.186	36.6	0.000015	<0.00010	<0.00030	0.000194	<0.00050	0.0665	0.077	<0.00020	4.56	4.17	0.96
KV-117	Christal Creek u/s Flame & Moth discharge	10-Oct-2024	Orange, ice forming	0.00296	0.00036	0.0008	1.05	0.000073	0.00435	0.0101	13.6	0.992	0.76	<0.0000050	0.000215	0.00515	0.0064	<0.050	0.310	<0.000050	4.98	<0.000010	1.45	0.152	43.2	0.000025	<0.00010	<0.00030	0.000136	<0.00050	0.102	0.074	<0.00020	4.47	4.46	1.00
KV-117	Christal Creek u/s Flame & Moth discharge	06-Nov-2024	Water was turbid and orange, pressure was released cutting through the ice.	0.00513	0.00048	0.0002	2.96	<0.000050	0.00327	0.0179	16.0	1.5	0.88	<0.0000050	0.000186	0.0069	0.008	<0.050	0.502	<0.000050	5.20	<0.000010	1.69	0.179	69.7	0.000018	<0.00010	<0.00030	0.000305	<0.00050	0.175	0.133	<0.00020	6.07	6.16	1.01
KV-117	Christal Creek u/s Flame & Moth discharge	05-Dec-2024	Covered in overflow and slush. orange particles floating in the water and the water is orange	0.00357	0.00022	0.0008	0.705	<0.000050	0.00341	0.0124	13.8	1.24	0.56	<0.0000050	0.000144	0.00332	0.0064	<0.050	0.622	0.000989	5.42	<0.000010	1.94	0.163	50.1	<0.000010	<0.00010	<0.00030	0.000080	<0.00050	0.0790	0.048	<0.00030	5.03	4.82	0.98
KV-121	Christal Seep	10-Feb-2019	SPC moving around (1024-750) depending on placement, taking time to stabilize.	0.00205	0.0003	0.00020	0.928	<0.000050	0.00227	0.0126	22.7	0.463	0.94	<0.0000050	0.000076	0.00481	0.00910	<0.050	0.40	0.000896	3.59	<0.000010	1.73	0.208	88.9	<0.000010	<0.00010	<0.00030	0.00268	<0.00050	0.108	0.077	<0.00030	7.35	7.09	0.98
KV-121	Christal Seep	12-Feb-2019	No sample taken, revisit for flow measurements. Good flow, mix in 3/4 bucket, mud disturbed when poured. Slightly d/s from original sampling site.						0.00075																							0.004			
KV-121	Christal Seep	06-Mar-2019	flowing well	0.00662	0.00024	0.0003	3.65	<0.000050	0.00375	0.0248	24.4	1.67	1.0	<0.0000050	0.000149	0.0117	0.0124	<0.050	0.45	0.000227	4.68	<0.000010	1.91	0.218	129	<0.000010	<0.00010	<0.00030	0.00125	<0.00050	0.251	0.122	<0.00030	9.88	9.77	0.99
KV-121	Christal Seep	18-Apr-2019	u/s: multiple outlets of the same seep collecting into one stream, with another stream (christal?) coming in from the south. Orange sludge with gray sediment.	0.00727	<0.00020	0.0002	3.19	0.000149	0.00311	0.0238	23.6	1.81	1.0	<0.0000050	0.000232	0.0122	0.0117	<0.050	0.41	0.000195	4.19	<0.000010	1.47	0.215	123	0.000012	<0.00010	<0.00030	0.00110	<0.00050	0.264	0.117	<0.00030	9.19	9.17	1
KV-121	Christal Seep	19-May-2019	SPC fluctuating. Many seeps at site too short for salt slug; salt slug starts where seeps combine and is measured down christal creek.	0.0101	<0.00020	0.0002	3.47	0.000121	0.00311	0.0259	31.9	2.3	1.0	<0.0000050	0.000172	0.0209	0.0169	<0.050	0.48	0.000252	3.87	<0.000010	2.04	0.305	157	0.000016	<0.00010	<0.00030	0.00258	<0.00050	0.425	0.119	<0.00030	12.6	13.4	1.03
KV-121	Christal Seep	07-Jun-2019	Many seeps at site, conjoin into 1 which flow into Christal Creek. From left to right 4 seeps identified and YSI for SPC/pH/ORP:1)721.9/6.97/64.7; 2) 626.2/7.09/52.4; 3) 643.3/7.01/66.5; 4) 609.7;7.01;71.1	0.00223	<0.00020	0.0003	0.819	<0.000050	0.00302	0.0125	28.3	0.464	0.93	<0.0000050	0.000063	0.00525	0.0115	<0.050	0.39	0.000954	3.63	<0.000010	2.17	0.269	118	<0.000010	<0.00010	<0.00030	0.00371	<0.00050	0.133	0.099	<0.00030	10.5	9.01	0.92
KV-121	Christal Seep	22-Jul-2019	Salt slug d/s (0.0171 m3/s) and u/s (0.0103 m3/s) of site. SPC jumping a bit.	0.00868	<0.00020	0.0005	3.96	<0.000050	0.00325	0.0245	33.1	1.77	0.65	<0.0000050	0.000124	0.0181	0.0149	<0.050	0.39	0.000555	4.25	<0.000010	1.77	0.292	173	0.000012	<0.00010	<0.00030	0.00339	<0.00050	0.357	0.068	<0.00030	13.6	12.7	0.97
KV-121	Christal Seep	01-Aug-2019	Flow measured d/s.	0.00965	<0.00020	0.0009	4.34	0.000118	0.00457	0.0291	31.2	1.92	0.77	<0.0000050	0.000144	0.0202	0.0162	<0.050	0.40	0.000448	4.17	<0.000010	1.64	0.292	173	0.000014	<0.00010	<0.00030	0.00279	<0.00050	0.393	0.096	<0.00030	14.0	13.1	0.97
KV-121	Christal Seep	17-Sep-2019	Took two sets of additional insitu readings nearby; both are u/s of KV-121.	0.00112	0.00026	0.0004	0.474	<0.000050	0.00281	0.0097	23.1	0.243	0.71	<0.0000050	0.000078	0.0026	0.0083	<0.050	0.31	0.000928	3.41	<0.000010	1.86	0.208	78.7	<0.000010	<0.00010	<0.00030	0.00252	<0.00050	0.0732	0.062	<0.00030	6.76	6.58	0.99
KV-121	Christal Seep	04-Oct-2019	No flow measurements	0.00793	<0.00020	0.0004	3.54	<0.000050	0.00358	0.0266	21.9	2.31	0.93	<0.0000050	0.000232	0.0112	0.0126	<0.050	0.33	<0.000050	4.67	<0.000010	1.30	0.227	116	<0.000010	<0.00010	<0.00030	0.000476	<0.00050	0.212	0.107	<0.00030	10.0	10.0	1
KV-121	Christal Seep	28-Nov-2019		0.00635	<0.00020	0.0003	2.87	<0.000050	0.00280	0.0225	23.5	1.62	0.93	<0.0000050	0.000182	0.0104	0.0111	<0.050	0.38	0.000281	4.33	<0.000010	1.72	0.213	109	0.000014	0.00019	<0.00030	0.00141	<0.00050	0.231	0.082	<0.00030	8.80	8.94	1.01
KV-121	Christal Seep	14-Dec-2019		0.00353	<0.00020	0.0007	1.40	<0.000050	0.00296	0.0146	23.7	0.777	0.46	<0.0000050	0.000114	0.00772	0.009	<0.050	0.36	0.000687	3.65	<0.000010	1.92	0.204	88.0	<0.000010	<0.00010	<0.00030	0.00223	<0.00050	0.165	0.047	<0.00030	7.75	8.18	1.03
KV-121	Christal Seep	31-Jan-2020	Too much snow to access site. Need snowshoes to break initial trail.						0.00075																							0.002			
KV-121	Christal Seep	15-Feb-2020	no flow not suitable	0.00800	<0.00020	0.0004	3.

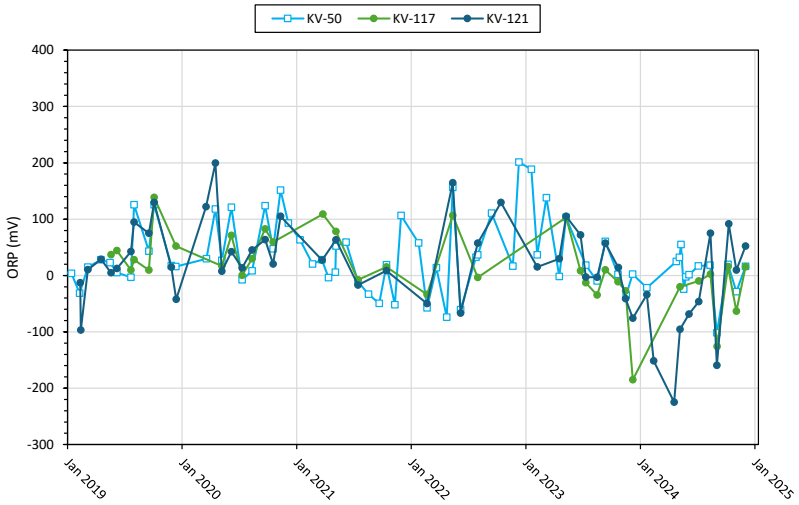
Station	Description	Sample Date	Sample Comments	Cobalt (Co), dissolved	Copper (Cu), dissolved	Calculated Cu-D BC-ENV	Iron (Fe), dissolved	Lead (Pb), dissolved	Calculated Pb-D BC-ENV	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Calculated Mn-D CCME PAL	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), dissolved	Calculated Ni-D BC-ENV	Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	-
KV-121	Christal Seep	17-Apr-2020		0.00788	0.00024	0.0003	3.50	0.000056	0.00273	0.0255	26.7	1.66	0.93	<0.0000050	0.000216	0.0157	0.0122	<0.050	0.40	0.000153	3.80	<0.000010	2.05	0.212	122	0.000014	0.00013	<0.00030	0.00199	<0.00050	0.332	0.078	<0.00030	10.6	9.98	0.97
KV-121	Christal Seep	07-May-2020	DO will not calibrate, membrane needs replacement. No flow at this site. Conditions for flow were not good, too much pooling. Sampled where two seeps join.	0.00138	0.00183	0.0028	0.636	0.000819	0.00973	0.0058	9.59	0.306	0.71	<0.0000050	0.000058	0.00351	0.0069	<0.050	1.24	0.000185	1.63	0.000027	1.36	0.0740	38.9	<0.000010	<0.00010	<0.00030	0.000474	<0.00050	0.547	0.127	<0.00030	3.23	3.09	0.98
KV-121	Christal Seep	07-Jun-2020		0.00792	<0.00020	0.0004	3.61	<0.000050	0.00318	0.0257	30.4	1.73	0.77	<0.0000050	0.000167	0.016	0.0141	<0.050	0.409	0.000410	4.10	<0.000010	1.92	0.272	159	0.000010	<0.00010	<0.00030	0.00242	<0.00050	0.333	0.084	<0.00030	12.0	11.6	1.02
KV-121	Christal Seep	11-Jul-2020		0.00900	<0.00020	0.0009	3.96	<0.000050	0.00881	0.0266	30.5	1.78	1.2	<0.0000050	0.000165	0.0184	0.0167	<0.050	0.365	0.000456	4.05	<0.000010	1.81	0.275	167	0.000014	<0.00010	<0.00030	0.00321	<0.00050	0.391	0.315	<0.00030	13.1	12.3	1.03
KV-121	Christal Seep	12-Aug-2020		0.00570	0.0004	0.00020	2.69	0.000065	0.00263	0.0203	28.7	1.18	0.93	<0.0000050	0.000106	0.0121	0.01280	<0.050	0.497	0.00142	4.14	<0.000010	2.23	0.278	139	0.000010	<0.00010	<0.00030	0.00513	<0.00050	0.264	0.081	<0.00030	12.5	10.4	1.09
KV-121	Christal Seep	23-Sep-2020		0.00875	<0.00020	0.0002	3.96	<0.000050	0.00333	0.0249	27.7	1.82	1.0	<0.0000050	0.000142	0.0178	0.0147	<0.050	0.401	0.000521	3.93	<0.000010	1.93	0.274	140	0.000014	<0.00010	<0.00030	0.00442	<0.00050	0.373	0.118	<0.00030	11.4	11.8	1.02
KV-121	Christal Seep	18-Oct-2020		0.00925	<0.00020	0.0002	4.18	0.000052	0.00321	0.0301	28.0	1.92	1.0	<0.0000050	0.000190	0.0189	0.0155	<0.050	0.441	0.000557	4.19	<0.000010	1.86	0.303	154	0.000017	<0.00010	<0.00030	0.00472	<0.00050	0.407	0.128	<0.00030	12.0	12.2	1.01
KV-121	Christal Seep	11-Nov-2020	Flow not measured. No ice on stream.	0.00330	0.00023	0.0003	1.07	<0.000050	0.00345	0.0133	23.5	0.677	0.94	<0.0000050	0.000106	0.00704	0.0104	<0.050	0.414	0.00160	3.67	<0.000010	2.23	0.245	92.4	<0.000010	<0.00010	<0.00030	0.00490	<0.00050	0.159	0.120	<0.00030	7.91	8.03	1.01
KV-121	Christal Seep	24-Mar-2021	No flow measurement, condtions not ideal. ORP slow to climb	0.00258	0.00022	0.0003	1.07	<0.000050	0.00310	0.0123	23.3	0.541	0.94	<0.0000050	0.000080	0.00544	0.0093	<0.050	0.412	0.00105	3.59	<0.000010	2.78	0.207	80.4	<0.000010	<0.00010	<0.00030	0.00289	<0.00050	0.134	0.101	<0.00030	7.48	7.20	1.02
KV-121	Christal Seep	07-May-2021		0.00317	0.00057	0.0007	1.41	0.00144	0.00722	0.0135	28.9	0.67	1.2	<0.0000050	0.000065	0.00681	0.0125	<0.050	2.77	0.000132	3.42	<0.000010	9.61	0.242	137	<0.000010	<0.00010	<0.00030	0.000764	<0.00050	0.643	0.272	<0.00030	9.45	9.45	<0.010
KV-121	Christal Seep	16-Jul-2021		0.00414	0.00022	0.0002	2.08	<0.000050	0.00224	0.0134	22.5	0.958	0.86	<0.0000050	0.000114	0.00783	0.0089	<0.050	0.381	0.000770	4.05	<0.000010	1.77	0.196	86.9	0.000012	<0.00010	<0.00030	0.00266	<0.00050	0.165	0.070	<0.00030	7.90	7.02	1.06
KV-121	Christal Seep	15-Oct-2021		0.0146	<0.00020	0.0002	6.72	<0.000050	0.00314	0.0379	31.9	2.91	1.2	<0.0000050	0.000159	0.029	0.0177	<0.050	0.434	<0.000050	4.83	<0.000010	1.62	0.318	195	0.000022	<0.00010	<0.00030	0.00257	<0.00050	0.647	0.106	<0.00030	14.6	14.2	1.01
KV-121	Christal Seep	22-Feb-2022	sample only	0.0108	0.00021	0.0002	5.00	0.000348	0.00275	0.0260	31.1	2.27	1.0	<0.0000050	0.000189	0.0209	0.0151	<0.050	0.481	0.000287	4.95	<0.000010	2.13	0.266	151	0.000019	<0.00010	<0.00030	0.00305	<0.00050	0.436	0.103	<0.00030	11.3	12.1	1.03
KV-121	Christal Seep	15-May-2022		0.0109	0.00039	0.0004	4.97	0.000095	0.00637	0.0253	25.8	2.31	1.2	<0.0000050	0.000181	0.0216	0.0136	<0.050	0.578	0.000109	3.71	<0.000010	1.63	0.226	124	0.000017	<0.00010	<0.00030	0.00186	<0.00050	0.490	0.271	<0.00030	9.18	10.3	1.06
KV-121	Christal Seep	09-Jun-2022		0.0110	0.00076	0.0004	5.88	0.000142	0.00423	0.0221	29.1	2.39	1.0	<0.0000050	0.000154	0.0193	0.0133	<0.050	0.464	0.000178	5.01	<0.000010	1.88	0.282	138	0.000025	<0.00010	<0.00030	0.00312	<0.00050	0.385	0.134	<0.00030	5.97	10.5	1.28
KV-121	Christal Seep	03-Aug-2022	seep, no flow	0.00543	0.00023	0.0003	2.27	<0.000050	0.00326	0.0203	26.8	1.21	1.0	<0.0000050	0.000152	0.0113	0.0129	<0.050	0.366	0.000558	4.29	<0.000010	2.04	0.268	123	<0.000010	<0.00010	<0.00030	0.00449	<0.00050	0.253	0.107	<0.00030	10.8	10.1	1.03
KV-121	Christal Seep	16-Oct-2022	Sample only, creek mostly frozen, bottom stirred up from breaking ice	0.0135	<0.00020	0.0006	6.10	<0.000050	0.00281	0.0359	33.1	2.9	0.32	<0.0000050	0.000175	0.0268	0.0153	<0.050	0.420	0.000153	4.43	<0.000010	1.70	0.327	179	0.000019	<0.00010	<0.00030	0.00291	<0.00050	0.589	0.040	<0.00030	14.3	15.6	1.04
KV-121	Christal Seep	09-Feb-2023		0.00822	0.00027	0.0005	3.84	<0.000050	0.00303	0.0240	23.6	1.78	0.65	<0.0000050	0.000116	0.0154	0.0107	<0.050	0.499	0.000463	4.61	<0.000010	2.02	0.222	116	0.000021	<0.00010	<0.00030	0.00280	<0.00050	0.326	0.061	<0.00030	10.2	9.14	0.95
KV-121	Christal Seep	20-Apr-2023	Sample only, very shallow/orange, hard to not stir up	0.0144	<0.00020	0.0002	7.01	<0.000050	0.00239	0.0351	28.3	2.86	1.2	<0.0000050	0.000172	0.0284	0.0158	<0.050	0.425	<0.000050	4.96	<0.000010	1.80	0.270	173	0.000023	<0.00010	<0.00030	0.00220	<0.00050	0.585	0.104	<0.00030	13.6	12.6	0.96
KV-121	Christal Seep	12-May-2023	May have sampled meltwater. No flow measurement.	0.00738	0.0005	0.00030	3.38	0.000068	0.00412	0.0183	19.0	1.68	1.0	<0.0000050	0.000119	0.014	0.00980	<0.050	0.624	0.000211	4.06	<0.000010	2.70	0.171	85.8	0.000020	<0.00010	<0.00030	0.00172	<0.00050	0.304	0.157	<0.00030	6.11	7.54	1.10
KV-121	Christal Seep	27-Jun-2023		0.0135	<0.00020	0.0002	6.66	<0.000050	0.00276	0.0350	36.2	2.9	1.2	<0.0000050	0.000132	0.0275	0.019	<0.050	0.461	0.000287	4.86	<0.000010	1.62	0.340	202	0.000022	<0.00010	<0.00030	0.00316	<0.00050	0.568	0.096	<0.00030	13.9	15.3	1.05
KV-121	Christal Seep	14-Jul-2023		0.00383	0.0002	0.00030	1.78	<0.000050	0.00252	0.0163	27.9	0.797	0.77	0.0000073	0.000075	0.00797	0.01180	<0.050	0.414	0.00110	3.75	<0.000010	2.75	0.258	117	<0.000010	<0.00010	<0.00030	0.00496	<0.00050	0.187	0.067	<0.00030	9.92	9.66	0.99
KV-121	Christal Seep	19-Aug-2023		0.00618	<0.00020	0.0002	2.86	<0.000050	0.00282	0.0210	26.7	1.36	1.0	<0.0000050	0.000082	0.0129	0.0131	<0.050	0.385	0.000709	4.13	<0.000010	2.07	0.256	123	0.000011	<0.00010	<0.00030	0.00355	<0.00050	0.308	0.099	<0.00030	10.5	10.3	0.99
KV-121	Christal Seep	14-Sep-2023		0.00621	<0.00020	0.0003	2.82	<0.000050	0.00323	0.0196	23.3	1.35	0.93	<0.0000050	0.000098	0.013	0.0117	<0.050	0.404	0.000672	3.95	<0.000010	2.10	0.241	128	<0.000010	<0.00010	<0.00030	0.00316	<0.00050	0.289	0.101	<0.00030	9.96	9.26	0.96
KV-121	Christal Seep	26-Oct-2023	Sample only	0.00509	0.00022	0.0002	2.28	<0.000050	0.00290	0.0180	20.1	1.1	0.94	<0.0000050	0.000086	0.0097	0.0101	<0.050	0.376	0.000653	4.05	<0.000010	1.62	0.193	93.4	<0.000010	<0.00010	<0.00030	0.00232	<0.00050	0.214	0.115	<0.00030	7.30	7.85	1.04
KV-121	Christal Seep	18-Nov-2023		0.00352	0.00028	0.0002	1.31	<0.000050	0.00282	0.0148	19.4	0.767	0.94	<0.0000050	0.000083	0.00744	0.0085	<0.050	0.351	0.000709	3.94	<0.000010	1.53	0.183	77.8	<0.000010	<0.00010	<0.00030	0.00232	<0.00050	0.165	0.098	<0.00030	6.52	6.46	1.00
KV-121	Christal Seep	11-Dec-2023		0.00658	<0.00020		5.11	<0.000050	0.00192	0.0214	18.1	1.72	0.94	<0.0000050	0.000205	0.00875		<0.050	0.344	<0.000050	5.37	<0.000010	1.40	0.196	97.7	0.000012	<0.00010	<0.00030	0.000378	<0.00050	0.234	0.064	<0.00030	7.68	7.66	1.00
KV-121	Christal Seep	25-Jan-2024		0.0107	<0.00020		4.85	<0.000050	0.00206	0.0317	31.6	2.32	0.77	<0.0000050	0.000152	0.0212		<0.050	0.524	0.000462	5.36	<0.000010	2.36	0.288	166	0.000016	<0.00010	<0.00030	0.00272	<0.00050	0.474	0.042	<0.00030	12.5	12.6	1.00
KV-121	Christal Seep	16-Feb-2024	seeps barely flowing, sampled collection pond	0.0141	<0.00020	0.0003	6.70	<0.000050	0.00257	0.0369	28.5	3.1	0.77	<0.0000050	0.000147	0.0282	0.0156	<0.050	0.403	<0.000050	4.96	<0.000010	1.56	0.273	176	0.000023	<0.00010	<0.00030	0.00202	<0.00050	0.606	0.065	<0.00030	13.6	13.2	0.99
KV-121	Christal Seep	29-Mar-2024	Glaciated						0.00075																						0.002				
KV-121	Christal Seep	21-Apr-2024	Muddy pool when first broke through but settled out nicely	0.0138	<0.00020	0.0007	6.34	0.000167	0.00287	0.0331	25.0	3.04	0.3	<0.0000050	0.000128	0.0257	0.0084	<0.050	0.430	<0.000050	5.00	<0.000010	2.26	0.249	152	0.000025	<0.00010	<0.00030	0.00183	<0.00050	0.530	0.039	<0.00030	11.6	11.3	0.99
KV-121	Christal Seep	10-May-2024	Light orange colour on bottom, clear water. Sampled from old auger hole near orange stain.	0.00829	0.00034	0.0029	3.45	0.000060	0.00737	0.0257	19.6	1.77	0.65	<0.0000050	0.000084	0.0161	0.0131	<0.050	0.506	<0.000050	4.14	<0.000010	2.28	0.189	114	0.000014	<0.00010	<0.00030	0.00138	<0.00050	0.382	0.130	<0.00030	7.87	8.51	1.04
KV-121	Christal Seep	08-Jun-2024	Sampled by tree before seep enters Christal. Lots of precipitate on seep bottom. Difficult not to stir up while sampling.	0.00214	<0.00020	0.0004	0.999	<0.000050	0.00243	0.0137	21.4	0.45	0.61	<0.0000050	0.000067	0.00467	0.0083	<0.050	0.400	0.000897	3.75	<0.000010	2.11	0.182	79.9	<0.000010	<0.00010	<0.00030	0.00278	<0.00050	0.117	0.047	<0.00030	7.26	6.96	0.98
KV-121	Christal Seep	09-Jul-2024	Sampled before seep flows into Christal, even drawing water up with syringe disturbed bottom, tried to not disturb while sampling but very hard	0.0146	<0.00020	0.0002	6.41	<0.000050	0.00226	0.0320	33.9	3.21	0.93	<0.0000050	0.000141	0.0285	0.0156	<0.050	0.426	0.000244	5.03	<0.000010	1.69	0.279	173	0.000017	<0.00010	<0.00030	0.00238	<0.00050	0.618	0.077	<0.00030	13.1	12.7	0.98
KV-121	Christal Seep	15-Aug-2024	Site looks good, no visible change	0.0123	<0.00020	0.0002	5.29	<0.000050	0.00206	0.0280	27.5	2.59	1.0	<0.0000050	0.000138	0.0241	0.0149	<0.050	0.423	0.000289	4.87	<0.000010	1.48	0.275	170	0.000021	<0.00010	<0.00030	0.00258	<0.00050	0.513	0.092	<0.00020	12.6	11.8	0.97
KV-121	Christal Seep	05-Sep-2024	Sample only, site is good no change. Flow not monitored.	0.00903	<0.00020	0.0002	3.88	<0.000050	0.00206	0.0261	25.5	2.12	1.0	<0.0000050	0.000090	0.0187	0.0135	<0.050	0.385	0.000305	4.55	<0.000010	1.51	0.256	144	0.000011	<0.00010	<0.00030	0.00224	<0.00050	0.389	0.086	<0.00020	9.59	10.7	1.05
KV-121	Christal Seep	13-Oct-2024		0.00619	<0.00020	0.0003	2.98	<0.000050	0.00222	0.0155	21.0	1.4	0.61	<0.0000050	0.000112	0.0112	0.0087	<0.050	0.372	0.000834	4.23	<0.000010	1.58	0.182	86.8	0.000014	<0.00010	<0.00030	0.00170	<0.00050	0.246	0.047	<0.00020	7.56	7.46	0.99
KV-121	Christal Seep	06-Nov-2024	Open spots but mostly frozen over.	<0.00010	0.00027	0.0002	<0.010	<0.000050	0.00222	0.0082	19.2	0.00248	0.88	<0.0000050	0.000052	<0.00050	0.0075	<0.050	0.398	0.00121	3.72	<0.000010	2.38	0.186	56.7	<0.000010	<0.00010	<0.00030	0.00195	<0.00050	0.0282	0.093	<0.00020	6.02	5.63	0.97
KV-121	Christal Seep	05-Dec-2024		<0.00010	0.00036	0.0002	<0.010	<0.000050	0.00236	0.0082	19.0	0.002	0.76	<0.0000050	<0.000050	<0.00050	0.0074	<0.050	0.487	0.00135	3.66	<0.000010	2.53	0.183	61.0	<0.000010	<0.00010	<0.00030	0.00166	<0.00050	0.0328	0.059	<0.00030	5.92	5.71	0.98
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021							0.00075																						0.002				
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021		0.00040	0.00075	0.0026	0.011	0.00472	0.00474	0.0182	54.6	0.118	0.15	<0.0000050	0.00684	0.00378	0.0064	<0.050	4.91	0.000320	5.57	<0.000010	27.2	0.627	233	0.000060	<0.00010	<0.00030	0.00798	0.00200	0.0085	0.057	<0.00030	15.7	15.1	1.02
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021		0.00021	0.00039	0.0019	<0.010	0.00335	0.00373	0.0184	46.8	0.0483	0.14	<0.0000050	0.00398	0.00289	0.0052	<0.050	3.12	0.000314	5.70	<0.000010	10.8	0.593	194	0.000053	<0.00010	<0.00030	0.00861	0.00195	0.0078	0.047	<0.00030	13.3	12.8	1.02

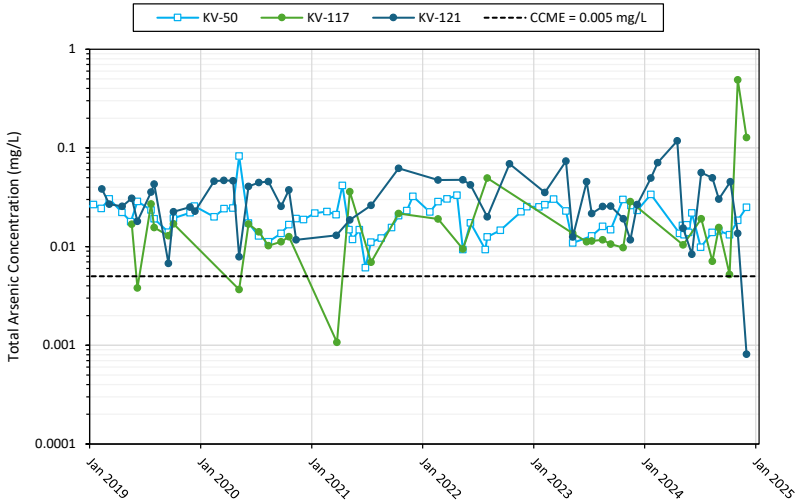
APPENDIX C:

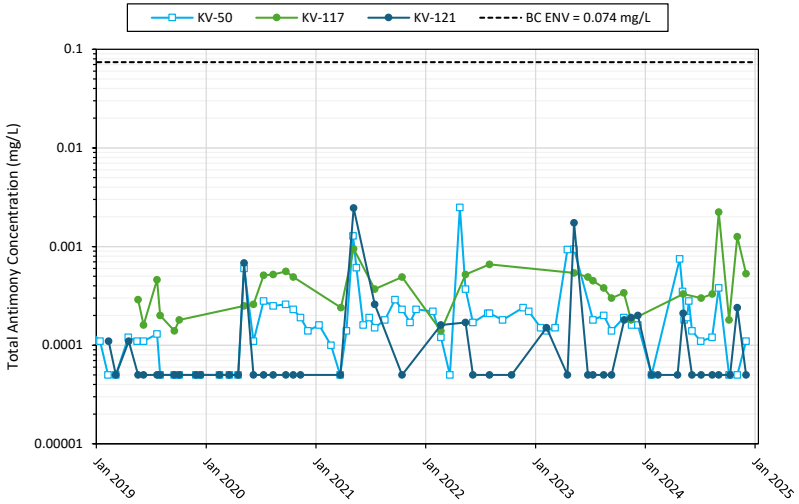
WATER QUALITY COMPARATIVE PLOTS

Plots of KV-117, KV-121, and KV-50

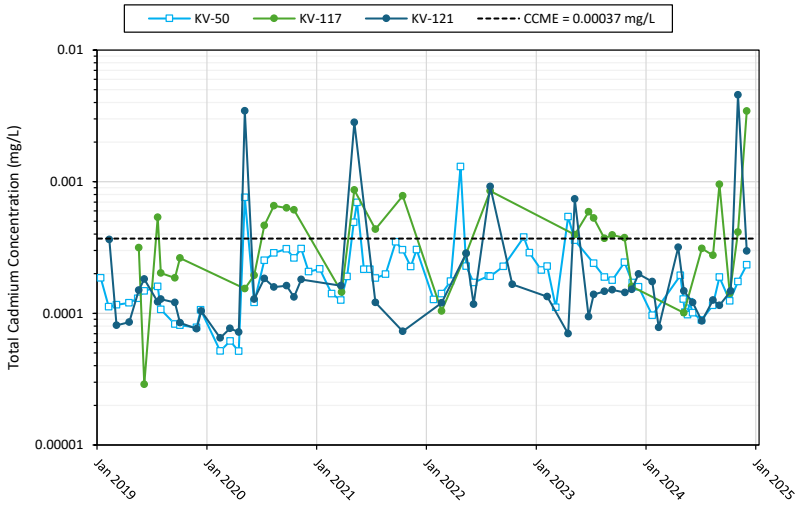


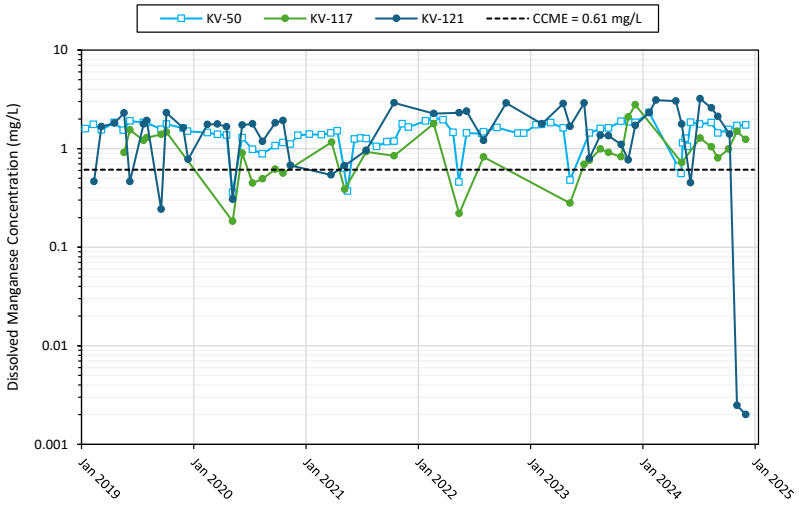


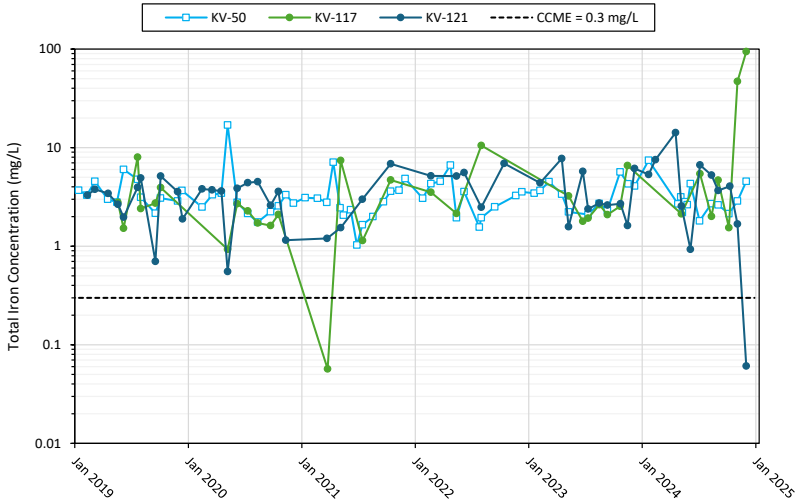


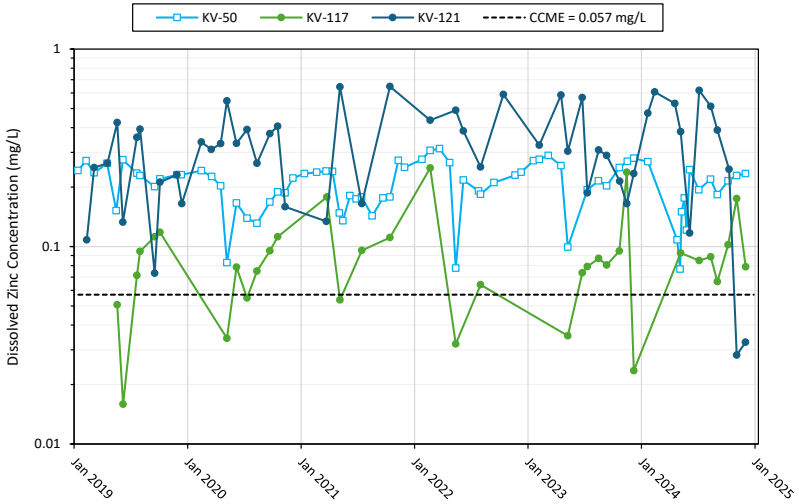


Plots of KV-117, KV-121, and KV-50

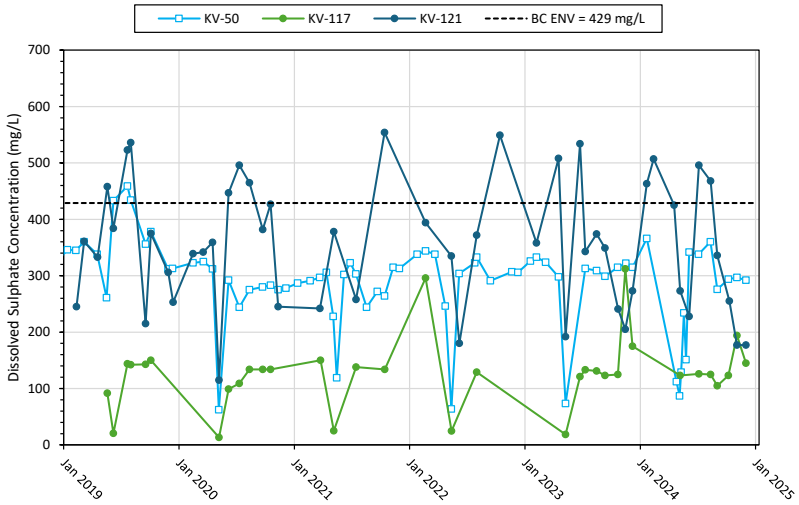


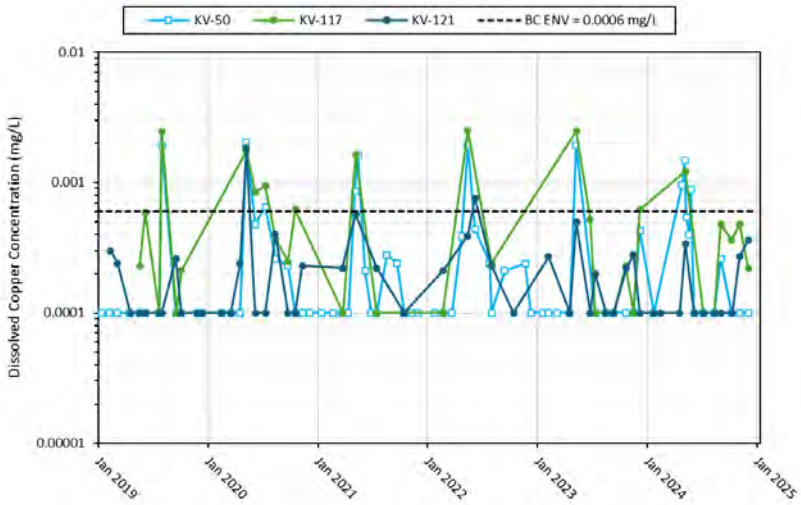


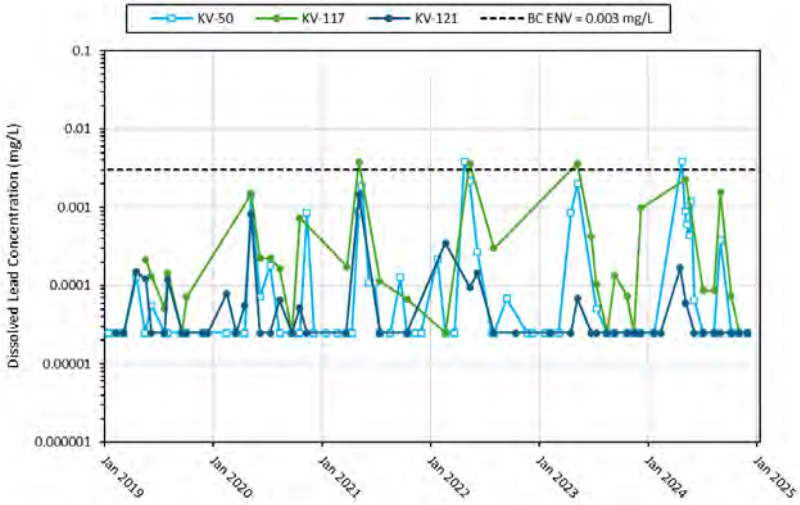


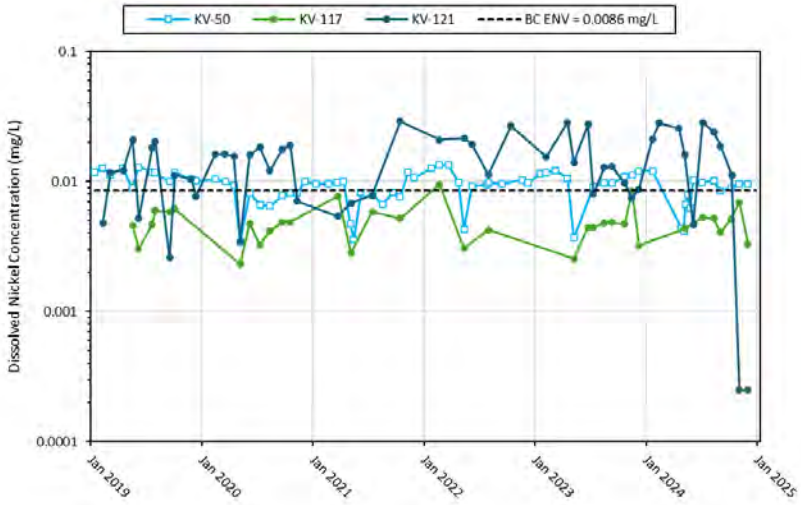


Plots of KV-117, KV-121, and KV-50









APPENDIX 2

SUPPORTING ENVIRONMENTAL DATA

APPENDIX 2.1

SITE CHARACTERIZATION REPORT

KENO HILL SILVER DISTRICT MINING OPERATIONS

SITE CHARACTERIZATION REPORT

December 2025

Prepared by:

Hecla Yukon

Prepared for:

Alexco Keno Hill Mining Corp.

VERSION HISTORY

ISSUE DATE	DESCRIPTION AND REVISIONS MADE
1996	Initial district-wide site characterization establishes existing state of mine conditions for United Keno Hill Mines Limited (UKHM). Submitted by Alexco Resources Corp. as part of Bellekeno Advanced Underground Exploration & Development Type B Water Licence application in 2008.
August 2009	Environmental Conditions Report, Version No.1., Keno Hill Silver District, Yukon, Access Consulting Group. Provided with Alexco Keno Hill Mining Corp. (AKHM) Type A Water Licence application existing environmental conditions of the region prior to the operation of the Bellekeno Mine and District Mill.
June 2011	Environmental Conditions Report Version No. 2, Keno Hill Silver District, Access Consulting Group, prepared for ERDC. This report provides an update to the description of the regional environmental setting previously documented in the 1996 *Site Characterization Report* (Access Mining Consultants Ltd., 1996) and is based on present environmental conditions as of the end of 2010. Submitted with QZ18-044 WL application.
October 2012	Biological Environment, Keno Hill Silver District Environmental Conditions, Report, prepared by Access Consulting Group, prepared for Aleco Keno Hill Mining Corp. Integrated assessment of available biotic and abiotic data to characterize current conditions within the headwaters and tributaries (stream sediment, benthic, fishers, wildlife, vegetation) and provided with QZ09-092-2 application.
April 2019	Biological Environment, KHSD Environmental Conditions Report, Alexco Environmental Group, prepared for Alexco Keno Hill Mining Corp. Submitted with QZ18-044 WL application. Supplement to Site Characterization Report for application to develop the New Bermingham Mine. Provides a summary of data collected for aquatic resources (fish, benthic invertebrates, sediment), wildlife, and vegetation from 2006 to 2018, in the KHSD
March 2020	Update submitted in accordance with QML-0009 Clause 13.1
February 2023	Update submitted in accordance with QML-0009 Clause 13.1.
December 2025	Update submitted in accordance with QML-0009 Clause 13.1.

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 PURPOSE 1
1.2 PROJECT LOCATION 1
1.3 OVERVIEW OF OPERATIONS 1
1.4 REGULATORY CONTEXT 2
1.5 RECENT CHANGES TO MINE OPERATIONS 3

2 CLIMATE AND AIR QUALITY 7

2.1 METEOROLOGICAL STATIONS 7
2.2 METEOROLOGICAL ANALYSIS 33
2.3 CLIMATE CHANGE 44
2.4 AIR QUALITY 47

3 SURFACE WATER 58

3.1 HYDROLOGY 58
3.2 WATER QUALITY 88

4 GROUNDWATER 137

4.1 GROUNDWATER CONDITIONS 137
4.2 GROUNDWATER MONITORING NETWORK 137
4.3 GROUNDWATER HYDROLOGY 144
4.4 GROUNDWATER QUALITY 154

5 GEOLOGY AND SOILS 163

5.1 REGIONAL DESCRIPTION 163
5.2 PROPERTY GEOLOGY 165
5.3 PHYSIOGRAPHY AND SURFICIAL GEOLOGY 169
5.4 PERMAFROST 172
5.5 SEISMICITY 173

6 GEOCHEMISTRY 175

6.1 ORE 175
6.2 WASTE ROCK 175
6.3 TAILINGS 206
6.4 SLUDGE 226

7 FISHERIES AND AQUATIC RESOURCES 240

7.1 AQUATIC RESOURCES 240

7.2 MONITORING OVERVIEW 240
7.3 CHRISTAL CREEK ATTENUATION STUDY 252
7.4 NO CASH CREEK ATTENUATION STUDY 252

8 ENVIRONMENTAL EFFECTS MONITORING - BELLEKENO 254

8.1 FISH LABORATORY EXPOSURE STUDY 257
8.2 BENTHIC INVERTEBRATES 258
8.3 STREAM SEDIMENT 259

9 ENVIRONMENTAL EFFECTS MONITORING – FLAME AND MOTH 266

9.1 FISH LABORATORY EXPOSURE STUDY 268
9.2 BENTHIC INVERTEBRATES 268
9.3 STREAM SEDIMENT 269

10 WILDLIFE 271

11 VEGETATION 274

12 NOISE MONITORING 281

12.1 PREDICTED SOUND LEVELS GENERATED BY MINING AND MILLING 281
12.2 MONITORING PROGRAM AND EQUIPMENT 281
12.3 MONITORING RESULTS 284

13 REFERENCES 299

LIST OF TABLES

Table 1-1: Keno Hill Silver District Mining Operations Overview 1
Table 1-2: Keno Hill Silver District Mine Operations Timeline 2
Table 1-3: Related Approvals, Permits, Licenses and Operational Management Plans 3
Table 2-1: District Mill Campbell Scientific Meteorological Station 9
Table 2-2: Monthly values for meteorological parameters collected at District Mill Weather Station 2011-2024 10
Table 2-3: Calumet HOBO Meteorological Station 17
Table 2-4: Monthly Values for Average Temperature Collected at the Calumet Station (2007-2024) 18
Table 2-5: Monthly Values for Total Rainfall Collected at the Calumet Station (2007-2024) 19
Table 2-6: Valley Tailings HOBO Meteorological Station 20
Table 2-7: Monthly Values for Meteorological Parameters Collected at Valley Tailings Station 21
Table 2-8: Regional Snow Survey Station Values 27
Table 2-9: Description of Snow Survey Stations 29
Table 2-10: Snow Survey Snow Water Equivalent Results 30
Table 2-11 Comparison of 24-hour Rainfall Depths between District Mill and Mayo A Stations 34
Table 2-12: Annual Precipitation at District Mill and Mayo A Stations, 2007-2024 36
Table 2-13: Regional Climate Stations 38
Table 2-14: Predicted Mayo A MAP-elevation Corrected Versus District Mill Measured Total Rain 40
Table 2-15: Predicted Mayo A MAP-elevation Corrected Versus Calumet Measured Total Rain 40
Table 2-16: Predicted Mayo A MAP-elevation Corrected Versus Valley Tails Measured Total Rain 41
Table 2-17: Estimated Valley Tailings and Approximate District Mill Evaporation 43
Table 2-18: Climate Change Adjusted Mayo A Station Rainfall Depth (mm), 2071-2100 46
Table 2-19: Historical and Climate Change Short Term Predicted Rainfall Depths 46
Table 2-20: Total Suspended Particulates, Coarse, and Fine Particulate Matter Summary Statistics 2012 to 2024 50
Table 2-21: Parameters greater than Ontario Ambient Air Quality Criteria by location and year 52
Table 2-22: Metal Concentrations Summary Statistics (24-hour) 2012 – 2024 53
Table 2-23: Wind Frequency Distribution District Mill, June 2011 – December 2024 56
Table 2-24: Average Coarse Particulate Matter (PM_{10}) concentrations 57
Table 3-1: McQuesten River Mean, Mean Minimum, and Mean Maximum Daily Flows 58
Table 3-2: Discrete Hydrometric Monitoring Stations 62
Table 3-3: Continuous Hydrometric Monitoring Stations 64
Table 3-4: Mean Monthly Derived Discharge at KV-41, Lightning Creek Above Keno City Bridge (m^3/s) . 67
Table 3-5: Discrete Discharge Measurements at KV-41, Lightning Creek above Keno City Bridge (m^3/s) 68
Table 3-6: Mean Monthly Derived Discharge at KV-81, Lightning Creek Southwest of Mill Site, for Months Where Continuous Data are Available (m^3/s) 69
Table 3-7: Discrete Discharge Measurements at KV-81, Lightning Creek Southwest of Mill Site (m^3/s) ... 70
Table 3-8: Changes to Hydrometric Station KV-6 75
Table 3-9: Mean Monthly Derived Discharge at KV-6, Christal Creek Below Christal Lake, for Months Where Continuous Data are Available (m^3/s) 76
Table 3-10: Discrete Discharge Measurements at KV-6, Christal Creek Below Christal Lake (m^3/s) 76
Table 3-11: Changes to Hydrometric Station KV-21 79
Table 3-12: Mean Monthly Derived Discharge at KV-21, No Cash Creek at Silver Trail Highway, for Months Where Continuous Data are Available (m^3/s) 79
Table 3-13: Discrete Discharge Measurements at KV-21, No Cash Creek at Silver Trail Highway (m^3/s) 80

Table 3-14: Mean Monthly Derived Discharge at KV-7, Christal Creek at Hanson-McQuesten Lakes Road Bridge (m^3/s) 82
Table 3-15: Discrete Discharge Measurements at KV-7, Christal Creek at Hanson-McQuesten Lakes Road Bridge (m^3/s) 82
Table 3-16: Mean Monthly Derived Discharge at KV-9, Flat Creek Near the Mouth (m^3/s) 84
Table 3-17: Discrete Discharge Measurements at KV-9, Flat Creek Near the Mouth (m^3/s) 85
Table 3-18: Mean Monthly Derived Discharge at KV-51, Christal Creek Downstream of Hinton Creek (m^3/s) 87
Table 3-19: Discrete Discharge Measurements at KV-51, Christal Creek Downstream of Hinton Creek (m^3/d) 87
Table 3-20: Keno Hill Silver District Surface Water Quality Monitoring Stations 89
Table 3-21: Keno Hill Silver District Adits and Wastewater Treatment Plants Locations 90
Table 3-22: Lightning Creek Water Quality Monitoring Sites 127
Table 3-23: Lightning Creek Drainage Total Zinc Summary Statistics, 2008 to 2024 130
Table 3-24: Lightning Creek Drainage Dissolved Zinc Summary Statistics, 2008 to 2024 131
Table 3-25: Lightning Creek Drainage Total Cadmium Summary Statistics, 2008 to 2024 132
Table 3-26: Lightning Creek Drainage Dissolved Cadmium Summary Statistics, 2008 to 2024 133
Table 4-1: Keno Hill Silver District Groundwater Monitoring Well Network 138
Table 6-1: Lithology Code Descriptions 175
Table 6-2: Number of ARD/ML Samples per ARD/ML Test and per Production Zone 177
Table 6-3: Lithologies Sampled for ARD/ML Characterization per Keno Hill Silver District Production Zones 177
Table 6-4: Comparison of SFE Data from Flame & Moth with Water Quality Guidelines 189
Table 6-5: Comparison of SFE Data from New Bermingham with Water Quality Guidelines 189
Table 6-6: Mine Feed Composition and Analyses Conducted on 2024 Tailings Samples 207
Table 6-7: PSA Results for 2024 Tailings Samples 207
Table 6-8: Median XRD Results of Tailings Samples 209
Table 6-9: Summary Statistics for ABA Results from Monthly Composite Tailings Samples 210
Table 6-10: Summary Statistics for Selected Metals Data for 2012-2023 and 2021-2024 Tailings Samples 215
Table 6-11: Shake Flask Extraction (SFE) Results of Tailings Samples 219
Table 6-12: Results of Particle Size Distribution Test of Water Treatment Plant Sludge Samples 2021-2022 226
Table 6-13: XRD Results of 2024 Sludge Samples 228
Table 6-14: ABA Testing Results of Water Treatment Plant Sludge Samples between 2018 to 2022 230
Table 6-15: ABA Testing Results of 2024 Sludge Samples 231
Table 6-16: Elemental Results by Aqua Regia Digest of WTP Sludge Samples 233
Table 6-17: Elemental Results by Aqua Regia Digest of Mill Pond Sludge Samples 236
Table 6-18: SFE Results of WTP Sludge Samples 238
Table 6-19: SFE Results of 2024 Mill Pond Sludge Samples 239
Table 7-1: Monitoring Frequency Schedule 240
Table 7-2: Sieve ASTM No. to U.S. Standard Conversion 242
Table 7-3: Summary of Mean Retained Percentages of Aquatic Sediment Particle Size 2023-2024 242
Table 7-4: Aquatic Sediment Parameters Exceeding CCME Guidelines 2024 243
Table 7-5: Habitat Characteristics and Water Chemistry for Benthic Monitoring Stations in 2023-2024 244
Table 7-6: Benthic Invertebrate Community Metrics in 2023-2024 245
Table 7-7: Benthic Invertebrate Tissue Metals Analysis, 2024 246
Table 7-8: Periphyton Metrics and Community Taxonomic Composition, 2024 247

Table 7-9: Periphyton Tissue Metals Analysis, 2024 248
Table 7-10: Habitat Descriptions, 2024 250
Table 7-11: Fish Inventory Summary, 2024 250
Table 7-12: Fish Tissue Metals Concentrations, 2024 251
Table 8-1: Metal Concentrations in Lightning Creek Sediment at KV-37 and KV-38, 2007-2022 260
Table 8-2: Metal Concentrations in Lightning Creek Sediment at KV-41, 2007-2022 261
Table 8-3: Metal Concentrations in Christal Creek Sediment at KV-6, KV-7, and KV-50, 2007-2022 262
Table 8-4: Metal Concentrations in Flat Creek Sediment KV-9, 2007-2021 263
Table 8-5: Metal Concentrations in No Cash Sediment at KV-21 and KV-56, 2018-2022 264
Table 8-6: Metal Concentrations in South McQuesten Sediment at KV-1, KV-3, and KV-4, 2007-2021 . 265
Table 9-1: Concordance Table EEM Sediment, Benthic and Water Quality Sample Locations 266
Table 9-2: Sediment Metal Concentrations and Particle Size, 2023 270
Table 10-1: Wildlife Species at Risk and Specially Protected that are potentially in the Region 272
Table 11-1: Bioclimate Zones in the Keno Hill Silver District 274
Table 12-1: Noise Receptor Monitoring Locations Assessed in Keno City 281
Table 12-2: Hecla Yukon activities near Keno City during monitoring period, 2014 to present 284
Table 12-3: 24-hr Noise Data and Corresponding Meteorological Data, 2014 to 2024 287

LIST OF FIGURES

FIGURE 1-1: KENO HILL SILVER DISTRICT MINING OPERATIONS OVERVIEW 6
FIGURE 2-1: KENO HILL SILVER DISTRICT METEOROLOGICAL STATIONS 8
FIGURE 2-2: SNOW SURVEY STATIONS 28
FIGURE 2-3: MONTHLY TEMPERATURE TRENDS, DISTRICT MILL AND MAYO A STATIONS 33
FIGURE 2-4: REGIONAL SNOW WATER EQUIVALENTS COMPARED TO SITE STATIONS BKS-4, 5, 8, 9, 10, AND 12 FOR 2011-2024 35
FIGURE 2-5: MARCH SNOW WATER EQUIVALENT AS A FUNCTION OF ELEVATION 35
FIGURE 2-6: MONTHLY AND CUMULATIVE PRECIPITATION AT THE DISTRICT MILL METEOROLOGICAL STATION, 2012 TO 2024 37
FIGURE 2-7: MONTHLY TOTAL PRECIPITATION TRENDS, DISTRICT MILL AND MAYO A STATIONS 37
FIGURE 2-8: REGIONAL ANALYSIS FOR MEAN ANNUAL PRECIPITATION (WITHOUT UNDERCATCH) AND ELEVATION 39
FIGURE 2-9: MEAN MONTHLY PRECIPITATION OF REGIONAL STATIONS 42
FIGURE 2-10: WINDSPEED COMPARISONS 43
FIGURE 2-11: MAYO A STATIONS ANNUAL TEMPERATURES 1925 TO 2022 44
FIGURE 2-12: METEOROLOGICAL AND AIR QUALITY MONITORING STATIONS LOCATIONS 49
FIGURE 2-13: WIND ROSE FOR KENO DISTRICT MILL WEATHER STATION, JUNE 2011 – DECEMBER 2024 56
FIGURE 3-1: ANNUAL FLOW DISTRIBUTION AT MCQUESTEN RIVER NEAR THE MOUTH (09DD004) 59
FIGURE 3-2: HYDROMETRIC MONITORING LOCATIONS 66
FIGURE 3-3: DERIVED DISCHARGE AT KV-41 ON LIGHTNING CREEK ABOVE KENO CITY BRIDGE (2011-2024) 69
FIGURE 3-4: DERIVED DISCHARGE AT KV-81 ON LIGHTNING CREEK SOUTHWEST OF MILL SITE (2024) 70
FIGURE 3-5: BERMINGHAM MONITORING LOCATIONS AND GROUNDWATER LEVEL CONTOUR MAP 72
FIGURE 3-6: 2024 DAILY BELLEKENO 625 TREATED EFFLUENT DISCHARGE (KV-42) RATE 73
FIGURE 3-7: DAILY FLAME & MOTH ADIT MINE WATER DISCHARGE (KV-105) AND TREATED EFFLUENT DISCHARGE TO LIGHTNING CREEK (KV-104L) 74
FIGURE 3-8: FLAME & MOTH WTP POND DISCHARGE TO LIGHTNING CREEK AUGUST 2018 TO DECEMBER 2024 74
FIGURE 3-9: DERIVED DISCHARGE AT KV-6 ON CHRISTAL CREEK BELOW CHRISTAL LAKE (2012-2024) 77
FIGURE 3-10: FLOW DISTRIBUTION AT KV-21 ON NO CASH CREEK AT SILVER TRAIL HIGHWAY (2016-2024) 81
FIGURE 3-11: DERIVED DISCHARGE AT KV-7 ON CHRISTAL CREEK AT HANSON-MCQUESTEN LAKES ROAD BRIDGE (2006-2024) 83
FIGURE 3-12: DERIVED DISCHARGE AT KV-9 AT FLAT CREEK NEAR THE MOUTH (2012-2024) 86
FIGURE 3-13: DERIVED DISCHARGE AT KV-51, CHRISTAL CREEK DOWNSTREAM OF HINTON CREEK (2015-2024) 88
FIGURE 3-14: SURFACE WATER QUALITY STATION LOCATIONS 92
FIGURE 3-15: TOTAL CADMIUM (TOP) AND DISSOLVED ZINC (BOTTOM) CONCENTRATIONS AT STATIONS KV-1 AND KV-2 IN THE SOUTH MCQUESTEN RIVER FROM 2008 TO 2024 94
FIGURE 3-16: MILL POND DISCHARGE, 2015 TO 2024 96
FIGURE 3-17: MILL POND AMMONIA, 2015 TO 2024 97
FIGURE 3-18: MILL POND TOTAL ZINC, 2015 TO 2024 97
FIGURE 3-19: MILL POND TOTAL LEAD, 2015 TO 2024 98
FIGURE 3-20: MILL POND TOTAL CADMIUM, 2015 TO 2024 98
FIGURE 3-21: TOTAL CADMIUM (TOP) AND DISSOLVED ZINC (BOTTOM) CONCENTRATIONS IN CHRISTAL CREEK FROM 2008 TO 2024 100
FIGURE 3-22: NEW BERMINGHAM DISSOLVED CADMIUM, 2019 TO 2024 102
FIGURE 3-23: NEW BERMINGHAM DISSOLVED COPPER, 2019 TO 2024 103

FIGURE 3-24: NEW BERMINGHAM DISSOLVED LEAD, 2019 TO 2024 103
FIGURE 3-25: NEW BERMINGHAM DISSOLVED SILVER, 2019 TO 2024 103
FIGURE 3-26: NEW BERMINGHAM DISSOLVED ZINC, 2019 TO 2024 104
FIGURE 3-27: NEW BERMINGHAM TOTAL NICKEL, 2019 TO 2024 104
FIGURE 3-28: NEW BERMINGHAM DISSOLVED ARSENIC, 2019 TO 2024 105
FIGURE 3-29: NEW BERMINGHAM FIELD PH, 2019 TO 2024 105
FIGURE 3-30: NEW BERMINGHAM AMMONIA, 2019 TO 2024 106
FIGURE 3-31: NEW BERMINGHAM TOTAL SUSPENDED SOLIDS, 2019 TO 2024 106
FIGURE 3-32: NO CASH CREEK DISSOLVED CADMIUM, 2015 TO 2024 109
FIGURE 3-33: NO CASH CREEK DISSOLVED ZINC, 2015 TO 2024 109
FIGURE 3-34: STAR CREEK TOTAL CADMIUM, 2015 TO 2024 110
FIGURE 3-35: STAR CREEK TOTAL ZINC, 2015 TO 2024 110
FIGURE 3-36: BELLEKENO 625 WATER TREATMENT SYSTEM FLOW THROUGH DISCHARGE AUGUST 2010 TO DECEMBER 2024 112
FIGURE 3-37: BELLEKENO 625 ADIT TOTAL ZINC (INTERNAL) AND PH (FIELD) AUGUST 2010 TO DECEMBER 2024 113
FIGURE 3-38: BELLEKENO 625 ADIT SULPHATE AND INTERNAL ZINC, AUGUST 2010 TO DECEMBER 2024 113
FIGURE 3-39: BELLEKENO 625 ADIT IRON CONCENTRATIONS, AUGUST 2010 TO DECEMBER 2024 114
FIGURE 3-40: BELLEKENO 625 ADIT IRON AND ZINC CONCENTRATION CORRELATION, AUGUST 2011 TO DECEMBER 2024 114
FIGURE 3-41: BELLEKENO 625 ADIT TOTAL CADMIUM AND ZINC CONCENTRATIONS, AUGUST 2010 TO DECEMBER 2024 115
FIGURE 3-42: BELLEKENO 625 DECANT EXTERNAL ZINC AND FIELD PH, AUGUST 2010 TO DECEMBER 2024 117
FIGURE 3-43: BELLEKENO 625 DECANT FLOW AND TSS AUGUST 2012 TO DECEMBER 2024 117
FIGURE 3-44: BELLEKENO 625 ADIT FLOW AND TSS AUGUST 2012 TO DECEMBER 2024 118
FIGURE 3-45: BELLEKENO 625 ADIT FLOW AND AMMONIA AUGUST 2010 TO DECEMBER 2024 118
FIGURE 3-46: BELLEKENO 625 DECANT FLOW AND AMMONIA AUGUST 2010 TO DECEMBER 2024 119
FIGURE 3-47: FLAME & MOTH ADIT DISCHARGE TO LIGHTNING CREEK, 2018 TO 2024 121
FIGURE 3-48: FLAME & MOTH POND DISCHARGE, 2018 TO 2024 121
FIGURE 3-49: FLAME & MOTH DISSOLVED ARSENIC, 2018 TO 2024 122
FIGURE 3-50: FLAME & MOTH DISSOLVED CADMIUM, 2018 TO 2024 122
FIGURE 3-51: FLAME & MOTH DISSOLVED COPPER, 2018 TO 2024 123
FIGURE 3-52: FLAME & MOTH DISSOLVED LEAD, 2018 TO 2024 123
FIGURE 3-53: FLAME & MOTH DISSOLVED NICKEL, 2018 TO 2024 124
FIGURE 3-54: FLAME & MOTH DISSOLVED SILVER, 2018 TO 2024 124
FIGURE 3-55: FLAME & MOTH DISSOLVED ZINC, 2018 TO 2024 125
FIGURE 3-56: FLAME & MOTH AMMONIA, 2018 TO 2024 125
FIGURE 3-57: FLAME & MOTH TOTAL SUSPENDED SOLIDS, 2018 TO 2024 126
FIGURE 3-58: FLAME & MOTH FIELD PH, 2018 TO 2024 126
FIGURE 3-59: UPPER LIGHTNING CREEK TOTAL AND DISSOLVED ZINC, 2008 TO 2024 134
FIGURE 3-60: LOWER LIGHTNING CREEK TOTAL AND DISSOLVED ZINC, 2008 TO 2024 134
FIGURE 3-61: THUNDER GULCH TOTAL AND DISSOLVED ZINC, 2008 TO 2024 135
FIGURE 3-62: UPPER LIGHTNING CREEK TOTAL AND DISSOLVED CADMIUM, 2008 TO 2024 135
FIGURE 3-63: LOWER LIGHTNING CREEK TOTAL AND DISSOLVED CADMIUM, 2008 TO 2024 136
FIGURE 3-64: THUNDER GULCH TOTAL AND DISSOLVED CADMIUM, 2008 TO 2024 136
FIGURE 4-1: KHSD GROUNDWATER MONITORING LOCATIONS 141
FIGURE 4-2: GROUNDWATER MONITORING LOCATIONS AT NEW BERMINGHAM AND NO CASH 142

FIGURE 4-3: GROUNDWATER MONITORING LOCATIONS AT FLAME & MOTH, CHRISTAL CREEK, AND LIGHTNING CREEK 143
FIGURE 4-4: GALENA HILL GROUNDWATER CONTOURS 145
FIGURE 4-5: GROUNDWATER LEVEL (MASL) IN NO CASH CREEK CATCHMENT WELLS 146
FIGURE 4-6: GROUNDWATER LEVEL (MASL) IN BERMINGHAM CATCHMENT WELLS 147
FIGURE 4-7: BERMINGHAM GROUNDWATER POTENTIOMETRIC SURFACE, JULY 2024 148
FIGURE 4-8: BERMINGHAM GROUNDWATER POTENTIOMETRIC SURFACE, OCTOBER 2024 149
FIGURE 4-9: GROUNDWATER WATER LEVELS IN CHRISTAL CREEK WELLS NEAR DISTRICT MILL 151
FIGURE 4-10: GROUNDWATER WATER LEVELS IN CHRISTAL CREEK WELLS NEAR KENO CITY 151
FIGURE 4-11: KENO CITY GROUNDWATER POTENTIOMETRIC SURFACE, JULY 2024 152
FIGURE 4-12: KENO CITY GROUNDWATER POTENTIOMETRIC SURFACE, OCTOBER 2024 153
FIGURE 4-13: LIGHTNING CREEK GROUNDWATER LEVELS 154
FIGURE 4-14: DISSOLVED CADMIUM IN NO CASH CREEK CATCHMENT WELLS 155
FIGURE 4-15: DISSOLVED ZINC IN NO CASH CREEK CATCHMENT WELLS 156
FIGURE 4-16: DISSOLVED CADMIUM IN BERMINGHAM GROUNDWATER MONITORING WELLS 157
FIGURE 4-17: DISSOLVED ZINC IN BERMINGHAM GROUNDWATER MONITORING WELLS 158
FIGURE 4-18: DISSOLVED CADMIUM IN CHRISTAL CREEK WELLS NEAR THE DISTRICT MILL 159
FIGURE 4-19: DISSOLVED CADMIUM IN CHRISTAL CREEK WELLS NEAR KENO CITY 160
FIGURE 4-20: DISSOLVED ZINC IN CHRISTAL CREEK WELLS NEAR THE DISTRICT MILL 160
FIGURE 4-21: DISSOLVED ZINC IN CHRISTAL CREEK WELLS NEAR KENO CITY 161
FIGURE 4-22: DISSOLVED CADMIUM IN LIGHTNING CREEK CATCHMENT WELLS 162
FIGURE 4-23: DISSOLVED ZINC IN LIGHTNING CREEK CATCHMENT WELLS 162
FIGURE 5-1: KHSD GEOLOGICAL FORMATIONS AND FAULTS 164
FIGURE 5-2: VEIN-FAULT REFRACTION CREATING OPEN SPACE ACROSS COMPETENCY CONTRASTS 167
FIGURE 5-3: PLAN VIEW SHOWING SELECTIVE OPEN SPACE GENERATION AT MAIN-NO. 9 VEIN-FAULT INTERSECTION 167
FIGURE 5-4: DIVISION OF HANTELMANN'S 12 PARAGENETIC STAGES INTO EARLY AND LATE PHASES WITH RESULTING MINERALOGY 169
FIGURE 5-5: KENO HILL SILVER DISTRICT SURFICIAL GEOLOGY 171
FIGURE 6-1: VARIABILITY IN NP AND AP OF WASTE ROCK SAMPLES FROM NEW BERMINGHAM, FLAME & MOTH, BELLEKENO, LUCKY QUEEN, AND ONEK 179
FIGURE 6-2: VARIABILITY IN NP AND AP OF QTZT, TQTZT, GSCH, SSCH, AND GNST LITHOLOGY WASTE ROCK SAMPLES FROM NEW BERMINGHAM 180
FIGURE 6-3:VARIABILITY IN NP AND AP OF QTZT, TQTZT, GSCH, SSCH, AND GNST LITHOLOGY WASTE ROCK SAMPLES FROM FLAME AND MOTH 181
FIGURE 6-4: VARIABILITY IN NP AND AP OF QTZT, TQTZT, AND GSCH LITHOLOGY WASTE ROCK SAMPLES FROM LUCKY QUEEN 182
FIGURE 6-5: VARIABILITY IN NP AND AP OF QTZT, TQTZT, GSCH, SSCH, AND GNST LITHOLOGY WASTE ROCK SAMPLES FROM BELLEKENO 183
FIGURE 6-6: VARIABILITY IN NP AND AP OF QTZT, TQTZT, GSCH, SSCH, AND GNST LITHOLOGY WASTE ROCK SAMPLES FROM ONEK 184
FIGURE 6-7: ELEMENTAL CONCENTRATIONS OF ANTIMONY, ARSENIC, CADMIUM, AND LEAD AT NEW BERMINGHAM, BELLEKENO, ONEK, LUCKY QUEEN, AND FLAME AND MOTH 186
FIGURE 6-8: ELEMENTAL CONCENTRATIONS OF SELENIUM, SILVER, AND ZINC AT NEW BERMINGHAM, BELLEKENO, ONEK, LUCKY QUEEN, AND FLAME AND MOTH 187
FIGURE 6-9: ACIDITY, ALKALINITY, PH, SULPHATE, CADMIUM, AND ZINC TRENDS OF FLAME & MOTH HUMIDITY CELL 192
FIGURE 6-10: SILVER, LEAD, NICKEL, AND COPPER TRENDS OF FLAME & MOTH HUMIDITY CELL 193

FIGURE 6-11: ARSENIC, ANTIMONY AND SELENIUM TRENDS OF FLAME & MOTH HUMIDITY CELL 194
FIGURE 6-12: PH, SULPHATE, ZINC, AND CADMIUM TRENDS WITHIN THE NEW BERMINGHAM N-AML WASTE ROCK HUMIDITY CELLS 196
FIGURE 6-13: SILVER, LEAD, NICKEL, AND COPPER TRENDS WITHIN THE NEW BERMINGHAM N-AML WASTE ROCK HUMIDITY CELLS 197
FIGURE 6-14: ARSENIC, ANTIMONY, SELENIUM, AND MOLYBDENUM TRENDS WITHIN THE NEW BERMINGHAM N-AML WASTE ROCK HUMIDITY CELLS 198
FIGURE 6-15: TRENDS OF PH, SULPHATE, ALKALINITY AND ACIDITY IN FLAME & MOTH FIELD BARRELS 203
FIGURE 6-16: TRENDS OF CADMIUM, ZINC, NICKEL, AND LEAD CONCENTRATION IN FLAME & MOTH FIELD BARRELS 204
FIGURE 6-17: TRENDS OF COPPER, ARSENIC, AND SELENIUM CONCENTRATIONS IN FLAME & MOTH FIELD BARRELS 205
FIGURE 6-18: PARTICLE SIZE ANALYSIS RESULTS FOR 2024 TAILINGS SAMPLES 208
FIGURE 6-19: MONTHLY MILL TAILINGS COMPOSITE TESTING, NEUTRALIZATION POTENTIAL 211
FIGURE 6-20: MONTHLY MILL TAILINGS COMPOSITE TESTING, NEUTRALIZATION POTENTIAL RATIO 212
FIGURE 6-21: MONTHLY MILL TAILINGS COMPOSITE TESTING, NEUTRALIZATION POTENTIAL RATIO 213
FIGURE 6-22: SILVER, ARSENIC, CADMIUM, COPPER, MANGANESE, AND LEAD BULK CONCENTRATIONS IN TAILINGS 216
FIGURE 6-23: ANTIMONY, AND ZINC BULK CONCENTRATIONS IN TAILINGS 217
FIGURE 6-24: SFE LEACHABLE CONCENTRATIONS VS. BULK METAL CONTENTS FOR ARSENIC, CADMIUM, LEAD, AND ANTIMONY 220
FIGURE 6-25: PH (TOP LEFT), ACIDITY AND ALKALINITY (TOP RIGHT), SULPHATE (BOTTOM LEFT), AND SELENIUM (BOTTOM RIGHT) OF THE NEW BERMINGHAM, FLAME & MOTH, AND BELLEKENO TAILINGS HUMIDITY CELLS 222
FIGURE 6-26: ARSENIC (TOP LEFT), ANTIMONY (TOP RIGHT), CADMIUM (BOTTOM LEFT), AND COPPER (BOTTOM RIGHT) TRENDS OF THE NEW BERMINGHAM, FLAME & MOTH, AND BELLEKENO TAILINGS HUMIDITY CELLS 224
FIGURE 6-27: LEAD (TOP LEFT), NICKEL (TOP RIGHT), SILVER (BOTTOM LEFT), AND ZINC (BOTTOM RIGHT) TRENDS OF THE NEW BERMINGHAM, FLAME & MOTH, AND BELLEKENO TAILINGS HUMIDITY CELLS 225
FIGURE 6-28: PARTICLE SIZE ANALYSIS RESULTS FOR 2024 SLUDGE SAMPLES 227
FIGURE 7-1: PERCENT PROPORTIONS OF AQUATIC SEDIMENT PARTICLE SIZES RETAINED IN 2023-2024 243
FIGURE 7-2: BENTHIC INVERTEBRATE COMMUNITY COMPOSITION IN 2023-2024 246
FIGURE 7-3: TOTAL DENSITY, RICHNESS, AND DIVERSITY OF PERIPHYTON COMMUNITIES, 2024 247
FIGURE 7-4: PERCENT COMPOSITION BY ALGA GROUP FOR PERIPHYTON COMMUNITIES, 2024 248
FIGURE 7-5: CHLOROPHYLL-*A* CONCENTRATION IN PERIPHYTON COMMUNITIES, 2024 248
FIGURE 8-1: KENO HILL WATERSHED OVERVIEW 255
FIGURE 8-2: BELLEKENO ENVIRONMENTAL EFFECTS MONITORING STATIONS 256
FIGURE 9-1: FLAME AND MOTH ENVIRONMENTAL EFFECTS MONITORING STATIONS 267
FIGURE 11-1: BIOCLIMATIC ZONES OF THE KENO HILL SILVER DISTRICT 275
FIGURE 11-2: CHRONOSEQUENCE ON MINE DISTURBANCE BOREAL HIGH 277
FIGURE 11-3: CHRONOSEQUENCE ON MINE DISTURBANCE SUBALPINE 278
FIGURE 11-4: CHRONOSEQUENCE ON MINE DISTURBANCE ALPINE 279
FIGURE 12-1: NOISE MONITORING SITES 283
FIGURE 12-2: 24-HR NOISE RESULTS PRESENTED WITH THE NOISE IMPACT ASSESSMENT VALUES, 2014 TO 2024 286

LIST OF ACRONYMS AND ABBREVIATIONS

AAQC	Ambient Air Quality Criteria
ABA	Acid Base Accounting
AHJ	Authorities Having Jurisdiction
AKHM	Alexco Keno Hill Mining Corp.
ARD/ML	Acid Rock Drainage and/or Metal Leaching
AP	Acid Potential
ASCE	American Society of Civil Engineers
BCMOE	British Columbia Ministry of the Environment
CCME	Canadian Council of Ministers of the Environment
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
COPI	Constituents of Potential Interest
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dB	Decibels
dBA	average decibels A
dba	doing business as
DIAND	Department of Indian Affairs and Northern Development
DL	Detection Limit
DOC	Dissolved Organic Carbon
DSTF	Dry Stack Tailings Facility
EEM	Environmental Effects Monitoring
EQS	Effluent Quality Standard
ERDC	Elsa Reclamation and Development Company
FNNND	First Nation of Na-Cho Nyäk Dun
%FS	Percentage of Foresight
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ISQG	Interim Sediment Quality Guidelines
ka	kilo-annum (thousands of years)
KHSD	Keno Hill Silver District
LAeq	A-weighted equivalent continuous sound level, in decibels
LAF	Fast A-weighted sound level, in decibels
LAS	Slow A-weighted sound level, in decibels
ma	mega-annum (millions of years)
masl	metres above sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
Mayo A	Mayo Airport

LIST OF ACRONYMS AND ABBREVIATIONS

N-AML	Non-Acid-Generating and/or Metal Leaching
NIA	Noise Impact Assessment
NP	Neutralization Potential
NPR	Neutralization Potential Ratio
PAG	Potentially Acid Generating
PAL	Protection of Aquatic Life, as used in CCME water quality guidelines
P-AML	Potentially-Acid-Generating and/or Metal Leaching
PEL	Probable Effects Level
PM	Particulate Matter
PSA	Particle Size Analysis
RefET	Reference Evapotranspiration
SFE	Shake flask extraction
SQG	Sediment Quality Guidelines
SWE	Snow Water Equivalent
TIC	Total inorganic carbon
TSP	Total Suspended Particulates
UKHM	United Keno Hill Mines
UTM	Universal Transverse Mercator coordinate system
WL	Water Licence
WQO	Water Quality Objectives
WRDA	Waste Rock Disposal Area, for non-acid-generating rock
WREVAP	Water Resources Evaporation-derived, a hydrological model
WRSA	Waste Rock Storage Area, for potentially acid-generating rock
WTP	Water Treatment Plant
YAAQS	Yukon Ambient Air Quality Standard
YCSR-AL	Yukon Contaminated Site Regulation – Agricultural Land Standard
YESAA	Yukon Environmental and Socio-economic Assessment Act
YESAB	Yukon Environmental and Socio-economic Assessment Board
YG	Yukon Government
YOR	YESAB Online Registry

1 INTRODUCTION

1.1 PURPOSE

The Site Characterization Report summarizes environmental conditions for the mining operations in the Keno Hill Silver District (KHSD) conducted by Alexco Keno Hill Mining Corp. (AKHM), a wholly owned subsidiary of Hecla Yukon. The AKHM Project areas within the KHSD include New Bermingham, Bellekeno, Flame & Moth, Onek 990, Lucky Queen, and the District Mill, and these areas are discussed in this report. This report provides an update to the previous Site Characterization Report issued February 28, 2023, in accordance with paragraph 13.1 of Quartz Mining License QML-0009.

1.2 PROJECT LOCATION

The KHSD is in central Yukon (63° 54' 32" N, 135° 19’ 18” W; NTS 105M/14 & 105M/13), 354 km due north of Whitehorse, in the vicinity of Keno City. The project site is situated within the traditional territory of the First Nation of Na-Cho Nyäk Dun (FNNND), approximately 40 km northeast of Mayo. Access to the property is via the Alaska, Klondike, and Silver Trail Highways from Whitehorse to Mayo (407 km) and an all-weather gravel road northeast from Mayo to Elsa (45 km); a total distance of 452 km.

The KHSD Mining Operations are located on and around Galena Hill, Keno Hill, and Sourdough Hill (Figure 1-1), to the south of the broad McQuesten River valley. The New Bermingham Mine is situated on Galena Hill. The Lucky Queen and Onek 990 deposits are on Keno Hill, while the Bellekeno Mine is on Sourdough Hill. The Flame & Moth Mine and the District Mill are located at the base of the three hills.

1.3 OVERVIEW OF OPERATIONS

AKHM owns and operates a series of small underground silver/lead/zinc mines with a centralized mill, as described in Table 1-1. Alexco Resource Corp. (doing business as [dba] Hecla Yukon), the parent company of AKHM, was acquired by Hecla Mining Company in September 2022.

Table 1-1: Keno Hill Silver District Mining Operations Overview

MINES / ORE DEPOSITS	Bellekeno (production 2010 – 2013, suspended 2013 – 2020, production 2020, temporary closure 2021) Flame & Moth (development 2018, suspended 2018 – 2020, development and production 2020 - present) New Bermingham (advanced exploration 2017 – 2018, development and production 2020 - present) Lucky Queen, Onek 990 (advanced exploration 2013, not active)
MILL	District Mill located in Flame & Moth Mine area Conventional floatation process producing separate lead/silver concentrate and zinc concentrate Tailings placed in Dry Stack Tailings Facility (DSTF) or underground as backfill
WORK FORCE	~ Camp capacity of 250 employees and contractors during active mine and reclamation operations (as per Yukon Environmental and Socio-economic Assessment Act (YESAA) file # 2018-0169 Decision Document)
AIRSTRIP	Village of Mayo, YT
CAMP FACILITIES	Flat Creek camp facilities include a trailer camp, kitchen facility, welcoming center, and fitness facility
POWER	Hydro grid power Yukon Energy, diesel power backup
WATER SUPPLY AND USE	Fresh water supply from Flat Creek and adjacent well Water treatment plants at Bellekeno 625, Flame & Moth, and New Bermingham for mine effluent Process water is recycled from the Mill Pond to the mill

The Keno Hill mining camp has a long mining history and is a brownfields site. AKHM (dba Hecla Keno Hill) develops the mineral resources, operates the KHSD mines and undertakes receiving environment monitoring

and treatment of mine discharge waters. Hecla Yukon's wholly owned subsidiary Elsa Reclamation and Development Company Ltd. (ERDC) undertakes remediation of the historic environmental liabilities in the camp.

The development history of AKHM's KHSD Mining Operations including the construction and operation of the District Mill is outlined in Table 1-2.

Table 1-2: Keno Hill Silver District Mine Operations Timeline

2006 – 2008	Alexco Resource Corp. acquires Keno Hill mining camp and begins aggressive surface exploration programs
2009	Underground development at the Bellekeno Mine
2010	Comprehensive Cooperation and Benefits Agreement signed with First Nation of Na-Cho Nyak Dun (FNNND) AKHM constructs the mill and surface facilities, and establishes DSTF Phase 1
2011	Production at Bellekeno Mine and District Mill
2012	Development and rehabilitation of Lucky Queen adit Development of new Onek 990 decline
2013	Temporary suspension of Bellekeno Mine operations and milling AKHM monitors KHSD mine sites during care and maintenance
2014 – 2020	Permitting and portal and ramp development of Flame & Moth and New Bermingham Continued surface exploration; advanced underground exploration at New Bermingham Care and maintenance and water treatment
2021	Ore production from Bellekeno and milling resumes Camp, surface facilities, and mill upgrades Mine development at Flame & Moth and New Bermingham Temporary suspension of Bellekeno operations Continued surface exploration and water treatment
2022	Ore production at Flame & Moth and New Bermingham and milling temporarily suspended June Continued mine development at Flame & Moth and New Bermingham Continued surface exploration and water treatment
2023	Ore production at Flame & Moth and New Bermingham resume February and District Mill resumed production May Progressive reclamation at Bellekeno commences Continued surface exploration and water treatment
2024 - 2025	Ore production from Flame & Moth and New Bermingham Camp, surface facilities, and mill upgrades Construction of DSTF Phase 2E Construction of the Cemented Tails Batch Plant at New Bermingham Mill Pond and DSTF water conveyance improvements Continued surface exploration and water treatment

1.4 REGULATORY CONTEXT

AKHM has all permits and authorizations in place for development and production of KHSD mines Bellekeno, Flame & Moth, and New Bermingham and operations of the District Mill. The existing assessments, approvals and operational management plans for mining and milling activities are summarized in Table 1-3. The operational management plans used to guide activities and monitoring associated with tailings characterization. This plan should be read in conjunction with these documents.

Table 1-3: Related Approvals, Permits, Licenses and Operational Management Plans

YESSA APPROVALS	Decision Documents and Evaluation Reports for projects #2009-0030, #2011-0315, #2013-0161 and #2017-0176
QUARTZ MINING LICENSE	Quartz Mining License (QML-0009, updated December 2021, expires 2037)
WATER LICENCE	Type A Water Licence (QZ18-044 expires 2037)
MANAGEMENT PLANS	• Adaptive Management Plan • Dust Abatement and Monitoring Plan • Environmental Monitoring, Surveillance and Reporting Plan • Groundwater Monitoring Plan • Hydrogeology Management Plan • Noise Monitoring and Management Plan • Reclamation and Closure Plan • Sludge Management Plan • Tailings Characterization Plan • Waste Rock Management Plan • Water Management Plant • Wildlife Monitoring Plan

Note. Management plans listed are not required by all the authorizations listed in this table.

1.5 RECENT CHANGES TO MINE OPERATIONS

The following subsection summarizes the changes that have occurred to site operations and site infrastructure since the previous Site Characterization Report was issued.

1.5.1 Mine Infrastructure

In 2023, a pad to support the installation of a concrete batch plant was cleared and foundation preparation commenced with the placement of granular material adjacent to the Flame & Moth ventilation raise. In 2024 the pad was converted into a lined pond and repurposed to temporarily store sediment from the Mill Pond. In 2025 the sediment was disposed of on the dry stack, the pond decommissioned, and the area was converted to a laydown.

In 2023, additional surface infrastructure installed included an administrative and technical service office, additional miner's dry facilities at New Bermingham. In 2024 site preparation work began for the cemented tailings backfill plant, laydown areas were expanded, and there was a fire break cleared in the area. In 2025 the cemented tailings backfill plant construction was completed with commissioning planned in 2026.

In 2025 a pad for a mechanical shop was built with construction of the facility planned to begin in 2026.

1.5.2 Mill Site Construction

In 2025, construction was completed on the Mill pond to increase the capacity, construct a spill way to the Flame and Moth pond and an emergency spillway from the Flame and Moth pond toward Christal Creek. Design details for the improvements are as follows:

- Mill pond capacity was increased from 5,242 m^3 to 8650 m^3 to accommodate a 1:50 year event runoff volume.

- The crest of the pond was raised from 896.59 m to 898.15 m.

- The spillway from the Mill pond to the Flame and Moth pond is designed and constructed to safely evacuate excess volumes from events higher than 1:200-year, including peak flows at 1:500-year.

Additionally, water conveyance structures from the phase 1 DSTF were improved by replacing sumps and pipes with the appropriately sized ditches and culverts to report to the Mill pond.

1.5.3 Dry Stack Tailings Facility

In 2023, liner was laid for the placement of additional tailings in accordance with the phase 1 DSTF design. In 2024 construction was initiated for phase 2 DSTF East.

Organics from the removal of the earthen mound in the phase 2 DSTF footprint were used on the DSTF or stockpiled.

1.5.1 Road Construction

No major upgrades occurred on the roads to New Bermingham, Lucky Queen, or the Lightning Creek Bypass, or the Bellekeno Haul Road in 2023. Standard maintenance occurred throughout the year.

In 2024 a section of the Christal Lake Road near road marker 4 was worked on in order to site prep for the Silver Trail water treatment plant (UKHM). No major upgrades occurred on the roads to New Bermingham, Lucky Queen, or the Lightning Creek Bypass, or the Bellekeno Haul Road. Standard maintenance occurred throughout the year.

Throughout 2024, AKHM maintained and utilized the haul roads between the Bellekeno East Portal and Bellekeno 625 Adit, the Bellekeno Haul Road, the Lightning Creek Bypass Road (also referred to as the Bellekeno Bypass Road), the Christal Lake Road, the Flame & Moth Access Road, the New Bermingham Access Road, and a section of the Duncan Creek Road (between the District Mill and Calumet Drive). A section of the Calumet Road between Duncan Creek Road and the New Bermingham Access Road was widened, maintained, and utilized.

The Onek Pipeline Road was maintained and used in 2024 with activities from the Elsa Reclamation and Development Company. The Onek Connector (also referred to as the Keno City Bypass Access Road), the Wernecke Road and the Lucky Queen Road were inactive.

1.5.2 Flat Creek Camp Upgrades

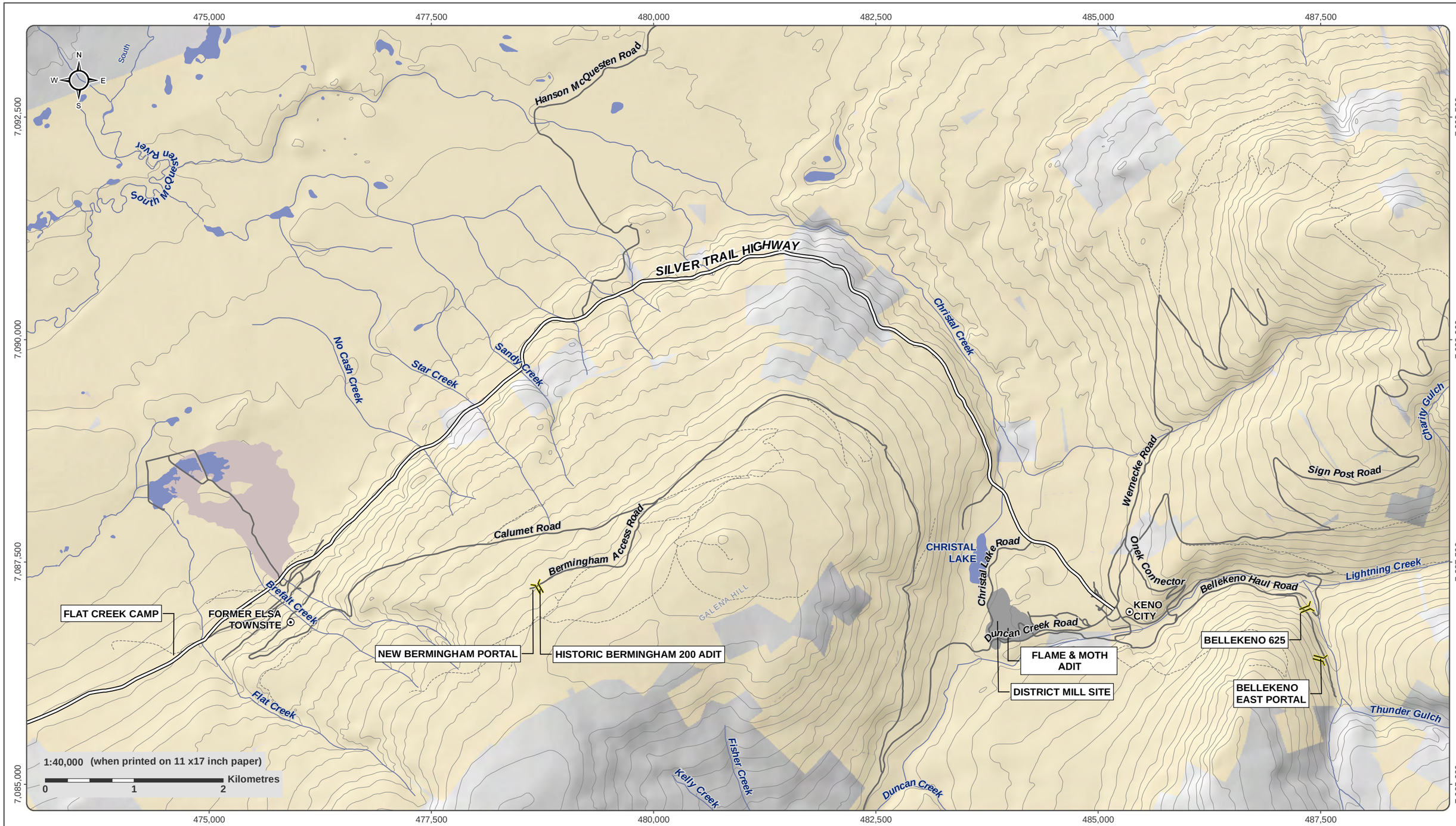
In 2023, upgrades included the installation of additional boardwalks, the construction of a smoking shelter, and the installation of a containerized membrane bioreactor sewage treatment plant near the existing absorption bed to expand the Flat Creek camp system. A fourth 38 bedroom modular dormitory was installed to the north of existing bunkhouses.

In 2024, a fifth 38 bedroom modular dormitory installed to the north of the existing bunkhouses, a containerized membrane bioreactor (MBR) sewage treatment plant installed near the existing absorption bed to expand the system, a relocation of the existing mine dry facilities from the Flat Creek Camp to the New Bermingham site, as well as the installation of a new modular kitchen and dining facility to the south of the existing bunkhouses.

In 2025, the potable water treatment plant was upgraded to include redundant filter packages and redundant UV disinfection systems, enhancing reliability and protection against system failure or maintenance.



Photo 1-1: Flat Creek Camp



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Datum: NAD 83; Map Projection: UTM Zone 8N

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- Adit
- AKHM/ERDC Quartz Claims Boundary
- District Mill Footprint
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Tailings Area
- Waterbody
- Watercourse
- Contours (100 ft intervals)

Hecla KENO HILL SM

ENSERO solutions

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 1-1

KENO HILL SILVER DISTRICT MINING OPERATIONS OVERVIEW

MARCH 2025

2 CLIMATE AND AIR QUALITY

The KHSD falls within the subarctic climate of the Koppen climate classification. The closest current long term climate record is that at the Mayo Airport at 504 masl. The 1981-2010 Canadian Climate Normals for Mayo give an average daily temperature of -2.4 °C and average annual precipitation of 313.5 mm with 203.8 mm falling as rain.

Updated Canadian Climate data from 1991-2020 sources for Mayo Airport show an average annual daily temperature of -2.2°C. Total annual precipitation average is 326.9 mm with 210.9 mm falling as rain. The wet season occurs in summer/fall with dryer winters. The District Mill sits at 913 masl and typically gets more precipitation than Mayo.

2.1 METEOROLOGICAL STATIONS

Automated meteorological monitoring stations collect data year-round for the Project. Hecla Yukon collects meteorological data from Onset Hobo stations located on Galena Hill and in the Valley Tailings Area; and a Campbell Scientific station located near the District Mill. The Calumet meteorological station on Galena Hill was commissioned in 2007, the Valley Tailings station in 2012, and the District Mill station in 2011. To accommodate the expansion of the Dry Stack Tailings Facility and reclamation efforts of the Valley Tailings the stations are occasionally relocated. The current and historic locations of the three meteorological stations are shown on Figure 1-1.

The region around the KHSD Mining Operations has been served by a network of Federal climate monitoring stations over the years. Climate stations were located at the former Elsa townsite and on the southern flank of Keno Hill. These two stations were maintained by the Atmospheric Environment Service until 1989 and 1982 respectively; Atmospheric Environment Service is now known as the Meteorological Service of Canada a branch of the Department of Environment. A third station was operated on a seasonal basis by the Department of Indian Affairs and Northern Development (DIAND) (currently referred to as CIRNAC) at a site in the Flat Creek catchment near the Elsa townsite. In addition to these stations, the Meteorological Service of Canada operates a principal climate station at the Mayo Airport (Mayo A), located approximately 40 km southwest of Elsa. The data from the Mayo A station can be combined with that of two discontinued stations in the near vicinity of the airport (i.e., Mayo Landing and Mayo) to construct a long-term climate record for the region. These stations have been active since 1953.

Hecla Yukon has conducted manual snow surveys since 2011 in February, March, April and occasionally May depending on conditions. There are also three regional snow survey sites that are monitored by the Yukon Government: Mayo Airport A, Mayo Airport B, and Calumet. Mayo Airport A and B are in the Village of Mayo and Calumet is on Galena Hill, near Hecla Yukon's Calumet meteorological station. The locations of the snow survey stations are shown on Figure 2-1.

475000 480000 485000 490000

7090000 7085000

N W E S

ID: VALLEY TAILINGS WEATHER STATION
ELEVATION: 708 masl

ID: VALLEY TAILINGS WEATHER STATION
ELEVATION: 718 masl
(Old Location)

ID: CALUMET WEATHER STATION
ELEVATION: 1388 masl

ID: DISTRICT MILL WEATHER STATION
ELEVATION: 900 masl

HANSON MCQUESTEN ROAD
Christal Creek
South McQuesten River
Star Creek
Sandy Creek
No Cash Creek
SILVER TRAIL HIGHWAY
CALUMET ROAD
GALLENA HILL
Galena Creek
Brefalt Creek
Flat Creek
Fisher Creek
Kelly Creek
DUNCAN CREEK ROAD
Forty Pup
Duncan Creek
Crystal Lake
CRYSTAL LAKE ROAD
ALEXCO DISTRICT MILL
KENO CITY
WERNECKE ROAD
SIGN POST ROAD
KENO SUMMIT
McKay Gulch
Faro Gulch
Charity Gulch
Hope Gulch
Lightning Creek
BELLE KENO HAUL ROAD
Thunder Gulch
SOURDOUGH HILL

1:50,000 (when printed on 11 x17 inch paper)
0 1 2 3 Kilometers

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Datum: NAD 83; Map Projection: UTM Zone 8N

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- Weather Station, Active
- Weather Station, Decomissioned
- Tailings Area
- Waterbody
- Watercourse
- Mill Site Footprint
- Silver Trail Highway
- Road
- Limited-Use Road
- Contours (100 ft)

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 2-1

METEOROLOGICAL STATIONS

NOVEMBER 2024

D:\Project\All\Projects\ALEX-05-01\gis\mxd\Overview_Maps\SpecificTopics\Monitoring\Weather Stations\WeatherStations_20241120.mxd
(Last edited by: amalia.shevska, 2024-11-20 08:45 AM)

2.1.1 District Mill

The District Mill Campbell Scientific automated meteorological station was installed above the DSTF and below the old Keno City dump near Keno, YT (UTM coordinates: 08 V 0484009 7086872, elevation: 936 masl) in 2011. In May 2022 the meteorological station was disassembled, and components sent to the manufacturer for maintenance, replacement, and calibration. The station was moved to Flame & Moth vent raise when it was reinstalled in November 2022 (Zone 8V -483859, 7086534, elevation: 900m), as its original location was within the DSTF Phase 1 footprint. All the District Mill meteorological station components are present in **Error! Not a valid bookmark self-reference.**.

Table 2-1: District Mill Campbell Scientific Meteorological Station

COMPONENT	MODEL	SERIAL NUMBER
Air Temperature and Relative Humidity Sensor	HMP45C212	n/a
Tipping Bucket Rain Gauge	Installed November 10, 2022:TE525M	45303-910
Wind Speed and Direction Sensor	Installed November 10, 2022: 05103AP-10-L	WM105907
Solar Panel	SX320J	T21008289B30EC8
Datalogger	CR1000X	n/a
Battery	PS-12120 F2	06299-HC
Pyranometer	SP Lite2	125766
Barometric Pressure	Vaisala C106	P3220823
Net Solar Radiation	Installed September 25, 2024: SN-500	SN-500-SS_2511
Snow Depth	Installed September 25, 2024: Snow Vue10	12288
Total Precipitation Gauge (Geonor)	Installed September 25, 2024: T-200B	121024,121124, 120924

Monthly averages were calculated from hourly values recorded by the datalogger (averaged values from a 10 second sampling interval) for the temperature, daily maximum temperature, daily minimum temperature, relative humidity, wind speed, maximum wind speed, barometric pressure, and solar radiation.

New components installed in 2024 include a total precipitation gauge (Geonor), snow depth sensor (SnowVue10) and net radiation sensor (SN-500). The datalogger was also updated to a CR1000X in 2024.

Annual temperature, humidity, windspeed, solar radiation wind speed and direction, and total rainfall are shown on Table 2-2 below. The barometric pressure has not been corrected for elevation and therefore represents the absolute pressure.

Table 2-2: Monthly values for meteorological parameters collected at District Mill Weather Station 2011-2024

Date	Extreme Max. Temp. (ºC)	Average Max. Temp. (ºC)	Average Temp. (ºC)	Average Min. Temp. (ºC)	Extreme Min. Temp. (ºC)	Average Relative Humidity (%)	Total Precip. Tipping Bucket (mm)	Average Wind Speed[1] (m/s)	Extreme Max. Wind Speed[1] (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration[8] (mm)	Average Snow Depth[14] (m)
Jun-11[2]	24.72	18.59	11.96	6.3	-2.56	n/a	n/a	1.35	9.14	n/a	n/a	n/a	n/a
Jul-11	25.67	18.5	12.91	8	5.09	n/a	n/a	1.15	8.02	n/a	n/a	n/a	
Aug-11	22.32	15.58	9.78	5.37	1.93	n/a	n/a	1.18	9.15	n/a	n/a	n/a	
Sep-11	17.97	11.29	6.07	1.85	-2.47	n/a	n/a	1.43	11.36	n/a	n/a	n/a	
Oct-11	7.2	0.2	-2.74	-5.41	-9.84	n/a	*2.603*	0.94	13.12	n/a	n/a	n/a	
Nov-11	-4.23	-16.79	-19.54	-22.47	-34.99	n/a	0	0.58	12.05	n/a	n/a	n/a	
Jan-12	-0.96	-19.1	-23.13	-26.79	-37.32	n/a	0	*0.59*	*9.51*	n/a	n/a	n/a	
Feb-12	2.77	-6.77	-10	-13.07	-26.78	n/a	0.10[4]	*1.38*	*15.62*	n/a	n/a	n/a	
Mar-12	5.33	-7.69	-13.37	-18	-27.8	n/a	0	*0.97*	*9.24*	n/a	n/a	n/a	
Apr-12	9.69	6.13	0.96	-3.87	-15.92	n/a	0.60[4]	1.37	10.27	n/a	n/a	n/a	
May-12	17.78	10.73	6.31	1.91	-3.47	*51.81*[5]	18.3	1.78	10.6	n/a	n/a	n/a	
Jun-12	27.62	18.41	13.46	8.29	4.42	56.35	21.7	1.44	10.26	n/a	n/a	n/a	n/a
Jul-12	25.14	18.07	12.75	7.73	1.64	69.26	85.8	1.36	12.99	n/a	n/a	n/a	
Aug-12	21.72	16.31	11.25	6.56	-0.89	67.79	47	1.62	9.41	n/a	n/a	n/a	
Sep-12	20.24	10.33	5.9	2.08	-5.22	69.51	36.4	1.84	14.27	n/a	n/a	n/a	
Oct-12	7.6	-3.95	-7.35	-10.32	-20.62	79.54	7.6	1.13	10.37	n/a	n/a	n/a	
Nov-12	-8.98	-19.55	-21.9	-24.32	-33.36	81.43	0	0.94	9.36	n/a	n/a	n/a	
Dec-12	-3.36	-21.3	-23.44	-25.58	-36.32	81.34	0	*0.26*	*5.93*	n/a	*1.01*[6]	*0.05*[7]	
Jan-13	-1.59	-17.06	-20.01	-23.08	-41.48	82.92	0	*0.76*	*14.48*	n/a	1.06	0.81	
Feb-13	1.54	-9.1	-12.52	-15.46	-23.74	88.36	0.30[4]	*0.85*	*12.25*	n/a	10.26	1.27	
Mar-13	3.26	-7.52	-13.16	-17.99	-29.96	64.08	3.9	1.59	12.47	n/a	95.82	6.33	
Apr-13	6.07	-2.76	-7.94	-13.69	-25.07	54.5	8.2	2.44	12.93	n/a	190.02	14.48	
May-13	23.31	10.2	5.27	0.23	-9.46	61.83	39.60	1.77	11.76	n/a	215.44	21.7	

Date	Extreme Max. Temp. (ºC)	Average Max. Temp. (ºC)	Average Temp. (ºC)	Average Min. Temp. (ºC)	Extreme Min. Temp. (ºC)	Average Relative Humidity (%)	Total Precip. Tipping Bucket (mm)	Average Wind Speed[1] (m/s)	Extreme Max. Wind Speed[1] (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration[8] (mm)	Average Snow Depth[14] (m)
Jun-13	30.51	19.97	14.27	8.30	1.84	58.72	57.30	1.82	12.87	n/a	234.69	29.79	
Jul-13	24.93	19.40	14.01	8.60	2.25	62.67	46.90	1.75	16.14	n/a	211.00	27.10	
Aug-13	27.34	18.54	12.98	8.01	-0.38	66.30	51.90	1.49	11.05	n/a	156.25	21.38	
Sep-13	16.11	9.69	5.81	2.26	-3.74	77.52	59.70	1.54	10.99	n/a	79.69	10.88	
Oct-13	8.25	1.61	-1.32	-4.21	-10.10	86.75	44.60	1.11	11.62	n/a	35.75	4.26	
Nov-13	0.18	-13.41	-16.68	-20.08	-37.96	84.26	10.60	*1.02*	*10.96*	n/a	4.93	*1.08*	
Dec-13	-1.73	-21.23	-23.91	-26.70	-35.29	78.77	4.90	*0.75*	*9.47*	n/a	0.57	*0.62*	
Jan-14	3.74	-9.33	-12.16	-15.10	-32.22	89.44	24.90	*0.72*	*10.03*	n/a	2.42	*0.64*	
Feb-14	-1.93	-15.25	-19.40	-23.02	-33.55	75.20	2.90	0.87	10.85	n/a	31.34	1.99	
Mar-14	4.57	-5.31	-11.29	-16.16	-26.79	54.77	0.70	1.57	11.98	n/a	115.54	9.17	
Apr-14	10.93	4.09	-0.96	-5.78	-17.33	57.54	5.10	1.64	12.05	n/a	171.28	15.77	
May-14	21.30	12.70	7.64	2.03	-3.03	52.18	12.80	2.09	19.21	n/a	217.91	29.81	
Jun-14	24.93	16.21	11.39	5.95	-0.13	56.14	40.40	1.78	10.43	n/a	217.90	28.58	
Jul-14	23.44	18.49	13.68	8.73	-0.04	65.01	31.00	1.63	13.38	n/a	187.31	23.84	
Aug-14	22.09	15.57	10.87	6.93	0.06	74.59	67.70	1.44	11.85	n/a	139.84	15.72	
Sep-14	17.70	8.76	4.28	0.49	-6.74	70.54	36.40	1.37	11.32	n/a	93.38	11.56	
Oct-14	7.47	-0.91	-3.79	-6.33	-15.42	88.21	15.70	1.24	12.80	n/a	24.83	3.39	
Nov-14	-2.21	-12.15	-14.34	-16.59	-30.16	88.64	1.40	*0.59*	*6.27*	n/a	3.12	*0.60*	
Dec-14	-0.09	-11.05	-13.67	-16.31	-26.66	89.06	1.40[9]	*0.51*	*8.87*	n/a	0.33	*0.40*	
Jan-15	-0.34	-13.69	-16.50	-19.11	-34.86	85.85	1.90	*0.49*	*5.49*	n/a	1.30	*0.43*	
Feb-15	2.87	-12.92	-15.93	-18.75	-39.39	84.95	12.70	0.75	10.36	n/a	9.06	0.86	
Mar-15	5.54	-4.76	-9.83	-14.21	-28.70	70.52	4.10	1.45	12.60	n/a	86.48	6.29	
Apr-15	10.90	5.36	0.56	-3.86	-10.48	61.71	4.20	1.75	12.37	n/a	163.45	16.03	
May-15	26.51	16.95	10.96	4.66	-7.00	45.35	1.40	1.89	10.64	n/a	246.80	34.67	
Jun-15	23.18	16.65	11.37	5.90	0.52	61.05	26.30	1.85	12.62	n/a	219.18	26.46	
Jul-15	25.43	17.60	12.54	7.77	4.73	68.63	72.40	1.48	12.62	n/a	190.74	19.98	

Date	Extreme Max. Temp. (ºC)	Average Max. Temp. (ºC)	Average Temp. (ºC)	Average Min. Temp. (ºC)	Extreme Min. Temp. (ºC)	Average Relative Humidity (%)	Total Precip. Tipping Bucket (mm)	Average Wind Speed[1] (m/s)	Extreme Max. Wind Speed[1] (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration[8] (mm)	Average Snow Depth[14] (m)
Aug-15	24.63	14.03	9.35	5.20	-3.09	75.14	54.90	*1.47*	*9.86*	n/a	146.76	*13.87*	
Sep-15	13.57	7.10	2.77	-0.61	-7.72	79.33	32.60	1.71	15.64	n/a	83.01	10.12	
Oct-15	7.32	0.92	-1.78	-4.12	-13.22	89.14	19.40	*1.08*	*10.07*	n/a	32.52	*2.92*	
Nov-15	0.83	-11.09	-13.75	-17.21	-31.38	89.09	22.80	*0.71*	*12.15*	n/a	4.03	*0.60*	
Dec-15	0.18	-12.37	-14.60	-16.94	-31.06	89.01	4.00	*4.59*	*14.24*	n/a	0.63	*0.13*	
Jan-16	1.17	-8.92	-11.14	-13.55	-21.91	88.06	24.90	*0.83*	*15.35*	n/a	1.67	*1.45*	
Feb-16	2.04	-7.62	-10.94	-14.22	-26.68	82.96	2.30	0.86	9.55	n/a	22.80	2.32	
Mar-16	12.35	-0.54	-4.96	-8.68	-16.96	73.13	7.10	1.26	8.11	n/a	82.81	7.12	
Apr-16	13.50	7.12	2.28	-2.15	-12.45	63.20	3.80	1.64	10.66	n/a	159.95	15.86	
May-16	22.80	13.61	8.44	3.08	-1.59	54.73	14.70	1.89	11.89	n/a	210.96	25.97	
Jun-16	25.98	18.41	12.88	7.21	2.27	56.52	40.00	1.76	13.37	n/a	234.99	29.78	
Jul-16	23.73	17.73	13.37	9.12	1.71	73.05	63.40	1.46	12.54	n/a	173.59	17.36	
Aug-16	24.42	16.71	11.92	7.91	1.22	70.86	42.20	1.50	10.69	n/a	152.32	17.72	
Sep-16	17.42	10.02	5.01	1.02	-6.18	71.05	28.90	1.50	10.81	n/a	100.94	14.02	
Oct-16	2.43	-3.18	-7.07	-9.98	-17.15	79.60	11.40	1.12	8.29	n/a	50.66	4.15	
Nov-16	4.05	-8.14	-10.89	-13.43	-25.46	86.45	7.60	*0.80*	*9.57*	n/a	5.70	*1.99*	
Dec-16	-4.20	-17.41	-19.62	-21.87	-32.16	83.76	1.30	*0.62*	*8.45*	n/a	0.56	*0.51*	
Jan-17	-0.10	-13.15	-16.02	-18.93	-33.59	82.95	0.80	*1.06*	*11.03*	n/a	1.64	*1.76*	
Feb-17	5.04	-11.33	-14.85	-17.99	-28.26	78.03	21.60	1.12	11.61	n/a	26.93	3.17	
Mar-17	9.56	-10.51	-16.13	-20.24	-32.14	64.03	8.40	1.72	8.83	n/a	100.75	6.51	
Apr-17	12.09	4.12	-1.23	-6.29	-16.26	57.70	7.10	1.81	10.50	n/a	173.66	15.44	
May-17	19.93	12.88	7.90	2.98	-2.30	54.38	16.80	1.92	11.54	n/a	211.85	27.95	
Jun-17	25.34	17.47	12.38	6.78	-0.90	54.93	20.20	1.73	13.32	n/a	225.93	28.61	
Jul-17	28.09	20.67	14.99	9.50	4.21	64.01	39.40	1.57	13.65	n/a	212.94	25.50	
Aug-17	28.31	18.22	12.83	8.25	1.95	64.85	16.70	1.46	11.01	n/a	156.87	21.67	
Sep-17	19.06	11.19	6.96	3.51	-2.32	77.06	48.70	1.34	11.06	n/a	78.21	10.37	

Date	Extreme Max. Temp. (ºC)	Average Max. Temp. (ºC)	Average Temp. (ºC)	Average Min. Temp. (ºC)	Extreme Min. Temp. (ºC)	Average Relative Humidity (%)	Total Precip. Tipping Bucket (mm)	Average Wind Speed[1] (m/s)	Extreme Max. Wind Speed[1] (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration[8] (mm)	Average Snow Depth[14] (m)
Oct-17	10.14	-0.30	-3.40	-6.24	-12.54	87.16	28.00	*1.05*	*8.65*	n/a	31.26	*3.40*	
Nov-17	-5.89	-17.86	-20.14	-22.28	-33.90	83.46	0.00	*0.45*	*5.47*	n/a	5.37	*0.45*	
Dec-17	4.27	-10.02	-12.27	-14.73	-31.16	86.62	19.80	*1.78*	*12.28*	n/a	0.74	2.00	
Jan-18	6.35	-14.26	-17.11	-19.90	-33.78	82.19	9.60	0.34	12.84	n/a	2.84	*1.68*	
Feb-18	-6.39	-17.06	-20.32	-22.93	-33.41	79.90	0.10	0.76	7.80	n/a	11.40	*1.01*	
Mar-18	9.71	-5.00	-10.46	-14.86	-27.81	63.15	17.20	1.55	14.32	n/a	84.89	*7.56*	
Apr-18	10.91	2.25	-3.44	-8.99	-21.32	50.97	0.00	1.77	9.28	n/a	180.88	15.92	
May-18	20.56	11.41	6.40	1.46	-10.30	61.61	67.60	1.75	11.42	n/a	186.76	21.96	
Jun-18	27.11	16.54	11.63	6.75	3.61	65.23	75.80	1.59	12.21	n/a	200.62	21.82	
Jul-18	27.68	20.26	14.32	8.36	3.78	59.75	19.70	1.66	10.06	n/a	212.37	28.97	
Aug-18	25.11	14.43	9.91	6.11	-0.43	79.09	110.60	1.47	17.10	n/a	132.47	12.32	
Sep-18	13.12	9.00	4.30	-0.37	-3.93	63.01	14.00	1.55	10.73	n/a	118.01	*6.56*	
Oct-18	10.16	2.57	-0.57	-3.65	-13.06	72.22	4.23	1.32	10.79	89.71	31.70	*4.56*	
Nov-18	2.31	-9.04	-11.41	-14.11	-25.19	89.76	0.00	0.56	10.49	90.09	3.34	*0.78*	
Dec-18	1.81	-10.91	-13.42	-16.22	-27.70	83.56	0.00	0.95	13.48	89.38	1.21	*2.63*	
Jan-19	-1.90	-15.40	-18.09	-20.82	-33.36	85.24	0.00	0.38	7.68	89.98	1.13	*0.40*	
Feb-19	-6.32	-16.42	-19.72	-22.27	-33.39	80.90	0.00	0.70	5.91	91.01	10.94	0.96	
Mar-19	12.89	1.69	-3.45	-7.58	-20.19	63.64	0.00	1.63	13.70	90.47	81.56	12.21	
Apr-19	9.18	4.20	-0.73	-5.51	-19.91	55.50	5.99	1.83	12.09	89.98	168.31	17.60	
May-19	25.43	14.51	9.42	4.00	-7.11	46.76	14.89	1.87	11.64	90.38	226.08	32.54	
Jun-19	25.09	18.50	13.19	7.57	3.39	52.95	29.48	1.90	11.74	90.55	244.49	35.61	
Jul-19	26.14	21.07	15.11	9.48	6.69	61.29	39.55	1.57	13.40	90.59	210.36	27.86	
Aug-19	21.95	14.62	9.20	4.19	-3.42	63.17	19.99	1.82	12.46	90.73	154.50	23.31	
Sep-19	23.52	11.86	6.61	2.48	-6.15	69.22	16.32	1.35	10.92	90.14	91.68	*37.1*	
Oct-19	9.26	-0.90	-3.96	-6.78	-15.44	88.66	0.80	0.95	7.76	90.06	25.51	*4.26*	
Nov-19	-0.82	-10.64	-13.43	-16.46	-26.14	87.87	0.10	0.80	11.13	90.05	5.24	*1.71*	

Date	Extreme Max. Temp. (ºC)	Average Max. Temp. (ºC)	Average Temp. (ºC)	Average Min. Temp. (ºC)	Extreme Min. Temp. (ºC)	Average Relative Humidity (%)	Total Precip. Tipping Bucket (mm)	Average Wind Speed[1] (m/s)	Extreme Max. Wind Speed[1] (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration[8] (mm)	Average Snow Depth[14] (m)
Dec-19	-1.43	-13.83	-17.20	-21.19	-32.37	85.42	0.00	0.76	10.79	89.08	0.70	*1.78*	
Jan-20	-0.70	-20.54	-23.42	-26.41	-36.14	78.70	0.10	0.64	4.52	89.57	2.56	*1.72*	
Feb-20	-0.39	-14.65	-18.31	-22.15	-37.03	80.67	3.00	1.04	8.85	89.66	16.12	*3.63*	
Mar-20	0.80	-9.68	-14.88	-19.56	-30.93	69.81	15.60	1.43	5.74	90.36	56.86	*7.57*	
Apr-20	10.70	2.20	-2.80	-7.69	-18.36	59.73	8.90	1.80	5.65	90.21	169.99	*22.06*	
May-20	20.29	12.98	7.48	1.97	-5.09	48.06	8.10	1.84	5.54	90.55	253.76	*48.75*	
Jun-20	22.57	15.51	10.68	6.28	2.57	69.21	44.00	1.44	4.48	90.11	185.80	*25.83*	
Jul-20	27.68	16.72	11.50	6.96	1.38	73.88	39.10	1.38	4.46	90.35	183.23	*23.8*	
Aug-20	26.13	15.59	10.94	7.06	3.58	75.83	53.70	1.24	4.11	90.06	131.31	*20.05*	
Sep-20	14.79	9.61	5.32	2.24	-1.95	78.21	45.80	1.25	6.29	90.31	82.70	*14.23*	
Oct-20	13.77	-4.06	-7.01	-9.65	-23.35	84.29	37.32	1.01	7.00	90.38	28.37	*7.51*	
Nov-20	-3.01	-14.17	-16.95	-19.50	-27.22	86.08	19.41	0.71	5.34	89.50	4.09	*1.51*	
Dec-20	5.31	-1.91	-5.52	-8.79	-17.47	85.44	12.69	2.10	9.78	88.73	1.82	*2.94*	
Jan-21	0.89	-9.93	-13.06	-16.39	-33.06	84.31	24.36	0.77	11.6	89.23	28.95	3.12	
Feb-21	-7.44	-18.53	-22.65	-25.93	-38.29	78.89	35.75	0.73	7.61	90.14	88.45	1.11	
Mar-21	0.8	-8.25	-14.22	-19.32	-26.87	72.32	0	1.47	9.06	89.63	592.98	6.34	
Apr-21	13.75	1.85	-4.96	-11.58	-27.79	52.27	0	2.01	14.11	90.52	1648.04	27.62	
May-21	14.9	10.66	5.61	1.04	-5.09	62.81	36.77	1.79	11.73	90.31	1638.02	30.33	
Jun-21	25.66	19.93	13.81	7.97	2.60	52.48	15.94	2.03	14.31	90.17	1850.27	56.6	
Jul-21	28.98	21.13	14.41	8.41	2.61	59.16	73.7	1.74	10.41	90.57	1757.92	45.98	
Aug-21	28.74	16.67	11.08	6.18	0.34	72.71	76.9	1.51	10.23	90.22	1195.82	23.56	
Sep-21	19.24	9.39	4.43	0.51	-7.94	79	15.2	1.39	9.3	89.5	703.12	12.59	
Oct-21	6.35	1.22	-1.81	-4.34	-11.41	83.89	0	1.05	11.65	87.11	252.03	3	
Nov-21	4.96	-2.33	-5.75	-9	-16.95	76.61	0	1.33	8.94	86.02	143.49	-	
Dec-21	-13.02	-20.19	-23.75	-27.14	-37.52	80.40	3.00	0.40	3.20	89.44	3.84	5.67	

Date	Extreme Max. Temp. (ºC)	Average Max. Temp. (ºC)	Average Temp. (ºC)	Average Min. Temp. (ºC)	Extreme Min. Temp. (ºC)	Average Relative Humidity (%)	Total Precip. Tipping Bucket (mm)	Average Wind Speed[1] (m/s)	Extreme Max. Wind Speed[1] (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration[8] (mm)	Average Snow Depth[14] (m)
Jan-22	-2.96	-16.25	-19.84	-23.10	-36.71	83.17	17.80	0.82	6.04	89.57	5.47	n/a	
Feb-22	-3.71	-14.63	-18.13	-22.70	-34.75	83.50	5.30	0.74	4.14	89.42	97.63	n/a	
Mar-22	2.44	-4.71	-9.99	-14.74	-29.17	74.96	11.10	1.42	5.35	89.94	602.95	n/a	
Apr-22	9.33	1.35	-3.99	-10.37	-25.08	53.92	3.90	1.76	5.91	90.36	1612.12	n/a	
May-22	15.41	8.59	4.51	-0.63	-2.75	61.49	14.60	2.05	5.98	90.07	1786.11	n/a	
Jun-22[11]	Station Down												
Jul-22[11]													
Aug-22[11]													
Sep-22[11]													
Oct-22	10.77	6.31	-5.81	-15.30	-18.30	89.98	n/a	n/a	n/a	88.20	n/a	n/a	
Nov-22[1,12]	3.58	-0.72	-14.20	-27.61	-32.18	87.24	0.00	0.83	2.85	90.81	n/a	n/a	
Dec-22	-2.18	-1.67	-21.60	-33.44	-38.22	85.01	0.00	0.10	2.39	90.66	n/a	n/a	
Jan-23[13]	*0.98*	*-6.93*	*-9.31*	*-13.30*	*-16.75*	*90.55*	*0.00*	*0.44*	*3.02*	*89.10*	*0.50*	*0.00*	
Feb-23[13]	*-4.19*	*-11.47*	*-17.36*	*-21.81*	*-30.86*	*84.96*	*0.00*	*0.72*	*4.01*	*90.05*	*13.44*	*0.05*	
Mar-23	7.60	-6.83	-12.95	-18.34	-30.35	69.53	3.30	1.39	5.63	90.51	100.33	0.58	
Apr-23	10.42	3.85	-2.82	-8.89	-17.76	67.48	14.70	1.84	7.04	89.89	149.42	1.47	
May-23	23.32	13.96	7.87	1.97	-5.26	61.50	20.40	1.75	7.79	90.55	204.36	3.36	
Jun-23	26.43	18.26	12.20	6.18	-0.86	59.85	25.10	1.82	8.52	90.57	213.95	4.04	
Jul-23	31.95	25.10	18.35	11.44	6.73	54.20	14.80	1.62	6.67	90.95	229.56	5.06	
Aug-23	27.29	21.20	14.57	9.14	4.52	67.03	35.40	1.48	7.16	90.80	158.15	2.91	
Sep-23	21.39	10.57	6.05	2.12	-5.49	80.06	20.10	1.36	6.60	90.00	71.46	1.09	
Oct-23	13.99	1.03	-3.12	-6.59	-19.40	87.37	31.70	1.21	5.61	90.71	30.18	0.22	
Nov-23	4.35	-6.91	-10.13	-13.69	-27.19	89.83	0.00	0.85	4.08	89.84	5.72	0.11	
Dec-23	3.56	-7.92	-12.21	-16.70	-25.76	88.51	0.00	0.93	4.37	89.13	0.73	0.00	
Jan-24	-	6.13	-23.36	-38.82	-	80.16	0.1	1.21	12.56	90.21	2.8	0.00	
Feb-24	-	-0.66	-17.58	-39.19	-	81.76	2.2	1.18	9.35	90.18	27.2	1.73	
Mar-24	-	8.77	-8.28	-32.34	-	69.92	5.7	1.07	11.52	90.07	85.9	6.07	

Date	Extreme Max. Temp. (ºC)	Average Max. Temp. (ºC)	Average Temp. (ºC)	Average Min. Temp. (ºC)	Extreme Min. Temp. (ºC)	Average Relative Humidity (%)	Total Precip. Tipping Bucket (mm)	Average Wind Speed[1] (m/s)	Extreme Max. Wind Speed[1] (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration[8] (mm)	Average Snow Depth[14] (m)
Apr-24	-	12.78	0.93	-14.67	-	52.38	0.0	1.41	10.05	90.41	186.2	20.63	
May-24	-	16.94	7.10	-0.74	-	58.99	18.4	1.27	11.35	90.27	201.2	22.1	
Jun-24	-	24.41	14.18	3.25	-	50.75	15.6	1.57	12.03	90.57	233.9	39.66	
Jul-24	-	26.98	14.41	6.60	-	66.69	27.7	1.66	12.79	90.66	178.2	29.45	
Aug-24	-	28.64	11.76	-0.11	-	68.54	34.5	1.71	15.07	90.71	153.1	28.32	
Sep-24	-	14.89	5.20	-3.50	-	84.95	24.0	1.25	10.54	90.10	75.1	6.61	
Oct-24	-	6.68	-5.11	-20.18	-	82.84	18.3	1.23	11.65	90.00	31.5	5.49	0.06
Nov-24	-	-1.49	-16.30	-33.19	-	88.86	9.8	0.67	7.62	90.20	1.9	0.76	0.26
Dec-24[15]	-	*3.52*	*-12.86*	*-31.64*	*-*	*91.62*	*11.70*	*0.80*	*10.15*	*90.01*	*1.3*	*0.38*	*0.32*

[1] Values in grey italics indicate a partial month.
[2] June 2011 has 29 days of complete data (station commissioned on June 2).
[3] 16 days of complete rain data.
[4] Rainfall recorded at temperatures below zero may be due to snowmelt.
[5] 25 days of complete RH data.
[6] 18 days of complete solar radiation data.
[7] 7 days of complete evapotranspiration data.
[8] Evapotranspiration is invalid where wind is invalid.
[9] Total precipitation likely underestimated due to partial freezing in snowfall conversion adaptor.
[10] Evapotranspiration invalid due to coding error.
[11] Station was disassembled for calibration, maintenance, and relocation, no data available.
[12] The station was re-installed in November 2022, therefore, no data from May-November was recorded. Some sensors (wind speed and direction) were re-installed incorrectly causing no data to be collected in November, these sensors were fixed during the December trip. Station missing data from November 23-24, 2022.
[13] The Station lost power between January 9 and February 9, 2023.
[14] Sensor installed September 25, 2024, no data prior.
[15] Data for this report ends December 15, 2024.

2.1.2 Calumet

This automated Onset HOBO meteorological station was installed on Galena Hill at 1380 masl in June 2007 (UTM coordinates: 08 V 480377 7087790). Table 2-3 provides a list of the station's components.

Table 2-3: Calumet HOBO Meteorological Station

COMPONENT	MODEL	SERIAL NUMBER
Datalogger	HOBO Weather Logger	1153440
Air Temperature & Relative Humidity Sensor	S-THB-XXXX	10064003
Soil Temperature Sensor	S-TMB-XXXX	985390
Pyranometer	S-LIB-XXXX	1048627
Rain Gauge	S-RGB-M002	1017667
Wind Speed & Direction Sensor	S-WCA-XXXX Installed April 19, 2019: S-WCF-M003	1254995 20584743
Barometric Pressure Sensor	S-BPA-XXXX	1037089
Solar Panel	SOLAR-6W Installed August 3, 2019: SOLAR-15W	

Monthly averages were calculated from 15-minute values recorded by the datalogger (averaged values from a 1-minute sampling interval). Average temperature and total rainfall are presented in Table 2-4 and Table 2-5, respectively below.

Table 2-4: Monthly Values for Average Temperature Collected at the Calumet Station (2007-2024)

Month	Average Temperature (°C)																	
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	-	-17.18	-18.84	-14.08	-16.78[3]	-18.71[4]	-16.9	[6]	-13.22	*-8.34*[8]	*-13.06*[9]	-13.8	[12]	[14]	[15]	*16.52*[16]	-9.53	-18.31
February	-	-16.99	-16.95	-9.09	-15.88[3]	-9.94[4]	-10.81	-15.69	-13.42	-9.32	[9]	-16.86	[12]	[14]	[15]	-15.23	-16.88	-14.99
March	-	-11.04	-16.39	-9.21	-12.92[3]	-12.92[4]	-14.45	-11.95	-10.69	-5.84	*-16.43*[9]	-11.99	[12]	*16.06*[14]	[15]	-10.68	-13.01	-9.10
April	-	-4.93	-4.75	-2.01	-3.77[3]	-1.88[4]	-12.32	-4.39	-3.33	-0.43	*-3.62*[10]	-6.33	*-4.21*[12]	-5.99	*-2.14*[15]	-7.27	-5.48	1.47
May	-	3.31	3.66	5.35	4.41[3]	1.61[4]	-	4.17	7.85	5.55	[10]	2.84	*-2.50*[13]	3.38	2.34	1.44	4.23	3.30
June	*11.25*[1]	8.7	9.58	8.68	8.82[3]	7.76[4]	11.59	*7.31*[7]	8.42	10.07	[10]	8.68	[13]	7.5	10.61	10.76	9.18	11.09
July	11.8	8.17	12.45	10.5	3.80[3]	7.84[4]	11.11	[7]	9.67	10.6	*11.81*[10]	11.93	[13]	8.59	11.73	11.06	16.49	11.04
August	9.63	5.54	7.47	9.61	[2]	8.34[5]	10.58	7.95	6.71	9.25	10.03	7.14	*6.02*[13]	8.19	8.22	8.80	11.54	8.66
September	1.12	2.27	3.58	2.4	[2]	3.39	3.33	1.86	*2.17*[8]	2.95	4.74	1.55	7.22	*5.51*[15]	1.38	3.61	2.61	*3.31*[17]
October	-6.53	-7.2	-4.73	-4.86	[2]	-8.16	-2.52	-5.02	[8]	-6.23	-4.94	-2.64	[14]	[15]	*-4.1*[16]	-1.21	-4.37	*5.13*[17]
November	-9.41	-10.17	-11.94	-11.19	-17.39[4]	-18.44	-15.5	-9.87	[8]	-8.87	-17.31	-9.29	[14]	[15]	[16]	- 12.63	-9.39	N/A
December	-16.19	-18.34	-11.16	-17.72	-11.78[4]	-18.83	-14.56[6]	-10.43	[8]	-15.27	-5.31[11]	-10.67[12]	[14]	[15]	[16]	-17.17	-10.37	N/A

Note. Values in grey italics indicate a partial month.

[1] Station commissioned June 15, 2007.

[2] Temperature probe malfunction – no proxy data available.

[3] Calculated from Mayo A data.

[4] Sensor occasionally offline but most data complete

[5] Sensor replaced August 7, 2012,

[6] The station was down from December 12, 2013, to January 31, 2014.

[7] Station was down between June 26 and July 31, 2014.

[8] Data missing from September 17, 2015, to January 5, 2016.

[9] Temperature data missing between January 14, 2017, and March 4, 2017.

[10] Data missing between April 7, 2017, and July 17, 2017.

[11] Last data download on December 15, 2017.

[12] Data missing between December 26, 2018, and April 19, 2019. Battery depletion and windspeed sensor failure.

[13] Data missing between May 8, 2019, and August 3, 2019. Solar panel issues.

[14] Data missing as battery depleted due to solar panels being covered by snow.

[15] Data missing due to a power issue September 4, 2020, to April 13, 2021.

[16] Station down between October 16, 2022, to January 26, 2022, due to a depleted battery.

[17] Station down due to the logger being pulled and sent for repair/replacement

Table 2-5: Monthly Values for Total Rainfall Collected at the Calumet Station (2007-2024)

Month	Total Rainfall (mm)																	
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	-	-	-	-	-	-	-	[7]	0	*0.01*[9]	*0.02*[11]	5.1	[13]	[15]	[16]	*0.0*[17]	0.0	2.2
February	-	-	-	-	1.8[4]	[5]	-	-	0.2	0.3	[11]	0.3	[13]	[15]	[16]	1.0	0.0	0.0
March	-	-	-	-	0.5[4]	[5]	0.6	-	2.8	2.8	*0.8*[11]	1.3	[13]	*0*[15]	[16]	2.2	1.0	1.6
April	-	1.0	-	1.3[4]	2.8[4]	[5]	0.2	6.2	8.6	7.8	*4.3*[12]	0.8	*1.0*[13]	5.8	*0*[16]	0.6	16.6	0.0
May	-	25.4	21.8	32.3[4]	15.5[4]	[5]	n/a	17.2	4.0	23.0	[12]	82.8	*0.5*[14]	23.8	54.26	12.4	46.4	36.4
June	*55.2*[1]	44.6	*11.9*[2]	56.7[4]	121.8[4]	[5]	45.2	*69.8*[8]	45.2	*43.0*[10]	[12]	116.3	[14]	135.5	19.43	28.4	50.6	29.0
July	108.8	108.4	*22.9*[3]	137.7[4]	135.9[4]	*27.8*[6]	39.2	[8]	135.5	[10]	*71.3*[12]	31.6	[14]	149.4	75.02	60.6	1.2	35.8
August	54.8	110.2	89.4	140.0[4]	[5]	45.0	35.6	112.0	97.0	[10]	44.5	164.3	*21.2*[14]	*31.3*[16]	120.73	54.4	59.8	55.4
September	57.6	61.4	50.4	78.0[4]	[5]	17.4	64.6	43.8	*46.4*[9]	[10]	115.2	15.9	41.5	[16]	27.31	50.8	30.0	*6.0*[18]
October	-	12.6	-	16.0[4]	[5]	1.6	14.6	15.2	[9]	*0.01*[10]	16.0	9.4	[15]	[16]	*1.01*[17]	33.2	42.2	N/A
November	-	-	-	-	-	0.2	-	0.2	[9]	0	0	3.3	[15]	[16]	[17]	0.0	0.0	N/A
December	-	-	-	-	-	-	*0.1*[7]	-	[9]	0	0	*0.5*[13]	[15]	[16]	[17]	0.0	0.0	N/A
Total	**276.4**	**363.6**	**196.4**	**462.21**	**305.5**	**137.01**	**200.1**	**211.6**	**375.7**	**115.9**	**299.1**	**431.4**	**216.2**	**489.7**	**297.76**	**243.6**	**247.8**	**166.4**

Note. Values in grey italics indicate a partial month.

[1] Station commissioned June 15, 2007.

[2] Rainfall gauge malfunction on June 11; total rainfall provided for June 1-11, 2009.

[3] Rainfall gauge back online; total rainfall provided for July 7-31, 2009.

[4] Calculated from MAYO A data.

[5] Tipping bucket malfunction – no proxy data available.

[6] Tipping bucket repaired July 4th; total rainfall provided for July 4-31, 2012.

[7] The station was down from December 12, 2013, to January 31, 2014.

[8] Station was down between June 26 and July 31, 2014.

[9] Data missing from September 17, 2015, to January 5, 2016.

[10] Rainfall data missing from June 23, 2016, to October 23, 2016.

[11] Rain data missing between January 26, 2017, and March 4, 2017.

[12] Data missing between April 7, 2017, and July 17, 2017.

[13] Meteorological Station sustained damage, no data available between December 12th, 2018, and April 19, 2019.

[14] Data missing between May 8, 2019, and August 3, 2019. Solar panel issues.

[15] Data missing between October 4, 2019, and March 21, 2020.

[16] Data missing due to a power issue August 14, 2020, to April 13, 2021.

[17] Station down between October 16, 2021, and January 26, 2022, due to a depleted battery.

[18] Station down due to the logger being pulled and sent for repair/replacement

2.1.3 Valley Tailings

In June 2024 the Valley Tailings Onset HOBO automated meteorological station was re-located due to ongoing reclamation efforts in the area where it was initially installed. The current location and elevation along with the former location (installed in 2012) are shown on Figure 2-1.

Table 2-6: Valley Tailings HOBO Meteorological Station

COMPONENT	MODEL	SERIAL NUMBER
Datalogger	U30 NRC	10231016
Solar Panel	SOLAR-6W Installed August 3, 2019: SOLAR-15W	
HOBOware	Pro	2580 2976 6309 4793
Air Temperature & Relative Humidity Sensor	THB-M002	10220040
Pyranometer	LIB-M003	10191222
Rain Gauge	RGB-M002	10222664
Wind Speed & Direction Sensor	WSET-A	10233230
Barometric Pressure Sensor	S-BPA	10212093
Soil Moisture Sensor	SMC-M005	10225679
Soil Temperature Sensor	n/a	10225679

Monthly averages from October 2012 to December 2024 are also shown in Table 2-7 below. The averages were calculated from instantaneous 15-minute values recorded by the datalogger for the following parameters: temperature, daily maximum temperature, daily minimum temperature, relative humidity, wind speed, gust speed, barometric pressure, and solar radiation. Monthly extreme maximum temperature, extreme minimum temperature, maximum and minimum relative humidity, maximum gust speed and total rainfall are also shown in Table 2-7. The barometric pressure has not been corrected for elevation and therefore represents the absolute pressure.

Table 2-7: Monthly Values for Meteorological Parameters Collected at Valley Tailings Station

Date	Extreme Minimum Temp. (ºC)	Average Minimum Temp. (ºC)	Average Temp. (ºC)	Average Maximum Temp. (ºC)	Extreme Maximum Temp. (ºC)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain[2,3] (mm)	Average Wind Speed (m/s)	Average Maximum Wind Speed (m/s)	Extreme Maximum Wind Speed (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content[4] (%)
Oct-12[1]	*-23.84*	*-20.12*	*-15.71*	*-9.71*	*-4.05*	*81.92*	*89.16*	*70.76*	n/a	*0.51*	*1.39*	*7.81*	*93.9*	*34.14*	n/a
Nov-12	-40.71	-27.24	-23.77	-20.42	-8.07	82.04	90.97	69.24	n/a	0.59	1.66	7.81	93.22	7.72	n/a
Dec-12	-44.2	-29.97	-26.29	-22.98	-3.99	82.75	97.2	71.67	n/a	0.52	1.75	6.04	92.61	1.48	n/a
Jan-13	-45.56	-25.98	-21.58	-17.72	0.74	84.73	94.43	72.6	n/a	0.94	2.1	14.61	92.96	4.78	n/a
Feb-13	-24.88	-16.72	-12.96	-8.8	2.4	90.08	96.67	81.42	n/a	0.9	2.09	10.83	91.99	23.7	n/a
Mar-13	-33.45	-21.4	-13.93	-5.74	5.57	68.05	92.35	53.08	n/a	0.84	2	13.85	93.18	93.31	n/a
Apr-13	-25.05	-14.66	-7.17	-0.87	8.37	53.23	81.57	39.58	n/a	2.01	4.1	16.62	93.01	171.18	n/a
May-13	-8.36	0.1	6.08	11.66	23.35	62.9	95	40.13	*4.8*	1.42	3.26	11.84	92.88	186.87	12.3
Jun-13	1.64	8.2	15.63	22	32.82	58.66	84.24	42.04	46.2	1.5	3.45	22.66	93.08	215.51	8
Jul-13	1.59	8.95	15.68	21.9	29.32	60.65	87.5	38.38	25.4	1.39	3.22	16.12	93.17	194.18	6.9
Aug-13	-1.9	6.94	13.85	20.49	29.49	68.65	95.18	44.98	43	0.93	2.45	13.6	92.69	144.34	9.6
Sep-13	-2.45	2	6.39	10.85	18.06	80.7	98.19	60.89	64.8	1.19	2.83	17.38	92.14	71.21	14.4
Oct-13	-11.22	-5.32	-1.54	2.56	9.11	91.89	99.04	68.02	49.4	0.61	1.86	11.58	92.72	32.16	12.2
Nov-13	-42.69	-22.4	-18.25	-14.23	-0.59	88.31	99.71	75.5	0	0.55	1.71	11.58	93.12	8.07	n/a
Dec-13	-40.38	-30.71	-27.25	-23.5	-2.48	83.73	95.83	72.42	0	0.49	1.72	9.07	93.68	1.69	n/a
Jan-14	-37.92	-18.28	-14.5	-10.52	1.67	93.54	99.99	81.1	0	0.17	1.96	6.3	92.62	2.73	n/a
Feb-14	-39.42	-27.88	-22.85	-14.48	-3.33	84.27	91.09	77.57	0	0.34	1.43	8.31	93.37	27.52	n/a
Mar-14	-30.55	-20.48	-12.32	-3.5	5.85	63.32	80.35	46.47	7	0.75	2.17	9.57	92.85	103.16	n/a
Apr-14	-20.69	-6.99	-0.45	6.19	11.52	59.76	87.11	43.1	5	1.34	3.2	13.09	92.37	152.86	n/a
May-14	-3.24	1.34	8.66	14.54	21.94	53.49	74.94	35.74	11.4	1.39	3.41	13.35	93.1	201.57	17.3
Jun-14	-0.85	6.35	12.79	18.09	28.17	56.74	87.94	38.68	56.8	1.39	3.45	15.61	92.66	206.09	14
Jul-14[5]	*6.86*	*9.96*	*16.01*	*21.5*	*24.85*	*64.71*	*82.34*	*48.07*	*32.2*	*1.3*	*3.24*	*13.35*	*93*	*193.02*	*14*
Aug-14[5]	Station Down – No Data														
Sep-14[5]															
Oct-14[5]	*-17.47*	*-12.34*	*-7.87*	*-4.47*	*-1.47*	*93.68*	*95.52*	*90.51*	*0*	*0.69*	*1.93*	*7.05*	*92.34*	*16.88*	n/a

Date	Extreme Minimum Temp. (ºC)	Average Minimum Temp. (ºC)	Average Temp. (ºC)	Average Maximum Temp. (ºC)	Extreme Maximum Temp. (ºC)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain[2,3] (mm)	Average Wind Speed (m/s)	Average Maximum Wind Speed (m/s)	Extreme Maximum Wind Speed (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content[4] (%)
Nov-14	-35.71	-18.96	-15.69	-12.75	-2.25	89.63	99.47	80.36	0	0.75	2.09	8.06	93.25	8.54	n/a
Dec-14	-29.59	-18.7	-15.22	-12.12	-1.73	92.55	98.58	85.41	0	0.59	1.93	10.32	92.47	1.53	n/a
Jan-15	-41.27	-22.34	-19.15	-15.78	-0.14	90.13	99.54	78.03	0	0.32	1.68	9.07	93.24	2.93	n/a
Feb-15	-41.5	-21.41	-17.51	-12.68	3.85	89.56	99.96	78.51	13.6	0.46	1.8	12.34	93.59	22.75	n/a
Mar-15	-31.12	-16.89	-10.2	-3.39	6.84	75.01	91.08	58.48	3.2	1	2.33	13.35	92.71	84.81	n/a
Apr-15	-11.15	-4.79	1.23	7.51	12.53	64.06	88.56	50.4	13.8	1.45	3.36	12.84	92.18	153.92	n/a
May-15	-6.99	3.25	11.76	18.45	27.55	48.65	67.29	33.82	6	1.43	3.41	17.12	93.28	235.7	21.4
Jun-15	1.24	5.77	12.99	19	25.82	59.92	81.85	34.81	27.2	1.48	3.49	16.62	92.96	213.66	13.1
Jul-15	4.14	7.64	13.9	19.65	27.16	69.15	93.72	43.99	82.6	1.05	2.63	10.83	92.77	180.54	17.2
Aug-15	-2.57	4.53	10.52	15.76	25.84	76.2	95.53	54.67	69.2	1.01	2.48	10.83	92.7	138.77	20.2
Sep-15	-8.1	-0.86	3.67	8.66	16.03	81.3	93.24	61.31	42.6	1.29	2.97	21.4	92.34	80.01	20.7
Oct-15	-12.79	-4.25	-1.37	1.63	7.7	91.95	99.99	65.89	14	0.75	2.01	8.56	92.48	33.28	8.6
Nov-15	-36.15	-18.71	-14.44	-10.89	2.64	92.87	99.34	82.48	0	0.4	1.71	7.05	92.19	6.59	n/a
Dec-15	-33.38	-18.58	-15.58	-12.85	3.01	92.73	97.5	83.71	0	0.46	2.12	11.84	91.92	1.26	n/a
Jan-16	-26.91	-16.61	-13.08	-10.02	4.17	91.42	98.22	78.66	0	0.69	2.08	17.38	92.23	4.92	n/a
Feb-16	-34.26	-17.54	-12.62	-7.02	2.96	89.23	97.6	79.77	2	0.49	1.71	9.82	92.45	26.62	n/a
Mar-16	-15.91	-9.95	-4.83	0.67	13.83	76.08	94.59	62.59	4.8	1.34	2.86	9.82	92.29	80.42	n/a
Apr-16	-10.97	-2.76	2.77	8.43	15.25	65.43	92	46.16	3.2	1.53	3.4	14.1	92.58	151.79	6.8
May-16	-2.1	2.56	9.64	15.44	23.88	56.1	83.81	36.95	16.4	1.66	3.66	15.11	93.1	205.21	25.5
Jun-16	3.01	7.16	14.43	20.48	27.53	55.89	88.06	36.6	40.4	1.63	3.64	15.11	92.8	233.69	21.6
Jul-16	0.63	9.33	14.84	20.11	26.92	73.54	93.34	54.86	67.2	1.08	2.67	11.84	92.94	173.57	23.9
Aug-16	-1.47	7.05	12.77	18.13	24.8	73.62	94.25	58.18	45.8	1.15	2.75	15.11	93.26	146.43	23.6
Sep-16	-6.14	0.03	5.67	11.48	18.11	73.7	94.96	34.79	39.4	0.96	2.56	14.86	92.74	98.46	23.4
Oct-16	-22.37	-11.82	-7.27	-1.85	5	84.13	97.87	63.33	0.6	0.57	1.77	9.32	92.97	47	5.2
Nov-16	-32.83	-17.19	-13.41	-9.77	5.62	90.97	99.91	74.28	6.8	0.49	1.84	10.83	91.99	6.43	1
Dec-16	-39.74	-25.23	-21.84	-18.83	-3.42	87.07	96.7	76.06	0	0.43	1.68	6.55	93.13	1.78	0.2

Date	Extreme Minimum Temp. (ºC)	Average Minimum Temp. (ºC)	Average Temp. (ºC)	Average Maximum Temp. (ºC)	Extreme Maximum Temp. (ºC)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain[2,3] (mm)	Average Wind Speed (m/s)	Average Maximum Wind Speed (m/s)	Extreme Maximum Wind Speed (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content[4] (%)
Jan-17	-39.63	-23.21	-18.99	-15.19	2.5	88.2	98.17	78.4	0	0.49	1.89	10.32	92.77	3.89	0.8
Feb-17	-29.66	-22.73	-17.66	-11.55	7.82	82.12	91.64	60.38	10.8	0.71	1.99	12.34	92.71	32.39	0.8
Mar-17	-36.15	-22.13	-16.15	-8.77	7.92	67.82	91.29	50.83	0.4	1.28	2.73	10.07	92.93	96.16	0.7
Apr-17	-16.87	-7.31	-0.65	5.49	12.61	59.67	90.36	41.47	1.8	1.7	3.5	13.85	92.78	168.37	7.5
May-17	-2.68	2.29	8.72	13.8	20.41	57.98	79.38	32.28	21.8	1.67	3.88	12.34	92.66	196.72	20.4
Jun-17	-0.7	6.84	13.8	19.6	27.46	55.91	89.64	34.15	33.2	1.5	3.48	14.1	92.68	216.92	10.6
Jul-17	5.59	9.64	16.44	22.52	30.12	64.72	91.24	37.41	58.8	1.2	2.84	15.61	92.95	207.55	12.7
Aug-17	0.58	7.36	13.81	19.9	29.32	67.3	87.41	49.47	23.2	1.14	2.86	13.09	92.63	153.3	13.4
Sep-17	-2.83	2.39	7.32	12.48	20.17	82.07	96.67	61.41	73.6	0.73	2.09	11.08	92.63	78.23	18.5
Oct-17	-16.28	-7.33	-3.35	0.57	10.12	90.46	99.4	76.38	17	0.49	2.02	11.58	92.5	30.46	5
Nov-17	-39.85	-25.71	-22.67	-19.4	-6.26	87.45	94.86	78	0	0.14	2.43	4.78	93.1	7.36	n/a
Dec-17	-38.41	-19.18	-15.91	-12.92	5	90.91	99.85	78.97	28.6	0.6	2.4	11.58	93.29	1.27	n/a
Jan-18	-40.27	-23.62	-19.76	-16.06	9.015	87.65	98.91	66.34	22.4	0.1	0.37	14.86	92.9	3.94	-0.06
Feb-18	-38.21	-27.19	-23.1	-16.9	-5.48	83.22	91.95	69.66	0	0.24	0.69	9.82	93.69	23.91	-0.06
Mar-18[6]	*-33.3*	*-18.23*	*-11.63*	*-3.79*	*17.06*	*79.08*	*88.52*	*59.93*	*6.2*	*0.49*	*1.54*	*12.09*	*93.12*	*77.13*	*-0.04*
Apr-18[6]	Station Down – No Data														
May-18[6]															
Jun-18[6]															
Jul-18[6]															
Aug-18[6]	*-1.33*	*5.08*	*10.06*	*12.9*	*21.1*	*77.11*	*93.85*	*61.77*	*25.2*	*1.48*	*3.28*	*12.34*	*92.82*	*126.5*	*0.21*
Sep-18[7]	*-4.71*	*-0.01*	*5.76*	*11.93*	*14.91*	*73.75*	*89.08*	*64.18*	*6.4*	*0.088*	*2.23*	*9.07*	*93.4*	*122.4*	*0.2*
Oct-18[7]	*-15.87*	*-6.28*	*-2.09*	*2.61*	*9.63*	*86.94*	*98.84*	*56.67*	*9.4*	*0.53*	*1.68*	*13.09*	*92.5*	*31.57*	*-0.02*
Nov-18	-32.29	-15.51	-12.42	-9.16	1.56	91.81	99.7	83.05	0.2	0.32	0.95	8.06	92.74	9.53	-0.003
Dec-18	-30.69	-19.42	-15.31	-11.67	3.99	89.00	96.19	66.25	5.80	0.26	0.79	13.85	92.12	1.89	-0.01
Jan-19	-39.32	-24.69	-20.79	-17.04	-2.89	88.50	97.19	77.47	0.00	0.00	0.02	4.53	92.87	2.79	-0.01
Feb-19	-40.49	-26.88	-22.49	-15.47	-3.48	85.07	91.46	78.07	0.00	0.04	0.35	5.04	93.96	30.10	-0.01

Date	Extreme Minimum Temp. (ºC)	Average Minimum Temp. (ºC)	Average Temp. (ºC)	Average Maximum Temp. (ºC)	Extreme Maximum Temp. (ºC)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain[2,3] (mm)	Average Wind Speed (m/s)	Average Maximum Wind Speed (m/s)	Extreme Maximum Wind Speed (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content[4] (%)
Mar-19	-26.67	-10.74	-4.37	2.81	12.85	71.05	94.67	49.27	10.40	0.96	2.38	13.60	93.09	87.29	0.04
Apr-19[8]	*-18.83*	*-5.70*	*-0.38*	*4.79*	*10.76*	*61.28*	*81.21*	*42.47*	*2.60*	*1.51*	*3.33*	*13.09*	*92.14*	*140.93*	*0.04*
May-19[8]	Station Down – No Data														
Jun-19[8]															
Jul-19[8]															
Aug-19[8]	*-4.20*	*3.38*	*10.03*	*16.39*	*21.60*	*62.48*	*85.84*	*51.03*	*10.20*	*1.42*	*3.19*	*11.08*	*93.22*	*155.57*	*0.10*
Sep-19	-7.90	0.80	6.78	13.11	22.97	75.23	96.72	51.50	34.60	0.67	1.87	15.86	92.64	89.10	0.10
Oct-19	-17.51	-7.39	-3.75	0.16	10.57	91.88	100.00	65.75	11.60	0.36	1.08	10.32	92.69	32.02	0.03
Nov-19	-32.29	-18.28	-14.68	-11.26	2.74	91.91	99.93	78.03	2.80	0.44	0.94	14.10	92.82	5.61	0.03
Dec-19	-39.32	-23.64	-19.26	-2.98	-2.77	90.26	98.84	79.63	0.00	0.08	0.36	18.63	91.93	1.69	0.03
Jan-20	-44.07	-31.50	-27.92	-24.72	-4.38	84.53	100.00	74.10	0.00	0.12	0.55	8.31	92.90	4.35	0.00
Feb-20	-40.82	-24.78	-19.79	-14.93	2.32	86.41	98.00	51.50	0.20	0.39	1.81	11.58	92.56	24.37	*0.00*[9]
Mar-20	-36.33	-21.52	-14.92	-7.97	2.72	73.43	98.00	26.00	5.20	0.87	2.69	6.80	93.17	85.52	
Apr-20	-23.73	-8.40	-1.95	5.05	15.32	61.74	99.20	26.10	3.40	1.19	3.38	5.79	92.81	166.02	
May-20	-4.02	1.49	8.34	14.17	20.79	51.38	100.00	20.80	11.40	1.88	5.17	8.81	93.06	239.54	
Jun-20[10]	*1.75*	*6.82*	*12.77*	*16.55*	*23.06*	*71.66*	*100.00*	*21.50*	*74.20*	*1.35*	*5.18*	*8.56*	*92.50*	*169.35*	
Jul-20[10]	Station Down – No Data														
Aug-20[10]	*4.74*	*7.52*	*11.70*	*16.87*	*21.56*	*80.17*	*100.00*	*31.50*	*47.60*	*0.67*	*3.43*	*7.55*	*92.60*	*116.56*	
Sep-20	-3.21	1.56	5.86	11.31	16.68	82.48	100.00	33.30	30.40	0.64	3.33	6.55	92.83	83.90	
Oct-20[11]	*-4.05*	*0.27*	*3.33*	*5.49*	*14.79*	*87.36*	*100.00*	*47.10*	*18.20*	*0.44*	*2.25*	*5.29*	*92.21*	*42.35*	
Nov-20[11]	Station Down – No Data														
Dec-20[11]															
Jan-21[11]	*-38.02*	*-21.29*	*-17.93*	*-14.02*	*-0.34*	*89.55*	*100.00*	*71.90*	*0.00*	*0.08*	*4.16*	*4.53*	*9.28*	*5.56*	*-0.01*
Feb-21	-41.73	-29.43	-25.12	-19.45	-7.71	83.85	95.20	33.00	0.00	0.18	2.14	4.28	9.32	12.87	-0.01
Mar-21	-30.97	-20.78	-14.09	-6.54	1.48	74.87	97.40	16.40	2.84	0.69	2.66	4.53	9.23	90.93	-0.01
Apr-21	-31.85	-12.57	-3.93	4.14	16.13	54.22	98.80	27.00	1.39	1.17	3.80	6.80	9.32	190.54	0.01

Date	Extreme Minimum Temp. (ºC)	Average Minimum Temp. (ºC)	Average Temp. (ºC)	Average Maximum Temp. (ºC)	Extreme Maximum Temp. (ºC)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain[2,3] (mm)	Average Wind Speed (m/s)	Average Maximum Wind Speed (m/s)	Extreme Maximum Wind Speed (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content[4] (%)
May-21	-6.04	-1.03	5.65	12.04	15.41	56.23	97.90	14.60	0.20	1.46	4.03	5.29	9.29	196.30	0.13
Jun-21	5.41	10.49	17.33	23.21	28.22	50.60	95.50	18.20	4.40	1.74	6.12	25.18	92.87	246.77	0.16
Jul-21	0.61	8.49	15.87	22.16	30.12	60.41	100.00	20.10	40.00	1.21	4.16	6.30	93.04	213.19	0.17
Aug-21	0.52	6.17	11.86	17.53	31.31	76.04	100.00	31.60	83.00	0.81	3.55	6.30	92.67	134.98	0.19
Sep-21	*-1.21*	*3.56*	*9.74*	*16.17*	*19.82*	*78.88*	*100.00*	*0.00*	*6.00*	*0.62*	*3.14*	*4.78*	*92.47*	*106.80*	*0.18*
Oct-21	Station Down – No Data														
Nov-21															
Dec-21															
Jan-22	*-34.76*	*-26.00*	*-23.21*	*-19.21*	*-15.75*	*83.03*	*91.20*	*71.80*	*0.00*	*6.55*	*3.28*	*18.14*	*93.06*	*14.31*	*-0.01*
Feb-22	-38.51	-24.55	-19.53	-14.54	-2.33	86.10	98.20	51.40	0.60	1.80	2.25	29.92	93.01	25.00	-0.01
Mar-22	-34.10	-15.81	-10.00	-4.06	6.43	76.96	98.70	33.40	3.20	3.57	2.84	19.94	92.64	88.63	-0.01
Apr-22	-27.83	-11.37	-3.72	3.08	10.69	56.11	96.80	23.60	2.00	4.42	3.79	23.58	92.99	183.46	0.00
May-22[12]	*-4.14*	*-0.45*	*4.41*	*8.72*	*10.64*	*63.87*	*100.00*	*31.30*	*6.20*	*5.48*	*4.97*	*29.02*	*92.14*	*203.93*	*0.14*
Jun-22[12]	*4.82*	*7.69*	*14.87*	*20.70*	*27.80*	*59.68*	*98.80*	*15.00*	*25.80*	*1.12*	*4.29*	*9.32*	*106.80*	*229.45*	*0.18*
Jul-22	1.51	8.63	14.68	20.22	29.29	68.85	100.00	23.10	56.60	1.06	4.44	8.31	106.50	167.36	0.79
Aug-22	0.16	7.05	12.56	18.19	25.79	75.13	100.00	29.90	52.60	1.25	4.52	8.31	106.75	144.47	0.74
Sep-22	-4.56	1.29	6.41	12.04	18.49	80.32	100.00	32.80	56.00	0.87	3.80	9.07	106.94	82.82	0.85
Oct-22	-19.01	-6.92	-3.10	0.37	14.17	93.96	100.00	34.40	51.00	0.62	2.55	10.32	106.94	30.79	0.91
Nov-22	-37.06	-18.68	-14.51	-10.51	5.67	91.63	100.00	66.70	0.60	0.13	0.97	4.03	106.94	6.76	0.63
Dec-22	-45.14	-26.94	-23.48	-19.64	-1.50	87.53	100.00	73.70	0.00	0.03	1.97	2.27	106.94	1.23	0.61
Jan-23[13]	*-28.73*	*-15.02*	*-11.34*	*-7.65*	*6.94*	*93.79*	*99.90*	*68.30*	*0.00*	*0.16*	*2.97*	*5.54*	*-*	*3.91*	*0.60*
Feb-23	-34.10	-24.81	-19.92	-14.55	-6.80	89.60	98.80	65.20	0.00	0.05	3.97	4.78	-	26.05	0.60
Mar-23	-31.33	-18.28	-11.27	-4.01	9.95	75.42	99.90	38.20	10.80	0.69	4.97	4.78	-	87.53	0.60
Apr-23	-19.42	-6.17	-0.35	4.88	9.93	69.86	99.90	33.20	12.40	1.56	5.97	7.05	-	144.59	0.61
May-23	-3.60	2.78	9.35	14.95	22.59	62.62	99.90	14.40	47.00	1.43	6.97	9.32	91.73	196.46	1.02
Jun-23	1.10	7.35	13.68	18.96	25.74	62.67	98.90	23.10	32.00	1.54	7.97	8.81	91.73	212.77	0.81

Date	Extreme Minimum Temp. (ºC)	Average Minimum Temp. (ºC)	Average Temp. (ºC)	Average Maximum Temp. (ºC)	Extreme Maximum Temp. (ºC)	Average Relative Humidity (%)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Total Rain[2,3] (mm)	Average Wind Speed (m/s)	Average Maximum Wind Speed (m/s)	Extreme Maximum Wind Speed (m/s)	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content[4] (%)
Jul-23	8.00	11.15	19.18	25.91	31.69	56.32	98.90	15.10	6.80	1.11	8.97	7.30	87.42	226.26	0.60
Aug-23[14]	*3.30*	*8.36*	*14.67*	*21.21*	*27.46*	*71.31*	*99.90*	*25.70*	*43.60*	*0.93*	*9.97*	*9.07*	*88.80*	*156.75*	*0.76*
Sep-23[14]	*-5.82*	*0.93*	*4.55*	*9.10*	*17.63*	*84.41*	*99.90*	*39.40*	*27.20*	*0.71*	*10.97*	*5.79*	*92.35*	*61.00*	*0.45*
Oct-23[15]	*-20.21*	*-6.27*	*-2.42*	*1.12*	*14.34*	*84.68*	*99.90*	*49.40*	*60.80*	*0.38*	*11.97*	*8.56*	*92.58*	*33.64*	*0.49*
Nov-23[15]	*-30.06*	*-18.43*	*-14.26*	*-10.27*	*-2.83*	*92.51*	*100.00*	*81.70*	*0.00*	*0.17*	*12.97*	*5.29*	*93.15*	*3.34*	*0.29*
Dec-23	-30.83	-18.24	-13.37	-8.73	5.08	89.17	100.00	36.90	6.40	0.59	13.97	9.82	24.46	1.60	0.29
Jan-24	-44.47	-25.91	7.97	82.31	100.00	40.30	15.80	0.27	15.80	932.97	3.45	29.38	-44.47	-25.91	7.97
Feb-24	-42.32	-19.56	-2.77	86.16	99.40	51.60	0.20	0.26	0.20	929.92	27.66	30.18	-42.32	-19.56	-2.77
Mar-24	-35.71	-9.06	9.31	73.76	98.90	30.30	0.80	0.87	0.80	926.06	89.49	30.38	-35.71	-9.06	9.31
Apr-24	-14.83	1.31	14.82	55.11	100.00	17.10	1.40	1.16	1.40	927.54	181.02	42.89	-14.83	1.31	14.82
May-24[16]	-2.07	7.84	17.37	61.23	99.00	22.70	44.00	1.55	44.00	*924.33*	194.68	55.40	-2.07	7.84	17.37
Jun-24[16]	2.56	14.94	26.67	53.78	98.20	16.30	36.00	1.39	36.00	-	232.38	38.69	2.56	14.94	26.67
Jul-24[16]	6.54	15.53	28.82	67.14	100.00	27.00	48.40	1.19	48.40	*928.60*	172.44	18.23	6.54	15.53	28.82
Aug-24	0.36	12.75	28.67	69.02	100.00	21.80	45.60	0.91	45.60	931.01	146.35	26.74	0.36	12.75	28.67
Sep-24	-5.51	5.98	15.84	86.24	100.00	40.10	43.60	0.51	43.60	925.42	73.55	50.35	-5.51	5.98	15.84
Oct-24	-24.11	-4.80	7.54	86.88	100.00	43.20	4.40	0.43	4.40	926.25	32.75	41.50	-24.11	-4.80	7.54
Nov-24[17]	*-11.87*	*-5.04*	*-1.24*	*98.33*	*100.00*	*93.00*	*0.00*	*0.11*	*0.00*	*919.75*	*8.53*	*35.86*	*-11.87*	*-5.04*	*-1.24*
Dec-24[17]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. Values in grey italics indicate a partial month.

[1] Station was commissioned on October 19, so October 2012 has 12 days of complete data.

[2] May 2013 has 14 days of compete rain data.

[3] Tipping bucket valid for summer months only, no snowfall adapter.

[4] Negative values reported from Oct 2012 to April 2013, from Nov 2013 to Apr 2014, from Oct 2014 to Apr 2015 and from Nov 2015 to March 2016 were invalidated – soil assumed to be frozen.

[5] Station was down between July 16 and October 26, 2014.

[6] Station was down between March 13 and August 15, 2018.

[7] Station down between September 10 and October 9, 2018.

[8] Station was down between April 20 and August 3, 2019.

[9] Soil moisture logger down as of February 19, 2020.

[10] Station down between June 25 to August 11, 2020

[11] Battery and Datalogger removed in October, station stopped recording on October 12, 2020

[12] Battery was depleted May 13 to June 9, 2022.

[13] Station was down from January 17 to 20, 2023.

[14] Station was down from August 19 to September 9, 2023.

[15] Station was down from October 26 to November 18, 2023.

[16] Barometric pressure down between May 11 and July 10, 2024.

[17] Unable to connect to the station in January, no data past November 6, 2024, available yet.

2.1.4 Snow Surveys

2.1.4.1 Yukon Government Stations

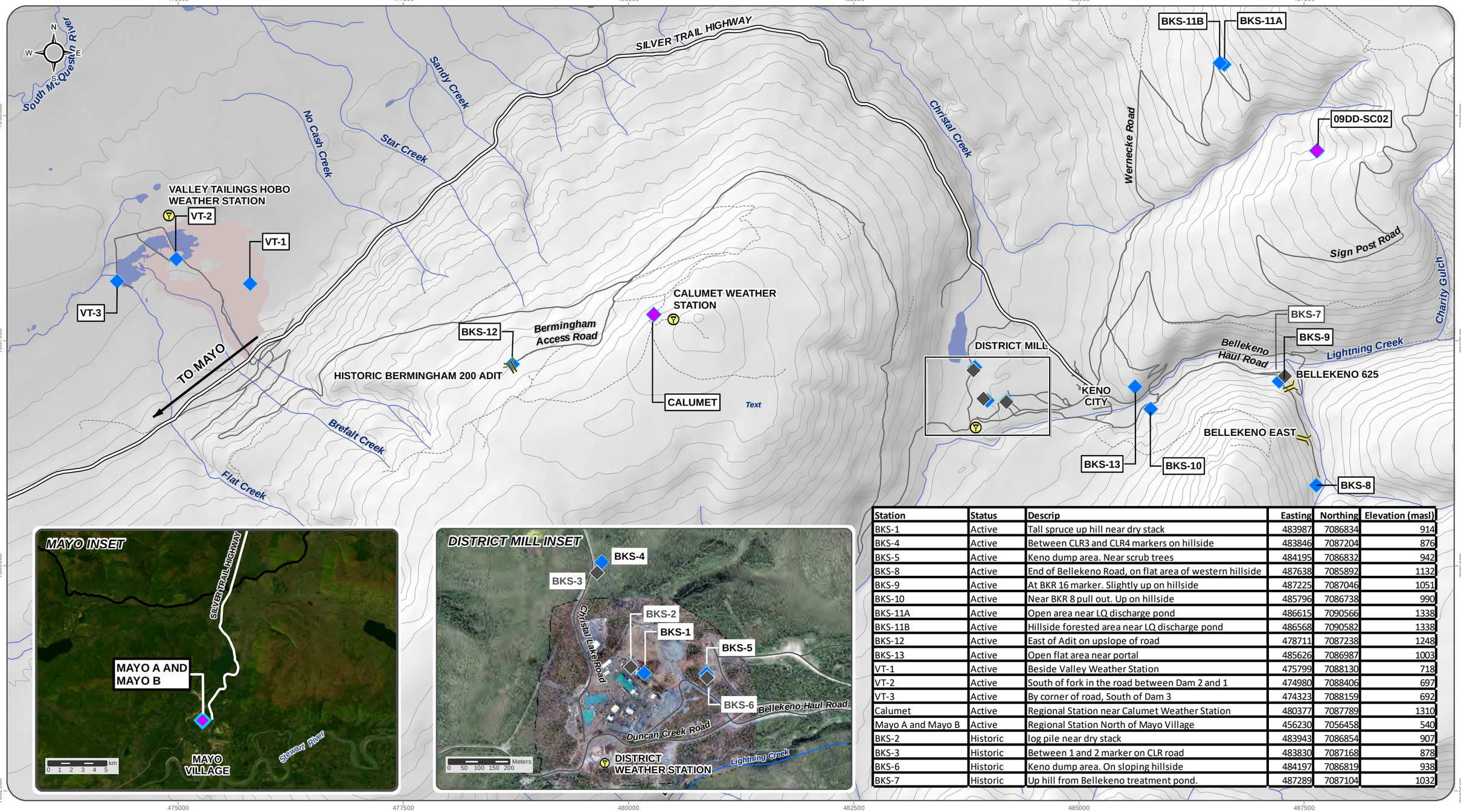
There are three regional snow survey sites that are monitored by the Yukon Government: Mayo Airport A, Mayo Airport B, and Calumet. Mayo Airport A and B are in the Village of Mayo and Calumet is on Galena Hill, near the Project's Calumet Meteorological station. The March and April monthly snow water equivalent (SWE) statistics for the three regional sites are shown in Table 2-8. The locations of the regional snow survey stations are shown on Figure 2-2.

Table 2-8: Regional Snow Survey Station Values

Station	Elevation (masl)	Period	Month	Min (mm)	Max (mm)	Average (mm)
Mayo A	540	1968-2024	March	30	172	91
		n = 56	April	10	180	99
Mayo B	540	1987-2024	March	52	176	94
		n = 37	April	48	192	105
Calumet	1310	1975-2024	March	94	298	174
		n = 49	April	95	305	196

2.1.4.2 Site Stations

Manual snow surveys have been conducted in the KHSD since 2011 to represent the varying snow conditions as a function of aspect and elevation. The locations of the Hecla Yukon snow survey stations are also shown on Figure 2-2 and a description of each station is provided in Table 2-9. The annual snow water equivalent (SWE) results for each of the 16 KHSD snow survey stations are presented in Table 2-10.



Station	Status	Descrip	Easting	Northing	Elevation (masl)
BKS-1	Active	Tall spruce up hill near dry stack	483987	7086834	914
BKS-4	Active	Between CLR3 and CLR4 markers on hillside	483846	7087204	876
BKS-5	Active	Keno dump area. Near scrub trees	484195	7086832	942
BKS-8	Active	End of Bellekeno Road, on flat area of western hillside	487638	7085892	1132
BKS-9	Active	At BKR 16 marker. Slightly up on hillside	487225	7087046	1051
BKS-10	Active	Near BKR 8 pull out. Up on hillside	485796	7086738	990
BKS-11A	Active	Open area near LQ discharge pond	486615	7090566	1338
BKS-11B	Active	Hillside forested area near LQ discharge pond	486568	7090582	1338
BKS-12	Active	East of Adit on upslope of road	478711	7087238	1248
BKS-13	Active	Open flat area near portal	485626	7086987	1003
VT-1	Active	Beside Valley Weather Station	475799	7088130	718
VT-2	Active	South of fork in the road between Dam 2 and 1	474980	7088406	697
VT-3	Active	By corner of road, South of Dam 3	474323	7088159	692
Calumet	Active	Regional Station near Calumet Weather Station	480377	7087789	1310
Mayo A and Mayo B	Active	Regional Station North of Mayo Village	456230	7056458	540
BKS-2	Historic	log pile near dry stack	483943	7086854	907
BKS-3	Historic	Between 1 and 2 marker on CLR road	483830	7087168	878
BKS-6	Historic	Keno dump area. On sloping hillside	484197	7086819	938
BKS-7	Historic	Up hill from Bellekeno treatment pond.	487289	7087104	1032

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Datum: NAD 83; Map Projection: UTM Zone 8N

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1:40,000 (when printed on 11 x17 inch paper)

Meters
0 500 1,000 1,500 2,000

- Hecla Snow Monitoring Station, Active
- Hecla Snow Monitoring Station, Historic
- Regional Snow Monitoring Stations
- Audit
- AKHM District Mill
- Tailings Area
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Contours (100 ft)

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 2-2

SNOW SURVEY STATIONS

JANUARY 2025

D:\Projects\AllProjects\ALEX-05-01\gis\mxd\Overview_Maps\Specific Topics\Monitoring\Snow Monitoring\SnowMonitoring_Weather_Stations_20250120.mxd
(Last edited by: amalia.shevska, 2025-01-20 10:22 AM)

Table 2-9: Description of Snow Survey Stations

Snow Survey Station	Site Description	Easting	Northing	Elevation (m)
BKS-1	Begin near the tall spruce up hill near dry stack	483987	7086834	914
BKS-2	log pile near dry stack	483943	7086854	907
BKS-3	Between 1 and 2 marker on CLR road	483830	7087168	878
BKS-4	Between CLR3 and CLR4 markers on hillside	483846	7087204	876
BKS-5	Keno dump area. Near scrub trees	484195	7086832	942
BKS-6	Keno dump area. On sloping hillside	484197	7086819	938
BKS-7	Up hill from Bellekeno treatment pond.	487289	7087104	1032
BKS-8	End of Bellekeno Road, on flat area of western hillside	487638	7085892	1132
BKS-9	At BKR 16 marker. Slightly up on hillside	487225	7087046	1051
BKS-10	Near BKR 8 pull out. Up on hillside	485796	7086738	990
BKS-11A	Open area near LQ discharge pond	486615	7090566	1338
BKS-11B	Hillside forested area near LQ discharge pond	486568	7090582	1338
BKS-12	East of Adit on upslope of road	478711	7087238	1248
BKS-13	Open flat area near portal	485626	7086987	1003
VT-1	Beside Valley Weather Station	475799	7088130	718
VT-2	South of fork in the road between Dam 2 and 1	474980	7088406	697
VT-3	By corner of road, South of Dam 3	474323	7088159	692
Calumet	Regional Station near Calumet Weather Station	480377	7087789	1310
Mayo A and Mayo B	Regional Station North of Mayo Village	456230	7056458	540

Table 2-10: Snow Survey Snow Water Equivalent Results

Station	BKS-1[1]	BKS-2[2]	BKS-3	BKS-4	BKS-5[2]	BKS-6	BKS-7	BKS-8	BKS-9	BKS-10	BKS-11	BKS-12	BKS-13	VT-1	VT-2	VT-3	Monthly Mean	YG - Mayo A	YG - Mayo B	YG - Calumet
Elevation (m)	914	907	878	876	942	938	1032	1132	1051	990	1338	1248	1003	718	697	692		540	540	1310
Description	Tall spruce up hill near dry stack	Log pile near dry stack	Between 1 and 2 marker on CLR road	Down road from BKS 3, closer to #2 CLR marker	Keno dump area. Near scrub trees	Keno dump area. On sloping hillside	Uphill from Bellekeno treatment pond	Far end of Bellekeno East. Near explosive storage shed	At BKR 16 marker. Slightly up on hillside	Near BKR 8 pull out. Up on hillside	Lucky Queen, upslope of the pond	East of Bermingham 200 adit, Upslope of road	Onek, upslope of portal near powerline	*Located at the Valley Tailing Weather Station*	*South of the middle pond on the Valley Tailings Road*	*West of Valley Tailings Dam facility*		Mayo Airport	Mayo Airport	Calumet Hill
11-Jan	7.6	7.6	7.6	7.6	5.1	2.5	7.6	7.6	7.6	10.1	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	7.1	Not sampled	Not sampled	Not sampled
11-Feb	7.6	7.6	10.2	7.6	7.6	2.5	10.2	7.6	10.2	7.6							7.9			
11-Mar	5.1	7.6	7.6	7.6	5.1		7.6	5.1	10.2	5.1							6.1	9	8.4	13.9
12-Jan	6	12.2	9.6	8.5	13.7	11.2	12.5	9.9	12.4	13.3							10.9	NS	NS	NS
12-Feb	16.1	13.6	12.5	17.6	11.3	12.6	13.6	13.8	13.3	16.5							14.1	-	-	-
12-Mar	18.7	9.3	4.4	12.3	12.2	14.8	4.8	17.6	17.1	27.7							13.9	7.8	10	15.1
12-Apr	8.7	20.8	7.7	8.8	9.6	19.8	8.5	19.5	NS	10.7							11.4	14.4	15.6	18
13-Jan	7.3	9.3	7.3	9.3	6.7	6.7	6.7	8	7.3	9.3							7.8	NS	NS	NS
13-Feb	11.3	10.7	10	11.7	9.7	9.2	11	10	10	10							10.4	-	-	-
13-Mar	13	11.7	14.3	18.3	13.3	12	10.3	18.5	15	12.3							13.9	12.9	8	15.8
13-Apr	15	13.8	14.7	14.3	13	11.3	13.7	19.7	14	14.3							14.4	12	-	18.6
14-Jan	12.3	10.3	13	12.7	11	10.7	13.3	9.3	12.3	14							11.9	NS	NS	NS
14-Feb	14	10.7	12.3	12	12	10.3	13	12.7	11.7	15.7							12.4	-	-	-
14-Mar	12.3	10	11	11.7	10.7	8.7	13	12.7	11.3	14.3							11.6	10.3	12	18.9
14-Apr	9.7	7.7	9.7	7.3	8.7	8.3	10	10.7	9	7							8.8	12.3	12.6	20.7
15-Feb	8	9	9.3	3.7	8.3	7.3	9	6.7	7.7	10							7.9	NS	NS	NS
15-Mar	9.3	10.3	7	8.7	10.7	8.7	12.7	17	10.7	10							10.5	7.6	9	18.4

Station	BKS-1[1]	BKS-2[2]	BKS-3	BKS-4	BKS-5[2]	BKS-6	BKS-7	BKS-8	BKS-9	BKS-10	BKS-11	BKS-12	BKS-13	VT-1	VT-2	VT-3	Monthly Mean	YG - Mayo A	YG - Mayo B	YG - Calumet
Elevation (m)	914	907	878	876	942	938	1032	1132	1051	990	1338	1248	1003	718	697	692		540	540	1310
Description	Tall spruce up hill near dry stack	Log pile near dry stack	Between 1 and 2 marker on CLR road	Down road from BKS 3, closer to #2 CLR marker	Keno dump area. Near scrub trees	Keno dump area. On sloping hillside	Uphill from Bellekeno treatment pond	Far end of Bellekeno East. Near explosive storage shed	At BKR 16 marker. Slightly up on hillside	Near BKR 8 pull out. Up on hillside	Lucky Queen, upslope of the pond	East of Bermingham 200 adit, Upslope of road	Onek, upslope of portal near powerline	*Located at the Valley Tailing Weather Station*	*South of the middle pond on the Valley Tailings Road*	*West of Valley Tailings Dam facility*		Mayo Airport	Mayo Airport	Calumet Hill
15-Apr	8.7	9	10.7	7.3	12	9	14	12.3	8.3	12							10.3	10.3	11.8	23.2
16-Feb	4	8	8	10	10	8	7.3	7.3	7.3	10.7	20.3						8.1	NS	NS	NS
16-Mar	8.7	11	9.3	8.7	8.7	8	7	9.3	7	6	20.7						8.4	11.3	10.4	20.2
16-Apr	7.7	10.3	10.7	12.3	10.7	8.3	11.3	-		11.7	15	23.3					9.8	7	4.8	18.1
17-Feb	5.7	6.7	4	5.7	5.7	7.3	7	7.7	7	6	11	7	3				6.4	NS	NS	NS
17-Mar	8.7	9.3	9.3	10.3	8.3	8	8.3	10.7	7.3	9.3	16	8.7	4				9.1	3.8	4.2	15
17-Apr	9.3	11.7	13	11.3	10.7	9.3	11	13	6.7	6.7	18	14.3	NS				10.4	8.8	8	16.5
18-Jan	4.3	6	6.3	6.3	6	5.7	5.7	9	8	8.7	8.7	6.3	6.3				6.7	NS	NS	NS
18-Feb	6.7	7.3	10	8.7	9.3	8	8.7	10.7	10	10	11.7	11	6				9.1	-	-	-
18-Mar	8.7	10	10	10.7	13.3	11.3	11.3	11.3	13.3	12	18	-	-				10	4.8	6.5	14.2
18-Apr	4	4.3	4	5	5	5	5	5.7	4.3	4.7	-	4.3	5.3				4.4	5.6	6.4	17.2
19-Jan	4.7	4.7	6	6.7	4	4	7.6	5.3	6	5.3	6.7	10.7	4.7				6	NS	NS	NS
19-Feb	6	6	6	6	8	8	6	8	8	7.3	8	-	6				7.4			
19-Mar	5.3	4.7	5.3	5.3	5.3	5.3	5.3	6.7	6.7	6.7		10					6.6	6.8	6	13
19-Apr	Not sampled	Not sampled	NS	NS	NS	NS	NS	9.3	7.3	8	Not sampled	14	Not sampled				9.7	0	0	9.5[3]
20-Jan			5.3	7.3	6.7	12	NS	NS	NS	NS		11.3					10	NS	NS	NS
20-Feb		16	15.3	14	16	14	12	15.3	15.3	16.7		16.7					15.1			
20-Mar	17	17.3	15.3	18	11.3	15.7	14	21.3	23.3	19.3		-					17.5	15.4	15	27.7
20-Apr	18.7	17	16	20.7	19.3	16.7	15.3	-	26	23.3	11.3	27.3		16.7	19.3	17.3	19.2	17.3	16.6	30.5

Station	BKS-1[1]	BKS-2[2]	BKS-3	BKS-4	BKS-5[2]	BKS-6	BKS-7	BKS-8	BKS-9	BKS-10	BKS-11	BKS-12	BKS-13	VT-1	VT-2	VT-3	Monthly Mean	YG - Mayo A	YG - Mayo B	YG - Calumet
Elevation (m)	914	907	878	876	942	938	1032	1132	1051	990	1338	1248	1003	718	697	692		540	540	1310
Description	Tall spruce up hill near dry stack	Log pile near dry stack	Between 1 and 2 marker on CLR road	Down road from BKS 3, closer to #2 CLR marker	Keno dump area. Near scrub trees	Keno dump area. On sloping hillside	Uphill from Bellekeno treatment pond	Far end of Bellekeno East. Near explosive storage shed	At BKR 16 marker. Slightly up on hillside	Near BKR 8 pull out. Up on hillside	Lucky Queen, upslope of the pond	East of Bermingham 200 adit, Upslope of road	Onek, upslope of portal near powerline	*Located at the Valley Tailing Weather Station*	*South of the middle pond on the Valley Tailings Road*	*West of Valley Tailings Dam facility*		Mayo Airport	Mayo Airport	Calumet Hill
21-Feb	8	No longer sampled	6.3	8.7	No longer sampled	8.7	12	8.3	-	12.3		7.7	9.0	10.3	9.2	NS	NS	NS		
21-Mar	10		9.3	10		12.3	13.7	11	19.3	16.7	11	11.0	11.3	14.3	12.8	9.8	9	16.7		
21-Apr	13		13.7	14		15	13.3	13.3	-	18.7	-	12.7	12.7	15.3	14.4	7.9	13.8	18.4		
22-Feb	10.7		15.7	9		7.7	14	10.3	15.3	20.7	11.3	9.7	17.7	11.7	13.0	NS	NS	21.3		
22-Mar	14		17	10		18.7	9.3	16.3	18	25.3	15.3	18.3	17	18	16.5	16	17.2	24.6		
22-Apr	19.3		14.3	16		16.3	15.7	19.7	-	26.7	-	15	15.3	15.3	17.4	16.7e	18	27.3		
23-Feb	10.1		12.3	10.7		9.7	5.7	10.7	11	17	0	11.3	10.7	10	10.8	11.2	10.4	15		
23-Mar	11.3		13.7	10		11	12	13.7	14.3	17.3	8.7	13.3	12.7	12.7	12.9	12	11.4	19.6		
23-Apr	0		0	0		13	12	18.7	0	26.3	11.7	12	12.3	14.3	9.9	9.8	9.4	25		
24-Feb	No longer sampled		8.3	8.7		10	8.7	9	12	-	8	13.7	6.3	9	9.5	NS	NS	NS		
24-Mar			NS	NS		10	2.7	11.3	NA	16.7	NA	6	7.3	7.3	8.8	6.4	6.2	12.8		
24-Apr			0	7.7		5.7	6.7	9.3	9	12.3	6	3.3	0	8.3	6.2	5.2	6.4	14.6		

Note. NS = Not sampled. NA = No access.
[1] Site removed in 2024
[2] Sites removed in 2021
[3] Estimated

2.2 METEOROLOGICAL ANALYSIS

2.2.1 Temperature

Figure 2-3 shows monthly temperature trends at District Mill (936 masl) and Mayo A (504 masl) stations. District Mill records lower temperatures than Mayo A across all months due to its higher elevation. Both stations show minimum temperatures in January (approximately -24°C at District Mill, -20°C at Mayo A) and maximum temperatures in July (approximately 14°C at District Mill, 17°C at Mayo A). The 2024 data at both stations follows historical patterns, with the 2011-2024 period at Mayo A consistent with 1981-2010 normals.

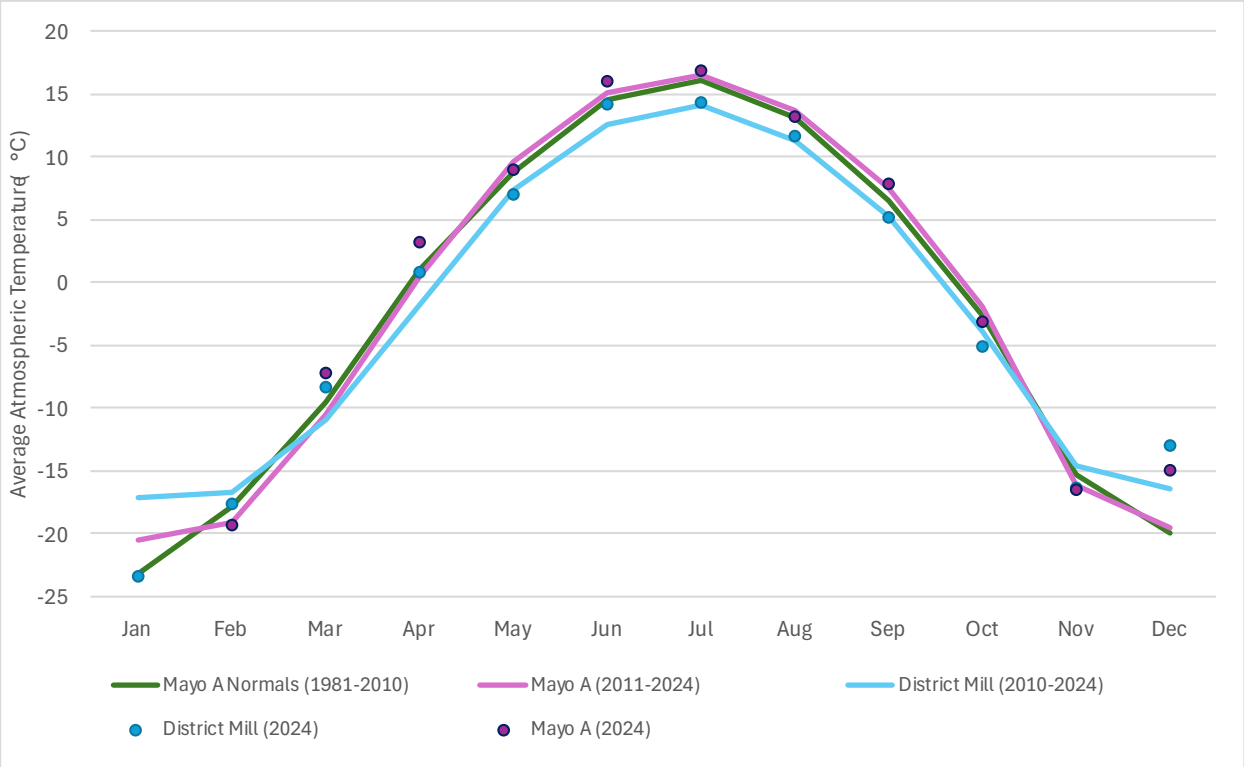

Figure 2-3: Monthly Temperature Trends, District Mill and Mayo A Stations

2.2.2 Precipitation

Of the three local meteorological stations, only the District Mill station measures total precipitation, whereas the other two stations measure rainfall only.

2.2.2.1 Rainfall

In 2025 Tetra Tech validated the data gathered at the District Mill weather station covering full-year periods from 2012 to 2023. Their analysis calculated the 24-hour precipitation depth for return periods ranging from 2 years to 200 years. When compared to the 1979 to 2016 24-hour precipitation depth derived from the Mayo A Stations, the analysis revealed that the 200-year rain depth estimated from the Mayo A Stations is 1.3% lower than the District Mill climate station, as shown in Table 2-11. Overall, the comparison indicates that the Mayo

A climate station provides a reasonable approximation of precipitation patterns for the KHSD Mining Operations (Tetra Tech, 2025a).

Table 2-11 Comparison of 24-hour Rainfall Depths between District Mill and Mayo A Stations

RETURN PERIOD (YEARS)	DISTRICT MILL 2012 TO 2023 24-HOUR RAINFALL (mm)	MAYO A 1979 TO 2016 24-HOUR RAINFALL (mm)	PERCENT DIFFERENCE (%)
200	37.6	37.1	-1.3
100	34.5	33.6	-2.6
50	31.5	31.2	-1.0
20	27.7	28.8	4.0
10	24.7	24.0	-2.8
5	21.7	21.6	-0.5
2	16.7	16.8	0.6

2.2.2.2 Snowfall

A comparison of site vs regional snow survey stations, 2011-2024, is presented in Figure 2-4. These stations were chosen based on elevation variation and their recorded SWE over the surveyed period.

Figure 2-5 presents SWE as a function of elevation. As predicted, the higher the elevation, the more snow is accumulated. The measured SWE of BKS-12 is comparable to Calumet station SWE which has a similar northwest aspect and elevation of 1310 masl.

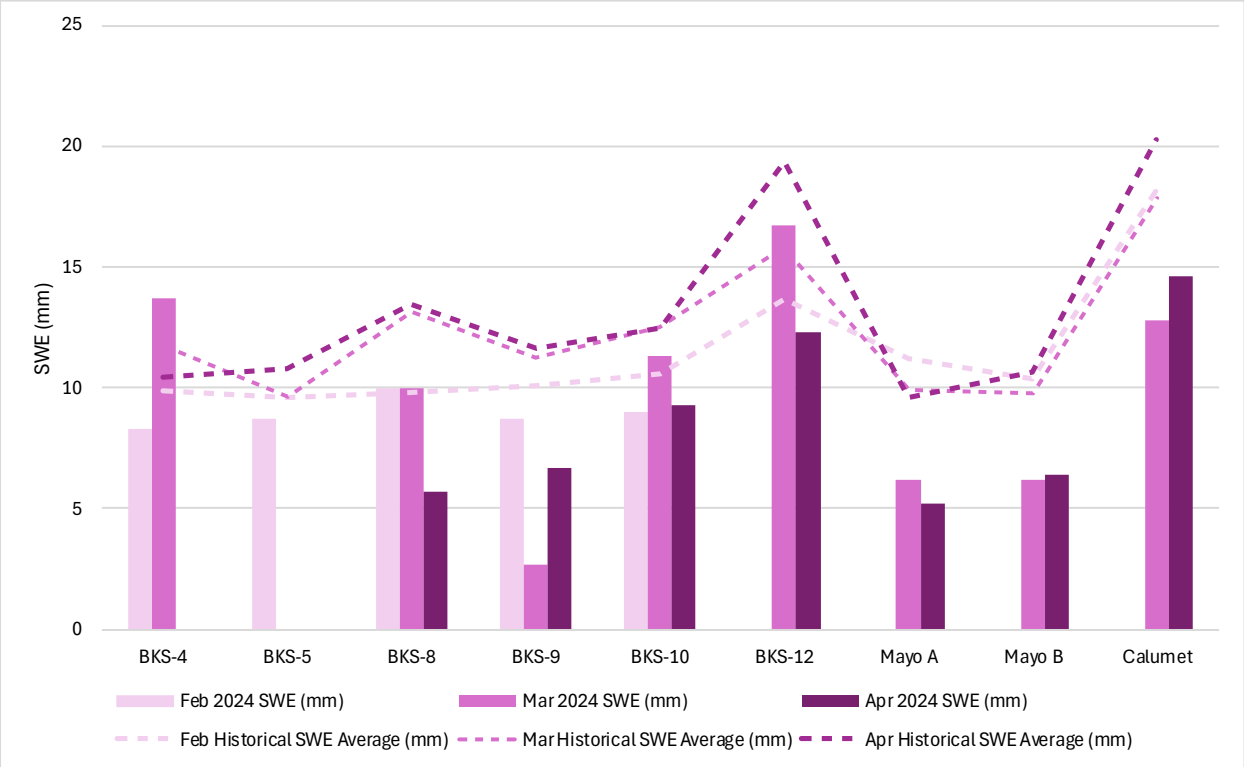

Figure 2-4: Regional Snow Water Equivalents Compared to Site Stations BKS-4, 5, 8, 9, 10, and 12 for 2011-2024

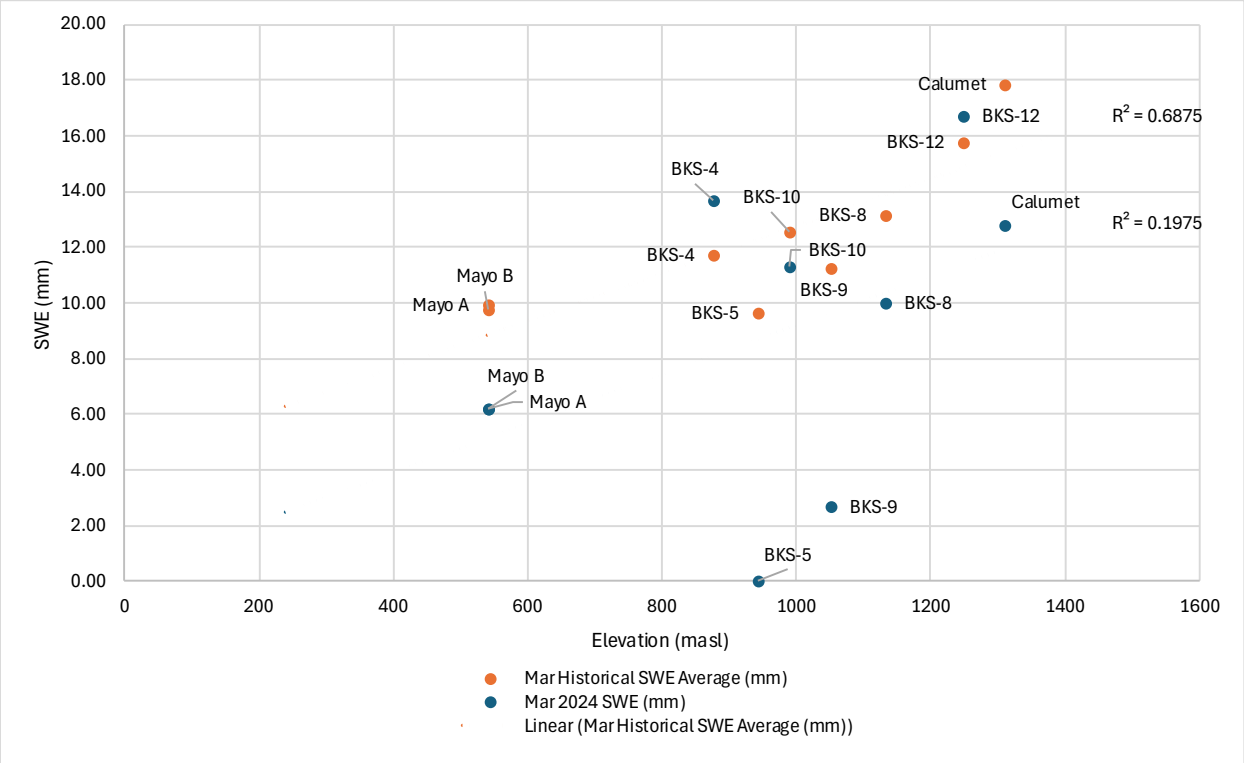

Figure 2-5: March Snow Water Equivalent as a Function of Elevation

2.2.3 Total Precipitation

The Mayo A station has reported both rain and total precipitation for decades, while the District Mill weather station has recorded total precipitation since 2014. **Error! Reference source not found.** presents the annual precipitation at these two stations.

Table 2-12: Annual Precipitation at District Mill and Mayo A Stations, 2007-2024

MAYO A STATION					DISTRICT MILL
Year	**Total Rain (mm)**	**Total Snow (cm)**	**Total Precipitation (mm)**	**% Rain**	**Precipitation (mm)**
2007	217.2	188.4	345.8	62.8	-
2008	309.3	157.8	429.3	72	-
2009	186.9	181.6	304.3	61.4	-
2010	198.1	129.8	293.7	67.4	-
2011	329.5	164.9	452.9	72.8	-
2012	171.7	158.4	276.1	62.2	217.5[1]
2013	226.3	144.1	359.2	63.0	400.0[1]
2014	287.7	50.3	376.3	76.5	292.6
2015	301	173.1	408.7	73.6	296.9
2016	245.6	124.4	316	77.7	277.7
2017	246.8	94.1	312.7	78.9	265.9
2018	292.5	78	338	86.5	344.9
2019	137.8	200.9	249.3	55.3	127.0
2020	306	206.7	435.6	70.2	287.7
2021	191.1	172.4	296.2	64.5	278.6
2022	303.3	176.3	410	74.0	no data[2]
2023	251.1	82.1	299.9	83.7	165.5
2024	185.5	88.8	273.7	68.0	218.4[3]
AVG	**243.7**	**142.9**	**343.2**	**70.6**	**248.4**

Note.

[1] District Mill Station reported rainfall only in 2012 and 2013

[2] District Mill station did not record precipitation between May and November 2022

[3] Ensero estimated data for December 15 to 30 (Ensero, 2025a)

During this time period (2007 to 2024), the average proportion of total precipitation that fell as rain was 70.6%, which is slightly higher than the original estimate of 60% by Clearwater Consultants (Access, 1996). Since the value of 60% was estimated using data collected between 1974 and 1982, it is possible that the proportion of total precipitation falling as rain has increased with the warming temperature trends observed in the Yukon (Ensero, 2025).

Figure 2-6 illustrates the monthly and annual accumulated precipitation recorded at the District Mill Station. Monthly total precipitation trends at the District Mill Station are compared to Mayo A Stations in Figure 2-7.

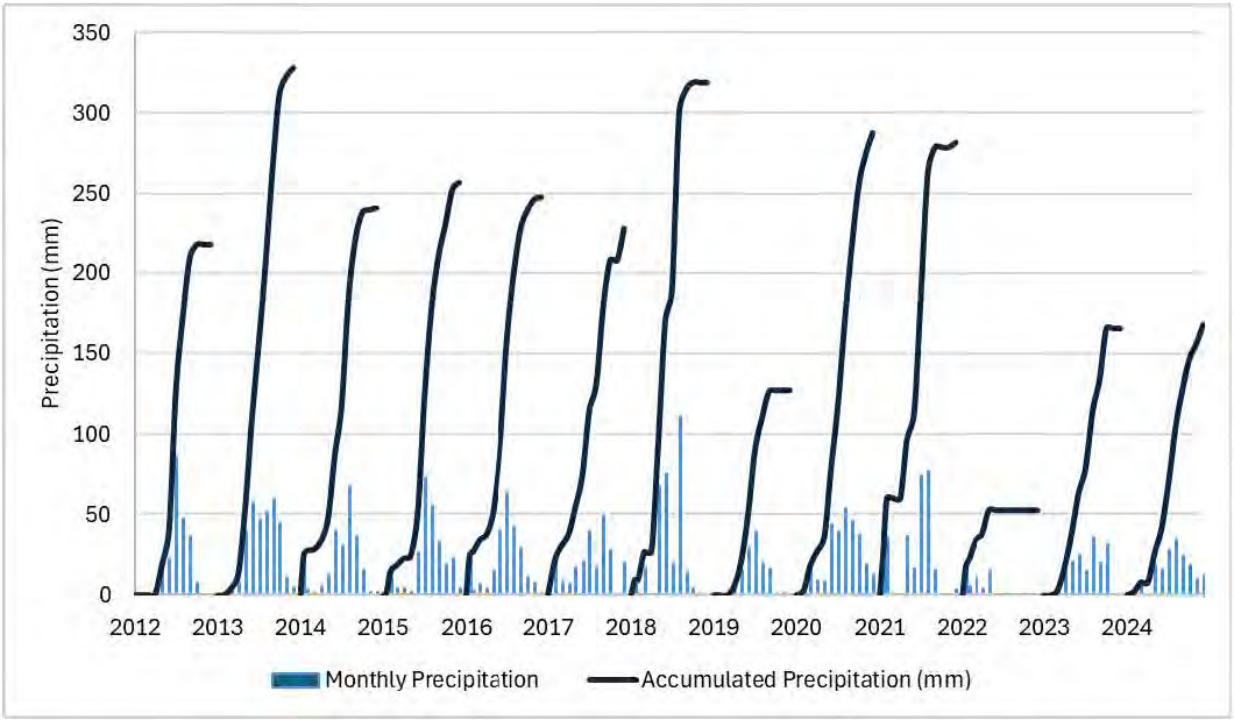

Figure 2-6: Monthly and Cumulative Precipitation at the District Mill Meteorological Station, 2012 to 2024

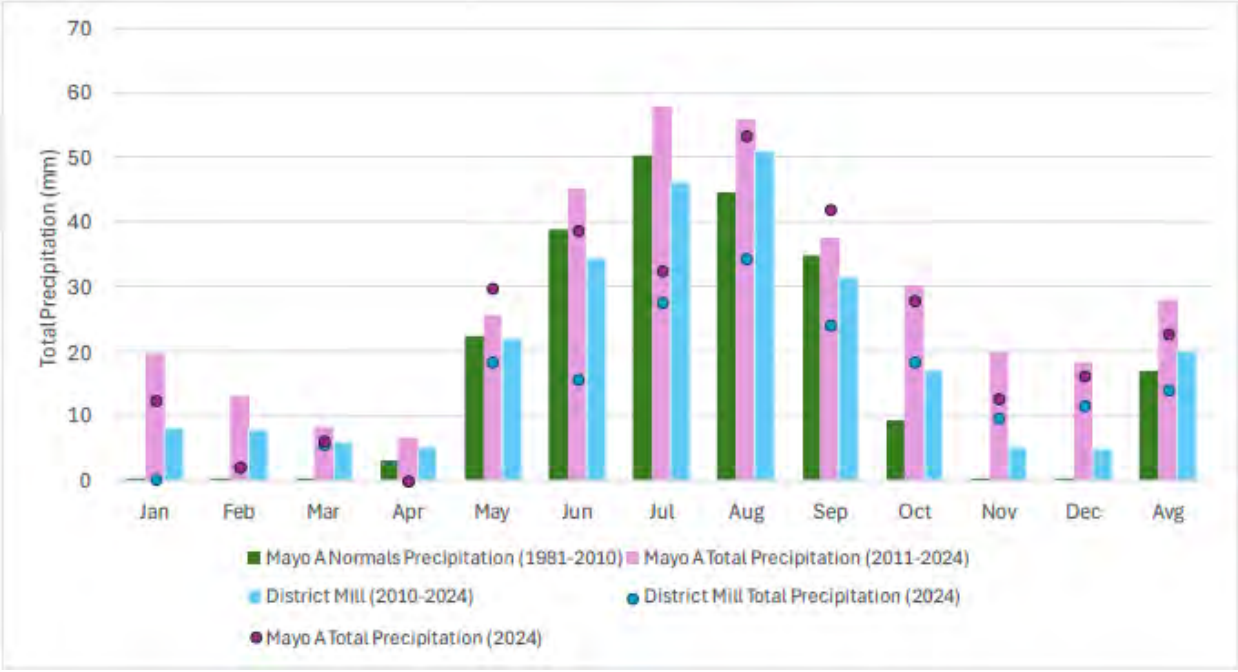

Figure 2-7: Monthly Total Precipitation Trends, District Mill and Mayo A Stations

Due to lack of snowfall data at the other two local stations, the Mayo A Stations was used as a proxy for estimating precipitation trends on site. The Mayo A Stations record includes rainfall, snowfall, and total precipitation before and after undercatch adjustment.

Precipitation undercatch is the systematic under-measurement of the true precipitation by a gauge. Undercatch can be de due to micro-meteorological conditions (wind effects) created by the gauge itself and it is generally more significant for snow and increased with wind speed (SRK, 2020).

2.2.4 Mean Annual Precipitation

Mean annual precipitation (MAP) within a mountainous region typically increases with increasing elevation. The significant relief over which the project area spans is well represented by the existing and historic weather stations. A description of the stations used to derive the relationship between MAP and elevations is presented in Table 2-13 and the results are illustrated in Figure 2-8. Assuming a linear relationship, a line was fitted to the data of these stations. The slope of this line indicates that MAP increases by an average of 28 mm for every 100 m of ascent, a value not too dissimilar from that observed values in other regions of the Yukon interior.

Table 2-13: Regional Climate Stations

Station Name	Elevation (masl)	Precipitation (mm)	Date range used
Elsa	814	413	1948-1965, 1974-1989
Keno Hill	1472	590	1974-1982
Mayo Airport	504	306	1924-1995
Snag Airport	587	339	1943-1966
Dawson	320	306	1897-1979
Dawson airport	369	340	1976-1995
Fort Selkirk	454	286	1954-1995
Clinton Creek	576	370	1964-1978
Klondike	960	469	1966-1995
Boundary	1036	576	1967-1978
Dawson Airport	370	324.4	1981-2010
Mayo Airport	504	313.5	1981-2010
McQuesten	458.2	344.1	1981-2010
Calumet, Predicted	1380	592	-
Valley Tailings, Predicted	718	400	-
District Mill, Predicted	936	465	-
District Mill, Average	936	310.5[1]	2012-2021, 2023-2024
Valley, Average	718	194.3	2013-2024
Calumet, Average	1380	225	2007-2024

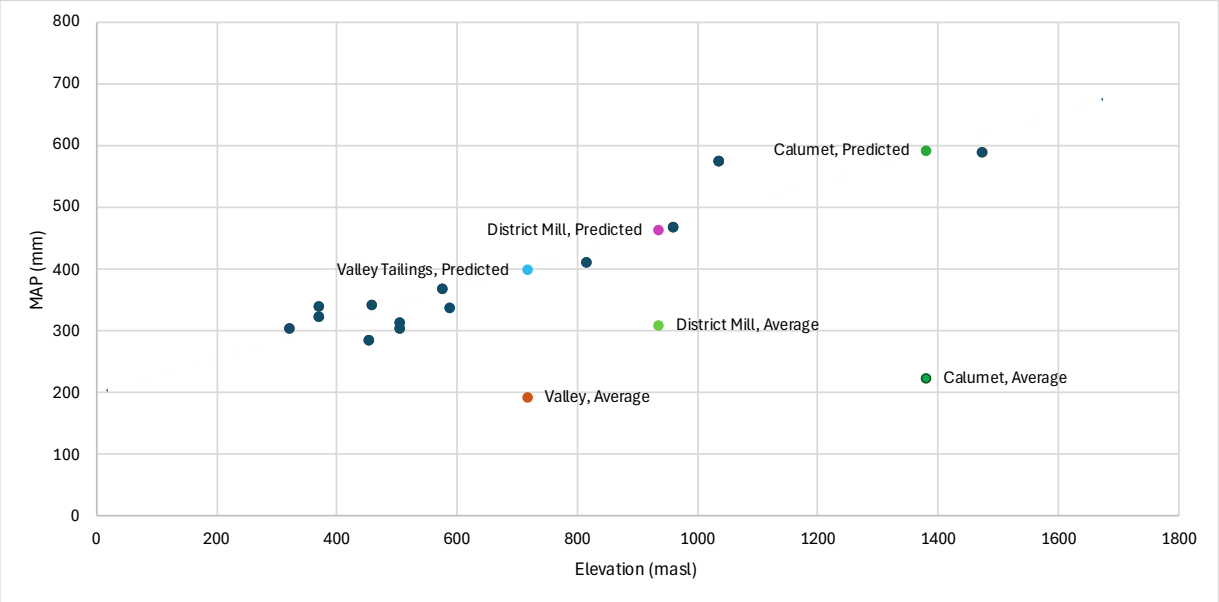

Figure 2-8: Regional Analysis for Mean Annual Precipitation (without undercatch) and Elevation

At the District Mill, total precipitation data are below the values predicted from the MAP-elevation relationship, suggesting that the snowfall under catch might be greater at this site than the average value reported in the literature, or that there is uncertainty in the MAP-elevation relationship. (Ensero, 2025)

For three of the years where the Calumet dataset is complete, the difference between actual and predicted total rainfall is positive (2008, 2010 and 2018), meaning that the recorded data showed higher precipitation levels then the predicted values. For two other years it is negative (2013 and 2014). The average difference between actual and predicted for those five years is positive (13.3%), implying that the linear relationship between MAP and elevation developed by Clearwater Consultants (Access, 1996) might underestimate total precipitation increase with elevation.

At the Valley Tailings station, the 2015, 2016 and 2017 dataset are complete and actual versus predicted rainfall are relatively similar (-2.6%, -3.3% and 13.8% difference, respectively).

Assuming the empirical linear relationship where the proportion of total precipitation that falls as rain decreases by about 2% for every 100 m ascent, it is expected that 45.2% of total precipitation falls as rain at Calumet, 54.1% at the District Mill and 58.5% at the Valley Tailings station. Based on Mayo A annual total precipitation from 2007 to 2024 (Table 2-13, Figure 2-8), predicted total rainfall according to the MAP-elevation correction is compared to total rainfall measured at District Mill (Table 2-14), Calumet (Table 2-15), and Valley Tailings (Table 2-16).

Table 2-14: Predicted Mayo A MAP-elevation Corrected Versus District Mill Measured Total Rain

Year	Predicted Total Precipitation (mm)	Predicted Total Rainfall (mm)	Measured Total Rainfall or Precipitation (mm)
District Mill (936 masl)			
2012	392.7	212.3	217.5
2013	475.8	257.2	400.0
2014	492.9	266.5	292.6
2015	525.3	284.0	296.9
2016	432.6	233.9	277.7
2017	429.3	232.1	267.3
2018	454.6	245.8	344.9
2019	365.9	197.8	127.0
2020	552.2	298.5	287.7
2021	412.8	223.2	278.6
2022	526.6	284.7	-
2023	416.5	225.2	165.5
2024	465.1	239.1	218.4 [1]
AVG	**457.1**	**246.2**	**264.5**

Table 2-15: Predicted Mayo A MAP-elevation Corrected Versus Calumet Measured Total Rain

Year	Predicted Total Precipitation (mm)	Predicted Total Rainfall (mm)	Measured Total Rainfall or Precipitation (mm)
Calumet (1380 masl)			
2007	582.3	263.1	*276.4*
2008	665.8	300.8	363.6
2009	540.8	244.3	*196.4*
2010	530.2	239.6	462.2
2011	689.4	311.5	*305.5*
2012	512.6	231.6	*137.0*
2013	595.7	269.1	200.6
2014	612.8	276.9	264.4
2015	645.2	291.5	*339.7*
2016	552.5	249.6	*76.9*
2017	549.2	248.1	-

2018	574.5	259.6	430.9
2019	485.8	219.5	*216.2*
2020	672.1	303.7	*489.7*
2021	532.7	240.7	*297.8*
2022	646.5	292.1	*254.6*
2023	536.4	242.4	*247.8*
2024	592.0	267.6	*166.4*
AVG	**584.3**	**263.9**	**278.0**

Table 2-16: Predicted Mayo A MAP-elevation Corrected Versus Valley Tails Measured Total Rain

Year	Predicted Total Precipitation (mm)	Predicted Total Rainfall (mm)	Measured Total Rainfall or Precipitation (mm)
Valley Tails (718 masl)			
2014	57.8	33.8	*112.4*
2015	466.5	272.5	272.2
2016	373.8	218.4	226.6
2017	370.5	216.4	269.2
2018	395.8	231.2	*75.6*
2019	307.1	179.4	*69.4*
2020	493.4	288.2	*94.4*
2021	354.0	206.8	*137.83*
2022	467.8	273.3	*232.4*
2023	357.7	209.0	*240.0*
2024	400.0	234.0	*241.0*
AVG	**367.7**	**214.8**	**179.2**

Note. Values in grey italics indicate that total precipitation is not from the entire year (i.e., some data missing due to weather station malfunctions).

2.2.5 Monthly Precipitation

As with MAP, the seasonal or monthly distribution is influenced by elevation. To demonstrate this influence, the monthly distributions for former Meteorological Service of Canada stations at Elsa, and Keno Hill, and the active Mayo Airport Meteorological Service of Canada station have been plotted in Figure 2-9. The proportion of total precipitation which falls as rain decreases as elevation increases (53% of total precipitation at Elsa, 1% at Keno Hill and 67% at Mayo Airport). The slope of the linear relationship indicates that the proportion of total precipitation that falls as rain decreases by about 2% for every 100 m ascent (Ensero 2025).

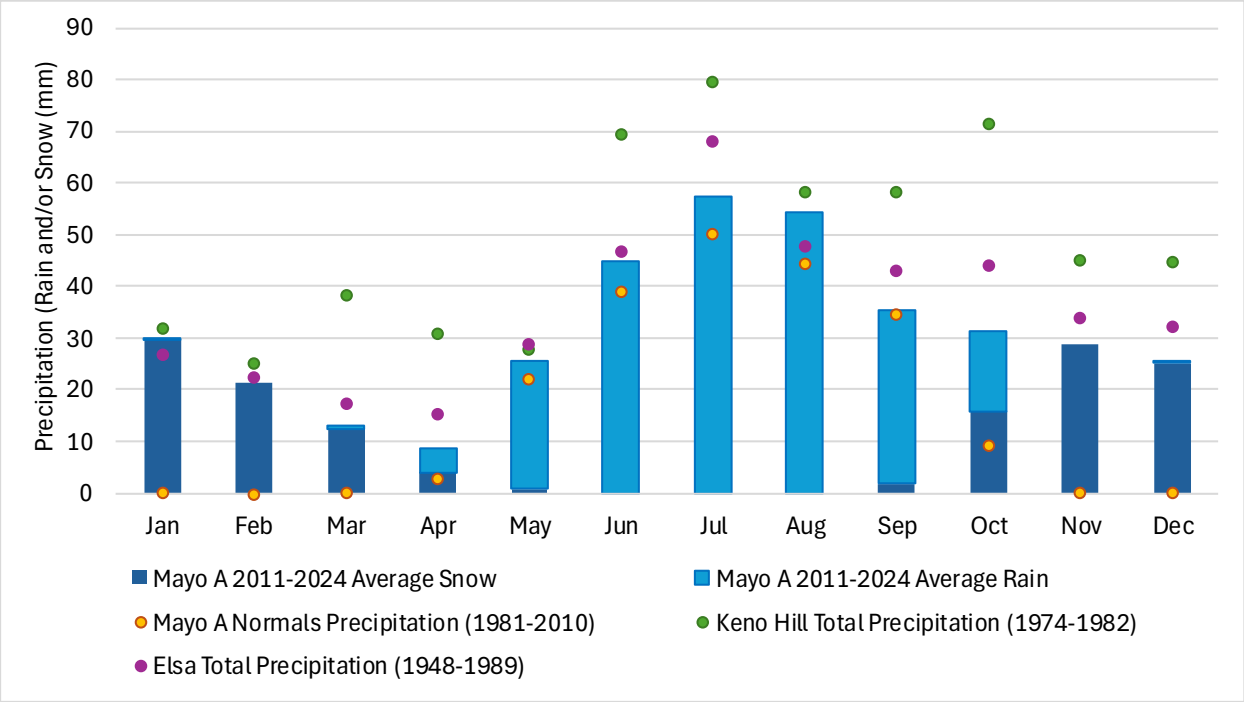

Figure 2-9: Mean Monthly Precipitation of Regional Stations

2.2.6 Probable Maximum Precipitation

The probable maximum precipitation (PMP) for a 24-hour duration event was evaluated by SRK using the Hershfield method, adopted by the World Meteorological Organisation (2009). This is a statistical method with adjustments being made for outliers within the dataset, sample size and maximum observed rainfall.

The PMP for the VTF was estimated from observed daily precipitation data recorded at the Mayo A Stations. Adjustments for elevation to extreme events is not as well described and as such, no elevation corrections were included. The PMP for a 24-hour duration event for the VTF site was estimated as 136 mm (SRK, 2020).

2.2.7 Wind

Where data are available, the windspeed patterns at the District Mill Station are similar to Mayo A Stations as illustrated in Figure 2-10 (Ensero 2025). The differences in timing between the average windspeed at District Mill and Mayo A Stations could also be attributed to equipment differences and elevation differences. The Canadian Climate Normals (ECCC, 2023) for the Mayo A Stations indicate the highest wind averages are reached in March, April, and October, and the lowest windspeeds from December to January and July to August. Wind data for the District Mill Station is further discussed in Section 2.4.3 are depicted in a wind rose (Figure 2-13)



Figure 2-10: Windspeed Comparisons

2.2.8 Evaporation

Commencing in 2013 evapotranspiration has been calculated from meteorological parameters recorded at the District Mill station. The evapotranspiration calculation uses temperature, relative humidity, wind speed, solar radiation, latitude, longitude, and altitude to calculate an evaporation rate for a short grass crop. This provides an approximation of actual evaporation, which varies locally depending on surface type and micro topography

Estimates for lake evaporation and potential evapotranspiration were developed for Valley Tailings by SRK (2020). SRK based the Lake evaporation estimates on the Mayo A Climate Normals (1981-2010), and the Potential Evapotranspiration estimates were developed using Oudin's (Oudin et al, 2005) temperature-index method.

The estimated lake evaporation and potential evapotranspiration for the Valley Tailings area and the average evapotranspiration measured at the District Mill station are listed in Table 2-17.

Table 2-17: Estimated Valley Tailings and Approximate District Mill Evaporation

MONTH	LAKE EVAPORATION Elevation 690 TO 865 masl [mm]	POTENTIAL EVAPOTRANSPIRATION Elevation 690 TO 865 masl [mm]	DISTRICT MILL EVAPOTRANSPIRATION Elevation 900 TO 936 masl (mm)
January	*0*	*0*	*1*
February	*0*	*0*	1.8
March	0	2	6.3
April	0	19	15.7
May	0	62	25.5
June	132	96	30.5

MONTH	LAKE EVAPORATION Elevation 690 TO 865 masl [mm]	POTENTIAL EVAPOTRANSPIRATION Elevation 690 TO 865 masl [mm]	DISTRICT MILL EVAPOTRANSPIRATION Elevation 900 TO 936 masl (mm)
July	120.9	101	25.6
August	80.6	68	18.8
September	48	28	13.2
October	*0*	*5*	4.7
November	*0*	*0*	*0.8*
December	*0*	*0*	*2.5*
Annual	**381.5**	**383**	**146.3**

Note. Values in grey italics indicate a partial month or less n < 6.

2.3 CLIMATE CHANGE

The long-term climate record at the Mayo A Stations shows a warming trend as illustrated on Figure 2-11. The rate of warming is greater for the minimum temperature than it is for the maximum temperature.

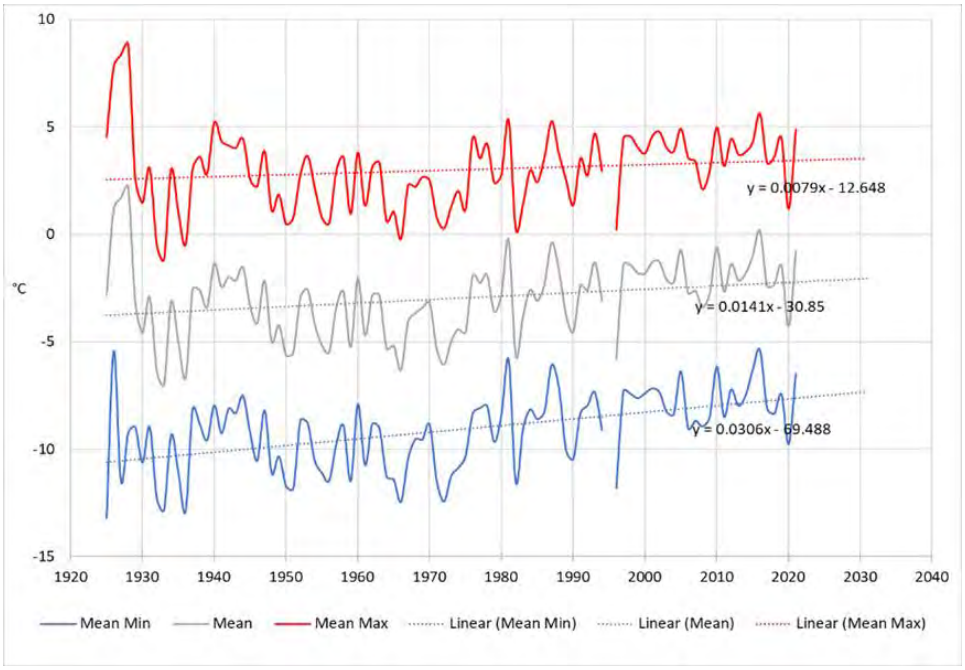

Figure 2-11: Mayo A Stations Annual Temperatures 1925 to 2022

A climate related risk assessment was conducted in 2023 for the KHSD Mining Operations based on Yukon Government *Guidelines for Mine Waste Management Facilities* (YG, 2023a) and section 4.1 of the Yukon *Reclamation and Closure Planning for Quartz Mining Projects* guidance (YG, 2013). Temperature, precipitation, and permafrost were considered in that evaluation. The risk evaluations are planned to continue during operations as required by AHJs.

Updated Climate Change contingency factors have been incorporated into the design of facilities, such as:

- A geothermal analysis was carried out in 2024 to investigate the long-term impact of dry-stacked tailings conditions for the DSTF Phase 2 design including Climate Change scenarios. The analyses were carried out using a two-dimensional finite element computer model, GEOTHERM. The model simulates transient, two-dimensional heat conduction with change of phase for a variety of boundary conditions. The heat exchange at the ground surface is modelled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation.

- Diversion ditches at the District Mill are designed for an Inflow Design Flood of 200 year and are planned to be increased to an Inflow Design Flood of 500 years for closure, which in part accounts for Climate Change.

- Improvements to the Mill Pond and Flame & Moth Water Treatment Plant (WTP) Pond are designed for Climate Change adjusted return periods of 100-year and 200-year storms.

For the Mayo A weather station, the climate data portal ClimateData.ca summarizes the annual average temperature and precipitation based on climate scenarios from the Coupled Model Intercomparison Project Phase 6 (CMIP6) global climate models (Sobie S.R., et al, 2024) as follows:

- For the 1971-2000 period, the annual average temperature was -3.2°C. Under a high emissions scenario, annual average temperatures are projected to be -0.9°C for the 2021-2050 period, 1.2°C for the 2051-2080 period and 3.3 ºC for the last 30 years of this century (ClimateData.ca, 2025).

- Average annual precipitation for the 1971-2000 period was 343 mm. Under a high emissions scenario, this is projected to be 28% higher for the 2051-2080 period and 37% higher for the last 30 years of this century (ClimateData.ca, 2025).

Historical and forecasted data from the climate data portal ClimateData.ca, was used by Tetra Tech (2025a) to determine projected climate changes between 2071 and 2100 for a high emission scenario. The precipitation depths and percentage increases are shown in Table 2-18 for durations ranging between six hours and 24 hours, predicted precipitation increases over time (Tetra Tech, 2025a).

An Intensity-Duration-Frequency (IDF) curve, produced by ECCC, for rainfall depths with climate change at Mayo A Stations was extracted from ClimateData.ca.

Table 2-19 depicts the rain depth adjusted for climate change, available for return periods up to 100-year (Tetra Tech, 2025a).

Table 2-18: Climate Change Adjusted Mayo A Station Rainfall Depth (mm), 2071-2100

Duration (hour)	Rainfall Depth under Return Period (mm)					
	2-year	5-year	10-year	25-year	50-year	100-year
1	10.00	14.00	17.00	20.00	23.00	25.00
2	13.00	16.60	19.20	22.00	24.00	26.00
6	18.00	21.60	24.60	28.20	30.00	33.00
12	21.60	27.60	28.80	34.80	36.00	39.60
24	26.40	33.60	36.00	43.20	48.00	50.40

(Tetra Tech, 2025a, Table 2-4)

Table 2-19: Historical and Climate Change Short Term Predicted Rainfall Depths

RETURN PERIOD (YEARS)	6-HOUR			12-HOUR			24-HOUR		
	Historical (mm)	Climate Change (2071-2100) (mm)	Increase (%)	Historical (mm)	Climate Change (2071-2100) (mm)	Increase (%)	Historical (mm)	Climate Change (2071-2100) (mm)	Increase (%)
100	21.4	33.0	54	26.1	39.6	52	22.6	50.4	50
50	19.9	30.0	51	24.2	36.0	49	31.0	48.0	55
25	18.3	28.2	54	22.3	34.8	56	28.4	43.2	52
10	116.2	24.6	52	19.6	28.8	47	24.9	36.0	45
5	14.5	21.6	49	17.6	27.6	57	22.1	33.6	52
2	12.0	18.0	50	14.1	21.6	50	17.9	26.4	47

(Tetra Tech, 2025a, Table 2-3)

2.4 AIR QUALITY

AKHM established an air quality monitoring program in 2009 to assess potential effects of particulate matter on receptors in Keno City. In 2014, comprehensive air dispersion modeling was conducted using CALPUFF, an EPA-recommended Gaussian puff model, to predict ambient concentrations at six discrete receptors in Keno City (Figure 2-12). The modeling evaluated three operational scenarios and predicted maximum 24-hour and annual concentrations for TSP, PM_{10}, and $PM_{2.5}$ at these receptors. Results indicated that all predicted concentrations would remain well below applicable Yukon Ambient Air Quality Standards (YAAQS) at all sensitive receptors in Keno City.

Air quality monitoring began in 2011 with Bergerhoff dustfall monitoring gauges installed at four locations near the District Mill site. The Bergerhoff deposit dust gauge measures dust deposition reported as weight per unit area over time. Initial monitoring results (March-May 2011) showed dustfall deposition rates ranging from 0.012 to 0.165 mg/(dm^2·day), well below the 1.7 mg/(dm^2·day) threshold that would trigger more intensive particulate matter monitoring.

The monitoring program was amended in 2012 to measure total particulates per volume of air for select size fractions using filter-based samplers. TSP and total metal monitoring was undertaken using BGI from OMNI ambient air quality samplers at two locations near the District Mill site beginning in August 2012. A third sampler (TSP-3) was installed in Keno City in December 2014. Additional sampling capability for PM_{10} and $PM_{2.5}$ fractions was added in August 2015.

In 2021, AKHM upgraded to BGI OMNI FT samplers, which provided enhanced performance with the same fundamental operating principles. However, equipment reliability issues began to emerge. In January 2021, the BGI OMNI sampler located east of the mill and crusher (TSP-1) became unsalvageable. It was replaced and relocated to a new location in Keno City in 2022. By June 2025, all three BGI OMNI samplers had become inoperative, and replacement parts and calibration services were no longer available from the manufacturer.

In July 2025, AKHM transitioned to Aeroqual Dust Sentry PCX monitors to replace the discontinued BGI OMNI samplers. The Dust Sentry PCX units provide real-time continuous monitoring with simultaneous measurement of multiple particle size fractions (TSP, PM_{10}, PM_4, $PM_{2.5}$, and PM_1). Key advantages of this system include automated flow measurement and control, remote data access and calibration capabilities, real-time alerts for potential exceedances, and integrated meteorological sensors (temperature and relative humidity). The units feature a 650 nm industrial laser with hemispherical-focusing optical particle counter technology, omni-directional sample inlet with integrated heater, and embedded PC with onboard data storage exceeding five years. Due to technical difficulties during commissioning, all three Aeroqual units were not fully operational until August 2025.

Concurrently with the transition to continuous real-time monitoring, AKHM reinstated dustfall monitoring using Bergerhoff dust gauges on 9-day sampling periods. This dustfall monitoring provides metal deposition data (reported as µg/m^2/day) to complement the continuous particulate mass concentration data from the Aeroqual monitors. The dual approach allows for both real-time concentration monitoring and metals speciation analysis.

The three monitoring locations (TSP-1, TSP-2, TSP-3; see Figure 2-12) correspond closely to receptors evaluated in the 2014 air dispersion modeling. TSP-3 is located near the originally modeled receptor R04 (adjacent to the Onek 400 water treatment plant on the north side of Keno City), while TSP-1 is located near receptor R05 (Keno City Baseball Diamond, on the western end of town). The goal of this multi-location approach is to capture variability in air quality during various weather conditions and to verify the 2014

modeling predictions. To date, monitoring results have been consistent with model predictions, with measured concentrations remaining well below YAAQS thresholds.

The initial air quality monitors established in 2012 were located near the DSTF Phase 1 and crusher—two of the main potential dust sources identified in the 2014 modeling study. TSP-1 and TSP-2 were positioned at the mill site, while TSP-3 was installed in Keno City in 2014 (Figure 2-12). To provide better understanding of how ambient concentrations vary throughout Keno City, the following changes were made to air quality monitoring station locations in Q2 2022: the dust monitor previously located at the north side of Keno City (TSP-3) was relocated adjacent to the Onek 400 water treatment plant (near modeled receptor R04), and a third sampler (TSP-1) was initially installed at the western end of Keno City (near modeled receptor R05, the location where the 2014 modeling predicted the highest concentrations in Keno City), however, in response to concerns raised by local residents about sampler noise, it was relocated to the Keno City Baseball Diamond (approximately 300 m west of R05). The sampler at the toe of the DSTF Phase 1 (TSP-2) remains in operation to provide information on ambient concentrations within the Project area and to provide data continuity, as this station has been monitored for TSP since August 2012.

Results from the monitoring program are used to determine if additional dust abatement and mitigation measures are required to address potential air quality effects from KHSD mining operations. Potential dust sources include the DSTF, the crusher, and unpaved access roads. In Q1 2024, the crusher was fully enclosed, thereby reducing it as a dust source. In September 2024, DSTF Phase 2 construction commenced, which enlarged the source area for dust from the DSTF. The nearest residence is 710 m from the DSTF and 860 m from the crusher. Particulate matter levels experienced at the nearest residence are better approximated by levels observed at air quality monitor TSP-3 (located near modeled receptor R04 in Keno City) or TSP-1 (located near modeled receptor R05), consistent with predictions from the 2014 air dispersion modeling.

Operations of the District Mill were suspended between September 2013 and December 2020, and again from June 2022 to May 2023. Air quality monitoring undertaken by AKHM during periods of District Mill suspension represents either ambient background conditions or low levels of activity.

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Hanson McQuesten Road

SILVER TRAIL H

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CALUMET WEATHER STATION

GALENA HILL

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Flat Creek

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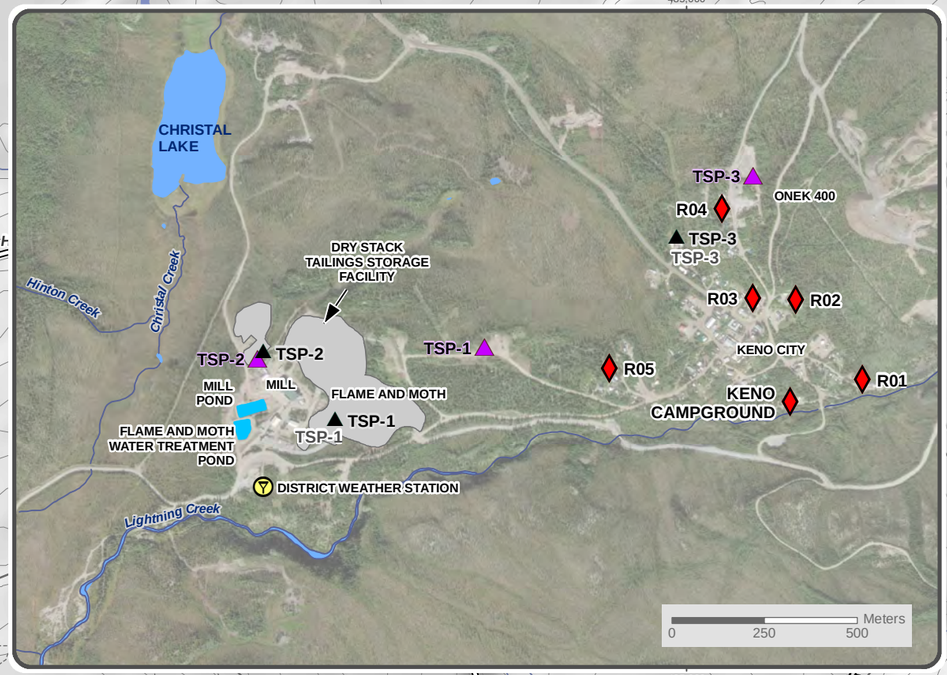

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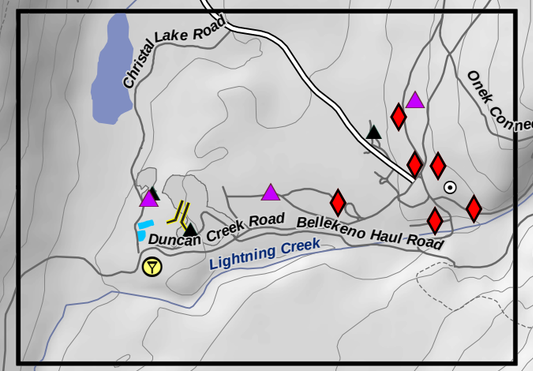

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Satellite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on November 2025

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Noise Receptor Location
- Current TSP Monitoring Stations
- Former TSP Monitoring Stations
- Weather Station
- Adit
- Mill Site Mine Features
- Mill Site Pond
- Tailings Area
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

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ENSERO solutions

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 2-12

METEOROLOGICAL AND AIR QUALITY MONITORING STATIONS LOCATIONS

NOVEMBER 2025

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(Last edited by: AnastasiyaMatiashevs;2025-11-10/11:09:AM)

2.4.1 Air Particulate

Results of the gravimetric analyses are converted into 24-hour average ambient concentrations based on the flow rate of the instruments. These are compared with the Yukon Ambient Air Quality Standard (YAAQS) (24-hour average): 120 µg/m^3 for TSP; 50 µg/m^3 for PM_{10}; and 27 µg/m^3 for $PM_{2.5}$ (Yukon Environment, 2019).

Summary statistics for 2012-2024 are presented in Table 2-20 for the three sampling locations (TSP-1, TSP-2, and TSP-3). When results were below the detection limit, half the detection limit was used to calculate the summary statistics.

Most results met standards for YAAQS, with the following exceptions noted:

- PM_{10} exceedances: TSP-1 on May 17, 2022; TSP-2 on November 7, 2022; TSP-3 on July 23, 2020, October 9, 2022, July 18, 2023, and August 11, 2023; and
- $PM_{2.5}$ exceedances: TSP-1 on July 9, 2019, July 24 and July 28, 2023; TSP-2 on June 22, 2021, June 16, 2022, June 18, 2022, July 23, 2023, and May 4, 2024; TSP-3 on July 9, 2023.

Table 2-20: Total Suspended Particulates, Coarse, and Fine Particulate Matter Summary Statistics 2012 to 2024

	TSP (µg/m^3)			PM_{10} (µg/m^3)			$PM_{2.5}$ (µg/m^3)		
Yukon Ambient Air Quality Standards	**120**			**50**			**27**		
Sampling Location	**TSP-1***	**TSP-2**	**TSP-3**	**TSP-1**	**TSP-2**	**TSP-3**	**TSP-1**	**TSP-2**	**TSP-3***
Average	5.7	6.9	6.2	4.9	5.7	5.2	4.1	4.9	4.2
Count	442	457	393	331	355	372	317	357	368
Minimum	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Maximum	93.5	106.8	97.4	**134.2**	**151.4**	**88.6**	**31.1**	**40.7**	**38.9**
Geometric Mean	4.1	4.6	4.1	3.6	4.1	3.8	3.4	3.8	3.6
Count < DL	0	0	0	0	0	0	0	0	0
Standard Deviation	7.3	9.5	10.3	8.5	9.5	8.5	3.8	5.2	3.5
1st Quartile	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Median	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
3rd Quartile	6.4	7.2	6	2.8	6.1	2.8	2.8	2.8	2.8
Count Over Standard	0	0	0	1	1	4	3	5	1
% Over Standard	0	0	0	0.3	0.3	1.1	0.9	1.4	0.3

Note. Bold text and blue fill = an exceedance of Yukon Ambient Air Quality Standard.
* Three outliers were removed (TSP-1 976.4 µg/m^3 on July 1, 2015; TSP-3 65 µg/m^3 on July 14, 2017; TSP-2 38.1 µg/m^3 on May 4, 2024.

The July 14, 2017 TSP-3 sample ($PM_{2.5}$ at 65 µg/m^3) is an outlier, with a value ten times higher than typical results. TSP-2 results from the same day were normal. TSP-1 and TSP-2, located closer to the District Mill and DSTF, recorded elevated but not outlier readings ($PM_{2.5}$ at 7.9 µg/m^3 and PM_{10} at 9.2 µg/m^3). The TSP-3 outlier likely resulted from laboratory error or filter contamination. No trends in the data before or after this date support the outlier result.

$PM_{2.5}$ concentrations at TSP-2 on May 4, 2024 exceeded the standard (38.1 µg/m^3 vs. 27 µg/m^3 standard); however, this was determined to be an outlier.

From 2012-2024, the greatest average TSP concentration was measured at TSP-2 (6.9 µg/m^3; **Error! Reference source not found.**). Concentration of TSP at station TSP-1 measured 5.7 µg/m^3, and TSP-3 measured 6.2 µg/m^3, and concentrations are less than the YAAQS (120 µg/m^3). For coarse particulate matter (PM_{10}), the greatest average concentration was recorded at TSP-2 (5.7 µg/m^3) and the lowest average at TSP-1 (4.9 µg/m^3). For fine particulate matter ($PM_{2.5}$), the greatest average concentration was recorded at TSP-2 (4.9 µg/m^3) and the lowest average at TSP-1 (4.1 µg/m^3). In 2024, exceedances were recorded for PM_{10} concentrations at monitoring location TSP-3 (July 18 and August 11, 2024).

All TSP samples collected to date were below the Yukon air quality standard for TSP, except for one sample collected at TSP-1 (July 1, 2015) which was determined to be an outlier.

All PM_{10} samples collected to date at the three monitoring locations are less than their respective YAAQS, except for five samples in 2022 and 2023 which were due to local forest fires or significantly colder weather. Exceedances include TSP-1 on May 17, 2022, TSP-2 on November 7, 2022, and TSP-3 on October 9, 2022, July 18 and August 11, 2023.

All $PM_{2.5}$ samples collected to date at the three monitoring locations are less than their respective YAAQS, except for ten samples: TSP-1 on July 9, 2019, July 24 and 28, 2023, TSP-2 on June 22, 2021, June 16 and June 18, 2022, July 23, 2023, and May 4, 2024, and TSP-3 on July 9, 2023. An exceedance was also observed at TSP-3 on July 15, 2017; however, this was determined to be an outlier. The 2019 result may be due to the Shanghai Creek wildfire which was near Elsa and Keno City in July and August causing poor air quality conditions. Additionally, exceedances observed in 2022 and 2023 are also likely due to local forest fires.

2.4.2 Metal Speciation

Dust originating from the DSTF may contain arsenic, aluminum, calcium, iron, magnesium, manganese, lead, and zinc, based on metal characterization analyses of the tailings. From the wind direction distribution, TSP-2 is more frequently located downwind of the DSTF than TSP-1.

There are no ambient air quality standards for metals in Yukon; however, the Ontario Ministry of Environment has developed a comprehensive list of Ambient Air Quality Criteria (AAQC) that includes 24-hr average concentrations for metals (Ontario Ministry of Environment Conservation and Parks, 2020). These are referenced in the following discussion for information (context) only.

As of year-end 2024, all parameters met AAQC except for cadmium (TSP-2 – 0.4% of samples; TSP-3 – 0.5% of samples), lead (TSP-1 – 0.4% of samples; TSP-2 – 0.2% of samples; TSP-3 – 0.3% of samples), manganese (TSP-2 – 1.3% of samples), and nickel (TSP-1 – 0.4% of samples). Table 2-21 illustrates the years in which the various stations did not meet the Ontario AAQC.

Table 2-22 presents the summary statistics for 2012 to 2024 for metal concentrations from samples TSP-1, TSP-2, and TSP-3. When results were below the detection limit a value of half the detection limit was used to calculate the statistics. As the samples were not normally distributed and variances were not equal, non-parametric tests (Kruskal-Wallis and Mann-Whitney) were used for statistical comparisons of the sample medians of 2024 data only and medians of data from all years (2012 – 2024) at a significance level (p) of 0.05. Usually, concentrations of total metals were greater at TSP-1 and TSP-2 compared to TSP-3 (located furthest from mining activity).

Table 2-21: Parameters greater than Ontario Ambient Air Quality Criteria by location and year

PARAMETER	CADMIUM			LEAD			MANGANESE			NICKEL		
Sampling Location	TSP-1	TSP-2	TSP-3	TSP-1	TSP-2	TSP-3	TSP-1	TSP-2	TSP-3	TSP-1	TSP-2	TSP-3
2012			na	X		na			na			na
2013		X		X	X			X				
2014		X										
2015												
2016												
2017								X				
2018												
2019			X									
2020												
2021	na		X	na			na			na		
2022												
2023						X		X		X		
2024								X				

Table 2-22: Metal Concentrations Summary Statistics (24-hour) 2012 – 2024

	Al	Sb	As	Ba	Be	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Sn	Ti	V	Zn	Zr
Ontario Ambient Air Quality Criteria (µg/m³)	**n/a**	**25**	**0.3**	**10**	**0.01**	**120**	**0.025**	**n/a**	**0.5**	**0.1**	**50**	**4**	**0.5**	**n/a**	**0.4**	**120**	**2**	**n/a**	**n/a**	**10**	**n/a**	**1**	**n/a**	**120**	**n/a**	**10**	**120**	**2**	**120**	**n/a**
TSP-1																														
Average	0.139	0.07289	0.02936	0.0022	0.00308	0.022	0.00736	0.359	0.0703	0.01838	0.020	0.150	0.03587	0.033	0.008	0.01867	0.02062	0.136	0.390	0.01853	0.365	0.01099	0.231	0.00214	31.9	0.02987	0.014	0.018	0.0262	0.020
Count	446	447	447	447	447	447	447	447	444	446	446	447	447	447	447	447	447	447	447	447	375	443	445	447	432	447	447	447	447	447
Minimum	0.014	0.00035	0.00035	0.0003	0.00035	0.021	0.00007	0.069	0.0208	0.00035	0.000	0.021	0.00035	0.021	0.000	0.00021	0.00035	0.056	0.035	0.00035	0.139	0.00014	0.069	0.00035	0.1	0.00035	0.014	0.014	0.0035	0.003
Maximum	5.292	0.13889	0.05556	0.0222	0.00556	0.264	0.01389	8.722	0.1458	0.03472	0.035	2.528	**1.08333**	0.429	0.301	0.09264	**0.42361**	0.208	1.035	0.07917	3.875	0.02083	2.444	0.04097	69.4	0.19306	0.061	0.021	0.8167	0.035
Geometric Mean	0.093	0.00815	0.00538	0.0018	0.00149	0.021	0.00147	0.249	0.0661	0.00390	0.010	0.091	0.01230	0.027	0.005	0.00331	0.00755	0.111	0.184	0.00390	0.243	0.00197	0.202	0.00134	2.2	0.00512	0.014	0.017	0.0140	0.011
Count <DL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Standard Deviation	0.358	0.06926	0.02750	0.0022	0.00261	0.016	0.00686	0.619	0.0235	0.01718	0.016	0.211	0.06776	0.038	0.020	0.01763	0.02813	0.076	0.324	0.01759	0.528	0.01034	0.173	0.00313	34.6	0.02938	0.003	0.004	0.0577	0.016
1st Quartile	0.058	0.00035	0.00035	0.0015	0.00035	0.021	7.00E-05	0.139	0.0532	0.00035	0.002	0.05	0.00211	0.021	0.002	0.00021	0.00139	0.056	0.035	0.00035	0.139	0.00014	0.194	0.00074	0.1	0.00035	0.014	0.014	0.0086	0.003
Median	0.139	0.13889	0.05556	0.0021	0.00556	0.021	0.01389	0.222	0.0681	0.03472	0.035	0.075	0.05556	0.021	0.006	0.03472	0.03472	0.208	0.694	0.03472	0.208	0.02083	0.208	0.00208	0.3	0.05556	0.014	0.021	0.0139	0.035
3rd Quartile	0.139	0.13889	0.05556	0.0021	0.00556	0.021	0.01389	0.444	0.0847	0.03472	0.035	0.202	0.05556	0.021	0.006	0.03472	0.03472	0.208	0.694	0.03472	0.292	0.02083	0.208	0.00208	69.4	0.05556	0.014	0.021	0.0217	0.035
Count Exceeding Standard	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
% Exceeding Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TSP-2																														
Average	0.121	0.06632	0.02736	0.0024	0.00282	0.021	0.00695	0.368	0.0714	0.01664	0.019	0.228	0.04985	0.042	0.025	0.01661	0.01745	0.128	0.358	0.01664	0.353	0.01038	0.209	0.00193	35.3	0.02664	0.014	0.017	0.0436	0.018
Count	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462	462	395	458	462	462	445	462	462	462	462	462
Minimum	0.014	0.00035	0.00035	0.0003	0.00035	0.021	0.00007	0.069	0.0208	0.00035	0.000	0.021	0.00035	0.021	0.000	0.00021	0.00035	0.056	0.035	0.00035	0.139	0.00014	0.069	0.00035	0.1	0.00035	0.014	0.014	0.0035	0.003
Maximum	1.625	0.13889	0.08528	0.0476	0.00556	0.099	**0.04028**	3.472	0.1889	0.03472	0.039	3.167	**0.73611**	0.468	**0.739**	0.03472	0.06417	0.208	1.014	0.03472	5.028	0.02083	1.125	0.03167	69.4	0.05556	0.032	0.021	0.5389	0.035
Geometric Mean	0.090	0.00781	0.00569	0.0019	0.00130	0.021	0.00172	0.279	0.0668	0.00310	0.010	0.128	0.02523	0.031	0.009	0.00253	0.00644	0.104	0.161	0.00309	0.231	0.00247	0.189	0.00138	3.0	0.00427	0.014	0.017	0.0247	0.010
Count < DL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Standard Deviation	0.125	0.06898	0.02718	0.0030	0.00260	0.005	0.00701	0.335	0.0249	0.01718	0.016	0.326	0.06300	0.049	0.071	0.01722	0.01669	0.076	0.324	0.01718	0.551	0.01006	0.106	0.00231	34.7	0.02749	0.001	0.003	0.0615	0.016
1st Quartile	0.056	0.00035	0.00035	0.0015	0.00035	0.021	0.00025	0.139	0.0533	0.00035	0.003	0.062	0.0097	0.021	0.006	0.00021	0.00136	0.056	0.035	0.00035	0.139	0.00014	0.171	0.00083	0.1	0.00035	0.014	0.014	0.0139	0.003
Median	0.139	0.00322	0.00819	0.0021	0.00035	0.021	0.00173	0.333	0.0694	0.00035	0.012	0.113	0.05556	0.021	0.006	0.00057	0.00333	0.056	0.159	0.00035	0.208	0.00358	0.208	0.00208	69.4	0.00131	0.014	0.014	0.0164	0.003
3rd Quartile	0.139	0.13889	0.05556	0.0021	0.00556	0.021	0.01389	0.486	0.0861	0.03472	0.035	0.31	0.05556	0.046	0.015	0.03472	0.03472	0.208	0.694	0.03472	0.208	0.02083	0.208	0.00208	69.4	0.05556	0.014	0.021	0.0485	0.035
Count Exceeding Standard	0	0	0	0	0	0	2	0	0	0	0	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Exceeding Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TSP-3																														
Average	0.129	0.04734	0.01938	0.0020	0.00211	0.023	0.00559	0.391	0.0687	0.01199	0.015	0.103	0.02476	0.035	0.006	0.01199	0.01329	0.108	0.273	0.01198	0.287	0.00722	0.200	0.00286	44.8	0.01927	0.014	0.016	0.0347	0.014

	Al	Sb	As	Ba	Be	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Sn	Ti	V	Zn	Zr
Ontario Ambient Air Quality Criteria (µg/m³)	**n/a**	**25**	**0.3**	**10**	**0.01**	**120**	**0.025**	**n/a**	**0.5**	**0.1**	**50**	**4**	**0.5**	**n/a**	**0.4**	**120**	**2**	**n/a**	**n/a**	**10**	**n/a**	**1**	**n/a**	**120**	**n/a**	**10**	**120**	**2**	**120**	**n/a**
Count	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	375	393	393	393	378	393	393	393	393	393
Minimum	0.014	0.00035	0.00035	0.0003	0.00035	0.021	0.00007	0.069	0.0035	0.00035	0.000	0.021	0.00035	0.021	0.000	0.00021	0.00035	0.056	0.035	0.00035	0.139	0.00014	0.069	0.00035	0.1	0.00035	0.014	0.014	0.0035	0.003
Maximum	2.778	0.13889	0.05556	0.0236	0.00556	0.218	**0.17361**	6.417	0.2556	0.03472	0.050	2.417	**1.00139**	0.553	0.233	0.03472	0.12028	0.208	1.006	0.03472	3.250	0.02083	1.472	0.17500	69.4	0.05556	0.014	0.021	1.1222	0.035
Geometric Mean	0.079	0.00284	0.00221	0.0016	0.00089	0.022	0.00073	0.276	0.0634	0.00167	0.006	0.063	0.00589	0.027	0.004	0.00128	0.00394	0.087	0.109	0.00166	0.204	0.00082	0.175	0.00107	7.0	0.00217	0.014	0.016	0.0134	0.007
Count < DL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Standard Deviation	0.252	0.06557	0.02604	0.0023	0.00247	0.016	0.01081	0.577	0.0241	0.01628	0.016	0.214	0.05610	0.052	0.019	0.01633	0.01707	0.072	0.311	0.01628	0.429	0.00978	0.117	0.01427	33.2	0.02611	0.000	0.003	0.1000	0.015
1st Quartile	0.044	0.00035	0.00035	0.0011	0.00035	0.021	7.00E-05	0.139	0.0543	0.00035	0.002	0.044	0.00115	0.021	0.002	0.00021	0.00117	0.056	0.035	0.00035	0.139	0.00014	0.153	0.00035	0.1	0.00035	0.014	0.014	0.0035	0.003
Median	0.093	0.00035	0.00035	0.0018	0.00035	0.021	0.00024	0.347	0.0674	0.00035	0.004	0.061	0.00397	0.021	0.004	0.00021	0.00174	0.056	0.035	0.00035	0.139	0.00014	0.208	0.00094	69.4	0.00035	0.014	0.014	0.0139	0.003
3rd Quartile	0.139	0.13889	0.05556	0.0021	0.00556	0.021	0.01389	0.472	0.0792	0.03472	0.035	0.089	0.05556	0.021	0.006	0.03472	0.03472	0.208	0.694	0.03472	0.208	0.02083	0.208	0.00208	69.4	0.05556	0.014	0.021	0.02	0.035
Count Exceeding Standard	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Exceeding Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note. "n/a" was used to signify when no Ontario Ambient Air Quality Criteria (µg/m³) exists for specific metals.
Bold values highlighted blue are greater than the Ontario Ambient Air Quality Criteria.

Historically, days where TSP levels were higher than average and where exceedances of the Ontario AAQCs were observed (lead at TSP-1), winds were generally blowing from the northeast and from the east (October 23, 2012, and June 18, 2013, respectively). Site activities occurring in October 2012 and June 2013 included active mining at Bellekeno, development at Lucky Queen and Onek, milling at the District Mill, and explorations activities at Flame & Moth. Unpaved road may have been a contributing source of ambient dust on these occasions. Roads within the vicinity of the TSP stations include mine access roads, as well as public roads including Duncan Creek Road.

Historically, when metals concentrations exceeded the Ontario AAQCs (cadmium, lead, and manganese) at TSP-2, winds were generally blowing from the north-northeast (August 23, 2012). A source of ambient dust in this event could have been the unpaved roads. On days where TSP levels were higher than average and/or where exceedances of the Ontario AAQCs were observed for manganese at TSP-2, winds were generally blowing from the northeast (March 23-24, 2013; August 9, 2017) and from the east (April 7, 2013). On these occasions, the DSTF could have been a source of TSP at TSP-2. Similarly, on days where exceedances of the Ontario AAQCs were observed for cadmium at TSP-2 (on September 28, 2013 and October 21, 2015 respectively), winds were generally from the northeast or north-northeast suggesting a possible influence of the DSTF but also of the unpaved roads. Site activities occurring in August 2012, March 2013 and April 2013 included mining at Bellekeno, development at Lucky Queen and Onek, and milling at the District Mill. Between September 2013 and December 2018, only care and maintenance activities were taking place as the mine and mill were under a temporary suspension of operations with exception of collaring Flame & Moth Portal in 2016 and the preparation of the Flame & Moth Pond.

2.4.3 Wind Analysis

Hourly wind speed and direction was recorded between June 2011 and December 2024, at the Keno District Mill weather station. The wind rose plot shown in Figure 2-13 depicts this information based on 36 wind direction categories, which was produced using WRPLOT View software. This period has a 92% data availability, i.e., refers to the available wind data in the total dataset, with the remaining 8% missing data attributed to periods of frozen sensors and maintenance.

The average wind speed is 1.26 m/s and winds are calm 20.97% of the time. Note that the wind sensor experienced occasional icing during the winter months and extended periods of zero wind speed were excluded from this analysis. Also, winter wind speeds may occasionally be underestimated due to the presence of ice on the sensor, but these occurrences cannot be detected in the data record. Wind speed and direction frequency distribution are compiled in Table 2-23 below, and are based on eight wind direction categories, and six wind speed categories. Wind speed and direction is also collected at the Valley Tailings and Calumet stations.

The dominant wind direction in Keno is from the north followed closely by east. When the predominant wind direction is from the northeast, air quality stations TSP-1 and TSP-2 are located downwind of the DSTF and the crusher. When the wind blows from the southeast those same stations are upwind from the DSTF and crusher. Given these generalities TSP-1 and TSP-2 may capture influences from facilities when the wind is from the northeast but are otherwise not downwind. Air quality station TSP-3, located on the outskirts of Keno City, is east of these potential dust sources. Based on Table 2-23, westerly winds only occur about 3% of the time (or roughly 13% of the time when combining northwest, west, and southwest), so the DSTF and crusher are expected to have very limited influence on air quality in Keno City (TSP-3).

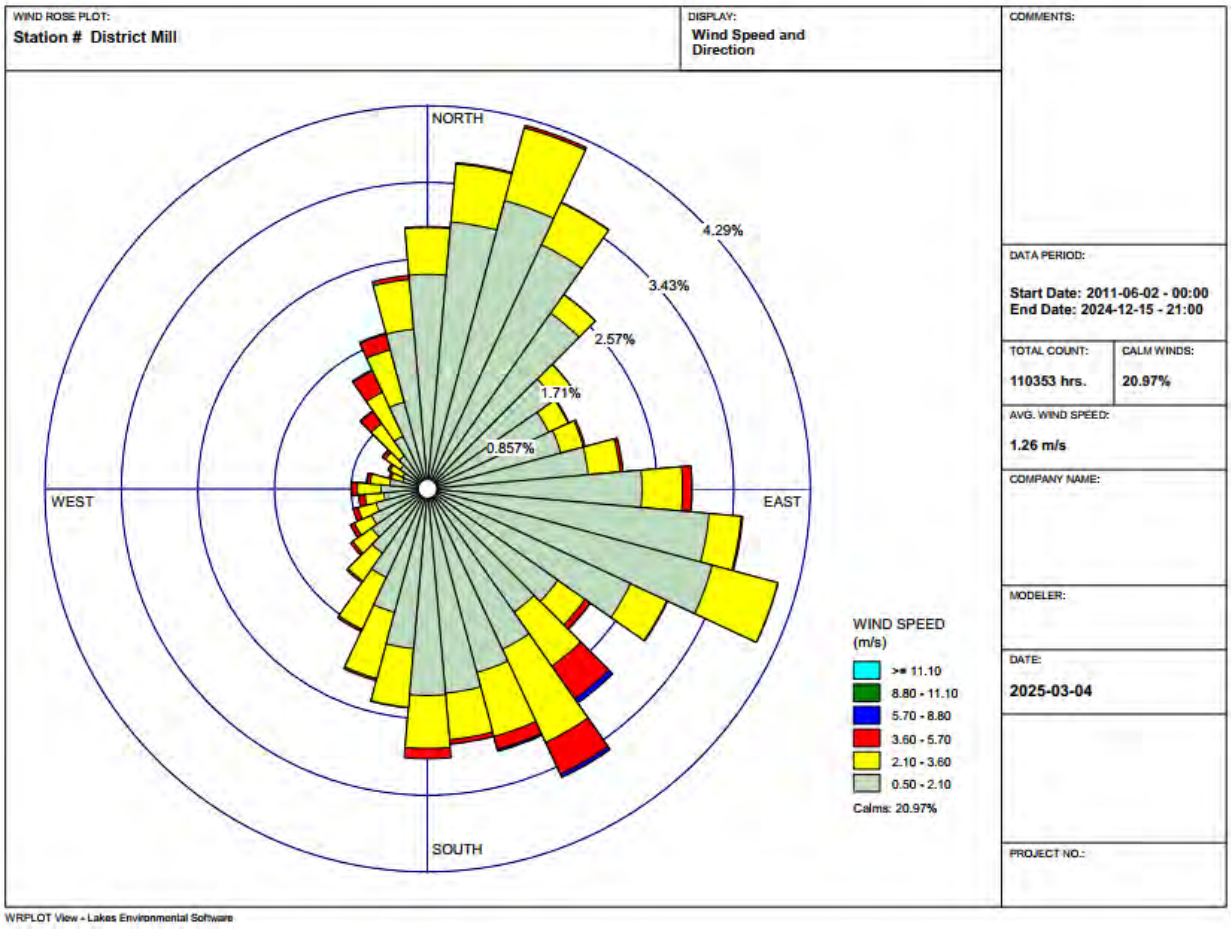


Figure 2-13: Wind Rose for Keno District Mill Weather Station, June 2011 – December 2024

Table 2-23: Wind Frequency Distribution District Mill, June 2011 – December 2024

DIRECTIONS / WIND CLASSES (M/S)	0.50 - 2.10	2.10 - 3.60	3.60 - 5.70	5.70 - 8.80	8.80 - 11.10	>= 11.10	TOTAL (%)
N	10.60	2.84	0.23	0.01	0.00	0.00	13.68
NE	9.71	1.48	0.04	0.00	0.00	0.00	11.23
E	11.16	1.96	0.17	0.00	0.00	0.00	13.30
SE	9.12	3.10	0.98	0.10	0.00	0.00	13.30
S	9.07	2.87	0.27	0.02	0.00	0.00	12.22
SW	3.89	1.72	0.15	0.00	0.00	0.00	5.76
W	2.08	0.93	0.23	0.02	0.00	0.00	3.27
NW	2.08	1.54	0.56	0.03	0.00	0.00	4.21
SUB-TOTAL	57.71	16.45	2.63	0.18	0.00	0.00	76.97
					Calm		20.97
					Total		100

2.4.4 PM_{10} Sampling by Yukon Government

Yukon Government conducted PM10 sampling in 2013 at locations shown in Figure 2-12. Station BG represents background (8 km outside Keno), KC stations are in Keno City, HR stations are along the Bellekeno Haul Road, and FL stations correspond to TSP-1 and TSP-2 locations.

Five-minute data averaged over different sampling periods are presented in Table 2-24. Sampling periods varied between sites (14 to 53 hours), but all average results were below the 24-hour YAAQS of 50 µg/m^3.

During the July 15-17, 2013 event, background PM10 (10.2 µg/m^3) exceeded some receptor locations, including HR1 (5.2 µg/m^3). This indicates variability in the data, with background and receptor concentrations often within the same range. Results are comparable to PM10 concentrations measured by AKHM at TSP-1, TSP-2, and TSP-3 (August 2015 to December 2024).

Table 2-24: Average Coarse Particulate Matter (PM_{10}) concentrations

SITE LOCATIONS	PM_{10} (µg/m^3)		
	JUNE 11-13, 2013	JULY 15-17, 2013	AUGUST 21-22, 2013
BG	2.8	10.2	3.8
KC1	6.2	NS	NS
KC2	3.8	NS	NS
KC3	8.3	NS	NS
KC4	2.1	NS	NS
HR1	NS	5.2	NS
HR2	NS	2.1	NS
HR3	NS	13.8	NS
HR4	NS	16.4	NS
FL1	NS	NS	0.8
FL2	NS	NS	39.3

Notes. Source: Yukon Government, 2014
NS: Not Sampled

Data presented in Table 2-24 were obtained from Yukon Government, not collected by AKHM. Details of the collection methods are not presented in this report. The data are assumed accurate but may not represent all conditions observed over a year due to the limited dataset.

3 SURFACE WATER

3.1 HYDROLOGY

Open water season is typically late May until mid-October. Low flows generally occur March to April. Maximum daily flows typically occur in spring in response to snowmelt and rain on snow events, however summer and fall rainstorms can also produce large events. Large increases in flow in response to rain events is common in the small streams of the area.

3.1.1 Regional Hydrology

Two watersheds exist within the Keno Hill Mining District: the May River Watershed and the South McQuesten River watershed. The closest and most relevant Water Survey of Canada hydrometric station is on McQuesten River near its mouth (Station 09DD004), located in the South McQuesten River watershed. The station has been monitored for flow and level since 1979. The drainage area is 4,750 km2 and the mean annual runoff (MAR) is 253.8 mm. Table 3-1 presents the mean daily flow as well as mean low flow and mean daily high flow for the 1979 to 2013 at McQuesten River near the mouth (Station 09DD004).

Table 3-1: McQuesten River Mean, Mean Minimum, and Mean Maximum Daily Flows

DISCHARGE	MEAN	MIN	MAX
m^3/d	3,300,480	1,909,440	5,590,080
m^3/s	38.2	22.1	64.7
$L/s/km^2$	8.0	4.6	13.6

The mean monthly flow distribution is typical of the region and Yukon in general, exhibiting a snowmelt dominated freshet period (Figure 3-1). Peak mean monthly and daily flows most often occur in May, but also in June, with summer and early fall rain sustaining flows till the onset of winter at which time discharge begins to decrease, reaching their lowest in March (Figure 3-1). The McQuesten River mean flow data presented below include all available mean monthly flow data including 1979 to 2023, which is the most up-to-date publicly available data.

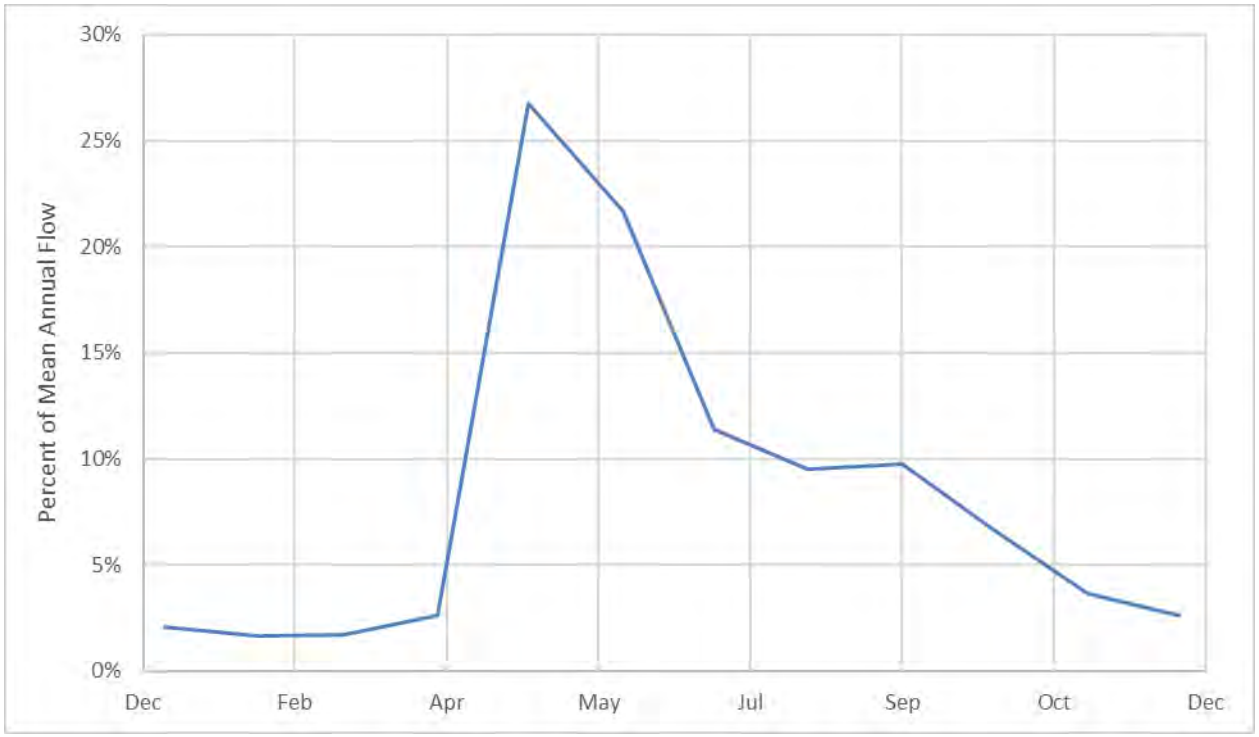


Figure 3-1: Annual Flow Distribution at McQuesten River Near the Mouth (09DD004)

McQuesten mean flow data available from 1979 to 2023.

3.1.2 Discrete Discharge Monitoring Stations

Discharge measurements and staff gauge observations are taken during scheduled visits at the stations identified in Figure 3-2. ERDC also monitors flow within the Keno Ladue catchment at KV-35, KL-10, KL-12, KL-15 and UL-W1. The velocity-area method is used for discharge measurements and taken with an electromagnetic current meter or acoustic doppler velocimeter, where and when creek flow is laminar, and the creeks are open. Salt dilution gauging is used when the flow is turbulent, generally steeper creeks with abundant boulders, or in winter when the creeks are covered in ice. Discrete data measurements are used to develop rating curves for computation of continuous stage data into derived continuous discharge records for the open water season.

Site	DESCRIPTION	SAMPLING SCHEDULE	CONTINUOUS (Y/N)	DRAINAGE AREA (km2)	MEDIAN ELEVATION (masl)	STATION ELEVATION (masl)	MAX ELEVATION (masl)	INSTRUMENT-ATION	MEASUREMENT FREQUENCY	ACCURACY (+/- %FS)[1]	NUMBER OF BENCHMARKS
Mayo River Watershed											
KV-41	Lightning Creek upstream of bridge at Keno City	Monthly	Y	59	1400	935	1988	Solinst M2	15 min	0.05	3
KV-43				NA							
KV-6	Christal Creek at Silver Trail Highway	Monthly	Y	6.1	1002	855	1350	Solinst M5	15 min	0.05	3
KV-72	Christal Creek at Hanson Road	Monthly	Y	35.8	970	675	1685	Solinst M5	15 min	0.05	3
KV-92,3	Flat Creek upstream of South McQuesten River	Monthly	Y	56.5	830	625	1411	Solinst M2	15 min	0.05	3
KV-21	No Cash Creek at Silver Trail Highway	Monthly	Y	1.4	1212	821	1389	Solinst M5	15 min	0.05	3
KV-812	Lightning Creek Southwest of Mill Site	Monthly WD	Y	NA				Solinst M5	15 min	0.05	3
KV-104L				NA							
South McQuesten River Watershed											
KV-512	Christal Creek downstream of Hinton Creek	Quarterly	Y	2.8	1172	861	1443	Solinst M2	15 min	0.05	3
KV-602,3	Galena Creek upstream of Silver King Adit	Quarterly	N discontinued	9.4	997	739	1400	Solinst M2	15 min	0.05	3
KV-642,3	Flat Creek at Silver Trail Highway	Quarterly	N discontinued	4.4	1159	818	1412	Solinst M2	15 min	0.05	3
KV-272,3	Galkeno 300 Adit		Continuous								
KV-282,3	Discharge from Galkeno 300 Pond Treatment Pond		Continuous								
KV-312,3	Galkeno 900 Adit		Continuous								
KV-322,3	Discharge from Galkeno 900 Pond Treatment Pond		Continuous								
KV-452	Onek 400 Adit		Continuous Monthly2								
KV-952,3	Discharge from Onek 400 Water Treatment Pond		Continuous								
KV-104C				NA							

Site	DESCRIPTION	SAMPLING SCHEDULE	CONTINUOUS (Y/N)	DRAINAGE AREA (km2)	MEDIAN ELEVATION (masl)	STATION ELEVATION (masl)	MAX ELEVATION (masl)	INSTRUMENT-ATION	MEASUREMENT FREQUENCY	ACCURACY (+/- %FS)[1]	NUMBER OF BENCHMARKS
KV-110											
KV-114											

Note.

[1] % FS is Percentage of Foresight

[2] Continuous monitoring not a requirement of QZ18-044

[3] Discrete monitoring not a requirement of QZ18-044

Figure 3-2Table 3-2: Discrete Hydrometric Monitoring Stations

SITE	DESCRIPTION	FLOW READING SCHEDULE
Mayo River Watershed		
KV-33[1]	Keno 700 Adit	Monthly
KV-37	Lightning Creek upstream of Hope Gulch	Quarterly
KV-38	Lightning Creek upstream of Thunder Gulch	Quarterly
KV-39	Hope Gulch upstream of Lightning Creek	Quarterly
KV-40	Charity Gulch upstream of Lightning Creek	Quarterly
KV-41	Lightning Creek u/s bridge at Keno City	Monthly
KV-44	Bellekeno 625 Seep	Monthly (May-October)
KV-65	Thunder Gulch upstream of Bellekeno 625 Adit	Quarterly
KV-76	Thunder Gulch downstream of Bellekeno 625 Adit	Quarterly
KV-77	Thunder Gulch upstream of Bellekeno East Portal	Quarterly
KV-81	Lightning Creek Southwest of Mill Site	Monthly WD
South McQuesten River Watershed		
KV-1	South McQuesten River upstream of Christal Creek	Quarterly
KV-2	South McQuesten River at Pumphouse	Quarterly
KV-3[1]	South McQuesten River upstream of Flat Creek	Quarterly
KV-4[1]	South McQuesten River 350 m downstream of Flat Creek	Quarterly
KV-6	Christal Creek at Keno Highway	Monthly
KV-7	Christal Creek at Hanson Road	Monthly
KV-8	Christal Creek at the mouth	Quarterly
KV-9[1]	Flat Creek upstream of South McQuesten River	Monthly
KV-9A[1]	Flat Creek upstream of Galena Creek	Monthly
KV-12[1]	Discharge from Valley Tailings Pond #3	Monthly
KV-13[1]	Silver King Adit	Continuous
KV-14[1]	Discharge from Silver King Treatment Pond	Monthly
KV-17[1]	Husky South West Shaft	Monthly
KV-18[1]	Bermingham Adit	Quarterly
KV-19[1]	Ruby Adit	Quarterly
KV-20[1]	No Cash 500 Adit	Monthly
KV-21	No Cash Creek at Silver Trail Highway	Monthly
KV-45	Onek 400 Adit	Quarterly[2]
KV-49	Hinton Creek upstream of Christal Creek	Quarterly
KV-50	Christal Creek upstream of Hinton Creek	Monthly WD
KV-51	Christal Creek downstream of Hinton Creek	Quarterly
KV-52	Natural Spring to Christal Lake at Old Mackeno pumphouse	Monthly
KV-54[1]	Erickson Gulch at Road to Lucky Queen	Monthly
KV-55[1]	Sandy Creek at Silver Trail Highway	Monthly

SITE	DESCRIPTION	FLOW READING SCHEDULE
KV-56	Star Creek at Silver Trail Highway	Monthly
KV-59[1]	Galena Creek at mouth (just upstream of Flat Creek)	Quarterly
KV-60A[1]	Galena Creek upstream of Silver King 75 adit	Quarterly
KV-61[1]	Porcupine Gulch at Calumet Road Crossing	Quarterly
KV-64[1]	Flat Creek at Silver Trail Highway	Quarterly
KV-72	South McQuesten River at McQuesten Lake	Quarterly
KV-111	No Cash Creek above No Cash 500 Adit	Monthly
KV-118	No Cash Creek at Calumet Road	Monthly

Note. [1] Discrete monitoring not a requirement of QZ18-044.

3.1.3 Continuous Hydrometric Monitoring Stations

Automated pressure transducers are deployed in stilling wells at each continuous hydrometric station (Table 3-3), these loggers are set to record water level (stage) values every 15 minutes. Discrete stage and discharge measurements are collected during scheduled field visits. These measurements are used to create a rating curve, which when applied to continuous stage readings, calculates derived discharge values. Since initial installation the stations have been moved or upgraded with industry standard monitoring equipment based on the location, major changes to stations are detailed in the sections below.

The seven continuous hydrometric stations currently being monitored by Hecla Yukon in the District include: KV-6, KV-7, KV-9, KV-21, KV-41, KV-51, and KV-81. The hydrometric stations are on Christal Creek, Flat Creek, No Cash Creek, and Lightning Creek as shown on Figure 3-2. Christal Creek, Flat Creek and No Cash Creek are within the South McQuesten River catchment and Lightning Creek is in the Mayo River catchment. Descriptions of the hydrometric monitoring stations are provided in Table 3-3.

The continuous monitoring of KV-6, KV-21, and KV-41 supports the monitoring outlined in Schedule A of AKHM's Water Use Licence QZ18-044. Though not required under QZ18-044, continuous monitoring data is also collected Stations KV-7, KV 9, and KV-51. A hydrometric station was installed at KV-81 in July 2024 and is currently visited monthly. Stations KV-60 on Galena Creek and KV-64 on Flat Creek at the Silver Trail Highway, were monitored until April 2023, at which point they were removed from the monitoring schedule outlined in ERDC's Water Use Licence QZ21-012.

Table 3-3: Continuous Hydrometric Monitoring Stations

SITE	DESCRIPTION	SAMPLING SCHEDULE	CONTINUOUS (Y/N)	DRAINAGE AREA (km^2)	MEDIAN ELEVATION (masl)	STATION ELEVATION (masl)	MAX ELEVATION (masl)	INSTRUMENT-ATION	MEASUREMENT FREQUENCY	ACCURACY (+/- %FS)[1]	NUMBER OF BENCHMARKS
Mayo River Watershed											
KV-41	Lightning Creek upstream of bridge at Keno City	Monthly	Y	59	1400	935	1988	Solinst M2	15 min	0.05	3
KV-43				NA							
KV-6	Christal Creek at Silver Trail Highway	Monthly	Y	6.1	1002	855	1350	Solinst M5	15 min	0.05	3
KV-7[2]	Christal Creek at Hanson Road	Monthly	Y	35.8	970	675	1685	Solinst M5	15 min	0.05	3
KV-9[2,3]	Flat Creek upstream of South McQuesten River	Monthly	Y	56.5	830	625	1411	Solinst M2	15 min	0.05	3
KV-21	No Cash Creek at Silver Trail Highway	Monthly	Y	1.4	1212	821	1389	Solinst M5	15 min	0.05	3
KV-81[2]	Lightning Creek Southwest of Mill Site	Monthly WD	Y	NA				Solinst M5	15 min	0.05	3
KV-104L				NA							
South McQuesten River Watershed											
KV-51[2]	Christal Creek downstream of Hinton Creek	Quarterly	Y	2.8	1172	861	1443	Solinst M2	15 min	0.05	3
KV-60[2,3]	Galena Creek upstream of Silver King Adit	Quarterly	N discontinued	9.4	997	739	1400	Solinst M2	15 min	0.05	3
KV-64[2,3]	Flat Creek at Silver Trail Highway	Quarterly	N discontinued	4.4	1159	818	1412	Solinst M2	15 min	0.05	3
KV-27[2,3]	Galkeno 300 Adit		Continuous								
KV-28[2,3]	Discharge from Galkeno 300 Pond Treatment Pond		Continuous								
KV-31[2,3]	Galkeno 900 Adit		Continuous								
KV-32[2,3]	Discharge from Galkeno 900 Pond Treatment Pond		Continuous								
KV-45[2]	Onek 400 Adit		Continuous Monthly[2]								

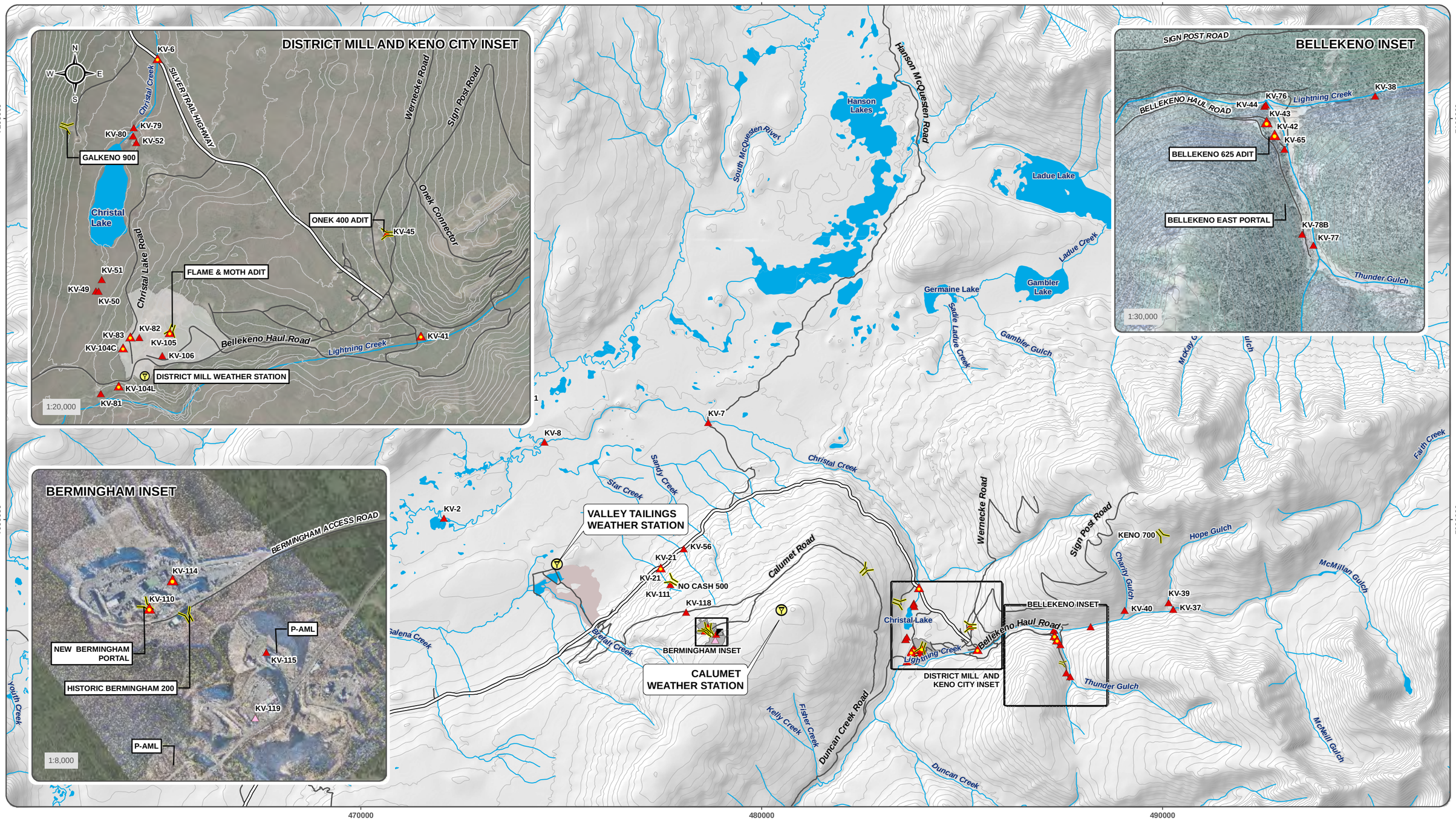
SITE	DESCRIPTION	SAMPLING SCHEDULE	CONTINUOUS (Y/N)	DRAINAGE AREA (km^2)	MEDIAN ELEVATION (masl)	STATION ELEVATION (masl)	MAX ELEVATION (masl)	INSTRUMENT-ATION	MEASUREMENT FREQUENCY	ACCURACY (+/- %FS)[1]	NUMBER OF BENCHMARKS
KV-95[2,3]	Discharge from Onek 400 Water Treatment Pond		Continuous								
KV-104C				NA							
KV-110											
KV-114											

Note.

[1] % FS is Percentage of Foresight

[2] Continuous monitoring not a requirement of QZ18-044

[3] Discrete monitoring not a requirement of QZ18-044



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Datum: NAD 83; Map Projection: UTM Zone 8N

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1:90,000 (when printed on 11 x17 inch paper)

0 1 2 3 4 5 Kilometers

- Active Surface Water Quality Station
- Pending/Proposed Water Quality Station
- Active Surface Water Quality and Continuous Flow Hydrology Station
- Adit
- Weather Station
- Mine Site
- Valley Tailings
- Silver Trail Highway
- Other Road
- Watercourse
- Waterbody

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 3-2
HYDROMETRIC MONITORING LOCATIONS

MARCH 2025

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3.1.3.1 Mayo River Watershed

KV-41 Lightning Creek at Keno City Bridge

Lightning Creek originates east of Keno City and drains the southern aspect of Keno Hill and the northern aspect of Mount Hinton. Lightning Creek flows to the south of Galena Hill into Duncan Creek. Within the Lightning Creek catchment there are Bellekeno and Flame & Moth mine workings/discharges and multiple historic adits including Keno 200 and 700, multiple old surface workings, and active placer mining on Thunder Gulch.

Hydrometric station KV-41 is located above the Keno City Bridge, and downstream of the Bellekeno Mine and local placer mining activity. The station at KV-41 was replaced August 12, 2020, with steel infrastructure as per the 2019 recommendations. A new vented Solinst pressure transducer was installed on September 16, 2023. Ice-free continuous water level data typically extends from late May to late September/early October after which ice begins to affect water level readings and the stage-discharge relationship.

Table 3-4 shows the mean monthly derived discharge record from 2004-2024, data from 2013 was lost due to a failure with the logger. Peak discharge generally occurs later in the season on Lightning Creek than on Christal and Flat Creeks, this is likely due to the higher elevation of the headwaters delivering a more temporally spread-out spring snowmelt and holding high elevation snowpack longer. The highest mean monthly derived discharge occurred in June 2022 at 2.855 m^3/s, followed by June 2018 at 2.565 m^3/s (Table 3-4). The highest measured discrete discharge on record was collected in June 2009 at 3.59 m^3/s, followed by June 2020 at 2.818 m^3/s (Table 3-4).

Derived discharge rates decrease throughout the summer and into winter, with the lowest mean monthly derived rates generally occurring in March or early April (Table 3-4). The lowest derived mean monthly discharge on record was in March 2016 at 0.029 m^3/s, followed by February 2016 at 0.037 m^3/s (Table 3-4). The lowest derived discharge values are generally observed in the January to April period. The lowest discrete discharge measurement was collected in February 2024 at 0.023 m^3/s, followed by January 2004 at 0.063 m^3/s (Table 3-4).

A record of the derived discharge collected at KV-41 from 2011-2024 is presented in its hydrograph below (Figure 3-3).

Table 3-4: Mean Monthly Derived Discharge at KV-41, Lightning Creek Above Keno City Bridge (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	0.098	0.067	0.056	0.13	1.802	1.418	0.989	1.111	0.958	0.637	0.452	0.299
2005	0.219	0.192	0.194	0.272	0.793	1.994	1.326	0.921	1.083	0.889	0.554	0.447
2006	-	-	-	-	1.231	1.926	1.193	-	-	-	-	-
2007	-	-	-	-	-	-	-	1.136	0.77	1.03	-	-
2008	-	0.11	0.128	0.069	1.595	1.628	-	-	-	-	-	-
2009	-	-	-	-	1.172	1.383	1.007	0.76	0.57	0.457	-	-
2010	-	-	-	-	-	0.713	1.068	0.911	0.627	-	-	-
2011	-	-	-	-	-	0.713	1.068	0.911	0.627	-	-	-
2012	-	-	-	-	0.868	1.182	0.806	0.416	0.508	0.373	-	-
2013	-	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	1.104	0.992	0.414	0.726	0.498	0.340	0.253	0.231

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	0.209	0.190	0.171	0.152	2.078	1.129	0.955	1.101	1.138	0.563	0.163	0.087
2016	0.040	0.037	0.029	0.073	0.724	1.554	0.989	1.237	0.915	0.544	0.259	0.244
2017	0.192	0.161	0.150	0.138	1.027	1.239	0.614	0.462	0.861	0.655	0.463	0.374
2018	0.197	0.241	0.278	0.267	1.663	2.565	1.133	1.449	0.953	0.469	0.392	0.312
2019	0.239	0.179	0.175	0.181	1.079	0.590	0.313	0.293	0.290	0.229	0.139	0.115
2020	0.103	0.103	0.103	0.104	1.141	2.146	0.989	1.092	0.975	0.478	-	-
2021	-	-	-	0.124	1.085	2.011	0.824	1.278	0.956	0.479	0.290	-
2022	-	-	-	0.070	0.607	2.855	1.290	1.086	1.006	1.203	0.439	0.221
2023	0.109	0.072	0.111	0.205	1.477	2.062	1.369	0.825	0.348	-	-	-
2024	-	-	0.198	0.203	0.839	1.578	0.790	0.590	0.964	0.462	0.127	-
Mean	0.156	0.135	0.145	0.153	1.193	1.609	0.945	0.906	0.789	0.587	0.321	0.259
Standard Deviation	0.065	0.063	0.067	0.066	0.394	0.588	0.288	0.318	0.255	0.256	0.140	0.108

Table 3-5: Discrete Discharge Measurements at KV-41, Lightning Creek above Keno City Bridge (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	0.063	-	-	-	-	-	0.961	-	-	-	-	-
2005	-	-	-	-	-	1.526	1.362	0.963	-	-	-	-
2006	0.192	-	-	-	-	-	-	-	-	-	-	-
2007	-	-	-	-	-	-	-	-	-	-	-	-
2008	-	-	-	-	-	-	0.664	1.493	0.713	1.191	-	-
2009	-	-	-	-	-	3.59	0.719		1.035	0.646	-	-
2010	-	-	-	-	0.441	1.675	0.967	0.818	0.483	0.415	-	-
2011	-	-	-	-	-	1.055	1.075	1.713	0.973	0.404	-	0.268
2012	0.251	-	0.182	-	0.202	-	1.958	0.884	0.795	0.566	-	-
2013	-	0.562	2.741	1.019	0.112	1.901	0.71	0.437	0.546	0.766	0.421	0.174
2014	0.149	0.126	0.096	0.519	0.72	0.908	1.092	0.429	0.705	0.65	-	0.187
2015	0.203	-	0.2	0.122	1.225	1.35	-	1.32	2.058	0.736	0.409	-
2016	0.2	0.213	0.229	0.176	0.236	1.802	0.884	1.366	1.05	0.522	0.282	0.321
2017	0.235	0.225	0.19	0.147	1.511	1.576	0.534	0.47	1.102	0.578	0.391	0.44
2018	0.129	0.301	-	0.253	0.967		0.897	1.532	0.94	0.439	0.386	-
2019	0.253	0.18	-	0.176	1.07	0.357	0.304	0.369	0.283	0.337	0.16	0.173
2020	-	0.093	0.101	0.107	0.128	2.818	1.094	0.811	1.066	0.736	0.285	0.246
2021	0.314	0.216	0.252	0.224	0.249	-	0.511	0.921	0.8	-	0.246	0.464
2022	0.196	0.108	0.141	0.125	-	-	1.038	0.94	1.22	1.068	-	-
2023	0.238	0.172	0.156	0.164	0.493	-	0.904	0.722	0.53	-	-	-
2024	0.169	0.023	0.144	0.163	0.457	1.824	1.174	0.526	-	0.598	0.336	0.221
Mean	0.199	0.202	0.403	0.266	0.601	1.699	0.936	0.924	0.894	0.643	0.324	0.277
Standard Deviation	0.061	0.135	0.741	0.250	0.441	0.812	0.356	0.412	0.393	0.229	0.083	0.104
	Salt dilution method used											
	Velocity-area method used											

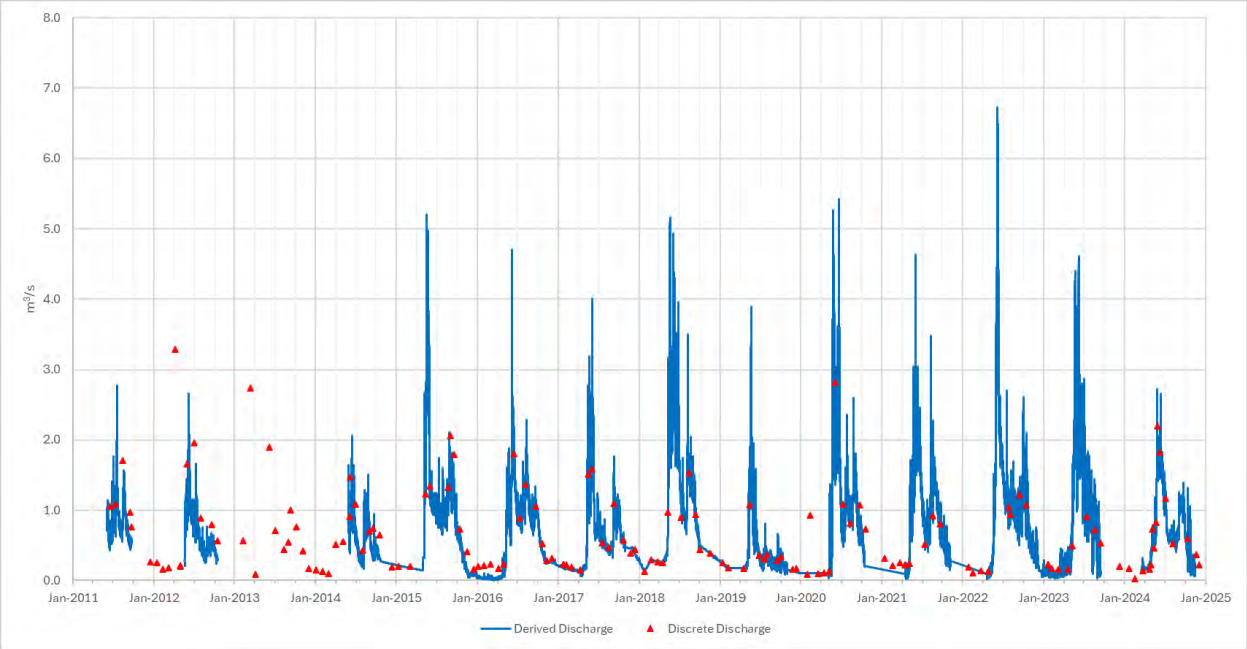


Figure 3-3: Derived Discharge at KV-41 on Lightning Creek above Keno City Bridge (2011-2024)

KV-81 Lightning Creek Southwest of Mill Site

The hydrometric station at KV-81 is located downstream of KV-41, local placer mining activity, and the Flame and Moth Water Treatment discharge point (KV-104L). The station was installed in July 2024 and has not required changes or upgrades since. The station has not seen significant movement or frost heaving since its installation.

Monthly mean discharge for the timeseries is provided in Table 3-6 below. Due to the limited dataset, trends cannot be seen at the station however, it is expected that KV-81 will follow similar trends as KV-41. The lowest mean monthly flow on record was in November 2024 at 0.425 m^3/s.

The lowest discrete discharge measurements have been observed between November and April, with the lowest being measured in March 2014 at 0.094 m^3/s, followed by April 2020 at 0.101 m^3/s (Table 3-7). The highest discrete discharge was measured in June 2013, at 3.09 m^3/s, followed by 2.76 m^3/s in June 2020 (Table 3-7). June and July typically see the highest discrete flows (Table 3-7). Spring freshet typically occurs between late May and early July within the lightning creek catchment (Figure 3-4), so it is likely that this period will see the highest derived mean monthly discharge at KV-81.

A complete record of the derived discharge collected at KV-81 is presented in its hydrograph below (Figure 3-4).

Table 3-6: Mean Monthly Derived Discharge at KV-81, Lightning Creek Southwest of Mill Site, for Months Where Continuous Data are Available (m^3/s)

	Month											
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2024	-	-	-	-	-	-	0.703	0.690	1.07	1.44	0.425	-

Table 3-7: Discrete Discharge Measurements at KV-81, Lightning Creek Southwest of Mill Site (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	-	0.126	-	-	0.240	-	1.37	-	-	0.565	-	-
2013	-	0.142	-	0.192	0.119	3.09	0.757	0.389	0.497	0.689	0.416	0.399[1]
2014	0.257	0.179[1]	0.094	0.138	0.174	0.761	1.07	-	0.755	0.641	-	0.352
2015	0.137	0.140	0.273	0.138	-	0.950	0.748	1.38	1.92	0.743	0.194	0.190
2016	0.400	0.212	0.171	0.147	0.301	1.65	0.916	-	1.10	0.677	0.289	0.254
2017	0.623	0.725	0.538	0.330	1.48	1.45	0.470	0.722	1.05	0.489	0.365	0.391
2018	0.178	0.193	0.279	0.278	0.672	-	0.848	1.43	0.920	0.465	0.294	0.237
2019	0.186	0.156	0.151	0.143	1.09	0.348	0.270	0.349	0.205	0.396	0.169	0.128
2020	0.130	0.117	0.115	0.101	0.196	2.76	1.07	0.860	0.984	0.962	-	0.442
2021	0.257	0.288	0.212	0.184	0.193	1.54	0.564	0.836	0.752	-	0.355	0.285
2022	0.251	0.174	0.158	-	0.174	-	0.980	0.995	1.41	1.26	0.769	0.217
2023	0.106	0.144	0.109	0.112	-	-	0.801	-	0.518	-	-	0.154
2024	0.239	0.194	0.168	0.184[1]	0.652[1]	1.87	1.17	-	-	0.530	0.147	0.204
Mean	0.251	0.215	0.206	0.177	0.481	1.602	0.849	0.870	0.919	0.674	0.333	0.271
Standard Deviation	0.141	0.154	0.120	0.067	0.427	0.841	0.288	0.373	0.447	0.237	0.177	0.098
	Salt dilution method used											
	Velocity-area method used											

Note. [1]Multiple instantaneous measurements were collected during the month, value presented is an average.

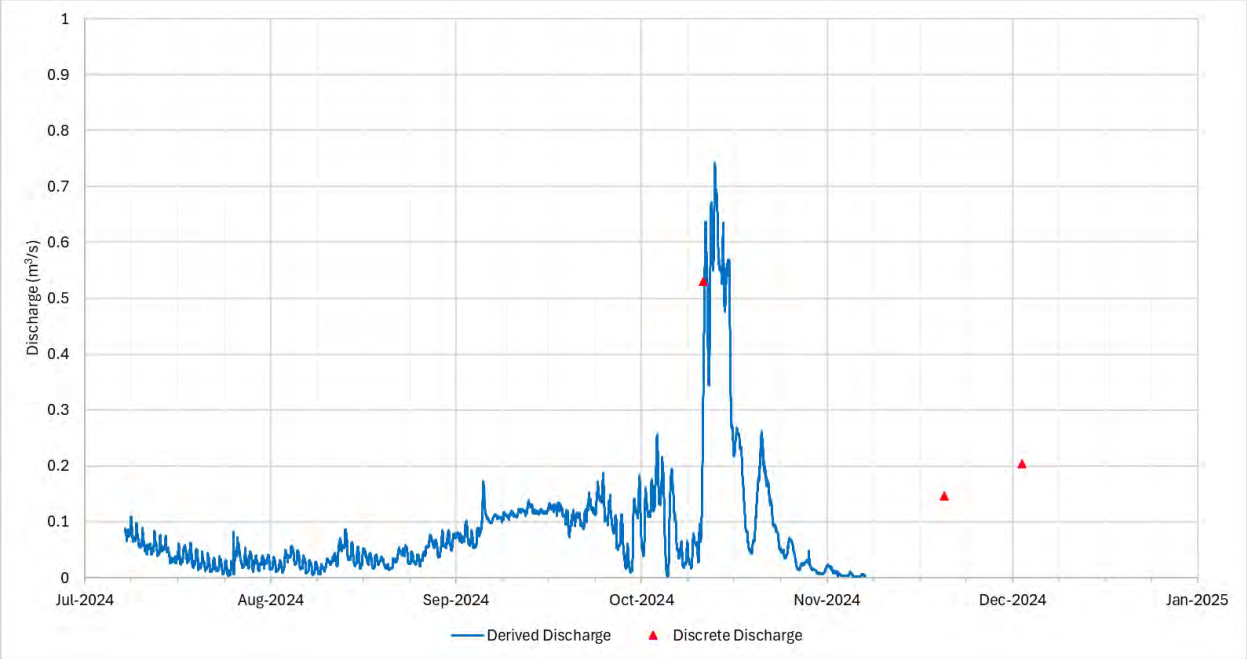


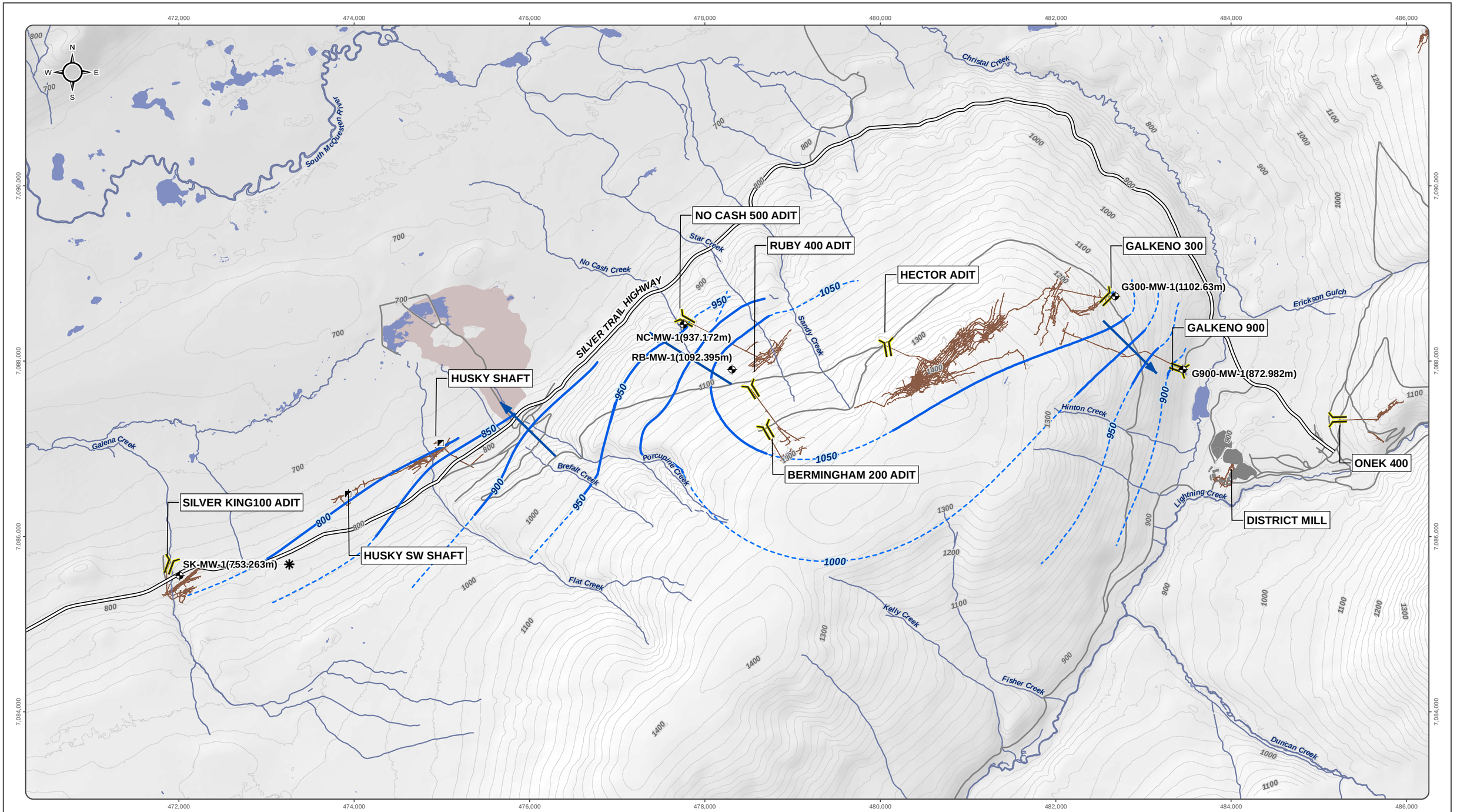
Figure 3-4: Derived Discharge at KV-81 on Lightning Creek Southwest of Mill Site (2024)

Discharge from Bellekeno Mine Water Treatment Plant

The Bellekeno Mine site is near the confluence of Thunder Gulch with Lightning Creek, on the north side of Sourdough Hill. Thunder Gulch flows into Lightning Creek roughly 300 m down the hill from the Bellekeno 625 Water Treatment Plant (WTP). Lightning Creek eventually converges with Duncan Creek, which then drains into the Mayo River. Bellekeno 625 treated decant water is discharged east of the treatment plant and reports to ground, flowing via a diffuse surface pathway into Lightning Creek, downstream of Thunder Gulch (Figure 3-5). This water eventually reports to placer mining sedimentation ponds located immediately downstream of the discharge point. The sedimentation ponds discharge into Lightning Creek farther downstream towards Keno City.

The Bellekeno Mine dewatering pump was halted October 15, 2021, at the completion of planned mining, and the mine workings have slowly been allowed to flood. The mine was put into temporary closure December 15, 2021, in accordance with Clause 123 of the Water Licence. In 2022, there was no discharge of mine water and the Bellekeno 625 WTP was inactive. Flooding of the underground workings reached the Bellekeno 625 Adit level and discharge to the WTP resumed on May 13, 2023. The settling ponds filled and discharge of treated mine effluent to the environment resumed on May 16, 2023. Discharge to the environment continued throughout 2024.

The daily Bellekeno 625 Adit discharge to the WTP (KV-42) for 2024 is presented in Figure 3-6. In Q2 2024, the accuracy of the flow meter was assessed by comparing results to timed bucket tests. The readings reported by the flow meter were not verified. On September 8, 2024, a new, manufacture calibration certified, magnetic flow meter to monitor the flow discharged from the WTP was installed and verified.



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Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2025

Datum: NAD 83; Map Projection: UTM Zone 8N

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Kilometres
0 0.25 0.5 0.75 1

- Groundwater Quality Monitoring (October 2024)
- Adit
- Shaft
- District Mill SIte Footprint
- Tailings Area

* *Not Used for Contouring*

- Estimated Groundwater Contour
- Inferred Groundwater Contour
- Groundwater Flow Direction
- Underground Mine Workings

- Waterbodies
- Watercourses
- Silver Trail Highway
- Secondary Road
- Contours (20m)

ERDC

ELSA RECLAMATION AND DEVELOPMENT COMPANY

FIGURE 3-5

GALENA HILL GROUNDWATER POTENTIOMETRIC SURFACE

FEBRUARY 2025

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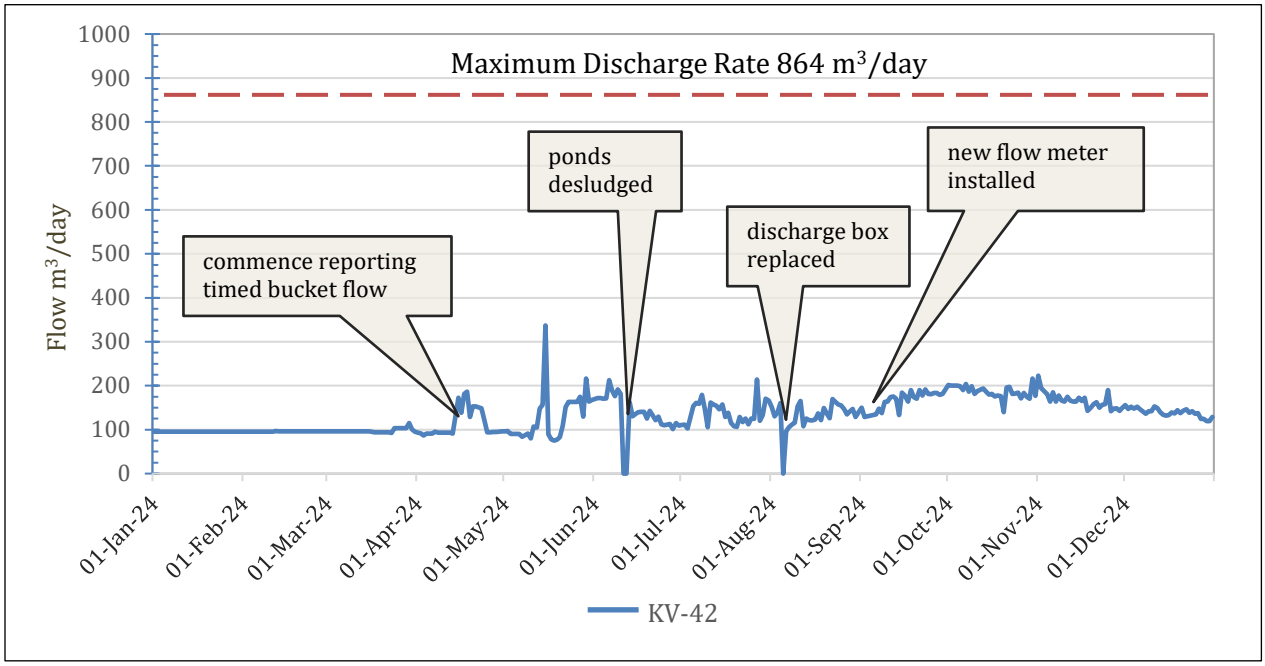


Figure 3-6: 2024 Daily Bellekeno 625 Treated Effluent Discharge (KV-42) Rate

Discharge from Flame & Moth Water Treatment Plant reporting to Lightning Creek

Flame & Moth Mine development began in the summer of 2018. The Flame & Moth water treatment system can discharge to Christal Creek or Lightning Creek. The EQS for each watershed are further defined by the discharge rate, with four ranges identified in Part G, Clause 65 and 66 of the Water Licence and shown in **Error! Reference source not found.** and **Error! Reference source not found.**. The Water Licence limits the effluent discharge rate from the mine to 3,024 m³/day, or the equivalent of continuous discharge at 35 L/s. The WTP was designed to accommodate a maximum flow of 35 L/s (AEG, 2017).

The daily Flame & Moth Adit discharge into the pond (KV-105) and discharge into Lightning Creek (KV-104L) for 2024 are presented in Figure 3-7. The median flow rate for the Flame & Moth Pond discharge (KV-104L) was 8.2 L/s in 2024. There were 77 days in 2024 that had flow measurements above 10 L/s, and for which the EQS associated with discharge between 10 and 20 L/s apply. The volume of water recirculated back underground from the Flame & Moth Pond is not measured.

On April 1, a new, manufacture calibration certified, magnetic flow meter to monitor the Flame & Moth Pond discharge flow (KV-104L) was installed and calibration verified. The flow measuring system at KV-105 was recalibrated and verified on April 10, 2024.

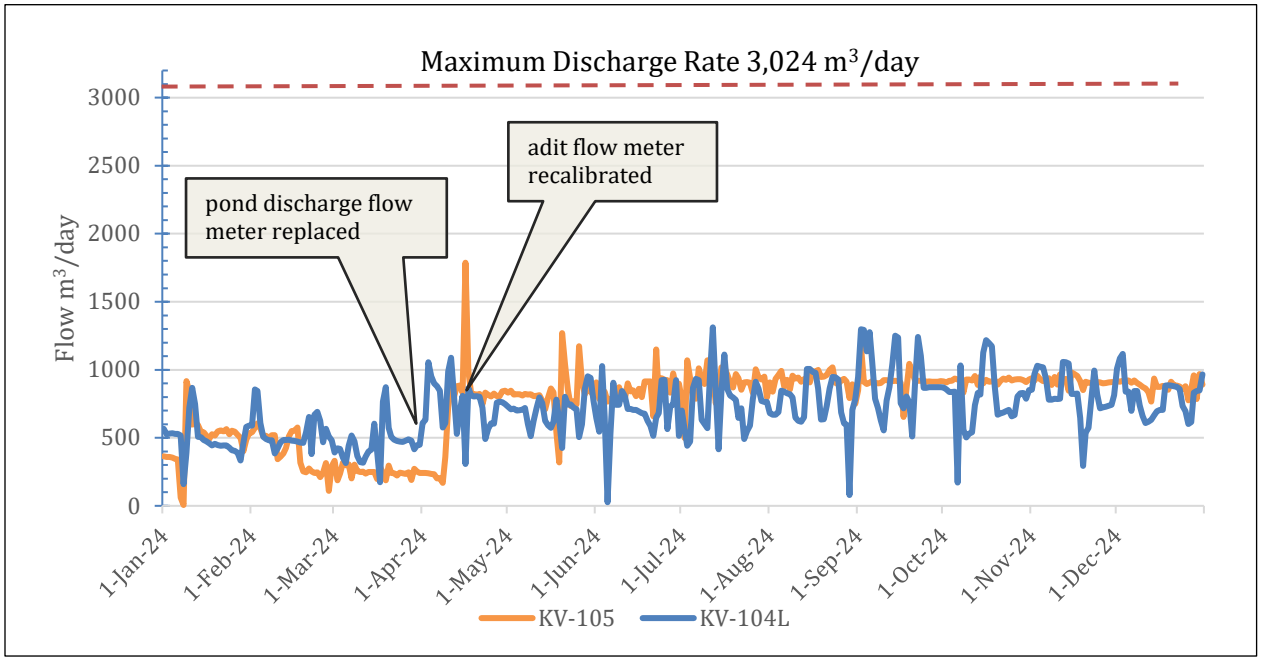


Figure 3-7: Daily Flame & Moth Adit Mine Water Discharge (KV-105) and Treated Effluent Discharge to Lightning Creek (KV-104L)

Figure 3-8 shows the discharge from Flame & Moth Pond to Lightning Creek. Between 2018 and 2024, the flow rates for the Flame & Moth decant (KV-104L) were mostly below 10 L/s (median of 9.01 L/s).

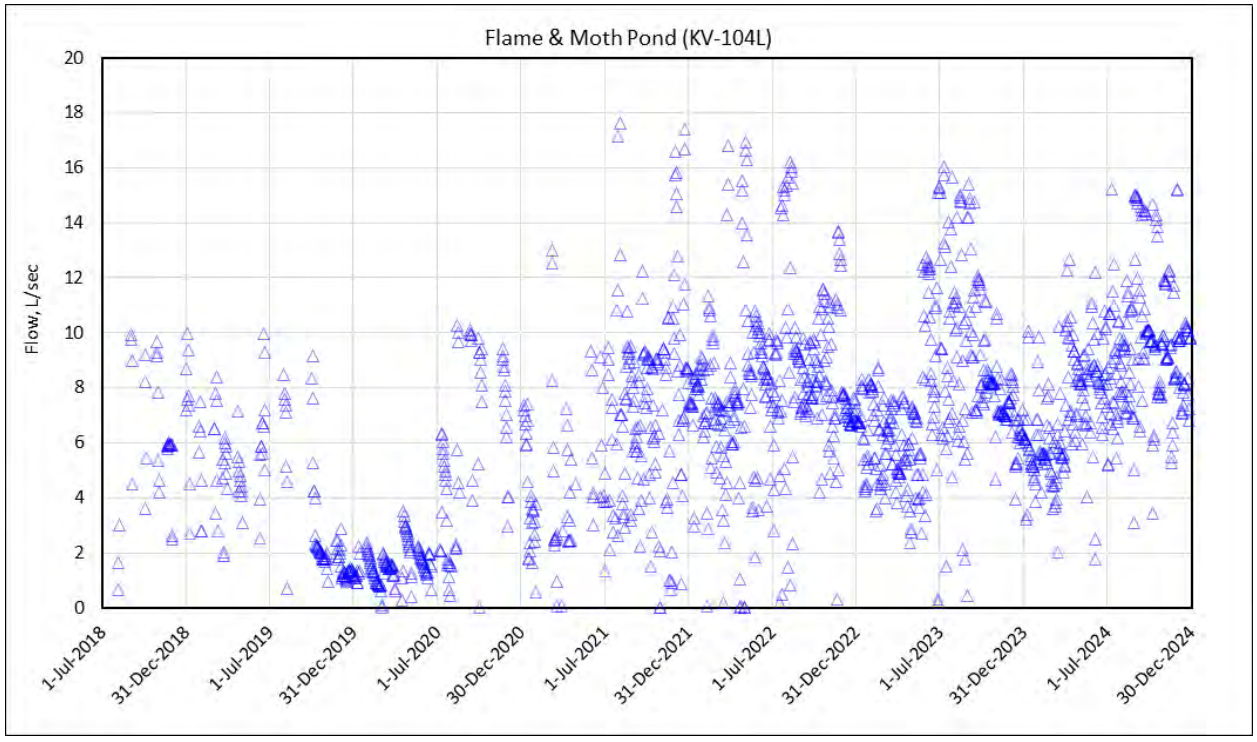


Figure 3-8: Flame & Moth WTP Pond Discharge to Lightning Creek August 2018 to December 2024

3.1.3.2 South McQuesten River Watershed

KV-6 Christal Creek above Silver Trail Highway

The hydrometric station on Christal Creek at KV-6 is just upstream of the Silver Trail highway and several hundred metres downstream of Christal Lake. The catchment area is approximately 6.1 km^2 with a median elevation of 1,002 metres above sea level (masl). Table 3-8 provides notable changes over time to the station. The staff gauge is located upstream of the culvert in a low banked creek, undergoes cycles of frost-heaving and experiences movement annually during the freeze thaw cycles. Ice-free continuous water level data typically extends from late March/early April to mid-October, after which ice begins to affect water level readings and the stage-discharge relationship.

Table 3-8: Changes to Hydrometric Station KV-6

YEAR	CHANGE
2008	Instantaneous discharge measurements have been collected since June 2008 monthly when possible
2011	A Solinst water level recorder was deployed at KV-6 in a stilling well on July 20, and retrieved on October 23.
2012	A Solinst Level Logger record begins May 1 and extends until mid-October. Ice begins to affect the pressure readings on October 10 making water levels following that unreliable. A staff gauge was installed along with the Level Logger on May 1 with a corresponding Barologger (barometric pressure data logger). After mid-July the record becomes unreliable due to a ponding effect.
2013	In the spring KV-6 station was moved upstream due to the ponding encountered from the road culvert in 2012; however, due to infrequent measurements a continuous record could not be produced. The station was moved again in September 2013 to a more stable reach with a better control section more favourable to measuring flow. The current location remains relatively stable and free of backwater effects.
2014	Reliable stage records began at the new location in late May 2014 and a derived discharge record has been produced continuously since that time.
2018	In March, there was an error with the Barologger causing it to stop logging. A new Solinst M5 logger was installed in September, as the old logger data was showing signs of drift and needing calibration.
2021	On July 16, the staff gauge ruler was changed as the previous ruler was worn out and, therefore, it was unable to be read accurately.
2024	A new staff gauge was built and equipped with a vented Solinst pressure transducer in July, but the logger sustained water damage, and the data recorded could not be used. The old logger was used along with the new staff gauge to determine discharge at KV-6.

Mean monthly derived discharge for 2012, and 2014 to 2024 are provided in Table 3-9. The highest derived discharge rates tend to be in May, as a result of spring snowmelt, and the lowest values are typically seen from October to April (Table 3-9). KV-6 has a dampening effect (Quin and Destouni, 2018) from the lake and wetland immediately upstream of it, decreasing the severity of rain and freshet events as shown in its hydrograph (Figure 3-9). May 2018 has the highest measured discrete discharge to date at 0.366 m^3/s, followed by May 2015 at 0.324 m^3/s (Table 3-10). May also sees the highest mean derived monthly discharge with an average of 0.164 m^3/s, and the highest recorded values occurring in 2018 (0.351 m^3/s) and 2020 (0.233 m^3/s) (Table 3-9). The lowest derived mean monthly discharge on record occurred in February 2020 at 0.006 m^3/s, followed by March of the same year at 0.009 m^3/s (Table 3-9). The lowest discrete discharge measurement was collected in October 2009 at 0.033 m^3/s, followed by October 2019 at 0.037 m^3/s (Table 3-10).

A complete record of the derived discharge collected at KV-6 is presented in its hydrograph below (Figure 3-9).

Table 3-9: Mean Monthly Derived Discharge at KV-6, Christal Creek Below Christal Lake, for Months Where Continuous Data are Available (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	-	-	-	-	0.123	0.089	0.102	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	0.063	0.096	0.073	0.117	0.115	0.107	0.081	0.077
2015	0.092	0.078	0.066	0.084	0.185	0.11	0.119	0.123	0.128	0.116	0.115	0.107
2016	0.101	0.09	0.072	0.115	0.127	0.11	0.136	0.154	0.126	0.113	0.102	0.093
2017	0.084	0.077	0.071	0.071	0.149	0.104	0.112	0.068	0.077	0.072	-	-
2018	0.066	0.05	0.043	0.073	0.351	0.157	0.116	0.152	0.123	0.091	0.084	0.077
2019	0.071	0.066	0.061	0.056	0.068	0.059	0.053	0.049	0.044	0.035	0.031	-
2020	0.014	0.006	0.009	0.029	0.233	0.104	0.136	0.149	0.150	0.091	0.045	0.041
2021	0.037	0.034	0.030	0.071	0.226	0.080	0.078	0.102	0.098	0.093	0.079	0.074
2022	0.089	0.082	0.083	0.097	0.151	0.122	0.116	0.111	0.113	-	-	-
2023	-	-	-	-	0.173	0.093	0.089	0.090	0.089	0.098	-	-
2024	-	-	0.042	0.065	0.120	0.084	0.074	0.075	0.087	0.078	-	-
Mean	0.069	0.060	0.053	0.073	0.164	0.101	0.100	0.108	0.105	0.089	0.077	0.078
Standard Deviation	0.028	0.027	0.022	0.023	0.076	0.023	0.026	0.034	0.028	0.022	0.027	0.020

Table 3-10: Discrete Discharge Measurements at KV-6, Christal Creek Below Christal Lake (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	-	-	-	-	-	0.064	0.13	0.119	0.08	0.161	-	-
2009	-	-	-	-	-	0.124	0.101	0.114	0.103	0.033	-	-
2010	-	-	-	-	0.071	-	0.094	0.061	0.141	0.094	-	-
2011	-	-	-	-	0.136	0.08	0.091	-	0.127	0.088	0.075	0.107
2012	-	0.077	-	0.062	0.126	0.089	0.095	0.091	0.089	0.076	-	-
2013	-	-	-	-	-	0.123	0.082	0.079	0.091	0.093	0.08	-
2014	-	-	0.05	0.052	0.143	0.059	0.1	0.063	0.11	0.102	0.08	-
2015	0.104	-	0.07	0.056	0.324	0.106	0.1	0.125	0.137	0.092	0.147	0.142
2016	0.130	0.067	0.086	0.071	0.170	0.104	0.098	0.180	0.122	0.094	0.087	-
2017	0.083	0.086	0.076	0.065	0.244	0.088	0.092	0.198	0.093	0.094	-	-
2018	-	-	-	-	0.366	0.122	0.107	0.162	0.112	0.072	0.111	0.095
2019	0.081	0.074	0.061	0.064	0.159	0.067	0.074	0.065	0.064	0.037	0.075	0.074
2020	-	-	-	0.059	0.256	0.083	0.110	0.096	0.121	0.085	0.137	0.128
2021	0.107	-	0.084	0.075	0.203	0.093	-	0.087	0.128	0.083	0.084	0.092
2022	-	0.065	-	0.066	0.246	0.125	0.099	0.083	0.106	-	-	-
2023	-	-	-	-	-	0.121	0.079	0.1	0.081	-	-	0.071

2024	-	-	-	0.083	0.078	0.101	0.078	0.064	0.087	0.076	0.055	-
Mean	0.101	0.074	0.071	0.065	0.194	0.097	0.096	0.105	0.105	0.085	0.093	0.101
Standard Deviation	0.018	0.008	0.013	0.009	0.086	0.022	0.013	0.041	0.021	0.028	0.028	0.024
	Salt dilution method used											
	Velocity-area method used											

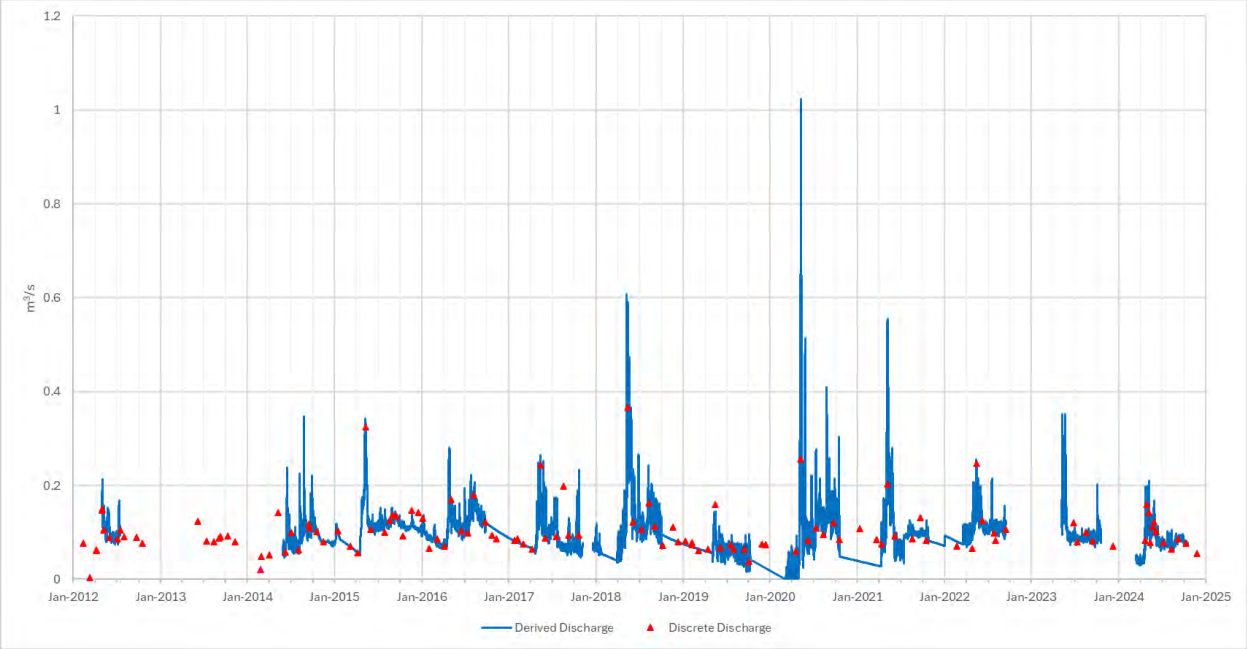


Figure 3-9: Derived Discharge at KV-6 on Christal Creek Below Christal Lake (2012-2024)

KV-21 No Cash Creek at the Silver Trail Highway

The New Bermingham Portal and associated infrastructure is in the No Cash Creek Catchment. The No Cash Creek is situated on the northwest slope of Galena Hill and flows down the hillside towards the wetlands northeast of Flat Creek. There is no direct connection between No Cash Creek and either Flat Creek or the South McQuesten River as No Cash Creek ends in a bog. From the headwaters on Galena Hill to dispersion in the bog, the distance is roughly 2.3 km. No Cash Creek flows just northeast of the former townsite of Elsa.

Hydrometric station KV-21 is located on No Cash Creek just above the Silver Trail Highway (KV-21). The No Cash Bog drainage includes the adit discharges from the historical No Cash 500 adit (KV-20), the historical Ruby 400 adit (KV-19), the historical Bermingham 200 adit (KV-18) and New Bermingham Mine (KV-114). Flow from the historic adits is monitored by ERDC.

In June of 2015, a V-notch weir was installed to gather continuous data; however, the station was unsuccessful due to significant glaciation and channel braiding in winter and high sedimentation in the summer. As such the continuous monitoring was discontinued and only the discrete measurements maintained. A new hydrometric

station was installed further downstream in August 2021; however, the datalogger had technical issues and was not functional until fall 2022.

The station was replaced in September 2022 but ongoing issues with the hydrometric station and the pressure transducer has caused challenges in collecting reliable continuous data. This creek has a steep mountainous morphology characterized by a high gradient and fast-moving water, as such salt dilutions are used exclusively to measure discrete discharge. The stream morphology at this station is variable and, as shown in 2023, can change annually. In 2024 the station was operational for the open water season. A full timeframe of upgrades and issues encountered at the station is outlined in Table 3-11.

Table 3-11: Changes to Hydrometric Station KV-21

YEAR	CHANGE
2014	A Solinst water level recorder was deployed at KV-21.
2015	
2016	
2017	
2018	
2019	Due to heavy icing conditions in the winter caused by discharge from the historical adits the station has sustained substantial damage over the years Station was not operable
2020	The station was operational for the open water season
2021	
2022	The station was replaced in September but ongoing issue with the hydrometric station and the pressure transducer has caused challenges in collecting reliable continuous data
2023	Logger was compromised due to a change in streambed morphology.
2024	The station was operational for the open water season.

Table 3-12 shows the mean monthly derived discharge record from 2013-2024 for KV-21, for periods when data was available. Peak discharge rates typically occur in May or June, and decrease throughout the open water season, with the lowest rates generally occurring from November to April, during ice cover (Table 3-12). The lowest derived mean monthly winter flow occurred in April 2018 at 0.001 m^3/s, followed by March 2023 at 0.003 m^3/s (Table 3-12). The lowest discrete winter discharge measurements at KV-21 were collected in April and November 2015, both measured a discharge of 0.002 m^3/s (Table 3-13). It is important to note that heavy glaciation at the station makes winter flow measurements difficult, leading to a limited number of discrete winter discharges within the data set. The highest mean monthly derived discharge occurred in May 2023 at 0.237 m^3/s, followed by October 2022 at 0.066 m^3/s (Table 3-12Table 3-13). The highest discrete discharge measurement was collected in May 2023 at 0.274 m^3/s, followed by May 2018 at 0.219 m^3/s (Table 3-13).

A complete record of the derived discharge collected at KV-21 can be seen in its hydrograph presented in Figure 3-10.

Table 3-12: Mean Monthly Derived Discharge at KV-21, No Cash Creek at Silver Trail Highway, for Months Where Continuous Data are Available (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	-	-	-	-	-	-	-	-	0.003	-	-	-
2014	-	-	-	0.009	0.010	0.049	0.001	0.020	0.012	-	-	-
2015	-	-	-	-	-	0.013	0.021	0.023	0.030	0.018	0.004	0.008
2016	0.005	0.004	0.005	0.011	0.048	0.021	0.023	0.022	0.022	-	-	-
2017	-	-	-	-	0.019	0.023	0.016	0.008	0.009	-	-	-
2018	-	-	-	0.001	0.004	-	-	-	-	-	-	-
2019	-	-	-	-	-	-	-	-	-	-	-	-
2020	-	-	-	-	-	0.025	0.021	0.005	0.004	0.004	-	-
2021	-	-	-	-	0.059	0.025	0.024	0.016	0.016	0.014	-	-

2022	-	-	-	-	-	-	-	-	-	0.066	0.024	0.009
2023	0.005	0.004	0.003	-	0.237	0.025	0.018	0.013	0.015	-	-	-
2024	-	-	-	-	0.025	0.016	0.015	0.012	0.027	0.015	0.009	0.006
Mean	0.005	0.004	0.004	0.007	0.057	0.025	0.017	0.015	0.015	0.024	0.012	0.008
Standard Deviation	0.000	0.000	0.001	0.004	0.076	0.010	0.007	0.006	0.009	0.022	0.008	0.001

Table 3-13: Discrete Discharge Measurements at KV-21, No Cash Creek at Silver Trail Highway (m^3/s)

Year	Month											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2013	-	-	-	-	-	-	-	-	0.022	0.017	0.004	-
2014	-	-	-	-	0.058	0.005	0.005	0.011	0.013	0.013	0.007	-
2015	0.003	-	-	0.002	-	0.011	-	-	0.035	0.017	0.002	0.010
2016	0.005	0.004	0.006	0.003	0.049	0.016	0.022	0.045	0.025	0.010	0.006	0.006
2017	-	-	-	-	0.135	0.025	0.015	0.007	0.024	0.015	-	0.005
2018	-	-	-	-	0.219	0.042	0.018	0.067	0.023	0.006	0.004	0.005
2019	-	-	-	-	0.069	0.005	0.001	0.007	0.014	0.007	0.003	0.004
2020	-	-	-	-	-	0.033	0.019	0.025	0.020	-	0.007	-
2021	0.006	-	-	-	-	0.017	0.009	0.033	0.016	0.015	0.007	-
2022	-	-	0.005	-	0.023	0.036	-	0.013	0.023	0.033	0.010	-
2023	-	-	-	-	0.274	0.028	0.016	0.021	0.015	-	-	0.008
2024	0.005	-	-	0.005	0.027	0.019	0.020	0.013	0.018	0.017	0.008	-
Mean	0.005	0.004	0.006	0.003	0.107	0.022	0.014	0.024	0.021	0.014	0.006	0.006
Standard Deviation	0.001	0.000	0.001	0.001	0.088	0.012	0.007	0.018	0.006	0.008	0.002	0.002
	Salt dilution method used											
	Velocity-area method used											

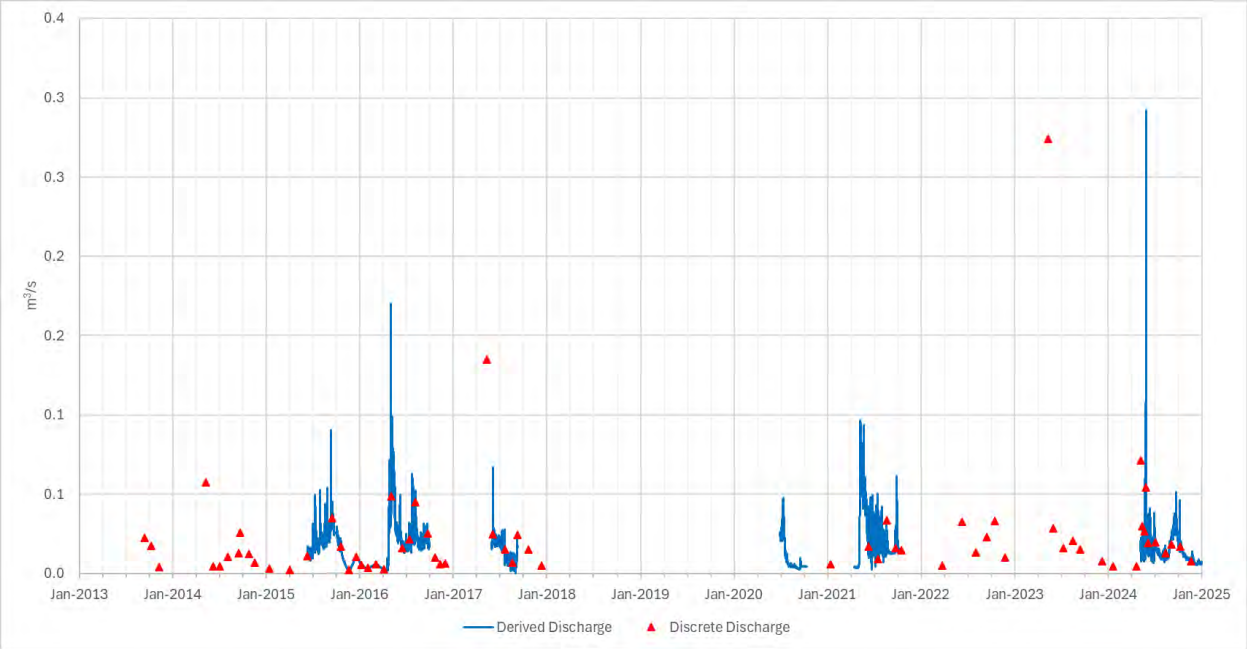


Figure 3-10: Flow Distribution at KV-21 on No Cash Creek at Silver Trail Highway (2016-2024)

KV-7 Christal Creek at Hanson-McQuesten Lakes Road Bridge

Christal Creek at KV-7 is located at the Hanson and McQuesten Lakes Road Bridge approximately 7 km downstream of KV-6. KV-7 drains an area of 35.8 km2 with a median elevation of 970 m and includes KV-6 and Christal Lake. Ice-free continuous water level data typically extends from early May to late September/early October. There are a number of old workings within the watershed including Galkeno 300, Galkeno 900, Brewis Red Lake (aka Shepard), Lucky Queen, Klondike Keno and, at least partially, Onek 400. Additionally, the District Mill, the Silver Trail Highway, and parts of Keno City including the Keno City dump are at least partially within the watershed. Ice-free continuous water level data typically extends from early May to mid-October (Figure 3-11), after which ice begins to affect water level readings and the stage-discharge relationship.

CCL summarized the data for 2004 to 2009 (CCL, 2008 and 2009). Data for 2010 and 2011 were processed by Ensero following the same methodology as CCL. Ensero has processed data at this site using Aquarius time series software since 2012. Mean monthly discharge calculated from the continuous record (unless otherwise noted) is shown since 2003 at KV-7 in Table 3-14. Peak derived discharge rates typically occur between early to late May, during spring freshet (Table 3-15, Figure 3-11). The highest mean monthly rate was recorded in May 2005 at 1.54 m^3/s, followed by May 2023 at 1.331 m^3/s (Table 3-14). The highest discrete discharge measurements collected to-date were in May 2015 and 2018, measuring 2.54 m^3/s and 2.079 m^3/s respectively (Table 3-15). Runoff generally decreases steadily over the winter months, assuming there is no major thaw, rain, or snow event (Table 3-14, Figure 3-11). Thus, discharge typically reaches the lowest volume in March or early April and begins to rise as temperatures warm near the end of the month (Table 3-14). The lowest mean monthly derived discharge on record occurred in April 2021, at 0.021 m^3/s, followed by March 2009, at 0.048 m^3/s (Table 3-14). The lowest discrete discharge measurement collected to-date was in April 2005 at 0.062 m^3/s, followed by February 2013 and January 2018, both measuring at 0.066 m^3/s (Table 3-15).

A record of the derived discharge collected at KV-7 from 2006-2024 is presented in its hydrograph below (Figure 3-11).

Table 3-14: Mean Monthly Derived Discharge at KV-7, Christal Creek at Hanson-McQuesten Lakes Road Bridge (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	-	-	-	-	-	-	-	0.42	0.51	-	-	-
2004	-	-	0.150	0.166	1.153	0.314	0.119	0.112	0.163	0.135	0.103	0.101
2005	-	0.122	0.112	0.391	1.54	0.264	0.294	0.398	0.335	0.259	0.189	0.15
2006	0.166	0.138	0.117	0.124	1.089	0.519	0.397	0.278	0.415	0.368	0.203	0.142
2007	0.151	0.120	-	-	0.757	0.327	0.54	0.218	0.335	0.154	-	-
2008	-	-	-	-	-	-	-	0.43	0.333	0.352	-	0.134
2009	0.079	0.068	0.048	0.074	1.123	0.338	0.102	0.183	0.368	-	-	-
2010	-	-	-	-	0.309	0.24	0.359	0.23	0.232	0.186	-	-
2011	-	-	-	-	1.26	0.142	0.503	0.419	0.268	0.173	0.126	-
2012	0.154	0.078	-	-	0.73	0.258	0.400	0.217	0.267	0.200	-	-
2013	0.075	0.066	-	-	-	0.285	0.126	0.08	0.332	0.227	0.14	0.11
2014	0.097	0.103	0.086	0.077	0.740	0.430	0.195	0.573	0.351	0.220	0.176	0.143
2015	0.129	0.105	0.084	0.164	1.042	0.172	0.334	0.472	0.562	0.244	0.177	0.168
2016	0.146	0.128	0.101	0.252	0.530	0.239	0.516	0.635	0.479	0.242	0.156	0.137
2017	0.122	0.121	0.089	0.118	0.622	0.244	0.161	0.124	0.335	0.135	0.099	0.083
2018	0.070	0.092	0.078	0.059	1.146	0.644	0.274	0.430	0.268	0.153	0.148	0.155
2019	0.109	0.087	0.074	0.084	0.229	0.157	0.128	0.092	0.115	0.091	0.102	-
2020	0.107	0.100	0.093	0.087	0.867	0.539	0.546	0.498	0.526	-	-	0.223
2021	-	-	-	0.021	0.69	0.304	0.187	0.367	0.302	0.251	-	-
2022	-	-	-	0.361	1.025	0.610	0.306	-	-	-	-	-
2023	-	-	-	0.193	1.331	0.437	0.192	0.171	0.217	0.250	-	-
2024	-	-	0.188	0.273	0.528	0.205	0.153	0.142	0.375	0.231	-	-
Mean	0.117	0.102	0.102	0.163	0.880	0.333	0.292	0.309	0.338	0.256	0.302	0.141
Standard Deviation	0.032	0.022	0.036	0.108	0.343	0.145	0.148	0.164	0.113	0.188	0.513	0.035

Table 3-15: Discrete Discharge Measurements at KV-7, Christal Creek at Hanson-McQuesten Lakes Road Bridge (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	-	-	-	-	-	-	-	0.165	-	-	-	-
2004	0.127	0.180	0.150	-	-	0.247	0.108	0.121	0.149	0.104	0.102	0.259
2005	0.352	0.233	0.290	0.062	0.657	0.136	0.204	0.237	-	0.186	-	-
2006	0.188	0.117	0.159	-	-	0.858	-	0.251	0.374	-	-	-
2007	-	-	-	-	-	-	-	-	0.189	-	-	-
2008	-	-	-	-	-	-	0.159	0.438	0.518	0.420	-	-
2009	-	-	-	-	-	0.442	0.124	-	0.269	0.229	-	-
2010	-	-	-	-	0.612	0.357	0.288	0.231	0.187	0.185	-	-
2011	-	-	-	-	0.357	0.105	-	0.259	0.286	0.173	0.126	-
2012	0.154	-	-	-	0.540	0.369	0.206	0.258	0.270	-	-	-

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	0.075	0.066	0.110	-	-	0.852	0.224	0.102	0.140	0.266	-	0.117
2014	0.107	0.086	-	0.098	1.760	0.116	0.203	0.200	0.270	0.283	0.150	0.137
2015	0.163	-	0.088	0.073	2.540	0.234	1.039	0.342	0.612	0.329	0.179	-
2016	0.163	0.145	0.111	0.100	0.106	0.257	0.519	0.575	0.473	0.207	0.189	0.237
2017	0.124	0.133	0.099	0.100	1.173	0.344	0.218	0.156	0.264	0.176	-	-
2018	0.066	0.108	-	-	2.079	0.939	0.298	0.763	0.423	0.144	0.153	0.161
2019	0.104	-	0.073	0.106	0.456	0.204	-	0.124	-	0.105	-	0.127
2020	0.078	0.089	0.080	0.075	-	0.366	0.547	0.286	0.405	-	-	0.223
2021	0.185	-	0.130	0.129	1.134	0.394	0.163	0.362	0.280	0.182	-	0.084
2022	0.179	0.118	-	-	1.013	0.899	0.257	0.202	0.291	-	-	-
2023	0.110	0.102	-	0.088	-	0.303	0.183	0.191	0.199	-	-	-
2024	0.111	-	0.115	-	0.328	0.224	0.197	0.148	0.230	0.224	-	-
Mean	0.143	0.125	0.128	0.092	0.981	0.402	0.290	0.271	0.307	0.214	0.150	0.168
Standard Deviation	0.066	0.045	0.057	0.019	0.712	0.267	0.220	0.159	0.125	0.081	0.030	0.060
	Salt dilution method used											
	Velocity-area method used											

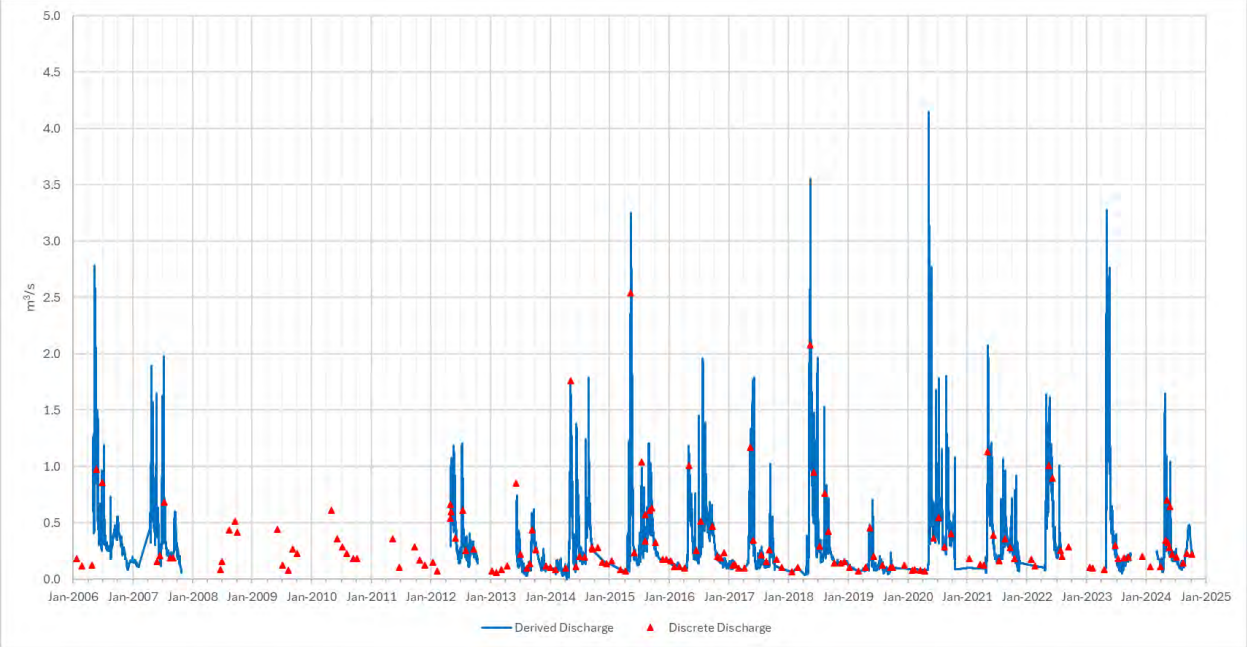


Figure 3-11: Derived Discharge at KV-7 on Christal Creek at Hanson-McQuesten Lakes Road Bridge (2006-2024)

KV-9 Flat Creek Near the Mouth

Station KV-9 is located just above the confluence of Flat Creek with the South McQuesten River approximately 10 km east of Elsa. Continuous monitoring of this station was a requirement under ERDC WL QZ17-076. With the issuance of the new ERDC water licence QZ21-012 in June 2023, KV-9 monitoring frequency became monthly.

The Flat Creek headwaters originate on the northwest face of Galena Hill above the former Elsa town site. Flat Creek at KV-9 also includes Thompson, Galena, Porcupine, and Brefault Creeks. Flowing adits and shafts within the Flat Creek catchment include, but are not limited to, Silver King and Husky Southwest. The former Elsa town site and the Valley Tailings Facility are also situated within the Flat Creek catchment making it one of the more heavily anthropogenically modified catchments in the district. The total drainage area of Flat Creek is approximately 56.5 km2 with a median elevation of approximately 830 masl.

Prior to 2022, Flat Creek at KV-9 remained partially open all winter allowing for accurate flow measurements with a velocity meter and applicable stage observations; however, in 2022 the creek banks accumulated ice and snow which did not allow for a velocity meter to be used. This station was replaced on August 14, 2020, as it was damaged from the forest fire.

High water makes it difficult to safely measure discharge at the station during freshet. May typically experiences the highest mean monthly derived discharge, with low flows generally occurring from December to March (Table 3-16). The highest mean monthly derived discharge on record occurred in May 2020 at 3.059 m^3/s, followed by May 2013 at 2.825 m^3/s (Table 3-16). The highest discrete measurements to-date were collected in May 2015 at 3.682 m^3/s, followed by May 2009 at 1.94 m^3/s (Table 3-17). The lowest mean monthly derived discharges on record were in January and February of 2015, measuring 0.009 m^3/s and 0.007 m^3/s respectively (Table 3-16). The lowest discrete measurement on record was collected in April 2017 at 0.006 m^3/s, followed by February 2015 at 0.008 m^3/s (Table 3-17).

Figure 3-12 presents a record of the derived discharge collected at KV-7 from 2006-2024.

Table 3-16: Mean Monthly Derived Discharge at KV-9, Flat Creek Near the Mouth (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	-	-	-	-	-	-	-	0.116	0.099	0.11	0.046	0.034
2005	0.03	0.028	0.126	0.273	2.077	1.017	0.282	0.34	0.33	0.28	-	-
2006	-	-	-	-	-	-	-	-	-	-	-	-
2007	-	-	-	-	-	-	-	-	-	-	-	-
2008	-	-	-	-	-	-	-	0.545	0.375	0.448	0.129	0.09
2009	0.053	0.029	0.02	0.01	2.155	0.51	0.088	0.092	0.364	-	-	-
2010	-	-	-	-	-	0.133	0.171	0.086	0.118	0.099	-	-
2011	-	-	-	-	1.97	0.349	0.927	0.756	0.364	0.299	-	-
2012	-	-	-	0.014	1.574	0.43	-	0.208	0.361	0.276	-	-
2013	-	-	-	-	2.825	0.636	0.159	0.084	0.102	0.411	0.081	-
2014	-	-	-	-	1.856	0.52	0.204	0.786	0.535	0.559	0.060	0.015

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	0.009	0.007	0.010	0.103	1.948	0.181	0.318	0.521	0.877	0.435	0.132	0.059
2016	0.023	0.016	0.011	0.545	1.025	0.207	0.408	0.669	0.539	0.151	0.066	0.040
2017	0.035	0.036	0.032	0.059	1.212	0.449	0.265	0.164	0.317	0.292	0.078	0.058
2018	0.064	0.096	0.072	0.119	1.724	0.693	0.335	0.510	0.281	0.092	0.035	0.039
2019	0.042	0.040	0.042	0.112	0.433	0.161	0.038	0.037	0.055	-	-	-
2020	0.037	0.024	0.023	0.202	3.059	1.127	0.787	0.702	0.641	-	-	-
2021	0.279	0.268	0.268	0.279	2.064	0.367	0.150	0.184	0.402	0.237	-	-
2022	-	-	-	-	2.346	0.739	0.284	0.242	0.340	0.878	-	-
2023	-	-	-	-	-	0.291	0.213	0.167	0.196	0.557	0.198	-
2024	-	-	-	1.227	1.059	0.452	0.217	0.119	0.333	0.305	-	-
Mean	0.064	0.060	0.067	0.268	1.822	0.486	0.303	0.358	0.365	0.358	0.097	0.050
Standard Deviation	0.082	0.082	0.084	0.353	0.690	0.285	0.237	0.261	0.207	0.214	0.052	0.024

Table 3-17: Discrete Discharge Measurements at KV-9, Flat Creek Near the Mouth (m^3/s)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	0.028	-	-	-	-	-	0.293	-	-	-	-	-
2005	0.025	-	-	-	-	-	0.282	0.245	-	-	-	-
2006	0.117	-	0.023	-	-	-	-	-	-	-	-	-
2007	-	-	-	-	-	-	1.093	-	0.166	-	-	-
2008	-	-	-	-	1.137	-	0.152	1.020	0.321	0.538	-	-
2009	-	-	-	-	1.940	0.474	0.174	-	0.253	0.202	-	-
2010	-	-	-	-	0.429	-	-	-	0.136	0.109	-	-
2011	-	-	-	-	1.179	-	0.541	-	-	0.155	-	-
2012	-	-	-	0.012	1.574	0.430	0.244	0.239	0.245	0.137	-	-
2013	-	-	-	-	-	0.766	0.290	-	0.526	0.411	0.081	-
2014	-	-	-	-	1.856	0.117	0.254	0.142	0.493	0.310	-	-
2015	-	0.008	0.013	0.017	3.682	0.243	0.218	0.515	1.049	0.357	0.077	-
2016	0.047	0.020	-	-	0.174	0.269	0.263	0.544	0.552	0.093	0.074	0.031
2017	0.012	0.013	0.013	0.006	1.465	0.481	0.196	-	0.095	0.213	0.047	0.030
2018	0.009	-	-	-	-	0.804	0.324	-	-	0.109	-	-
2019	-	-	-	-	0.874	0.066	0.022	-	-	0.082	-	-
2020	-	-	-	-	-	1.295	-	-	-	-	-	-
2021	-	-	-	-	-	-	0.109	-	0.392	0.229	-	-
2022	-	-	-	-	-	-	-	0.240	-	0.452	-	-
2023	-	0.046	-	-	-	0.312	0.157	0.199	0.170	-	-	-
2024	-	-	-	-	1.432	0.460	0.273	0.109	0.167	0.240	-	0.055

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.043	0.022	0.016	0.012	1.580	0.340	0.208	0.284	0.395	0.222	0.066	0.039
Standard Deviation	0.040	0.017	0.006	0.006	0.926	0.359	0.242	0.290	0.261	0.142	0.015	0.014
	Salt dilution method used											
	Velocity-area method used											

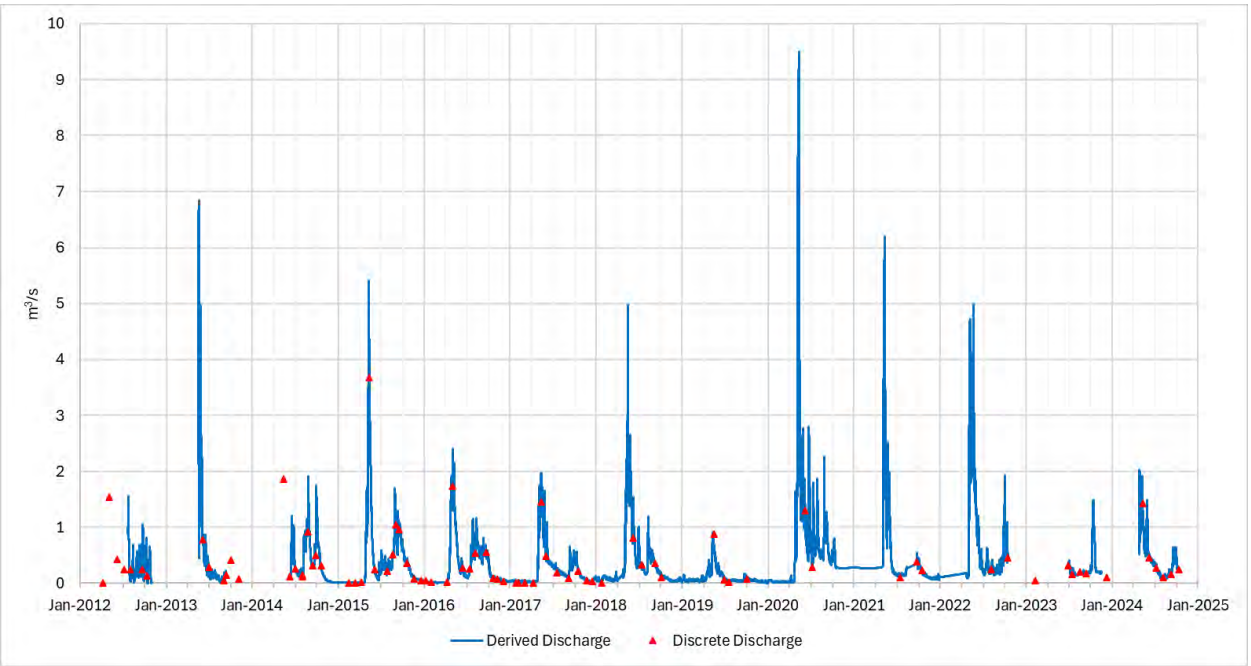


Figure 3-12: Derived Discharge at KV-9 at Flat Creek near the mouth (2012-2024)

KV-51 Christal Creek downstream of Hinton Creek

In 2015, a new hydrometric station was commissioned above Christal Lake to better quantify the water balance of Christal Lake. The 2015 hydrograph begins in early June when the station was established and shows similar event peaks to lower Christal Creek sites. The KV-51 station is subject to heavy icing in winter months causing data loss in low flow conditions and early freshet peak flows. Table 3-18 summarizes the continuous data collected to date as mean monthly discharge. This station data indicates backwater effects through the spring, which would affect the spring data. The monitoring at this site was changed from monthly to quarterly in 2021. As such, fewer data points are contributing to the rating curve development which contributes to the variation in observed discharge.

Peak derived discharge rates typically occur in May and June, and the lowest generally occurring from October to April (Table 3-18). Ice-free continuous water level data usually extends from mid/late May to mid-October (Table 3-18), after which ice begins to affect the water level readings and the stage-discharge relationship. The highest derived mean monthly discharge rate on record occurred in May 2018, at 0.206 m^3/s, followed by June 2020 at 0.129 m^3/s (Table 3-18). The highest measured discrete discharge was collected in June 2018 at 0.197 m^3/s, followed by May of the same year at 0.717 m^3/s (Table 3-19). The lowest derived discharge rates on record occurred in November 2016 and 2018, both measuring at 0.001 m^3/s (Table 3-18). The lowest discrete

discharge measured collected at KV-51 to-date occurred in February 2023 at 0.008 m^3/s, followed by July 2024 at 0.009 m^3/s (Table 3-19). It is important to note that that winter discharge measurements are difficult to collect at KV-51 due to the heavy icing and overflow conditions often found at the station.

A complete record of the derived discharge collected at KV-51 is presented in its hydrograph below (Figure 3-13).

Table 3-18: Mean Monthly Derived Discharge at KV-51, Christal Creek Downstream of Hinton Creek (m^3/s)

YEAR	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2015	-	-	-	-	-	0.024	0.029	0.034	0.045	0.038	0.035	0.034
2016	0.033	0.031	0.031	0.036	0.053	0.043	0.052	0.067	0.051	0.026	0.001	-
2017	0.016	0.015	0.013	0.012	0.081	0.023	0.022	0.015	0.015	-	-	-
2018	-	-	-	0.004	0.206	0.087	0.037	0.060	0.058	0.013	0.001	-
2019	0.015	0.014	0.014	0.014	0.031	0.018	0.018	0.016	0.018	0.015	0.014	0.016
2020	0.028	0.040	0.052	0.064	0.076	0.129	0.033	0.034	0.033	0.023	0.016	0.011
2021	0.012	0.027	-	0.017	0.056	0.033	0.033	0.045	0.043	0.033	-	-
2022	-	-	-	0.064	0.066	0.047	0.036	0.032	-	-	-	-
2023	-	-	-	0.030	0.089	0.031	0.023	-	-	-	-	-
2024	-	-	-	-	0.013	0.010	0.011	0.014	0.021	0.021	-	-
Mean	0.020	0.025	0.027	0.03	0.075	0.045	0.029	0.035	0.036	0.024	0.014	0.020
Standard Deviation	0.008	0.010	0.016	0.022	0.052	0.035	0.011	0.018	0.015	0.008	0.013	0.010

Table 3-19: Discrete Discharge Measurements at KV-51, Christal Creek Downstream of Hinton Creek (m^3/d)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	-	-	-	-	0.116	0.035	0.026	-	0.046	0.038	-	0.035
2016	0.037	0.025	0.026	-	0.047	0.047	0.041	0.079	0.053	0.042	0.030	0.037
2017	0.025	0.027	0.023	0.019	0.152	0.034	0.032	0.032	-	0.03	0.028	-
2018	0.012	-	-	0.014	0.171	0.197	0.041	0.043	0.060	0.029	-	-
2019	0.017	-	0.012	0.015	0.093	0.019	0.018	0.014	0.014	-	-	0.013
2020	-	-	-	-	-	0.020	0.032	0.032	0.045	-	-	-
2021	-	-	-	-	-	-	0.028	-	-	0.027	-	-
2022	-	-	-	-	0.052	-	-	0.033	-	-	-	-
2023	-	0.008	-	-	-	-	-	-	-	-	-	-
2024	-	-	-	-	0.018	-	0.009	-	-	0.015	-	-
Mean	0.023	0.020	0.020	0.016	0.093	0.059	0.028	0.039	0.044	0.030	0.029	0.028
Standard Deviation	0.010	0.008	0.006	0.002	0.053	0.063	0.010	0.020	0.016	0.008	0.001	0.011

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Salt dilution method used											
	Velocity-area method used											

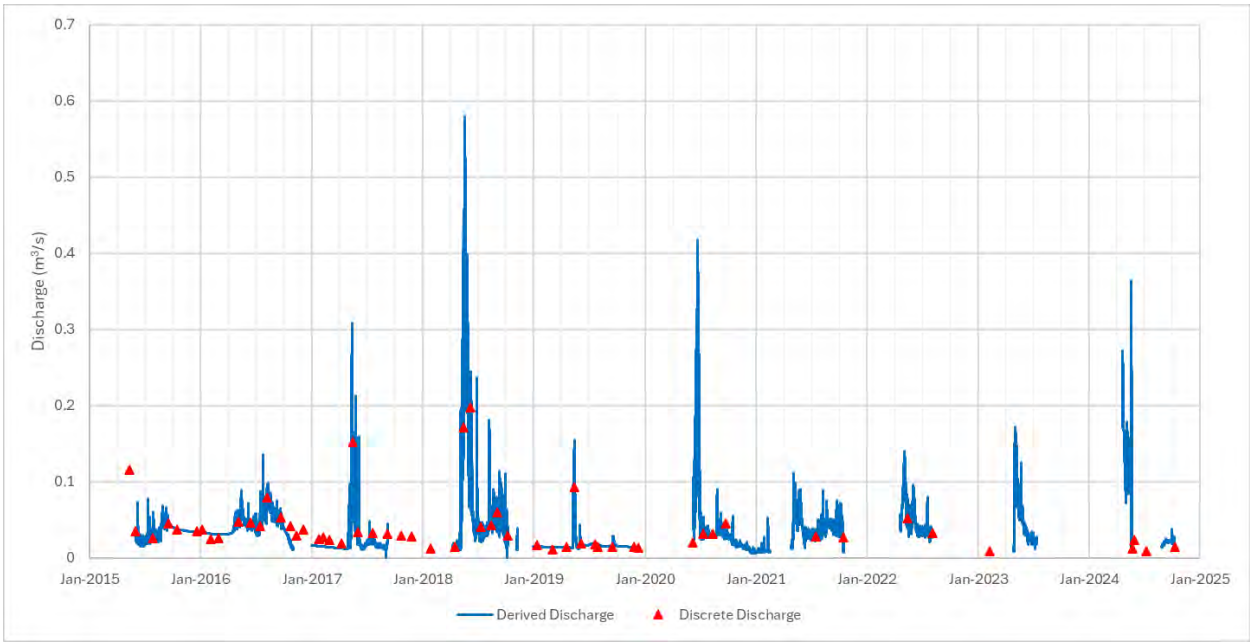


Figure 3-13: Derived Discharge at KV-51, Christal Creek Downstream of Hinton Creek (2015-2024)

3.2 WATER QUALITY

Surface water quality results in watercourses potentially impacted by KHSD Mining Operations include the South McQuesten River, No Cash Bog/Creek, and Christal Creek within the McQuesten Watershed, and the Lightning Creek catchment within the Mayo River watershed. Water quality stations are shown in Figure 3-14.

Surface water quality is monitored to assess and track changes in the condition of water of the various watersheds on the property. Through monitoring, AKHM can characterize waters and identify changes or trends in water quality over time, identify specific existing or emerging water quality problems and determine whether goals, including compliance with WL EQS and water quality objectives (WQO), are being met. The data are also used for building and maintaining site-wide and localized loading balances for closure planning purposes. Water quality for watercourses in the KHSD have been assessed over the last twenty plus years by Alexco Resources Corp and their subsidiaries.

In 2008, Minnow Environmental Inc. (Minnow) was contracted to analyze site wide water quality data to identify parameters and locations of concern within receiving waters relative to established guidelines and background water quality concentrations. Minnow identified two contaminants of potential concern for property held by Alexco Resources Corp.: zinc and cadmium (Minnow, 2008). Because of the limitations of the dataset, other 'potential' contaminants of concern (COCs) were identified but not confirmed.

In 2013, Minnow revaluated the COCs and concluded that cadmium and zinc should remain and no additional COCs are warranted (Minnow, 2013). Subsequent assessments of receiving environment water quality have also indicated that cadmium and zinc remain the COCs for the receiving environment (Minnow, 2015; 2018;

2020) based on water quality data obtained for background stations, Lightning Creek, Christal Creek, No Cash Creek, Flat Creek and the South McQuesten River.

The following potential contaminants of concern (PCOCs) were identified as being elevated above recommended water quality guidelines and potentially hazardous to aquatic life: aluminum, arsenic, cyanide, chromium, copper, iron, lead, manganese, mercury, nitrate, nitrite, phosphorus, selenium, silver, sulphate, total Kjeldahl nitrogen, and uranium. For many of the total metal parameters, the maximum values tended to occur when the total suspended solids (TSS) were also elevated (such as during spring freshet), suggesting that concentrations were associated with particulate matter in water samples. Comparison of filtered metal (dissolved) values at the same sites were confirmed to be below guidelines and less bioavailable (and less harmful) to aquatic life. Many constituents that exceeded guidelines showed concentrations that had either stabilized or decreased over time and were therefore not considered future COCs. Final COCs flagged for the project sites were cadmium and zinc which form the focus of the following sections.

While cadmium and zinc form the key COCs across the District, a full suite of analytes is included in the water quality monitoring conducted at mine sources and receiving environment stations. This data is used in the Adaptive Management Plan (AMP), which also considers a wider suite of indicator parameters for which water quality trigger thresholds have been developed. For the adaptive management initiative (AMI) for discharge water quality, these parameters include those for which an effluent quality standard applies, and so includes arsenic, cadmium, copper, lead, nickel, silver, radium-226, zinc, pH, ammonia, and total suspended solids (Hecla, 2025).

For the receiving environment AMI, a wider selection of parameters than just cadmium and zinc are also presented. These include nitrate, nitrite, ammonia, arsenic, cadmium, copper, lead, nickel, silver, uranium, zinc, sulphate, and selenium. As such, a wider selection of parameters than just cadmium and zinc are captured under the AMP (Hecla, 2025).

Unless otherwise noted, only total cadmium and dissolved zinc are discussed, as these are the fractions with CCME long-term guidelines for the protection of aquatic life. These reports provided: a data quality review, identified COCs, PCOCs, and characterized water quality for stations in the KHSD. Reports were prepared as part of district closure studies and the long-term monitoring plan and included assessments.

The following sections describe an overview of results of the KHSD water quality sampling program from 2007 to 2024, which includes surface water quality monitoring stations on Lightning Creek, Christal Creek, No Cash Creek and the South McQuesten River, and the relevant KHSD adits and wastewater treatment plants within their respective catchments. Monitoring locations for each catchment are presented on Figure 3-14 and in Table 3-20: Keno Hill Silver District Surface Water Quality Monitoring Stations and Table 3-21.

Table 3-20: Keno Hill Silver District Surface Water Quality Monitoring Stations

SITE*	DESCRIPTION
Mayo River Watershed	
Lightning Creek	
KV-37	Lightning Creek upstream of Hope Gulch
KV-38	Lightning Creek upstream of Thunder Gulch
KV-41	Lightning Creek upstream of bridge at Keno City
KV-65	Thunder Gulch upstream of Bellekeno East Portal
KV-76	Thunder Gulch downstream of Bellekeno 625 Adit

SITE*	DESCRIPTION
KV-81	Lightning Creek southwest of Mill Site
McQuesten River Watershed	
Christal Creek	
KV-6	Christal Creek at Silver Trail Highway
KV-7	Christal Creek at Hanson Road
KV-8	Christal Creek at mouth
KV-49	Hinton Creek upstream of Christal Creek
KV-50	Christal Creek upstream of Hinton Creek
KV-51	Christal Creek downstream of Hinton Creek
No Cash Creek	
KV-21	No Cash Creek upstream of Silver Trail Highway
KC-111	Upper No Cash Creek above No Cash 500 Adit
KV-118	Upper No Cash Creek at Calumet Drive
South McQuesten River	
KV-1	South McQuesten River upstream of Christal Creek
KV-2	South McQuesten River at pump house downstream of Christal Creek

Note. * CCME-PAL is applied to the above monitoring sites.

Table 3-21: Keno Hill Silver District Adits and Wastewater Treatment Plants Locations

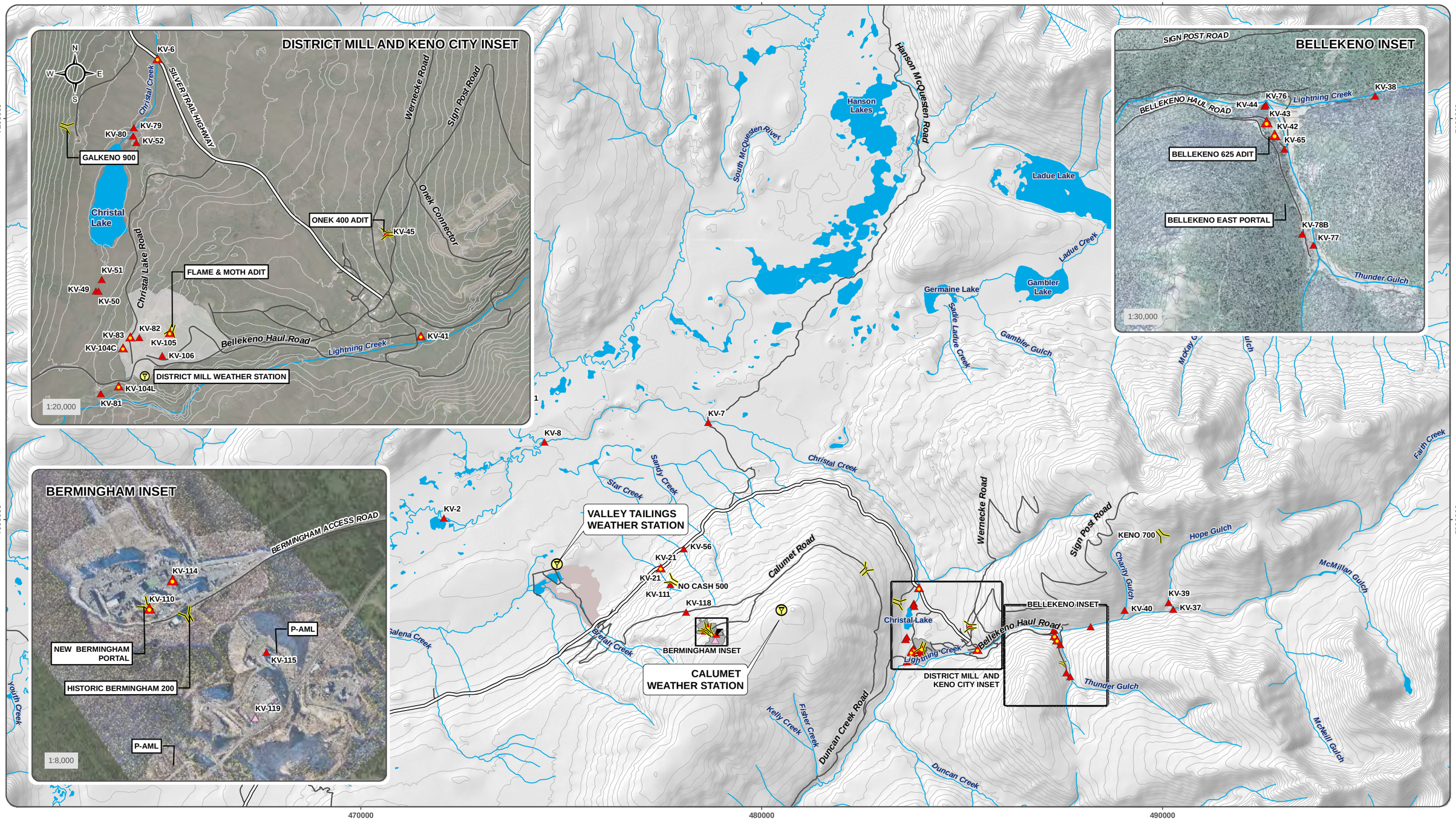
SITE	DESCRIPTION
Mayo River Watershed	
Lightning Creek	
KV-33	Keno 700 Adit
KV-42	Bellekeno 625 Adit
KV-43*	Bellekeno 625 Treatment Pond Decant
KV-104L*	Flame & Moth effluent discharged to Lightning Creek
KV-105	Flame & Moth Adit discharge
McQuesten River Watershed	
Christal Creek	
KV-27	Galkeno 300 Adit
KV-28**	Galkeno 300 Treatment Pond Decant
KV-31	Galkeno 900 Adit
KV-32**	Galkeno 900 Treatment Pond Decant
KV-34	Lucky Queen Adit
KV-45	Onek 400 Adit
KV-104C	Flame & Moth effluent discharged to Christal Creek
KV-95**	Onek 400 Treatment Pond Decant
No Cash Creek	
KV-18	Historical Bermingham 200 Adit

SITE	DESCRIPTION
KV-19	Ruby 400 Adit
KV-20	No Cash 500 Adit
KV-110	New Bermingham Portal discharge
KV-114*	New Bermingham Treatment Pond Decant

Note.

* Effluent Quality Standard (EQS) is applied under Type A Water Licence QZ18-044

** EQS is applied under Type B Water Licence QZ17-076



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Datum: NAD 83; Map Projection: UTM Zone 8N

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1:90,000 (when printed on 11 x17 inch paper)

0 1 2 3 4 5 Kilometers

- Active Surface Water Quality Station
- Pending/Proposed Water Quality Station
- Active Surface Water Quality and Continuous Flow Hydrology Station
- Adit
- Weather Station
- Mine Site
- Valley Tailings
- Silver Trail Highway
- Other Road
- Watercourse
- Waterbody

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 3-14

SURFACE WATER QUALTIY STATIONS

MARCH 2025

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3.2.1 South McQuesten River Drainage

The South McQuesten River is a large watercourse that drains much of the western portion of the KHSD. It receives drainage from Christal and Flat Creeks; the Flat Creek catchment is not discussed further since there are no KHSD Mining Operations within this catchment. No Cash Creek also drains towards the South McQuesten River but infiltrates to ground approximately 2 km south of the South McQuesten River.

3.2.1.1 South McQuesten River

Water quality stations installed along the South McQuesten River have been monitored by AKHM (2008 to 2024) to evaluate any potential impact on water quality related to mining activities at the project site.

Water quality in the South McQuesten River downstream of all mining related activities has improved over the years as management practices and interim Care and Maintenance activities at the historic environmental liabilities by ERDC have reduced the overall loading of metals into the receiving environment. However, since 2006 an unrelated source (Cache Creek) upstream of the KHSD's influence on the South McQuesten River has affected downstream water quality, resulting in increasing concentrations of metals, particularly cadmium and zinc. Station KV-1 is located on the South McQuesten River upstream of any loading sources from AKHM activities or historical mine contributions being managed by ERDC within the KHSD. Samples collected at KV-1 between 1994 and 2006 yielded a median total zinc concentration of 0.031 mg/L (n = 72), whereas samples collected between 2007 and 2016 returned a median total zinc concentration of 0.12 mg/L (n = 108). An investigation into the source of the elevated metals indicated that a scree field in the upper headwater region of Cache Creek was responsible for the increase in metal concentrations in the South McQuesten River (ITL, 2011; EDI, 2005). This area is also located upstream of AKHM and ERDC historical KHSD claims and although the Cache Creek drainage has had some minimal surface exploration, no substantial mining activity has taken place in this area.

Total cadmium and dissolved zinc concentrations in the South McQuesten River were generally higher at KV-1 located upstream of Christal Creek than those downstream at KV-2 (Figure 3-15). For reference, the CCME guideline for total cadmium and dissolved zinc displayed in Figure 3-15 is calculated based on the median guideline calculated for all samples (KV-1 and KV-2) collected in the Christal Creek catchment. Approximately 95% of samples at station KV-1 had exceedances of CCME-PAL total cadmium guideline between 2008 and 2024, while 91% of samples exceeded the guideline at station KV-2. Similarly, 85% of samples at KV-1 and 67% of samples at KV-2 exceeded the CCME-PAL dissolved zinc guideline. As such, the AKHM and historical metal loading captured by Christal Creek do not have a significant effect on the existing cadmium and zinc levels in the South McQuesten River. Seasonal patterns of dissolved zinc concentrations were similar at the South McQuesten River sites in which minima normally occurred in September and October and peak concentrations were observed in the spring. Similar seasonality was observed for total cadmium concentrations.

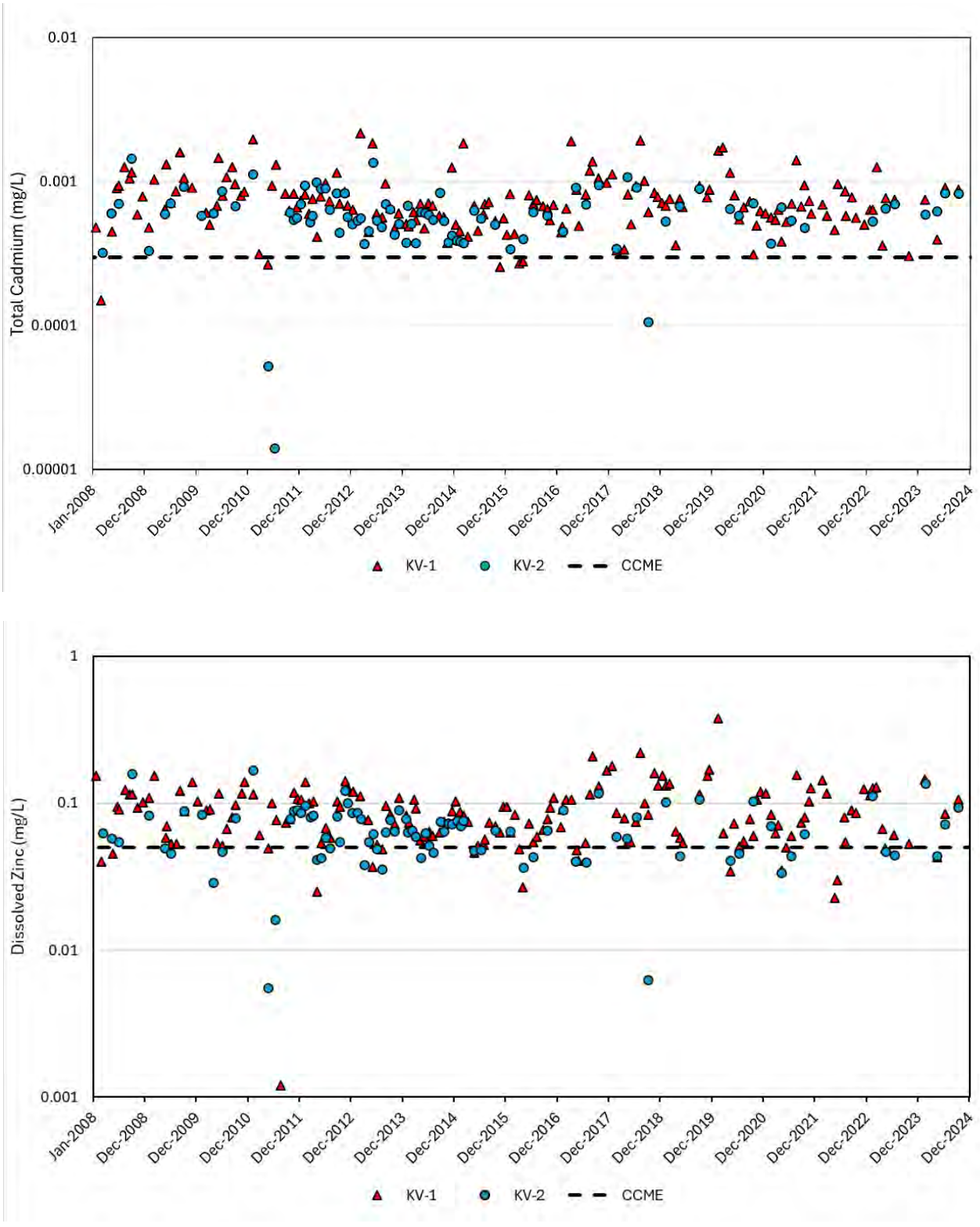

Figure 3-15: Total Cadmium (top) and Dissolved Zinc (bottom) Concentrations at Stations KV-1 and KV-2 in the South McQuesten River from 2008 to 2024

Plotted CCME guideline based off median calculated guideline from stations KV-1 and KV-2. Values shown above this guideline do not necessarily mean exceedance and is for comparative purposes only.

3.2.1.2 Christal Creek Catchment

Christal Creek originates on the south side of Galena Hill, flows into Christal Lake, and discharges at the north end of the lake, where it meanders north and west until it discharges into the South McQuesten River approximately 10 km downstream of the lake. The stream is predominately high gradient with erosional habitat through most of the upper reaches, but near the mouth of the creek, it becomes a low gradient meandering watercourse.

Major sources of metal load to Christal Creek include the Galkeno 300 and Galkeno 900 adits, both of which are treated under care and maintenance as part of the Type B Water Licence (QZ17-076). Historically, the Onek 400 adit discharge infiltrated to ground within a few hundred metres of the portal; however, since October 2020 it has been piped to a water treatment plant which discharges treated water at Wernecke Road. Tailings from the historical Mackeno mill, which are deposited at the mouth of Christal Lake and dispersed downstream within Christal Creek, are additional sources of metal load. ERDC manages these historic environmental liabilities.

Of the KHSD Mining Operations components, the Flame & Moth water treatment plant (WTP) and District Mill pond represent the primary sources of water discharge to the Christal Creek catchment.

Flame & Moth Water Treatment Plant

The Flame & Moth WTP can discharge to Christal Creek or Lightning Creek. The EQS for each watershed are further defined by the discharge rate, with four ranges identified in Part G, Clause 65 and 66 of Water Licence QZ18-044. Discharge from the Flame & Moth to Christal Creek has only occurred from April 30 to May 7 and May 15 to 16 of 2021 (station KV-104C); otherwise discharge has been directed to Lightning Creek (station KV-104L). Discharge may also be stopped and samples during non-discharge periods are referred to as KV-104ND.

District Mill Pond

Construction and placement of the DSTF was initiated in December 2010 during the commissioning of the District Mill. The District Mill Pond and DSTF are located south of Christal Lake, and immediately north of Lightning Creek. Until August 2015, the mill had not produced a discharge to the receiving environment. On August 24, 2015 water was released from the District Mill pond with decanting discontinued by October 17, 2015 to lower the level within the mill pond. Water was discharged from the pond at about 0.5 L/s intermittently over 50 or so days with a total effluent volume of 2,025 m^3 released in 2015.Water was again released from the sedimentation pond starting June 26, 2016 with periodic discharges occurring through July to August 20, 2016. During September 10 to 20, 2016 additional water was pumped from the District Mill pond for a total of 1,675 m^3 released in 2016.

No water was released from the Mill Pond in 2017. On June 18, 2018, water started being discharged from the sediment pond with periodic discharges occurring in July, August, October, and November. Discharge from the Mill Pond to the environment did not occur from 2019 to 2024. Discharge measurements from the Mill Pond between August 2015 and December 2024 are shown on Figure 3-16 .

Mill Pond concentrations of ammonia as well as total zinc, lead, and cadmium in comparison to the corresponding EQS for the Mill Pond decant (KV-83) and the Mill Pond (KV-82) are shown on Figure 3-17 to Figure 3-20. In November 2020, the District Mill was recommissioned, which included recycling water in the Mill Pond, causing an increase in concentrations of metals and ammonia. No water was discharged from the Mill Pond from 2019 to 2024; therefore, comparisons of the water quality in the Mill Pond to the EQS are for

context only. Total cadmium concentrations in the Mill Pond were elevated above the EQS in December 2020, September 2021, September 2024, and October 2024. Total zinc concentrations were also above the EQS during these same months, plus April 2021, March 2023, and December 2024. Total lead concentrations were above the EQS (0.2 mg/L) in most samples collected in 2021 (91% of samples in 2021) compared to concentrations consistently below the EQS observed in previous years. In 2022, the May sample returned lead concentrations in exceedance of the EQS for total lead, which coincided with elevated total iron concentrations during this event. Two samples exceeded the EQS for total lead in 2023 (March and May). In 2024, three of eleven samples (27%) exceeded the total lead EQS, which may be related to higher TSS (median 20.7 mg/L in 2024) compared to previous years (median of 4.9 mg/L for the historical period). The Mill Pond also exhibited alkaline pH in 2024, which was within the range of pH levels observed since 2020. Fifty-six percent of the 2024 pH measurements at KV-82 exceeded the upper bound EQS.

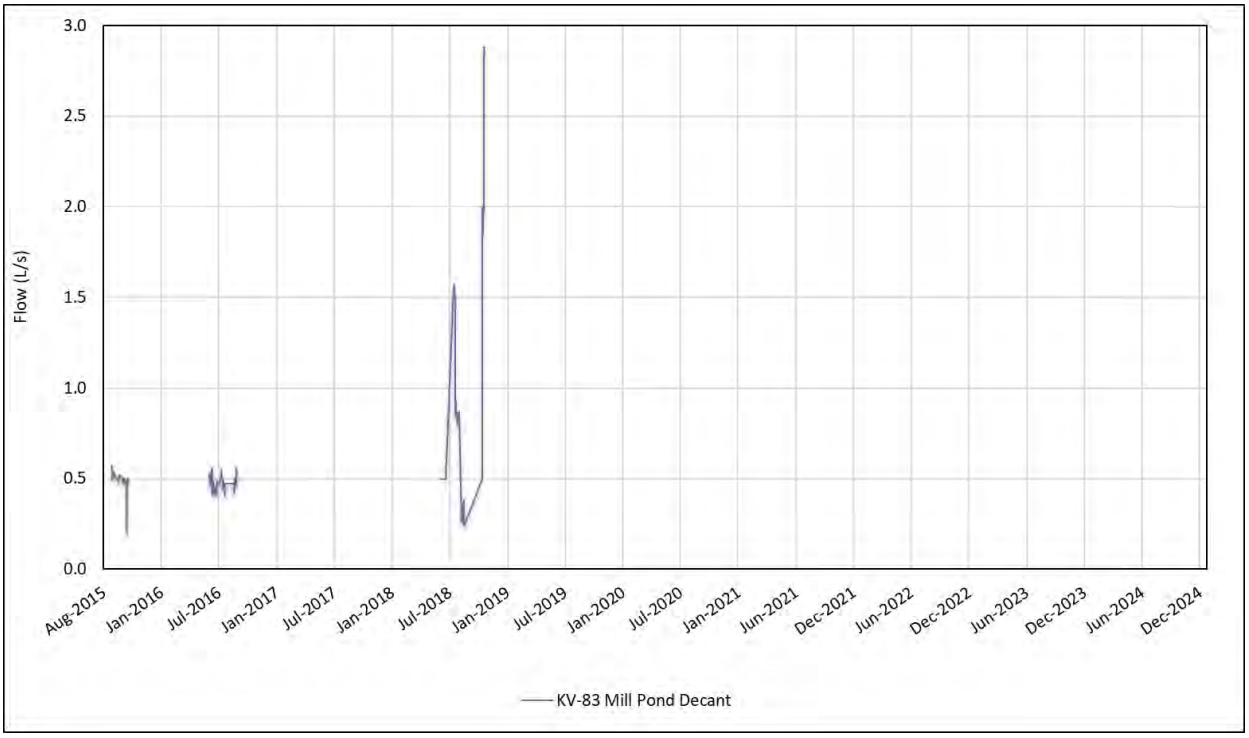

Figure 3-16: Mill Pond Discharge, 2015 to 2024

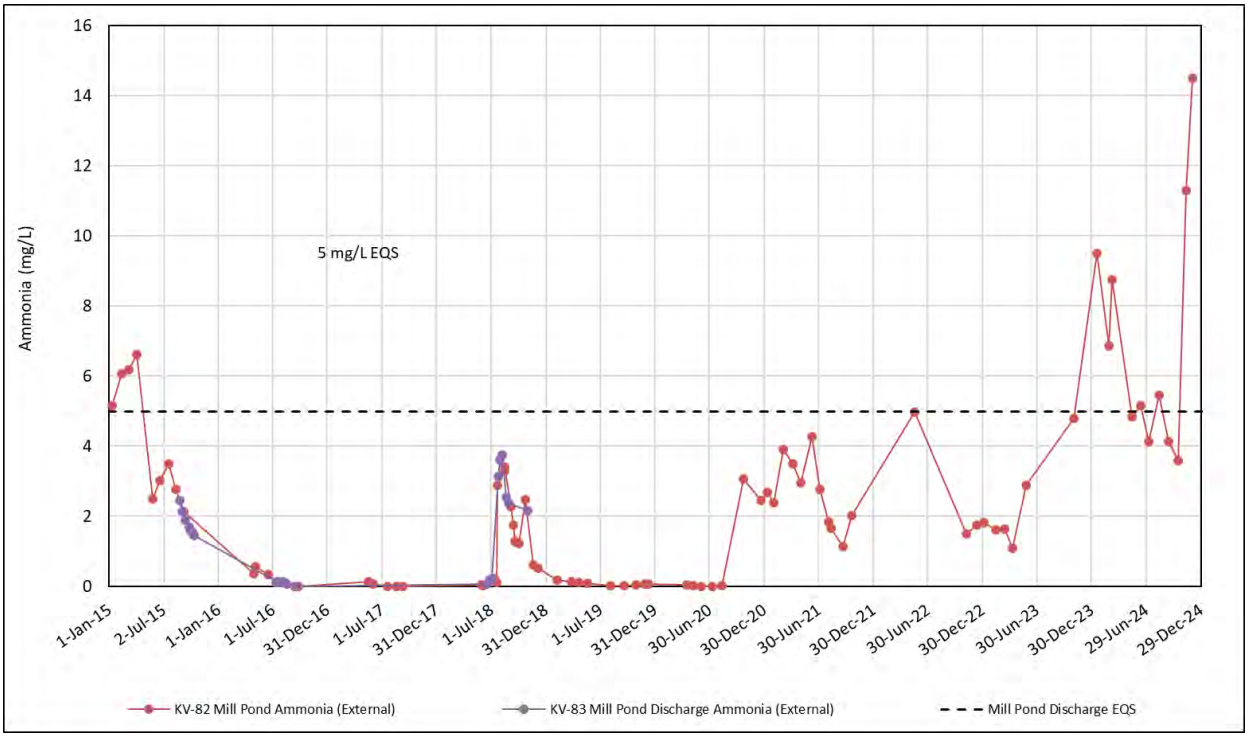

Figure 3-17: Mill Pond Ammonia, 2015 to 2024

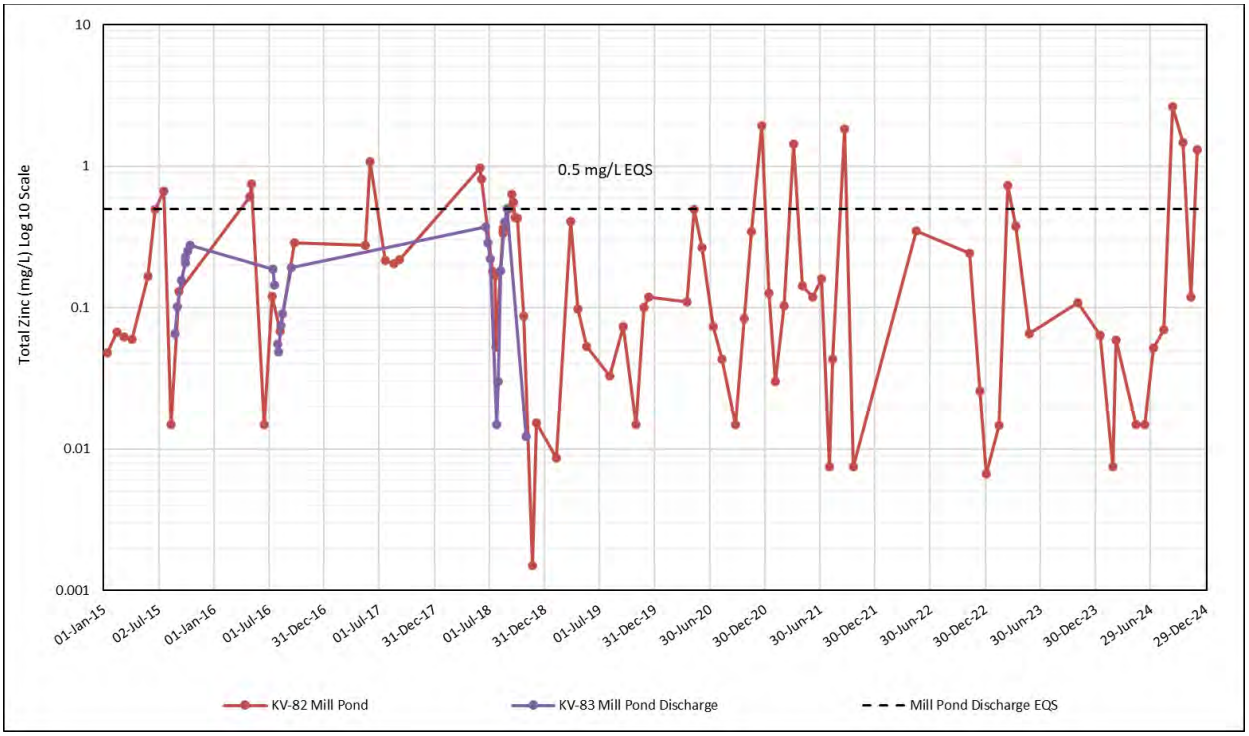

Figure 3-18: Mill Pond Total Zinc, 2015 to 2024

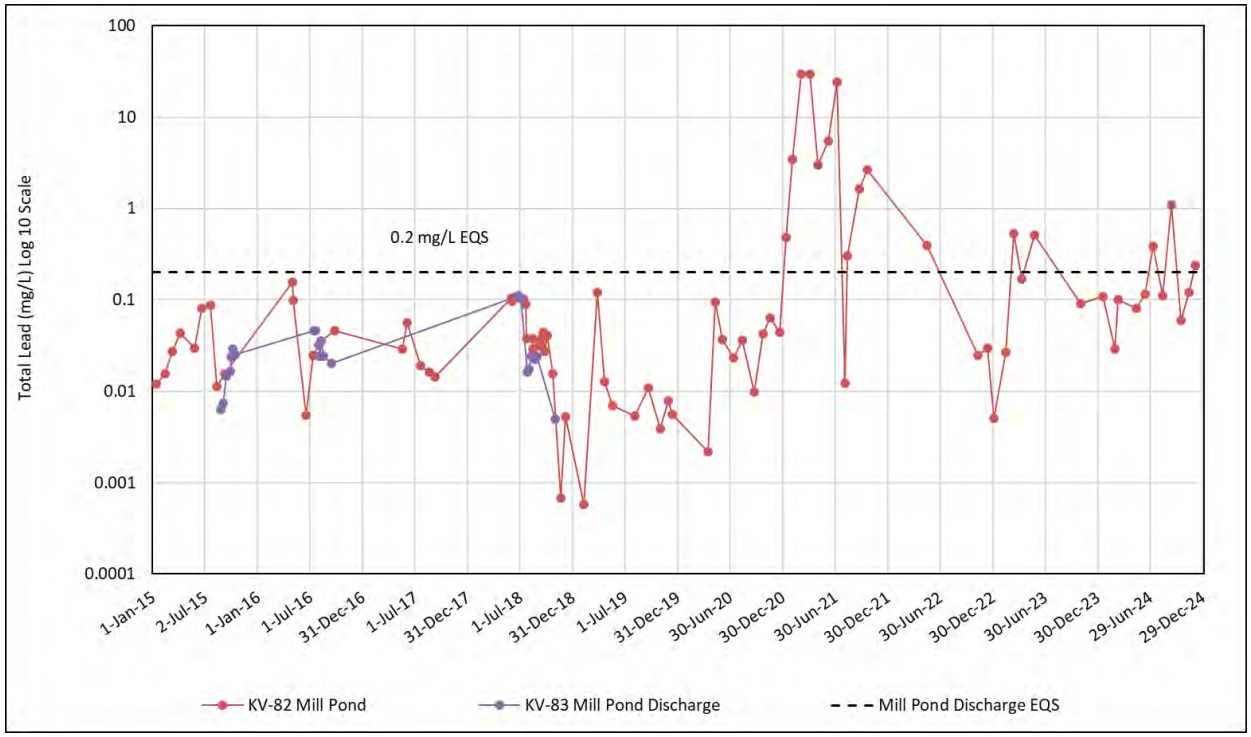

Figure 3-19: Mill Pond Total Lead, 2015 to 2024

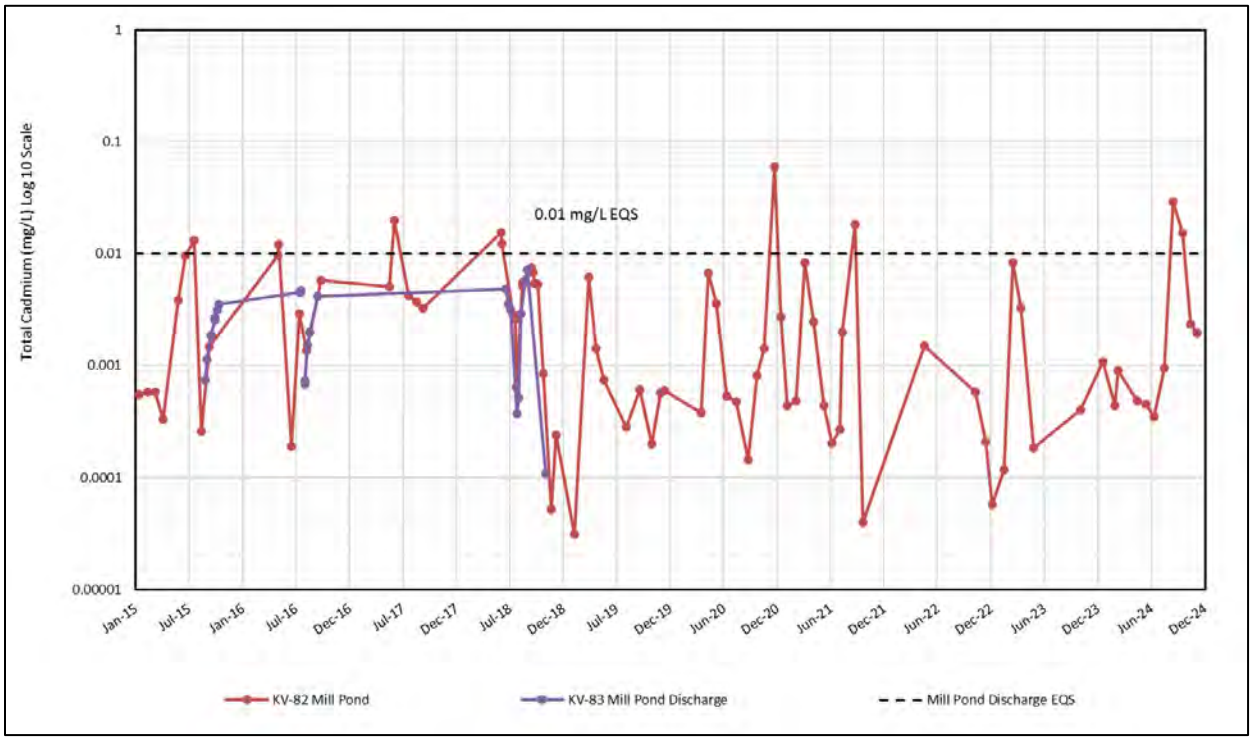

Figure 3-20: Mill Pond Total Cadmium, 2015 to 2024

Christal Creek

Water quality in Christal Creek is monitored at upstream stations KV-49, KV-50, and KV-51, and downstream along the creek at KV-6, KV-7, KV-8. Stations KV-7 and KV-8 are downstream of all mine sources and integrate effects from the main load sources in the catchment (treated discharge from the Galkeno 300 and Galkeno 900 adits, untreated and treated [since October 2020] discharge from the Onek 400 adit, and the Mackeno Tailings that are adjacent to and partially within Christal Lake and upper Christal Creek). These sites also capture effects of contributions from the UN and Lucky Queen adits, dispersed tailings within Christal Creek, and drainage from Erickson Gulch.

Christal Creek waters are circumneutral to mildly alkaline pH and have high hardness. Time series of total cadmium and dissolved zinc concentrations at each station in the Christal Creek catchment are shown in Figure 3-21. For reference, the CCME guideline for total cadmium and dissolved zinc displayed in Figure 3-21 is calculated based on the median guideline calculated for all samples (KV-6, KV-7, KV-8, KV-49, KV-50, KV-51) collected in the Christal Creek catchment.

Cadmium and zinc concentrations have remained relatively steady within seasonal bounds, typically peaking during spring freshet and again in the late fall. The concentrations of both metals typically exceeded their CCME guidelines during spring freshet, due to the markedly lower hardness (and therefore, lower CCME guidelines) present at this time owing to dilution by snowmelt. Total cadmium concentrations at Christal Creek were higher in downstream locations (stations KV-6, KV-7, and KV-8) and lower in upstream locations (stations KV-49, KV-50, and KV-51). In upper Christal Creek, total cadmium concentrations were above the CCME-PAL guideline in 44% of samples at KV-49, 19% at KV-50, and 19% at KV-51 from 2008 to 2024. On the other hand, in lower Christal Creek, 99%, 87%, and 90% of samples at KV-6, KV-7, KV-8 had exceedances of the total cadmium CCME-PAL guideline, respectively, from 2008 to 2004. Station KV-6 had the highest median total cadmium concentration of all sites within the catchment. These downstream sites generally show total cadmium concentrations peaking from May to July (during freshet).

No evident spatial pattern was identified for dissolved zinc concentrations at Christal Creek. Seasonal fluctuations are likely related to dilution from spring snowmelt. No seasonal variation for dissolved zinc was observed at KV-49. In upper Christal Creek, dissolved zinc concentrations exceeded the guideline in approximately 89% of samples at KV-50 and 80% of samples at KV-51 from 2008 to 2024. However, dissolved zinc concentrations were relatively low at station KV-49, showing 11% of samples with exceedances of CCME-PAL dissolved zinc guideline. In lower Christal Creek, dissolved zinc concentrations were above the guideline in 91% of samples at KV-6, 81% at KV-7, and 80% at KV-8. The trends in the lower Christal Creek stations (KV-7 and KV-8) are similar to those observed at the mouth of Christal Creek (KV-6) with higher levels of dissolved zinc concentrations observed during May to September.

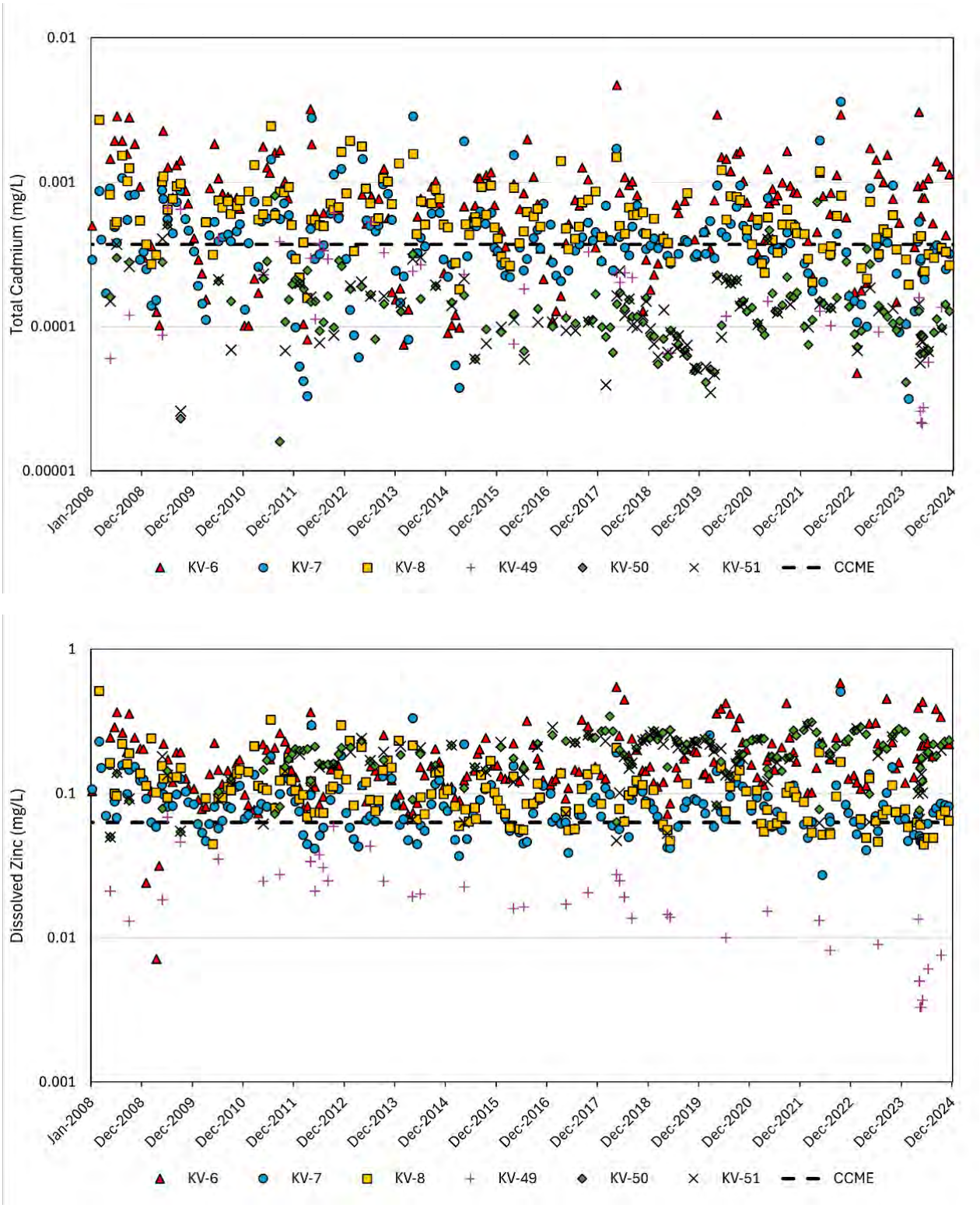

Figure 3-21: Total Cadmium (top) and Dissolved Zinc (bottom) Concentrations in Christal Creek from 2008 to 2024

Plotted CCME guideline based off median calculated guideline from stations in Christal creek. Values shown above this guideline do not necessarily mean exceedance and is for comparative purposes only.

3.2.1.3 No Cash Creek Catchment

No Cash Creek is located on the northwest side of Galena Hill. The No Cash Creek headwaters are located upstream of the No Cash 500 adit, although the majority of flow in No Cash Creek is supplied by discharge from No Cash 500. The Ruby 400 and historical Bermingham 200 adits are located farther up the hillside; discharge from these adits infiltrates to ground such that there is typically no surface connection to No Cash Creek, although one may form in winter when ground is frozen. Below the Silver Trail Highway, No Cash Creek intersects the No Cash Diversion Ditch and then runs through a poorly drained valley containing extensive areas of heavily vegetated peat bog/marsh. No Cash Creek is not a direct tributary of any other streams but instead terminates in a small pond in a low-lying boggy area of the valley approximately 2 km south of the South McQuesten River.

Discharge of untreated wastewater from No Cash 500, Ruby 400, and Bermingham 200 adits is authorized under the ERDC Type B Water Licence (QZ17-076 and draft Water Licence QZ21-012). No EQS is specified for these adits under the ERDC or AKHM water licences. The New Bermingham mine portal is located adjacent to the historical Bermingham 200 adit.

New Bermingham

Discharge from the New Bermingham mine commenced in mid-2017. Mine dewatering was required during development activities at the New Bermingham mine and with issuance of QZ18-044 discharge commenced from the water management pond decant (KV-114) in September 2020. The New Bermingham WTP was installed in November 2020. The water discharged from the New Bermingham mine is treated through the New Bermingham WTP and discharged to ground in the upper No Cash Creek catchment. There is no overland connection with downstream watercourses such as No Cash Creek.

The dissolved concentrations of COPI in surface waters sampled from the New Bermingham pond decant (KV-114) were compared with EQS for the New Bermingham WTP. The EQS are defined in WL QZ18-044 and those that apply to New Bermingham WTP pond decant came into effect on July 23, 2020 (YWB, 2020). Although they do not apply to the untreated (raw water) discharge from the underground workings, the EQS were also compared with data collected from the New Bermingham Portal discharge (KV-110) to provide a benchmark for comparison.

The licence also limits the effluent discharge rate from the mine to 1,200 m^3/day, or the equivalent of continuous discharge at 13.9 L/s. Flows at KV-114 ranged between 0 and 14.5 L/s (median 6.3 L/s) since September 16, 2020.

There have been no exceedances of the dissolved cadmium EQS (0.01 mg/L) for KV-114 (Figure 3-22), and there have only been a few exceedances at KV-110 (3.6% of samples). Dissolved copper concentrations were generally below the EQS (0.024 mg/L) for both KV-114 and KV-110 (Figure 3-23). Dissolved lead showed more EQS (0.048 mg/L) exceedances at KV-110 (7.7% of samples) compared to KV-114 (0.9% of samples) over the dataset (Figure 3-24). Dissolved silver concentrations were generally below detection limit at both stations (**Error! Reference source not found.**), with only a few exceedances of the EQS (0.00062 mg/L) at KV-114 (0.9% of samples). Dissolved zinc concentrations were also generally well below the EQS (0.5 mg/L; Figure 3-26), with only minor exceedances observed at KV-110 (4% of samples). Total nickel concentrations showed few exceedances of the EQS (0.37 mg/L) for KV-110 (1.6% of samples), while KV-114 has no exceedances (Figure 3-27). In 2020, 64% of the samples from KV-114 had dissolved arsenic higher than the EQS and coincided with increases in dissolved arsenic concentrations at KV-110 above the EQS (Figure 3-28) and with

an increase of field pH to alkaline levels (Figure 3-29). In 2024, there were no EQS exceedances of dissolved arsenic concentrations at KV-114 owing to improvements in the WTP operation.

There were no exceedances of the EQS for radium-226 at KV-114, with all samples below the detection limit from 2020 to 2024. KV-114 had a higher proportion of samples (15.9%) exceeding the EQS for ammonia-N (5 mg-N/L) compared to KV-110 (5%; Figure 3-30Figure 3-30**Error! Reference source not found.**). One sample in August 2024 exceeded the associated EQS for ammonia-N at KV114; comparatively, concentrations surpassed the ammonia-N EQS for 10 of the 55 samples (18%) collected at KV-110 in 2024 (Figure 3-30Figure 3-28). 5.4% of samples collected at KV-114 returned a *field* pH greater than the EQS of 9.5 or less than 6.5 (Figure 3-29Figure 3-29); however, only 0.5% of *external lab* pH samples exceeded the EQS. There were select exceedances (8.1% of samples between 2020 to 2024) of the EQS for TSS (25 mg/L) at KV-114 (Figure 3-31). TSS in the treated effluent ranged from <1.0 to 66.5 mg/L with a median of 9.5 mg/L. Additionally, TSS concentrations at KV-110 were higher relative to KV-114, ranging between <1.0 and 37,000 mg/L (median 325 mg/L; Figure 3-31).

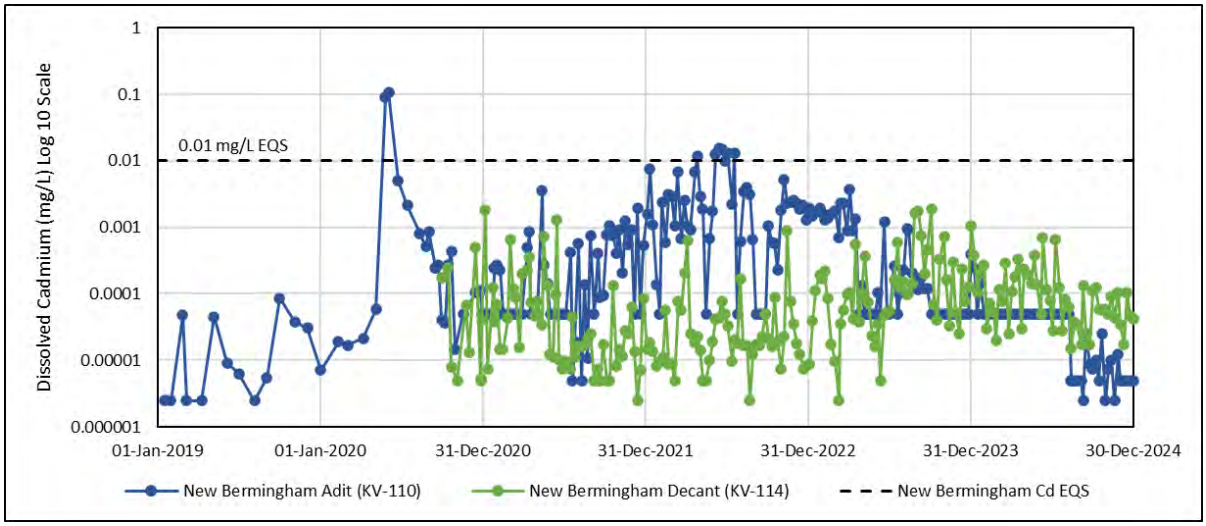

Figure 3-22: New Bermingham Dissolved Cadmium, 2019 to 2024

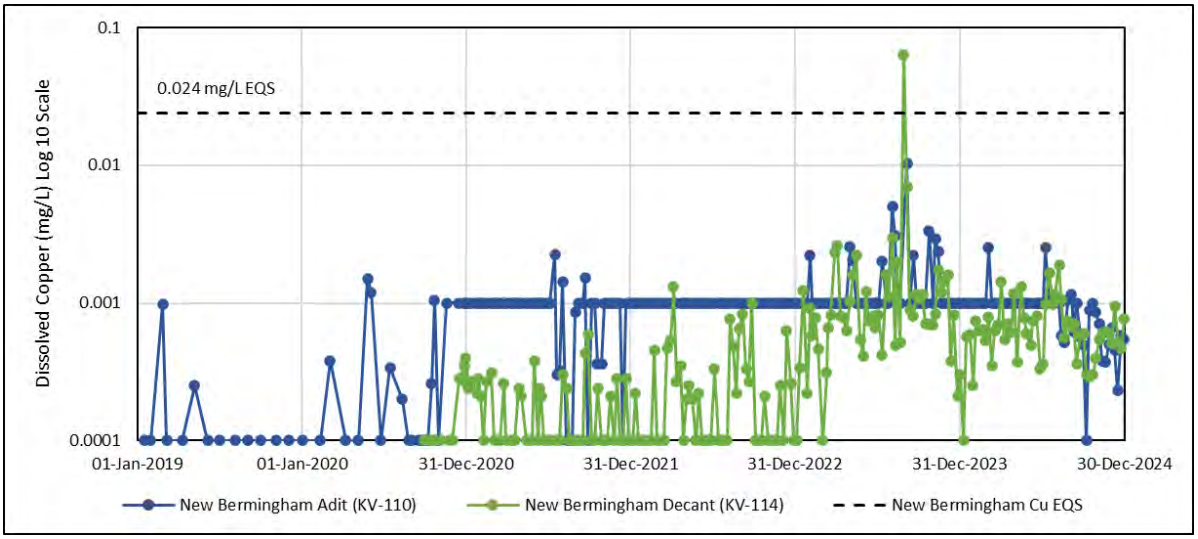

Figure 3-23: New Bermingham Dissolved Copper, 2019 to 2024

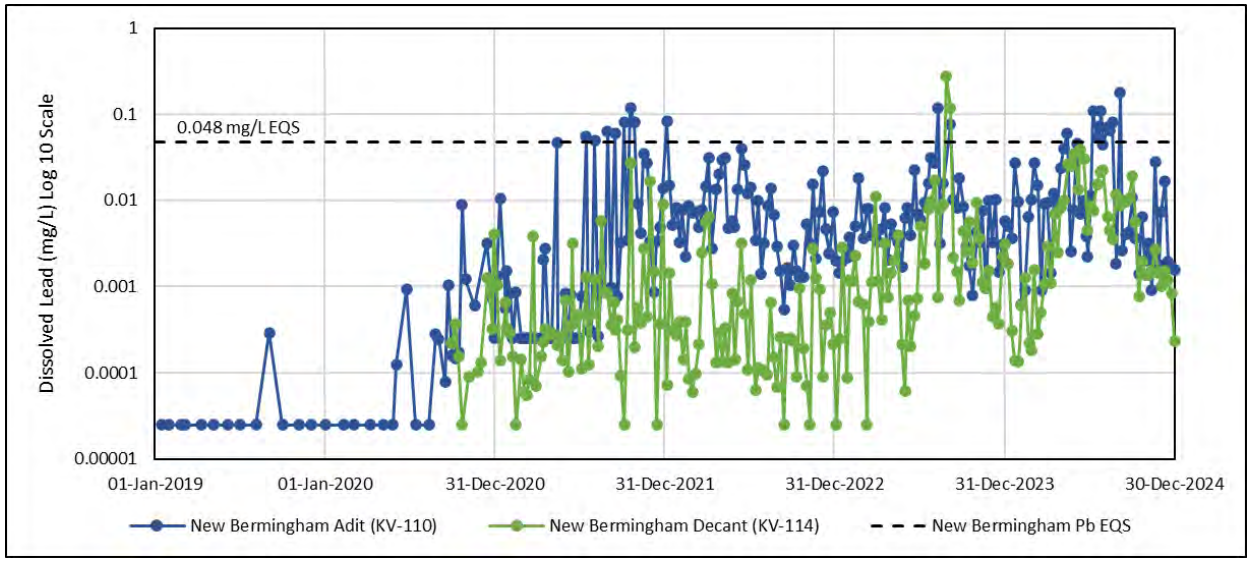

Figure 3-24: New Bermingham Dissolved Lead, 2019 to 2024

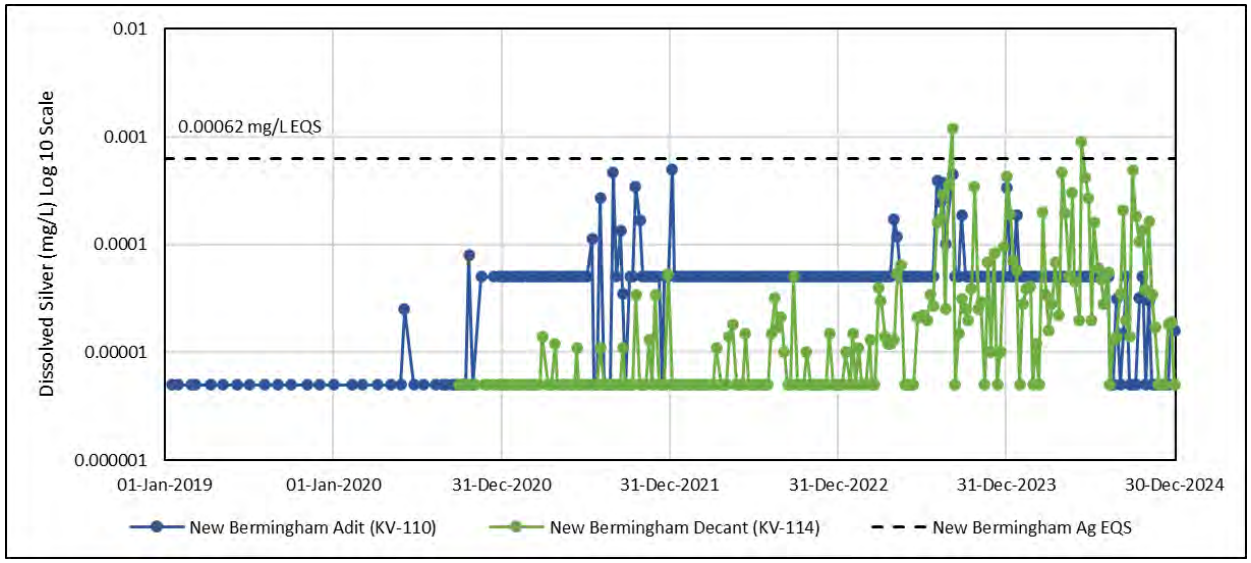

Figure 3-25: New Bermingham Dissolved Silver, 2019 to 2024

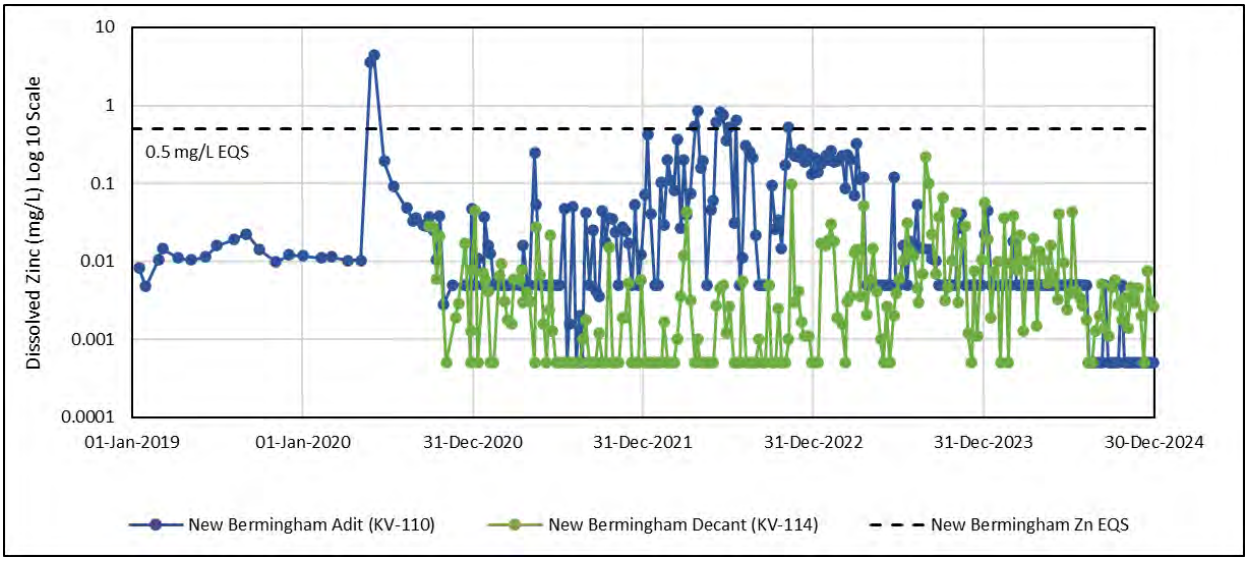

Figure 3-26: New Bermingham Dissolved Zinc, 2019 to 2024

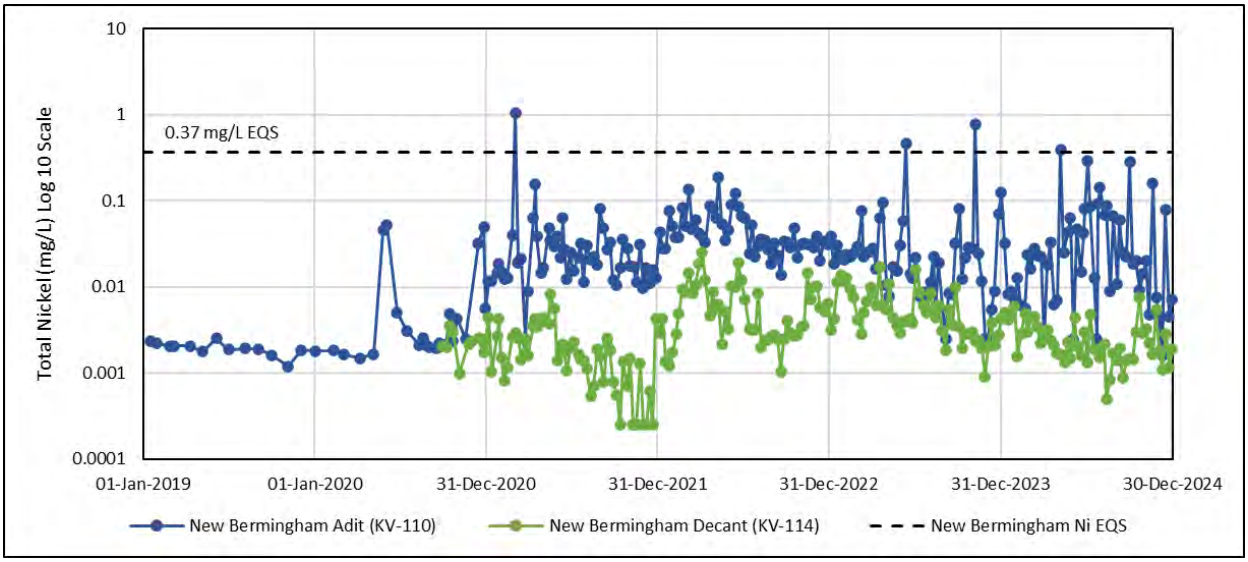

Figure 3-27: New Bermingham Total Nickel, 2019 to 2024

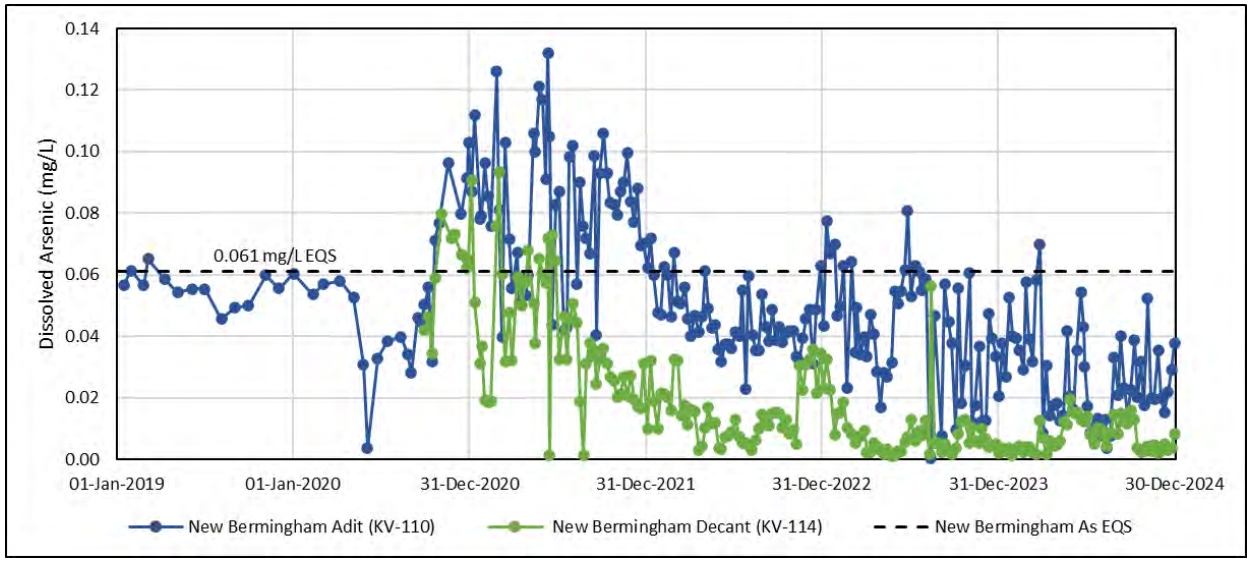

Figure 3-28: New Bermingham Dissolved Arsenic, 2019 to 2024

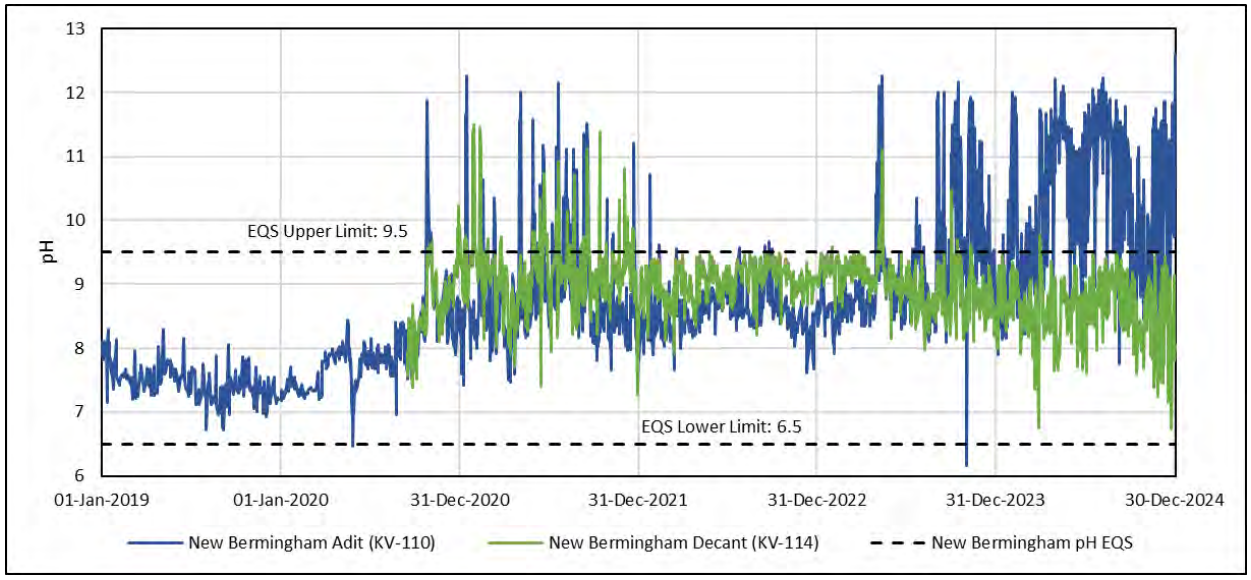

Figure 3-29: New Bermingham Field pH, 2019 to 2024

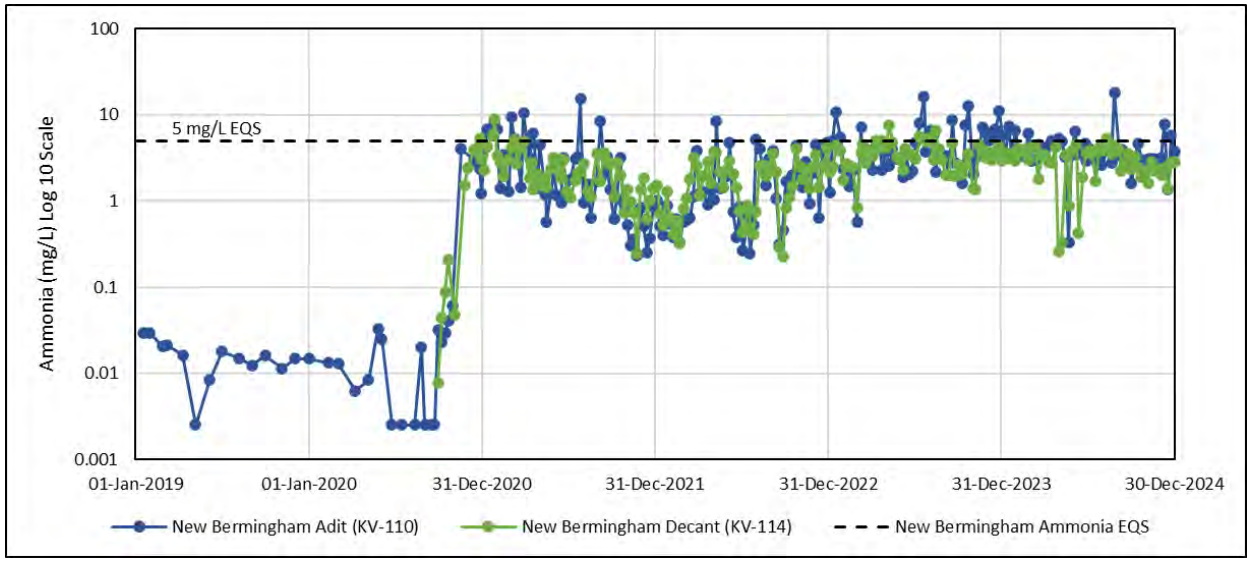

Figure 3-30: New Bermingham Ammonia, 2019 to 2024

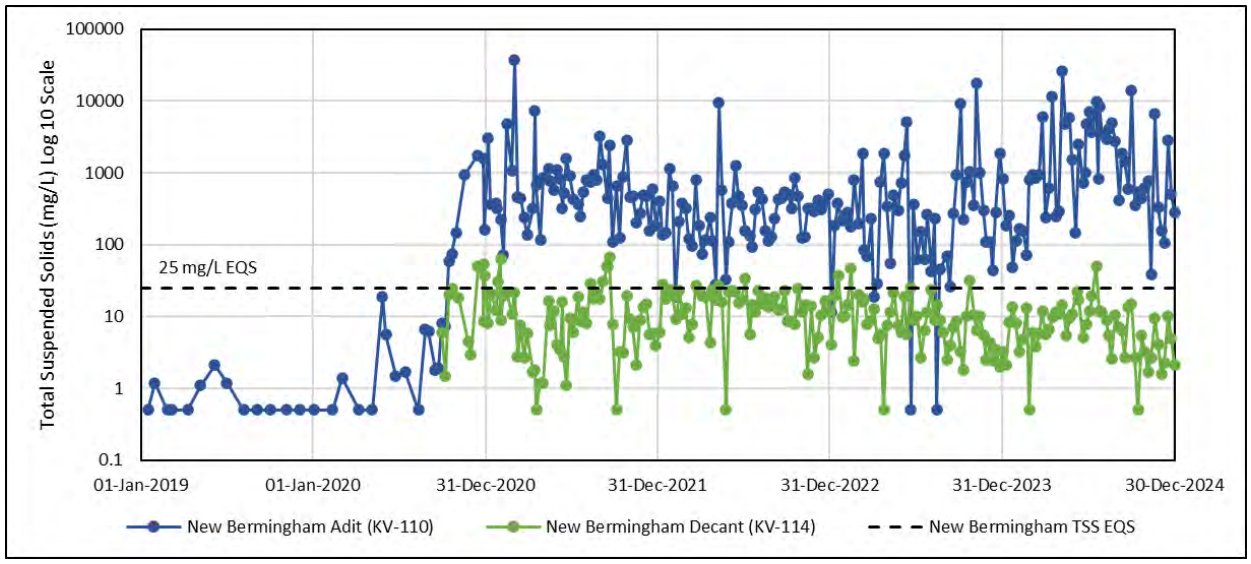

Figure 3-31: New Bermingham Total Suspended Solids, 2019 to 2024

No Cash Creek

No Cash Creek is situated on the northwest slope of Galena Hill and flows down the hillside towards the wetlands northeast of the Valley Tailings Facility. From the headwaters on Galena Hill to dispersion in the bog, the distance is approximately 5.2 km. The No Cash Bog drainage includes the adit discharges from the historical No Cash 500 adit, the historical Ruby 400 adit, the historical Bermingham 200 adit and AKHM's New Bermingham Mine. The No Cash Creek catchment is currently monitored by three water quality monitoring stations located on No Cash Creek: KV-21, KV-111, and KV-118. The water quality of station KV-21 is affected by the discharge from the historical No Cash 500 adit, located approximately 500 m upstream of station KV-21. Stations KV 111 and KV-118 are located upstream of the No Cash 500 adit and largely reflect background water quality. Similar to No Cash Creek, Star Creek (monitored at station KV-56) flows down the hillside towards the

wetlands northeast of the Valley Tailings Facility. The flow path runs parallel to and between No Cash Creek and Sandy Creek. Star Creek originates near the No Cash Mine at the 100-level adit (although no flow discharges from the No Cash 100 adit).

The dissolved concentrations of COPI in surface waters sampled at KV 21 were compared with the No Cash Creek WQO listed in the AMP (Hecla Yukon, 2023). For hardness-, pH-, and/or temperature-dependent constituents (lead, nickel, and ammonia), the WQO was determined concurrently using these parameters. The WQOs for cadmium, copper, sulphate, and zinc were calculated using the background concentration procedure since existing water quality at KV-21 exceeded generic Canadian water quality guidelines (Hecla Yukon, 2023). In these cases, two WQOs are available – a short-term WQO that is compared on a sample-by-sample basis, and a long-term WQO which is compared against the average of the past 24 months of samples.

Temporal changes in dissolved cadmium and zinc concentrations between 2015 and 2024 are displayed in Figure 3-32 and Figure 3-33, respectively. Concentrations reported as below detection were plotted at half the value of the detection limit. The KV 21 short-term WQO for dissolved cadmium (0.0445 mg/L) and zinc (4.94 mg/L) were not exceeded in the samples collected in 2024. Additionally, the 24-month moving average concentrations calculated for the samples collected in 2024 did not exceed the long-term WQO. Dissolved cadmium concentrations were originally elevated above the short-term WQO at KV-21 from July to October 2020; dissolved zinc concentrations were elevated in July 2020 as well as September to November 2020. Consequently, the 24-month rolling average concentrations exceeded long-term WQO from August 2021 to August 2022 for dissolved cadmium, and from June 2021 to November 2022 for dissolved zinc at KV-21.

TSS concentrations were generally lower in 2024 than those observed in 2020. The higher TSS and metal concentrations observed at KV-21 in 2020 are likely due to the greater flows noted in 2020 causing greater infiltration and flushing of the No Cash Mine which supplies the bulk of cadmium and zinc to No Cash Creek. In 2024, TSS concentrations increased in May (17.9 mg/L), likely a result of higher flows observed during spring freshet. The highest 2024 concentrations were measured in October (33.8 mg/L), which may be associated with autumn storm events.

In 2024, dissolved cadmium and zinc concentrations were similar to the historical record and generally followed the expected seasonal pattern. Cadmium and zinc concentrations at KV-21 typically peaked in the fall (October or November) with the lowest concentrations observed in late winter or in May. All other parameters with a WQO at KV-21 (ammonia, nitrate, nitrite, sulphate, dissolved arsenic, copper lead, nickel, selenium, silver, and uranium) were below their respective WQO in 2024.

The dissolved cadmium concentrations in the New Bermingham Portal discharge (KV-110) and the New Bermingham Pond Decant (KV-114) were consistently lower than the EQS (0.01 mg/L) in 2024 (Figure 3-32). The dissolved cadmium concentrations at KV-110 were elevated during early monitoring, decreased by approximately three orders of magnitude between late 2018 through 2019, increased again in mid-2020 to 2022, and subsequently decreased between 2022 and 2024 (Figure 3-32). This behaviour reflects initial advancement of the underground workings, a suspension of activity, then further expansion of the workings upon receipt of the WL. KV-118, which represents the upper reach of No Cash Creek that experiences seasonal flow, returned dissolved cadmium concentrations generally higher than the New Bermingham Portal discharge (KV-110). Compared to KV-118, lower dissolved cadmium concentrations were observed farther downstream on No Cash Creek at KV-111 (situated upstream of the No Cash 500 adit), suggestive of dilution and/or cadmium attenuation in Upper No Cash Creek. Cadmium concentrations at the farthest downstream No Cash Creek station (KV-21) were approximately two orders of magnitude higher than those at KV-111 due to the contribution from the No Cash 500 adit discharge, which flows into No Cash Creek between these two stations.

The dissolved zinc concentrations at KV-110 and KV-114 were consistently lower than the EQS (0.5 mg/L) and no exceedances were detected at either station in 2024 (Figure 3-33). Dissolved zinc concentrations at KV 110 declined more than two orders of magnitude from 0.6 mg/L in January 2018 to between 0.005 and 0.02 mg/L between late 2018 and April 2020, reflecting the minimal site activity over this period. Dissolved zinc then increased sharply to 4.4 mg/L in June 2020, then sharply decreased to concentrations almost two orders of magnitude lower than the EQS over the remainder of 2020. In 2021, dissolved zinc concentrations were typically elevated compared to concentrations observed in 2019 and early 2020, while 2022 and 2023 zinc concentrations were within the range of concentrations reported from 2021. The elevated concentrations were linked to active development of the New Bermingham Mine workings in 2021 to 2023. In 2024, dissolved zinc concentrations were lower compared to the 2019 to 2023 dataset, with the majority of samples below the detection limit of <0.01 mg/L. Dissolved zinc concentrations downstream in No Cash Creek above the No Cash 500 adit (KV-111) were generally lower than those at KV-110 for the same period; although similar or higher concentrations were observed at KV-111 in 2023 and 2024. Dissolved zinc concentrations in the most downstream No Cash Creek station (KV 21) were generally one to two orders of magnitude higher than those in upper No Cash Creek due to the input from the No Cash 500 adit.

Dissolved cadmium and zinc results for No Cash Creek above the No Cash 500 adit (KV-111) for 2017 to 2024 are shown in Figure 3-32 and Figure 3-33, respectively. Dissolved concentrations were compared to the KV-111 WQOs (Hecla Yukon, 2023). The 24-month moving average (cadmium and zinc only) was calculated with limited data as KV-111 was only sampled between April to November in 2019, May to October in 2020, February to October in 2021, June and August to October in 2022, January and June to October in 2023, and April to November in 2024. There were no exceedances of the WQOs (for ammonia, nitrate, nitrite, sulphate, dissolved arsenic, cadmium, copper, lead, nickel, selenium, silver, uranium, and zinc) at KV-111 in 2024 or since WL QZ18-044 came into effect. Concentrations of cadmium and zinc measured in the eleven 2024 samples at KV-111 were similar to the historical record (Figure 3-32 and Figure 3-33, respectively) .

Total cadmium and zinc results for Star Creek (KV-56) for 2015 to 2024 are shown in Figure 3-34 and Figure 3-35, respectively; total concentrations are plotted since the KV-56 WQO apply to the total fraction (Hecla Yukon, 2023). The 24-month moving average (cadmium only) was calculated with limited data as KV-56 was only sampled between May to October in 2019 and 2020, between May to November in 2021, between May and September in 2022 and 2023, and between April and November in 2024. There were no exceedances of the WQOs at KV-56 in 2024 or since WL QZ18-044 came into effect, except for total cadmium, total copper, and total zinc. Four exceedances of the total copper WQO were observed since the WL came into effect (August 2020, May, July, and November 2021). One sample in 2021 marginally exceeded the cadmium short-term WQO of 0.000297 mg/L in July 2021 (0.000300 mg/L). Total and dissolved zinc concentrations for two samples collected in May 2023 and May 2024 marginally exceeded the zinc WQO (6.5% since WL QZ18-044 came into effect). No exceedances of the cadmium and copper WQOs occurred in 2024. Concentrations of cadmium and zinc measured in the eleven 2024 Star Creek samples were generally within the historical range for concentrations at this monitoring station (Figure 3-34 and Figure 3-35, respectively).

Natural attenuation of cadmium and zinc via co-precipitation with and sorption on iron and manganese (oxyhydr)oxides along the reach of No Cash Creek serves to lower concentrations of cadmium and zinc such that they approach their respective CCME-PAL guidelines towards the terminus of No Cash Creek (ITL, 2013).

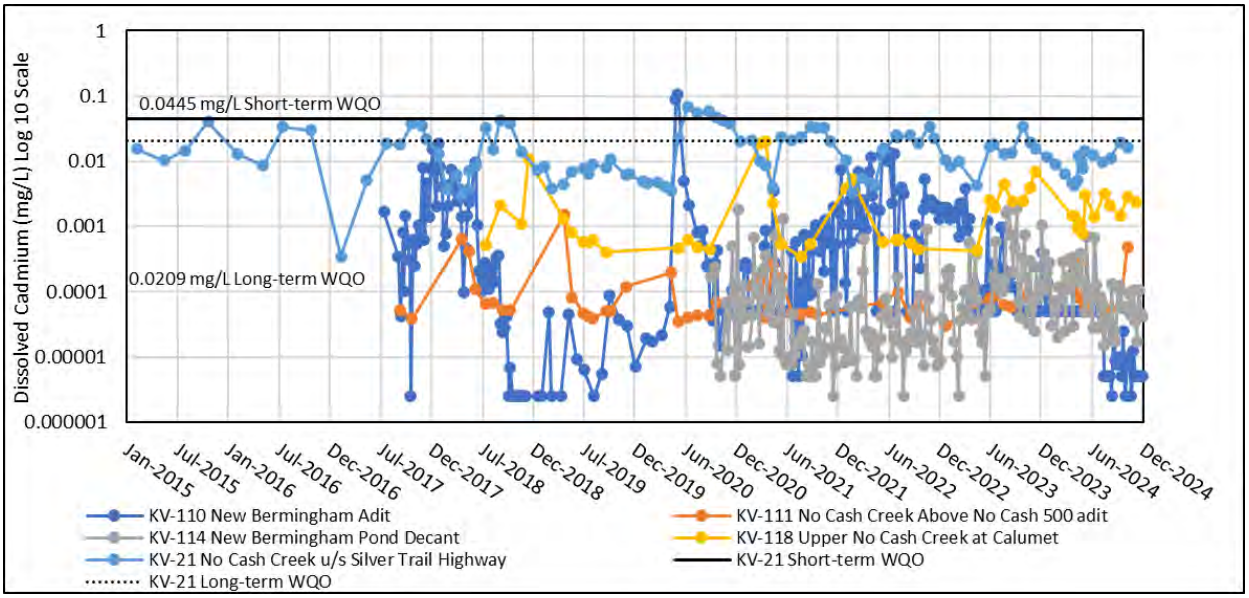

Figure 3-32: No Cash Creek Dissolved Cadmium, 2015 to 2024

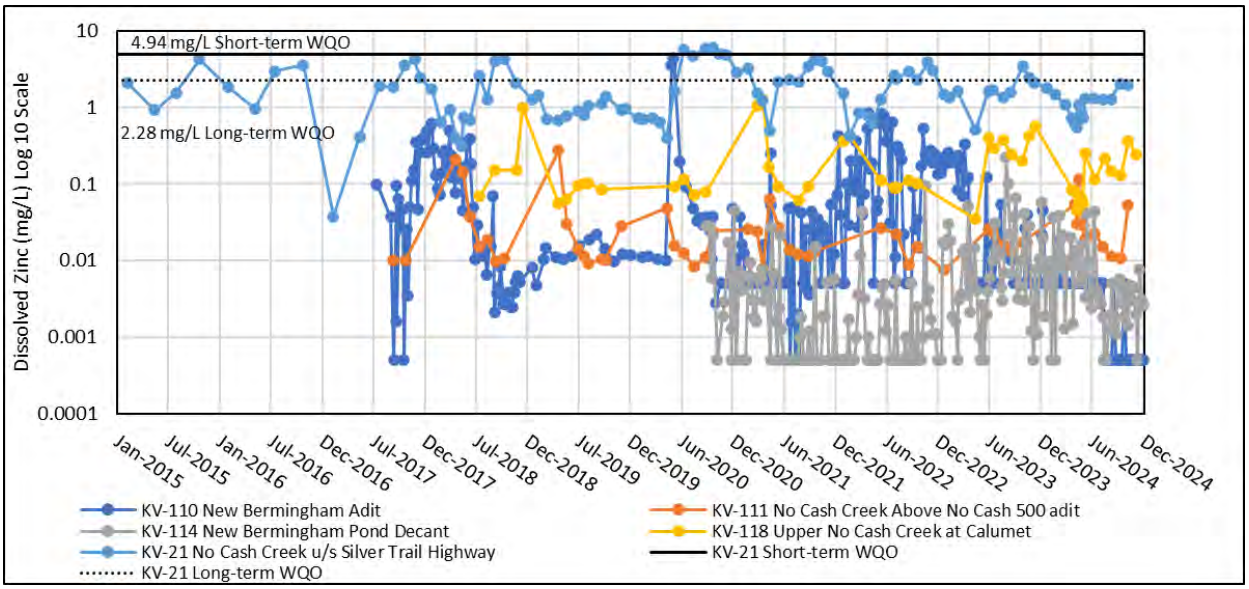

Figure 3-33: No Cash Creek Dissolved Zinc, 2015 to 2024

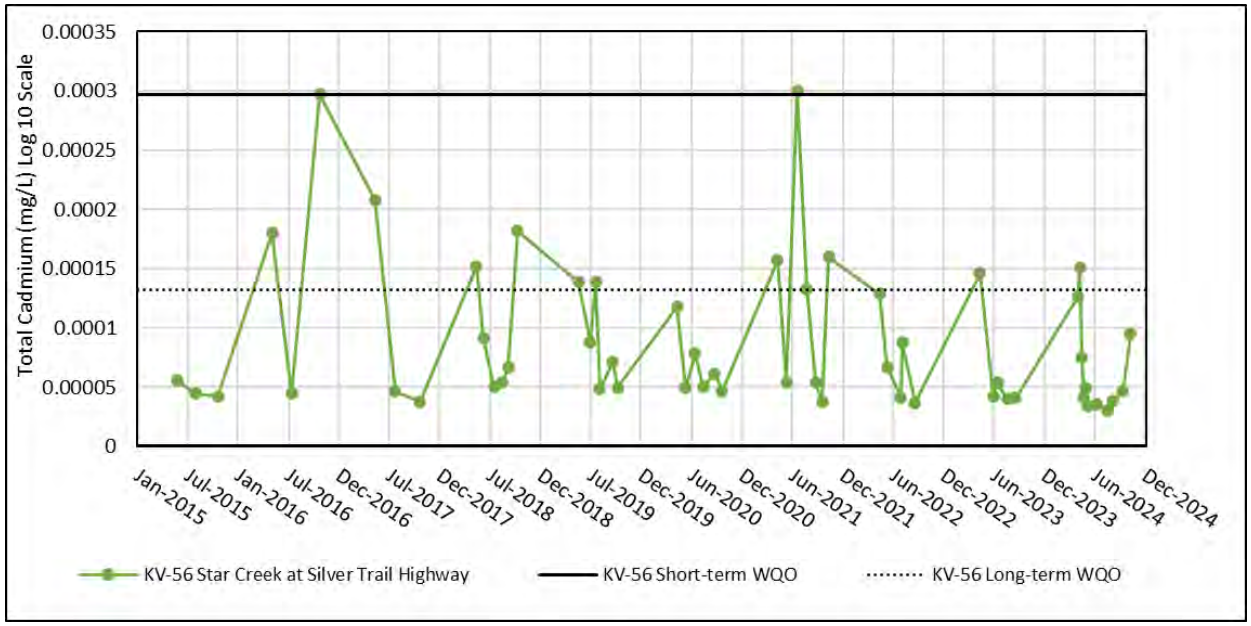

Figure 3-34: Star Creek Total Cadmium, 2015 to 2024

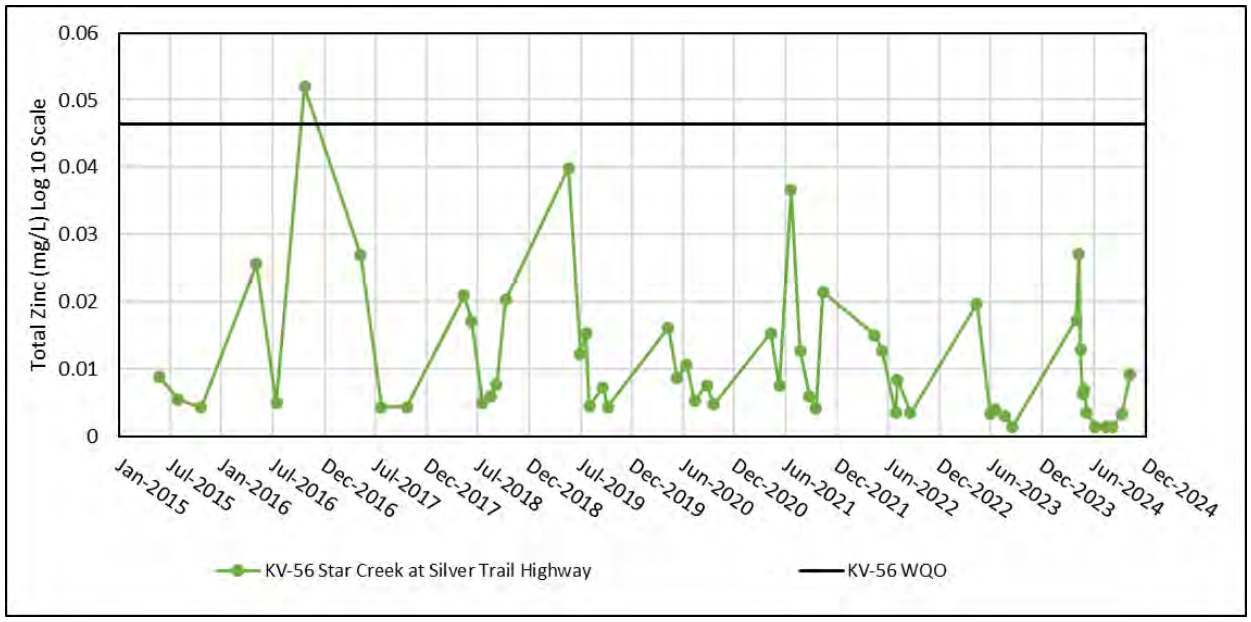

Figure 3-35: Star Creek Total Zinc, 2015 to 2024

KV-56 WQO is based on the dissolved zinc CCME water quality guideline for the protection of aquatic life. For representative purposes the guideline plotted was calculated using the median hardness, pH, and DOC for KV-56.

3.2.2 Mayo River Drainage

3.2.2.1 Lightning Creek Catchment

Lightning Creek is a mountainous alpine stream flowing within a narrow valley with steep gradient from the north side of Sourdough Hill into Duncan Creek, which drains into the Mayo River. Hope Gulch and Thunder Gulch flow into Lightning Creek within the bounds of potential effects from the KHSD Mining Operations.

Several legacy mines have operated in the Lightning Creek catchment, including Keno 700, Bellekeno, Homestake, Demon, Bema, Divide, Comstock, Apex, Charity, Vanguard, Runner, Ironclad, Hogan, and Gold Hill number 2, with Keno 700 representing a significant source of metal load. Placer mining in Lightning Creek and Thunder Gulch predates the AKHM KHSD Mining Operations that commenced at the Bellekeno Mine and has been active in the vicinity of Keno City since the 1960s. These placer mining operations have significantly impacted habitat and water quality, particularly with respect to suspended solids.

Of the KHSD Mining Operations components, the Bellekeno 625 WTP pond decant (KV-43) and Flame & Moth WTP effluent (KV-104L) discharge to Lightning Creek and are regulated under Type A Water Licence QZ18-044.

Bellekeno Mine

Discharge at the Bellekeno 625 Adit has been monitored since at least 1984, with consistent records beginning in 2006. The frequency of monitoring increased with the Type B WL issuance and advanced exploration activities at the Bellekeno Mine in 2009.

Two periods of dewatering occurred in the history of the Bellekeno Mine: in 1994 during exploration activities and again in 2008 to 2009 during advanced exploration activities by Alexco. Additional dewatering activities occurred in 2020 following the cessation of temporary closure. In 2021 dewatering ceased.

During 1994 exploration, the flooded underground workings were dewatered and pumped. Water quality results prior to and during dewatering in this period show:

- No clear seasonal variations in either drainage chemistry or flow, indicating that there is little surface recharge to the workings.
- Consistently alkaline pH values, between 7 and 8.
- Variable conductivity values in the range of 700 µs/cm, but no clear and consistent change over time in conductivity, sulphate, or total dissolved solids.
- Iron concentrations were very low, consistent with the alkaline pH and lack of sulphide oxidation.
- Internal results showed cadmium values above detection, however, analyses at independent laboratories consistently show total cadmium at <0.05 mg/L.
- Zinc was the only metal to show an apparent increase from 1990-1992 however the values in 1993/94 were comparable to those in the mid-1980s; and
- High lead and zinc during production in 1985 to 1988 (no settling pond).

The above indicates that the Bellekeno underground workings and associated waste rock have not historically been of concern with respect to acid rock drainage (ARD). The chemistry of the drainage water appears to be reasonably constant with time and there were no parameters which indicate that ARD was developing. Leaching of zinc from oxidation of zinc sulphides was the only real concern from this adit.

Data at Bellekeno collected from 2010 to present shows the following characteristics of Bellekeno underground water:

- Historical discharge flows typically ranged between 1.0 and 6.0 L/s, with a median flow of 2.3 L/s (Figure 3-36**Error! Reference source not found.**). In 2024, flow was generally higher from July until December 2024 (median of 1.81 L/s), compared to the first half of the year (average of 0.32 L/s);

- Slightly alkaline pH values, typically between 7 and 8 (median of 7.53 for the historical period). In 2024, field pH was between 6.4 and 10.7, with a median pH of 7.7 (Figure 3-37);
- Sulphate concentrations were typically high, generally more than 400 mg/L, and appeared to trend with zinc concentrations until temporary closure in September 2013 (Figure 3-38). Between 2014 to 2024, the correlation between sulphate and zinc concentrations was not clearly discernable. Sulphate concentrations in 2024 ranged from 794 mg/L in June and 1320 mg/L in February, consistent with previous years;
- Iron concentrations generally remained low with occasional cycles of increased iron in the adit discharge (Figure 3-39). Concentrations followed the same trend as zinc , with a high correlation with both (see Figure 3-40 for zinc; $R^2 = 0.93$) suggesting that dissolution of iron occurred in tandem with these other two parameters; and
- Cadmium concentrations were correlated with those of zinc (Figure 3-41).

The above summary generally indicates that the mine rock is non-acid generating and leaching of zinc continues to be the primary concern from this adit. The Bellekeno 625 Adit discharge pH was slightly alkaline with no correlation with metals concentrations in the water.

During active mining, mine water discharge volume varied from day-to-day, and variability has also been seen in zinc concentrations (Figure 3-37).

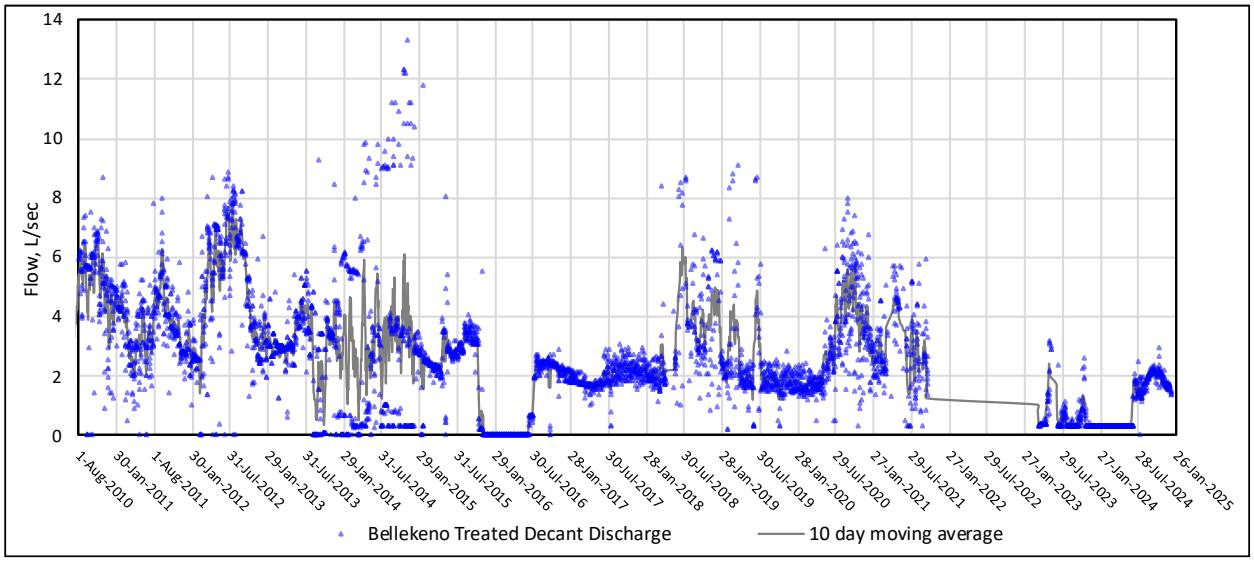

Figure 3-36: Bellekeno 625 Water Treatment System Flow through Discharge August 2010 to December 2024

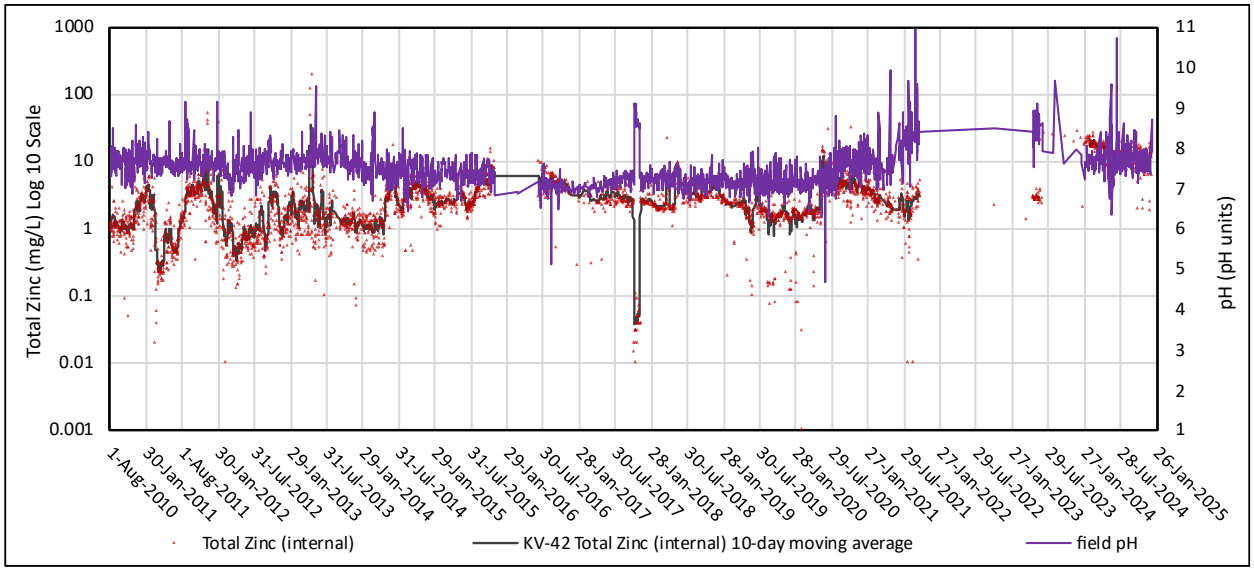

Figure 3-37: Bellekeno 625 Adit Total Zinc (Internal) and pH (field) August 2010 to December 2024

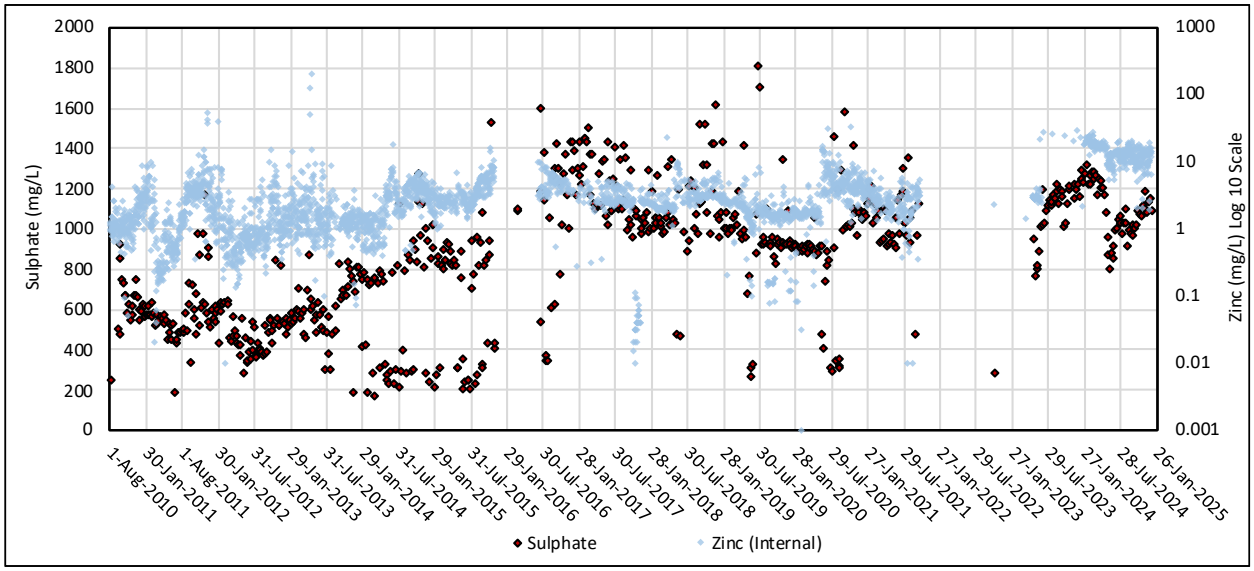

Figure 3-38: Bellekeno 625 Adit Sulphate and Internal Zinc, August 2010 to December 2024

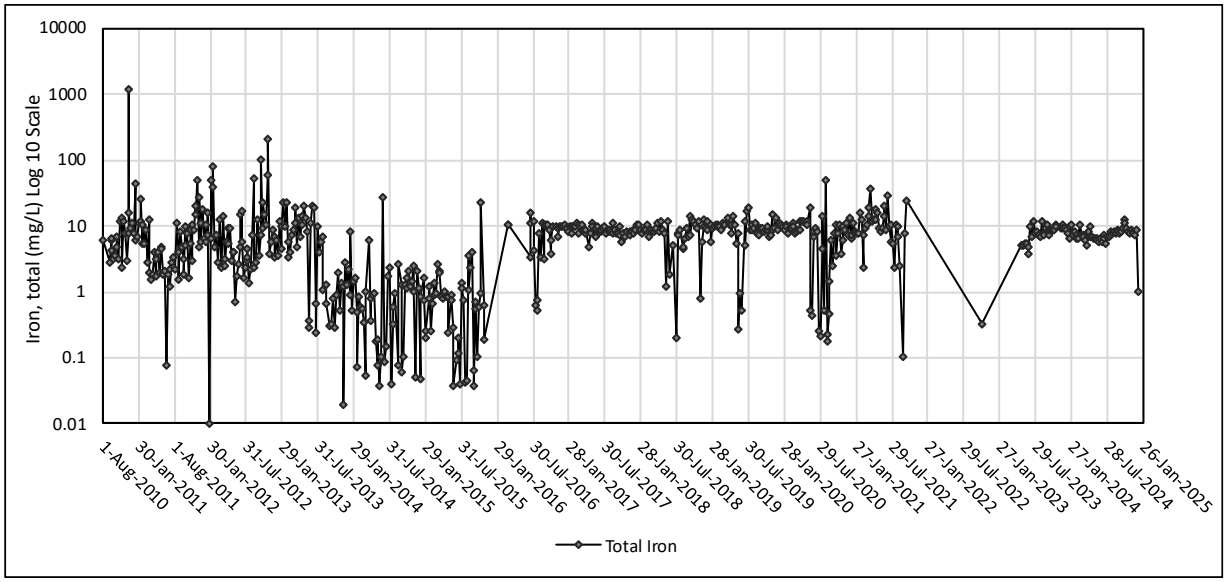

Figure 3-39: Bellekeno 625 Adit Iron Concentrations, August 2010 to December 2024

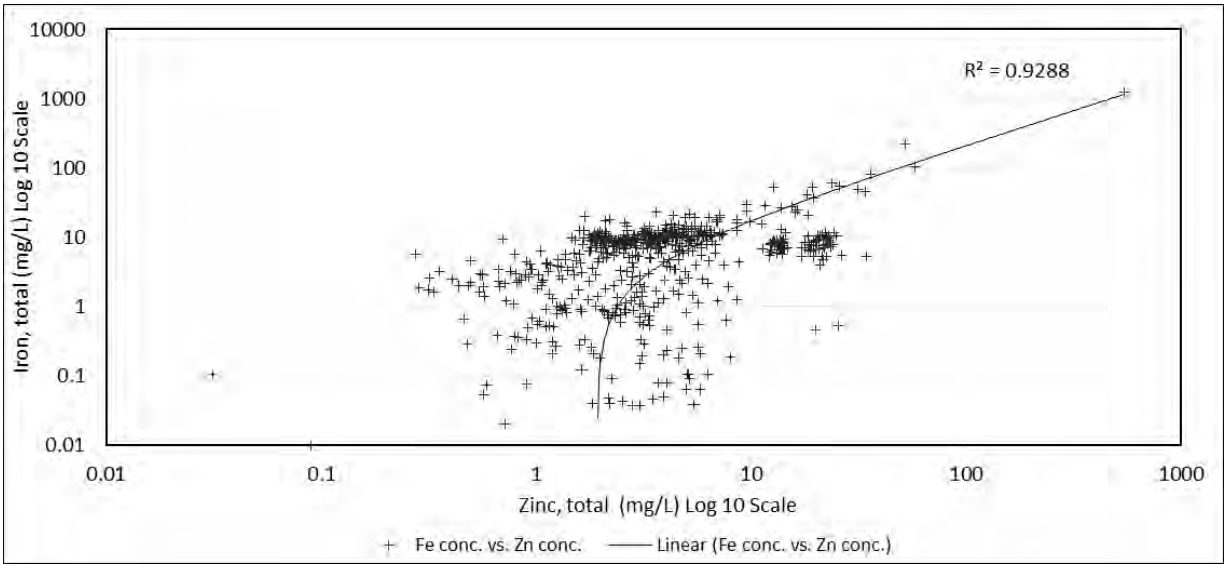

Figure 3-40: Bellekeno 625 Adit Iron and Zinc Concentration Correlation, August 2011 to December 2024

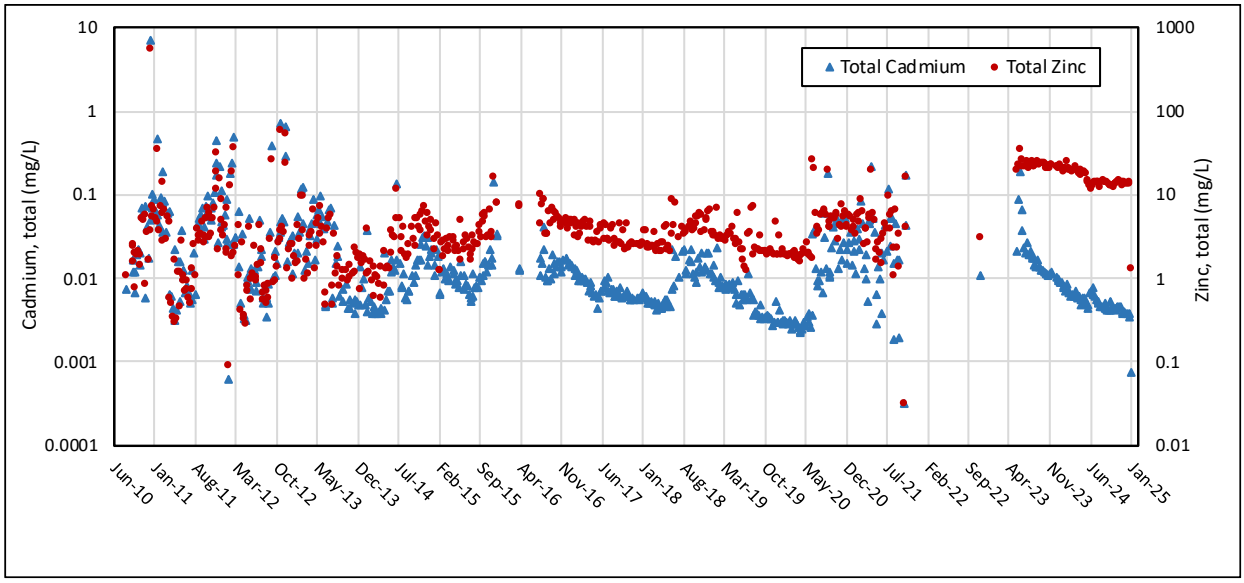

Figure 3-41: Bellekeno 625 Adit Total Cadmium and Zinc Concentrations, August 2010 to December 2024

Bellekeno Water Treatment Plant

The Bellekeno mine site is near the confluence of Thunder Gulch with Lightning Creek, on the north side of Sourdough Hill. Thunder Gulch flows into Lightning Creek roughly 300 m down the hill from the Bellekeno 625 Water Treatment Facility. Bellekeno 625 WTP decant water is discharged east of the treatment facility eventually flowing via a diffuse surface pathway into Lightning Creek, downstream of Thunder Gulch. Lightning Creek converges with Duncan Creek, which then drains into the Mayo River.

Discharge at the Bellekeno 625 adit has been monitored since at least 1984. Continuous discharges were recorded from August 2010 through 2024, except during 2015–2016 when part of the mine was allowed to flood, and during 2021–2023 when the Bellekeno Mine was temporarily closed. In the fall of 2015 infrastructure was removed from the 900 level of the Bellekeno mine to allow the 900-level working to flood up to the 800 level. Flooding of the 900 level workings began in November 2015, therefore, no discharge from the mine occurred for several months. In early July 2016, groundwater reached the 800 level and water was once again pumped to surface and treated as required, with treated effluent discharge starting up again July 8, 2016. The Bellekeno Mine stopped dewatering activities on October 15, 2021, and was placed into temporary closure in December 2021. The static water level in the underground workings continued to rise until it reached the 625 level in May 2023. Periodic discharge from melt water occurred in March 2023, which has been directed to the existing WTP, but there was no discharge to the environment as the ponds filled. There was mine water discharge from the adit on May 13, 2023 to the water treatment plant but there was no discharge to the environment until May 16, 2023 when the ponds had filled.

Total zinc concentrations and pH of the treated decant water at Bellekeno 625 are shown in Figure 3-42. An exceedance of the WL EQS for zinc was observed on November 24, 2015 due to particulates in the sample. On January 17, 2017, a slightly elevated total zinc result was measured due to a power outage and the lime pump being shut off. On October 31, 2019, the external total zinc for KV-43 was 0.687 mg/L compared to the internal result of 0.38 mg/L. On September 8, 2020, the external total zinc for KV-43 was 1.45 mg/L compared to the internal result of 0.25 mg/L. There were no external total zinc EQS exceedances for KV-43 in 2021 and 2022.

On May 29, 2023, total zinc concentration for KV-43 exhibited concentrations above the EQS of 0.5 mg/L (0.723 mg/L). This was the only exceedance for total zinc at this station for 2023. TSS concentrations (external) on the same day were not shown to be elevated, and dissolved zinc accounted for approximately 18% of total zinc (0.127 mg/L), suggesting that zinc was largely in a particulate fraction. There were three pH EQS exceedances in 2021 (6% of samples): June 7 (pH 9.70), August 10 (pH 10.70), and October 5 (pH 9.80). There were three field pH EQS exceedances in 2023 (1.4% of samples): June 21 (pH 9.76), December 17 (pH 9.85), and December 18 (pH 9.65); however, no external lab pH samples exceeded the EQS. There were no EQS exceedances for total zinc, and one exceedance of the upper threshold EQS for pH (January) in 2024.

Other WL EQS for the treated decant water at Bellekeno were also exceeded for total cadmium, lead, and silver on September 8, 2020. The total concentration of these metals in the treated decant being higher than the untreated adit discharge suggests that particles front the decant box may have been introduced into the treated decant sample due to low-flow collection from the decant box at the time of sampling. Total lead concentrations also exceeded the EQS for the treated decant water at Bellekeno four times in 2021: February 25 (0.452 mg/L), August 17 (0.272 mg/L), October 5 (0.378 mg/L), and October 6 (0.231 mg/L). Most of these exceedances were driven by elevated particulate-lead as dissolved lead concentrations were at least one order of magnitude lower and below the EQS, except on August 17 when 81% of total lead concentration was in dissolved form. There were no exceedances of the other metal parameters with an EQS in 2024.

The licence also limits the effluent discharge rate from the mine to 864 m^3/day, or the equivalent of continuous discharge at 10 L/s. The discharge rate at the Bellekeno 625 decant has historically been <10 L/s (Figure 3-43), ranging between 0.3 and 6.0 L/sec in 2021. No mine water discharge from Bellekeno 625 adit occurred between October 2021 to May 2023 due to the cessation of mining activities. Flow resumed in May 2023 and continued throughout 2024. As flow from the mine fluctuated, so did concentrations for certain parameters. During temporary closure, less fluctuation was observed compared to 2013 and previous years especially for TSS and ammonia, primarily due to no underground mining. Both TSS and ammonia varied widely during fluctuations in flow (Figure 3-44 and Figure 3-45). TSS concentrations in the adit water appeared slightly elevated since July 2016 when water was again pumped to surface, compared to TSS concentrations prior to November 2015 when pumping was discontinued (Figure 3-44). TSS remained consistent in Bellekeno 625 Adit water since fall 2016 until approximately August 2020, when the resumption of mining activities caused the flow rate and TSS to increase. In 2024, TSS concentrations in Bellekeno 625 Adit water ranged from 1.8 mg/L to 231 mg/L, indicative of the variability in TSS concentrations due to changing flow conditions.

TSS concentrations exceeded the EQS (25 mg/L) for the treated decant water at Bellekeno on five occasions in 2021 (Figure 4-10): January 25, March 29, April 12, September 27, and October 5. The TSS concentrations measured on these dates ranged from 25.6 to 40.2 mg/L. The accumulation of sludge in the pond reduced the volume available for settling. There were marginal exceedances of the TSS EQS of 25 mg/L on December 5, 2023 (33.6 mg/L) and January 9, 2024 (25.9 mg/L).

In fall of 2020, mine development and blasting resumed at the Bellekeno Mine, which contributed ammonia to the underground water circuit (Figure 3-46). In 2023, one sample (December 5) exceeded the TSS EQS of 25 mg/L for KV-43 (33.6 mg/L). No EQS exceedances were observed for ammonia in 2024.

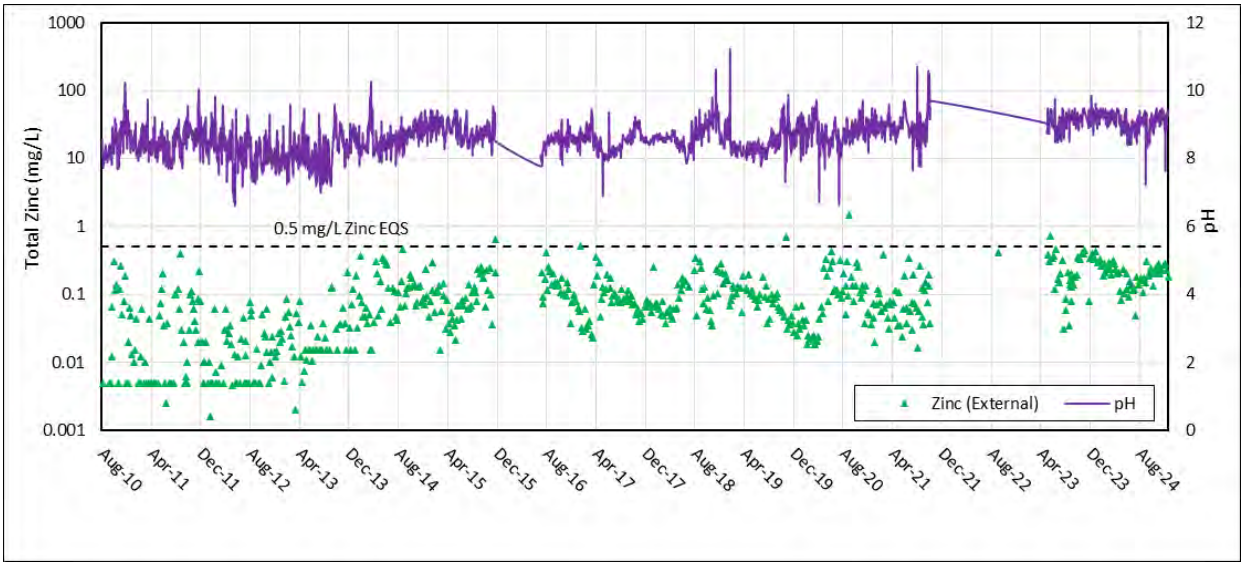

Figure 3-42: Bellekeno 625 Decant External Zinc and Field pH, August 2010 to December 2024

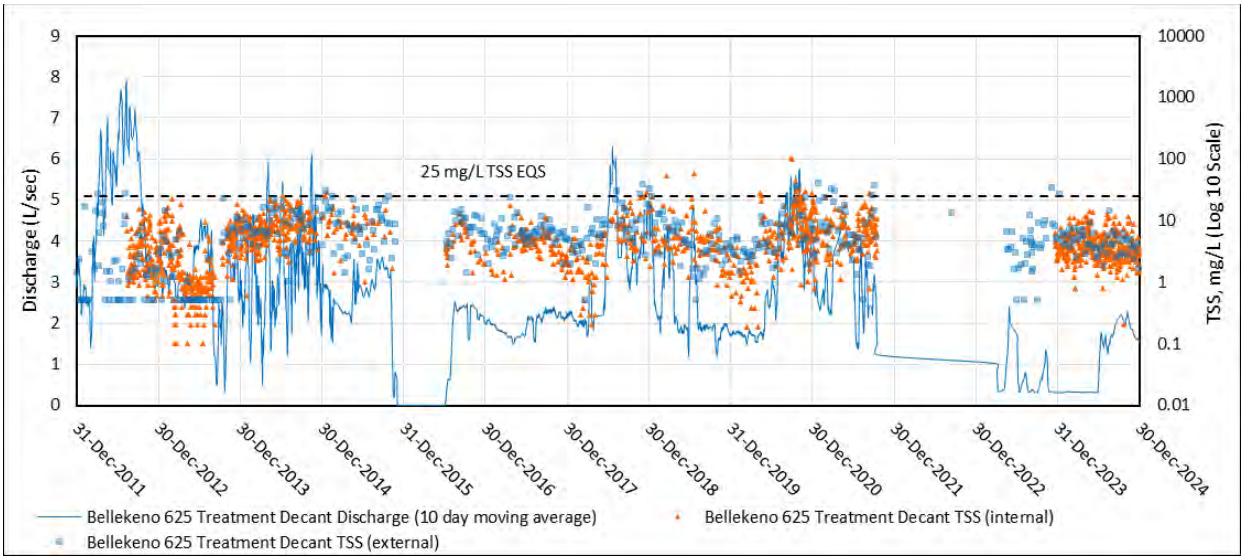

Figure 3-43: Bellekeno 625 Decant Flow and TSS August 2012 to December 2024

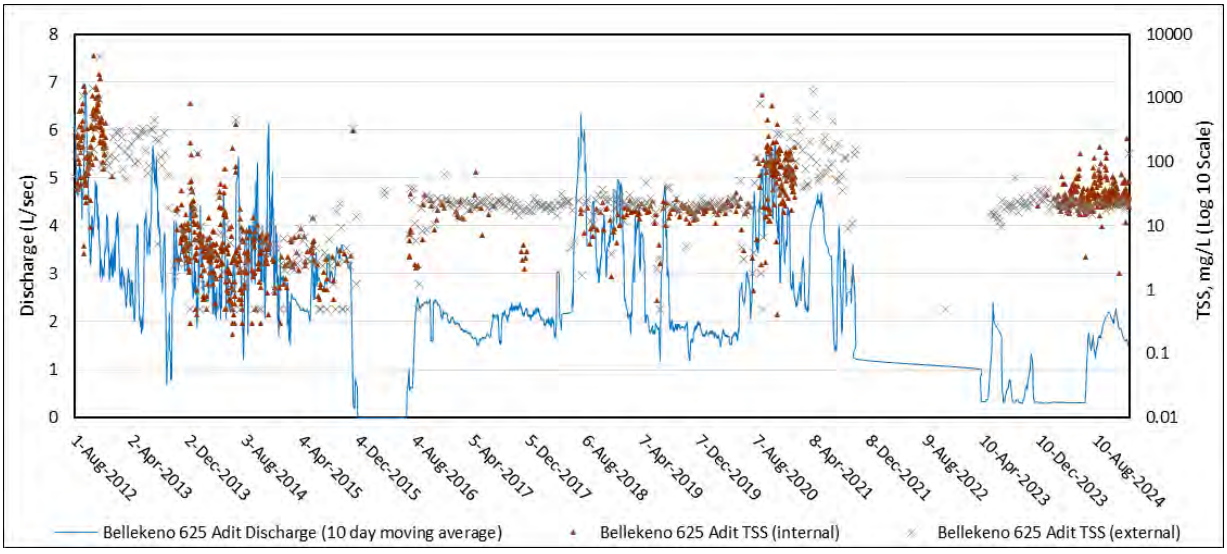

Figure 3-44: Bellekeno 625 Adit Flow and TSS August 2012 to December 2024

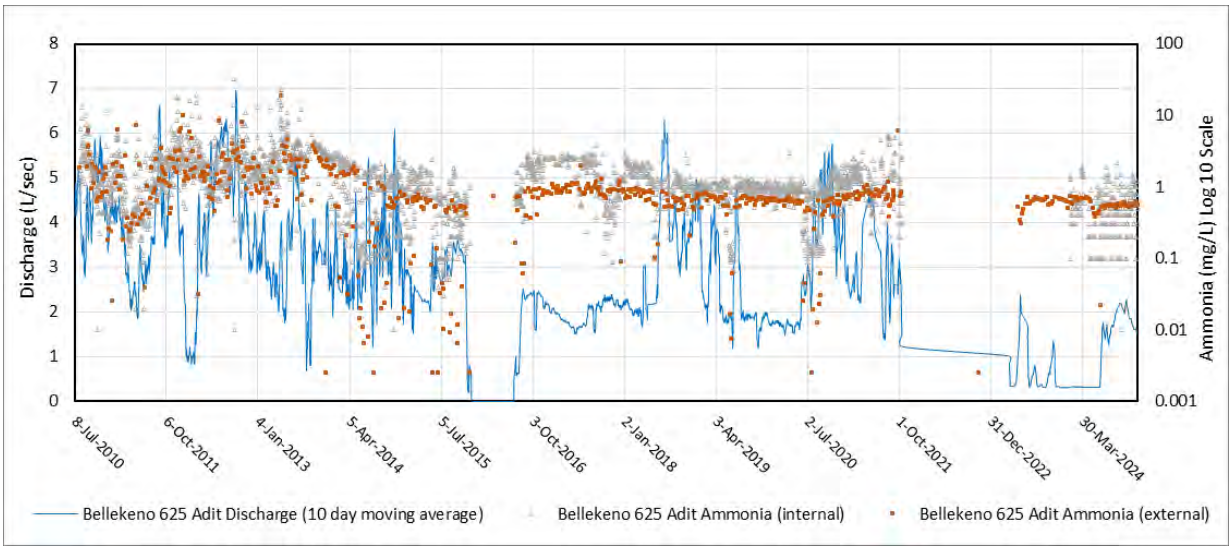

Figure 3-45: Bellekeno 625 Adit Flow and Ammonia August 2010 to December 2024

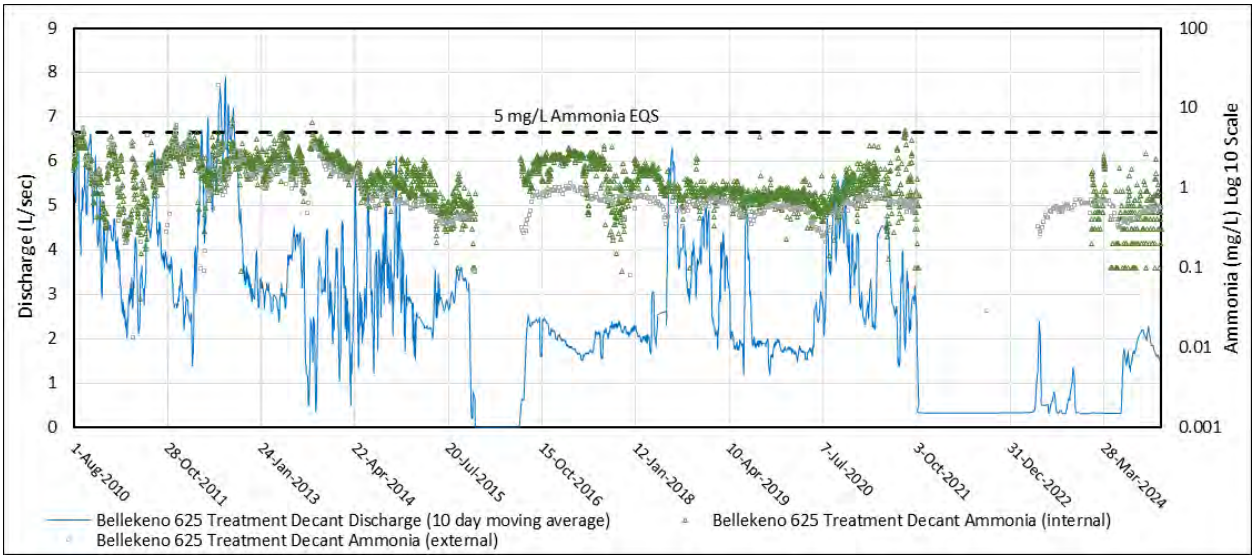

Figure 3-46: Bellekeno 625 Decant Flow and Ammonia August 2010 to December 2024

Flame & Moth Water Treatment Plant

The Flame & Moth water treatment system can discharge to Christal Creek or Lightning Creek. The EQS for each watershed are defined by the discharge rate, with four ranges identified in Part G, Clauses 65 and 66 of WL QZ18-044. The licence also limits the effluent discharge rate from the mine to 3,024 m^3/day, or the equivalent of continuous discharge at 35 L/s.

In July and August 2018, the first Flame & Moth Adit (KV-105) samples were collected with discharge going to Lightning Creek. Effluent discharge from the Flame & Moth Pond occurs to the Lightning Creek watershed (KV-104L), with none directed to the Christal Creek watershed in 2018 to 2024 other than for 10 days in May 2021 (KV-104C).

Discharge measurements from the Flame & Moth Adit (KV-105) and treatment pond (KV-104L) since 2018 are shown on Figure 3-47 and Figure 3-48, respectively. Sample results from the Flame & Moth Adit and Pond for analytes with EQS are provided in Figure 3-49 to Figure 3-58. The comparison between sample results and EQS is presented for KV-104L as EQS only applies to the WTP decant. Note that the EQS for metal(loid)s in the Flame & Moth treated water discharged to Lightning Creek apply to the dissolved fraction. Dissolved arsenic concentrations from the Flame & Moth adit (KV-105) showed a decreasing trend from 2018 to 2023. The trend continued into 2024, but concentrations increased again from May to July 2024 (likely driven by spring freshet and active mining periods), followed by continued decreasing concentrations until the end of December.

Historically and in 2024, dissolved cadmium, arsenic, copper, lead, nickel, silver, zinc, and ammonia from the decant (KV-104L) were below the EQS, , except for the following excursions: dissolved lead was measured at 0.0369 mg/L in October 2021, slightly above the EQS (0.036 mg/L) and dissolved cadmium in August 2023 (measured 0.00080 mg/L and above the EQS of 0.00072 mg/L). Dissolved copper, lead, and silver concentrations (Figure 3-51, Figure 3-52, and Figure 3-54, respectively) from the adit were below or near to laboratory detection limits from 2018 to 2024 (Figure 3-52).

Higher flows from the Flame & Moth adit and pond from mid-August 2020 to September 2022 (Figure 3-47 and Figure 3-48) reflect the advancement of the mine workings and associated requirement for greater mine dewatering. A significant decrease can also be observed in the KV-105 discharge beginning September 15, 2022. The decreased flow observed beginning September 15, 2022, continued April 2, 2023, with median flows of ~4 L/s at KV-105 during this period. Adit flows (KV-105) ranged between 0.01 and 17.1 L/s in 2024, with higher flows observed early April 2024 and exhibiting persistent high flows to December. This represents an overall increase in flow from the Flame & Moth adit (median flow of 9.52 L/s in 2024 compared to 4.33 L/s and 6.54 L/s in 2023 and the historical record, respectively). The higher TSS observed over this period (since mid-August 2020) also reflects mining activities (Figure 4-24). Similarly, ammonia and lead concentrations were also higher during the period of increased flow from 2020 to 2022 (Figure 3-56 and Figure 3-52, respectively), though the ammonia concentrations decreased gradually in 2023 to concentrations pre-dating August 2020. In 2024, ammonia concentrations increased in early March and fluctuated between 0.13 to 9.71 mg/L as N. Dissolved copper and silver concentrations from the adit during this period were frequently below the detection limit (Figure 3-51 and Figure 3-54, respectively).

Between 2018 and 2024 flow rates for the Flame & Moth decant (KV-104L) were mostly below 10 L/s (median of 9.01 L/s). There were 77 days in 2024 that had flow measurements above 10 L/s and for which the EQS associated with discharge between 10 and 20 L/s apply. At the Flame & Moth Pond decant (KV-104L), TSS was only found slightly above the EQS of 15 mg/L in seven sampling events (3% of samples) from 2018 to 2024. Exceedances occurred in November 2020 (19.8 mg/L), September 2021 (16.8 mg/L), October 2022 (16 mg/L), March 2023 (19.5 mg/L), December 2023 (19.4 mg/L), March 2024 (15.3 mg/L), and May 2024 (23.7 mg/L) (Figure 4-24). Seven daily field pH measurements for the KV-104L treatment pond exceeded the upper pH EQS (9.5); however, there was no discharge from the pond for those times, except for KV-104L on August 14, 2023 and KV-104L on June 1, 2024, (9.7 and 11.0, respectively). No external lab pH samples exceeded the EQS.

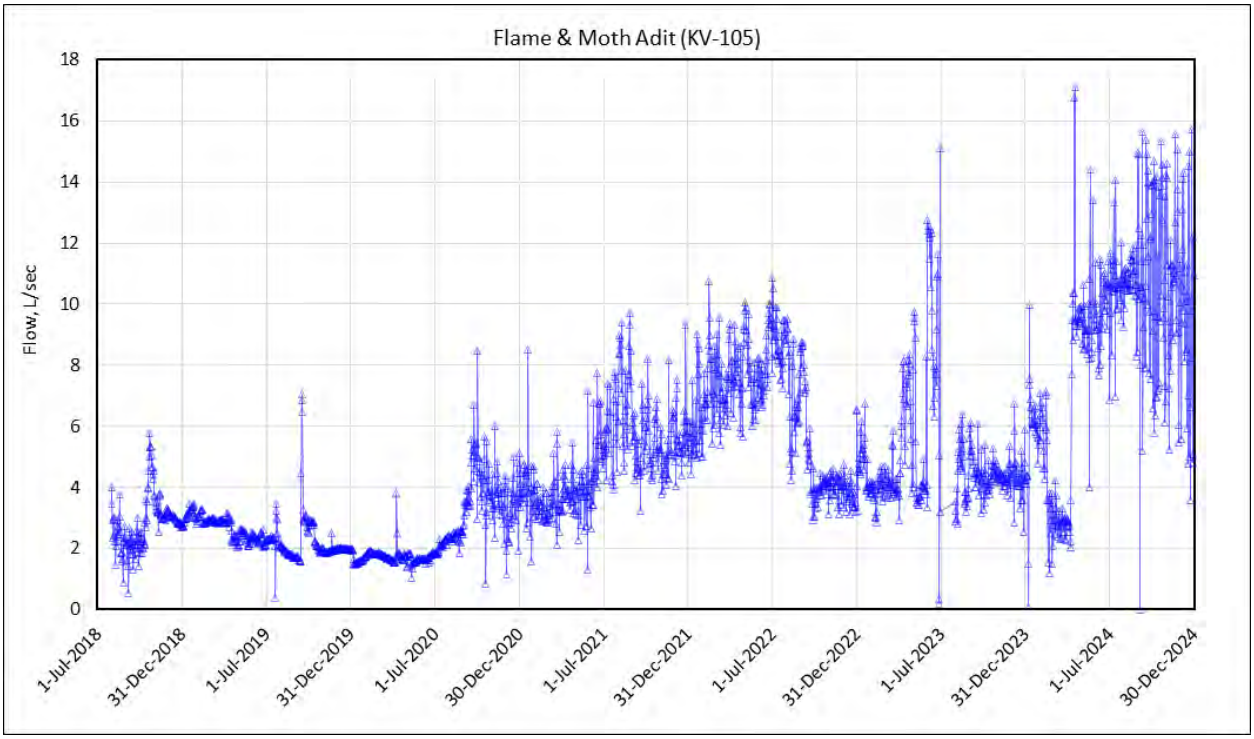

Figure 3-47: Flame & Moth Adit Discharge to Lightning Creek, 2018 to 2024

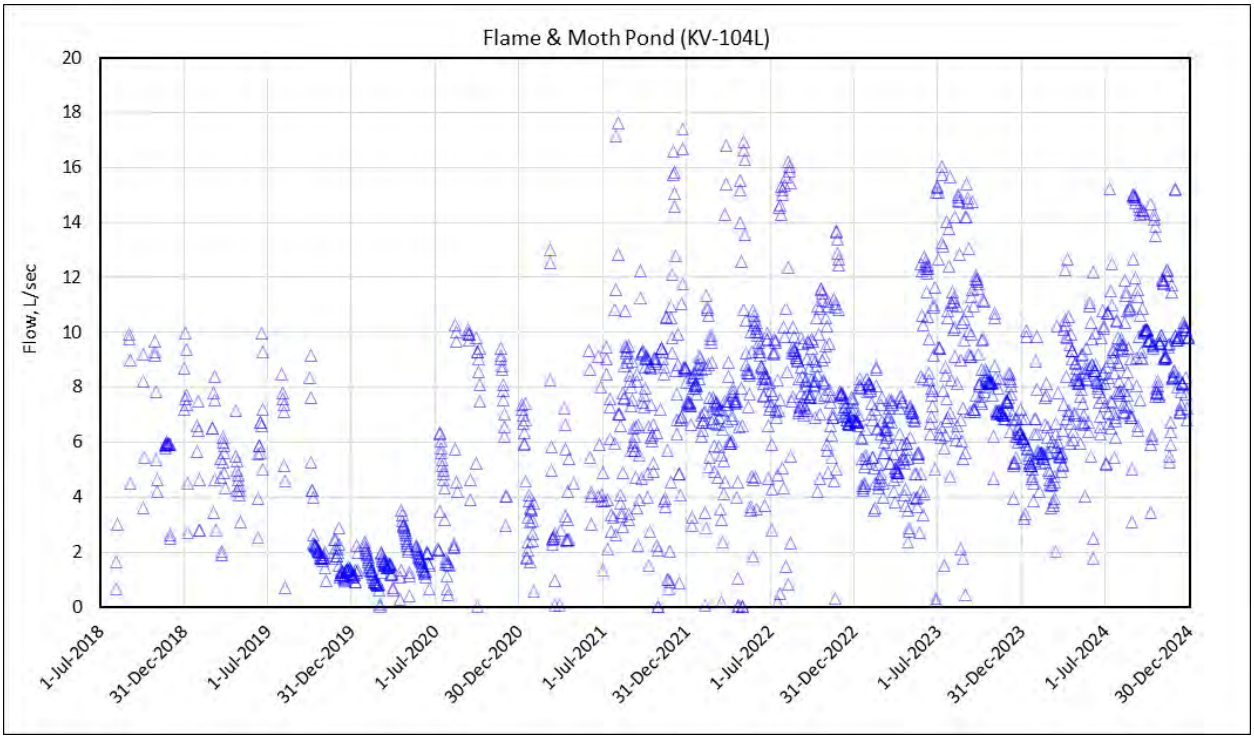

Figure 3-48: Flame & Moth Pond Discharge, 2018 to 2024

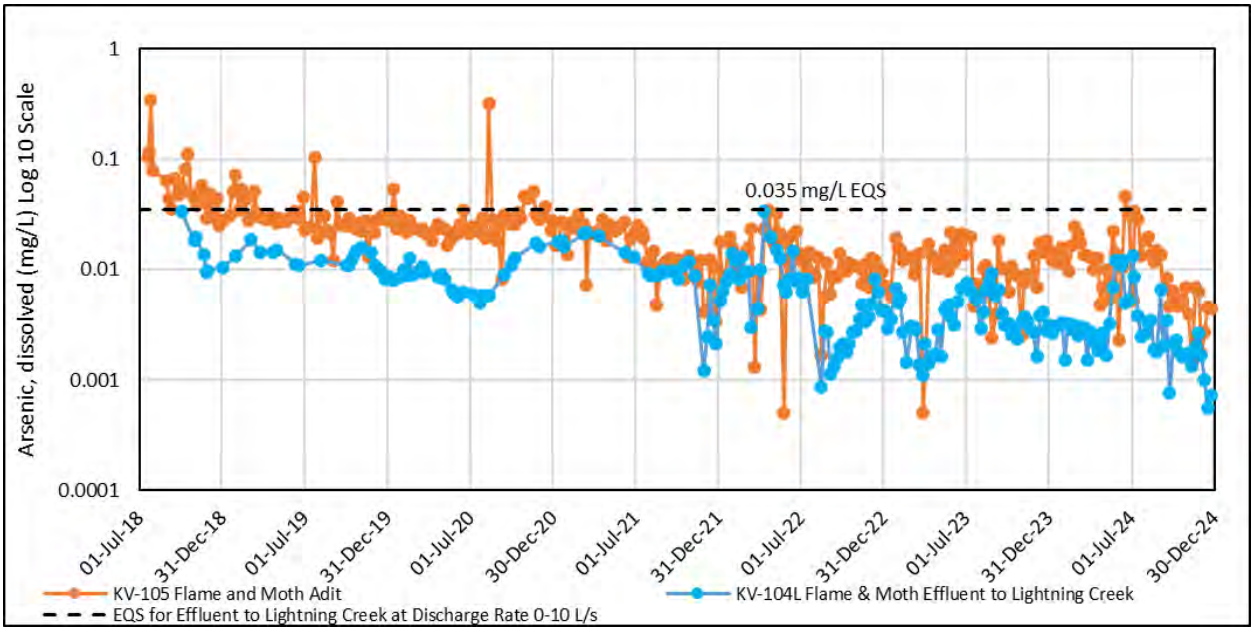

Figure 3-49: Flame & Moth Dissolved Arsenic, 2018 to 2024

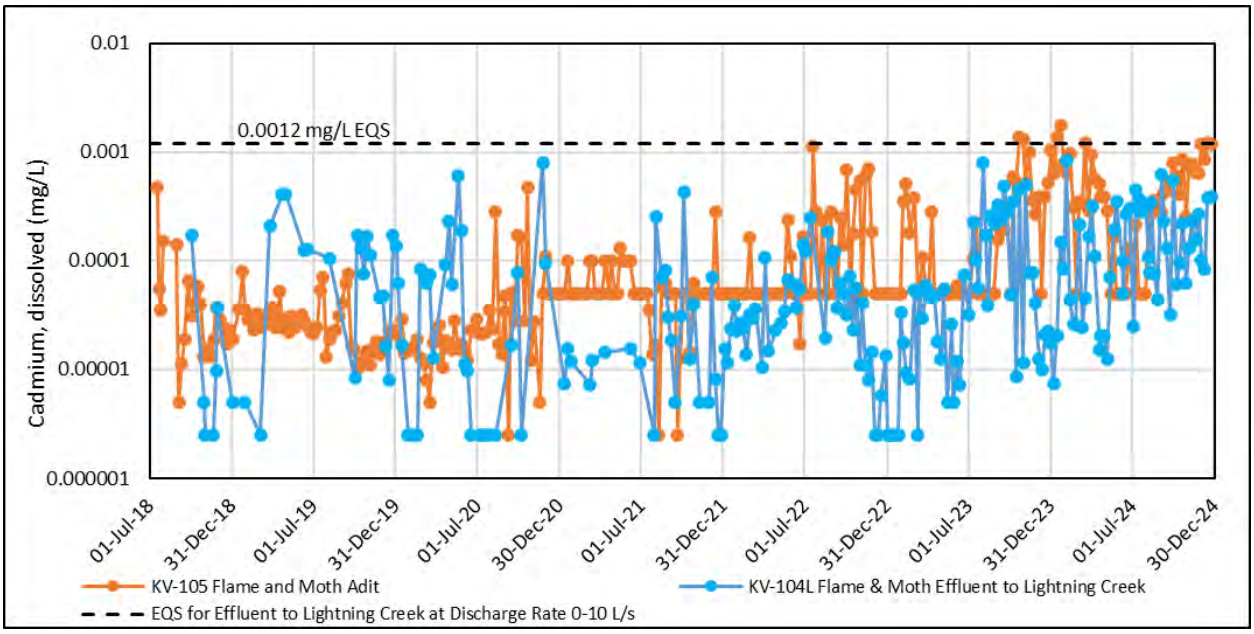

Figure 3-50: Flame & Moth Dissolved Cadmium, 2018 to 2024

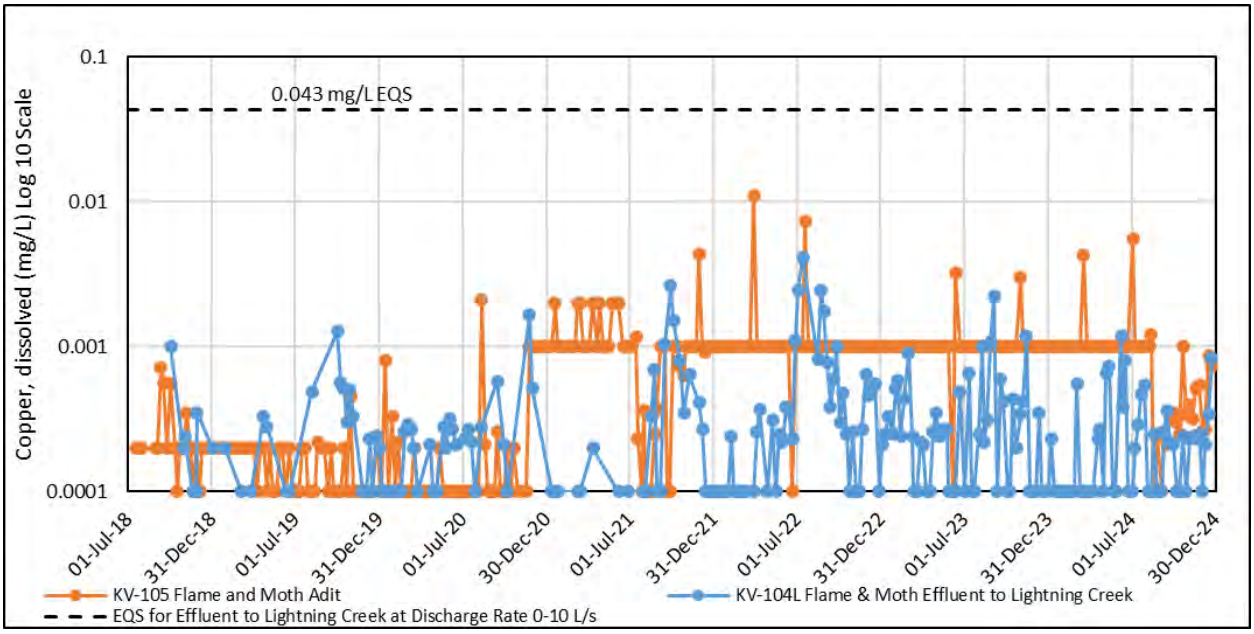

Figure 3-51: Flame & Moth Dissolved Copper, 2018 to 2024

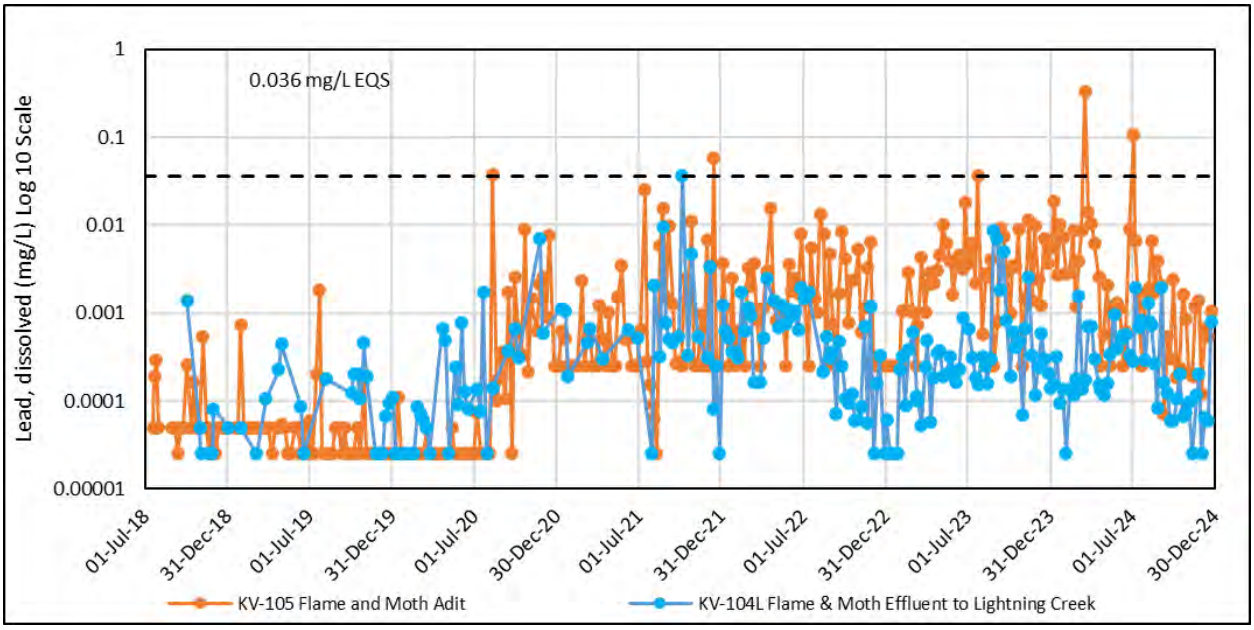

Figure 3-52: Flame & Moth Dissolved Lead, 2018 to 2024

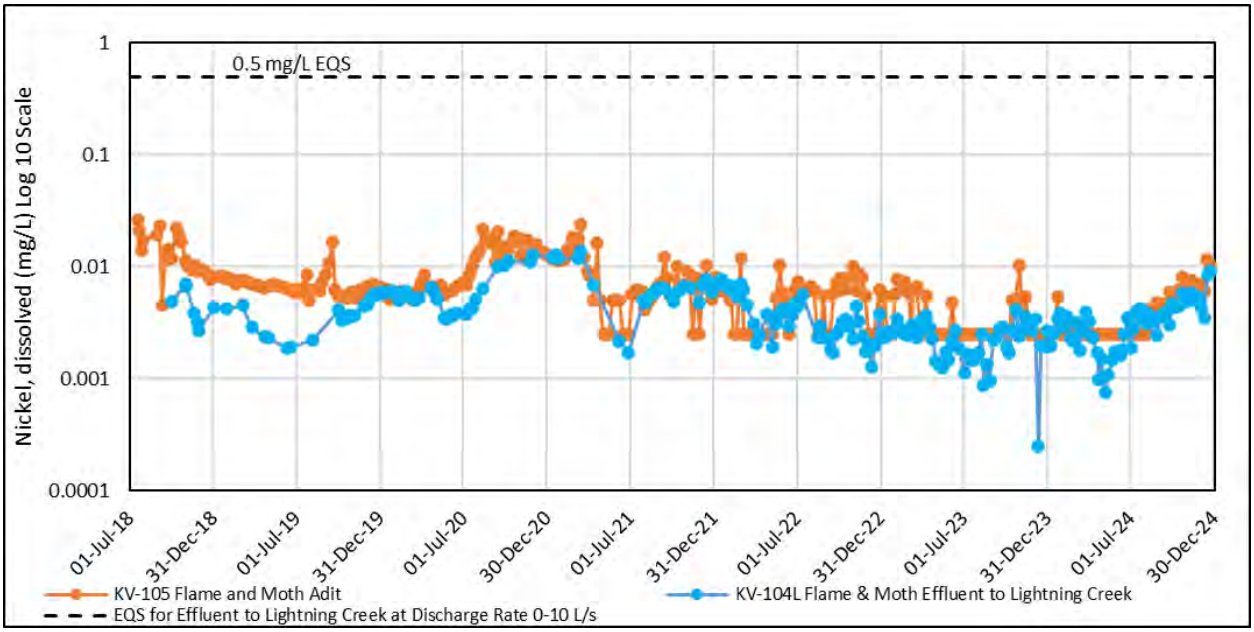

Figure 3-53: Flame & Moth Dissolved Nickel, 2018 to 2024

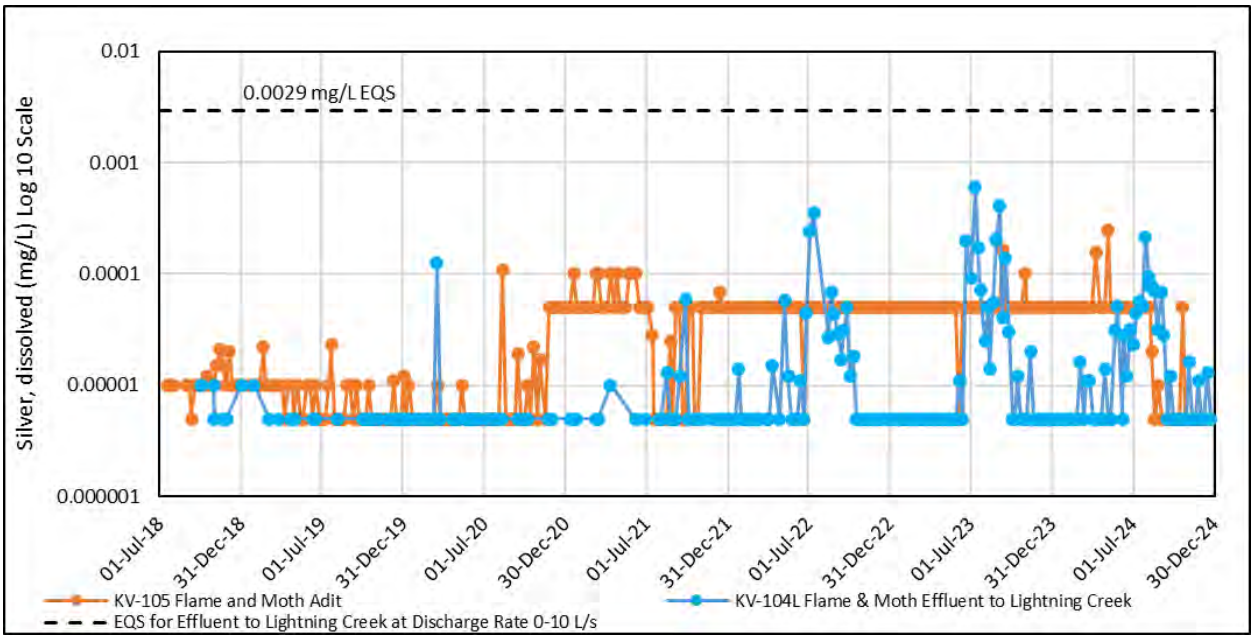

Figure 3-54: Flame & Moth Dissolved Silver, 2018 to 2024

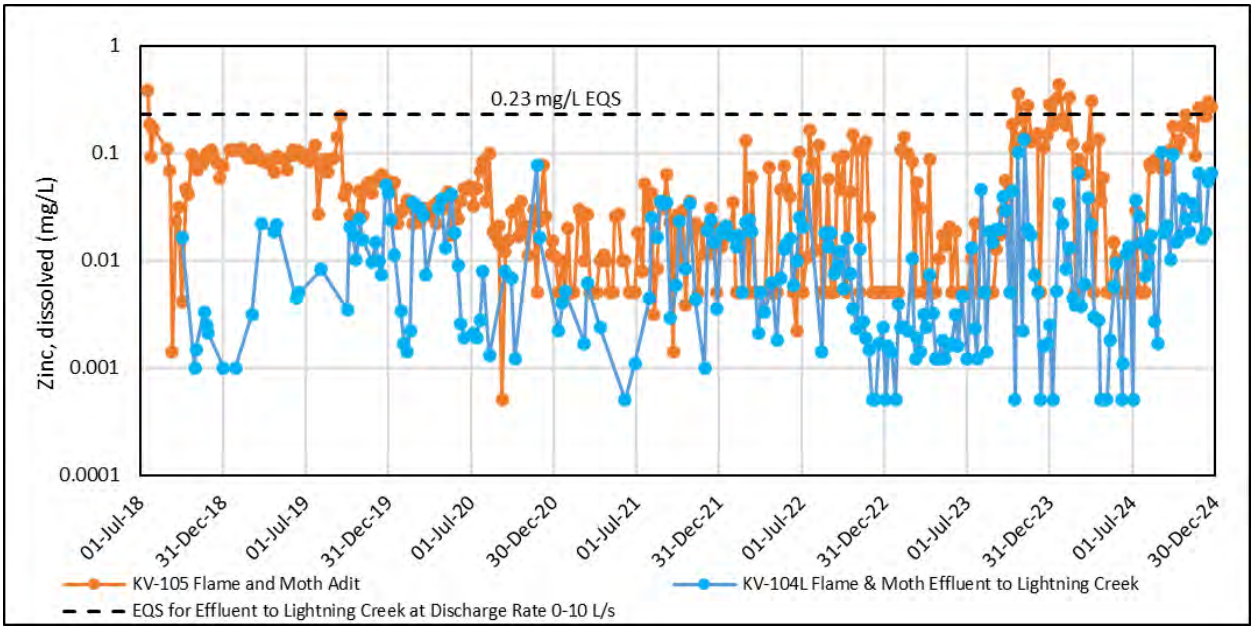

Figure 3-55: Flame & Moth Dissolved Zinc, 2018 to 2024

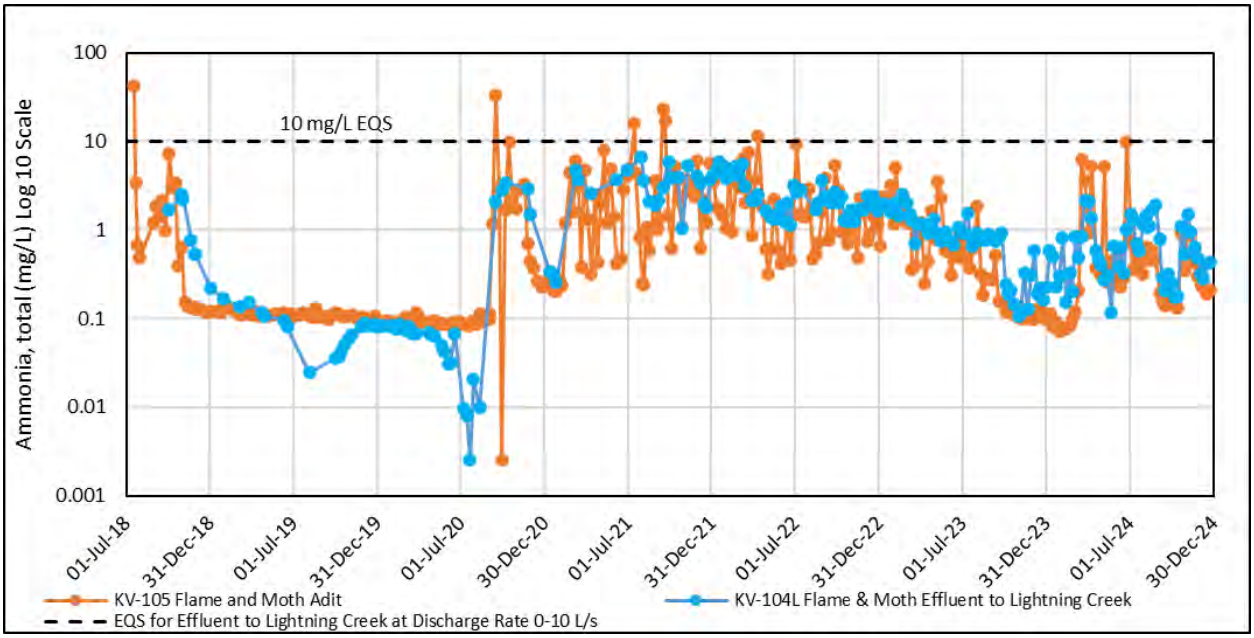

Figure 3-56: Flame & Moth Ammonia, 2018 to 2024

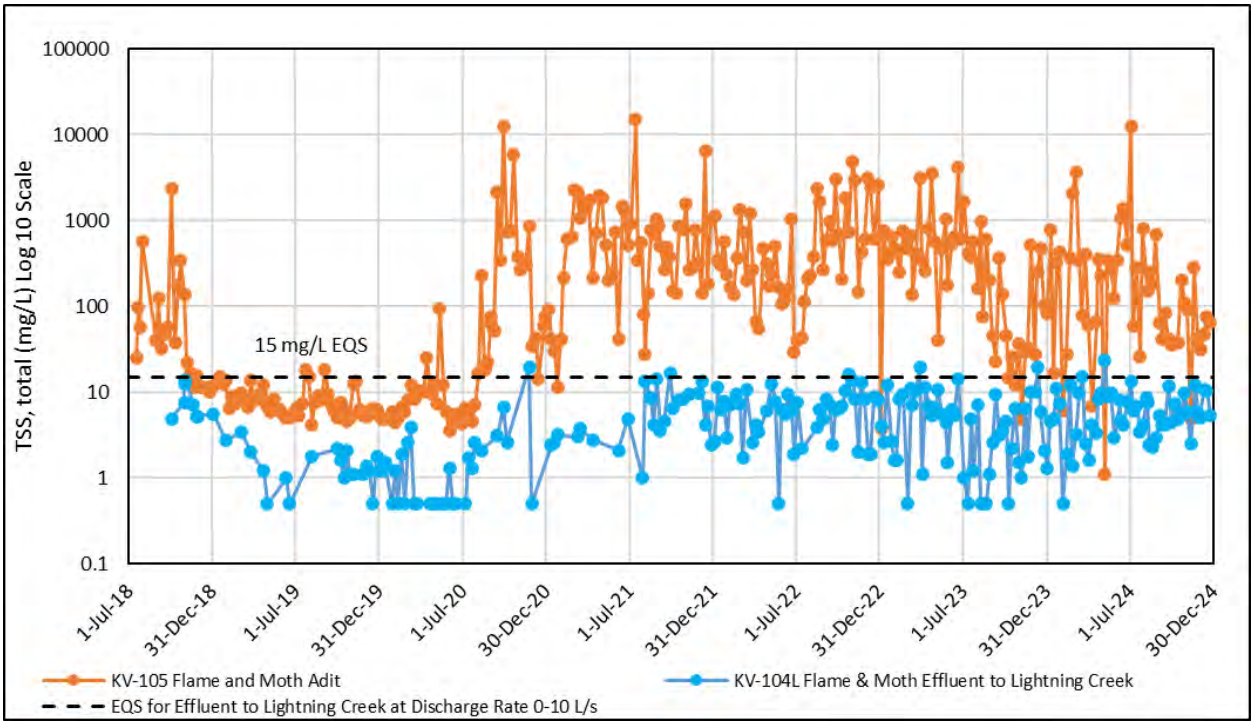

Figure 3-57: Flame & Moth Total Suspended Solids, 2018 to 2024

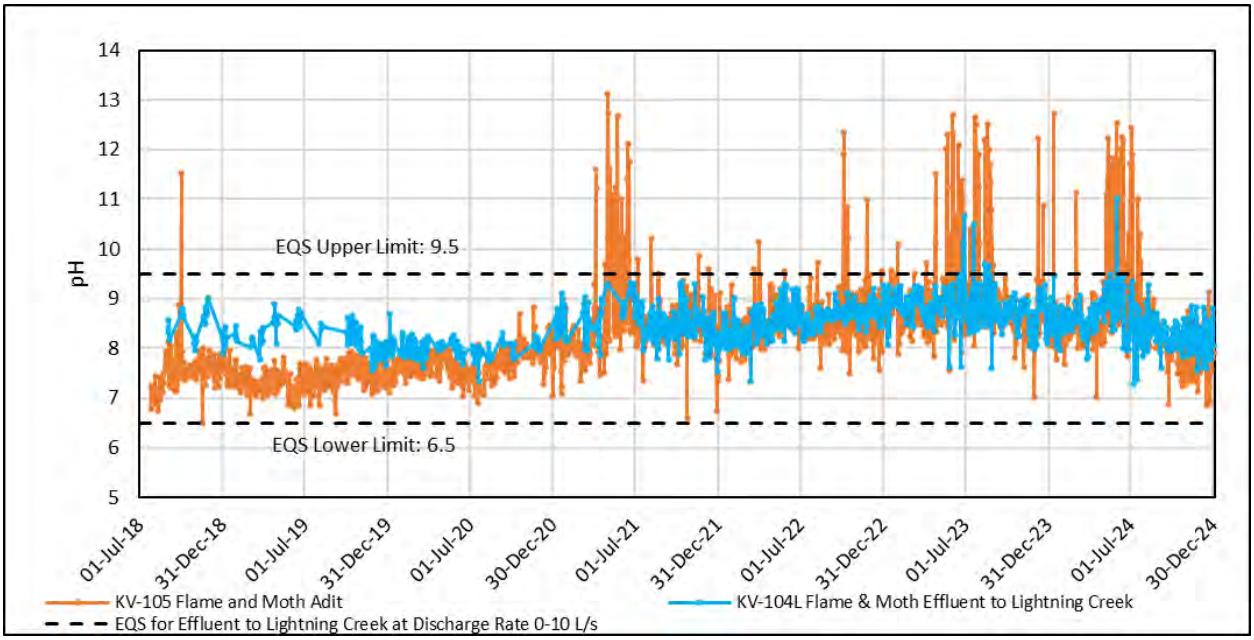

Figure 3-58: Flame & Moth Field pH, 2018 to 2024

Lightning Creek

There are nine regularly monitored sites (Table 3-22) under AKHM Water Licence QZ18-044 within the Lightning Creek catchment, of which the cadmium and zinc concentrations in samples collected from stations located on Lightning Creek and Thunder Gulch are discussed herein:

- KV-37, located upstream of KHSD Mining Operations and historical mine inputs and represent background concentrations (although placer mining has occurred upstream in recent years);
- KV-38 located on Lightning Creek downstream of input from the historical Keno 700 adit and upstream of the Bellekeno and Flame & Moth WTP discharges;
- KV-41 located on Lightning Creek downstream of the Bellekeno WTP discharge and upstream of the Flame & Moth WTP discharge; and
- KV-81 located on Lightning Creek downstream of both the Bellekeno and Flame & Moth WTP discharges.

Table 3-22: Lightning Creek Water Quality Monitoring Sites

SITE	SITE DESCRIPTION	WL QZ18-044 MONITORING FREQUENCY
KV-37	Lightning Creek upstream Hope Gulch	Quarterly
KV-38	Lightning Creek upstream Thunder Gulch	Quarterly
KV-39	Hope Gulch upstream Lightning Creek	Quarterly
KV-40	Charity Gulch upstream Lightning Creek	Quarterly
KV-41	Lightning Creek upstream bridge at Keno City	Monthly
KV-65	Thunder Gulch upstream of Bellekeno	Monthly
KV-76	Thunder Gulch downstream of Bellekeno 625 Adit	Quarterly
KV-77	Thunder Gulch upstream of Bellekeno East	Quarterly
KV-81	Lightning Creek Southwest of Mill Site	Monthly/Weekly while Flame & Moth treatment plant discharges to Lightning Creek

Cadmium and zinc are the main COCs for the site and discussed herein. Figure 3-59 to Figure 3-64 show the temporal zinc and cadmium concentrations of stations located on Lightning Creek and Thunder Gulch. For comparative purposes, the graphs also show the Canadian Council of Ministers of the Environment (CCME) Protection of Aquatic life (PAL) dissolved zinc guideline calculated based on the median hardness, pH, and dissolved organic carbon of the sites within each plot. The total cadmium CCME-PAL guideline is based on the median hardness of sites within each plot. Summary statistics for the stations are presented in Table 3-23 to Table 3-26. The guideline value was calculated on a sample-specific basis, using the hardness, pH, and dissolved organic carbon (DOC) for each sample. Where DOC data were not available, 0.3 mg/L of DOC was used to calculate the guideline since this is the lowest end of the DOC range used in the CCME-PAL guideline calculation.

Reference water chemistry data on Lightning Creek is collected at station KV-37. Two creeks, Hope Gulch and Charity Gulch, flow from the south side of Keno Hill into Lightning Creek upstream of Thunder Gulch and the Bellekeno 625 treated effluent discharge. Hope Gulch and Charity Gulch are sampled upstream of the confluence with Lightning Creek (stations KV-39 and KV-40 respectively). Another water quality monitoring site on Lightning Creek (KV-38) is located downstream of Hope Gulch and Charity Gulch but upstream of

Thunder Gulch. A water quality sampling site on Thunder Gulch upstream of all current mining activities (KV-77) also provides reference information on the quality of water flowing into Lightning Creek. Additional Thunder Gulch sites KV-76 and KV-65 monitor water quality along the watercourse and prior to the confluence with Lightning Creek. However, in 2024, significant placer mining activity in Thunder Gulch between KV-65 and upstream of KV-77 has widened the area, creating cascade above KV-77. The use of KV-77 as a reference station may need to be reconsidered. A third station on Lightning Creek (KV-41) downstream of the Bellekeno 625 adit flow, Thunder Gulch, and the placer operations gives an indication of the combined influence of these inputs and activities. The fourth station on Lightning Creek, KV-81 tracks water quality downstream of the Flame & Moth treated discharge.

Discharge from the historical Keno 700 adit is an important source of metal loading to Lightning Creek. The Keno 700 adit discharge drains over the Keno 700 waste rock dump and directly into Hope Gulch, which enters Lightning Creek upstream of station KV-38.

Median zinc and cadmium concentrations at the reference station on Lightning Creek at KV-37 were 3- to 7-fold lower than those observed downstream at station KV-38 in 2024 (Table 3-23 to Table 3-26). Although cadmium and zinc concentrations were elevated at KV-38 relative to KV-37 due to the contribution from the Keno 700 adit discharge, 63% and 69% of samples collected between 2008 and 2024 were below the CCME-PAL guideline for total cadmium and dissolved zinc, respectively at KV-38 (Table 3-23 to Table 3-26). Cadmium and zinc concentrations observed at KV-38 in 2024 were comparable to the historical record, with two total cadmium (both in May 2024) exceedances and zero dissolved zinc exceedances of the CCME-PAL guideline in 2024 (Table 3-23 to Table 3-26).

Farther downstream on Lightning Creek, median cadmium concentrations at KV-41 were generally lower than those observed at KV-38 from 2008 -2024 (Table 3-23 to Table 3-26), reflecting dilution from Thunder Gulch. Median total zinc concentrations were comparable between the two sites (KV-38 and KV-41), but dissolved concentrations were slightly lower at KV-41 from 2008-2024. In 2024, zinc concentrations were similar or slightly lower at KV-41 than those observed at KV-38. Peak total cadmium and zinc concentrations at KV-41 in 2024 occurred in May (Figure 3-63 and Figure 3-60), coincident with the most elevated TSS concentrations in 2024 (up to 44 mg/L). Cadmium and zinc concentrations at KV-41 in 2024 were comparable with the historical record. These observations indicate that zinc and cadmium contributions from Thunder Gulch and treated discharge from the Bellekeno Mine are minimal. Median cadmium and zinc concentrations at KV-81 are historically similar to those observed upstream at KV-41 (Table 3-23 to Table 3-26), suggesting the treated discharge from the Flame & Moth Mine which enters Lightning Creek between these two stations does not materially affect downstream water quality. Cadmium and zinc concentrations observed at KV-81 in 2024 (median concentrations of 0.000089 mg/L and 0.0106 mg/L, for cadmium and zinc respectively) were generally comparable with the historical record. Median concentrations for both total cadmium and zinc exhibited a decrease in 2024 compared to 2023 median concentrations (0.00011 mg/L and 0.013 mg/L, for cadmium and zinc respectively). In 2024, increases in total cadmium and zinc concentrations between the months of May to June were observed with spring freshet; however, cadmium and zinc concentrations decreased rapidly in the following months. Total cadmium and zinc concentrations at KV-81 comprised mostly of the dissolved fraction for the majority of samples collected in May and June (ranging from 10 - 91% dissolved cadmium and 6-91% dissolved zinc) and median of 67% and 73%, respectively (Figure 3-63 and Figure 3-60).

Placer mining upstream of the KHSD Mining Operations occurs or has occurred in Hope Gulch, Thunder Gulch, and Lightning Creek. Placer mining has a significant effect on water quality due to sediment released during operations, and the potential for increased TSS and metals concentrations associated with the suspended sediment. In recent years, Thunder Gulch has been the focus of placer mining activity, which is likely responsible for the elevated TSS levels observed in Thunder Gulch (e.g., KV-65) and downstream in Lightning

Creek (KV-41). It can be reasonably assumed that water quality has been altered because of this activity, as it has taken place on both Lightning Creek and Thunder Gulch since at least the 1960s.

For example, KV-65 on Thunder Gulch had the highest and second highest total zinc and cadmium concentrations established on September 22, 2016, and July 10, 2018, respectively, which was due to extremely high TSS (2,360 and 3,110 mg/L, respectively). These dates are outside the flow peak during freshet when TSS is naturally elevated; rather placer mining activity is likely responsible for this behaviour. Dissolved zinc was below laboratory detection levels and dissolved cadmium was below the laboratory detection limit on September 22, 2016, and comprised 0.1% of the total cadmium concentration on July 10, 2018, indicating that the total metal concentrations are TSS-related. Total cadmium and zinc concentrations at KV-65 measuring above the CCME-PAL guideline in September 2021 were likely a result of elevated TSS (450 mg/L) observed on the same date; dissolved concentrations remained below the CCME-PAL guideline. The same occurrences of increased total cadmium and zinc concentrations coincident with elevated TSS concentrations were observed in August to December 2022, from May to August in 2023, and again from April to September in 2024. Dissolved concentrations of both zinc and cadmium for that time period in 2024 only accounted for 6-54% of the total concentration at KV-65 (indicating high proportion of particulate zinc and cadmium). In 2024, TSS concentrations peaked in May (153 mg/L), then rose again in September (87 mg/L), and remained lower for the rest of the year. These TSS values represent a decrease in median concentrations in 2024 (35 mg/L) when compared to 2023 concentrations (69 mg/L). Cadmium and zinc concentrations in the Upper Lightning Creek watershed showed little to no seasonality, historically (Figure 3-62 and Figure 3-59). Zinc and cadmium concentrations at KV-40 and in the Lower Lightning Creek watershed (KV-38, KV-41, KV-81) typically peaked in May, June or July, historically and in 2024, and were influenced by the spring freshet (Figure 3-59, Figure 3-62, Figure 3-60, Figure 3-63). In Thunder Gulch (KV-65, KV-76, and KV-77) weak seasonality was observed for zinc and cadmium concentrations between 2008 and 2024 (Figure 3-61 and Figure 3-64). Cadmium and zinc concentrations in Thunder Gulch typically peaked in the spring (May or June) or summer (July), whereas KV-65 also sometimes peaked in the fall (September or October).

WQOs are established for dissolved metals at KV-81 (Hecla Yukon, 2023). In 2024, the WQOs were exceeded for cadmium (1.6% of samples), copper (8.1% for the short-term WQO only), and zinc (6.5%) at KV-81. The AMP was triggered for the zinc (January) and cadmium (May) exceedances in 2024, with review of water quality data suggesting that Flame & Moth WTP discharge upstream of KV-81 exhibited dissolved cadmium and zinc concentrations that were consistently lower than the observed concentrations at KV-81. Flow from the WTP also contributes a small proportion of total flow to Lightning Creek, and so cadmium and zinc load at KV-81 is attributed more so to upstream contributions from the Lightning Creek Catchment.

Table 3-23: Lightning Creek Drainage Total Zinc Summary Statistics, 2008 to 2024

Zinc, total									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
2024									
Average	0.00199	0.0098	0.15	0.0026	0.011	0.0087	0.0099	0.010	0.015
Count	9	9	4	2	2	16	4	17	62
Minimum	<0.0030	0.0064	0.12	<0.0030	0.0038	<0.0030	<0.0030	0.0048	0.0055
Maximum	0.0059	0.013	0.20	0.0037	0.018	0.019	0.029	0.024	0.10
Count < DL	8	0	0	1	0	1	1	0	0
Standard Deviation	0.0015	0.0022	0.035	0.0016	0.010	0.0055	0.013	0.0063	0.015
1st Quartile	0.0030	0.0090	0.13	0.0021	0.0074	0.0046	0.0032	0.0059	0.0074
Median	0.0030	0.0091	0.14	0.0026	0.011	0.0059	0.0045	0.0077	0.011
3rd Quartile	0.0030	0.012	0.16	0.0032	0.015	0.014	0.011	0.012	0.015
99 Percentile	0.0056	0.013	0.20	0.0037	0.018	0.018	0.028	0.024	0.076
2008-2024									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.0081	0.015	0.19	0.0071	0.10	0.031	0.057	0.016	0.019
Count	139	110	63	43	58	189	69	216	357
Minimum	<0.001	0.0037	0.095	<0.0030	0.00040	0.0014	<0.0030	<0.0030	0.0039
Maximum	0.24	0.10	0.47	0.027	3.2	1.1	0.83	0.14	0.52
Count < DL	61	0	0	4	8	10	2	1	5
Standard Deviation	0.030	0.013	0.070	0.0058	0.43	0.11	0.15	0.017	0.033
1st Quartile	0.0015	0.0080	0.14	0.0033	0.0022	0.0039	0.0070	0.0070	0.0088
Median	0.0030	0.011	0.17	0.0046	0.0088	0.0062	0.013	0.011	0.013
3rd Quartile	0.0037	0.018	0.21	0.0089	0.033	0.016	0.029	0.018	0.019
99 Percentile	0.19	0.064	0.43	0.024	1.7	0.41	0.71	0.079	0.10

Table 3-24: Lightning Creek Drainage Dissolved Zinc Summary Statistics, 2008 to 2024

Zinc, dissolved									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
2024									
Average	0.0017	0.0087	0.15	0.0026	0.0011	0.0015	0.0022	0.0076	0.0085
Count	9	9	4	2	2	16	4	17	62
Minimum	<0.0010	0.0061	0.12	0.0024	<0.0010	<0.0010	<0.0010	0.0043	0.0043
Maximum	0.0057	0.012	0.21	0.0029	0.0016	0.0038	0.0048	0.018	0.025
Count < DL	3	0	0	0	1	4	1	0	0
Standard Deviation	0.0016	0.0021	0.042	0.00040	0.00078	0.00091	0.0019	0.0042	0.0042
1st Quartile	0.0010	0.0072	0.13	0.0025	0.00078	0.00095	0.0010	0.0050	0.0058
Median	0.0012	0.0081	0.13	0.0026	0.0011	0.0016	0.0017	0.0058	0.0069
3rd Quartile	0.0020	0.010	0.16	0.0028	0.0013	0.0018	0.0029	0.0079	0.0096
99 Percentile	0.0054	0.012	0.21	0.0029	0.0016	0.0037	0.0047	0.017	0.023
Count > Guideline	0	0	4	0	0	0	0	0	4
% > Guideline	0	0	100.0	0	0	0	0	0	6.5
2008-2024									
Average	0.0077	0.014	0.18	0.0063	0.010	0.0032	0.0071	0.010	0.011
Count	139	110	63	43	59	189	69	216	357
Minimum	<0.0010	0.0050	0.089	0.0024	<0.0010	<0.0010	<0.0010	0.0016	0.0026
Maximum	0.23	0.059	0.41	0.020	0.19	0.041	0.031	0.27	0.25
Count < DL	21	0	0	0	25	30	6	0	5
Standard Deviation	0.029	0.0093	0.061	0.0047	0.036	0.0039	0.0065	0.018	0.015
1st Quartile	0.0011	0.0080	0.14	0.0030	0.00050	0.0014	0.0022	0.0052	0.0060
Median	0.0020	0.011	0.17	0.0038	0.0014	0.0020	0.0048	0.0071	0.0080
3rd Quartile	0.0032	0.016	0.20	0.0088	0.0026	0.0036	0.010	0.011	0.012
99 Percentile	0.19	0.052	0.40	0.019	0.17	0.015	0.026	0.040	0.046
Count > Guideline	11	34	63	1	4	6	8	20	42
% > Guideline	7.9	30.9	100	2.3	6.8	3.2	11.6	9.3	11.8

Table 3-25: Lightning Creek Drainage Total Cadmium Summary Statistics, 2008 to 2024

Cadmium, total									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
2024									
Average	0.000024	0.00011	0.0018	0.000047	0.000073	0.000068	0.000093	0.000086	0.00012
Count	9	9	4	2	2	16	4	17	62
Minimum	0.000011	0.000083	0.0016	0.000044	0.000029	0.000022	0.000022	0.000036	0.000045
Maximum	0.000069	0.00015	0.0025	0.000051	0.00012	0.00014	0.00026	0.00021	0.00063
Count < DL	0	0	0	0	0	0	0	0	0
Standard Deviation	0.000018	0.000027	0.00044	0.0000050	0.000062	0.000039	0.00011	0.000051	0.00011
1st Quartile	0.000014	0.000095	0.0016	0.000045	0.000051	0.000036	0.000041	0.000049	0.000063
Median	0.000019	0.00011	0.0016	0.000047	0.000073	0.000053	0.000048	0.000060	0.000089
3rd Quartile	0.000024	0.00014	0.0018	0.000049	0.000095	0.000089	0.000100	0.00010	0.00012
99 Percentile	0.000066	0.00015	0.0024	0.000051	0.00012	0.00014	0.00025	0.00021	0.00052
Count > Guideline	0	2	4	0	0	4	1	3	9
% > Guideline	0	22.2	100	0	0	25	25	17.6	14.5
2008-2024									
Average	0.000087	0.00016	0.0024	0.000079	0.00091	0.00023	0.00055	0.00014	0.00017
Count	139	110	63	43	58	189	69	216	357
Minimum	<0.0000050	0.000033	0.0014	0.000029	<0.00001	<0.00001	0.000020	0.0000070	0.000035
Maximum	0.0026	0.0012	0.0061	0.00033	0.026	0.0080	0.011	0.0011	0.0076
Count < DL	8	0	0	0	2	2	0	0	1
Standard Deviation	0.00034	0.00015	0.00079	0.000064	0.0036	0.00075	0.0016	0.00015	0.00043
1st Quartile	0.000012	0.000083	0.0019	0.000036	0.000023	0.000036	0.000074	0.000053	0.000073
Median	0.000019	0.00012	0.0023	0.000046	0.000083	0.000060	0.00013	0.000078	0.00010
3rd Quartile	0.000032	0.00018	0.0026	0.000098	0.00022	0.00014	0.00030	0.00015	0.00016
99 Percentile	0.0022	0.00076	0.0053	0.00028	0.017	0.0024	0.0080	0.00068	0.00068
Count > Guideline	15	41	63	6	22	48	30	56	85
% > Guideline	10.8	37.3	100	14	37.9	25.4	43.5	25.9	23.8

Table 3-26: Lightning Creek Drainage Dissolved Cadmium Summary Statistics, 2008 to 2024

Cadmium, dissolved									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
2024									
Average	0.000020	0.000093	0.0018	0.000042	0.000017	0.000023	0.000035	0.000068	0.000072
Count	9	9	4	2	2	16	4	17	62
Minimum	0.0000062	0.000049	0.0015	0.000038	0.0000092	0.000010	0.000015	0.000038	0.000037
Maximum	0.000065	0.00013	0.0024	0.000046	0.000025	0.000057	0.000074	0.00016	0.00022
Count < DL	0	0	0	0	0	0	0	0	0
Standard Deviation	0.000018	0.000026	0.00046	0.0000054	0.000011	0.000012	0.000027	0.000039	0.000037
1st Quartile	0.000011	7.36E -05	0.0015	0.000040	0.000013	0.000017	0.000022	0.000045	0.000051
Median	0.000015	0.000089	0.0016	0.000042	0.000017	0.000020	0.000026	0.000051	0.000061
3rd Quartile	0.000018	0.00011	0.0018	0.000044	0.000021	0.000027	0.000038	0.000072	0.000074
99 Percentile	0.000061	0.00013	0.0024	0.000046	0.000025	0.000055	0.000073	0.00016	0.00020
Count > Guideline	0	0	0	0	0	0	0	0	0
% > Guideline	0	0	0	0	0	0	0	0	0
2008-2024									
Average	0.000082	0.00014	0.0023	0.000074	0.000088	0.000038	0.000095	0.000078	0.00010
Count	139	110	63	43	59	189	69	216	357
Minimum	<0.0000050	0.000031	0.0013	0.000026	<0.000010	<0.000010	<0.0000050	0.000030	0.000020
Maximum	0.0028	0.00060	0.0046	0.00020	0.0014	0.00040	0.00056	0.00084	0.0031
Count < DL	9	0	0	0	5	4	2	0	4
Standard Deviation	0.00035	0.000097	0.00065	0.000053	0.00028	0.000042	0.000099	0.000071	0.00018
1st Quartile	0.000011	0.000076	0.0019	0.000036	0.0000092	0.000017	0.000030	0.000045	0.000052
Median	0.000016	0.00010	0.0022	0.000045	0.000018	0.000024	0.000061	0.000059	0.000067
3rd Quartile	0.000025	0.00017	0.0025	0.00010	0.000026	0.000043	0.00013	0.000085	0.000094
99 Percentile	0.0022	0.00058	0.0043	0.00019	0.0013	0.00017	0.00043	0.00030	0.00049
Count > Guideline	0	0	0	0	0	0	0	0	0
% > Guideline	0	0	0	0	0	0	0	0	0

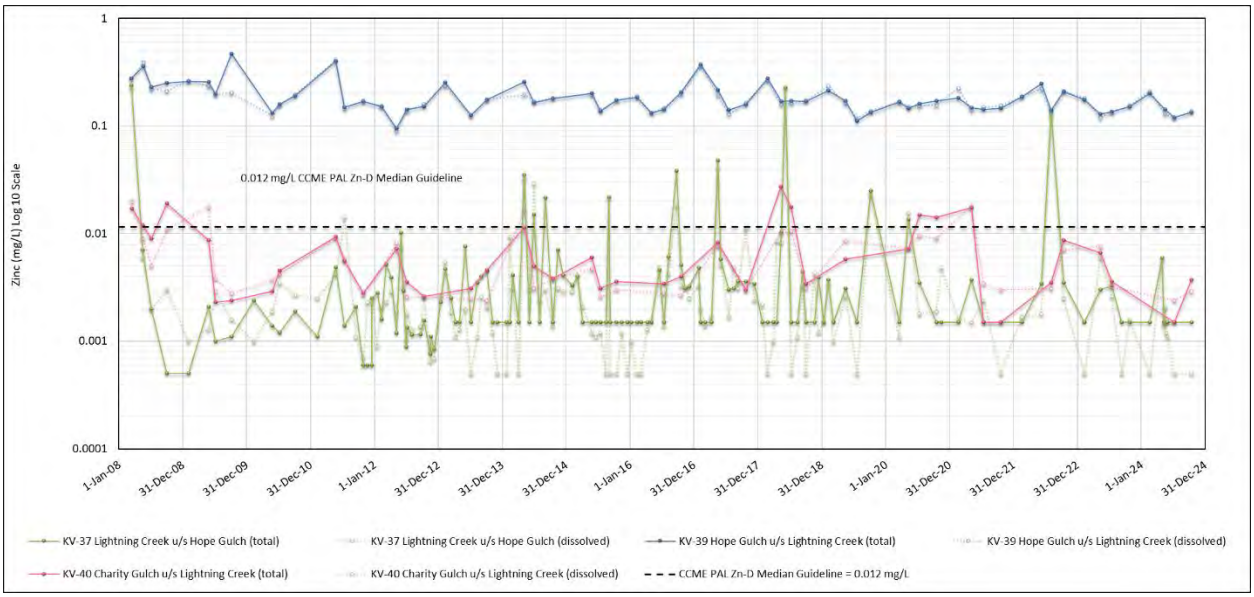

Figure 3-59: Upper Lightning Creek Total and Dissolved Zinc, 2008 to 2024

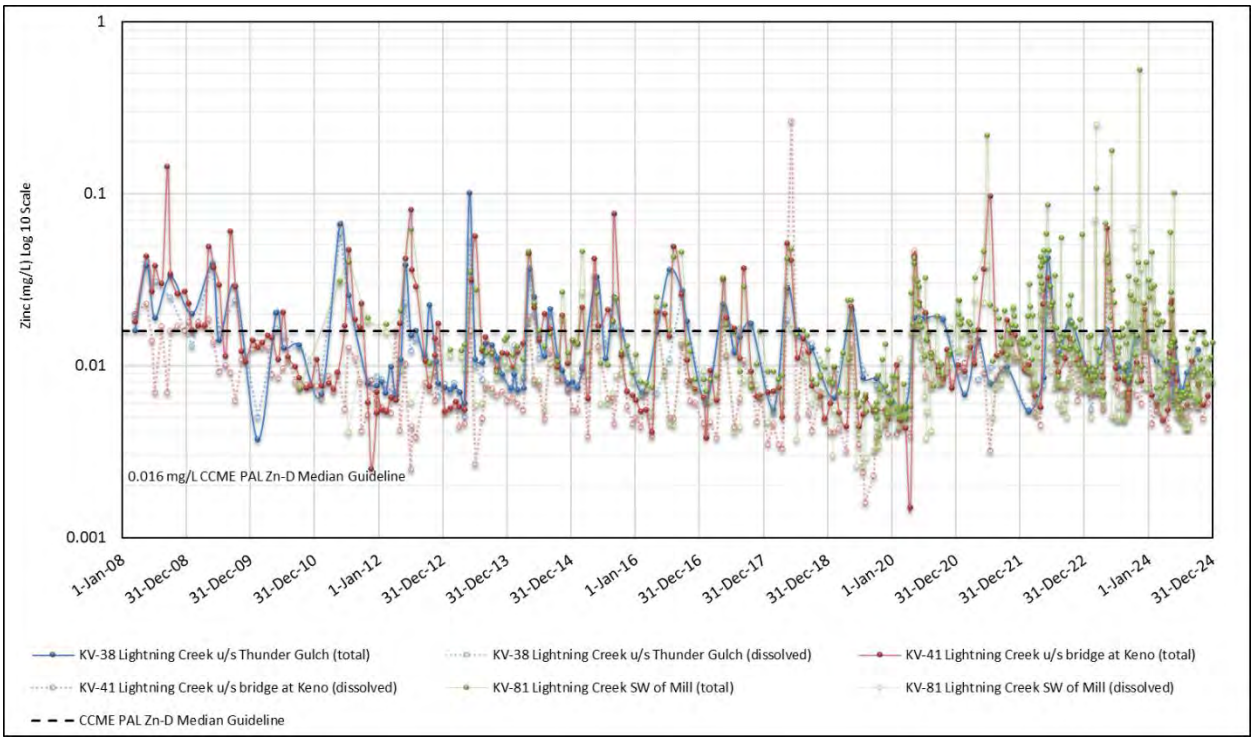

Figure 3-60: Lower Lightning Creek Total and Dissolved Zinc, 2008 to 2024

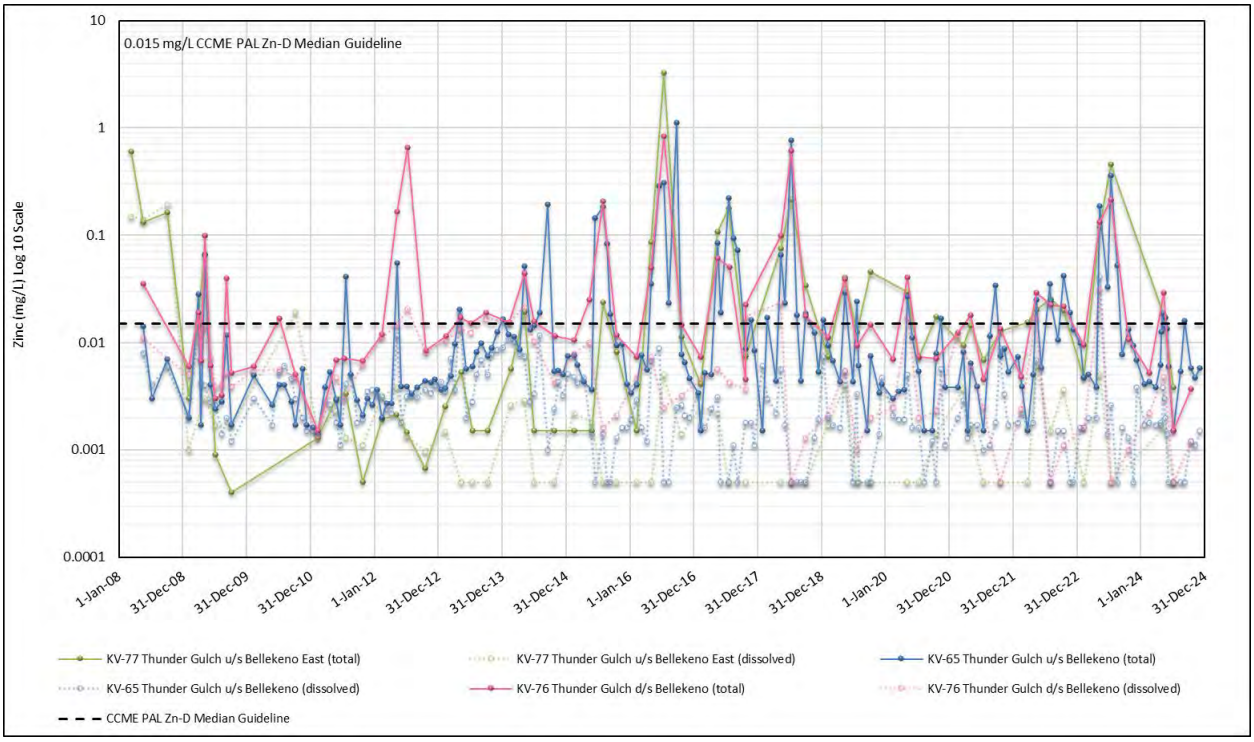

Figure 3-61: Thunder Gulch Total and Dissolved Zinc, 2008 to 2024

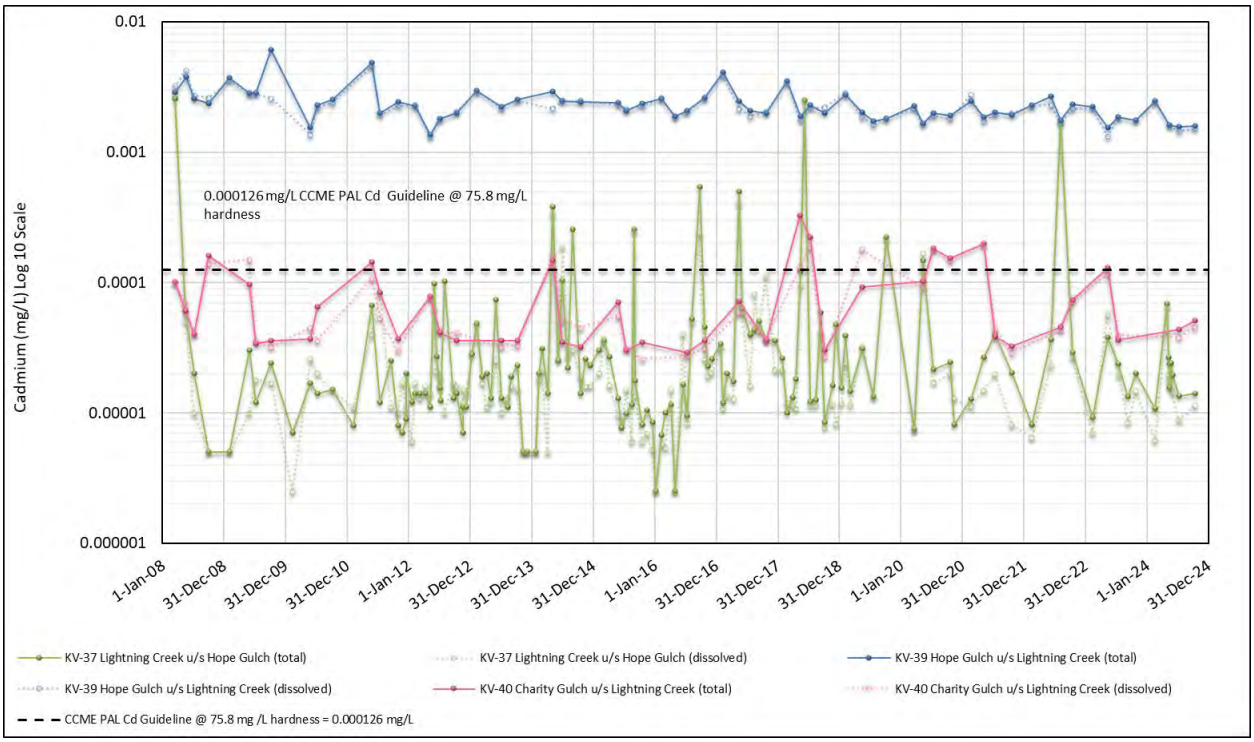

Figure 3-62: Upper Lightning Creek Total and Dissolved Cadmium, 2008 to 2024

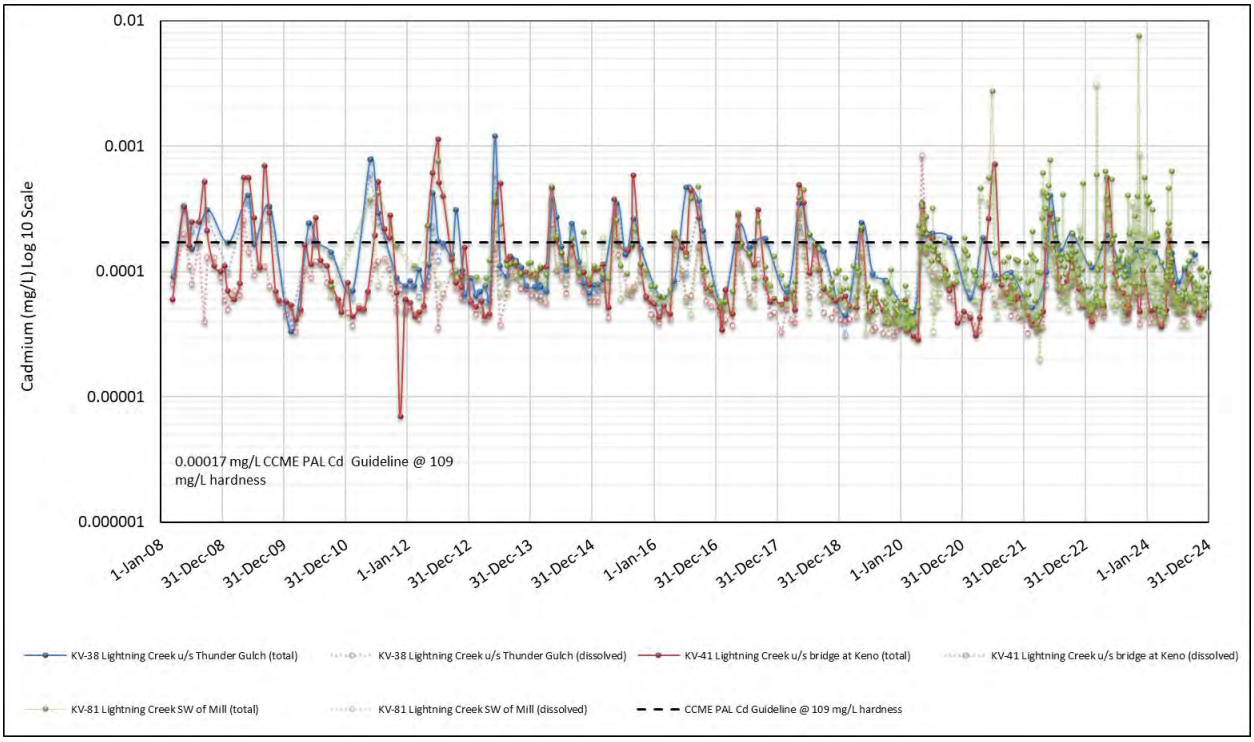

Figure 3-63: Lower Lightning Creek Total and Dissolved Cadmium, 2008 to 2024

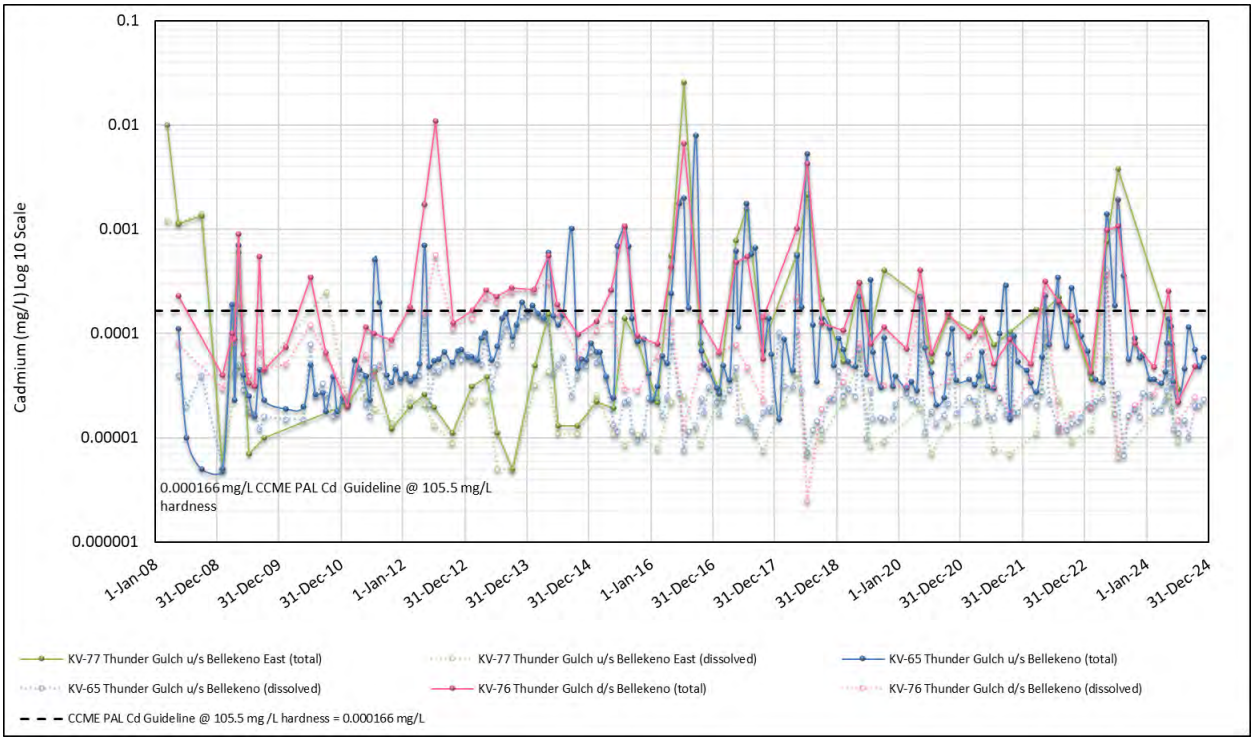

Figure 3-64: Thunder Gulch Total and Dissolved Cadmium, 2008 to 2024

4 GROUNDWATER

4.1 GROUNDWATER CONDITIONS

Extensive groundwater studies have been conducted throughout the KHSD, which include mapping of the geology and historic mine development in the KHSD, hydrogeological investigations, and ongoing monitoring. A Conceptual Model and Preliminary 3D Groundwater Model (Piteau, 2016) was also developed that includes particle tracking to map the potential groundwater flow paths from historical mine workings.

Regionally, the KHSD groundwater flow regime is controlled by (1) topography, (2) hydraulic characteristics of the local geologic units, and (3) natural infiltration of meteoric water (recharge), particularly in the three prominent hills that comprise the KHSD, Galena Hill, Sourdough Hill and Keno Hill. The water table is generally a muted image of the overlying topography so that groundwater flow directions are similar to the regional ground slopes. Groundwater flow divides are interpreted to coincide with the major watershed divides. Groundwater migrates from highland areas (where most recharge occurs) towards lowland areas where groundwater discharges to perennial streams (primarily Flat Creek, Christal Creek, Lightning Creek). Groundwater flow is concentrated in higher permeability geologic materials, which include overburden (where present) and shallow bedrock (which tends to be more fractured).

Locally, the regional groundwater flow characteristics can be altered by the presence of higher permeability rock discontinuities (faults, fracture zones, mineralized veins) and underground mine workings. It is common for underground mine workings to operate as hydraulic sinks so that groundwater inflows are conveyed through the workings to adit portals where the collected groundwater is discharged to surface water (Piteau, 2016). Adit discharges can be significant for underground workings that intersect permeable faults or are located below open mine pits that collect surface runoff/snowmelt and convey this water into the subsurface. Some underground workings collect groundwater at upgradient locations, convey this water through the workings, and then recharge the groundwater system at downgradient locations without adit discharges.

Groundwater flow is concentrated in higher permeability geologic materials, which include overburden (where present) and shallow bedrock (which tends to be more fractured). The regional groundwater flow system results in perennial streams that are gaining (receiving groundwater discharge) along most of their lengths. An exception to this occurs along Lightning Creek south and west of Keno City. Along this reach, Lightning Creek is a losing stream that recharges the groundwater system north of the creek.

4.2 GROUNDWATER MONITORING NETWORK

The groundwater monitoring well locations for the existing KHSD Mining Operations are detailed in Table 4-1, and the locations of the wells are shown on Figure 4-1 to Figure 4-3. Two drilling programs have been undertaken to install additional groundwater monitoring wells to the existing network since the KHSD QML-0009 Site Characterisation Report issued on February 28, 2023.

A drilling program was carried out in winter 2023 to add additional groundwater monitoring wells to the existing network, namely, FM-MW23-06, FM-MW23-07, FM-MW23-08S, FM-MW23-08D, FM-MW23-09A, BH-MW23-10, BH-MW23-11, BH-MW23-12, and BH-MW23-13. The aim of these monitoring wells was to facilitate the collection of additional groundwater monitoring data (water levels and groundwater quality samples) in areas not currently covered by the existing monitoring network. These monitoring wells are not detailed in WL QZ18-044, and thus are supplementary to the existing groundwater monitoring network. During this drilling

program, KV-109A was drilled as a replacement well to KV-109 which was noted to be damaged in 2023 (Table 4-1).

In the summer of 2025, another drilling program was carried out with the specific intention of replacing damaged monitoring wells detailed in WL QZ18-044, namely BH-39, FM-MW-1, KV-116, KV-123, KV-124, KV-126, KV-127, BH-MW-1, KV-85S, KV-85D, KV-86, KV-88S, KV-89D, and KV-89S. The damaged monitoring wells were decommissioned and replaced, with the exception of BH-39 and FM-MW-1. Access to BH-39 proved challenging for the drill rig and thus was unable to be replaced. Drilling of a replacement FM-MW-1 was attempted numerous times but was ultimately unsuccessful due to challenging ground conditions. The following monitoring wells were completed during the 2025 drilling program: KV-116N, KV-123N, KV-124N, KV-126N, KV-127N, BH-MW-01N, KV-85SN, KV-85DN, KV-86N, KV-88SN, KV-89DN, and KV-89SN. Details for the new monitoring wells are provided in Table 4-1 with the wells displayed on Figure 4-1 to Figure 4-3.

Table 4-1: Keno Hill Silver District Groundwater Monitoring Well Network

Well ID	Description	Total Depth (m)	Screen Length (m)	Lithology of screened interval	Comment
BH-MW-1	Well downgradient of the historical Bermingham 200 Adit	21.3	3.0	Graphitic Schist/ Quartzite	Replaced by BH-MW-01N in 2025.
RB-MW-1	Well downgradient of the Ruby 400 Adit and WRSA	13.4	3.0	Gravel, Sand, Silt and Cobble/Graphitic Schist	
NC-MW-1	Well upgradient of the NC 500 Adit	35.7	12.0	Bedrock	
KV-116	New Bermingham Waste Rock Disposal Area	12.9	6.0	Bedrock	Replaced by KV-116N in 2025.
KV-122	New Bermingham Waste Rock Disposal Area	26.7	6.0	Bedrock	
KV-123	New Bermingham Waste Rock Disposal Area	44.6	6.0	Bedrock	Replaced by KV-123N in 2025.
KV-124	New Bermingham Waste Rock Disposal Area	15.8	6.0	Bedrock	Replaced by KV-124N in 2025.
KV-125	New Bermingham Waste Rock Disposal Area	59.2	6.0	Bedrock	
KV-126	New Bermingham Waste Rock Disposal Area	71.2	7.0	Bedrock	Replaced by KV-126N in 2025.
KV-127	New Bermingham Waste Rock Disposal Area	27.6	9.0	Bedrock	Replaced by KV-127N in 2025.
KV-84ND	Bedrock well on Keno Firehall lot to replace KV-84	88.4	12.0	Graphite/Schist/ Quartzite/Muscovite/ Sericite Schist/Pyrite	
KV-85D	DSTF and Mill Site Groundwater Well #1 (PH2) Deep	42.7	3.0	Bedrock	Replaced by KV-85DN in 2025.
KV-85S	DSTF and Mill Site Groundwater Well #1 (Shallow)	4.0	1.5	Gravel and Silt	Replaced by KV-85SN in 2025.
KV-86	DSTF and Mill Site Groundwater Well #2 (PH5)	36	3.0	Gravel and Sand	Replaced by KV-86N in 2025.
KV-87	DSTF and Mill Site Groundwater Well #3 (PH6)	57.9	3.1	Bedrock	Replaced by KV-87N in 2020.

Well ID	Description	Total Depth (m)	Screen Length (m)	Lithology of screened interval	Comment
KV-87N	New 2020 Flame & Moth Site Groundwater Well #3	94.8	21.0	Bedrock	
KV-88D	DSTF and Site Groundwater Well #4 (Deep)	50.1	15	Bedrock	
KV-88S	DSTF and Mill Site Groundwater Well #4 (Shallow)	4.1	1.5	Sand/Gravel/Silt/ Bedrock	Replaced by KV-88SN in 2025.
KV-89D	Flame & Moth Site Groundwater Well #5 (Deep)	38.3	10	Bedrock	Replaced by KV-89DN in 2025.
KV-89S	DSTD and Mill Site Groundwater Well #5 (Shallow)	4.8	1.5	Overburden	Replaced by KV-89SN in 2025.
KV-103	Mill Supply Well	82.3	n/a	Sand with Gravel/ Glitstone (Shale)	
KV-108	Upgradient of DSTF expansion area	94.3	12.0	Bedrock	
BH-39	Phase I of DSTF	7.5	7.5	Tailings	Well was demolished. Replacement planned in 2025 but was unsuccessful due to challenging access.
FM-MW-1[1]	Flame & Moth Well #1 (KAR-01)	182.3	12.2 12.2	Quartzite/Schist/Graphite Schist/Sericite Schist Greenstone/Mineralized Vein	Well was demolished. Replacement attempted in 2025 but was unsuccessful due to challenging ground conditions.
FM-MW-2[1]	Flame & Moth Well #2 (KAR-02)	244.4	12.2 12.2	Quartzite Quartzite/Stringer Zone	
FM-MW-3	Flame & Moth Well #3 (KAR-16)	195.7	12.2	Quartzite/Graphitic Schist	
KC-MW-4	Well south of Onek 400 Adit	82.3	2.2	Gravel/Sand/Boulder/ Cobble	Well was damaged. Decommissioned in 2025.
ON-MW-2	Onek Monitoring Well #1 d/g Project Facilities	66.3	6.0	Bedrock/Quartzite/ Graphitic schist	
KV-109	Flame & Moth Lightning Creek Discharge area near KV-81	27.6	3.1	Schist/Quartzite	Replaced by KV-109A in 2023.
FM-MW23-06	Flame & Moth well upgradient north expansion area	74.1	3.1	Quartzite	
FM-MW23-07	Flame & Moth well upgradient central expansion area	85.9	4.6	Graphitic Schist	
FM-MW23-08S	Flame & Moth shallow well d/g south expansion area	23.9	4.6	Graphitic Schist	
FM-MW23-08D	Flame & Moth deep well d/g south expansion area	50.3	6.1	Graphitic Schist	
FM-MW23-09A	Flame & Moth well downgradient of mine	22.0	1.5	Gravel	

Well ID	Description	Total Depth (m)	Screen Length (m)	Lithology of screened interval	Comment
BH-MW23-10	Bermingham well downgradient south expansion area	29.8	3	Schist	
BH-MW23-11	Bermingham well downgradient north expansion area	24.0	4.5	Schist	
BH-MW23-12	Bermingham well upgradient south expansion area	17.1	3.2	Graphitic Schist	
BH-MW23-13	Bermingham well upgradient north expansion area	50.0	3.0	Graphitic Schist	
KV-109A	New Lightning Creek Monitoring Well near KV-81	27.9	3.1	Quartzite	
KV-116N	Replacement for KV-116	22.1	6	Sericitic Schist	
KV-123N	Replacement for KV-123	56.3	6.1	Sericitic Schist	
KV-124N	Replacement for KV-124	32.2	6.1	Graphitic Schist	
KV-126N	Replacement for KV-126	85.3	7.6	Graphitic Schist	
KV-127N	Replacement for KV-127	44.6	9.2	Graphitic / Sericitic Schist and Quartzite	
BH-MW-01N	Replacement for BH-MW-01N	32.6	3	Graphitic and Sericite Schist	
KV-85DN	Replacement for KV-85D	56.3	3.1	Graphitic Schist	
KV-85SN	Replacement for KV-85S	6.8	1	Sand and Gravel	
KV-86N	Replacement for KV-86	15.6	3	Silt, Gravels and Cobbles	
KV-88SN	Replacement for KV-88S	5.7	1.5	Sand and Gravel	
KV-89DN	Replacement for KV-89D	50.0	3.1	Graphitic and Sericitic Schist	
KV-89SN	Replacement for KV-89S	15.9	3.1	Sand and Gravel	

Note. [1] These wells have two sections of screen. Screen lengths and lithology values are presented in order of upper screen and lower screen.

476000 478000 480000 482000 484000 486000

7092000 7090000 7088000 7086000

BERMINGHAM INSET

KV-116
BERMINGHAM ACCESS ROAD
BH-MW-1
KV-126
KV-125
P-AML
NEW BERMINGHAM PORTAL
KV-127
HISTORIC BERMINGHAM 200
KV-123
KV-122

DISTRICT MILL AND KENO CITY INSET

Christal Lake
Christal Lake Road
Silver Trail Highway
Onek Connector
ON-MW-1
ON-MW-2
KV-84ND
KC-MW-4
FLAME AND MOTH PORTAL
KV-88 S/D
KV-85 S/D
BH-39
KV-89 S/D
KV-87N
KV-108
FM-MW23-09A
KV-89S
KV-103
KV-107
Bellekeno Haul Road
Lightning Creek
KV-86
FM-MW23-06
FM-MW-03
FM-MW23-07
Duncan Creek Road
FM-MW23-08 S/D
FM-MW-02
KV-109N
KV-109

Hanson McQuesten Road
Christal Creek
SILVER TRAIL HIGHWAY
Wernecke Road
NC-MW-1
RB-MW-1
Calumet Road
Sign Post Road
Brefalt Creek
Flat Creek
Bellekeno Haul Road

BERMINGHAM INSET

DISTRICT MILL AND KENO CITY INSET

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0 0.5 1 1.5 Kilometers

- Adit
- Groundwater Monitoring Location
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 4-1

GROUNDWATER MONITORING LOCATIONS, 2024

MARCH 2025

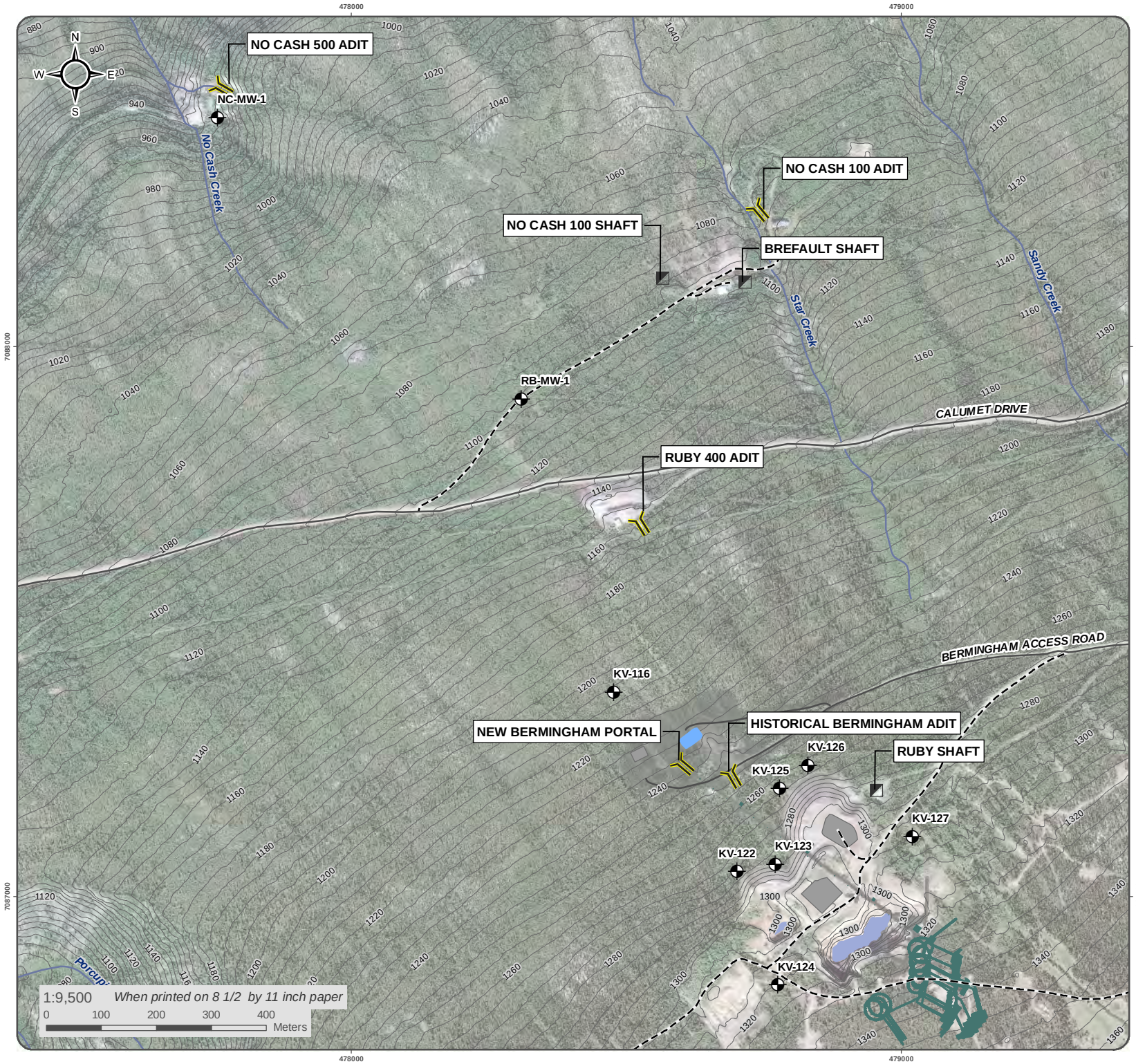
D:\Projects\All\Projects\Keno_Area_Mines\ALL-SITES\02-Map\01_Overview\04-WQ\GW\GWMonitoring_KenoHill_Expansion_20250314.mxd
(Last edited by: amalias\evska; 2025-03-14/10:35 AM)

HECLA KENO HILL

FIGURE 4-2

BERMINGHAM GROUNDWATER MONITORING LOCATIONS

FEBRUARY 2023



- Adit/Portal
- Shaft
- Groundwater Quality Monitoring, Existing
- Groundwater Quality Monitoring, Proposed
- Pond
- Proposed Underground Workings
- Road
- Limited-Use Road
- Contour (5m interval)

Satellite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 06 2023

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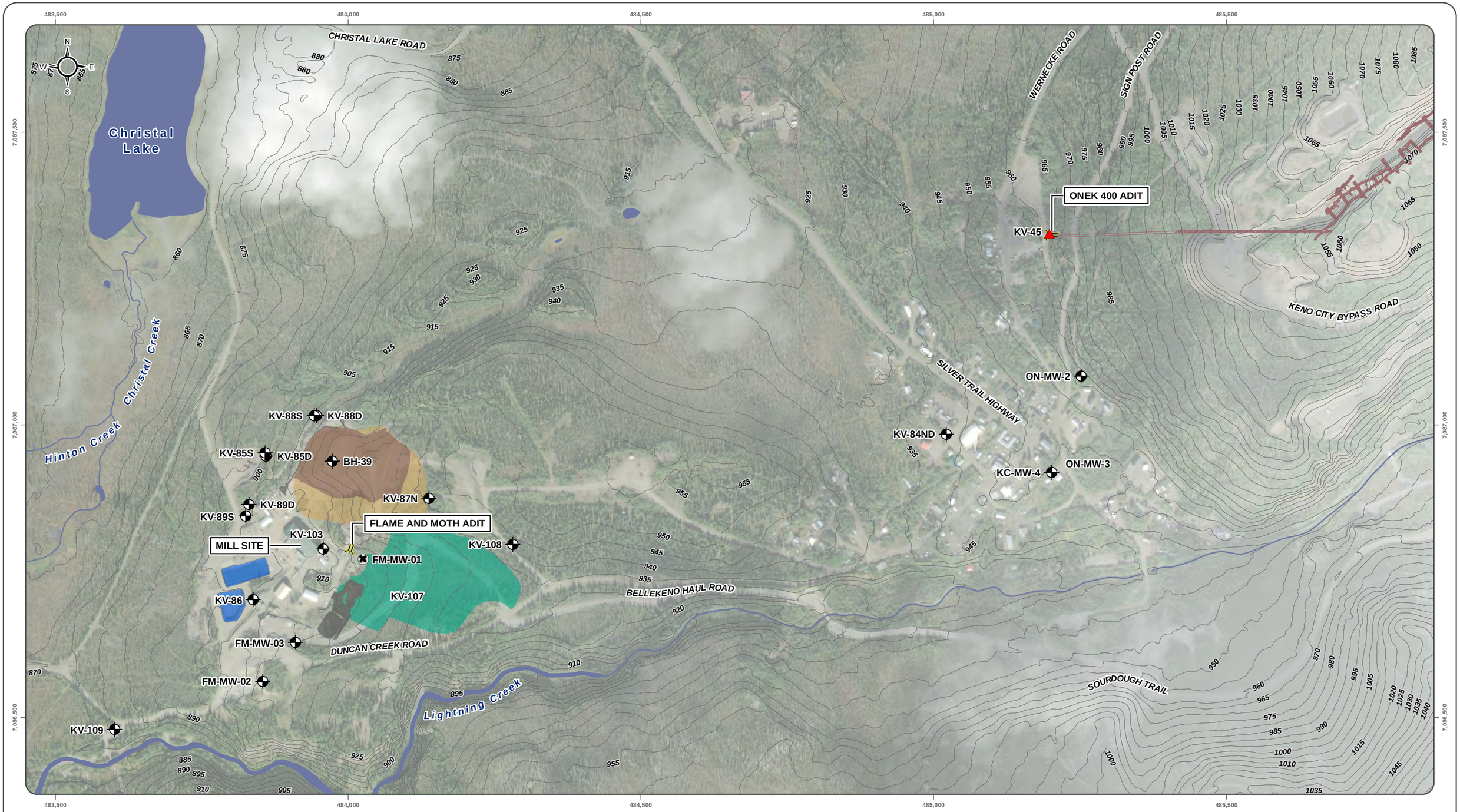

Satelite imagery obtained from ESRI Imagery map service http://goto.arcgisonline.com/maps/World_Imagery on February 2023

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1:6,000 *(when printed on 11 x17 inch paper)*

0 50 100 150 200 250 Meters

- Monitoring Well
- Decomissioned Monitoring Well
- Surface Water Quality Station
- Adit

- Infrastructure Footprint
- Pond
- DSTF 322k Tonnes Design
- Current DSTF
- To Be Constructed Features

- Underground Workings
- Waterbody
- Watercourse
- Contour (5m)

HECLA KENO HILL

FIGURE 4-3

GROUNDWATER MONITORING LOCATIONS AT DISTRICT MILL SITE, FLAME AND MOTH, ONEK 990 AND KENO CITY

FEBRUARY 2023

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4.3 GROUNDWATER HYDROLOGY

Characterization of the KHSD groundwater hydrology has been done conceptually, as well as through physical testing. Pumping tests and slug tests have been conducted on most of the wells installed throughout the KHSD, and water level elevations are tracked manually and through a network of continuous loggers. This field data combined with the mapped geology is used to describe the expected flow paths and seasonal changes to the water table for each mine. Previously, characterization work was done around the New Bermingham and Flame & Moth mines where mine dewatering rates needed to be estimated. Air lift testing was also carried out during the drilling of monitoring wells at both the mine sites to provide an estimate on the hydraulic conductivity within the overburden and bedrock formations.

Additional air lift testing and aquifer testing was carried out during the 2023 drilling program. Hydraulic conductivity testing was carried out between May 6-8, 2024 on six of the new installed groundwater monitoring wells, namely: FM-MW23-06, FM-MW23-08S, FM-MW23-08D, FM-MW23-09A, BH-MW23-10, and BH-MW23-11. The results concluded that the wells screened within bedrock typically exhibited a slower recovery indicating a lower hydraulic conductivity than FM-MW23-09A, which is screened in gravels. Estimated hydraulic conductivities for bedrock wells ranged from 5.5×10^{-5} m/s to 2.1×10^{-6} m/s, with the gravel well (FM-MW23-09A) ranging from 2.4×10^{-4} to 2.6×10^{-4} m/s.

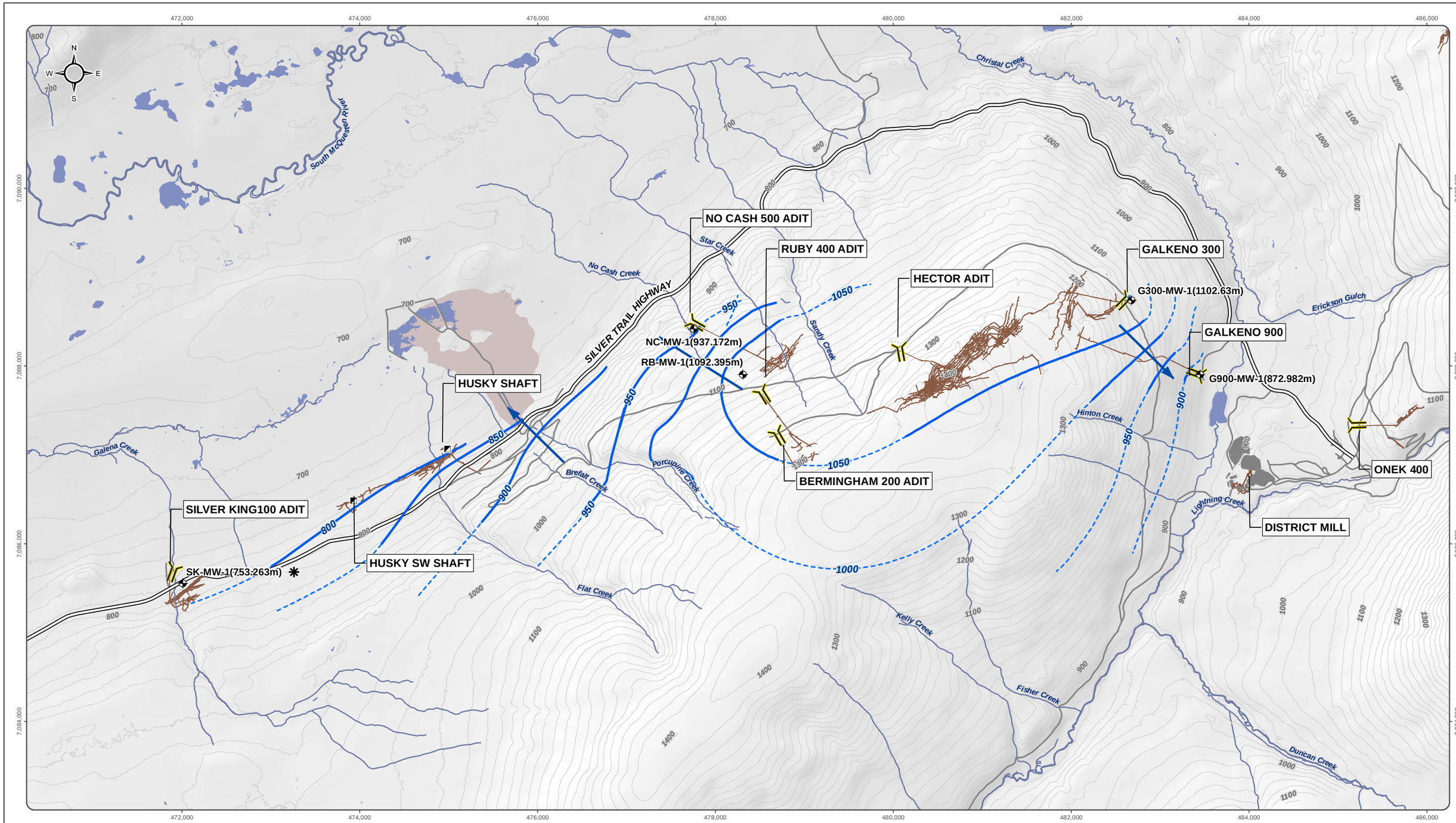
Figure 4-5 presents conceptual groundwater level contours and groundwater flow directions for Galena Hill using October 2024 groundwater levels. The contours were constructed so that water levels were:

- below ground surface;
- at ground surface at streams in gullies;
- consistent with measured water levels; and
- met with mine pool levels.

Although the contours are conceptual in nature, they provide an indication of flow directions and the apparent catchment area of the various mines. The primary discharge areas illustrated are Flat Creek Valley, No Cash Creek, Star Creek, Sandy Creek, Christal Creek Valley, and Lightning Creek Valley.

Based on the contours, the gradients indicated range from 3% to 30%. Much of the groundwater is expected to migrate in the more permeable shallow bedrock and overburden. For this high-level conceptual assessment, inferred velocities on the north and northwest side above an elevation of 950 masl to 1150 masl are estimated to be ~10-100 m yr^{-1} in the overburden, and ~1 m d^{-1} to tens of m yr^{-1} in the disturbed bedrock.

The groundwater entering the mine workings is sourced from meteoric recharge. This recharge is enhanced in some areas by open-pit workings that overlie underground workings, and waste dumps that reduce evapotranspiration. Some historic mine workings have caused noticeable deviations from natural groundwater flowpaths toward mine discharge areas, including Galkeno and Hector Calumet, Ruby, No Cash, and Silver King.



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Kilometres
0 0.25 0.5 0.75 1

- Groundwater Quality Monitoring (October 2024)
- Adit
- Shaft
- District Mill SIte Footprint
- Tailings Area

** Not Used for Contouring*

- Estimated Groundwater Contour
- Inferred Groundwater Contour
- Groundwater Flow Direction
- Underground Mine Workings

- Waterbodies
- Watercourses
- Silver Trail Highway
- Secondary Road
- Contours (20m)

ERDC

ELSA RECLAMATION AND DEVELOPMENT COMPANY

FIGURE 4-4

GALENA HILL GROUNDWATER POTENTIOMETRIC SURFACE

FEBRUARY 2025

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(Last edited by: amalishevska;2025-02-27;15:54 PM)

4.3.1 No Cash Creek

In 2016, Piteau Associates Engineering Ltd. (Piteau) conducted a preliminary groundwater model for the KHSD for Elsa Reclamation and Development Company Ltd. for mine reclamation. The preliminary model included particle tracking to determine probable groundwater flow paths from historical mine workings. The particle tracking indicated that regional groundwater derived from the Ruby, historical Bermingham, and No Cash mine workings discharges downgradient between the lower reaches of Star Creek and Christal Creek (Piteau, 2016).

In October 2016 drilling and testing of two boreholes at New Bermingham were performed. After each hole was drilled, one or two airlift pumping tests were performed. After a period of sustained pumping, the airlift was discontinued, and time was allowed for water-level recovery in the borehole. The best-estimate hydraulic conductivities were calculated for the two boreholes and were found to be similar, providing evidence that the rock mass is relatively homogeneous with regard to hydraulic properties. The average of the calculated hydraulic conductivities was 4.3 x 10^{-6} cm/s, which is taken as the best-estimate of the large-scale (bulk) hydraulic conductivity for rock within the mine area. Based on the average hydraulic conductivities a portal discharge rate during closure was estimated to be 220 m^3/d (2.5 L/s).

Groundwater levels in No Cash Creek have been recorded between ~932.46 to 1202.5 masl. Generally, this equates to being approximately 3.5 to 21.3 m below ground surface. Geodetic groundwater levels for the No Cash Creek area are shown on Figure 4-5.

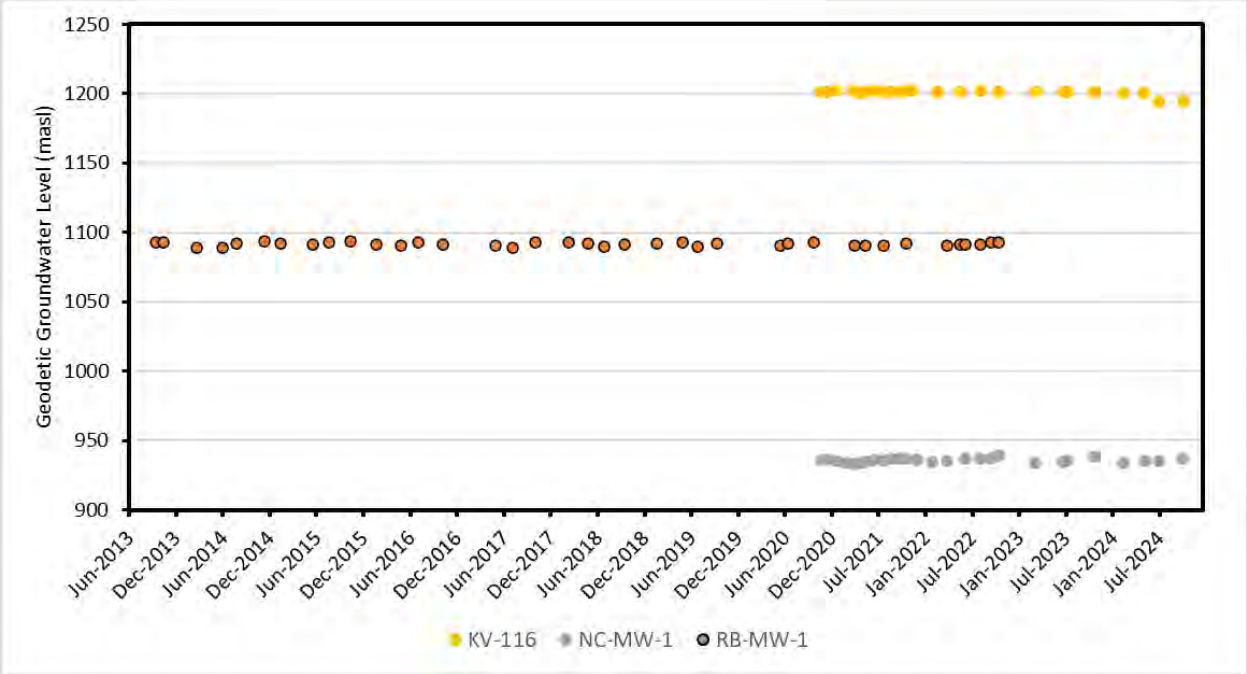

Figure 4-5: Groundwater Level (masl) in No Cash Creek Catchment Wells

4.3.2 New Bermingham

Groundwater flow in the Bermingham area follows topography, so the general flow direction is from southeast to northwest. Construction and continued dewatering of the New Bermingham workings have modified the flow patterns. Figure 4-7 and Figure 4-8 are interpreted groundwater elevation contour maps of the

Bermingham area in July and October 2024, respectively. Shown on the map is interpreted groundwater flowpaths, which are generally drawn perpendicular to the contours. The maps show flow lines converging along the New Bermingham decline, which operates as a groundwater sink. Groundwater inflows in the decline are collected by a sump system and pumped via pipeline to the portal where the mine water is discharged via the water treatment plant. The groundwater effects (drawdowns) are most pronounced at the far end of the portal where the depth of excavation below the natural (preconstruction) water table is the greatest. As one proceeds away from the decline, the effects diminish, and groundwater becomes more similar to the natural regional system characterized by southeast to northwest flow. Geodetic groundwater levels for the Bermingham area are shown on Figure 4-6. Groundwater levels in New Bermingham have been recorded between ~1202.30 to 1311.09 masl. Generally, this equates to being approximately 10 to 60 m below ground surface.

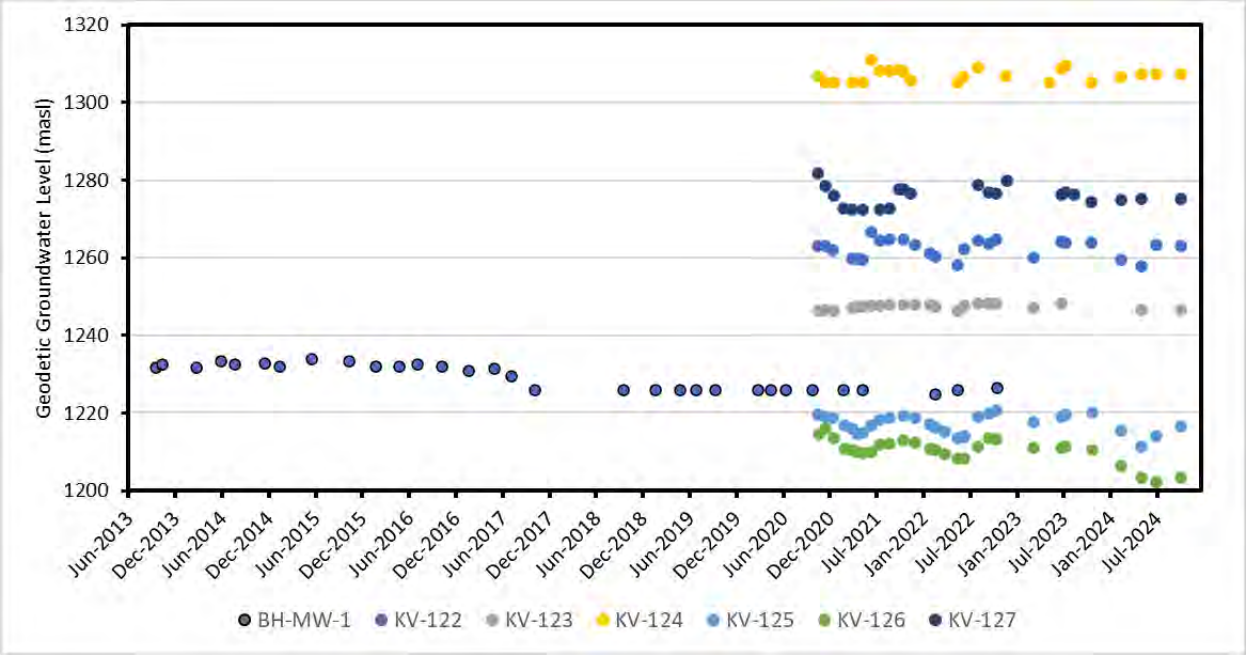

Figure 4-6: Groundwater Level (masl) in Bermingham Catchment Wells

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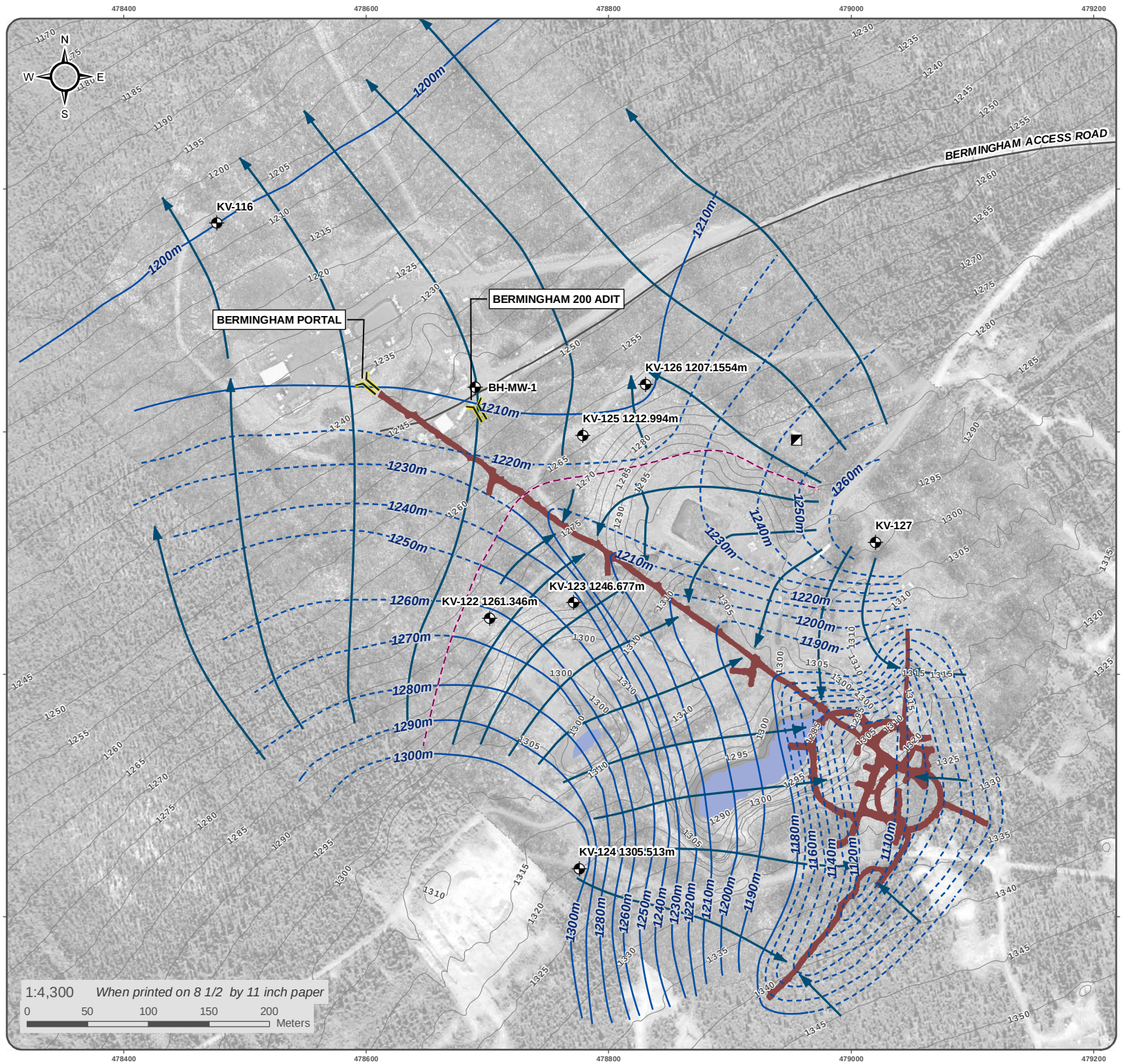
FIGURE 4-7

BERMINGHAM MONITORING LOCATIONS AND GROUNDWATER LEVEL CONTOUR MAP, JUNE 2022

JANUARY 2023



- Adit/Portal
- Shaft
- Groundwater Quality Monitoring, Existing
- Groundwater Contour
- Estimated Groundwater Contour
- GW Flow
- GW Divide
- Contour (5m interval)

Water Elevations are based on Groundwater Data Collected in June 2022

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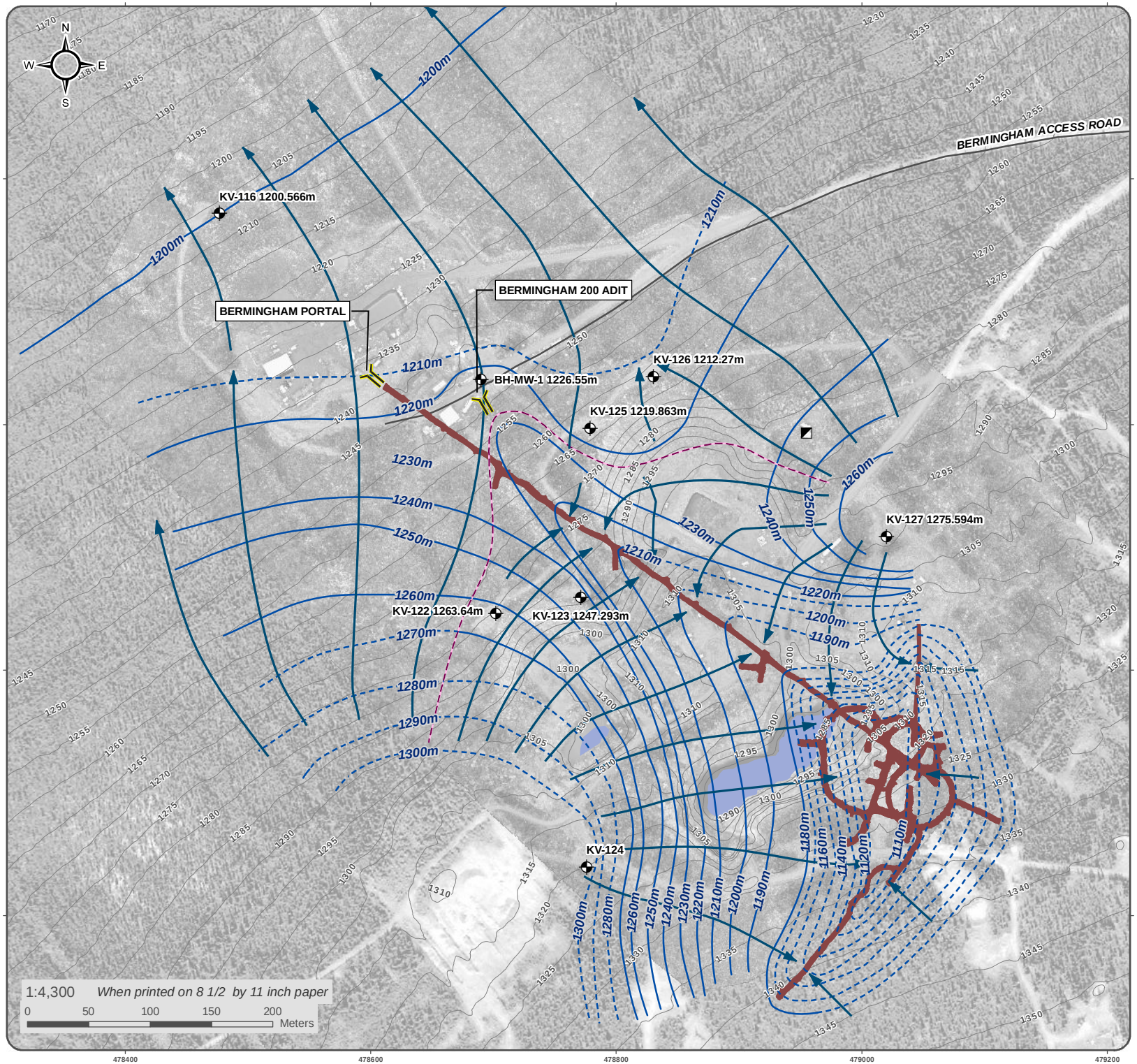

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FIGURE 4-8

BERMINGHAM MONITORING LOCATIONS AND GROUNDWATER LEVEL CONTOUR MAP, OCTOBER 2022

FEBRUARY 2023

- Adit/Portal
- Shaft
- Groundwater Quality Monitoring, Existing
- Groundwater Contour
- Estimated Groundwater Contour
- GW Flow
- GW Divide
- Contour (5m interval)

Water Elevations are based on Groundwater Data Collected in October 2022

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Datum: NAD 83; Map Projection: UTM Zone 8N

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(*Last edited by: amatlashevska;2023-02-01/10:44 AM*)

4.3.3 Christal Creek

The 2016 preliminary groundwater modelling and particle tracking conducted by Piteau indicated that groundwater from the area of the historical Onek 400 mine workings flows towards the upper reaches of Christal Creek (Piteau, 2016). The Keno City conceptual groundwater model conducted by Interralogic estimated from synoptic water level events that groundwater from Keno City flows northwest towards Christal Lake (Interralogic, 2012). Generally, groundwater flow converges in Keno City and flows to the northwest towards Christal Lake and Christal Creek. Groundwater in the vicinity of the historical Lucky Queen 500 adit is also conceptually understood to flow down towards Christal Creek.

In August and September 2013, three deep monitoring wells (FM-MW-1, FM-MW-2, and FM-MW-3) were drilled, and a 72-hr air lift pumping test was completed on FM-MW-1 to calculate the potential mine inflows for the Flame & Moth mine. The maximum predicted flow rate for the Flame & Moth mine was conservatively calculated to be 3.0 x 10^3 m^3/d or 35 L/s. The conclusion of the dewatering estimations and conceptual model is that Flame & Moth mine dewatering will not have a significant impact on surface water flows in Lightning Creek and it is highly unlikely that mine dewatering will have an effect on groundwater levels.

Figure 4-11 and Figure 4-12 are interpreted groundwater elevation contour maps of the District Mill and Keno City area in July and October 2024, respectively. The groundwater contours were created using water level measurements taken during sampling events in July and October 2024. Generally, groundwater flows from Keno City to the northwest towards Christal Lake or west towards Christal Creek. The groundwater flow direction for the Flame & Moth mine is towards the northwest in the direction of Christal Lake.

Figure 4-9 presents water level elevations for the bedrock wells in the District Mill area. Water elevations around the District Mill have been recorded between ~ 815.7 to 904.2 masl. Generally, this equates to being approximately 0.9 to 98.2 m below ground surface. The groundwater elevation for the Flame & Moth portal location was estimated to be 820 masl from Figure 4-9, compared to the surface elevation of the portal at 910 masl (a difference of 90 m). The water level elevation at KV-87N is between ~864 to 869 masl while the level at KV-87 is between ~898 and 889 masl. The effects of mine workings development and associated dewatering activities is manifested in the marked water level decline for wells located close to the mine (e.g., FM-MW-2 and FM-MW-3).

Figure 4-10 presents water level elevations for the bedrock wells in the Keno City area. Water levels near Keno City have been recorded between ~ 883.0 to 931.7 masl. Generally, this equates to being approximately 27.5 to 61 m below ground surface.

As shown on Figure 4-9 and Figure 4-10, groundwater levels generally follow a seasonal pattern, which was broadly observed at all sites. It was typically lowest in early May prior to the onset of freshet. Once snowmelt began, the groundwater levels rose due to increased recharge until around November, when progressive freezing over winter likely limited recharge and lowered groundwater levels.

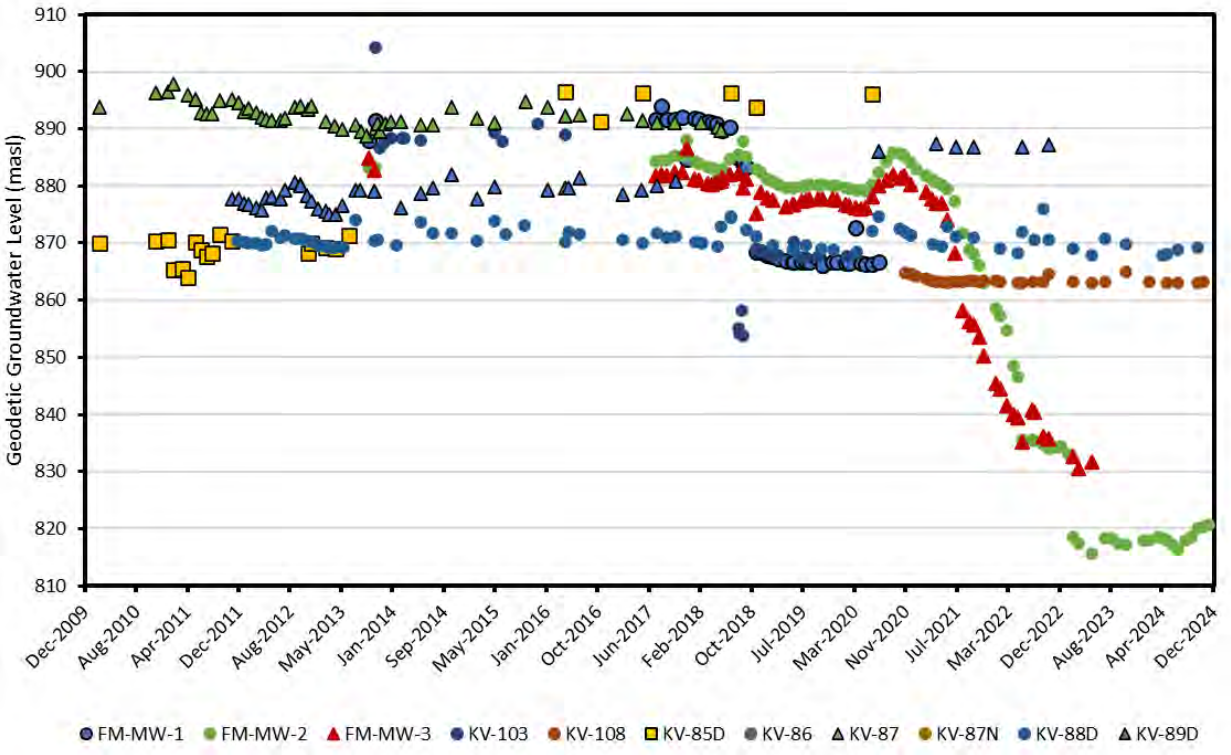


Figure 4-9: Groundwater Water Levels in Christal Creek Wells near District Mill

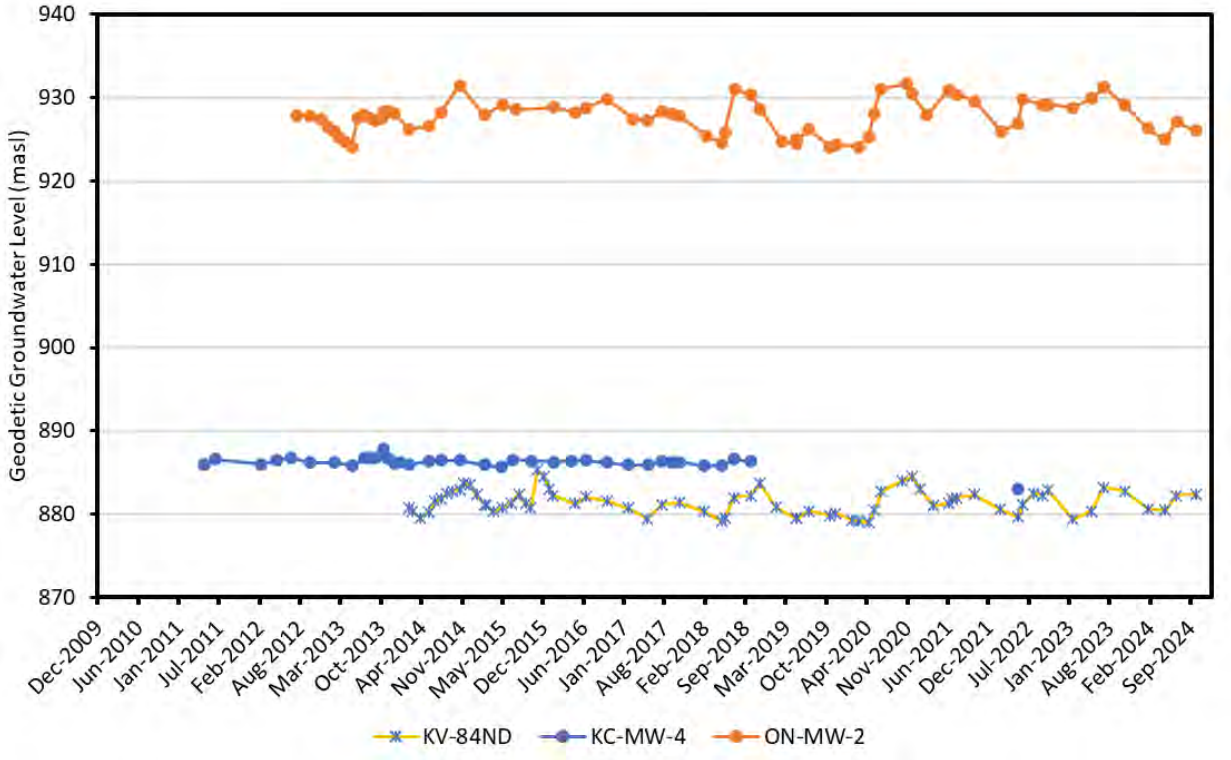
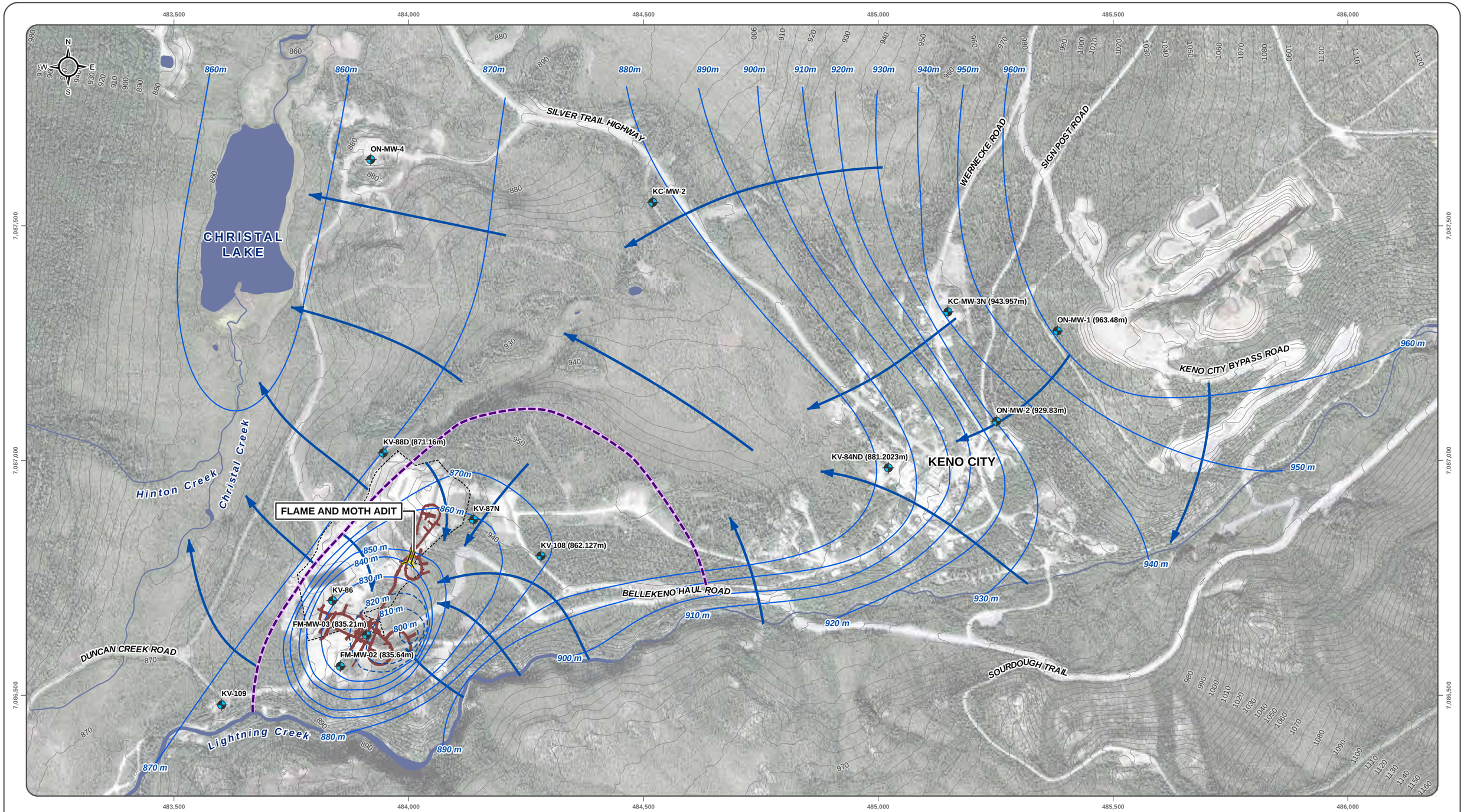


Figure 4-10: Groundwater Water Levels in Christal Creek Wells near Keno City



Satelite imagery obtained from ESRI Imagery map service http://goto.arcgisonline.com/maps/World_Imagery on January 2023

Datum: NAD 83; Projection: UTM Zone 8N

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1:7,500 *(when printed on 11 x17 inch paper)*

0 100 200 300 400 Meters

- Well (water levels measured June 2022)
- Adit
- Flame And Moth Underground Workings, As Built End of 2022
- Groundwater Contour (10m)
- Inferred Groundwater Contour (10m)
- Groundwater Flow Direction
- Groundwater Divide
- AKHM District Mill
- Topo Contour (5m)
- Watercourse
- Waterbody

WATER ELEVATIONS ARE BASED ON GROUNDWATER DATA COLLECTED JUNE 2022

HECLA KENO HILL

FIGURE 4-11
KENO CITY JUNE 2022 GROUNDWATER LEVEL CONTOUR MAP

JANUARY 2023

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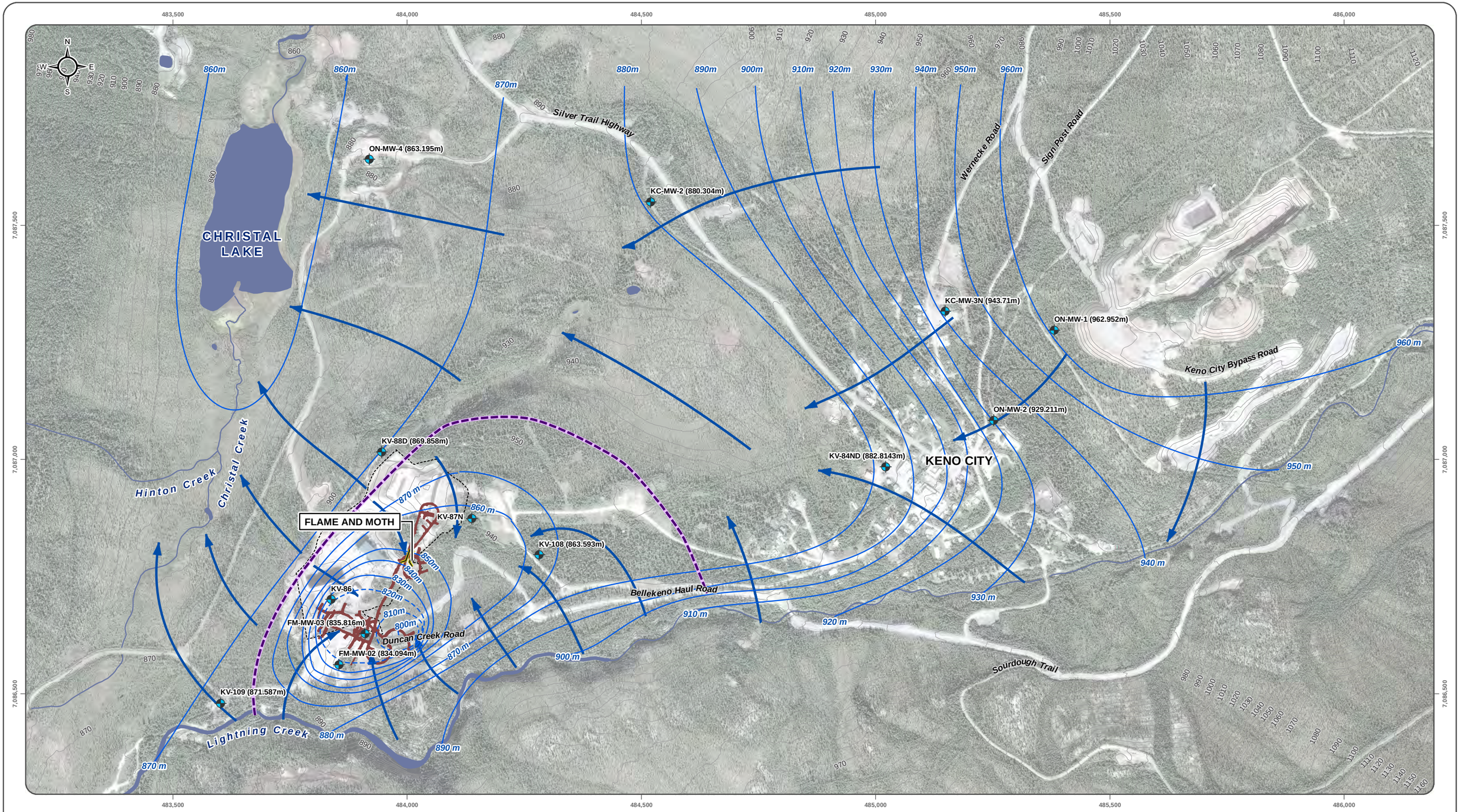
[Last edited by: amatlashevska,2023-01-13 07:20 AM]



Satelite imagery obtained from ESRI Imagery map service http://goto.arcgisonline.com/maps/World_Imagery on January 2023

Datum: NAD 83; Projection: UTM Zone 8N

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1:7,500 *(when printed on 11 x17 inch paper)*

0 100 200 300 400 Meters

- Well (water levels measured Ocober 2022)
- Adit
- Flame And Moth Underground Workings, As Built End of 2022
- Groundwater Contour (10m)
- Inferred Groundwater Contour (10m)
- Groundwater Flow Direction
- Groundwater Divide
- AKHM District Mill
- Topo Contour (5m)
- Watercourse
- Waterbody

WATER ELEVATIONS ARE BASED ON GROUNDWATER DATA COLLECTED OCTOBER 2022

HECLA KENO HILL

FIGURE 5-9
KENO CITY OCTOBER 2022 GROUNDWATER LEVEL CONTOUR MAP

JANUARY 2023

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(Last edited by: amalishevska;2023-01-31/08:10 AM)

4.3.4 Lightning Creek

In June 2018, a monitoring well (KV-109) was installed between Lightning Creek and the Flame & Moth mine site, to meet Clause 108 (c) of Water License QZ09-92-2. KV-109 was subsequently pump-tested in July 2018 by a two-hour step-test. A best-estimate hydraulic conductivity of 1.3 x 10^{-4} cm/s was calculated for the well by relating flow rates to drawdown. In 2023, KV-109 was noted to be damaged and was subsequently decommissioned and replaced with KV-109A during a 2023 drilling program. Figure 4-13 presents groundwater level elevations for KV-109 and KV-109A.

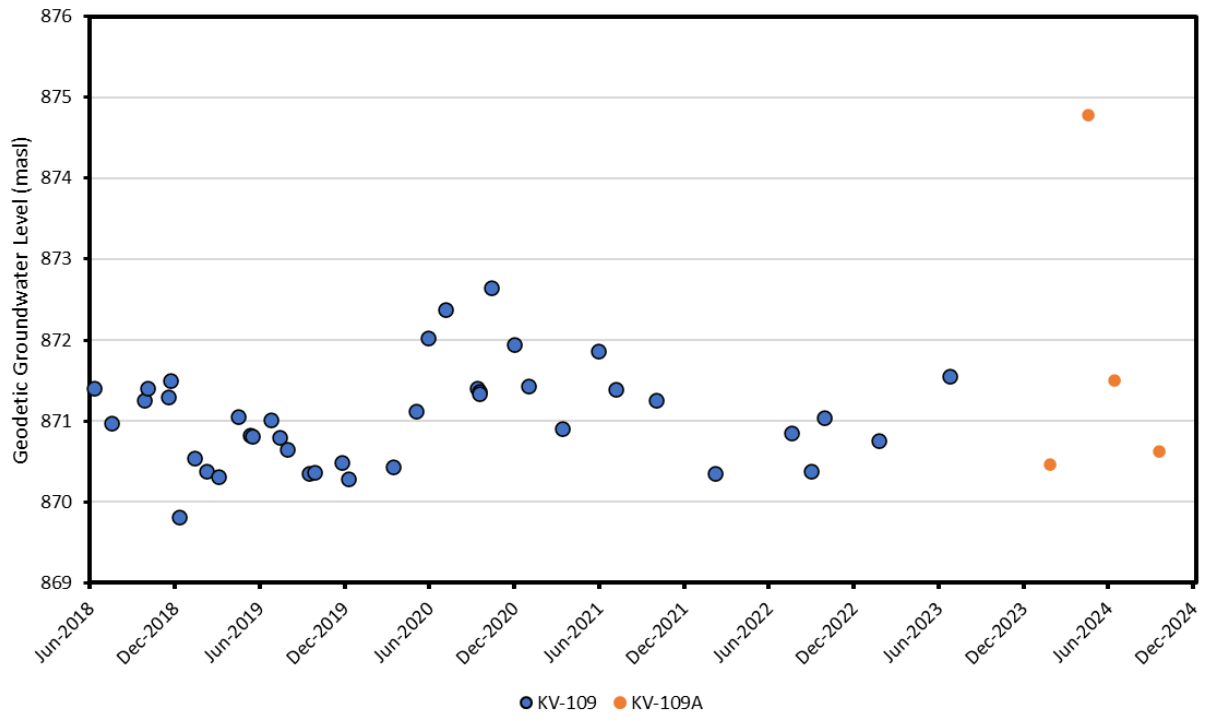


Figure 4-13: Lightning Creek Groundwater Levels

4.4 GROUNDWATER QUALITY

The groundwater monitoring well network (Table 4-1) is monitored for groundwater levels in addition to groundwater chemistry, with data available since 2010. Generally, the presence and behaviour of the parameters monitored within the KHSD wells are related to:

- The occurrence of natural mineralization in the subsurface; and
- Differences in the prevailing local geochemical regime of the groundwater (e.g., reducing conditions).

Within KHSD, observed elevated concentrations of indicator parameters cadmium and zinc are expected to be controlled by the local mineralization. Sphalerite is the primary source of zinc and cadmium in KHSD waters. As such, both elements showed a correspondence with dissolved sulphate such that elevated levels of dissolved zinc and cadmium typically coincided with high dissolved sulphate concentrations.

As discussed in Section 3.2, contaminants of concern (COCs) flagged for the project sites were cadmium and zinc, which form the focus of the groundwater quality review. Groundwater quality results are evaluated by catchment in Section 4.4.1 to 4.4.4, with the groundwater quality results assessed in relation to the Yukon Contaminated Sites Regulation (YCSR) standards for aquatic life.

4.4.1 No Cash Creek

Dissolved cadmium and zinc concentrations in monitoring wells KV-116, NC-MW-1 and RB-MW-1 are presented in Figure 4-14 and Figure 4-15, respectively. Dissolved cadmium concentrations in the No Cash monitoring wells were generally below the Yukon Contaminated Sites Regulation standards for aquatic life (YCSR-AL) (0.0006 mg/L), expect for two occasions in RB-MW-1, 0.00073 mg/L in July 2015 and 0.00083 mg/L in May 2018, and KV-116 exceeded the YCSR-AL standard in May 2024 with 0.00101 mg/L. KV-116 shows an increasing trend in dissolved cadmium, with the well noted to be installed downgradient of the New Bermingham N-AML waste rock disposal area and the water treatment discharge location. NC-MW-1 was consistently below the YCSR-AL standard for cadmium. All samples collected from the monitoring wells were below the YSCR-AL standard for zinc (1.5 mg/L).

Adit discharge from both the historical Bermingham 200 and Ruby adits are documented to infiltrate within a few hundred metres of their respective adit portals; however, there is no evidence that groundwater impacts water quality in No Cash Creek, upstream of the No Cash 500 adit. Indeed, No Cash Creek water sampled at station KV-111 located immediately upstream of the No Cash 500 adit typically has relatively low concentrations of cadmium (median 0.000063 mg/L) and zinc (0.016 mg/L), suggesting that any groundwater metal loading contribution to the upstream reach of No Cash Creek is minimal. Furthermore, extensive natural attenuation of cadmium and zinc concentrations has been documented by monitoring studies in No Cash Creek (ITL, 2013; Kwong et al., 1994; 1997), indicating that any nominal groundwater metal load would likely be sequestered along the reach of No Cash Creek by natural attenuation processes.

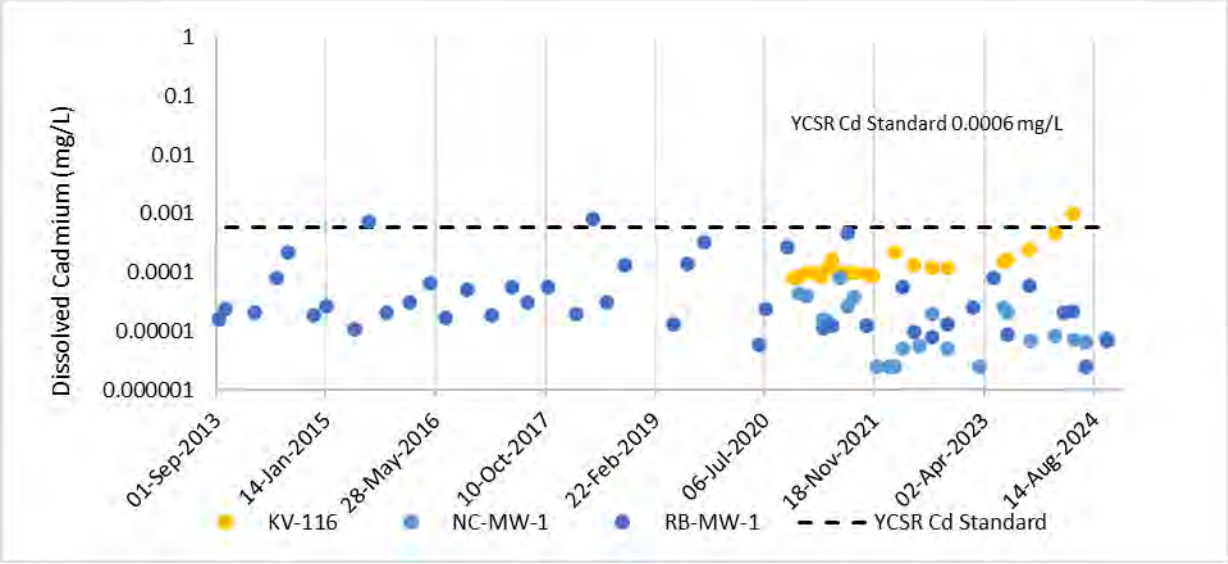


Figure 4-14: Dissolved Cadmium in No Cash Creek Catchment Wells

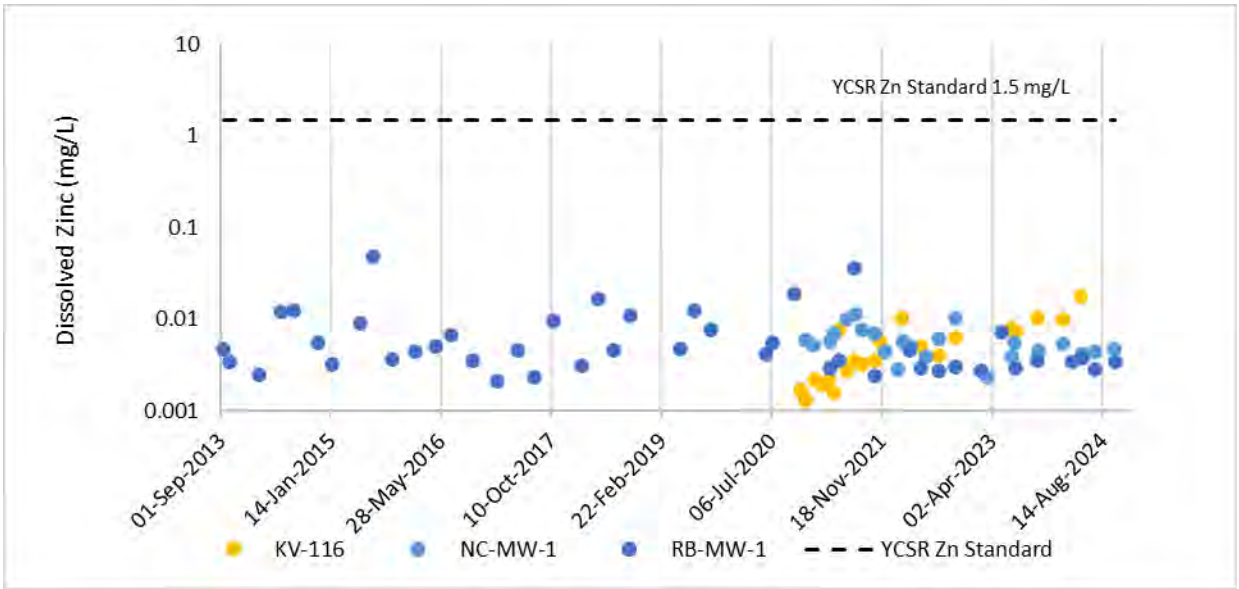


Figure 4-15: Dissolved Zinc in No Cash Creek Catchment Wells

4.4.2 New Bermingham

A series of New Bermingham monitoring wells were installed in November 2020 to collect baseline information on groundwater conditions, as well as information on the potential impacts of the groundwater quality upgradient and downgradient of the historic Bermingham Southwest open pit, and New Bermingham P-AML (potentially acid generating/metal leaching) waste rock storage facility. The monitoring wells installed in November of 2020 include KV-122 through KV-127, with all six New Bermingham wells completed in bedrock. WL QZ18-044 Clauses 82 and 83 require a comparison of groundwater quality with YCSR-AL. P-AML waste rock has been placed in the New Bermingham P-AML waste rock storage facilities since October 22, 2021; water treatment sludge has been placed in the historical Bermingham South West open pit throughout 2021. Analytical results from November 2020 to January 2021 monitoring events can be assumed to provide reference conditions for this area prior to KHSD Mining Operations.

BH-MW-1 has been monitored since 2013 and was installed at the historical Bermingham adit portal. BH-MW-1 has not had sufficient water to collect a sample since October 2017 due to water level drawdown as the New Bermingham mine has advanced. Prior to October 2017 there were no exceedances of dissolved zinc relative to the YCSR-AL, and only one exceedance for dissolved cadmium in June 2014 (0.00052 mg/L).

Monitoring well KV-123 was consistently elevated compared to the YCSR-AL standard for dissolved cadmium (0.0005 mg/L), and exhibited the highest dissolved cadmium concentrations of the Bermingham monitoring wells (median 0.013 mg/L; Figure 4-16). In 2021, KV-122, KV-125, KV-126, and KV-127 had one to two excursions above the YCSR-AL standard, while in 2022 only two excursions were found, both at KV-125 (located downgradient of the New Bermingham P AML waste rock storage facility). KV-124 exhibited the lowest concentrations of dissolved cadmium with a median concentration of 0.000019 mg/L. Monitoring wells KV-122 and KV-123 (downgradient of Bermingham Southwest pit), and KV-124 (upgradient of Bermingham Southwest pit), exhibited relatively stable concentrations of dissolved cadmium. Two monitoring wells located downgradient of the rock storage facility and underground mine workings, KV-125 and KV-126, exhibited marked variability of dissolved cadmium concentrations.

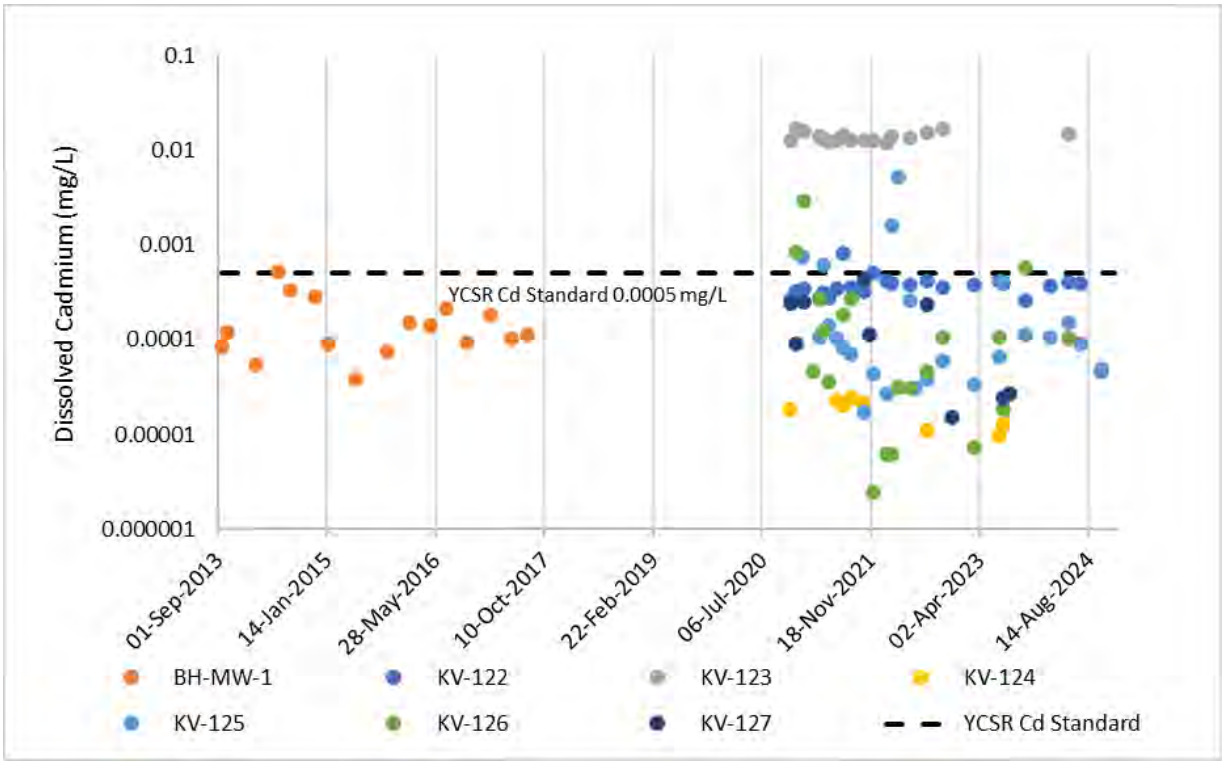


Figure 4-16: Dissolved Cadmium in Bermingham Groundwater Monitoring Wells

Monitoring well KV-123 exhibited the highest dissolved zinc concentrations of the Bermingham monitoring wells (median 1.15 mg/L) and was the only well that consistently exceeded the YCSR-AL standard (0.7 mg/L; Figure 4-17. All other Bermingham monitoring wells were consistently below the YCSR-AL standard, with KV-124 exhibiting the lowest dissolved zinc concentration of the Bermingham monitoring wells (median concentration of 0.0012 mg/L).

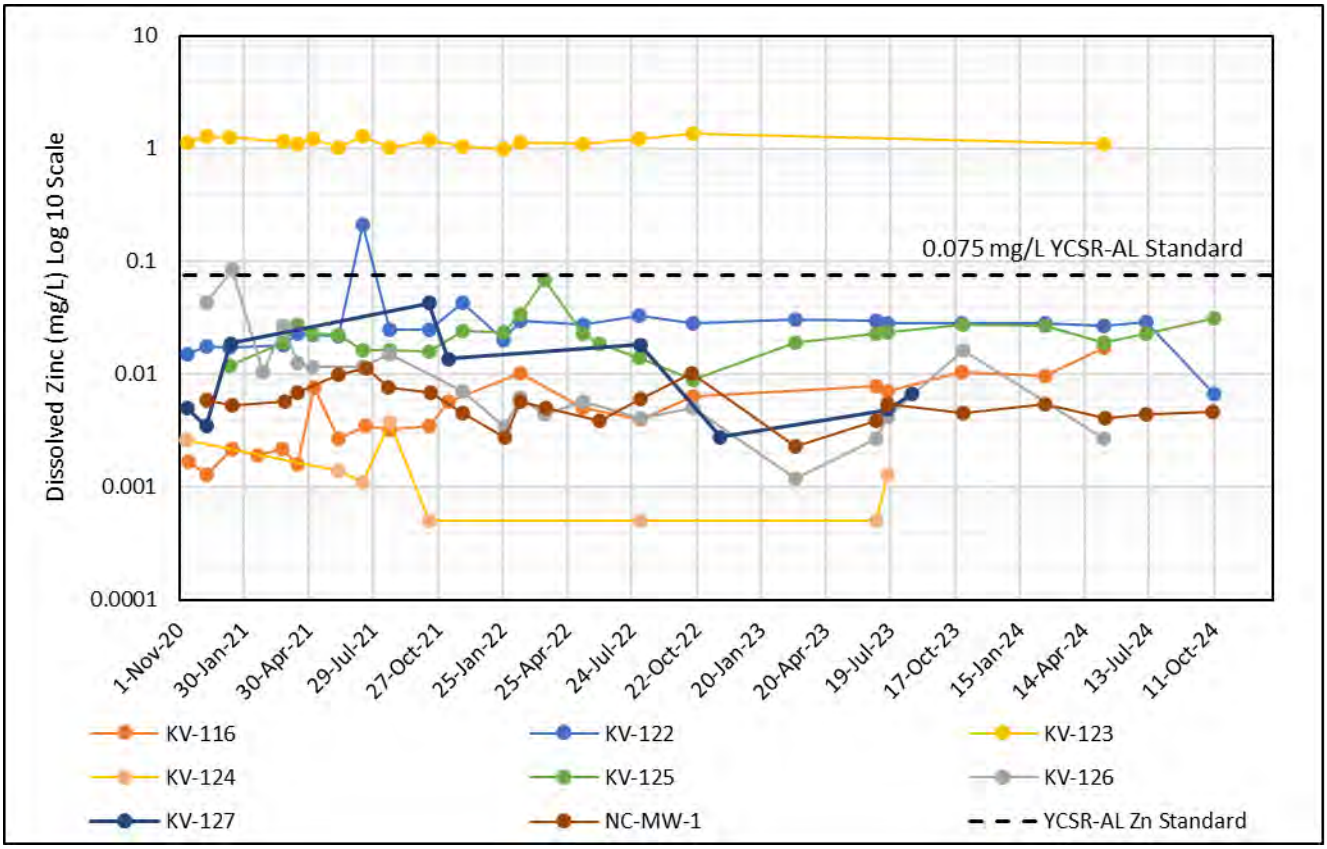


Figure 4-17: Dissolved Zinc in Bermingham Groundwater Monitoring Wells

4.4.3 Christal Creek

Figure 4-18 to Figure 4-21 presents the dissolved cadmium and zinc concentrations, respectively, for the bedrock wells in the Christal Creek catchment. The wells were separated into Christal Creek wells located near the District Mill (FM-MW-1, FM-MW-2, FM-MW-3, KV-103, KV-108, KV-85D, KV-86, KV-87, KV-87N, KV-88D, and KV-89D) and wells located near Keno City (KV-84ND, KC-MW-4, and ON-MW-2).

The deep groundwater boreholes in the District Mill (FM-MW-1, FM-MW-2, and FM-MW-3) were sampled following airlifting in 2013. In 2013 the dissolved zinc concentrations in the deep groundwater wells ranged from 0.0026 mg/L to 0.014 mg/L, all below the YCSR-AL standard (2.40 mg/L), and the dissolved cadmium concentrations were below the detection limit (<0.000010 mg/L to <0.000020 mg/L). Dissolved metals concentrations in the deep wells were generally lower than those measured in the shallower groundwater wells around the District Mill. It is therefore anticipated that groundwater encountered during the development of the Flame & Moth will not contain significant metals concentrations. The deep groundwater boreholes are not currently monitored for groundwater quality as monitoring of groundwater levels in these wells is solely specified in WL QZ18-044 . Monitoring well KV-87 was not monitored past May 2018; however, in December of 2020 monitoring well KV-87N was added to the program to continue the data collection at this location.

Monitoring wells near the District Mill have not exceeded the YCSR-Al standard for dissolved zinc (2.40 mg/L) with monitoring wells near Keno City displaying similar trends, except for ON-MW-2 which consistently demonstrated elevated concentrations of dissolved zinc (median of 2.15 mg/L). ON-MW-2 exceeded the YCSR-Al standard for dissolved zinc on four occasions: in February 2018 (2.57 mg/L), May 2019 (2.91 mg/L), February 2022 (2.51 mg/L), and February 2024 (2.43 mg/L). Dissolved zinc concentrations were higher in the Keno City wells compared to the deep Flame & Moth wells.

Prior to 2015, monitoring wells near the District Mill were found to exceed the YCSR-Al standard for dissolved cadmium (0.0006 mg/L) consistently (Figure 4-18). Since 2015, dissolved cadmium has been exceeded three times, KV-89D in July 2015 (0.0010 mg/L), KV-86 in October 2019 (0.00080 mg/L), and KV-87N in July 2024 (0.00061 mg/L).

Monitoring wells near Keno City were found to be below the YCSR-AL standard for cadmium (0.0006 mg/L) except for the following exceedances: ON-MW-2 had an exceedance in October 2021 (0.00092 mg/L), KV-84ND in June 27, 2014 (0.00062), and KC-MW-4 consistently exceeded the YCSR-AL standard for dissolved cadmium the years it was sampled (2011 to 2014).

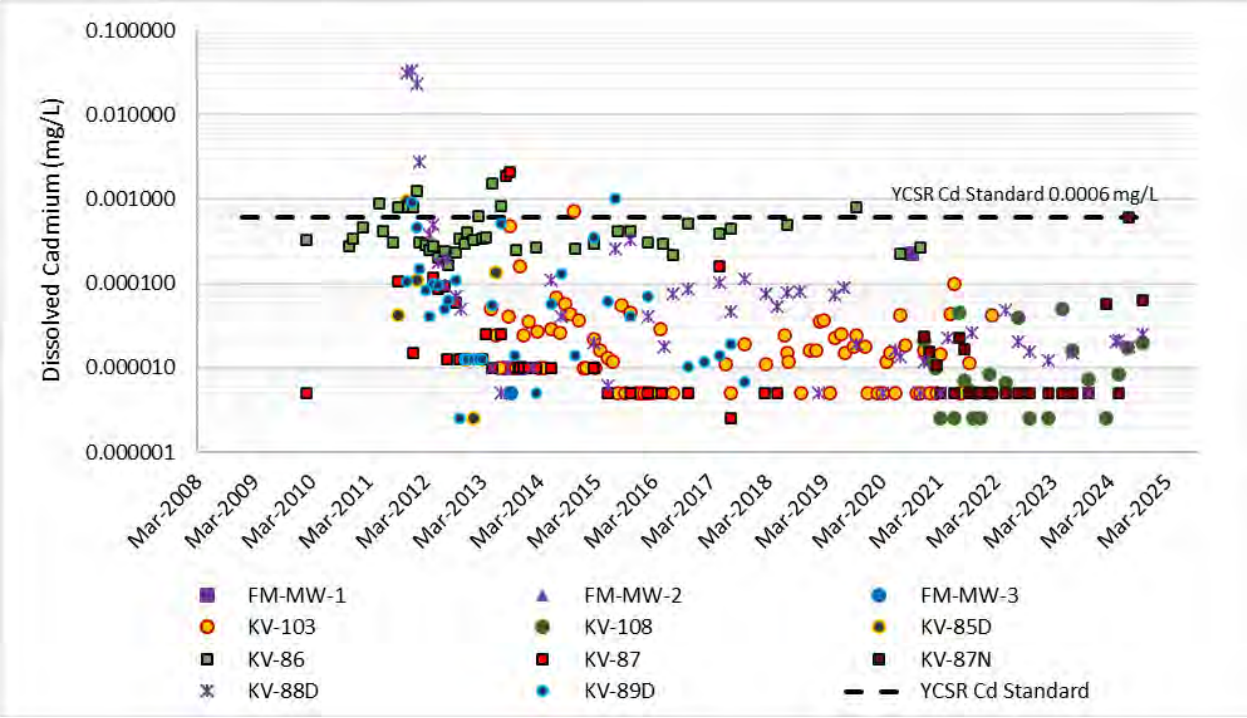


Figure 4-18: Dissolved Cadmium in Christal Creek Wells near the District Mill

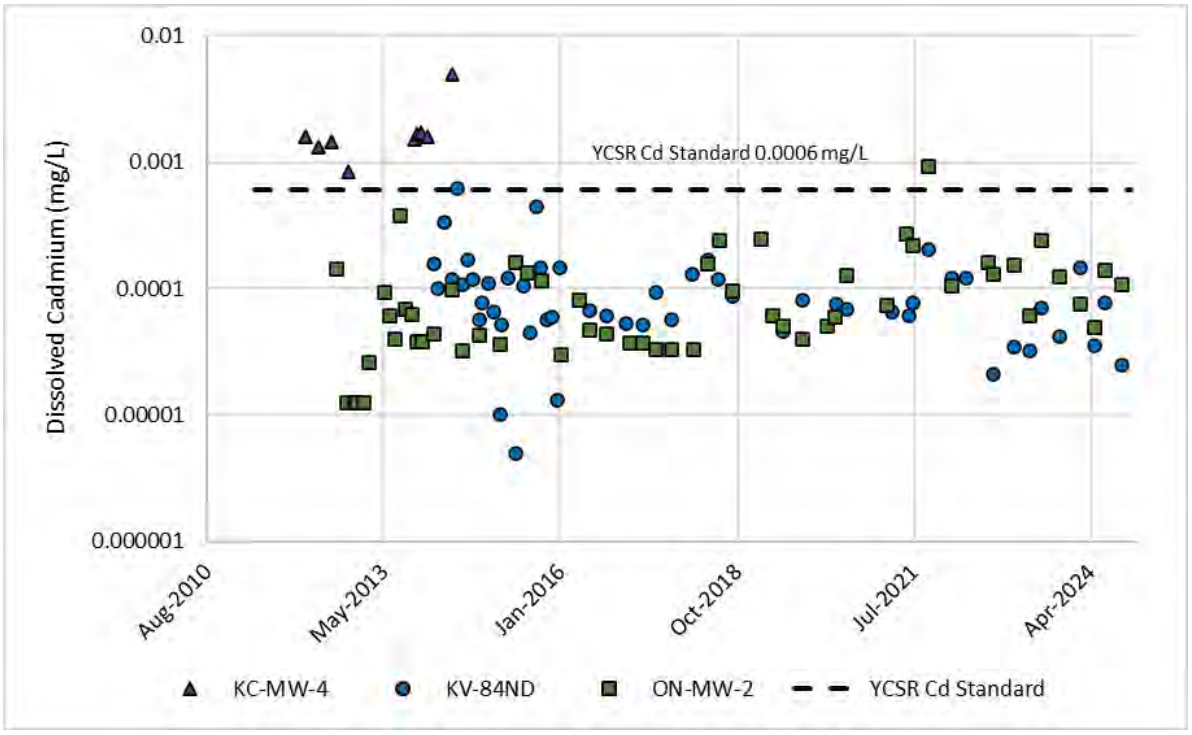


Figure 4-19: Dissolved Cadmium in Christal Creek Wells near Keno City

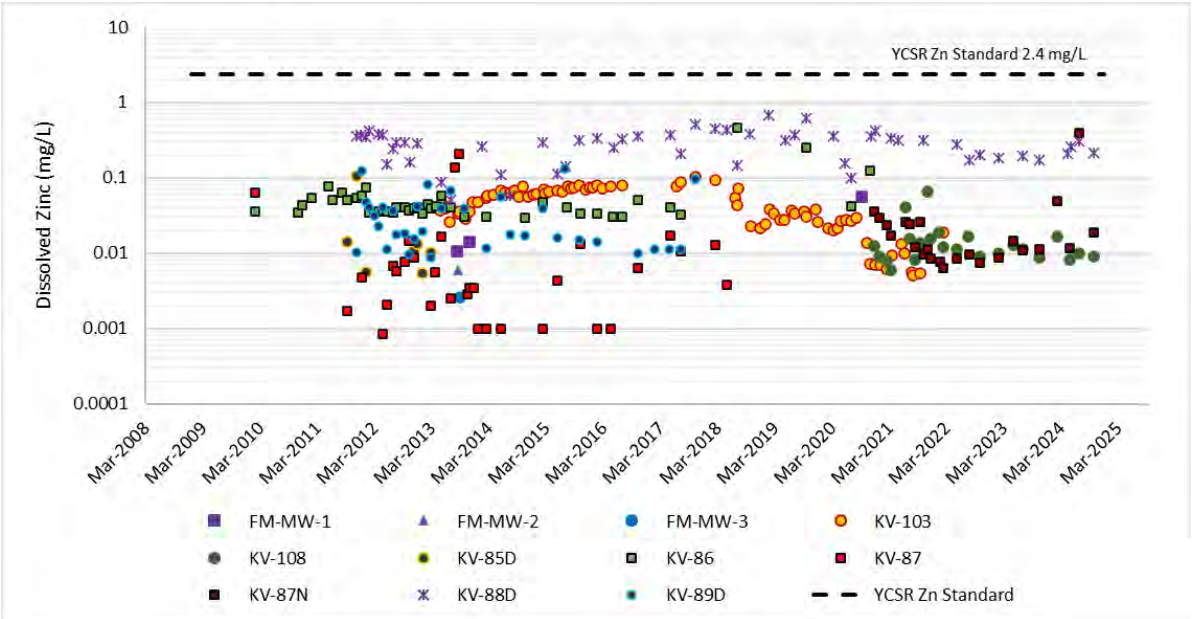


Figure 4-20: Dissolved Zinc in Christal Creek Wells near the District Mill

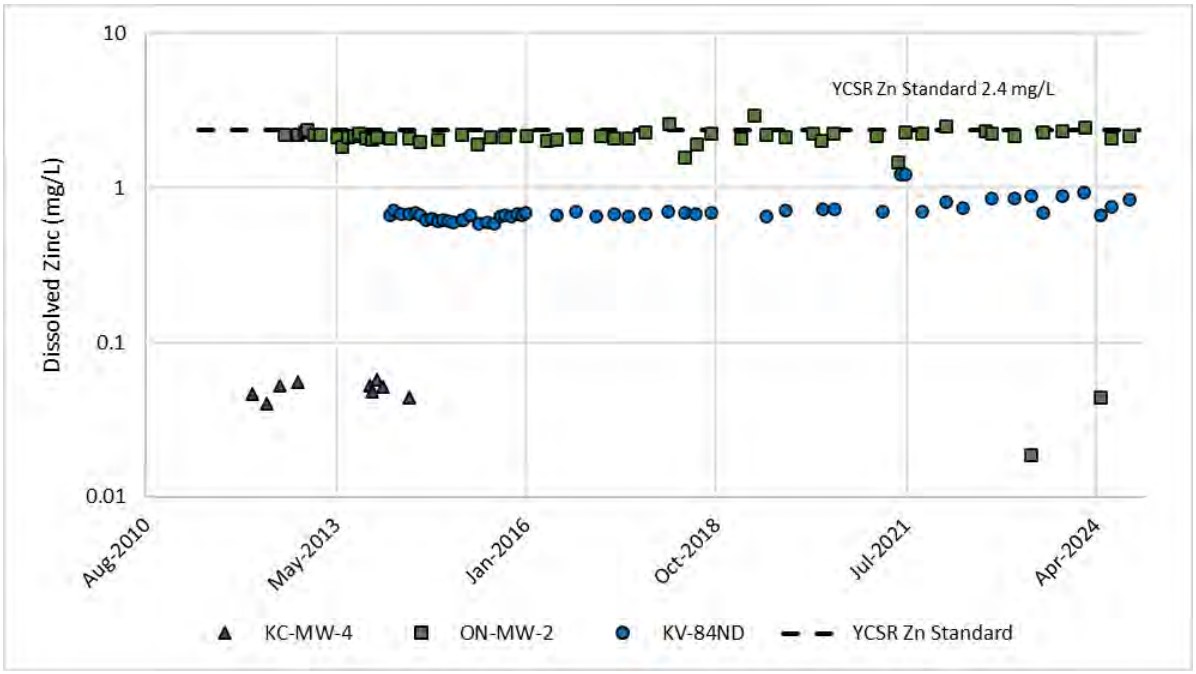


Figure 4-21: Dissolved Zinc in Christal Creek Wells near Keno City

4.4.4 Lightning Creek

Following development of the KV-109 monitoring well on June 8, 2018, water quality samples were collected to characterize groundwater chemistry. KV-109 was damaged in October 2023 and thus could not be sampled in the winter sampling event in 2023. KV-109 was replaced in December 2023 with KV-109A, which was sampled for the first time in 2024.

For the Lightning Creek monitoring wells, dissolved cadmium and dissolved zinc were consistently below the YCSR-AL standards, 0.0006 mg/L and 2.4 mg/L, respectively. For KV-109, the concentration of dissolved cadmium ranged from below detection limit (0.000005 mg/L) to 0.000095 mg/L, and dissolved zinc ranged from 0.017 to 0.039 mg/L, as shown in Figure 4-22 and Figure 4-23, respectively. For KV-109A, the concentration of dissolved cadmium ranged from 0.000069 to 0.00016 mg/L, and dissolved zinc ranged from 0.012 to 0.026 mg/L.

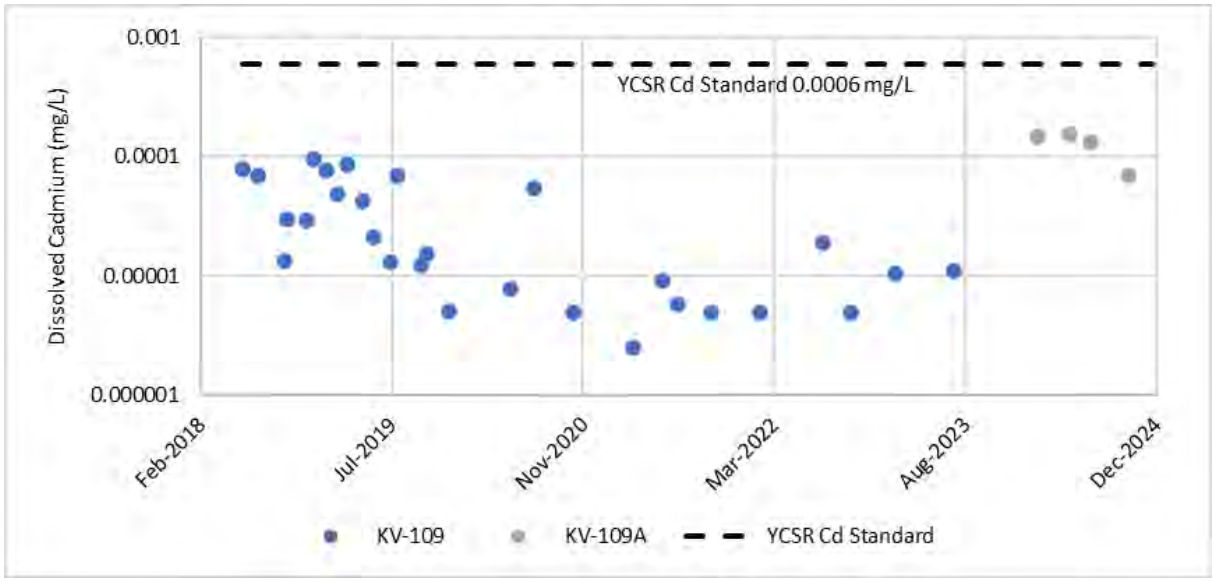


Figure 4-22: Dissolved Cadmium in Lightning Creek Catchment Wells

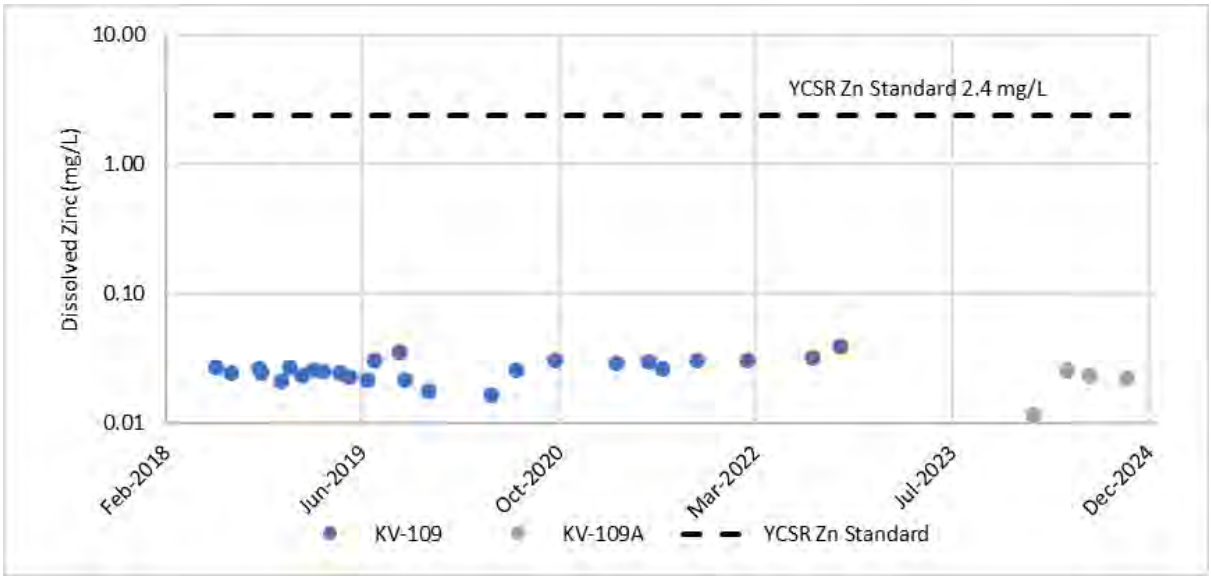


Figure 4-23: Dissolved Zinc in Lightning Creek Catchment Wells

5 GEOLOGY AND SOILS

The Keno Hill mining camp is a polymetallic silver-lead-zinc vein deposit with characteristics similar to mining camps such as the Slocan (southern British Columbia), Coeur d'Alene (Idaho), Freiberg and Harz Mountains (Germany), and Příbram (Czech Republic). Multiple faulting and folding events have shaped the district's geology and mineralogy, which influence the surface and groundwater flow regime.

A complete description of the regional, district and surficial geology has been provided to add insight into structural controls (faults, permeable flowpaths, etc.) on groundwater flow in the alluvial material, bedrock zone, and the surface/groundwater interfaces. Hydrogeology studies and mine histories suggest that groundwater within the district originates from infiltrated meteoric water, which migrates within unconsolidated glacial deposits and through fractures in metamorphic rocks (SRK, 2014).

5.1 REGIONAL DESCRIPTION

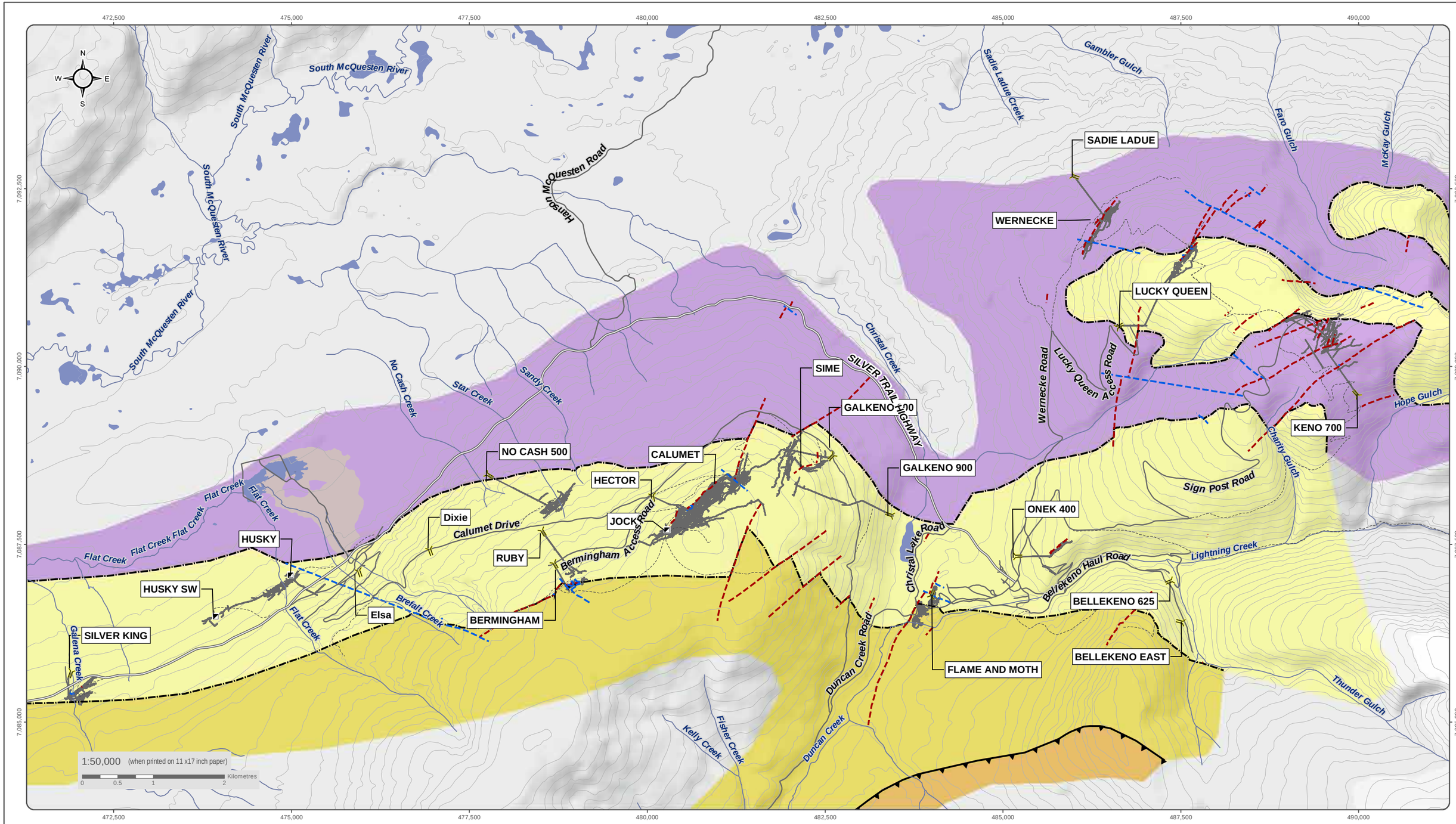
Keno Hill mining camp lies within Selwyn Basin in an area where northwest-trending Robert Service Thrust Sheet and Tombstone Thrust Sheet overlap. The area consists of Upper Proterozoic to Mississippian metasedimentary rocks originally deposited in a marine shelf environment along the northern Cordilleran continental margin. These two regionally extensive thrust faults slice this succession into two thrust sheets (Figure 5-1).

The Robert Service Thrust Sheet, lying south of Keno Hill, consists of an Upper Proterozoic to Cambrian, dominantly coarse-grained, quartz-rich turbidity sequence of the Yusezyu Formation. The underlying Tombstone Thrust Sheet consists of Devonian phyllite, felsic meta-tuff, meta-clastic rock and minor limestone composing the Earn Group that underlies the Mississippian Keno Hill Quartzite Formation. Murphy (1997) included a sequence of sericite, chlorite-sericite and graphite schists, gritty (quartz) schist, quartz meta-grit and limestone overlying the quartzite forming an expanded Keno Hill Quartzite Formation. Because of the economic importance of the quartzite and to distinguish it from other quartzites, Read et al., (2020 and 2021) subdivided the formation into a Basal Quartzite Member and the overlying rocks into the Sourdough Hill Member.

Deformed and metamorphosed mid-Triassic sills, consisting of greenstone, meta-gabbro and meta-diorite, intrude rocks of the Earn Group and the Basal Quartzite member. Although the voluminous undeformed late Cretaceous granitic intrusions of the Tombstone suite (92 to 94 ma) are present outside Keno Hill mining camp, within the camp, the subjacent intrusions and exposed aplite sills/dykes are related to gold and probably silver mineralization. Additionally, these mineral occurrences include the elements, tungsten, copper, lead, zinc, antimony and arsenic.

The thrust sheets consist of isoclinally deformed chlorite zone metamorphic rocks with the first phase of isoclinal folding and attendant metamorphism happening during the Cretaceous in the 100 to 110 ma interval. Based on 40Ar/39Ar dating of phlogopite and muscovite, the later brittle deformation and mineralization started as early as 89 ma.

After development of the thrust sheets, the earliest phase of brittle deformation produced the vein-faults which host the veins. These are left-lateral oblique-slip normal faults with apparent left-lateral movements of up to 500 m. Post-mineralization faulting results from right-lateral oblique-slip normal faults with apparent right-lateral displacements of up to nearly 1000 m.



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Datum: NAD 83; Map Projection: UTM Zone 8N

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- Adit
- Shaft
- Post-Mineral Fault
- Pre-Mineral Fault
- Main Stratigraphic Break
- Robert Service Thrust Fault
- Underground_Workings_Dissolved
- Keno Hill Basal Quartzite Member
- Earn Group
- Keno Hill Sourdough Hill Member
- Hyland Group
- Silver Trail Highway
- Other Road
- Limited-Use Road

HECLA KENO HILL

FIGURE 5-1
KHSD GEOLOGICAL FORMATIONS AND FAULTS

FEBRUARY 2023

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5.2 PROPERTY GEOLOGY

In the 1950's McTaggart (1960) developed a stratigraphic framework for the mining camp and recognized widespread isoclinal folding. Boyle (1965) studied the mechanism of vein development, realized that they are in faults and detailed their mineralogy and geochemistry. In the 1990's, Murphy (1997) recognized the presence of Robert Service Thrust and Tombstone Thrust, emphasized the widespread extent of the isoclinal folding discovered by McTaggart and extended the stratigraphy of the Keno Hill Quartzite Formation to include rocks up to base of the Robert Service Thrust. In 2007, Alexco initiated the digital recording of United Keno Hill Mines' 70 years of surface and underground geology mapping and drilling and production data. Together with additional surface geology mapping this resulted in the publication of a new geology map of the mining camp at 1:25000-scale based on mapping at 1:5000- and 1:1000-scales (Read et al., 2020) and a preliminary publication providing a detailed stratigraphy of the mining camp, episodes of folding, mechanisms for the development of vein-faults and some radiometric age dating placing limits on the age of mineralization (Read et al., 2021).

Lying between Tombstone Thrust and the overlying Robert Service Thrust is an undetermined thickness of the Devonian metasedimentary Earn Group with an uppermost chlorite-sericite schist developed from a felsic meta-tuff. Probably conformable overlying this is the Mississippian Keno Hill Quartzite consisting of two members. The Basal Quartzite Member is dominantly a thick- to thin-bedded, locally calcareous quartzite, with minor intercalated graphite and sericite schists that all together attain a combined thickness of up to 1100 m. As we shall see, the presence of schist intervals plays an important role in vein development. A succession of graphite and sericite schists, called the "marker schists", is typically up to 60 m thick and heralds the start of the Sourdough Hill Member. Overlying this is a succession, up to 250 m thick, known as the "upper quartzite" composed of medium to dark grey quartzite with interbedded thin graphite schist intervals that yield a characteristic platy weathering debris. Among the overlying metasedimentary rocks of the Sourdough Hill Member, gritty quartz schists and quartz meta-grits can be easily confused with similar rocks of the Yusezyu Formation.

The Earn Group and Basal Quartzite Member host Middle Triassic greenstone sills, of which some retain a diabase texture. They are up to 100 m in thickness, and they, along with the host rocks, have been deformed and metamorphosed to the chlorite zone of the greenschist facies. Despite the intense deformation, one of these sills has been traced for 8 km from Bellekeno to Bermingham. The first phase of isoclinal folding and attendant regional metamorphism to the chlorite zone of the greenschist facies is approximated as occurring in the interval of 110 to 100 ma. Aplite and quartz eye porphyry, that are compositionally and temporally related to the Tombstone Suite of intrusions, form two undeformed and unmetamorphosed dikes that acutely cross the foliation of the host rocks and extend for several kilometres. Two U/Pb zircon dates from an aplite dike on the eastern edge of the map area yield 93.5 ± 1.2 and 93.6 ± 1.4 ma (Tupper and Bennett (2010), which give a minimum age for regional deformation and metamorphism. A single minette lamprophyre dike intersects the Formo vein-fault and shows hydrothermal alteration at its intersections. Phlogopite from an unaltered portion of the dike yields a 40Ar/39Ar date of 89.02 ± 0.28 ma giving the oldest age for mineralization. This is in agreement with the oldest 40Ar/39Ar date of 88.8 ± 1.1 ma of coarse muscovite from the Mackeno vein.

Three phases of folding and associated mesoscopic folds are present. The isoclinal early phase consists of isoclinal folds of uncertain orientation that may be associated with soft sediment deformation rather than tectonism. The first phase mesoscopic folds, assuredly associated with the regional isoclinal folding, outline northerly overturned sub-horizontally plunging folds with an axial-plane foliation that dips gently to moderately (25 to 35°) southeasterly on the west side of the mining camp, southerly in the central portion and

southwesterly on the east side of the mining camp. From south to north, Keno Hill exposes two northward overturned isoclinal anticlines filled by rocks of the Earn Group with each anticline separated by a northward overturned syncline core by the Basal Quartzite Member (Figure 5-1). McTaggart (1960) thought that the first phase of folding formed tectonically dismembered fold hinges torn apart along the isoclinal fold limbs. However, detailed mapping on Keno Hill and elsewhere indicates continuity of the macroscopic folds on the tectonically attenuated fold limbs. Second phase folds are chevron style, have subvertical axial planes and plunge moderately south-southeasterly. In the mining camp, it develops only on microscopic and mesoscopic scales, but southeast of the camp it generates macroscopic scale folds. On the microscopic scale, strained minerals, particularly bent mica flakes, indicate that this phase of folding developed after the metamorphic peak.

Of the phases of faulting, the first three are the most important. Although not dated, the Robert Service and Tombstone thrusts are post-metamorphic with associated brecciated and gouged wall rocks. Just northeast of the Robert Service thrust, a klippe composed of Yusezyu schist has the first phase foliation of the schist outlining the upright, open synformal shape of the base of the klippe (Figure 5-1). The gently warped attitude of the first phase foliation in the klippe negates the possibility that the klippe results from first phase folding but rather it must be later and associated with the thrust event.

The fault system hosting the veins is known as the vein-fault system (Boyle, 1965). There are two major mechanisms for generating open space for vein deposition. Boyle noted that the differing rock strength or competence of rocks, such as quartzite and graphitic schist or greenstone and schist would change the angle at which a fault would transect rocks of differing competency with a shallower dip associated with weak rocks and a steeper dip associated with strong rocks (Figure 5-2). This change in dip angle, termed “refraction” results in a stepped, non-planar fault surface with open spaces distributed along the fault surface where the adjacent rock walls are strong and a lack of space where adjacent rock walls are weak. Boyle also noted that there are two sets of vein-faults. A more easterly trending or longitudinal set closer to the strike of the foliation in the wall rocks and a more northerly striking or transverse set at a higher angle to strike of the foliation in the wall rocks. Read et al., (2021) observed this in the vein-fault deposits at the top of Keno Hill and in the major deposits at Hector Calumet and Bermingham where the economic veins preferentially developed in the transverse vein orientation (Figure 5-3). They attributed this selective vein-fault development to synchronous vein-fault movement on both sets with the movement vector lying in the plane of the 3 to 10 time longer strike length of the longitudinal set compared to the transverse set and the oblique normal movement direction plunging at a shallower angle than the line of intersection between the longitudinal and transverse sets. This selectively generates open space along the transverse vein-fault set and yields an apparent left-lateral separation across the longitudinal vein-fault, which is consistent with field observations. Apparent left-lateral separations are up to 500 m along the vein faults.

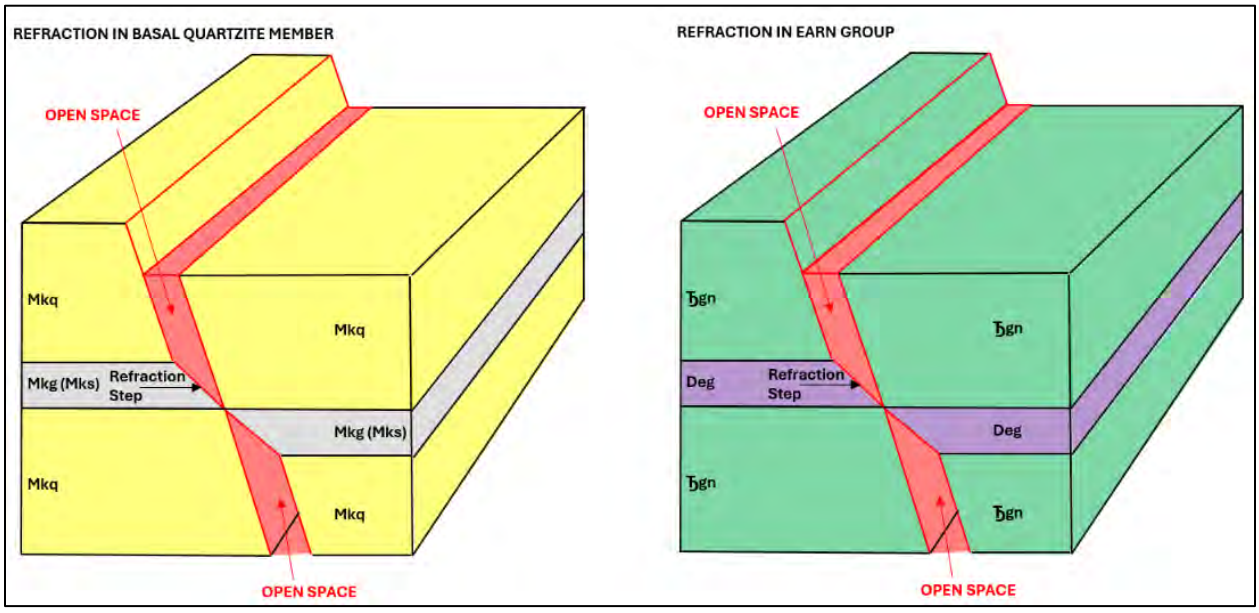


Figure 5-2: Vein-fault refraction creating open space across competency contrasts

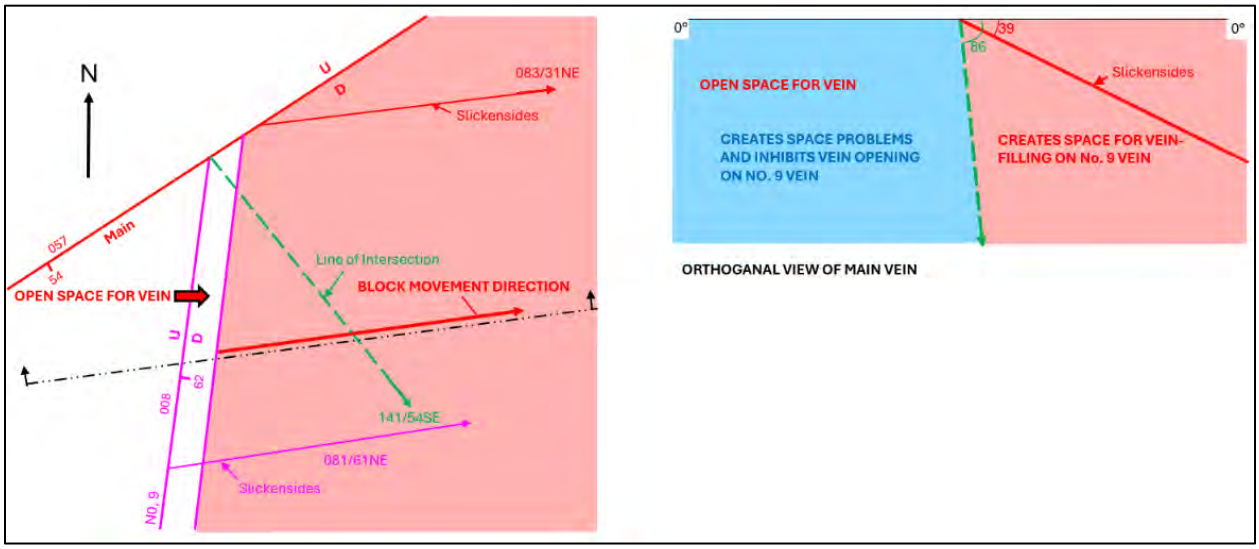


Figure 5-3: Plan view showing selective open space generation at Main-No. 9 vein-fault intersection

In most of the mining camp, post-vein faulting is northwesterly striking with moderate to steep southwesterly dips and has right-lateral oblique-slip normal displacement. However, at the southwest end of the camp the strike veers to almost westerly. These are the widespread post-vein cross faults. More difficult to detect are the less common parallel post-vein faults. These exist where cross faults that offset rock units and some vein faults come to a major vein-fault but do not cross it. The most outstanding example is the post-vein Calumet, Hector and Jock faults which terminate on the western side of the McLeod vein fault without offsetting it (Figure 5-1). These cross faults, particularly Jock fault, significantly offset greenstone sills. A second example is Flame vein fault where Hinton Creek cross fault at its northwest end does not offset McLeod vein-fault and extends to its southeastern end where it does not cross Flame vein yet in between it crosses and offsets Moth vein-fault. This geometry results from the synchronous movement along the line of intersection of the cross and parallel post-

vein faults. Underground measurements of slickensides on the parallel fault along the footwall of Flame vein yield measurements that are likely close to the line of intersection of the parallel and cross faults involved. The post-vein cross faults can form breccia and gouge zones that may exceed 15 m in thickness and cause mining problems, and the parallel faults form weak walls that can affect mining widths.

The mineralization is of the polymetallic silver-lead-zinc vein type that typically exhibits a succession of hydrothermally precipitated minerals. Multiple stages of hydrothermal or fluid boiling, probably related to repeated reactivation and breccia formation along the synchronously moving vein-fault openings, have formed up to 12 stages of distinct mineral assemblages as outlined by Hantelmann (2013) (Figure 5-4). Supergene alteration has modified the original assemblages with much of this zone removed by glaciation. The complexity of 12 stages can be reduced to two by the recognition that the "Early Phase" is characterized by arsenic and the "Late Phase" by antimony. Because logging of the veins relies on mineral textures and the mineral assemblages present, it has successfully captured the difference between the two phases. From an analytical perspective, the basis for the difference between the two phases depends upon the two elements, As and Sb, which have been consistently assayed for starting in 2006. The As/Sb ratio with a value of 1 is the dividing line with values greater than 1 associated with Early Phase and values less than 1 associated with the Late Phase. Silver values principally lie in the antimonial sulphosalts starting with widespread argentiferous tetrahedrite (freibergite) and in order of diminishing importance, pyrargyrite, stephanite, polybasite and acanthite; native silver is rare. The amount of argentiferous galena present is uncertain. Hantelmann's electron microprobe analyses confirm that only the antimony end-members of the sulphosalts are present. The phase distribution of other minerals are summarized in Figure 5-4, which shows that in addition to the above silver-bearing minerals, chalcopyrite and calcite are Late Phase as is most of the galena. Characteristic Early Phase minerals include pyrrhotite, arsenopyrite, cassiterite, and native gold and most of the quartz. Longitudinal and transverse veins host both phases that may form multiple repetitions across a single vein-fault. The important difference is that the transverse vein-fault zones are thicker than those in the longitudinal vein-faults.

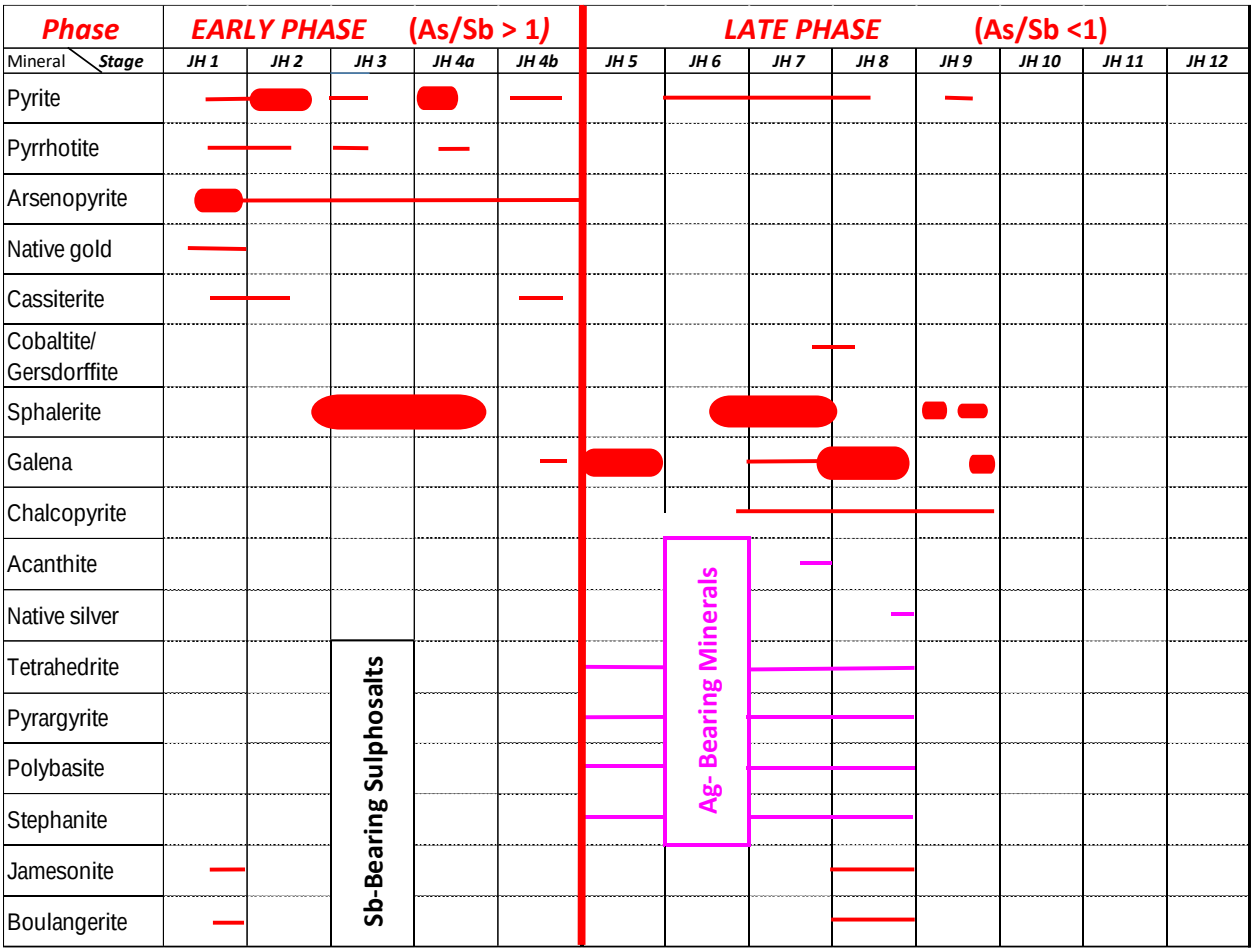


Figure 5-4: Division of Hantelmann's 12 paragenetic stages into Early and Late Phases with resulting mineralogy

5.3 PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The KHSD lies within the northeastern Yukon Plateau and is characterized by mountainous terrain with elevations ranging from 610 masl (McQuesten River valley) to 1,848 masl (summit of Keno Hill). The district has been shaped by several glacial advances, notably the Reid glaciation (approximately 200-300 ka) and the McConnell glaciation (approximately 20 ka) (Lipovsky et al., 2001). The Reid glaciation almost completely covered the KHSD, with the exception of the peaks of Keno Hill. The McConnell glaciation was less extensive, with the peak extent reaching an approximate elevation of 1,100 masl. Less evidence of the Reid glaciation remains around the KHSD compared to the more recent McConnell glaciation. The McConnell glaciation advanced from east to west, flowing onto the McQuesten River valley, while a tongue of this glacier extended between Galena and Keno hills, terminating near Keno City.

This extensive glaciation has defined the KHSD's surficial geology and surficial groundwater flow regime. The valleys are broad, glacially scoured, and typically boggy with thick peat deposits. Widespread discontinuous permafrost dominates the valley floors (Smith et al., 2004). The lower slopes of Galena and Keno Hills contain sand, gravel, and silt deposits, including kames and terraces, deposited from the sides of retreating glaciers and meltwater streams. These till deposits range from 10 m to 50 m thick and are typically present up to 1,100

masl, the extent of the last glaciation. Till deposits throughout the KHSD are striated with lenses dominated by gravel or sand within a silt matrix.

At higher elevations above the last glaciated extents, thin layers of colluviated sediments and soils overlie exposed bedrock along ridge-tops, gulches, and cirques (LeBarge et al., 2002). Freeze-thaw cycles over the past 300,000 years have created frost-shattered bedrock boulder fields running down the higher elevation hillsides of Keno and Galena hills. Upper slopes may be covered with scree material. Treeline occurs at 1,300 masl on northern aspects and up to 1,360 masl on southern aspects.

Surface conditions at the District Mill are influenced by past glacial meltwater activity and consist predominantly of glacial till and glaciofluvial sediments (silt, sand, and gravel) with glaciofluvial channeling. Massive ground ice, weathered bedrock, and competent bedrock are evident in places (Tetra Tech, 2025c).

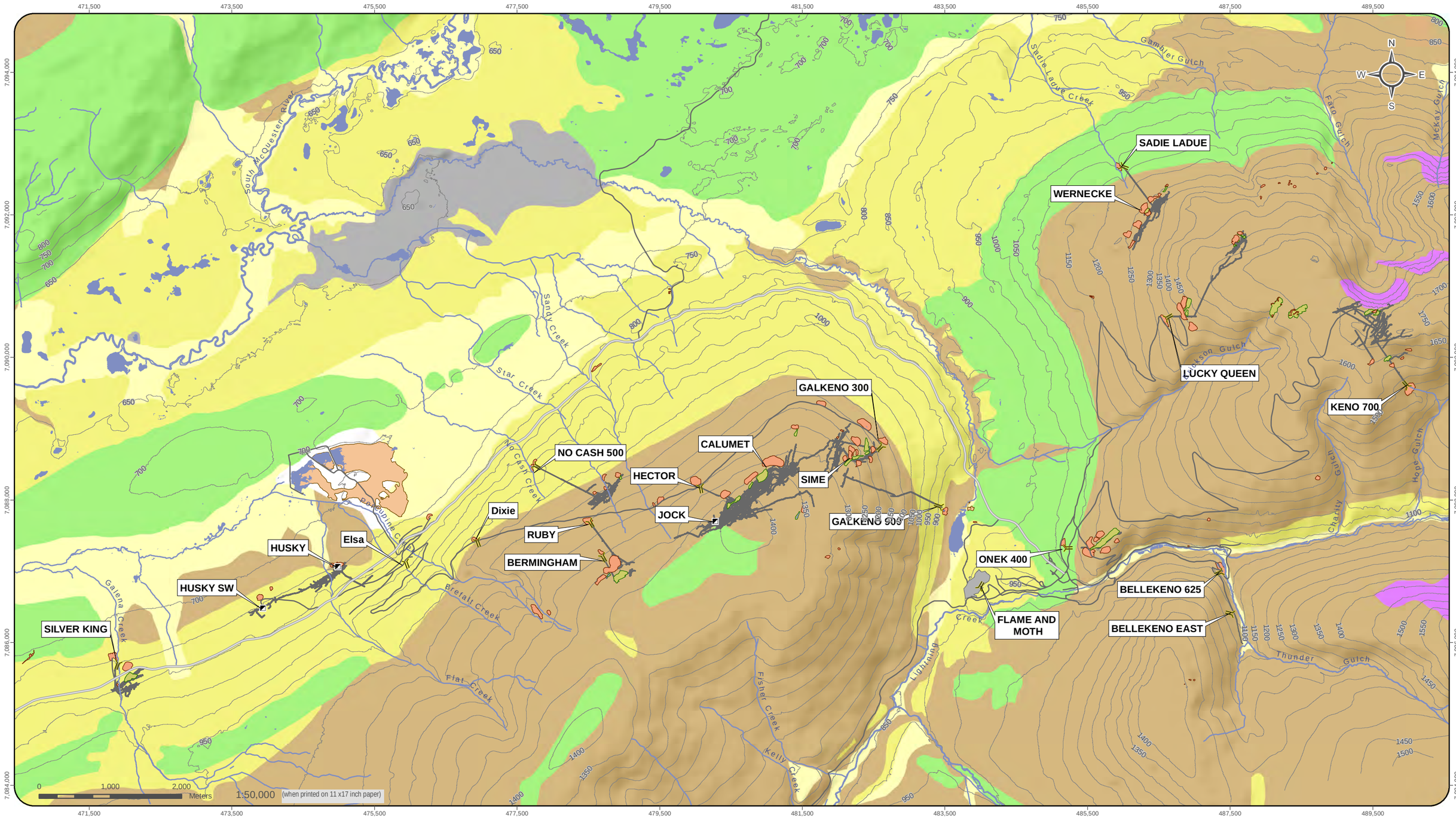
Except for a few localized areas, soils are not strongly weathered or deeply leached. They exhibit poor profile development, particularly where underlain by permafrost. Soils in the area can be classified into two types: (1) residual and (2) muck peat/half bog. Residual soils formed principally from weathering of various bedrock types or, as evident in some places, from decomposition of till predating the last glaciation.

A map of the surficial geology of the KHSD is provided in Figure 5-5.

Galena Hill trends northeast between Duncan Creek and the McQuesten River valley. It has an elevation of 1,444 masl, a moderately steep southwestern slope, and steeper north, northwestern, and southeastern slopes. The terrain above 1,310 masl is relatively flat and rolling, marked by several level grassy meadows. The north, northwestern, and southeastern slopes are crossed by several streams that have cut steep gulches into the rock strata. The principal streams responsible for these gulches are Galena, Flat, Brefalt, and Sandy Creeks and Porcupine Gulch on the northwestern slope, and Hinton and Fisher Creeks on the eastern and southeastern slopes.

Keno Hill and Sourdough Hill are adjacent hills separated by Lightning Creek. Sourdough Hill lies southwest of Keno Hill and trends north between Thunder, Lightning, and Duncan Creeks. The portion of the hill described in this report lies on the northern and northwestern slopes, which are gentle up to 1,280 masl and from there rise abruptly to a steep rocky hogsback that trends southwest to 1,828 masl.

The lower slopes of the hills were severely glaciated during the Pleistocene by ice sheets that spread from the east over the entire area. Glacial till, gravel, and other debris lie in a series of benches on the slopes and floor the valleys. These deposits in the KHSD are generally 1.5 to 6 m thick, but in some areas—such as the southern slope of Keno Hill facing Lightning Creek and north of Christal Lake—they are 9 to 15 m thick or more.



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Datum: NAD 83; Map Projection: UTM Zone 8N

- Anthropogenic
- Colluvium
- Fluvial (Active)
- Fluvial (Glacial)
- Morainal
- Organic
- Bedrock
- Adit
- Shaft
- Underground Workings
- Silver Trail Highway
- Secondary Road
- Contours (50 meter)
- Watercourse
- Waterbody
- District Mill
- Open Pit
- Waste Rock Dump
- Tailings

* Only showing mine sites referenced in document

KENO HILL SILVER DISTRICT
CHARACTERIZATION REPORT

FIGURE 5-5
KHSD SURFICIAL GEOLOGY

APRIL 2016

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5.4 PERMAFROST

Permafrost considerations in reclamation and closure planning are linked to long-term geotechnical stability of the DSTF and WRDA foundations. Design criteria for the DSTF and WRDAs consider the potential for permafrost degradation over time.

Regional permafrost is irregularly distributed, and its occurrence is dependent upon the elevation, hillside exposure, depth of overburden, soil types, amount of vegetative cover, and presence of flowing underground and surface water. At high elevations and on slopes with a northern exposure it is generally present.

The effects of frost action, soil creep, and slope wash are marked on the hills within the district, particularly at the higher elevations. Frost action is responsible for features such as stone rings and stripes, and produces a general 'boiling action' that brings rock float, mineralized float, and soil from deeper layers to the surface. In places where surface and underground water are flowing the permafrost has been thawed out and frost-free windows and strips are present.

In the valley where the Flame & Moth Mine, District Mill and DSTF are located discontinuous permafrost is present. In boreholes within the DSTF Phase 1 footprint, permafrost was encountered at less than 1 m depth and typically extended to about 15 to 20 m depth.

F&M WRSA:

The active layer (i.e., seasonal freeze/thaw) is anticipated to vary locally across the Flame & Moth WRSA site depending on the surficial materials, depth of groundwater, depth of bedrock, and thickness of snow and vegetation cover. It is estimated that the depth of the active layer at the proposed site can range up to 3.0 m below ground surface (EBA 2014); however, this may vary considerably depending on ground conditions.

Following the Program, ground temperature measurements in Boreholes BH25-FMWR-03 and BH25-FMWR-13 indicated the depth of the active layer ranged from 1.2 m to 2.8 m below ground surface, respectively. The active layer may be deeper at other borehole locations where ground temperatures were not measured and frozen soils were logged to the top of permafrost.

The Flame & Moth WRSA is located within a zone of Extensive Discontinuous Permafrost where 50% to 90% of the land area is estimated to be underlain by permafrost (Heginbottom et al. 1995). Ground ice abundance is anticipated to be Low meaning excess ice volume in the top 5 m of permafrost is estimated to be less than 10% (O'Neill et al. 2020).

Ground ice contents ranged from no excess ice content (0%) to solid, massive ice (100%). From the permafrost mapping completed for the Program, 88.5% of the proposed site was mapped as having permafrost present. 85.7% of the proposed site is underlain by ice-rich permafrost with low to medium excess ice content (<10% to 50% excess ice by volume). Massive ground ice (50% to 100% excess ice by volume), ranging in thickness from 10 m to 14 m, was encountered in several boreholes and mapped in the southwestern portion of the proposed site beneath glaciofluvial sediments up to 5 m thick. The small portion of permafrost free ground was mapped on southernly-facing slopes in weathered bedrock, bedrock, and glacial till surficial materials. Depth to the permafrost table was observed during the Program to range from 2.8 m to 10.2 m below ground surface. The depth to the base of the permafrost was observed to be up to 16.8 m below ground surface. Long-term ground temperature monitoring (i.e., greater than two years) would be required to refine these depths to permafrost table and base.

Tetra Tech reviewed and assigned a facility classification of Class I for the Flame & Moth WRSA, per the Guidelines for Mine Waste Management Facilities (YG-EMR 2023). To maintain this classification, ice-rich permafrost soils and massive ground ice will be avoided from within the facility's foundation. Ice-poor permafrost soils under critical elements of the facility's foundation (e.g., lower bench toes) will need to be removed and replaced with thaw-stable materials. The current design includes a 40 m-wide by 2 m-deep subexcavation along the western toe of the facility to remove ice-poor permafrost soils and replace them with mine waste rock.

F&M DSTF Phase 2:

Permafrost was encountered throughout the DSTF Phase 2 footprint. The ground ice contents estimated in the field ranged from non-visible and non-excess to visible. The ice rich permafrost was generally observed in the upper 2.0 m to 4.0 m of original ground. BH22-10 contained the most rice-rich soil with ice contents estimated up to 45% by volume (Tetra Tech, 2024).

Massive ice has been encountered in several boreholes, outside of the DSTF footprint, with thickness ranging between 4 m and 15 m. The active layer near the DSTF Phase I has been observed to be as thin as 200 mm in thickness in some locations, protected by a thick organic cover (EBA, 2011).

New Bermingham WRSA:

Within the Bermingham WRSA footprint, thaw unstable permafrost such as ice-rich or massive ground ice conditions have not been observed and are not anticipated. The area has been stripped of organics, and it is anticipated that the permafrost is thaw stable and is located within the bedrock.

5.5 SEISMICITY

F&M WRSA:

Seismicity is the occurrence or frequency of earthquakes in a region, which is measured based on seismograph recordings of naturally occurring earthquakes. Although it can be observed that seismicity in northern Canada is low, based on the observed lack of strong earthquake motions, the seismic hazard for a given site is independent of the frequency of earthquakes. Seismic hazard is defined by the magnitude and ground motion of an earthquake that is permissible at a given site for a given annual exceedance probability (AEP).

The seismic hazard for the Flame & Moth WRSA can be considered Moderate based on the number of seismic sources (i.e., fault zones) near the Keno Hill Silver District and the facility's subsurface conditions. The peak ground acceleration (PGA) under a potential earthquake at the Flame & Moth WRSA was estimated from the 2020 National Building Code of Canada seismic hazard website (NRC 2020) for Site Designation XD. Both frozen and unfrozen stiff soils are expected in the subsurface for the Flame & Moth WRSA; therefore, Site Designation X_D was deemed appropriate.

The estimated PGA is 0.104 g for a 20% in 50-year AEP (0.004 per annum or 1 in 250-year return) and 0.279 g for a 2% in 50-year AEP (0.000404 per annum or 1 in 2,475-year return) for the proposed Flame & Moth WRSA site.

New Bermingham WRSA:

Seismic loading was modelled using a pseudo-static approach with a design horizontal peak ground acceleration (PGA) of 0.082 g. This is the value estimated from the 2020 National Building Code of Canada seismic hazard model (Kolaj, M., et al. 2020) for a 20% in 50 years probability of exceedance (0.004 per annum or 1 in 250 year return) for Site Designation XC. This coincides with design criteria for a Class 1 facility and would require to be designed using the 1 in 200 year event. Bedrock is shallow to the ground surface and competent bedrock is assumed generally within 3 m of the bedrock surface profile; thus a Site Class C was considered appropriate.

6 GEOCHEMISTRY

6.1 ORE

AKHM has not conducted geochemical testing on ore to assess the potential for acid rock drainage and metal leaching (ARD/ML). This approach is justified because ore and stored in a covered facility until milling occurs, limiting weathering and water contact that would generate ARD/ML. Geochemical testing has instead focused on tailings and waste rock, which may remain exposed to the environment.

6.2 WASTE ROCK

AKHM conducted waste rock geochemical characterization studies throughout the KHSD and specifically within each of the mineralized target zones (i.e., Bellekeno, Onek 990, Lucky Queen, Flame & Moth, and New Bermingham) to understand the weathering behavior and potential for ARD/ML potential related to the rocks. These characterization studies have been ongoing since 2006. The results of these studies for each deposit were provided as appendices to the QZ18-044 Water Use Licence application (AEG, 2019a). An update of the testing conducted as of 2020 was included as an appendix to the Waste Rock Management Plan Revision 6.5 (Ensero, 2021). Results from samples analyzed since 2021 have been included in annual reports filed under WL QZ18-044.

Waste rock generated by the KHSD Mining operations consist of quartzite, schist and greenstone lithological units. The lithological units mapped underground and evaluated in the geochemical dataset are further subdivided as listed in Table 6-1.

Table 6-1: Lithology Code Descriptions

CODE	LITHOLOGY	DESCRIPTION
GNST	Greenstone	Generally massive greyish green to dark green, chlorite - actinolite - calcite sills locally with relict phaneritic texture and sometimes schistose - particularly on margins
GSCH	Graphitic Schist	Graphite must be observed. Grey to dark grey to black schist (phyllite) with graphite as a major constituent, with well developed foliation, comprising > about 80%, with common quartzite bands generally < 1cm thick. A soft, Weak rock that breaks along foliation. Commonly contain plications, wrinkle laminations, small drag folds and crenulations. Most contain irregular masses of quartz as stringers or boudins. A soft, Weak rock that breaks along foliation. Commonly contain plications, wrinkle laminations, small drag folds and crenulations. Most contain irregular masses of quartz as stringers or boudins.
SSCH	Sericite Schist	Light green or mottled greenish yellow fine grained schist (phyllite), commonly with a silvery luster. Commonly show marked schistosity, plications, crenulations and contain numerous stringers, masses and boudins of white quartz. If rock makes up less than 5% of unit the sericite modifier "s" can be used
QTZT	Quartzite	Massive buff, light to medium grey to white or bluish grey, may have a weak schistosity defined by sericite. Some are very fine grained, white and resemble re-crystallized cherts. Bedding may be visible throughout. Some are very fine grained, with a sugary texture and resemble recrystallized cherts. Minor GSCH (to about 5%) is generally present as very narrow bands.
SM	Stringer Mineralization	Zone of stringers (< 1 cm true width) that contain hypogene mineralization (not syngenetic sulphides)
TQTZT	Thin Bedded Quartzite	Grey quartzite bands 5 - >10 cm in thickness, with mud/graphitic schist bands up to about 20%

CODE	LITHOLOGY	DESCRIPTION
ICQS	Interbedded Carbonaceous Quartzite and Schist	Define by it's overall "mud/quartz" content and competency. Highly foliated with very narrow carbonaceous horizons interbedded / intercalated with mm to cm scale quartzite bands. Commonly break across foliation, as well as along it.
BXM	Breccia	Healed breccia cemented with siderite, pyrite, sphalerite, galena, sulphosalts, etc., but no quartz
BXQ	Breccia	Healed breccia cemented by quartz
FLT	Fault Gouge	Fault Gouge
VM	Mineralized Vein	Zone of veins (> 10 cm true width) that contain hypogene mineralization (not syngenetic sulphide), but usually containing quartz, calcite or dolomite.
QTZ	Quartz Vein	Quartz or quartz/carbonate vein not mineralized
SID	Siderite Vein	Siderite Vein

6.2.1 Laboratory Test Program

The samples were collected from exploration drill holes for Bellekeno, Lucky Queen, Onek, Flame & Moth, and New Bermingham, and from development and production underground sampling at Bellekeno, Flame & Moth, and New Bermingham. The laboratory test program included static and kinetic testing by accredited laboratories. The static testing consists of:

- Acid base accounting (ABA) analyses, including:
    - Paste pH.
    - Modified Sobek and/or siderite-corrected neutralization potential (NP) as per Skousen et al. (1997).
    - Total sulphur by Leco.
    - Sulphate sulphur by Leco using a hydrochloric acid leach.
    - Sulphide sulphur by difference, used to calculate acid potential (AP).
    - Total inorganic carbon (TIC) using a hydrochloric acid leach.
- Bulk elemental analysis using aqua regia digestion and inductively coupled plasma mass spectrometry (ICP-MS).
- Shake flask extraction (SFE) testing to evaluate soluble constituents (Price, 2009).

Kinetic testing consists of humidity cells and field leach barrels. Humidity cells tests have been conducted for the following materials:

- Flame & Moth non-acid generating/metal leaching (N-AML) waste rock composite (98 weeks, completed),
- New Bermingham N-AML cover hole waste rock composite HC-01 (57 weeks, completed), and

- New Bermingham N-AML advance exploration hole waste rock composite HC-03 (107 weeks, completed).

In 2025, to meet the requirements of the Waste Rock Management Plan, laboratory kinetic testing was initiated for N-AML waste rock from New Bermingham (four humidity cells) and N-AML waste rock from Flame & Moth (one humidity cell). This test work is ongoing, and an update will be provided in the 2025 annual report.

Field kinetic testing consisted of five field barrels containing N-AML waste rock and potentially acid generating/metal leaching (P-AML) waste rock from the Flame & Moth.

Results from static and kinetic testing of waste rock drill core conducted to support potential expansion of New Bermingham, Flame & Moth, and Lucky Queen was not included in this report.

Table 6-2 lists the number of samples tested per production zone, while Table 6-3 provides a breakdown of number of samples per lithology and per production zone. Further details on the material tested, testing program and interpretation results for each site can be found in Altura (2008) for Bellekeno, ACG (2011a) for Onek, ACG (2011b) for Lucky Queen, ACG (2011c) for Silver King, AEG (2016a) and Ensero (2023) for Flame & Moth, and AEG (2019) and Ensero (2023) for New Bermingham.

Table 6-2: Number of ARD/ML Samples per ARD/ML Test and per Production Zone

MINE	ARD/ML TEST				
	ACID BASE ACCOUNTING	ELEMENTAL ANALYSIS	SHAKE FLASK EXTRACTION	HUMIDITY CELL	FIELD BIN
Bellekeno	216	483	12	-	-
Onek	50	50	17	-	-
Lucky Queen	24	24	-	-	-
Flame & Moth	131	224	94	1	5
New Bermingham	484	1184	113	2	-
Total	**905**	**1965**	**236**	**3**	**5**

ARD/ML – acid rock drainage and metal leaching

Table 6-3: Lithologies Sampled for ARD/ML Characterization per Keno Hill Silver District Production Zones

PRODUCTION ZONE	LITHOLOGY (NUMBER OF SAMPLES)									TOTAL
	GNST	GSCH	QTZT	SSCH	TQZT	ICQS	CQTZT	CHSCH	CSCH	
Bellekeno	12	13	12	11	0	0	12	1	0	61
Onek	4	14	17	8	0	0	0	1	0	44
Lucky Queen	0	2	13	0	9	0	0	0	0	24
Flame & Moth	1	18	135	22	16	9	10	6	1	73
New Bermingham	23	144	647	8	102	137	16	2	0	1079
Total	**40**	**191**	**689**	**49**	**127**	**146**	**28**	**10**	**1**	**1281**

ARD/ML – acid rock drainage and metal leaching

6.2.2 Results

6.2.2.1 Acid Base Accounting

ABA is used to quantify the acid potential (AP) and neutralization potential (NP) of rock samples and to determine the ratio of their potentially acid producing and potentially acid consuming minerals. This provides an indication of the potential of geologic materials to generate acid in the long-term. The potential for acid potential was assessed using the MEND criteria (Price, 2009). Based on these criteria, three categories of potential for acid generation can be defined based on the NP/AP ratio (or neutralization potential ratio; NPR):

Samples are classified as potentially acid generating (PAG) if NPR<1;

Samples are capable of acid generation but with some uncertainty if 1≤NPR≤2; and,

Samples are classified as not potentially acid generating (non-PAG) if NPR>2.

Figure 6-1 presents NP values versus AP values for KHSD waste rock samples. NP values were plotted versus AP values for each major lithology and production zone in Figure 6-2 to Figure 6-6.

Most waste rock samples collected from (potential) production zones from the KHSD had low potential for acid generation (i.e., NPR>2). The majority of the samples from Lucky Queen, Onek, Flame & Moth, New Bermingham, and Bellekeno had low potential for acid generation (58%, 73%, 75%, 51%, and 79% of samples, respectively). Overall, the waste rock from the easternmost deposits (e.g., Bellekeno, Onek, and Flame & Moth) tended to have higher NP than waste rock from the deposits located in the western portion of the KHSD (i.e., New Bermingham), consistent with ABA characterization of historical KHSD waste rock (SRK, 2009). Approximately 27% and 22% of the samples collected from New Bermingham were classified as PAG and Uncertain, respectively, due to combination of low NP and AP. Onek also had a few PAG samples (16%); however, unlike New Bermingham, these generally had high AP and NP.

Analyzed based by major lithology, the QTZT, TQTZT, and GSCH samples broadly reflected the general NPR sample distribution, consistent with the numerical dominance of these lithologies. The GNST and SSCH samples were predominantly non-PAG (Figure 6-2 to Figure 6-6).

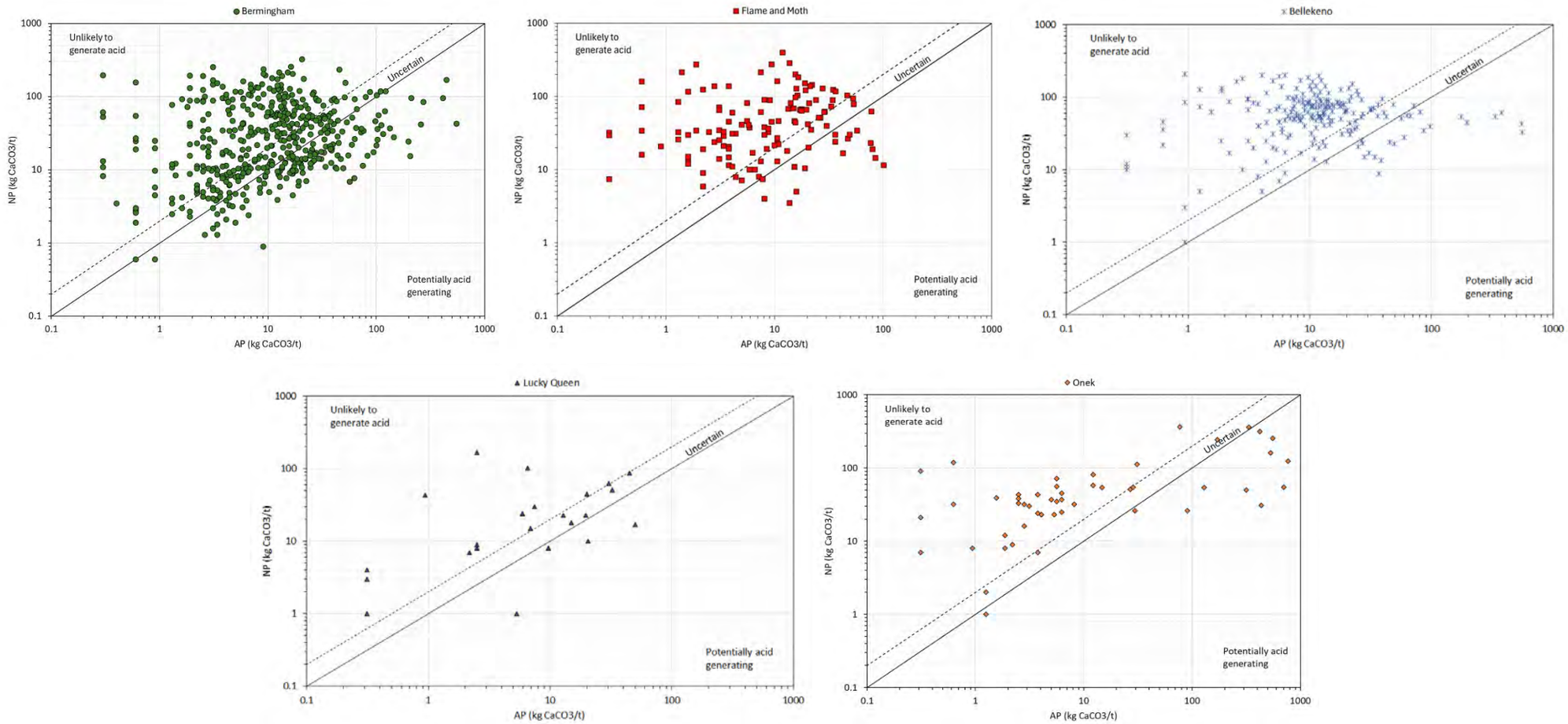


Figure 6-1: Variability in NP and AP of Waste Rock Samples from New Bermingham, Flame & Moth, Bellekeno, Lucky Queen, and Onek

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

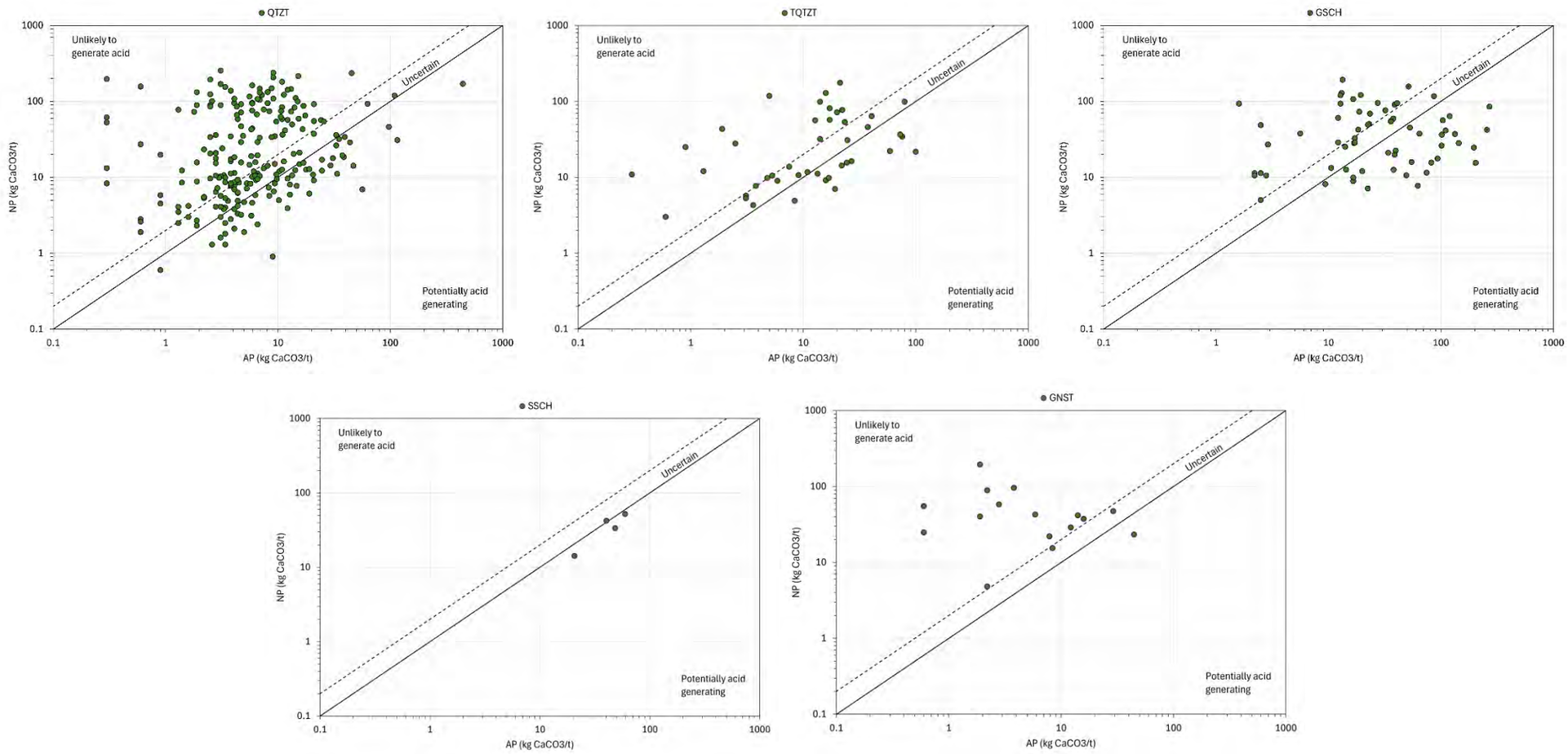


Figure 6-2: Variability in NP and AP of QTZT, TQTZT, GSCH, SSCH, and GNST Lithology Waste Rock Samples from New Bermingham

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

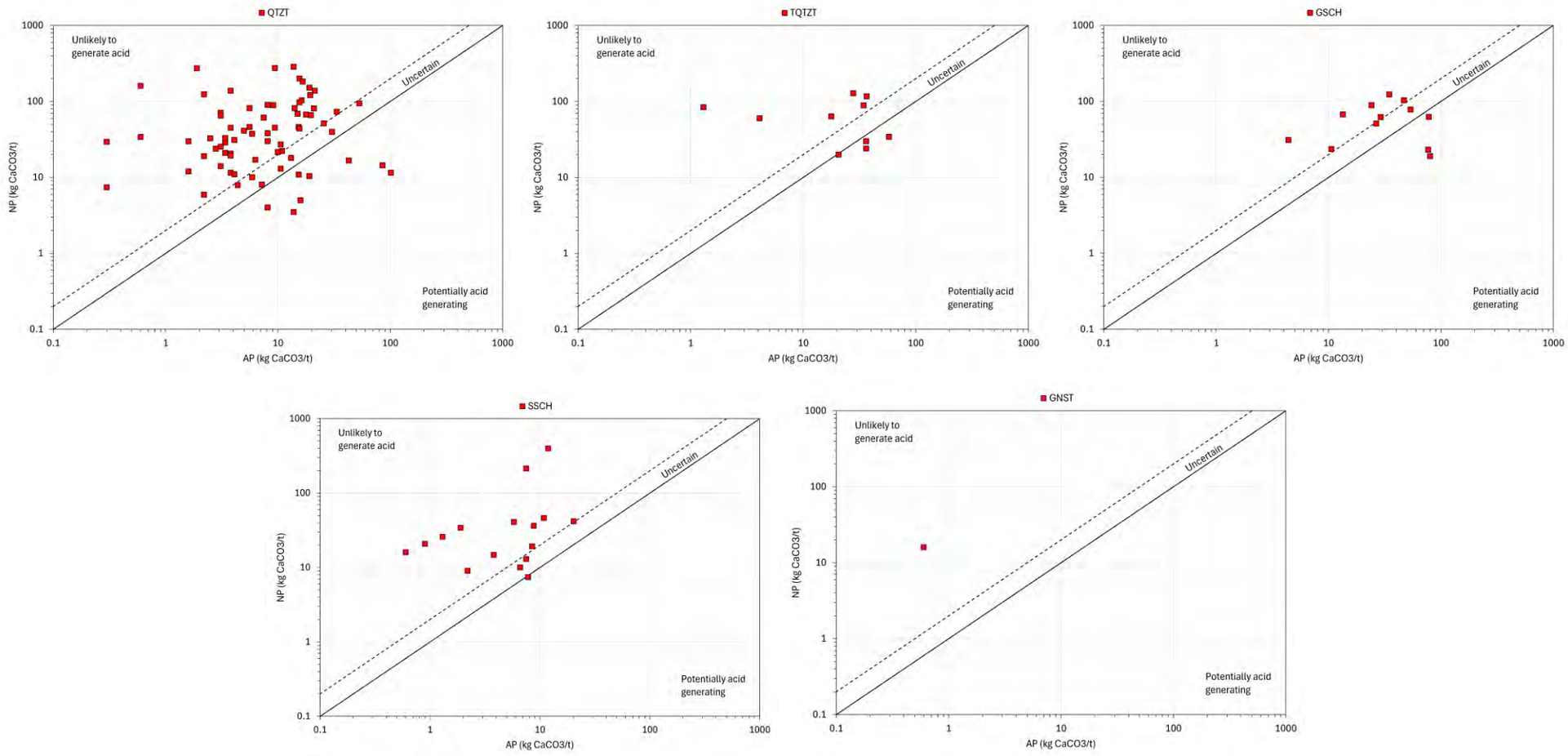


Figure 6-3:Variability in NP and AP of QTZT, TQTZT, GSCH, SSCH, and GNST Lithology Waste Rock Samples from Flame and Moth

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

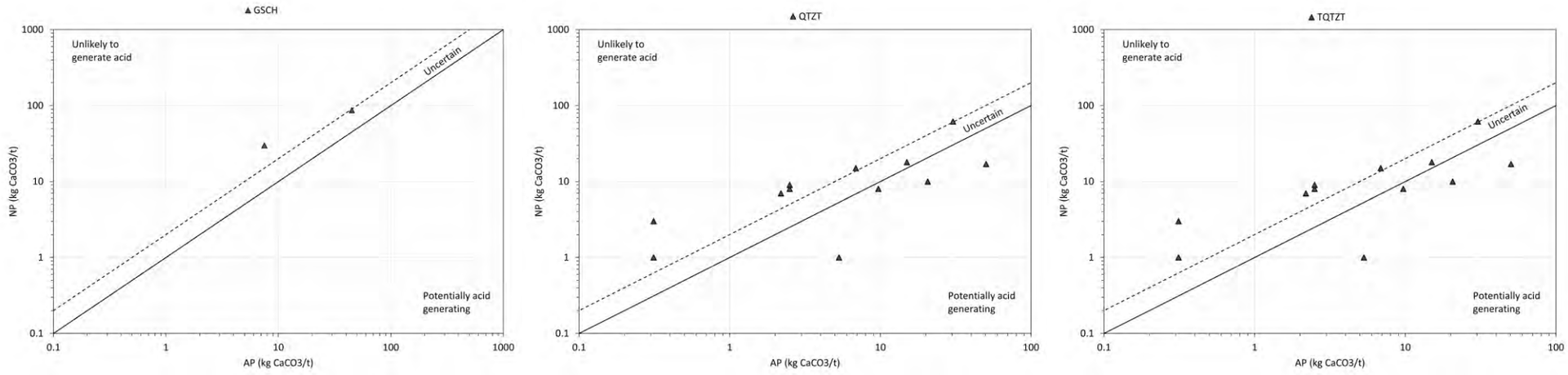


Figure 6-4: Variability in NP and AP of QTZT, TQTZT, and GSCH Lithology Waste Rock Samples from Lucky Queen

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

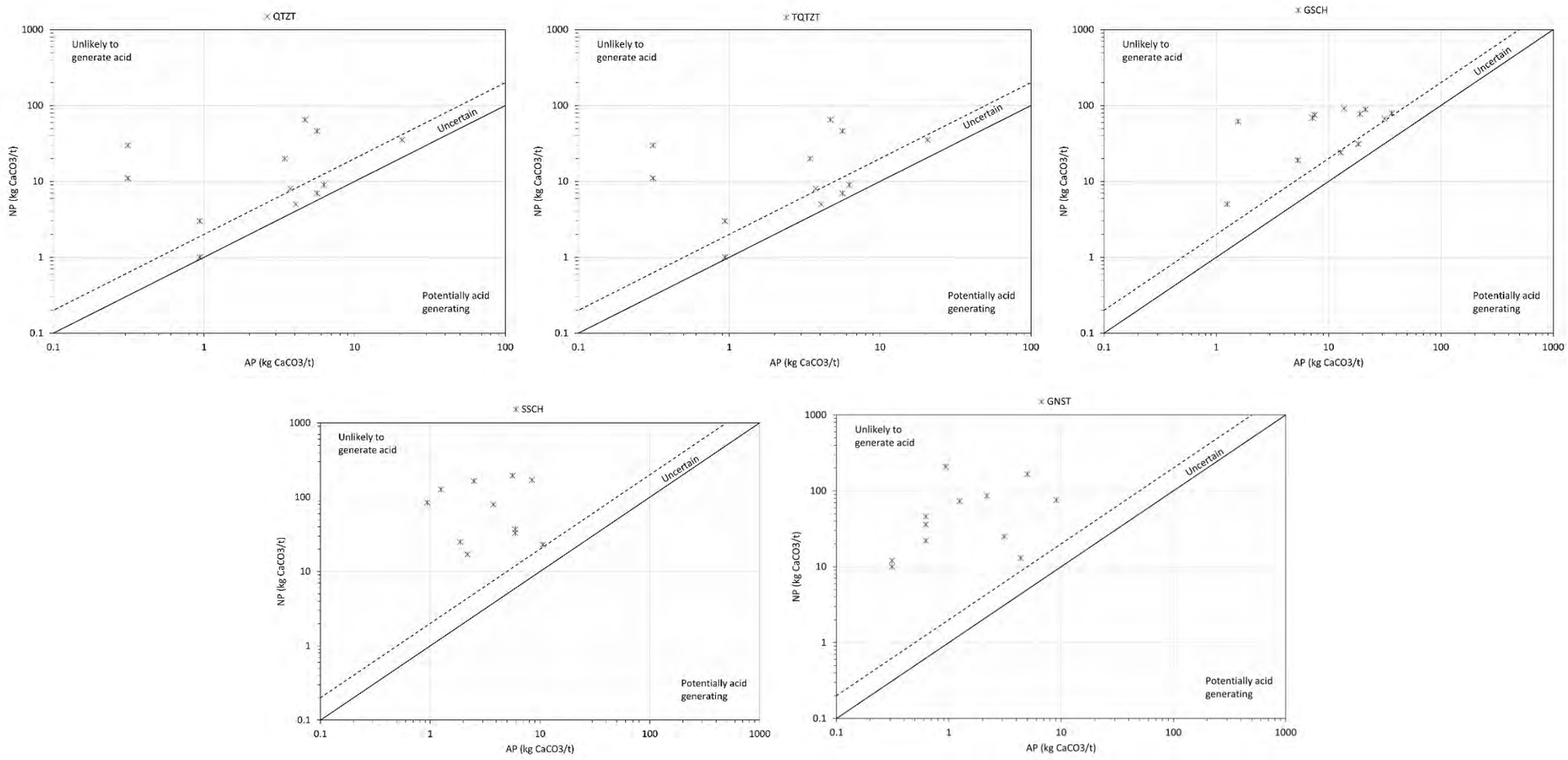


Figure 6-5: Variability in NP and AP of QTZT, TQTZT, GSCH, SSCH, and GNST Lithology Waste Rock Samples from Bellekeno

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

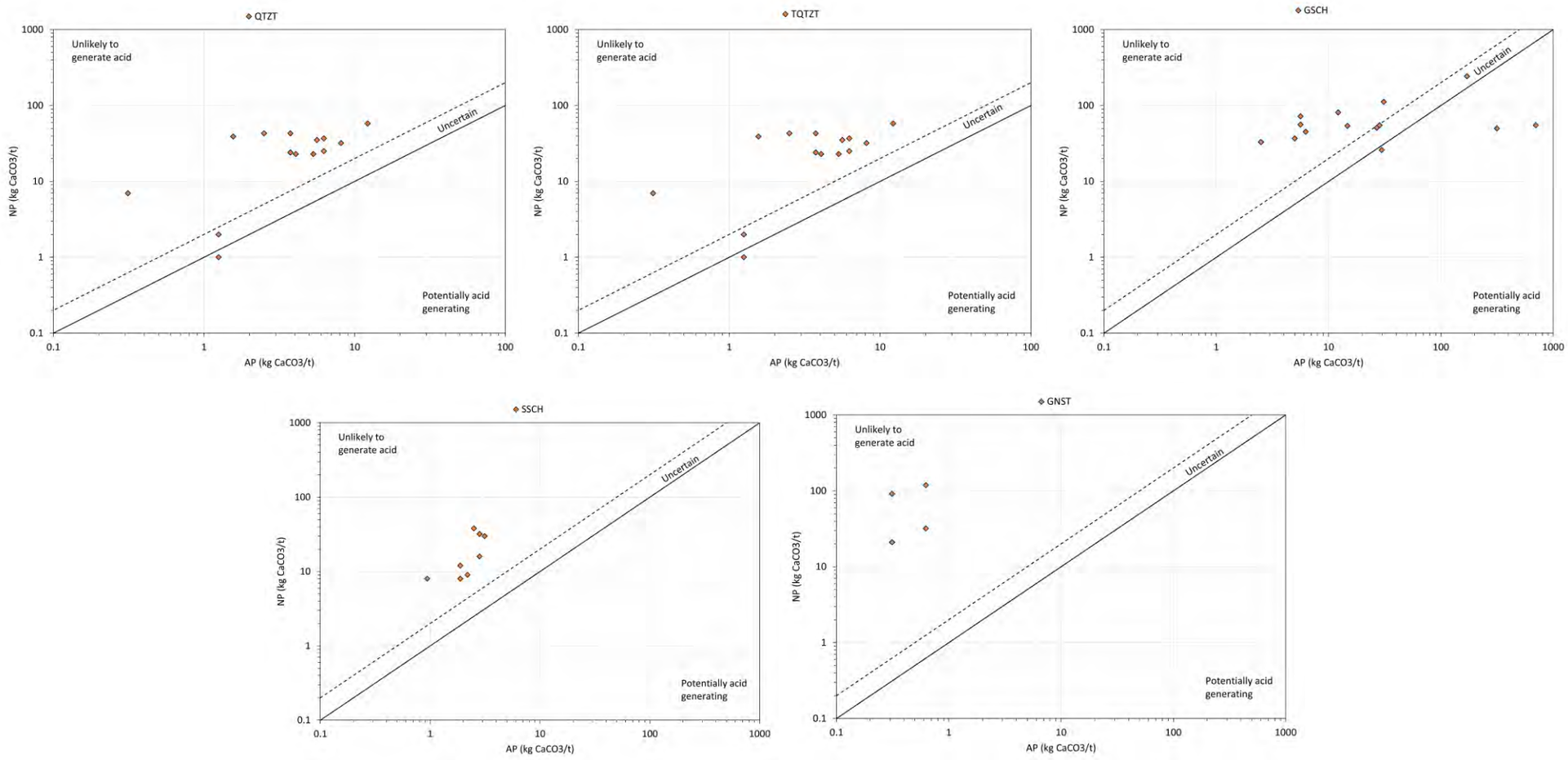


Figure 6-6: Variability in NP and AP of QTZT, TQTZT, GSCH, SSCH, and GNST Lithology Waste Rock Samples from Onek

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

6.2.2.2 Elemental Chemistry

The bulk concentration of an element is not a direct measure of how mobile an element may be during weathering because a multitude of factors (e.g., hydrology, climate, pH, redox conditions, presence of complexing ligands) ultimately affect the mobility and bioavailability of an element. However, the bulk concentration provides a preliminary indication of constituents that are elevated in the rock samples and which may result in high leachate concentrations.

The results of the bulk elemental analysis were compared to 10 times (10x) the average crustal abundance to assess whether the waste rock from KHSD Mining Operations deposits is enriched or depleted compared to the crustal average (CRC, 2005). Bulk content of antimony, arsenic, selenium, silver, cadmium, and zinc often exceeded their respective average crustal abundance by one to three orders of magnitude. Also, elevated lead concentration was evident in a few rock samples from all deposits except Lucky Queen and Flame & Moth. The concentrations of these elements in waste rock from the KHSD Mining Operations deposits are shown in Figure 6-7 and Figure 6-8.

Antimony and silver concentrations were higher than their respective 10x crustal abundance (2 and 0.85 ppm, respectively) in most waste rock samples from New Bermingham, Bellekeno, Onek, and Lucky Queen (Figure 6-7 and Figure 6-8). Lower antimony and silver concentrations were observed for Flame & Moth waste rock samples. Bulk selenium concentrations exhibited similar distributions and were elevated above the 10x crustal abundance (0.5 ppm) in the majority of New Bermingham and Flame & Moth samples. Selenium was not analyzed in Onek waste rock and the poor detection limits (10 ppm) used for Lucky Queen and Bellekeno dataset prevent a meaningful interpretation of their selenium data.

The highest arsenic, cadmium, and zinc concentrations were observed in waste rock from Onek, New Bermingham, and Bellekeno. The lowest concentrations of these metal(loids), and silver, were recorded in Flame & Moth waste rock samples, which were consistently lower than the crustal abundance for all four elements.

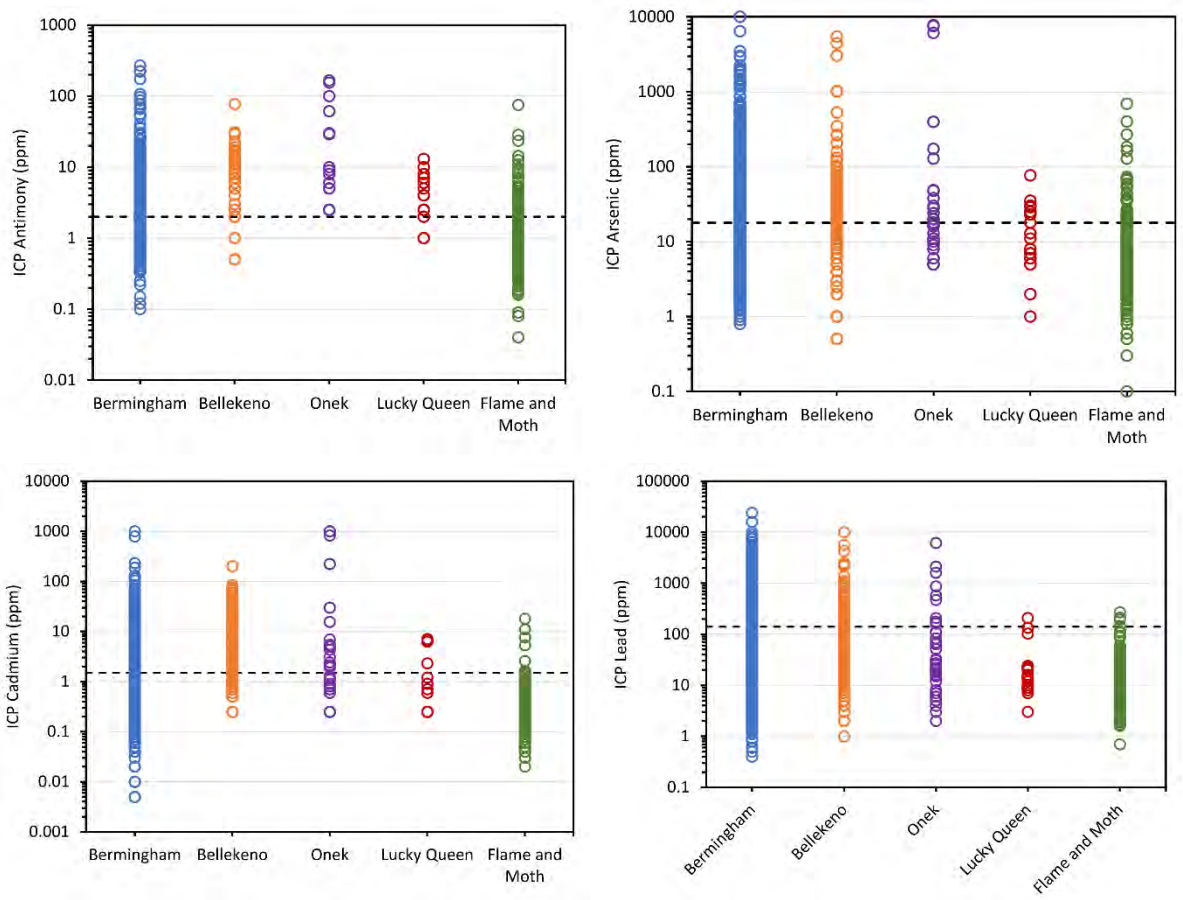


Figure 6-7: Elemental Concentrations of Antimony, Arsenic, Cadmium, and Lead at New Bermingham, Bellekeno, Onek, Lucky Queen, and Flame and Moth

Dashed line represents 10x crustal abundance.

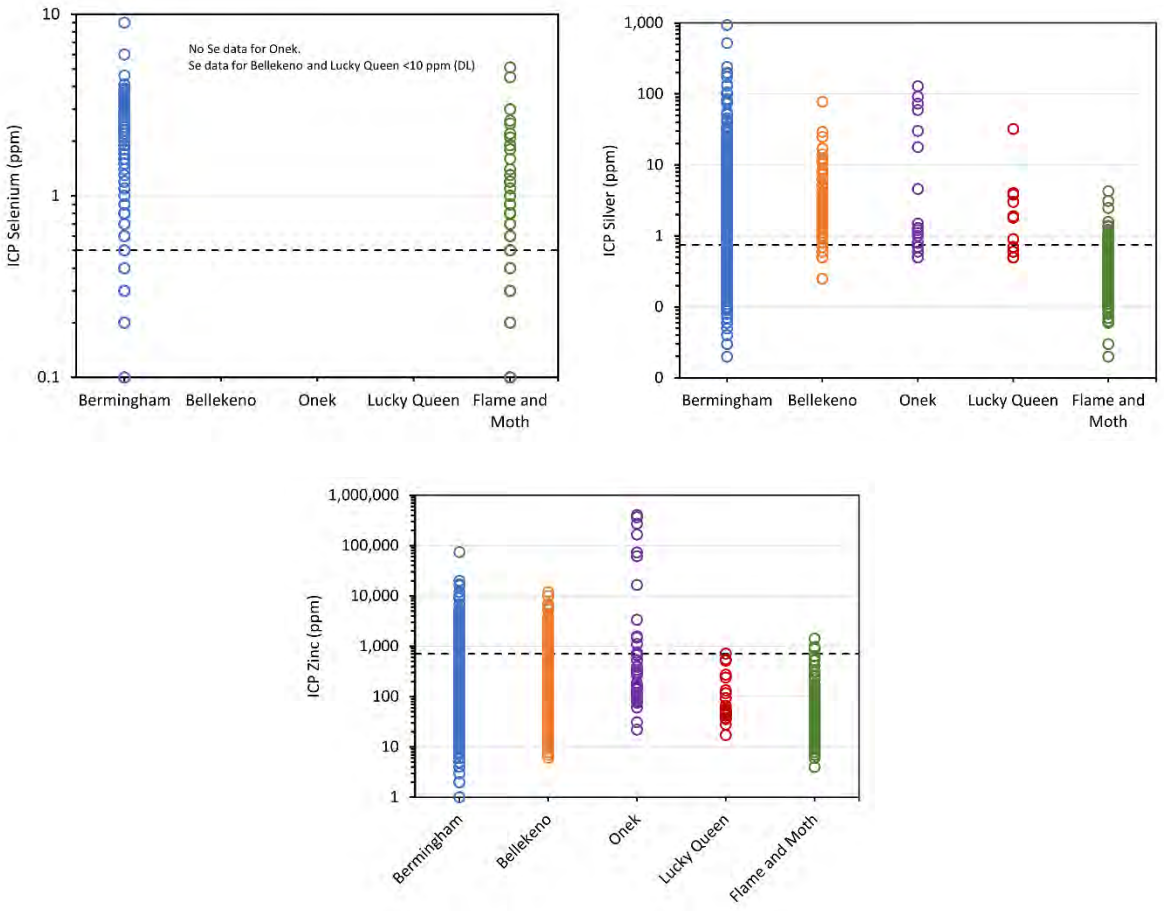


Figure 6-8: Elemental Concentrations of Selenium, Silver, and Zinc at New Bermingham, Bellekeno, Onek, Lucky Queen, and Flame and Moth

Dashed line represents 10x crustal abundance.

6.2.2.3 Shake Flask Extraction

SFE provides an indication of readily soluble elements in a sample that may be mobilized/solubilized under short-term leaching. A summary of results of SFE tests carried out on samples from the main lithologies at Flame & Moth and New Bermingham are reported in Table 6-4 and Table 6-5, respectively. No SFE data with adequate trace element detection limits for a meaningful comparison with generic water quality guidelines are available for the other deposits.

The focus of the discussion herein is on constituents that were enriched in the rock sample relative to 10x average crustal abundance during the elemental analysis. Constituents elevated relative to generic water quality guidelines (WQGs) are also discussed. The use of WQGs is for comparative purposes only rather than an assessment of compliance with site water quality standards. WQGs issued by the Canadian Council of Ministers of the Environment (CCME) were plotted. Antimony does not have a CCME guideline so the guideline published by the British Columbia Ministry of Environment and Parks (BC ENV) was used. For guidelines that incorporate modifying factors such as pH, dissolved organic carbon, and hardness, calculations were performed using the 2020–2025 dataset from station KV-50 in the receiving environment of Christal Creek which is located downstream of the Flame & Moth Mine.

The SFE pH of Flame & Moth and New Bermingham samples was circumneutral to alkaline, with 15% and 24% of samples exceeding the CCME WQGs for pH, respectively. The aluminum CCME guideline (0.1 mg/L) was exceeded by 67% and 45% of samples from Flame & Moth and New Bermingham, respectively.

A small proportion of SFE antimony concentrations exceeded the BC ENV guideline (0.074 mg/L; 1% of samples) in the Flame & Moth dataset, whereas 4% of New Bermingham samples exceeded. Conversely, a higher proportion of New Bermingham samples had SFE arsenic concentrations above the CCME WQG (0.005 mg/L; 55% of samples) compared with the Flame & Moth SFE results (11% of samples), consistent with the higher elemental arsenic in New Bermingham samples compared to Flame & Moth (Figure 6-7). Higher proportions of SFE selenium concentrations resulted in 45% and 36% of samples exceeding the WQG in the Flame & Moth and New Bermingham datasets, respectively. Smaller proportions of SFE cadmium (1%), chromium (5%), iron (3%), mercury (3%), and silver (1%), samples exceeded their respective WQGs in the Flame & Moth dataset. Similarly, a small proportion of SFE cadmium (2%), chromium (7%), lead (4%), mercury (3%), nickel (1%), silver (1%), and thallium (4%) samples exceeded their respective WQGs in the New Bermingham dataset.

Table 6-4: Comparison of SFE Data from Flame & Moth with Water Quality Guidelines

N = 94	PH	ALUMINUM	ANTIMONY	ARSENIC	CADMIUM	CHROMIUM	IRON	MERCURY	SELENIUM	SILVER
	-	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
Guideline for Comparison	CCME	CCME	BC ENV	CCME	CCME	CCME	CCME	CCME	CCME	CCME
Aquatic Life Guideline	6.5 – 9.0	0.1	0.074	0.005	0.00036	0.001	0.3	0.000026	0.001	0.0003
Maximum	9.2	6.17	0.13	0.012	0.00073	0.02	2.33	0.03	0.03	0.0014
3rd Quartile	8.6	0.40	0.017	0.0021	0.000025	0.0003	0.015	0.000025	0.002	0.00003
Median	8.3	0.16	0.01	0.0013	0.000025	0.0003	0.015	0.000025	0.001	0.00003
1st Quartile	7.3	0.065	0.0050	0.0005	0.000007	0.00025	0.0043	0.00001	0.0003	0.00001
Minimum	5.8	0.002	0.00059	0.00011	0.000001	0.00005	0.001	0.00001	0.0001	0.00001
Samples >CCME/BC ENV	15%	67%	1%	11%	1%	5%	3%	3%	45%	1%

SFE – shake flask extraction. Results exceeding CCME/BCMOE are presented in red.

Table 6-5: Comparison of SFE Data from New Bermingham with Water Quality Guidelines

N = 94	PH	ALUMINUM	ANTIMONY	ARSENIC	CADMIUM	CHROMIUM	LEAD	MERCURY	NICKEL	SELENIUM	SILVER	THALLIUM
	-	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
Guideline for Comparison	CCME	CCME	BC ENV	CCME	CCME	CCME	CCME	CCME	CCME	CCME	CCME	CCME
Aquatic Life Guideline	6.5 – 9.0	0.1	0.074	0.005	0.00036	0.001	0.0068	0.000026	0.15	0.001	0.0003	0.0008
Maximum	11.6	18.6	0.14	0.26	0.002	0.077	0.107	0.05	0.53	0.027	0.00088	0.0077
3rd Quartile	7.9	0.19	0.022	0.012	0.000022	0.00025	0.00025	0.00025	0.0012	0.0016	0.00004	0.00011
Median	7	0.081	0.010	0.0059	0.000005	0.00025	0.00008	0.00001	0.00037	0.0007	0.00001	0.000065
1st Quartile	6.7	0.026	0.0052	0.0026	0.0000033	0.00025	0.000025	0.00001	0.00025	0.0003	0.000005	0.000027
Minimum	5.1	0.002	0.000025	0.00005	0.000001	0.00005	0.00002	0.00001	0.00002	0.00005	0.000001	0.000005
Samples >CCME/BC ENV	26%	45%	4%	55%	2%	8%	4%	3%	1%	36	1%	4%

SFE – shake flask extraction. Results exceeding CCME/BCMOE are presented in red.

6.2.3 Kinetic Testing

In 2025, to meet the requirements of the Waste Rock Management Plan, kinetic testing was initiated for N-AML waste rock from New Bermingham (four humidity cells) and N-AML waste rock from Flame & Moth (one humidity cell). This test work is ongoing, and an update will be provided in the 2025 annual report.

The results of completed laboratory humidity cells and field leach barrel tests are presented and discussed herein. The discussion is focused on constituents identified as constituents of potential interest due to their elevated concentration. Results were compared against generic WQG issued by CCME and BC ENV as outlined in Section 6.2.2.3.

6.2.3.1 Flame and Moth Humidity Cell

Figure 6-9 to Figure 6-11 present the humidity cell leachate data collected for constituents of interest for 98 weeks of testing of N-AML Flame & Moth waste rock.

pH, Acidity, Alkalinity and Sulphate

The leachate of the N-AML humidity cell was slightly alkaline during the entire test period, ranging from pH 7.5 to 8.4. The alkalinity was much higher than the acidity generated during the entire test period. It declined from a peak of 127 mg/L CaCO3 at week 1 and stabilized around 50 – 60 mg/L CaCO3 since week 60. While acidity was not measured during the first 9 weeks of humidity cell operations, acidity was 17 mg/L CaCO3 at the initial sampling at week 10 then remained below 6 mg/L CaCO3 during the reminder of the test (Figure 6-9).

Dissolved sulphate concentrations were below the BC ENV guideline (429 mg/L) at all times. Dissolved sulphate concentrations were highest during the initial rinse cycle (183 mg/L at week 0) as soluble metal sulphate salts stored in the sample were rinsed out of the cell. Sulphate concentrations then declined slightly before reaching a plateau of between 100 and 130 mg/L for weeks 2 to 11 as a result of metal sulphide weathering. Thereafter, sulphate concentration declined and stabilized between 20 and 30 mg/L since week 66.

Constituents of Interest

Dissolved concentrations of cadmium, zinc, silver, lead, nickel, and copper in the N-AML humidity cell leachate were typically below their respective detection limits for most of the test duration, and well below their respective water quality guidelines (Figure 6-9 and Figure 6-10).

The concentrations of antimony were highest during the initial rinse (0.011 mg/L), but well below BC ENV water quality guideline (0.074 mg/L), then gradually declined over time, stabilizing below 0.001 mg/L since week 41 (Figure 6-11). Arsenic concentrations were stable between week 0 and week 20 (between 0.00071 and 0.00091 mg/L), then rose slowly reaching 0.0024 mg/L by week 54. Thereafter, arsenic concentration declined then stabilized between 0.0016 and 0.002 mg/L (Figure 6-11). Arsenic concentrations were at least two times lower than the CCME guideline (0.005 mg/L) during the test.

Selenium concentrations in the leachate had a pattern different from all other constituents. Selenium initially declined sharply from the initial flush value of 0.0028 mg/L to approximately 0.001 mg/L over the first two weeks before rising sharply to a peak concentration of 0.0031 mg/L at week 8 (Figure 6-11) The selenium peak coincided with the sulphate peak suggesting that the dissolution of selenium-bearing sulphides is the likely

source of selenium. Selenium concentrations then tailed off sharply, stabilizing between 0.0003 and 0.0005 mg/L from week 31 onwards (falling below the CCME guideline of 0.001 mg/L after week 16).

Sulphide and NP depletion times were estimated at 16 and 54 years, respectively, indicating that substantial amounts of NP will remain after the sulphide minerals have been exhausted (i.e., the waste rock is non-PAG). The Flame & Moth N-AML humidity cell was terminated after the concentrations of constituents of interest had stabilized.

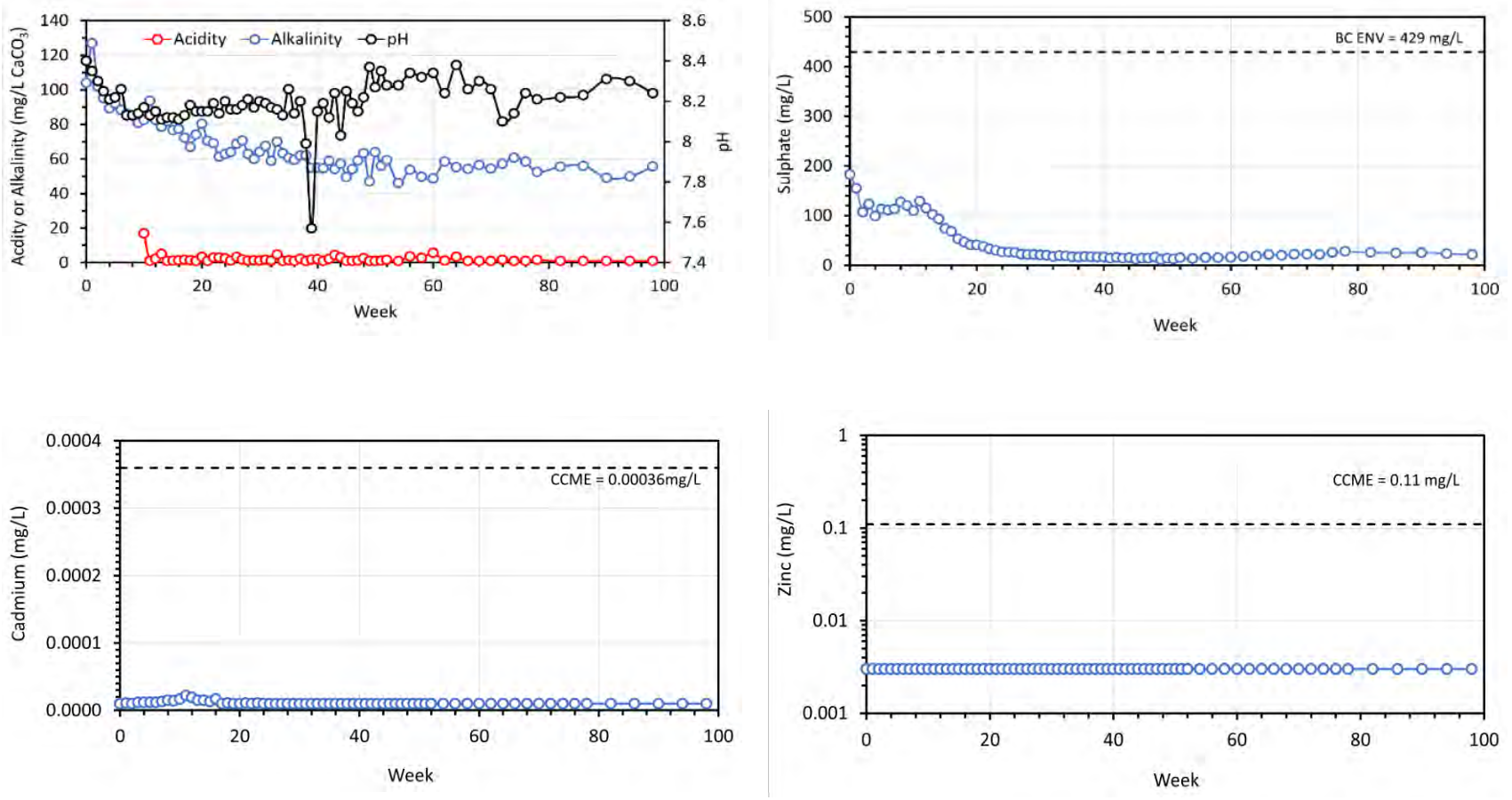


Figure 6-9: Acidity, Alkalinity, pH, Sulphate, Cadmium, and Zinc Trends of Flame & Moth Humidity Cell

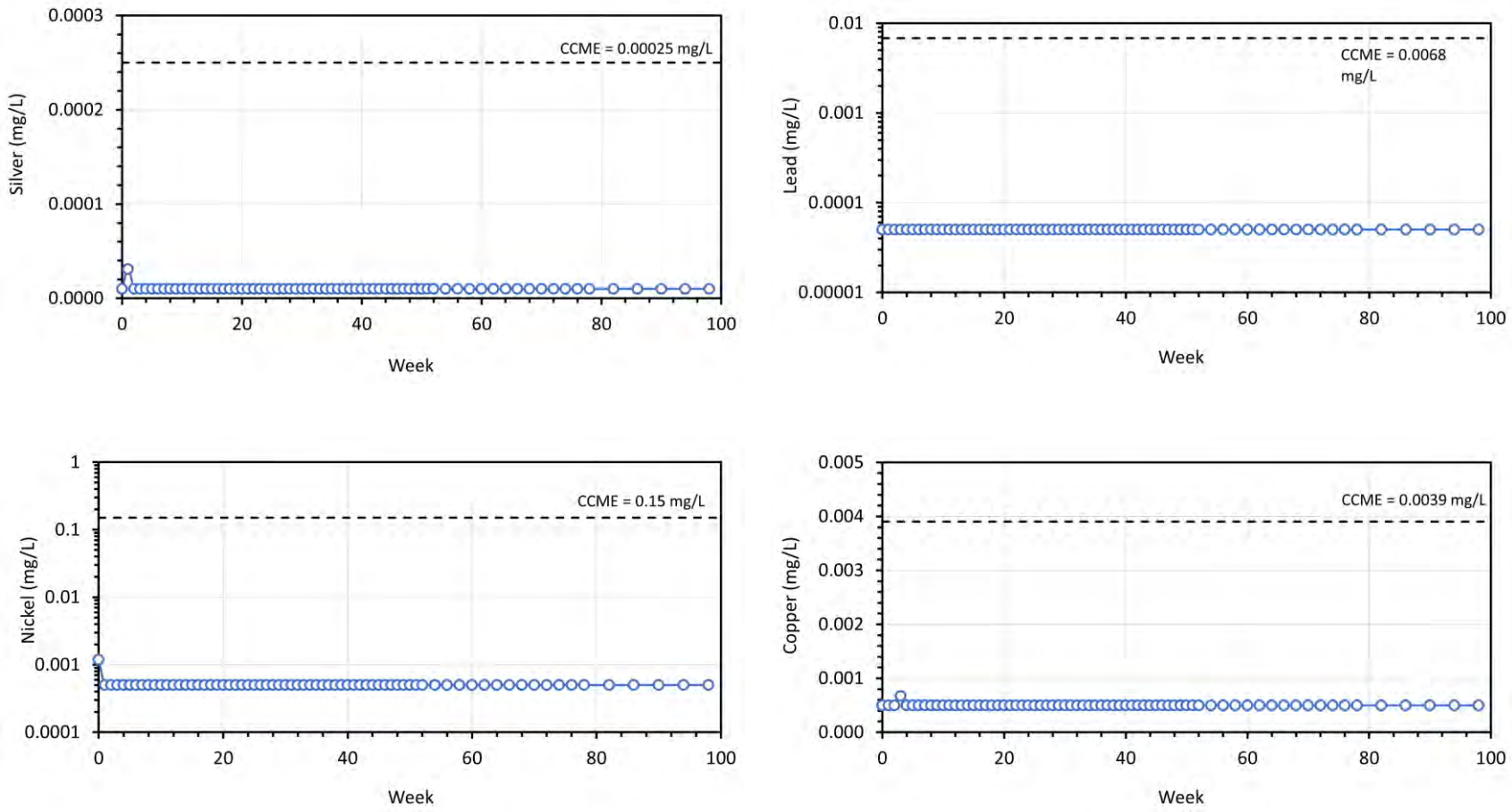


Figure 6-10: Silver, Lead, Nickel, and Copper Trends of Flame & Moth Humidity Cell

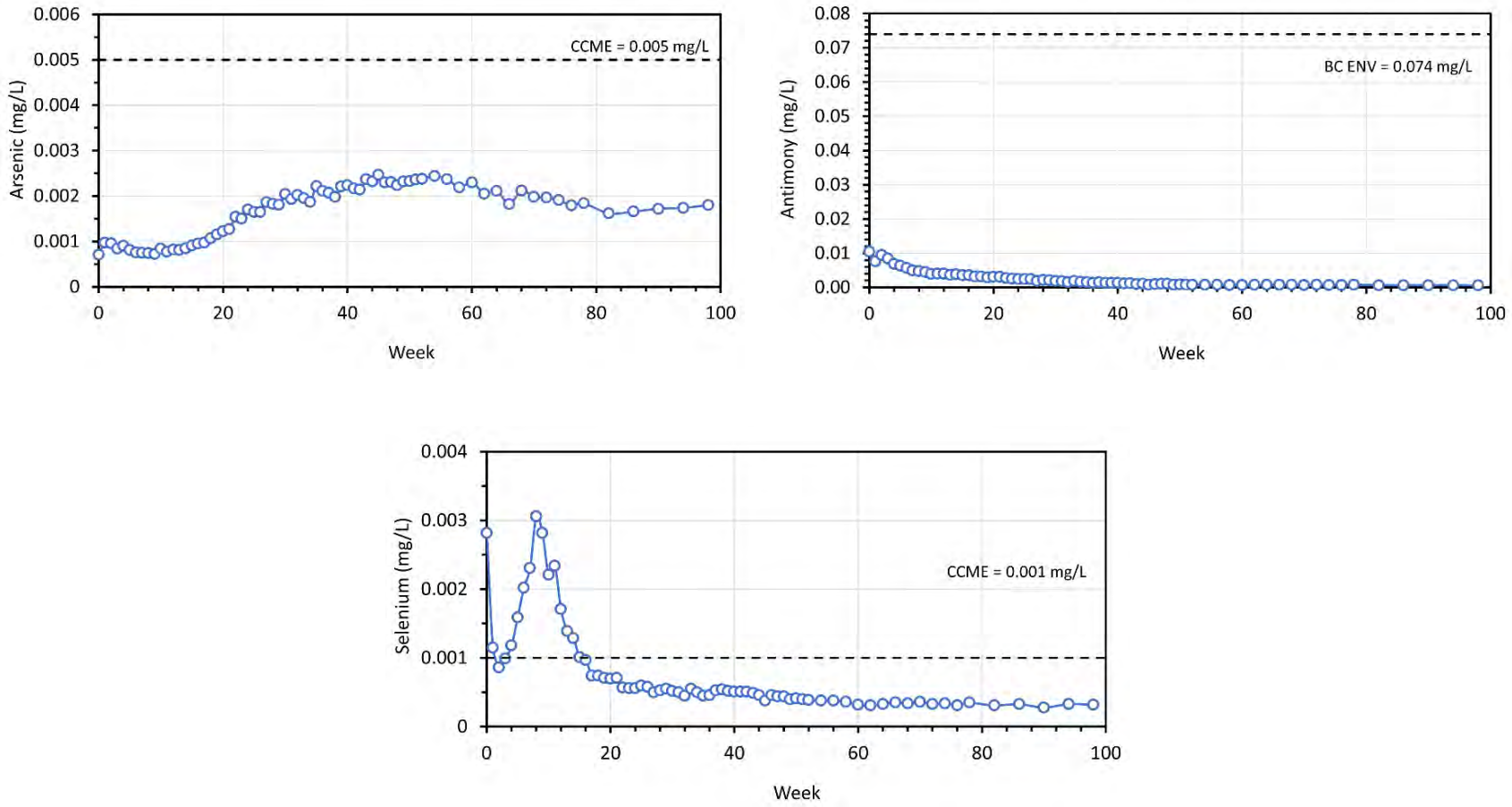


Figure 6-11: Arsenic, Antimony and Selenium Trends of Flame & Moth Humidity Cell

6.2.3.2 New Bermingham Humidity Cells

Two waste rock humidity cells were operated for New Bermingham in order understand the potential for ARD/ML and rates of release from the New Bermingham N-AML waste rock. The first humidity cell (HC-01) was constructed using a composite of N-AML New Bermingham waste rock from cover holes with total sulphur closer to the lower percentile (12%), NP close to the 24th percentile of ABA data, and an NPR of 4.1 (total sulphur = 0.09 wt.%; NP = 10.3 kg CaCO3/t; AP = 2.5 kg CaCO3/t). The cell also had trace metal contents close to the 70th percentile and was operated for 57 weeks. The second humidity cell (HC-03) was constructed using a composite of N-AML New Bermingham waste rock from advanced exploration drill holes with total sulphur close to the median (51st percentile), NP close to the median (53rd percentile), AP close to the median (52nd percentile) of ABA data, and an NPR of 2.6 (Total sulphur = 0.36 wt.%; NP = 29.0 kg CaCO3/t; AP = 11.3 kg CaCO3/t). Figure 6-12 to Figure 6-14 show the cell leachate data collected for constituents of interest.

pH, Acidity, Alkalinity, and Sulphate

Humidity cell HC-01 leachate was circumneutral (pH 6.7 to 7.6; Figure 6-12), with relatively low levels of alkalinity (4.5 to 16 mg/L CaCO3) and negligible acidity (below or at the detection limit of 0.5 mg/L CaCO3). Sulphate concentrations were also low (2.5 to 15.3 mg/L) and much lower than the sulphate WQG (429 mg/L; Figure 6-12).

Humidity cell HC-03 leachate was also neutral to slightly alkaline (pH 7.3 to 8.1) with relatively low levels of alkalinity (9.0 to 42.1 mg/L CaCO3) and negligible acidity (<0.5 to 1.1 mg/L CaCO3). Sulphate concentrations from HC-03 were higher than HC-01, ranging between 10.9 and 42.8 mg/L, reflecting its higher sulphur content. The sulphate concentration difference between the two cells gradually widened after cycle 16 but the sulphate concentration of the HC-03 was also much lower than the WQG (Figure 6-12).

Constituents of Interest

Aside from selenium in HC-01, and arsenic, copper, and selenium in HC-03, the concentrations of all constituents of interest in the leachates of New Bermingham N-AML humidity cells were well below their respective WQG values (Figure 6-12 to Figure 6-14). Except for selenium, HC-03 had higher (pH, sulphate, zinc, nickel, arsenic, antimony and molybdenum) or comparable (cadmium, silver, lead, and copper) leachate concentrations with HC-01.

Selenium concentrations in HC-01 peaked at 0.009 mg/L after week 1, then gradually declined with concentrations by week 53 (0.00085 mg/L) below the CCME guideline (0.001 mg/L). Selenium concentrations in HC-03 had a similar trend as HC-01, though concentrations remained generally below the CCME guideline following week 11 when concentrations were 0.0009 mg/L. Cadmium concentrations of HC-01 and HC-03 were comparable and were generally one or more orders of magnitude lower than the average CCME guideline (0.00036 mg/L). Arsenic concentrations in HC-01 and HC-03 were relatively low; however, concentrations were above the CCME guideline for HC-03 during the initial sampling events (Figure 6-14). Arsenic concentrations in HC-03 decreased below the WQG (0.005 mg/L) by week 10 (0.00482 mg/L).

The concentrations of cadmium, zinc, lead, nickel, and copper in the New Bermingham N-AML humidity cell HC-01 and HC-03 were relatively low and generally below their respective WQGs (Figure 6-12 and Figure 6-13). Silver was below the detection limit in the majority of humidity cell samples.

Sulphide and NP depletion time calculations were 21 and 39 years for HC-01, respectively, and 18 and 21 years, for HC-03, respectively. This indicates that a significant amount of NP will remain in HC-01 after the depletion of sulphide minerals, but only a limited amount of NP will remain after HC-03 is depleted of its sulphides, confirming the non-PAG character of the waste rock used for these humidity cells. Both humidity cells were terminated after the concentrations of constituents of interest had stabilized.

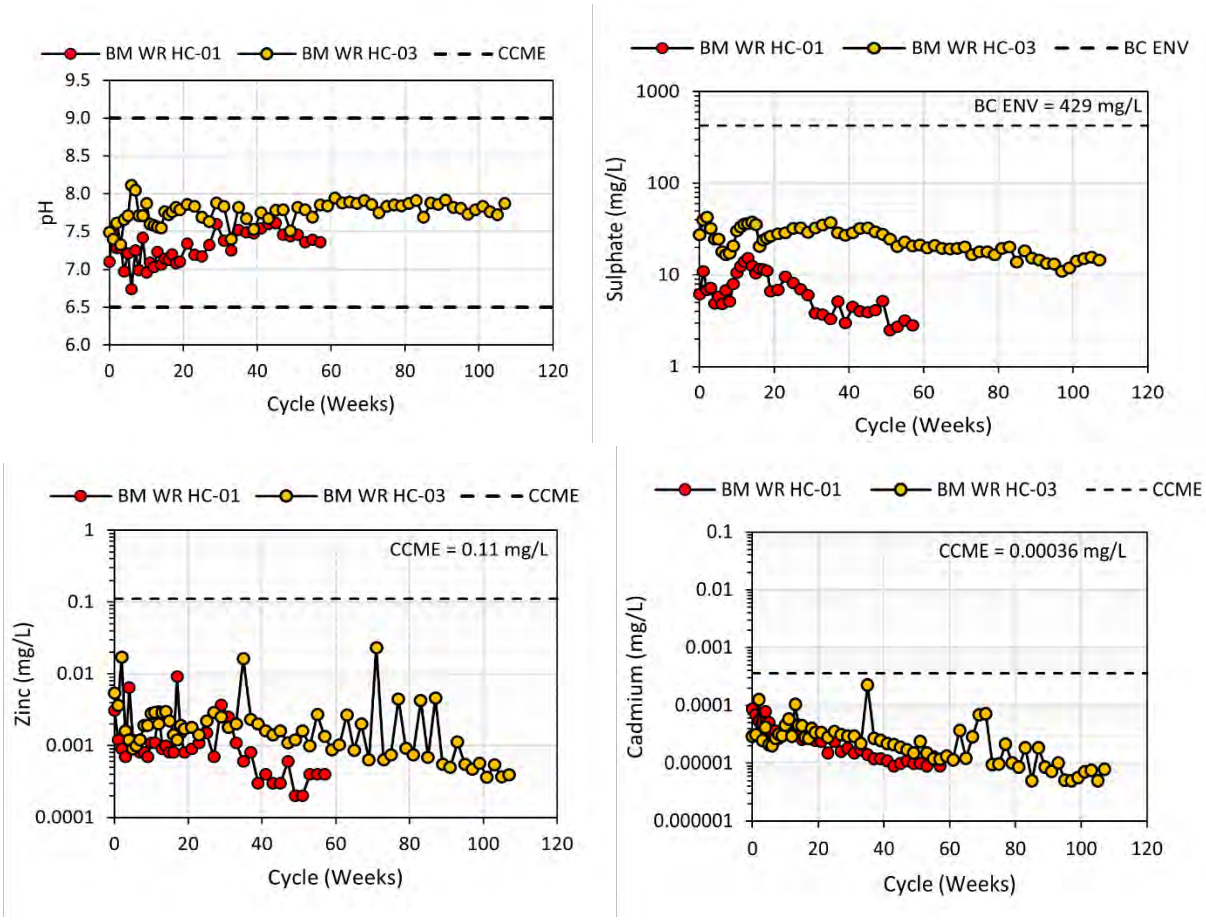


Figure 6-12: pH, Sulphate, Zinc, and Cadmium Trends within the New Bermingham N-AML Waste Rock Humidity Cells

N-AML – non-acid generating/metal leaching; BM WR – New Bermingham waste rock.

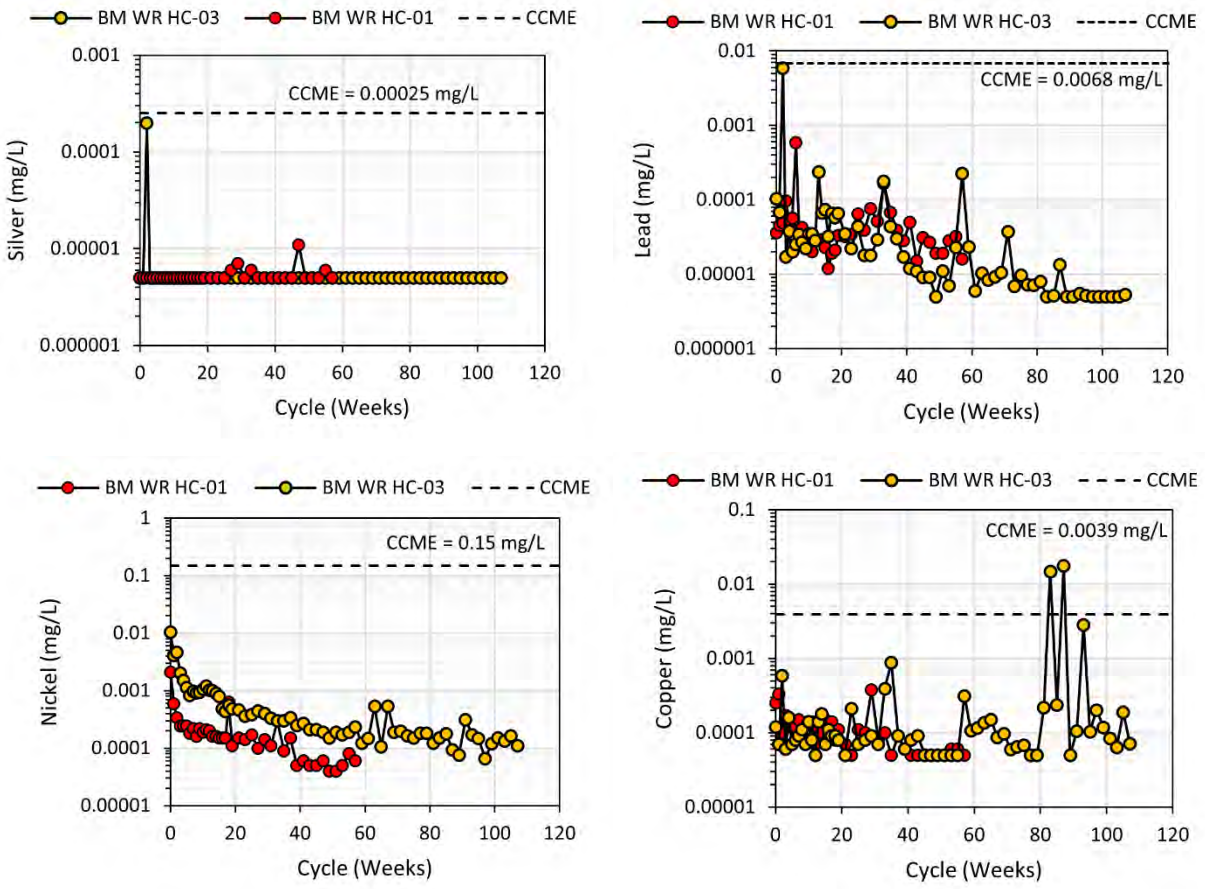


Figure 6-13: Silver, Lead, Nickel, and Copper Trends within the New Bermingham N-AML Waste Rock Humidity Cells

N-AML – non-acid generating/metal leaching; BM WR – New Bermingham waste rock.

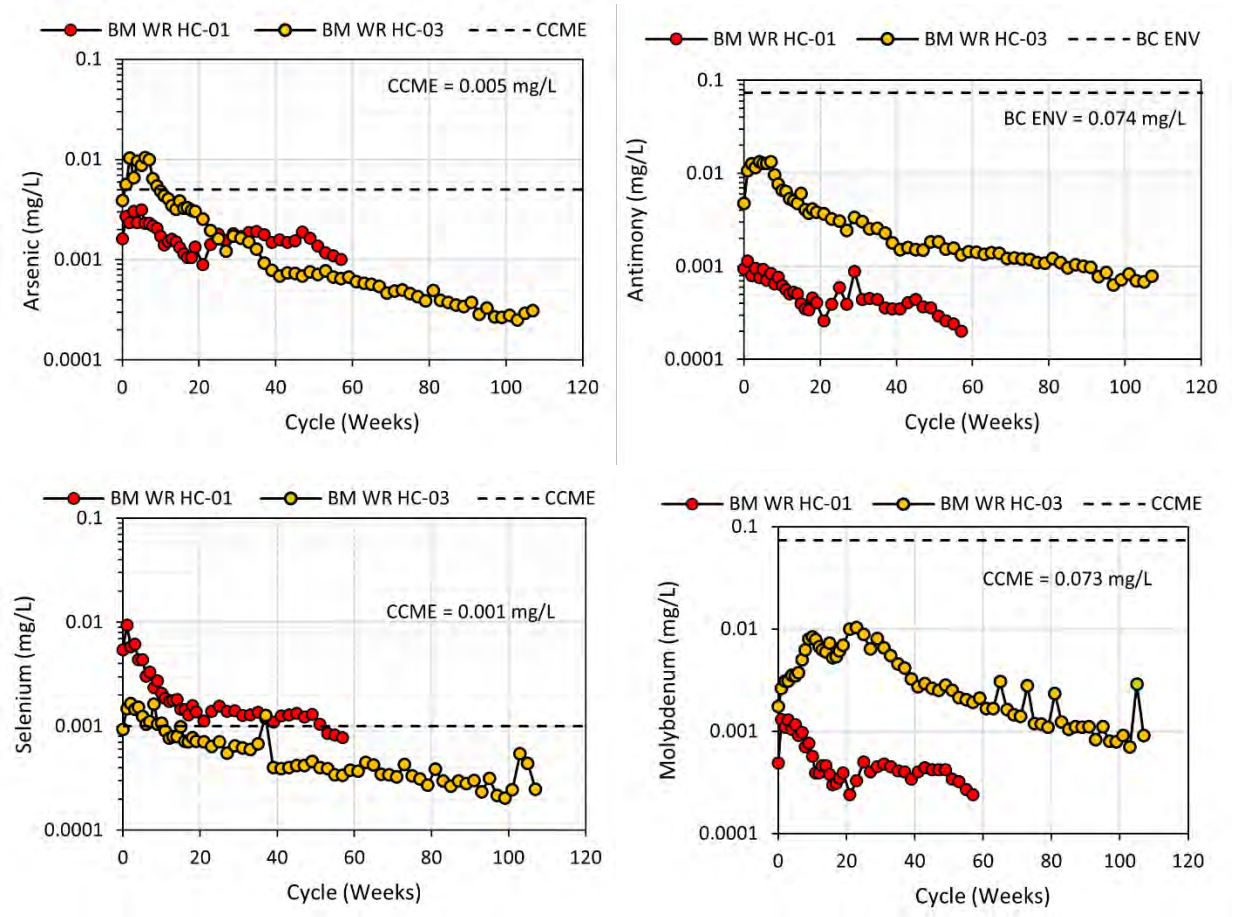


Figure 6-14: Arsenic, Antimony, Selenium, and Molybdenum Trends within the New Bermingham N-AML Waste Rock Humidity Cells

N-AML – non-acid generating/metal leaching; BM WR –New Bermingham waste rock.

6.2.4 Field Leach Barrels

Five field barrels containing Flame & Moth waste rock were constructed onsite in June 2013 and continue to be monitored to date. Only field leach barrels 1 to 4 (FMB1 to FMB4) are used to evaluate the geochemical characteristics of the waste rock. FMB1 to FMB4 were also used to examine the ARD/ML potential of P-AML and N-AML rocks from the dominant lithologies identified during the development of the Flame & Moth deposit. Field barrel 1 (FMB1) was filled with P-AML rock with elevated sulphur content (median 2.79%), median NPR <1, and high metal concentrations. Field barrel 2 (FMB2) was filled entirely with N-AML rock and had the highest median NP, relatively low sulphur content, and highest metal content of all the field bins. Field barrels 3 and 4 (FMB3 and FMB4, respectively) were filled with N-AML rock based on Flame & Moth screening criteria. This is primarily reflected in the sulphur content (median 0.39% and 0.43% for FMB3 and FMB4, respectively) and NPR (median 1.9 and 3.1 for FMB3 and FMB4, respectively). Damage to the FMB1 barrel was observed in early 2020 and the barrel was replaced in June 2020. This is coincident with a shift to higher pH leachate and lower metal concentrations.

The results are discussed and displayed herein and further details regarding the composition of the field barrels can be found in AEG (2016b). The field leach barrels are generally sampled three to five times a year except in 2019 when they were only sampled twice due to dry conditions and lack of leachate in the collection bins. Additionally, only FMB3 and FMB4 were sampled twice each in 2025, while FMB1 and FMB2 were both dry during the sampling events. Results were compared against generic WQG issued by CCME and BC ENV as outlined in Section 6.2.2.3.

pH, Acidity, Alkalinity and Sulphate

Leachates from FMB1 to FMB4 had circumneutral to slightly alkaline pH during the monitoring period until 2016. Between 2016 to 2019, leachate pH below the CCME guideline of 6.5 was observed in FMB1 consistently, while only occasional measurements of pH below the guideline were observed for FMB2, FMB3, and FMB4. FMB1 generally displayed pH below 6.0 values between September 2017 and September 2019, consistent with its P-AML status, then increased to circumneutral levels thereafter (when the barrel was replaced). FMB2 and FMB4 barrels showed intermittent low pH (<6.5) between the 2018 to 2025 sampling events (Figure 6 15); however, FMB3 showed pH below the CCME guideline on numerous occasions beginning in 2022.

FMB1 exhibited higher acidity (<1.0 – 1560 mg/L CaCO3) than observed for FMB2, FMB3, and FMB4 (<1.0 – 42 mg/L CaCO3). The difference between the leachate acidity from P-AML (FMB1) and the N-AML barrels (FMB2 to FMB4) decreased since July 2020 (Figure 6 15). The September 2019 acidity result for FMB1 was unusually high (1560 mg/L CaCO3) as soluble products may have accumulated in the barrel since the barrel was not sampled between May and July.

Alkalinity of FMB1 decreased from the start of the experiment and then generally stabilized from September 2013 to 2019. It is worth noting that FMB1 alkalinity was below the detection limit during July 2017 to September 2019, indicating a reduction in buffering capacity and explaining the acidic leachate pH observed. FMB1 alkalinity later increased, ranging from 21 to 42 mg/L from July 2020 to September 2022. Alkalinity in FMB1 decreased again following this sampling event and remained low into late 2024. After the initial reduction in alkalinity in the 2013 sampling event, leachate alkalinity fluctuated but appeared to be relatively stable for FMB2 to FMB4 from 2014 to 2022. Alkalinity decreased for FMB2 and FMB3 beginning in late 2022, indicating a reduction in buffering capacity.

FMB1 showed the highest dissolved sulphate concentrations, ranging from 415 to 4930 mg/L with a median of 1710 mg/L (Figure 6 15). FBM2 to FMB4 had comparable dissolved sulphate concentrations with median values ranging from 334 to 577 mg/L. Dissolved sulphate concentrations were typically highest in the summer months (July-September) and lowest in the spring and fall sampling events. Sulphate concentrations in all the FMB1 leachate samples exceeded the BC ENV guideline of 429 mg/L, except for one sampling event in May 2019 (415 mg/L). Sulphate concentrations in the FMB2, FMB3, and FMB4 leachates were intermittently above the BC ENV guideline throughout their datasets; however, sulphate concentrations were typically above the guideline for all barrels in 2024 and 2025.

Constituents of Interest

The trends of trace element broadly reflected the P-AML/N-AML classification of the barrels. FMB1 was composed of P-AML material and the leachate from it regularly contained the highest concentrations of zinc, cadmium, nickel, lead, and copper, especially during the earlier stages of the dataset (Figure 6 16 and Figure 6 17). FMB2, FMB3, and FMB4 were primarily composed of waste rock with low potential for ARD. These field barrels generally exhibited zinc, cadmium, nickel, lead, and copper leachate concentrations lower than FMB1.

The similar patterns of zinc, cadmium, nickel, copper, and lead and their high concentrations in the P-AML leach barrel FMB1 coincide with high sulphate and acidity levels, indicating a common source via sulphide oxidation. Conversely, the low concentrations of arsenic, antimony, and selenium in FMB1 leachates compared with the N-AML field barrels may suggest lower release rate and/or attenuation of oxyanions under acidic conditions of the P-AML rock drainage compared with circumneutral N-AML drainage.

Zinc

Zinc concentrations were consistently below the average CCME guideline (0.11 mg/L) in the N-AML FMB4 leachate, showing the lowest zinc concentrations than the other three field barrels (Figure 6 16). Recent measurements in 2024 and 2025 showed infrequent exceedances that were marginally above the guideline. Zinc concentrations of FMB2 leachate showed higher concentrations than FMB4 and more CCME guideline exceedances compared to FMB4. Zinc leachate concentrations in FMB2 also increased by more than an order of magnitude during the sampling events in 2024 compared to previous years. Zinc concentrations from FMB3 were higher than FMB2 and was generally above the average CCME guideline throughout the dataset. All FMB1 samples collected between 2013 to 2025 had zinc concentrations above the average calculated CCME guideline and were approximately one to two orders of magnitude higher than the zinc levels in the other field barrels between 2013 to 2019.

FMB1 showed an increasing trend in zinc concentrations (0.4 – 722 mg/L) between 2013 and 2019, subsequently decreased and stabilized to approximately 1 mg/L between September 2020 to September 2022. The increasing trend in zinc concentrations of FMB1 between 2013 to 2019 coincided with the increasing trends in sulphate and acidity observed during this period, reflecting the character of P-AML rock in FMB1. The decreasing trend in zinc concentrations of FMB1 from 2020 to 2022 is coincident with the increased pH levels recorded during this period. Concentrations of zinc appear to show an increasing for all field barrels since 2022, which may be related to a decrease in alkalinity and pH in the barrels.

Cadmium

Cadmium concentrations had very similar trends to those of zinc (Figure 6 16). Cadmium concentrations in FMB1, FMB2, and FMB3 leachates exceeded the CCME guideline (0.00037 mg/L) for all samples collected to date, except one sample of FMB2 in 2015. FMB1 displayed the highest cadmium concentrations ranging from 0.01 to 6.9 mg/L, reflective of the metal-leaching nature of P-AML material. Cadmium concentrations in FMB4 leachates were regularly lower or just slightly above the CCME guideline between 2013 to 2020; however, concentrations have been above the guideline for all sampling events since September 2021. Like zinc, cadmium concentrations in FMB1 leachate exhibited an increasing trend from 2013 to 2019, then decreased and stabilized between 2020 to 2022, and then increasing again in more recent samples. The increasing cadmium concentrations in FMB1 leachate from 2013 to 2019 coincided with the decreasing pH and increasing sulphate and acidity during this period, reflecting the character of P-AML rock in FMB1. The decreasing and then stabilizing cadmium concentrations between 2020 to 2022 coincided with an increase in leachate pH, while the increasing trend in recent years may be related to a decrease in alkalinity and pH.

Nickel

Nickel concentrations were highest in P-AML FMB1 leachate collected from 2013 to 2020, consistently exceeding the average CCME guideline of 0.15 mg/L (Figure 6 16). Like zinc and cadmium, nickel concentrations in FMB1 displayed an increasing trend from 2013 to 2019, coinciding with the minor increasing trends in sulphate and acidity observed during this period. Nickel concentrations in FMB2, FMB3 and FMB4

(N-AML) leachates gradually declined from September 2019 to September 2020, subsequently decreasing and stabilizing from September 2020 to 2022. The reason for the increasing and then decreasing patterns in nickel concentrations of FMB1 is likely the same as it is for zinc and cadmium, related to the changes in pH observed for this period.

Nickel concentrations in leachate from FMB2, FMB3, and FMB4 were consistently lower than the CCME guideline for most of the dataset. FMB3 began showing elevated nickel concentrations above the CCME WQG in September 2022 and has remained elevated coinciding with elevated sulphate, as well as a decrease in pH and alkalinity.

Lead

FMB1 generally contained the highest lead concentrations (0.0013 – 0.74 mg/L) from 2013 to 2019, consistently above the average CCME guideline (0.0068 mg/L) between August 2016 and September 2019, reflective of the P-AML nature of its waste rock content. Similar to the aforementioned constituents of interest, lead concentrations showed a minor increasing trend from 2013 to 2019, followed by a decrease and stabilization between 2020 to 2022, and an increase again in concentrations in more recent samples.

Lead concentrations from the three N-AML field barrels (FMB2, FMB3, and FMB4) were typically below the CCME guideline of 0.0068 mg/L (Figure 6 16) except for a select few instances. Similar to other constituents such as zinc, cadmium and nickel, lead concentrations increased significantly in FMB3 beginning in 2022.

Copper

FMB1 and FMB4 generally had higher copper concentrations than FMB2 and FMB3 between 2013 to 2019 (0.003 – 7.7 mg/L) and exceeded the average CCME guideline (0.0039 mg/L) for the first three sampling events in 2013 and most sampling events between 2017 and 2019 (Figure 6 17). Copper concentrations in FMB1 leachates decreased and then stabilized from 2020 to 2022 and then increased again similar to the other constituents during recent sampling events. Copper concentrations in N-AML FMB3 remained below the average CCME guideline for most sampling events between 2013 to 2022 but increased significantly in September 2022 and remained elevated throughout the dataset. The copper concentrations from both FMB2 and FMB4 frequently exceeded the CCME threshold since the beginning of each test (Figure 6 17). Like all previous metals, an unusually high copper concentration was measured in FMB1 in September 2019 due to flushing of accumulated weathering products.

Arsenic

The leachate from FMB1 and FMB3 showed concentrations of arsenic which were below the CCME threshold (0.005 mg/L) for all but three FMB1 samples (Figure 6 17). Arsenic concentrations in FMB2 and FMB4 were comparable for most of the dataset (0.006 – 0.019 mg/L), higher than FMB1 and FMB3, and exceeded or were comparable to the CCME guideline for most samples (Figure 6 17). Leachate from FMB3 did show an increasing trend in arsenic concentrations beginning in 2022 that coincides with other increasing metals in the barrel. As mentioned previously, it is suggested that the decrease in pH, alkalinity, and increases in sulphate around this time are indicative of changing geochemical conditions in the barrel.

Selenium

Selenium concentrations exceeded the CCME guideline (0.001 mg/L) in most leachate samples from all field barrels (Figure 6 17). The lowest (FMB3: 0.00037 – 0.017 mg/L) and highest (FMB2: 0.002 – 0.065 mg/L; FMB4: 0.0037 – 0.034 mg/L) selenium concentrations were observed in the leachate from the N-AML field barrels, suggesting that the leaching behaviour of this element cannot be predicted based on AML classification. It is however worth noting that a similar pattern in selenium was observed for all field barrels since June 2016 to June 2021, and selenium concentrations in FMB1 and FMB3 were almost comparable during the same period. Selenium concentrations in FMB2, FMB3, and FMB4 shared a similar changing pattern comparable between June 2021 and September 2022, whereas selenium concentration in FMB1 continued to decrease during this period. FMB3 and FMB4 continued to show similar concentrations in the more recent dataset (i.e., 2022 to 2025), whereas FMB2 has had fluctuations and FMB1 is generally stable.

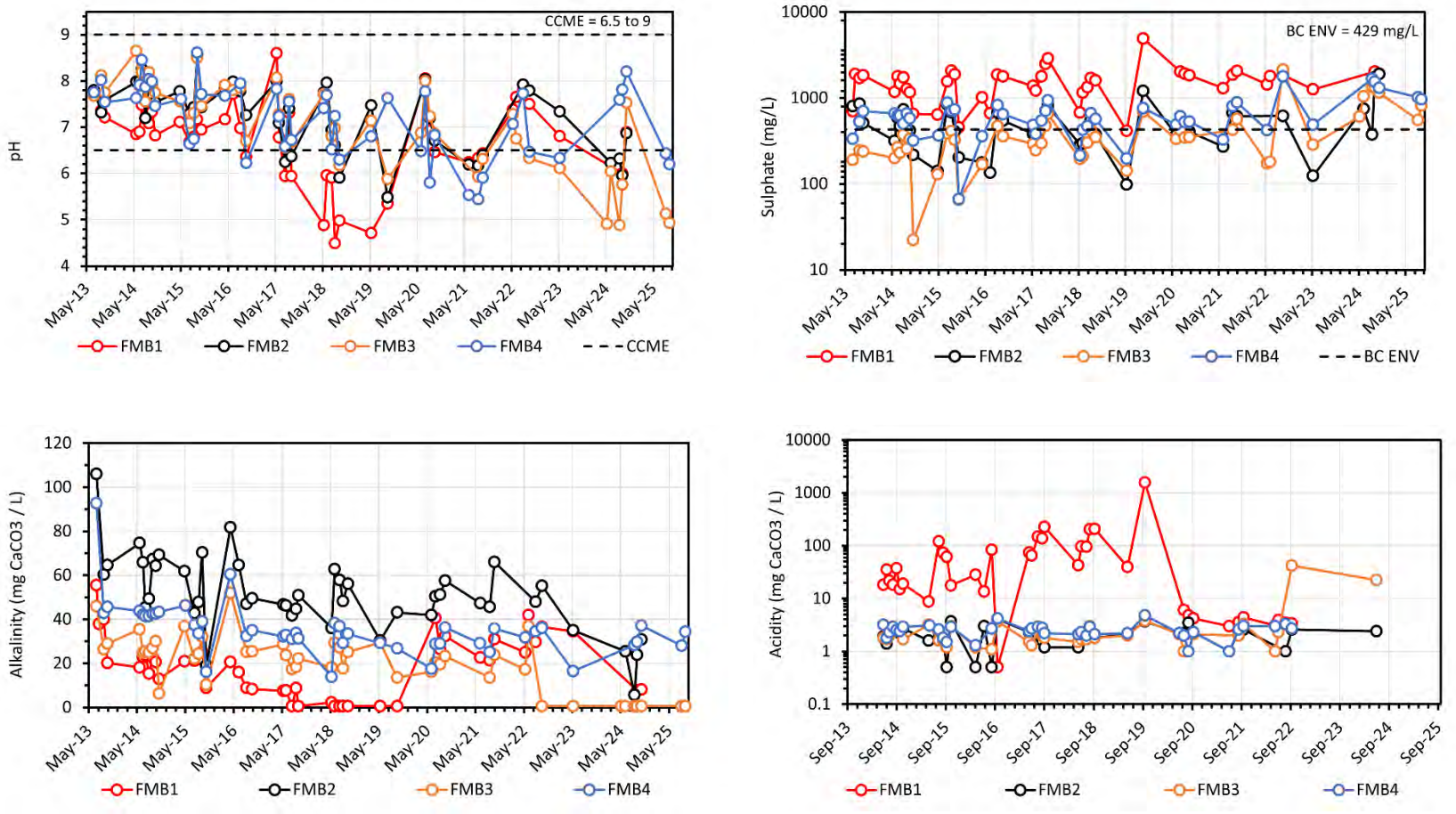


Figure 6-15: Trends of pH, Sulphate, Alkalinity and Acidity in Flame & Moth Field Barrels

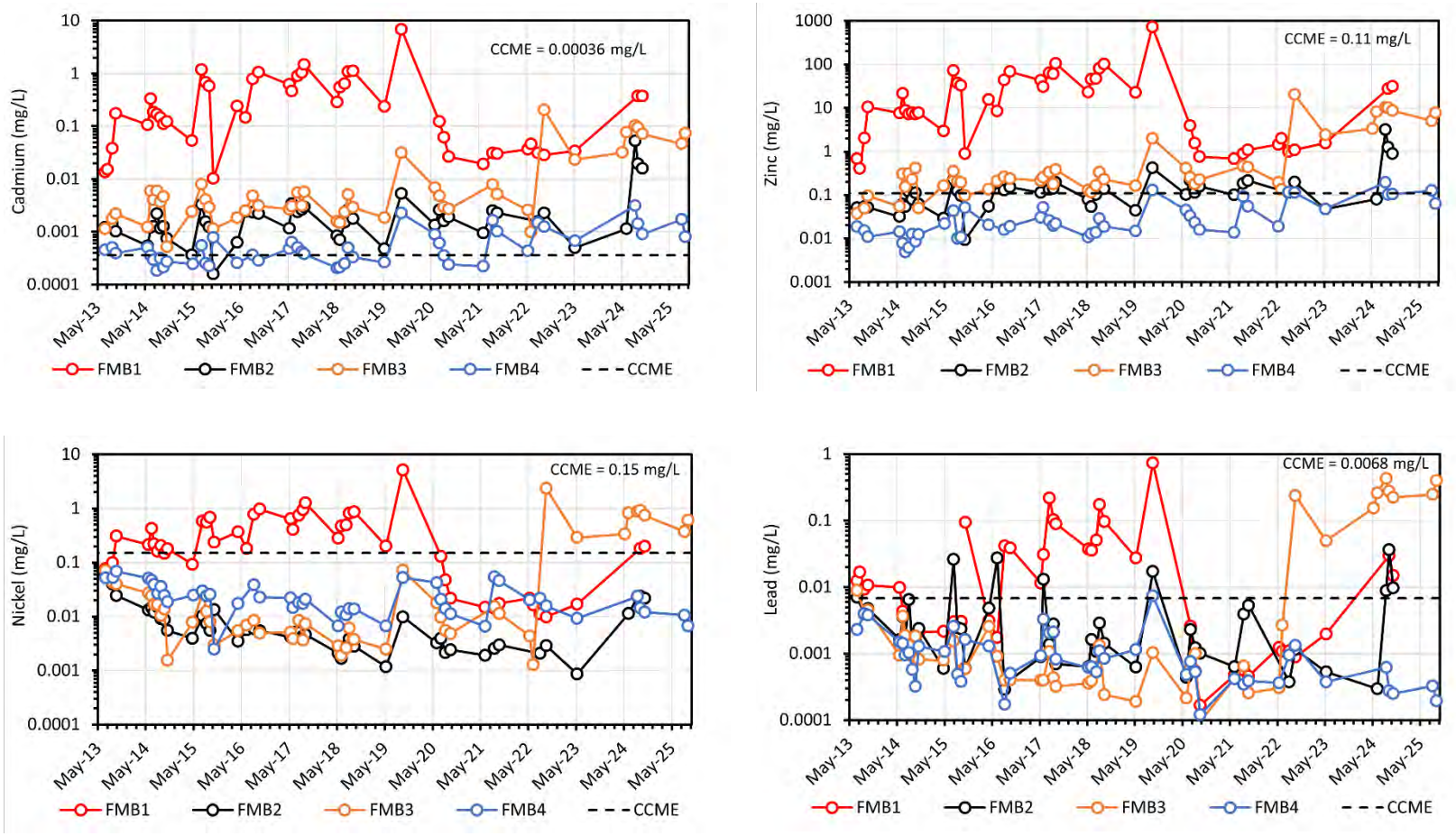


Figure 6-16: Trends of Cadmium, Zinc, Nickel, and Lead Concentration in Flame & Moth Field Barrels

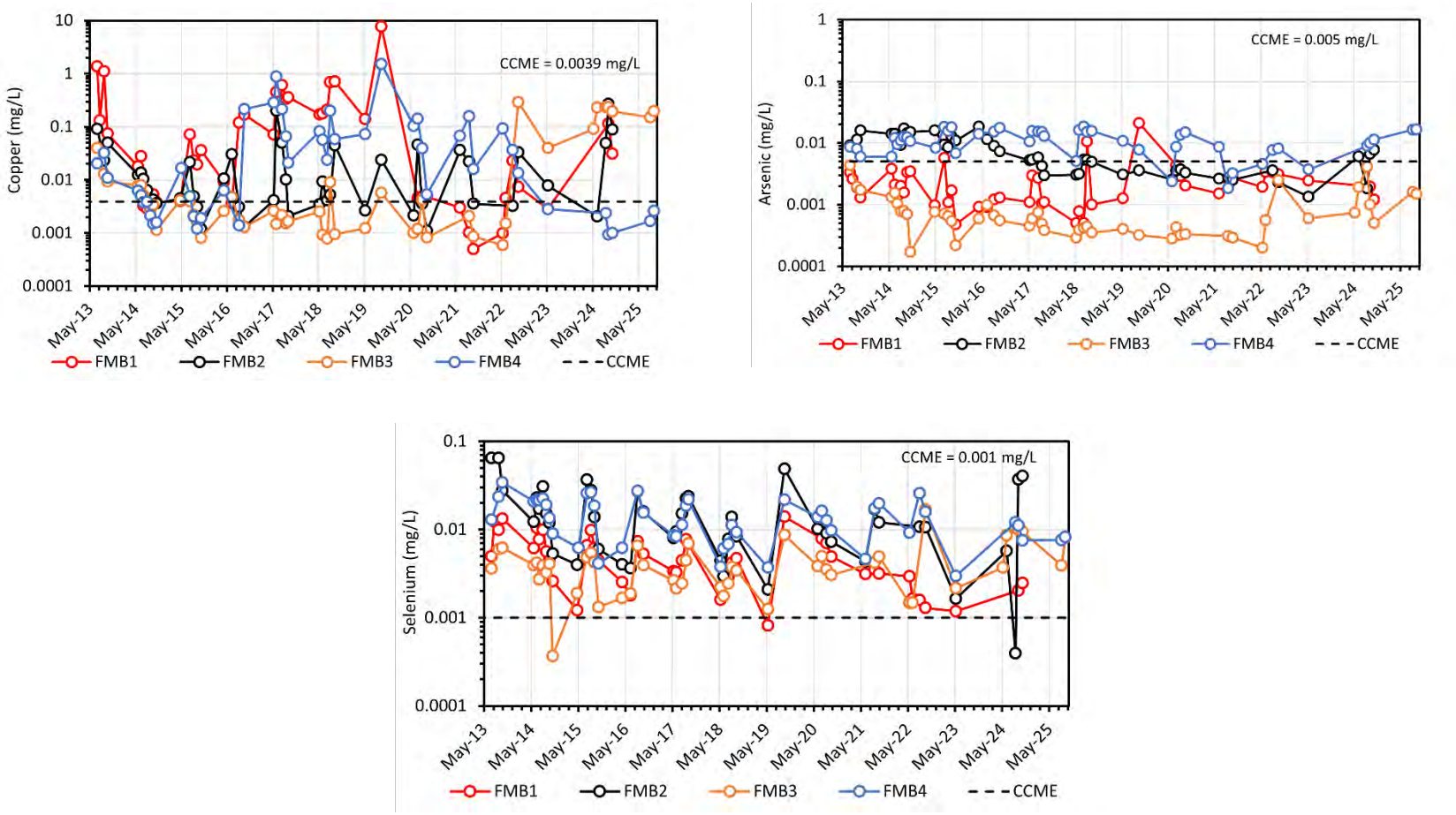


Figure 6-17: Trends of Copper, Arsenic, and Selenium Concentrations in Flame & Moth Field Barrels

6.3 TAILINGS

AKHM also carried out geochemical characterization of the tailings from each of the mineralized target zones in order to understand their potential ARD/ML. These characterization studies have been ongoing for several years and continue to date. The results of the characterizations were reported for the Onek, Lucky Queen, and Flame & Moth tailings in ACG (2012; 2015), New Bermingham in AEG (2019d), Bellekeno and New Bermingham in Ensero (2022a). This section summarizes the results of geochemical testing conducted on tailings samples collected by AKHM from the Mill between 2011 and 2024 and evaluates the tailings ARD/ML potential. WL QZ18-044 was issued on July 23, 2020, as a renewal for the previous WL QZ09-092, authorizing AKHM to conduct mine development, production, and milling of ore produced from the Bellekeno, Flame & Moth, and New Bermingham mines. The Tailings Characterization Plan (TCP) for KHSD Mining Operations details the sampling and testing procedures, including frequency, used to evaluate the physical, geochemical, and mineralogical properties of the tailings which were produced by the Mill (AKHM, 2021).

6.3.1 Tailings Samples and Analysis

Tailings samples were collected monthly when the Mill was in operation. Each monthly sample is a composite of weekly samples collected throughout the month, as described in the TCP. In 2024, approximately 81,146 and 3,617 dry metric tonnes of tailings were generated from development at New Bermingham and Flame & Moth mines, respectively. The proportion of the monthly mine feed to the Mill from each mine in 2024 is presented in Table 6-6, along with a summary of the samples analyzed (the Mill did not operate in September through November 2024). The tailings samples were submitted for:

- Particle size analysis (PSA)
- Mineralogical analysis, by Rietveld x-ray diffraction (XRD)
- ABA, including paste pH, bulk NP using the siderite corrected method (Skousen et al., 1997), TIC by hydrochloric acid leach, total sulphur by Leco, sulphate-sulphur by hydrochloric acid leach, and sulphide-sulphur by difference.
- Elemental analysis, by aqua regia digestion with ICP-MS.
- Leachable elements, using SFE testing with ICP-MS analysis of the filtered leachate (Price, 2009).

Table 6-6: Mine Feed Composition and Analyses Conducted on 2024 Tailings Samples

Tailings Sample	Mine Feed Contribution[1]				Sample Type[2]	Analyses[3]				
	New Bermingham (dmt)		Flame & Moth (dmt)			ABA	ICP-MS	SFE	XRD	PSA
January 2024	100%	6,948	0%	0	Monthly	x	x	x		
February 2024	100%	6,999	0%	0	Monthly	x	x	x		
March 2024	100%	8,883	0%	0	Monthly	x	x	x		
April 2024	100%	9,793	0%	0	Monthly	x	x	x		x
May 2024	100%	11,559	0%	0	Monthly	x	x	x		x
June 2024	100%	12,192	0%	0	Monthly	x	x	x	x	x
Q2 Composite 2024	-	-	-	-	Quarterly				x	
July 2024	90%	10,152	10%	1,145	Monthly	x	x	x	x	
August 2024	76%	8,029	24%	2,472	Monthly	x	x	x	x	
December 2024	100%	6,591	0%	0	Monthly	x	x	x	x	

Note.

[1] dmt = dry metric tonne.

[2] Monthly composite samples were made from four weekly samples collected through the month.

[3] ABA = acid base accounting, SFE = shake flask extraction, XRD = x-ray diffraction, PSA = particle size analysis.

6.3.2 Results

The results of ABA, elemental analyses, and SFE leachate analyses are summarized in the following sections. Additional details for the samples may be found in the annual reports.

6.3.2.1 Particle Size Analysis

Three tailings samples were submitted for PSA in 2024. The samples were silt to sand sized, with 49% to 59% passing at 0.075 mm and 31% to 39% passing at 0.053 mm (Table 6-7; Figure 6-18). May and June 2024 samples had very nearly the same particle size distribution, while the April 2024 sample was similar, but slightly finer-grained.

Table 6-7: PSA Results for 2024 Tailings Samples

PARTICLE SIZE (MM)	PERCENTAGE PASSING, BY MASS (%)		
	APRIL 2024	MAY 2024	JUNE 2024
2	100	100	100
0.85	100	100	100
0.5	100	99.6	99.8
0.25	99.7	93.5	95
0.125	84.4	72	73.8
0.075	59.6	49.4	50.1
0.053	39.2	30.9	31.3
0.038	19.1	15.8	15.4
<0.037	0	0.1	0

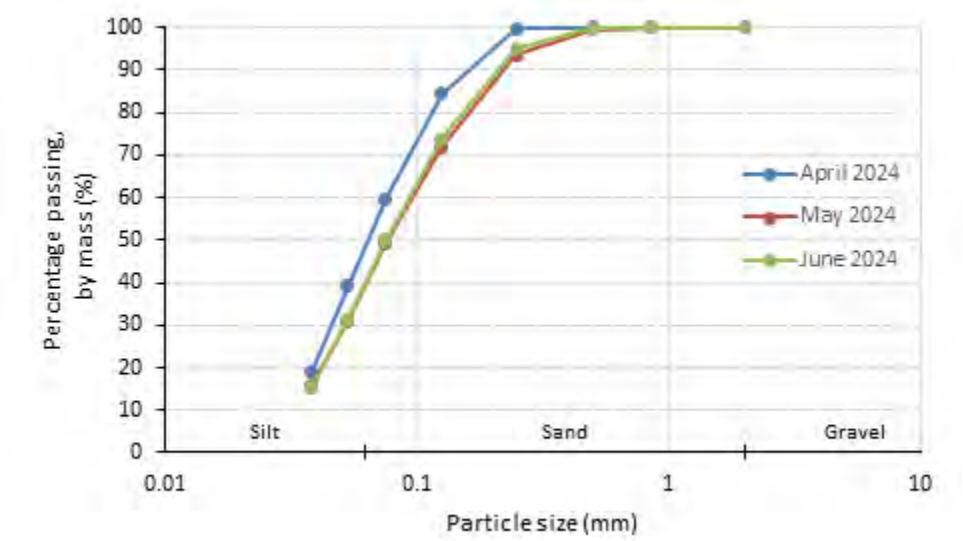


Figure 6-18: Particle Size Analysis Results for 2024 Tailings Samples

6.3.2.2 Mineralogical Analysis

Quantitative XRD analysis was conducted on composite samples to evaluate the crystalline mineralogy and identify phases that may influence the ARD/ML potential of the Mill tailings. Carbonate minerals (e.g., calcite and dolomite) are typically the principal contributors to NP, whereas sulphide minerals (e.g., pyrite) are usually the primary sources of AP. The XRD results are summarized in Table 6-8, and compare the median abundances from the 2011-2013 dataset (i.e., Bellekeno tailings) to the 2021-2024 dataset (i.e., Bermingham and Flame & Moth tailings). The abundances reported represent the relative amounts of crystalline phases normalized to 100% (i.e., the results do not include amorphous phases).

Quartz (SiO_2) was the most abundant mineral in the samples from both datasets, with median weight percentages of 54% and 62.3 % for the 2011-2013 and 2021-2024 datasets, respectively. Illite-muscovite was the other principal silicate mineral, with median weight percentages of 4.7% for the 2011-2013 dataset and 7.1% for the 2021-2024 dataset.

Siderite-rhodochrosite ($Fe^{2+}CO_3$ - $Mn^{2+}CO_3$) was the most abundant carbonate mineral in both datasets. The median weight percentage of the 2021-2024 dataset was 15.9%, which is roughly half the median of the 2011-2013 dataset (31.3 wt.%). Calcite ($CaCO_3$) also had a median weight percentage in the 2021-2024 dataset (1.4%) that was half the median weight percentage of the 2011-2013 dataset (2.8%). Ankerite-dolomite-kutnohorite ($Ca(Fe^{2+},Mg)(CO_3)_2$ - $CaMg(CO_3)_2$ - $Ca(Mn^{2+})(CO_3)_2$) were identified at higher content in the 2021-2024 dataset; the 2011-2013 dataset generally had higher calcite abundances and did not consistently identify ankerite-dolomite-kutnohorite. Calcite is the most reactive carbonate mineral and readily contributes to acid neutralization but was only present in small abundance in the more recent dataset (i.e., 2021-2024).

Pyrite (FeS_2) and sphalerite ((Zn,Fe)S) were the most abundant sulphide minerals identified in both datasets, along with minimal galena (PbS). Pyrite median content in the 2021-2024 dataset (5.6 wt.%) was more than

double that of the 2011-2013 dataset (2.3 wt.%). Sphalerite median weight percentage content was slightly higher in the 2011-2013 dataset (2.3%) compared to the more recent dataset (1.4%).

Since the Mill switched from processing Bellekeno ore (i.e., 2011-2013) to New Bermingham and Flame & Moth ore (i.e., 2021 to present), the tailings mineralogy has had decreased calcite and siderite-rhodochrosite content, and increased pyrite content.

Table 6-8: Median XRD Results of Tailings Samples

MINERAL	FORMULA	MEDIAN 2011 TO 2013 (N=10) [1]	MEDIAN 2021 TO 2024 (N=11) [2]
Silicates			
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$		0.9
Dravite	$NaMg_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$		1.1
Grossular	$Ca_3Al_2(SiO_4)_3$		2.1
Illite-Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$ - $KAl_2AlSi_3O_{10}(OH)_2$	4.7	7.1
Kaolinite	$Al_2Si_2O_5(OH)_4$		0.4
Quartz	SiO_2	54.0	62.3
Carbonates			
Ankerite-Dolomite-Kutnohorite	$Ca(Fe^{2+},Mg)(CO_3)_2$ - $CaMg(CO_3)_2$ - $Ca(Mn^{2+})(CO_3)_2$		0.5
Calcite	$CaCO_3$	2.8	1.4
Siderite-Rhodochrosite	$Fe^{2+}CO_3$ - $Mn^{2+}CO_3$	31.3	15.9
Sulphides			
Galena	PbS	0.4	
Pyrite	FeS_2	2.3	5.6
Sphalerite	(Zn,Fe)S	2.3	1.4
Sulphates			
Gypsum	$CaSO_4 \cdot 2H_2O$		0.7
Oxides			
Rutile	TiO_2		0.4

Note.
The amounts represent the relative amounts of crystalline phases normalized to 100%.
[1] Mill tailings produced primarily from Bellekeno ore.
[2] Mill tailings produced primarily from New Bermingham and Flame & Moth ore.

6.3.2.3 Acid-Base Accounting

The statistical summary results of the ABA testing of the monthly composite tailings samples are provided in in Table 6-9. For discussion purposes, the 95th percentile, median, and 5th percentiles of the tailings datasets from the historical 2011 to 2013 samples (n = 24; i.e., Bellekeno ore only) are compared to the more recent 2021 to 2024 samples (n = 26; i.e., New Bermingham and Flame & Moth ore, primarily). Samples in the 2011-2013 dataset that did not have the siderite-corrected NP analyzed, were not included in the statistical summary or discussion. Carbonate NP was not included in the 2011-2013 dataset.

Paste pH values in the 2021-2024 dataset (median = 7.80) were slightly lower than those in the 2011-2013 dataset (median = 8.20), indicating less alkaline conditions in the more recent dataset. The 5th percentile for pH in the 2021-2024 dataset (7.11) compared to the 2011-2013 dataset (7.83) shows greater variability compared to the median pH of both datasets and highlights more neutral conditions in recent tailings.

For the 2021-2024 dataset, the carbonate NP and siderite-corrected (or bulk) NP median were 93.0 and 55.6 CaCO3/t, respectively (Table 6-9). The siderite-corrected NP of the 2021-2024 samples were slightly lower compared to the range in the 2011-2013 samples (Table 6-9; Figure 6-19). The carbonate NP is typically higher than the siderite-corrected NP in most samples of the recent dataset (i.e., 2021-2024). Generally, carbonate minerals contribute the bulk of NP in these tailings samples, and the lower siderite-corrected NP relative to carbonate NP indicates that iron and/or manganese carbonate minerals (i.e., siderite or rhodochrosite) comprise the majority of the carbonate mineralogy. These iron/manganese carbonate minerals do not contribute to net acid neutralization under oxic weathering conditions as the acid neutralized by the carbonate portion of the mineral is offset by the acid produced during oxidation and hydrolysis of the iron and manganese. The siderite-corrected NP procedure accounts for this, resulting in lower bulk NP compared to carbonate-NP (which is calculated from the inorganic carbon content) for samples with a significant iron and/or manganese carbonate content.

The total sulphur content of the 2021-2024 tailings (median 2.82 wt.%) were higher compared to the sulphur content of the 2011-2023 tailings (median of 2.16 wt.%), and generally showed more variability in sulphur content (Table 6-9; Figure 6-20). Sulphide sulphur followed a similar trend, with a median of 2.76 wt.% in 2021–2024 compared to 2.15 wt.% in the older dataset. Sulphate sulphur content was generally low between both datasets, with median of 0.02 and 0.06 wt.% in the historical and recent dataset, respectively (Table 6-9). Sulphide sulphur was the dominant form of sulphur in both datasets, accounting for most of the total sulphur (Table 6-9). The acid potential (AP) of the tailings samples in the 2011-2013 dataset ranged from 28.1 to 113 kg CaCO3/t (median of 67.2 kg CaCO3/t), while the 2021-2024 dataset ranged from 40.6 to 389 kg CaCO3/t, with a median of 86.3 kg CaCO3/t.

The neutralization potential ratio (NPR), calculated as the ratio of bulk NP to AP, was relatively lower in the 2021-2024 dataset (median of 0.8) compared to the historical dataset (median of 1.3; Table 6-9). All 2021-2024 samples were classified as potentially acid generating (PAG; NPR <1) or uncertain (1≤ NPR ≤2; Table 6-9; Figure 6-21). Sequential net acid generation (NAG) testing was performed on New Bermingham tailings produced during metallurgical testing prior to mine development. These tailings had an NPR of 1.3 (i.e., uncertain potential for acid generation); however, the sequential NAG testing demonstrated that net acid generation was not expected (AEG, 2019d).

Table 6-9: Summary Statistics for ABA Results from Monthly Composite Tailings Samples

DATASET	PASTE PH	TOTAL INORGANIC CARBON	CARBONATE NP	SIDERITE-CORRECTED NP	TOTAL SULPHUR	SULPHATE SULPHUR	SULPHIDE SULPHUR	AP	NPR
	-	WT. %	KG $CACO_3$/T	KG $CACO_3$/T	WT. %	WT. %	WT. %	KG $CACO_3$/T	-
2011 – 2013 (n = 24)									
95th Percentile	8.30	4.16	-	126.9	3.19	0.06	3.16	98.6	2.5
Median	8.20	3.44	-	87.0	2.16	0.02	2.15	67.2	1.3
5th Percentile	7.83	1.31	-	45.6	1.10	0.01	1.06	33.3	0.9
2021 – 2024 (n = 26)									
95th Percentile	7.96	2.02	168.1	97.0	6.95	0.11	6.87	214.5	1.3
Median	7.80	1.12	93.0	55.6	2.82	0.06	2.76	86.3	0.8
5th Percentile	7.21	0.32	26.3	52.6	1.57	0.03	1.51	47.0	0.3

Note. NP = Neutralization Potential, AP = Acid Potential, NPR = Neutralization Potential Ratio.

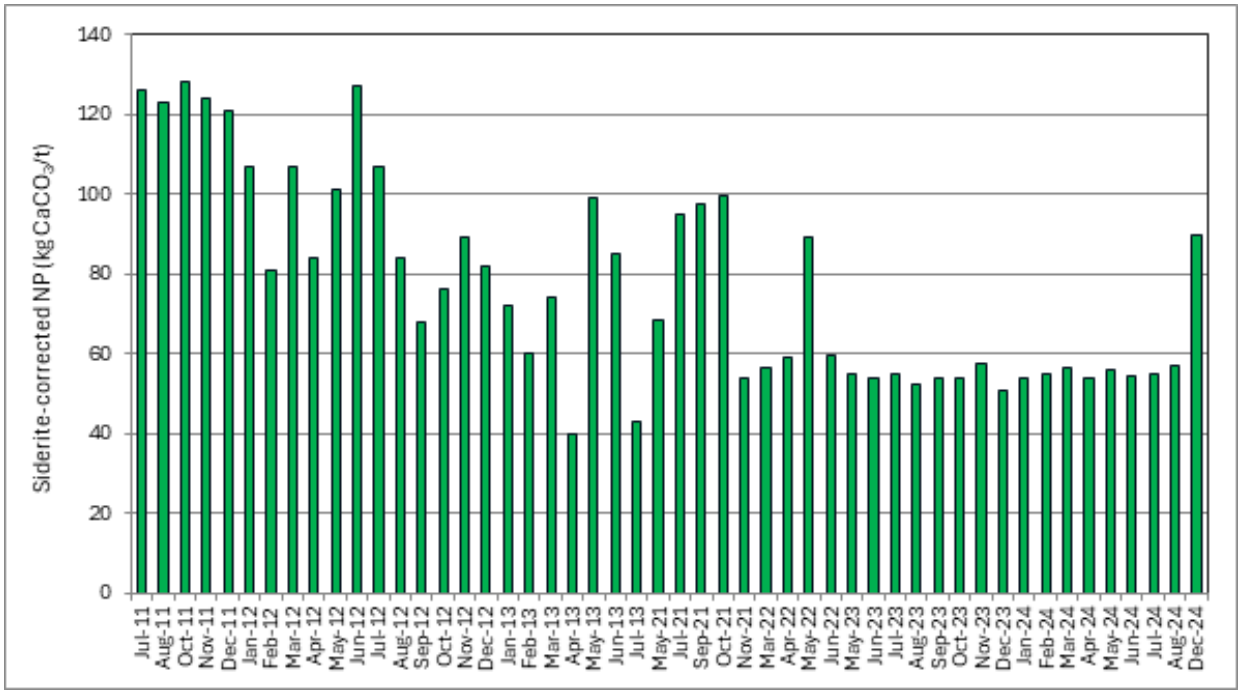


Figure 6-19: Monthly Mill Tailings Composite Testing, Neutralization Potential

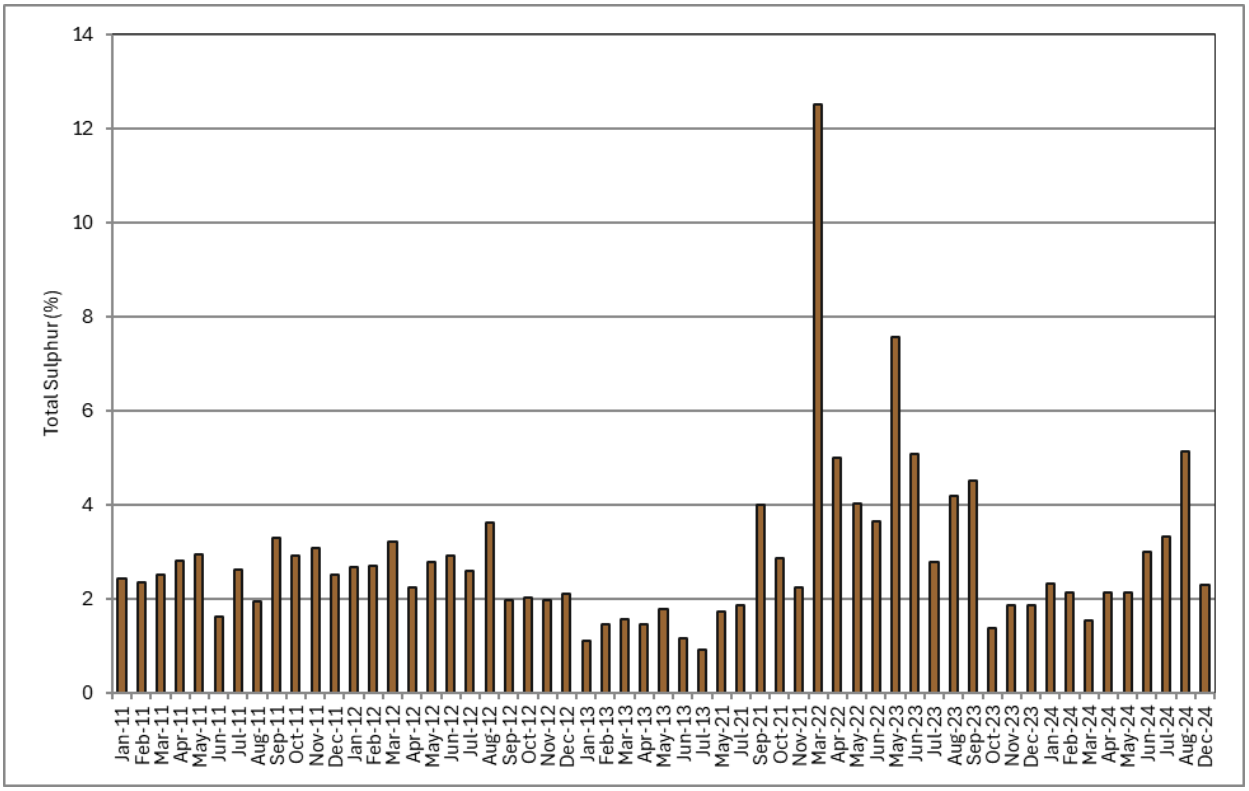


Figure 6-20: Monthly Mill Tailings Composite Testing, Neutralization Potential Ratio

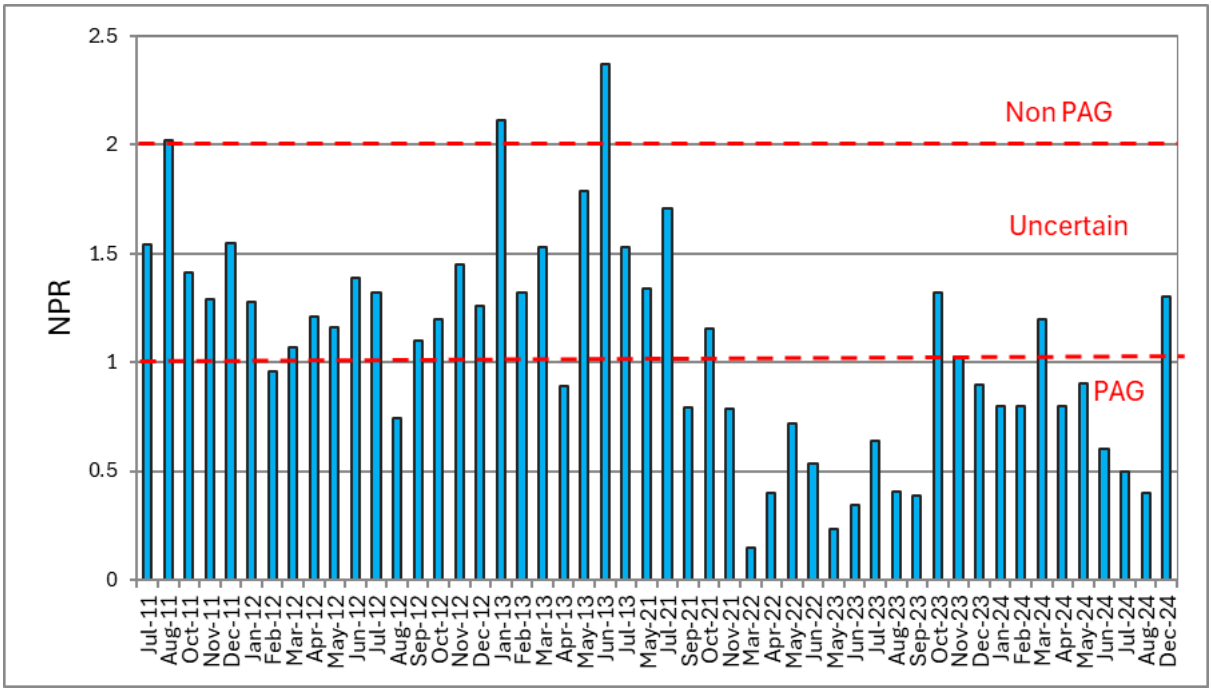


Figure 6-21: Monthly Mill Tailings Composite Testing, Neutralization Potential Ratio

6.3.2.4 Elemental Analysis

The summary results of the elemental analysis of the monthly composite tailings samples are presented in Table 6-10 for the historical (2012-2013) and more recent dataset (2021-2024). The tailings samples' 95th percentile, median, and 5th percentile metal concentrations were compared to ten times (10x) the average elemental continental crustal abundance (Haynes et al., 2014) to identify elevated concentrations. In both datasets, arsenic, antimony, bismuth, cadmium, lead, manganese, silver, and zinc regularly exceeded their respective 10x average crustal abundances (Table 6-10).

The 95th percentile bulk elemental analysis of the 2021-2024 tailings samples were compared to the 95th percentile of the historical data (2012-2013 tailings samples) focusing on the elements that were elevated relative to their 10x average crustal abundance and are potentially mobile under typical environmental conditions (Table 6-10). The box plots presented in Figure 6-22 and Figure 6-23 show the ranges of bulk concentrations of the elevated constituents. Cadmium, copper, lead, and zinc generally returned lower bulk concentrations for the 2021-2024 samples compared to the historical dataset. Antimony, manganese, and silver showed variance in bulk concentrations between the historical and more recent dataset.

Table 6-10: Summary Statistics for Selected Metals Data for 2012-2023 and 2021-2024 Tailings Samples

	SILVER	ARSENIC	CADMIUM	COPPER	MANGANESE	LEAD	ANTIMONY	SELENIUM	ZINC
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
10x Crustal Abundance[1]	**0.75**	**18**	**1.5**	**600**	**0.95**	**140**	**2**	**0.5**	**700**
2012 – 2013 (n = 14) [2]									
95th Percentile	97.1	2,880	261	346	32,825 [3]	13,890	209	0.8	20,510
Median	45.5	2,170	165	240	32,150 [3]	4,755	121	0.5	12,150
5th Percentile	18.9	1,391	109	163	31,475 [3]	1,913	45.4	0.4	8,287
2021 – 2024 (n = 26)									
95th Percentile	91.9	5,506	442	470	30,962	7,959	182	0.9	31,325
Median	37.5	1,422	48.2	95	25,301	2,187	45.6	0.6	4,461
5th Percentile	13.6	405.2	8.2	37.8	11,771	734	21.9	0.4	866
Count (%) > P95 of 2012-2013	2 (8%)	7 (27%)	3 (12%)	2 (8%)	1 (4%)	0 (0%)	1 (4%)	2 (8%)	3 (12%)

Note.

Highlighted results exceed 95th percentile of the 2012-2013 dataset.

[1] Haynes et al. (2014).

[2] Elemental data for tailings not available for 2011.

[3] For manganese, n = 2 in the 2012-2013 dataset.

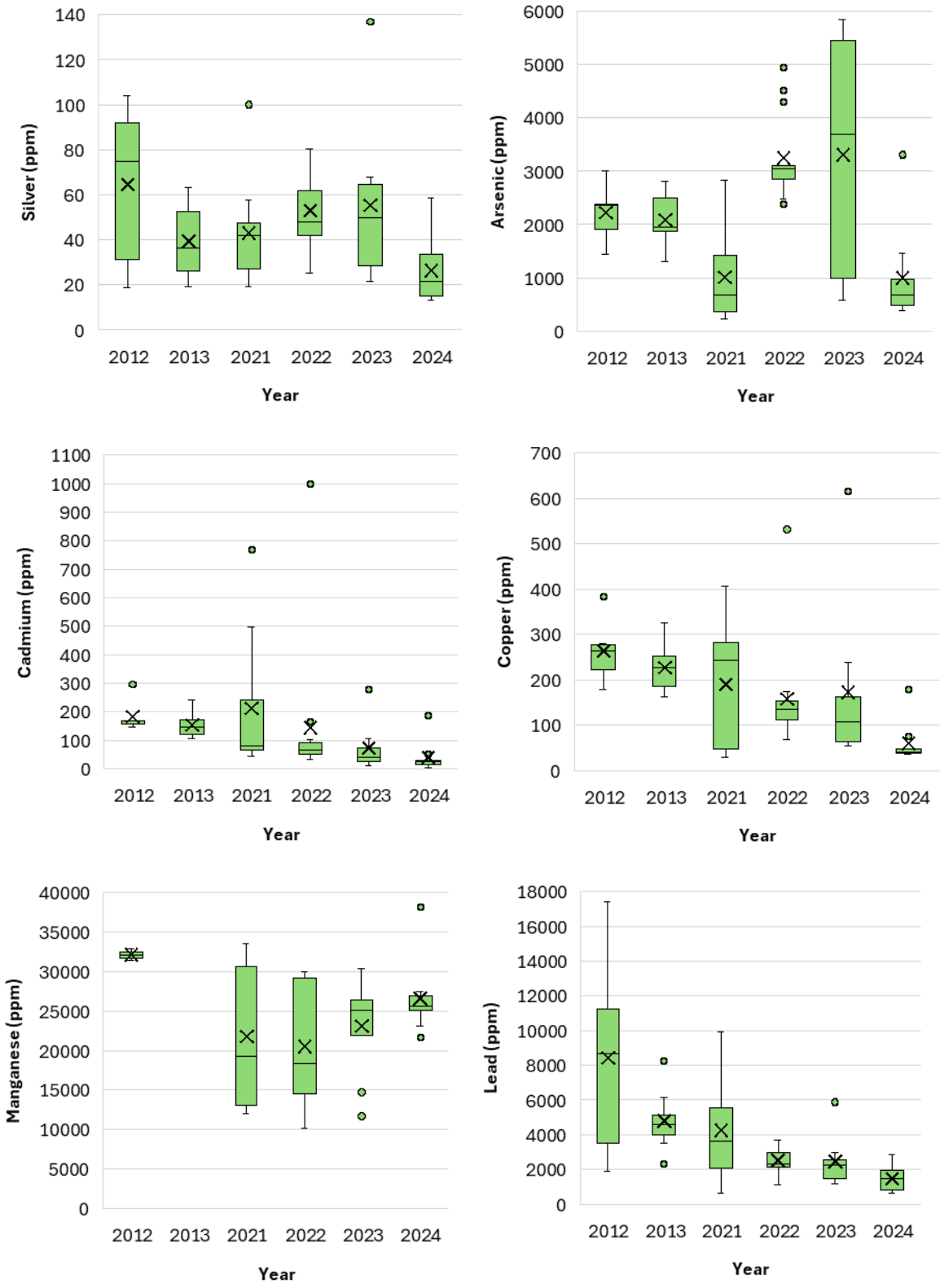


Figure 6-22: Silver, Arsenic, Cadmium, Copper, Manganese, and Lead Bulk Concentrations in Tailings

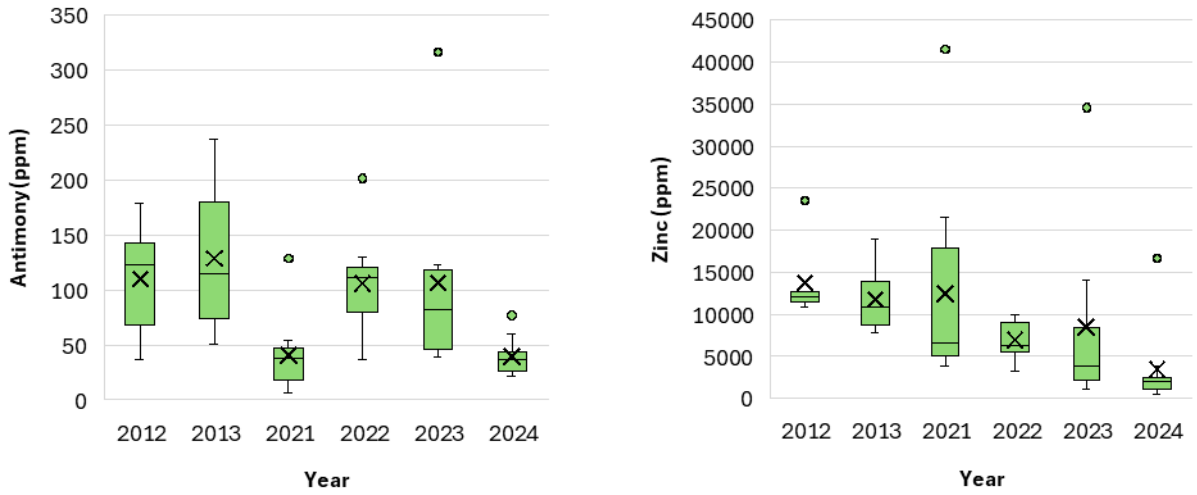


Figure 6-23: Antimony, and Zinc Bulk Concentrations in Tailings

6.3.2.5 Shake Flask Extraction

The summary results of SFE testing leachate analysis for the 2012-2013 and 2021-2024 tailings samples are presented in Table 6-11. For reference purposes only, the SFE results were compared to the Mill effluent quality standards (EQS) for KV-83 but are not required for compliance with the water licence.

The SFE leachate pH in the more recent dataset was generally much lower than the historical dataset (median 6.4 compared to 8.3) and was generally slightly lower than the EQS minimum pH 6.5. Four elements (antimony, arsenic, cadmium, and lead) exhibited a correlation between SFE leachate and solid-phase bulk metals concentrations (Figure 6-24). Increased leaching was observed in samples with higher bulk concentrations relative to 10x crustal abundance for antimony, lead, and cadmium, though this correlation was more apparent in lead and cadmium (Figure 6-24). Conversely, decreased leaching was observed in the 2024 samples with higher bulk concentrations for arsenic (Figure 6-24), which differs to trends observed in other years. When comparing the 95th percentiles from both datasets, most parameters were below their respective EQS (Table 6-11). The 95th percentiles for cadmium and zinc in the more recent dataset (2021–2024) were elevated, however, compared to their respective EQS. Although some bismuth and tin samples had elevated bulk concentrations relative to the 10x crustal abundance, their leachable concentrations were below their respective laboratory reporting limits.

Table 6-11: Shake Flask Extraction (SFE) Results of Tailings Samples

Leachable Metals	Unit	2012 – 2013 (n = 14)			2021 – 2024 (n = 25)			EQS (KV-83)
		P95	Median	P5	P95	Median	P5	
pH	pH units	8.4	8.3	7.9	7.3	**6.4**	**6.0**	6.5-9.5
Sulphate	mg/L	-	-	-	785	426	141	
Acidity (to pH 8.3)	mg/L	-	-	-	38	22	10	
Alkalinity (to pH 4.5)	mg/L	-	-	-	46	21	13	
Fluoride	mg/L	-	-	-	0.91	0.11	0.05	
Dissolved Hardness (CaCO3)	mg/L	-	-	-	742	504	180	
Aluminum	mg/L	0.043	0.025	0.013	0.029	0.009	0.0021	
Antimony	mg/L	0.058	0.041	0.033	0.047	0.019	0.01	
Arsenic	mg/L	0.017	0.0073	0.0032	0.014	0.0007	0.00023	0.1
Barium	mg/L	0.05	0.024	0.011	0.078	0.035	0.022	
Beryllium	mg/L	0.0005	0.00025	0.00025	0.00005	0.000005	0.000005	
Bismuth	mg/L	0.0005	0.00025	0.00025	0.00005	0.000005	0.000005	
Boron	mg/L	0.11	0.094	0.085	0.11	0.052	0.023	
Cadmium	mg/L	0.0051	0.0024	0.0015	**0.04**	0.0047	0.0015	0.01
Calcium	mg/L	191	130	87	277	188	64	
Chromium	mg/L	0.0005	0.00025	0.00025	0.00071	0.00025	0.00018	
Cobalt	mg/L	0.00042	0.00026	0.0002	0.002	0.00026	0.000095	
Copper	mg/L	0.0096	0.0077	0.0047	0.0078	0.0007	0.0003	0.1
Iron	mg/L	0.015	0.015	0.015	0.005	0.001	0.001	
Lead	mg/L	0.1	0.084	0.019	0.15	0.042	0.0074	0.2
Lithium	mg/L	0.048	0.035	0.019	0.039	0.016	0.0063	
Magnesium	mg/L	7.4	5.6	4.4	15	6.2	2.9	
Manganese	mg/L	0.93	0.66	0.48	3.1	0.93	0.46	
Mercury	mg/L	0.000025	0.000025	0.000025	0.02	0.00001	0.00001	
Molybdenum	mg/L	0.013	0.011	0.0072	0.0052	0.0023	0.00099	
Nickel	mg/L	0.0013	0.00077	0.0005	0.0058	0.0013	0.00031	0.5
Phosphorus	mg/L	0.34	0.15	0.15	0.64	0.22	0.05	
Potassium	mg/L	13	11	6.4	28	7.0	3.2	
Selenium	mg/L	0.0012	0.0011	0.00041	0.0011	0.00039	0.00012	
Silicon	mg/L	4.1	3.6	3.0	1.9	0.8	0.41	
Silver	mg/L	0.0049	0.002	0.00021	0.0019	0.00009	0.000015	0.02
Sodium	mg/L	30	26	19	9.4	6.1	2.2	
Strontium	mg/L	0.68	0.51	0.34	0.64	0.33	0.093	
Thallium	mg/L	0.00032	0.0002	0.00011	0.00097	0.00041	0.00018	
Tin	mg/L	0.0005	0.00025	0.00025	0.00025	0.000025	0.000025	
Titanium	mg/L	0.013	0.005	0.005	0.0021	0.0001	0.0001	
Uranium	mg/L	0.003	0.0012	0.00043	0.00043	0.00014	0.00001	
Vanadium	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	
Zinc	mg/L	0.061	0.048	0.022	**2.2**	0.11	0.052	0.5

Note.

Results that exceed the Mill effluent quality standard (EQS) for KV-83 are bold highlighted. When concentrations were below detection limit, a value equal to half the detection limit was substituted in for statistical analysis.

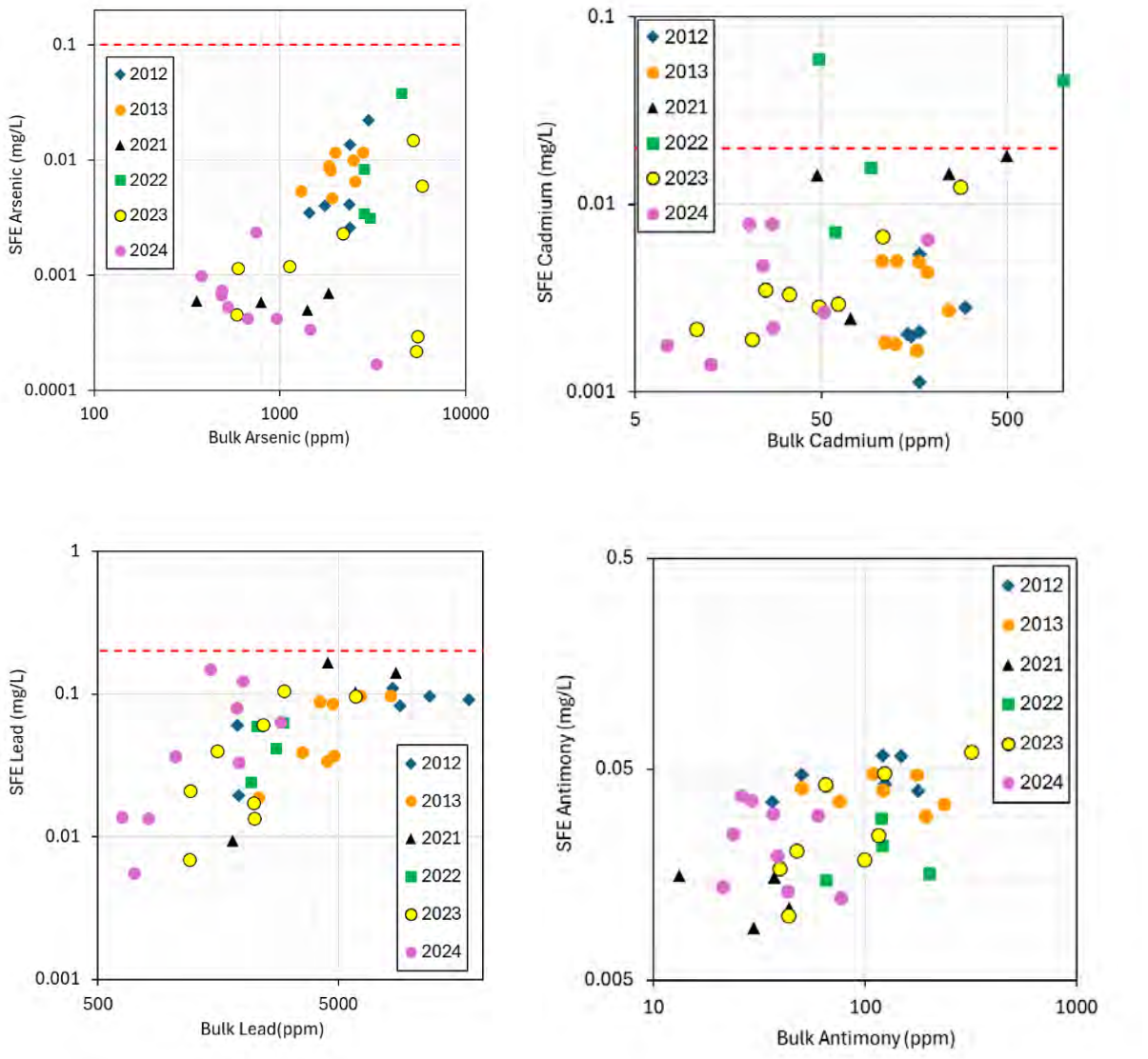


Figure 6-24: SFE Leachable Concentrations vs. Bulk Metal Contents for Arsenic, Cadmium, Lead, and Antimony

SFE – shake flask extraction. Dashed red lines indicate Mill EQS (KV-83) for arsenic (0.1 mg/L), cadmium (0.02 mg/L), and lead (0. 2 mg/L)

6.3.3 Kinetic Testing

Kinetic testing is ongoing for Mill tailings produced during recent operations (June 2024 composite sample) in accordance with Water Licence QZ18-044 requirements. Since this test work is ongoing, an update will be provided in the 2025 annual report. As part of permitting of the KHSD mining operations, humidity cell (HC) testing was conducted using tailings material generated from metallurgical testing. One tailings HC was operated for each of the following deposits: Flame & Moth, Bellekeno, and New Bermingham. Flame & Moth, Bellekeno, and New Bermingham tailings HCs were terminated after 113, 208, and 103 weeks of testing, respectively.

Time series of selected constituents of interest (i.e., pH, alkalinity, acidity, sulphate, and metals and metalloids of potential environmental concern) are presented in Figure 6-25, Figure 6-26, and Figure 6-27. Generic WQGs are also plotted for comparative purposes only rather than an assessment of compliance with site water quality standards. WQGs issued by the Canadian Council of Ministers of the Environment (CCME) were plotted. Antimony and sulphate do not have a CCME guideline so the guideline published by the British Columbia Ministry of Environment and Parks (BC ENV) were used for these parameters. For guidelines that incorporate modifying factors such as pH, dissolved organic carbon, and hardness, calculations were performed using the 2020–2025 dataset from station KV-50 in the receiving environment of Christal Creek which is located downstream of the DSTF. These calculations applied to cadmium, copper, lead, nickel, and zinc, and the average guideline value across the dataset was used for comparison.

The pH, acidity, alkalinity, and sulphate released from the leachate of the New Bermingham during the tests are plotted in Figure 6-25. All the tailings HCs had neutral pH within the WQG range (6.5 - 9.0), ranging between 7.1 and 8.0 with a median of 7.4. All the tailings HCs showed fairly low acidity of less than 7.4 mg/L $CaCO_3$, with a median equivalent to the detection limit 0.5 mg/L $CaCO_3$. The alkalinity of each cell was sufficient to buffer the acidity released, showing a maximum of 40 mg/L $CaCO_3$ and a median of 21 mg/L $CaCO_3$. The sulphate concentrations were relatively low (median 51 mg/L) in all the tailings cells, indicating a low sulphide oxidation rate. The acidity, alkalinity, and sulphate concentrations showed a first flush effect, resulting from the release of readily soluble products, followed by a decrease then stabilization of the concentrations until cycle 43 and 37 for acidity and alkalinity, respectively. Recurrent spikes of acidity were observed until cycle 69, after which the acidity was typically below the detection limit. Alkalinity gradually increased after cycle 37 from 12 mg/L to 40 mg/L at cycle 99, coincident with an increase in pH from 7.3 to 8.0. The sulphate concentrations showed a slight increase between cycles two and nine (85 mg/L), then decreased and continued to decline during the test reaching 29 mg/L during the last two cycles.

The pH and alkalinity levels in the leachate from the New Bermingham humidity cell were lower than those observed in the Flame & Moth and Bellekeno tailings HCs (Figure 6-25), reflecting its lower NP and lack of calcite. During the first 30 cycles, sulphate concentration decreased from 374 to 29 mg/L in the New Bermingham leachate and decreased from 1,150 to 158 mg/L in the Bellekeno HC. The sulphate concentrations were markedly lower in the New Bermingham HC than those observed in the Bellekeno HC. Then, sulphate concentrations from both New Bermingham and Bellekeno HCs decreased and became similar from cycle 55 onward. Sulphate concentrations of the Flame & Moth HC leachate also exhibited a decreasing trend during the first 17 cycles from 1130 mg/L to approximately 40 mg/L, after which the sulphate concentration fluctuated but remained relatively stable ranging from approximately 20 to 30 mg/L. This trend is expected for Bellekeno, which has a higher sulphide-sulphur content (4.8 wt.%) than the New Bermingham tailings (1.4 wt.%) but is somewhat unexpected for the early cycles of the test for Flame & Moth because of its lower sulphide-sulphur content (0.7 wt.%). Sulphides in the Flame and Moth tailings were likely exposed to leaching at the onset of the test resulting in higher release rate early on and gradual decline thereafter. However, the three tailings

generally showed a similar sulphate release pattern despite the difference in absolute concentration, although the sulphate released from the Flame & Moth HC stabilized whereas sulphate concentrations in the New Bermingham and Bellekeno HCs continued to slowly decrease (Figure 6-25).

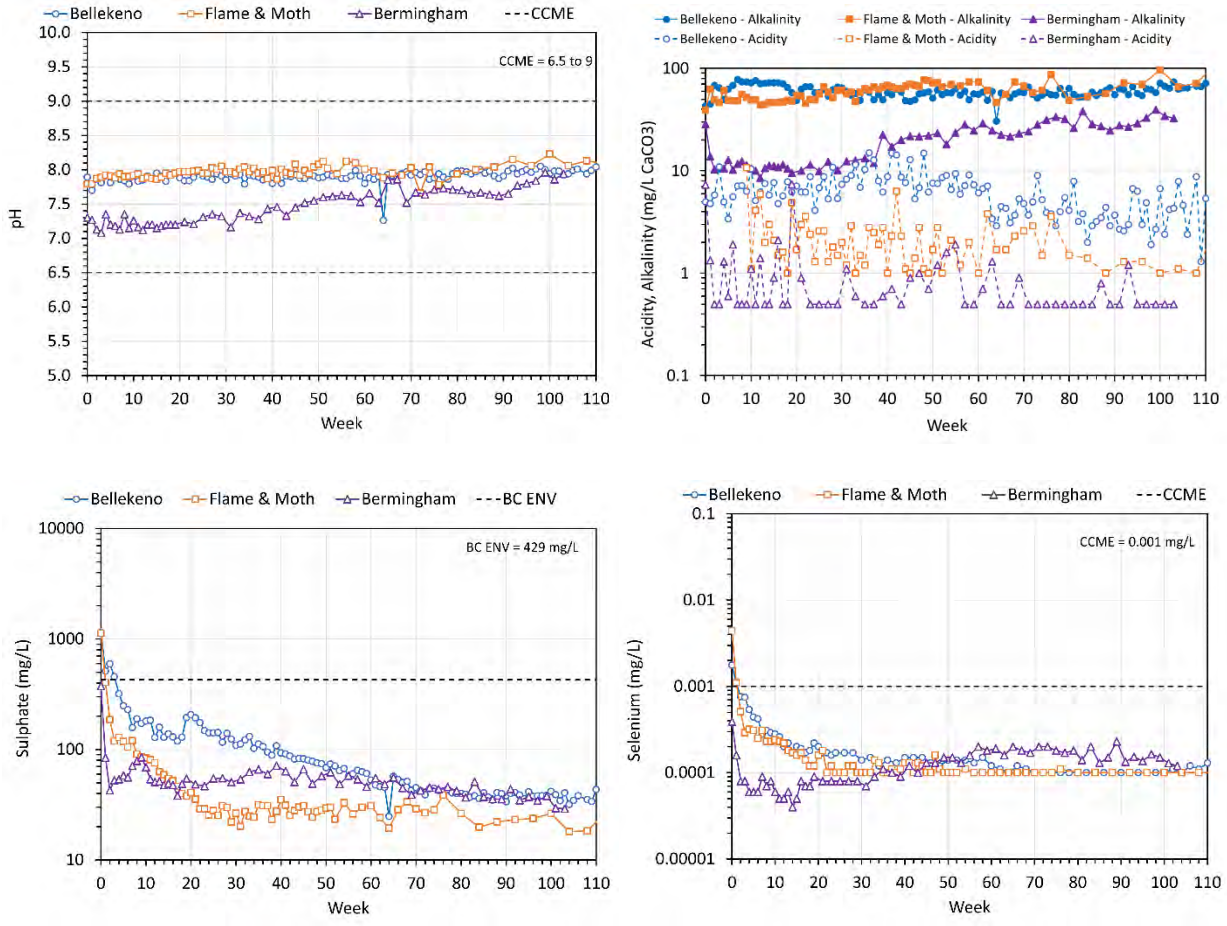


Figure 6-25: pH (top left), Acidity and Alkalinity (top right), Sulphate (bottom left), and Selenium (bottom right) of the New Bermingham, Flame & Moth, and Bellekeno Tailings Humidity Cells

Figure 6-26 presents the time series of arsenic, antimony, cadmium, and copper, and Figure 6-27 displays the time series of lead, nickel, silver, and zinc. Cadmium, lead, and zinc of the Bellekeno HC were regularly above their respective WQGs. For the Flame & Moth HC, arsenic, copper, lead, and silver were regularly above their respective WQGs during early cycles but decreased below their WQGs around cycles 40 to 60. Zinc concentrations at the Flame & Moth HC were above the WQG during early cycles but decreased below or remained around the WQG following 20 cycles. Cadmium concentrations were typically above the WQG for the New Bermingham humidity cell but decreased below the WQG following around 70 cycles. Lead and zinc concentrations at the New Bermingham humidity cell were above their respective WQGs during the first 20 cycles; however, concentrations were generally below their guidelines for the remainder of the cycles. The Bellekeno HC generally had the highest concentration release for sulphate, cadmium, lead, and zinc throughout the 103 cycles, and nickel during the last 70 cycles. The leachate of the New Bermingham had the highest nickel

during the first 30 cycles. The Flame & Moth HC had the highest concentration release for arsenic, antimony, copper, and silver during the first 80 cycles.

Time-series metals and metalloids of the New Bermingham humidity cell showed similar patterns, showing the highest concentration at cycle 0 due to flush effect, followed by a decreasing trend in concentration and a stabilization as early as cycle 11 onward (antimony and silver) or later (cycle 55 onward for arsenic, copper; cycle 81-89 onward for cadmium, lead and nickel; cycle ~95 for zinc.). All metal and metalloid concentrations fluctuated sporadically but the fluctuations in concentrations were more evident for arsenic, nickel, silver, lead, and copper.

Aside from the initial flush, the arsenic concentration in the New Bermingham humidity cell leachate was lower than that of the Bellekeno and Flame & Moth HC leachates, likely due to its lower bulk arsenic concentration. Arsenic concentrations in the New Bermingham HC were at least an order of magnitude lower than those in the Bellekeno and Flame & Moth HCs since cycle 35. During the first 35 cycles, cadmium and zinc concentrations were comparable in the New Bermingham and the Flame & Moth HCs leachates, showing similar decreasing trends in both HC leachates. After cycle 35, cadmium and zinc concentrations in the leachate of the New Bermingham HC were markedly lower by up to two orders of magnitudes than those of the Bellekeno HC. These trends likely reflect the higher contents of zinc and cadmium in the Bellekeno tailings bulk elemental composition.

Lead concentrations in the New Bermingham HC leachate gradually decreased from approximately 0.1 mg/L to 0.0001 mg/L throughout a total of 103 cycles. Lead concentrations of the New Bermingham HC leachate exhibited a significant fluctuation during cycle 21 to cycle 55, showing occasionally high releases of lead with concentrations varying from 0.0001 to 0.01 mg/L. Lead concentrations of the Flame & Moth HC leachate continued to decrease until stabilized from cycle 81 to cycle 103. The Bellekeno HC leachate showed a relatively stable lead concentrations throughout the 103 cycles, varying from 0.05 to 0.1 mg/L.

Nickel concentrations in the leachate of the New Bermingham humidity cell were relatively stable during the first 35 cycles, ranging from 0.002 to 0.009 mg/L, higher than those in the Flame & Moth and Bellekeno HC leachates during the same period. Nickel concentration decreased from 0.002 mg/L at cycle 35 to 0.0001 mg/L at cycle 75, subsequently remaining relatively stable from cycle 75 to 103. The Bellekeno HC leachate showed a relatively stable nickel concentrations throughout the test, varying from 0.001 to 0.006 mg/L.

Copper concentrations in the leachate of the New Bermingham humidity cell were relatively stable from cycle 1 to 20, varying from 0.0004 to 0.001 mg/L. Copper concentrations in the New Bermingham HC increased slightly to 0.003 mg/L and remained the same order of magnitude from cycle 46 to 103. Copper concentrations in the Flame and Moth HC leachate decreased gradually from 0.004 to 0.001 mg/L during 103 cycles. The Bellekeno HC leachate showed a fluctuating trend in nickel concentrations, varying from 0.0001 to 0.001 mg/L.

Silver concentrations in the leachate of the New Bermingham humidity cell were generally below the detection level (i.e., <0.000005 mg/L) similar to the silver release from the Bellekeno cell although spikes of concentration (0.0001 mg/L) were recurrent during the test. Silver concentrations in the Flame & Moth HC leachate fluctuated and decreased from 0.001 mg/L to below the detection limit of 0.00001 mg/L during the test. Antimony concentrations in the New Bermingham HC leachate were lower than that of the Bellekeno and Flame and Moth HC leachates despite a bulk antimony concentration (44.6 ppm) that was comparable with the Flame and Moth tailings (41 ppm).

Selenium concentrations in the leachate of the New Bermingham humidity cell exhibited a pattern different from all the parameters of interest (Figure 6-25). From the first flush to cycle 20, selenium concentration decreased by up to an order of magnitude in all HC leachate. Selenium concentrations stabilized in the Bellekeno and Flame & Moth HC leachates from cycle 20 to 103, showing concentrations of approximately 0.0001 mg/L for both HC leachates. A more evident fluctuation was observed in selenium concentrations of the New Bermingham HC leachate after the first 20 cycles, varying from 0.00008 to 0.0002 mg/L.

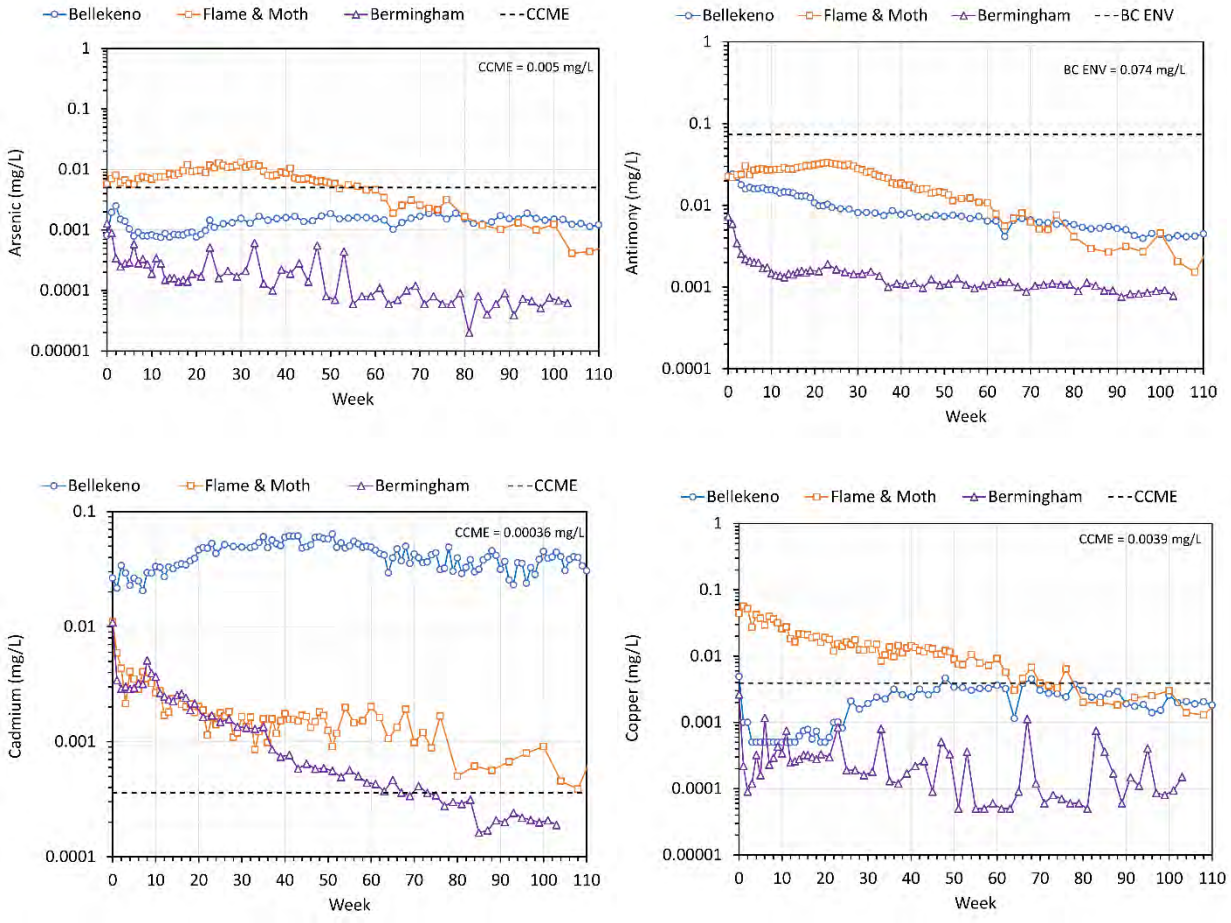


Figure 6-26: Arsenic (top left), Antimony (top right), Cadmium (bottom left), and Copper (bottom right) Trends of the New Bermingham, Flame & Moth, and Bellekeno Tailings Humidity Cells

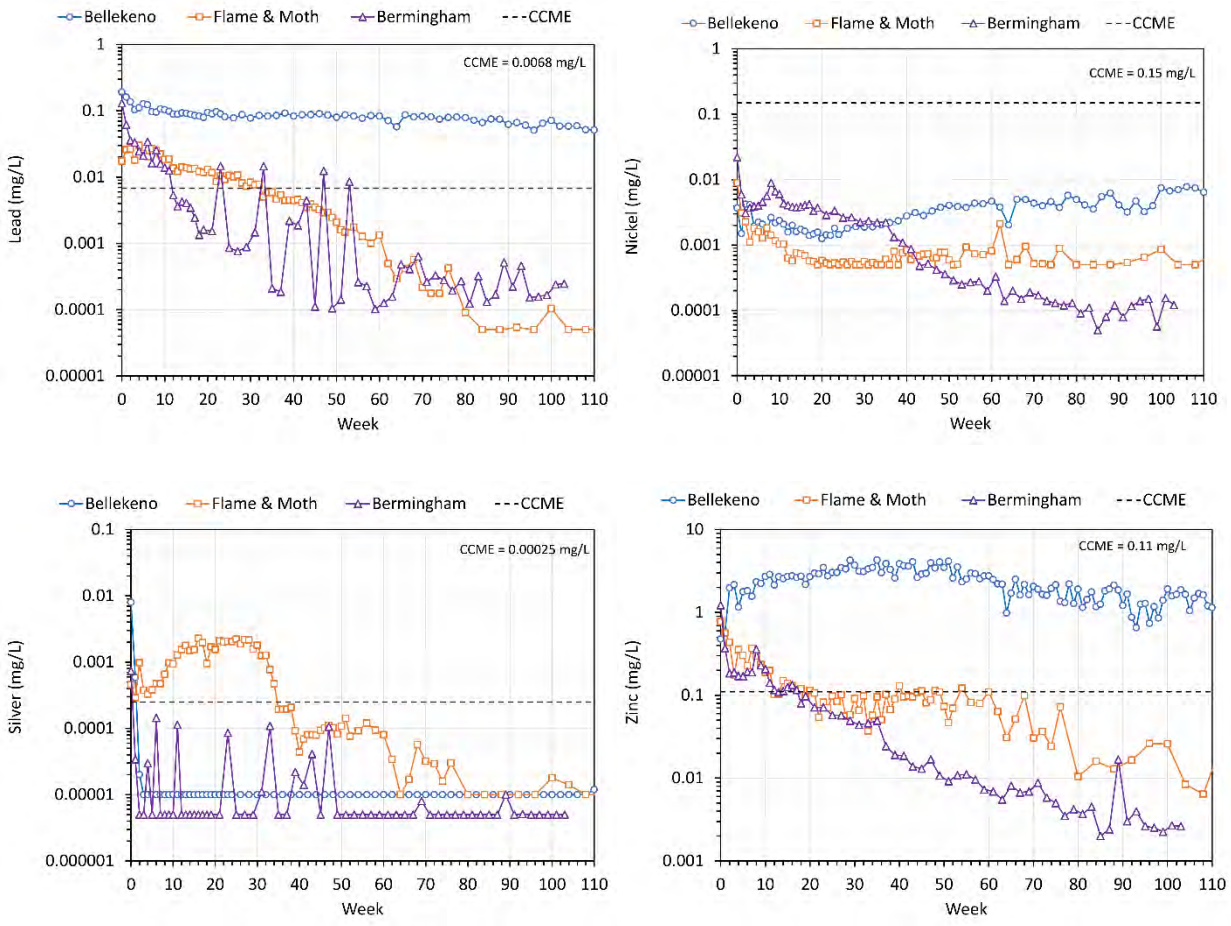


Figure 6-27: Lead (top left), Nickel (top right), Silver (bottom left), and Zinc (bottom right) Trends of the New Bermingham, Flame & Moth, and Bellekeno Tailings Humidity Cells

6.4 SLUDGE

Sludge samples collected Bellekeno 625, Flame & Moth and New Bermingham WTPs have undergone geochemical laboratory tests consisting of:

- Particle size analysis (PSA)
- Mineralogical analysis, by Rietveld x-ray diffraction (XRD)
- ABA, including paste pH, bulk NP using the modified Sobek method (Coastech, 1991) or siderite corrected method (Skousen et al., 1997), total inorganic carbon (TIC) by hydrochloric acid leach, total sulphur by Leco, sulphate-sulphur by hydrochloric leach, and sulphide-sulphur by difference.
- Elemental analysis, by aqua regia digestion with inductively coupled plasma mass spectrometry (ICP-MS).
- Leachable elements, using SFE testing with ICP-MS analysis of the filtered leachate (Price, 2009).

Surficial sludge from the Mill Pond was also collected in 2024 and subjected to ABA, XRD, SFE, and elemental analysis. Further information regarding historical geochemical tests is reported in AEG (2019b and 2020), Ensero (2021, 2022, 2023, and 2025a), and Hecla (2023).

6.4.1 Particle Size Analysis

The results of particle size distribution (PSD) for the 2021 to 2022 samples showed that the New Bermingham and Flame & Moth WTP sludge samples primarily comprised silt-sized material (73-82%), supplemented by a finer-grained clay fraction (16 26%) and trace sand (2% or less; Table 6-12). Bellekeno WTP sludge has a coarser PSD, and consisted of 75.5% silt, 22.4% clay and 3% sand (Table 6-12).

Table 6-12: Results of Particle Size Distribution Test of Water Treatment Plant Sludge Samples 2021-2022

Grain Size	Units	Detection Limit	BK	F&M		BH	
Sampling Year			2021	2021	2022	2021	2022
Clay (<0.004mm)	%	1.0	22.4	26.6	18.4	17.7	16.5
Silt (0.063 mm - 0.004 mm)	%	1.0	75.5	73.0	79.6	81.0	81.7
Sand (0.2 mm - 0.063 mm)	%	1.0	1.3	<1.0	-	<1.0	-
Sand (2.0 mm - 0.2 mm)	%	1.0	<1.0	<1.0	-	<1.0	-
Sand (2.0 mm - 0.063 mm)	%	1.0	2.1	<1.0	2	1.3	1.8
Gravel (>2 mm)	%	1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Nine sludge samples from the Mill Pond were submitted for particle size analysis (PSA) in 2024. The samples were clay to silt sized, with approximately 95% passing at 0.050 mm and approximately 15% passing at 0.004 mm (Figure 6-28). All samples had similar particle size distribution.

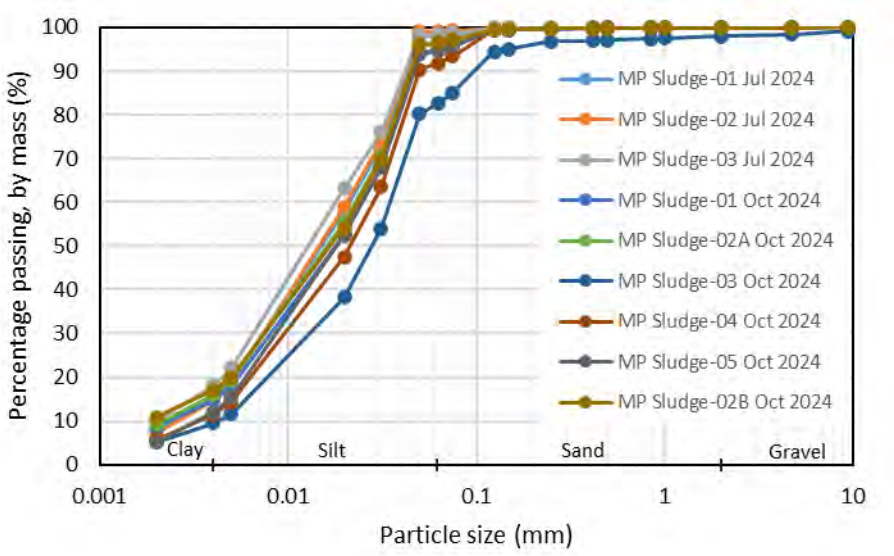


Figure 6-28: Particle Size Analysis Results for 2024 Sludge Samples

6.4.2 Mineralogical Analysis

Quantitative XRD analysis was conducted on five samples from the Mill Pond to evaluate the crystalline mineralogy and identify phases that may influence the ARD/ML potential of the sludge. Carbonate minerals (e.g., calcite and dolomite) are typically the principal contributors to NP, whereas sulphide minerals (e.g., pyrite) are usually the primary sources of AP. The XRD results are provided in Table 6-13 and compared to the median mineralogy abundances for tailings from the 2011-2013 dataset (i.e., Bellekeno tailings) and the 2021-2024 dataset (i.e., Bermingham and Flame & Moth tailings), since a significant proportion of the Mill Pond sludge material is expected to be composed of tailings from the Mill. The abundances reported represent the relative amounts of crystalline phases normalized to 100% (i.e., the results do not include amorphous phases). In general, the Mill Pond mineralogy appeared similar to the 2021-2024 tailings, but with higher abundance of illite-muscovite at the expense of quartz.

Quartz (SiO2) was the most abundant mineral in the samples, at approximately 55 wt.%, which was consistent with the 2011-2013 data and slightly less than the 2021-2024 dataset. Illite-muscovite was the other principal silicate mineral identified with abundance at approximately 15 wt.%, which was higher than the historical tailings datasets.

Siderite-rhodochrosite ($FeCO_3$-$MnCO_3$) was the most abundant carbonate mineral in the samples, at approximately 14 wt.%, which was consistent with the 2021-2024 tailings data. Calcite ($CaCO_3$) and ankerite-dolomite-kutnohorite [$Ca(FeMg)(CO_3)_2$ - $CaMg(CO_3)_2$ - $Ca(Mn)(CO_3)_2$] were also identified at abundances similar to the 2021-2024 tailings dataset. Calcite is the most reactive carbonate mineral and readily contributes to acid neutralization but was only present at 0.9% to 1.8% wt.%. Ankerite-dolomite-kutnohorite was also identified with low abundance, at 1.1 to 1.4 wt.%.

Pyrite (FeS_2) and sphalerite ((Zn,Fe)S) were the most abundant sulphide minerals identified, along with minimal galena (PbS). Pyrite content ranged from 4.1 to 5.4 wt.% and sphalerite content ranged from 0.3 to 1.6 wt.%, which was similar to the 2021-2024 tailings dataset.

Table 6-13: XRD Results of 2024 Sludge Samples

MINERAL	FORMULA	MEDIAN 2011 TO 2013[1] (N=10)	MEDIAN 2021 TO 2024[2] (N=11)	MP SLUDGE-02A 2024	MP SLUDGE-02B 2024	MP SLUDGE-03 2024	MP SLUDGE-04 2024	MP SLUDGE-05 2024
Silicates								
Chamosite	$(Fe^{2+},Mg,Fe^{3+})_5Al(Si_3Al)O_{10}(OH,O)_8$							
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$		0.9	1.7	1.7	1.5	1.5	1.6
Dravite	$NaMg_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$		1.1	0.9	0.8	1.9	0.9	1.1
Grossular	$Ca_3Al_2(SiO_4)_3$		2.1					
Illite-Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$ - $KAl_2AlSi_3O_{10}(OH)_2$	4.7	7.1	18.2	17.5	13.1	16.7	18.6
Kaolinite	$Al_2Si_2O_5(OH)_4$		0.4	0.8	0.8	0.8	0.8	1.0
Quartz	SiO_2	54.0	62.3	54.7	55.2	57.9	57.7	53.8
Carbonates								
Ankerite-Dolomite-Kutnohorite	$Ca(Fe^{2+},Mg)(CO_3)_2$ - $CaMg(CO_3)_2$ - $Ca(Mn^{2+})(CO_3)_2$		0.5	1.2	1.4	1.1	1.3	1.2
Calcite	$CaCO_3$	2.8	1.4	1.3	1.3	1.8	0.9	1.4
Siderite-Rhodochrosite	$Fe^{2+}CO_3$ - $Mn^{2+}CO_3$	31.3	15.9	14.0	14.2	13.4	14.1	14.0
Sulphides								
Galena	PbS	0.4		0.2	0.2	0.2	0.2	0.2
Pyrite	FeS_2	2.3	5.6	4.6	4.7	5.4	4.1	4.6
Sphalerite	(Zn,Fe)S	2.3	1.4	0.4	0.4	1.6	0.3	0.5
Sulphates								
Gypsum	$CaSO_4 \cdot 2H_2O$		0.7	1.3	1.3	0.9	1.1	1.3
Oxides								
Rutile	TiO_2		0.4	0.5	0.5	0.4	0.5	0.6
Total				**100**	**100**	**100**	**100**	**100**

Note.

Italicized results are uncertain.

The amounts represent the relative amounts of crystalline phases normalized to 100%.

[1] Mill tailings produced primarily from Bellekeno ore.

[2] Mill tailings produced primarily from New Bermingham and Flame & Moth ore.

6.4.3 Acid Base Accounting

The ABA provides an indication of the acid generation and neutralization potentials of geologic materials by determining the content and ratio of potentially acid producing and consuming minerals in a sample. The results of the ABA testing of the sludge samples between 2018-2022 are presented in Table 6-14 for the Bellekeno, Flame & Moth and New Bermingham WTPs. Table 6-15 presents results of the ABA testing in 2024 for the five Mill Pond samples, as well as one sample each from Bellekeno, Flame & Moth and New Bermingham. The 2024 samples were separated out from the other samples due to the use of siderite-corrected NP, whereas previous samples employed the modified Sobek NP method.

The 2018-2024 results show that samples from each of the WTP locations had neutral to mildly alkaline paste pH (8.0 to 9.0; Table 6-14; Table 6-15). The Mill Pond samples in 2024 were relatively neutral and ranged from 7.9 to 8.2 (Table 6-15).

A marked continuous decrease of carbonate-NP (from 870 to 113 kg CaCO3/t) was observed in the Flame & Moth WTP sludge from 2019 to 2022 (Table 6-14); however, carbonate-NP increased slightly in 2024 (183 kg CaCO3/t). Similar decreases in carbonate-NP can also be noted in the New Bermingham sludge (from 201 to 96.7 kg CaCO3/t) from 2021 to 2024 (Table 6-14; Table 6-15). This is likely due to lower lime addition over the years at both WTPs. The carbonate-NP remained the main contributor to the bulk neutralization potential for all samples from the WTP (2018-2024), suggesting that most NP is from reactive carbonates. However, the Mill Pond samples from 2024 showed siderite-corrected NP that was much lower than the carbonate NP which indicates that iron and/or manganese carbonate minerals (i.e., siderite or rhodochrosite) comprise the majority of the carbonate mineralogy, similar to the tailings (Section 6.3.2.3).

The sulphate-sulphur content in the 2019 to 2022 samples of the Flame & Moth sludge was much lower in 2021 and 2022 compared to the previous years. Similarly, the sulphate-sulphur content reported in 2024 was also low. This was likely due to lower addition of lime (i.e., less precipitation of the calcium sulphate mineral gypsum that forms as calcium from the lime reacts with sulphate in the mine water). Total sulphur for the Flame & Moth sludge was relatively lower between 2019 to 2022 (range of 0.47 to 0.75 wt.%; Table 6-14) and increased in the 2024 sample (2.84 wt.%). The total sulphur concentration in the Bellekeno samples between 2018 to 2024 ranged from 0.8 to 1.67 wt.%. The sulphate content comprised the majority of the sulphur content between 2018 to 2020 (Table 6-14). This shifted beginning in 2021, when sulphide-sulphur became more abundant (1.03 wt.%). Sulphate content increased in 2024 (Table 6-15) and comprised the majority of the total sulphur content. Sulphide-sulphur content has comprised the majority of the total sulphur content in all the New Bermingham WTP samples (Table 6-14; Table 6-15).

The NPR for the WTP sludge samples confirmed a low potential for acid generation (i.e., NPR greater than 2; Table 6-14; Table 6-15), and were classified as non-potentially acid generating (non-PAG). The NPRs for WTP sludge samples collected in 2024 were lower than previously observed at Flame & Moth and New Bermingham, although continue to be non-PAG. The Mill Pond sludge samples were identified as potentially acid generating (PAG; NPR <1) since they are likely dominated by Mill tailings.

Table 6-14: ABA Testing Results of Water Treatment Plant Sludge Samples between 2018 to 2022

PARAMETER	UNITS	DETECTION LIMIT	BK				F&M				BH	
			2018	2019	2020	2021	2019	2020	2021	2022	2021	2022
Paste pH	pH unit	0.1	9.0	8.5	8.6	8.8	8.3	8.0	8.6	8.3	8.9	8.3
Inorganic Carbon (C)	wt.%	0.05	10.05	9.91	8.39	7.38	10.4	6.62	2.41	1.4	2.41	1.32
Inorganic Carbon Dioxide (CO_2)	wt.%	0.2	36.7	36.3	30.8	27	38.2	24.2	8.8	5.1	8.9	4.9
Total Sulphur	wt.%	0.01	1.01	1.11	1.22	1.67	0.75	0.68	0.47	0.72	0.46	0.35
Sulphate-Sulphur	wt.%	0.01	0.98	1.09	0.72	0.64	0.77	0.45	0.02	0.06	<0.01	0.02
Sulphide Sulphur (by diff.)	wt.%	0.01	0.03	0.02	0.5	1.03	<0.01	0.23	0.45	0.66	0.46	0.33
Carbonate Equivalent Neutralization Potential (NP)	kg $CaCO_3$/t	1	835	826	700	615	869	550	201	113	201	111
Acid Generation Potential (AP)	kg $CaCO_3$/t	0.3	0.9	0.6	15.6	32.2	0.3	7.2	14.1	22.5	14.4	10.9
Modified Sobek Neutralization Potential (NP)	kg $CaCO_3$/t	1	837	868	695	600	902	520	195	91	202	100
Neutralization Potential Ratio (NPR)	NA	0.1	930	1447	45	19	3007	72	14	4.0	14	9.2
Acid Rock Drainage Classification	NA	-	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG

Note.
BK: Bellekeno 625; F&M: Flame & Moth; BH: New Bermingham
NP: neutralization potential
NA: not available

Table 6-15: ABA Testing Results of 2024 Sludge Samples

SAMPLE	PASTE PH	TOTAL INORGANIC CARBON	CARBONATE NP	SIDERITE-CORRECTED NP	TOTAL SULPHUR	SULPHATE SULPHUR	SULPHIDE SULPHUR	AP	NPR
	-	WT. %	KG $CACO_3$/T	KG $CACO_3$/T	WT. %	WT. %	WT. %	KG $CACO_3$/T	-
BK Sludge 2024	8.71	8.53	711	779	0.80	0.52	0.28	8.8	88.5
FM Sludge 2024	8.07	2.20	183	224	2.84	0.12	2.72	85.0	2.6
BH Sludge 2024	8.12	1.16	96.7	92.2	1.03	0.05	0.98	30.6	3.0
MP Sludge-01 2024	7.89	1.21	101	56.5	2.82	0.13	2.69	84.1	0.7
MP Sludge-02A 2024	8.14	1.50	125	61.4	2.72	0.13	2.59	80.9	0.8
MP Sludge-02B 2024	8.16	1.54	128	61.2	2.76	0.13	2.63	82.2	0.7
MP Sludge-03 2024	8.12	1.52	127	61.5	3.63	0.07	3.56	111	0.6
MP Sludge-04 2024	8.14	1.47	123	39.1	2.40	0.08	2.32	72.5	0.5
MP Sludge-05 2024	8.18	1.54	128	61.3	2.76	0.12	2.64	82.5	0.7

Note.
NP – Neutralization Potential; AP – Acid Potential; NPR – Neutralization Potential Ratio

6.4.4 Elemental Analysis

The bulk metal concentration of an element provides a preliminary indication of constituents that could be solubilized and remobilized when exposed to leaching, depending on the speciation of the metal. However, the enrichment (or depletion) of a constituent in a sample is not a direct measure of its potential mobility or bioavailability because several factors including hydrogeology, biogeochemistry, climate, pH, and redox conditions which together ultimately determine the mobility and bioavailability of an element in the environment. In the case of sludge, climate, pH, and redox conditions are the primary controls on the potential elemental mobility.

The results of the trace elemental analysis of the WTP sludge samples are presented in Table 6-16, while the Mill Pond samples are presented in Table 6-17. The sludge samples' metal concentrations were compared to ten times (10x) the average elemental continental crustal abundance (Haynes et al., 2014) to identify elevated concentrations.

The results of the elemental analysis showed high metal(loid) concentrations in the sludges as expected from a treatment system (Table 6-16 and Table 6-17). The discussion herein is focused on the constituents of potential interest (COPI) related to the KHSD mineralization such as arsenic, cadmium, copper, lead, nickel, manganese, iron, silver and zinc. The metalloid content of the Bellekeno sludge largely reflects the metal(loid) load supplied by the adit discharge to the WTP. The elevated manganese, lead, and zinc concentrations in the Bellekeno sludge reflect the high loading of these metal(loid)s supplied by the Bellekeno 625 adit (Table 6-16). The Bermingham sludge also contained elevated silver, arsenic, cadmium, manganese, and lead. The high acid buffering capacity of the sludges create favorable conditions for the precipitation of metal oxyhydroxides that scavenge and coprecipitate these metals(loids), limiting their solubility and mobility in the environment.

The sludge metal data collected to date also showed some variation of the concentration of metal(loid)s at each mine site. For example, the concentrations of many metal(loids) including arsenic, cadmium, copper, lead, silver, and zinc in the Bellekeno sludge increased significantly from 2019 to 2021 (Table 6-16). This behaviour

reflected changes to the concentration of these metal(loid)s in the Bellekeno 625 adit discharge, with mining activity likely responsible for the higher metal(loid) concentrations in both the adit discharge and associated sludge in 2021. Following cessation of active mining, some of these metals decreased in 2024 at Bellekeno, which included arsenic, cadmium, lead, and silver. The concentrations of some metals (e.g., arsenic, cadmium, copper, lead, manganese, and silver) in the Flame & Moth sludge also increased significantly in 2024 compared to previous years, while New Bermingham showed marked increases in manganese, lead, and zinc (Table 6-16).

The results of the elemental analysis show that elevated concentrations of COPI are present in the sludges as expected from a treatment system. Tessier sequential extraction testing was conducted in 2018 on Bellekeno and Flame & Moth sludge samples (AEG, 2019) and showed that the precipitated metal(loid)s were largely bound to the residual and reducible phases. The precipitated metal(loid)s were predominantly in stable forms and unlikely to be re-mobilized unless exposed to acidic or reducing conditions.

Table 6-16: Elemental Results by Aqua Regia Digest of WTP Sludge Samples

Element	Unit	Bellekeno					Flame & Moth					New Bermingham		10x Crustal Abundance[1]
		2018	2019	2020	2021	2024	2018	2019	2020	2021	2024	2021	2024	
Silver (Ag)	ppm	0.86	0.46	102	>100	24.9	0.99	0.06	1.21	4.18	220	>100	299	0.75
Aluminum (Al)	%	0.03	0.03	0.18	0.18	0.12	0.67	0.03	0.68	0.73	1.03	0.83	0.88	82.3
Arsenic (As)	ppm	36.3	21.9	242	308	107	38.6	89.2	73	30.8	1654	248	275	18
Barium (Ba)	ppm	20	20	30	30	22	70	10	40	120	101	90	113	4,250
Calcium (Ca)	wt. %	>25.0	>25.0	>25.0	22.7	>25	12.9	>25.0	22.6	7.96	7.34	8.04	3.44	41.5
Cadmium (Cd)	ppm	21.9	10.25	100.5	140.5	47.8	0.67	0.13	2.24	2.81	169	21.1	61.2	1.5
Cobalt (Co)	ppm	19.2	13.1	12.1	11.60	60.3	3.8	3.1	3.2	5.1	7.2	8.10	6.3	250
Chromium (Cr)	ppm	6	<1	4	5.00	2	19	2	15	19	32	18	41	1,020
Copper (Cu)	ppm	12.1	2.8	109	210	35.8	16	3	15.1	33	524	55.3	139	600

Element	Unit	Bellekeno					Flame & Moth					New Bermingham		10x Crustal Abundance[1]
		2018	2019	2020	2021	2024	2018	2019	2020	2021	2024	2021	2024	
Iron (Fe)	wt. %	2.46	1.86	2.72	2.89	2.69	1.6	1.31	1.94	1.71	5.31	2.36	2.83	56.3
Mercury (Hg)	ppm	0.01	<0.01	0.14	0.25	0.04	0.02	<0.01	0.04	0.05	0.46	0.09	0.2	0.85
Potassium (K)	wt. %	0.01	0.01	0.03	0.02	0.02	0.04	<0.01	0.04	0.04	0.08	0.06	0.09	20.9
Lithium (Li)	ppm	1.3	1.5	1.5	2.3	1.4	9.9	1.4	8	14	14.8	11.4	9.6	200
Magnesium (Mg)	wt. %	1.13	0.6	0.77	0.49	1.78	0.67	0.37	0.44	0.5	1.28	0.44	0.48	23.3
Manganese (Mn)	ppm	7130	4980	7030	7800	19749	759	1220	1150	595	4002	4280	6129	9,500
Molybdenum (Mo)	ppm	1.07	0.12	0.95	1.57	0.52	1.96	0.12	0.86	4.84	5.49	3.07	6.94	12
Sodium (Na)	wt. %	0.03	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.03	23.6
Nickel (Ni)	ppm	68.1	46.4	44.3	34.20	125	20.6	8.9	16.2	25.4	27.9	30.6	25	840
Phosphorous (P)	ppm	50	40	160	180	73	640	40	510	500	442	660	690	10,500

Element	Unit	Bellekeno					Flame & Moth					New Bermingham		10x Crustal Abundance[1]
		2018	2019	2020	2021	2024	2018	2019	2020	2021	2024	2021	2024	
Lead (Pb)	ppm	111	52.1	9750	>10000	2707	50.4	7.7	116	523	5738	1815	7676	140
Sulphur (S)	wt. %	1.07	1.14	1.38	1.73	0.98	0.69	0.78	0.79	0.49	3.09	0.48	1.15	0.35
Antimony (Sb)	ppm	2.14	1.06	95.4	174	24.1	3.44	2.83	4.57	4.68	219	66	165	2
Selenium (Se)	ppm	0.4	0.7	1.3	1.40	0.2	0.5	0.4	0.7	0.9	0.6	0.7	0.9	0.5
Tin (Sn)	ppm	1	<0.2	8.9	14.80	3.8	2.2	9.5	1.9	2.2	216	3.50	2.5	23
Strontium (Sr)	ppm	758	683	655	520	509	310	730	578	188	157	129	73.3	3,700
Uranium (U)	ppm	13.7	12.65	10.2	7.07	13.4	5.71	7.86	5.3	3.56	4.76	2.17	1.19	27
Zinc (Zn)	ppm	8380	5150	>10000	>10000	26500	133	169	361	331	22800	1500	4634	700

Note.
Red highlighted results exceed 10x the crustal abundance value. Values highlighted in blue may exceed 10x the crustal abundance value.
[1] Haynes et al. (2014)

Table 6-17: Elemental Results by Aqua Regia Digest of Mill Pond Sludge Samples

Element	Units	MP Sludge-01 2024	MP Sludge-02A 2024	MP Sludge-02B 2024	MP Sludge-03 2024	MP Sludge-04 2024	MP Sludge-05 2024	10x Crustal Abundance [1]
Silver (Ag)	ppm	44.1	41.3	39.7	68.2	32.8	46.4	0.75
Aluminum (Al)	%	0.54	0.51	0.51	0.50	0.50	0.51	82.3
Arsenic (As)	ppm	1,019	955	1,013	2,104	845	1,160	18
Barium (Ba)	ppm	60	65	60	56	57	64	4,250
Calcium (Ca)	wt. %	1.54	1.47	1.48	1.55	1.26	1.54	41.5
Cadmium (Cd)	ppm	38.4	39.6	38.6	107	30.9	43.3	1.5
Cobalt (Co)	ppm	7.6	8.1	8.4	8.1	8.0	7.8	250
Chromium (Cr)	ppm	82	88	86	76	94	90	1,020
Copper (Cu)	ppm	82.6	85.1	82.6	263	70.0	109	600
Iron (Fe)	wt. %	6.71	6.67	6.83	7.82	6.64	6.91	56.3
Mercury (Hg)	ppm	0.15	0.14	0.15	0.29	0.13	0.16	0.85
Potassium (K)	wt. %	0.11	0.11	0.11	0.09	0.11	0.11	20.9
Lithium (Li)	ppm	5.8	7.4	7.3	7.4	6.5	7.0	200
Magnesium (Mg)	wt. %	0.44	0.42	0.43	0.45	0.42	0.44	23.3
Manganese (Mn)	ppm	24,347	25,024	25,350	22,873	26,344	25,021	9,500
Molybdenum (Mo)	ppm	1.92	2.11	2.09	2.12	1.81	2.21	12
Sodium (Na)	wt. %	0.02	0.01	0.01	0.01	0.01	0.01	23.6
Nickel (Ni)	ppm	23.4	24.6	25.2	24.6	23.5	24.9	840
Phosphorous (P)	ppm	467	467	484	424	498	459	10,500
Lead (Pb)	ppm	2,508	2,372	2,319	2,976	1,981	2,598	140
Sulphur (S)	wt. %	2.90	2.87	2.95	3.94	2.58	2.95	0.35
Antimony (Sb)	ppm	55.2	57.0	56.2	99.2	47.3	64.2	2
Selenium (Se)	ppm	0.6	0.7	0.7	0.7	0.7	0.7	0.5
Tin (Sn)	ppm	13.2	14.3	14.0	78.3	11.8	19.6	23
Strontium (Sr)	ppm	27.0	27.8	27.7	27.8	23.0	28.1	3,700
Uranium (U)	ppm	0.79	0.86	0.84	0.89	0.80	0.92	27
Zinc (Zn)	ppm	3,614	3,529	3,482	11,300	2,852	4,087	700

Results in red font exceed 10x the crustal abundance value

[1] *Haynes et al. (2014)*

6.4.5 Shake Flask Extraction

The results of SFE testing leachate analysis for the WTP sludge samples are presented in Table 6-16, while the 2024 Mill Pond sludge samples are presented in Table 6-17. For reference purposes only, the SFE results are compared to the Mill effluent quality standards (EQS) for KV-83 but are not required for compliance with the water licence.

The SFE leachate pH ranged from pH 6.3 to pH 9.0. The leachate pH was lowest at Bellekeno in 2024 (6.3) and highest at BK in 2018 (9.0). The SFE leachate concentrations were lower than the EQS for the parameters with an established EQS (arsenic, cadmium, copper, lead, nickel, silver, zinc) for each WTP sludge. The Mill Pond samples pH were relatively lower (range of 6.3 to 6.6), with three samples that fell below the pH EQS of 6.5. All other SFE leachate concentrations for the Mill Pond samples were lower than EQS limits.

Table 6-18: SFE Results of WTP Sludge Samples

Leachable Metals	Unit	New Bermingham			Flame & Moth		Bellekeno	EQS (KV-83)
		2021	2022	2024	2022	2024	2024	
pH	-	8.25	7.41	6.3	7.42	6.7	9.0	6.5-9.5
EC	µS/cm	-	-	419	-	705	1,231	
Acidity, as $CaCO_3$	mg/L	-	-	30.2	-	26.9	<0.5	
Alkalinity, total, as $CaCO_3$	mg/L	-	-	28.2	-	45.2	176	
Sulphate	mg/L	120	201	207	398	462	1,015	
Hardness, dissolved, as $CaCO_3$	mg/L	237	225	271	426	585	1,280	
Aluminum, dissolved	mg/L	0.0546	0.03	0.0263	0.0204	0.0121	0.0030	
Antimony, dissolved	mg/L	0.153	0.117	0.225	0.0676	0.178	0.00202	
Arsenic, dissolved	mg/L	0.0279	0.0091	0.0104	0.0054	0.0122	0.000623	0.1
Barium, dissolved	mg/L	0.0488	0.0316	0.0771	0.0444	0.0316	0.00183	
Boron, dissolved	mg/L	0.279	0.095	0.291	0.05	0.0778	0.0213	
Cadmium, dissolved	mg/L	0.000136	0.00022	0.000376	0.000177	0.000377	0.0000343	0.01
Calcium, dissolved	mg/L	46.8	51.8	79.5	104	98.8	8.0	
Cobalt, dissolved	mg/L	0.00033	0.00018	0.0000607	<0.00010	0.0000424	0.000659	
Copper, dissolved	mg/L	<0.0010	<0.0010	0.00034	<0.0010	0.00061	0.00113	0.1
Iron, dissolved	mg/L	0.083	<0.030	<0.0020	<0.030	<0.0020	<0.0020	
Lead, dissolved	mg/L	0.0149	0.00093	0.0320	0.00094	0.00608	0.00201	0.2
Lithium, dissolved	mg/L	0.106	0.0291	0.0618	0.0205	0.0304	0.0118	
Magnesium, dissolved	mg/L	29.2	23.3	17.6	40.5	82.1	307	
Manganese, dissolved	mg/L	0.1	0.138	0.0537	0.0345	0.108	0.0292	
Mercury, dissolved	mg/L	0.015	<0.00050	<0.000020	<0.000050	<0.000020	<0.000020	
Molybdenum Dissolved	mg/L	0.00833	0.02	0.0247	0.0187	0.0303	0.00418	
Nickel, dissolved	mg/L	0.00172	0.0015	0.000536	0.00075	0.000533	0.00163	0.5
Phosphorus, dissolved	mg/L	<0.30	<0.30	<0.010	<0.30	0.033	<0.010	
Potassium, dissolved	mg/L	4.08	4.58	8.00	5.27	5.63	2.03	
Selenium, dissolved	mg/L	0.00188	0.00225	0.00044	0.00083	0.00045	0.00337	
Silicon, dissolved	mg/L	11	5.18	4.50	2.62	3.76	0.62	
Silver, dissolved	mg/L	<0.000050	0.000214	0.000190	<0.000050	0.000019	0.000014	0.02
Sodium, dissolved	mg/L	6.18	9.66	9.96	10.7	6.78	4.18	
Strontium, dissolved	mg/L	0.509	0.367	0.244	0.887	0.505	0.0224	
Sulphur, dissolved	mg/L	41.1	78.7	113	146	212	402	
Uranium Dissolved	mg/L	0.00698	0.00104	0.000514	0.000661	0.000822	0.000880	
Zinc Dissolved	mg/L	<0.010	<0.010	0.004	<0.010	0.011	0.033	0.5

Note. Results that did not meet the Mill EQS for KV-83 are highlighted in red.

Table 6-19: SFE Results of 2024 Mill Pond Sludge Samples

Leachable Metals	Unit	MP Sludge-01 2024	MP Sludge-02A 2024	MP Sludge-02B 2024	MP Sludge-03 2024	MP Sludge-04 2024	MP Sludge-05 2024	EQS (KV-83)
pH	-	6.4	6.3	6.5	6.6	6.4	6.5	6.5-9.5
EC	µS/cm	2,090	1,531	1,573	975	914	1,162	
Acidity, as $CaCO_3$	mg/L	27.3	23.4	21.7	21.5	20.0	21.7	
Alkalinity, total, as $CaCO_3$	mg/L	27.9	20.0	20.5	23.7	15.5	18.0	
Sulphate	mg/L	1,212	809	852	446	414	603	
Hardness, dissolved, as $CaCO_3$	mg/L	1,470	969	1,000	543	500	647	
Aluminum, dissolved	mg/L	0.0142	0.0157	0.0129	0.0092	0.0104	0.0112	
Antimony, dissolved	mg/L	0.0717	0.0313	0.0274	0.0253	0.0186	0.0238	
Arsenic, dissolved	mg/L	0.00405	0.00218	0.00130	0.00146	0.000892	0.00114	0.1
Barium, dissolved	mg/L	0.0290	0.0214	0.0219	0.0233	0.0193	0.0205	
Boron, dissolved	mg/L	0.143	0.0738	0.0674	0.0490	0.0395	0.0525	
Cadmium, dissolved	mg/L	0.00231	0.00197	0.00297	0.00323	0.00164	0.00200	0.01
Calcium, dissolved	mg/L	567	372	386	197	192	246	
Cobalt, dissolved	mg/L	0.000451	0.000233	0.000206	0.000165	0.000108	0.000127	
Copper, dissolved	mg/L	0.00078	0.00064	0.00082	0.00144	0.00061	0.00152	0.1
Iron, dissolved	mg/L	<0.0040	0.0064	<0.0020	<0.0020	<0.0020	<0.0020	
Lead, dissolved	mg/L	0.00812	0.00676	0.0190	0.0193	0.0162	0.0124	0.2
Lithium, dissolved	mg/L	0.0285	0.0134	0.0131	0.0103	0.0087	0.0106	
Magnesium, dissolved	mg/L	13.2	9.74	9.00	12.5	5.10	7.61	
Manganese, dissolved	mg/L	1.92	1.06	0.963	0.914	0.640	0.754	
Mercury, dissolved	mg/L	<0.000040	<0.000020	<0.000020	0.000023	<0.000020	<0.000020	
Molybdenum Dissolved	mg/L	0.0226	0.0132	0.0123	0.0106	0.00689	0.00938	
Nickel, dissolved	mg/L	0.00444	0.00197	0.00174	0.00121	0.000891	0.00107	0.5
Phosphorus, dissolved	mg/L	0.388	0.293	0.254	0.137	0.201	0.207	
Potassium, dissolved	mg/L	13.9	10.1	9.76	6.40	7.01	7.66	
Selenium, dissolved	mg/L	0.00055	0.00031	0.00035	0.00018	0.00021	0.00021	
Silicon, dissolved	mg/L	2.48	1.18	1.07	0.85	0.67	0.82	
Silver, dissolved	mg/L	0.000098	0.000132	0.000158	0.000577	0.000066	0.000099	0.02
Sodium, dissolved	mg/L	13.3	9.19	8.60	5.95	5.43	5.81	
Strontium, dissolved	mg/L	1.02	0.645	0.641	0.414	0.327	0.468	
Sulphur, dissolved	mg/L	528	342	355	202	178	237	
Uranium Dissolved	mg/L	0.00260	0.00124	0.00117	0.000437	0.000423	0.000585	
Zinc Dissolved	mg/L	0.057	0.046	0.071	0.080	0.043	0.054	0.5

Note. Results that did not meet the Mill EQS for KV-83 are highlighted in red.

7 FISHERIES AND AQUATIC RESOURCES

This section provides a summary of components that make up the regional ecosystem that may be affected by mining operations, including fish and fish habitat.

7.1 AQUATIC RESOURCES

Aquatic resources have been documented in the KHSD through numerous environmental studies conducted over the last two decades. Study methods and results were presented in previous assessments for projects within the KHSD. In general, most of the reports were consistent in their findings with respect to the characterization of the aquatic resources in local watersheds or catchment areas within the KHSD.

The main watercourses in the KHSD potentially affected by the Project are Lightning Creek, downgradient of the Bellekeno adit and Mill and flows west and south into Duncan, ultimately draining into the Mayo River and Stewart River watershed. No Cash and Star Creeks drain the No Cash, Ruby, and Bermingham adits into a bog catchment (approximate 2 km radius) with no surface connection to any rivers. Christal Creek is directly west of the District Mill and DSTF and flows into Christal Lake and eventually into the South McQuesten River and Stewart River watershed. Flat Creek drains the Valley Tailings Facility and flows into the South McQuesten River. The Keno Ladue watershed is located northeast of the Project site and is not discussed in this report. A map of the stations monitored (bi)annually for aquatic resources is presented in Figure 71.

The characterization and monitoring of the aquatic habitat section was developed using past WUL Reports findings from attenuation studies and multiple cycles from Environmental Effects Monitoring (EEM) programs over a three-year period. Monitoring frequency schedule requirements and monitoring are listed below in Table 7-1 as a condition of the water license.

Table 7-1: Monitoring Frequency Schedule

SITE ID	FREQUENCY	MONITORING
KV-6	Biennial (every two years)	Aquatic Sediment, Benthic Invertebrate Community
KV-21	Annually	Aquatic Sediment, Benthic Invertebrate Community
KV-38	Annually	Aquatic Sediment, Benthic Invertebrate Community
KV-41	Annually	Aquatic Sediment, Benthic Invertebrate Community
KV-42	Annually	Aquatic Sediment
KV-82	Annually	Aquatic Sediment
KV-104L	Annually	Aquatic Sediment
KV-104C	Annually	Aquatic Sediment
KV-111	Annually	Aquatic Sediment, Benthic Invertebrate Community

7.2 MONITORING OVERVIEW

Aquatic resources monitoring for the KHSD Mining Operations was conducted under a Type A Water Licence (WL QZ18-044). License monitoring sites include Christal Creek (KV-6 & KV-111), No Cash Creek (KV-21), Lightening Creek (KV-38 & KV-41), the Bellekeno 625 adit (KV-42), Keno Hill Silver District mill pond (KV-82), and the Flame & Moth water treatment pond decant which discharges into Lightening Creek (KV-104L) and Christal Creek (KV-104C).

Aquatic sediment samples are collected and analyzed for metal content, and particle size organic content (BCMOE 2019).

Benthic invertebrate community monitoring is conducted to detect changes that may reflect long term exposure to disturbances (CABIN 2012). Benthic invertebrate species vary in sensitivity to disturbances and can be used as indicators for short term pollution events, habitat degradation, and changes in water levels/flows (CABIN 2012).

Periphyton monitoring followed methods described in the British Columbia Field Sampling Manual (BCMOE 2020) and was consistent with the Yukon Guidelines for Mine Waste Management Facilities (YG 2023). This monitoring assesses the condition of periphyton, including algae and microorganisms on submerged surfaces to evaluate aquatic ecosystem health.

7.2.1 Aquatic Sediment Monitoring

Sediment samples were collected September 10 and 11, 2023 at sites within No Cash Creek (KV-21 and KV-111) and Lightning Creek (KV-38 and KV-41). Through an internal error from the lab, analysis for total metals and loss of ignition was not completed on the 2023 sediment samples and samples were discarded. No residual sample was retained to conduct the analysis after the error was identified. Therefore, data discussed from 2023 are limited to particle size. A summary of the mean aquatic sediment particle size data from 2023-2024 is presented in Table 7-3 and comparative data are provided in Figure 71. In 2023, the majority of the aquatic sediment samples collected were composed of coarse sand (0.420-0.841mm) for all samples.

Sediment samples were also collected between August 5-9th, 2024 at sites within No Cash Creek (KV-21 and KV-111), Lightning Creek (KV-38 and KV-41), Christal Creek (KV-6), and the Flame and Moth water treatment pond decant discharge into Lightening Creek (KV-104L). Sites on the WUL that were not sampled include the Bellekeno 625 Adit (KV-42) and the Keno Hill Silver District mill pond (KV-82). Both lacked habitat and sediment deposits due to the pipes and lined ponds. The majority of the aquatic sediment samples collected were composed of fines (0.05 mm). Sites KV-41, KV-21, and KV-111 consisted of one fifth gravel (>2.0 mm) which was the second highest particle size percentage for each station. Site KV-104L contained the highest percentage of silt/clay (<0.05 mm) at one third of the sample composition.

A summary of the guideline exceedances for metal content is presented in Table 7-4. Concentrations of arsenic, cadmium, and zinc from samples at all monitoring stations in 2024, exceeded the CCME guidelines (either ISQG or PEL). Samples collected from all sites except for KV-6 exceeded ISQG guidelines for chromium, and all sites except KV-41 and KV-111 exceeded ISQG or PEL guidelines for copper. All sites except for KV-111 exceeded ISQG or PEL guidelines for lead. Additionally, sites KV-104L and KV-6 were the only two sites to exceed ISQG guidelines for mercury.

Some analytical results for the split samples collected during sediment monitoring in 2024, were determined to have RPD greater than 25% but most were below the PQL. In the KV-6 samples, all RPD values were below 25% for the fraction passing through the 100 mesh, and for the fraction retained on the 100 mesh, only total silver was determined to have a RPD above 25% and both values above the PQL. In the KV-38 sample, for the fraction passing through the 100 mesh, total chromium, total manganese, total molybdenum and total nickel were determined to have a RPD above 25% and both values above the PQL. And, for the fraction retained on the 100 mesh, total carbon and total arsenic were determined to have a RPD above 25% and both values above the PQL. Additionally, high RPDs above the PQL were found with eight particle size passing analyses between 0.02 mm and 0.25 mm. Therefore, the field variability within the split sample was determined to be high. The

variability in metal concentrations may be due to the low homogeneity in particle size between the sediment sample replicate and the split sample, as shown by the high RPDs in the eight particle size passing analyses. Of the analytes with high RPDs, only arsenic has a CCME guideline, and all concentrations of arsenic in both fractions and both the replicate and split samples, were above the PEL threshold for arsenic, indicating the high variability in the sample, likely did not impact the determination of the arsenic concentration meeting the threshold.

Table 7-2: Sieve ASTM No. to U.S. Standard Conversion

ASTM NO.	U.S STANDARD
10	2 mm
20	0.850 mm
40	0.425 mm
60	0.250 mm
100	0.150 mm
140	0.106 mm
270	0.053 mm

Table 7-3: Summary of Mean Retained Percentages of Aquatic Sediment Particle Size 2023-2024

Site ID	Sample Date	Gravel	Coarse Sand		Medium Sand		Fines Sand	Fines	Silt/Clay
		% >2.0 mm	% 0.841 mm	% 0.420 mm	% 0.250 mm	% 0.149 mm	% 0.125 mm	% 0.05 mm	% <0.05 mm
KV-21	11-Sept-23	1.8	24.8	36.7	19.9	7.0	1.7	3.5	4.6
KV-38	10-Sept-23	3.1	22.9	26.4	13.8	10.6	2.5	8.9	11.9
KV-41	10-Sept-23	1.5	28.4	29.5	13.9	8.1	1.9	8.1	8.6
KV-111	11-Sept-23	2.3	21.5	30.3	15.7	5.8	1.4	4.5	18.7
KV-6	08-Aug-24	0.2	0.5	1.3	1.9	7.8	1.9	77.7	8.7
KV-21	08-Aug-24	23.4	19.7	11.3	6.2	4.2	1	31.6	2.8
KV-38	09-Aug-24	11.8	17	13.8	8.9	8.3	1.9	34.4	3.8
KV-41	07-Aug-24	20.9	13.3	8.4	5	7.7	1.8	40	3
KV-104L	06-Aug-24	0.1	0.5	0.8	0.7	0.3	0	64.3	33.2
KV-111	09-Aug-24	21.6	15.9	11.3	6.5	3.6	0.9	34.9	5.3

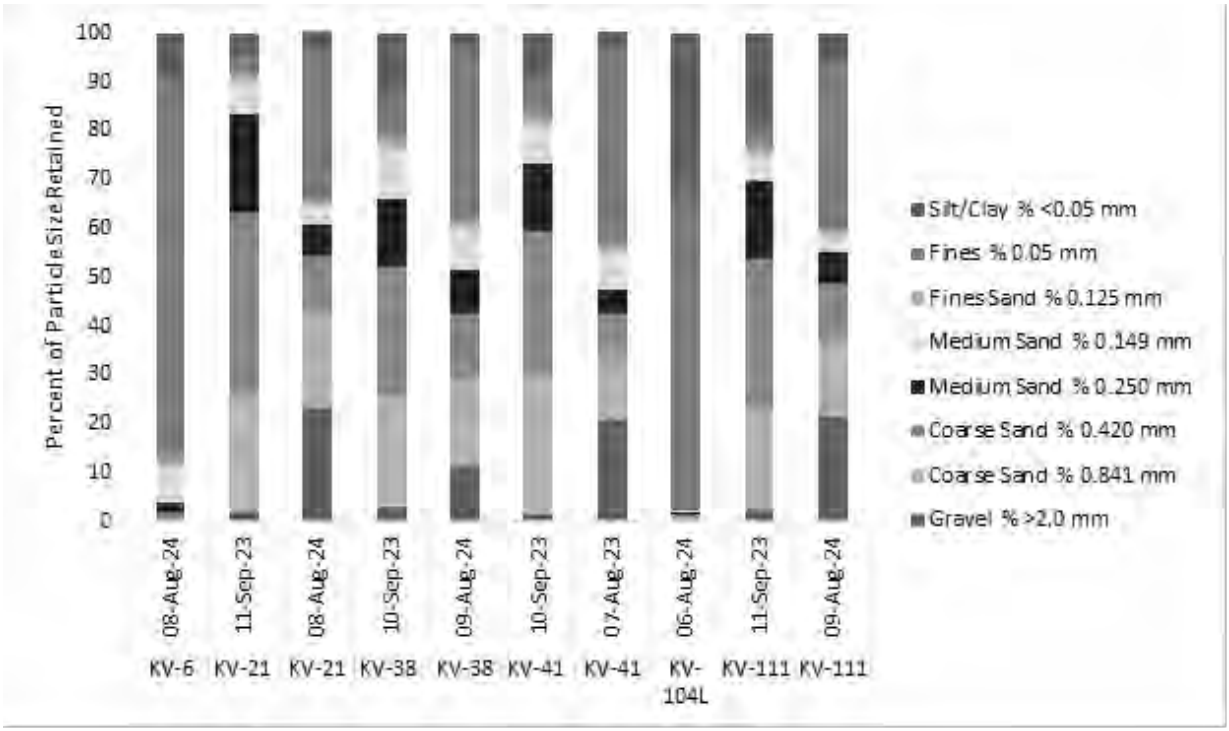


Figure 7-1: Percent Proportions of Aquatic Sediment Particle Sizes Retained in 2023-2024

Table 7-4: Aquatic Sediment Parameters Exceeding CCME Guidelines 2024

SITE	SAMPLE DATE	LOSS ON IGNITION (600 °C)	ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	MERCURY	ZINC
		%	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
CCME-ISQG		-	5.9	0.6	37.3	35.7	35.0	0.17	123
CCME- PEL		-	17.0	3.5	90.0	197	91.3	0.486	315
KV-6	08-Aug-24	11.16	1171	105.6	15.6	72.2	3910	0.194	7325
KV-21	08-Aug-24	5.13	146	145	52.3	85.0	1210	0.105	11558
KV-38	09-Aug-24	4.80	128	4.7	49.4	39.5	128	0.035	363
KV-41	07-Aug-24	2.12	31	1.1	62.4	32.5	44	0.017	139
KV-104L	06-Aug-24	11.3	475	55.2	53.8	219	5723	0.228	5480
KV-111	09-Aug-24	8.33	31	2.4	74.2	31.4	30	0.036	347

7.2.2 Benthic Invertebrate Community Monitoring

Benthic invertebrate community data were collected from Sept 10-11, 2023 from stations KV-21 (No Cash Creek), KV-38 (Lightning Creek upstream of Thunder Gulch), KV-41 (Lightning Creek upstream of bridge at Keno City), and KV-111 (No Cash Creek above No Cash 500 Adit). Benthic invertebrate community data were also collected from August 5-9, 2024 at KV-21, KV-38, KV-41 and Christal Creek (KV-6). KV-111 was not sampled in 2024 due to the creeks channel being too small for a kicknet.

Requirements outlined for benthic invertebrate community monitoring in the WUL (WL QZ18-044) were conducted using CABIN protocols (CABIN 2012). A summary of the stream characteristics in 2023 and 2024, for each site where benthic invertebrate community monitoring was conducted is presented in Table 7-5.

A summary of mean community metrics in 2023 and 2024 are presented in Table 7-6. In 2023, the mean total abundance was greatest at site KV-41 (6366 organisms) and lowest at site KV-21 (114 organisms). During 2024, the mean total abundance was greatest at site KV-38 (3848 organisms) and lowest at site KV-21 (253 organisms). In 2023, taxonomic richness was highest at site KV-38 (20) and lowest at site KV-111 (8). In 2024, taxonomic richness was highest at site KV-6 (22) and lowest at site KV-21 (17). In 2023, the proportion of EPT was greatest at site KV-41 (88%), where Plecoptera was the dominant order along with KV-38 (53%), whereas Diptera was the dominant order for the other two sites. In 2024, the proportion of EPT was greatest at site KV-41 (75%), where Plecoptera was the dominant order, however, % EPT was lower at the remaining sites (12-49%). Diptera was the dominant order for sites KV-38 (37%), KV-21 (66%), and KV-6 (74%), whereas at KV-41, % Diptera was lowest (21%). The lower abundance of EPT taxa, which are more sensitive to pollution and stressors in the aquatic environment, and the dominance of Diptera, which are more tolerant to environmental stressors, suggests the aquatic environment is more impacted at sites KV-6 (Christal Creek), KV-21 (No Cash Creek), and KV-38 (Lightning Creek), in comparison to site KV-41 (farther downstream on Lightning Creek), where diversity, evenness and % EPT are highest. The gradient of tolerant taxa transitioning to sensitive taxa with increasing mine influence, in the context of transitioning downstream from KV-38 to KV-,41 is the opposite of what may be expected when mining is impacting the aquatic ecosystems. Benthic invertebrate community composition by taxonomic order is illustrated below (Figure 7-2).

Benthic invertebrate tissue metals analysis was compared to the British Columbia Ministry of Environment's (BCMOE's) Ambient Water Quality Guidelines for selenium (4 µg/g) and only site KV-38 exceeded the guideline Table 7-7.

Table 7-5: Habitat Characteristics and Water Chemistry for Benthic Monitoring Stations in 2023-2024

Habitat Characteristics		KV-6	KV-21	KV-21	KV-38	KV-38	KV-41	KV-41	KV-111
		08-Aug-24	11-Sep-23	08-Aug-24	10-Sep-23	09-Aug-24	10-Sep-23	07-Aug-24	11-Sep-23
Latitude (N)		63.921125	63.925884	63.925912	63.912794	63.912811	63.909833	63.907714	63.921798
Longitude (W)		-135.327905	-135.460118	-135.460061	-135.240055	-135.239992	-135.285972	-135.296912	-135.453884
Channel Wetted Width (cm)		210	98	252	434	390	679	565	75
Average Channel Depth (cm)		19.6	9	10	24.8	23.2	21.1	21	8.7
Average Water Velocity (m/s)		0.194	1.16	-	-	0.531	0.41	0.571	0.7
Stream Morphology	Pool	Yes	-	Yes	-	Yes	-	Yes	Yes
	Rapid	-	-	-	-	-	-	Yes	-
	Cascade	-	Yes	Yes	-	-	-	-	Yes
	Riffle	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
	Run	Yes	-	-	Yes	Yes	Yes	Yes	-
Gradient (%)		1.18	11.5	14.16	1.85	2	1.40	4.1	11.1
Substrate Properties	Composition (Particle Size)	Fine sand, silt or clay – coarse sand	Coarse sand	Small pebbles	Fine sand, silt or clay	Small pebbles	Fine sand, silt or clay	Small pebbles	Fine sand, silt or clay – coarse sand
	Average Sze (cm)	< 0.1	-	9	<0.1	9	<0.1	10	0.1 – 0.2
	Average Embeddedness (%)	-	0	33%	0-75	20%	0-75	23%	0-50

Habitat Characteristics		KV-6	KV-21	KV-21	KV-38	KV-38	KV-41	KV-41	KV-111
		08-Aug-24	11-Sep-23	08-Aug-24	10-Sep-23	09-Aug-24	10-Sep-23	07-Aug-24	11-Sep-23
	Dominant Interstitial Material	Fine silt or clay	-	Coarse sand / gravel	Gravel	Fine-coarse sand	Gravel	Fine sand, silt or clay	-
Vegetation (% coverage)	Macrophytes (%)	0	0	0	0	0	0	0	-
	Periphyton	0.5-1 mm	0.5-1 mm	0.5-1 mm	5-20 mm	1-5 mm	5-20 mm	1-5 mm	0.5-1 mm
Riparian Features	Vegetation Types Present	Grass, shrubs, coniferous	Shrubs, deciduous, coniferous	Grass, shrubs, deciduous, coniferous	Grass, shrubs, deciduous, coniferous	Grass, shrubs, deciduous, coniferous	Grass, shrubs, deciduous, coniferous	Grass, shrubs, deciduous, coniferous	Shrubs, deciduous trees, coniferous trees
	Dominant Vegetation Type	Grasses	Shrubs	Shrubs	Shrubs	Shrubs	Shrubs	Shrubs	Shrubs
	Canopy Coverage (%)	25-Jan	26-50	51-75	26-50	25-Jan	1-25	26-50	51-75
Water Chemistry Data	Water Temperature (°C)	13.4	3.5	7.4	5.6	7.5	5.8	7.5	1.7
	pH	7.78	8.73	8.18	7.67	7.81	8.05	7.83	7.85
	Specific Conductance (µS/cm)	803	733.7	1,002	203.8	235.4	210.9	265.6	360.1
	Dissolved Oxygen (%)	9.47	72.3	94.1	71.3	95.7	76	-	73.4
	ORP (mV)	-	-	-	197	-	189.4	-	116.4
General notes	Surrounding Land Use	Mining	Mining	Mining	Forest, mining	Mining	Mining	Mining	Mining
	Evidence of Anthropogenic Disturbance	District Mill immediately upstream	Historic Placer mining	Road and Adit upstream	Historical Placer mining	Historic Placer mining	Historic Placer mining	Historic Placer mining	Historic Placer mining

Table 7-6: Benthic Invertebrate Community Metrics in 2023-2024

Metric	KV-6	KV-21	KV-21	KV-38	KV-38	KV-41	KV-41	KV-111
	08-Aug-24	11-Sep-23	08-Aug-24	10-Sep-23	09-Aug-24	10-Sep-23	07-Aug-24	11-Sep-23
Total Abundance	3,263	114	253	5,285	3,848	6,366	3,123	3,732
Taxonomic Richness (S)	22	18	17	20	19	19	18	8
Simpson's Index of Diversity (1-D)	0.86	0.91	0.84	0.93	0.9	0.93	0.93	0.65
Evenness (1/D/S)	0.34	0.46	0.38	0.42	0.55	0.38	0.79	0.19
EPT (% of total)	14%	31%	12%	53%	49%	88%	75%	1%
Diptera (% of total)	74%	43%	66%	35%	37%	10%	21%	92%
Dominant Order	Diptera	Diptera	Diptera	Plecoptera	Diptera	Plecoptera	Plecoptera	Diptera

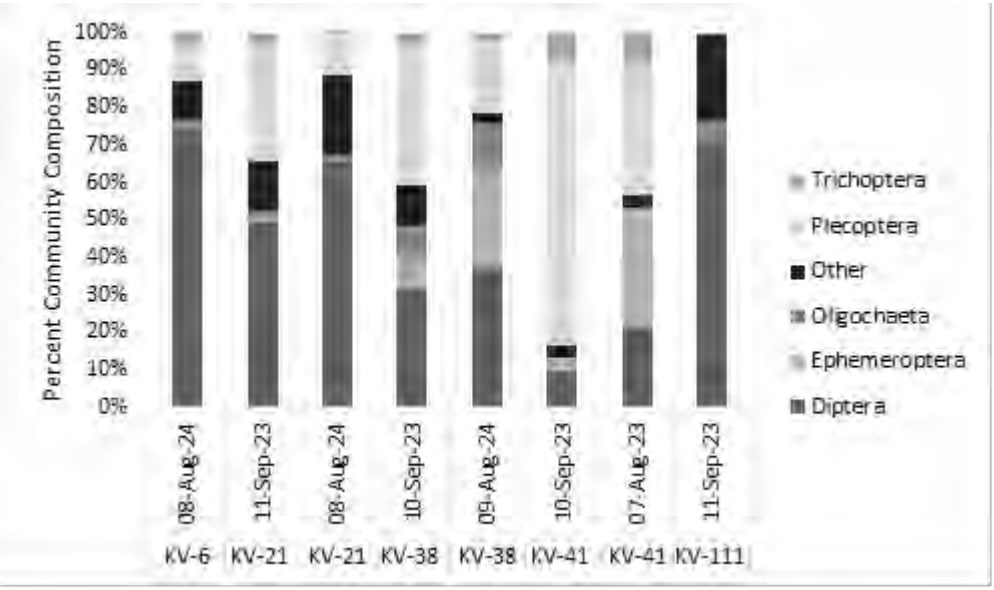


Figure 7-2: Benthic Invertebrate Community Composition in 2023-2024

Table 7-7: Benthic Invertebrate Tissue Metals Analysis, 2024

BCMOE Guideline	Site	KV-6	KV-38	KV-41
		08-Aug-24	09-Aug-24	07-Aug-24
Selenium limit = 4 µg/g		<2.37	5.59	2.135

7.2.3 Periphyton Monitoring

In 2024, periphyton monitoring followed methods described in the British Columbia Field Sampling Manual (BCMOE 2020) and was consistent with the Yukon Guidelines for Mine Waste Management Facilities (YG 2023). Each periphyton replicate sample was collected from five randomly selected (previously undisturbed) rocks in a riffle habitat. Metrics assessed include density, richness, diversity, and community composition. Periphyton cell densities were calculated as the total number of cells collected from the surface area measured. Species richness was measured as the total number of species in a sample. Periphyton diversity was calculated using Simpson's Diversity Index (D) which considers abundance patterns and taxonomic richness, and ranges from zero to one, with higher values representing more diverse communities (EC, 2012). Results from laboratory tissue analyses were compared to the British Columbia Ministry of Environment's (BCMOE's) Ambient Water Quality Guidelines for selenium which provides an upper concentration threshold for selenium in aquatic dietary tissue of 4 µg/g dry weight (BCMOE, 2014).

A summary of the periphyton metrics from all sites is presented in Table 7-8, with community metrics presented in Figure 7-3, species composition presented in Figure 7-4, and chlorophyll-*a* concentrations in Figure 7-5.

Total density was highest at KV-21 and lowest at KV-41. The highest richness (taxa) and Simpson's Diversity were both found at KV-38. Samples from all sites were composed primarily of blue-green algae and diatoms, with the highest density of diatoms at KV-38 and the highest density of blue-green algae at KV-21. Quality assurance and control for periphyton community metrics included re-analysis of sample KV-41, which resulted in 87.76% agreement.

Chlorophyll-a samples ranged from 0.18-0.4 µg/cm^2, with the highest concentration at KV-38 and the lowest concentration at KV-41. All values were below the upper chlorophyll-a concentration limit in the Nutrients and Algae Water Quality Guidelines of 10 µg/cm2 (BCMOE 2021).

Periphyton tissue metals analysis was compared to the British Columbia Ministry of Environment's (BCMOE's) Ambient Water Quality Guidelines for selenium (4 µg/g) with no sites exceeding the guidelines Table 7-9.

Table 7-8: Periphyton Metrics and Community Taxonomic Composition, 2024

Metric	KV-21	KV-38	KV-41
	08-Aug-24	09-Aug-24	07-Aug-23
Density (cells/cm^2)	8,959,530	5,877,997	2,692,451
Richness (taxa)	5	12	8
Simpson's Diversity	0.39	0.59	0.29
Bacillariophyceae (Diatoms) (cells/cm^2)	23,074	80,916	16,572
Chlorophyta (Green Algae) (cells/cm^2)	0	0	1,571
Cyanophyta (Blue Green Algae) (cells/cm^2)	8,936,456	5,764,778	2,674,275
Rhodophyta (Red Algae) (cells/cm^2)	0	32,304	33

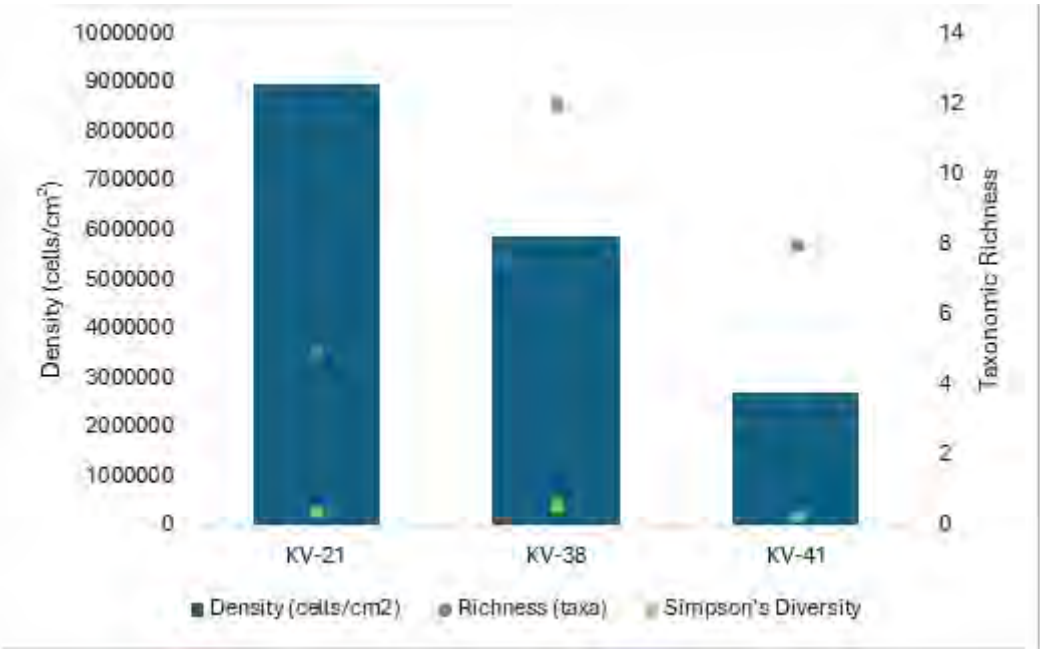


Figure 7-3: Total Density, Richness, and Diversity of Periphyton Communities, 2024

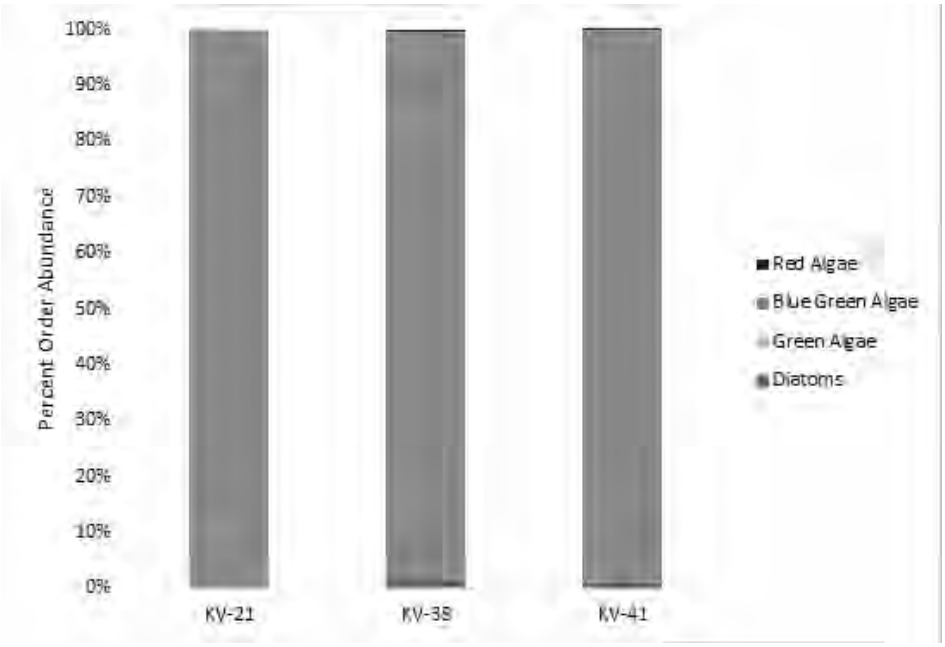


Figure 7-4: Percent Composition by Alga group for Periphyton Communities, 2024

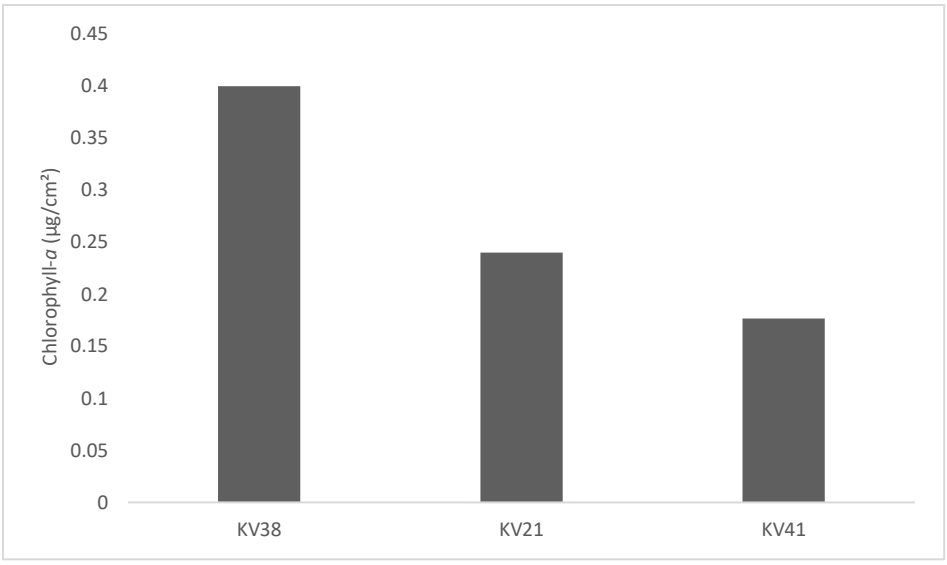


Figure 7-5: Chlorophyll-*a* Concentration in Periphyton Communities, 2024

Table 7-9: Periphyton Tissue Metals Analysis, 2024

BCMOE Guideline	Site	KV-6	KV-38	KV-41
		08-Aug-24	09-Aug-24	07-Aug-24
Selenium Limit = 4 µg/g		1.63	1.26	3.19

7.2.4 Fish And Fish Habitat Monitoring

Fish inventory assessments followed RIC standards (1997) for fish collection to confirm presence or non-detection of resident fish species. Fish monitoring locations (KV-6, KV-21, KV-38, and KV-41) are outlined in Figure 71. Fish inventories were conducted using minnow traps, electrofishing, and visual survey methods. Gee-type minnow traps were baited using dry cat food, were placed in habitats that may support fish, and were left for up to 24 hours. Electrofishing was conducted by a two-person crew using a Halltech HT2000B, Smith-Root 12A or LR-24 backpack unit. The crew, consisting of one operator and one netter, moved upstream in each watercourse following RIC standards (1997). Angling surveys using both fly fishing and spin reel methods with single hooks and no bait. Visual assessments were completed by two people moving slowly upstream, paying particular attention to cut banks and deep pools. During fish inventory assessments, fish captured were identified to species, measured (fork length and total length in millimetres; mm); and in 2024, weight was also measured (in grams; g). Select fish were also retained for tissue analysis. In September 2024, a total of 8 samples were taken between KV-6 and KV-41.

Results from laboratory analyses were compared to the CCME Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota which provides the upper concentration threshold for methylmercury (0.033 µg/g wet weight). Methylmercury is the most toxicologically important and predominant form of mercury in fish (CCME 2000). Furthermore, the British Columbia Ministry of Environment's Ambient Water Quality Guidelines for Selenium provides an upper concentration threshold for selenium in whole body samples of 4 µg/g dry weight (BCMOE 2014).

Other than No Cash Bog, which is not fish bearing and has no surface connection to fish bearing waters, most of the drainages identified in the KHSD support a diverse fish population. Ten different fish species were identified within the KHSD including: Arctic grayling (most abundant), slimy sculpin (most widely dispersed), round whitefish (*Prosopium cylindraceum*), northern pike *(Esox lucius),* Arctic lamprey (*Lethenteron camtschaticum*), Chinook salmon (*Oncorhynchus tshawytscha*), burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), least cisco (*Coregonus sardinella*), and lake chub (*Couesius plumbeus*).

Habitat characteristics are summarized in Table 7-10. Site KV-6 is a slow flowing section with deeper pools downstream of the mill and upstream of the road and culvert leading into Keno City. The tall grass and woody debris provide shade over fine organic and cobble stream bottom providing habitat for fish and benthic invertebrates. Site KV-21 is located downstream of a culvert on the Silver Trail Highway, the steep gradient and cascade pools are formed from cobbles and boulders. Site KV-38 is a medium riffled stream with fast water moving over cobbles and large boulders. It is surrounded by shrubs and conifer trees providing plenty of shade and a small eroding sloped bank on the left side of the creek. Site KV-41 is located just outside of Keno city upstream of a culvert where the stream widens and consists of large boulders and cobbles creating both riffles, cascades and pools. On the downstream side of the culvert there is a large deep pool shaded over by mixed wood trees creating effective fish habitat.

Fish inventory method and metric data are summarized in Table 7-11. Slimy sculpin (*Cottus cognatus*) were captured at sites KV-6 using both electrofishing and minnow trapping techniques. Arctic grayling (*Thymallus arcticus*) were captured at site KV-41 using angling techniques. No fish were caught or observed at KV-21 and KV-38. No unplanned mortalities occurred during any method of sampling. A total of 8 tissue samples were collected between KV-6 and KV-41 (Table 7-12). There were no metals exceedances of mercury or selenium in the fish tissue samples collected form KV-6 and KV-41.

Table 7-10: Habitat Descriptions, 2024

Site	Date	Morphology	Channel Banks						Vegetation				Substrate	
			Average Channel Width (m)	Average Wetted Width (m)	Average Depth (m)	Gradient (%)	Shape	Substrate	Cover (%)	Crown Closure (class)	Riparian Vegetation	Instream Vegetation	Dominant	Sub-dominant
KV-6	08-Aug-24	Run and Pool	5.14	2.01	0.37	1.18	U and V-shaped to sloped	Fines and Gravel	1-20%	1	Grass and Shrubs	Moss	Fines	Gravel
KV-21	08-Aug-24	Cascade and Pool	3.84	1.34	0.21	14.16	U and V-shaped to sloped	Fines, Gravel, Cobble, Boulder	41-70%	3	Grass, Shrub, Conifer, Deciduous	Algae and Moss	Cobble	Boulder
KV-38	09-Aug-24	Riffle and Pool	5.97	4.15	0.53	2	U and V-shaped to sloped	Fines, Gravel, Cobble, Boulder	1-20%	1	Grass, Shrub, Conifer	Algae and Moss	Cobble	Gravel
KV-41	07-Aug-24	Riffle, Cascade, Pool	8.63	6.5	0.41	4.1	V-shaped to sloped	Fines, Gravel, Cobble, Boulder	21-40%	2	Grass, Shrub, Mixed Wood	Algae and Moss	Cobble	Boulder

Table 7-11: Fish Inventory Summary, 2024

Site	Date	Electrofishing			Minnow Traps			Angling		Species	Total Captured	Total Observed
		Distance (m)	Effort (sec)	CPUE (catch per minute)	Number of traps	Effort (hours)	CPUE (Catch per trap per 24 hours)	Effort (mins)	CPUE (catch per hour)			
KV-6	08-Aug-24	100	403.3	1.64	4	14.6	0.48	-	-	Slimy Sculpin	18	3
KV-21	08-Aug-24	100	324	0	-	-	-	-	-	No Fish Caught	0	0
KV-38	09-Aug-24	-	-	-	4	20.3	0	-	-	No Fish Caught	0	0
KV-41	07/08-Aug-24	100	517.9	0	4	22.2	0	30	0.33	Arctic Grayling	10	5

Table 7-12: Fish Tissue Metals Concentrations, 2024

Site	Monitoring Year	Species	Life Stage	Arsenic (mg/kg wwt)	Cadmium (mg/kg wwt)	Chromium (mg/kg wwt)	Copper (mg/kg wwt)	Lead (mg/kg wwt)	Mercury (mg/kg wwt)	Selenium (mg/kg dwt)	Zinc (mg/kg wwt)
				No guideline	No guideline	No guideline	No guideline	No guideline	CCME Guideline 0.033 mg/kg wwt	BCMOE Guideline 4 mg/kg dwt	No guideline
KV-41	2024	Arctic Grayling	Undetermined	0.616	0.134	0.082	0.916	0.814	0.0172	1.78	28.1
KV-41	2024	Arctic Grayling	Undetermined	0.117	0.118	0.034	0.694	0.103	0.0196	2.63	21.5
KV-41	2024	Arctic Grayling	Undetermined	0.141	0.0944	0.056	0.674	0.481	0.0151	1.95	23.7
KV-41	2024	Arctic Grayling	Undetermined	0.188	0.129	0.073	0.793	0.484	0.0314	2.7	23.3
KV-41	2024	Arctic Grayling	Undetermined	0.149	0.15	0.057	0.958	0.205	0.0211	2.68	30.5
KV-6	2024	Slimy Sculpin	Undetermined	3.01	0.395	0.034	0.72	8	0.0043	1	58.2
KV-6	2024	Slimy Sculpin	Undetermined	2.74	0.403	0.067	0.937	9.51	0.003	0.841	69.8
KV-6	2024	Slimy Sculpin	Undetermined	7.27	0.878	0.195	1.24	18.6	0.003	0.991	118

7.3 CHRISTAL CREEK ATTENUATION STUDY

The Christal Creek attenuation study began in 2018 to satisfy regulatory requirements and assess natural attenuation potential along the flow path between the Flame & Moth WTP discharge diffuser and Christal Creek. Baseline work included soil, vegetation, surface water, and groundwater seep characterization. Soils along the proposed discharge corridor were predominantly silt loam with moderate moisture and relatively high organic matter content (median 14.7-22.4%), providing substantial capacity for metal interaction. Soil pH values were neutral (6.0-6.7), supporting iron and aluminum oxyhydroxide precipitation and favourable adsorption conditions. Sequential extraction results showed most constituents of potential interest associated with residual, reducible, and organic/sulphide phases, indicating limited mobility under site conditions. Microbial profiling identified sulphate-reducing bacteria and other organisms capable of sulphur redox transformations, suggesting the potential for sulphide mineral formation and biologically mediated metal sequestration.

Surface water monitoring along Christal Creek showed periodic or occasional exceedances of sulphate, arsenic, cadmium, copper, iron, lead, manganese, nickel, and zinc relative to water quality guidelines; however, no discharge from the WTP to Christal Creek occurred between 2022 and 2024, and two brief discharge events in 2021 had no measurable effect on downstream water quality. Moss samples showed the highest metal concentrations at the transect nearest the diffuser location. Long-term monitoring data also indicated that groundwater seep KV-121 contributes trace metals to Christal Creek independently of WTP discharge. The study concludes that existing site conditions—including soil texture, moisture, organic matter, pH, stable metal partitioning, and active microbial communities—are favourable for natural attenuation processes. The conclusions also emphasize that reducing conditions in the organic-rich soils are expected to promote sulphide precipitation, maintaining metal sequestration once discharge begins. Continued monitoring will be required to assess attenuation performance during sustained WTP discharge to Christal Creek.

Additional information and figures on the Christal Creek Attenuation Study can be found in the Annual Report - Water License QZ18-044.

7.4 NO CASH CREEK ATTENUATION STUDY

The current attenuation study began in 2018 to satisfy regulatory requirements and to evaluate natural attenuation processes along the approximately 1,500m pathway between the New Bermingham Mine discharge and the headwaters of No Cash Creek. Baseline characterization included soil, vegetation, surface water, and groundwater sampling. Soil samples collected along the proposed discharge corridor were predominantly silt and silty loam, with moisture contents indicating moderate water-holding capacity and organic matter contents that, while relatively low, provide some capacity for metal interaction. Soil pH values were acidic to mildly acidic, with higher pH values occurring toward the downstream end of the channel. Sequential extraction testing showed that most metals were associated with reducible iron and manganese oxyhydroxides, with cadmium and zinc also present in carbonate phases and copper associated with organic matter. Microbial profiling identified organisms capable of sulphur redox transformations, including sulphate-reducing bacteria, suggesting conditions suitable for sulphide mineral formation.

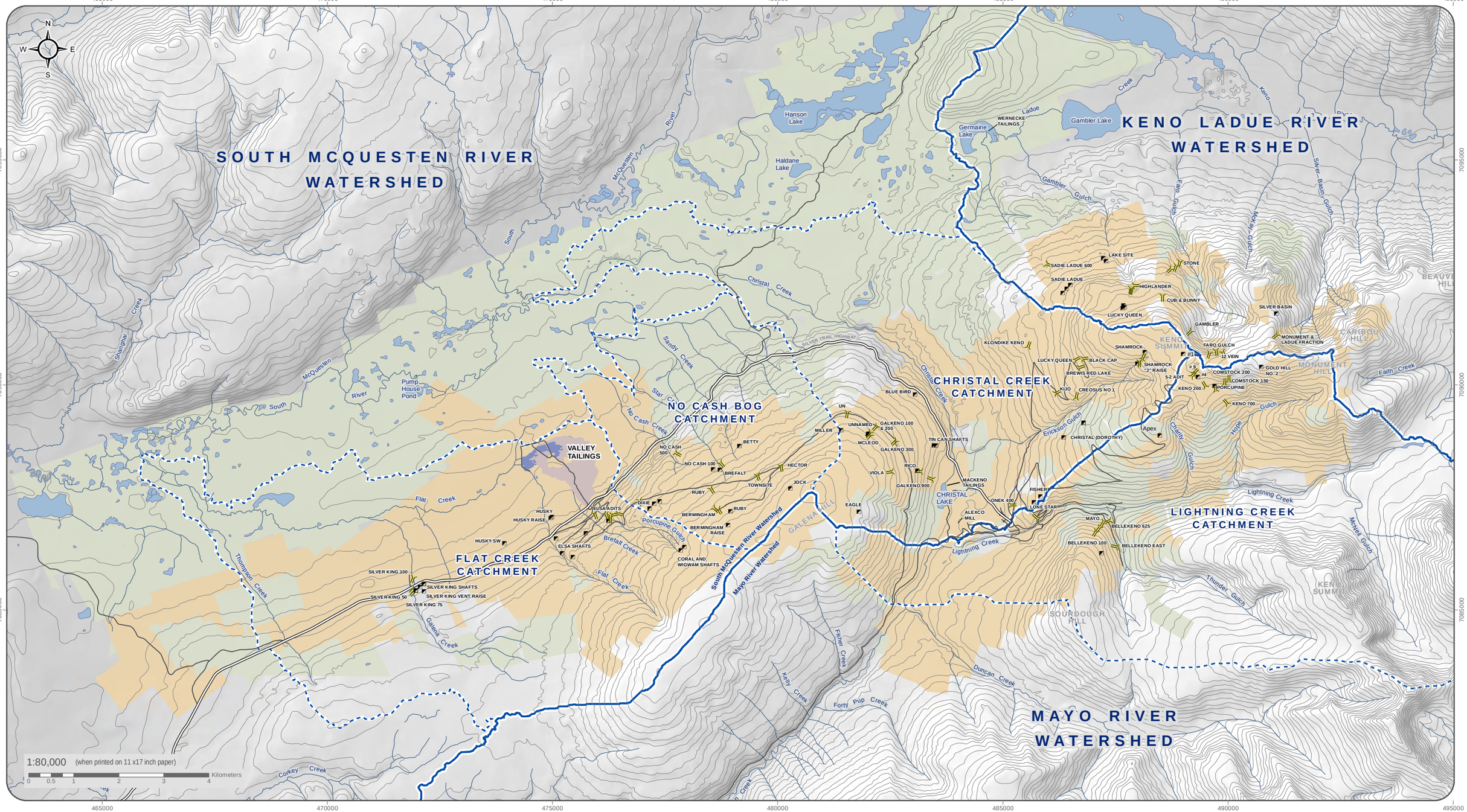
Surface water monitoring along the discharge corridor during the 2023 synoptic program showed little to no change in water quality over the flow path, with elevated cadmium and zinc at the channel end likely influenced by Ruby 400 adit discharge. Moss samples exhibited the highest metal concentrations at the most downstream site, though this may have been influenced by residual soil material. Review of long-term water quality data indicated that concentrations of several parameters in the New Bermingham discharge increased during

periods of mine development, while cadmium and zinc declined in 2024. Comparisons between WTP discharge and upstream No Cash Creek stations showed that the discharge often had equal or lower concentrations for most metals except arsenic, nickel, selenium, ammonia-N, and lead. Groundwater monitoring indicated sub-oxic to oxic conditions, circumneutral pH, and occasional exceedances of regulatory standards for pH, arsenic, and cadmium. The report concludes that current site conditions including soil composition, moisture, pH, and microbial communities are favourable for natural attenuation processes, and that additional monitoring is required to assess attenuation performance as WTP discharge continues.

Additional information on the No Cash Creek Attenuation study can be found in the Annual Report - Water License QZ18-044.

8 ENVIRONMENTAL EFFECTS MONITORING - BELLEKENO

Historical fisheries resource data for Lightning Creek and surrounding drainages (Figure 8-1) is limited to information collected by White Mountain Environmental Consulting (WMEC) in 1995 and 2006, Access Consulting Group (ACG) in September 2008, De Graff and Burns in 2011 and Minnow Environmental in 2012. Investigations of fish and fish habitat were conducted at numerous sites, including two sites on Lightning Creek. More recent investigations have been conducted as part of the Environmental Effects Monitoring (EEM) conducted by Ensero for the Bellekeno Mine, with the most recent program completed in 2023. A map of the Bellekeno environmental effects monitoring stations is presented in (Figure 8-2).



Topographic Data (CANVEC) data at a scale of 1:50,000 and crown grant (land parcels and mineral survey claims) data compiled by the Department of Natural Resources Canada. Quartz claim boundaires and ownership are current as of Marchth 2017; obtained from Geomatics Yukon, Government of Yukon. Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on March 2017

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Adit
- Shaft
- Watershed
- Catchment
- Alexco Keno Hill Mining Corp. Owned Quartz Claims
- ERDC Owned Quartz Claims or Crown Grants
- Tailings
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Contours (100 ft intervals)

HECLA KENO HILL

FIGURE 8-1

KENO HILL WATERSHED OVERVIEW

FEBRUARY 2023

D:\Projects\AllProjects\ALEX-05-01\gis\mxd\Overview_Maps\Property_Overviews\Project_Overview_ALL_Adits_and_Shafts_Complex_Symbology_20230207.mxd (Last edited by: amalashevska; 2023-02-07 10:42 AM)

482500 485000 487500 490000

7087500 7085000

N W E S

SILVER TRAIL HIGHWAY
Calumet Drive
Erickson Gulch
Wernecke Road
Sign Post Road
Charity Gulch
Hope Gulch
Christal Lake Road
CHRISTAL LAKE
Hinton Creek
Christal Creek
Keno City Bypass Road
Bellekeno Haul Road
Duncan Creek Road
Lightning Creek
Duncan Creek
Thunder Gulch

REFERENCE 1
KV-39
KV-37
KV-40
REFERENCE 2
KV-38
REFERENCE 3
KV-76
DISTRICT MILL WEATHER STATION
FLAME AND MOTH PORTAL
EXPOSURE 2
KENO CITY
KV-41
BELLEKENO 625 PORTAL
KV-65
EXPOSURE 3
KV-81
BELLEKENO EAST PORTAL
P-AML STORAGE FACILITY
KV-77

1:22,000 (when printed on 11 x17 inch paper)
Kilometers
0 0.25 0.5 0.75 1 1.25

Topographic Data (CANVEC) data at a scale of 1:50,000 and crown grant (land parcels and mineral survey claims) data compiled by the Department of Natural Resources Canada.
Sattellite Imagery obtained from Yukon Geomatics web service http://mapservices.gov.yk.ca/ArcGIS/services on January 2018

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Adit
- Surface Water Quality Station of Interest
- District Mill Weather Station
- Exposure Location
- Reference Location
- AKHM District Mill
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road

Hecla KENO HILL SM

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BELLEKENO MINE PROJECT

FIGURE 8-2

EEM AQUATIC SAMPLE LOCATIONS

JANUARY 2023

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8.1 FISH LABORATORY EXPOSURE STUDY

Due to small fish populations, after the first Bellekeno EEM cycle, a stream-side aquaculture experimental setup was used to conduct the fish population element of the EEM biological testing. This method has continued through up to the most recent cycle (Cycle 5). A summary of the fish component of the most recent cycles follows.

The stream-side aquaculture experimental setup was assembled inside a shed near the Galkeno 900 Portal, the shed allowed for better control of critical variables such as temperature and light. The rearing infrastructure consisted of circular rearing vessels 1.5 m in diameter and 0.76 m deep providing 1.33 m3 of potential wetted rearing volume. Rearing vessels received water supplied by individual water reservoirs with dimensions of 1.6 x 1.6 x 1.3 m and total volume of 3.3 cubic metres. Water was gravity-fed to the rearing vessels via polyethylene hose (20 mm diameter). All rearing vessels were configured the same and included an aerator and air stone and a water supply inlet with a flow control valve. A passive heat exchange system was used between the tanks to allow equilibrium of the water temperature between the tanks and maintain cooler temperatures independently from ambient air temperature. Water flowing through the system was then delivered to each tank at a flow rate of approximately 1L per minute. Fish were reared in the tanks for a total of six weeks to determine growth (length and weight), condition (Fulton's index, length-at-body-weight relationship; Fulton, 1902), and survival (or mortality rate).

During Cycle 4, the fish laboratory exposure study was conducted using Kokanee Salmon and designed to allow for distinguishing potential effects from the Bellekeno mine effluent from those of the Thunder Gulch placer mine discharge, influences that are not possible to isolate in situ. The Metal Mining Technical guidance for EEM (Environment Canada, 2012) suggested a critical effect size (CES) of ±10% (of the reference mean) for condition factor and 25% for weight-at-age. Exceeding the effects threshold may indicate potential for impacts to environmental variables. However, since immature fish were used in this study, effects were determined using p-values. When a significant effect was found, the magnitude of difference (%) between the reference and the exposure site was also reported. At the end of the experiment, the reference group significantly differed from at least one of the exposure groups for all endpoints. Since Exposure 2 weight, fork length, and condition were significantly larger at the end of the study compared to the reference group, macronutrients in mine effluent could be stimulating a stronger growth response. When comparing fish endpoints between EEM cycles, similar effects between two consecutive studies were not detected.

During Cycle 5, the fish laboratory exposure study was designed to aid in distinguishing potential effects from the Bellekeno Mine effluent from those of the Thunder Gulch placer mine discharge, influences that are not possible to isolate in situ due to low fish population densities present in Lightning Creek. The analysis of fish metrics endpoints before and after 44 days of the experiment demonstrated no increased mortality associated with exposure to mine effluent. Fish exposed to mine effluent (Exposure 1) had greater condition ratings than fish from the Reference group at the end of the study, though not statistically significant. Fish exposed to both mine effluent and Placer mining activities (Exposure 2) had the highest condition by the end of the study, though not statistically significant. However, the Reference group began the study with a lower condition factor, suggesting this pattern began prior to the experiment beginning, and at the middle sampling point, the only group of fish to have a decrease in condition factor, was the Reference group. Considering the Reference group had the lowest condition factor compared to the other groups, and this did not change throughout the course of the study, this may provide supporting evidence that the Mine effluent poses low risk to higher aquatic trophic levels. Reference fish had the largest increase in fork length and weight, while Exposure 2 had the largest increase in condition factor from the beginning to the end of the experiment. The daily accumulated

thermal units were slightly higher in the Exposure 2 tank and could have positively influenced growth. Considering immature fish were used in Cycle 5, the effect of effluent was determined using p-values instead of critical effect sizes. At the end of the study, the only effect found was on weight at length when comparing the reference group to Exposure 2. However, there was also a significant difference in weight at length before the experiment when comparing the reference group with both exposure groups.

8.2 BENTHIC INVERTEBRATES

Benthic invertebrate sampling has taken place sporadically in the KHSD, dating back to 1975. Environmental Protection Services carried out biological monitoring in the area in 1975, 1985, 1986, 1990, 1994, 2007, and 2011. Further investigations have been conducted as part of EEM for the Bellekeno mine, completed in 2018, 2021, and 2023 (AEG 2019c; Ensero, 2022c).

Benthic communities in each watercourse varied based on habitat conditions and historical impacts, but are generally dominated by Plecoptera, Diptera, and Chironomids. Benthic communities in Lightning Creek drainage were found the be robust and represented by a healthy proportion of population-sensitive species. Benthic community metrics in Christal and Flat Creek suggest communities are potentially stressed compared to reference condition. Benthic samples within No Cash and Star Creek are limited to one sampling event in September 2018. Potential effects to benthic invertebrates were determined during EEM for the Bellekeno mine by comparing reference sites to all downstream exposure sites, as reference sites were upstream of mine effluent discharge and encompassed effects from historical placer and current mine activities. Although some of the metrics assessed for exposure sites showed an effect to benthic invertebrates, either negatively or positively, this difference was also detected between reference sites located upstream of effluent discharge. This suggests that impairment of the benthic community existed previously and is unrelated to mine effluent. This was supported by water chemistry, as one of the reference sites shared similar water chemistry with the exposure site, for TSS and elevated total metals (aluminum, iron, zinc), chemistry that is often associated with placer activity. As well, sediment chemistry measured metals exceedances in all reference sites, with some parameters far exceeding concentrations measured in downstream exposure sites. This is likely an influence from the placer mining in Thunder Gulch, which may explain some differences in benthic community composition.

During Bellekeno Mine Cycle 4 EEM, a significant effect and direction of effect was detected on the Bray-Curtis (B-C) index when comparing Reference 1 to the exposure groups in past EEM cycles. Therefore, an Investigation of Cause (IOC) study was conducted during Cycle 5 EEM which will focussed on using principal component analysis to compare benthic invertebrate indices with existing water quality data and additional data collected specifically for the study (Ensero, 2022c).

The EEM cycle 5 study included an Investigation of Cause (IOC) study due to confirmed similar type of effect directions of mine effluent on the benthic community (effect on B-C Index between in the past three EEM cycles). The IOC found that Reference 3 grouped closer to Exposure 2 and Exposure 3 than with the other reference sites and that community compositional differences observed at exposure versus reference sites are likely MDMER parameter concentration driven. This suggests that a combination of current placer mining activity and Bellekeno Mine effluent may explain the difference in benthic invertebrate endpoints between reference and exposure groups. It is difficult to fully separate the effects of current placer mining activity in Thunder Gulch from the effects of the Bellekeno Mine effluent due to the common entry point into Lightning Creek that was present during this study due to the presence of the Thunder Gulch Placer Mine Diversion. A similar investigation more tailored to investigate the influence of placer mining on the confirmed effects would

be advised for Cycle 6. During the Bellekeno Mine Cycle 5 EEM, the benthic invertebrate endpoints examined showed no significant differences in organism abundance, taxa richness or evenness between any sites. The Bray-Curtis similarity index was significantly increased at all sites, compared to Reference 1, indicating the community structure of all downstream sites is more different than alike to Reference 1, including other reference sites. The effects endpoints for exposure sites varied but generally remained in the range of the Reference 3 site. Biotic indices measured as supporting endpoints showed the two upstream reference sites as well as Reference 3 had lower counts of Diptera, compared to Reference 1 and Reference 2. And only Reference 2 had lower counts of EPT compared to Exposure 2. This observation may reflect minor impacts of historical placer mining on water quality and potentially impaired background water quality in the watercourse as diversity in the EPT community and less dominance by Diptera generally indicates reasonable water quality and habitat. The statistically significant effects endpoints that exceeded the CES criteria of ±2 SDs were noted for the Bray-Curtis index when comparing Reference 1, Reference 2, and Reference 3 to both exposure sites. Sample size for the benthic invertebrate community sampling were reduced to n=3 in Cycle 5 which resulted in instances of the minimum detectable effect size being larger than 2 SD, therefore increasing the sample size to n=5 for Cycle 6 is recommended to increase the power of the analyses.

8.3 STREAM SEDIMENT

Stream sediment sampling was carried out annually or biannually since 2010 in Christal and Lightning Creek. Stream sediment sampling for No Cash Creek was carried out at KV-56 and KV-21 in 2018, then continued at KV-21 in 2020, 2021, and 2022. In 2023, sediment samples were collected at the same time as benthic sample collection, at the project reference site, KV-38, and the project impact site, KV-41. An error in logging the requested analyses was made by ALS. This resulted in only grain size analysis being performed on the samples, and samples being disposed of before the error could be corrected by performing the additional requested analyses. Therefore, the tables below will not include 2023 metals analysis data. Sediment quality within each of the affected watercourses has not exhibited obvious increasing or decreasing trends since 1990. Despite several metals that exceeded the Canadian Interim Sediment Quality Guideline (ISQG) and the Sediment Quality Guideline Probable Effects Level (PEL), sediment toxicity tests suggested that elevated metals were not in a form that was biologically available (i.e., dissolved at concentrations that would induce mortalities or sublethal effects), at most sites.

In Lightning Creek, arsenic consistently exceeded the PEL at all sites (KV-37, KV-38, and KV-41; Table 8-1, Table 8-2), while cadmium, lead, and zinc frequently exceeded the ISQG and occasionally the PEL. Copper frequently exceeded the ISQG. In Christal Creek, arsenic, cadmium, lead, and zinc all consistently exceed the PEL at both KV-6 and KV-7 (Table 8-3). In Flat Creek, arsenic, cadmium, lead, and zinc all exceeded the PEL at KV-9 (Table 8-4). Copper exceeded the PEL once and exceeded the ISQG for the remainder of the samples. No Cash drainage (Table 8-5) measured arsenic exceedance of the PEL at KV-21 and KV-56. Cadmium, lead, and zinc exceeded the PEL and copper exceeded the ISQG at all samples at KV-21. Cadmium and zinc exceeded the ISQG at KV-56. In the South McQuesten sediment, arsenic, cadmium, and zinc all frequently exceed the PEL at KV-1, KV-3, and KV-4 (Table 8-6). Lead exceeded the PEL at KV-3 and KV-4. Copper exceeded the ISQG at KV-3 and KV-4 during all events and frequently exceeded the ISQG at KV-1.

Table 8-1: Metal Concentrations in Lightning Creek Sediment at KV-37 and KV-38, 2007-2022

TOTAL METAL CONCENTRATION mg/kg	LAB MDL	GUIDELINE		KV-37						KV-38									
		CCME ISQG	CCME PEL	31-JUL-07	23-SEP-11	23-AUG-12	02-SEP-15	13-SEP-18	27-AUG-21	31-JUL-07	30-AUG-13	26-AUG-14	01-SEP-15	22-SEP-16	18-AUG-17	13-SEP-18	23-SEP-20	26-AUG-21	22-SEP-21	17-SEP-22
Aluminum	50	-	-	12533	6828	8110	8940	8650	8850	9023	8280	6940	8510	11598	10452	7502	8967	6767	9088	7460
Antimony	0.1	-	-	0.4	2.69	9.38	17.7	4.67	10.1	13.9	19.6	16.8	1.61	9.7	7.57	8.62	3.13	2.65	6.65	2.055
Arsenic	0.1	5.9	17	115.4	74.1	82.6	324	95.3	170	433	179	277	27.1	185	143	135	67.1	39.6	155	38
Cadmium	0.02	0.6	3.5	2.7	0.9	0.87	20.4	8.23	8.33	31.2	15.4	16.8	1.11	8.61	5.22	7.36	1.18	2.15	7.06	1.28
Copper	0.5	35.7	197	41.6	39.5	26.1	46.6	41.9	46.1	56	58.7	46.7	24.1	62.5	51.1	43	30.8	31.8	49	28.9
Iron	50	-	-	27633	20072	18400	27000	29533	25100	34833	30250	23600	19200	31467	23683	24333	20700	19517	23583	20950
Lead	2.5	35	91.3	40	51.9	53.2	541	130	232	642	352	275	30.2	216	173	162	41.5	69.2	175	36.7
Mercury	0.005	0.17	0.486	0.084	<0.05	0.033	0.135	0.02	0.08	0.228	0.079	0.106	0.0443	n/a*	0.0566	0.035	0.0276	0.02	0.052	0.0291
Nickel	0.5	-	-	29.7	21.3	20	33.3	24.9	25.6	42.3	32.7	23.9	24.5	40.2	33.9	45	61.7	24.2	29.6	24.8
Selenium	0.2	-	-	1.4	<0.5	0.67	1.37	0.32	0.63	2	0.83	0.89	0.59	0.91	0.97	0.59	0.43	0.43	0.925	0.653
Silver	0.1	-	-	0.8	0.31	0.55	16.1	1.11	5.8	15	9.95	15.5	0.49	4.52	3.72	3.57	1.63	1.24	3.22	0.725
Zinc	10	123	315	125	137	118	1260	621	753	1637	1259	1357	127	638	430	539	138	172	545	142.3

Note.
MDL – method detection limit. Text in blue exceeded the Canadian Council for Ministers of the Environment (CCME) Interim Sediment Quality Guideline (ISQG). Text in red exceeded the CCME Sediment Quality Guideline Probable Effects Level (PEL).

Table 8-2: Metal Concentrations in Lightning Creek Sediment at KV-41, 2007-2022

Total Metal Concentration mg/kg	LAB MDL	GUIDELINE		KV-41												
		CCME ISQG	CCME PEL	31-JUL-07	23-SEP-11	22-AUG-12	30-AUG-13	26-AUG-14	01-SEP-15	22-SEP-16	18-AUG-17	12-SEP-18	23-SEP-20	26-AUG-21	21-SEP-21	17-SEP-22
Aluminum	50	-	-	8693	6625	8550	7033	7530	9430	10290	12067	7140	9893	8685	9748	7820
Antimony	0.1	-	-	0.5	2.67	1.67	3.05	2.7	1.98	1.63	2.18	2	3.67	2.24	2.45	2.28
Arsenic	0.1	5.9	17	62.5	37.8	21.5	67	50	28.3	30.6	40.7	31	39.4	35	43.1	42.9
Cadmium	0.02	0.6	3.5	3.4	0.84	1	2.28	1.74	1.48	1.63	2.13	1.05	1.77	1.34	1.36	1.4
Copper	0.5	35.7	197	33.8	30.6	30.9	55	40	34.2	35.8	55.3	26	44.4	36.2	47.9	29.2
Iron	50	-	-	26000	20072	20600	21600	19233	21700	22333	25083	19633	24150	21750	24450	21100
Lead	2.5	35	91.3	82.2	40.4	31.5	138	108	70.6	30.1	47.1	42.7	61.6	59.3	66	83.9
Mercury	0.005	0.17	0.486	0.055	<0.05	0.037	0.055	0.029	0.032	n/a*	0.058	0.016	0.04	0.026	0.029	0.00487
Nickel	0.5	-	-	30.4	22.6	26.4	34.3	28.8	27	27.5	35.1	36.5	30.2	28.1	33.4	25.3
Selenium	0.2	-	-	0.8	<0.5	0.63	0.72	0.47	0.47	0.81	0.91	0.45	0.87	0.393	0.52	0.48
Silver	0.1	-	-	1.9	0.35	0.91	2.38	2.35	1.09	0.51	0.92	0.87	2.48	0.64	0.97	1.68
Zinc	10	123	315	247	121	110	228	196	177	127	200	134	183	156	178	180

Note.
MDL – method detection limit. Text in blue exceeded the Canadian Council for Ministers of the Environment (CCME) Interim Sediment Quality Guideline (ISQG). Text in red exceeded the CCME Sediment Quality Guideline Probable Effects Level (PEL).

Table 8-3: Metal Concentrations in Christal Creek Sediment at KV-6, KV-7, and KV-50, 2007-2022

Total Metal Concentration mg/kg	Lab MDL	Guideline		KV-6											KV-7							KV-50		
		CCME ISQG	CCME PEL	31-JUL-07	08-AUG-09	13-JUL-10	30-AUG-11	21-AUG-12	26-AUG-14	01-SEP-15	23-SEP-16	08-SEP-18	20-SEP-20	17-SEP-22	31-JUL-07	22-AUG-09	13-JUL-10	21-AUG-13	04-SEP-15	08-SEP-18	24-SEP-21	09-SEP-18	23-SEP-20	22-SEP-21
Aluminum	50	-	-	9410	8420	5880	7563	7130	6733	7450	7470	5490	5845	4675	7253	9540	6000	6580	6050	5043	7127	8286	5413	8208
Antimony	0.1	-	-	14.8	2	96.2	37.2	66.7	37.3	0.84	5.45	44.1	102	139.7	0.25	21.8	9.5	9.12	5.89	5.65	4.39	3.39	3.52	3.94
Arsenic	0.1	5.9	17	284	31.8	1030	448	923	544	16.5	85.2	598	1257	2107	34.7	194	121	122	66.2	85.2	76.5	597	1165	645
Cadmium	0.02	0.6	3.5	28.2	2.48	91.4	33.5	95.3	43.1	0.99	6.97	50.6	122	148.2	3.7	32.4	18.8	16.1	3.83	9.92	8.28	4.72	6.84	10.58
Copper	0.5	35.7	197	41.3	39	67.6	35.5	69.6	54.2	21.9	33.3	49.6	79.7	86	26.6	48.5	32.2	28.1	17.3	26	29.9	34.3	33.8	63
Iron	50	-	-	27133	18400	43800	28467	46900	36500	15100	21867	38400	48100	71600	20367	32300	24200	22600	16700	21567	24267	124750	215167	133067
Lead	2.5	35	91.3	954	73.4	4130	1388	3400	1533	27.5	237	1980	4690	8082	56.4	1040	453	348	227	223	235	34.5	28.5	42.9
Mercury	0.005	0.17	0.486	0.102	0.06	0.18	0.07	0.164	0.096	0.036	n/a*	0.09	0.214	0.294	0.068	0.1	0.025	0.051	0.047	0.026	0.04	0.04	0.042	0.065
Nickel	0.5	-	-	27.9	29.5	32.8	25.8	45.8	46	25.2	29.1	99.6	43.9	47.6	22.6	59.3	38.4	36.1	18.7	55.6	34.1	65.27	77.1	67.8
Selenium	0.2	-	-	2.5	1.6	1.5	0.8	2.1	1.3	1	1.2	1.11	1.59	1.52	1.2	1.7	1.2	1	0.4	0.62	0.68	1.43	1.72	2.36
Silver	0.1	-	-	12.2	1.04	66.5	22.6	50.6	32.5	0.43	3.19	29.1	72.6	125	0.8	14.1	5.51	3.72	3.23	2.62	2.27	0.6	0.48	0.88
Zinc	10	123	315	1483	237	5820	2122	5270	3100	132	599	4154	8595	10692	404	4330	2010	1580	362	1021	876	1207	2150	1800

Note.
MDL – method detection limit. Text in blue exceeded the Canadian Council for Ministers of the Environment (CCME) Interim Sediment Quality Guideline (ISQG). Text in red exceeded the CCME Sediment Quality Guideline Probable Effects Level (PEL).

Table 8-4: Metal Concentrations in Flat Creek Sediment KV-9, 2007-2021

Total Metal Concentration mg/kg	Lab MDL	Guideline		KV-9						
		CCME ISQG	CCME PEL	31-Jul-07	22-Aug-09	31-Aug-11	22-Aug-12	03-Sep-15	07-Sep-18	24-Sep-21
Aluminum	50	-	-	7323	7520	6600	6600	7630	5867	6025
Antimony	0.1	-	-	150	63.6	145	58.2	106	62.9	56.2
Arsenic	0.1	5.9	17	**586**	**196**	**413**	**167**	**319**	**217**	**199**
Cadmium	0.02	0.6	3.5	**57.1**	**71.4**	**37.4**	**16.1**	**25.4**	**31.1**	**17.6**
Copper	0.5	35.7	197	**194**	**285**	**141**	**62.3**	**99.3**	**97.7**	**74.2**
Iron	50	-	-	75533	31500	51000	27600	43800	32983	32550
Lead	2.5	35	91.3	**6290**	**5850**	**4760**	**2300**	**3580**	**3305**	**2352**
Mercury	0.005	0.17	0.486	**0.589**	0.15	**0.34**	0.156	**0.309**	0.14	0.103
Nickel	0.5	-	-	31.6	47.9	26.1	19.6	27.3	34.7	24.4
Selenium	0.2	-	-	11	0.6	1.5	0.67	1.12	0.66	0.58
Silver	0.1	-	-	16	22.3	65.3	24.6	42.1	23.8	19.5
Zinc	10	123	315	**3143**	**3360**	**2670**	**1130**	**1680**	**1552**	**1147**

Note.
MDL – method detection limit. Text in blue exceeded the Canadian Council for Ministers of the Environment (CCME) Interim Sediment Quality Guideline (ISQG). Text in red exceeded the CCME Sediment Quality Guideline Probable Effects Level (PEL).

Table 8-5: Metal Concentrations in No Cash Sediment at KV-21 and KV-56, 2018-2022

Total Metal Concentration mg/kg	Lab MDL	Guideline		KV-21				KV-56
		CCME ISQG	CCME PEL	09-Sep-18	24-Sep-20	22-Sep-21	17-Sep-22	09-Sep-18
Aluminum	50	-	-	5925	6067	6637	6043	7862
Antimony	0.1	-	-	43	16.7	59.2	20.6	1.46
Arsenic	0.1	5.9	17	**205**	**61.5**	**471.7**	**88**	**118.6**
Cadmium	0.02	0.6	3.5	**150**	**74.2**	**142.7**	**103.6**	**1.59**
Copper	0.5	35.7	197	**80.3**	**53.2**	**114.2**	**66**	32.15
Iron	50	-	-	30283	19950	38667	23517	29033
Lead	2.5	35	91.3	**1522**	**389**	**2483**	**860**	25.98
Mercury	0.005	0.17	0.486	0.11	0.043	0.124	0.103	0.03
Nickel	0.5	-	-	95.5	66.9	73.7	56.4	57.2
Selenium	0.2	-	-	1.08	0.5	2.36	0.71	0.61
Silver	0.1	-	-	58.6	10.9	100.7	22	0.34
Zinc	10	123	315	**10363**	**5662**	**13380**	**8035**	**192.7**

Note.
MDL – method detection limit. Text in blue exceeded the Canadian Council for Ministers of the Environment (CCME) Interim Sediment Quality Guideline (ISQG). Text in red exceeded the CCME Sediment Quality Guideline Probable Effects Level (PEL).

Table 8-6: Metal Concentrations in South McQuesten Sediment at KV-1, KV-3, and KV-4, 2007-2021

Total Metal Concentration mg/kg	Lab MDL	Guideline		KV-1						KV-3							KV-4						
		CCME ISQG	CCME PEL	31-Jul-07	23-Aug-09	01-Sep-11	21-Aug-12	08-Sep-18	24-Sep-21	31-Jul-07	22-Aug-09	01-Sep-11	22-Aug-12	03-Sep-15	06-Oct-18	24-Sep-21	31-Jul-07	22-Aug-09	31-Aug-11	22-Aug-12	03-Sep-15	07-Sep-18	24-Sep-21
Aluminum	50	-	-	8050	9570	9810	12000	9440	11452	8140	7640	12900	10600	8750	9098	8970	9557	9790	8690	8470	9360	7062	7882
Antimony	0.1	-	-	<0.5	0.9	0.8	1.17	0.94	0.84	15.6	29	15.1	23.2	22.4	14	24	32.3	21.9	26.5	18.4	12.3	8.88	79.7
Arsenic	0.1	5.9	17	18.8	22.6	17.7	32.8	40.6	30.9	130	128	94.1	145	108	113	126	180	109	116	100	68.7	45.3	284.5
Cadmium	0.02	0.6	3.5	3.3	4.18	4.08	9.44	6.49	6.11	13.5	13.9	15.7	22.8	11.5	14.7	24.4	17	16.1	14	11.8	8.57	3.57	27.53
Copper	0.5	35.7	197	25.4	36.2	32.7	64.1	42.3	44	41.5	37.3	67	67.1	42.2	45.2	53.6	59	57.1	39.9	40.7	37.6	22.6	105
Iron	50	-	-	17533	19900	17900	24000	24367	25950	25467	24000	25900	25300	23900	25167	26083	31800	25000	24100	22600	19700	15800	40967
Lead	2.5	35	91.3	13.9	11.9	11.1	16.7	14.9	12.3	423	463	336	614	342	388	728	985	422	376	372	266	248	3643
Mercury	0.005	0.17	0.486	0.054	<0.05	<0.05	0.0716	0.0284	0.0399	0.088	0.06	0.07	0.0856	0.0634	0.0502	0.0896	0.173	0.07	<0.05	0.0557	0.0707	0.0311	0.2183
Nickel	0.5	-	-	74	103	102	195	210	192	69.4	56.1	186	140	96	161	73.1	66.8	128	93.3	101	81.6	52.1	48.2
Selenium	0.2	-	-	1.2	1.3	1.5	3.01	1.32	1.77	2.5	1.3	2.5	2.07	1.14	1.3	2.23	3.5	1.5	1.4	1.14	1.16	0.32	1.32
Silver	0.1	-	-	0.2	0.21	0.14	0.3	0.19	0.5	7.1	11.6	5.77	8.78	7.32	5.14	11.43	16.2	8.87	8.47	6.61	4.85	2.81	44.47
Zinc	10	123	315	512	800	799	1300	1190	1258	1054	1380	1960	1960	1280	1534	1470	1333	1690	1390	1270	922	271	2078

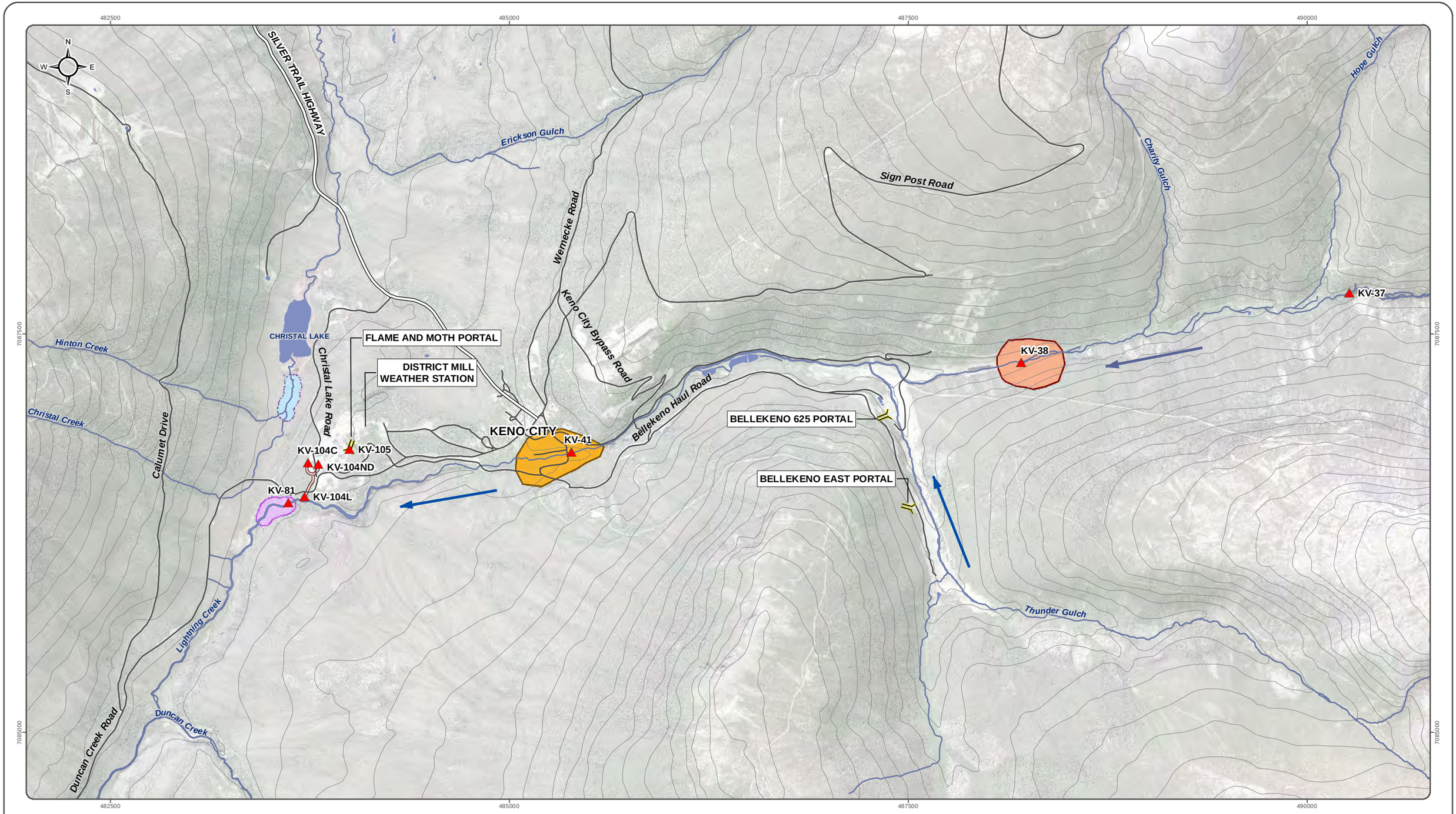
Note.
MDL – method detection limit. Text in blue exceeded the Canadian Council for Ministers of the Environment (CCME) Interim Sediment Quality Guideline (ISQG). Text in red exceeded the CCME Sediment Quality Guideline Probable Effects Level (PEL).

9 ENVIRONMENTAL EFFECTS MONITORING – FLAME AND MOTH

The objective of the 2023 Flame and Moth EEM Cycle 1 study was to determine the influence of treated mine effluent from Flame and Moth on the biological communities of Lightning Creek. To meet this objective, effluent quality and receiving environment water quality monitoring data collected by the Mine were used to support the interpretation of benthic invertebrate community survey data collected in the effluent-exposed area of Lightning Creek, and two reference sites located upstream. Lightning Creek encompasses both the receiving environment and the reference sites (Table 9-1; Figure 9-1). Reference (Ref1, Ref2) and exposure (Exp1) sites were chosen to isolate the influence of active placer mining activity and the Bellekeno Mine from Flame & Moth Mine effluent. The first reference area (Ref1) has a collection station at KV-38. Here aquatic receptors are exposed to Lightning Creek water, an area located upstream of current mining activities. The second reference (Ref2) site is in Lightning Creek at water quality station KV-41, an area located downstream of potential influences including the Bellekeno Mine discharge as well as historical and current placer mining. A laboratory fish exposure study was also undertaken to study the influence mine effluent from Flame & Moth alone could have on fish health and growth in Lightning Creek and what the combined effect of the actual discharge occurring from placer mining, Bellekeno and Flame & Moth mines in the system during the study period. The first EEM cycle report for Flame & Moth was submitted to ECCC November 30, 2023, which covered pre-development and mine development periods (Ensero 2023a).

Table 9-1: Concordance Table EEM Sediment, Benthic and Water Quality Sample Locations

Area	EEM Sample Sites	WQ Sample Sites
Reference Sites	Ref1 Area	KV-38
	Ref2 Area	KV-41
Exposure Site	Exp1 Area	KV-81



Sattellite Imagery obtained from Yukon Geomatics web service http://mapservices.gov.yk.ca/ArcGIS/services

Datum: NAD 83; Map Projection: UTM Zone 8N

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0 0.25 0.5 0.75 1 Kilometers

- Adit
- Surface Water Quality Station of Interest
- Pipeline
- Ref1
- Ref2
- Exposure Area
- Potential Exposure Area
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road

Hecla YUKON

FLAME AND MOTH - ENVIRONMENTAL EFFECTS MONITORING PROGRAM - CYCLE 1 STUDY DESIGN

FIGURE 9-1

LIGHTNING CREEK ENVIRONMENTAL MONITORING STATIONS

NOVEMBER 2023

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9.1 FISH LABORATORY EXPOSURE STUDY

A laboratory fish exposure study was undertaken, set up and run at the same time as the Bellekeno EEM fish study, to study the influence mine effluent from Flame & Moth alone could have on fish health and growth in Lightning Creek at a maximum discharge rate of 6% (Exposure 1) and what the combined effect of the actual discharge occurring from placer mining, Bellekeno and Flame & Moth mines in the system during the study period (Exposure 2). These treatments were compared to Reference 1, located upstream of the Flame & Moth discharge and downstream of the Bellekeno discharge. The Metal Mining Technical guidance for EEM (Environment Canada, 2012a) suggests a CES of ±10% (of the reference mean) for condition factor and 25% for weight-at-age for adult fish, however, since immature fish were used in this study, effects were determined using p-values.

The analysis of fish metrics endpoints before and after 42 days of the experiment demonstrated no increased mortality associated with exposure to mine effluent. Fish exposed to mine effluent (Exposure 1) had slightly higher condition ratings than fish from the Reference 1 and Exposure 2 groups at the start and end of the study, but all three tanks observed a similar improvement in condition factor by the time the study concluded. The results of the Flame & Moth EEM Cycle 1 study did not identify any negative effects of the Exposure 1 and Exposure 2 waters when compared to the Reference 1 waters. As immature fish were used for this study, the effect of effluent was determined using p-values instead of critical effect sizes. It should be noted that the reference 1 and exposure groups differed significantly in condition during the initial processing, prior to effluent exposure, as all tanks increased at similar rates (4.2% to 4.4% increase in condition between all three tanks) it is not surprising that the final measuring event also detected a difference in condition factors. As stated above condition factor improved for all three groups at a similar percentage over the course of the study.

9.2 BENTHIC INVERTEBRATES

Benthic invertebrate samples were collected in the fall using the same kick net methods described for the Bellekeno EEM benthic invertebrate sampling, at the locations referenced in Table 9-1 and Figure 9-1.

To determine potential effects detected during Cycle 1 monitoring, Reference 1 and 2 were compared to a downstream exposure area; reference areas were upstream of the effluent discharge and encompassed effects from historical and more recent placer mining activities, unrelated to Hecla operations.

9.2.1 Placer Mine Influence (Ref 1 and Ref 2)

The influence of placer mining on benthic invertebrates was evaluated by comparing Reference 1 (placer influence upstream of Thunder Gulch) with Reference 2 (placer influence receiving input from Lightning Creek and Thunder Gulch). No significant statistical difference was detected between Reference 1 with Reference 2 areas for taxa richness and evenness. However, significant differences in abundance and community structure (i.e., Bray-Curtis (BC) Index) were noted between the two areas. Ref 1 had greater taxa richness and abundance compared to Ref2 which is likely driving the dissimilarity measurements. This may indicate that the benthic community at Reference 2 is impaired and more accurately reflects the true condition of the KHSD, which encompasses historic and/or current mining operations. To note, Ref2 area samples had greater amounts of EPT and lower Diptera compared to Ref 1 samples, which could be reflective of input from Thunder Gulch and placer mining activity. Along with the presence of heavy metals in water (aluminum) and sediment (arsenic, cadmium, lead, zinc), these observations suggest that impairment of the benthic community may have existed previously and is unrelated to mine effluent.

9.2.2 Mine Effluence Influence (Exp1)

Metrics were compared between upstream reference areas to the exposure area to gauge if there was an influence on benthic communities from Flame and Moth effluent. Exposure area samples had greater taxa richness compared to upstream Ref2 (though not significant) and greater abundance. Exp1 and Ref2 samples shared a similar distance from Ref1 area samples (BC Index), suggesting they are both the same level of dissimilarity and the community structure in those areas may have more in common than to Ref1. Exp1 and Ref2 also shared similar levels of EPT and Diptera, again suggesting the community structure is similar for those taxa.

Aluminum and iron exceeded CCME guidelines for PAL in the downstream exposure, metals often associated with release of sediment due to place mining operations. TSS levels (September 15, 2022) were also twice as high downstream. Nitrate levels may indicate the presence of effluent/mine water, however concentrations measured did not appear significantly different between the reference and exposure areas,

Water chemistry measured in samples from the Exposure area (KV-81) for this cycle showed TSS and metals are slightly higher than those measured at KV-41 (Ref2); however, concentrations were within the same order of magnitude between the two areas. While sediment chemistry measured metals exceedances in all three reference sites, both the exposure area and Ref2 area had consistently greater metals values compared to Ref1. For example, lead concentration in Ref2 (62 mg/kg) and Exp1 (60 mg/kg) was over 1.5x the concentration in Ref1 (37 mg/kg). Zinc measured greater in Exp1 (209 mg/kg) and Ref2 (174 mg/kg) compared to Ref1 (142 mg/kg). The elevated metal concentrations in sediment at Reference 2 may reflect the naturally elevated metal input from Thunder Gulch combination with historical activities.

Effects on benthic invertebrate endpoints include an increase in benthic abundance in the exposure area, and a dissimilar community structure between the exposure and reference areas. Considering the various lines of evidence in context with the legacy mining that has occurred upstream of the Mine, the effects measured are likely caused by historical placer mining activities, rather than by mine site effluent.

9.3 STREAM SEDIMENT

Stream sediment was collected in areas of sediment deposition with slow moving water adjacent to the benthic invertebrate sampling at the locations referenced in Table 9-1. Sediments were dried and screened for particle size distribution and the fine fraction particles of the sediment was analysed for total metal chemistry. Sediment metals analysis was then compared to the CCME Interim Sediment Quality Guidelines (ISQG) and the Probable Effects Level (PEL) guidelines.

Stream sediment metal concentration analysis and particle size data is presented in Table 9-2. The stream sediment metals concentration found in all sites exceeded the ISQG Guidelines for cadmium, lead, and zinc and the PEL Guidelines for arsenic. Additionally, Exposure 1 (KV-81) exceeded the ISQG Guidelines for copper. Particle size analysis indicated that Ref1 and Exp1 were composed primarily of fines and sand, with Ref2 being primarily composed of gravel.

Table 9-2: Sediment Metal Concentrations and Particle Size, 2023

Total Metal Concentration (mg/kg)	Lab MDL	Guideline		Station		
		CCME ISQG	CCME PEL	Exp1 (KV-81)	Ref1 (KV-38)	Ref2 (KV-41)
Aluminum	50	-	-	8970	7460	7640
Antimony	0.1	-	-	2.60	2.05	2.65
Arsenic	0.1	5.9	17	43.9	37.98	40
Cadmium	0.02	0.6	3.5	2.05	1.28	1.48
Chromium		37.3	90	21.07	18.73	20.18
Copper	0.5	35.7	197	38.6	28.85	31.25
Iron	50	-	-	24,050	20,950	21,900
Lead	2.5	35	91.3	60.3	36.7	62.2
Mercury	0.005	0.17	0.486	0.040	0.029	0.034
Nickel	0.5	-	-	31.3	24.8	27.5
Selenium	0.2	-	-	1.09	0.65	0.44
Silver	0.1	-	-	1.01	0.73	1.13
Zinc	10	123	315	208.5	142.3	174.3
Particle Size and TOC						
Total Organic Carbon (TOC)				5.80	1.08	0.62
% Gravel				9.3	5	22.5
% Sand - Coarse				5	3.5	10.5
% Sand - Medium				12	12.5	17
% Sand - Fine				22.3	36.5	30.5
% Fines				51.7	42	19.5
% Loss on Ignition				14.52	3.30	2.45

10 WILDLIFE

10.1.1 Regional

The Keno Hill mining camp supports a variety of wildlife including ungulates, bears, furbearers, small mammals, upland game birds and waterfowl. A general descriptive overview of biophysical properties is found within Ecoregions of the Yukon Territory (Smith et al., 2004), while detailed biophysical information is found within Heart of the Yukon—A Natural and Cultural History of the Mayo Area (Bleiler et al., 2006). The Current State of Wildlife in the Keno Hill Silver District (Lortie, 2009) provides a summary on wildlife use in the area.

There are several species of ecological, economic, and cultural importance in the Keno Hill mining camp. Moose (Alces alces) are highly valued to a subsistence and commercial lifestyle for the peoples in this area, including the FNNND. The Keno Hill mining camp is an important habitat for the moose population. The subalpine zones on the Keno Hill, Bunker Hill and Sourdough Hill uplands are key rutting and post rutting aggregation areas (O'Donoghue, pers. Comm. as cited in Lortie, 2009). Further, the wetlands associated with and above Pumphouse Pond, the South McQuesten River and the Elsa valley tailings areas are important calving and post calving areas (O'Donoghue, pers. Comm. as cited in Lortie, 2009). The moose census results from 2006, 2011 and 2017 indicated a declining trend in moose densities in the area (O'Donoghue et al., 2019). In 2022, the Keno Hill mining camp became part of a larger threshold hunt area (September 1 to October 31), whereby the hunt closes at the season end date or when the threshold limit of eleven (11) moose is met (YG, 2023b). This threshold limit remains unchanged to present date.

Woodland caribou are not presently found in the Keno Hill mining camp, apart from fewer than 10 to 12 caribou scattered in very small groups in the Mt. Hinton and Bunker Hill areas during the summer (O'Donoghue, pers. comm. as cited in Lortie, 2009).

Thinhorn sheep (*Ovis dalli*) were formerly present on Keno Hill but hunted to extinction in the early 20th century. Heart of the Yukon (Bleiler et al., 2006) indicates that sheep are not present in the Keno Hill mining camp area, and the nearest population of about 70 animals inhabits the Ddhaw Ghro Habitat Protection Area south of Ethel Lake. Black bear (*Ursus americanus*) and grizzly bear (*Ursus arct*os) are common in the area (Bleiler et al., 2006).

Several furbearers known to use the project area include gray wolves (*Canis lupus*), coyotes (*Canis latrans*), foxes (*Vulpes vulpes*), marten (*Martes Americana)*, mink (*Neovison vison)*, Canada lynx (*Lynx canadensis*), wolverine (*Gulo gulo*) and river otter (*Lontra canadensis*). A number of these species are culturally and economically important to trappers in the area and the FNNND. Beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) are also economically important and common in aquatic habitats in the region.

Other small mammals common to the area include ground squirrel, red squirrel, varying hare, weasel, vole, shrew, porcupine, and the less common chipmunk. Alpine areas have local populations of hoary marmot and collared pika (*Ochotona collaris*). A thorough and comprehensive narrative of birds in the area can be found within *Heart of the Yukon* (Bleiler et al., 2006).

The only amphibian known to the area is the wood frog (*Lithobates sylvaticus*). It lives in a wide variety of habitats and adults can be found well away from water. They gather to breed in clear, shallow ponds from late April through June, often with some ice still on the water (YG, 2023c).

Table 10-1 lists wildlife species that are recognized by the federal or territorial government as needing extra protection or monitoring and may be found in study area.

Table 10-1: Wildlife Species at Risk and Specially Protected that are potentially in the Region

SPECIES	STATUS	SOURCE
Short eared owl (*Asio flammeus*)	Threatened	COSEWIC (2021)
Common nighthawk (*Chordeiles minor*)	Special Concern	COSEWIC (2018)
Olive-sided fly catcher (*Contopus cooperi*)	Special Concern	COSEWIC (2018)
Rusty blackbird (Euphagus carolinus)	Special Concern	COSEWIC (2017)
Gyrfalcon (*Falco rusticolus*)	Specially Protected	Yukon Wildlife Act (2012, amended 2014)
Trumpeter swan (*Cygnus buccinator*)	Specially Protected	Yukon Wildlife Act (2012, amended 2014)
Barn swallow (*Hirundo rustica*)	Special Concern	COSEWIC (2021)
Bank swallow (*Riparia riparia*)	Threatened	COSEWIC (2013)
Canada warbler (*Wilsonia canadensis*)	Special Concern	COSEWIC (2020)
Horned Grebe (*Podiceps auratus*)	Special Concern	COSEWIC (2009)
Lesser Yellowlegs (*Tringa flavipes)*	Threatened	COSEWIC (2020)
Red-necked Phalarope (Phalaropus fulicarius)	Special Concern	COSEWIC (2014)
Little Brown Bat (*Myotis lucifugus*)	Endangered	COSEWIC (2013)
Northern Long-eared Bat (*Myotis septentrionalis*)	Endangered	COSEWIC (2013)
Wolverine (*Gulo gulo*)	Special Concern	COSEWIC (2014)
Grizzly bear (*Ursus arctos*)	Special Concern	COSEWIC (2012)
Woodland caribou (*Rangifer tarandus caribou*)	Special Concern	COSEWIC (2014)
Cougar (*Puma concolor*)	Specially Protected	Yukon Wildlife Act (2012, amended 2014)
Collared pika (*Ochotona collaris*)	Special Concern	COSEWIC (2011)

Note.

Not all species listed in this table have been observed in the project area.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in an independent advisory panel of wildlife experts and scientists that assess the status of wildlife species as extirpated, endangered, threatened or special concern and forwards its assessments to the Minister of Environment and Climate Change Canada (ECCC) for consideration to be legal listed under the Species at Risk Act (SARA)

10.1.2 Community-Based Fish and Wildlife Management

Development of community-based fish and wildlife management plans originated in the community of Mayo and has since been applied throughout the Yukon to engage communities in work planning exercises. These are practical plans that coordinate and unify the management of fish and wildlife populations and their habitats using a cooperative approach between the First Nation of Na-Cho Nyäk Dun, Mayo District Renewable Resources Council, and Environment Yukon. Community-based work plans are developed to address community concerns about moose, caribou, bear, wolf, and fish populations, as well as habitat, harvest, wildlife viewing, and other wildlife and land management issues. These plans provide opportunities for public participation and inform area residents about management activities.

The 2024-2028 Community-Based Fish and Wildlife Work Plan is the sixth plan for the Na-Cho Nyäk Dun Traditional Territory, building on more than 25 years of collaborative management. The previous 2014-2019

plan achieved significant successes, including wildlife surveys to map seasonal habitats in areas with high industrial development (particularly the upper Stewart River watershed) to provide baseline data for environmental assessments; water quality monitoring in Cache Creek; moose population surveys in the Mayo area; and hiring of year-round land guardians. The 2024-2028 plan priorities include improved understanding of habitat and wildlife populations, enhanced land use planning and environmental assessment processes, better management of access and development impacts, and monitoring of climate change effects on fish, wildlife, and habitat (Na-Cho Nyäk Dun Fish and Wildlife Planning Team 2024).

10.1.3 Effects of Project on Wildlife

The effects of the Project on flora and fauna were discussed in a Human Health and Ecological Risk Assessment by SENES Consultants Ltd. (2011, 2014). Key findings of the assessment indicate that there are no issues for large mammals directly exposed to conditions on site. Waterfowl that consume benthic invertebrates as their main food source, with incidental sediments, and beaver, may be exposed to elevated levels of arsenic, lead, and selenium from Christal Creek and Christal Lake.

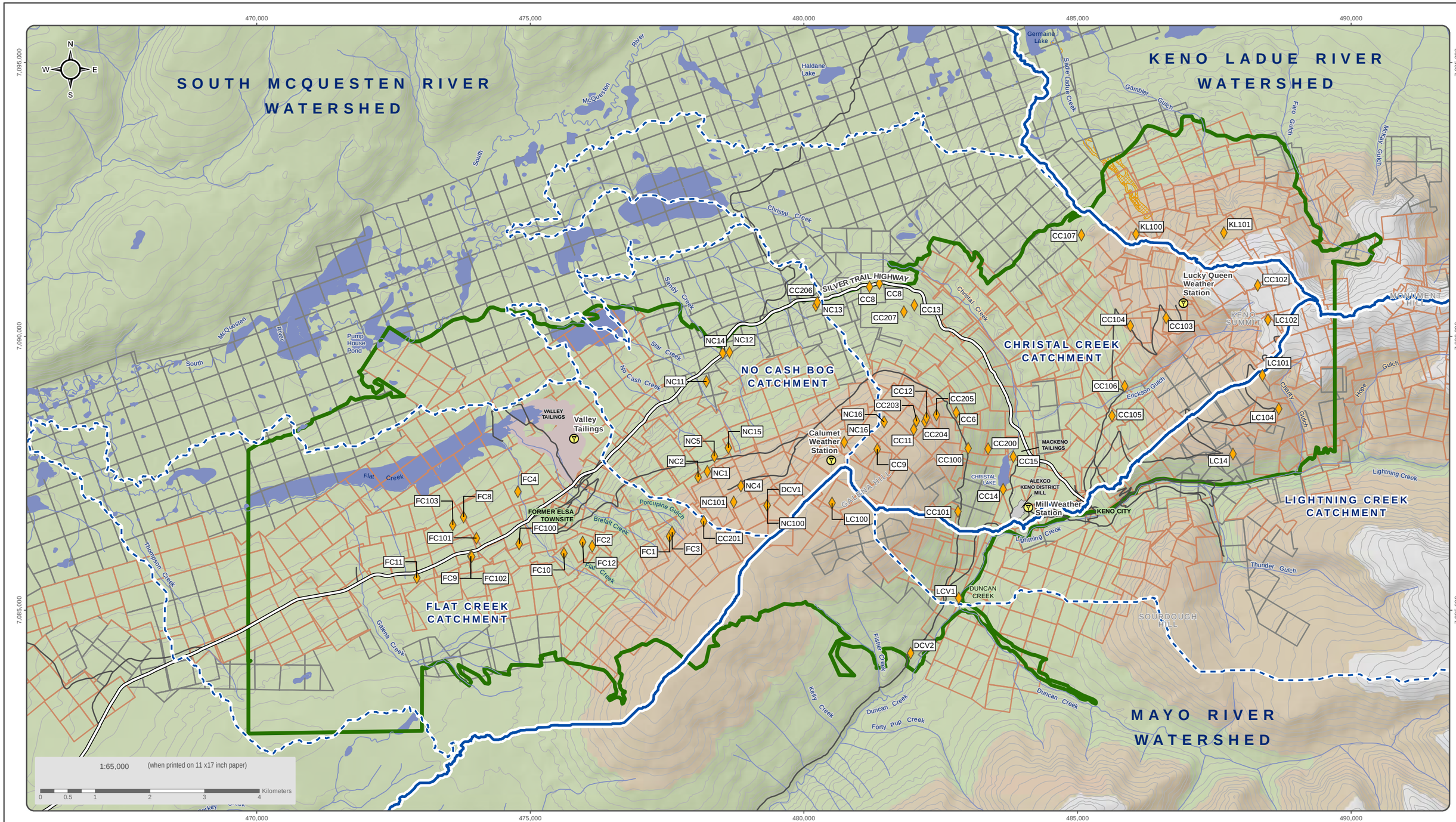
11 VEGETATION

The Keno Hill mining camp lies within the Stewart Plateau region of the Yukon Plateau – North Ecoregion. The area is characterized by a series of table lands divided by broad deep cut valleys which are dominated by widespread discontinuous permafrost (Smith et al, 2004). Many valleys include peatlands, palsas, fens and meadows of sedge tussocks. Upper slopes may be covered with scree material, with treeline occurring at 1,300 masl on northern aspects and up to 1,360 masl on southern aspects.

Three bioclimatic zones exist within the general Project's study area: Boreal High, Boreal Subalpine, and Alpine, described in Table 11-1. The Boreal High bioclimate zone is the most predominant, comprising roughly two thirds of the KHSD, followed by the Boreal Subalpine (approximately one quarter of the study area). The Boreal Subalpine bioclimatic zone is found on both Galena and Keno hills. The Alpine zone occurs over a relatively confined area on Keno Hill in the eastern extent of the claims (Figure 11-1).

Table 11-1: Bioclimate Zones in the Keno Hill Silver District

BIOCLIMATIC ZONE (ELEVATION RANGE)	DEFINITION
Boreal High (500−1,225 m)	The Boreal High forested areas are predominantly a mix of white and black spruce, with a shrub, lichen, and moss understory. The higher elevation extents of this bioclimatic zone support a mix of subalpine fir, scrub birch, and willow as it approaches the Boreal Subalpine zone. The Boreal High tends to have more of an open canopy than Boreal Low and a moderate to well-developed shrub layer. Non-forested areas include wetlands, riparian areas, avalanche tracks, exposed soil/rock, and anthropogenic disturbances.
Boreal Subalpine (1,225−1,450 m)	Open to sparse forest canopy cover, main trees species are subalpine fir and white spruce that become less frequent at the higher elevations. A well-developed shrub layer is composed mainly of scrub birch, willow species, and vaccinium. At the higher extent of this zone small woody shrubs, Dryas, mosses, and lichen replace the forest cover with only a few krummholz subalpine fir scattered amongst the landscape.
Alpine (1,450 m+)	Alpine communities include dwarf ericaceous shrubs, scrub birch, willow species, grass/sedges, forbs, lichen, and bare bedrock at elevations above the treeline. Trees if present are low growing krummholz that exist in small microsites where they can receive enough moisture and nutrients to grow. This bioclimatic zone is present only on Keno Hill.



Topographic Data (CANVEC) data at a scale of 1:50,000 and crown grant (land parcels and mineral survey claims) data compiled by the Department of Natural Resources Canada. Quartz claim boundaires and ownership are current as of Marchth 2017; obtained from Geomatics Yukon, Government of Yukon.
Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on March 2017

Datum: NAD 83; Map Projection: UTM Zone 8N

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BIOCLIMATIC ZONES

- Boreal Low (< 500m) 0%
- Boreal High (500 - 1225m) 62.6%
- Subalpine (1225 - 1450m) 32.0%
- Alpine (> 1450m) 5.4%
- Vegetation Classification Outline
- Ecosystem Plot Location
- Weather Station
- Watershed
- Catchment
- ERDC Owned Quartz Claims or Crown Grants
- Tailings Area
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Contours (100 ft intervals)

Hecla YUKON

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 11-1

BIOCLIMATE ZONES OF KHSD

REVISION 5	NOVEMBER 2021	JOB:007-4
DRAWN BY GIS	DESIGNED BY GIS	REVIEWED BY: LB

D:\Project\AllProjects\ALEX-05-01\gis\mxd\Overview_Maps\SpecificTopics\Biodimatic_Zones\Fig4_65_Biodimatic Zones_20211125.mxd (*Last edited by: tosberg: 11/25/2021(09:49 AM)*)

11.1.1 Boreal High

The Boreal High vegetation in this region comprises forested areas as a mix of white and black spruce with a lichen and moss understory on most of the slopes. White spruce, green alder, and willow occur in drainage areas, whereas black spruce is the dominant species in low lying areas and wetlands. Balsam poplar and Alaskan birch occur in more open areas with a moderate to well-developed shrub layer. Non-forested areas include wetlands, riparian areas, avalanche tracks, exposed soil/rock, and anthropogenic disturbances.

Within the Boreal high zone there are large patches of disturbed unvegetated areas, as well as wetlands, shrub lands, and forests in various stages of succession. Early successional communities are typically herbaceous or shrub dominated if <30 years from the time of disturbance or they experience regular/frequent disturbances (e.g., flooding, wetlands, fire, extensive browsing). In these early successional communities, tree species, if present, generally make up <10% of cover.

If early successional communities do not experience recurring disturbances they may progress into a sapling forest with emerging tree cover above a shrub and herb layer. The tree canopy can become denser during the sapling forest stage, limiting light and ultimately shifting successional trajectories to an older stage. Eventually, broadleaf tree species will begin to self-thin around 30 years, whereas coniferous species will begin this process around 40 years; this opens the tree canopy and vigorous growth may then occur. These sapling forests can be very diverse with communities in the area dominated by white spruce, black spruce, various shrubs, and feather moss. Shade tolerant species thrive during this period. Once thinning has begun, the system shifts to a young forest stage (<80 years). Young forests are dominated by black spruce, Labrador tea, and sphagnum moss. Minimally disturbed mature forests (80 to 140 years) have mature trees with well-developed understories; dominant species are black spruce, white spruce, shrub birch, and Labrador tea. Figure 11-2 illustrates a generalized natural succession found within the Boreal High bioclimatic zone within the study area.

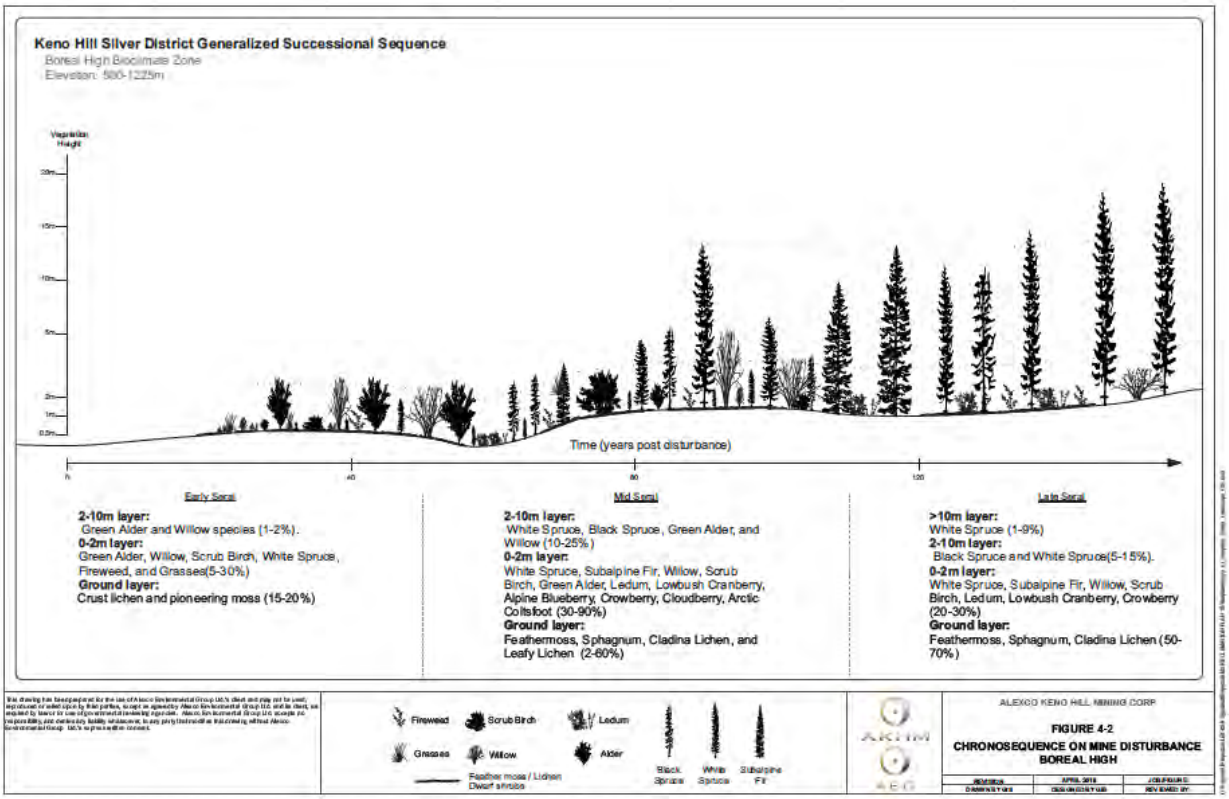

Figure 11-2: Chronosequence on Mine Disturbance Boreal High

11.1.2 Boreal Subalpine

The Boreal Subalpine bioclimatic zone is found on Galena, Keno and Sourdough Hill, and characteristically contains sparse forest canopy cover of subalpine fir and white spruce. Communities range in successional stages from early-stage grass and dwarf shrub dominated areas to mature forests older than 140 years. This diverse bioclimatic zone can range from containing thick feather moss layers with Labrador tea on lower slopes with higher moisture, to sparsely vegetated areas on steep slopes or rocky terrain.

Early succession communities are typically dwarf shrub and sedge dominated and may be initiated in small depressions or slumps, generally having thin soil layers. These may develop into white spruce, Alaskan birch, willow, and fir dominated zones that transition into shrubland as elevation increases. Figure 11-3 illustrates a generalized natural succession found within the Subalpine bioclimatic zone within the study area.

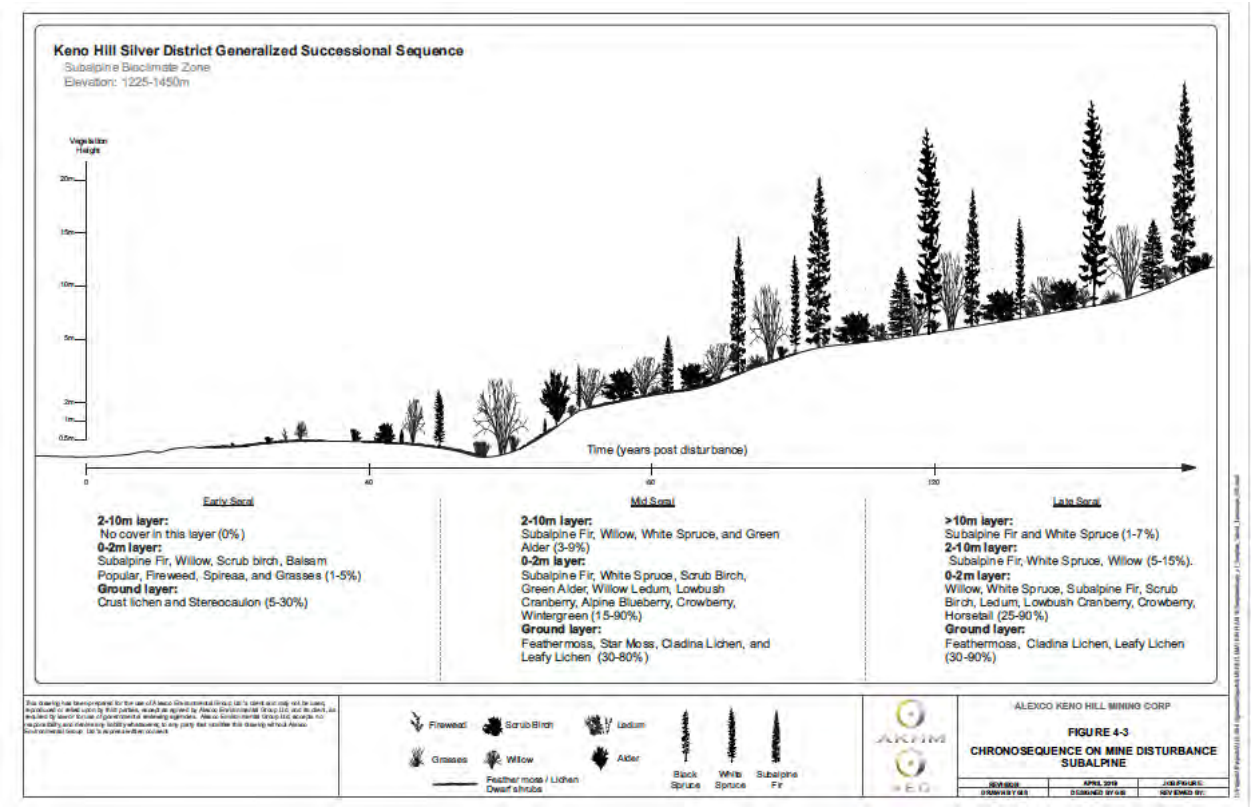

Figure 11-3: Chronosequence on Mine Disturbance Subalpine

11.1.3 Alpine

Alpine communities are present in the area on Keno Hill, but not Galena Hill. Alpine communities are characterized by dwarf ericaceous shrubs, scrub birch, willow, grass/sedges, forbs, lichens, and bare bedrock at elevations above tree line. On Keno Hill, there are large areas dominated by grasses, willows, and dwarf shrubs with patches of rock outcroppings. Communities on rocks are mainly lichen and moss with some grass and forbs growing in crevasses and cracks. These slow-growing communities can be considered early successional stages; however, in the presence of severe weather or physical stress (e.g., rockslides, wind, erosion, herbivory), these communities may remain stable. Figure 11-4 illustrates a generalized natural succession found within the Alpine bioclimatic zone within the study area.

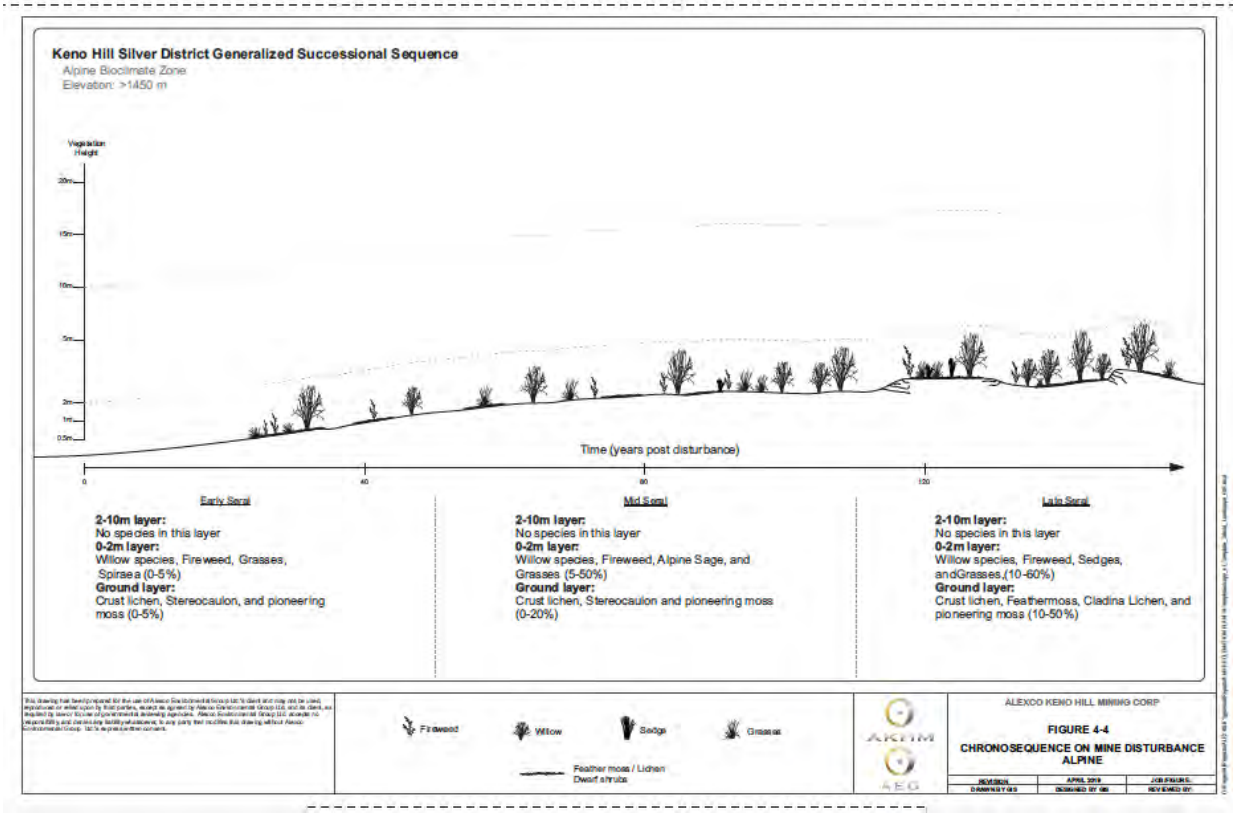

Figure 11-4: Chronosequence on Mine Disturbance Alpine

11.1.4 Contaminants in Vegetation

Metal levels in local wetland plant species were investigated as part of the Galkeno 900 pilot wetland test work in 1995 (AMC, 1996). Samples for metal analyses were collected from wetland plant tissue and sediments to determine the extent of metal uptake by plants. The study found that although sediments were enriched in metals by 1-2 orders of magnitude compared to reference sites, metal concentrations in plant tissue were similar to reported values for reference sites, with no evidence of metal uptake by plants in these wetland areas.

Environmental Dynamics Inc. (EDI) conducted three terrestrial effects studies in the Keno Hill mining camp, from 2007 to 2009. Results of terrestrial effects assessments concluded there was aerial contamination of metals to lichens but was limited to the eastern portion of the Valley Tailings Facility (EDI, 2008; 2009). Other results showed evidence of elevated heavy metal concentrations in some medicinal plants used by FNNND as compared to control sites, particularly near the historic tailings site (EDI, 2008; 2009). EDI noted that metal concentration in plants appears to be species-specific; willow samples had higher concentrations of metals, while Labrador tea contained lower concentrations. The data further suggests that in this region there is little to no correlation between metal concentration in soils and metal concentration in plants. Therefore, the most likely pathway of metal accumulation in plant samples is aerial deposition of dust from the Valley Tailings Facility on the surface of plant tissues and is likely not being incorporated into the tissues of plants (EDI, 2010).

In 2013 an assessment of metals in soil and vegetation (ACG, 2013) was conducted in the study area to determine the extent, degree, and pathways of metals contamination in the local ecosystems originating in

waste rock and tailings located on the former UKHM sites within the KHSD. Some sites had very localized conditions of contamination/hotspots, such as exposed ore waste, tailings, and adit areas. However, analysis was limited to those sites that were not highly disturbed. The assessment concluded that these hotspots may be from current anthropogenic sources, or sites where historic contamination was not documented, or from naturally occurring mineralization.

Several Human Health and Ecological Risk Assessments (HHERAs) have been prepared for the Keno Hill Silver District since 2011. The most recent was a 2019 post-reclamation HHERA. Additionally, SENES Consultants Ltd. completed a focused Human Health Risk Assessment (HHRA) in 2012 for year-round residents of Keno City, which is being updated to address comments from Health Canada and will be provided in 2026.

Soil sampling was conducted around Keno City in summer 2011 at 54 stations; 21 of these stations were resampled in September 2023. No trends were identified between 2011 and 2023. Arsenic, lead, and manganese were identified as contaminants of potential concern (COPC) for the HHRA. Other metals including beryllium, antimony, chromium, cobalt, lithium, mercury, molybdenum, silver, thallium, tin, uranium, and vanadium had maximum concentrations below applicable guidelines. Although maximum concentrations of barium, copper, nickel, selenium, and zinc exceeded soil quality guidelines (SQG), they were below human health guidelines (SQGHH) and were not identified as COPC.

11.1.5 Revegetation

An assessment of disturbed mine site areas completed by AEG (2016c) focused on historical waste rock pits, dumps, and trenching. Photo records of natural revegetation at historical disturbed waste rock storage and pit sites (No Cash mine) documented succession over a six-year period. As expected, once primary colonizing species were established on site, microsites were created that increased surface organics and promoted growing conditions for greater species diversity. Several sites showed evidence of multiple factors that would limit successful revegetation, including insufficient substrate moisture, unfavourable substrate texture, and unfavourable slope.

Vegetation trials at the KHSD historical environmental liabilities have been ongoing to determine feasible surface treatments for promoting revegetation of disturbed sites. This has included scarifying the disturbance with machinery to add microsite conditions, applying seed mix and fertilizer amendments, and adding natural growth media in the form of organic material or coarse woody fragments.

At locations being monitored for active revegetation work on newly disturbed waste rock, it was found that vegetation coverage benefitted from a second application of fertilizer and seed, particularly the year immediately following the second application. The reapplication of seed and fertilizer had less impact the second year after application (AEG, 2017).

12 NOISE MONITORING

12.1 PREDICTED SOUND LEVELS GENERATED BY MINING AND MILLING

Five noise sensitive receptor locations were selected for Noise Impact Assessments (NIAs) conducted by Patching Associates Acoustical Engineering Ltd. (PAAE) on behalf of YESSB to evaluate existing and predicted noise levels from KHSD Mining Operations.

Sound propagation calculations used CadnaA modeling software by Datakustik, which calculates contribution levels at each receiver location in octave bands and overall dBA levels. The model incorporated frequency-dependent factors including ground absorption, air absorption, elevation relative to sound sources, and barrier effects. Modeling used worst-case conditions of 10°C temperature and 80% relative humidity for minimum air absorption.

The 2012 NIA focused on Bellekeno Mine and mill operations (PAAE, 2012). Predicted noise levels at the five receivers from mill operations and ore haulage on the Bellekeno Haul Road (between call signs BKR 1 to BKR 5) showed combined ambient sound levels and mine activities ranging from 32 dBA at station R03 to 39 dBA at station R01.

The 2014 NIA update evaluated increased sound levels from mining at Flame & Moth, Onek 990, and Lucky Queen combined with Bellekeno operations (PAAE, 2014). The assessment predicted a maximum increase of 2 dB at station R04 for both daytime and nighttime conditions associated with Flame & Moth Mine activities.

12.2 MONITORING PROGRAM AND EQUIPMENT

The noise monitoring sites in Keno City are proximate to local businesses, tourist sites, and residences (Table 12-1; Figure 12-1), providing sufficient coverage to effectively monitor community noise (PAAE, 2012, 2014). AKHM uses these same general locations to monitor noise levels during mine development, operation, and temporary closure phases. Between April 2013 and November 2014, noise monitoring was conducted using an Extech Integrating Sound Level Datalogger (Model 407780) to capture average dBA over single ten-minute periods. In 2021, monitoring equipment was upgraded to a Larson Davis Soundtrack LxT sound meter.

Table 12-1: Noise Receptor Monitoring Locations Assessed in Keno City

SITE	GPS LOCATION	DESCRIPTION
R01	N63.90799 W135.29516	East end residence, north side of Lightning Creek Road. ~50 m southeast of NIA station
R02	N63.91015 W135.30061	Residence, east side of Sign Post Road. ~50 m west of NIA station
R03	N63.90978 W135.30176	Town Center, at the Snack Bar. ~50 m southwest of NIA station
R04	N63.91259 W135.302870	North end residence, east side of Wernecke Road at Onek 400. ~50 m east of NIA station
R05	N63.90915 W135.31669	Keno City Ball Park, 500 m east of the District Mill. ~350 m northwest of NIA station and west end residences
Campground	~N63.90747 ~W135.30288	Keno City Campground, south side of Keno City adjacent Lightning Creek. Actual location selected to avoid campers that are using the facility

Starting in December 2014, 24-hour noise monitoring readings were collected using a sound level meter with a microphone mounted at approximately 1.5 meters above ground and fitted with a windscreen.

Monitoring equipment has been updated over time, with gaps in data due to equipment issues, vandalism, or temperatures below operating conditions. Data collection methodology changed from fast to slow time rating in 2021, 2023, and from August 2024 to present.

All 2022 measurements are considered invalid due to damaged equipment.

484000 484500 485000 485500

7087500 7087000 7086500

N W E S

CHRISTAL LAKE

CHRISTAL LAKE ROAD

Christal Creek

DRY STACK TAILINGS FACILITY

MILL

FLAME AND MOTH

MILL POND

CRUSHER

FLAME & MOTH WATER TREATMENT POND

P-AML

DUNCAN CREEK ROAD

Lightning Creek

SILVER TRAIL HIGHWAY

SIGN POST ROAD

ONEK 400

R04

WERNECKE ROAD

R03

R02

KENO CITY BYPASS ROAD

ONEK 990 PORTAL

R05

R01

KENO CAMPGROUND

BELLEKENO HAUL ROAD

SOURDOUGH TRAIL

484000 484500 485000 485500

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on April 2023

Datum: NAD 83; Projection: UTM Zone 8N

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1:6,000 *(when printed on 11 x17 inch paper)*

0 50 100 150 200 250 Meters

Noise Monitoring Station

Adit

Weather Station

Current DSTF

Pond

Mine Feature Footprint

Watercourse

Silver Trail Highway

Secondary Road

Hecla YUKON

ENSERO solutions

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 12-1
NOISE MONITORING SITES

FEBRUARY 2024

D:\Project\AllProjects\Keno_Area_Mines\ALL-SITES\02-Map\04-Studies\Air_Noise_Dust\Air_Quality_NOise_Mill_20230427.mxd
(Last edited by: amatlashevska;2023-04-27/14:23 PM)

12.3 MONITORING RESULTS

All 24-hour noise recording results from 2014 to 2024 (all data runs with <24-hour have been excluded) are presented in Figure 12-2, along with the NIA values (PAAE, 2012, 2014).

A summary of the primary activities undertaken by Alexco Resources Corp. (dba Hecla Yukon) subsidiaries AKHM and ERDC in the vicinity of Keno City are listed in Table 12-2.

Table 12-2: Hecla Yukon activities near Keno City during monitoring period, 2014 to present

TIME PERIOD	MINE DEVELOPMENT AND OPERATIONS ACTIVITY
December 2014 to April 2018	considered baseline noise levels.
May 2018 to October 2018	considered operation noise data: • In 2018, Flame & Moth decline was developed, hence blasting activities, material transportation and surface facility construction took place
November 2018 to July 2020	considered baseline noise levels.
August 2020 to present	considered operation noise data: • August to September 2020 o ERDC constructed Onek water treatment plant adjacent to R04 • Summer of 2023 o ERDC construction of a pipeline route from Onek 400 and Galkeno 900 to the Silver Trail Highway Water Treatment Plant commenced o rehabilitation of the Galkeno 900 and Onek 400 portals was completed and as a result heavy equipment traffic in the area also increased o rehabilitation of Onek 440 Adit by ERDC • September 2024 o actively screening rock at the historic Onek open pit by ERDC

There has been an increase in activities by other proponents in the Keno City area since 2024. The work done by ERDC on the Onek pipeline road, helicopter activity facilitating diamond drilling by True Point Exploration Company, as well as the seasonal operation of motorbikes and ATVs by visitors to Keno would have elevated noise levels at the receiver sites.

Ambient noise levels experienced between the different sites will vary depending on nearby activities and climate parameters like relative humidity, temperature, and temperature inversions. These parameters influence how the receptors interpret sound level and propagation.

Sound travels faster through warm air since warm air is less dense, resulting in different noise readings compared to a receptor site situated in a cooler area. Humidity has a similar effect on noise—dry air absorbs far more acoustical energy compared to moist air. Therefore, noise is expected to travel more efficiently in summer months when the ambient air is warmer and more humid. These environmental factors contribute to the seasonal patterns observed in the monitoring data.

Table 12-3 presents all 24-hour period noise data available from 2014 through 2024 (all data runs with <24-hour have been excluded), and associated meteorological parameters obtained from the District Mill meteorological station (averaged from hourly data for the corresponding 24-hour period).

Baseline Periods (Care and Maintenance)

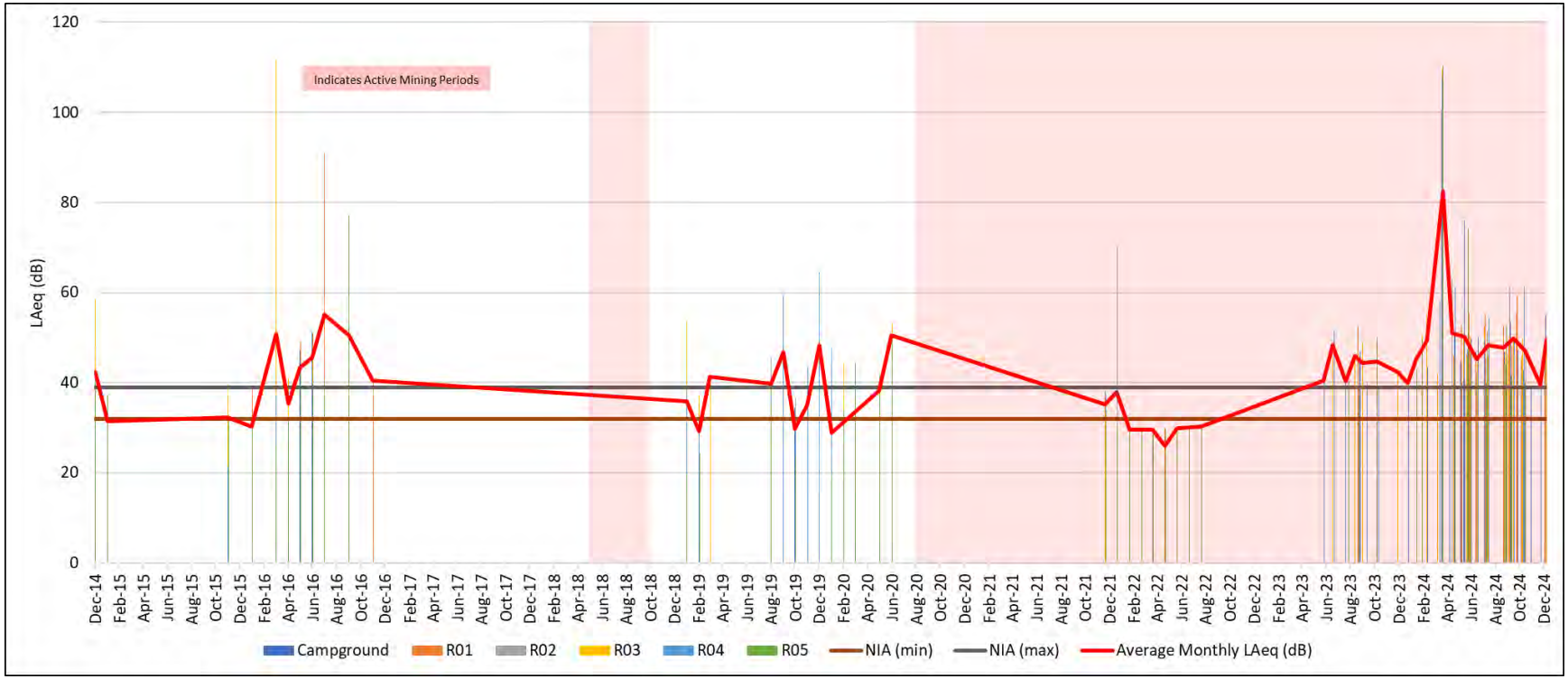
During baseline (care and maintenance) periods from December 2014 to April 2018 and November 2018 to July 2020, 119 measurements were recorded with LAeq values ranging from 19.3 to 115.0 dBA and an average of 40.2 dBA. Approximately 52.1% of measurements exceeded the 39 dBA threshold predicted by the NIA for cumulative noise levels, with LAeq exceeding L10 in 56.5% of measurements, indicating that short-term loud events elevated the energy-average above typical levels in over half of monitoring periods. Seasonal averages showed substantial variation, ranging from 35.1 dBA in winter to 46.1 dBA in summer, with spring (42.5 dBA) and fall (39.1 dBA) intermediate.

Operations Periods

During operations periods from May to October 2018 and August 2020 to present, 195 measurements recorded LAeq values ranging from 24.2 to 127.8 dBA with an average of 46.6 dBA—a 6.4 dBA increase over baseline conditions. The percentage of measurements exceeding the 39 dBA threshold increased to 77.4%, and LAeq exceeded L10 in 66.7% of measurements, reflecting more frequent transient noise events during active mining. Seasonal averages during operations ranged from 40.5 dBA in winter to 52.5 dBA in spring, with summer (45.8 dBA) and fall (46.5 dBA) showing elevated but more moderate levels. Extreme values recorded in 2018 during Flame & Moth development represent atypical quiet periods and anomalous transient events rather than typical mining operations.

Comparison to NIA Predictions

NIA predictions were overestimated in winter months (predicted 39 dBA vs. measured 35–41 dBA) and underestimated in summer months (predicted 39 dBA vs. measured 45–53 dBA), reflecting seasonal variations in sound propagation and ambient environmental noise as described above. The predictions remain valid for comparative purposes when seasonal context is considered.



Active Mining Periods
All data runs <24 hours excluded from graph

Figure 12-2: 24-hr Noise Results presented with the Noise Impact Assessment Values, 2014 to 2024

Table 12-3: 24-hr Noise Data and Corresponding Meteorological Data, 2014 to 2024

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R01	2014-12-14	43.1	N/A	N/A			72.7	45.3	92.4	59.4	16.4	-4.4	92.6	n/a
R02	2014-12-15	44.3	N/A	N/A			77.1	49.6	93.7	64.3	20.0	-1.9	76.4	1.35
R03	2014-12-17	58.6	N/A	N/A			59.4	62.0	108.0	59.2	0.6	-8.4	94.4	0.7
R05	2014-12-18	42.0	N/A	N/A			50.6	45.2	91.3	48.5	6.6	-13.6	90.7	0.6
Campground	2014-12-22	25.4	N/A	N/A			43.5	27.4	74.8	38.0	12.6	-9.6	93.8	n/a
R01	1/10/2015	28.8	N/A	N/A			38.2	33.4	78.2	35.6	6.8	-10.2	93.7	n/a
R01	11/16/2015	34.7	19.5	16	Yes	18.7	51.2	37	84	49.2	14.5	-17.4	87.3	n/a
R02	1/11/2015	33.8	N/A	N/A			43.8	36	83.2	40.3	6.5	-10.1	93.3	n/a
R02	11/19/2015	33.1	16	15.5	Yes	17.6	46.9	40.3	82.4	44.2	11.1	-28.4	76.7	n/a
R03	1/13/2015	28.6	N/A	N/A			40.7	31.6	78	37.9	9.3	-7.3	95.3	n/a
R03	11/21/2015	39.7	17.5	16	Yes	23.7	47.8	46	89	46.3	6.6	-9	94	n/a
R04	1/14/2015	36.5	N/A	N/A			51.4	41.8	85.9	47.6	11.1	-9.4	93.9	n/a
R04	11/17/2015	21.3	18	15.5	Yes	5.8	46.4	27.3	70.6	36.3	15	-21	83.9	n/a
R05	1/15/2015	37.5	N/A	N/A			47.8	42.1	86.9	41.1	3.6	-1.8	99	0.52
R05	11/14/2015	32.8	17	15	Yes	17.8	42.4	33.6	82.2	39.2	6.4	-18.4	86.5	n/a
Campground	1/22/2015	23.2	N/A	N/A			28	23.4	72.6	22.5	-0.7	-9.8	93.6	0.47
R01	1/9/2016	39	20	15.5	Yes	23.5	48.9	41.7	88.4	79.3	6.4	-14.6	89.7	0.51
R01	2/28/2016	22.4	20.5	16.5	Yes	5.9	55.1	26.1	71.8	65	15.6	-2.8	85	0.92
R01	4/25/2016	39.1	39.5	36.5	No	2.6	55.1	39.5	88.4	73.4	13.5	5.7	57.5	1.78
R01	5/15/2016	49.3	50.5	48	No	1.3	57.5	49.7	98.7	66.3	3.3	12.2	47.4	2.3
R01	6/13/2016	50.9	51	50	No	0.9	53.8	54.5	100.2	85.4	2.5	11.1	78	1.63
R01	7/31/2016	91	92.5	61.5	No	29.5	105.5	97.9	140.3	128.2	5.4	12.5	65.7	1.93
R01	9/22/2016	46.5	47	45	No	1.5	64.8	46.9	95.8	72.8	5.2	7.2	56.4	2.47
R01	11/11/2016	40.4	40.5	37.5	No	2.9	53.6	42.4	89.8	83.4	7.1	1.3	69.8	1.9
R02	4/23/2016	29.1	28.5	16.5	Yes	12.6	65.9	38	78.5	66.9	20.1	7.3	59.3	1.44
R02	5/16/2016	44.4	42.5	24.5	Yes	19.9	64.9	56.9	93.8	84.1	10.7	5.9	71.5	3.12
R03	1/8/2016	28.3	19.5	16.5	Yes	11.8	40	35.9	77.7	74.6	4.5	-11.5	90.4	0.44

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R03	2/17/2016	23.9	19	15	Yes	8.9	40.3	30.2	73.3	66.8	11.6	-22.9	77.9	0.45
R03	3/17/2016	111.8	115.5	45.5	No	66.3	127.7	120.4	161.2	136.7	7.8	-4.9	70.9	1.09
R03	4/16/2016	41	34.5	17	Yes	24	60.8	43.7	90.4	75.3	12.1	3.7	57.2	1.56
R03	5/18/2016	38.7	38.5	24.5	Yes	14.2	60.2	40.4	88.1	76.9	13.6	7.5	66.6	1.88
R03	6/29/2016	48	44	22.5	Yes	25.5	61	53.6	97.3	91.1	10.8	15.5	67.8	1.35
R03	7/30/2016	40.3	38.5	27	Yes	13.3	61.1	46.4	89.7	84.8	14	13.7	69	2
R04	2/15/2016	25.5	19	15.5	Yes	10	48.5	33.9	74.9	68.1	6.3	-7.8	89	1.12
R04	3/12/2016	37.5	25	15.5	Yes	22	56.9	44.4	86.8	82	3.8	-5.3	62.8	1.03
R04	4/18/2016	28	27	17	Yes	11	56.3	36.1	77.4	72	11.9	0.5	64.2	1.73
R04	5/19/2016	39.2	34	21.5	Yes	17.7	59.5	46.8	88.6	81	6.3	10.3	56.7	1.57
R04	6/20/2016	38.5	34	21	Yes	17.5	55.6	48.8	87.9	82.7	10	10.3	79.6	1.47
R04	9/23/2016	33.9	33.5	23.5	Yes	10.4	57.2	38.1	83.3	72	13.8	4.1	59.1	1.85
R05	1/10/2016	30.6	20.5	15.5	Yes	15.1	44.1	35.5	80	71.6	5.7	-18.2	86.5	0.33
R05	3/15/2016	26.1	22	17	Yes	9.1	56.1	32.5	75.5	65.4	13.8	-6.2	91.4	0.86
R05	4/15/2016	31.9	30	18	Yes	13.9	54.3	34.4	81.2	67.1	9.1	3.2	63.6	1.51
R05	5/22/2016	41	44	30.5	No	10.5	52.8	42.8	90.4	69.9	10.3	9.9	66.2	1.72
R05	6/19/2016	39.7	42.5	31.5	No	8.2	53	41.6	89.1	70.4	7.5	19.6	26.9	2.28
R05	7/17/2016	40.5	42	30.5	No	10	52.9	43.3	89.9	75.8	8.9	14.8	64.6	2.5
R05	9/24/2016	77.2	73.5	39.5	Yes	37.7	89.3	89.8	126.6	122.1	4.5	0.9	94.4	0.88
R05	11/10/2016	45.6	48.5	31	No	14.6	72.7	53.3	94.7	85.5	13.4			
Campground	1/7/2016	23.2	20	15.5	Yes	7.7	38.1	30.2	72.5	75.8	7.8	-16.1	81.8	0.63
Campground	2/26/2016	21.4	21.5	16	No	5.4	43.9	26	68.9	57	9.3			
Campground	3/18/2016	27.7	30.5	18.5	No	9.2	57.5	31.3	77.1	63.7	12.9	-7.8	72.8	1.89
Campground	4/24/2016	35.2	34.5	27.5	Yes	7.7	52.4	36.9	84.5	67.9	14.3	7.6	59.9	1.28
Campground	5/21/2016	47.1	48.5	44.5	No	2.6	56.8	47.8	96.4	79.2	7.7	16.6	39.4	1.47
Campground	6/30/2016	51.1	51	15.5	Yes	35.6	57	60.1	100.5	95.4	5	12.7	83.3	0.69
Campground	7/18/2016	48.3	46.5	44.5	Yes	3.8	54.1	56.6	97.6	90.1	4.7	11.2	82.5	1.61
Campground	9/21/2016	44.3	46	40.5	No	3.8	59.3	47.9	93.7	77.5	5.1	10.1	36.8	2.63
Campground	11/9/2016	34.2	34	32.5	Yes	1.7	56.4	39.5	69.2	68	6.3			

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R01	6/26/2018	39.2					51.3	38	79.5	50	15.5	11.3	71.8	1.38
R01	8/30/2018	53.1	53.5	52.5	No	0.6	57.4	54.6	102.4	55.9	12.8	6.7	74.7	1.46
R01	9/7/2018	46.8	47	45	No	1.8	62.7	47.6	96.2	55.1	8.3	4.7	85.5	1.07
R02	6/19/2018	26.8					40.9	26.9	69.2	34.7	10.5	17.4	45.1	2.11
R02	9/9/2018	31	30.5	20.5	Yes	10.5	59.1	36.3	80.4	49.2	18.2	4.7	65.2	2.25
R03	8/31/2018	47.4	46	29.5	Yes	17.9	65.9	55.2	96.8	60	12.6	4.1	90.7	0.98
R03	9/6/2018	42.2	42	25.5	Yes	16.7	65.5	52.2	94.5	56.6	11.4	5	89.4	0.6
R03	10/7/2018	45.9	40.5	21	Yes	24.9	64.7	53.1	95.3	63.3	17.4	-3.5	53.8	2.26
R04	8/29/2018	37.1	32.5	23.5	Yes	13.6	62.3	41.1	86.4	50.5	13.4	8.3	75.5	1.4
R05	6/14/2018	42.4					38.6	28.9	71.5	37.4	11.4	10.4	53	1.74
R05	6/21/2018	34.5					50.6	51.3	84	49.4	10.1	16.9	55.8	1.47
R05	7/19/2018	24.2					43.4	31.4	72.1	40.6	13.8	11.6	64.2	1.3
R05	9/10/2018	35.7	36.5	24.5	Yes	11.2	63.1	38.5	85.1	50	14.3	5.6	57.2	1.2
Campground	7/24/2018	26					73.5	49	85.9	66.1	23.7	17.3	52.9	1.17
Campground	9/5/2018	48.4	47.5	47	No	1.4	56.8	53.3	97.8	54.2	5.8	7.1	73	1.37
Campground	10/8/2018	127.8	129.5	124	No	3.8	131.1	128.5	177.1	129.3	1.5	-7.2	65.2	1.29
Campground	1/25/2019	22.5	22	17	Yes	5.5	44.6	28	71.9	37.9	15.4	-10.1	92.8	0
Campground	2/23/2019	20.5	19	17	Yes	3.5	37.2	23.7	69.8	31.1	10.6	-21.5	77.9	0.95
Campground	5/10/2019	48.5	44.5	42	Yes	6.5	63.9	58.8	97.8	53.7	5.2	9.7	34.5	2.51
Campground	7/11/2019	53.5	40	37	Yes	16.5	67.9	62.3	102.9	65.9	12.4	13.6	77.2	1.23
Campground	10/31/2019	34.4	35	32.5	No	1.9	42.2	36.9	83.8	38.4	4	-4.6	95.9	0.93
Campground	11/14/2019	21	23	17	No	4	41.8	24.8	70.4	32.6	11.6	-17.3	84.4	0.9
R01	1/29/2019	40.6	41	40	No	0.6	50.1	40.8	84.2	39.6	-1	-16.4	87.8	0.41
R01	2/24/2019	43.2	43.5	42	No	1.2	51.5	43.2	92.5	41.5	-1.7	-18.4	77.8	0.75
R01	4/25/2019	41.8	40.5	18.5	Yes	23.3	59.6	43.6	91.1	58.6	16.8	-3.4	63.4	1.63
R01	5/1/2019	34.8	38	21	No	13.8	55.9	38.8	84.2	48.1	13.3	5.2	33.9	2.95
R01	7/16/2019	37.7	38.5	26.5	No	11.2	52.6	39.8	87	50.3	12.6	14.8	64.7	1.54
R01	9/24/2019	38.3	39	26.5	No	11.8	50.5	39.7	87.7	49.4	11.1	2.3	71.9	1.3
R01	10/23/2019	49.8	40	39	Yes	10.8	53.9	51.1	99.1	51.1	1.3	-5.5	91.5	1.02

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R02	8/28/2019	45.5	44	43	Yes	2.5	60.3	47.2	91.1	52.9	7.4	8.4	61	1.56
R02	9/27/2019	45.8	45.5	44.5	Yes	1.3	61.1	46.7	84.8	51	5.2	-1.2	64.2	1.42
R03	3/5/2019	41.3	44	17.5	No	23.8	52.2	42.2	89	45	3.7	-16.2	65	0.92
R03	3/7/2019	37.5	41.5	17	No	20.5	53.1	38.6	75.1	44.6	7.1	-14.9	57.5	0.92
R03	2/22/2019	40.3	31	17.5	Yes	22.8	55.6	41.6	82.2	53.7	13.4	-19.3	73.1	1.33
R03	3/7/2019	28.3	21	17	Yes	11.3	48.8	30.4	70.6	45.4	17.1	-14.7	61.6	1.2
R03	4/20/2019	45.1	39.5	21.5	Yes	23.6	65.3	48.4	94.5	58.8	13.7	0.4	56.1	1.84
R03	5/23/2019	56.4	45.5	27	Yes	29.4	83.2	68.8	105.7	74.6	18.2	14	44.2	1.57
R03	8/27/2019	39.1	39	23.5	Yes	15.6	60.7	42.6	84.8	53.6	14.5	8.1	61.7	1.89
R03	9/19/2019	43.4	45.5	24.5	No	18.9	67.9	51.8	92.7	62.4	19	5.4	93.5	1.03
R03	10/25/2019	24.3	22.5	19	Yes	5.3	42.6	32.6	71.8	38.9	14.6	-5	91.2	0.98
R03	11/20/2019	40.6	23.5	17.5	Yes	23.1	47.3	43.6	89.9	44.3	3.7	-6	95.5	0.8
R03	12/17/2019	42.4	45	17.5	No	24.9	50.6	42.4	91.7	42.2	-0.2	-21.4	83.3	0.21
R04	1/31/2019	39.4	40	39	No	0.4	50	39.5	76.4	39.9	0.5	-14.2	86.1	1.62
R04	2/26/2019	31.4	21	17.5	Yes	13.9	41.6	34.7	80.7	38.5	7.1	-14.4	78.2	0.6
R04	4/16/2019	27	30	20.5	No	6.5	52.3	31.3	63.3	44.7	17.7	0	69.5	1.11
R04	4/19/2019	39.2	35.5	21.5	Yes	17.7	61.8	42.6	88.5	55.7	16.5	2.2	60.1	2.27
R04	5/9/2019	33.6	34	20.5	No	13.1	67.4	35.7	82.9	52.5	18.9	8.4	50.1	2.35
R04	6/26/2019	38.3	33.5	21.5	Yes	16.8	58.1	42.9	87.6	46.4	8.1	15.2	49.4	1.96
R04	7/4/2019	39.4	32.5	20.5	Yes	18.9	53.9	47.1	88.7	43	3.6	15.7	67.6	1.42
R04	8/23/2019	39.2	33	22.5	Yes	16.7	55	43	83.5	46.4	7.2	8.5	61	1.22
R04	9/18/2019	59.8	58.5	22.5	Yes	37.3	69.7	72.4	109.1	63.1	3.3	5.1	86	1.53
R04	10/17/2019	29.6	28.5	20.5	Yes	9.1	46.8	35.4	79	40.4	10.8	-3.2	88.3	0.77
R04	11/15/2019	43.4	45	18.5	No	24.9	50.9	44.5	92.8	42.5	-0.9	-21.2	80.8	0.69
R04	12/13/2019	64.5	66	59	No	5.5	67	71.5	85.3	66	1.5	-11.1	89.6	0.35
R05	1/23/2019	19.8	19.5	17	Yes	2.8	37.7	22.9	69.2	29.1	9.3	-23.9	80.8	0
R05	2/21/2019	24.3	27	17	No	7.3	47.4	26	73.1	32.6	8.3	-16.9	82	1.66
R05	4/15/2019	115	117.5	110	No	5	124.2	117.6	164.4	120.2	5.2	-0.6	66.6	1.37
R05	5/7/2019	33	35	19	No	14	54.7	35.3	82.4	43.6	10.6	8.3	53.5	1.82

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R05	6/27/2019	35.5	39	23.5	No	12	50.3	36.3	81.1	40.9	5.4	15.4	29.8	1.64
R05	8/22/2019	35.4	39	19.5	No	15.9	49.2	37	79	42.7	7.3	4.8	66	1.2
R05	10/22/2019	23.7	26	19	No	4.7	43.8	26.5	73.1	30.7	7	-3.1	90.4	0.93
R01	2/21/2020	19.3	20	17	No	2.3	45.3	21.5	66.7	32.9	13.6	-3.4	59.2	0.33
R01	3/31/2020	44.2	47.5	17.5	No	26.7	56.2	44.2	93.5	43.7	-0.5	-12.5	31.6	2.27
R01	6/25/2020	53.3	54	52.5	No	0.8	64	53.8	102.7	56.8	3.5	10.4	72.7	1.27
R02	Station was not monitored in 2020.													
R03	2/20/2020	44.2	48	18	No	26.2	77.8	46	93.6	65.3	21.1	-5.8	63.7	2.44
R03	3/12/2020	43.4	45.5	18	Yes	25.4	52.7	43.9	92.7	46	2.6	-21.2	57.1	0.99
R03	5/6/2020	40.9	34.5	20	Yes	20.9	56.2	47.6	90.3	50.4	9.5	10	32.4	2.27
R03	6/23/2020	53.2	54	33	No	20.2	60.6	65.5	102.6	56.8	3.6	5.7	94.3	1.76
R04	1/31/2020	47.7	46	45.5	Yes	2.2	58.8	50	97	51.8	4.1	-13	89.6	0.54
R04	2/18/2020	110.7	114	103	No	7.7	123.4	116.2	160.1	116.2	5.5	-21.3	80.3	0.52
R04	3/9/2020	34.6	31	19.5	Yes	15.1	62.8	41	83.9	47.8	13.2	-10.5	83.3	1.01
R04	5/7/2020	31.8	33	23.5	Yes	8.3	55	36.3	76	41.5	9.7	10.4	35.4	0.97
R04	6/30/2020	44.4	42.5	30	Yes	14.4	51.9	53.5	93.7	50.3	5.9	11.7	72	2.48
R05	1/23/2020	19.4	20	17.5	No	1.9	47.5	23.3	59.5	27.9	8.5	-11.9	90.4	0.04
R05	2/26/2020	33.8	19.5	17	Yes	16.8	44.3	41.3	83.1	41.5	7.7	-18.6	83.5	1.2
R05	3/26/2020	44.4	47.5	21	No	23.4	74.6	44.9	93.8	59.7	15.3	-5	67.6	3.03
R05	5/22/2020	41.8	36.5	28.5	Yes	13.3	60.1	46.5	80.1	52.2	10.4	16.8	21.7	2.05
R05	6/24/2020	51.1	43.5	27	Yes	24.1	55.9	63.2	100.5	53.3	2.2	7.2	91.8	1.38
Campground	1/30/2020	19.4	18.5	17	Yes	2.4	45.2	23.8	68.7	27.8	8.4	-12	90.3	0.74
R01	11/14/2021	38.2	28.9	26.5	Yes	11.7	87.6	51.7	13.4	45.4	38.2	-11.8	90.1	0.67
R01	12/2/2021	38.9	27.2	26.5	Yes	12.4	88.3	38.9	8.9	47.5	38.9	-18.1	86.1	0.36
R02	11/13/2021	31.8	28.2	26.6	Yes	5.2	81.2	42.6	10.8	40.7	31.8	-11.3	87.1	0.68
R02	12/7/2021	70.1	71.9	54.4	No	15.7	93.3	82.4	12.3	81.9	70.1	-27.4	76.9	0.38
R02	12/20/2021	30.4	30.6	30.3	No	0.1	79.8	31.5	1.1	31.3	30.4	-24.2	80.2	0.13
R02	12/30/2021	29.4	29.5	29.4	No	0	78.8	29.7	0.3	29.6	29.4	-18.7	85.4	0.02
R03	11/10/2021	33.1	33.2	27.2	No	5.9	82.4	44.1	11	39.8	33.1	-13.7	83.2	1.69

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R03	12/8/2021	29.3	29.4	29.3	No	0	78.7	29.7	0.4	29.5	29.3	-17.6	86.3	0.33
R03	12/21/2021	30.1	30.6	29.3	No	0.8	79.4	30.9	0.9	30.8	30.1	-18.9	85.1	0.6
R03	12/24/2021	29.4	29.6	29.2	No	0.2	78.7	29.7	0.3	29.6	29.4	-27.1	77.3	0.39
R04	11/12/2021	37.6	31.9	26.8	Yes	10.8	87	46.7	9.1	46.5	37.6	-12.9	86.9	0.79
R04	12/9/2021	29.4	29.5	29.3	No	0.1	78.8	29.7	0.3	29.6	29.4	-17.3	86.7	0.38
R04	12/19/2021	30.4	30.6	30.3	No	0.1	79.8	31.6	1.1	31.4	30.4	-24	80.3	0.18
R04	12/28/2021	29.5	29.5	29.4	No	0.1	78.8	29.8	0.3	29.6	29.4	-23	81.4	0.39
R05	11/16/2021	33.2	27.3	26.5	Yes	6.7	82.6	46	12.8	42.8	33.2	-19.8	84.1	0.21
R05	12/10/2021	29.5	29.5	29.4	No	0.1	78.8	29.8	0.3	29.6	29.4	-20.5	83.8	0.18
R05	12/25/2021	29.2	29.3	29.1	No	0.1	78.5	29.5	0.4	29.4	29.2	-26.9	77.3	0.71
Campground	11/11/2021	37.3	39.7	26.4	No	10.9	86.7	39.8	2.5	41.5	37.3	-10	91.9	1.01
Campground	12/18/2021	30.4	30.6	30.2	No	0.2	79.8	31.4	1	31.2	30.4	-26.2	78.2	0.11
Campground	12/27/2021	29.5	29.7	29.4	No	0.1	78.9	29.8	0.3	29.7	29.5	-29.3	75	0.07
R01	5/16/2023	35.6	35.9	30	No	5.6		42.8		51	15.4	9.8	39.7	1.79
R01	6/4/2023	37.1	34.3	29.8	Yes	7.3		43.4		49.3	12.2	11.5	53.3	1.38
R01	6/15/2023	53.7	53.4	52.1	Yes	1.6		53.7		54.6	1.8	9.3	49.5	1.81
R01	7/5/2023	61.3	43.5	32.2	Yes	29.1		76.5		62.9	1.6	16.7	51.8	2.36
R01	7/7/2023	40	35	29.5	Yes	10.5		48.2		50.1	10.1	18.5	43.1	1.51
R01	8/16/2023	65.9	66.2	65.3	No	0.6		66.5		66.8	0.9	11.3	72.5	1.31
R01	8/20/2023	52.7	52.6	51.8	Yes	0.9		54		56.1	3.4	14.1	63.2	1.83
R01	8/23/2023	52.2	52.4	51.4	No	0.8		54.4		54.5	2.3	13	61.3	1.29
R01	9/2/2023	53.7	53	52.1	Yes	1.6		55.6		55.6	1.9	9.3	78.2	1.64
R01	9/9/2023	55.5	52.5	51.3	Yes	4.2		57.3		60.5	5	9	74.1	1.19
R02	7/19/2023	47.9	42.2	31.1	Yes	16.8		51.3		57	9.1	15.7	77.1	1.03
R02	8/13/2023	42.2	38.9	30.4	Yes	11.8		53.2		50.2	8	10.6	79.6	1.62
R02	8/24/2023	44.5	40.3	32	Yes	12.5		47.2		54.5	10	14.3	56.2	1.72
R02	9/1/2023	42	41.3	31.1	Yes	10.9		46.1		52.4	10.4	11.5	76.6	2.24
R02	9/11/2023	50.8	46.5	33.7	Yes	17.1		56		57.7	6.9	12.9	54.2	1.9
R03	6/12/2023	56.3	36.9	29.8	Yes	26.5		67.2		66.2	9.9	12.1	51.3	2.37

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R03	6/16/2023	61.2	53.9	52	Yes	9.2		67.9		70.8	9.6	11	48	1.61
R03	6/17/2023	45.6	46.6	43.6	No	2		47.4		51.6	6	11.2	57.9	2
R03	7/10/2023	38.3	36.5	29.5	Yes	8.8		44.9		52.9	14.6	18.4	30.6	1.59
R03	7/22/2023	47.7	41.1	29.5	Yes	18.2		53.2		61.3	13.6	20.2	46.2	1.58
R03	7/23/2023	45	39.5	29.6	Yes	15.4		49.3		57.7	12.7	20.2	49.3	1.15
R03	7/24/2023	41.7	38.6	29.5	Yes	12.2		45.8		54	12.3	21.8	43.9	1.86
R03	8/12/2023	46.1	48.2	28.9	No	17.2		50.4		58.7	12.6	12.1	86.8	1.14
R03	8/21/2023	47.2	41	31.3	Yes	15.9		52.3		58.8	11.6	11.2	68.8	1.54
R03	9/1/2023	48.8	43.9	30.2	Yes	18.6		54.4		58	9.2	11.5	76.6	2.24
R03	9/8/2023	50.8	48.9	32.8	Yes	18		54		62.8	12	8.1	77.5	1.09
R03	11/29/2023	42.3	29.3	26.7	Yes	15.6		45.4		54.6	12.3	-8.4	96.4	n/a
R03	12/24/2023	76.7	58.8	38.5	Yes	38.2		77.2		79.9	3.2	-13	92.7	0.47
R04	5/26/2023	40.4	37.6	30.2	Yes	10.2		45.2		58.1	17.7	12.4	57.7	1.58
R04	6/20/2023	47.4	47.5	35.1	No	12.3		50.5		54.5	7.1	13.1	58.7	1.85
R04	7/20/2023	40.1	34.5	28.6	Yes	11.5		50.4		47.4	7.3	16.9	66.6	1.47
R04	7/26/2023	37.4	33.5	28.7	Yes	8.7		45.9		46.4	9	16.3	65.8	1.39
R04	8/11/2023	38.1	34.4	28.6	Yes	9.5		45.4		48.3	10.2	13.8	79	1.24
R04	8/19/2023	38.7	35.3	29.9	Yes	8.8		47.6		51	12.3	10	72.9	1.94
R04	9/5/2023	38.8	35.1	28.3	Yes	10.5		47.9		49	10.2	5.2	74.7	4.88
R04	9/12/2023	39.9	37.6	29.4	Yes	10.5		49.3		51.9	12	12.1	50.7	1.54
R04	10/11/2023	39.3	31.8	28.4	Yes	10.9		45.5		51.2	11.9	2.5	97.2	1.62
R05	6/18/2023	47.8	45.4	31.7	Yes	16.1		61.7		52.7	4.9	10.6	78.3	1.16
R05	7/17/2023	43.8	38.6	30.5	Yes	13.3		51.4		52	8.2	20	43.2	1.62
R05	7/28/2023	40.4	34.3	28.6	Yes	11.8		46.5		52.1	11.7	19.3	51.7	1.65
R05	8/17/2023	42.1	38.3	34.3	Yes	7.8		53.6		47.1	5	8.6	89	1.05
R05	8/22/2023	39.2	38.3	29.4	Yes	9.8		47.7		50.9	11.7	11.2	80	1.29
R05	9/4/2023	41.7	42.2	36.6	No	5.1		49.7		49.7	8	4.5	71.4	1.71
R05	9/13/2023	41	42.8	30.4	No	10.6		49.7		57.6	16.6	8.7	72	1.97
R05	10/7/2023	50.2	38.3	31	Yes	19.2		65.7		52.7	2.5	-2.3	98.9	0.62

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
Campground	6/13/2023	54.1	53.5	51.3	Yes	2.8		61.4		54.1	3.1	8.1	81.1	2.14
Campground	6/22/2023	51.6	47.5	29	Yes	22.6		53.2		55.9	4.3	14.1	74.2	1.42
Campground	7/18/2023	51.8	52.1	51.2	No	0.6		52.7		54.6	2.8	17.3	73.5	1.99
Campground	7/21/2023	52.1	52.5	51.5	No	0.6		53		53.4	1.3	18.1	52.3	1.34
Campground	8/15/2023	51.3	51.5	50.5	No	0.8		54.3		53	1.7	11.1	73.3	1.69
Campground	8/25/2023	46.8	44.4	43.5	Yes	3.3		53.1		50.1	3.3	14.8	60.9	1.99
Campground	9/3/2023	45.1	45.2	44.4	No	0.7		47.1		49.2	4.1	6.9	81.2	8.02
Campground	9/10/2023	51.4	51.8	49.3	No	2.1		53.7		58.5	7.1	12.8	51.2	2.38
Campground	12/25/2023	39.9	43.2	29.7	No	10.2		43.5		61	21.1	-0.5	69.1	4.02
R01	2/15/2024	30.3	29.1	27.7	Yes	2.6		39		47.7	8.7	-15.4	88.1	2.56
R01	3/9/2024	33.1	30.3	28.3	Yes	4.8		45.2		47.7	12.1	-5.2	91.2	-0.91
R01	4/13/2024	36.5	29.4	27.6	Yes	8.9		42.9		49.2	6.4	-1.7	49.3	0.73
R01	4/22/2024	39.2	31.9	28	Yes	11.2		44.4		54.4	5.2	5.9	38.7	1.68
R01	5/7/2024	52.9	53.7	51.7	No	1.2		53.5		56.5	0.6	5.5	60.1	0.88
R01	5/26/2024	55.6	56.5	54.5	No	1.1		56.4		57.3	0.8	9.2	72.6	0.89
R01	6/13/2024	45.4	45	34	Yes	11.4		48.8		53.2	3.4	11.2	76.3	2.05
R01	7/6/2024	55	55.3	54.5	No	0.5		55.6		57.3	0.6	14.5	64	1.88
R01	7/11/2024	44.5	36.7	32.7	Yes	11.8		50.3		52.1	5.8	12.3	85.9	1.75
R01	8/21/2024	52.6	52.9	52	No	0.6		53.9		53.7	1.3	6.3	69.4	2.19
R01	9/4/2024	48.3	46.8	33.6	Yes	14.7		51.2		59.6	2.9	7.9	65.7	2.24
R01	9/11/2024	48.2	47.6	35.6	Yes	12.6		52.2		56.4	4	5.2	90.6	1.06
R01	9/23/2024	55.4	56	54.3	No	1.1		56.3		57.1	0.9	4.8	83.5	1.12
R01	9/24/2024	59.5	55.9	54.8	Yes	4.7		60.2		62.4	0.7	6.3	82	1.26
R01	9/25/2024	55	55.1	54.5	No	0.5		55.7		56.4	0.7	4.6	91.4	0.83
R01	10/3/2024	38	35.3	30.2	Yes	7.8		41.8		49.9	3.8	0	89.3	0.85
R01	12/4/2024	47.1	43	28.8	Yes	18.3		51.4		63.8	4.3	-9.7	95.9	89.89
R02	1/15/2024	41.3	28.8	27.3	Yes	14		55.8		47.2	14.5	-27	80	0.194
R02	3/15/2024	35.8	29.2	27.8	Yes	8		45.2		43.8	9.3	-7.9	87.2	1.99
R02	3/18/2024	100.5	82.7	73.7	Yes	26.8		109.4		106.9	8.9	-5.9	79.3	2.04

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R02	4/14/2024	63.1	62.6	49	Yes	14.1		76.7		66.9	13.7	-3	59	1.43
R02	4/17/2024	38.1	36.2	28.3	Yes	9.8		45.9		53.9	7.8	2.4	39	3.33
R02	5/8/2024	39.9	39.8	32.4	Yes	7.5		46.4		57.1	6.5	4.5	47	1.29
R02	5/17/2024	39.7	36.9	28.7	Yes	11		45.6		55.3	5.9	8.7	40.1	1.46
R02	5/28/2024	48.9	47.2	31.8	Yes	17.1		51.6		59.1	2.7	8.6	62.1	1.3
R02	6/14/2024	42.3	42.5	29.7	No	12.6		46.2		54.8	3.9	12.2	61.2	2.08
R02	7/7/2024	45.3	44.2	31.6	Yes	13.7		51		54.9	5.7	13.8	58.2	1.82
R02	7/12/2024	42.4	43.8	31.2	No	11.2		45.6		55.8	3.2	15.4	58.9	1.95
R02	8/24/2024	39.3	40.9	30.3	No	9		44.8		51.7	5.5	7.9	67	1.11
R02	8/28/2024	51.6	49	32.9	Yes	18.7		54.1		61.1	2.5	9.2	74.1	1.16
R02	9/5/2024	61.5	48.3	30.7	Yes	30.8		77.1		68.7	15.6	10.6	71.4	1.3
R02	10/5/2024	45	47.9	30.9	No	14.1		49.1		63.5	4.1	1.7	73.5	1.32
R02	10/6/2024	44.7	47	31.3	No	13.4		50.5		64.5	5.8	0.3	85.4	1.26
R02	10/16/2024	46.2	39.6	30.4	Yes	15.8		50		59.7	3.8	-3.2	91.1	2.11
R02	12/6/2024	49.9	31.9	28	Yes	21.9		55.5		54.6	0	-3.5	95.5	89.28
R03	1/29/2024	50.5	51.1	35.8	No	14.7		54.5		70.2	4	4.2	72	1.47
R03	2/10/2024	55.2	32.4	27.7	Yes	27.5		57		68.2	1.8	-8	91.1	0.07
R03	3/7/2024	41.9	29.2	28.4	Yes	13.5		44.3		53.1	2.4	-13.2	85.5	0.55
R03	3/19/2024	109.6	109.8	109.4	No	0.2		109.8		109.7	0.2	-0.8	70.6	2.73
R03	4/18/2024	46	35.1	29	Yes	17		51.3		57.3	5.3	5	32.9	3.25
R03	5/13/2024	49.9	43.7	30.8	Yes	19.1		54.3		56.9	4.4	2.4	85.9	0.83
R03	5/20/2024	46.3	41.4	29.1	Yes	17.2		49.8		56.3	3.5	6.7	52.6	1.48
R03	5/29/2024	50.3	45.5	33.7	Yes	16.6		52.7		66.7	2.4	7.2	80.5	1.71
R03	6/16/2024	44.5	44	30.6	Yes	13.9		48.7		53.6	4.2	14.7	31.4	2.18
R03	7/4/2024	52.5	46.3	33.7	Yes	18.8		54.5		58.7	2	11.9	71.3	2.25
R03	7/13/2024	46	45.9	33.6	Yes	12.4		49.7		58.1	3.7	14.9	49.7	1.56
R03	8/25/2024	46.9	43.5	30.2	Yes	16.7		52.3		59.5	5.4	8.8	76.9	1.1
R03	8/30/2024	46.3	45	35.8	Yes	10.5		49.2		55.6	2.9	8.6	77.6	1.74
R03	9/6/2024	50.3	51.1	31.8	No	18.5		55.4		62.5	5.1	8	79.7	1.18

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R03	9/15/2024	50.2	47.3	31.7	Yes	18.5		52.5		58.8	2.3	5.9	80.1	1.82
R03	10/7/2024	45.9	42.7	31.7	Yes	14.2		50.2		55.6	4.3	2.9	72.3	1.84
R03	10/8/2024	49.7	44.2	30.1	Yes	19.6		52.2		58.7	2.5	0.8	84.5	0.81
R03	12/7/2024	46.1	34.1	28	Yes	18.1		51.3		52.7	5.2	-3.4	100.9	89.69
R04	3/13/2024	58.1	37.7	29.5	Yes	28.6		61.4		64	3.3	-4.6	73.4	0.54
R04	3/20/2024	107.9	107.4	107	Yes	0.9		109.1		114	1.2	-4.8	50.9	2.3
R04	4/7/2024	39.4	34.2	29.4	Yes	10		49.4		49.6	10	-1.6	54.3	0.02
R04	4/20/2024	61.1	42.2	32.6	Yes	28.5		64.9		67.1	3.8	5.7	37.2	1.81
R04	5/12/2024	40.5	36.3	30.3	Yes	10.2		47		53.2	6.5	5	55.8	0.57
R04	5/21/2024	47.4	38.1	29.8	Yes	17.6		60.9		56.2	13.5	7.6	54.5	1.88
R04	6/17/2024	42	41.3	29.6	Yes	12.4		46.3		58.8	4.3	15.6	33.5	1.82
R04	7/3/2024	49.5	39.3	31.4	Yes	18.1		60.8		56.9	11.3	13.7	74.4	2.33
R04	7/14/2024	54.3	38.4	30.4	Yes	23.9		58		60.3	3.7	15.6	59.2	0.98
R04	8/26/2024	44	45.7	30	No	14		47.4		52.3	3.4	7.5	92.1	1.39
R04	9/7/2024	38.6	37.2	29.9	Yes	8.7		44.7		45.6	6.1	7.5	93.4	1.18
R04	9/16/2024	46.3	43.7	31.6	Yes	14.7		50.5		54.3	4.2	5.1	92.7	1.3
R04	9/27/2024	47.1	49.7	30.1	No	17		48.4		54.6	1.3	2.5	93.3	0.7
R04	9/27/2024	40.2	39.5	30.5	Yes	9.7		44.5		49.4	4.3	2.5	93.3	0.7
R04	10/10/2024	42.8	38.8	30.8	Yes	12		48.5		55	5.7	0.9	89.9	0.86
R04	10/11/2024	61.4	44.4	31.2	Yes	30.2		64.9		65.4	3.5	0.9	77.8	1.07
R04	11/23/2024	39.6	34.8	29.7	Yes	9.9		49.3		50.5	9.7	-25.6	82.1	91.76
R05	1/16/2024	42.9	33.6	30.9	Yes	12		54.6		50.9	11.7	-24.2	83	0.281
R05	1/28/2024	49.5	52.7	33.1	No	16.4		49.5		73	4	-10.5	82.5	0.279
R05	3/13/2024	34.8	33.2	28.1	Yes	6.7		42.4		58.9	7.6	-4.6	73.4	0.54
R05	3/21/2024	110.3	108.4	108	Yes	2.3		122		124.1	11.7	-6.2	60.6	2.25
R05	4/21/2024	45.6	44.7	42.3	Yes	3.3		49.4		52.2	3.8	5	40.8	1.1
R05	5/22/2024	45.7	46	44.2	No	1.5		48.7		58.6	3	11.1	35.6	1.49
R05	5/23/2024	74.3	45.2	44.4	Yes	29.9		74.4		74.3	0.1	8.4	52.5	1.15
R05	5/27/2024	40.4	42.2	33.7	No	6.7		45.3		59.6	4.9	8.3	76.8	1.07

Site	Start Date	LAeq (dB)	L10 (dB)*	L90 (dB)*	LAeq > L10	LAeq - L90 (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R05	7/9/2024	39.9	42.2	31	No	8.9		45		57.2	5.1	14.1	63.4	1.36
R05	7/10/2024	51.5	37.5	30.9	Yes	20.6		61.6		55	10.1	17.2	52	1.22
R05	8/22/2024	44.2	38.7	30.3	Yes	13.9		46		50	1.8	6.8	88.8	1.32
R05	8/29/2024	52.7	45.2	33.3	Yes	19.4		55.7		60.4	3	6.7	89.9	1.53
R05	9/9/2024	41.6	42.5	36.5	No	5.1		46.6		51.4	5	7.5	85.3	1.02
R05	9/10/2024	41.2	40.7	36.9	Yes	4.3		46.1		50	4.9	6.8	88.2	0.91
R05	10/14/2024	40.1	40.4	37.3	No	2.8		45.9		57.8	5.8	0.9	87.4	0.83
R05	10/15/2024	37.5	40.1	28.2	No	9.3		46		56.9	8.5	0.3	95	1.16
Campground	1/30/2024	41.6	37.8	28.3	Yes	13.3		49		57.2	7.4	1.4	58.7	0.94
Campground	2/11/2024	43.4	39.3	30.7	Yes	12.7		53.1		54.6	9.7	-8.6	78.7	0.56
Campground	3/16/2024	35.7	35.4	28.9	Yes	6.8		46.4		51.6	10.7	-7.1	87.9	1.26
Campground	3/22/2024	49.6	37.5	29.7	Yes	19.9		53.8		60.8	4.2	-5.7	65.3	1.99
Campground	4/11/2024	33.1	32.6	29.7	Yes	3.4		41		52.6	8	1.3	54.6	0.94
Campground	4/19/2024	50.9	37.8	28.7	Yes	22.2		54.3		58.7	3.4	4.9	36.9	3.09
Campground	5/5/2024	44.8	46.2	41.4	No	3.4		46.9		53.2	2.1	10.9	36.5	0.03
Campground	5/15/2024	76	43.4	29.8	Yes	46.2		76.1		76.1	0.1	5.6	52.8	1.54
Campground	5/31/2024	49.7	50.6	48.3	No	1.4		50.9		54.4	1.2	10.3	55.3	1.62
Campground	6/12/2024	46.8	42.2	33.2	Yes	13.6		52		57.6	5.2	11.2	72.1	1.58
Campground	6/18/2024	50	51	48.9	No	1.1		50.7		55.9	0.7	16.7	42.1	1.73
Campground	7/5/2024	49.7	50.1	48.6	No	1.1		50.8		55.4	1.1	10.1	88.6	1.79
Campground	7/15/2024	48.8	42.6	29.4	Yes	19.4		53.4		61	4.6	15.2	63	1.24
Campground	8/23/2024	46.9	46.7	45.8	Yes	1.1		48.7		52.3	1.8	6.8	75.6	1.21
Campground	9/8/2024	53.5	49.9	48.7	Yes	4.8		54.6		57.7	1	7.5	88.8	1.23
Campground	9/17/2024	50.1	50.3	48.3	No	1.8		53.8		53.1	3.7	3.9	83.4	1.21
Campground	10/12/2024	55.3	52	44	Yes	11.3		65		61.8	9.7	2.8	64.5	2.54
Campground	10/29/2024	39.2	39.6	37.1	No	2.1		44.9		48.2	5.8	-13.1	92.7	0.43
Campground	12/5/2024	55	55	54.9	No	0.1		61.4		77.5	7.2	-0.5	96.7	89.25

*Data in 2021, 2023 present termed LAS 10 and LAS 90.

It should be noted that August-December 2024 data, along with 2021 data was captured with a slow time weighting instead of a fast time weighting and, therefore, units differ in for these time periods.

73 data points were collected from unknown stations where the location was not recorded. Data for unknown stations can be found in Ensero (2022b).

Legend:	
Yes	When LAeq > LAS10
<5	LAeq - LAS90 (dB) less than 5
>10	LAeq - LAS90 (dB) greater than 10

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APPENDIX 3

ENGINEERING SUPPORTING DOCUMENTS

APPENDIX 3.1

ENGINEERING DESIGN PACKAGE

APPENDIX 3
ENGINEERING SUPPORTING DOCUMENTS

APPENDIX 3.1
ENGINEERING DESIGN PACKAGE

Sheet List	
Sheet Number	Sheet Title
AKHM-13-01-G-0000	Sheet List
AKHM-13-01-S-0301	Typical Adit Closure Design
AKHM-13-01-S-0302	Cofferdam Design
AKHM-13-01-S-0303	Shaft/Raise to Surface, Typical Caps
AKHM-13-01-B-0301	Road Reclamation - typ.
AKHM-13-01-D-2102	Bellekeno Bioreactor
AKHM-13-01-D-2301	BioReactor Sections
AKHM-13-01-D-2601	Bellekeno P&ID
Reclamation Measures	
AKHM-13-01-C-1401	Flame & Moth Reclaim Measures
AKHM-13-01-C-2401	Bellekeno East Reclaim Measures
AKHM-13-01-C-2402	Bellekeno 625 Reclaim Measures
AKHM-13-01-C-3401	Lucky Queen Reclaim Measures
AKHM-13-01-C-4401	Onek Relcaim Measures
AKHM-13-01-C-5401	Bermingham Reclaim Measures
AKHM-13-01-C-6401	Mill Site Reclaim Measures
AKHM-13-01-C-7401	DSTF Reclaim Measures
AKHM-13-01-C-8401	Sludge Pond Reclaim Measures
AKHM-13-01-C-9401	Flat Creek Camp Reclaim Measures
Final Grading Details	
AKHM-13-01-B-2101	Bellekeno East Grading Plan
AKHM-13-01-B-2102	Bellekeno 625 Grading Plan
AKHM-13-01-B-3101	Lucky Queen Grading Plan
AKHM-13-01-B-3301	Lucky Queen Grading Sections
AKHM-13-01-B-4101	Onek Grading Plan
AKHM-13-01-B-4301	Onek Grading Sections
AKHM-13-01-B-5101	Bermingham Grading Plan
AKHM-13-01-B-5301	Bermingham Grading Section
AKHM-13-01-B-6101	Mill Site Grading Plan
AKHM-13-01-B-6301	Mill Grading Sections
AKHM-13-01-B-9101	Flat Creek Camp Grading
AKHM-13-01-B-9301	Flat Creek Camp Sections

Sheet Naming Convention

A-1234

A = Discipline

1 = Site

2 = Sheet Type

3,4 = Sequential Number

Disciplines	Sites	Sheet Types
G = General	0 = General (Not site specific)	1 = Plans (Horizontal Views)
H = Hazardous Materials	1 = Flame & Moth	2 = Elevations (Vertical Views)
V = Survey/Mapping	2 = Bellekeno	3 = Sections (Sectional Views)
B = Geotechnical	3 = Lucky Queen	4 = Large Scale Views (Plans, Sections & Elevations that are not Details)
C = Civil	4 = Onek	5 = Details
L = Landscape	5 = Bermingham	6 = Schedules and Diagrams
S = Structural	6 = Mill Site	7 = User Defined
A = Architectural	7 = DSTF	8 = User Defined
I = Interiors	8 = KHSD Sludge Pond	9 = 3D Representations (Isometrics, Perspectives and Photographs)
Q = Equipment	9 = Flat Creek Camp	
F = Fire Protection		
P = Plumbing		
D = Process		
M = Mechanical		
E = Electrical		
W = Distributed Energy		
T = Telecommunications		
R = Resource		
X = Other Disciplines		
Z = Contractor/Shop Drawings		
O = Operations		

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-02-05	Draft for review	A	KAB	--

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-G-0000

Sheet List

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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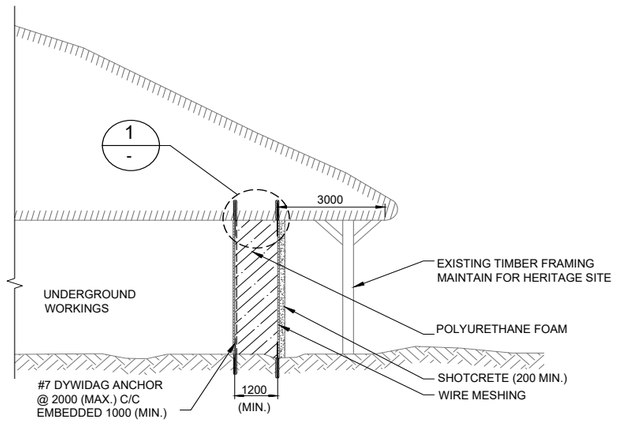
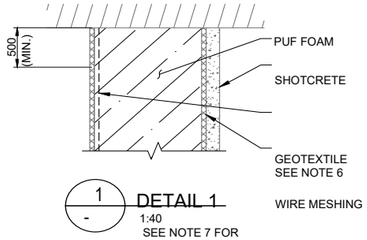
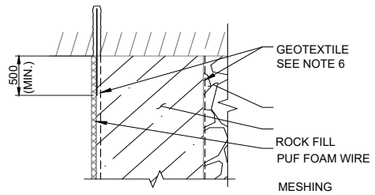


TYPICAL ADIT CLOSURE TYPE 1



1 / - DETAIL 1
1:40
SEE NOTE 7 FOR
CONSTRUCTION SEQUENCE

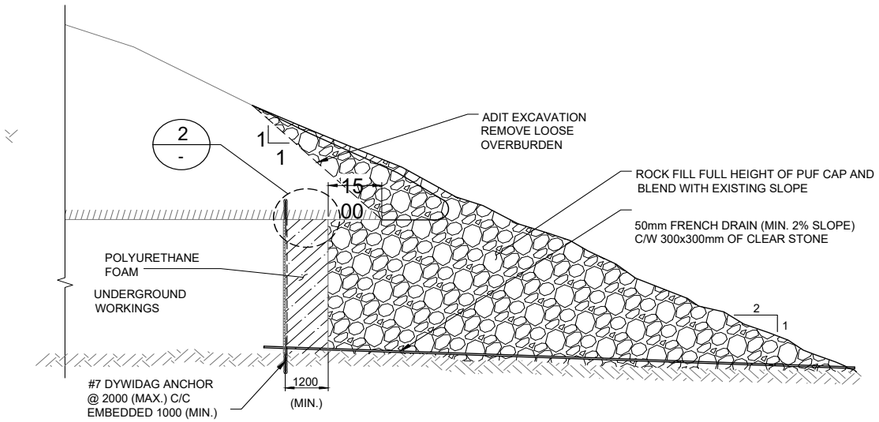


2 / - DETAIL 2
SEE NOTE 8 FOR
CONSTRUCTION SEQUENCE

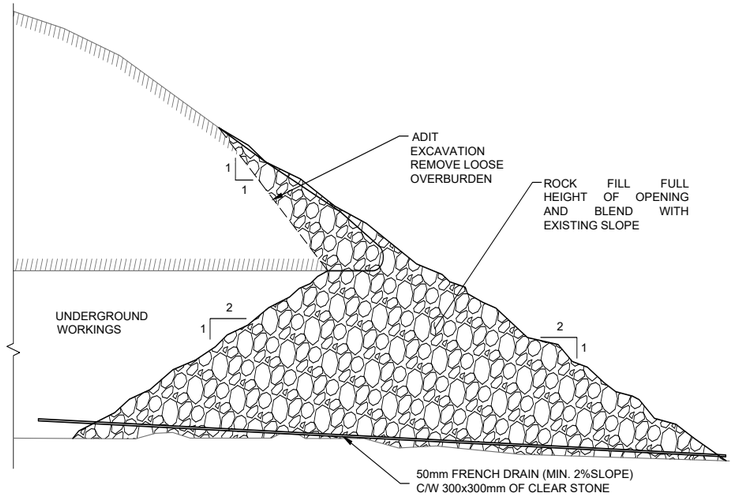
NOTES:

1. SEE DRAWING AKHM-13-01-S-0303 FOR GENERAL NOTES.
2. SEE DRAWING AKHM-13-01-S-0303 FOR CONCRETE NOTES
3. SEE DRAWING AKHM-13-01-S-0303 FOR PUF NOTES
4. VERIFY ADIT DIMENSIONS ARE CONSISTENT WITH DRAWING.

   ALL DEVIATIONS MUST BE REPORTED TO THE PROJECT ENGINEER BEFORE COMMENCING CONSTRUCTION.
5. ALL DIMENSIONS IN MILLIMETERS U.N.O.
6. GEOTEXTILE TO BE ARMTEC 835 WOVEN GEOTEXTILE OR APPROVED ALTERNATE WITH MINIMUM OVERLAP OF 300mm.
7. CONSTRUCTION SEQUENCE TYPE 1:
   - 7.1. INSTALL DYWIDAG ANCHORS ALONG WITH WIRE MESHING AND GEOTEXTILE ON FAR SIDE OF PUF PLUG LOCATION.
   - 7.2. SPRAY PUF PLUG TO DESIRED THICKNESS.
   - 7.3. INSTALL DYWIDAG ANCHORS ON NEAR SIDE OF PLUG.
   - 7.4. INSTALL WIRE MESH AND SPRAY SHOTCRETE OVER ENTIRE AREA OF THE PLUG.
8. CONSTRUCTION SEQUENCE TYPE 2:
   - 8.1. INSTALL DYWIDAG ANCHORS ALONG WITH WIRE MESHING AND GEOTEXTILE ON FAR SIDE OF PUF PLUG LOCATION.
   - 8.2. SPRAY PUF PLUG TO DESIRED THICKNESS.
   - 8.3. FASTEN GEOTEXTILE TO PUFAND BACKFILL TO THE FULL HEIGHT OF THE ADIT WITH ROCKFILL.



TYPICAL ADIT CLOSURE TYPE 2



TYPICAL ADIT CLOSURE TYPE 3

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
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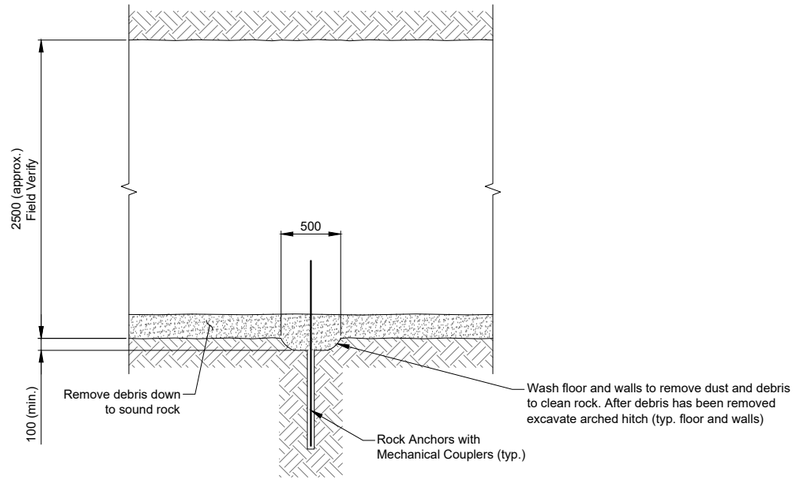
AKHM
TETRA TECH EBA

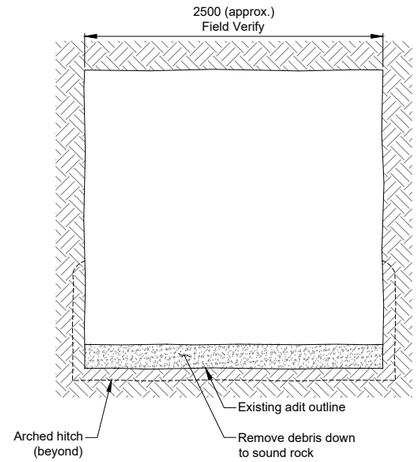
Keno District Mine Operations
Reclamation and Closure Plan
Drawing No:
AKHM-13-01-S-0301

Portal Closure
Typical Adit Closure Design

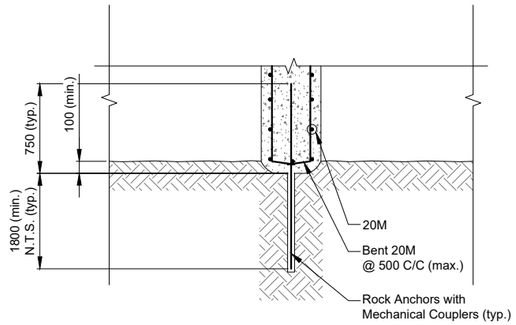
REVISION: 0A	2021-04-23	PROJECT No.: AKHM-13-01
DRAWN BY: Tetra Tech EBA	DESIGNED BY: Tetra Tech EBA	REVIEWED BY: KSW



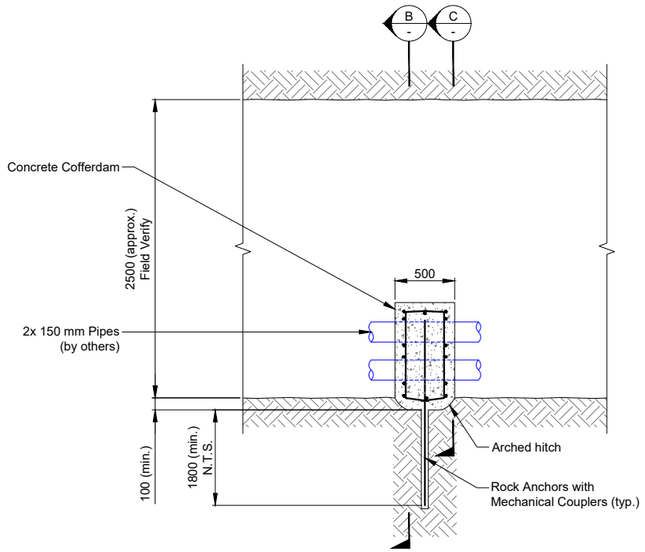
1 COFFERDAM PREPARATION - LONGITUDINAL SECTION
Scale: 1:50



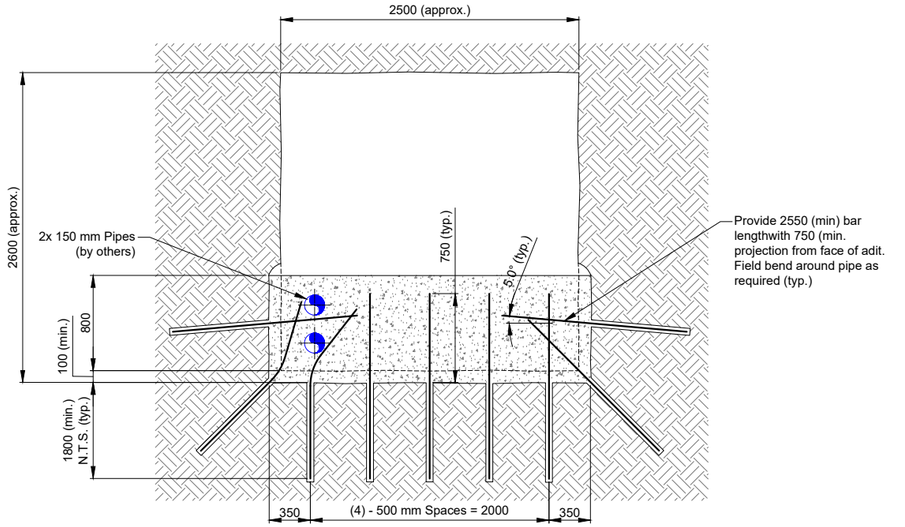
A ADIT CROSS SECTION
Scale: 1:50
*Rock anchors not shown for clarity



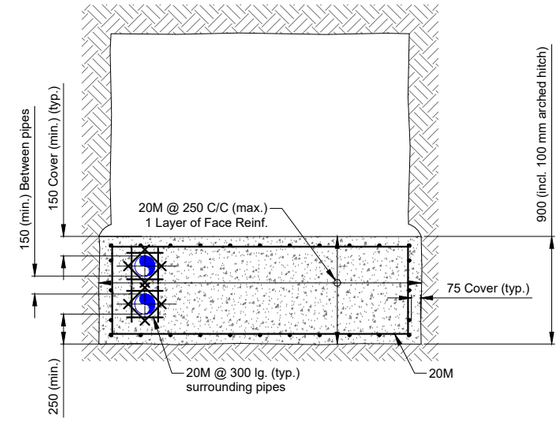
3 ARCHED HITCH DETAIL (TYP. ALL SIDES)
Scale: 1:50



2 COFFERDAM - LONGITUDINAL SECTION
Scale: 1:50



B COFFERDAM - TRANSVERSE SECTION
Scale: 1:50
*Reinforcing steel not shown for clarity



C COFFERDAM - TRANSVERSE SECTION
Scale: 1:50
*Rock anchors not shown for clarity

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2021-11-25	Draft for review	B	KAB	--
2021-11-18	Draft for review	A	KAB	--

DRAFT
NOT FOR
CONSTRUCTION

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-S-0302

Sections and Details
Concrete Cofferdam
Adit Closure

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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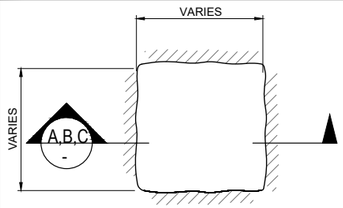
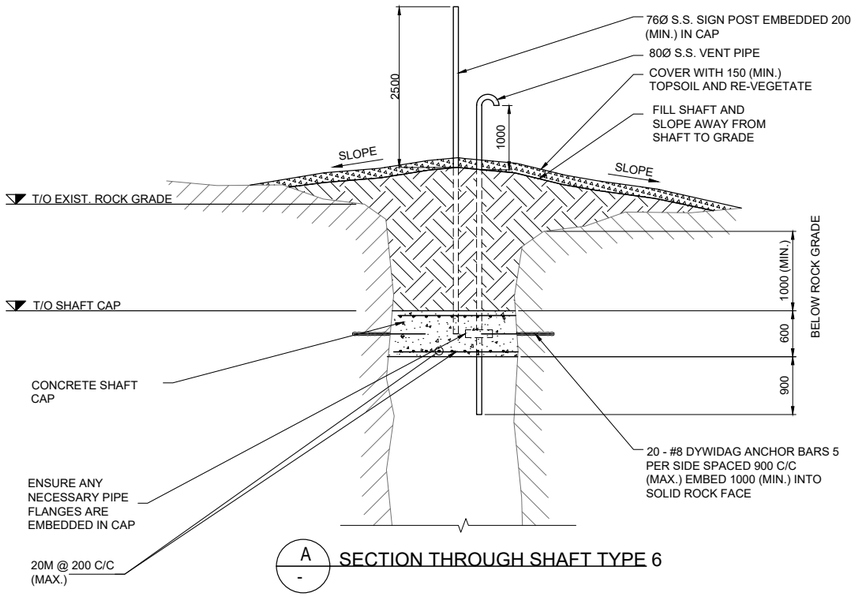
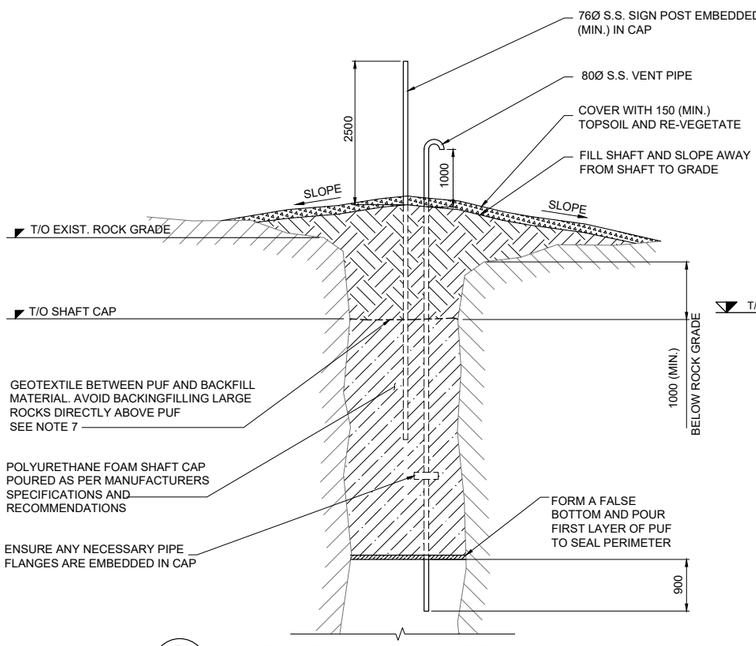


EXISTING SHAFT PLAN VIEW

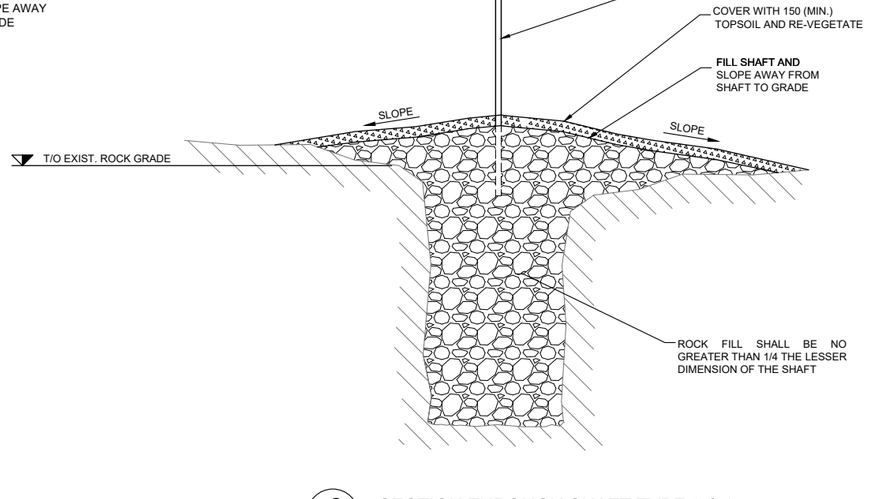


A
-
SECTION THROUGH SHAFT TYPE 6

CLOSURE TYPE	DESCRIPTION
1	LEVEL AS IS, OR FILL IN MINOR INDENT IN GROUND WHERE PREVIOUS SHAFT WAS BACKFILLED
2	FOR SHALLOW SHAFTS, DEPOSIT ROCK INTO SHAFT UNIT REFUSAL
3	FOR DEEPER SHAFTS, EXTENSIVE AMOUNTS OF ROCK PUSHED INTO SHAFT UNTIL REFUSAL
4	POLYURETHANE FOAM PLUG FOR SMALL SHAFTS (LESS THAN OR EQUAL TO 2 x 2m). FORM AND POUR PUF. MINOR BACKFILL REQUIRED.
5	POLYURETHANE FOAM PLUG FOR LARGER SHAFTS (GREATER THAN 2 x 2m) THAT REQUIRE EXTENSIVE FORMWORK FOR PLACEMENT. FORM AND POUR PUF. MINOR BACKFILL
6	FORM, REINFORCE AND POUR CONCRETE CAP TO PLUG SHAFT. MINOR BACKFILL REQUIRED.



B
-
SECTION THROUGH SHAFT TYPE 4 & 5



C
-
SECTION THROUGH SHAFT TYPE 2 & 3

GENERAL NOTES:

1. ALL SUPPORTS TO BE FOUNDED ON SOUND ROCK. THE DESIGN IS BASED ON A MINIMUM BEARING VALUE OF GOOD QUALITY SEDIMENTARY ROCK (e.g., SHALE) = 600 kPa.
2. COMPETENCY OF THE ROCK AT THE SUPPORTS SHALL BE EXAMINED AND APPROVED BY A QUALIFIED PROFESSIONAL ENGINEER PRIOR TO CONSTRUCTION.
3. ALL LOOSE ROCK SHALL BE REMOVED FROM THE ROCK ANCHORAGES TO COMPETENT ROCK. VERIFY SHAFT DIMENSIONS ARE CONSISTENT WITH DRAWING.
4. ALL DEVIATIONS MUST BE REPORTED TO THE PROJECT ENGINEER BEFORE COMMENCING CONSTRUCTION.
5. THOROUGHLY COMPACT ALL CONCRETE USING VIBRATORS OR OTHER SUITABLE TOOLS DURING THE PLACING OPERATION. THOROUGHLY WORK THE CONCRETE INTO THE CORNERS OF THE FORMS AND ROCK SURFACES AND AROUND THE REINFORCEMENT.
6. SHAFT CAP SHALL NOT BE LOADED UNTIL THE 28-DAY CONCRETE STRENGTH HAS BEEN VERIFIED BY CYLINDER TESTS IN ACCORDANCE WITH CAN/CSA-A23.2.
7. GEOTEXTILE TO BE ARMTEC 835 WOVEN GEOTEXTILE OR APPROVED ALTERNATE WITH MINIMUM OVERLAP OF 300mm.

DESIGN LOADS:

6. LIVE LOAD = 2.0 METERS OF SATURATED SOIL COVER AT 19 kN/cu.m. + THE GREATER EFFECT OF A SPECIFIED 12 kPa UNIFORMLY DISTRIBUTED LOAD, OR 24 kN CONCENTRATED LOAD OVER AN AREA 0.3 m by 0.3 m, ANYWHERE ON THE SLAB.
7. DEAD LOAD = WEIGHT OF CAP

CAST-IN-PLACE CONCRETE:

1. ALL CONCRETE WORK, MIXES, PLACING, CURING, AND TESTING TO BE IN ACCORDANCE WITH CSA-A23.1-19/A23.2-19 "CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION/TEST METHODS AND STANDARD PRACTICES FOR CONCRETE".
2. CONCRETE ADMIXTURES CONFORM TO CSA A3000-18 "CEMENTITOUS MATERIALS COMPENDIUM."
3. CONCRETE MIXES TO BE IN ACCORDANCE WITH CSA-A23.1-19 ALTERNATIVE 1.
4. USE COLD WEATHER CONCRETING METHODS WHEN THE MEAN AMBIENT TEMPERATURE FALLS BELOW 41°F (+5°C). ADDITIONAL TEST CYLINDERS WILL BE PREPARED DURING COLD WEATHER CONCRETING
5. TEST CYLINDERS TO BE FIELD CURED UNDER THE SAME CONDITIONS AS THE CONCRETE WHICH THEY REPRESENT.
6. FORMWORK TO BE IN ACCORDANCE WITH CAN/CSA S269.1-16 "FALSEWORK AND FORMWORK". NO COLUMN OR WALL FORMS SHALL BE REMOVED BEFORE CONCRETE HAS REACHED 8MPa.
7. FORM OIL TO BE NON-STAINING, NON-TOXIC AND NON-VOLATILE.
8. BEFORE CONCRETE IS PLACED, REVIEW SHOP DRAWINGS FOR EQUIPMENT, OPENINGS, ANCHOR BOLTS, EMBEDS, INSERTS, ETC. TO ENSURE COMPLETENESS.
9. ALL PIPES, CONDUITS, AND SLEEVES EMBEDDED IN CONCRETE SHALL BE INSTALLED IN ACCORDANCE WITH CSA A23.1-19.
10. TESTING:
    A) QUALITY CONTROL TO BE UNDERTAKEN BY AN INDEPENDENT TESTING AGENCY OBTAINED BY THE CONTRACTOR, RESULTS OF FIELD TESTING WILL BE REPORTED IMMEDIATELY TO THE CONTRACTOR AND ERDC. ERDC MAY ENGAGE AN INDEPENDENT INSPECTION/ TESTING AGENCY TO CONDUCT TESTING; HOWEVER INSPECTION AND TESTING BY ERDC DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR QUALITY CONTROL AND CONTRACTUAL OBLIGATIONS.
    B) TEST PROCEDURE SHALL INCLUDE, BUT NOT LIMITED TO, THREE TEST CYLINDERS FROM EACH 50m3 OF CONCRETE, OR FRACTION THEREOF, FOR EACH DAY, TYPE OF CONCRETE, OR TYPE OF STRUCTURAL COMPONENT. ONE SLUMP TEST AND ONE ENTRAINED AIR TEST FOR EACH SET OF CYLINDERS.
11. ACCESSORIES SUCH AS HI-CHAIRS, SPACERS ETC., WILL BE SUPPORTED USING PADS OF PLYWOOD OR TEMPERED FIBREBOARD TO PREVENT PUNCTURING. POLYSTYRENE IS NOT AN ACCEPTABLE FORM MATERIAL

CONCRETE REINFORCING:

1. ALL REINFORCING STEEL TO MEET CAN/CSA-G30.18-09 (R2019) "CARBON STEEL BARS FOR CONCRETE REINFORCEMENT", 400 MPa DEFORMED BARS EXCEPT 10M TIES MAY BE 300 MPa.
2. ALL STEEL TO BE DETAILED IN ACCORDANCE WITH CSA A23.1-19 "CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION", A23.3-19 "DESIGN OF CONCRETE STRUCTURES" AND THE LATEST EDITION OF THE REINFORCING STEEL MANUAL OF STANDARD PRACTICE BY THE REINFORCING INSTITUTE OF CANADA.

CONCRETE REINFORCING (CONT'D):

3. CLEAR COVER TO REINFORCING WILL BE:

   CONCRETE CAST AGAINST EARTH -
   ALL BARS..... 75mm

   CONCRETE PLACED IN FORMS -
   20M OR LARGER..... 50mm
   10M & 15M..... 40mm

4. PROVIDE LAPS TO CSA A23.3 OR THE FOLLOWING MINIMUMS:
   10M - 700mm
   15M - 1000mm
   20M - 1200mm
   25M - 1900mm
5. ALL REINFORCING TO BE HELD IN PLACE AND TIED WITH PROPER ACCESSORIES, HI-CHAIRS AND SPACERS. DETAIL, SUPPLY AND INSTALL ALL ACCESSORIES. HI-CHAIRS TO HAVE 4 LEGS AND TO BE STAPLED OR NAILED TO THE FORMWORK.
6. REINFORCING STEEL SHALL HAVE ADEQUATE SUPPORTS SPACED NOT MORE THAN 1200mm APART IN ANY DIRECTION AND SHALL BE FIRMLY ANCHORED BEFORE CONCRETE IS POURED.
7. ALL REQUIRED OPENINGS NOT SHOWN ON STRUCTURAL DRAWINGS SHALL BE APPROVED BY THE CONSULTANT PRIOR TO CONSTRUCTION.
8. REINFORCING STEEL SHALL BE CLEAN AND FREE OF ALL DIRT, GREASE AND OTHER DELETERIOUS MATERIALS PRIOR TO PLACING CONCRETE.
9. FOR OPENINGS OR INSERTS LESS THAN 450mm, THE REINFORCING STEEL SHALL BE DEFLECTED, NOT CUT.
10. REINFORCING STEEL SHALL NOT BE WELDED, HEATED OR BENT ON-SITE WITHOUT PRIOR APPROVAL OF THE CONSULTANT.
11. DOWELS TO CONCRETE SLABS AND WALLS TO MATCH SLAB REINFORCING UNLESS NOTED OTHERWISE.

ROCK ANCHORS:

1. ROCK BOLTS AND ACCESSORIES TO BE IN ACCORDANCE WITH CAN/CSA M430-90 (R2016) "ROOF AND ROCK BOLTS, AND ACCESSORIES".
2. ROCK ANCHORS TO BE: 'DYWIDAG' THREADBAR, GRADE 75 (517 MPa) OR APPROVED ALTERNATIVE.
3. MINIMUM EMBEDMENT TO BE 2000mm INTO SOUND ROCK UNLESS NOTED OTHERWISE. GROUT FULL DEPTH.
4. INSTALL RESIN AS PER MANUFACTURER'S RECOMMENDATIONS AND INSTRUCTIONS.
5. SCALE ROCK THOROUGHLY PRIOR TO DRILLING ANCHOR HOLES.
6. ANCHOR HOLES SHALL BE CLEAN AND DRY PRIOR TO INSTALLING RESIN.

POLYURETHANE FOAM (PUF) STORAGE AND APPLICATION:

THE CURED PUF MUST MEET THE FOLLOWING SPECIFICATION(S):

COMPRESSIVE STRENGTH 140 kPa

4. PERFORM ALL POLYURETHANE FOAM (PUF) WORK INCLUDING STORAGE AND PLACEMENT TO THE MANUFACTURERS SPECIFICATIONS AND RECOMMENDATIONS
5. PUF CONTAINERS SHALL BE STORED IN A DRY TEMPERATE LOCATION OUT OF THE SUNLIGHT AND BELOW 30 °C.
6. THE APPLICATION AND MIXTURE OF 2-PART PUF PRODUCTS SHALL BE ACCURATELY METERED AND MIXED TO COMPLY WITH THE MANUFACTURERS SPECIFICATIONS.
7. FORMWORK FOR PUF SHOULD BE SUFFICIENT TO PREVENT THE LEAKAGE OF THE LIQUID DOWN THE SHAFT. THE FIRST LAYER OF PUFF SHOULD BE POURED TO SEAL THE PERIMETER OF THE FORM AND THE VENT. METHOD MAY VARY DEPENDING ON SHAFT CROSS SECTION.
8. ENSURE EACH LAYER OF PUF IS EVENLY APPLIED ACROSS SHAFT OPENING. NO LAYER OF PUF SHALL EXCEED THE LESSER OF THE MANUFACTURERS SPECIFICATIONS OR 450mm.
9. A MINIMUM TIME OF 20 MINUTES SHOULD BE ALLOWED BETWEEN THE POURING OF EACH LAYER OF PUF. THE LAYER SHOULD BE COOL AND REACH A TACK FREE TEXTURE BEFORE POURING THE NEXT LAYER.
10. BACKFILL SHOULD BE COMPLETED NO SOONER THAN 60 MINUTES AFTER THE COOLING OF THE LAST PUF LAYER. THE BACKFILL SHOULD BE NO LESS THAN 1M OF DIRT OVER THE TOP OF THE PUF CAP. THE GRADE SHOULD SLOPE AWAY FROM THE SHAFT CENTER.

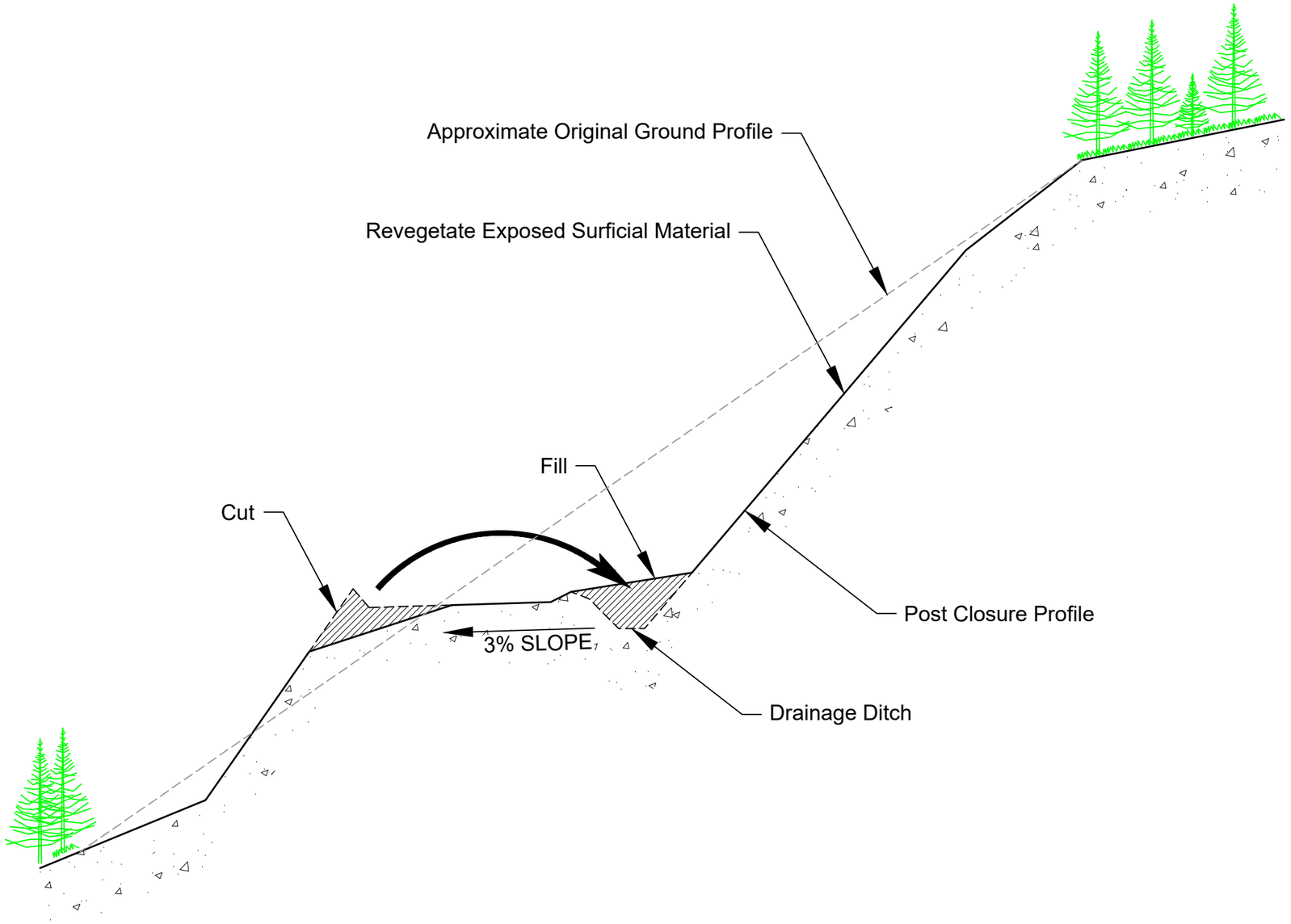
DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-04-23	Draft for Review	0A	TT	--

AKHM
TETRA TECH EBA

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No:
AKHM-13-01-S-0303

Shaft/Raise to Surface
Typical Concrete, PUF and Backfilled Caps

REVISION: 0A	2021-04-23	PROJECT No.: AKHM-13-01
DRAWN BY: Tetra Tech EBA	DESIGNED BY: Tetra Tech EBA	REVIEWED BY: KSW



Notes:

1. Pull back slope and fill ditch.
2. Remove culverts.
3. Install erosion breaks on steep slopes as necessary.
4. Scarify road surface and prepare for natural revegetation.

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2021-11-25	Draft for review	B	KAB	--
2018-01-29	Draft for review	A	KAB	--

Sand & Gravel

Existing Vegetation

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Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-B-0301

Haul Road and Site Road Reclamation Typical Section

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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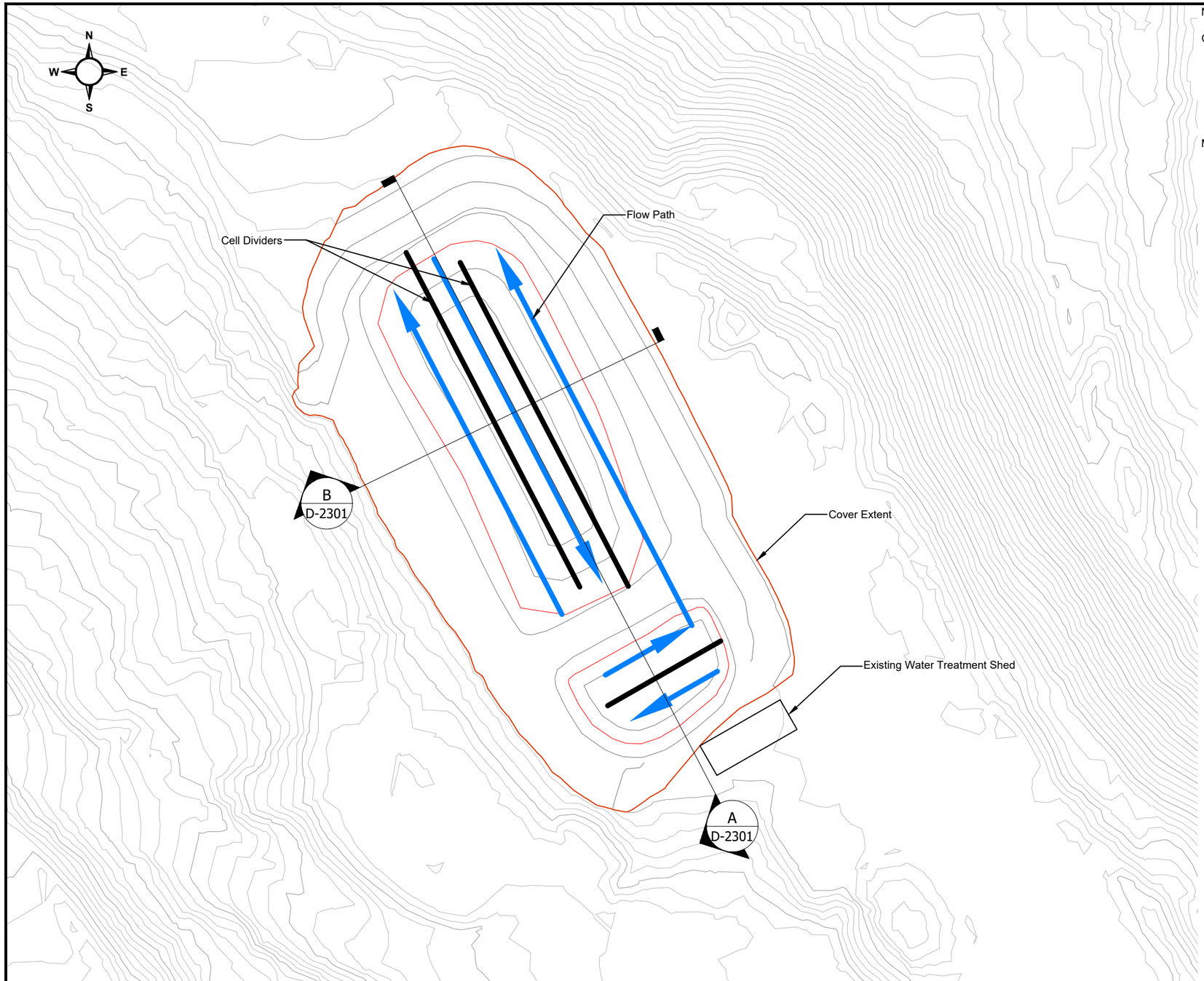

Notes:

Conceptual Design Assumptions:

1. Divide Pond 1 in to two zones with an HDPE liner divider. Two cells of approximately 6 m x 15 m
2. Divide Pond 2 in to three zones with HDPE liner dividers. Three cells of approximately 5.3 m x 42 m
3. Total Volume = 2,800 m^3
4. Porosity = 40%
5. Flowrate = 4 lps
6. Retention Time = (2800 m^3 x 0.40)/4 lps = 3.1 days

Material Quantities:

Placer Gravel Rock Substrate:	2,800 m^3
Geotextile Barrier:	1,410 m^2
Soil Cover:	4,010 m^3

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2021-11-25	Draft for review	B	KAB	--
2018-02-01	Draft for review	A	KAB	--

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Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-D-2102

Bellekeno 625
Bioreactor Design

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: KSW

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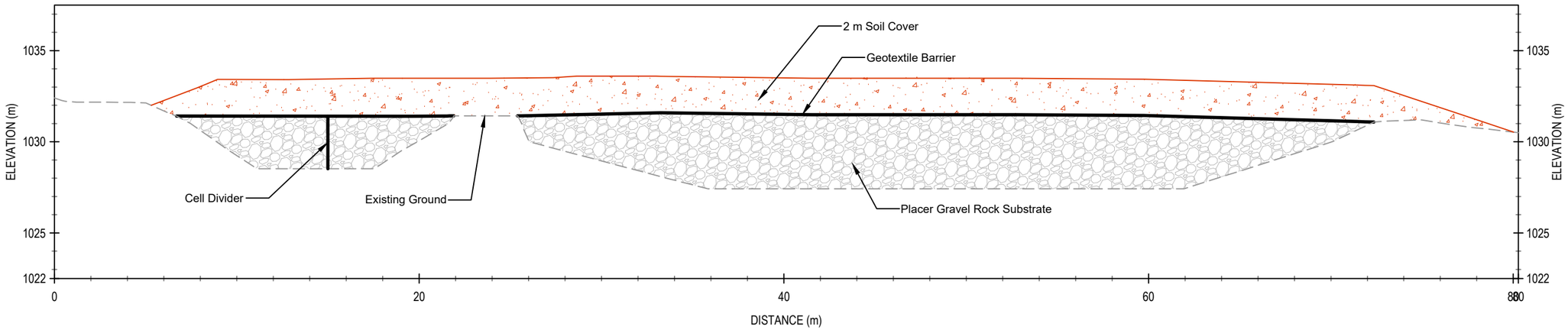

Section A

Section B

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2021-11-25	Draft for review	B	KAB	--
2018-02-01	Draft for review	A	KAB	--

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-D-2301

Bellekeno 625
Bioreactor Design Sections

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: KSW

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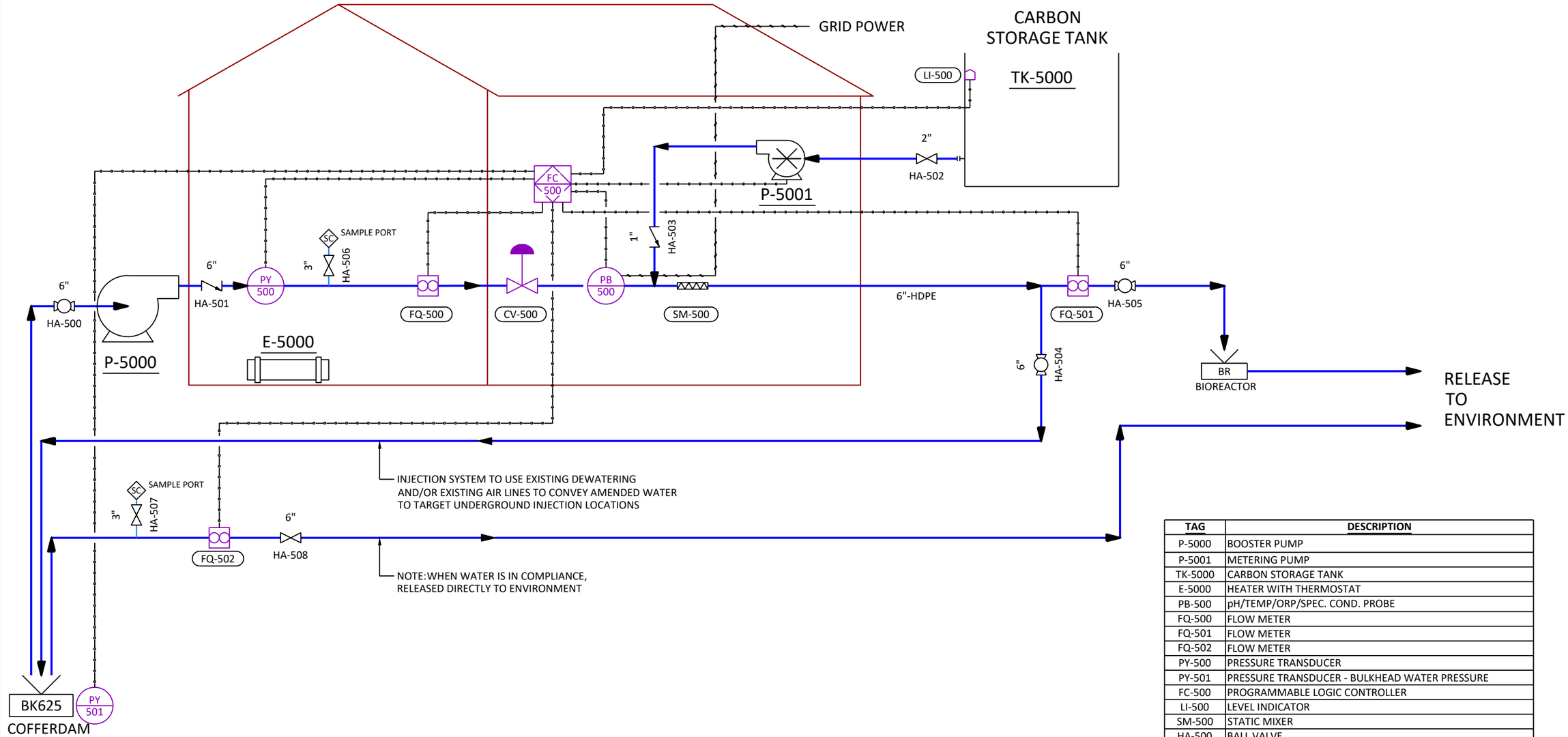

TAG	DESCRIPTION
P-5000	BOOSTER PUMP
P-5001	METERING PUMP
TK-5000	CARBON STORAGE TANK
E-5000	HEATER WITH THERMOSTAT
PB-500	pH/TEMP/ORP/SPEC. COND. PROBE
FQ-500	FLOW METER
FQ-501	FLOW METER
FQ-502	FLOW METER
PY-500	PRESSURE TRANSDUCER
PY-501	PRESSURE TRANSDUCER - BULKHEAD WATER PRESSURE
FC-500	PROGRAMMABLE LOGIC CONTROLLER
LI-500	LEVEL INDICATOR
SM-500	STATIC MIXER
HA-500	BALL VALVE
HA-501	CHECK VALVE
HA-502	ISOLATION VALVE
HA-503	CHECK VALVE
HA-504	BALL VALVE
HA-505	BALL VALVE
HA-506	GATE VALVE
HA-507	GATE VALVE
HA-508	GATE VALVE
CV-500	THROTTLING VALVE

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-02-05	Draft for review	A	KAB	--

NOTES:

1) Treatment will be performed in treatment campaigns periodically as necessary to maintain low redox potential, and low zinc.
2) A centrifugal booster pump will be installed near the bulkhead, allowing for water to be pumped from the mine, amended with carbon, and injected back underground
3) A throttling valve will control the pump speed.
4) System's flow rate and pressure will be monitored, with carbon injection proportional to flow rate. Monitoring information of all adit discharge will be continuously monitored with datalogging field parameters: specific conductivity, temperature, ORP, pH, and pressure behind the bulkhead.
5) When in compliance, water will be released to the environment.

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No.: AKHM-13-01-D2601

Bellekeno Closure Treatment System

Piping & Instrumentation Diagram

REVISION B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: EJL	REVIEWED BY: JMH

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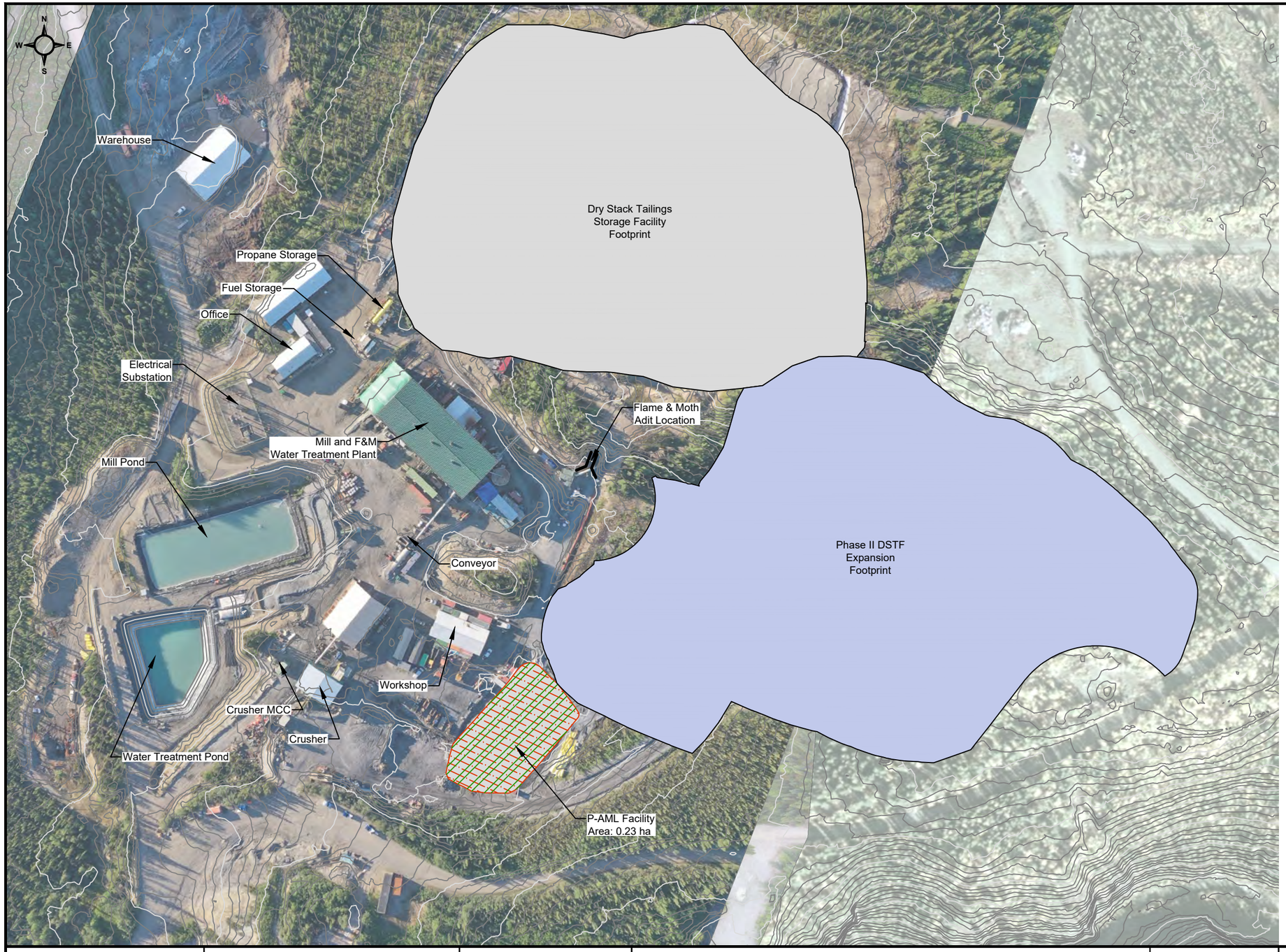

Notes:

1. Surface buildings associated with Flame and Moth are portable structures that will be removed and transported offsite for salvage.
2. P-AML rock stored within the temporary facility will be moved back underground as backfill.
3. Rock pile portal closure to be installed. See drawing AKHM-13-01-C-S0301.
4. Surface areas to be regraded as required for positive drainage, and scarified to promote revegetation
5. Further surface amendments detailed on drawings AKHM-13-01-C-6401 and AKHM-13-01-B6101.

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-26	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to be recontoured
- Area to be scarified and revegetated

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-C-1401

Flame & Moth Reclamation Measures

REVISION: B	2021-11-26	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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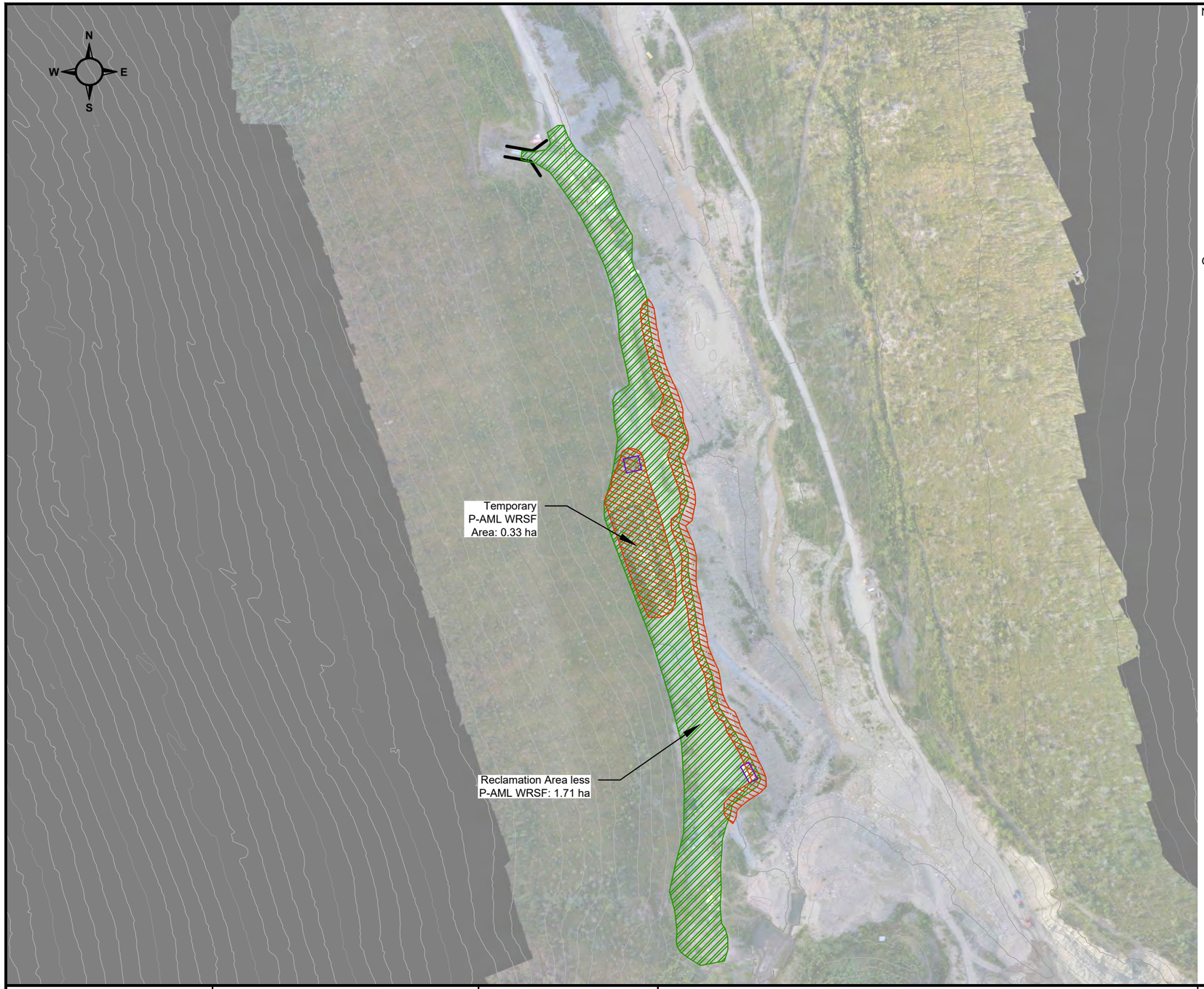

Notes:

1. The WRSF will be regraded to promote positive drainage and the area will be covered and revegetated.
2. The Bellekeno East portal will receive a rock pile closure. See drawing AKHM-13-01-S-0301.
3. The mine will be allowed to flood and will receive *in situ* mine pool treatment. Water will exit via the Bellekeno 625 adit. See drawing AKHM-13-01-C-2402
4. The 200 level vent raise is an historic vent raise to surface that connected to the 99 zone of the Bellekeno mine. The 200 vent raise will be capped with an engineered concrete cap. See Drawing AKHM-13-01-S-0303.
5. All the surface buildings at Bellekeno East are portable structures will be removed and transported offsite for salvage at closure.
6. Sediment ponds at Bellekeno East for the development of the decline will be progressively reclaimed prior to mine closure.
7. Contaminated soil will be removed and treated in a land treatment facility.
8. The Bellekeno East portal site will be recontoured and scarified to establish drainage and facilitate revegetation.
9. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quantities:

Area of recontouring:	7,400 m^2
Area of scarification and revegetation:	20,400 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to be recontoured
- Area to be scarified and revegetated

Scale: 1:3000

0 20 40 80 Meters

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-C-2401

Bellekeno East
Reclamation Measures

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: --

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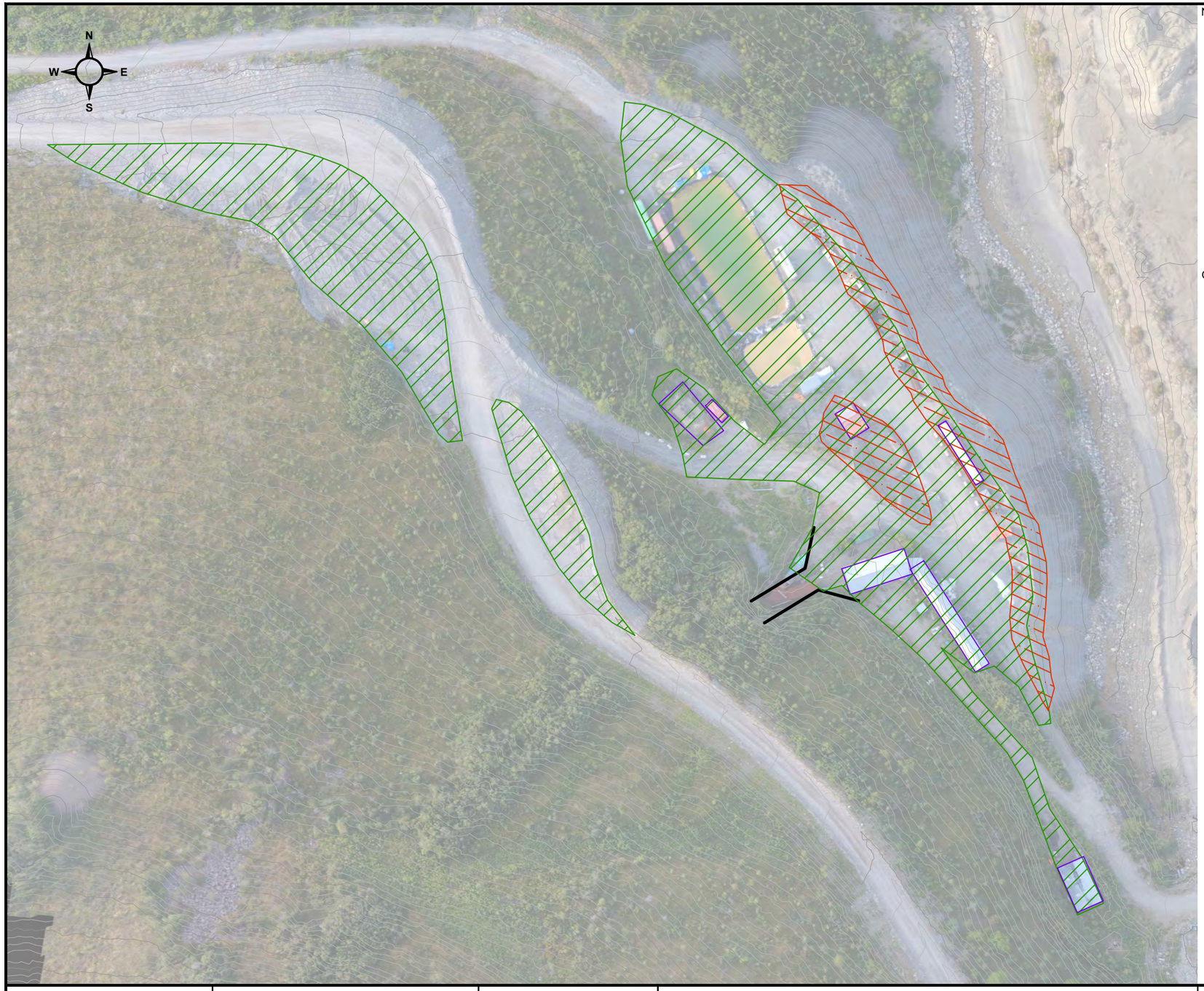

Notes:

1. The Bellekeno 625 adit will be closed with a concrete cofferdam to control water exiting the adit. See drawing AKHM-13-01-S-0302.
2. The mine will be allowed to flood and will receive *in situ* mine pool treatment.
3. Current water treatment ponds at the Bellekeno 625 adit will be converted into a bioreactor passive treatment system to treat mine water exiting the bulkhead. See drawing AKHM-13-01-D-2101.
4. The current water treatment facility will be shut down and decommissioned. The treatment buildings will be conveted into treatment sheds for *in situ* treatment.
5. The 200 level vent raise is an historic vent raise to surface that connected to the 99 zone of the Bellekeno mine. The 200 vent raise will be capped with an engineered concrete cap. See Drawing AKHM-13-01-S-0303.
6. A WRDA was proposed to be constructed along the northeast flank of Sourdough Hill, but is not currently planned for construction. If constructed, at closure, the slopes will be regraded to 3H:1V. Surfaces will be scarified and revegetated.
7. The existing Bellekeno 625 WRDA will have surface equipment removed, the crests pulled back with an excavator, and flat surfaces will be scarified and revegetated.
8. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quantities:

Area of recontouring:	2,300 m^2
Area of scarification and revegetation:	12,900 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to be recontoured
- Area to be scarified and revegetated

Scale: 1:1250

0 18.75 37.5 75 meters

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-C-2402

Bellekeno 625
Reclamation Measures

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: --

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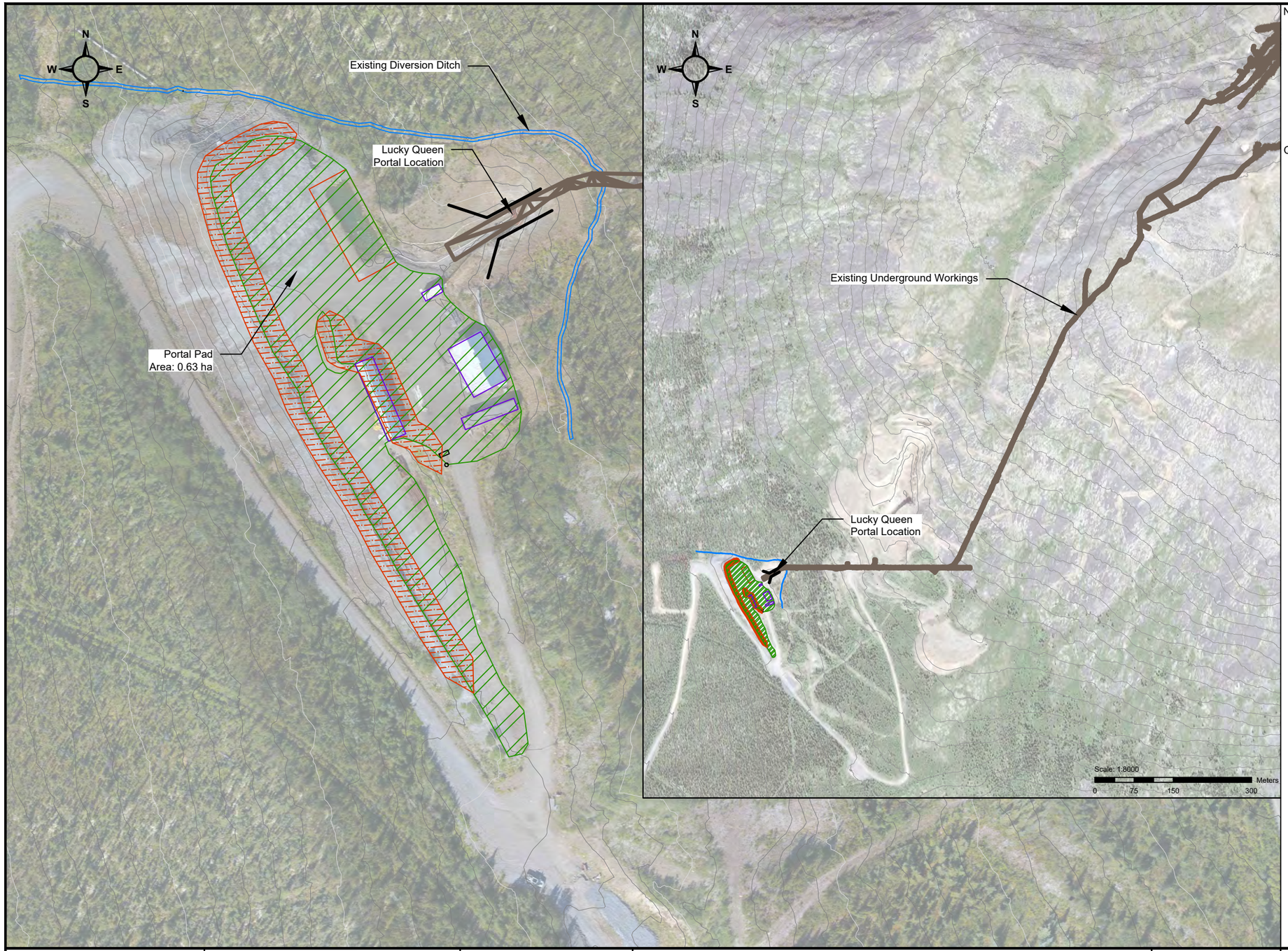

Notes:

1. A rockpile closure will be used to close the portal. See drawing AKHM-13-01-S-0302, Type 3 Closure.
2. Shop and other buildings and infrastructure will be removed for salvage or reuse.
3. Contaminated soil will be removed and treated in a land treatment facility.
4. The portal site will be recontoured and scarified to establish drainage and facilitate revegetation.
5. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quatities:

Area of recontouring:	2,520 m^2
Area of scarification and revegetation:	6,350 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to be recontoured
- Area to be scarified and revegetated

Satelite imagery for inset obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on 2018-01-12.

Scale: 1:1250
Meters
0 10 20 40

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-C-3401

Lucky Queen
Reclamation Measures

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: --

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Notes:

1. A rock pile cover will be constructed to close the portal opening. See Drawing AKHM-13-01-S-0301.
2. The constructed P-AML WRSF contains no P-AML rock. Closure will include the removal of the liner, and recontouring of the containment berms, followed by scarification of the surface, and seeding.
3. Shop and other buildings and infrastructure will be removed for salvage or reuse.
4. Contaminated soil will be removed and treated in a land treatment facility.
5. The portal site will be recontoured and scarified to establish drainage and facilitate revegetation.
6. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quantities:

Area of recontouring:	5,600 m^2
Area of scarification and revegetation:	8,300 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to be recontoured
- Area to be scarified and revegetated

Scale: 1:3000

0 25 50 100 Meters

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-C-4401

Onek
Reclamation Measures

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: --

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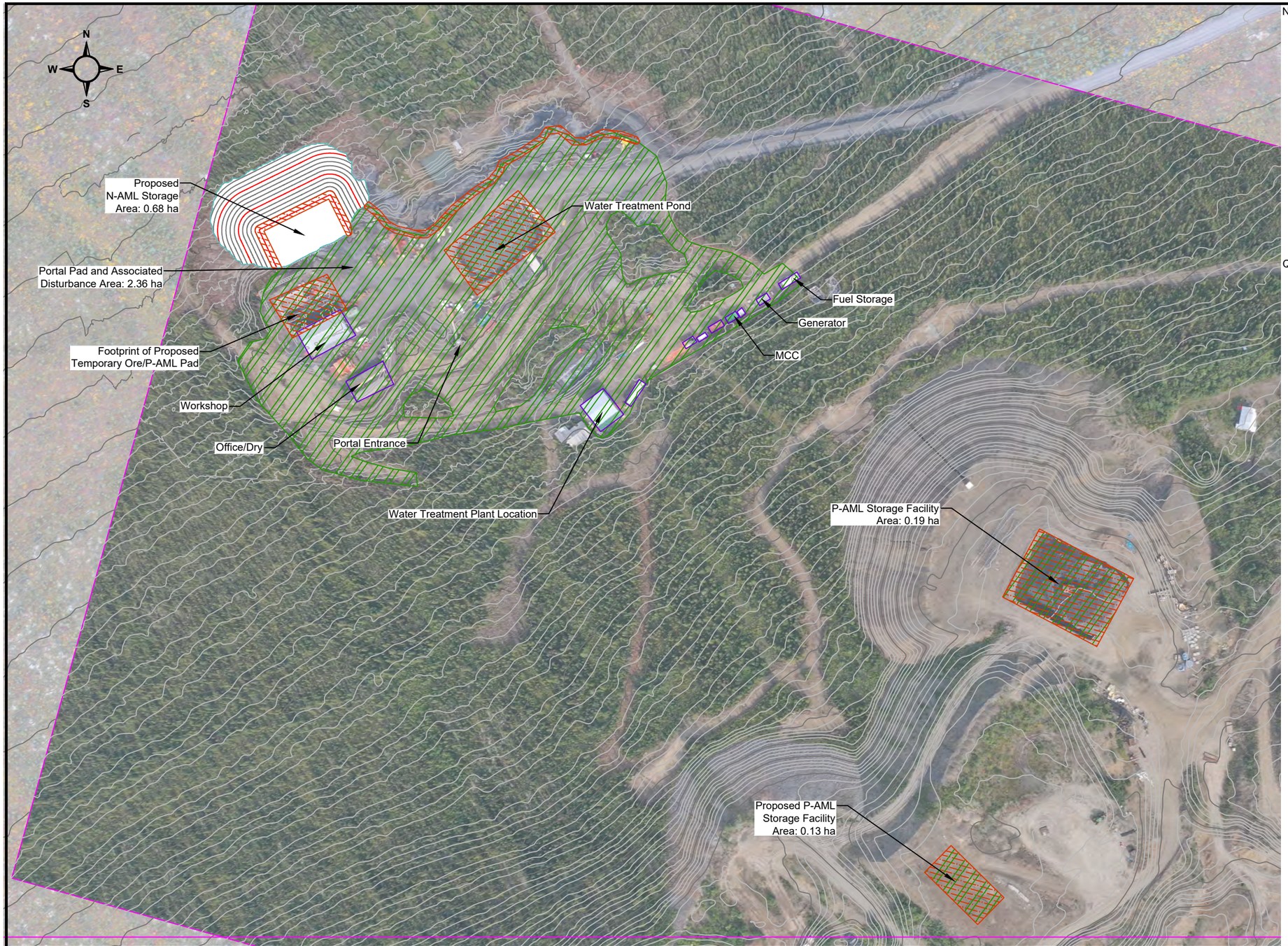

Notes:

1. A rock pile cover will be constructed to close the portal opening. See Drawing AKHM-13-01-S-0301.
2. P-AML waste rock contained in the P-AML WRSF will be relocated to underground.
3. The liner of the P-AML WRSF will be removed, and the containment berms will be recontoured, followed by scarification of the surface, and seeding.
4. The crest of the N-AML WRDA will be pulled back. Flat surfaces will be scarified and revegetated.
5. Shop and other buildings and infrastructure will be removed for salvage or reuse.
6. Contaminated soil will be removed and treated in a land treatment facility.
7. The surrounding portal site will be recontoured and scarified to establish drainage and facilitate revegetation.
8. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.
9. The vent raise will be capped with an engineered concrete or PUF cap. See Drawing AKHM-13-01-S-0303.

Quantities:

Total area of recontouring:	5,240 m^2
Total area of scarification and revegetation:	26,140 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-26	Draft for review	B	KAB	--
2017-12-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to be recontoured
- Area to be scarified and revegetated

Scale: 1:2000

0 15 30 60 Meters

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-C-5401

Bermingham
Reclamation Measures

REVISION: B	2021-11-26	PRJ. No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: --

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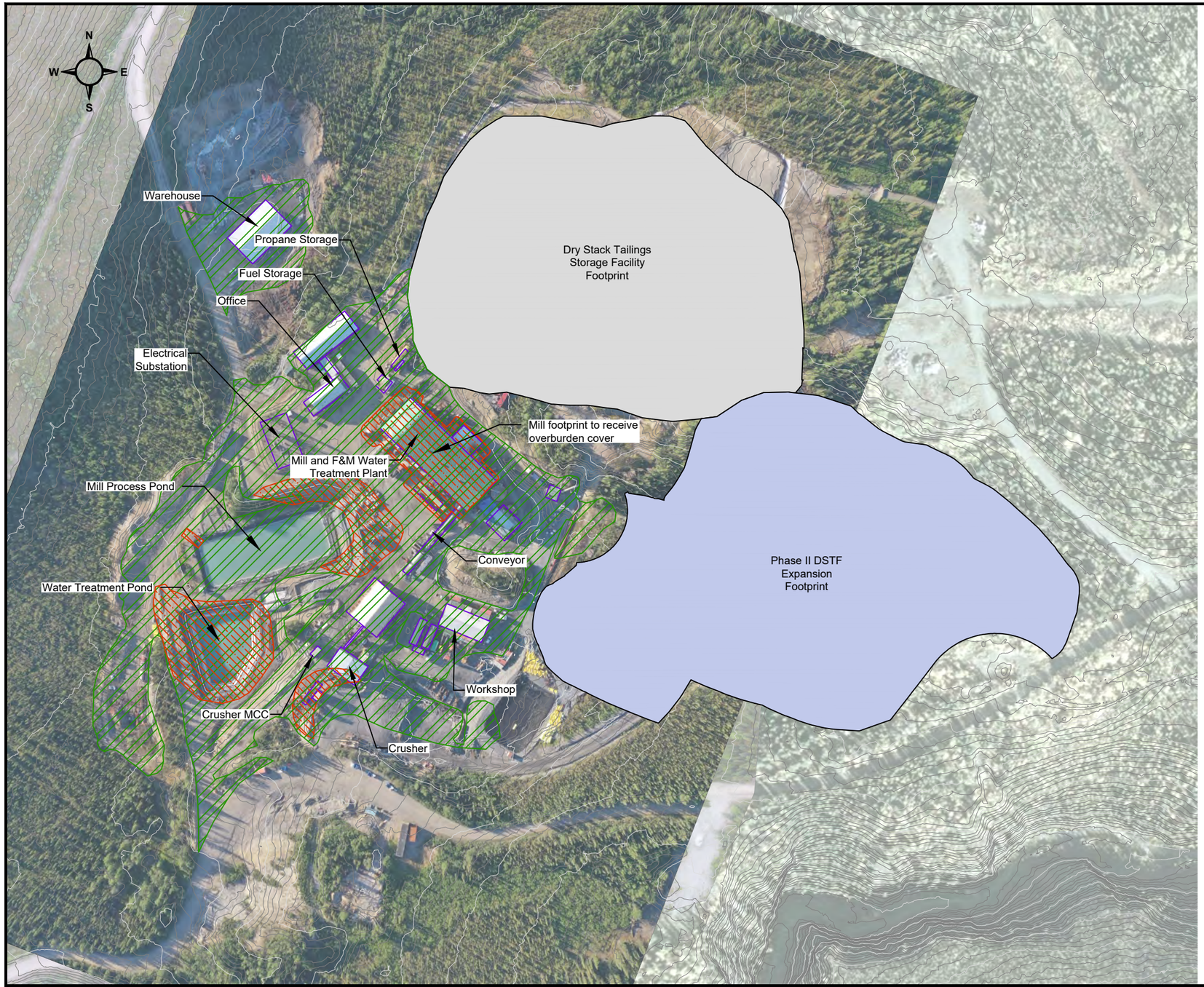

Notes:

1. Modular prefabricated trailer style buildings will be removed from site and salvaged.
2. Rigid steel frame buildings will be dismantled on site. The steel will be sold for salvage.
3. Concrete slabs and above grade footings and foundations will be broken up and covered with 1 m overburden cover, scarified, and revegetated.
4. Both the mill process pond and water treatment pond will have the liners removed. The slopes of the Mill Pond will be scarified and revegetated and it will serve as a sedimentation pond during closure until revegetation is stabilized. A spillway will be cut into the Mill Pond to allow for long term discharge to the environment. The F&M Water Treatment Pond will be recontoured by having the berms pushed in to create a continuous slope.
5. Crusher equipment will be removed from site for salvage.
6. Sea-containers will be removed from site for salvage.
7. Any remaining fine ore will be excavated from the stockpile and milled.
8. The buried tunnel associated with the crushing plant and ore stockpile will be removed and salvaged.
9. Diesel storage tanks and propane tanks will be removed and returned to their suppliers.
10. Buried infrastructure will be left in ground and marked on a site plan to be submitted to regulatory authorities for future reference.
11. Surface piping will be decontaminated and removed for salvage or disposal.
12. Above ground electric cabling will be de-energized and removed for salvage or disposal.
13. Contaminated soil will be removed and treated in a land treatment facility.
14. The mill site will be recontoured and scarified to establish drainage and facilitate revegetation.
15. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quantities:

Area of recontouring:	6,050 m^2
Area of scarification and revegetation:	47,900 m^2
Area to receive overburden cover:	3,150 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-26	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to receive overburden cover
- Area to be scarified and revegetated

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-C-6401

Mill Site
Reclamation Measures

REVISION: B	2021-11-26	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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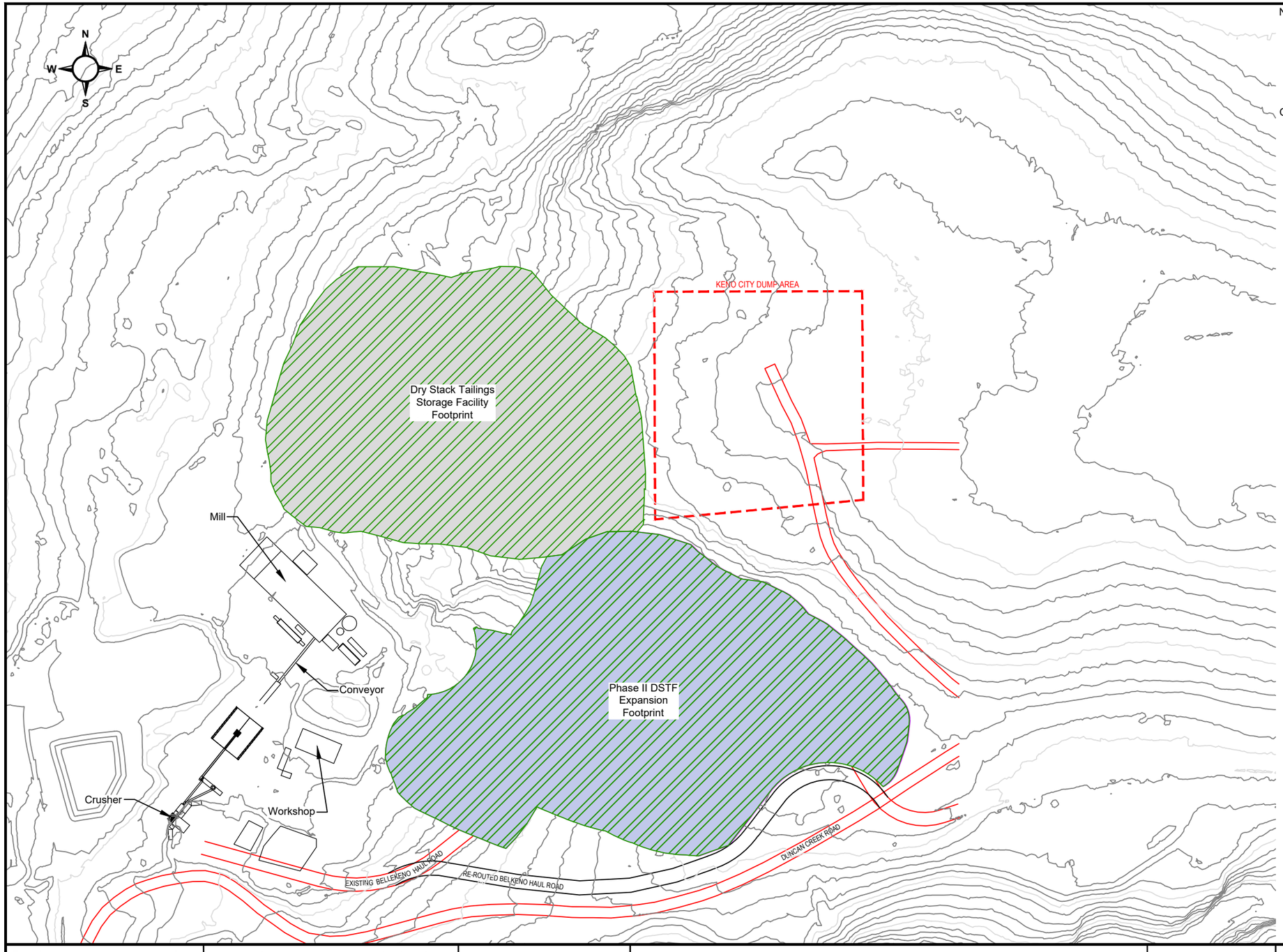

Notes:

1. The DSTF has been progressively reclaimed but recontouring to a 3H:1V slope, with the placement of a 0.25 - 0.5 m cover and seeding.
2. Upon closure, any remaining, unreclaimed areas of the DSTF will be recontoured, covered, and revegetated in the same manner.

Quantities:

Area of scarification and revegetation: 71,500 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-26	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Area to be recontoured
- Area to be scarified and revegetated

Scale: 1:2500

0 20 40 80 Meters

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-C-7401

Dry Stack Tailings Facility Reclamation Measures

REVISION: B	2021-11-26	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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Notes:

1. Sludge contained in the storage cells in the Valley Tailings will be transported either back underground in Bellekeno East decline, or placed in the DSTF.
2. The sludge storage cells are wholly contained within the area of the VTF which is to be excavated and relocated as part of the District Closure Plan. Therefore no other closure activities are planned within the Keno District Mine Operations RCP.

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Scale: 1:5000

0 40 80 160 Meters

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-C-8401

KHSD Sludge Ponds Reclamation Measures

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: --

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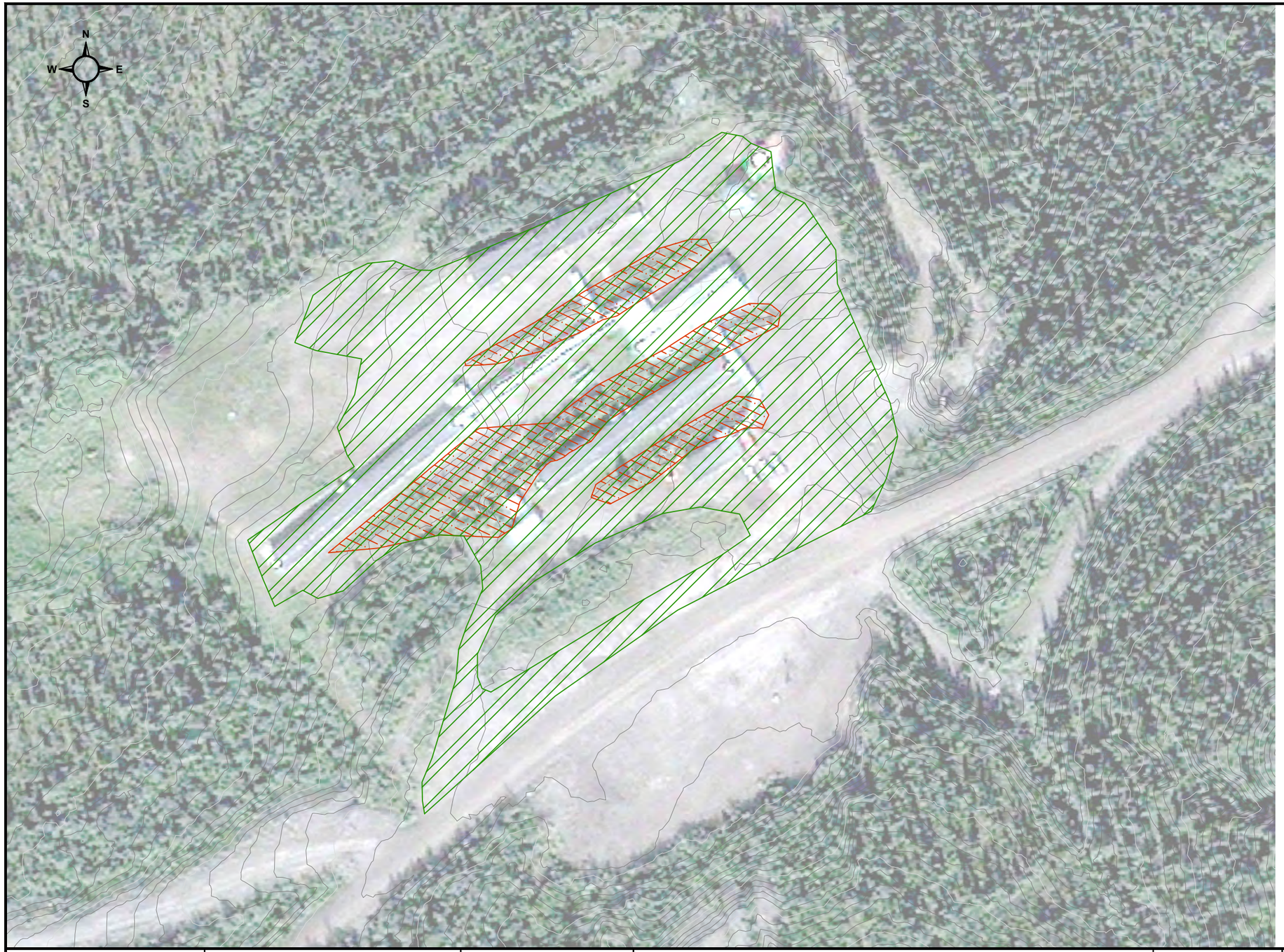

Notes:

1. Slopes will be recontoured as required for a 3H:1V slope.
2. Buildings and infrastructure will be removed for salvage or reuse.
3. Contaminated soil will be removed and treated in a land treatment facility.

Quantities:

Area of recontouring:	3,200 m^2
Area of scarification and revegetation:	18,000 m^2

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

Legend

- Infrastructure to be removed
- Area to be recontoured
- Area to be scarified and revegetated

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on 2018-01-03.

Scale: 1:1250

0 17.5 35 70 m

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-C-9401

Flat Creek Camp
Reclamation Measures

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: --	REVIEWED BY: --

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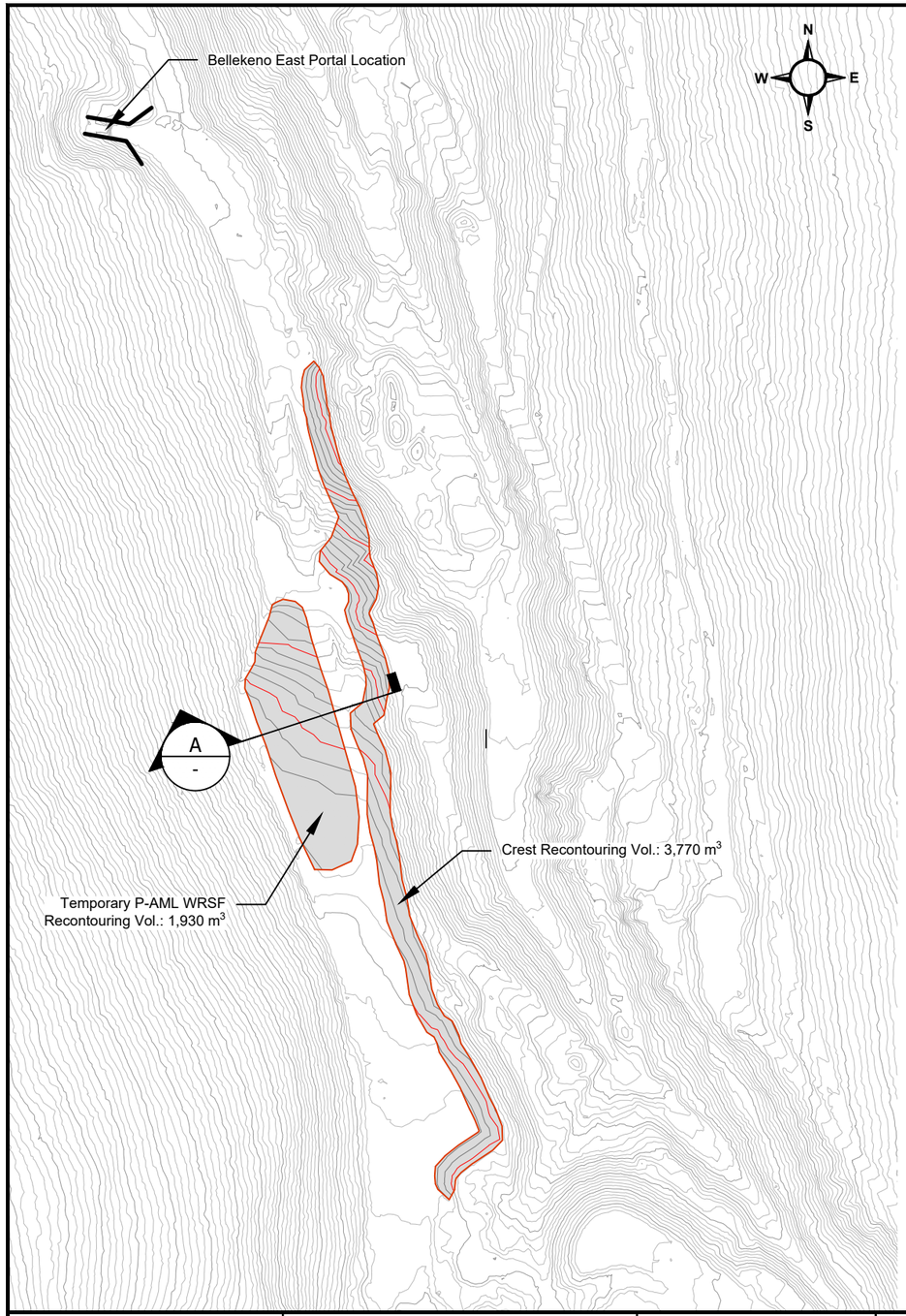
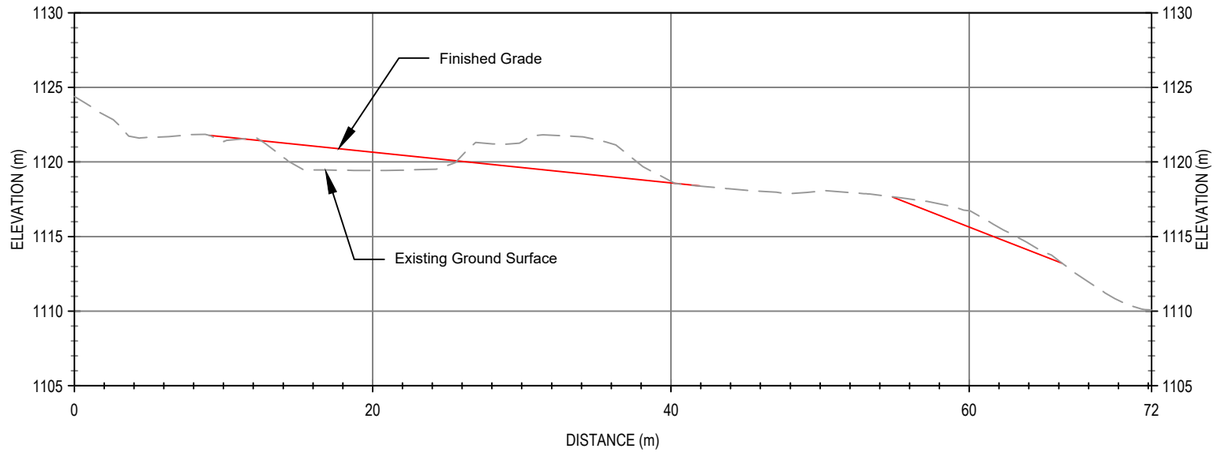


Notes:

1. Remaining P-AML waste rock on surface, stored in the lined storage facility will be backfilled to underground.
2. The WRSF liner will be removed and disposed of in a waste facility.
3. The WRSF will be regraded to promote positive drainage.
4. Portal area crests will be rolled back via excavator.

Quantities:

Volume of material to be recontoured: 5,700 m^3



Section A

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-02-01	Draft for review	A	KAB	--

Scale: 1:2500

0 20 40 80 Meters

ENSERO solutions

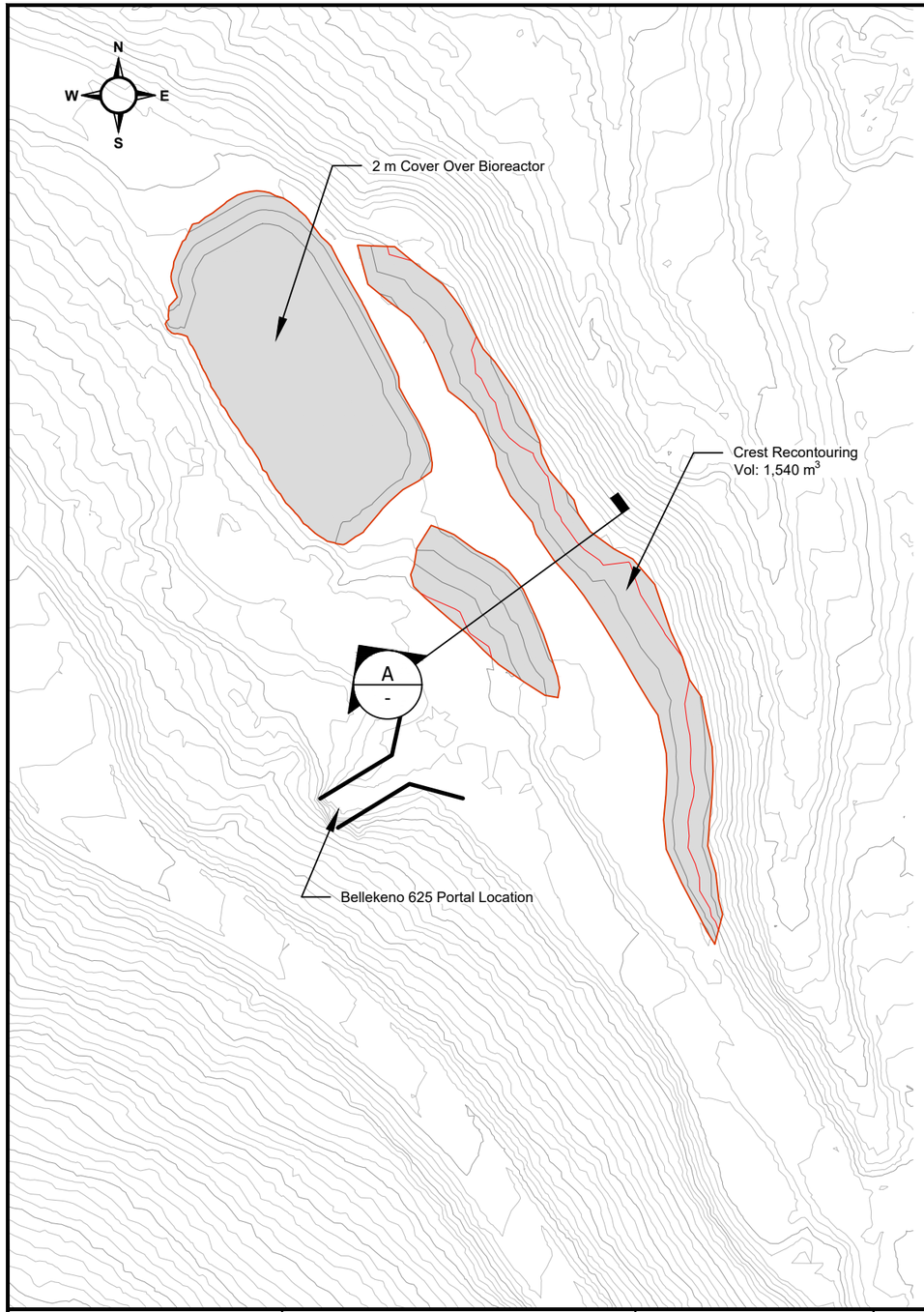
AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-B-2101

Bellekeno East Grading Plan and Cross Section

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\2-Bellekeno\B-Geotech\AKHM-13-01-B-2101-BK_East-Grading.dwg (last edited by: KBoldt; 2021/11/25 - 5:04 PM

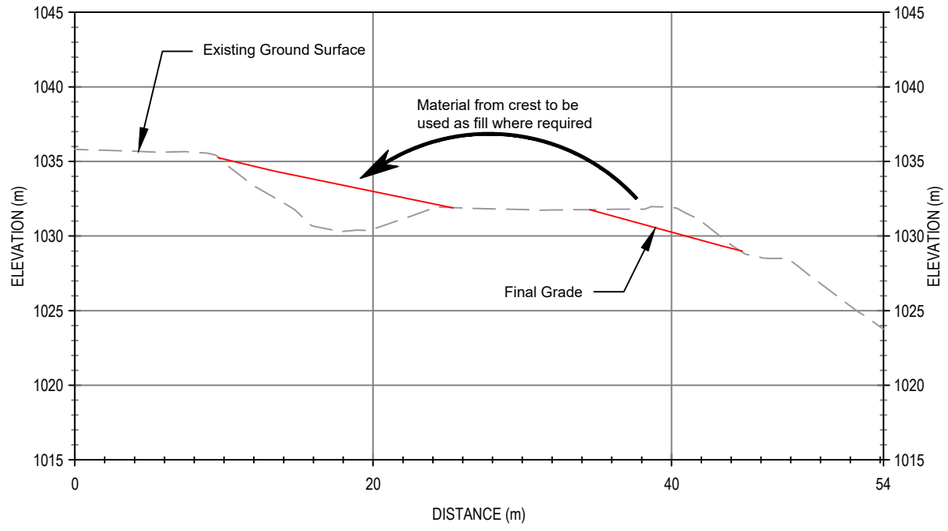


Notes:

1. Current water treatment ponds at the Bellekeno 625 adit will be converted into a bioreactor passive treatment system to treat mine water exiting the bulkhead. See drawing AKHM-13-01-D-2101.
2. A WRDA was proposed to be constructed along the northeast flank of Sourdough Hill, but is not currently planned for construction. If constructed, at closure, the slopes will be regraded to 3H:1V. Surfaces will be scarified and revegetated.
3. The existing Bellekeno 625 WRDA will have surface equipment removed, the crests pulled back with an excavator, and flat surfaces will be scarified and revegetated.
4. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quantities:

Volume of material to be recontoured*: 1,540 m^3
* Does not include cover material over bioreactor



Section A

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2021-11-25	Draft for review	B	KAB	--
2018-02-02	Draft for review	A	KAB	--

Scale: 1:1250
0 12.5 25 50 m

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-B-2102

Bellekeno 625 Grading Plan and Cross Section

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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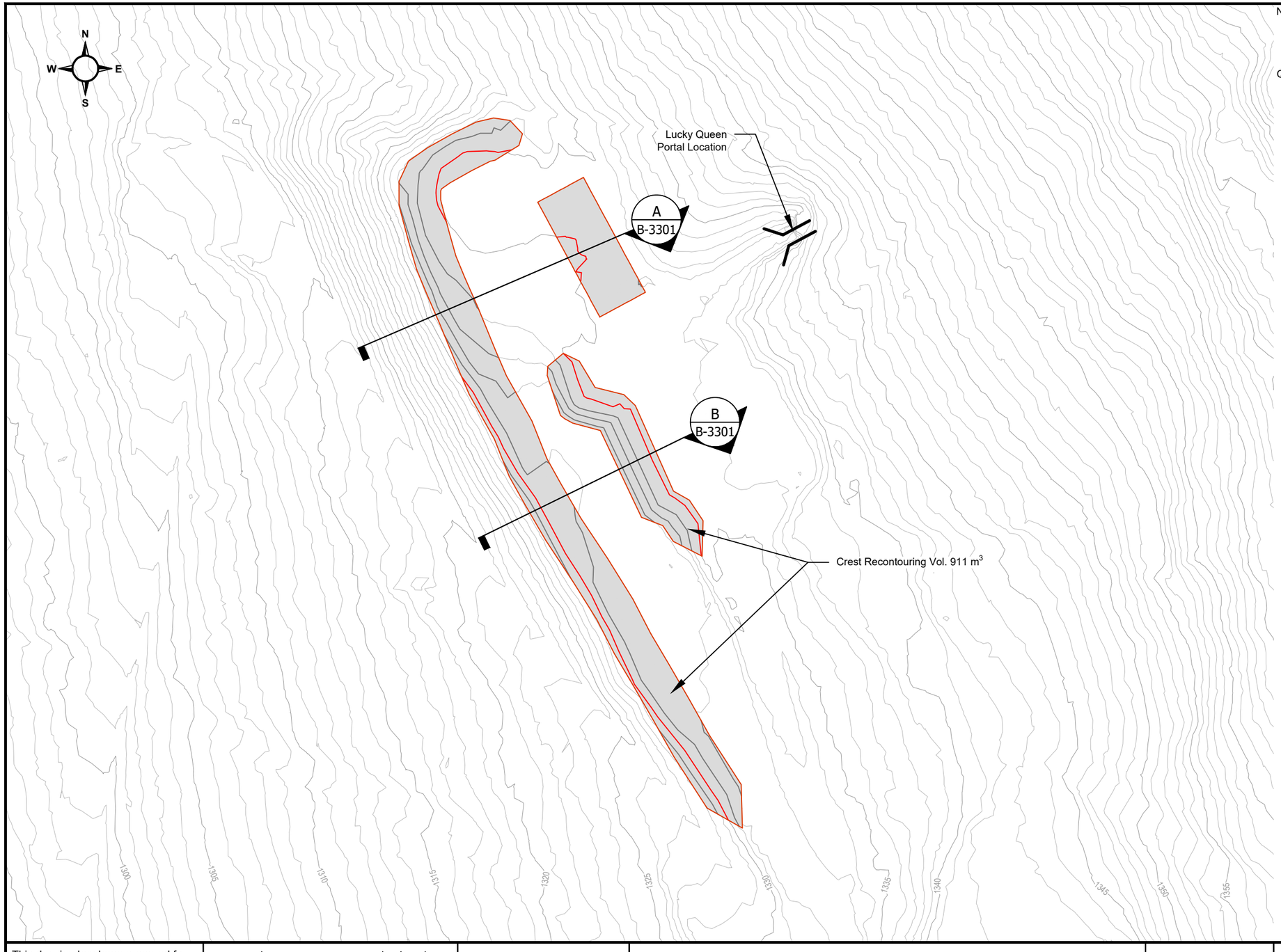

Notes:
1. Crest of the portal pad will be rolled back via excavator.
2. Existing settling pond will be recontoured to match surrounding grade.

Quatities:

Volume of material to be recontoured: 927 m^3

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2018-01-30	Draft for review	A	KAB	--

Scale: 1:1000

0 10 20 40 m

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AKHM

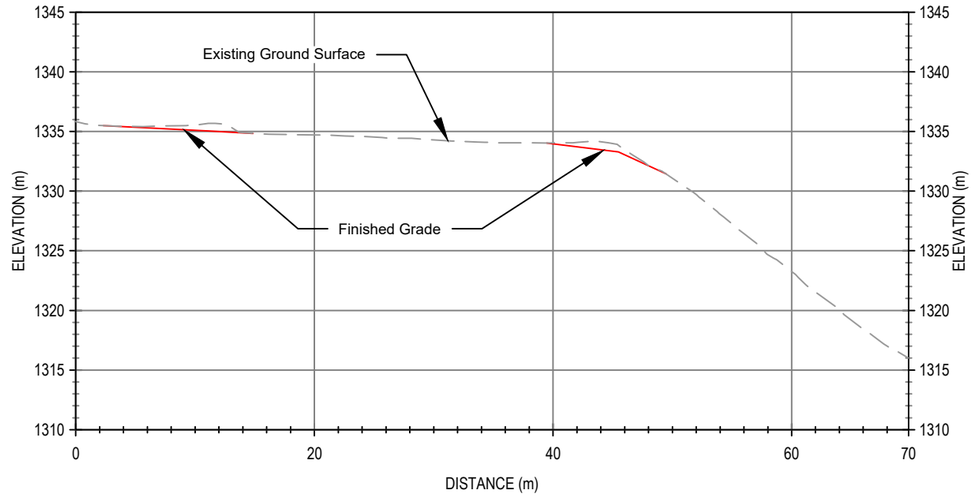
Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-B-3101

Lucky Queen Grading Plan

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\3-Lucky Queen\B-Geotech\AKHM-13-01-B-3101-LQGrading.dwg (last edited by: KBoldt: 2021/11/25 - 5:14 PM



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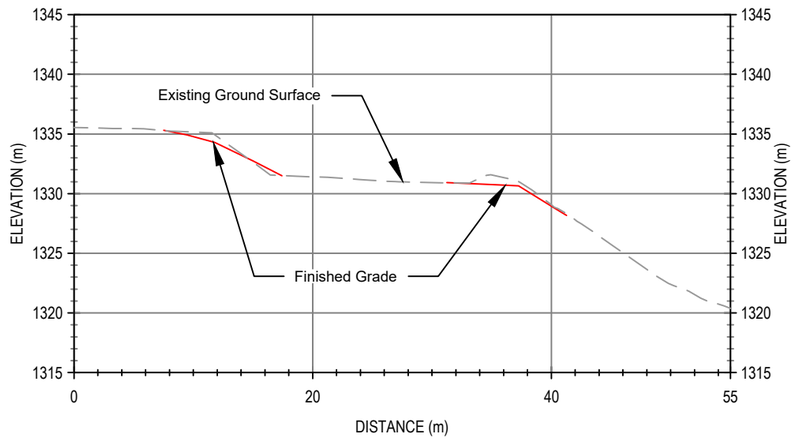

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2021-11-25	Draft for review	B	KAB	--
2018-01-30	Draft for review	A	KAB	--

Scale: 1:500

0 5 10 20 m

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-B-3301

Lucky Queen Grading
Cross Sections

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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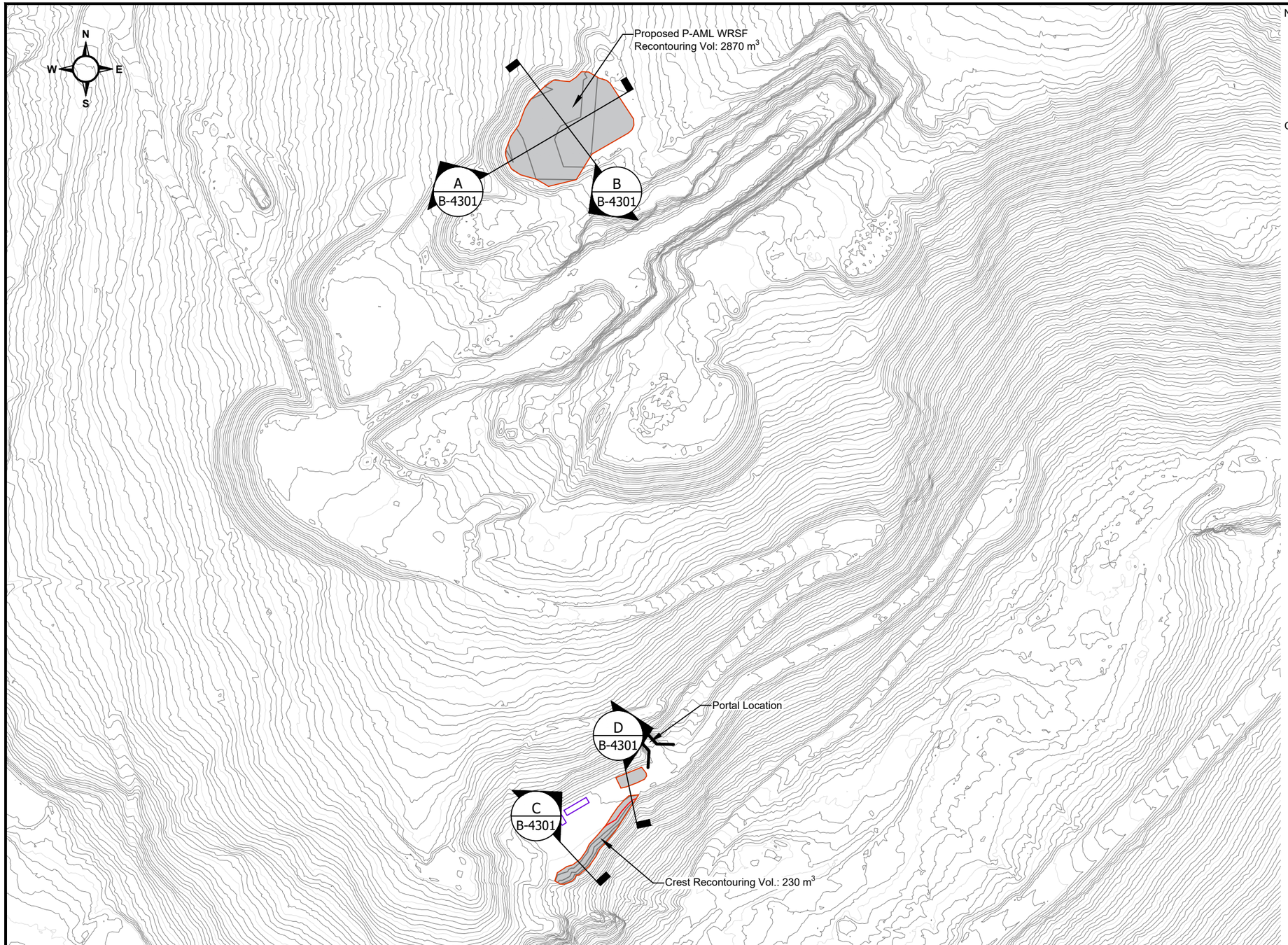

Notes:

1. The constructed P-AML WRSF contains no P-AML rock. Closure will include the removal of the liner, and recontouring of the containment berms, followed by scarification of the surface, and seeding.
2. The constructed settling pond will be recontoured to match surrounding grade.
3. The portal area crest will be rolled back via excavator.

Quantities:

Volume of material to be recontoured: 3,100 m^3

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2018-01-31	Draft for review	A	KAB	--

Scale: 1:3000

0 25 50 100 Meters

ENSERO solutions

AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-B-4101

Onek Grading Plan

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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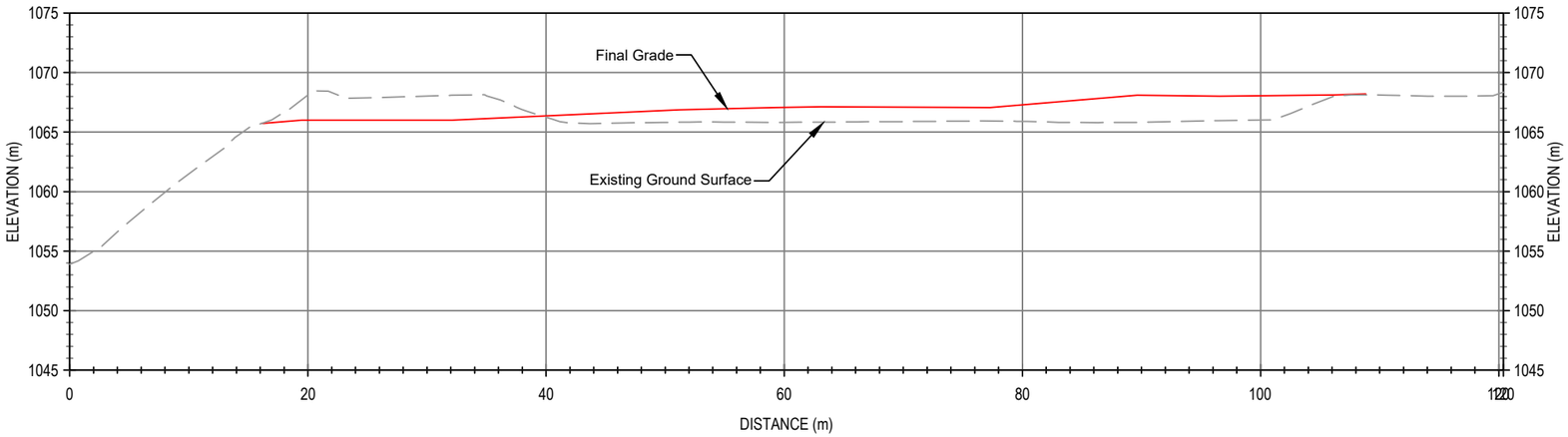

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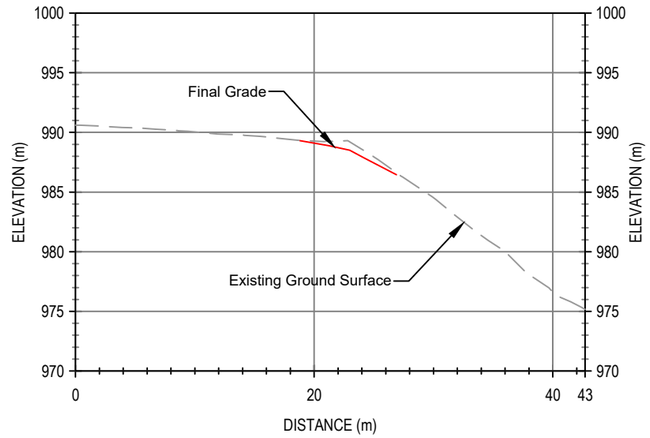

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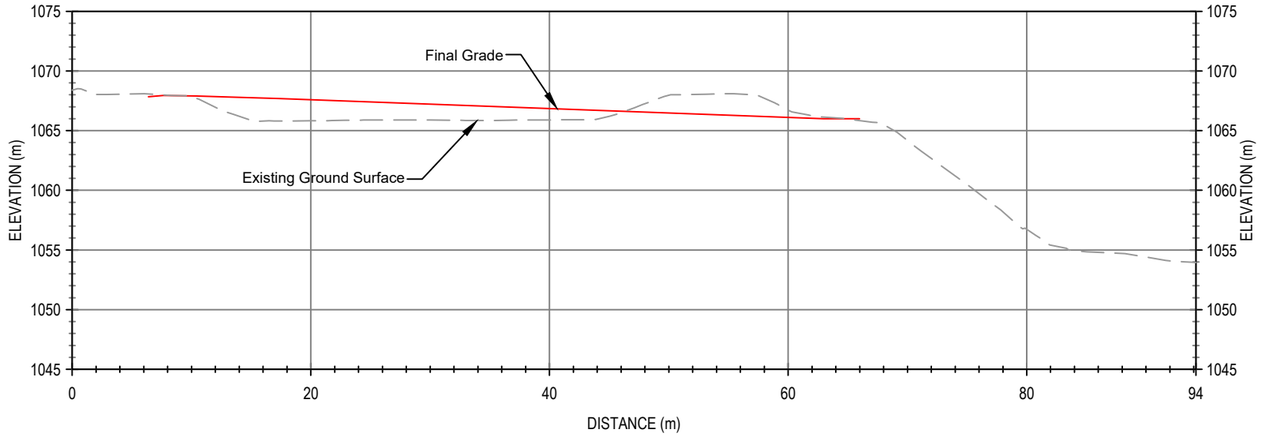

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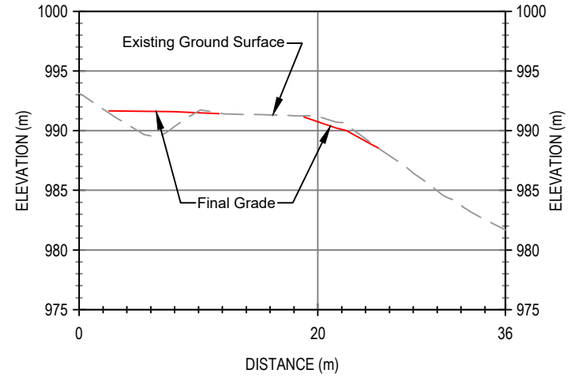

Section D

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-B-4301

Onek Grading
Sections

REVISION: B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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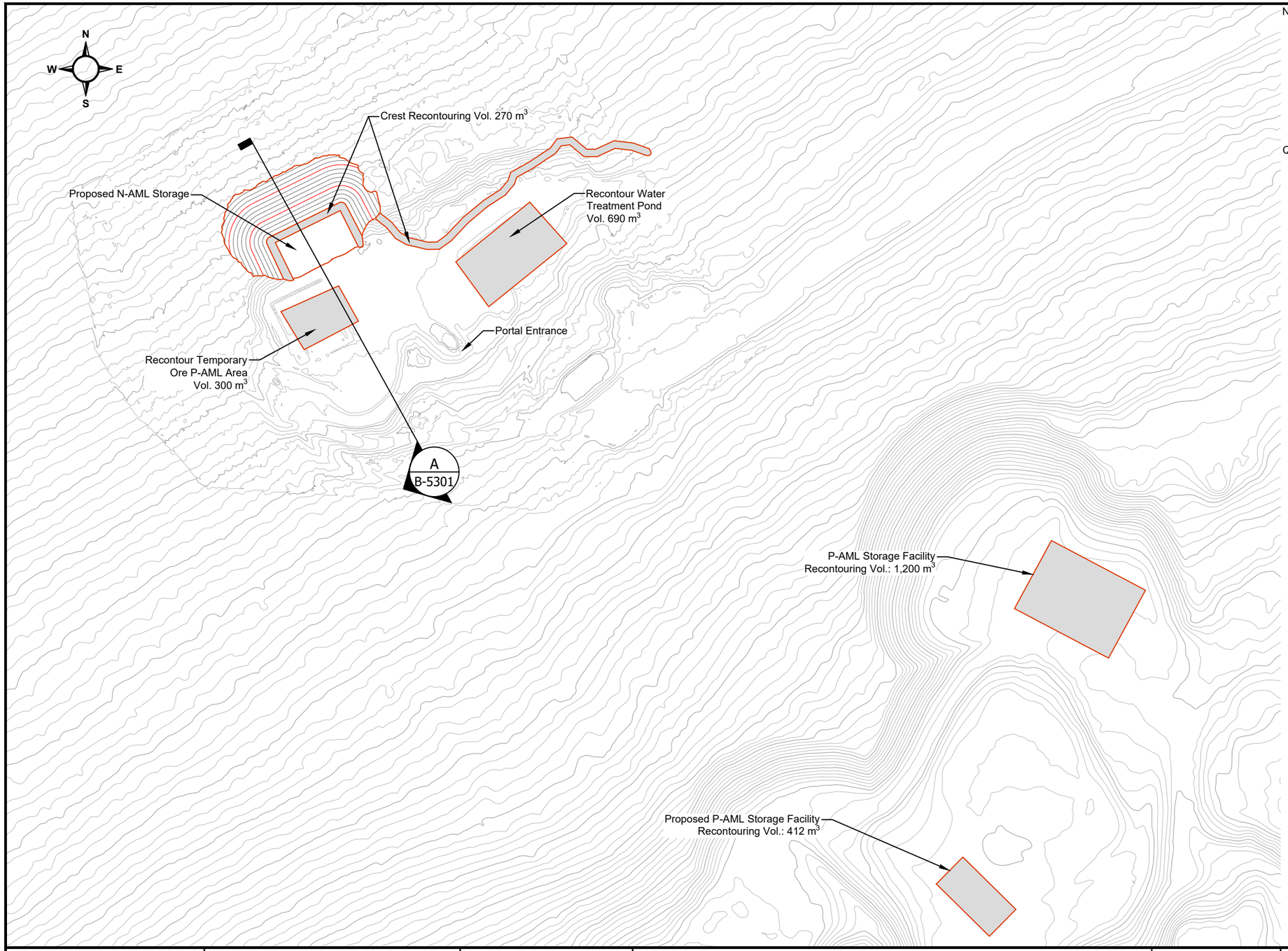

Notes:

1. P-AML waste rock contained in the P-AML WRSF will be relocated to underground.
2. The liner of the P-AML WRSF will be removed, and the containment berms will be recontoured, followed by scarification of the surface, and seeding.
3. The crest of the N-AML WRDA will be pulled back as required. Flat surfaces will be scarified and revegetated.
4. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quantities:

Volume of material to be recontoured: 3,070 m^3

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Scale: 1:2000

0 12.5 25 50 m

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-B-5101

Bermingham Grading Plan

REVISION: B	2021-11-26	PRJ. No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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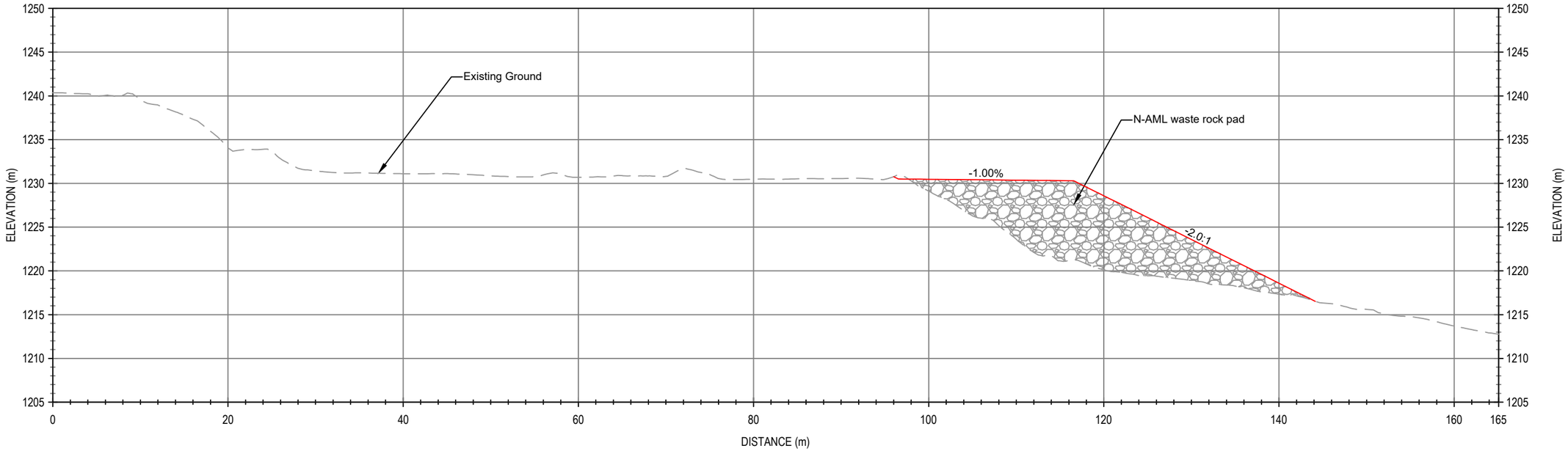

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-B-5301

Bermingham Grading
Cross Section

REVISION: B	2021-11-26	PRJ. No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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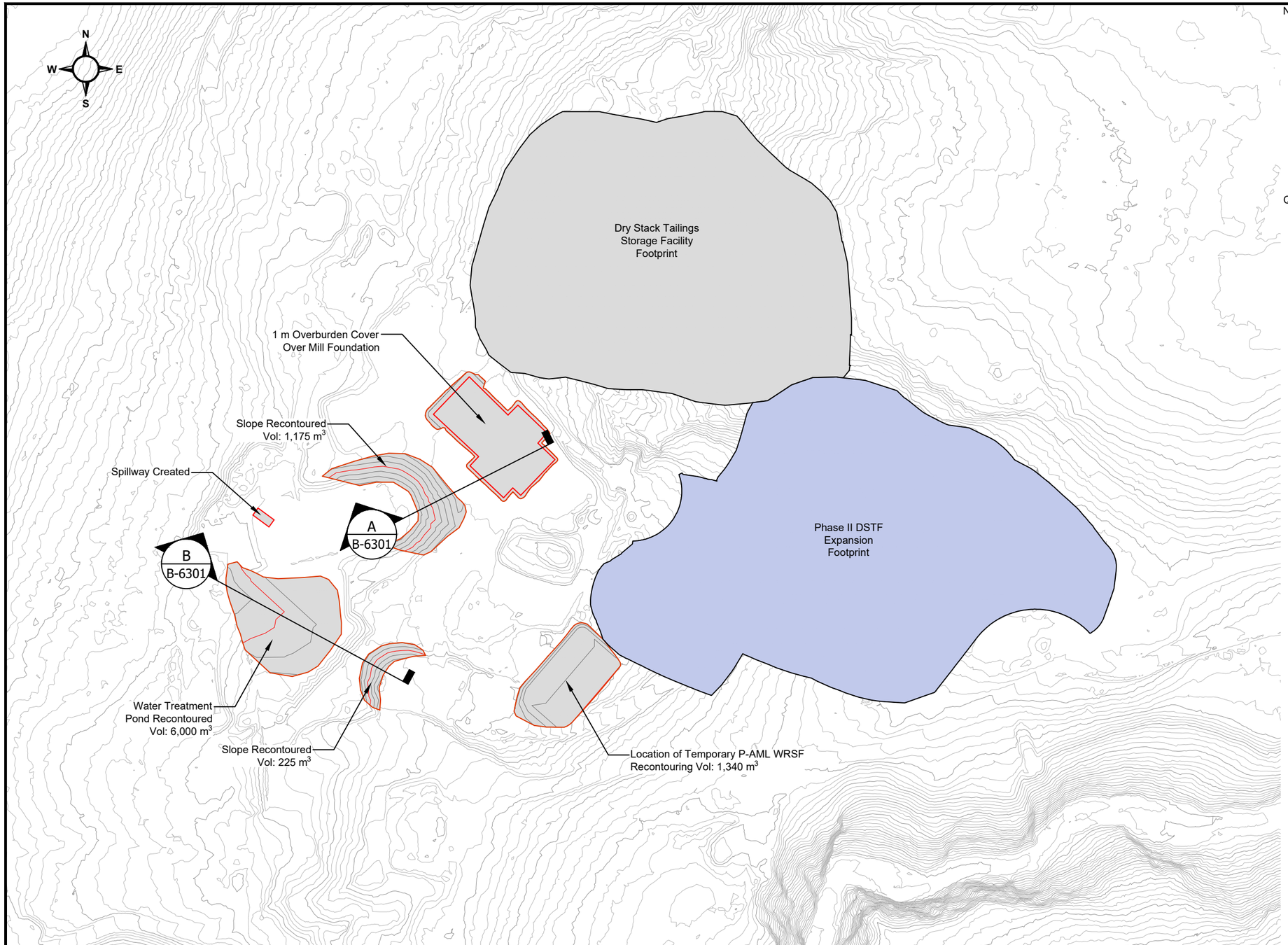

Notes:

1. Concrete slabs and above grade footings and foundations will be broken up and covered with 1 m overburden cover, scarified, and revegetated.
2. The mill process pond will have the liner removed. The slopes will be scarified and revegetated. The pond will serve as a sedimentation pond during closure until revegetation is stabilized. A spillway will be cut into the Mill Pond to allow for long term discharge to the environment.
3. The F&M Water Treatment Pond will be recontoured by having the berms pushed in to create a continuous slope.
4. The mill site will be recontoured and scarified to establish drainage and facilitate revegetation.
5. Surface water diversion infrastructure (berms, ditches) will be maintained to manage runoff and limit erosion.

Quantities:

Volume of material to be recontoured:	8,740 m^3
Volume of overburden cover:	1,800 m^3

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AKHM

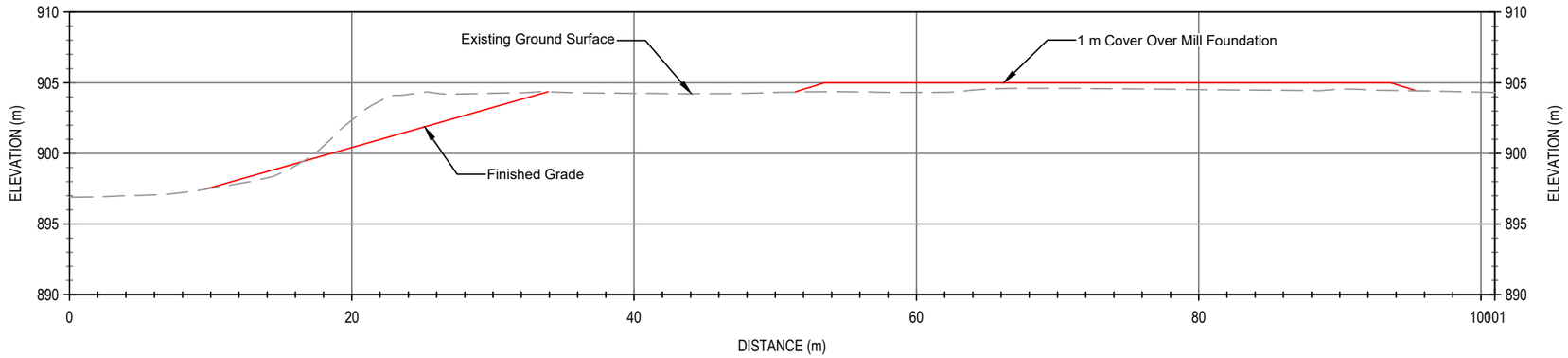
Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-B-6101

Mill Site Grading Plan

REVISION: B	2021-11-26	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\6-Mill Site\B-Geotech\AKHM-13-01-B-6101-MillSiteGrading.dwg (last edited by: KBoldt; 2021/11/26 - 1:36 PM



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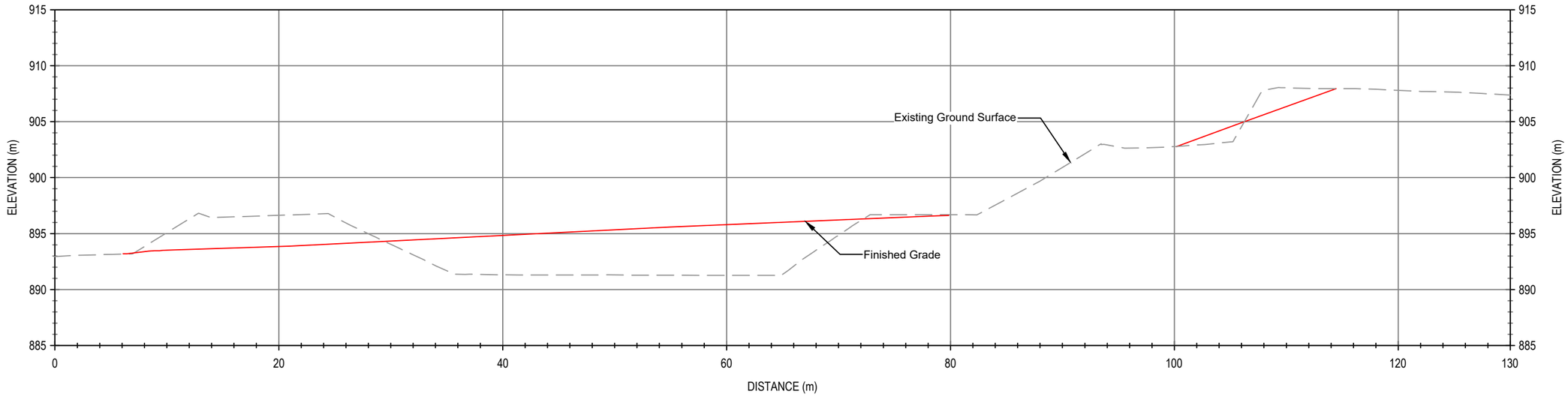

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-B-6301

Mill Site Grading
Cross Sections

REVISION: B	2021-11-26	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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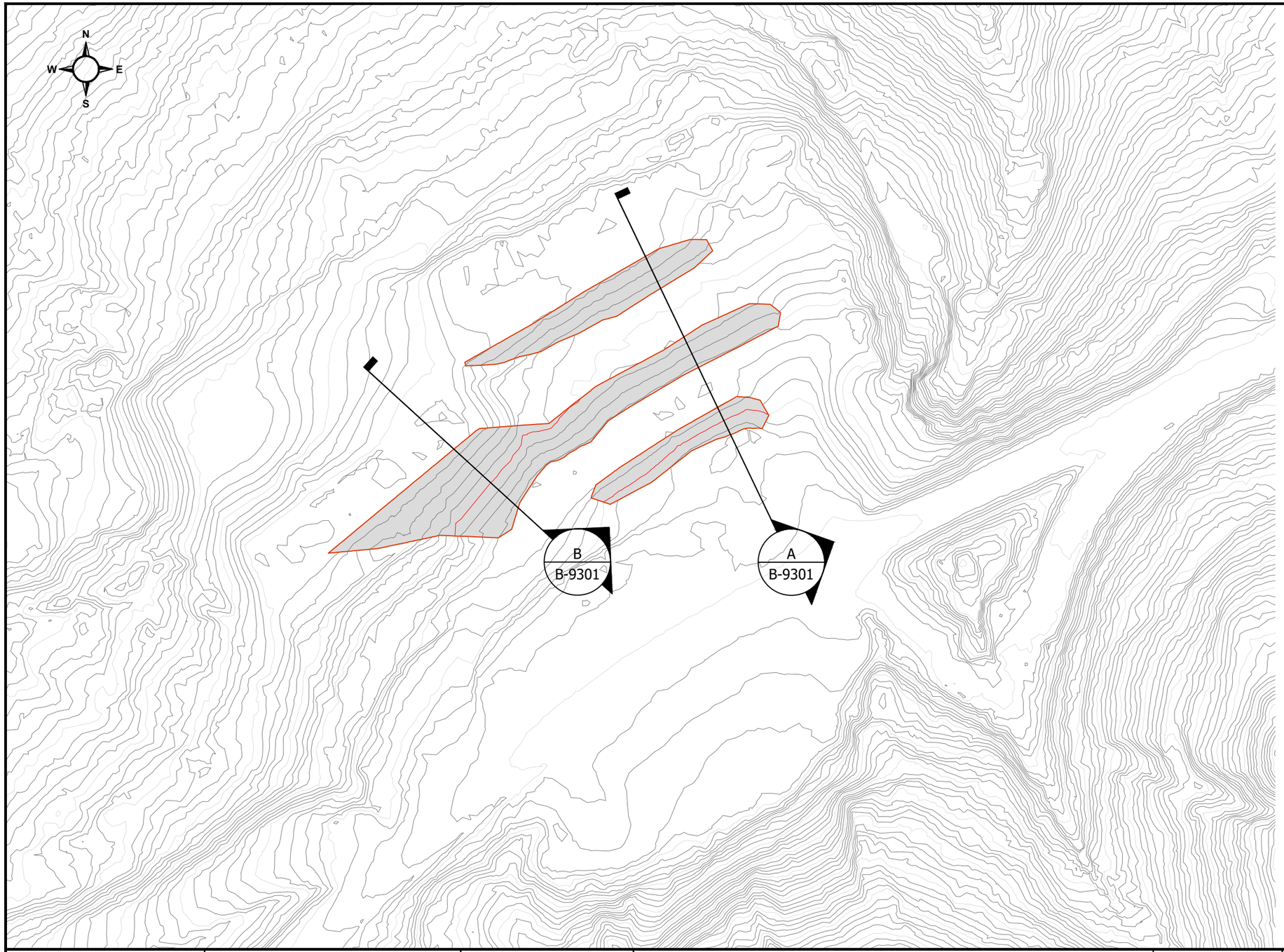

Notes:

1. Slopes will be recontoured as required for a 3H:1V slope.
2. Buildings and infrastructure will be removed for salvage or reuse.
3. Contaminated soil will be removed and treated in a land treatment facility.

Quantities:

Volume of material to be recontoured: 1,060 m^3

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan

Drawing No: AKHM-13-01-B-9101

Flat Creek Camp
Grading Plan

REVISION: B	2021-11-26	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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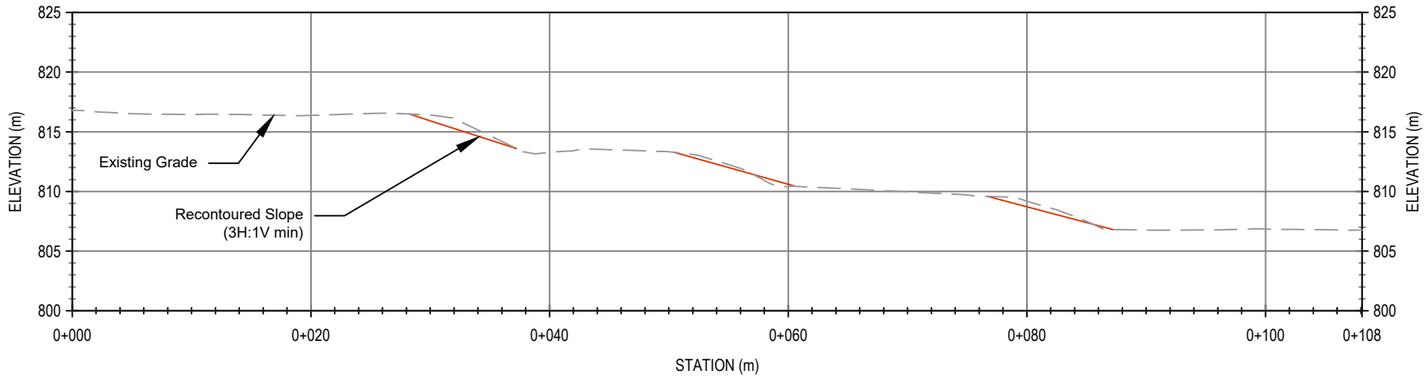
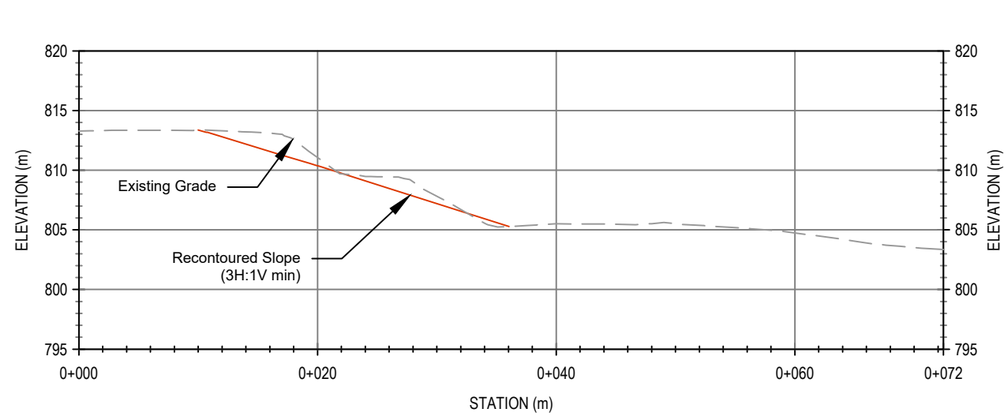
Notes:
1. Slopes will be recontoured as required for a 3H:1V slope.
2. Buildings and infrastructure will be removed for salvage or reuse.
3. Contaminated soil will be removed and treated in a land treatment facility.

Quantities:



Alignment-A



Alignment-B

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-B-9301

Flat Creek Camp
Grading Plan - Sections

REVISION: B	2021-11-26	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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APPENDIX 3.2

TYPICAL WASTE CONTAINMENT FACILITY DESIGN, EBA 2008

Alexco Resource Canada Corp.

TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT
CONSTRUCTION SPECIFICATIONS
ISSUED FOR USE

W14101142

July 2008

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA

TABLE OF CONTENTS

Section		Number of Pages
Section 1001	Definitions	1
Section 1002	General	2
Section 1003	Fill Materials	2
Section 1004	Fill Placement	2
Section 1005	Liner System	11
Section 1006	Quality Assurance	5
Section 1007	Design Alternatives	2
Section 1008	Operation and Maintenance	2

APPENDICES

Appendix A Construction Drawings

Section 1001

DEFINITIONS

DEFINITIONS

1.0 General

.1 Definitions of terms used throughout the Construction Specifications are presented in this Section.

2.0 Definitions

Construction Drawings:	the drawings, as issued for construction, of the Typical Waste Containment Facility Design.
Construction Specifications:	this document.
Contract:	the legal and binding agreement between the Contractor and Alexco Resource Corp. regarding construction of the Waste Containment Facility.
Contractor:	the general contractor responsible for constructing the Waste Containment Facility.
Engineer:	the Professional Geotechnical Engineer registered in the Yukon who is associated with the construction process.
Owner:	Alexco Resource Corp.
Site:	the area in which construction of the Waste Containment Facility or related activity is occurring.
Unsuitable:	not meeting the requirements stated herein or not receiving the Engineer's approval.
Facility:	all components of the Waste Containment Facility.

END OF SECTION

Section 1002

GENERAL

GENERAL

1.0 General

.1 Alexco Resource Canada Corp. intends to construct a containment facility to store waste rock from the Bellekeno advanced underground exploration and development program. As the company advances through the Keno Hill Silver District, it is anticipated further underground exploration and development programs will require similar containment facilities. Therefore, a typical design has been developed to account for the various potential site and construction material conditions.

.2 The Facility is to be located within previously disturbed areas, all of which will be incorporated within a district wide closure plan. This district wide closure plan is required under the water license QZ06-074.

.3 Site specific conditions and Facility location have not been provided or considered. Once Facility location and site specific conditions are known, they must be reviewed by the Engineer. Furthermore, the base of the Facility must be approved by the Engineer prior to fill placement.

.4 The Facility will be lined with a suitable geomembrane. Water in the Facility will flow towards the vertical culvert and pond within the voids of the waste material.

.5 Water in the Facility will be monitored and tested on a regular basis. Based on water quality analysis, the waste water will be extracted via pump truck and discharged to the environment or treated in a designated treatment facility.

.6 Once the Facility reaches its ultimate capacity, the Facility will be capped and reclaimed.

2.0 Scope of Work

.1 The scope of work for the construction of the Facility is as follows:

a. Construct the liner subgrade and berms with Zone B material at the specified grade. This could include cut/fill operations should the foundation material be satisfactory;

b. If required, install a geotextile layer to act as separator for Zone A and Zone B materials;

c. Construct the liner bedding with Zone A material;

d. Install the liner system consisting of a suitable liner material and if required, protective geotextile layers above and below the liner, and a geocomposite reinforcing layer;
e. Place and compact cover material, Zone A material, over the liner system;
f. Install vertical culvert as specified on the Construction Drawings;
g. Place and compact the waste material;
h. Regrade the waste material and place and compact capping material;
i. Install vegetative cover.

END OF SECTION

Section 1003

FILL MATERIALS

FILL MATERIALS

1.0 General

.1 This section describes the construction material specifications for the Waste Containment Facility.

2.0 Reference Standards

.1 The most recent copy of American Society for Testing Materials, ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.

3.0 Material Sources

.1 No material of any type shall be borrowed or excavated without the Owner's prior approval.

.2 Pits and quarries shall be maintained and managed in accordance with the requirements set out in the Owner's Land Use and Quarry Permits.

.3 Zone A material shall be obtained from sources approved by the Owner, provided the final product meets the requirements specified herein. Processing may be required to achieve the specified gradation.

.4 Zone B material shall be obtained from sources approved by the Owner, provided the final product meets the requirements specified herein. Processing may be required to achieve the specified gradation.

.5 The parent rock from which all fill materials are derived shall consist of sound, hard, durable material free from soft, thin, elongated or laminated particles and shall contain no unsuitable substances. The potential quarry source shall be approved by the Engineer.

.6 The quarry source for the Facility fill materials shall be inspected by the Engineer throughout material processing to ensure the product meets the requirements stated herein.

4.0 Material Specifications

.1 Zone A Material

The Zone A material shall consist of hard, durable particles, shall be free of roots, topsoil, and deleterious material and shall have a particle size distribution, as measured by ASTM C136, as presented in Table 1003.1.

TABLE 1003.1: ZONE A MATERIAL (10 MM MINUS) - PARTICLE SIZE DISTRIBUTION LIMITS

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
10	100	100
5	80	100
2	55	100
0.63	25	65
0.25	10	40
0.08	2	15

.2 Zone B Material

The Zone B material shall be free of roots, topsoil and other deleterious material and shall have a particle size distribution within the limits presented in Table 1003.2.

TABLE 1003.2: ZONE B MATERIAL (200 MM MINUS) - PARTICLE SIZE DISTRIBUTION LIMITS

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
200	100	100
100	85	100
50	65	100
25	40	100
5	20	55
2	0	20

END OF SECTION

Section 1004

FILL PLACEMENT

FILL PLACEMENT

1.0 General

.1 The fill placement methods to be used during construction of the Waste Containment Facility are described in this Section.

.2 Construction shall be performed in accordance with the best modern practice and with equipment best adapted to the work being performed. Embankment materials shall be placed so that each zone is homogeneous; free of stratifications; ice chunks, lenses or pockets; and layers of material with different texture grading not conforming to the requirements stated herein.

.3 No fill material shall be placed on any part of the foundation until it has been prepared, as specified herein. Placement of fill material shall conform to the lines, grades and elevations shown on the Construction Drawings.

.4 Embankment construction shall not proceed when the work cannot be performed in accordance with the requirements of the Construction Specifications. Any part of the embankment that has been damaged by the action of rain, snow or any other cause shall be removed and replaced with the appropriate material conforming to the requirements stated herein.

.5 Stockpiling, loading, transporting, placing, and spreading of all materials shall be carried out in such a manner to avoid segregation. Segregated materials shall be removed and replaced with the materials meeting the requirements stated herein.

.6 The Contractor shall remove all debris, vegetation or any other material not conforming to the requirements stated herein. The Contractor shall dispose of these materials in an area approved by the Owner.

2.0 Zone B Material Placement

.1 The Zone B material shall be placed to the design elevation as specified in the Construction Drawings in lifts no greater than 500 mm in uncompacted thickness.

.2 The design elevation for the top of the Zone B berm material shall be no less than 0.5 m above original ground.

.3 Moisture condition and compact using the minimum number of passes established in accordance with section 1006.4.2.

3.0 Zone A Material Placement

.1 The Zone A material shall be placed as bedding for the liner system (minimum 300 mm thick) to the design grade specified in the Construction Drawings.

.2 Subsequent to the liner installation, the Zone A material shall be placed as liner system cover material. The liner system cover material shall be placed to the minimum thickness specified in Table 1004.1 dependent on the type of liner selected.

TABLE 1004.1: RECOMMENDED MINIMUM COVER THICKNESSES

Liner Material	Minimum Required Thickness
Enviro Liner® 4040 (Without Geocomposite)	1.3 m
Enviro Liner® 4040 (With Geocomposite)	0.3 m
HDPE 60	0.3 m
PVC 40 (With Geocomposite)	0.3 m

.3 The Construction Drawings are based on the selection of Enviro Liner® 4040 with the installation of a geocomposite reinforcing material. Other design alternatives are detailed in Section 1007.

.4 Zone A material shall be placed in lifts not exceeding 300 mm in uncompacted thickness. Vehicle traffic is prohibited from maneuvering within the Facility until the cover material has reached the minimum thickness required as specified in Table 1004.1.

.5 Moisture condition and compact with using the minimum number of passes established in accordance with section 1006.4.1.

.6 Equipment with ground pressures higher than 380 kPa should not be permitted inside the Facility once the liner system has been placed. Care is required to provide the appropriate thickness of fill beneath a vehicle when placing material above the liner system to ensure it is not damaged. Traffic in the area should be restricted to low ground pressure equipment.

END OF SECTION

Section 1005

LINER SYSTEM

LINER SYSTEM

1.0 General

.1 The product and installation specifications for the non-woven geotextile, liner systems and geocomposite materials to be used in the Waste Containment Facility are presented in this section.

.2 The liner system will be provided by the Owner and installed by the Contractor.

2.0 Reference Standards

.1 The most recent copy of the following American Society for Testing Materials standards:

a. ASTM D638 Standard Methods for Tensile Properties of Plastics.

b. ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

c. ASTM D1004 Standard Test Methods for Initial Tear Resistance of Plastic Film and Sheeting.

d. ASTM D1603 Standard Test Methods for Carbon Black in Olefin Plastics.

e. ASTM D1777 Standard Test Methods for Thickness of Textile Materials.

f. ASTM D4533 Standard Test Methods for Trapezoidal Tearing Strength of Geotextiles.

g. ASTM D4632 Standard Test Methods for Grab Breaking Load and Elongation of Geotextile.

h. ASTM D4751 Standard Test Methods for Determining Apparent Opening Size of a Geotextile.

i. ASTM D4833 Standard Test Methods for Index Puncture Resistance for Geotextile, Geomembranes, and Related Products.

j. ASTM D5199 Standard Test Methods for Measuring the Nominal Thickness of Geosynthetics.

k. ASTM D5261 Standard Test Methods for Measuring Mass per Unit Area of Geotextiles.

l. ASTM D5994 Standard Test Methods for Measuring Core Thickness of textured Geomembranes

.2 Federal Test Method

a. FTM Standard 101.

3.0 Materials

.1 Geotextile

a. The non-woven geotextile shall have a weight of 542 g/m^2. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.1.

TABLE 1005.1: RECOMMENDED MINIMUM GEOTEXTILE PROPERTIES

Physical Property	Minimum Average Roll Value (Weakest Principle Direction)
Thickness – Typical (ASTM D5199)	3.6 mm
Grab Tensile Strength (ASTM D4632)	1690 N
Elongation at Failure (ASTM D4632)	50 %
Trapezoidal Tear Strength (ASTM D4533)	645 N
Puncture (ASTM D4833)	1070 N
Apparent Opening Size (ASTM D4751)	150 microns
Weight – Typical (ASTM D5261)	542 g/m^2

b. Any visible damage to the shipment of geotextile shall be noted on the freight receipt and project records.

c. Storage of geotextile rolls on site shall be in a secure location that will minimize exposure to the elements, UV light and physical damage.

.2 Enviro Liner® 4040

a. The Enviro Liner® shall be 1.0 mm (40 mil) thick geomembrane or equivalent. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.2.

TABLE 1005.2: RECOMMENDED MINIMUM GEOMEMBRANE PROPERTIES

Property	Enviro Liner® 4040
Minimum Average Thickness (ASTM D5994)	1.0 mm
Relative Density (ASTM D792)	0.939
Tensile Strength at Yield (ASTM D638)	26.6 N/mm
Elongation at Yield (ASTM D638)	800 %
Tear Resistance (ASTM D1004)	98 N
Puncture Resistance (FTMS 101)	271 N
Carbon Black Content (ASTM D1603)	2.0 – 3.0 %

b. The liner material supplied under the specifications shall not have any blisters, holes, undispersed raw materials or any signs of contamination or inclusions of foreign matter. Such defects shall be repaired using techniques in accordance with manufacturer's recommendations. Excessive defects may be grounds for rejecting the entire roll of liner.

c. Storage of geomembrane rolls on site shall be in a secure location that will minimize exposure to the elements and physical damage.

d. Enviro Liner® geomembrane is suitable for secondary containment of hydrocarbons and other chemicals, and primary containment of water and water based effluents or as approved by manufacturer.

.3 HDPE Liner

a. The HDPE geomembrane shall be 1.5 mm (60 mil) thick geomembrane or equivalent. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.3.

TABLE 1005.3: RECOMMENDED MINIMUM GEOMEMBRANE PROPERTIES

Property	Textured HDPE 60
Minimum Average Thickness (ASTM D5994)	1.5 mm
Relative Density (ASTM D792)	0.94
Tensile Strength at Yield (ASTM D638)	22.0 kN/m
Elongation at Yield (ASTM D638)	12 %
Tear Resistance (ASTM D1004)	187 N
Puncture Resistance (FTMS 101)	480 N
Carbon Black Content (ASTM D1603)	2.0 – 3.0 %

b. The liner material supplied under the specifications shall not have any blisters, holes, undispersed raw materials or any signs of contamination or inclusions of foreign matter. Such defects shall be repaired using welding techniques in accordance with manufacturer's recommendations. Excessive defects may be grounds for rejecting the entire roll of liner.

c. Extrusion resin used for extrusion joining of sheets and for repairs should be HDPE from the same resin batch as the sheet resin. Physical properties must be the same as the liner sheets.

d. HDPE liner is suitable for containment of hydrocarbons and chemicals as well as water and water based effluents or as approved by manufacturer.

e. Storage of geomembrane rolls on site shall be in a secure location that will minimize exposure to the elements and physical damage.

.4 PVC Liner

a. The PVC geomembrane shall be 0.95 mm (38 mil) thick geomembrane or equivalent. The manufacturer shall, prior to shipment of materials, provide to the

Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.4.

TABLE 1005.4: RECOMMENDED MINIMUM GEOMEMBRANE PROPERTIES

Property	PVC 40
Minimum Average Thickness (ASTM D5994)	0.95 mm
Tensile Strength at Yield (ASTM D638)	17 N/mm
Elongation at Yield (ASTM D638)	430 %
Tear Resistance (ASTM D1004)	44 N

b. The liner material supplied under the specifications shall not have any blisters, holes, undispersed raw materials or any signs of contamination or inclusions of foreign matter. Such defects shall be repaired using techniques in accordance with manufacturer's recommendations. Excessive defects may be grounds for rejecting the entire roll of liner.

c. PVC liner is suitable for containment of water and water based effluents or as approved by manufacturer. It is not suitable for containment of hydrocarbons.

d. Storage of geomembrane rolls on site shall be in a secure location that will minimize exposure to the elements, UV light and physical damage.

.5 Geocomposite

a. The geocomposite reinforcing material shall be 5 mm (200 mil) thick or equivalent. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.5.

TABLE 1005.5: RECOMMENDED MINIMUM GEOCOMPOSITE PROPERTIES

Property	Geo-Comp 5
Minimum Average Thickness (ASTM D5994)	5 mm
Relative Density (ASTM D792)	0.94
Tensile Strength at Yield (ASTM D638)	79 N/cm
Puncture Resistance (FTMS 101)	489 N
Carbon Black Content (ASTM D1603)	2.0 %

b. The geocomposite material supplied under the specifications shall not have defects or any signs of contamination or inclusions of foreign matter. Excessive defects may be grounds for rejecting the entire roll of geocomposite.

4.0 Installation - Enviro Liner® 4040 Design (with Geocomposite)

.1 The liner system consists of the following layers (starting from the top layer):

- Geo-Comp 5 or equivalent geocomposite
- Enviroliner 4040 or equivalent geomembrane

.2 The liner should line the entire surface of the Facility, which includes the crest of the berms, inside slopes, and floor. The geocomposite material is only required on the floor and approach berm of the Facility.

.3 The Contractor shall ensure that the integrity of the liner system and its components are not compromised during construction. Precautions the Contractor may take to avoid damaging the liner system may include, but will not be limited to, providing light plants in the work area to improve visibility or using pylons to mark the lift/liner system interface.

.4 Any damage to the liner system and/or its components shall be repaired as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

.5 The liner system shall be anchored at the top of the berm so that movement downslope does not occur during backfilling at any stage of construction.

.6 The Contractor shall take the necessary steps to ensure that backfilling does not induce tensile stress in the liner system. Care shall be taken to avoid making sharp turns, sudden stops or sudden starts adjacent to the liner system. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall not be permitted.

Enviro Liner® Installation

.7 The Enviro Liner® should be deployed subsequent to the placement of Zone A bedding material.

.8 The Engineer should walk the liner to observe for any defects caused by on-site equipment and tools. Any liner area showing injury due to excessive scuffing, puncture, or distress from any cause should be replaced or repaired with an additional piece of Enviro Liner® installed as per the manufacturer's specifications over the defective area. All patches should have rounded edges and extend a minimum of 150 mm beyond the affected area.

.9 Low ground pressure equipment should be used to deploy the liner material. No equipment shall be allowed on the liner.

Geocomposite Reinforcing Installation

.10 The geocomposite material should be deployed subsequent to the placement of the Liner.

.11 No equipment is permitted on the liner material during the placing of the geocomposite reinforcing material. The geocomposite reinforcing material must rolled out by hand and the cover material placed in accordance with Section 1004.

Material Quantities

.12 Estimated material quantities required for the lined pad are listed in Table 1005.6

TABLE 1005.6: MATERIAL QUANTITY ESTIMATES

Material	Total Area (m^2)
Enviro Liner® 4040	1900
Geo-Comp 5	905

5.0 Installation - HDPE 60 Design

.1 The liner system consists of the following layers (starting from the top layer):

- HDPE 60 mil or equivalent geomembrane

.2 The liner should line the entire surface of the Facility, which includes the crest of the berms, inside slopes, and floor.

.3 The Contractor shall ensure that the integrity of the liner system and its components are not compromised during construction. Precautions the Contractor may take to

avoid damaging the liner system may include, but will not be limited to, providing light plants in the work area to improve visibility or using pylons to mark the lift/liner system interface.

.4 Any damage to the liner system and/or its components shall be repaired as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

.5 The liner system shall be anchored at the top of the berm so that movement downslope does not occur during backfilling at any stage of construction.

.6 The Contractor shall take the necessary steps to ensure that backfilling does not induce tensile stress in the liner system. Care shall be taken to avoid making sharp turns, sudden stops or sudden starts adjacent to the liner system. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall not be permitted.

HDPE Liner Installation

.7 The HDPE liner should be deployed subsequent to the placement of Zone A bedding material. The liner should be placed with no horizontal seams on the slopes. Tie-in seams should be located on the floor at a minimum of 1.5 m from the toe of the slopes.

.8 The liner panels shall be welded together along the full length of the seam to the top of the berm.

.9 Both the wedge and the extrusion welding equipment should be qualified by conducting trial seam tests prior to start-up each day and at approximately 4-hour intervals during seaming operations. During the trial seam, the minimum peel and shear strength criteria set by the manufacturer for the 60 mil HDPE geomembrane should be met. The industry-accepted peel and shear strengths for 60 mil HDPE geomembrane are 78 ppi (pounds/inch) and 120 ppi, respectively.

.10 The Engineer should walk the liner to observe for any defects caused by on-site equipment and tools. Any liner area showing injury due to excessive scuffing, puncture, or distress from any cause should be replaced or repaired with an additional

piece of HDPE liner extrusion welded over the defective area. All patches should have rounded edges and extend a minimum of 150 mm beyond the affected area.

.11 Low ground pressure equipment should be used to deploy the liner material. No track-wheel equipment shall be allowed on the liner. Equipment travel on the liner material should be kept to a minimum.

Material Quantities

.12 Estimated material quantities required for the lined pad are listed in Table 1005.7

TABLE 1005.7: MATERIAL QUANTITY ESTIMATES

Material	Total Area (m^2)
HDPE 60 Liner	1900

6.0 Installation - PVC 40 Design

.1 The liner system consists of the following layers (starting from the top layer):

- Geo-Comp 5 or equivalent geocomposite
- PVC 40 mil or equivalent geomembrane

.2 The liner system should line the entire surface of the Facility, which includes the crest of the berms, inside slopes, and floor. The geocomposite material is only required on the floor and approach berm of the Facility.

.3 The Contractor shall ensure that the integrity of the liner system and its components are not compromised during construction. Precautions the Contractor may take to avoid damaging the liner system may include, but will not be limited to, providing light plants in the work area to improve visibility or using pylons to mark the lift/liner system interface.

.4 Any damage to the liner system and/or its components shall be repaired as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

.5 The liner system shall be anchored at the top of the berm so that movement downslope does not occur during backfilling at any stage of construction.

.6 The Contractor shall take the necessary steps to ensure that backfilling does not induce tensile stress in the liner system. Care shall be taken to avoid making sharp turns, sudden stops or sudden starts adjacent to the liner system. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall not be permitted.

PVC Liner Installation

.7 The PVC liner should be deployed subsequent to the placement of Zone A bedding material.

.8 The Engineer should walk the liner to observe for any defects caused by on-site equipment and tools. Any liner area showing injury due to excessive scuffing, puncture, or distress from any cause should be replaced or repaired with an additional piece of PVC liner installed as per the manufacturer's specifications over the defective area. All patches should have rounded edges and extend a minimum of 150 mm beyond the affected area.

.9 Low ground pressure equipment should be used to deploy the liner material. No equipment shall be allowed on the liner.

Geocomposite Reinforcing Installation

.10 The geocomposite material should be deployed subsequent to the placement of the Liner.

.11 No equipment is permitted on the liner material during the placing of the geocomposite reinforcing material. The geocomposite reinforcing material must rolled out by hand and the cover material placed in accordance with Section 1004.

Material Quantities

.12 Estimated material quantities required for the lined pad are listed in Table 1005.8

TABLE 1005.8: MATERIAL QUANTITY ESTIMATES

Material	Total Area (m^2)
PVC 40 Liner	1900
Geo-Comp 5	905

END OF SECTION

Section 1006

QUALITY ASSURANCE

QUALITY ASSURANCE

1.0 General

.1 The quality assurance testing suggested is described in this section.

2.0 Reference Standards

.1 The most recent edition of the following American Society for Testing Materials standards:

a. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

b. ASTM D698 – Standard -Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

d. ASTM D4437 – Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

.2 Geosynthetic Research Institute

a. GRI Test Method GM6 – Pressurized Air Channel Test for Dual Seamed Geomembranes.

3.0 Fill Particle Size Testing Requirements

.1 Zone A Material

a. Samples of the Zone A material should be evaluated from locations within the borrow source prior to construction. One sample will be evaluated every 500 m^3 placed during construction to ensure the placed gradation meets the specification stated herein. The required tests and testing frequency for the Zone A material are presented in Table 1006.1.

TABLE 1006.1: TESTING AND FREQUENCY OF ZONE A MATERIAL	
Test	**Test Frequency**
Particle Size Analysis	One (1) test every 500 m^3 during construction.

.2 Zone B Material

a. Samples of the Zone B material will be evaluated from the foundation material within the Facility prior to construction and every 2000 m^3 placed during construction to ensure the placed gradation meets the specification stated herein. The required tests and testing frequency for the Zone B material are presented in Table 1006.2.

TABLE 1006.2: TESTING AND FREQUENCY OF ZONE B MATERIAL	
Test	**Test Frequency**
Particle Size Analysis	One (1) location within the Facility and One (1) test every 2000 m^3 during construction.

4.0 Fill Compaction Testing Requirements

.1 Zone A Material

a. Compact each lift with a minimum of six passes using a large smooth-drum, vibratory compactor. The optimum vibratory frequency and number of passes should be determined during construction using proof-roll tests, which demonstrate optimum compaction. The Engineer should inspect the compaction effort to ensure that this effort results in a density equivalent to about 95% MDD.

.2 Zone B Material

a. Compact each lift with a minimum of six passes using a large smooth-drum, vibratory compactor. The optimum vibratory frequency and number of passes should be determined during construction using proof-roll tests, which demonstrate optimum compaction. The Engineer should inspect the compaction effort to ensure that this effort results in a density equivalent to about 98% MDD.

b. The foundation material (Zone B or subcut material) should also be compacted as specified in section 1006.4.1.

5.0 Geomembrane Testing Requirements

.1 General

a. The Contractor is responsible for obtaining mill certificates from the manufacturer and forwarding them to the Engineer.

b. If applicable, the Contractor shall record all seam parameters (i.e. time, date, operator, welding speed and temperature) on the liner.

c. If applicable, the Contractor shall be responsible for completing the vacuum box testing and pressure testing for the appropriate seams. The Contractor shall mark the test number and parameters on the liner.

d. If applicable, the Contractor shall supply and use a field tensiometer for testing liner seams for shear and peel strength.

e. The Contractor is responsible for maintaining testing records.

f. All coupons and test specimens remain the property of the Owner.

.2 Qualifying Welds

a. Qualifying seams shall be conducted on fragmented pieces of material at the following times:

- At the start of each shift of production seaming, and at 4 hour intervals during production seaming;
- When a new operator or new machine starts welding;
- When a machine is restarted after repairs;
- When welding is stopped for sixty (60) minutes or more;
- When there is a change in the ambient conditions; and
- At the discretion of the Engineer.

b. Qualifying seams shall be 1 m long, and shall be subject to shear and peel testing. The test seam shall meet the minimum requirements stated herein for seam strength, when tested on a field tensiometer. If a qualifying seam fails, the seaming procedure shall be reviewed and the test shall be repeated.

.3 Non-Destructive Testing

a. Test all wedge-welded seams over their full length using a vacuum unit or air pressure test.

- Seam intersections will also be subject to vacuum box testing, regardless of seaming method employed.
- The Contractor shall supply all apparatus and personnel for this type of test.
- The tests shall be witnessed and documented by the Engineer.

b. Clean all seams to permit proper inspection.

c. Repair any seams which fail non-destructive testing in accordance with this Specification. Repairs shall be fully documented by the Contractor.

.4 Vacuum Box Testing

a. Extrusion welded seams should be tested using either vacuum box testing or pick-testing. Vacuum box testing involves placing the extrusion weld under a vacuum. The weld is first coated with a soapy water solution and any holes in a weld would be indicated by a stream of bubbles when vacuum is applied.

b. No leaks shall be permitted while conducting vacuum box testing.

c. Pick-testing is conducted on uneven surfaces where a vacuum cannot be maintained. During pick testing, attention should be paid to the following specific items:

- The width of the weld;
- Weld bond to the underlying geomembrane;
- Joints between three panels ("T" joints);
- Defects such as bubbles created within the weld due to moisture; and
- Textured weld surfaces due to temperature fluctuation in the extrusion welder.

.5 Air Pressure Testing

a. Wedge welded seams should be air-pressure tested over their full lengths using an air pressure test. Air pressure testing involves pressurizing the air channel located between the dual tracks of the seams to a minimum pressure of 40 psi for a period of five minutes.

b. During the test, the air pressure is not allowed to drop more than 4 psi (10% allowance). Any leaks and bubbling in the seams found during the non-destructive tests must be repaired by extruding a patch of HDPE material over the defect.

c. Air pressure testing shall be carried out according to GRI Test Method GM6, Pressurized Air Channel Test for Dual Seamed Geomembranes.

.6 Destructive Testing for Production Seams

a. Cut-out coupons shall be taken at a minimum frequency of one (1) per 150 m of seam, or once per seam. Coupons shall be cut by the contractor at the location directed by the Engineer. Coupons shall generally be taken from a location that does not affect the performance of the liner. All cut-outs shall have rounded corners. Care shall be taken to ensure that no slits penetrate the parent liner.

b. All holes left by cut outs shall be patched immediately.

.7 Testing of Repairs

a. All repairs shall be tested using the Vacuum Box in accordance with test method ASTM 4437.

END OF SECTION

Section 1007

DESIGN ALTERNATIVES

DESIGN ALTERNATIVES

1.0 General

.1 This section provides design alternatives for the Facility should the fill materials available on or near site not adhere to the gradation specifications stated in Tables 1003.1 and 1003.2.

.2 Should Zone A, Zone B or both materials not meet the gradation specifications stated in Tables 1003.1 and 1003.2 then the recommended design alternatives are available in Table 1007.1.

TABLE 1007.1: RECOMMENDED DESIGN ALTERNATIVES FOR GRADATION NON-COMPLIANCE

		Zone B		
		Meets Specifications	**Gradation Below Fine Limit**	**Gradation Above Coarse Limit**
Zone A	**Meets Specifications**	This section does not apply	This section does not apply	See Section 1007.2
	Gradation Below Fine Limit	See Section 1007.2	See Section 1007.2	See Section 1007.2
	Gradation Above Coarse Limit	See Section 1007.3	See Section 1007.3	See Section 1007.4

2.0 Detailed Design Alternatives – Non-Compliance Criteria I

.1 If the fill materials do not comply with gradation specifications as per Table 1007.1 geotextile material is required at the interface between Zone A and Zone B materials.

.2 The geotextile material should be deployed prior to the placement of Zone A material.

.3 The geotextile should be placed with a minimum overlap of 150 mm and connected at the seam by heat bonding. If heat bonding is not available an overlap of 300 mm should be used. Horizontal seams should be kept to a minimum on the side slopes. If a horizontal seam is unavoidable, the overlap shall be capped with a 300 mm wide strip of the same geotextile and heat bonded to the underlying material.

.4 Any tears or holes made in the geotextile should be repaired by placing a patch of geotextile on the defect and held in place by heat bonding. The patch should extend at least 300 mm beyond the damage, in all directions.

3.0 Detailed Design Alternatives – Non-Compliance Criteria II

.1 If the fill materials do not comply with gradation specifications as per Table 1007.1 geotextile material is required above and below the liner system.

.2 The geotextile material should be deployed prior to the deployment of the liner system as well as subsequent to the deployment of the liner system.

.3 The geotextile should be placed with a minimum overlap of 150 mm and connected at the seam by heat bonding. If heat bonding is not available an overlap of 300 mm should be used. Horizontal seams should be kept to a minimum on the side slopes. If a horizontal seam is unavoidable, the overlap shall be capped with a 300 mm wide strip of the same geotextile and heat bonded to the underlying material.

.4 Any tears or holes made in the geotextile should be repaired by placing a patch of geotextile on the defect and held in place by heat bonding. The patch should extend at least 300 mm beyond the damage, in all directions.

4.0 Detailed Design Alternatives – Non-Compliance Criteria III

.1 If the fill materials do not comply with gradation specifications as per Table 1007.1 geotextile material is required above and below the liner system as well as at the interface between Zone A and Zone B materials.

.2 The geotextile material should be placed prior to the placing of Zone A material, prior to the deployment of the liner system as well as subsequent to the deployment of the liner system.

.3 The geotextile should be placed with a minimum overlap of 150 mm and connected at the seam by heat bonding. If heat bonding is not available an overlap of 300 mm should be used. Horizontal seams should be kept to a minimum on the side slopes. If a horizontal seam is unavoidable, the overlap shall be capped with a 300 mm wide strip of the same geotextile and heat bonded to the underlying material.

.4 Any tears or holes made in the geotextile should be repaired by placing a patch of geotextile on the defect and held in place by heat bonding. The patch should extend at least 300 mm beyond the damage, in all directions.

END OF SECTION

Section 1008

OPERATION AND MAINTENANCE

OPERATION AND MAINTENANCE

5.0 General

.1 This section provides a general guideline for the operation and maintenance of the Waste Containment Facility.

6.0 Geomembrane Lined Pad

.1 Structure Maintenance

a. This section refers to the structure as the berm, side slopes, and floor of the Facility.

b. The structure shall be inspected regularly. Attention shall be concentrated on the following:

- Eroded and/or damaged granular slope and floor surfaces and
- Exposed liner material

c. Any identified problems should be repaired immediately. The repair can be conducted by reconstructing the damaged or eroded slopes with a material of similar gradation to Zone A material. Any exposed liner material can be recovered with Zone A material; however, if the liner material is damaged, liner installation personnel shall be retained to repair the liner.

.2 Surface Water Management

a. The Facility is designed to drain all surface water to the installed vertical culvert. Each month, the water lever must be inspected, pumped and disposed of appropriately.

b. The frequency of monitoring must be increased during times of high precipitation or snow melt within the Facility.

7.0 Filling Procedure

.1 The filling procedure for the Facility is as follows:

a. Waste material is not to exceed a height of 3.0 m above the level of the top of the berm unless approved by the Engineer;

b. Waste material is not to be placed higher than relative elevation 0.5 m below the crest of the liner unless approved by the Engineer.

8.0 Closure

.1 Upon reaching capacity the Facility will be capped with material meeting the specifications outlined in Table 1008.1 or as approved by the Engineer.

TABLE 1008.1: CAPPING MATERIAL- PARTICLE SIZE DISTRIBUTION LIMITS

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
100	100	100
50	95	100
25	90	100
20	85	100
5	65	90
0.63	35	60
0.08	5	20

.2 The capping material shall have a minimum thickness of 0.5 m.

.3 The vegetative cover must be capable of self-regeneration without continuous dependence on fertilizer or re-seeding.

.4 The vegetative cover must have sufficient density and species diversity to stabilize the surface against the effects of long term erosion.

.5 Closure monitoring should include inspection for any ponding water. If ponded water is present capping material should be added or re-graded.

END OF SECTION

APPENDIX

APPENDIX A CONSTRUCTION DRAWINGS

NOTES

1. CONTAINMENT FACILITY SIZED FOR 4900 m³ OF DEWATERED ASH. CONFIGURATION OF BASE AREA CAN BE MODIFIED SHOULD SITE CONDITIONS WARRANT. HOWEVER, SPECIFIED BERM CROSS-SECTION, FILL MATERIAL & LINER SYSTEM AND GENERAL DESIGN CRITERIA MUST BE ADHERED TO.
2. SPECIFIC CONDITIONS AND FACILITY LOCATION HAVE NOT BEEN PROVIDED OR CONSIDERED. ONCE FACILITY LOCATION AND SITE SPECIFIC CONDITIONS ARE KNOWN, THEY MUST BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.
3. ALL ELEVATIONS ON PLAN ARE FOR TOP OF ZONE B MATERIAL.

REVISIONS						
MLM	DATE	DWN	CKD	APR	DESCRIPTION	

DRAWING STATUS				
NUM	DATE	APR	DESCRIPTION	
B	09/07/06	JPS	ISSUED FOR CONSTRUCTION	
A	03/26/06	JPS	ISSUED FOR REVIEW	

PERMIT

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ORIGINAL
SIGNED AND SEALED

Permit: J. Richard Tribble, P.Eng. Seal: Jason Dobson, P.Eng.
Date: July 6, 2006 Date: July 6, 2006

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EBA Engineering Consultants Ltd.

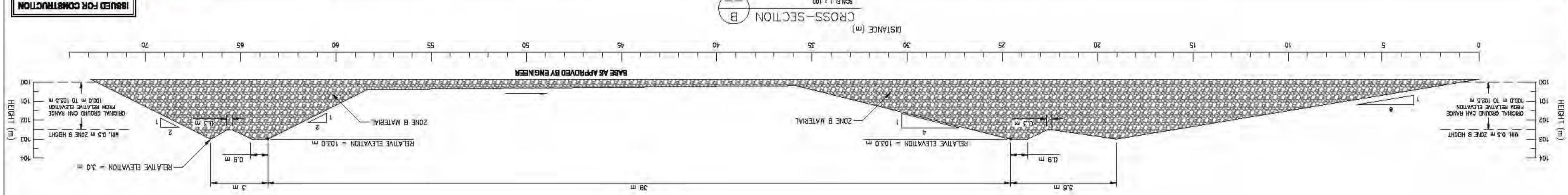
ALEXCO

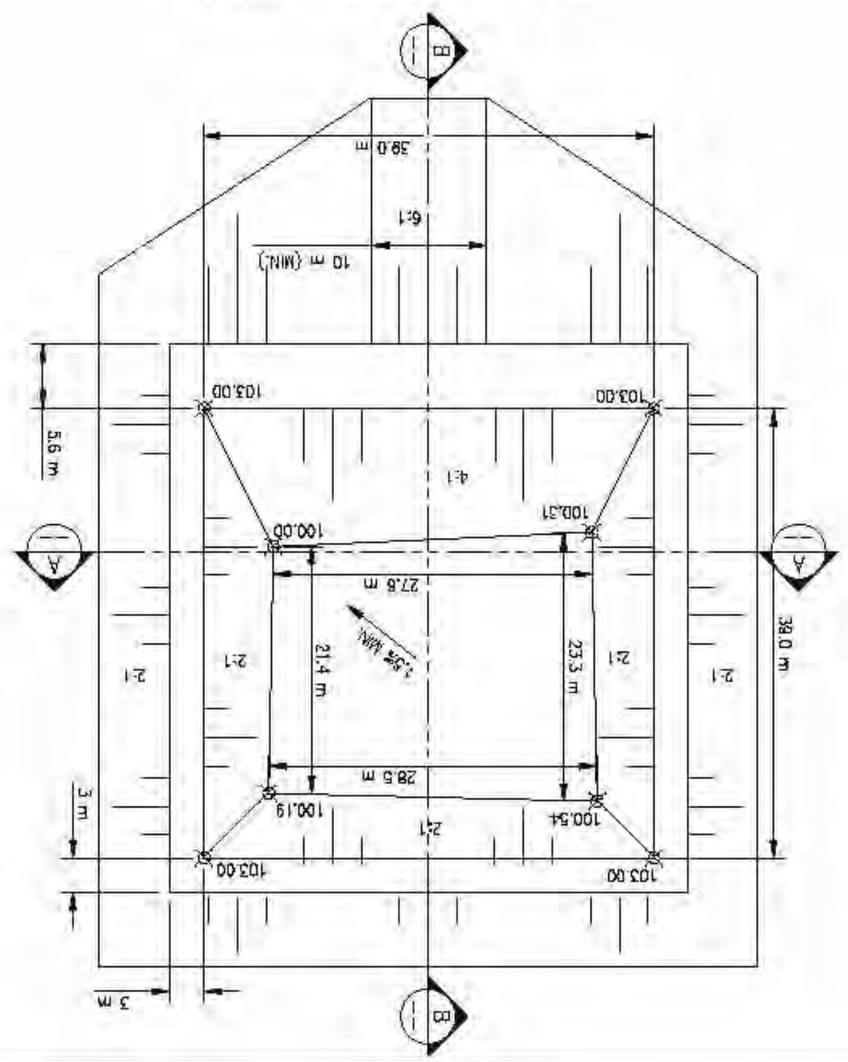
TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

ZONE B MATERIAL PLAN & CROSS SECTIONS

PROJECT No.	DRAWN	DSN	CHD	REV	DRAWING
VA10-142	CP/SE	DWB	JPS	0	WCF-1
DATE	SCALE AS NOTED	APP			
June 26, 2006	1 of 4	KLT	JRT	B	

ISSUED FOR CONSTRUCTION





NOTES

1. CONTAINMENT FACILITY SIZED FOR 1800 m^3 OF GENERATED ASH. CONFIGURATION OF BASE AREA CAN BE MODIFIED SHOULD SITE CONDITIONS WARRANT. HOWEVER, SPECIFIED BERM CROSS-SECTION, FILL MATERIALS, LINER SYSTEMS AND GENERAL DESIGN CRITERIA MUST BE ADHERED TO.
2. SPECIFIC CONDITIONS AND FACILITY LOCATION HAVE NOT BEEN PROVIDED OR CONSIDERED. ONCE FACILITY LOCATION AND SITE SPECIFIC CONDITIONS ARE KNOWN, THEY MUST BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.
3. ALL ELEVATIONS ON PLAN ARE FOR TOP OF ZONE A MATERIAL.

REVISIONS						
MLM	DATE	DWN	CKD	APR	DESCRIPTION	

DRAWING STATUS			
NUM	DATE	APR	DESCRIPTION
B	09/27/06	JPS	ISSUED FOR CONSTRUCTION
A	09/26/06	JPS	ISSUED FOR REVIEW

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Date: July 6, 2006 Date: July 31, 2006

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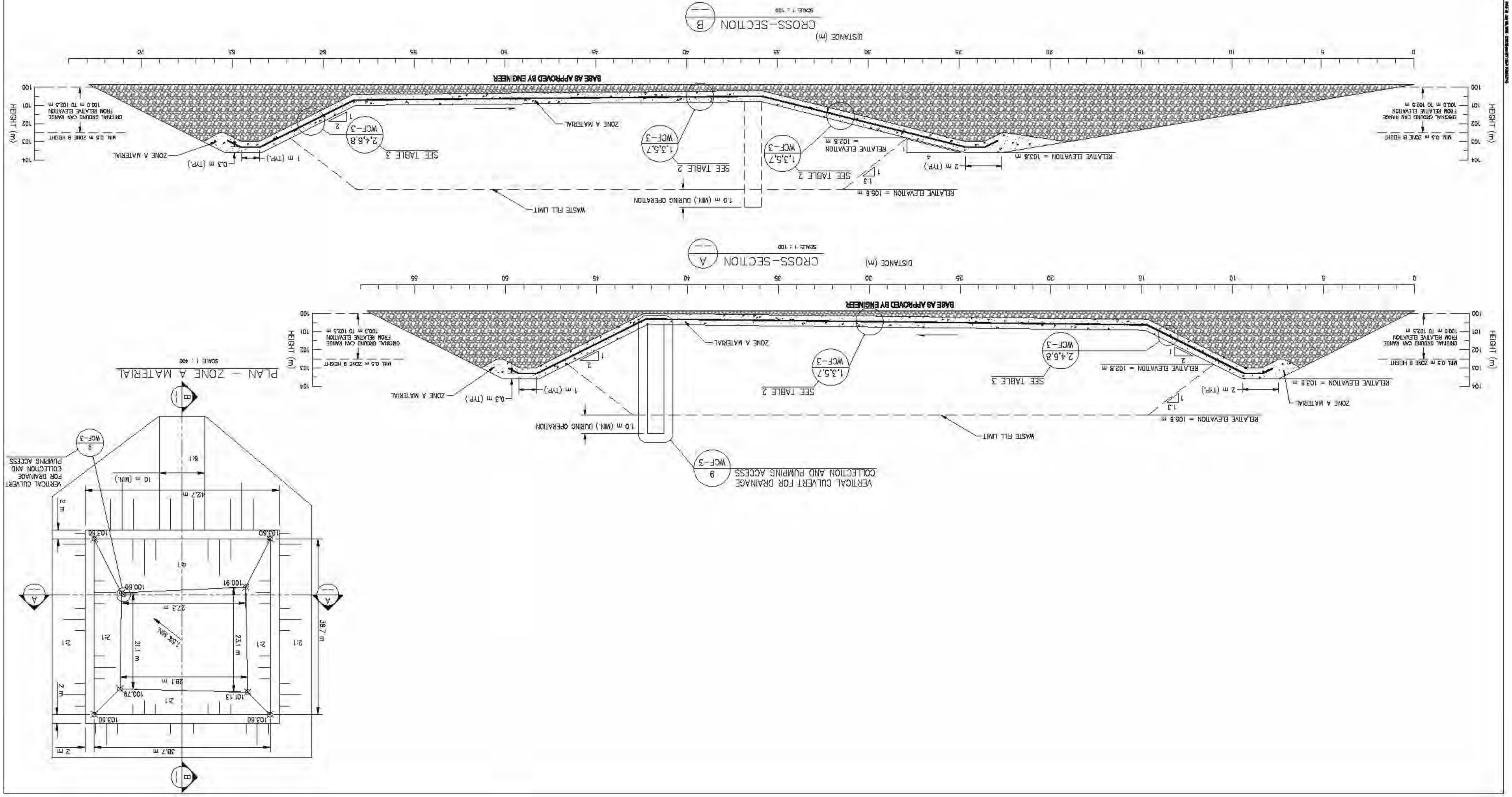
TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

ZONE A MATERIAL PLAN & CROSS SECTIONS

PROJECT No.	DESIGN	DRAWN	CHECKED
VH10142	VH/BE	JTP	JPS
DATUM	SCALE/As	DWG	APP
UTM	2 of 4	KLT	JRT
June 26, 2006			

WCF-2

ISSUED FOR CONSTRUCTION



C:\Projects\Active\Projects\W14101142 Keno Hill Silver District\Drawings\W14101142 Keno Hill Silver District.dwg, 2008-06-25 14:49:46, Plotted by: Jason Behrens

NOTES

1. CONTAINMENT FACILITY SIZED FOR 1900 m³ OF GEOMEMBRANE. CONFIGURATION OF BASE AREA CAN BE MODIFIED SHOULD SITE CONDITIONS WARRANT. HOWEVER, SPECIFIED BERM CROSS-SECTION, FILL MATERIALS, LINER SYSTEMS AND GENERAL DESIGN CRITERIA MUST BE ADHERED TO.
2. SPECIFIC CONDITIONS AND FACILITY LOCATION HAVE NOT BEEN PROVIDED OR CONSIDERED. ONCE FACILITY LOCATION AND SITE SPECIFIC CONDITIONS ARE KNOWN, THEY MUST BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.

REVISIONS					
NUM	DATE	DWN	CKD	APR	DESCRIPTION

DRAWING STATUS			
NUM	DATE	APR	DESCRIPTION
B	08/07/08	JPB	ISSUED FOR CONSTRUCTION
A	08/06/25	JPB	ISSUED FOR REVIEW

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Date: July 8, 2008 Date: July 8, 2008

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PROFESSIONAL SEAL

CLIENT

ALEXCO

EBA Engineering Consultants Ltd.

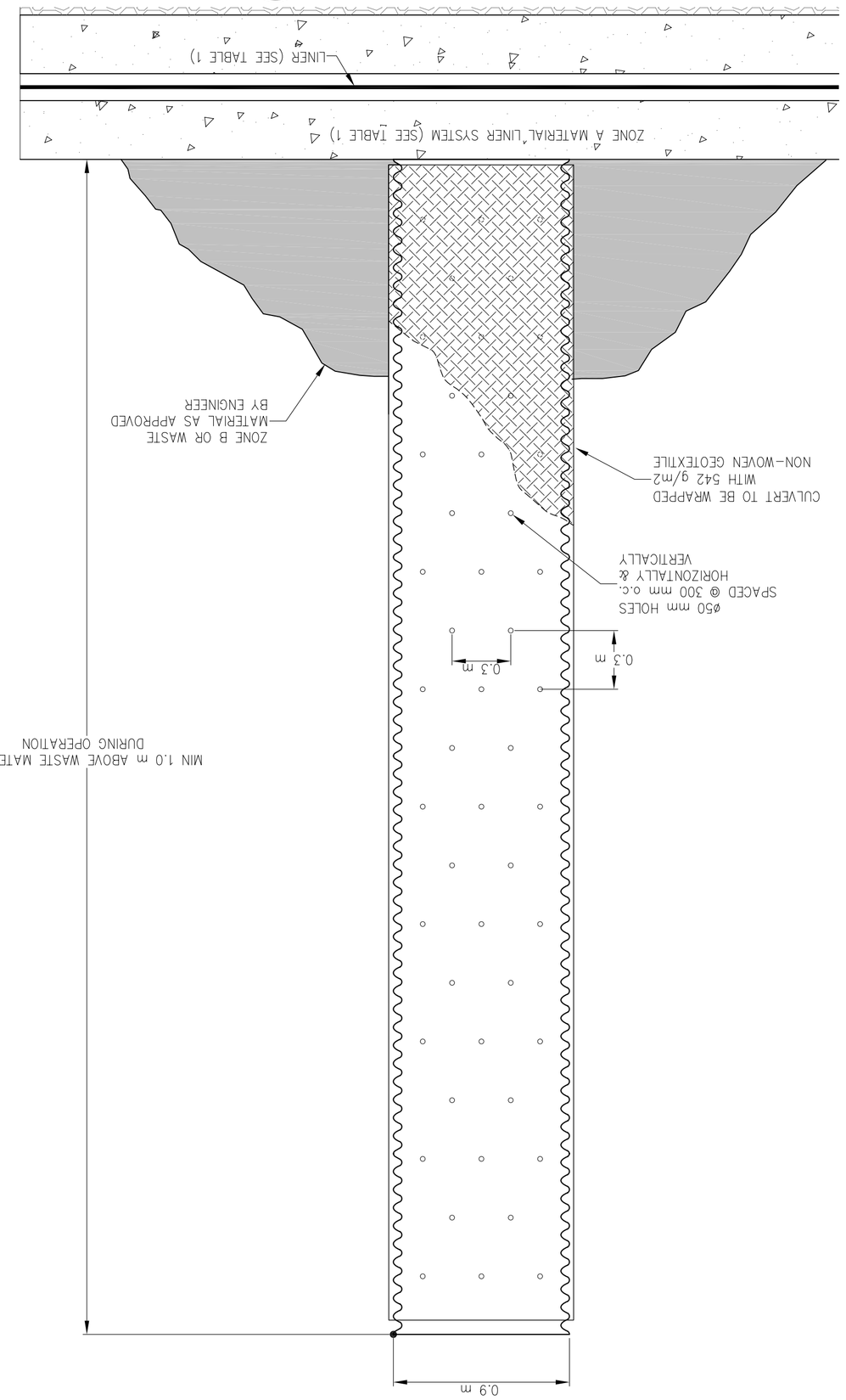
PROJECT No.	OFFICE	DES.	CKD	REV
W14101142	WHSE	JTP	JPB	0
DATE:	SHEET No.	DWN	APP	STATUS
JUNE 25, 2008	3 of 4	KLT	JRT	B

DRAWING: WCF-3

TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

DETAILS

ISSUED FOR CONSTRUCTION



DETAIL 1 – VERTICAL CULVERT
SCALE: 1 : 20
9 WCF–1

Table 1: Recommended Minimum Cover Thicknesses

Liner Material	Drainage Composite	Minimum Required Thickness
Enviro Liner® 4040 (Without Geocomposite)	Not Required	1.5 m
Enviro Liner® 4040 (With Geocomposite)	Required	0.3 m
HDPE 60	Not Required	0.3 m
PVC 40 (With Geocomposite)	Required	0.3 m

Table 2: Liner System Floor and Approach Berm

	Zone B		
	Meets Specifications	Gradation Below Fine Limit	Gradation Above Coarse Limit
Zone A: Meets Specifications	Detail 1	Detail 1	Detail 3
Zone A: Gradation Below Fine Limit	Detail 3	Detail 3	Detail 3
Zone A: Gradation Above Coarse Limit	Detail 5	Detail 5	Detail 7

Table 3: Liner System Berm

	Zone B		
	Meets Specifications	Gradation Below Fine Limit	Gradation Above Coarse Limit
Zone A: Meets Specifications	Detail 1	Detail 1	Detail 3
Zone A: Gradation Below Fine Limit	Detail 3	Detail 3	Detail 3
Zone A: Gradation Above Coarse Limit	Detail 5	Detail 5	Detail 7

Table 4: Zone A Material (10 mm Minus) - Particle Size Distribution Limits

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
10	100	100
5	80	100
2	55	100
0.63	25	65
0.25	10	40
0.08	2	15

Table 5: Zone B Material (200 mm Minus) - Particle Size Distribution Limits

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
200	100	100
100	85	100
50	65	100
25	40	100
5	20	55
2	0	20

LINER SYSTEM DETAIL KEY

LINER SYSTEM FLOOR & APPROACH BERM

ZONE A MATERIAL

GEOCOMPOSITE DRAIN, IF REQUIRED (SEE TABLE 1)

542 g/m² NON-WOVEN GEOTEXTILE

SELECTED GEOMEMBRANE

ZONE B MATERIAL

LINER SYSTEM BERMS

1 WCF–1 FLOOR & APPROACH — NOT TO SCALE
IF REQUIRED; SEE TABLE 1; 0.3 m MIN

2 WCF–1 BERM — NOT TO SCALE
0.3 m MIN; 0.3 m MIN

3 WCF–1 FLOOR & APPROACH — NOT TO SCALE
IF REQUIRED; SEE TABLE 1; 0.3 m MIN

4 WCF–1 BERM — NOT TO SCALE
0.3 m MIN; 0.3 m MIN

5 WCF–1 FLOOR & APPROACH — NOT TO SCALE
IF REQUIRED; SEE TABLE 1; 0.3 m MIN

6 WCF–1 BERM — NOT TO SCALE
0.3 m MIN; 0.3 m MIN

7 WCF–1 FLOOR & APPROACH — NOT TO SCALE
IF REQUIRED; SEE TABLE 1; 0.3 m MIN

6 WCF–1 BERM — NOT TO SCALE
0.3 m MIN; 0.3 m MIN

NOTES

1. CONTAINMENT FACILITY SIZED FOR 4900 m³ OF GENERATED ASH. CONFIGURATION OF BASE AREA CAN BE MODIFIED SHOULD SITE CONDITIONS WARRANT. HOWEVER, SPECIFIED BERM CROSS-SECTION, FILL MATERIALS, LINER SYSTEMS AND GENERAL DESIGN CRITERIA MUST BE ADHERED TO.
2. SPECIFIC CONDITIONS AND FACILITY LOCATION HAVE NOT BEEN PROVIDED OR CONSIDERED. ONCE FACILITY LOCATION AND SITE SPECIFIC CONDITIONS ARE KNOWN, THEY MUST BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.

REVISIONS

MLM	DATE	DWN	CKD	APR	DESCRIPTION

DRAWING STATUS

NUM	DATE	APR	DESCRIPTION
2	09/27/06	JPS	ISSUED FOR CONSTRUCTION
1	09/26/06	JPS	ISSUED FOR REVIEW

PERMIT

PROFESSIONAL SEAL

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Permit: J. Richard Thistle, P.Eng. Date: Jason Dobson, P.Eng.
Date: July 6, 2006 Date: July 6, 2006

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ALEXCO

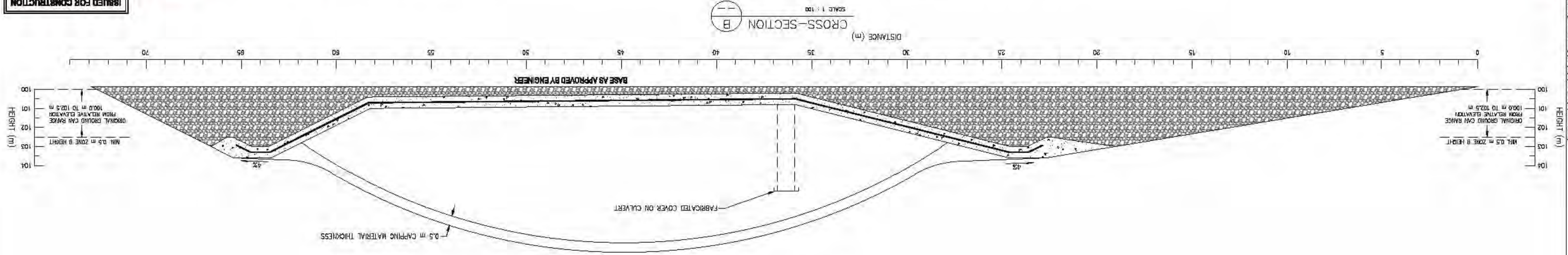
PROJECT No.	CREW	DES	CHK	REV
VH10142	VH/EE	JTP	JPS	0
DATE	DRWG No.	APP	KLT	JRT
June 26, 2006	4 of 4			B

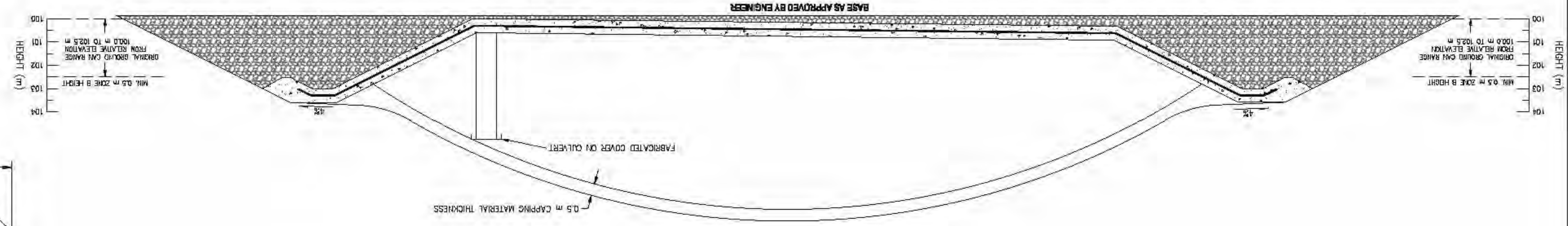
WCF-4

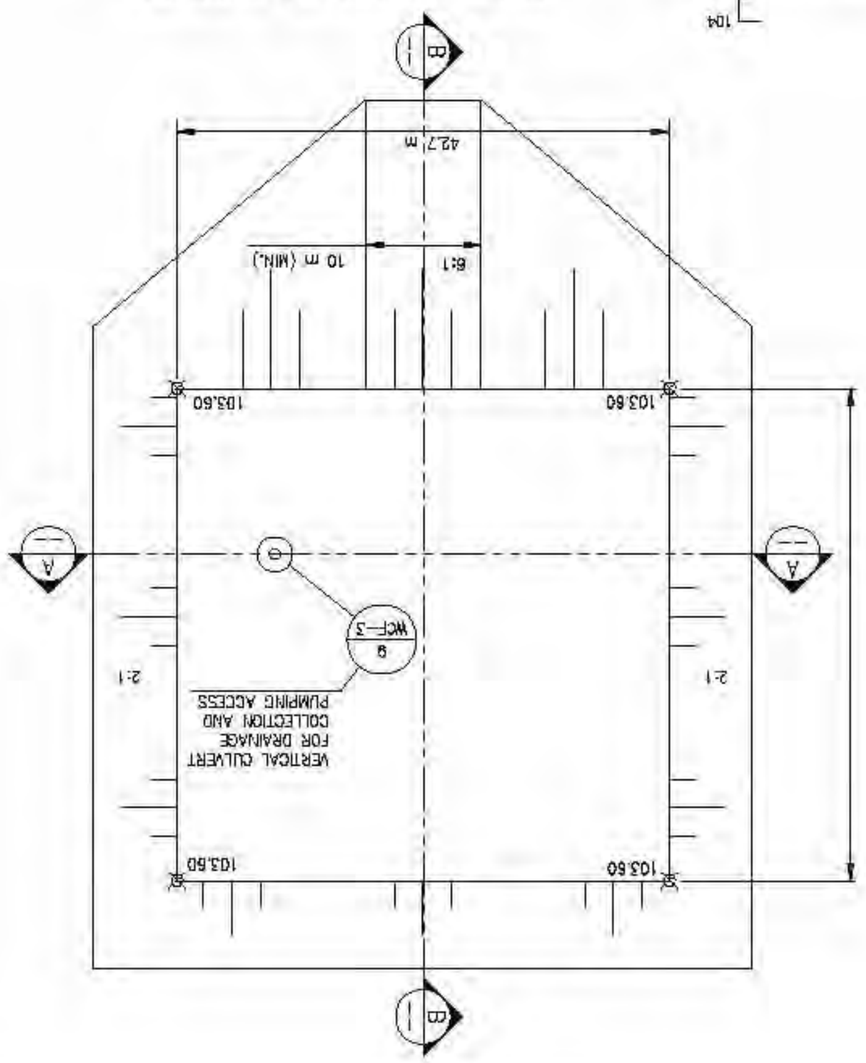
TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

FACILITY CLOSURE PLAN & CROSS SECTIONS

ISSUED FOR CONSTRUCTION







APPENDIX 3.3

GEOCHEMISTRY SUMMARY FOR WASTE ROCK AND TAILINGS

Memorandum

To: Linda Broughton, Alexco Resource Corp.

From: Cheibany Ould Elemine and Andrew Gault, Ensero Solutions Canada, Inc.

Date: September 22, 2021

Re: AKHM Waste Rock ARD/ML Characterization Update 5 – September 2021

1 INTRODUCTION

Acid rock drainage and metal leaching (ARD/ML) characterization of waste rock produced from prospective production areas in the Keno Hill District (KHSD) has been ongoing since Alexco Keno Hill Mining Corp. (AKHM) initiated exploration in 2006. This dataset includes static (e.g., acid base accounting, elemental metals, shake flask leach test) and kinetic (e.g., humidity cells and field barrels) of material from the following areas:

- Bellekeno;
- Onek;
- Lucky Queen;
- Flame & Moth;
- Silver King; and
- Bermingham.

This memorandum summarizes the waste rock static and kinetic data collected by AKHM to date. More detailed reporting can be found in the source documentation cited throughout.

2 REGIONAL AND DISTRICT GEOLOGY

The KHSD is primarily composed of Yukon Group metasedimentary rocks which are described in the Keno Hill Silver District Environmental Conditions Report (AEG, 2016a) and the NI43-101 technical report for the Bermingham Exploration Project (Roscoe Postle and Associates Inc., 2017). The mineralization of the KHSD is hosted within the Mississippian Keno Hill Quartzite Formation in the Tombstone Thrust Sheet, which conformably overlies the Devonian Earn Group to the north and is structurally overlain by the Upper Proterozoic Hyland Group Yusezyu Formation across the Robert Service Thrust Fault in the south (Roscoe Postle and Associates Inc., 2017).

The stratigraphic units in the district are mainly composed of the Earn Group and the Keno Hill Quartzite. The Earn Group comprises typically phyllitic, grey graphitic metasediments with an upper band of greenish chlorite-sericite meta-felsic volcanics, and minor interbedded quartzite proximal to the conformable transition to the overlying Keno Hill Basal Quartzite Member. The Keno Hill Quartzite is structurally approximately 1,900 m thick and contains the lower massive blocky Basal Quartzite Member (approximate structural thickness of 1,100 m) with thin to thick quartzite and graphitic schist interbeds and the Sourdough Hill Member (~800 m) with basal horizons of sericitic meta-rhyolite and graphitic schist, intermediate units of an Upper Quartzite, quartz eye grits, and chloritic schist that enter an overlying carbonate rich section containing well-defined black limestone beds. Mid-Triassic greenstone lenses up to 100 m thick are also contained within the Keno Hill sequence but only to the top of the Basal Quartzite Member (Roscoe Postle and Associates Inc., 2017).

One to two phases of deformation and chloritic grade regional metamorphism and isoclinic folding produced overturned isoclines in the Keno Hill Quartzite Basal Member overlying the Earn Group. The mineralization was developed in northeast striking, southeasterly dipping normal oblique normal faults with displacement of tens to hundreds of metres formed likely during the early stages of deformation.

The KHSD mineralization is in the form of silver-rich base metal quartz-carbonate veins that are predominantly present in steep southeasterly dipping vein-filled faults with deposits hosted by thick competent Basal Quartzite of the Keno Hill Quartzite or occasionally where greenstone forms part of the Earn Group wall rock (Roscoe Postle and Associates Inc., 2017).

A brief descriptive overview of the major lithology types is summarized below from Boyle (1962), Altura (2008) and (Roscoe Postle and Associates Inc., 2017).

- Quartzite (QTZT): The dominant lithology unit at the Bermingham deposit development rock and occurs both as thickly and thinly bedded sequences with assemblages of graphitic schist. The quartzites are variably silicified with purer quartzites a few metres thick and darker grey, impure quartzites on to four metres thick. Quartzites are comprised primarily of quartz but also contain some mica, carbonate minerals and carbonaceous materials. Accessory minerals include leucoxene, tourmaline, zircon, apatite and pyrite. Calcareous quartzite (CQTZT) contains disseminated primary calcite that fizzes readily when subjected to dilute hydrochloric acid.

- Schist (SCH): The schist within the Bermingham development area are most commonly graphitic schist (GSCH), which are black or dark gray in color due to their significant carbon content, occur in beds from millimetre to many meters in scale, and can be intercalated with quartzites as well as the other

lithologies. In addition to graphite; quartz, mica, carbonates, feldspar, chlorite, isotropic colloidal material and pyrite metacrysts have been identified in thin sections within these rocks. Although not anticipated to be present in significant quantities in the Bermingham development (i.e., <5%), other forms of schist are documented elsewhere in the KHSD. These include quartz sericite schist (SSCH) and chlorite schists (CHSCH), which are pale to dark green in colour. Thin sections of sericite schists show primarily quartz and sericite composition, with trace carbonate minerals and leucoxene. Accessory minerals include apatite, zircon, tourmaline and pyrite metacrysts. Calcareous schist (CSCH) contains disseminated primary calcite that fizzes readily when subjected to dilute hydrochloric acid (HCl). Interbedded carbonaceous quartzite and schist (ICQS) and thin bedded quartzite (TQTZT), the latter of which does occur in the Bermingham development area, are also included as their own lithologies, but these units are predominantly composed of schist.

- Greenstone (GNST): Greenstones vary from narrow (0.3 – 2 m wide) to 100 m thick and vary in color from greyish green to dark green. Greenstones occur in conformable elongated lenses and sills as a result of boudinage, particularly within the more ductile schist units. Greenstones units are generally more resistant than the quartzites and schists and appear geomorphologically as the prominent hills in the KHSD. Thin sections show significant variety in mineral composition and texture but generally show a high degree of alteration. The primary mineralogy of the greenstones includes hornblende, actinolite, saussurite (zoisite, epidote, albite, sericite, carbonate), plagioclase (oligoclase to andesine), chlorite, stilpnomelane, biotite, sericite, leucoxene, and carbonate minerals. Quartz, K-feldspar, ilmenite, magnetite, limonite and apatite are minor constituents with some pyrite. Chlorite is also generally present, which is primarily responsible for this rock's color.

3 DATA SOURCES

The data presented in this summary memorandum are primarily sourced from AKHM's growing database of ARD/ML static and kinetic testing of waste rock samples generated from exploration of deposits of interest in the KHSD. These largely comprise waste rock from:

- Bellekeno;
- Lucky Queen;
- Onek;
- Flame & Moth;
- Silver King; and
- Bermingham.

3.1 STATIC TESTING

Static testing of these materials has typically consisted of:

- Acid base accounting (ABA) analyses, including:
    - Paste pH;
    - Siderite-corrected neutralization potential (NP) using the method of Skousen et al. (1997);
    - Total sulphur by Leco;
    - Sulphate sulphur by HCl extraction;
    - Sulphide sulphur by difference, used to calculate acid potential (AP); and
    - Total inorganic carbon (TIC) by HCl leaching.
- Bulk elemental analysis by aqua regia digestion and ICP-MS analysis of digestate; and
- Shake flask extraction (MEND SFE) to determine soluble constituents associated with these materials (Price 2009).

3.2 KINETIC TESTING

Kinetic testing has largely comprised of laboratory-based humidity cells and site-based field leach barrels. Humidity cells tests have all been conducted for the following materials:

- Flame & Moth non-acid generating/metal leaching (N-AML) waste rock composite (98 weeks, completed);
- Bermingham N-AML cover hole waste rock composite HC-01 (57 weeks, completed); and
- Bermingham N-AML advance exploration hole waste rock composite HC-03 (107 weeks, completed).

Five field barrels have also been in operation at the KHSD site since June 2013 and comprise Flame & Moth waste rock drill core (280 to 340 kg) in barrels that are open to atmospheric weathering conditions. The field leach barrels contain a range of N-AML and potentially acid generating/metal leaching (P-AML) waste rock Precipitation that percolates through the barrels is collected in pails that are sampled on a monthly basis during the ice-free months.

4 STATIC TESTING DATA

ARD/ML data of waste rock samples collected from exploration drill core at prospective production zones shown in Figure 4-1 within the KHSD were compiled. These included the:

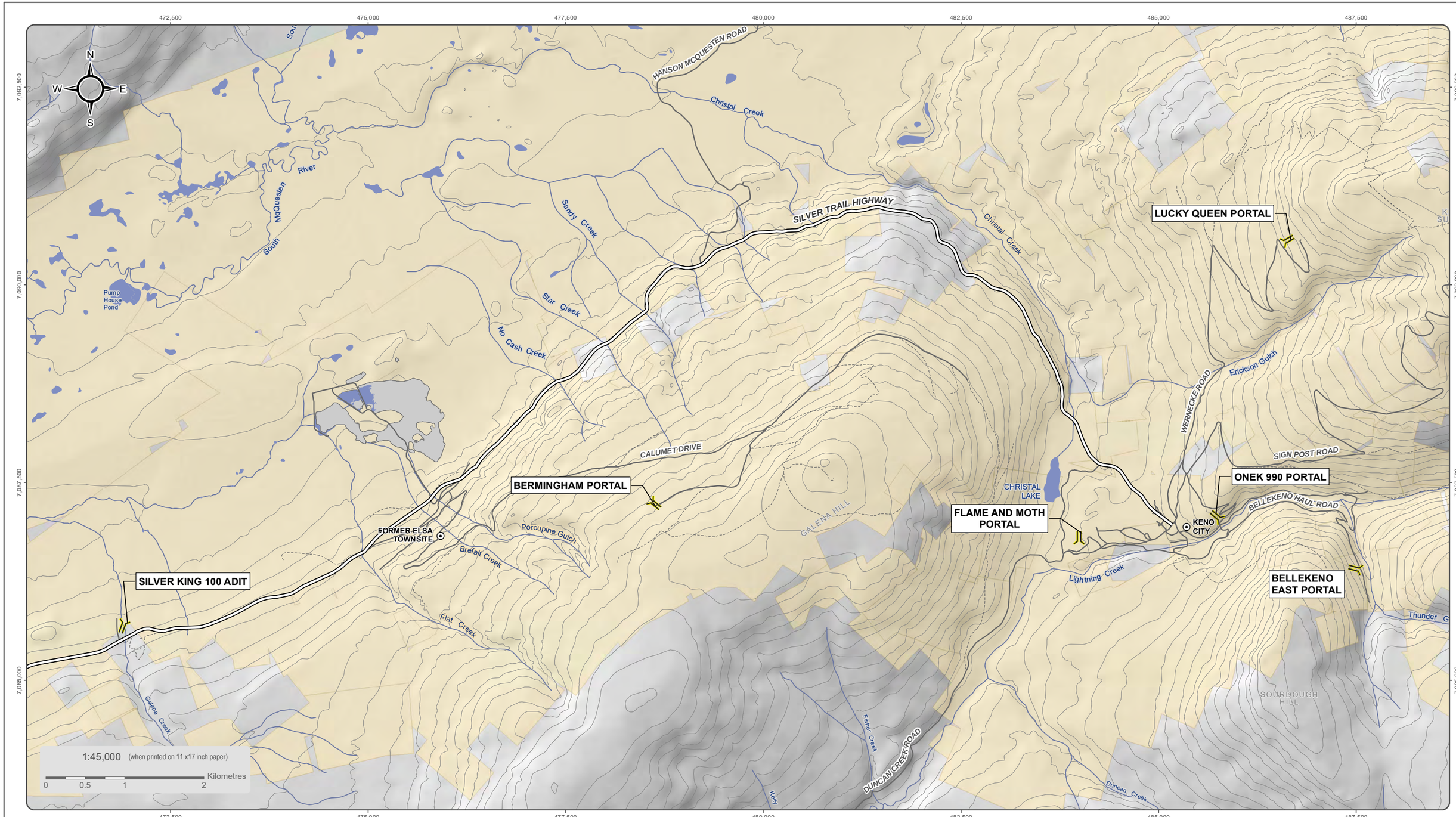
- Bellekeno (Altura, 2008);
- Onek (ACG, 2011a);
- Lucky Queen (ACG, 2011b);
- Silver King (ACG, 2011c);
- Flame & Moth (AEG, 2016b); and
- Bermingham zones (AEG, 2018).

The lithological distribution of samples in each production zone is presented in Table 4-1.

Table 4-1: AKHM Prospective KHSD Production Zones Sample Lithologies Sampled for ARD/ML Characterization

Production Zone	Lithology (Number of Samples)									Total
	GNST	GSCH	QTZT	SSCH	TQTZT	ICQS	CQTZTZ	CHSCH	CSCH	
Bellekeno	12	13	12	11	0	0	12	1	0	61
Onek	4	14	17	8	0	0	0	1	0	44
Lucky Queen	0	2	13	0	9	0	0	0	0	24
Silver King	1	2	7	3	7	4	0	0	0	24
Flame & Moth	1	5	28	6	7	0	2	0	1	50
Bermingham [a]	3	26	97	1	51	0	0	0	0	178
Total	**21**	**62**	**174**	**29**	**74**	**4**	**14**	**2**	**1**	**381**

[a] Three fault samples collected from Bermingham not included



National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on September 2017

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Place of Interest
- Adit
- Valley Tailings
- Alexco/ERDC Quartz Claims
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

AKHM

ALEXCO ENVIRONMENTAL GROUP

ALEXCO KENO HILL MINING CORP.

FIGURE 4-1

LOCATIONS OF WASTE ROCK ARD/ML STUDIES TO SUPPORT ALEXCO KHSD DEVELOPMENT

SEPTEMBER 2017

D:\Projects\All Projects\ALEX-05-01\gis\mxd\Overview_Maps\Property_Overviews\Alexco_Proposed_Deposits_Overview_20170914.mxd
(Last edited by: amatiashevska,15/09/2017/12:55 PM)

4.1.1 Acid Base Accounting

The purpose of ABA is to quantify the content and ratio of potentially acid producing and potentially acid consuming minerals in each sample. This provides an indication of the acid generation potential of geologic materials.

Plots of NP versus AP, which provide an overview of the potential for net acid generation, are displayed for all the KHSD production units waste rock samples in Figure 4-2, and broken out by lithology in Figure 4-3 to Figure 4-7. In general, three categories of potential acid generation can be defined based on the NP/AP ratio (or neutralization potential ration; NPR) of a sample (Price, 2009):

- NPR<1 samples are classified as potentially acid generating (PAG);
- 1≤NPR≤2 samples are capable of acid generation but with some uncertainty; and
- NPR>2 samples are considered not potentially acid generating (non-PAG).

In general, the majority of waste rock samples collected from potential production zones across the KHSD are non-PAG (i.e., NPR>2; Figure 4-2). Samples from Silver King had the highest proportion that were PAG (i.e., NPR<1; 68%), largely due to their low NP content (Figure 4-2). Twenty-nine percent (29%) of the samples collected from Bermingham were also PAG and 23% fell in the uncertain category largely due to low NP and AP. Onek also had a handful of samples that were PAG (16%); however, these generally had high AP and NP. The majority of the Lucky Queen, Onek, Flame & Moth, Bermingham, and Bellekeno waste rock samples were non-PAG (58%, 73%, 74%, 48%, and 87% of samples, respectively). Overall, the waste rock from the easternmost deposits (e.g., Bellekeno, Onek, and Flame & Moth) tended to have higher NP than that found in samples from the deposits located in the western portion of the KHSD (i.e., Silver King and Bermingham).

Broken down by major lithology, the QTZT, TQTZT, and GSCH samples broadly reflected the general NPR sample distribution (11% to 31% PAG samples; 44% to 76% non-PAG; Figure 4-3 to Figure 4-5), consistent with the numerical dominance of these lithologies. The GNST and SSCH samples are predominantly non-PAG (Figure 4-6 and Figure 4-7).

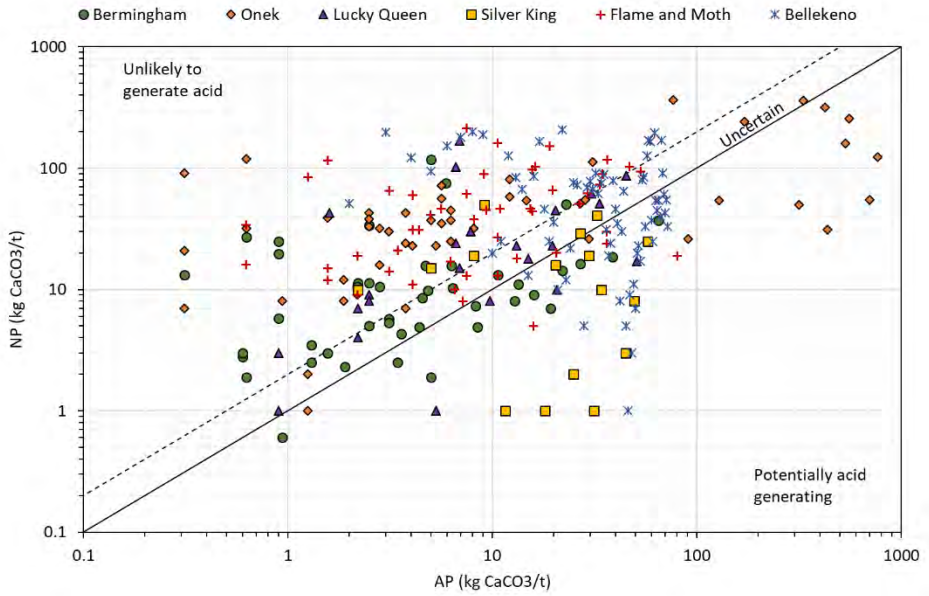
4.1.2 Bulk Elemental Chemistry

Bulk concentrations of antimony, arsenic, selenium, silver, cadmium, and zinc often exceed their respective average crustal abundance by an order of magnitude (CRC, 2005) in waste rock from the KHSD. Also, elevated lead concentration is notable in a few rock samples from all deposits except Lucky Queen and Flame & Moth. Although the bulk concentration of an element does not offer a direct measure of how mobile an element may be during weathering, it can provide a preliminary indication of constituents that should be monitored for high solubility in subsequent leach and/or kinetic test. The concentrations of these elements in waste rock (as accessed by aqua regia digestion) from the Bermingham, Bellekeno, Onek, Lucky Queen, Silver King, and Flame & Moth deposit areas are displayed in Figure 4-8.

Bulk antimony and silver concentrations were higher than their respective 10x crustal abundance (2 and 0.85 ppm, respectively) for the majority of waste rock samples from Bermingham, Bellekeno, Onek, Lucky Queen, and Silver King. Lower concentrations were observed for Flame & Moth waste rock. Bulk selenium

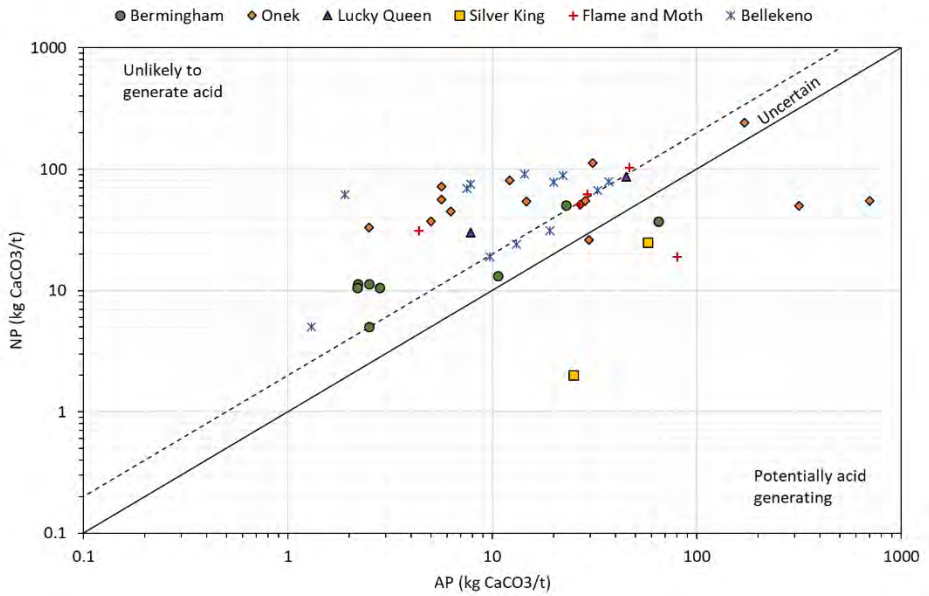
concentrations were elevated (>10x crustal abundance; 0.5 ppm) in the majority of Bermingham and Flame & Moth samples and exhibited similar distributions. Poor detection limits (10 ppm) prevented interpretation of the Lucky Queen and Silver King selenium dataset, while selenium was not analyzed in the aqua regia digests of Bellekeno or Onek waste rock.

The highest arsenic, cadmium, and zinc concentrations were observed in waste rock from Onek, Bermingham and Bellekeno. The lowest concentrations of these metal(loids), in addition to silver and lead, were returned by Flame & Moth waste rock, which were consistently lower than the crustal abundance for all three elements.



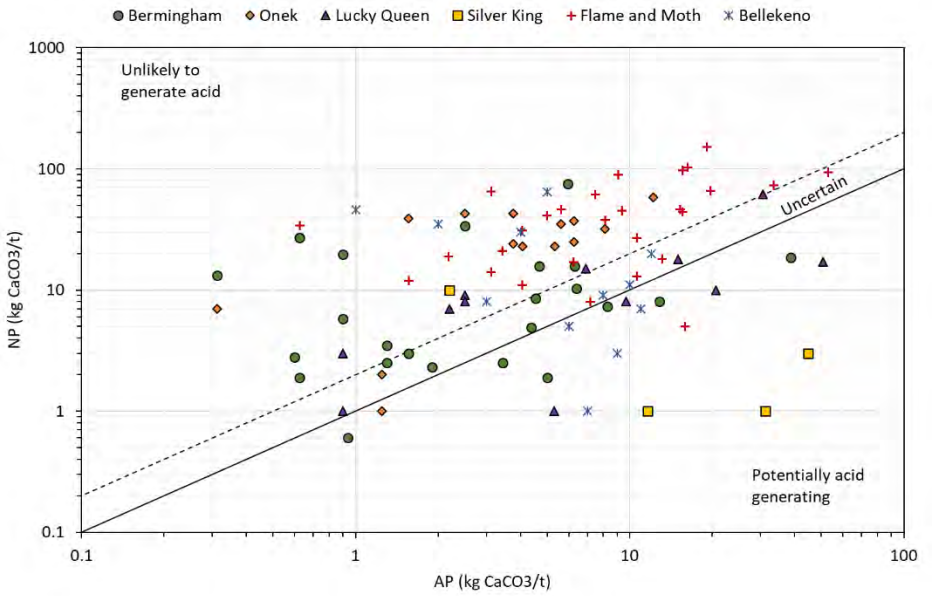
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-2: Variability in NP and AP of Waste Rock Samples from KHSD Deposits



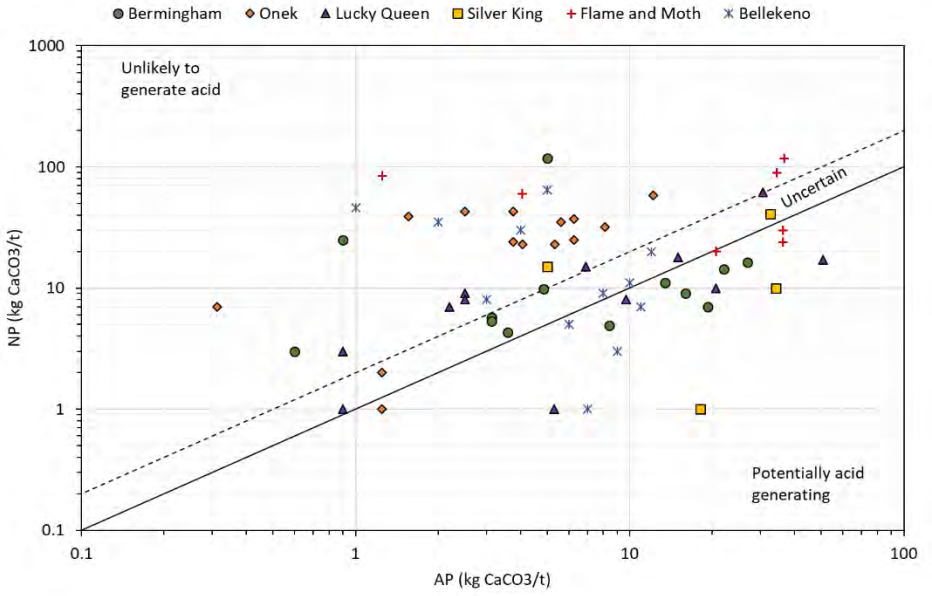
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-3: Variability in NP and AP of GSCH Lithology Waste Rock Samples from KHSD Deposits



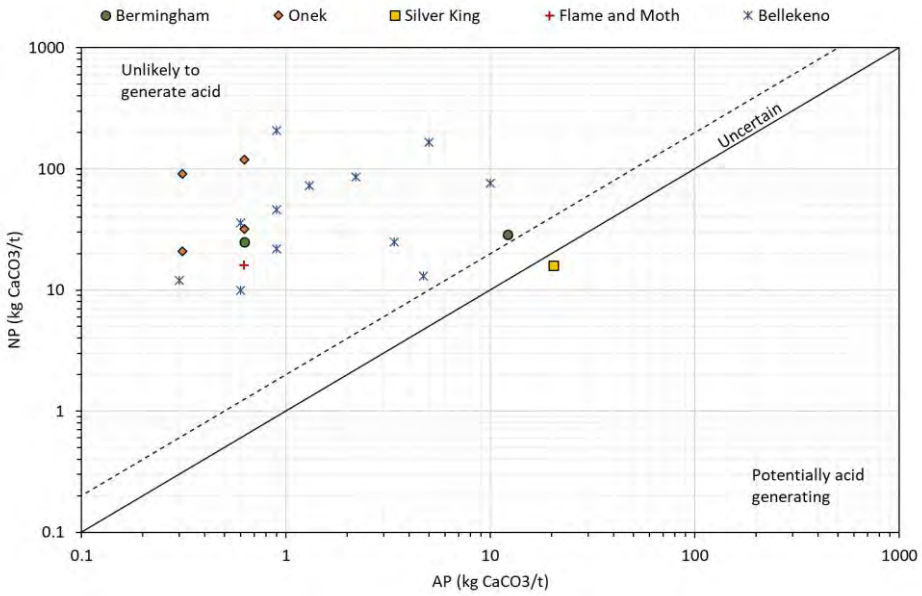
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-4: Variability in NP and AP of QTZT Lithology Waste Rock Samples from KHSD Deposits



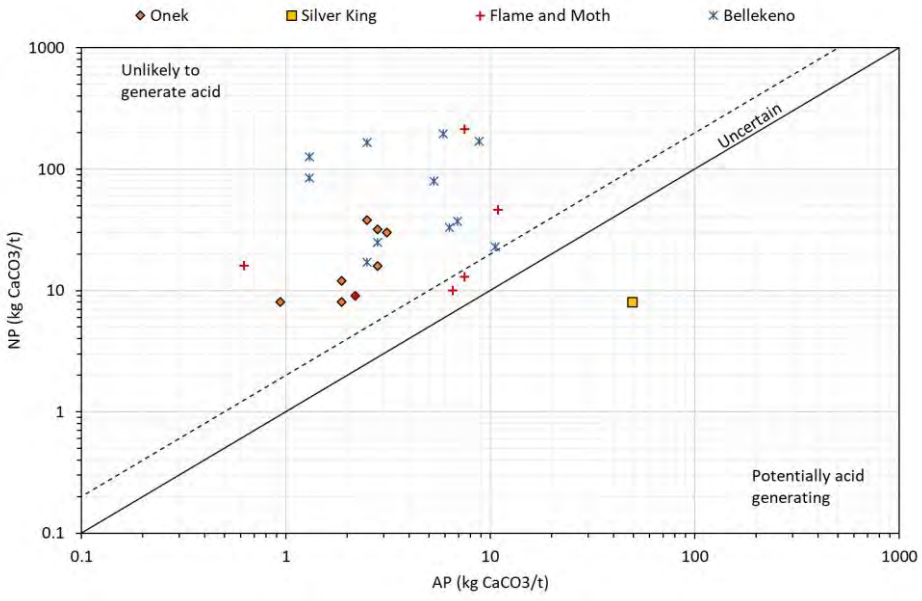
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-5: Variability in NP and AP of TQTZT Lithology Waste Rock Samples from KHSD Deposits



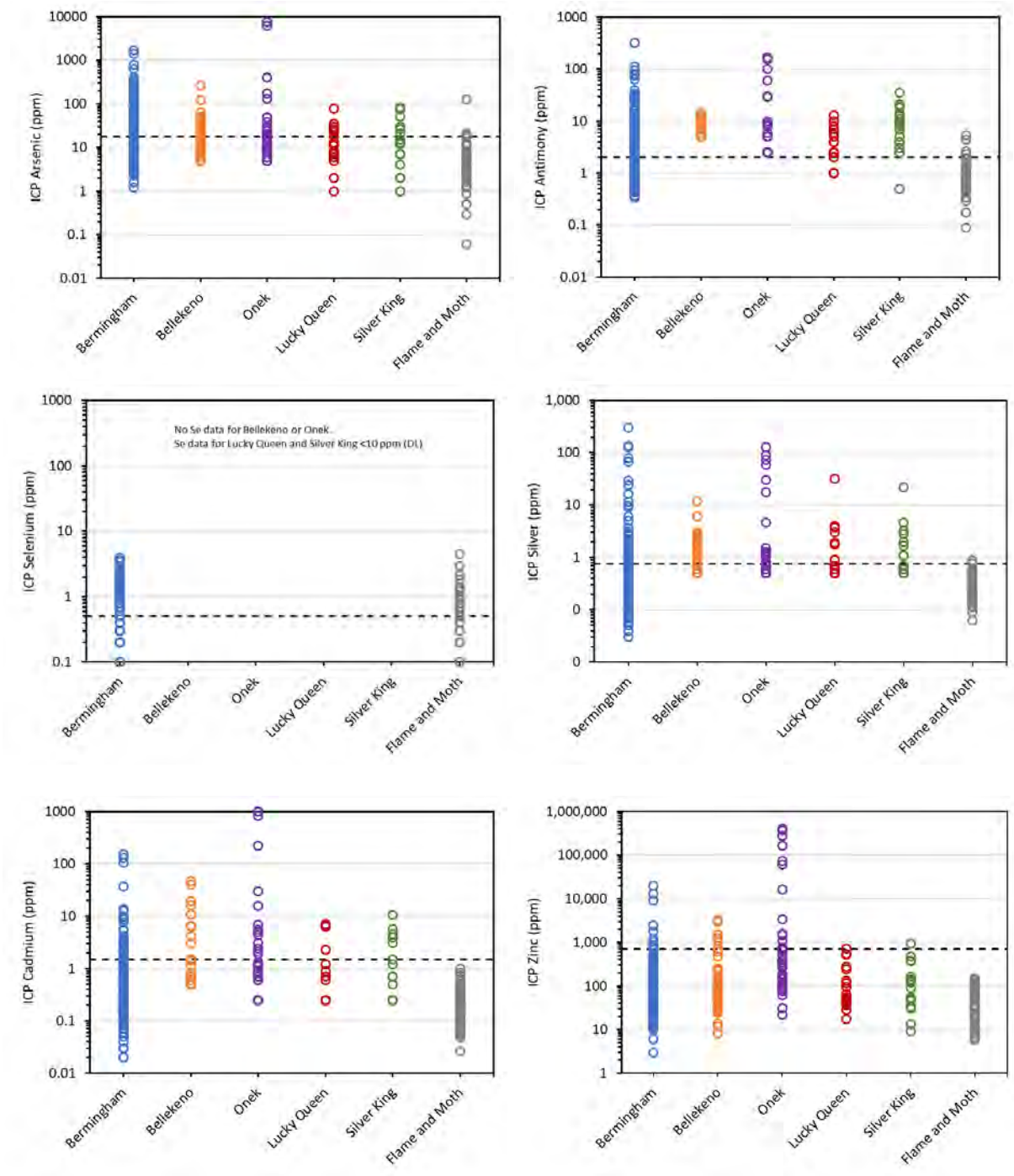
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-6: Variability in NP and AP of GNST Lithology Waste Rock Samples from KHSD Deposits



Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-7: Variability in NP and AP of SSCH Lithology Waste Rock Samples from KHSD Deposits



Dashed line represents 10x crustal abundance

Figure 4-8: Distributions of Bulk Concentrations of Antimony, Arsenic, Selenium. Silver, Cadmium, and Zinc by Deposit

4.1.3 Shake Flask Extraction

SFE provides a measure of the soluble metals in the sample that may be mobilized in the short term upon leaching processes. A summary of SFE leach tests carried out on samples from the main lithologies at Flame & Moth zone samples (n=50) and Bermingham (n = 29) are shown in Table 4-2 and Table 4-3, respectively. No SFE data are available for the other deposit areas that have appropriate trace element detection limits.

The discussion of the results is focussed on constituents that were found to be elevated relative to crustal abundance from bulk elemental analysis and/or had SFE test data that were elevated relative to Canadian Council of Ministers of the Environment (CCME, 2017) or British Columbia Ministry of the Environment (BCMOE, 2016) long-term water quality guidelines for freshwater aquatic life. Where both CCME and BCMOE guidelines were available for a constituent, the most recently updated guideline was used since this captures the most recent scientific publication related to environmental risk. Although such short-term leach extractions are not strictly comparable to water quality guidelines, such comparison aids in the identification of elevated concentrations of potentially soluble constituents and the potential for trace element leaching. This comparison is strictly for reference purposes and does not indicate compliance or otherwise with CCME, BCMOE or other water quality guidelines.

The pH of both sets of SFE sample datasets was circumneutral to alkaline, with a few samples (three Bermingham and two Flame & Moth) in exceedance of the upper CCME pH guideline (pH 9.0). Also, four Bermingham samples had SFE pH lower than the CCME pH lower guideline (pH 6.5). Elevated concentrations of SFE leachable fluoride (92% of samples exceeded 0.12 mg/L CCME guideline) and aluminum (76% of samples exceeded 0.1 mg/L CCME guideline) were observed in the Flame & Moth samples, whereas a lower proportion of exceedances (and lower concentrations) were obtained for the Bermingham samples (45% and 31% of samples exceeded guidelines for fluoride and aluminum, respectively).

A high proportion of SFE leachable antimony concentrations exceeded the BCMOE interim guideline (0.009 mg/L; 78% of samples) in the Flame & Moth dataset, whereas only six (21%) exceedances were observed for the Bermingham samples despite higher bulk antimony concentrations in the Bermingham waste rock samples (Figure 4-8 and Figure 4-9). Conversely, a higher proportion of Bermingham samples had SFE leachable arsenic concentrations that exceeded the CCME water quality guideline (0.005 mg/L; 41% of samples) compared with the Flame & Moth SFE results (6% of samples), consistent with the higher bulk arsenic in Bermingham samples (Figure 4-9). On the other hand, a similar proportion of Flame & Moth SFE leachable selenium concentrations exceeded the BCMOE guideline for selenium (0.002 mg/L; 46% of samples) as with the Bermingham dataset (45% of samples), although both sample datasets spanned a similar concentration range (Figure 4-9).

Broadly positive correlations were observed between SFE leachable and aqua regia bulk concentrations of aluminum and selenium (Figure 4-9), although the selenium correlation appears stronger within each deposit area's lithology rather than for the entire dataset.

Overall, the same constituents (fluoride, and selenium) were observed at elevated levels in the SFE leachate from both the Bermingham and Flame & Moth samples. The only notable differences were the elevated arsenic

concentrations observed in 41% of the Bermingham samples, but only 6% of the Flame & Moth samples, and the elevated antimony and aluminum concentrations which were recorded in the majority of Flame & Moth dataset, but which were generally lower than the water quality guidelines in the Bermingham samples.

Table 4-2: Comparison of SFE data from Flame & Moth Zone Samples with Water Quality Guidelines

n = 50	pH	Fluoride	Aluminum	Antimony	Arsenic	Selenium
		mg/L	mg/L	mg/L	mg/L	mg/L
Guideline for Comparison	**CCME**	**CCME**	**CCME**	**BCMOE**	**CCME**	**BCMOE**
Aquatic Life Guideline	**6.5 - 9.0**	**0.12**	**0.1** [a]	**0.009**	**0.005**	**0.002**
Maximum	9.2	4.49	6.2	0.13	0.012	0.030
3rd Quartile	8.7	0.94	0.63	0.027	0.0018	0.0036
Median	8.6	0.51	0.29	0.013	0.0012	0.0018
1st Quartile	8.4	0.28	0.10	0.0094	<0.0005	0.00085
Minimum	7.9	0.068	0.017	0.00099	<0.0005	0.00025
Samples >CCME/BCMOE	4%	92%	76%	78%	6%	46%
Highlighted Results Exceed CCME/BCMOE						

[a] Guideline based on receiving waters with pH>6.5

Table 4-3: Comparison of SFE data from Bermingham Zone Samples with Water Quality Guidelines

n = 29	pH	Fluoride	Aluminum	Antimony	Arsenic	Cadmium	Selenium
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Guideline for Comparison	CCME	CCME	CCME	BCMOE	CCME	CCME	BCMOE
Guideline Value	6.5 - 9.0	0.12	0.1 [a]	0.009	0.005	0.0002 [b]	0.002
Method Detection Limit	-	0.01	0.0005	0.00005	0.00002	0.000005	0.00004
Maximum	9.3	0.80	0.58	0.032	0.066	0.0004	0.03
3rd Quartile	8.8	0.26	0.11	0.005	0.011	0.00004	0.004
Median	8.1	0.10	0.04	0.002	0.003	0.00002	0.002
1st Quartile	7.1	0.07	0.02	0.001	0.002	0.00001	0.0004
Minimum	6.2	0.04	0.004	0.0004	0.0006	0.000003	0.00005
Samples >CCME/BCMOE	7	13	9	6	12	1	13
Percent >10x Crustal Abundance	24%	45%	31%	21%	41%	3%	45%
Highlighted Results Exceed CCME/BCMOE							

[a] Guideline based on receiving waters with pH>6.5

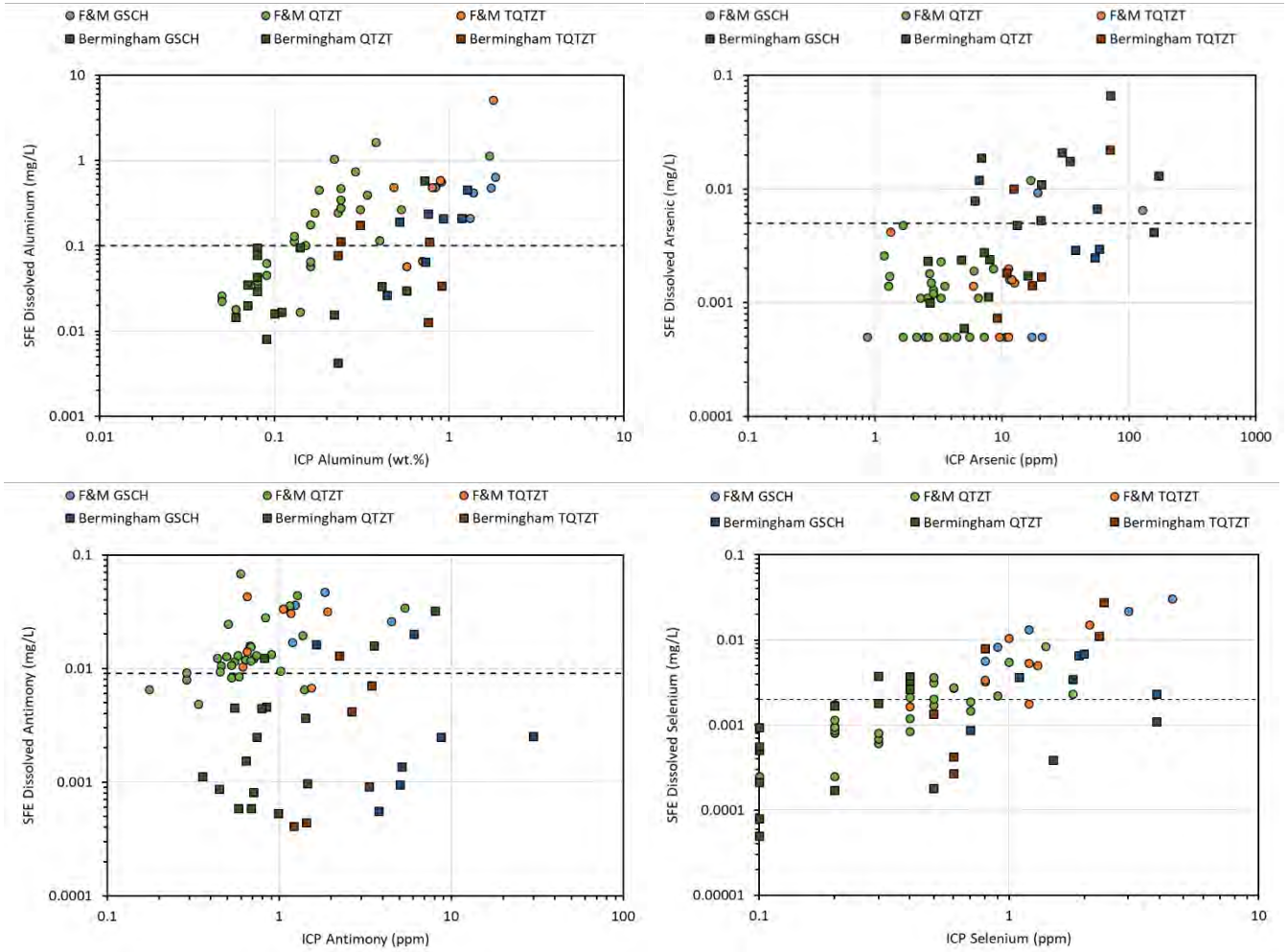


Figure 4-9: Comparison of SFE Leachable and Aqua Regia Bulk Concentrations of Aluminum, Antimony, Arsenic, and Selenium for the main lithologies in Bermingham (squares) and Flame & Moth (circles)

5 KINETIC TESTING DATA

Concentrations of constituents of interest in the leachate from the kinetic experiments conducted using waste rock are presented and discussed here. The effluent quality standards (EQS) set out in water licence QZ09-092, water quality objectives (WQO) at KV-21 for Bermingham, and Canadian Council of Ministers of the Environment (CCME) or British Columbia Ministry of Environment (BCMOE) (whichever is the most recent) water quality guidelines for the protection of aquatic life are also displayed where applicable for comparative purposes. The lower (i.e., 25th) percentile hardness and dissolved organic carbon (DOC) and the upper (i.e., 75th) pH for the nearest receiving environment was used to calculate hardness-dependent guidelines based on the 2013 to 2017 dataset:

- Station KV-51 in Christal Creek was used for Flame & Moth waste rock (25th percentile hardness 527 mg/L; 25th percentile DOC 8.6 mg/L and 75th percentile pH 7.3); and
- Station KV-21 in No Cash Creek was used for Bermingham waste rock (25th percentile hardness 327 mg/L).

5.1 HUMIDITY CELLS

5.1.1 Flame & Moth

One humidity cell was conducted using a composite of N-AML Flame & Moth waste rock and operated for 98 weeks. Details regarding the composition (ABA, metal content, etc.) of this humidity cell can be found in AEG (2016b).

pH, Acidity, Alkalinity and Sulphate

The Flame & Moth N-AML humidity cell leachate remained slightly alkaline, ranging from pH 7.5 to 8.4 (Figure 5-1)throughout the test period., The alkalinity was higher than the acidity generated during the entire test period. But declined from a peak of 127 mg/L $CaCO_3$ at week 1 to stabilize between 49 and 61 mg/L $CaCO_3$ since week 60 (Figure 5-1). Acidity was not measured during the first 9 weeks of humidity cell operations. At week 10, acidity was 16.9 mg/L $CaCO_3$, but since then remained below 6 mg/L $CaCO_3$, typically ranging between 1 and 2 mg/L $CaCO_3$ (Figure 5-1). Dissolved sulphate concentrations were the highest during the initial rinse cycle (183 mg/L at week 0) as soluble metal sulphate salts, which likely accumulated during sample storage, were washed out of the cell. Sulphate concentrations then declined slightly before reaching a plateau of between 98.9 and 129 mg/L for weeks 2 to 11 (Figure 5-1), which was likely due to a supply of metal sulphides undergoing weathering within the humidity cell. Sulphate levels declined thereafter, stabilizing between 20 and 28 mg/L since week 66 (Figure 5-1). Sulphate concentrations was below the BCMOE guideline (429 mg/L) at all times.

Trace Elements of Interest

Concentrations of cadmium, zinc, silver, lead, nickel, and copper in the Flame & Moth N-AML humidity cell leachate were typically below their respective detection limits for the majority of the 98 week operation, and well below their respective water quality guidelines (Figure 5-1 and Figure 5-2).

Antimony concentrations were highest during the initial rinse (0.011 mg/L), marginally exceeding the BCMOE working water quality guideline (0.009 mg/L), before they gradually declined over time. Antimony concentration stabilized and remained ≤0.001 mg/L since week 41 (Figure 5-3). Arsenic concentrations exhibited a stable concentration between 0.00071 and 0.00091 mg/L between week 0 and week 15 (Figure 5-3). After week 15, arsenic levels began to slowly increase, reaching 0.0024 mg/L by week 54, before declining slightly and stabilizing between 0.0016 and 0.002 mg/L since week 70 (Figure 5-3). Throughout the test period, the humidity cell leachate arsenic concentration was still at least two times lower than the CCME guideline (0.005 mg/L).

Selenium concentrations in the humidity cell leachate showed a different pattern than all other constituents. it initially declined from the initial flush value of 0.0028 mg/L to approximately 0.001 mg/L over the first two weeks before rising sharply to a peak concentration of 0.0031 mg/L at week 8 (Figure 5-3). The selenium peak coincided with the sustained elevated sulphate levels, suggesting that the dissolution of selenium-bearing metal sulphides is the likely source of selenium, and hence result in these higher selenium concentrations. Dissolved selenium concentrations then tailed off sharply as it rose, stabilizing between 0.0003 and 0.0005 mg/L from week 31 onwards (falling below the BCMOE guideline of 0.002 mg/L after week 12).

It is estimated that that the time to sulphides and NP depletion are in order of 16 and 54 years, respectively, indicating that significant portion of NP will remain after the sulphide minerals have been exhausted. The humidity cell was terminated after the concentrations of constituents of interest have stabilized. Preliminary closedown static test results show that the acidity potentially generated from remaining sulphides is less than 0.5 kg CaCO3/t significantly lower than remaining NP (51 kg CaCO3/t).

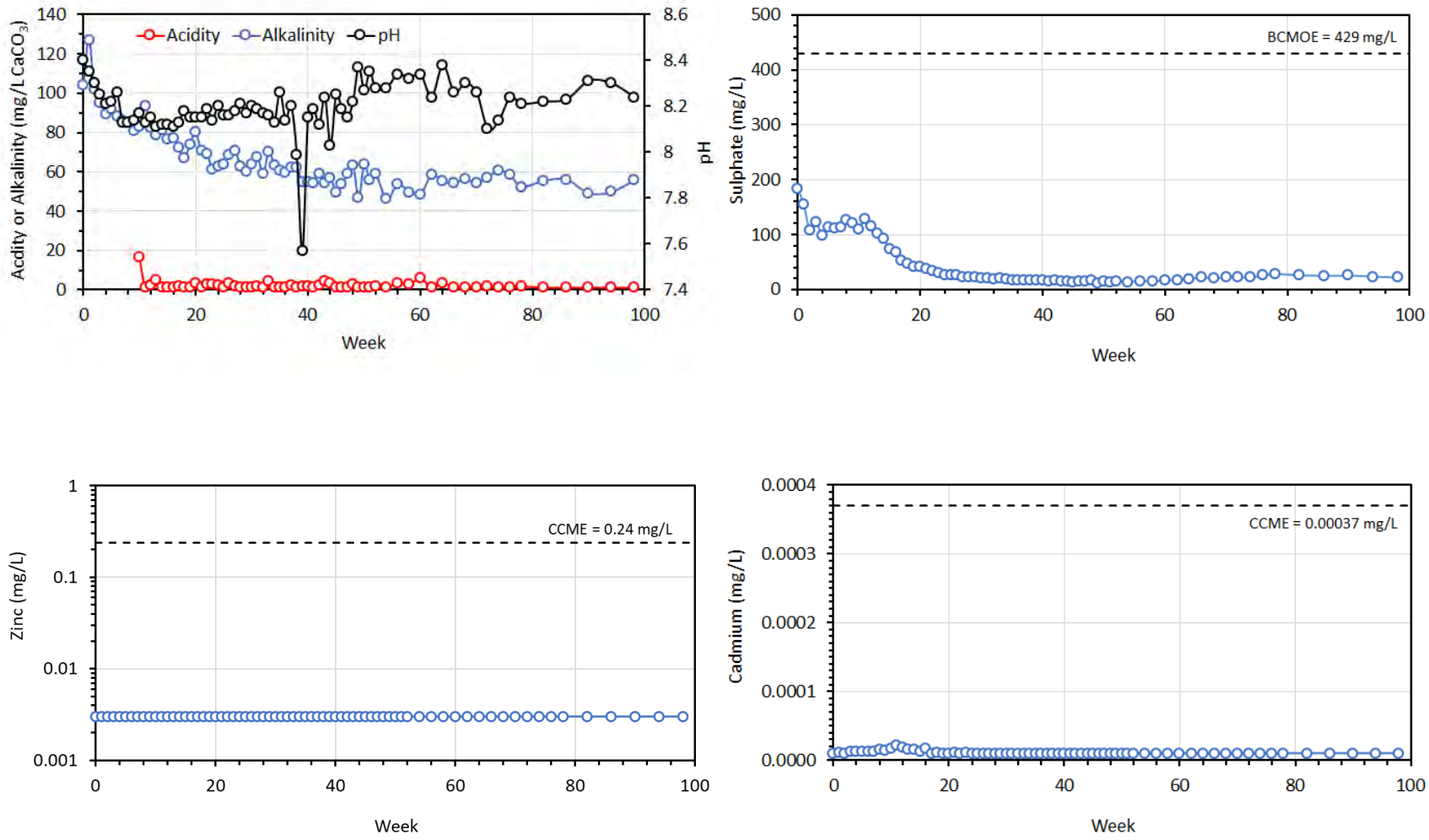


Figure 5-1: Acidity, Alkalinity, pH, Sulphate, Zinc and Cadmium Trends within the Flame & Moth N-AML Waste Rock Humidity Cell

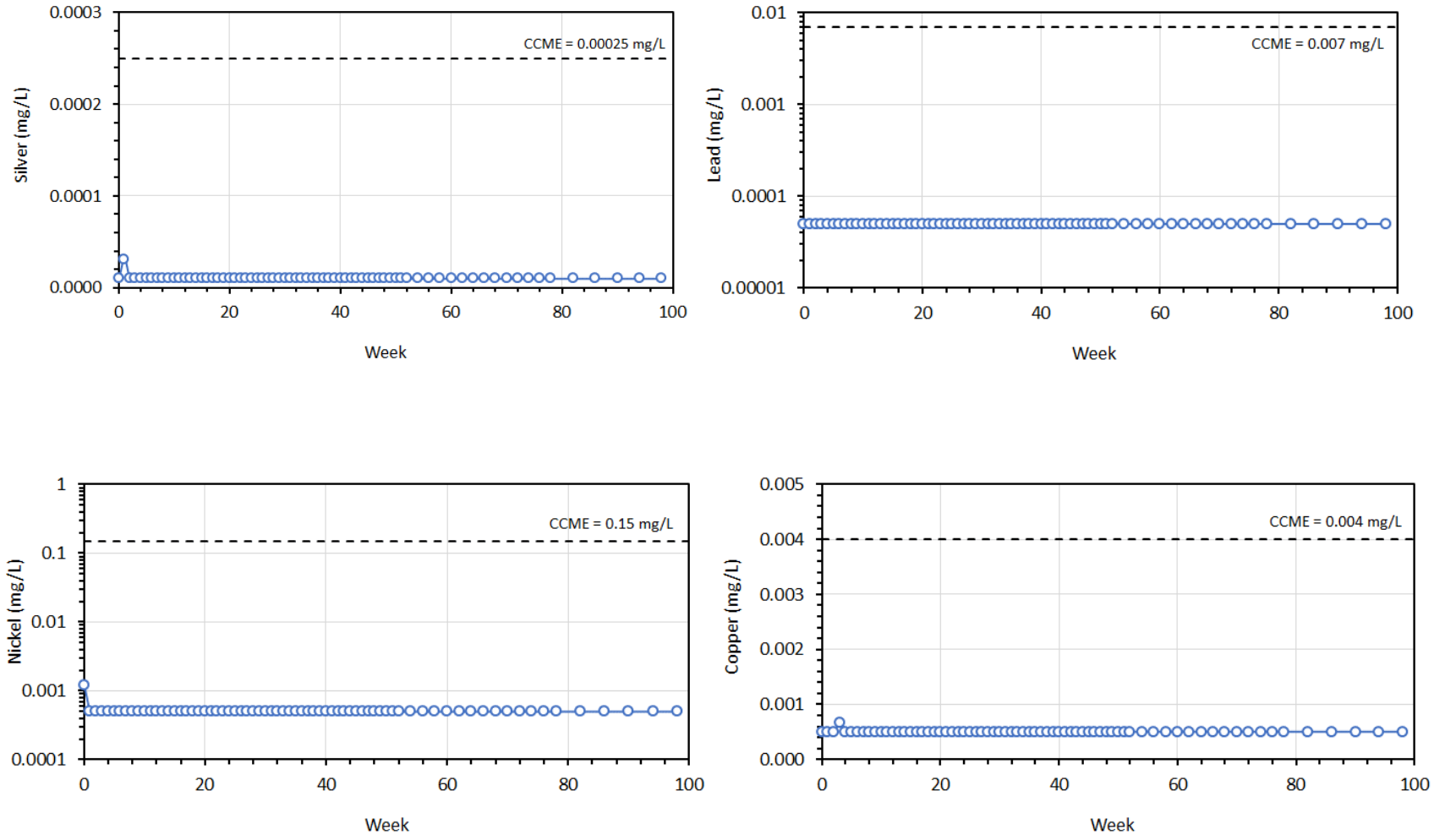


Figure 5-2: Silver, Lead, Nickel, and Copper Trends within the Flame & Moth N-AML Waste Rock Humidity Cell

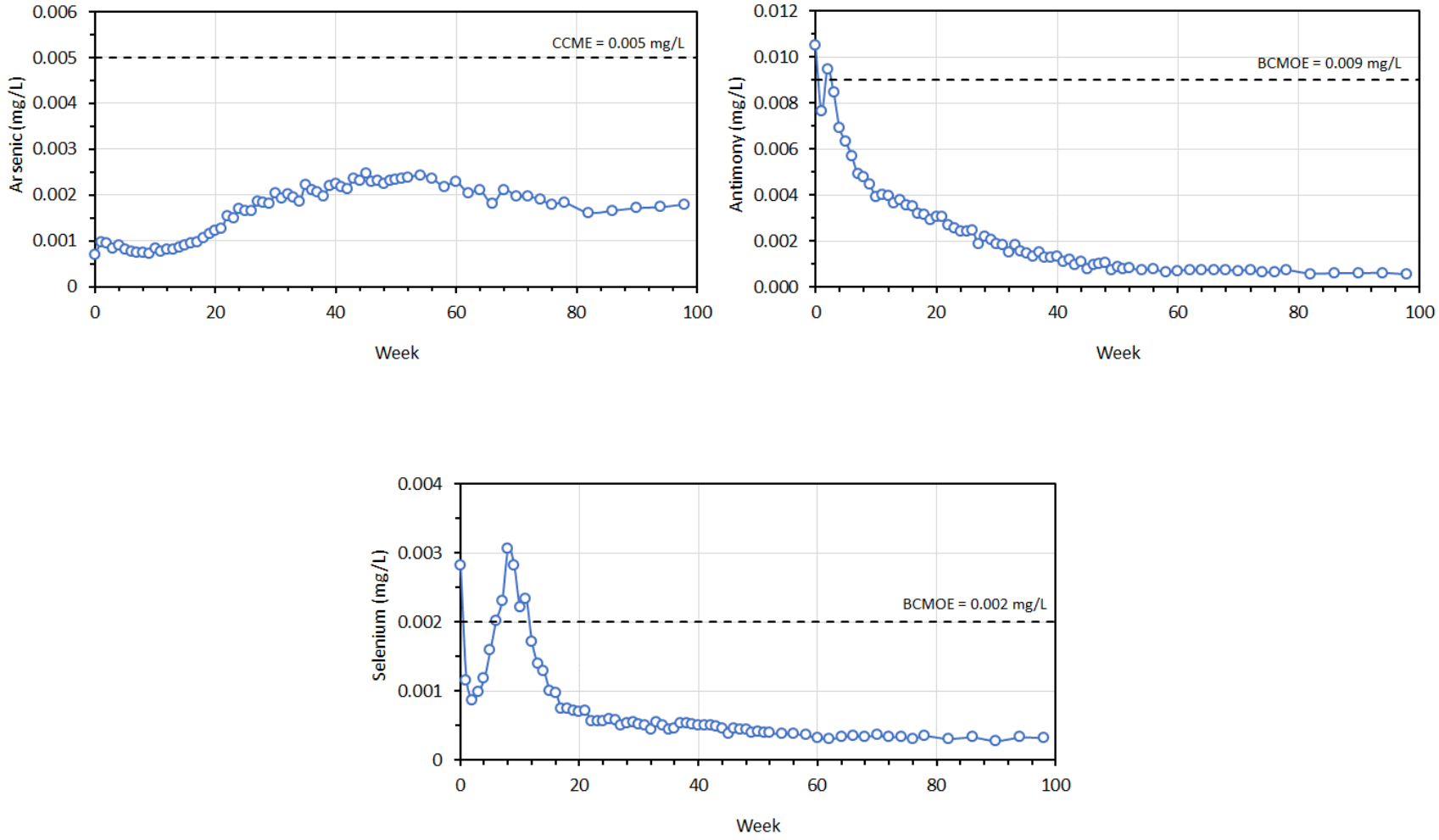


Figure 5-3: Arsenic, Antimony and Selenium Trends within the Flame & Moth N-AML Waste Rock Humidity Cell

5.1.2 Bermingham

Two waste rock humidity cells were operated to understand the potential for acid rock drainage and metal release rates from the Bermingham N-AML waste rock. The first humidity cell (HC-01) was constructed using a composite of N-AML Bermingham waste rock from cover holes with total sulphur and NP closer to the lower percentile (36%), NP close to the median (51%) of ABA data and an NPR of 4.1 (Total sulphur = 0.09 Wt.%; NP= 10.3 kg $CaCO_3$/t; AP= 2.5 kg $CaCO_3$/t). The cell also had elevated trace metal contents close to the 70th percentile and was operated for 57 weeks (Table 5-1). The second humidity cell (HC-03) was constructed using a composite of N-AML Bermingham waste rock from advanced exploration drill holes with total sulphur close to the 78th percentile, NP close to the 87% percentile, AP close to the 79% of ABA data and an NPR of 2.6 (Total sulphur = 0.36 Wt.%; NP= 29.0 kg $CaCO_3$/t; AP= 11.3 kg $CaCO_3$/t). The second cell also had elevated trace metal content close to the 90th percentile of the elemental data and was operated for 107 weeks (Table 5-2). Figure 5-4 to Figure 5-6 present the humidity cell leachate data collected for constituents of interest.

Table 5-1: Select ABA and Trace Element Composition of N-AML Humidity Cell Material HC-01

	Paste pH	Total Inorganic Carbon	Carbonate NP	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	AP	NP	Neutralization Potential Ratio
	pH Units	wt%	kg $CaCO_3$/t	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	N/A
	8.00	0.21	4.8	0.09	0.01	0.08	2.5	10.3	4.1
Percentile:	37%	63%	53%	36%	48%	36%	36%	51%	68%
	Arsenic	Antimony	Cadmium	Copper	Lead	Nickel	Selenium	Silver	Zinc
	ppm	ppm	ppm	ppm	Ppm	ppm	ppm	ppm	ppm
	41	2.4	0.39	12	12	15	1.1	0.38	76
Percentile:	81%	66%	65%	69%	66%	54%	80%	69%	69%

Table 5-2: Select ABA and Trace Element Parameter Composition of High Sulphide N-AML Humidity Cell Material HC-03

	Paste pH	Total Inorganic Carbon	Carbonate NP	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	AP	NP	Neutralization Potential Ratio
	pH Units	wt%	kg $CaCO_3$/t	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	N/A
	8.58	1.25	28.4	0.36	0.01	0.36	11.3	29.0	2.6
Percentile:	82%	95%	92%	78%	48%	79%	79%	87%	60%
	Arsenic	Antimony	Cadmium	Copper	Lead	Nickel	Selenium	Silver	Zinc
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	17	2.2	1.03	16	32	13	0.6	0.61	115

	Paste pH	Total Inorganic Carbon	Carbonate NP	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	AP	NP	Neutralization Potential Ratio
Percentile:	59%	62%	89%	77%	90%	47%	61%	79%	84%

pH, Acidity, Alkalinity and Sulphate

The Bermingham humidity cell HC-01 leachate was circumneutral (pH 6.7 to 7.6; Figure 5-4), with relatively low levels of alkalinity (4.5 to 16 mg/L $CaCO_3$) and negligible acidity (below or at the detection limit of 0.5 mg/L $CaCO_3$;). Sulphate concentrations were also low, ranging between 2.5 and 15.3 mg/L, over an order of magnitude lower than the sulphate WQO (524 mg/L; Figure 5-4).

The leachate from the higher sulphur cell HC-03 was also neutral to slightly alkaline (pH 7.3 to 8.1; Figure 5-4) with relatively low levels of alkalinity (9.0 to 42.1 mg/L $CaCO_3$) and acidity mostly below the detection limit except in a few cases (<0.5 to 1.1 mg/L $CaCO_3$). These parameters reflect the higher sulphide-sulphur and NP content of this cell compared to HC-01. Sulphate concentrations from HC-03 were also higher than HC-01, ranging between 10.9 and 42.8 mg/L, reflecting its elevated sulphur content. The sulphate concentration difference between the two cells has gradually widened after cycle 16. Sulphate concentration of the HC-03 was also several times lower than WQO (524 mg/L; Figure 5-4).

The sulphate release trends of the Bermingham cells were comparable to that of Flame & Moth but the concentrations released were different. Sulphate content of HC-01 was an order of magnitude lower due to its lower sulphide content compared to the Flame & Moth humidity cell composite sample. Bermingham HC-03 also had lower sulphate than Flame & Moth during the first 20 cycles, then the sulphate release rate increased resulting in higher sulphate in HC-03 over Flame & Moth after the 25th week until week 65 after which the concentration decreased below the Flame & Moth. Sulphate leached from HC-03 has decreased gradually since week 35 (37 mg/L) reaching sulphate level of 14.5 mg/L at the last week of testing.

Trace Elements of Interest

Aside from selenium in HC-01, antimony and copper in HC-03 the concentrations of all constituents of interest in the leachates of Bermingham N-AML humidity cells were consistently well below their respective WOQ, EQS, CCME or BCMOE values (Figure 5-4 to Figure 5-6). Selenium in HC-01 concentrations peaked at 0.009 mg/L after week one, then continued to decline gradually such that by week 11 (0.0018 mg/L) they were below the BCMOE (0.002 mg/L). Selenium concentration in HC-03 had a similar pattern as HC-01, but with concentrations constantly below HC-01 and the WQO. Selenium concentrations in HC-03 gradually decreased since the peak measured at week 03. It is worth nothing that among all constituents of interested analyzed only selenium concentrations were regularly higher in the Bermingham HC-01 leachate compared to Flame & Moth, except during weeks 8-9. Selenium concentrations in HC-03 were comparable to the Flame and Moth except between cycles 6 and 16 when the concentration in the Flame & Moth peaked. Copper concentration in HC-01 and HC-03 where consistently more than one order of magnitude below the WQO except for two isolated peaks at weeks 83 and 87 (0.0147 – 0.0175 mg/L) where the concentration exceeded the WQO. Copper concentration was consistently below the detection limit (0.0005 mg/L) in the Flame & Moth. Cadmium concentration in HC-01 and HC-03 were two to three orders of magnitude lower than the Bermingham EQS. Cadmium concentrations were higher in the Bermingham leachates than Flame & Moth during the first ~40 weeks before

declining and becoming comparable with Flame & Moth concentrations then lower during the last weeks of testing for HC-01 and HC-03. Arsenic concentrations in HC-01 and HC-03 were also more than an order of magnitude lower than the WQO. The arsenic concentrations were also higher in the Bermingham leachates than Flame & Moth during the first ~20 weeks, before gradually declining below the Flame & Moth concentrations thereafter (Figure 5-6)

The concentrations of arsenic, cadmium, zinc, lead, nickel, and copper in the Bermingham N-AML humidity cell HC-01 and HC-03 were relatively low and more than an order of magnitude below their water quality guidelines (Figure 5-4 through Figure 5-6). The concentrations of these elements in the Bermingham humidity cell leachates were initially lower or became lower during the last cycles than those observed in the Flame & Moth humidity cell; however, this is largely due to the better detection limits available for the Bermingham test work and the high detection limit used in Flame & Moth. Silver was below the detection limit in all humidity cells.

Aside from selenium, HC-03 had higher (pH, sulphate, zinc, cadmium, nickel, antimony, and molybdenum) or comparable (copper) leachate concentrations compared to HC-01 reflecting its higher sulphur and bulk metal contents. HC-03 had lower lead, arsenic and selenium at during the last 20 weeks of operation of HC-01.

The time to sulphide and NP depletion in the Bermingham N-AML waste rock humidity cell HC-01 was calculated to be 21 and 39 years, respectively, while HC-03 provided shorter sulphide depletion times (18 years) and NP depletion time (21 years). This indicates that a significant portion of NP will remain in HC-01 after the sulphide minerals have been depleted but only a limited amount of NP will remain after HC-03 is depleted from its sulphide sulphur. Both humidity cells were terminated after the concentrations of constituents of interest had stabilized. Closedown static test data for HC-01 and HC-03 indicated that the acidity potentially from the remaining sulphides was less than 2 and 8.8 kg $CaCO_3$/t, respectively, significantly lower than the remaining NP (7.3 and 49 kg $CaCO_3$/t, respectively), consistent with the sulphide and NP depletion calculations. The results are also consistent with the mineralogical data showing low sulphides (0.6 - 0.7wt.%) and the presence of reactive carbonates (0. 4 -2.0 wt.%) in the cell residues

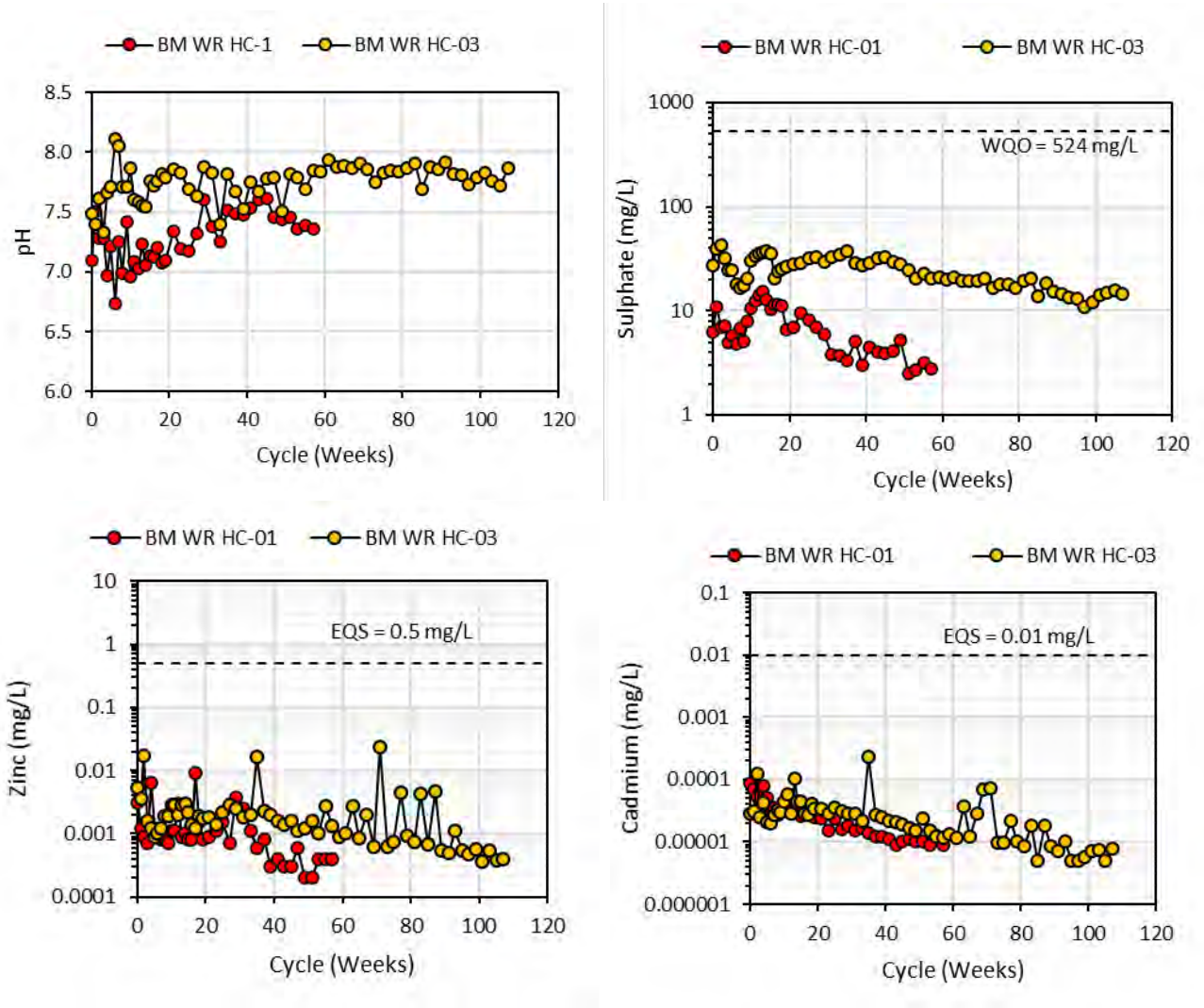


Figure 5-4: pH, Sulphate, Zinc and Cadmium Trends within the Bermingham N-AML Waste Rock Humidity Cells

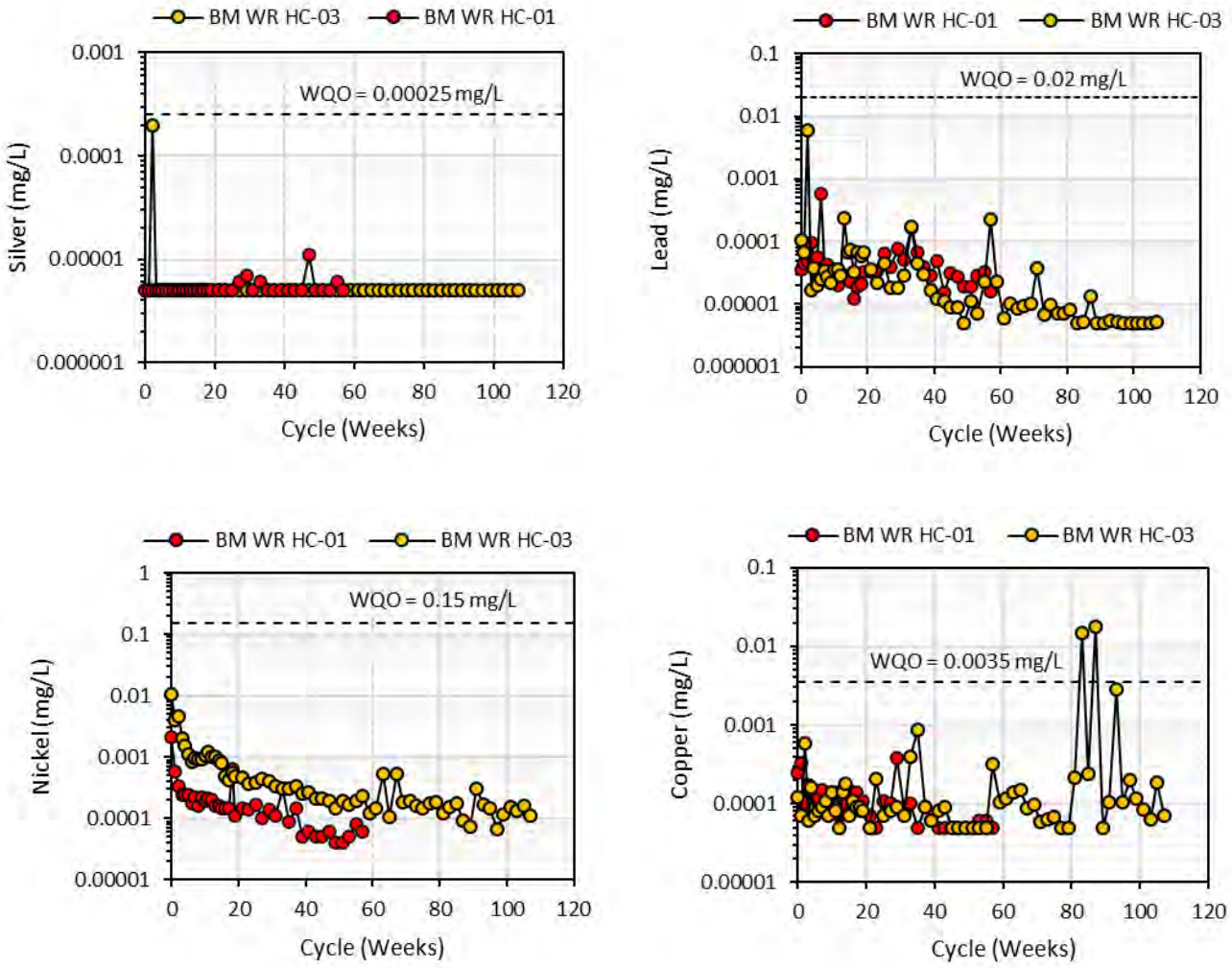


Figure 5-5: Silver, Lead, Nickel, and Copper Trends within the Bermingham N-AML Waste Rock Humidity Cells

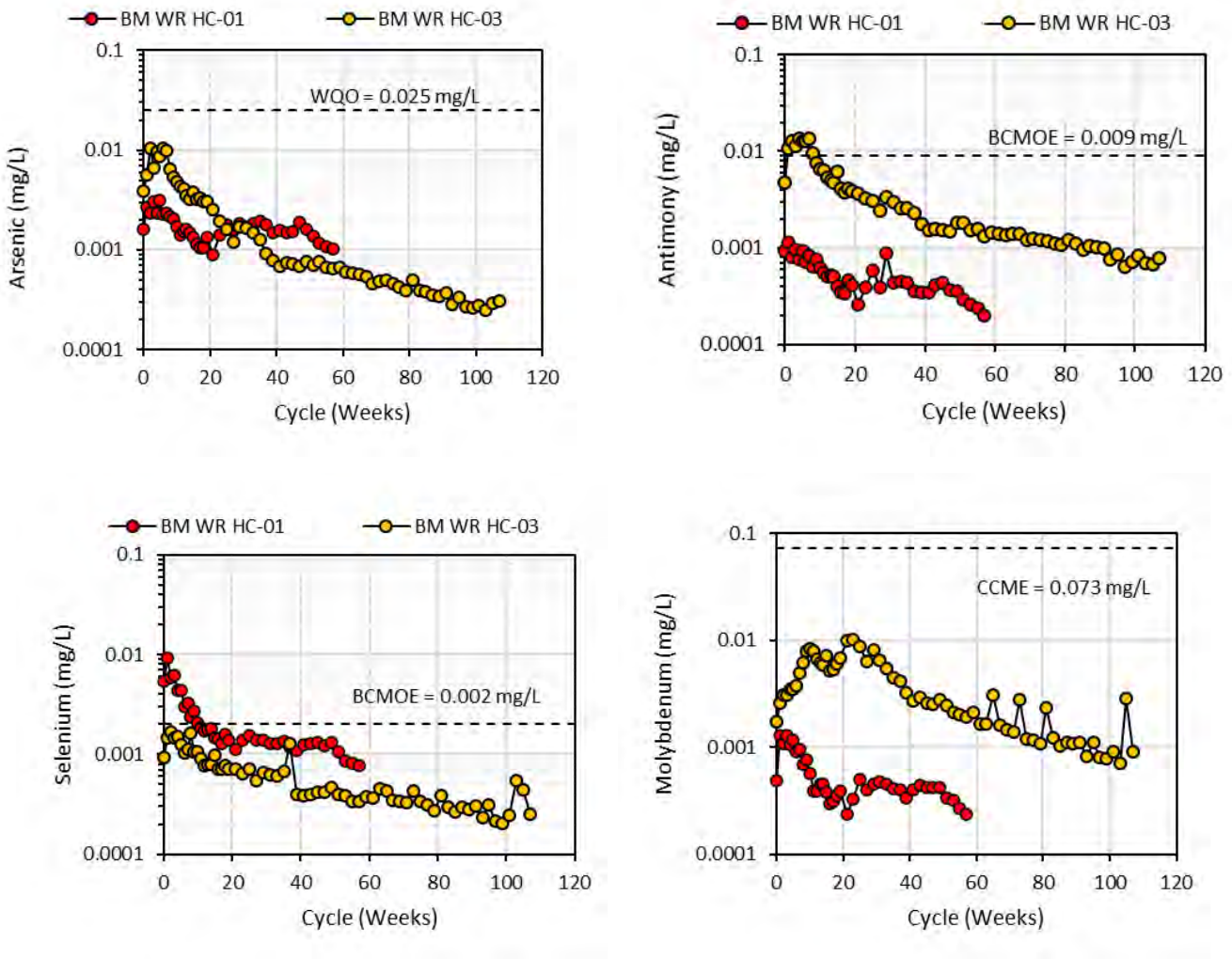


Figure 5-6: Arsenic, Antimony Selenium and Molybdenum Trends within the Bermingham N-AML Waste Rock Humidity Cells

5.2 FIELD BARRELS

Five field barrels containing Flame & Moth waste rock were constructed onsite in the June 2013 and continue to be monitored to date. Only field leach barrels 1 to 4 are used to evaluate the proposed Flame & Moth geochemical waste rock management screening criteria and their results are discussed and displayed here. The bulk composition of field bin 5 is not representative of the material to be generated by the screening criteria proposed for Flame & Moth; therefore, the results are not discussed in this memorandum.

Field barrels 1 through 4 were built to examine P-AML and N-AML from the dominant lithologies to be encountered in the development of the Flame & Moth deposit, specifically in the area of the decline. Field barrel 1 (FMB1) was filled with P-AML rock as indicated by its elevated sulphur content (median 2.79% sulphur), median NPR <1, and high maximum metal concentrations. Field barrel 2 (FMB2) was filled entirely with N-AML rock using the Bellekeno geochemical screening criteria, and has the highest median NP, relatively low sulphur content and lowest median and maximum metal content of all the field bins. Field barrels 3 and 4 (FMB3 and FMB4) were filled with N-AML rock using the proposed Flame & Moth screening criteria, but which according to the Bellekeno screening criteria contained portions of P-AML designated waste rock. This is primarily reflected in the sulphur content (median 0.39% and 0.43% for FMB3 and FMB4, respectively) and NPR (median 1.9 and 3.1 for FMB3 and FMB4, respectively) for these field barrels. These field leach barrels were constructed to examine the impact of P-AML rock on the overall acid rock drainage/metal leaching (ARD/ML) behaviour from the dominantly N-AML waste rock materials that would be extracted and stored within surface waste rock dumps during the development of the Flame & Moth decline/deposit. Further details regarding the composition of the field barrels can be found in AEG (2016b). All the barrels are generally sampled at least four times a year except in 2019 when they were only sampled twice due to dry conditions and lack of leachate in the collection bins.

pH, Acidity, Alkalinity and Sulphate

The field barrel leachate pH fluctuated but has remained circumneutral to slightly alkaline during most of the monitoring period until 2016. Since 2016, leachate pH below 6.5 was constantly observed in FMB1 and occasionally observed (three times) in FMB2. FMB1 generally displayed the lowest pH values (below pH 6.0 since September 2017) consistent with its P-AML designation, whereas the highest pH values were often recorded in the leachate from FMB3 although its pH decreased below 6.5 during the September 2018 and 2019 samplings events. All N-AML barrels had leachate pH <6.5 during the September 2018 and 2019 sampling events except FMB4 that had a pH of 7.6 in 2019.

This trend was reversed for the acidity levels, where FMB1 consistently exhibited significantly higher acidity (<1.0 – 226 mg/L $CaCO_3$) than observed for FMB2, FMB3 and FMB4 (<1.0 – 4.8 mg/L $CaCO_3$; Figure 5-7). The acidity difference between FMB1 and the N-AML barrels increased significantly as the test progressed reaching about 200 mg/L $CaCO_3$ during the 2018 last two sampling events then the gap decreased to 40 mg/L in May 2019. The September 2019 acidity result for FMB1 was unusually high as the concentration reached 1560 mg/L $CaCO_3$. Since the cell had remained undrained since May 2019, it is believed that soluble products had accumulated in the barrel between May and July and were flushed out in September 2019. Alkalinity levels showed some limited correlation with pH, as FMB1, which was had the lowest leachate pH range also had the

lowest alkalinity (<0.5 – 56 mg/L $CaCO_3$). This is consistent with the P-AML bulk rock materials composition that comprised FMB1. In general, alkalinity levels were the highest at the start of the field barrel experiment and declined gradually as the test progressed. FMB1 alkalinity was below the detection limit during the last six sampling events indicating a depletion of buffering capacity and explaining the acidic leachate pH observed.

FMB1 and FMB3 showed the highest and lowest dissolved sulphate concentrations, respectively (Figure 5-7). Dissolved sulphate concentrations were typically highest in the warmer summer months (July-September) and lowest for the spring and fall sampling events, except for the 2017 and 2018 datasets, which showed a general increase in sulphate concentrations through the year (Figure 5-7). Indeed, leachate from the P-AML FMB1 recorded its highest sulphate concentration to date (4,930 mg/L) in the September 2019 sampling event. FMB1 sulphate concentrations always exceeded the BCMOE guideline (429 mg/L), leachate from FMB3 generally had sulphate concentrations below the BCMOE guideline, whereas the sulphate concentration in FMB2 and FMB4 oscillated about the BCMOE guideline. All field barrel samples exceeded the BCMOE sulphate guidelines in September 2019 likely due to the build up of soluble products in the field barrels between May and July and subsequent flushing in September.

Trace Elements of Interest

The trace element leaching trends were broadly consistent with the P-AML / N-AML classification of the rock that comprised each field barrel. FMB1 was composed of P-AML material and the leachate from this bin regularly contained the highest concentrations of zinc, cadmium, nickel, lead, copper, and silver (Figure 5-8 and Figure 5-9) with cadmium and zinc constantly exceeding the EQS and nickel and copper in exceedance since August 2016. FMB2, FMB3, and FMB4 were primarily composed of N-AML rock. These field barrels generally exhibited much lower zinc, cadmium, nickel, lead, copper, and silver leachate concentrations, and did not exceed any QZ09-092 EQS except six copper exceedances in FMB4 between 2016 and 2019, one copper exceedance in FMB2 in 2017, and one cadmium and zinc exceedance in FMB3 in 2019 (Figure 5-8 and Figure 5-9).

Zinc

Leachate from the N-AML rock-bearing materials found within FMB4 had the lowest zinc concentrations, which were consistently below the CCME guideline (0.24 mg/L; Figure 5-8). Leachate zinc concentrations from FMB2 were also typically lower than the CCME guideline although higher than FMB4. Leachate zinc concentrations from FMB3 were higher than FMB2 and FMB4, recurrently higher than the CCME guideline but constantly lower than the EQS for zinc (0.5 mg/L) except during the last sampling event when unusually high sulphate and low pH were observed. FMB1 consistently showed the highest zinc concentrations (0.4 – 105 mg/L) between 2013 and 2018 and an unusually high zinc release in September 2019 (722 mg/L). Almost all the FMB1 samples exceeded the EQS for zinc and were one to two orders of magnitude higher than the zinc levels recorded in the other field barrels. Zinc concentrations observed in 2017 and 2018 in FMB1 had comparable patterns and the leachate zinc levels were generally higher than in previous years, consistent with the higher sulphate (2017) and acidity levels (2017 and 2018). This metal leaching behaviour is in line with the predominantly P-AML rock that comprises FMB1. The zinc concentration in leachates collected from the N-AML field leach barrels FMB1, FMB2, and FMB3 have not exceeded the EQS to date except for the last sampling event for FMB3 (September

2019). The high zinc release in 2019 coincided with the highest sulphate release indicating a common source, likely the flushing of soluble weathering products stored in the field barrels since May 2019 sampling event.

Cadmium

Cadmium concentrations followed remarkably similar trends to those of zinc (Figure 5-8). The cadmium concentration in the leachate for all the field barrels FMB1 and FMB3 exceeded the CCME guideline (0.00037 mg/L) for all samples collected to date. FMB2 leachate cadmium concentrations also regularly exceeded the CCME guideline with one decrease below the CCME guideline in 2015. FMB4 cadmium concentrations were regularly lower or slightly higher than CCME (Figure 5-8) except in September 2019 when the concentration was almost one order of magnitude higher than CCME guideline. FMB1 displayed the highest leachate cadmium levels (0.01 – 1.5 mg/L), all of which exceeded the EQS (0.1 mg/L), further confirming the P-AML nature of the rock used for this field barrel. Like zinc, cadmium concentrations observed in 2017 and 2018 in FMB1 leachate had similar patterns and were generally higher than in previous years, consistent with the higher sulphate (2017 and 2019) and acidity levels (2017 – 2019) observed. Leachate from the other three N-AML rock filled field barrels contained cadmium levels that were below the EQS except the last sampling event of FMB3 where the concentration exceeded the EQS (0.0315 mg/L) Like zinc and sulphate, unusually high cadmium concentrations were recorded in all field barrels in September 2019.

Nickel

Nickel concentrations were highest in the leachate from the P-AML rock-bearing materials in FMB1 (Figure 5-8). The nickel level exceeded the CCME threshold (0.15 mg/L) for all FMB1 samples collected since June 2015, with the EQS nickel threshold (0.5 mg/L) exceeded in three consecutive sampling events in the summer and fall of 2015, and the majority of sampling events since July 2016. Like zinc and cadmium. nickel concentrations observed in 2017 and 2018 in FMB1 leachate were generally higher than in previous years, consistent with higher sulphate (2017 and 2019) and acidity levels (2017 – 2019). The nickel concentrations in the leachate collected from the three N-AML field barrels (FMB2, FMB3 and FMB4) have gradually declined over the monitoring period until September 2019 when relatively high nickel concentrations were recorded. Nickel concentrations in leachate from FMB2, FMB3 and FMB4 never exceed the CCME guideline or the EQS (Figure 5-8). Like zinc, sulphate, and cadmium, unusually high nickel concentrations were measured in all field barrels in September 2019 likely due to accumulation of soluble nickel-bearing weathering products over the summer.

Lead

The leachate from FMB1 generally contained the highest lead concentrations (0.0013 – 0.74 mg/L), which constantly exceeded the CCME threshold (0.007 mg/L; Figure 5-8) since August 2016, and hence confirmed the P-AML nature of the rock materials used in this field barrel. Like other metal(loids), lead concentrations observed in 2017, 2018, and 2019 in FMB1 leachate were generally higher than in previous years, consistent with the higher sulphate (2017 and 2019) and acidity levels (2017,2018 and 2019). Lead concentrations in FMB1 exceeded the EQS (0.2 mg/L) in July 2018 and September 2019. Lead concentrations in the leachate from the three N-AML field barrels (FMB2, FMB3 and FMB4; 0.00017 – 0.027 mg/L) were typically below the CCME guideline (0.007 mg/L) except in a few instances for FMB2 (June and July sampling events of 2015 – 2017 and September 2019) and one instance for FMB4 (September 2019). Like previous elements of interest and sulphate, the highest lead concentrations observed to date were recorded in September 2019, likely related to

flushing of soluble lead-bearing minerals that accumulated during weathering of the P-AML material over the summer. The lead concentrations from the N-AML field barrels in September 2019 was largely consistent with historical levels.

Copper

Copper concentrations followed a similar trend to those observed for lead except there was a higher rate of exceedances of the CCME copper guideline and EQS in leachates from N-AML barrels. The P-AML rock-bearing field leach barrel FMB1 (0.003 – 7.7 mg/L) generally exhibited the highest copper concentrations over the monitoring period, exceeding the EQS (0.1 mg/L) in the first three monitoring events in 2013 and for the majority or all of the 2017 – 2019 sampling events (Figure 5-9). Copper concentrations in leachate from N-AML FMB3 remained below both the EQS and CCME guideline (0.004 mg/L) for the majority of sampling events since late 2014 except in August 2018 and September 2019 when the leachate concentration surpassed the CCME guideline. Conversely, FMB2 exceeded the copper EQS once in 2017 and FMB4 periodically exceeded the EQS since 2016. Leachate copper concentrations from both FMB2 and FMB4 frequently exceeded the CCME threshold since the beginning of each test (Figure 5-9). Like other metals, an unusually high copper concentration was measured in FMB1 in September 2019 due to flushing of accumulated secondary weather products. The copper concentrations observed in the leachate from the N-AML field barrels in September 2019 were broadly consistent with historical levels.

Silver

The P-AML FMB1 displayed the highest silver concentration in its leachate (<0.00005 – 0.001 mg/L). It was not particularly elevated compared to the other N-AML field barrels (<0.00001 - 0.0001 mg/L; Figure 5-9) until September 2017 after which the silver concentration in the leachate from N-AML field barrels was typically below the detection limit whereas the P-AML silver concentration remained an order of magnitude higher. Only the initial sampling event and the September 2019 sample (0.00046 and 0.001 mg/L, respectively) exceeded the silver CCME guideline (0.00025 mg/L). The silver levels in leachate from other FMB1 sampling events and all the N-AML field barrels were below the CCME threshold and more than two orders of magnitude lower than the EQS (0.02 mg/L).

Arsenic

The leachate from FMB1 and FMB3 contained comparable levels of arsenic (typically 0.0005 – 0.012 mg/L), which were below the CCME threshold (0.005 mg/L) for all but three FMB1 samples collected to date (Figure 5-9). Arsenic concentrations in leachate from FMB2 and FMB4 were also comparable (0.006 – 0.019 mg/L), higher than FMB1 and FMB3, and exceeded or were comparable to the CCME limit for the majority of samples collected to date (Figure 5-9). The arsenic concentrations in all the field barrel leachates were well below the EQS (0.1 mg/L). Unlike all elements of interests discussed thus far, no increase of arsenic concentration was observed in any of the N-AML field barrels in September 2019.

Antimony

The antimony leaching behaviour was similar to that of arsenic. The lowest antimony concentrations were observed in leachate from FMB1 and FMB3 (0.0013 – 0.026 mg/L), in which the majority of the samples

collected to date were at, or below the BCMOE working guideline (0.009 mg/L) (Figure 5-9). The antimony levels in the leachate from FMB4 and FMB2 were all above or comparable to the BCMOE guideline, with the latter field barrel showing the highest antimony concentrations (0.012 – 0.071 mg/L). A declining trend in the leachate antimony concentration from the field barrels was broadly observed for all barrels. Like arsenic no increase of antimony concentration was observed in any of the N-AML field barrels in September 2019.

Selenium

The leachate selenium concentrations exceeded the BCMOE guideline (0.002 mg/L) for all samples collected to date from the FMB2 and FMB4 field barrels, and for the majority of samples collected from FMB1 and FMB3 (Figure 5-10). The lowest (FMB3: 0.00037 – 0.0087 mg/L) and highest (FMB2: 0.002 – 0.065 mg/L; FMB4: 0.0037 – 0.034 mg/L) selenium concentrations were observed in the leachate from the N-AML field barrels, suggesting that the leaching behaviour of this element cannot be predicted based on AML classification. It is however worth noting that an identical selenium pattern was observed for all field barrels since June 2016 despite the difference in selenium absolute concentrations. Also, an increase in leachate selenium concentration was observed in all field barrels in September 2019.

The similar patterns of zinc, cadmium, nickel, copper, and lead and their high concentration in the P-AML leach barrel FMB1, coincident with high sulphate and acidity levels, indicate a common source via sulphide oxidation. Conversely, the low concentrations of arsenic, antimony, and selenium in FMB1 leachate compared with the N-AML field barrels may suggest lower release rate of oxyanions under acidic conditions of the P-AML rock drainage compared with circumneutral N-AML drainage. A decrease of pH below 6.5 was observed in FMB3 in September 2018 and 2019. This tendency toward acidic pH may explain the low concentrations of arsenic, antimony and selenium in this barrel similar to that observed for the P-AML FMB1.

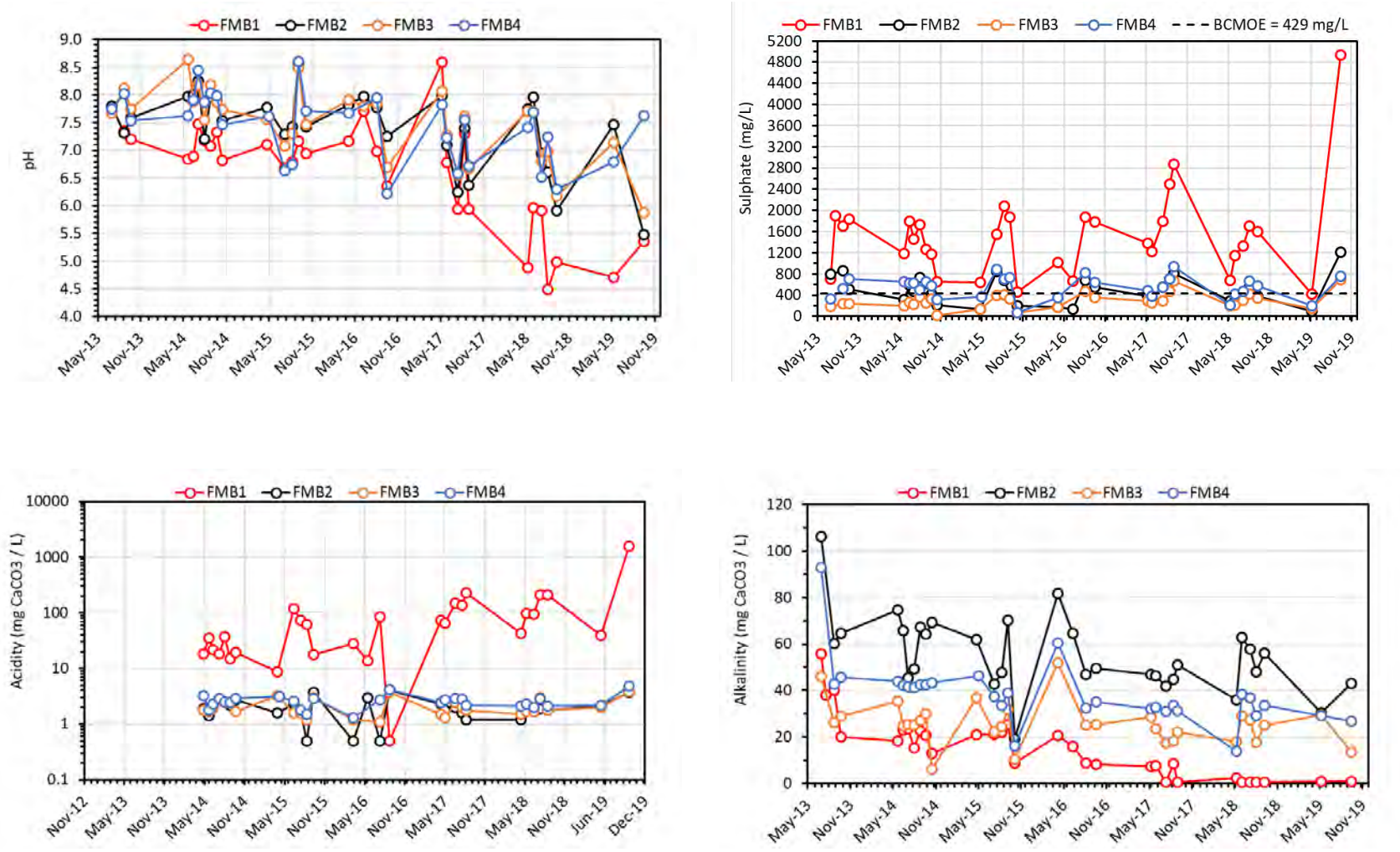


Figure 5-7: Trends in Flame & Moth Waste Rock Field Barrel pH, Sulphate, Alkalinity and Acidity Levels

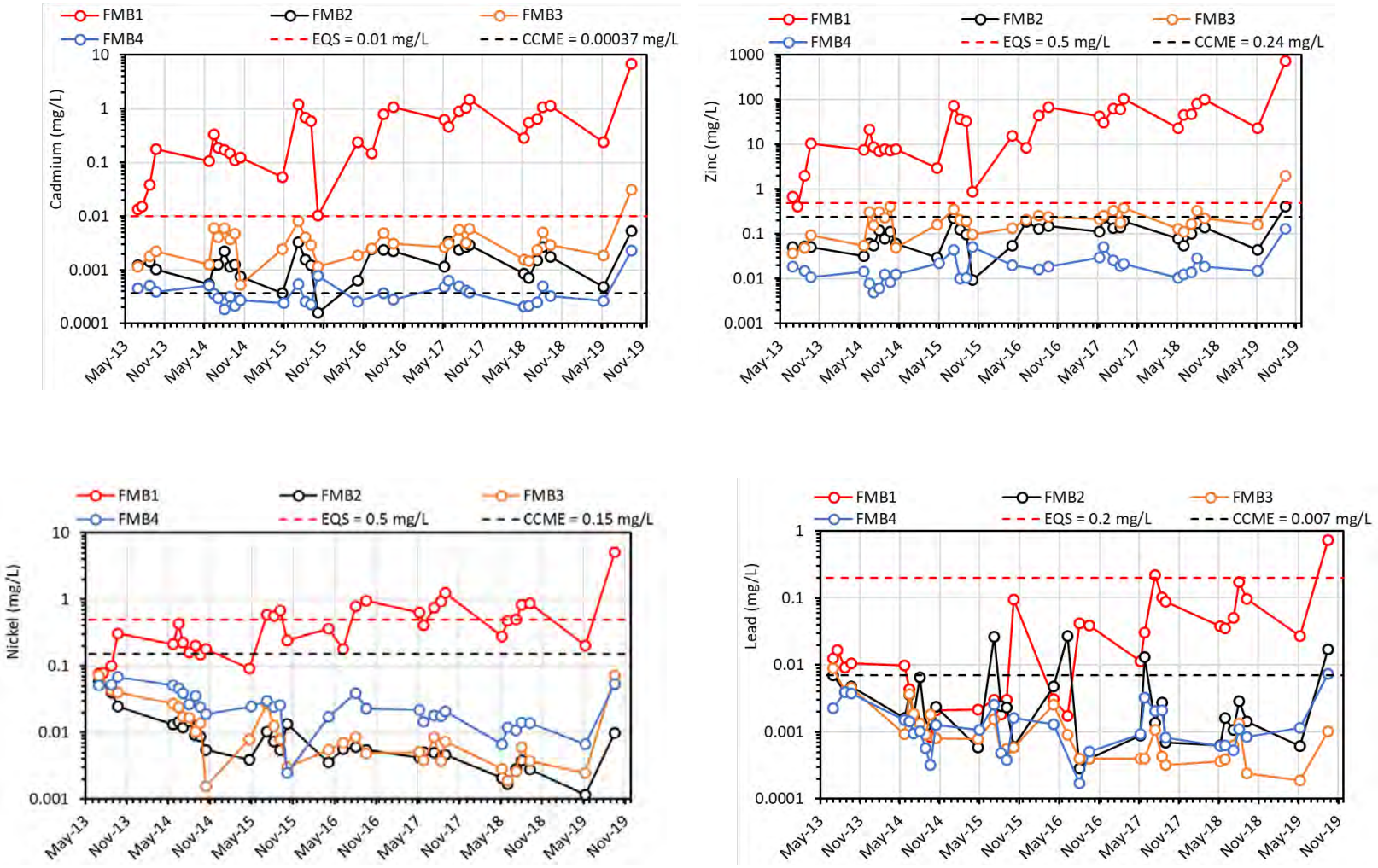


Figure 5-8: Trends in Flame & Moth Waste Rock Field Barrel Cadmium, Zinc, Nickel, and Lead Concentration

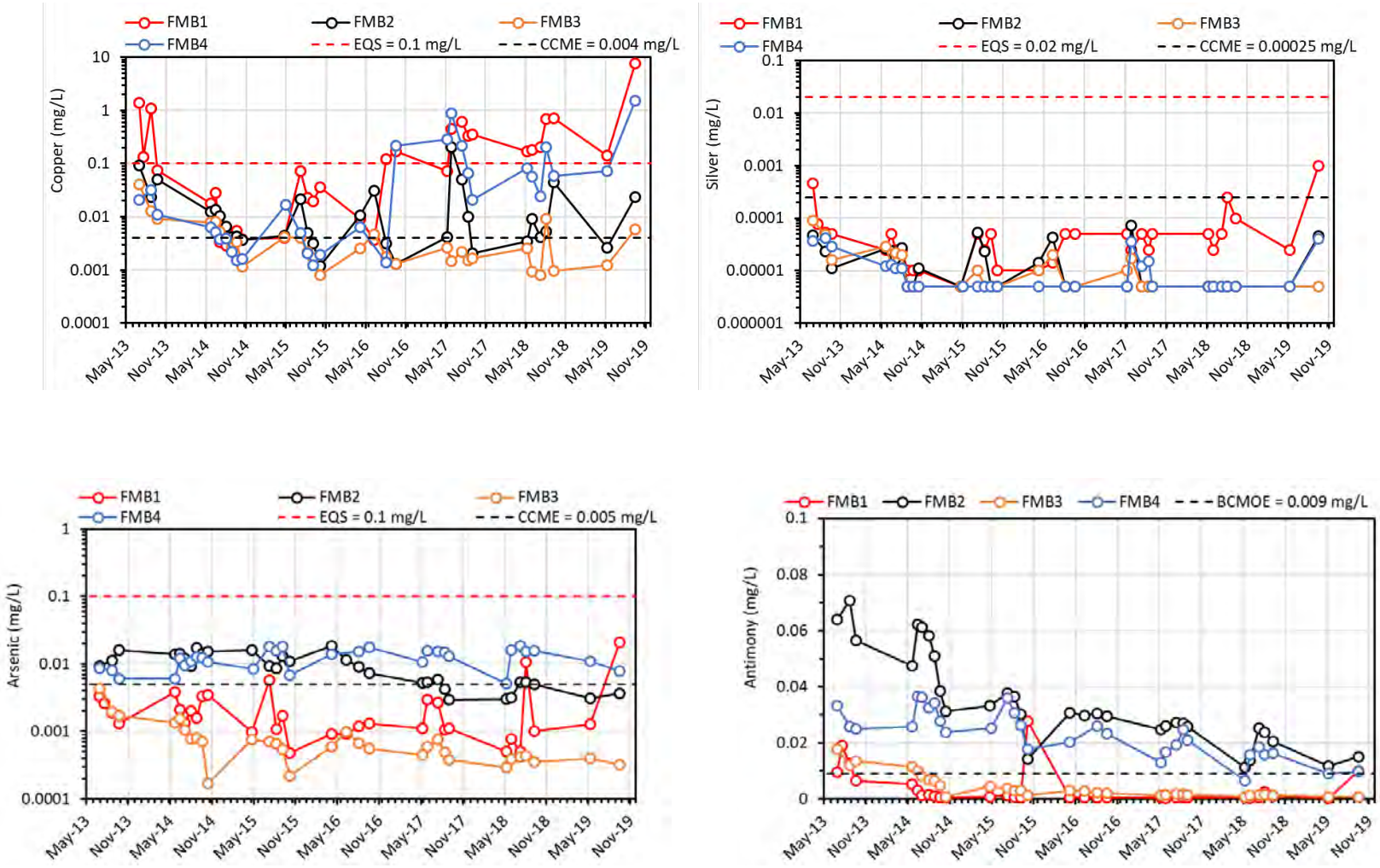


Figure 5-9: Trends in Flame & Moth Waste Rock Field Barrel Copper, Silver, Arsenic, and Antimony Concentrations

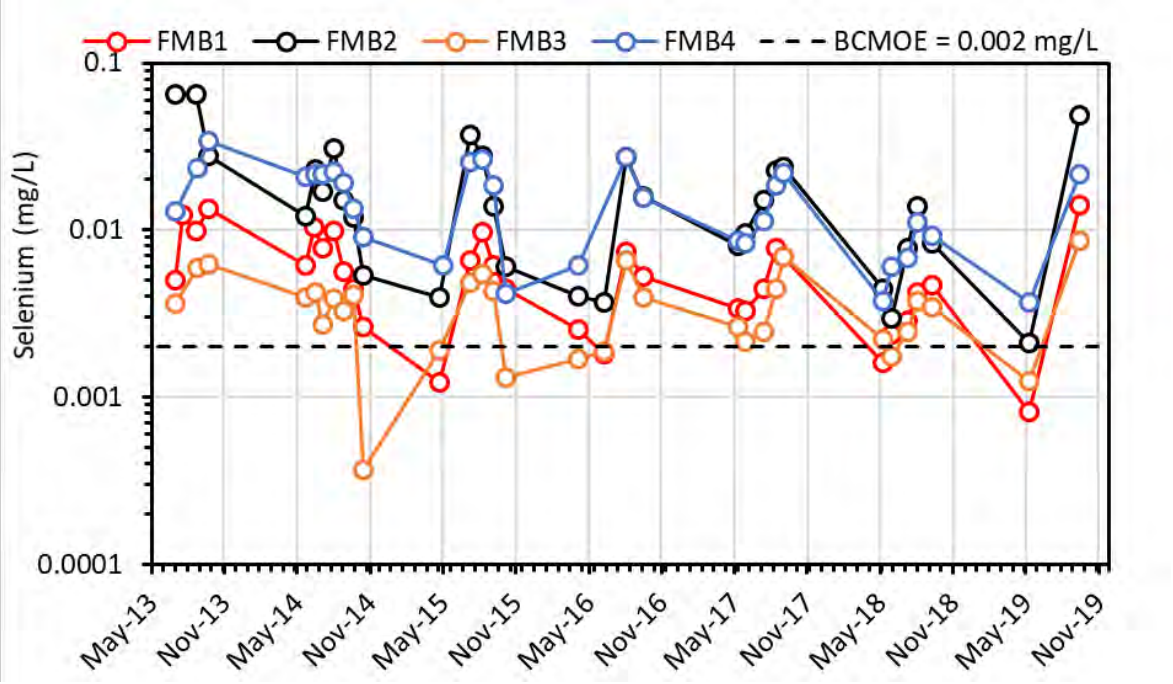


Figure 5-10: Trends in Flame & Moth Waste Rock Field Barrel Selenium Concentrations

6 SUMMARY

- Waste rock generated from deposits of interest within the KHSD is expected to be predominantly non-acid generating. Only waste rock from Silver King and Bermingham is expected to have a sizeable (68% and 29 %, respectively) PAG component, perhaps reflecting a regional control on waste rock ARD potential;

- SFE test suggested elevated soluble concentrations of fluoride, aluminum, antimony, arsenic, and selenium and potential exceedances of the CCME and BCMOE guidelines. Antimony predominantly exceed in samples from Flame & Moth, while the exceedances of arsenic were more recurrent at Bermingham;

- Humidity cell testing indicated higher pH and higher concentration release from the Flame & Moth compared to Bermingham waste rock cells except for arsenic (first 20 cycles only), antimony and cadmium with only antimony and selenium potentially exceeding the generic guidelines during early flushing events. Unlike HC-01, the high sulphur Bermingham cell HC-03 exceeded the sulphate released from the Flame & Moth after 5 months of testing then declined to half of Flame & Moth during the last cycles.

- Field kinetic testing of N-AML waste rock indicated that long-term metal leaching was expected to be low, although antimony, arsenic and selenium concentrations in leachate from some Flame & Moth N-

AML field barrels exceeded CCME and BCMOE guidelines by up to an order of magnitude. On the other hand, P-AML waste rock is expected to release elevated acidity and concentrations of sulphate, cadmium, nickel, lead, copper and zinc in excess of water quality guidelines. Abnormally elevated leachate acidity, sulphate, and metal concentrations were observed in most of the field barrels, especially in P-AML FMB1, for the September 2019 sampling event. This is a sporadic release likely due to poor flushing conditions during this dry year resulting in the storage of weathering products in the barrels following the May 2019 sampling event and their subsequent flushing in September.

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Memorandum

To: Alexco Keno Hill Mining Corp.

From: Cheibany Ould Elemine, P.Geo., Ensero Solutions Canada, Inc.

Date: September 9, 2020

Re: Geochemical Characterization of Bermingham Locked Cycle Tailings

1 INTRODUCTION

The Bermingham Mine Development and Production Project has received Water Licence QZ18-044 and amended Quartz Mining License QML-0009 authorizing the development and production of the deposit in addition to the Flame and Moth and Bellekeno deposits. This memorandum has been updated to satisfy the requirements of the Water Licence and Quartz Mining License.

The scope of the Bermingham Project includes the development of underground workings and ventilation/escape raise, construction of surface and underground infrastructure, underground definition drilling, development of ore accesses, mining and processing ore through the Keno District Mill, deposition of waste rock on surface, treatment and release of water and deposition of tailings in the licenced Dry Stack Tailings Facility (DSTF).

To characterize the acid rock drainage and metal leaching (ARD/ML) potential related to the tailings when exposed to oxidizing surface conditions, two large tailings samples were collected from the locked cycle (LC) metallurgical testing of Bermingham ore, and tested for their geochemical composition and properties. This technical memorandum summarizes the results of the geochemical static and kinetic tests conducted on these tailings material and provide a comparison with the tailings from Flame and Moth, Bellekeno, Lucky Queen, and Onek deposits in the Keno Hill District (KHSD).

2 TAILINGS SAMPLE PREPARATION

Two representative 5.5 kg tailings samples (Berm LCT1 and LCT2) were obtained from the LC metallurgical testing and sent to Maxxam Analytics, Burnaby, British Columbia for static and kinetic testing. Each tailings sample was homogenized without any further crushing prior to shake flask extraction analysis and kinetic testing. Two subsamples of the tailings were crushed further to 85% passing 200 mesh (75 µm) for acid base accounting, elemental, and X-ray diffraction analyses.

3 LABORATORY GEOCHEMICAL TESTING

The acid base accounting (ABA) test included: paste pH, total inorganic carbon, bulk neutralization potential by the siderite-corrected method, and sulphur speciation with the sulphide sulphur determined by difference between total sulphur (Leco) and sulphate sulphur (HCl extraction). A sequential net acid generation (NAG) test was done as a cross-check on the ABA test work. The metal content of the tailings samples was determined by *aqua regia* digestion followed by inductively coupled plasma mass spectrometry (ICP-MS) analysis, and the mineralogical composition determined by X-ray diffraction (XRD) with Rietveld refinement. A standard shake flask extraction (MEND SFE) test was also performed using a 3:1 liquid to solid ratio using deionized water as leaching fluid. Kinetic testing using the standard humidity cell (HC) was also performed using the LCT2 sample. The HC analysis was started in July 2018 and terminated on June 23, 2020 after operating for 103 weeks. The cell was terminated as per standard closedown procedure and its residue subjected to ABA, bulk elemental, and XRD analyses similar to the head sample. Detailed descriptions of each of the above analytical methods can be found in Price (2009).

4 RESULTS

4.1 ACID BASE ACCOUNTING

The results of the Bermingham ABA testing are presented Table 4-1 alongside those of the Onek F7+F8 tailings, Lucky Queen F9+F10 tailings, Flame & Moth F4+F5 composite tailings and the average of monthly ABA analyses of composite tailings samples produced from Bellekeno ore between January 2011 and July 2013 (ACG, 2015). These results show that the Bermingham LC tailings have a slightly alkaline paste pH (7.6-8.15), a very high carbonate neutralization potential (carbonate-NP; 184-204 kg $CaCO_3$/t) and relatively low bulk neutralization potential (bulk NP; 50.5-56 kg $CaCO_3$/t). The carbonate-NP was significantly (3.6 times) higher than the bulk NP due to the anticipated presence of a large proportion of iron and/or manganese carbonates such as siderite and ankerite that do not contribute to the net acid neutralization under oxidizing conditions. The sulphate content of the tailings samples was extremely low (at the detection limit of 0.01 wt. %) indicating that the bulk of sulphur (1.29-1.38 wt.%) of the tailings consists of sulphide-sulphur.

The tailings from other four deposits generally have similar ABA characteristics as Bermingham tailings: They had circumneutral to slightly alkaline paste pH (7.8 to 8.1) and high carbonate NP (273 to 389 kg $CaCO_3$/t). Their carbonate-NP was significantly higher than the siderite-corrected bulk NP (100 to 132 kg $CaCO_3$/t) indicating that ferrous and or manganese carbonates such as siderite ($FeCO_3$) comprise a substantial portion

of the carbonate mineralogy in the tailing like at Bermingham. The sulphate contents of the tailings from Flame & Moth, Bellekeno, Lucky Queen and Onek were also extremely low (maximum = 0.04 wt. %) indicating that the bulk of sulphur consists of sulphide-sulphur. The Bellekeno tailings contained the highest sulphide-sulphur content (2.21 wt.%), followed by the Bermingham tailings (1.29 and 1.38 wt.%). The tailings from the other three sites had sulphide-sulphur concentrations less than 0.5 wt.%; Table 4-1. The neutralization potential ratio (NPR), defined as the ratio of the (siderite-corrected) neutralization potential to the acid potential, provides an indication of acid generation over the long-term. A sample with an NPR less than one is termed "potentially acid generating (PAG), a sample with NPR greater than two is considered not potentially acid generating (non-PAG) and a sample with NPR between 1 and 2 is considered "Uncertain" with respect to acid generation and require further testing to confirm the potential ARD/ML classification.

The Bermingham tailings returned an NPR of 1.3 and was classified as "Uncertain" The other tailings had NPR greater than 2 except Bellekeno tailings which was classified as Uncertain (NPR = 1.9). Onek, Lucky Queen and Flame and Moth tailings where all non-PAG (calculated NPR > 7).

As indicated above, an NPR between 1 and 2 indicates that the potential to generate acid is Uncertain and further testing or expert judgment of the data available are needed to provide a final classification of the material. Given that the bulk NP available for acid neutralization may be underestimated due to the oxidation of Mn (II) during the siderite-corrected NP method, the NPR calculated for the Bermingham and Bellekeno tailings samples could be considerably higher. This is supported by detailed mineralogical examination of historic tailings deposited in the KHSD in which material initially classified as potentially acid generating by conventional ABA analysis but was found to be not potentially acid generating when its manganese carbonate content was included in the NPR calculation (SRK, 2009). Also, it is likely that the siderite calcian end-member will contribute some effective NP for acid neutralization.

Table 4-1: ABA Data for Bermingham LCT, Flame and Moth, Bellekeno, Lucky Queen and Onek Tailings

Sample	Paste pH	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	CO_2	CO_3-NP	Siderite-Corrected NP	AP	NPR
	pH Units	%	%	%	%	kg $CaCO_3$/t			Unitless
Berm LCT1	7.6	1.30	0.01	1.29	8.09	184	50.5	40.3	1.3
Berm LCT2	8.2	1.39	0.01	1.38	8.96	204	56.3	43.1	1.3
Onek F7 + F8 average	7.8	0.16	0.04	0.12	n/a	n/a	31.4	3.8	8.4
Lucky Queen F9 + F10 average	7.9	0.19	0.04	0.15	n/a	n/a	19.1	4.5	4.2
Flame & Moth F4+F5 Composite Tailings	8.0	0.45	0.02	0.43	17.1	389	100	14.1	7.1
Bellekeno Tailings, Jan 11- July 13 Monthly Avg.	8.1	2.3	0.02	2.21	12	273	132	71.7	1.9

AP: acid potential:
NP: neutralization potential
NPR: neutralization potential ratio

4.2 SEQUENTIAL NAG

The NAG test is often used as a cross check on the ABA results regarding potential for net acid generation. The NAG test rapidly oxidizes the sulphide in the sample by reacting it with an excess of hydrogen peroxide. In this work, the NAG test was performed sequentially such that four successive NAG cycles were conducted on the same sample to ensure all of the available sulphide-sulphur was oxidized. The pH of the NAG leachate after each cycle provides an indication of the capacity of the acid neutralizing minerals in the sample to buffer the acid produced from sulphide oxidation and therefore the overall net acid generation potential of the sample.

The results of the sequential NAG reported in Table 4-2 show that a negligible amount of acidity (i.e., 0.19 kg $CaCO_3$/t) was generated during the test and only during the first cycle suggesting a very low oxidation rate or that the sulphides content of the tailings is not reactive. The potential for acid generation is considered low because the NAG pH was circumneutral during the four cycles; the NAG test indicates a sample is non-PAG if the NAG pH is greater than 4.5. In short, the sequential NAG provides clarification regarding the "Uncertain" acid generation potential indicated by the ABA work – that is, net acid generation is not expected from these tailings. Ongoing kinetic testing will provide further confirmation of the ARD potential of the Bermingham tailings. The NAG test was not conducted on tailings from other sites to provide a site wide comparative assessment.

Table 4-2: Sequential NAG Data for Bermingham Locked Cycle Tailings

Sample ID	Cycle Number	NAG pH	NAG Volume to pH 4.5	NAG Volume to pH 7.0	NAG NaOH Conc.	NAG Acidity pH 4.5	NAG Acidity pH 7.0
		pH Units	mL	mL	N	kg $CaCO_3$/t	kg $CaCO_3$/t
Berm LCT2	Cycle 1	6.56	0.0	0.1	0.1	0.000	0.192
	Cycle 2	7.81	0.0	0.0	0.1	0.000	0.000
	Cycle 3	8.28	0.0	0.0	0.1	0.000	0.000
	Cycle 4	7.81	0.0	0.0	0.1	0.000	0.000

4.3 MINERALOGY

The mineralogical composition of the tailings was determined by XRD and the results of the test are reported in Table 4-3. These results show that the Bermingham tailings are mainly composed of quartz (SiO_2; 59.3 to 63.2 wt. %) and calcium rich siderite ($FeCO_3$; 21.2 to 27.8 wt. % as calcian siderite) similar to the Flame & Moth and Bellekeno tailings. The Bermingham tailings contain sulphide minerals, the main source of acidity, as pyrite (FeS_2; 1.6 to 2.2 wt. %), sphalerite (ZnS; 0.3 to 0.6 wt. %) and galena (PbS; 0.3 to 0.8 wt. %). Pyrite content was similar to the concentration in the Bellekeno tailings (2.3 wt.%) but Flame and Moth pyrite content were low (0.7 wt.%). Sphalerite and galena were less abundant or comparable in the Bermingham tailings samples than in the Bellekeno tailings (2.4 wt.% sphalerite; 0.6 wt.% galena) and completely absent from the Flame and Moth composite tailings.

In addition to calcian siderite, the Bermingham tailings contained another carbonate mineral, ankerite (Ca (Fe, Mg, Mn) $(CO_3)2$; 1.0 to 1.4 wt. %), with no effective buffering capacity. Ankerite was also identified in the

Bellekeno tailings (0.4 wt.%), but was not detected in the Flame & Moth composite. No calcite ($CaCO_3$) was detected in the Bermingham samples, which differed from the 1.2 and 3.2 wt.% calcite content in the Flame & Moth and Bellekeno tailings, respectively. These data indicate that the Bermingham tailings consist predominantly of geochemically inert silica (~ 60 wt. %) and iron and manganese carbonate minerals (28 wt. %) like other tailings. The major difference between the three is the lack of calcite in the Bermingham tailings, the lack of sphalerite and galena in the Flame and Moth tailings and the presence of trace chalcopyrite (0.1 wt. %) and wurtzite (0.2 wt. %) in Bellekeno tailings.

Iron and manganese carbonates have a net neutral buffering capacity under aerobic conditions because the amount of acidity consumed during dissolution is subsequently generated during the oxidation and hydrolysis of ferrous iron. However, the XRD data indicates a calcium rich siderite where substitution of calcium for iron occurs which may result in some neutralization capacity of a portion of the siderite.

The Bermingham potential AP estimated from the pyrite content of the tailings (AP = ~37 kg $CaCO_3$ /t) is slightly lower than the AP from the ABA meaning that the sulphide-sulphur from galena and sphalerite, minerals that do not generate acid when oxygen is the only oxidant, may be the source of excess of AP in the ABA test. The XRD data corroborate the Bermingham sample ABA showing that the lower siderite-corrected NP is likely due to the deficiency of calcite content relative to the other tailings. Although both the Bermingham and Bellekeno tailings samples share similar pyrite concentrations (1.6 to 2.2 and 2.3 wt.%, respectively), the higher AP for the Bellekeno sample mainly reflects its higher sphalerite content and the presence of trace chalcopyrite and wurtzite compared to that of the Bermingham samples. The low AP of the Flame & Moth sample is due to its low pyrite content (0.7 wt.%) and absence of other sulphides.

Table 4-3: Mineralogy of Bermingham LCT, Flame and Moth and Bellekeno Tailings

Mineral	Bermingham LCT1	Bermingham LCT2	Flame & Moth F4 + F5 Composite	Bellekeno Tailings Monthly Composite July 12 - Aug 13
Ankerite – Dolomite	1.4	1.0	-	0.4
Calcite, Magnesian	-	-	1.2	3.2
Cassiterite	-	-	0.5	-
Clinochlore	-	-	1.3	0.4
Dravite	-	-	3.2	-
Galena	0.8	0.3	-	0.6
Illite-Muscovite 2M1	9.6	8.2	2.5	6.6
Kaolinite	1.0	0.9	-	-
Pyrite	1.6	2.2	0.7	2.3
Quartz	63.2	59.3	45.2	52.6
Rutile ?	0.6		-	0.3
Siderite, calcian	21.2	27.8	45.3	29.8
Sphalerite	0.6	0.3	-	2.4
Plagioclase	-	-	-	0.8
Gahnite	-	-	-	0.2

Mineral	Bermingham LCT1	Bermingham LCT2	Flame & Moth F4 + F5 Composite	Bellekeno Tailings Monthly Composite July 12 - Aug 13
Chalcopyrite	-	-	-	0.1
Wurtzite	-	-	-	0.2
K-Feldspar	-	-	-	0.3
Total	100	100	100	100

4.4 METALS CONTENT

The bulk metal concentration of an element provides a preliminary indication of constituents that are elevated or depleted in a geologic material and should be monitored during leaching tests. However, the enrichment or depletion of a constituent in a sample is not a direct measure of their potential mobility or bioavailability (or lack thereof) because several parameters, including but not limited to, site hydrogeology, biogeochemistry, climate, pH and redox conditions ultimately determine the mobility and bioavailability of an element.

The results of the solid-phase metals analysis of the Bermingham LC tailings are presented in Table 4-4 alongside that of the Flame & Moth F4+F5 composite tailings, Onek F7+F8 tailings, Lucky Queen F9+F10 tailings, and the monthly average of tailings from Bellekeno between July 2012 and August 2013.

A premilitary screening of the tailings metal content against the 10x their crustal abundance (CRC, 2005) was done and revealed that antimony, arsenic, bismuth, cadmium, lead, manganese, selenium, silver, and zinc were typically high. The elevated metals and metalloids concentration were expected considering the source of the parent material (i.e., ore). The enrichment or depletion of metals in the Bermingham tailings was assessed by comparison with the tailings from other deposits and focused on a few of those identified during preliminary screening because of their potential for environmental concern namely; antimony, arsenic, cadmium, lead, selenium, silver and zinc.

The Bermingham tailings contained similar arsenic content to the Onek, ,1.7 and more than 5 times lower than Flame and Moth tailings and Bellekeno, respectively, and twenty times higher than the arsenic concentration in the Lucky Queen tailings. The highest antimony was in the Bellekeno (121 mg/L) and was nearly three times greater than the Bermingham (BERM LCT2) and Flame and Moth tailings and more than thirteen times that of Onek and Lucky Queen.

The cadmium and zinc concentration in the Bermingham tailings were higher than that of both the Lucky Queen (*ca.* 4- to 11-fold higher) and Flame and Moth (*ca.* 2- to 3-fold higher) tailings, but approximately 2- to 7-fold lower than the Onek tailings and Bellekeno, respectively. Lead content of the Bermingham tailings sample BERM LCT1 was 3 times higher than BERM LCT2 and was the highest among the all tailings. The lead content of BERM LCT2 was approximately 3 to 6 times higher than the Onek, Lucky Queen, and Flame and Moth tailings but 2.7 lower than Bellekeno tailings. The Bellekeno tailings generally had the highest concentration of these elements, with arsenic, antimony, cadmium, and zinc concentrations present at levels three- to seven-fold higher levels than those in the Bermingham tailings.

The Bermingham, Flame and Moth and Bellekeno tailings contained comparable concentrations of selenium concentrations. Bermingham tailings sample LCT2 and Bellekeno also had comparable silver content 50 to 56 ppm, that was four to seven time higher than Flame and Moth, Onek and Lucky Queen. But Bermingham tailings sample LCT1 had a silver concentration nearly twice that of Bellekeno.

The metal concentrations of lead and zinc are particularly elevated in Bellekeno, Lucky Queen and Bermingham tailings because they are the main base metals in sphalerite, galena chalcopyrite and wurtzite remaining in the tailing after processing as indicated by the results of XRD. The high concentration of arsenic is likely due to its known presence as trace element in sulphidic ore. The potential for leachability and solubility of these metals and metalloids is assessed in the SFE and HC tests.

Table 4-4: Elemental Content of Bermingham LCT, Flame and Moth, Bellekeno, Lucky Queen and Onek Tailings

Element	Unit	Berm LCT1	Berm LCT2	Onek F7 + F8 average	Lucky Queen F9 + F10 average	Flame & Moth F4+F5 Composite	Bellekeno Tailings Monthly Composite Jul 12 - Aug 13
Aluminum (Al)	%	0.15	0.16	0.36	0.74	0.2	0.2
Antimony (Sb)	ppm	99.8	44.6	<5	9	41	120.6
Arsenic (As)	ppm	369	401	375	17.5	699	2147
Barium (Ba)	ppm	30	30	24	125	11.5	16.4
Bismuth (Bi)	ppm	0.06	0.04	<2	<2	6.59	2.1
Cadmium (Cd)	ppm	46.1	23.4	72.8	3.95	7.19	165.8
Calcium (Ca)	%	0.63	0.73	0.47	0.38	0.59	1.52
Chromium (Cr)	ppm	133	115	174	265.5	185.5	5.5
Cobalt (Co)	ppm	4.3	4.3	2	3	2.7	9.9
Copper (Cu)	ppm	60.8	57.5	377	254	565	242.4
Iron (Fe)	%	6.35	7.07	18.6	6.4	16.3	10.1
Lead (Pb)	ppm	7460	2330	413	555	789	6359
Magnesium (Mg)	%	0.32	0.36	0.47	0.34	0.31	0.31
Manganese (Mn)	%	37900	4.43	5.19	2.47	4.28	3.22
Mercury (Hg)	ppm	0.19	0.13	n/a	n/a	0.055	0.19
Molybdenum (Mo)	ppm	2.06	2.02	<1	2	3.74	1.16
Nickel (Ni)	ppm	49.8	49.1	44	51	86.6	19.5
Phosphorus (P)	%	290	0.032	0.014	0.013	0.01	0.02
Potassium (K)	%	0.07	0.08	0.08	0.275	0.03	0.04
Selenium (Se)	ppm	0.9	0.8	n/a	n/a	0.1	0.52
Silver (Ag)	ppm	99.6	56.4	6.4	16.4	12.35	50.1
Sodium (Na)	%	<0.01	<0.01	0.02	0.025	0.006	0.014
Strontium (Sr)	ppm	14.3	15	11	15	4.81	24
Thallium (Tl)	ppm	0.78	1.9	17.5	11	0.652	0.129
Tin (Sn)	ppm	2.7	2	n/a	n/a	32.9	17.6
Titanium (Ti)	%	<0.005	<0.005	<0.01	0.02	0.001	0.002
Uranium (U)	ppm	0.39	0.38	n/a	n/a	0.406	1.052
Vanadium (V)	ppm	6	5	5.5	12.5	9.4	5.18
Zinc (Zn)	ppm	3510	2080	8784	557	1265	12623

4.5 SHAKE FLASK EXTRACTION

SFE provides preliminary indication of the leachability, solubility and potential mobility of metals and metalloids during short-term leaching by meteoric water under oxidizing conditions. SFE is also used to screen for potential exceedances of water quality objectives, discharge standards or generic water quality guidelines.

The results of the SFE of all tailings are reported in Table 4-5 alongside the Keno Hill District Mill Site pond effluent quality standards (EQS) at KV-83. Table 4-5 shows that Bermingham tailings had a circumneutral pH (pH= 7.3-8.2) consistent with the ABA paste pH, low leachable sulphate content (19.1-46.1 mg/L) and no measurable acidity (less than the method detection limit of 0.5 mg/L $CaCO_3$). Table 4-5 also show that SFE was also circumneutral for those tailings (i.e., Lucky Queen) for which the SFE pH data was available.

To screen for potential water quality exceedances, the SFE data were compared with the Mill pond EQS as any seepage would report to the mill pond. No exceedance of the Mill pond EQS were found in any of the tailings. The solubility of metals and metalloids highlighted in Section 4.4 as elevated in the tailings did not generate exceedances despite the vigorous condition of the SFE test. Note that the comparison of result of SFE data with the EQS is not and should not be used as a measure of compliance with site water quality standards and objectives. Rather, the comparison provides a guide for potential constituents of concern in drainage from the tailings, which should be confirmed by kinetic testing.

Table 4-5: SFE Results for the Bermingham LCT, Flame and Moth, Bellekeno, Lucky Queen and Onek Tailings

Leachable Metals	Unit	Berm LCT1	Berm LCT2	Flame & Moth F4+F5 Composite	Bellekeno Tailings Monthly Composite July 12 - Aug 13	Lucky Queen F9	Lucky Queen F10	KHSD Mill Site EQS (KV-83)
pH	pH units	7.27	8.17	7.90	-	8.1	8.0	6.5-9.5
EC	uS/cm	154.5	97.1	547	-	434	352	
SO_4	mg/L	46.1	19.1	245	-	183	140	
Acidity to pH4.5	mg/L	<0.5	<0.5	-	-	-	-	
Acidity to pH8.3	mg/L	2.1	<0.5	-	-	-	-	
Total Alkalinity	mg/L	11	14	39.9	-	28.2	25.1	
Bicarbonate	mg/L	14	18	-	-	-	-	
Carbonate	mg/L	<0.5	<0.5	-	-	-	-	
Hydroxide	mg/L	<0.5	<0.5	-	-	-	-	
Fluoride	mg/L	0.27	0.2	0.189	-	0.078	0.035	
Hardness $CaCO_3$	mg/L	55.6	35	-	-	204	158	
Aluminum (Al)-Leachable	mg/L	0.00609	0.0214	0.0109	0.0282	<0.0050	<0.0005	
Antimony (Sb)-Leachable	mg/L	0.00419	0.0111	0.0217	0.0387	0.016	0.0116	
Arsenic (As)-Leachable	mg/L	0.000219	0.000331	0.0061	0.0072	<0.0010	<0.0010	0.1
Barium (Ba)-Leachable	mg/L	0.0354	0.0134	0.0253	0.0234	0.037	0.0459	

Leachable Metals	Unit	Berm LCT1	Berm LCT2	Flame & Moth F4+F5 Composite	Bellekeno Tailings Monthly Composite July 12 - Aug 13	Lucky Queen F9	Lucky Queen F10	KHSD Mill Site EQS (KV-83)
Beryllium (Be)-Leachable	mg/L	<0.000010	<0.000010	<0.00050	<0.00050	<0.00050	<0.00050	
Bismuth (Bi)-Leachable	mg/L	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	
Boron (B)-Leachable	mg/L	<0.050	<0.050	0.071	0.0942	0.025	0.014	
Cadmium (Cd)-Leachable	mg/L	0.0027	0.000309	0.0024	0.00318	0.00164	0.0509	0.01
Calcium (Ca)-Leachable	mg/L	18.7	12.4	105	138	74.9	59.6	
Chromium (Cr)-Leachable	mg/L	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	
Cobalt (Co)-Leachable	mg/L	0.000925	0.000099	0.0004	0.00031	0.0002	0.00702	
Copper (Cu)-Leachable	mg/L	0.000116	0.000334	0.0271	0.0096	0.0303	0.0503	0.1
Iron (Fe)-Leachable	mg/L	0.0022	<0.0010	<0.030	<0.030	<0.030	<0.030	
Lead (Pb)-Leachable	mg/L	0.0607	0.0188	0.0144	0.0593	0.0181	0.112	0.2
Lithium (Li)-Leachable	mg/L	0.00339	0.00294	0.0071	0.0339	<.0.0050	<.0.0050	
Magnesium (Mg)-Leachable	mg/L	2.15	0.988	6.9	6.01	3.96	2.27	
Manganese (Mn)-Leachable	mg/L	2.28	0.445	1.95	0.797	0.765	1.14	
Mercury (Hg)-Leachable	mg/L	<0.000050	<0.000050	0.0001	<0.000050	<0.000050	<0.000050	
Molybdenum (Mo)-Leachable	mg/L	0.000225	0.000928	0.0024	0.0108	0.00318	0.000718	
Nickel (Ni)-Leachable	mg/L	0.00213	0.000368	0.0012	0.0009	0.0006	0.00253	0.5
Phosphorus (P)-Leachable	mg/L	0.0503	0.0414	<0.30	<0.30	<0.30	<0.30	
Potassium (K)-Leachable	mg/L	1.89	1.7	2.04	10.6	3.93	1.87	
Selenium (Se)-Leachable	mg/L	0.000058	0.000041	0.0009	0.00106	0.00871	0.00463	
Silicon (Si)-Leachable	mg/L	0.42	0.45	1.55	3.4	1.91	1.11	
Silver (Ag)-Leachable	mg/L	<0.0000050	0.00003	0.0009	0.0018	0.000144	0.00627	0.02
Sodium (Na)-Leachable	mg/L	0.854	0.596	2.36	24.1	6.19	4.57	
Strontium (Sr)-Leachable	mg/L	0.0261	0.0172	0.38	0.515	0.193	0.141	
Thallium (Tl)-Leachable	mg/L	0.000335	0.000177	0.0001	0.0002	0.00011	<0.00010	
Tin (Sn)-Leachable	mg/L	<0.00020	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050	
Titanium (Ti)-Leachable	mg/L	<0.00050	<0.00050	0.01	0.012	<0.010	<0.010	
Uranium (U)-Leachable	mg/L	<0.0000020	<0.0000020	0.000048	0.00162	0.000011	<0.000010	
Vanadium (V)-Leachable	mg/L	<0.00020	<0.00020	<0.0010	<0.0010	<0.0010	<0.0010	
Zinc (Zn)-Leachable	mg/L	0.142	0.017	0.156	0.051	0.0189	0.0955	0.5

Note: EQS: effluent discharge standards at KV-83 for the KHSD

4.6 HUMIDITY CELL

The HC test provides an indication of the long-term acid generation and rate of release of constituents (i.e., acidity, alkalinity, sulphate, major and trace elements) and constitutes robust evidence on the ARD/ML potential of a geologic material.

The results of 103 weeks (cycles) of Bermingham HC testing are discussed herein. Time series of selected constituents of interest are provided and discussed below to assess the rate of release and the long-term ARD/ML potential of the Bermingham tailings. The HC data were plotted with HC results for Bellekeno and Flame and Moth tailings to provide a site wide comparison. The Mill pond EQS are also plotted for comparative purposes only rather than an assessment of compliance with site water quality standards.

4.6.1 pH, Sulphate, Acidity and Alkalinity

The pH, acidity, alkalinity and sulphate released from the Bermingham tailings during the tests are plotted in Figure 4-1. The plot shows a stable neutral pH of between 7.1 and 8.0 (median = 7.4) within the EQS range (6.5 - 9.5), very low acidity (maximum 7.4 mg/L $CaCO_3$; median equivalent to the detection limit 0.5 mg/L $CaCO_3$), alkalinity high enough to buffer the acidity released (maximum 39.6 mg/L $CaCO_3$; median 20.8 mg/L $CaCO_3$), and relatively low sulphate concentrations (median 51 mg/L), indicating a low sulphide oxidation rate. The acidity, alkalinity and sulphate concentrations showed a first flush effect resulting from the release of readily soluble products followed by a decrease then stabilization of the concentrations until cycle 43 and 37 for acidity and alkalinity, respectively, although recurrent spikes of acidity were observed until cycle 69 after which the acidity was typically below the detection limit. Alkalinity gradually increased after cycle 37 from 12 mg/L to 40 mg/L at cycle 99, coincident with an increase in pH from 7.3 to 8.0. The sulphate concentrations showed a slight increase between cycles two and nine (85 mg/L), then decreased and continued to decline during the test reaching 29 mg/L during the last two cycles.

The pH and alkalinity levels in the leachate from the Bermingham tailings humidity cell were lower than those observed in the Flame and Moth and Bellekeno tailings HCs (Figure 4-1), reflecting its lower NP and lack of calcite, however the pH was comparable to that observed for Bellekeno and Flame and Moth during the last three cycles due to the gradual increase observed since cycle 37. The Bermingham sulphate concentrations recorded during the test (29 to 374 mg/L) were markedly lower than those observed in the Bellekeno HC (158 to 1,150 mg/L) during the first 30 cycles then the gap gradually shrank until reaching a comparable level at cycle 55 onward. The Bermingham sulphate concentrations were also lower than in the Flame and Moth HC leachate (120 to 1130 mg/L) during the first 17 cycles after which the sulphate concentration in the HC leachate from the Bermingham tailings increased and remained above that of the Flame and Moth HC during the remainder of the test. This trend is expected for Bellekeno, which has a higher sulphide-sulphur content (2.2 wt.%) than the Bermingham tailings (1.4 wt.%), but is somewhat unexpected for the early cycles of the test for Flame and Moth because of its lower sulphide-sulphur content (0.4 wt.%). Sulphides in the Flame and Moth tailings were likely exposed to leaching at the onset of the test resulting in higher release rate early on and gradual decline thereafter. However, the three tailings generally showed a similar sulphate release pattern despite the difference in absolute concentration, although the sulphate released from the Flame and Moth HC stabilized whereas sulphate concentrations in the Bermingham and Bellekeno HCs continued to slowing decrease (Figure 4-1).

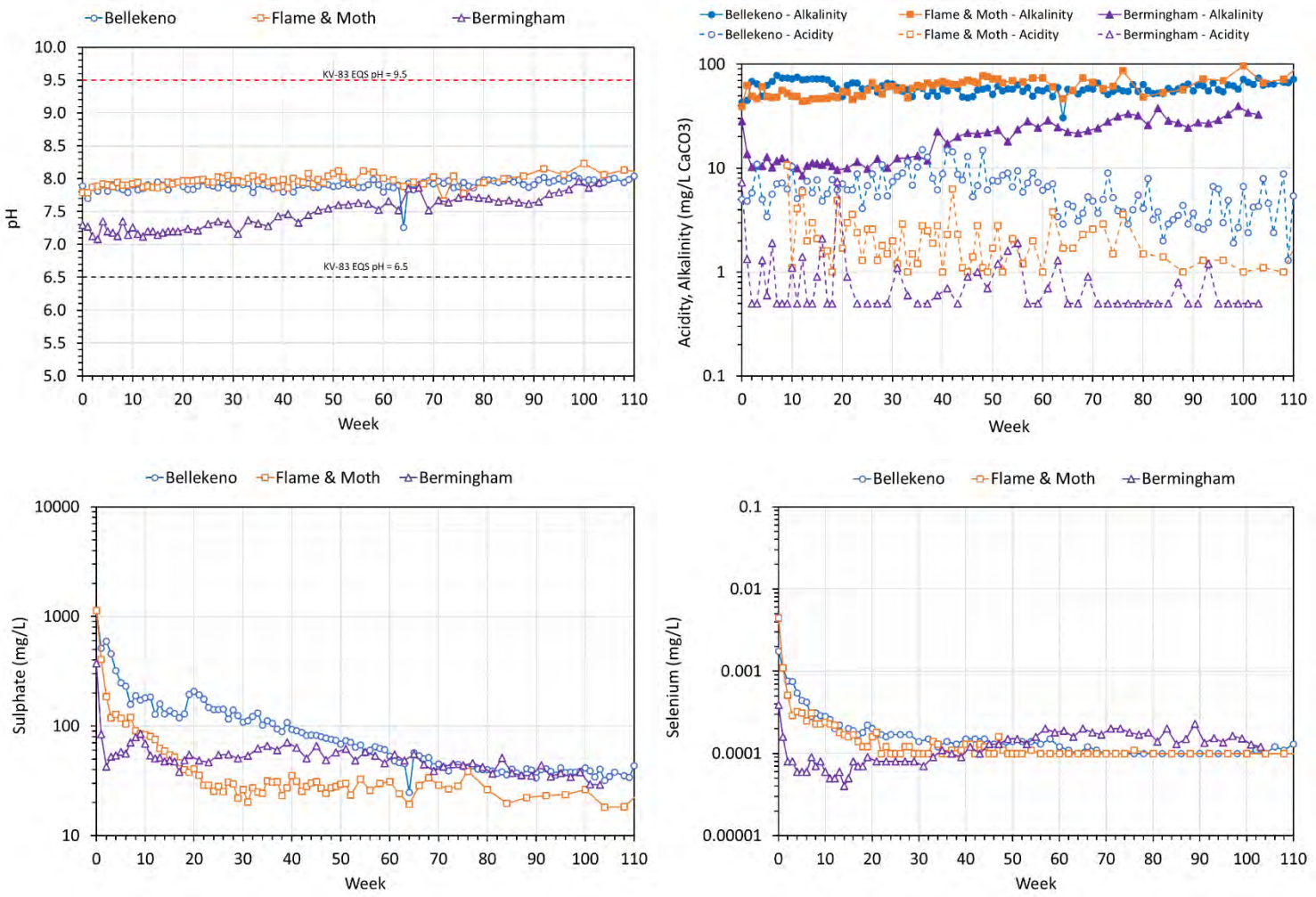

Figure 4-1: pH (top left), Acidity and Alkalinity (top right), Sulphate (bottom left) and Selenium (bottom right) Trends within the Bermingham LC, Flame and Moth and Bellekeno Tailings Humidity Cells

4.6.2 Constituents of Potential Concern

The times series of metals and metalloids of potential environmental concern in the Bermingham tailings HC are plotted in Figure 4-2 and Figure 4-3 alongside those of Bellekeno and Flame and Moth.

The time series of arsenic, antimony, cadmium, and copper are displayed in Figure 4-2 and lead, nickel, silver, and zinc are shown in Figure 4-3. Analysis of the Bermingham tailings metals and metalloids time series showed similar patterns characterized by a flush effect during cycle 0 followed by a decrease of concentration during the following two to three weeks and then a short-term increase which peaked between cycles six and eight. This was followed by a second short or extended decrease and a stabilization as early as cycle 11 onward (antimony and silver) or later (cycle 55 onward for arsenic, copper; cycle 81-89 onward for cadmium, lead and nickel; cycle ~95 for zinc.). However, sporadic fluctuations of concentration were visible in the plots of arsenic, nickel, silver, lead, and copper.

Aside from the initial flush, the arsenic concentration in the HC leachate from the Bermingham tailings was lower than that of the Bellekeno and Flame and Moth HC leachates, likely due to its lower bulk arsenic concentration. Arsenic concentrations in the HC leachate from the Bermingham HC were an order of magnitude or more lower than those of the Bellekeno and Flame and Moth HCs since cycle 35 and no exceedance of the arsenic EQS (0.1 mg/L) was observed in any of the cells. Cadmium and zinc concentrations in the Bermingham tailings HC leachate were comparable to those of Flame and Moth during the first 35 cycles, then their concentrations sharply decreased below Flame and Moth. Cadmium and zinc concentrations in the Bermingham tailings HC leachate were markedly lower (up to two orders of magnitude) than those observed from the Bellekeno humidity cell during the same period. Besides the first cycle, exceedances of the cadmium and zinc EQS (0.01 and 0.5 mg/L, respectively) were only observed in the Bellekeno HC leachate. The Bermingham tailings cadmium and zinc trends likely reflects the lower concentration of these elements in the Bermingham tailings relative to Bellekeno but somewhat expected compared to Flame and Mock considering its higher cadmium and zinc (Table 4-4). Lead concentrations in the Bermingham humidity cell leachate were almost comparable to the Bellekeno tailings cell during the initial flush, then the concentration markedly decreased to levels that were one order of magnitude lower at cycle 11 and more than two orders of magnitude during the last cycles. Lead concentrations in the Bermingham humidity cell leachate were generally comparable to those of Flame and Moth during the first 11 cycles, then decreased to levels that were one order of magnitude lower than lead concentrations measured in the Flame and Moth HC leachates. Lead concentrations increased again after cycle 59 surpassing and remaining above the Flame and Moth HC after the 79th cycle. Occasional high releases of lead from the Bermingham tailings HC were observed during the test resulting in peak concentrations above those of the Flame and Moth HC. The Bermingham tailings HC leachate generally had the highest nickel concentrations during the first 35 cycles, then the nickel concentration decreased sharply such that it was below the nickel concentration in the Flame and Moth and Bellekeno HC leachates from cycle 43 onwards and generally stabilized after cycle 89. Note that nickel concentrations in the three cells were orders of magnitude lower than the nickel EQS (0.5 mg/L; Figure 4-3).

Aside from sulphate, selenium (last phase of the test), and nickel (early phase of the test), the Bellekeno and Flame and Moth tailings HCs had higher constituent concentrations than the Bermingham HC during the test period. The Bellekeno tailings had the highest concentration release for sulphate during the first half of the test, and the highest cadmium, lead, zinc, and nickel concentrations during the last 68 cycles. The Flame and Moth HC had the highest concentration release for arsenic, antimony, copper, and silver during the first 50 to 70

cycles then their concentrations become comparable or decreased below those in the Bellekeno cell. Copper concentrations in the Bermingham tailings HC leachate were slightly lower than the Bellekeno HC leachate during the first 23 cycles after which time the gap increased markedly (approximately two orders of magnitude difference at the last cycle). Silver concentrations in the Bermingham tailings cell leachate were generally below the detection level (i.e., <0.000005 mg/L) similar to the silver release from the Bellekeno cell although spikes of concentration (0.0001 mg/L) were recurrent during the test. Antimony concentrations in the HC leachate from the Bermingham tailings were lower than that of the Bellekeno and Flame and Moth HC leachate despite a bulk antimony concentration (44.6 ppm) that was comparable with the Flame and Moth tailings (41 ppm; Table 4-4).

Selenium concentrations in the Bermingham tailings HC exhibited a pattern different from all the parameters of interest (Figure 4-1). The concentration decreased after the first flush and was up to an order of magnitude lower than the Flame and Moth and Bellekeno leachate selenium levels during the first 20 cycles. After a stabilization at 0.00008 mg/L during the next 10 cycles, selenium concentrations in the Bermingham tailings cell leachate gradually increased to approximately 0.0002 mg/L, surpassing and remaining slightly above those of the Flame and Moth cell at cycle 49 and Bellekeno at cycle 55 (both approximately 0.0001 mg/L). The selenium concentration then decreased to levels that were comparable to the other cells during the last three cycles.

The tailings kinetic test results indicate that the trace element release rates for Bermingham were lower than the effluent quality standards at KV-83, the KHSD Mill Site. The data also suggest that the trace element release rates for the last ten cycles observed for the Bellekeno and Flame and Moth tailings may be used as a conservative proxy (upper boundary) for most constituents, except selenium, for the Bermingham tailings under the circumneutral conditions expected in the tailings storage facility.

It is worth noting that trace element concentrations released from the Bellekeno and Flame and Moth tailings cells were also lower than the effluent quality standards at KV-83, the KHSD Mill Site with the exception of zinc and cadmium in Bellekeno (Figure 4-2 and Figure 4-3). This is likely related to the elevated bulk zinc and cadmium concentrations in the Bellekeno tailings compared to the other tailings.

Additional information derived from the analysis of Bermingham HC data included:

- The concentration of ammonia was very low (median = 0.005 mg/L), at or below the detection limit in 76% of the cycles and well below the EQS of 5 mg/L;
- The concentrations of the following constituents were below the detection limit in all or the majority of leachates since cycle four: nitrate, nitrite, ammonia, beryllium, bismuth, boron, cesium chromium, lanthanum, iron, mercury, silver, sodium, tellurium, thorium, tin, titanium, tungsten, vanadium and zirconium; and
- The concentration of molybdenum was below the detection limit in the second half of the test.

The neutral pH, significant alkalinity, low acidity and sulphate releases, and lower concentration of metal and metalloids compared to the EQS are evidence of low potential for acid generation and metal release from the Bermingham (and other) tailings consistent with the sequential NAG and SFE results.

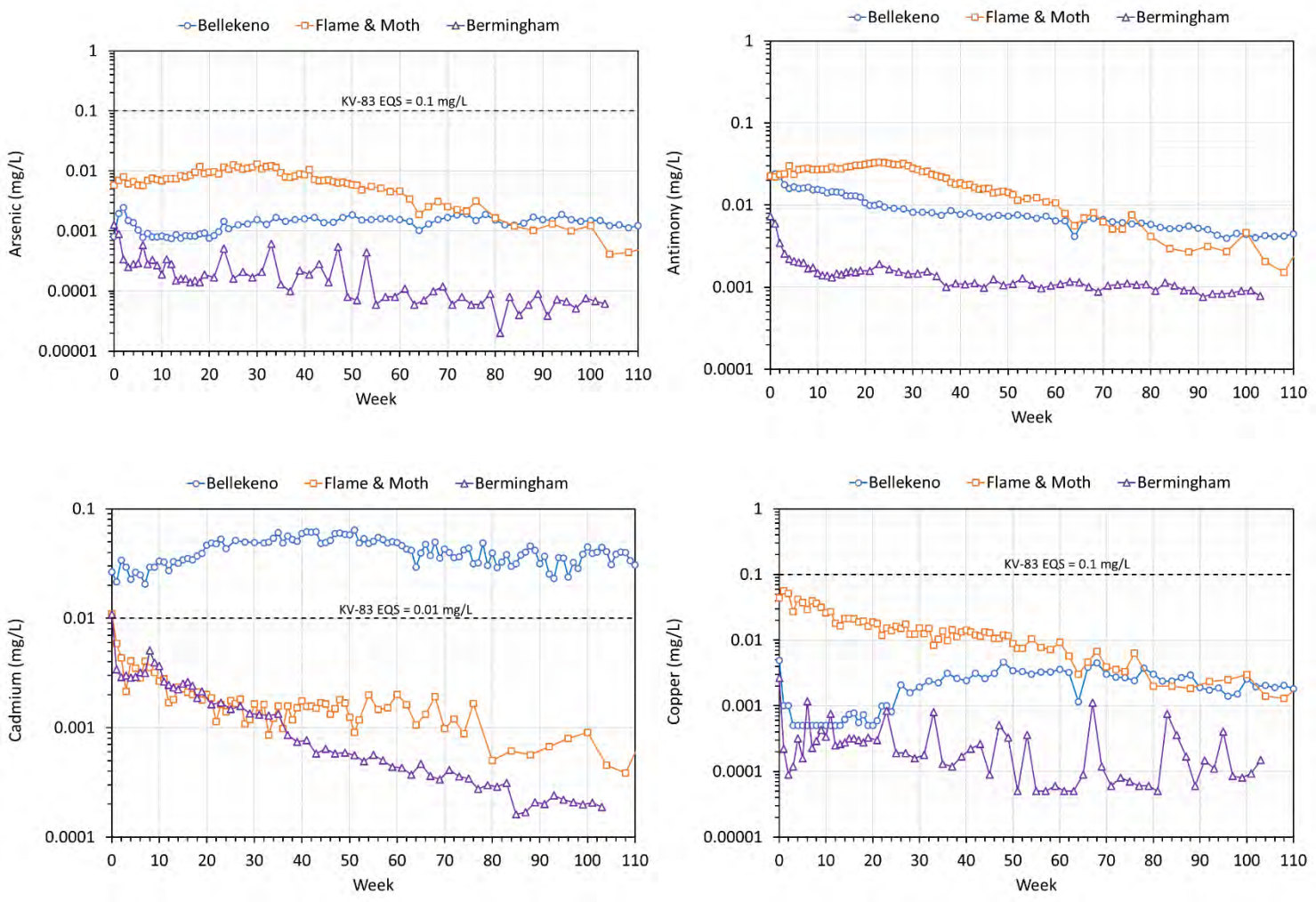

Figure 4-2: Arsenic (top left), Cadmium (bottom left), Antimony (top right), and Copper (bottom right) Trends within the Bermingham LC, Flame and Moth and Bellekeno Tailings Humidity Cells

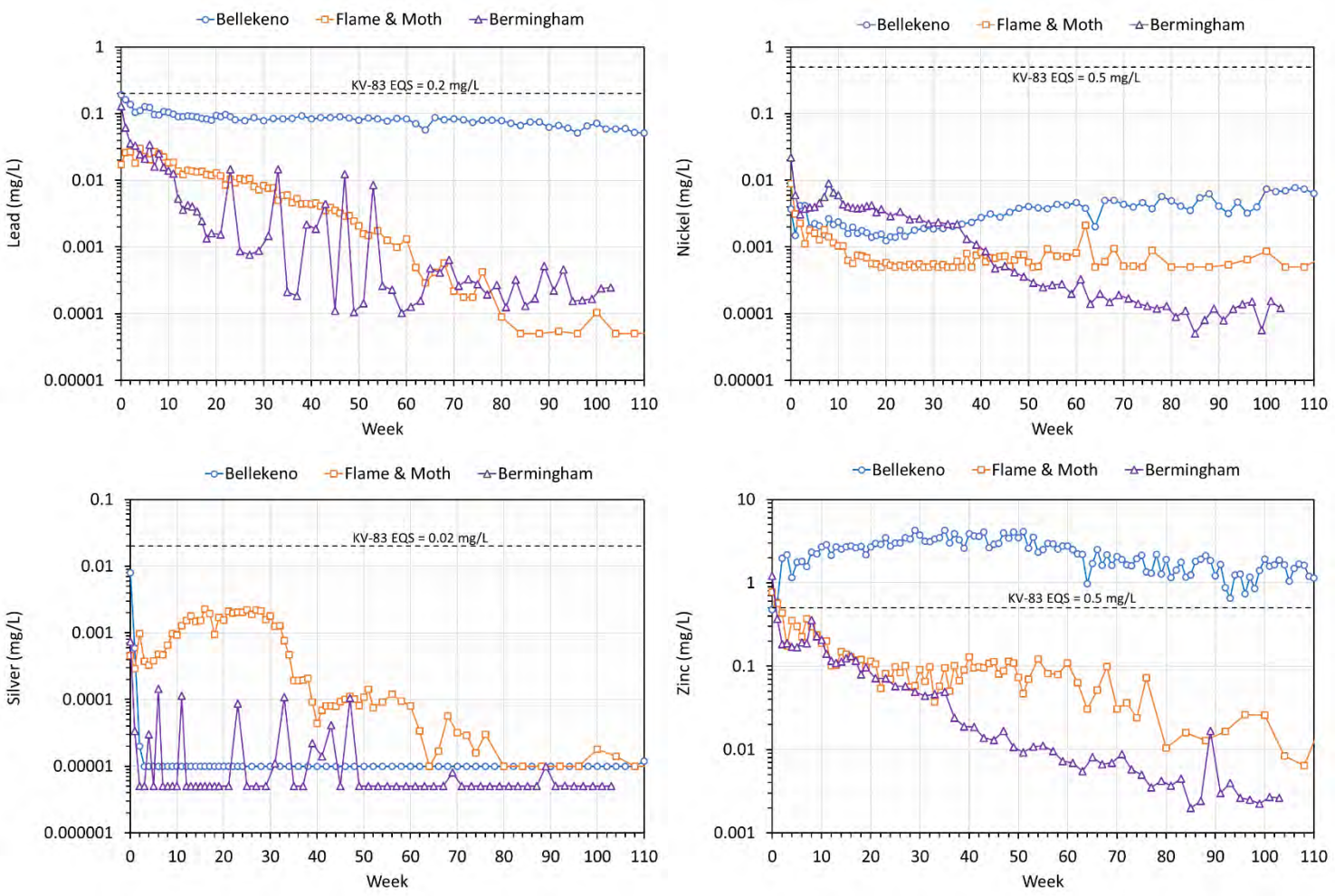

Figure 4-3: Lead (top left), Silver (bottom left), Nickel (top right), and Zinc (bottom right) Trends within the Bermingham LC, Flame and Moth and Bellekeno Tailings Humidity Cells

The estimation of the lag time to acid generation for the Bermingham tailings HC indicates that the times to sulphide and bulk NP depletion are approximately 31 and 40 years, respectively (Figure 4-4). Therefore, some bulk NP will remain in the tailings after the sulphide has been depleted, suggesting that net acid generation is not expected from the tailings. This is consistent with the sequential NAG results.

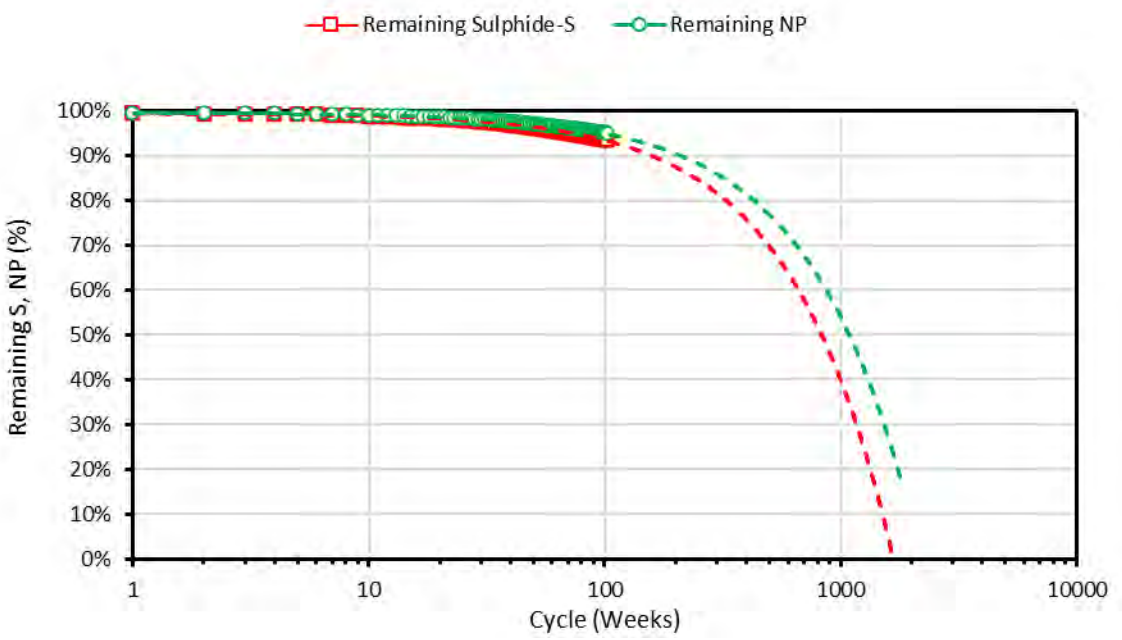

Figure 4-4: Calculations of Sulphide Sulphur and NP Depletion in Bermingham Tailings Humidity Cell

4.6.3 Humidity Cell Closedown

The purpose of the closedown procedure is to help in the interpretation of humidity cell test results by identifying and estimating the changes that may have occurred during the test. The results of the closedown tests on HC residue are reported in Table 4-6 to Table 4-9. The results of the ABA, metal, and XRD analyses on the tailings sample before the HC test are also included for comparison.

The XRD results suggest that weathering and leaching of sulphides (i.e., pyrite, sphalerite, and galena) and carbonate minerals (i.e., ankerite-dolomite and calcian siderite) identified in the head (pre-kinetic) samples occurred. The weathering process resulted in the reduction of the sulphides by 27% to 67% and of carbonates by 10% to 60% (Table 4-6). The changes induced by the leaching and weathering process and the loss of readily soluble minerals resulted in a higher percentage of less soluble minerals (i.e., quartz and aluminosilicates). Sample heterogeneity and/or normalization of the XRD results are the likely explanation for the appearance of

paragonite and rutile. The ABA results confirm these changes as indicated by a decrease in total sulphur and carbonate NP by 15% and 16%, respectively (Table 4-7). However, the cell residue still contains enough carbonate and bulk NP to prevent the onset of ARD. The bulk NP apparent increase in the residue by 4% is likely due to the heterogeneity of the sample.

Table 4-6: Mineralogy of Original Tailings and Residue of Tailings Humidity Cell

Mineral	Bermingham LCT2 Tailing	
	Pre-kinetic (%)	Post-kinetic (%)
Ankerite – Dolomite	1	-
Dolomite	-	0.4
Galena	0.3	0.1
Illite-Muscovite 2M1	8.2	7.8
Kaolinite	0.9	1.4
Pyrite	2.2	1.6
Quartz	59.3	61.2
Rutile?	-	0.4
Siderite, calcian	27.8	25.1
Sphalerite	0.3	0.2
Paragonite	-	1.8
Total	**100**	**100**

Table 4-7: ABA Results for Original Tailings and Residue of Tailings Humidity Cell

Sample	pH Units	Bermingham LCT2 Tailing	
		Pre-kinetic	Post-kinetic
Paste pH	-	8.2	8.2
Total Sulphur	%	1.39	1.18
Sulphate Sulphur	%	0.01	<0.01
Sulphide Sulphur	%	1.38	1.18
Total Inorganic Carbon	%	8.96	7.52
Carbonate-NP	kg $CaCO_3$/t	204	170.9
Siderite-Corrected NP	kg $CaCO_3$/t	56.3	58.5
AP	kg $CaCO_3$/t	43.1	36.9
NPR	-	1.3	1.6

No marked change of concentration was observed for the majority of elements. Aside from antimony, calcium, magnesium, selenium, sodium, and thallium, the decreases of metal concentration was less than 16%. Aluminum, barium, molybdenum, nickel uranium, and vanadium reported concentrations higher than the pre-kinetic test. Likely due to sample heterogeneity.

Table 4-8: Elemental Content of Original Tailings and Residue of Tailings Humidity Cell

Element	Unit	Bermingham LCT2 Tailing	
		Pre-kinetic	Post-kinetic
Aluminum (Al)	%	0.16	0.17
Antimony (Sb)	ppm	44.6	30.9
Arsenic (As)	ppm	401	371
Barium (Ba)	ppm	30	34
Bismuth (Bi)	ppm	0.04	<0.1
Cadmium (Cd)	ppm	23.4	20.6
Calcium (Ca)	%	0.73	0.54
Chromium (Cr)	ppm	115	114
Cobalt (Co)	ppm	4.3	3.9
Copper (Cu)	ppm	57.5	54.7
Iron (Fe)	%	7.07	6.01
Lead (Pb)	ppm	2330	2230
Magnesium (Mg)	%	0.36	0.35
Manganese (Mn)	%	4.43	>1
Mercury (Hg)	ppm	0.13	0.12
Molybdenum (Mo)	ppm	2.02	2.5
Nickel (Ni)	ppm	49.1	51.1
Phosphorus (P)	%	0.032	0.028
Potassium (K)	%	0.08	0.07
Selenium (Se)	ppm	0.8	<0.5
Silver (Ag)	ppm	56.4	48.8
Sodium (Na)	%	<0.01	0.003
Strontium (Sr)	ppm	15	13
Thallium (Tl)	ppm	1.9	0.7
Tin (Sn)	ppm	2	-
Titanium (Ti)	%	<0.005	<0.001
Uranium (U)	ppm	0.38	0.4
Vanadium (V)	ppm	5	7
Zinc (Zn)	ppm	2080	1790

The closedown SFE results generally returned lower constituent concentrations than those observed for the pre-humidity cell sample except for some major elements (Table 4-9). Electric conductivity, sulphate, alkalinity, calcium, magnesium, potassium, sodium, strontium, copper, and cadmium returned leachable concentrations higher (1.6 to 10 times higher) than the pre-humidity cell sample indicating the accumulation of some soluble products in the cell. However, no leachable concentrations exceeded the EQS.

To determine and estimate the load of constituents that may have accumulated in the HC, the closedown SFE concentrations were normalized by the weight of the tailing cell residue and compared with the normalized data for the last cycle of the humidity cell (Table 4-10). The load released from the closedown SFE was more than six-fold higher than that observed for the final humidity cell cycle for the majority of constituents. Several

metals (i.e., aluminum, arsenic, barium, cobalt, copper, iron, lead, lithium, manganese, molybdenum, nickel, potassium, silicon, sodium, uranium, tin, and zinc) were twenty to more than hundred times higher. This confirms the accumulation of constituents during the humidity cell testing and redistribution of the closedown SFE load evenly over all weeks of the test is likely to increase the loading of each cycle by at least 6%. However, the redistribution of the closedown SFE concentration evenly over all weeks of the test will result in a modest increase of the weekly concentration released and unlikely to result in weekly or steady-state concentrations higher than the Bellekeno, Flame and Moth or EQS. Thus, the trace element release rates for the last ten cycles observed for the Bellekeno and Flame and Moth tailings are still a valid conservative proxy for most constituents, except selenium, for the Bermingham tailings.

Table 4-9: Comparison of Pre-Humidity Cell SFE, Closedown SFE and Humidity Cell Last Cycle

Leachable Metals	Unit	Bermingham LCT2 Tailing			KHSD Mill Site EQS (KV-83)
		Pre-kinetic SFE	Closedown SFE	Last Kinetic Cycle	
pH	pH units	8.17	8.02	7.94	6.5-9.5
EC	uS/cm	97.1	180	131	-
SO_4	mg/L	19.1	31	29.1	-
Acidity to pH4.5	mg/L	<0.5	<0.5	<0.5	-
Acidity to pH8.3	mg/L	<0.5	<0.5	<0.5	-
Total Alkalinity	mg/L	14	65.3	32.7	-
Fluoride	mg/L	0.2	0.05	<0.05	-
Hardness $CaCO_3$	mg/L	35	132	60.8	-
Aluminum (Al)-Leachable	mg/L	0.0214	0.00438	0.00101	-
Antimony (Sb)-Leachable	mg/L	0.0111	0.0019	0.000783	-
Arsenic (As)-Leachable	mg/L	0.000331	0.000264	0.000062	0.1
Barium (Ba)-Leachable	mg/L	0.0134	0.005	0.000264	-
Beryllium (Be)-Leachable	mg/L	<0.000010	<0.000010	<0.000010	-
Bismuth (Bi)-Leachable	mg/L	<0.0000050	<0.0000050	<0.0000050	-
Boron (B)-Leachable	mg/L	<0.050	<0.050	<0.050	-
Cadmium (Cd)-Leachable	mg/L	0.000309	0.000526	0.000189	0.01
Calcium (Ca)-Leachable	mg/L	12.4	40.3	14	-
Chromium (Cr)-Leachable	mg/L	<0.00010	<0.00010	<0.00010	-
Cobalt (Co)-Leachable	mg/L	0.000099	0.0000783	0.0000089	-
Copper (Cu)-Leachable	mg/L	0.000334	0.0026	0.00015	0.1
Iron (Fe)-Leachable	mg/L	<0.0010	0.006	0.0016	
Lead (Pb)-Leachable	mg/L	0.0188	0.00119	0.000247	0.2
Lithium (Li)-Leachable	mg/L	0.00294	0.00284	0.00062	-
Magnesium (Mg)-Leachable	mg/L	0.988	7.52	6.24	-
Manganese (Mn)-Leachable	mg/L	0.445	0.343	0.0211	-
Mercury (Hg)-Leachable	mg/L	<0.000050	<0.000050	<0.000010	-
Molybdenum (Mo)-Leachable	mg/L	0.000928	0.00105	<0.000050	-
Nickel (Ni)-Leachable	mg/L	0.000368	0.000335	0.000121	0.5
Phosphorus (P)-Leachable	mg/L	0.0414	0.0074	0.0041	-
Potassium (K)-Leachable	mg/L	1.7	3.41	0.192	-
Selenium (Se)-Leachable	mg/L	0.000041	0.000117	0.00012	-
Silicon (Si)-Leachable	mg/L	0.45	0.88	0.15	-
Silver (Ag)-Leachable	mg/L	0.00003	0.0000131	<0.0000050	0.02
Sodium (Na)-Leachable	mg/L	0.596	2.44	<0.050	-
Strontium (Sr)-Leachable	mg/L	0.0172	0.183	0.0143	-
Thallium (Tl)-Leachable	mg/L	0.000177	0.000105	0.0000808	-
Tin (Sn)-Leachable	mg/L	<0.00020	0.00077	<0.00020	-
Titanium (Ti)-Leachable	mg/L	<0.00050	<0.00050	<0.00050	-
Uranium (U)-Leachable	mg/L	<0.0000020	0.00019	0.0000071	-
Vanadium (V)-Leachable	mg/L	<0.00020	<0.00020	<0.00020	-
Zinc (Zn)-Leachable	mg/L	0.017	0.0152	0.00263	0.5

Table 4-10: Comparison of Tailing Cell Last Cycle and Closedown SFE Loadings

Leachable Metals	Unit	Last Kinetic Cycle	Closedown SFE
pH	pH units	7.9	8.0
EC	uS/cm	-	-
SO_4	mg/kg	13.8	93
Acidity to pH4.5	mg/kg	0.24	1.5
Acidity to pH8.3	mg/kg	0.24	1.5
Total Alkalinity	mg/kg	15.53	195.9
Fluoride	mg/kg	0.024	0.15
Hardness $CaCO_3$	mg/kg	28.9	396
Aluminum (Al)-Leachable	mg/kg	0.00048	0.01314
Antimony (Sb)-Leachable	mg/kg	0.00037	0.0057
Arsenic (As)-Leachable	mg/kg	0.0000295	0.000792
Barium (Ba)-Leachable	mg/kg	0.000125	0.015
Beryllium (Be)-Leachable	mg/kg	0.0000047	0.00003
Bismuth (Bi)-Leachable	mg/kg	0.0000024	0.000015
Boron (B)-Leachable	mg/kg	0.0237	0.15
Cadmium (Cd)-Leachable	mg/kg	0.000089	0.001578
Calcium (Ca)-Leachable	mg/kg	6.65	120.9
Chromium (Cr)-Leachable	mg/kg	0.000047	0.0003
Cobalt (Co)-Leachable	mg/kg	0.00000423	0.0002349
Copper (Cu)-Leachable	mg/kg	0.000071	0.0078
Iron (Fe)-Leachable	mg/kg	0.00076	0.018
Lead (Pb)-Leachable	mg/kg	0.00012	0.00357
Lithium (Li)-Leachable	mg/kg	0.000295	0.00852
Magnesium (Mg)-Leachable	mg/kg	2.96	22.56
Manganese (Mn)-Leachable	mg/kg	0.01	1.029
Mercury (Hg)-Leachable	mg/kg	0.0000047	0.00015
Molybdenum (Mo)-Leachable	mg/kg	0.000024	0.00315
Nickel (Ni)-Leachable	mg/kg	0.000057	0.001005
Potassium (K)-Leachable	mg/kg	0.09	10.23
Selenium (Se)-Leachable	mg/kg	0.000057	0.000351
Silver (Ag)-Leachable	mg/kg	0.0000024	0.0000393
Sodium (Na)-Leachable	mg/kg	0.024	7.32
Strontium (Sr)-Leachable	mg/kg	0.0068	0.549
Thallium (Tl)-Leachable	mg/kg	0.000038	0.000315
Tin (Sn)-Leachable	mg/kg	0.000095	0.00231
Titanium (Ti)-Leachable	mg/kg	0.00024	0.0015
Uranium (U)-Leachable	mg/kg	0.0000034	0.00057
Zinc (Zn)-Leachable	mg/kg	0.00125	0.0456

4.7 DISCUSSION AND TAILINGS MANAGEMENT

The comparison of the results of geochemical testing of the Bermingham tailings sample with Onek, Lucky Queen, Flame and Moth, and Bellekeno tailings indicates that the tailings share similar geochemical characteristics with respect to ARD/ML. All the tailings had low potential for ARD/ML, with lower SFE-leachable metal(loid) concentrations observed for the Bermingham tailings compared to other tailings. Also, the Bermingham tailings HC data indicated that most metal(loid) concentrations release rates were comparable or markedly lower than those observed from Flame and Moth and Bellekeno tailings. One exception was the slightly elevated nickel concentration compared to those observed in the Flame and Moth and Bellekeno tailings humidity cell leachate during the first thirty cycles of the test but nickel concentrations later decreased mirroring the other metal(loid)s. The other exception was the higher selenium concentration above that of the Flame and Moth and Bellekeno HC during the second half of the test. Aside from the first flush cadmium and zinc concentrations, no exceedance of the Mill site EQS were observed in the Bermingham SFE or HC test indicating low potential for metal leaching.

While ABA work indicated that the Bermingham tailings had an Uncertain potential for acid generation, the sequential NAG and the kinetic results confirmed their low potential for acid generation. The Uncertain acid potential based on calculated NPR could be explained by the following:

1. The siderite-corrected NP method likely underestimated the effective NP available for acid neutralization. A portion of the iron and manganese carbonate material will likely contribute to net acid neutralization given the slow oxidation kinetics of manganese at circumneutral pH and siderite calcian end-member.

2. XRD analysis identified sphalerite (0.3 to 0.6 wt.%), galena (0.3 to 0.8 wt.%), and pyrite (1.6 to 2.2 wt.%) in the Bermingham tailings sample. Under oxic weathering conditions, the oxidation of galena and sphalerite by oxygen is not an acid generating process. Both these minerals constitute approximately 20% to 47% of the XRD-measured sulphide mineralogy, indicating that the AP was likely overestimated.

Furthermore, sequential NAG testing revealed that there is sufficient NP in the Bermingham tailings to buffer the acid generated from sulphide oxidation. Sulphide and NP depletion calculations for the Bermingham tailings humidity cell also confirmed that the NP will outlast the AP generated from sulphide, indicating that net acid generation is not anticipated from the Bermingham tailings.

The results of the humidity cell closedown tests indicated that geochemical changes consisting of the removal of some constituents from the sample and the accumulation of others in the residue occurred during the kinetic test. Despite these changes, the tailings material remains low potential for long-term acid generation and metal leaching.

The tailings deposited in the DSTF or underground as cemented tailings backfill at Bermingham will either be standalone Bermingham tailings or a combination of tailings originating from the mines currently permitted in the KHSD. Blending and/or co-disposal of the Bermingham tailings with high effective NP (high in fast reactive calcite) tailings from the Flame and Moth and Bellekeno in the DSTF would significantly increase the bulk NP of the tailings mix, thus the net long-term acid generation is not anticipated. The geochemical testwork

completed on the Bellekeno tailings stored on the DSTF and their performance indicate that the tailings are not a concern from an acid generating potential perspective.

5 SUMMARY

The results of static and kinetic tests conducted on the Bermingham tailings indicate that the tailings were mainly composed of silica, calcian iron and manganese carbonates and minor sulphides. They had low potential for long-term acid generation due to an adequate NP buffering the acidity released from sulphide oxidation. The tailings had elevated bulk concentrations of several metals and metalloids but laboratory simulated short- and long-term leaching tests (SFE and HC) suggests that relatively low levels of metal leaching may be expected from the Bermingham tailings. Similar geochemical characteristics were observed for the tailings humidity cell residue.

The Bermingham tailings had similar geochemical characteristics as the tailings from other deposits. Their lower bulk metal composition might be in part due to spatial variability in mineralization between the deposits. The SFE leachable metal(loid)s and HC metal(loid) release rates were comparable or markedly lower than those observed from other tested tailings, except for nickel and selenium, with leachate constituent concentrations well below the EQS at the Mill site pond. Their low fast reactive carbonate content (e.g., low readily available NP) will be compensated by NP from calcian siderite and by NP from other tailings with high NP during co-disposal or blending. Overall, the Bermingham tailing have low potential for acid and metal release.

6 REFERENCES

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APPENDIX 3.4

FLAME & MOTH WASTE ROCK DISPOSAL AREA DESIGN

TETRA TECH EBA

October 2, 2014

ISSUED FOR USE
FILE: W14103485
Via Email: kwoloshyn@alexcoresource.com

Alexco Resource Corp.
3-151 Industrial Road
Whitehorse, YT Y1A 2V3

Attention: Kai Woloshyn, Environmental Manager

Subject: Waste Storage Facility Design – Revision I
Flame & Moth Property, Keno City, Yukon

1.0 INTRODUCTION

Alexco Resource Corp. (Alexco) retained Tetra Tech EBA Inc. (Tetra Tech EBA) to provide a preliminary design for a waste containment facility for the storage of potentially acid metal leaching (P-AML) material at their Flame & Moth property west of Keno City, Yukon.

This letter summarizes the site specific foundation conditions, provides foundation preparation recommendations, and includes facility design drawings for two proposed facility locations. It also includes recommendations for the disposal of P-AML within the existing Dry Stacked Tailings Facility (DSTF). Tetra Tech EBA has reviewed the structural stability of the DSTF assuming co-mingling of produced tailings and P-AML waste rock. We have assumed the chemical implications of P-AML disposal in the DSTF will be reviewed by others. For additional information regarding the use of this report, please refer to Tetra Tech EBA's General Conditions included in Appendix A.

2.0 FLAME & MOTH WASTE STORAGE FACILITY

The Flame & Moth waste storage facility design is based on the previously completed "Typical Waste Containment Facility Design, Keno Hill Silver District, YT – Construction Specifications" (EBA 2008). The overall facility dimensions were determined based on the storage of 4,500 m^3 of waste material, as requested by Alexco.

2.1 Location I

Location I for the proposed Flame & Moth facility is southeast of the existing mill building between the Flame and Moth portal and the proposed Dry Stack Phase II Expansion. The proposed facility location and footprint are shown on the attached Figure 1.

Tetra Tech EBA has site specific historic subsurface information from a testpit excavated within the proposed footprint in 2009. W14101178.002-TP03 was excavated to a final depth of 4.0 m through roughly 3.5 m of frozen peat and SILT, over ice-poor SAND. The detailed testpit log is included in Appendix B.

2.1.1 Location I Waste Storage Facility Recommendations

Tetra Tech EBA considers Location I for the Flame & Moth waste storage facility suitable provided the following recommendations are adhered to and the facility is constructed to the dimensions and specifications in the attached Drawings.

- Tetra Tech EBA understands Alexco is currently excavating a pad for access to the Flame & Moth portal to an elevation of 907 m adjacent to the proposed waste storage facility footprint. The excavation will be about 2 m

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below existing grade, exposing frozen peat and silt in the upslope wall. The disturbance caused by the portal pad excavation increases the potential for thaw settlement in the ice rich peat and silt under the proposed facility – it should be removed.

- The portal pad excavation should be extended under the facility footprint to remove all frozen peat and silt, exposing the underlying sand. Any visible ice in the sand must also be removed.
- Subsequent to peat removal, 16 oz. non-woven geotextile should be placed over the entire footprint of the facility (including beneath perimeter berms and armoured slopes graded to meet original ground).
- 0.6 m of "Zone B" material should be placed and compacted over the frozen sand prior to facility construction.
- If thicker peat/silt deposits are encountered, additional "Zone B" material will be required to prepare a level working surface. The "Zone B" material should be placed in lifts no thicker than 0.5 m in uncompacted thickness and compacted to at least 95% of maximum dry density using standard effort (as per ASTM D698).
- The excavation walls beyond the footprint of the facility should be shaped at 1.5:1 (horizontal:vertical) to meet original ground, lined with non-woven geotextile as described above, and armoured with waste rock as shown on the attached Drawings.

2.2 Location II

Location II for the proposed Flame & Moth facility is east of the existing coarse ore stockpile concrete pads. The proposed facility location and footprint are shown on the attached Figure 1.

Tetra Tech EBA has site specific historic subsurface information from a testpit excavated near the proposed footprint in 2009. W14101178.002-TP07 was excavated to a final depth of 5.4 m through shallow frozen peat, 2.5 m of gravelly SAND, and 3 m SILT (till). The detailed testpit log is included in Appendix B.

2.2.1 Location II Waste Storage Facility Recommendations

Tetra Tech EBA considers Location II for the Flame & Moth waste storage facility suitable provided the following recommendations are adhered to and the facility is constructed to the dimensions and specifications in the attached Drawings.

- The existing organic cover should be left in place to reduce the risk of thaw related settlement of the facility after construction.
- A level surface for facility construction should be prepared by constructing a waste rock pad as shown on the attached Drawings.

3.0 DSTF WASTE STORAGE

The existing DSTF is a lined facility designed for the long term storage of tailings waste generated during the milling process. Tetra Tech EBA has reviewed the stability of the DSTF with respect to the storage of P-AML waste rock and determined that the calculated factors of safety increase slightly with its inclusion. This is expected as the waste rock has a larger angle of internal friction due to its angularity. Additionally, its placed weight is less than that of tailings due to its clast nature and the associated voids.

The calculated factors of safety in the most critical scenario (permafrost condition) originally presented in the "Dry Stacked Tailings Facility – Risk Assessment Stability Model Update" (EBA 2013) are compared with the

calculated factors of safety when waste rock is co-mingled with tailings in the following Table 1. Detailed stability results, including critical failure surfaces, are available upon request.

Table 1: DSTF Slope Stability Factors of Safety – Fully Frozen Case

Stability Condition	Factor of Safety Suggested Minimum[1]	Calculated Factor of Safety		Calculated Factor of Safety (Waste Rock Included)	
		Alignment A	Alignment B	Alignment A	Alignment B
Stability of Surface					
Short-term (during construction – static)	1.0	2.0	2.2	2.1	2.3
Long-term (after construction – static)	1.1	2.0	2.3	2.1	2.3
Deep Seated Stability					
Short-term (during construction – static)	1.1-1.3	2.0	2.0	2.0	2.0
Short-term (during construction – pseudo-static)	1.0	1.4	1.4	1.4	1.5
Long-term (after closure – static)	1.3	1.5	1.4	1.5	1.4
Long-term (after closure – pseudo-static)	1.0	1.4	1.5	1.4	1.5

[1] Mined Rock and Overburden Piles Investigation and Design Manual (BC Mine Waste Rock Pile Research Committee, 1991)

3.1 DSTF Disposal Recommendations

Tetra Tech EBA considers the disposal of P-AML waste rock within the DSTF acceptable provided the following recommendations are adhered to:

- Waste rock should be placed in lifts no thicker than 1.0 m to limit the risk of void formation within the facility as tailings naturally filter into the voids within the placed rock during and after compaction.
- At least 0.5 m of tailings must be placed and compacted between subsequent waste rock lifts to reduce the risk of preferred pathways for water infiltration through the DSTF.
- Waste rock should not be placed within 1.0 m of the extents or final surface of the DSTF to allow for adequate encapsulation.
- Waste rock may be placed in isolated partial lifts at differing locations throughout the DSTF. In fact this approach is preferred to limit the regional variability of material used to construct the DSTF.

4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Resource Corp and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Alexco Resource Corp, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

5.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.



Justin Pigage, P.Eng.
Geotechnical Engineer, Arctic Region
Direct Line: 867.668.9213
Justin.Pigage@tetratech.com



REVISION I SUMMARY:

Added recommendations for alternate facility location (Location II).

REFERENCES

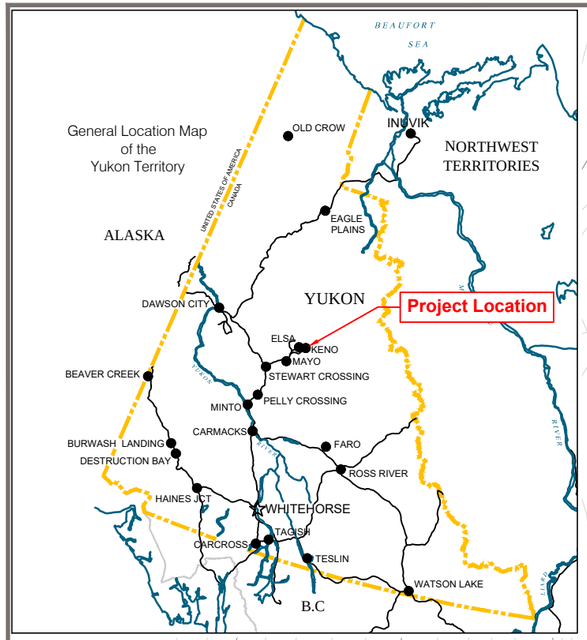
EBA, A Tetra Tech Company “Dry Stacked Tailings Facility – Risk Assessment Stability Model Update, Keno Hill District Mill Site, Yukon” February 2013.

EBA Engineering Consultants Ltd. “Typical Waste Containment Facility Design, Keno Hill Silver District, YT – Construction Specifications” July 2008.

Piteau Associates Engineering Ltd. “Investigation and Design of Mine Dumps – Interim Guidelines.” Prepared for British Columbia Mine Waste Rock Pile Research Committee, May 1991.

FIGURES

Figure 1 Site Plan
Figure 2 Location I Cross-Sections
Figure 3 Location II Cross Sections
Figure 3 Details and Notes



STATUS

PRELIMINARY - NOT FOR CONSTRUCTION

LEGEND

⌗ - TESTPIT LOCATION (2009)

0 100 m

Scale: 1 : 1750 @ 11"x17"

CLIENT

ALEXCO

FLAME AND MOTH WASTE STORAGE FACILITY
KENO HILL DISTRICT, YUKON

SITE PLAN

TETRA TECH EBA

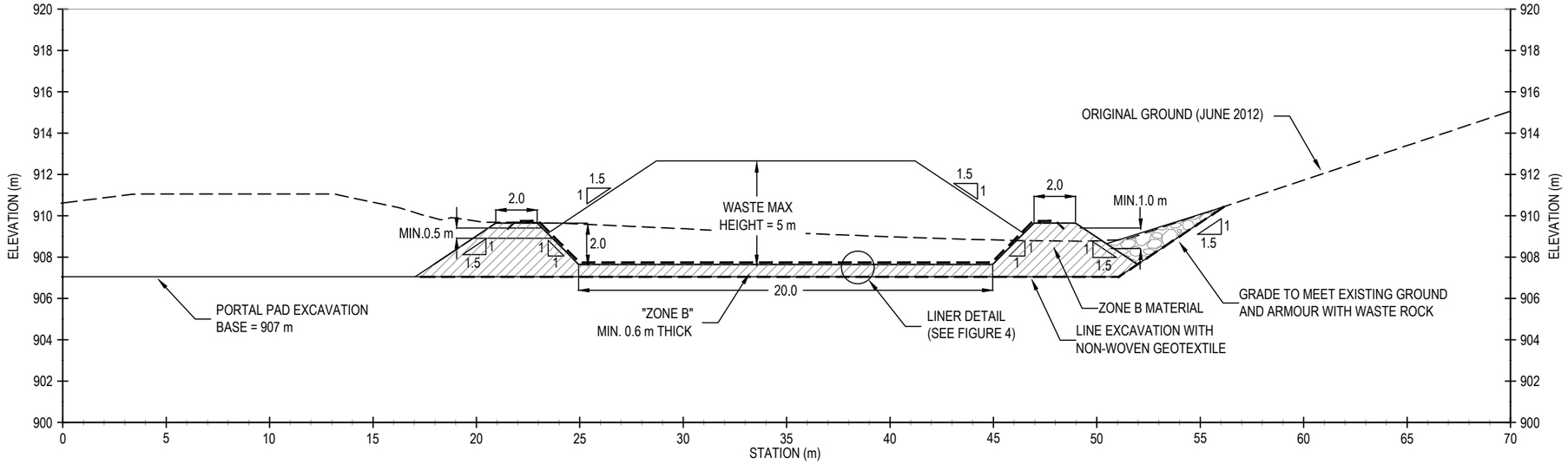
PROJECT NO.	DWN	CKD	REV
W14103485-01	CB	JTP	0

OFFICE: EBA-WHSE

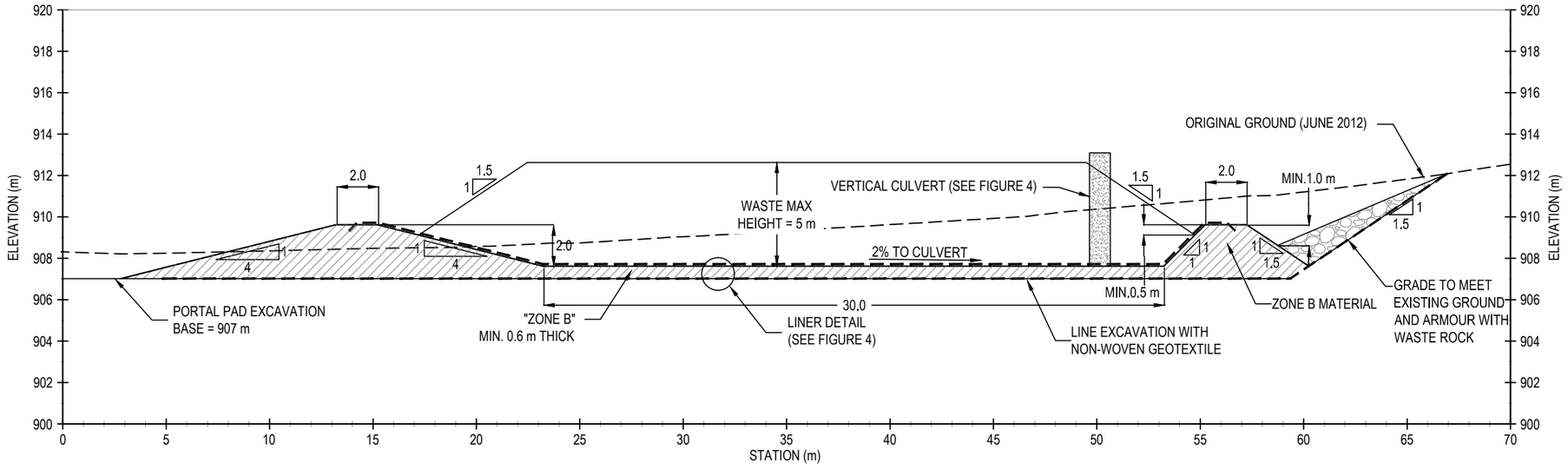
DATE: September 25, 2014

Figure 1

Q:\Whitehorse\Data\0201drawings\Keno\W14103485-01 Flame & Moth P-AML Design\W14103485-01 Figs. I-3_R0.dwg [FIGURE 1] October 01, 2014 - 2:19:36 pm (BY: BUCHAN, CAMERON)



SECTION A - A'



SECTION B - B'

STATUS

PRELIMINARY - NOT FOR CONSTRUCTION

0 10 m

Scale: 1:250 @ 11"x17"

CLIENT

ALEXCO

TETRA TECH EBA

FLAME AND MOTH WASTE STORAGE FACILITY
KENO HILL DISTRICT, YUKON

LOCATION I CROSS-SECTIONS

PROJECT NO.	DWN	CKD	REV
W14103485-01	CB	JTP	0
OFFICE: EBA-WHSE	DATE: September 25, 2014		

Figure 2

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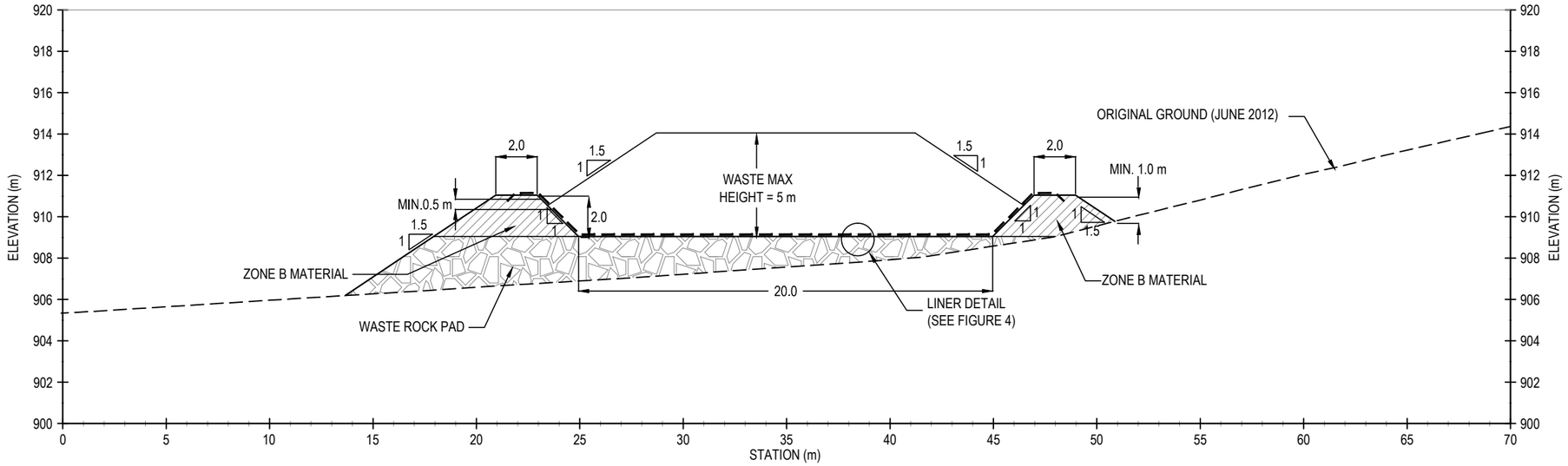
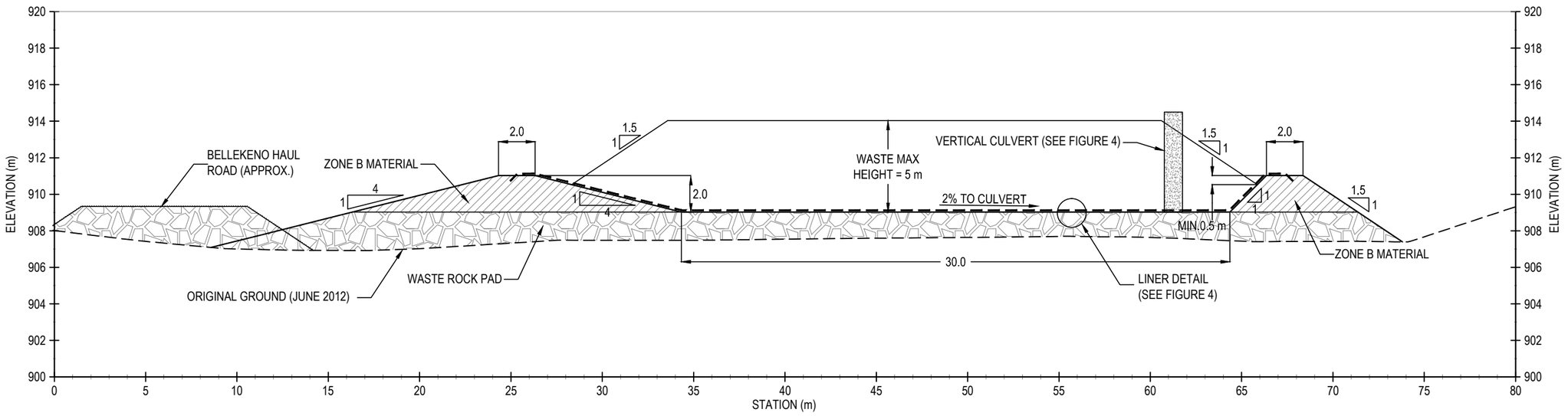


SECTION C - C'



SECTION D - D'

STATUS
PRELIMINARY - NOT FOR CONSTRUCTION

0 10 m
Scale: 1:250 @ 11"x17"

CLIENT
ALEXCO

TETRA TECH EBA

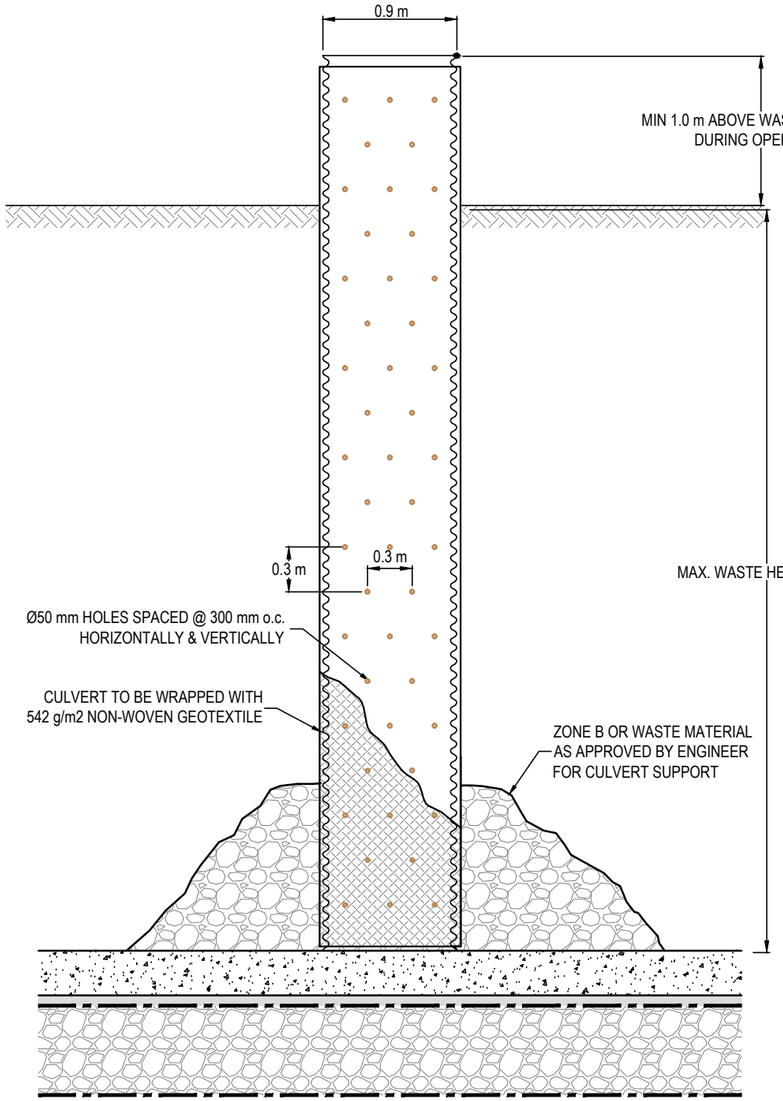
FLAME AND MOTH WASTE STORAGE FACILITY
KENO HILL DISTRICT, YUKON

LOCATION II CROSS-SECTIONS

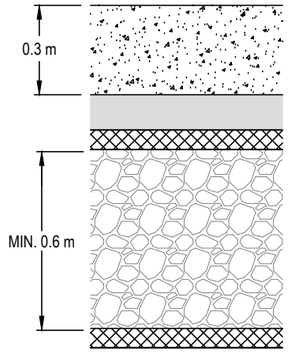
PROJECT NO.	DWN	CKD	REV
W14103485-01	CB	JTP	0
OFFICE: EBA-WHSE	DATE: September 25, 2014		

Figure 3

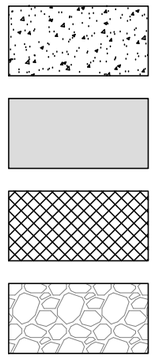
Q:\Whitehorse\Data\0201drawings\Keno\W14103485-01 Flame & Moth P-AML Design\W14103485-01 Figs 1-3 R0.dwg [FIGURE 3] October 01, 2014 - 2:21:44 pm (BY: BUCHAN, CAMERON)



DETAIL 1 - VERTICAL SUMP CULVERT



DETAIL 2 - FACILITY FLOOR AND BERMS



LINER SYSTEM DETAIL KEY

NOTES :

These specifications, relevant to construction of the Flame & Moth Waste Storage Facility, have been extracted from the Typical Waste Containment Facility Design Construction Specifications, Keno Hill Silver District, YT (EBA July 2008).

The Flame & Moth Waste Storage Facility shall be constructed to the specifications below and the dimensions indicated on the Construction Drawings.

Water in the facility will flow towards and pond in the vertical culvert where it will be monitored and tested on a regular basis. Based on water quality analysis, the waste water will be extracted via pump truck and discharged to the environment or treated in a designated treatment facility.

The facility has been sized based on containment of approximately 4,500 m3 of waste, when the ultimate capacity is reached a 0.5 m soil cover will be placed over the entire facility.

The Zone A material shall consist of hard, durable particles, shall be free of roots, topsoil, and deleterious material and shall have a particle size distribution, as measured by ASTM C136, as presented in Table 1, or as approved by the Engineer.

The Zone B material shall consist of hard, durable particles, shall be free of roots, topsoil, and deleterious material and shall have a particle size distribution, as measured by ASTM C136, as presented in Table 1, or as approved by the Engineer.

The fill materials shall be placed in lifts not exceeding 0.5 m in uncompacted thickness and compacted to at least 95% of maximum dry density using standard effort as per ASTM D698.

The non-woven geotextile shall be 542 g/m2 Layfield LP16 or equivalent approved by the Engineer.

The HDPE geomembrane shall be 1.6 mm (60 mil) thick Layfield HDPE 60 or equivalent approved by the Engineer.

The HDPE geomembrane seems shall be welded by a suitably qualified contractor. Trial seems shall be conducted prior to start-up each day and at approximately 4-hour intervals during seaming operations. During the trial seam, the minimum strength criteria set by the manufacturer for the geomembrane should be met.

No construction equipment shall be allowed to travel on the liner prior to the placement of the protective Zone A cover material.

Table 1: Particle Size Distribution Limits

Zone B Material		Zone A Material	
Particle Size (mm)	% Passing by Mass	Particle Size (mm)	% Passing by Mass
200	100		
100	85 – 100		
50	65 – 100		
25	40 – 100	10	100
5	20 – 55	5	80 – 100
2	0 – 20	2	55 – 100
		0.63	25 – 65
		0.25	10 – 40
		0.08	2 – 15

STATUS

PRELIMINARY - NOT FOR CONSTRUCTION

NOTE

- THIS PLAN IS NOT TO SCALE

CLIENT

ALEXCO

TETRA TECH EBA

FLAME AND MOTH WASTE STORAGE FACILITY
KENO HILL DISTRICT, YUKON

DETAILS AND NOTES

PROJECT NO.	DWN	CKD	REV
W14103485-01	CB	JTP	0

OFFICE: EBA-WHSE

DATE: September 26, 2014

Figure 4

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APPENDIX A
TETRA TECH EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA’s Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B
HISTORIC TESTPIT LOGS

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP03
near Keno City, YT	7086760N; 484004E; Zone 8	ELEVATION: 907.4m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	STANDARD PENETRATION (N) 20 40 60 80 / POCKET PEN. (kPa) 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - amorphous granular, roots, organics, black and brown, frozen					Frozen	907.0
			SA01		354		
1							906.0
			SA02		1158		
2							905.0
3	SILT - some sand, trace clay, soft (est.), low-plastic, massive, frozen, olive grey		SA03	-1.7	H	Vs (35%) ice lens up to 10cm thick	904.0
	SAND - silty, gravelly, trace clay, firm (est.), non-plastic, massive, frozen, olive grey		SA04			Vs and Vc (5%)	
4	EOH - target depth						903.0
5							902.0
6							

EBA Engineering Consultants Ltd.

LOGGED BY: CJD	COMPLETION DEPTH: 4m
REVIEWED BY: JRT	COMPLETE: 5/6/2009
DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP07
near Keno City, YT	7086712N; 483955E; Zone 8	ELEVATION: 906.7m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	STANDARD PENETRATION (N) 20 40 60 80 / POCKET PEN. (kPa) 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - some silt, woody, roots, black					Frozen	
	SILT - sandy, some gravel, medium, non-plastic, frozen, brown, organics, roots		SA01				906.0
	SAND - gravelly, trace cobbles, trace silt,, compact (est.), medium grained, well graded, damp to moist, brown, sub-rounded						
1			SA02			Unfrozen	
							905.0
	- seepage						
2						Frozen Nbn	
	SILT - sandy, some gravel, trace clay, stiff (est.), low plastic, massive, olive grey						904.0
3			SA03	-0.1	H	Vx, Vc (<5%)	
							903.0
						Unfrozen	
4							
			SA04	1.5	▲		902.0
5							
	EOH - refusal at probable bedrock (quarzite)						901.0
6							

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 5.4m
	REVIEWED BY: JRT	COMPLETE: 5/6/2009
	DRAWING NO: Figure 2	Page 1 of 1

APPENDIX 3.5

BERMINGHAM MINE WASTE ROCK DISPOSAL AREA DESIGN

Bermingham WRSA Expansion Design
Keno Hill Mine, YT





PRESENTED TO

Alexco Keno Hill Mining Corp.

JUNE 9, 2025
ISSUED FOR USE
FILE: 704-ENG.WARC04673-06

Tetra Tech Canada Inc.
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Project Description 1
1.2 Previous Work 1

2.0 SITE CONDITIONS 1
2.1 Surficial Conditions and Existing WRSA 1
2.2 Subsurface Conditions 2
2.2.1 Review of Historical Information 2
2.2.2 Geophysical Survey 3
2.2.3 Summary of Anticipated Conditions 3
2.3 Precipitation 4

3.0 FACILITY CLASSIFICATION AND DESIGN CRITERIA 5
3.1 Design Workshop 5
3.2 Facility Classification 5
3.3 Design Criteria and Guidelines 5
3.3.1 Design Guidelines 5
3.3.2 Design Criteria 6

4.0 WRSA DESIGN ASSESSMENTS 6
4.1 Slope Stability Assessment 6
4.1.1 Analysis Methodology 6
4.1.2 Geotechnical Design Materials and Design Parameters 7
4.1.3 WRSA Operations Slope Geometry 8
4.1.4 Seismic Design Parameters 8
4.1.5 Stability Model Results 8
4.2 Deformation and Seismic Displacement 10
4.3 Runout Assessment 10
4.3.1 Methodology 10
4.3.2 Results 11
4.4 Surface Water Management 12

5.0 DESIGN SUMMARY AND RECOMMENDATIONS 15

6.0 CLOSURE 16

REFERENCES 17

LIST OF TABLES IN TEXT

Table 2-1: Climate Stations Near the Project Site 4
Table 2-2: Summary of Total 24-Hour Precipitation for Various Return Periods 4
Table 3-1: Design Criteria for the Bermingham WRSA 6
Table 4-1: Bermingham WRSA Design Material Parameters 8
Table 4-2: Bermingham WRSA Slope Stability Analysis Results 9
Table 4-3: Waste Rock Failure Travel Angles 11
Table 4-4: Flow-R Model Properties 11
Table 4-5: Rainfall Intensities for Various Return Periods 13

APPENDIX SECTIONS

FIGURES

Bermingham WRSA Expansion Drawings – Issued for Construction

APPENDICES

Appendix A Tetra Tech's Limitations on Use of this Document
Appendix B Geophysics Results
Appendix C Slope Stability Assessment
Appendix D Empirical Data Used for Runout Assessment

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Keno Hill Mining Corp. and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Alexco Keno Hill Mining Corp., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

1.1 Project Description

Tetra Tech Canada Inc. (Tetra Tech) was engaged by Alexco Keno Hill Mining Corp. (AKHM) to complete an expansion design for a non-acid and/or metal leaching (NAML) Waste Rock Storage Area (WRSA) at the Bermingham Mine, located near Keno City, Yukon.

The Keno Hill Silver District is located in central Yukon, approximately 360 km north of Whitehorse by air, and 450 km by road.

This work is being completed under the Engineering Services Agreement between AKHM and NELPCo dated September 23, 2024, of which Tetra Tech is the primary service provider, with reference to purchase order PO-20356.

This design report is intended to summarize the work completed, including:

- Background information and existing conditions;
- Design classification and design criteria;
- Geotechnical and hydrotechnical analyses; and
- Final WRSA expansion design.

Tetra Tech understands this design report will be submitted to Yukon Government Department of Energy, Mines, and Resources (EMR) in accordance with AKHM's Quartz Mining License QML-0009 and Water License QZ18-044.

1.2 Previous Work

In 2021, Tetra Tech completed a design report for the initial NAML waste rock stockpile at Bermingham Mine (Tetra Tech 2021). The design report summarized historical and more recent geotechnical investigations to aid the detailed design.

A geotechnical investigation consisting of six testpits was completed within the WRSA footprint, and encountered organics and silt overlying weathered and competent bedrock. Competent bedrock was generally found between 0.8 m to 1.5 m below ground level. These findings supplemented with historical information of the area was used for the slope stability analysis where long-term static and pseudo-static cases were modelled.

2.0 SITE CONDITIONS

2.1 Surficial Conditions and Existing WRSA

The Bermingham WRSA expansion area is located along a northwest facing slope. The organic layer within the expansion footprint has been removed, exposing colluvium and weathered bedrock.

The Bermingham portal is located upslope and southeast of the existing WRSA footprint. The general mine area is constructed on the side-slope, and consists of offices, laydowns, ore pads, and water treatment facilities. The area is accessed by the Berm haul road, which enters the site from the east.

A water diffusion pond and mine access road are located approximately 60 m and 300 m down-slope of the expansion footprint, respectively.

The existing WRSA at the time of this reporting extends over approximately a third of the overall proposed expansion footprint. The crest elevation of the WRSA is approximately 1,230 m, and the maximum height is approximately 16 m. Current operations consist of top-down construction, resulting in a typical slope of approximately 1.25H:1V.

2.2 Subsurface Conditions

2.2.1 Review of Historical Information

An intrusive site investigation was not carried out as part of this design scope. However, several previous testpitting and drilling programs have been completed within the expansion footprint, and within the immediate vicinity. Tetra Tech completed a desktop review of these previous programs, which included:

- 2024 – Bermingham Septic Field Test Pitting Program
  - A test pitting program was completed approximately 40 m northeast of the Bermingham WRSA expansion footprint in June 2024. The purpose of the program was to identify the subsurface conditions within the proposed septic field area.
  - Two test pits were excavated and shallow weathered bedrock was encountered in each. Generally, the subsurface conditions consisted of organic topsoil, underlain by silt, underlain by weathered bedrock. The average depth from ground surface to bedrock was 0.4 m.
- 2021 – Bermingham NAML WRSA Design (Tetra Tech 2021)
  - A design report was completed, outlining historical and a recent testpitting investigation, slope stability analysis on the permitted NAML waste rock stockpile, recommendations for the waste rock stockpile construction and maintenance during mining operations, and a design drawing outlining the stockpile geometry and location with respect to the other mining infrastructure.
  - The site conditions during the field evaluation were generally consistent comprising a layer of organics (typically 300 mm), underlain by a thin layer of non-plastic silt. Underlaying the silt was a veneer of weathered bedrock (angular rock within a matrix of silt) or colluvium that ranged in thickness before termination on competent bedrock, typically within 1.0 m from the surface.
- 2020 – Monitoring Well Installations
  - A technical memo was completed, detailing the installation of 11 monitoring wells throughout the Keno mine site. The memorandum details the subsurface conditions observed, installation depths, installation materials used, volume of water pumped during installation, and comments on the credibility of the data obtained from the wells.
  - Borehole KV-116 was located near the center of the current WRSA expansion design. Subsurface condition observed consisted of weathered bedrock at or near the surface to 6.5 m, where competent bedrock was encountered.

- 2014 – Terrain Mapping (Tetra Tech 2014)
  - A letter report was completed summarizing the terrain mapping provided by Tetra Tech (EBA at the time) for the various sites in the Keno Hill Silver District. The Bermingham Mine Site was found to border on two different surficial geology deposits; colluvium and bedrock, and till. The colluvium and bedrock consisted of gravelly silty sand or sandy silt near the surface whereas the till was a heterogenous mixture of silt, gravel and boulders.

2.2.2 Geophysical Survey

In addition to the previous investigations discussed above, an Electrical Resistivity Tomography (ERT) and Ground Penetrating Radar (GPR) investigation was completed to help understand subsurface conditions. Both methods were collected along two parallel profiles approximately 220 m in length within the Bermingham WRSA area. Figure B1 in Appendix B presents a site map of the location of the ERT and GPR profiles.

ERT is a geophysical method that can model a cross-section of apparent resistivity measurements. GPR is a geophysical method that sends an electromagnetic pulse into the ground. The measured reflected waves can then be used to calculate depths to stratigraphic interfaces.

Data was collected by Tetra Tech on April 4, 2025. ERT pins were placed at an electrode spacing of 5 m. GPR was collected with a 250 MHz and a 100 MHz Rough Terrain Antenna. All data was georeferenced to GPS during data collection. Elevations were shifted to the site LiDAR elevations in processing.

Figures B2 and B3 in Appendix B present the geophysical results for Lines 1 and 2 respectively. The top profiles on the figures are the ERT models. Higher resistivity values (>10,000 Ohm*m) are displayed in oranges and reds. Lower resistivity values (<2,000 Ohm*m) are displayed in blues and purples. Below the ERT model are the GPR profiles. Borehole KV-116 (Tetra Tech 2021) is plotted on the Line 2 profiles to aid the interpretation.

The interpreted weathered/competent bedrock interface is presented on the data as a dashed black line. This interpretation is based off primarily the GPR data. The thickness of the weathered rock layer generally ranges up to 6 m. In both profiles, the interpreted weathered/competent bedrock interface nears the surface towards the northeast.

Both profiles have higher resistivity values near the surface between chainages 20 m to 60 m, 100 m to 130 m, and 180 m to 200 m. These higher resistivities could be temperature related (i.e., frozen weathered rock), or be weathered rock with higher silica content. In both profiles, higher resistivities are also modelled at an elevation of approximately 1,190 m. These higher resistivities could be due to a different rock type at this depth, or frozen competent rock. Areas with lower resistivities are likely associated with bedrock with more weathering and fracturing, assuming a relatively homogeneous bedrock type.

2.2.3 Summary of Anticipated Conditions

Based on the historical information reviewed and geophysical surveys completed, the following general subsurface conditions are anticipated:

- Colluvium and/or weathered bedrock – typically 0.5 m to 1.0 m thick, and up to 6.0 m thick locally; underlain by
- Competent bedrock, anticipated to consist of quartzite.

Based on records provided to Tetra Tech, the monitoring well installed at KV-116 was noted to have a static water level ranging between approximately 4 m to 6 m from surface between November 2020 and May 2024. In the

summer of 2024, the water diffusion pond previously located near the edge of the existing WRSA footprint, upgradient of KV-116 was decommissioned and relocated further down slope, below the proposed expansion footprint. Monitoring well measurements taken by AKHM in July 2024 and October 2024 indicate the well is now dry.

The overall Keno Hill District area is considered to be underlain by discontinuous, warm permafrost. Within the Bermingham WRSA footprint, thaw unstable permafrost such as ice-rich or massive ground ice conditions have not been observed and are not anticipated. The area has been stripped of organics, and it is anticipated that the permafrost is thaw stable and is located within the bedrock.

2.3 Precipitation

Precipitation data was evaluated to estimate the surface runoff reporting to the WRSA. Precipitation data, in proximity to the Bermingham Mine, is available from both the Mayo Airport climate station and the District Mill climate station (Environment Canada 2025). The data sources are summarized in Table 2-1. A frequency analysis for both sites were conducted and the resulting 24-hour rainfall for different return periods are summarized in Table 2-2. The frequency analysis show an average 1/200 year rainfall event equivalent to 37.5 mm, with an average annual rainfall (1/2) of 16.8 mm.

Table 2-1: Climate Stations Near the Project Site

Station Number/Name	Location	Distance from Site	Duration of Record	Frequency	Type of Data	Agency
1572	Mayo Airport	42 km	1953-2013	Hourly	Temperature, precipitation, snow thickness, wind speed	ECCC
			1924-2013	Daily		
51426	Mayo Airport	42 km	2013-present	Daily, Hourly		
District Mill	DSTF, Keno Hill	< 1 km	2011-present	Hourly	Precipitation	AKHM
Multiple	DSTF, Keno Hill	< 5 km	2011-2024	Monthly	Temperature, precipitation, snowpack (SWE)	Ensero Solutions

Table 2-2: Summary of Total 24-Hour Precipitation for Various Return Periods

Return Period (years)	Keno Hill Precipitation (mm)	Mayo Airport Precipitation (mm)
200	37.6	37.1
100	34.5	33.6
50	31.5	31.2
20	27.7	28.8
10	24.7	24.0
5	21.7	21.6
2 (Avg)	16.7	16.8

3.0 FACILITY CLASSIFICATION AND DESIGN CRITERIA

3.1 Design Workshop

On March 27, 2025, a virtual workshop was held to review design expectations, operational considerations, and to identify data gaps. Key goals of this workshop were to confirm the appropriate facility classification and design criteria.

After the workshop, a memorandum summarizing key discussion points, and requesting clarification or information related to identified data gaps was issued (Tetra Tech 2025). AKHM provided responses by email (L. McGrail, pers. comm., April 5, 2025).

3.2 Facility Classification

The Bermingham WRSA facility was classified based on the Mine Rock Management Facility (MRMF) Classification Table 6-1 provided in Guidelines for Mine Waste Management Facilities (2023) by Department of Energy, Mines, and Resources, Yukon Government (EMR 2023).

A facility classification of “Class 1” was assigned to the Bermingham WRSA Expansion based on the following characteristics:

- Maximum height above natural ground – Less than 50 m.
- Presence of permafrost – No ice rich permafrost or massive ice present under critical elements.
- Geochemistry of rock – Only Non-acid generating materials will be stored in the facility.
- Predicted water quality of waste rock seepage or runoff – AKHM has advised that surface runoff and seepage are predicted to comply with existing QML and Waste Rock Management Plan.
- Runoff or leachate management requirements – Protection of receiving water does not require active or passive management of water discharges other than sediments controls during the operations phase.
- Surface water conditions – The footprint of the expansion does not encompass any known stream channels nor natural water resources.
- Human health and safety – Other than the temporary presence of mine workers carrying out their duties, there is no identifiable population at risk from a failure of the facility.
- Facility closure costs – AKHM has advised that the cost estimate of the closure for the operational WRSAs will not exceed 10 M dollars.

3.3 Design Criteria and Guidelines

3.3.1 Design Guidelines

The following design guidelines and standards were used or referenced during the design of the WRSA expansion:

- Guidelines for Mine Waste Management Facilities (2023) by Department of Energy, Mines, and Resources, Yukon Government; and

- Guidelines for Mine Waste Dump and Stockpile Design (2017) by M. Hawley and J. Cunning.

3.3.2 Design Criteria

Design criteria was selected in accordance with Table 6-2 of the 2023 EMR Guidelines (2023), based on a "Class 1" facility and are summarized below in Table 3-1. Note, only applicable criteria are adapted below; for example, a spillway is not required for this facility, and is omitted from the table.

Closure criteria were considered; however, final closure design is considered outside of the scope of this design.

Table 3-1: Design Criteria for the Bermingham WRSA

Category	Sub-Category	Design Criteria
Design Events	Seismic Design of Rock Piles	Operations: 200 year EDGM Closure: 200 year EDGM
	Design Flood: Surface Water Diversion and Conveyance Systems	Operations: 200 year AEP Closure: 200 year AEP
Design Methods and Factors of Safety	Rock Pile Factors of Safety: During Operations	Static: greater than 1.3 Pseudo-Static: greater than 1.0
	Rock Pile Factors of Safety: During Closure and Post-Closure	Static: greater than 1.3 Pseudo-Static: greater than 1.0 Post-Earthquake: greater than 1.1
	Analyses is to consider: Average shear strength properties Expected phreatic surfaces Limit equilibrium methods of stability calculations Pseudo-static calculations for earthquake design	
Surface Water Management	Water Quality Pond Capacity	Pond not required.
	Catchment Area for Determining IDF	Catchment area for the MRMF plus catchment areas of the surface water diversions, in the event the surface water diversions are designed to a smaller design flood than the MRMF

Adapted from Table 6-2 in EMR Guidelines (2023).

4.0 WRSA DESIGN ASSESSMENTS

4.1 Slope Stability Assessment

4.1.1 Analysis Methodology

Limit equilibrium stability analyses were carried out to evaluate the stability of the Bermingham WRSA using SLOPE/W by GeoStudio (Bentley Systems Inc. 2023). The Morgenstern-Price method with a half-sine interslice force assumption was adopted in the analyses. The analyses were conducted to evaluate the waste rock slope stability during mining operations. The required design factor of safety (FoS) is used to account for the uncertainty and variability in the input parameters.

The principles underlying the method of limit equilibrium analyses of slope stability are as follows:

- A slip mechanism is postulated;
- The shear resistance required to equilibrate the assumed slip mechanism is calculated by means of statics;
- The calculated shear resistance required for equilibrium is compared with the available shear strength to determine the FoS for each potential slip mechanism; and
- The slip mechanism with the lowest FoS is determined through iteration.

Potential seismic loading was modelled using pseudo-static analysis considering a horizontal acceleration factor (k_h) selected based on the PGA described in Section 4.1.4. The k_h applied in the stability analyses uses the full PGA of 0.082. Acceptable FoS for both static and seismic conditions were described earlier in Section 3.3.

In the slope stability analyses conducted, the entry and exit method was used in SLOPE/W to determine the FoS. Slip surfaces less than 2 m in depth were not considered a general slope instability as these are generally addressed through operations and maintenance.

Sensitivity analyses were run concurrent with the stability analysis to determine the impact of variability within assumed material parameters, an assumed phreatic surface, as well as the thickness of weathered bedrock overlying competent bedrock within the foundation. Waste rock strength parameters were assumed based on existing literature, back analyses of existing conditions, and engineering judgement. The thickness of the weathered bedrock layer was observed in both the testpitting investigation completed in the previous WRSA design report (Tetra Tech 2021) and the borehole KV-116 drilled for the monitoring well installations (Tetra Tech 2020). The monitoring well borehole encountered 6.5 m of weathered rock from ground surface whereas the testpits encountered competent bedrock within 2 m below ground level. Based on these observations, Tetra Tech assumed the models' foundation profile to consist of a maximum of 6 m of weathered bedrock as seen in the model figures in Appendix C.

4.1.2 Geotechnical Design Materials and Design Parameters

The geotechnical design parameters for slope stability, provided in Table 4-1, were preliminarily selected based on the 2021 design report (Tetra Tech 2021) and were reviewed and updated to reflect the current conditions of the waste rock stockpile. The soil stratigraphy modelled beneath the WRSA was generally overburden consisting of colluvium including and silt, overlying weathered bedrock and competent bedrock. The friction angle for the waste rock was determined by back analyzing the slope of the existing waste rock pile and determining the soil parameters assuming marginally stable conditions, as shown in Figure C1 of Appendix C. The internal friction angles were assumed to be unfrozen soil/rock properties, except during winter operations when a frozen layer may be present; in this case, it was assumed that the frozen waste rock had a marginally higher internal friction angle.

Table 4-1: Bermingham WRSA Design Material Parameters

Material	Unit Weight, γ (kN/m^3)	Cohesion, c (kPa)	Friction Angle, ϕ (°)
Existing Waste Rock	19.5	0	37
Expanded Waste Rock Storage	19.5	0	37
Weak Interface (Silt)	17	0	30
Frozen Waste Rock	19.5	0	39
Frozen Waste Rock Interface	19.5	0	34
Bedrock - Weathered	19	0	32
Bedrock - Competent	Considered impenetrable		

Two different cases were analyzed for the location of the phreatic surface; Case 1 was shallow and ran along the weak interface assumed underneath the waste rock. This was considered longer-term in construction and pore water pressures were given adequate time to dissipate. Case 2 assumed the phreatic surface to be midslope as the presence of fine-grained soils within the waste rock pile is possible and the generation of some excess during placement/rainfall events can disturb the stability of the slope. Note KV-116 monitoring well measurements indicate the well is dry, and therefore each of these cases are considered conservative.

4.1.3 WRSA Operations Slope Geometry

The operational WRSA geometry was developed in discussion with AKHM, establishing the maximum WRSA capacity within the permitted area while maintaining the existing elevation. The crest of the WRSA was set at 1,230 m in elevation, and the slopes were to follow an overall resultant 2H:1V gradient. The resulting bench configuration for the fully constructed WRSA comprises intermediate 6 m high benches with 1.25H:1V slopes (based on the waste rock's angle of repose) and a 4.5 m width. The total capacity with this established geometry is estimated to be 185,500 m^3.

Drawing No.002 presents a plan layout of the Bermingham WRSA within the permitted footprint, while Drawing No.003 shows the proposed typical sections for storing waste rock during mining operations. From discussions with the AKHM, there will be two methodologies of waste rock placement throughout the year. Generally, winter months will consist of top-down construction with waste rock end dumped onto the existing stockpile crest and pushed over the crest using a dozer and the summer months will consist of bottom-up construction utilizing a lower access road.

4.1.4 Seismic Design Parameters

Seismic loading was modelled using a pseudo-static approach with a design horizontal peak ground acceleration (PGA) of 0.082 g. This is the value estimated from the 2020 National Building Code of Canada seismic hazard model (Kolaj, M., et al. 2020) for a 20% in 50 years probability of exceedance (0.004 per annum or 1 in 250 year return) for Site Designation X_C. This coincides with design criteria for a Class 1 facility and would require to be designed using the 1 in 200 year event. Bedrock is shallow to the ground surface and competent bedrock is assumed generally within 3 m of the bedrock surface profile; thus a Site Class C was considered appropriate.

4.1.5 Stability Model Results

One cross-section was modelled for the slope stability of the WRSA (running approximately southeast to northwest) as the site topography slopes down away from the mining facility and this was considered the critical slope based on the overall topography, and final waste rock height, as shown in Figure C2. For the base case the waste rock pile was considered unfrozen and the phreatic surface was located at original ground elevation. The snowfall and

frozen active layer reduce the interlocking capabilities of the newly placed rock and thus, reduces the interface shear strength. A localized case looked at the sensitivity of winter end dumping compared to thawed conditions during the summer.

The results in Table 4-2 indicate that the calculated FoS meets or exceeds the design criteria.

Table 4-2: Bermingham WRSA Slope Stability Analysis Results

Scenario	Estimated FoS	Required FoS
Benched 1.25H:1V Slope, Resultant 2H:1V Overall – Static	1.4	1.3
Benched 1.25H:1V Slope Resultant 2H:1V Overall – Pseudo Static	1.1	1.0
Benched 1.25H:1V Slope Resultant 2H:1V Overall – Post-seismic	1.1	1.1

Tetra Tech also completed several sensitivity analyses including:

- Location of Phreatic Surface
  - As described in Section 4.1.2, the sensitivity of raising the phreatic surface to midslope of the waste rock stockpile yielded a static stability FoS of 1.2, less than the required 1.3 FoS; However, our assumption of the phreatic surface in the slope stability model may not be representative of in situ porewater pressure (PWP) conditions as there was no particle size distribution testing within the waste rock material to estimate the permeability of the material. Monitoring during operations through field instrumentation would be beneficial to determine the actual PWP conditions and ensure the stability of the slope is maintained. Slip surfaces generated in the slope stability models are attached in Appendix C.
- Waste Rock Parameters
  - The results for the sensitivity analyses that determined the influence the waste rock pile's parameters have on the stability of the critical slip surfaces are included in Appendix C (Figures C8 to C11). The general trend observed that the friction angle was more sensitive than the unit weight in "dry" conditions; a ±1.5 kN/m^3 change in unit weight saw negligible change in the FoS. The sensitivity of the parameters when the phreatic surface was placed mid-slope was shown to have a lower range for FoS, meaning the location of the phreatic surface was more critical to the slope stability.
- Thickness of Weathered Bedrock
  - The thickness of weathered bedrock varied within the WRSA footprint from less than 2 m below ground level to 6.5 m, as encountered in the testpits and monitoring well borehole. Sensitivity cases modelled constant 2, 4, and 6 m thick weathered bedrock layers underneath the weak overburden interface to determine how it would change the slip surfaces out the toe of the slope. The general trend found the slope to be less stable with a deeper weathered bedrock surface; However, 6 m of weathered bedrock underneath the waste rock stockpile still met the required design criteria.

The waste rock materials are not generally expected to undergo a significant reduction in shear strength post-earthquake, provided they do not become fully saturated. Tetra Tech completed a sensitivity analysis to estimate the overall material strength loss in the foundation soils required to reduce the resultant FoS to 1.1. Analyses indicate that all the foundation materials would require at least a 20% reduction in shear strength to lower the resultant post-seismic FoS to 1.1.

4.2 Deformation and Seismic Displacement

The foundation underneath the waste rock pile primarily consists of a thin layer of colluvium or weathered bedrock, over bedrock. It is also anticipated that there are no ice-rich soils or permafrost within the WRSA footprint; Therefore, there is no potential for thaw settlements and negligible long-term foundation settlements are expected under static conditions from the waste rock placement during mining operations.

Earthquake-induced displacements that undergo shear deformation during subduction, crustal, and/or intraslab zone interface earthquakes can be estimated based on the simplified procedure proposed by Bray and Macedo (2017; 2023). The procedure considers the seismic response of a deformable sliding block, using the initial fundamental period of the sliding mass (T_S), the yield coefficient of the sliding mass (k_y), spectral acceleration given the T_S ($S_a(T_S)$), magnitude of earthquake event (M_W), and the peak ground velocity (PGV). Results from the simplified procedure suggest the seismic deformation would be on the order of 10 cm. Assumptions for shear wave velocities for the waste rock pile were made in absence of in- situ field data and could potentially increase the settlement; However, it is not expected to significantly impact the WRSA and thus would be considered of low consequence.

4.3 Runout Assessment

A runout assessment was performed to estimate the potential distance that WRSA debris could travel in the event of a failure. The results of this assessment should be used by AKHM to better understand the potential areas of impact within the downslope environment.

Downslope hazard zonation mapping was undertaken for the proposed expansion of the WRSA to identify areas located in potential waste rock runout zones based on simplified source areas and empirical propagation assumptions. This assessment does not account for the likelihood of runout occurrence; it inherently assumes that failure and runout occur.

Propagation modelling of potential waste rock runout was performed using Flow-R (Flow path assessment of gravitation hazards at a regional scale) Version 2.1.0 (Terranum, 2025; Horton et al. 2013). Flow-R is a regional assessment tool that uses topographic inputs and incorporates multiple spreading algorithms and simple frictional laws to determine gravitational hazard propagation characteristics.

The following sections detail the methodology and modelling parameters, and results of the assessment.

4.3.1 Methodology

4.3.1.1 Waste Rock Failure Data

Empirical waste rock failure data collected as part of the BC Mine Waste Rock File Research Committee (BCMWRPRC 1995) was used for the determination of waste rock runout mobility parameters. Waste rock failure data was grouped into the following two categories based on mobility trends within the database:

1. High Mobility / Normal Mobility (confined).

2. Normal Mobility (partially confined) / Normal Mobility (unconfined).

The empirical waste rock failure data is presented in Appendix D.

Considering the proposed WRSA geometry and the surrounding topography, it was assumed that failures originating from the WRSA would behave similarly to the normal mobility and unconfined/partially confined empirical data. The potential failure volume was estimated to be 50,000 m^3 based on the available BCMWRPRC data (1995), the proposed waste rock geometry, and the results of the slope stability analysis (Section 4.1). This volume was used to determine a range of potential mobility cases (travel angles) based on the BCMWRPRC data (1995).

The 10% and 50% exceedance probability failure scenarios were considered for this assessment. Table 4-3 presents travel angles used during the runout propagation assessment.

Table 4-3: Waste Rock Failure Travel Angles

Exceedance Probability	H/L Ratio (1)	Travel Angle (°)
50%	0.434	23.5
10%	0.354	19.5
(1) H/L Ratio refers to the ratio of failure height (H) over failure runout length (L)		

4.3.1.2 Model Parameters

A 5 m digital elevation model (DEM) was produced from available topographic data provided by AKHM (collected in May 2025) and the proposed WRSA expansion design surface. Potential failure source point locations were identified along the crest of the proposed waste rock geometry.

The propagation model used the Holmgren modified spreading algorithm to determine directional flow and spread of the waste rock failure debris. The models also used the travel angle friction loss function and the energy limitation option to avoid unrealistically high velocities/kinetic energy values. Travel angle relationships for waste rock were based on the BCMWRPRC data (1995).

Table 4-4 presents the model algorithm inputs and energy limitation values (maximum velocity values) used during the runout propagation assessment.

Table 4-4: Flow-R Model Properties

Hazard	Directions Algorithm	dh	exp	Inertial Algorithm	Energy Limitation (velocity - m/s)
Waste Rock Failure	Holmgren Modified	5	2	Weights - cosine	50

4.3.2 Results

Drawing No.005 in Appendix D presents the propagation model runs performed and the downslope hazard zonation for each of the mobility cases.

The propagation results show varying amounts of waste rock mobility based on the travel angle cases analyzed. The modelling results showed that failure debris would extend up to approximately 30 m from the toe of the WRSA for the 50% exceedance probability failure scenario and 65 m from the toe of the WRSA for the 10% exceedance probability failure scenario.

4.3.2.1 Model Limitations

- Any topographic changes that occurred since the collection of the DEM data in May 2025 would not be incorporated in the results. Small changes in terrain are not expected to influence model results, but larger scale surface modifications or terrain changes could affect the model runout extents.
- Travel angle relationships are based on published empirical data values.

4.4 Surface Water Management

The approximate catchment area, as depicted in Figure 1, was delineated through a high-level estimate. Its spatial extent is approximately 0.13 km^2. The Guidelines for Mine Waste Management Facilities (EMR 2023) stipulate that the design flood for surface water diversions for a Class I facility is the 1/200-year design flood. To calculate this design discharge, the Rational method was used. For urban watersheds up to 1 km^2, the Rational method is appropriate (BC MoTI 2019). The equation is as follows:

$$Q_p = \frac{\mathrm{CiA}}{360}$$

Where:

Q_p is the peakj flow in m3/s

C is the runoff coefficient

i is the rainfall intensity in mm/h

A is the drainage area in ha

For this site, the runoff coefficient is estimated to be 0.9 due to the surface cover type and the slope (BC MoTI 2019). The calculation of rainfall intensity first requires the determination of the time of concentration, which can be estimated using various empirical methods. For this WRSA, the Water Management Method was employed, yielding a time of concentration of 15 minutes.

To estimate rainfall intensity, the Intensity-Duration-Frequency (IDF) curves provided by the IDF-CC tool at Mayo Airport were utilized. The analysis incorporated the Shared Socioeconomic Pathway (SSP) 5.85 climate change scenario, representing a high-emissions trajectory. The resulting 15-minute intensities for return periods ranging from 2-year to 100-year were summarized in Table 4-5. Since the 200-year intensity was not provided, it was established by extrapolating using a logarithmic fit as shown in Figure 2, its value was also included in Table 4-5.

The 200-year discharge was calculated to be 2.4 m^3/s. Note that this analysis was completed under the assumption that rainfall is the dominant factor for high flow events.

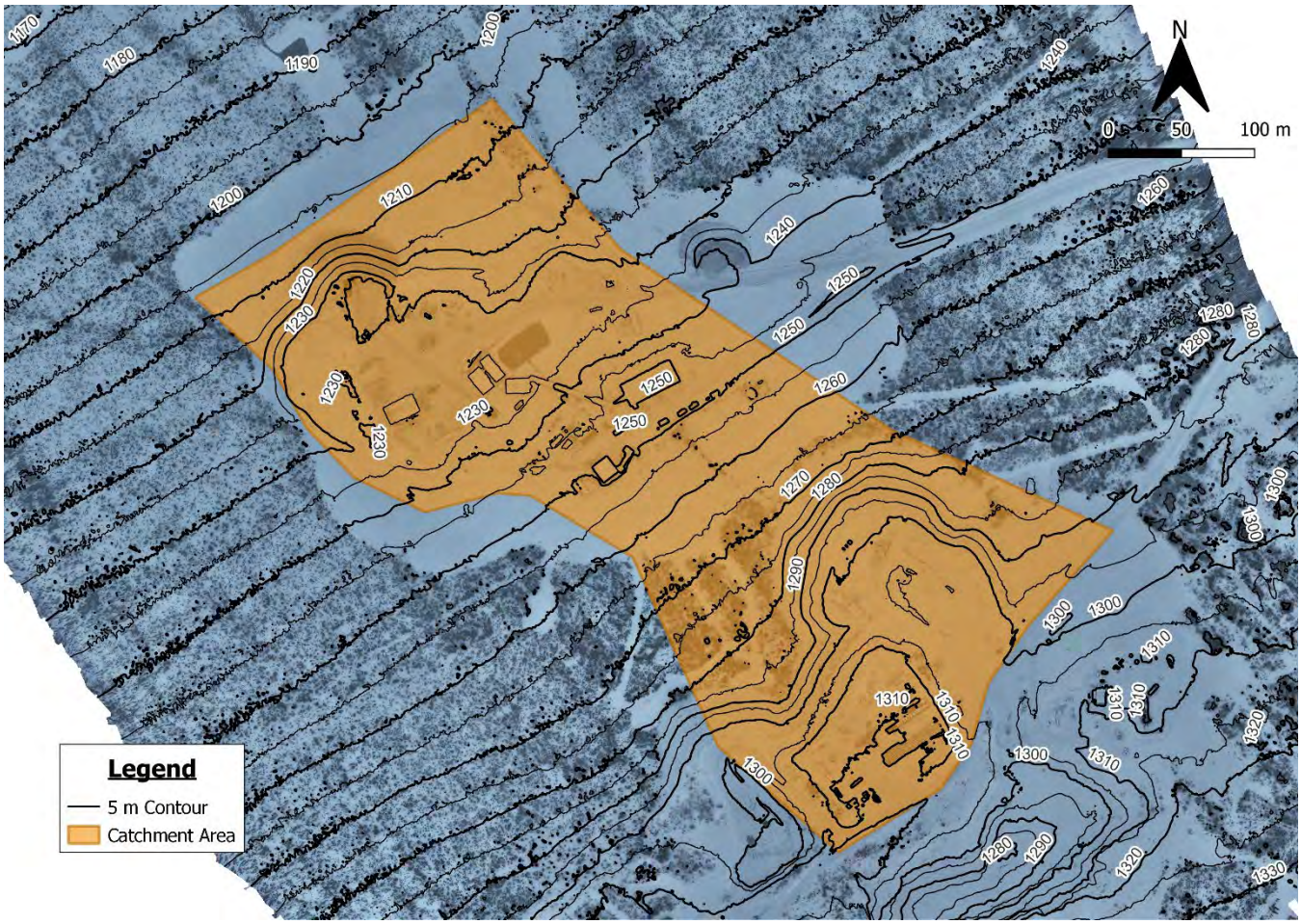

Figure 1: Design Catchment Area

Table 4-5: Rainfall Intensities for Various Return Periods

Return Period (Year)	I_{15min} (mm/h)
2	20
5	29
10	38
20	45
25	49
50	63
100	70
200	78[1]

1 – Extrapolated using a logarithmic fit.

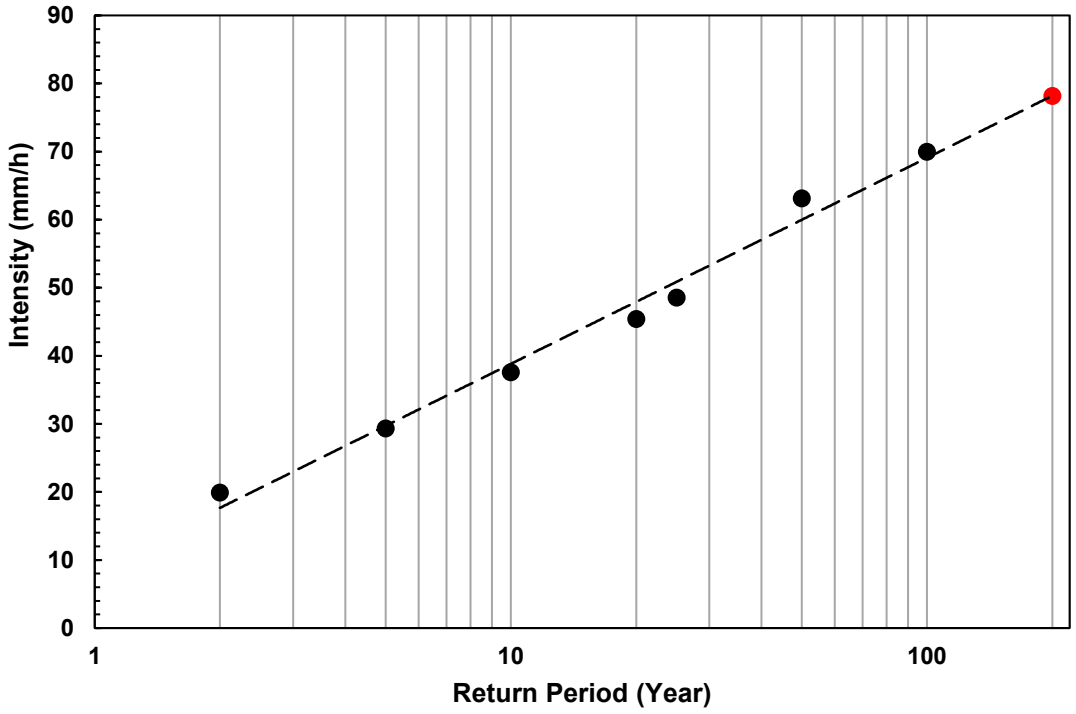

Figure 2: Extrapolation of the 200-Year Return Period Rainfall Intensity

Manning's equation was used to estimate the requirements for ditching and water management around the WRSA. The equation was expressed as:

$$Q = \frac{1}{\mathrm{n}} A R^{\frac{2}{3}} \sqrt{S}$$

Where:

Q is the flow in m^3/s

n is the Manning's roughness coefficient

A is the flow area in m^2

R is the hydraulic radius in m

S is the channel slope in m/m

The design flow of 2.4 m^3/s can be accommodated by perimeter ditching 1 m wide, 0.75 m deep with side slopes 1.5H:1V. It is recommended that a minimum grade of 2 percent be maintained to accommodate inconsistencies in grade control and limitations associated with grading waste rock material.

5.0 DESIGN SUMMARY AND RECOMMENDATIONS

Key design points are summarized below:

- The Bermingham WRSA expansion was classified as a “Class 1” facility based on the MRMF Classification Table 6-1 (EMR 2023).
- The design geometry includes an ultimate shell with overall resultant slope of 2H:1V to maximum elevation of 1,230 m and will be constructed with 4.5 m wide benches 6 m in height with 1.25H:1V interim slopes. The estimated additional storage volume available relative to May 2025 will be approximately 185,500 m^3.
- AKHM has indicated that waste rock generation will be typically fall between 10,000 and 15,000 tonnes per month. The design has included considerations that will allow for AKHM to implement a placement strategy consisting generally of bottom-up construction during the summer and top-down construction during winter conditions.
- Stability analyses indicated that the calculated FoS for selected scenarios met or exceeded the required design criteria, and the sensitivity studies found:
  - The friction angle of the waste rock was found to be more sensitive to stability than the unit weight.
  - The phreatic surface level is critical to the FoS; a higher phreatic surface is less favorable to the FoS, indicating the importance of monitoring in-situ pore water pressure conditions
- Earthquake-induced displacements were estimated to be on the order of 10 cm.
- Run-out analysis indicated that failure debris could extend approximately:
  - 30 m from the toe of the WRSA for the 50% exceedance probability failure scenario.
  - 65 m from the toe of the WRSA for the 10% exceedance probability failure scenario.
- The design 200-year discharge was calculated to be 2.4 m^3/s based on rainfall intensity data. with the 200-year intensity extrapolated to be 312 mm/h. Perimeter ditching should be provided to manage surface flow around the WRSA.
- The design and construction of the WRSA include extending the existing facility with a 1.25H:1V slope at a 6 m bench height and a 4.5 m bench width during the operation/construction stage to reach ultimate elevation of 1,230 m and allows for re-sloping the facility to a 2H:1V gradient post-construction, prior to closure.
- Tetra Tech understands AKHM anticipates storing up to 500 tonnes of fine sediment material per month. This material can be placed within the WRSA footprint, provided it is set back at least 20 m from the operating crest and allowed to dry prior to being covered. Specific storage locations can be determined based on operational requirements.

Construction drawings for the Bermingham WRSA expansion are attached.

6.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

FILE. 704-ENG.WARC04673-06
FILE. 704-ENG.WARC04673-06
FILE. 704-ENG.WARC04673-06
FILE. 704-ENG.WARC04673-06

Prepared by:
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PROFESSIONAL ENGINEER
YUKON TERRITORY
YANG ZHANG
JUNE 09 2025
FILE. 704-ENG.WARC04673-06
FILE. 704-ENG.WARC04673-06

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/jf

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FIGURES

Bermingham WRSA Expansion Drawings – Issued for Construction

Hecla MINING COMPANY

BERMINGHAM WASTE ROCK STORAGE AREA EXPANSION DESIGN

ALEXCO KENO HILL MINE, YT

ISSUED FOR CONSTRUCTION
JUNE 9, 2025

SHEET NUMBER	REV	DATE (YYYY-MM-DD)	SHEET TITLE
001	0	2025-06-09	COVER PAGE & DRAWING LIST
002	0	2025-06-09	AERIAL SITE PLAN
003	0	2025-06-09	TOPOGRAPHICAL SITE PLAN
004	0	2025-06-09	CROSS SECTIONS AND TYPICAL DETAILS

TETRA TECH

COVER SHEET & DRAWING LIST

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-06	KEL	CC	DA	0	001
DATE: June 9, 2025	SHEET No. 1 of 4	DWN CC	APP GDK	STATUS IFC	

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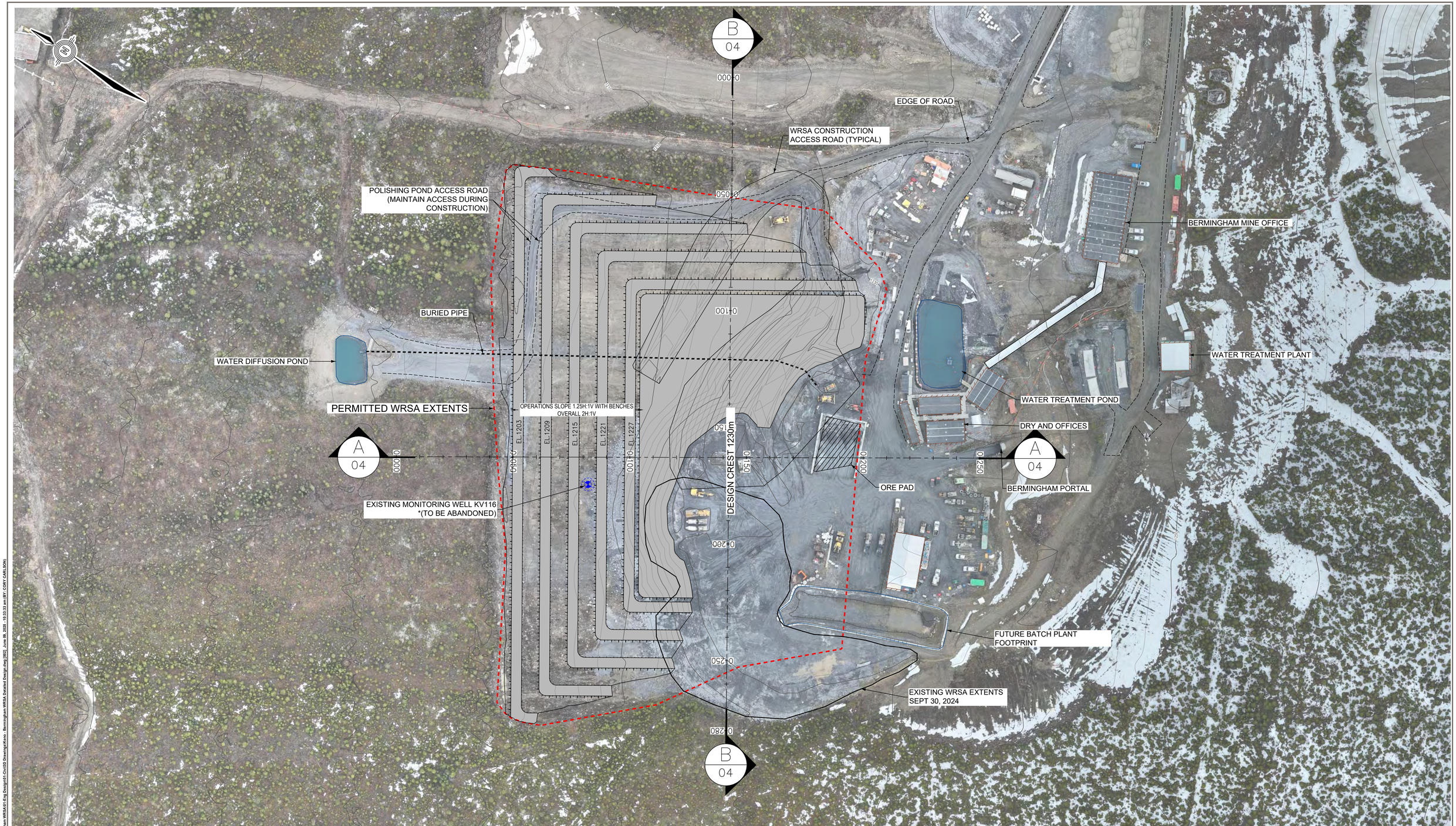

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Scale: 1: 750

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.
3. IMAGE SHOWN FROM MAY 25, 2025.

WRSA EXP. VOLUME	
FILL MATERIAL (m3)	185,500

NUM	DATE	APR	DESCRIPTION
0	June 9 2025	GDK	ISSUED FOR CONSTRUCTION
D	May 30 2025	GDK	ISSUED FOR REVIEW
C	May 30 2025	GDK	ISSUED FOR REVIEW
B	May 9 2025	GDK	ISSUED FOR REVIEW
A	May 9 2025	GDK	ISSUED FOR REVIEW

DRAWING STATUS

PERMIT

PROFESSIONAL SEAL

CLIENT

Hecla MINING COMPANY

TETRA TECH

BERMINGHAM WRSA
AKHM KENO HILL MINE, YT

WRSA DESIGN
AERIAL SITE PLAN

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-06	KEL	CC	DA	0	002
DATE: June 9, 2025	SHEET No. 2 of 4	DWN CC	APP GDK	STATUS IFC	

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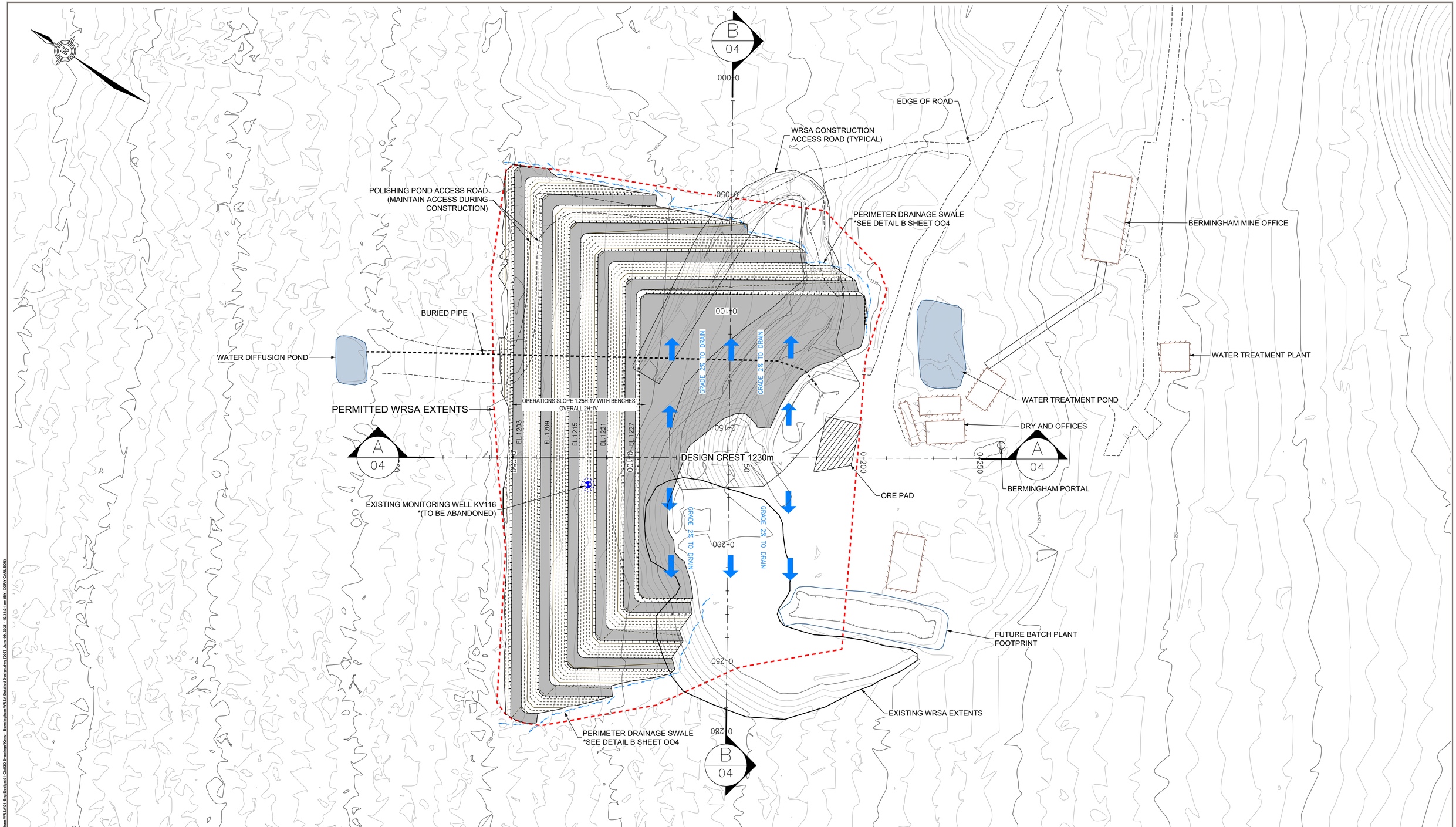

0 50 m

Scale: 1: 1000

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.
3. CONTOUR DATA SHOWN GENERATED FROM MAY 25, 2025 SURVEY.

WRSA EXP. VOLUME	
FILL MATERIAL (m3)	185,500

NUM	DATE	APR	DESCRIPTION
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D	May 30 2025	GDK	ISSUED FOR REVIEW
C	May 30 2025	GDK	ISSUED FOR REVIEW
B	May 9 2025	GDK	ISSUED FOR REVIEW
A	May 9 2025	GDK	ISSUED FOR REVIEW

DRAWING STATUS

PERMIT

PROFESSIONAL SEAL

CLIENT

Hecla MINING COMPANY

TETRA TECH

BERMINGHAM WRSA
AKHM KENO HILL MINE, YT

WRSA DESIGN
TOPOGRAPHICAL PLAN

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-06	KEL	CC	DA	0	003
DATE: June 9, 2025	SHEET No. 3 of 4	DWN CC	APP GDK	STATUS IFC	

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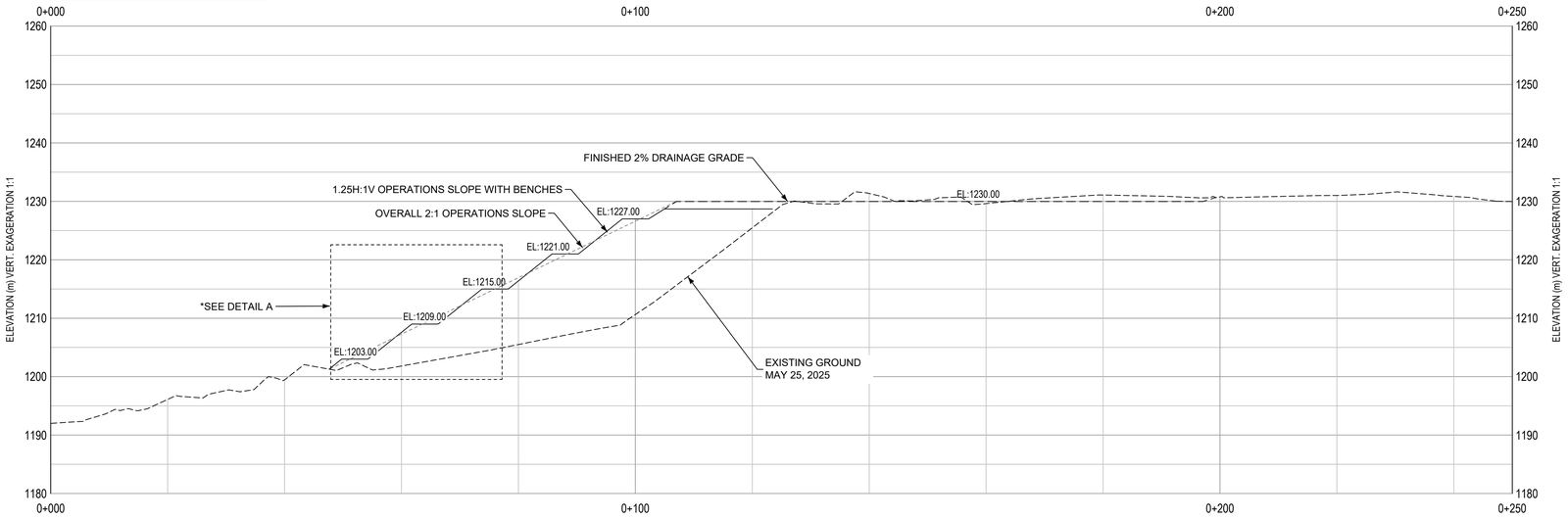
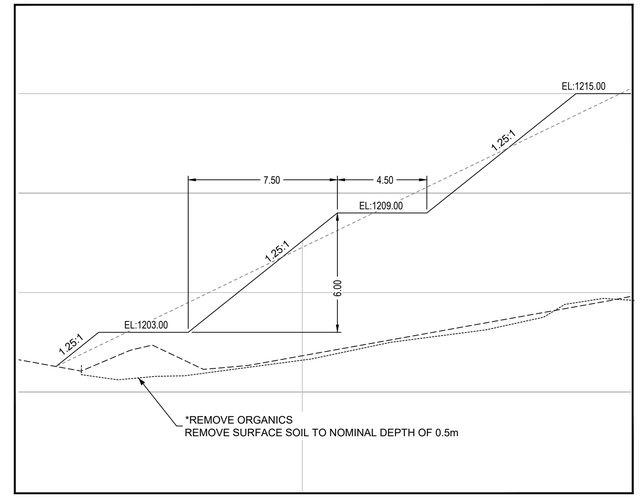
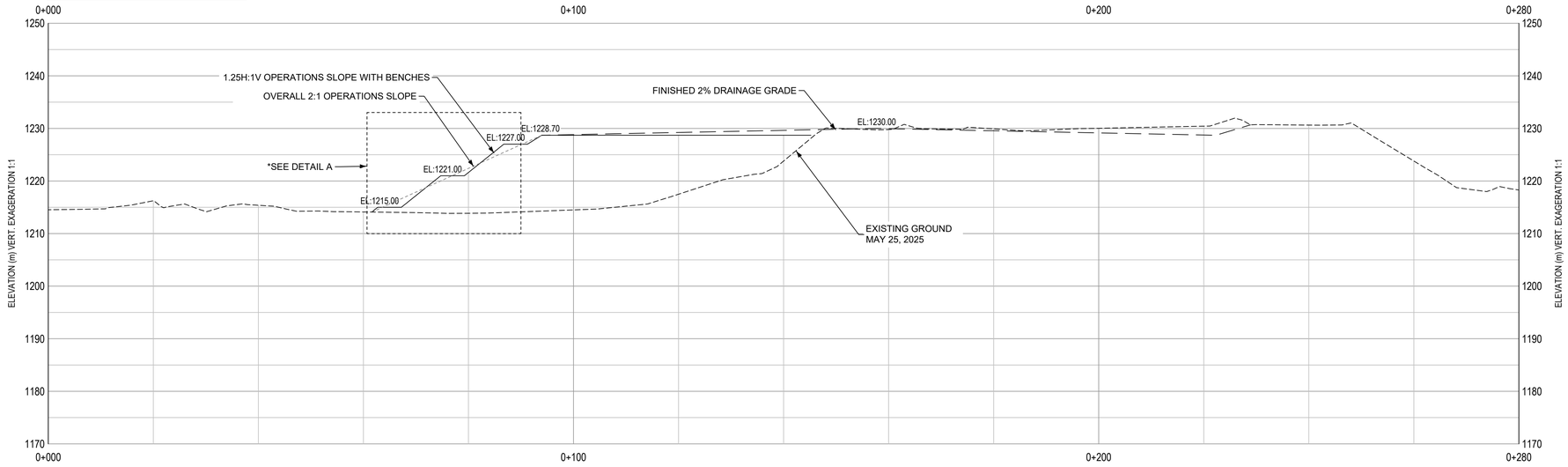
PROFILE VIEW: SECTION A

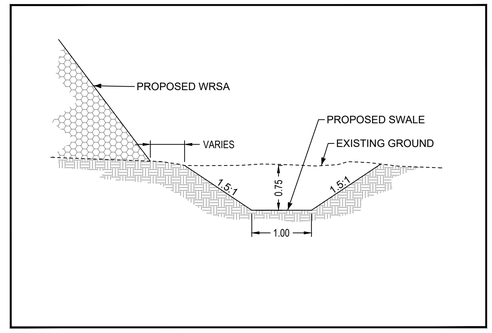




DETAIL A
SCALE 1:150

PROFILE VIEW: SECTION B





DETAIL B
SWALE DETAIL
SCALE 1:50

0 25 m
Scale: 1: 500

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.

NUM	DATE	APR	DESCRIPTION
0	June 9 2025	GDK	ISSUED FOR CONSTRUCTION
D	May 30 2025	GDK	ISSUED FOR REVIEW
C	May 30 2025	GDK	ISSUED FOR REVIEW
B	May 9 2025	GDK	ISSUED FOR REVIEW
A	May 9 2025	GDK	ISSUED FOR REVIEW

DRAWING STATUS

PERMIT

PROFESSIONAL SEAL

CLIENT

Hecla MINING COMPANY

TETRA TECH

BERMINGHAM WRSA
AKHM KENO HILL MINE, YT

WRSA DESIGN
CROSS SECTIONS
AND TYPICAL DETAILS

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-06	KEL	CC	DA	0	004
DATE: June 9, 2025	SHEET No. 4 of 4	DWN CC	APP GDK	STATUS IFC	

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APPENDIX A

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 BEARING CAPACITY

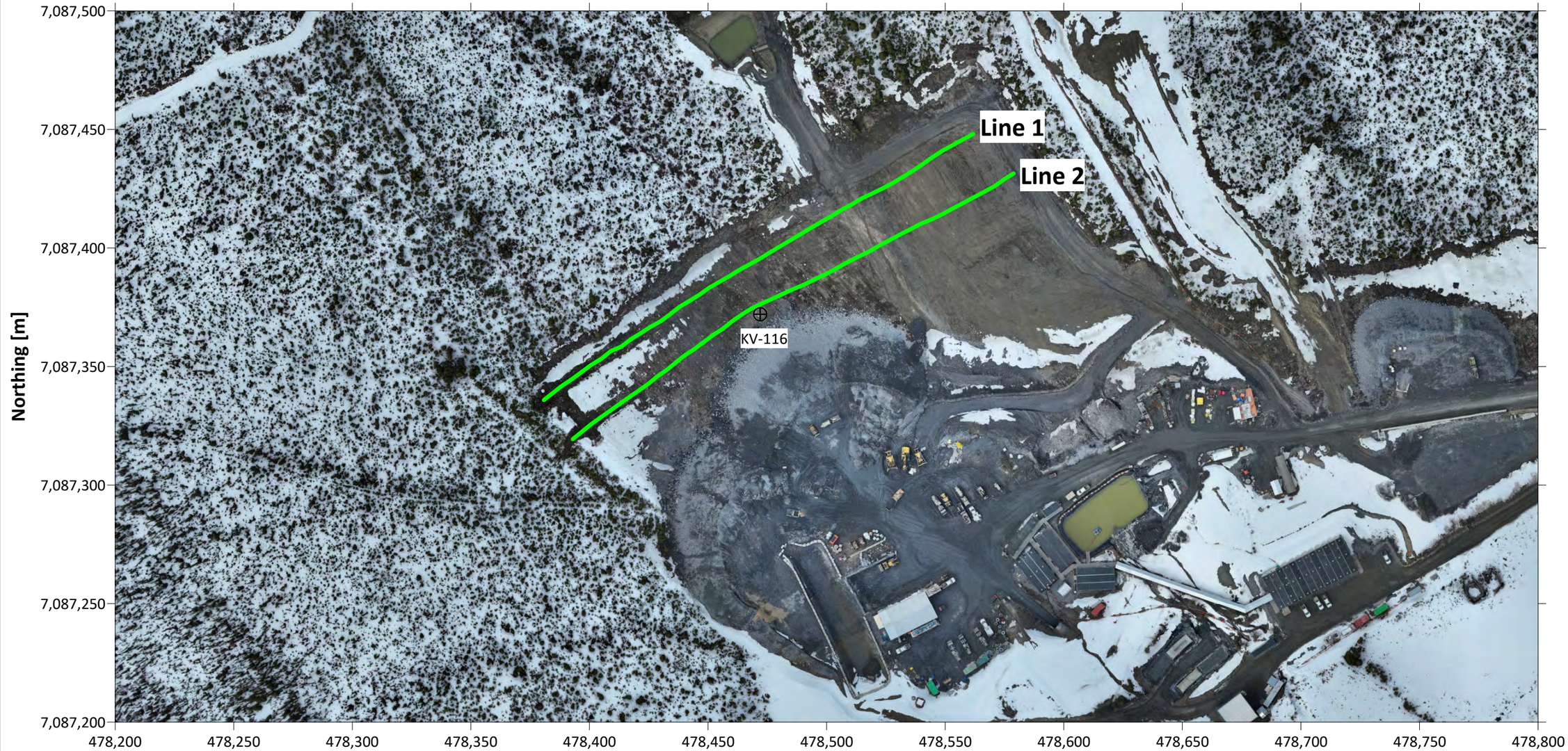
Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

APPENDIX B

GEOPHYSICS RESULTS



Air Imagery: May 11, 2025

LEGEND

Geophysical Lines (ERT and GPR)

Historical Borehole

SCALE 1:1,750
NAD83
UTM Z08N
CVGD2013

CLIENT

Hecla MINING COMPANY

TETRA TECH

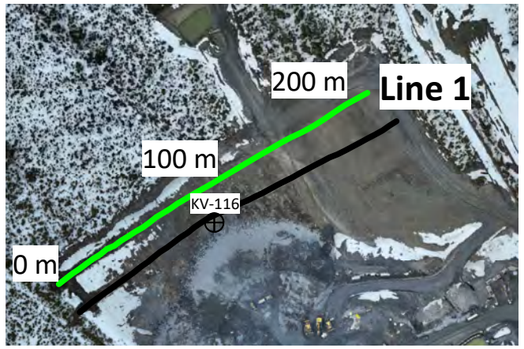
Bermingham WRSA Design Report

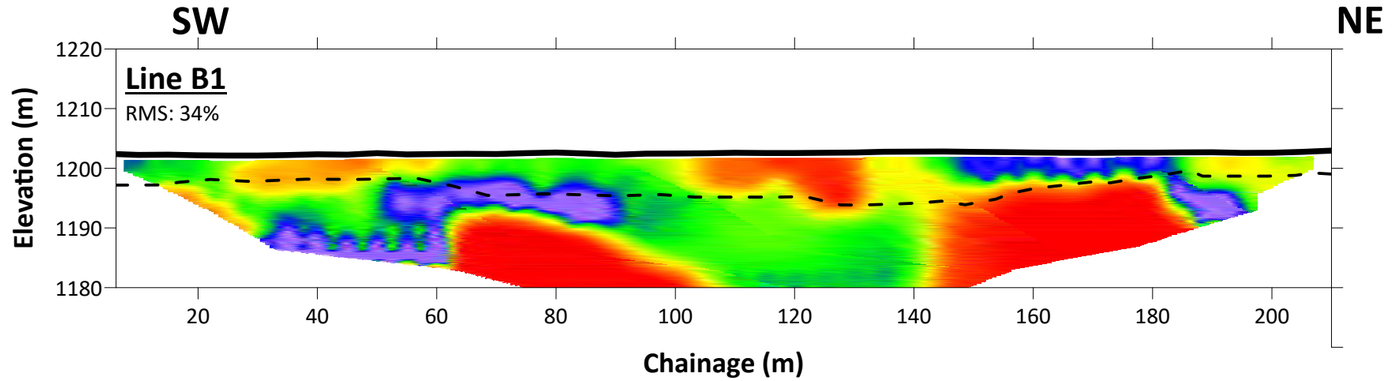
Geophysical Survey Site Map
ERT & GPR Data collected: April 4, 2025

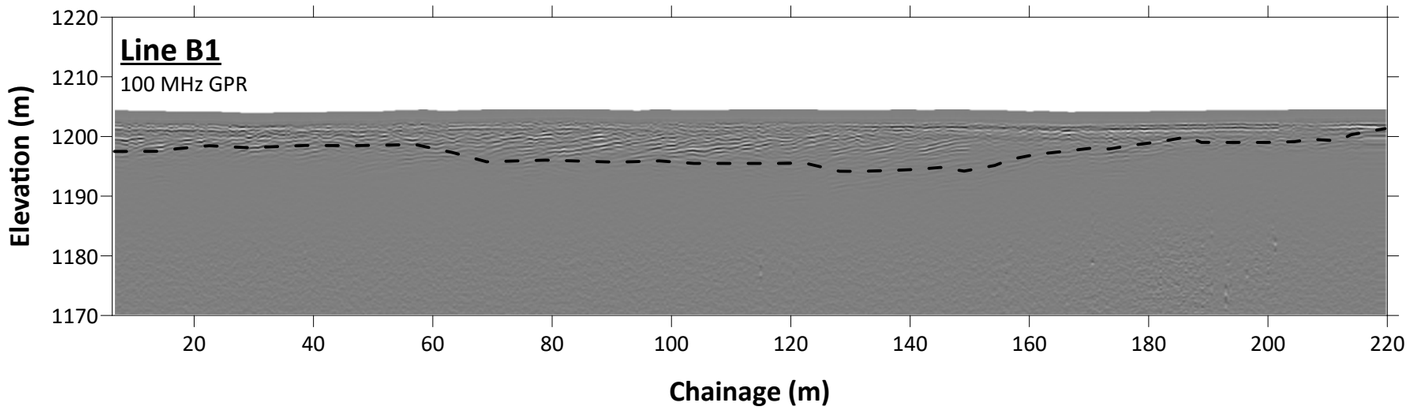
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	RRM	DSM	NSP	00

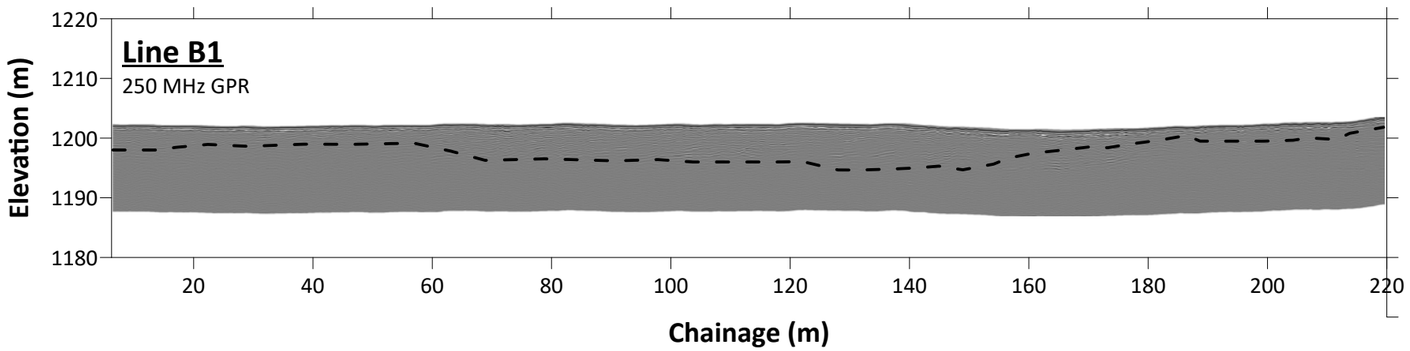
OFFICE	DATE
EBA-EDM	May 20, 2025

Figure B1









LEGEND

- - - - · Interpreted Weathered/Competent Rock Interface

Modelled Resistivity (Ohm*m)

500 1000 2000 5000 10000 20000

DATA SCALE 1:1,000
MAP SCALE 1:3,500

CLIENT: Hecla MINING COMPANY

TETRA TECH

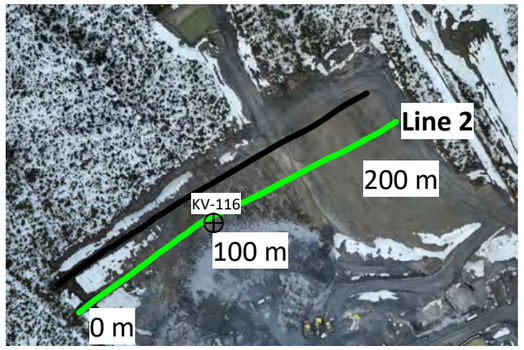
Bermingham WRSA Design Report

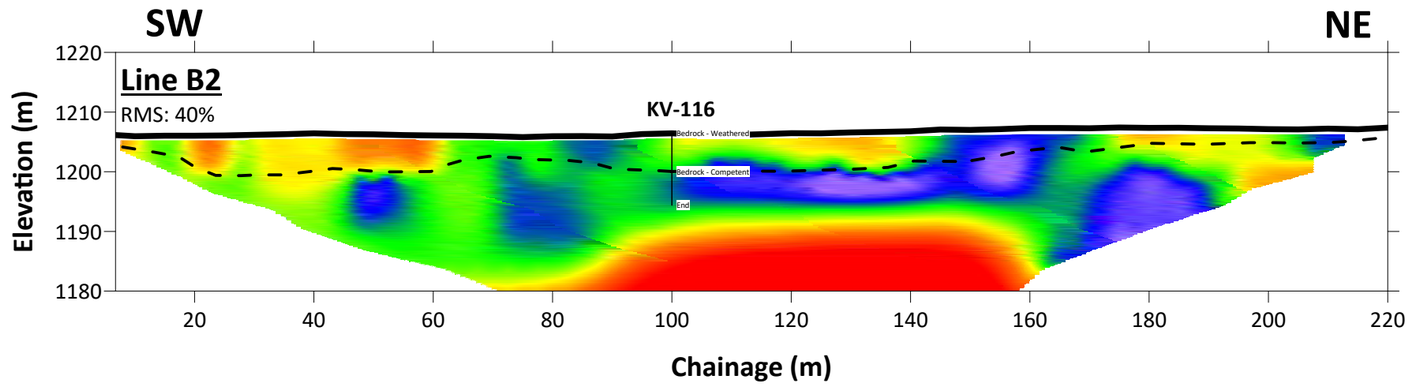
Geophysical Line 1
ERT & GPR Data Collection: April 4, 2025

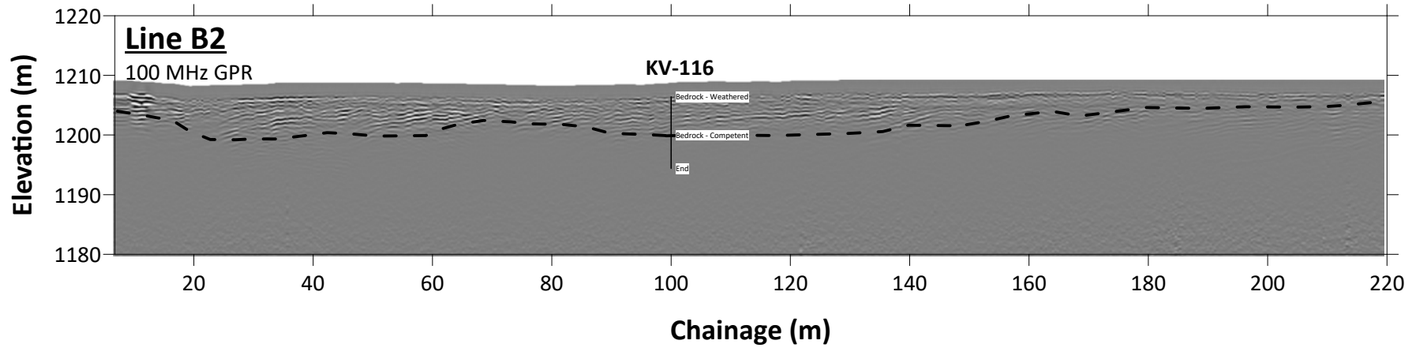
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	RRM	DSM	NSP	0

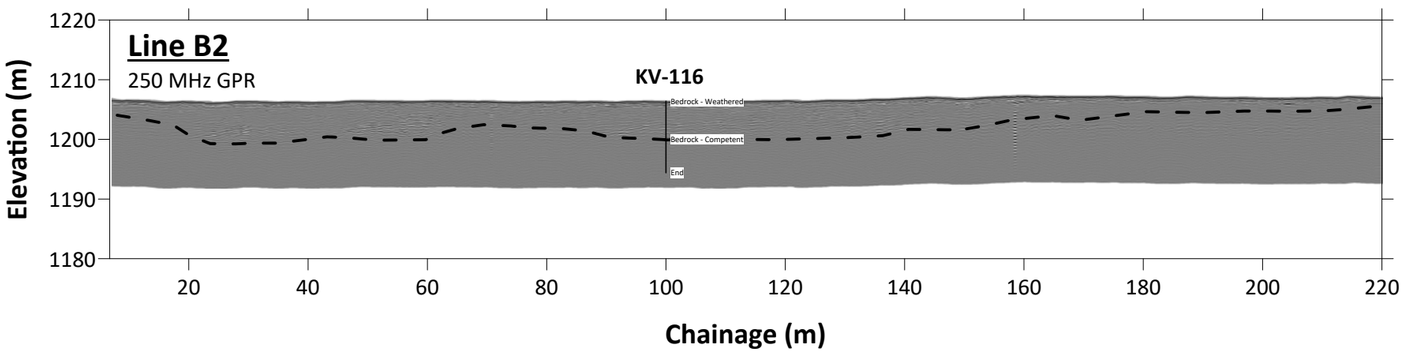
OFFICE	DATE
EBA-EDM	May 20, 2025

Figure B2









Estimated GPR Velocity: 0.13 m/ns

LEGEND

- – – – · Interpreted Weathered/Competent Rock Interface

DATA SCALE 1:1,000
MAP SCALE 1:3,500

Modelled Resistivity (Ohm*m)

500 1000 2000 5000 10000 20000

CLIENT: Hecla MINING COMPANY

TETRA TECH

Bermingham WRSA Design Report

Geophysical Line 2
ERT & GPR Data Collection: April 4, 2025

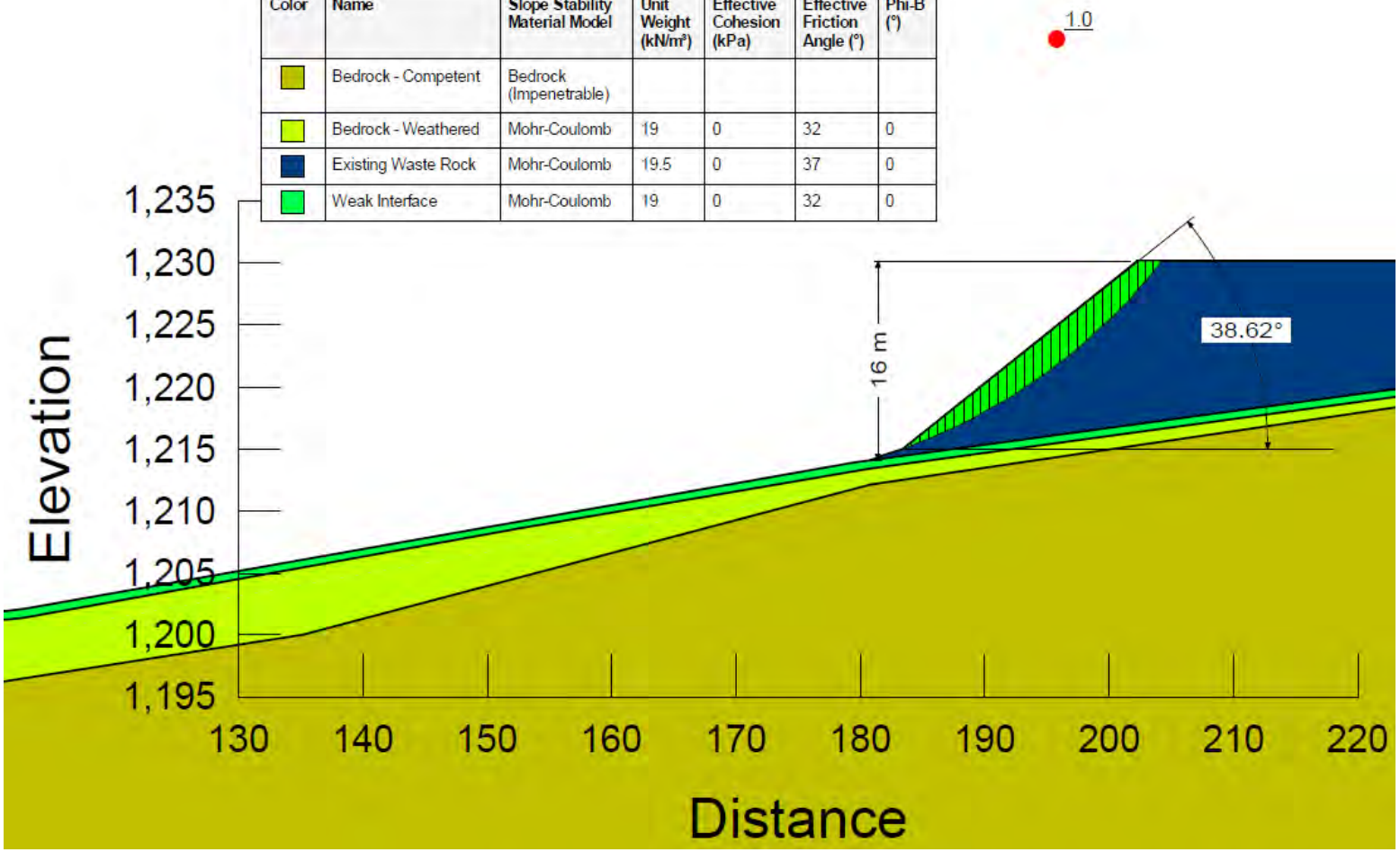
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	RRM	DSM	NSP	0
OFFICE: EBA-EDM	DATE: May 20, 2025			

Figure B3

APPENDIX C

SLOPE STABILITY ASSESSMENT

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock - Competent	Bedrock (Impenetrable)				
	Bedrock - Weathered	Mohr-Coulomb	19	0	32	0
	Existing Waste Rock	Mohr-Coulomb	19.5	0	37	0
	Weak Interface	Mohr-Coulomb	19	0	32	0



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

Bermingham WRSA Design Report
Keno Hill Mine, YK

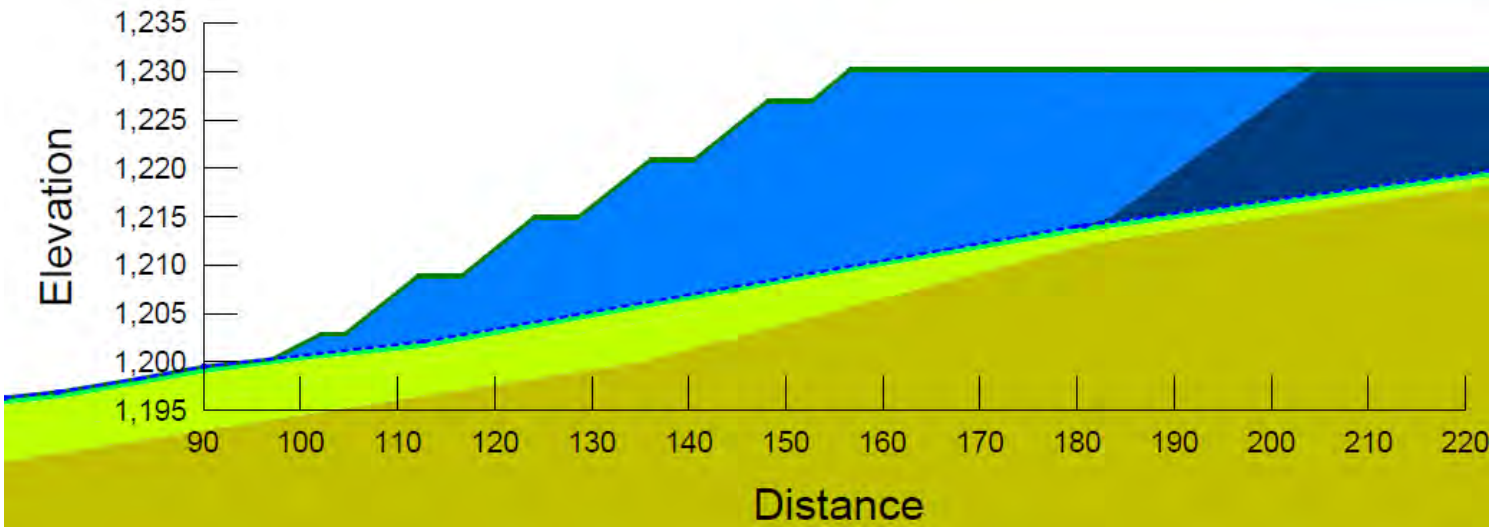
Back Analysis for Existing Waste Rock Stockpile

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C1

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
	Bedrock - Competent	Bedrock (Impenetrable)					1
	Bedrock - Weathered	Mohr-Coulomb	19	0	32	0	1
	Existing Waste Rock	Mohr-Coulomb	19.5	0	37	0	1
	Expanded Waste Rock Storage	Mohr-Coulomb	19.5	0	37	0	1
	Weak Interface	Mohr-Coulomb	19	0	32	0	1



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

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Bermingham WRSA Design Report
Keno Hill Mine, YK

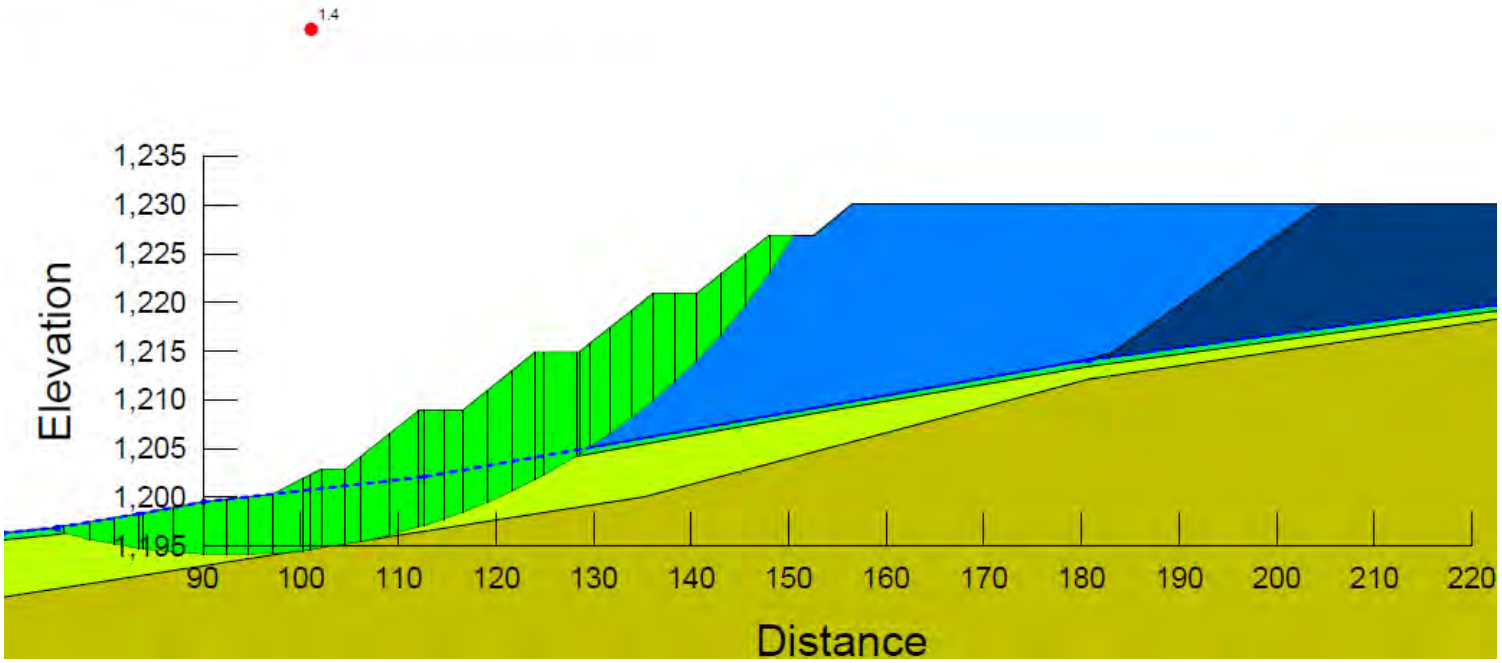
Static Stability Model

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C2

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
	Bedrock - Competent	Bedrock (Impenetrable)					1
	Bedrock - Weathered	Mohr-Coulomb	19	0	32	0	1
	Existing Waste Rock	Mohr-Coulomb	19.5	0	37	0	1
	Expanded Waste Rock Storage	Mohr-Coulomb	19.5	0	37	0	1
	Weak Interface	Mohr-Coulomb	19	0	32	0	1



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

Bermingham WRSA Design Report
Keno Hill Mine, YK

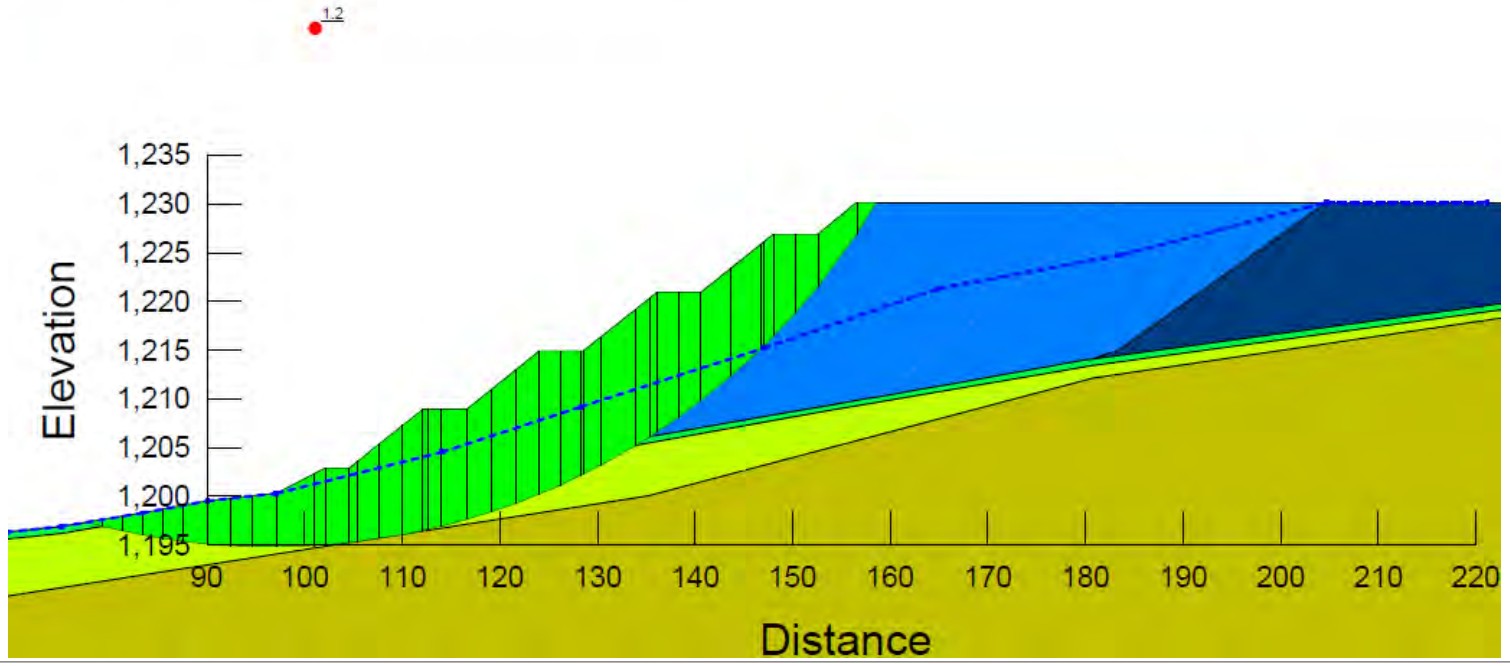
Static Stability Results

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C3

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
	Bedrock - Competent	Bedrock (Impenetrable)					1
	Bedrock - Weathered	Mohr-Coulomb	19	0	32	0	1
	Existing Waste Rock	Mohr-Coulomb	19.5	0	37	0	1
	Expanded Waste Rock Storage	Mohr-Coulomb	19.5	0	37	0	1
	Weak Interface	Mohr-Coulomb	19	0	32	0	1



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

Bermingham WRSA Design Report
Keno Hill Mine, YK

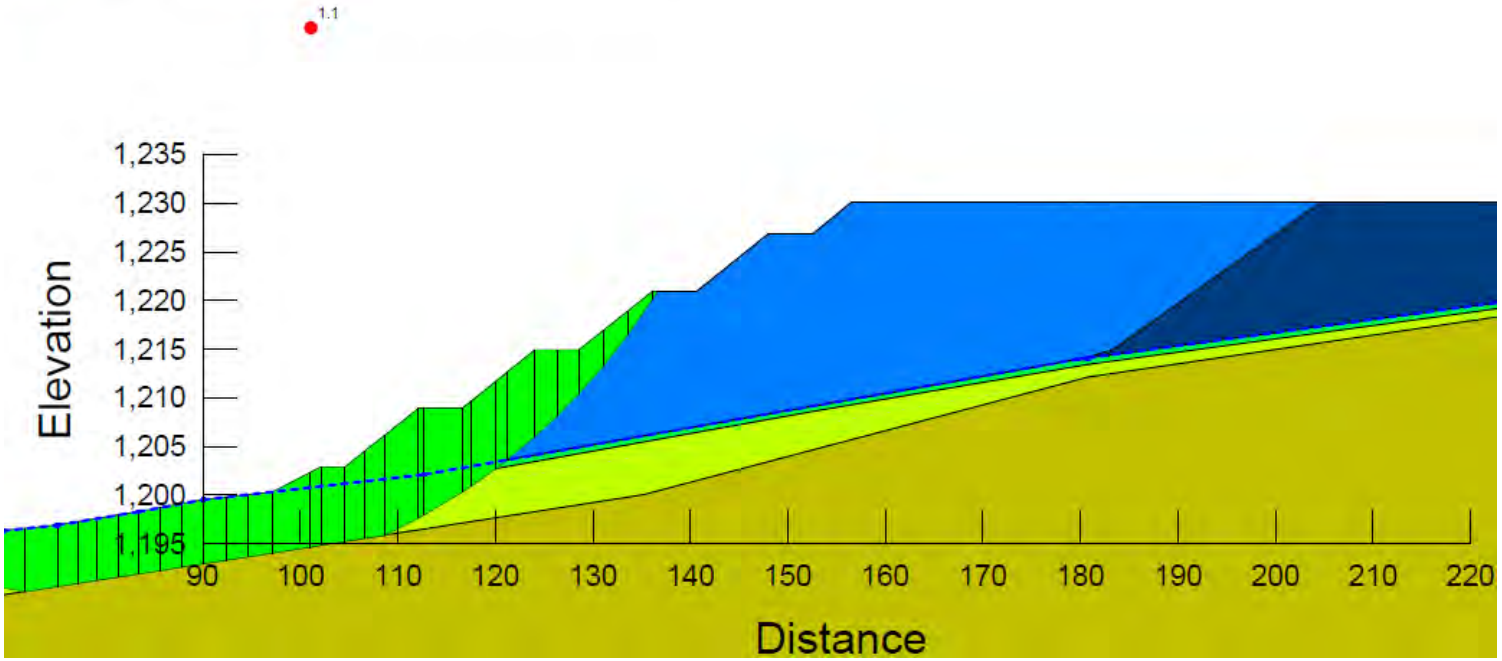
Static with High PWP Stability Results

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C4

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
	Bedrock - Competent	Bedrock (Impenetrable)					1
	Bedrock - Weathered	Mohr-Coulomb	19	0	32	0	1
	Existing Waste Rock	Mohr-Coulomb	19.5	0	37	0	1
	Expanded Waste Rock Storage	Mohr-Coulomb	19.5	0	37	0	1
	Weak Interface	Mohr-Coulomb	19	0	32	0	1



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

Bermingham WRSA Design Report
Keno Hill Mine, YK

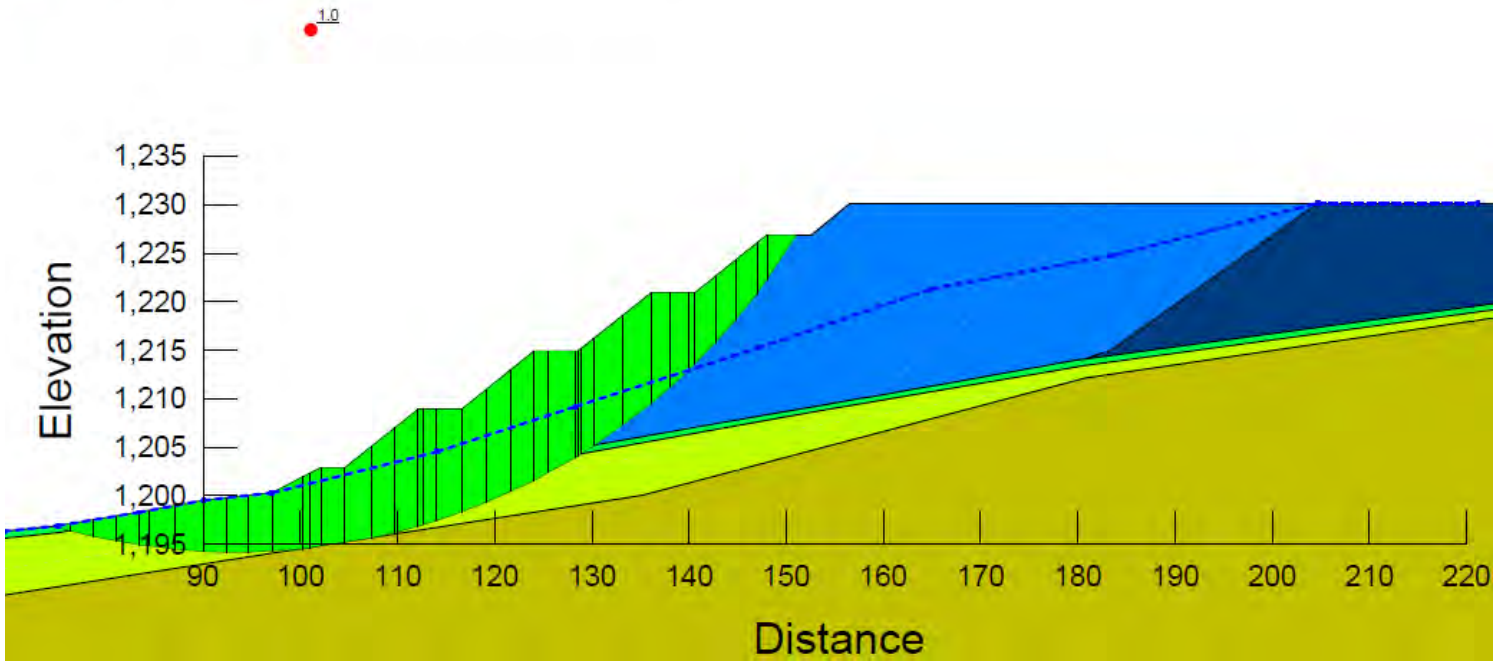
Pseudo-Static Stability Results

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C5

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
	Bedrock - Competent	Bedrock (Impenetrable)					1
	Bedrock - Weathered	Mohr-Coulomb	19	0	32	0	1
	Existing Waste Rock	Mohr-Coulomb	19.5	0	37	0	1
	Expanded Waste Rock Storage	Mohr-Coulomb	19.5	0	37	0	1
	Weak Interface	Mohr-Coulomb	19	0	32	0	1



LEGEND

NOTES

STATUS
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Hecla MINING COMPANY

TETRA TECH

Bermingham WRSA Design Report
Keno Hill Mine, YK

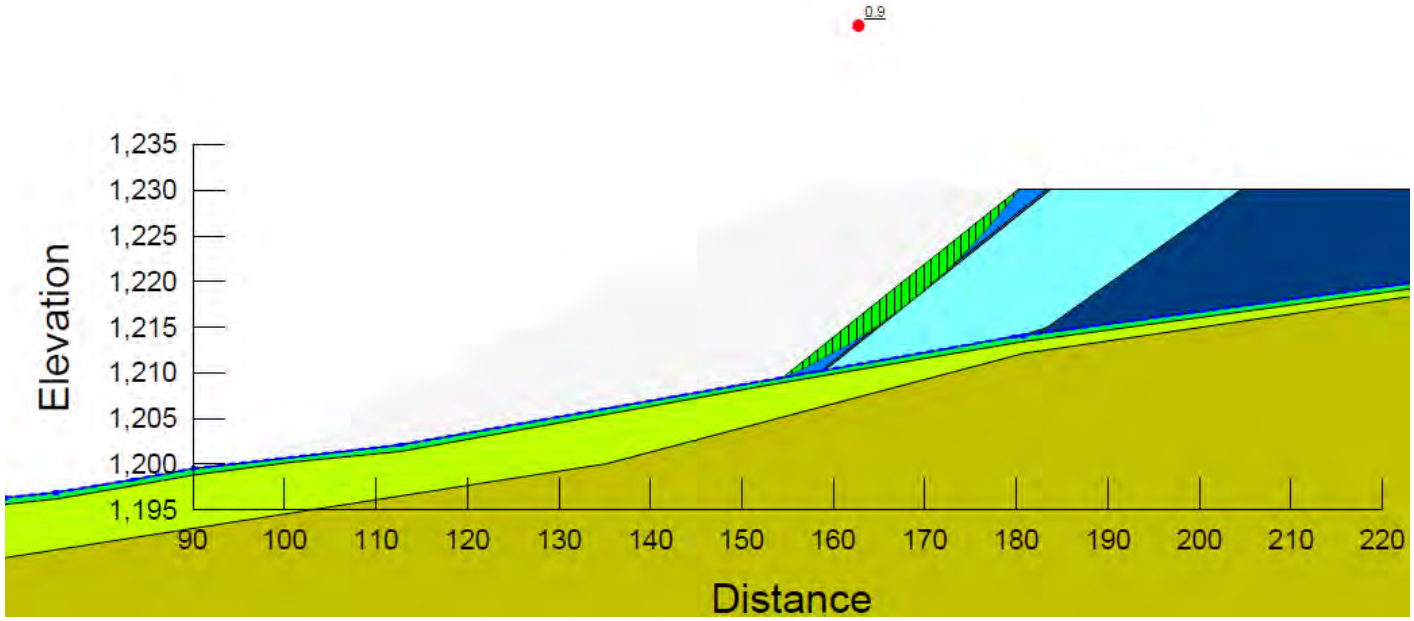
Pseudo-Static with High PWP Stability Results

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C6

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
	Bedrock - Competent	Bedrock (Impenetrable)					1
	Bedrock - Weathered	Mohr-Coulomb	19	0	32	0	1
	Existing Waste Rock	Mohr-Coulomb	19.5	0	37	0	1
	Expanded Waste Rock Storage	Mohr-Coulomb	19.5	0	37	0	1
	Frozen Interface	Mohr-Coulomb	19.5	0	34	0	1
	Frozen Waste Rock	Mohr-Coulomb	19.5	0	39	0	1
	Weak Interface	Mohr-Coulomb	19	0	32	0	1



LEGEND

NOTES

STATUS
ISSUED FOR USE

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Hecla MINING COMPANY

TETRA TECH

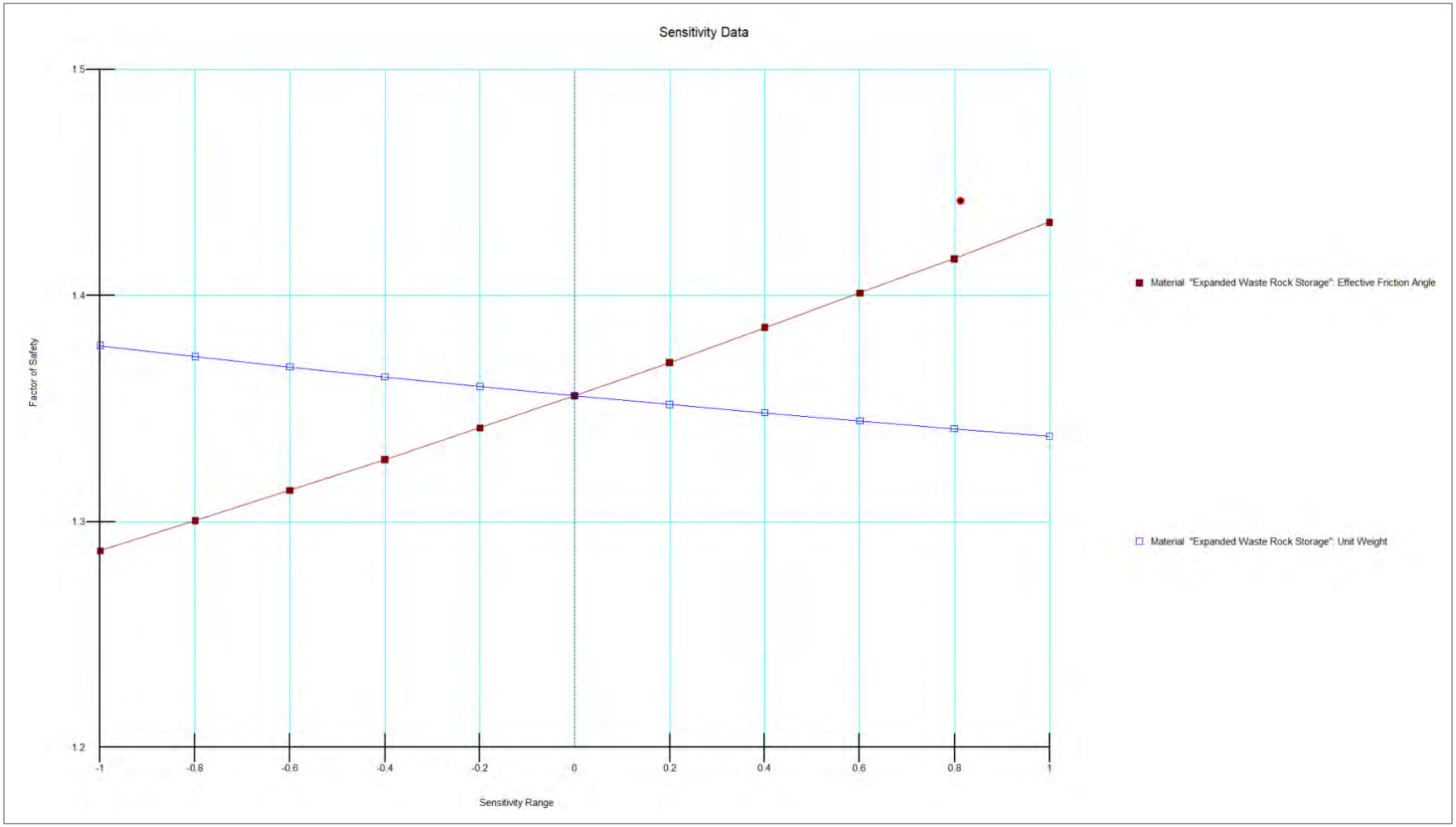
Bermingham WRSA Design Report
Keno Hill Mine, YK

End-Dumping Waste Rock on Frozen Rock Layer

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C7



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

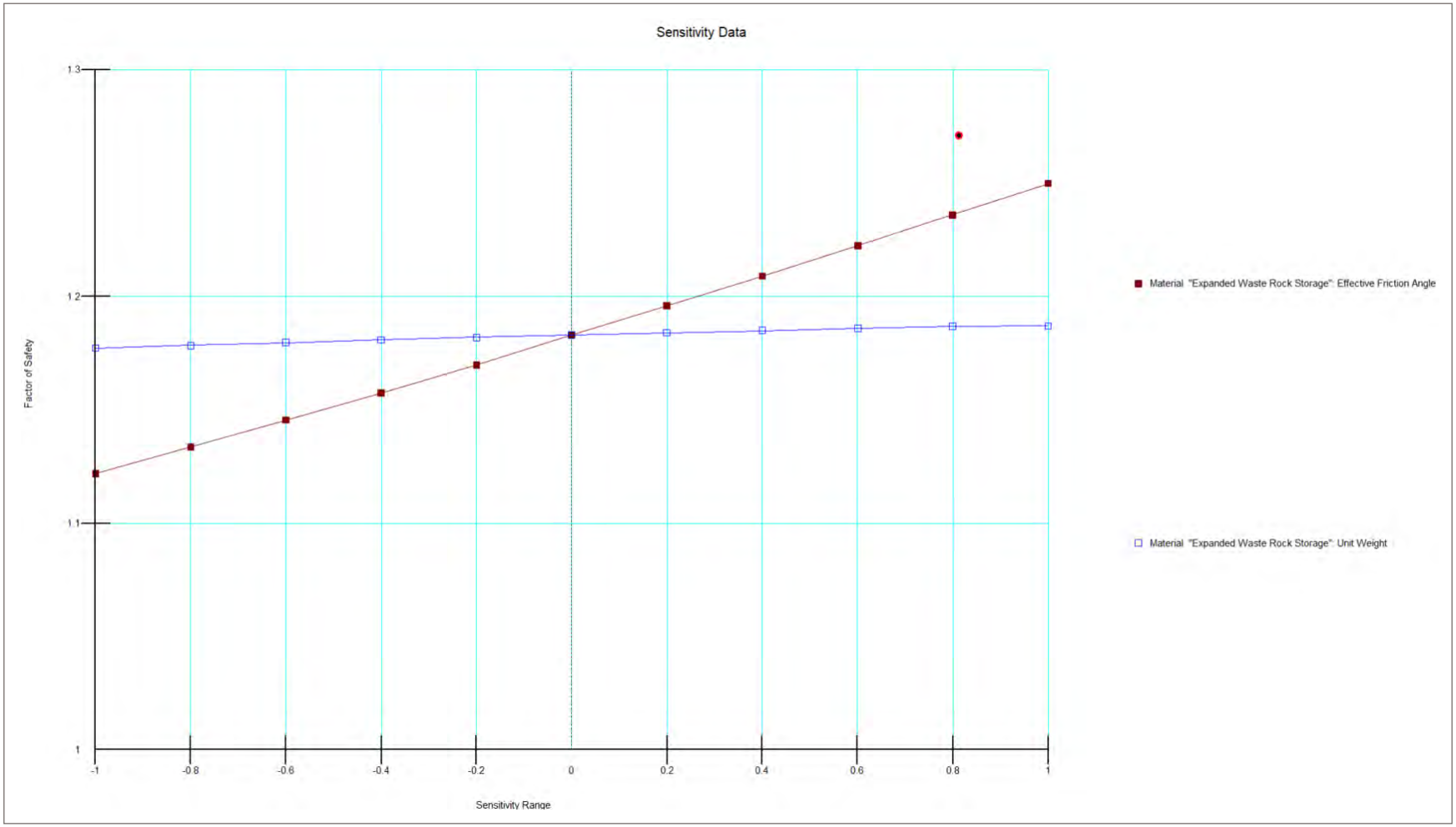
Bermingham WRSA Design Report
Keno Hill Mine, YK

Sensitivity Analysis for Static Stability Results

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C8



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

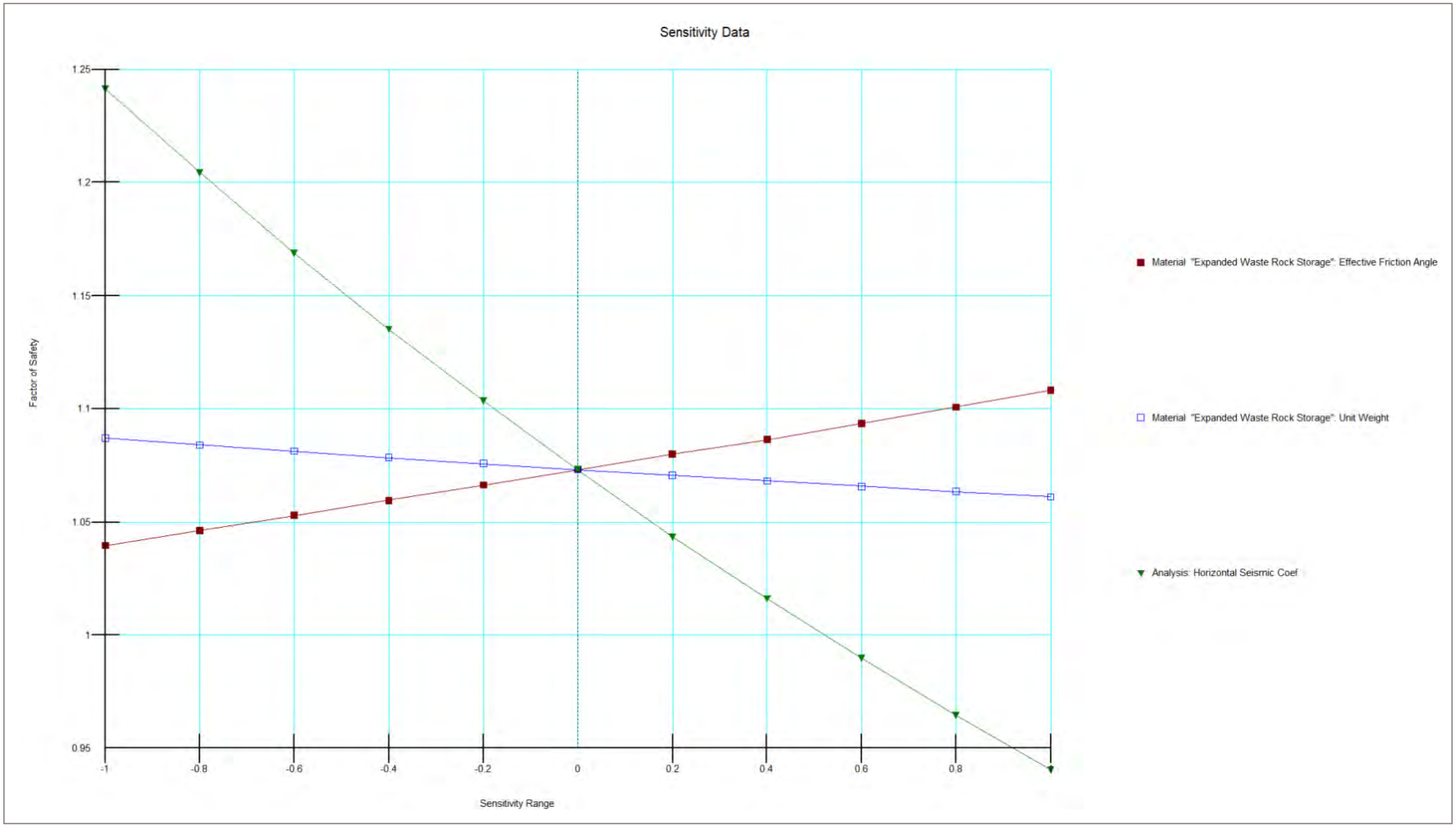
Bermingham WRSA Design Report
Keno Hill Mine, YK

Sensitivity Analysis for Static with High GWT Stability Results

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C9



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

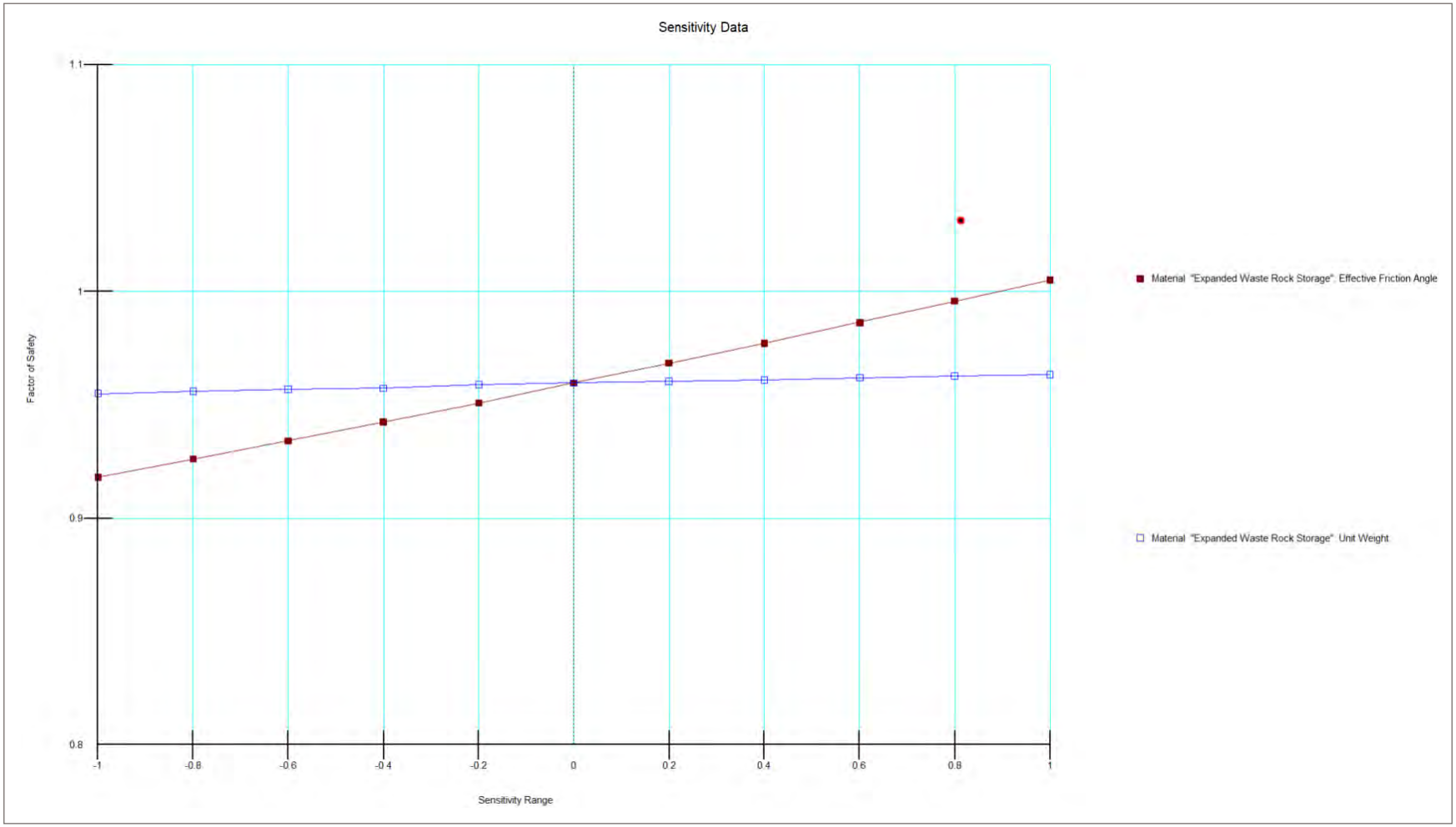
Bermingham WRSA Design Report
Keno Hill Mine, YK

Sensitivity Analysis for Pseudo-Static Stability Results

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C10



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

Bermingham WRSA Design Report
Keno Hill Mine, YK

Sensitivity Analysis for Pseudo-Static with High GWT Stability Results

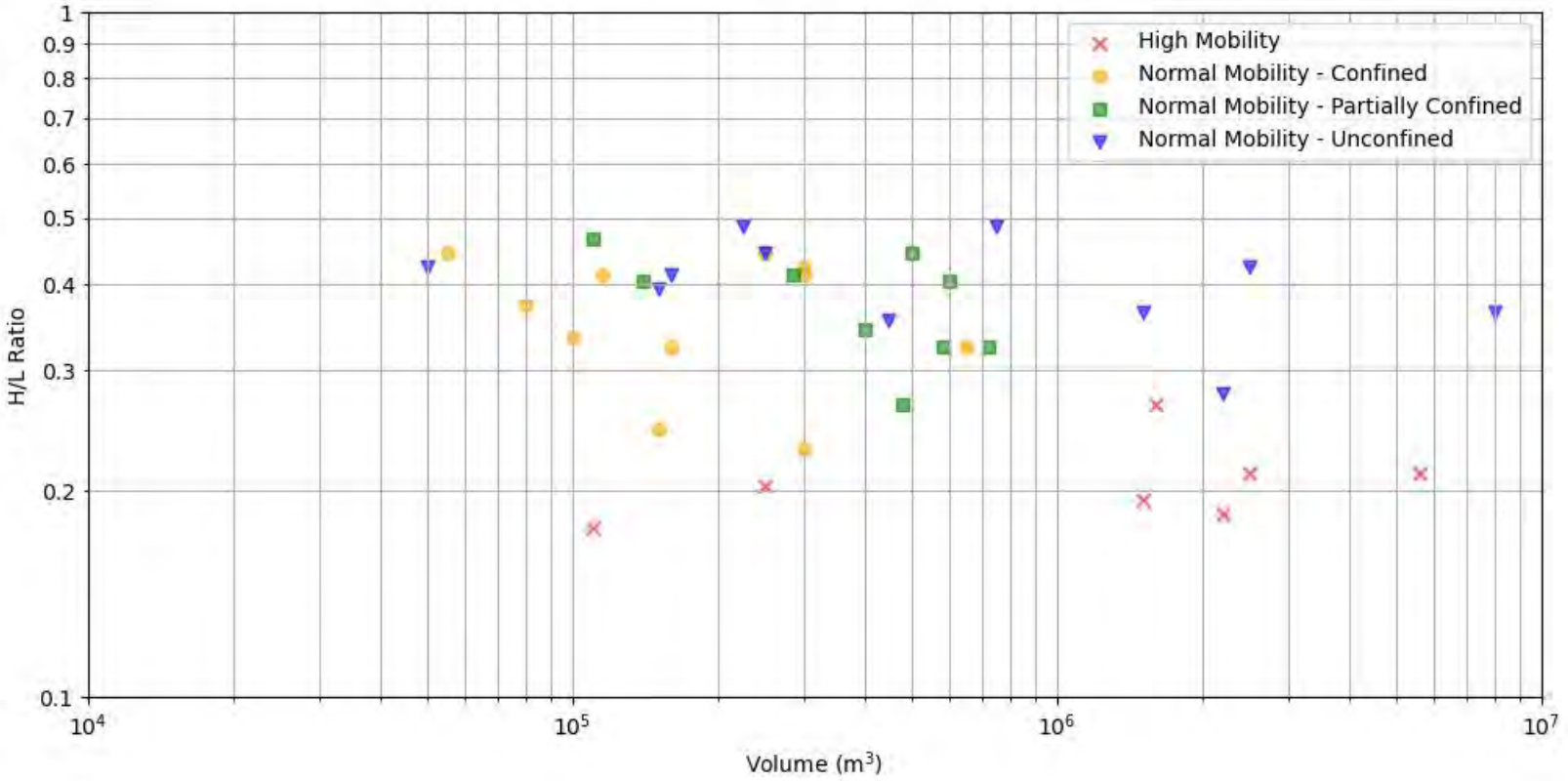
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	DA		IM	0

OFFICE	DATE
WH	May 2025

Figure C11

APPENDIX D

EMPIRICAL DATA USED FOR RUNOUT ASSESSMENT



NOTES

- Runout data is based on BCMWRPC (1995) data

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BERMINGHAM WRSA
AKHM KENO HILL MINE, YT

Waste Rock Runout Data
H/L Ratio vs. Volume

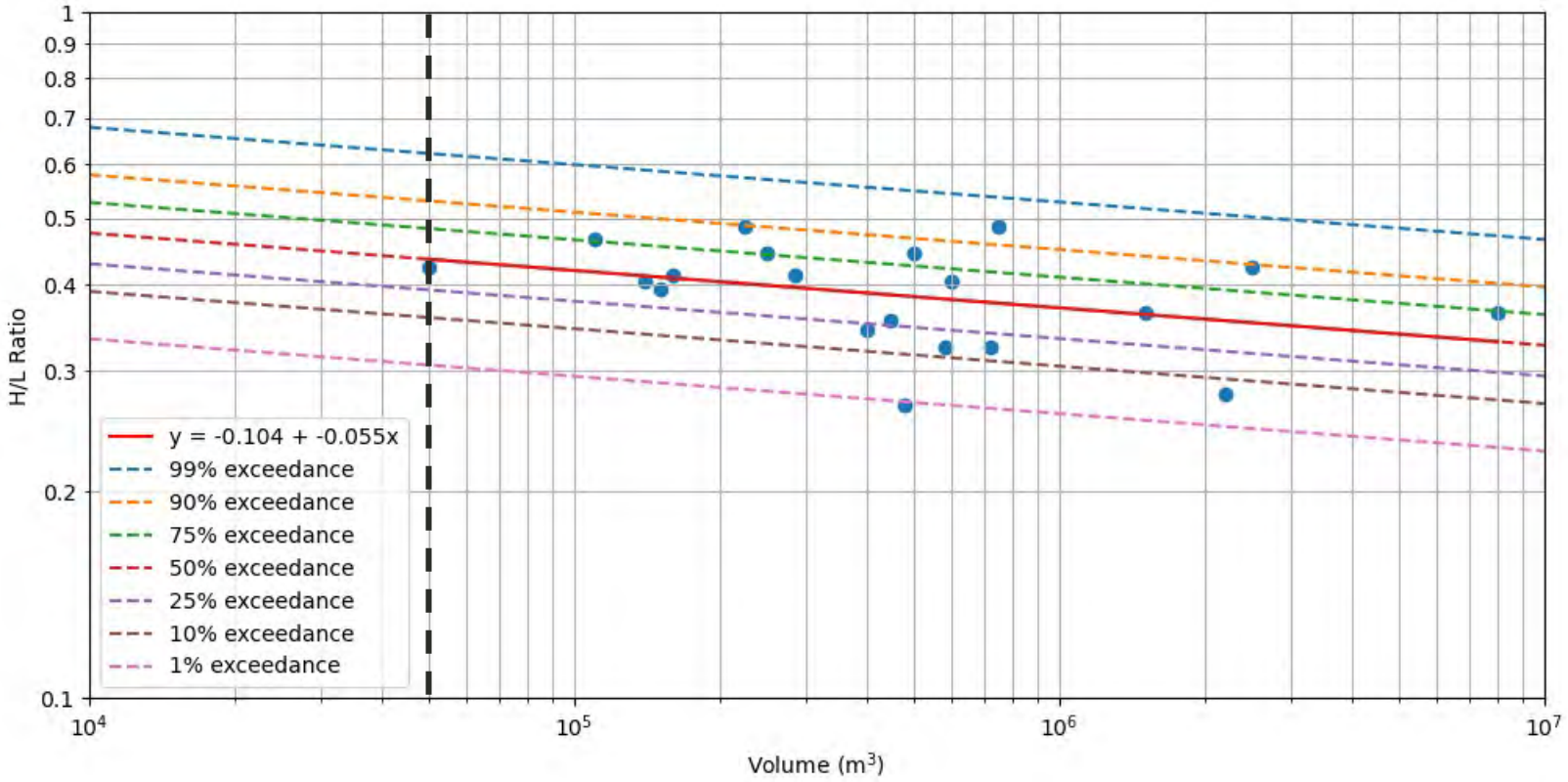
TETRA TECH

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	CW	BC	BC	-

OFFICE	DATE
NANAIMO	May 2025

Figure D.1

STATUS
ISSUED FOR USE



NOTES

– – – – 50,000 m^3 potential failure volume

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AKHM KENO HILL MINE, YT

Normal Mobility (Unconfined and Partially Confined) Data

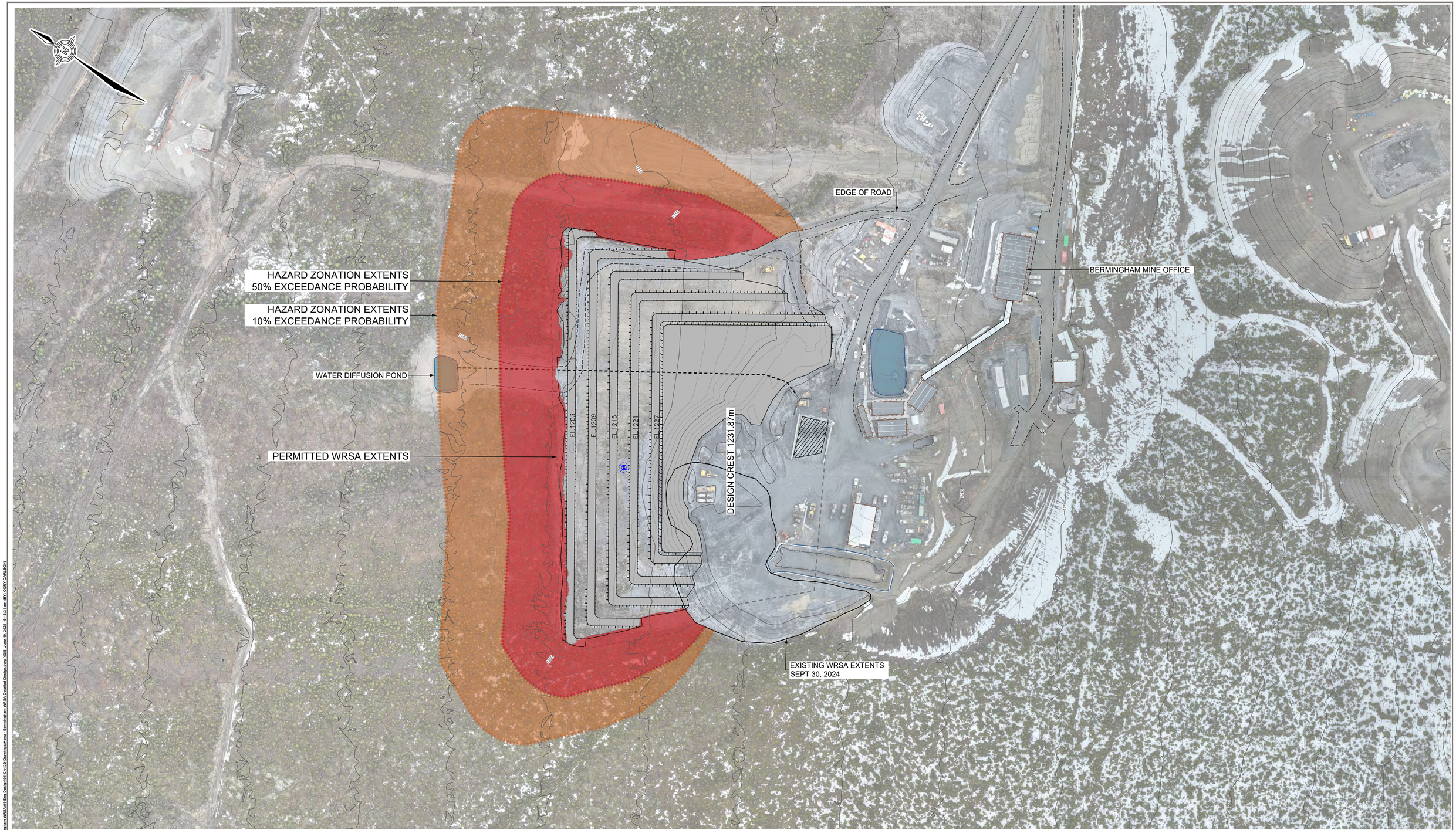
TETRA TECH

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-06	CW	BC	BC	-

OFFICE	DATE
NANAIMO	May 2025

Figure D.2

STATUS
ISSUED FOR USE



0 50 m

Scale: 1: 1000

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.
3. IMAGE SHOWN FROM SEPT 30, 2024.

LEGEND:

HAZARD ZONATION IMPACT AREAS	HAZARD ZONATION IMPACT EXTENTS
10% EXEEDANCE PROBABILITY	10% EXEEDANCE PROBABILITY
50% EXEEDANCE PROBABILITY	50% EXEEDANCE PROBABILITY

NUM	DATE	APR	DESCRIPTION
0	June 9 2025	GDK	ISSUED FOR USE
A	May 22 2025	GDK	ISSUED FOR REVIEW

DRAWING STATUS

PERMIT

PROFESSIONAL SEAL

CLIENT

Hecla MINING COMPANY

TETRA TECH

BERMINGHAM WRSA
AKHM KENO HILL MINE, YT

WRSA DESIGN
RUNOUT ANALYSIS
SITE PLAN

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-06	KEL	CC	DA	0	005
DATE: June 9, 2025	SHEET No. 1 of 1	DWN CC	APP GDK	STATUS IFC	

D:\Projects\Tetra Tech\704-ENG.WARC04673-06 Keno Bermingham WRSA\41-Eng Design\21-Civil\3-Drawings\Keno - Bermingham WRSA Detailed Design.dwg [005], June 19, 2025 - 8:15:31 am (BY: CORY CARLSON)

APPENDIX 3.6

DSTF FAILURE MODES AND EFFECTS ANALYSIS JULY 2013

Bellekeno Mine - Dry Stack Failure Modes and Effects Analysis
Final Draft

Prepared for

Alexco Resource Corp.



Prepared by

SRK Consulting (Canada) Inc.
1CA009.006
July 2013

Bellekeno Mine - Dry Stack Failure Modes and Effects Analysis
Final Draft

July 2013

Prepared for

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Suite 1150 – 200 Granville Street
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Tel: +1 604 633 4388
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Tel: +1 604 681 4196
Web: www.srk.com

Project No: 1CA009.006

File Name: BellekenoMine_DryStackFMEA_Report_1CA009.006_dvz_ccs_20130703_FNL DRAFT.docx

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srk consulting

Table of Contents

1 Introduction 1
2 Objective 1
3 The Boundaries of the Risk Assessment 1
4 FMEA Process 1
4.1 Preparation 1
4.2 Workshop 2
5 FMEA Results 2

List of Tables

Table 1: Likelihood Terminology 3
Table 2: Consequence Severity Matrix 4
Table 3: Risk Matrix 5
Table 4: FMEA Results for Bellekeno Dry Stack Tailings 6

List of Appendices

Appendix A: Introductory PowerPoint Presentations

1 Introduction

Alexco Resource Corp. entered into a contract with SRK Consulting (Canada) Inc. to perform a Failure Modes and Effects Analysis (FMEA) for the Ken District Mill Dry Stack Tailings Facility. Alexco owns and operates the Bellekeno Mine (silver, lead and zinc) in the Keno Hill Silver District of the central Yukon.

Based on concerns raised by technical staff and consultants of Na-cho Nyak Dun regarding the suitability and long-term stability of the DSTF and ice rich permafrost in foundation soils, Alexco commissioned the FMEA workshop to address these concerns using an objective risk-based approach. Following some preparatory work, the FMEA for the DSTF was completed in a workshop on September 24, 2012 at the Whitehorse, Yukon office of Alexco. This report describes the approach to the project and the results.

2 Objective

The overall objective of the FMEA for the Bellekeno Dry Stack Tailings Facility is to evaluate the risks associated with the presence of permafrost in the foundation materials adjacent to the dry stack facility. The objectives of the workshop were to evaluate the likelihood of occurrence and consequences associated with a series of failure modes for the dry stack at the site and to identify high concern issues.

3 The Boundaries of the Risk Assessment

The physical boundaries of the FMEA were the immediate surroundings of the dry stack, however; surface water impacts on facilities downstream of the facility, e.g. Christal Lake, were included. The temporal boundaries included operations as well as long-term considerations, assumed to be about 50 years.

4 FMEA Process

4.1 Preparation

Preparation for the workshop included the following activities:

- Review of site information;
- Identification of workshop participants; and
- Circulation of failure likelihood and severity of consequence descriptions for review by the participants.

4.2 Workshop

The FMEA workshop was held on September 24, 2012 at the Alexco's office in Whitehorse, Yukon. The workshop participants and their affiliations were:

- Brad Thrall, Alexco Resource Corp.;
- Richard Trimble, EBA, a Tetra Tech Company;
- Justin Pigage, EBA, a Tetra Tech Company;
- Kim Winnicky, consultant to First Nation of Na-cho Nyak Dun (NND);
- Bill Slater, consultant to First Nation of Na-cho Nyak Dun (NND);
- Rob McIntyre, Alexco Resource Corp.; and
- Dirk van Zyl, SRK Consulting (Canada) Inc. (facilitator).

As an introduction to the workshop, EBA made a presentation of site conditions. The presentation is provided in Appendix A.

Failure modes were identified, described and discussed during the workshop. A participant described the failure mode and its effect (or manifestation of the failure mode). During this discussion, descriptions were added in the FMEA table for the columns labelled ID, Failure Mode and Consequence Type.

There was open discussion amongst the workshop participants to review and agree on the description of the failure mode and its effects, i.e. reach consensus on the description in the FMEA table for the columns above. Based on this discussion, initial suggestions for the following columns in the FMEA table were made: Likelihood (using the descriptions in Table 1 as guidance) and Consequence Severity (using the descriptions in Table 2 as guidance).

Participants discussed the initial ratings with a view to obtaining consensus on the likelihood, severity, and notes for further consideration. The Risk Rating Descriptive Column was completed using the Risk Matrix in Table 3.

5 FMEA Results

In total, 15 failure modes were identified and discussed at the workshop. The FMEA outcome for the workshop is presented in Table 4.

The cells in Table 4 describing the risks are shaded using the colors in the attached Risk Table (Table 3). The colors indicate the various risks posed by a combination of the likelihood of a failure occurring and the consequence severity of the failure mode if it should occur. For example, dark orange to red correspond to high to very high risk failure modes while the green colors correspond to a low risk failure mode. None of the failure modes identified in the workshop received a high or very high risk rating.

Twelve of the fifteen failure modes identified resulted in a low risk rating (refer to Table 4). Two resulted in medium risk and one in a moderately high risk rating. The failure modes resulting in medium risk ratings are:

- Large differential settlement in the long-term (~50 years) leading to tailings exposure on the surface from compromised covers (environmental consequence).
- Large precipitation event erodes through the surface cover, exposes the tailings resulting in transport of tailings into natural environment (special considerations consequence).

The moderately high risk rating was linked to large differential settlement in the long-term (~50 years) leading to tailings exposure on the surface from compromised cover (special considerations consequence).

The special considerations consequences were identified as being of specific concern to the NND and comments are provided in Table 4 for the further evaluation and mitigation of these, as well as the medium risk associated with the environmental consequences.

Table 1: Likelihood Terminology

Likelihood	Descriptor 2	Frequency Descriptor	Probability of occurrence over twenty years	Probability of occurrence in any one year
Almost Certain	Happens often	High frequency (more than once every 5 years)	98%	17.8%
Likely	Could easily happen	Event does occur, has a history, once every 15 years	75%	6.7%
Possible	Could happen and has happened elsewhere	Occurs once every 40 years	40%	2.5%
Unlikely	Hasn't happened yet but could	Occurs once every 200 years	10%	0.5%
Very Unlikely	Conceivable, but only in extreme circumstances	Occurs once every 1000 years	2%	0.1%

Table 2: Consequence Severity Matrix

Consequence Categories	Low	Minor	Moderate	Major	Critical
1. Environmental Impact	No impact.	Minor localized or short-term impacts.	Significant impact on valued ecosystem component.	Significant impact on valued ecosystem component and medium-term impairment of ecosystem function.	Serious long-term impairment of ecosystem function.
2. Special Considerations	Some disturbance but no impact to traditional land use.	Minor or perceived impact to traditional land use.	Some mitigable impact to traditional land use.	Significant temporary impact to traditional land use.	Significant permanent impact on traditional land use.
3. Legal Obligations	Informal advice from a regulatory agency.	Technical/Administrative non-compliance with permit, approval or regulatory requirement. Warning letter issued.	Breach of regulations, permits, or approvals (e.g. 1 day violation of discharge limits). Order or direction issued.	Substantive breach of regulations, permits or approvals (e.g. multi-day violation of discharge limits). Prosecution.	Major breach of regulation – wilful violation. Court order issued.
4. Consequence Costs	< $100,000	$100,000 - $500,000	$500,000 - $2.5 Million	$2.5-$10 Million	>$10 Million
5. Community/ Media Reputation	Local concerns, but no local complaints or adverse press coverage.	Public concern restricted to local complaints or local adverse press coverage.	Heightened concern by local community, criticism by NGOs or adverse local /regional media attention.	Significant adverse national public, NGO or media attention.	Serious public outcry/demonstrations or adverse International NGO attention or media coverage.
6. Human Health and Safety	Low-level short-term subjective symptoms. No measurable physical effect. No medical treatment.	Objective but reversible disability/impairment and/or medical treatment injuries requiring hospitalization.	Moderate irreversible disability or impairment to one or more people.	Single fatality and /or severe irreversible disability or impairment to one or more people.	Multiple fatalities.

Table 3: Risk Matrix

Likelihood	Consequence Severity				
	Low	Minor	Moderate	Major	Critical
Almost Certain	Moderate	Moderately High	High	Very High	Very High
Likely	Moderate	Moderate	Moderately High	High	Very High
Possible	Low	Moderate	Moderately High	High	High
Unlikely	Low	Low	Moderate	Moderately High	Moderately High
Very Unlikely	Low	Low	Low	Moderate	Moderately High

Table 4: FMEA Results for Bellekeno Dry Stack Tailings

ID	Failure Mode	Consequence Type	Severity	Likelihood	Risk Rating Descriptive	NOTES
1	Large differential settlement in the long-term (~50 years) leading to tailings exposure on surface from compromised cover.	Env. Imp.	Minor	Likely	Moderate	Check for other examples in the district for settling. Look at additional modeling with real data.
2	Large differential settlement in the long-term (~50 years) leading to tailings exposure on surface from compromised cover.	Spec. Cons.	Moderate	Likely	Moderately High	Check for other examples in the district for settling. Look at additional modeling with real data. Cover maintenance.
3	Large differential settlement in the long-term (~50 years) leading to breach of liner/drainage blanket/containment system resulting in contamination of localized GW from tailings porewater.	Env. Imp.	Minor	Unlikely	Low	
4	Large differential settlement in the long-term (~50 years) leading to breach of liner/drainage blanket/containment system resulting in upwelling of GW/melt water into the tailings resulting in slope instability	Env. Imp.	Minor	Very Unlikely	Low	
5	Large differential settlement in the long-term (~50 years) leading to breach of liner/drainage blanket/containment system resulting in contamination of surface water (i.e. Christal Lake)	Env. Imp.	Minor	Very Unlikely	Low	Took into account present state of Christal Lake.
6	Large precipitation event erodes through surface cover, exposes tailings resulting in transport of tailings into natural environment	Env. Imp.	Minor	Unlikely	Low	
7	Large precipitation event erodes through surface cover, exposes tailings resulting in transport of tailings into natural environment	Spec. Cons.	Moderate	Unlikely	Moderate	Mitigate by cleaning up the tailings released during the large precipitation event.
8	Poor cover performance (vegetation, other) leads to increased infiltration and increased pore water transport resulting in metals migration	Env. Imp.	Minor	Unlikely	Low	
9	Metals uptake in soil cover vegetation leads to introduction into food chain and human health impacts	Human H&S	Low	Unlikely	Low	Used guidance from Env. Impact to rate.
10	Metals uptake in soil cover vegetation leads to introduction into food chain and human health impacts	Spec. Cons.	Minor	Unlikely	Low	
11	Earthquake larger than design event leads to slope failure resulting in exposure of tailings long-term	Env. Imp.	Minor	Very Unlikely	Low	
12	Earthquake larger than design event leads to slope failure resulting in exposure of tailings long-term	Spec. Cons.	Moderate	Very Unlikely	Low	
13	Modeling has underestimated the foundation pore pressures leading to slope failure and exposure of tailings long-term	Env. Imp.	Minor	Very Unlikely	Low	
14	Failure to follow OMS manual leads to stack not performing to design, resulting in environmental impacts	Env. Imp.	Minor	Unlikely	Low	OMS in place, 3rd party QA/QC every 6 weeks.
15	Dust migration from DSTF leads to (i.e. temporary closure, construction, not following OMS) environmental impacts	Env. Imp.	Minor	Unlikely	Low	OMS in place, 3rd party QA/QC every 6 weeks.

This final draft report, "Bellekeno Mine - Failure Modes and Effects Analysis", was prepared by SRK Consulting (Canada) Inc.

Dirk van Zyl

Dirk van Zyl, Ph.D., P.E
Principal Consultant (Associate)

and reviewed by

Cam Scott, P.Eng.
Principal Consultant

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

Appendix A: Introductory PowerPoint Presentations

DSTF Risk Assessment

ALEXCO

- Introductions
- Participants
- Objecve s
- Risk Assessment Process Overview
- DSTF Overview
- DSTF Risk Assessment

Keno District Timeline

- **2005** Company Founded
- **2006** Acquired Keno Hill Silver District, Care maintenance change over
- **2007** District wide closure plan studies begins
- **2008** Advanced exploration/development Bellekeno
- **2009** QML Granted - Bellekeno Construction Begins
- **2010** Comprehensive Cooperation Agreement with FNNND
- **2010** Water License Granted – mill/DSTF commissioned
- **2011** Commercial Production – Bellekeno mine/mill
- **2012** Lucky Queen/ Onek new mine development, YESAB/QML

Dry Stack Tailings Technology

ALEXCO

- **Advantages**
  - Reduced makeup water – increased recycle
  - Progressive reclamation enhanced
  - Decreased footprint from higher compaction, stack heights
  - Higher geotechnical stability if constructed appropriately
  - Pore water seepage significantly reduced – groundwater contamination eliminated if operated appropriately

Dry Stack Tailings Technology

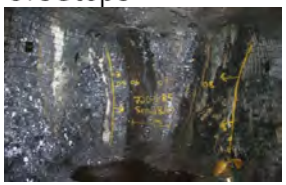
- **Disadvantages**
  - Increased capital and operating costs
  - Increased process bottlenecks – decreased operating flexibility
  - Potential dust migration due to lower moisture content

Mill Area Layout



Mill Process Flowsheet

Underground Ore Stope



Drill/Blast Ore



Load Ore



Ore Haulage



ing

Crushing



Grinding



Classification





Thickening/Filtration



Concentrate Storage



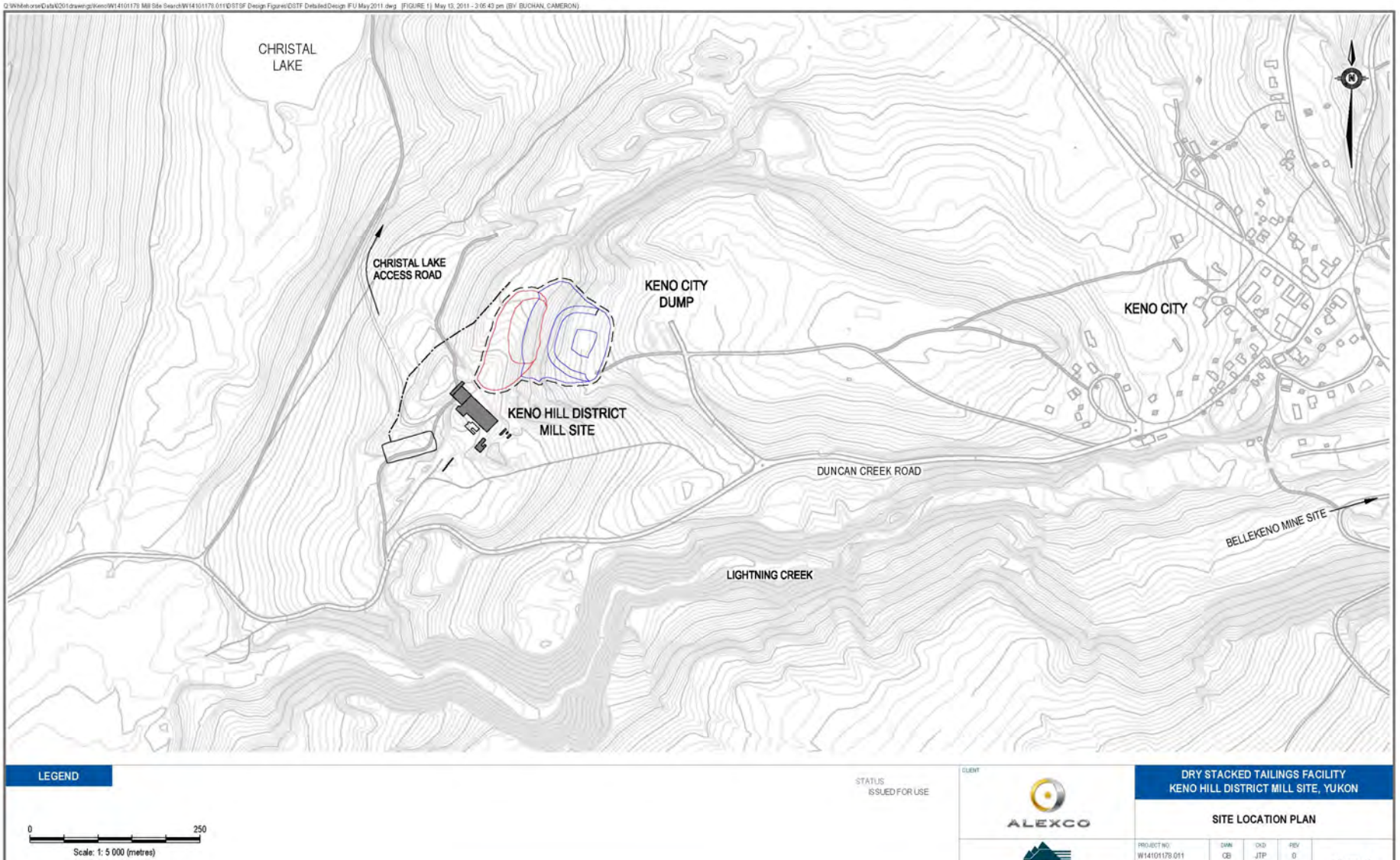
Concentrate Shipment (Ag, Pb, Zn)



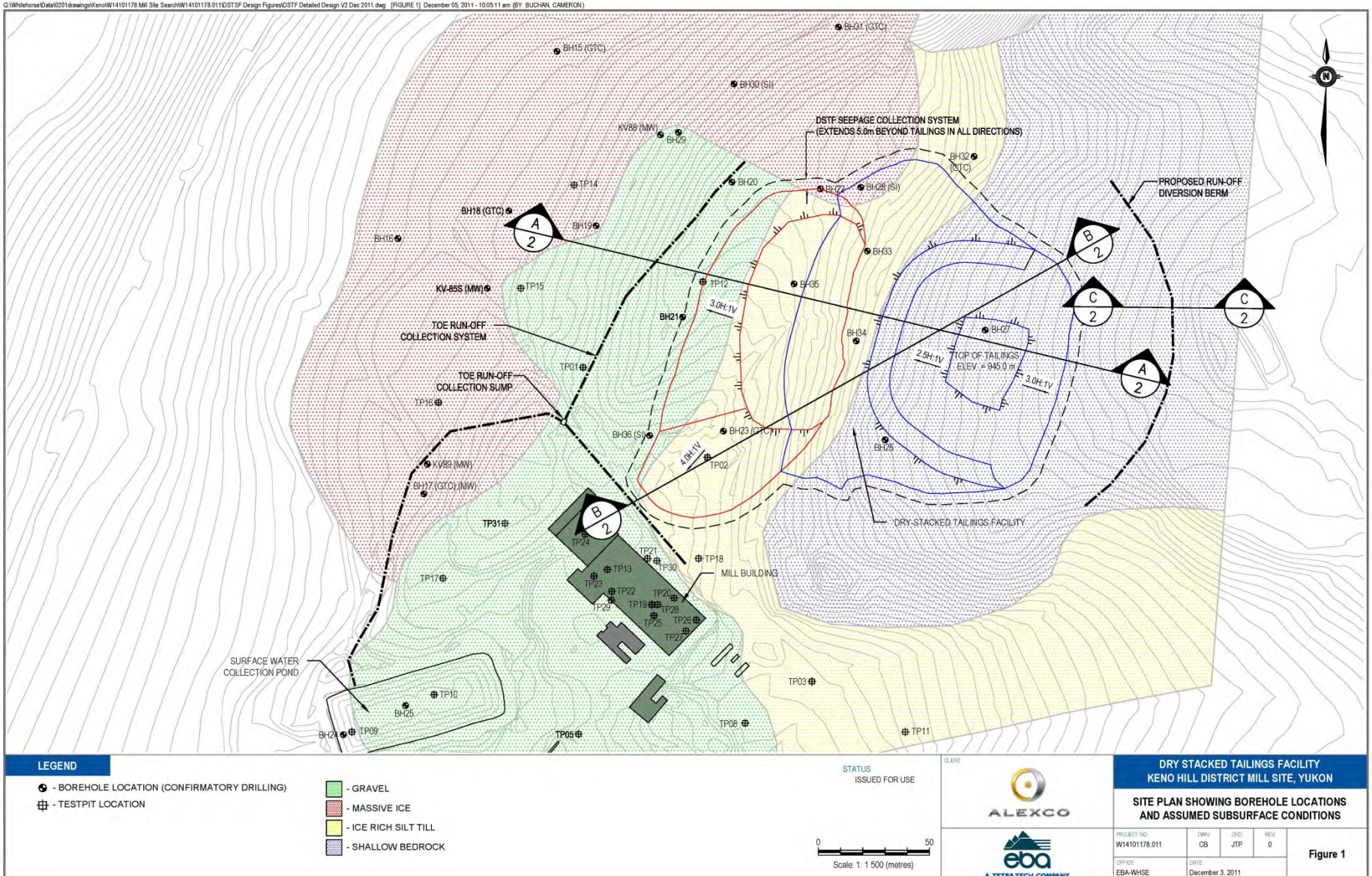


Dry Stack Tailings Storage

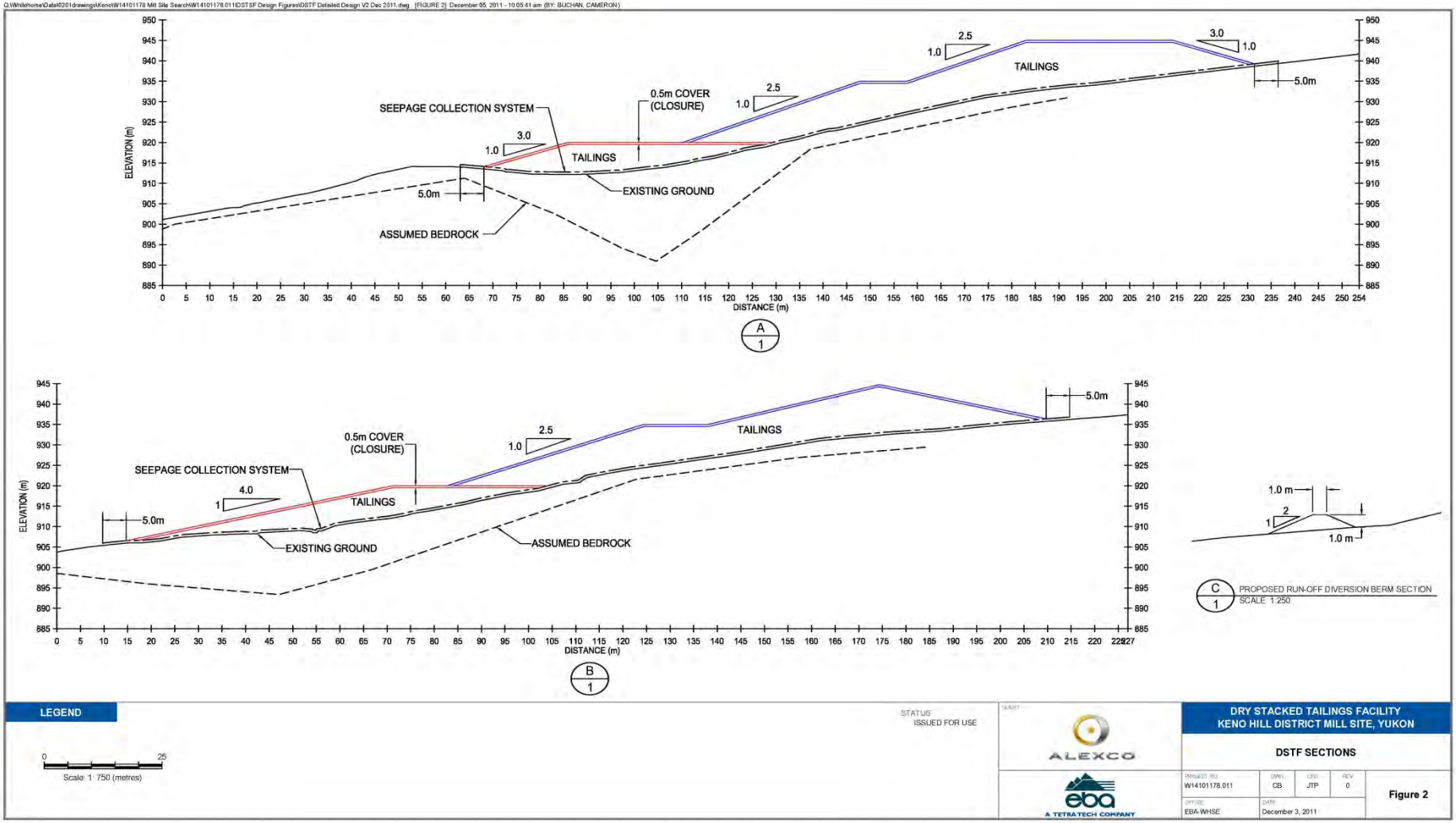
DSTF Design


CHRISTAL LAKE
CHRISTAL LAKE ACCESS ROAD
KENO CITY DUMP
KENO CITY
KENO HILL DISTRICT MILL SITE
DUNCAN CREEK ROAD
BELLEKENO MINE SITE
LIGHTNING CREEK
LEGEND
0
250
Scale: 1: 5 000 (metres)
STATUS
ISSUED FOR USE
CLIENT
ALEXCO
DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON
SITE LOCATION PLAN
PROJECT NO:
W14101178.011
DWN
CB
CKD
JTP
REV
0

DSTF Design


Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\W14101178.011\DSTSF Design Figures\DSTF Detailed Design V2 Dec 2011.dwg [FIGURE 1] December 05, 2011 - 10:05:11 am (BY: BUCHAN, CAMERON)
BH31 (GTC)
BH15 (GTC)
BH30 (SI)
KV88 (MW)
BH29
DSTF SEEPAGE COLLECTION SYSTEM
(EXTENDS 5.0m BEYOND TAILINGS IN ALL DIRECTIONS)
BH32 (GTC)
BH20
BH22
BH28 (SI)
PROPOSED RUN-OFF DIVERSION BERM
TP14
BH18 (GTC)
BH19
BH16
BH33
KV-85S (MW)
TP15
TP12
BH35
3.0H:1V
BH21
TOE RUN-OFF COLLECTION SYSTEM
BH34
BH27
2.5H:1V
TOP OF TAILINGS ELEV. = 945.0 m
3.0H:1V
TP01
TOE RUN-OFF COLLECTION SUMP
TP16
BH36 (SI)
BH23 (GTC)
BH26
4.0H:1V
TP02
KV89 (MW)
BH17 (GTC) (MW)
DRY-STACKED TAILINGS FACILITY
TP31
TP24
TP21
TP18
TP13
TP30
MILL BUILDING
TP17
TP23
TP22
TP20
TP19
TP28
TP29
TP25
TP26
TP27
SURFACE WATER COLLECTION POND
TP03
TP10
BH25
BH24
TP09
TP05
TP08
TP11
A
B
C
2
N
LEGEND
- BOREHOLE LOCATION (CONFIRMATORY DRILLING)
- TESTPIT LOCATION
- GRAVEL
- MASSIVE ICE
- ICE RICH SILT TILL
- SHALLOW BEDROCK
STATUS
ISSUED FOR USE
0
50
Scale: 1: 1 500 (metres)
CLIENT
ALEXCO
eba
A TETRA TECH COMPANY
DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON
SITE PLAN SHOWING BOREHOLE LOCATIONS AND ASSUMED SUBSURFACE CONDITIONS
PROJECT NO
W14101178.011
DWN
CB
CKD
JTP
REV
0
OFFICE
EBA-WHSE
DATE
December 3, 2011
Figure 1

DSTF Design


SEEPAGE COLLECTION SYSTEM
0.5m COVER (CLOSURE)
TAILINGS
EXISTING GROUND
ASSUMED BEDROCK
5.0m
3.0
1.0
2.5
1.0
ELEVATION (m)
DISTANCE (m)
A
1
4.0
1
B
1
1.0 m
2
C
PROPOSED RUN-OFF DIVERSION BERM SECTION
SCALE 1:250
LEGEND
Scale: 1 :750 (metres)
STATUS
ISSUED FOR USE
ALEXCO
eba
A TETRA TECH COMPANY
DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON
DSTF SECTIONS
W14101178.011
CB
JTP
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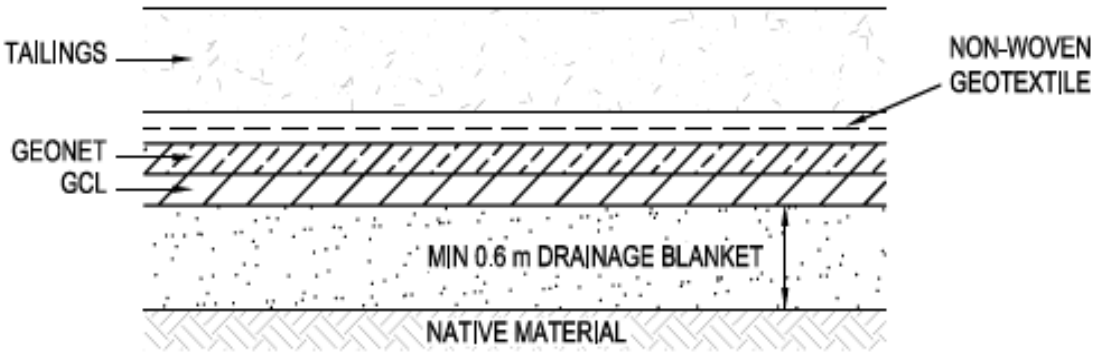
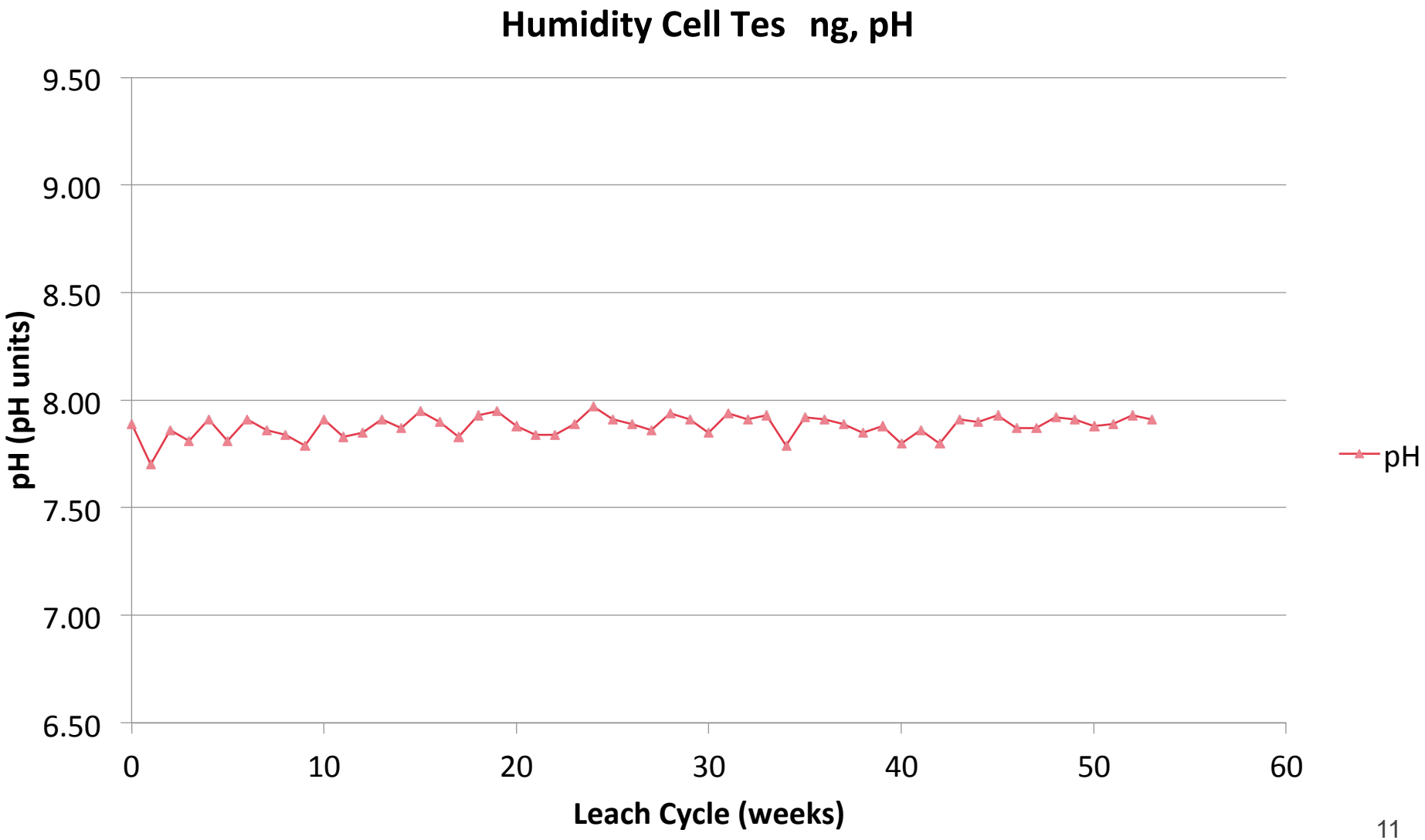
EBA-WHSE
December 3, 2011
Figure 2

DSTF Design

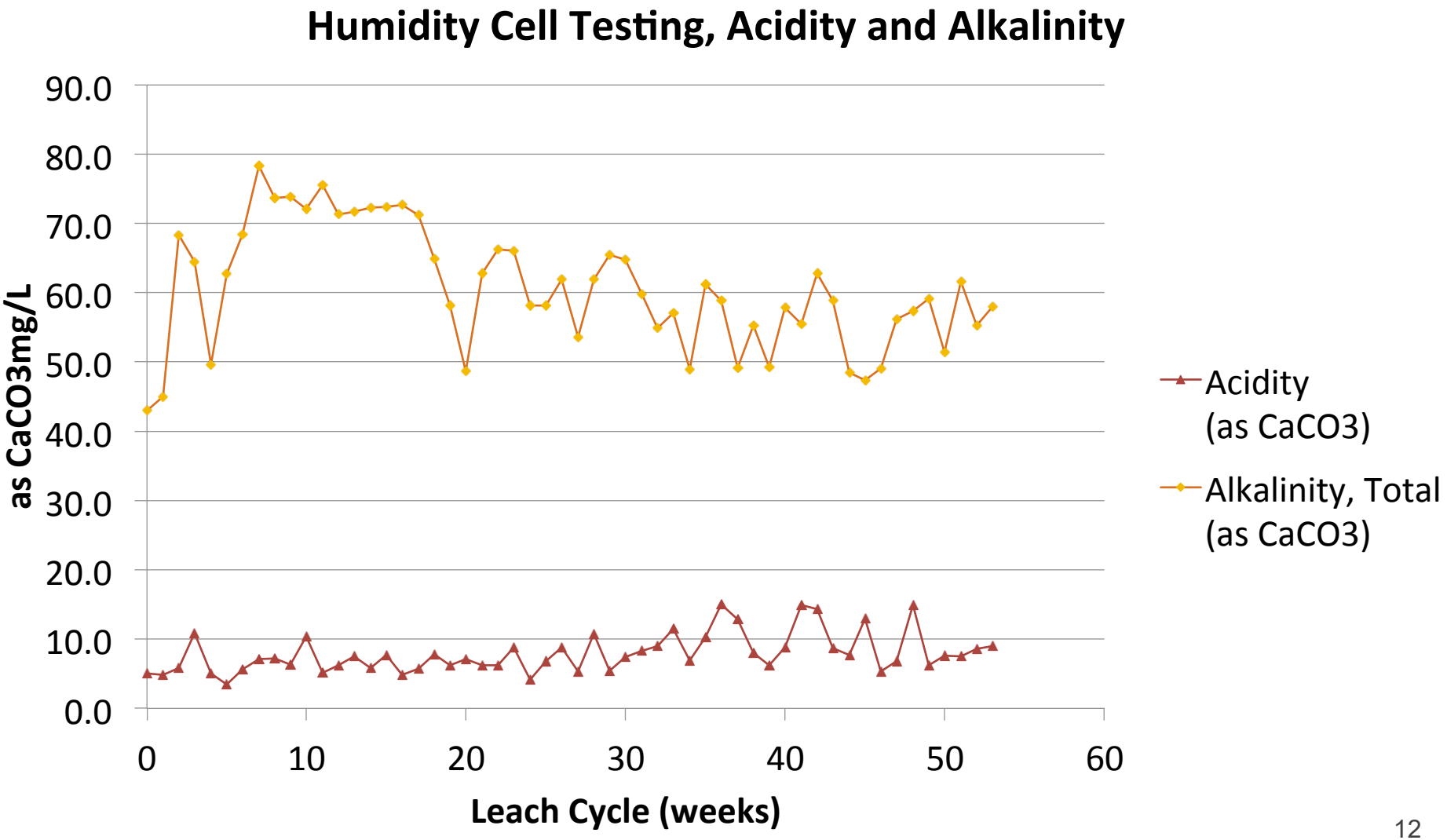


SEEPAGE COLLECTION SYSTEM DETAIL

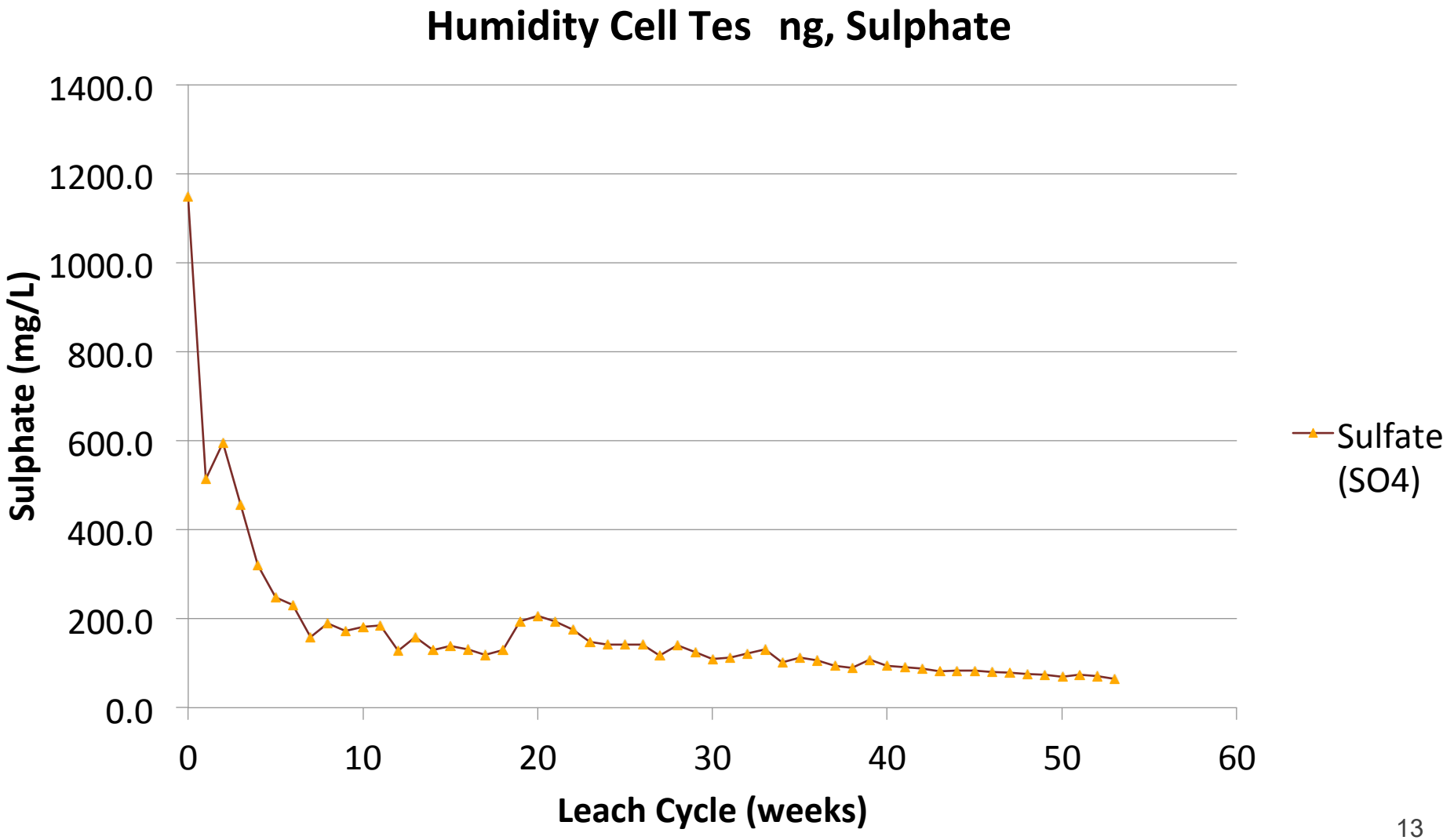
DSTF Performance



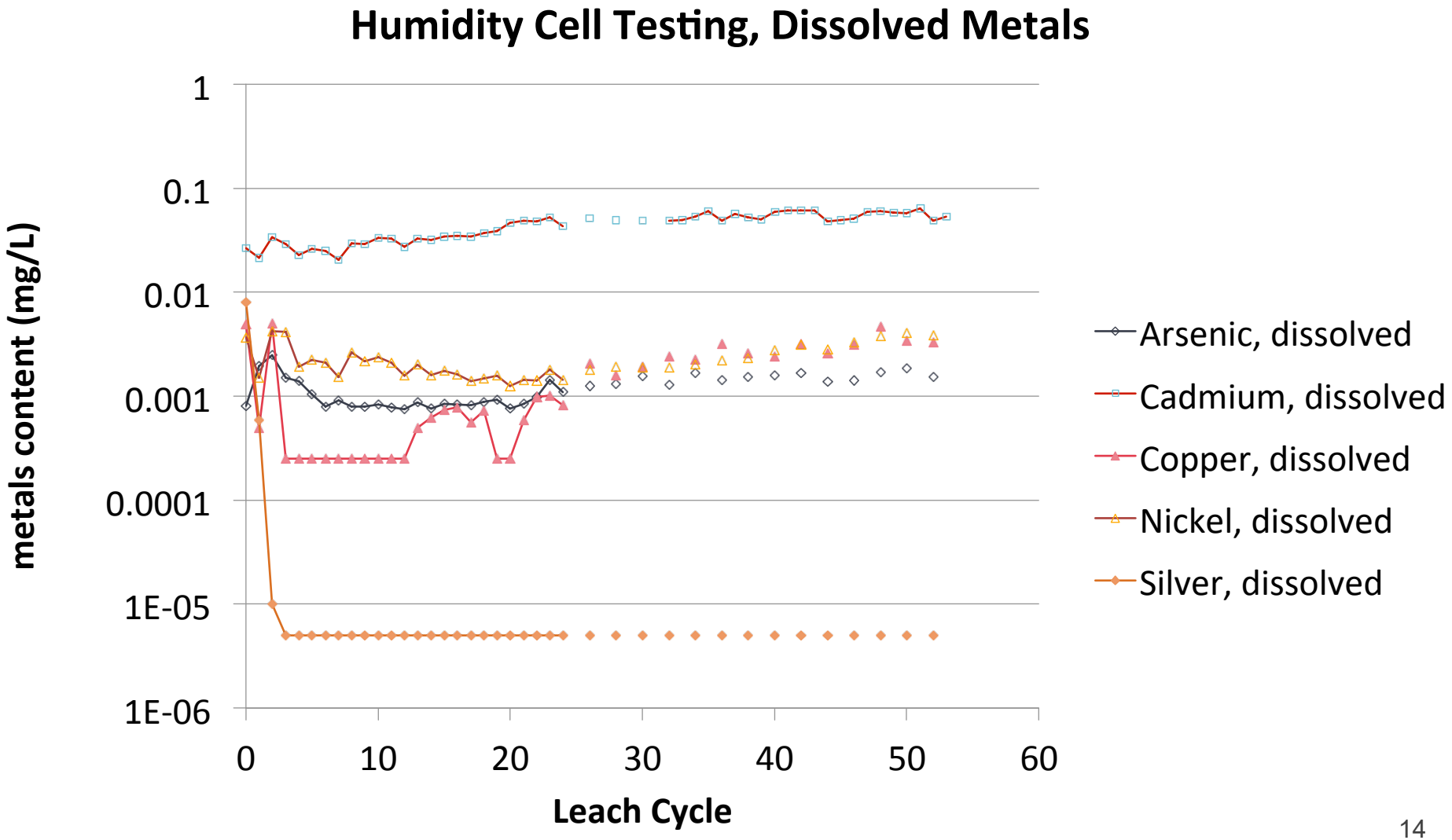
DSTF Performance



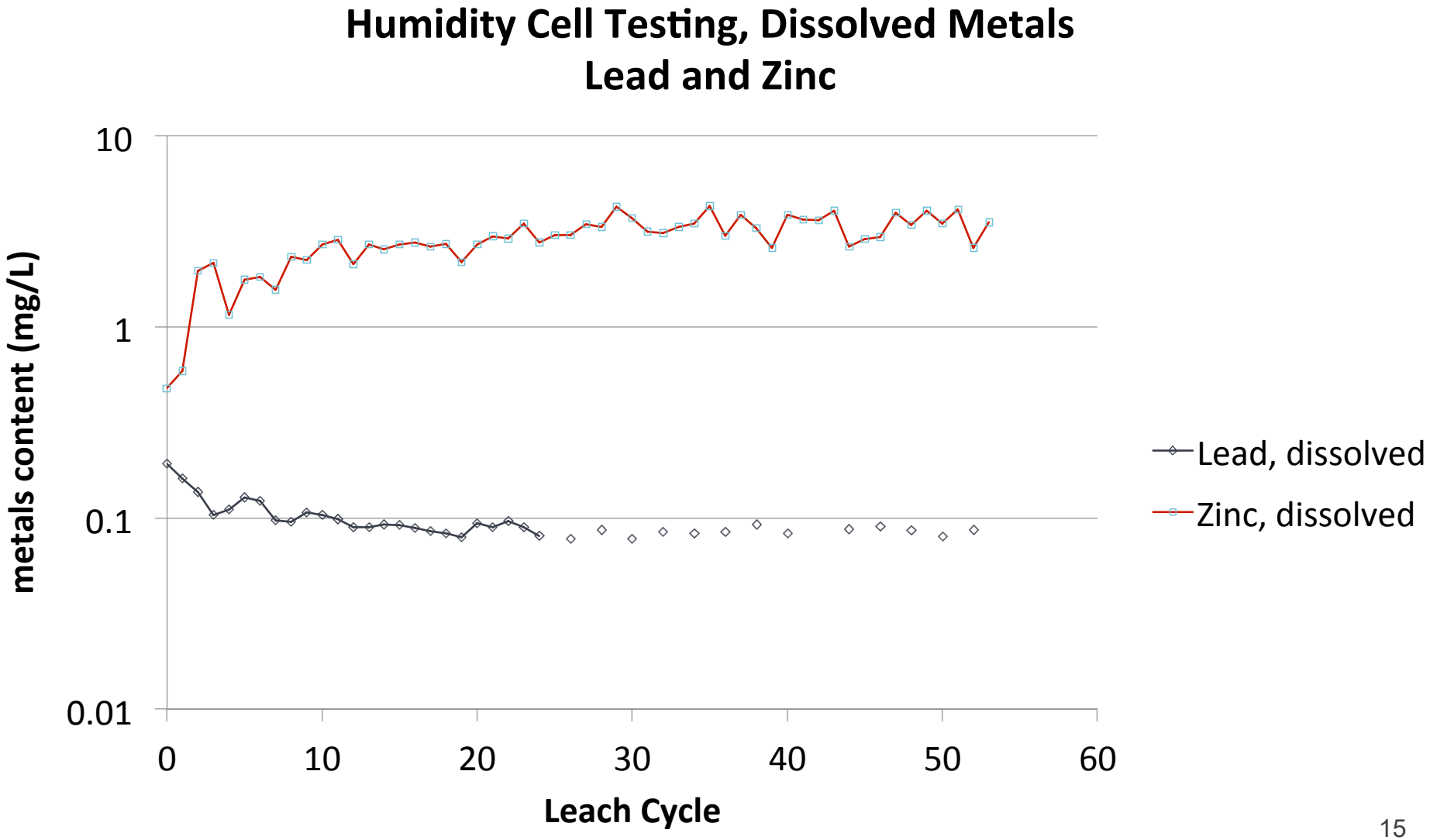
DSTF Performance



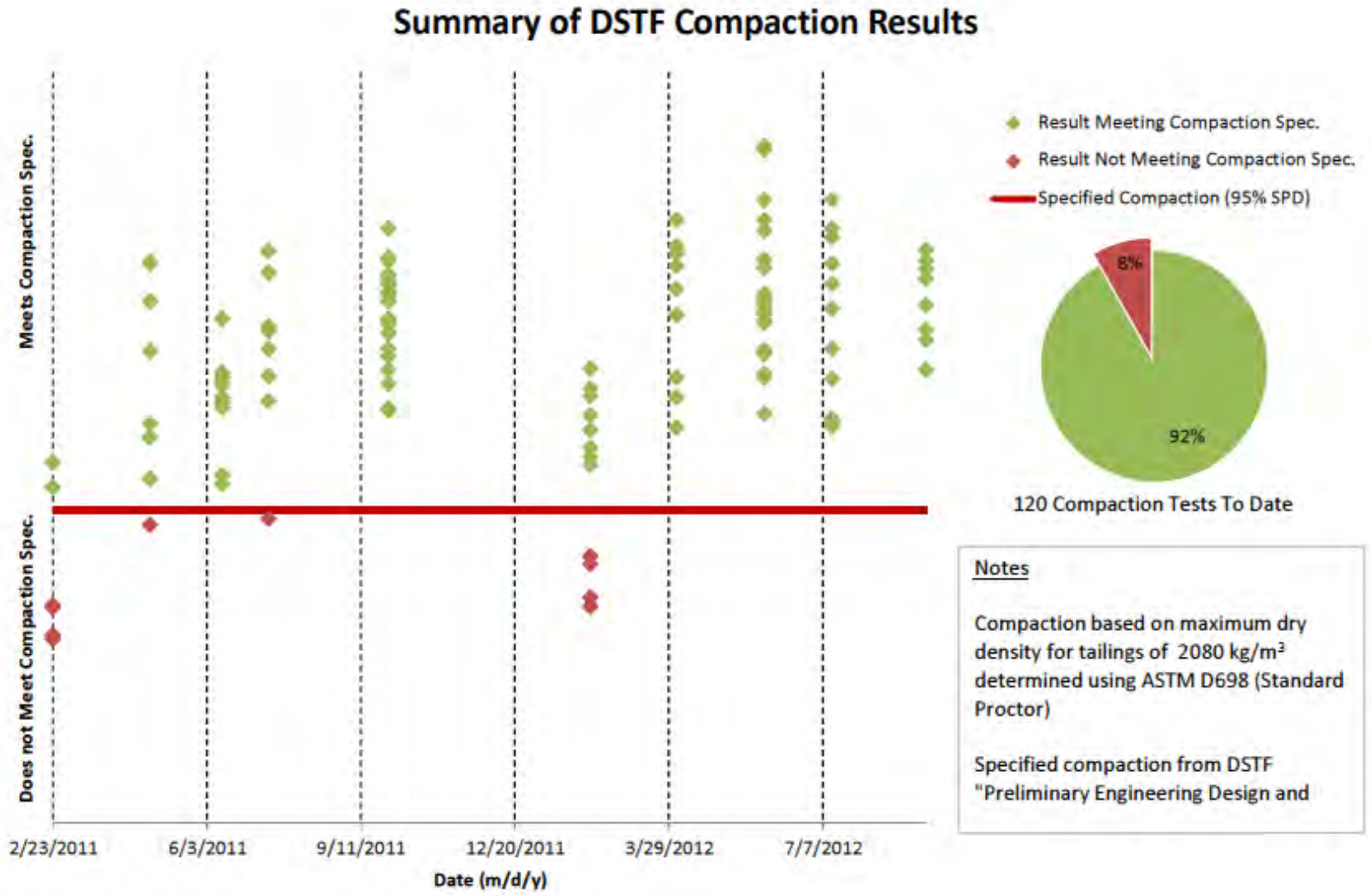
DSTF Performance



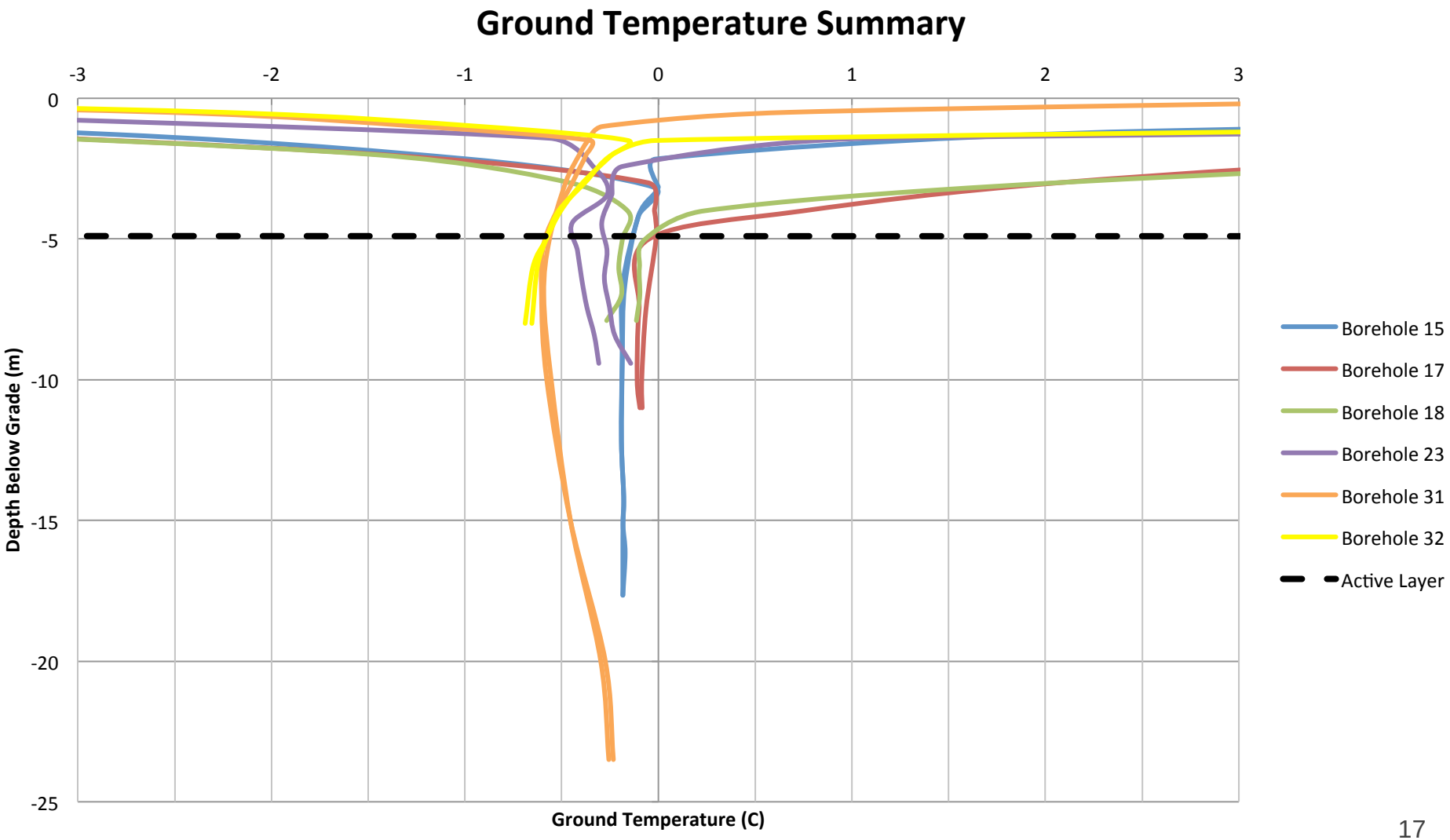
DSTF Performance



DSTF Performance - Compaction



DSTF Performance - Temperature



DSTF Progressive Reclamation



DSTF Progressive Reclamation



DSTF Progressive Reclamation

ALEXCO



APPENDIX 3.7

FLAME AND MOTH MINE WASTE ROCK STORAGE AREA DESIGN

Design Report

Flame & Moth Mine Waste Rock Storage Area
Keno Hill Silver District, Yukon Territory





PRESENTED TO
Alexco Keno Hill Mining Corp.

AUGUST 1, 2025
ISSUED FOR USE
FILE: 704-ENG.WARC04673-07.500

Tetra Tech Canada Inc.
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Scope of Work 1
1.2 Facility Concept 1

2.0 SITE CONDITIONS 2
2.1 Surface Conditions 2
2.2 Subsurface Conditions 2
2.2.1 Stratigraphy 2
2.2.2 Permafrost 3
2.2.3 Groundwater 3
2.3 Seismicity 3
2.4 Precipitation 3

3.0 DESIGN BASIS AND CRITERIA 5
3.1 Design Basis 5
3.2 Design Criteria 6
3.2.1 Mine Rock Management Facility Classification 6
3.2.2 Minimum Design Criteria 7
3.3 Design Geometry 8
3.4 Design Storage Capacity 8

4.0 ENGINEERING ANALYSES 8
4.1 Slope Stability Analysis 9
4.1.1 Geotechnical Material Properties 9
4.1.2 Seismic Loadings 10
4.1.3 Slope Stability Analysis Results 10
4.2 Deformation Analysis 11
4.2.1 Thaw Settlement 12
4.2.2 Consolidation Settlement 12
4.2.3 Earthquake-Induced Deformation 13
4.2.4 Deformation Analysis Results 13
4.3 Runout Assessment 13
4.3.1 Mine Waste Rock Failure Mobility Parameters 14
4.3.2 Runout Assessment Results 14
4.4 Hydrotechnical Analysis 15
4.4.1 Design Storm Events 15
4.4.2 Catchment Area 16
4.4.3 Hydrological Model Development 17
4.4.4 Hydrotechnical Analysis Results 19

5.0 DESIGN SUMMARY 23

6.0 CLOSURE 24

REFERENCES 26

LIST OF TABLES IN TEXT

Table 2-1: Climate Stations near the Flame & Moth WRSA 4
Table 2-2: Comparison of 24-Hour Rainfall Depths between District Mill and Mayo Airport 4
Table 2-3: Climate Change-Adjusted Rainfall Depth for Various Return Periods and Durations 5
Table 3-1: Mine Rock Management Facility Classification for the Flame & Moth WRSA 6
Table 3-2: Minimum Design Criteria for the Flame & Moth WRSA 7
Table 3-3: Target Storage Capacities for the Flame & Moth WRSA 8
Table 4-1: Geotechnical Material Properties for Flame & Moth WRSA Slope Stability Analysis 9
Table 4-2: Slope Stability Analysis Results for the Flame & Moth WRSA 11
Table 4-3: Thaw and Consolidation Settlement Input Parameters for the Flame & Moth WRSA 12
Table 4-4: Mine Waste Rock Failure Travel Angles for the Flame & Moth WRSA 14
Table 4-5: Soil Conservation Service Hydrological Soil Types 18
Table 4-6: Hydrological Modelling Parameters for the Flame & Moth WRSA 18
Table 4-7: Hydrological Modelling Results for the Flame & Moth WRSA 22

LIST OF FIGURES IN TEXT

Figure 4-1: Comparison of SCS Rainfall Curves Versus Actual Rainfall Data by Cumulative Distribution 16
Figure 4-2: Catchment Area for the Flame & Moth WRSA (shown in blue) 17
Figure 4-3: Hydrological Model for the Flame & Moth WRSA 19
Figure 4-4: Peak Discharges at the Culvert and Outfall for the Flame & Moth WRSA 20
Figure 4-5: Overview of the Flame & Moth WRSA Surface Water Conveyance System 21

APPENDIX SECTIONS

DESIGN DRAWINGS

Drawing 010 Cover Sheet & Drawing List
Drawing 011 Foundation Preparation and Haul Road Site Plan
Drawing 012 Stage 1 Site Plan
Drawing 013 Stage 2 Site Plan
Drawing 014 Stage 3 Site Plan
Drawing 015 Waste Rock Storage Area Profile Views A & B
Drawing 016 Waste Rock Storage Area Profile Views C & D
Drawing 017 Haul Road Profile View
Drawing 018 Haul Road Cross Section Views
Drawing 019 Haul Road Cross Section Views
Drawing 020 Typical Details

APPENDICES

Appendix A Slope Stability Analysis Results
Appendix B Runout Assessment Results
Appendix C Tetra Tech's Limitations on Use of this Document

ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
AEP	Annual Exceedance Probability
AKHM	Alexco Keno Hill Mining Corp.
Data Report	*Flame & Moth Mine Waste Rock Storage Area – Geotechnical and Geophysical Data Report* (Tetra Tech 2025)
DEM	Digital Elevation Model
DSTF	Flame and Moth Mine Dry Stack Tailings Facility
EDGM	Earthquake Design Ground Motion
EP	Exceedance Probability
Flame & Moth	Flame and Moth Mine
FS	Factor of Safety
IDF	Intensity Duration Frequency
Investigation Program	Flame & Moth WRSA Geotechnical and Geophysical Investigation Program
Mine	Flame and Moth Mine
NELPCo	NND EBA Land Protection Corp., operating as NELPCo Limited Partnership
PCSWMM	Personal Computer Storm Water Management Model
PGA	Peak Ground Acceleration
SCS	Soil Conservation Service
SOW	Scope of Work
Tetra Tech	Tetra Tech Canada Inc.
WRSA	Waste Rock Storage Area
YG-EMR	Government of Yukon, Department of Energy, Mines and Resources
YT	Yukon Territory

LIMITATIONS OF REPORT

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1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by NND EBA Land Protection Corp., operating as NELPCo Limited Partnership (NELPCo), at the request of Alexco Keno Hill Mining Corp. (AKHM) to complete engineering design of a new waste rock storage area (WRSA) at the Flame and Moth Mine (Flame & Moth or the Mine) in the Keno Hill Silver District, Yukon Territory (YT). The Mine is located in the central Yukon, at Latitude *63.90588° North*, Longitude *135.32931° West*, and lies within the traditional territory of the First Nation of Na-Cho Nyäk Dun.

The Flame & Moth WRSA is a proposed mine rock management facility with associated overburden (i.e., reclamation) and vegetation stockpiles that will support underground mining operations at Flame & Moth. The objective of Tetra Tech's engineering design work is to prepare detailed (100%) design of the facility, including design drawings and design report, on behalf of AKHM for regulatory submission to the Government of Yukon, Department of Energy, Mines and Resources (YG-EMR).

This design report presents the site conditions, design basis, engineering analyses, and detailed design for the Flame & Moth WRSA. Results from the Flame & Moth WRSA Geotechnical and Geophysical Investigation Program (the Investigation Program) are presented in a separate data report titled *Flame & Moth Mine Waste Rock Storage Area – Geotechnical and Geophysical Data Report* (Tetra Tech 2025, the Data Report), which should be read in conjunction with this design report.

1.1 Scope of Work

Tetra Tech's scope of work (SOW) for the Flame & Moth WRSA was to prepare an engineering design for the facility. The SOW, which is detailed in this design report, included the following tasks:

- Review the relevant background information and applicable mine waste design guidelines;
- Characterize the facility's surface, subsurface, and climate conditions;
- Review and establish a design basis for the facility with input from AKHM;
- Review and classify the facility to establish design criteria;
- Perform geotechnical and hydrotechnical analyses, including slope stability, deformation, runout, and hydrological assessments, to inform design of the facility;
- Prepare detailed (100%) design drawings for the facility; and
- Document engineering design of the facility in a design report.

1.2 Facility Concept

The Flame & Moth WRSA is a proposed mine rock management facility for permanently storing unmineralized and uneconomic rock from underground mining at the Mine. It will have associated overburden and vegetation stockpiles for the temporary storage of overburden soils, organics (e.g., peat, topsoil), and vegetation (e.g., trees, shrubs) cleared from foundation preparation for the facility. Access to the Flame & Moth WRSA is planned via a haul road connecting to an existing access road in the northwest corner of the Mine.

AKHM identified a proposed location for the Flame & Moth WRSA within an undeveloped area approximately 400 m north of the Mine, as shown on Drawing *011* (see Design Drawings section). The facility is bound by the Flame &

Moth Mine to the south, a bedrock ridge and future infrastructure development area to the north, and an existing access road and powerline to the west. The Investigation Program, which covered the western portion of this area, was undertaken by Tetra Tech in 2025 and is detailed in the Data Report.

At the request of AKHM, the Flame & Moth WRSA design considered three storage option scenarios:

- Stage 1 = 125,000 T (~62,500 m^3);
- Stage 2 = 400,000 T (~200,000 m^3); and
- Stage 3 = 684,000 T (~342,000 m^3).

2.0 SITE CONDITIONS

Site conditions for the Flame & Moth WRSA, including surface conditions, subsurface conditions, seismicity, and precipitation, are summarized in the following subsections. Detailed descriptions of the surface and subsurface conditions for the facility are provided in the Data Report (Tetra Tech 2025), which should be read in conjunction with this design report.

2.1 Surface Conditions

Surface conditions for the Flame & Moth WRSA were influenced by past glacial meltwater activity, as the proposed site is located within an area of predominantly glacial till and glaciofluvial sediments with glaciofluvial channeling evident in places. The topography surrounding the proposed facility includes moderately steep slopes with drainage flowing to the west-northwest. Surficial materials predominantly consist of glacial till and glaciofluvial deposits, with smaller areas of weathered bedrock, organics soils and exposed quartzite bedrock.

2.2 Subsurface Conditions

Subsurface conditions within the Flame & Moth WRSA's proposed footprint were investigated as part of the Investigation Program, as documented in the Data Report (Tetra Tech 2025). The stratigraphy, permafrost, and groundwater conditions for the proposed facility are summarized in the following subsections.

2.2.1 Stratigraphy

The subsurface conditions identified for the Flame & Moth WRSA consisted of four primary stratigraphic layers:

- Silts, Sands, and Gravels (Glacial Till and Glaciofluvial);
- Massive Ground Ice;
- Weathered Bedrock; and
- Quartzite (Competent Bedrock).

The site was typically covered with a layer of Organics (Peat) where not cleared or covered in Fill. Silts, Sands, and Gravels (Glacial Till and Glaciofluvial) were encountered in 10 of the 12 geotechnical boreholes drilled. Massive Ground Ice was encountered in three geotechnical boreholes below the Glacial Till deposits and was typically massive and clear to cloudy. Weathered Bedrock was encountered in seven of the 12 geotechnical boreholes drilled

and generally comprised of black-brown, fine to coarse-grained rock fragments. Quartzite (Competent Bedrock) was encountered at depth in 10 of the 12 geotechnical boreholes drilled.

2.2.2 Permafrost

The Flame & Moth WRSA is located within a zone of *Extensive Discontinuous Permafrost* and permafrost soils, including massive ground ice, was encountered in nearly all of the geotechnical boreholes drilled. Ground ice contents ranged from no excess ice content (0%) to solid, massive ice (100%).

Permafrost soils were mapped to cover 88.5% of the proposed site, ranging from low to high excess ice. Massive ground ice was encountered in three geotechnical boreholes, with thicknesses up to 14 m and excess ice contents up to 98%. The active layer (i.e., seasonal freeze/thaw) is estimated to range from 1.2 m to 2.8 m below ground surface.

2.2.3 Groundwater

Groundwater at the Flame & Moth WRSA was observed and measured in two geotechnical boreholes. All measured groundwater levels were within Glacial Till layers and ranged in elevation from +882.6 m and +891.4 m.

2.3 Seismicity

Seismicity is the occurrence or frequency of earthquakes in a region, which is measured based on seismograph recordings of naturally occurring earthquakes. Although it can be observed that seismicity in northern Canada is low, based on the observed lack of strong earthquake motions, the seismic hazard for a given site is independent of the frequency of earthquakes. Seismic hazard is defined by the magnitude and ground motion of an earthquake that is permissible at a given site for a given annual exceedance probability (AEP).

The seismic hazard for the Flame & Moth WRSA can be considered *Moderate* based on the number of seismic sources (i.e., fault zones) near the Keno Hill Silver District and the facility's subsurface conditions. The peak ground acceleration (PGA) under a potential earthquake at the Flame & Moth WRSA was estimated from the 2020 National Building Code of Canada seismic hazard website (NRC 2020) for Site Designation X_D. Both frozen and unfrozen stiff soils are expected in the subsurface for the Flame & Moth WRSA; therefore, Site Designation X_D was deemed appropriate.

The estimated PGA is 0.104 g for a 20% in 50-year AEP (0.004 per annum or 1 in 250-year return) and 0.279 g for a 2% in 50-year AEP (0.000404 per annum or 1 in 2,475-year return) for the proposed Flame & Moth WRSA site.

2.4 Precipitation

Precipitation data from nearby climate stations was used to estimate the surface runoff reporting to the Flame & Moth WRSA, as summarized in Table 2-1. Daily and hourly precipitation data is available from three nearby climate stations, including two stations at the Mayo Airport operated by Environment and Climate Change Canada (ECCC 2025) as well as one station at the Mine's District Mill.

Table 2-1: Climate Stations near the Flame & Moth WRSA

Climate Station ID	Location	Distance from WRSA	Duration of Record	Frequency	Type of Data	Agency
1572	Mayo Airport	42 km	1953 to 2013	Hourly	▪ Temperature ▪ Precipitation ▪ Snowpack ▪ Wind Speed	ECCC
			1924 to 2013	Daily		
51426			2013 to Present	Daily, Hourly		
District Mill	Flame & Moth Mine	< 1 km	June 2011 to Present	Hourly	▪ Temperature ▪ Relative Humidity ▪ Precipitation ▪ Wind Speed ▪ Evapotranspiration	AKHM
BKS-1 *BKS-4* *BKS-5*	Galena Hill Calumet VTF	< 5 km	January 2011 to April 2023	Monthly	▪ Temperature ▪ Precipitation ▪ Snowpack	ERDC

The rainfall data from various locations were validated by comparing them through a frequency analysis of precipitation data from the *District Mill* weather station, covering full-year periods from 2012 to 2023.

This analysis calculated the 24-hour precipitation depth for return periods ranging from 2 years to 200 years. When compared to the 24-hour precipitation depth derived from the *Mayo Airport* climate stations (1979 to 2016), the analysis revealed that the 200-year rain depth estimated from the *Mayo Airport* climate stations is 1.3% lower than the *District Mill* climate station, as shown in Table 2-2.

Table 2-2: Comparison of 24-Hour Rainfall Depths between District Mill and Mayo Airport

Return Period (years)	2012 to 2023 District Mill 24-Hour Rainfall (mm)	1979 to 2016 Mayo Airport 24-Hour Rainfall (mm)	Percent Difference (%)
200	37.6	37.1	-1.3%
100	34.5	33.6	-2.6%
50	31.5	31.2	-1.0%
20	27.7	28.8	4.0%
10	24.7	24.0	-2.8%
5	21.7	21.6	-0.5%
2	16.7	16.8	0.6%

The difference is statistically insignificant. Overall, the comparison indicates that the *Mayo Airport* climate station provides a reasonable approximation of precipitation patterns for the Mine. Previous hydrology studies for the Keno Hill Silver District (Ensero 2023), noted the precipitation data at *District Mill* climate station has missing periods in 2022 and is not representative of that year. Based on this, Tetra Tech has selected the *Mayo Airport* climate station for hydrological modelling as it covers a greater historical record.

An Intensity Duration Frequency (IDF) curve for climate change-adjusted rainfall depths at the *Mayo Airport* climate station was sourced from ECCC (2025) and then extrapolated to match the required design return period and duration. Table 2-3 lists the rainfall depth adjusted for climate change, available for return periods (expressed in T-Year) up to 100-year, which was used for extrapolation to 200-year.

Table 2-3: Climate Change-Adjusted Rainfall Depth for Various Return Periods and Durations

Duration (minute/hour)	Rainfall Depth for Return Period (mm)					
	2-year	5-year	10-year	25-year	50-year	100-year
5-minute	4.50	6.75	8.25	10.17	11.58	12.92
10-minute	6.00	9.33	11.50	14.33	16.33	18.33
15-minute	7.00	10.75	13.00	16.25	18.50	20.50
30-minute	8.50	12.50	15.50	19.00	21.50	24.00
1-hour	10.00	14.00	17.00	20.00	23.00	25.00
2-hour	13.00	16.60	19.20	22.00	24.00	26.00
6-hour	18.00	21.60	24.60	28.20	30.00	33.00
12-hour	21.60	27.60	28.80	34.80	36.00	39.60
24-hour	26.40	33.60	36.00	43.20	48.00	50.40

3.0 DESIGN BASIS AND CRITERIA

Design basis and criteria for the Flame & Moth WRSA were developed in accordance with YG-EMR's current design guidelines and industry best practices considered applicable to the facility. The following design guidelines were referenced for engineering design of the Flame & Moth WRSA:

- *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023); and
- *Guidelines for Mine Waste Dump and Stockpile Design* (Hawley and Cunning 2017).

The design basis, criteria, geometry, and storage capacity adopted for engineering design of the Flame & Moth WRSA is outlined in the following subsections.

3.1 Design Basis

The design basis for the Flame & Moth WRSA was developed based on information and input provided by AKHM as well as Tetra Tech's understanding of the site conditions. The facility's design was developed based on the following considerations:

- Locate the WRSA within the undeveloped area approximately 400 m north of the Mine (see Section 1.2);
- Optimize the facility's footprint based on the site conditions (see Section 2.0);
- Provide storage capacity for the following materials:
  - Permanent storage for mine waste rock from the Flame & Moth Mine; and
  - Temporary storage for overburden soils, organics (e.g., peat, topsoil), and vegetation (e.g., trees, shrubs) cleared from foundation preparation for the facility.
- Divert and manage surface water away from the facility, where possible;
- Target a resultant sideslope of 3H:1V for the facility to accommodate a future closure cover;
- Design haul roads (and associated safety berms) for two-way traffic that can accommodate a CAT *745C* (or similar) articulated dump truck; and

- Target a mine rock management facility classification of *Class I*, per the *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023).

3.2 Design Criteria

Chapter 6 (*Mine rock management facilities*) in the *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023) provides a mine rock management facility classification system for establishing minimum design criteria for mine rock management facilities in the YT. Per Table 6-1 (*Mine rock management facility classification*), the classification system requires the evaluation of eight facility characteristics, including:

- Maximum height above natural ground;
- Presence of permafrost;
- Geochemistry of waste rock;
- Predicted water quality of waste rock runoff or seepage;
- Runoff or leachate management requirements;
- Surface water conditions;
- Human health and safety; and
- Facility closure costs.

3.2.1 Mine Rock Management Facility Classification

Tetra Tech reviewed and evaluated the above mine rock management facility characteristics for the Flame & Moth WRSA and assigned a facility classification of *Class I*. Table 3-1 provides a detailed description of the mine rock management facility classification assigned for the Flame & Moth WRSA.

Table 3-1: Mine Rock Management Facility Classification for the Flame & Moth WRSA

Facility Characteristic	Classification Description	Corresponding Facility Class
Maximum height above natural ground	▪ The maximum vertical depth of waste rock above natural ground for the Flame & Moth WRSA will not exceed 50 m.	*Class I*
Presence of permafrost	▪ No permafrost present under critical elements of facility. ▪ Ice-rich permafrost and massive ground ice will be avoided and not present under the Flame & Moth WRSA. ▪ Ice-poor permafrost soils under critical elements of the facility (e.g., lower bench toes) will be removed and replaced with thaw-stable materials.	*Class I*
Geochemistry of waste rock	▪ AKHM has advised that only non-acid generating mine waste rock will be stored in the Flame & Moth WRSA.	*Class I*
Predicted water quality of waste rock runoff or seepage	▪ AKHM has advised that the water quality of waste rock runoff/seepage for the Flame & Moth WRSA are predicted to comply with the Mine's quartz mining licence *QML-0009* and its associated waste rock management plan.	*Class I*
Runoff or leachate management requirements	▪ Protection of receiving water does not require active or passive management of water discharges other than sediments controls during the operations.	*Class I*

Table 3-1: Mine Rock Management Facility Classification for the Flame & Moth WRSA

Facility Characteristic	Classification Description	Corresponding Facility Class
Surface water conditions	▪ The Flame & Moth WRSA is not located on any stream channels.	*Class I*
Human health and safety	▪ Other than the temporary presence of workers from the Mine carrying out their duties, there is no identifiable population at risk from a failure of the Flame & Moth WRSA.	*Class I*
Facility closure costs	▪ AKHM has advised that the total closure cost for the Flame & Moth WRSA is not expected to exceed $10,000,000.	*Class I*

3.2.2 Minimum Design Criteria

Per Table 6-2 (*Minimum Design Criteria for Mine Rock Management Facilities*), mine rock management facility designs must comply with the minimum requirements for each facility classification (YG-EMR 2023). Minimum design criteria for the Flame & Moth WRSA were determined based on the facility classification of *Class I* (see Section 3.2.1) and are outlined in Table 3-2.

Table 3-2: Minimum Design Criteria for the Flame & Moth WRSA

Category	Minimum Design Criteria for *Class I* Mine Rock Management Facility Classification
Design Events	▪ Seismic Design of Mine Rock Piles – Operations: 200-year Earthquake Design Ground Motion (EDGM) – Closure: 200-year EDGM
	▪ Design Flood (Surface Water Diversion and Conveyance Systems) – Operations: 200-year AEP – Closure: 200-year AEP
Design Methods	▪ Design Methods for Mine Rock Pile – Average shear strength properties. – Expected phreatic surfaces. – Limit equilibrium methods of stability calculations. – Pseudo-static calculations for earthquake design.
Factors of Safety	▪ Mine Rock Pile Factors of Safety – During Operations: • Static: greater than 1.3 • Pseudo-Static: greater than 1.0 – During Closure and Post-Closure: • Static: greater than 1.3 • Pseudo-Static: greater than 1.0 • Post-Earthquake: greater than 1.1
Permafrost Considerations	▪ Field Data Collection Requirements – Identify presence and characteristics of permafrost. – See Data Report (Tetra Tech 2025).
Surface Water Management	▪ Catchment Area for Determining IDF – Catchment area for the facility plus catchment areas of the surface water diversions, in the event the surface water diversions are designed to a smaller design flood than the facility.

It should be noted that only minimum design criteria categories applicable to the Flame & Moth WRSA were included in the table above (e.g., rock drains and water quality ponds are not considered applicable and were omitted).

Minimum design criteria for closure were considered; however, closure design for the facility is considered outside of the current SOW.

3.3 Design Geometry

A proposed design geometry for the Flame & Moth WRSA was initially developed in discussion with AKHM to guide the engineering analyses for the facility. The geometry parameters established for the facility included:

- Sideslopes (Overall Resultant) = 3H:1V;
- Interim Benching:
  - Bench Height = 6.0 m
  - Bench Width = 10.8 m
  - Bench Sideslopes = 1.25H:1V
- Top Elevation of Pile = +925.0 m (maximum); and
- Top Width of Pile = 20.0 m (minimum).

3.4 Design Storage Capacity

The Flame & Moth WRSA is planned to permanently store mine waste rock from underground mining at the Mine and three storage capacity scenarios were considered at the request of AKHM, as summarized in Table 3-3. The facility will also have associated overburden and vegetation stockpiles for temporarily storing overburden soils, organics, and vegetation cleared from the facility's footprint.

Table 3-3: Target Storage Capacities for the Flame & Moth WRSA

Stage	Target Mine Waste Rock Storage Capacity		Target Overburden and Vegetation Storage
	Mass (T)	Volume (m^3)	
1	125,000	~62,500	Based on WRSA Footprint
2	400,000	~200,000	
3	Maximum		

4.0 ENGINEERING ANALYSES

Tetra Tech performed geotechnical and hydrotechnical analyses, including slope stability, deformation, runout, and hydrological assessments, to inform engineering design of the Flame & Moth WRSA. Relevant information from the Data Report (Tetra Tech 2025) was used to characterize subsurface conditions for the facility. The analyses were conducted based on design basis and criteria established for the facility (see Section 3.0).

Engineering analyses results for the Flame & Moth WRSA are detailed in the following subsections. Plan and profile views of the facility are provided in the Design Drawings (see Design Drawings section).

4.1 Slope Stability Analysis

Limit equilibrium stability analyses were conducted for the Flame & Moth WRSA to determine the factor of safety (FS) against slope failure for the facility during mining operations. The slope stability FS is the ratio of the forces resisting a slope failure to the forces driving a slope failure. A slope with a FS of 1.0 is at equilibrium (i.e., the forces causing slope movement are equal to the forces resisting slope movement). A FS of less than 1.0 indicates that the slope is marginally stable and likely deforming. FS values greater than 1.0 indicate higher levels of stability. The minimum design criteria for FS, per the *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023), were used to account for the uncertainty and variability with the input parameters (see Section 3.2.2).

Slope stability analyses for the Flame & Moth WRSA were conducted using the two-dimensional, limit equilibrium software *GeoStudio SLOPE/W*, developed by Seequent Limited. The *Morgenstern-Price* method with a half-sine interslice force assumption was adopted in the analyses. The principles underlying the method of limit equilibrium analysis of slope stability are as follows:

- A slip mechanism is postulated;
- The resisting forces required to equilibrate the assumed slip mechanism is calculated by means of statics;
- The calculated resisting forces required for equilibrium are compared with the driving forces in terms of FS; and
- The slip mechanism with the lowest FS is determined through iteration.

In the slope stability analyses conducted, the entry and exit method was used in to determine the FS. Generally, slip surfaces less than 2 m in depth were not considered a slope instability and it is assumed that these smaller failures will be addressed through operation and maintenance of the Flame & Moth WRSA.

4.1.1 Geotechnical Material Properties

Geotechnical material properties for the Flame & Moth WRSA stability analyses were selected based on findings from the Investigation Program as well as previous geotechnical studies conducted for the Mine. Where applicable, material properties were adjusted to reflect observations noted during the Investigation Program. The geotechnical material properties chosen for the Flame & Moth WRSA are presented in Table 4-1.

Table 4-1: Geotechnical Material Properties for Flame & Moth WRSA Slope Stability Analysis

Material Type	Frozen / Unfrozen State	Unit Weight γ (kN/m^3)	Effective Cohesion c' (kPa)	Effective Friction Angle ϕ' (°)
Glacial Till	Frozen (Ice-Rich)	12.8	0	30
	Frozen (Ice-Poor)	18.0	0	30
	Unfrozen	20.0	0	30
Topsoil	Frozen	19.0	0	28
	Unfrozen	21.0	0	28
Waste Rock	-	19.5	0	37
Weathered Bedrock	-	Impenetrable		

For the Glacial Till, Tetra Tech conducted one consolidated-drained (CD) direct shear test on a remolded, thawed till sample from the Investigation Program and the results indicated peak and residual friction angles of 36.9° and 32.2°, respectively (Tetra Tech 2025). A lower friction angle of 30° was selected for design, considering that a few Glacial Till samples from other boreholes contain higher silt content than the tested sample. The frozen ice-poor

and ice-rich Glacial Till was evaluated under the assumption that the materials would behave as frictional under short-term conditions; therefore, the same friction angle as the thawed Glacial Till was used. Unit weights for the Glacial Till were adjusted based on ground ice content, since higher ground ice contents correspond with lower unit weights.

For the Waste Rock, the friction angle was determined through back-analysis of the existing Bermingham Mine WRSA slope. It was assumed that the current slope conditions are marginally stable and performing adequately.

For the Topsoil, it was assumed that a thin layer of Organics at the ground surface will compress under the weight of the placed mine waste rock and any thicker layers of Organics, if encountered during construction, will be removed during foundation preparation. The strength parameters of the thawed Topsoil were estimated based on engineering judgment and prior experience. For frozen Topsoil, it was evaluated under the assumption that it behaves as a frictional material under short-term conditions, using the same friction angle as the thawed Topsoil, with its unit weight adjusted to account for ground ice content.

4.1.2 Seismic Loadings

Potential seismic loadings for earthquake design were modelled based on a PGA of 0.104 g for a 20% in 50 years probability of exceedance (0.004 per annum or 1 in 250-year return), per Site Designation X_D (see Section 2.3). The PGA selected for engineering design meets the minimum design criteria specified for a *Class I* mine waste rock management facility, which requires seismic design to consider a minimum design event of 200-year EDGM (see Section 3.2.2).

Potential seismic loadings were modelled using pseudo-static loading conditions considering a horizontal acceleration factor (k_h) selected based on the design PGA. The k_h applied in the slope stability analyses used the full PGA of 0.104 g.

4.1.3 Slope Stability Analysis Results

Slope stability analyses for the Flame & Moth WRSA were performed based on the geotechnical material properties and seismic loadings outlined in Sections 4.1.1 and 4.1.2, respectively. The facility's slope stability was conservatively analyzed at two sections (one longitudinal and one transverse) where slope gradients were steepest and subsurface conditions were less favourable:

- **Section A** (see Design Drawing *015*) – A longitudinal section that is situated in an area of with ice-poor Glacial Till near the toe of the Flame & Moth WRSA. The section was analyzed assuming that an approximately 40 m-wide zone beneath the western toe of the facility will be subexcavated and replaced with waste rock.
- **Section C** (see Design Drawing *016*) – A transverse section that crosses the central portion of the Flame & Moth WRSA. The waste rock is primarily placed in an ice-poor area, with bedrock outcrops beneath the northern first bench and an ice-rich zone beyond the southern toe of the waste rock

For each section, two cases were evaluated considering different thermal conditions for the Flame & Moth WRSA's foundation soils:

- **Case 1 (Fully Frozen)** – Short-term stability case assuming that the topsoil and permafrost soils are frozen during construction.
- **Case 2 (Fully Thawed)** – Long-term stability case assuming that the topsoil and permafrost soils are fully thawed, and the phreatic surface is at ground surface.

For each section and case, a minimum FS was calculated for the critical slip surface under static and pseudo-static loading conditions to evaluate the Flame & Moth WRSA's stability. Slope stability results are presented on Figures A1 to A8 in Appendix A and summarized in Table 4-2.

Table 4-2: Slope Stability Analysis Results for the Flame & Moth WRSA

Section	Case	Loading Conditions	Failure Mode Type	North Slope		South Slope	
				Minimum Calculated FS	Appendix A Figure	Minimum Calculated FS	Appendix A Figure
A	1 (Frozen)	Static	Toe	1.8	A1	-	-
			Global	2.9	A2	-	-
		Pseudo-Static	Toe	1.3	A1	-	-
			Global	1.9	A2	-	-
	2 (Thawed)	Static	Toe	1.4	A3	-	-
			Global	2.1	A4	-	-
		Pseudo-Static	Toe	1.0	A3	-	-
			Global	1.4	A4	-	-
C	1 (Frozen)	Static	Global	2.9	A5	2.2	A6
		Pseudo-Static		2.2	A5	1.7	A6
	2 (Thawed)	Static	Global	2.7	A7	2.0	A8
		Pseudo-Static		2.0	A7	1.5	A8

Based on the topography for the Flame & Moth WRSA, both toe and global stability were evaluated for the north face of Section A, while global stability was assessed for both the north and south faces of Section C. The results indicate that ground improvement at the northern toe of Section A enhanced slope stability to meet the design criteria. Additionally, the calculated FS for all other scenarios exceed the required design thresholds. It is noted that local bench failure may occur with the current bench slope; however, such failures are typically shallow and produce minimal debris, making significant consequences unlikely.

4.2 Deformation Analysis

Different types of deformation are anticipated to occur in the Flame & Moth WRSA's foundation and pile. Based on the Investigation Program, ice-rich permafrost soils were observed in two boreholes drilled at the west-southwest portion of the proposed facility. The ice-rich permafrost soils are assumed to thaw under long-term climate change scenarios based on thermal modelling results from the Mine's nearby Dry Stack Tailings Facility (DSTF), located approximately 400 m south of the Flame & Moth WRSA (Tetra Tech 2024). Tetra Tech recommends that ice-poor permafrost soils within critical components of the proposed footprint of the Flame & Moth WRSA be subexcavated and removed prior to any placement of mine waste rock.

If the permafrost soils are not completely removed, localized thaw settlement is expected to occur when the ground ice content in the soils start to melt. Once thaw settlement has occurred, the thawed permafrost soils are subjected to further loading from the deposited waste rock, which can induce consolidation settlement. In addition to thawing-related deformations, potential earthquakes at mine site generate seismic waves that travel through soils, leading to displacement of facility. In the following subsections, deformation related to thawing of the permafrost soils and the earthquake-induced deformation were estimated to support engineering design of the Flame & Moth WRSA.

4.2.1 Thaw Settlement

Thaw settlement is defined by the total volume change of thawing permafrost soils that will result from both phase change (ice to water) and the flow of excess water out of the soil with no compression of the soil skeleton (Andersland and Ladanyi 2003). Thaw settlement is estimated using the following empirical equation for the soil with moisture content greater than 25%:

$$\varepsilon = 43.03 \times \ln(w) - 140.1$$

where:

ε is the thaw strain (%)

w is the soil's moisture content (%)

4.2.2 Consolidation Settlement

Consolidation settlement is defined by the total volume change of thawed permafrost soil due to the gradual expulsion of porewater under load. The consolidation settlement was obtained using the following equation:

$$S_c = \frac{C_c h}{1 + e_0} \log\left(\frac{\sigma_0 + \Delta\sigma_{avg}}{\sigma_0}\right)$$

where:

S_c is the consolidation settlement (m)

C_c is compression index

h is the thickness of the permafrost soil layer (m)

e_0 is the initial void ratio

σ_0 is the initial effective stress (kPa)

$\Delta\sigma_{avg}$ is the average effective stress (kPa, average of initial and final effective stress)

The input parameters used in the estimation of thaw settlement and consolidation settlement are summarized in the Table 4-3.

Table 4-3: Thaw and Consolidation Settlement Input Parameters for the Flame & Moth WRSA

Soil Type	Unit Weight (kN/m³)	Moisture Content (%)	Layer Thickness (m)	Initial Void Ratio	Compression Index	Loading from Deposited Waste Rock (kPa)
Ice-Rich Glacial Till	16.0 [a]	40.0 [b]	3.0 [c]	1.08 [d]	0.2 [e]	382

Notes:
[a] Unit Weight assumed based on similar materials encountered for the Flame & Moth DSTF (Tetra Tech 2024).
[b] Moisture Content based on Borehole BH25-FMWR-05 from the Investigation Program (Tetra Tech 2025).
[c] Layer Thickness based on Borehole BH25-FMWR-05 from the Investigation Program (Tetra Tech 2025).
[d] Initial Void Ratio estimated assuming a specific gravity of 2.7 for thawed, ice-rich Glacial Till.
[e] Compression Index assumed based on similar materials encountered for the Flame & Moth DSTF (Tetra Tech 2024).

4.2.3 Earthquake-Induced Deformation

In addition to static deformation, earthquake-induced displacement that undergoes shear deformation during subduction, crustal, and/or intraslab zone interface earthquakes can be estimated based on the simplified procedure proposed by Bray et al. (2017; 2023). The procedure considers the seismic response of a deformable sliding block, using the initial fundamental period of the sliding mass (T_S), the yield coefficient of the sliding mass (k_y), spectral acceleration given the T_S ($S_a(T_S)$), magnitude of earthquake event (M_W), and the peak ground velocity (PGV).

4.2.4 Deformation Analysis Results

Key results from the deformation analyses performed for the Flame & Moth WRSA are discussed below:

- Based on the empirical correlation between thaw strain rate and moisture content, considering the effective layer thickness extending 50% to soil samples above and below, the estimated thaw settlement for Borehole *BH25-FMWR-05* from the Investigation Program is 16 cm.
- The surcharge load at near Borehole *BH25-FMWR-05* was estimated as 382 kPa, assuming a facility height of 20 m, which is considered conservative side for engineering design. The resulting consolidation settlement at Borehole *BH25-FMWR-05* was estimated to be 44 cm.
- The total settlement was calculated by combining the thaw settlement and the consolidation settlement, resulting in an estimated total settlement of 60 cm. The deformation estimation conducted in this study was based on limited available data (i.e., compression index), along with assumptions and parameters derived from past experiences. As more data becomes available, the deformation estimates should be revisited and updated in future design phases.
- Assuming a relatively large 7.5 magnitude earthquake, results from the simplified procedure suggest the seismic deformation would be in the order of 10 cm: displacement along Section A was estimated at approximately 2.9 cm with a probability of exceedance of 5%, and 3.8 cm with a probability of exceedance of 2%. Assumptions for shear wave velocities for the Flame & Moth WRSA were made in absence of in situ field data and could potentially increase the settlement; however, it is not expected to significantly impact the facility and thus would be considered of low consequence.

4.3 Runout Assessment

A runout assessment was performed to estimate the potential distance that waste rock debris from the Flame & Moth WRSA could travel in the event of a failure. The results of this runout assessment are intended to inform AKHM of the potential areas of impact of bench and multi-bench WRSA failures within the downslope environment.

Deep-seated foundation failures of the WRSA (i.e., Section A Global Stability) were not addressed as part of the runout assessment. These types of failures are addressed in Sections 4.1 and 4.2.

The runout assessment consisted of downslope hazard zonation mapping to identify areas located in potential waste rock runout zones based on simplified source areas and empirical propagation assumptions. This assessment does not account for the likelihood of runout occurrence; it inherently assumes that failure and runout will occur.

The following subsections detail the methodology and results of the runout assessment completed for the Flame & Moth WRSA.

4.3.1 Mine Waste Rock Failure Mobility Parameters

Empirical mine waste rock failure data collected as part of the British Columbia Mine Waste Rock Pile Research Committee (BCMWRPRC 1995) was used for the determination of mine waste rock runout mobility parameters. Mine waste rock failure data was grouped into the following two categories based on mobility trends within the database:

1. *High Mobility* or *Normal Mobility (confined)*
2. *Normal Mobility (partially confined)* or *Normal Mobility (unconfined)*

The empirical mine waste rock failure data used in the runout assessment for the Flame & Moth WRSA is presented in Appendix B. Considering the proposed facility geometry (see Section 3.3), the potential for thawed permafrost foundation conditions, a thin organic layer at surface, and potentially saturated foundation conditions, it was assumed that failures originating from the Flame & Moth WRSA could behave similarly to the *High Mobility* mine waste rock failure data.

The runout assessment considered two potential failure mechanisms for the Flame & Moth WRSA: isolated bench failures and multi-bench failures. Potential failure volumes for these mechanisms were estimated based on the Section B and Section C slope stability analyses (see Section 4.1) and the proposed WRSA geometry. Potential failure volumes were used to determine a range of potential mobility cases (i.e., travel angles) based on the mine waste rock failure data (BCMWRPRC 1995). The 10% and 50% exceedance probability (EP) failure scenarios were considered for this runout assessment. Estimated failure volumes and travel angles are presented in Table 4-4.

Table 4-4: Mine Waste Rock Failure Travel Angles for the Flame & Moth WRSA

Mine Waste Rock Failure Mechanism [1]	Exceedance Probability	Estimated Failure Volume (m^3)	Travel Angle (°)
Multi-bench	50%	60,000	20
	10%	60,000	14
Bench	50%	2,000	30
	10%	2,000	22

[1] *A global failure mechanism along Section A (longitudinal direction) was assessed but estimates did not result in failure debris exiting outside of the Flame & Moth WRSA footprint. Only cases where failure debris could impact areas outside of the facility footprint were included in the runout assessment results.*

4.3.2 Runout Assessment Results

The results from the runout assessment for the Flame & Moth WRSA are presented as downslope hazard zonation on Figure B3 in Appendix B. Downslope hazard zonation for the 50% and 10% EPs are shown.

The modelling results for the 50% EP failure scenario showed that failure debris could travel an average of 5 m from the toe of the Flame & Moth WRSA in most directions. However, debris could travel could up to approximately 35 m from the toe of the facility in the northeast corner due to steeper downslope topography.

The modeling results for the 10% EP failure scenario showed that failure debris could travel an average of 10 m from the toe of Flame & Moth WRSA in most directions. However, debris could travel up to approximately 55 m from the toe of the facility in the northeast corner due to steeper downslope topography. Failure debris from the 10% EP scenario could also travel up to a maximum of 85 m from the toe of the facility along the west side.

It should be noted that modelled travel angle relationships are based on published empirical data values. The failure database was for large, end-dumped mine waste rock piles and may overestimate runout extents for smaller facilities.

4.4 Hydrotechnical Analysis

A digital elevation model (DEM) surface for the Flame & Moth WRSA was created by merging the proposed facility's design surface over the existing LiDAR data collected on June 9, 2025. Both datasets served as the basis for the hydrotechnical analysis performed for the facility which was conducted using the software *Personal Computer Storm Water Management Model* (PCSWMM) developed by Computational Hydraulics Inc.

4.4.1 Design Storm Events

For storms of 2-hour duration or less, the design rainfall was uniformly distributed. For storms longer than 2 hours, an SCS (Soil Conservation Service) *Type II* rainfall distribution was used. Using uniform distribution for 1-hour and 2-hour storms is deemed more appropriate as SCS rainfall distributions are not intended for such short durations, which otherwise result in unrealistically high intensities.

Given the SCS rainfall distribution curves are intended for the United States, and in the absence of an actual distribution map for Canada, the rainfall distribution representative of the Flame & Moth WRSA was determined by comparing SCS rainfall distribution curves from adjacent US states to storm data from the Mine. The following curves were used for comparison based on the shape of distribution, all having a duration of 24 hours:

- SCS *Type II* is representative of areas in the western United States that are east of the Rockies. It also extends to the prairie provinces in Canada by geography.
- SCS *Type IA* is representative of areas on the west coast of United States and Canada, namely Washington, Oregon, northern California, and British Columbia.
- SCS *Type I* is representative of most areas in Alaska.
- Significant rainfall events recorded at the Mine's *District Mill* climate station included the following storm events (sorted by descending depths):
  - August 9, 2021 = 27.2 mm in 24 hours
  - February 13, 2021 = 25.4 mm in 24 hours
  - August 4, 2021 = 24.4 mm in 24 hours
  - August 16, 2013 = 19.5 mm in 24 hours
  - January 18, 2021 = 13.0 mm in 24 hours

The above rainfall data was selected as it represents the more extreme events in the data available. Figure 4-1 presents a comparison of the SCS rainfall curves against actual rainfall data for the Mine. Many of the actual rainfall curves resemble a peak similar to the SCS *Type II* distribution, which affirms its use for design storm events for the Flame & Moth WRSA.

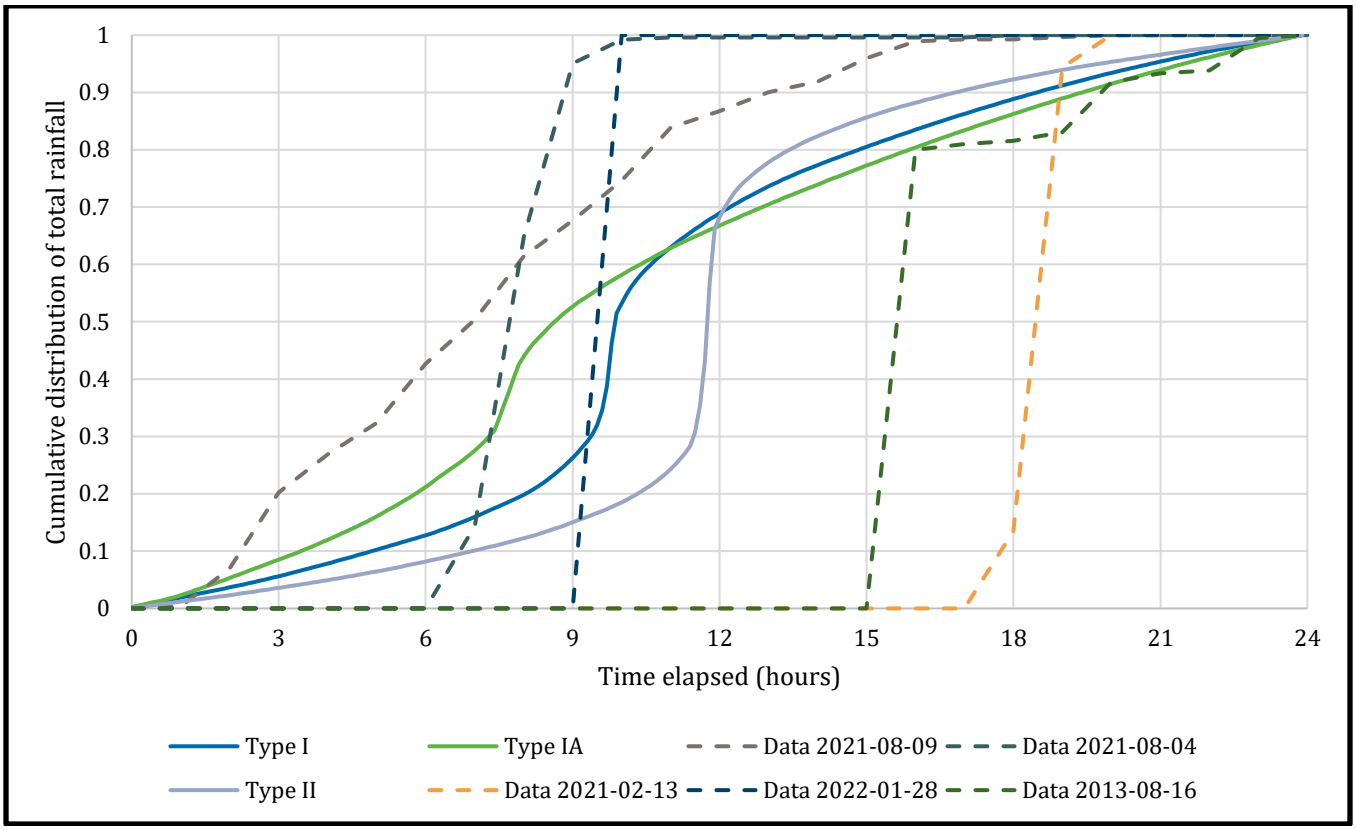

Figure 4-1: Comparison of SCS Rainfall Curves Versus Actual Rainfall Data by Cumulative Distribution

4.4.2 Catchment Area

The catchment area for the Flame & Moth WRSA, as depicted below in Figure 4-2, was delineated using the watershed delineation tool in PCSWMM. The spatial extents of the catchment area is approximately 0.1179 km^2 (11.79 ha). Per Table 6-2 in the *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023), the minimum design flood event criteria for a *Class I* mine rock management facility is 200-year AEP design flood.

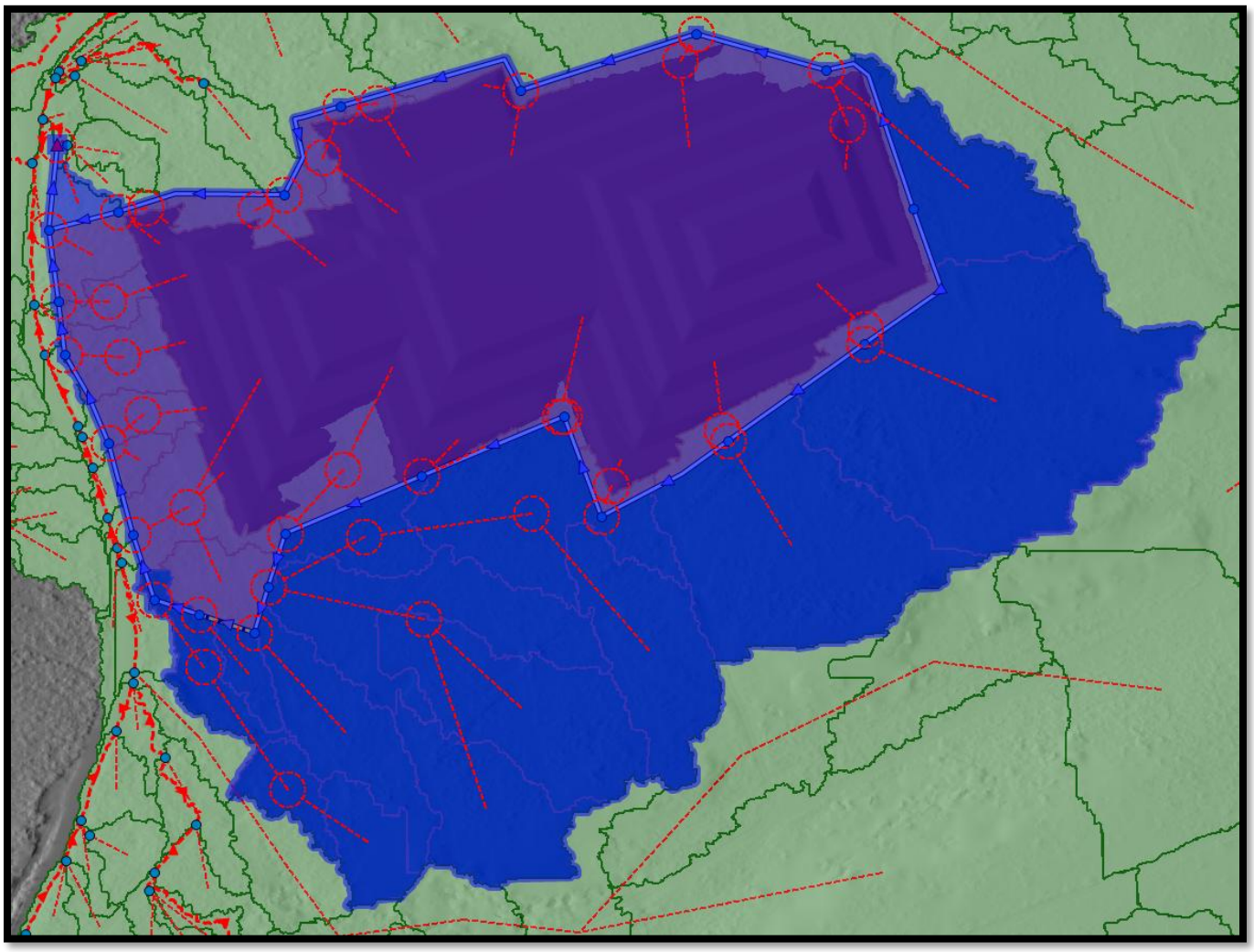

Figure 4-2: Catchment Area for the Flame & Moth WRSA (shown in blue)

4.4.3 Hydrological Model Development

The contributing catchments within the catchment area for the Flame & Moth WRSA were adjusted based on existing and proposed land uses, while maintaining natural drainage boundaries. Parameters used for development of the hydrological model were determined for the different land use types based on the following references:

- SCS Hydrologic Soil Type:
  - *HYSOGs250m*, a global gridded dataset of hydrologic soil groups where soil types for the Mine area are considered Type C (Ross et al. 2018), as summarized in Table 4-5.
- Overland flow roughness (or Manning's 'n') Values:
  - *FHWA HIF-24-007 Highway Hydrology, Third Edition* (Kilgore et al. 2024).
- Depression Storage:
  - *Design and Construction of Urban Stormwater Management Systems* (WEF and ASCE 1992).

- SCS Curve Numbers:
  - *TR-55 Urban Hydrology for Small Watersheds* (USDA 1986).

Table 4-5: Soil Conservation Service Hydrological Soil Types

SCS Hydrologic Soil Type	SCS Hydrologic Soil Description	Infiltration Rate (mm/hour)
A	Sand, loamy sand, or sandy loam	> 7.62
B	Silt loam or loam	3.81 to 7.62
C	Sandy clay loam	1.27 to 3.81
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay	0 to 1.27

Three primary land use types were identified within the catchment area for the Flame & Moth WRSA, namely:

- Forested (i.e., undisturbed land surrounding the facility)
- Cleared (i.e., disturbed land surrounding the facility)
- WRSA

Table 4-6 summarizes the soil attribute values estimated for each land use type based on the references above.

Table 4-6: Hydrological Modelling Parameters for the Flame & Moth WRSA

Land Use Type	Impervious (%)	Manning's 'n' Value		Depression Storage (mm)		Curve Number (CN)
		Impervious	Pervious	Impervious	Pervious	
Forested	0	0.01	0.4	2	8	77
Cleared	25	0.01	0.02	2	5	87
WRSA	75	0.01	0.02	2	2	90

The conveyance system in the model, which consists of ditches and a culvert under road, are based on the facility's geometry (see Section 3.3), as illustrated on Figure 4-3. Gradients were determined based on the surrounding topography using the following common parameters:

- Ditches:
  - Shape: Trapezoidal
  - Bottom Width: 1.0 m
  - Depth: 1.0 m
  - Sideslopes: 1.5H:1V
  - Hydraulic Roughness assumed to be 0.035 (e.g., lined with liners and riprap)
- Culverts (corrugated steel pipe or HDPE):
  - Diameter: 600 mm
  - Hydraulic Roughness assumed to be 0.024

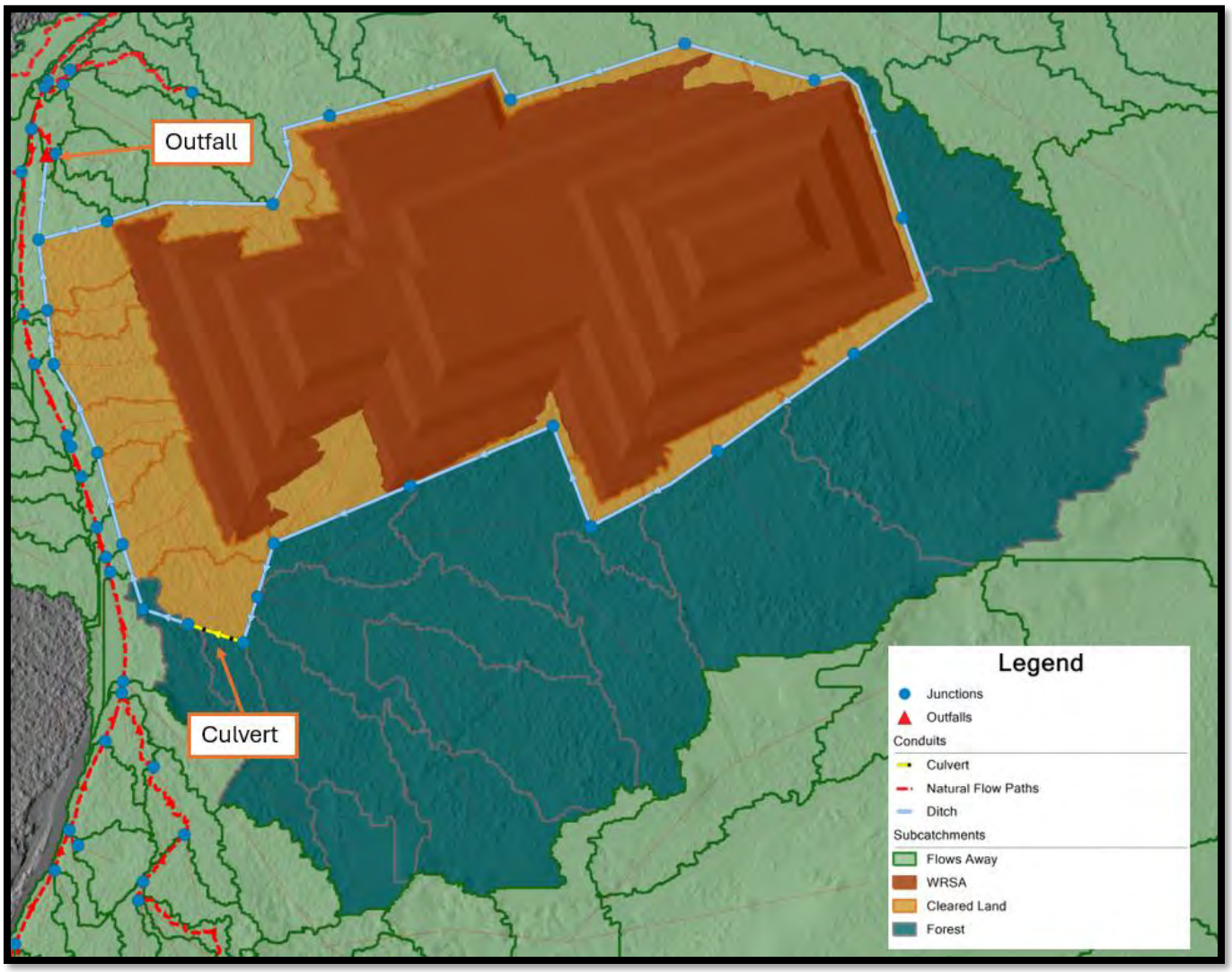

Figure 4-3: Hydrological Model for the Flame & Moth WRSA

4.4.4 Hydrotechnical Analysis Results

Peak discharges at the culvert and riprap apron (i.e., outfall) for the Flame & Moth WRSA were initially modelled for all design storm events, as presented in Figure 4-4. The 5-minute (or instantaneous) storm event yielded the highest modelled maximum discharges, at 0.98 m^3/s and 2.47 m^3/s at the culvert and riprap apron, respectively. Based on this, the 5-minute storm event was selected as the design storm event for evaluating the Flame & Moth WRSA and its associated surface water conveyance system.

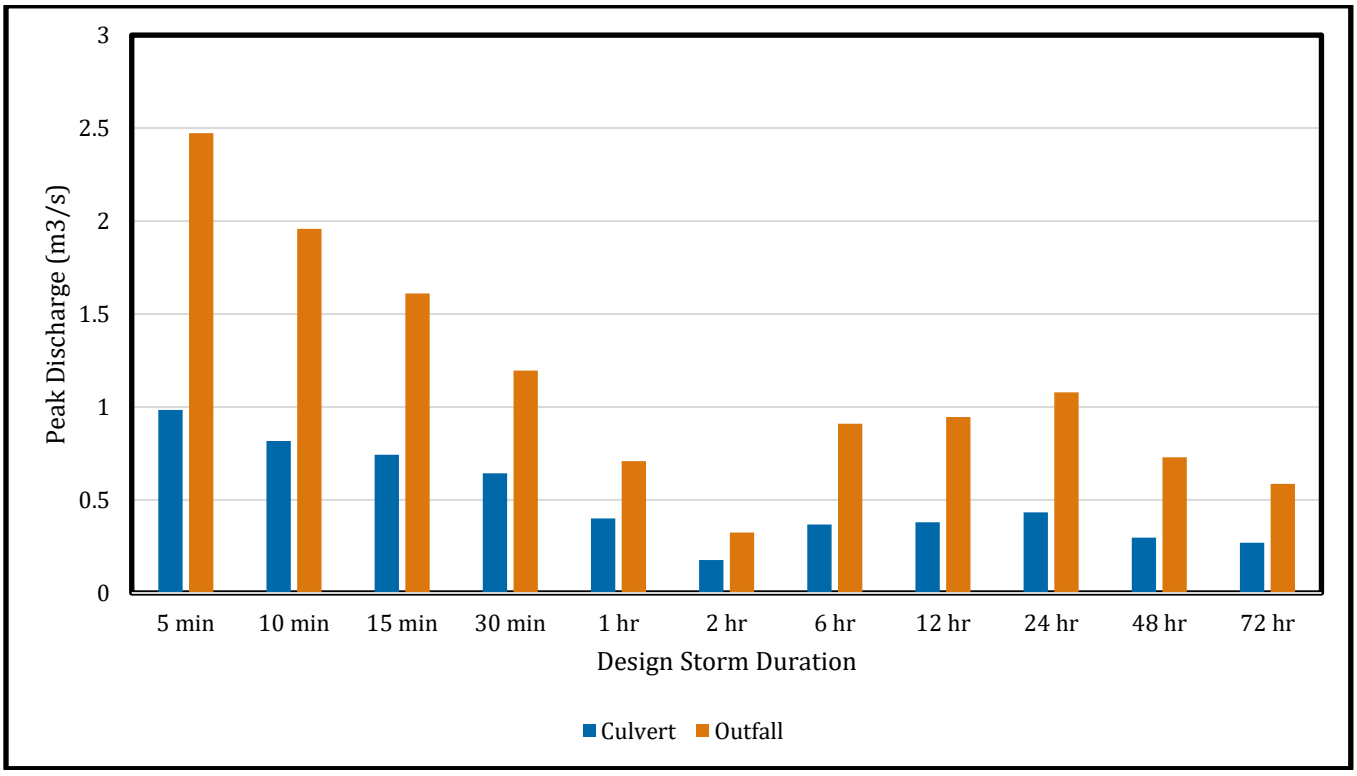

Figure 4-4: Peak Discharges at the Culvert and Outfall for the Flame & Moth WRSA

Figure 4-5 depicts the proposed surface water conveyance system for the Flame & Moth WRSA, which consists of perimeter ditching around the facility and along the access road to the west.

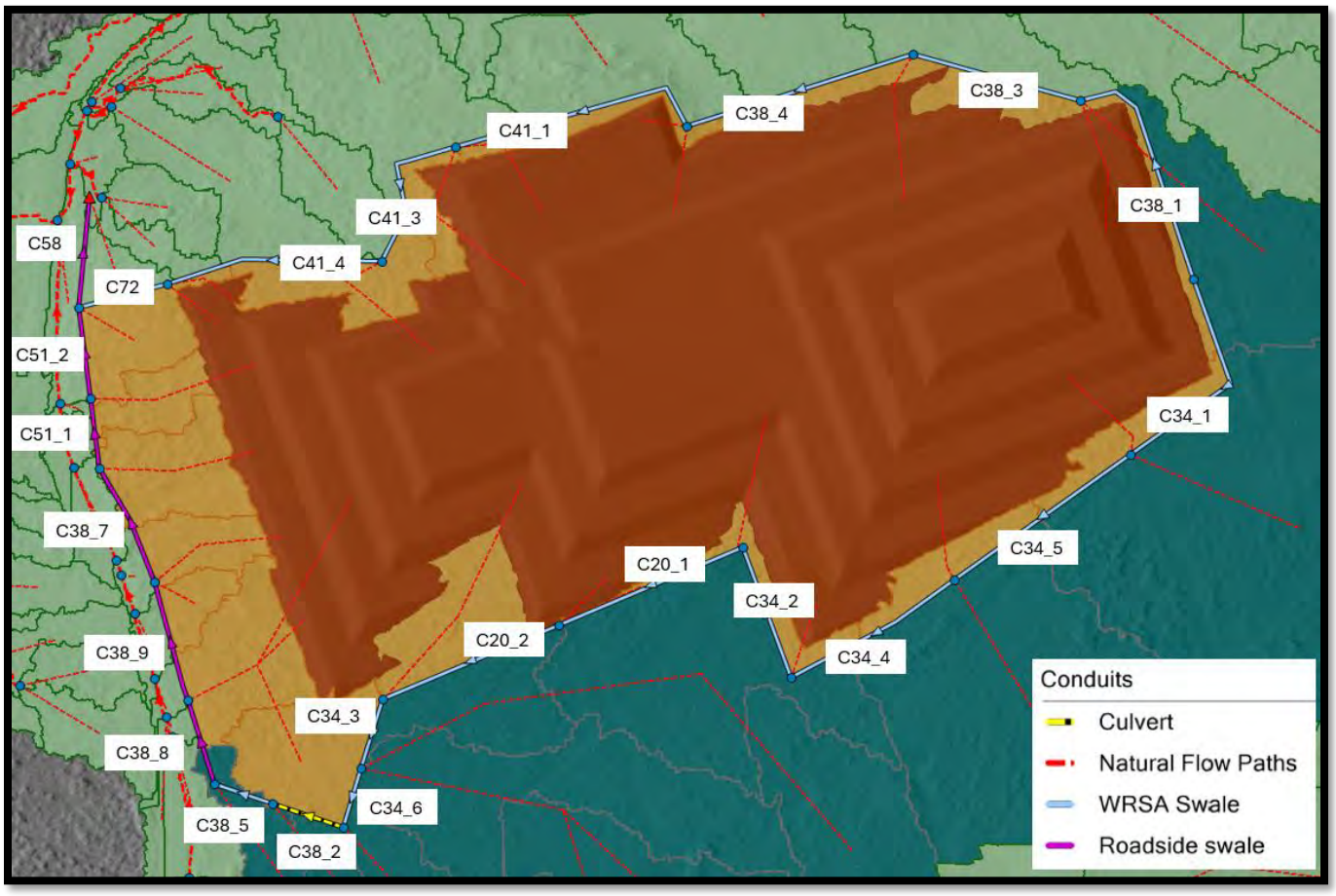

Figure 4-5: Overview of the Flame & Moth WRSA Surface Water Conveyance System

Modelling of the Flame & Moth WRSA's surface water conveyance system under the 200-year, 5-minute design storm event shows that all conduit sections are able to convey the peak runoff discharge without flooding. The hydrological modelling results, including maximum discharge, velocity, and depth, are summarized in Table 4-7.

Table 4-7: Hydrological Modelling Results for the Flame & Moth WRSA

Area	Name	Type	Slope (m/m)	Maximum Discharge (m^3/s)	Maximum Velocity (m/s)	Maximum Depth (m)
North Side of Facility	C38_1	ditch	0.056	0.00	0.00	0.045
	C38_3	ditch	0.126	0.18	1.03	0.143
	C38_4	ditch	0.054	0.47	1.48	0.240
	C41_1	ditch	0.028	0.64	1.67	0.278
	C41_3	ditch	0.058	0.82	2.37	0.248
	C41_4	ditch	0.145	0.98	3.7	0.203
	C72	ditch	0.407	1.01	2.05	0.390
South Side of Facility	C34_1	ditch	0.046	0.00	0.00	0.045
	C34_5	ditch	0.062	0.15	1.12	0.113
	C34_4	ditch	0.100	0.31	1.79	0.143
	C34_2	ditch	0.061	0.34	1.35	0.195
	C20_1	ditch	0.077	0.75	2.61	0.218
	C20_2	ditch	0.142	0.77	1.18	0.405
	C34_3	ditch	0.002	1.00	0.89	0.593
	C34_6	ditch	0.002	0.99	1.13	0.503
	C38_2	culvert	0.156	0.99	6.27	0.330
	C38_5	ditch	0.148	0.99	3.03	0.240
Roadside	C38_8	ditch	0.090	0.99	1.81	0.368
	C38_9	ditch	0.015	1.30	1.80	0.435
	C38_7	ditch	0.035	1.34	1.92	0.428
	C51_1	ditch	0.020	1.41	1.61	0.503
	C51_2	ditch	0.012	1.45	1.36	0.570
	C58	ditch	0.022	2.47	2.14	0.608

It should be noted that the most downstream section of the Flame & Moth WRSA (North Side of Facility, Conduit C72), as well as other downstream sections (Roadside, Conduits C51_1, C51_2, C58), convey the peak discharge with available freeboards less than 300 mm. It is therefore recommended that the entire roadside ditching, as well as the most downstream sections of WRSA ditching, have a minimum depth of 1.0 m for sufficient freeboard.

The velocities in the swales and culverts generally exhibit high values, indicating high potential for erosion. Particular attention should be given to the culvert location, which is modelled to have a maximum velocity of 6.27 m/s. Based on guidance from the *BC Supplement to TAC Geometric Design Guide* (BC MoTI 2019), it is recommended that a riprap apron or stilling basin be placed at the culvert's outlet, protected with minimum class 250 kg riprap at a thickness of 1.0 m and length of 2.4 m (i.e., four times the culvert diameter).

5.0 DESIGN SUMMARY

Engineering design for the Flame & Moth WRSA was completed based on the site conditions, design basis and criteria, and engineering analyses detailed in this design report. Plan and profile views illustrating the facility's design are provided in the Design Drawings (see Design Drawings section).

A summary of the engineering design for the Flame & Moth WRSA is provided below:

- Tetra Tech reviewed and assigned a facility classification of *Class I* for the Flame & Moth WRSA, per the *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023). To maintain this classification, ice-rich permafrost soils and massive ground ice will be avoided from within the facility's foundation. Ice-poor permafrost soils under critical elements of the facility's foundation (e.g., lower bench toes) will need to be removed and replaced with thaw-stable materials. The current design includes a 40 m-wide by 2 m-deep subexcavation along the western toe of the facility to remove ice-poor permafrost soils and replace them with mine waste rock.
- The design geometry of the facility includes an ultimate shell with an overall resultant sideslope gradient of 3H:1V to a maximum elevation of +925.0 m. The facility is designed to have interim benching consisting of 10.8 m-wide by 6 m-high benches with 1.25H:1V sideslopes. Progressive flattening of the interim sideslopes to the overall resultant sideslopes may be completed during facility development as opposed to construction of discrete benches.
- The Flame & Moth WRSA design considered three storage option scenarios:
  - Stage 1 = 125,000 T (~62,500 m^3)
  - Stage 2 = 400,000 T (~200,000 m^3)
  - Stage 3 = 684,000 T (~342,000 m^3)
  - The facility design includes a staged approach for storage capacity to account for growth during subsequent development.
- Slope stability analysis results for the Flame & Moth WRSA indicate the FS for frozen and unfrozen subsurface conditions met the minimum design criteria, per the *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023).
- Thaw and consolidation settlement for the facility was estimated to be up to 60 cm, assuming ice-rich permafrost soils underly the facility's foundation. Subexcavation of permafrost soils within the facility's footprint will reduce the risk of settlement and associated deformation. Earthquake-induced deformations were estimated to up to 10 cm.
- Runout assessment results for the Flame & Moth WRSA indicated that failure debris could extend up to 21 m and 85 m from the toe of the facility for the 50% EP and 10% EP failure scenarios, respectively. The empirical database used for estimates was for large, end-dumped mine waste rock piles and may overestimate runout extents for smaller facilities.
- Hydrotechnical analysis resulted in selection of a design storm event with 200-year AEP and duration of 5 minutes for design of the facility, per the *Guidelines for Mine Waste Management Facilities* (YG-EMR 2023). The storm duration was selected because it resulted in the largest peak instantaneous flows for the facility. A surface water conveyance system, including ditching and culverts, has been designed to accommodate a design flood of 0.98 m^3/s.
- The facility is located within an area containing ice-poor permafrost soils based on findings from the Investigation Program (Tetra Tech 2025). If the facility is to be expanded or developed outside of the current

design footprint, additional geotechnical investigation work will be required to confirm subsurface conditions and review the facility classification.

6.0 CLOSURE

We trust this design report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

FILE: 704-ENG.WARC04673-07.500
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DESIGN DRAWINGS

Drawing 010	Cover Sheet & Drawing List
Drawing 011	Foundation Preparation and Haul Road Site Plan
Drawing 012	Stage 1 Site Plan
Drawing 013	Stage 2 Site Plan
Drawing 014	Stage 3 Site Plan
Drawing 015	Waste Rock Storage Area Profile Views A & B
Drawing 016	Waste Rock Storage Area Profile Views C & D
Drawing 017	Haul Road Profile View
Drawing 018	Haul Road Cross Section Views
Drawing 019	Haul Road Cross Section Views
Drawing 020	Typical Details

Hecla SM
KENO HILL

FLAME & MOTH MINE
WASTE ROCK STORAGE AREA
DETAILED (100%) DESIGN

KENO HILL SILVER DISTRICT, YUKON TERRITORY

ISSUED FOR USE
JULY 31, 2025

SHEET NUMBER	REV	DATE (YYYY-MM-DD)	SHEET TITLE
010	0	2025-07-31	COVER SHEET & DRAWING LIST
011	0	2025-07-31	FOUNDATION PREPARATION AND HAUL ROAD - SITE PLAN
012	0	2025-07-31	STAGE 1 - SITE PLAN
013	0	2025-07-31	STAGE 2 - SITE PLAN
014	0	2025-07-31	STAGE 3 - SITE PLAN
015	0	2025-07-31	WASTE ROCK STORAGE AREA PROFILE VIEWS A & B
016	0	2025-07-31	WASTE ROCK STORAGE AREA PROFILE VIEWS C & D
017	0	2025-07-31	HAUL ROAD PROFILE VIEW
018	0	2025-07-31	HAUL ROAD CROSS SECTION VIEWS
019	0	2025-07-31	HAUL ROAD CROSS SECTION VIEWS
020	0	2025-07-31	TYPICAL DETAILS

TETRA TECH

COVER SHEET & DRAWING LIST

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
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DATE: July 31, 2025	SHEET No. 1 of 11	DWN CC	APP GDK	STATUS IFU	

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PROPOSED WRSA EXTENTS

PROPOSED RIPRAP APRON

SUBEXCAVATE ICE-POOR PERMAFROST SOILS AND REPLACE WITH WASTE ROCK TO A MINIMUM OF 2m BELOW GROUND SURFACE (TO BE FIELD VERIFIED)

PROPOSED 600mm CSP OR HDPE
30m @ 12%
INLET INVERT ELE. 877.75m
OUTLET INVERT ELE. 874m
(SEE DRAWING 020, DETAILS B & C)

EXISTING EDGE OF ROAD

PROPOSED DRAINAGE SWALE (SEE DRAWING 020, DETAIL A)

PROPOSED WRSA HAUL ROAD (SEE DRAWING 020, DETAIL A)

PROPOSED 600mm CSP OR HDPE
50m @ 6%
INLET INVERT ELE. 888m
OUTLET INVERT ELE. 885m
(SEE DRAWING 020, DETAILS B & C)

VEGETATION STOCKPILE

OVERBURDEN STOCKPILE

BH25-FMWR-01
BH25-FMWR-02
BH25-FMWR-03
BH25-FMWR-04
BH25-FMWR-05
BH25-FMWR-06
BH25-FMWR-07
BH25-FMWR-08
BH25-FMWR-09
BH25-FMWR-10
BH25-FMWR-11
BH25-FMWR-12
BH25-FMWR-13
BH25-FMWR-14

0 50 m
Scale: 1: 1 250

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.
3. IMAGE SHOWN FROM MAY 16, 2025.

LEGEND:

- UNFROZEN SOILS
- INTERPRETED MASSIVE ICE
- INTERPRETED ICE-RICH SOILS
- INTERPRETED ICE-POOR SOILS
- INTERPRETED HIGHLY WEATHERED BEDROCK
- 2025 BOREHOLES (Tetra Tech 2025)

HAUL ROAD QUANTITIES

ITEM	VOLUME (m³)	FOOTPRINT AREA (m²)
ROAD SURFACING AGGREGATE	1,020	
NAML WASTE ROCK EMBANKMENT FILL	14,680	
BIAXIAL GEOGRID		6,600

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON
GARY KOOP
TERRITORY
2025-07-31

PROFESSIONAL SEAL

CLIENT: SM Hecla KENO HILL

TETRA TECH

FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

FOUNDATION PREPARATION AND HAUL ROAD SITE PLAN

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04573-07	KELOWNA	CC	TB	0	011
DATE: July 31, 2025	SHEET No. 2 of 11	DWN CC	APP GDK	STATUS IFU	

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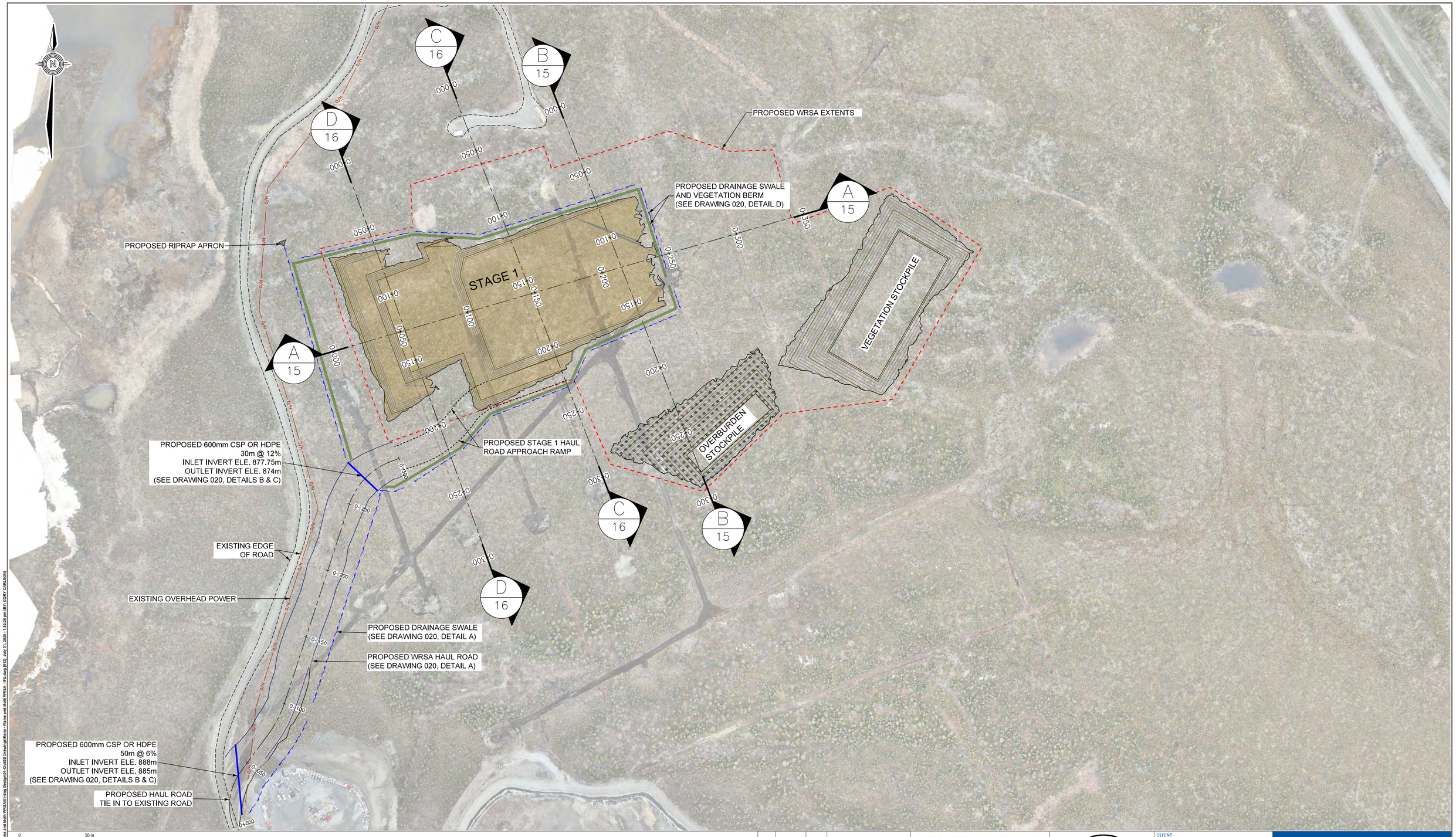

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.
3. IMAGE SHOWN FROM MAY 16, 2025.

WRSA STORAGE CAPACITY

STAGE	WASTE ROCK (m³)	FOOTPRINT AREA (m²)	OVERBURDEN (m³)	VEGETATION (m³)
STAGE 1	78,000	21,660	6,500	47,500
STAGE 2	209,000	41,600	12,480	
STAGE 3	339,000	44,900	22,000	

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON TERRITORY
GARY KOOP
2025-07-31

PROFESSIONAL SEAL

CLIENT
Hecla KENO HILL SM

TETRA TECH

FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

STAGE 1
SITE PLAN

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-07	KELOWNA	CC	TB	0	012
DATE: July 31, 2025	SHEET No. 3 of 11	DWN CC	APP GDK	STATUS IFU	

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0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON
GARY KOOP
TERRITORY
2025-07-31

PROFESSIONAL SEAL

CLIENT
Hecla KENO HILL SM

TETRA TECH

FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

STAGE 2
SITE PLAN

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-07	KELOWNA	CC	TB	0	013
DATE: July 31, 2025	SHEET No. 4 of 11	DWN CC	APP GDK	STATUS IFU	

D:\Projects\Hecla Keith\704-ENG.WARC04673-07 Keno Flame and Moth WRSA\01-Eng Design\2-Civil\3D Drawings\Keno - Flame and Moth WRSA - PT.dwg [013] July 31, 2025 - 1:52:58 pm (BY: CORY CARLSON)



NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.
3. IMAGE SHOWN FROM MAY 16, 2025.

WRSA STORAGE CAPACITY

STAGE	WASTE ROCK (m³)	FOOTPRINT AREA (m²)	OVERBURDEN (m³)	VEGETATION (m³)
STAGE 1	78,000	21,660	6,500	47,500
STAGE 2	209,000	41,600	12,480	
STAGE 3	339,000	44,900	22,000	

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER YUKON TERRITORY GARY KOOP
2025-07-31

PROFESSIONAL SEAL

CLIENT
Hecla KENO HILL SM

TETRA TECH

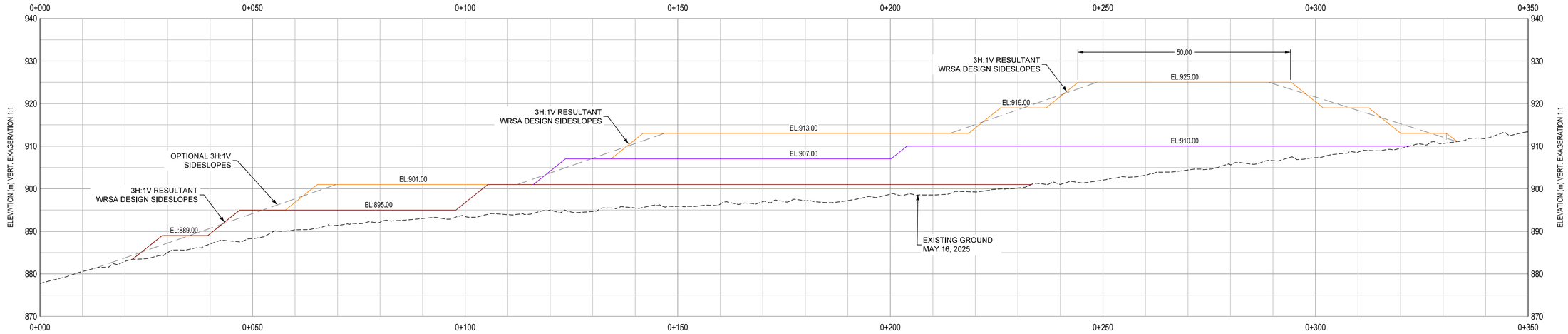
FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

STAGE 3
SITE PLAN

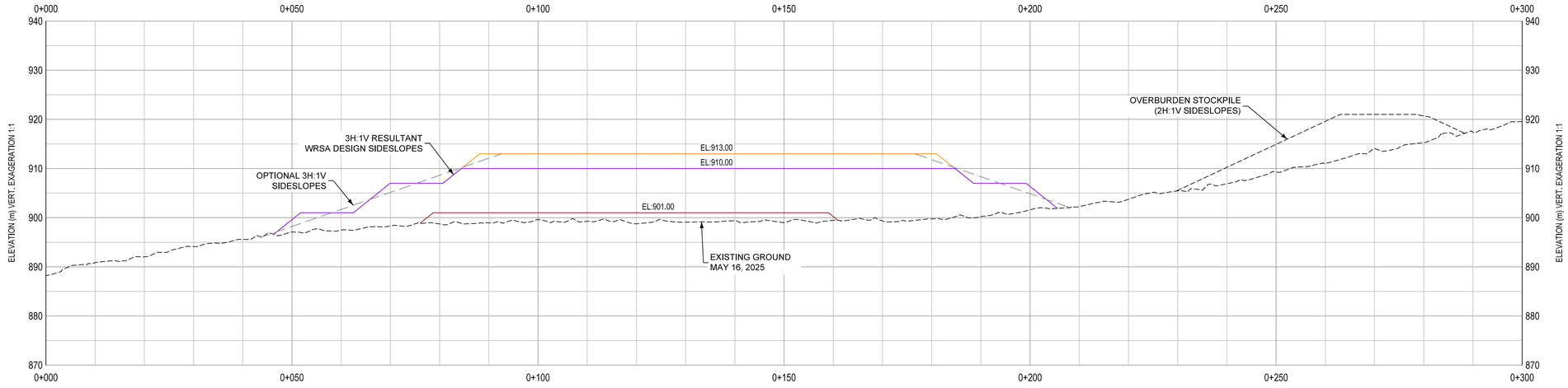
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-07	KELOWNA	CC	TB	0	014
DATE: July 31, 2025	SHEET No. 5 of 11	DWN CC	APP GDK	STATUS IFU	

D:\Projects\Hecla Keith\704-ENG.WARC04673-07 Keno Flame and Moth WRSA\01-Eng Design\2-Civil\3-Design\Keno - Flame and Moth WRSA - PT.dwg [014] July 31, 2025 - 15:13:1 pm (BY: CORY CARLSON)

PROFILE VIEW: SECTION A



PROFILE VIEW: SECTION B



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Scale: 1: 500

NOTES:
1. BENCHES CAN BE GRADED TO AN OPTIONAL SIDESLOPE OF 3H:1V DURING OPERATIONS IF REQUIRED

LEGEND:
STAGE 1
STAGE 2
STAGE 3

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon
PERMIT

PROFESSIONAL ENGINEER
YUKON TERRITORY
GARY KOOP
2025-07-31
PROFESSIONAL SEAL

CLIENT
SM
Hecla KENO HILL
TETRA TECH

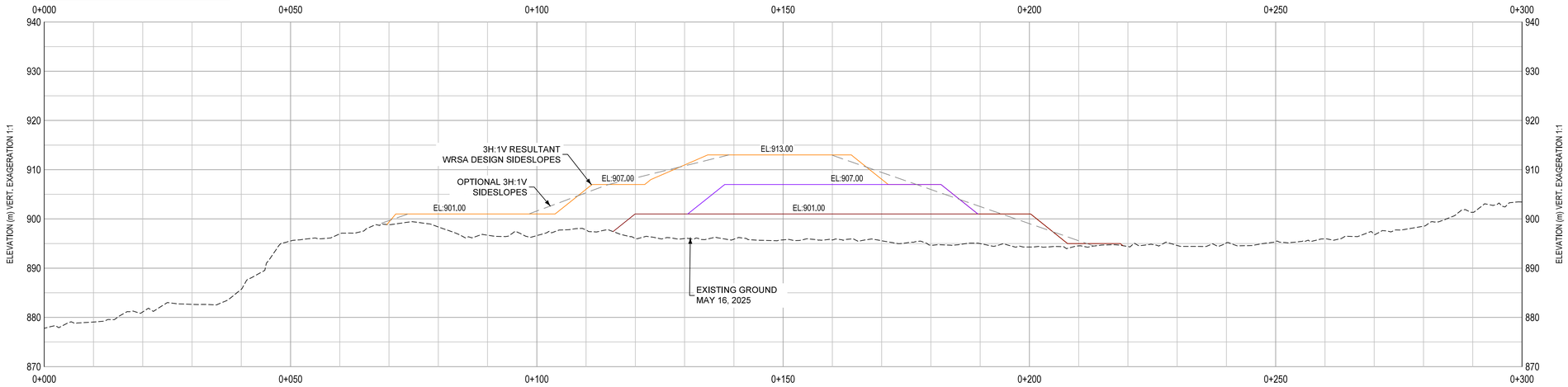
FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

WASTE ROCK STORAGE AREA
PROFILE VIEWS A & B

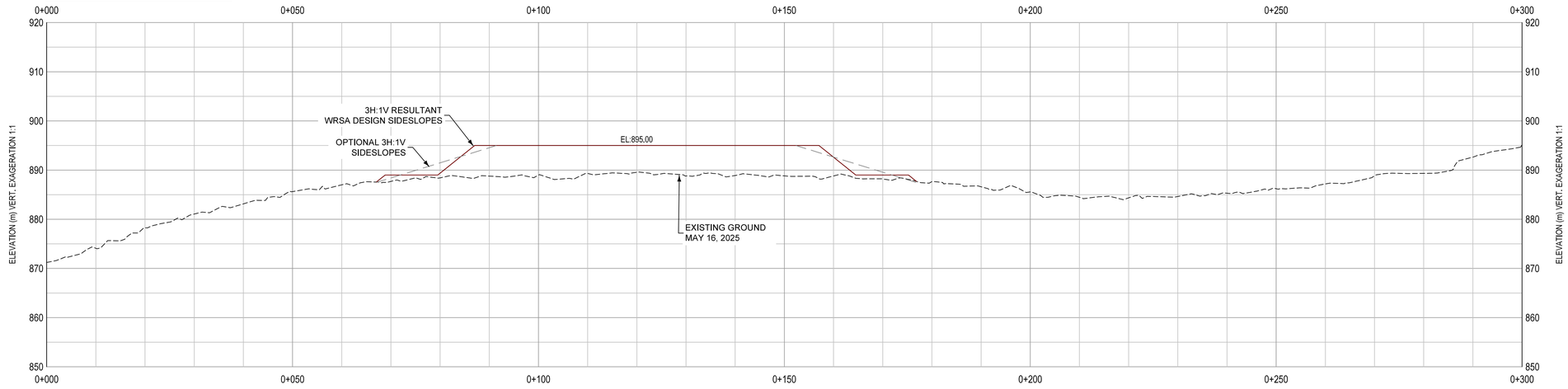
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04573-07	KELOWNA	CC	TB	0	015
DATE: July 31, 2025	SHEET No. 6 of 11	DWN CC	APP GDK	STATUS IFU	

D:\Projects\Tetra Tech\704-ENG.WARC04573-07 Keno Flame and Moth WRSA\4-Eng Design\3-Civil\3D Drawings\Keno - Flame and Moth WRSA - 15Jul.dwg [015] July 31, 2025 - 1:51:36 pm (BY: CORY.CARLSON)

PROFILE VIEW: SECTION C



PROFILE VIEW: SECTION D



0 25 m
Scale: 1: 500

NOTES:
1. BENCHES CAN BE GRADED TO AN OPTIONAL SIDESLOPE OF 3H:1V DURING OPERATIONS IF REQUIRED

LEGEND:
STAGE 1
STAGE 2
STAGE 3

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon
PERMIT

PROFESSIONAL ENGINEER
YUKON
GARY KOOP
TERRITORY
2025-07-31
PROFESSIONAL SEAL

CLIENT
Hecla KENO HILL SM

FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

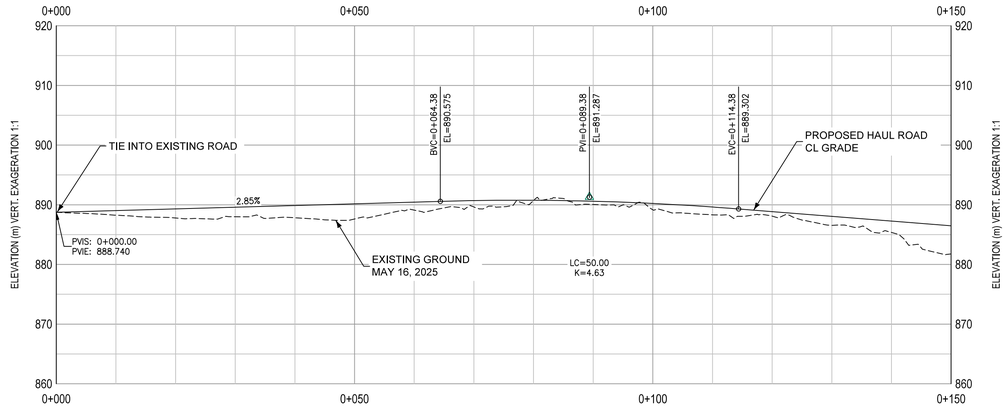
WASTE ROCK STORAGE AREA
PROFILE VIEWS C & D

TETRA TECH

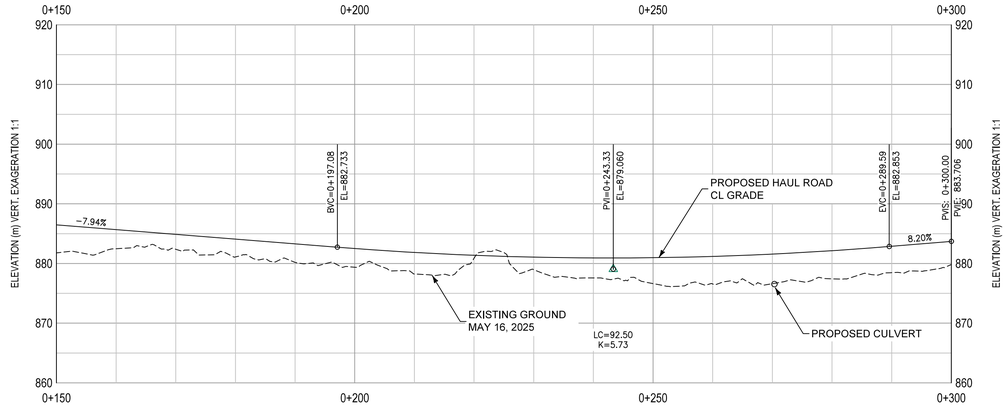
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04573-07	KELOWNA	CC	TB	0	016
DATE: July 31, 2025	SHEET No. 7 of 11	DWN CC	APP GDK	STATUS IFU	

D:\Projects\Tetra Tech\704-ENG.WARC04573-07 Keno Flame and Moth WRSA\4-Eng Design\5-Civil\3D Drawings\Keno - Flame and Moth WRSA - IFU.dwg [016] July 31, 2025 - 1:51:25 pm (BY: CORY.CARLSON)

PROFILE VIEW: HAUL ROAD DESIGN



PROFILE VIEW: HAUL ROAD DESIGN



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Scale: 1: 500

LEGEND:

EXISTING GROUND ----------

PROPOSED GRADE ——————

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON
GARY KOOP
TERRITORY
2025-07-31

PROFESSIONAL SEAL

CLIENT
Hecla KENO HILL SM

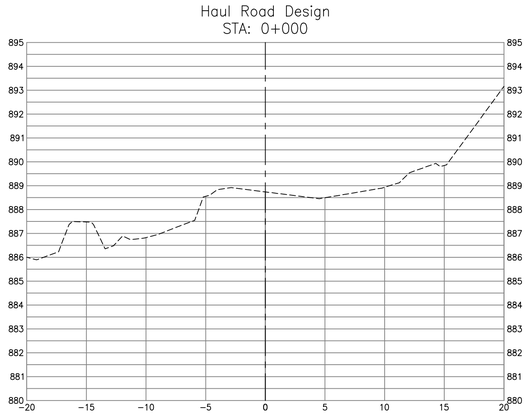
TETRA TECH

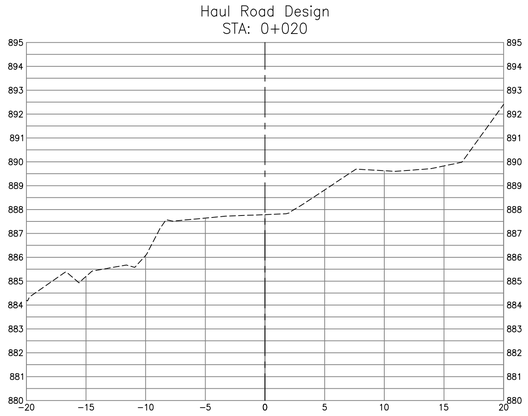
FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

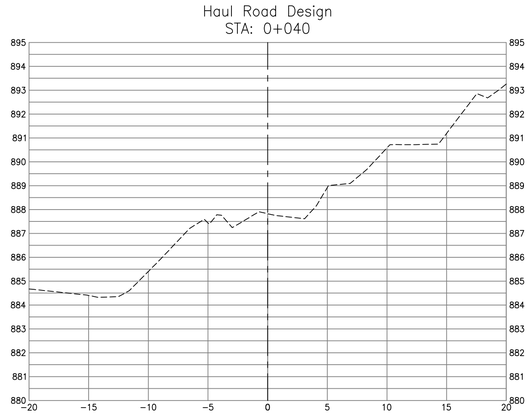
HAUL ROAD
PROFILE VIEW

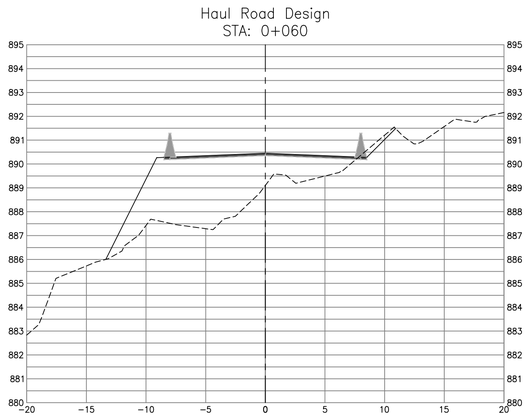
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04573-07	KELOWNA	CC	TB	0	017
DATE: July 31, 2025	SHEET No. 8 of 11	DWN CC	APP GDK	STATUS IFU	

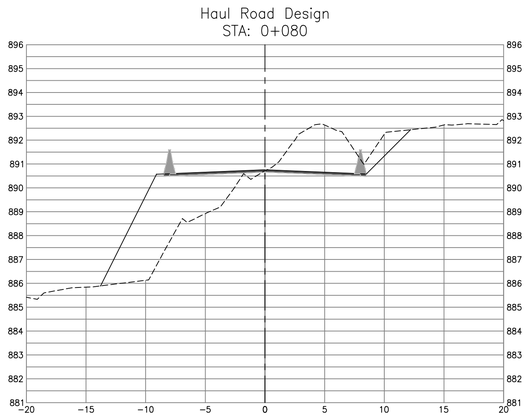
D:\Projects\Tetra Tech\704-ENG.WARC04573-07 Keno Flame and Moth WRSA\4-Eng Design\5-CAD\3D Drawings\Keno - Flame and Moth WRSA - IFU.dwg [017] July 31, 2025 - 1:51:14 pm (BY: CORY.CARLSON)

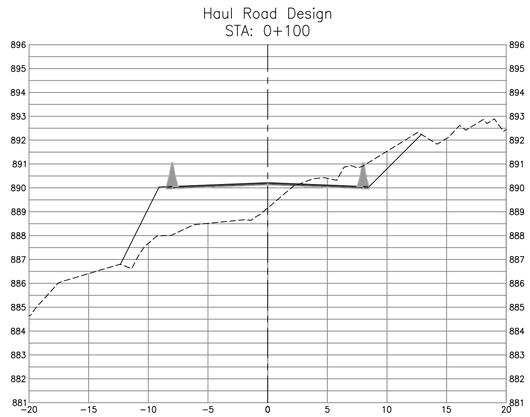


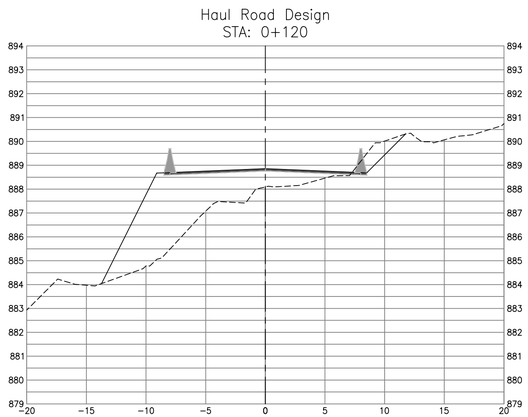


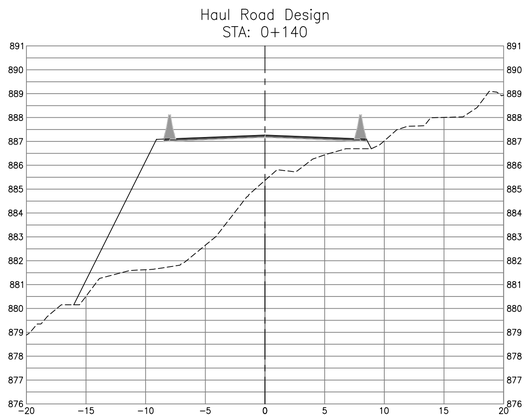


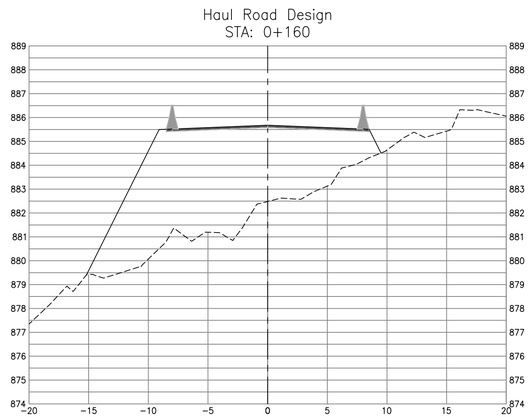












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Scale: 1: 250

LEGEND:

EXISTING GROUND

PROPOSED GRADE

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON
GARY KOOP
TERRITORY
2025-07-31

PROFESSIONAL SEAL

CLIENT
Hecla KENO HILL SM

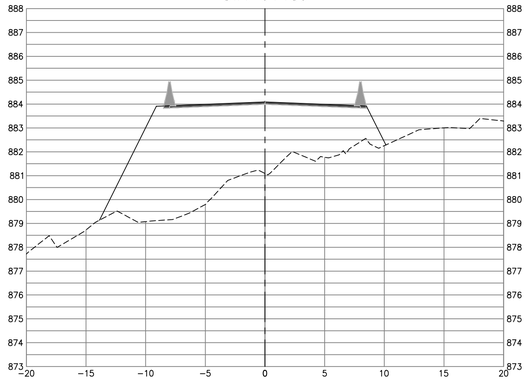
TETRA TECH

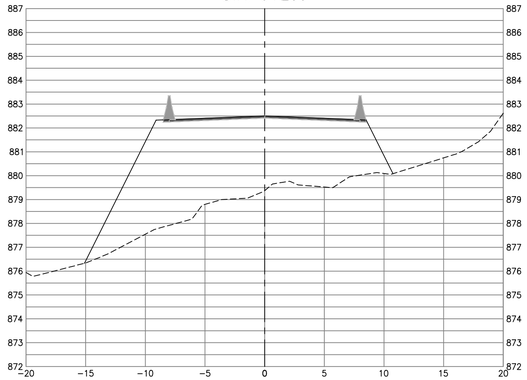
FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

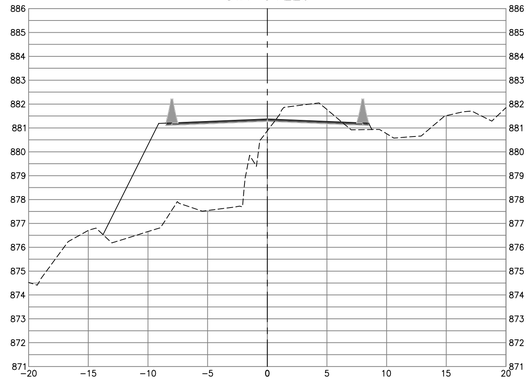
HAUL ROAD
CROSS SECTION VIEWS

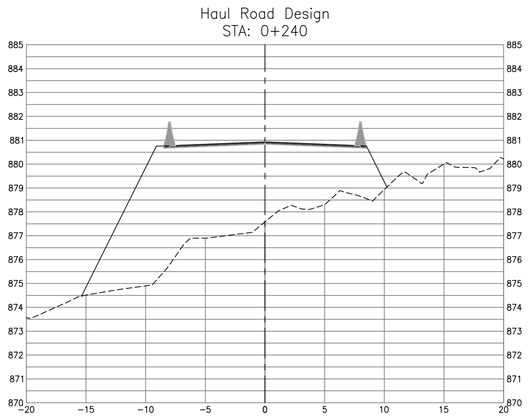
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-07	KELOWNA	CC	TB	0	018
DATE:	SHEET No.	DWN	APP	STATUS	
July 31, 2025	9 of 11	CC	GDK	IFU	

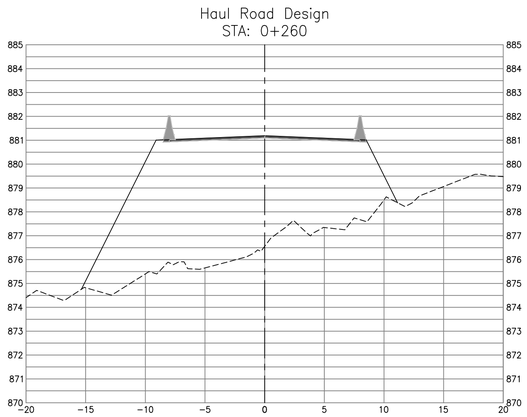
D:\Projects\Tetra Tech\704-ENG.WARC04673-07 Keno Flame and Moth WRSA\04-Eng Design\02-CivilD Drawings\Keno - Flame and Moth WRSA - PFD.dwg [018] - July 31, 2025 - 1:51:01 pm (By: CGNY CARLSON)

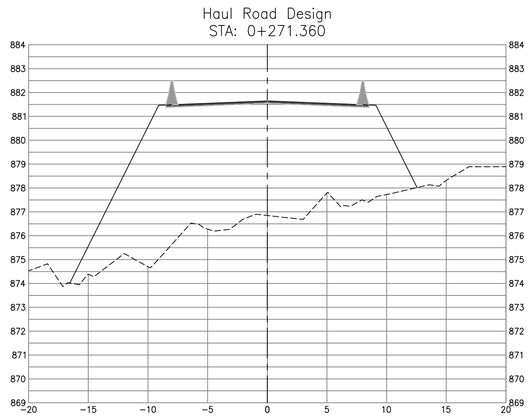


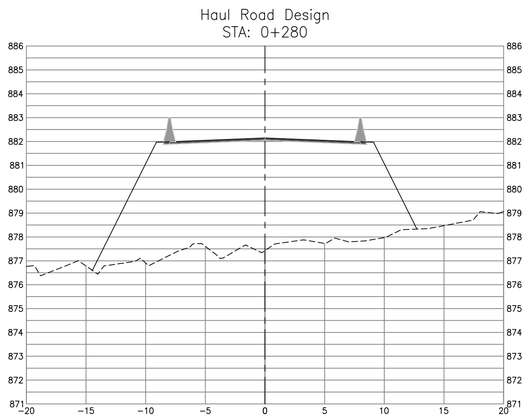


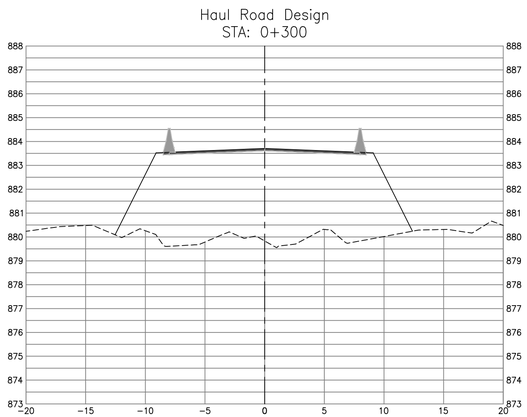












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Scale: 1: 250

LEGEND:

EXISTING GROUND

PROPOSED GRADE

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON
GARY KOOP
TERRITORY
2025-07-31

PROFESSIONAL SEAL

CLIENT

Hecla KENO HILL SM

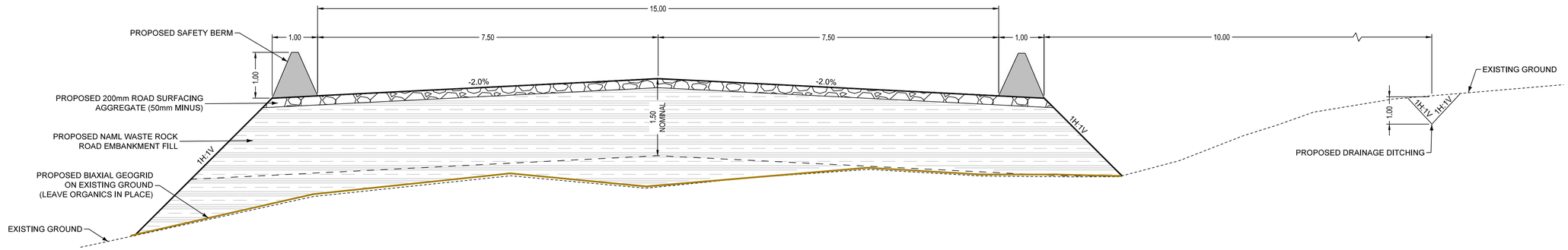
TETRA TECH

FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

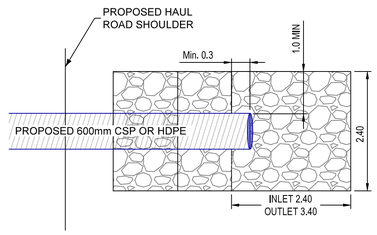
HAUL ROAD
CROSS SECTION VIEWS

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-07	KELOWNA	CC	TB	0	019
DATE:	SHEET No.	DWN	APP	STATUS	
July 31, 2025	10 of 11	CC	GDK	IFU	

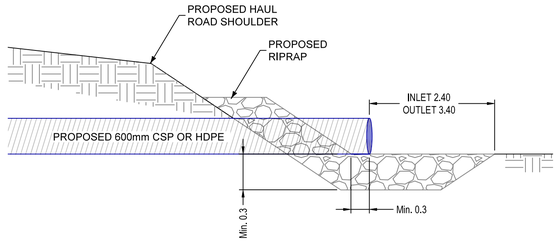
D:\Projects\Tetra Tech\704-ENG.WARC04673-07 Keno Flame and Moth WRSA\04-Eng Design\02-Civil\3D Drawings\Keno - Flame and Moth WRSA - PD.dwg [019] July 31, 2025 - 1:58:53 pm (BY: CORY CARLSON)



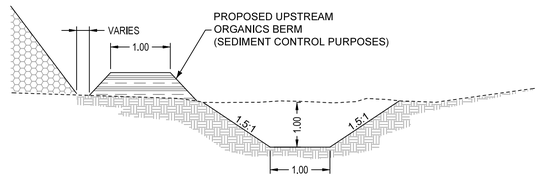
DETAIL A
TYPICAL HAUL ROAD SECTION
SCALE 1:50



DETAIL B
CULVERT INLET & OUTLET
PLAN DETAIL
SCALE 1:100



DETAIL C
CULVERT INLET & OUTLET
PROFILE DETAIL
SCALE 1:100



DETAIL D
WRSA PERIMETER SWALE
SCALE 1:50

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON
GARY KOOP
TERRITORY
2025-07-31

PROFESSIONAL SEAL

CLIENT
Hecla KENO HILL SM

TETRA TECH

FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

TYPICAL DETAILS

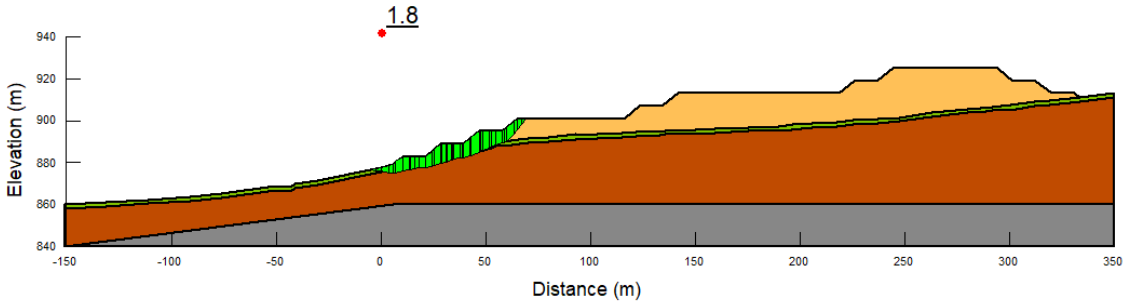
PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04573-07	KELOWNA	CC	TB	0	020
DATE:	SHEET No.	DWN	APP	STATUS	
July 31, 2025	11 of 11	CC	GDK	IFU	

D:\Projects\Tetra Tech\704-ENG.WARC04573-07 Keno Flame and Moth WRSA\4-Eng Design\01-CAD\3D Drawings\Keno - Flame and Moth WRSA - IFU.dwg [020] July 31, 2025 - 1:59:42 pm (BY: CORY CARLSON)

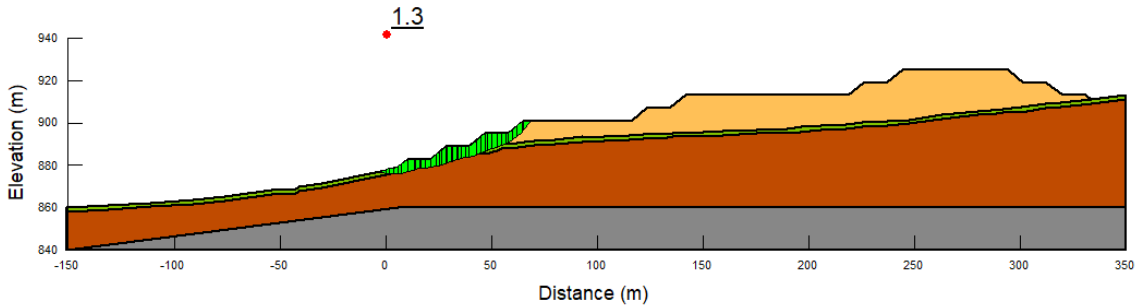
APPENDIX A

SLOPE STABILITY ANALYSIS RESULTS

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock			
	Till - Ice Poor	16	0	30
	Topsoil - Frozen	19	0	28
	Waste Rock	19.5	0	37



Toe Failure (Static)



Toe Failure (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

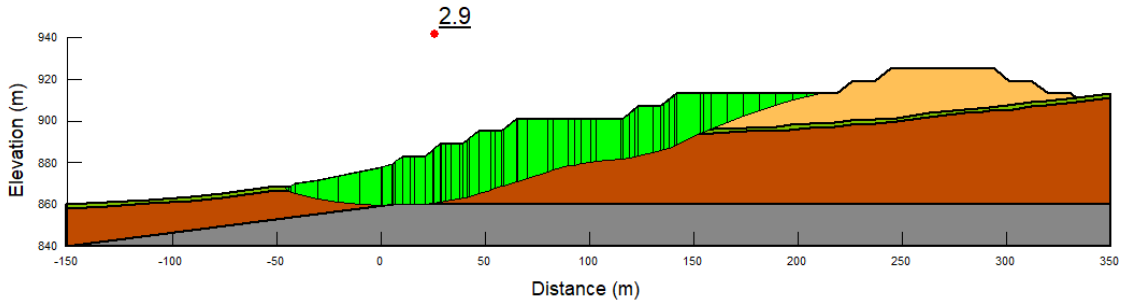
Section A: Fully Frozen (Toe Failure)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

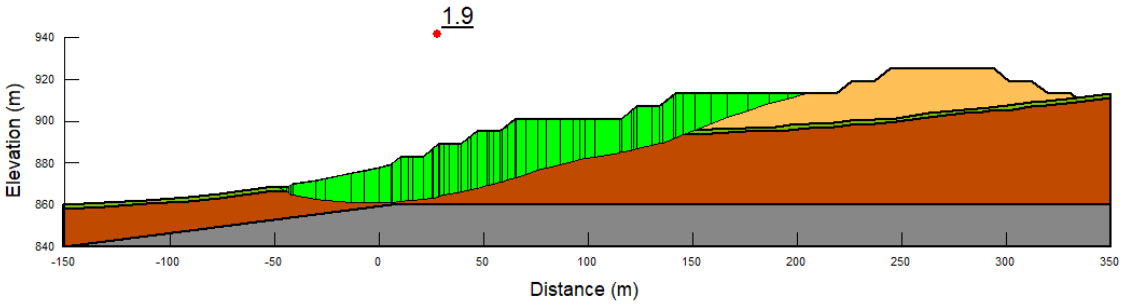
OFFICE: Edmonton
DATE: August 1, 2025

A1

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock			
	Till - Ice Poor	16	0	30
	Topsoil - Frozen	19	0	28
	Waste Rock	19.5	0	37



Global Failure (Static)



Global (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

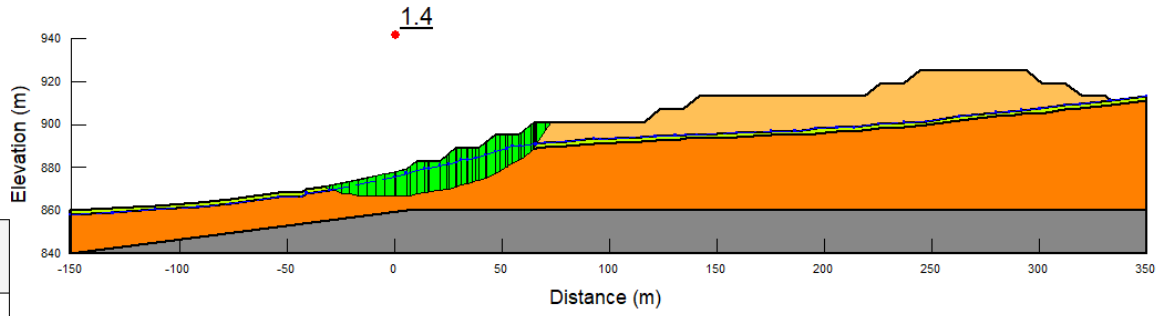
Section A: Fully Frozen (Global Failure)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

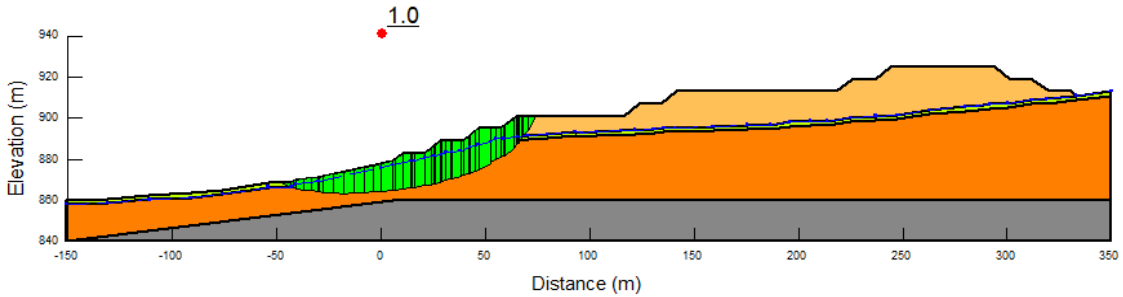
OFFICE	DATE
Edmonton	August 1, 2025

A2

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Surface
	Bedrock				
	Till - Thawed	19.1	0	30	1
	Topsoil - Thawed	21	0	28	1
	Waste Rock	19.5	0	37	



Toe Failure (Static)



Toe Failure (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

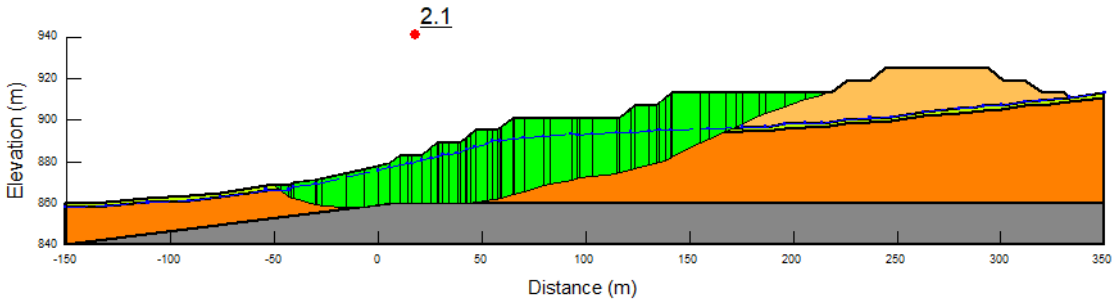
Section A: Fully Thawed (Toe Failure)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

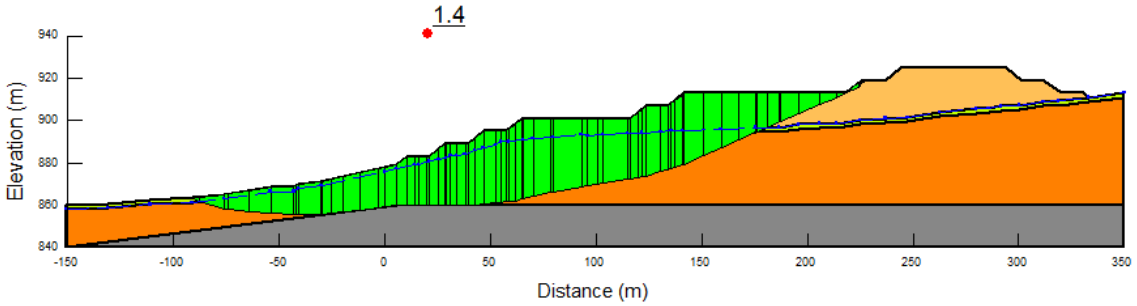
OFFICE: Edmonton
DATE: August 1, 2025

A3

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Surface
	Bedrock				
	Till - Thawed	19.1	0	30	1
	Topsoil - Thawed	21	0	28	1
	Waste Rock	19.5	0	37	



Global Failure (Static)



Global (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

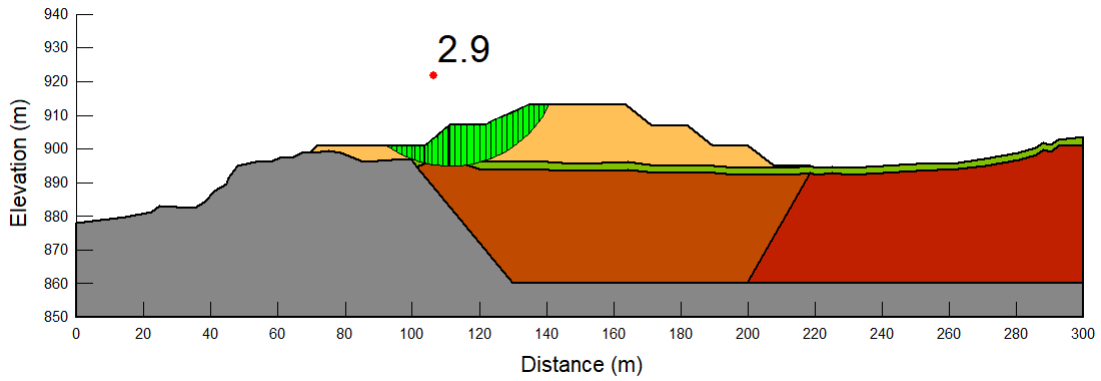
Section A: Fully Thawed (Global Failure)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

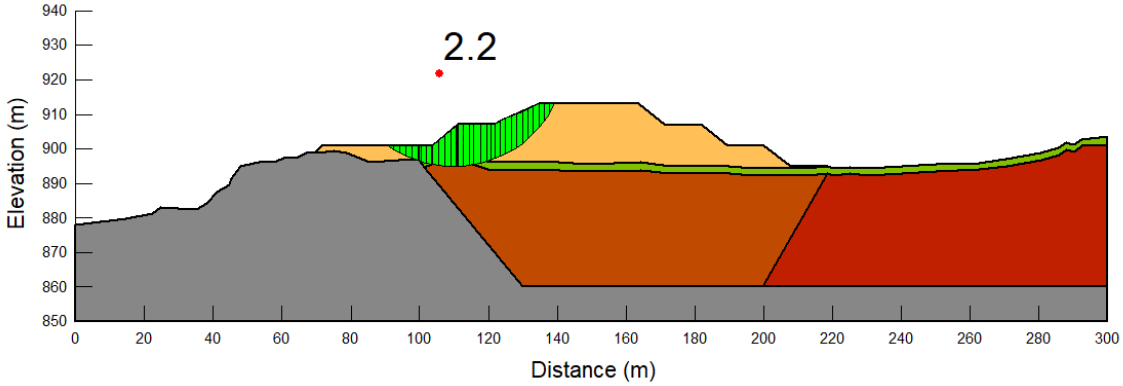
OFFICE	DATE
Edmonton	August 1, 2025

A4

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock			
	Overburden	21	0	28
	Till - Ice Poor	16	0	30
	Till - Ice Rich	11.8	0	30
	Topsoil - Frozen	19	0	28
	Waste Rock	19.5	0	37



Global Failure (Static)



Global (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

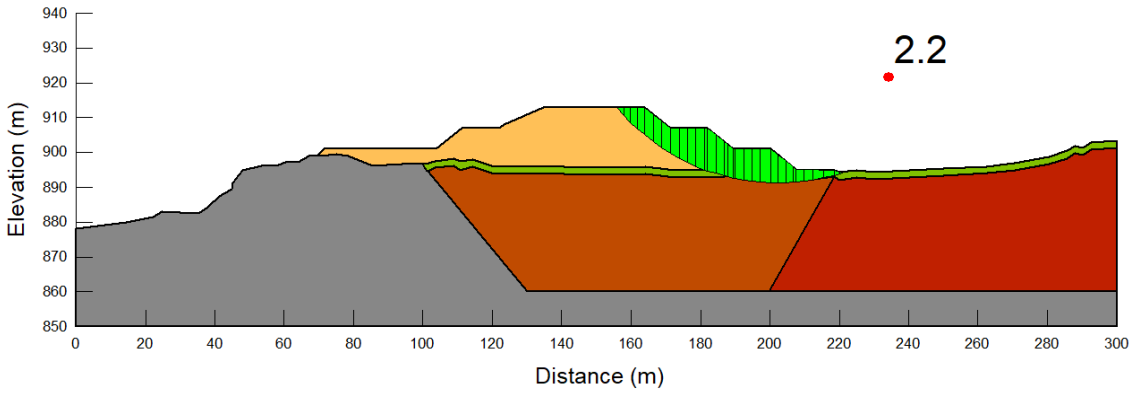
Section C: Fully Frozen (North Face)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

OFFICE: Edmonton
DATE: August 1, 2025

A5

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock			
	Overburden	21	0	28
	Till - Ice Poor	16	0	30
	Till - Ice Rich	11.8	0	30
	Topsoil - Frozen	19	0	28
	Waste Rock	19.5	0	37



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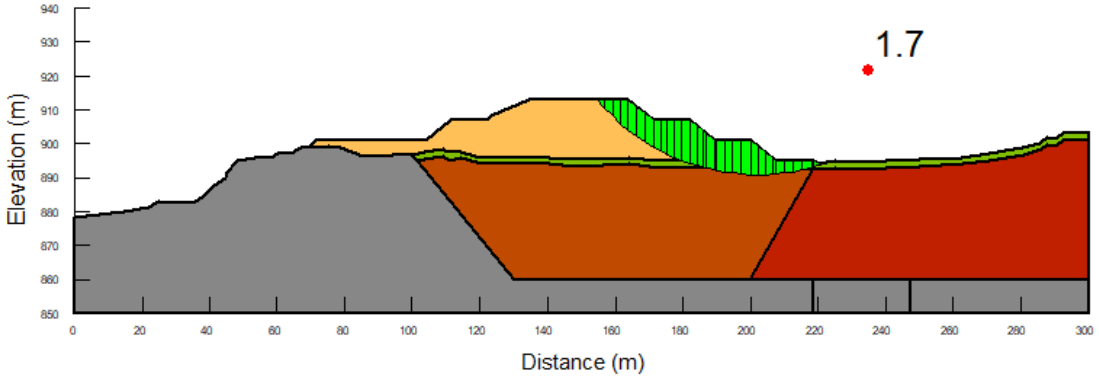


Global (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

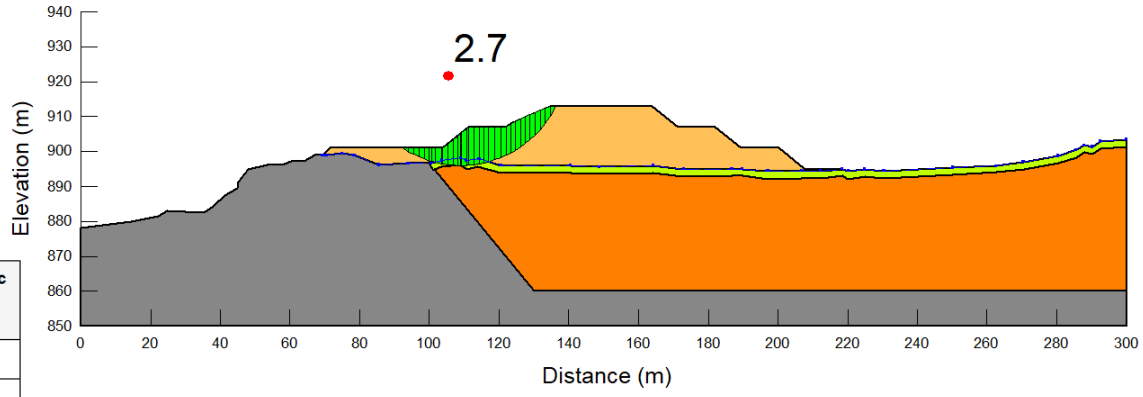
Section C: Fully Frozen (South Face)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

OFFICE	DATE
Edmonton	August 1, 2025

A6

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Surface
	Bedrock				
	Overburden	21	0	28	
	Till - Thawed	19.1	0	30	1
	Topsoil - Thawed	21	0	28	1
	Waste Rock	19.5	0	37	



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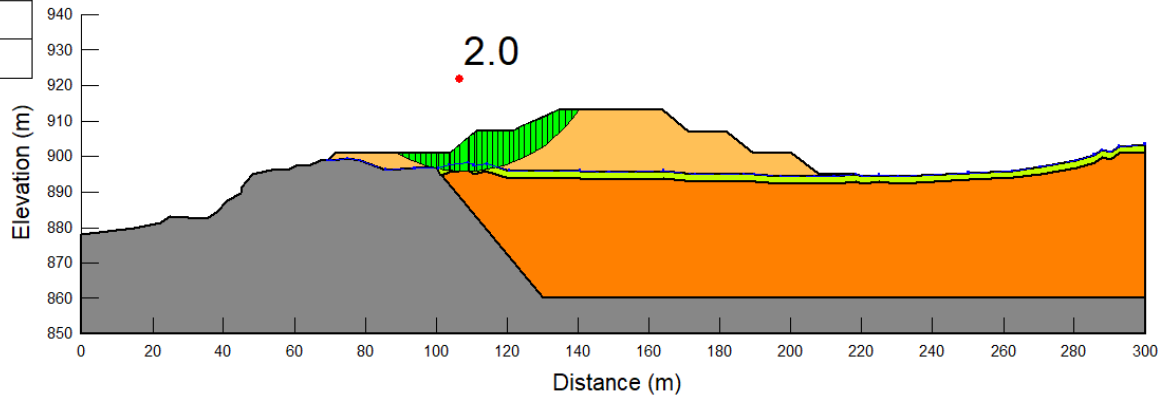


Global (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

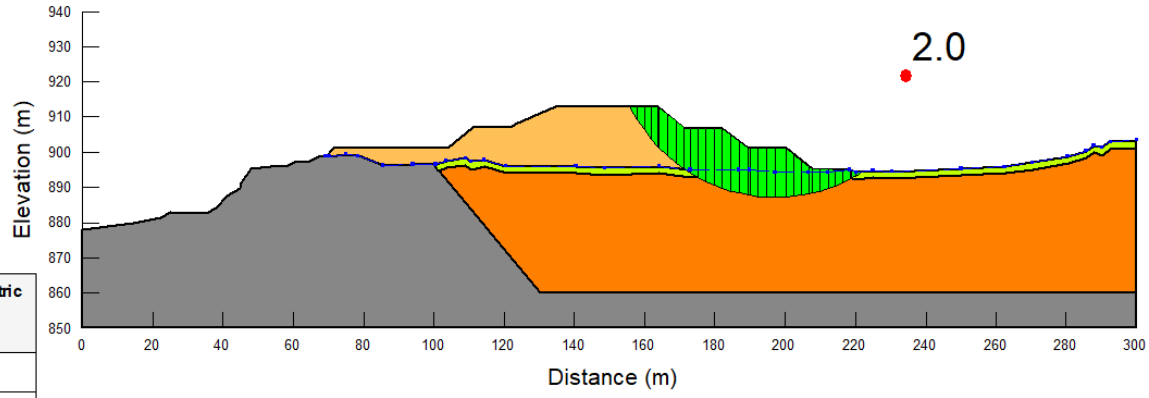
Section C: Fully Thawed (North Face)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

OFFICE	DATE
Edmonton	August 1, 2025

A7

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Surface
	Bedrock				
	Overburden	21	0	28	
	Till - Thawed	19.1	0	30	1
	Topsoil - Thawed	21	0	28	1
	Waste Rock	19.5	0	37	



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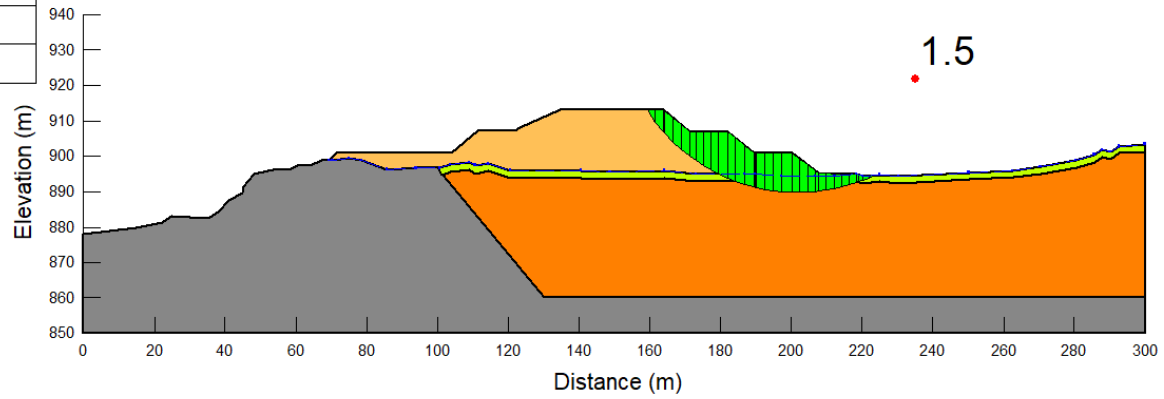


Global (Pseudo Static)

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

Flame & Moth Mine WRSA Design
Keno Hill Silver District, YT

Section C: Fully Thawed (South Face)

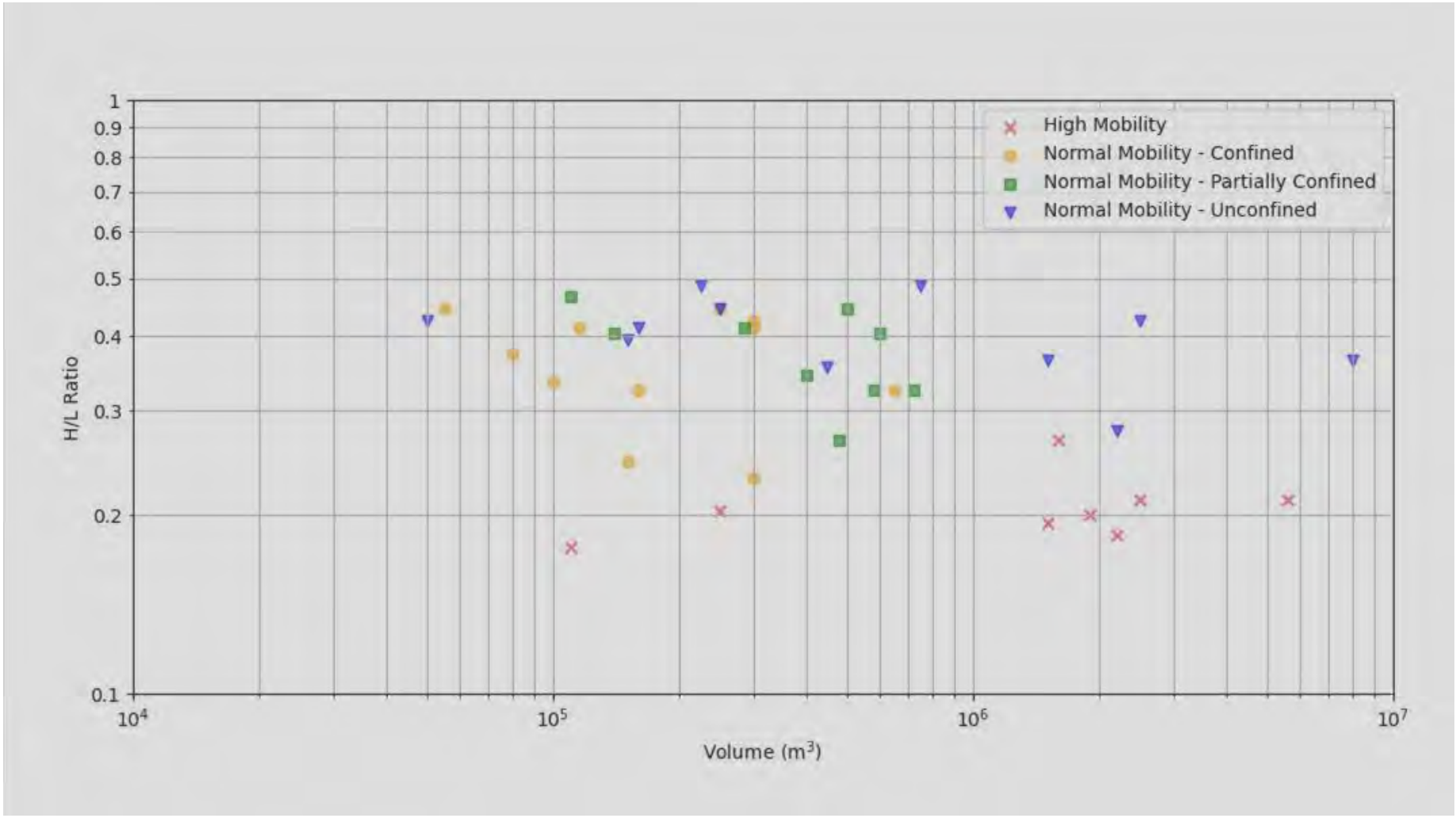
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	YL	TB	GK	IFU

OFFICE	DATE
Edmonton	August 1, 2025

A8

APPENDIX B

RUNOUT ASSESSMENT RESULTS



NOTES

Runout data is based on BCMWRPC (1995).

CLIENT

Hecla KENO HILL SM

Flame & Moth Mine Waste Rock Storage Area
Keno Hill Silver District, Yukon Territory

Mine Waste Rock Runout Data
H/L Ratio vs. Volume

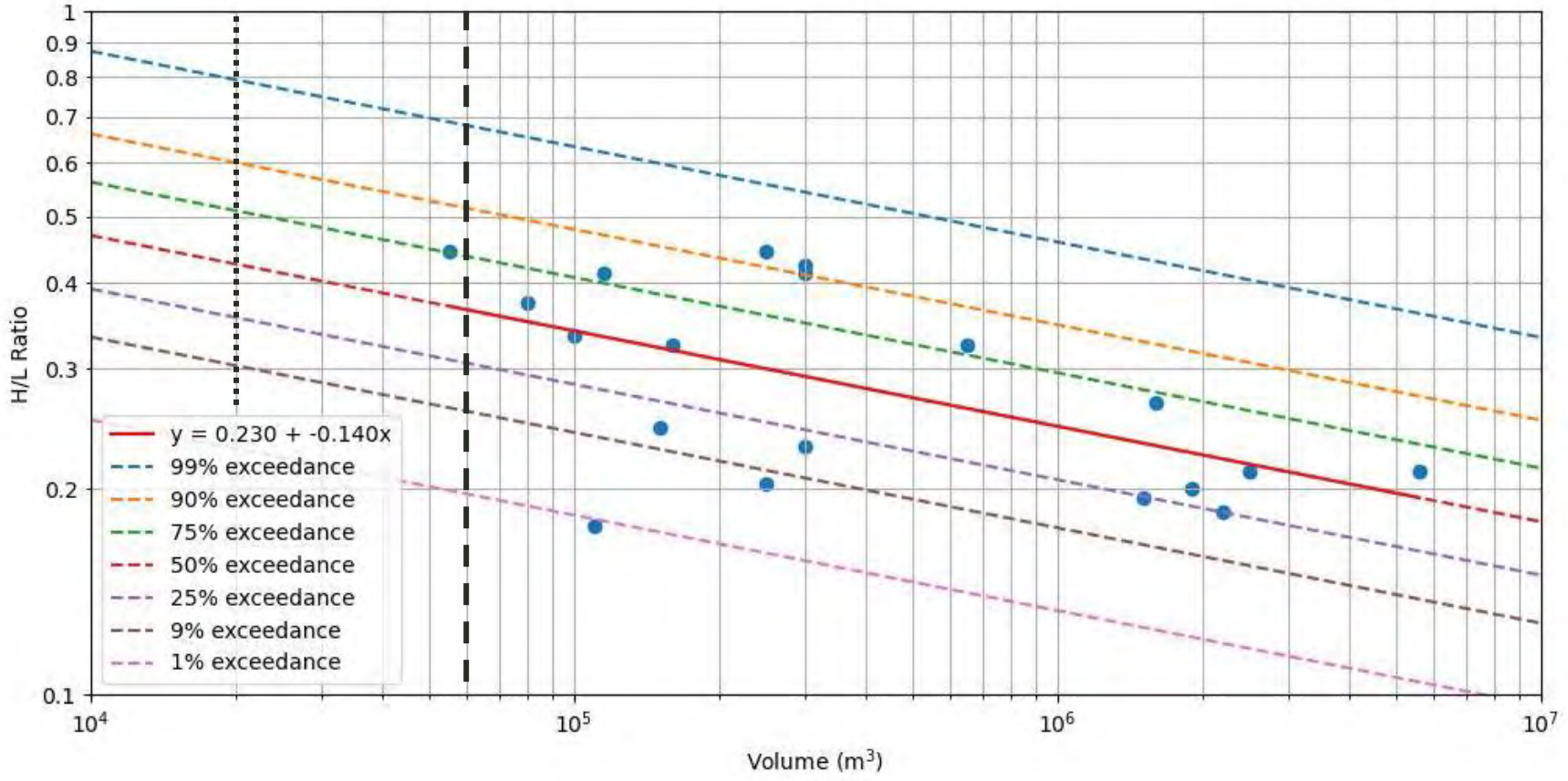
TETRA TECH

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	CW	BC	BC	IFU

OFFICE	DATE
NANAIMO	August 1, 2025

STATUS
ISSUED FOR USE

B1



NOTES

2,000 m³ Potential Failure Volume

60,000 m³ Potential Failure Volume

STATUS
ISSUED FOR USE

CLIENT
Hecla KENO HILL SM

TETRA TECH

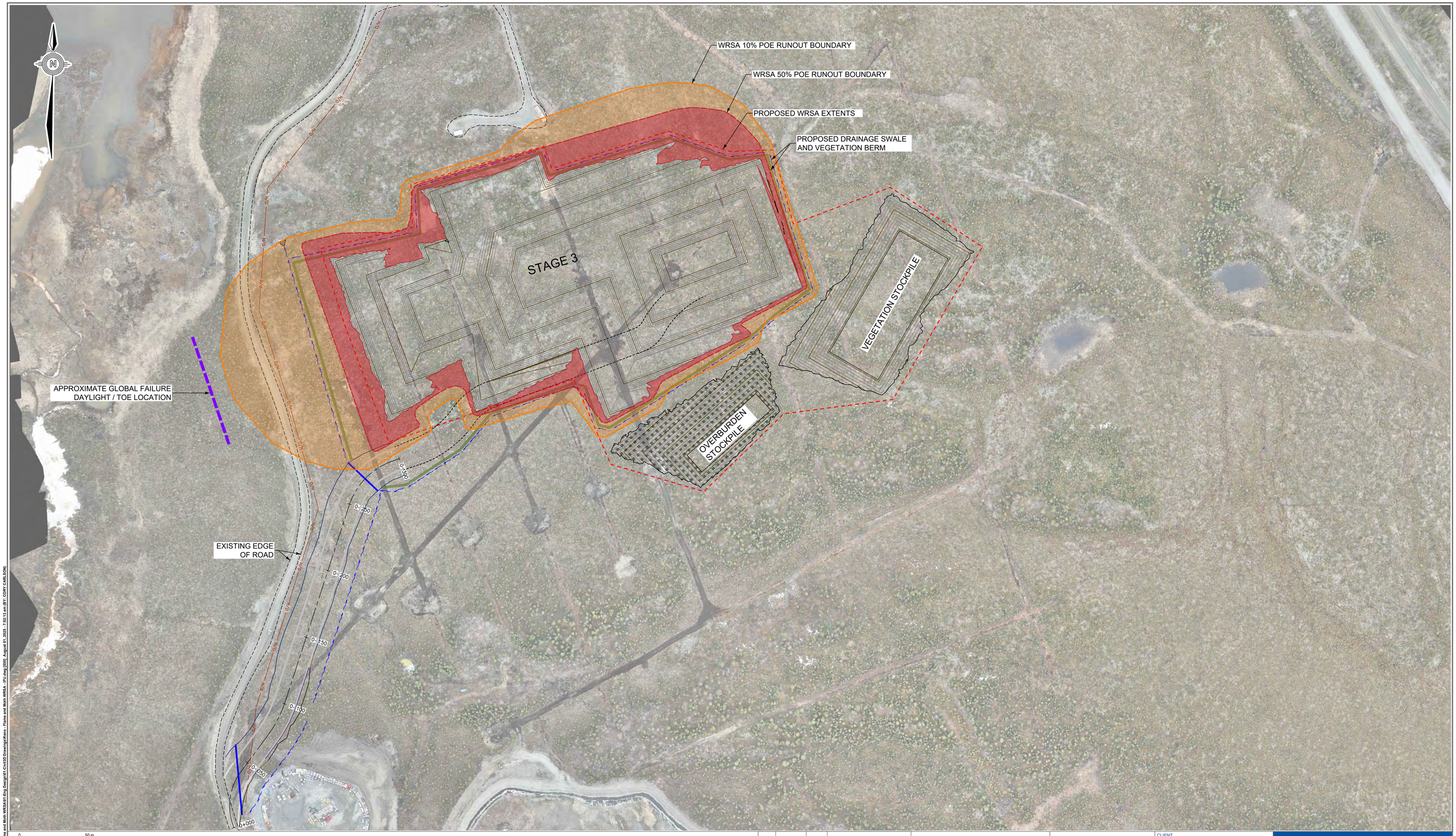
Flame & Moth Mine Waste Rock Storage Area
Keno Hill Silver District, Yukon Territory

High Mobility / Normal Mobility
Confined Data

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04673-07	CW	BC	BC	IFU

OFFICE	DATE
NANAIMO	August 1, 2025

B2



0 50 m
Scale: 1: 1 250

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES.
2. ALL COORDINATES ARE IN UTM NAD83 PROJECTION.
3. IMAGE SHOWN FROM MAY 16, 2025.

LEGEND:

HAZARD ZONATION IMPACT AREAS	HAZARD ZONATION IMPACT EXTENTS
10% EXEEDANCE PROBABILITY	10% EXEEDANCE PROBABILITY
50% EXEEDANCE PROBABILITY	50% EXEEDANCE PROBABILITY

NUM	DATE	APR	DESCRIPTION
0	July 31, 2025	GDK	ISSUED FOR USE

DRAWING STATUS

PERMIT

PROFESSIONAL SEAL

CLIENT: SM Hecla KENO HILL

TETRA TECH

FLAME & MOTH MINE WASTE ROCK STORAGE AREA
KENO HILL SILVER DISTRICT, YUKON TERRITORY

WRSA DESIGN
SITE RUNOUT ANALYSIS
SITE PLAN

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
704-ENG.WARC04673-07	KELOWNA	CC	BC	0	B3
DATE: July 31, 2025	SHEET No. 1 of 1	DWN CC	APP GDK	STATUS IFU	

D:\Projects\Tetra Tech\704-ENG.WARC04673-07 Keno Flame and Moth WRSA\01-Eng Design\3-Civil\3D Drawings\Keno - Flame and Moth WRSA - PO.dwg [3D] August 01, 2025 - 7:52:13 am BY: CORY CARLSON

APPENDIX C

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

DESIGN REPORT

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless so stipulated in the Design Report, TETRA TECH was not retained to explore, address or consider, and has not explored, addressed or considered any environmental or regulatory issues associated with the project specific design.

1.8 CALCULATIONS AND DESIGNS

TETRA TECH may have undertaken design calculations and prepared project specific designs in accordance with terms of reference that were previously set out in consultation with, and agreement of, TETRA TECH's client. These designs have been prepared to a standard that is consistent with current industry practice. Notwithstanding, if any error or omission is detected by TETRA TECH's Client or any party that is authorized to use the Design Report, the error or omission should be immediately drawn to the attention of TETRA TECH.

1.9 GEOTECHNICAL CONDITIONS

A Geotechnical Report is commonly the basis upon which the specific project design has been completed. It is incumbent upon TETRA TECH's Client, and any other authorized party, to be knowledgeable of the level of risk that has been incorporated into the project design, in consideration of the level of the geotechnical information that was reasonably acquired to facilitate completion of the design.

If a Geotechnical Report was prepared for the project by TETRA TECH, it may be included in the Design Report as appropriate. The Geotechnical Report contains Limitations that should be read in conjunction with these Limitations for the Design Report.

1.10 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This report has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.

APPENDIX 3.8

DSTF PHASE 2 EAST INITIAL TAILINGS DEPOSITION PLAN

484 000 E
484 050 E
484 100 E
484 150 E
484 200 E
484 250 E
484 300 E
484 350 E
7 086 800 N
7 086 750 N
7 086 700 N
7 086 650 N
EXISTING ROW
NORTH DITCH
NORTH ACCESS ROAD
30m OFFSET FROM PUBLIC ROAD CENTRELINE
PUBLIC ROAD
WEST INTERIOR BERM NOTCH
APPROXIMATE EXTENTS OF TEMPORARY P2E INTERIOR SUMP
PHASE 2 EAST TOE BUTTRESS
WEST INTERIOR BERM
APPROXIMATE P2E ACCESS
PLACEMENT @ EL. 932 m
APPROX. VOLUME = 29,000 m³
PLACEMENT @ EL. 934 m
APPROX. VOLUME = 5,000 m³
PLACEMENT @ EL. 940 m
APPROX. VOLUME = 22,000 m³
2.0%
3.25:1
3.00:1
A 50-C-401
B 50-C-401
C 50-C-402
D 50-C-402

NOTES:
1. UTM WITH NAD83 DATUM, ZONE 8, METER; CENTRAL MERIDIAN 135D W.

SCALE 1:1500
10 0 10 30 60m

NUM	DATE	DWN	CKD	APR	DESCRIPTION
2	18-FEB-25	EL	IM	GK	REVISED DEPOSITION OUTSIDE SLOPE TO 3.25H:1V
1	20-DEC-24	EL	IM	GK	REVISED DEPOSITION PLAN BASED ON DECEMBER 15, 2024 PHOTOGAMETRY SCAN
0	23-SEP-24	EL	IM	GK	ISSUED FOR CONSTRUCTION

REVISIONS

PERMIT

PROFESSIONAL SEAL

CLIENT
Hecla MINING COMPANY

TETRA TECH

DRY STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

DSTF PHASE 2 EAST
INITIAL TAILINGS DEPOSITION PLAN

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
WARC04415-10	EDM	YQ	IM	2	50-C-400
DATE	SHEET No.	DWN	APP	STATUS	
February 18, 2025	1 of 3	EL	GK	IFC	

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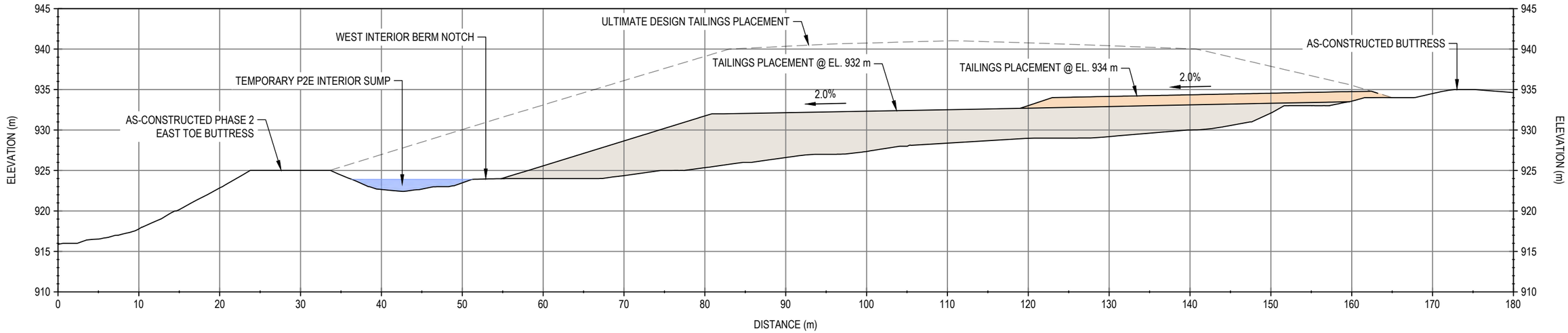

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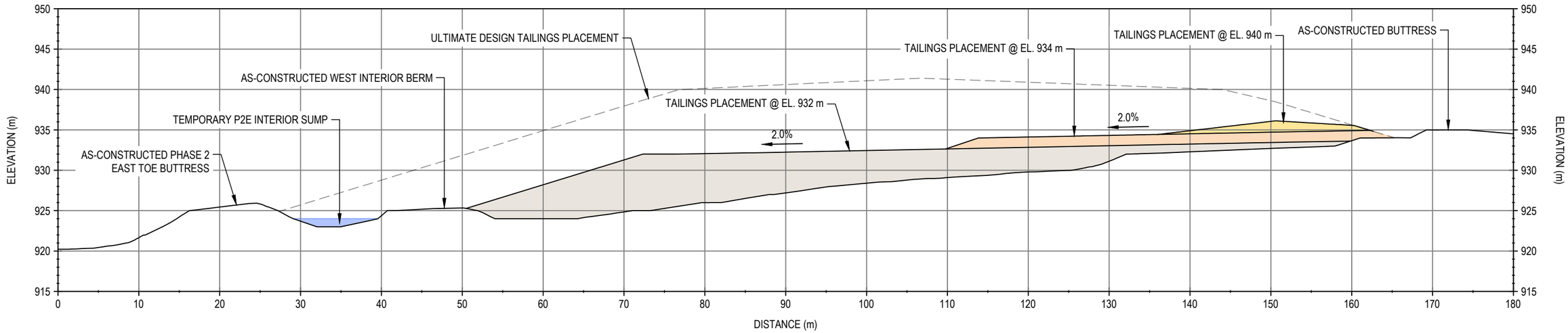
SCALE: 1:500



B 50-C-400 **CROSS-SECTION**
SCALE: 1:500

NUM	DATE	DWN	CKD	APR	DESCRIPTION
2	18-FEB-25	EL	IM	GK	REVISED DEPOSITION OUTSIDE SLOPE TO 3.25H:1V
1	20-DEC-24	EL	IM	GK	REVISED DEPOSITION PLAN BASED ON DECEMBER 15, 2024 PHOTOGAMETRY SCAN
0	23-SEP-24	EL	IM	GK	ISSUED FOR CONSTRUCTION

REVISIONS

PERMIT

PROFESSIONAL SEAL

CLIENT

Hecla MINING COMPANY

TETRA TECH

DRY STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

DSTF PHASE 2 EAST
INITIAL TAILINGS DEPOSITION CROSS-SECTION

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
WARC04415-10	EDM	YQ	IM	2	50-C-401
DATE	SHEET No.	DWN	APP	STATUS	
February 18, 2025	2 of 3	EL	GK	IFC	

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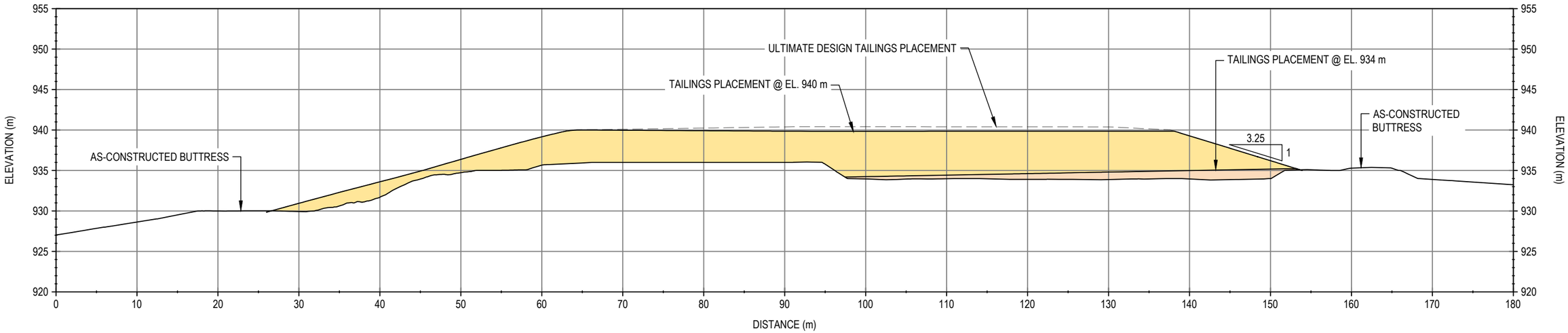
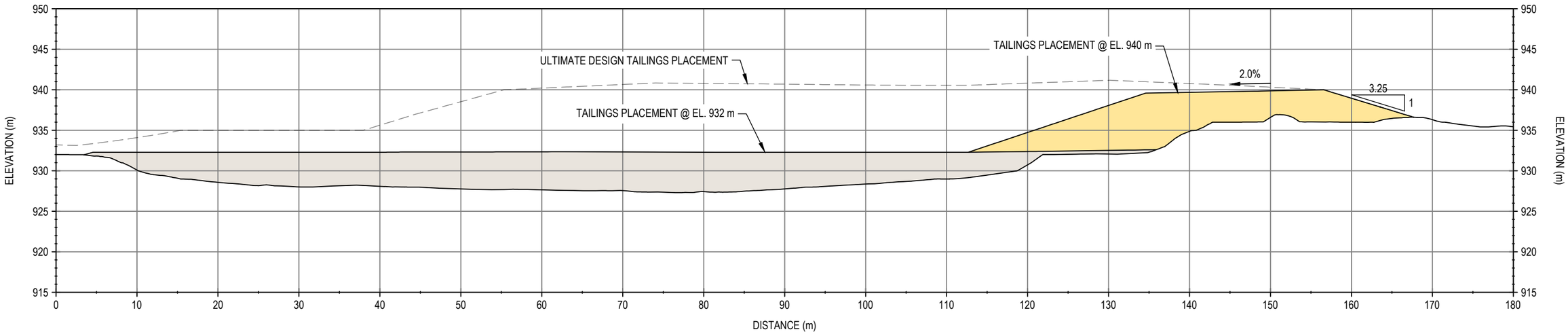


C 50-C-400 CROSS-SECTION
SCALE: 1:500



D 50-C-400 CROSS-SECTION
SCALE: 1:500

NUM	DATE	DWN	CKD	APR	DESCRIPTION
2	18-FEB-25	EL	IM	GK	REVISED DEPOSITION OUTSIDE SLOPE TO 3.25H:1V
1	20-DEC-24	EL	IM	GK	REVISED DEPOSITION PLAN BASED ON DECEMBER 15, 2024 PHOTOGAMETRY SCAN
0	23-SEP-24	EL	IM	GK	ISSUED FOR CONSTRUCTION

REVISIONS

PERMIT

PROFESSIONAL SEAL

CLIENT

Hecla MINING COMPANY

TETRA TECH

DRY STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

DSTF PHASE 2 EAST
INITIAL TAILINGS DEPOSITION CROSS-SECTION

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
WARC04415-10	EDM	YQ	IM	2	50-C-402
DATE	SHEET No.	DWN	APP	STATUS	
February 18, 2025	3 of 3	EL	GK	IFC	

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APPENDIX 3.9

KENO HILL IN SITU SYSTEM OPERATIONS AND MAINTENANCE PLAN

KENO HILL SILVER DISTRICT MINING OPERATIONS

KENO HILL IN SITU SYSTEM OPERATIONS AND MAINTENANCE PLAN

October 2020

Prepared for:

ALEXCO KENO HILL MINING CORP.

Prepared by:

TABLE OF CONTENTS

1. INTRODUCTION 1-1
1.1 PURPOSE 1-1
1.2 SCOPE OF THIS DOCUMENT 1-1
2. LOCATION AND DESCRIPTION 2-1
3. PROCESS DESCRIPTION 3-1
3.1 TREATMENT PERFORMANCE 3-1
3.2 PROCESS OVERVIEW 3-1
3.3 DESIGN BASIS 3-1
3.4 PLANT LAYOUT AND EQUIPMENT 3-2
3.4.1 Underground In Situ Treatment System 3-2
3.4.2 Secondary Treatment 3-3
4. PLANT OPERATION 4-1
4.1 IN SITU SYSTEM 4-1
4.2 START-UP PROCEDURE – CARBON AMENDMENT 4-1
4.3 SHUTDOWN PROCEDURE – CARBON AMENDMENT 4-1
4.4 ROUTINE CHECKS AND SAMPLES 4-2
4.4.1 Maintenance Injections 4-2
4.4.2 Upset Conditions 4-2
4.5 CHEMICAL REAGENT PROCEDURES 4-3
4.5.1 In Situ Carbon Tank Makeup 4-3
4.5.2 Secondary Treatment Lime Tank Makeup 4-4
4.5.3 Secondary Treatment Polymer Tank Makeup 4-4
5. ROUTINE PLANT MAINTENANCE 5-1
6. PLANT SAFETY AND EMERGENCY PREPAREDNESS 6-1
6.1 PERSONAL PROTECTIVE EQUIPMENT 6-1
6.2 CHEMICAL SAFETY 6-1
6.2.1 Hydrated Lime 6-1
6.2.2 Drewfloc 2499 or Equivalent 6-2
6.2.3 Glycerol 6-2
6.2.4 Molasses 6-2
6.3 FIRE 6-2
6.4 WINTER CONDITIONS 6-3
7. REFERENCES 7-1

LIST OF TABLES

Table 3-1: Bellekeno In Situ Treatment Design Parameters 3-2

LIST OF FIGURES

Figure 3-1: Bellekeno Closure Treatment System Piping & Instrumentation Diagram 3-4

LIST OF PHOTOS

Photo 2-1: Bellekeno 625 WTP Area Overview 2-1

LIST OF APPENDICES

APPENDIX A. SDS SHEETS
APPENDIX B. DRAWINGS
APPENDIX C. PROCESS CONTROL NARRATIVE

LIST OF ACRONYMS AND ABBREVIATIONS

AKHM	Alexco Keno Hill Mining Corp.
BDOP	Bioreactor Design and Operation Plan
DOC	Dissolved Organic Carbon
EQS	Effluent Quality Standard
HRT	Hydraulic Retention Time
OMP	Operations and Maintenance Plan
PLC	Programmable Logic Controller
PPE	Personal Protective Equipment
SDS	Safety Data Sheets
TSS	Total Suspended Solids
WTP	Water Treatment Plant

1. INTRODUCTION

1.1 PURPOSE

Alexco Keno Hill Mining Corp. (AKHM) will be operating a semi-passive water treatment system at the Bellekeno Mine after completion of mining. This document has been prepared to fulfill the requirements of Clause 63.(a) of Water Licence QZ18-044 relating to this treatment circuit as follows:

63. The Licensee must submit to the Board and implement an updated Operating and Maintenance Plan (OMP) for the Keno Hill Silver District:

    a) within 90 days of the effective date of this Licence to reflect the operating conditions of this Licence;

    b) 90 days prior to mine pool treatment commencing at the Bellekeno Mine; and

    c) provide any subsequent updates as part of the annual report.

The Reasons for Decision document that supports this Water Licence provides more explanation of the specific requirement of this Clause; this OMP update is specific to the proposed post-closure *in situ* semi passive water treatment for the underground mine water.

The treatment system will be implemented upon completion of mining as documented in the site Reclamation and Closure Plan. Based on the current mine plan, mining would be completed in Q1 of 2020. The estimated time to retreat from the mine workings and for the mine to completely flood following mining is at minimum 6 months, or Q4 of 2021. Subclauses (b) and (c) would be triggered at that time.

1.2 SCOPE OF THIS DOCUMENT

This OMP will provide the necessary information for the operation, maintenance and trouble-shooting of the systems to ensure they operate to design standards and criteria. It is important that all operators, technicians, and maintenance personnel understand and follow the guidelines and procedures described in this OMP. A copy of this plan, as well as any applicable supplements, shall always be maintained on site and available for review once the treatment system is in operation.

The OMP will also include the necessary safety procedures and emergency action plans required, as part of the operations and monitoring activities. The treatment plant system will be operated and monitored in compliance with the Yukon's Occupational Health and Safety regulations. Environmental monitoring and surveillance are addressed in a separate document.

2. LOCATION AND DESCRIPTION

The Bellekeno mine area is located approximately 3 km east of Keno City within the Keno Hill Silver District. The water management and treatment ponds for the Bellekeno Mine are shown in Photo 2-1. The Bellekeno Mine consists of the underground workings and surface adit entrances (Bellekeno East portal and decline and the Bellekeno 625 adit), water treatment facility and associated buildings and infrastructure.



Photo 2-1: Bellekeno 625 WTP Area Overview

3. PROCESS DESCRIPTION

3.1 TREATMENT PERFORMANCE

The expected performance of the Bellekeno 625 water treatment for operations is specified in Part G, Clause 64 of Water Licence QZ18-044 for station KV-43. During operations, Clause 2 of the Water Licence also limits the effluent discharge rate from the mine to 864 m^3/day, or the equivalent of continuous discharge at 10 L/s. The semi-passive *in situ* treatment system is currently designed to achieve those Effluent Quality Standard (EQS) values in post closure despite the significantly lower flow rates which are expected once mining ceases.

3.2 PROCESS OVERVIEW

In situ treatment is a water treatment approach with two main objectives; to create anaerobic (oxygen deficient) conditions within the underground mines to limit further oxidation and to reprecipitate the metals within the mine workings by in situ sulphate reduction. This anaerobic process essentially reverses the process that originally created the metals in the mine discharge. These are naturally occurring reactions.

This naturally occurring process is enhanced within the workings by supplying an organic carbon (alcohols, sugars, syrups, starches, or cellulosic materials) into the flooded mine workings. These materials are consumed by naturally occurring microorganisms native to the mining environment, and the anaerobic environment is then created and sustained by these microbial processes. The concentration and type of organic carbon used is selected to control the amount and rate of sulphate reduction, thus ensuring that sufficient sulphate reduction is accomplished to achieve metals precipitation. These biogeochemical reactions occur over a wide range of temperature conditions.

The required residence time to allow for the biogeochemical treatment processes to precipitate metals from the solution to ensure treatment and compliant discharge has been designed from experience with pilot testing on site and laboratory testing. The residence time can be managed by installation of hydraulic bulkheads to retain water underground.

The Bellekeno Mine *in situ* system consists of carbon amendment equipment to periodically inject a dose of dissolved organic carbon (DOC) into the mine workings to facilitate microbe growth and fuel *in situ* treatment. During carbon amendment, circulation water is drawn with a well pump, dosed with glycerol and then distributed to three separate injection locations. A hydraulic bulkhead will be installed at the portal to both limit access to the mine, and, to retain water underground and control the discharge rate. The mine discharge adit is also designed with equipment to control and monitor the adit discharge pressure and monitor effluent pH and turbidity.

3.3 DESIGN BASIS

The design basis for the Bellekeno treatment is discussed in detail in the Reclamation and Closure Plan (AKHM 2019). A summary of the key design parameters for in situ treatment of Bellekeno mine water is presented in Table 3-1. Based on the design flow of 4 L/s and void openings of 67,600 m^3, it is calculated that there is approximately 200 days of retention time in the Bellekeno mine pool which is more than ample for effective in situ treatment.

Table 3-1: Bellekeno In Situ Treatment Design Parameters

Design Parameter	Unit	
Mine Inflow	Base Flow: 4 L/s	Max Flow: 6 L/s
Zn Untreated	Average: 4 mg/L	Max: 8 mg/L
Zn Treated	Discharge Criteria: 0.5 mg/L	
Mine Volume	67,600 m^3	
Retention Time	Average Retention: 200 days	Minimum Retention: 130 days

The Bellekeno mine post closure water treatment system includes two stages of treatment; the primary treatment in the underground workings followed by a contingency for secondary treatment at surface in the existing settling ponds. This approach is currently used at the pilot *in situ* water treatment at the Silver King. In that case, the second stage of "treatment" is for minor pH adjustment and settling of solids prior to discharge. The pilot *in situ* treatment system has worked effectively for several years, and no secondary biological treatment is required to augment or replace the underground *in situ* treatment, as proposed for Bellekeno. This secondary treatment is discussed further in the Bioreactor Design and Operation Plan (BDOP) as required under Clause 55 of the Water Licence.

3.4 PLANT LAYOUT AND EQUIPMENT

3.4.1 UNDERGROUND IN SITU TREATMENT SYSTEM

The following summarizes the main design features of the Bellekeno in situ treatment system. The process flow and instrumentation diagram for the Bellekeno *in situ* treatment system is shown in Figure 3-1 which is extracted from the Reclamation and Closure Plan (Alexco, 2019).

An adit concrete bulkhead at 625 will collect and manage water stored in the mine and provide hydraulic retention time (HRT), as well as providing access control. The bulkhead will consist of pressure monitoring instrumentation, clean out conduit (4") for removal of built up sediments behind the bulkhead and upper and lower discharge lines to gravity drain water from behind the bulkhead to the bioreactor. The final flooded water elevation is expected to be below any other openings to surface (i.e. Bellekeno East), thus no other bulkheads are required.

A pipeline and recirculation pump to inject reagents and water recirculation to various levels of the mine. The Bellekeno mine is equipped with both air and water lines from surface to all levels throughout the mine and will be used as the recirculation and reagent addition pipeline upon closure. Existing pipelines for operational mine water management will be utilized and twinned where required for recirculation. The discharge location of the injection pipe is planned to be in the stopes on the 850 level of the Southwest Zone. Water from the 625 level will be collected, amended with the design dose of reagents, and injected in the underground workings, using the existing water lines. Site power will be supplied by current grid power connected at the Bellekeno 625 substation.

A process control and monitoring shed will be used to house the controls and monitoring systems for each site. This system will allow for the observation of the mine pool levels, in situ water chemistry parameters (pH, ORP, specific conductivity, and water temperature), flow rates, bulkhead pressures, and reagent tank levels. The collected information will be data logged, which allows for the review of the collected data over

time. A sampling port will also be available to sample each site for lab water chemistry parameters. The current water treatment shed at 625 will be repurposed for this requirement.

A reagent storage tank will be used to store site reagents. In most cases, an alcohol-based reagent will be utilized and stored in a tank sized to hold up to 12 months of reagent demand.

A reagent dosing pump with variable speed controls will be used to transfer reagents from the storage tank to the system pipeline for static mixing and conveyance for injection. The reagent dosing pump will be controlled by a Programmable Logic Controller located within the process control and monitoring shed, which allows reagent additions to be proportional to system flow rates.

Programmable Logic Controller (PLC) will be located in the process control and monitoring shed. This system is capable of monitoring inputs from pressure gauges, flow meters, level sensors, and other monitoring equipment. In addition, it can control metering pumps, proportional flow valves, and other control equipment. The PLC system currently designed for each site will be connected to the internet allowing for real-time process monitoring and remote alarm notifications.

3.4.2 SECONDARY TREATMENT

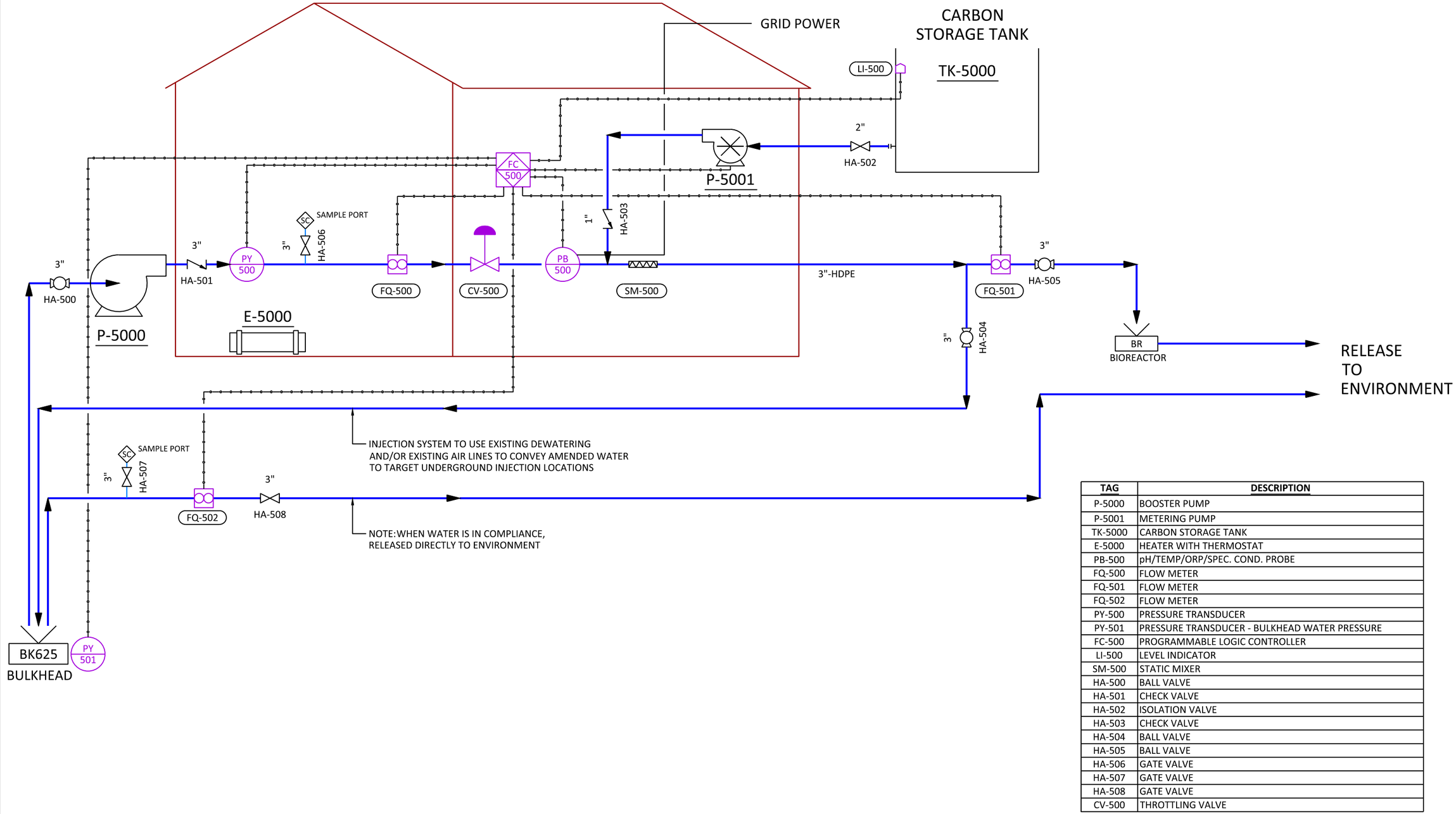
The existing settling ponds at the Bellekeno 625 mine site will be retained at closure and will be converted to use as secondary treatment as a bioreactor. This secondary treatment is discussed further in the BDOP as required under Clause 55 of the Water Licence.

Briefly; the existing conventional water treatment system for addition of lime and flocculant would be retained during the commissioning period (active reclamation) of the underground water treatment process. This is to provide a contingency for final polishing of effluent as steady state conditions are being established in the underground *in situ* treatment system.

Once treatment is established underground and the site moves into post closure, the setting ponds will be converted to a bioreactor treatment system, to allow for a more passive final polishing step. Water quality will be monitored at both the outlet from the underground for assessment of treatment effectiveness, as well as the final point of discharge from the pond.

In the Reclamation and Closure Plan, it was proposed to convert the ponds to bioreactors while the mine is flooding. As part of advancing this design, and the design of other *in situ* treatment systems across the District, it is being considered that it may be prudent to retain conventional water treatment capability while the mine is flooding and the conditions for the biological treatment are being established, perhaps one to two years. Based on experience at Silver King, the amount of reagent that could be required is minimal. There is no material change to operator time (labour) as this would be done as part of routine monitoring and maintenance.

The construction of the bioreactor in one of the ponds can be done while using the other for treatment, followed by the second pond once the underground treatment is operating at steady conditions. The decisions on timing for conversion of the ponds to bioreactors would be based on water flow and water chemistry. The specifics of this change will be documents in the update to the Reclamation and Closure Plan, due by November 27, 2021.



TAG	DESCRIPTION
P-5000	BOOSTER PUMP
P-5001	METERING PUMP
TK-5000	CARBON STORAGE TANK
E-5000	HEATER WITH THERMOSTAT
PB-500	pH/TEMP/ORP/SPEC. COND. PROBE
FQ-500	FLOW METER
FQ-501	FLOW METER
FQ-502	FLOW METER
PY-500	PRESSURE TRANSDUCER
PY-501	PRESSURE TRANSDUCER - BULKHEAD WATER PRESSURE
FC-500	PROGRAMMABLE LOGIC CONTROLLER
LI-500	LEVEL INDICATOR
SM-500	STATIC MIXER
HA-500	BALL VALVE
HA-501	CHECK VALVE
HA-502	ISOLATION VALVE
HA-503	CHECK VALVE
HA-504	BALL VALVE
HA-505	BALL VALVE
HA-506	GATE VALVE
HA-507	GATE VALVE
HA-508	GATE VALVE
CV-500	THROTTLING VALVE

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-02-05	Draft for review	A	KAB	--

NOTES:

1) Treatment will be performed in treatment campaigns periodically as necessary to maintain low redox potential, and low zinc.
2) A centrifugal booster pump will be installed near the bulkhead, allowing for water to be pumped from the mine, amended with carbon, and injected back underground
3) A throttling valve will control the pump speed.
4) System's flow rate and pressure will be monitored, with carbon injection proportional to flow rate. Monitoring information of all adit discharge will be continuously monitored with datalogging field parameters: specific conductivity, temperature, ORP, pH, and pressure behind the bulkhead.
5) When in compliance, water will be released to the environment.

ALEXCO ENVIRONMENTAL GROUP

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No.: AKHM-13-01-D2601

Bellekeno Closure Treatment System

Piping & Instrumentation Diagram

Figure 3-1

REVISION A	2018-02-05	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: EJL	REVIEWED BY: JMH

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\2-Bellekeno\D-Process\Bellekeno\PID DWG\AKHM-13-01-D-2601.dwg (last edited by: KBoldt; 2018/02/15 - 2:32 PM

4. PLANT OPERATION

4.1 IN SITU SYSTEM

The following defines the key process indicators that indicate the system is functioning as designed:

- Adit discharge water is to be sampled weekly and analyzed for DOC, and total and dissolved metals to inform target setting of future carbon amendment campaigns; and
- Molasses will be used as the carbon source for the commissioning stage. The duration of treatment between injections should progressively increase throughout the commissioning stage until it reaches greater than 6 months between injection events and the EQS/load reduction targets for zinc and cadmium are met.

The following parameters will be used to determine the end of the commissioning phase as basis for confirming the treatment system is meeting design specifications:

- The effluent being discharged into the environment meets the commissioning threshold for cadmium and zinc for more than 6-month period between carbon injections. The commissioning threshold is defined as 20% below the EQS/50% load reduction, which is an estimate of the expected future EQS defined in the WUL. At this point the carbon source will be switch from molasses to glycerol; and
- No major electrical, mechanical, instrumentation/process control or civil failures for at least 3 months.

4.2 START-UP PROCEDURE – CARBON AMENDMENT

Prior to starting any carbon amendment procedure, ensure there is adequate inventory of carbon source available in the tank. If not, perform makeup procedures as required as outlined in Section 4.5.1.

Startup of the carbon amendment system is performed as follows:

1. Inspect and ensure all valves on the circulation line are open allowing an unobstructed flow path of water to the injection locations;

2. Start the circulation pump from its variable frequency drive and set the flow rate to the circulation target;

3. Throttle the hand valves as required to balance flow between them. Verify the flow rates in each line with a portable doppler flow meter as required;

4. Ensure carbon pump isolation valves are open to allow carbon input into the circulation line; and

5. Start the carbon pump from its variable frequency drive and set the injection flow rate to the carbon input target. Verify the carbon flow with a graduated cylinder and stopwatch timer.

4.3 SHUTDOWN PROCEDURE – CARBON AMENDMENT

Shutdown of the carbon amendment system is performed as follows:

1. Stop the carbon pump from its variable frequency drive. Shut isolation valves;

2. If the shutdown is going to for an extended period (for the season), disconnect the suction and discharge lines of the carbon pump and run it for a short period to ensure all fluid is drained from the pump and lines. Direct these small flows into a bucket to avoid a mess on the floor;

3. Stop the circulation well pump from its variable frequency drive; and

4. If the shutdown is going to last for an extended period or may persist through freezing outside temperatures, drain all water from the circulation line by first opening vent line valves and drain valves to drain water from the well injection lines.

4.4 ROUTINE CHECKS AND SAMPLES

In future revisions of this document, a detailed table will be prepared of the required checks and frequency for operation of the in situ treatment systems. In addition to standard system operations, the key parameter is the adit discharge water chemistry, to be analysed both at the onsite laboratory on at least a weekly basis, with monthly samples at an accredited analysis laboratory.

4.4.1 MAINTENANCE INJECTIONS

Total and dissolved cadmium and zinc concentrations in the effluent water should be plotted as a function of time to monitor changes in response to carbon addition. These should also be compared with plots of adit discharge to evaluate the effects of seasonal changes in flow on cadmium and zinc concentrations. For purposes of design, the following events were evaluated as triggers for a regular maintenance injection of glycerol:

- Total cadmium or zinc concentrations equal to or greater than 80% of the EQS; or
- Increasing trend (accounting for any documented seasonality) is evident in the total cadmium or zinc concentration data that indicates the 50% load reduction target or EQS will be exceeded within 3 months; or
- The seasonal behaviour of total cadmium and zinc concentrations in the adit discharge indicates that exceedance of the 50% load reduction target or EQS may be reasonably expected during the next seasonal high flow event (e.g., spring freshet) that is due within the next 3 months.

4.4.2 UPSET CONDITIONS

The following examples constitute upset conditions that may be encountered during routine operations:

1. Sharp increase in adit discharge that is equal to or greater than the 95th percentile adit discharge rate;

2. Insufficient flow from for reagent injection e.g., pipeline blockage due to frozen water or precipitate scaling;

3. Total cadmium or zinc concentrations increase sharply to greater than or equal to the EQS; and

4. Total suspended solids (TSS) exceeds the EQS of 25 mg/L (e.g., during high flow periods such as spring freshet which lower the HRT in the ponds for settling to occur).

Responses to the above conditions will be detailed as part of the next revision of the OMP, closer to implementation. Responses would include:

1. Although there should still be adequate HRT to maintain treatment at higher flow, the following precautionary measures should be undertaken:

    a. Collect a sample of the adit discharge water and submit to site lab for total zinc analysis.

    b. Prepare for maintenance carbon injection between May and October or possible batch alkali addition in settling pond. If high flow conditions persist, consider implementation of surface reclamation to divert significant inflows to mine workings.

2. Inspect injection pipeline and steam flush/de-scale if needed;

3. Implement short-term batch addition of lime to the settling pond(s) to treat water and perform a maintenance carbon injection;

4. Implement short-term batch addition of lime to the settling pond(s) to raise pH above 6.5 until high flows abate; and

5. Implement short-term batch addition of flocculant to lower TSS within settling pond.

4.5 CHEMICAL REAGENT PROCEDURES

4.5.1 IN SITU CARBON TANK MAKEUP

Makeup of carbon amendment reagent is similar across all three *in situ* installations. The general procedure is outlines as follows:

For molasses makeup:

1. Molasses is highly viscous and needs to be diluted 1:1 with water. Water should always be added to the storage tank first. Determine the tank level that needs to be made up and divide by two to determine the water level addition required;

2. Connect the water delivery truck discharge line to the tank offloading line. Pump water into the tank to add the target level to the tank;

3. Connect the molasses delivery truck discharge line to the offloading line. Pump molasses into the tank to add the target level to the tank; and

4. Reconnect the water delivery truck discharge line to the offloading line and flush the line with water as required to clear residual molasses.

For glycerol makeup:

1. Glycerol is a viscous fluid which freezes at approximately 18°C in its pure form. It requires dilution to improve its flowing properties and lower its freezing point (approximately -45°C). Water should always be added to the storage tank first;

2. Connect the water delivery truck discharge line to the tank offloading line. Pump water into the tank to add the target level to the tank;

3. Connect the glycerol delivery truck discharge line to the offloading line. Pump glycerol into the tank to add the target level to the tank; and

4. Reconnect the water delivery truck discharge line to the offloading line and flush the line with water as required to clear residual glycerol.

4.5.2 SECONDARY TREATMENT LIME TANK MAKEUP

During active reclamation, makeup of lime for secondary treatment is performed as follows:

1. Connect the lime slurry truck to the tank offloading line and begin pumping lime into the tank;

2. If the lime tank is being filled from empty, do not start the agitator until the level in the tank reaches at least 50%. Damage to the agitator drive hub can occur if it is run without adequate level in the tank; and

3. Flush the offloading line with water to remove any potential for line plugging.

4.5.3 SECONDARY TREATMENT POLYMER TANK MAKEUP

During active reclamation, makeup of polymer for secondary treatment is performed as follows:

1. If the polymer tank is being filled from empty, do not start the agitator until the level in the tank reaches at least 50%. Damage to the agitator drive hub can occur if it is run without adequate level in the tank. Otherwise start the agitator, 102-AG-406;

2. Add water to the tank by opening HV-403 and throttling HV-401 to provide backpressure. Fill the tank to the target level as per the plant target sheet;

3. Add concentrated polymer to the tank by turning on the polymer tote pump 102-PP-407. Run the pump for the duration specified in the plant target sheet; and

4. Allow the polymer to mix for one hour before shutting down the agitator, 102-AG-406.

5. ROUTINE PLANT MAINTENANCE

Continued reliability of the *in situ* and secondary treatment systems requires routine maintenance of the process equipment and instrumentation. Operating and maintenance plans for all installed equipment and instrumentation will be appended to a future revision of this plan closer to implementation. Maintenance and calibration of equipment should be performed as per instructions and frequency prescribed in these manual.

6. PLANT SAFETY AND EMERGENCY PREPAREDNESS

6.1 PERSONAL PROTECTIVE EQUIPMENT

Refer to the Emergency Response Plan for details on the emergency contact list. Contact the water treatment superintendent for immediate assistance.

Personal protective equipment (PPE) will always be used within the Water Treatment Plant (WTP). Standard PPE to be worn at all times when working in *in situ* treatment buildings:

- Hardhat;
- CSA approved safety footwear;
- Safety glasses;
- Long sleeve shirt and pants;
- High visibility vest; and
- Ear plugs (where designated with signage).

There are additional PPE requirements for working with and handling the various chemicals used, outlined in Section 6.2 below.

6.2 CHEMICAL SAFETY

This section outlines general safety precautions, PPE, and spill response to be used when working with the various plant chemicals that are currently specified. A comprehensive summary of chemical safety, toxicological information and handling guidelines can be found on the Safety Data Sheets (SDS) in Appendix 1 (for future revision of this document). Should the chemical change the safety procedures will be revised accordingly

The locations of eyewash bottles in the various *in situ* and secondary treatment areas are denoted on general arrangement drawings attached in Appendix 2 (for future revision of this document). Ensure the eyewash bottle is in the designated location before any chemical handling occurs. Inspect the eyewash bottle on a monthly basis for expiry.

6.2.1 HYDRATED LIME

Hydrated lime (calcium hydroxide) is an insoluble white powder and a strong base when combined with water. Lime is a respiratory and skin/eye irritant. In addition to the standard PPE, the following additional PPE should be worn when handling hydrated lime:

- Nitrile or otherwise chemical resistant gloves;
- Respirator with purple dust cartridges installed (if contact with airborne dry lime powder is expected);
- Face shield (if risk of chemical splash is present); and
- Chemical resistant footwear (if risk of walking through pooled slurry is present).

In the event of a spill of hydrated lime, collect slurry in a contained area and transfer to an appropriate container for reuse or disposal.

6.2.2 DREWFLOC 2499 OR EQUIVALENT

Drewfloc 2499 is a soluble emulsion polymer and is an eye irritant. In addition to the standard plant PPE, the following additional PPE should be worn when handling polymer solution:

- Nitrile or otherwise chemical resistant gloves; and
- Face shield (if risk of chemical splash is present).

Polymer spills can be very slippery, so it is advised to wear slip resistant footwear if risk of walking through floor where polymer may be present or have spilled. In the event of a spill of polymer, cover the spill in absorbent material to absorb all moisture and then clean up with a shovel.

6.2.3 GLYCEROL

Glycerol is a colourless, odourless, viscous liquid. Glycerol is a slight skin and eye irritant. In addition to the standard PPE, the following additional PPE should be worn when handling glycerol solution:

- Nitrile or otherwise chemical resistant gloves.

In the event of a glycerol spill use absorbent material to contain the spill and then collect in an appropriate container for disposal or reuse. Small amounts can be diluted with water to rinse clean.

6.2.4 MOLASSES

Molasses is a dark coloured, viscous sweet-smelling liquid. Molasses is a slight skin and eye irritant. In addition to the standard PPE, the following additional PPE should be worn when handling molasses solution:

- Nitrile or otherwise chemical resistant gloves.

In the event of a molasses spill use absorbent material to contain the spill and then collect in an appropriate container for disposal or reuse. Small amounts can be diluted with water to rinse clean.

6.3 FIRE

The locations of fire extinguishers within the various *in situ* and secondary treatment areas are shown in general arrangement drawings attached in Appendix 2. In the event of a fire, workers may extinguish the fire if they are trained on using fire extinguishers and the fire is small (generally no larger than a small waste-paper basket). If the fire is too big to extinguish, all workers will evacuate the building.

In the event of fire, site security should be contacted immediately to communicate with emergency dispatch.

6.4 WINTER CONDITIONS

Winter conditions including snow and ice accumulation will be present around the *in situ* and secondary treatment buildings several months of the year. Weather appropriate clothing and slip resistance footwear should always be worn when working outside. Snow and ice accumulation from doorways should be cleared within 24 hours.

7. REFERENCES

Alexco Keno Hill Mining Corp. (AKHM), 2019. *Reclamation and Closure Plan Keno District Mine Operations Keno Hill Silver District, Rev 5.1*.

APPENDIX A.
SDS Sheets

For future revision of this document

APPENDIX B.
Drawings

For future revision of this document

APPENDIX C.

Process Control Narrative

For future revision of this document

APPENDIX 3.10

BIOREACTOR DESIGN AND OPERATION PLAN

KENO HILL SILVER DISTRICT MINING OPERATIONS

BIOREACTOR DESIGN AND OPERATION PLAN

November 2023

Prepared for:

HECLA YUKON

Prepared by:

TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 PURPOSE OF THE PLAN 1
1.2 SCOPE OF THIS DOCUMENT 1

2. LOCATION AND DESCRIPTION 2

2.1 BELLEKENO 2
2.2 FLAME & MOTH 2

3. PREVIOUS STUDIES 4

4. PROCESS DESCRIPTION 5

4.1 BELLEKENO 5
4.1.1 DESIGN BASIS 5
4.1.2 PRELIMINARY DESIGN 5
4.1.3 DETAILED DESIGN AND SCHEDULE 9
4.1.4 PLANT COMMISSIONING AND OPERATION 9
4.1.4.1 COMMISSIONING 10
4.1.4.2 REAGENT MAKEUP AND ADDITION 10
4.1.4.3 START-UP PROCEDURES 10
4.1.4.4 SHUTDOWN PROCEDURES 10
4.1.4.5 MONITORING AND INSPECTIONS 10
4.1.4.6 MAINTENANCE 11
4.2 FLAME & MOTH 11
4.2.1 DESIGN BASIS 11
4.2.2 SCHEDULE 11
4.2.3 CONCEPTUAL DESIGN 12
4.2.4 DETAILED DESIGN AND SCHEDULE 19

5. REFERENCES 20

LIST OF FIGURES

Figure 4-1: Bellekeno Closure Treatment System, Piping & Instrumentation Diagram 6
Figure 4-2: Bellekeno 625 Bioreactor Design 7
Figure 4-3: Bellekeno 625 Bioreactor Design Sections 8
Figure 4-4: Flame and Moth and Mill Ponds As-Built Site Plan 13
Figure 4-5: Flame and Moth Water Treatment Pond As-Built Cross Sections 14
Figure 4-6: Mill Pond As-Built Cross Sections 15

1. INTRODUCTION

1.1 PURPOSE OF THE PLAN

In 2022 Hecla Mining Company acquired Alexco Resource Corporation (Corp.) which was developing the Keno Hill Silver District as Alexco Keno Hill Mining Corp. (AKHM). The mining district includes five major deposits, including Bellekeno. AKHM will be operating a semi-passive water treatment system at the Bellekeno Mine after completion of mining. This document has been prepared to fulfill the requirements of Clause 55 of Water Licence QZ18-044 relating to the secondary treatment as follows:

> 55. Within 90 days of the effective date of this Licence, the Licensee must submit to the Board and implement an updated Bioreactor Design and Operation Plan (BDOP) which addresses the proposed Bellekeno and Flame and Moth bioreactors.

1.2 SCOPE OF THIS DOCUMENT

This document provides the preliminary design for the Bellekeno bioreactor, and the plan for detailed design, commissioning, and operations.

The Flame & Moth bioreactor is discussed conceptually. Drawings of the pond which would be used as the bioreactor are provided and discussed at a conceptual level only. At this time, there is no flow of water from the mine or mill site that would require treatment in a bioreactor, therefore, it is not possible to precisely size and design a bioreactor treatment system beyond a conceptual level.

2. LOCATION AND DESCRIPTION

2.1 BELLEKENO

The Bellekeno mine area is located approximately 3 km east of Keno City within the Keno Hill Silver District. The water management and treatment ponds for the Bellekeno Mine are shown in Photo 2-1. The Bellekeno Mine consists of the underground workings and surface adit entrances (Bellekeno East portal and decline and the Bellekeno 625 adit), water treatment facility and associated buildings and infrastructure.



Photo 2-1: Bellekeno 625 WTP Area Overview

2.2 FLAME & MOTH

The Flame & Moth mine area is located adjacent to the District Mill. Water treatment for Flame & Moth is done in the mill facility. There are two ponds at the Mill: one for mill process water (above and left on photo), and the second for the water treatment circuit effluent which is called the Flame & Moth pond (bottom, centre of photo). The District Mill, the Flame & Moth portal, and the ponds are shown in Photo 2-2.



Photo 2-2: Flame & Moth and District Mill Area Overview

3. PREVIOUS STUDIES

A bioreactor was constructed and operated from 2009-2011 at Galkeno 900 as part of the District-wide closure planning process. The results of the Galkeno 900 bioreactor performance were included as Appendix 1.4 of the site Reclamation and Closure Plan (AKHM, 2021). That information supports this approach in closure of the Bellekeno mine and the design.

The treatment mechanism in the bioreactor is essentially the same as in the mine workings (the *in situ* treatment). The primary mechanism is reductive precipitation under anaerobic conditions. In addition, in the proposed bioreactor ponds, there can be some (seasonal) treatment of parameters such as ammonia by oxidation. Longer term studies in larger ponds and open pits following closure have shown that there are additional treatment mechanisms that can be effective at the surface of the bioreactor, such as sorption and chelation reactions with biological material. At this time, the biologically driven processes under anaerobic conditions such as sulphate reduction are the only mechanisms relied upon for metal removal in these bioreactors. These bioreactors are simply polishing processes and contingency measures.

4. PROCESS DESCRIPTION

4.1 BELLEKENO

4.1.1 DESIGN BASIS

The proposed bioreactor treatment is a final polishing step for the treated mine water from the Bellekeno underground mine workings, post closure. The lined ponds at Bellekeno 625 will be converted into a bioreactor and serve as a contingency treatment system. Although the *in situ* treatment of Bellekeno is expected to produce direct discharge compliant water, an additional contingency treatment system in the form of a bioreactor adds additional confidence and conservatism in the water management plan for Bellekeno upon closure.

However, as discussed in the Operations and Maintenance Plan for the Bellekeno *in situ* Treatment System (AKHM 2020a), the existing conventional water treatment system for addition of lime and flocculant would be retained during the commissioning period (active reclamation) of the underground water treatment process. This is to provide a contingency for final polishing of effluent as steady state conditions are being established in the underground *in situ* treatment system. Once treatment is established underground and the site moves into post closure, the settling ponds will be converted to a bioreactor treatment system to allow for a more passive final polishing step.

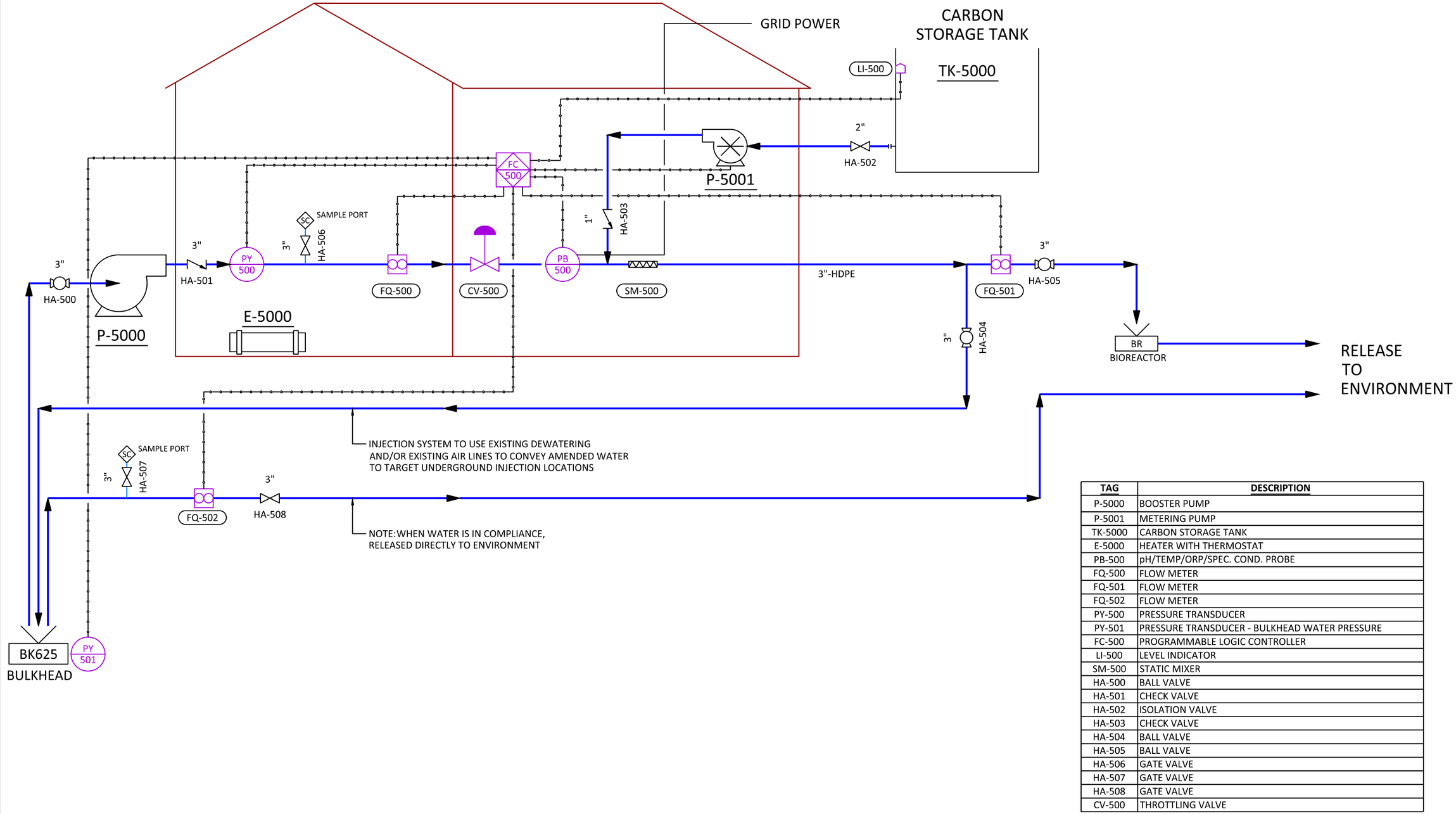
Water quality will be monitored at both the outlet from the underground for assessment of treatment effectiveness, as well as the final point of discharge from the pond.

4.1.2 PRELIMINARY DESIGN

The Bellekeno post closure water treatment system is shown in Figure 4-1. The bioreactor is also shown on this figure. The next two drawings show specifics of the bioreactor, Figure 4-2 and Figure 4-3. These figures are extracted from the AKHM Reclamation and Closure Plan (AKHM, 2023).

The bioreactor construction is a relatively simple process, since the existing ponds will be used. The construction of the adit plug and piping is included in the design of the underground mine water *in situ* system and not repeated herein. The steps for bioreactor construction include:

1. Complete detailed water chemistry analyses of the underground water chemistry and reagent requirements to determine the schedule for conversion of ponds to bioreactors. Confirm transition plan for managing water quality in the interim;
2. Remove (vacuum truck) remaining sludge in Bellekeno lined ponds;
3. Install piping distribution system in bottom of ponds;
4. Install HDPE cell dividers and fill ponds with clean gravel sourced from adjacent placer mine. Install geotextile barrier over surface of gravel;
5. Place 2 metre soil cover over top of geotextile;
6. Complete tie-ins with the existing water management piping and instrumentation; and
7. Use underground mine water to flow through bioreactor, and commission.



TAG	DESCRIPTION
P-5000	BOOSTER PUMP
P-5001	METERING PUMP
TK-5000	CARBON STORAGE TANK
E-5000	HEATER WITH THERMOSTAT
PB-500	pH/TEMP/ORP/SPEC. COND. PROBE
FQ-500	FLOW METER
FQ-501	FLOW METER
FQ-502	FLOW METER
PY-500	PRESSURE TRANSDUCER
PY-501	PRESSURE TRANSDUCER - BULKHEAD WATER PRESSURE
FC-500	PROGRAMMABLE LOGIC CONTROLLER
LI-500	LEVEL INDICATOR
SM-500	STATIC MIXER
HA-500	BALL VALVE
HA-501	CHECK VALVE
HA-502	ISOLATION VALVE
HA-503	CHECK VALVE
HA-504	BALL VALVE
HA-505	BALL VALVE
HA-506	GATE VALVE
HA-507	GATE VALVE
HA-508	GATE VALVE
CV-500	THROTTLING VALVE

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2018-02-05	Draft for review	A	KAB	--

NOTES:

1) Treatment will be performed in treatment campaigns periodically as necessary to maintain low redox potential, and low zinc.
2) A centrifugal booster pump will be installed near the bulkhead, allowing for water to be pumped from the mine, amended with carbon, and injected back underground
3) A throttling valve will control the pump speed.
4) System's flow rate and pressure will be monitored, with carbon injection proportional to flow rate. Monitoring information of all adit discharge will be continuously monitored with datalogging field parameters: specific conductivity, temperature, ORP, pH, and pressure behind the bulkhead.
5) When in compliance, water will be released to the environment.

ALEXCO ENVIRONMENTAL GROUP

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No.: AKHM-13-01-D2601

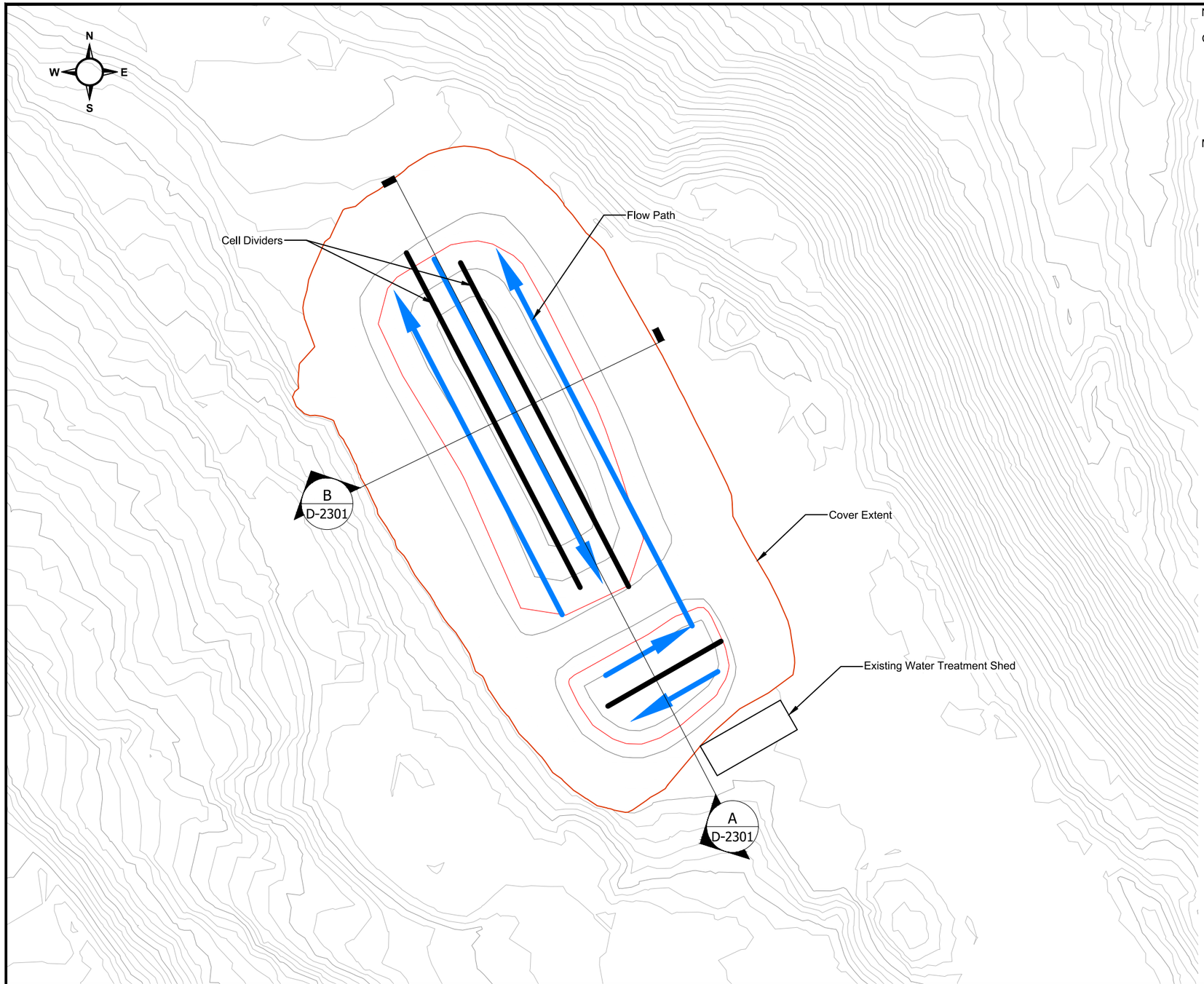
Bellekeno Closure Treatment System

Piping & Instrumentation Diagram

Figure 4-1

REVISION A	2018-02-05	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: EJL	REVIEWED BY: JMH

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\2-Bellekeno\D-Process\Bellekeno\PID DWG\AKHM-13-01-D-2601.dwg (last edited by: KBoldt; 2018/02/15 - 2:32 PM



Notes:

Conceptual Design Assumptions:

1. Divide Pond 1 in to two zones with an HDPE liner divider. Two cells of approximately 6 m x 15 m
2. Divide Pond 2 in to three zones with HDPE liner dividers. Three cells of approximately 5.3 m x 42 m
3. Total Volume = 2,800 m^3
4. Porosity = 40%
5. Flowrate = 4 lps
6. Retention Time = (2800 m^3 x 0.40)/4 lps = 3.1 days

Material Quantities:

Placer Gravel Rock Substrate:	2,800 m^3
Geotextile Barrier:	1,410 m^2
Soil Cover:	4,010 m^3

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan

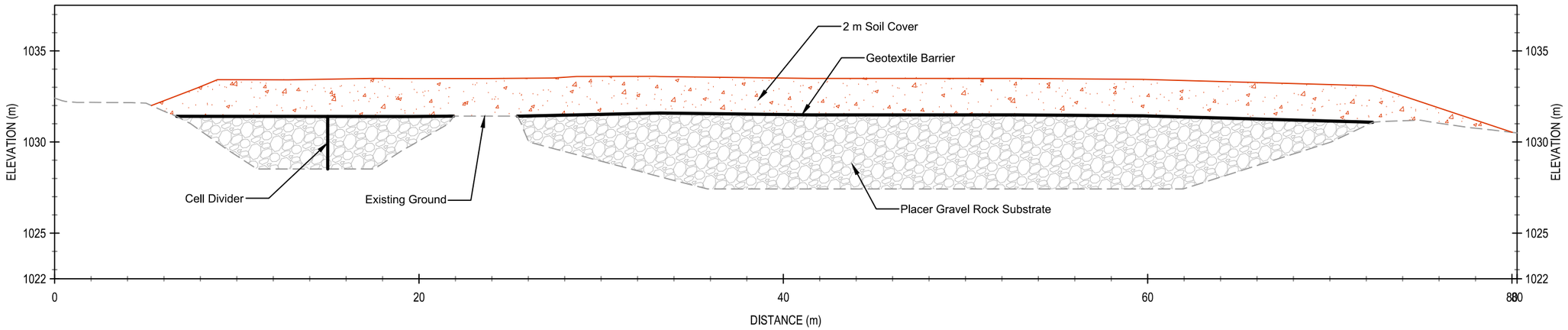
Drawing No: AKHM-13-01-D-2102

Figure 4-2

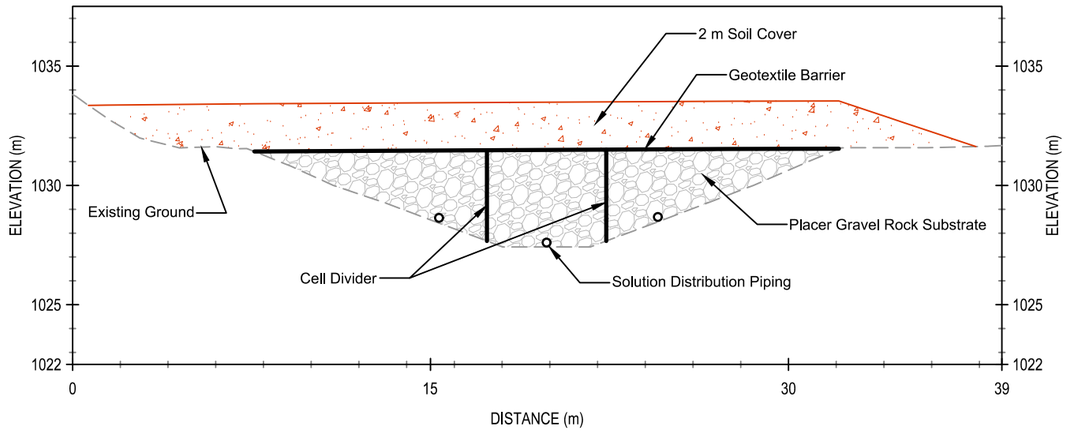
Bellekeno 625
Bioreactor Design

REVISION: A	2018-02-01	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: –	REVIEWED BY: KSW

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\2-Bellekeno\D-Process\AKHM-13-01-D-2102-BK625Bioreactor.dwg (last edited by: KBoldt: 2018/02/15 - 2:17 PM



Section A



Section B

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ALEXCO ENVIRONMENTAL GROUP

AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-D-2301

Figure 4-3

Bellekeno 625
Bioreactor Design Sections

REVISION: A	2018-02-01	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: –	REVIEWED BY: KSW

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\2-Bellekeno\D-Process\AKHM-13-01-D-2102-BK625Bioreactor.dwg (last edited by: KBoldt; 2018/02/15 - 2:17 PM

4.1.3 DETAILED DESIGN AND SCHEDULE

As noted in other documents, it is anticipated that the existing ponds may be retained as conventional water treatment facilities for up to two years following cessation of mining. The anticipated program is as follows:

- Once safe access to the Bellekeno underground is established and mine dewatering advances, sample underground water chemistry;
- Update calculations of time to flooding, hydraulic residence time, and underground mine water quality;
- Using experience from elsewhere on site (Silver King), estimate the range of water chemistry and time period to reach "steady state" of the underground *in situ* biological treatment (equivalent to the commissioning period for the underground treatment system);
- From those data, assess requirements for secondary treatment during active reclamation. This would include:
    - Requirements for conventional lime/flocculant treatment; and
    - Residence time required in ponds and therefore schedule to convert ponds to bioreactors.
- Revise design of bioreactor and plan schedule for construction, to provide residence time to treat effluent water and achieve compliance for discharge;
- Update Reclamation and Closure Plan;
- Update design report and submit to Yukon Water Board; and
- Construct and commission.

The following contingency measures will be considered as part of the bioreactor construction and commissioning:

- The construction of the bioreactor will be scheduled during periods of lower flow rate/loading.
- The mine workings would be pumped down partially and treated in the active water treatment plant.
- The active water treatment plant will remain in place as a contingency during commissioning of in situ.
- Once the in situ water treatment is commissioned, the pond would be converted into a bioreactor. During commissioning of the bioreactor lime may be added to the bioreactor intake if required to meet compliance.

4.1.4 PLANT COMMISSIONING AND OPERATION

The following procedures are described for the operation of the bioreactors. This is based on the current assumption under the Water Licence that no conventional water treatment is required during active

reclamation or post closure. This would be amended as required as a result of the detailed design that will be completed during mining at Bellekeno (anticipated for Q4 2020 and Q1 2021).

4.1.4.1 *Commissioning*

Water from the flooded underground would be piped to the settling ponds currently in place at 625 for commissioning and optimization of the bioreactor. Flow would be controlled to prevent disturbance of the soil layer.

4.1.4.2 *Reagent Makeup and Addition*

Reagents are required for the commissioning of this system to provide a carbon source to develop the biomass. Periodic reagent addition may be required for ongoing operation of the bioreactor. However, the specific reagent addition requirements will depend on the required biomass which, in turn, is based on the influent water chemistry. This will be defined as noted above in Section 4.1.3.

The reagent makeup and handling systems will be the same systems used for the *in situ* treatment underground. The carbon sources that can be used are molasses or an alcohol such as ethanol or glycerol.

4.1.4.3 *Start-Up Procedures*

There are no start-up procedures required for this passive treatment system, in the traditional sense of plant operation "start-up" and "shutdown". Reagents will be added periodically to provide nutrition for development of the biomass.

Water flow to the bioreactors is managed as part of the Bellekeno mine water management and treatment systems and controls (AKHM 2020a).

4.1.4.4 *Shutdown Procedures*

There are no shutdown procedures required for this passive treatment system, in the traditional sense of active water treatment plants.

Water flow from the bioreactors will be managed to maintain design freeboard requirements. The piping and discharge systems between and from the ponds will be designed to allow control of non-compliant discharge. However, this is a polishing system and not primary treatment. The primary control is managing discharge from the underground mine at the Bellekeno 625 adit (AKHM 2020).

4.1.4.5 *Monitoring and Inspections*

Water chemistry will be monitored within the ponds and at the influent and effluent points, during the initial period of operation to confirm effective performance. The permitted effluent point at the outlet from the final pond will be monitored as prescribed for active reclamation and closure. The mine water chemistry (which is the pond influent) will be monitored in parallel with the effluent monitoring. Samples will be collected both for analysis on site (general parameters and zinc total and dissolved), as well as for analysis at external laboratories as described in the AKHM Monitoring, Surveillance and Reporting Plan (AKHM 2020b).

Monitoring for physical stability would continue to be done as part of the AKHM site inspection procedures. The ponds would continue to be included in the AKHM annual inspections by a qualified third party.

4.1.4.6 *Maintenance*

Maintenance of these facilities will be included in the operations and maintenance plans for the Bellekeno site, as documented in part in the Bellekeno *in situ* OMP (AKHM 2020a).

4.2 FLAME & MOTH

4.2.1 DESIGN BASIS

The contingency for a bioreactor at the Flame & Moth site is proposed for the potential requirement post-closure to treat either:

- Potential seepage from the dry stack tailings facility (the DSTF); and
- Potential discharge from the Flame & Moth underground mine.

During operations, any seepage from the DSTF is collected in a sump at the toe of the dry stack and piped to the mill pond. The physical system of drainage around the DSTF is specifically designed to identify any seepage and to monitor the flow and quality of that seepage. To date, there has been no seepage from the DSTF identified and only runoff from rain and snow melt conveyed to the Mill pond.

Tailings are filtered to approximately 10% moisture, placed in layers on the dry stack, compacted and then covered with up to 0.5 m of soil and vegetated. The final tailings surface is graded to shed precipitation and revegetated to encourage evapotranspiration. Thus, there is surface runoff from the facility, as intended by design. This, in turn, minimizes infiltration and the potential for seepage in the long-term.

Therefore, treatment after closure of the mine operations is not expected to be required for either based on:

- The DSTF is designed to "shed" water rather than collect water. There has been no seepage draining from the DSTF since it was constructed and commissioned in 2010; and
- The natural groundwater table at the Flame & Moth mine is approximately 20 m below the portal elevation. This has been confirmed by ongoing groundwater level monitoring. In fact, the mine was designed such that the portal would be above the final flooded elevation and there would be no discharge from the mine.

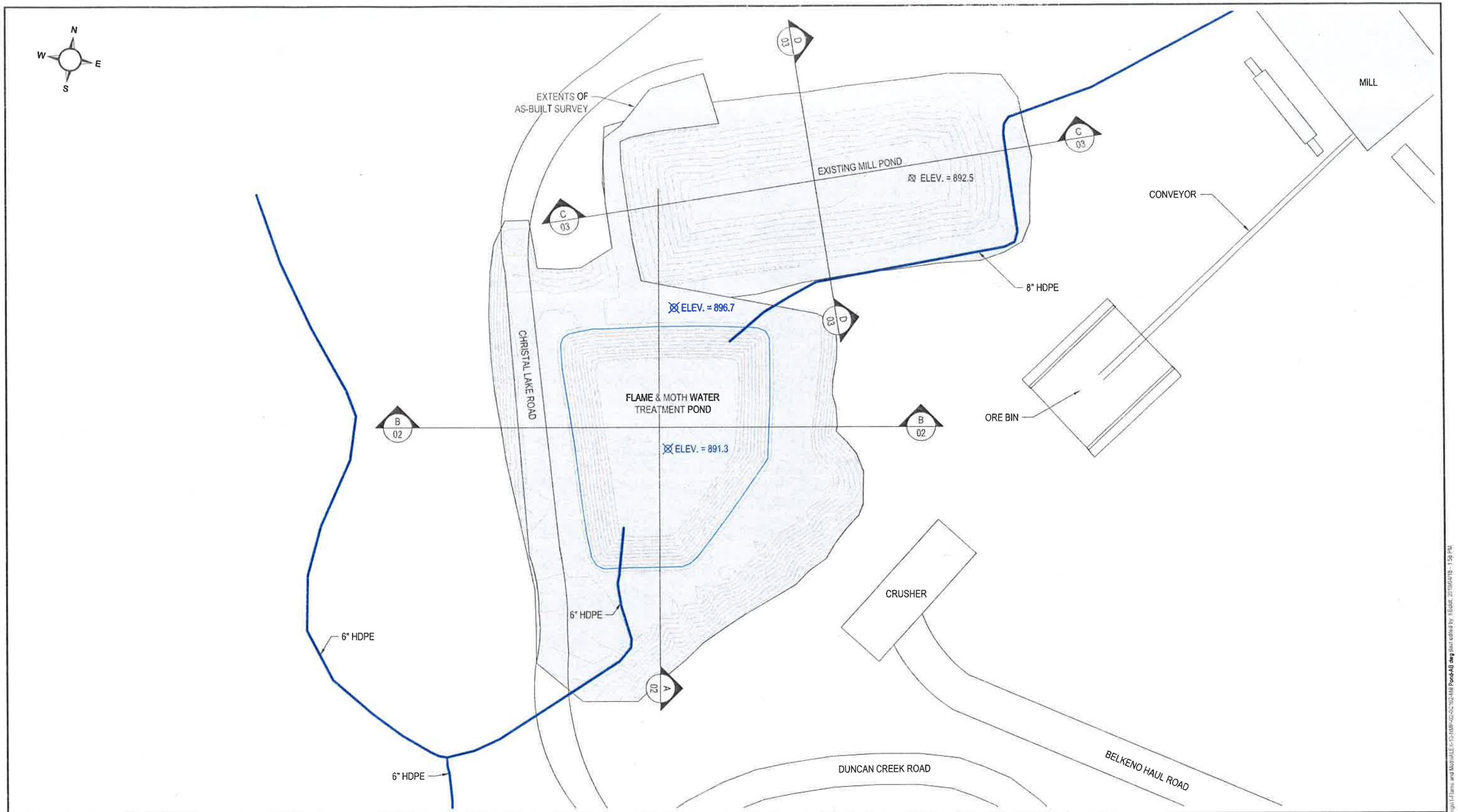
4.2.2 SCHEDULE

There is ongoing water management and water treatment at the mill area during operations, as there was during the temporary closure from 2013 till 2020. The pond levels are also actively managed to provide storage for design events. AKHM is currently resuming production and will continue to use both of these ponds for active water management during operations.

The planned mine life for AKHM at this time is seven years from start of production (~Q4 2020). Therefore, none of the ponds would be converted to a bioreactor in the near future.

4.2.3 CONCEPTUAL DESIGN

As shown in Photo 2.2, there are two ponds in the area of the Flame & Moth portal. A plan and sections of each of these ponds are provided in Figure 4-4, Figure 4-5 and Figure 4-6.



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2019-04-18	Draft for review	C	KB	KW
2019-04-13	Draft for review	B	KB	KW
2019-04-18	Draft for review	A	KB	KW

0 25m

Scale: 1:750 @ 11"x17"

APPROXIMATE AS-BUILT CONSTRUCTION VOLUMES FOR FLAME & MOTH POND(m^3)
CUT = 4685 m^3
FILL = 2265 m^3

NOTE
ORIGINAL GROUND CONTOURS FROM LIDAR DATA (DATED NOVEMBER 2014)

ALEXCO

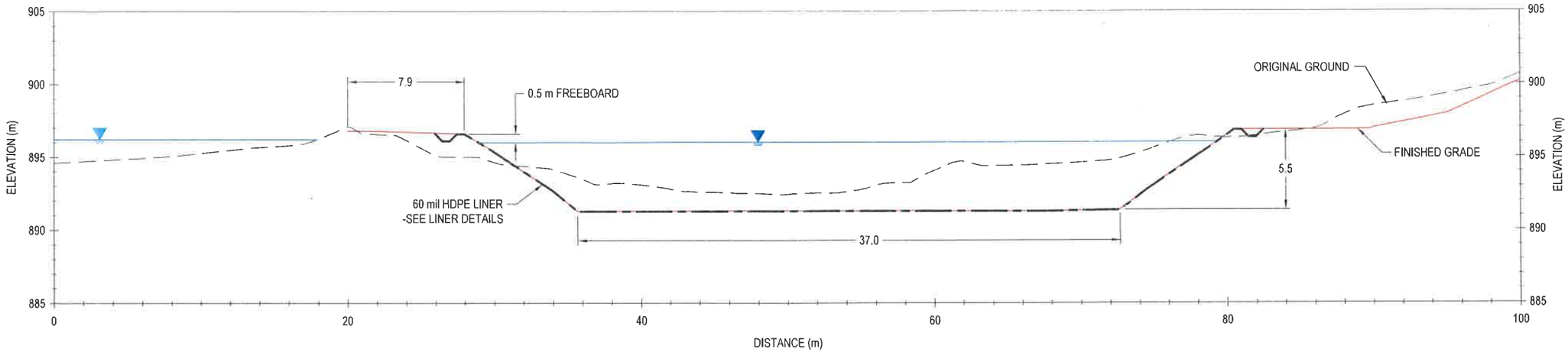
Flame & Moth
Water Use License
Drawing No: ALEX-13-NMP-02-0C102.01

Figure 4-4

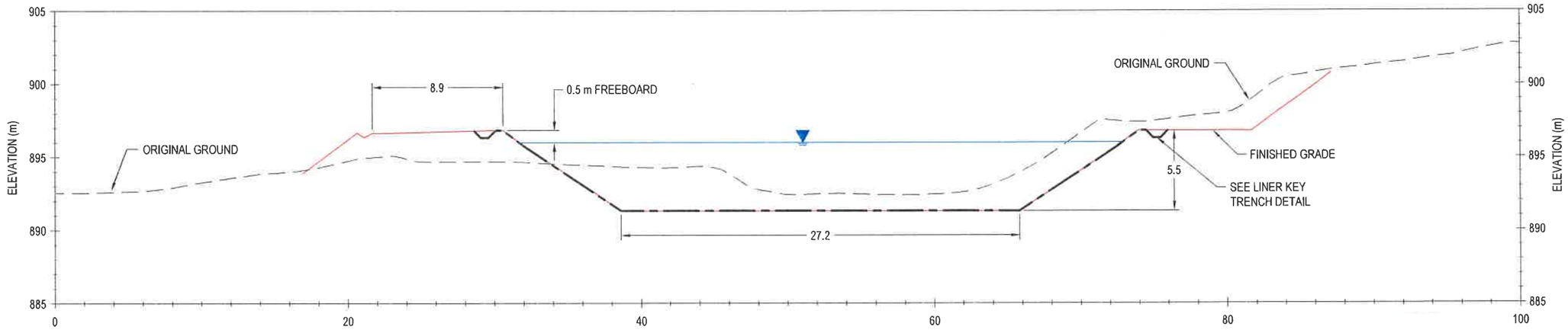
Flame & Moth and Mill Ponds As-Built Site Plan

REVISION: 0	2019-04-18	PROJECT No.: ALEX-13-NMP-02
DRAWN BY: KAB	DESIGNED BY: JP (EBA)	REVIEWED BY: NC

D:\Data\Active\Projects\Alexco-Keno Mines\Production\Drawings\Flame and Moth\ALEX-13-NMP-02\0C102\Mill Pond-AB.dwg [last edited by: KBabb, 2019/04/18 - 1:56 PM]



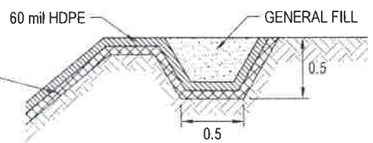
SECTION A - A'



SECTION B - B'



LINER DETAIL



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2019-04-18	Draft for review	B	KB	KW
2019-04-17	Draft for review	A	KB	KW

0 15m

Scale: 1:300 @ 11"x17"

NOTE: DETAILS NOT TO SCALE
ALL DIMENSIONS IN METERS UNLESS OTHERWISE DENOTED

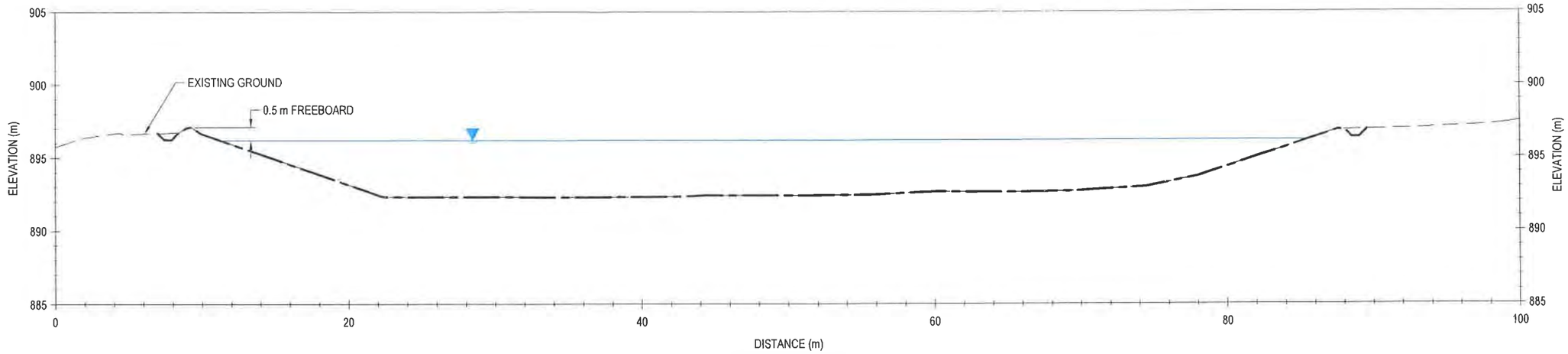
ALEXCO

Flame & Moth
Water Use License
Drawing No: ALEX-13-NMP-02-0C102.02

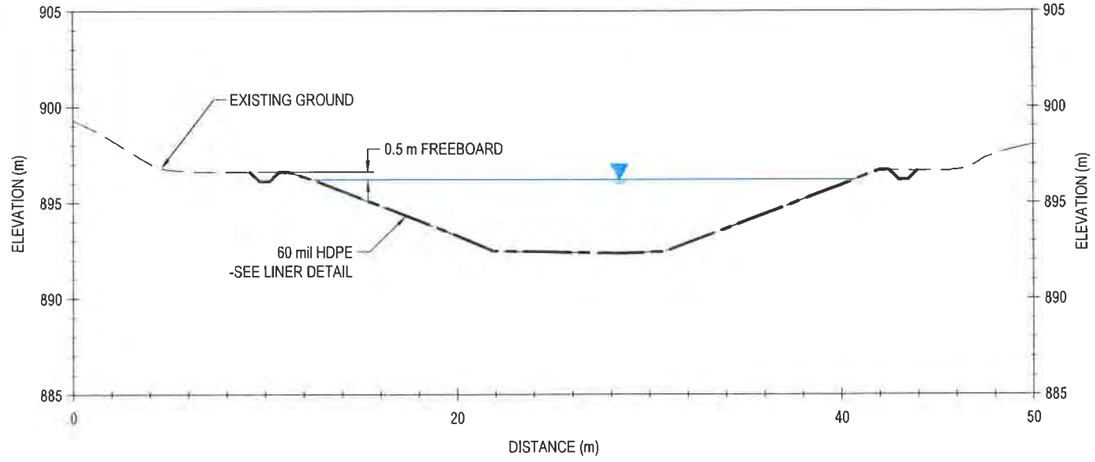
Figure 4-5

Flame & Moth Water Treatment Pond As-Built
Cross Sections

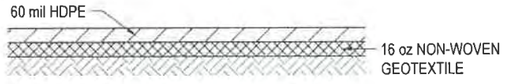
REVISION: 0	2019-04-18	PROJECT No.: ALEX-13-NMP-02
DRAWN BY: KB	DESIGNED BY: JP (EBA)	REVIEWED BY: NC



SECTION C - C'



SECTION D - D'



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2019-04-18	Stamped	0	KB	NC
2019-04-18	Draft for review	B	KB	KW
2019-04-18	Draft for review	A	KB	KW

0 15m

Scale: 1:300 @ 11"x17"

ALEXCO

Flame & Moth
Water Use License

Drawing No: ALEX-13-NMP-02-0C102.03

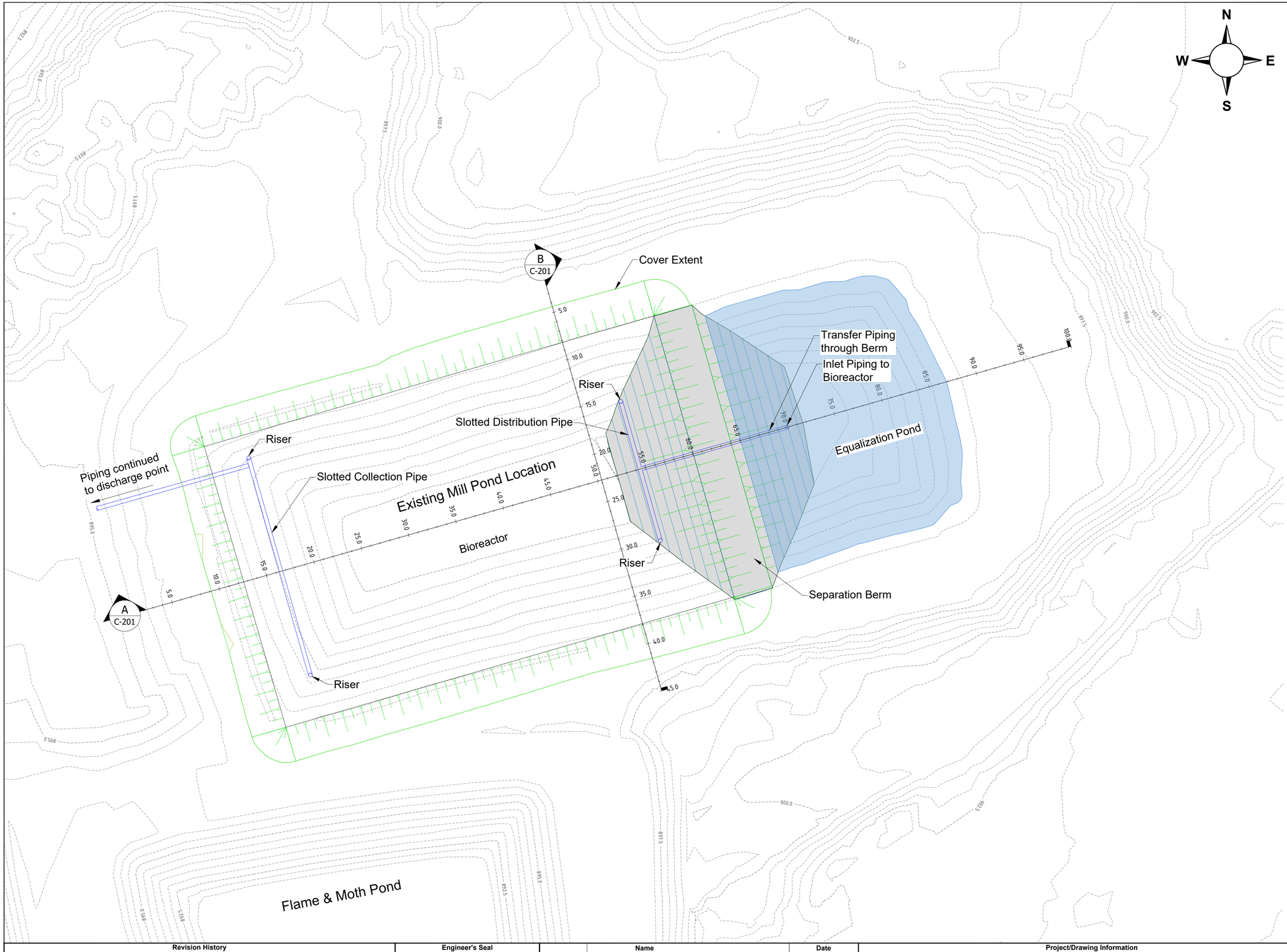
Figure 4-6

Mill Pond As-Built
Cross Sections

REVISION: 0	2019-04-18	PROJECT No.: ALEX-13-NMP-02
DRAWN BY: KB	DESIGNED BY: JP (EBA)	REVIEWED BY: NC

I:\Data\Alexco\Projects\13-NMP\02-0C102-Mill\Planning\Flame and Moth\FLE-13-NMP-02-0C102-Mill Pond-AB Dwg [Mod modified by: KSmith 2019/04/18 - 1:59 PM

The pond that is proposed to be used as the potential bioreactor is the smaller of the two, the "Mill" pond. The design storage volume of that pond is approximately 5,242 m^3., whereas the Flame and Moth pond has a storage volume of 6,993 m^3. Clearly both are much larger ponds than would be required for managing seepage from the DSTF. The conceptual design is to reduce the active storage volume by constructing an internal berm in the existing pond to separate it into an equalization pond and a placer gravel filled bioreactor. The bioreactor portion would require a 2.0 m thick soil cover to act as both a frost barrier and protection for humans and wildlife. Inlet piping would allow gravity flow from the equalization pond to the bioreactor, and collection piping at the opposite end of the bioreactor would allow for discharge of the treated water. Pipe risers at the ends of the piping at both the inlet and outlet sides of the bioreactor would act as clean-out locations. Additionally, treatment amendments could be added to the bioreactor through the inlet side risers. Further details of the conceptual design can be found in Figure 4-7 and Figure 4-8.



N

W E

S

Notes:

Conceptual Design Assumptions:

1. Pond divided into 2 zones with a gravel fill separation berm to create an equalization pond on the east side of the separation berm, and a bioreactor on the west side of the berm.
2. Placer gravel rock used to fill pond on the west side of the separation berm and act as bioreactor substrate.
3. 2.0 m thick soil cover placed over bioreactor substrate to act as frost barrier and to protect from exposure to humans and wildlife.
4. Geotextile barrier placed on top of bioreactor substrate prior to cover placement to separate soil cover from substrate and prevent ingress of soil fines.
5. Estimated placer gravel volume) = 3,050 m³.
6. Estimated gravel porosity = 40%
7. Estimated cover material volume = 3,350 m³.
8. Transfer pipeline to be placed through berm with a riser in the equalization pond to covey water into the bioreactor.
9. Slotted piping inside the bioreactor will accept flow from the transfer piping and distribute the water into the bioreactor.
10. Capped risers at each end of the distribution piping will allow for treatment amendment dosing.
11. Flow to exit bioreactor for discharge via slotted collection piping connected to a discharge pipeline in the north-west corner of the bioreactor.
12. A capped riser connected at each end of the slotted collection pipe will act as clean-outs if required.
13. Installation of the collection and discharge piping at an elevation below the inlet riser in the equalization pond will ensure proper flow direction through the bioreactor.

CONCEPTUAL
NOT FOR
CONSTRUCTION

Scale: 1:200

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Checked	A. Gault	--
Approved	J. Harrington	--

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Project/Drawing Information	
Project Name	Keno District Mine Operations, Reclamation and Closure Plan
Project Number	ECA23YT00340
Project Location	Keno City, Yukon Territory

Drawing Name

Mill Pond Bioreactor
Conceptual Design - Plan Layout

Drawing Number

ECA23YT00340-C-200

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#3 Calcite Business Centre, 151 Industrial Road
Whitehorse, YT Y1A 2V3

ALEXCO KENO HILL MINING CORP.

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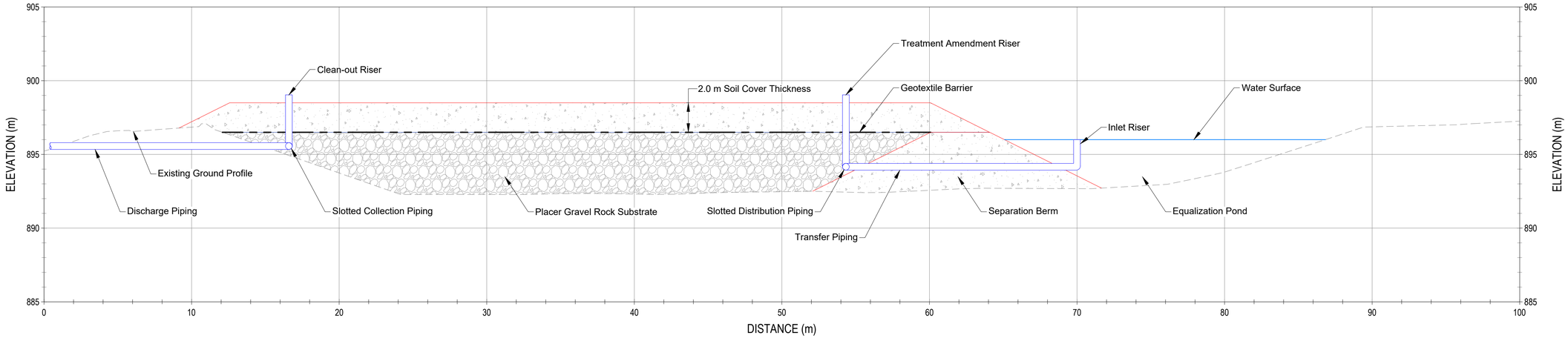
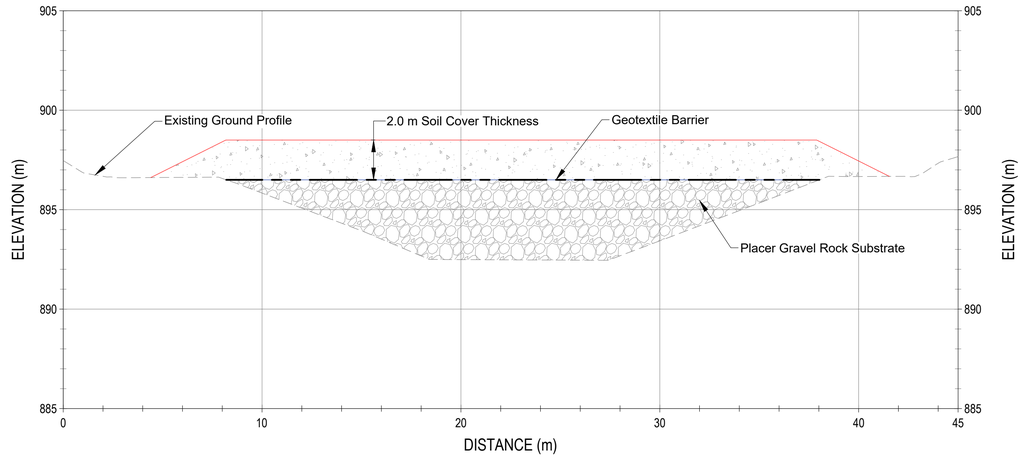


Section A



Section B

Revision History		
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Project/Drawing Information	
Project Name	Keno District Mine Operations, Reclamation and Closure Plan
Project Number	ECA23YT00340
Project Location	Keno City, Yukon Territory
Drawing Name	
Mill Pond Bioreactor Conceptual Design - Section Views	
Drawing Number	
ECA23YT00340-C-201	

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4.2.4 DETAILED DESIGN AND SCHEDULE

At this time, there is no requirement for a bioreactor for Flame & Moth. However, it is prudent to regularly test the assumptions and field conditions on which that is based. This can be done with data and studies that are required under other management plans. More specifically, for seepage from the DSTF, the following steps will be done to advance to detailed design of the bioreactor:

- Continue to monitor seepage flow and seepage chemistry from the dry stack;
- Collect the laboratory data on tailings geochemistry (static and kinetic testing) as documented in the Tailings Characterization Plan (AKHM 2020c);
- Annually review these data (the DSTF and the laboratory testing), to assess the potential for the DSTF to generate drainage water chemistry that would not be compliant for discharge in the longer term. This assessment includes consideration of both flow and chemistry. It would be done in conjunction with the physical characterization of tailings and the conditions of the cover, as completed under other studies; and
- At each update of the Reclamation and Closure Plan (RCP), consider the design size of a bioreactor for the "worst reasonable case" and update the RCP accordingly.

5. REFERENCES

Alexco Keno Hill Mining Corp. (AKHM), 2023. *Reclamation and Closure Plan Keno District Mine Operations Keno Hill Silver District, Rev 7*.

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Alexco Keno Hill Mining Corp. (AKHM), 2020b. *Keno Hill October 2020 Monitoring, Surveillance and Reporting Plan October 2020,* prepared by AKHM and Ensero Solutions.

Alexco Keno Hill Mining Corp. (AKHM), 2020c. *Keno Hill October 2020 Tailings Characterization Plan October 2020,* prepared by AKHM and Ensero Solutions.

APPENDIX 3.11

2025 MONITORING WELL DRILLING REPORT



AKHM Drilling 2025 Factual Report

Final Report

Hecla

December 2025

ENSERO solutions

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This report has been prepared and the work referred to herein has been undertaken by Ensero Solutions Canada, Inc. (Ensero) for Alexo Keno Hill Mining Corp. (AKHM). It is intended for the sole and exclusive use of AKHM, its affiliated companies and partners and their respective agents, employees and advisors (collectively, "AKHM" Any use, reliance on or decision made by any person other than AKHM based on this report is the sole responsibility of such other person. Ensero makes no representation or warranty to any other person with regard to this report and the work referred to herein and accepts no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action take based on this report or the work referred to herein.

The work undertaken by Ensero with respect to this report and any conclusions or recommendations made in this report reflect Ensero's judgement based on site conditions observed at the time of the site inspection on the date(s) set out in this report and on information examined at the time of preparation of this report. This report has been prepared for specific application to this site and it is based, in part, upon visual observation of the site during a specific time interval, all as described in this report. Unless this report otherwise states, the findings cannot be extended to previous or future site conditions, portions of the site which were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters, materials or analysis which were not addressed. If site conditions or applicable standards change or if any additional information becomes available at a future date, modification to the findings, conclusions and recommendations in this report may be necessary.

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Revision History

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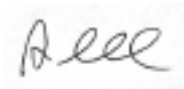
Report reviewed by:  December 10, 2025

Andrea McMillan, B.Sc., P.Geo.

Senior Hydrogeologist

TABLE OF CONTENTS

1.0 INTRODUCTION 2

1.1 Scope of Work 2

2.0 METHODOLOGY 2

2.1 Drill Pad Preparation and Access 8

2.2 Borehole Drilling 8

2.2.1 Pilot Borehole BH-TH-01 9

2.2.2 Water Supply Well BH-SW-01 9

2.3 Well Installation 9

2.3.1 WL QZ18-044 Replacement Wells 9

2.3.2 New Bermingham Water Supply Well 10

2.4 Well Development 10

2.5 Well Decommissioning 11

2.6 Aquifer Testing 11

2.6.1 Water Quality Sampling 12

3.0 OBSERVATIONS AND RESULTS 12

3.1 Ground and Drilling Conditions 13

3.1.1 WL QZ18-044 Replacement Wells 13

3.1.2 New Bermingham Water Supply Well 13

3.2 Soil and Bedrock 14

3.3 Groundwater 14

3.3.1 WL QZ18-044 Replacement Wells 14

3.3.2 New Bermingham Water Supply Well 15

3.4 Well Development 16

3.5 Frozen Ground 16

3.6 Aquifer Testing 17

3.7 Groundwater Quality Sampling 18

3.8 Survey 18

4.0 SUMMARY 19

5.0 RECOMMENDATIONS FOR FUTURE WORK 20

6.0 REFERENCES 21

LIST OF TABLES

Table 2-1: WL QZ18-044 Well Replacement Rationale 5
Table 3-1: Groundwater Occurrence at WL QZ18-044 Wells 14
Table 3-2: Groundwater Occurrence at New Bermingham Water Supply Well and Pilot Borehole 16
Table 3-3: Well Development Completion Summary 16
Table 3-4: Estimated Aquifer Parameter Values 17
Table 3-5: Well Survey Summary 18

LIST OF FIGURES

Figure 2-1: Flame and Moth Replacement Well Locations 6
Figure 2-2: New Bermingham Replacement Well Locations 7

APPENDICES

Appendix A. Existing Borehole Logs
Appendix B. Replacement Borehole Logs
Appendix C. Pumping Test Data and Analysis
Appendix D. Water Quality Sameple Results

1.0 INTRODUCTION

Ensero Solutions Canada, Inc. (Ensero) was retained by Alexco Keno Hill Mining Corp. (AKHM), a wholly owned subsidiary of Hecla Yukon (Hecla), to provide hydrogeological technical support. The hydrogeological support included the replacement of water license (WL) QZ18-044 groundwater monitoring wells within the Flame & Moth and New Bermingham mines, as well as drilling, installation, and testing of a water supply well at New Bermingham mine. The New Bermingham and Flame & Moth mines are part of the Keno Hill Silver District (KHSD) (the Site) located approximately 400 km north of Whitehorse within the First Nation of Na-Cho Nyäk Dun (NND) Traditional Territory. This report summarizes the work completed during the 2025 drilling program at the Site.

1.1 SCOPE OF WORK

As detailed in the Proposal for Decommissioning and Reinstalling Monitoring Wells required under the WL QZ18-044 and Evaluating a Potable Groundwater Well at the New Bermingham Mine provided to Hecla on August 22, 2024 (Ensero, 2025a), the proposed scope of work included:

- Decommissioning and reinstallation of compliance monitoring wells associated with WL QZ18-044.
- Determining an appropriate location for a groundwater supply well to be installed for use at the New Bermingham Mine.
- Drilling, installation, and testing of the water supply well.

In accordance with the August 2024 letter proposal and subsequent change orders signed by Ensero and Hecla, fifteen (15) groundwater monitoring wells associated with WL QZ18-044 were identified as requiring replacement due to physical damage. These wells have been damaged or destroyed through various site activities, such as mine expansion, snow ploughing, and environmental factors i.e. frost heaving. It was recommended that these wells be decommissioned and replaced, where necessary, to ensure compliance with the WL.

An evaluation of potable groundwater in the New Bermingham area was conducted to identify a location for the proposed supply well for the New Bermingham mine. A desk study review of geological maps, groundwater chemistry, water level data, and aquifer testing was completed for the assessment and submitted as draft to Hecla on July 31, 2025 (Ensero, 2025a). Preliminary locations for a groundwater supply well were identified in the findings and further explored during the 2025 drilling program at the Site.

2.0 METHODOLOGY

The primary objective of the WL QZ18-044 well replacement program was to install new monitoring wells at the same locations as the original wells, with each replacement well drilled to a target depth 10 meters deeper than the original monitoring well depth. This depth adjustment was intended to account for localized groundwater level declines caused by continued dewatering operations in both mine areas.

Within the New Bermingham area of the Site, six (6) monitoring wells were scoped for replacement and decommissioning:

- BH-MW-1
- KV-116

- KV-123
- KV-124
- KV-126
- KV-127

Within the Flame & Moth area of the Site, nine (9) monitoring wells were scoped for replacement and decommissioning:

- BH-39
- FM-MW-01
- KV-85S & KV-85D
- KC-MW-4 (decommissioning only)
- KV-86
- KV-88S
- KV-89S & KV-89D

The scope for the following wells were altered to account for upcoming amendments to the WL and for a cost-saving opportunity:

- KC-MW-4 was confirmed as damaged but was not recommended for replacement, as it is not expected to be included in the upcoming WL amendment.
- The WL replacement location for FM-MW-01 was re-scoped as a VWP installation as per Change Order 1 (Purchase Order 16829) in lieu of a groundwater monitoring well, as it was identified that WL QZ18-044 only requires monthly groundwater level monitoring.

A detailed summary of the well replacement rationale is provided in Table 2-1, and well locations are shown in Figure 2-1 and Figure 2-2.

Following the August 2024 letter proposal and subsequent change orders signed by Ensero and Hecla, a desktop water supply evaluation was conducted to identify potential locations for water supply wells in both the New Bermingham and Flame & Moth areas of the Site (Ensero 2025a; Ensero 2025b). The evaluation incorporated available data sources, including geological mapping, groundwater chemistry, water level data, and historical aquifer testing results. Three location options were proposed for each area (Ensero 2025a; Ensero 2025b).

Per email correspondence with Hecla on August 27, the Flame & Moth water supply well was deferred from the current scope of work. This decision was based on the pending finalization of development plans for the infrastructure and offices for the Flame & Moth mine. As a result, only the New Bermingham water supply well was advanced in the 2025 drilling program.

Following initial project scoping and during subsequent field activities, it was decided to drill a pilot borehole (BH-TH-01) to inform the design and placement of the New Bermingham water supply well (BH-SW-01). A 6-inch diameter pilot borehole was proposed to reduce risk and cost associated with drilling a larger-diameter production well. The pilot borehole (BH-TH-01), served the following purposes:

- Provided preliminary insight into subsurface conditions, helping anticipate ground challenges that could impede the drilling and installation of the 6-inch supply well (BH-SW-01).
- Facilitated groundwater exploration, reducing the risk of advancing a more costly borehole in the absence of a viable water source.

- Enabled a short-duration pumping test to assess the sustainability of the water source prior to advancing BH-SW-01.
- Functioned as an observation well during pumping tests on the water supply well BH-SW-01.

Provision for step rate pumping testing (SRT) and one 24-hour constant rate pumping test (CRT) was included in the scope to evaluate the sustainable yield of the New Bermingham water supply well. Additionally, the scope included laboratory analysis of one groundwater quality sample collected after a minimum of 24 hours of pumping.

This phased and data-informed approach supported a more reliable and cost-effective advancement of the New Bermingham water supply well.

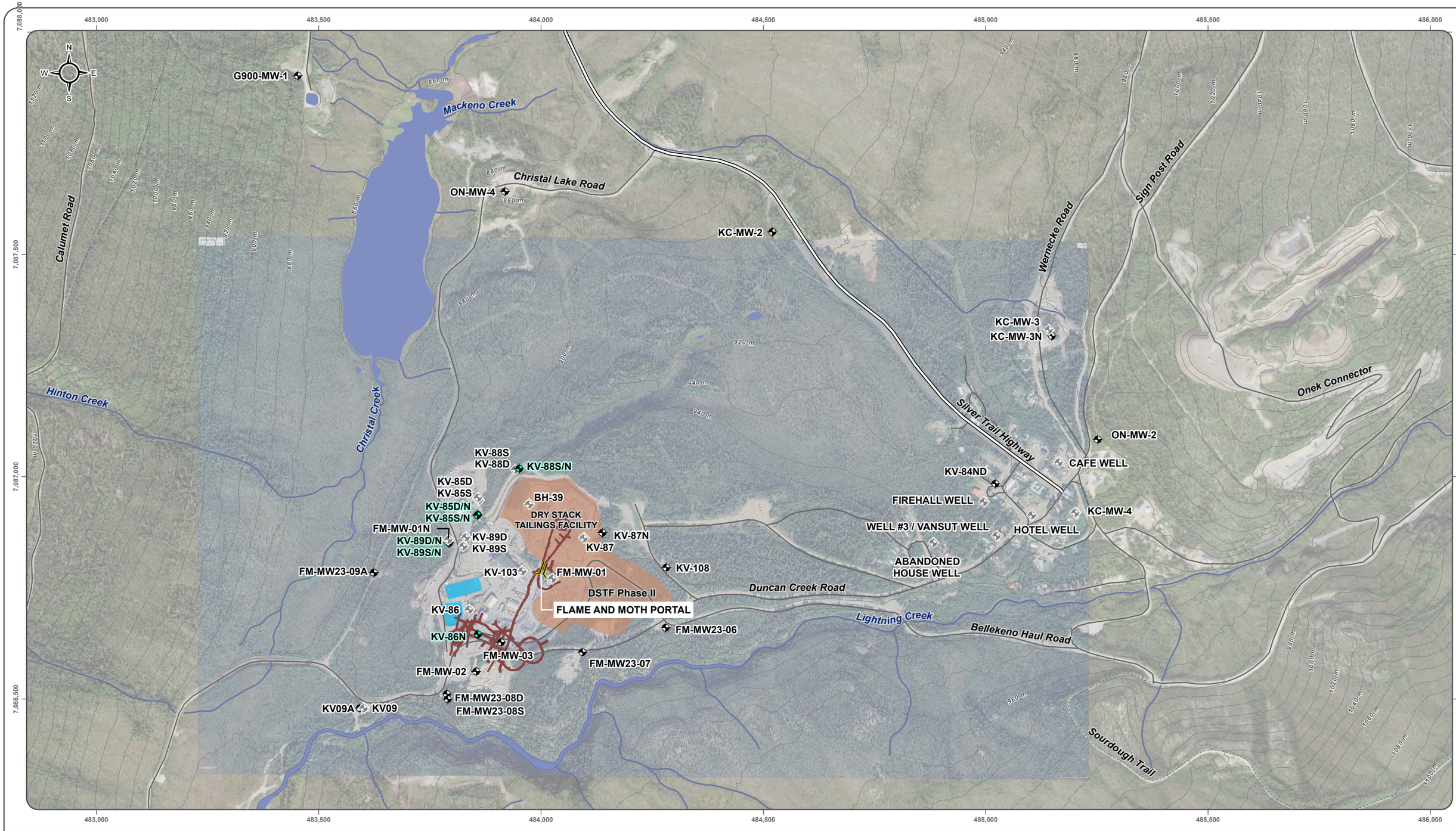
Table 2-1: WL QZ18-044 Well Replacement Rationale

Area	Well ID	Lithological Unit Monitored	Requirement in WL QZ18-044	Replacement Rationale	Bottom of Screen (mbgs)	Screen Length (m)	Decommissioning Required
Flame & Moth	BH-39	Sand and Silt (Tailings)	M	Well noted to be covered by earthworks.	7.5	unknown	Already demolished by site activities.
	FM-MW-01	Greenstone quartzite and graphitic schist	M - WL data only	Well destroyed during mine development.	165	37	Already demolished by site activities.
	KC-MW-4	Gravel and sand	Q	Well damaged.	67.5	9.5	Y
	KV-85D	Bedrock (No further information)	Q	Well damaged, casing frost jacked.	41	3	Y
	KV-85S	Gravel	Q	Well damaged from mine development.	4	1.3	Y
	KV-86	Gravel and Sand	Q	Well damaged, casing bent.	34	3	Already demolished by site activities.
	KV-88S	Sand, gravel, and silt	Q	Well damaged, casing broken	4	1.5	Y
	KV-89D	Bedrock (No further information)	Q	Well damaged, casing bent.	38.3	3.3	Y
	KV-89S	Silt (till)	Q	Well damaged, casing broken.	4.8	1.9	Y
New Bermingham	KV-116	Bedrock: possible quartzite	Q	Well destroyed due to surface workings associated with the mine.	12	6	Already demolished by site activities.
	KV-123	Bedrock: possible graphitic schist	Q	Well damaged, casing frost jacked.	43.4	6.4	Y
	KV-124	Bedrock: possible quartzite	Q	Well damaged.	13	6	Y
	KV-126	Bedrock: possible graphitic schist	Q	Well damaged, casing frost jacked.	70.6	7.6	Y
	KV-127	Bedrock: possible quartzite	Q	Well damaged, casing frost jacked.	26.6	9.1	Y
	BH-MW-1	Quartzite and graphitic schist	M	Well dry.	21.4	2.9	Y

*mbgs: metres below ground surface

M: monthly and quarterly groundwater samples and water level data

Q: quarterly groundwater samples and water level data



Satellite imagery obtained from ESRI Imagery map service http://goto.arcgisonline.com/maps/World_Imagery on December 2025

Datum: NAD 83; Projection: UTM Zone 8N

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0 50 100 150 200 250 Meters

- Groundwater Monitoring Location, Installed in 2025 as Replacement for Damaged Wells
- Groundwater Monitoring Location, Active
- Groundwater Monitoring Location, Damaged/Destroyed/Not Active
- Adit
- Underground Workings, As Built End of 2024
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

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FIGURE 2-1
FLAME AND MOTH
GROUNDWATER MONITORING NETWOR

DECEMBER 2025

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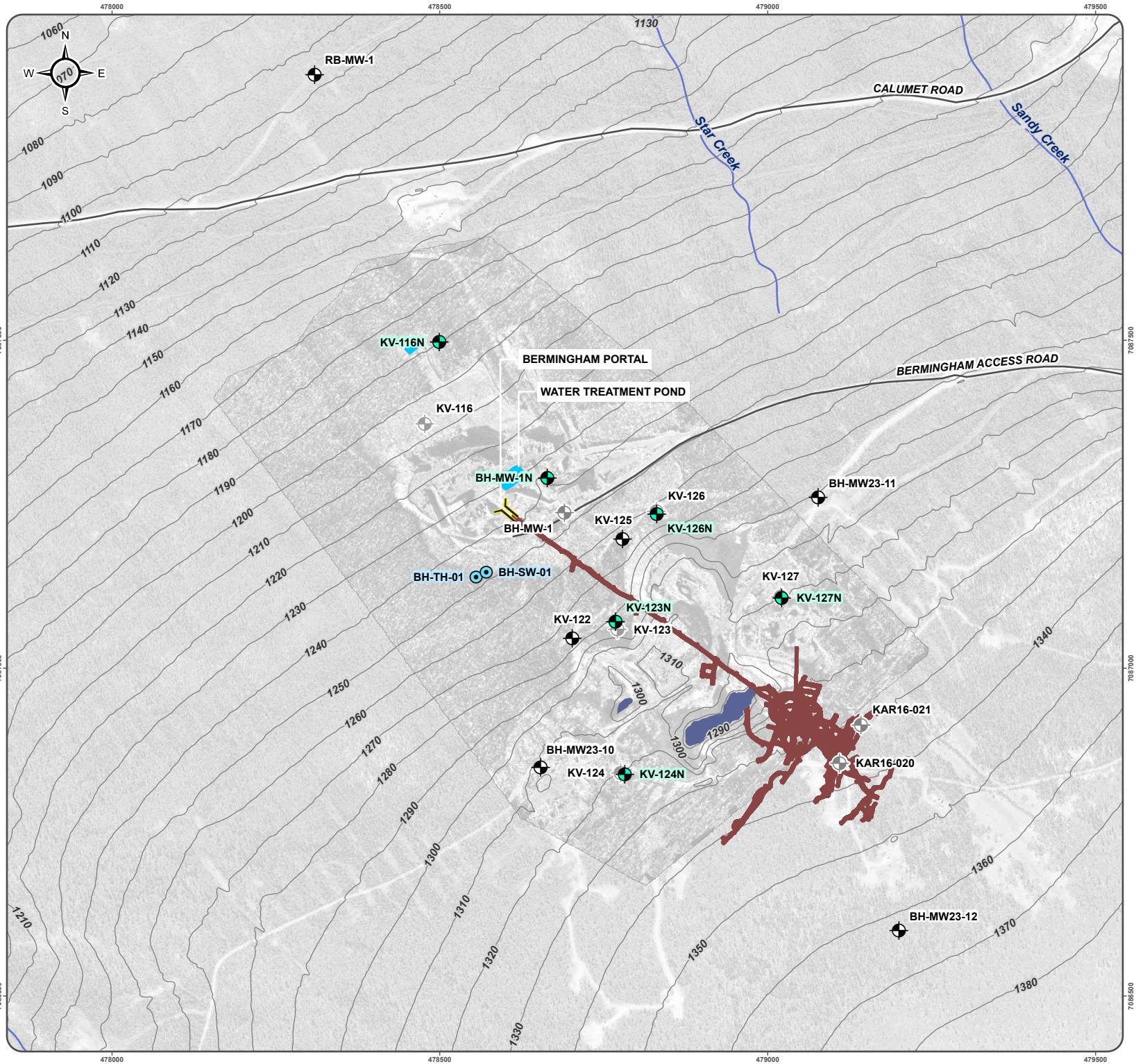

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FIGURE
2-2
NEW BERMINGHAM REPLACEMENT WELL LOCATIONS

DECEMBER 2025

- Water Supply Well, Installed 2025
- Groundwater Monitoring Location, Installed in 2025 as Replacement for Damaged Wells
- Groundwater Quality Monitoring, Existing
- Groundwater Quality Monitoring, Damaged
- Adit/Portal
- Underground Workings, As Built End 2024
- Proposed Disturbance Footprint
- Underground Workings, Proposed
- Watercourse
- Waterbody

0 50 100 150 200 Meters

Satellite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on December 2025
Site Data provided by Hecla, February 25, 2025

Datum: NAD 83; Map Projection: UTM Zone 8N

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2.1 DRILL PAD PREPARATION AND ACCESS

Drill pad siting and clearing was coordinated among Ensero, Anderson Water Services Ltd (Anderson), and Hecla during pre-field kickoff meetings in July 2025 and August 2025. Each location was selected to ensure safe access for the truck-mounted drill rig and suitable drill pad set-up to accommodate the chase truck. Anderson specified a minimum drill pad size of 17 × 17 meters. Consideration was also given to roads, utilities, overhead lines, underground workings, and proximity to water features.

Hecla Site Services conducted clearing and leveling of drill pads prior to drilling in August 2025. Locally sourced crushed rock was used for construction of the drill pads, when required. Hecla also performed utility sweeps at each pad to identify, and mark live underground lines.

Final drill pad locations were confirmed on-site through joint discussions between Ensero, Hecla, and Anderson. For the WL QZ18-044 replacement wells, drill pad locations were prioritized adjacent to the existing WL monitoring wells or as close as possible, and moved based on current and proposed underground and surface workings, when required.

The New Bermingham water supply well location was selected following consultations between Hecla and Ensero. Three options for the water supply well location were presented to Hecla in the Potable Water Supply Evaluation (Ensero, 2025a), with Option 2 selected for advancement of the New Bermingham water supply well.

The replacement monitoring well BH-39N was removed from the current program after no viable access route could be identified for the truck-mounted drill rig to reach the top of the dry stack tailings facility (DSTF) at Flame & Moth.

2.2 BOREHOLE DRILLING

From August 9 to September 11, 2025, a total of 15 boreholes were drilled with twelve (12) boreholes completed as replacement monitoring wells, one (1) pilot borehole well, one (1) water supply well, and one (1) borehole abandoned and backfilled with bentonite.

Anderson based in Fort St. John, B.C., drilled, installed, and developed the wells using a REICH-T-650 truck-mounted drill rig equipped with a hydrocyclone to facilitate the management of cuttings and drill water, and to enable rock chip sample collection. Ensero personnel supervised the field activities. Air rotary drilling with downhole hammer (DHH) for steel casing were employed for all boreholes in the program. Discharge of drilling water was diverted to sumps as requested by Hecla, with sumps dug by Hecla Site Services. The borehole diameter of the replacement monitoring wells, and pilot borehole well was 6-inches, and the borehole diameter of the water supply well was 10-inches.

Borehole logging was completed by Ensero personnel. Rock chips were sampled at a frequency of every one to three meters. Rock chip sample frequency was reduced from every meter to every three meters once consistent lithology was observed from borehole drilling. Airlift flow testing was conducted by Anderson and supervised by Ensero, using the bucket and stopwatch method, when notable water strikes were encountered.

Occasionally throughout the program, difficult drilling conditions were encountered, at times requiring deviations to the scoped program, and are summarized in Section 3.1. General trends and observations pertaining to

lithology, groundwater, and frozen ground occurrence are also summarized in Sections 3.2, 3.3, and 3.4, respectively.

2.2.1 Pilot Borehole BH-TH-01

Drilling of the 6-inch pilot borehole (BH-TH-01) was completed on August 31, 2025. Upon completion of drilling, and prior to well installation at BH-TH-01, preliminary airlift testing was conducted for 3.5 hours at a rate of 95 litres per minute (L/min). The selected airlift testing depth was 46 meters below ground surface (mbgs). Although water was encountered at multiple intervals during drilling (55, 70, and 80 mbgs), a borehole collapse to 55 mbgs necessitated testing above the maximum depth to evaluate the viability and sustainable yield of the remaining open borehole. The water clarity cleared rapidly and remained clear throughout the duration of the test.

2.2.2 Water Supply Well BH-SW-01

Drilling of the New Bermingham 10-inch water supply well (BH-SW-01) was completed on September 14, 2025. Prior to well installation, airlift testing was conducted at a depth of 49 mbgs at a rate of 95 L/min. The test was terminated after 30 minutes due to observed debris ingress, which was inferred to originate from a large fracture zone. Anderson advised against continued airlifting from this depth to avoid destabilizing the borehole and potentially creating a void around the fracture zone.

2.3 WELL INSTALLATION

Monitoring well installation was designed and supervised by Ensero and executed by Anderson. Ensero personnel were responsible for documenting all technical details related to the installation.

Steel casing from drilling was left in place to mitigate potential frost jacking. The protective casing extended to a depth ranging from 1 to 24 m and was left with a stick-up of approximately 1 m above ground surface serving as the well monument.

Annular materials used during installation included filter pack sand (20/40 sand), bentonite pellets, and bentonite chips. Monitoring well installations included a 0.7 m to 4.0 m sand pack above the top of the screened interval, followed by 2 m bentonite pellet seal, followed by bentonite chips to ground surface. The bentonite chips were hydrated from surface following installation. Annular materials were added slowly by Anderson to prevent bridging. The annulus was tagged frequently by Anderson during the installation of annular material (bag or bucket of product) with measurements recorded by Ensero to ensure consistent rise, to track and monitor for bridging throughout the installation process. Filter pack sand was placed between the PVC riser and steel protective casing within the stick-up above ground surface. End caps were installed at the bottom of each screened interval, and J-plugs were placed at the top of each PVC riser on the wells. Installation details are provided on the borehole logs in Appendix B.

2.3.1 WL QZ18-044 Replacement Wells

Well design for the WL QZ18-044 replacement monitoring wells were designed to adhere as close as possible to the original monitoring well being replaced (Appendix A) with each replacement well drilled to a target depth 10

meters deeper than the original monitoring well depth. This depth adjustment was intended to account for localized groundwater level declines caused by continued dewatering operations in both mine areas.

Six monitoring wells (BH-MW-01N, KV-85SN, KV-88SN, KV-89SN, KV-116N, and KV-124N,) were installed using 2-inch diameter schedule 40 PVC for shallow installations (less than 35 mbgs) where 3-inch diameter schedule 40 PVC was used for deeper well installations (greater than 35 mbgs) at monitoring wells KV-85DN, KV-86N, KV-89DN, KV-123N, KV-126N, and KV-127N. The monitoring well screens were 10-slot screen, and screen length was prescribed based on the design of the original well being replaced. Well installation details for WL QZ18-044 replacement monitoring wells are included in Appendix B.

2.3.2 New Bermingham Water Supply Well

The addition of pilot borehole BH-TH-01 was a deviation to the original scope. BH-TH-01 was approved on the same day that drilling and installation activities commenced. Anderson had 4.9-inch diameter PVC with 20-slot (0.02-inch) size screen available on site, allowing for the installation to proceed without delay. The 4.9-inch diameter PVC was installed within the 6-inch borehole. Annular materials such as filter pack sand and bentonite were not installed, as BH-TH-01 was intended to function solely as a temporary observation well for monitoring water levels and supporting pumping tests at the adjacent water supply well BH-SW-01.

The water supply well BH-SW-01 was installed within the 10-inch diameter borehole with annular backfill materials similar to the WL QZ18-044 replacement wells. The water supply well consisted of 7-inch outer diameter (OD) solid PVC casing (Blue Brute) and 20 slot (0.020-inch slot size) screen. Details of the well installation details for both BH-TH-01 and BH-SW-01 are included in Appendix B.

2.4 WELL DEVELOPMENT

Well development of all newly installed groundwater monitoring wells was attempted to purge drilling artifacts from the well and to properly set the sand pack around the well screen.

Initial development efforts were undertaken by Anderson during the drill program site visit in August and September 2025, with Anderson employing the drill rig and an airline under the supervision of Ensero personnel. For the WL QZ18-044 replacement monitoring wells, development was performed after well installation. In contrast, the New Bermingham water supply well (BH-SW-01) and pilot borehole (BH-TH-01) were developed prior to installation, while the boreholes remained open. Prior to well installation and the pumping test, preliminary airlift testing was performed using the drill rig and airline. This served both as well development and as a preliminary assessment of the sustainable yield from the water-bearing fracture zone.

Development at each well was monitored by Ensero personnel. Development continued until the produced water had minimal suspended sediment (less than a quarter-sized amount of sediment in pail) or until the well went dry. Development time and volume at each well varied depending on the ground conditions (unconsolidated soil versus bedrock), the length of well screen, and the development method.

The replacement wells that could not be successfully developed during the first site visit were re-attempted by Ensero field staff during a follow-up site visit from October 6 to 9, 2025 using an actuated inertial pump, Waterra tubing, surge block, and foot valve.

2.5 WELL DECOMMISSIONING

From August 9 to September 15, 2025, Anderson, with assistance from Hecla Site Services, decommissioned 11 monitoring wells under the supervision of Ensero personnel. The decommission dates and notes are listed in Table 2-2. Water level data loggers were retrieved from wells, where possible, and well monuments were subsequently removed. Hydrated bentonite chips and pellets were used to seal wells prior to pulling PVC riser pipe out of the ground. The removal of PVC was attempted at all wells when possible, and when not possible, PVC was cut below ground level.

Table 2-2: Well Decommissioning Summary

Well ID	Date Decommissioned	Notes
KV-88S	August 9, 2025	
KV-85D	August 13, 2025	
KV-85S	August 13, 2025	
KV-89D	August 13, 2025	
KV-124	August 15, 2025	
KV-127	August 16, 2025	
KC-MW-4	August 17, 2025	Decommissioned by hand due to mobilization concerns of rig onto private property. PVC could not be removed from ground.
KV-123	August 17, 2025	PVC could not be removed from ground.
KV-126	August 17, 2025	PVC could not be removed from ground.
FM-MW-01	n/a	Already demolished by Site.
BH-MW-01	September 9, 2025	Well sealed only. Site services to return to pull PVC at later date.
KV-116	n/a	Already demolished by Site.
Mill Well	September 15, 2025	Additional requested scope while on-site. Well sealed with bentonite chips only. Piping did not attempt to be removed as requested by Hecla.

2.6 AQUIFER TESTING

On September 10, 2025, aquifer testing in the form of step-rate testing (SRT) and a short-term (4-hour) constant-rate pumping test was conducted at the pilot borehole (BH-TH-01) to assess the feasibility of advancing a 10-inch water supply well at this location. On September 17, 2025, following the drilling and installation of the water supply well (BH-SW-01), a 48-hour constant-rate pumping test (CRT) was conducted to evaluate the sustainable yield of the water supply well. The water supply well was pumped at a constant rate of 38 L/min (10 gpm) for 48 hours, commencing at 9:30 am on September 17, 2025 and terminating at 9:30 am September 19, 2025.

Achieving steady state is critical for pumping test analysis and sustainable yield estimation. The CRT was extended from the originally planned 24 hours to 48 hours as steady-state had not been reached within the initial 24-hour period of the test. The CRT was terminated after 48 hours due to cost-benefit analysis of the remaining budget and resources.

All aquifer testing was conducted by Anderson under the supervision of Ensero. Ensero and Anderson staff were onsite during the day and only Anderson personnel monitored the pump and water level overnight. Ensero personnel monitored drawdown in the pumping (BH-SW-01) and observation wells (BH-TH-01 and BH-MW-01N) using water level data loggers, and manual water level measurements. Ensero personnel also monitored the flow rate via volumetric testing to ensure it did not vary by more than 5% during the duration of the test. Other nearby wells were either located more than 100 m from the pumping well (BH-SW-01) or lacked sufficient water to function as observation wells.

Anderson personnel ensured that the discharge line was not blocked during the test, and monitored the pump, pumping rates, rig, and water levels both during the day and night.

Testing was performed using a Goulds Water Technology 25GBC30 centrifugal multi-stage submersible 4-inch pump. A discharge hose directed pumped water cross-gradient from the pumping well. Flow measurements were recorded by Anderson using the bucket and stopwatch method.

The submersible pump was installed without a shroud at a depth of 32.9 mbgs, positioned above the screened interval (43.8 mbgs to 49.8 mbgs). A water level data logger was mounted directly onto the rising main above the pump intake to minimize data noise and logger movement caused by turbulent flow within the water column.

Once the CRT was completed, the pump was turned off and left in the well to allow for recovery to be monitored without disturbance. Continued groundwater level monitoring within the test well (BH-SW-01) and the nearby observation wells (BH-TH-01 and BH-MW-01N) were monitored for 20 hours. Both the water level data logger and manual groundwater level measurements were taken during the recovery period.

2.6.1 Water Quality Sampling

Water quality samples were collected from the discharge pipe prior to completion of the constant-rate test. The water supply well was sampled for the following analytical schedule:

- Routine parameters (major ions, pH, conductivity, alkalinity, hardness, total dissolved solids, turbidity)
- Dissolved metals
- Anions and nutrients (ammonia-nitrogen, bromide, chloride, fluoride, nitrate-nitrogen, nitrite-nitrogen, Total Kjeldahl Nitrogen, total nitrogen)
- Microbiological (total coliforms and E. coli)

Samples were field filtered and preserved as required. Samples were collected in laboratory supplied containers and stored in coolers for transport to ALS in Vancouver for priority rush analysis to meet the required 30-hour hold time for bacteriological analysis.

3.0 OBSERVATIONS AND RESULTS

This factual drilling report includes observations recorded from on-site drilling between August 7 to September 21, 2025, and includes a factual summary of the surficial and bedrock geology, ground and drilling conditions, groundwater occurrence, pumping test analysis, and well installation specifications.

3.1 GROUND AND DRILLING CONDITIONS

3.1.1 WL QZ18-044 Replacement Wells

3.1.1.1 FM-MW-01N

Challenging drilling conditions were encountered at the FM-MW-01N replacement well location within the Flame & Moth area from August 25 to 28, 2025. Drilling rates progressively decreased beyond 70 mbgs, leading to a change in tooling from a DHH to a tricone drill bit at 133 mbgs; drilling continued at very slow rates until reaching 151 mbgs. In consultation with Hecla, drilling was terminated at this depth, short of the originally scope target depth of 165 m. This decision was reached based on the extremely slow rates of drilling, as well as confirmation that the target lithological (interbedded graphitic and sericitic schists and quartzite) unit had been reached.

Following drill rod trip-out, installation of the 1.5-inch PVC vibrating wire piezometer (VWP) instrumentation was attempted but could not proceed beyond 45 mbgs. Anderson reported that the borehole had become unstable around this depth, likely due to fractured rock that was sliding into and obstructing the borehole. Significant rock debris was observed flushing out during the airlift test, which drillers also attributed to unstable fractures or voids within the formation. Multiple attempts were made by Anderson to re-drill and clear the blockage at 45 mbgs. However, drill rods consistently became stuck around 40 mbgs, with over six unsuccessful attempts to advance past the obstruction.

Ensero advised that installing a VWP or monitoring well to 40 mbgs would not provide additional value to the AKHM groundwater monitoring network, as a monitoring well of similar depth already exists on the same pad. Hecla subsequently decided to abandon the borehole, as completing it would require significantly more costly methods. The client opted not to pursue redrilling at this location due to the challenging ground conditions that occurred with this method of drilling. Steel casing was left in the ground at this location as due to the install depth of 22.5 mbgs, retracting 20.5 m of steel embedded in rock would have proved challenging, time consuming, and may not have been successful.

3.1.2 New Bermingham Water Supply Well

3.1.2.1 Pilot Borehole BH-TH-01

Drilling of the New Bermingham pilot borehole (BH-TH-01) was completed on August 31, 2025 and installed on September 1, 2025. Challenging ground conditions were encountered at this borehole. Drilling rates slowed noticeably after 38 mbgs, with particularly difficult conditions observed at 55 mbgs. Drillers noted signs of borehole instability, describing the formation as “caving in on itself like a funnel,” and anticipated difficulty advancing or installing beyond this point. Drilling conditions improved past 60 mbgs, allowing progress to continue until 95 mbgs, where rods began getting stuck. Attempts to drill through and deeper than the blockage at 95 mbgs were unsuccessful, and following rod trip-out, the borehole collapsed again to 95 mbgs. Given the proximity to the target depth of 100 m and the likelihood of further collapse, the decision was made to terminate drilling at 95 mbgs. The following morning, the borehole was found to have collapsed to 55 mbgs. It was decided that installation would continue at 55 mbgs with 4.9-inch Blue Brute PVC installed in the well.

3.1.2.2 Water Supply Well BH-SW-01

Drilling of the New Bermingham water supply well (BH-SW-01) was carried out between September 11 and 14, 2025, with installation completed on September 16, 2025. Drilling rates slowed after 16 mbgs, prompting a change from the DHH to a tricone bit at 22 mbgs. Despite the switch, progress remained slow and challenging, as anticipated. At 42 mbgs, a polycrystalline diamond compact (PDC) bit was trialed but proved ineffective, leading to a final change to an 8¾-inch DHH with plans to ream the borehole to 10 inches after reaching the target depth. At around 48 mbgs, the drillers reported increasing signs of borehole instability, including caving and significant debris return, inferred to be indicative of a highly fractured zone. Drilling continued to 55 mbgs; however, the borehole remained unstable, with rods getting stuck and borehole collapse occurring beyond 49 mbgs. Following reaming and rod retrieval, the borehole collapsed to 50 mbgs, which was accepted as the final total depth for installation of BH-SW-01.

3.2 SOIL AND BEDROCK

Specific details of the stratigraphy encountered at each borehole location, including the results of the airlift testing are presented on the borehole logs in Appendix B. Overburden thickness ranged from 2 m (KV-116N, KV-123N) to 19.5 m (KV-89DN), and consisted primarily of colluvial sands, gravels, and silts (Appendix B). The sand was fine to medium grained, coarse gravel, silty. Bedrock lithology was generally consistent across the drilled locations with highly interbedded graphitic and sericitic schists and quartz veins.

3.3 GROUNDWATER

Static water levels and approximate flow rates from airlift testing (where applicable) are summarized in Table 33-1 and Table 33-2 for the WL QZ18-044 replacement well drilling, and New Bermingham water supply well drilling, respectively.

3.3.1 WL QZ18-044 Replacement Wells

Static water levels (SWL) for the WL QZ18-044 replacement wells ranged from dry to 80.17 mbgs (KV-126N, screened in bedrock). Groundwater elevations ranged from 1171.96 metres above sea level (masl) (KV-116N) to 1305.88 masl (KV-124N) at New Bermingham area and from 863.36 masl (KV-85DN) to 896.28 masl (KV-85SN) at Flame & Moth area. Static water levels and approximate flow rates at depth from airlift testing are summarized in Table 33-1.

Table 33-1: Groundwater Occurrence at WL QZ18-044 Wells

Site Area	Well ID	SWL* (mbgs)	DTB** (mbgs)	Groundwater Elevation (masl)	Date Measured	Airlift Testing and Depth
New Bermingham	KV-116N	17.49	21.9	1171.96	29-Aug	@22m: <0.1 L/min
	KV-123N	54.41	56.2	1226.15	29-Aug	@34m: 16 L/min @56m: <0.5 L/min
	KV-124N	15.50	32.2	1305.88	29-Aug	@22m: 1 L/min @32m: 4 L/min

Site Area	Well ID	SWL* (mbgs)	DTB** (mbgs)	Groundwater Elevation (masl)	Date Measured	Airlift Testing and Depth
	KV-126N	80.17	85.2	1180.37	24-Aug	
	KV-127N	37.36	44.4	1261.72	29-Aug	
	BH-MW-01N	29.30	32.0	1205.31	31-Aug	
Flame & Moth	KV-85DN	35.67	56.3	863.36	26-Aug	
	KV-85SN	2.57	5.0	896.28	26-Aug	
	KV-86N	Dry	15.0	-	26-Aug	
	KV-88SN	Dry	5.4	-	26-Aug	
	KV-89DN	24.25	50.0	873.29	26-Aug	@50m: 0.5 L/min
	KV-89SN	Dry	15.7	-	26-Aug	
	FM-MW-01N	-	-	-	19-Sep	@73m: 19 L/min @91m: 76 L/min @94m: 114 L/min @121m: 189 L/min @130m: 227 L/min @133m: 227 L/min

*SWL: Static water level

** DTB: Depth to base

3.3.2 New Bermingham Water Supply Well

The groundwater supply well was drilled with the intent of supplying water for the New Bermingham offices and the mine dry facilities. A daily demand rate for the New Bermingham water supply well was not provided at the time of the drill program. Therefore, the pilot borehole (BH-TH-01) and water supply borehole (BH-SW-01) were both exploratory in nature to establish an understanding of the aquifer yield available for the chosen drilling location at New Bermingham.

Drilling of the pilot borehole BH-TH-01 revealed a water-bearing fracture zone within schist lithology at around 46 mbgs, with borehole instability leading to collapse past 55 mbgs. The water supply well BH-SW-01 was drilled approximately 15 m to the east of BH-TH-01, and similar lithology was encountered at comparable depths: a water-bearing fracture zone within schists was encountered around 48 mbgs, with borehole instability leading to collapse at 50 mbgs. Similar groundwater inflow rates from airlift testing were encountered between 45 mbgs to 55 mbgs at both the pilot borehole and water supply well boreholes (Table 33-2).

Table 33-2: Groundwater Occurrence at New Bermingham Water Supply Well and Pilot Borehole

Site Area	Well ID	SWL (mbgs)	DTB (mbgs)	Groundwater Elevation (masl)	Date Measured	Airlift Testing and Depth
New Bermingham	BH-TH-01	32.40	55	1213.81	01-Sep	@55m: 76 L/min @70m: 94 L/min @80m: 132 L/min
	BH-SW-01	34.00	49.8	1212.62	18-Sep	@45m: 53 L/min @48m: 76 L/min

3.4 WELL DEVELOPMENT

A summary of well development outcomes by site visit is provided in**Error! Reference source not found.**. Monitoring wells that contained insufficient water for development during the follow-up site visit in October 2025 (KV-116N, KV-126N, KV-85SN, KV-86N, KV-88SN, and KV-89SN) are recommended to be developed at a later date.

Table 3-3: Well Development Completion Summary

Well ID	Drill Program Site Visit	October Follow-up Site Visit	Date Complete
BH-MW-01N	Insufficient water to develop	Developed	Oct. 8
KV-123N	Insufficient water to develop	Developed	Oct. 7
KV-124N	Developed	-	Aug. 22
KV-126N	Insufficient water to develop	Dry	-
KV-127N	Insufficient water to develop	Developed	Oct. 9
KV-116N	Insufficient water to develop	Dry	-
KV-85SN	Insufficient water to develop	Insufficient water to develop	-
KV-85DN	Developed	-	Aug. 12
KV-86N	Insufficient water to develop	Dry	-
KV-88SN	Insufficient water to develop	Dry	-
KV-89SN	Insufficient water to develop	Dry	-
KV-89DN	Developed	-	Aug. 15
BH-SW-01	Developed	-	Sep. 14
BH-TH-01	Developed	-	Sep. 1

3.5 FROZEN GROUND

Frozen ground or permafrost was not a main focus of this drilling program, however, ice chips in the sample return were noted while drilling at FM-MW-01N, KV-85SN, and KV-85DN. While drilling, ice chips were encountered from approximately 14 to 15.5 mbgs at FM-MW-01N, from approximately 5 to 6.8 mbgs at KV-85SN, and from approximately 5 to 10.3 mbgs at KV-85DN.

3.6 AQUIFER TESTING

Steady-state conditions were not achieved during any stage of the aquifer testing at either the pilot borehole (BH-TH-01) or the water supply well (BH-SW-01). Reaching steady-state conditions during aquifer testing is important because it allows for more accurate and reliable interpretation of aquifer properties. Without steady-state, transient analysis must be employed, which requires more complex models and assumptions. Steady-state conditions may not be reached during aquifer testing due to:

- Short test durations
- Low permeability formations
- Large aquifer storage
- Boundary effects or recharge dynamics

The water level data logger data from the CRT pumping test were compensated for barometric pressure variation and the collected data was reviewed for quality assurance/quality control (QA/QC). Following the QA/QC process, drawdown data collected during the pumping period and residual drawdown data collected during the recovery period were analyzed using HydroSOLVE Inc.'s AQTESOLV Pro (Version 4.5) software. To estimate aquifer parameters, Moench (1984) solution was selected. The Moench slab blocks solution method assumes isotropic conditions and a dual-porosity system made up of fractures and the matrix. This solution method assumes that matrix blocks are modeled as flat and planar in geometry; as well as accounts for fracture skin effect, as well as wellbore storage and skin effects.

Curve fitting was performed in AQTESOLV Pro using both displacement-versus-time data and derivative data to refine estimates of fractured aquifer parameters. Results of the analysis and parameter estimations are provided in Appendix C and summarized in Table 3-4. Storativity and specific storage were not estimated from the pumping well because the water levels measured in the pumping well are significantly affected by well-specific phenomena (well losses, skin effects, turbulent flow) that obscure the true aquifer storage properties. In contrast, observation wells, located some distance away, provide data that more accurately reflect the bulk aquifer properties.

Table 3-4: Estimated Aquifer Parameter Values

Parameter	Units	BH-SW-01	BH-TH-01
Fracture hydraulic conductivity, K	m/s	3.0×10^{-6}	1.8×10^{-6}
Fracture specific storage, Ss	1/m	-	3.6×10^{-6}

Hydraulic conductivity estimates for the screened fracture zone, derived from curve fitting of data from BH-SW-01 and BH-TH-01, were 3.0×10^{-6} m/s and 1.8×10^{-6} m/s, respectively. These values fall within the expected range for crystalline fractured bedrock (Freeze & Cherry, 1979). The specific storage estimate from curve fitting of the BH-TH-01 data was 3.6×10^{-6} m^{-1}, which is also consistent with typical values for crystalline fractured bedrock (Freeze and Cherry, 1979).

The theoretical long-term pumping rate for the New Bermingham water supply well was approximated using the 100-day method. The 100-day method is derived from the Theis and Jacob solutions to groundwater flow to a pumping well, and was originally developed to assess bedrock water supply wells.

The hydrogeologic setting is characterized by crystalline fractured bedrock, and the water-bearing zone at the water supply well is from approximately 45 to 50 mbgs, with a static water level is at 30 mbgs, suggesting a confined or semi-confined aquifer condition. The sustainable yield from the 100-day method was approximated to be 28 m^3/day (5 gpm), as follows:

$$Q = s_{available} \cdot Sf \cdot \frac{Q_t}{s_{100\ day\ projected}}$$

Where:

- **Q** = Sustainable yield or pumping rate (m^3/day)
- $\mathbf{S_a}$ = available drawdown (m) = 4 m
- **0.7** = Safety factor (70%) for long-term sustainability
- $\mathbf{Q_t}$ = pumping rate of the constant rate test, 54.5 m^3/day
- $\mathbf{S_{100\ projected}}$ = projected drawdown at 100 days = 5.4 m

Parameter Assumptions:

- $\mathbf{S_a}$**:** available drawdown was taken to be 4 m, the differential from the first water strike encountered in the fracture zone (45 mbgs) to the bottom of the well screen (49 mbgs)
- $\mathbf{S_{100\ projected}}$**:** the projected drawdown at 100 days was taken to be 5.4 m, extrapolated from late-time curve fitting of the constant rate test.

3.7 GROUNDWATER QUALITY SAMPLING

Groundwater quality samples were taken from BH-SW-01 following 24 hours of pumping during the CRT. The sample was tested for drinking water parameters and screened against the Canadian Drinking Water Quality (CDWQ) Guidelines (Health Canada, 2025) as well as the Yukon Contaminated Sites Regulation (YSCR) Schedule 3 for Drinking Water. Results of the laboratory analysis indicate a dissolved manganese concentration of 2.10 mg/L, which exceeds both CDWQ guidelines (0.12 mg/L) and YCSR standards (0.05 mg/L). No other parameter concentrations were elevated relative to the CDWQ guidelines nor YCSR standards. The results of laboratory analysis are included in Appendix D.

3.8 SURVEY

A survey was completed by Hecla following the completion of monitoring well drilling and installation. A summary of survey values with the calculated PVC stick-up are provided in Table 3-5.

Table 3-56: Well Survey Summary

Site Area	Well ID	Easting (m)	Northing (m)	Top of Casing Elevation (masl)	Ground Elevation (masl)
New Bermingham	KV-116N	478499.45	7087497.15	1189.65	1188.43
	KV-123N	478768.13	7087070.47	1281.52	1280.46

Site Area	Well ID	Easting (m)	Northing (m)	Top of Casing Elevation (masl)	Ground Elevation (masl)
	KV-124N	478782.07	7086838.00	1321.38	1320.28
	KV-126N	478831.04	7087235.42	1262.24	1261.25
	KV-127N	479021.42	7087107.23	1300.02	1299.01
	BH-MW-01N	478664.13	7087290.21	1235.76	1234.61
	BH-TH-01	478555.43	7087139.10	1246.75	1246.21
	BH-SW-01	478571.10	7087146.07	1247.39	1246.62
Flame & Moth	KV-85DN	483857.88	7086914.02	900.02	898.96
	KV-85SN	483856.87	7086912.88	899.85	898.90
	KV-86N	483858.00	7086645.96	908.76	907.88
	KV-88SN	483951.09	7087018.59	907.73	906.83
	KV-89DN	483793.44	7086850.90	898.53	897.50
	KV-89SN	483792.84	7086852.39	898.54	897.56
	FM-MW-01N	483910.08	7086627.69	908.33	no data

4.0 SUMMARY

Drilling conducted across the Flame & Moth and New Bermingham areas of the Site revealed consistent bedrock geology, characterized by fractured interbedded graphitic and sericitic schists with quartzite. This lithology was observed consistently across all boreholes, to a maximum drill depth of 151 mbgs. Overburden materials consisted of silts, sands, and gravels, with thicknesses ranging from 2 to 19.5 m. Groundwater was encountered in the monitoring and supply wells drilled except for KV-86N, KV-88SN, and KV-89SN, which were dry. These three wells are screened within the overburden at Flame & Moth.

The following deviations from the original scope of work were noted:

- Deferral of drilling and installation of BH-39, replacement well atop the dry stack tailings facility (DSTF).
- The originally scoped water supply well at Flame & Moth was deferred due to pending finalization of development plans for the infrastructure and offices for the Flame & Moth mine.
- Installation of a vibrating wire piezometer (VWP) at FM-MW-01N was abandoned due to excessively difficult ground and drilling conditions.
- A pilot borehole, BH-TH-01, was added during the drill program in light of the difficult ground conditions encountered, and to support the informed advancement of BH-SW-01.

Despite these deviations, the WL QZ18-044 monitoring wells were successfully replaced (with the exceptions of BH-39 and FM-MW-01N), and all wells scoped for decommissioning were completed. The drilling and installation of a water supply well at New Bermingham was also successfully completed. All newly drilled and installed wells were developed, with the exception of KV-116N, KV-126N, KV-85SN, KV-86N, KV-88SN, and KV-89SN, which could

not be fully developed due to insufficient water levels. Decommissioning was successfully completed at the scoped locations.

Aquifer testing were conducted on BH-TH-01 and BH-SW-01 to inform the sustainable yield of the water supply at New Bermingham. Analysis of the test data yielded hydraulic conductivity values on the order of 10^{-6} m/s (1.8×10^{-6} to 3.0×10^{-6} m/s for BH-TH-01 and BH-SW-01, respectively); and specific storage 3.6×10^{-6} m^{-1} derived from curve fitting of the observation well data, BH-TH-01. These values were used in the Farvolden approximation, resulting in a sustainable yield estimate of 23 L/min (0.10 gallons per minute).

Laboratory analysis of a groundwater sample collected from BH-SW-01 after more than 24 hours of constant-rate pumping indicated that all parameters were below the Canadian Drinking Water Quality Guidelines, with the exception of manganese (2.10 mg/L), which exceeded the guideline limit (0.12 mg/L).

5.0 RECOMMENDATIONS FOR FUTURE WORK

The following recommendations are made based on the observations and outcomes of the 2025 drilling program:

- Install concrete surface seal at wellheads for all twelve (12) new monitoring wells and the trial well (BH-TH-01) in accordance with Protocol 7.
- Install concrete base pad and concrete surface seal at supply well, BH-SW-01.
- Complete drilling and installation of WL QZ18-044 replacement well BH-39N, located atop the dry stack tailings facility (DSTF).
- Re-attempt drilling and installation of VWP location FM-MW-01N.
- Water supply well drilling and installation in the Flame and Moth area, pending finalization of future mine and office plans.
- Complete well development at KV-116N, KV-126N, KV-85SN, KV-86N, KV-88SN, and KV-89SN.
- Incorporate WL QZ18-044 replacement wells into the ongoing routine groundwater sampling program.
- Install water level data loggers in all new WL QZ18-044 replacement wells.
- Install a barometric data logger at New Bermingham.

6.0 REFERENCES

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APPENDIX A. EXISTING BOREHOLE LOGS

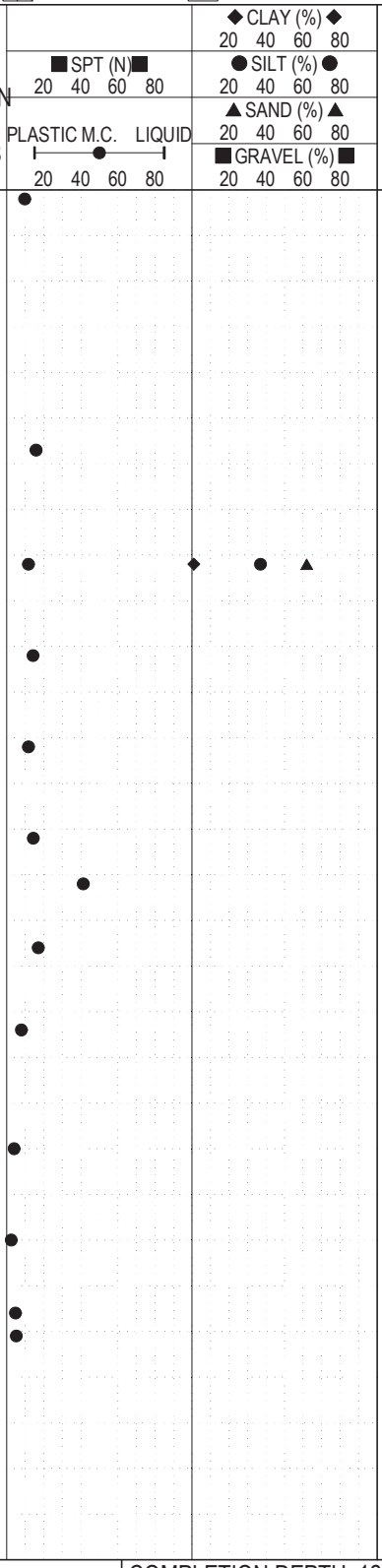
BH-39

Dry Stack Tailings Facility GTC Installation	CLIENT: Alexco Resource Corp. Ltd.	BOREHOLE NO: W14103025-BH39
Keno Hill District Mill Site	DRILL: Air Rotary (MS Driltech)	PROJECT NO: W14103025-01
Keno City, YT	7086938N; 483973E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS
0	SAND and SILT (TAILINGS) - trace clay, moist, light grey		SA01	- unfrozen
3			SA02	
4			SA03	
5			SA04	
6			SA05	
7			SA06	
7.6	SILT - some sand, trace gravel, poorly graded, non-plastic, dark brown, organics throughout, strong organic odour		SA07	
8			SA08	
9			SA09	
10				
10.6	BEDROCK - light grey		SA10	
11			SA11	
12			SA12	
12.6	END OF BOREHOLE @ 12.6 m (Target Depth)		SA13	
13	NOTE: 50 mm slotted PVC monitoring well installed to 7.5 m			
15				

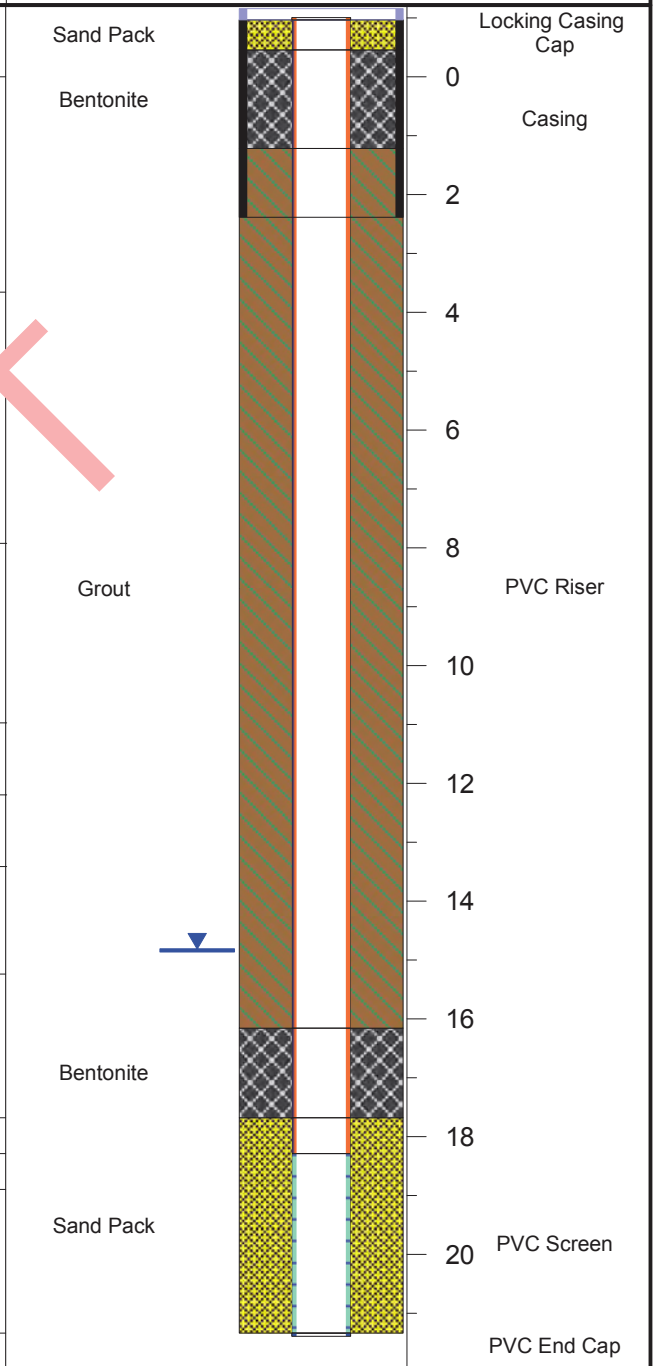


Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 49

eba A TETRA TECH COMPANY	LOGGED BY: IM	COMPLETION DEPTH: 12.6m
	REVIEWED BY: JTP	COMPLETE: 8/1/2012
	DRAWING NO:	Page 1 of 1

ACCESS	PROJECT: **ERDC Site Wide Monitoring Plan (13 002-4)**	BORING ID: **KAR13-012**	**BH-MW-01**
	LOCATION: **Keno Hills Silver District (KHSD)**	WELL ID: **Birmingham Adit (Completed)**	
	DRILLING CONTRACTOR: **Access Consulting Group**	NORTHING: **7087237**	EASTING: **478690**
	DRILLING EQUIPMENT: **Midnight Sun Drilling Inc.**	GROUND SURFACE ELEV. (masl): **1242**	TOC ELEVATION (m ags): **0.97**
	DRILLING METHOD: **Air Rotary**	TOTAL DEPTH (m): **21.34**	WATER DEPTH (m bgs): **14.83**
LOGGED BY: **MR**	SAMPLING METHOD: **2 Feet (0.61 m) Continuous Sampling**	DATE STARTED: **September 3, 2013**	DATE COMPLETED: **September 3, 2013**

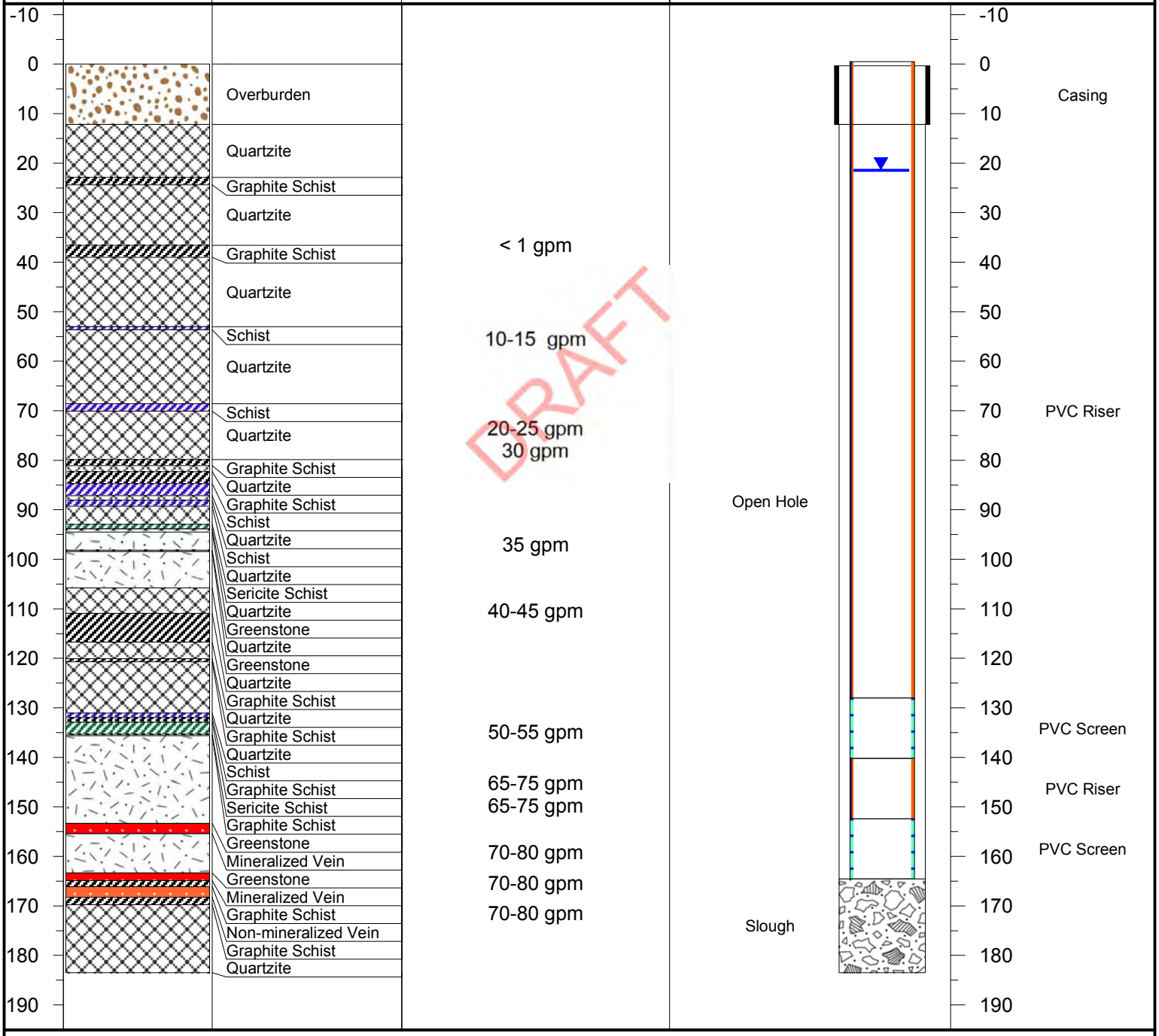
Depth (m)	Graphic Log	Description
0		
2		WASTE ROCK with GRAVEL (road fill) from 0.0 - 2.4 meters. Native Soils start at 2.4 meters. Organics noted, oxidation low, some Silt, brown, loose to firm (clumpy), moist to wet
4		QUARTZITE, some Graphitic Schist, bedrock contact, light brown to grey, damp to wet to moist
6		
8		GRAPHITIC SCHIST, dark grey to brown to black, dry to damp
10		
12		QUARTZITE, some Graphitic Schist, brown to dark brown, dry to damp,
		GRAPHITIC SCHIST, some Quartzite, grey to dark brown, dry to damp
14		QUARTZITE, some Graphitic Schist, grey, dry to damp
16		GRAPHITIC SCHIST, some Quartzite, brown to dark grey, dry to damp
18		QUARTZITE, some Graphitic Schist, brown to grey, damp
		GRAPHITIC SCHIST, dark grey, damp to saturated
20		QUARTZITE, some Graphitic Schist, FAULT noted from 20.1 to 21.3 meters, fractured, Clay Seam noted in fault, brown, saturated. EOH @ 21.34 m



DRAFT

NOTES: Wells are 2 inches in diameter.
EOH @ 21.34m.

ACCESS	PROJECT: **ERDC Site Wide Monitoring Plan (13 002-04)**	WELL ID: **KAR13001 (FM-1)**	**FM-MW-01**
	LOCATION: **Keno Hills Silver District (KHSD)**	WELL MATERIAL: **Christal Zone**	
	DRILLING CONTRACTOR: **Access Consulting Group**	NORTHING: **7086562.16**	EASTING: **483854.14**
	DRILLING EQUIPMENT: **Midnight Sun Drilling Inc.**	GROUND SURFACE ELEV. (masl): **913.1**	TOC ELEVATION (m ags): **0.5**
	DRILLING METHOD: **Air Rotary**	TOTAL DEPTH (m): **182.3**	WATER DEPTH (m bgs): **21.431**
LOGGED BY: **MR/LF**	SAMPLING METHOD: **Logged by major lithology**	DATE STARTED: **August 22, 2013**	DATE COMPLETED: **August 24, 2013**



NOTES:

Overburden Borehole Diameter: 7 3/8"

Bedrock Borehole Diameter: 6"

Monitoring Well Installation	CLIENT: Access Consulting Group	PROJECT NO. - BOREHOLE NO.
Keno City, YT	DRILL: Air Rotary	W23101422-MW-4
	7086914N; 485205E; Zone 8	KC-MW-4

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
0	SAND and GRAVEL - moderately sorted, subangular to subrounded, dry, grey and brown				0
1					
2	SAND - fine grained, damp, brown				5
	SAND and GRAVEL - moderately sorted, fine to coarse grained sand, subangular to subrounded, dry, grey and brown				
3	- as above with occasional schist fragments and well rounded gravels				10
4	SAND - trace gravel,uniformly sorted, fine grained sand, dry, brown				
	SAND and GRAVEL - moderately sorted, fine to coarse grained sand, subangular to subrounded, dry, grey and brown				15
5					
6					20
7					
8					25
9	SAND and GRAVEL - poorly sorted, fine grained sand, some coarse grained sand, subangular to subrounded, dry, grey, brown and white				30
	SAND - fine grained, damp, brown				
10	SAND - uniformly graded, fine grained, moist to wet, brown/slightly grey				
11					35
12	SAND and GRAVEL - poorly sorted, fine grained sand with some coarse grained sand, subangular to subrounded, dry, grey, brown and white				40
	SAND and GRAVEL - well sorted, coarse grained sand with some fine grained sand, subangular with occasional subrounded gravels, dry, grey, some white and brown				
13					
14					45
15					
	SAND - some gravel, poorly sorted, gravel subrounded, dry, brown				50
16	SAND - uniformly sorted, fine grained, damp, brown				
17	SAND - uniformly sorted, fine grained, moist to wet, brown/slightly grey				55
18					
	SAND and GRAVEL - moderately sorted, fine to coarse grained, subangular to subrounded, dry, grey, some brown				60
19					
20					65.6

EBA Engineering Consultants Ltd.

LOGGED BY: AS	COMPLETION DEPTH: 82.3m
REVIEWED BY: SK	COMPLETE: 4/18/2011
DRAWING NO:	Page 1 of 5

Monitoring Well Installation	CLIENT: Access Consulting Group	PROJECT NO. - BOREHOLE NO.
Keno City, YT	DRILL: Air Rotary	W23101422-MW-4
	7086914N; 485205E; Zone 8	KC-MW-4

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
20	SAND and GRAVEL - well sorted, coarse grained sand, some fine grained sand, subangular with some subrounded gravels, dry, grey, some white and brown				
21					70
22					
23					75
24					
25					80
26					
27	- trace schist present				85
28					
29					90
30	SAND - well sorted, fine and medium grained sand, dry, grey, brown and light brown				
31	SAND and GRAVEL - well sorted, coarse grained sand, some fine to medium grained sand, fine grained gravel, rounded to subrounded, dry, grey, brown and white				95
32					
33	- as above with occasional schist fragments and well rounded gravels				100
	SILT - soft, moist to damp, brown		- water in returns after casing and rods added - not significant amount - driller started to inject water as cuttings not returning to surface		105
34					
35	- became dark grey in colour				110
36					
37			- no water in cuttings after rods and casing added		115
38					
39	SILTY GRAVEL - some sand, moderately sorted, generally subrounded, moist to damp, grey, brown and orange				120
40	SAND and GRAVEL - trace silt, well graded, fine to coarse grained sand, fine grained gravel, subrounded, moist, grey, brown and orange				125
					130
					131

Monitoring Well Installation	CLIENT: Access Consulting Group	PROJECT NO. - BOREHOLE NO.
Keno City, YT	DRILL: Air Rotary	W23101422-MW-4
	7086914N; 485205E; Zone 8	KC-MW-4

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
40	- becoming drier, less silt				
41	SAND and GRAVEL - well graded, fine to coarse grained sand, fine grained gravel, subrounded, dry, grey with some orange and white				135
42	GRAVEL - some sand, moderately to well graded, fine grained gravel, subrounded, dry, grey with trace white				
43	SAND - well graded, fine to medium grained sand, subrounded, dry, grey, brown, orange and white				140
44	GRAVEL and SAND - moderately graded, fine grained gravel and fine grained sand, subrounded, damp, brown, grey, orange and white				145
45	- dry				
46					150
47	- boulder/cobble to around 46.5 m				155
48					
49					160
50					165
51					
52					170
53					175
54					
55					180
56					185
57	- boulder/cobble to around 56.7 m				
58					190
59	SAND - some gravel, well graded, fine to coarse grained sand, fine grained gravel, subangular to subrounded, damp, grey, orange and white				
60	- saturated				195

4/17/2011

EBA Engineering Consultants Ltd.

LOGGED BY: AS	COMPLETION DEPTH: 82.3m
REVIEWED BY: SK	COMPLETE: 4/18/2011
DRAWING NO:	Page 3 of 5

Monitoring Well Installation	CLIENT: Access Consulting Group	PROJECT NO. - BOREHOLE NO.
Keno City, YT	DRILL: Air Rotary	W23101422-MW-4
	7086914N; 485205E; Zone 8	KC-MW-4

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
60					
61					200
62					
63					205
64					
65					210
66					
67					215
68	SAND - well graded, fine to coarse grained, subrounded to rounded, saturated, brown with grey, white and orange				220
69					
70					225
71					
72					230
73					
74					235
75					
76					240
77					
78					245
79	- increasing fine sand and silt				
80			- slow drilling, bit worn?		250
					255
					260
					265

EBA Engineering Consultants Ltd.

LOGGED BY: AS	COMPLETION DEPTH: 82.3m
REVIEWED BY: SK	COMPLETE: 4/18/2011
DRAWING NO:	Page 4 of 5

Monitoring Well Installation	CLIENT: Access Consulting Group	PROJECT NO. - BOREHOLE NO.
Keno City, YT	DRILL: Air Rotary	W23101422-MW-4
	7086914N; 485205E; Zone 8	KC-MW-4

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
80					265
81					
82					270
83	EOH @ 82.3 m (270 ft) NOTE: bit not drilling, too worn. Bedrock not reached. Hole collapsed to 59.4 m (195 ft) when 4" casing pulled. Redrilled to 67.1 m (220 ft).				
84					275
85					
86					280
87					
88					285
89					
90					290
91					
92					295
93					
94					300
95					
96					305
97					
98					310
99					
100					315
					320
					325
					328

EBA Engineering Consultants Ltd.

LOGGED BY: AS	COMPLETION DEPTH: 82.3m
REVIEWED BY: SK	COMPLETE: 4/18/2011
DRAWING NO:	Page 5 of 5

Alexco Keno Hill Mining Corp.

Borehole No: **KV-116**

Project: MW Monitoring and Installation	Project No: ENG.WARC03905-01
Location: Bermingham	Ground Elev: 1206.112 m
Keno City, Yukon	UTM: 478472.068 E; 7087372.123 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description
0			
2	Air Rotary (casing)	BEDROCK - weathered, brown, subrounded	Unfrozen
4			
6	bit	BEDROCK - competent, light grey and brown, silt and angular rock chips, easy drilling	
8	Air Rotary (165 mm	- possibly quartzite, water initially encountered	
10		- light grey and white, hard drilling	
12		- light grey	
14		END OF BOREHOLE (12.04 metres) water - 3.96 metres on October 31, 2020 Monitoring well installed to 12.04 metres Note: Target depth reached	
16			
18			
20			
22			
24			
26			
28			
30			
32			
34			
36			
38			
40			

Oct31/20

Moisture Content (%)

Plastic Limit | Moisture Content | Liquid Limit
20 40 60 80

KV-116

Elevation (m)
1205
1200
1195
1190
1185
1180
1175
1170

TETRA TECH

Contractor: Midnight Sun Drilling	Completion Depth: 12.04 m
Drilling Rig Type: Schramm T450GT	Start Date: 2020 October 30
Logged By: NJ	Completion Date: 2020 October 31
Reviewed By: JRT	Page 1 of 1

Alexco Keno Hill Mining Corp.

Borehole No: **KV-123**

Project: MW Monitoring and Installation	Project No: ENG.WARC03905-01
Location: Bermingham	Ground Elev: 1282.872 m
Keno City, Yukon	UTM: 478767.788 E; 7087059.391 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description
0		BEDROCK - weathered, damp, brown, subrounded	Unfrozen
2	Air Rotary (casing)	BEDROCK - possibly graphitic schist, competent, dark brown, silt and angular rock chips, easy drilling	
		- light brown	
4		- light brownish grey	
		- brown	
6		- light brownish grey	
		- brown	
8		- light brownish grey	
		- brown	
10		- black	
		- light brownish grey	
12		- black	
		- dark grey	
14	Air Rotary (165 mm bit)	- possibly quartzite, light grey, hard drilling	
		- light brownish grey	
16		- possibly graphitic schist, black, easy drilling	
		- possibly quartzite, light grey, harder drilling	
18		- dark grey	
		- light brown	
20		- light grey	
		- light brownish grey	
22		- dark grey	
		- light brownish grey	
24		- dark grey	
		- light grey	
26		- dark grey	
28		- light grey	
		- light brownish grey	
30		- possibly graphitic schist, dark grey, easy drilling	
32		- brown	
		- light grey	
34		- water initially encountered	
36 ▼ Oct30/20		- poor recovery of rock cuttings, some mud, brown, cannot distinguish rock type to end of hole	
38			
40			

Moisture Content (%): Plastic Limit 20 | Moisture Content 40 60 | Liquid Limit 80

KV-123

Elevation (m): 1280, 1275, 1270, 1265, 1260, 1255, 1250, 1245

▼ Oct30/20

TETRA TECH

Contractor: Midnight Sun Drilling	Completion Depth: 44.8 m
Drilling Rig Type: Schramm T450GT	Start Date: 2020 October 28
Logged By: TP	Completion Date: 2020 October 29
Reviewed By: JRT	Page 1 of 2

Alexco Keno Hill Mining Corp.

Borehole No: **KV-123**

Project: MW Monitoring and Installation	Project No: ENG.WARC03905-01
Location: Bermingham	Ground Elev: 1282.872 m
Keno City, Yukon	UTM: 478767.788 E; 7087059.391 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	KV-123	Elevation (m)
40							
42			Unfrozen				1240
44							
46		END OF BOREHOLE (44.80 metres) water - 36.31 metres on October 30, 2020 Monitoring well installed to 43.43 metres Note: Target depth reached					
48							1235
50							
52							1230
54							
56							
58							1225
60							
62							1220
64							
66							
68							1215
70							
72							1210
74							
76							
78							1205
80							

TETRA TECH

Contractor: Midnight Sun Drilling	Completion Depth: 44.8 m
Drilling Rig Type: Schramm T450GT	Start Date: 2020 October 28
Logged By: TP	Completion Date: 2020 October 29
Reviewed By: JRT	Page 2 of 2

Alexco Keno Hill Mining Corp.

Borehole No: **KV-124**

Project: MW Monitoring and Installation	Project No: ENG.WARC03905-01
Location: Bermingham	Ground Elev: 1320.098 m
Keno City, Yukon	UTM: 478778.636 E; 7086839.912 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description
0	Air Rotary (casing)	OVERBURDEN - brown, subrounded, hard drilling	Unfrozen
2		BEDROCK - weathered, dark brown, subrounded, relatively easier drilling	
4		BEDROCK - competent, light grey, silt and angular rock chips, easy drilling	
6		- possibly quartzite, dark grey	
8			
10 Oct11/20		- weathered, brown and grey	
12		- light grey, hard drilling	
14		- water first noted while drilling	
16		END OF BOREHOLE (15.09 metres) water - 9.11 metres on October 10, 2020 Monitoring well installed to 14.84 metres Note: Target depth reached	
18			
20			
22			
24			
26			
28			
30			
32			
34			
36			
38			
40			

Moisture Content (%)

Plastic Limit | Moisture Content | Liquid Limit

20 40 60 80

KV-124

Elevation (m)

1320 1315 1310 1305 1300 1295 1290 1285

Oct13/20

TETRA TECH

Contractor: Midnight Sun Drilling	Completion Depth: 15.09 m
Drilling Rig Type: Schramm T450GT	Start Date: 2020 October 09
Logged By: NJ	Completion Date: 2020 October 13
Reviewed By: JRT	Page 1 of 1

Alexco Keno Hill Mining Corp.

Borehole No: **KV-126**

Project: MW Monitoring and Installation	Project No: ENG.WARC03905-01
Location: Bermingham	Ground Elev: 1261.279 m
Keno City, Yukon	UTM: 478828.868 E; 7087235.42 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description
0			
2	Air Rotary (casing)	No Recovery - plugged cyclone hose	Unfrozen
4		BEDROCK - competent, dark grey, silt and angular rock chips, easy drilling - light grey, harder drilling	
6		- possibly graphitic schist, dark grey, easy drilling - brown - light grey, harder drilling	
8		- possibly graphitic schist, dark grey, easy drilling - light grey, harder drilling	
10		- possibly graphitic schist, dark grey, easy drilling - brown	
12			
14		- light grey, hard drilling	
16		- brown - light grey	
18			
20	Air Rotary (150 mm bit)	- possibly graphitic schist, dark grey/brownish, easy drilling - light grey, harder drilling	
22		- brown	
24		- light grey - possibly graphitic schist, brown/grey, easy drilling	
26		- black	
28			
30			
32		- light grey, hard drilling	
34			
36		- possibly graphitic schist, dark grey, easy drilling - light grey, harder drilling	
38			
40			

Moisture Content (%): Plastic Limit | Moisture Content | Liquid Limit; 20 40 60 80

KV-126

Elevation (m): 1260, 1255, 1250, 1245, 1240, 1235, 1230, 1225

TETRA TECH

Contractor: Midnight Sun Drilling	Completion Depth: 73.2 m
Drilling Rig Type: Schramm T450GT	Start Date: 2020 October 22
Logged By: TP	Completion Date: 2020 October 25
Reviewed By: JRT	Page 1 of 2

Alexco Keno Hill Mining Corp.

Borehole No: **KV-126**

Project: MW Monitoring and Installation	Project No: ENG.WARC03905-01
Location: Bermingham	Ground Elev: 1261.279 m
Keno City, Yukon	UTM: 478828.868 E; 7087235.42 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	KV-126	Elevation (m)
40			Unfrozen				1220
42	Air Rotary (150 mm bit)						
44		- dark grey - light grey					
46		- brown - light grey					1215
48							
50		- dark grey - light grey					1210
52		- possibly graphitic schist, dark grey, easy drilling					
54							
56							1205
58							
60		- light grey, harder drilling					
62							1200
64	Air Rotary (146 mm bit)	- water initially encountered - poor recovery of rock cuttings, some mud, brown, cannot distinguish rock type to end of hole					
66							1195
68							
70							
72							1190
74		END OF BOREHOLE (73.20 metres) water - 46.63 metres on October 26, 2020 Monitoring well installed to 70.61 metres Note: Target depth reached					
76							1185
78							
80							

Oct26/20

Oct26/20

TETRA TECH

Contractor: Midnight Sun Drilling	Completion Depth: 73.2 m
Drilling Rig Type: Schramm T450GT	Start Date: 2020 October 22
Logged By: TP	Completion Date: 2020 October 25
Reviewed By: JRT	Page 2 of 2

Alexco Keno Hill Mining Corp.

Borehole No: **KV-127**

Project: MW Monitoring and Installation	Project No: ENG.WARC03905-01
Location: Bermingham	Ground Elev: 1298.736 m
Keno City, Yukon	UTM: 479020.784 E; 7087108.687 N; Z 8 NAD83

Depth (m)	Method	Soil Description	Ground Ice Description
0	Air Rotary (casing)	OVERBURDEN - brown, hard, subrounded	Unfrozen
2		BEDROCK - weathered, brown and grey, silt and angular chips, easy drilling	
4	Air Rotary (150 mm bit)	BEDROCK - competent, silt and angular chips, moderately hard drilling - possibly quartzite, dark grey, hard drilling	
6		- light grey	
8			
10			
12		- grey	
14			
16		- light grey and white	
18			
20			
22			
24		- water initially encountered	
26			
28			
30		END OF BOREHOLE (28.90 metres) slough - 26.64 metres water - 16.22 metres on October 12, 2020 Monitoring well installed to 26.64 metres Note: Target depth reached	
32			
34			
36			
38			
40			

Moisture Content (%): Plastic Limit | Moisture Content | Liquid Limit; 20 40 60 80

KV-127

Elevation (m): 1295, 1290, 1285, 1280, 1275, 1270, 1265, 1260

Oct12/20

Contractor: Midnight Sun Drilling	Completion Depth: 29.11 m
Drilling Rig Type: Schramm T450GT	Start Date: 2020 October 12
Logged By: NJ	Completion Date: 2020 October 12
Reviewed By: JRT	Page 1 of 1

TETRA TECH

SRK Consulting
Engineers and Scientists

BOREHOLE LOG KV-85D

SHEET 1 of 1

PROJECT No: 1CA009.003
SITE: Bellekeno
CLIENT: Alexco Resource Corp.

DATE: Feb. 2010
LOGGED BY: Jacek Scibek
DRILL HOLE: PH2

EASTING: 483864
NORTHING: 7086952
ELEVATION: 898.5 masl

DEPTH (m)	ELEV (masl)	WELL	DESCRIPTION	LITHO SYMBOL	DETAILED LITHOGRAPHY	COMMENTS
0	898.5		0.85 m stickup		Ground Surface	
					Gravel	
	895.0				**Till** some water	
5			2" PVC		**Ice**	
					Gravel no water, frozen?	
	890.0					
10					**Till** dry	
					Bedrock	
	885.0					
15			bentonite chips to surface			
	880.0					
20		27.86 m below TOC				
	875.0					
25						
	870.0					
30						
	865.0		bentonite pellets			
35			sand			
	860.0		screen			39.6 m Producing water up to 20 L/min
40						
	855.0					
45						

NOTES: Coordinates are +/- 5m, they are from a handheld GPS. Elevations are +/- 1m, they are taken from a topo map.

Reviewed By: | FILE

Keno DSTF Monitoring Well Installation	CLIENT: Alexco Resource Corp.	PROJECT NO. - BOREHOLE NO.
Alexco Keno Mill	DRILL: Drilltech M5 Sandvik	W23101499 KV-85S
near Keno City, YT	7086939N; 483858E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Depth (ft)
0	SAND and GRAVEL - some silt, poorly graded, fine to coarse grained sand, sub-angular to sub-rounded gravel, brown		- Sitckup +0.46 mag - Tricone bit and casing hammer from 0.0 to 4.6 mbg	0
1				
				5
2				
	GRAVEL - some sand, trace silt, poorly graded, sub-angular to sub-rounded gravel, greyish brown			
3	- becomes saturated			10
4	SILT and GRAVEL (TILL) - sub-angular gravel, wet, grey			
				15
	END OF BOREHOLE @ 4.6 m - low permeability unit encountered NOTE: pulled casing back 2 feet to close up base of hole to base of gravel layer (13 ft)			
5				16

eba A TETRA TECH COMPANY	LOGGED BY: AJS	COMPLETION DEPTH: 4.03 m
	REVIEWED BY: SK	COMPLETE: 10/6/2011
	DRAWING NO:	Page 1 of 1

SRK Consulting
Engineers and Scientists

BOREHOLE LOG

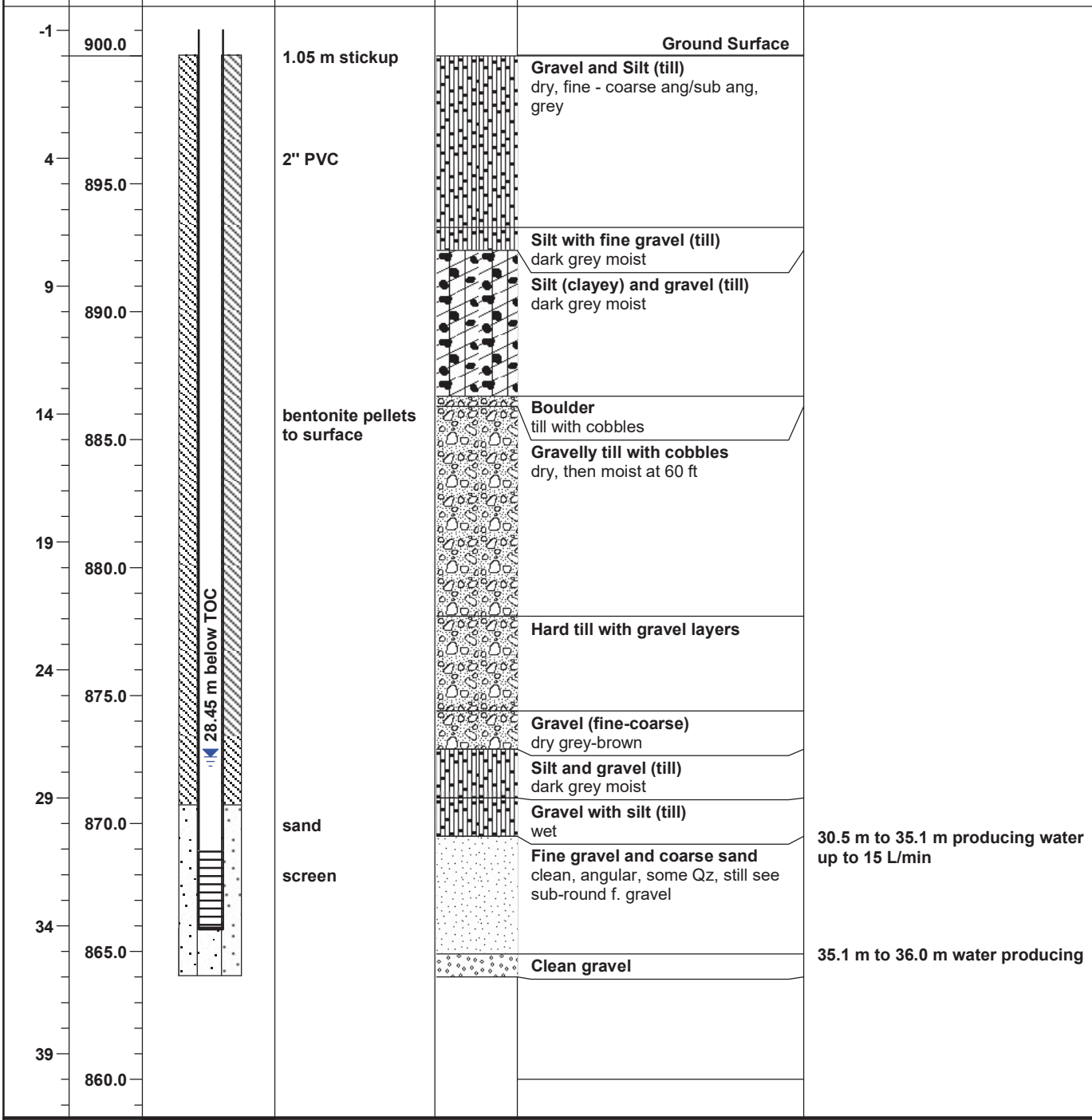
SHEET 1 of 1

PROJECT No: 1CA009.003
SITE: Bellekeno
CLIENT: Alexco Resource Corp.

DATE: Feb. 2010
LOGGED BY: Jacek Scibek
DRILL HOLE: PH5

KV-86

EASTING: 483836
NORTHING: 7086707
ELEVATION: 900 masl



NOTES: Coordinates are +/- 5m, they are from a handheld GPS. Elevations are +/- 1m, they are taken from a topo map.

	Reviewed By:	FILE

Keno DSTF Monitoring Well Installation	CLIENT: Alexco Resource Corp.	PROJECT NO. - BOREHOLE NO.
Alexco Keno Mill	DRILL: Drilltech M5 Sandvik	W23101499 KV-88S
near Keno City, YT	7087013N; 483945E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Depth (ft)
0	SAND and GRAVEL (FILL) - some silt, poorly graded, fine to coarse grained sand, sub-angular to sub-rounded gravel, damp to moist, brown with black and orange		- Stickup +0.60 mag - Tricone bit and casing hammer from 0.0 to 4.11 mbg	0
1				
				5
2	- organic material, moss			
	SAND and GRAVEL (NATIVE) - some silt, poorly graded, fine to coarse grained sand, sub-angular to sub-rounded gravel, damp to moist, brown with black and orange			
	- increasing silt content			
3	SILT - some sand, some gravel, damp to moist, brown			10
4	BEDROCK - slightly to moderately weathered, dry, grey with white and orange			
	END OF BOREHOLE @ 4.11 m (bedrock)			
				15
5				16

eba A TETRA TECH COMPANY	LOGGED BY: AJS	COMPLETION DEPTH: 4.11 m
	REVIEWED BY: SK	COMPLETE: 10/6/2011
	DRAWING NO:	Page 1 of 1

Keno DSTF Monitoring Well Installation	CLIENT: Alexco Resource Corp.	PROJECT NO. - BOREHOLE NO.
Alexco Keno Mill	DRILL: Drilltech M5 Sandvik	W23101499 KV-89D
near Keno City, YT	7086859N; 483831E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	KV89-D	Depth (ft)
0	SAND and GRAVEL - some silt, some cobble, poorly graded, sub-rounded to rounded gravel and cobble, dry, brown with some black and orange and white		- Stickup +0.58 mag - Tricone bit and casing hammer from 0.0 to 16.2 mbg		0
1					
2	- increasing moisture content				5
3	- becomes damp to moist		- 1.5 m section of casing welded on, water in returns when drilling recommenced		10
4					
5	SILT and GRAVEL (TILL) - some sand, poorly graded, rounded to sub-rounded gravel, wet, brown				15
6	SILT (TILL) - moist, dark grey				20
7					
8					25
9	ICE				30
10					
11					35
12					40
13	ICE and SILT - yellowish brown ICE and SILT - dark grey				
14					45
15	SILT and SAND and GRAVEL (TILL) - poorly graded, sub-angular gravel, damp, grey				50
16					
17	BEDROCK - dry, dark grey and black		- DHH from 16.2 to 38.3 mbg		55
18					60
19					
20					65 66

eba A TETRA TECH COMPANY	LOGGED BY: AJS	COMPLETION DEPTH: 38.3 m
	REVIEWED BY: SK	COMPLETE: 10/7/2011
	DRAWING NO:	Page 1 of 2

Keno DSTF Monitoring Well Installation	CLIENT: Alexco Resource Corp.	PROJECT NO. - BOREHOLE NO.
Alexco Keno Mill	DRILL: Drilltech M5 Sandvik	W23101499 KV-89D
near Keno City, YT	7086859N; 483831E; Zone 8	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	KV89-D	Depth (ft)
20					70
21					
22 ▼					75
23	- dry				
24					80
25					
26					85
27					
28					90
29					
30					95
31	- dry				
32					100
33					
34					105
35					
36					110
37					
38	- water in returns after rod added and air turned on				115
	END OF BOREHOLE @ 38.3 m				
39					120
40					125
					130
					131

eba A TETRA TECH COMPANY

LOGGED BY: AJS	COMPLETION DEPTH: 38.3 m
REVIEWED BY: SK	COMPLETE: 10/7/2011
DRAWING NO:	Page 2 of 2

KV-89S

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH17
Keno City, YT		ELEVATION: 899.9m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	SPT (N)	STANDARD PENETRATION (N) 20 40 60 80 / POCKET PEN. (kPa) 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Monitoring well	Thermistor	Elevation (m)
0	GRAVEL (FILL) - sandy, trace silt, loose, coarse grained, well graded, damp, brown						UNFROZEN			
	PEAT - amorphous granular									
	GRAVEL - sandy, some cobbles, trace silt, compact, coarse grained, well graded, damp, brown, subrounded									
1			SA01	-0.1						899.0
	8/30/2009									8/30/2009
2			SA02	0						898.0
	SILT (TILL) - gravelly, some sand, trace clay, firm, non-plastic, massive, damp, olive grey		SA03							
3				0						897.0
			SA04		19					
			SA05							
4				0						896.0
	- becomes stiff, low plastic		SA06							
	ICE AND SILT - some gravel, some sand, trace clay, low plastic, grey		SA07	0			FROZEN Vs (40%), Vr (15%)			895.0
5			SA08							
6			SA09			1643				894.0
	ICE - massive ice						MASSIVE ICE - randomly oriented crystals, trace silt (90% ICE/10% SILT)			
	- no recovery from 6.2 - 7.2 m									
7										893.0
			SA10	-0.1						
8			SA11			2379				892.0
			SA12			14391				
			SA13			19396				
9			SA14							891.0
	- no recovery from 9.2 - 10.1 m									
10										890.0

EBA Engineering Consultants Ltd.

LOGGED BY: CJD	COMPLETION DEPTH: 15.25m
REVIEWED BY:	COMPLETE: 8/30/2009
DRAWING NO:	Page 1 of 2

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH17
Keno City, YT		ELEVATION: 899.9m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	SPT (N)	STANDARD PENETRATION (N) 20 40 60 80 / POCKET PEN. (kPa) 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Monitoring well	Thermistor	Elevation (m)
10	ICE AND SILT - sandy, some gravel, trace clay, low plastic, massive, grey			-0.1			Vs (25%), Vr (15%)			
	SILT (TILL) - sandy, gravelly, trace clay, non-plastic, massive, grey						Vr (5%)			
11			SA15	-0.1						889.0
			SA16							
12			SA17	-0.1						888.0
			SA18							
13				0						887.0
14				0.1						886.0
	BEDROCK (quartzite)		SA19	0.1						
15										885.0
	END OF BOREHOLE - target depth 15.25 m									
16										884.0
17										883.0
18										882.0
19										881.0
20										880.0

EBA Engineering Consultants Ltd.

LOGGED BY: CJD	COMPLETION DEPTH: 15.25m
REVIEWED BY:	COMPLETE: 8/30/2009
DRAWING NO:	Page 2 of 2

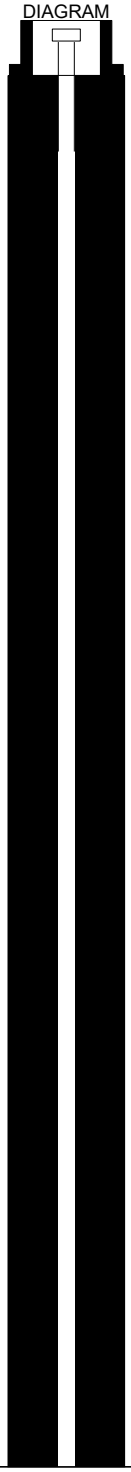
APPENDIX B. REPLACEMENT BOREHOLE LOGS

ENSERO solutions

WELL NUMBER BH-MW-01N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-30-2025 **COMPLETED** 08-30-2025
POSITION N: 7087290.3 m E: 478664.0 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 1234.61 m **TOP PVC ELEV** 1235.81
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 29.30 mbgs **FINAL DEPTH** 32.60 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 152
Drilling diameters: 167.6mm: 0.0-8.4m. 152.4mm: 8.4-32.6m. 6.6-inch steel casing: 1.2mags-8.4m. 2-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1.2mags-29.0m. 10-slot Screen: 29.0-32.0m. Bentonite Chips: 0.0-26.9m. Bentonite Pellets: 26.9-28.2m. 20/40 Sand: 28.2-32.6m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY S Battaglia **CHECKED BY** A McMillan

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0	1234		SCHIST - sericitic and quartz, silty, brown, moderate weathering
1			
	1233		
2			- @ 2m trace quartz
	1232		
3			
	1231		
4			- @ 4m trace quartz, trace weathering
	1230		
5			- @ 5m sericitic and graphitic, grey, some iron oxidation
	1229		
6			
	1228		
7			- @ 7m trace to some iron oxidation
	1227		
8			- @ 8m increasing quartz content and iron oxidation
	1226		
9			
	1225		
10			
	1224		
11			
	1223		
12			- @ 12m sericitic and graphitic, moderate iron oxidation, trace quartz
	1222		
13			
	1221		
14			- @ 14m some graphitic schist and quartz
	1220		
15			- @ 15m trace quartz
	1219		
16			
	1218		
17			
	1217		
18			



No water encountered during drilling.

WELL NUMBER BH-MW-01N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
1216		SCHIST - sericitic and quartz, silty, brown, moderate weathering	
1215		- @ 20m no quartz content, trace iron oxidation	
1214		- @ 21m some quartz	
1213		22.00 1212.61	
1212		QUARTZITE - some sericitic and graphitic schist, moderate to intense iron oxidation	
		23.00 1211.61	
1211		SCHIST - graphitic and sericitic, some quartz, moderate to intense iron oxidation	
1210		- @ 25m intensely iron stained, trace quartz	
1209			
1208			
1207			Bentonite pellets
1206			
1205			▽
1204		- @ 30m trace quartz	20/40 Sand
1203		- @ 31m increasing quartz content	2-in Slotted Schedule 40 PVC, threaded, 10-slot
1202		32.60 1202.01	
1201		Terminated at 32.60 m.	
1200			
1199			
1198			
1197			
1196			

NOTES No water encountered during drilling.

WELL NUMBER BH-SW-01

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 09-11-2025 **COMPLETED** 09-11-2025
POSITION N: 7087146.2 m E: 478571.1 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 1246.62 m **TOP PVC ELEV** 1247.39
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 34.00 mbgs **FINAL DEPTH** 55.00 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 254
Drilling diameters: 267mm: 0.0-8.0m. 254mm: 8.0-55.0m. 10.5-inch steel casing: 0.77mags-8.0m. 7-inch Blue Brute, threaded PVC. Well cap and end cap. PVC: 0.77mags-43.8m. 20-slot Screen: 43.8-49.8m. Bentonite Chips: 0.0-34.8m. Bentonite Pellets: 34.8-37.8m. 10/20 Sand: 37.8-50.3m. Hole collapsed: 50.3-55.0m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY S Battaglia **CHECKED BY** A McMillan

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
1246		NO RECOVERY	PIPE HEIGHT: 0.77 m PIPE ELEV.: 1247.39 m
1240		7.00 1239.62	
1239		SCHIST - sericitic, trace iron staining	
1237		- @ 10m trace quartz	
1236		- @ 11m highly fractured, trace iron staining	
1234		- @ 13m trace quartz	
1231		16.00 1230.62	
1230		QUARTZITE - hard drilling - @ 16m some quartz	Bentonite chips
1228		19.00 1227.62	
1227		SCHIST - graphitic	
1225		- @ 22m sericitic schist, some quartz, some iron staining	7-in Solid Blue Brute, threaded
1222		- @ 25m sericitic and graphitic, moderate weathering	
1221			

WELL NUMBER BH-SW-01

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
1219		SCHIST - graphitic	
1218		- @ 28m sericitic, some quartz, trace to some iron staining	
1217			
1216			
1215		- @ 31m graphitic and sericitic	
1214			
1213		- @ 33m graphitic, trace quartz, trace iron staining	
1212			
1211			
1210		- @ 36m graphitic and sericitic	Bentonite pellets
1209			
1208			
1207			
1206			
1205			
1204		- @ 42m sericitic, some quartz, some iron staining	
1203			
1202			10/20 Sand
1201		- @ 45m trace quartz, flow test: 53 L/min	
1200			
1199			7-in Slotted Blue Brute, threaded, 20-slot
1198		- @ 48m sericitic schist, some iron staining, no quartz. flow test: 76 L/min	
1197		- @ 49m sericitic schist, trace iron staining, some quartz, no fracturing	
1196			
1195			
1194			Slough
1193			
1192		55.00 1191.62	
1191		Terminated at 55.00 m.	

NOTES

WELL NUMBER BH-TH-01

ENSERO solutions

CLIENT Hecla
PROJECT NUMBER ECA24YT00449
DATE STARTED 08-30-2025 **COMPLETED** 08-30-2025
DRILLING CONTRACTOR Anderson Water Services Ltd
DRILLING METHOD Air Rotary with DHH for steel casing
EQUIPMENT REICH- T-650 Drill Rig
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
LOGGED BY S Battaglia **CHECKED BY** A McMillan

PROJECT NAME AKHM Well Replacement
PROJECT LOCATION Keno City, Yukon
POSITION N: 7087139.1 m E: 478555.4 m (NAD83(CSRS) / UTM zone 8N)
GROUND ELEVATION 1246.21 m **TOP PVC ELEV** 1246.71
STATIC WATER LEVEL 32.40 mbgs **FINAL DEPTH** 95.00 m

WELL INSTALLATION DETAILS

Drilling diameters: 167.6mm: 0.0-10.8m. 152.4mm: 10.8-95.0m. 6.6-inch steel casing: 0.5mags-10.8m. 4.9-inch Blue Brute, threaded PVC. PVC: 0.6mags-46.0m. 20-slot Screen: 46.0-55.0m. Hole collapsed: 55.0-95.0m. Steel casing raised above GL for monument. Lockable well cap.

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SCHIST - silty, moderate weathering and iron oxidation, trace quartz
1	1245		
2	1244		- @ 2m graphitic, some quartz
3	1243		
4	1242		- @ 4m some quartz, trace iron oxidation
5	1241		
6	1240		- @ 6m sericitic and graphitic
7	1239		
8	1238		
9	1237		- @ 9m no silt
10	1236		
11	1235		
12	1234		- @ 12m increasing quartz
13	1233		
14	1232		- @ 14m graphitic, some sericitic, some quartz
15	1231		- @ 15m graphitic and sericitic, moderate iron oxidation
16	1230		
17	1229		17.00 1229.21 QUARTZITE - some sericitic schist, moderate to intense iron oxidation
18	1228		18.00 1228.21 SCHIST - sericitic and quartz, potential clay, slight to moderate iron oxidation
19	1227		
20	1226		
21	1225		- @ 21m intense iron oxidation
22	1224		- @ 22m sericitic and graphtiic, moderate iron oxidation, trace quartz
23	1223		
24	1222		
25	1221		
26	1220		- @ 26m increasing quartz
27	1219		
28	1218		
29			

WELL DIAGRAM

PIPE HEIGHT: 0.50 m
PIPE ELEV.: 1246.71 m

4.9-in Solid Blue Brute, threaded

No Backfill

No backfill installed, only Blue Brute PVC downhole.

WELL NUMBER BH-TH-01

CLIENT Hecla **PROJECT NAME** AKHM Well Replacement

PROJECT NUMBER ECA24YT00449 **PROJECT LOCATION** Keno City, Yukon

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
30	1216		SCHIST - sericitic and quartz, potential clay, slight to moderate iron oxidation	
31	1215			
32	1214			▼
33	1213			
34	1212			
35	1211			
36	1210			
37	1209			
38	1208			
39	1207			
40	1206		- @ 40m sericitic and graphitic, trace quartz and iron oxidation	
41	1205			
42	1204			
43	1203			
44	1202			
45	1201			
46	1200		- @ 46m grey, less graphitic	
47	1199			
48	1198			
49	1197			
50	1196			
51	1195			4.9-in Slotted Blue Brute, threaded, 20-slot
52	1194			
53	1193			
54	1192		- @ 54m some quartz	
55	1191		- @ 55m flow test: 76 L/min	
56	1190			
57	1189			
58	1188		- @ 58m intense iron oxidation	
59	1187			
60	1186			
61	1185			
62	1184		- @ 62m graphitic and sericitic, trace quartz	

NOTES No backfill installed, only Blue Brute PVC downhole.

WELL NUMBER BH-TH-01

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
63	1183		SCHIST - sericitic and quartz, potential clay, slight to moderate iron oxidation	
64	1182		- @ 64m some quartz	
65	1181			
66	1180		- @ 66m increasing graphitic schist	
67	1179			
68	1178			
69	1177			
70	1176		- @ 70m flow test: 95 L/min	
71	1175			
72	1174			
73	1173			
74	1172			
75	1171			Slough
76	1170			
77	1169			
78	1168			
79	1167			
80	1166		- @ 80m trace graphitic, flow test: 132 L/min	
81	1165			
82	1164			
83	1163			
84	1162		- @ 84m graphitic and sericitic	
85	1161			
86	1160		- @ 86m increasing graphitic, decreasing quartz	
87	1159			
88	1158		- @ 88m sericitic, some quartz, trace iron oxidation and graphitic	
89	1157			
90	1156			
91	1155			
92	1154			
93	1153			
94	1152			
95	1151		95.00 1151.21 Terminated at 95.00 m.	

NOTES No backfill installed, only Blue Brute PVC downhole.

ENSERO solutions

WELL NUMBER FM-MW-01N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-25-2025 **COMPLETED** 08-29-2025
POSITION N/A
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION N/A **TOP PVC ELEV** N/A
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL N/A **FINAL DEPTH** 151.00 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
Drilling diameters: 167.6mm: 0.0-22.5m. 152.4mm: 22.5-151.0m. 6.6-inch steel casing: 0.5mags-22.5m. Bentonite Chips: 0.0-151.0m.
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
LOGGED BY S Battaglia **CHECKED BY** A McMillan

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
907		FILL - weathered granitic schist, some quartzite	PIPE HEIGHT: 0.50 m PIPE ELEV.: N/A
906		2.00 — 905.83	
905		SCHIST - graphitic, some quartz, trace iron oxidation	
904		- @ 3m trace iron staining	
903			
902			
901		- @ 7m sericitic schist	
900			
899			
898			
897			
896			
895			
894		14.00 — 893.83	
893		ICE	
		15.50 — 892.33	
892		SCHIST - graphitic, some sericitic schist, some quartz and iron staining, some granitoid	
891			
890			
889		- @ 18m clay gouge	
888			
887			
886		22.00 — 885.83 — - @ 21m grey	
885		QUARTZITE - some sericitic schist	
884			
883		25.00 — 882.83	
882		SCHIST - graphitic and sericitic, some quartz, trace iron oxidation	
881			
880			
879			
878			
877			
876			
875			
874			
873			
872			
871			
870			
869			
868			
867			
866			
865			
864		- @ 44m trace pyrite	
863			
862			

Borehole abandoned due to issues with fractured bedrock collapsing and blocking the hole. Borehole drilled out twice, but with no success. Backfilled with bentonite chips.

WELL NUMBER FM-MW-01N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
47				
48	860		SCHIST - graphitic and sericitic, some quartz, trace iron oxidation	
49	859			
50	858			
51	857			
52	856			
53	855			
54	854			
55	853			
56	852			
57	851			
58	850			
59	849			
60	848			
61	847			
62	846			
63	845			
64	844			
65	843			
66	842			
67	841			
68	840			
69	839			
70	838			
71	837			
72	836			
73	835		- @ 73m flow test: 19 L/min	
74	834			
75	833			
76	832			Bentonite chips
77	831			
78	830			
79	829		- @ 79m trace quartz	
80	828			
81	827			
82	826			
83	825			
84	824			
85	823			
86	822			
87	821			
88	820			
89	819			
90	818			
91	817		- @ 91m flow test: 76 L/min	
92	816			
93	815			
94	814		- @ 94m flow test: 114 L/min	
95	813			
96	812			
97	811			
98	810			
99	809			

NOTES Borehole abandoned due to issues with fractured bedrock collapsing and blocking the hole. Borehole drilled out twice, but with no success. Backfilled with bentonite chips.

WELL NUMBER FM-MW-01N

CLIENT Hecla **PROJECT NAME** AKHM Well Replacement

PROJECT NUMBER ECA24YT00449 **PROJECT LOCATION** Keno City, Yukon

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
807		SCHIST - graphitic and sericitic, some quartz, trace iron oxidation	
787		- @ 121m flow test: 189 L/min	
778		- @ 130m flow test: 227 L/min	
775		- @ 133m flow test: 227 L/min	
763		- @ 145m trace pyrite	
757		151.00 756.83 Terminated at 151.00 m.	

NOTES Borehole abandoned due to issues with fractured bedrock collapsing and blocking the hole. Borehole drilled out twice, but with no success. Backfilled with bentonite chips.

WELL NUMBER KV-116N

ENSERO solutions

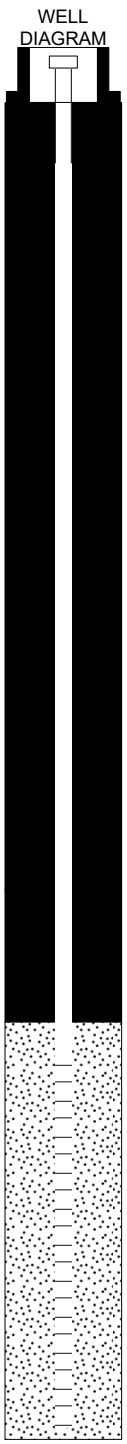
CLIENT Hecla
PROJECT NUMBER ECA24YT00449
DATE STARTED 08-29-2025 **COMPLETED** 08-29-2025
DRILLING CONTRACTOR Anderson Water Services Ltd
DRILLING METHOD Air Rotary with DHH for steel casing
EQUIPMENT REICH- T-650 Drill Rig
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
LOGGED BY S Battaglia **CHECKED BY** A McMillan

PROJECT NAME AKHM Well Replacement
PROJECT LOCATION Keno City, Yukon
POSITION N: 7087497.2 m E: 478499.5 m (NAD83(CSRS) / UTM zone 8N)
GROUND ELEVATION 1188.43 m **TOP PVC ELEV** 1189.63
STATIC WATER LEVEL 17.49 mbgs **FINAL DEPTH** 22.10 m

WELL INSTALLATION DETAILS

Drilling diameters: 167.6mm: 0.0-7.2m. 152.4mm: 7.2-22.1m. 6.6-inch steel casing: 1.2mags-7.2m. 2-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1.2mags-15.9m. 10-slot Screen: 15.9-21.9m. Bentonite Chips: 0.0-13.0m. Bentonite Pellets: 13.0-15.2m. 20/40 Sand: 15.2-22.1m. Steel casing raised above GL for monument. Lockable well cap.

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0	1188		FILL (sand and gravel) - silty, fine to medium sand, coarse gravel, brown, trace quartz and schist
1	1187		
2			2.00 — 1186.43
	1186		SCHIST - sericitic, weathered, some quartz
3	1185		- @ 3m silt
4	1184		
5	1183		- @ 5m very weathered, trace quartz and iron oxidation
6	1182		
7	1181		- @ 7m highly weathered
8	1180		- @ 8m sericitic and graphitic and quartz, moderate iron oxidation
9	1179		- @ 9m quartz and graphitic schist, some sericitic, moderate to high iron oxidation
10	1178		
11			11.00 — 1177.43
	1177		QUARTZITE - highly weathered, trace sericitic and graphitic schist
12			12.00 — 1176.43
	1176		SCHIST - sericitic, some quartz, highly weathered, trace graphitic schist
13	1175		- @ 13m brown clay
14	1174		- @ 14m trace quartz and iron oxidation
15	1173		- @ 15m increase to some quartz and iron oxidation
16	1172		
17	1171		▼
18	1170		
19	1169		
20	1168		
21	1167		- @ 21m clay (gouge)
22			22.10 — 1166.33
	1166		- @ 22m flow test <0.1 L/min
			Terminated at 22.10 m.



WELL NUMBER KV-123N

ENSERO solutions

CLIENT Hecla
PROJECT NUMBER ECA24YT00449
DATE STARTED 08-20-2025 **COMPLETED** 08-21-2025
DRILLING CONTRACTOR Anderson Water Services Ltd
DRILLING METHOD Air Rotary with DHH for steel casing
EQUIPMENT REICH- T-650 Drill Rig
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
LOGGED BY L Connolly **CHECKED BY** A McMillan

PROJECT NAME AKHM Well Replacement
PROJECT LOCATION Keno City, Yukon
POSITION N: 7087070.5 m E: 478768.1 m (NAD83(CSRS) / UTM zone 8N)
GROUND ELEVATION 1280.46 m **TOP PVC ELEV** 1281.52
STATIC WATER LEVEL 54.41 mbgs **FINAL DEPTH** 56.30 m

WELL INSTALLATION DETAILS

Drilling diameters: 167.6mm: 0.0-7.8m. 152.4mm: 7.8-56.3m. 6.6-inch steel casing: 1.1mags-56.3m. 3-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1.1mags-50.1m. 10-slot Screen: 50.1-56.2m. Bentonite Chips: 0.0-45.0m. Bentonite Pellets: 45.0-47.0m. 20/40 Sand: 47.0-56.3m. Steel casing raised above GL for monument. Lockable well cap.

DEPTH (m)	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0	1280		SILT - gravelly, brown, gravels of schist and quartzite, very weathered
2.00	1278.46		
			SCHIST - graphitic, grey, weathered rock, iron staining, trace brown silt, trace quartzite
5	1275		- @ 5.0-6.5m grey silt
7	1273		- @ 7m competent rock, decrease in weathering
8	1272		- @ 8m light grey sericitic schist, trace quartzite, iron staining on quartzite
10	1270		- @ 10-11m: highly weathered section of rock
11.00	1269.46		
			QUARTZITE - white, some grey graphitic and sericite schist with trace weathering, driller noted hard drilling
15.00	1265.46		
			SCHIST - graphitic, light grey to dark grey, some quartzite and sericitic schist
21	1259		- @ 21m increase in weathering
23	1257		- @ 23m trace quartz with iron staining
24	1256		- @ 24m: Driller noted tough conditions to drill, soft, weathered rock.
26	1254		

WELL DIAGRAM

PIPE HEIGHT: 1.06 m
PIPE ELEV.: 1281.52 m

Bentonite chips

3-in Solid Schedule 40 PVC, threaded

WELL NUMBER KV-123N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
1253		SCHIST - graphitic, light grey to dark grey, some quartzite and sericitic schist	
1252		29.00 1251.46	
1251		MUDSTONE - very weathered, mottled sand	
1248		33.00 1247.46	
1247		SCHIST - sericitic, light grey, some quartz	
1246		- @ 34m: Driller estimated discharge of 16 L/min	
1245		- @ 35m dark grey graphitic schist increasing, some quartzite, trace weathering	
1244			
1243		- @ 37-38m quartz increasing	
1242			
1241			
1240		- @ 40m moderate weathering	
1239			
1238			
1237		- @ 43m graphitic schist, dark grey	
1236			
1235			
1234		- @ 46m quartz increasing	Bentonite pellets
1233			
1232			
1231			
1230			
1229			20/40 Sand
1228			
1227			3-in Slotted Schedule 40 PVC, threaded, 10-slot
1226			▽
1225			
1224		56.30 - @ 56m flow rate <0.5 L/min 1224.16	
		Terminated at 56.30 m.	

NOTES

WELL NUMBER KV-124N

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-15-2025 **COMPLETED** 08-16-2025
POSITION N: 7086838.0 m E: 478782.0 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 1320.28 m **TOP PVC ELEV** 1321.38
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 15.54 mbgs **FINAL DEPTH** 32.20 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 152
Drilling diameters: 167.6mm: 0.0-1m. 152.4mm: 1-32.2m. 6.6-inch steel casing: 1.1mags-1m. 2-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1.1mags-26.1m. 10-slot Screen: 26.1-32.2m. Bentonite Chips: 0.0-21.0m. Bentonite Pellets: 21.0-23.0m. 20/40 Sand: 23.0-32.2m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY L Connolly **CHECKED BY** A McMillan

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
1320		POSSIBLE FILL - weathered rock, some silt, grey, iron staining, trace schist and red/ white staining
1319		1.50 — 1318.78
1318		SCHIST - grey, very weathered, iron stained, weak bedding
1317		
1316		
1315		
1314		
1313		- @ 7.5m graphitic, decrease in weathering, trace quartzite
1312		
1311		
1310		
1309		- @ 11m increase in white quartzite, dark-grey schist
1308		12.00 — 1308.28 QUARTZITE - white, trace graphitic schist
1307		13.00 — 1307.28 SCHIST - dark grey, trace quartzite
1306		
1305		- @ 15m increase in quartzite, trace iron staining
1304		
1303		

WELL DIAGRAM

PIPE HEIGHT: 1.10 m
PIPE ELEV.: 1321.38 m

Bentonite chips

2-in Solid Schedule 40 PVC, threaded

WELL NUMBER KV-124N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
1301		SCHIST - dark grey, trace quartzite	
1300			
1299		- @ 21m sericitic schist, trace quartzite	
1298		- @ 22m flow rate of 1 L/min	Bentonite pellets
1297			
1296			
1295		- @ 25m some graphitic schist, trace iron staining	
1294			
1293			20/40 Sand
1292			
1291			2-in Slotted Schedule 40 PVC, threaded, 10-slot
1290			
1289			
1288		32.20 - @ 32m flow rate of 4 L/min 1288.08	
		Terminated at 32.20 m.	
1287			
1286			
1285			
1284			
1283			
1282			

NOTES

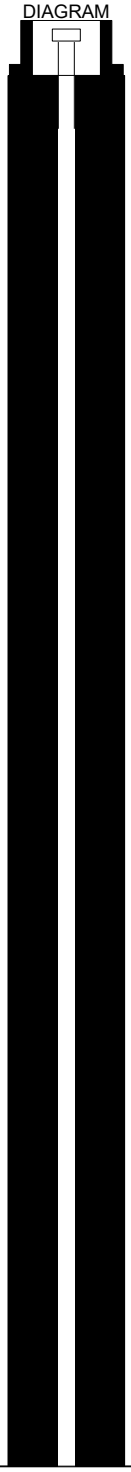
WELL NUMBER KV-126N

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-22-2025 **COMPLETED** 08-24-2025
POSITION N: 7087235.4 m E: 478830.9 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 1261.25 m **TOP PVC ELEV** 1262.24
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 80.17 mbgs **FINAL DEPTH** 85.30 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 152
Drilling diameters: 167.6mm: 0.0-3.4m. 152.4mm: 3.4-85.3m. 6.6-inch steel casing: 1.0mags-3.4m. 3-inch PVC Schedule 80, threaded. J-plug and slip end cap. PVC: 1.0mags-77.6m. 10-slot Screen: 77.6-85.2m. Bentonite Chips: 0.0-71.9m. Bentonite Pellets: 71.9-74.7m. 20/40 Sand: 74.7-85.3m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY L Connolly/S Battaglia **CHECKED BY** A McMillan

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0	1261		SILT - gravelly, schist, and quartz
1	1260		
2	1259		2.50 1258.75
3	1258		SCHIST - graphitic, some sericitic, grey, some quartz, and iron oxidation
4	1257		- @ 4m trace clay
5	1256		- @ 5m increasing sericitic schist
6	1255		
7	1254		
8	1253		
9	1252		
10	1251		
11	1250		
12	1249		
13	1248		
14	1247		
15	1246		- @ 15m increasing iron oxidation and quartz
16	1245		
17	1244		
18	1243		
19	1242		
20	1241		- @ 20m decrease in quartz, some iron oxidation and sericitic schist
21	1240		
22	1239		
23	1238		- @ 23m increase in sericitic schist
24	1237		
25	1236		
26			

WELL DIAGRAM



PIPE HEIGHT: 0.99 m
PIPE ELEV.: 1262.24 m

No airflow tests as yield too low for bucket and stopwatch test.

WELL NUMBER KV-126N

CLIENT Hecla **PROJECT NAME** AKHM Well Replacement

PROJECT NUMBER ECA24YT00449 **PROJECT LOCATION** Keno City, Yukon

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
27	1234		SCHIST - graphitic, some sericitic, grey, some quartz, and iron oxidation - @ 27m less iron oxidation	
28	1233		- @ 28m increase in quartz	
29	1232			
30	1231			
31	1230			
32	1229		- @ 32m no quartz, no iron oxidation	
33	1228			
34	1227			
35	1226		- @ 35m increasing iron oxidation	
36	1225			Bentonite chips
37	1224			
38	1223			3-in Solid Schedule 80 PVC, threaded
39	1222			
40	1221		- @ 40m decreasing quartz and iron oxidation	
41	1220			
42	1219			
43	1218		- @ 43m trace quartz	
44	1217			
45	1216			
46	1215			
47	1214			
48	1213			
49	1212			
50	1211			
51	1210			
52	1209			
53	1208		- @ 53m increase in quartz	
54	1207			
55	1206			

NOTES No airflow tests as yield too low for bucket and stopwatch test.

WELL NUMBER KV-126N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
1205		SCHIST - graphitic, some sericitic, grey, some quartz, and iron oxidation	
57		57.00 — 1204.25	
1204		QUARTZITE - some graphitic schist	
58		58.00 — 1203.25	
1203		SCHIST - graphitic	
59		- @ 59m trace iron oxidation	
1202			
60		- @ 60m some sericitic, trace quartz	
1201			
61		- @ 61m some iron oxidation	
1200			
62		- @ 62m seriticitc, some quartz, slower drilling likely due to increasing quartz content	
1199			
63			
1198			
64			
1197			
65			
1196			
66			
1195			
67			
1194			
68			
1193			
69			
1192			
70		- @ 70m some sericitic schist and quartz	
1191			
71			
1190			
72			
1189			
73			Bentonite pellets
1188			
74			
1187			
75		- @ 75m trace quartz	
1186			
76			
1185			
77		- @ 77m sericitic	
1184			
78		- @ 78m some quartz, trace iron oxidation	
1183			
79			
1182			
80			20/40 Sand
1181			
81			3-in Slotted Schedule 80 PVC, threaded, 10-slot
1180			
82			
1179			
83		- @ 83m sericitic, some graphitic schist	
1178			
84		- @ 84m trace weathering	
1177			
85			
1176		85.30 — 1175.95	
		Terminated at 85.30 m.	

NOTES No airflow tests as yield too low for bucket and stopwatch test.

WELL NUMBER KV-127N

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-17-2025 **COMPLETED** 08-18-2025
POSITION N: 7087107.4 m E: 479021.5 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 1299.01 m **TOP PVC ELEV** 1300.01
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 37.36 mbgs **FINAL DEPTH** 44.60 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
Drilling diameters: 167.6mm: 0.0-2.5m. 152.4mm: 2.5-44.6m. 6.6-inch steel casing: 1.0mags-2.5m. 3-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1.0mags-35.2m. 10-slot Screen: 35.2-44.4m. Bentonite Chips: 0.0-25.6m. Bentonite Pellets: 25.6-31.4m. 20/40 Sand: 31.4-44.6m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY L Connolly **CHECKED BY** A McMillan

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SCHIST - graphitic, grey, brown silt, some quartzite, white, trace iron staining
1	1298		- @ 0-2.5m highly weathered, heavily iron stained
2	1297		
3	1296		- @ 2.5m rock becoming more competent, less iron staining
4	1295		
5	1294		
6	1293		
7	1292		
8	1291		
9	1290		
10	1289		
11	1288		
12	1287		
13	1286		
14	1285		
15	1284		
16	1283		
17	1282		- @ 17m some sericitic, blue/grey
18	1281		
19	1280		
20	1279		
21	1278		

WELL DIAGRAM



PIPE HEIGHT: 1.00 m
PIPE ELEV.: 1300.01 m

Bentonite chips

3-in Solid Schedule 40 PVC, threaded

No airflow tests as yield too low for bucket and stopwatch test.

WELL NUMBER KV-127N

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
23	1276		SCHIST - graphitic, grey, brown silt, some quartzite, white, trace iron staining	
			- @ 23m increasing iron staining	
24	1275			
25	1274		- @ 25m some sericitic, blue/grey	
26	1273			
27	1272			
28	1271		- @ 28m decrease in iron staining	Bentonite pellets
29	1270			
30	1269			
31	1268			
32	1267			
33	1266			
34	1265			
35	1264			
36	1263			
37	1262			▽
38	1261			20/40 Sand
39	1260			
40	1259		- @ 40m sericitic	3-in Slotted Schedule 40 PVC, threaded, 10-slot
			41.00 1258.01	
41	1258		QUARTZITE - white, some graphitic schist, light grey to blue, trace sericitic, trace iron staining	
42	1257			
43	1256			
			44.00 1255.01	
44	1255		SCHIST - sericitic, trace quartz, competent	
			44.60 1254.41	
45	1254		Terminated at 44.60 m.	
46	1253			

NOTES No airflow tests as yield too low for bucket and stopwatch test.

WELL NUMBER KV-85DN

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-10-2025 **COMPLETED** 08-10-2025
POSITION N: 7086914.0 m E: 483857.9 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 898.96 m **TOP PVC ELEV** 900.01
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 35.60 mbgs **FINAL DEPTH** 56.30 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 152
Drilling diameters: 167.6mm: 0.0-12.8m. 152.4mm: 12.8-56.3m. 6.6-inch steel casing: 1.1mags-12.8m. 3-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1.1mags-53.2m. 10-slot Screen: 53.2-56.3m. Bentonite Chips: 0.0-47.5m. Bentonite Pellets: 47.5-50.9m. 20/40 Sand: 50.9-56.3m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY L Connolly **CHECKED BY** A McMillan

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				PIPE HEIGHT: 1.05 m PIPE ELEV.: 900.01 m
1	898		SILT - fine to coarse grained, brown, gravelly, slightly sandy, fine to coarse grained, weathered, angular, possible fill	
2	897			
3	896		- @ 3m damp, sandy	
4	895		4.00 894.96	
5	894		SAND AND GRAVEL - fine to coarse grained, silty, angular to subrounded, gravels are dark grey, sands are brown, white, and red, well graded - @ 5-10.3m ice	
6	893			
7	892			
8	891			
9	890			
10	889		10.30 888.66	
11	888		GRAVEL - some quartzite, grey, angular, weathered, some quartzite, trace cobbles, trace sand, yellow and red 11.50 887.46	
12	887		SCHIST - graphitic, dark grey to blue/black, trace weathering	
13	886			
14	885			
15	884			
16	883			
17	882			
18	881			
19	880			
20	879		- @ 20m trace quartzite	
21	878			
22	877			
23	876			
24	875			Bentonite chips
25	874			
26	873		- @ 26m sericitic, grey to blue	3-in Solid Schedule 40 PVC, threaded

Water encountered at 6mbgs.

WELL NUMBER KV-85DN

CLIENT Hecla **PROJECT NAME** AKHM Well Replacement

PROJECT NUMBER ECA24YT00449 **PROJECT LOCATION** Keno City, Yukon

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
27			SCHIST - graphitic, dark grey to blue/black, trace weathering	
28	871			
29	870			
30	869		- @ 30m blue graphitic schist	
31	868			
32	867		- @ 32m increasing quartzite and sericitic schist	
33	866			
34	865			
35	864			
36	863			▼
37	862			
38	861			
39	860			
40	859			
41	858			
42	857		- @ 42m graphitic, trace quartzite	
43	856			
44	855			
45	854			
46	853			
47	852			
48	851			
49	850			Bentonite pellets
50	849			
51	848			
52	847			
53	846			20/40 Sand
54	845			
55	844			3-in Slotted Schedule 40 PVC, threaded, 10-slot
56	843		56.30 842.66 Terminated at 56.30 m.	

NOTES Water encountered at 6mbgs.

WELL NUMBER KV-85SN

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-14-2025 **COMPLETED** 08-14-2025
POSITION N: 7086912.9 m E: 483857.0 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 898.90 m **TOP PVC ELEV** 899.85
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 2.57 mbgs **FINAL DEPTH** 6.80 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
Drilling diameters: 167.6mm: 0.0-6.8m. 6.6-inch steel casing: 1.0mags-2.0m. 2-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1mags-4m. 10-slot Screen: 4-5m. Bentonite Chips: 0.0-2.1m. Bentonite Pellets: 2.1-3.0m. 20/40 Sand: 3.0-5.8m. Bentonite Pellets: 5.8-6.8m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY L Connolly **CHECKED BY** A McMillan

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
898		SILT - brown, sandy, grey, gravelly, well graded
897		
896		- @ 3m material damp
895		4.00 894.90
894		SAND AND GRAVEL - grey, white, and red, silty, grey, well graded, subrounded to subangular
893		- @ 5-6.8m ice
892		6.80 892.10
891		Terminated at 6.80 m.
890		

WELL DIAGRAM

PIPE HEIGHT: 0.95 m
PIPE ELEV.: 899.85 m

Bentonite chips

2-in Solid Schedule 40 PVC, threaded

Bentonite pellets

20/40 Sand
2-in Slotted Schedule 40 PVC, threaded, 10-slot

Bentonite pellets

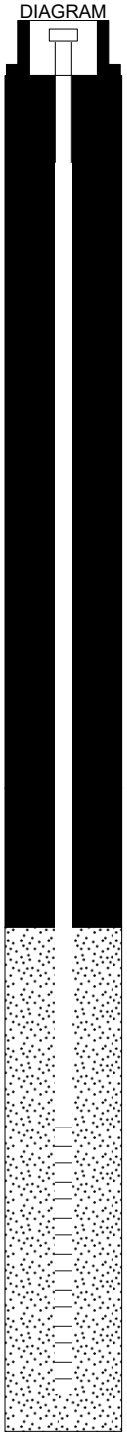
WELL NUMBER KV-86N

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-19-2025 **COMPLETED** 08-19-2025
POSITION N: 7086646.1 m E: 483858.1 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 907.88 m **TOP PVC ELEV** 908.76
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL Dry **FINAL DEPTH** 15.60 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
Drilling diameters: 167.6mm: 0.0-15.6m. 6.6-inch steel casing: 0.9mags-8.0m. 2-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 0.9mags-12.1m. 10-slot Screen: 12.1-15.2m. Bentonite Chips: 0.0-8.2m. Bentonite Pellets: 8.2-9.8m. 20/40 Sand: 9.8-15.6m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY L Connolly **CHECKED BY** A McMillan

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0	907		FILL - crushed rock fill material for drillpad, gravels of schist, angular, brown to grey
1			
2	906		
3	905		
4	904		
5	903		5.00 — 902.88
			SILT - some gravels and sands, dark brown, organics and rootlets, angular weathered rock fragments of schist
6	902		6.00 — 901.88
			GRAVEL - grey, schist, silty, brown, sandy, subrounded to angular
7	901		
8	900		8.00 — 899.88
			SILT - gravelly, brown
9	899		
10	898		- @ 10m sandy, grey
11	897		
12	896		12.00 — 895.88
			GRAVELS AND COBBLES - sandy, mudstone, quartzite, schist, grey, white and red
13	895		
14	894		- @ 14m trace silt, brown
15	893		15.20 — 892.68
			SCHIST - sericitic, grey, quartzite, slow drilling
			15.60 — 892.28
			Terminated at 15.60 m.

WELL DIAGRAM



PIPE HEIGHT: 0.88 m
PIPE ELEV.: 908.76 m

Bentonite chips

3-in Solid Schedule 40 PVC, threaded

Bentonite pellets

20/40 Sand

3-in Slotted Schedule 40 PVC, threaded, 10-slot

No water encountered during drilling.

WELL NUMBER KV-88SN

ENSERO solutions

CLIENT Hecla
PROJECT NUMBER ECA24YT00449
DATE STARTED 08-09-2025 **COMPLETED** 08-09-2025
DRILLING CONTRACTOR Anderson Water Services Ltd
DRILLING METHOD Air Rotary with DHH for steel casing
EQUIPMENT REICH- T-650 Drill Rig
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
LOGGED BY L Connolly **CHECKED BY** A McMillan

PROJECT NAME AKHM Well Replacement
PROJECT LOCATION Keno City, Yukon
POSITION N: 7087018.6 m E: 483951.1 m (NAD83(CSRS) / UTM zone 8N)
GROUND ELEVATION 906.83 m **TOP PVC ELEV** 907.73
STATIC WATER LEVEL Dry **FINAL DEPTH** 5.70 m

WELL INSTALLATION DETAILS

Drilling diameters: 167.6mm: 0.0-5.7m. 6.6-inch steel casing: 0.9mags-2.0m. 2-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 0.9mags-3.9m. 10-slot Screen: 3.9-5.4m. Bentonite Chips: 0.0-1.8m. Bentonite Pellets: 1.8-2.6m. 20/40 Sand: 2.6-5.7m. Steel casing raised above GL for monument. Lockable well cap.

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0		POSSIBLE FILL - silt, brown, gravel, grey to black, angular
906		
1		
905		
2	2.00	904.83
		SAND AND GRAVEL - fine to coarse grained, angular to subangular, and silty, weathered staining on gravels
904		
3		
903		
4		- @ 4m silt is damp
902		
5	5.60	901.23
	5.70	SCHIST - blue-grey, possible top of rock 901.13
901		Terminated at 5.70 m.
6		
900		
7		

WELL DIAGRAM

PIPE HEIGHT: 0.90 m
PIPE ELEV.: 907.73 m

Bentonite chips

2-in Solid Schedule 40 PVC, threaded

Bentonite pellets

20/40 Sand

2-in Slotted Schedule 40 PVC, threaded, 10-slot

No water encountered during drilling

WELL NUMBER KV-89DN

ENSERO solutions

CLIENT Hecla
PROJECT NAME AKHM Well Replacement
PROJECT NUMBER ECA24YT00449
PROJECT LOCATION Keno City, Yukon
DATE STARTED 08-11-2025 **COMPLETED** 08-12-2025
POSITION N: 7086850.9 m E: 483793.5 m (NAD83(CSRS) / UTM zone 8N)
DRILLING CONTRACTOR Anderson Water Services Ltd
GROUND ELEVATION 897.50 m **TOP PVC ELEV** 898.53
DRILLING METHOD Air Rotary with DHH for steel casing
STATIC WATER LEVEL 24.25 mbgs **FINAL DEPTH** 50.00 m
EQUIPMENT REICH- T-650 Drill Rig
WELL INSTALLATION DETAILS
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
Drilling diameters: 167.6mm: 0.0-24.0m. 6.6-inch steel casing: 1.0mags-24.0m. 152.4mm: 24.0-50.0m. 3-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1.0mags-46.7m. 10-slot Screen: 46.7-49.8m. Bentonite Chips: 0.0-41.0m. Bentonite Pellets: 41.0-44.0m. 20/40 Sand: 44.0-50.0m. Steel casing raised above GL for monument. Lockable well cap.
LOGGED BY L Connolly **CHECKED BY** A McMillan

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
897		FILL - gravel, grey, weathered, angular, poorly graded, crushed rock for drill pad
		2.50 / 895.00
895		SAND AND GRAVEL - silty, grey to brown, subrounded to rounded, gravels of quartzite and schist, grey, white, and red gravels and sands, well graded
		9.00 / 888.50
888		GRAVEL - silty, sandy, subangular to subrouneded, quartzite and schist gravels, grey, green, white, and red, well graded
		17.00 / 880.50
880		GRAVELS AND COBBLES - silty, angular to subangular, quartzite and schist gravels, grey, green, and white, poorly graded
		19.50 / 878.00
878		SCHIST - graphitic, grey, trace iron staining
876		- @ 21.5m no iron staining

WELL DIAGRAM

PIPE HEIGHT: 1.03 m
PIPE ELEV.: 898.53 m

Bentonite chips

3-in Solid Schedule 40 PVC, threaded

WELL NUMBER KV-89DN

CLIENT Hecla **PROJECT NAME** AKHM Well Replacement

PROJECT NUMBER ECA24YT00449 **PROJECT LOCATION** Keno City, Yukon

ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
873		SCHIST - graphitic, grey, trace iron staining
		- @ 24m trace quartzite, white
872		
871		
870		
869		
868		
867		- @ 30m sericitic
866		
865		- @ 32m some quartzite, light grey to white
864		
863		- @ 34m graphitic, grey to black
862		
861		
860		
859		
858		- @ 39m graphitic and sericitic
857		
856		
855		
854		
853		
852		
851		
850		
849		
848		
847		50.00 847.50 Terminated at 50.00 m.

WELL DIAGRAM

Bentonite pellets

20/40 Sand

3-in Slotted Schedule 40 PVC, threaded, 10-slot

NOTES

WELL NUMBER KV-89SN

ENSERO solutions

CLIENT Hecla
PROJECT NUMBER ECA24YT00449
DATE STARTED 08-13-2025 **COMPLETED** 08-13-2025
DRILLING CONTRACTOR Anderson Water Services Ltd
DRILLING METHOD Air Rotary with DHH for steel casing
EQUIPMENT REICH- T-650 Drill Rig
CASING DIAMETER (mm) 51 **BOREHOLE DIAMETER (mm)** 168
LOGGED BY L Connolly **CHECKED BY** A McMillan

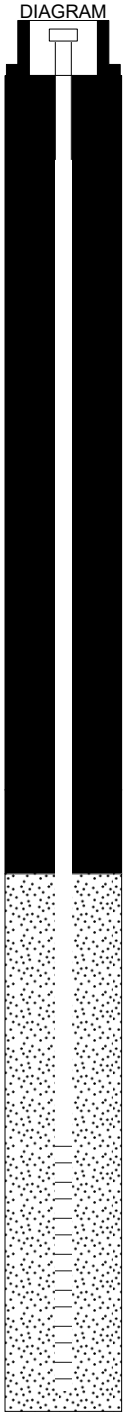
PROJECT NAME AKHM Well Replacement
PROJECT LOCATION Keno City, Yukon
POSITION N: 7086852.3 m E: 483792.8 m (NAD83(CSRS) / UTM zone 8N)
GROUND ELEVATION 897.56 m **TOP PVC ELEV** 898.54
STATIC WATER LEVEL Dry **FINAL DEPTH** 15.90 m

WELL INSTALLATION DETAILS

Drilling diameters: 167.6mm: 0.0-15.9m. 6.6-inch steel casing: 1.0mags-5.0m. 2-inch PVC Schedule 40, threaded. J-plug and slip end cap. PVC: 1mags-12.6m. 10-slot Screen: 12.6-15.7m. Bentonite Chips: 0.0-8.5m. Bentonite Pellets: 8.5-9.5m. 20/40 Sand: 9.5-15.9m. Steel casing raised above GL for monument. Lockable well cap.

	ELEVATION (m)	GRAPHIC LOG	MATERIAL DESCRIPTION
0	897		FILL - gravels, grey, crushed rock from drill pad
1			
1.80	896		895.76
2			SAND AND GRAVEL - silty, brown, schist and quartzite gravels, fine to coarse grained, rounded to subrounded
3	895		
4	894		
5	893		
6	892		- @ 5.2m damp
7	891		- @ 6m subrounded to rounded gravel
8	890		
9	889		
10	888		
11	887		
12	886		
13	885		
14	884		
15	883		
15.90	882		881.66
16			Terminated at 15.90 m.

WELL DIAGRAM



PIPE HEIGHT: 0.98 m
PIPE ELEV.: 898.54 m

Bentonite chips

2-in Solid Schedule 40 PVC, threaded

Bentonite pellets

20/40 Sand

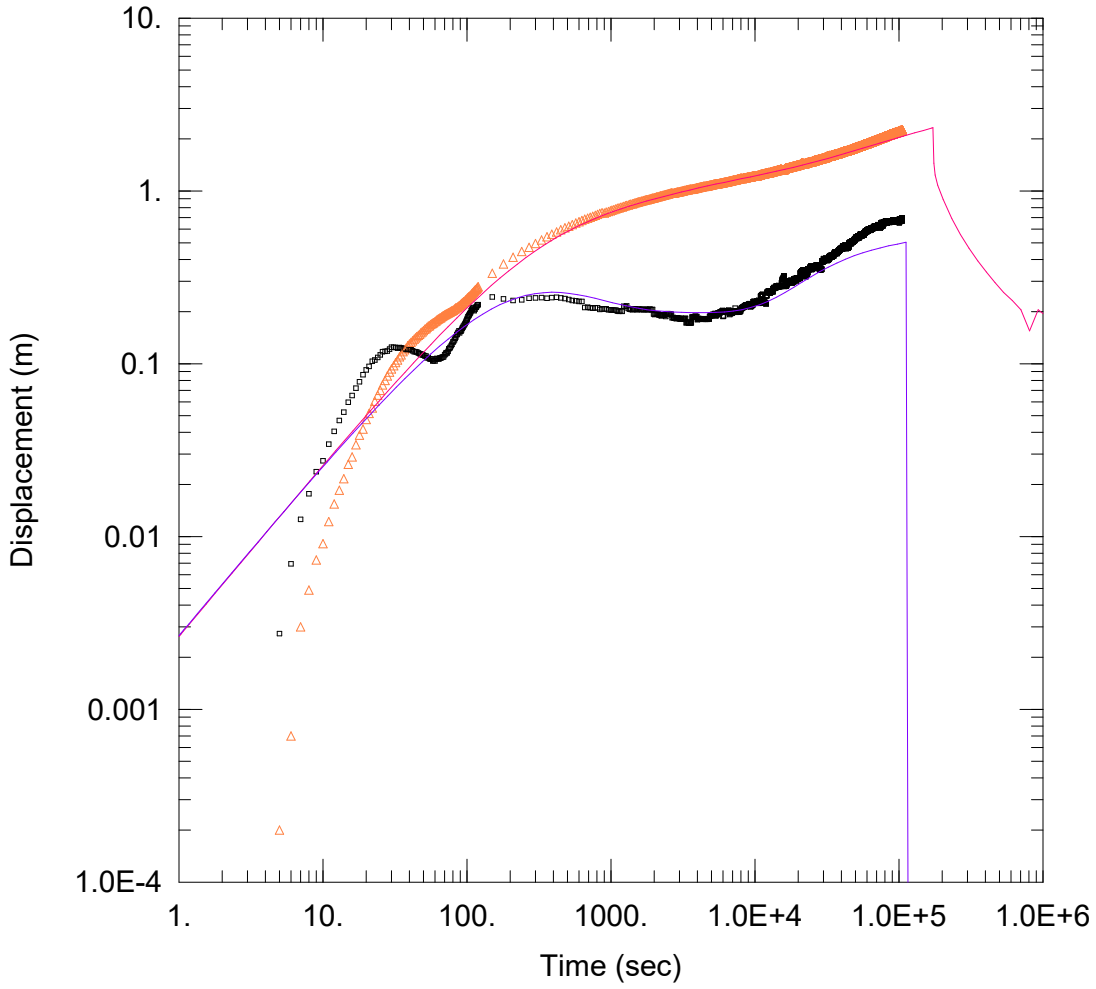
2-in Slotted Schedule 40 PVC, threaded, 10-slot

No water encountered during drilling.

APPENDIX C. PUMPING TEST DATA AND ANALYSIS

Constant Rate Pumping Test - BH-SW-01

Prepared By:	Prepared For:
Ensero Solutions	Hecla Yukon
Project:	**Location:**
New Bermingham Water Supply Well Drilling	AKHM Mine, Elsa, Yukon



Data Set: C:\Users\amcmillan\OneDrive - Ensero\AKHM Pumping Test\BH-TH-01_AQUIFER DATA
Date: 10/31/25 Time: 10:39:37

Saturated Thickness: 22.12 m Slab Block Thickness: 1. m

SOLUTION

Aquifer Model: Fractured
Solution Method: Moench w/slab blocks

K = 1.843E-6 m/sec
K' = 3.981E-8 m/sec
Sw = 0.
r(w) = 13.92 m

Ss = 3.577E-6 m^{-1}
Ss' = 0.00631 m^{-1}
Sf = 0.05
r(c) = 0.2754 m

WELL DATA

Pumping Wells

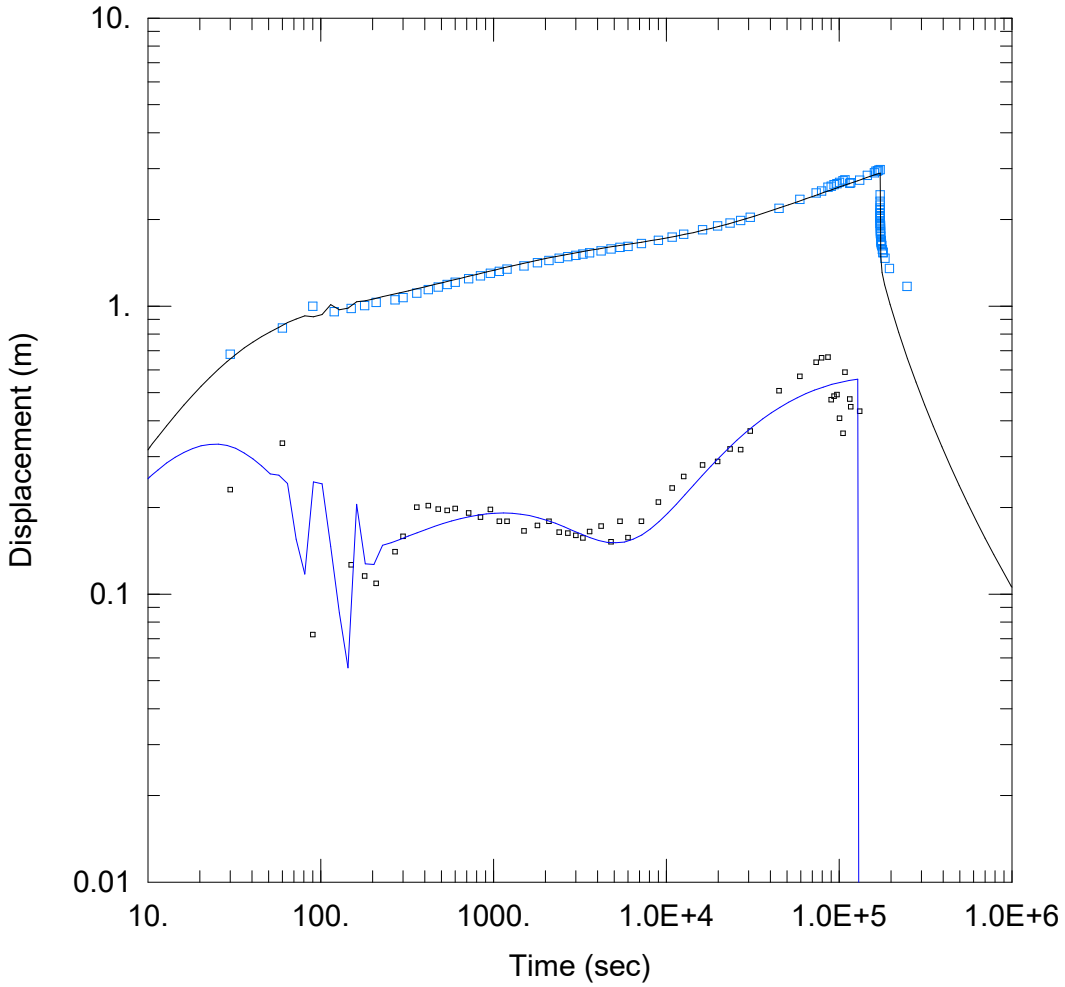
Well Name	X (m)	Y (m)
BH-SW-01	478570	7087141

Observation Wells

Well Name	X (m)	Y (m)
△ BH-TH-01	478558	7087137

Constant Rate Pumping Test - BH-SW-01

Prepared By:	Prepared For:
Ensero Solutions	Hecla Yukon
Project:	**Location:**
New Bermingham Water Supply Well Drilling	AKHM Mine, Elsa, Yukon



Data Set: C:\Users\amcmillan\OneDrive - Ensero\AKHM Pumping Test\BH-SW-01_AQUIFER DATA
Date: 10/31/25 Time: 10:37:39

SOLUTION

Aquifer Model: Fractured
Solution Method: Moench w/slab blocks

K = 3.044E-6 m/sec
K' = 2.239E-6 m/sec
Sw = 0.15
r(w) = 5.205 m
Ss = 0.01036 m^{-1}
Ss' = 0.05623 m^{-1}
Sf = 1.85
r(c) = 0.07128 m

Saturated Thickness: 22.12 m Slab Block Thickness: 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
BH-SW-01	478570	7087141

Observation Wells

Well Name	X (m)	Y (m)
□ BH-SW-01	478570	7087141

APPENDIX D. WATER QUALITY SAMPLE RESULTS

BH-SW-1 Groundwater Results Compared to Drinking Water Criteria

	Station Name	YCSR-Sched3 Drinking Water - Total Metals (W)	YCSR-Sched3 Drinking Water - Dissolved Metals (W)	Health Canada Drinking Water Guidelines - Maximum Acceptable Concentration (D)	Health Canada Drinking Water Quality Guidelines - Aesthetic Objective (E)	BH-SW-1
	Description					Bermingham water supply well
	Sample Date					18-Sep-2025
	Sampled By					S.Battaglia
Total Dissolved Solids (lab)	mg/L				500	311
Turbidity (lab)	NTU			0.1		<0.10
pH (lab)	pH units				7.0 - 10.5	7.42
Specific Conductance (lab)	µS/cm					486
Hardness (from dissolved)	mg/L					237
Alkalinity, bicarbonate HCO3	mg/L					89.8
Alkalinity, carbonate CO3	mg/L					<1.0
Alkalinity, hydroxide OH	mg/L					<1.0
Alkalinity, total	mg/L					89.8
Bromide	mg/L					<0.050
Chloride	mg/L	250	250		250	14.5
Fluoride	mg/L	1.5	1.5	1.5		0.214
Sulphate, dissolved	mg/L	500	500		500	140
Sulphide	mg/L	0.05	0.05		0.05	<0.010
Sulfide, Total (as H2S)	mg/L					<0.011
Ammonia (N)	mg/L					<0.0050
Nitrite (N)	mg/L	3.2	3.2	1.0		0.0043
Nitrate (N)	mg/L	10	10	10		1.10
Nitrite & Nitrate, as N	mg/L	10	10			1.10
Total Kjeldahl Nitrogen	mg/L					0.091
Colour	TCU				15	<5.0
Total Coliforms	cfu/100mL			0		<1 D
Fecal Coliforms, E. Coli	cfu/100mL			0		<1 D
Aluminum (Al), dissolved	mg/L		0.2	2.9	0.1	0.0035
Antimony (Sb), dissolved	mg/L		0.006	0.006		<0.00010
Arsenic (As), dissolved	mg/L		0.025	0.010		0.00100
Barium (Ba), dissolved	mg/L		1	2.0		0.0101
Beryllium (Be), dissolved	mg/L					<0.000100
Bismuth (Bi), dissolved	mg/L					<0.000050
Boron (B), dissolved	mg/L		5	5		<0.010
Cadmium (Cd), dissolved	mg/L		0.005	0.007		0.000617
Calcium (Ca), dissolved	mg/L					71.6
Cesium (Cs), dissolved	mg/L					<0.000010
Chromium (Cr), dissolved	mg/L		0.05	0.05		<0.00050
Cobalt (Co), dissolved	mg/L					0.00309
Copper (Cu), dissolved	mg/L		1	2.0	1.0	<0.00020

BH-SW-1 Groundwater Results Compared to Drinking Water Criteria

	Station Name	YCSR-Sched3 Drinking Water - Total Metals (W)	YCSR-Sched3 Drinking Water - Dissolved Metals (W)	Health Canada Drinking Water Guidelines - Maximum Acceptable Concentration (D)	Health Canada Drinking Water Quality Guidelines - Aesthetic Objective (E)	BH-SW-1
	Description					Bermingham water supply well
	Sample Date					18-Sep-2025
	Sampled By					S.Battaglia
Iron (Fe), dissolved	mg/L		0.3		0.3	<0.010
Lead (Pb), dissolved	mg/L		0.01	0.005		0.000081
Lithium (Li), dissolved	mg/L					0.0088
Magnesium (Mg), dissolved	mg/L		100			14.1
Manganese (Mn), dissolved	mg/L		0.05	0.12	0.02	2.10 WDE
Mercury (Hg), dissolved	mg/L		0.001	0.001		<0.0000050
Molybdenum (Mo), dissolved	mg/L		0.25			0.000157
Nickel (Ni), dissolved	mg/L					0.00535
Phosphorus (P), dissolved	mg/L					<0.050
Potassium (K), dissolved	mg/L					0.270
Rubidium (Rb), dissolved	mg/L					0.00036
Selenium (Se), dissolved	mg/L		0.01	0.05		0.00120
Silicon (Si), dissolved	mg/L					4.76
Silver (Ag), dissolved	mg/L					<0.000010
Sodium (Na), dissolved	mg/L		200		200	4.69
Strontium (Sr), dissolved	mg/L			7.0		0.107
Sulphur (S), dissolved	mg/L					45.1
Tellurium (Te), dissolved	mg/L					<0.00020
Thallium (Tl), dissolved	mg/L					<0.000010
Thorium (Th), dissolved	mg/L					<0.00010
Tin (Sn), dissolved	mg/L					<0.00010
Titanium (Ti), dissolved	mg/L					<0.00030
Tungsten (W), dissolved	mg/L					<0.00010
Uranium (U), dissolved	mg/L		0.1	0.02		0.000074
Vanadium (V), dissolved	mg/L					<0.00050
Zinc (Zn), dissolved	mg/L		5		5.0	0.249
Zirconium (Zr), dissolved	mg/L					<0.00020

APPENDIX 3.12

2024 DSTF PHASE 2 FAILURE MODES AND EFFECTS ANALYSIS

Failure Modes and Effects Analysis
DSTF Phase II, Keno Hill Mine, Yukon



PRESENTED TO
Hecla Mining Company

NOVEMBER 29, 2024
ISSUED FOR USE
FILE: 704-ENG.WARC04415-10

Tetra Tech Canada Inc.
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

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TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SITE DESCRIPTION 1

3.0 FMEA PROCESS AND FRAMEWORK 1

3.1 Overview 1
3.2 Failure Definition 3
3.3 Potential Failure Modes 4
3.4 Likelihood and Consequence Ratings 5
3.4.1 Likelihood 5
3.4.2 Consequence 6
3.5 Risk Analysis 7

4.0 POTENTIAL FAILURE MODES AND RISK ASSESSMENT 9

5.0 SUMMARY OF FINDINGS 12

5.1 Key Controls 13
5.2 Recommended Additional Controls and Action Items 13

6.0 LIMITATIONS OF REPORT 14

7.0 CLOSURE 15

REFERENCES 16

LIST OF TABLES IN TEXT

Table 3-1: Summary of FMEA Participants 3
Table 3-2: PFM Ratings and Descriptions 5
Table 3-3: FMEA Likelihood Definitions 6
Table 3-4: FMEA Consequence Definitions 7
Table 3-5: FMEA Consequence Definitions 9
Table 4-1: Summary of Evaluated PFMs 9
Table 4-2: SQRA Matrix for PFMs Without Controls 11
Table 4-3: SQRA Matrix for PFMs With Controls 12

APPENDIX SECTIONS

TABLES

Table 1 FMEA Results Summary
Table 2 SQRA Heat Map “Without Controls” Scenario
Table 3 SQRA Heat Map “With Controls” Scenario
Table 4 Detailed FMEA Table

APPENDICES

Appendix A Tetra Tech’s Limitations on the Use of this Document

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Keno Hills Mining Corporation and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Alexco Keno Hills Mining Corporation, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

NND EBA Land Protection Corp., operating as NELPCo Limited Partnership (NELPCo), was retained by Alexco Keno Hill Mining Corp. (AKHM) doing business as Hecla Yukon (Hecla) to undertake a Failure Modes and Effects Assessment (FMEA) for the Phase II expansion of the Dry Stack Tailings Facility (DSTF) at the Keno Hill Mine site located near Keno City, YT.

NELPCo is a limited partnership corporation owned by the NND Development Corporation (NNDDC) and Tetra Tech Canada Inc. (Tetra Tech). Tetra Tech is NELPCo's exclusive engineering services provider.

The Keno Hill Mine is located about 1 km west of Keno City, Yukon. The Phase I DSTF is located northeast of the Keno Hill mill building. The proposed Phase II (P2) expansion of the DSTF is located east of the Keno Hill mill building and Mill Pond, and south of the DSTF Phase I (P1) footprint.

This report presents the results of a FMEA, and semi-quantitative risk assessment (SQRA) completed on the Phase II expansion of the DSTF. The FMEA was conducted based on the proposed Phase II design and existing site conditions to identify key failure risks of the Phase II expansion, and to provide insight to support and guide improvements with the DSTF. Additional design work was being completed concurrently and has continued since this workshop.

2.0 SITE DESCRIPTION

A detailed description of existing site conditions and the existing proposed design can be found in the following documents:

- DSTF Phase II Expansion Design Report (Tetra Tech 2024).
- DSTF Phase II Expansion Preliminary Design Report (Tetra Tech EBA, 2015).
- DSTF Phase I Detailed Design Report (EBA, A Tetra Tech Company, 2011).

3.0 FMEA PROCESS AND FRAMEWORK

3.1 Overview

The evaluation of risk is inherent in geotechnical mine design, particularly for structures that may remain on the landscape over the long-term. Risk is commonly defined as the product of the likelihood of an adverse event occurring and the consequences of that event.

Risk = Likelihood x Consequence

The impacts from an adverse event can range in severity and can have (amongst others) economic, environmental, health and safety, regulatory, and public trust implications. Systematic approaches to identify and quantify risks associated with adverse events have been developed over the years as a means of identifying ways to avoid or mitigate against them. The FMEA is an example of one such approach which looks to identify, assess, and ultimately address risks associated with complex, long-term engineered systems (Robertson and Shaw 2002).

As part of the planning process for the Phase II expansion of the DSTF at the Keno Hill Mine, a FMEA of the proposed development was conducted, with consideration for current site conditions and the performance of the Phase I DSTF. This FMEA included the identification and classification of potential failure modes (PFMs) and associated effects. A SQRA was also completed to evaluate the significance of the potential failure modes. The results from these assessments will be used to refine and direct subsequent design improvements, instrumentation, and monitoring programs, as well as the development of operations and maintenance procedures for the Phase II expansion.

The FMEA and SQRA approach adopted by Tetra Tech for the Keno Hill FMEA generally follows the methods presented in the joint publication by the U.S. Department of the Interior Bureau of Reclamation (USBR) and U.S. Army Corps of Engineers (USACE) (2019) and the Federal Energy Regulatory Commission (FERC 2020). Both publications outline a systematic approach to developing the key components of a FMEA and SQRA, which include:

- Identification of PFMs; and
- Assessment of risk through the consideration of likelihood and consequence of failure.

Likelihood and consequence categories, which are inputs to the SQRA, were reviewed and incorporated from Hecla's internal standards.

For the Keno Hill FMEA, two scenarios were evaluated within the context of the Phase II expansion of the DSTF:

1. Without Controls: Failure likelihood of the PFM is determined with consideration of current site conditions and the performance of the Phase I DSTF, but assuming that no controls (i.e., design, construction, operational) are in place to mitigate the risk.
2. With Controls: Failure likelihood of the PFM is determined with consideration of current site conditions and the performance of the Phase I DSTF, assuming that controls are in place and operating properly to mitigate risk. Examples of some of the controls considered for this purpose include:
   - *Design*. Include design components so facility meets required stability design criteria.
   - *Construction Monitoring.* Routine Quality Control Quality Assurance (QAQC) for the construction of the Phase II expansion of the DSTF, including the foundation preparation, surface preparation, liner installation, and liner covering.
   - *Tailings Placement Management.* Regular monitoring and review of the degree of compaction and tailings placement specifications at the DSTF to ensure material is sufficiently compacted.
   - *Water Quality Monitoring.* Regular long-term in-foundation and downstream monitoring of water quality to review the geochemical compatibility of the tailings material and the seepage collection system.

Two multidisciplinary workshops were held to review and provide input into the FMEA. The workshops were attended by site personnel, Hecla's consultants, and members of the Independent Tailings Review Board (ITRB). Both workshops were held virtually on July 3, 2024, and key participants are summarized in Table 3-1.

The first workshop included:

- Review of preliminary PFMs, and selection of priority PFMs for discussion;
- Categorization of PFMs; and

- Identification of adverse and favourable factors with the potential to contribute to PFMs.

The secondary workshop discussed:

- Development of likelihood and consequence ratings for credible PFMs; and
- Creation of a list of controls that can be implemented to mitigate each PFM.

A list of preliminary PFMs was developed beforehand by Tetra Tech. Due to time constraints, select PFMs were chosen from this list and assessed for credibility (i.e., whether the PFM is realistic or plausible given known site conditions and available information). Some of these PFMs were discussed in detail during the FMEA workshops, while others were circulated to the technical team for review. All PFMs were assigned ratings for failure likelihood and consequence, which, when multiplied together, produced the overall risk for each PFM. PFMs not discussed during the workshop were evaluated by Tetra Tech and circulated to the technical team for review and comment. The results presented herein reflect both the discussions held during the FMEA workshops and the feedback received from the technical team on the PFMs that were circulated but not discussed in the workshop.

Table 3-1: Summary of FMEA Participants

Company	Name	Role/Title	Workshop 1	Workshop 2
Hecla	Aaron Marsh	Corporate Tailings Manager, and Phase II Project Manager	✓	✓
	Baoyao Tang	Chief Mine Engineer	✓	✓
	Brett Clute	Manager of Mines	✓	-
	Coralee Kirby	Health and Safety Manager	✓	-
	Denver Winslow	Operations Manager	✓	-
	Jason Palin	Vice President – General Manager	✓	-
	Justin Patterson	Technical Services Manager	✓	-
	Brian Erickson	Vice President - Alaska & Yukon Operations	✓	-
	Carlos Aguiar	Vice President – Operations	✓	-
	Martin Stearns	Director of Environmental Operations	✓	✓
	Arlene Stearman	Senior Environmental Coordinator – Standing in for Kevin Eppers	✓	-
ITRB	Mike Henderson	Member of Independent Tailings Review Board (ITRB)	✓	✓
	Ian Hall	Support to Independent Tailings Review Board (ITRB)	✓	✓
Tetra Tech	Mamun Al-Mamun	FMEA facilitator	✓	✓
	Richard Trimble	EOR	✓	✓
	Ian MacIntyre	Project Manager / Deputy EOR	✓	✓
	Gary Koop	EOR Support, Sr. Engineer	✓	✓
	Bereket Fisseha	EOR Support, Sr. Engineer	✓	✓
	Amy Hudson	Geochem Support	✓	✓
	Emma Forsberg	Scribe	✓	✓

3.2 Failure Definition

The failure of tailings containment areas is often characterized as a sudden, rapid release of tailings from the impoundment; however, FERC (2020) notes that the definition of failure can also include events which lead to

unacceptable performance. For the Keno Kill P2 FMEA and SQRA assessments failure was defined as materially unwanted events that results in:

- Slope deformation that disrupts operations;
- Tailings or contact water being released outside of the DSTF footprint;
- Exceedance of water quality criteria at a monitoring point;
- Operational issue that leads to mill shut down;
- Repairs or mitigation that exceed bonding; and/or
- Unacceptable impacts to AKHM's reputation.

3.3 Potential Failure Modes

PFMs describe the means by which a failure (as defined above) may occur. This forms the initial and potentially most critical step in conducting a risk analysis, and serves as the basis for establishing a likelihood, consequence, and SQRA.

Prior to the workshop, Tetra Tech pre-populated a risk register with several common and site-specific PFMs. During the workshop, a brainstorming session was also held to identify additional PFMs with the help of site personnel and members of the ITRB. Each PFM was identified alongside its potential triggers and failure mechanisms.

A total of 21 PFMs were identified for the P2 DSTF. One PFM was identified as non-credible during the FMEA with SQRA being completed on the remaining PFMS. PFMs and associated risks are summarized in Section 4, with detailed registers and summaries presented in appended Tables 1 through 4, attached.

PFMs were classified based on the categories in Table 3-2 (FERC 2020) to denote priority PFMs, PFMs that were not credible, or PFMs were additional data was required to fully assess the PFM risk.

During this process, adverse and favourable factors for each PFM were also identified and documented. These adverse and favourable factors are defined to make a PFM "more likely" and "less likely," respectively.

Table 3-2: PFM Ratings and Descriptions

Category	Title	Description
I	Highlighted Potential Failure Modes	Those potential failure modes of greatest significance considering need for awareness, potential for occurrence, magnitude of consequence and likelihood of adverse response (physical possibility is evident, fundamental flaw or weakness is identified and conditions and events leading to failure seemed reasonable and credible) are highlighted.
II	Potential Failure Modes Considered but not Highlighted	**These are judged to be of lesser significance and likelihood. Note that even though these potential failure modes are considered less significant than Category I they are all also described and included with reasons for and against the occurrence of the potential failure mode. The reason for the lesser significance is noted and summarized in the documentation report or notes.**
III	More Information or Analyses are needed to classify	These potential failure modes to some degree lacked information to allow a confident judgment of significance and thus a dam safety investigative action or analyses can be recommended. Because action is required before resolution the need for this action may also be highlighted.
IV	Potential Failure Mode Ruled Out	Potential failure modes may be ruled out because the physical possibility does not exist, information came to light which eliminated the concern that had generated the development of the potential failure mode, or the potential failure mode is clearly so remote a possibility as to be non-credible or not reasonable to postulate.

3.4 Likelihood and Consequence Ratings

Risk is assessed by considering the likelihood of a failure event and its associated consequence. Ratings for the P2 DSTF were based on a qualitive assessment of likelihood and consequence; this is considered adequate for identifying key risks and guiding design and operations decisions.

3.4.1 Likelihood

The likelihood of failure is an estimate of the probability of failure based on the strength and weight of the evidence (FERC 2020). It considers both the probability of a conditions occurring and the likelihood that the condition will lead to failure (USBR and USACE 2019). For the Keno Hill P2 FMEA, likelihood definitions were approached for each PFM through consideration of their identified triggering events. As one of the primary goals of this FMEA is the evaluation of PFMs to provide a guide for improvements with the P2 expansion of the DSTF, this level of likelihood assessment is considered appropriate for the analysis being undertaken.

The likelihood definitions employed in this FMEA are summarized in Table 3-3. This system presents likelihoods as eight categories ranging from “almost certain” to “close to non-credible.” The likelihood of failure is based on an estimate of the return period of the PFM. As previously discussed in Section 3.1, two likelihood ratings were assigned to each PFM, describing a scenario in which controls were assumed to be in place and functional, and a scenario in which they were not. Once likelihoods were assigned to the failure events being considered, the corresponding scores were brought forward to the SQRA.

Table 3-3: FMEA Likelihood Definitions

Likelihood	Likelihood Description	Inferred Return Period
A – Almost Certain	Common or frequently occurs at least once per month	Less than 1 year
B – Likely	Has happened before or could happen twice a year	**1 year**
C – Possible	Has happened elsewhere or could happen once every five years	1 – 5 years
D – Unlikely	Not likely to occur in more than five years	5 – 10 years
E1 – Rare	Exceptional conditions or once in ten years	10 – 100 years
E2 – Very Rare	It is estimated to occur once every 100 years or longer	100 – 1,000 years
E3 – Extremely Rare	Could occur in a 1,000 to 10,000 year period	1,000 – 10,000 years
E4 – Close to Non-Credible	Could occur in a period greater than 10,000 years	Greater than 10,000 years

3.4.2 Consequence

Failure consequence assesses the impact if a trigger event results in failure of the structure or adversely affects its functionality, as defined in Section 3.2. In this FMEA, failure consequence is evaluated across multiple categories including health and safety, environment, financial, and social impacts. A numerical ranking is assigned according to the severity of the impact. The consequence score for an individual failure is governed by the category with the most severe impact (e.g., if the environmental impact is assigned a low consequence but the human health and safety impact is considered moderate, the higher consequence score of moderate would be assigned overall).

The failure consequence rating system used for the Keno Hill P2 FMEA is summarized in Table 3-4. Failure consequence is presented as five categories with an associated score (1-5). PFMs are assessed for each consequence category and assigned a consequence score. The consequence category with the highest score becomes the governing rating and is carried forward into the SQRA.

Table 3-4: FMEA Consequence Definitions

Rating	1 – Minor	2 – Medium	3 – Serious	4 – Major	5 – Catastrophic
Financial	Less than $500,000 damage.	$500,000 - $5M damage.	$5M - $25M damage.	$25M - $100M damage	> $100M damage.
License to Operate	Notice of Violation (NOV) from regulators, no shut-down.	One or more NOVs from regulators. Up to 1-week unplanned shut-down affecting the entire mine.	Unplanned shut-down for 1 week to 6 months affecting the entire mine with potential to resume operations.	Shut down for > 6 months affecting the entire mine with potential to resume operations.	Permanent shut-down of mine is possible.
Health and Safety	Reversible health effects of little concern, requiring first aid treatment at most. No potential loss of life.	Reversible injuries requiring treatment but does not lead to restricted duties. Typically, a medical treatment. 1 to 10 population at risk. Unspecified potential loss of life, includes temporary works at the TDF.	Reversible injury or moderate irreversible damage or impairment to one or more persons. Typically, a lost time injury. 10 to 100 potential population at risk. Unspecified potential loss of life.	Irreversible health effects or irreversible disabling injury. 100 to 1,000 potential population at risk. Unspecified potential loss of life.	Permanent damage to multiple people. > 1,000 potential population at risk. Likely to result in 1 or more loss of life.
Environment	Near source confined and reversible impact. No long-term loss.	Impact that is unconfined and requiring long term recovery, leaving residual damage. No significant loss or deterioration of fish or wildlife habitat, loss of marginal habitat only. Restoration in kind highly possible.	Impact that is unconfined and requiring long term recovery, leaving residual damage. Significant loss or deterioration of important fish or wildlife habitat. Restoration in kind highly possible.	Impact that is unconfined and requiring long term recovery, leaving residual damage. Significant loss or deterioration of critical fish or wildlife habitat. Restoration in kind possible but impractical.	Impact that is widespread-unconfined and requiring long term recovery, leaving major residual damage. Major loss of critical fish or wildlife habitat. Restoration in kind impossible.
Community	Minimal effects and disruption of business and livelihoods. No disruption to community or cultural assets.	Significant disruption of business, service, or social dislocation. Low likelihood of loss of regional heritage, recreation, community, or cultural assets.	500 – 1,000 people affected by disruption of business, service, or social dislocation. Disruption of regional heritage, recreation, community, or cultural assets.	1,000 people affected by disruption of business, services, or social dislocation for more than one year. Significant loss of national heritage, community, or cultural assets.	5,000 people affected by disruption of business, services, or social dislocation for more than one year. Significant loss of national heritage, community, or cultural assets.

3.5 Risk Analysis

Following the identification of PFMs, the failure risk of each PFM was assessed using a SQRA. The SQRA was used (in part) to identify which PFMs could remain the focus of regular inspections and monitoring activities and which might require further assessment or study to reduce associated uncertainties. Failure modes with a higher risk or whose risk profile may increase with time warrant specific attention as designs are developed.

A SQRA considers the likelihood of a triggering event (e.g. flood, earthquake) causing failure and the consequence of that failure, assigning likelihood and consequence category ratings to each. The category ratings are then plotted on a risk matrix to identify individual PFM risk and overall project risk.

It should be noted that in some cases, the group identified data gaps that introduced a degree of uncertainty in the selection of likelihood and consequence ratings. For these cases, assumptions were made and documented to permit the assignment of preliminary failure ratings. Follow-up action items were also agreed upon to address the data gaps, these are discussed in Section 5.0.

In addition to completing the SQRA, during Workshop 2 the group also identified specific controls for each failure mode. A control in this context is defined to be an engineered or administrative/operational procedure that can reduce the risk of a failure mode by either reducing its likelihood or consequence rating. Once these controls were identified, they were documented and included within the risk register, attached.

The SQRA matrix is 5 x 7 with the axes formed by the likelihood and consequence categories established earlier in the process. Four risk categories were adopted for the Keno Hill P2 FMEA, each with a corresponding level of action:

- Low – Take corrective actions as considered necessary to further reduce the risk.
- Moderate – Take corrective action within a reasonable timeframe to reduce risk to as low as reasonably achievable. Control measures to be reviewed where appropriate.
- High – Take corrective / preventative action immediately to reduce the risk to as low as reasonably achievable. Control measures to be reviewed or established.
- Critical – Unacceptable level of risk: Stop or do not start the activity. Take corrective / preventative action immediately to reduce the risk to as low as reasonably achievable. Only recommence the activity when controls are in place.

The SQRA risk matrix used for the Keno Hill FMEA is illustrated in Table 3-5; PFMs that plot in the green risk categories of the matrix are preferable. .

Table 3-5: FMEA Consequence Definitions

		Consequence				
		1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
Likelihood	A - Almost Certain	MOD	HIGH	CRITICAL	CRITICAL	CRITICAL
	B - Likely	MOD	HIGH	HIGH	CRITICAL	CRITICAL
	C - Possible	LOW	MOD	HIGH	CRITICAL	CRITICAL
	D - Unlikely	LOW	LOW	MOD	HIGH	CRITICAL
	E1 - Rare	LOW	LOW	MOD	HIGH	HIGH
	E2 - Very Rare	LOW	LOW	LOW	MOD	MOD
	E3 - Extremely Rare	LOW	LOW	LOW	LOW	LOW
	E4 - Close to Non-Credible	LOW	LOW	LOW	LOW	LOW

4.0 POTENTIAL FAILURE MODES AND RISK ASSESSMENT

A summary of the PFMs evaluated, including likelihoods with and without controls, consequences, and risk levels with and without controls is presented below in Table 4-1.

Table 4-1: Summary of Evaluated PFMs

Unique PFM ID	Failure Mode	PFM Category	Likelihood W/O Controls	Likelihood W/ Controls	Consequence Category	Risk Level W/O Controls	Risk Level W/ Controls
PFM-001	Global slope instability - deep seated static failure through foundation	Category I	D - Unlikely	E3 - Extremely Rare	3 - Serious	MOD	LOW
PFM-002	Global slope instability - deep seated static failure through tailings	Category I	B - Likely	E1 - Rare	2 - Medium	HIGH	LOW
PFM-003	Global slope instability - Static translational / sliding failure along liner interface	Category I	C - Possible	E2 - Very Rare	3 - Serious	HIGH	LOW
PFM-004	Slope instability during seismic event - liquefaction of tailings	Category III	E1 - Rare	E2 - Very Rare	3 - Serious	MOD	LOW
PFM-005	Slope instability during seismic event - liquefaction of the foundation soils	Category III	E2 - Very Rare	E3 - Extremely Rare	3 - Serious	LOW	LOW
PFM-006	Slope instability during seismic event - seismic displacement	Category II	E2 - Very Rare	E2 - Very Rare	2 - Medium	LOW	LOW
PFM-007	Static liquefaction of tailings	Category III	E1 - Rare	E2 - Very Rare	4 - Major	HIGH	MOD

Unique PFM ID	Failure Mode	PFM Category	Likelihood W/O Controls	Likelihood W/ Controls	Consequence Category	Risk Level W/O Controls	Risk Level W/ Controls
PFM-008	Static liquefaction of foundation soils	Category II	E2 - Very Rare	E3 - Extremely Rare	3 - Serious	LOW	LOW
PFM-009	Crest / side-slope erosion (i.e., vehicle traffic, heavy equipment, lack of compaction, general precipitation erosion on side-slopes, leading to discharge of tailings outside containment)	Category II	C - Possible	E2 - Very Rare	2 - Medium	MOD	LOW
PFM-010	Large differential settlement or deformation due to permafrost thaw, leading to surface tailings exposure and/or breach of seepage collection system	Category I	D - Unlikely	E1 - Rare	3 - Serious	MOD	LOW
PFM-011	Geochemical compatibility of tailings and seepage collection system	Category II	C - Possible	E2 - Very Rare	3 - Serious	HIGH	LOW
PFM-012	Compromised physical performance of seepage collection system (puncture, lack of overlap, etc.)	Category I	B - Likely	E2 - Very Rare	2 - Medium	HIGH	LOW
PFM-013	Large precipitation event erodes through surface cover, exposes tailings resulting in transport of tailings/sediments into natural environment	Category II	C - Possible	E1 - Rare	2 - Medium	MOD	LOW
PFM-014	Overtopping or failure of Mill Water Pond, Water Treatment Pond, and/or DSTF Sump resulting in transport of tailings/sediments into natural environment	Category I	B - Likely	C - Possible	2 - Medium	HIGH	MOD
PFM-015	Overtopping of water diversions and conveyance system	Category II	C - Possible	E2 - Very Rare	2 - Medium	MOD	LOW
PFM-016	Poor cover performance leads to increased infiltration and increased water transport through dry stack.	Category IV	-	-	-	#N/A	#N/A
PFM-017	Release of dust from facility impacting off-site air quality, soils, or water	Category II	A - Almost Certain	B - Likely	2 - Medium	HIGH	HIGH
PFM-018	Operational safety due to poor construction (e.g. vehicle roll over). This impacts AKHM's reputation and could possibly delay material placement for investigations or clean up	Category II	C - Possible	E2 - Very Rare	3 - Serious	HIGH	LOW
PFM-019	Placement/release of tailings outside of the containment area	Category II	D - Unlikely	E2 - Very Rare	1 - Minor	LOW	LOW
PFM-020	Public access to site, including vandalism, sabotage, leading to unsafe site conditions	Category II	E1 - Rare	E2 - Very Rare	1 - Minor	LOW	LOW
PFM-021	Extreme climate conditions (e.g. fire, rainfall, pandemic) that trigger failure or lapse in operations/ maintenance and water treatment activities.	Category II	E2 - Very Rare	E2 - Very Rare	2 - Medium	LOW	LOW

Risk levels for each of these PFMs are plotted in the SQRA matrices without and with controls below in Tables 4-2 and 4-3, respectively.

Table 4-2: SQRA Matrix for PFMs Without Controls

Likelihood	Consequence: 1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
A - Almost Certain		PFM-017			
B - Likely		PFM-002 PFM-012 PFM-014			
C - Possible		PFM-009 PFM-013 PFM-015	PFM-003 PFM-011 PFM-018		
D - Unlikely	PFM-019		PFM-001		
E1 - Rare	PFM-020		PFM-004 PFM-010	PFM-007	
E2 - Very Rare		PFM-006 PFM-021	PFM-005 PFM-008		
E3 - Extremely Rare					
E4 - Close to Non-Credible					

Table 4-3: SQRA Matrix for PFMs With Controls

Likelihood	Consequence: 1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
A - Almost Certain					
B - Likely		PFM-017			
C - Possible		PFM-014			
D - Unlikely					
E1 - Rare		PFM-002 PFM-013			
E2 - Very Rare	PFM-019 PFM-020	PFM-006 PFM-009 PFM-012 PFM-015 PFM-021	PFM-003 PFM-004 PFM-010 PFM-011 PFM-018	PFM-007	
E3 - Extremely Rare			PFM-001 PFM-005 PFM-008		
E4 - Close to Non-Credible					

5.0 SUMMARY OF FINDINGS

A summary of comments related to the PFMs presented in Section 4 is below:

- 6 PFMs were identified as Category I.
- 11 PFMs were identified as Category II.

- 3 PFMs were identified as Category III.
- 1 PFM was identified as Category IV, and therefore not carried through in the SQRA.
- Without controls, the process identified 8 high risk, 6 moderate risk, and 6 low risk PFMs. No critical risks were assessed.
- With controls, these PFMs were subsequently reduced to the following: 1 high risk and 2 moderate risk PFMs (see below), as well as 17 low risk PFMs.
  - PFM-017 Release of dust from facility impacting off-site air quality, soils, or water - High
  - PFM-007 Static Liquefaction of Tailings - Moderate
  - PFM-014 Overtopping or failure of Mill Water Pond, Water Treatment Pond, and/or DSTF Sump - Moderate

5.1 Key Controls

Several common key controls were identified during the process that are critical in mitigating and managing the likelihoods and associated risks of evaluated PFMs.

These common key controls included:

- Selection of appropriate design criteria, design events, minimum factors of safety.
- QAQC during foundation preparation, liner installation, and construction.
- QAQC during operations (i.e., tailings gradation and moisture content, placement, and compaction).
- Visual and instrumentation monitoring and surveillance per the OMS.
- Maintenance per the OMS (i.e., cleaning of ditches, ponds as required).
- Training of site staff.

PFM specific controls are identified in the FEMA register in Appendix B.

5.2 Recommended Additional Controls and Action Items

The following are recommended additional controls and/or action items that are intended to reduce the risk level for remaining moderate or high-risk PFMs:

- Additional characterization of tailings to further confirm liquefaction or cyclic softening potential including:
  - Triaxial / cyclic shear testing.
  - Incorporation of relevant data collected during upcoming P1 geotechnical evaluation (i.e., CPT, lab data).
- Multi-interface shear testing of liner system, including drainage blanket and confining materials.
- Further evaluation to characterize thawed foundation soil conditions and liquefaction potential (likely incorporating data from upcoming P1 evaluation).
- Evaluate Maximum Credible Earthquake.

- Evaluate current cover design relative to Hecla requirements.
- Complete a site wide water balance model to determine Mill Pond capacity / loading.
- Evaluate and implement winter tailings placement and compaction procedures.
- Minimize sediment loading to Mill Pond.
- Develop and implement Clean Work Area Management Plan, truck wheel washes, etc.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Keno Hill Mining dba Hecla Yukon and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Alexco Keno Hill Mining dba Hecla Yukon, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

7.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
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TABLES

Table 1 FMEA Results Summary
Table 2 SQRA Heat Map “Without Controls” Scenario
Table 3 SQRA Heat Map “With Controls” Scenario
Table 4 Detailed FMEA Register Table

TABLE 1 - DSTF PHASE 2 FMEA SUMMARY

Facility	Unique PFM ID	Failure Mode	PFM Category (drop down list)	Likelihood W/O Controls Category (drop down list)	Likelihood W/ Controls Category (drop down list)	Consequence Category (drop down list)	Risk Level W/O Controls	Risk Level W/ Controls
DSTF Phase 2	PFM-001	Global slope instability - deep seated static failure through foundation	Category I	D - Unlikely	E3 - Extremely Rare	3 - Serious	MOD	LOW
DSTF Phase 2	PFM-002	Global slope instability - deep seated static failure through tailings	Category I	B - Likely	E1 - Rare	2 - Medium	HIGH	LOW
DSTF Phase 2	PFM-003	Global slope instability - Static translational / sliding failure along liner interface	Category I	C - Possible	E2 - Very Rare	3 - Serious	HIGH	LOW
DSTF Phase 2	PFM-004	Slope instability during seismic event - liquefaction of tailings	Category III	E1 - Rare	E2 - Very Rare	3 - Serious	MOD	LOW
DSTF Phase 2	PFM-005	Slope instability during seismic event - liquefaction of the foundation soils	Category III	E2 - Very Rare	E3 - Extremely Rare	3 - Serious	LOW	LOW
DSTF Phase 2	PFM-006	Slope instability during seismic event - seismic displacement	Category II	E2 - Very Rare	E2 - Very Rare	2 - Medium	LOW	LOW
DSTF Phase 2	PFM-007	Static liquefaction of tailings	Category III	E1 - Rare	E2 - Very Rare	4 - Major	HIGH	MOD
DSTF Phase 2	PFM-008	Static liquefaction of foundation soils	Category II	E2 - Very Rare	E3 - Extremely Rare	3 - Serious	LOW	LOW
DSTF Phase 2	PFM-009	Crest / side-slope erosion (i.e., vehicle traffic, heavy equipment, lack of compaction, general precipitation erosion on side-slopes, potentially leading to discharge of tailings outside containment)	Category II	C - Possible	E2 - Very Rare	2 - Medium	MOD	LOW
DSTF Phase 2	PFM-010	Large differential settlement or deformation due to permafrost thaw, leading to surface tailings exposure and/or breach of seepage collection system	Category I	E1 - Rare	E2 - Very Rare	3 - Serious	MOD	LOW
DSTF Phase 2	PFM-011	Geochemical compatibility of tailings and seepage collection system	Category II	C - Possible	E2 - Very Rare	3 - Serious	HIGH	LOW
DSTF Phase 2	PFM-012	Compromised physical performance of seepage collection system (puncture, lack of overlap, etc.)	Category I	B - Likely	E2 - Very Rare	2 - Medium	HIGH	LOW
DSTF Phase 2	PFM-013	Large precipitation event erodes through surface cover, exposes tailings resulting in transport of tailings/sediments into natural environment	Category II	C - Possible	E1 - Rare	2 - Medium	MOD	LOW
DSTF Phase 2	PFM-014	Overtopping or failure of Mill Water Pond, Water Treatment Pond, and/or DSTF Sump resulting in transport of tailings/sediments into natural environment	Category I	B - Likely	C - Possible	2 - Medium	HIGH	MOD
DSTF Phase 2	PFM-015	Overtopping of water diversions and conveyance system	Category II	C - Possible	E2 - Very Rare	2 - Medium	MOD	LOW
DSTF Phase 2	PFM-016	Poor cover performance leads to increased infiltration and increased water transport through dry stack.	Category IV	-	-	-	-	-
DSTF Phase 2	PFM-017	Release of dust from facility impacting off-site air quality, soils, or water	Category II	A - Almost Certain	B - Likely	2 - Medium	HIGH	HIGH
DSTF Phase 2	PFM-018	Operational safety due to poor construction (e.g. vehicle roll over). This impacts AKHM's reputation and could possibly delay material placement for investigations or clean up	Category II	C - Possible	E2 - Very Rare	3 - Serious	HIGH	LOW
DSTF Phase 2	PFM-019	Placement/release of tailings outside of the containment area	Category II	D - Unlikely	E2 - Very Rare	1 - Minor	LOW	LOW
DSTF Phase 2	PFM-020	Public access to site, including vandalism, sabotage, leading to unsafe site conditions	Category II	E1 - Rare	E2 - Very Rare	1 - Minor	LOW	LOW
DSTF Phase 2	PFM-021	Extreme climate conditions (e.g. fire, rainfall, pandemic) that trigger failure or lapse in operations/ maintenance and water treatment activities.	Category II	E2 - Very Rare	E2 - Very Rare	2 - Medium	LOW	LOW

Table 2 - SQRA Heat Map - Risk Matrix W/O Controls

Likelihood	Consequence				
	1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
A - Almost Certain		PFM-017			
B - Likely		PFM-002 PFM-012 PFM-014			
C - Possible		PFM-009 PFM-013 PFM-015	PFM-003 PFM-011 PFM-018		
D - Unlikely	PFM-019		PFM-001		
E1 - Rare	PFM-020		PFM-004 PFM-010	PFM-007	
E2 - Very Rare		PFM-006 PFM-021	PFM-005 PFM-008		
E3 - Extremely Rare					
E4 - Close to Non-Credible					

Table 3 - SQRA Heat Map - Risk Matrix W/ Controls

Likelihood	Consequence				
	1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
A - Almost Certain					
B - Likely		PFM-017			
C - Possible		PFM-014			
D - Unlikely					
E1 - Rare		PFM-002 PFM-013			
E2 - Very Rare	PFM-019 PFM-020	PFM-006 PFM-009 PFM-012 PFM-015 PFM-021	PFM-003 PFM-004 PFM-010 PFM-011 PFM-018	PFM-007	
E3 - Extremely Rare			PFM-001 PFM-005 PFM-008		
E4 - Close to Non-Credible					

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-001
Failure Mode	Global slope instability - deep seated static failure through foundation
Failure Initiator (Trigger)	1. Loading foundation to strength capacity (excessive loading) 2. Unsuitable geotechnical condition in foundation or tailings 3. Increased porewater pressure in foundation due to permafrost thaw
Failure Mechanism (Process)	1. An increase in pore water pressure in foundation, embankment or tailings or foundation soil softening; increased loading exceeds shear strength of soils 2. Shallow slumping resulting in change in load and sliding on the downstream surface impacting the integrity of the embankment 3. Mobilization of slip surface 4. Failure along slip surface
Facts and Conditions	DSTF is a Class II facility per Guidelines for Mine Waste Management Facilities (Yukon Government EMR, 2023), also see Hecla Design Basis Slope Stability – limit equilibrium - Operations and Closure Static FOS > 1.5 Foundation Condition: organic layer underlain by silt to sand till, frozen ice poor to ice rich foundation, ground ice content decreases with depth to bedrock (bedrock varies from several meters to >30 m), sand and gravel interbedding. Ice rich soils primarily encountered in western extents. Southeast area consists mainly of sand and gravel, possible kame. Seepage collection system consists of base drainage material overlain by geotextile, Geosynthetic clay liner (GCL); Geonet; and Geotextile; Confining layer of drainage blanket material over liner system, prior to tailings placement - Final tailings slope of 3.25H:1V - Tailings typically leave mill at 15-20% moisture (by weight) - SILT, sandy, trace to some clay - typical Stability - Scenarios: fully frozen foundation, fully thawed foundation, failure along liner interface - Lower bound frictional strengths assumed - residuals for liner interface - Phreatic surface being considered along liner - i.e., top of drainage blanket - Toe buttress for global stability / incorporated into runoff collection system - Interior berm for global stability (slips surface along liner materials) - Stability analyses based on survey topography - Stability analysis methods and consideration (Mohr-Coulomb, phreatic surface near OG). Comments
Adverse factors	- Heterogeneous ground conditions, localized ice-rich zones, particularly near toe at junction with P1 DSTF
Positive factors	- Slopes designed at 3.25:1 - Minimum FS for stability met by design - Controls during material placement - Effective runoff collection and seepage collection systems - Observations of the existing facility do not indicate presence of thaw water / rapid generation of thaw water and increased porewater pressures due to permafrost thaw
Design Phase Risk Mitigations and Controls	- Design FOS, lower bound strength assumptions, reduction in assumed strength for till - Residual strength used at liner interface for all analyses
Construction / Operations Phase Mitigations and Controls	- Foundation and buttress construction QAQC - QAQC and monitoring during operations, i.e., tailings gradation, placement/compaction, and moisture contents
PFM Category (drop down list)	Category I
PFM Category Considerations & Confidence	Ground conditions well characterized and understood, global failure has significant down gradient impacts (workers, infrastructure)
Likelihood W/O Controls Category (drop down list)	D - Unlikely
Likelihood W/ Controls Category (drop down list)	E3 - Extremely Rare
Likelihood Considerations & Confidence	Slopes are designed at 3.25:1 and FOS are above threshold values.
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	Health & Safety (H&S): 2 (Approx. 1-10 people at risk), Financial: 3 ($5M-$25M), Env: 2 (restoration is highly possible), LTO: 3 (based on estimates from Vic. Gold failure), Community: 2
Notes	**Recommended additional controls - consider removal of ice-rich materials in P2W footprint during its design phase.** Comments: The consequence associated with PFM-001 is higher than PFM-002 due to the increased requirements for stabilization of a potential zone of failure (foundation restoration and liner repair)

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-002
Failure Mode	Global slope instability - deep seated static failure through tailings
Failure Initiator (Trigger)	1. Unsuitable geotechnical condition in tailings 2. Increase in degree of saturation in tailings 3. Loosely placed tailings, buried snow 4. Constructing above design elevation 5. Placing off-spec tailings
Failure Mechanism (Process)	1. An increase in pore water pressure in embankment or tailings; increased loading exceeds shear strength of tailings 2. Shallow slumping resulting in change in loads and sliding on the downstream surface impacting the integrity of the tailings stack 3. Mobilization of slip surface 4. Failure along slip surface
Facts and Conditions	DSTF is a Class II facility per Guidelines for Mine Waste Management Facilities (Yukon Government EMR, 2023), also see Hecla Design Basis Slope Stability – limit equilibrium - Operations and Closure Static FOS > 1.5 Dry stack tailings: - Final tailings slope of 3.25H:1V - Tailings typically leave mill at 15-20% moisture (by weight) - SILT, sandy, trace to some clay - typical Stability - Scenarios: fully frozen foundation, fully thawed foundation, failure along liner interface - Lower bound frictional strengths assumed for tailings based on direct shear testing - Phreatic surface being considered along liner - i.e., top of drainage blanket - Toe buttress for global stability / incorporated into runoff collection system - Interior berm for global stability (slip surface along liner materials) - Stability analyses based on survey topography - Stability analysis methods and consideration focus on tailings (Mohr-Coulomb, phreatic surface near OG). Comments - Will likely involve a semi-circular failure surface due to consistency of the tailings. Laboratory testing results showed that material is generally 70% finer than a No. 200 sieve, non-plastic, MC is approx. or slightly above optimum moisture content (OMC) at 15-20%, placement and spreading of tailings causes a slight reduction in MC. - Note that failure has the potential to obstruct the portal opening, however Hecla noted that there is a secondary escapeway located at the vent raise. - Current practice: placement in 0.5m lifts, stockpiled outside the mill, until a dozer operator is available for placement (two main operations contribute to increased risk of freezing, when the tailings are in stockpiles outside the mill and prior to placement/compaction at the facility)
Adverse factors	- Inadequate snow removal during operations - Placement of frozen tailings - Heavy rainfall which saturates tailings - Inconsistent or inadequate QAQC during placement
Positive factors	- Slopes designed at 3.25:1 - Minimum FS for stability met by design - Consistent QAQC during construction and operations; QA/QC linked to OMS procedures - Effective runoff collection and seepage collection systems
Design Phase Risk Mitigations and Controls	- Use lower bound of tailings strength as determined by direct shear testing
Construction / Operations Phase Mitigations and Controls	- QAQC and monitoring during operations, i.e., tailings gradation, placement/compaction, and moisture contents, control during buttress construction - Quality control with respect to degree of saturation, placement, compaction, proper management of off-spec tailings.
PFM Category (drop down list)	Category I
PFM Category Considerations & Confidence	- Based on evidence of previous movement within the facility, including observations in P1, the PFM was labelled as Category 1. - Potential downstream impacts to infrastructure and workers
Likelihood W/O Controls Category (drop down list)	B - Likely
Likelihood W/ Controls Category (drop down list)	E1 - Rare
Likelihood Considerations & Confidence	Evidence of movement has been observed in the P1 DSTF - as such without control this PFM has been observed before (Category B), while with proper control implementation the likelihood would be reduced (Category E1). Factors such as poor construction practices (e.g. compaction) can lead to low shear strength conditions, excess pore pressures, unfavourable water conditions, etc. SOP is required as a control to reduce the likelihood of this PFM.
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 2 (Approx. 1-10 people at risk), Financial: 2 ($500,000-$5M), Env: 2 (restoration is highly possible), LTO: 3 (based on estimates from Vic. Gold failure), Community: 2
Notes	Controls: removal of snow prior to placement, careful monitoring of construction (e.g. compaction), training of operators, implementation of SOP. **Recommended additional controls - further characterization of tailings (triaxial testing)**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-003
Failure Mode	Global slope instability - Static translational / sliding failure along liner interface
Failure Initiator (Trigger)	1. Loading interface to strength capacity (excessive loading) 2. Thaw deformation below interface 3. Loss of shear strength in GCL/liner materials 4. Strain along liner interface mobilization residual shear strength in liner system 5. Poorly functioning drainage blanket below liner interface
Failure Mechanism (Process)	1. Loading exceeds shear strength of liner system. May be induced by dead load on liner, or strain caused by foundation deformation (or combination) 2. Sliding of tailings along liner interface initiated 3. Mobilization of slip surface 4. Failure along slip surface
Facts and Conditions	DSTF is a Class II facility per Guidelines for Mine Waste Management Facilities (Yukon Government EMR, 2023), also see Hecla Design Basis Slope Stability – limit equilibrium - Operations and Closure Static FOS > 1.5 Seepage collection system consists of base drainage material overlain by geotextile, Geosynthetic clay liner (GCL); Geonet; and Geotextile; Confining layer of drainage blanket material over liner system, prior to tailings placement Dry stack tailings: - Final tailings slope of 3.25H:1V - Tailings typically leave mill at 15-20% moisture (by weight) - SILT, sandy, trace to some clay - typical Stability -Liner interface testing completed -Scenarios: failure along liner interface -Lower bound frictional strengths assumed - residuals for liner interface being considered -Phreatic surface being considered along liner - i.e., top of drainage blanket -Toe buttress for global stability / incorporated into runoff collection system -Interior berm for global stability (slips surface along liner materials) - Stability analyses based on survey topography -Stability analysis methods and consideration focus on tailings (Mohr-Coulomb, phreatic surface near OG). Comments - Max OG slope is 5.5:1, down to 10:1 , i.e., along the liner. Localized areas of steeper slope such as buttress, ditching, etc. - Note that failure has the potential to obstruct the portal opening, however Hecla noted that there is a secondary escapeway located at the vent raise.
Adverse factors	- Delayed confinement of the GCL upon deployment leading to unconfined hydration (requires proper QAQC to ensure appropriate liner installation) - Spring thaw leading to additional water in the liner - Improper storage of the GCL prior to installation leading to premature hydration - Sliding along liner may cause tension cracks which could act as a flow path for surface water to contact the liner system
Positive factors	- Use of residual strength for all static analyses - Controls during material placement - Effective runoff collection and seepage collection systems
Design Phase Risk Mitigations and Controls	- Use residual strength at liner interface for static conditions
Construction / Operations Phase Mitigations and Controls	- Monitoring construction during placement of liner, proper confinement, runoff and seepage collection systems - Quality control with respect to degree of saturation, placement, compaction, proper management of off-spec tailings
PFM Category (drop down list)	Category I
PFM Category Considerations & Confidence	Deemed to be credible, as it is a strength limiting component of the structure, and could be impacted by both seismic and static instability, Category 1.
Likelihood W/O Controls Category (drop down list)	C - Possible
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	Without controls (Category C), with controls (Category E2), considerations including Tt being on site full time for construction (QA/QC), lowering likelihood of liner being improperly placed, and operations will not be installing the liner but rather a contractor (different operational structure from P1).
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	H&S: 2 (Approx. 1-10 people at risk), Financial: 3 ($5M-$25M), Env: 2 (restoration is highly possible), LTO: 3 (based on estimates from Vic. Gold failure), Community: 2
Notes	Controls: Construction QA/QC, contractor on site for development. **Recommended additional controls - verify the design assumptions regarding interface behaviour and strength, to revisit and revise shear strength of liner system if applicable (multi-interface shear testing of liner system).** Comments: The consequence associated with PFM-003 is higher than PFM-002 due to the increased requirements for stabilization of a potential zone of failure (e.g. excavating to the liner).

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-004
Failure Mode	Slope instability during seismic event - liquefaction of tailings
Failure Initiator (Trigger)	1. Seismic Event/Earthquake
Failure Mechanism (Process)	1. Increase in pore pressure causes a strength reduction in a susceptible, saturated soil, usually loose silts and sands 2. Mobilization of slip surface along liquified tailings 3. Deformation of the DSTF 4. Slope failure of DSTF
Facts and Conditions	- Tailings historically assumed to be drained and unsaturated. - Drilling program in 2022, indicated moisture contents between 11-17% in phase 1. - Design assumes 95% SPMDD compaction - SILT, sandy, trace to some clay - typical - Design event: Annual Exceedance Probability (AEP) of 1 in 2,475 years earthquake - DCP Testing in Phase 1 DSTF shows relatively dense tailings up to at least 1.5 m below ground surface (limit of instrument); unlikely to liquefy Comments: - PGA of 0.27 => moderate seismic activity - Same construction controls as PFM-002 can be applied to this PFM (compaction, monitoring water levels and movement, and preventing inclusion of snow between tailings lifts) - Dry stacks may gain moisture over time, as continued loading and compaction make the base of the dry stack less permeable. This can lead to moisture concentration at the base of dry stack and increase the risk of liquefaction -The drainage blanket gravel in the foundation is designed to dissipate excess pore pressure,-and should mitigate, rather than contribute to, liquefaction hazards
Adverse factors	- Loosely placed tailings - Poor runoff control, ponding water on surface
Positive factors	- Tailings placed and compacted - QAQC during placement - Surface sealed following placement
Design Phase Risk Mitigations and Controls	- Minimum target densities included as part of OMS - Future triaxial and critical state testing to be completed to determine liquefaction susceptibility
Construction / Operations Phase Mitigations and Controls	-QAQC during tailings placement and compaction -QAQC of tailings (i.e., proper management of off-spec tailings) -Training of site staff
PFM Category (drop down list)	Category III
PFM Category Considerations & Confidence	Could be a potentially critical failure mode, testing required to better delineate the characteristics of potentially liquefiable material in the DSTF
Likelihood W/O Controls Category (drop down list)	E1 - Rare
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	- Design event is 1:2,475 earthquake. Likelihood of occurrence is low - Operational control reduce the risk of liquefaction during earthquake event - With the absence of data, assuming the OBE could cause liquefiable conditions (Category E2)
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	H&S: 3 (approx. 30-35 workers in this area at a given time, incl. office staff), Financial: 3 ($5M-$25M), Env: 3, LTO: 3 (minimum assuming a flow type failure), Community: 2, **lower confidence on consequence due to limited information and data**
Notes	**Additional recommended controls: Additional tailings characterization, triaxial and cyclic testing, also consider data collected during P1 characterization/CPT program**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-005
Failure Mode	Slope instability during seismic event - liquefaction of the foundation soils
Failure Initiator (Trigger)	1. Seismic Event/ Earthquake 2. Liquefaction / loss of shear strength in foundation
Failure Mechanism (Process)	1. Increase in pore pressure causes a strength reduction in a susceptible, saturated soil, usually loose silts and sands 2. Reduction in effective stress and soils strength 3. Mobilization of slip surface along foundation soils 4. Deformation of the DSTF 5. Slope failure of DSTF
Facts and Conditions	- A design earthquake magnitude of 7.5 has been estimated for the site (Design Summary Report Rev2), and the displacements along different sections were estimated at approximately 35 cm with a probability of exceedance of 5%, and 54 cm with a probability of exceedance of 2%. - Foundation soils similar to those encountered in phase 1 footprint, with generally lower ground ice and moisture contents. Assessment using Youd et al NCEER SPT method during Phase 1 concluded: *The calculated factor of safety against cyclic liquefaction ranged from 1.2 to 1.5 for high earthquake magnitudes (7.0 and 7.5). A FoS greater than or equal to 1.0 was determined against cyclic liquefaction in the foundation soils for an earthquake magnitude less than 8.0, which is considered to be an extreme event. It was estimated that the consequences of any liquefaction would amount to limited movement and cracking of the tailings, as opposed to catastrophic failure.* - This pertains to thawed foundation soils; potential for elevated pore pressures in thawing soils if insufficient drainage pathways exist to dissipate pore pressures - this will be localized within the DSTF footprint to areas with excess ice (note under consideration to be removed) - investigations within the DSTF P2 footprint show ice-rich till is generally limited to the NW corner of the facility
Adverse factors	Potential for thawing ground ice and reduced local density Limited literature and study on liquefaction in permafrost soils
Positive factors	Ice-rich permafrost is present in localized zones within the DSTF footprint but is not continuous throughout the foundation. Thawing is unlikely to cause a rapid increase in pore pressures in foundation soils which could contribute to potential liquefaction.
Design Phase Risk Mitigations and Controls	Design assumes non liquefiable soils; confirmation of liquefaction potential is required
Construction / Operations Phase Mitigations and Controls	-QAQC during construction of drainage blanket and water control structures
PFM Category (drop down list)	Category III
PFM Category Considerations & Confidence	Some uncertainty regarding the liquefaction potential of thawing soils. Although most of the facility is underlain by ice-poor or non permafrost materials, there may be potential for ice-rich material to liquefy locally if thawed.
Likelihood W/O Controls Category (drop down list)	E2 - Very Rare
Likelihood W/ Controls Category (drop down list)	E3 - Extremely Rare
Likelihood Considerations & Confidence	Large earthquake event required to liquefy foundation soils (if at all). Reduction in potential for thawing soils with subexcavation of ice-rich soils
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	H&S: 3 (approx. 30-35 workers in this area at a given time, incl. office staff), Financial: 3 ($5M-$25M), Env: 3, LTO: 3 (minimum assuming a flow type failure), Community: 2
Notes	**Additional study should be undertaken to estimate soil condition upon thaw, with particular attention to density condition as this affects liquefaction susceptibility** **Additional recommended controls: Analyze data collected during P1 characterization/CPT program**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-006
Failure Mode	Slope instability during seismic event - seismic displacement
Failure Initiator (Trigger)	1. Seismic Event/ Earthquake loading causes deformation/ displacement
Failure Mechanism (Process)	1. Seismic horizontal ground acceleration motion yields the capacity of the tailings and/or foundation soils 2. Displacement occurs along slip surface and accumulates with ongoing ground acceleration 3. Tension crack or toe bulging 4. Displacement continues and slope loses integrity 5. Slope failure
Facts and Conditions	- Minimum FOS of 1.0 under pseudo-static analyses - Additional stability analyses completed using post-seismic strengths under static conditions achieved minimum FOS - Critical/lowest FOS through liner, based on residual strengths from interface testing - Bray and Macedo method - estimated displacement of 35 cm with a probability of exceedance of 5%, and 54 cm with a probability of exceedance of 2%, assuming an Annual Exceedance Probability (AEP) of 1 in 2,475 years earthquake
Adverse factors	Localized variations in tailings density due to inconsistent placement
Positive factors	Pseudo-static and post-earthquake stability criteria satisfied by design
Design Phase Risk Mitigations and Controls	Minimum Factor of Safety (FOS).
Construction / Operations Phase Mitigations and Controls	Monitoring of placement/compaction and moisture contents
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Post seismic stability considered as part of design; pseudo-static analyses as well as post-seismic strengths under static loading
Likelihood W/O Controls Category (drop down list)	E2 - Very Rare
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	Likelihood in line with design seismic event
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 2 (Approx. 1-10 people at risk), Financial: 2 ($500,000-$5M), Env: 2 (restoration is highly possible), LTO: 3 (based on estimates from Vic. Gold failure), Community: 2
Notes	**Additional recommended controls - evaluate MCE, displacement estimation with new geometry/ design**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-007
Failure Mode	Static liquefaction of tailings
Failure Initiator (Trigger)	1. Increase of pore water pressure within tailings from flooding, high intensity precipitation event, permafrost thaw 2. Increase in pore pressure and change in stress conditions 3. Rapid construction, compaction quality, moisture conditions in tailings, and deformability of the facility foundation that could possibly contribute to instability
Failure Mechanism (Process)	1. Increase in pore pressure causes strength reduction in a susceptible, saturated soil 2. Mobilization of slip surface along liquefied tailings 3. Deformation of slope 4. Slope failure
Facts and Conditions	- Tailings historically assumed to be drained and unsaturated. - Drilling program in 2022, indicated moisture contents between 11-17% in phase 1. - Design assumes 95% SPMDD compaction - SILT, sandy, trace to some clay - typical - DCP Testing in Phase 1 DSTF shows relatively dense tailings up to 1.5 m below ground surface (limit of equipment); unlikely to liquefy Comments: - The compaction of materials to dilative conditions should also be considered to eliminate the risk of static liquefaction (this method could be used with zonation and by targeting suspect tailings)
Adverse factors	- Fast and poor quality tailings placement - Poor tailings compaction - Placement of saturated tailings - Placement of tailings in freezing conditions - Presence of a deformable foundation below the DSTF
Positive factors	- Tailings placed and compacted - QAQC during placement - Surface sealed following placement to promote runoff
Design Phase Risk Mitigations and Controls	- Minimum target densities/ compaction requirements included as part of OMS
Construction / Operations Phase Mitigations and Controls	- QAQC during tailings placement and compaction - QAQC of tailings (i.e., no off-spec tailings placed) - Training of site staff
PFM Category (drop down list)	Category III
PFM Category Considerations & Confidence	In situ tailings properties are not well understood at this time. Although static liquefaction is considered unlikely based on near-surface DCP testing, and investigation data from the Phase 1 DSTF, additional characterization of the P2 tailings is required.
Likelihood W/O Controls Category (drop down list)	E1 - Rare
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	With the underlying assumption that the tailings are liquefiable, the likelihood without controls is Category E1, while the likelihood with controls (see below) is Category E2
Consequence Category (drop down list)	4 - Major
Consequence Considerations & Confidence	H&S: 3 (approx. 30-35 workers in this area at a given time, incl. office staff), Financial: 3 ($5M-$25M), Env: 3, LTO: 4 (minimum assuming a flow type failure), Community: 2, **lower confidence on consequence due to limited information and data**
Notes	Controls: compaction monitoring, runoff control, water management, activity near the toe should be limited or reviewed by geotechnical engineer, training of operators, change management. **Additional recommended controls: Further research into the liquefaction potential of tailings material (laboratory testing) as per PFM-004** During workshop the likelihood w/o controls was classified as C-Possible; however, w/o controls likelihood was reduced to E1-Rare during AKHM/Tt discussions post-workshop due to further consideration of tailings placement/ compaction (even w/o QAQC controls).

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-008
Failure Mode	Static liquefaction of foundation soils
Failure Initiator (Trigger)	1. Increase of pore water pressure within tailings from flooding, high intensity precipitation event, permafrost thaw 2. Increase in pore pressure and change in stress conditions
Failure Mechanism (Process)	1. Increase in pore pressure causes strength reduction in a susceptible, saturated soil 2. Mobilization of slip surface along liquefied foundation soils 3. Deformation of slope 4. Slope failure
Facts and Conditions	Foundation Condition: organic layer underlain by silt to sand till, frozen ice poor to ice rich foundation, ground ice content decreases with depth to bedrock (bedrock varies from several meters to >30 m). Ice rich soils primarily encountered in western extents. Southeast area consists mainly of sand and gravel, possible kame. - Rate of thaw not expected to be high enough to generate excess porewater pressures
Adverse factors	- Heterogeneous ground conditions - Localized ice-rich zones, particularly near toe at junction w/ P1 DSTF
Positive factors	- Large portions of the P2 DSTF are ice-poor, with some areas are permafrost free (i.e., southeastern extents) - Drainage blanket is installed below the liner system to dissipate pore pressures - Ice-rich areas are localized and are expected to thaw slowly, reducing the risk of excess pore pressure development
Design Phase Risk Mitigations and Controls	- Drainage blanket incorporated into design - Ground temperature cables (GTC) are installed to monitor permafrost temperatures and potential degradation - VWPs are installed above and below liner system to detect development of excess pore pressures
Construction / Operations Phase Mitigations and Controls	- Minimize disturbance of Ground cover to reduce rate of permafrost thaw - Monitoring of instrumentation to identify issues
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	- Occurrence would likely be localized, not global
Likelihood W/O Controls Category (drop down list)	E2 - Very Rare
Likelihood W/ Controls Category (drop down list)	E3 - Extremely Rare
Likelihood Considerations & Confidence	- Ice-rich permafrost is limited to localized areas within the P2 DSTF footprint, and possibility of removing ice-rich soil. Thaw will generally be slow and is unlikely to generate excess pore pressure.
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	H&S: 3 (approx. 30-35 workers in this area at a given time, incl. office staff), Financial: 3 ($5M-$25M), Env: 3, LTO: 3 (minimum assuming slumping or flow failure), Community: 2, **lower confidence on consequence due to limited information and data**
Notes	Controls: compaction monitoring, runoff control, water management, training of operators, change management. Possibly removal of ice rich soil under critical facility elements. **Additional recommended controls: Further research into the liquefaction potential of foundation material (Laboratory testing of samples collected during SI).**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-009
Failure Mode	Crest / side-slope erosion (i.e., vehicle traffic, heavy equipment, lack of compaction, general precipitation erosion on side-slopes, potentially leading to discharge of tailings outside containment)
Failure Initiator (Trigger)	1. Erosion due to extreme storm, spring freshet 2. Rutting due to machinery 3. Unmanaged or poorly functioning diversions
Failure Mechanism (Process)	1. Heavy precipitation event, or ponding water near crest 2. Change in crest or slope geometry directs water over side slopes 3. Formation of gullies / erosion channels 4. Containment loss, transportation of tailings
Facts and Conditions	- Slope designed at 3.25H:1V - Perimeter ditching to capture runoff; expected to contain some eroded material - Operations and construction to ensure positive drainage / runoff, adequate compaction, controlled placement, no off-spec tailings, proper cover placement, etc. Comments: - Materials are expected to be erodible, mitigated by covering of finished slopes, material compaction, runoff control - Issues with delayed material covering has occurred in the past due to disturbance associated with repairs to the placed tailings, resulting in erosional vulnerability. - Implementation of a SOP that ensures slopes are properly graded, compacted, etc. is required to ensure that the risk of erosion is mitigated.
Adverse factors	Delayed covering of tailings following placement, disturbances to the DSTF following tailings placement (e.g. repairs), insufficient material compaction, poor performance of runoff control, severe weather events, increasing the risk of erosion, improper slope grading
Positive factors	-Runoff management -Slope geometries - relatively flat, etc.
Design Phase Risk Mitigations and Controls	-Long term cover / erosion protection
Construction / Operations Phase Mitigations and Controls	-Effective runoff water management (OMS)
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Controls to be established, SOPs, etc. Considered to be a maintainable PFM, through dedicated monitoring and control implementation.
Likelihood W/O Controls Category (drop down list)	C - Possible
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	Without controls Category C, with controls Category E2, erosional events have occurred historically based on records and observations on site (once or twice per year), but a failure is deemed to be an event of greater magnitude (e.g. propagation of erosion that results tailings discharge)
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 1, Financial: 1, Env: 1-2 (risk associated with concentration of zinc and cadmium in tailings, lower if monitoring control is in place), LTO: 1, Community: 1
Notes	Controls: Rapid response to erosional events, preventing propagation of erosional features, appropriately sized ditches, cleaning ditches, proper tailings placement management, concurrent reclamation, and grading the tailings surface to prevent uncontrolled drainage down steep slopes

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-010
Failure Mode	Large differential settlement or deformation due to permafrost thaw, leading to surface tailings exposure and/or breach of seepage collection system
Failure Initiator (Trigger)	1. Thawing of ice rich permafrost or pockets of higher ground ice contents than those observed during geotechnical evaluations 2. Thaw consolidation/ settlement of foundation soils
Failure Mechanism (Process)	1. Differential settlement causing excess strains on seepage collection system 2. Release of tailings and/or seepage water from containment
Facts and Conditions	- Thaw consolidation estimates indicate up to approximately 1.1 m of differential movement due to thaw settlement (based on moisture content and Andersland/Ladanyi empirical methods). - Strain on GCL is estimated, all well below 5%, literature indicates failure strain >10% (Koerner) - Localized ice-rich ground under P2 DSTF, predominantly in NW corner of the facility - Moisture contents observed during drilling indicate ice-poor material underlies most of the DSTF footprint
Adverse factors	-Heterogeneous ground conditions, localized ice-rich zones
Positive factors	- Strain capabilities of GCL - Self healing properties of GCL - No massive ice encountered during geotechnical evaluations - Large portion of footprint ice-poor, thaw stable, or non-permafrost
Design Phase Risk Mitigations and Controls	- Estimated <5% strain induced in GCL by differential thaw settlement - Ground temperature cables (GTC) will provide indication of changing conditions below facility - Evaluating option to remove ice-rich material under critical elements
Construction / Operations Phase Mitigations and Controls	- QAQC during placement of drainage blanket material - Evaluate option to remove ice rich material under critical facility components - Monitoring of liner deployment, minimum overlaps, QAQC - Instrumentation (GTC) data collection/ review - Maintain organic mat to slow permafrost degradation
PFM Category (drop down list)	Category I
PFM Category Considerations & Confidence	GCL is primary barrier, therefore Category 1 selection deemed appropriate
Likelihood W/O Controls Category (drop down list)	E1 - Rare
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	- Controls include QAQC during drainage blanket construction, liner installation QAQC, adequate overlapping, etc. - Limited zones of ice-rich material present in footprint; unlikely to see widespread thaw deformation
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	H&S: 1, Financial: 3 (removal and relocation), Env: 2 (variable based on whether or not water quality monitoring is in place), LTO: 1, Community: 1
Notes	N/A

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-011
Failure Mode	Geochemical compatibility of tailings and seepage collection system
Failure Initiator (Trigger)	1. Incompatibility of seepage collection system materials (GCL) with tailings. 2. Tailings material or leachate from tailings with high calcium concentrations (or high ionic strength solutions) can cause degradation of the GCL through ion exchange with the sodium in the bentonite, increasing the permeability of the GCL. Significant exchange reactions can result in an increase in the permeability of (decrease in the level of protection from) the GCL.
Failure Mechanism (Process)	1. Infiltration contact with GCL 2. Degradation of GCL causing increased permeability
Facts and Conditions	- Visual observations from existing DSTF have not shown indications of significant seepage or water quality issues associated with operation. - While lime is used in ore processing, there are limited carbonates naturally in the geologic units. - Paste pH values from ABA and SFE testing are circumneutral, though recent tailings samples characterized as PAG. - From SFE testing, cadmium and zinc present greatest metal leaching risk. Comments: - Basic ion exchange in GCL (sodium for calcium) alters the permeability of the GCL, impacting the strength of the bonds. - The current main concern is limiting the calcium that will be released in the GCL to preserve its integrity. - Confinement material can provide physical separation and protection of GCL, would require additional testing to fully evaluate its potential. - 50% of the ore rock type is siderite; limestones and dolostones are the primary sources of geochemical concerns and special consideration is required. - Having a clear monitoring program in place is essential to reduce risk of failure which would have a significant impact on Hecla's reputation. - Amy notes that based on absence of seepage observed in the P1 facility, geochemical risk is relatively low, despite noted cadmium and zinc concentrations and PAG classification, no chemical bonding/cementation/physical impacts are expected
Adverse factors	Insufficient monitoring of geochemical conditions in the DSTF, excess lime being added to tailings prior to placement (not currently in process).
Positive factors	- Confining material / drainage blanket material above liner provides physical separation between tailings and GCL - No seepage observed in existing DSTF
Design Phase Risk Mitigations and Controls	- Construction of drainage blanket over GCL - Grade DSTF at closure to direct runoff to collection ditches
Construction / Operations Phase Mitigations and Controls	- Limit addition of calcium to tailings / proper change management when evaluating changes to mill reagents - Maintain positive drainage during construction to prevent ponding and direct runoff to collection ditches
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Geochemical concerns are hard to categorize; if these controls are implemented, these issues can be effectively managed. Improper monitoring can be an extreme liability issue, so future conversations must address the development of a robust system for effectively monitoring geochemical conditions.
Likelihood W/O Controls Category (drop down list)	C - Possible
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	With controls E2, without controls Category C
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	H&S: 1, Financial: 3 (removal and relocation), Env: 2 (variable based on whether or not water quality monitoring is in place), LTO: 1, Community: 1
Notes	- Removal of the GCL from the liner design (switching to something simpler such as geomembrane) would eliminate the issue, but is not very practical due to the materials already being available on site, P1, etc. - Sampling of GCL at P1 exposed to the leachate could be used to evaluate the alteration of permeability in the liner. - Recommended additional controls - explore options to evaluate current condition and performance of P1 GCL if work is completed that exposes liner.

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-012
Failure Mode	Compromised physical performance of seepage collection system (puncture, lack of overlap, etc.)
Failure Initiator (Trigger)	1. Liner construction practices (punctures, lack of cover for equipment, lack of overlap at joints) 2. Damage to liner during ditch maintenance.
Failure Mechanism (Process)	1. Potential release of tailings or seepage
Facts and Conditions	-GCL is preferred based on "self-healing" properties (Koerner, others) -Construction/installation controls to ensure overlapping is adequate -Alluvial, rounded gravel will be used in drainage blanket and confining material Comments: - Removal/repair of puncture locations is essential during construction to reduce the risk of this PFM, and requires careful construction monitoring. - Cleaning ditches needs to be done with caution in order to prevent damage to the liner, requires having a spotter and appropriate SOP. - GCL needs to be covered rapidly following placement to prevent degradation and minimize damage potential
Adverse factors	- Fabric on the GCL tends to degrade under UV (placement must be followed by rapid covering of material), protection from equipment damage (puncture) and contamination must be a priority, sediment cleaning involves careful construction and maintenance of surface water and erosion controls
Positive factors	- Construction deployment by contractor, not operations staff - QAQC during deployment (inspection and approval of drainage blanket as bedding, overlaps, bentonite - "Self-healing" properties of GCL
Design Phase Risk Mitigations and Controls	- Inclusion of a layer of NW geotextile below GCL - Self healing capabilities of GCL
Construction / Operations Phase Mitigations and Controls	- Proper storage and handling of liner materials - QAQC of drainage blanket construction and liner installation - During construction ensuring subgrade is prepared (stumps, vegetation removed), 600 mm of drainage blanket placed, track-packed and smooth rolled. SOP for post-construction maintenance
PFM Category (drop down list)	Category I
PFM Category Considerations & Confidence	GCL is primary barrier. This PFM is assumed more likely of occurring without proper attention and controls, magnitude of the consequence might be lower due to nature of failure.
Likelihood W/O Controls Category (drop down list)	B - Likely
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	Without controls (Category B), with controls (Category E2), considerations including Tt being on site full time for construction (QAQC), lowering likelihood of liner preparation construction and installation.
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 1, Financial: 1 (ditch) / 2 (liner), Env: 1 (ditch) / 2 (liner), LTO: 1, Community: 1
Notes	N/A

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-013
Failure Mode	Large precipitation event erodes through surface cover, exposes tailings resulting in transport of tailings/sediments into natural environment
Failure Initiator (Trigger)	1. Large precipitation event or spring freshet melt 2. Poorly graded and /or constructed surfaces and slopes of cover 3. Poorly graded and/or constructed surfaces of dry stack 4. Poor water management, or loss of function of water management
Failure Mechanism (Process)	1. Erosion of cover material 2. Erosion of dry stack 3. Tailings/sediment overtopping perimeter conveyance system (ditches) or 4. Tailings/sediment/contact water discharging into and overtopping water treatment pond due to insufficient water treatment capacity/retention time
Facts and Conditions	- Cover design currently consists of 0.5 m of evapotranspirative granular cover material. - Vegetation growth within this medium will contribute to resisting erosion - Analog to this can be seen in P1, where the full cover has been installed, minimal if any erosion has been noted, where cover not meeting design criteria, or no cover at all has been installed, erosion of tailings has been noted in localized areas
Adverse factors	Cover likely not placed immediately in all areas due to future P2W expansion, proper runoff control will be critical.
Positive factors	Perimeter ditching should capture and collect eroded materials. Maintenance/cleaning will be required, incorporated into OMS. Proper tailings compaction will reduce erosion potential.
Design Phase Risk Mitigations and Controls	Perimeter ditching in design.
Construction / Operations Phase Mitigations and Controls	- QAQC during ditching and diversion construction - QA/QC during tailings and cover placement - Monitoring and maintenance per OMS (i.e., maintain ditches, should be no release to environment)
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Expected to be a credible PFM, however not identified as a highlighted PFM.
Likelihood W/O Controls Category (drop down list)	C - Possible
Likelihood W/ Controls Category (drop down list)	E1 - Rare
Likelihood Considerations & Confidence	With controls in place (QAQC during construction, tailings placement, and regular maintenance during operations such as cleaning ditches as necessary) unlikely to see release into environment.
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 1, Financial: 2, Env: 2 (as per Hecla specifications), LTO: 2, Community: 2
Notes	**Recommended additional controls: further evaluate expected performance of current cover design relative to Hecla expectations, and update as necessary.**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-014
Failure Mode	Overtopping or failure of Mill Water Pond, Water Treatment Pond, and/or DSTF Sump resulting in transport of tailings/sediments into natural environment
Failure Initiator (Trigger)	1. Large precipitation event or freshet melt 2. Operations failure (pump, maintenance, etc.) 3. Insufficient freshet storage reserved before freshet season (from Mill Water Pond) 4. Insufficient treatment capacity (from Water Treatment Pond)
Failure Mechanism (Process)	1. DSTF P2 sump overtops 2. Mill water pond overtops 3. Water treatment pond overtops 4. Release of containment water
Facts and Conditions	- Mill Water Pond had limited freeboard, -as observed in 2023 July drone photos and July 2024 site inspection. - It is believed that the Mill Pond was originally sized to accommodate a 1:200 year, 10-day freshet, expected to be undersized for current design criteria. - P2E sump sized to accommodate P2E design volume in this event, i.e., so flow to Mill Pond can be managed effectively. - Sludge buildup in Mill Pond which reduces its capacity
Adverse factors	- Sediment/sludge build up in Mill pond, sumps, etc. - Mill Pond likely undersized
Positive factors	- P2E designed for full event
Design Phase Risk Mitigations and Controls	- Sump sized for 1:500 year event
Construction / Operations Phase Mitigations and Controls	- Maintenance of ponds / removal of sludge etc. as required - Proper operation of mill infrastructure to minimize sediment to Mill Pond
PFM Category (drop down list)	Category I
PFM Category Considerations & Confidence	Evaluation of Mill water pond capacity / design is required, designated Category 1 to highlight.
Likelihood W/O Controls Category (drop down list)	B - Likely
Likelihood W/ Controls Category (drop down list)	C - Possible
Likelihood Considerations & Confidence	- Additional work required to confirm likelihoods with and without controls. Categorized as possible in interim. - Mill pond has overtopped within the last 10 years - Overtopping generally tied to large design events; likelihood set to reflect this
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 1, Financial: 2, Env: 2 (as per Hecla specifications), LTO: 2, Community: 2
Notes	**Recommended additional controls: complete a site wide water balance to confirm pond capacity and address unknowns. If additional capacity is required, review options and implement solution.** **Minimize sludge/sediment volume in pond to increase fluid storage capacity.**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-015
Failure Mode	Overtopping of water diversions and conveyance system
Failure Initiator (Trigger)	1. Flood event 2. Failure of diversion berm 3. Inadequate maintenance of drainage/drain pipes (sediment build-up) 3.1 Snowpack/ice blocking the ditches/pipes 3.2 Tree branches blocking the ditches/pipes 3.3 Wildlife damaging the ditches/pipes
Failure Mechanism (Process)	1. Large storm event 2. Change in flow paths 3. Internal ditch capacity exceeded 4. Loss of containment
Facts and Conditions	-Ditches sized to accommodate 1:500 year peak instantaneous flow -OMS/inspection and maintenance to be completed
Adverse factors	- Winter icing / spring freshet flows - Possible differential movement due to thawing permafrost
Positive factors	-OMS, i.e., inspections, maintenance as necessary
Design Phase Risk Mitigations and Controls	- Ditches sized to accommodate 1:500 year peak instantaneous flow - Heat tracing of critical elements
Construction / Operations Phase Mitigations and Controls	- Construction QAQC of liner, ditches, and diversions - Monitoring / visual inspections per OMS - Maintenance as required - to remove blockages, branches etc. - Ability to steam during late winter/early spring if necessary
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Lesser significance and likelihood.
Likelihood W/O Controls Category (drop down list)	C - Possible
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	- OMS implementation - 1 in 500 year event - Very Rare
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 1, Financial: 1, Env: 2 (as per Hecla specifications), LTO: 1, Community: 1
Notes	N/A

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-016
Failure Mode	Poor cover performance leads to increased infiltration and increased water transport through dry stack.
Failure Initiator (Trigger)	1. Poorly graded and /or constructed surfaces and slopes of cover 2. Poorly graded and/or constructed surfaces of dry stack 3. Poor water management, or loss of function of water management
Failure Mechanism (Process)	1. Saturation of placed dry stack tailings 2. Infiltration through dry stack material 3. May contribute to other failure modes
Facts and Conditions	- Moisture contents on tailings samples collected within the lower bench of P1 range from 11 to 17% (note a ponded area existed above this location for several seasons during freshet). - No indication of significant transport of water through DSTF - Compaction and proper runoff tailings and tailings surfaces is critical to minimize infiltration
Adverse factors	-Winter placement and compaction challenges
Positive factors	- Samples collected in tailings of lower bench, where a ponded area had existed for several years did not indicate elevated moisture contents range from 11 to 17%
Design Phase Risk Mitigations and Controls	Design assumes compaction of placed tailings, reducing infiltration potential.
Construction / Operations Phase Mitigations and Controls	- Quality Assurance (QA) during tailings placement - Actively cover areas built out to final design as soon as possible
PFM Category (drop down list)	Category IV
PFM Category Considerations & Confidence	Increased infiltration in itself does not constitute a failure of the DSTF; however, it may contribute to other failure modes already discussed
Likelihood W/O Controls Category (drop down list)	
Likelihood W/ Controls Category (drop down list)	
Likelihood Considerations & Confidence	NA
Consequence Category (drop down list)	
Consequence Considerations & Confidence	NA
Notes	N/A

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-017
Failure Mode	Release of dust from facility impacting off-site air quality, soils, or water
Failure Initiator (Trigger)	1. Higher than expected wind and/or finer than expected desiccated tailings 2. Delay in constructing cover 3. Dust and tailings on the roadway
Failure Mechanism (Process)	1. Winds kick up dust off facility 2. Health concern for surrounding communities and mine employees. 3. Negative effect of health of fauna and flora in the surrounding area.
Facts and Conditions	Comments: - Dust and tailings tracking happens under current procedures. - Transportation of material in haul trucks is a primary factor, as the haul distance is ~500m (relatively short) so trucks aren't covered. - Low moisture content during compaction can have a significant contribution to dust generation. - An alternative transportation method could be the implementation of covered conveyors, but that becomes a financial issue. - Controls such as a clean/dirty management plans and minimizing tailings stockpile time prior to placement can help reduce the risk of this PFM. - Hecla has engaged in public education with local community to address dust concerns.
Adverse factors	- Poor moisture content during compaction, insufficient compaction monitoring, haul truck transportation of tailings without dedicated clean/dirty management plan.
Positive factors	- Tailings generally leaving mill at or just above optimum moisture content (OMC), helps reduce dust generation if compacted immediately
Design Phase Risk Mitigations and Controls	Design assumes compaction of tailings is completed as soon as reasonably possible.
Construction / Operations Phase Mitigations and Controls	- Compact tailings immediately after placed - Implementing clean access work area plan - Monitoring dust/air quality at designated stations
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Dust maintenance is a primary concern of their group, operations have engaged in public education with local community regarding dust concerns that have risen during P1
Likelihood W/O Controls Category (drop down list)	A - Almost Certain
Likelihood W/ Controls Category (drop down list)	B - Likely
Likelihood Considerations & Confidence	Without controls (Category A), with controls (Category B), dust generation is triggered largely by transportation of tailings, and low MC during compaction, without controls in place generation is almost certain to occur.
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 1, Financial: 1, Env: 2 (as per Hecla specifications), LTO: 1, Community: 1
Notes	Controls: Monitoring of compaction conditions of the tailings (moisture content - lower than optimum can contribute to dust generation), clean/dirty management plan (separating tails haulage from traffic leaving the site, e.g. wheel washing, isolation of clean dump areas), minimizing the time that stockpile sits on the facility prior to placement, use a power broom if dust is wet (mud) - requires mud sumps, concurrent cover placement, discussed possible use of covered conveyors **Additional recommended controls - clean/dirty management plan, truck wheel wash, Tt understands these plans are in progress by Hecla**

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-018
Failure Mode	Operational safety due to poor construction (e.g. vehicle roll over). This impacts AKHM's reputation and could possibly delay material placement for investigations or clean up
Failure Initiator (Trigger)	1. Poorly compacted embankments or shoulders 2. Travelling near slopes 3. Saturated surface conditions
Failure Mechanism (Process)	1. Equipment rolls off soft embankment 2. Equipment becomes stuck in saturated tailings 3. Equipment / Personnel interactions
Facts and Conditions	Comments: - Improperly compacted tailings can produce soft or yielding zones. This is of particular concern on trafficable areas near crest and edges - Most construction will involve vehicles and equipment; some potential interactions between survey and equipment
Adverse factors	- Variable weather can create saturated zones during placement - Some people on foot may need to work around equipment
Positive factors	- Operational controls manage people/vehicle interactions - QA/QC procedures for placing material
Design Phase Risk Mitigations and Controls	Bumpers, turning radii etc., as outlined in Design Basis
Construction / Operations Phase Mitigations and Controls	QAQC during construction. Proper compaction, no loose material (i.e., on shoulders, etc.)
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Not necessarily a facility failure mode, however a critical consideration for human health and safety.
Likelihood W/O Controls Category (drop down list)	C - Possible
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	Proper material placement significantly reduces the potential for soft and yielding zones. Existing protocols and procedures protect ground staff
Consequence Category (drop down list)	3 - Serious
Consequence Considerations & Confidence	H&S: 2, Financial: 1, Env: 1, LTO: 3, Community: 1
Notes	N/A

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-019
Failure Mode	Placement/release of tailings outside of the containment area
Failure Initiator (Trigger)	1. Poor communication with staff leads to dumping in incorrect location. 2. Incident during transport (i.e., roll over, etc.) 3. Edges of facility are poorly delineated
Failure Mechanism (Process)	1. Tailings intentionally or unintentionally placed outside of containment.
Facts and Conditions	- Should be addressed with proper training of site staff, signage, and management of safety hazards.
Adverse factors	NA
Positive factors	NA
Design Phase Risk Mitigations and Controls	N/A
Construction / Operations Phase Mitigations and Controls	- Training site staff on operations - Signage
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Not considered a highlighted failure mode, however would involve tailings placed outside of containment.
Likelihood W/O Controls Category (drop down list)	D - Unlikely
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	Without training considered possible.
Consequence Category (drop down list)	1 - Minor
Consequence Considerations & Confidence	H&S: 1, Financial: 1, Env: 1, LTO: 1, Community: 1
Notes	Assumption is occurrence could be limited (i.e., single truck load) and could be cleaned up as required with minimal effort.

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-020
Failure Mode	Public access to site, including vandalism, sabotage, leading to unsafe site conditions
Failure Initiator (Trigger)	1. Public protests suspend tailings placement 2. Vandalism or damage to equipment
Failure Mechanism (Process)	1. Public actions slow or halt tailings placement
Facts and Conditions	- Keno Hill Mine is near the townsite of Keno Hills - Pubic can access site via road - Road is not monitored by security and there are no guardhouses
Adverse factors	N/A
Positive factors	- 24 hour operations may deter people - Daily equipment checks for damage or tampering
Design Phase Risk Mitigations and Controls	N/A
Construction / Operations Phase Mitigations and Controls	Signage, security
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Operational potential failure mode, or may lead to unsafe conditions requiring addressing.
Likelihood W/O Controls Category (drop down list)	E1 - Rare
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	Signage, fencing, security etc.
Consequence Category (drop down list)	1 - Minor
Consequence Considerations & Confidence	H&S: 1, Financial: 1, Env: 1, LTO: 1, Community: 1
Notes	N/A

Table 4 - Detailed FMEA Ledger	
Facility	DSTF Phase 2
Unique PFM ID	PFM-021
Failure Mode	Extreme climate conditions (e.g. fire, rainfall, pandemic) that trigger failure or lapse in operations/ maintenance and water treatment activities.
Failure Initiator (Trigger)	Extreme event (e.g. fire, rainfall, pandemic) triggers failure or lapse in operations/ maintenance, water treatment activities.
Failure Mechanism (Process)	Lack of personnel, or equipment, etc., on site. Operations is paused, i.e., water treatment discontinued, maintenance staff unable to maintain ditches, runoff, contact water, etc.
Facts and Conditions	It is anticipated a site presence, as well as DSTF OMS activities are maintained at all times, outside of force majeure / extreme events.
Adverse factors	- Active wildfire seasons in recent years - Pandemic within last 3 years
Positive factors	- Proximity to highways and evacuation routes
Design Phase Risk Mitigations and Controls	NA
Construction / Operations Phase Mitigations and Controls	-Maintain drainage and compaction tailings to allow for temporary evacuation if required
PFM Category (drop down list)	Category II
PFM Category Considerations & Confidence	Operational potential failure mode, or may lead to unsafe conditions requiring addressing.
Likelihood W/O Controls Category (drop down list)	E2 - Very Rare
Likelihood W/ Controls Category (drop down list)	E2 - Very Rare
Likelihood Considerations & Confidence	N/A
Consequence Category (drop down list)	2 - Medium
Consequence Considerations & Confidence	H&S: 1, Financial: 1, Env: 1, LTO: 1, Community: 1
Notes	N/A

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

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If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this document, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to explore, address or consider and has not explored, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historical environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional exploration and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques, and construction sequence are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function. Where temporary or permanent drainage systems are installed within or around a structure, these systems must protect the structure from loss of ground due to mechanisms such as internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design details regarding the geotechnical aspects of such systems (e.g. bedding material, surrounding soil, soil cover, geotextile type) should be reviewed by the geotechnical engineer to confirm the performance of the system is consistent with the conditions used in the geotechnical design.

1.16 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

1.18 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.