Hecla Yukon
#3, Calcite Business Centre – 151 Industrial Rd.
Whitehorse, YT Y1A2V3
PH: 867-995-3113

27 November 2023

Via Electronic Mail: (Harvey.McIntyre@yukon.ca; ywb@yukonwaterboard.ca)
Via Certified Mail

Mr. Harvey McIntyre, Mining Technologist
Energy, Mines, and Resources; Mineral Resources
Government of Yukon
Box 2703
Whitehorse, Yukon Y1A 2C6
Telephone: 867-332-3848

Piers McDonald, Chairperson
Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, YT Y1A 3V1
Telephone: 867-456-3980

RE: Updated Alexco Keno Hill Reclamation and Closure Plan

Dear Mr. McIntyre:

Alexco Keno Hill Mine (AKHM) owns and operates a series of small underground silver/lead/zinc mines with a centralized mill. On September 7, 2022, Alexco Resource Corp. (doing business as Hecla Yukon), the parent company of AKHM, was acquired by Hecla Mining Company. AKHM respectfully submits the attached update to its Keno Hill Mine Operations Reclamation and Closure Plan. Please note that the updated reclamation cost estimate is being submitted under separate cover.

If you have any questions or require additional information regarding this correspondence, please contact me at 867-995-3113 or keppers@hecla.com.

Sincerely,

Kevin Eppers

Kevin Eppers, Environmental Manager
Alexco Keno Hill Mine (dba Hecla Mining)

ec: D. Stiles, Hecla Mining Company
S. Tolgyesi, W.Zigarlick, Hecla Keno Hill

KENO HILL SILVER DISTRICT MINING OPERATIONS

RECLAMATION AND CLOSURE PLAN

Revision 8

November 2023

Prepared by:

Hecla Yukon and Ensero Solutions

Prepared for:

Alexco Keno Hill Mining Corp.

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 QZ09-092
January 2011	Reclamation and Closure Plan, 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 includes the most recent envisioned 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. Revision 6 issued pursuant to paragraph 7.2 of QML-0009 (November 27, 2019) which requires an updated RCP every two years and to address review comments on the Revision 5.1 plan to fulfill QML-0009, Schedule C Section 4.1 requirements
October 2022	Reclamation and Closure Plan, Keno District Mine Operations Keno Hill Silver District, Revision 7 Revision 7 addresses review comments on the Revision 6 submission
November 2023	Revisions made in this version are provided in the Document Revision table Revision 8 issued pursuant to paragraph 7.2 of QML-0009 (November 27, 2019) which requires an updated RCP every two years, and to fulfill QML-0009 Schedule C (May 4, 2023) Section 4.1 requirements

Document Revisions

SECTION	SUMMARY OF CHANGES
Entire Document	Updated to reflect new ownership of company and revised reporting structure, Bermingham Mine renamed New Bermingham Mine. INAC renamed CIRNAC. Area held by ERDC and AKHM jointly referred to as the Keno Hill mining camp. Onek mine managed by ERDC is referred to either as historic Onek or Onek 400. The Onek mine managed by AKHM is referred to as Onek 990
Version History	Table added that lists the previous revisions of the plan. A brief description of the changes made provided
Document Revisions	Table added to indicate areas where changes have been made to the previous revision of the Plan
Concordance Tables	Concordance with WL and QML reclamation and closure plan requirements relocated to front of document Was Section 1.3 in Revision 7
Section 1.1	Overview of the Undertaking created
Section 1.2	Was Section 1.1 in Revision 7 Solid waste management facilities added as a mine component Statement about report outline and best management practices found in Revision 7 moved to Section 2.1
Section 1.3	Was Section 1.2 in Revision 7 Paragraph about which deposits are authorized for mining removed as it is stated in the table in this section Table 1-2 exploration and ERDC approvals removed to reduce confusion; this is an AKHM RCP
Section 3.3.2	Updated to reflect 2023 EMR approved AMP
Table 3-5	Removed Onek 990 reclamation units that are not scheduled to be constructed
Section 4.1	Revised to reflect current position of District Mill meteorological station
Section 4.5	Subheadings renamed Regional moose density and hunting restrictions updated; information on caribou added Information on trapping and outfitting concessions moved to Section 4.7 Table 4-13 updated to reflect local wildlife survey results and current conservation status
Section 5.11	Updated to reflect current status of kinetic testing
Error! Reference source not found.	Objectives updated to reflect WQOs presented in 2023 EMR approved AMP
Section 8.3.1	Discussion of Onek and Lucky Queen tailings removed Updated to reflect current status of kinetic testing
Section 8.5.4.2	Additional closure details added
Section 8.5.1	Objectives updated to reflect WQOs presented in 2023 EMR approved AMP
Section 8.5.2	Updated to reflect change in status of Bellekeno 625 water treatment
Section 8.5.5	Updated to reflect current status
	MCC merged
Section 8.9	Section revised to reflect 2023 Waste Management Plan and recent changes to waste management infrastructure
Section 8.9	Added objective from District Wide RCP of enable pre-mining human and wildlife utilization of linear infrastructure
Section 8.9.1	Additional details added to reflect 2023 Road Development and Operations Plan Road names updated to conform with nomenclature used in 2023 Road Development and Operations Plan
Section 8.12.4	Updated to reflect status of district wide research

SECTION	SUMMARY OF CHANGES
Section 8.13	Revised to reflect framework of 2023 MSR Plan (MDMER requirements added) Table 7-4 Keno Hill Mine Operations Reclamation and Closure Plan Surveillance Network Monitoring Schedule split into two (surface water and groundwater) Reference to Table 5-8 corrected (was Table 7-4)
Section 8.14.3	Revised to reflect framework of 2023 EMR approved AMP
Section 9	Nomenclature of sites standardized
Section 9.1	Revised to reflect change in status of Bellekeno 625 water treatment
Section 10	Updated
Section 11	Reference list updated

WATER LICENCE QZ18-044 CONCORDANCE TABLE

CLAUSE	CONDITION	ADDRESSED IN SECTION
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);	Sections 5.4 and 8.1
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;	Section 8
134I	Updates on all DSTF engineered cover designs and modelling of expected cover performance, incorporating the results of ongoing research and data collection (geochemical characterization);	Appendix 1.1
134(d)	Results of reclamation research activities and a description of any revisions to the research program with rationale for those revisions;	Section 2.4
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 2.4
134(f)	Updated and detailed closure cost estimates for all existing and proposed work, including, but not limited to, the following: • all changes required by this license; • a Microsoft Excel security costing workbook, with all supporting spreadsheets including and describing all formulas and assumptions; • 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: • location of material; and • tonnages and volumes; • a detailed cost estimate to haul and place P-AML waste rock and ore permanently underground, which includes the following details: • equipment types and quantities; • productivity assumptions for the haulage equipment; • haulage distances to permanent disposal sites and the anticipated long- term groundwater characteristics of each site (saturated or dry); • a detailed cost estimate for this activity including all equipment rental and operating costs and general mine expenses including adequate supervision; and • a demonstration of compliance with YWCB safety requirements for work inside any underground mine	Section 10
134(g)	Descriptions, preliminary designs, and installation methodology for all mine closure facilities, including: • all mine bulkheads and ventilation raise caps; and • the mine pool injection system;	Appendix 3.1

CLAUSE	CONDITION	ADDRESSED IN SECTION
134(h)	A detailed description of water management and treatment activities planned for the post- closure years, including: • the location of permanent mine effluents and any plans for collection, transportation, and/or treatment; • the installation, maintenance, or operation of any water collection or transfer systems, such as ditches, collection ponds, pumping systems, or truck haulage; • the operation and maintenance of any active or inactive water treatment facilities; • the operation and maintenance of the mine pool injection system; and • the installation of any new water treatment facilities such as bio-reactors;	Section 7.4 Appendix 3.1, 3.7, 3.8
134(i)	A detailed summary of findings or description of all planned additional kinetic testing including: • saturated columns for backfill material at each mine; and • humidity cell(s) and saturated column(s) for tailings;	Appendix 3.3 and Section 5.9
134(j)	A detailed summary of findings or detailed description of seasonal water quality objectives including: • the development of site specific WQO for arsenic; • details on how water quality objectives will be developed for KV-111 (upstream of KV-21 on No Cash Creek); and • an update on seepage chemistry predictions or investigations.	Section 5.9

Quartz Mining Licence QML-0009, May 4, 2023 - Schedule C Concordance Table

ITEM	DESCRIPTION	ADDRESSED IN SECTION
4.1 (a)	Provide measurable closure completion criteria for all units, including:	Section 3.3
	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	Sections 2.3 and 3.2
4.1 (b)	Provide description on how the revegetation approach connects to end land use objectives, including:	Section 3.2
	i. results for cover and revegetation trial plots to support design approach; and	Section 8.12.4
	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.	Sections 4.4.2.2 and 8.12.4
4.1 (c)	Provide information on how arsenic concentrations at Bermingham will be controlled/managed by mine pool treatment, specifically addressing the following questions:	
	i. arsenic concentrations increased at Silver King after mine pool treatment, how will concentrations be controlled or decreased at Bermingham; and	Appendix 1.3; Section 8.5.5
	ii. what is the expected residence time in the underground pool at Bermingham and how does this compare to the residence time at Silver King.	Section 8.5.5
4.1 (d)	Provide updated data on the performances of the Silver King in-situ treatment, including: including:	Appendix 1.3
	i. results for performance data up to 2022;	Section 8.5.2
	ii. clarification that the mine pool treatment is not fully passive and what types of long-term management will be required;	Sections 8.5.2 and 8.5.5
	iii. details regarding how often carbon addition would be required, what would trigger carbon addition need to be addressed - should carbon addition be required on a regular basis, how will the degree of mixing between carbon and water be measured;	Appendix 3.6; Sections 8.5.2 and 8.5.5
	iv. a discussion on how the updated data potentially impacts the design and planning of in situ treatment for Bellekeno and Bermingham; and	Sections 8.5.2 and 8.5.5
	v. a water quality comparison between the Bellekeno and Bermingham sites and the water quality at Silver King.	Sections 8.5.2 and 8.5.5
4.1 (e)	Provide updated predictions on mine flows with depth at both Flame and Moth and Bermingham, including:	
	i. updated water treatment plans (mine pool treatment, mill pond bioreactor) and closure strategies based on updated predictions;	Sections 8.5.4 and 8.5.5
	ii. details on the use of the mill pond as a bioreactor; and	Section 8.5.4.2
	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.	Appendix 3.6; Sections 8.5.2 and 8.5.5
	iv. a discussion on how the updated data potentially impacts the design and planning of in situ treatment for Bellekeno and Bermingham; and	Sections 8.5.2 and 8.5.5
	v. a water quality comparison between the Bellekeno and Bermingham sites and the water quality at Silver King.	Sections 8.5.2 and 8.5.5
4.1 (f)	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 3.3 Sections 5.11, 8.3.1

ITEM	DESCRIPTION	ADDRESSED IN SECTION
4.1 (g)	Provide updated geotechnical stability analyses for the DSTF, including:	Section 5.7
	i. information regarding the efficacy of a 3H:1V slope at closure	
	i. inclusion of the DSTF Phase 1 design as either an appendices, or briefly described in a dedicated sub-section to demonstrate:	Section 5.7
	a. what slope stability criteria has been used for static and pseudo-static conditions, and which guidelines were followed; and	Section 5.7
	b. general tailings and foundation characteristics and shear strength parameters, and the results of slope stability analyses showing overall slope stability, and stability Factor of Safety values for different conditions, including a failure mode occurring at the interface of the tailings and drainage system; and	Section 5.7
	ii. review of the 2012 FMEA to ensure seismic criteria meets current guidelines (e.g. Mining Dams guidelines 2014 and 2019 by the CDA).	Section 5.7
4.1 (h)	Provide completed monitoring and analyses on the DSTF cover performance (inclusive of 2022 data), including:	Section 8.3
	i. purpose/primary objective(s) of the cover;	Section 8.3
	ii. detailed description of the monitoring plan for closure;	Section 8.13
	iii. results of all engineering evaluations of the cover; and	Section 8.3.1
	iv. an estimate of the reduction in precipitation infiltration from the area of the DSTF that was covered based on performance data to-date.	Section 8.3.1
4.1 (i)	Provide summary of Bellekeno closure activities, including:	Sections 6.3 and 8.2.2
	i. details on the type of materials used for backfill and procedures used to backfill stopes;	
	ii. location of P-AML material underground;	
	iii. location of crown pillars and any stability assessment results;	Section 5.4.1.3
	iv. results of hydrogeological study during mine operations;	Section 8.5.2
	v. results and summary of all targeted campaigns of water sampling and reagent additions following the cessation of mining; and	Section 8.5.2
	vi. description of the planned sequencing for constructing, commissioning, and transitioning water treatment systems and contingencies.	Section 8.5.2
4.1 (j)	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:	Sections 6.3 and 8.2.2 Appendix 3.3
	i. geochemistry of any rock fill material	
	i. volume of overburden removal required;	
	ii. location of coffer dam in engineered drawings; and	
	iii. supporting appendices reflect the chosen closure concept; and	
	iv. signed and sealed engineered drawings.	

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF APPENDICES

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
EQS	Effluent Quality Standard
ERDC	Elsa Reclamation and Development Company
ERM	Energy, Mines and Resources
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
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
PFU	Polyurethane Foam
QA	Quality Assurance
QML	Quartz Mining Licence
QC	Quality Control
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) owns and operates of a series of underground silver/lead/zinc mines with a centralized mill, the KHSD Mining Operations as described in Table 1-1. On September 7, 2022, Alexco Resource Corp. (doing business as Hecla Yukon), the parent company of AKHM, was acquired by Hecla Mining Company.

The KHSD Mining Operations is 354 km north of Whitehorse, in the vicinity of 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.

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 (Constructed 2010) 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, and welcoming center Four refurbished houses and a bunkhouse located nearby in the townsite of Elsa
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 plant
FIRST NATIONS	First Nation of Na-Cho Nyak Dun (FNNND)

1.2 THIS DOCUMENT

The KHSD Mining Operations Reclamation and Closure Plan (RCP) Revision 8 represents an update to RCP Revision 7, as required under Quartz Mining Licence QML-0009. The RCP was most recently reviewed by the Yukon Water Board in 2021 resulting in the approval of RCP Revision 6 under Water Licence QZ18-044.

The KHSD Mining Operations Reclamation and Closure Plan addresses the following mine area 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) 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 I-II;
- Bellekeno, 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 stock piles;
- 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.

1.3 PERMITS AND AUTHORIZATIONS

The Keno Hill mining camp has a long mining history and is a brownfields site. AKHM develops the mineral resources, operates the KHSD mines and undertakes receiving environmental monitoring and treatment of mine discharge waters. Hecla Yukon's wholly owned subsidiary Elsa Reclamation and Development Company Ltd. (ERDC) undertakes care and maintenance, environmental monitoring and water treatment of historic adit drainages, district-wide closure planning, studies, and 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 1-2. Additional minor approvals will be required to implement permanent closure measures.

Table 1-2: 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]

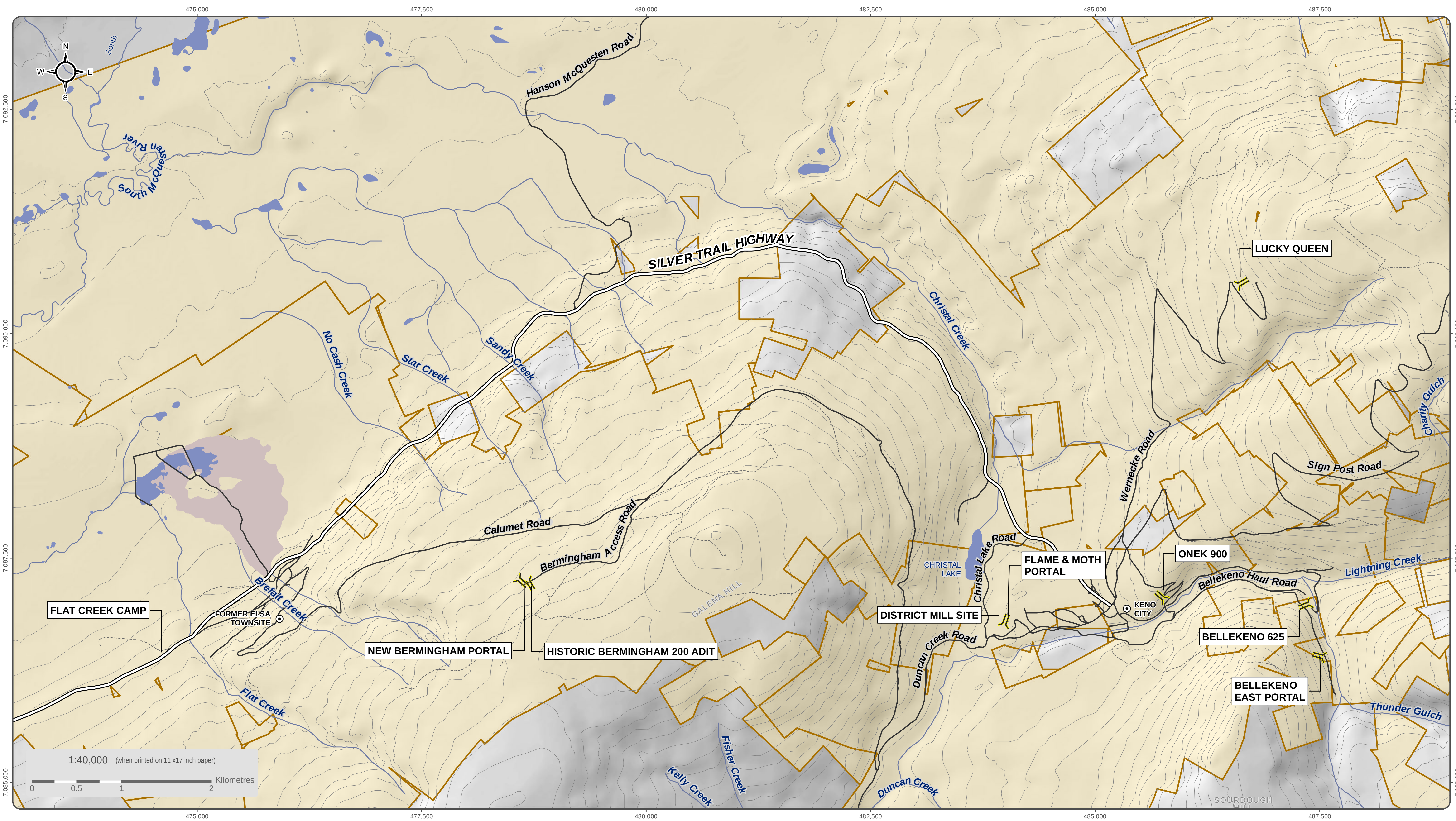
Notes:
1. https://emr-ftp.gov.yk.ca/emrweb/COMM/major-mines/keno-hill/mml-keno-qml-0009-nov2019.pdf
2. QML-0009, Schedule C amended May 4, 2023, Schedule D amended January 4, 2023
3. http://www.yukonwaterboard.ca/waterline

KENO HILL SILVER DISTRICT
MINING OPERATIONS

FIGURE 1-1
PROJECT LOCATION

OCTOBER 2023

D:\Project\AllProjects\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*)



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

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

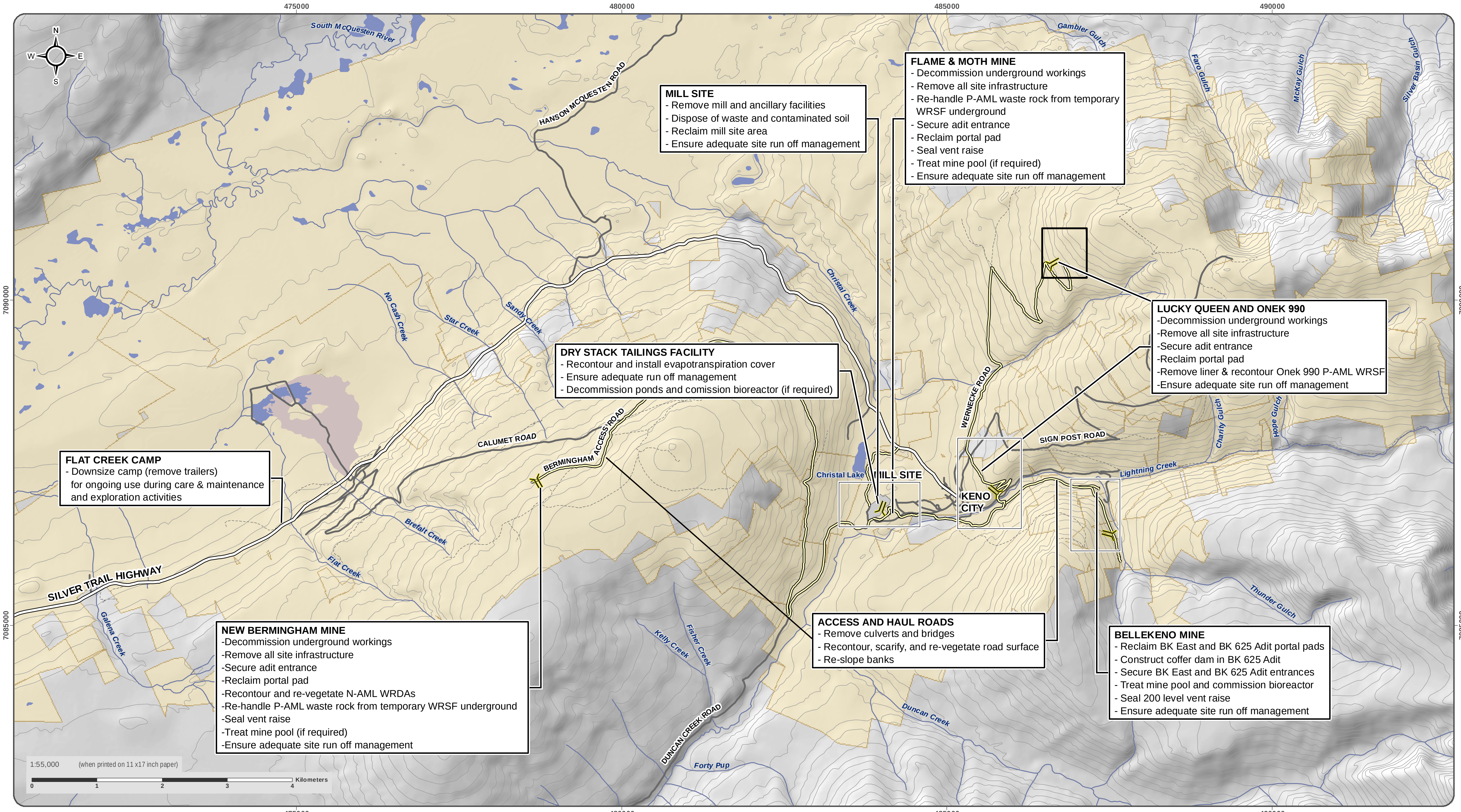
Hecla YUKON

ENSERO solutions

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 1-2
KENO HILL SILVER DISTRICT MINING OPERATIONS OVERVIEW

SEPTEMBER 2023



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

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 2023

D:\Project\AllProjects\Keno_Area_Mines\ALL-SITES\02-Map\04-Closure\16-Keno Hill Reclamation Closure Plan 2021\Site_Reclamation_Plan_20230929.mxd
(Last edited by: amatlashevska; 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 8 in QML-0009 –Schedule C dated May 4, 2023. 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 3.4.

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 and YWB, 2013) (RCPQMP) 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. (doing business as Hecla Yukon), Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) (formerly referred to as Indigenous and Northern Affairs Canada [INAC]) and the First Nation of Na-

Cho Nyäk Dun (FNNND). 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 modern 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.

As a result, FNNND is well informed about our applications, and their input is reflected in our project proposals. FNNND have long been active partners in the design of the District-Wide Closure Plan as well as site operations and particularly environmental monitoring.

2.3 CONSULTATION AND ENGAGEMENT

Hecla Yukon continues to conduct ongoing consultation and stakeholder engagement with respect to all of its activities within the Keno Hill mining camp. Consultation and engagement is 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 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 issuance and renewal of the Type A water licence, as well as issuance of plans under the QML, provide additional opportunity 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 are underway to reflect improvements and the new ownership of the parent company.

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 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 of new mines, development of the District-Wide Closure Plan or general updates on the mine development and production activities. There are no substantial changes in this revision of the KHSD Mining Operations Reclamation and Closure Plan and thus no specific consultation events completed.

2.4 RECLAMATION RESEARCH

Reclamation research and field validation of reclamation designs (hereafter collectively referred to as "research") can be a useful part of the closure planning process. The results are used to support site specific refinement of closure measure designs such as *in situ* water treatment.

There are currently a number of reclamation research and field validation programs underway as part of the ERDC District Closure Plan that are co-funded and managed by AKHM as well as reclamation research and progressive reclamation directly related to the KHSD Mining Operations. The following reclamation research programs are currently in progress and the results will be utilized for reclamation and closure planning of the KHSD Mining Operations:

- progressive reclamation on the DSTF;
- cover system and vegetation field trials – active monitoring was completed in 2019, observation of the physical conditions continues;
- natural attenuation studies (Appendix 1.6 and 1.7); and
- *in situ* treatment demonstration at Silver King.

Summary reports of the results of the reclamation research programs are included in Appendix 1. Data Collection Programs for Reclamation and Closure Planning. In addition, reclamation performance monitoring of the historical mines will inform reclamation and closure planning for the operating mines.

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. Additional details on this process are in Section 8.5.2.

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.

The Bellekeno site also provides an opportunity to observe natural revegetation rate and extent, along with the rate of passive attenuation of petroleum hydrocarbons in soil. The upper laydown yard has been cleared of infrastructure and contaminated soil remediated in Q3 2023. Portions of the upper laydown yard will be scarified to allow vegetation to establish (and to inhibit its use as storage for scrapped vehicles and equipment). Observation of the growth will be added to the information collected at test plots as discussed in Section 8.12.4.

3 CLOSURE OBJECTIVES AND DESIGN CRITERIA

3.1 DESIGN BASIS

AKHM's overall closure objective is to leave the site or the mine area 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, and
- future land use which considers the surrounding landscape, visual aesthetics, traditional values, and public safety.

The *Reclamation and Closure Planning for Quartz Mining Projects. Plan requirements and closure costing guidance* (YG and YWB, 2013) document provides fundamental objectives for important values (Table 3-1) to guide 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

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.

EMR has developed a schedule which details specific objectives for the RCP to achieve in closure. The objectives of that schedule are reproduced here and referenced according to where in this RCP revision they are adhered to (Table 3-2). Technical guidelines that provide direction on achieving terrestrial performance objectives have also been developed (YG, 2013), and coherence with these guidelines in this revision of the RCP are summarized in Table 3-3.

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: Reclamation and Closure Plan Requirements Reference List

CLOSURE PLAN REQUIREMENT	DOCUMENT LOCATION
(a) A statement of the objectives to be achieved as a result of reclamation and closure of the site;	Section 3
(b) an analysis of the measures required to be implemented to ensure the ongoing physical and chemical stability of the site;	Bellekeno Mine (Section 8.2.2) Flame & Moth (Section 8.2.3) Bermingham (Section 8.2.4) Dry Stack Tailings Facility (Section 8.3) Waste Rock (Section 8.4) Mill and Infrastructure (Section 8.7) Camp (Section 8.8) Roads (Section 8.9)
(c) a description of how the Licensee will meet the performance standards set out in Schedule 1 (attached to this letter) unless other standards are agreed to in writing by the Chief in advance of submission of the plan;	Table 3-2
(d) target indicators to ensure that reclamation objectives have been met;	Table 3-3
(e) engineered (stamped or sealed) designs for the closure of all engineered structures, works, and installations associated with the Undertaking, including embankments and other containment structures, dry stack tailings facility, spillways, diversion ditches, waste rock and overburden dumps, the Bellekeno Haul Road and any other roads at the site, and ore stockpiles;	Section 8 and appendices
(f) a program and implementation schedule for the removal of all infrastructure at the site, including the mill and all infrastructure, camp, and roads;	Section 8.7, 8.8, 8.9
(g) a program and implementation schedule for ensuring the long-term stability and closure of the dry stack tailings facility and waste rock storage facilities;	Dry Stack Tailings Facility (Section 8.3) Waste Rock Storage Areas (Sections 8.4)
(h) a program and implementation schedule for progressive reclamation to be carried out during development and production;	Section 6
(i) a program for revegetation of disturbed areas, including a description of how soils will be tested for quality and quantity of nutrients and organic matter to support plant growth and a description of the seed mix to be utilized;	Section 8.12
(j) details of the covers (if any) to be placed over the non-acid generating or metal leaching and the potentially acid generating or metal leaching waste rock storage facilities and dry stack tailings facility;	Section 8.12
(k) a monitoring and maintenance program and implementation schedule to obtain surface and hydrogeological information adequate to verify that the reclamation objectives and discharge requirements applicable for all engineered structures, works and installations are met at closure and post-closure;	Closure Monitoring and Maintenance (Section 8.13) Adaptive Management (Section 8.14.13)
(l) a cost estimate to implement the plan, including a cost estimate for post closure monitoring, inspections, interim care and maintenance;	Section 10

CLOSURE PLAN REQUIREMENT	DOCUMENT LOCATION
(m)details respecting maintenance of security at the site, including any requirements for continuous care by an on-site caretaker, during reclamation and closure and post closure;	Section 9
(n) updates on the collection and interpretation of hydrogeological information, related geochemical effects and water discharge from the mine;	Section 4.3
(o) a program and implementation schedule for determining the effects on the receiving environment during closure and post-closure, including details of monitoring of geochemical and physical stability of all facilities at the Site and other matters as appropriate;	Section 8.13
(p) description of the quantity and quality of available organic material and borrow material stockpiles for use in reclamation;	Section 8.11
(q) list of equipment required to be on-site to ensure that the Licensee can provide an adequate response to an unexpected water flow or level, a spill or a release of a hazardous substance;	Section 8
(r) details of how technological developments and best management practices will be incorporated into the plan over time;	Sections 6.4, Sections 7.2 and 7.4 (*in situ* treatment)
(s) details respecting management of a temporary closure, including the following:	Section 7
(i) how the Licensee will secure the site during a temporary closure and ensure that all engineered structures, works and installations remain stable;	Section 7.2
(ii) how all engineered structures, works, and installations required to resume mining, milling, hauling and waste treatment will be maintained in good order on the site during a temporary closure;	Section 7.1
(iii) how the various roads under the control of the Licensee at the site will be monitored and controlled to prevent public use where appropriate and ensure public safety;	Section 7.1 and 7.3
(iv) a list of equipment required to be on-site to ensure that any unexpected water flows or levels or other contingencies are properly managed by the Licensee to protect the environment and human safety;	Bellekeno Mine (Section 8.5.3) Flame & Moth Mine (Section 8.5.4) Bermingham Mine (Section 8.5.5)
(vi) monitoring and reporting schedules for ensuring the geochemical and physical stability of all engineered structures, works, and installations associated with the Undertaking, and	Sections 7.2
(vii) a cost estimate to implement (i) to (vi), as well as any other activities to be undertaken for a temporary closure of five years.	Section 10

Table 3-3: Performance Objectives for Key Mine Features Derived from the Yukon Mine Site Reclamation and Closure Policy

TECHNICAL GUIDELINE #	THEME	CLOSURE OBJECTIVE	DOCUMENT REFERENCE
T-01	Water Retention and Sediment Control Structures	Ensure decommissioning of water retention and sediment control structures, and their appurtenances, in such a way that drainage at, and adjacent to the site, is stable in the long term.	Existing water treatment ponds will be decommissioned and reclaimed (see Section 8.5) for the Bellekeno Mine water treatment facility; mill pond; Bellekeno East water storage ponds, Flame & Moth Treatment Pond and Bermingham water ponds)
T-02	Watercourses	Restore watercourses to meet current water management objectives (in accordance with the approved reclamation and closure plan).	Watercourses have not been physically altered by mining activities
T-03	Water Quality	Prevent contamination of receiving environments. Following decommissioning, water quality must consistently meet the requirements of applicable territorial and federal legislation. Recognition will be given to background levels of substances occurring prior to start of operations.	A bioreactor will be installed in the current water treatment ponds at the Bellekeno Mine for treatment of mine discharge (see Section 8.5.3). If monitoring indicates seepage from the DTSF requires treatment, a bioreactor will be installed. *In situ* mine water treatment will be undertaken at Bellekeno and Bermingham mines. There is no discharge expected from F&M. (Section 8.5.4)
T-04	Site Contamination	Prevent exposure to and mobilization of substances that pose a risk to human health and the environment through physical and chemical stability.	Section 8
T-05	Acid Rock Drainage Potential	Walk-away solution. Reliance on long-term active treatment is not considered acceptable for reclamation and closure planning.	P-AML waste rock is being stored in a temporary lined storage facilities during operations, and will be placed back in the underground mine below the long-term static water level of the mine at closure. (see Section 8.4)
T-06	Tailings Management	Ensure physical and chemical stability in the long term and eliminate the need for long-term active treatment.	The DSTF will be constructed in a manner that is physically stable and covered with a water shedding cover at closure to limit infiltration and promote vegetation (see Section 8.3)
T-07	Underground Workings and Openings to Surface	Meet water quality objectives. Except for authorized access, prevent inadvertent or intentional underground access that may be a hazard to humans and wildlife. Prevent subsidence or changes in the topography that may result in a hazard to humans or wildlife.	A rock pile will be placed at the portal to block access to the Bellekeno East Adit (Section 8.2.2.1), Onek 990 adit (Section 8.2.6), Lucky Queen (Section 8.2.5) New Bermingham (Section 8.2.4) and Flame & Moth adit (Section 8.2.3). A rock pile will be placed at the portal to block access to the Bellekeno East Adit (Section 8.2.2.1), Onek 990 adit (Section 8.2.6), Lucky Queen (Section 8.2.5) New Bermingham (Section 8.2.4) and Flame & Moth adit (Section 8.2.3). A coffer dam will be installed at the Bellekeno 625 Adit to provide the ability to manage water discharge (Sections 8.2.2.2). An engineered cap will be placed at the Bellekeno 200 Level Vent Raise (Section 8.2.2.3), Flame & Moth vent raise (8.2.3) and New Bermingham vent raise (8.2.4).

TECHNICAL GUIDELINE #	THEME	CLOSURE OBJECTIVE	DOCUMENT REFERENCE
T-08	Terrain Hazards	Terrain hazards at the site should be no more significant hazard to people and wildlife than is present in the surrounding vicinity.	Section 7
T-09	Mine Rock Piles	Rock piles and dumps must be physically and chemically stable in the long term to prevent erosion, subsidence, or collapse, and such that dump runoff and surface drainage meet legal requirements.	P-AML waste rock will be stored in approved, engineered facilities during operations and placed in the underground mine at closure (see Section 8.4)
T-10	Roads and Other Access	Protect public safety is a key objective. As well, in decommissioning linear infrastructure the intention is to human and wildlife utilization in the area to revert to pre-development levels and types, all other factors being equal. If, however, an alternate future land use has been identified for the site, or population in the area has increased, alternative objectives may be identified in the approved reclamation and closure plan.	Road decommissioning will occur in a manner commensurate with EMR's Yukon Mine Site and Reclamation Closure Policy (see Section 8.9.1)
T-11	Erosion Control	Physical stability such that upon closure, slopes, excavations, and other disturbed lands are in a condition that will limit the incidence of soil erosion, slumping and other instabilities that are likely to impede re-vegetation of a reclaimed site, pose a threat to public safety, lead to wildlife mortality or because excessive sediment loads to enter nearby water bodies.	Slopes will be regraded to at least 2.5H:1V or better, for physical stability
T-12	Re-vegetation	Ensure physical stability and prevent a temporary loss of wildlife habitat utilization from becoming permanent by re-establishing a vegetative mat (food source, hide, etc.) leading to self-sustaining natural revegetation.	Revegetation will occur in a manner that meets EMR's Yukon Mine Site and Reclamation Closure Policy (see Section 8.12) and that achieves the closure of objectives of aesthetics and reducing erosion (also see Section 8.12.2)
T-13	Mine Infrastructure	Ensure physical stability and to remove potential threats to public health and safety, including identification and removal of hazards and hazardous materials.	All infrastructural buildings and equipment will be removed and transported offsite for salvage at the end of mine life (see Section 8.6 and 8.7)
T-15	Temporary Closure Site Conditions	Ensure public health and safety and protection of the environment in the event of a temporary closure and to manage risks associated with potential abandonment of the site	Section 7

3.2 INTEGRATION WITH DISTRICT-WIDE CLOSURE PLANNING

Alexco Resource Corp. worked with stakeholders to develop specific closure objectives for the ERDC UKHM Reclamation Plan project through workshops and meetings. These objectives were signed by CIRNAC, YG, FNNND, and ERDC in 2013. The agreed upon objectives are provided in Table 3-4.

Table 3-4: District-Wide Closure Objectives Agreed with Stakeholders

VALUE	PROJECT CLOSURE OBJECTIVE
Protect Public and Worker Health and Safety	Prevent, minimize, or mitigate any adverse effects on the health and safety of people using the land and water. Prevent, minimize, or mitigate any adverse effects on the health and safety of people working at the site.
Protect and Restore the Environment	Prevent, minimize, or mitigate adverse effects on the aquatic environment. Prevent, minimize, or mitigate adverse effects on the terrestrial environment.
Restore Mine Site to a State that Supports Community and Traditional Land Uses	Minimize access restrictions. Reclaim disturbed areas to support future community and traditional land use. Preserve identified historical resources.
Maximize First Nation, Local, and Yukon Socio-economic Benefits	Maximize training, capacity building, and employment and business opportunities for First Nation citizens. Maximize training, capacity building, and employment and business opportunities for local residents and other Yukoners.
Minimize Project Related Liability and Risk	Minimize risks associated with project implementation. Minimize post-closure residual liabilities. Minimize post-closure risks.
Minimize Cost	Minimize project implementation costs. Minimize post-closure operations and maintenance costs.

These objectives informed the specific reclamation measures and designs considered and guided the selection of closure measures and design for the implementation of the UKHM Reclamation Plan. The UKHM Reclamation Plan completed the Environmental Assessment process in July 2020 and a Water License was issued in April 2023. The implementation of the UKHM Reclamation Plan commenced on September 15, 2023.

The intent of this KHSD Mining Operations RCP is to ensure that the site-specific closure objectives for the new mines are aligned with the UKHM Reclamation Plan objectives. The district-wide closure objectives also provide guidance to Hecla Yukon for the exploration, planning, development, and expansion of its operations in the Keno Hill mining camp.

3.3 DESIGN CRITERIA

The design criteria for the existing facilities are defined in the design reports and summarized in Section 5. The specific design basis for each reclamation measure is discussed in Section 8.

3.3.1 Physical Stability

Physical stability is ensured by protecting the surface against wind and water erosion, providing for surface drainage, minimizing hazardous conditions, and contouring the surface to meet land capability objectives. Physical structures such as underground openings, sedimentation and treatment ponds, spillways, surface openings and waste rock storage areas will meet the following requirements:

- Be physically stable and designed in accordance with acceptable design criteria.
- Pose minimal hazard to the public and wildlife health and safety as a result of failure or physical deterioration.
- Continue to perform the function for which they were designed.
- Have stable land surfaces with minimal surface erosion.

3.3.2 Chemical Stability

The reclaimed mine sites operated by AKHM will be chemically stable. For reclamation measures, this means removing or controlling sources of leaching or other discharge e.g., contaminated soils, hazardous or special wastes, and acid rock drainage. Specifically, this means surface waters and groundwater will be protected against significant adverse environmental effects resulting from discharges. In addition, discharges will not endanger public and wildlife health and safety, nor result in unacceptable deterioration of environmental resources.

The measurement of chemical stability will be water quality for both surface water and groundwater. Water quality objectives (WQOs) for the RCP will be consistent with the Adaptive Management Plan (AMP) (Hecla Yukon, 2023a). The AMP is a living document that is reviewed annually to evaluate whether indicators and thresholds remain appropriate for identification of potential adverse effects. Modifications to the AMP may be made based on changes to trends in monitoring data, regulatory guidelines, site operations, available technology, and/or 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, 2023a).

Wind erosion and transport are not significant mechanisms of contaminant dispersal for the active mining operations due to physical controls planned as part of closure.

Aspects to be monitored closely will 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 effects due to any acid rock drainage via surface or ground water will be mitigated. The success of physical reclamation will influence chemical and physical stability.

3.3.3 Biological Stability

The biological stability of the closed sites and potential effects on the surrounding environment are closely related to methods of reclamation, the end land use, and the physical and chemical characteristics of the site.

Biological stability to vegetation and wildlife habitats is reached when these habitats are stable, self-sustaining, and productive, and meet the closure objectives.

3.4 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 3-5 provides a general overview of each Mine Area Component and the site conditions associated with meeting completion criteria.

Table 3-5: 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	Salvageable equipment removed. All other equipment cleaned of hydrocarbons Infilling of underground stopes with P-AML waste rock and tailings material Mine openings stabilized, barricaded, and free-flowing with respect to water, where applicable	All chemicals and contaminants remediated or removed; Effluent water quality requirements as required by the Water License	N/A
Waste Rock Storage Facilities and Disposal Areas			
Bellekeno Benched N-AML WRDA Bellekeno Temporary P-AML Facility Flame & Moth Temporary P-AML Facility New Bermingham Temporary P-AML New Bermingham N-AML WRDA	Stable slopes Waste rock covered where applicable No significant wind or water erosion	No acid rock drainage or metal leachate seepage concerns	Safe wildlife access
Water Management Structures			
Bellekeno 635 WTP Settling Pond Flame & Moth WTP Settling Pond New Bermingham WTP Settling Pond Mill pond	All impediments to normal hydrologic conditions broken down to re-establish hydrologic flow Bellekeno 625 ponds converted to geotechnically-stable bioreactors Other pond liners removed and stable Contingency in place to convert other ponds to bioreactors	All chemicals and contaminants remediated or removed	Safe ingress/egress for wildlife
Mine Surface Infrastructure			
Buildings Maintenance Shop Electrical Substation Fuel Storage Tanks and Propane Tank Laydown Yards	All infrastructure disassembled and removed Infrastructure supports and foundations removed or buried and berms broken down	All chemicals and contaminants removed	Sustainable vegetation cover

RECLAMATION UNITS	COMPLETION CRITERIA CONDITIONS		
	PHYSICAL STABILITY REQUIREMENTS	**CHEMICAL STABILITY REQUIREMENTS**	**BIOLOGICAL STABILITY REQUIREMENTS**
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	All infrastructure disassembled and removed Infrastructure supports and foundations removed or buried and berms broken down	All processing chemicals, contaminants and ore stockpiles removed	Sustainable vegetation cover
Dry Stack Tailing Facility			
DSTF Phase I DSTF Phase II	DSTF covered with evapo-transpirative cover and vegetation. No significant erosion or infiltration. Tailings geotechnically stable	Any seepage reporting to Christal Creek watershed will not result in an adverse impact (i.e., WQO)	Wildlife access
Water Diversion Structures			
DSTF diversion berms	No significant erosion along channel banks and banks of dam structures	All chemicals and contaminants removed	
Sedimentation Pond			
DSTF settling ponds	No exposed sedimentation areas No significant wind erosion	Effluent water quality requirements as required by the Water License	
Bridges and Culverts			
Lightning Creek Bridge Onek Bridge Culverts	Stream and cut banks are stable and have no significant erosion Clear span bridges are removed	All chemicals and contaminants remediated or removed	
Flat Creek Camp			
Accommodations Camp Wastes	Camp downsized to pre-production level. Areas where camp buildings have been removed are stable with no significant wind or water erosion	All chemicals and contaminants remediated or removed	Sustainable vegetation cover
Linear Disturbances			
Haul Roads AKHM Controlled Access Roads Powerlines	No significant erosion along road banks and areas where culverts have been removed	All chemicals and contaminants remediated or removed	Sustainable vegetation cover

4 Environmental and 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.

Table 4-1 summarizes existing environmental conditions in the KHSD Mining Operations project area. 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 4-1: 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

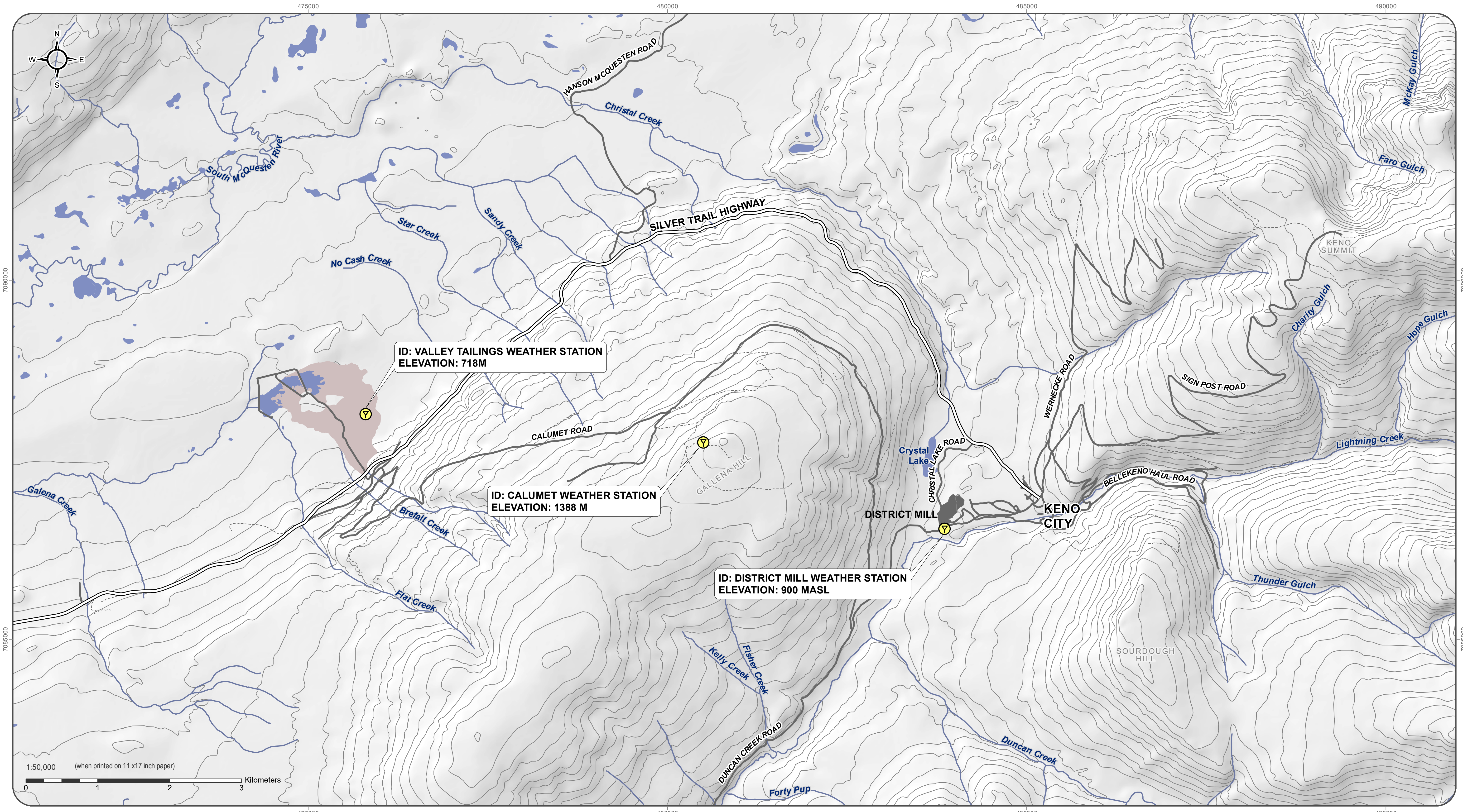
4.1 Climate

The following provides a summary of the Climate information for the Site and additional details regarding Climate are presented in the QML-0009 Site Characterization Report (Appendix 2).

The Keno Hill mining camp falls in the subarctic clime of the Koppen climate classification. The closest current long-term climate record is at the Mayo Airport, which had an average daily temperature of -2.4°C and average annual precipitation of 313.5 mm, with 203.8 mm falling as rain for the 1981 to 2010 Climate Normal period. The wet season occurs in summer/fall with drier winters.

Meteorological data have been collected in the Keno Hill mining camp since 2007 at the Calumet weather station (as part of the development of the ERDC District Closure Plan supporting studies), since 2011 at the District Mill meteorological station (installed as part of Bellekeno mining operations) and since 2012 at the Valley Tailings meteorological station. The location for the District Mill weather was changed in 2022 and it is now located adjacent the Duncan Creek Road at the Flame & Moth Mine vent raise. The District Mill meteorological station was previously located within the DSTF Phase 1 footprint. The station locations are shown on Figure 4-1. All three stations collect air temperature, relative humidity, rainfall, solar radiation, wind speed and wind direction. In addition, the District Mill station has a snowfall conversion adaptor and calculates evapotranspiration, while the Valley Tailings station collects barometric pressure and soil water content. The Calumet station collects soil temperature.

The region around the Keno Hill mining camp has been served by a network of climate monitoring stations over the years. At least three climate stations have been operated within the boundaries of the Keno Hill mining camp. Two of these stations were located in former Elsa town site 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. The 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 town site. 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. These stations have been active since 1953.



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Weather Station
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 4-1

METEOROLOGICAL STATIONS

OCTOBER 2023

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4.1.1 Temperature

Table 4-2 presents monthly and annual mean temperatures, calculated for the entire period of record for the three local meteorological stations, as well as the 1981-2010 climate normal period for the Mayo A station; these are updated every 10 years. The 1991-2020 Canadian Climate Normals had not been published at the time of the report. The monthly temperatures are on average colder at the three Keno Hill mining camp stations than at Mayo A, which is expected given the higher site elevation. This pattern is not as clear during the winter months and could reflect the fact that the region experiences frequent temperature inversions.

Table 4-2: Mean Monthly and Annual Temperatures (°C)

MONTH	CALUMET (2007–2022) ELEV. 1,380 MASL	DISTRICT MILL (2011–2022) ELEV. 900 MASL	VALLEY TAILINGS FACILITY (2012–2022) ELEV. 718 MASL	MAYO A NORMALS (1981–2010) ELEV. 504 MASL
January	-12.2	-17.3	-19.7	-23.1
February	-13.7	-16.6	-19.4	-17.9
March	-12.4	-11.1	-11.2	-9.6
April	-4.5	-2.0	-1.6	1.0
May	3.3	7.3	7.9	8.8
June	9.3	12.5	14.3	14.5
July	10.1	13.6	15.3	16.1
August	8.2	10.9	11.9	13.1
September	3.1	5.2	6.4	6.4
October	-4.8	-3.9	-4.3	-2.7
November	-12.7	-14.9	-16.6	-15.3
December	-13.7	-17.2	-20.0	-19.9
Annual	**-3.3**	**-2.8**	**-3.1**	**-2.4**

The long-term climate record at Mayo A indicates a warming trend as can be observed in Figure 4-2. The rate of warming is greater for the minimum temperature than it is for the maximum temperature, consistent with observations made in other parts of Canada (ECCC, 2016).

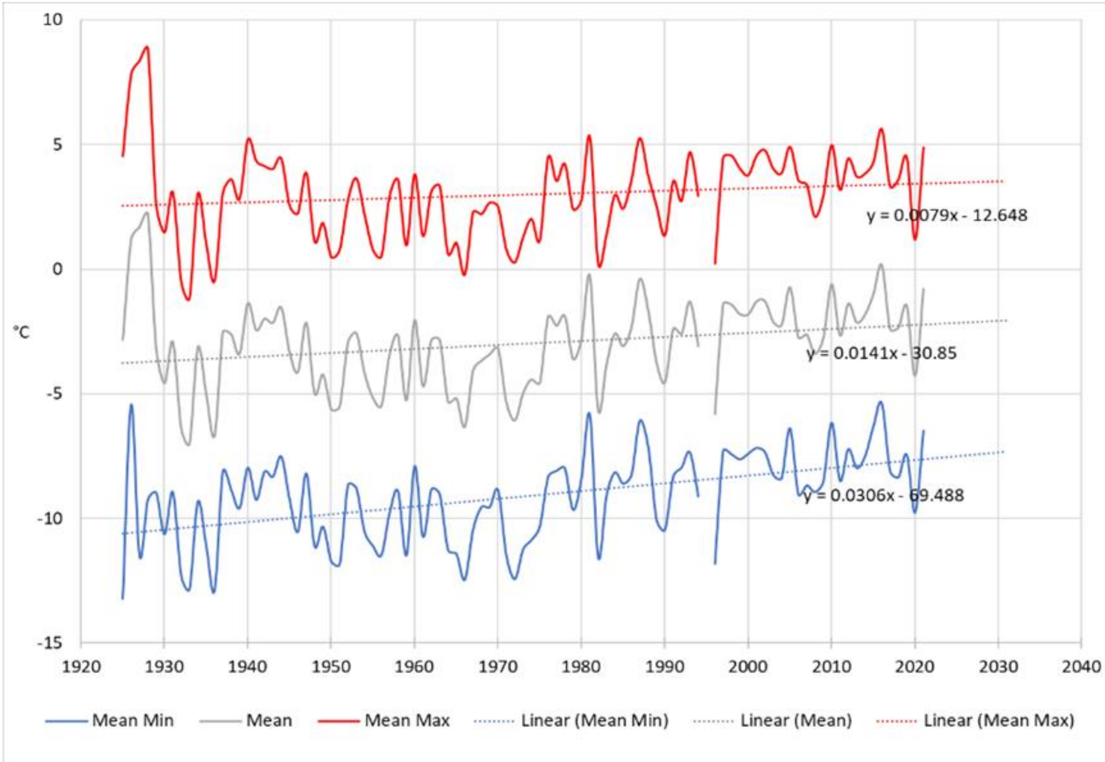


Figure 4-2: Mayo A Annual Temperatures, 1925–2022

SRK (2020) extended the local Calumet weather station record by correlating the data with the regional Mayo A station data (Figure 4-3). This allowed the extension of the local Calumet weather station to be extended to 95 years (October 1924 to July 2020). The monthly results are provided in Table 4-3.

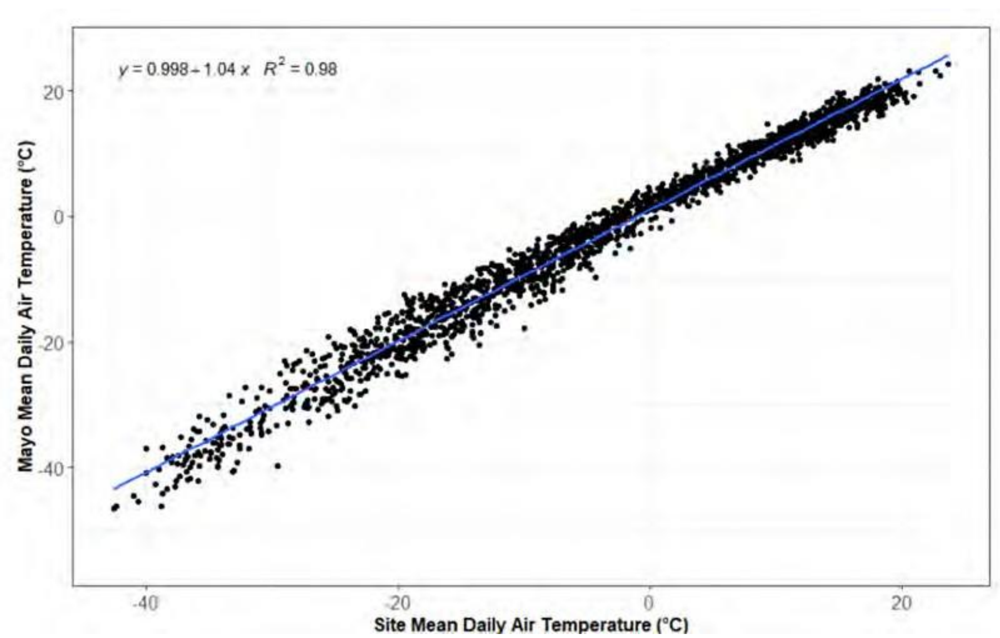


Figure 4-3: Daily Air Temperature – Mayo Airport vs. Calumet Weather Station (SRK, 2020)

Table 4-3: Extended Air Temperature Averages for 1990-2020 (SRK, 2020)

MONTH	MIN. TEMPERATURE (°C)	AVG. TEMPERATURE (°C)	MAX. TEMPERATURE (°C)
January	-58.3	-25.1	10.1
February	-62.2	-19.3	12.2
March	-48.9	-10.7	15.8
April	-41.1	0	22.8
May	-21.7	8.3	33.5
June	-3.9	13.8	36.1
July	-2.8	15.4	35.6
August	-10.6	12.6	32.6
September	-15.6	6.5	26.7
October	-36.7	-2.2	22.6
November	-50.6	-15.4	13.9
December	-57.2	-22.1	11.8

4.1.2 Precipitation

Of the three local meteorological stations, only the District Mill station measures total precipitation – since October 2013 – whereas the other two stations measure rainfall only. Analysis indicates that these data are not adequate for estimating precipitation trends on site, and as such the Mayo A station, before and after undercatch adjustment was used as a proxy.

Mean annual precipitation (MAP) within a mountainous region typically increases with increasing elevation. The significant relief over which the Keno Hill area spans is well represented by two historical weather stations with Elsa at 814 masl and the Keno Hill weather station at 1,472 masl. SRK (2020) derived a relationship between MAP and elevation, using the Mayo A data (not corrected for undercatch), Elsa, Keno, 7 regional stations (red points) and gridded precipitation from the Modern-Era Retrospective analysis for Research and Applications (MERRA2) dataset (black points), as shown on Figure 4-4 (SRK, 2020). Using a linear relationship, as exhibited by the data, a line was fitted to the data of these stations. The slope of this line indicates that MAP increases by an average of 37.7 mm for every 100 m of ascent. Using this relationship, MAP values were developed for each design component based on its elevation:

- MAP for the VTF at a median elevation of 703 masl is 420 mm. This value was then adjusted for undercatch, resulting in an adjusted MAP for the VTF of 483 mm; and
- MAP for the upper hillslope region above the VTF, ranging in elevation from 704 to 1,400 masl (median elevation of 1,123 masl) is 577 mm. After corrections for undercatch, the MAP value for the upper hillslope region is 663 mm.

Table 4-4 presents mean monthly and annual rainfall, snowfall, total precipitation, and percentage of total precipitation falling as rain at the Mayo A station for the 1981-2010 climate normal period. Additionally, snow surveys have been conducted by Alexco Resource Corp. and Yukon Government for sites within the Keno Hill mining camp area and a summary of the data is provided in Appendix 2.

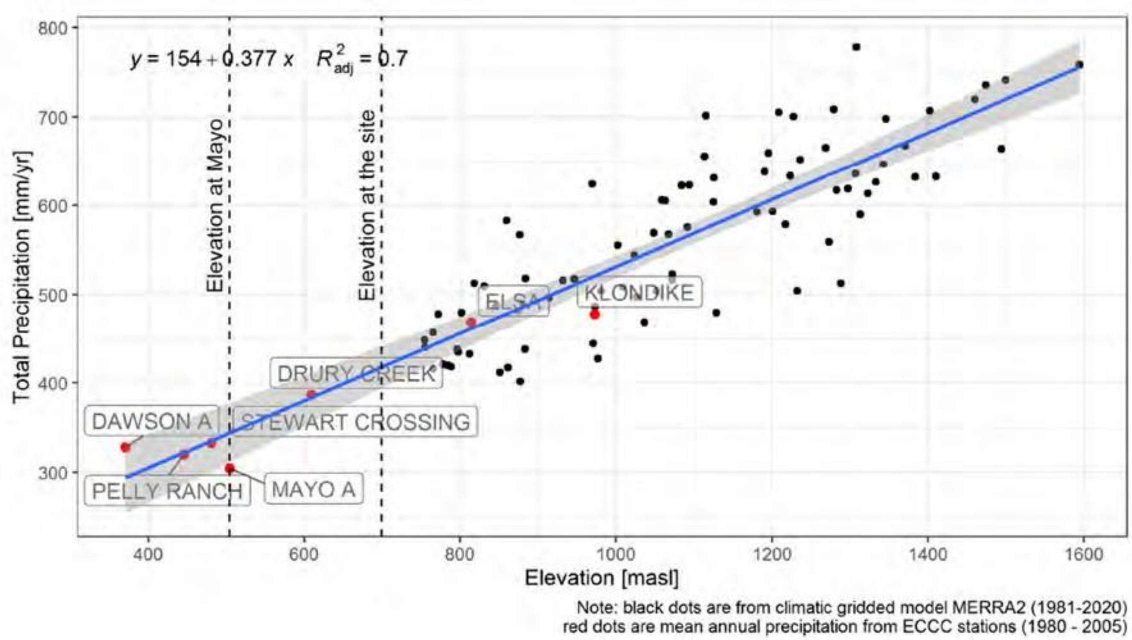


Figure 4-4: Map Annual Precipitation (MAP) – without undercatch – as a function of Elevation

Table 4-4: Mayo A Climate Normal (1981-2010) Average Precipitation

Month	Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	% Rain
January	0.3	28.3	18.3	1.6
February	0.0	20.2	13.0	0.0
March	0.1	14.5	9.9	1.0
April	2.9	7.8	8.8	33.0
May	22.2	1.0	23.2	95.7
June	38.9	0.1	39.0	99.7
July	50.2	0.0	50.2	100.0
August	44.5	0.3	44.6	99.8
September	34.8	3.9	38.7	89.9
October	9.4	23	27.0	34.8
November	0.3	31.8	21.1	1.4
December	0.3	29.8	19.8	1.5
Annual	**203.8**	**160.6**	**313.5**	**65.0**

4.1.3 Evaporation

No direct measurement of evaporation is carried out at Site. Estimates for lake evaporation and potential evapotranspiration were developed 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 are presented in Table 4-5.

Table 4-5: Estimated Long-Term Monthly Evaporation

MONTH	LAKE EVAPORATION [mm]	POTENTIAL EVAPOTRANSPIRATION [mm]
January	*0*	*0*
February	*0*	*0*
March	0	2
April	0	19
May	0	62
June	132	96
July	120.9	101
August	80.6	68
September	48	28
October	*0*	*5*
November	*0*	*0*
December	*0*	*0*
Annual	**381.5**	**383**

Notes: Values in grey italics indicate a partial month

4.2 SURFACE WATER QUALITY

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 effluent quality standards (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.

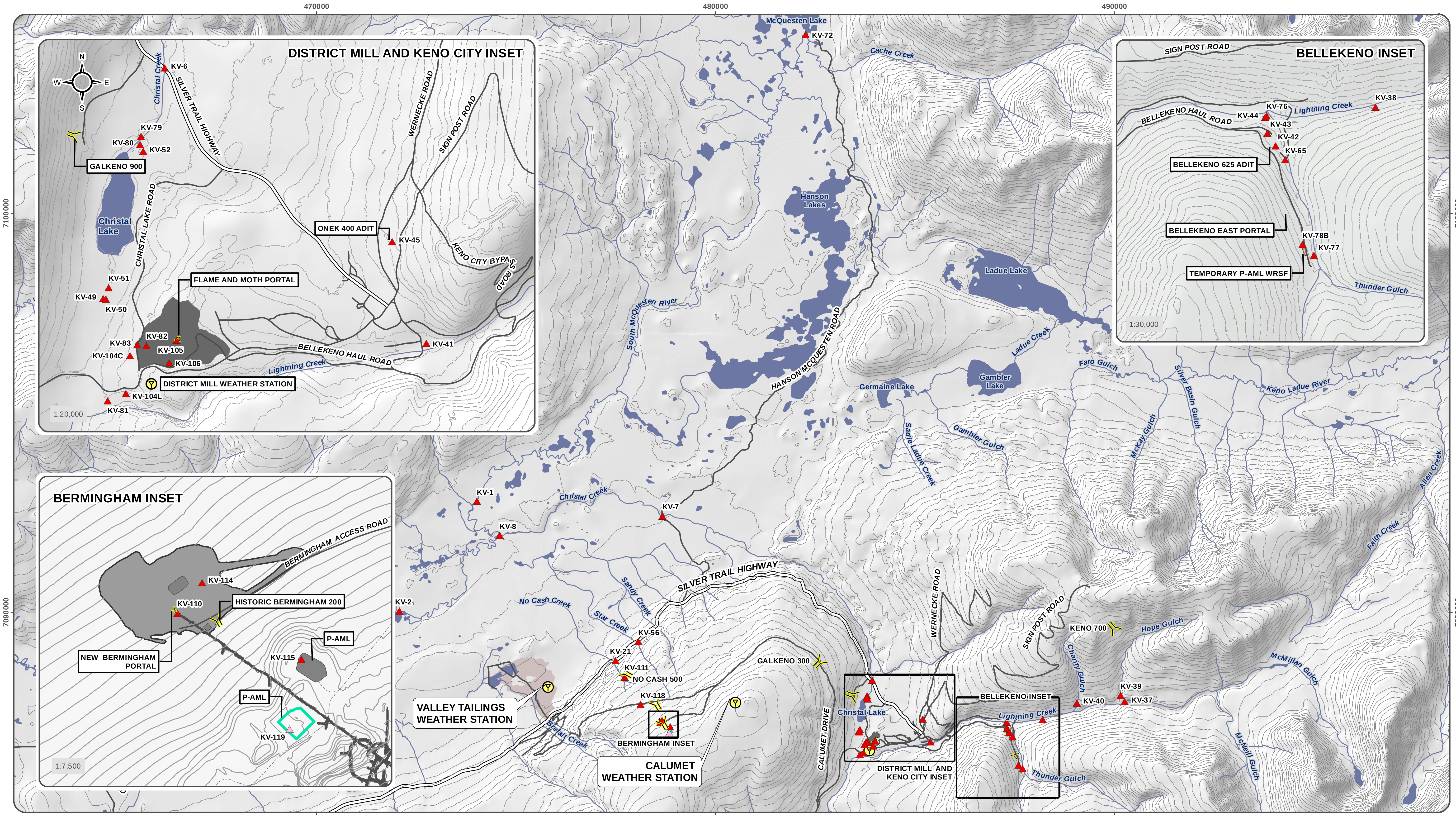
The comprehensive water quality monitoring program is outlined in Schedule B of WL QZ18-044 (see Figure 4-5 for station locations). The program is continuously reassessed for its effectiveness at canvassing the site and for its ability to help plan site activities.

The network of sampling stations has been established with the goal of addressing three main issues:

- Identify sources and sinks for contaminants along natural watercourses;
- Identify “reference” water chemistry (i.e., in areas unaffected by mining); and
- Determine what effect mine discharges may have on downstream water quality and aquatic life in the receiving environment.

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 concern for the Keno Hill mining camp: zinc and cadmium (Minnow, 2008). Because of the limitations of the dataset, other ‘potential’ contaminants of concern

(COPCs) were identified but not confirmed. In September 2013, Minnow revaluated the COPCs and concluded that cadmium and zinc should remain as the contaminates of concern and that no additional contaminates of concern are warranted (Minnow, 2013). Subsequent assessments of receiving environment water quality have also indicated that cadmium and zinc remain the contaminates of concern for the receiving environment (Minnow, 2015; 2018; 2020). The focus of this section is on the contaminates of concern zinc and cadmium; however, additional results for other parameters (COPCs) are presented in the water quality summary tables provided in Water Licence annual report.



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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
- Weather Station
- Adit
- As Built Mine Structure
- Permitted To Be Constructed Mine Features
- Valley Tailings
- Silver Trail Highway
- Other Road
- Watercourse
- Waterbody

Hecla KENO HILL

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 4-5

SURFACE WATER QUALITY STATION LOCATIONS
18-044

OCTOBER 2023

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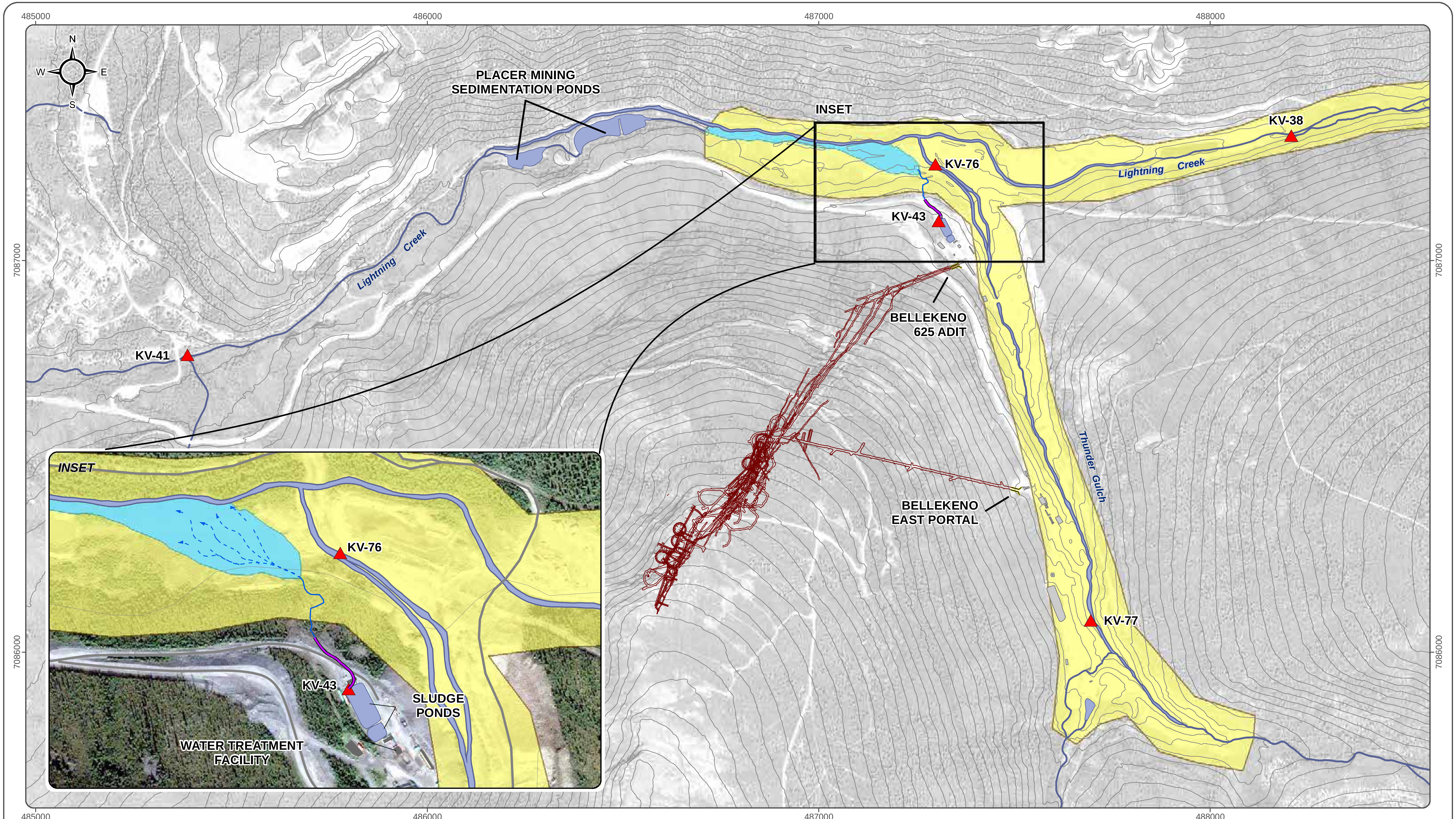
4.2.1 Bellekeno

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 4-6). 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. Mining activities at Bellekeno resumed in September 2020. The Bellekeno Mine stopped dewatering activities on October 2021, and was placed into temporary closure on December 2021. In 2022, the Bellekeno Mine was not actively discharging as the underground workings continued to fill. Discharge resumed in Q2 2023 from the Bellekeno 625 adit into the WTP.

Both Thunder Gulch and Lightning Creek have undergone extensive placer mining activities in the past; Thunder Gulch is a current site of active placer activities. This has an impact on aquatic conditions and can make it difficult to distinguish the effects of placer mining from the effects of underground mining. The Lightning Creek drainage is also affected by other historical mines in the district which continue to produce metals loading to the creek.



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

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0 125 250 500 Meters

- Water Quality Stations
- Bellekeno Adit
- Pipeline
- Underground Workings
- Placer Disturbed Area
- Bellekeno Effluent Discharge
- Waterbody
- Watercourse

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 4-6

BELLEKENO TREATED EFFLUENT DISCHARGE PATH AND PLACER MINING DISTURBANCES

OCTOBER 2023

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*4.2.1.1 **Bellekeno Adit Water Quality***

Historical Data

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 Water Licence issuance and advanced exploration activities at the Bellekeno Mine in 2009.

Three periods of dewatering occurred in the history of the Bellekeno Mine: in 1994 during exploration activities, again in 2008 to 2009 during advanced exploration activities by Alexco Resource Corp, and in 2020 following the cessation of temporary closure.

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 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 are no parameters which indicate that ARD was developing. Leaching of zinc, probably from oxidation of zinc sulphides, was the only real concern from this adit.

Contemporary Data

Data collected since the 1994 dewatering are sparse following the shutdown of operations by UKHM; however, consistent data at Bellekeno collected from 2006 up to present day shows or confirms the following characteristics of Bellekeno underground water:

- Discharge flows typically ranged between 2.0 and 5.0 L/s, while 2021 median flow was 2.8 L/s (Figure 4-7). In 2021, flow was generally higher from March until the end of June (average of 3.5 L/s), compared to the remainder of the year (average of 2.7 L/s).
- Slightly alkaline pH values, typically between 7 and 8. In 2021, pH was between 6.95 and 10.96, with a median pH of 7.83 (Figure 4-8).

- 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 4-9). During 2014 to 2021, the correlation between sulphate and zinc concentrations was not clearly discernable.
- Iron concentrations generally remained low with occasional cycles of increased iron in the adit discharge (Figure 4-10). Concentrations followed the same trend as zinc and cadmium, with a high correlation with both (see Figure 4-7 for zinc; R = 0.98) suggesting that dissolution of iron occurred in tandem with these other two parameters.
- Cadmium concentrations were correlated with those of zinc (Figure 4-12).

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. Results from the Bellekeno Mine Wall Testing from 2010 to 2013 indicated that ARD was not developing in the mine walls underground (AEG, 2013). There is sufficient alkalizing material in Bellekeno rock to neutralize the mine water. The Bellekeno 625 Adit discharge pH was slightly alkaline with no correlation with metals concentrations in the water.

Conditions with respect to mine water have changed since the period of advanced exploration dewatering was begun in December 2008. Mine water discharge volume can vary from day to day and variability has also been seen in zinc concentrations (Figure 4-8); however, less variability was observed since mining operations temporarily ceased at the end of August 2013.

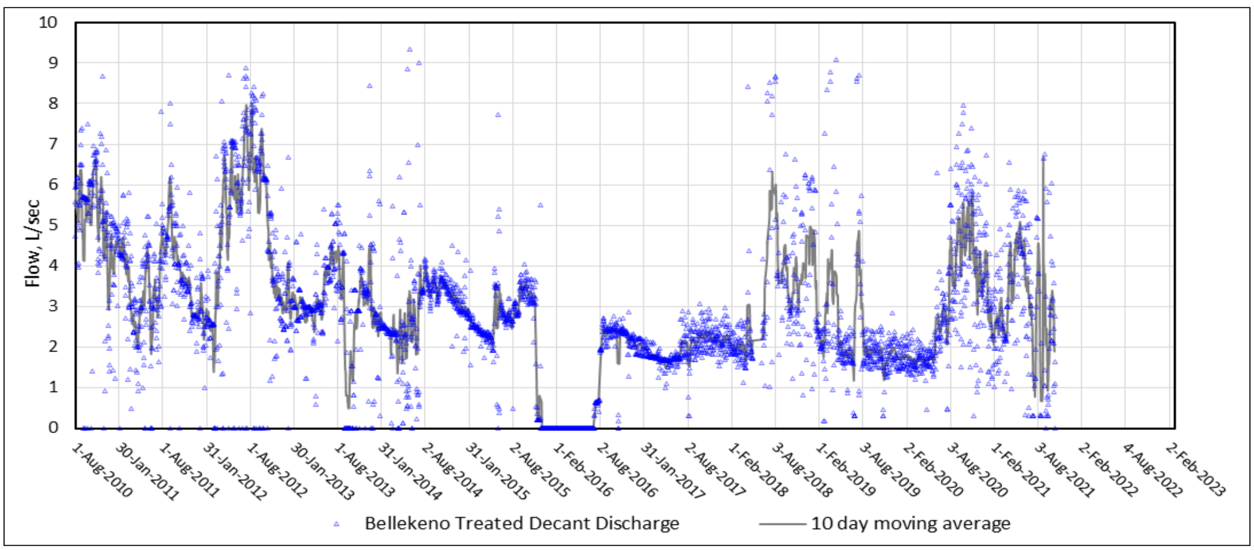


Figure 4-7: Bellekeno 625 Treatment System Flow through Discharge August 2010 to December 2022

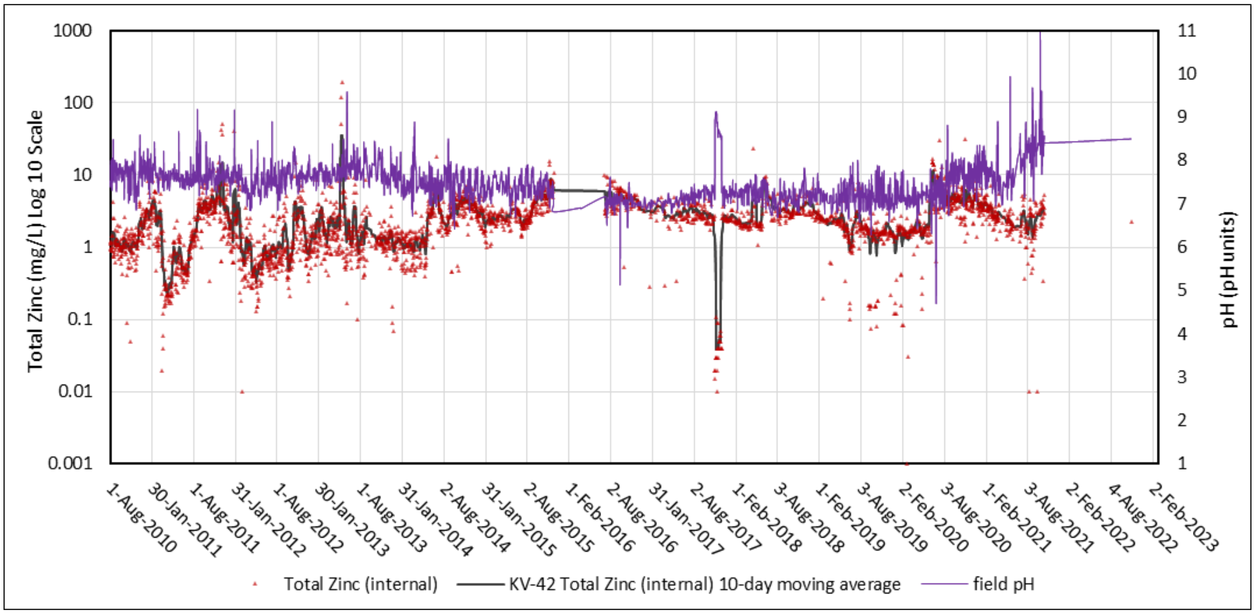


Figure 4-8: Bellekeno 625 Adit Total Zinc (Internal) and pH (field) August 2010 to December 2022

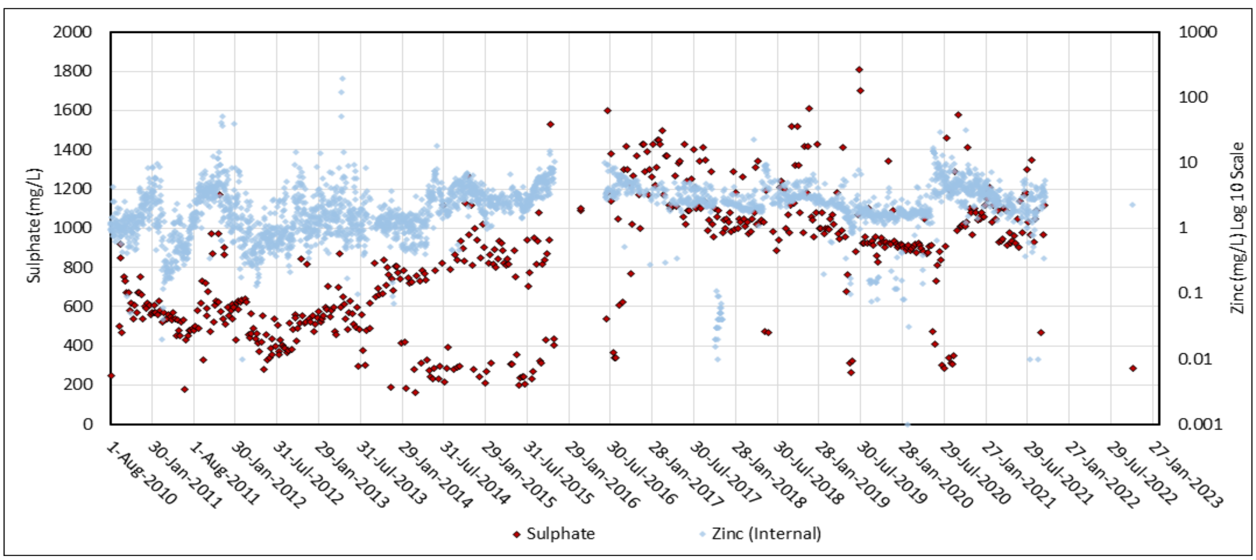


Figure 4-9: Bellekeno 625 Adit Sulphate and Internal Zinc, August 2010 to December 2022

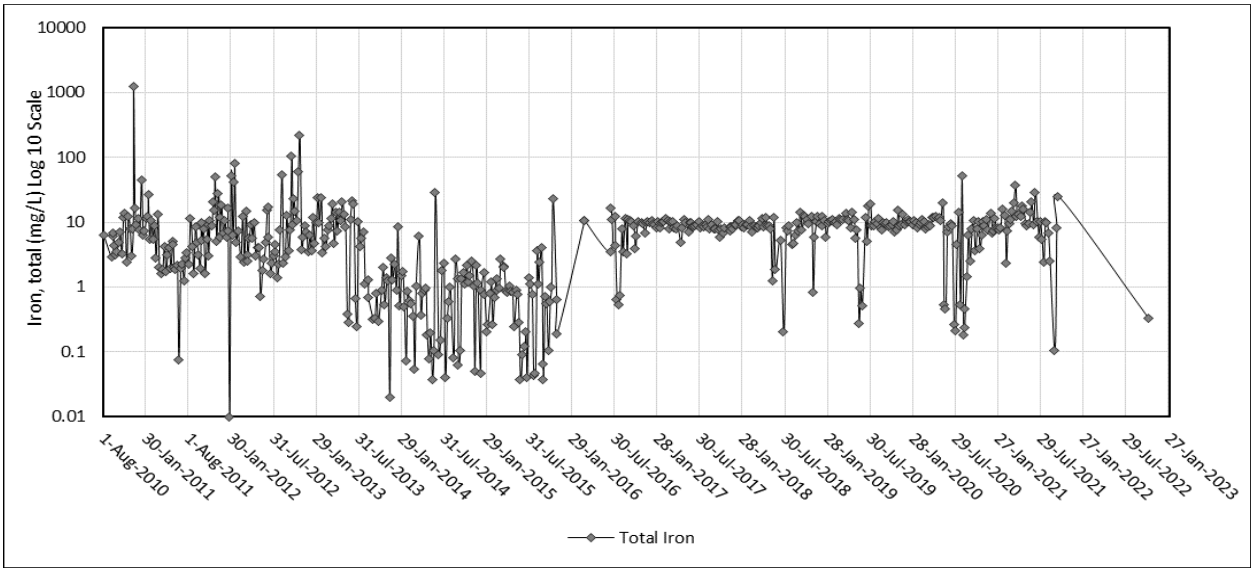


Figure 4-10: Bellekeno 625 Adit Iron Concentrations, August 2010 to December 2022

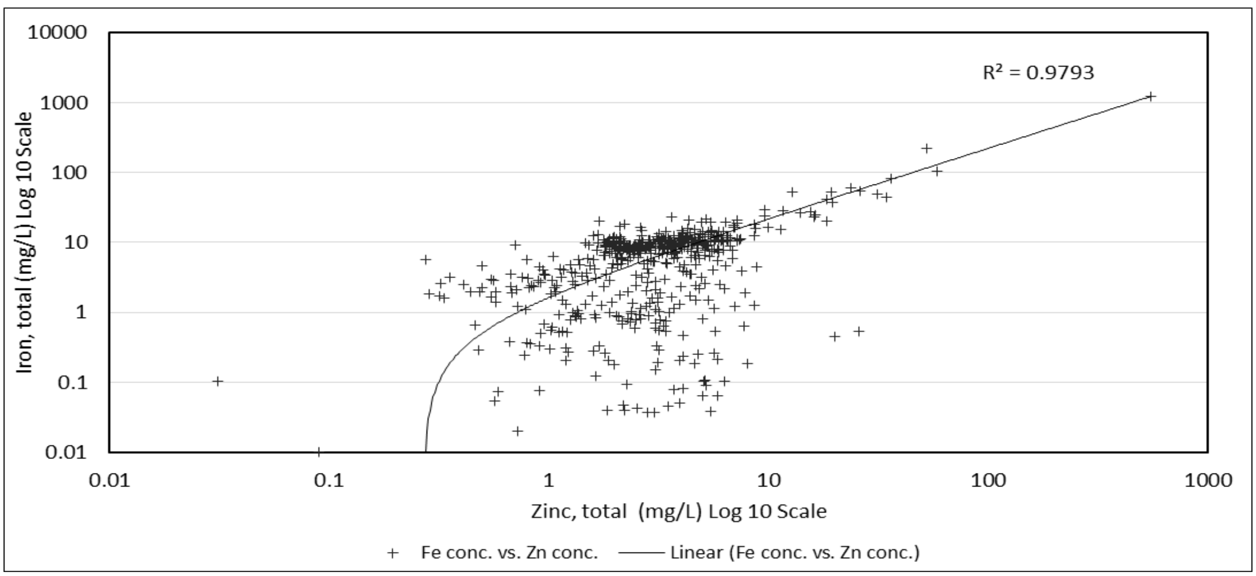


Figure 4-11: Bellekeno 625 Adit Iron and Zinc Concentration Correlation, August 2010 to December 2022

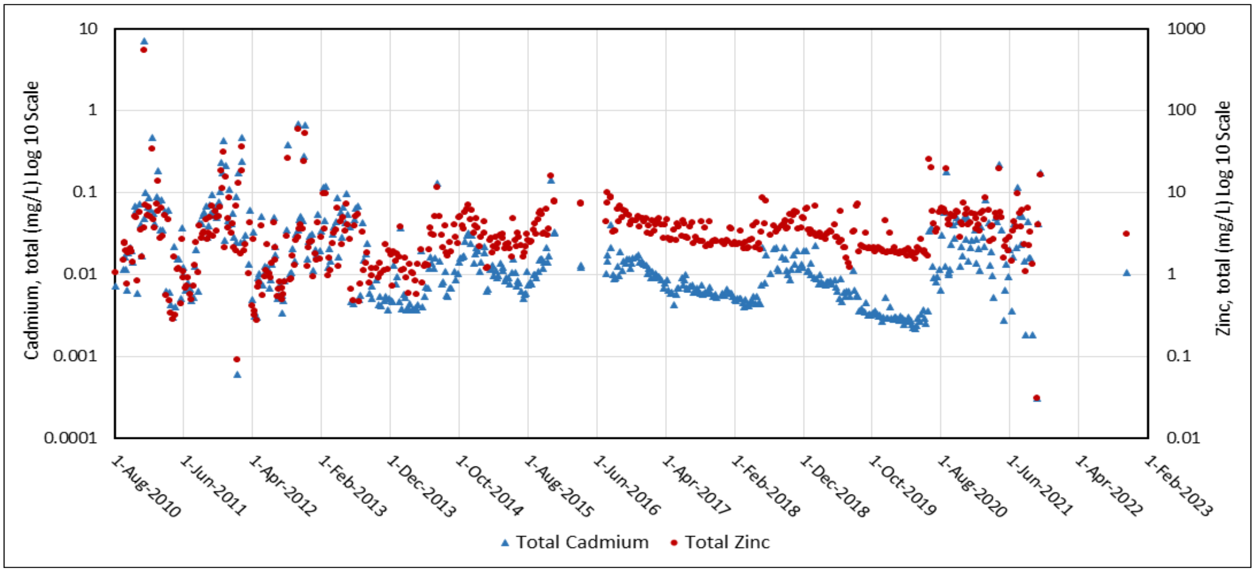


Figure 4-12: Bellekeno 625 Adit Total Cadmium and Zinc Concentrations, August 2010 to December 2022

*4.2.1.2 **Bellekeno Treatment Plant Water Quality***

Dewatering activities at the Bellekeno Mine stopped in October 2021. No discharge from the Bellekeno Mine occurred in 2022, so no water treatment was required. In 2022, the only discharge from the Bellekeno 625 WTP settling pond occurred in fall 2022 in preparation for 2023 spring melt. Discharge from the Bellekeno 625 adit resumed in May 2023, when the workings had re-flooded to their static water level. Adit discharge water was directed to the existing water treatment plant.

Total zinc concentrations and pH of the treated decant water at Bellekeno are shown in Figure 4-13. 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.

Other WL EQS for the treated decant water at Bellekeno were also exceeded for total cadmium, lead, and silver on September 8, 2020. That the total concentration of these metals in the treated decant were higher than the untreated adit discharge suggests that foreign particles 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 more 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). 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 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).

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 4-14), ranging between0.3 and 6.0 L/sec in 2021. No discharge from Bellekeno 625 adit has occurred since October

2021 due to the cessation of mining activities. 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 total suspended solids (TSS) and ammonia, primarily due to no underground mining. Both TSS and ammonia varied widely during fluctuations in flow (Figure 4-15 and Figure 4-16). 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 4-10). TSS remained consistent in Bellekeno adit water since fall 2016 until approximately August 2020, when the resumption of mining activities caused the flow rate and TSS to increase.

TSS concentrations exceeded the EQS (25 mg/L) for the treated decant water at Bellekeno on five occasions in 2021 (Figure 4-14). January 25, March 29, April 12, September 27, and October 5. The TSS concentrations measured on these dates ranged from 25.6-40.2 mg/L. The accumulation of sludge in the ponds reduced the volume available for settling. Sludge (198.5 m^3) was removed from the ponds during the no discharge period in 2022.

In Fall of 2020, mine development and blasting resumed at Bellekeno, which contributed ammonia to the underground water circuit (Figure 4-17).

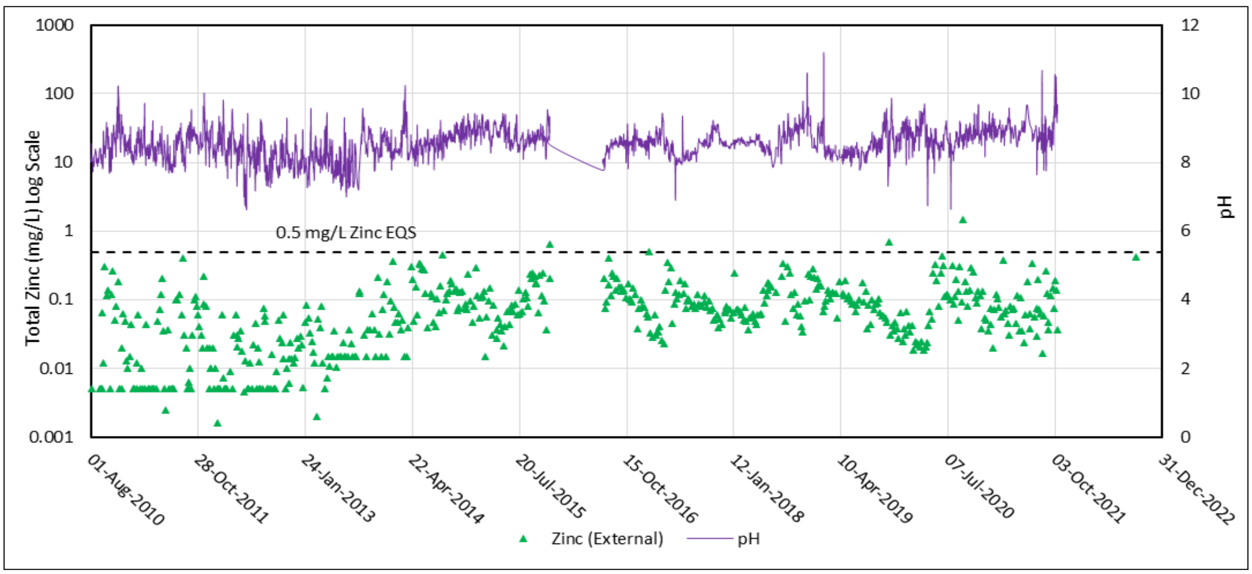


Figure 4-13: Bellekeno 625 Decant Internal Zinc and pH, August 2010 to December 2022

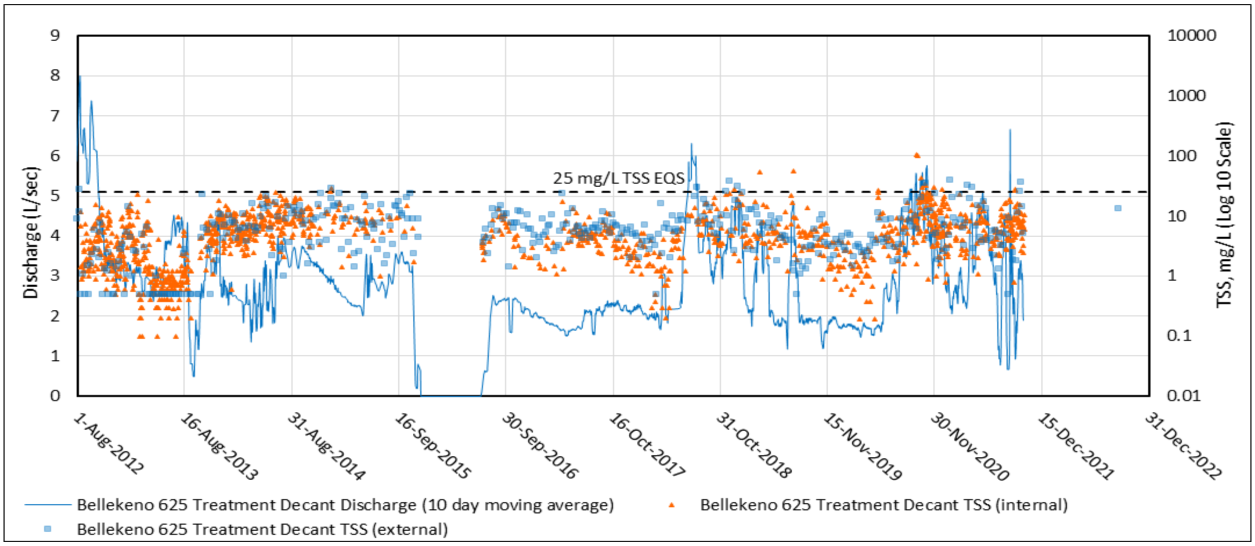


Figure 4-14: Bellekeno 625 Decant Flow and TSS August 2012 to December 2022

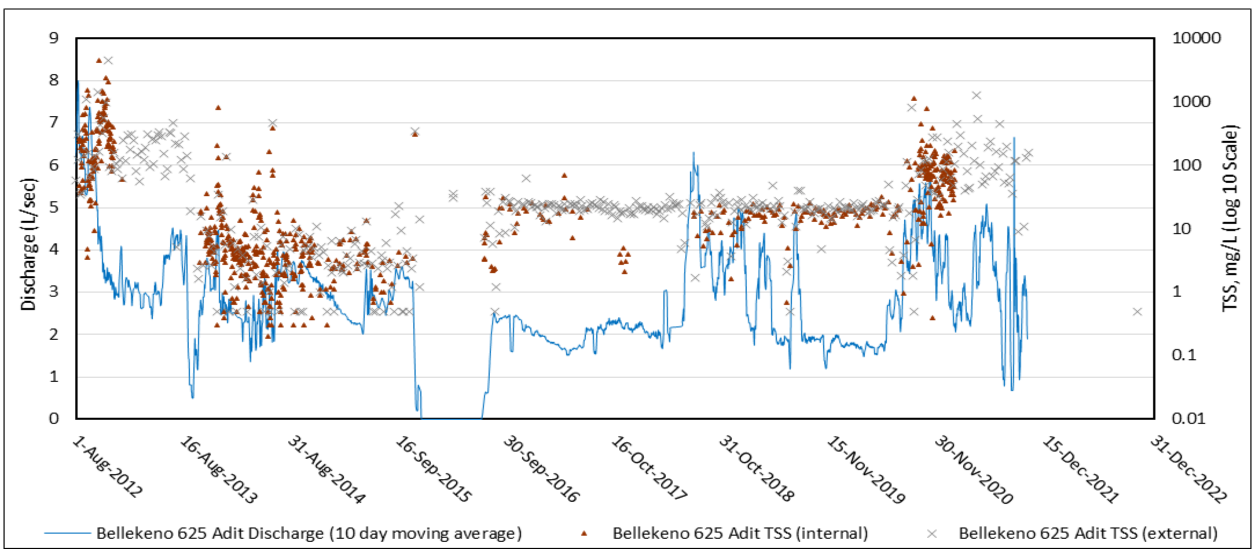


Figure 4-15: Bellekeno 625 Adit Flow and TSS August 2012 to December 2022

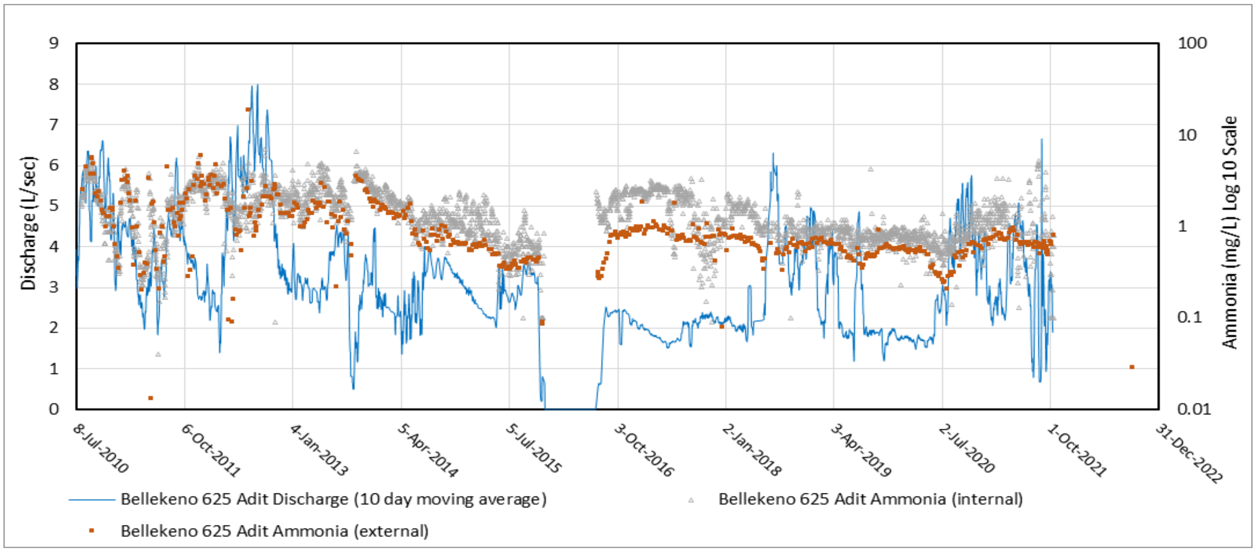


Figure 4-16: Bellekeno 625 Adit Flow and Ammonia August 2010 to December 2022

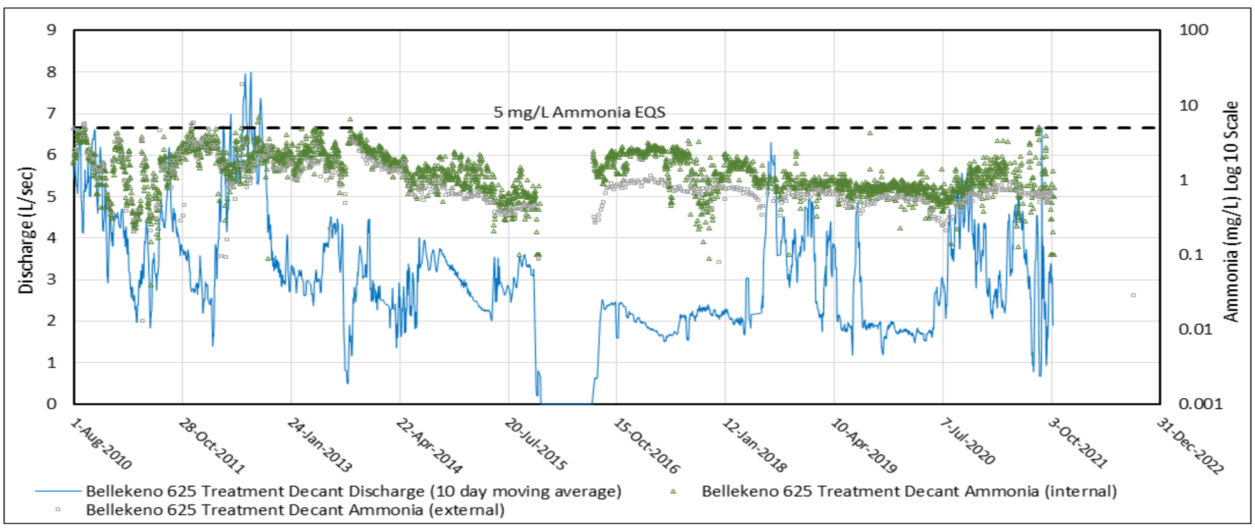


Figure 4-17: Bellekeno 625 Decant Flow and Ammonia August 2010 to December 2022

4.2.2 Flame & Moth

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, Clauses 65 and 66 of Water Licence 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 (KV-104L) occurred periodically to the Lightning Creek watershed, with none directed to the Christal Creek watershed in 2018 to 2022 other than for 10 days in May 2021.

Discharge measurements from the Flame & Moth adit and pond since 2018 are shown on Figure 4-14 and Figure 4-15, respectively. Sample results from the Flame & Moth adit and pond for analytes with EQS are provided in Figure 4-16 to Figure 4-25. 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 2022. The dissolved parameters, such as cadmium, arsenic, copper, nickel, silver, zinc, and ammonia from the decant (KV-104L) were below the EQS, except lead, which was measured at 0.0369 mg/L in October 2021, slightly above the EQS for lead of 0.036 mg/L. Dissolved copper, lead, and silver concentrations (Figure 4-22 Figure 4-23, and Figure 4-25, respectively) from the adit were below or near to laboratory detection limits from 2018 to 2022 (Figure 4-23).

Higher flows out of the Flame & Moth adit and pond from mid-August 2020 to September 2022 (Figure 4-18 and Figure 4-19) 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, suggesting that the flowmeter may need calibration. The higher TSS observed over this period also reflects mining activities (Figure 4-28). Similarly, ammonia and lead concentrations were also higher during this time frame (Figure 4-27 and Figure 4-23, respectively). Dissolved copper and silver concentrations from the adit during this period were at the detection limit (Figure 4-22 and Figure 4-25, respectively). At the Flame & Moth pond decant (KV-104L), TSS at KV-104L was only found slightly above the EQS of 15 mg/L in three sampling events, showing 19.8 mg/L in November 2020, 16.8 mg/L in September 2021, and 16 mg/L in October 2022 (Figure 4-28).

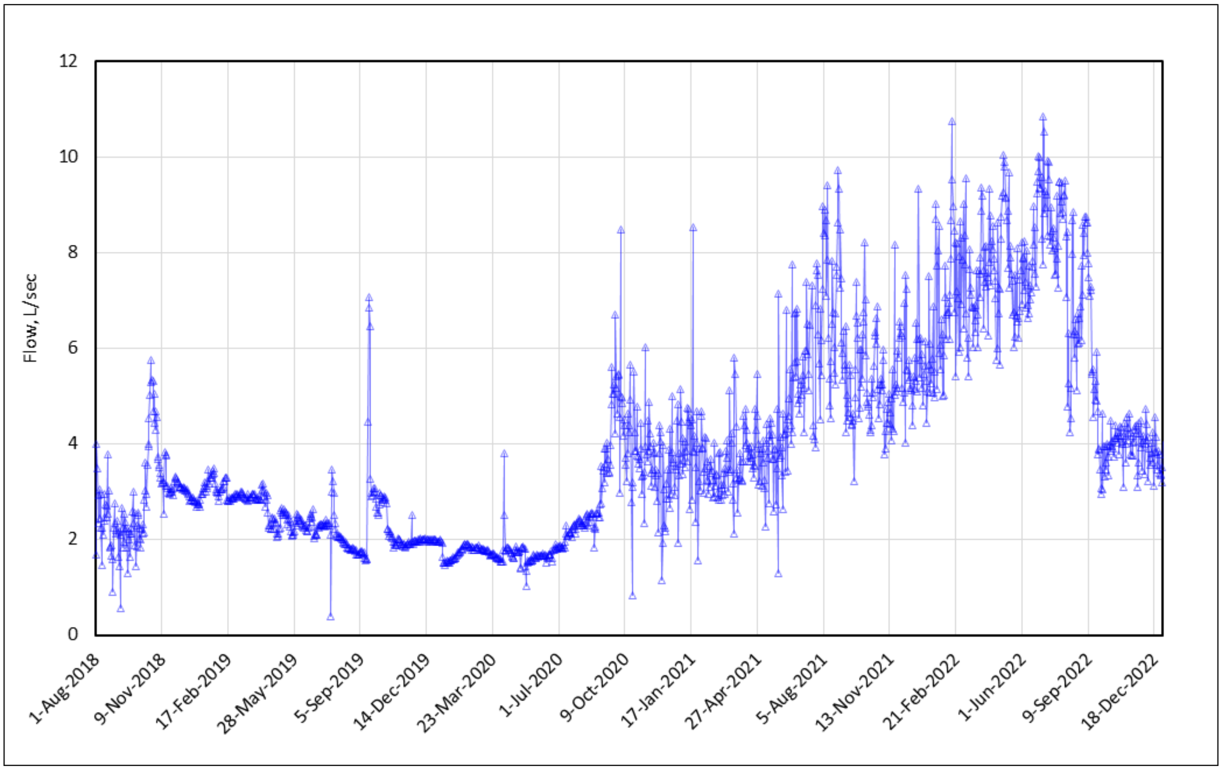


Figure 4-18: Flame & Moth Adit Discharge August 2018 to December 2022

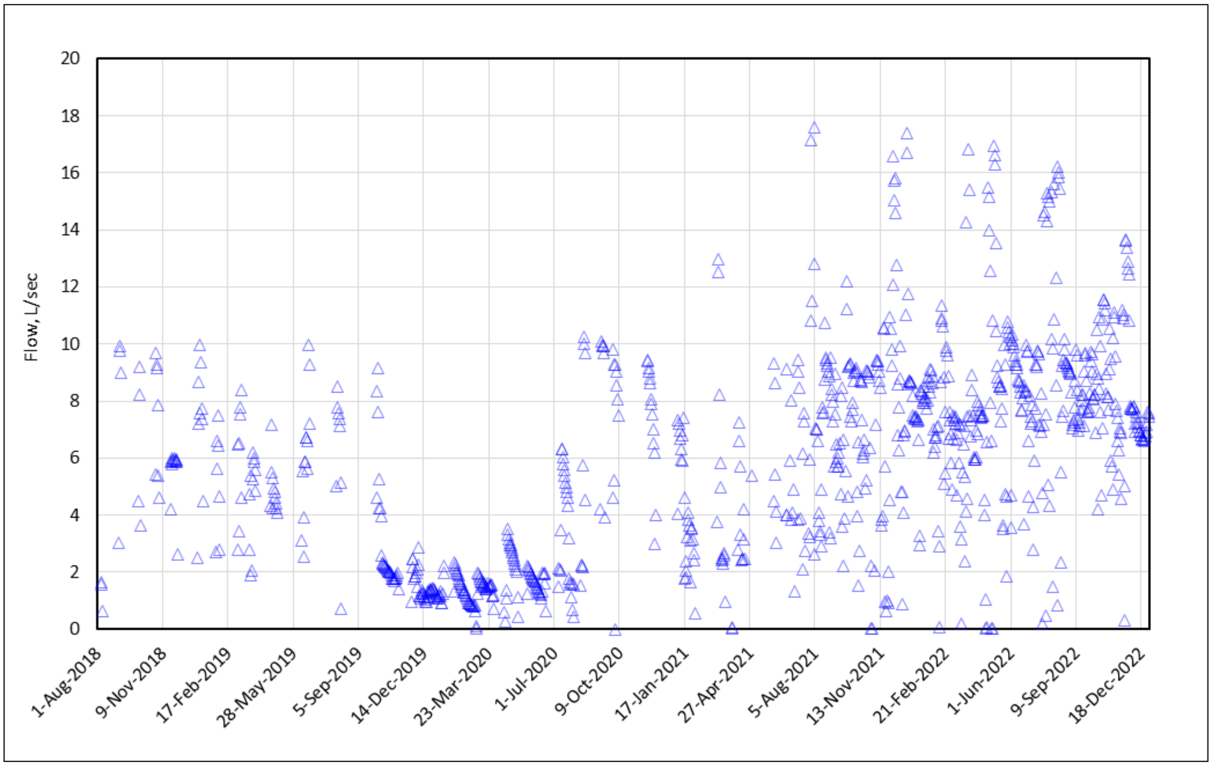


Figure 4-19: Flame & Moth Pond Discharge August 2018 to December 2022

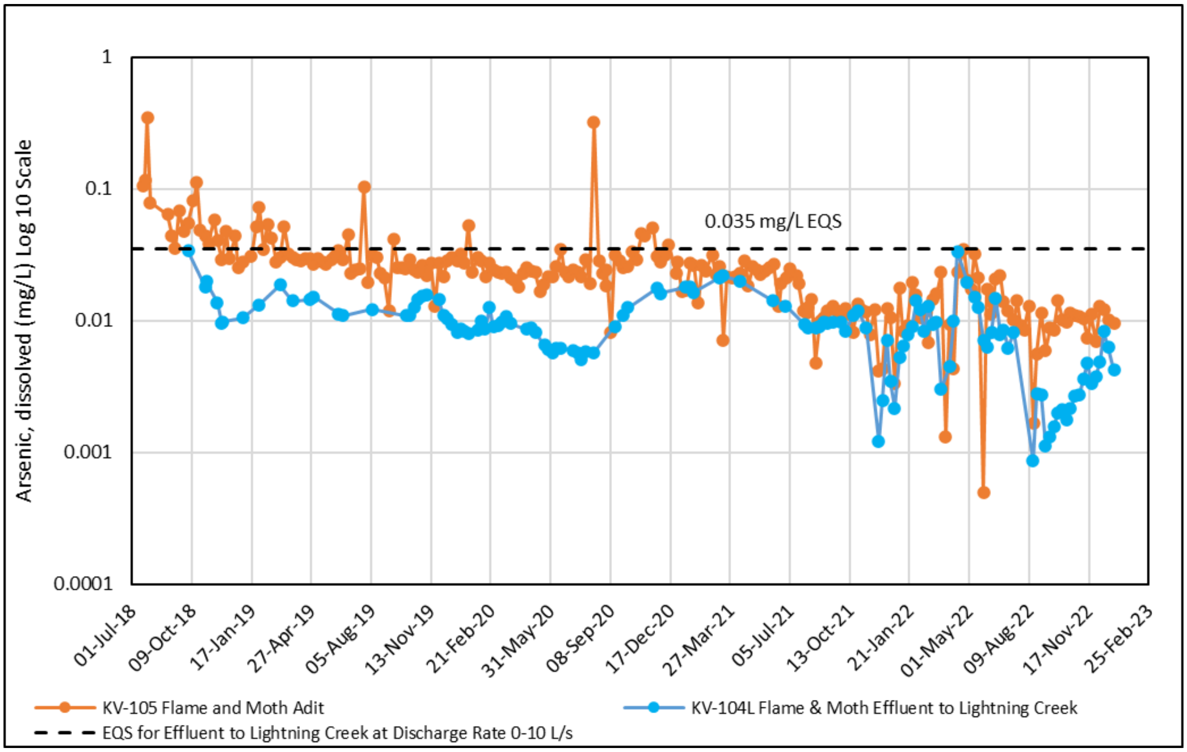


Figure 4-20: Flame & Moth Dissolved Arsenic, 2018 to 2022

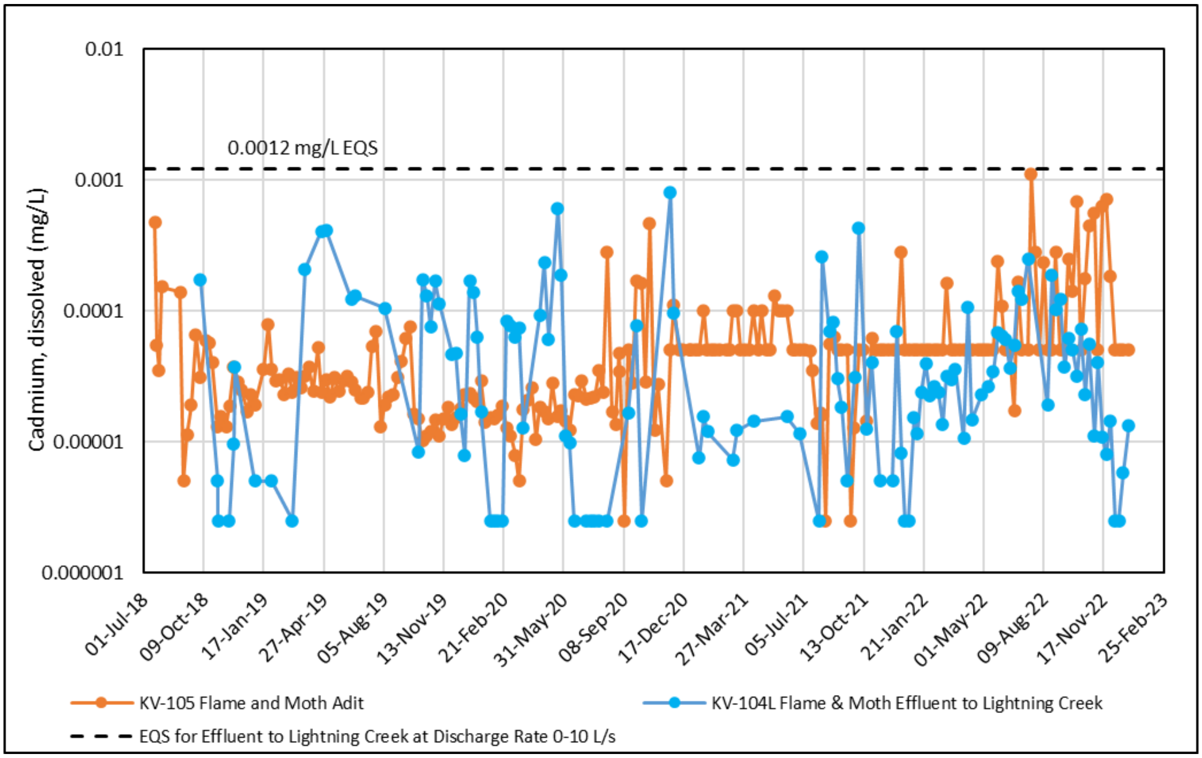


Figure 4-21: Flame & Moth Dissolved Cadmium, 2018 to 2022

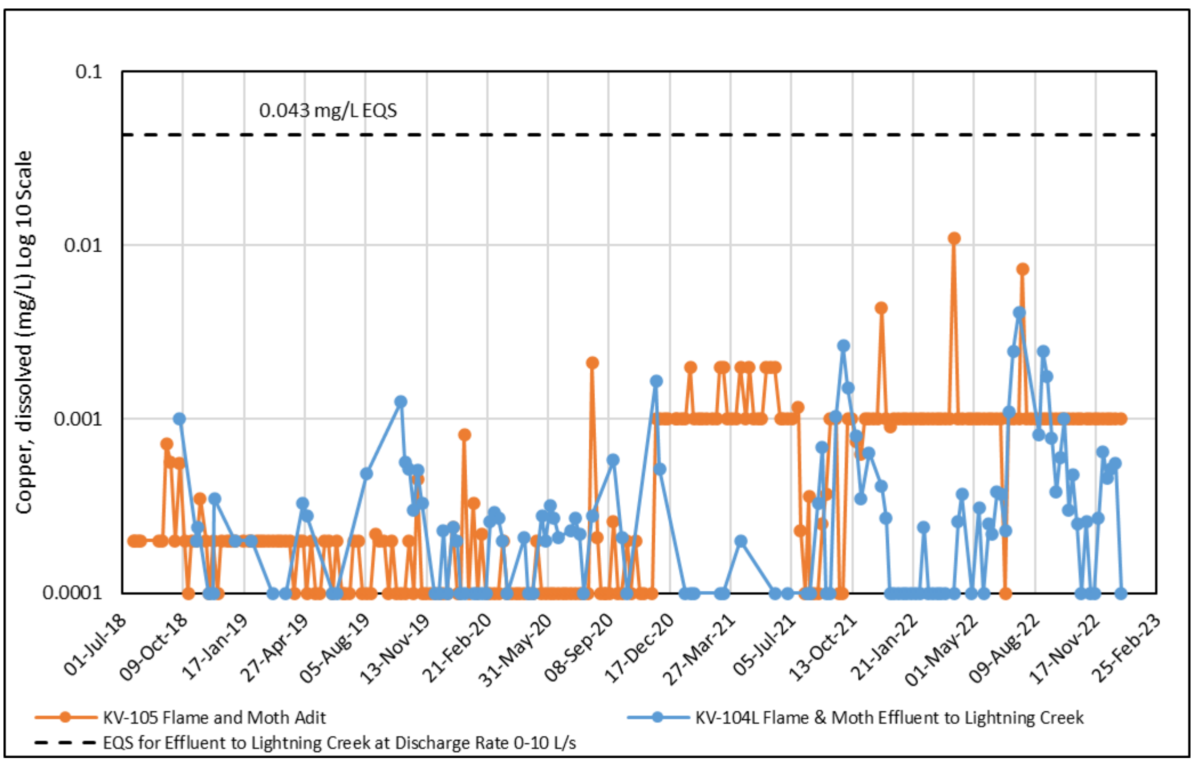


Figure 4-22: Flame & Moth Dissolved Copper, 2018 to 2022

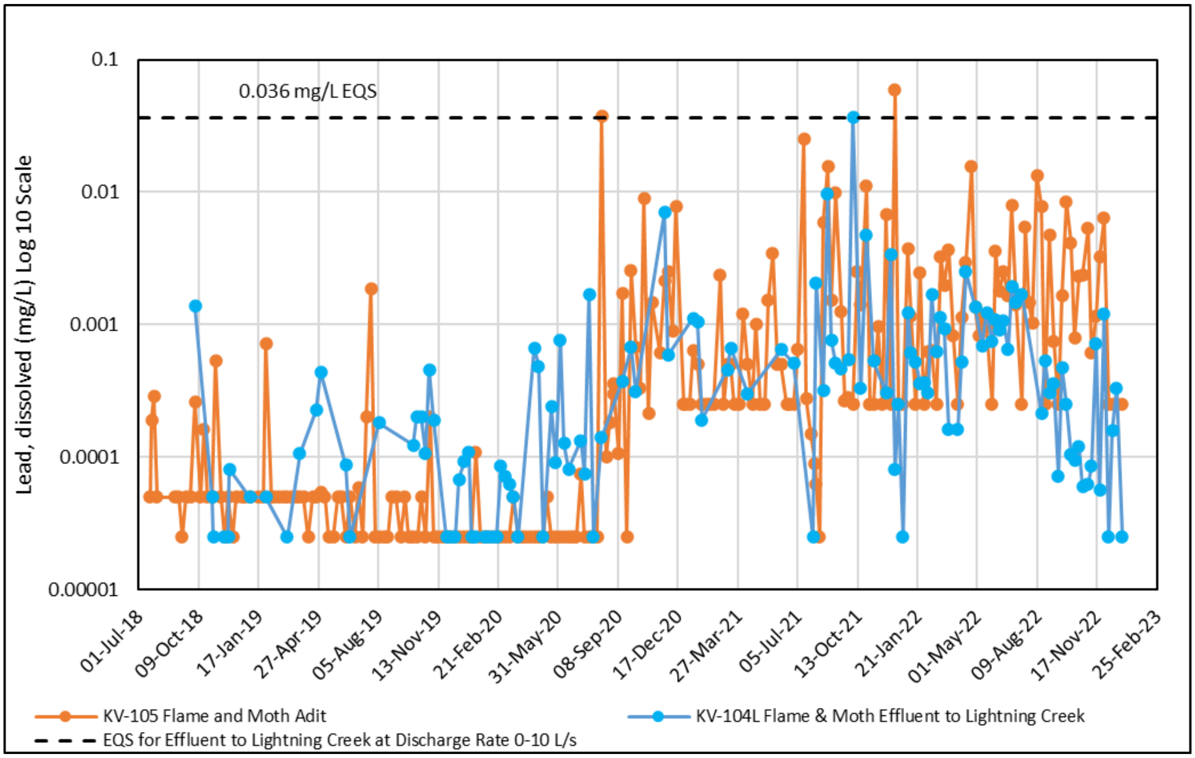


Figure 4-23: Flame & Moth Dissolved Lead, 2018 to 2022

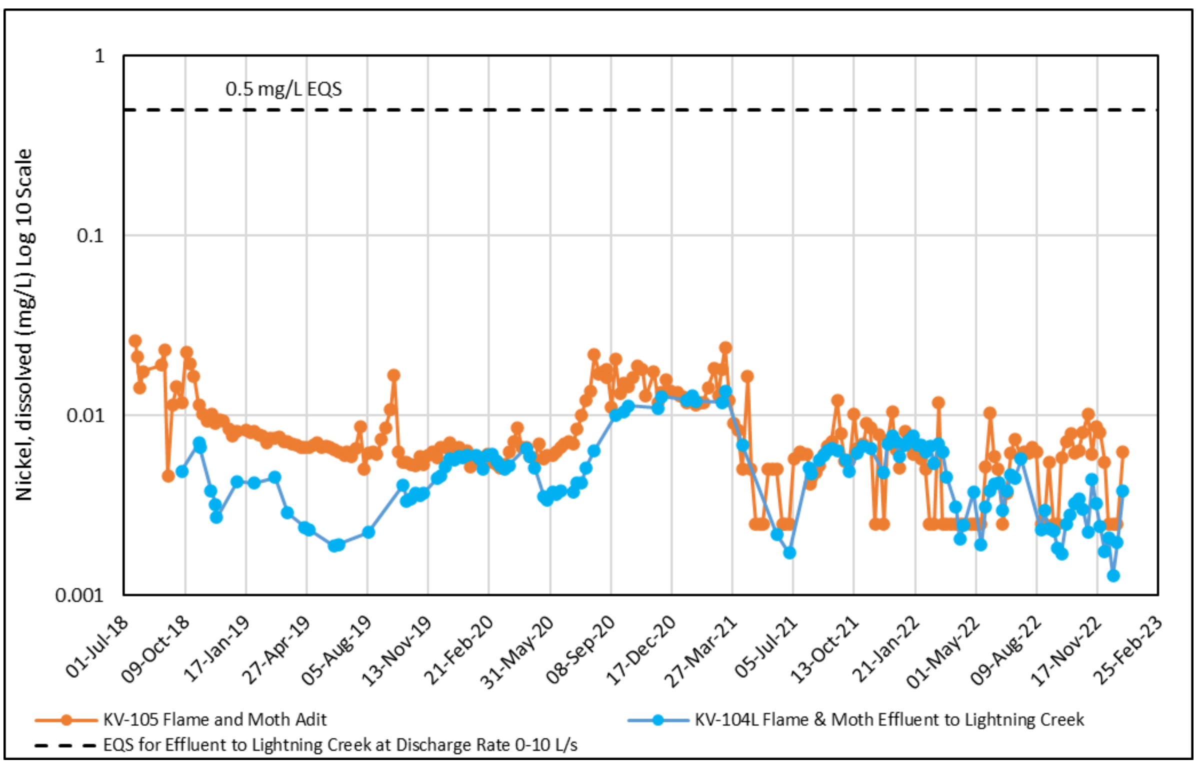


Figure 4-24: Flame & Moth Dissolved Nickel, 2018 to 2022

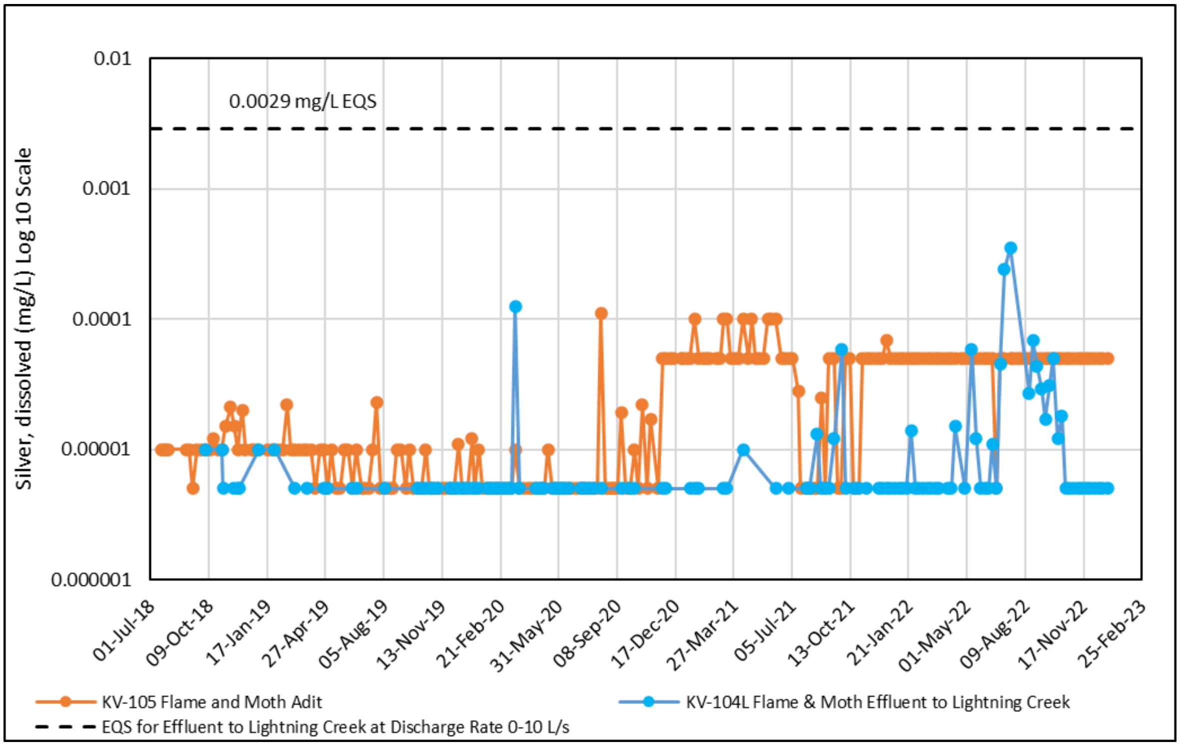


Figure 4-25: Flame & Moth Dissolved Silver, 2018 to 2022

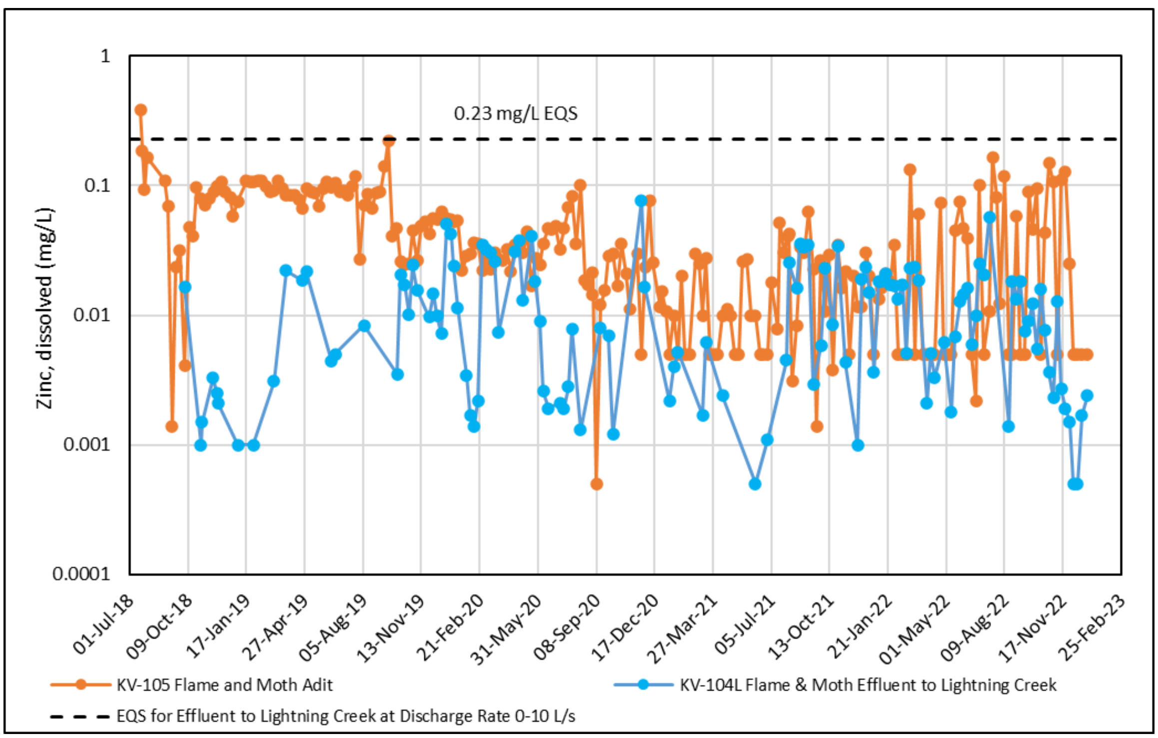


Figure 4-26: Flame & Moth Dissolved Zinc, 2018 to 2022

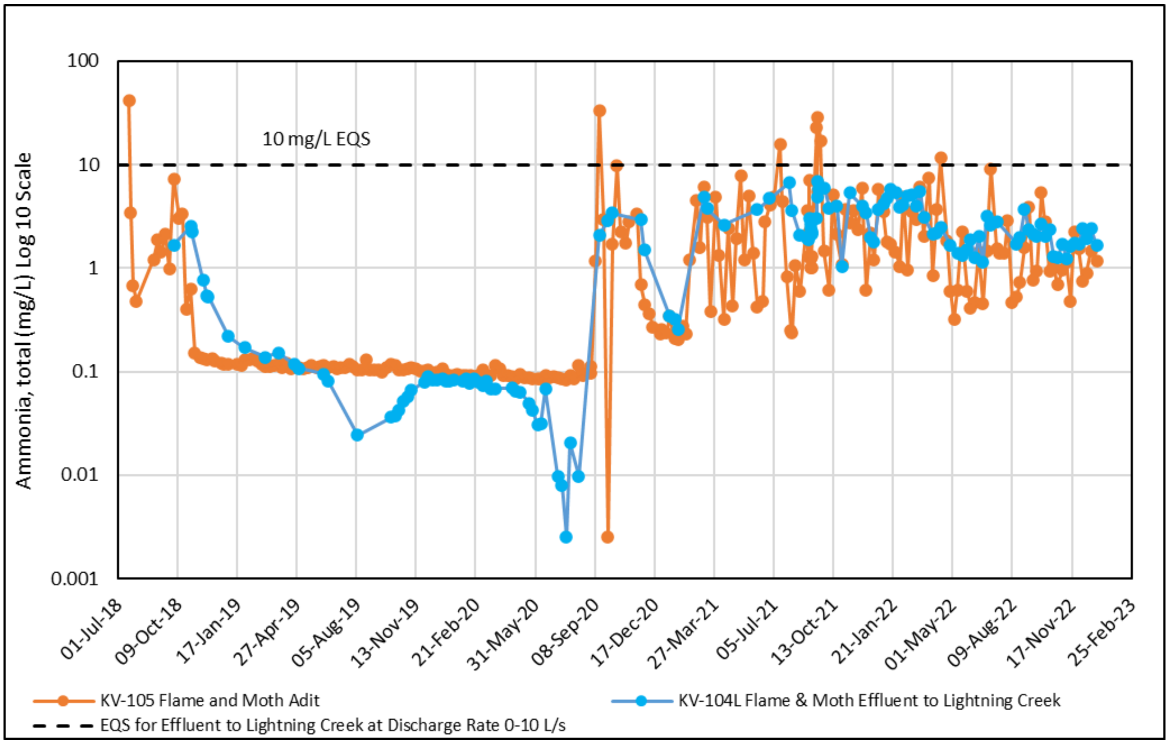


Figure 4-27: Flame & Moth Ammonia, 2018 to 2022

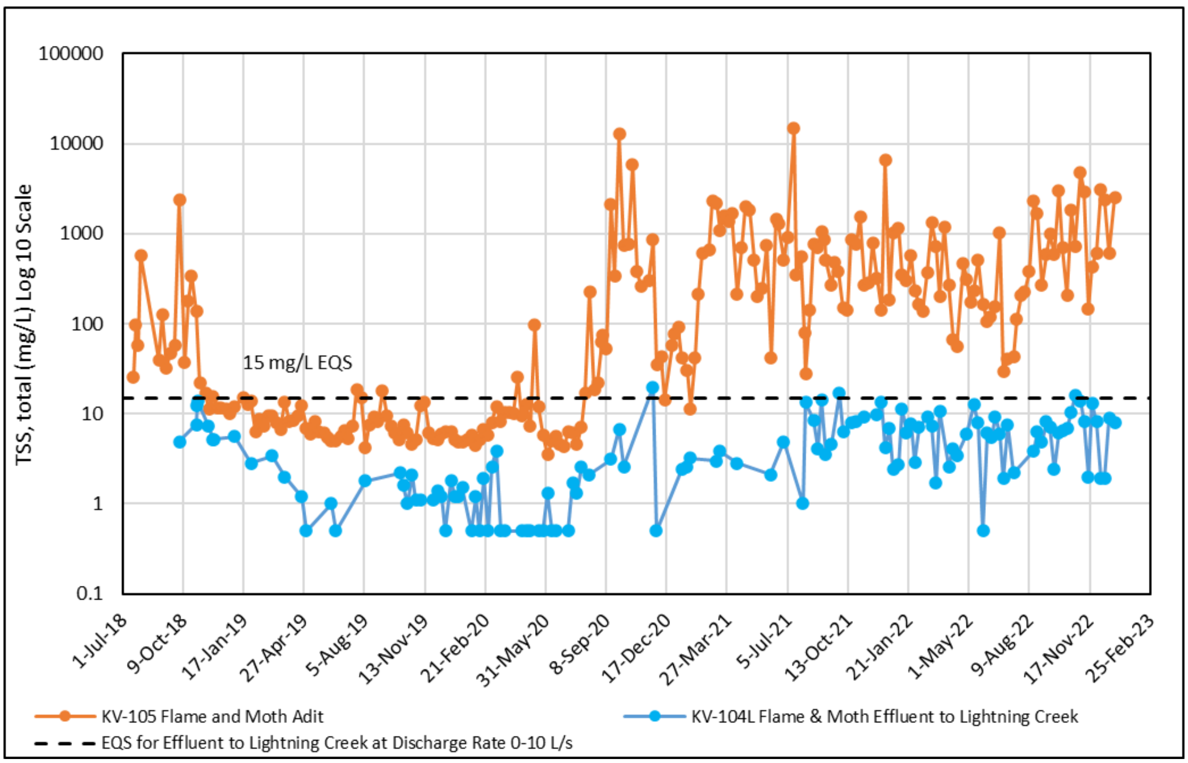


Figure 4-28: Flame & Moth Total Suspended Solids, 2018 to 2022

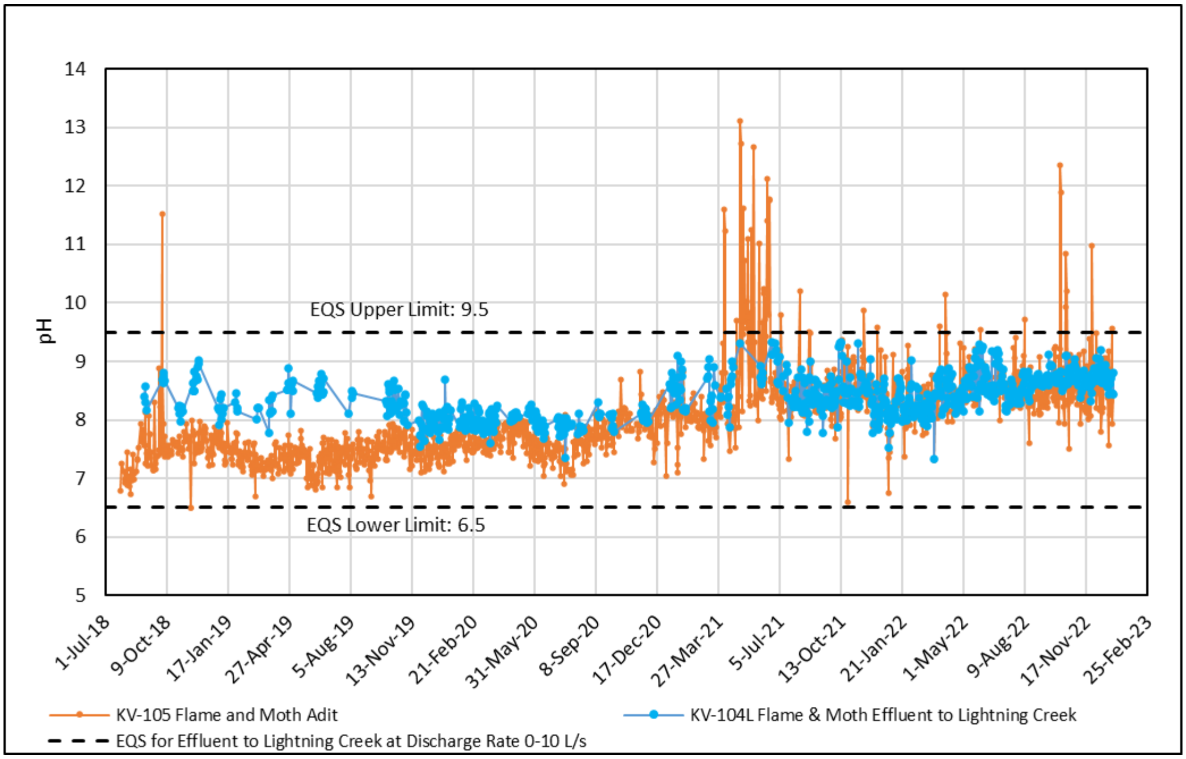


Figure 4-29: Flame & Moth pH, 2018 to 2022

4.2.3 Lightning Creek

Lightning Creek is a mountainous alpine stream flowing within a narrow valley with a steep gradient from the north side of Sourdough Hill into Duncan Creek, which drains into the Mayo River. Historically several mines have been in operation in the Lightning Creek watershed including: Keno 700, Bellekeno, Homestake, Demon, Bema, Divide, Comstock, Apex, Charity, Vanguard, Runner, Ironclad, Hogan and Gold Hill number 2. Placer mining in Lightning Creek and Thunder Gulch predate the AKHM operations of the Bellekeno Mine. The water treatment plant treats Bellekeno 625 adit discharge, with treated effluent discharged to ground up hill from the placer ponds, eventually reporting to Lightning Creek. Farther downstream, treated water from the Flame & Moth Mine is discharged towards Lightning Creek.

Hope and Thunder Gulches flow into Lightning Creek within the bounds of KHSD Mining Operations property. Lightning Creek and its tributaries have been the site of extensive placer mining in the vicinity of Keno City both historically and at present time.

Lightning Creek is one of only two creeks in the Keno Hill mining camp not connected to the South McQuesten River (the other is the Sadie Ladue drainage, which reports to the Ladue River). There are nine regularly monitored surface water stations under WL QZ18-044 within the watershed from the reference station at KV-37 to the farthest downstream station KV-81, southwest of the District Mill (Table 4-6).

Table 4-6: 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

Figure 4-30 to Figure 4-35 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 lowest median hardness of sites within the catchment. Summary statistics for the stations are presented in Table 4-7 and Table 4-8.

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. 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 District Mill and Flame & Moth treated discharge.

There is only one historical mine site which drains to the Lightning Creek watershed – the Keno 700 adit and associated waste rock dump. 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 4- to 7-fold lower than those observed downstream at station KV-38 (Table 4-7 and Table 4-8). Although cadmium and zinc concentrations were elevated at KV-38 relative to KV-37, due to the contribution from the Keno 700 adit discharge, , 58% and 62% of samples collected between 2008 and 2022 were below the CCME-PAL guideline for total cadmium and dissolved zinc, respectively (Table 4-7 and Table 4-8). Cadmium and zinc concentrations observed at KV-38 in 2022 were comparable to the historical record, with three total cadmium concentration above the CCME-PAL guideline observed in June, August and October 2022 and two dissolved zinc exceedances (June and October) (Figure 4-30 and Figure 4-33).

Farther downstream on Lightning Creek, median cadmium and zinc concentrations at KV-41 were lower than those observed at KV-38 (Table 4-7 and Table 4-8), reflecting dilution from Thunder Gulch. Median zinc concentrations were comparable between the two sites. In 2022, 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 2022 occurred in June (Figure 4-31 and Figure 4-34), coincident with elevated TSS (76 mg/L). Cadmium and zinc concentrations observed at KV-41 in 2022 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 were similar to those observed upstream at KV-41 (Table 4-7 and Table 4-8), 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 2022 were generally comparable with the historical record. Similar increases in concentrations between the months of April-July 2022 were observed, where total cadmium and zinc concentrations comprised mostly of the particulate fraction (ranging from 17-68% dissolved; Figure 4-31 and Figure 4-34).

Placer mining upstream of the Keno Hill mining camp 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 Lighting 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 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 were observed in August to December 2022, with dissolved concentrations of both zinc and cadmium only accounting for 2-14% of total concentration at KV-65 (indicating high concentration of particulate zinc and cadmium). Dissolved zinc and cadmium concentrations from Thunder Gulch in 2022 were relatively consistent between KV-77, KV-65, and KV-76 with slight increases moving downstream (Table 4-7 and Table 4-8).

Cadmium and zinc concentrations in the Upper Lightning Creek watershed showed little to no seasonality (Figure 4-30 and Figure 4-33). 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 and were influenced by the spring freshet (Figure 4-26, Figure 4-27, Figure 4-29, Figure 4-30). In Thunder Gulch (KV-65, KV-76, and KV-77) weak seasonality was observed for zinc and cadmium concentrations between 2008 and 2022 (Figure 4-32 and Figure 4-35). 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).

Table 4-7: Lightning Creek Drainage Zinc Summary Statistics, 2008 to 2022

Zinc, total									
2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.03635	0.0173	0.196	0.0061	0.0202	0.01598	0.0195	0.0128	0.02287
Count	4	5	4	2	4	12	4	12	56
Minimum	<0.0030	0.0054	0.140	0.0035	0.0155	<0.0030	0.0048	0.0057	0.0076
Maximum	0.137	0.0425	0.248	0.0087	0.0252	0.0414	0.0293	0.0323	0.0854
Count<DL	1	0	0	0	0	1	0	0	1
Standard Deviation	0.06711	0.0149	0.045	0.0037	0.0040	0.01298	0.0104	0.0075	0.01571
1st Quartile	0.00292	0.0085	0.174	0.0048	0.0188	0.0056	0.0174	0.0093	0.0128
Median	0.00345	0.0118	0.197	0.0061	0.0201	0.0119	0.022	0.0106	0.0158
3rd Quartile	0.03688	0.0183	0.218	0.0074	0.0215	0.0243	0.0241	0.0121	0.02905
99 Percentile	0.13299	0.0415	0.247	0.0086	0.0251	0.0407	0.0291	0.0312	0.07039
2008-2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.00882	0.01637	0.1950	0.00747	0.09977	0.03130	0.05832	0.01729	0.01790
Count	125	91	55	39	53	161	61	181	238
Minimum	<0.001	0.0037	0.0952	<0.0030	0.0004	0.0014	0.0015	<0.0030	0.0039
Maximum	0.239	0.101	0.468	0.0273	3.23	1.11	0.829	0.144	0.219
Count<DL	50	0	0	3	8	9	1	1	2
Standard Deviation	0.03179	0.01386	0.0726	0.00596	0.44783	0.11307	0.15306	0.01740	0.01787
1st Quartile	<0.0030	0.0079	0.1465	0.00325	0.0019	0.0038	0.0071	0.0073	0.00892
Median	<0.0030	0.0118	0.172	0.005	0.0081	0.006	0.0145	0.0115	0.0133
3rd Quartile	0.0039	0.01895	0.2155	0.00915	0.0297	0.0162	0.0293	0.0199	0.02055
99 Percentile	0.20464	0.07004	0.4318	0.02415	1.86396	0.4918	0.7264	0.08332	0.06062
Zinc, dissolved									
2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.0322	0.0154	0.188	0.0051	0.00295	0.00209	0.00530	0.0107	0.01083
Count	4	5	4	2	4	12	4	12	56
Minimum	0.0017	0.0055	0.133	0.0031	<0.0010	<0.0010	<0.0010	0.0045	<0.0100
Maximum	0.123	0.0341	0.221	0.0071	0.0062	0.0068	0.0172	0.0260	0.0276
Count<DL	0	0	0	0	1	4	1	0	1
Standard Deviation	0.0605	0.0115	0.039	0.0028	0.00252	0.00209	0.00797	0.0067	0.00496
1st Quartile	0.0018	0.0077	0.174	0.0041	0.00125	0.0005	0.00095	0.007	0.0076
Median	0.0022	0.0113	0.2	0.0051	0.00255	0.00155	0.00175	0.0091	0.0093
3rd Quartile	0.0326	0.0182	0.214	0.0061	0.00425	0.0019	0.0061	0.0103	0.0122
99 Percentile	0.1194	0.0335	0.221	0.0071	0.00612	0.0067	0.01676	0.0256	0.02524
Count > Guideline	1	2	4	0	0	0	0	1	5
% > Guideline	25.0	40.0	100.0	0.0	0.0	0.0	0.0	8.3	8.9
2008-2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.00833	0.01450	0.1873	0.00656	0.01078	0.00320	0.00727	0.01038	0.01002
Count	125	91	55	39	54	161	61	181	238
Minimum	<0.0010	0.005	0.0888	0.0024	<0.0010	<0.0010	<0.0010	0.0016	0.0026
Maximum	0.23	0.0587	0.412	0.02	0.194	0.0190	0.0235	0.265	0.0379
Count<DL	16	0	0	0	22	24	4	0	2
Standard Deviation	0.03081	0.00996	0.0626	0.00481	0.03738	0.00288	0.00593	0.01990	0.00571
1st Quartile	0.0011	0.00792	0.1505	0.003	0.0005	0.0015	0.0025	0.005	0.00602
Median	0.002	0.0111	0.171	0.0042	0.0014	0.0021	0.0052	0.0076	0.0085
3rd Quartile	0.00325	0.0174	0.2065	0.00905	0.00258	0.0041	0.011	0.0108	0.01195
99 Percentile	0.2028	0.05375	0.4007	0.01928	0.17068	0.01302	0.0223	0.03574	0.03029
Count > Guideline	11	34	55	1	4	5	8	18	23
% > Guideline	8.8	37.4	100.0	2.6	7.4	3.1	13.1	9.9	9.7

Table 4-8: Lightning Creek Drainage Cadmium Summary Statistics, 2008 to 2022

Cadmium, total									
2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.0004559	0.0001809	0.00226	0.0000598	0.000173	0.0001325	0.0001781	0.0000944	0.0001910
Count	4	5	4	2	4	12	4	12	56
Minimum	0.0000081	0.0000514	0.00174	0.0000458	0.000130	0.0000272	0.0000504	0.0000372	0.0000433
Maximum	0.00175	0.000404	0.00268	0.0000739	0.000222	0.000347	0.000314	0.000282	0.000771
Count<DL	0	0	0	0	0	0	0	0	0
Standard Deviation	0.00086	0.00014	0.00039	0.00002	0.00004	0.00011	0.00011	0.00007	0.00015
1st Quartile	0.00002	0.00010	0.00215	0.00005	0.00016	0.00006	0.00012	0.00005	0.00010
Median	0.00003	0.00015	0.00231	0.00006	0.00017	0.00009	0.00017	0.00007	0.00013
3rd Quartile	0.00046	0.00020	0.00242	0.00007	0.00018	0.00020	0.00023	0.00010	0.00023
99 Percentile	0.00170	0.00040	0.00267	0.00007	0.00022	0.00034	0.00031	0.00027	0.00068
Count > Guideline	1	3	4	0	3	5	3	2	21
% > Guideline	25.0	60.0	100.0	0.0	75.0	41.7	75.0	16.7	37.5
2008-2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.00009445	0.0001747	0.00246	0.0000804	0.0009022	0.0002370	0.0005856	0.0001461	0.0001562
Count	125	91	55	39	53	161	61	181	238
Minimum	*<0.0000050*	0.000033	0.00135	0.0000289	*<0.000010*	*<0.00001*	0.00002	0.000007	0.0000349
Maximum	0.00255	0.00119	0.00606	0.000326	0.0256	0.00795	0.0109	0.00113	0.00274
Count<DL	8	0	0	0	2	2	0	0	0
Standard Deviation	0.00035471	0.0001621	0.00081	0.0000663	0.0037273	0.0007886	0.0016758	0.0001578	0.0002069
1st Quartile	0.000012	0.000079	0.001980	0.000036	0.000022	0.000036	0.000079	0.000057	0.000075
Median	0.000018	0.000123	0.002290	0.000046	0.000081	0.000060	0.000131	0.000082	0.000105
3rd Quartile	0.000036	0.000201	0.002590	0.000098	0.000222	0.000139	0.000303	0.000163	0.000164
99 Percentile	0.0023048	0.0008246	0.00541	0.0002861	0.0174308	0.003304	0.008338	0.0007002	0.0007011
Count > Guideline	15	38	55	5	20	40	27	52	60
% > Guideline	12.0	41.8	100.0	12.8	37.7	24.8	44.3	28.7	25.2
Cadmium, dissolved									
2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.0004366	0.0001458	0.00210	0.0000572	0.0000313	0.0000249	0.0000801	0.0000714	0.0000977
Count	4	5	4	2	4	12	4	12	56
Minimum	0.0000065	0.0000408	0.00169	0.0000427	0.0000092	0.0000118	0.0000116	0.0000320	0.0000200
Maximum	0.00169	0.000301	0.00229	0.0000716	0.0000817	0.000101	0.000254	0.000163	0.000434
Count<DL	0	0	0	0	0	0	0	0	1
Standard Deviation	0.0008357	0.0001006	0.00028	0.0000204	0.0000342	0.0000245	0.0001165	0.0000439	0.0000721
1st Quartile	0.000019	0.000078	0.002040	0.000050	0.000011	0.000014	0.000016	0.000038	0.000055
Median	0.000025	0.000137	0.002210	0.000057	0.000017	0.000018	0.000027	0.000060	0.000075
3rd Quartile	0.000442	0.000172	0.002270	0.000064	0.000038	0.000023	0.000092	0.000075	0.000114
99 Percentile	0.001640	0.000296	0.002290	0.000071	0.000080	0.000093	0.000248	0.000162	0.000355
Count > Guideline	1	3	4	0	3	5	3	2	21
% > Guideline	25.0	60.0	100.0	0.0	75.0	41.7	75.0	16.7	37.5
2008-2022									
	KV-37	KV-38	KV-39	KV-40	KV-77	KV-65	KV-76	KV-41	KV-81
Average	0.00008880	0.0001427	0.00235	0.0000750	0.0000936	0.0000388	0.0000985	0.0000802	0.0000902
Count	125	91	55	39	54	161	61	181	238
Minimum	*<0.0000050*	0.0000311	0.00131	0.0000260	*<0.000010*	*<0.00001*	*<0.0000050*	0.0000304	0.0000200
Maximum	0.0028	0.000603	0.00455	0.000198	0.00142	0.00019	0.000561	0.000838	0.000575
Count<DL	9	0	0	0	5	4	2	0	1
Standard Deviation	0.00036756	0.0001050	0.00065	0.0000543	0.0002890	0.0000348	0.0000962	0.0000728	0.0000693
1st Quartile	0.000011	0.000076	0.001920	0.000035	0.000009	0.000017	0.000034	0.000045	0.000053
Median	0.000016	0.000100	0.002200	0.000045	0.000019	0.000025	0.000062	0.000063	0.000070
3rd Quartile	0.000026	0.000179	0.002600	0.000104	0.000026	0.000048	0.000136	0.000090	0.000098
99 Percentile	0.002336	0.0005985	0.00435	0.0001942	0.0013034	0.0001574	0.0004086	0.000274	0.000383
Count > Guideline	11	34	55	5	6	4	17	17	32
% > Guideline	8.8	37.4	100.0	12.8	11.1	2.5	27.9	9.4	13.4

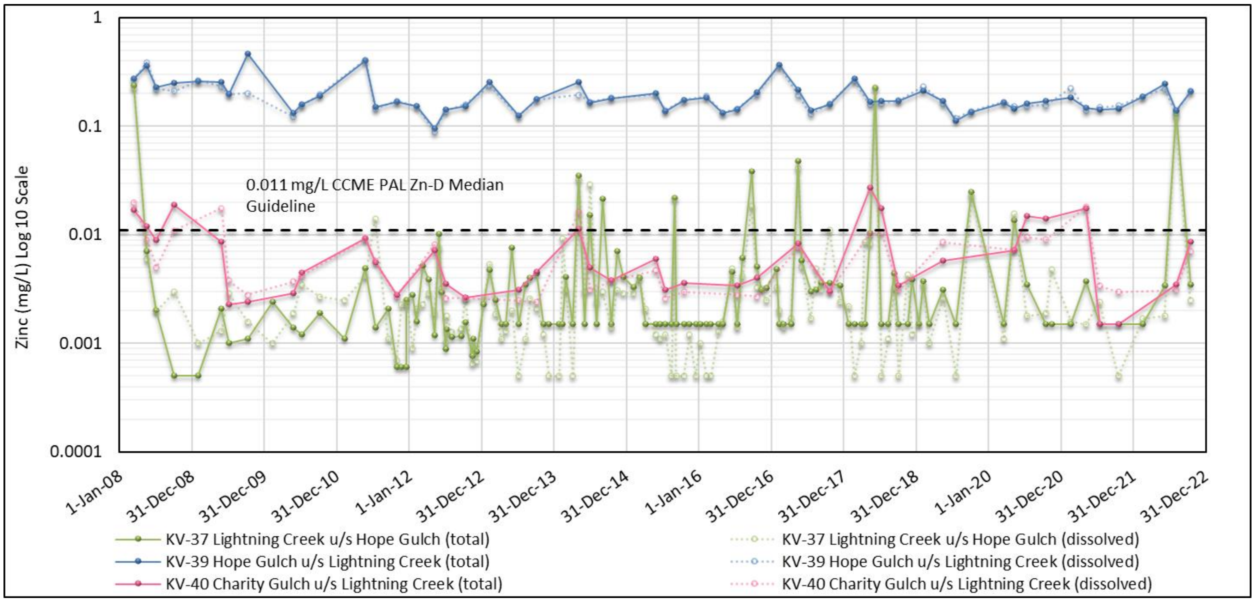


Figure 4-30: Upper Lightning Creek Total and Dissolved Zinc, 2008 to 2022

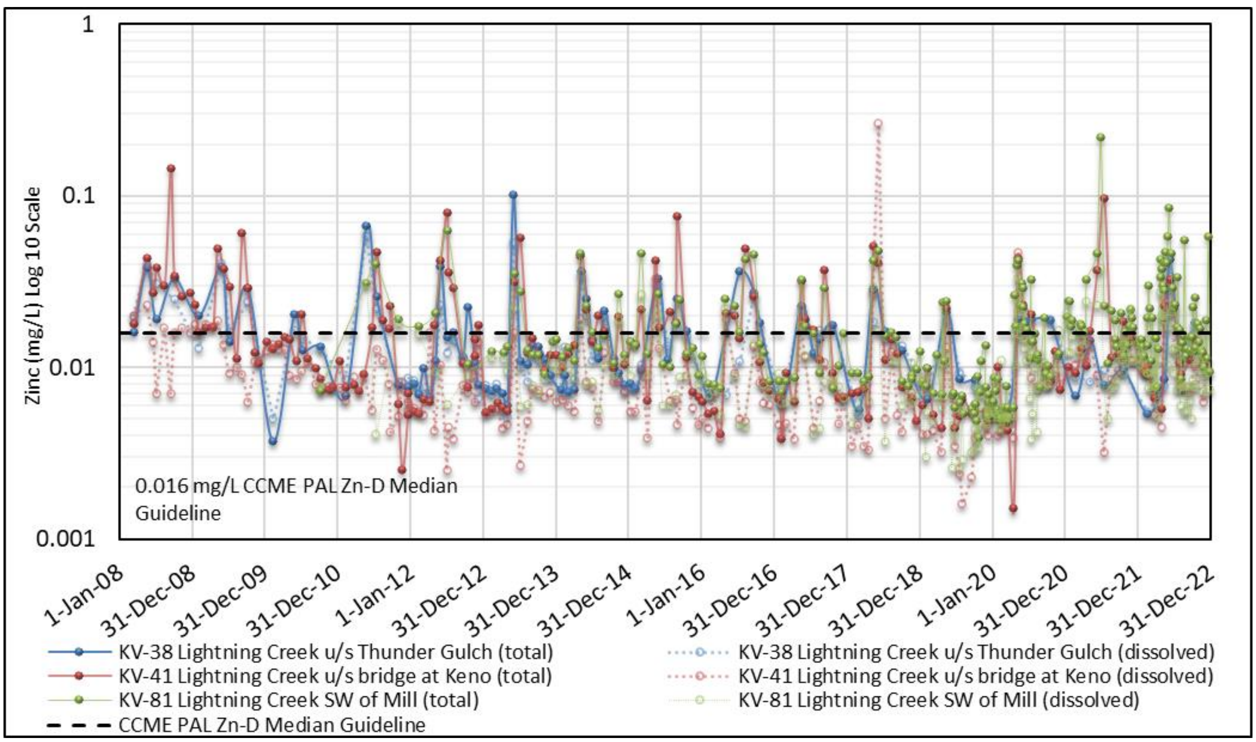


Figure 4-31: Lower Lightning Creek Total and Dissolved Zinc, 2008 to 2022

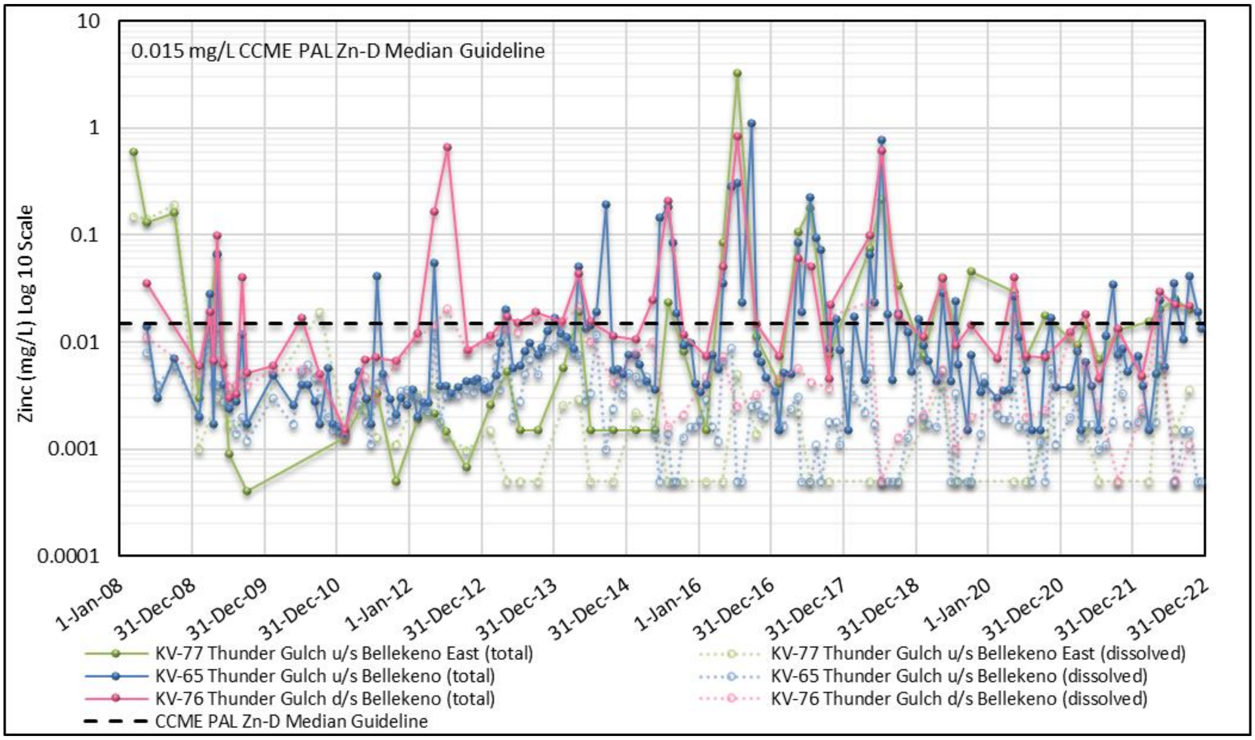


Figure 4-32: Thunder Gulch Total and Dissolved Zinc, 2008 to 2022

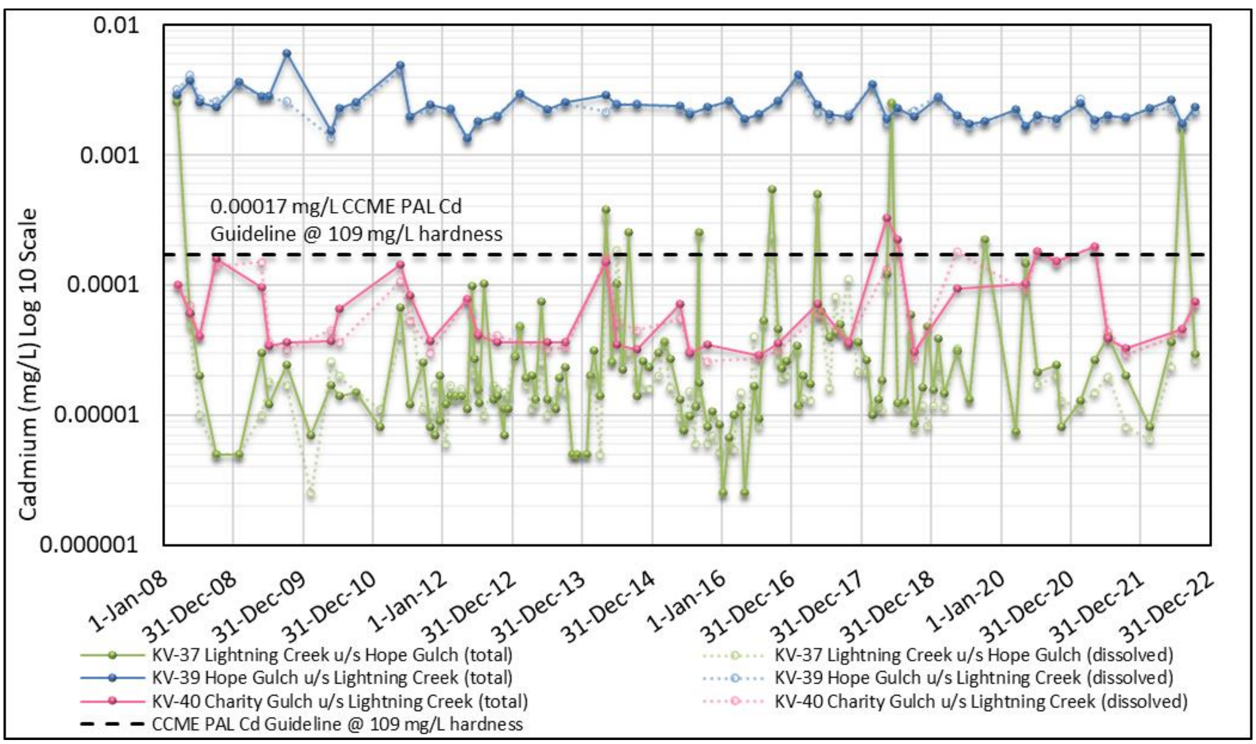


Figure 4-33: Upper Lightning Creek Total and Dissolved Cadmium, 2008 to 2022

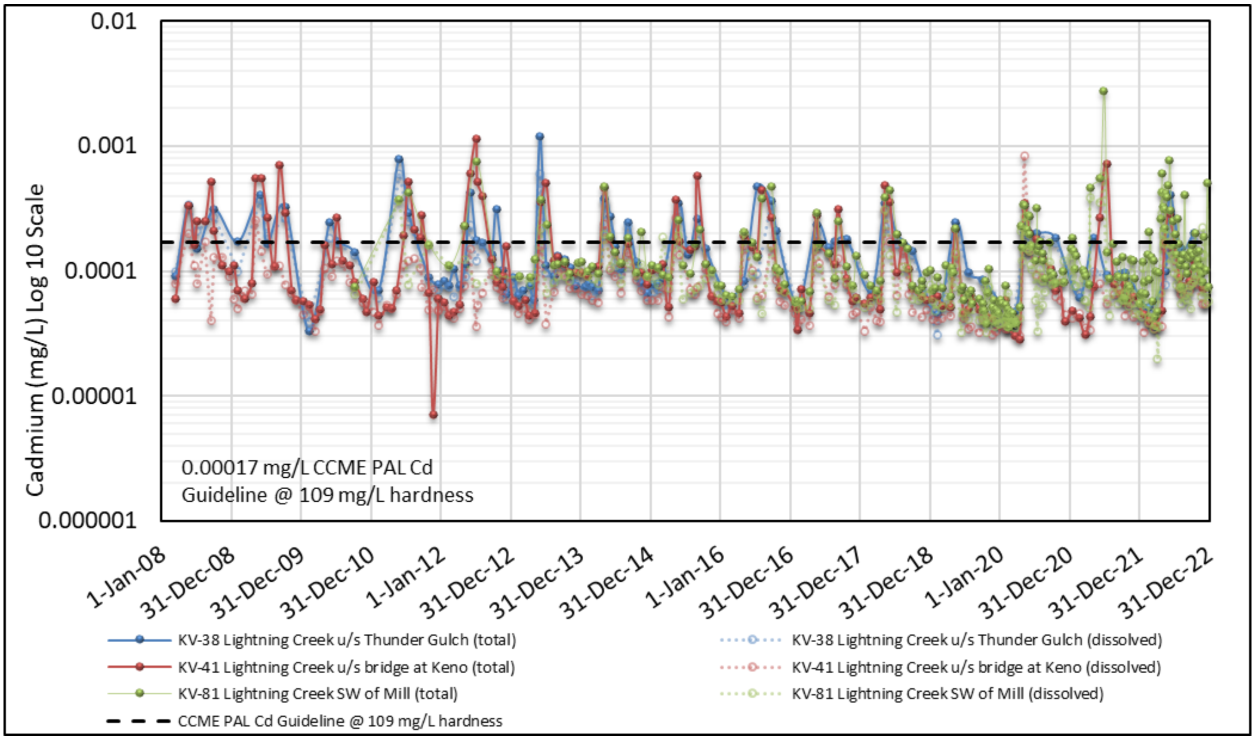


Figure 4-34: Lower Lightning Creek Total and Dissolved Cadmium, 2008 to 2022

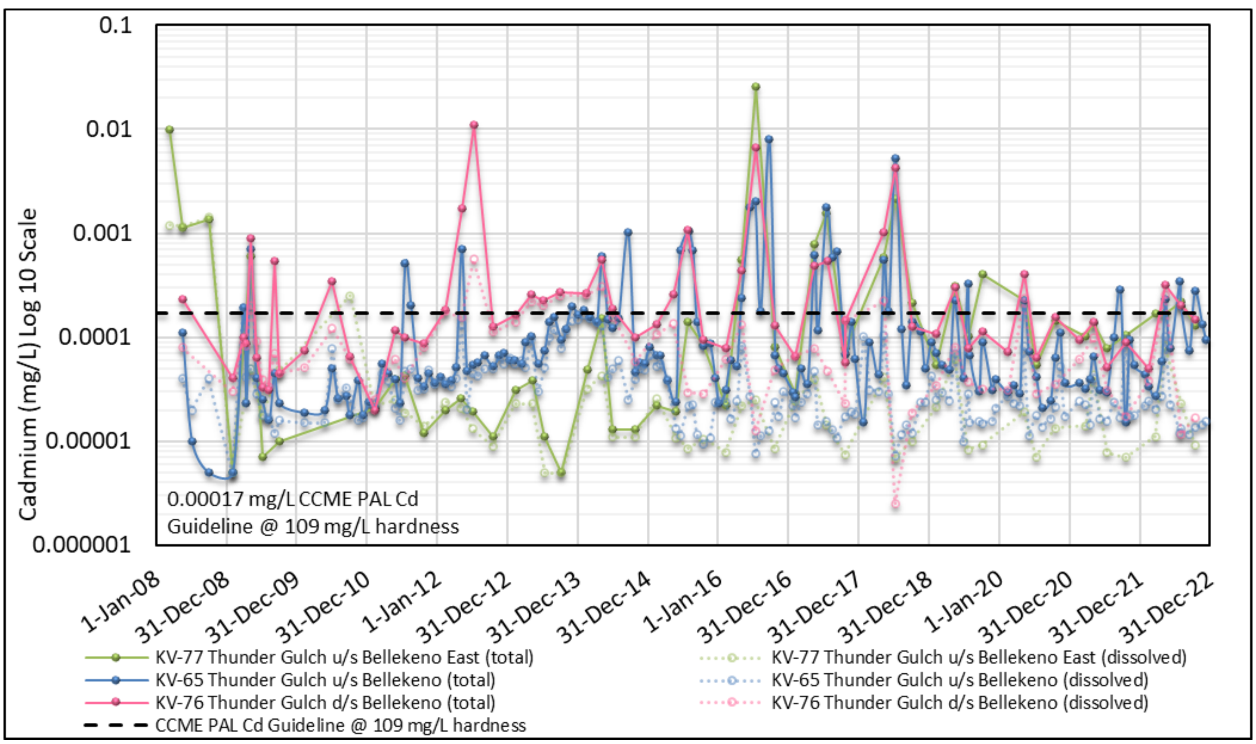


Figure 4-35: Thunder Gulch Total and Dissolved Cadmium, 2008 to 2022

4.2.4 District Mill

Construction of the DSTF was initiated in December 2010 during the commissioning of the mill. The mill pond is located south of Christal Lake, and immediately north of Lightning Creek. The facilities are situated such that discharges will enter the Christal Creek watershed. Up to August 2015, the mill had not produced a discharge to the receiving environment. On August 24, 2015 water was released from the sedimentation 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 over approximately 50 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 sedimentation pond for a total of 1,675 m^3 released in 2016. No water was released from the district 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 2018. Discharge from the mill pond to the environment have not occurred since 2018. Discharge measurements from the mill pond between August 2015 and December 2020 are shown on Figure 4-36.

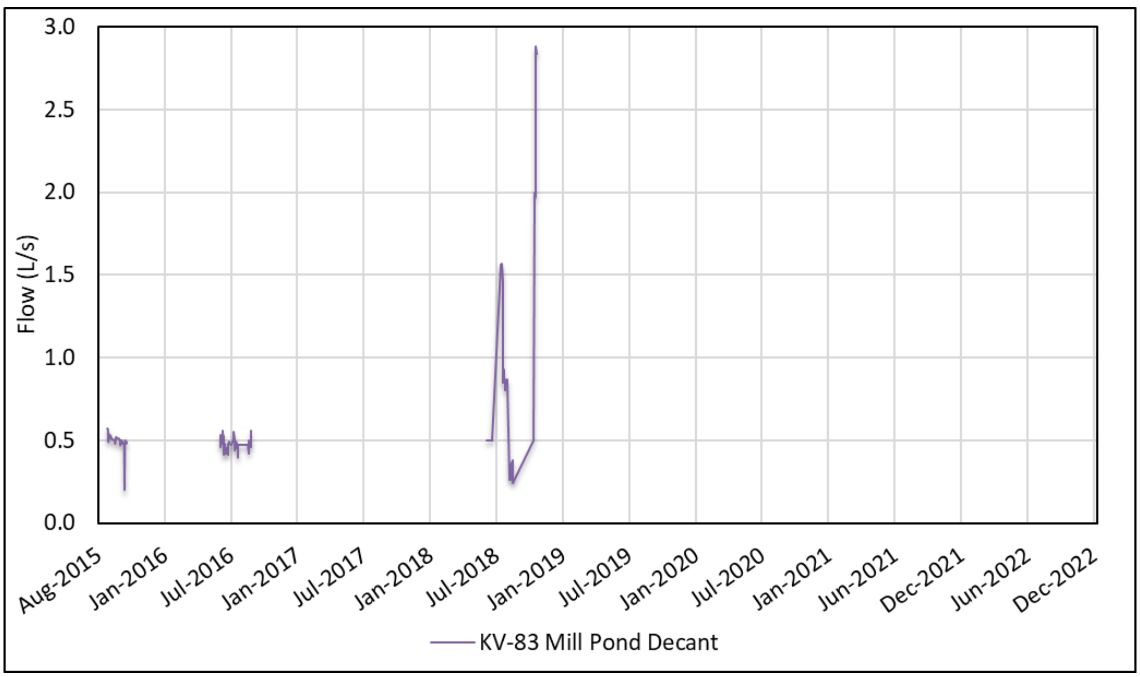


Figure 4-36: Mill Pond Discharge, 2015 to 2022

Mill pond concentrations of ammonia, total zinc, lead, and cadmium in comparison to the EQS for the KHSD Mill Pond treatment plant discharge (KV-83) and the KHSD Mill Pond (KV-82) are shown on Figure 4-37 to Figure 4-40. 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 2020 to 2022 and comparisons of the water quality in the mill pond to the EQS are for illustrative purposes only. Total zinc and cadmium concentrations in the mill pond were elevated above the EQS in December 2020, April 2021, and September 2021, but not in 2022. Total lead concentrations were above the EQS (0.2 mg/L) in the majority of samples collected in 2021 (91% of samples in 2021) compared to concentrations below the EQS observed in previous years; only the May 2022 event returned lead concentrations in exceedance of the EQS for total lead, which coincided with elevated total iron concentrations during this event. TSS concentrations from 2022 were within the range of those observed in 2021 and were higher than those observed in previous years. The mill pond exhibited alkaline pH in 2022 which was within the range of pH levels observed in 2021, with two of the three pH readings from 2022 at KV-82 exceeding the upper bound EQS.

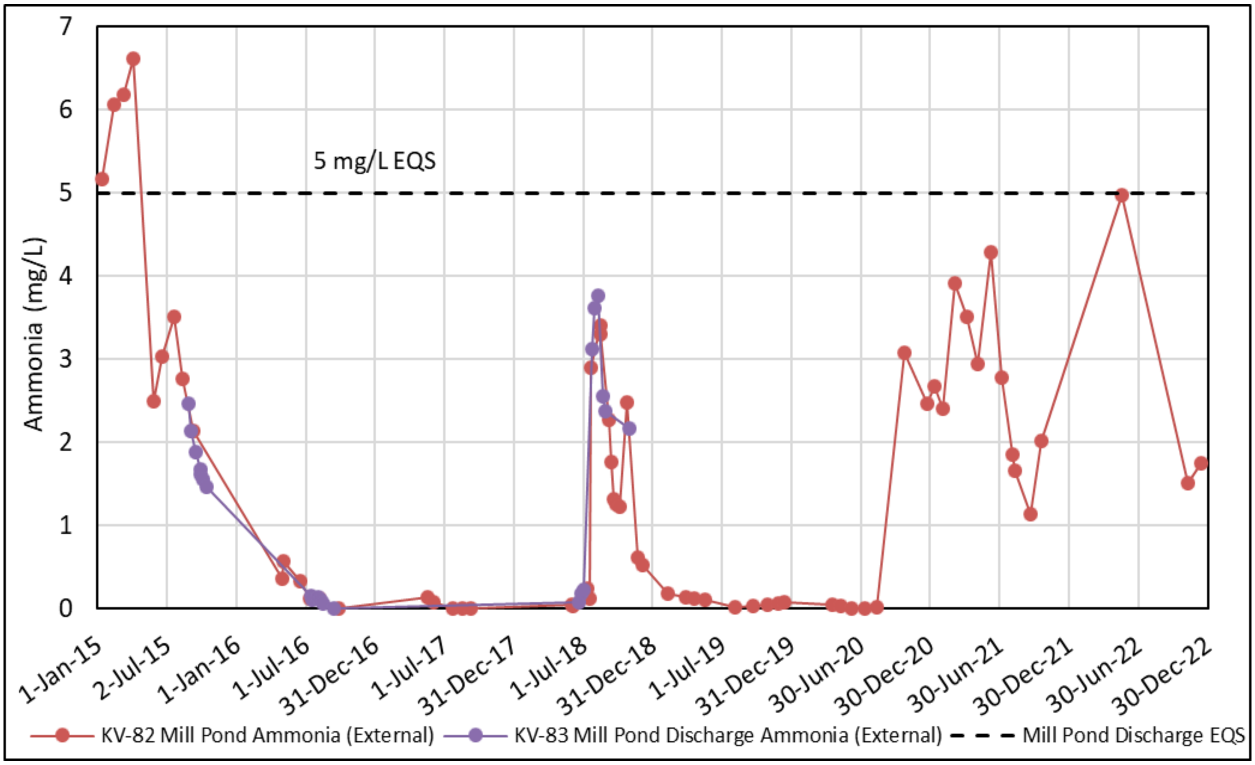


Figure 4-37: Mill Pond Ammonia, 2015 to 2022

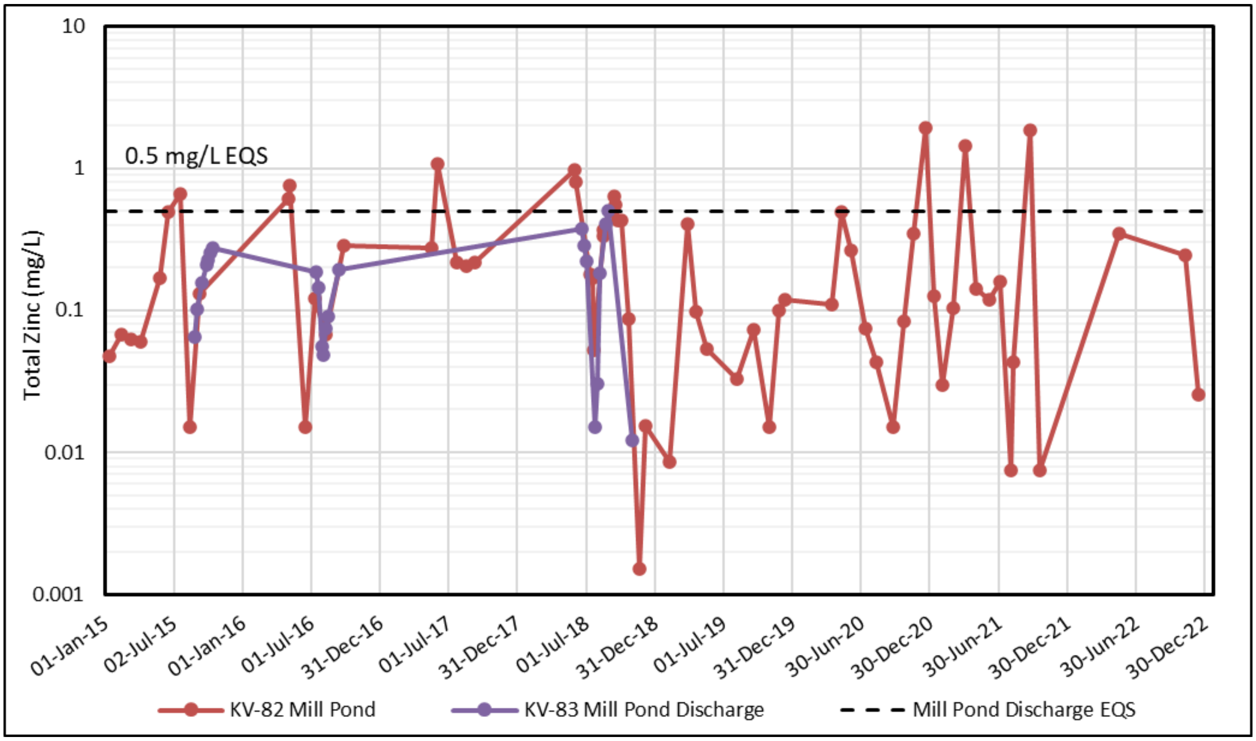


Figure 4-38: Mill Pond Total Zinc, 2015 to 2022

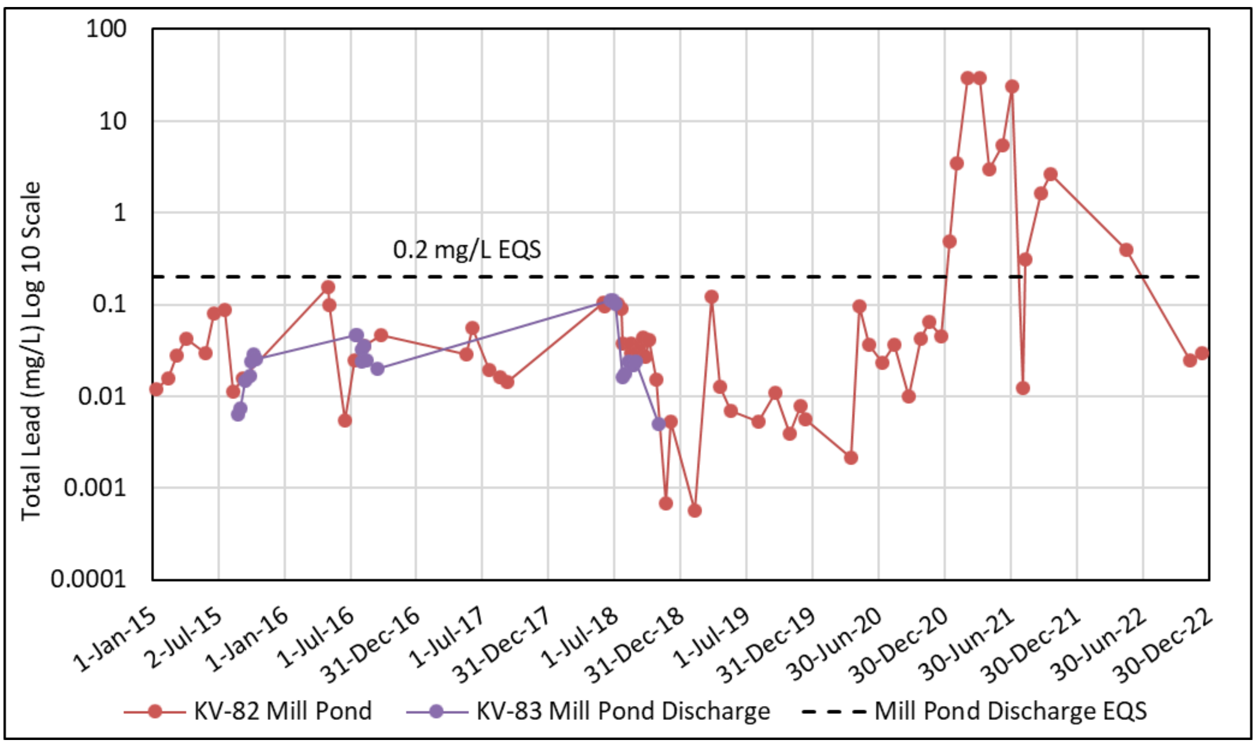


Figure 4-39: Mill Pond Total Lead, 2015 to 2022

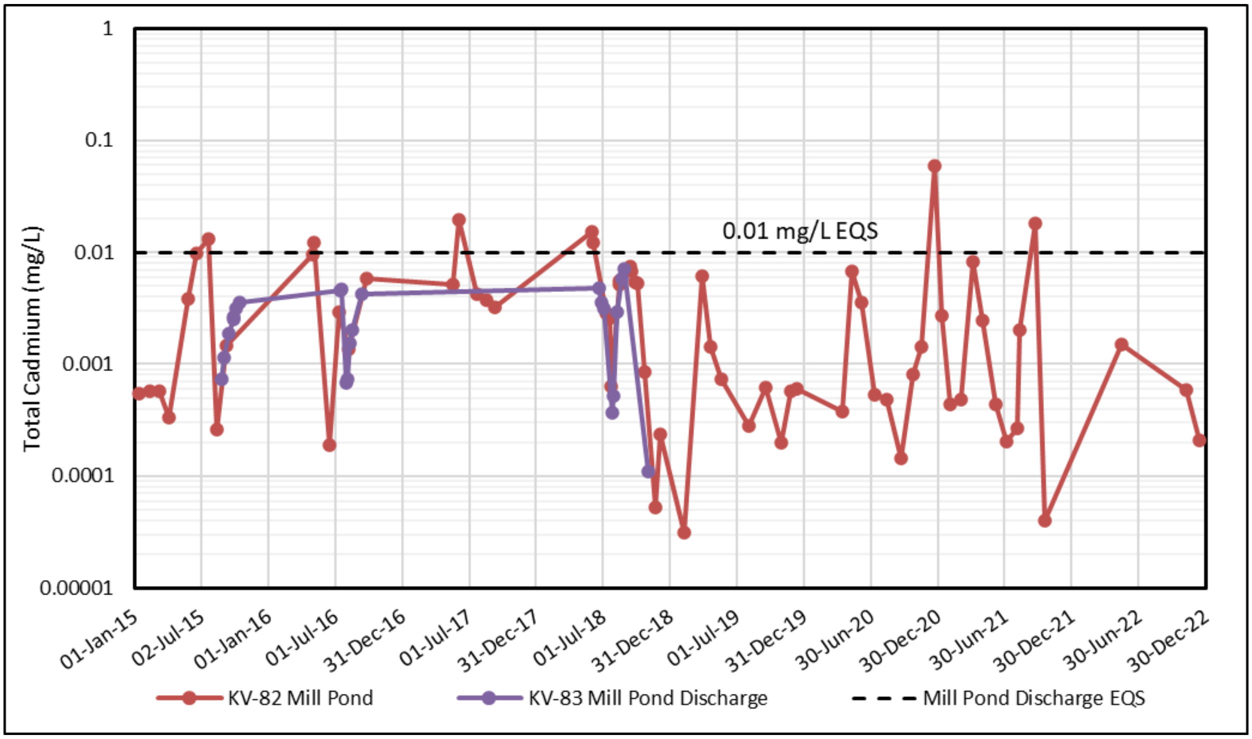


Figure 4-40: Mill Pond Total Cadmium, 2015 to 2022

4.2.5 New Bermingham

The New Bermingham WTP was commissioned in November 2020. Mine dewatering was required during development activities at the New Bermingham Mine. The water discharged from the New Bermingham Mine was treated through the New Bermingham WTP and discharged to ground in the upper No Cash Creek catchment.

The dissolved concentrations of COPCs in surface waters sampled from the New Bermingham Mine Pond Decant (KV-114) for 2022 were compared with EQS for the New Bermingham WTP. The EQS are defined in the Water Licence (QZ18-044) and those that apply to New Bermingham pond decant came into effect on July 23, 2020 (YG, 2020). 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.

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 ranged between 0.00 and 14.49 L/s (average 5.07 L/s) since September 16, 2020.

There were no exceedances of the EQS at KV-114 in 2020 for dissolved cadmium, copper, lead, silver, zinc, and total nickel, (Figure 4-41 to Figure 4-46). Additionally, there were no exceedances of the EQS for radium-226 at KV-114, with all values measured less than the detection limit in 2020 to 2022. 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 and with an increase of field pH to alkaline levels (Figure 4-47); in 2022 there were no exceedances of dissolved arsenic concentrations at KV-114 measured above the EQS owing to improvements in the WTP operation.

No samples collected at KV-114 in 2022 returned a field pH greater than the EQS of 9.5 (Figure 4-48). All samples from 2022 at KV-114 were below the EQS for ammonia-N concentrations (Figure 4-49). Comparatively, ammonia concentrations surpassed the EQS on two of the 52 samples (3.8%) collected at KV-110 in 2022. There were four exceedances of the TSS EQS at KV-114 of the 52 samples collected in 2022 (7.7% of samples, with average concentration of 15.3 mg/L, ranging from <1.0 to 34.3 mg/L in 2022) compared to a range of <1.0 to 66.5 mg/L in 2021. TSS concentrations at KV-110 in 2022 were much higher than at KV-114, ranging from 18.8 to 9,430 mg/L (average 509.3 mg/L; Figure 4-50).

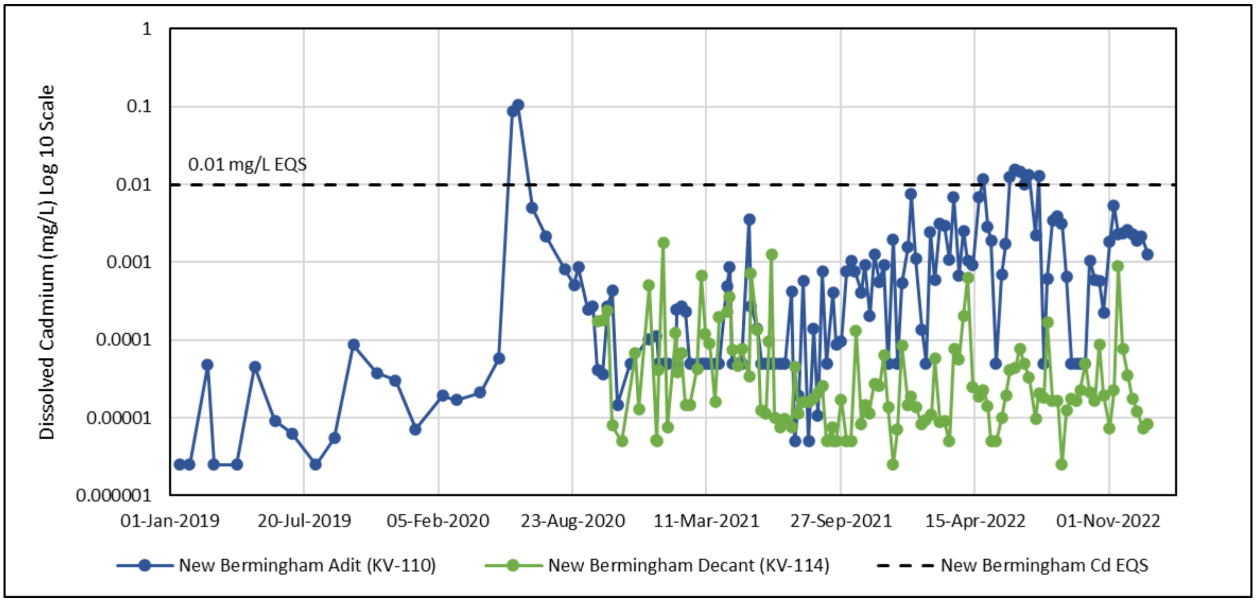


Figure 4-41: Bermingham Dissolved Cadmium, 2019 to 2022

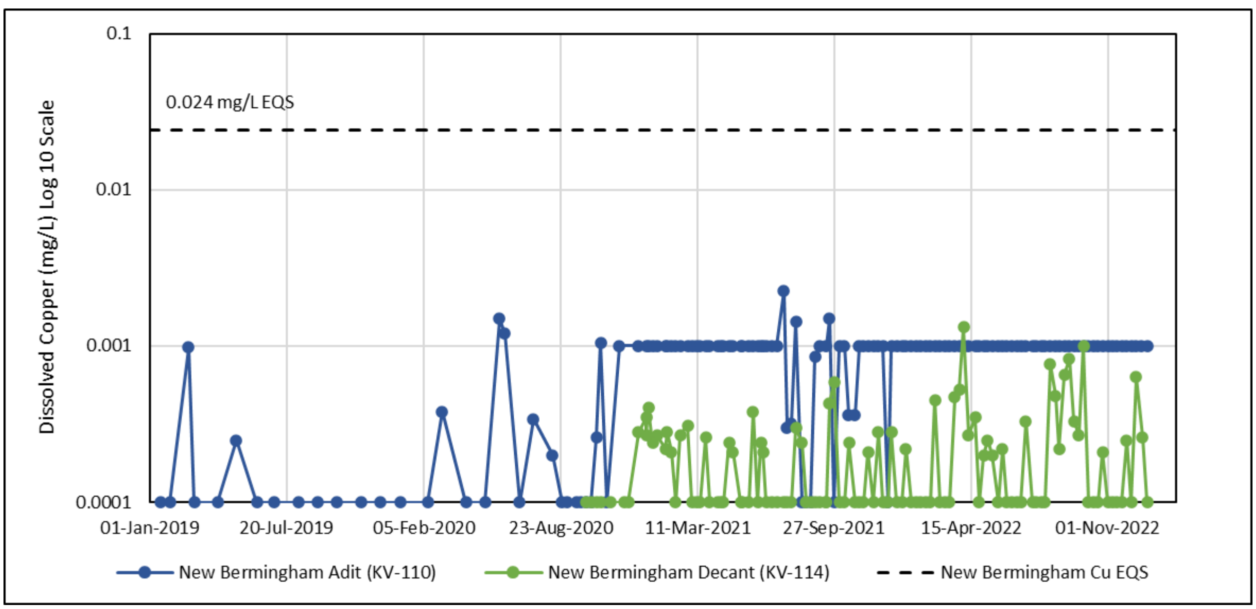


Figure 4-42: Bermingham Dissolved Copper, 2019 to 2022

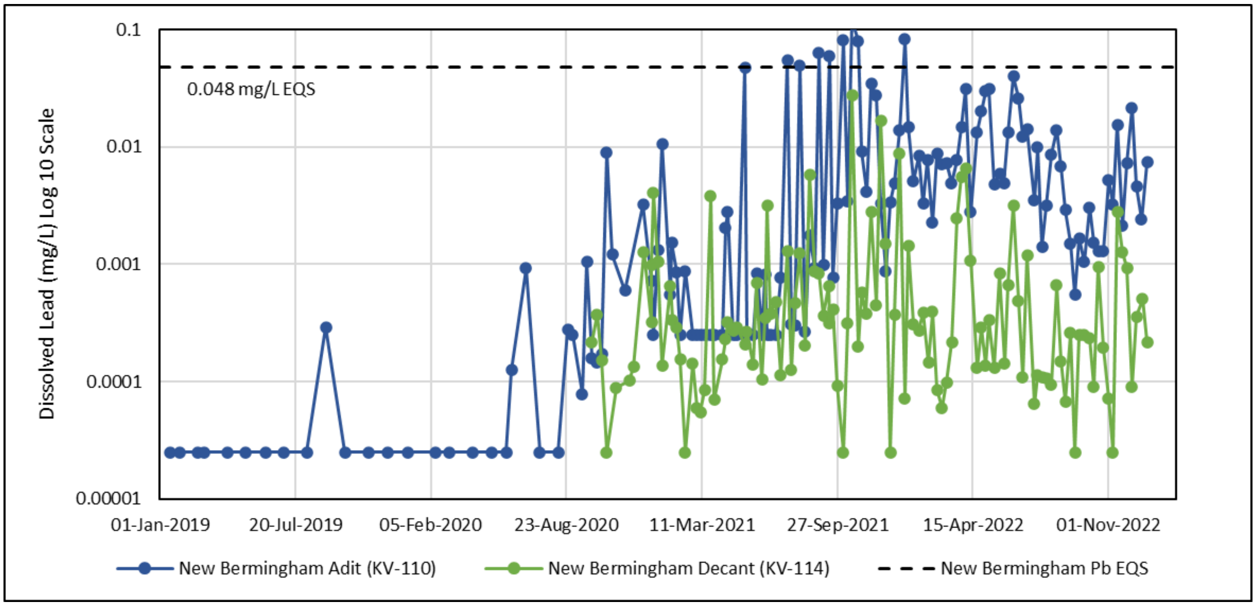


Figure 4-43: Bermingham Dissolved Lead, 2019 to 2022

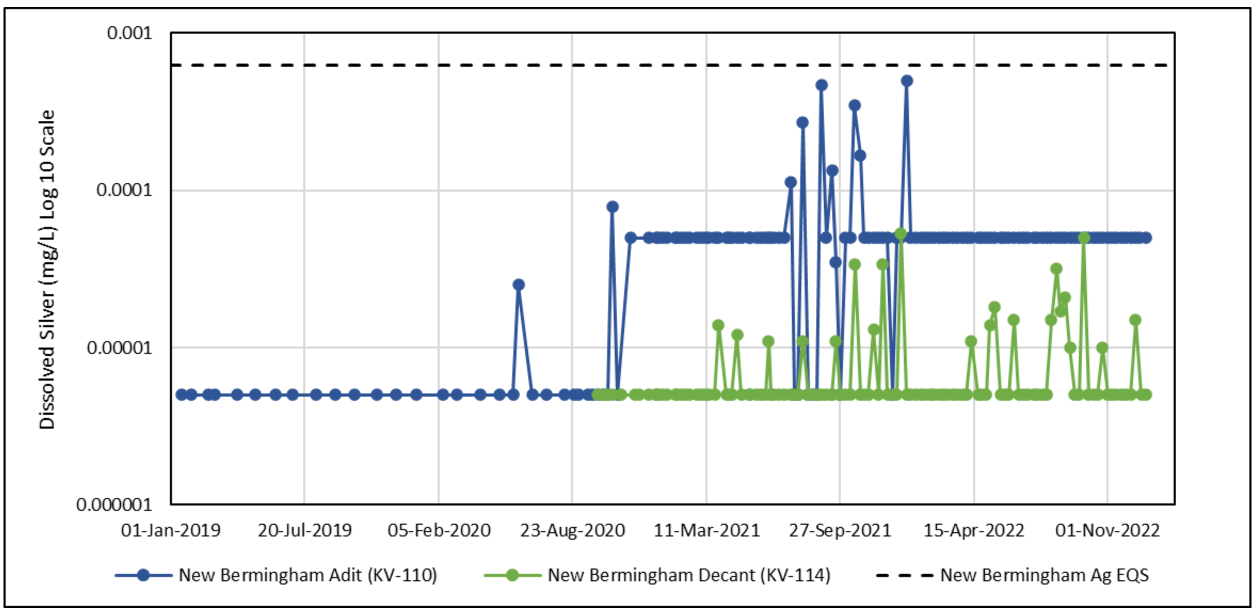


Figure 4-44: Bermingham Dissolved Silver, 2019 to 2022

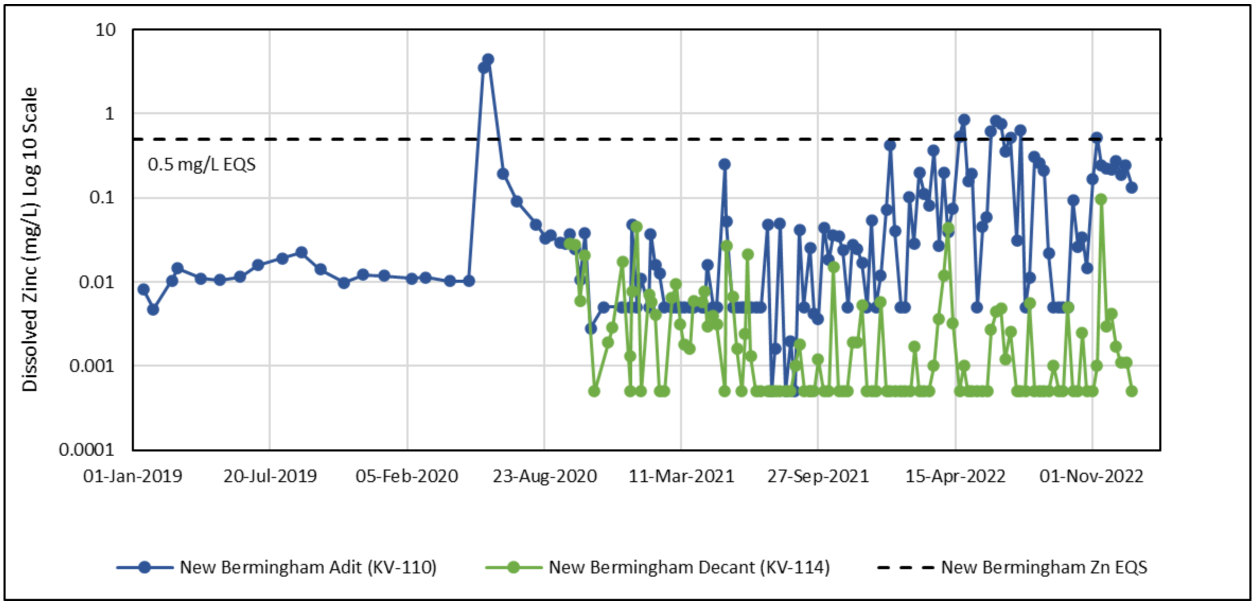


Figure 4-45: Bermingham Dissolved Zinc, 2019 to 2022

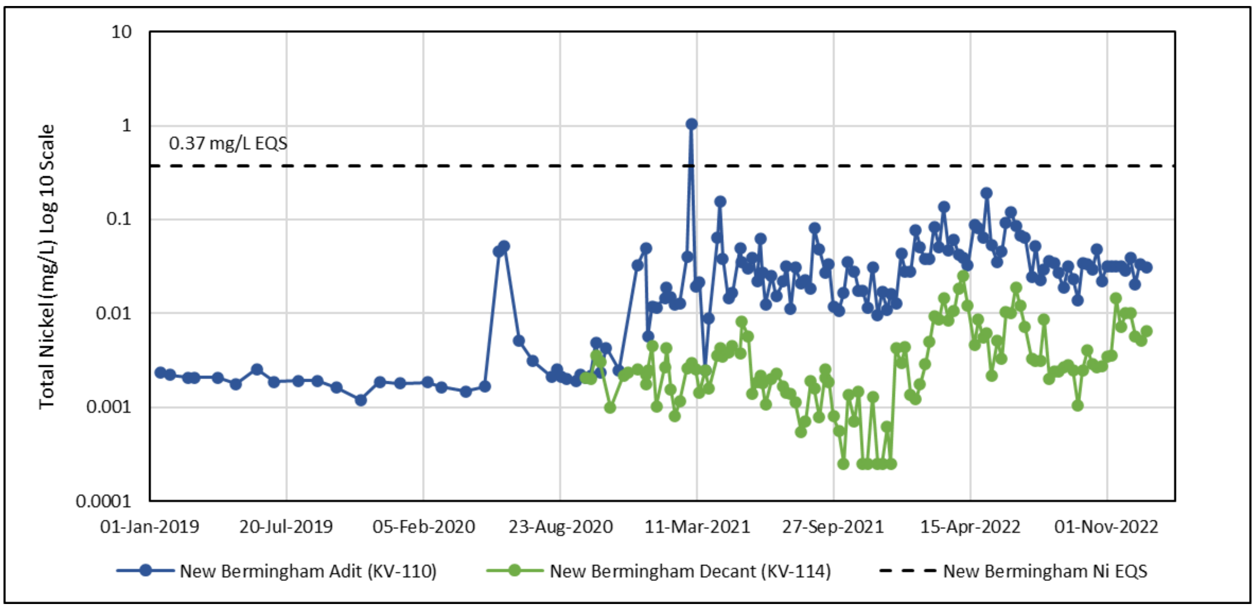


Figure 4-46: Bermingham Total Nickel, 2019 to 2022

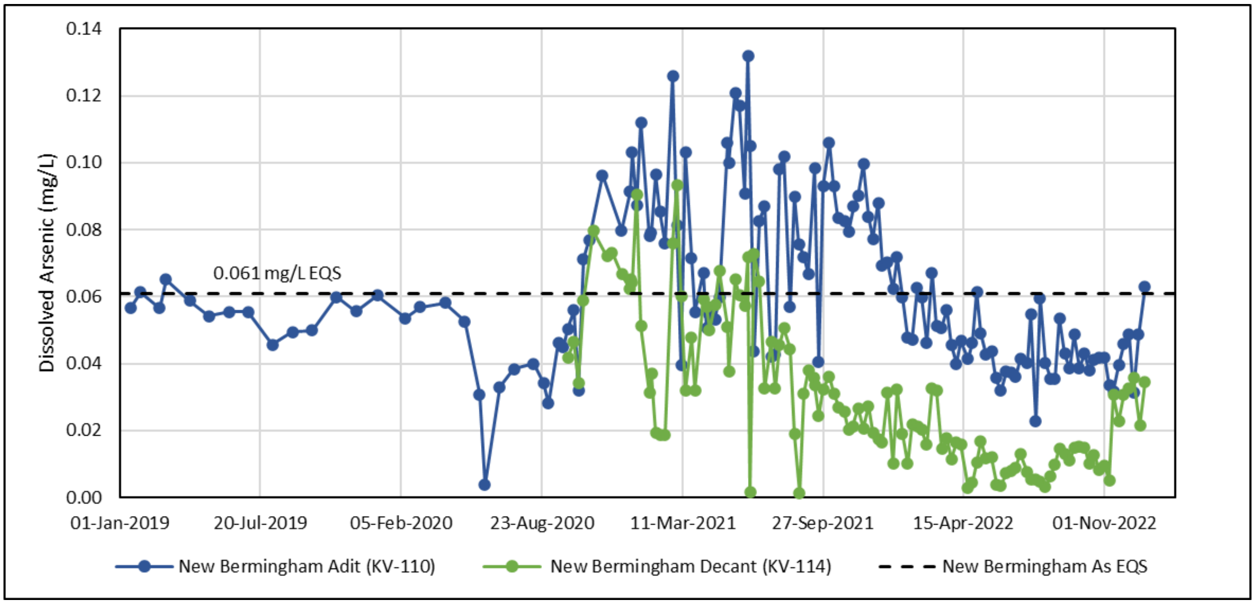


Figure 4-47: Bermingham Dissolved Arsenic, 2019 to 2022

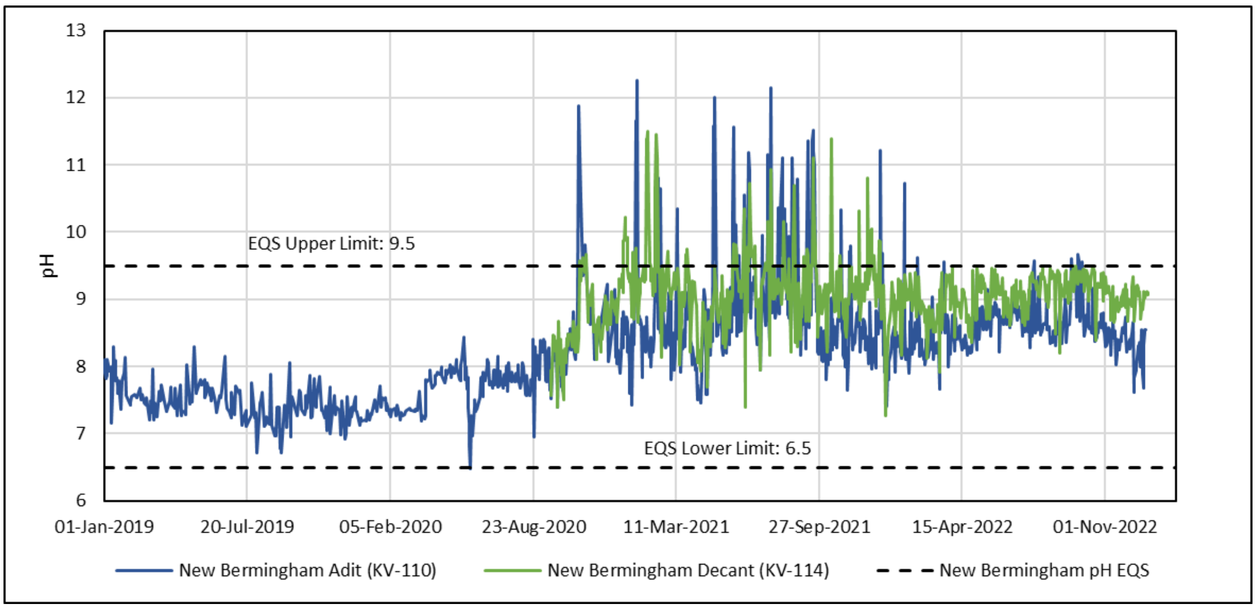


Figure 4-48: Bermingham Field pH, 2019 to 2022

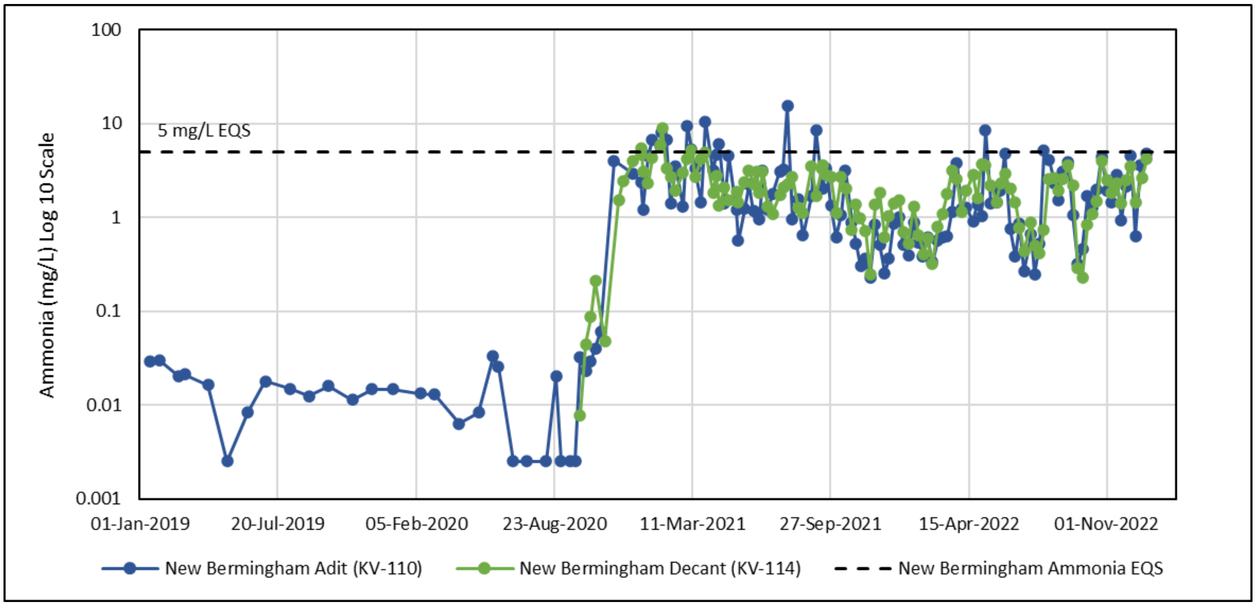


Figure 4-49: Bermingham Ammonia, 2019 to 2022

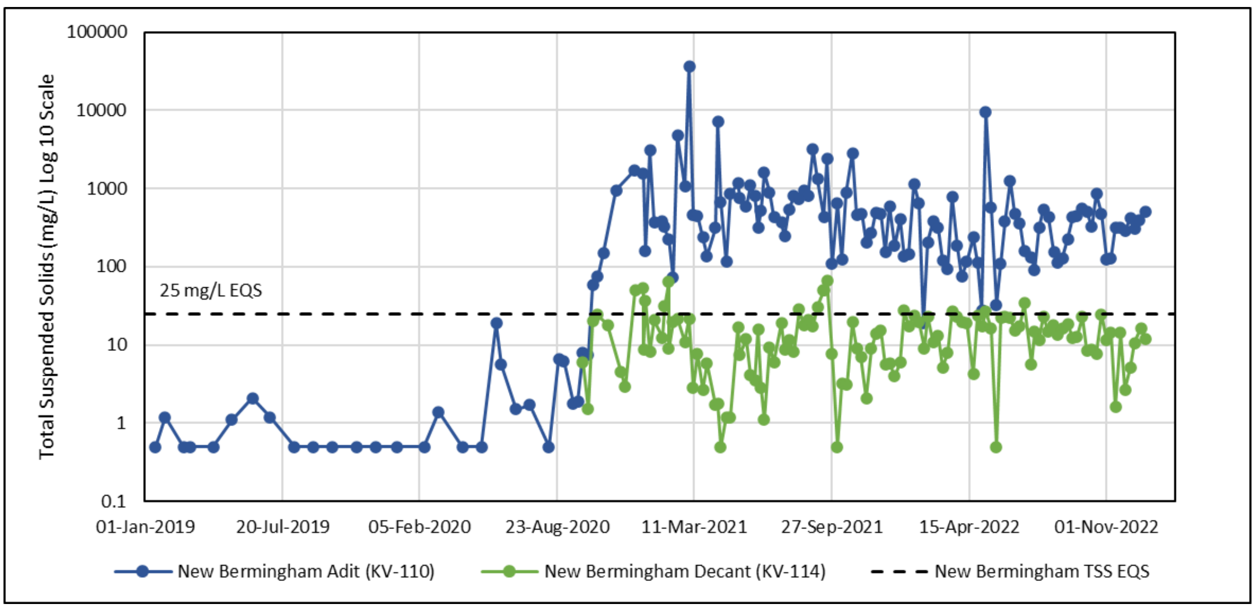


Figure 4-50: Bermingham Total Suspended Solids, 2019 to 2022

4.2.6 No Cash Creek Catchment

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 historical adit discharges from the No Cash 500 adit, the Ruby 400 adit, the historic 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 and Sandy Creeks. 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 COPC in surface waters sampled at KV-21 were compared with the No Cash Creek WQO listed in the AMP (Hecla Yukon, 2023a). For hardness-, pH-, and 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, 2023a). 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 12 months of samples.

Temporal changes in dissolved cadmium and zinc concentrations between 2015 and 2022 are displayed in Figure 4-51 and Figure 4-52, respectively. Concentrations reported as below detection were plotted at half the value of the detection limit. The KV-21 short-term WQO for cadmium (0.0398 mg/L) and zinc (4.26 mg/L) were not exceeded in the samples collected in 2022; however, 82% of dissolved cadmium and 88% of dissolved zinc 12-month moving average concentrations calculated since August 2020 exceeded the long-term WQO. Dissolved cadmium concentrations were elevated above the WQO at KV-21 from July to October 2020; dissolved zinc concentrations were elevated July 2020, and September to November 2022. Rolling average concentrations exceeded long-term WQO from January to November 2021 for dissolved cadmium, and from January 2021 to January 2022 for dissolved zinc at KV-21.

TSS concentrations were generally lower in 2022 than those observed in 2020 and 2021. 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.

2022 concentrations of cadmium and zinc concentrations generally remained elevated compared to 2019 to mid-2020 period but were lower than the concentrations observed in 2020 and within the range of concentrations observed in 2021. Cadmium and zinc concentrations at KV-21 typically peaked in the fall (October or November) with the lowest concentrations observed in late winter. All other parameters with a WQO at KV-21 (ammonia, nitrate, nitrite, sulphate, dissolved arsenic, lead, nickel, selenium, silver, and uranium) were below their respective WQO in 2022.

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 2022 (Figure 4-51). The dissolved cadmium concentrations at KV-110 were elevated during early monitoring, decreased by approximately three orders of magnitude between late 2018 through 2019 before they increased in mid-2020 to present (Figure 4-51). 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 which experiences seasonal flow, returned cadmium concentrations generally higher than the New Bermingham portal discharge. 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), 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 regularly lower than the EQS (0.5 mg/L) and no exceedances were detected at either station in 2022 (Figure 4-45). 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 at KV-110, 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; 2022 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 and 2022. 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. 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.

Dissolved cadmium and zinc results for the No Cash Creek above the No Cash 500 adit (KV-111) for 2017 to 2022 are shown in Figure 4-51and Figure 4-52, respectively. Dissolved concentrations were compared to the KV-111 WQOs (Ensero, 2021). The 12-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, and June, August to October in 2022. 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 2022 or since WL QZ18-044 came into effect. Concentrations of zinc and cadmium measured in the nine 2022 samples at KV-111 were similar to the historical record (Figure 4-51and Figure 4-52).

Total cadmium and zinc results for Star Creek (KV-56) for 2015 to 2022 are shown in Figure 4-53 and Figure 4-54, respectively; total concentrations are plotted since the KV-56 WQO apply to the total fraction (Ensero, 2021). The 12-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, and between May and September in 2022. There were no exceedances of the WQOs (for ammonia, nitrate, nitrite, sulphate, total arsenic, lead, nickel, selenium, silver, uranium, and zinc) at KV-56 in 2022 or since WL QZ18-044 came into effect, except for total cadmium and total copper. Four exceedances of total copper 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), however no exceedances of the copper WQO occurred in 2022. Concentrations of zinc and cadmium measured in the five 2022 Star Creek samples were within the historical range for concentrations at this monitoring station (Figure 4-53 and Figure 4-54).

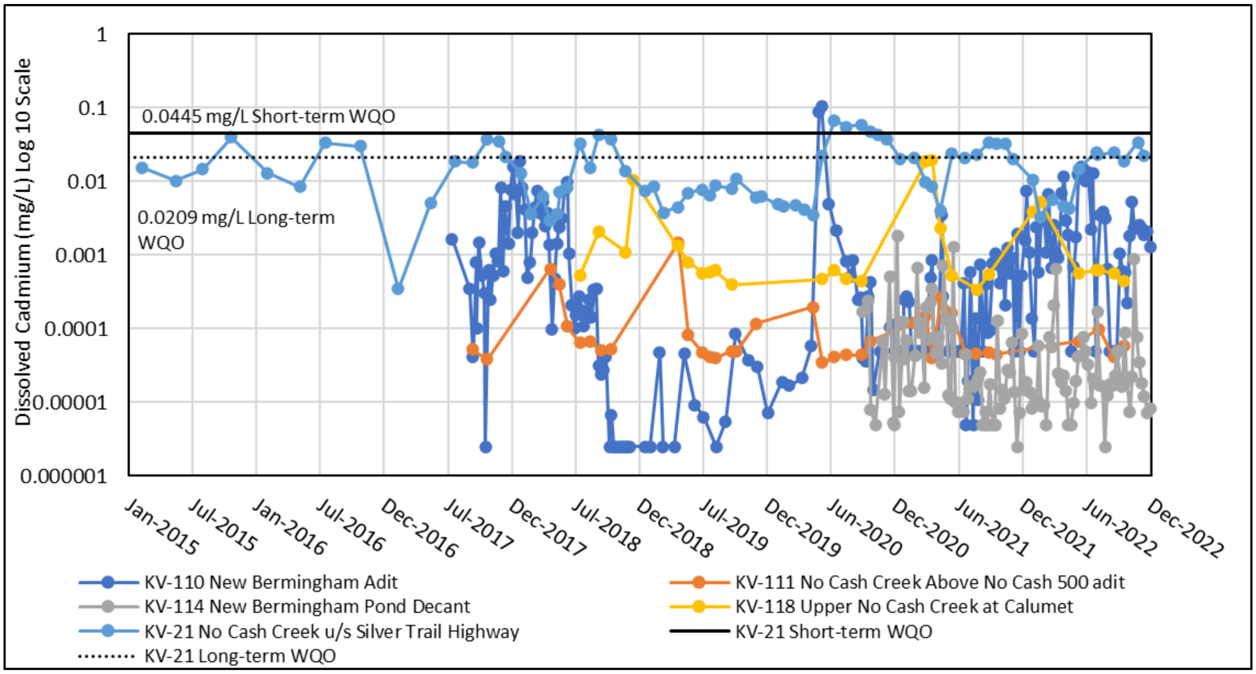


Figure 4-51: No Cash Creek Dissolved Cadmium, 2015 to 2022

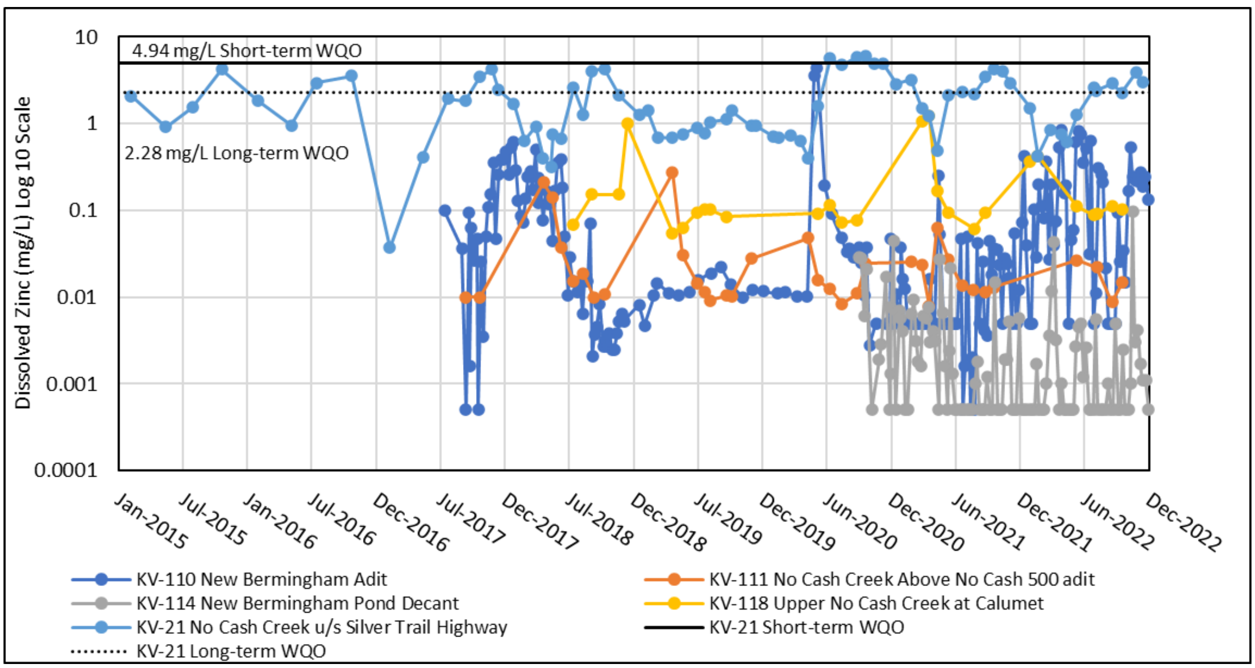


Figure 4-52: No Cash Creek Dissolved Zinc, 2015 to 2022

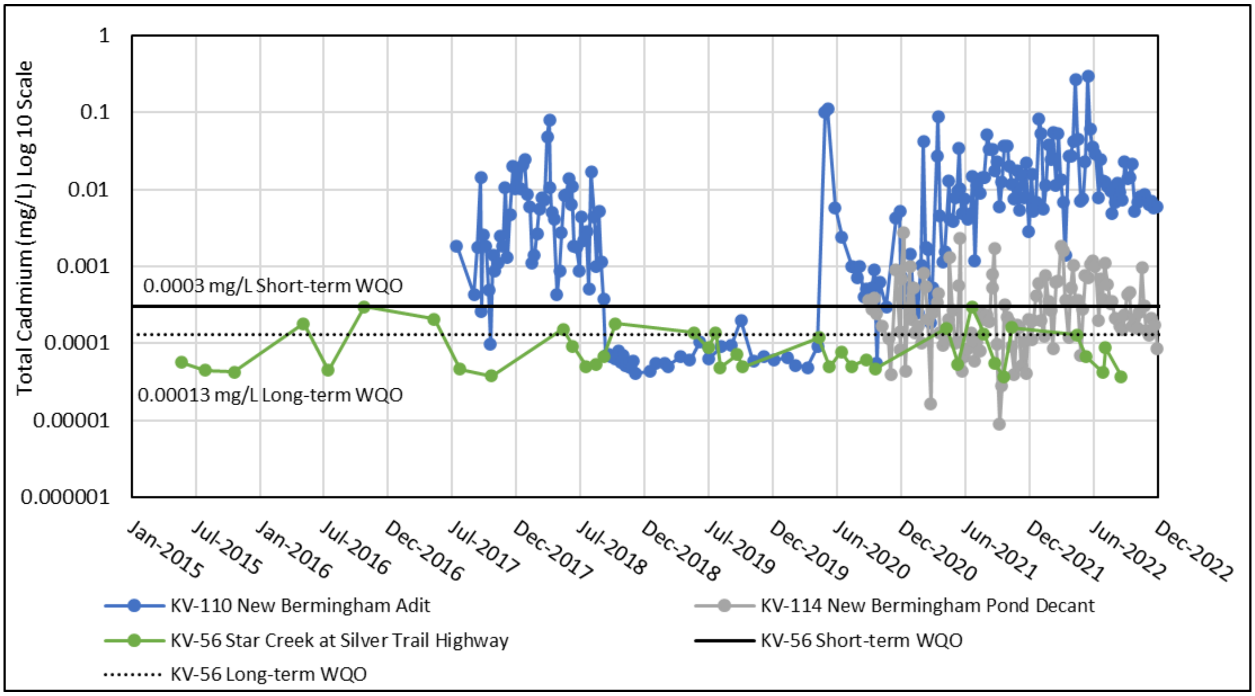


Figure 4-53: Star Creek Total Cadmium, 2015 to 2022

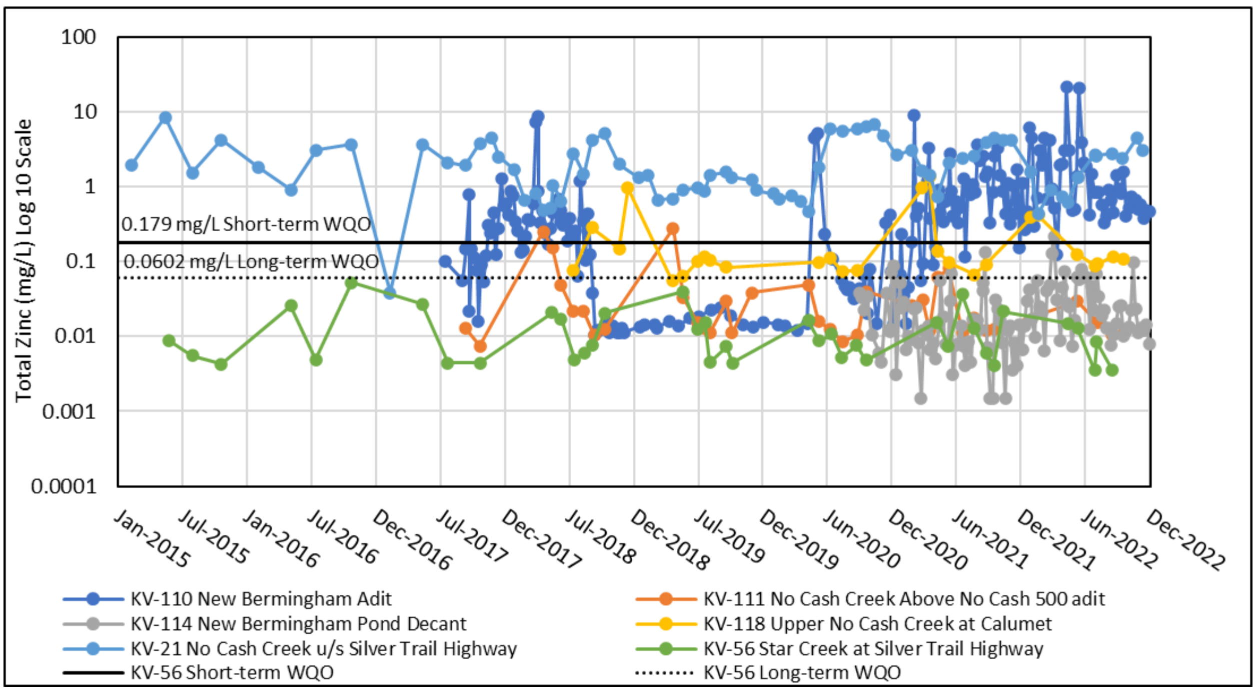


Figure 4-54: Star Creek Total Zinc, 2015 to 2022

4.3 Groundwater

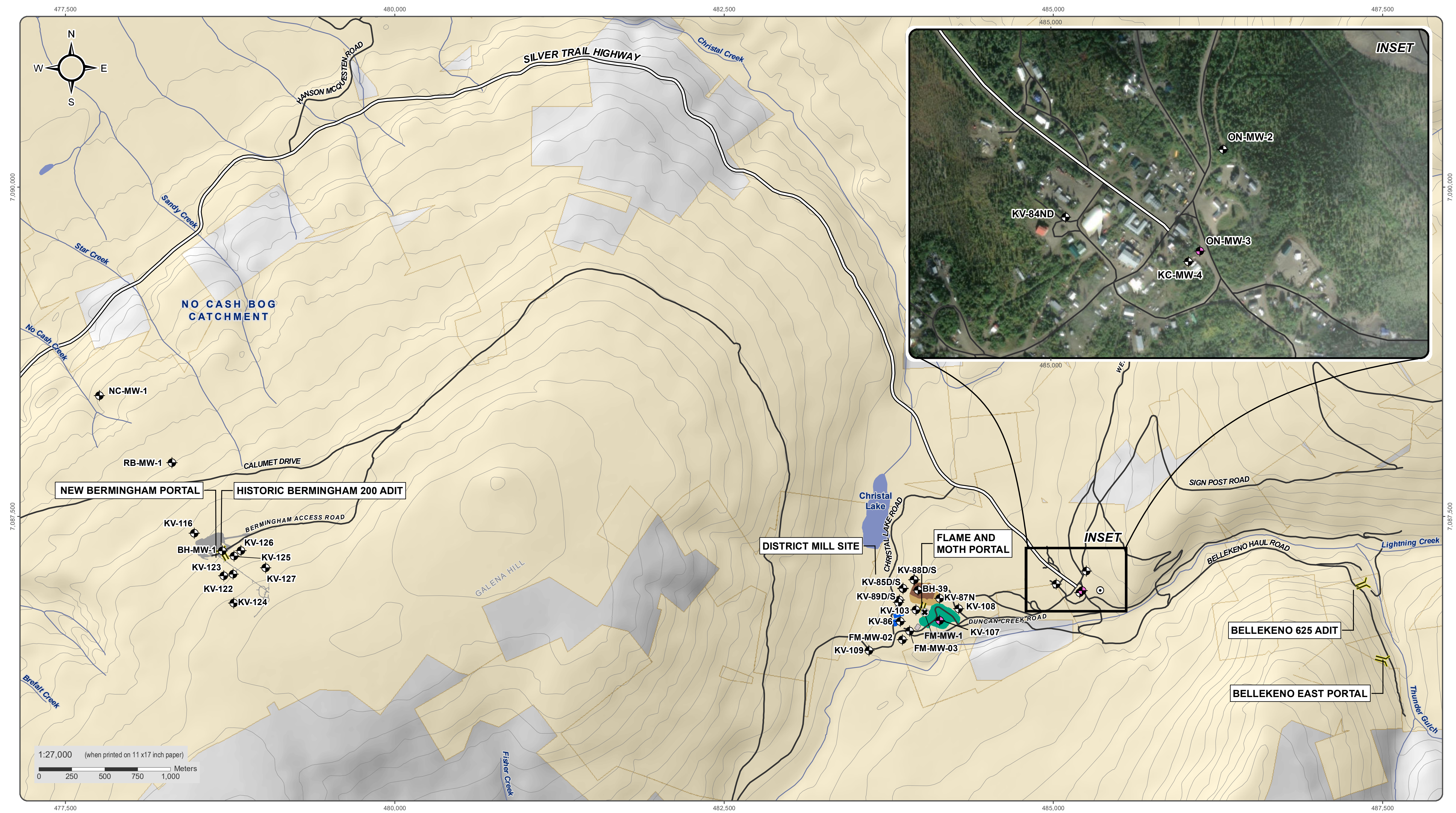
Groundwater monitoring is a critical component of the water-resource management program at the Keno Hill mining camp. The hydrologic connections between groundwater and surface water mandate that the monitoring program for all water resources be closely linked. By acknowledging this close hydrologic connection, groundwater monitoring can provide critical support to the surface monitoring program.

Groundwater quality monitoring is an integrated activity for obtaining and evaluating information on the physical, chemical, and biological characteristics of groundwater in relation to human health, a designated groundwater and surface water uses and receiving environment. In the case of the KHSD Mining Operations, this relates to the condition of groundwater within the No Cash Creek, Christal Creek and Lightning Creek watersheds, and the potential impacts to Keno City groundwater from activities relating to the Project. With accurate information, the current state of the project's groundwater resources can be assessed; water-resource protection, preservation, and abatement programs can be run more effectively; and trends in groundwater quality and the success of the management programs can be evaluated.

The full groundwater sampling program commenced during freshet 2011 after thaw of all groundwater wells installed in October 2010. Cold weather and frozen ground conditions makes the program challenging during winter. The groundwater monitoring program is detailed in Schedule B, QZ18-044, and the monitoring sites are shown in Figure 4-55, along with other wells in the area that are public or part of district closure studies underway by ERDC as part of WL QZ17-076. Keno City monitoring well KV-84 was removed from WL QZ18-044 in favor of KV-84ND, as it was not in an ideal location relative to Onek 400 mine and the Firehall well. In 2018, groundwater monitoring well KV-109 was installed near Lightning Creek as a requirement of the Water License for monitoring Flame & Moth.

A drilling program in late fall of 2020 replaced KC-MW-3 and KV-87 with new wells (called KC-MW-3-N and KV-87N, respectively) and a new well KV-108 was installed in the District Mill area upgradient of the phase 2 DSTF expansion area. In addition, seven new wells were installed in the vicinity of the New Bermingham portal/historic Bermingham adit (KV-116, KV-122 through KV-127); one new well was installed at No Cash Creek (NC-MW-1) (Figure 4-55).

Groundwater monitoring data is discussed by area, with groundwater chemistry and groundwater level data, including assessment of estimated versus observed groundwater dewatering rates, presented in Section 4.3.1 for District Mill Area/Flame & Moth Mine, and in Section 4.3.2 for New Bermingham Mine.



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

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- Proposed Monitoring Well
- Monitoring Well
- Decomissioned Monitoring Well
- Adit
- As-Built MIne Footprint
- Pond
- DSTF 322k Tonnes Design
- Current DSTF
- To Be Constructed Mine Features
- Alexco/ERDC Quartz Claims
- Silver Trail Highway
- Other Road

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FIGURE 4-55

KHSD GROUNDWATER MONITORING LOCATIONS

OCTOBER 2023

4.3.1 District Mill and Flame & Moth

4.3.1.1 ***Groundwater Quality***

The District Mill monitoring wells have been installed to collect baseline information on groundwater conditions, as well as information on the potential impacts of ancillary activities, construction and impacts from the DSTFT. Precautions have been taken in the design and construction of the DSTF to prevent porewater seepage to groundwater by providing an impermeable basal layer to allow capture of any potential DSTF seepage and directing it to the mill pond.

Wells were installed at the District Mill site in October 2010 to monitor groundwater in Keno City and the District Mill/DSTF area. Shallow wells were installed into overburden and deep wells into the bedrock aquifer. Operation of the mill and placement of the first lift of tailings began on November 17, 2010. Functioning groundwater wells associated with monitoring of Flame & Moth Mine include KV-84ND, KV-85S, KV-87N, KV-88D, KV-103, and KV-108. As shown in Figure 4-55:

- Nested shallow and deep wells were installed down-gradient of the DSTF at KV-85 and KV-88;
- Nested shallow and deep wells were installed down-gradient of the mill at KV-89;
- A well was installed in overburden cross-gradient of the mill ore stockpiles at KV-86;
- KV-87 was installed in the bedrock up-gradient of the DSTF but cross-gradient from KV-86. A replacement well for KV-87 (labelled KV-87N) was drilled in November of 2020 near the location of the original well KV-87, and this well was sampled for the first time in December of 2020;
- KV-84 was installed north of the Fire Hall well in Keno City; in late 2013 KV-84ND was drilled to replace KV-84. KV-84ND is in a better location relative to the city supply Firehall well and has been replaced by KV-84 in WL QZ09-092 Amendment 2;
- Monitoring well ON-MW-2 (located between Onek 400 adit and Keno City, and upgradient of Christal Lake) and Lucky Queen Monitoring Well LQ-MW-1 were established in August of 2012; and
- A new well, KV-108, was installed in November of 2020 upgradient of the phase 2 DSTF expansion area.

Water Licence QZ18-044 Clauses 82 and 83 requires a comparison of groundwater quality with *Yukon Contaminated Sites Regulation* Schedule 3: Generic Numerical Water Standards (Aquatic Life) (YCSR-AL) and wells near Keno City are also to be compared with YCSR Drinking Water Standards (YCSR-DW). The groundwater monitoring plan was updated in October 2020.

Deviations to the Keno Hill Silver District Mill groundwater sampling program are listed in Table 4-9.

Table 4-9: Deviations to Groundwater Sampling Program at District Mill and Flame & Moth

MONITORING WELL	DEVIATION
KV-86	destroyed in 2022
KV-87	become compromised and was replaced; replacement well KV-87N was sampled for the first time in December of 2020
KV-88S	broken and no samples have been collected since 2012
KV-85D	broken and no samples have been collected since 2012
KV-89D	not been sampled since 2017 due to structural issues inhibiting sampling
KC-MW-4	not been sampled since May 2014 due to structural issues inhibiting sampling
FM-MW-01	destroyed in 2020 with the advancement of the Flame and Moth decline. monthly water are recorded at adjacent KV-103 in its place
KV-87N and KV-108	not sampled from April to June 2021 due to issues with specialized equipment needed to sample these two deep wells; wells were direct sampled using a bailer in July 2021, and discrete-sampled from August 2021 onwards using a HydraSleeve
KV-109	damaged in 2023

The following subsections provide graphical presentation and discussion of water quality analytical results of samples collected from the groundwater monitoring wells at the District Mill site, Keno City (KV-84ND and ON-MW-2) and Lightning Creek monitoring well KV-109. District Mill groundwater quality data are compared against the monitoring results collected in 2011 as these results largely represent background conditions in the District Mill area. The following subsections report on COPCs, which were listed in a 2018 Waste Rock ARD/ML memorandum prepared for Alexco Resource Group by AEG in 2018.

Arsenic

KV-88D, ON-MW-2, KV-85D, and KV-109, were consistently above YCSR-AL and YCSR-DW standards for arsenic (0.05 mg/L and 0.025 mg/L, respectively; Figure 4-56); KV-87N had several excursions above the YCSR-AL standard. KV-88D and ON-MW-2 consistently exhibited the highest arsenic concentrations out of the District Mill monitoring wells with median concentrations of 0.85 mg/L and 0.23 mg/L, respectively. The remaining monitoring wells had arsenic concentrations below the YCSR-AL standard, except for two excursions slightly above this standard at KV-87. Monitoring wells KV-84ND (median 0.015 mg/L), KV-85S (median 0.00073 mg/L), KV-86 (median 0.00056 mg/L), and KV-89S (median 0.0064 mg/L) arsenic results were consistently below the YCSR-DW standard except for four excursions above the standard at KV-89S prior to 2014.

KV-85S and KV-86 consistently exhibited the lowest arsenic concentrations; KV-85D, KV-88D, and KV-89S exhibited marked variability in arsenic concentration values, while the arsenic concentration at KV-84ND, KV-86, and KV-89D have remained fairly stable. Data from the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for arsenic. KV-85S and KV-84ND show elevated arsenic concentrations compared to initial 2011 concentrations at these wells; KV-89S shows lower arsenic concentrations compared to initial 2011 concentrations.

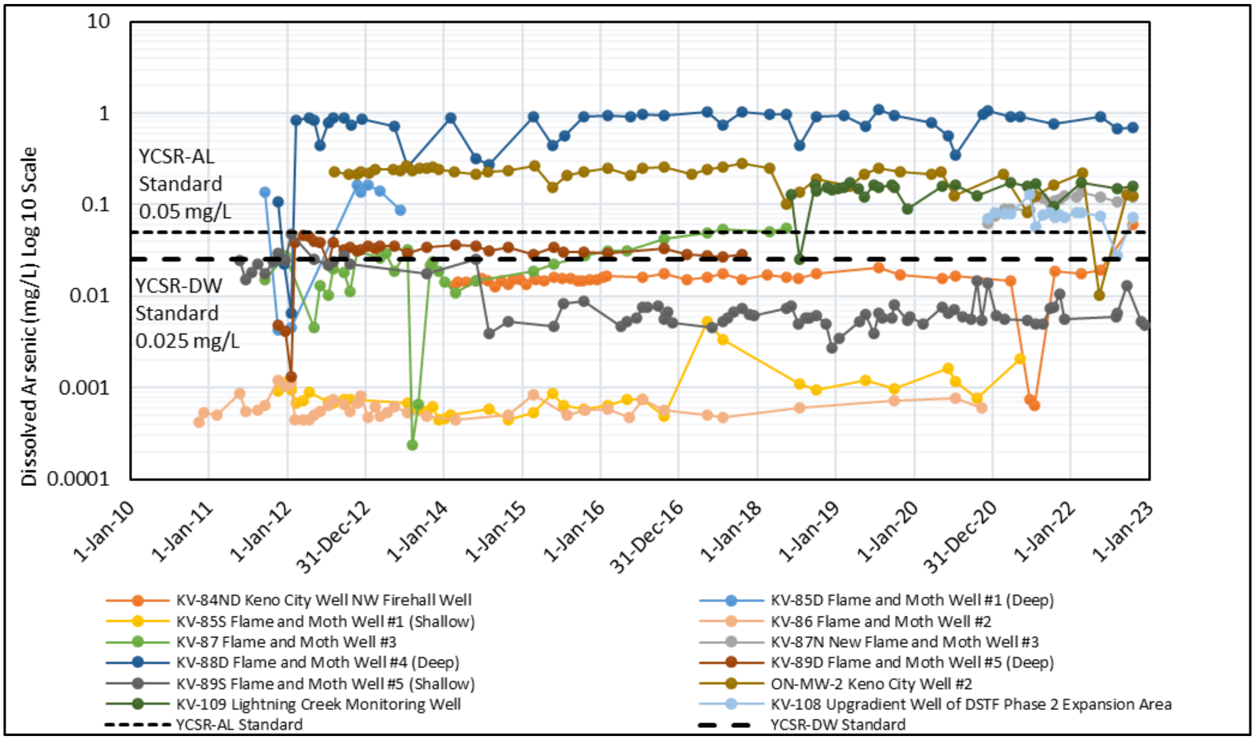


Figure 4-56: District Mill and Keno City Groundwater Monitoring, Dissolved Arsenic

Cadmium

Monitoring well KV-89S was consistently above YCSR-AL and YCSR-DW standards for cadmium (0.0006 mg/L [hardness ≥ 150 mg/L] and 0.005 mg/L, respectively; Figure 4-57). KV-89S exhibited the highest concentration for cadmium of the District Mill monitoring wells with a median concentration of 0.0117 mg/L, as well as the largest variability in cadmium concentrations of the District Mill wells; a possible increasing trend in cadmium concentrations is noted for this well. KV-85S also shows large variability of the District Mill wells, and a possible increasing trend is noted at this monitoring location.

The remaining monitoring wells had cadmium results below the YCSR-AL standard, except for three excursions above this standard by KV-88D in 2012. KV-86 was predominantly below the YCSR-DW standard for cadmium but had several excursions above the guideline with a median cadmium concentration of 0.00034 mg/L. The remaining monitoring wells in the District Mill area exhibited fairly consistent results below the YCSR-DW standard, except for occasional excursions above 0.005 mg/L by KV-85S, KV-87, KV-89D, and ON-MW-2 with median concentrations of 0.000068 mg/L, 0.00001 mg/L, 0.000053 mg/L, and 0.00006 mg/L respectively.

All monitoring wells in the District Mill area exhibited marked variability in cadmium concentration values during the monitoring period. Data from the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for cadmium.

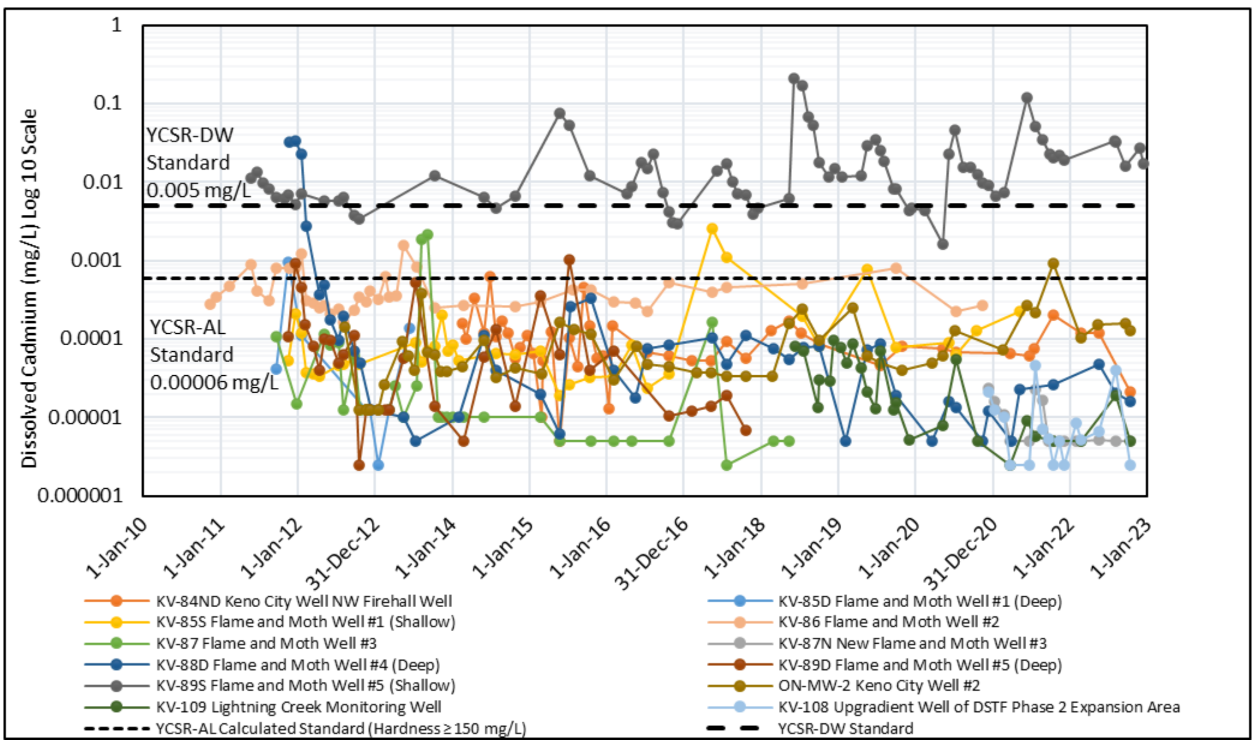


Figure 4-57: District Mill and Keno City Groundwater Monitoring, Dissolved Cadmium

Copper

All monitoring wells in the District Mill area returned copper concentrations below both YCSR-AL and YCSR-DW standards of 0.09 mg/L (hardness ≥ 200 mg/L) and 1 mg/L, respectively (see Figure 4-58). The majority of concentrations at KV-84ND, KV-89D, KV-109, KV-108, and ON-MW-2 were below the detection limit for copper (0.0002 mg/L) with median concentrations of 0.0002 mg/L, 0.0001 mg/L, 0.0001 mg/L, 0.0001 mg/L, and 0.0002 mg/L respectively. These five wells consistently exhibited the lowest concentrations of copper in the District Mill area. KV-89S often had the highest copper concentrations with a median concentration of 0.0023 mg/L.

Copper concentrations in wells KV-86, KV-89S, and KV-85S tended to be higher than KV-87, which typically returned copper concentrations below detection. All wells including the Keno City well KV-84ND had copper concentrations below the YCSR-AL standard; the YCSR-DW standard is much higher at 1 mg/L. Data from the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for copper.

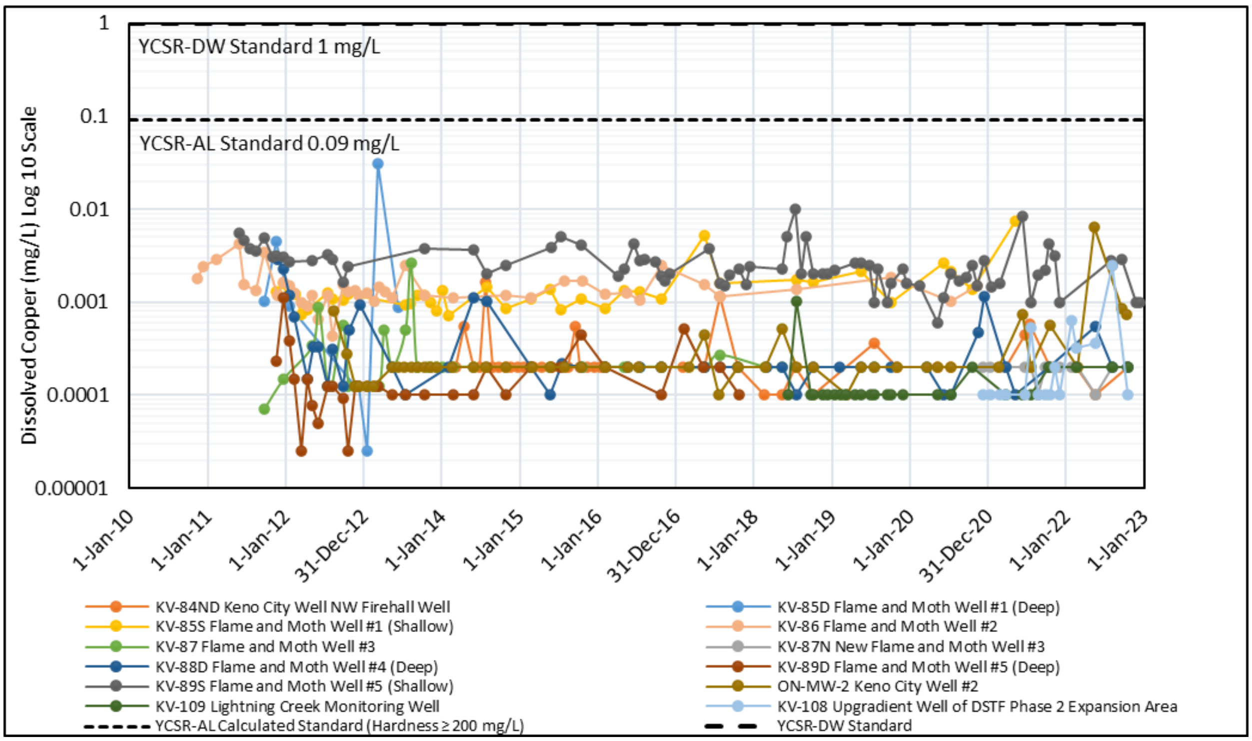


Figure 4-58: District Mill and Keno City Groundwater Monitoring, Dissolved Copper

Lead

All monitoring wells in the District Mill area show marked variability in lead concentrations across sampling events; no clear seasonal trends were discernible (See Figure 4-59Figure 4-58). All monitoring wells returned concentrations of lead below the YCSR-AL standard (0.11 mg/L, hardness 200 to < 300 mg/L) for 2022. KV-86 recurrently exhibited the highest lead concentrations, with a median concentration of 0.0017 mg/L, and is the only well have multiple excursions above the YCSR-DW standard (0.01 mg/L). KV-84ND (median 0.000078 mg/L), KV-87 (median 0.00013 mg/L), KV-88D (median 0.000084 mg/L), and ON-MW-2 (median 0.00014 mg/L) had several results under the detection limit for lead. Data from the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for lead.

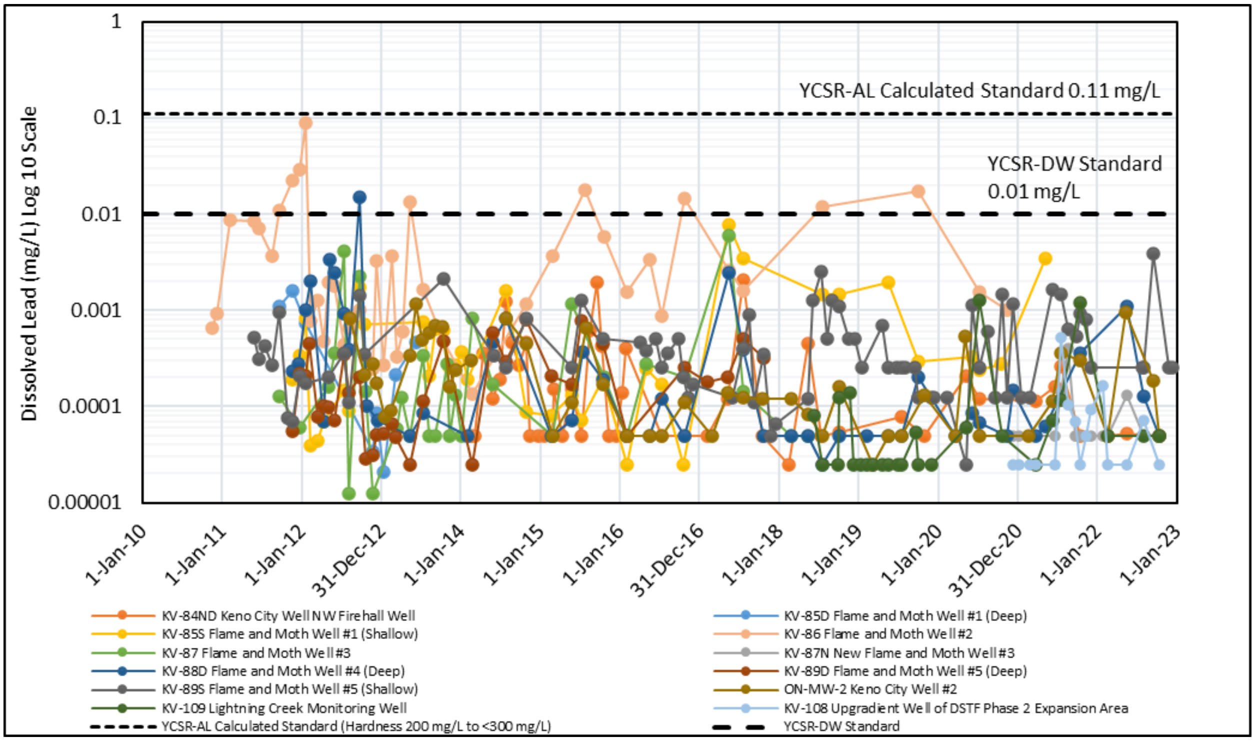


Figure 4-59: District Mill and Keno City Groundwater Monitoring, Dissolved Lead

Nickel

All District Mill monitoring wells exhibited nickel concentrations below the YCSR-AL standard of 1.5 mg/L (hardness ≥180 mg/L) (see Figure 4-60). There is no applicable YCSR-DW standard for nickel. KV-88D and KV-89S showed the highest nickel concentrations with median values of 0.092 mg/L and 0.077 mg/L, respectively. KV-85S returned the lowest nickel concentrations with a median value of 0.00071 mg/L. KV-87, KV-88D, KV-89S, and KV-108 displayed marked variability in nickel concentrations. The other monitoring wells in the District Mill area showed stable concentration levels across sampling events. Data from the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for nickel.

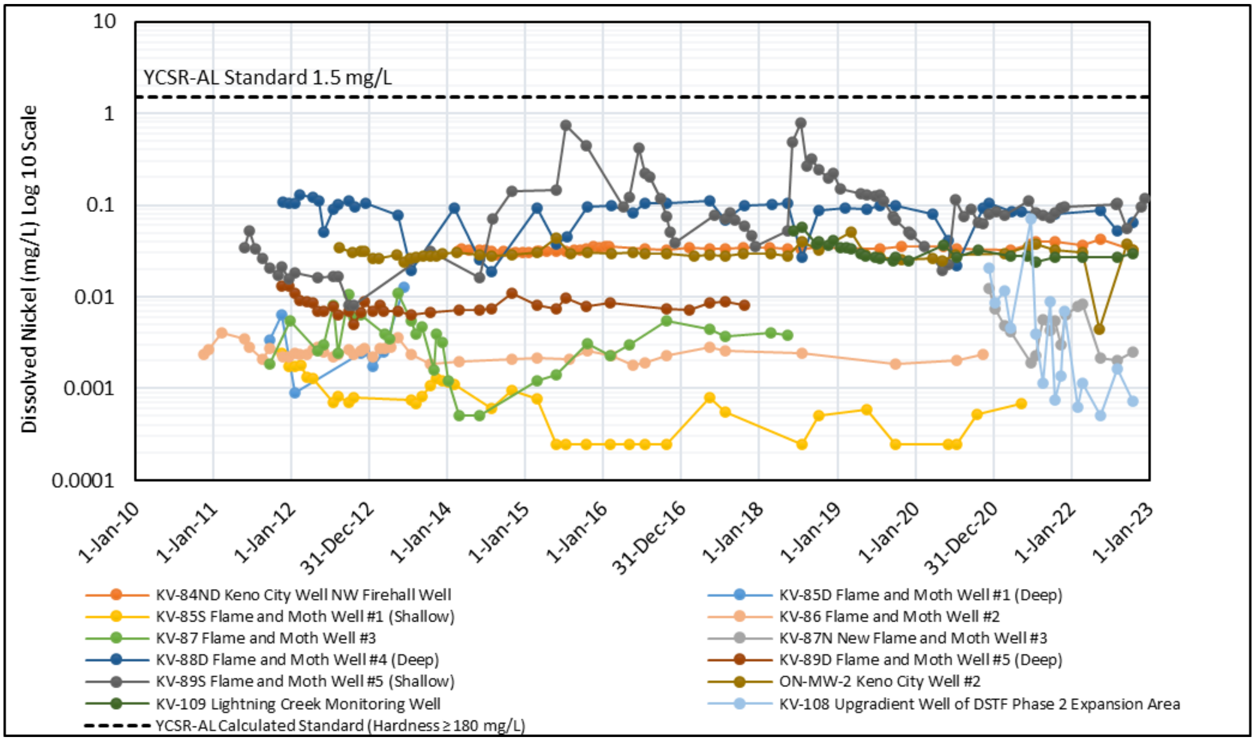


Figure 4-60: District Mill and Keno City Groundwater Monitoring, Dissolved Nickel

Silver

Silver concentrations for all District Mill groundwater monitoring wells were below the YCSR-AL standard of 0.015 mg/L (hardness ≥ 100 mg/L; Figure 4-61). There is no YCSR-DW standard for silver. Silver concentrations were mostly below detection for KV-84ND (median 0.00001 mg/L), KV-86 (median 0.000005 mg/L), KV-108 (median 0.000005 mg/L), KV-109 (median 0.000005 mg/L), and ON-MW-2 (median 0.00001 mg/L). KV-89S exhibited the highest silver concentrations of the District Mill groundwater wells with a median value of 0.000035 mg/L and showed marked fluctuations in concentrations. From the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for silver.

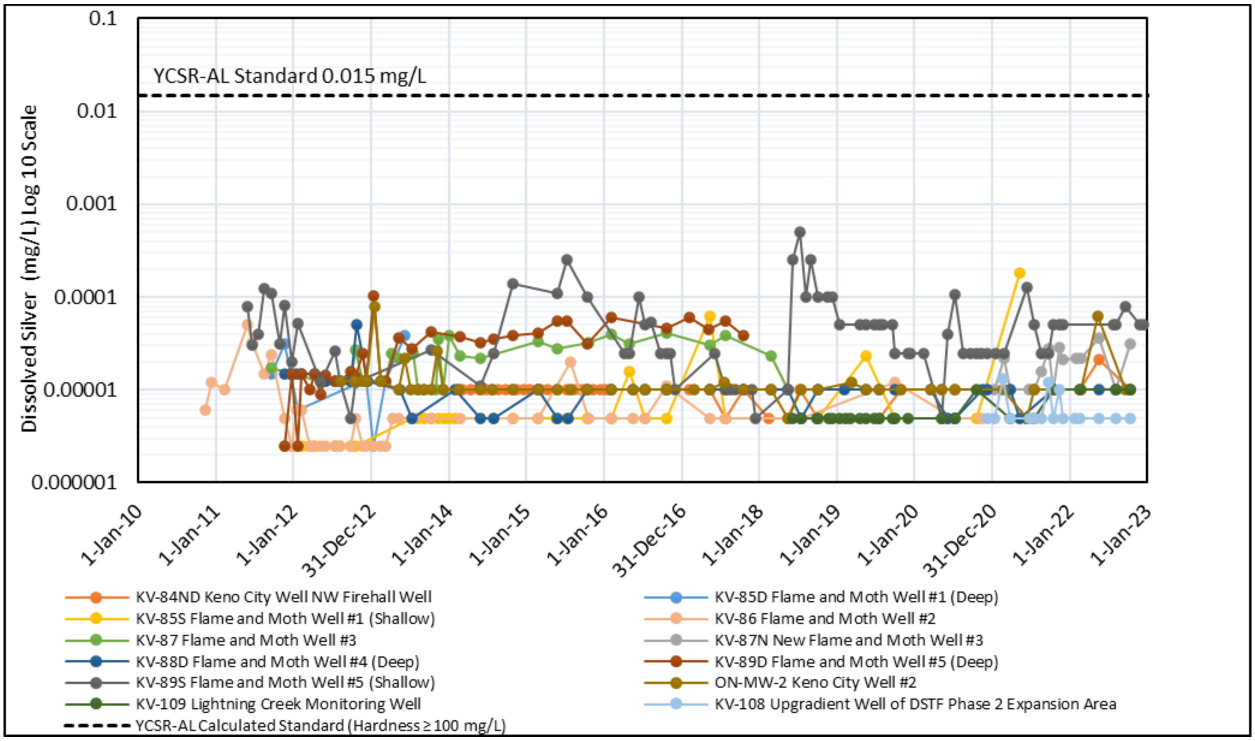


Figure 4-61: District Mill and Keno City Groundwater Monitoring, Dissolved Silver

Zinc

Zinc concentrations at KV-89S were consistently above the YCSR-DW and YCSR-AW standards of 5 mg/L and 1.65 mg/L (hardness 200 mg/L to <300 mg/L), respectively (Figure 4-62). KV-89S also exhibited the highest concentrations of zinc. Dissolved zinc concentrations at KV-89S appear elevated as compared to the pre-mining reference period (i.e. 2011), however, no increases trends have been remarked since 2020. District monitoring wells, with a median concentration of 22.7 mg/L. ON-MW-2 had the second highest concentrations of zinc amongst District Mill monitoring wells with a median value of 2.14 mg/L; ON-MW-2 concentrations across events were generally stable and consistently below the YCSR-DW standard, but over the YCSR-AW standard.

KV-84ND, KV-86, KV-87, KV-85S, and KV-109 were all consistently below the YCSR-DW and YCSR-AW standards; KV-85S and KV-87 returned the lowest zinc concentrations of the District Mill groundwater monitoring wells (median values of 0.0038 mg/L and 0.0043 mg/L, respectively). KV-84ND, KV-86, and KV-109 exhibited relatively stable concentrations across sampling events, while KV-89S showed marked variability. Data from the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for zinc.

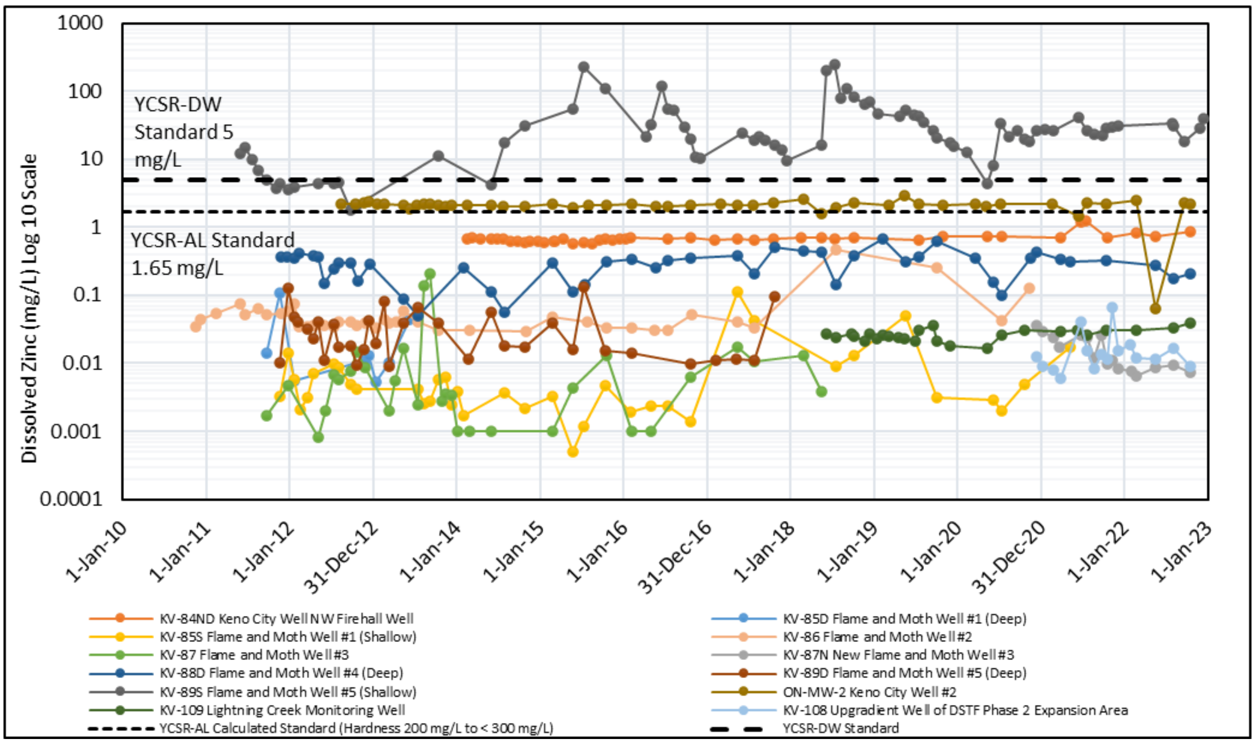


Figure 4-62: District Mill and Keno City Groundwater Monitoring, Dissolved Zinc

Sulphate

Monitoring wells KV-89S, KV-88D, and KV-87 exhibited elevated sulphate concentrations relative to YCSR-AL and YCSR-DW standards (1,000 mg/L and 500 mg/L, respectively; Figure 4-63). KV-89S and KV-88D had the highest sulphate concentrations of the District Mill monitoring wells, with median concentrations of 1,255 mg/L and 1,630 mg/L, respectively; KV-89S and KV-88D showed marked fluctuations in sulphate concentrations, while the remaining wells in the District had stable sulphate concentration levels.

Monitoring wells ON-MW-2, KV-84ND, KV-85D, KV-89D, KV-108, and KV-109 had elevated concentrations relative to the YCSR-DW standard but have remained under the YCSR-AL standard. KV-85S and KV-86 had the lowest sulphate concentrations of the District Mill wells with median values of 66.8 mg/L and 214 mg/L, respectively, and were consistently below the YCSR-DW standard for sulphate. Data from the 2022 sampling events were consistent with the historical trends of the District Mill groundwater monitoring wells for sulphate.

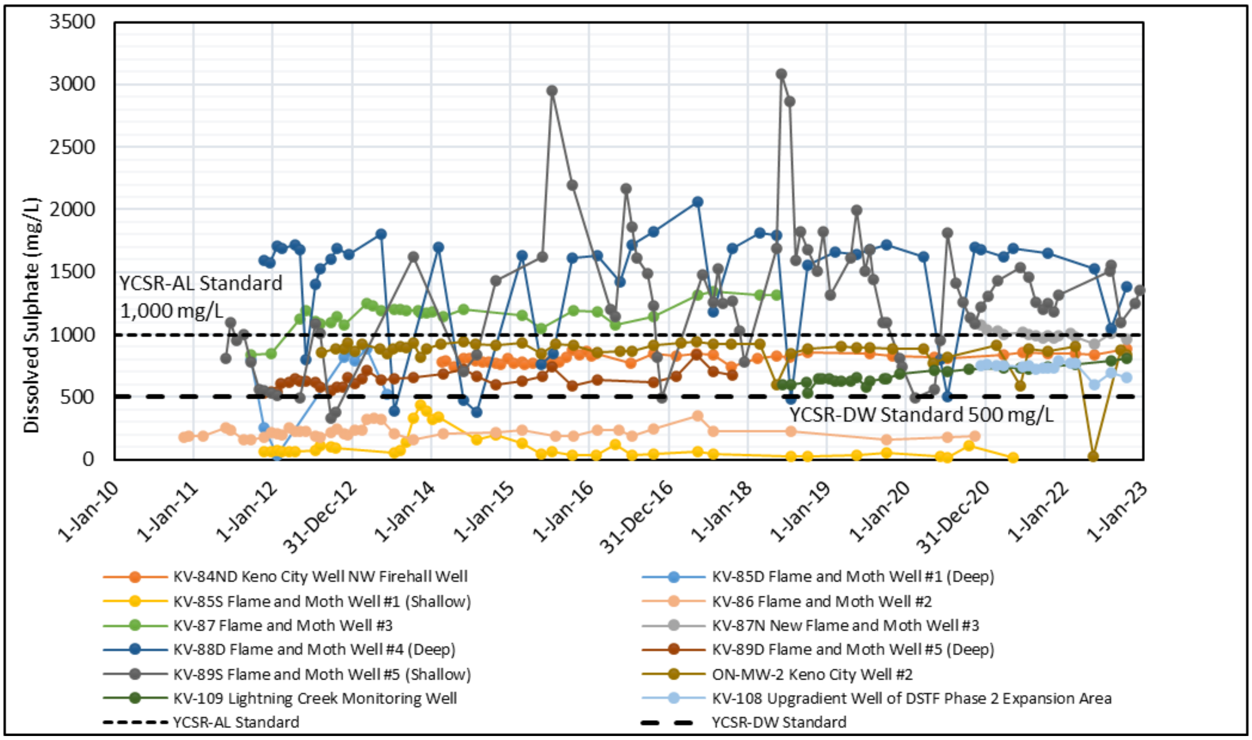


Figure 4-63: District Mill and Keno City Groundwater Monitoring, Sulphate

4.3.1.2 *Groundwater Quantity*

Across the Keno Hill mining camp, the groundwater table is a subdued reflection of the overlying topography, and natural groundwater flow paths tend to follow the surface topography from higher to lower elevations where the groundwater discharges to surface water. This general picture is modified by the presence of surface and underground mine workings, particularly when these features are actively dewatered or are drained by free-flowing adits. As such, active dewatering or free discharge from adit portals can create groundwater sinks that collect groundwater within and adjacent to the mine workings and convey this flow to surface water.

Figure 4-66 and Figure 4-67 are interpreted groundwater elevation contour maps extending from Keno City through the District Mill site and westward to Christal Creek/Lake based on geodetic groundwater level data from the June and October 2022 groundwater level synoptic events, respectively. On the map, selected groundwater flowpaths are drawn to be perpendicular to the contours. Important features of the contour map are summarized below:

- The general groundwater flow direction is from east to west-northwest with natural groundwater discharge to Christal Lake and Christal Creek.
- Based on converging groundwater flow paths and the spacing of groundwater contours, it is postulated that a higher permeability zone extends from Keno City to the northwest.
- West of Keno City, surface water in Lightning Creek recharges the groundwater system north of the creek. This northward flowing recharge converges with the natural west-northwest flow of the regional groundwater system.
- Continued advancement and dewatering of the of the Flame & Moth Mine has further depressed the groundwater sink as expected. Groundwater flows radially to the deepest portion of the decline where it is removed by pumping. Some of the discharge to the sink may be derived from Lightning Creek surface water.

Estimated Mine Dewatering Rate for Flame & Moth Mine

Groundwater inflow estimates for Flame & Moth Mine were developed analytically by Interralogic and are summarized in a memo entitled *Groundwater Evaluation of Flame and Moth,* prepared for Alexco Resource Corp. in 2013. A maximum inflow rate into the mine of 35 L/s at a maximum mine depth of 270 mbgs was estimated using an analytical solution that was presented as a conservative estimate. The conceptual mine inflow model, as well as a graphical presentation of estimated inflow rates versus mine workings depth from can be found in Appendix 1.

Observed dewatering rates from Flame & Moth Mine were below the maximum analytical predicted mine inflows, and daily pump-out rates from Flame & Moth Mine are presented in Figure 4-64. As of July 2023, the current maximum mine bottom of the Flame & Moth Mine workings was 800 m asl (approximately 115 m below portal elevation), with observed groundwater dewatering rates of 4 to 6 L/s; the predicted groundwater inflow rate at this depth is 12 L/s (Interralogic, 2013). No details regarding quantities and timing of makeup water used for underground drilling are available, and therefore observed groundwater dewatering rates are considered to be inclusive of make-up water as well as recharge. Observed mine dewatering rates from Flame & Moth Mine are lower than the estimated mine inflow rates but agree within a factor of two. Due to uncertainty relating to structurally-controlled inflows in the mine area, this is considered to be reasonable agreement, and no additional updates to the mine inflow estimates for Flame & Moth are recommended. Predicted analytical groundwater inflow rates as a function of mine depth are presented in Figure 4-65, with annotations indicating measured monthly average pump-out rates observed at KV-110, the Flame & Moth Adit monitoring location, for comparison of measured vs predicted rates. Initial estimates predicted no long-term discharges from the portal post-closure, as pre-pumping groundwater elevations were found to be below the portal elevation.

A review of mine dewatering completed by Itasca (2023) indicates that two assumptions included as part of the analytical estimate for the predicated groundwater inflows at the Flame & Moth Mine (Alexco, 2013) did not agree with the observed site conditions, such that (1) the site condition demonstrated that groundwater flow was observed to be fault-controlled, and (2) the observed site conditions indicate that inflow is sensitive to recharge. Despite these differences, the long-term predictions for inflows during closure, are not expected to vary. However, operational groundwater inflow rates may be revised as the mine progresses deeper. At present, the measured mine inflow rates are less than predicted by the analytical model.

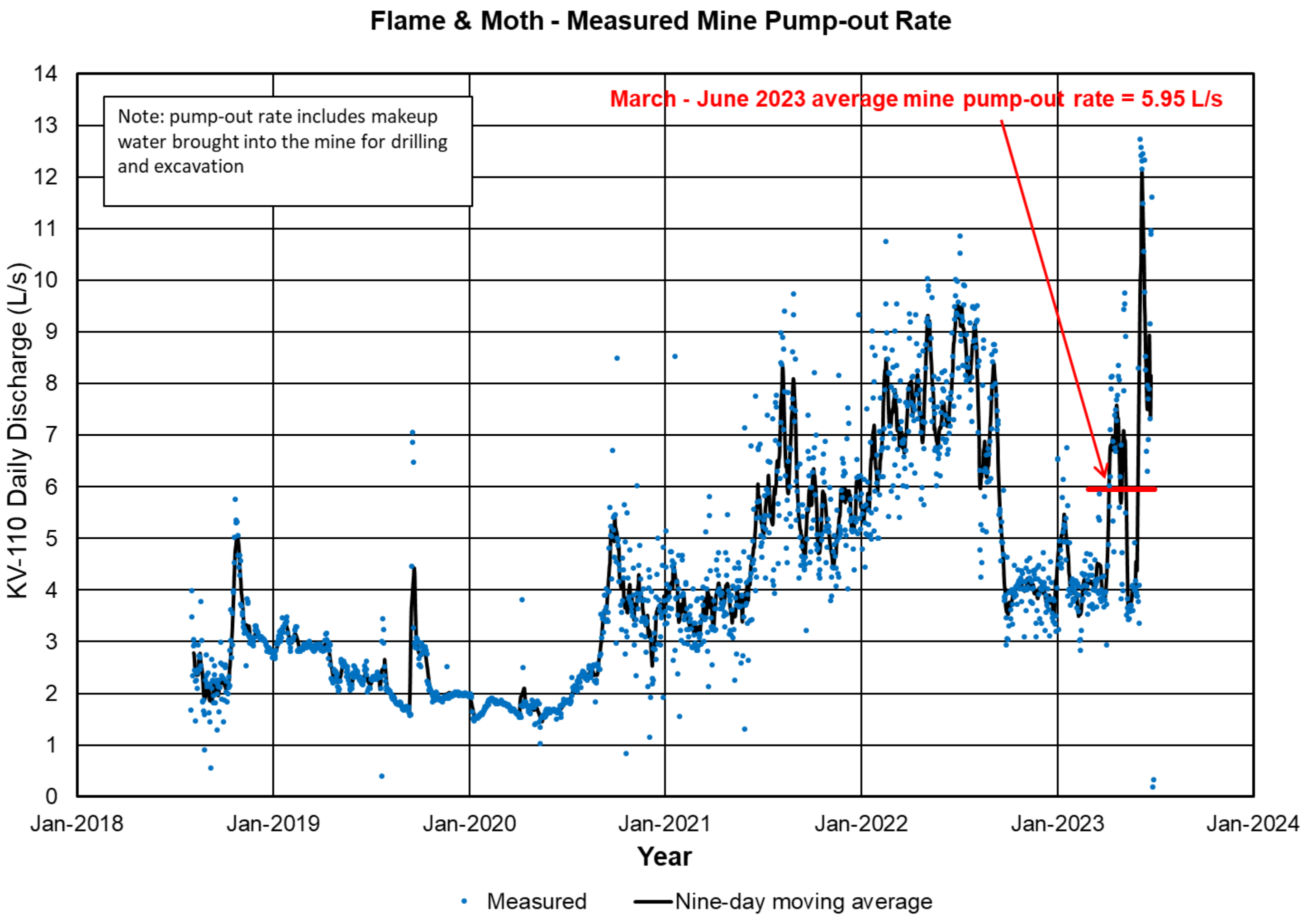


Figure 4-64: Flame & Moth Mine Measured Daily Pump-out Rate

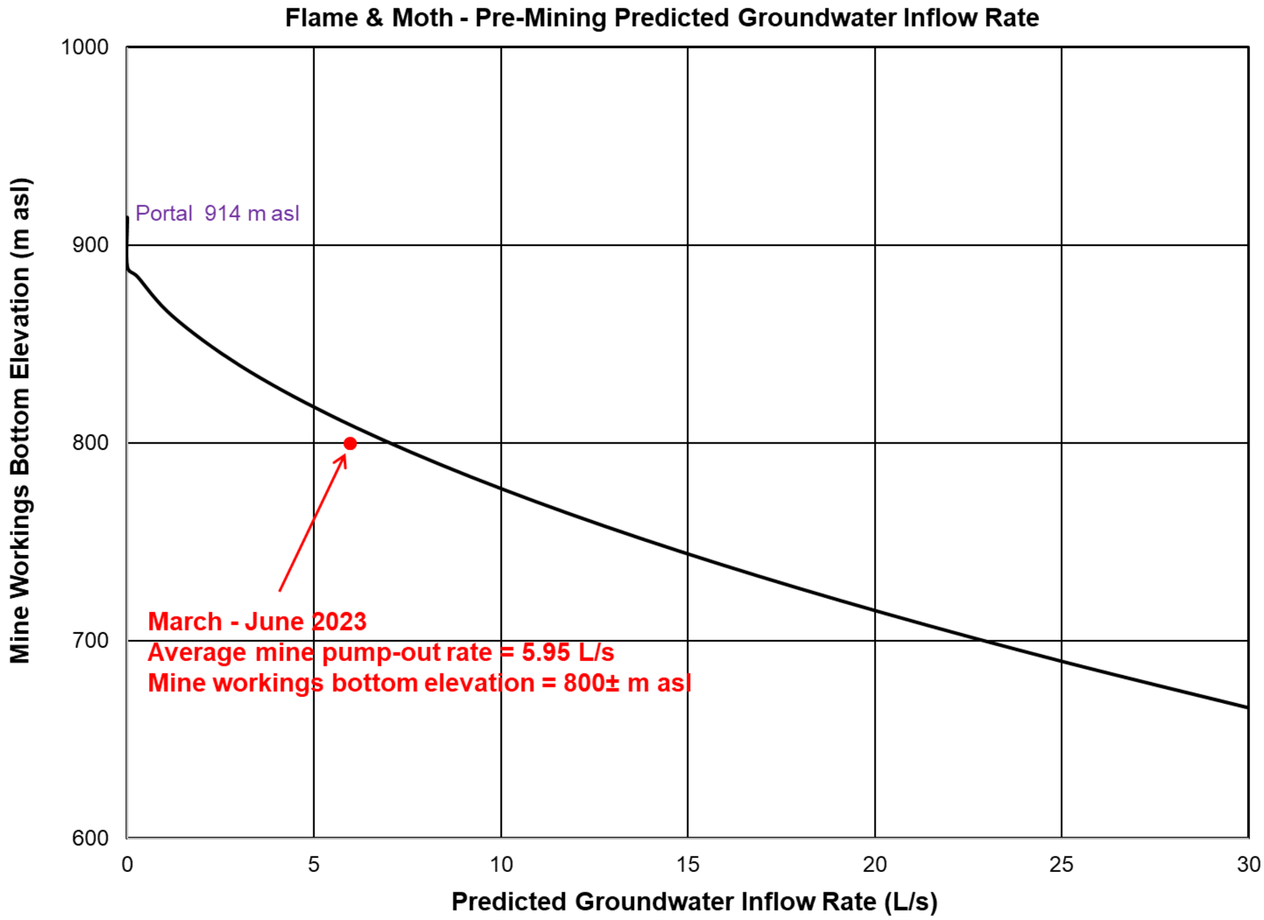
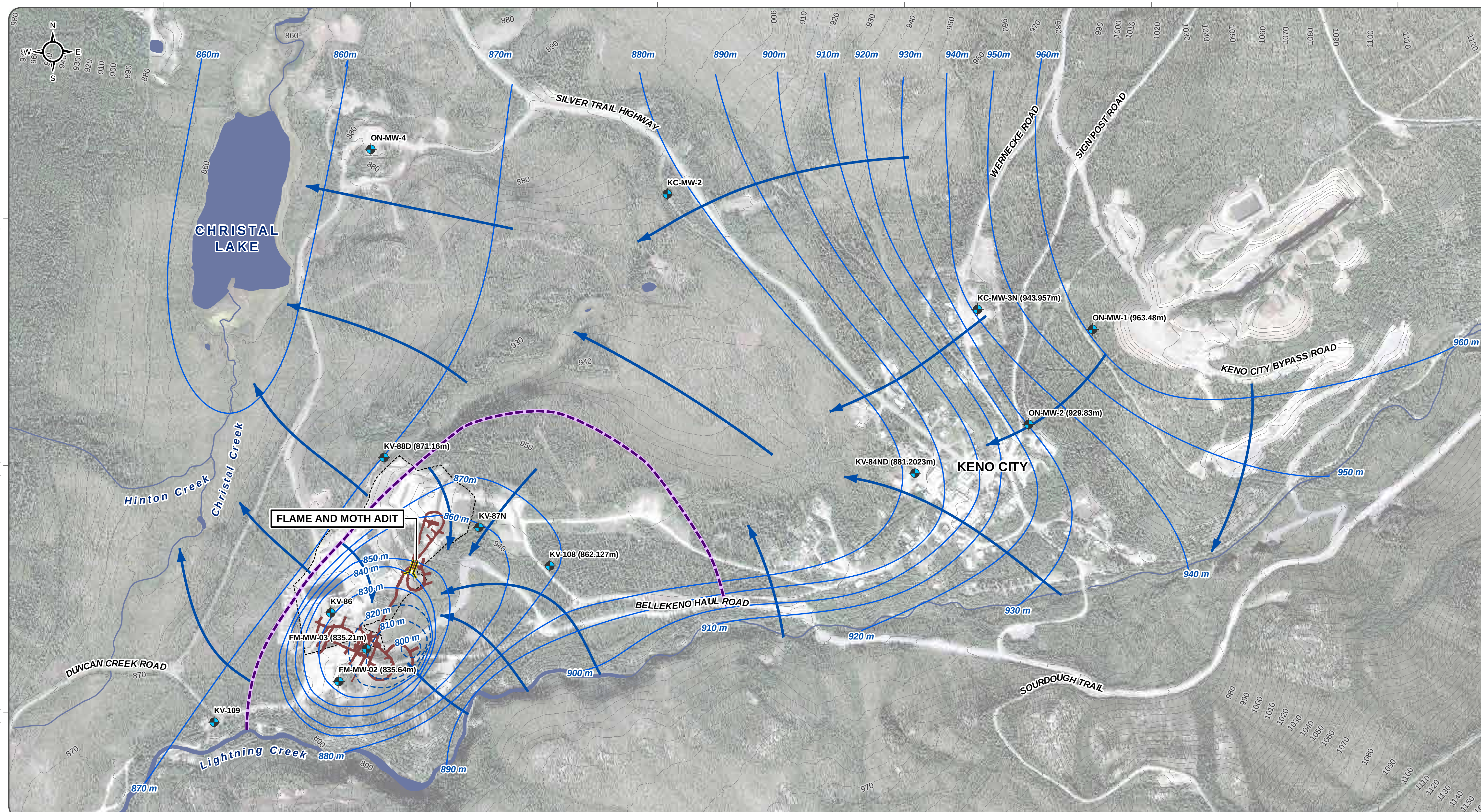


Figure 4-65: Flame & Moth Mine Predicted Groundwater Inflow vs. Mine Depth of Workings

4.3.1.3 ***District Mill Area Summary***

The groundwater elevation in the Keno Hill mining camp reflects the surface topography, and groundwater flow paths tend to follow topography from higher to lower elevations where the groundwater discharges to surface water. Generally, groundwater flow converges in Keno City and flows to the northwest towards Christal Lake and Christal Creek, as shown on Figure 4-66 and Figure 4-67. While the overall groundwater flow pattern remained consistent to the previous years, pumping at the Flame & Moth Adit has resulted in a larger area of influence of groundwater drawdown in this area. This flow pattern is modified by the dewatering of mine workings. Dewatering can create groundwater sinks that collect groundwater within and adjacent to the mine workings and convey this flow to surface water. Mine inflow rates are currently less than predicted by Interralogic (2013), however, no long-term dewatering is expected through the Flame & Moth Adit during closure as the groundwater table is below the elevation of the adit.

The groundwater monitoring program shows spatially variable water chemistry. The background well KV-87 generally had the lowest concentration of COPCs typically below the YCSR-AL and YCSR-DW standards except for sulphate. The concentration of COPCs in the majority of groundwater wells in the District Mill area returned concentrations below the YCSR-AL and YCSR-DW standards with the notable exception of arsenic, cadmium, zinc, and sulphate in a few wells. These elevated concentrations could be related to the mineralization of the area. Arsenic was elevated in the deep wells (KV-88D, ON-MW-2, KV-108, KV-109, KV-87N, KV-89D, and KV-85D) likely due to the reducing conditions in these wells which promote the dissolution of arsenic bearing minerals and amorphous phases. Cadmium and zinc were commonly elevated in the shallow well KV-89S and zinc in the shallow well ON-MW-2. Sulphate was elevated above YCSR-DW standard in several wells, but only KV-89S, KV-87 and KV-87N (background well), and KV-88D were higher than the YCSR-AL. The elevated sulphate concentrations in these wells, including the background well, indicate a generally elevated concentration of sulphate in the area. Fluctuations of the concentrations of COPCs in groundwater were noticeable at several wells but only KV-89S exhibited seasonality characterized by highest concentrations of COPCs in May through July and the lowest concentration during the remainder of the year. Several wells also returned concentrations of cadmium, nickel, copper, lead, zinc, and silver below the detection limit. No significant increasing trends in COPCs have been observed.



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

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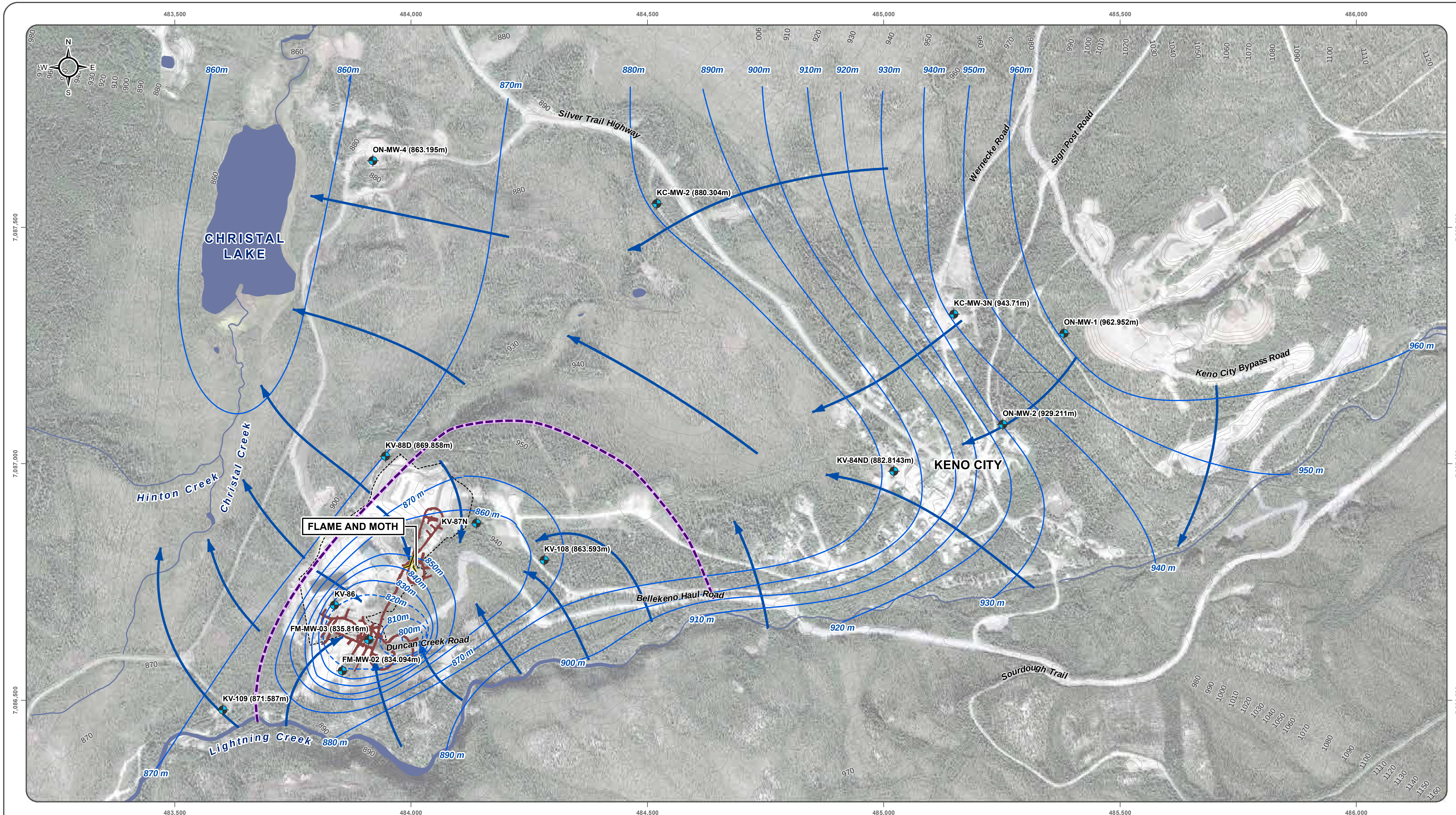
HECLA KENO HILL SILVER DISTRICT
MINING OPERATIONS

FIGURE 4-66
KENO CITY GROUNDWATER LEVEL CONTOUR,
UNE 2022 SAMPLING EVENT

OCTOBER 2023



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

Legend

- 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

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FIGURE 4-67
KENO CITY GROUNDWATER CONTOUR, OCTOBER 2022 SAMPLING EVENT

OCTOBER 2023

4.3.2 New Bermingham

4.3.2.1 ***Groundwater Quality***

The 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 waste rock storage facility. The monitoring wells installed in November of 2020 include KV-116, KV-122 through KV-127, and NC-MW-1; all nine wells were completed in the bedrock aquifer. WL QZ18-044 requires new groundwater monitoring wells be sampled monthly for the first twelve months following installation, after which the frequency can be reduced to quarterly sampling. WL QZ18-044 Clauses 82 and 83 require a comparison of groundwater quality with YCSR-AL. Since no drinking water wells exist within a 1.5 km radius of the New Bermingham Mine workings and open pits, comparison to YCSR-DW standards is not required.

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 SW open pit throughout 2022. Analytical results from November 2020 to October 2021 monitoring events can be assumed to provide reference conditions for this area of the Keno Hill mining camp prior to AKHM mining operations. As shown in Figure 4-55:

- KV-124 installed upgradient of Bermingham Southwest Pit.
- KV-122 and KV-123 installed downgradient of Bermingham Southwest Pit.
- KV-127 installed upgradient of the New Bermingham P-AML waste rock storage facility.
- KV-125 and KV-126 installed downgradient of the New Bermingham P-AML waste rock storage facility.
- KV-116 installed downgradient of the N-AML waste rock disposal area to monitor groundwater downgradient of the N-AML waste rock disposal area and the water treatment discharge location.
- NC-MW-1 was installed to monitor groundwater downgradient of the underground mine workings at New Bermingham.

Deviations to the Bermingham Area groundwater sampling program are listed in Table 4-10.

Table 4-10: Deviations to Groundwater Sampling Program at New Bermingham

MONITORING WELL	DEVIATION
All New Wells	wells were not visited December 2021 because of scheduling issues: the November 2021 trip occurred late in the month, and the December 2021 site visit could not take place before the 2021 holidays without happening within two weeks of the November trip
KV-124	well freezes during the winter months and was only possible to sample June through October of 2021, and June and July of 2022; not accessible in February, March, April, and December 2022
KV-122,	discrete sampled using a HydraSleeve.
KV-125	discrete sampled using a HydraSleeve.
KV-126	discrete sampled using a HydraSleeve.
KV-127	well was dry January through August 2021; while the well was not dry in September 2021, tubing was not brought on the trip (usually dry) and it could not be sampled; the well was sampled in October and November of 2021. well was not accessible in April and December of 2022, and dry every other month visited; it was successfully sampled in August and November of 2022.

The following sections provide graphical presentation and discussion of water quality analytical results of samples collected from the groundwater monitoring wells from the Bermingham area with regards to the applicable standards. Hardness-dependent standards for the Bermingham area groundwater wells are determined using site KV-118 as this is the nearest downgradient surface water site and is considered to be the receiving environment. The following subsections report on COPCs, which were listed in a 2018 Waste Rock ARD/ML memorandum prepared for Alexco Resource Group by AEG in 2018.

Arsenic

All Bermingham groundwater monitoring wells were below the YCSR-AL standard of 0.05 mg/L for arsenic, except for KV-126; KV-126 had the highest concentration of dissolved arsenic of all the Bermingham wells (median concentration of 0.0272 mg/L) but has decreased to below the YCSR-AL standard in all monitoring events since August 2021 (Figure 4-68). Monitoring wells KV-124 and NC-MW-1 had the lowest concentrations of arsenic of the Bermingham groundwater monitoring wells, with median concentrations of 0.00042 mg/L and 0.00089 mg/L, respectively. All Bermingham monitoring wells exhibited relatively stable concentrations of dissolved arsenic.

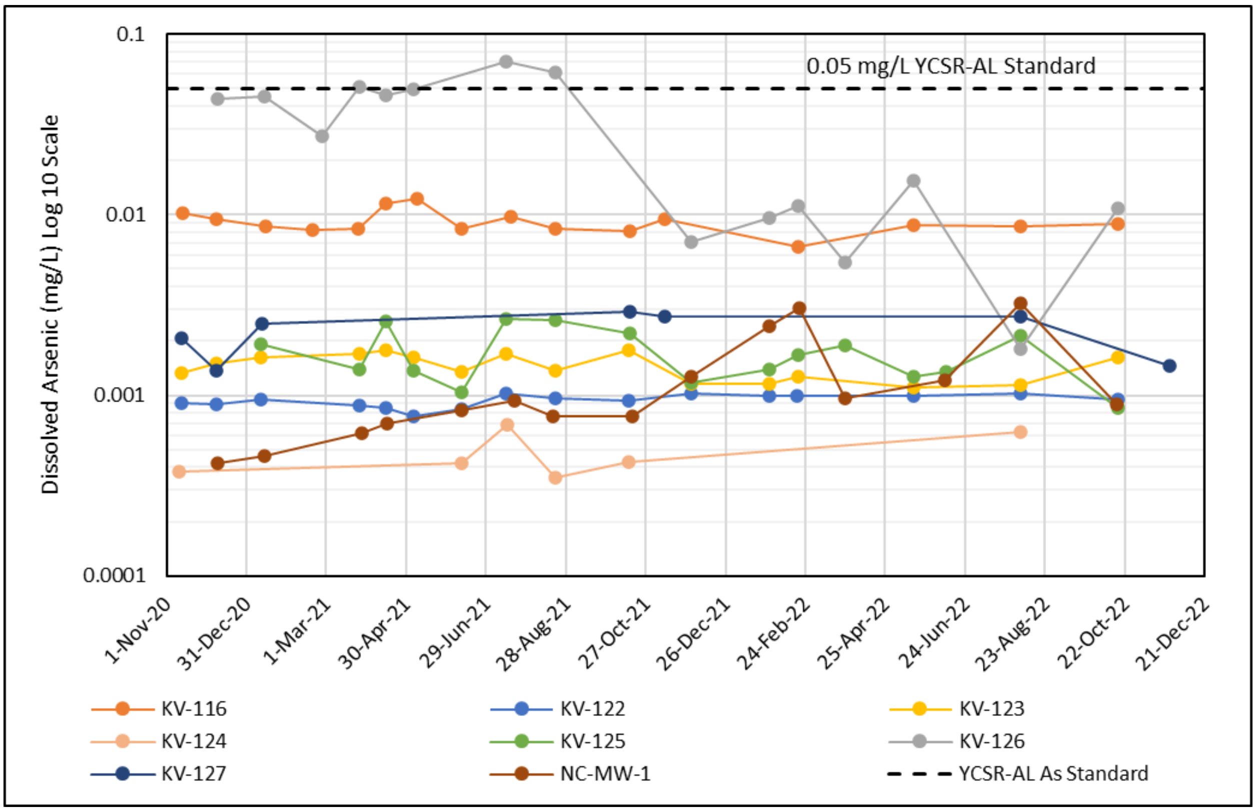

Figure 4-68: Bermingham Groundwater Monitoring, Dissolved Arsenic

Cadmium

Monitoring well KV-123 was consistently elevated compared to the YCSR-AL standard for dissolved cadmium of 0.0003 mg/L (hardness-dependent, 30 to <90 mg/L), and exhibited the highest dissolved cadmium concentrations of the Bermingham monitoring wells (median concentration of 0.013 mg/L; Figure 4-69). In 2021 KV-122, KV-125, KV-126, and KV-127 had one or two excursions above the YCSR-AL standard, while in 2022 only two excursions were found, both at KV-125. KV-124 and NC-MW-1 returned the lowest concentrations of dissolved cadmium with median concentrations of 0.000021 mg/L and 0.000014 mg/L, respectively. Monitoring wells KV-116, KV-122, KV-123, and KV-124, displayed relatively stable concentrations of dissolved cadmium, while KV-125, KV-126, and NC-MW-1 exhibited marked variability of dissolved cadmium concentration values; NC-MW-1 and KV-126 both showed notably low concentrations of dissolved cadmium during the last groundwater monitoring event.

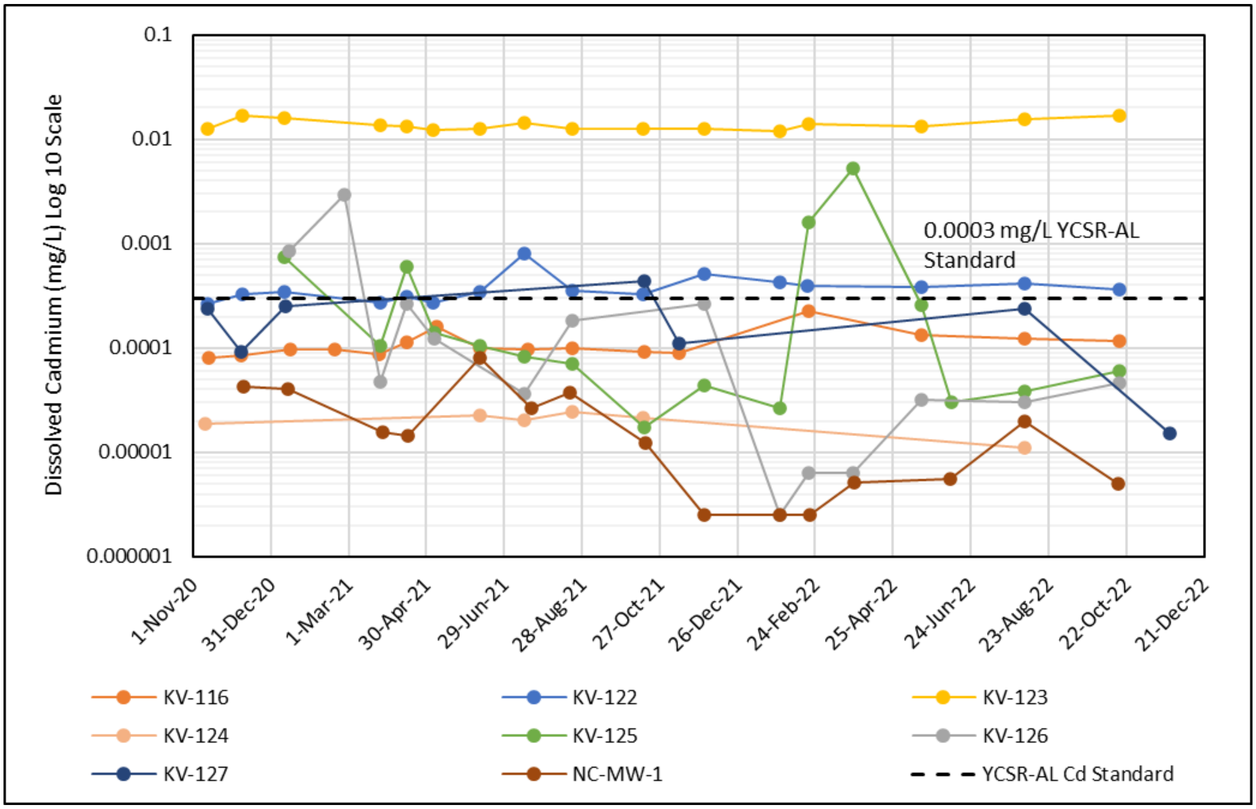

Figure 4-69: Bermingham Groundwater Monitoring, Dissolved Cadmium

Copper

All Bermingham monitoring wells returned copper concentrations below the YCSR-AL standard of 0.04 mg/L (hardness 75 to <100 mg/L; Figure 4-70). KV-127 exhibited the highest concentrations of dissolved copper (median concentration 0.0013 mg/L), and NC-MW-1 had the lowest concentrations with several samples below the detection limit (median concentration 0.00010 mg/L).

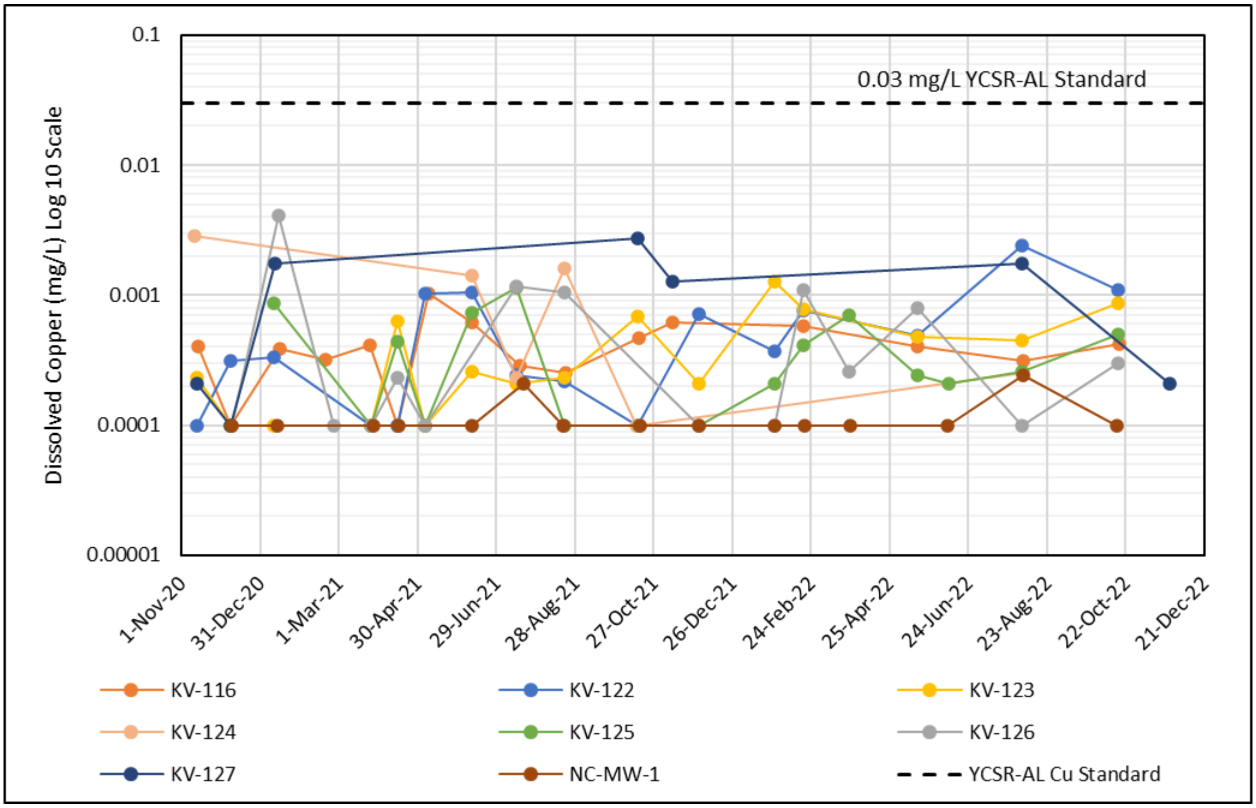

Figure 4-70: Bermingham Groundwater Monitoring, Dissolved Copper

Lead

All Bermingham monitoring well samples had lead concentrations below the YCSR-AL standard of 0.05 mg/L (hardness 50 to <100 mg/L; Figure 4-71). KV-126 exhibited the highest concentration of dissolved lead of the Bermingham monitoring wells, with a median concentration of 0.0005 mg/L; KV-116, KV-122, KV-123, and NC-MW-1 had several concentrations below the detection limit for lead. Monitoring wells KV-116, KV-125, KV-126, and NC-MW-1 showed marked variability in lead concentrations.

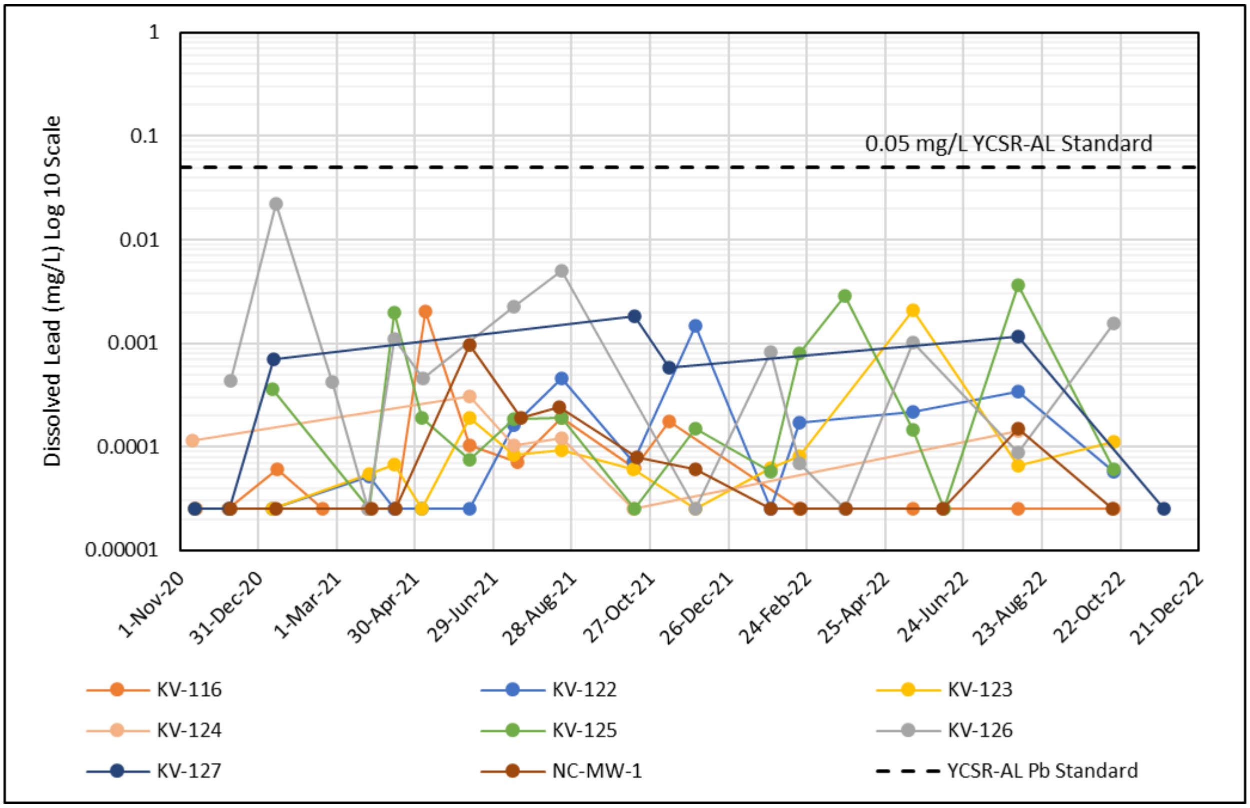

Figure 4-71: Bermingham Groundwater Monitoring, Dissolved Lead

Nickel

All Bermingham monitoring wells exhibited nickel concentrations below the YCSR-AL standard of 0.65 mg/L (hardness 60 to <120 mg/L; Figure 4-72). KV-126 and NC-MW-1 returned the highest concentrations of dissolved nickel of the Bermingham wells with median concentrations of 0.0064 mg/L and 0.0059 mg/L, respectively. KV-116 had the lowest concentration of dissolved lead with a median concentration of 0.00057 mg/L. KV-122, KV-123, KV-124, and NC-MW-1 showed relatively stable concentrations of dissolved nickel, whereas KV-116 and KV-126 exhibited marked variability of dissolved nickel concentrations.

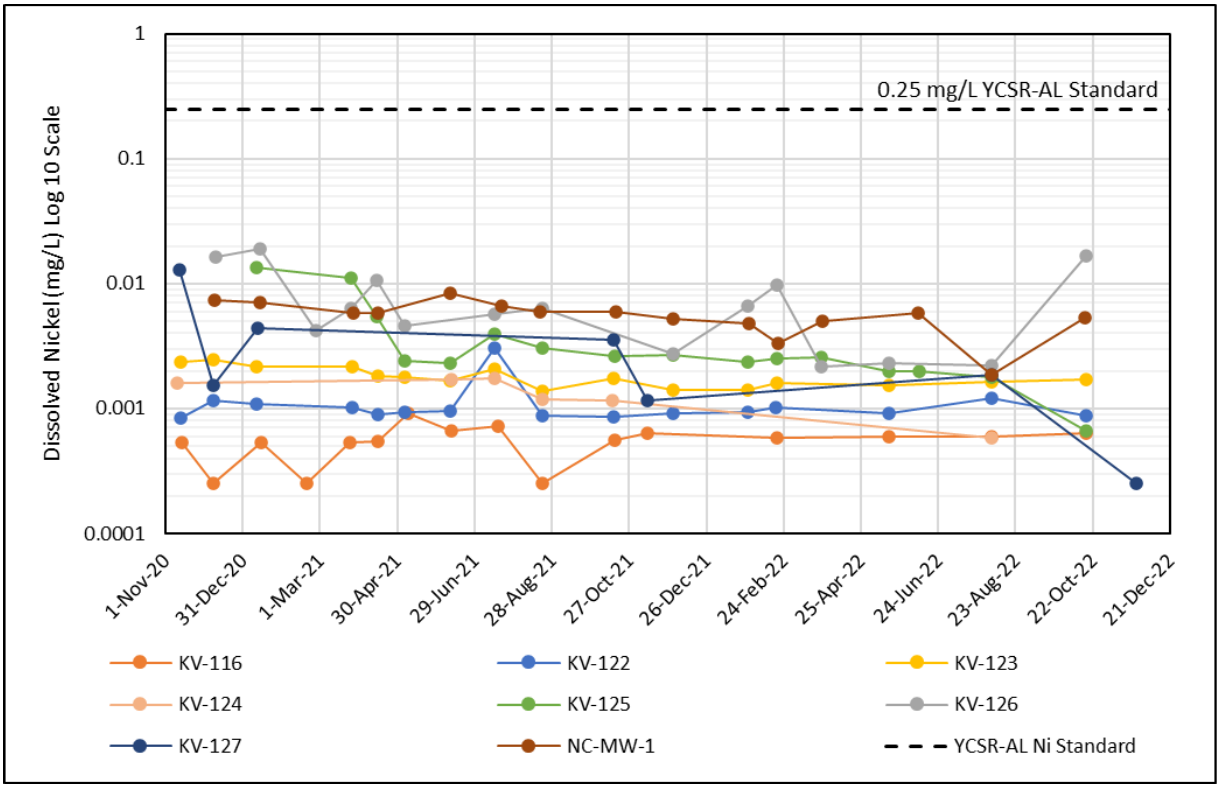

Figure 4-72: Bermingham Groundwater Monitoring, Dissolved Nickel

Silver

All Bermingham monitoring wells had silver concentrations orders of magnitude below the YCSR-AL standard of 0.0005 mg/L (hardness <100 mg/L; Figure 4-73). Furthermore, most results across sampling events for all Bermingham monitoring wells returned dissolved silver concentrations below the detection limit.

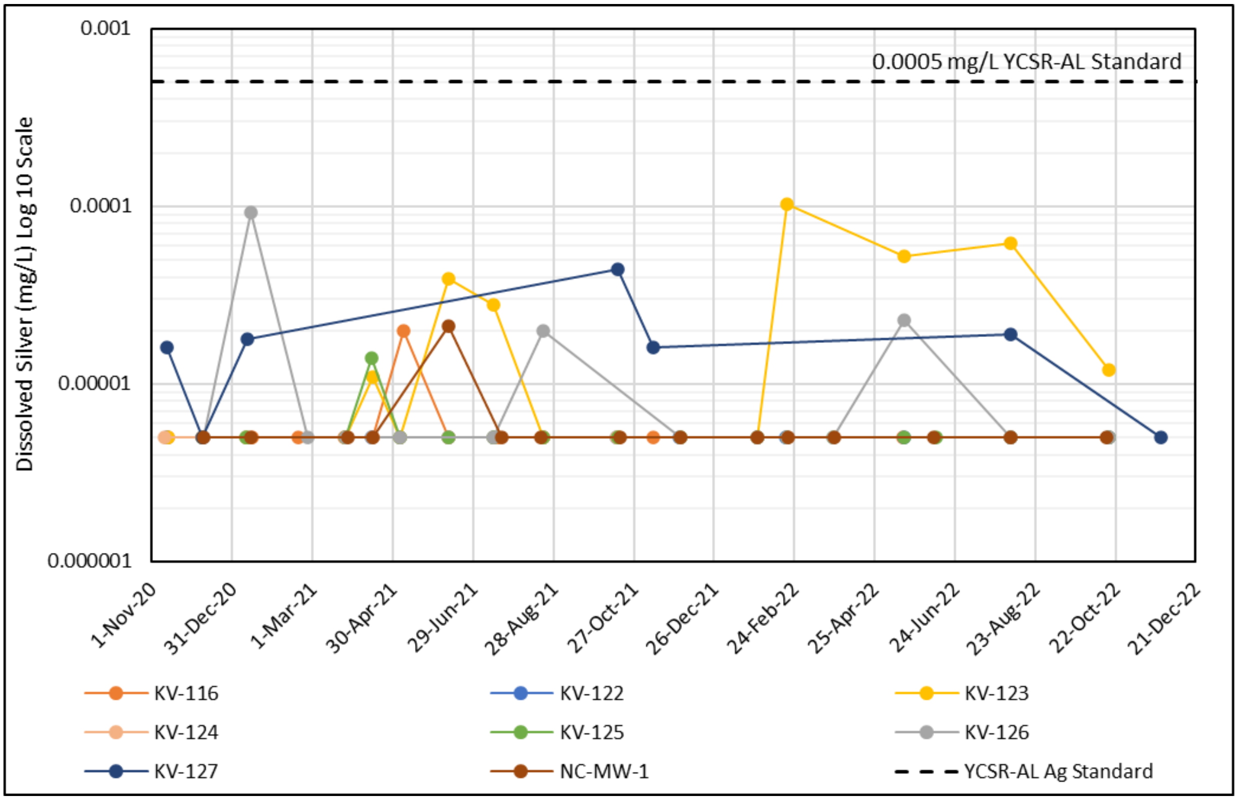

Figure 4-73: Bermingham Groundwater Monitoring, Dissolved Silver

Zinc

Monitoring well KV-123 exhibited the highest dissolved zinc concentrations of the Bermingham monitoring wells, with a median concentration of 1.17 mg/L; KV-123 consistently had dissolved zinc concentrations above the YCSR-AL standard of 0.0005 mg/L (hardness <90 mg/L; Figure 4-74). Results from monitoring wells KV-116, KV-124, and KV-125 returned dissolved zinc concentrations that were consistently below the YCSR-AL standard; KV-116 and KV-124 had the lowest dissolved zinc concentrations of the Bermingham monitoring wells (median concentrations of 0.0034 mg/L and 0.0013 mg/L respectively).

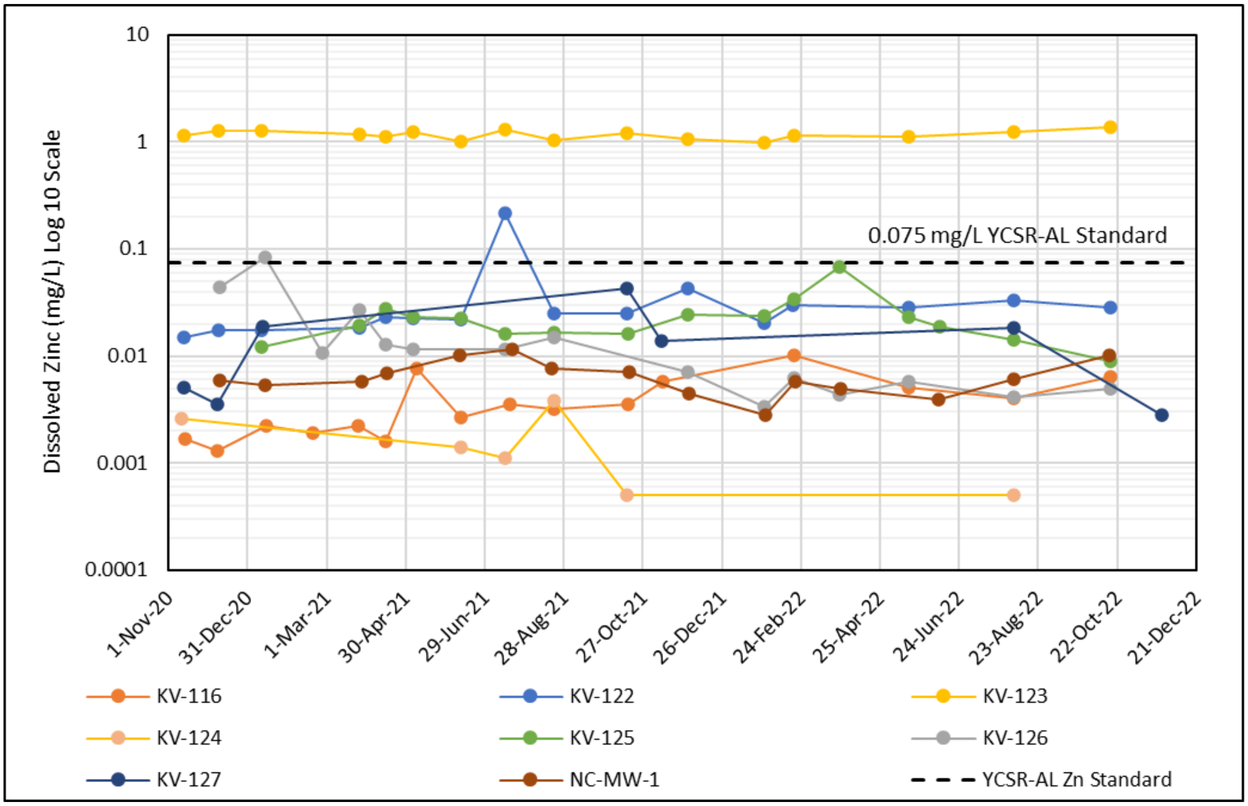

Figure 4-74: Bermingham Groundwater Monitoring, Dissolved Zinc

Sulphate

All Bermingham monitoring wells presented dissolved sulphate concentrations below the YCSR-AL standard of 1,000 mg/L (Figure 4-75). NC-MW-1 exhibited the highest concentrations for dissolved sulphate, with a median concentration of 283 mg/L. KV-127 consistently had the lowest concentrations of dissolved sulphate, with a median concentration of 3.06 mg/L. All Bermingham wells displayed relatively stable dissolved sulphate concentrations.

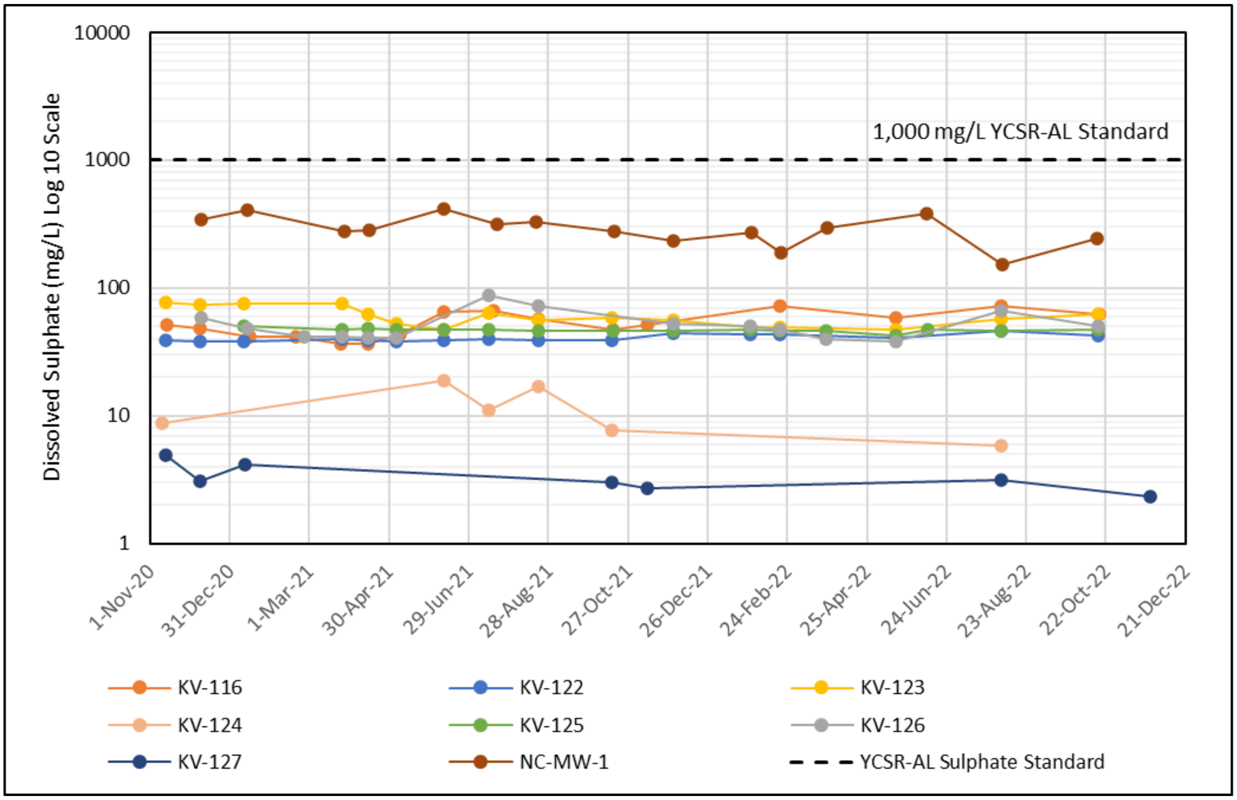

Figure 4-75: Bermingham Groundwater Monitoring, Dissolved Sulphate

4.3.2.2 ***Groundwater Quantity***

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 decline have modified the flow patterns. Based on measured groundwater levels in wells and the expected hydrologic effect of the decline, Figure 4-74 and Figure 4-75 are interpreted groundwater elevation contour maps of the Bermingham area in June and October 2022, respectively. Shown on the maps are interpreted groundwater flowpaths, which are generally drawn perpendicular to the contours. The maps show flow lines converging along the 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. The groundwater contours are as anticipated per the groundwater model submitted as part of WL application.

Estimated Mine Dewatering Rate for New Bermingham Mine

In 2023, the mine dewatering rates were monitored by flowmeter at the mine adit (KV-110). The average monthly flow rates are presented below in Table 4-11, with the exception of November and December which are from 2022. SRK consulting has been engaged to conduct a hydrogeological model exercise along with facilitating the collection of additional inflow data within the Berm underground workings. This modeling and data collection exercise is intended to improve mine inflow rate predictions.

Table 4-11: 2022/2023 Bermingham Dewatering Rates

MONTH	UNITS	KV-110 DISCHARGE
January	m^3/day	544.32
February	m^3/day	518.4
March	m^3/day	570.24
April	m^3/day	639.36
May	m^3/day	648
June	m^3/day	803.52
July	m^3/day	889.92
August	m^3/day	760.32
September	m^3/day	622.08
October	m^3/day	449.28
November (2022)	m^3/day	536.5
December (2022)	m^3/day	568.5

Groundwater inflow estimates for the New Bermingham mine were developed analytically by Alexco Environmental Group (AEG) in 2017 and were provided in a memorandum entitled *Bermingham Mine Water Evaluation* (AEG, 2017). Groundwater inflow rates were predicted using a variation of the Theim equation for steady-state radial flow resulting in a range of predicted inflows of 6.9 to 11.1 L/s at the maximum mine depth of 370 m. The conceptual mine inflow model, as well as a graphical presentation of estimated inflow rates versus mine workings depth from the 2017 Alexco memo, can be found in Appendix J.

Daily pump-out rates from New Bermingham Mine are presented graphically in Figure 4-76, below. Predicted analytical groundwater inflow rates as a function of mine depth are presented in Figure 4-77, with annotations indicating measured monthly average pump-out rates observed at the New Bermingham portal monitoring location, KV-114, for November 2022 and July 2023 monthly averages for comparison of measured and predicted discharges. The maximum depth of the New Bermingham Mine is approximately 150 mbgs as of July 2023, which produces an observed groundwater pump-out rate of 9.7 L/s (average monthly pump-out for July), compared to the estimated analytical groundwater inflow rate of 3-5 L/s at this depth (Figure 4-76).Overall, the measured groundwater dewatering rates are greater than the analytical predicted mine inflow rate for the New Bermingham Mine. This discrepancy is attributed to structurally-controlled inflows in the mine area (Itascas, 2023). However, the observed difference between the measured and predicted inflows is within a factor of two and is considered an overall reasonable agreement. Mine make-up water was not documented during the time of mine excavation on site and therefore cannot be accounted for when discussing the observed groundwater inflow rates.

The long-term discharge rates from the portal during closure were estimated at 2.5 L/s, and details of this analytical prediction can be found in Alexco (2017). No re-evaluation of mine inflows is proposed at this time.

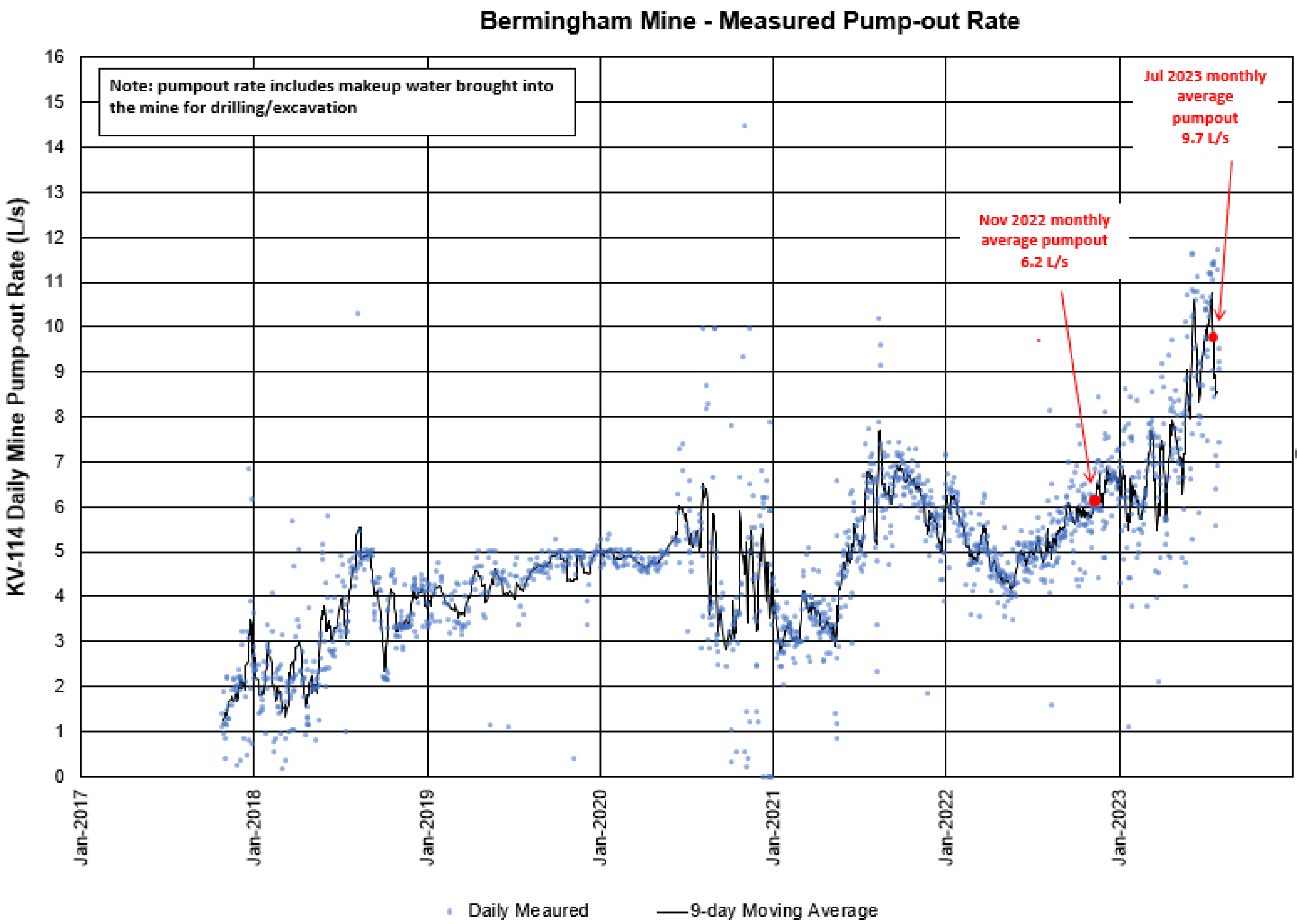

Figure 4-76: New Bermingham Mine Daily Measured Pump-out Rate

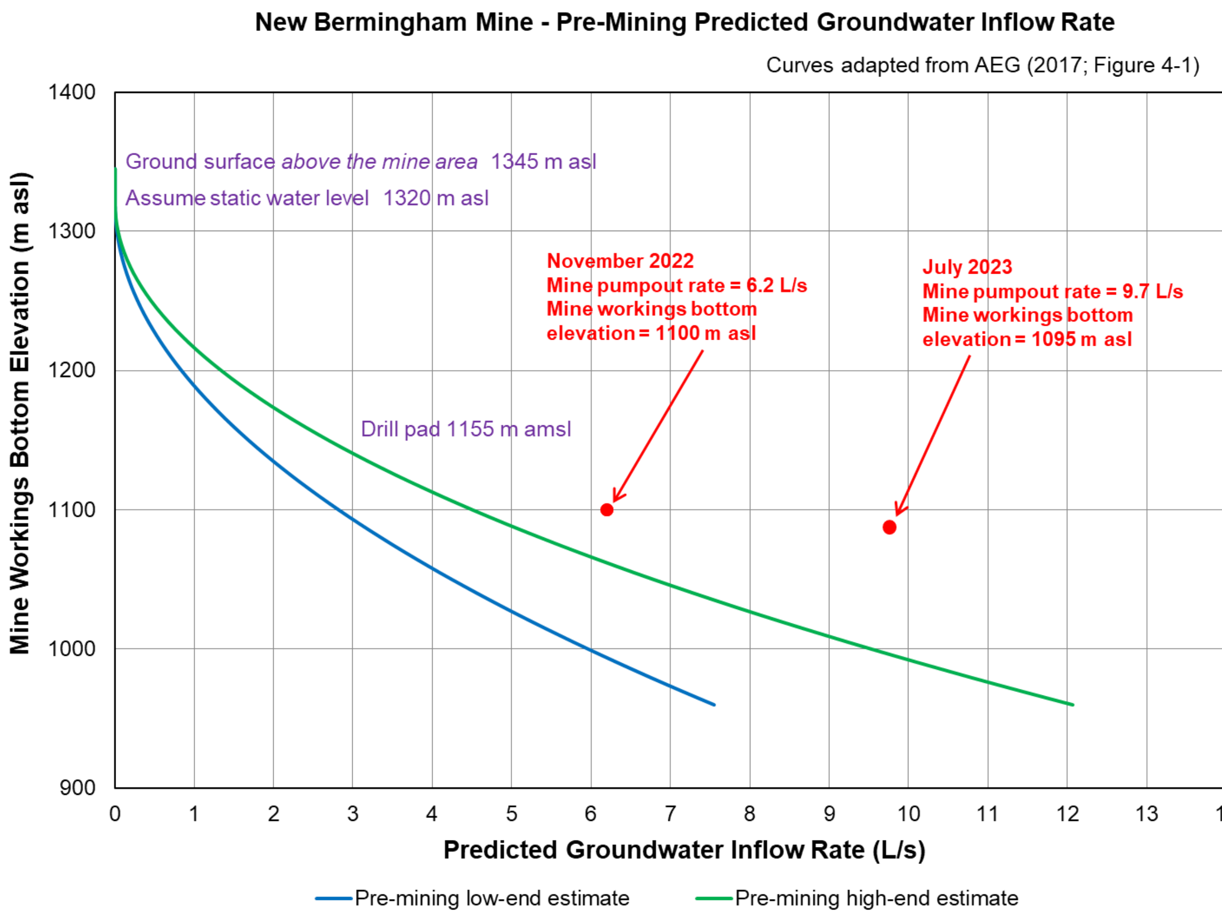

Figure 4-77: New Bermingham Mine Predicted Groundwater Inflow vs. Mine Bottom Elevation

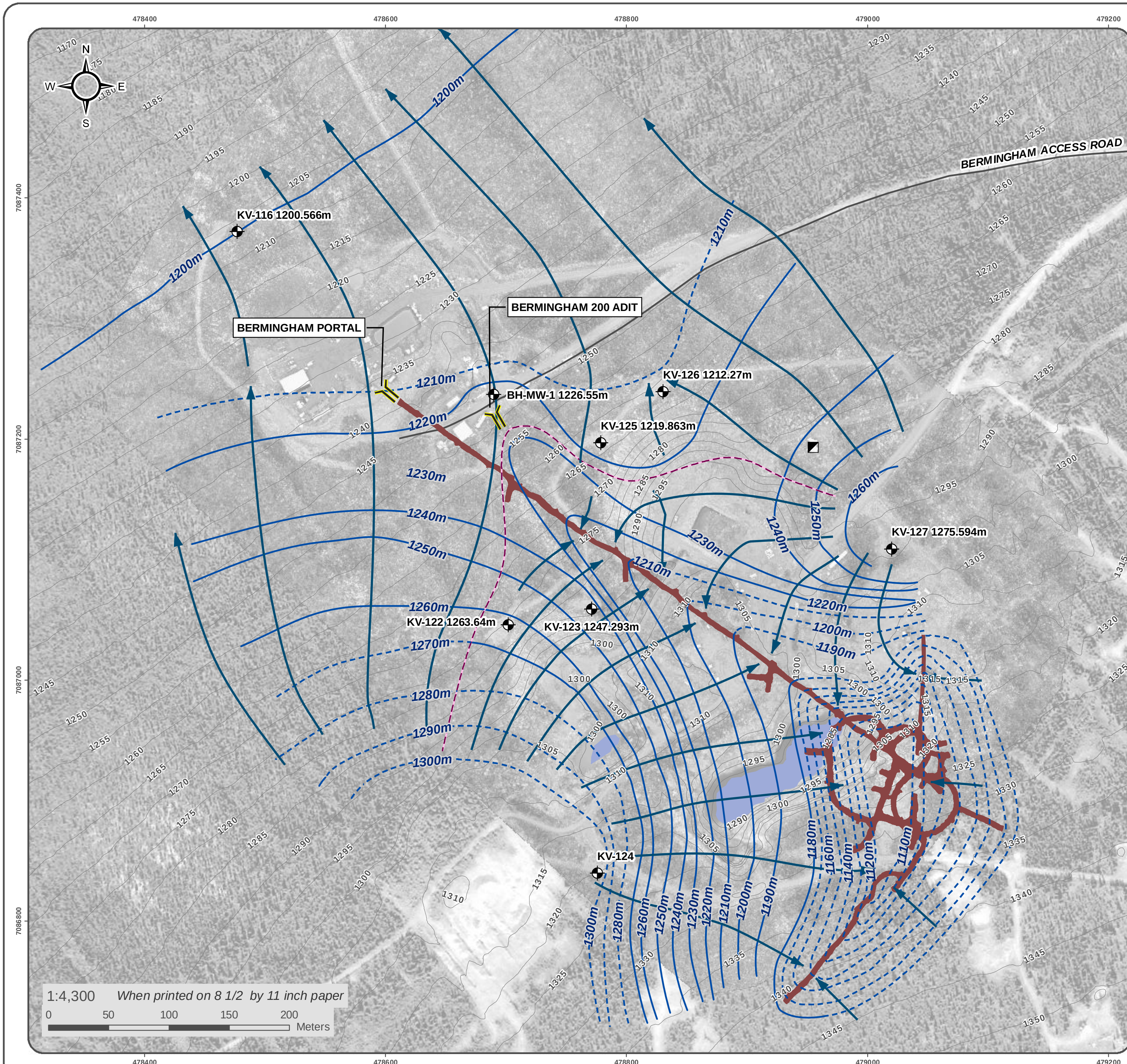

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FIGURE 4-79

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

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 under license from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.
Satellite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2023

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

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*4.3.2.3 **Bermingham Area Summary***

Most wells in the Bermingham area returned concentrations below the YCSR-AL standards for all COPCs; KV-123 was the only monitoring well elevated compared to the YCSR-AL standards for cadmium and zinc, while KV-126 presented occasionally elevated concentrations of arsenic in comparison to the YCSR-AL standards.

Early results of the groundwater quality monitoring of wells newly constructed upgradient and downgradient of the New Bermingham Mine and related structures (e.g., Bermingham SW open pit, P-AML facility, N-AML disposal area, water treatment discharge) indicate low concentrations of arsenic, lead, nickel, silver, and sulphate. The wells returned concentrations of COPCs well below the YCSR-AL standards for most COPCs, save for cadmium which was elevated in KV-122, KV-123, KV-126, and KV-127 with respect to the YCSR-AL standards; KV-126 was elevated for arsenic with respect to YCSR-AL standards, and zinc was elevated at KV-123 relative to the YCSR-AL standard; KV-122 and KV-126 had one excursion each above the YCSR-AL standard for zinc. Concentrations of COPCs have generally been stable at all monitoring wells since mining began.

Groundwater flow in the Bermingham area reflects the surface topography, and groundwater flow paths tend to follow topography from higher to lower elevations. Groundwater generally flows from southeast to northwest, however groundwater flow at Bermingham is influenced and modified by the presence and dewatering of the New Bermingham underground workings, which creates groundwater sinks. Advancement and pumping of the New Bermingham underground mine workings has resulted in a larger area of influence on groundwater in this area of Site. Dewatering can create groundwater sinks that collect groundwater within and adjacent to the mine workings and convey this flow to surface water. Mine inflow rates are currently more than predicted by Alexco Environmental Group (2017), however agree with predicted analytical estimates within a factor of two.

4.4 VEGETATION

The following sections summarize the vegetation and monitoring programs at the Keno Hill mining camp and additional information is provided in the Site Characterization Report (Appendix 2).

4.4.1 Biophysical Background

Details of vegetation in the Keno Hill mining camp can be found in the *2013 KHSD ecosystem mapping report* (ACG, 2013a), *2011- 2013 Soil and Vegetation Baseline Study and Analysis* (ACG, 2011, 2012, 2013b) and site characterization reporting (AMC, 1996; Ensero, 2023).

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). The South McQuesten River valley bounds the property to the north, while the Lightning Creek watershed confines the property to the south-east and the Keno Ladue drainage system to the north-east of the property. The climate is characterized by hot dry summers, while winters are cold with minimal snowfall. 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.

The Keno Hill mining camp comprises three bioclimatic zones which are summarized in Table 4-12 and shown in Figure 4-80. The predominant bioclimatic zone is the Boreal High, making up two thirds of the Keno Hill mining camp, followed by the Subalpine zone (one quarter of the 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.

Table 4-12: Bioclimatic Zones in the Keno Hill Silver District

BIOCLIMATIC ZONE (ELEVATION RANGE)	DEFINITION
Boreal High (500 – 1,225 masl)	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 subalpine zone. The boreal high tends to have more of an open canopy then 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.
Subalpine (1,225 – 1,450 masl)	Open to sparse forest canopy cover where the main tree species are Sub-alpine fir and White spruce which become less frequent at the higher elevations. The shrub layer is well-developed and composed mainly of scrub birch, willow species and vaccinium species. At the higher extent of this zone small woody shrubs, Dryas, mosses and lichen replace the forest cover with only a few krummholtz subalpine fir scattered amongst the landscape.
Alpine (1,450 masl+)	Alpine communities include dwarf ericaceous shrubs, scrub birch, willow species, grass/sedges, forbs, lichen and bare bedrock at elevations above the tree line. Trees if present are low growing krummholtz that exist in small microsites where they can receive enough moisture and nutrients to grow. This bioclimatic zone is only present on Keno Hill.

4.4.2 Vegetation Monitoring

Revegetation monitoring have been conducted in the Keno Hill mining camp since 2007 when the Galena Hill revegetation trials began. Cover systems and natural succession trials have also been done and are monitored regularly (Section 4.4.2.1). Studies to determine contaminant levels in vegetation have been conducted by Microbial Technologies (included in AMC, 1996) and by Environmental Dynamics Inc. (Section 4.4.2.2; EDI 2008, 2009).

*4.4.2.1 **Vegetation Monitoring***

Ensero Solutions (formerly Alexco Environmental Group Ltd.) conducted five vegetation monitoring trials in 2019 (AEG, 2020), to document the continued development of vegetation on different applied surface treatments. Monitoring focused on percent cover of vegetation, general observations of species diversity, and chronosequencing observations. The site visit in 2019 included the following programs:

1) the 2007 revegetation trials on Galena Hill waste rock storage areas,
2) the 2014 cover systems and vegetation field trials,
3) the 2015 operational trials, and
4) No Cash 100 chronosequence trials.

Overall, natural succession and recolonization has been observed across the site and at the various vegetation trial sites. The chronosequence monitoring at No Cash 100 show that natural succession initially occurs at a slower rate (vegetation was sparse for the first 30 years), but once sufficient vegetation has established, the rate of natural revegetation increases. 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 seemed to have less of an impact the second year after application. Establishing significant vegetation cover will need time similar to natural revegetation.

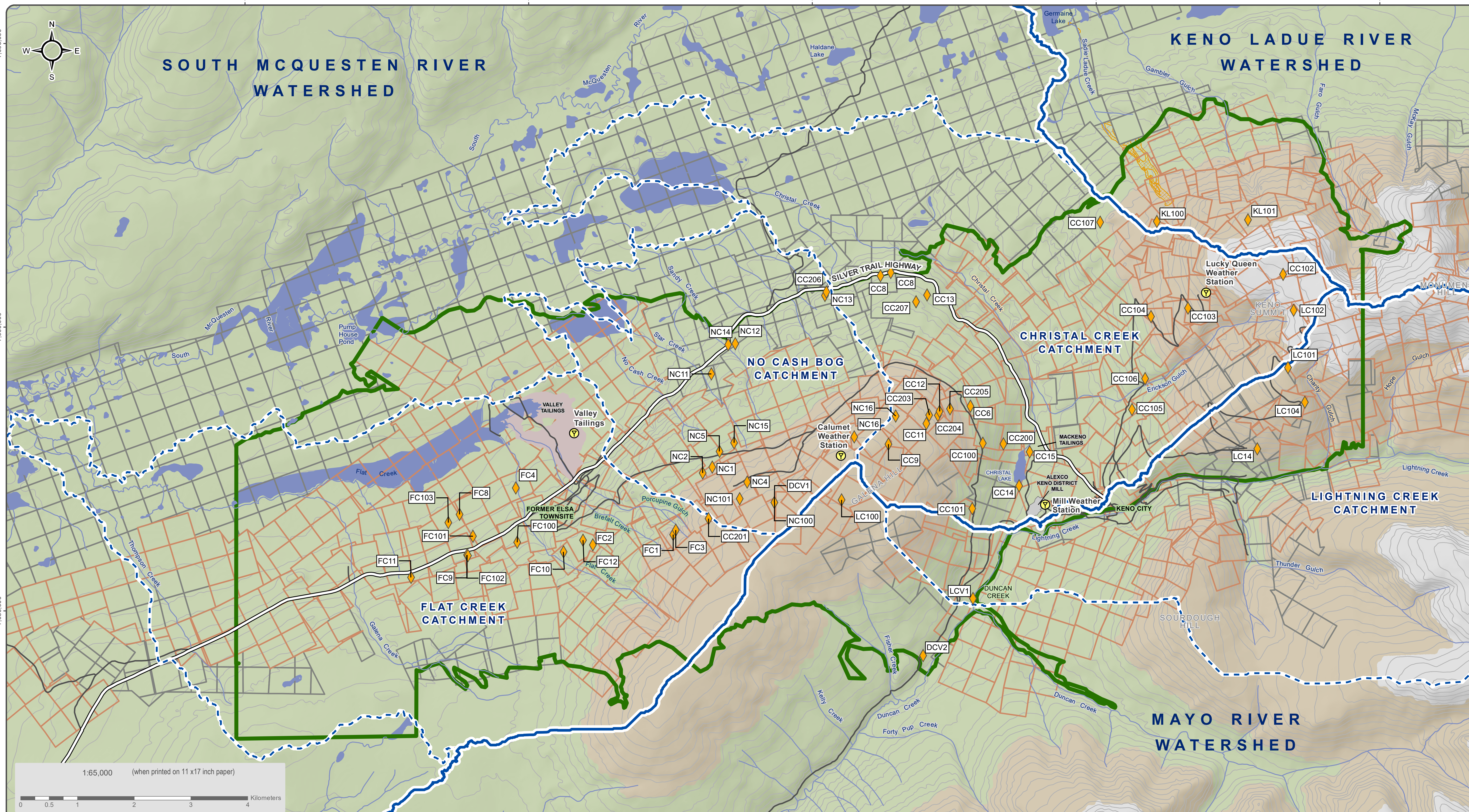
Visual inspections of the lysimeter covers indicated that the covers appeared largely stable since installation in 2015; however, the thickest covers were showing slightly more erosion at edges than the thinnest covers, suggesting that 0.25 m of Husky SW till is sufficient and stable cover. The water quality results from the Husky and Valley Tailings cover system field trials indicate that cover thickness does not appear to affect the water quality, but solely the volume of water percolating through the materials. It is understood that the lysimeter cover trials are expected to be finished next year, but should they be continued, maintenance would be required on the connections to each on the tanks. The limited collection of water quality samples from most of the tanks indicates a potential problem with piping connections that feed the percolated lysimeter water to the collection tanks.

In 2012 reclamation was initiated on the DSTF 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 (see Figure 4-81) that were covered with granular material and seeded to test various cover trials as described in Section 6.1. Details regarding this program are included in Appendix 1.1.

4.4.2.2 ***Contaminants in Vegetation***

Access Mining Consultants Ltd. Investigated the concentration of metals in local wetland plant species tissue and found that although the sediments in the wetland sampling areas were enriched in metals compared to reference sites, metal concentrations in plant tissue, were similar to reported values for reference sites. There was no evidence of metal uptake in plants in these wetland areas. Results from this study were reported in the "Design of a Passive System for Treatment of Discharges for the Galkeno 900 Adit at the United Keno Hill Mine Camp" prepared by Microbial Technologies in 1995 and included in the report by Access Mining Consultants Ltd. (AMC, 1996).

EDI conducted three terrestrial effects study in the Keno Hill mining camp, from 2007 to 2009. They first investigated the area of the VTF, to determine if aerial dispersion of metals in dust had occurred and the extent of dispersion (EDI, 2008, 2009). Results concluded metals contamination were present in the eastern portion of the VTF. The second study investigate the extent of metals uptake in plants from the original sample sites, as well as areas used for traditional harvest by the local First Nation. The study concluded there was heavy metals uptake in some of the traditional medicinal plants gathered. The last study found greater concentrations of heavy metals in plants growing in the VTF compared to those growing near to adit discharge. EDI also noted that metals uptake differed between species. For example, willow samples had greater concentrations per weight than Labrador tea samples. There was no correlation made between metals concentration in the soil, and metals concentration in plant tissue.



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 boundaries and ownership are current as of March 2017; obtained from Geomatics Yukon, Government of Yukon.
Satellite 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

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

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FIGURE 4-80

BIOCLIMATE ZONES OF KHSD

REVISION 5	NOVEMBER 2021	JOB:007-4
DRAWN BY GIS	DESIGNED BY GIS	REVIEWED BY: LB

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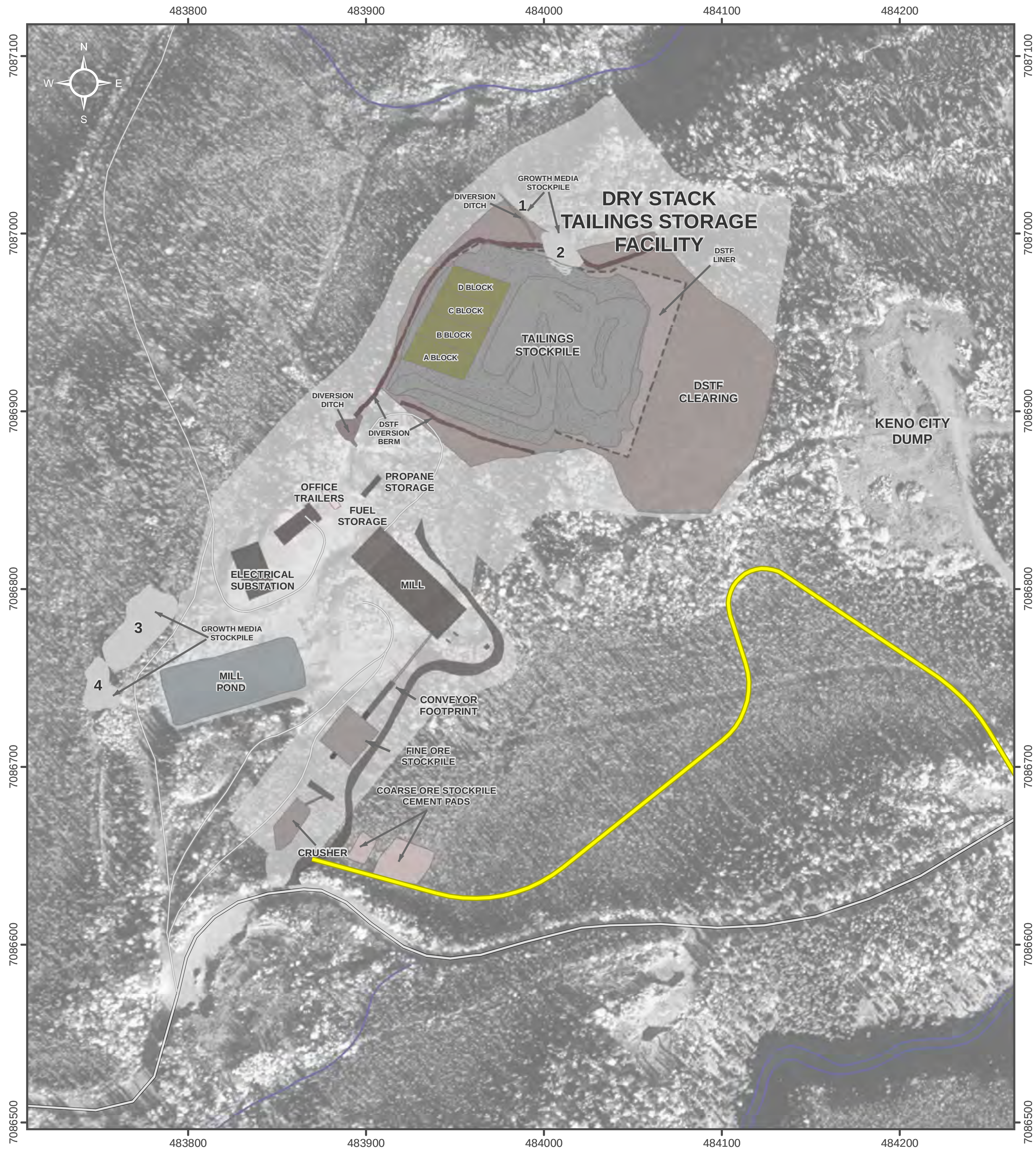

DSTF Cover Trial
Duncan Creek Road
Mill Access
Haul Road

1:3,000 *When printed on 8.5 by 11 inch paper*

0 50 100 150 Meters

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FIGURE 4-81
DSTF VEGETATION COVER TRIAL 2012

Hecla YUKON

MARCH 2013

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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4.5 WILDLIFE

The following sections summarize wildlife study results in the Keno Hill mining camp and additional information is provided in the QML-0009 Site Characterization Report (Appendix 2).

4.5.1 Regional

The Keno Hill mining camp lies between the Stewart and South McQuesten Rivers, which is located entirely within the Yukon Plateau – North Ecoregion and 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. Of these. 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. For example, 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, 2023a).

Woodland caribou are not presently found in the Keno Hill mining camp with the apart from the appearance, in summer, of fewer than 10 to 12 caribou scattered in very small groups in the Mt. Hinton and Bunker Hill areas (O'Donoghue, pers. comm. as cited in Lortie, 2009).

Other species of importance are 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 are known to use the project area including 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, and porcupine. Less common are 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).

Table 4-13 lists wildlife species that are recognized by the federal or territorial government as needing extra protection or monitoring and may be found in Keno Hill mining camp.

Table 4-13: 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 (2006)
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 (2004)
Grizzly bear (*Ursus arctos*)	Special Concern	COSEWIC (2012)
Woodland caribou (*Rangifer tarandus caribou*)	Special Concern	COSEWIC (2002)
Cougar (*Puma concolor*)	Specially Protected	Yukon Wildlife Act (2012, amended 2014)
Collared pika (*Ochotona collaris*)	Special Concern	COSEWIC (2011)

Notes:

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)

4.5.2 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 the First Nation, local Renewable Resources Council, and Environment Yukon. Community-based work plans are developed to address community concerns about moose, caribou, bear, wolf, and fish populations, along with habitat, harvest, wildlife viewing and other wildlife and land issues, and it presented opportunities for public participation and ways to better inform area residents about management activities (Na-Cho Nyäk Dun Fish and Wildlife Planning Team. 2008).

The 2014-2019 Community-Based Fish and Wildlife Management Work Plan for the Nacho Nyäk Dun Traditional Territory was the fifth community-based fish and wildlife plan for the traditional territory of the FNNND. The development of the plan followed the "1993–1996 Integrated Big Game Management Plan for the Mayo Region," the "1997 Integrated Wildlife Management Plan for the Nacho Nyäk Dun Traditional Territory", the "2002–2007 Community-Based Fish and Wildlife Management Plan for the Nacho Nyäk Dun Traditional Territory" and the

"2008–2013 Community-Based Fish and Wildlife Management Plan for the Nacho Nyäk Dun Traditional Territory".

Recommendations from these work plans have resulted in reoccurring moose surveys in the vicinity of the Keno Hill mining camp and a site-specific study of waterbird use of the Christal Creek area as described above in Section 4.5.1.

4.5.3 Local

A site-specific waterbird use of the Christal Creek area was jointly conducted by Ducks Unlimited and the FNNND in 2004 (Leach and Hogan, 2005). The Rusty Blackbird (*Euphagus carolinus*) and Olive-Sided Flycatcher (*Contopus cooperi*) and the Common Nighthawk (*Chordeiles minor*) were observed.

Wildlife studies were completed in 2018 and 2019 to obtain additional wildlife information to support AKHM mine development and the ERDC reclamation projects.

The objectives of the work conducted in 2018 were to:

- determine what waterfowl species are using the ponds within the Valley Tailings, Germaine Lake and Christal Lake,
- complete wildlife transects to identify what wildlife are using the area during the summer construction season in each habitat type around the proposed reclamation areas,
- determine if bats are using adits or portals as habitat, and
- collect local knowledge of the wildlife presence by interviewing long term workers at the site.

The objective of the 2019 waterfowl surveys was to assess and document waterfowl breeding and rearing young in habitat in and around Germaine Lake, the Valley Tailings Ponds, and Christal Lake during the breeding and rearing period.

Identified objectives were met by following standardized protocols for wildlife detection. Waterfowl surveys included Breeding Pair and Brood Count surveys and the methods used were based on the British Columbia waterfowl survey protocols (BC RIC, 1999). Wildlife transects were completed by walking a specified distance in varying habitats and recording any wildlife seen or heard. Bat surveys were completed by monitoring bat movement at adits through visual confirmation. Interviews were conducted with two long-time Alexco Resource Corp. employees to determine species presence in the area through personal observations and experience.

The 2018 waterfowl survey confirmed the presence of breeding birds on all three sites sampled, with higher abundance on the third pond of the Valley Tailings. None of the waterfowl species identified during the survey were species of conservation concern. One species of special concern, the olive-sided flycatcher, was identified at Germaine Lake in the Keno-Ladue area. This species was noticed during two surveys, as the birds were constantly audible across the lake from the tailing's delta (suitable tree habitat available).

The wildlife transect survey confirmed the presence of species known to be in the Keno area. The collared pika was the only mammal observed during the survey that is rated as vulnerable in the Yukon. The wood frog has been identified in the lower valley close to the Valley Tailings, mitigations should be considered before disturbing habitat areas. Breeding sites are the most important habitat for this species.

Little brown bats are known to live in the area around Keno but have not been observed by any workers on the Keno mine property. The survey at historic Onek adit indicated that little brown bats are not likely using abandoned adits in the Keno area.

Two waterfowl surveys were conducted in 2019 (June and July), to assess and document waterfowl breeding and rearing habitat for Germaine Lake (Keno-Ladue drainage), the Valley Tailings Ponds, and Christal Lake (AEG, 2019). Numerous species were observed breeding and nesting in all three area waterbodies.

Five Species at Risk, as listed through the Federal Species at Risk Act, by the Committee on the Status of Endangered Wildlife in Canada or under the *Yukon Wildlife Act*, were observed during the surveys. Trumpeter Swans and Horned Grebe were observed nesting in Germaine Lake and the Valley Tailings Ponds. The Trumpeter Swan is listed under the *Yukon Wildlife Act* as Specially Protected (Government of Yukon, 2019). The Collared Pika, Horned Grebe, Olive-sided flycatcher, and Red-necked Phalarope are listed as species of Special Concern by COSEWIC. Lesser Yellowlegs were observed in Germaine Lake, the Valley Tailings and Christal Lake and is listed as a Species under Review by COSEWIC (COSEWIC, 2023).

Protective measures identified in the Wildlife Protection Plan should be implemented during reclamation and closure of the KHSD Mining Operations. The surveys did not identify any other potential species that would require additional or different mitigations measures to be included in the Wildlife Protection Plan.

No further wildlife assessments were recommended until District-wide reclamation activities commence.

4.6 SOIL AND BEDROCK

The Keno Hill mining camp is located in the northwestern part of the Selwyn Basin in an area where the northwest-trending Robert Service Thrust Sheet and the Tombstone Thrust Sheet overlap. The area is underlain by Upper Proterozoic to Mississippian rocks that were deposited in a shelf environment during the formation of the northern Cordilleran continental margin. The area underwent regional compressive tectonic stresses during the Jurassic and the Cretaceous, producing thrusts, folds, and penetrative fabrics of various scales.

The Robert Service Thrust Sheet in the south is composed of Late Proterozoic to Devonian clastic sandstone, minor limestone, siltstone, argillite, chert, and conglomerate. The Tombstone Thrust Sheet to the north consists of Devonian phyllite, felsic meta-tuffs and metaclastic rocks, overlain by Carboniferous quartzite, which is the main host for the silver mineralization in the Keno Hill mining camp.

Except for a few localized areas, the soils are not strongly weathered or deeply leaching. They also exhibit a poor profile development, particularly those underlain by permafrost. The soils in the area can be conveniently classified into two general types: 1) residual and 2) muck peat/half bog. Residual soils were formed principally from the weathering of the various types of bedrocks, or as is evident in some places, from the decomposition of a till that predates the last glaciation.

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.

Permafrost has been observed to be discontinuous in the DSTF area. In most historical boreholes, permafrost was encountered at less than 1 m depth and typically extended to about 15 to 20 m depth. Outside of the DSTF area, permafrost has been encountered as deep as 76 m at Keno Hill (see Appendix 2).

Soil and bedrock considerations in reclamation and closure planning are importantly linked to long-term geotechnical stability of the DSTF foundation. Design criteria for the DSTF consider the potential for permafrost degradation over time.

Massive ice has been encountered in several boreholes, outside of the DSTF Phase I 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).

Permafrost was encountered throughout the Phase II DSTF 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, 2023).

4.7 SOCIO-ECONOMIC

The Keno Hill mining camp lies within the traditional territory of the 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 ever since. 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 188 people (YG,2022) and serves as a distribution and service centre for the surrounding area, supporting mineral development, tourism, and other activities. Mayo is also the administrative centre for the FNNND. In addition to being a tourist destination, the community is a base for wilderness and mining tourism, canoeing, hiking, big-game hunting, and fly-in fishing.

4.7.1 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.

4.7.1.1 ***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).

4.7.1.2 ***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.

4.7.2 Local Economy and Human Resources

4.7.2.1 ***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.

4.7.2.2 ***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. Construction also provides considerable employment to Mayo residents.

The Mayo Official Community Plan outlines local economic conditions and describes community priorities: "Mayo's economy is presently based on its role as a regional administrative and service centre, mineral exploration and placer mining and tourism. In addition, traditional activities play a large role in the community's economic life. Diversification and stabilization of the regional economy remains a community priority" (Mayo Official Community Plan, 2006, p. 11). The Mayo Official Community Plan recognizes opportunities for local economic diversification in terms of supporting mineral exploration and development, expanding the local service sector, maximizing the use of the local labour force and reducing dependence on outsiders to fill local employment opportunities.

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.

4.7.2.3 ***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 Project Description

5.1 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. Since Alexco Resource Corp. acquired the assets of the Keno Hill mining camp, the following major milestones listed in Table 5-1 have been achieved.

Table 5-1: 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 and development of 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 Camp, surface facilities, and mill upgrades Mine development at Flame & Moth and New Bermingham 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 Continued surface exploration and water treatment Hecla Mining Company acquires Alexco Resource Corp.
2023	Ore production at New Bermingham and Flame & Moth mines resumes Continued mine development at Flame & Moth and New Bermingham Continued surface exploration and water treatment Expansion of Flat Creek Camp and New Bermingham surface facilities

5.2 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 5-2 presents a summary of the present KHSD Mining Operations. This RCP Revision 8 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.

Table 5-2: Keno Hill Silver District Mining Operations Summary

Mines/Ore Deposits	Bellekeno Mine (Active 2010 – 2013, suspended 2013) Flame & Moth Mine, New Bermingham Mine (in 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	8 years including initial development
Current Total Project Life	8 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)

5.3 MINE PLAN

The KHSD Mining Operations comprise a series of small underground mines which a centralized mill (District Mill). The current LOM mine plan includes a combination of Bellekeno, Flame & Moth, and New Bermingham operating over an 8 year period. Table 5-3 summarizes the mine operations schedule from 2023 through to the completion of the current Life of Mine (LOM) plan. A more detailed project schedule is included as Table 5-8.

Table 5-3: Keno Hill Silver District Mining Operations Projected Timeline

YEAR	SUMMARY OF MAIN PROJECT ACTIVITY
2022-2027	Operate New Bermingham and Flame & Moth mines
2027	Complete mining of New Bermingham
2028	Complete mining at Flame & Moth
	Commence closure plan activities
	District care and maintenance
2029 – 2037	Care and Maintenance 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 5-4 presents the current LOM plan that is the basis for the RCP, additional details for each mine are provided in Table 5-5, Table 5-6, and Table 5-7. The LOM plan was based on mine development and operations beginning in 2021 and AKHM is in Year 3 of operations. The current LOM plan is currently being updated and will reflect the most recent proven and probable ore reserves and will be incorporated into the 2025 RCP update.

Table 5-4: Keno Hill Mine Operations LOM Plan (Bellekeno, Flame & Moth and New Bermingham)

CONSOLIDATED MINE PLAN	TOTAL	2022 (YEAR 1)	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9
Mill Feed Tonnes	1,367,700	67,100	132,400	180,500	201,400	202,000	202,200	189,200	158,600	34,300
Waste Tonnes	796,400	99,500	160,200	187,600	193,500	98,900	44,600	12,100	0	0
Total Tonnes	2,164,100	166,600	292,600	368,100	395,000	300,900	246,700	201,300	158,600	34,300
MCF (Tonnes)	656,500	50,900	100,700	122,000	138,600	118,900	60,300	49,300	15,800	0
LHOS (Tonnes)	707,800	12,800	31,600	58,500	62,900	83,100	141,800	139,900	142,800	34,300
MCF Backfill Tonnes	473,400	38,500	81,500	83,400	120,300	66,200	37,800	30,500	15,300	0
LHOS Backfill Tonnes	294,900	0	0	0	0	33,800	70,200	80,800	80,000	30,100
Total Backfill Tonnes	768,300	38,500	81,500	83,400	120,300	100,000	108,000	111,300	95,300	30,100
Development (m)	18,600	2,400	3,600	4,400	4,600	2,400	1,000	300	0	0

Notes: *Development (m) are lateral and vertical metres*
Mill feed tonnes are all Probable Mineral Reserves calculated from Alexco Technical Report (Alexco, 2021).
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered
Tonnage are in metric units.

Table 5-5: Life of Mine Plan for Bellekeno

BELLEKENO	TOTAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9
Mill Feed Tonnes	16,206	16,206	-	-	-	-	-	-	-	-
Ag(g/t)	981	981	-	-	-	-	-	-	-	-
Au(g/t)	-	-	-	-	-	-	-	-	-	-
Pb (%)	15	14.82	-	-	-	-	-	-	-	-
Zn (%)	7	6.72	-	-	-	-	-	-	-	-
Waste Tonnes	-	-	-	-	-	-	-	-	-	-
Total Tonnes	16,206	16,206	-	-	-	-	-	-	-	-
MCF Tonnes	-	-	-	-	-	-	-	-	-	-
LHOS Tonnes	12,809	12,809	-	-	-	-	-	-	-	-
MCF Backfill Tonnes	-	-	-	-	-	-	-	-	-	-
LHOS Backfill Tonnes	-	-	-	-	-	-	-	-	-	-
Total Backfill Tonnes	-	-	-	-	-	-	-	-	-	-
Development (m)	-	-	-	-	-	-	-	-	-	-

Notes: *Development (m) are lateral and vertical metres*
Mill feed tonnes are all Probable Mineral Reserves calculated from Alexco Technical Report (Alexco, 2021).
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered
Tonnage are in metric units.

Table 5-6: 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
Mill Feed Tonnes	721,322	25,684	64,406	76,761	82,458	82,038	82,308	114,704	158,646	34,315
Ag(g/t)	672	648	698	751	961	802	674	550	537	489
Au(g/t)	0.49	0.34	0.43	0.44	0.66	0.64	0.59	0.46	0.38	0.38
Pb (%)	2.69	2.6	2.8	3.13	5.84	3.85	2.09	1.79	1.53	1.09
Zn (%)	6.21	6.72	7.98	5.93	5.05	7.27	5.95	5.8	5.96	6.64
Waste Tonnes	385,709	47,779	81,247	93,359	102,387	45,943	8,957	6,037	-	-
Total Tonnes	1,107,031	73,463	145,653	170,120	184,846	127,981	91,266	120,741	158,646	34,315
MCF Tonnes	356,198	25,684	42,101	42,438	81,299	69,646	45,050	34,158	15,821	-
LHOS Tonnes	365,124	-	22,306	34,323	1,159	12,391	37,258	80,546	142,826	34,315
MCF Backfill Tonnes	239,514	20,352	29,915	28,812	52,472	51,722	24,103	16,873	15,265	-
LHOS Backfill Tonnes	153,116	-	-	-	-	-	-	42,996	79,989	30,131
Total Backfill Tonnes	392,630	20,352	29,915	28,812	52,472	51,722	24,103	59,868	95,254	30,131
Development (m)	8,939	1,127.76	1,740.53	2,228.38	2,333.22	1,099.23	245.62	163.88	-	-

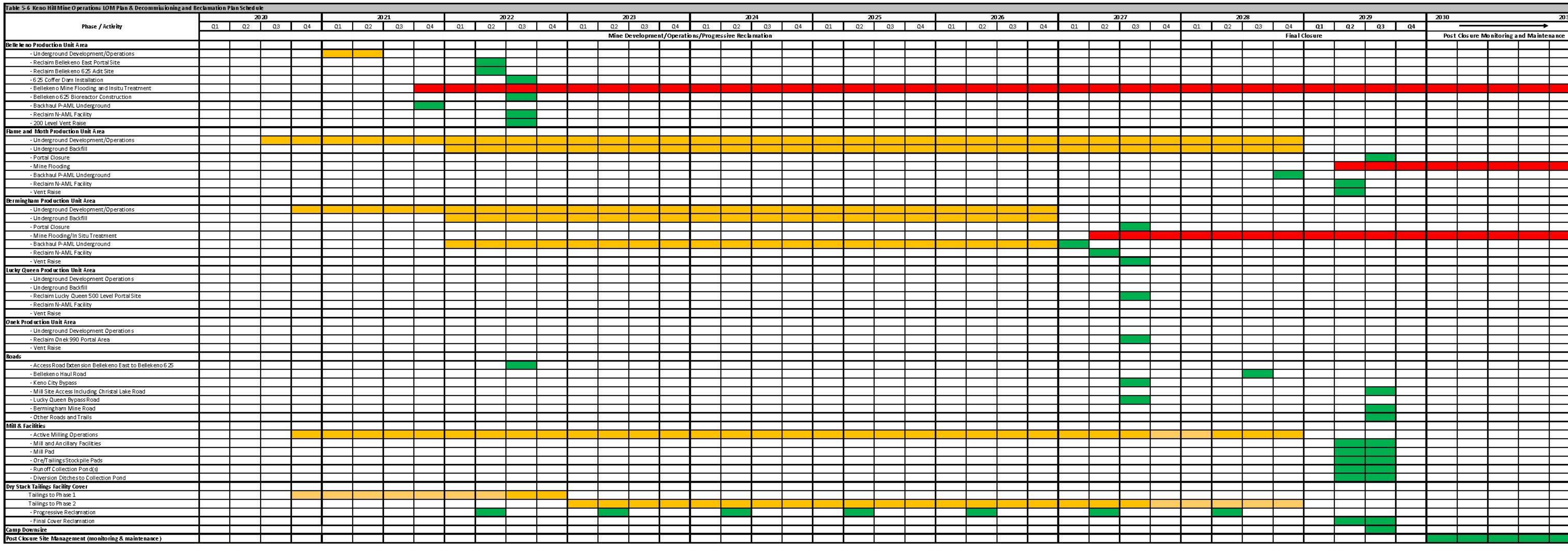
Notes: *Development (m) are lateral and vertical metres*
Mill feed tonnes are all Probable Mineral Reserves calculated from Alexco Technical Report (Alexco, 2021).
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered
Tonnage are in metric units.

Table 5-7: 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
Mill Feed Tonnes	630,173	25,220	67,984	103,692	118,977	119,965	119,849	74,487	-	-
Ag(g/t)	899	1,218	1,450	1,011	806	645	844	775	-	-
Au(g/t)	0.13	0.1	0.16	0.14	0.13	0.12	0.13	0.11	-	-
Pb (%)	2.26	3.02	3.05	2.69	1.78	1.54	2.37	2.47	-	-
Zn (%)	1.3	1.74	1.44	1.2	1.27	1.08	1.49	1.24	-	-
Waste Tonnes	410,652	51,676	78,945	94,268	91,132	52,921	35,626	6,083	-	-
Total Tonnes	1,040,825	76,896	146,929	197,960	210,109	172,886	155,475	80,570	-	-
MCF Tonnes	300,344	25,220	58,645	79,528	57,253	49,274	15,280	15,144	-	-
LHOS Tonnes	329,829	0	9339	24164	61723	70690	104570	59343	-	-
MCF Backfill Tonnes	233,934	18,166	51,590	54,544	67,827	14,451	13,708	13,648	-	-
LHOS Backfill Tonnes	141,768	0	0	0	0	33825	70162	37781	-	-
Total Backfill Tonnes	375,702	18,166	51,590	54,544	67,827	48,276	83,870	51,429	-	-
Development (m)	9,707	1,247	1,846	2,200	2,257	1,251	741	166	-	-

Notes: *Development (m) are lateral and vertical metres*
Mill feed tonnes are all Probable Mineral Reserves calculated from Alexco Technical Report (Alexco, 2021).
Rounding as required by reporting guidelines may result in apparent summation differences between tonnes;
Tonnages are diluted and recovered
Tonnage are in metric units.

Table 5-8: Keno Hill Silver District Mining Operations Life of Mine Plan and Decommissioning and Reclamation Plan Schedule



Active Operations
Reclamation and Closure
Water Management

5.4 MINING

5.4.1 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) 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.

*5.4.1.1 **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 or cemented rockfill (CRF) 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 of the attack ramp and working off the muck pile/horizon. Figure 5-1 illustrates the sequence of activities with MCF mining.

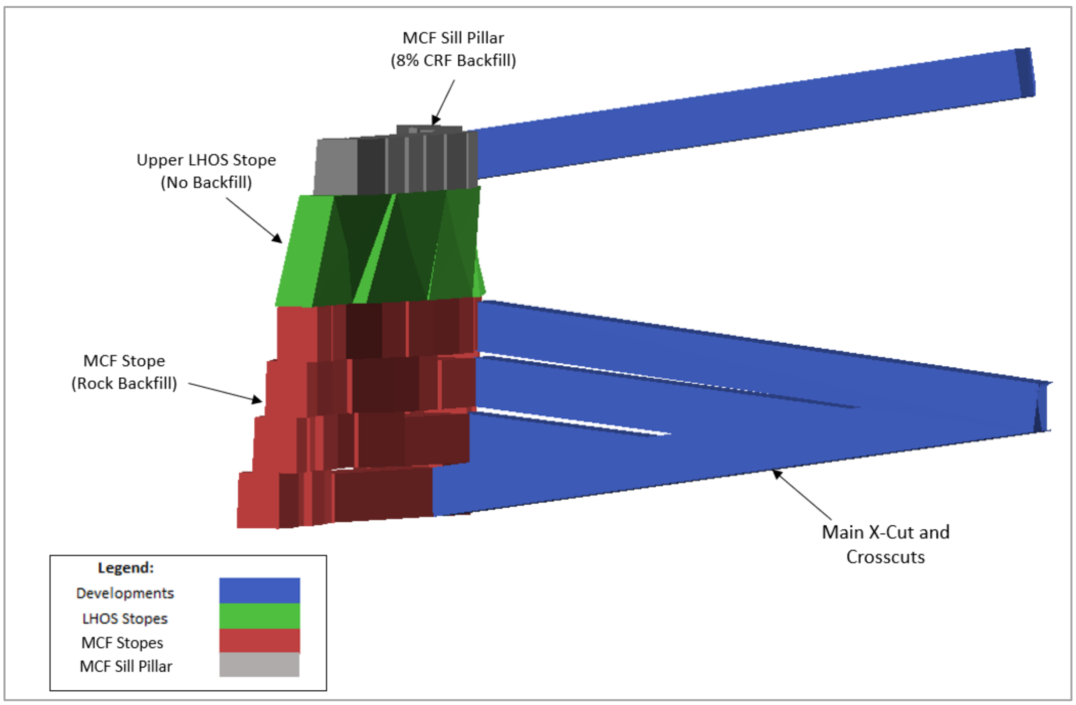


Figure 5-1: Mechanized Cut and Fill Lifts with Uphole Stopes Section

MCF drift 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 to ensure a stable wall to allow adjacent mining activity.

For the Flame & Moth and New Bermingham mines, the lifts are sequenced bottom up 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 5-2 depicts a section view of an example shanty back MCF profile versus standard vertically aligned hanging walls.

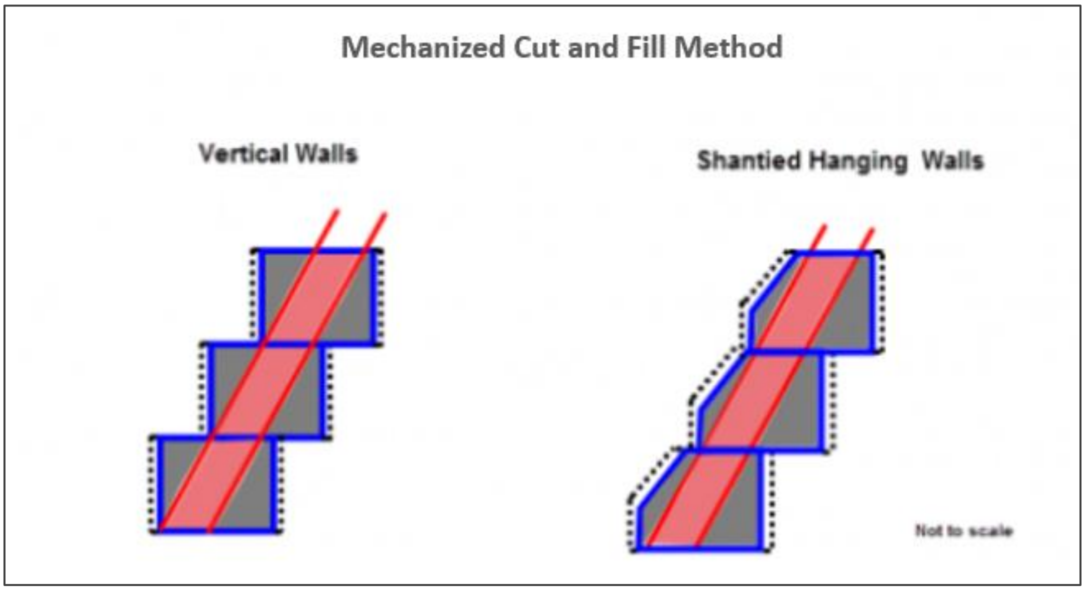


Figure 5-2: Shanty MCF Development Shapes Example

5.4.1.2 *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). Cemented rockfill mix design and curing times to achieve required strengths were determined by an independent consultant and are detailed in Alexco's standard operating procedures. Figure 5-3 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.

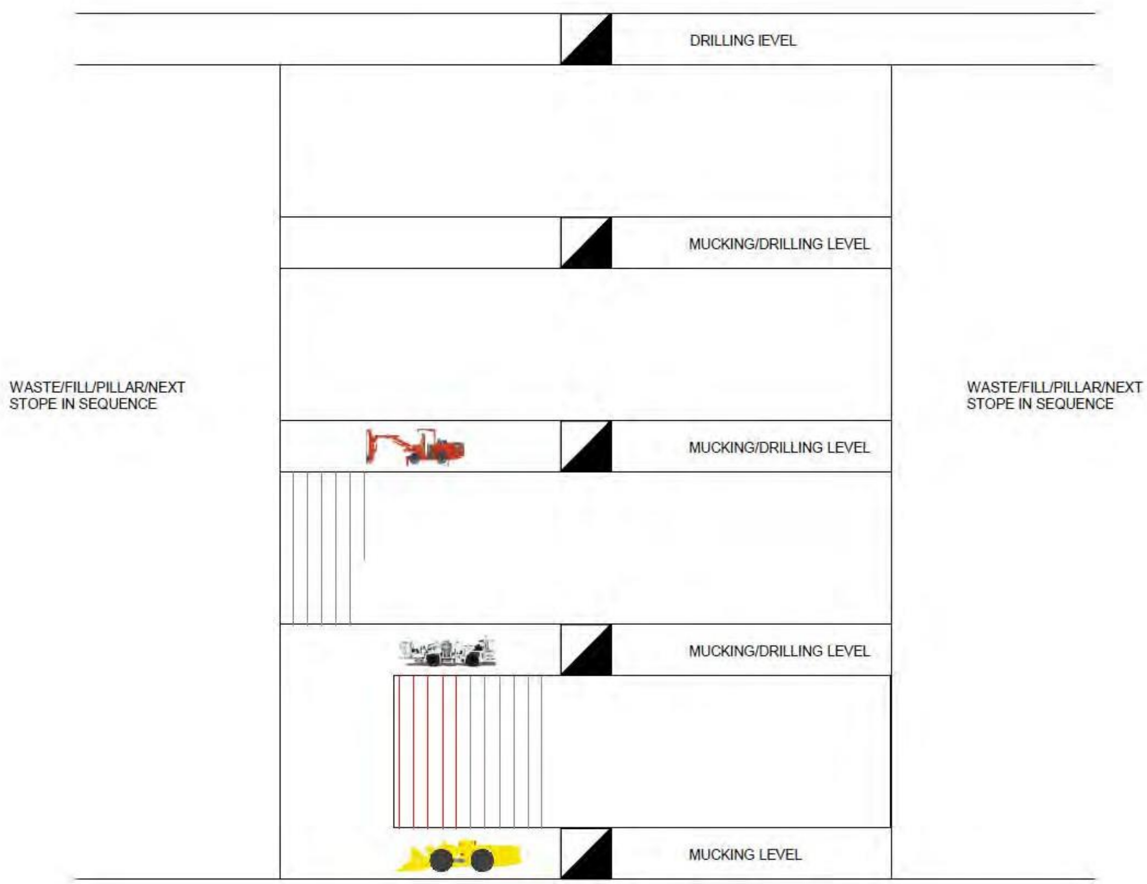


Figure 5-3: (Downhole) Longhole Stoping

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. Cemented rockfill mix design and curing times to achieve required strengths for the CRF 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 5-4 illustrates the uphole stoping method.

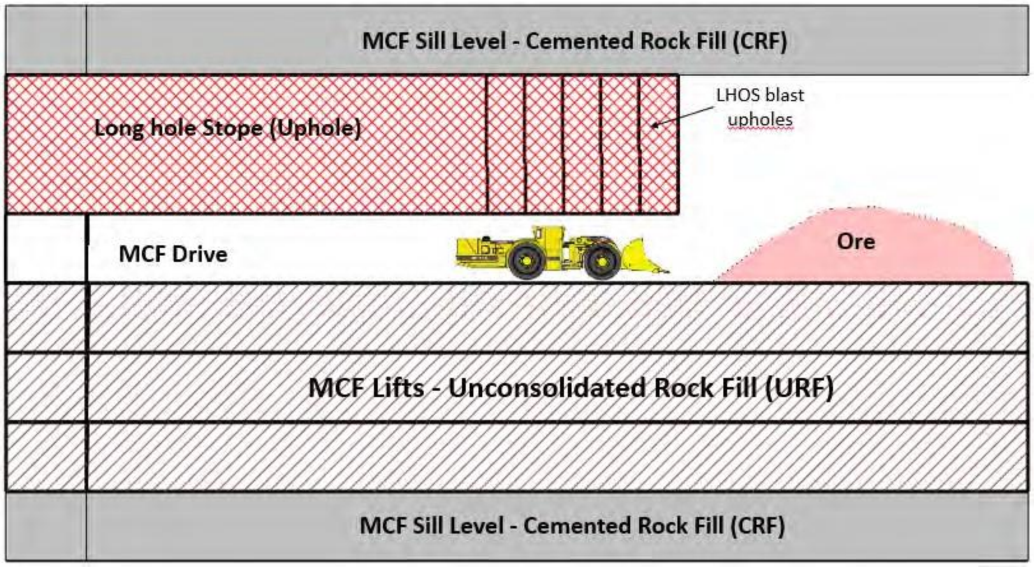


Figure 5-4: Uphole Longhole Stoping

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.

*5.4.1.3 **Ground Control***

A geotechnical ground control management plan (GCMP) has been developed for each mine that governs the ground support methodology (Hecla Yukon, 2023b, 2023c). 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.

5.4.2 Backfill

Backfill materials consisting of development waste rock (N-AML and P-AML) and dry filtered tailings will be placed into empty stopes by Load Haul Dump (LHD) or 15-tonne trucks. The mix of these materials was determined based on geotechnical requirements and characteristics of backfill materials available (Minefill, 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 5-4 summarizes the amount of backfill required during the LOM Plan schedule.

Based on the planned stopes geometry, the required strength for each stope, with a factor of safety of 1.3, was determined. Material samples sourced from Flame & Moth and the mill were sent to an independent laboratory to determine the optimal mix design to achieve the required strength. Refer to the Laboratory Test Report (Minefill, 2021) for detailed required strengths, mix design for each type of placement, and curing times.

Cemented backfill with the same cement by weight will be used in longhole and cut and fill stopes, except for the first lift of cut and fill stopes, where cement contentment will be higher. The cement, rock and water will be mixed by LHD bucket in a small sump-like cut out near the empty stope. Cement will be transported underground in bulk bags.

For cut and fill stopes, the backfill will be pushed up tight to the back using an LHD equipped with a rammer jammer. 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. 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, including blasting beyond the vein contacts to provide a clean, rough surface for the fill to hang on. 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.

5.4.2.1 ***Cemented Tailings/Waste Rock Backfill***

Cemented tails 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.

5.4.3 Mine Infrastructure

5.4.3.1 ***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 5-1). The facility was designed according to the approved generic design (EBA, 2008) Appendix 3.2.

The Bellekeno 625 waste rock dump (Photo 5-2) 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 5-2), 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 5-1: Former Bellekeno P-AML WRSF

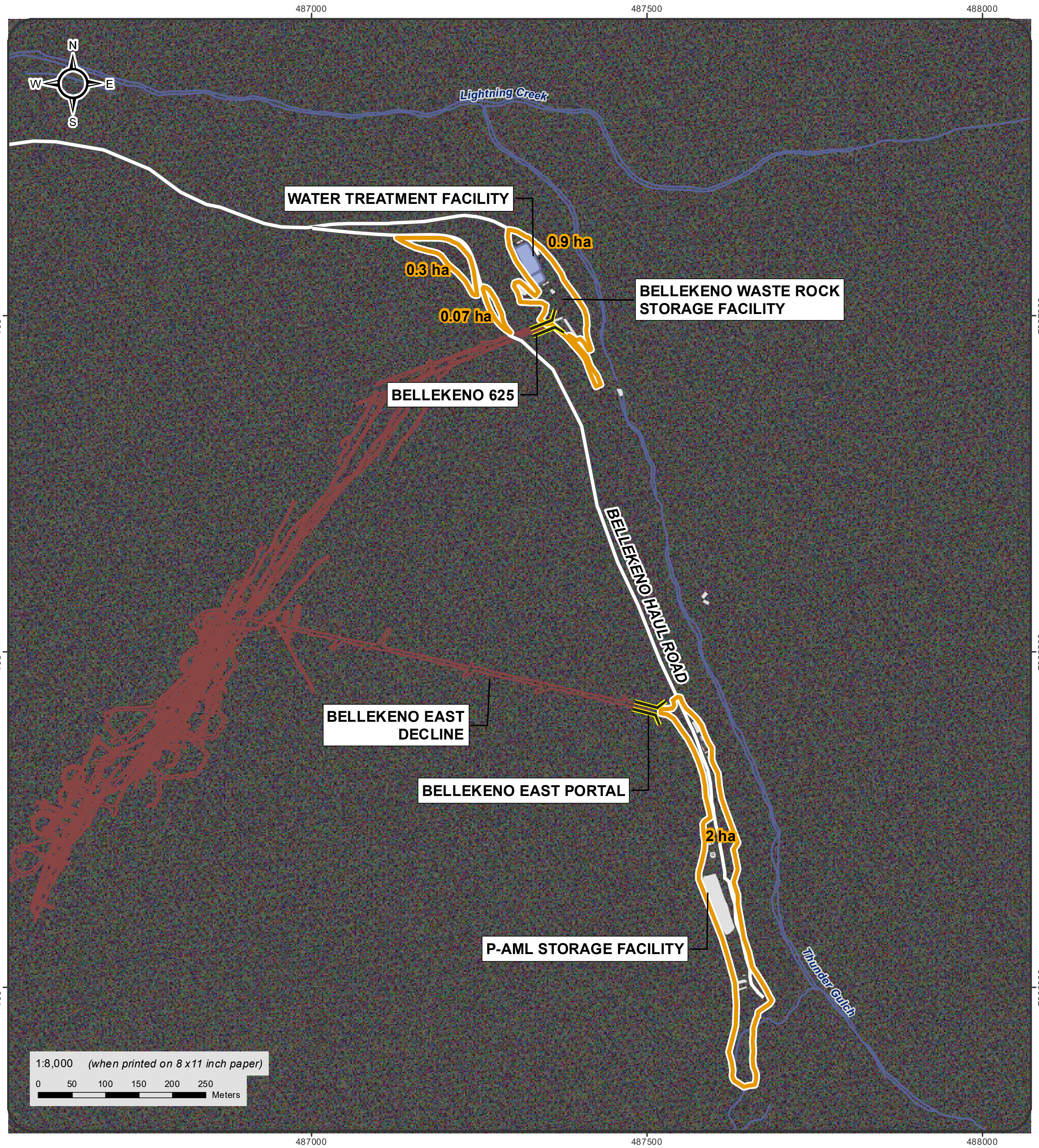
Photo 5-2: Bellekeno N-AML waste rock used for construction of Bellekeno Haul Road

Underground

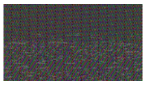
The Bellekeno Mine consists of the underground workings and surface adit entrances (Bellekeno East portal and decline and the Bellekeno 625 adit). The Bellekeno East portal is the primary ingress/egress point for the Bellekeno Mine (Photo 5-3). An as built of the Bellekeno Mine underground workings at the end of the LOM is shown in Figure 5-6. 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 5-3: Bellekeno East Portal



Adit
As Built Mine Feature
Pond
Revegetation
Underground Workings
Haul Road
Watercourse



Satellite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on October 02 2023.

Datum: NAD 83; Projection: UTM Zone 8N

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 5-5

BELLEKENO MINE OVERVIEW

OCTOBER 2023

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(*Last edited by: amatlashevska; 2023-10-02/10:25 AM*)

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FIGURE 5-6

BELLEKENO MINE AS-BUILTAT EOM

5.4.3.2 *Flame & Moth Mine Infrastructure*

Surface

The Flame & Moth Mine surface facilities sit within the District Mill area footprint and disturbance and utilizes much the same mill infrastructure possible. Figure 5-7 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 is 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 will 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 5-4 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. 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 surface magazines. A second powder and detonator magazine is to be constructed underground using existing remucks off the main decline.

Photo 5-4: Flame & Moth P-AML Pad and Mill Ore Pad

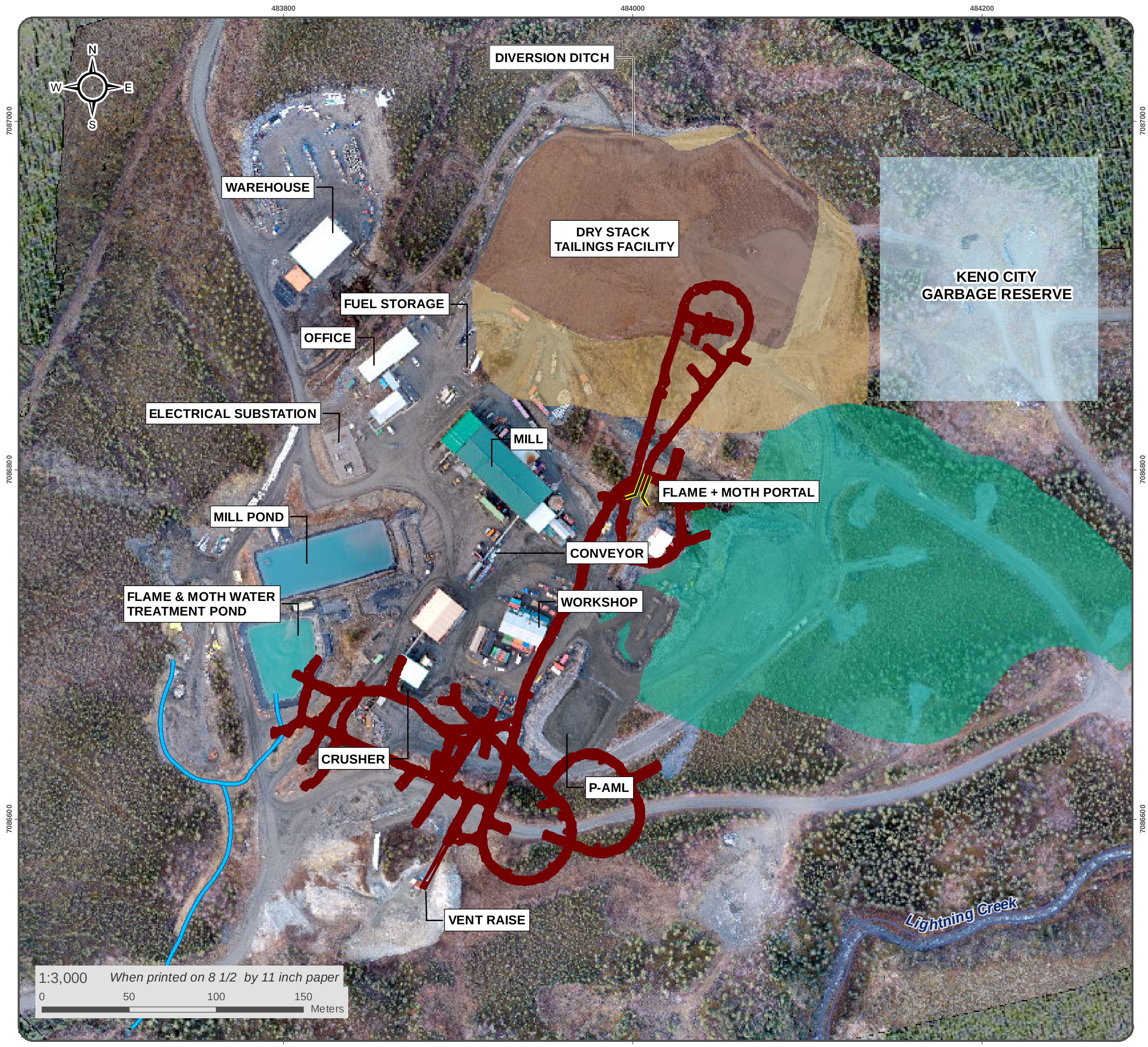
N-AML waste rock from the Flame & Moth Mine will either be used for construction or used as backfill. Flame & Moth N-AML materials may be used within the District Mill area for construction of the portal pad and laydown area, expansion of the coarse ore stockpile, mill yard expansion, District Mill truck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

HECLA KENO HILL SILVER
DISTRICT MINING OPERATIONS

FIGURE 5-7

DISTRICT MILL AND FLAME AND MOTH LAYOUT

SEPTEMBER 2023



Adit
Infrastructure Footprint
DSTF 322k Tonnes Design
Current DSTF
Permitted To Be Constructed Features
Land Disposition
Underground Workings, As-Built End of 2022
Pipeline

Aerial Imagery aquired on August, 2022.

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

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(*Last edited by: amatlashevska;2023-09-29/10:27 AM*)

Underground

The Flame & Moth deposit was outlined by surface exploration drilling in 2010 through 2013 with ongoing surface exploration. The Flame & Moth Mine portal location is approximately 50 metres. The location of the Flame & Moth Mine in relation to the District Mill and the ore zones is shown in Figure 5-10. The Flame & Moth underground workings design is shown in Figure 5-9 (Alexco Technical Report (Alexco, 2021)).

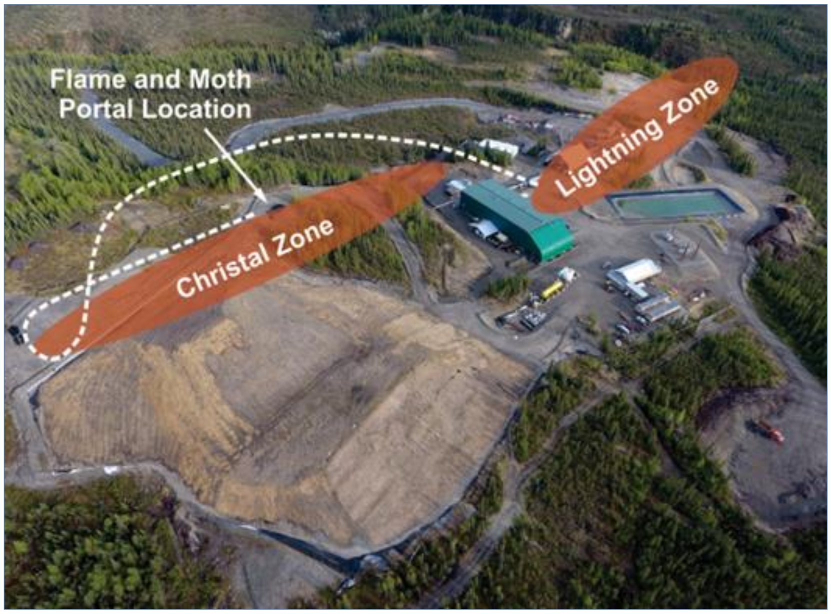


Figure 5-8: Flame & Moth Plan View Showing Ore Zones

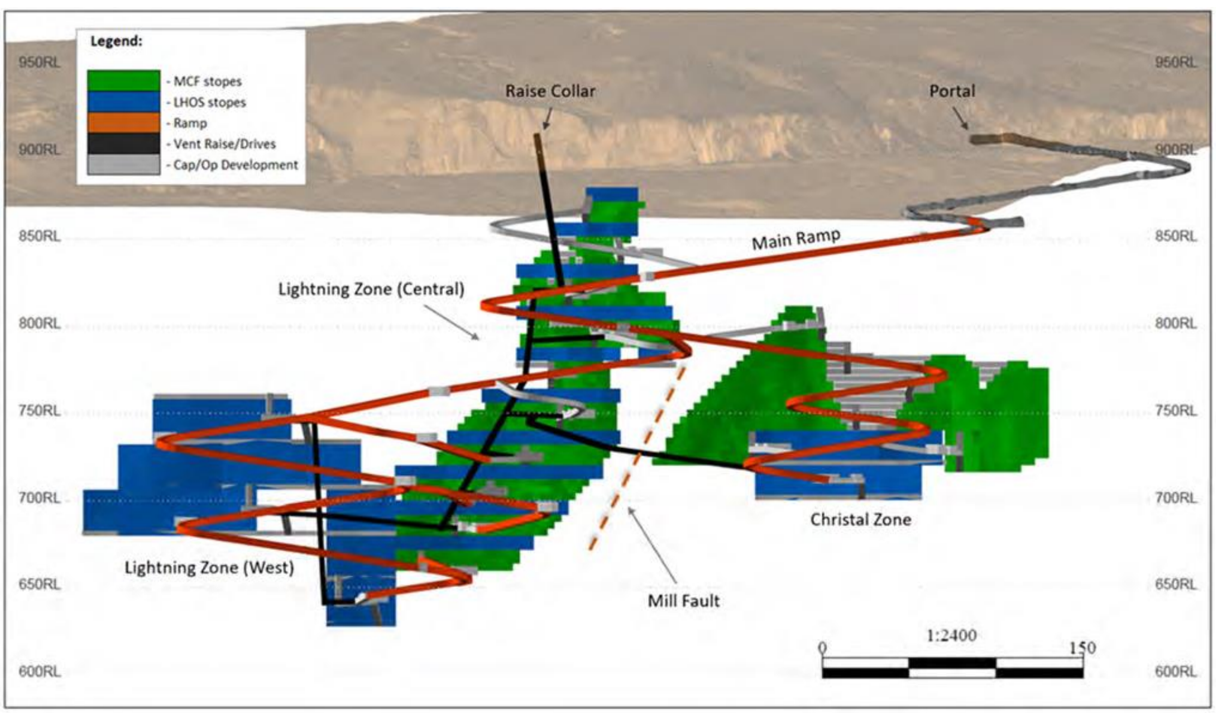
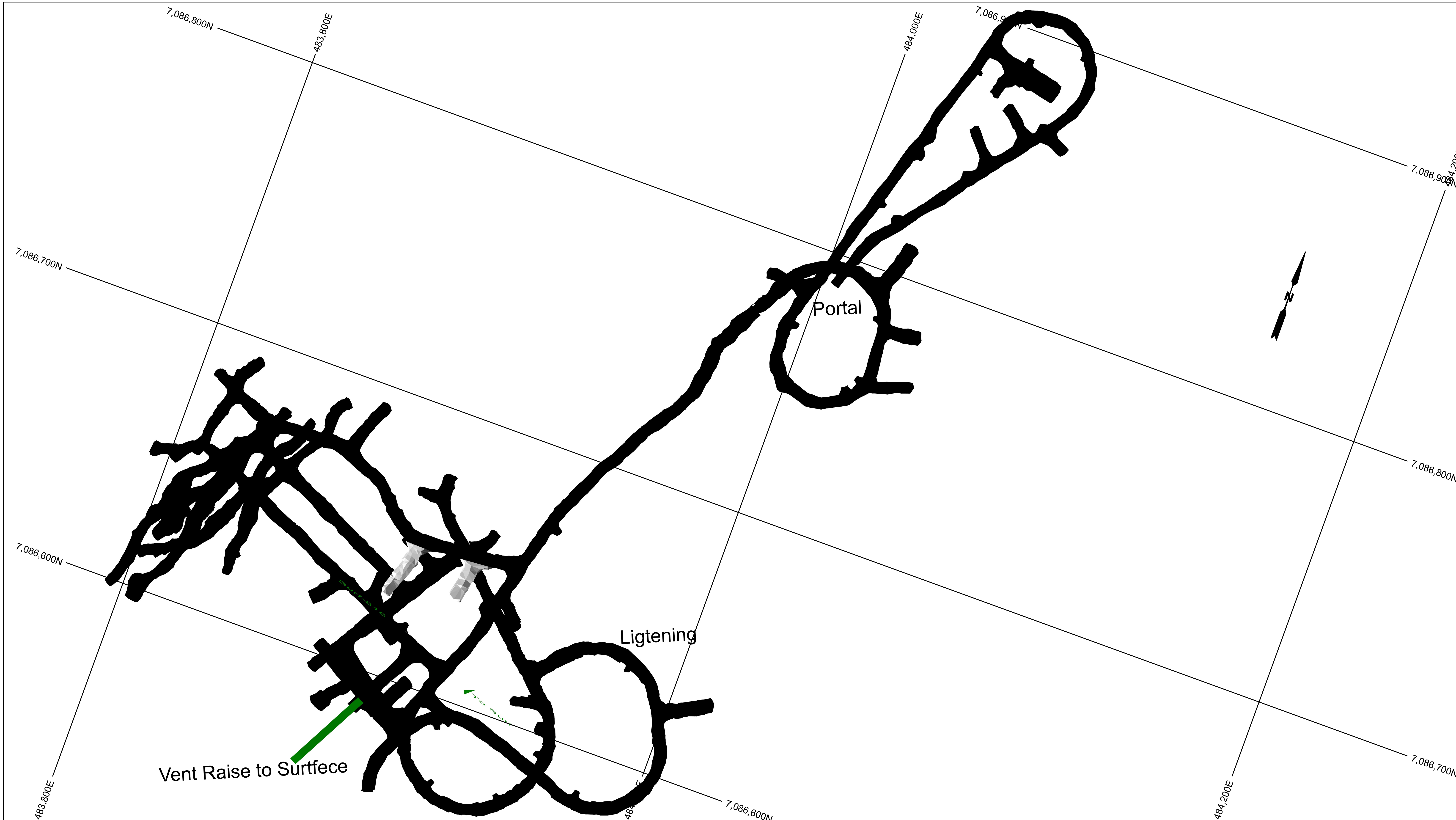


Figure 5-9: Flame & Moth Life of Mine Plan



Hecla YUKON

Revision Comments	Approvals					
	Name	mtanasa				
	Signed					
	Date	2023-11-27				
		Originator	Engineering	Geology	Mine / Ops Manager	

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 5-10

FLAME AND MOTH MINE LAYOUT AS-BUILT

Scale: 1:1250	Support:	Rev #:	Mine:

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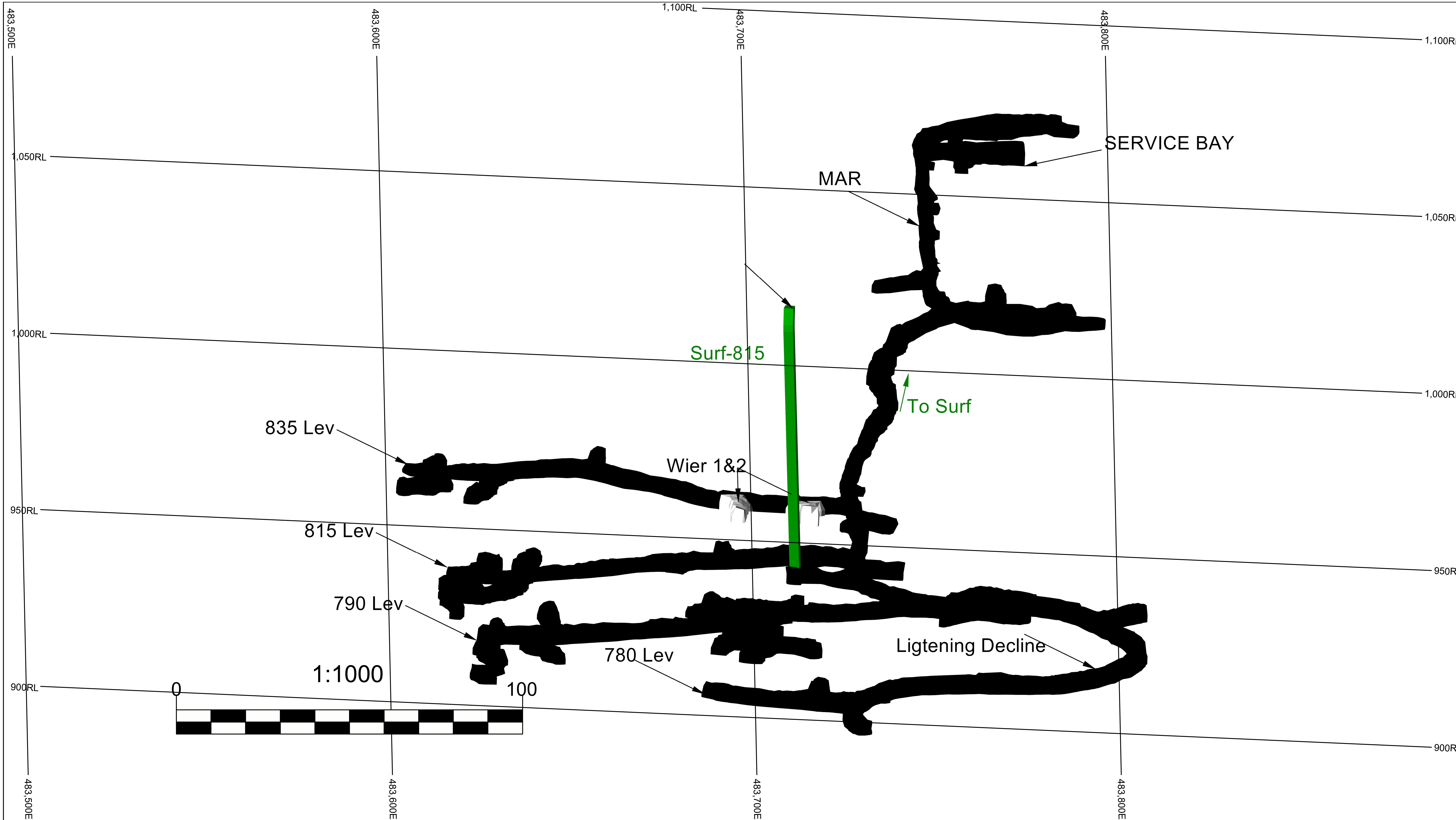


Revision Comments	Approvals					
	Name	mtanasa				
	Signed					
	Date	2023-11-27				
		Originator	Engineering	Geology	Mine / Ops Manager	

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 5-11

FLAME AND MOTH MINE LAYOUT AS-BUILT - SECTION VIEW

Scale: 1:1000	Support:	Rev #:	Mine:

File Path: T:\ Engineering\ 10 - Survey\ As Built\ Flame Oct.duf

Hecla YUKON

*5.4.3.3 **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. P-AML waste rock is 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, and are stored in licensed and permitted surface magazines. A second powder and detonator magazine were constructed underground using existing remucks off the main decline.

A view of the New Bermingham surface facilities (current and proposed) and layout is shown in Photo 5-5 and Photo 5-7. The surface infrastructure present as of September 2021 is shown in Photo 5-6.

Photo 5-5: New Bermingham Surface Infrastructure (October 2023)

Photo 5-6: New Bermingham Surface Infrastructure (September 2021)

Photo 5-7: New Bermingham P-AML Waste Rock Storage Facility #1

Underground

The LOM as published in the Alexco Technical Report (Alexco, 2021) is shown in Figure 5-11. The current underground mine workings as-built is provided in Figure 5-12 and Figure 5-13.

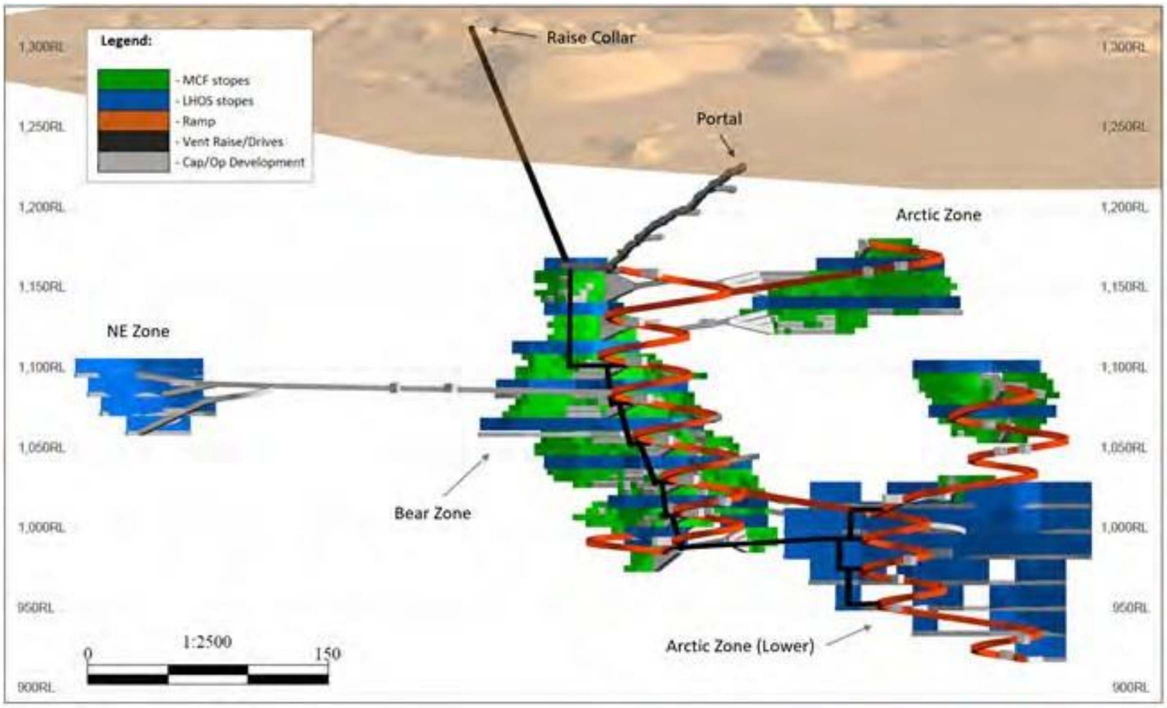
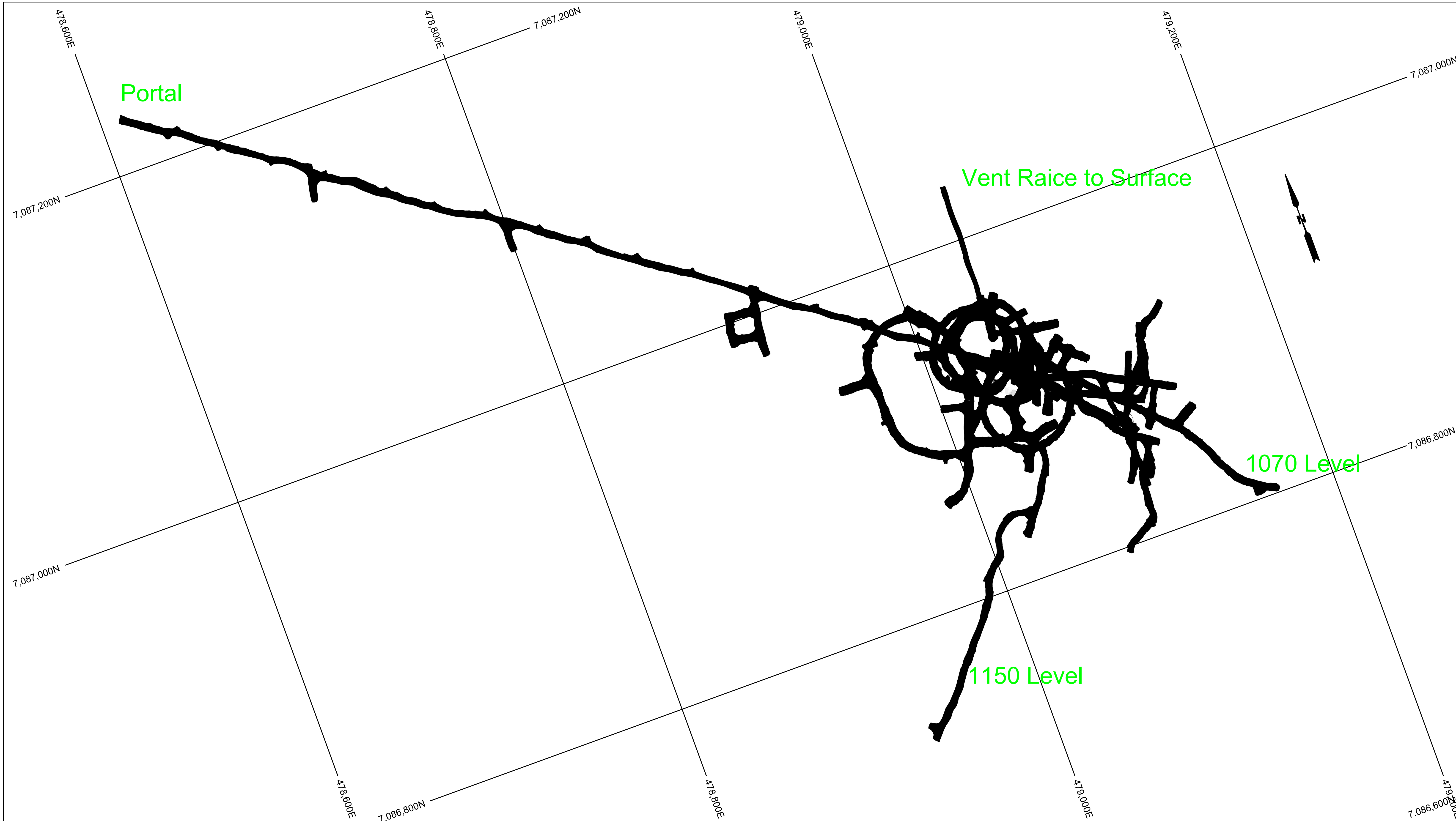


Figure 5-12: New Bermingham LOM Plan



HECLA YUKON

Revision Comments	Approvals					
	Name	mtanasa				
	Signed					
	Date	2023-11-27				
		Originator	Engineering	Geology	Mine / Ops Manager	

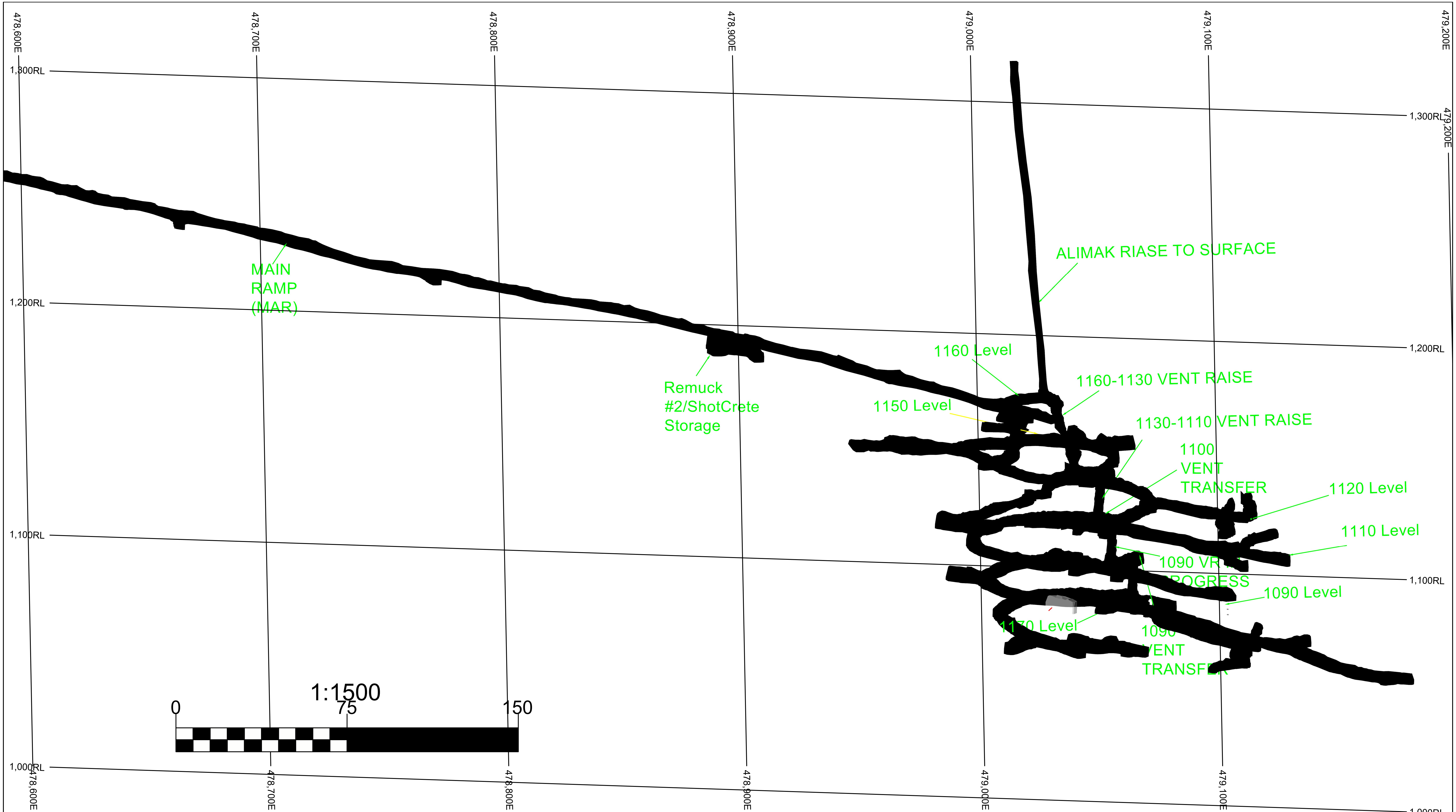
HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE5-13

NEW BERMINGHAM MINE LAYOUT AS BUILT, 2023

Scale: 1:2000	Support:	Rev #:	Mine:

File Path: T:\ Engineering\ 10 - Survey\ As Built\ Bermingham October 29.duf



Revision Comments	Approvals					
	Name	mtanasa				
	Signed					
	Date	2023-11-27				
		Originator	Engineering	Geology	Mine / Ops Manager	

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YUKON

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FIGURE 5-14

NEW BERMINGHAM MINE AS BUILT - SECTION VIEW, 2023

Scale: 1:1500	Support:	Rev #:	Mine:

File Path: T:\ Engineering\ 10 - Survey\ As Built\ Bermingham October 29.duf

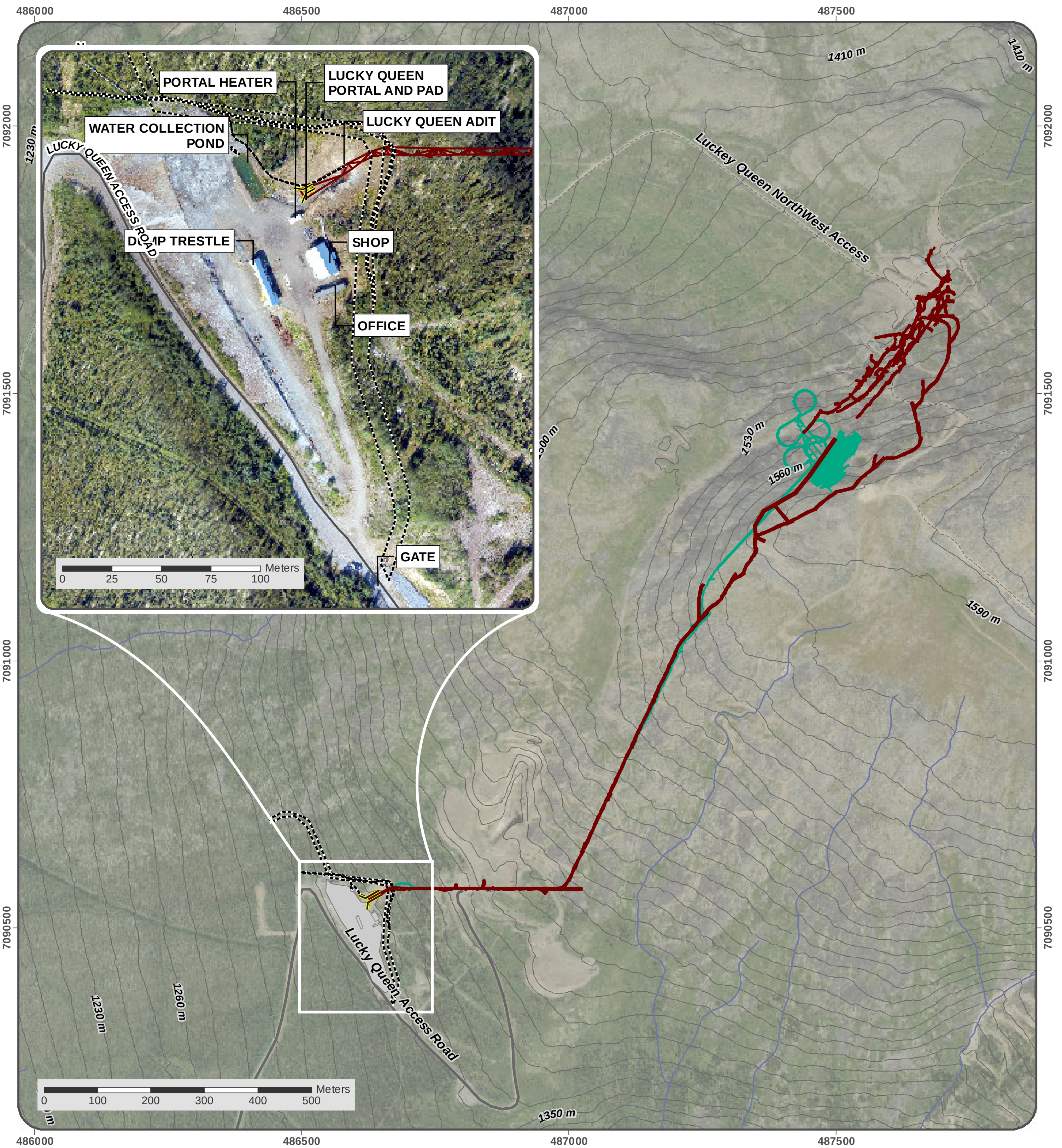
5.4.3.4 ***Lucky Queen***

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 (Figure 5-15).

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 5-8: and Photo 5-9. 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 5-16.

Photo 5-8: Lucky Queen Portal

Photo 5-9: Lucky Queen Portal Pad (October 2023)



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

Hecla KENO HILL

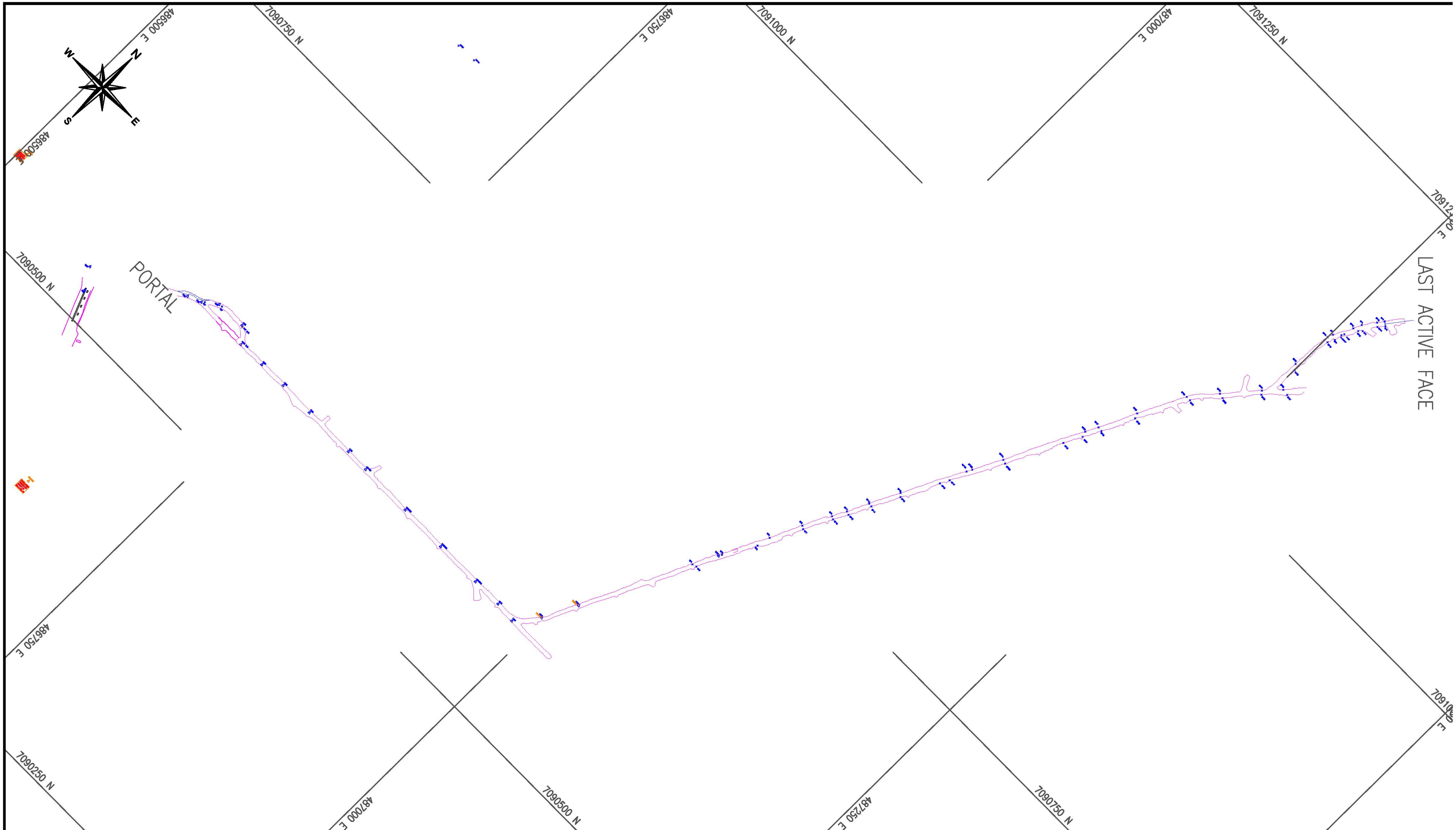
HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 5-15

LUCKY QUEEN MINE LAYOUT

SEPTEMBER 2023

D:\Project\AllProjects\Keno_Area_Mines\LQ\Maps\1_Overview_Maps\Project_Overview\LQ_Layout_20230929.mxd
(*Last edited by: amatlashevska; 2023-09-29/11:25 AM*)



HECLA KENO HILL SILVER
DISTRICT MINING OPERATIONS

Hecla
YUKON

DEPT.	APPROVED BY	DATE	COMMENTS
SURVEY			
ENGINEERING			
GEOLOGY			
ALEXCO MANAGER			
PROCON SUPER			

TITLE:

LUCK QUEEN MINE

Asbuilt March 8, 2013

Figure 5-16

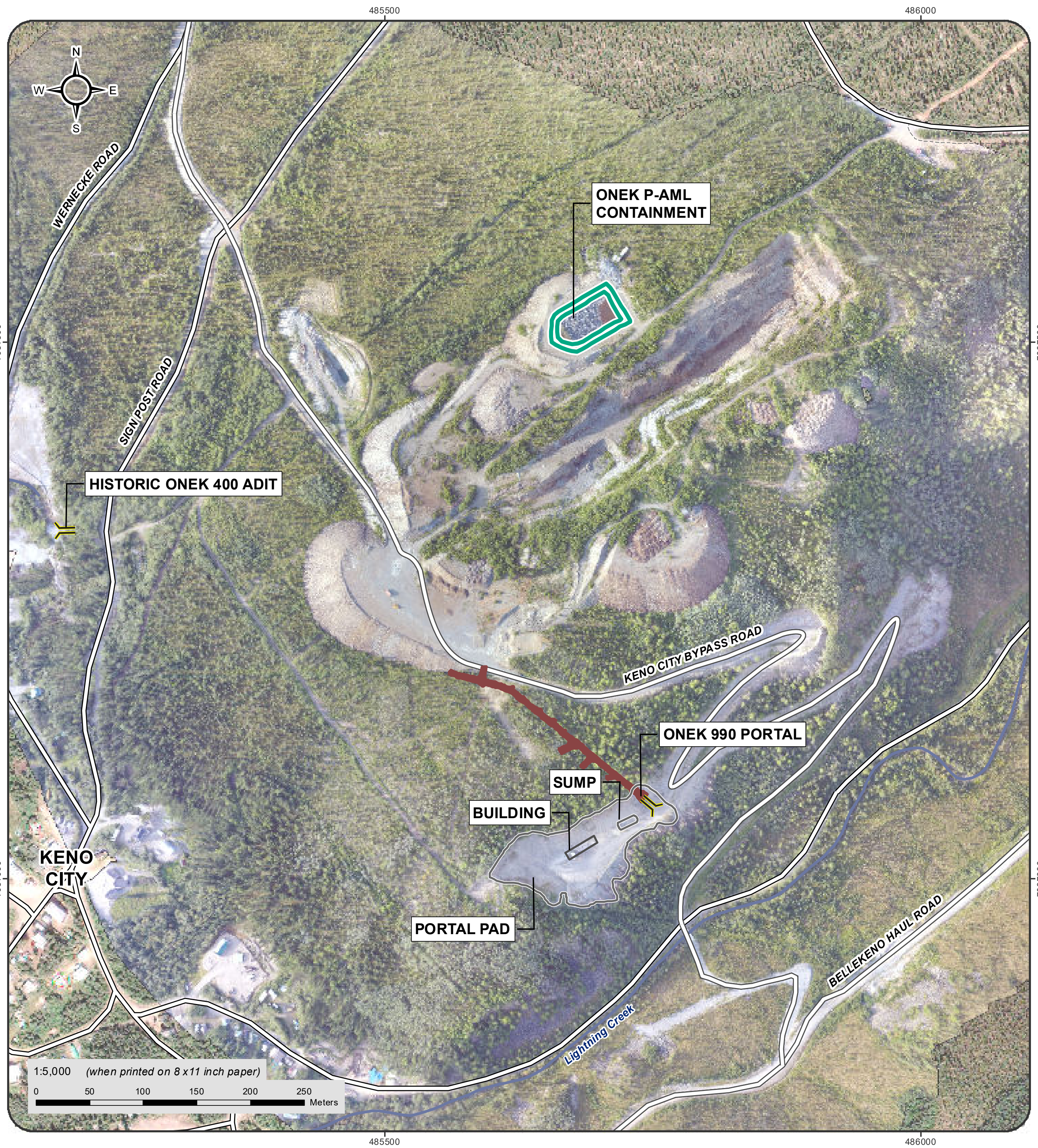
Drawn by: DARIN BAKER		Scale: 1:2500	
Date: 03/08/2013		Approval:	Date:
File: C:\Users\Darin Baker\Documents\Drawing1.dwg			

*5.4.3.5 **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 5-11 and Figure 5-17. An as built of the Onek mine underground workings is shown in Figure 5-18.

Photo 5-10: Onek 990 Portal Shed (October 2023)

Photo 5-11: Onek Mine Surface Overview



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

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

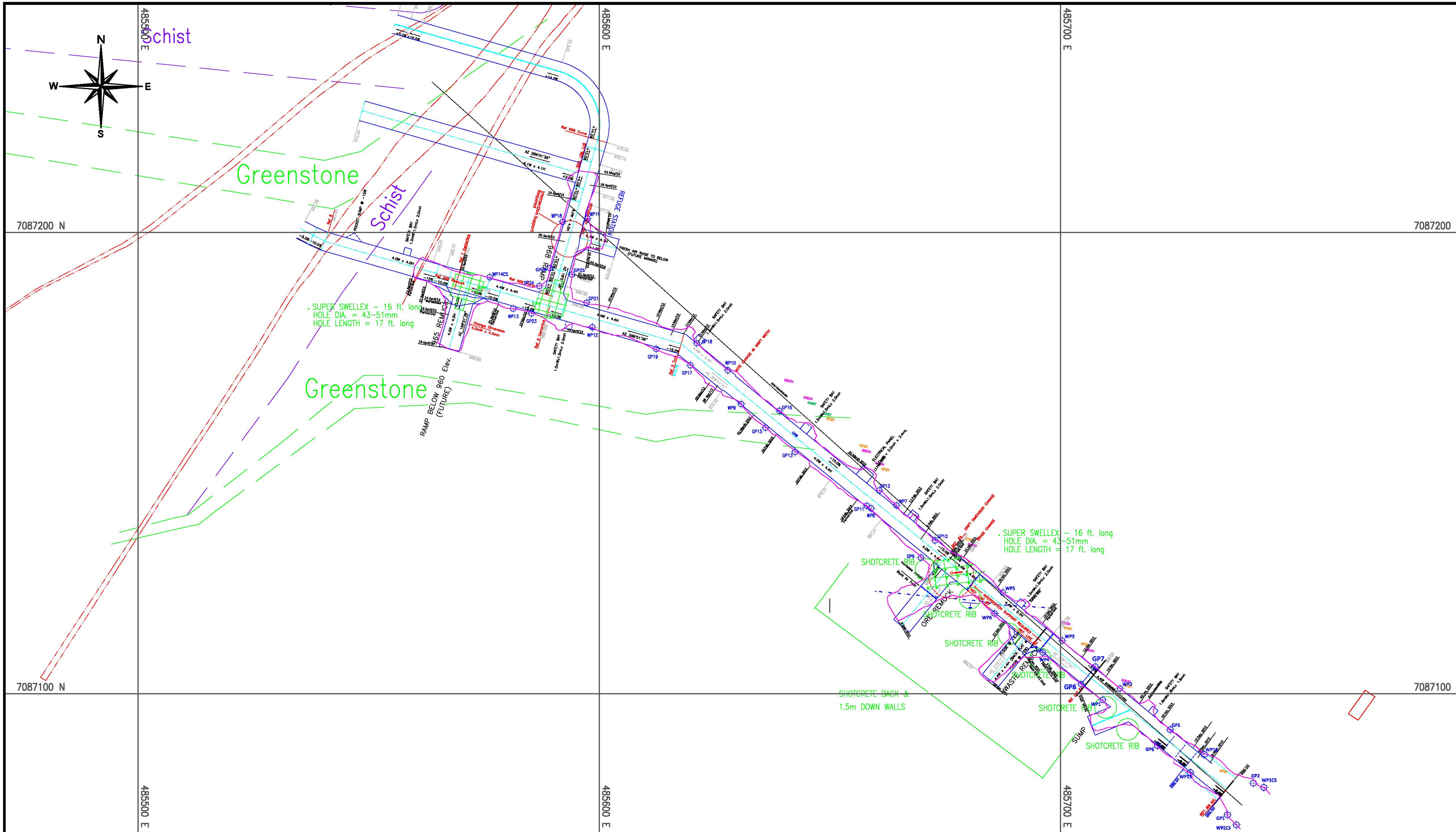
FIGURE 5-17
ONEK 990 MINE LAYOUT

SEPTEMBER 2023

Aerial Imagery aquired on August 2017

Datum: NAD 83; Projection: UTM Zone 8N

D:\Project\AllProjects\Keno_Area_Mines\ONEK\Maps\1_Overview_Maps\Project_Overview\Onek990_Overview_20230427.mxd
(Last edited by: amatlashevska; 2023-04-27/11:33 AM)



HECLA KENO HILL SILVER DISTRICT
MINING OPERATIONS

Hecla
YUKON

DEPT.	APPROVED BY	DATE	COMMENTS
SURVEY			
ENGINEERING			
GEOLOGY			
ALEXCO MANAGER			
PROCON SUPER			

TITLE: **ONEK**
ASBUILT 30 May 2013

Figure 5-18

Drawn by: DARIN BAKER
Scale: 1:750
Date: 05/30/2013
Approval:
Date:
File: H:\Bellekeno Underground\Development-Planning\Promine\promine draWi

5.4.4 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.

5.5 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 Bellekeno mines. Storage and settling ponds have been constructed at each site and include berms built up around all sides to ensure no surface runoff enters the ponds. All water management pond designs have a freeboard of 0.5 m to ensure collection of the 1 in 100 year 24 hour maximum rain event.

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. The largest proposed loading source, Flame & Moth Mine discharge, is only of short duration and will cease at the end of the mine life. 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, which will be 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.

5.5.1 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. The water treatment plant at Bellekeno has operated successfully for over 10 years and is well demonstrated and proven, as is shown in Figure 5-19.

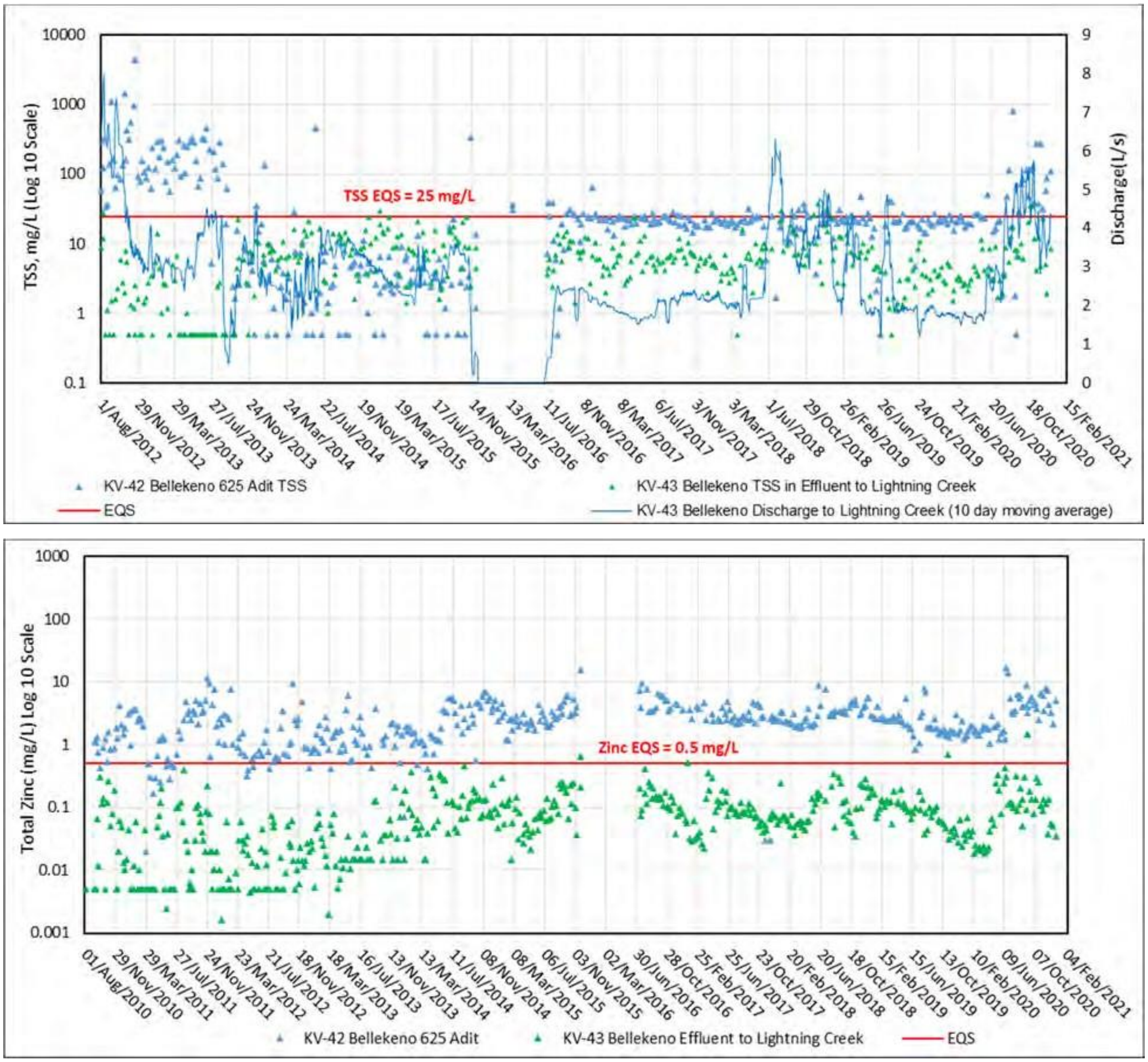


Figure 5-19: Bellekeno Water Treatment Plant Performance – TSS, Flow Rate (top) and Zinc (bottom)

The Bellekeno mine is currently not operational, thus has no water use requirements.

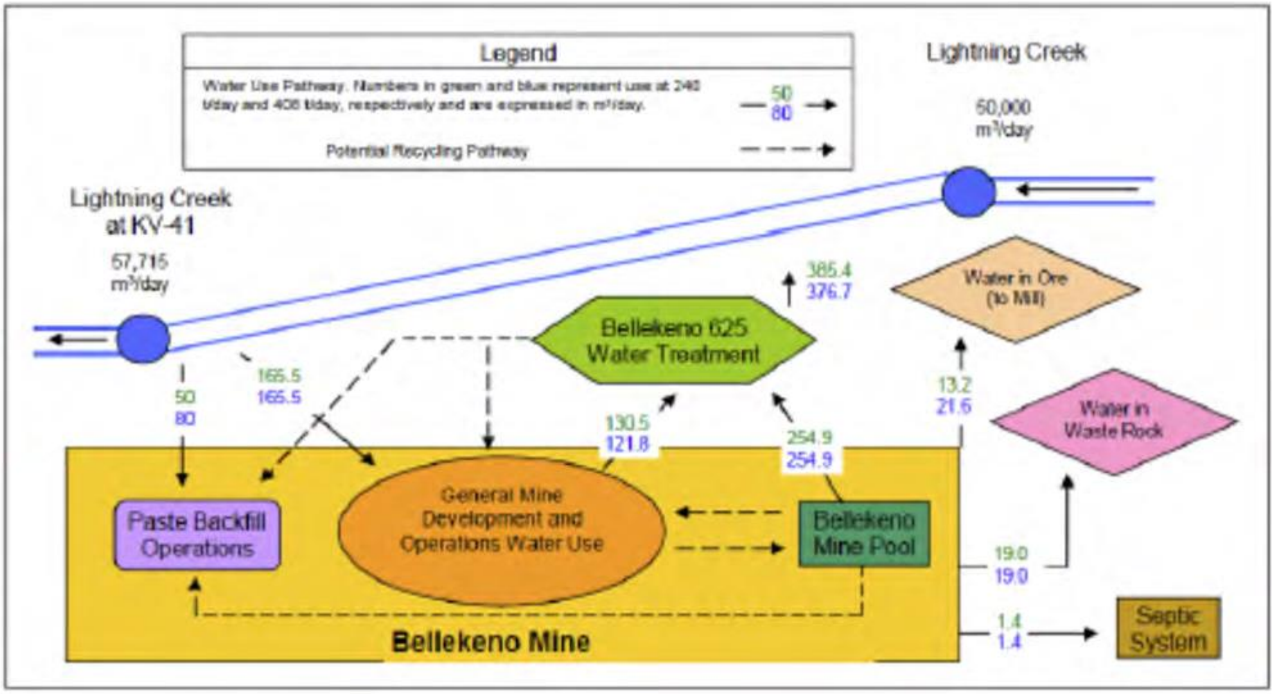


Figure 5-20: Bellekeno Water Balance Schematic; Please note that the Bellekeno mine is not currently operational so no Water Use is required for the mine at this time.

5.5.2 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 m³/day, while the underground development requires up to 140.1 m³/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. The flow rates from the Flame & Moth underground will be reported and reviewed in the annual report. Flow rates for 2023 have averaged 4.57 L/s from the underground mine.

The as-built pond and process flowsheet are shown in Photo 5-12 and Figure 5-22. 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.

Photo 5-12: Flame & Moth Settling Pond and Mill Pond

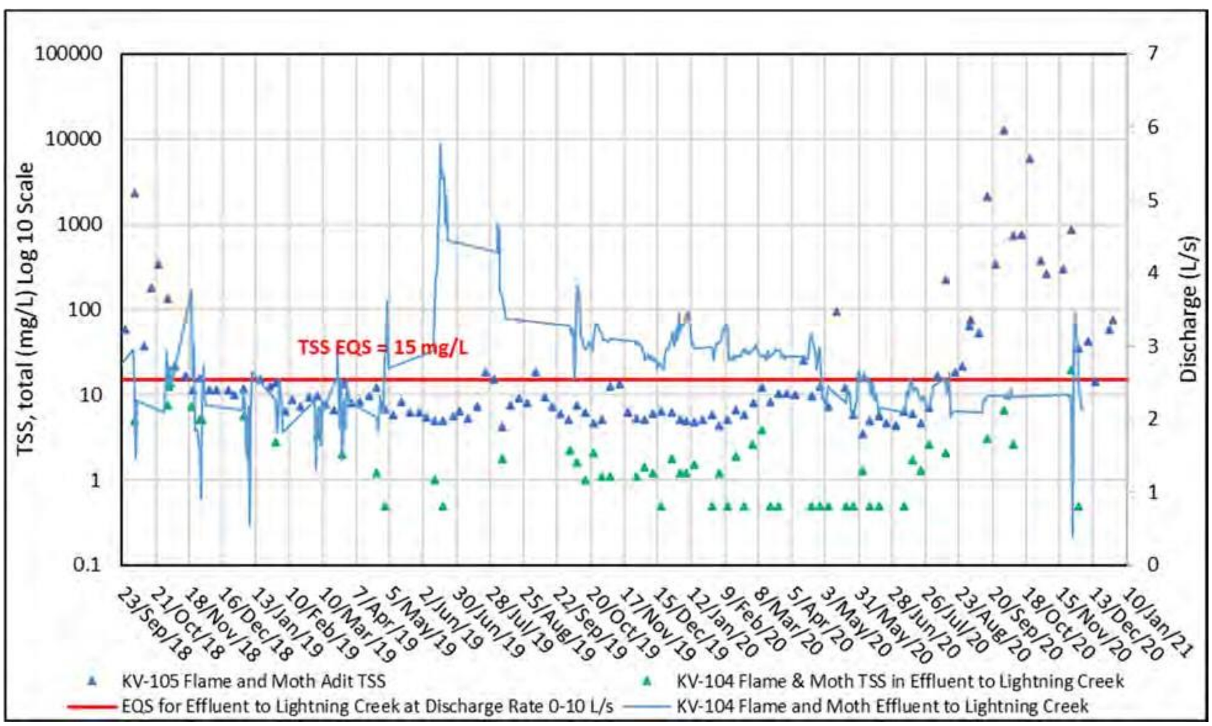
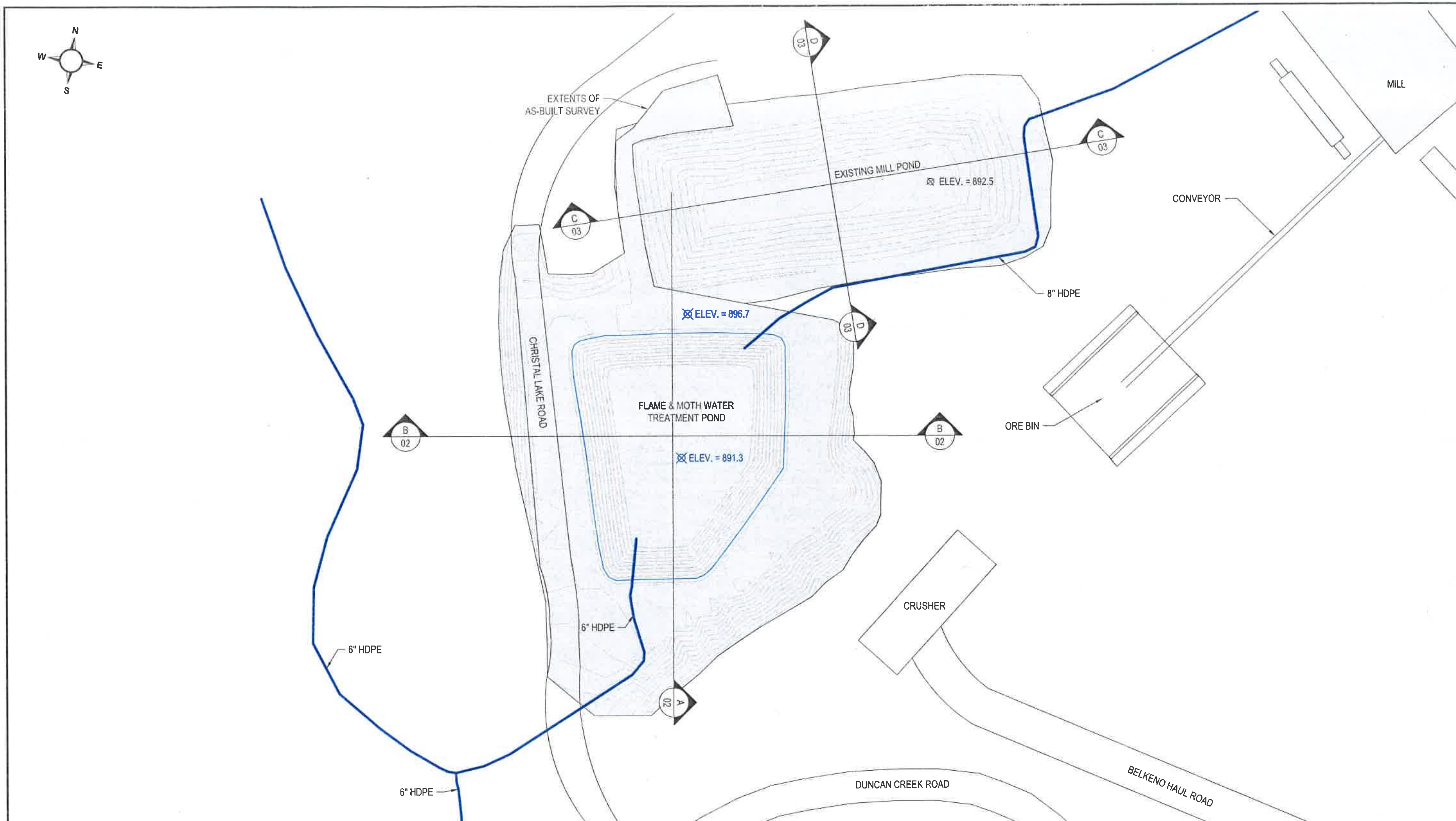


Figure 5-21: Flame & Moth Water Treatment Plant Performance



DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2019-04-18	Stamped	0	KB	NC
2019-04-18	Draft for review	C	KB	KW
2019-04-18	Draft for review	B	KB	KW
2019-04-18	Draft for review	A	KB	KW

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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

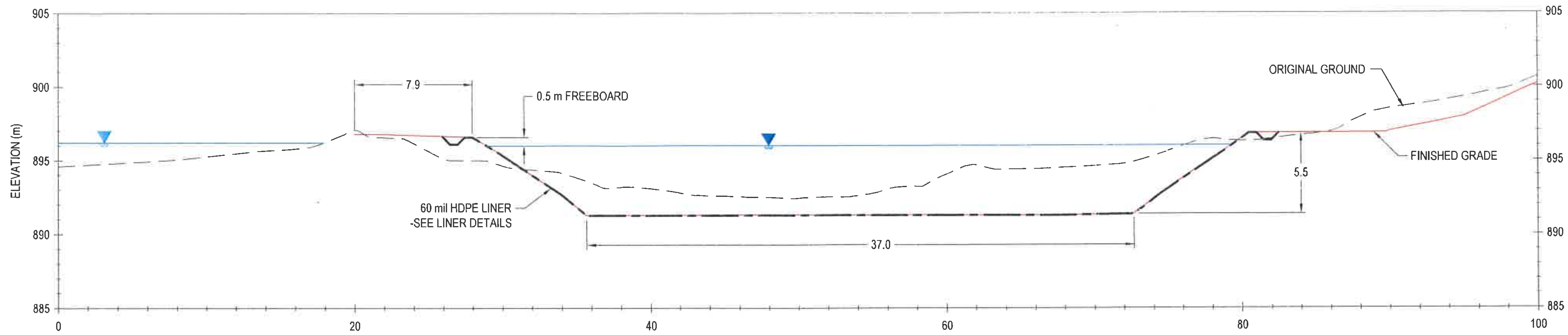
ORIGINAL GROUND CONTOURS FROM LIDAR DATA (DATED NOVEMBER 2014)

Flame & Moth
Water Use License
Drawing No: ALEX-13-NMP-02-0C102.01

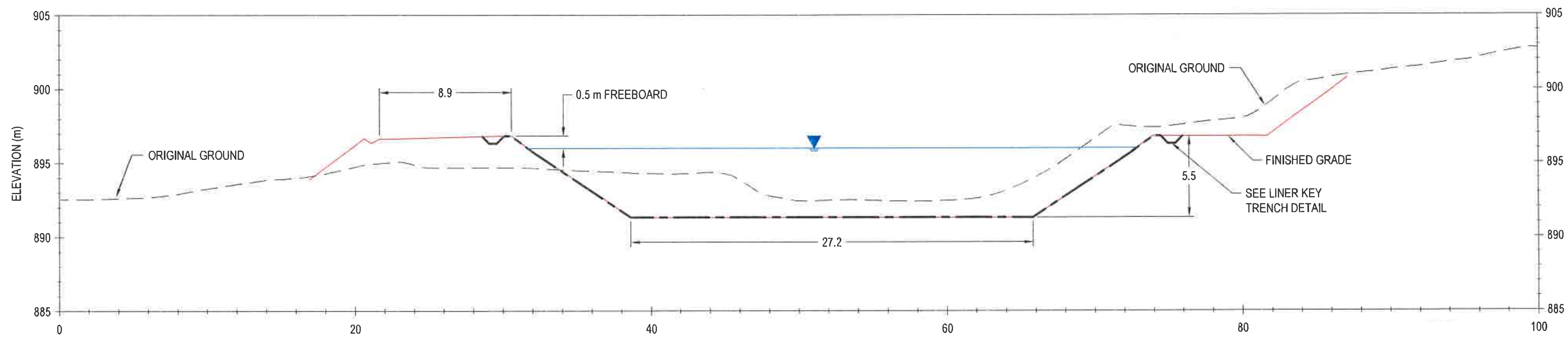
Figure 5-22

Flame & Moth and Mill Ponds As-Built
Site Plan

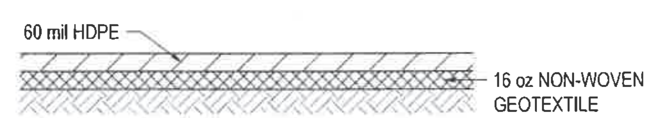
REVISION: 0	2019-04-18	PROJECT No.: ALEX-13-NMP-02
DRAWN BY: KAB	DESIGNED BY: JP (EBA)	REVIEWED BY: NC



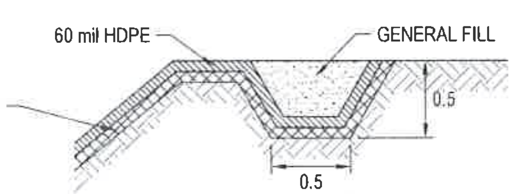
SECTION A - A'



SECTION B - B'



LINER DETAIL



LINER KEY TRENCH DETAIL

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2019-04-18	Stamped	0	KB	NC
2019-04-18	Draft for review	B	KB	KW
2019-04-17	Draft for review	A	KB	KW

Hecla YUKON

0 15m

Scale: 1:300 @ 11"x17"

NOTE: DETAILS NOT TO SCALE
ALL DIMENSIONS IN METERS UNLESS OTHERWISE DENOTED

Flame & Moth
Water Use License
Drawing No: ALEX-13-NMP-02-0C102.02

Figure 5-23

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

5.5.3 New Bermingham

The New Bermingham underground development and production requires 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.

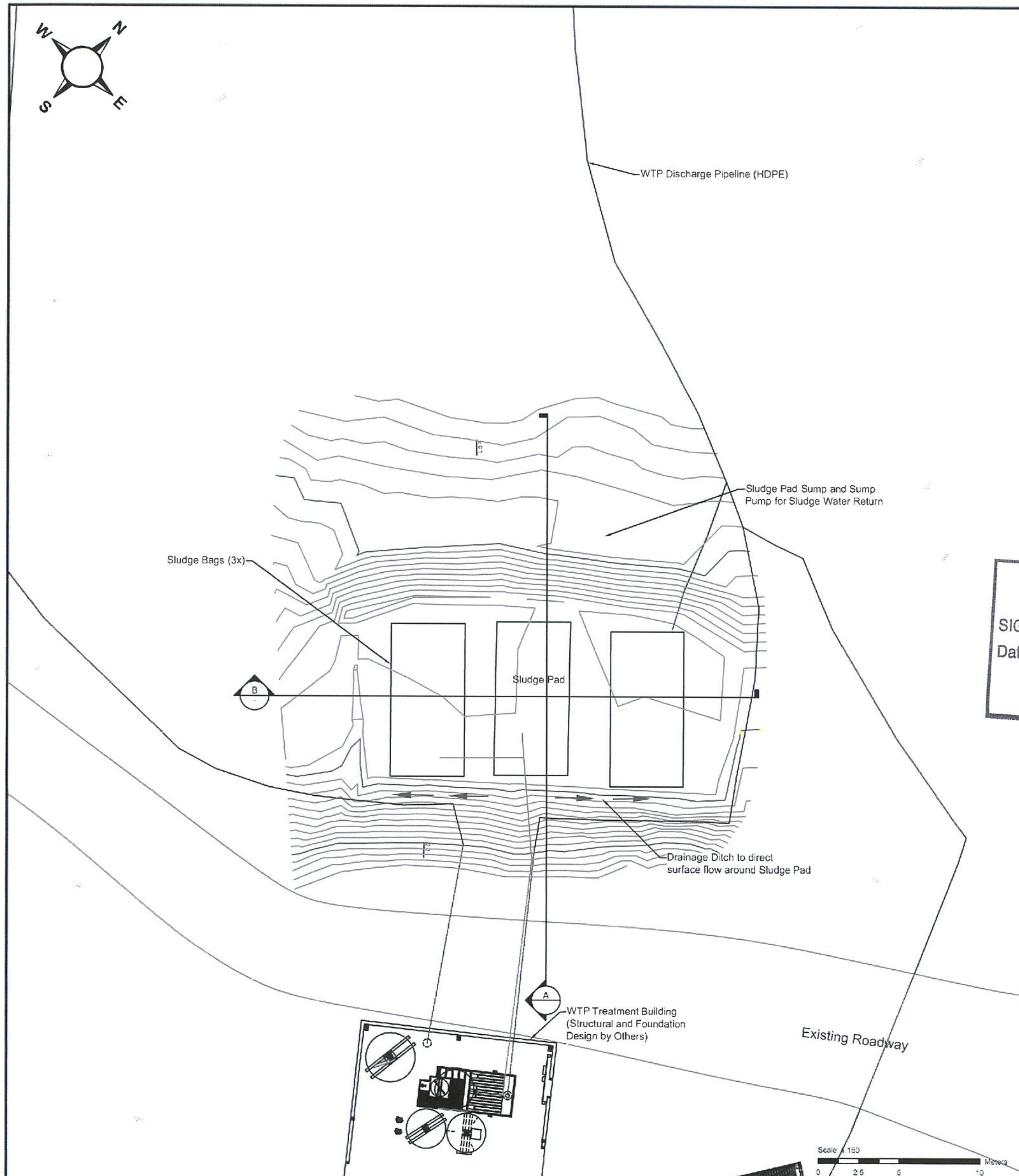
As part of mine operations at New Bermingham, a water treatment plant similar to Flame & Moth has been constructed. All of the systems and technology used in this WTP are proven technologies operating at Keno Hill or elsewhere in the industry. The system operates as follows:

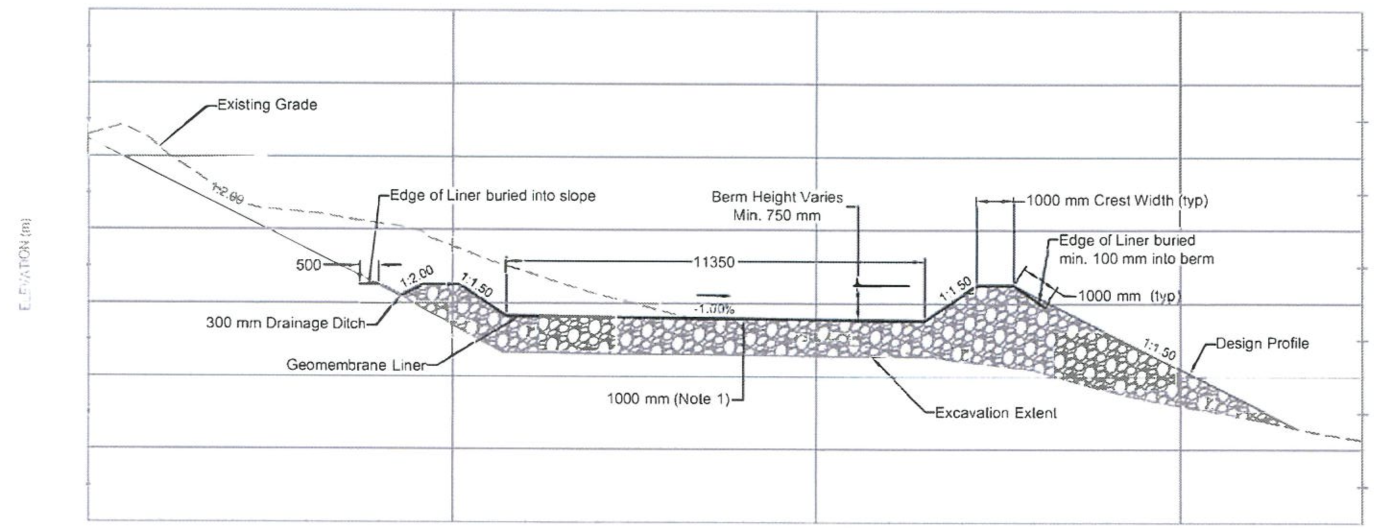
- Once primary settling of solids has occurred in the sumps, water is pumped to surface via a submersible pump in the sump through a 4” pipeline line to a reactor tank. Lime and ferric sulphate are added into the reactor tank and aggressively mixed. The reactor tank provides sufficient residence time 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;
- 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.

The pond, its as-built pond and the process flowsheet are shown in Photo 5-13, Figure 5-24 and Figure 5-25.

Photo 5-13: New Bermingham Settling Pond

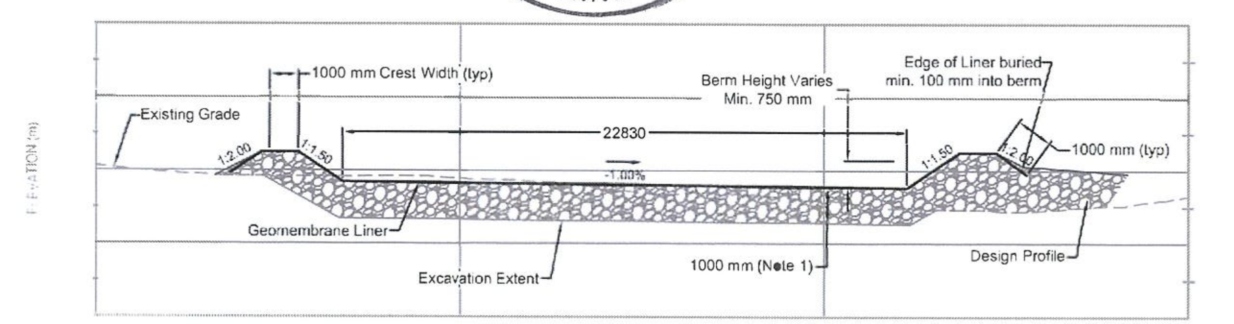




Section A

PERMIT TO PRACTICE
ALEXCO RESOURCE CORP.
SIGNATURE
Date July 1, 2021
PERMIT NUMBER PP750
Association of Professional Engineers of Yukon

PROFESSIONAL
YUKON
NEIL CHAMBERS
TERRITORY
ENGINEER



Section B

Notes:
1. Subgrade of Sludge Pad to be excavated to a depth to allow for placement of a minimum of 1000 mm thick compacted gravel pad unless otherwise approved by a geotechnical engineer.
2. Fill to be placed in accordance with the specifications detailed in General Notes (G1003).

Scale: 1:100 — 0, 2, 4, 8 Meters

REVISION HISTORY

REV No.	DESCRIPTION	DATE	DRWN	APP
D	As-Built completed by AxHM	2021-06-24	DS	NC
C	Revised per client request	2021-02-09	KB	SA
B	Issued for Report	2020-08-07	KB	SA
A	Draft for Review	2020-08-06	KB	--

ISSUED FOR REPORT

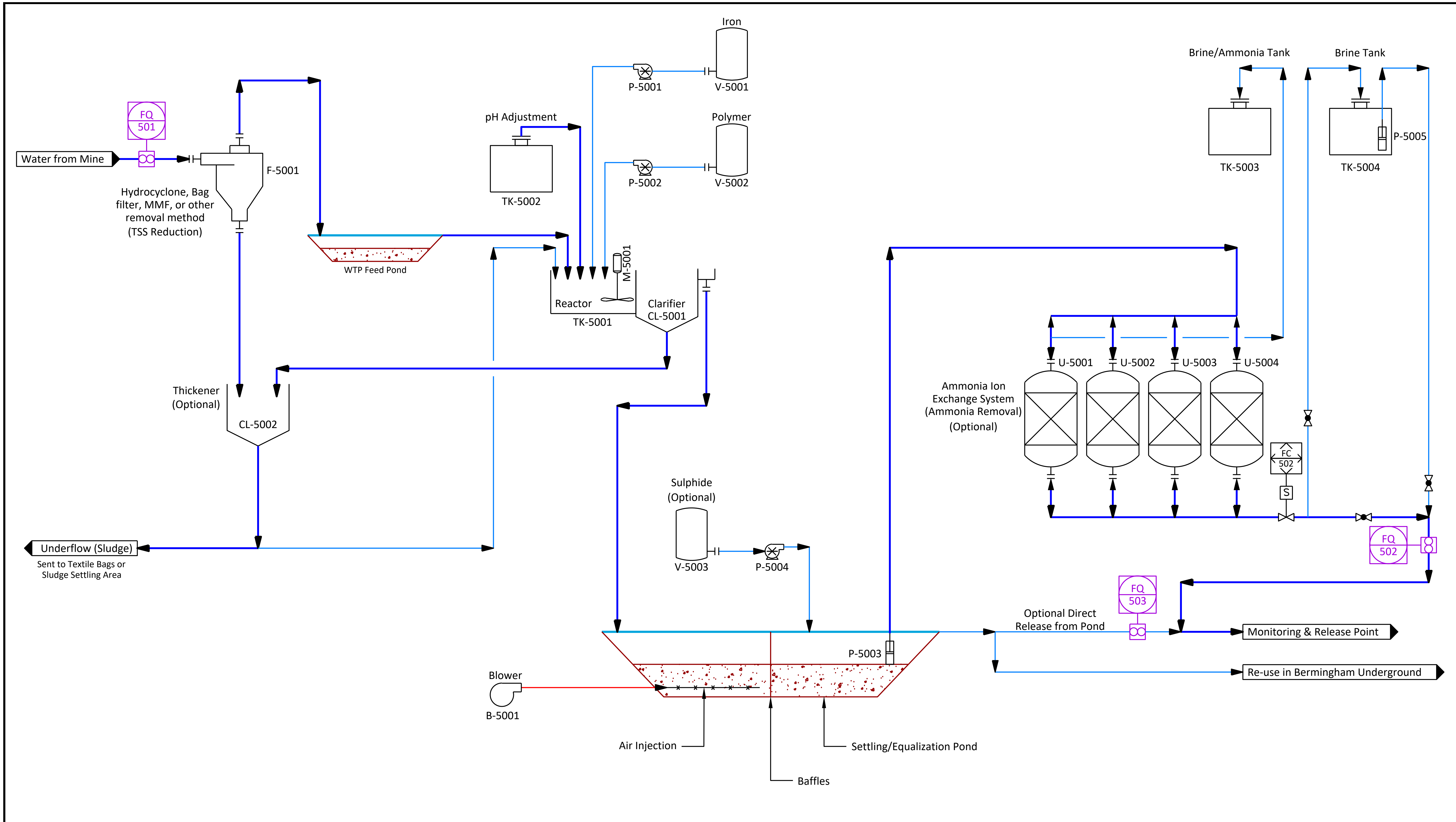
Hecla YUKON

PROJECT NO	DESIGNED BY	DRAWN BY	DATE
ECA20YT00030-222	PJ	DS	2021-06-24

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

Figure 5-24
Bermingham Water Treatment Pond As built

ECA20YT00030-222-C1002 — REVISION C



DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-07-25	Draft for review	A	KAB	--

HECLA YUKON

Bermingham WTP
Bermingham Water Treatment Plant
Drawing No.: ALEX-16-NMP-03-5DI602

Piping and Instrumentation Diagram

Figure 5-25

REVISION A	2018-07-25	PROJECT No.: ALEX-16-NMP-03
DRAWN BY: KB	DESIGNED BY: EL	REVIEWED BY: BT

5.6 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. Further improvements are to be completed in Q4 2023.

5.6.1 Mill Design Criteria

Design criteria for the mill operations are summarized in Table 5-9.

Table 5-9: District Mill Design Criteria

DESCRIPTION	UNIT	VALUE
Ore Characteristics		
Specific Gravity	g/cm^3	3.46
Bulk Density	t/m^3	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

5.6.2 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 5-26.

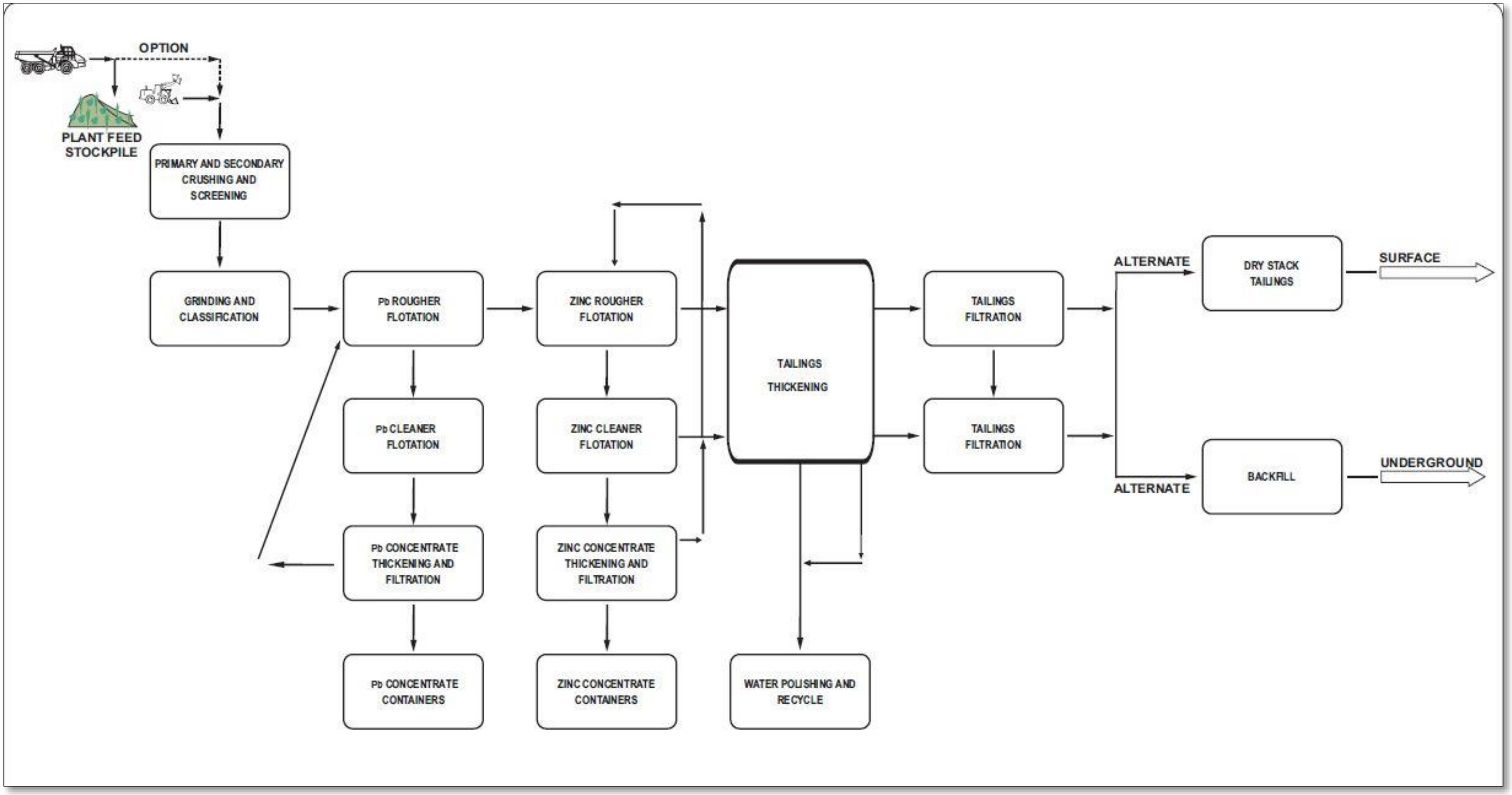


Figure 5-26: District Mill Process Flowchart

5.6.3 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 5-15).

Photo 5-14: Ore Stockpile and Flame & Moth P-AML Pad

5.6.4 District Mill Infrastructure

An aerial photo showing the District Mill and Flame & Moth Mine infrastructure is provided in Figure 5-27. Infrastructure at the District Mill facility includes the mill and DSTF along with:

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

Figure 5-27: 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.

A metallurgical and assay laboratory conducts all basic testwork 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 5-15: Fine Ore Storage, Secondary and Primary Crusher Building

Photo 5-16: Mill Expansion and Assay Lab

5.6.5 Motor Control Centres

A Motor Control Centre (MCC) for the mill building (Photo 5-17) 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 5-18) 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 5-17: Mill MCC

Photo 5-18: Crusher MCC

5.6.1 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. The facilities are situated such that discharges will enter the Christal Creek watershed 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 process pond is 32 x 79 meters in dimension with a total design capacity of 5,000 m^3. The mill pond receives runoff from the DSTF area as discussed in Section 5.5.

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 5-19: Mill Pond

5.7 DRY STACK TAILINGS FACILITY

5.7.1 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. A photo of the placement of tailing lift on the DSTF is shown in Photo 5-20**Error! Reference source not found.**. The DSTF components are summarized in Table 5-10 (TetraTech, 2023).

Photo 5-20: Compacted DSTF Lift

Table 5-10: 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.

The existing DSTF presently holds a volume of 223,000 tonnes, or 106,000 m^3 and covers an area of approximately 2.4 hectares. The ultimate proposed DSTF capacity is approximately 825,000 tones, or 360,000 m^3, and will cover an area of 5.5 hectares. and is designed to provide for storage and confinement of the tailings.

5.7.1 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 5-28 and Figure 5-29. Changes in mine planning led to the entire 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 (Figure 5-30). Constructed slopes in Phase I are generally 2H:1V to 2.5H:1V, with some localized steeper areas.

5.7.1 Phase II

The Phase II expansion is located generally to the south of the existing Phase I. Currently, the area is mostly undisturbed, except for the Flame & Moth WRSA footprint, and the extensions of the Bellekeno Haul Road. The former Keno City waste transfer station and access road are adjacent on the northwest side of Phase II (Figure 5-30).

Detailed design for Phase 2 of the DSTF was issued in 2023 (Tetra Tech, 2023). DSTF Phase 2 construction is scheduled to start in summer 2023, pending final design review and approval. Ground surface preparation is generally consistent with that of Phase 1/1b. The design for Phase 2 is shown in Figure 5-31 and Figure 5-32.

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, 3H:1V slopes have been designed, except for an area near the Phase I boundary, where a 3.5H:1V has been adopted to achieve minimum stability requirements.

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.

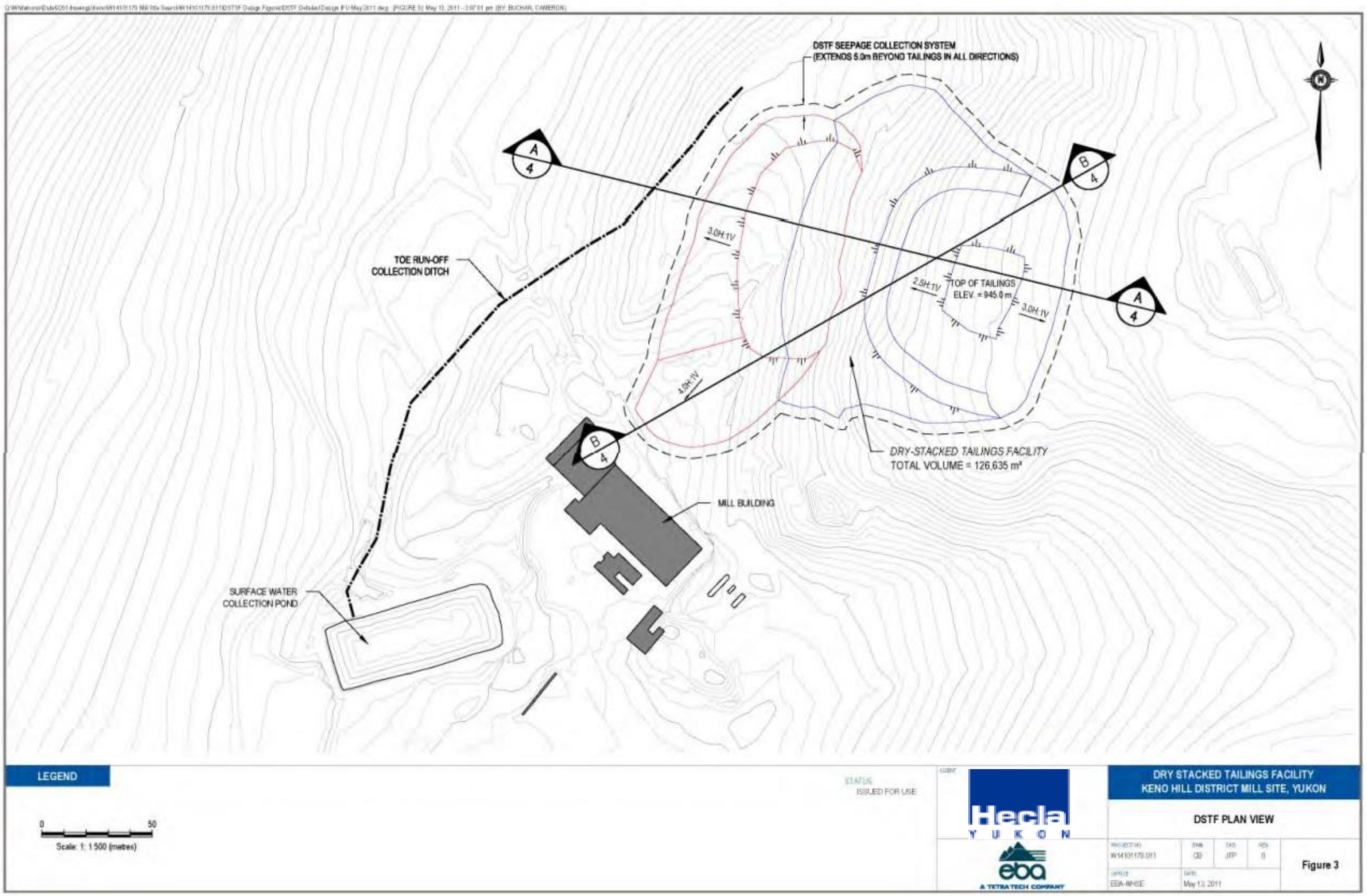


Figure 5-28: DSTF Phase I Plan View

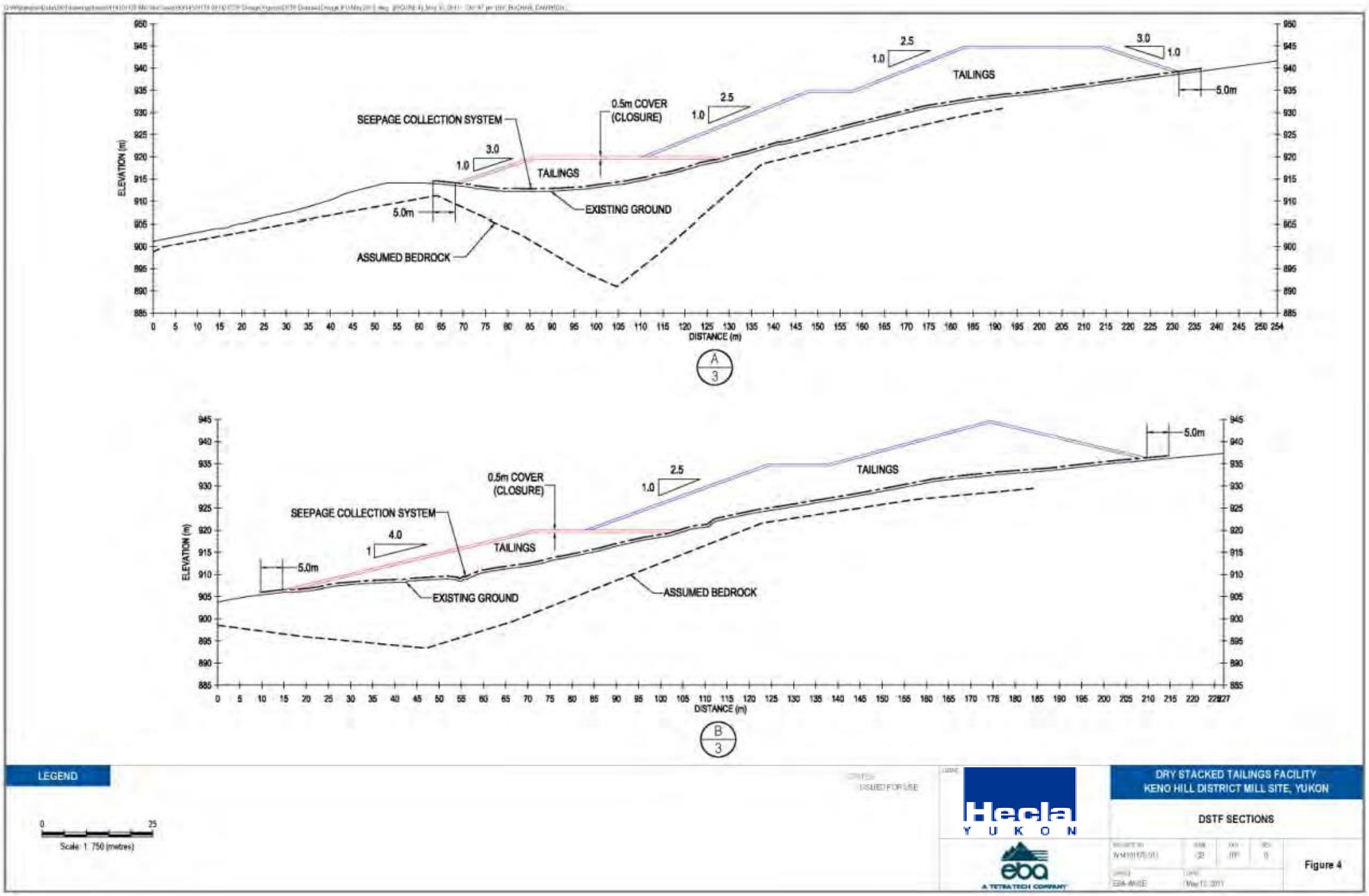


Figure 5-29: DSTF Phase I Sections

	VOLUME	TONNAGE *
PHASE 1 (ORIGINAL DESIGN) **	125,000 m^3	286,000
PHASE 1 (AS-BUILT)	100,000 m^3	229,090
PHASE 2 (DESIGN)	260,000 m^3	595,000
TOE BUTTRESS (DESIGN)	4,000 m^3	N / A

* TONNAGE BASED ON 2.29 T / m^3 PER HECLA

** FULL FOOTPRINT OF ORIGINAL DESIGN NOT CONSTRUCTED

ISSUED FOR REVIEW

LEGEND

- DSTF TAILINGS FOOTPRINT
- PHASE I AS-BUILT FOOTPRINT
- PHASE II TAILINGS FOOTPRINT
- EXISTING SURFACE RUNOFF DITCH
- PROPOSED SURFACE RUNOFF DITCH (SHOWN WHITE)
- PHASE I ORIGINAL DESIGN FOOTPRINT

NOTE

- DRONE IMAGERY COLLECTED BY HECLA IN OCTOBER 2022

0 — 100m

Scale: 1:2,000 @ 11"x17"

CLIENT

Hecla MINING COMPANY

TETRA TECH

DRY-STACKED TAILINGS FACILITY PHASE II DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

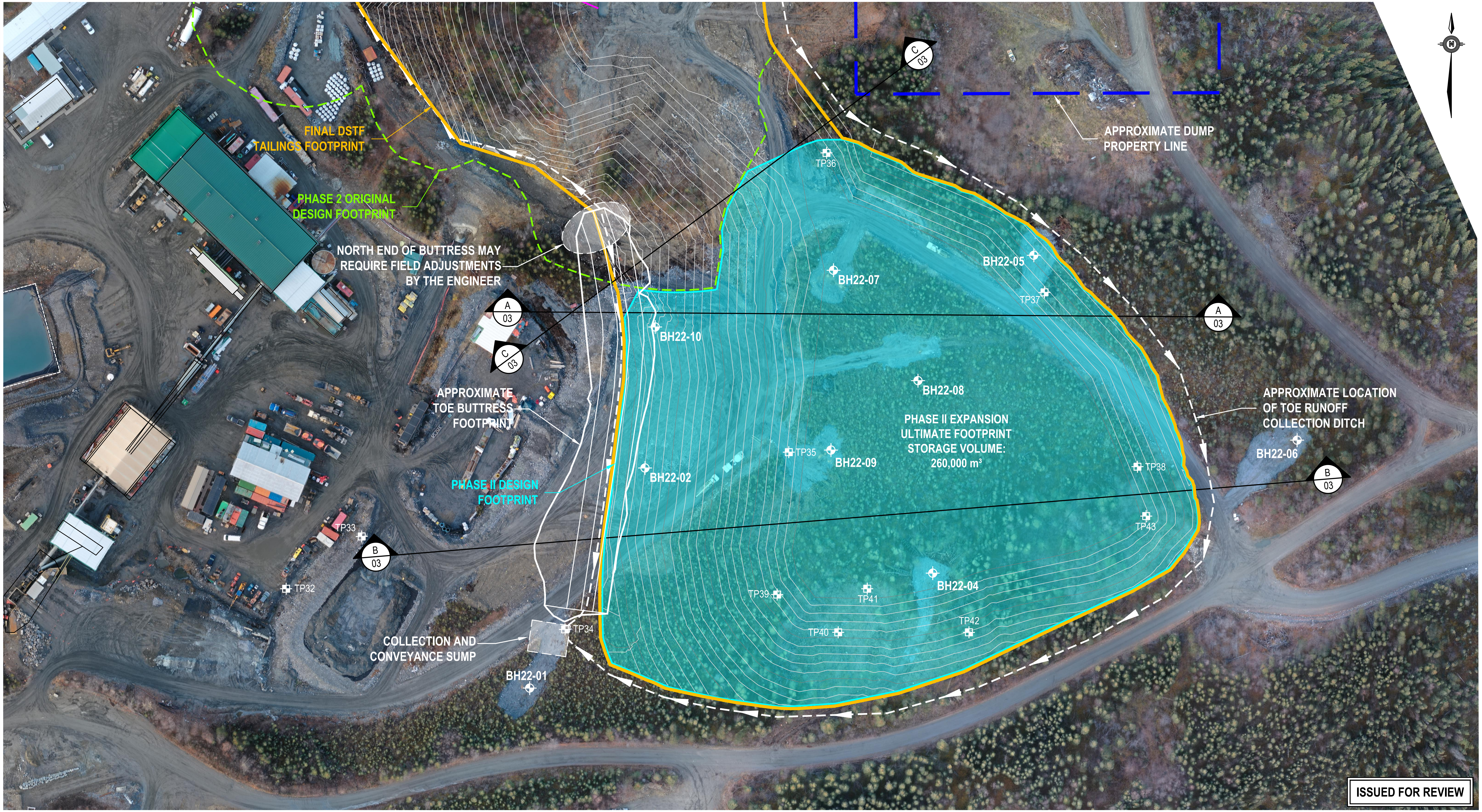
OVERALL DSTF FINAL CONSTRUCTION PLAN

PROJECT NO.	DWN	CKD	REV
ENG.WARC04307-01	CB	IM	0

OFFICE	DATE
EBA-WHSE	June 15, 2023

Figure 5-30

Q:\Whitehorse\Data\0201\drawings\Keno\ENG\WARC04307-01 Keno DSTF Phase 2 Design\ENG.WARC04307-01 DSTF Final Design Fig.1-R0_JS JUNE 16,2023.dwg [FIGURE 1] June 16, 2023 - 9:28:22 am (BY: SWARTZ, JACOB)



LEGEND

- DSTF TAILINGS FOOTPRINT
- PHASE I AS-BUILT FOOTPRINT
- PHASE II TAILINGS FOOTPRINT
- EXISTING SURFACE RUNOFF DITCH
- PROPOSED SURFACE RUNOFF DITCH (SHOWN WHITE)
- PHASE I ORIGINAL DESIGN FOOTPRINT
- BOREHOLE LOCATION
- TESTPIT LOCATION

FOUNDATION COMPONENTS	ESTIMATED QUANTITY (m^3)
DRAINAGE BLANKET	20,000
GEOSYNTHETIC CLAY LINER	35,000
GEOCOMPOSITE DRAIN	35,000

* NOTE : ONLY ROUGH ESTIMATES FOR PLANNING PURPOSES

NOTE

- DRONE IMAGERY COLLECTED BY HECLA IN OCTOBER 2022

0 50m

Scale: 1:1,250 @ 11"x17"

CLIENT

Hecla MINING COMPANY

TETRA TECH

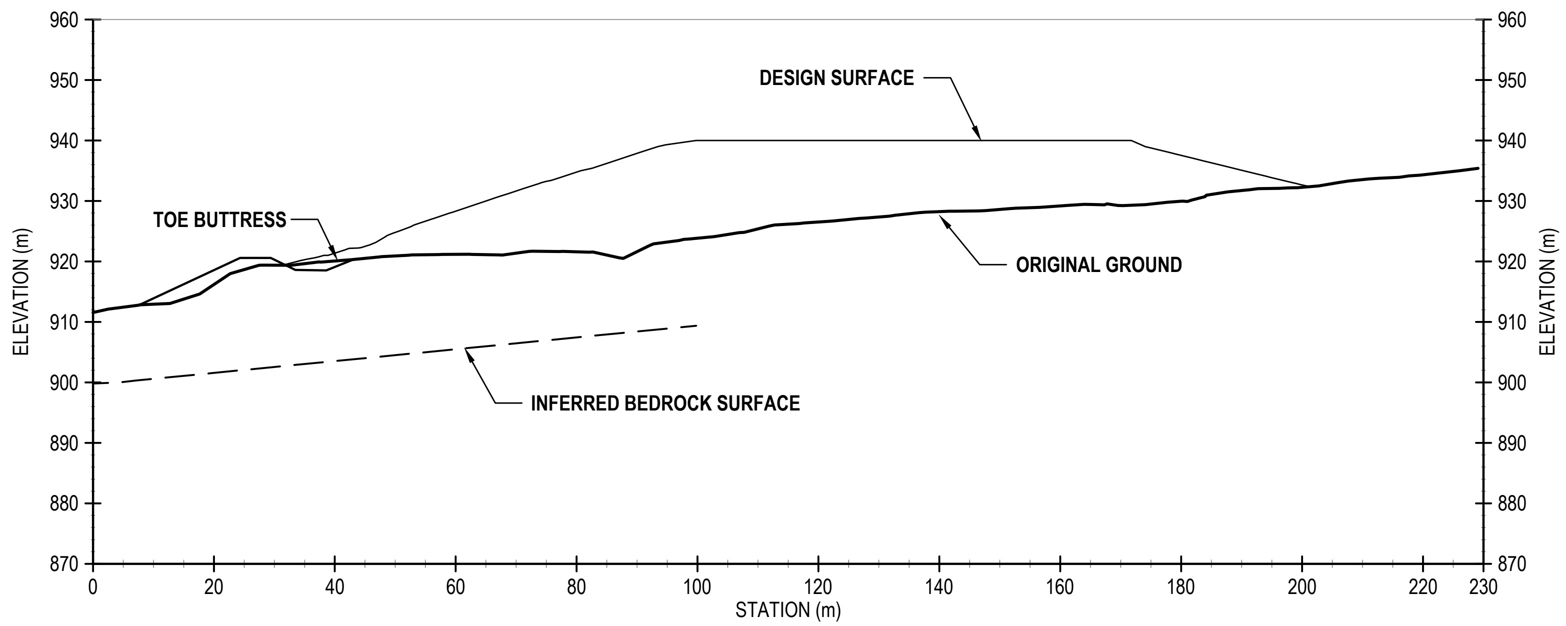
DRY-STACKED TAILINGS FACILITY PHASE II DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

DSTF PHASE II FINAL CONSTRUCTION PLAN

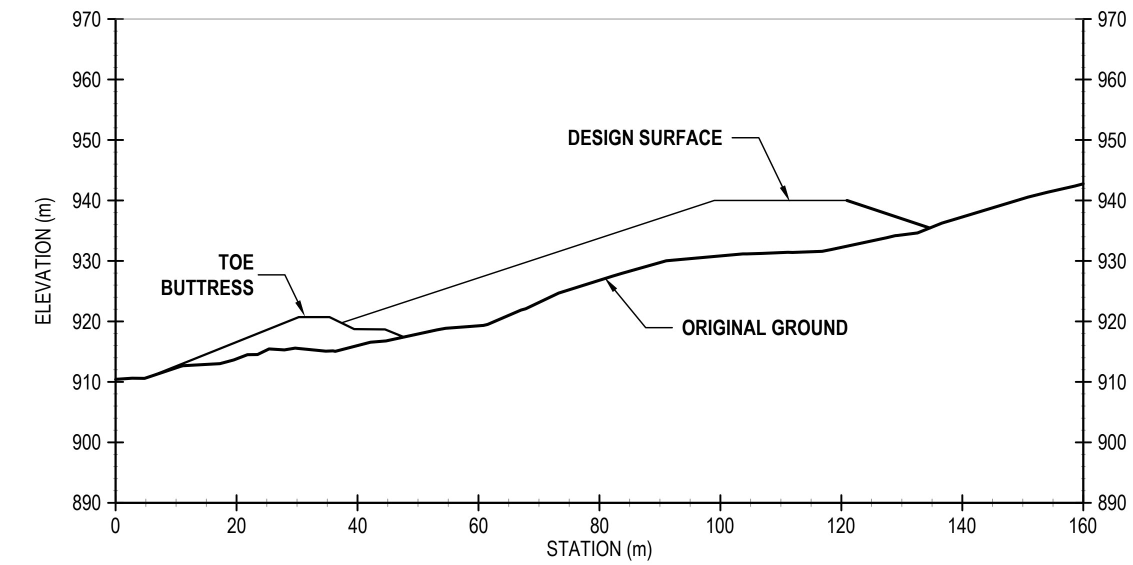
PROJECT NO.	DWN	CKD	REV
ENG.WARC04307-01	CB	IM	0
OFFICE	DATE		
EBA-WHSE	June 15, 2023		

Figure 5-31

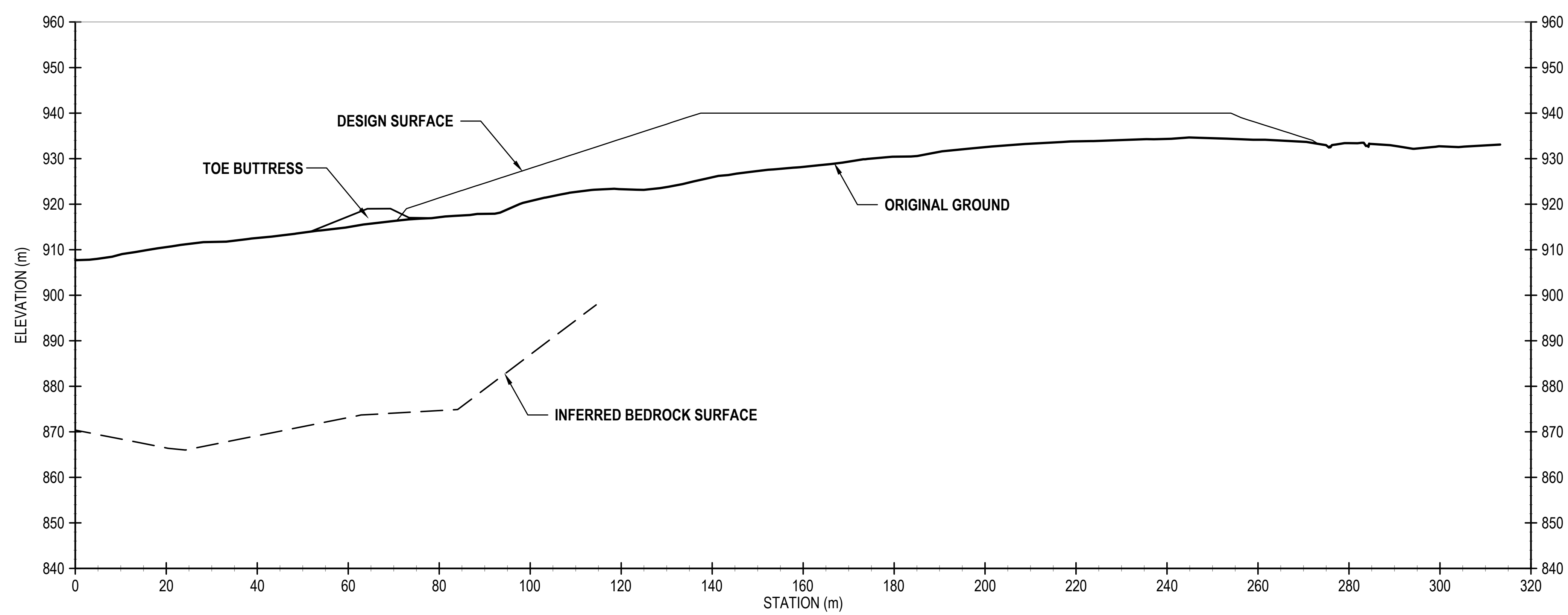
Q:\Whitehorse\Data\0201drawings\Keno\ENG.WARC04307-01 Keno DSTF Phase 2 Design\ENG.WARC04307-01 DSTF Final Design Fig 1-R0_JS JUNE 16 2023.dwg [FIGURE 2] June 16, 2023 - 9:28:26 am (BY: SWARTZ, JACOB)



SECTION A - A'



SECTION C - C'



SECTION B - B'

ISSUED FOR REVIEW

0 50m

Scale: 1:1,250 @ 11"x17"

CLIENT

HECLA MINING COMPANY

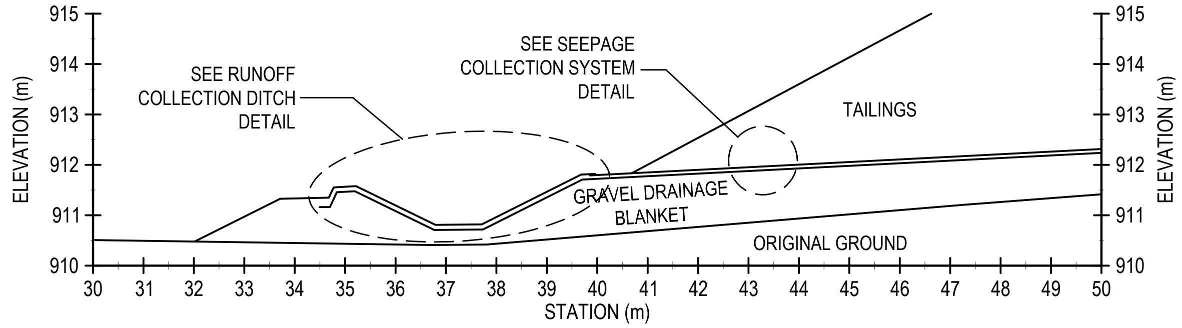
TETRA TECH

DRY-STACKED TAILINGS FACILITY PHASE II DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

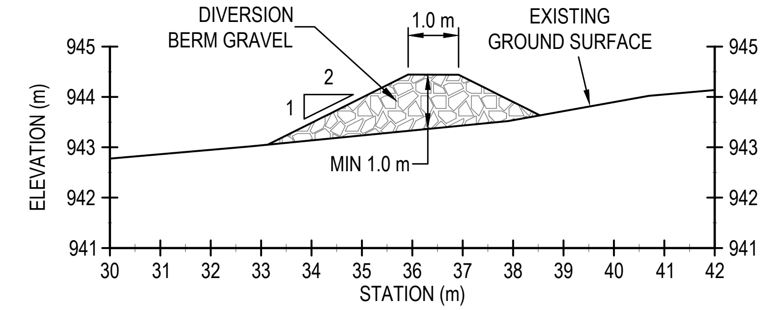
DSTF PHASE II CROSS-SECTIONS

PROJECT NO.	DWN	CKD	REV
ENG.WARC04307-01	CB	IM	0
OFFICE	DATE		
EBA-WHSE	June 15, 2023		

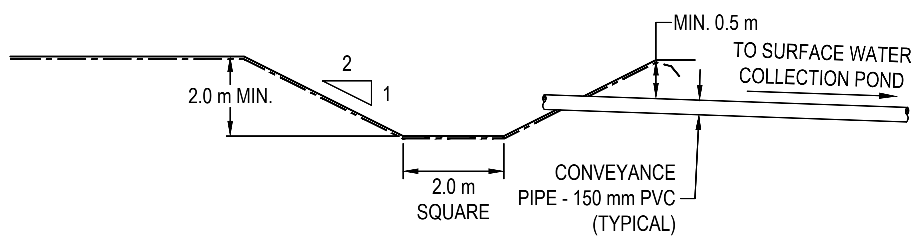
Figure 5-32



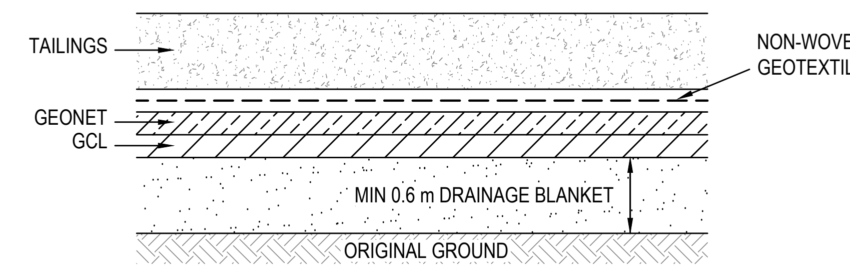
RUNOFF COLLECTION DITCH - TYPICAL SECTION



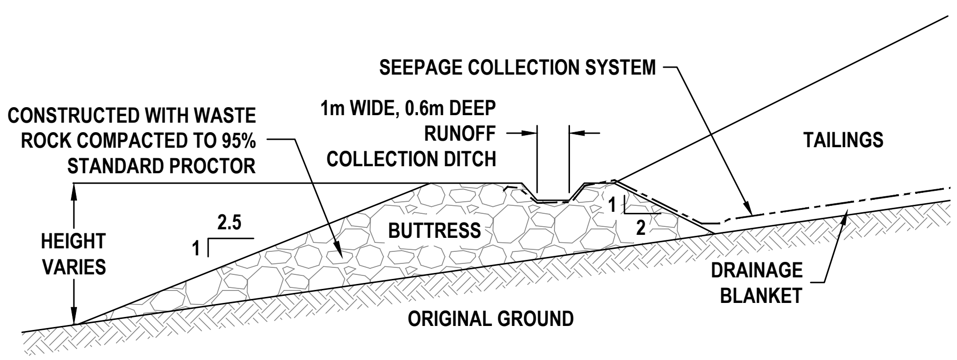
UPHILL DIVERSION BERM DETAIL



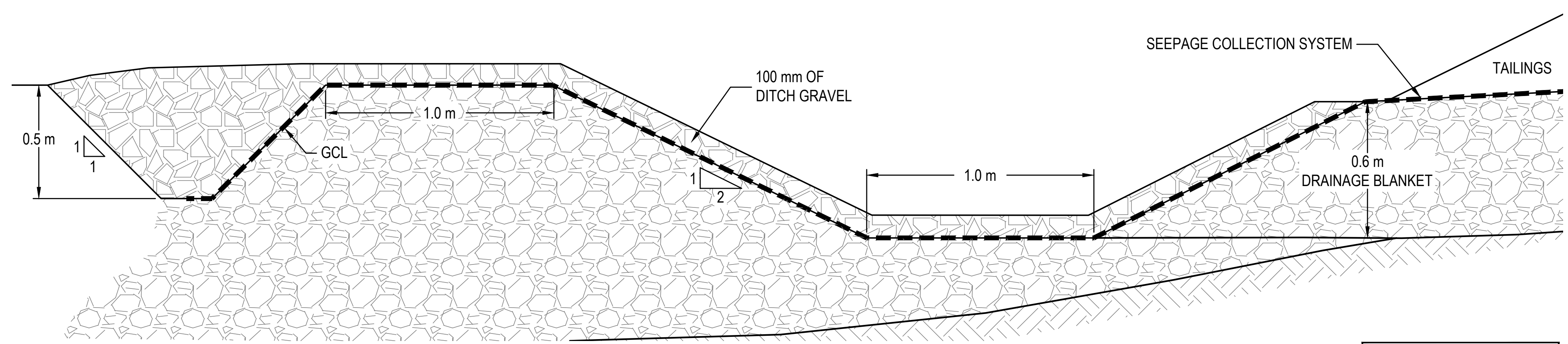
COLLECTION SUMP & CONVEYANCE PIPE



SEEPAGE COLLECTION SYSTEM DETAIL



TYPICAL TOE BUTTRESS AND RUNOFF COLLECTION DITCH DETAIL



TOE RUNOFF COLLECTION DITCH DETAIL

ISSUED FOR REVIEW

Q:\Whitehorse\Data\0201drawings\Keno\ENG\WARC04307-01 Keno DSTF Phase 2 Design\ENG.WARC04307-01 DSTF Final Design Fig.1-R0_JS JUNE 16,2023.dwg [FIGURE 4] June 16, 2023 - 9:28:36 am (BY: SWARTZ, JACOB)

CLIENT

Hecla® MINING COMPANY

TETRA TECH

DRY-STACKED TAILINGS FACILITY PHASE II DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

DSTF PHASE II TYPICAL DETAILS

PROJECT NO.	DWN	CKD	REV
ENG.WARC04307-01	CB	IM	0
OFFICE	DATE		
EBA-WHSE	June 15, 2023		

Figure 5-33

5.8 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 5-21).

Photo 5-21: Electrical Substation

5.9 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 162 permanent beds. There are four refurbished houses located nearby in the townsite of Elsa with a total of 25 rooms, and an additional 19 rooms available in a bunkhouse next to the houses, which is used primarily for seasonal surface exploration programs. 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. The entire capacity of the camp facilities is 206 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. Waste water 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 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*. …

Photo 5-22: Flat Creek Camp – October 2023

5.10 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.

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.

5.11 RISK AND ADAPTIVE MANAGEMENT

This is documented in the adaptive management plan (Hecla Yukon, 2023a). Additionally, as part of risk management for the project the seepage source terms will be updated as the Flame & Moth and New Bermingham mines produce waste rock and tailings and are characterized through the static and kinetic testing requirements outlined in the Tailings Characterization Plan and Waste Rock Management Plan. Kinetic tests will include humidity cells and subaqueous columns for tailings, cemented tailings, P-AML and N-AML waste rock, and cemented P-AML and N-AML waste rock. Preliminary results from these kinetic tests are expected in 2024. Once these data are available, they will be incorporated into a revised water quality model and source terms will be revised where appropriate.

6 PROGRESSIVE RECLAMATION

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

6.1 DRY STACK TAILINGS

The DSTF has been progressively constructed and has been progressively reclaimed over the life of the facility. A portion of the DSTF is built on an on-going basis each year. In the summer of each year or as the progression of the facility allows, progressive reclamation occurs through recontouring the side slopes to the final design slope angle and placing cover material.

Progressive reclamation of the DSTF cover will occur for the most part during operations; however, the installation of the final closure cover system will be conducted in the next 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.

In 2012 reclamation was initiated on the DSTF 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. Details regarding this program are included in Appendix 1.1.

In 2022 progressive reclamation of the DSTF was implemented to maintain site stability and control dust. Progressive reclamation of the DSTF occurs through recontouring the side slopes to the final design slope angle and placing granular/organic material as a cover. Observations of the physical conditions of the cover system and vegetation field trials continued. The most recent formal documentation was completed in 2019 (AEG, 2020).

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.

The seed mix used on the progressive reclamation of the DSTF over two periods 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 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.

Photo 6-1: DSTF Progressive Reclamation, June 2012

Photo 6-2: DSTF Progressive Reclamation, August 2013

Photo 6-3: DSTF Progressive Reclamation, September 2016

Photo 6-4: DSTF Progressive Reclamation, August 2023

The primary objective of the soil cover for the DSTF is to minimize erosion of the compacted tailings. Physical inspections from 2013 – 2023 demonstrate that the soil cover has been effective in doing so and has established vegetative cover as shown in Photo 6-3 and Photo 6-4.

6.2 DISTURBED SLOPES

Progressive reclamation during operations is done to promote slope stabilization and reduce erosion during the life of the mine. Disturbed slopes are stabilized and revegetated as required. Construction areas not able to be progressively reclaimed due to the onset of winter are targeted for the following snow-free period.

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

6.3.1 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.

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

*6.3.1.1 **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 (**Error! Reference source not found.**). The f acility 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.

*6.3.1.2 **Fuel Tank Decommissioned***

A lined and bermed fuel tank facility locate near the Bellekeno East Portal was decommissioned (Photo 6-5 and Photo 6-6). 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 6-5: Bellekeno Fuel Tank Farm – 2021

Photo 6-6: Bellekeno Fuel Tank Farm – 2023

*6.3.1.3 **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 5-2:Photo 5-2)

6.3.2 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 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 7-1 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.

7.1 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.

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.

7.2 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.

7.3 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 access the performance of the specific component and determine whether the design, operation, or surveillance of that component must be adjusted.

Table 7-1: 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.		Alexco	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

8 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)
3) Waste Rock Storage and Overburden Areas (Appendix 3.1)
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)

8.1 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 the different times, including current disturbance, end of Year 2 and End of Mine life. Table 8-1 summarizes the disturbance by Mine Area Component at these different stages in the LOM Plan.

Table 8-1: Summary of Disturbance Area by Mine Component

MINE COMPONENT	UNITS	CURRENT (2023)	YEAR 2 LOM PLAN	END OF LOM PLAN
DISTRICT MILL FACILITIES				
Ore Mined/Milled	tonnes	337,241	719,141	1,351,495
Dry Stack Tailings Facility	tonnes	378,513	512,827	907,000
Dry Stack Tailings Facility Area (unreclaimed)	ha	0.8	2.5	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
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	ha	0.33	0.33	0.33
Temporary P-AML WRSF	tonnes	0	0	0
Temporary P-AML WRSF	m^3	0	0	0
FLAME & MOTH				
Yards/Portal/Laydown Areas	ha	0	0	0
N-AML WRDA	tonnes	0	0	0
N-AML WRDA	ha	0	0	0
P-AML WRSF	tonnes	66,410	0	125,000
P-AML WRSF	ha	0.23	0.23	0.23
P-AML WRSF	m^3	1,798	1,798	12,000
NEW BERMINGHAM				
Yards/Portal/Laydown Areas	ha	3.0	3.0	3.0
N-AML WRDA	tonnes	70,000	190,000	190,000
N-AML WRDA	ha	0.68	0.68	0.68
P-AML WRSF	tonnes	3,424	12,000	12,000
P-AML WRSF	ha	0.19	0.19	0.32
P-AML WRSF	m^3	1,268	5,286	5,286
ROADS AND OTHER				
Camp Accommodations	ha	2.2	2.2	2.2
Sludge Volume	m^3	250	250	350
BK Haul Road length	metres	5,661	5,661	5,661
Christal Lake Road	metres	1,299	1,299	1,299
Onek Connector	metres	2,060	2,060	2,060
Bermingham Access Road	metres	1,979	1,979	1,979
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	ha	0	0	0
P-AML WRSF	tonnes	0	0	0
P-AML WRSF	m^3	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
P-AML WRSF	tonnes	0	0	0
P-AML WRSF	ha	0	0	0
P-AML WRSF	m^3	0	0	0

8.2 UNDERGROUND WORKINGS AND OPENINGS TO SURFACE

This RCP address the mine workings as listed in Table 8-2.

Table 8-2: 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/Secondary Escape	Flame & Moth Vent Raise/Secondary Escape	New Bermingham Vent Raise/Secondary Escape		
Bellekeno 200 Vent Raise				

8.2.1 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 the mine pool.
3) Minimize safety risks to people and wildlife (control or prevent access).
4) Reclaim the site to an aesthetically acceptable level.

8.2.2 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 underground, please note this step has been completed.
2) Backfill any remaining P-AML waste rock on surface to underground, please note this step has been completed.
3) Remove/salvage underground assets and equipment, please note this step has been completed.
4) Remove/salvage surface facilities and infrastructure.
5) Remove any hazardous materials, please note this has been completed.
6) Install mine pool treatment infrastructure, please note this step has been completed.
7) Install rock pile portal cover 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 existing 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 8.5.2.

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.

8.2.2.1 ***Bellekeno East Portal***

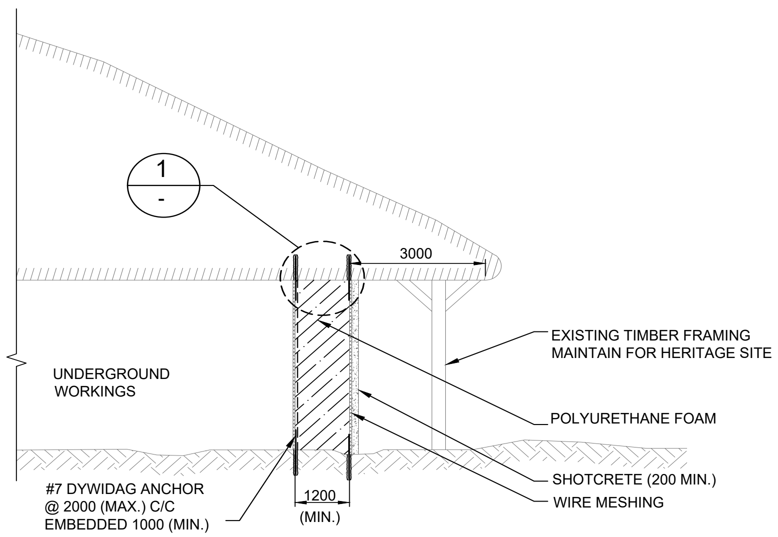
The Bellekeno East adit opening is planned to be blocked by inserting rock fill to protect human health and safety and prevent wildlife access (Figure 8-1). This method, in use at other northern Canadian mines, allows for movement of water and air through the opening, as well as allowing for any movement 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

8.2.2.2 ***Bellekeno 625 Adit***

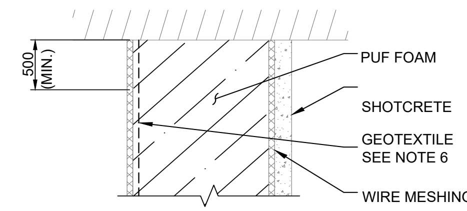
A stainless steel grate will be installed at the adit entrance to restrict access by humans or wildlife. A padlocked door within the grate will allow for access to the coffer dam for closure monitoring and maintenance as needed.

8.2.2.3 ***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 an engineered polyurethan foam (PUF) cap similar to what is used at mines elsewhere in Canada. This plug will restrict physical entry and prevent air movement and possible ice plug formation at the adit. A design for a PUF cap is included in Figure 8-2.

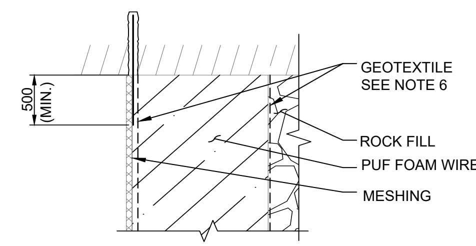


TYPICAL ADIT CLOSURE TYPE 1



1 - DETAIL 1

1:40
SEE NOTE 7 FOR
CONSTRUCTION SEQUENCE



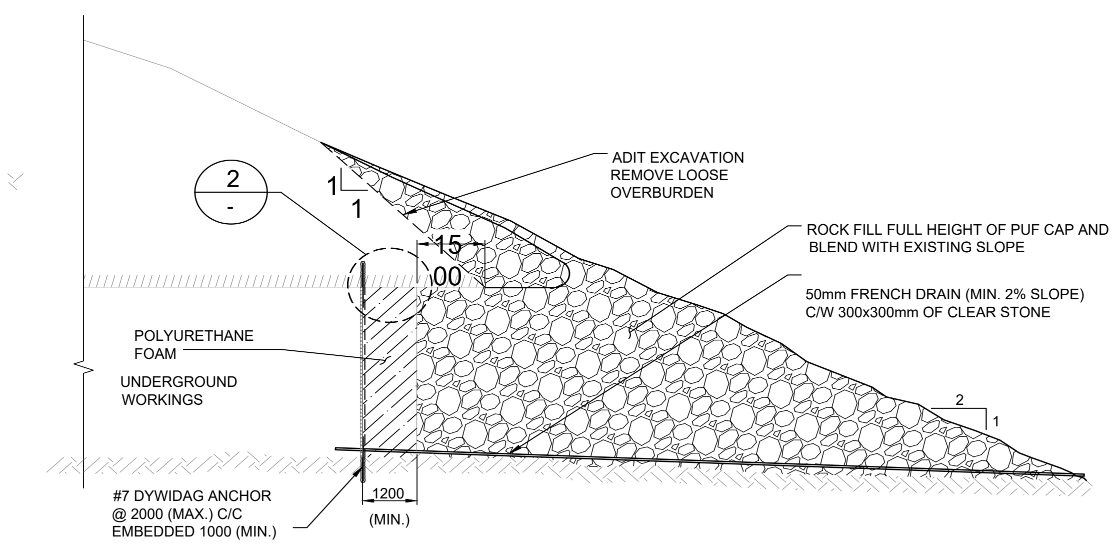
2 - DETAIL 2

SEE NOTE 8 FOR
CONSTRUCTION SEQUENCE

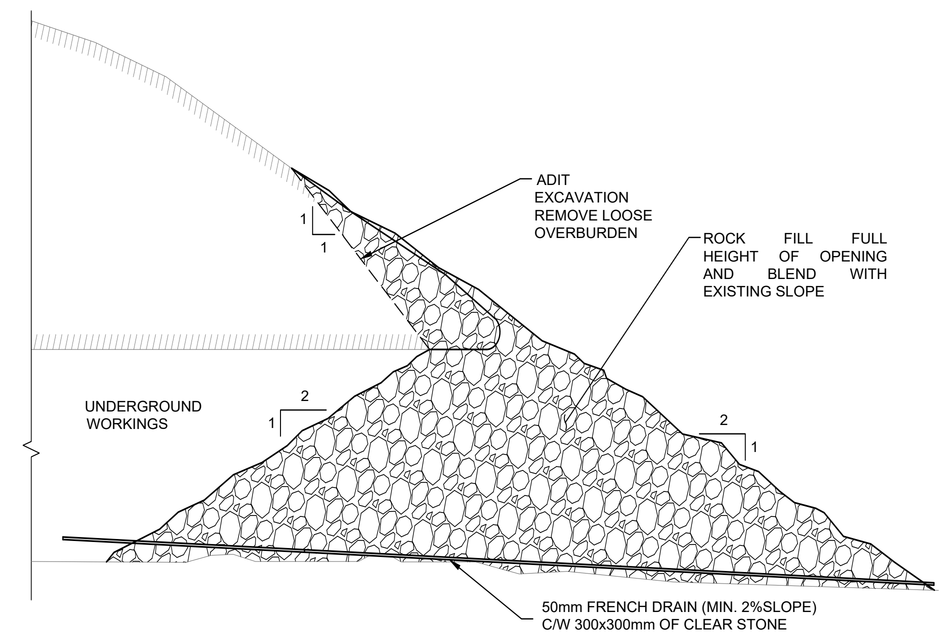
NOTES:

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

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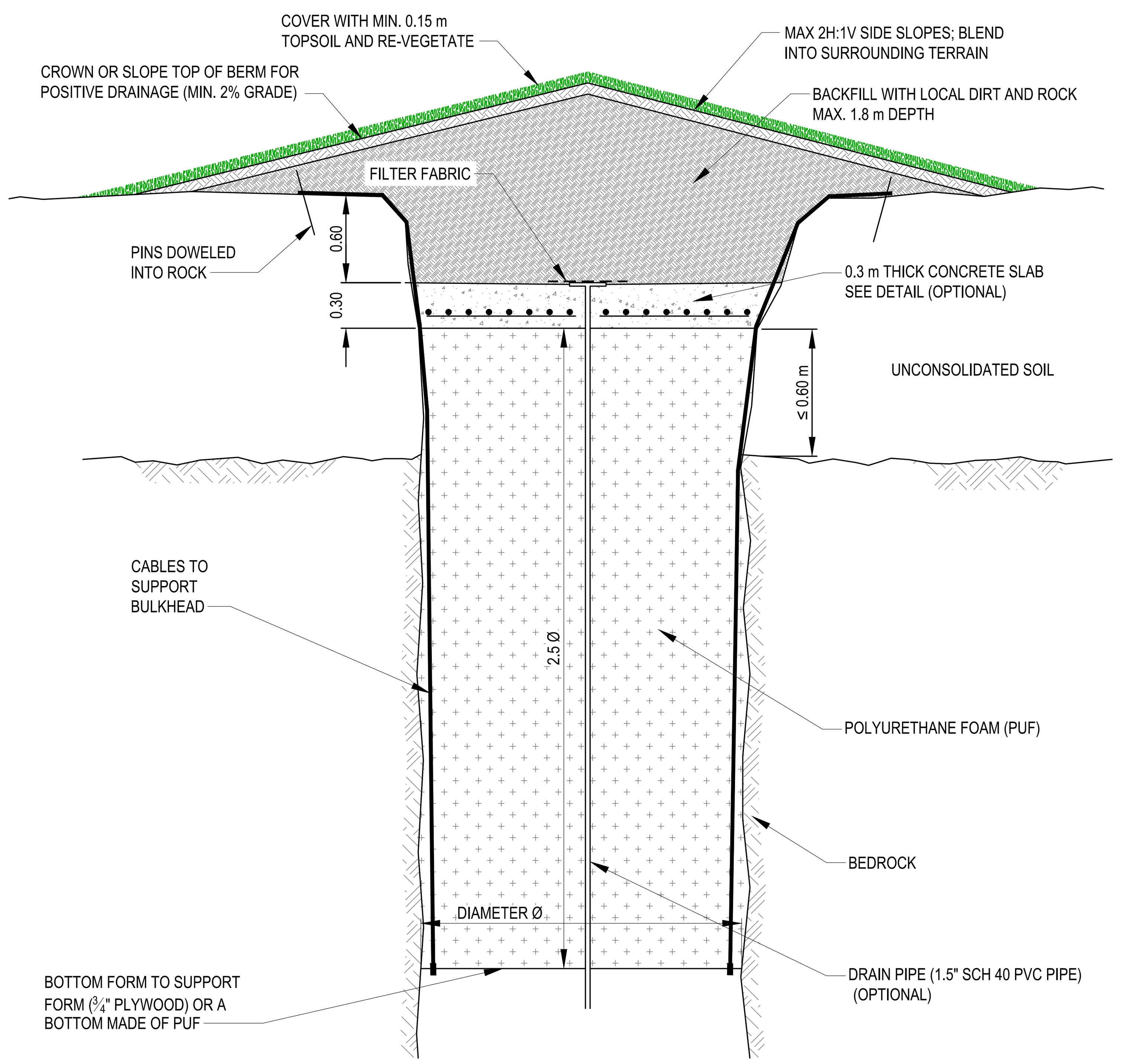
HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

AKHM-13-01-S-0301

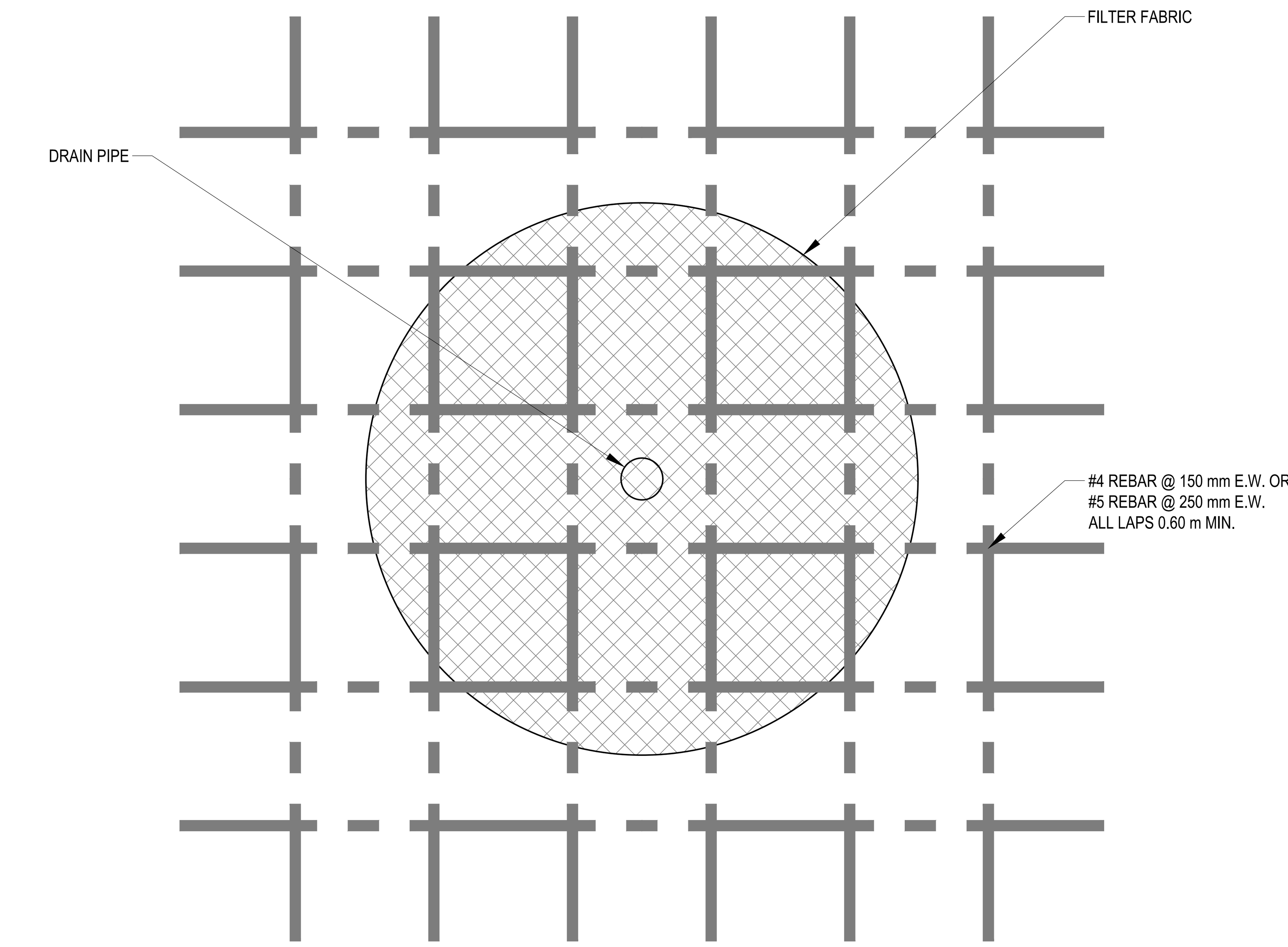
Figure 8-1
Portal Closure
Typical Adit Closure Design

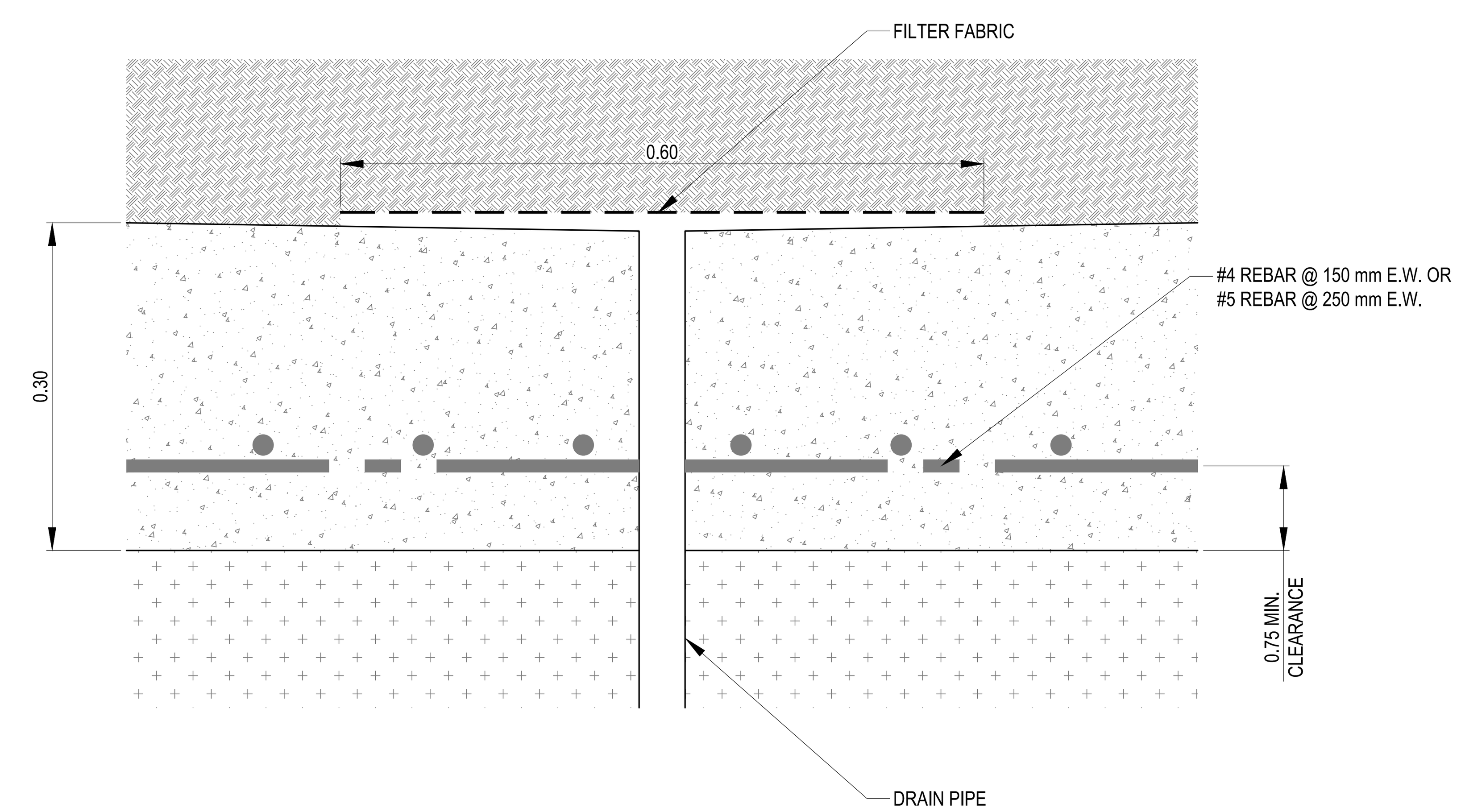
REVISION: 0A	2021-04-23	PROJECT No.: AKHM-13-01
DRAWN BY: Tetra Tech EBA	DESIGNED BY: Tetra Tech EBA	REVIEWED BY: KSW



SHAFT PUF WITH CONCRETE SLAB CLOSURE

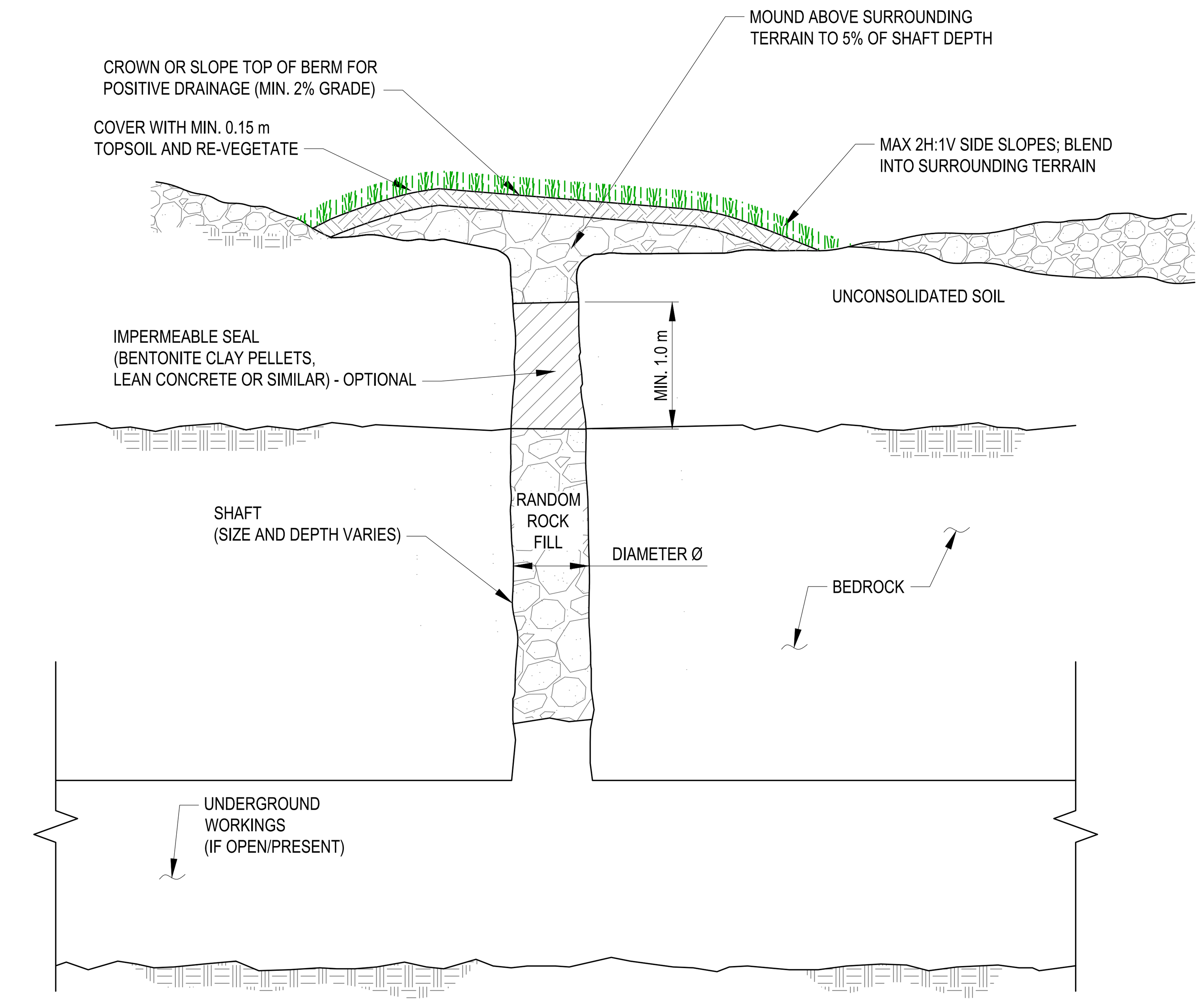
NOT TO SCALE





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. 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.

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 1/4 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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2018-02-05	Draft for review	A	TT	--

HECLA YUKON

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Figure 8-2

Shaft/Raise to Surface Typical Concrete, PUF and Backfilled Caps

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

8.2.3 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) install polyurethane foam (PUF) or concrete cap on vent raise, and
7) install rock pile portal cover.

During operations, the Flame & Moth mine is expected to produce up to 35 L/s at the deepest level of the mine. 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.

8.2.4 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 PUF or concrete cap on vent raise; and
8) Install rock pile portal cover.

During operations, the Bermingham mine is expected to produce up to 13.9 L/s at the deepest level of the mine. 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 PUF plug and then laying rockfill in front of it. A french drain would penetrate through the rockfill or PUF plug to ensure drainage (Figure 8-1 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. AKHM has a permitted commercial solid waste facility located in Elsa. 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.

8.2.5 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 predominantly 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.

8.2.6 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 8-1) 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.

8.3 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 8-3.

The closure objectives for the DSTF are to:

1) Ensure physical and geochemical stability of the DSTF;
2) Minimize erosion;
3) Effectively manage runoff;
4) Reduce water infiltration into the DSTF;
5) Minimize safety risks to people and wildlife; and
6) Reclaim the site to an aesthetically acceptable level.

8.3.1 DSTF Geochemical Performance

Geochemical characterization of the tailings is being conducted as part of the Tailings Characterization Plan which was submitted in October 2020 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. Additional static and kinetic testing data for tailings produced from the District Mill are expected in 2024.

8.3.2 DSTF Soil Cover

Closure measures for the DSTF are included in the final design report for the facility. Although the DSTF will be built in compacted 0.3 – 0.6 m lifts to limit water penetration, closure measures will include covering the recontoured stack with a 0.25 m thick soil cover consisting of sandy loam growth media and granular material that is locally stored in stockpiles. The cover will limit water migration through the stack. The DSTF has been progressively reclaimed in 2 phases. The first phase of reclamation was completed in June 2012 and included the western slope of the DSTF with recontouring to a 3:1 slope, placement of a 0.25 – 0.5 m cover and seeding/fertilization. Photo 6-1 shows the reclamation underway on the DSTF during June 2012. The second phase of progressive reclamation was completed in August 2013 (Photo 6-2) and included recontouring the western slope of the upper bench and north and south slopes, placement of a 0.25 m cover and seeding/fertilization. A photo from the DSTF from September 2016 is presented in Photo 6-3. A summary report on the progressive reclamation on the DSTF completed in 2012 is included in Appendix 1.1.

The evapo-transpirative cover is placed progressively as areas of the DSTF fill. This cover serves as a growth medium for revegetation. When the ultimate capacity of the DSTF is reached, closure and decommissioning will include finishing placement of the evapo-transpirative cover, recontouring the slope as necessary, and ensuring that revegetation is occurring as designed. A similar evapotranspiration cover was constructed at the Brewery Creek Mine both on the heap leach pad (0.25 m cover) and a waste rock storage dump (0.5 m cover). The actual performance results of the Brewery Creek covers indicate precipitation infiltration rates between 7% – 22% with the variation related to differences in cover thickness and topography. Given the performance of the Brewery Creek covers over a seven-year period, the similarities in soil properties and climate conditions and the highly compacted nature of the DSTF, the reclamation measures proposed for the DSTF are expected to result in <10% infiltration through the DSTF. The climate conditions at Brewery Creek are very similar to the Keno Hill Silver District and the actual performance results of the Brewery Creek cover are a supporting reference to the expected performance results on the DSTF.

The DSTF cover performance to date has shown no seepage from the toe of the dry stack facilities. Additionally, groundwater well BH39 located in the dry stack tailings facility remains dry since installation. Runoff during snow melt and runoff from large rain events is captured and conveyed to the mill pond showing the cover is shedding water. These site data and observations support the reclamation plan. The conversion of the existing pond near the mill into a bioreactor provides the contingency for future changes in conditions or performance.

8.3.1 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 Section 9.4 Surface Water Conveyance Structures to Table 9-9 of the Closure Costs to accommodate construction of the 1:500 diversion channel on the DSTF. Total surface area disturbance, including sideslopes, for the proposed channel is 0.12 hectares (7.71 w x 150 l = 1,156.2 m^2; 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. A CAT 235 or similar excavator 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 CAT D7 dozer or similar.

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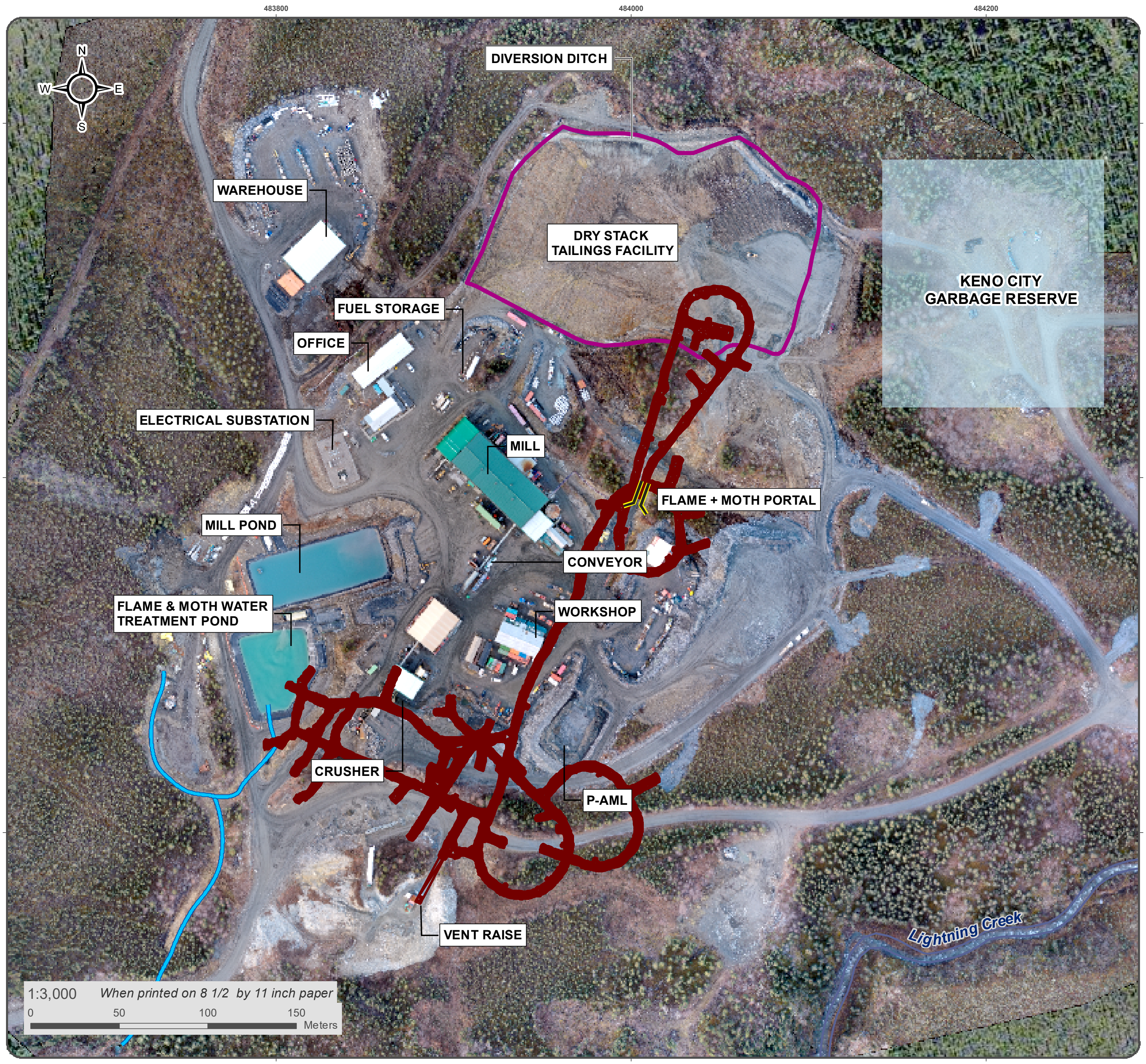
FIGURE 8-3

DRY STACK TAILINGS FACILITY LAYOUT CURRENT CONDITIONS

OCTOBER 2023



Adit

Current DSTF

Land Disposition

Underground Workings, As-Built End of 2022

Pipeline

Aerial Imagery aquired on August, 2022.

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

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Hecla YUKON

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(Last edited by: amatiashevska;2023-10-02/10:02 AM)

AKHM has proposed a reclamation and revegetation program that meets the EMR technical guidelines for erosion control and revegetation. The Yukon Mine Site and Reclamation Closure Policy includes establishment of stable slopes that prevent surface erosion and are conducive to successful re-vegetation by native plant species or other species adaptable to that environment (EMR, 2008).

Appendix 1.1 provides soil properties and nutrient analysis for the DSTF cover material. To maximize the efficacy of the cover, an engineering evaluation of the constructed 0.25 m cover will be carried out using information collected at the site as a part of the environmental monitoring programs designed by AKHM and prescribed in Water Licence QZ18-044. This includes hydrologic information available for the site, as well as precipitation and snowpack data, together with laboratory soil properties and in-situ measurements of the hydraulic conductivity for the DSTF and identified cover material.

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.

8.4 WASTE ROCK 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.

8.4.1 Bellekeno Waste Rock Storage Facilities and Disposal Areas

*8.4.1.1 **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.

*8.4.1.2 **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.

8.4.1.3 ***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.

8.4.2 Flame & Moth Waste Rock Storage Facilities and Disposal Areas

8.4.2.1 ***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.

8.4.2.2 ***Flame & Moth N-AML Waste Rock Storage Facilities***

It is unlikely that any material will remain at N-AML WRDA at final closure as this material is needed for construction, maintenance and backfill. Should a stockpile of N-AML waste rock remain, it will be regraded to inhibit ponding water.

8.4.3 Bermingham Waste Rock Storage Facilities and Disposal Areas

8.4.3.1 ***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-MAL 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.

8.4.3.2 ***New Bermingham N-AML Waste Rock Disposal Area***

Waste rock remaining in the N-AML WRDA at closure will be regraded as described in Drawings B-5101 and B-5301, located in Appendix 3.1.

8.4.3.3 ***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.

8.4.1 Lucky Queen Waste Rock Storage Facilities and Disposal Areas

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

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

8.4.1.2 N-AML Waste Rock Disposal Area

The existing disturbance at Lucky Queen N-AML WRDA will be recontoured by pulling the crests back with an excavator 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.

8.4.1.3 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.

8.4.2 Onek 990 Waste Rock Storage Facility and Disposal Areas

8.4.2.1 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 and stored from development of the Onek decline. 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.

8.4.2.2 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.

8.4.2.3 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.

8.5 WATER MANAGEMENT STRUCTURES AND SYSTEMS

8.5.1 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 8-3.

Table 8-3: Mine Water Management Summary

MINE	UNITS
Bellekeno East	No water discharges from Bellekeno East Rock fill in front of adit
Bellekeno 625	Mine floods and discharges 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	Mine floods and reaches pre-mining static groundwater elevation (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	Mine floods and assumed to 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 or PUF plug in front of adit

8.5.2 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.

8.5.3 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 Figure 8-5. 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 design for the coffer dam is shown in Figure 8-5 (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. A process and instrumentation diagram for this system is included in Figure 8-4. Evidentiary information to support the expected success of the in mine pool treatment of Bellekeno 625 is included in Appendices 1.2 and 1.3 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 8-6) 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 1.2 and 1.3.

A comparison of total cadmium and zinc concentrations in the untreated mine water discharge from Bellekeno and Silver King is presented in Table 8-4. 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:

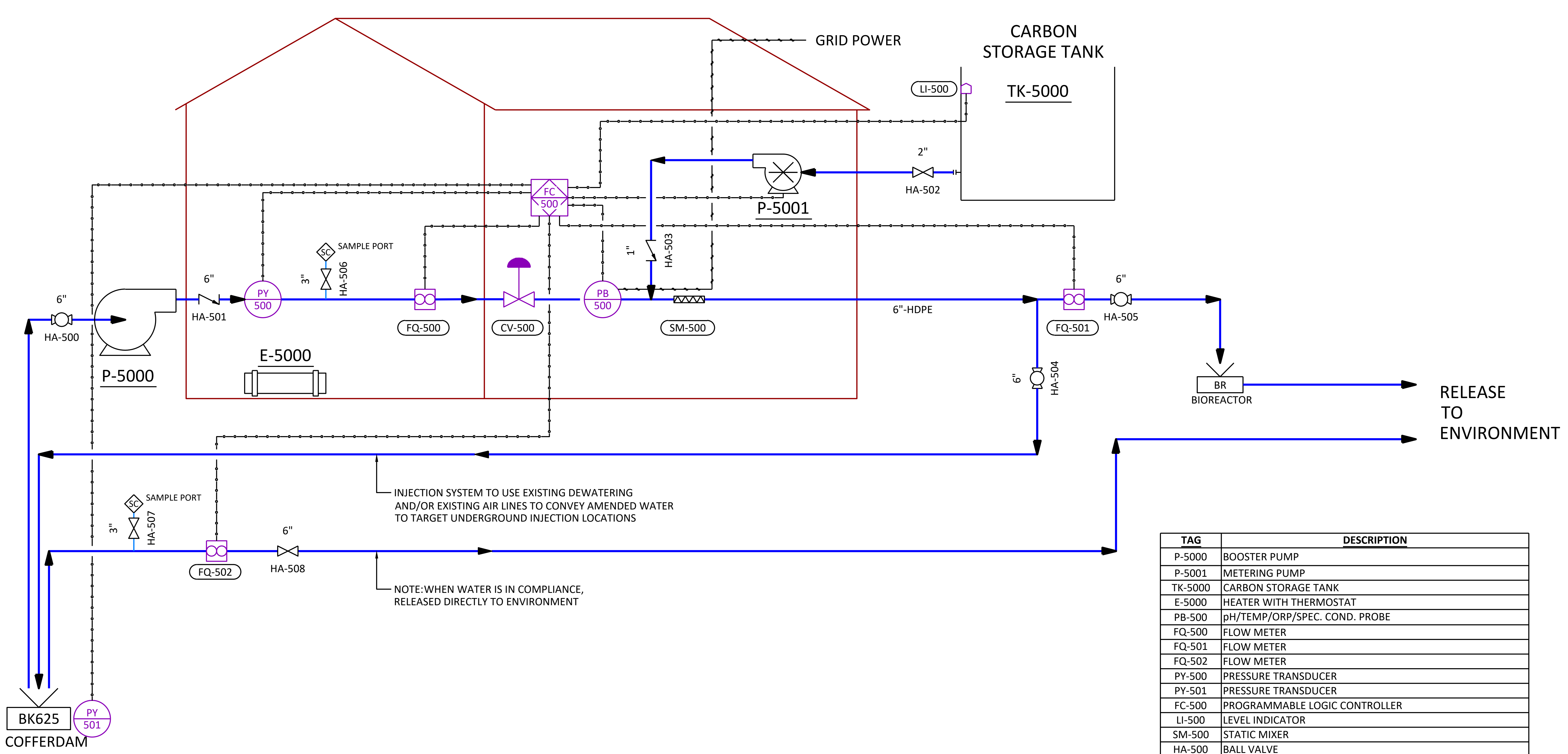
- Longer hydraulic residence time available in the Bellekeno mine workings (200 days; Appendix 3.6) compared with Silver King (81 days; AEG, 2021) under average flow conditions, thus allowing for greater treatment to occur along the mine water flow path;
- Successful *in situ* treatment of similarly 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 8-4: 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 3.6. 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 3.6; 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.



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

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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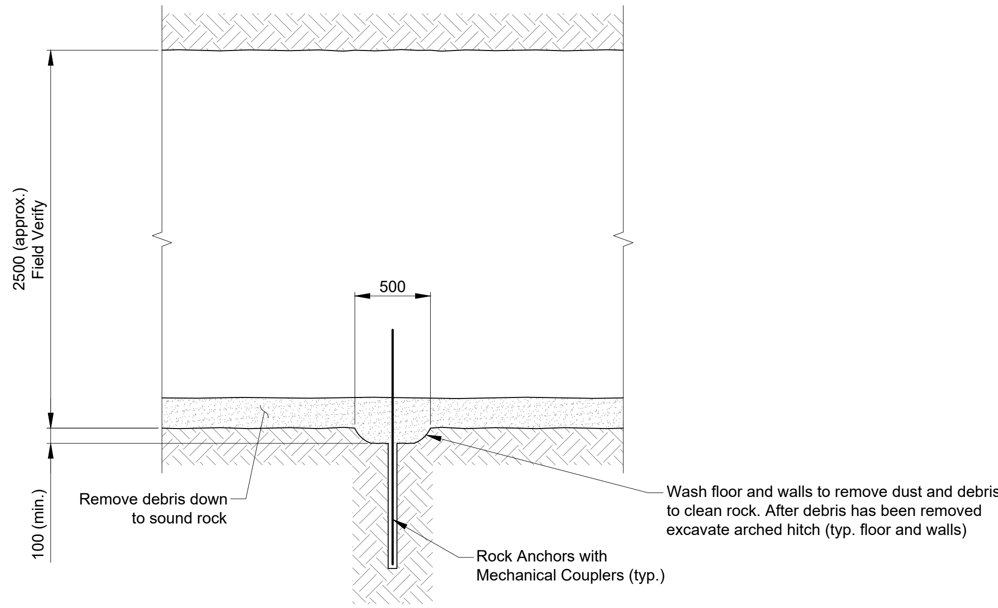
Reclamation and Closure Plan

Drawing No.: AKHM-13-01-D2601

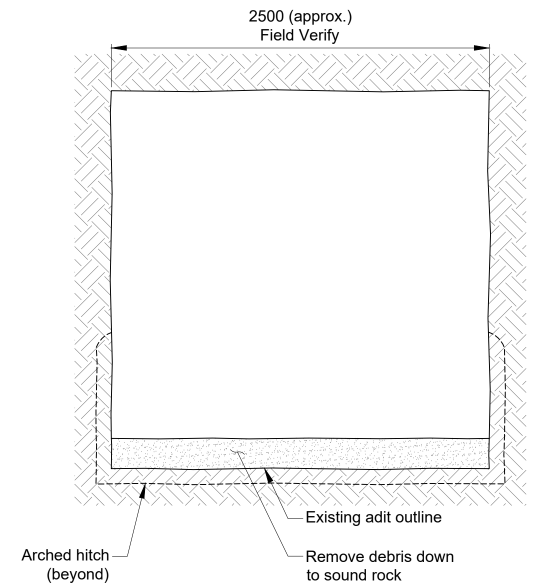
Figure 8-4

Bellekeno 625 In Situ Treatment Process Flow and Instrumentation Diagram

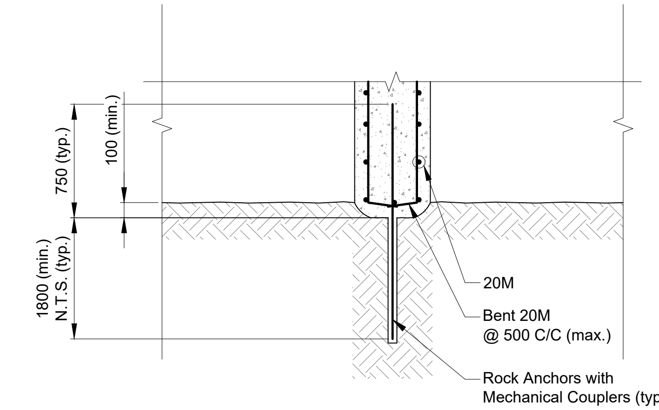
REVISION B	2021-11-25	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: EJL	REVIEWED BY: JMH



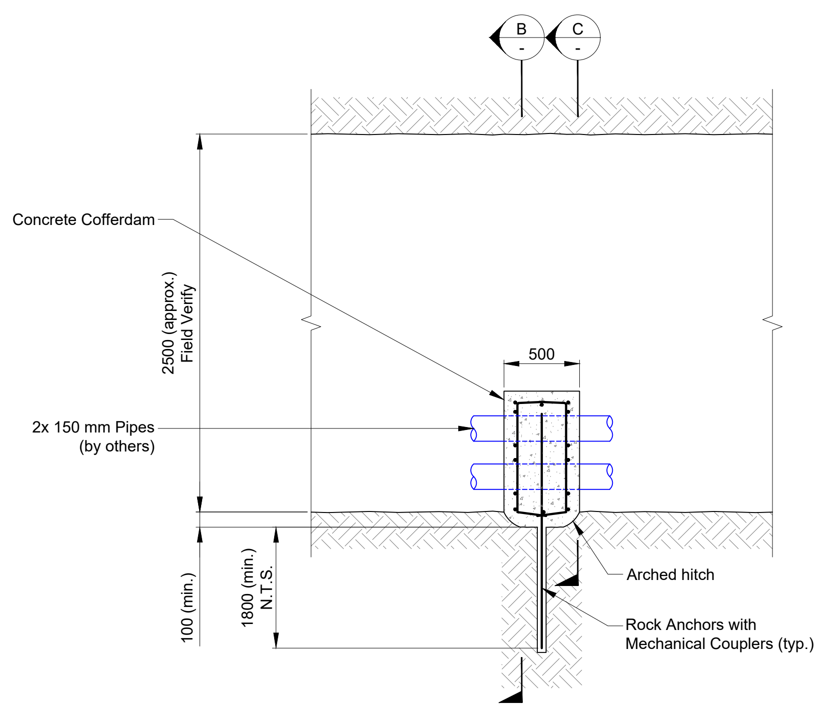
1 COFFERDAM PREPARATION - LONGITUDINAL SECTION
Scale: 1:50



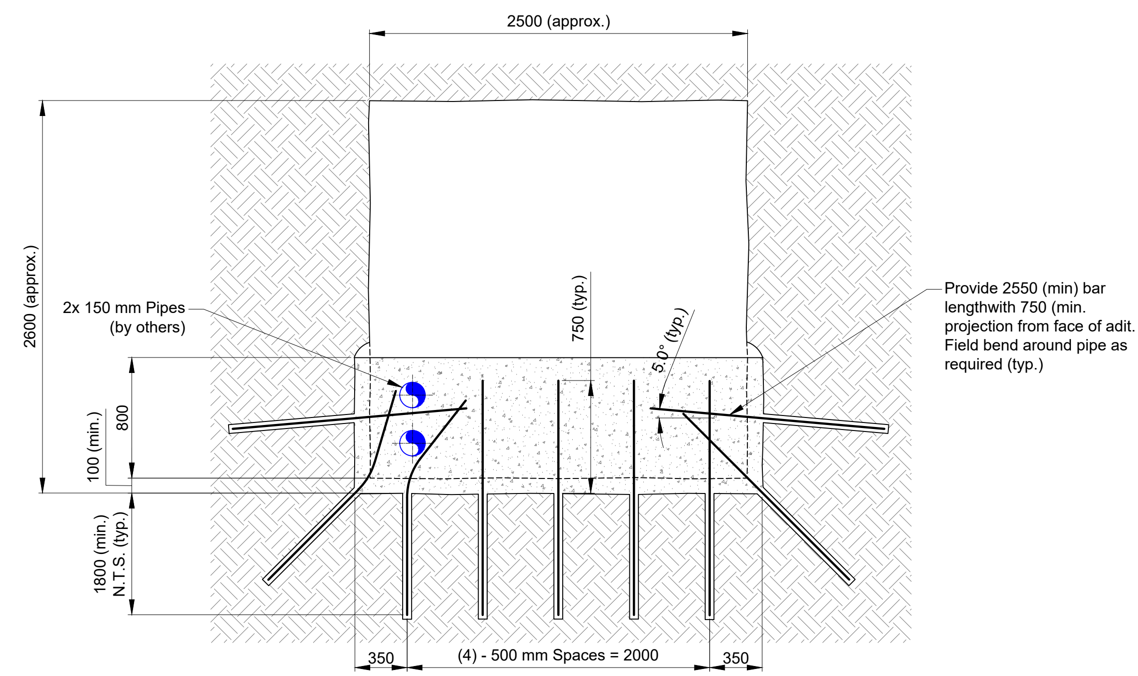
A ADIT CROSS SECTION
Scale: 1:50
*Rock anchors not shown for clarity



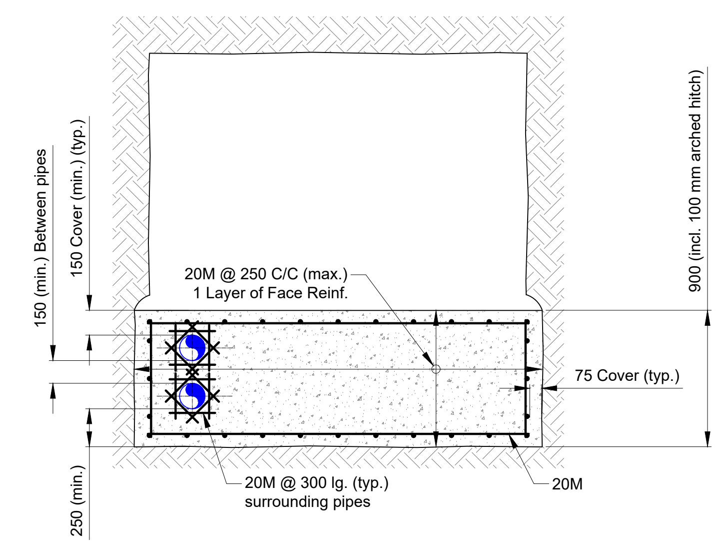
3 ARCHED HITCH DETAIL (TYP. ALL SIDES)
Scale: 1:50



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

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2021-11-18	Draft for review	A	KAB	--

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NOT FOR
CONSTRUCTION

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Keno District Mine Operations Reclamation and Closure Plan

Drawing No: AKHM-13-01-S-0302

FIGURE 8-5

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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Figure 8-5: Sections and Details Concrete Cofferdam Adit Closure

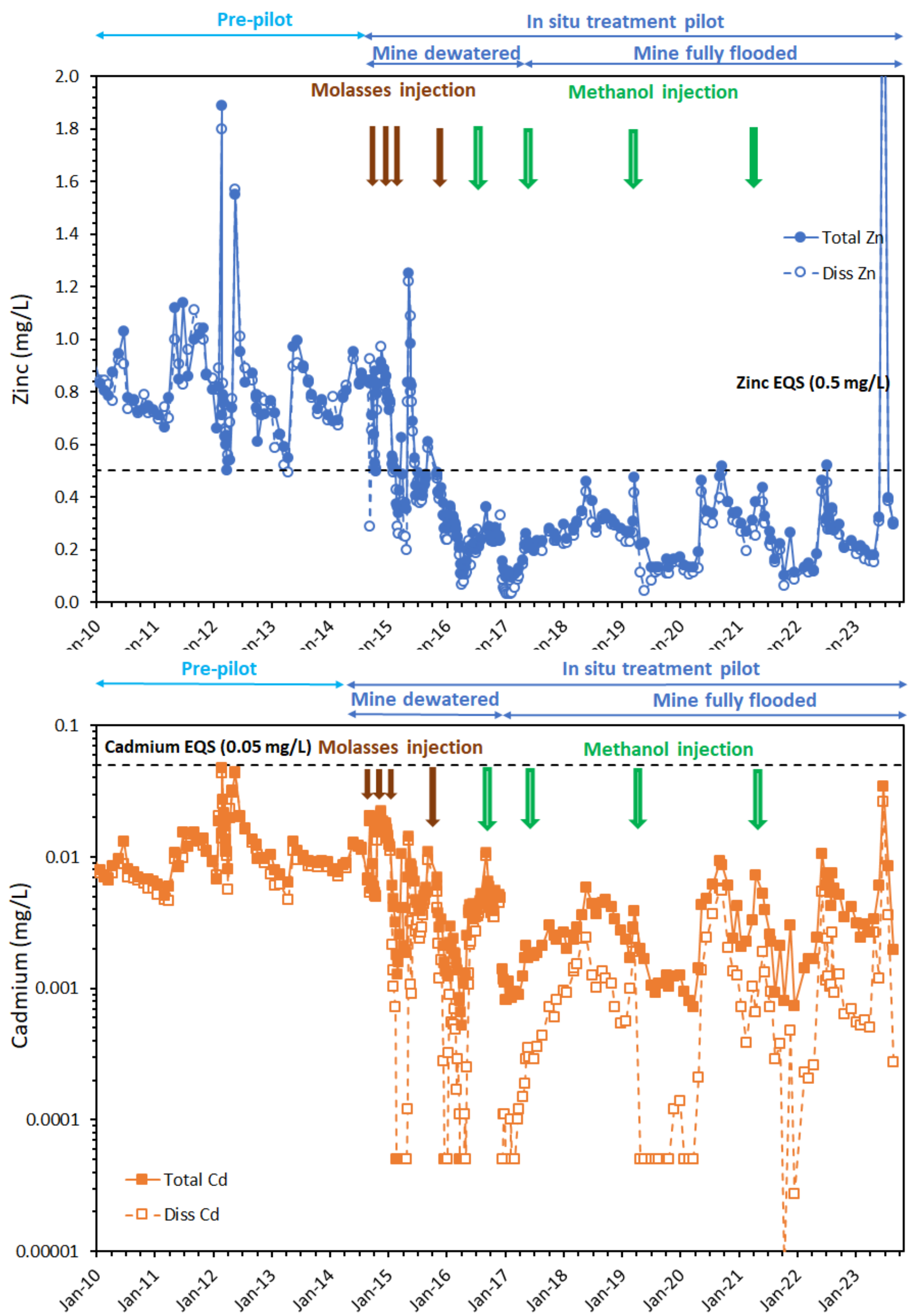


Figure 8-6: Total and Dissolved Cadmium and Zinc Concentrations in Water Discharged from the Silver King Mine Before and During *In Situ* Treatment Pilot Test

*8.5.3.1 **Bellekeno 625 Existing Water Treatment Plant***

The Bellekeno 625 Water Treatment Plant (WTP) (Photo 8-1) 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 8-1: Bellekeno 625 WTP Area Overview

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

A minimum of 10 cm of soil from below the Bellekeno sludge dewatering area with be removed and disposed of underground, and area recontoured.

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.

*8.5.3.2 **Bellekeno 625 Bioreactor***

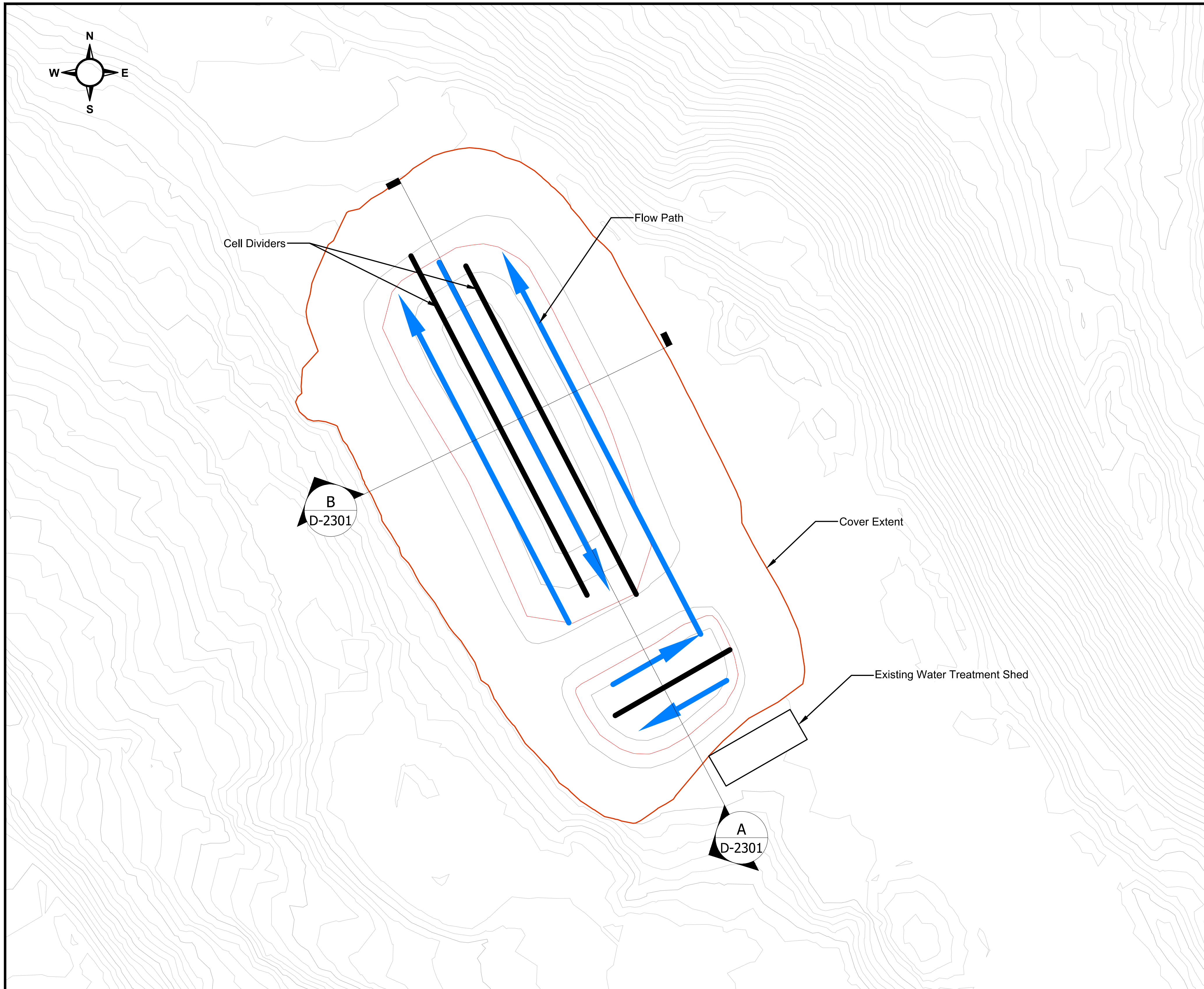
A preliminary design of the bioreactor at Bellekeno 625 is shown in Figure 8-7 and Figure 8-8.

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 8-5. 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 1.3 as support for this approach in closure of the Bellekeno mine.



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

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-02-01	Draft for review	A	KAB	--

Hecla YUKON

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS
Reclamation and Closure Plan
Drawing No: AKHM-13-01-D-2102

Figure 8-7

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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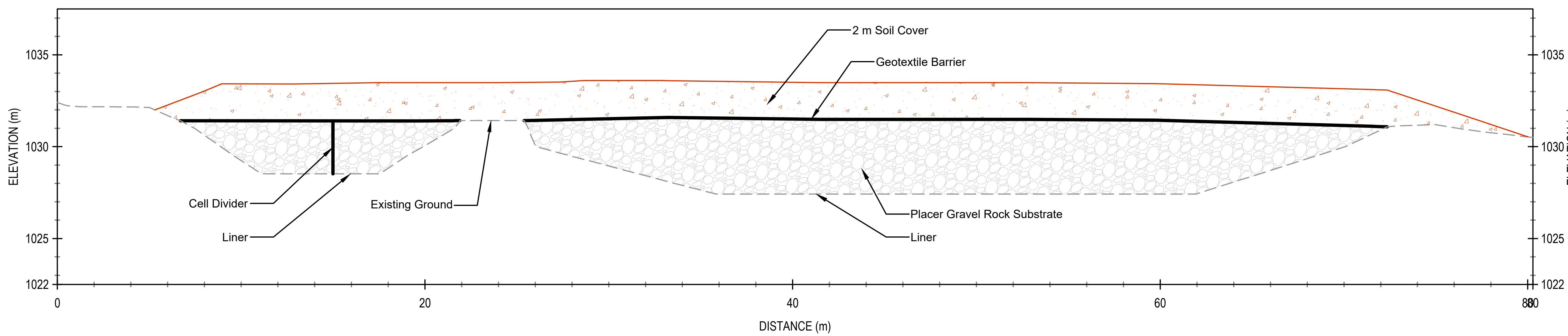
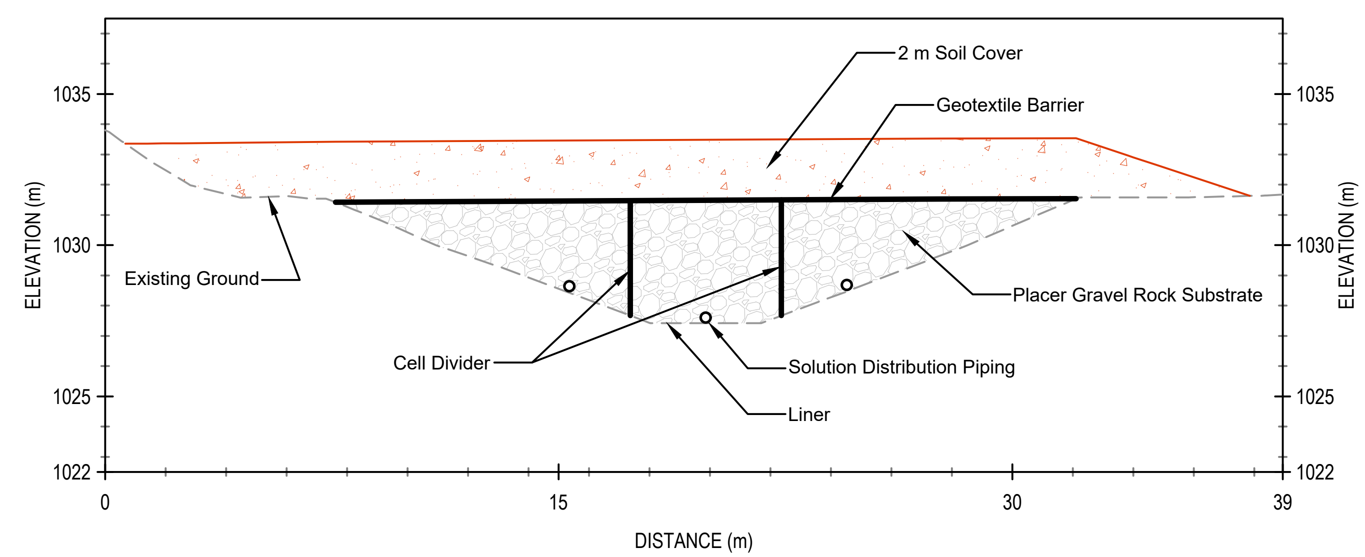


Section A



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 8-8
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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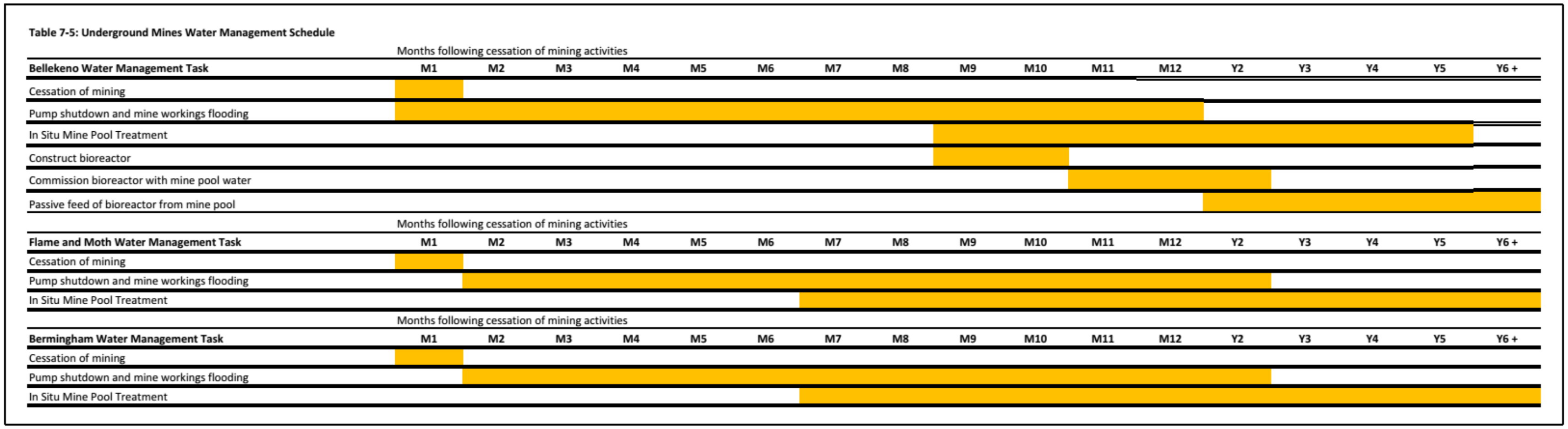
Table 8-5: Underground Mines Water Management Schedule



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8.5.4 Flame & Moth

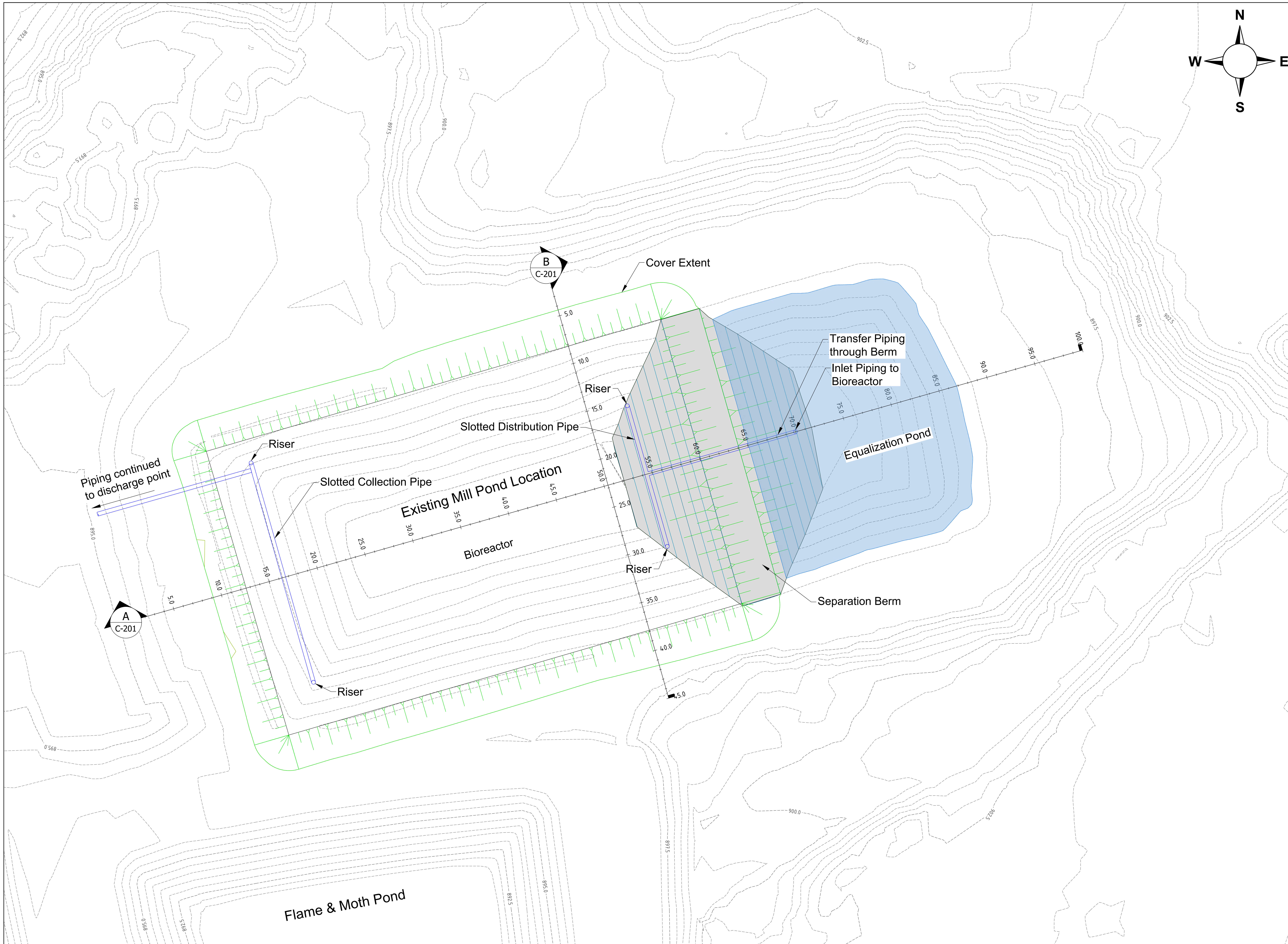
8.5.4.1 ***Flame & Moth Pond***

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.

8.5.4.2 ***Mill Pond***

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 with a total design capacity of 3,500 m^3.

Since the mill process pond was excavated and not constructed with an engineered fill embankment there is no long term stability concern that needs to be addressed at closure. Closure of the pond consists of removing and burying the HDPE liner, scarification of the side slopes and revegetation. An overflow spillway will be constructed at closure to allow the pond to serve as a sedimentation pond during closure. It would capture surface water, if necessary, until revegetation is stabilized. Although not a component of the closure for the mill area, the pond could also serve as a bioreactor facility if the DSTF produces seepage requiring treatment. 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. Further details of the conceptual design of the mill pond bioreactor can been seen in Figure 8-9 and Figure 8-10.



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

0 5 10 20 Meters

Rev.	Description	Date
A	Draft for review	2023-11-02

Revision History

Engineer's Seal

	Name	Date
Design	K. Boldt	2023-10-06
Drawn	K. Boldt	2023-11-02
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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Figure 8-9

#3 Calcite Business Centre, 151 Industrial Road Whitehorse, YT Y1A 2V3

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

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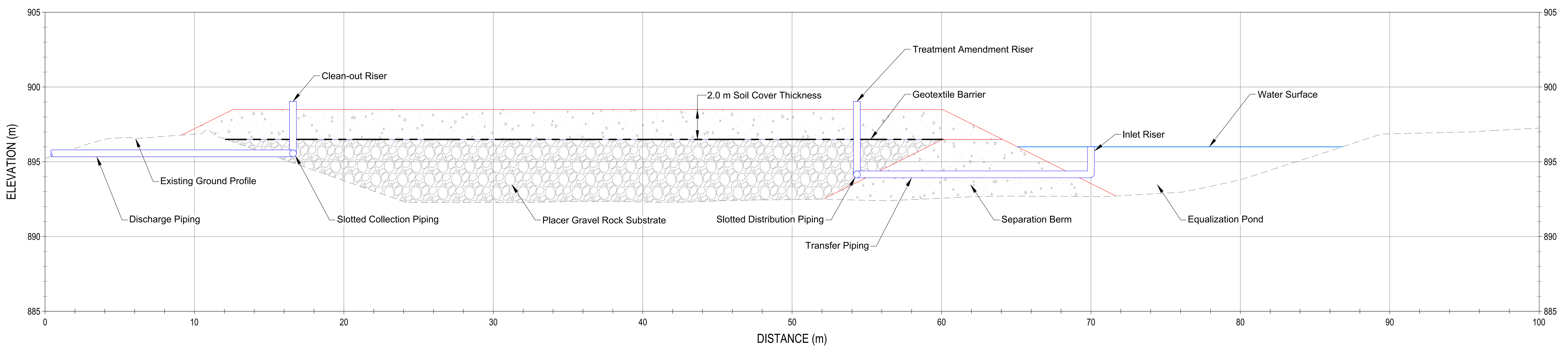
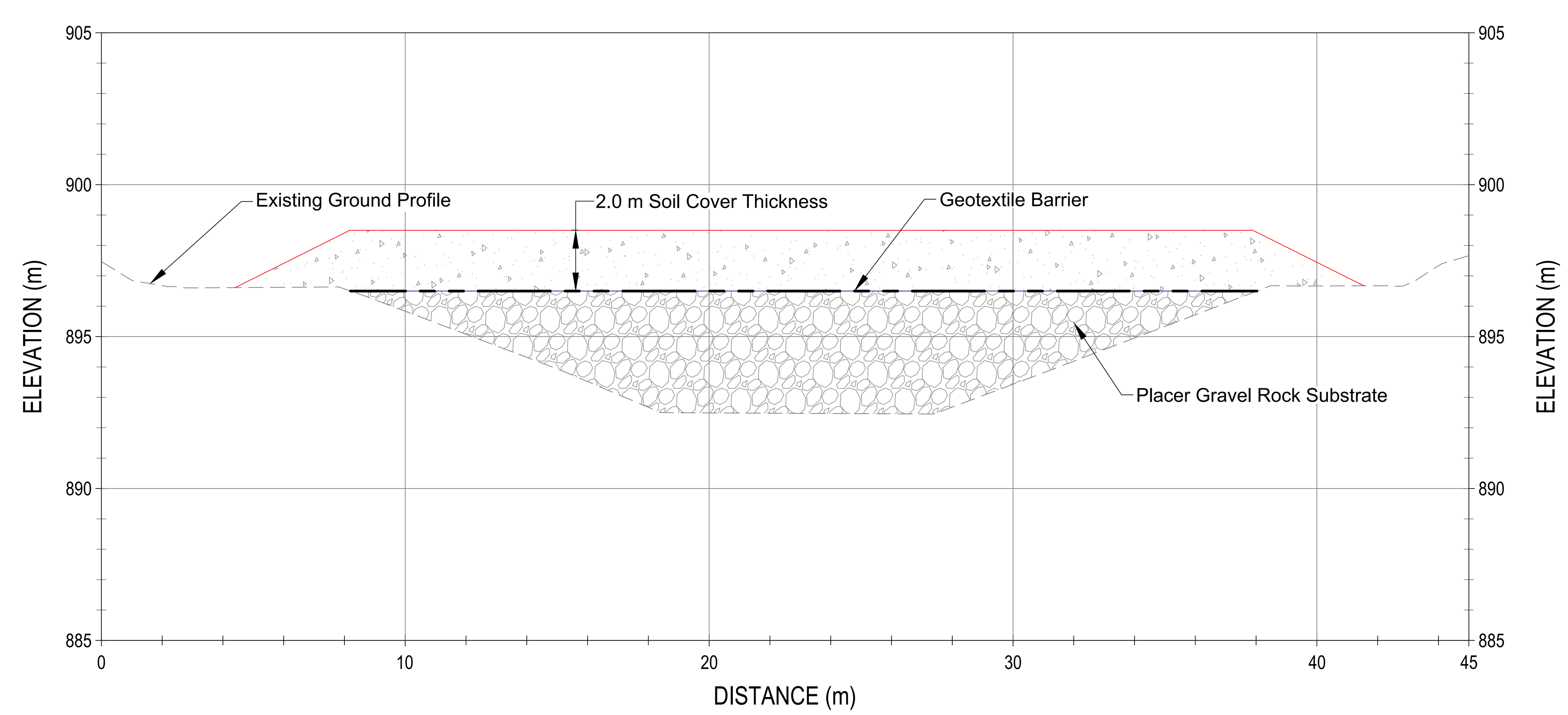


Section A



Section B

Revision History		
A	Draft for review	2023-11-02
Rev.	Description	Date

Engineer's Seal

DRAFT
NOT FOR
CONSTRUCTION

	Name	Date
Design	K. Boldt	2023-10-06
Drawn	K. Boldt	2023-11-02
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 - Section Views

Drawing Number

ECA23YT00340-C-201

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Figure 8-10

#3 Calcite Business Centre, 151 Industrial Road Whitehorse, YT Y1A 2V3

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

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8.5.5 New Bermingham

The mine will flood at closure due to its design of being accessed via a decline and will always remain flooded to the local groundwater table which is located approximately 20 vertical metres down the exploration decline. A N-AML rockfill or PUF 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 (up to 2.5 L/s) will infiltrate to ground.

At mine closure, the sludge disposed of in the Bermingham Southwest pit will be covered with waste rock and till material.

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 8-6. 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 8-6: 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

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 1.2 and 1.3), 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 3.6; 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. During the 2022 summer months, the flows from underground are on average about 1 L/s lower than the same period in 2021. The period noted by reviewers of July – November in 2021 averaged 6.3 L/s whereas July to October (to date) averages 5.3 L/s. These data will be compared and reported in the annual Water Licence report for the year. The extent of the mine workings at the time of closure will determine the location and requirement for carbon injection.

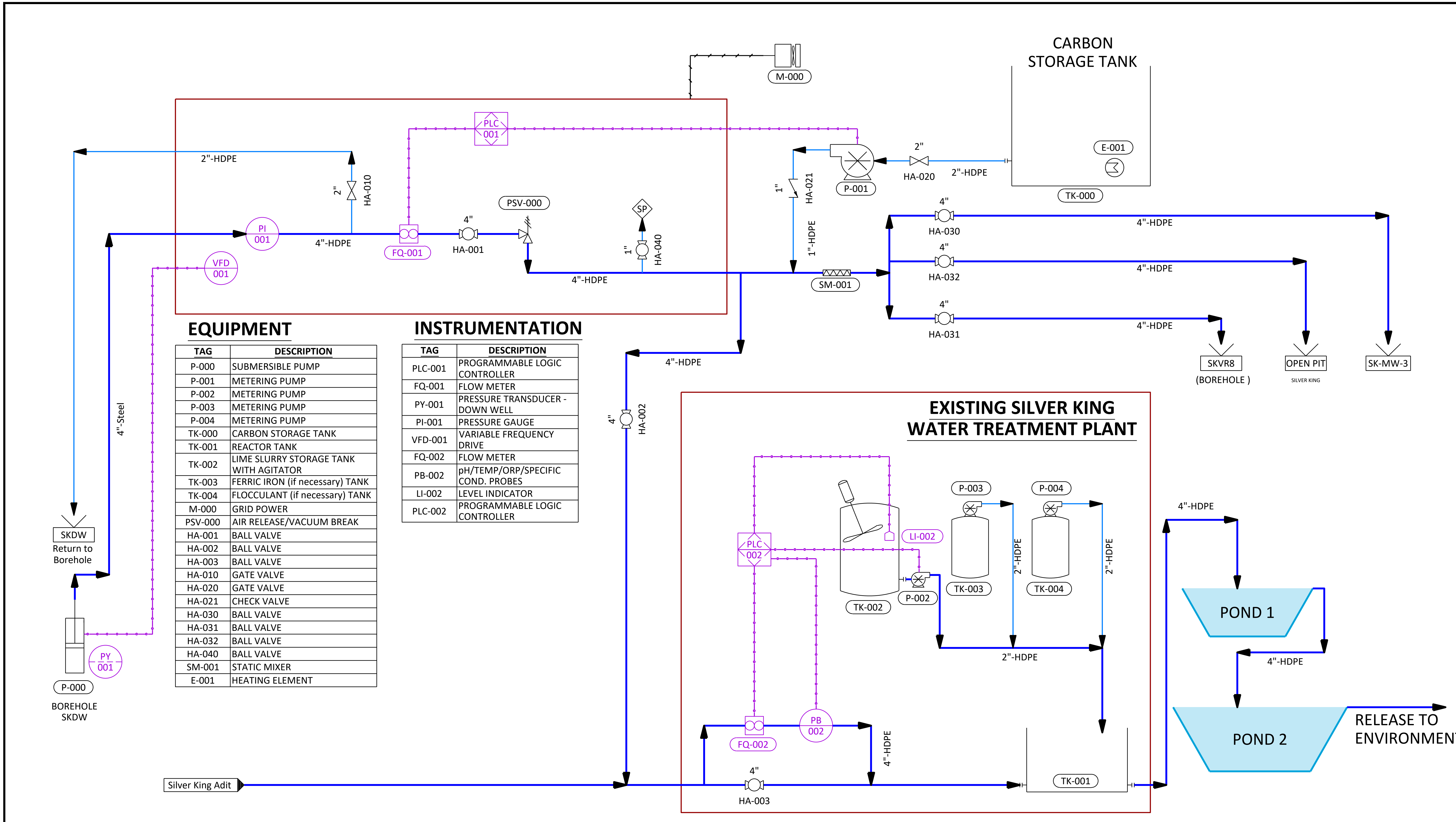
- The open (i.e., not backfilled) mine workings flooded volume at closure is approximately 46,000 m^3 as determined from MineSight. Based on the calculated post-closure, flooded workings portal discharge rate of 2.5 L/s, the hydraulic retention time on the mine workings is 213 days. This is an upper 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 8-6). *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 as-built is provided in Figure 8-11 and 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 3.6)



EQUIPMENT

TAG	DESCRIPTION
P-000	SUBMERSIBLE PUMP
P-001	METERING PUMP
P-002	METERING PUMP
P-003	METERING PUMP
P-004	METERING PUMP
TK-000	CARBON STORAGE TANK
TK-001	REACTOR TANK
TK-002	LIME SLURRY STORAGE TANK WITH AGITATOR
TK-003	FERRIC IRON (if necessary) TANK
TK-004	FLOCCULANT (if necessary) TANK
M-000	GRID POWER
PSV-000	AIR RELEASE/VACUUM BREAK
HA-001	BALL VALVE
HA-002	BALL VALVE
HA-003	BALL VALVE
HA-010	GATE VALVE
HA-020	GATE VALVE
HA-021	CHECK VALVE
HA-030	BALL VALVE
HA-031	BALL VALVE
HA-032	BALL VALVE
HA-040	BALL VALVE
SM-001	STATIC MIXER
E-001	HEATING ELEMENT

INSTRUMENTATION

TAG	DESCRIPTION
PLC-001	PROGRAMMABLE LOGIC CONTROLLER
FQ-001	FLOW METER
PY-001	PRESSURE TRANSDUCER - DOWN WELL
PI-001	PRESSURE GAUGE
VFD-001	VARIABLE FREQUENCY DRIVE
FQ-002	FLOW METER
PB-002	pH/TEMP/ORP/SPECIFIC COND. PROBES
LI-002	LEVEL INDICATOR
PLC-002	PROGRAMMABLE LOGIC CONTROLLER

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-11-28	Updated for pilot system	C	KAB	EJL
2017-03-22	Updated Borehole IDs	B	KAB	EJL
2015-07-16	Initial issue	A	KAB	EJL

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HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

UKHM-*In Situ*
ESM Reclamation Plan - *In Situ* Treatment Design Report
Figure 8-11

Silver King In Situ Treatment As Built

REVISION C	2018-11-28	PROJECT No.: 007-4
DRAWN BY: KAB	DESIGNED BY: EJL	REVIEWED BY: JMH

D:\Users\KBoldt\Projects\Keno\Production Drawings\UKHM-InSitu\PID DWG\SilverKing\0000-Silver King-Existing.dwg (last edited by: KBoldt; 2018/11/28 - 4:23 PM

8.5.1 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.

8.5.2 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.

8.6 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.

8.6.1 Bellekeno Surface Infrastructure

*8.6.1.1 **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.

*8.6.1.2 **Bellekeno 625 Adit Surface Facilities***

The primary facilities remaining in place at Bellekeno 625 are seen in Photo 8-2 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 8-2: Bellekeno 625 Surface Facilities – October 2023

8.6.2 Flame & Moth Surface Infrastructure

Infrastructure at the Flame & Moth Mine consists of a miners' office trailer and miners' dry facility, electrician shed, 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, 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 (e.g. explosives and cap magazine).

Additional details on closure activities in this area are described in Section 8.7.

8.6.3 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 8.9.

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.

8.6.1 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 8.9.

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.

8.6.2 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 8.9.

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.

8.7 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 8-12. The buildings at the District Mill site that require removal under the closure plan are listed in Table 8-7 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 8-7: 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				✓	
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 8-12: Aerial View of Mill Site Infrastructure and Layout

8.7.1 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.

8.7.1.1 ***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 8-3). In 2021 an expansion to the mill building was added between the mill and the assay lab to house the secondary grinder (Photo 8-4).

Photo 8-3: Mill Building

Photo 8-4: Assay Lab and Mill Extension

Closure measures for the mill building include 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.

*8.7.1.2 **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 8-4). 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.

8.7.1.3 ***Mill Office and Dry***

The mill office and dry facility is comprised of two skid mounted trailer units and one 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.

8.7.2 Crushing Plant

Coarse ore from the Flame & Moth and New Bermingham mines is transported to a crushing plant (Photo 8-5) 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.

Photo 8-5: Crushing Plant – November 2023

8.7.3 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 aluminium 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.

8.7.4 Motor Control Centres

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

8.7.5 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.

8.7.6 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.

8.7.7 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.

8.7.8 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.

8.7.1 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.

8.8 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 the development of Lucky Queen, Onek 990 and other deposits as well as 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.

8.9 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.

8.9.1 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 8-13 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.

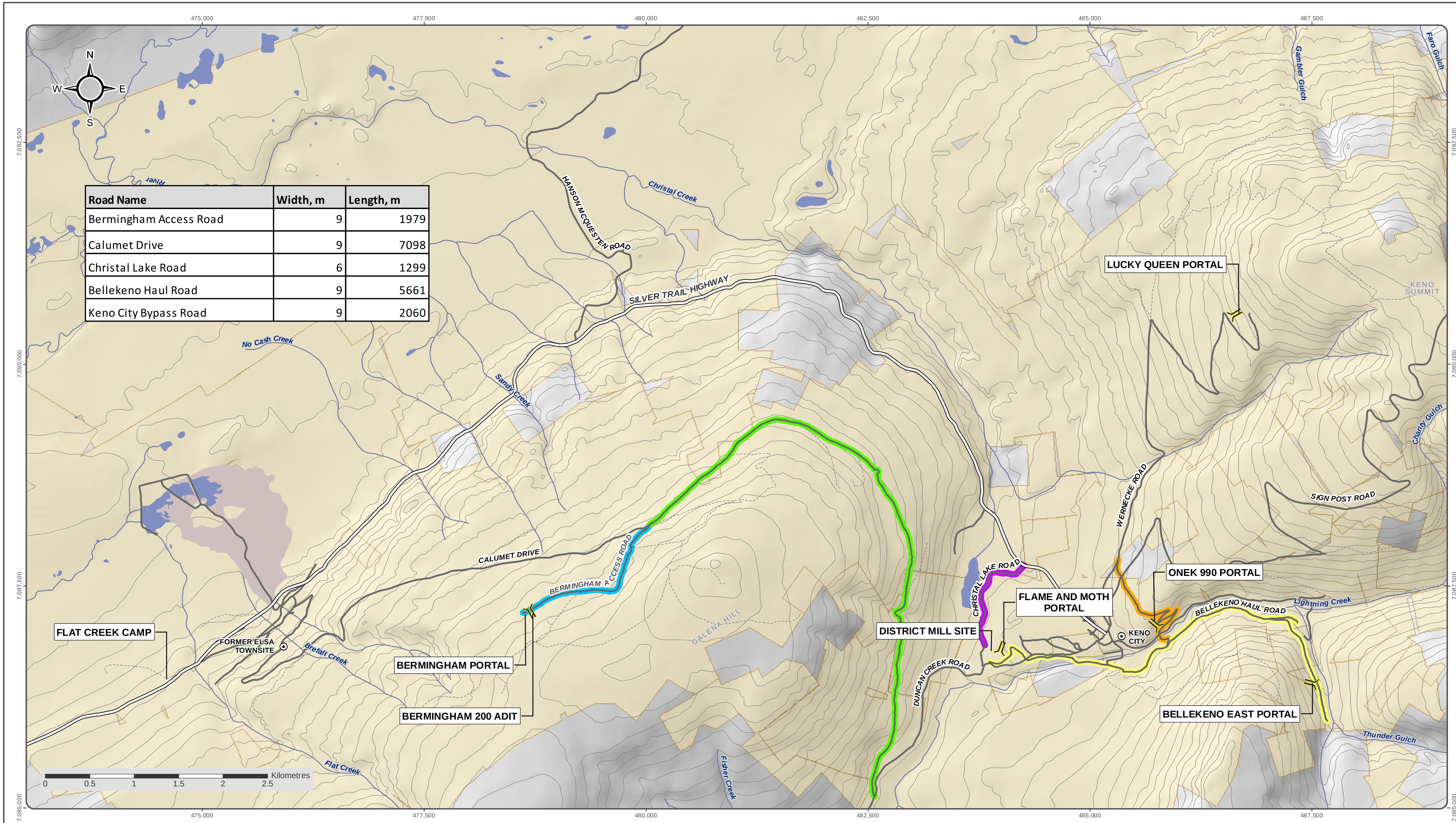
Decommissioning measures will involve removal of the two clear span bridges (and abutments) across Lightning Creek. The banks will be stabilized through revegetation and strategic placement of the existing rip rap.

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.

8.9.2 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.



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

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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

HECLA KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 8-13

ROADS SUBJECT TO STANDARD DECOMISSIONING AND RECLAMATION

OCTOBER 2023

8.10 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 8-14).

Figure 8-14: 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.

8.10.1 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.

8.10.2 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.

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.

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 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.

8.10.3 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 is the in-vessel composter being installed in Q4 2023. 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.

8.11 BORROW MATERIALS PLANNING

8.11.1 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.

8.11.2 Growth Media Sources

Overburden and organics material will be required as growth media for the cover systems. There is site dedicated for the storage of organic material at the District Mill area as shown on Figure 8-15. This material is used to for DSTF cover construction and reclamation purposes. The volume of growth media stored at the District Mill stockpile is approximately 10,000 m^3 as of Q4 2023. The amount of growth media in this stockpile 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 being installed in Q4 2023 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.

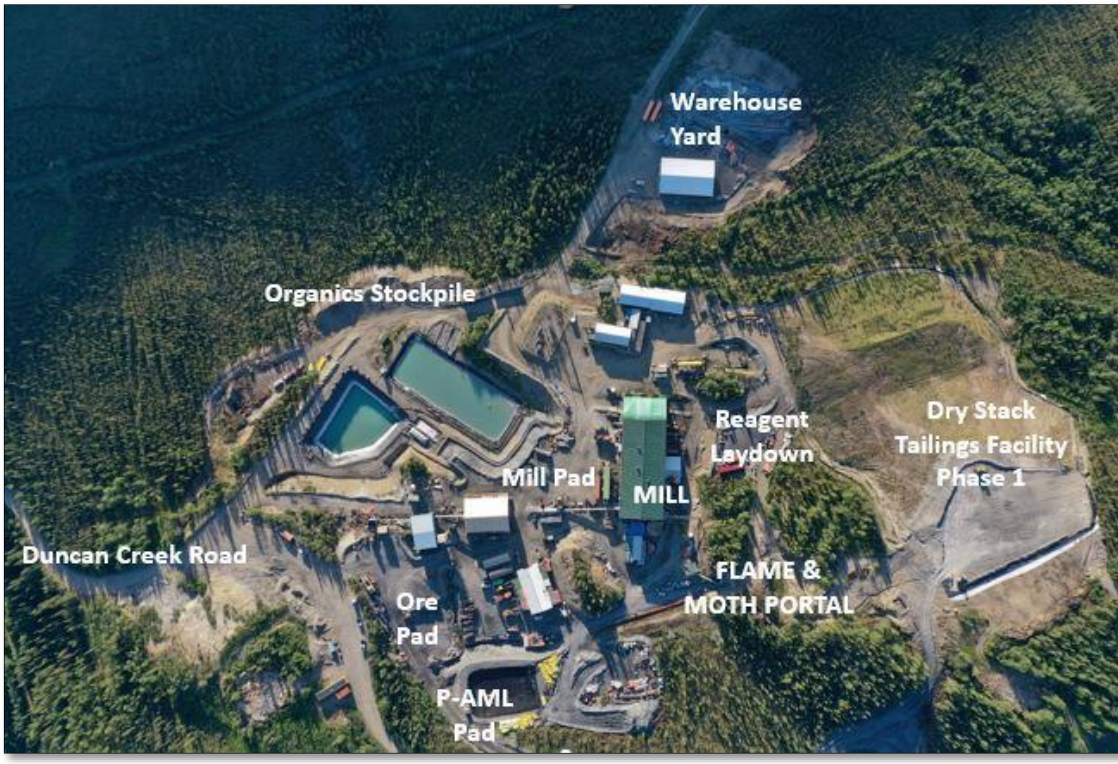

Figure 8-15: Growth Media Stockpile at District Mill

8.12 COVER DESIGN AND REVEGETATION

8.12.1 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 0.25 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.

8.12.2 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.

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.

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.

8.12.3 Cover System Design and Field Trials

As part of a reclamation research program for district-wide closure project, ERDC constructed two sets of cover system field trials in 2013 and 2014. Each set had six test plots, each of which reflected different design variables such as cover thickness, vegetation, and treatment on cover material. The trials consisted of lysimeters, instrumentation, and cover material over waste rock and tailings material. The purpose of the test plots was to understand seasonal performance throughout the year related to hydrologic and thermal aspects of the cover as well as to monitor any physical changes that would impact long term stability and integrity of the covers.

Overall, trials with a cover, regardless of thickness, reduced the net percolation through the covers and waste material compared to plots without covers. Generally, the thinnest cover (0.25 m) was enough to completely reduce the net percolation through redirection of water and storage. However, none of the cover thicknesses were sufficient to completely reduce net percolation during freshet or rain events that saturated the cover material. The cover did not appear to affect water quality, but only reduced the volume of water percolating through the material (AEG, 2019). This research will provide input to cover system design for the KHSD Mining Operations.

*8.12.3.1 **Cover Modelling***

This reclamation plan does not require any covers to function as "low permeability" covers to prevent infiltration. There will be no reactive (P-AML) waste rock left on surface nor reactive tailings. Therefore, conventional cover modelling which evaluates design and performance of covers in terms of reduction of net percolation etc. is not required.

The cover on the DSTF facility is designed to reduce erosion, enhance runoff and facilitate a vegetated surface after closure. The DSTF cover is an additional control on infiltration, as well as providing erosion control and a vegetated surface. The demonstration of the cover performance is tracked during operation by both observations of surface conditions (saturation, cracking etc.) and monitoring of any seepage from the DSTF which would be collected through the existing system of ditching and piping at the toe of the facility.

8.12.4 Site Revegetation Field Trials

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. The monitoring for potential metal uptake in vegetation and soils will be documented as part of the UKHM revegetation program. ERDC is working with local consultants and the FNNND to develop the detailed revegetation plan at the former UKHM site. This research will provide input to the cover system design and revegetation plan for the KHSD Mining Operations.

8.13 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 8-9 and Table 8-8
2) hydrological monitoring,
3) groundwater monitoring (as per Table 8-10),

4) physical and engineered structures monitoring (geotechnical assessment),
5) sediment, benthic and aquatic resources monitoring, and
6) climate monitoring.

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 10 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 8.14.3. 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 aligns with closure objectives for local hire and FNNND's stewardship of the land.

Table 8-8: 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 8-9: 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/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 8-10: 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
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
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
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
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
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
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
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
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
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
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
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
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
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
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 5-8 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 licences:

- 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 10-year post closure monitoring period. The requirement for ground temperature monitoring will be reviewed 10 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.

8.14 PERFORMANCE UNCERTAINTY AND RISK MANAGEMENT

8.14.1 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 in Figure 8-16:

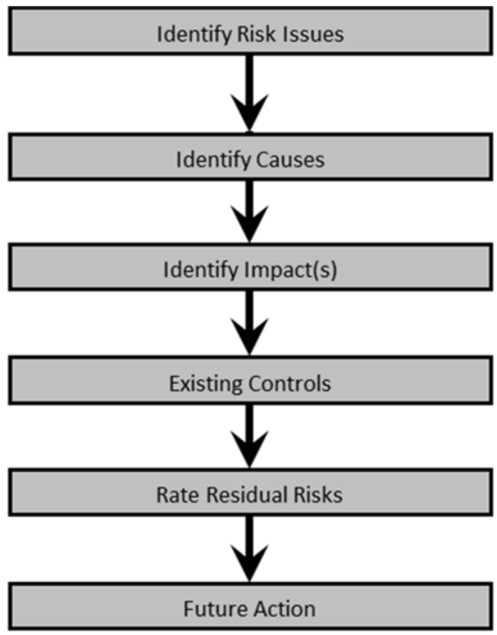

Figure 8-16: Risk Assessment Process Flow Chart

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.

8.14.2 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. The results of the DSTF risk assessment are included in Appendix 3.5. 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.

8.14.3 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.

9 RECLAMATION AND CLOSURE SCHEDULE AND EXECUTION STRATEGY

The closure phase of the Bellekeno, Flame & Moth, and New Bermingham mines will commence with the cessation of economic mining at each respective operation. The closure measure required at Lucky Queen and Onek 990 will be of existing disturbances created by AKHM activities at these deposits. Closure management and monitoring of the site will be guided by licence requirements, the performance of physical structures remaining on site and the ability to achieve and demonstrate long-term compliance with effluent quality standards. Once overall closure performance has been demonstrated through the completion criteria for all aspects of decommissioning, the necessity of maintaining licences or permits would be examined. At this point, a Certificate of Closure, under the *Quartz Mining Act* would be requested. The following sections provide a general outline of the site management approach that will be taken at the Bellekeno, Flame & Moth and New Bermingham mines and the Lucky Queen and Onek 990 deposits during the closure phase.

Implementation of the RCP will be accomplished through AKHM site management and supervision, a combination of contractors and in-house employees and equipment and the integration of care & maintenance personnel on-site to implement decommissioning and reclamation tasks. Generally, these tasks entail closure of mine components, salvage and removal of infrastructure, equipment and reagents, maintaining contingency water treatment plants, decommissioning of roads and reclamation and revegetation of disturbed lands. A Site Contamination Assessment Plan will be prepared leading up to closure which:

- locates through a site investigation program all contaminated material, if any, on the mine sites arising from any operation, transportation, storage, handling, or processing;
- characterizes the type, concentration, and horizontal and vertical extent of the contamination; and
- proposes methods for dealing with the contamination.

These activities would be undertaken on a seasonal basis and directed by an on-site manager responsible for implementation of the KHSD Mining Operations RCP.

During site decommissioning, camp accommodations would be available to support site personnel. As other activities are currently scheduled to be undertaken in the Keno Hill mining camp by Hecla Yukon, a project specific site caretaker or security personnel will not be required.

9.1 RECLAMATION AND CLOSURE SCHEDULE

Mine decommissioning and reclamation including removal of equipment and infrastructure will mainly take place during the first year of mine closure (or temporary closure). The Bellekeno 625 WTP is anticipated to be transitioned from active to passive treatment. The schedule for implementation of water management and treatment at Bellekeno, New Bermingham, and Flame & Moth is shown in Table 8-5 and Table 5-8 shows the project decommissioning and reclamation schedule.

9.2 SUPERVISION AND DOCUMENTATION OF WORK

All decommissioning and reclamation works will be supervised to ensure that works are constructed according to their design and that this work is properly carried out and documented. The project manager or construction supervisor would supervise all closure works. Regular inspection procedures would be completed to document work progress, deficiencies, and completion.

Upon completion of the decommissioning and reclamation works, a final site plan report will be prepared that will outline the facilities or works remaining on the site following closure including the locations of subsurface features. It is expected that this plan would be used to support an Application for a Certificate of Closure under the *Quartz Mining Act.*

9.3 SITE PRESENCE AND DISTRICT-WIDE CLOSURE

Currently, the Keno Hill Silver District is undergoing planning for full-scale district-wide closure to address the historic environmental liabilities. ERDC and CIRNAC are in partnership to reclaim the abandoned former United Keno Hill Mine (UKHM) mines. The temporal scope of the post closure monitoring for this project is on the order of decades, and as such there will be a site presence for many years to come in the Keno Hill mining camp. Closure activities at the UKHM mines are expected to be completed prior to AKHM closure activities commencing and efficiencies and design optimization will be incorporated into AKHM's Final Reclamation and Closure Plan.

10 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 $11,946,800. Hecla Yukon also has estimated the reclamation and closure costs for the current operations at $10,647,716 and after two years of operations for the current mine plan at $11,543,633. The amount of security currently held by YG for reclamation and closure of the KHSD Mining Operations is $10,232,955. It is important to note that not all of the liabilities included in the cost estimate have yet been realized or created.

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 (e.g., D7 Dozer from both Finning Caterpillar and Pelly Construction), all costs were averaged to produce the final rate used in the Closure Costs model. Where cost updates were not possible, an inflation adjustment of 10.92 percent (reflecting the consumer price index increase from 2021 to 2023) has been added (Bank of Canada, 2023b). Costs indicated in gray highlight in Table 10-2 did not receive a vendor quote sufficiently timely and the inflation-only 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.

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 0.25 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 disposal and the management of hydrocarbon contaminated soils from sources such as around the fuel storage facilities and equipment maintenance shop. It is assumed that contaminated soils will be transported offsite given the minimal volume and operational requirements to manage day to day.

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. 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 7, 2023.

Table 10-1 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 10-1 below summarizes the costs associated with the RCP, including indirect costs.

Table 10-1: Summary Table of Estimated Closure Costs - Keno Hill Mine Operations

Description of Cost	Proposed Cost Current - AKHM 2023	Proposed Cost Year 2 - AKHM 2023	Proposed Cost EOM - AKHM 2023
Closure Implementation			
T3 General & Administration	$1,826,267	$1,826,267	$1,826,267
T4 Exploration Disturbances	$0	$0	$0
T5 Closure Planning	$166,506	$389,475	$557,204
T6 Mine Workings - Underground	$512,410	$584,990	$720,246
T7 Waste Dumps	$98,052	$475,555	$478,715
T8 Mill and Surface Facilities	$602,019	$602,019	$602,019
T9 DSTF	$14,301	$61,998	$199,244
T10 Waste Disposal/Remediation	$59,137	$59,137	$59,137
T11 Landfills	$7,538	$7,538	$7,538
T12 Roads and Trails	$105,890	$105,890	$94,563
T13 Water and Solutions Management	$248,147	$248,147	$248,450
T14 Interim Care and Maintenance	$1,990,753	$1,990,753	$1,990,753
Sub-total Direct Costs	$5,631,020	$6,351,769	$6,784,136
Indirect Costs (%)	15%	15%	15%
Indirect Costs	$844,653	$952,765	$1,017,620
Contingency Costs (%) [2]	18%	18%	18%
Contingency Costs	$1,013,870	$1,144,558	$1,225,129
Cost Inflation [1]	$152,178	$171,657	$183,341
Total Closure Implementation Costs	**$7,641,721**	**$8,620,749**	**$9,210,227**
T15 Long Term Monitoring and Maintenance			
Onsite Management	$154,356	$154,356	$154,356
Transport Costs	$399,300	$399,300	$399,300
Water Treatment Costs			
Active Treatment			
Capital Costs	$0	$0	$0
Capital Replacement Costs	$0	$0	$0
Operating Costs	$872,394	$872,394	$872,394
Passive Treatment			
Capital Costs	$166,375	$166,375	$166,375
Operation and Maintenance Costs	$183,767	$183,767	$183,767
Reclamation & Closure Research Plan (Post Closure)	$0	$0	$0
Monitoring & Reporting	$1,131,490	$1,131,490	$1,131,490
Sub-Total	$2,907,682	$2,907,682	$2,907,682
Sub-Total NPV (1.0198% DROR)	$2,312,304	$2,248,372	$2,105,056
Indirect Costs (%)	15%	15%	15%
Indirect Costs	$346,846	$337,256	$315,758
Contingency Costs (%)	15%	15%	15%
Contingency Costs	$346,846	$337,256	$315,758
Total (NPV)	$3,005,995	$2,922,884	$2,736,573
Total Financial Security (incl. Indirect Costs)	**$10,647,716**	**$11,543,633**	**$11,946,800**

Table 10-2: Keno Hill Mine Operations Unit Rates

Equipment Rates		
Equipment	**Unit Rates**	**Per Unit**
D7 Dozer	$191	per hr
A30 Haul Truck	$180	per hr
Cat 235 Excavator	$90	per hr
Cat 235 Excavator w hammer	$152	per hr
Cat 324E Excavator (Demo)	$196	per hr
Cat 14H grader	$161	per hr
966 Loader	$101	per hr
Tractor Trailer (lowbed)	$250	per hr
Vacuum Truck	$166	per hr
30 ton Crane	$211	per hr
3 yd Underground LHD	$244	per hr
15 tonne Underground Truck	$222	per hr
Vibratory Packer	$71	per hr
Pickup Truck	$6,000	per mo

Personnel Rates		
Personnel	**Unit Rates**	**Per Unit**
General Labourer	$45	per hr
Equipment Operator	$51	per hr
Trades Labourer	$90	per hr
Site Supervisor	$1,240	per day
Design Engineer	$177	per hr
Project Manager	$2,318	per day
Site Caretaker, Operator	$1,080	per day
Field Engineer, QA/QC	$110	per hr
Environmental Monitor	$128	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)	$3,540	per ha
Seed/Fertilizer Application	$1,980	per ha
Erosion Barrier	$2.81	per sq.m
Revegetation cost per ha. Including application cost	**$3,347.36**	**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)	$5.15	per cu.m
Custom Rate B (Load, haul and dump mineralized rock stockpile in BK East Decline)	$5.29	per cu.m
Compact and Contour Cover	$2.22	per cu.m
Excavation of Soil	$5.55	per cu.m
Supply and place Geotextile	$7.76	per cu.m
Load, haul and place soil cover	$8.87	per cu.m
Haul & Place rock cover	$8.87	per cu.m
Produce Rip-Rap	$17.47	per cu.m
Screen Rip-Rap	$5.55	per cu.m
Load and Haul and Place Rip Rap	$14.42	per cu.m
HDPE Liner Install	$13.31	per sq. m
Erosion barriers	$2.81	per sq. m
Freight run to Whitehorse	$3,700	per load
Camp Cost	$68	per day per person
Power and Heat	$10,000	per month
Employee Transport Costs	$10,300	per month

Table 10-3: 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	$2,318	$150,522	$150,522	$150,522
	Project Management (on site Active Closure 6 months per year, 2 years	Project Manager	days	260	$2,318	$602,087	$602,087	$602,087
	Site Supervisor (on site Active Closure 6 months per year, 2 years	Site Supervisor	days	260	$1,240	$322,055	$322,055	$322,055
	Pickup truck (2 trucks, 6 months per year, 2 years)	Pickup Truck	monthly	24	$6,000	$144,000	$144,000	$144,000
	Seasonal shutdown/startup costs Y1-Y2	Unit Cost Basis	annually	2	$8,319	$16,638	$16,638	$16,638
	Sundry equipment maintenance	Unit Cost Basis	annually	2	$5,546	$11,092	$11,092	$11,092
	Power and heat (6 months per year, 2 years)	Power and Heat	monthly	12	$10,000	$120,000	$120,000	$120,000
	General Administrative expenses (6 months per year, 2 years	Unit Cost Basis	monthly	12	$2,218	$26,620	$26,620	$26,620
	Geotechnical Inspections (included in T16		annually	-		$0	$0	$0
	Reclamation Inspections (Active Closure 1 time)		annually	1	$11,092	$11,092	$11,092	$11,092
	Camp Costs (Average 7 people, 6 months/season, 2 seasons	Camp Cost	man-day	2,520	$68	$171,360	$171,360	$171,360
					Sub-Total	$1,575,464	$1,575,464	$1,575,464
3.2	**Transport Costs**							
	Employee transport costs (7 months per year, 2 years	Employee Transport Costs	monthly	14	$3,882	$54,349	$54,349	$54,349
	Commercial flights		monthly	14	$3,882	$54,349	$54,349	$54,349
					Sub-Total	$108,698	$108,698	$108,698
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	$3,700	$74,000	$74,000	$74,000
					Sub-Total	$74,000	$74,000	$74,000
3.4	**Mobilize Equipment & Fuel**							
	Heavy Equipment							
	D7 Dozer	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	A30 Haul Truck	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 235 Excavator	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 235 Excavator w hammer	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 324E Excavator (Demo)	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 14H grader	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	966 Loader	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Tractor Trailer (lowbed)	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Vacuum Truck	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	30 ton Crane	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	3 yd Underground LHD	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Vibratory Packer	Tractor Trailer (lowbed)	hrs	11	$250	$2,745	$2,745	$2,745
	15 tonne Underground Truck	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
					Sub-Total	$32,693	$32,693	$32,693
3.5	**Demobilize Equipment**							
	Heavy Equipment							
	D7 Dozer	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	A30 Haul Truck	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 235 Excavator	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 235 Excavator w hammer	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 324E Excavator (Demo)	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Cat 14H grader	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	966 Loader	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Tractor Trailer (lowbed)	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Vacuum Truck	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	30 ton Crane	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	3 yd Underground LHD	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	15 tonne Underground Truck	Tractor Trailer (lowbed)	hrs	10	$250	$2,496	$2,496	$2,496
	Vibratory Packer	Tractor Trailer (lowbed)	hrs	11	$250	$2,745	$2,745	$2,745
	Sea Containers (supplies, mobile offices)	Other	hrs	60	$45	$2,719	$2,719	$2,719
					Sub-Total	$35,412	$35,412	$35,412
Total Estimated Cost for General & Administration During Closure						$1,826,267	$1,826,267	$1,826,267

Table 10-4: 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 10-5: 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	$24,956	$0	$24,956	$74,869
	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	$54,956	$164,869
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	$11,092	$11,092	$22,183	$20,000
					Sub-Total	$11,092	$22,183	$20,000
5.4	**Contaminated Site Assessment Plan**							
	Develop Plan	Misc.	l.s.	1	$8,319	$8,319	$8,319	$8,319
	Site Reporting	Misc.	l.s.	1	$11,092	$11,092	$11,092	$11,092
					Sub-Total	$19,410	$19,410	$19,410
5.5	**Reclamation & Closure Research Plan**							
	Research to finalize closure plan ($25K per year)	Misc.	l.s.	1	$27,729	$27,729	$166,375	$166,375
	Closure Water Management Treatment Optimization	Misc.	l.s.	1	$33,275	$0	$33,275	$33,275
					Sub-Total	$27,729	$199,650	$199,650
5.6	**Passive Treatment Design**							
	Design for mill pond bioreactor	Misc.	l.s.	1	$33,275	$33,275	$33,275	$33,275
					Sub-Total	$33,275	$33,275	$33,275
Total Estimated Cost for Closure Planning						$166,506	$389,475	$557,204

Table 10-6: 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**	7.1.3, 7.5.1.1	7-1, 7-2	1.71							
	Remove underground equipment (already complete)				3 yd Underground LHD	hrs		$244	$0	$0	$0
					A30 Haul Truck	hrs		$180	$0	$0	$0
					Trades Labourer	hrs		$90	$0	$0	$0
					General Labourer	hrs		$45	$0	$0	$0
	Remove shop and other buildings (trailers, explosives and cap magazine, etc)					lump sum	2	$16,638	$33,275	$33,275	$33,275
	Load/Haul and place rip rap for portal cover					cu.m.	700	$14	$10,093	$10,093	$10,093
	Screen rip rap					cu.m.	700	$6	$3,882	$3,882	$3,882
	Labour for portal barrier				General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Characterize settling ponds sediments analytical costs					unit cost	2	$333	$666	$666	$666
	Remove pond water/sediments				Vacuum Truck	hrs	8	$166	$1,331	$1,331	$1,331
					General Labourer	hrs	8	$45	$363	$363	$363
	Remove settling ponds liners to landfill				A30 Haul Truck	hrs	2	$180	$360	$360	$360
					Cat 235 Excavator	hrs	8	$90	$720	$720	$720
					General Labourer	hrs	8	$45	$363	$363	$363
	Clean out fuel tank residue					lump sum	1	$1,109	$1,109	$1,109	$1,109
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs	6	$90	$540	$540	$540
					A30 Haul Truck	hrs	6	$180	$1,080	$1,080	$1,080
					General Labourer	hrs	16	$45	$725	$725	$725
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					A30 Haul Truck	hrs	20	$180	$3,600	$3,600	$3,600
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Test area soils for contamination				Environmental Monitor	hrs	16	$128	$2,041	$2,041	$2,041
	Laboratory Analysis for soils testing					unit cost	4	$333	$1,331	$1,331	$1,331
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$90	$1,440	$1,440	$1,440
					A30 Haul Truck	hrs	16	$180	$2,880	$2,880	$2,880
	Recontour and scarify area and slopes to establish drainage		C-2401, B-2101		D7 Dozer	hrs	25	$191	$4,694	$4,694	$4,694
			C-2401, B-2101		Cat 14H grader	hrs	2	$161	$323	$323	$323
	Revegetation		C-2401	1.71 ha	Revegetation cost per ha. Including ap	ha	1.71	$3,347	$5,724	$5,724	$5,724
	Install Signage				Misc.	lump sum	1	$555	$555	$555	$555
	Certified Underground Supervisor				Site Supervisor	days	7	$1,240	$8,677	$8,677	$8,677
	Underground safety equipment				Misc.	lump sum	1	$5,546	$5,546	$5,546	$5,546
	Engineering Design				% of Direct Costs	%	8%		$7,256	$7,256	$7,256
								Sub-Total	$103,998	$103,998	$103,998
6.2	**Bellekeno 625 Adit Area**	7.1.3, 7.5.1.2	7-1	1.29							
	Remove electrical substation				Misc.	lump sum	1	$16,638	$16,638	$16,638	$16,638
	Remove electrical transmission line (Keno City to BK 625)				Misc.	lump sum	1	$27,729	$27,729	$27,729	$27,729
	Remove shop/loadout facility, compressor station				Misc.	lump sum	1	$33,275	$33,275	$33,275	$33,275
	Remove ammonia treatment plant trailers				Misc.	lump sum	1	$11,092	$11,092	$11,092	$11,092
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					A30 Haul Truck	hrs	20	$180	$3,600	$3,600	$3,600
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Test area soils for contamination				Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020
	Laboratory Analysis for soils testing					unit cost	4	$333	$1,331	$1,331	$1,331
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$90	$1,440	$1,440	$1,440
					A30 Haul Truck	hrs	16	$180	$2,880	$2,880	$2,880
	Recontour and scarify area and slopes to establish drainage		C-2402, B-2102		D7 Dozer	hrs	10	$191	$1,917	$1,917	$1,917
			C-2402, B-2102		Cat 14H grader	hrs	2	$161	$323	$323	$323
	Revegetation		C-2402	1.29 ha	Revegetation cost per ha. Including ap	ha	1.29	$3,347	$4,318	$4,318	$4,318
	Install Signage				Misc.	lump sum	1	$555	$555	$555	$555
	Engineering Design				% of Direct Costs	%	8%		$8,230	$8,230	$8,230
								Sub-Total	$117,960	$117,960	$117,960
6.3	**Bellekeno 200 Level Vent Raise**	7.1.3.1	7-6								
	Engineering for Expansion foam cap		S-0303		Misc.	l.s.	1	$11,092	$11,092	$11,092	$11,092
	Expansion foam				Misc.	l.s.	1	$11,092	$11,092	$11,092	$11,092
					966 loader	hrs	12	$101	$1,215	$1,215	$1,215
					Tractor Trailer (lowbed)	hrs	48	$250	$11,979	$11,979	$11,979
					30 ton Crane	hrs	48	$211	$10,116	$10,116	$10,116
	Labour for cap				General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
					Trades Labourer	hrs	40	$90	$3,604	$3,604	$3,604
	Engineering Design				% of Direct Costs	%	8%		$3,548	$3,548	$3,548
								Sub-Total	$54,458	$54,458	$54,458
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**

Table 10-6: 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
6.5	**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	$14	$10,093	$10,093	$10,093
	Labour for portal barrier				~~General Labourer~~	~~hrs~~	40	$45			
					Trades Labourer	hrs	40	$90	$3,604	$3,604	$3,604
	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	$90	$900	$900	$900
					A30 Haul Truck	hrs	8	$180	$1,440	$1,440	$1,440
					General Labourer	hrs	20	$45	$906	$906	$906
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	8	$333	$2,662	$2,662	$2,662
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$90	$720	$1,440	$1,440
					A30 Haul Truck	hrs	16	$180	$1,440	$2,880	$2,880
	Recontour and scarify area and slopes to establish drainage		C-4401, B-4101		D7 Dozer	hrs	7	$191	$1,307	$1,307	$1,307
			C-4401, B-4101		Cat 14H grader	hrs	4	$161	$645	$645	$645
	Recontour crests of pad		C-4401, B-4101		Cat 235 Excavator	hrs	4	$90	$360	$360	$360
	Install Signage				Misc.	l.s.	1	$555	$555	$555	$555
	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	$90	$720	$720	$720
					A30 Haul Truck	hrs	12	$180	$2,160	$2,160	$2,160
	Revegetation		C-4401	0.35 ha	Revegetation cost per ha. Including ap	ha	0.35	$3,347	$1,172	$1,172	$1,172
	Engineering Design				% of Direct Costs	%	8%		$2,228	$2,390	$2,390
								Sub-Total	$31,932	$34,254	$34,254
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	$5,546	$5,546	$5,546	$5,546
	Supply rockfill for portal barrier				Load and Haul and Place Rip Rap	m3	700	$14	$10,093	$10,093	$10,093
	Labour for portal barrier				General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Clean out fuel tank residue				Misc.	l.s.					
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs		$90	$0	$0	$0
					A30 Haul Truck	hrs		$180	$0	$0	$0
					General Labourer	hrs		$45	$0	$0	$0
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					A30 Haul Truck	hrs	20	$180	$3,600	$3,600	$3,600
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	6	$333	$1,997	$1,997	$1,997
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$90	$1,440	$1,440	$1,440
					A30 Haul Truck	hrs	16	$180	$1,440	$2,880	$2,880
	Recontour and scarify area and slopes to establish drainage		C-3401, B-3101		D7 Dozer	hrs	6	$191	$1,154	$1,154	$1,154
			C-3401, B-3101		Cat 14H grader	hrs	1	$161	$161	$161	$161
	Recontour crests		C-3401, B-3101		Cat 235 Excavator	hrs	4	$90	$389	$389	$389
	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	$5,546	$5,546	$5,546	$5,546
	Install Signage				Misc.	l.s.	1	$555	$555	$555	$555
	Characterize settling pond sediments/sludge				Analytical Costs	Unit Cost	2	$333	$666	$666	$666
					Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020
	Remove sludge from settling pond				Vacuum Truck	hrs	40	$166	$1,664	$1,664	$1,664
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Remove settling ponds liners to landfill (not yet constructed)				A30 Haul Truck	hrs		$180			
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$90	$720	$720	$720
					A30 Haul Truck	hrs	12	$180	$2,160	$2,160	$2,160
	Revegetation		C-3401	0.63 ha	Revegetation cost per ha. Including ap	ha	0.63	$3,347	$2,109	$2,109	$2,109
	Install Signage				Misc.	l.s.	1	$555	$555	$555	$555
	Misc. Supplies & Tools				Misc.	l.s.	1	$5,546	$5,546	$5,546	$5,546
	Engineering Design				% of Direct Costs	%	8%		$4,096	$4,204	$4,204
								Sub-Total	$58,714	$60,262	$60,262

Table 10-6: 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**									
					Misc.	l.s.					
					966 loader	hrs					
	Not constructed and not licensed for production				Tractor Trailer (lowbed)	hrs					
					General Labourer	hrs					
					% of Direct Costs	%	8%		$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**
6.9	**Flame & Moth Underground**	**7.1.5**									
	Remove underground equipment				3 yd Underground LHD	hrs	60	$244	$3,660	$7,321	$14,641
					A30 Haul Truck	hrs	60	$180	$2,700	$5,400	$10,800
					Trades Labourer	hrs	120	$90	$2,703	$5,406	$10,812
					General Labourer	hrs	120	$45	$5,438	$5,438	$5,438
	Remove shop and other buildings (explosives and cap magazine)				Misc.	hrs	2	$5,546	$11,092	$11,092	
	Supply rockfill for portal barrier				Load and Haul and Place Rip Rap	m3	700	$14	$10,093	$10,093	$10,093
					Screen Rip-Rap	m3	700	$6	$3,882	$3,882	$3,882
	Labour for portal barrier				~~General Labourer~~	~~hrs~~	40	$45			
					Trades Labourer	hrs	40	$90	$3,604	$3,604	$3,604
	Clean out fuel tank residue				Misc.	l.s.	1	$1,109	$1,109	$1,109	$1,109
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs	6	$90	$540	$540	$540
					A30 Haul Truck	hrs	6	$180	$1,080	$1,080	$1,080
					General Labourer	hrs	16	$45	$725	$725	$725
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	10	$90	$900	$900	$900
					A30 Haul Truck	hrs	10	$180	$1,800	$1,800	$1,800
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	8	$333	$2,662	$2,662	$2,662
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$90	$720	$1,440	$1,440
					A30 Haul Truck	hrs	16	$180	$1,440	$2,880	$2,880
	Recontour and scarify area and slopes to establish drainage (Incl. with Mill)		C-6401, C-6101		D7 Dozer	hrs		$191	$0	$0	$0
			C-6401, C-6101		Cat 14H grader	hrs		$161	$0	$0	$0
	Remove electrical substation (included in mill facilities)				Misc.	l.s.	1				
	Install Signage				Misc.	l.s.	1	$555	$555	$555	$555
	Characterize settling pond sediments/sludge				Analytical Costs	Unit Cost	2	$333		$666	$666
					Environmental Monitor	hrs	8	$128	$1,020		$1,020
	Remove sludge from settling pond				Vacuum Truck	hrs	30	$166		$4,991	$4,991
					General Labourer	hrs	30	$45		$1,360	$1,360
	Remove settling ponds liners to landfill				A30 Haul Truck	hrs	4	$180		$720	$720
					General Labourer	hrs	12	$45		$544	$544
					Cat 235 Excavator	hrs	12	$90		$1,080	$1,080
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$90	$360	$720	$720
					A30 Haul Truck	hrs	12	$180		$2,160	$2,160
	Certified Underground Supervisor				Site Supervisor	days	5	$1,240	$6,198	$6,198	$6,198
	Underground safety equipment				Misc.	lump sum	1	$5,546	$5,546	$5,546	$5,546
	Misc. Supplies & Tools				Misc.	l.s.	1	$8,319	$8,319	$8,319	$8,319
	Engineering Design				% of Direct Costs	%	8%		$4,836	$5,889	$9,016
								Sub-Total	$83,816	$107,972	$129,225
6.10	**Flame & Moth Vent Raise**	**7.1.5**	**S-0303**								
	Concrete Batch (may use PUF alternatively) (not constructed)				Misc.	m3	7	$1,664		$11,646	$11,646
					966 loader	hrs	12	$101		$1,215	$1,215
					Tractor Trailer (lowbed)	hrs	48	$250		$11,979	$11,979
	Labour for cap				Trades Labourer	hrs	40	$90		$3,604	$3,604
					General Labourer	hrs	40	$45		$1,813	$1,813
	Engineering Design				% of Direct Costs	%	8%		$0	$2,269	$2,269
								Sub-Total	$0	$32,526	$32,526
6.11	**Bermingham Underground Portal and Surface Site**	**7.1.7 & 7.5.3**		**2.36**							
	Remove underground equipment				3 yd Underground LHD	hrs	60	$244	$3,660	$7,321	$14,641
					A30 Haul Truck	hrs	60	$180	$2,700	$5,400	$10,800
					Trades Labourer	hrs	120	$90	$2,703	$5,406	$10,812
					General Labourer	hrs	120	$45	$5,438	$5,438	$5,438
	Remove electrical substation located at Ruby				Misc.	lump sum	1	$16,638	$16,638	$16,638	$16,638
	Load/Haul and place rip rap for portal cover				Load and Haul and Place Rip Rap	cu.m.	700	$14	$10,093	$10,093	$10,093
	Screen rip rap				Screen Rip-rap	cu.m.	700	$6	$3,882	$3,882	$3,882
	Labour for portal barrier				General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	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	$90	$720	$720	$720
					A30 Haul Truck	hrs	12	$180	$2,160	$2,160	$2,160
	Clean out fuel tank residue				Misc.	l.s.	1	$1,109	$1,109	$1,109	$1,109
	Haul fuel tank for reuse				966 Loader	hrs	6	$101	$608	$608	$608
					Tractor Trailer (lowbed)	hrs	6	$250	$1,497	$1,497	$1,497
					General Labourer	hrs	16	$45	$725	$1,450	$1,450
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					A30 Haul Truck	Unit Cost	40	$333	$13,310	$13,310	$13,310
					Cat 235 Excavator	hrs	16	$90	$1,440	$1,440	$1,440
	Test area for soils for contamination				Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020

Table 10-6: Mine Workings - Underground (continued)

/	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
	Laboratory analysis for soils testing					unit cost	4	$333	$1,331	$1,331	$1,331
	Haul contaminated soils to LTF				Cat 235 Excavator	hrs	16	$90	$1,440	$1,440	$1,440
					A30 Haul Truck	hrs	16	$180	$2,880	$2,880	$2,880
	Recontour and scarify area and slopes to establish drainage		C-5401, B-5101		D7 Dozer	hrs	2	$191	$336	$336	$336
			C-5401, B-5101		Cat 14H grader	hrs	3	$161	$484	$484	$484
	Revegetation		C-5401	2.36	Revegetation cost per ha. Including ap	ha	2.36	$3,347	$7,900	$7,900	$7,900
	Install signage				Misc.	lump sum	1	$555	$555	$555	$555
	Certified Underground Supervisor				Site Supervisor	days	5	$1,240	$6,198	$6,198	$6,198
	Underground safety equipment				Misc.	lump sum	1	$5,546	$5,546	$5,546	$5,546
	Misc. Supplies & Tools				Misc.	l.s.	1	$8,319	$8,319	$8,319	$8,319
	Engineering Design				% of Direct Costs	%	8%		$8,348	$9,457	$10,816
								Sub-Total	$119,653	$135,550	$155,036
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 Tota l**
6.12	**Bermingham Vent Raise**	**7.1.7**	**S-0303**								
	Concrete Batch (may use PUF alternatively)				Misc.	m3	7	$1,664	$11,646	$11,646	$11,646
					966 loader	hrs	12	$101	$1,215	$1,215	$1,215
					Tractor Trailer (lowbed)	hrs	48	$250	$11,979	$11,979	$11,979
	Labour for cap				Trades Labourer	hrs	40	$90	$3,604	$3,604	$3,604
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Engineering Design				% of Direct Costs	%	8%		$2,269	$2,269	$2,269
								Sub-Total	$32,526	$32,526	$32,526
Total Estimated Cost in Reclaiming Underground Mines									$512,410	$584,990	$720,246

Table 10-7: 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.		$244	$0	$0	$0
					A30 Haul Truck	hrs		$180	$0	$0	$0
					Cat 235 Excavator	hrs		$90	$0	$0	$0
					General Labourer	hrs		$45	$0	$0	$0
	Site Recontouring		C-2401, B-2101		D7 Dozer	hrs	13	$191	$2,403	$2,403	$2,403
			C-2401, B-2101		Cat 235 Excavator	hrs	9	$90	$823	$823	$823
	Revegetation		C-2401		Revegetation cost per ha. Including application cost	ha	0.3	$3,347	$1,105	$1,105	$1,105
	Engineering Design				% of Direct Costs	%	8%		$325	$325	$325
								Sub-Total	$4,656	$4,656	$4,656
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	$90	$657	$657	$657
	Up-slope Diversion Ditch-no lining specified				Cat 235 Excavator	hrs	4	$90	$360	$360	$360
	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	$3,347	$4,318	$4,318	$4,318
	Engineering Design				% of Direct Costs	%	8%		$400	$400	$400
								Sub-Total	$5,735	$5,735	$5,735
7.4	**Onek P-AML WRSF**	**7.3.4**	**7-15**	**0.48**							
	Remove impounded water (no water liner not complete)				Vacuum Truck	hrs	-	$166	$0	$0	$0
					General Labourer	hrs	4	$45	$181	$181	$181
	Remove P-AML rock and place underground at Onek				D7 Dozer	hrs	-	$191	$0	$0	$0
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	2	$180	$360	$360	$360
					Cat 235 Excavator	hrs	4	$90	$360	$360	$360
					General Labourer	hrs.	8	$45	$363	$363	$363
	Recontour for drainage		C-4401, B-4101		D7 Dozer	hrs	19	$191	$3,573	$3,573	$3,573.5
	Revegetation		C-4401	0.48 ha	Revegetation cost per ha. Including application cost	ha	0.48	$3,347	$1,607	$1,607	$1,606.7
	Engineering Design				% of Direct Costs	%	8%		$483	$483	$483
								Sub-Total	$6,927	$6,927	$6,927
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**
7.8	**Flame and Moth Temporary P-AML WRSF**	**7.3.2**		**0.23**							
	Rehandle underground										
	6000 m3 @ 24m3/hr cycle time to underground (vol estimate based on maximum capacity assuming full)				3 yd Underground LHD	hrs.	857	$244		$209,157	$209,157
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	8	$180		$1,440	$1,440
					Cat 235 Excavator	hrs	48	$90		$4,320	$4,320
					General Labourer	hrs	24	$45		$1,088	$1,088
	Certified Underground Supervisor				Site Supervisor	days	12	$1,240	$14,876	$14,876	$14,876
	Underground safety equipment				Misc.	l.s.	1	$5,546	$5,546	$5,546	$5,546
	Site Recontouring		C-1401, B6101		D7 Dozer	hrs	9	$191	$1,668	$1,668	$1,668
	Revegetation		C-1401		Revegetation cost per ha. Including application cost	ha	0.23	$3,347	$770	$770	$770
	Engineering Design				% of Direct Costs	%	8%		$1,714	$17,915	$17,915
								Sub-Total	$24,574	$256,779	$256,779
7.9	**Flame & Moth N-AML WRDA**	**7.3.2**									
	All of the Flame & 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**		**0.68**							
	Recontour crests		C-5401, B-5101		Cat 235 Excavator	hrs.	20	$90	$1,800	$1,800	$1,800
	Scarify surface		C-5401		D7 Dozer	hrs.	13	$191	$1,261	$2,521	$2,521
	Revegetation		C-5401		Revegetation cost per ha. Including application cost	ha	1	$3,347.36	$1,138	$2,276	$2,276
	Engineering Design				% of Direct Costs	%	8%		$315	$495	$495
								Sub-Total	$4,514	$7,092	$7,092
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	$244		$122,008	$122,008
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	24	$180		$4,320	$4,320
					Cat 235 Excavator	hrs	48	$90		$4,320	$4,320
					General Labourer	hrs	24	$45		$1,088	$1,088
	Certified Underground Supervisor				Site Supervisor	days	12	$1,240	$14,876	$14,876	$14,876
	Underground safety equipment				Misc.	l.s.	1	$5,546	$5,546	$5,546	$5,546
	Site Recontouring		C-5401, B-5101		D7 Dozer	hrs	10	$191		$669	$2,007
	Revegetation		C-5401		Revegetation cost per ha. Including application cost	ha	0.32	$3,347		$357	$1,071
	Engineering Design				% of Direct Costs	%	8%		$1,532	$11,489	$11,643
								Sub-Total	$21,953	$164,672	$166,878
7.12	**Borrow Areas (2ha currently, 3ha by EOM)**	**7.8.1**		**2.00**							
	Stabilize slopes				Cat 235 Excavator	hrs	12	$90	$713	$713	$1,080
					D7 Dozer	hrs	8	$191	$1,010	$1,010	$1,530
	Revegetation				Revegetation cost per ha. Including application cost	ha	2.0	$3,347	$6,695	$6,695	$6,695
	Engineering Design				% of Direct Costs	%	8%		$631	$631	$698
								Sub-Total	$9,049	$9,049	$10,003
7.13	**Coarse Ore Pad**	**7.5.6**		**0.30**							
	Concrete Demolition and Burial				Cat 235 Excavator w hammer	hrs	16	$152	$2,428	$2,428	$2,428
					D7 Dozer	hrs	16	$191	$3,060	$3,060	$3,060
	Dismantle Sprung Structure over fine ore stockpile				Misc.	l.s.	1	$11,092	$11,092	$11,092	$11,092
	Haul contaminated soils/materials to DSTF or underground				Cat 235 Excavator	hrs	6	$90	$540	$540	$540
					A30 Haul Truck	hrs	6	$180	$1,080	$1,080	$1,080
	Revegetation				Revegetation cost per ha. Including application cost	ha	0.3	$3,347	$1,004	$1,004	$1,004
	Engineering Design				% of Direct Costs	%	8%		$1,440	$1,440	$1,440
								Sub-Total	$20,644	$20,644	$20,644
Total Estimated Cost in Reclaiming Overburden and Waste Rock Dumps									$98,052	$475,555	$478,715

Table 10-8: 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	$45	$27,192	$27,192	$27,192
					Trades Labourer	hrs	400	$90	$36,038	$36,038	$36,038
					966 loader	hrs	150	$101	$15,188	$15,188	$15,188
					Cat 235 Excavator	hrs	35	$90	$3,150	$3,150	$3,150
					Cat 324E Excavator (Demo)	hrs	35	$196	$6,869	$6,869	$6,869
					A30 Haul Truck	hrs	20	$180	$3,600	$3,600	$3,600
					Tractor Trailer (lowbed)	hrs	150	$250	$37,434	$37,434	$37,434
	Load and return extra chemicals/reagents				General Labourer	hrs	75	$45	$3,399	$3,399	$3,399
					Misc.	l.s.	1	$11,092	$11,092	$11,092	$11,092
	Dismantle Mill Building				966 loader	hrs	70	$101	$7,088	$7,088	$7,088
					Cat 324E Excavator (Demo)	hrs	70	$196	$13,738	$13,738	$13,738
					A30 Haul Truck	hrs	30	$180	$5,400	$5,400	$5,400
					Tractor Trailer (lowbed)	hrs	90	$250	$22,461	$22,461	$22,461
					Trades Labourer	hrs	300	$90	$27,029	$27,029	$27,029
					General Labourer	hrs	1000	$45	$45,320	$45,320	$45,320
	Removal and burial of outside pipelines				General Labourer	hrs	80	$45	$3,626	$3,626	$3,626
					966 loader	hrs	40	$101	$4,050	$4,050	$4,050
	Concrete Demolition				Cat 235 Excavator w hammer	hrs	40	$152	$6,070	$6,070	$6,070
					D7 Dozer	hrs	40	$191	$7,650	$7,650	$7,650
	Elec. Substation (disconnect, remove from site)				Misc.	Unit Cost	1	$22,183	$22,183	$22,183	$22,183
	Dismantle/remove other area bldgs (dry, lab, MCCs, etc)				Misc.	Unit Cost	5	$5,546	$27,729	$27,729	$27,729
	Disconnect services				Misc.	Misc.	4	$2,218	$8,873	$8,873	$8,873
	Decommission buried infrastructure				Misc.	Misc.	1	$5,546	$5,546	$5,546	$5,546
	Dismantle/remove fresh water tank				Misc.	Misc.	1	$11,092	$11,092	$11,092	$11,092
	Remove diesel & propane Tanks (owned by vendors)										
	Disconnect services				Misc.	Misc.	2	$1,109	$2,218	$2,218	$2,218
	Crane Support				30 ton Crane	hrs	200	$211	$42,148	$42,148	$42,148
	Haul Scrap to Solid Waste Facility				Cat 235 Excavator	hrs	50	$90	$4,500	$4,500	$4,500
					A30 Haul Truck	hrs	100	$180	$18,000	$18,000	$18,000
	Misc. Supplies and Tools				Misc.	hrs	1	$5,546	$5,546	$5,546	$5,546
	Project Management & Engineering				% of Direct Costs	%	8%		$32,567	$32,567	$32,567
								Sub-Total	$466,794	$466,794	$466,794
8.2	**Warehouse**										
	Dismantle Mill Building				966 loader	hrs	30	$101	$3,038	$3,038	$3,038
					Tractor Trailer (lowbed)	hrs	30	$250	$7,487	$7,487	$7,487
					Trades Labourer	hrs	100	$90	$9,010	$9,010	$9,010
					General Labourer	hrs	250	$45	$11,330	$11,330	$11,330
	Concrete Demolition				Cat 235 Excavator w hammer	hrs	20	$152	$3,035	$3,035	$3,035
					D7 Dozer	hrs	20	$191	$3,825	$3,825	$3,825
	Haul Scrap to Solid Waste Facility				Cat 235 Excavator	hrs	15	$90	$1,350	$1,350	$1,350
					A30 Haul Truck	hrs	10	$180	$1,800	$1,800	$1,800
	Misc. Supplies and Tools				Misc.	l.s.	1	$5,546	$5,546	$5,546	$5,546
	Engineering Design				% of Direct Costs	%	8%		$3,481	$3,481	$3,481
								Sub-Total	$49,901	$49,901	$49,901
8.3	**Mill Pad**	**7.5.6**		**4.8**							
	Regrade embankment shoulders		C-6401, B-6101		D7 Dozer	hrs	9	$191	$1,743	$1,743	$1,743
	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	$15,972	$15,972	$15,972
	Recontour area to bury any footings & provide drainage, in prep for revegetation		C-6401, B-6101		D7 Dozer	hrs	94	$191	$17,892	$17,892	$17,892
	Revegetate		C-6401		Revegetation cost per ha. Including application cost	ha	4.8	$3,347	$16,034	$16,034	$16,034
	Engineering Design				% of Direct Costs	%	8%		$3,873	$3,873	$3,873
								Sub-Total	$55,514	$55,514	$55,514
8.4	**Camp Downsize**	**7.5.7**									
	Dismantle 5 trailer units and transport to Lot 960				Misc.	l.s.	1	$27,729	$27,729	$27,729	$27,729
	Engineering Design				% of Direct Costs	%	8%		$2,080	$2,080	$2,080
								Sub-Total	$29,809	$29,809	$29,809
Total Estimated Cost in Reclaiming Mill and Ancillary Facilities									$602,019	$602,019	$602,019

Table 10-9: Dry Stack Tailings Facility

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Unit Rates	Current Total	Year 2 Total	EOM Total
9.1	**DSTF - Current**	**7.2**		**0.75**					
	Recontour slopes to final design and compact			Equipment hours and productivities from 2014 progressive reclamation tracking	D7 Dozer	$191	$3,060		
					Vibratory Packer	$71	$713		
	Place soil cover and spread (0.5 m thickness)				A30 Haul Truck	$180	$2,880		
					Cat 235 Excavator	$90	$1,080		
					D7 Dozer	$191	$3,060		
	Revegetation				Revegetation Seed Mix - 50kg/ha	$840	$630		
					Fertilizer - 250kg/ha	$528	$396		
					Seed/Fertilizer Application	$1,980	$1,485		
	Engineering Design				% of Direct Costs		$998	$0	$0
						Sub-Total	**$14,301**		
9.2	**DSTF - Year 2**	**7.2**		**2.0**					
	Recontour slopes to final design and compact				D7 Dozer	$191		$7,650	
					Vibratory Packer	$71		$1,140	
	Place soil cover and spread (0.5 m thickness)				A30 Haul Truck	$180		$18,000	
					Cat 235 Excavator	$90		$10,800	
					D7 Dozer	$191		$13,388	
	Revegetation				Revegetation Seed Mix - 50kg/ha	$840		$1,680	
					Fertilizer - 250kg/ha	$528		$1,055	
					Seed/Fertilizer Application	$1,980		$3,960	
	Engineering Design				% of Direct Costs		$0	$4,325	$0
						Sub-Total		**$61,998**	
9.3	**DSTF - EOM**	**7.2**		**7.2**					
	Recontour slopes to final design and compact		C-7401		D7 Dozer	$191			$27,380
					Vibratory Packer	$71			$4,076
	Place soil cover and spread (0.5 m thickness)		C-7401		A30 Haul Truck	$180			$64,350
					Cat 235 Excavator	$90			$38,610
					D7 Dozer	$191			$22,817
	Revegetation		C-7401		Revegetation Seed Mix - 50kg/ha	$840			$6,006
					Fertilizer - 250kg/ha	$528			$3,772
					Seed/Fertilizer Application	$1,980			$14,156
	Engineering Design				% of Direct Costs		$0	$0	$13,587
						Sub-Total			**$194,754**
Total Estimated Cost in Reclaiming DSTF							$14,301	$61,998	$199,244

Table 10-9: Dry Stack Tailings Facility (continued)

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	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	$90			$384
	Place soil cover and spread (0.5 m thickness)				A30 Haul Truck	hrs	11	$180			$2,025
					Cat 235 Excavator	hrs	3	$90			$246
					D7 Dozer	hrs	6	$191			$1,121
	Revegetation				Revegetation Seed Mix - 50kg/ha	ha	0.1	$840			$101
					Fertilizer - 250kg/ha	ha	0.1	$528			$63
					Seed/Fertilizer Application	ha	0.1	$1,980			$238
	Engineering Design				% of Direct Costs	%	8%		$0	$0	$313
								Sub-Total			**$4,490**
Total Estimated Cost in Reclaiming DSTF									**$14,301**	**$61,998**	**$199,244**

Table 10-10: 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	$16,638	$16,638	$16,638	$16,638
	Off-site disposal					l.s.	1	$8,319	$8,319	$8,319	$8,319
	Engineering Design				% of Direct Costs	%	8%		$1,872	$1,872	$1,872
	Sub-Total								$26,828	$26,828	$26,828
10.3	**Contaminated Soils**	**7,6**									
	Test area soils for contamination				Environmental Monitor	hrs	16	$128	$2,041	$2,041	$2,041
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	40	$333	$13,310	$13,310	$13,310
	Excavation and packaging of contaminated soils				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Haul any contaminated soils to nearest Land Treatment Facility					l.s.	1	$11,092	$11,092	$11,092	$11,092
	Engineering Design				% of Direct Costs	%	8%		$2,254	$2,254	$2,254
	Sub-Total								$32,309	$32,309	$32,309
	Total Estimated Cost in Reclaiming Waste Disposal and Remediation								$59,137	$59,137	$59,137

Table 10-11: 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	$90	$1,800	$1,800	$1,800
					General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
	Site Recontouring				D7 Dozer	hrs	12	$191	$2,295	$2,295	$2,295
	Revegetation				Revegetation cost per ha. Including application cost	ha	0.3	$3,347	$1,105	$1,105	$1,105
	Engineering Design				% of Direct Costs	%	8%		$526	$526	$526
								Sub-Total	$7,538	$7,538	$7,538
Total Estimated Cost in Reclaiming Landfills									$7,538	$7,538	$7,538

Table 10-12: 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	$90	$900	$900	$900
					General Labourer	hrs	10	$45	$453	$453	$453
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	16	$90	$1,440	$1,440	$1,440
	Scarify road surface			0.5	Cat 14H grader	hrs	16	$161	$2,580	$2,580	$2,580
	Erosion barrier (50% of length)				Erosion Barrier	m2	500	$3	$1,407	$1,407	$1,407
	Engineering Design				% of Direct Costs	%	8%		$509	$509	$509
								Sub-Total	$7,289	$7,289	$7,289
12.2	**Bellekeno 625 Access**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (3 ea)				Cat 235 Excavator	hrs	12	$90	$1,080	$1,080	$1,080
					General Labourer	hrs	12	$45	$544	$544	$544
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	12	$90	$1,080	$1,080	$1,080
	Scarify road surface			0.25	Cat 14H grader	hrs	16	$161	$2,580	$2,580	$2,580
	Erosion barrier (50% of length)				Erosion Barrier	m2	250	$3	$703	$703	$703
	Engineering Design				% of Direct Costs	%	8%		$449	$449	$449
								Sub-Total	$6,436	$6,436	$6,436
12.3	**Bellekeno Haul Road**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (15 ea)				Cat 235 Excavator	hrs	60	$90	$5,400	$5,400	$5,400
					General Labourer	hrs	60	$45	$2,719	$2,719	$2,719
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	40	$90	$3,600	$3,600	$3,600
	Scarify road surface			5.7	Cat 14H grader	hrs	30	$161	$4,838	$4,838	$4,838
	Erosion barrier (50% of length)				Erosion Barrier	m2	5,700	$3	$16,038	$16,038	$16,038
	Engineering Design				% of Direct Costs	%	8%		$2,445	$2,445	$2,445
								Sub-Total	$35,039	$35,039	$35,039
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	$90	$1,800	$1,800	$1,800
					General Labourer		20	$45	$906	$906	$906
	Reslope banks/remove safety berms				Cat 235 Excavator		24	$90	$2,160	$2,160	$2,160
	Scarify road surface			2.1	Cat 14H grader	hrs	16	$161	$2,580	$2,580	$2,580
	Erosion barrier (50% of length)				Erosion Barrier	hrs	12	$3	$34	$34	$34
	Remove Lightning Creek Bridge (Bellekeno)				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					Tractor Trailer (lowbed)	hrs	12	$250	$2,995	$2,995	$2,995
	Erosion barrier (50% of length)				Erosion Barrier	m2	2,100	$3	$5,909	$5,909	$5,909
	Engineering Design				% of Direct Costs	%	8%		$1,364	$1,364	$1,364
								Sub-Total	$19,547	$19,547	$19,547
12.5	**Christal Lake Road**	**7.7**	**B-0301 & Fig 7-46**								
	Culvert Excavation and install swales (5 ea)				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					General Labourer	hrs	30	$45	$1,360	$1,360	$1,360
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	12	$90	$1,080	$1,080	$1,080
	Scarify road surface			1.3	Cat 14H grader	hrs	16	$161	$2,580	$2,580	$2,580
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,300	$3	$3,658	$3,658	$3,658
	Engineering Design				% of Direct Costs	%	8%		$786	$786	$786
								Sub-Total	$11,263	$11,263	$11,263
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	$90	$3,600	$3,600	$3,600
					General Labourer	hrs	16	$45	$725	$725	$725
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	10	$90	$900	$900	$900
	Scarify road surface			1.2	Cat 14H grader	hrs	12	$161	$1,935	$1,935	$1,935
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,200	$3	$3,376	$3,376	$3,376
	Engineering Design				% of Direct Costs	%	8%		$790	$790	$790
									$11,327	$11,327	$11,327
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	$90	$2,880	$2,880	$2,880
					General Labourer	hrs	16	$45	$725	$725	$725
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	10	$90	$900	$900	$900
	Scarify road surface			2.0	Cat 14H grader	hrs	4	$161	$645	$645	$645
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,979	$3	$5,568	$5,568	$5,568
	Engineering Design				% of Direct Costs	%	8%		$804	$804	$804
								Sub-Total	$11,522	$11,522	$11,522
12.8	**Other Roads and Trails**	**7.7**	**B-0301 & Fig 7-46**								
	Scarify road surface			3.0	Cat 14H grader	hrs	20	$161	$3,225	$3,225	$3,225
	Engineering Design				% of Direct Costs	%	8%		$242	$242	$242
								Sub-Total	$3,467	$3,467	$3,467
Total Estimated Cost for Roads & Trails									$105,890	$105,890	$94,563

Table 10-13: 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	$191	$3,825	$3,825	$3,825
					Cat 235 Excavator	hrs	10	$90	$900	$900	$900
	Recontour Diversion Ditch above Mill Area			285	D7 Dozer	hrs	10	$191	$1,913	$1,913	$1,913
					Cat 235 Excavator	cu.m.	5	$90	$450	$450	$450
	Enhance Diversion Ditch above DSTF, to closure criteria			300	D7 Dozer	hrs	10	$191	$1,913	$1,913	$1,913
					Cat 235 Excavator	cu.m.	5	$90	$450	$450	$450
	Revegetate			1	Erosion barriers	m	500	$3	$1,407	$1,407	$1,407
	Engineering Design				% of Direct Costs	%	8%		$814	$814	$814
								Sub-Total	$11,671	$11,671	$11,671
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	$11,092	$11,092	$11,092	$11,092
	Construct coffer dam				General Labourer	hrs	24	$45	$1,088	$1,088	$1,088
					Trades Labourer	hrs	24	$90	$2,162	$2,162	$2,162
	Concrete Batch				Misc.	cu.m	2	$1,941	$3,882	$3,882	$3,882
					966 loader	hrs	8	$101	$810	$810	$810
	Misc for concrete coffer dam (anchors, drainage pipe, etc)				Misc.	lump sum	1	$5,546	$5,546	$5,546	$5,546
	Remove salvageable equipment				Cat 235 Excavator	hrs	16	$90	$1,440	$1,440	$1,440
					Trades Labourer	hrs	16	$90	$1,442	$1,442	$1,442
	Load & return extra reagents/chemicals				General Labourer	hrs	8	$45	$363	$363	$363
					Misc.		1	$2,218	$2,218	$2,218	$2,218
					Disposal by supplier		1	$2,000	$2,000	$2,000	$2,000
	In mine pool treatment implementation				Misc.	l.s.	1	$44,367	$44,367	$44,367	$44,367
	Characterize settling ponds sediments/sludge				Analytical Costs	Unit Cost	2	$333	$666	$666	$666
	Remove sludge from settling ponds (to underground)				Vacuum Truck	hrs		$166	$0	$0	$0
					General Labourer	hrs		$45	$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	$11,092	$11,092	$11,092	$11,092
	Construct Bellekeno 625 bioreactor		D-2301		A30 Haul Truck	hrs	100	$180	$18,000	$18,000	$18,000
					966 loader	hrs	60	$101	$6,075	$6,075	$6,075
					Cat 235 Excavator	hrs	60	$90	$5,400	$5,400	$5,400
					General Labourer	hrs	60	$45	$2,719	$2,719	$2,719
					Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020
					HDPE Liner Install	per sq. m	1,410	$13	$18,767	$18,767	$18,767
	Operate Bellekeno 625 bioreactor (included in Post Closure)				Misc.	years	10		$0	$0	$0
	Site levelling				D7 Dozer	hrs	25	$191	$4,781	$4,781	$4,781
	Scrap hauled to solid waste facility				A30 Haul Truck	hrs	8	$180	$1,440	$1,440	$1,440
					Cat 235 Excavator	hrs	12	$90	$1,080	$1,080	$1,080
	Haul BK 625 sludge from Valley Tailings to BK East UG				Cat 235 Excavator	hrs	30	$90	$2,700	$2,700	$2,700
					A30 Haul Truck	hrs	40	$180	$7,200	$7,200	$7,200
	Misc. Supplies & Tools				Misc.	l.s.	1	$8,319	$8,319	$8,319	$8,319
	Engineering Design				% of Direct Costs	%	8%		$12,425	$12,425	$12,425
								Sub-Total	$178,093	$178,093	$178,093

Table 10-13: 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	$333	$1,997	$1,997	$1,997
					General Labourer	hrs	10	$45	$453	$453	$453
					Environmental Monitor	hrs	10	$128	$1,276	$1,276	$1,276
	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 (10 years) costs included in Care and Maintenance (T.15.3.2)										
	Construct outlet channel				Cat 235 Excavator	hrs	20	$90	$1,800	$1,800	$1,800
					D7 Dozer	hrs	20	$191	$3,825	$3,825	$3,825
					Place rip rap	cu.m.	5	$1,386	$6,932	$6,932	$6,932
					General Labourer	hrs	30	$45	$1,360	$1,360	$1,360
	Engineering Design				% of Direct Costs	%	8%		$1,323	$1,323	$1,323
								Sub-Total	**$18,965**	**$18,965**	**$18,965**
13.5	**Flame and Moth Water Management**	**7.4.3**									
	Pump down collected water				General Labourer	hrs	36	$45	$1,632	$1,632	$1,632
					Pump	daily	3	$111	$333	$333	$333
	Misc. Supplies and Tools				Misc.	l.s.	1	$1,109	$1,109	$1,109	$1,109
	Characterize pond sediments/sludge				Analytical Costs	Unit Cost	2	$333	$666	$666	$666
					General Labourer	hrs	2	$45	$91	$91	$91
	Remove pond sediments/sludge (240 m3)				Vacuum Truck	hrs	16	$166	$2,662	$2,662	$2,662
					General Labourer	hrs	16	$45	$725	$725	$725
	Breach dyke				D7 Dozer	hrs	4	$191	$765	$765	$765
	Remove & bury HDPE liner (1620 m2)				General Labourer	hrs	40	$45	$1,813	$1,813	$1,813
					Cat 235 Excavator	hrs	12	$90	$1,080	$1,080	$1,080
					A30 Haul Truck	hrs	4	$180	$720	$720	$720
	Recontour area				D7 Dozer	hrs	30	$191	$5,738	$5,738	$5,738
			C-6401		Cat 235 Excavator	hrs	30	$90	$2,700	$2,700	$2,700
	Stabilize slopes with erosion barriers				Cat 235 Excavator	hrs	30	$90	$2,700	$2,700	$2,700
					Erosion Barrier	per sq. m	100	$3			$281
	Remove discharge pipeline				General Labourer	hrs	30	$45	$1,360	$1,360	$1,360
	Discharge pond inventory (5,000 m3)				Analytical Costs	Unit Cost	6	$333	$1,997	$1,997	$1,997
	Engineering Design				% of Direct Costs	%	8%		$1,957	$1,957	$1,978
								Sub-Total	**$28,045**	**$28,045**	**$28,347**

Table 10-13: 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	$45	$453	$453	$453
					Pump	daily	6	$111	$666	$666	$666
	Misc. Supplies and Tools				Misc.	l.s.	1	$832	$832	$832	$832
	Characterize pond sediments/sludge				Analytical Costs	Unit Cost	2	$333	$666	$666	$666
					Environmental Monitor	hrs	8	$128	$1,020	$1,020	$1,020
	Remove pond sediments/sludge				Vacuum Truck	hrs	8	$166	$1,331	$1,331	$1,331
					General Labourer	hrs	12	$45	$544	$544	$544
	Remove & bury HDPE liner				General Labourer	hrs	12	$45	$544	$544	$544
					Cat 235 Excavator	hrs	8	$90	$720	$720	$720
					A30 Haul Truck	hrs	4	$180	$720	$720	$720
	~~In mine pool treatment implementation~~	-	-	-	~~Misc.~~	~~l.s.~~	—	~~$40,000~~	~~$0~~	~~$0~~	~~$0~~
	Recontour area				D7 Dozer	hrs	8	$191	$1,530	$1,530	$1,530
	Stabilize slopes with erosion barriers				Cat 235 Excavator	hrs	8	$90	$720	$720	$720
					Erosion Barrier	per sq. m	200	$2.81	$563	$563	$563
	Remove discharge pipeline				General Labourer	hrs	6	$45	$272	$272	$272
	Engineering Design				% of Direct Costs	%	8%		$793	$793	$793
								Sub-Total	**$11,373**	**$11,373**	**$11,373**
Total Estimated Cost in Water and Solutions Management									**$248,147**	**$248,147**	**$248,450**

Table 10-14: 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	$1,080	$788,400
	Extra Personnel					
	Electrician (3 days every other month)	Trades Labourer	$/hr	432	$90	$38,921
	Mechanic (3 days every other month)	Trades Labourer	$/hr	432	$90	$38,921
	Supervisor (5 days/month on site)	Site Supervisor	$/day	120	$1,240	$148,755
	Camp Costs					
	for above personnel	Camp Cost	mandays	994	$68	$67,592
	Employee Transport Costs					
	Driving in allowance (Whitehorse based)	Employee Transport Costs	monthly	6	$3,882	$23,293
	Driving in allowance (Mayo based)	Employee Transport Costs	monthly	18	$2,218	$39,930
					Sub-total Personnel	**$1,145,812**
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	$3,328	$79,860
	Fuel (500 l/month)	Misc.	$/litre	12,000	$1.75	$21,000
	Power and heat	Power and Heat	monthly	24	$10,000	$240,000
	General Administrative expenses	Unit Cost Basis	monthly	24	$2,218	$53,240
					Sub-total Misc.	**$394,100**
					Total 2 year Interim C&M	**$1,990,753**

Table 10-15: 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	$2,500	$5,400	$10,800			
	Sundry equipment maintenance									
	Post Closure 15 Years			9		$2,773	$24,956			
	Power and heat (na)									
	Post Closure 15 Years			9		$2,773	$24,956			
	General Administrative expenses									
	Post Closure 15 Years			9		$3,605	$32,443			
	Camp Costs/Perdiem									
	Post Closure 15 Years	Unit Cost Basis	man-day	900	$82	$6,120	$61,200			
	Subtotal - Post Closure 15 Years					$15,436	$154,356	$173,517	$163,878	$142,536
15.2	**Transport Costs**									
	Employee transport costs									
	Post Closure 10 Years	Unit Cost Basis	Years	10		$26,620	$399,300			
	Subtotal - Post Closure 15 Years						$399,300	$50,642	$48,344	$43,257
15.3	**Water Treatment Costs**									
15.3.1	Active Treatment (Active treatment at BK 625 & Berm for 1 year)	Misc	monthly							
	Capital Costs	Misc.	annually							
	Capital Replacement Costs	Misc.	annually							
	Operating Costs	Misc.	annually	-			$872,394	$872,394	$872,394	$872,394
15.3.2	Passive Treatment (*In situ* + bioreactor)									
	Capital Costs (Bellekeno & Mill Pond)	Misc.	ls	1			$122,008	$122,008	$122,008	$122,008
	Capital Costs (Bermingham)						$44,367	$44,367	$40,000	$40,000
	Operation and Maintenance Costs	Misc.	annually	15		$12,251	$183,767	$140,382	$131,877	$113,043
	Subtotal - Post Closure 15 Years						$1,222,536	$1,179,151	$1,166,279	$1,147,445
15.4	**Reclamation & Closure Research Plan**									
	Reclamation & Closure Research Plan	Misc.	annually	-	$0	$0	$0			
	Subtotal - Post Closure 15 Years						**$0**		**$0**	**$0**
15.5	**Monitoring & Reporting (Sec 7.9)**									
15.5.1	Disbursements (non-labour/non-analytical)	Misc.	annually	15		$5,028	$75,423	$59,265	$56,385	$50,007
15.5.2	Water Quality Monitoring									
	Active Closure 2 year + Post Closure Years 1-5	Misc.	each	188		$83,188	$582,313	$503,979	$481,167	$430,654
	Post Closure Years 6-15	Misc.	each	126		$35,493	$177,467	$114,977	$107,208	$90,005
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	$38,821	$33,599	$32,078	$28,710
	Post Closure Years 6-15	Misc.	annually	8	$4,000	$4,000	$11,092	$7,554	$13,167	$11,054
	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		$4,067	$61,004	$47,719	$45,244	$39,764
15.5.6	Reclamation Inspections:									
	Active Closure + Post Closure Years 1-15	Misc.	annually	15		$4,067	$61,004	$47,719	$45,244	$39,764
15.5.7	Site Maintenance									
	Active Closure + Post Closure Years 1-15	Misc.	each	15		$3,438	$51,576	$41,187	$39,154	$34,651
15.5.8	Annual Inspection + report - Active and Post Closure yrs 1-15	Misc.	annually	15		$4,000	$66,550	$49,874	$47,104	$40,969
						Sub-Total	$1,131,490	$908,994	$869,870	$771,819
Total Estimated Cost for Compliance Monitoring and Reporting							$2,907,682	$2,312,304	$2,248,372	$2,105,056

Bellekeno 625 & New Bermingham Active Water Treatment	
Manpower: as per Alexco	2,773
Vacuum truck:every 3d for 3hrs@ $120/hr	3,993
Camp costs: 1/4 manday/d, 30d/mo @ $65/d	488
Lime: as per Alexco	1,997
Ferric chloride	
Power: as per Alexco	2,773
Mntce of facilities: as per Alexco	666
Replacement of equipment & parts @ $4k/yr	369
WQ analyses, internal 2/wk @ $200 each	1,775
Winter road access: grader 3h/wk x 6mo/yr @$270/hr	1,620
Misc Supplies: consumables	222
Other (9%)	1,501
Treatment Operation at Bellekeno 625 / month	$18,175

Table 10-17: 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	3235										808.75	808.75			808.75	808.75														
Equipment Operator	6257										1564.186	1564.186			1564.186	1564.186														
Trades Labourer	1984										496	496			496	496														
Site Supervisor	2754									459	459	459		459	459	459														
Design Engineer	547										136.6512	136.6512			136.6512	136.6512														
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	9117	269	269	269	269	269	269	269	269	200	200	200	200	200	200	200	200	774	774	774	774	774	209	296	209	296	209	296	209	296
Camp mandays/month	147	82	82	82	82	82	82	82	82	109	137	137	80	109	137	137	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

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Appendix 1

Reclamation Research Summary Reports

Appendix 1.1

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

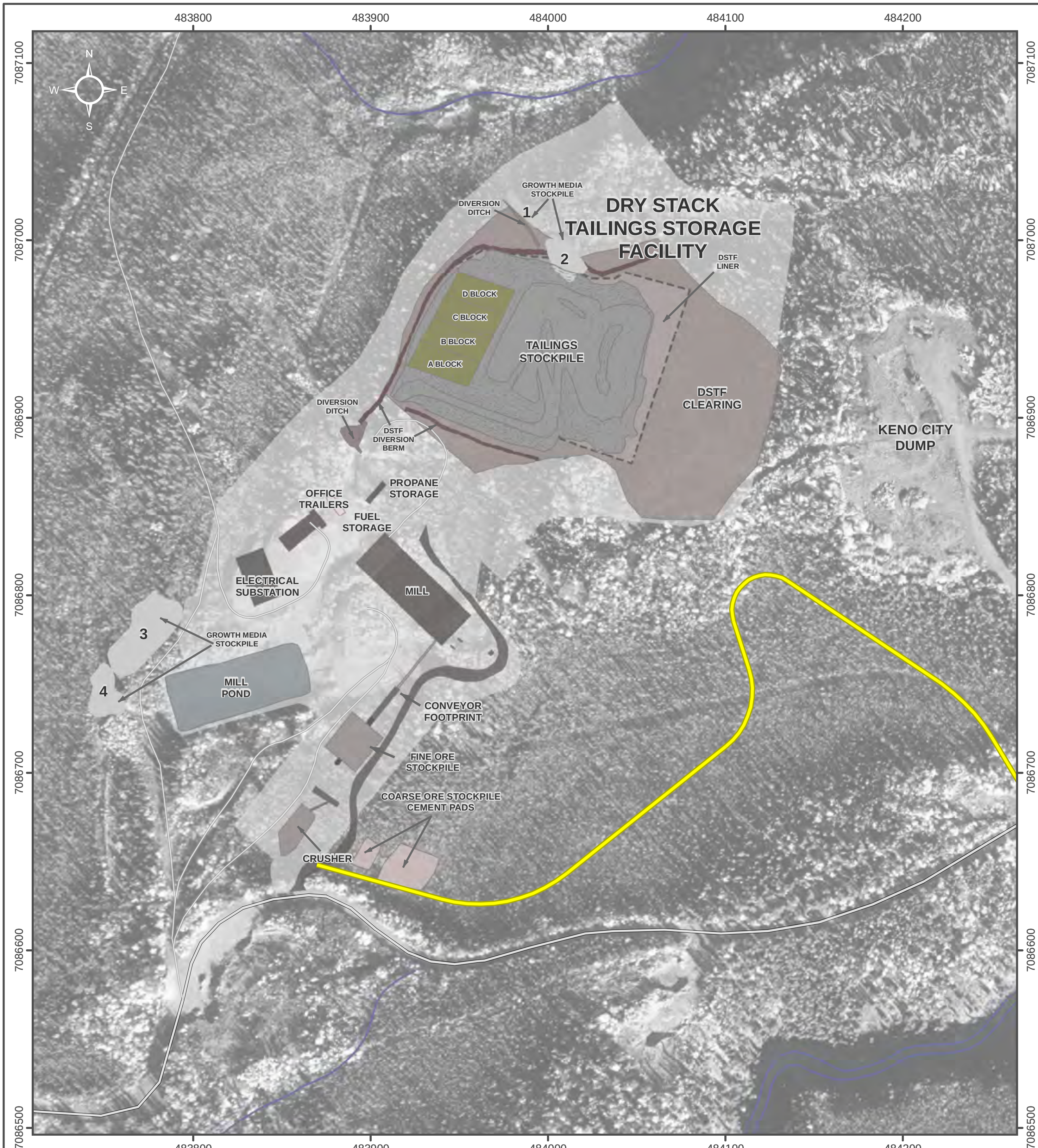
Re: 2012 Dry Stack Tailings Facility Cover Trial

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

ALEXCO KENO HILL MINING CORP.

FIGURE 1
DSTF VEGETATION COVER TRIAL 2012

AKHM ACCESS

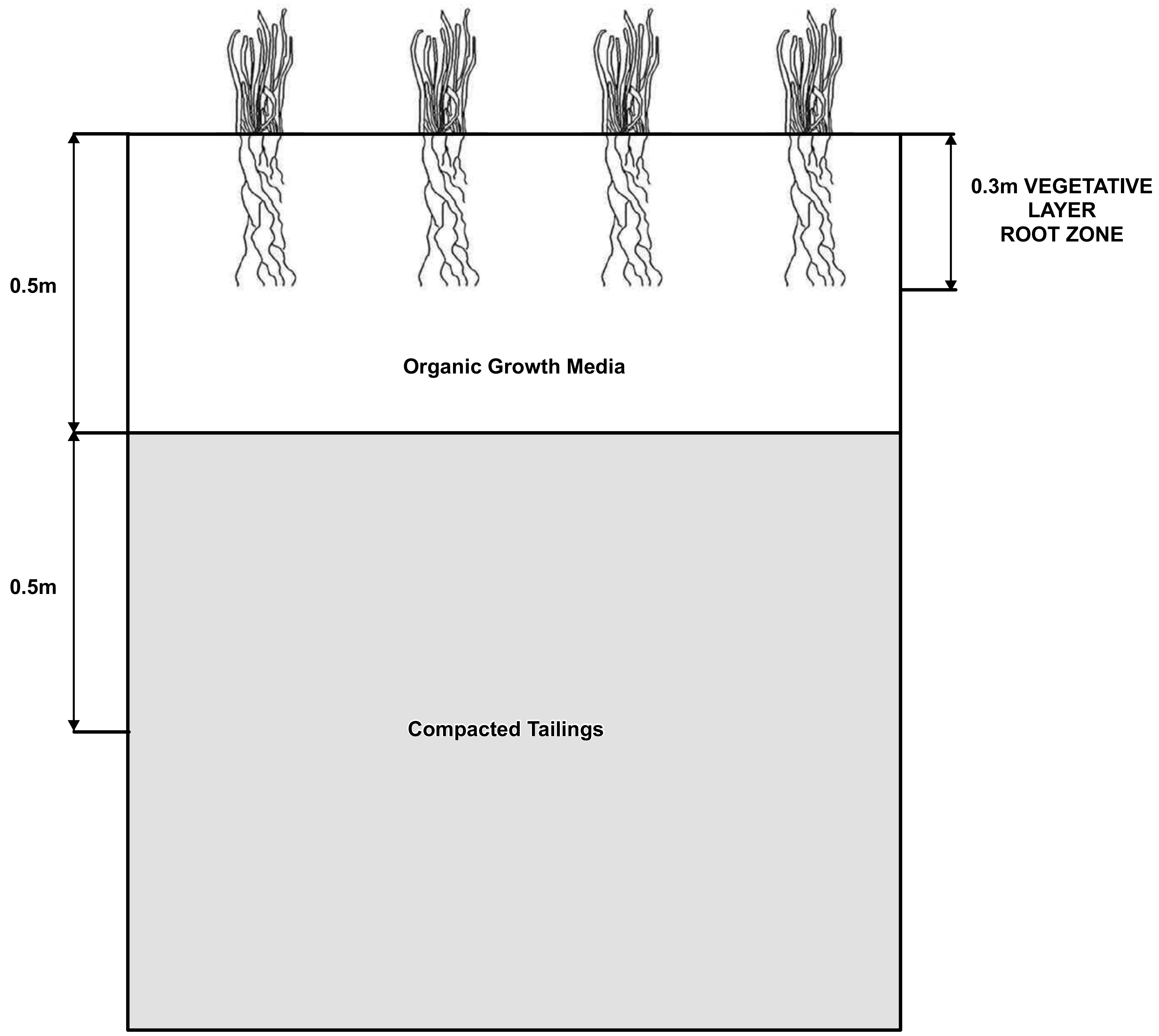
MARCH 2013

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

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.

AKHM

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

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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

==
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 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 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 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

Package 1	1.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

General Comments

.

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 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 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 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

PAGE 1 OF 1

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):	PROJECT MANAGER:	LABORATORY CONTACT:
Lisa Knight	Scott Davidson	Lanoy Luangkhamdeng

#	FIELD SAMPLE ID	MAXXAM LAB # (LAB USE ONLY)	GROUNDWATER	SURFACE WATER	DRINKING WATER	SOIL	OTHER	DATE DD/MM/YY	TIME	# CONTAINERS	ICP Metals	pH/EC	Texture	TOC	C:N Ration	CEC	Total N	Nutrients	Phosphorus
1	WP1 (DSTF)	DL5561				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:

	DATE: DD/MM/YY	TIME:	
RELINQUISHED BY SAMPLER:			RECEIVED BY:
RELINQUISHED BY:	18/05/12	08:30	RECEIVED BY: Nicole Lockyer
RELINQUISHED BY: Lisa Knight			RECEIVED BY LABORATORY:

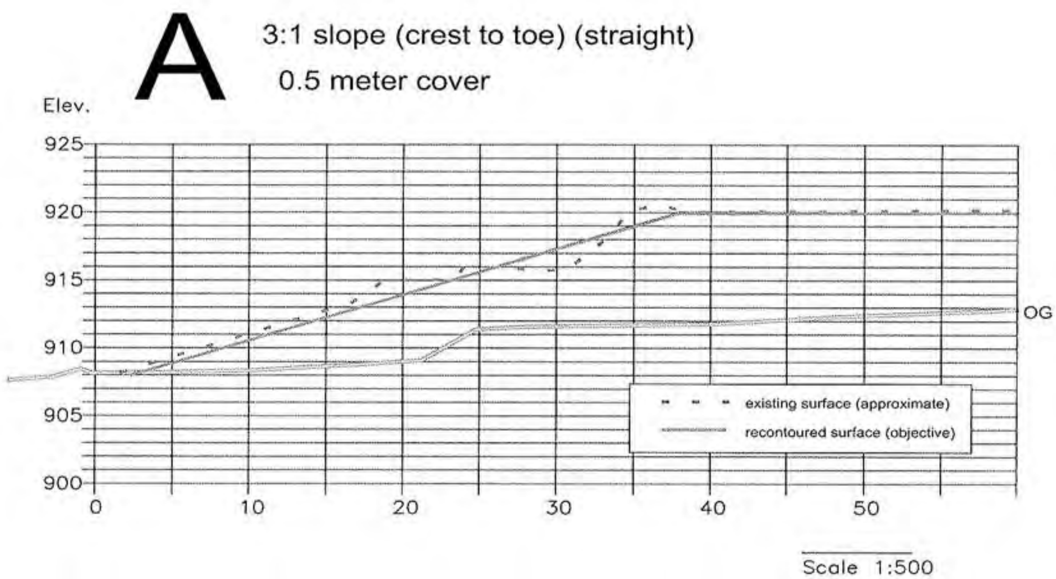
CUSTODY RECORD

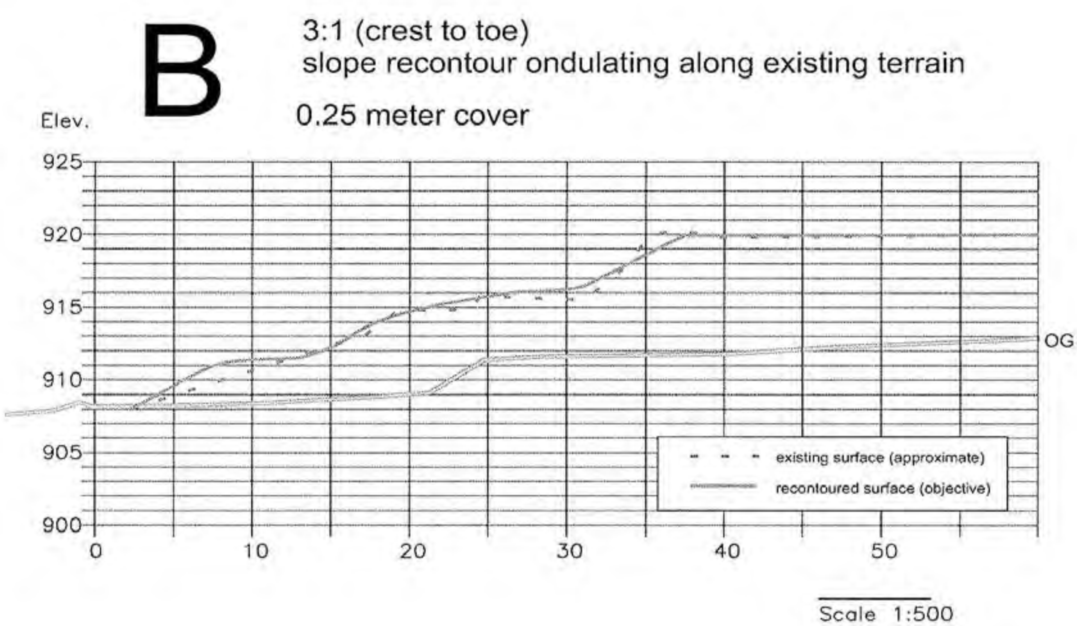
COCFORM - BC - 20070882

APPENDIX B

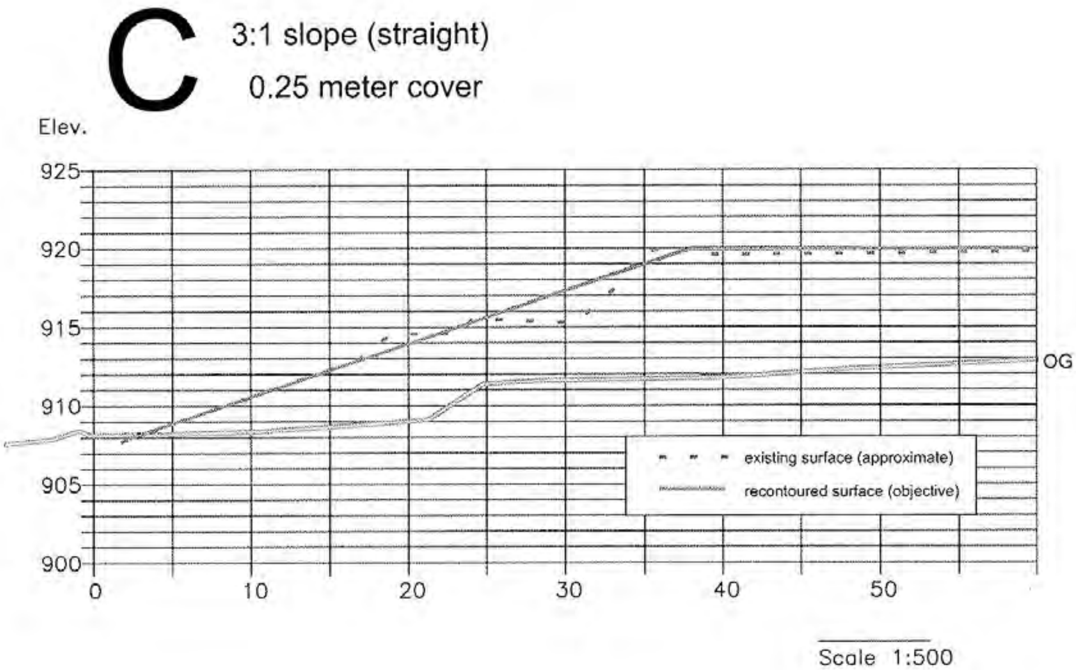
BLOCK PROFILES

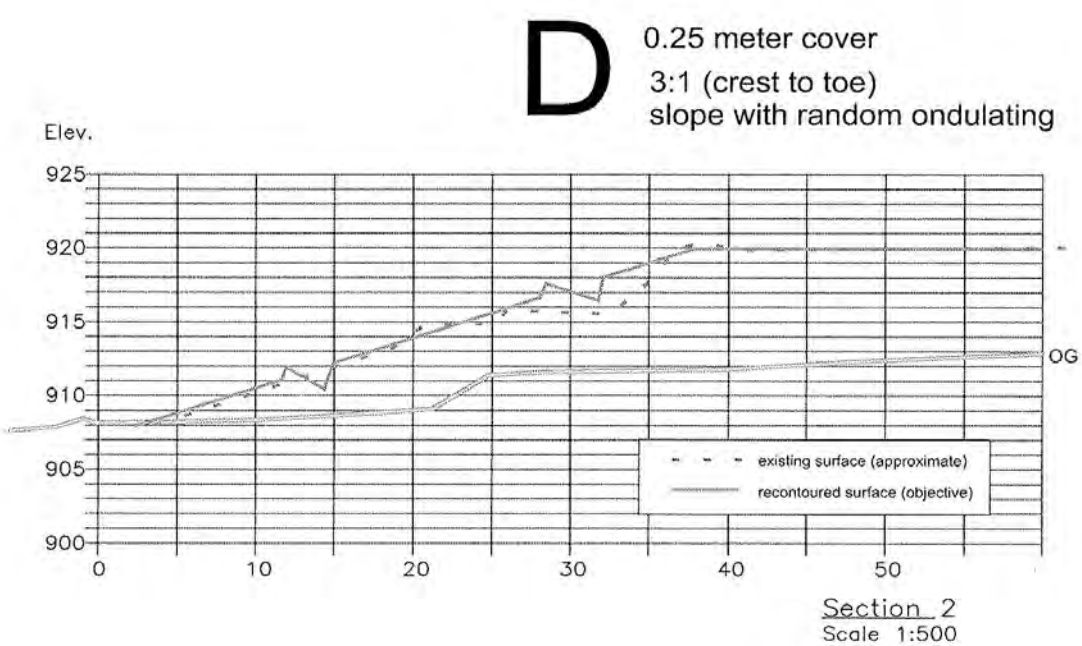
DSTF Phase I Reclamation - Slope Profiles





I


C
3:1 slope (straight)
0.25 meter cover
Elev.
925
920
915
910
905
900
0
10
20
30
40
50
OG
existing surface (approximate)
recontoured surface (objective)
Scale 1:500


D
0.25 meter cover
3:1 (crest to toe)
slope with random ondulating
Elev.
925
920
915
910
905
900
0
10
20
30
40
50
OG
existing surface (approximate)
recontoured surface (objective)
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

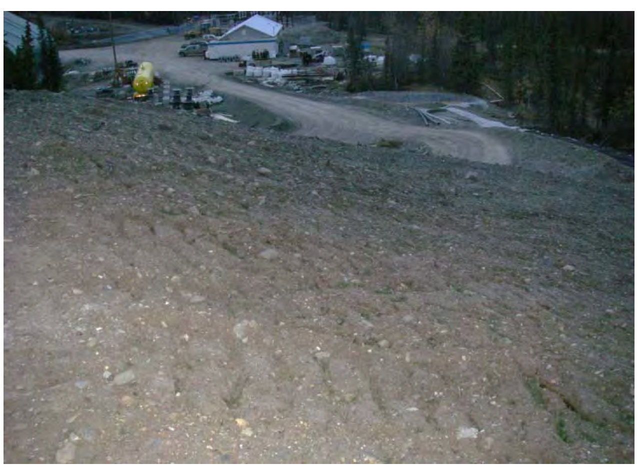


Photo 11: Grass sprouts DSTF looking south from crest

Photo 12: Grass sprouts DSTF looking west from crest

APPENDIX 1.2

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

---

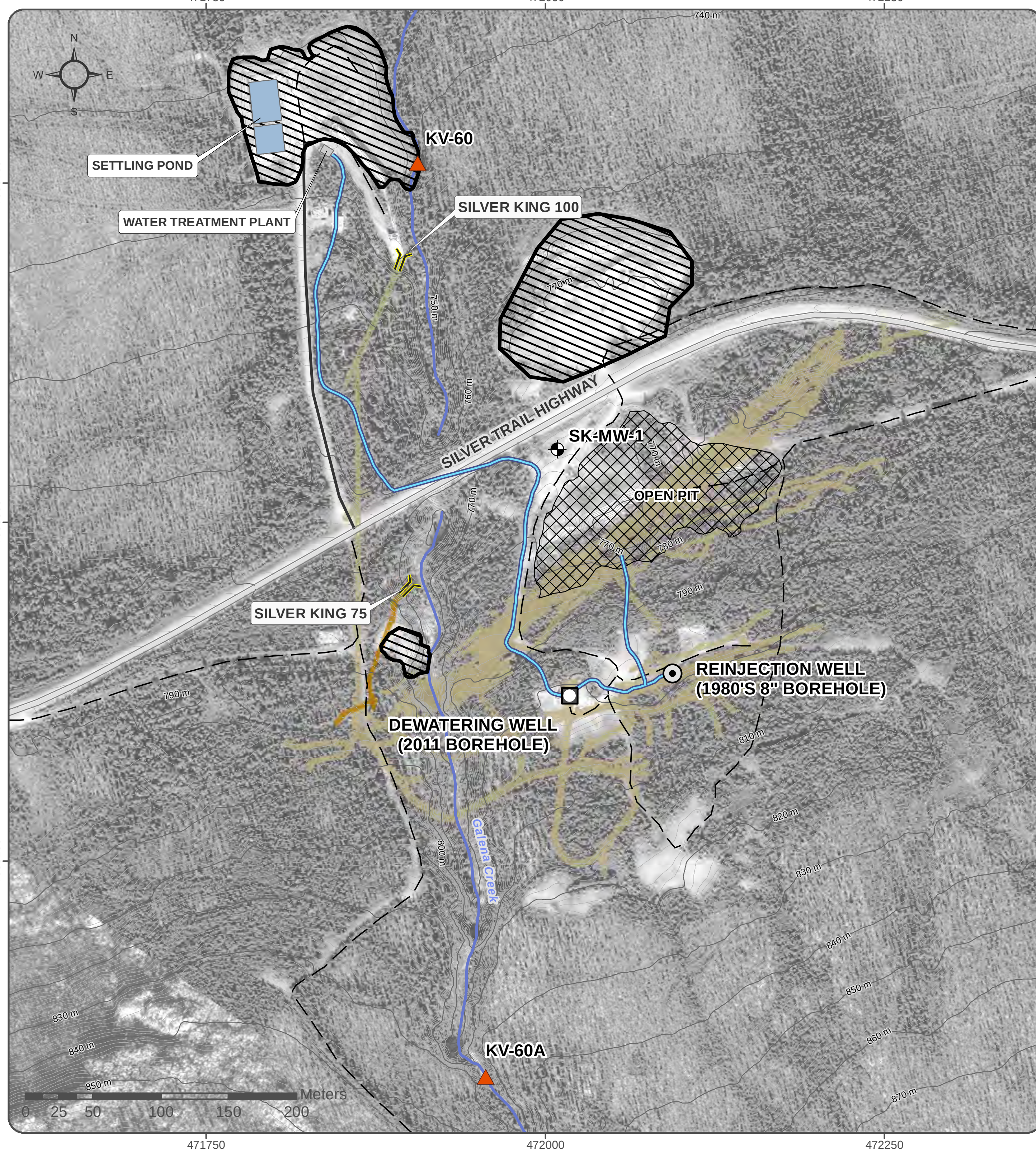
1 Introduction

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

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.

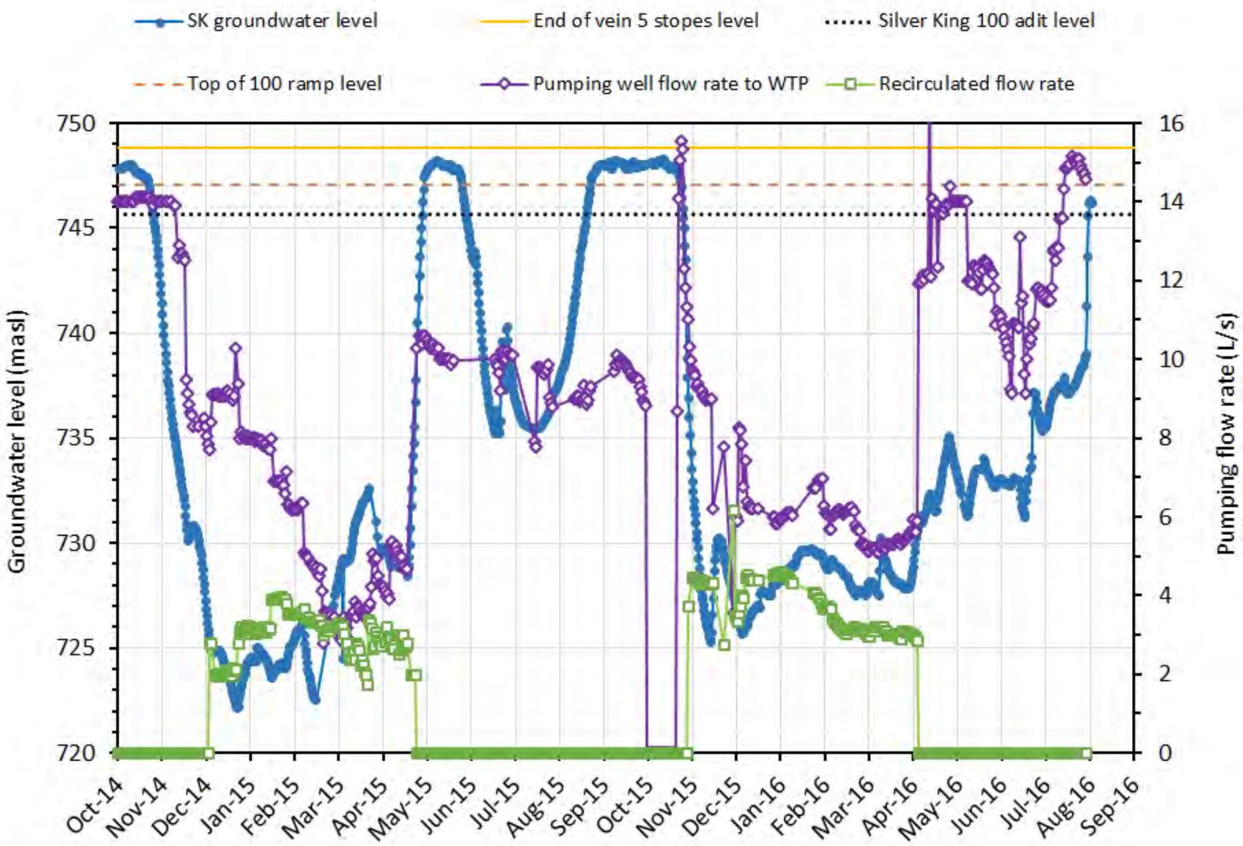


Figure 2-2: Response of groundwater level in SK mine pool during dewatering only and dewatering-recirculation phases of testing at different pumping flow rates. The level of the end of the Vein 5 stopes, top of the 100 ramp and SK100 adit are shown for reference.

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).

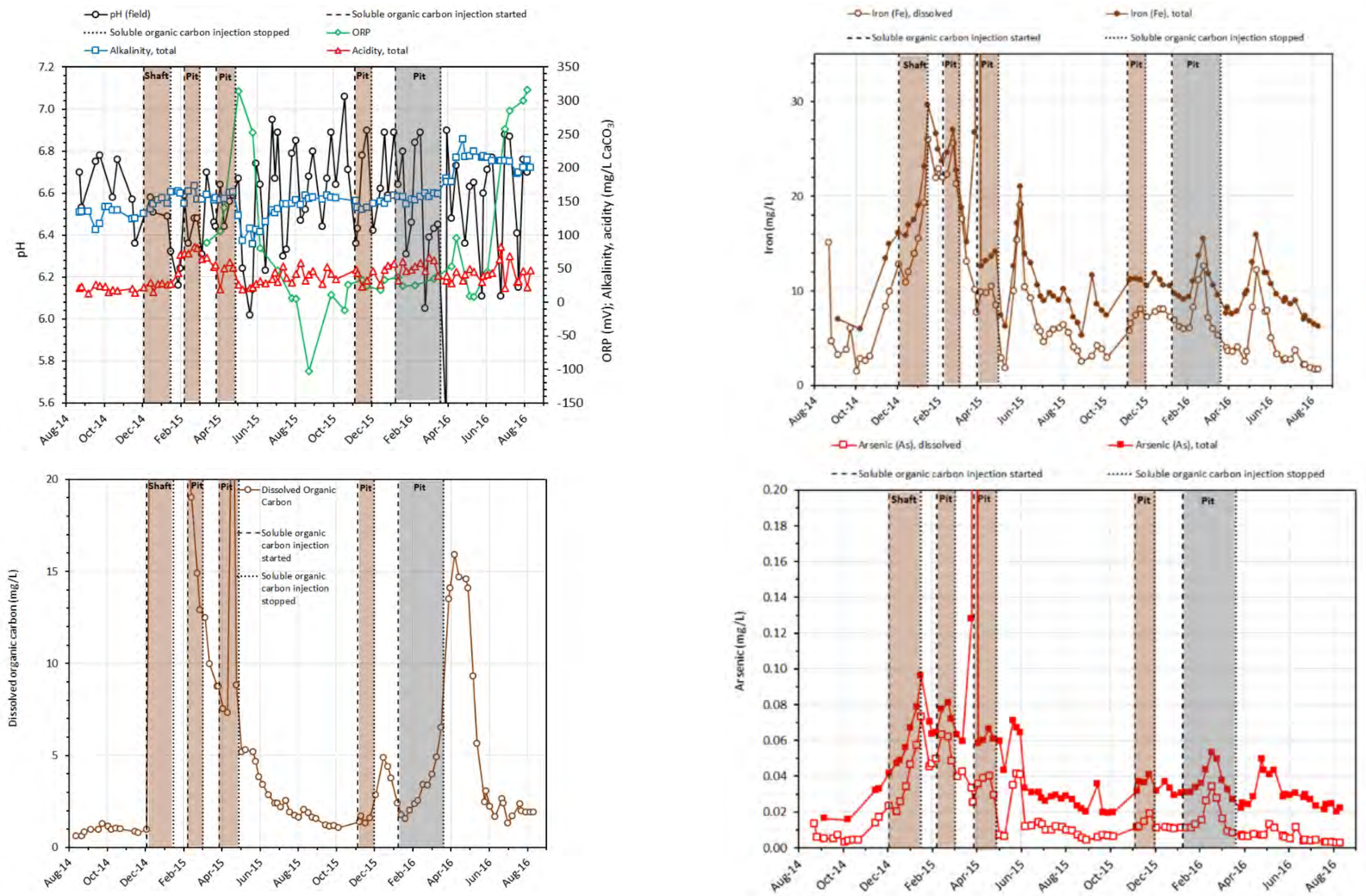


Figure 2-3: Change in selected constituents in SK mine pool water (collected via the dewatering borehole) during the dewatering and molasses amendment phases of the in situ mine pool treatment testing. The shaded areas indicate when continuous injection of molasses (brown) or methanol (grey) was ongoing with recirculation to either the shaft or pit; data collected prior to this were sampled when the mine pool was undergoing dewatering only.

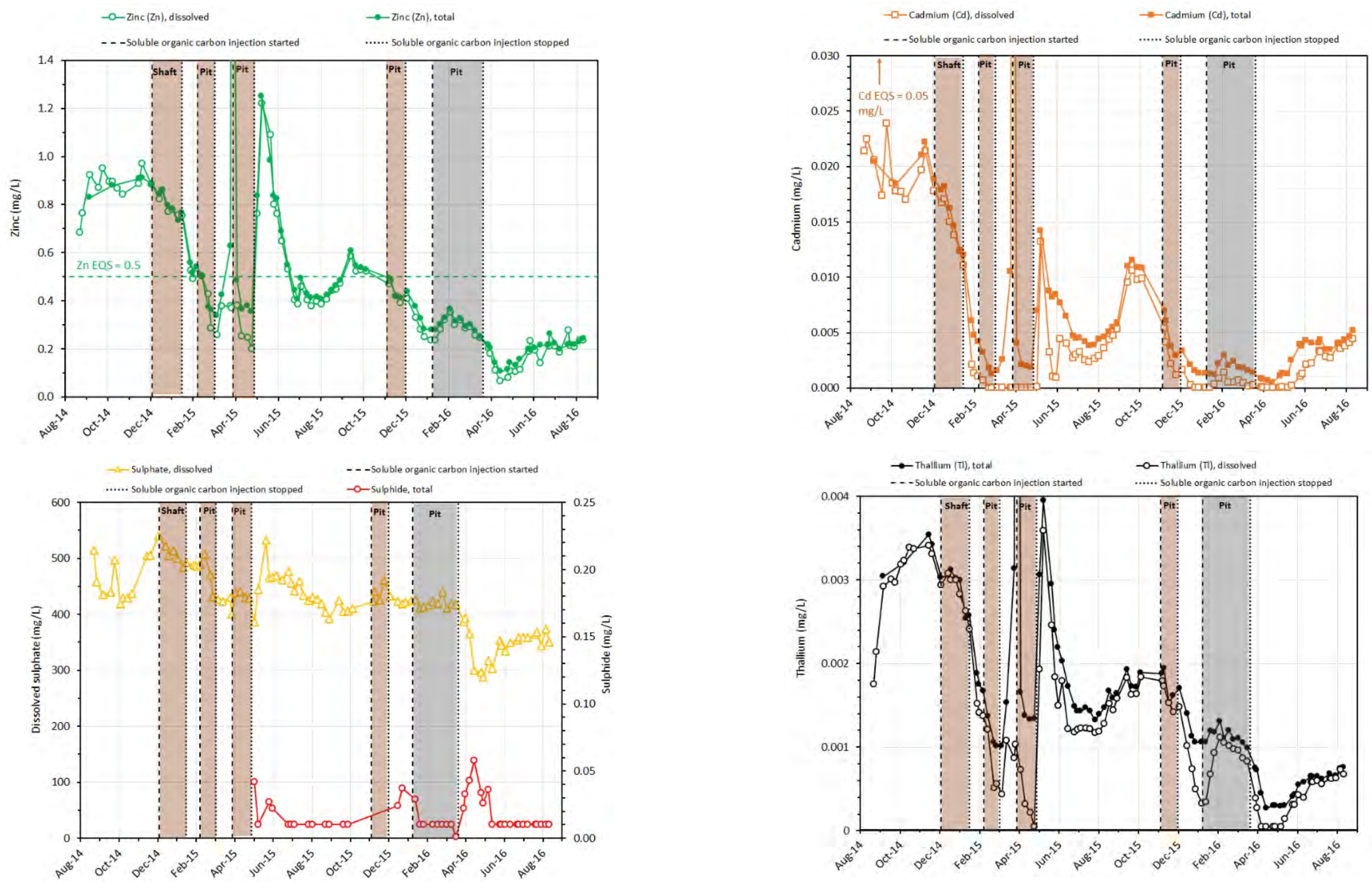


Figure 2-4: Change in zinc, cadmium, sulphur species, and thallium concentrations in SK mine pool water (collected via the 2011 dewatering borehole) during the dewatering and molasses amendment phases of the in situ mine pool treatment testing. The shaded areas indicate when continuous injection of molasses (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.

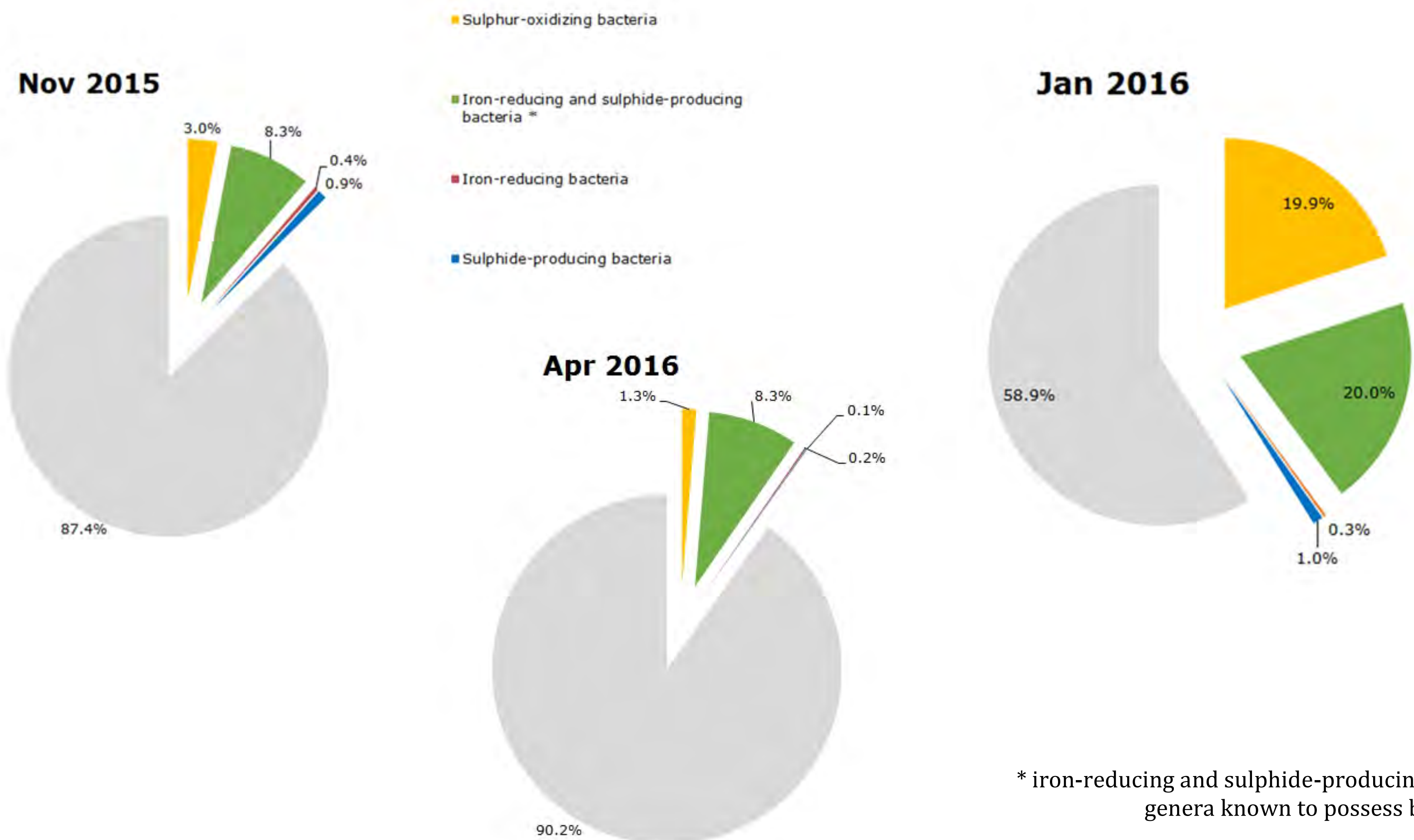
2.3 SILVER KING MINE POOL MICROBIOLOGY

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.

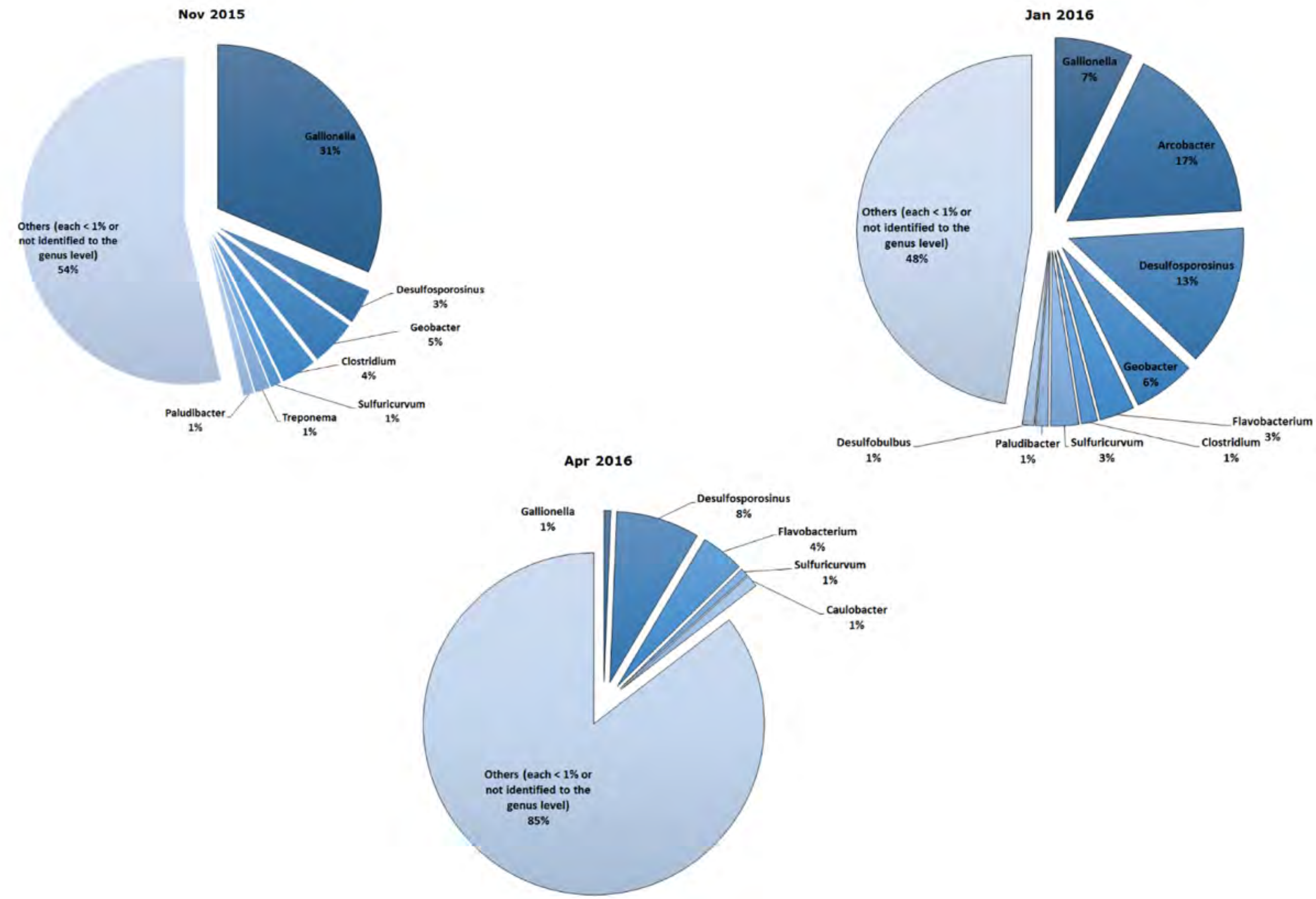


Figure 2-6: Highest percentage of organisms identified to genus level for November 2015, January 2016, and April 2016 sampling events

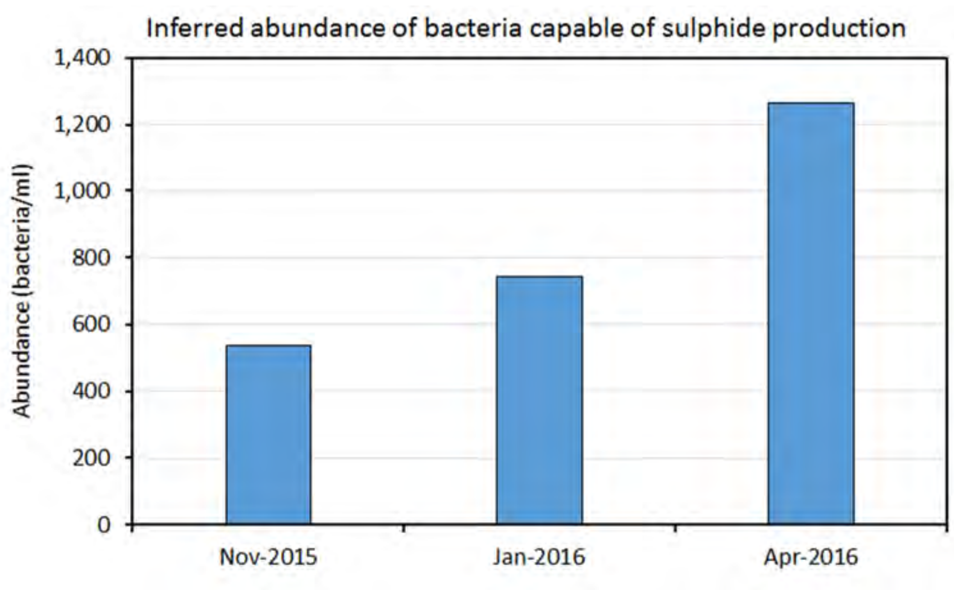


Figure 2-7: Inferred abundance of microorganisms with ability to produce sulphide determined for November 2015, January 2016, and April 2016 sampling events

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 $\delta^{34}S$-SO_4 ratio between January and mid February, 2016, however, the $\delta^{34}S$-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 $\delta^{34}S$-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 $\delta^{34}S$-SO_4 measurements in identifying microbially mediated sulphate reduction in this system.

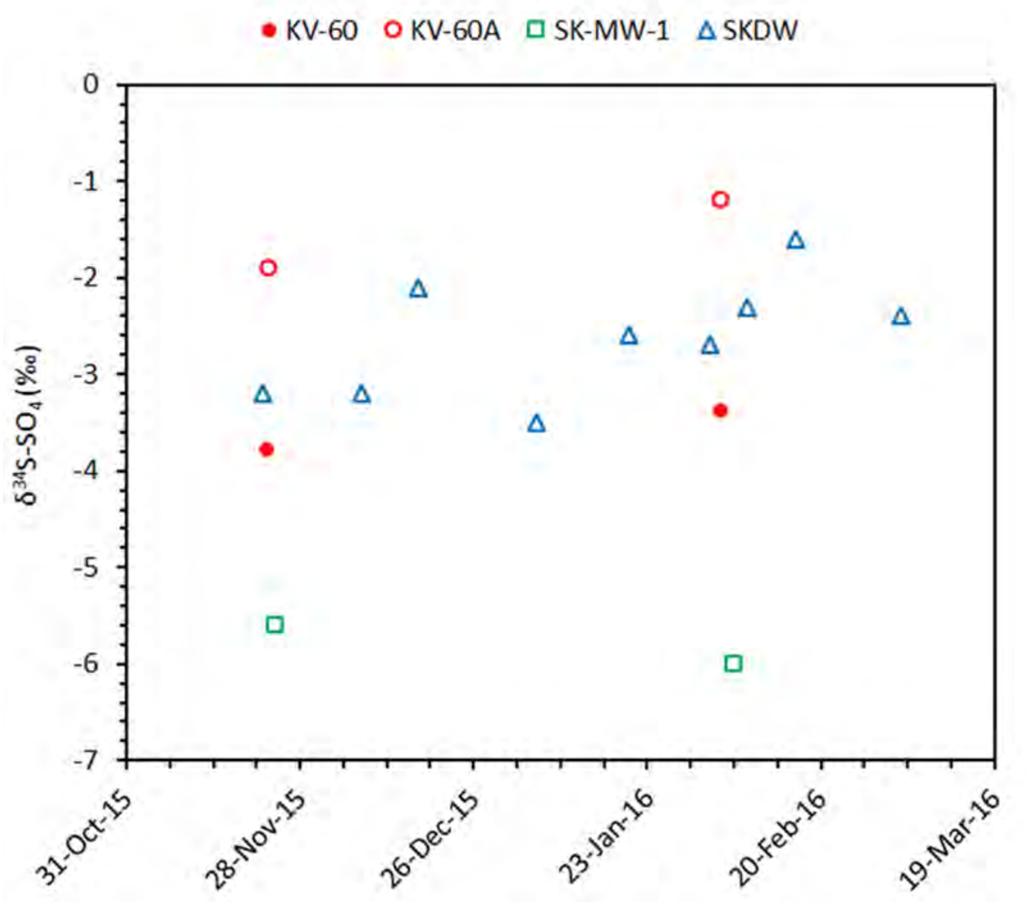


Figure 2-8: $\delta^{34}S$-SO_4 measurements from water samples collected from Galena Creek (KV-60 and KV-60A), the flooded SK mine workings (SKDW), and local groundwater (SK-MW-1).

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.

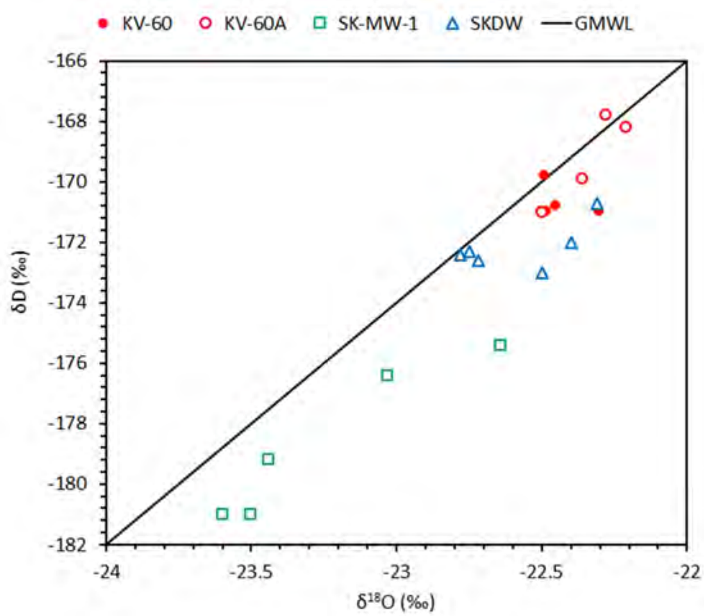


Figure 2-9: δD versus $\delta^{18}O$ plot of water samples from Galena Creek (KV-60 and KV-60A), the flooded SK mine workings (SKDW), and local groundwater (SK-MW-1).

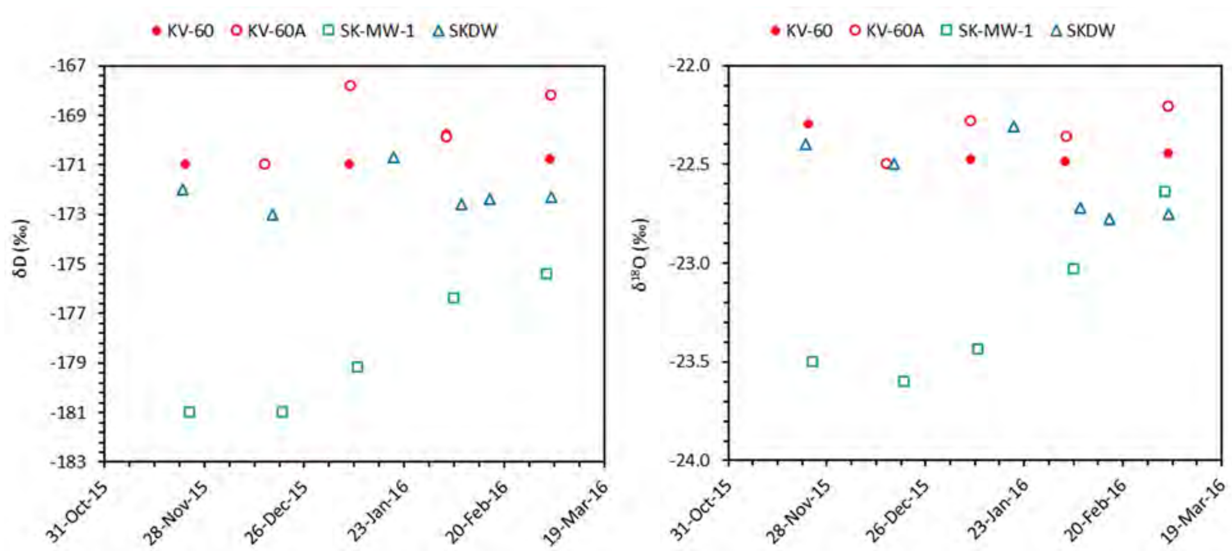


Figure 2-10: Temporal changes in hydrogen (left) and oxygen (right) isotope ratios measured in water samples collected from Galena Creek (KV-60 and KV-60A), the flooded SK mine workings (SKDW), and local groundwater (SK-MW-1).

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:

$$x*\delta D_{KV\text{-}60A} + (1-x)*\delta D_{SK\text{-}MW\text{-}1} = \delta D_{SKDW}$$

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 1.3

SILVER KING IN SITU TREATMENT PILOT – 2023 UPDATE

Memorandum

To: Elsa Reclamation and Development Company Ltd.

From: Andrew Gault, Ensero Solutions Canada, Inc.

CC: Kai Woloshyn, Ensero Solutions Canada, Inc.

Date: March 28, 2023

Deliverable: 2022-23-001-2_49

Re: Silver King In Situ Treatment Pilot – 2022 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 (SK) 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 2021 (Ensero, 2022). This memorandum provides an overview of the work performed and results collected for the SK *in situ* treatment test between January and December of 2022.

2 2022

2.1 OPERATIONS

No significant operations associated with the *in situ* treatment pilot were performed in 2022 other than routine water quality monitoring of the 100 (SK100) level adit discharge. There were no changes to the buildings, equipment, or infrastructure during this period.

On May 7, May 18, Site staff observed that the culvert on the south side of the Silver Trail Highway, near the Silver King water treatment plant (WTP), was blocked. This resulted in pooling of water on the upstream side of Galena Creek but no water was observed to collect on the downstream side. Water was observed to flood around the SK75 adit. Although this adit is plugged, the floor beneath the plug had eroded such that the pooled water was able to enter the SK mine workings and subsequently discharge from the SK100 adit. This continued for approximately 3 weeks before the culvert was unblocked and flow from the SK100 adit returned to seasonal norms.

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. The carbon injection events typically last three to six weeks and are achieved by mixing a portion of the pumped mine water with molasses or methanol and re-injecting via a historical borehole (SKVR8) that intersects the Vein 5 workings, or the SK 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 maintenance carbon injection event occurred in 2021 to ensure metal concentrations (primarily total zinc) remained below the QZ17-076 effluent quality standards (EQS) in the SK100 adit discharge. Mine water was pumped from the SK dewatering well (SKDW) to the SK open pit at 4 L/s between August 16 and October 15, 2021. Methanol was blended into the pumped mine water at 0.16 L/min. The methanol dosing was accidentally halted between September 15 and 25, 2021. No carbon injection occurred during 2022.

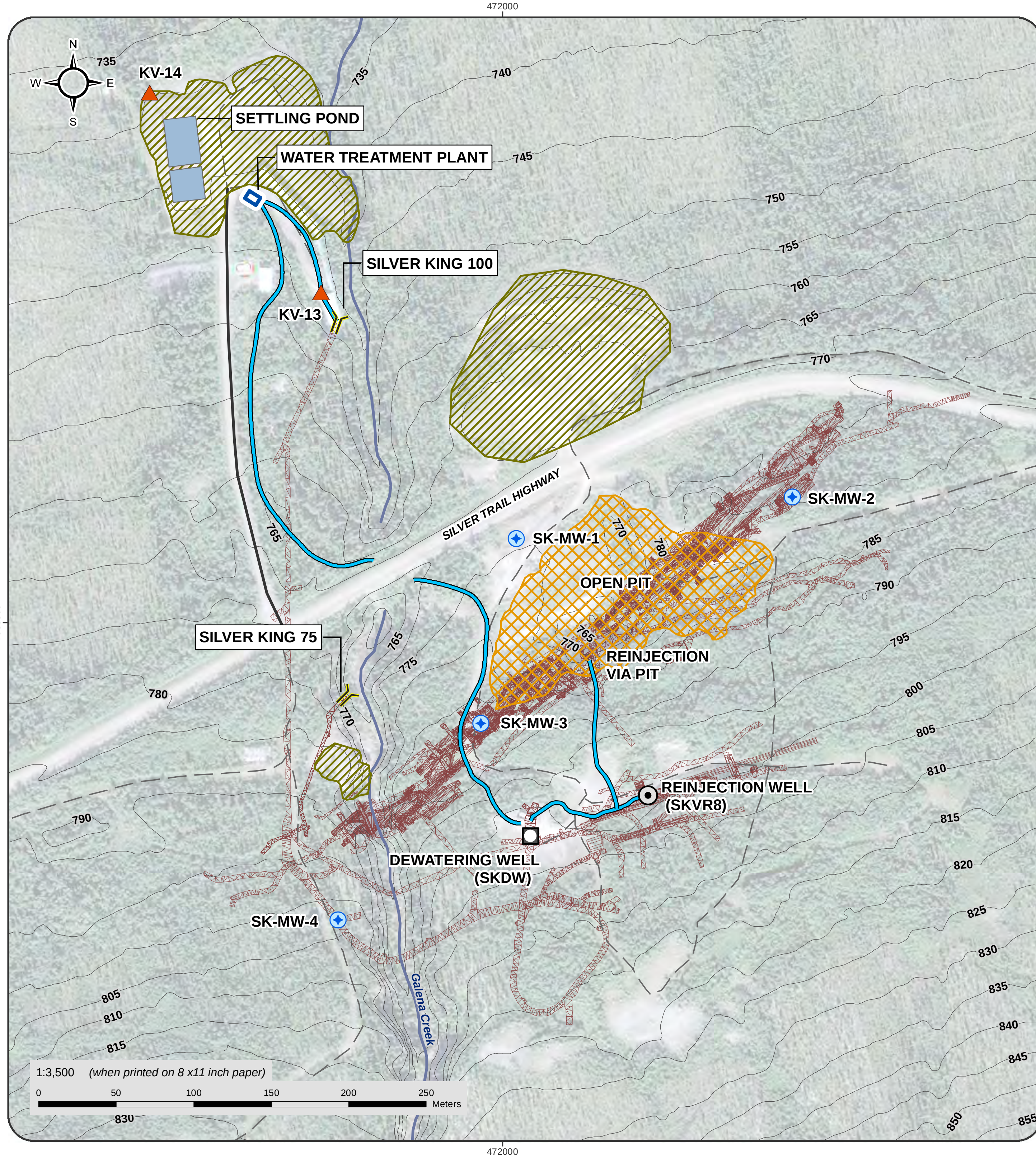
2.3 WATER QUALITY MONITORING

Water quality monitoring of the SK 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. 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 SK mine workings (SK-MW-2, SK-MW-3, and SK-MW-4) was discontinued in 2019. Water quality monitoring related to the *in situ* treatment pilot continues only for the SK 100 adit discharge (station KV-13).

Water quality was sampled monthly. The samples collected were shipped on ice to ALS (Burnaby, BC) for analysis of:

- pH, conductivity;
- Alkalinity;
- Major anions; and
- Total and dissolved metals.

Flow from the SK100 adit was measured regularly (typically daily) by site personnel as part of ongoing Care and Maintenance activities.



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

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3 SK100 ADIT FLOW

The flow recorded from the SK100 adit between 2010 and 2022 is presented in Figure 3-1. 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, 2021), 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 3-1). Flows recorded in 2022 from the SK100 adit were considerably lower than those observed in 2020 (average 8.1 and 11.5 L/s in 2022 and 2020, respectively) and similar to the historical average flow (7.9 L/s for 2008 to 2019 data set; Figure 3-1 and Figure 3-2).

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 95^{th} 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, 2020) 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 (2021) and summarized in Section 4. In contrast, only 2% of daily flow measurements of the SK100 adit discharge exceeded 12.8 L/s in 2022 (Figure 3-1 and Figure 3-2). These occurred during the annual peak flow conditions during spring freshet. Indeed, peak flow (20 L/s) occurred between May 9 and 14, coincident with the flooding event caused by the plugged culvert, consistent with the hypothesis that the ponded water reported to the SK mine workings and was discharged via the SK100 adit. The 20 L/s flow is considered a lower bound given flow monitoring constraints – the actual flow was likely considerably higher.

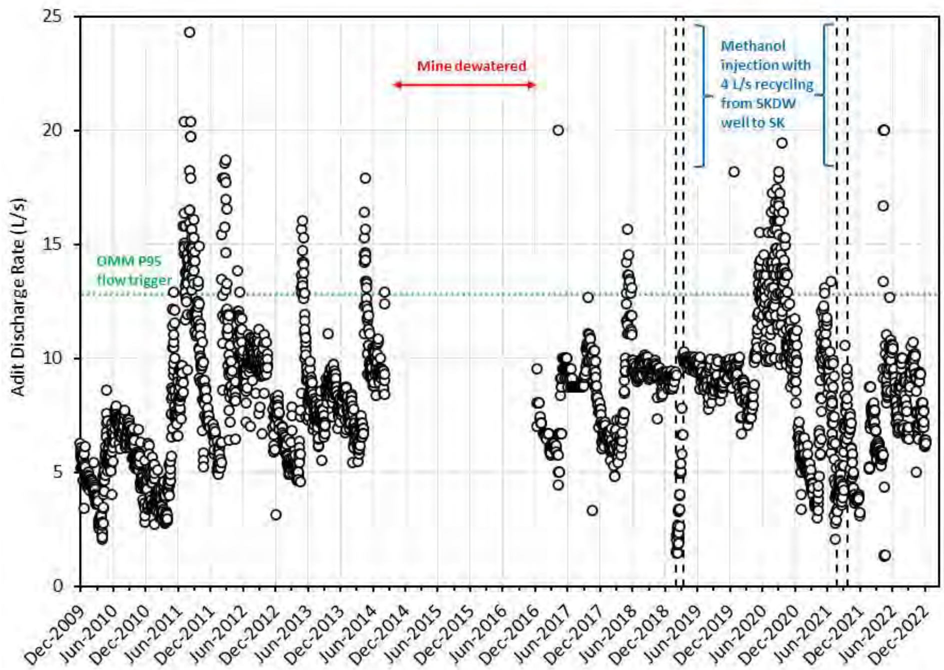

Figure 3-1: Variation in Silver King 100 Adit Discharge Flow Rate Between 2010 and 2022

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.

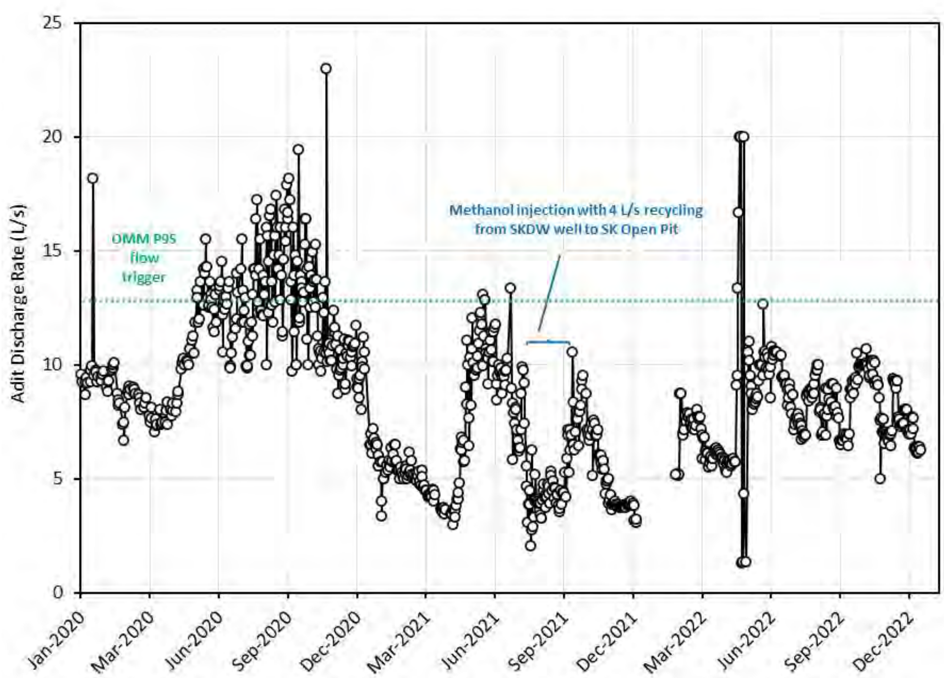

Figure 3-2: Variation in Silver King 100 Adit Discharge Flow Rate in 2020 and 2022

Dotted green horizontal line indicates 95th percentile flow trigger in In Situ Design Operations and Maintenance Manual.

4 CADMIUM AND ZINC IN THE SK100 ADIT DISCHARGE

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. The concentrations of total and dissolved cadmium and zinc in the SK100 adit discharge during the pilot test are presented in Figure 4-1. Although the Care and Maintenance EQS (under Water Licence QZ17-076) apply to total metal concentrations, ERDC has proposed that EQS for the closure of the former United Keno Hill Mines site will apply to the dissolved phase (draft Water Licence QZ21-012). This is consistent with the development of receiving environment water quality goals for the dissolved cadmium and zinc fraction (Minnow, 2020). Furthermore, most total cadmium and zinc in the Silver King 100 discharge is present in dissolved form (Figure 4-1). As such, dissolved cadmium and zinc data are also presented and discussed herein.

The Silver King mine was dewatered 10 to 15 m below the 100-level adit in the first phase of the *in situ* treatment pilot (September 2014 until December 2016) to provide some control on the hydraulic residence time (HRT) within the mine workings. Spikes in the cadmium and zinc concentrations observed in 2015 and 2016 were due to failures of the dewatering pump, which led to rapid flooding of the mine workings with associated diminished HRT (and so less time for treatment). In addition, such flooding may have dissolved soluble metal salts formed on the unsaturated mine workings surfaces under the previously dewatered conditions. Regardless, 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 zinc EQS consistently since December 2015, aside from two slight excursions (both 0.52 mg/L) in October 2020 and July 2022 (Figure 4-1).

A methanol injection occurred between 18 November and 22 December 2016, after which dewatering of the mine was ended and allowed to flood to its static water level and discharge from the SK100 adit. Over the subsequent 24 months, treatment of cadmium and zinc was maintained, including through two spring freshet events (Figure 4-1). The median total cadmium (0.0021 mg/L) and zinc (0.24 mg/L) concentrations observed over this period were 78% and 69% lower than those observed prior to the start of the *in situ* treatment pilot (0.0095 mg/L cadmium and 0.77 mg/L zinc for October 2012 to September 2014 dataset), respectively.

A subsequent methanol injection was performed between late February and early April 2019 to maintain treated conditions within the flooded mine workings. This resulted in a decline in cadmium and zinc levels, which stabilized between July 2019 and May 2020 at median concentrations equivalent to an 89% and 83% reduction compared to pre-pilot test concentrations. Both cadmium and zinc concentrations increased sharply in June 2020 (Figure 4-1), 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 4-1), again related to sustained elevated discharge during the fall (Figure 3-2). 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. The QZ17-076 EQS for total zinc at Silver King (0.5 mg/L) was marginally exceeded for the October 2020 sampling event, although it should be noted that discharge from the 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). Dissolved zinc concentrations remained below the EQS; however, the October 2020 sample (0.495 mg/L) was essentially equivalent to the EQS.

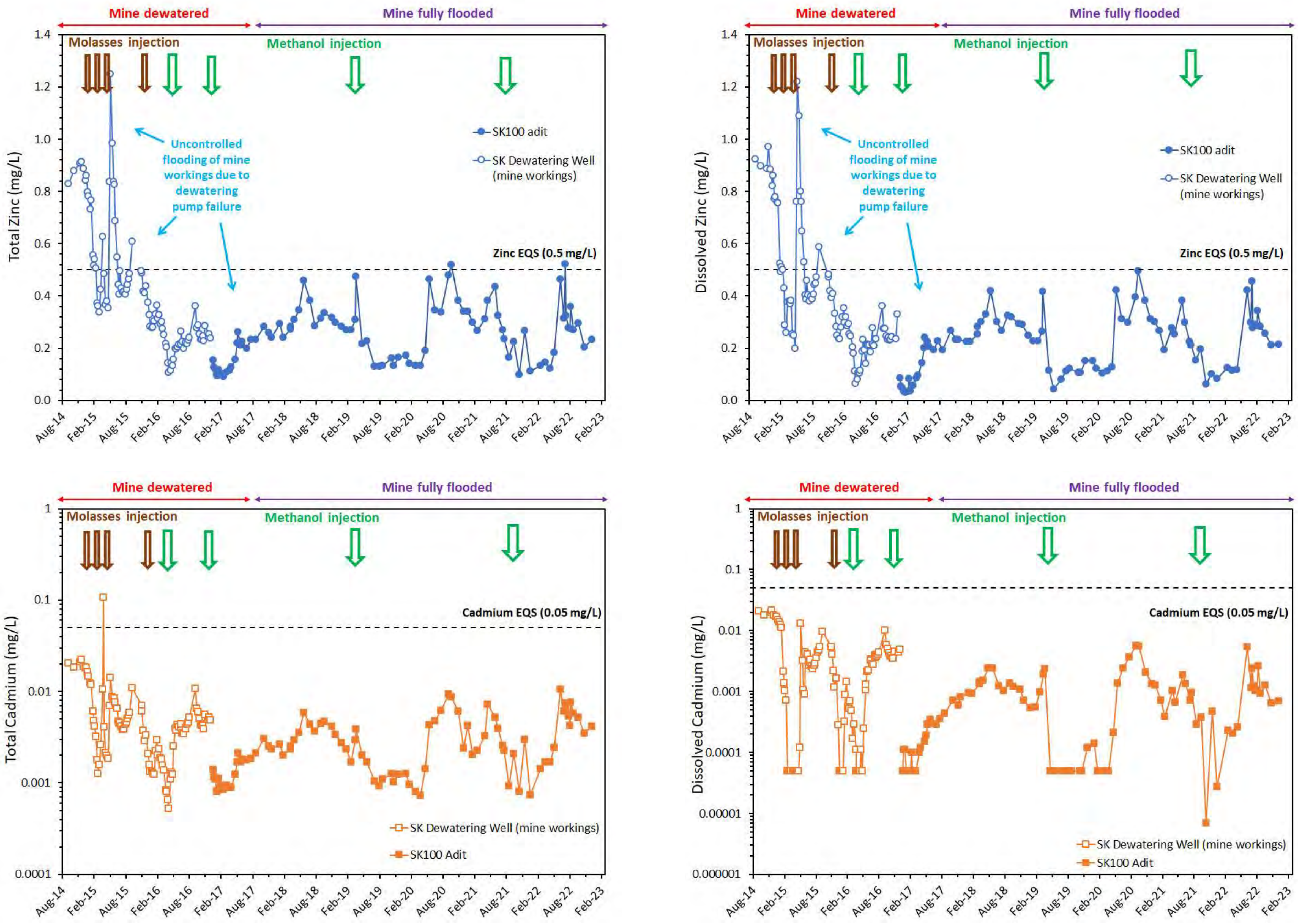

Figure 4-1: Total and Dissolved Cadmium and Zinc Concentrations in Water Discharged from the Silver King Mine During *In Situ* Treatment Pilot Test

Both cadmium and zinc concentrations increased in spring 2021, coincident with peak flow from the SK100 adit due to freshet recharge. The seasonal response of increased cadmium and zinc concentrations in the spring 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 well below their pre-*in situ* treatment concentrations (Figure 4-1) and did not exceed the EQS. This is notable given the treated workings have experienced three spring freshets and a particularly high flow year in 2020 since the previous carbon injection event was completed in April 2019. Following the 2021 spring peak, cadmium and zinc concentrations declined through the year. The carbon (methanol) injection event that occurred between August and October 2021 is responsible for the sustained low concentrations observed over the fall and winter of 2021/2022 as more strongly sulphate-reducing conditions conducive to cadmium and zinc removal (as precipitated metal sulphides) were likely established within the workings.

In 2022, cadmium and zinc concentrations peaked in June/July resulting in a total zinc concentration (0.52 mg/L) that marginally exceeded the EQS (0.5 mg/L). Dissolved zinc was slightly lower (0.46 mg/L), and below the EQS. Following this peak, cadmium and zinc concentrations had declined by at least 50% by the end of 2022, coincident with a decrease in SK100 adit flow rate consistent with winter conditions. Two SK100 adit water quality samples were collected during the plugged culvert flooding event that resulted in very high flow from the SK100 adit:

- May 10 – sample collected by Site personnel for analysis of total zinc using the atomic absorption spectrophotometer in the Site lab; and
- May 25 – sample collected by Site personnel submitted to accredited external laboratory (ALS) for total metals analysis.

The May 10 and 25 samples returned total zinc concentrations of 0.04 and 0.18 mg/L, respectively. These are comparable with total zinc concentrations reported for previous months (0.11 to 0.15 mg/L for monthly samples collected between January 4 and May 2, 2022) and well below the 0.5 mg/L EQS. That treated conditions were maintained in the SK100 adit discharge despite the markedly increased mine workings recharge from the culvert flooding event is evidence of the robustness of the *in situ* treatment process.

Although total zinc concentrations have twice exceeded the EQS in recent years (October 2020 and July 2022), it is important to note that dissolved zinc concentrations have remained below the EQS, which is proposed to apply to the dissolved phase under the draft water licence prepared for the closure of the former UKHM site. Furthermore, the two existing settling ponds located downstream of SK100 adit will be retained as part of the full *in situ* treatment design. These will 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.

5 SUMMARY

- Flow from the SK100 adit in 2022 (average 8.13 L/s) were 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).
- Cadmium and zinc concentrations peaked in spring 2021 coincident with higher adit discharge due to elevated recharge to the mine workings but remained well below the pre-pilot levels and did not exceed the EQS. This is notable given the previous carbon injection event was completed over two years ago (February to April 2019) and the workings have experienced three seasonal peak flow periods (i.e., spring) and a particularly high flow year in 2020. 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 persisted through the spring 2019 to spring 2021 period points to the robustness of the *in situ* treatment approach at Silver King.
- Cadmium and zinc concentrations in the SK100 adit discharge declined through the remainder of 2021, partly driven by the maintenance carbon (methanol) injection event that occurred between mid-August and mid-October.
- In 2022, cadmium and zinc concentrations peaked in June/July. The total zinc concentration (0.52 mg/L) marginally exceeded the EQS, but dissolved zinc did not (0.46 mg/L). Cadmium and zinc levels declined by at least 50% towards the end of the year as *in situ* treated conditions persisted under the lower flow winter conditions.
- Based on the behaviour of previous years, treated conditions (i.e., below both the pre-*in situ* treatment levels and the EQS) are expected to endure throughout 2023.

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Appendix 1.4

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

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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.

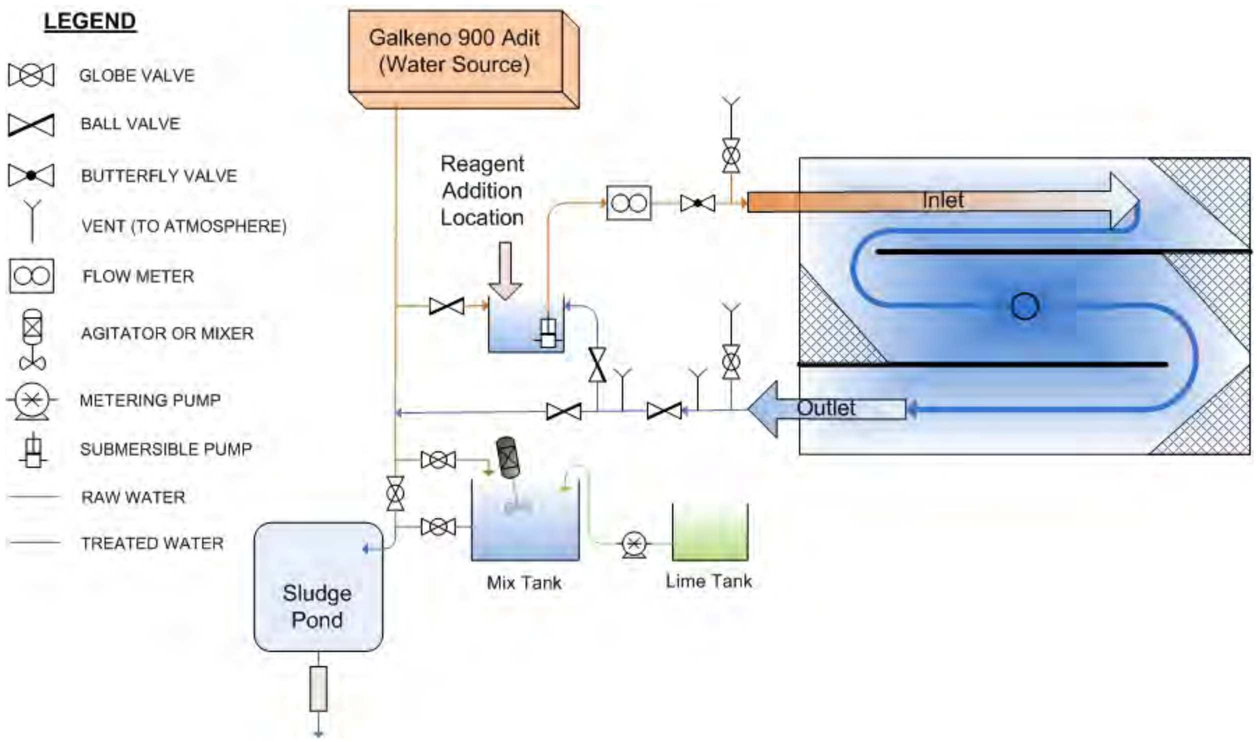

Figure 1 - Galkeno 900 Layout

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.

Figure 4 - Bioreactor Inlet

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.

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

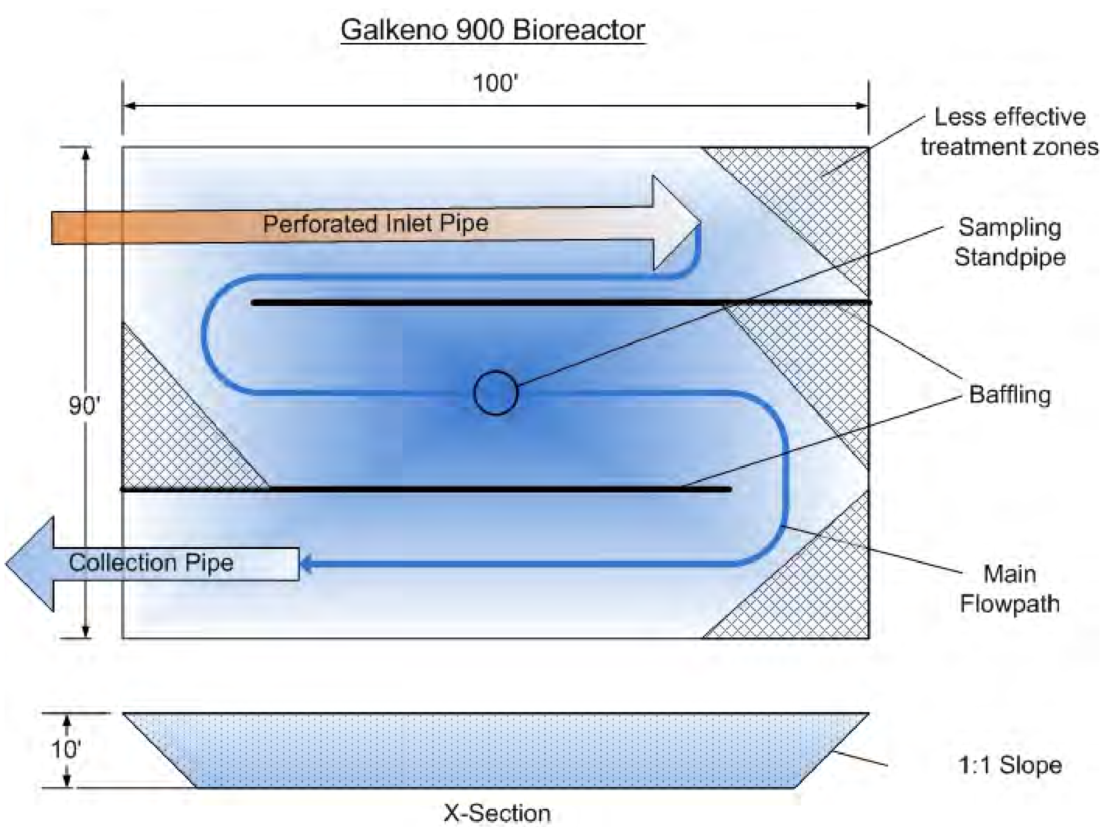

Figure 7 - Bioreactor Layout

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:

$$\text{Volume of reactor} = \text{mass of dye added} \div \text{concentration measured}$$

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.

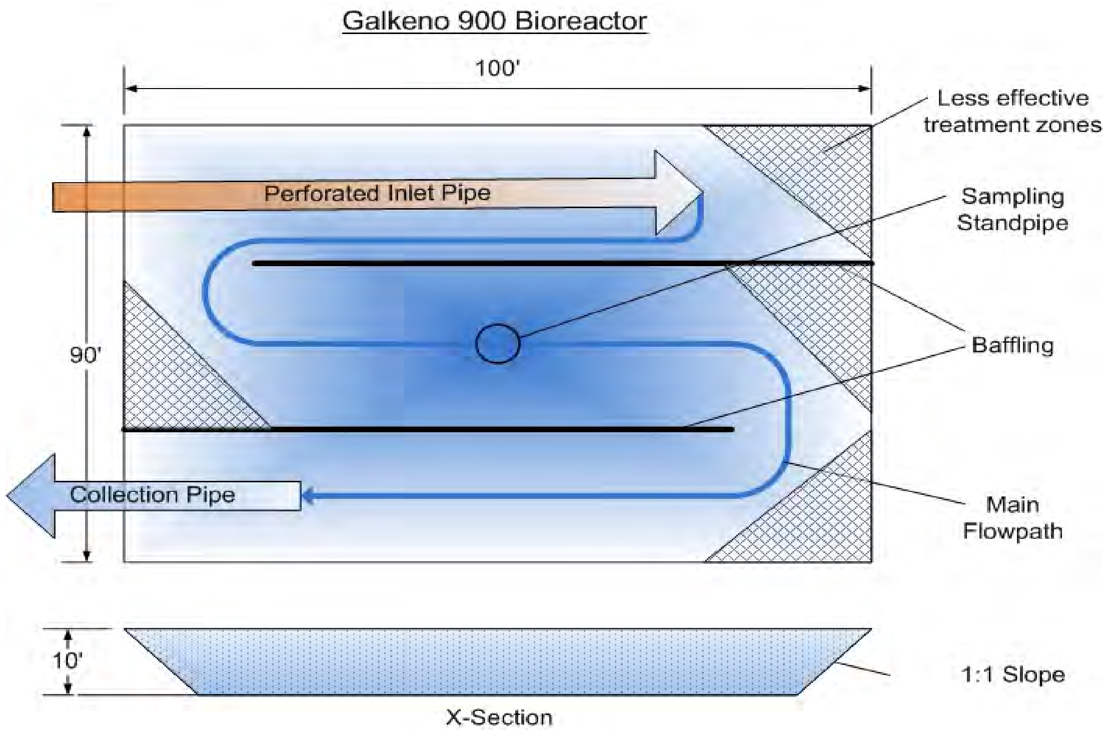

Figure 9 - Conceptualization of Flow Path in the Bioreactor

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.

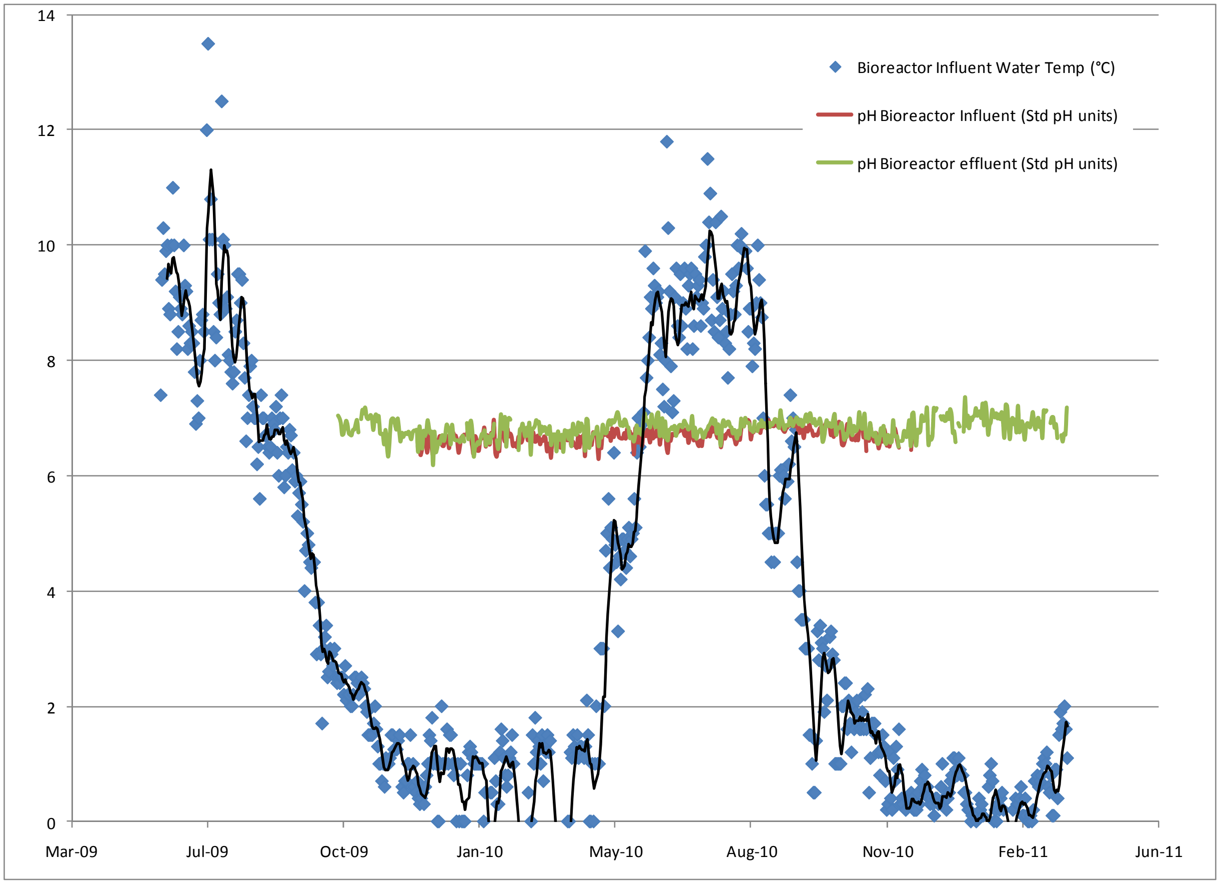

Figure 10 - Comparison of Galkeno 900 Adit pH and Bioreactor pH vs. Temp

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%

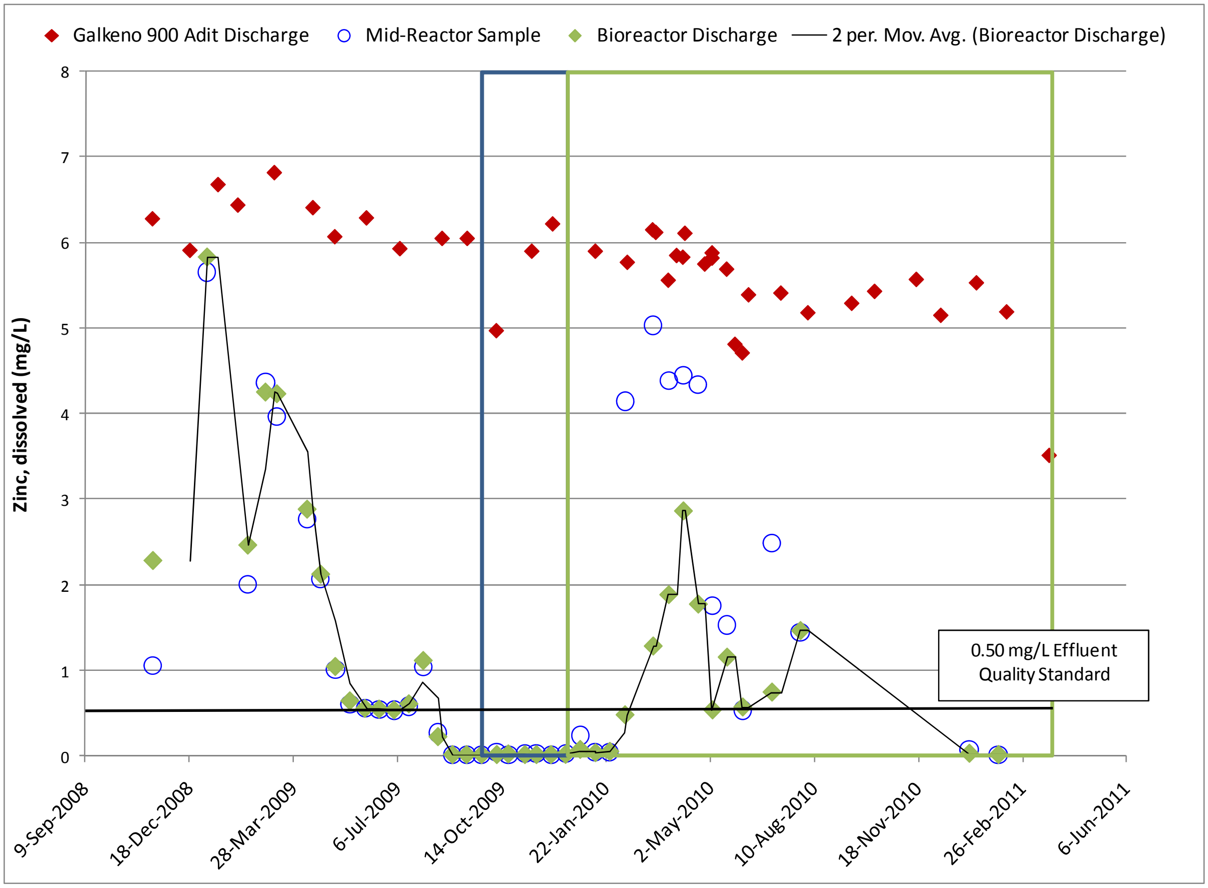

Figure 11 - Zinc removal by the Galkeno 900 Bioreactor

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.

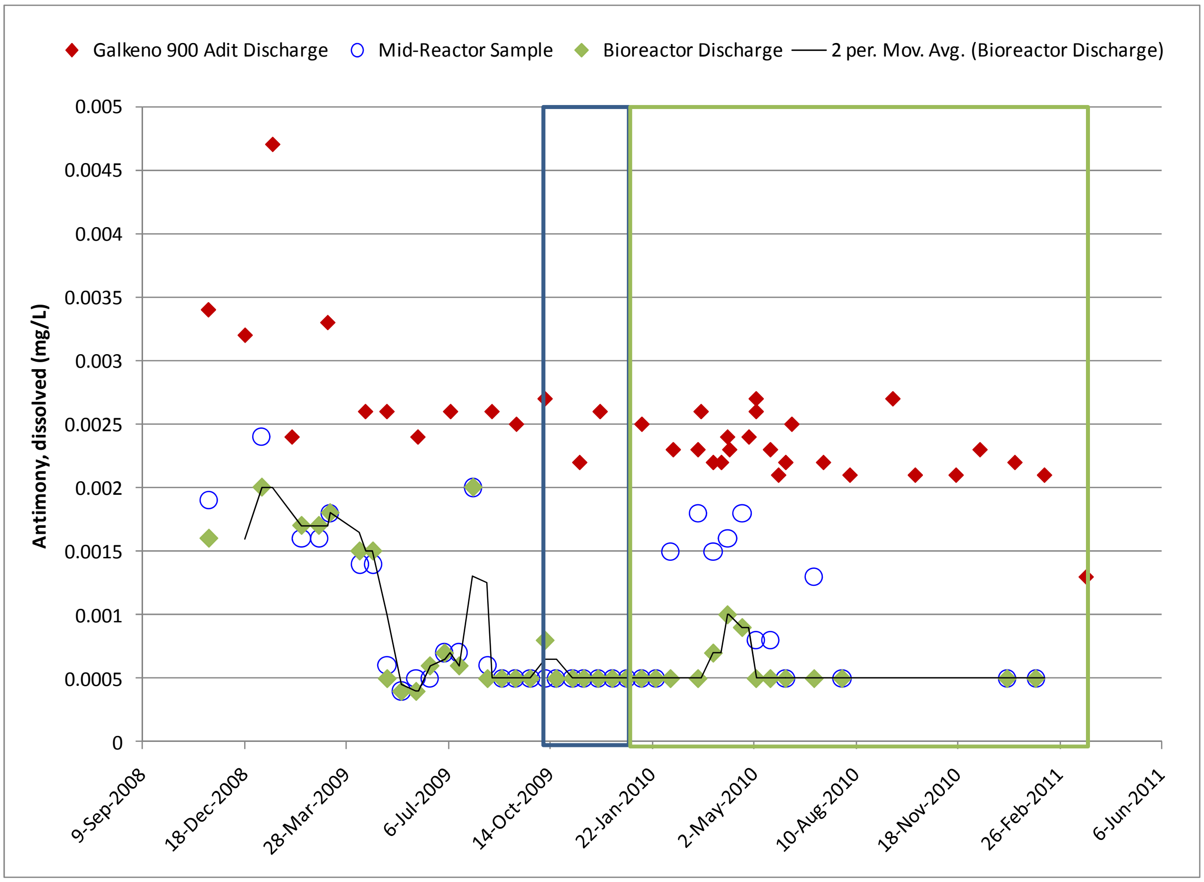

Figure 12 - Antimony Removal by the Galkeno 900 Bioreactor

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.

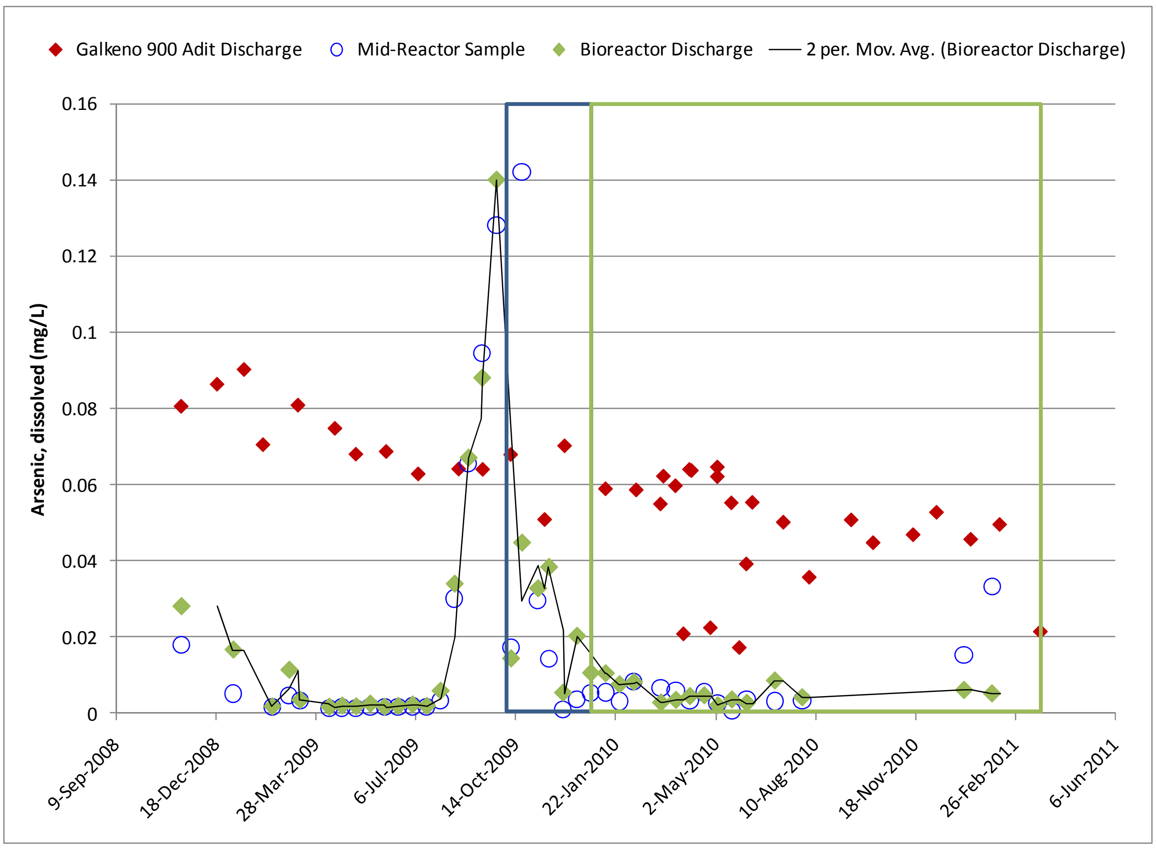

Figure 13 - Arsenic Removal by the Galkeno 900 Bioreactor

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.

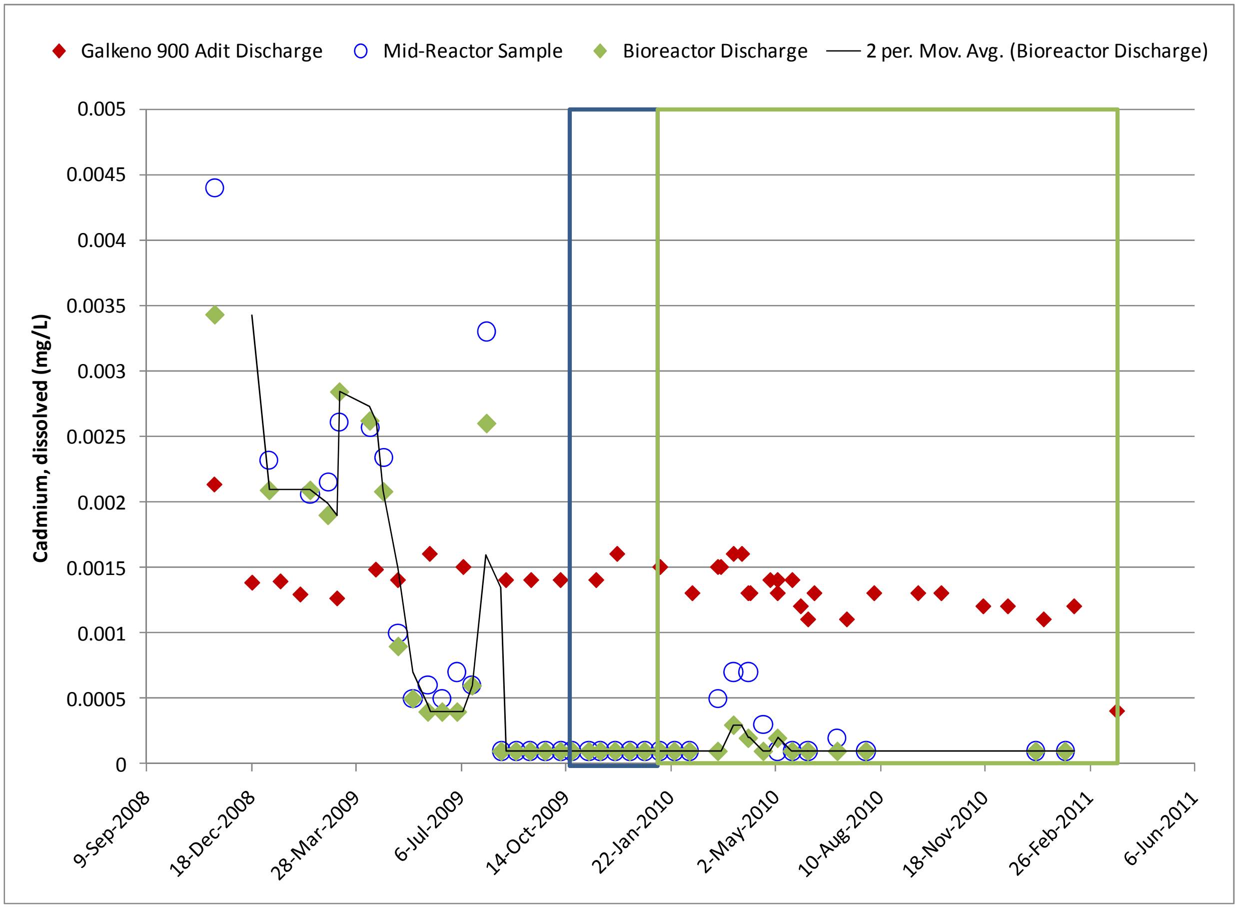

Figure 14 - Cadmium Removal by the Galkeno 900 Bioreactor

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.

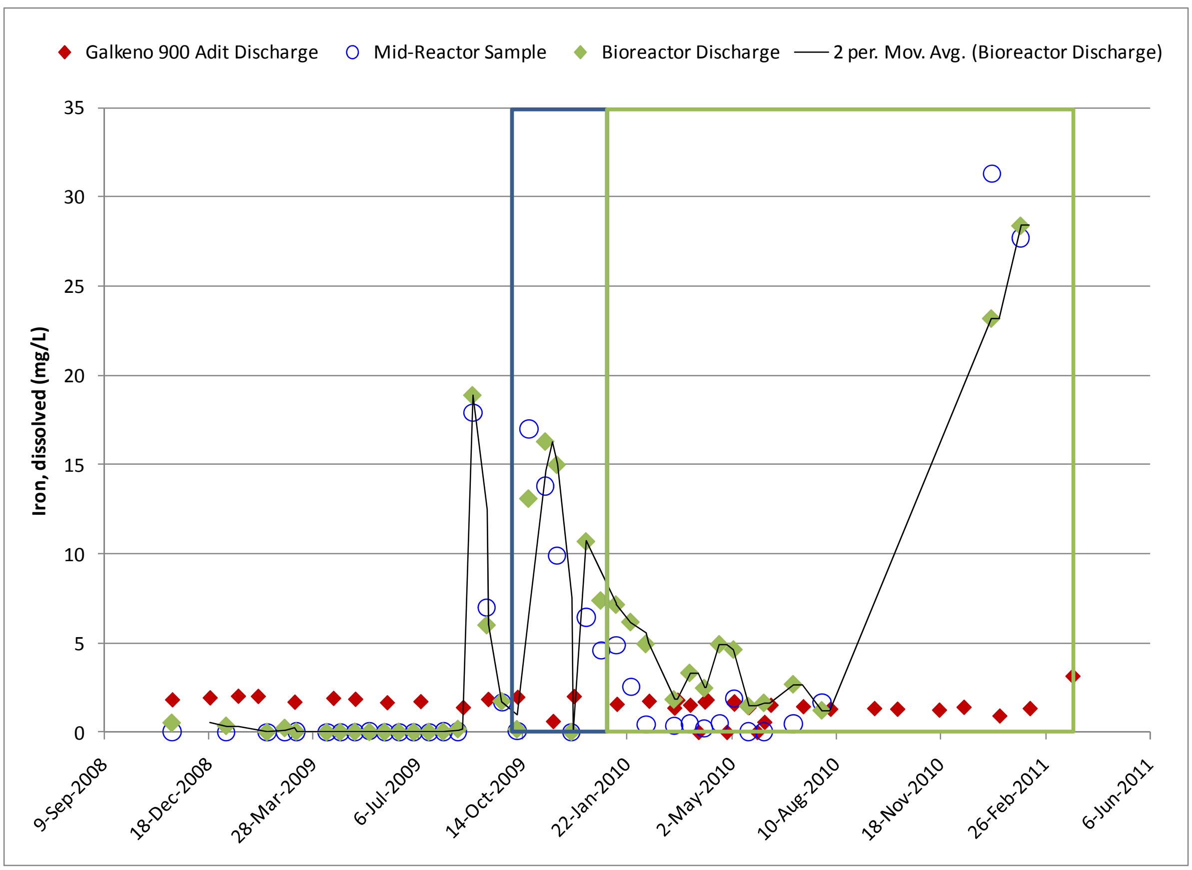

Figure 15 - Iron Removal by the Galkeno 900 Bioreactor

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.

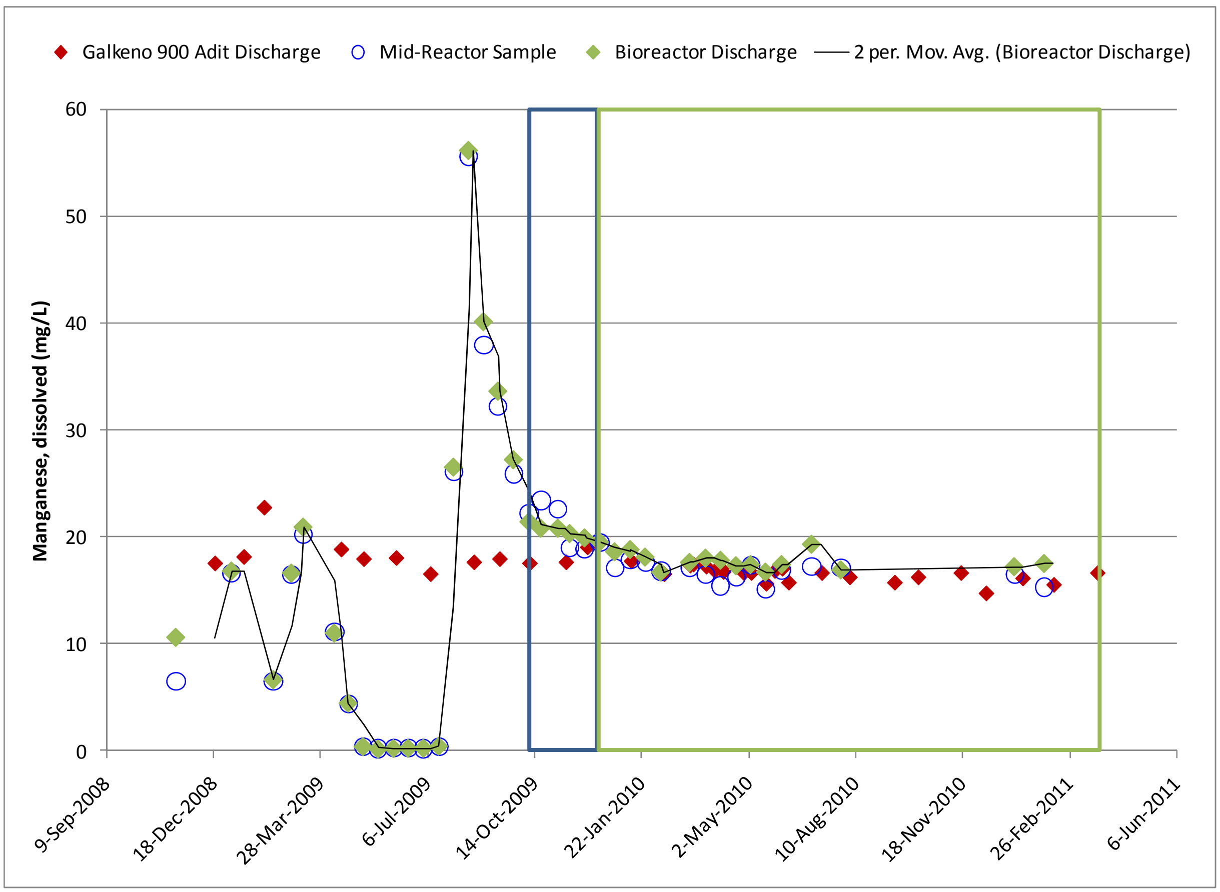

Figure 16 - Manganese Removal by the Galkeno 900 Bioreactor

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.

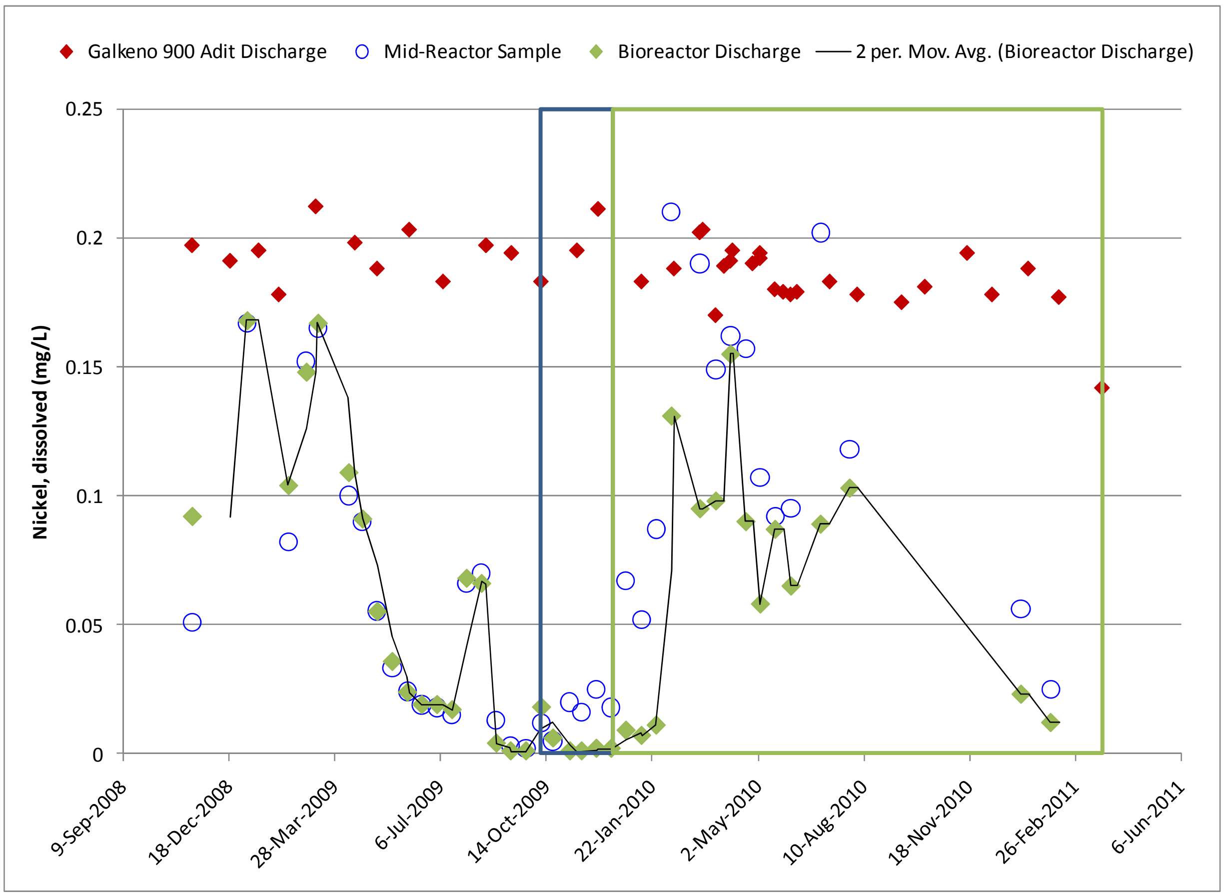

Figure 17 - Nickel Removal by the Galkeno 900 Bioreactor

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.

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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

Barbara L. Sherriff Ph.D., P.Geo.,

Sherriff Environmental Inc.

5394 Manson Ave.,

Powell River,

BC, V8A3P4

Submitted, November 25, 2011

Table of Contents

List of Figures

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)

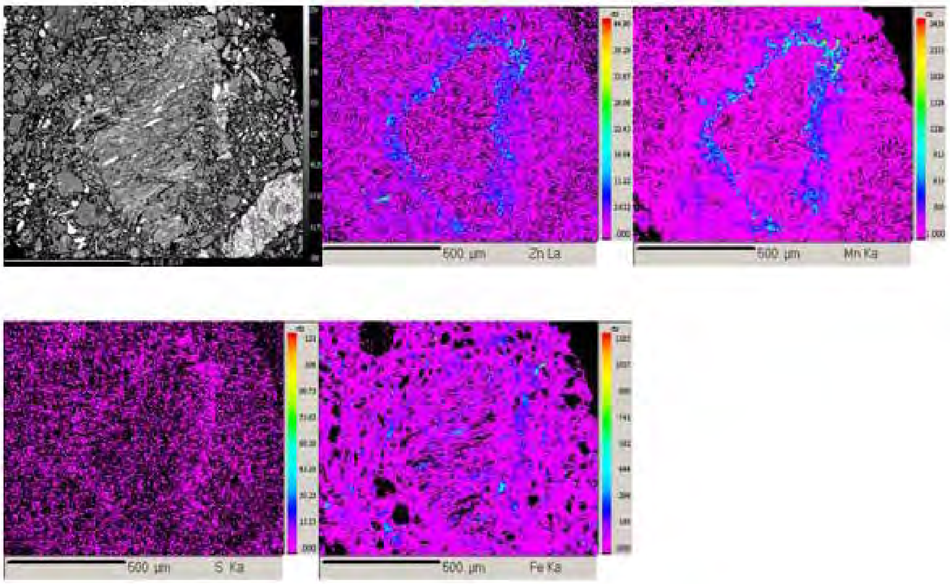

Figure 1: BSE images and element scans of Sample 8A FM Silt and Clay Bottom showing Mn and Zn rich coating around a lithic grain

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).

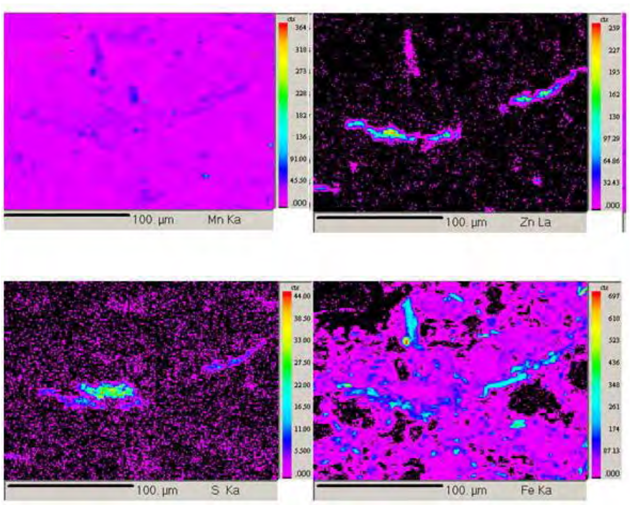

Figure 2: 1B G900 BIO BSE images and element maps

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).

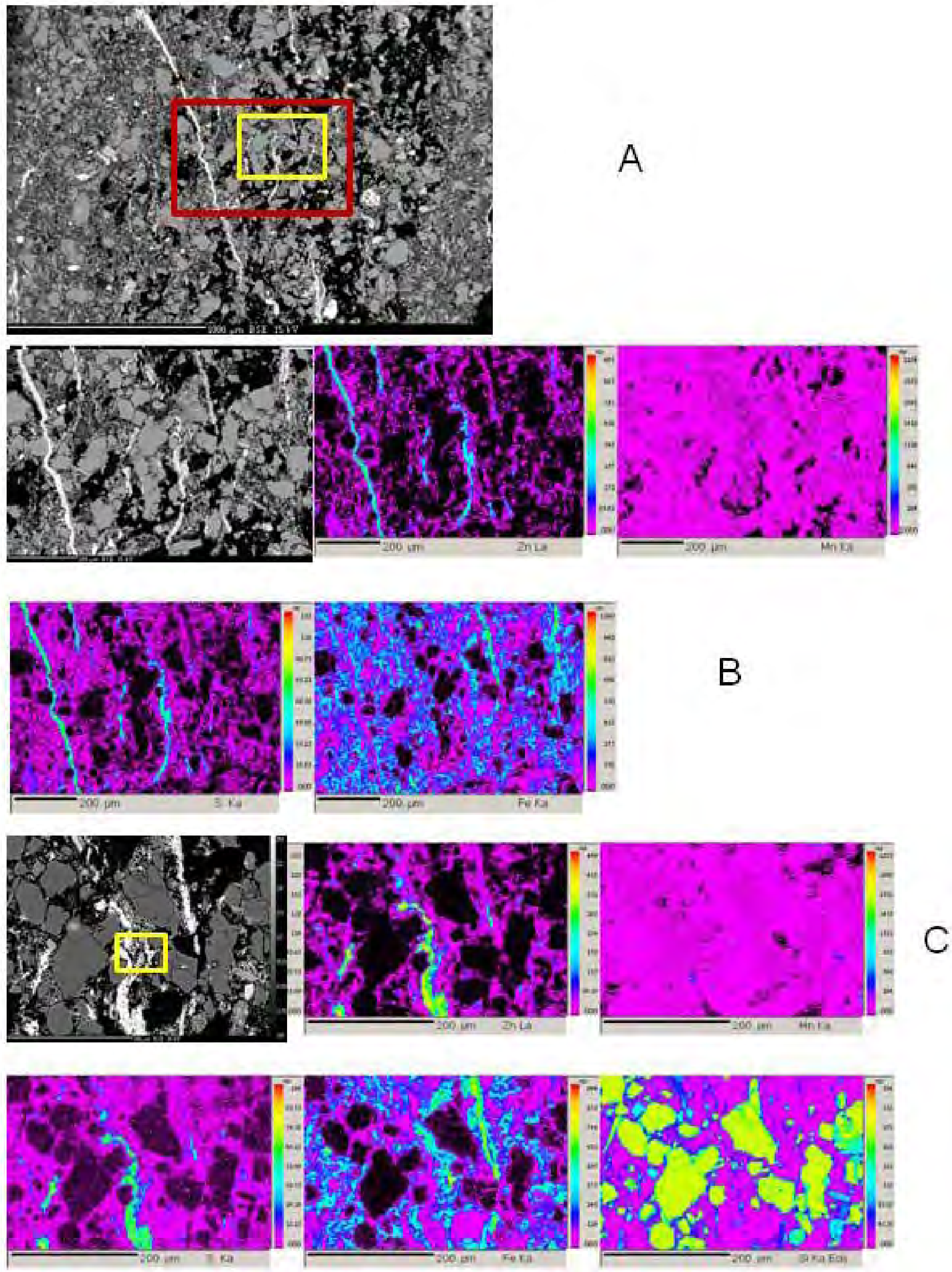

Figure 3 GK900 Bioreactor sample. (A) BSE image showing extensive bright bands of ZnS and Fe(B) BSE image and element scans of area in red box in (A) (C) BSE image and element scans of area yellow box in (A)

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.

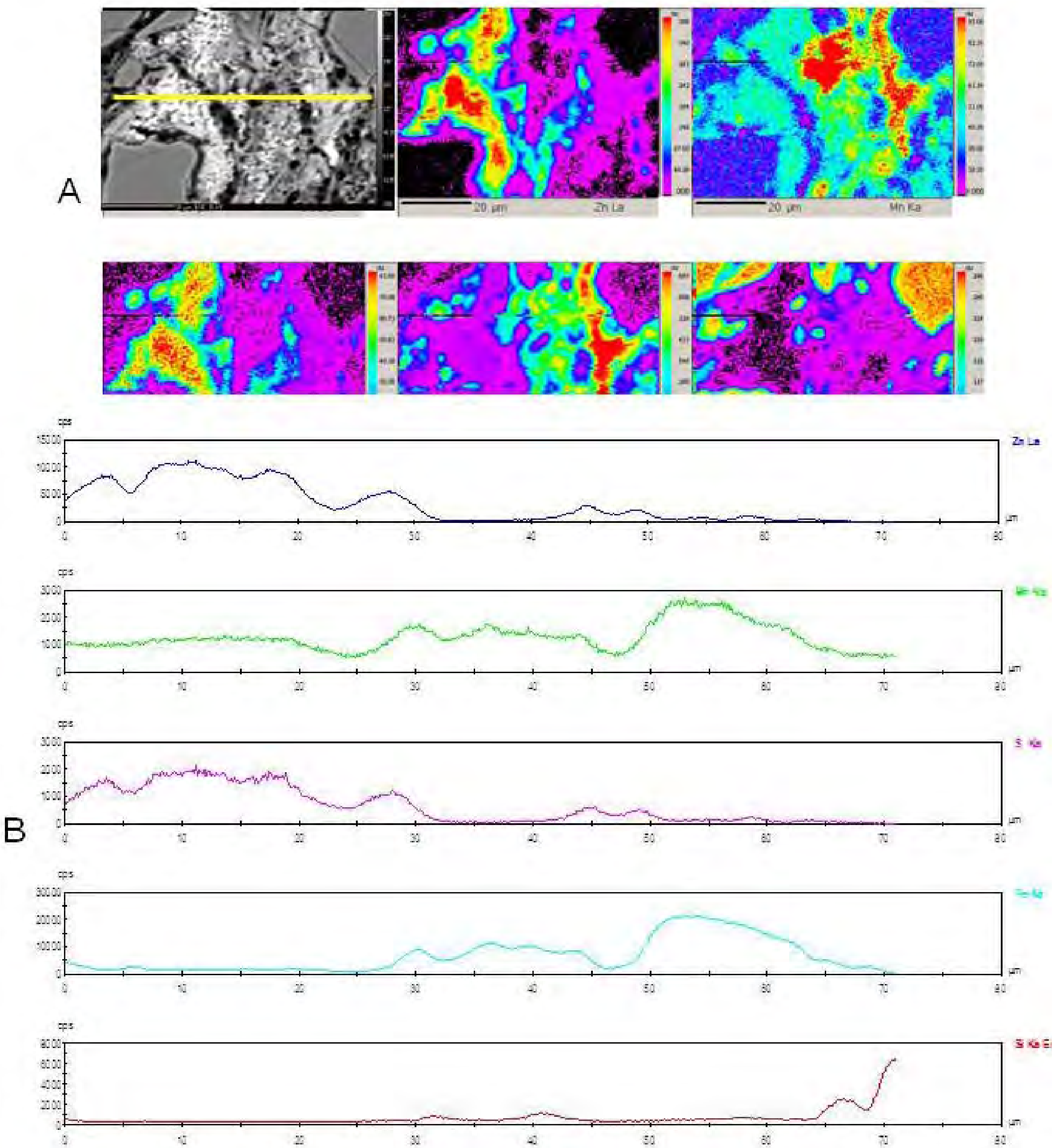

Figure 4: GK900. BSE image and element scans of area in yellow box in Figure 3 Element scans along the yellow line in BSE image (A)

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).

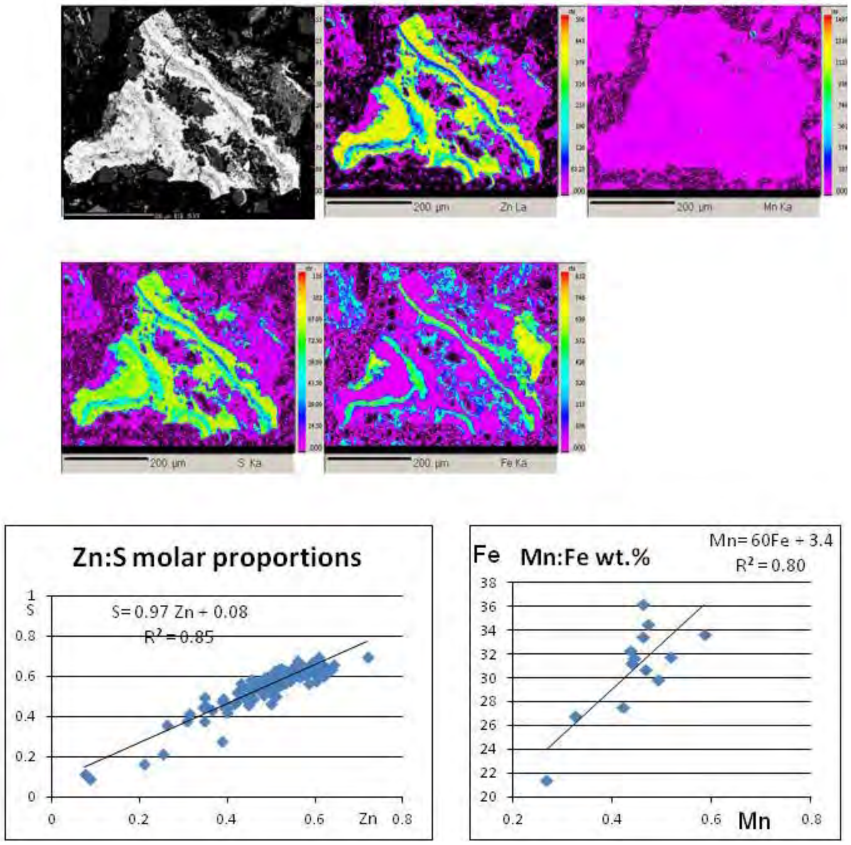

Figure 5: BioR sediment: BSE image and element maps showing the relation ship of Fe and Mn, Zn and S. Plots of molar Zn:S in the ZnS rich band and Mn:Fe wt % in the Fe rich band.

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.

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Appendix 1.5

Preliminary Assessment of Performance for WRSA Closure Cover Systems

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.

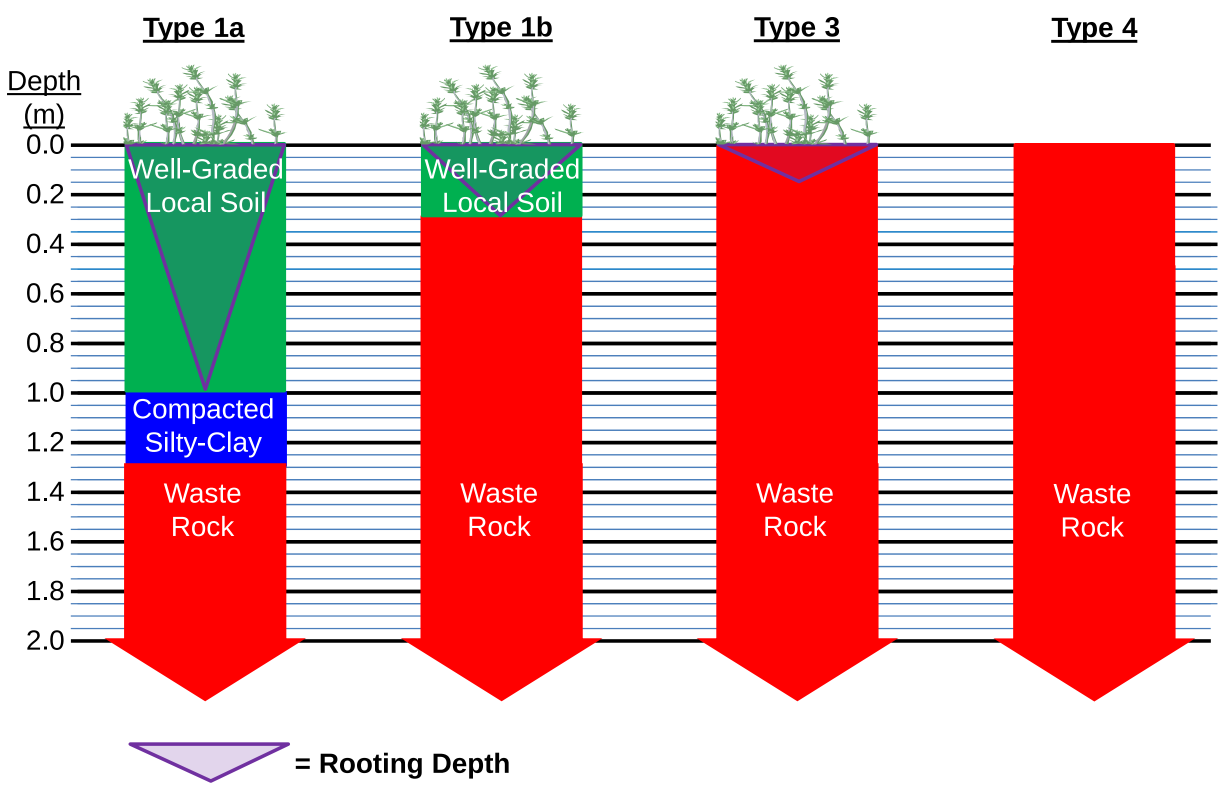


Figure 1 Schematic of four reclamation scenarios modelled for possible closure of WRSAs.

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.

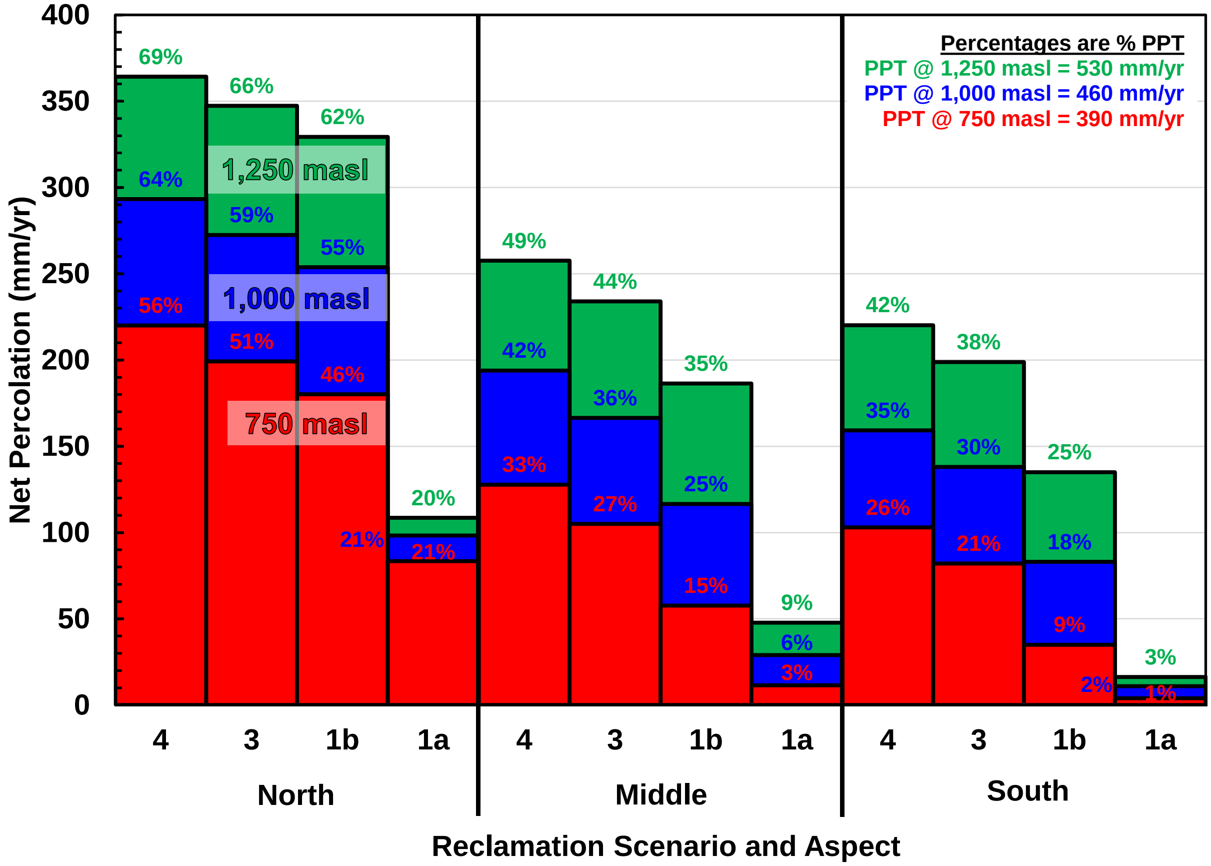


Figure 2 Annual average net percolation rates estimated for range of reclamation scenarios, elevations, and slope aspects.

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.

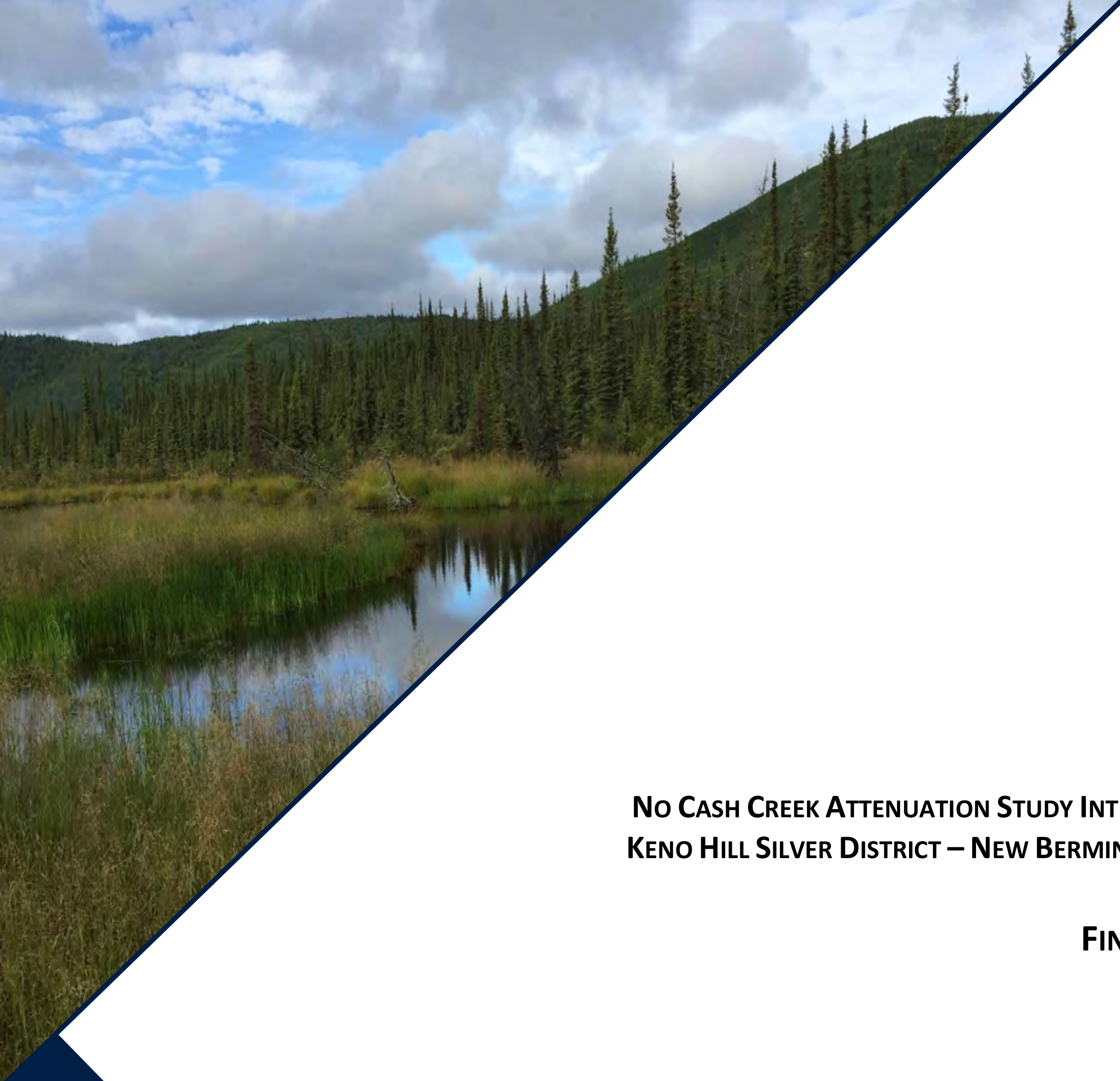
Sincerely yours,

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 1.6

NO CASH CREEK ATTENUATION STUDY INTERIM REPORT



No Cash Creek Attenuation Study Interim Report
Keno Hill Silver District – New Bermingham Mine

Final Report

Prepared for:

Alexco Keno Hill Mining Corp.

Date:

March 29, 2023

ENSERO solutions

ENSERO SOLUTIONS CANADA, INC. SIGNATURES

Report prepared by:	Collin Burelle Junior Scientist	3/29/2023
Report reviewed by:	Andrew Gault, PhD Practice Lead – Geochemistry	3/29/2023
Report reviewed by:	Kai Woloshyn, BSc, PChem Vice President Strategic Projects	3/29/2023

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.

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 discharge 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 2022 remained similar to 2021 values for these parameters.

Surface water monitoring data indicate circumneutral pH and oxic conditions at most of the monitoring stations. The water quality at the New Bermingham discharge 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 for the same period. This means that the water treatment plant discharge from the New Bermingham Mine will contribute to improving water quality in upper No Cash Creek waters except during the isolated peak concentrations. It was also noted that the water quality at KV-111 (No Cash Creek above the No Cash 500 adit) was better than KV-118 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. In 2022, two years after discharge from the New Bermingham decant pond began, the decrease in ammonia, arsenic, and copper concentrations along the flow path from Upper No Cash Creek to downstream No Cash Creek were likely due mainly to dilution while the decrease in lead, nickel, and silver concentrations were likely due to dilution and attenuation. Attenuation after discharge from New Bermingham decant pond started in September 2020 was less than 50% for ammonia, arsenic, copper, and likely silver between KV-118 and KV-111 along Upper No Cash Creek. Additionally, ammonia and dissolved arsenic concentrations measured at KV-114 were two-three orders 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, further suggesting that the New Bermingham decant was not a significant contributor for these metals. 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.

Local groundwater monitoring 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 arsenic and cadmium in one and two site monitoring wells, respectively. 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 adit.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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.

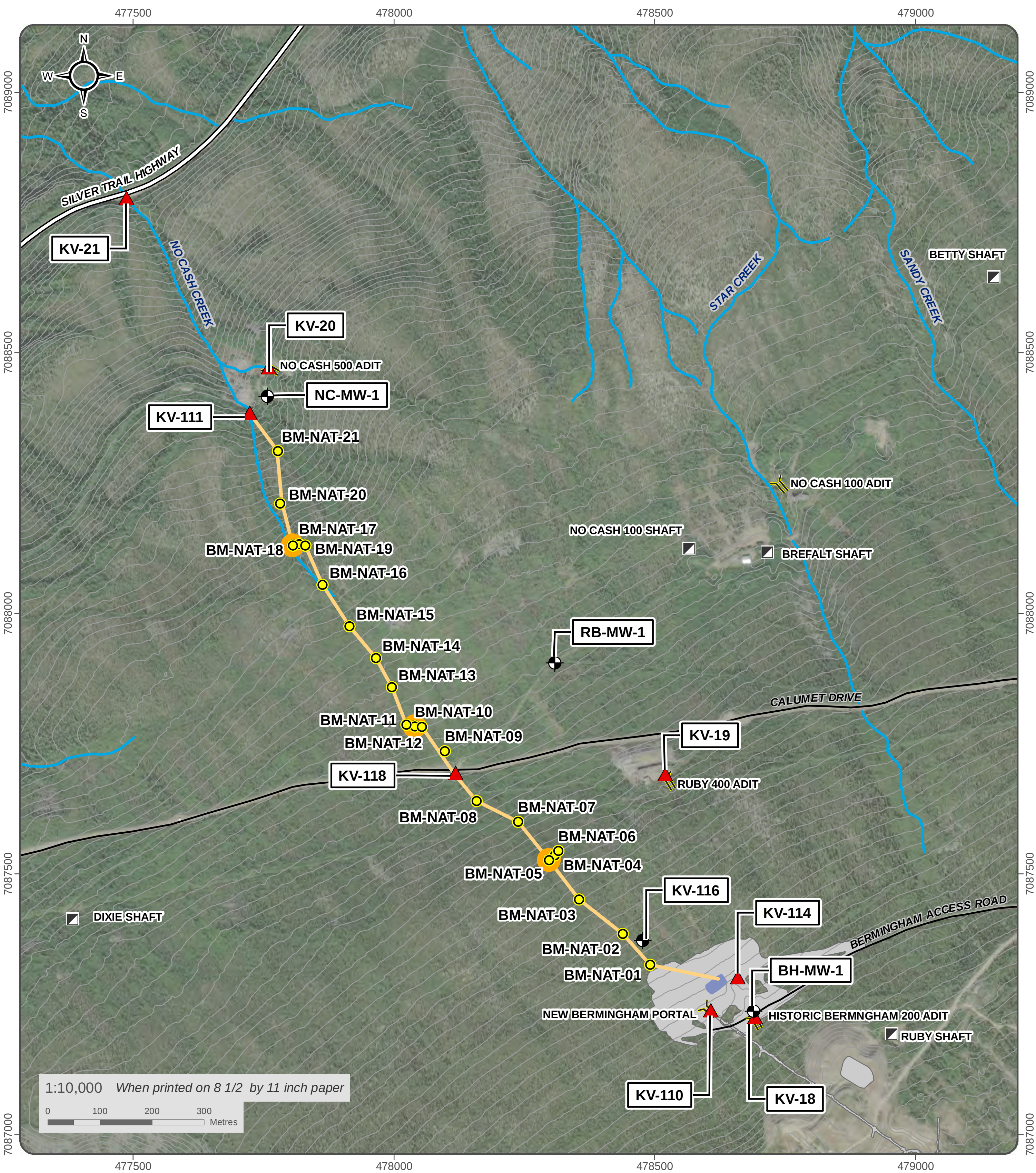
Bentonite clay was used as drilling fluid during exploration activities and bentonite particles can be found mixed with dewatering effluents from the New Bermingham portal as noted by Water Resources Branch during their site inspection in June 10 to 14, 2018 (YG, 2018). Although bentonite particles could 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.

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

Attenuation Study Line

Adit

Shaft

Mine Infrastructure Footprint As Built

Contours (5m interval)

Waterbody

Watercourse

HECLA KENO HILL

FIGURE 2-1
BERMINGHAM NATURAL ATTENUATION STUDY AREA

MARCH 2023

Satelite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on November 16 2022.
Datum: NAD 83; Projection: UTM Zone 8N

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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 will be conducted on select samples in 2023 when the New Bermingham pond discharge is mapped. The selection of the samples will be done such to capture the range of concentration (i.e., minimum, median, and maximum) of constituents of interest such as cadmium and zinc, and soil total organic and clay contents.

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 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

Fifteen years (2008 to 2022) of surface water quality (WQ) and ten years (2013 to 2022) 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.

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:

$$RPD\ (\%) = 100\ \mathrm{X}\ \frac{\mathrm{ABS\ (Sample\ mv - Duplicate\ mv)}}{\mathrm{Average\ (Sample\ mv, Duplicate\ mv)}}$$

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

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 one and four field duplicates were taken during each monthly water quality sampling event throughout the KHSD. Only three of these duplicates (two taken at KV-21, in July and November 2022, one taken at KV-18 in August 2022) correspond 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.

One parameter for KV-18 in August 2022, three parameters for KV-21 in November 2022, and six parameters for KV-21 in July 2022 showed instances of duplicate samples with an RPD >25%. The KV-18 parameter with RPD > 25% did not meet the PQL, and of the nine parameters with an RPD > 25% at KV-21 (July and November 2022), three parameters did not meet the PQL (Table 3-3). Variability in the dissolved lead concentration in the July 2022 duplicate sample may have resulted from variability in the adit discharge. The difference in TSS between duplicates samples likely explains the differences in total aluminium, iron, and barium as the dissolved fraction did not appear to have quantifiable variability (i.e., dissolved concentrations had an RPD less than 25%).

Table 3-3: Field Duplicate 2022 Results – Analytes Detected above the PQL for KV-21.

Collection Date	Parameter	Units	DL 1	DL 2	Result 1	Result 2	RPD	PQL 1	PQL 2
28-Jul-22	Titanium (Ti), total	mg/L	0.00030	0.00030	0.00207	0.00803	118%	6.9	26.8
28-Jul-22	Aluminum (Al), total	mg/L	0.0030	0.0030	0.0784	0.246	103%	26.1	82.0
28-Jul-22	Iron (Fe), total	mg/L	0.010	0.010	0.720	1.05	37%	72.0	105.0
28-Jul-22	Barium (Ba), total	mg/L	0.00010	0.00010	0.0217	0.0313	36%	217.0	313.0
28-Jul-22	Lead (Pb), dissolved	mg/L	0.00005	0.00005	0.00044	0.00059	28%	8.9	11.7
24-Nov-22	Nitrate (N)	mg/L	0.0250	0.0050	0.133	0.0867	42%	5.3	17.3

One field blank (excluding November 2021) and one trip blank (excluding August, September, and December 2021) was sampled per monthly sampling event. An analyte is considered to be reliably quantifiable in the field blank and trip blank (thus indicating contamination) if its concentration is more than three and two times the detection limit, respectively. In 2022, there were four occurrences when parameter concentrations measured >3x the DL in the field blank (Table 3-4) and two occurrences when parameter concentrations measured >2x the DL in the trip blanks (Table 3-5). Of the four parameters identified in the field blank samples, ammonia was flagged twice, which indicates that there may be contamination entering the samples from the ambient environment or during transportation which could be influencing the ammonia concentrations, as it was also observed twice in the trip blanks. Nevertheless, the absolute concentrations detected in the blanks are not considered high enough to have a material effect on the data collected and its interpretation.

Table 3-4: Field Blank 2022 Results – Analytes Detected above Three Times the RDL

Collection Date	Parameter	Units	RDL	Result	Result/RDL
24-Feb-21	Ammonia (N)	mg/L	0.00500	0.0188	3.8
24-Mar-21	Manganese (Mn), total	mg/L	0.00010	0.00033	3.3
09-May-21	Ammonia (N)	mg/L	0.0050	0.0647	12.9
01-Dec-21	Molybdenum (Mo), total	mg/L	0.0001	0.000312	6.2

Table 3-5: Trip Blank 2022 Results – Analytes Detected above Twice the RDL

Collection Date	Parameter	Units	RDL	Result	Result/RDL
09-May-21	Ammonia (N)	mg/L	0.0050	0.0191	3.8
11-Nov-21	Ammonia (N)	mg/L	0.0050	0.0173	3.5

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.

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.

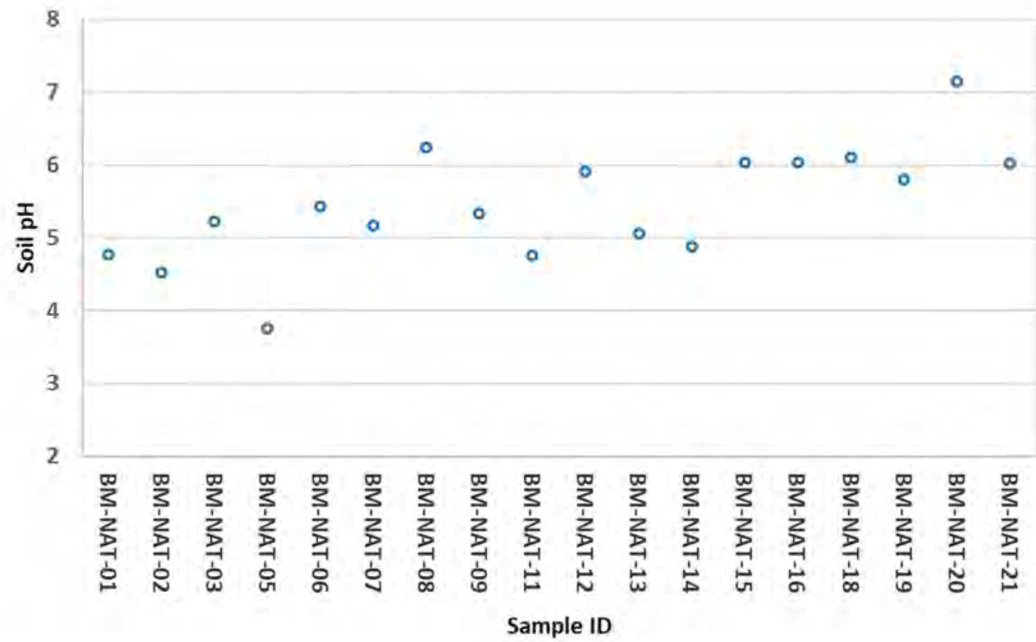


Figure 4-1: Soil Paste pH Profile Along the Discharge Channel

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.

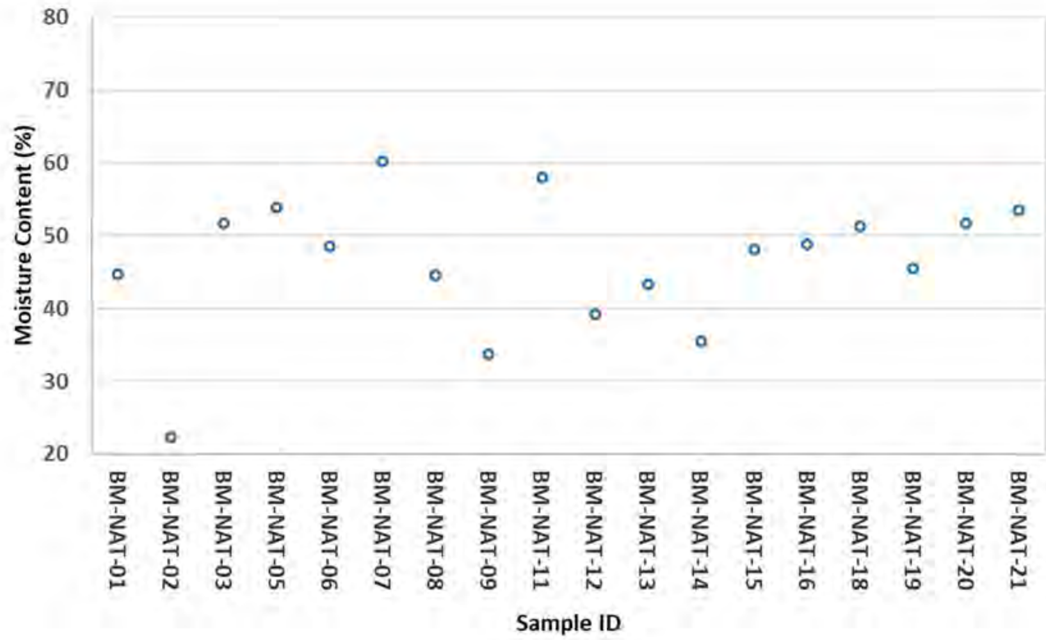


Figure 4-2: Moisture Content of Soil Along the Discharge Channel

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
Cobalt (Co)	0.1	ppm	4.7	5.2	5.8	4.7	6.1	29.4	10.5	13.9	8.3

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
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 SOIL MICROBIOLOGY

BM-NAT-04, BM-NAT-10, and BM-NAT-17 were selected for microbial community profiling. Bacteria identified to the genus level that comprised >1% of the OTUs in at least one sample are presented in Table 4-4. Only a single genus, *Nitrospira*, accounted for >1% of the OTUs in at least one soil sample.

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 4-5) 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 4-4: 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 4-5 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.

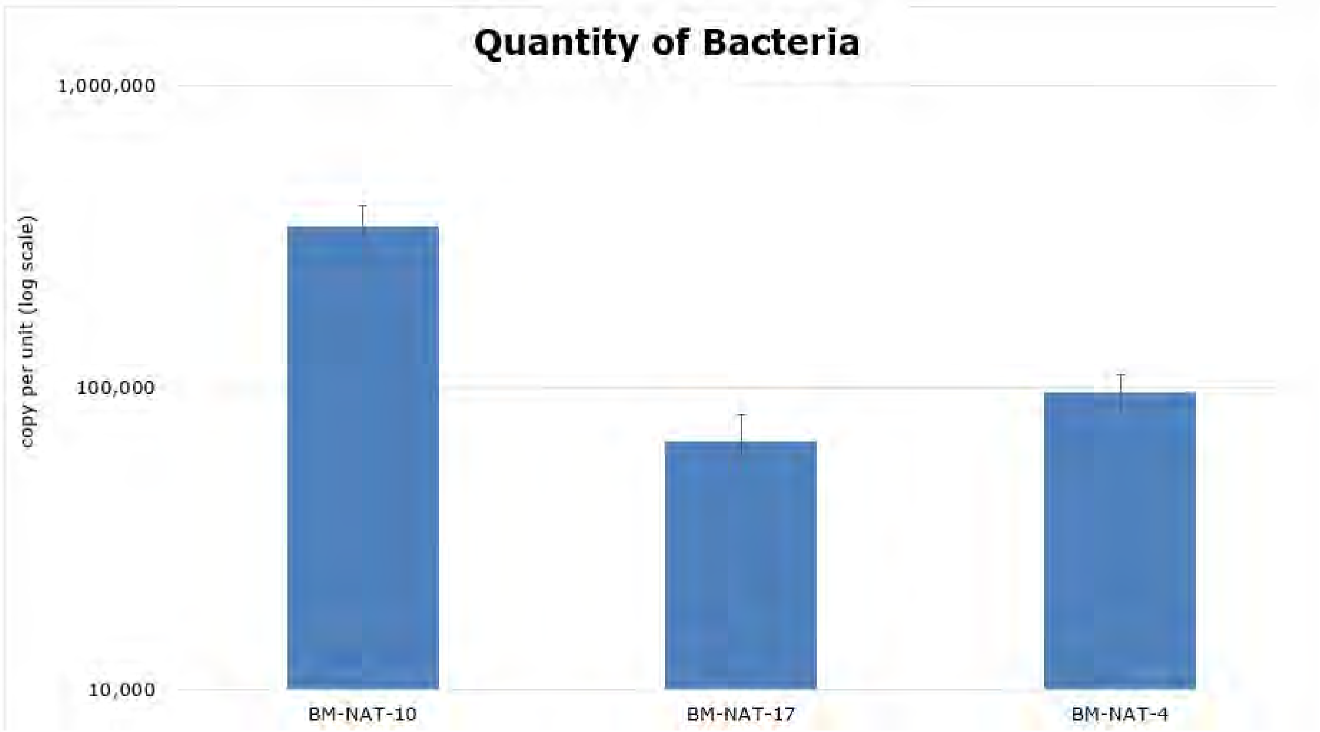


Figure 4-3: Quantity of Sulphate-reducing Bacteria in Soil Samples

Table 4-5: 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.*

4.3 VEGETATION (MOSS)

The baseline total metal composition of moss collected from the likely discharge corridor is provided in Table 4-6 and laboratory reports are compiled in Appendix A. The 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 4-6: 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

Parameter	Lowest Detection Limit	Sample ID	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
Manganese (Mn)-Total	0.050	mg/kg	415	350	311	918	1540	2440
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

4.4 WATER QUALITY

4.4.1 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 2022 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 (Ensero, 2021) 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 namely 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 WQ data prior to the start of untreated discharge from the New Bermingham portal during advanced exploration; and
- Provide a benchmark for comparison with surface WQ 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 4-7 through Table 4-16. Values measuring less than the detection limit were halved for statistics and plots. Dissolved arsenic was elevated above the EQS in more than 10% of the samples collected from the treated New Bermingham decant (KV-114; 13% exceedances) and the untreated New Bermingham portal (KV-110; 36% exceedances). At KV-110, these elevated concentrations mostly occurred pre-2019 and since the end of September 2020. 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 (no exceedances in 2022). Dissolved selenium was elevated above the No Cash Creek WQO (0.002 mg/L) in 13% of the samples taken at KV-110 and in two samples (2% exceedances) in the New Bermingham decant pond discharge (KV-114). At KV-114, 11 of the 123 samples (9%) collected returned a pH greater than 9.5 and 14 of 119 samples (12%) collected returned TSS concentrations above the EQS (25 mg/L) from September 2020 (start of sampling) to December 2022. The maximum short-term WQOs at KV-21 for dissolved cadmium and zinc were not exceeded in any of the samples collected in 2022; and no samples collected in 2022 returned 12-month rolling average concentrations greater than the long-term WQO for sulphate, cadmium, and copper. There was one instance of exceedance of the long-term WQO for zinc in 2022. There appears to be an improvement in water quality at KV-21 in 2022 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).

4.4.1.1 FIELD PH

Field pH data indicate a generally stable neutral field pH despite a few isolated exceedances (Figure 4-4). Also, there was no seasonality depicted in the field pH data. The field pH has remained in the neutral range (pH 6.5 — 9.0) during the monitoring period except for a few excursions of field pH below pH 6.5 at the Bermingham 200 adit (KV-18) and Ruby 400 adit (KV-19) mostly pre-2016 and stabilized around circumneutral pH in 2022. Recurrent alkaline pH at KV-114 continued into 2022, with values close to the upper EQS defined pH boundary (9.5). 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 in 2022. No Cash Creek samples were typically 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).

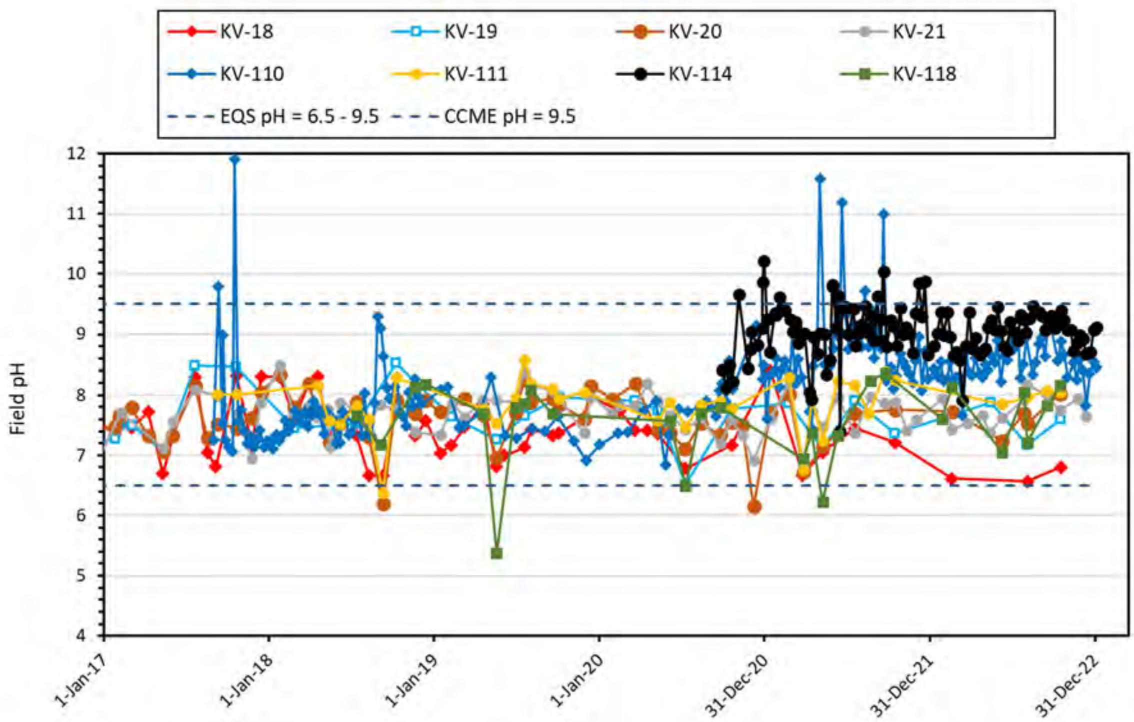


Figure 4-4: Field pH at Monitoring Stations, 2017-2022 Data

4.4.1.2 FIELD REDOX POTENTIAL

As expected, the oxidation-reduction potential (ORP) at the monitoring stations was oxidizing but large fluctuations were recurrent in the dataset (-5). The redox potential was largely positive with a median field ORP ranging from +43.2 mV (at the New Bermingham discharge location) to +151 mV (at No Cash 500 Adit KV-20). 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 2022 continued to be largely oxidizing, with a high outlier noted for KV-18 on August 10, 2022.

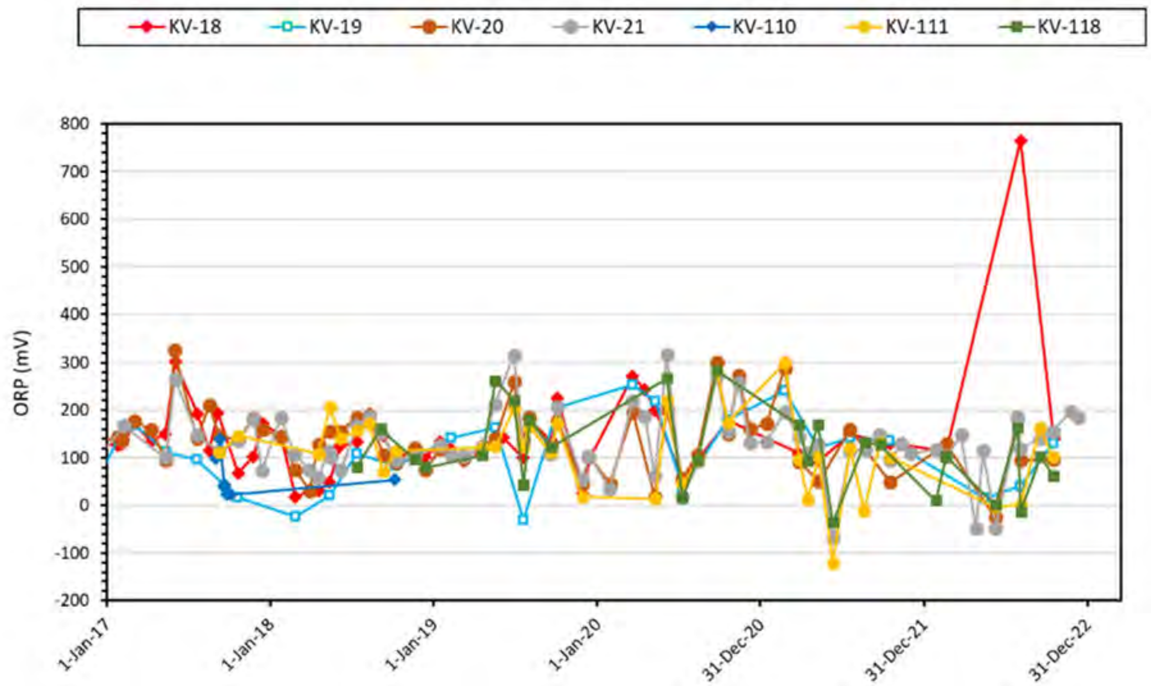


Figure 4-5: Field ORP at Monitoring Stations, 2017-2022 Data

Oxidation-reduction potential (ORP) data not available for KV-114. Therefore, site is not shown on the graph.

4.4.1.3 SILVER

The dissolved silver time series plot and statistical summary of the monitoring data are shown in Figure 4-6 and Table 4-7, respectively. Historically, and in 2022, dissolved silver concentrations in the New Bermingham portal discharge (KV-110) and in the decant pond (KV-114) remained below the EQS (0.00062 mg/L), and most of the samples taken at these points had dissolved silver concentrations below the detection limit. The dissolved silver concentration at KV-21 was usually below the detection limit and was only above the WQO in 2% of samples. Dissolved silver was regularly below the detection limit at KV-20 historically, and in 2022. It was noted that elevated silver concentrations at the adit monitoring stations (KV-18 and KV-20) and KV-110 and KV-111 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) historically, but all samples in 2022 were below the detection limit. These historical seasonal highs were followed by a decline and lowest concentration in the summer/fall (August through October). 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) and downgradient upper No Cash Creek (KV-111) may suggest an influence of the Ruby 400 adit.

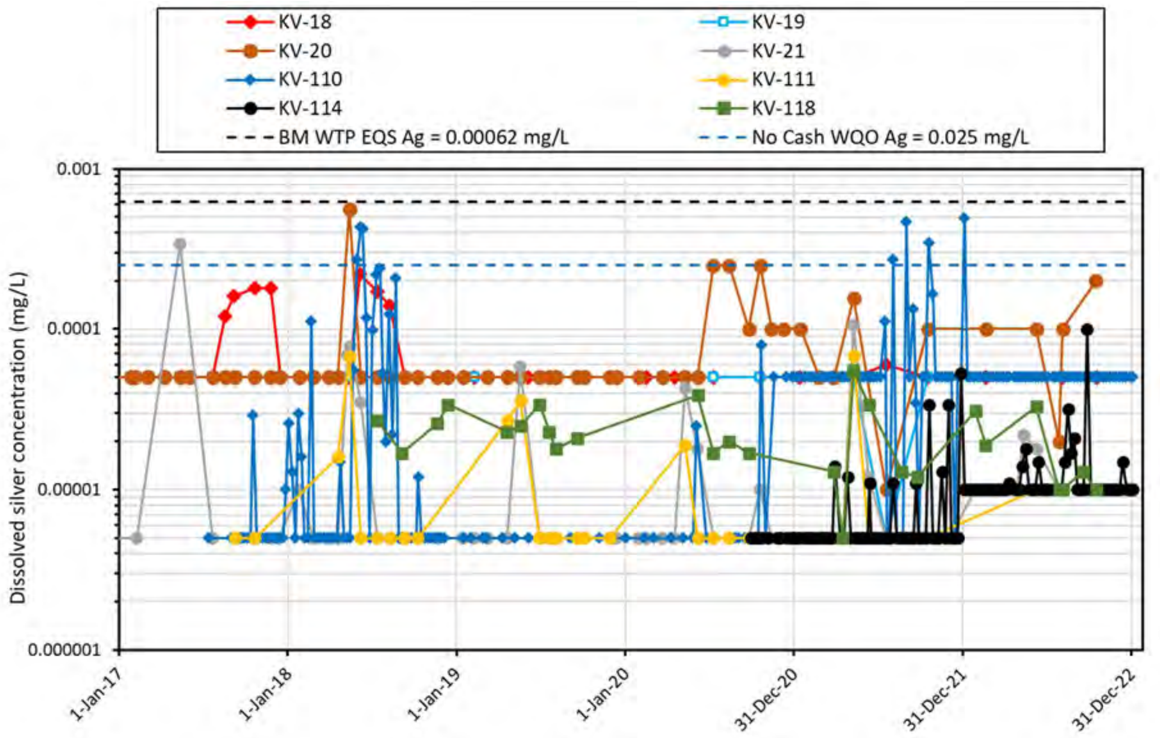


Figure 4-6: Dissolved Silver at Monitoring Stations, 2017-2022 Data

Table 4-7: Dissolved Silver Statistics at Monitoring Stations, 2008-2022 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	0.000089	0.000047	0.000063	0.000030	0.000059	0.000011	0.000010	0.000022
Count	129	104	132	126	211	36	118	27
Minimum	0.000003	0.000003	0.000003	0.000003	0.000005	0.000005	0.000005	0.000005
Maximum	0.000900	0.000100	0.000560	0.000600	0.000495	0.000068	0.000100	0.000055
Count <DL	103	103	126	104	179	30	97	4
Standard Deviation	0.000130	0.000016	0.000063	0.000065	0.000078	0.000015	0.000011	0.000011
1st Quartile	0.000050	0.000050	0.000050	0.000005	0.000005	0.000005	0.000005	0.000013
Median	0.000050	0.000050	0.000050	0.000005	0.000050	0.000005	0.000010	0.000020
3rd Quartile	0.000050	0.000050	0.000050	0.000050	0.000100	0.000010	0.000010	0.000029
99 Percentile	0.000162	0.000050	0.000100	0.000050	0.000100	0.000023	0.000014	0.000034
Count Over Guideline	-	-	-	2	0	-	0	-
% Over Guideline	-	-	-	2%	0%	-	0%	-

[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).*

4.4.1.4 ARSENIC

The dissolved arsenic time series plot and statistical summary of the monitoring data are shown in Figure 4-7 and Table 4-8, 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. This increase above the EQS was also observed at KV-114 (at which the EQS applies) 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. Dissolved arsenic concentrations measured at KV-114 from July 2021 to December 2022 were below the EQS. Over the historical period, 36% and 13% 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 2022. Low dissolved arsenic concentrations were also measured at KV-21 without ever surpassing the WQO (0.025 mg/L) in the 15-year dataset. Elevated arsenic concentrations were noted in the historical Bermingham 200 adit discharge (KV-18) compared to moderate concentrations at the Ruby 400 (KV-19) and No Cash 500 (KV-20) adit discharges. There was a marked 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 2022), perhaps partially due to the lower sampling frequency enacted at KV-18 since mid-2020 (changed from monthly to quarterly). 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, also showed seasonal variation marked by peak concentrations during freshet (April through May) and lowest concentration in the fall (September through October), though in 2022, sampling did not occur until June for KV-111. Interestingly, 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).

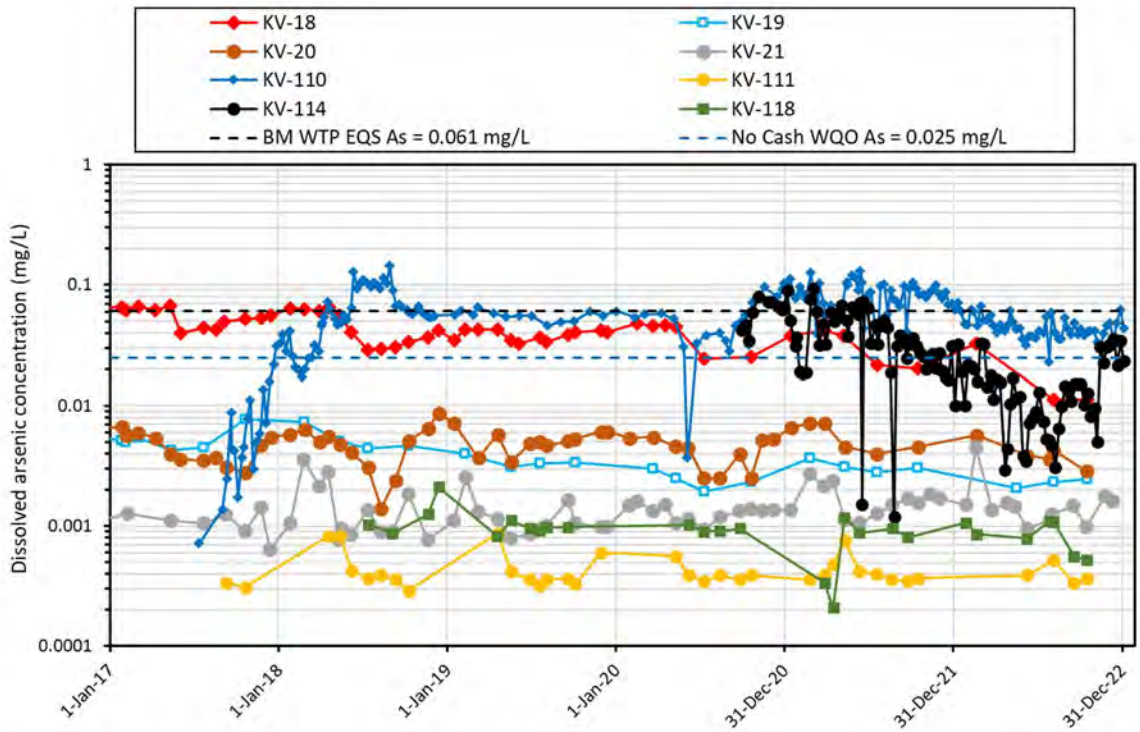


Figure 4-7: Dissolved Arsenic at Monitoring Stations, 2017-2022 Data

Table 4-8: Dissolved Arsenic Statistics at Monitoring Stations, 2008-2022 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	0.0448	0.00378	0.00448	0.00141	0.0570	0.00044	0.0308	0.00093
Count	129	104	132	126	211	36	118	27
Minimum	0.0074	0.00100	0.00080	0.00064	0.00072	0.00029	0.00120	0.00021
Maximum	0.0776	0.00770	0.0104	0.00460	0.144	0.00087	0.0934	0.00212
Count <DL	0	0	3	0	0	0	0	0
Standard Deviation	0.0162	0.00112	0.00154	0.00069	0.0292	0.00015	0.0219	0.00033
1st Quartile	0.0346	0.00300	0.00340	0.00100	0.0396	0.00036	0.0134	0.00084
Median	0.0456	0.00369	0.00444	0.00120	0.0545	0.00038	0.0262	0.00096
3rd Quartile	0.0568	0.00442	0.00550	0.00150	0.0758	0.00042	0.0453	0.00105
99 Percentile	0.0650	0.00740	0.00640	0.00227	0.0995	0.00068	0.0647	0.00114
Count Over Guideline	-	-	-	0	77	-	15	-
% Over Guideline	-	-	-	0%	36%	-	13%	-

[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).

4.4.1.5 CADMIUM

The dissolved cadmium time series plot and statistical summary of the monitoring data are shown in Figure 4-8 and Table 4-9, 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. Cadmium concentrations were typically one to three orders of magnitude lower than the EQS in the New Bermingham decant (KV-114). The dissolved cadmium concentrations in the New Bermingham portal discharge (KV-110) were elevated during early monitoring, decreased by approximately three orders of magnitude between late 2018 through 2019 before they increased in mid 2020 to present (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 constantly 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, which may suggest an influence from the Ruby 400 adit. Water discharged from the Bermingham 200 (KV-18), Ruby 400 (KV-19), and No Cash 500 (KV-20) adits had elevated cadmium concentrations. 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), 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. Three percent of samples collected at KV-21 were higher than the short-term maximum WQO (most of which occurred in 2020, none in 2022) and 29% of the calculated 12-month rolling averages over the past three years were higher than the long-term WQO (0.0209 mg/L). The majority of these occurred between October 2020 and November 2021 and were related to the sustained higher cadmium concentrations in the No Cash 500 adit discharge in 2020, likely related to higher flow conditions for that year.

A 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), Ruby 400 adit (KV-19), and No Cash 500 adit (KV-20) monitoring stations. 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 marked in which peak cadmium concentrations occurred during freshet (April through May) followed by a decline and lowest concentration in the summer/fall (August through October). The Ruby 400 adit also showed an increase in dissolved cadmium after relatively unchanged concentrations in 2019, though the concentrations stabilized in 2022.

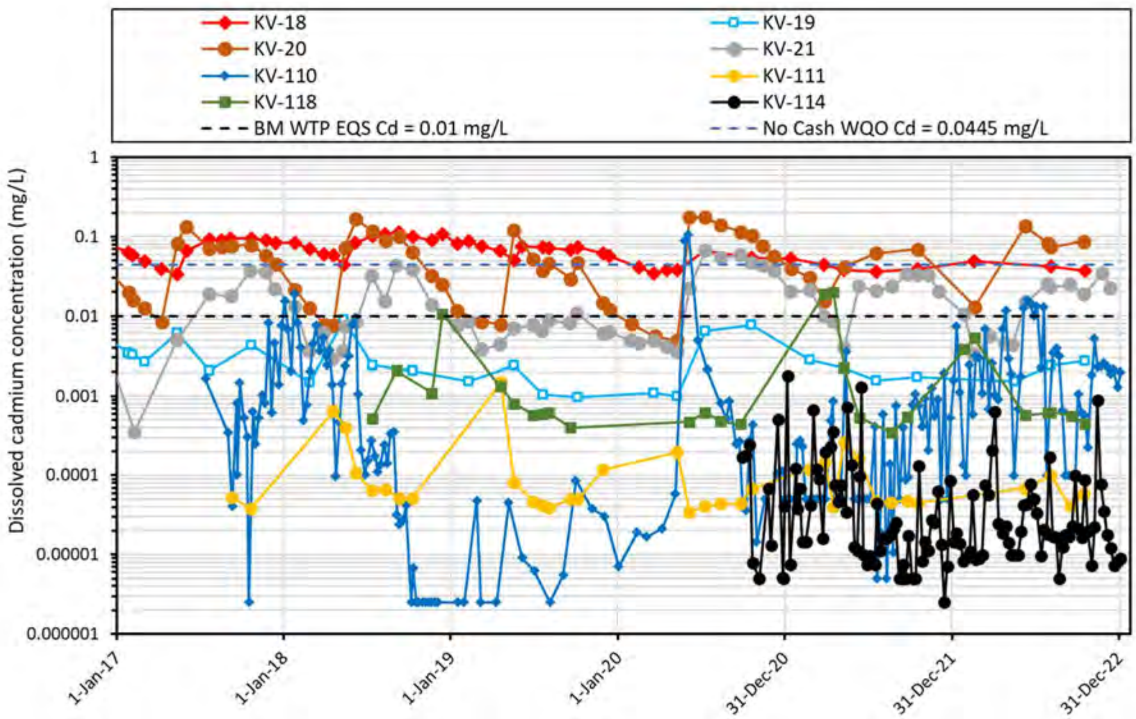


Figure 4-8: Dissolved Cadmium at Monitoring Stations, 2017-2022 Data

Table 4-9: Dissolved Cadmium Statistics at Monitoring Stations, 2008-2022 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	0.0855	0.00612	0.0733	0.0158	0.00262	0.000140	0.000096	0.00277
Count	130	104	132	126	211	36	118	27
Minimum	0.0230	0.000970	0.00492	0.000348	0.0000025	0.0000344	0.0000025	0.000342
Maximum	0.420	0.0223	0.545	0.0671	0.1060	0.00150	0.00180	0.0198
Count <DL	0	0	0	0	49	0	18	0
Standard Deviation	0.0599	0.00463	0.0679	0.0132	0.00985	0.00026	0.00024	0.00513
1st Quartile	0.0441	0.00264	0.0200	0.00575	0.00005	0.00004	0.00001	0.00053
Median	0.0735	0.00412	0.0624	0.0101	0.00040	0.00005	0.00002	0.00062
3rd Quartile	0.101	0.00880	0.104	0.0229	0.00193	0.00011	0.00007	0.00170
99 Percentile	0.152	0.02220	0.136	0.0339	0.00528	0.00023	0.00018	0.00741
Count Over Guideline	-	-	-	4	11	-	0	-
% Over Guideline	-	-	-	3%	5%	-	0%	-

[a] KV-21 compared to WQO (0.0445 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.01 mg/L).

4.4.1.6 COPPER

The dissolved copper time series plot and statistical summary of the monitoring data are shown in Figure 4-9 and Table 4-10, 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. 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. 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 exhibited no WQO exceedances in 2022, with all 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, while KV-18 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).

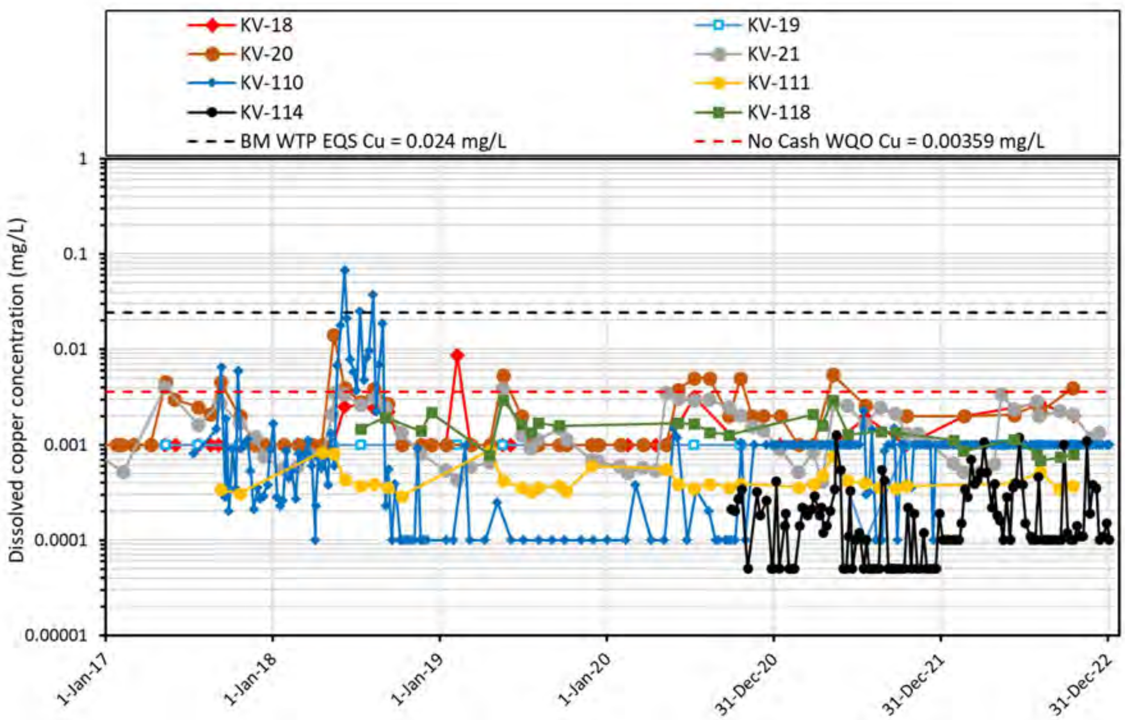


Figure 4-9: Dissolved Copper at Monitoring Stations, 2017-2022 Data

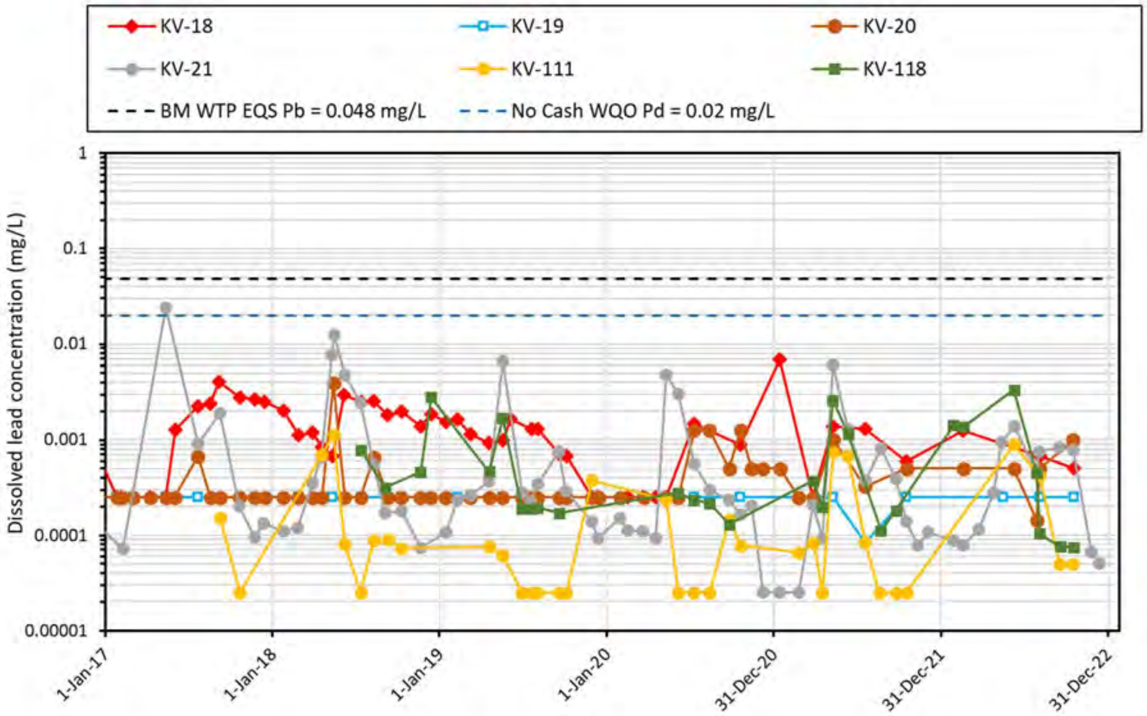
Table 4-10: Dissolved Copper Statistics at Monitoring Stations, 2008-2022 Data

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	0.00188	0.00086	0.00337	0.00171	0.00213	0.00140	0.00025	0.00147
Count	129	104	132	126	211	36	118	27
Minimum	0.00009	0.00010	0.00050	0.00041	0.00010	0.00066	0.00010	0.00068
Maximum	0.01600	0.00200	0.10700	0.00900	0.06770	0.00250	0.00200	0.00295
Count <DL	94	96	71	11	135	0	70	0
Standard Deviation	0.00242	0.00034	0.00954	0.00130	0.00597	0.00033	0.00024	0.00058
1st Quartile	0.00100	0.00050	0.00100	0.00074	0.00030	0.00122	0.00010	0.00114
Median	0.00100	0.00100	0.00200	0.00133	0.00100	0.00138	0.00020	0.00138
3rd Quartile	0.00140	0.00100	0.00310	0.00243	0.00200	0.00154	0.00027	0.00168
99 Percentile	0.00400	0.00110	0.00500	0.00323	0.00200	0.00175	0.00041	0.00214
Count Over Guideline	-	-	-	8	3	-	0	-
% Over Guideline	-	-	-	6%	1%	-	0%	-

[a] KV-21 compared to WQO (0.00359 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.024 mg/L).

4.4.1.7 LEAD

The dissolved lead time series plot and statistical summary of the monitoring data are shown in Figure 4-10 and Table 4-11, 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). Only one sample was above the EQS in 2022 (June 13). The dissolved lead concentrations in the New Bermingham WTP decant (KV-114) were below the EQS, mostly by one or more orders of magnitude. The elevated dissolved lead concentrations from the New Bermingham portal discharge in 2018 did not affect the downstream stations KV-111 and KV-118 at which lead concentrations remained 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 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 2022. Seasonal peak dissolved lead concentrations above the WQO were occasionally measured in the downstream No Cash Creek station KV-21 (6% of samples). A seasonal lead pattern characterized by peak concentrations in May through September followed by gradual decline during the rest of the year was observed at the Bermingham 200 adit (KV-18) and No Cash Creek KV-21 monitoring stations while dissolved lead concentrations at the Ruby 400 adit (KV-19) and No Cash 500 adit (KV-20) were mostly below the detection limit from mid-2013 to 2022.



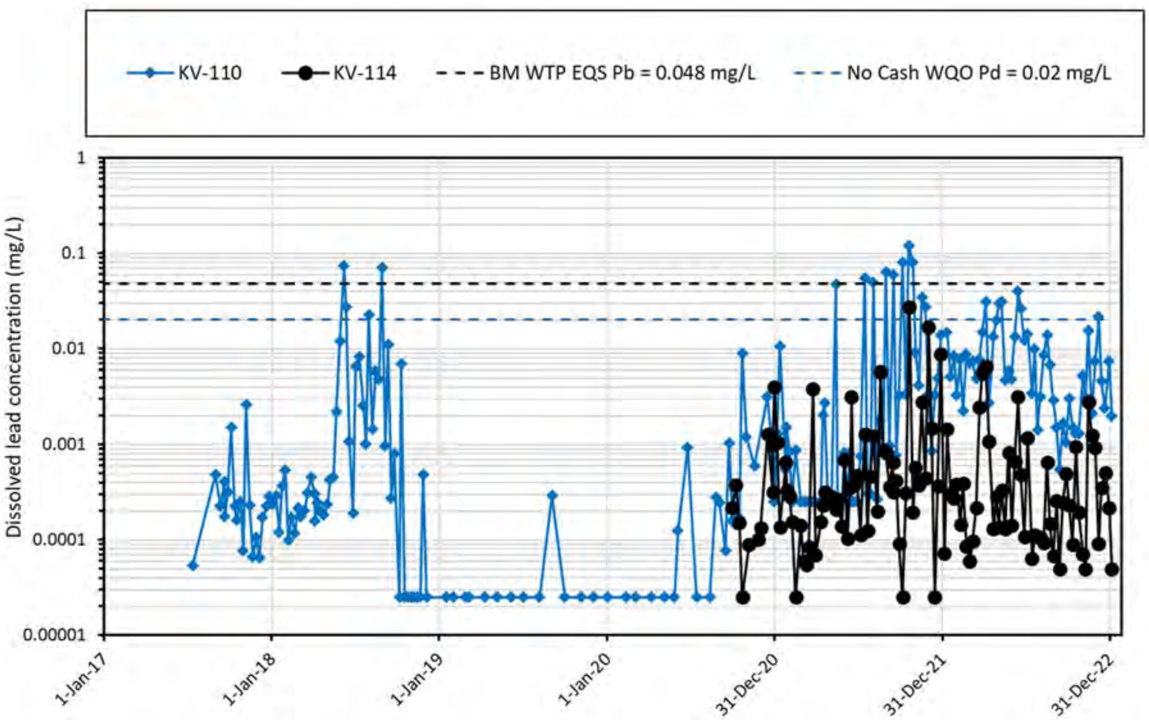


Figure 4-10: Dissolved Lead at Monitoring Stations, 2017-2022 Data

Table 4-11: Dissolved Lead Statistics at Monitoring Stations, 2008-2022 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	0.00163	0.00030	0.00050	0.02177	0.00697	0.00019	0.00111	0.00073
Count	129	104	132	126	210	36	118	27
Minimum	0.00005	0.00004	0.00008	0.00380	0.00003	0.00003	0.00003	0.00008
Maximum	0.01930	0.00540	0.01000	0.16600	0.11900	0.00114	0.02740	0.00337
Count <DL	45	90	104	14	46	16	7	0
Standard Deviation	0.00282	0.00055	0.00105	0.02953	0.01625	0.00028	0.00315	0.00090
1st Quartile	0.00025	0.00010	0.00025	0.00500	0.00023	0.00003	0.00012	0.00018
Median	0.00083	0.00025	0.00025	0.01000	0.00082	0.00007	0.00029	0.00028
3rd Quartile	0.00183	0.00025	0.00033	0.02300	0.00508	0.00015	0.00067	0.00097
99 Percentile	0.00308	0.00180	0.00086	0.05550	0.01586	0.00070	0.00258	0.00205
Count Over Guideline	-	-	-	8	9	-	0	-
% Over Guideline	-	-	-	6%	4%	-	0%	-

[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).

4.4.1.8 NICKEL

The dissolved nickel time series plot and statistical summary of the monitoring data are shown in Figure 4-11 and Table 4-12, respectively. Total nickel concentrations are reported and plotted for KV-110 and KV-114 since the EQS applies to the total fraction. There were no exceedances for total nickel concentrations in the New Bermingham portal discharge (KV-110) in 2022. 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 2022. 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 2022, 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 cyclic 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 was not observed in 2019. KV-111 also showed a seasonal trend marked by peak nickel concentrations during freshet (April through July) followed by a sharp decline and lowest concentration in the fall to early winter (October). Dissolved nickel was consistently below the WQO KV-21 in 2022.

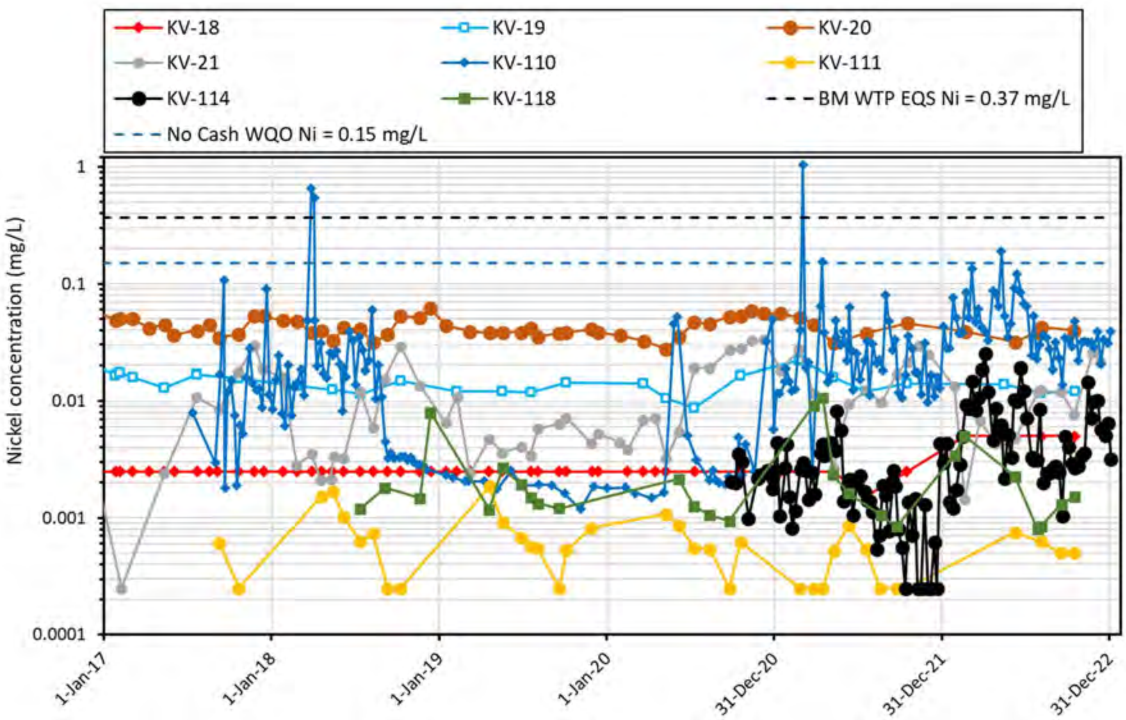


Figure 4-11: Dissolved Nickel at Monitoring Stations (Total Nickel at KV-110 and KV-114), 2017-2022 Data

Table 4-12: Nickel at Monitoring Stations, 2008-2022 Data

Dissolved 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	0.00255	0.0164	0.0480	0.00988	0.0359	0.00063	0.00403	0.00254
Count	129	104	132	126	213	36	118	27
Minimum	0.00050	0.00400	0.0040	0.00025	0.00119	0.00025	0.00025	0.0008
Maximum	0.00700	0.03600	0.0741	0.0331	1.05	0.00186	0.0252	0.0107
Count <DL	94	0	0	5	2	13	7	0
Standard Deviation	0.00080	0.00405	0.0110	0.00811	0.0930	0.00040	0.00414	0.00257
1st Quartile	0.00250	0.0140	0.0410	0.00374	0.00628	0.00025	0.00154	0.00119
Median	0.00250	0.0159	0.0476	0.00695	0.0186	0.00055	0.00262	0.00148
3rd Quartile	0.00250	0.0179	0.0556	0.0135	0.0344	0.00077	0.00458	0.00230
99 Percentile	0.00300	0.0288	0.0615	0.0226	0.0603	0.00105	0.00952	0.00620
Count Over Guideline	-	-	-	0	3	-	0	-

Dissolved Nickel (EQS = 0.37 mg/L) [a,b]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
% Over Guideline	-	-	-	0%	1%	-	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.

4.4.1.9 SELENIUM

The dissolved selenium concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-12 and Table 4-13, 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 (54%, 71%, and 59% 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. After that, 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. 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 typically returned the lowest selenium concentrations observed (typically <0.00024 mg/L). 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 (25% of samples; Table 4-13) from 2008 to 2022. Dissolved selenium also showed a seasonal pattern at KV-111 similar to other COPI.

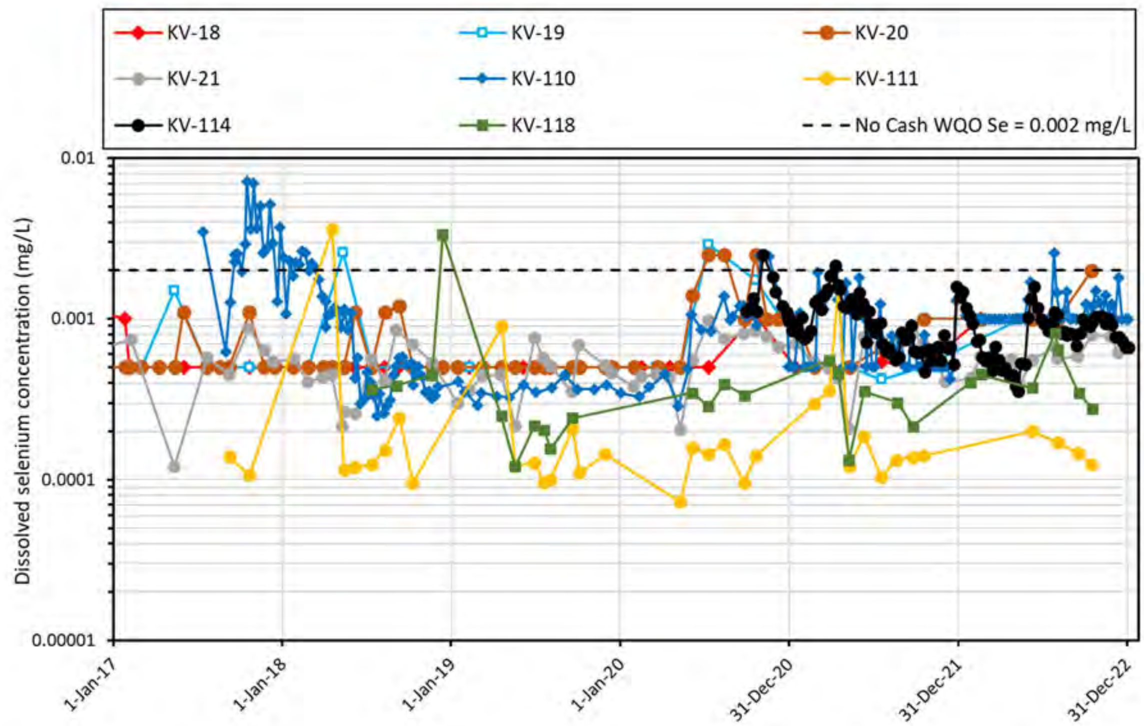


Figure 4-12: Dissolved Selenium at Monitoring Stations, 2017-2022 Data

Table 4-13: Dissolved Selenium Statistics at Monitoring Stations, 2008-2022 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	0.00080	0.00103	0.00074	0.00053	0.00116	0.00031	0.00094	0.00046
Count	129	104	132	126	211	36	118	27
Minimum	0.00040	0.00030	0.00013	0.00010	0.00025	0.00007	0.00036	0.00012
Maximum	0.00150	0.00370	0.00250	0.00320	0.00717	0.00362	0.00250	0.00338
Count <DL	70	61	94	31	53	0	1	0
Standard Deviation	0.00036	0.00084	0.00042	0.00031	0.00099	0.00062	0.00037	0.00059
1st Quartile	0.00050	0.00050	0.00050	0.00040	0.00050	0.00012	0.00066	0.00025
Median	0.00050	0.00050	0.00050	0.00048	0.00100	0.00014	0.00087	0.00035
3rd Quartile	0.00110	0.00150	0.00100	0.00066	0.00129	0.00017	0.00112	0.00043
99 Percentile	0.00140	0.00370	0.00119	0.00079	0.00227	0.00033	0.00142	0.00059
Count Over Guideline	-	-	-	1	27	-	2	-
% Over Guideline	-	-	-	1%	13%	-	2%	-

[a] KV-21 compared to WQO (0.002 mg/L).

4.4.1.10 ZINC

The dissolved zinc concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-13 and Table 4-14, 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 (6% of the dataset, 2008-2022) above the EQS in the New Bermingham portal discharge (KV-110). 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 sharply 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). The water treatment plant decant (KV-114) shows markedly lower zinc concentrations compared to the adit stations, with no exceedances recorded since 2019.

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 (July 2018-2021) 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 2022. 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 higher at KV-20. The KV-20 samples in 2022 continue to show elevated zinc concentrations (average of 7.13 mg/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 and long-term WQO in 3% and 33% of samples, respectively. The majority of these occurred between October 2020 and November 2021, with no instances of exceedance in 2022, 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. A seasonal cyclic zinc 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.

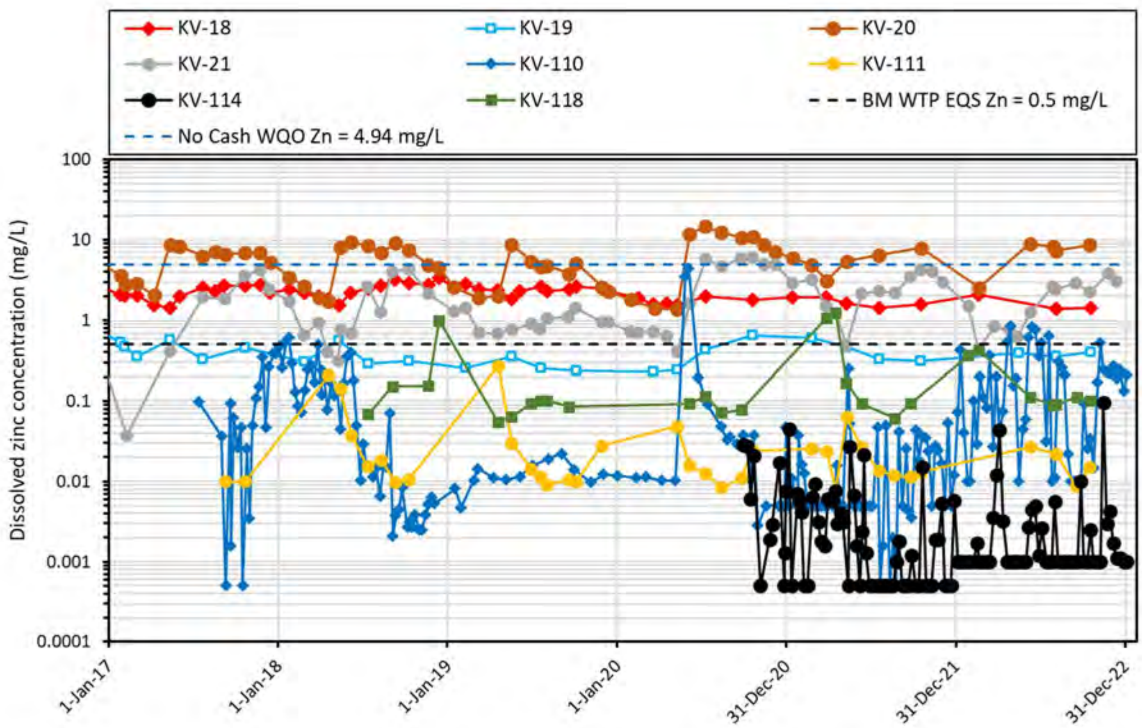


Figure 4-13: Dissolved Zinc at Monitoring Stations, 2017-2022 Data

Table 4-14: Dissolved Zinc Statistics at Monitoring Stations, 2008-2022 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	2.43	0.62	7.13	1.82	0.14	0.03	0.00	0.23
Count	130	105	132	126	211	36	118	27
Minimum	0.6550	0.1520	1.1300	0.0374	0.0005	0.0079	0.0005	0.0552
Maximum	7.740	1.600	32.300	6.090	4.400	0.274	0.097	1.250
Count <DL	0	0	0	0	42	0	57	0
Standard Deviation	0.9180	0.2655	4.2315	1.3432	0.4102	0.0560	0.0114	0.3208
1st Quartile	1.8625	0.4430	3.6450	0.7873	0.0059	0.0107	0.0010	0.0869
Median	2.3100	0.5830	6.9150	1.2650	0.0265	0.0147	0.0010	0.1020
3rd Quartile	2.7775	0.7600	9.3375	2.5900	0.1310	0.0269	0.0039	0.1530

Dissolved Zinc EQS = 0.5 mg/L) [a]	KV-18	KV-19	KV-20	KV-21	KV-110	KV-111	KV-114	KV-118
99 Percentile	3.5490	1.5080	11.4900	3.9500	0.3510	0.0561	0.0096	0.6566
Count Over Guideline	-	-	-	4	13	-	0	-
% Over Guideline	-	-	-	3%	6%	-	0%	-

[a] KV-21 compared to WQO (4.94 mg/L) and KV-110 and KV-114 compared to New Bermingham EQS (0.5 mg/L).

4.4.1.11 SULPHATE

The dissolved sulphate time series plot and statistical summary of the monitoring data are shown in Figure 4-14 and Table 4-15, 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 336 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 5% and 21% 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 35 mg/L) and KV-111 (median 51 mg/L) were generally comparable (KV-118) or slightly higher (KV-111) than that in the New Bermingham portal discharge (KV-110; median 43 mg/L) suggesting an additional source of sulphate along the flow path likely from the Ruby 400 adit (KV-19). 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. The sulphate concentration in the New Bermingham decant pond (KV-114) was low and stable (median 53.1 mg/L). A sulphate seasonality characterized by peak concentration in April followed by a sharp decline was also observed at KV-111.

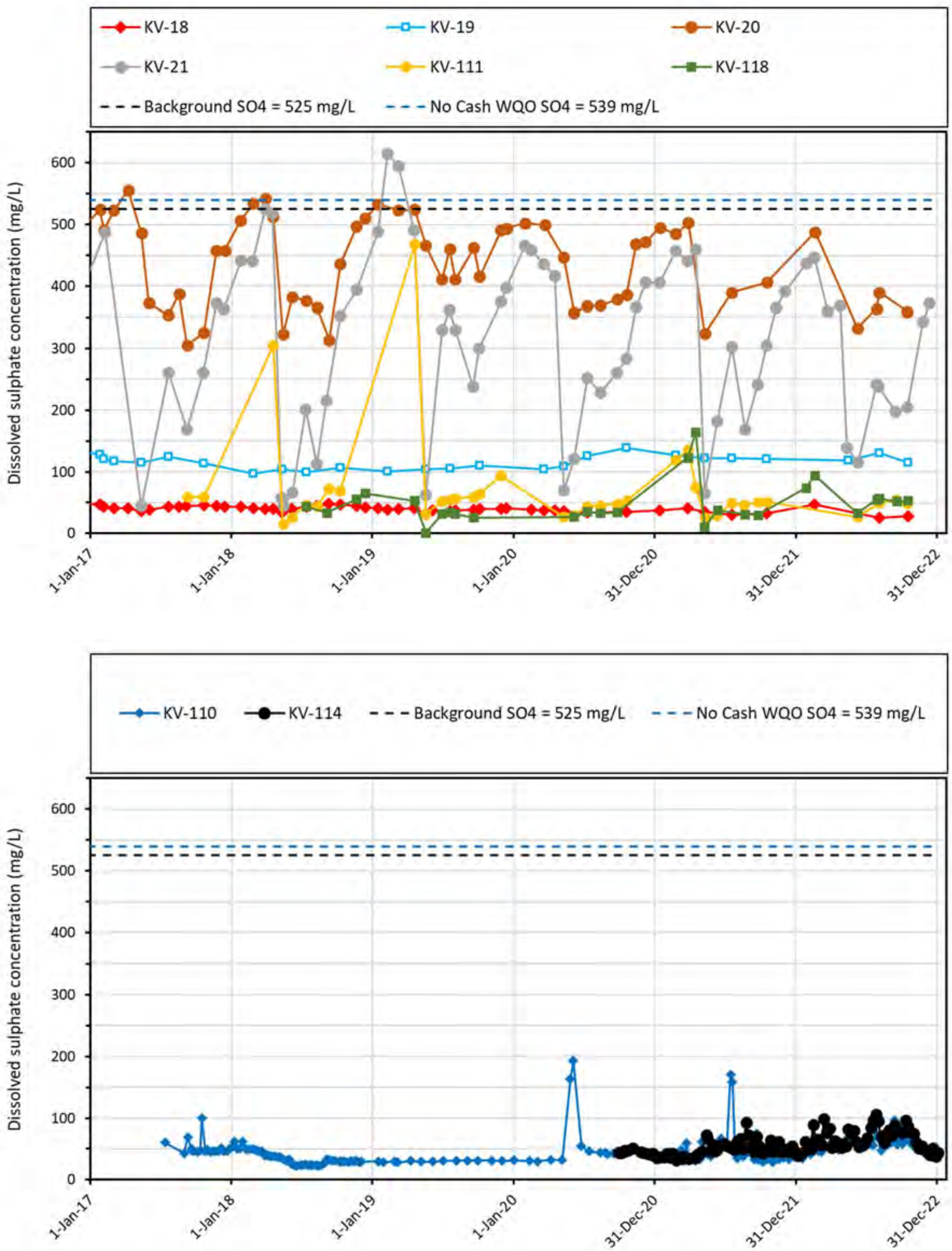


Figure 4-14: Dissolved Sulphate at Monitoring Stations, 2017-2022 Data

Table 4-15: Dissolved Sulphate Statistics at Monitoring Stations, 2009-2022 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	41.1	122	444	319	46.1	72.0	56.9	48.9
Count	121	96	123	109	212	36	118	27
Minimum	19.4	96.9	130	44.7	22.4	15.4	32.4	1.43
Maximum	54.4	166	620	615	193	468	106	164
Count <DL	0	0	0	0	0	0	0	0
Standard Deviation	5.90	12.0	91.1	141	22.0	82.2	16.8	33.0
1st Quartile	38.6	115	374	228	32.4	43.9	44.5	31.8
Median	41.4	120	452	336	43.3	51.2	53.1	35.4
3rd Quartile	44.9	128	511	430	51.2	61.2	66.7	55.4
99 Percentile	48.0	153	555	493	61.7	107	81.0	82.1
Count Over Guideline	-	-	-	5	-	-	-	-
% Over Guideline	-	-	-	5%	-	-	-	-

[a] KV-21 compared to proposed WQO (539 mg/L)
Dissolved sulphate monitoring began in 2009 and, therefore, data from 2009 onwards is shown.

4.4.1.12 AMMONIA

The ammonia-N time series plot and statistical summary of the 2016-2022 monitoring data are shown in Figure 4-15 and Table 4-16, 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, and twice in 2022 (totalling 8% of samples exceeding the EQS over the 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 but surpassed the EQS (5 mg/L) on four occasions (no exceedances in 2022).

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. Dissolved ammonia-N at KV-21 was below the detection limit in 60% of the samples and never increased above the temperature and pH dependent WQO (the 25th percentile concentration of the calculated CCME guideline is shown in Figure 4-15 for reference).

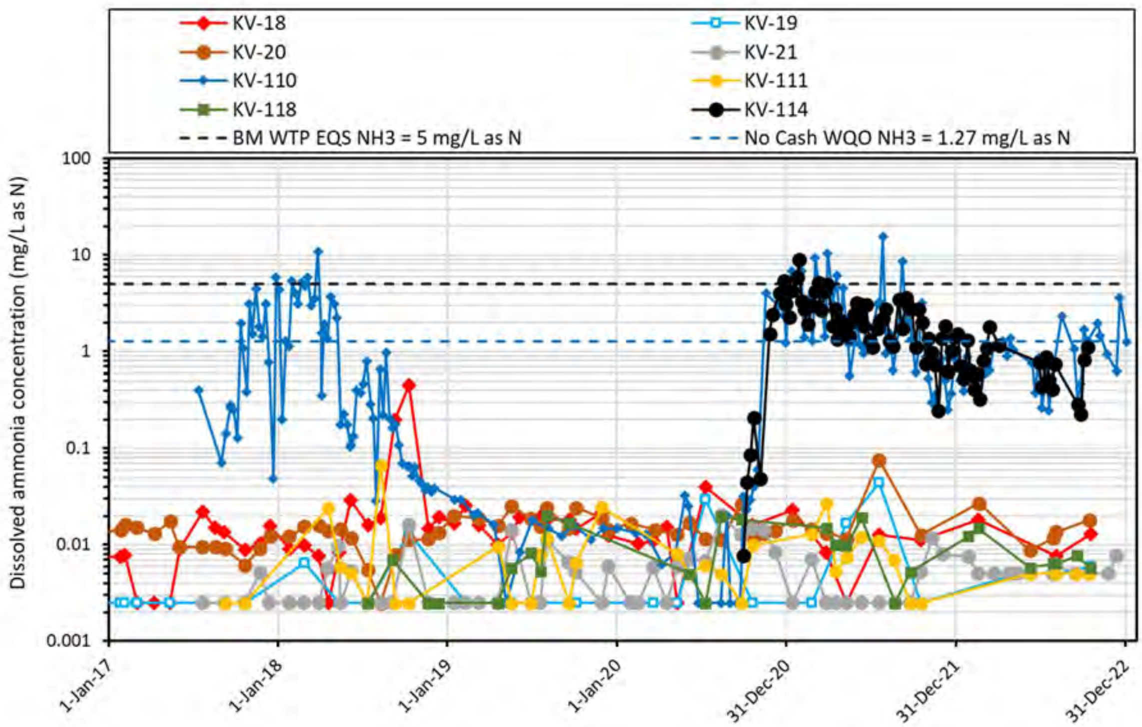


Figure 4-15: Dissolved Ammonia-N at Monitoring Stations, 2017-2022 Data

Table 4-16: Dissolved Ammonia-N Statistics at Monitoring Stations, 2014-2022 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	0.0173	0.0044	0.0138	0.0055	1.71	0.0091	2.10	0.0089
Count	82	57	88	65	211	36	117	27
Minimum	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0078	0.0025
Maximum	0.455	0.044	0.077	0.020	15.4	0.067	9.02	0.020
Count <DL	31	50	1	39	7	13	0	6
Standard Deviation	0.0534	0.0068	0.0082	0.0040	2.30	0.0116	1.422	0.0059
1st Quartile	0.0025	0.0025	0.0097	0.0025	0.169	0.0025	1.10	0.0051
Median	0.0082	0.0025	0.0131	0.0050	0.884	0.0052	1.93	0.0064
3rd Quartile	0.0154	0.0025	0.0155	0.0066	2.29	0.0097	2.75	0.0136
99 Percentile	0.0200	0.0364	0.0187	0.0115	4.56	0.0186	3.82	0.0187
Count Over Guideline	-	-	-	0	17	-	4	-
% Over Guideline	-	-	-	0%	8%	-	3%	-

[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.

4.4.1.13 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) 2022 water quality showed some instances of slightly elevated arsenic and ammonia concentrations,, though none exceeded the EQS. It also exhibited the most alkaline pH observed to date. However, these elevated concentrations were not recorded at monitoring stations downstream of the pond.
- In general, concentrations of many of the metal parameters and sulphate at New Bermingham portal discharge (KV110) 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 with some exceptions noted as follows. 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. Median cadmium and 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 but still comparable.
- 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. 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.

4.4.1.14 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 the discharge channel 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 COPI removal of 49%, 62%, 87%, 61%, 74%; however, copper showed little to no decrease (12% removal). Sodium is expected to behave conservatively and showed a median percent decrease of 29% between KV-118 and KV-111, 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, removal of these COPIs is likely due to attenuation from sorption or precipitation of the metal(loid)s along the flow path and oxidation 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 2022, two 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 COPI removal of 45-88% from KV-118 (for date-paired at both KV-111 and KV-118) between March and October 2021 and 2022 (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 COPI removal of 31%, 45%, -1% (increases in concentrations of copper from KV-118 to KV-111), 73%, 77%, and 60%, respectively. Sodium concentrations showed 44% lower concentrations post 2020 due to dilution along the flow path from Upper No Cash Creek to downstream No Cash Creek. This suggests that arsenic, 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. The decrease in ammonia, and copper concentrations along the flow path from Upper No Cash Creek to downstream No Cash Creek were likely due mainly to dilution. Attenuation after discharge from New Bermingham decant pond started is less than 50% for ammonia, arsenic copper, selenium, and likely silver 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.

At Upper No Cash Creek, measured ammonia, lead, nickel, and silver concentrations were often close to the detection limit (i.e., less than five times the detection limit) and only ammonia concentrations had several concentrations measured below the detection limit. Ammonia, lead, nickel, and silver concentrations measured at downstream No Cash Creek were 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 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.

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. Given the seasonal nature of flow in Upper No Cash Creek which limits the year-round data available, it is recommended that another year of data collection is performed before doing a more detailed assessment of constituent loadings to KV-21 to determine COPI attenuation along the KV-114 to KV-21 flow path.

Ammonia and dissolved arsenic concentrations measured at KV-114 were two-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, suggest 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-118 and KV-111 compared to KV-114 indicates that there are sources other 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, suggesting that much of the attenuation occurred downstream of Upper No Cash Creek, but in 2022 KV-114 saw higher nickel and lead concentrations compared to KV-118, suggestive of dilution and/or attenuation of these metals along the discharge corridor. As noted above, attenuation was difficult to assess due to the low lead and nickel concentrations, particularly at KV-111.

4.4.2 GROUNDWATER WATER QUALITY

The dissolved concentrations of COPI in groundwater samples collected from monitoring wells BH-MW-1 and RB-MW1 between 2013 and 2022 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, DOC, and temperature dependent elements were calculated for each sample using its hardness, pH, DOC, and temperature data. For plotting purposes (lines on graphs), the 25th percentile hardness and DOC and 75th percentile pH and temperature 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 are shown in Figure 4-16 through Figure 4-19 and associated summary statistics of those showing excess of the guidelines are reported in Table 4-17 through Table 4-21.

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: 83% of samples over YCSR standard for RB-MW-1 only;
- Dissolved cadmium: 6% of samples over YCSR standard for both RB-MW-1 and BH-MW-1; and
- pH: BH-MW-1 two samples below lower limit; RB-MW-1 three samples below lower limit, KV-116 one sample below lower limit.

4.4.2.1 FIELD PH, REDOX POTENTIAL, AND ELECTRICAL CONDUCTIVITY

Besides the two first pH measurements, the groundwater field pH remained circumneutral for all four monitoring wells, between pH 6.5 and 8.2, save for few excursions out of this range. The median pH values for RB-MW-1, BH-MW-1, KV-116, and NC-MW-1 were 6.95, 6.96, 7.32, and 7.31, respectively (Figure 4-16).

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. The redox potential at the Ruby groundwater monitoring well RB-MW-1 was lower and fluctuated between -200 mV to +157 mV indicating more reducing conditions than observed in the Bermingham 200 monitoring well (Figure 4-16). 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. The ORP at KV-116 was oxidizing from November

2020 to November 2022, with one event in June 2021 below 0 mV; the range for ORP at KV-116 was -67 to +262 mV. The ORP at NC-MW-1 ranged from -148 to +166 mV with a median ORP of 12 mV and the lowest ORP reading was also in June 2021.

The median electrical conductivity for BH-MW-1, KV-116, RB-MW-1, and NC-MW-1 were 256, 287, 415, and 953 µS/cm, respectively, indicating low salinity (fresh) groundwater.

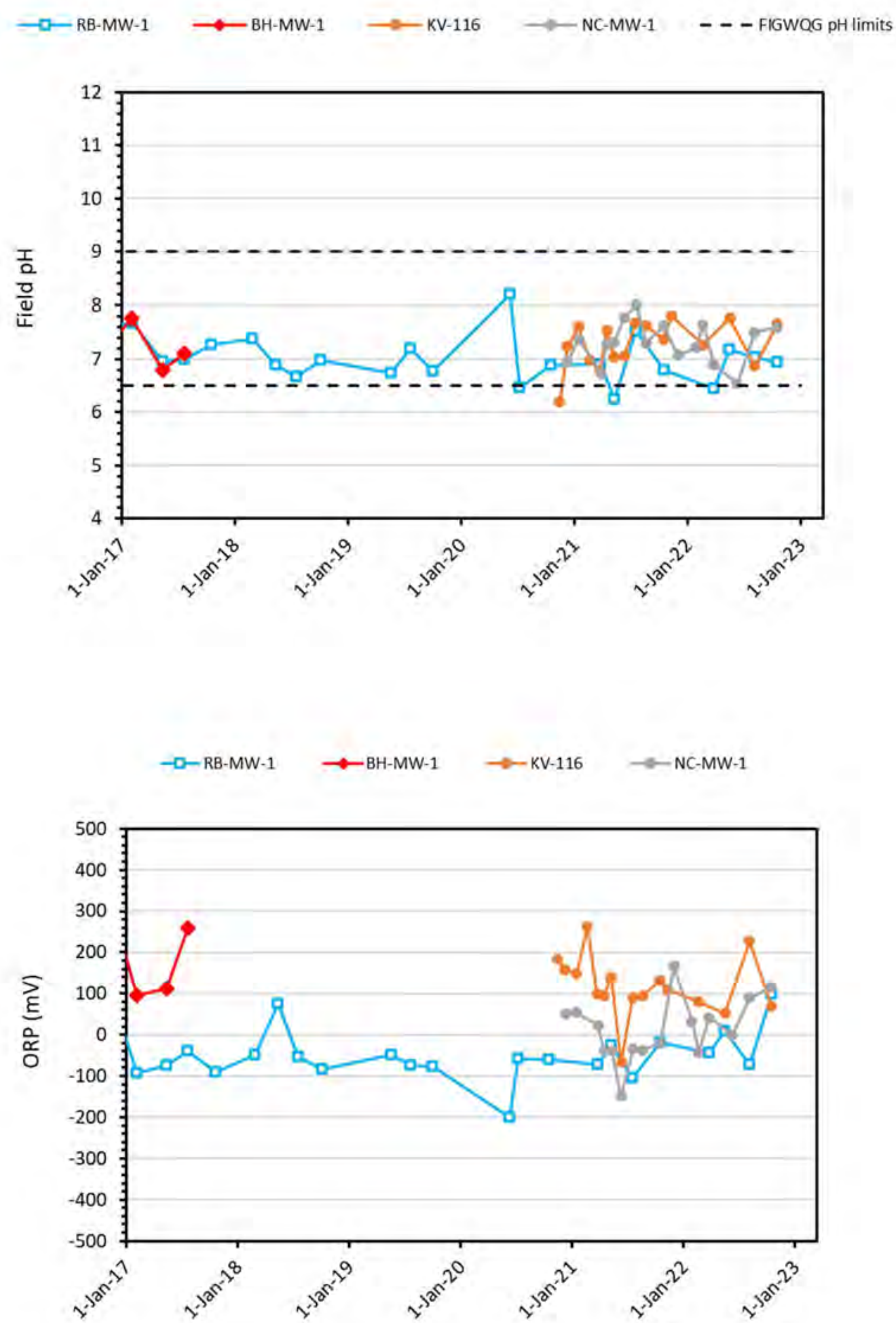


Figure 4-16: Field pH and ORP of Groundwater Monitoring Wells, 2017-2022 Data

4.4.2.2 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 (83% and 6% of samples, respectively) and dissolved cadmium exceeded at BH-MW-1 (6%) as shown in the statistical summary tables (Table 4-17 and Table 4-18) 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 consistently 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 appear to be developing a slight increasing trend, but given the limited dataset, it is difficult to determine the nature of this increase.

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. Cadmium concentrations at KV-116 were comparable to those observed at BH-MW-1, but with more limited variation. 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 monitoring wells.

Lead and zinc concentrations at RB-MW-1 and NC-MW-1 were also comparable and appeared to follow a similar pattern. 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 exhibited the same seasonality that was observed with cadmium, with peaks in the spring/fall and minimum concentrations in the summer/winter. Lead concentrations at RB-MW-1 did not observe any strong seasonality although peak concentrations were often observed in October or July.

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 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 in RB-MW-1 cannot be ascribed to a simple geochemical process or common groundwater source. Also, the elevated dissolved iron, sulphate, and zinc in NC-MW-1 compared to KV-116, the higher ORP, cadmium, selenium, and arsenic in KV-116 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.

Table 4-17: Dissolved Arsenic in Groundwater Monitoring Wells, 2013-2022 Data

Dissolved Arsenic YCSR = 0.05 mg/L	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.000171	0.06810	0.00123	0.00909
Count	16	36	15	16
Minimum	<0.00010	0.00035	0.00042	0.00660
Maximum	0.00051	0.0981	0.00322	0.0122
Count <DL	2	0	0	0
Standard Deviation	0.000106	0.0245	0.00090	0.00136
1st Quartile	0.00012	0.0588	0.00074	0.00836
Median	0.00015	0.0777	0.00089	0.00866
3rd Quartile	0.000205	0.0834	0.00124	0.00957
Count over Guideline	0	30	0	0
% Over Guideline	0.0	83.3	0.0	0.0

Table 4-18: Dissolved Cadmium in Groundwater Monitoring Wells, 2013-2022 Data

Dissolved Cadmium YCSR = Hardness Dependent	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.00016	0.00012	0.000030	0.00010
Count	16	32	9	12
Minimum	0.000038	0.0000058	0.0000025	0.000080
Maximum	0.00052	0.00083	0.000080	0.00016
Count <DL	0	0	1	0
Standard Deviation	0.00012	0.00020	0.000023	0.000021
1st Quartile	0.000089	0.000018	0.000014	0.000088
Median	0.00012	0.000029	0.000027	0.00010
3rd Quartile	0.00019	0.000095	0.000041	0.00010
Count over Guideline	1	2	0	0
% Over Guideline	6%	6%	0%	0%

Table 4-19: Dissolved Copper in Groundwater Monitoring Wells, 2013-2022 Data

Dissolved Copper YCSR = Hardness Dependent	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.00022	0.00044	0.00011	0.00042
Count	16	32	9	12
Minimum	<0.00020	<0.00020	0.00010	0.00010
Maximum	0.00054	0.0037	0.00021	0.0010
Count <DL	8	18	8	2
Standard Deviation	0.00015	0.00075	0.000037	0.00026
1st Quartile	0.00010	0.00010	0.00010	0.00028
Median	0.00015	0.00010	0.00010	0.00040
3rd Quartile	0.00030	0.00039	0.00010	0.00051
Count over Guideline	0	0	0	0
% Over Guideline	0%	0%	0%	0%

Table 4-20: Dissolved Selenium in Groundwater Monitoring Wells, 2013-2022 Data

Dissolved Selenium YCSR = 0.01 mg/L	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	0.0010	0.000050	0.00015	0.00072
Count	16	32	9	12
Minimum	0.0008	<0.000050	0.00007	0.00045
Maximum	0.0013	0.00010	0.00033	0.00098
Count <DL	0	16	0	0
Standard Deviation	0.00017	0.000019	0.000085	0.00016
1st Quartile	0.00091	0.000025	0.000080	0.00064
Median	0.0010	0.000051	0.00012	0.00072
3rd Quartile	0.0012	0.000061	0.00019	0.00082
Count over Guideline	0	0	0	0
% Over Guideline	0%	0%	0%	0%

Table 4-21: Dissolved Sulphate in Groundwater Monitoring Wells, 2013-2022 Data

Dissolved Sulphate YCSR = 1000 mg/L	BH-MW-1	RB-MW-1	NC-MW-1	KV-116
Average	45.1	115	294	53.4
Count	16	36	15	16
Minimum	40.7	73.9	152	36.8
Maximum	50.4	143	417	73.1
Count <DL	0	0	0	0
Standard Deviation	2.9	18.4	74	12.2
1st Quartile	43.4	101	257	42.6
Median	44.8	120	283	51.6
3rd Quartile	47.3	129	337	63.6
Count over Guideline	0	0	0	0
% Over Guideline	0%	0%	0%	0%

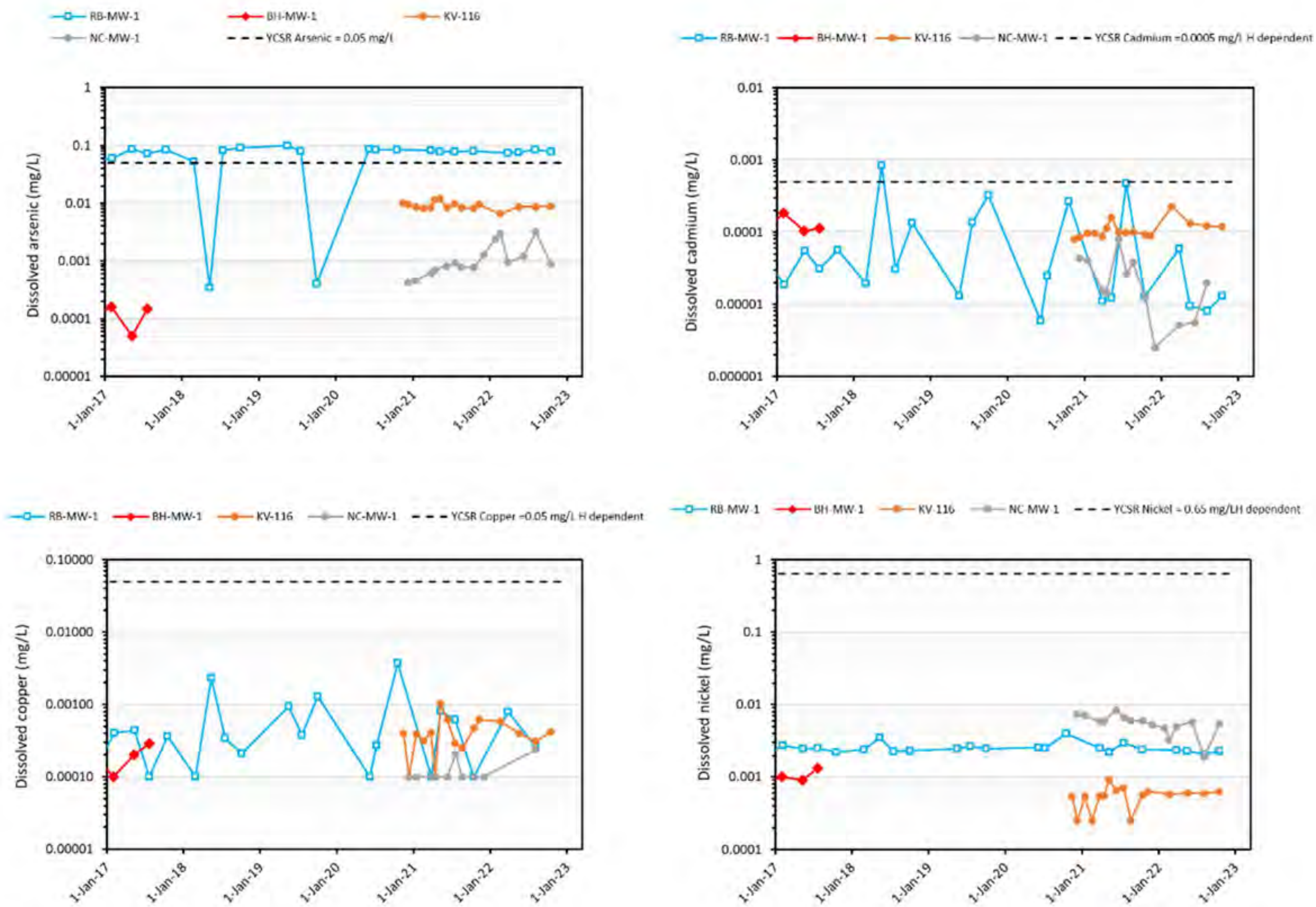


Figure 4-17: Dissolved Arsenic, Cadmium, Copper, and Nickel of Groundwater Monitoring Wells, 2017-2022 Data

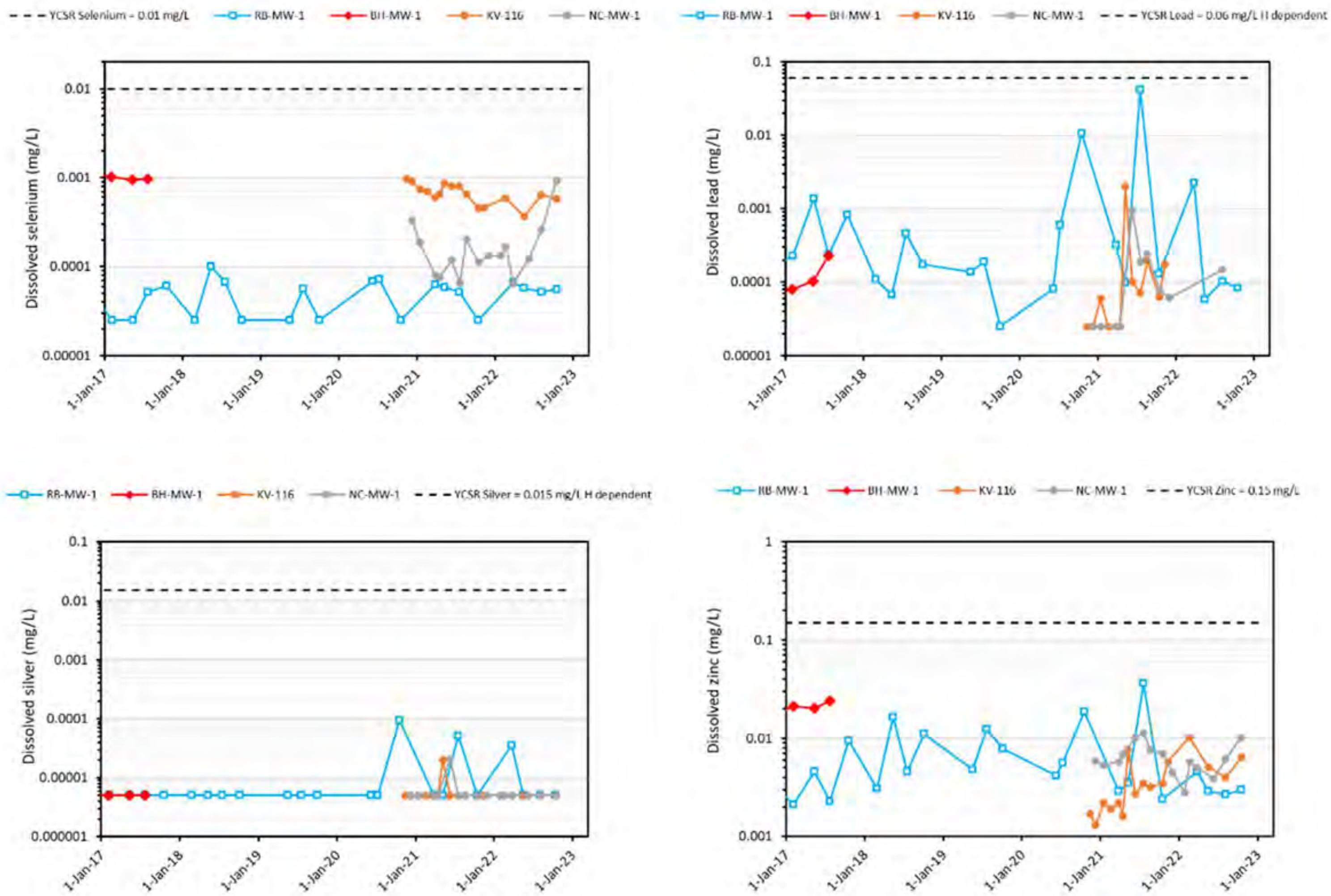


Figure 4-18: Dissolved Lead, Selenium, Silver, and Zinc of Groundwater Monitoring Wells, 2017-2022 Data

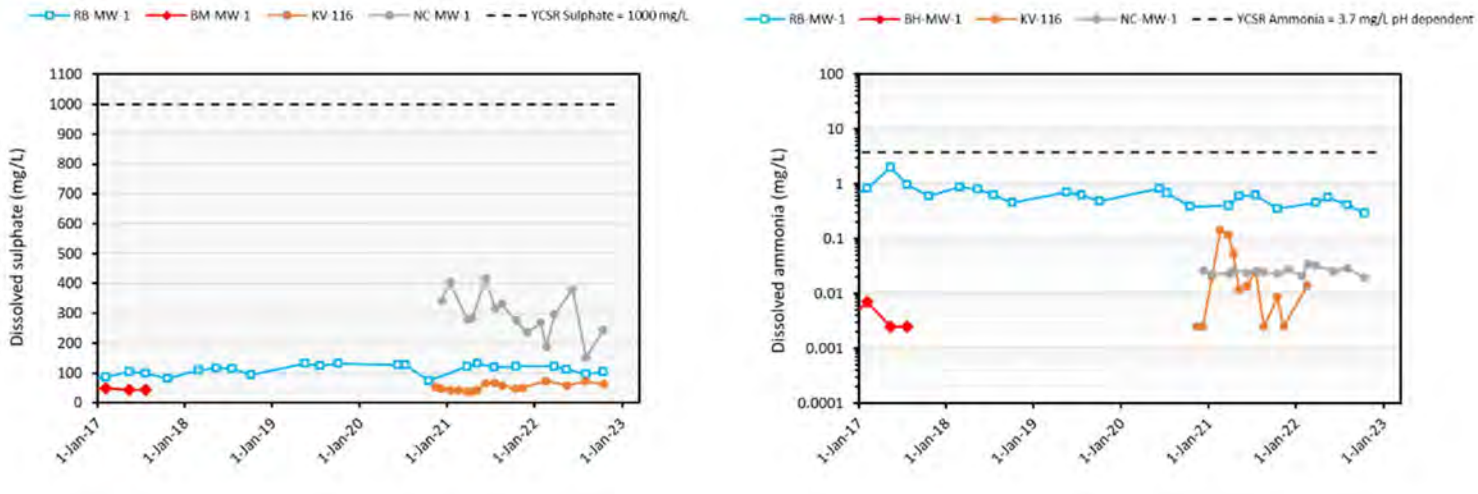


Figure 4-19: Dissolved Sulphate and Ammonia of Groundwater Monitoring Wells, 2017-2022 Data

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.

- 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 2022, it did not result in exceedances compared to EQS at New Bermingham pond decant (KV-114) except for arsenic and ammonia which surpassed their EQS in 13%, 2%, and 3% of the samples respectively (but not since July 2021). Values for pH also surpassed the EQS to a lesser extent (16% of samples, no exceedances in 2022).

- The COPI concentrations at New Bermingham portal discharge (KV-110) were often lower or comparable to the COPI concentrations in Upper No Cash Creek (KV-118) except during peak concentration of arsenic, nickel, selenium, and ammonia observed in 2020 and again in 2021 and 2022. 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.

- 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 2022, two years after discharge from the New Bermingham decant pond began, ammonia, arsenic, copper, lead, nickel, and silver had a median COPI removal of 31%, 45%, -1%, 73%, 77%, 60%, respectively between Upper No Cash Creek (KV-118) and downstream No Cash Creek (KV-111). The decrease in ammonia, arsenic, and copper concentrations along the flow path from Upper No Cash Creek to downstream No Cash Creek were likely due mainly to dilution as the decrease in concentrations was similar to sodium. The decrease in lead, nickel, and silver concentrations along the flow path were likely due to dilution and attenuation. Attenuation after discharge from New Bermingham decant pond started is less than 50% for ammonia, arsenic, copper, and likely silver between KV-118 and KV-111; however, many of the ammonia, arsenic, lead, nickel, and silver concentrations measured at downstream No Cash Creek were often less than the detection limit or close to the detection limit making it difficult to accurately quantify percent removal. Additionally, ammonia and dissolved arsenic concentrations measured at KV-114 were two-three orders 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, further suggesting that the New Bermingham decant was not a significant contributor for these metals. 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.

- 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) exceedance of YCSR standard by arsenic and cadmium in one of monitoring wells or both. Dissolved arsenic was recurrently elevated at RB-MW-1 and dissolved cadmium intermittently exceeded at RB-MW-1 and BH-MW-1.

- 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:

- Collect soil samples for sequential Tessier analysis from mine discharge path. This will provide insight into the soil "compartments" with which the COPIs are associated (e.g., easily extractable, carbonates, iron/manganese oxyhydroxides, organic matter/sulphides) which will inform both the nature of COPI sequestration along the flow path and their susceptibility to remobilization;
- 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.

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APPENDIX A:

LABORATORY ANALYTICAL REPORTS – SOIL AND MOSS GEOCHEMICAL AND MICROBIOLOGICAL, SURFACE WATER, AND GROUNDWATER 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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	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
Grouping	**Analyte**					
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

	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
Grouping	**Analyte**					
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

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						
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.

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
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

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

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
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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	WEI-21 Recvd Wt. kg 0.02	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
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 *****

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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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 Cu ppm 0.2	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 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 *****

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
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

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	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
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

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North Vancouver BC V7H 0A7
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www.alsglobal.com/geochemistry

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 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
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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North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
www.alsglobal.com/geochemistry

To: **ALS ENVIRONMENTAL**
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BURNABY BC V5A 1W9

Finalized Date: 25-SEP-2018
Account: APN

Project: L2160708

CERTIFICATE OF ANALYSIS VA18228682

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).

Applies to Method: ME-MS41

LABORATORY ADDRESSES

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

Applies to Method: LOG-22 ME-MS41 SCR-41 WEI-21

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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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

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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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	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
	Units	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
	LOD	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
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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2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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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	ME-MS41 Fe % 0.01	ME-MS41 Ga ppm 0.05	ME-MS41 Ge ppm 0.05	ME-MS41 Hf ppm 0.02	ME-MS41 Hg ppm 0.01	ME-MS41 In ppm 0.005	ME-MS41 K % 0.01	ME-MS41 La ppm 0.2	ME-MS41 Li ppm 0.1	ME-MS41 Mg % 0.01	ME-MS41 Mn ppm 5	ME-MS41 Mo ppm 0.05	ME-MS41 Na % 0.01	ME-MS41 Nb ppm 0.05	ME-MS41 Ni ppm 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
North Vancouver BC V7H 0A7
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 / Analyte / Units / LOD	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	ME-MS41 Tl ppm 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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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 / 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

Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).

Applies to Method: ME-MS41

LABORATORY ADDRESSES

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

Applies to Method: LOG-22 ME-MS41 SCR-41 WEI-21

Chain of Custody
Canada Toll
www

L2160708-COFC

C #

Page 1 of of 1

ALS Environmental

Report To	
Company:	Alexco Resource Corp.
Contact:	Kai Woloshyn
Address:	#3 Calcite Business Centre, 151 Industrial Road
	Whitehorse, YT Y1A 2V3
Phone:	867-668-6463 Fax: 867-633-4882
Invoice To	Same as Report ? ☐ Yes ☑ No
Hardcopy of Invoice with Report?	☐ Yes ☑ No
Company:	Alexco Resource Corp.
Contact:	Derek Meneghin
Address:	Suite 1150 - 200 Granville St. Vancouver BC V6C 1S4
Phone:	604-633-4888 Fax: 604-633-4887
Lab Work Order # (lab use only)	

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Digital ☐ Fax	
Email 1:	environment@alexcoresource.com
Email 2:	nichole@accessconsulting.ca
Email 3:	amacphail@accessconsulting.ca; agault@alexco
Client / Project Information	
Job #:	Bermingham Natural Attenuation Study
PO / AFE:	
LSD:	
Quote #:	
ALS Contact:	Shane Stack
Sampler:	

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

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	Paste pH	Moisture Content	PSA-PIPET+GRAVEL-SK	Total Organic Carbon	Aqua regia ICP-MS metals	Tessier Seq Extract ICP-MS									Number of Containers
																		P	
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 [redacted]	Date (dd-mmm-yy) Sept 7, 2018 [redacted]	Time (hh-mm) 7:30 [redacted]	Received by: EHF	Date: 2018 7 Sep	Time: 14:30	Temperature: 6.0 °C	Verified by: HA	Date: 9/11	Time: 12:40p	Observations: Yes / No ? If Yes add SIF

Alex Zheng (signature)

10

GENF 20.00 Front

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	**Date Samples Received**	26/Sep/2018
		Report Date	08/Nov/2018
		Report Revision	A
		Version	FINAL

Client Phone 867-668-6463, 613-329-0085

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

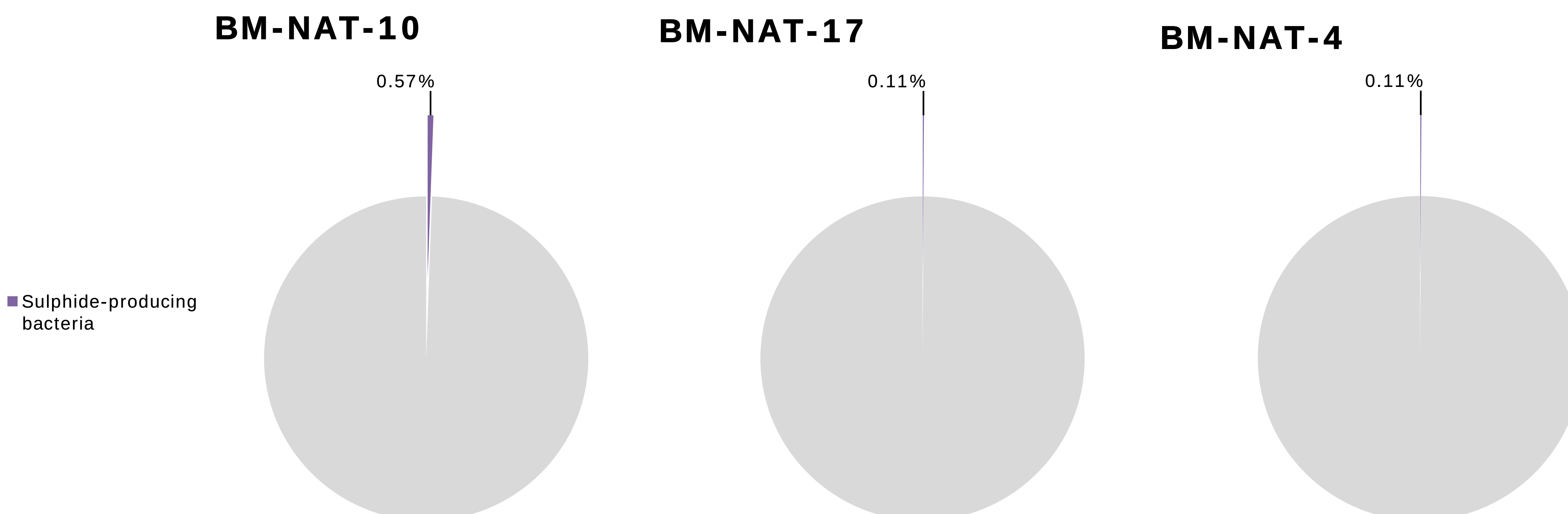
Summary of add-on analyses performed

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

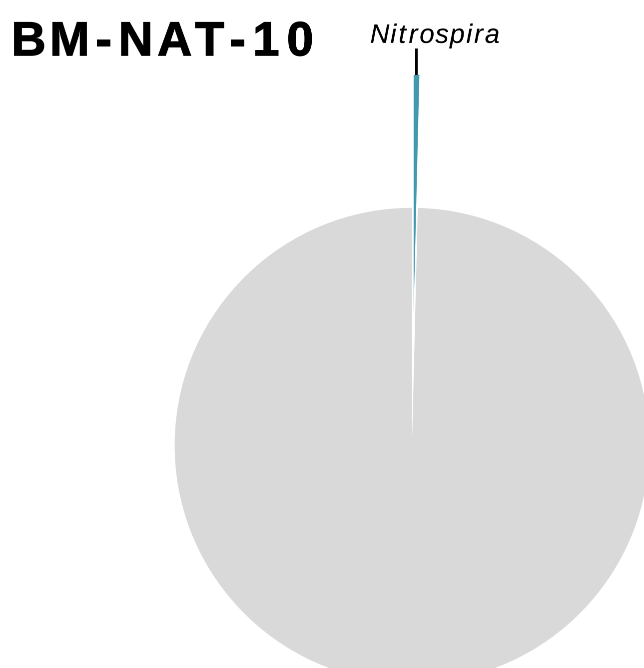


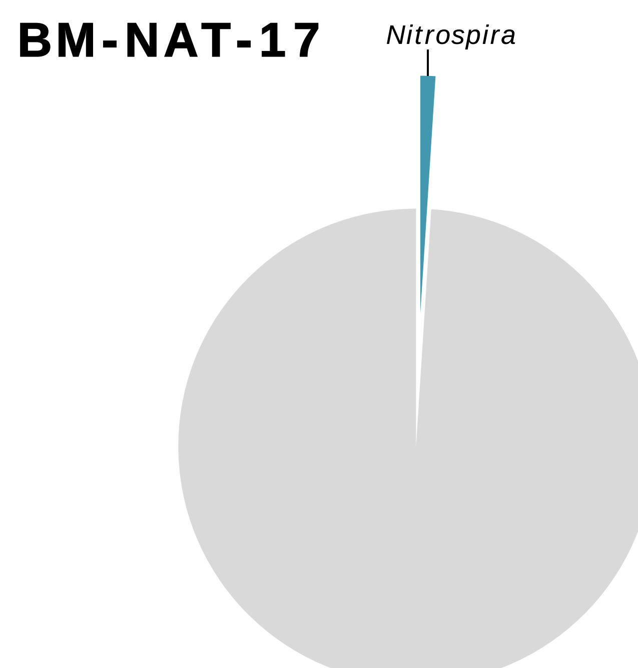
Abundant bacteria identified to the genus level

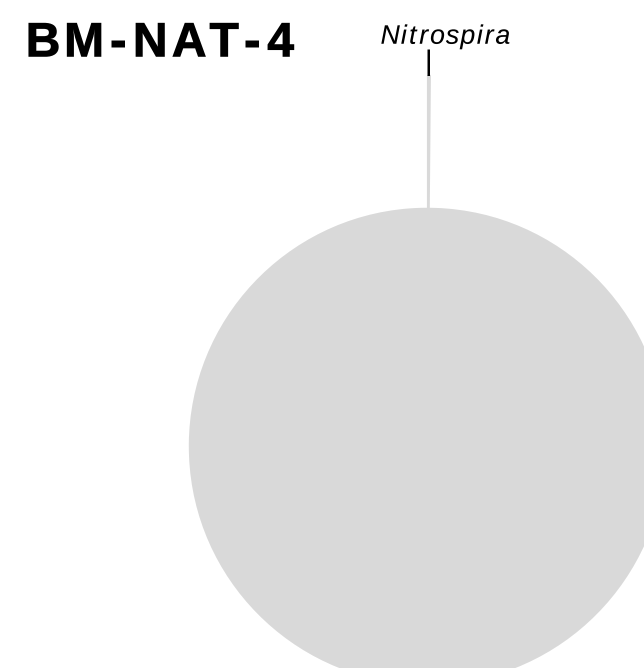
Of bacteria identified to the genus level, those with the highest percentage are provided if ≥ 1% in at least one sample.

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__Phenylobac
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__Sphingomo
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__Chthonomo
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__Methylobac
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__Schlesneri
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.

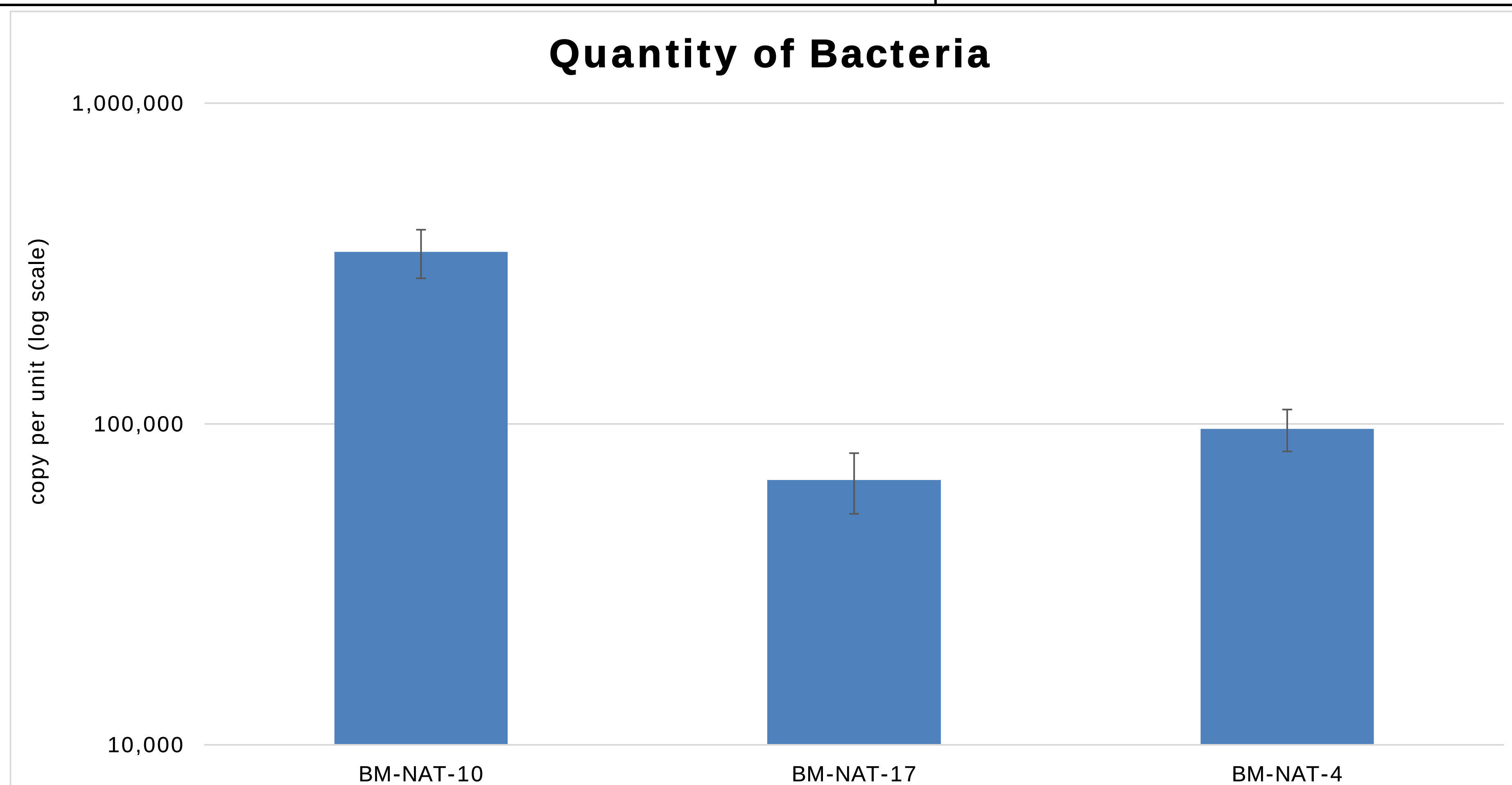
Report Number	029_1118_08A
Project Name	Alexco
P.O Number	AKHM-13-01
COC Number	00191
Report To	Andrew MacPhail, Andrew Gault, Kai Woloshyn
Date Samples Received	26/Sep/2018
Report Date	08/Nov/2018
Report Revision	A

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 sulph
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

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2366434-1	L2366434-2	L2366434-3	L2366434-4	L2366434-5
	Sample ID	L2366434-1	L2366434-2	L2366434-3	L2366434-4	L2366434-5
	Description	Moss	Moss	Moss	Moss	Moss
	Sampled Date	06-OCT-19	06-OCT-19	06-OCT-19	06-OCT-19	06-OCT-19
	Sampled Time	16:10	16:10	15:50	15:50	16:00
	Client ID	T1-A	T1-B	T2-A	T2-B	T3-A
Grouping	**Analyte**					
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

	Sample ID	L2366434-6	L2366434-7	L2366434-8	L2366434-9	L2366434-10
	Description	Moss	Moss	Moss	Moss	Moss
	Sampled Date	06-OCT-19	03-OCT-19	03-OCT-19	03-OCT-19	03-OCT-19
	Sampled Time	16:00	13:35	13:35	14:16	14:16
	Client ID	T3-B	BM-NAT-05-A	BM-NAT-05-B	BM-NAT-10-A	BM-NAT-10-B
Grouping	**Analyte**					
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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

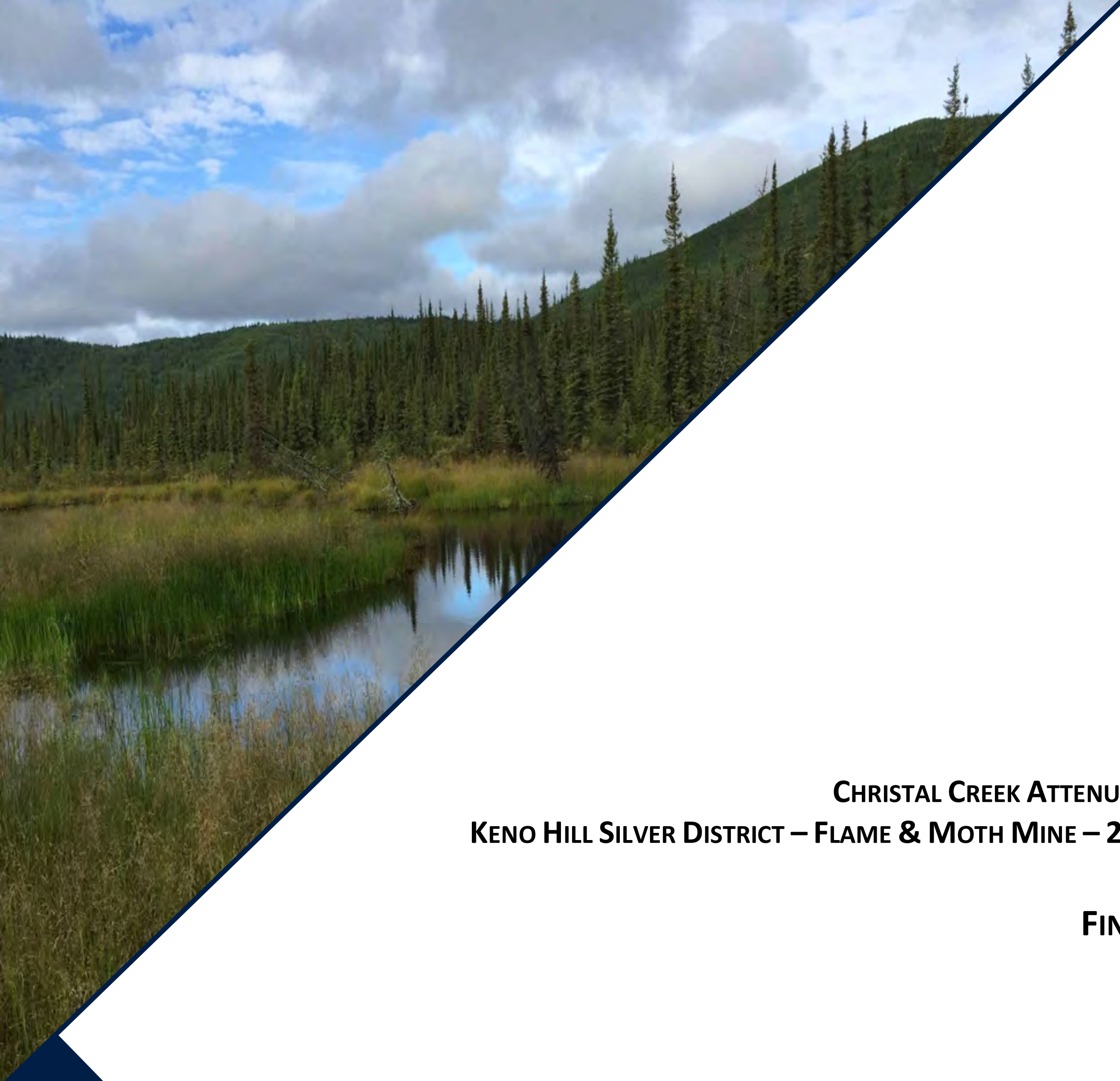
GLOSSARY OF REPORT TERMS

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 1.7

Christal Creek Attenuation Study Interim Report



Christal Creek Attenuation Study
Keno Hill Silver District – Flame & Moth Mine – 2022 Update

Final Report

Prepared for:

Alexco Keno Hill Mining Corp.

Date:

March 29, 2023

ENSERO solutions

ENSERO SOLUTIONS CANADA, INC. SIGNATURES

Report prepared by: ______________________ 3/29/2023

Stefan Nenson
Technologist III

Report reviewed by: ______________________ 3/29/2023

Andrew Gault, Ph.D
Practice Lead Geochemistry

Report reviewed by: ______________________ 3/29/2023

Kai Woloshyn, B.Sc. P.Chem
Vice President Strategic Projects

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 in order 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% to13%, 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 constantly or occasionally elevated concentrations of sulphate, arsenic, cadmium, copper, iron, lead, manganese, and zinc above their respective generic Canadian water quality guidelines at stations along Christal Creek. The only noteworthy water quality changes in 2022 compared to the previous years was a decrease of sulphate along Hinton creek (KV-49). 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

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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 a natural attenuation rate of 50% 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 fourth 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. This report is an update to the 2021 attenuation report and includes additional water quality data from surface and groundwater monitoring stations. All the sections pertaining to the soil and vegetation assessment have remained unchanged from the previous attenuation study report (Ensero, 2021) as no new soil or vegetation data was collected in 2021 or 2022.

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;
- 15-year baseline surface water records at the following monitoring stations: KV-6, KV-49, KV-50, and KV-51 and three 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.

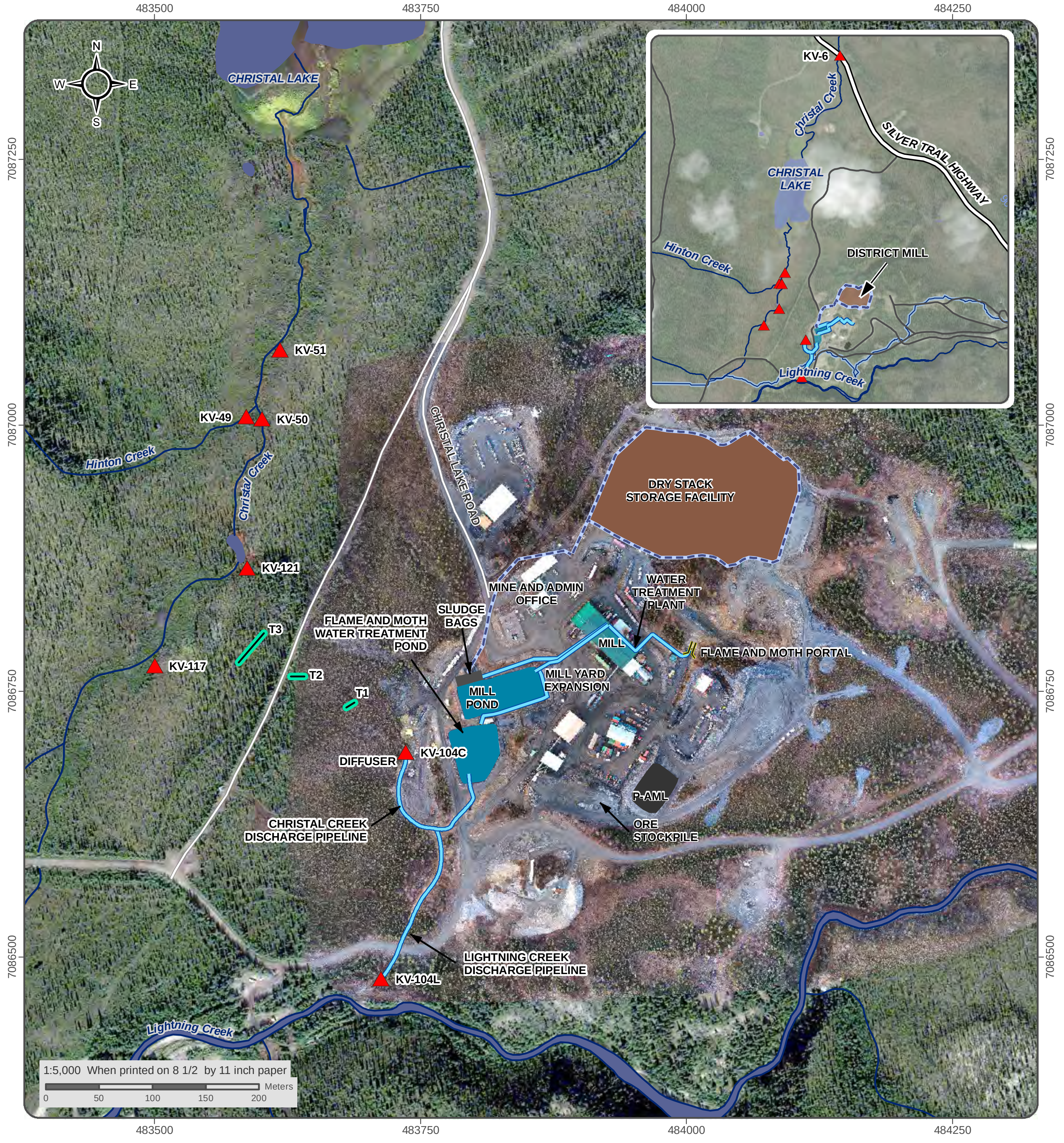
When the solution pH is circum-neutral or slightly acidic, cationic metal species precipitate as aluminum and iron hydroxide, oxyhydroxide, or hydroxy-sulphate minerals (Nordstrom, 1982). Under these pH conditions, dissolved metals may adsorb onto surfaces of these amorphous and minerals and/or other 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

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on March 2023

Datum: NAD 83; Projection: UTM Zone 8N

Hecla KENO HILL

HECLA KENO HILL

FIGURE 2-1

CHRISTAL CREEK ATTENUATION STUDY AREA

MARCH 2023

D:\Project\AllProjects\Keno_Area_Mines\ALL-SITES\02-Map\04-Studies\Attenuation_Study\Attenuation_Study_Transects_WM_Hecla_20221116.mxd
(Last edited by: amatlashevska; 2023-03-28/15:21 PM)

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

Fifteen years (2008 to 2022) 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 proposed 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. Four 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				
		Sample ID	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.

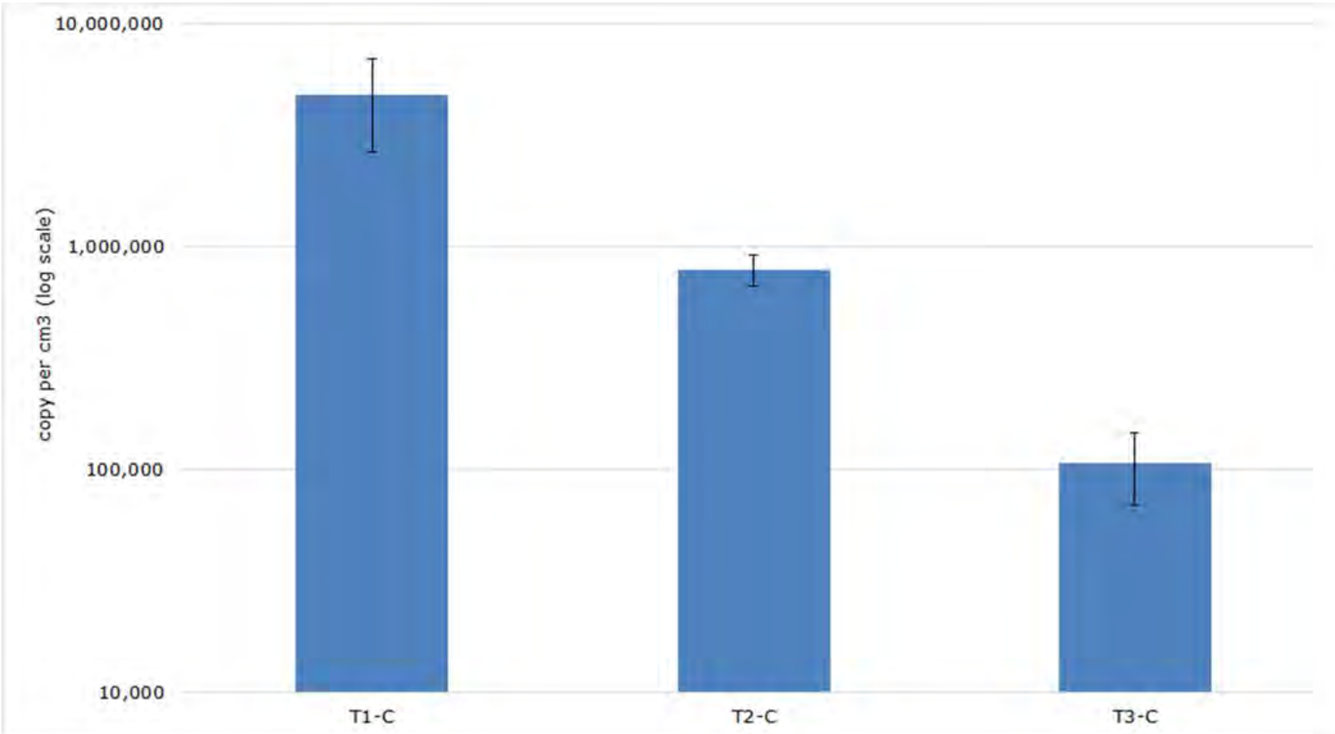


Figure 4-1: Quantity of Sulphate-Reducing Bacteria in Transect Soil Samples

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 2022 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). Total concentrations are presented except where the water quality guideline specifies that the dissolved fraction be used (copper, manganese, and zinc). The comparison of water quality results with the generic guidelines was 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 exceedances of the lower guideline for pH were occasionally observed for field pH.

4.5.1 FIELD pH

Besides a few (four) excursions of field pH below pH 6.5 along Hinton Creek (KV-49) and (once each) at KV-51 and KV-6, the field pH has remained in the circumneutral CCME FWAL range (pH 6.5 -9.0) during the monitoring period. There were periods of high and low pH measurements, but no clear seasonality was depicted in the field pH data. Monitoring station KV-6, located downstream of Christal Lake, generally had the highest field pH (median field pH 7.6) 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; this variation was not observed in 2022. On May 16, 2021, the pH at KV-50 increased to 8.2, a level not seen since 2012. This coincided with the most recent discharge from the Flame & Moth WTP.

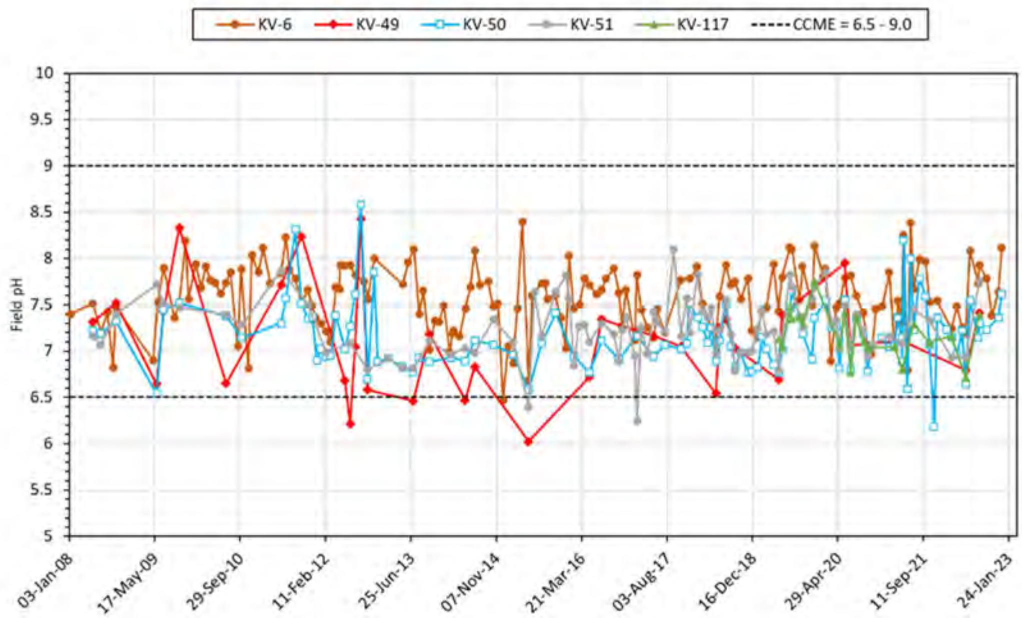


Figure 4-2: Field pH at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

4.5.2 FIELD REDOX POTENTIAL

As expected, the oxidation-reduction potential (ORP) at the monitoring stations was oxidizing but large fluctuations were recurrent in the data (Figure 4-3). The redox potential was largely positive with a median field ORP ranging from +19.2 mV to +127.4 mV. However, periodic negative ORP measurements were also observed during several sampling events coinciding with low flows and turbid waters in July-December.

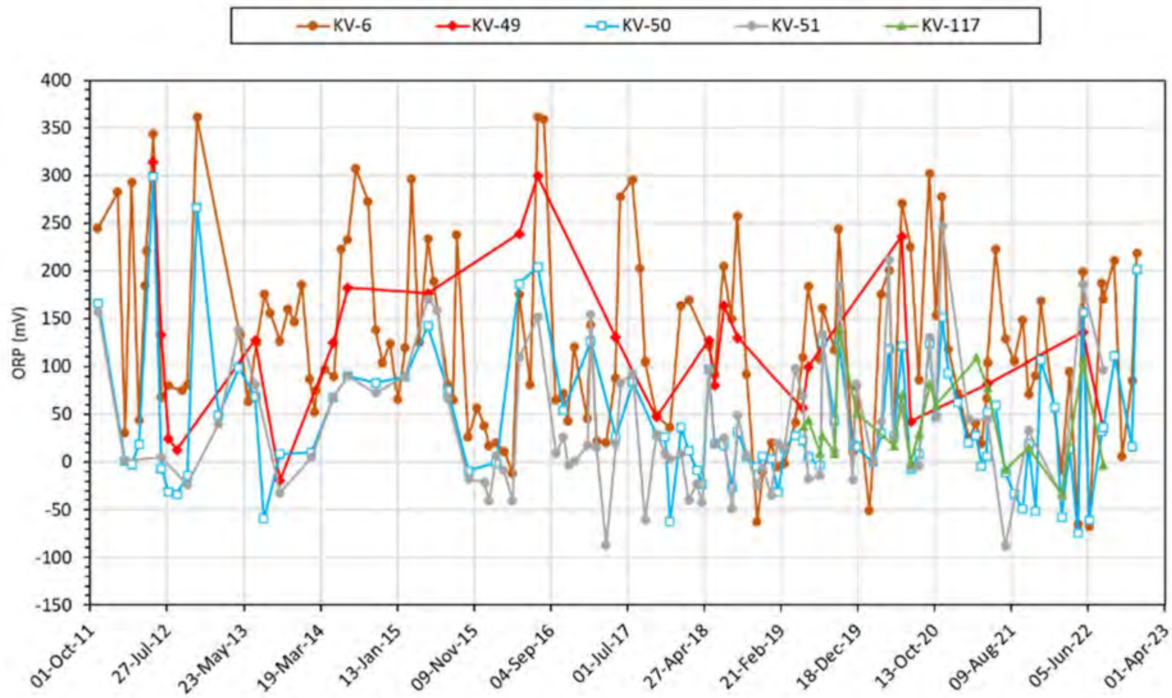


Figure 4-3: Field ORP at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2011-2022 Data

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 KV-6 generally had comparable and the highest total arsenic concentrations, which exceeded the CCME guideline (0.005 mg/L) for most samples collected. The background station KV-117 also had total arsenic comparable to KV-50, KV-51, but showed higher seasonal variation resulting in low concentrations below the guideline during freshet. The lowest arsenic concentrations were measured at KV-49 with no exceedance of the guideline during the monitoring period. KV-6 had total arsenic concentrations that were typically comparable to or higher than the guideline (70% sample exceedance; Table 4-11). Most exceedances occurred in May during freshet and a weak seasonality was noticeable in the data since 2013.

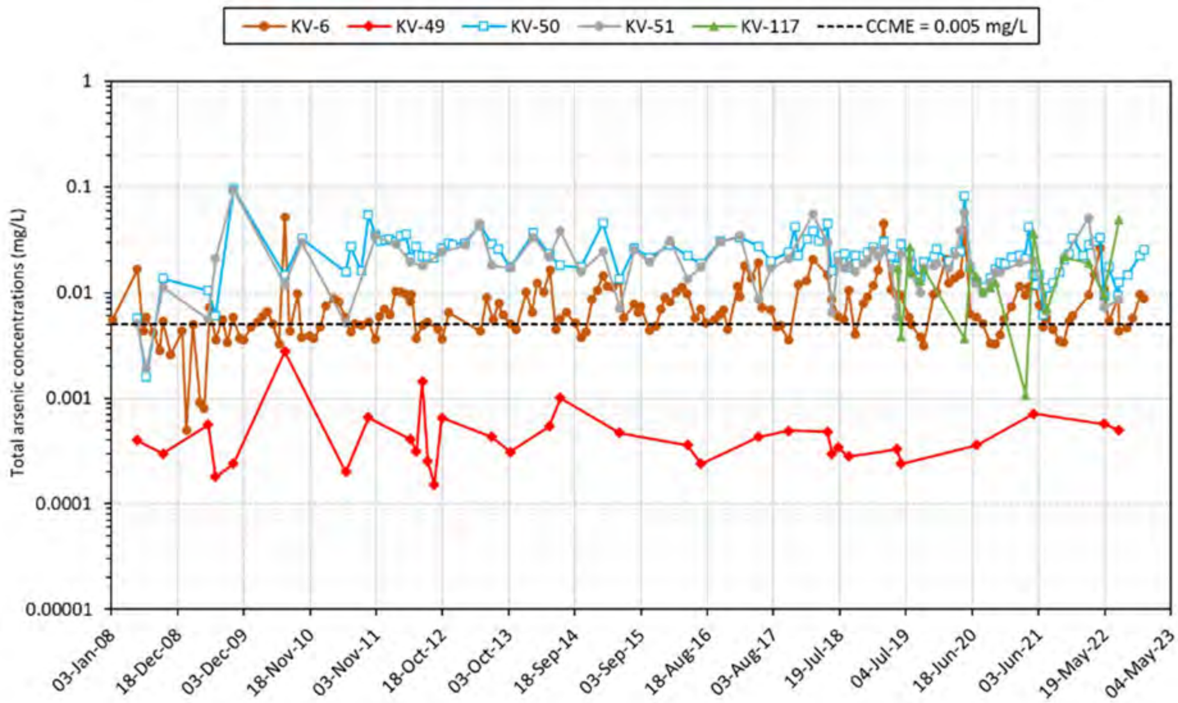


Figure 4-4: Total Arsenic at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-11: Total Arsenic Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Arsenic (mg/L); CCME = 0.005 mg/L					
Average	0.000512	0.0245	0.0215	0.00815	0.0161
Count	33	110	72	169	19
Minimum	0.000153	0.0016	0.0019	0.0005	0.00107
Maximum	0.00275	0.096	0.093	0.0513	0.0494
Count <DL	0	0	0	0	0
Standard Deviation	0.000474	0.0128	0.0141	0.00644	0.0116
1st Quartile	0.0003	0.0173	0.0146	0.00472	0.00983
Median	0.0004	0.0225	0.0188	0.00613	0.0141
3rd Quartile	0.00054	0.0293	0.0250	0.00976	0.018
Count over Guideline	0	109	71	118	16
% Over Guideline	0.0%	99.1%	98.6%	69.8%	84.2%

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 single exceedance of the BC ENV working guideline (0.009 mg/L) was recorded. The concentrations were generally comparable at the five monitoring stations (median = 0.00015 to 0.00037 mg/L) although antimony concentrations at KV-6 were slightly higher than the other sites since 2013. The total antimony concentration at KV-49 was relatively stable during the monitoring period. Total antimony concentrations that were below the detection limit were observed at KV-50 and KV-51 in 2020 and 2021.

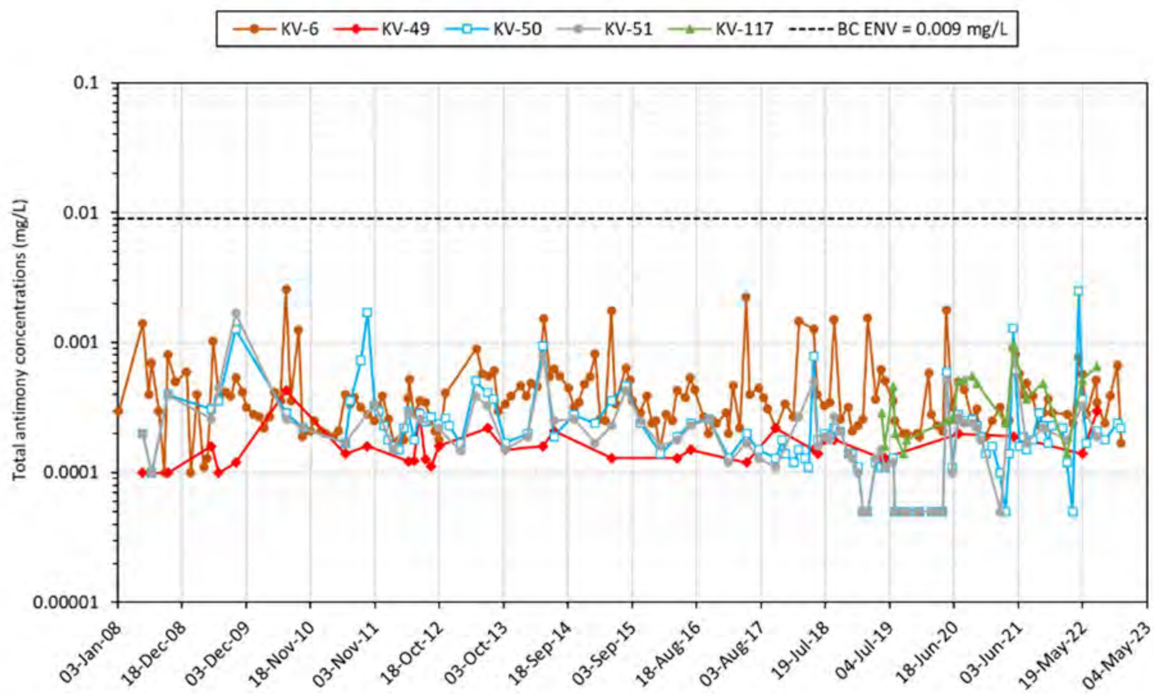


Figure 4-5: Total Antimony at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-12: Total Antimony Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Antimony (mg/L); BC ENV = 0.009 mg/L					
Average	0.000166	0.000274	0.000234	0.000448	0.00039
Count	33	110	72	169	19
Minimum	0.0001	0.00005	0.00005	0.0001	0.00014
Maximum	0.00043	0.00249	0.00167	0.00257	0.00095
Count <DL	2	13	12	2	0
Standard Deviation	0.000068	0.000327	0.000228	0.000373	0.00021
1st Quartile	0.000128	0.00014	0.000127	0.00025	0.00022
Median	0.00015	0.000195	0.000185	0.000349	0.00037
3rd Quartile	0.00018	0.000267	0.00026	0.00049	0.00052
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% of samples), KV-49 (52%), and KV-117 (63%) while only sporadic exceedances were noted at KV-50 and KV-51 (23% and 21%, respectively). The median cadmium concentrations at KV-49, KV-50, KV-51, and KV-117 were comparable (median = 0.00022 to 0.00032 mg/L) and lower than that of KV-6 (median 0.0011 mg/L). The total cadmium concentration at KV-117 continued to increase since 2019 and remained higher than KV-50 for the same period, resulting in two of the three 2022 measurements being higher than the CCME guideline. KV-50 showed a more visible seasonal pattern characterized by peak concentration during spring freshet (May-June).

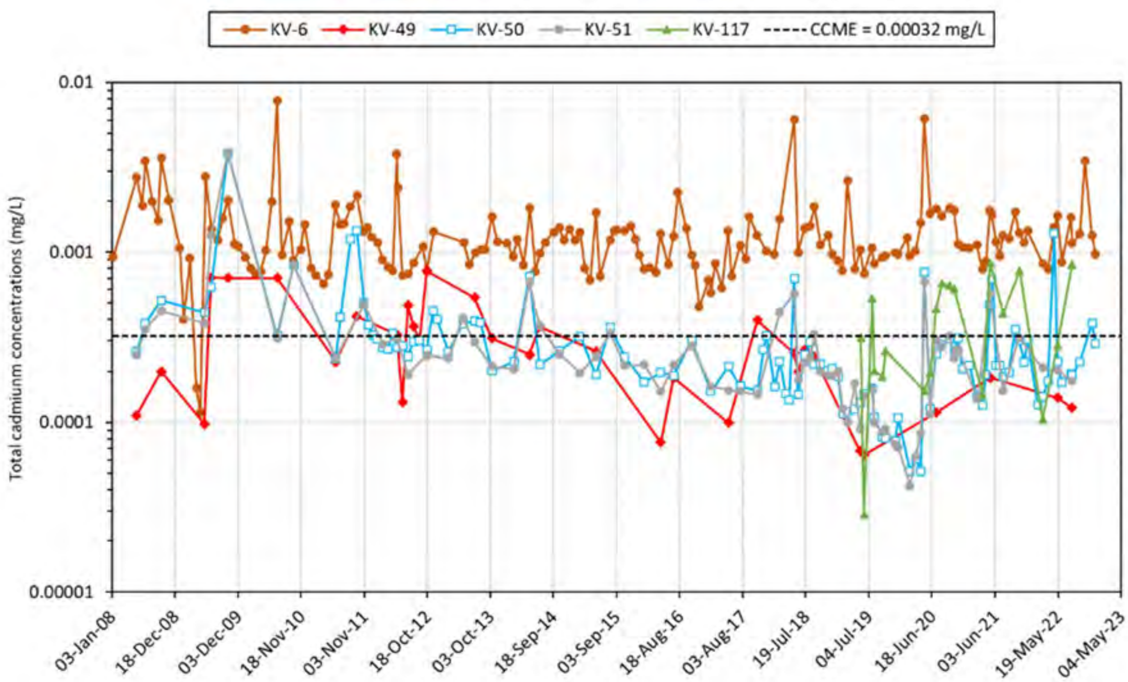


Figure 4-6: Total Cadmium at Monitoring Stations KV-49, KV-50, KV-51, KV-117 and KV-6, 2008-2022 Data

Table 4-13: Total Cadmium Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117 and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Cadmium (mg/L); CCME = 0.00032 mg/L					
Average	0.000294	0.000326	0.000315	0.00134	0.000406
Count	33	110	72	169	19
Minimum	0.0000642	0.0000516	0.0000423	0.000114	0.0000289
Maximum	0.000774	0.00384	0.00385	0.00779	0.000865
Count <DL	0	0	0	0	0
Standard Deviation	0.000202	0.000404	0.000464	0.000921	0.000265
1st Quartile	0.000131	0.000174	0.000155	0.000894	0.00019
Median	0.00025	0.00024	0.000219	0.00113	0.000315
3rd Quartile	0.000366	0.000322	0.000311	0.00145	0.000621
Count over Guideline	17	25	15	168	12
% Over Guideline	51.5%	22.7%	20.8%	99.4%	63.2%

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 (93%, 83%, 63%, and 63% of samples, respectively). KV-50 and KV-51 shared similar trends and had the highest concentrations (median = 1.6 and 1.5 mg/L, respectively). KV-117 had dissolved manganese concentrations generally comparable to KV-50 (and KV-51) for the same period although the concentrations were slightly lower at times. The lowest concentrations were measured at KV-49 (median = 0.0077 mg/L) with no exceedance of the CCME guideline. Dissolved manganese concentrations at KV-6 were slightly lower than KV-50 and KV-51 and showed 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.

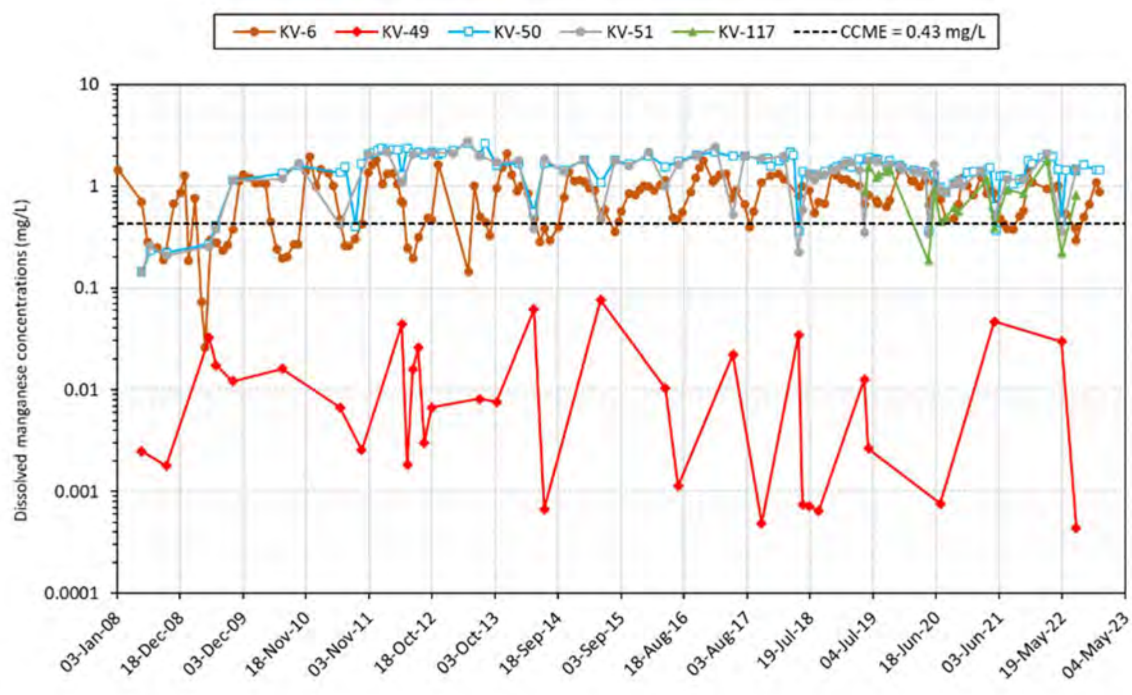


Figure 4-7: Dissolved Manganese at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-14: Dissolved Manganese Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Manganese (mg/L); CCME guideline is pH and hardness dependent					
Average	0.01532	1.53	1.34	0.816	0.904
Count	33	110	72	171	19
Minimum	0.00044	0.143	0.142	0.026	0.183
Maximum	0.0754	2.65	2.78	2.08	1.79
Count <DL	1	0	0	0	0
Standard Deviation	0.0190	0.548	0.624	0.425	0.466
1st Quartile	0.0018	1.29	1.01	0.467	0.528
Median	0.00765	1.56	1.45	0.822	0.9
3rd Quartile	0.0221	1.92	1.78	1.12	1.25
Count over Guideline*	0	98	57	100	12
% Over Guideline**	0%	93.3%	82.6%	62.9%	63.2%

**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 total iron concentrations (median 3.6, 3.1, and 2.4 mg/L, respectively), which were the highest observed of the sites and were higher than the CCME guideline (0.3 mg/L) for all (KV-50 and KV-51) or most (18 of 19 samples for KV-117) of the samples collected. Lower total iron concentrations were observed at KV-6 (median 0.47 mg/L) and KV-49 (median 0.086 mg/L). The total iron concentration measured at KV-49 and KV-6 exceeded the CCME guideline in 12% and 71% of samples, respectively.

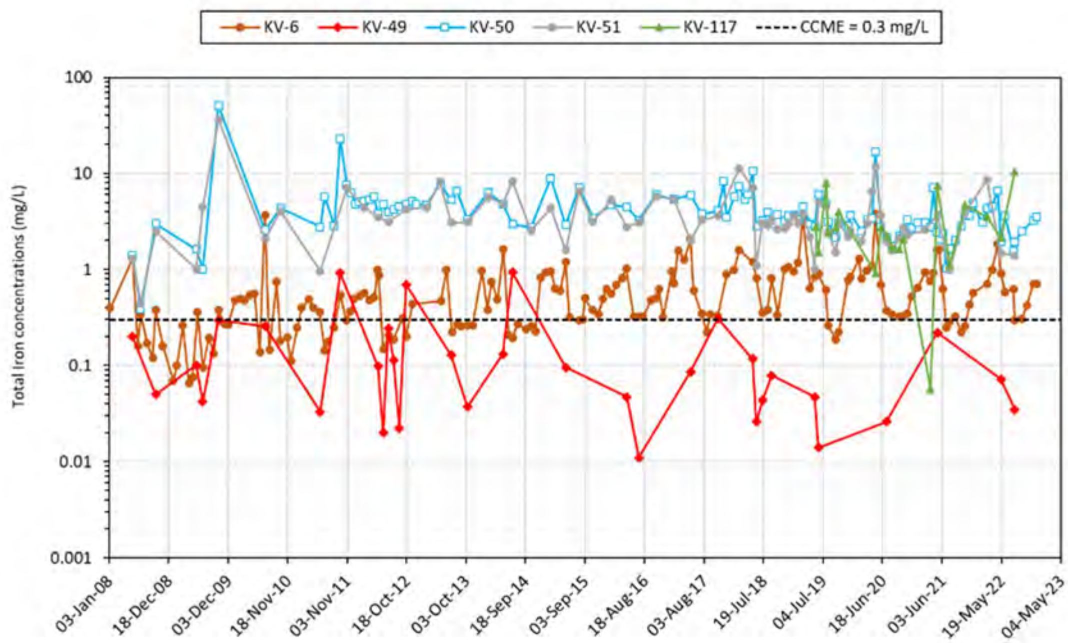


Figure 4-8: Total Iron at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-15: Total Iron Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Iron (mg/L); CCME = 0.3 mg/L					
Average	0.169	4.70	4.09	0.608	3.28
Count	33	110	72	169	19
Minimum	0.011	0.39	0.45	0.066	0.057
Maximum	0.934	50.8	36.3	3.79	10.5
Count <DL	0	0	0	0	0
Standard Deviation	0.237	5.25	4.46	0.560	2.67
1st Quartile	0.037	2.8	2.20	0.27	1.67
Median	0.086	3.61	3.08	0.469	2.41
3rd Quartile	0.2	5.11	4.42	0.807	3.73
Count over Guideline	4	110	72	120	18
% Over Guideline	12.1%	100%	100%	71%	94.7%

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 patterns of dissolved zinc concentrations were similar at KV-50 and KV-51 (median = 0.19 and 0.18 mg/L, respectively), with 79% and 72% of their samples returning zinc concentrations above the CCME guideline, respectively. KV-6 and KV-117 returned 84% and 58% of samples with dissolved zinc concentrations higher than the CCME guideline, respectively. Dissolved zinc concentrations at KV-117 exhibited a similar pattern to those of KV-50 (and KV-51) for the same period although the concentrations were generally lower. The dissolved zinc concentration at KV-117 continued to increase since initiation of monitoring resulting in one of the three 2022 measurements being higher than the guideline. The lowest dissolved zinc concentrations were measured at KV-49 with no recorded exceedance of the CCME guideline. Dissolved zinc concentrations at KV-6 were generally within the same range as KV-50 and KV-51.

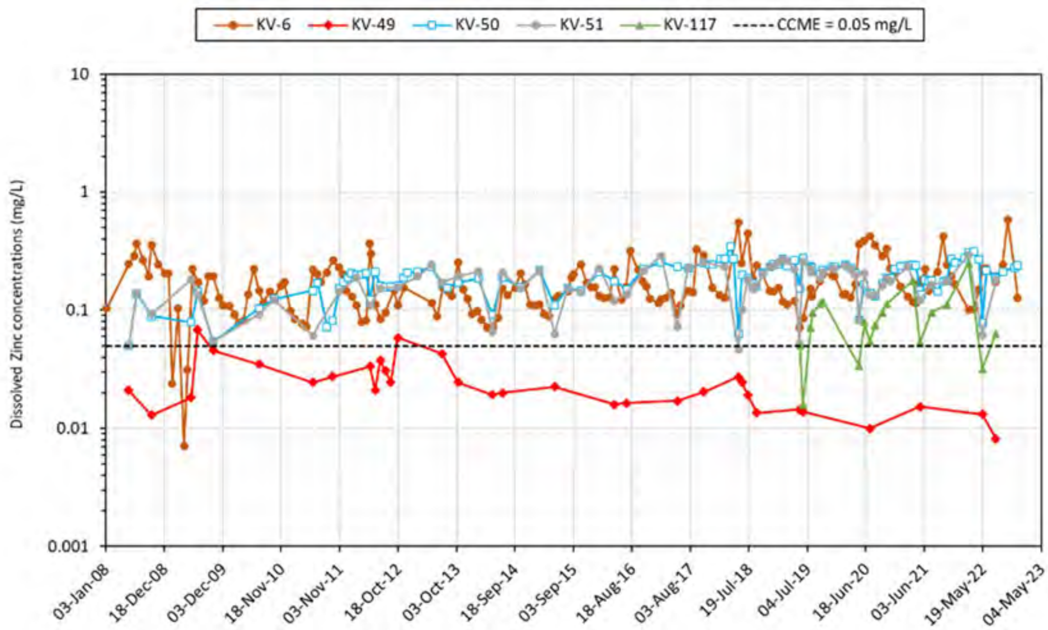


Figure 4-9: Dissolved Zinc at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-16: Dissolved Zinc Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Zinc (mg/L); CCME guideline is pH, hardness, and DOC dependent					
Average	0.0249	0.191	0.171	0.173	0.0893
Count	33	110	72	171	19
Minimum	0.0082	0.05	0.047	0.0071	0.0159
Maximum	0.0684	0.344	0.294	0.583	0.250
Count <DL	0	0	0	0	0
Standard Deviation	0.0135	0.0585	0.0636	0.0893	0.0543
1st Quartile	0.016	0.155	0.134	0.116	0.0543
Median	0.021	0.19	0.180	0.15	0.0787
3rd Quartile	0.0275	0.233	0.221	0.204	0.112
Count over Guideline*	0	80	46	116	11
% Over Guideline**	0.0%	79.2%	71.9%	83.5%	57.9%

** 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 comparable and the highest dissolved sulphate concentrations, and 37% and 29% of their samples were elevated above the BC ENV guideline (429 mg/L), respectively. However, the sulphate concentration measured at both these stations declined in recent years (mid-2018 onwards). Since mid-2018, dissolved sulphate measured at KV-6 was generally comparable to KV-50 and KV-51 due to a decrease of their dissolved sulphate, and the sulphate concentration at all stations was typically below the BC ENV guideline since mid-2018. The lowest sulphate concentrations were measured at KV-49 and KV-117 (median = 196 mg/L and 134 mg/L, respectively) with only one exceedance at KV-49 during the monitoring period. All stations showed muted or clear seasonality with the lowest sulphate concentrations observed in May-June and peak concentrations in June-October since 2014. Sulphate concentrations at KV-117 were distinctly lower compared to KV-50 indicating additional sulphate loading along the flow path.

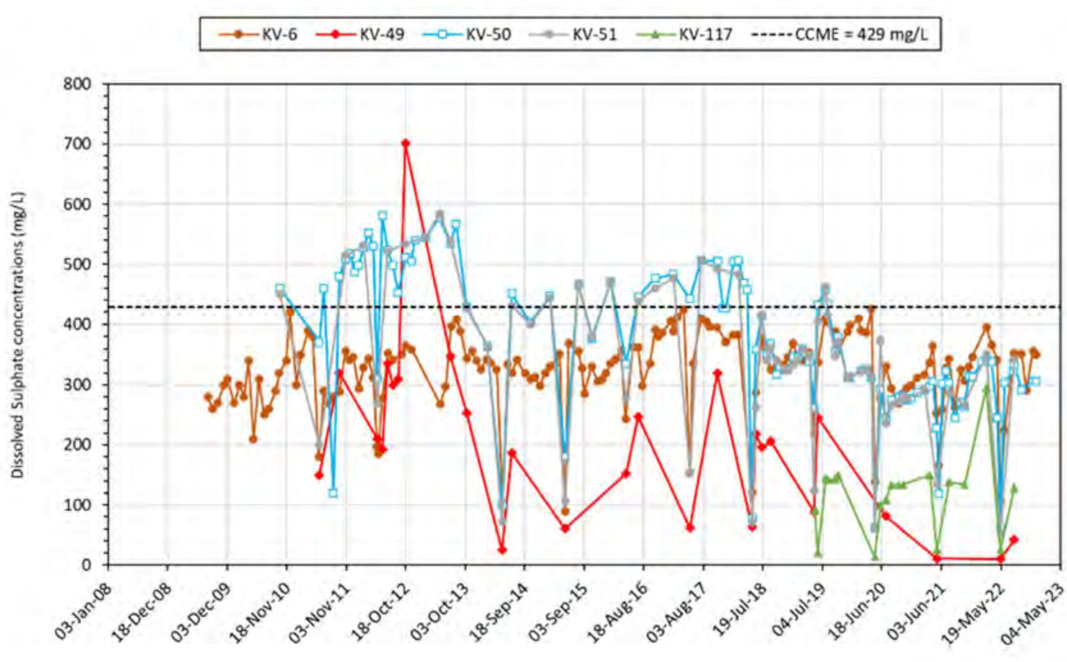


Figure 4-10: Dissolved Sulphate at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-17: Dissolved Sulphate Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Dissolved Sulphate (mg/L); BC ENV guideline is hardness dependent					
Average	198	371	347	322	116
Count	27	103	65	155	19
Minimum	10.1	62.4	51.9	88.7	13.4
Maximum	701	581	584	425	296
Count <DL	0	0	0	0	0
Standard Deviation	148	118	129	65.0	65.0
1st Quartile	72.5	303.5	276	295	95.4
Median	196	351	348	336	134
3rd Quartile	277	467	444	359	143
Count over Guideline	1	38	19	0	0
% Over Guideline	3.7%	36.9%	29.2%	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 30% of their samples and all stations showed a clear seasonality characterized by peak copper concentrations during spring freshet. KV-50, KV-51, and KV-117 returned comparable dissolved copper concentrations (median 0.00012, 0.00019, and 0.00025 mg/L, respectively) and similar peak concentrations (approximately 0.003 mg/L) during freshet. KV-6 also returned a dissolved copper concentration trend similar to KV-50 and KV-51 (comparable peak concentrations), however, the post-freshet concentrations (July to December) where higher at KV-6. The highest dissolved concentrations were observed along Hinton creek, KV-49 (31% exceedance; Table 4-18).

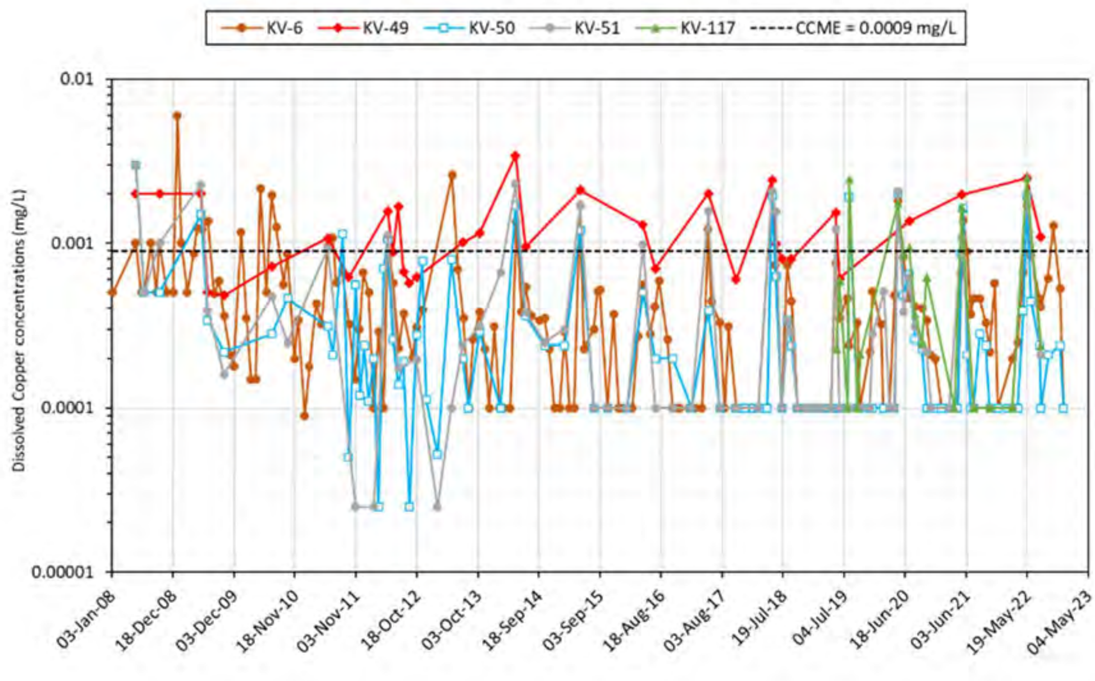


Figure 4-11: Dissolved Copper at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-18: Dissolved Copper Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 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	0.00129	0.000363	0.000496	0.000505	0.000698
Count	33	110	72	171	19
Minimum	0.00048	0.000025	0.000025	0.00009	0.00010
Maximum	0.00341	0.003	0.003	0.006	0.00251
Count <DL	0	53	35	50	6
Standard Deviation	0.000716	0.000515	0.000673	0.000619	0.000803
1st Quartile	0.0007	0.0001	0.0001	0.0001	0.0001
Median	0.00107	0.000116	0.000187	0.00035	0.00025
3rd Quartile	0.00198	0.00034	0.000503	0.000571	0.000895
Count over Guideline*	9	10	5	4	2
% Over Guideline**	31.0%	9.6%	7.6%	2.9%	10.5%

** 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 total lead concentration time series plot and statistical summary of the monitoring data are shown in Figure 4-12 and Table 4-19, respectively. KV-50 and KV-51 returned similar total lead concentrations (median 0.00071 and 0.00066 mg/L, respectively). The KV-6 total lead concentration has increasingly surpassed the CCME guideline since 2020; eight of 14 samples had total lead concentrations above the guideline in 2021 compared to three of 12 in 2020. In 2022, six of 11 samples were above the guideline. The total lead concentration at KV-117 was slightly higher than KV-50 and continued to increase since initiation of monitoring and only exceeded the CCME guideline once in May 2021 and again in May of 2022. Monitoring station KV-49 had the lowest total lead concentration among the stations in recent years. Out of four samples taken since 2020, there was one exceedance of the guideline in May 2021.

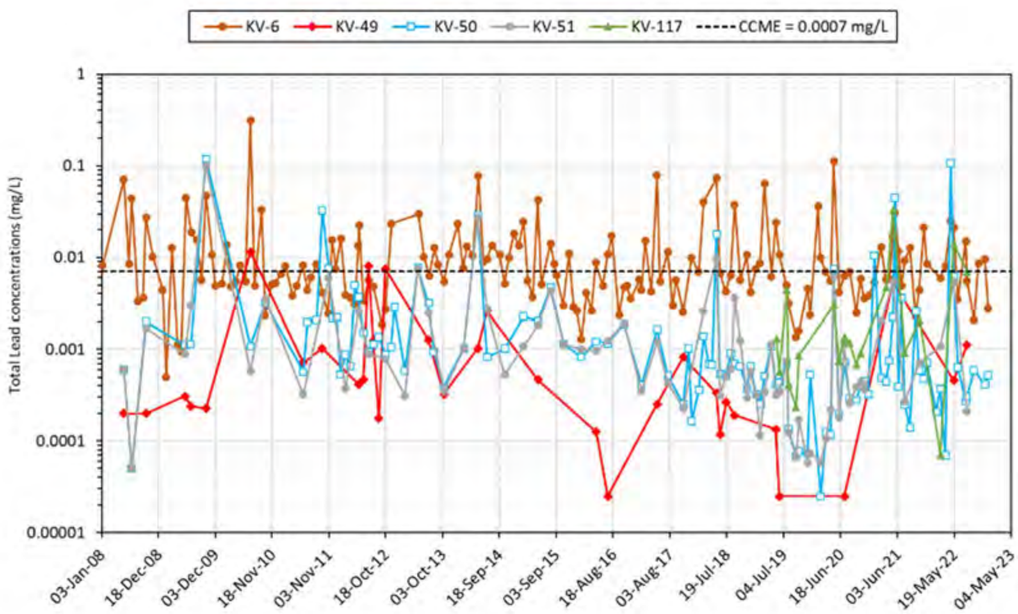


Figure 4-12: Total Lead at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

Table 4-19: Total Lead Statistics at Monitoring Stations KV-49, KV-50, KV-51, KV-117, and KV-6, 2008-2022 Data

	KV-49	KV-50	KV-51	KV-6	KV-117
Total Lead (mg/L); CCME is hardness dependent					
Average	0.0014336	0.0044174	0.003153	0.014047	0.004082
Count	33	110	72	169	19
Minimum	0.000025	0.000025	0.00005	0.0005	0.000071
Maximum	0.0115	0.119	0.1	0.312	0.0331
Count <DL	3	2	1	0	0
Standard Deviation	0.0026852	0.0160293	0.012120	0.028092	0.007773
1st Quartile	0.0002	0.0004	0.000317	0.00439	0.000719

	KV-49	KV-50	KV-51	KV-6	KV-117
Median	0.000335	0.0007075	0.000664	0.00663	0.00118
3rd Quartile	0.00103	0.00183	0.00186	0.0127	0.00368
Count over Guideline	5	11	6	80	3
% Over Guideline	15.2%	10%	8.3%	47.3%	15.8%

4.5.12 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 4-20.

Dissolved element concentrations generally accounted for most of their counterpart total concentrations, indicating that most elements were transported as dissolved species. The exceptions were cadmium, iron, manganese, arsenic, antimony, and zinc in February and June 2019, and cadmium in August 2022 when the dissolved concentrations represented less than 50% of the total concentration. Dissolved aluminum only accounted for more than 50% of total aluminum concentrations in seven out of 30 samples since monitoring began. Fluctuations of sulphate and metal(loid)s concentrations occurred at the seep and the peak total concentration of parameters of interest occurred at different periods of the year, generally in May through October. In 2022, total cadmium and lead concentrations peaked in August while antimony and copper peaked in May. Total arsenic, zinc, manganese, iron, and dissolved sulphate showed an increasing trend with their peak concentrations observed in October.

The four-year dataset was plotted with KV-117 and KV-50 to determine how the WQ of the seep compared to the background (KV-117) and the downstream stations (KV-50) and to assess its potential metal loadings contribution to Christal Creek. All comparative plots are compiled in Appendix C. The visual comparison shows that:

- Concentrations of sulphate, total arsenic, 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 was commonly below the detection limit and lower than the seep KV-121 and background station KV-117. The peak dissolved copper concentrations at KV-50 and KV-117 were comparable and higher than those in the seep.
- Total iron and dissolved manganese concentrations at KV-50 and KV-121 were comparable.
- Dissolved copper and total concentrations of lead, cadmium, and antimony at the seep KV-121 were lower than those at the background station KV-117. Field pH and ORP were comparable, but sulphate, arsenic, manganese, and zinc were higher than KV-117 (Appendix C).

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, and manganese as the concentrations of these constituents were 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 4-20: Summary of Main Constituents of Interest at KV-121, 2019-2022 Data

Parameter	Field pH	Sulphate	Arsenic	Antimony	Cadmium	Copper	Manganese	Iron	Zinc
Unit	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Average	7.10	362	0.0331	0.000170	0.000363	0.000369	1.537	3.50	0.327
Count	31	30	30	30	30	30	30	30	30
Minimum	6.45	115	0.00676	0.00005	0.0000649	0.00025	0.243	0.554	0.0732
Maximum	8.06	554	0.0690	0.00246	0.00345	0.00200	2.91	6.92	0.647
Count <DL	0	0	0	23	0	26	0	0	0
Standard Deviation	0.36	112	0.0155	0.000449	0.000774	0.000383	0.758	1.65	0.155
1st Quartile	6.91	270	0.0226	0.00005	0.000091	0.00025	0.822	2.52	0.217
Median	7	366	0.0332	0.00005	0.000128	0.00025	1.745	3.62	0.333
3rd Quartile	7.22	442	0.0454	0.00005	0.000177	0.00025	1.92	4.50	0.404

** Arsenic, antimony, cadmium, and iron 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 2022 surface water quality data showed that the concentrations of sulphate, arsenic, cadmium, copper, iron, lead, manganese, and zinc were constantly or occasionally above their respective guidelines along Christal Creek, while pH below pH 6.5 was occasionally observed at KV-49, KV-50, and KV-51.
- Aside from the further decline of sulphate at KV-49, no other major changes of water quality occurred in 2022 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;
- 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

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

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

Grouping	Analyte	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
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

		L2128495-6	L2128495-7	L2128495-8	L2128495-9	L2128495-10
	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 Description Sampled Date Sampled Time Client ID		L2128495-11 Other 05-JUL-18 14:40 T3-A	L2128495-12 Other 05-JUL-18 14:50 T3-B	L2128495-13 Other 05-JUL-18 15:00 T3-D	L2128495-14 Other 05-JUL-18 15:10 T3-E	L2128495-15 Other 05-JUL-18 15:20 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)			DLM <2.0		
	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			

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			

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 Easily Reducible Metals and Iron Oxides .

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 Organic Bound 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 Residual 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.

ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7
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-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:

Colin Ramshaw, Vancouver Laboratory Manager

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
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-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

Sample Description	Method / Analyte / Units / LOD	WEI-21 Recvd Wt. kg 0.02	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
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 *****

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North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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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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2103 Dollarton Hwy
North Vancouver BC V7H 0A7
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-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

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
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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2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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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
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BURNABY BC V5A 1W9

Finalized Date: 25-JUL-2018
Account: APN

Project: L2128495

CERTIFICATE OF ANALYSIS VA18171352

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5g).

Applies to Method: ME-MS41

LABORATORY ADDRESSES

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

Applies to Method: CRU-31 LOG-22 ME-MS41 PUL-31 SPL-21 WEI-21

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L2128495-COFC

COC #

Page 1 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	Analysis Request
Invoice To	Same as Report ? ☐ Yes ☑ No	Client / Project Information		Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #:	Natural Attenuation Study	
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 (signature)	Date (dd-mmm-yy) 12-Jul-18	Time (hh-mm) 13:00	Received by: EHF	Date: 2018 12July	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

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)		DLDS <0.25	DLDS <0.25			
	Chloride (Cl) (mg/L)		DLDS <2.5	DLDS <2.5			
	Fluoride (F) (mg/L)		0.14	0.12			
	Nitrate (as N) (mg/L)		0.290	0.293			
	Nitrite (as N) (mg/L)		DLDS <0.0050	DLDS <0.0050			
	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 Description Sampled Date Sampled Time Client ID	L2232039-1 Surface Water 10-FEB-19 14:01 KV-121	L2232039-2 Surface Water 10-FEB-19 14:10 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:

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.

L2232039-COFC

Chain of Custody / Analytical
Canada Toll Free: 1 800
www.alsglobal.co

ALS Environmental

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	VIC100-MET-T-LOW-VA	VIC100-MET-D-LOW-VA	VIC100-MET-T-HIGH-VA + Hg	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 (Fort Collins)	Number of Containers
					P	F/P	P	F/P						F/P	P	P	P	P	
	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:	Observations: Yes / No ? If Yes add SIF
Kyle Nault	13-2-2019		[signature]	Feb 13/19	09:35	4/2 °C	ZZ	Feb 14, 2019	1:16 pm	

GENF 20.00 Front

7°C

Forward looking. Lateral thinking.

Report To	**Andrew MacPhail, Andrew Gault, Kai Woloshyn**	**Date Samples Received**	16-Jul-2018
	Alexco Resource Corp.	**Report Date**	27-Aug-2018
	3 Calcite Business Centre, 151 Industrial Road	**Report Revision**	A
	Whitehores, YT	**Version**	FINAL
	Y1A 2V3		

Client Phone 867-668-6463, 613-329-0085

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
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		
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**
	Can reduce				Environment						DNA_195	DNA_194	DNA_193	**Contango Sample ID**
Genus	**Sulphate**	**Thiosulphate**	**Sulphite**	**Sulphur**	**Aerobic/Anaerobic Characteristics**	**Temperature**	**pH**	**Electron donors that may be used**	**Complete Oxidizer**	**Trait Assignment Category**	soil	soil	soil	**Sample Type**
											%	%	%	**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 CO_2; 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
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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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2366434-1	L2366434-2	L2366434-3	L2366434-4	L2366434-5
	Description	Moss	Moss	Moss	Moss	Moss
	Sampled Date	06-OCT-19	06-OCT-19	06-OCT-19	06-OCT-19	06-OCT-19
	Sampled Time	16:10	16:10	15:50	15:50	16:00
	Client ID	T1-A	T1-B	T2-A	T2-B	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

	Sample ID Description Sampled Date Sampled Time Client ID	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
Grouping	**Analyte**					
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Test Code	Matrix	Test Description	Method Reference**
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

Christal Creek Attenuation Study, 2008 to 2022 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
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
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008				6	7.4	7.87		731	0.1					449	
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008				41	7.51	7.74		457	3					233	
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008				5		7.96		702						381	
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008		129.6		9	7.2	7.98		660	8.5					351	
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008		119.385		10	7.42	7.85		601	7					320	
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008		80.18		11	6.82	7.87		635	6					396	
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008		160.71		20	7.47	7.7		594	5					349	
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008				1		7.87		665						339	
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	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009				1		7.74		816						451	
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009				26		7.75		631						405	
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009				2		7.58		803						368	
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009				2		8.1		510					251	255	
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009				2	6.9	7.6		36	2.8				19.4	19.9	
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009		124.365		18	7.53	7.9		530	16				262	270	
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009		101.233		2	7.9	8.1		710	9.6				379	398	
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009				6		8.1		813					457	451	
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009		102.54		1	7.36	7.9		756	7.2				448	422	
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009		33.155		4	7.51	8		801	2.1				428	423	
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009				2	8.19	7.9		872	0.1				449	462	
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009				1	7.56	7.8		845	0.1				463	457	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010				2	7.94	7.8		851	0.5				474	490	
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010				2	7.68	8		860	1				481	500	
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010				2	7.91	7.9		883	0.2				527	512	
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010				2	7.77	7.9		853	0.2				503	522	
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010		71.19		2	7.74	7.9		555	2.3				276	276	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010				1	7.62	8.1		784	10.6				390	423	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010		94.01815		3	7.74	7.93		749	13.5				404	410	
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010		61.129433		2	7.85	8.03		765	14				434	456	
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
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010		94.041		2	7.88	7.97		796	1				429	429	120
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
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
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
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
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
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
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
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
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008					429		7.51					0.053	0.1	0.0003	0.0055	0.08	0.00005	0.00025	0.002	0.00094	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008					429		4.58					0.45C	0.1	0.0014	0.0166	0.05	0.00005	0.00025	0.001	0.00275	0.000320
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008					429		2.10					0.034	0.1	0.0004	0.0043	0.062	0.00005	0.00025	0.003	0.00187	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008					429		5.99					0.077	0.1	0.0007	0.0058	0.061	0.00005	0.00025	0.006	0.00346	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008					429		4.08					0.023	0.1	0.0003	0.0042	0.055	0.00005	0.00025	0.003	0.00198	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008					429		17.5					0.012	0.1	0.0001	0.0028	0.05	0.00002	0.00005	0.0025	0.00153	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008					429		4.27				4	0.074	0.1	0.0008	0.0053	0.056	0.00002	0.00005	0.0025	0.00359	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008					429		2.58				1.6	0.025	0.1	0.0005	0.0026	0.071	0.00002	0.00005	0.0025	0.00203	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008					429		2.52				1.4	~	0.1	~	~	~	~	~	~	~	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009					429		3.47				1.7	0.01	0.1	0.0006	0.0043	0.093	0.00005	0.00025	0.004	0.00106	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009					429		3.39					0.042	0.1	0.0001	0.0005	0.02	0.00002	0.00005	0.0025	0.0004	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009					429		5.01					0.012	0.1	0.0004	0.005	0.053	0.00002	0.00005	0.0025	0.00092	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009					429		1.52					0.0473	0.1	0.00011	0.00091	0.0348	0.000005	0.0000025	0.025	0.00016	0.000340
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009					128		18.9					0.0492	0.1	0.00013	0.0008	0.00689	0.000005	0.0000025	0.025	0.000114	0.00004
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009					429		1.58					0.0379	0.1	0.00102	0.00719	0.0486	0.000005	0.000032	0.025	0.00278	0.000353
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009					429		1.11					0.0055	0.1	0.00039	0.00356	0.0608	0.000005	0.0000025	0.025	0.00137	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009				280	429		1.52					0.0106	0.1	0.00042	0.00558	0.0616	0.000005	0.0000025	0.025	0.00117	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009				260	429		4.60					0.0081	0.1	0.00039	0.00338	0.0586	0.000005	0.0000025	0.025	0.00159	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009				270	429		4.94					0.0241	0.1	0.00054	0.00584	0.0581	0.000005	0.0000025	0.025	0.00203	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009				300	429		1.23					0.0131	0.1	0.00042	0.00369	0.0591	0.000005	0.000007	0.025	0.00112	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009				310	429		5.20					0.0085	0.1	0.00032	0.00355	0.0671	0.000005	0.0000025	0.025	0.00108	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010				270	429		2.10					0.0076	0.1	0.00028	0.00474	0.0635	0.000005	0.0000025	0.025	0.000934	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010				300	429		3.66					0.0069	0.1	0.00027	0.00523	0.0624	0.000005	0.0000025	0.025	0.0008	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010				280	429		2.31				0.8	0.0094	0.1	0.00022	0.00597	0.0594	0.000005	0.0000025	0.025	0.000744	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010				340	429		3.18					0.0135	0.1	0.00027	0.00664	0.0574	0.000005	0.0000025	0.025	0.00077	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010				210	429		2.87					0.0373	0.1	0.00042	0.00511	0.0429	0.000005	0.0000025	0.025	0.00102	0.000368
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010				310	429		1.94					0.0091	0.1	0.00036	0.00327	0.0483	0.000005	0.0000025	0.025	0.00197	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010				250	429		1.18					0.26C	0.1	0.00257	0.0513	0.0739	0.00001	0.000016	0.025	0.00779	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010				260	429	0.06	0.889				2.8	0.0097	0.1	0.00036	0.00431	0.0509	0.000005	0.000053	0.025	0.00096	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010				290	429	0.0025	12.0	0.0025	0.07		2	0.0231	0.1	0.00125	0.00976	0.0494	0.000005	0.0000025	0.025	0.00151	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010				320	429	0.01	2.32	0.0025	0.13		2.4	0.0049	0.1	0.00019	0.00374	0.0458	0.000005	0.0000025	0.025	0.000895	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010				340	429	0.012	29.2	0.0025	0.18		1.1	0.0062	0.1	0.00021	0.00387	0.0541	0.000005	0.0000025	0.025	0.00104	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010				420	429	0.047	1.73	0.0025	0.23		3.5	0.0083	0.1	0.00025	0.0037	0.0687	0.000005	0.0000025	0.025	0.00146	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011				300	429	0.046	2.70	0.0025	0.24		0.7	0.0044	0.1	0.00021	0.00471	0.0602	0.000005	0.0000025	0.025	0.000802	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011				350	429	0.14	1.49	0.0025	0.23		1.5	0.0062	0.1	0.0002	0.00749	0.0603	0.000005	0.0000025	0.025	0.00073	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011				390	429	0.1	3.40	0.0025	0.22		1.3	0.0097	0.1	0.00019	0.00873	0.0632	0.000005	0.0000025	0.025	0.000651	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011				380	429	0.089	3.64	0.0025	0.26		1.2	0.0092	0.1	0.00021	0.00817	0.0578	0.000005	0.0000025	0.025	0.000735	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011				180	429		1.05				8.6	0.0247	0.1	0.0004	0.00583	0.0365	0.000005	0.0000025	0.025	0.00189	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011				290	429	0.018	0.492				0.25	0.0078	0.1	0.00034	0.00421	0.0552	0.000005	0.0000025	0.025	0.00145	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011				270	429	0.043	0.909	0.0025	0.1		4.5	0.0103	0.1	0.00038	0.00503	0.0442	0.000005	0.0000025	0.025	0.00147	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008	133	0.00025	0.0004	0.0005	0.004	0.4	0.0082	0.007	0.0249	0.014	23	1.41	5.5		0.0005	0.0022	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008	72.3	0.0014C	0.0014	0.004	0.004	1.3	0.0709	0.007	0.0127	0.007	11.2	1.04	3.1		0.0005	0.0044	0.15
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008	117	0.00025	0.0001	0.0005	0.004	0.16	0.0084	0.007	0.0208	0.01	20.9	0.311	4.7		0.0005	0.0035	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008	116	0.0006	0.0003	0.002	0.004	0.34	0.0442	0.007	0.0191	0.01	21.2	0.372	4.4		0.0005	0.0014	0.15
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008	97.3	0.0005	0.0002	0.002	0.004	0.17	0.0033	0.007	0.0173	0.009	17.6	0.261	4.1		0.0005	0.0028	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008	106	0.0006	0.00016	0.0005	0.004	0.12	0.0036	0.007	0.0217	0.008	19.1	0.207	4.9		0.00011	0.002	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008	104	0.0005	0.00048	0.002	0.004	0.38	0.027	0.007	0.0189	0.007	18.5	0.338	4.4		0.00019	0.003	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008	111	0.0004	0.00042	0.003	0.004	0.16	0.0101	0.007	0.0184	0.008	21.7	0.701	4.3		0.0001	0.003	0.15
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008	~	~	~	~	0.004	~	~	0.007	0.0214	~	~	~	4.9		~	~	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009	147	0.0007	0.0005	0.002	0.004	0.07	0.0044	0.007	0.0250	0.014	26.4	1.39	5.5		0.0005	0.0038	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009	128	0.0007	0.00016	0.002	0.004	0.1	0.0005	0.007	0.0222	0.008	14	0.173	5.0		0.00106	0.001	0.15
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009	124	0.0004	0.0003	0.0005	0.004	0.26	0.0126	0.007	0.0200	0.01	22.5	0.661	4.6		0.00012	0.003	0.15
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009	87.5	0.0011C	0.000137	0.00138	0.004	0.066	0.00114	0.007	0.0136	0.011	7.94	0.0765	3.3	0.00001	0.00074	0.00065	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009	5.92	0.0002	0.000043	0.00128	0.002	0.076	0.000947	0.001	0.00370	0.00025	1.12	0.0281	0.75	0.000005	0.00005	0.00093	0.025
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009	83.1	0.0002	0.000252	0.00132	0.004	0.358	0.0449	0.007	0.0142	0.007	13.2	0.4	3.4	0.000005	0.0002	0.00264	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009	117	0.0001	0.000098	0.00053	0.004	0.095	0.0187	0.007	0.0207	0.0082	21.5	0.216	4.7	0.000005	0.00019	0.0017	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009	142	0.00005	0.000149	0.00043	0.004	0.195	0.0155	0.007	0.0253	0.0115	25.1	0.304	5.6		0.00024	0.00227	0.15
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009	141	0.0003	0.000105	0.00035	0.004	0.134	0.00567	0.007	0.0248	0.0094	23.3	0.273	5.5	0.000005	0.00024	0.00218	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009	135	0.0003	0.000486	0.00067	0.004	0.378	0.0472	0.007	0.0236	0.0111	22.2	0.488	5.3		0.00052	0.003	0.15
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009	140	0.0005	0.00131	0.00048	0.004	0.271	0.0107	0.007	0.0249	0.0145	23.9	1.15	5.5	0.00002	0.00049	0.00409	0.15
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009	150	0.0004	0.00114	0.00038	0.004	0.266	0.00491	0.007	0.0257	0.0131	21.8	1.33	5.6	0.000005	0.00038	0.00301	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010	149	0.0003	0.00131	0.00033	0.004	0.482	0.00515	0.007	0.0264	0.0134	24.8	1.17	5.8		0.00019	0.00317	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010	153	0.0003	0.00137	0.00033	0.004	0.496	0.0136	0.007	0.0268	0.0143	24.3	1.11	5.8	0.000005	0.00021	0.0034	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010	168	0.0003	0.00133	0.00027	0.004	0.481	0.00476	0.007	0.0297	0.015	25.9	1.15	6.3	0.00001	0.00021	0.00351	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010	161	0.0002	0.00155	0.00067	0.004	0.543	0.00541	0.007	0.0282	0.0151	24.7	1.03	6.1	0.000005	0.00021	0.00405	0.15
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010	87.5	0.0003	0.000795	0.00094	0.004	0.564	0.00816	0.007	0.0149	0.0074	13.9	0.45	3.6		0.00022	0.00295	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010	118	0.0003	0.000151	0.00055	0.004	0.139	0.00543	0.007	0.0213	0.0122	23.2	0.275	4.8	0.000005	0.00028	0.00209	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010	127	0.0009	0.00156	0.00507C	0.004	3.7	0.312	0.007	0.0221	0.0118	21.1	1.42	5.0	0.000005	0.00028	0.00457	0.15
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010	133	0.0004	0.000128	0.00046	0.004	0.147	0.00489	0.007	0.0239	0.0128	24.6	0.216	5.3	0.000005	0.00027	0.00204	0.15
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010	131	0.0006	0.000284	0.00071	0.004	0.741	0.0331	0.007	0.0233	0.0123	23.6	0.386	5.2	0.000005	0.00021	0.00265	0.15
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010	133	0.0003	0.000268	0.00026	0.004	0.181	0.00231	0.007	0.0236	0.0131	23.5	0.293	5.3	0.000005	0.00019	0.00247	0.15
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010	158	0.0003	0.00139	0.00027	0.004	0.196	0.00506	0.007	0.0277	0.0144	24.3	1.42	6.0	0.000005	0.00019	0.00439	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010	162	0.0002	0.00133	0.00055	0.004	0.112	0.00522	0.007	0.0291	0.0178	27.6	1.91	6.2	0.00002	0.00021	0.00428	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011	150	0.0006	0.00124	0.00023	0.004	0.249	0.00663	0.007	0.0268	0.0136	25.5	1.05	5.8	0.000005	0.00018	0.00419	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011	161	0.0003	0.00165	0.00014	0.004	0.4	0.00795	0.007	0.0281	0.0163	24.2	1.37	6.1	0.000005	0.00017	0.00433	0.15
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011	183	0.0004	0.00166	0.00029	0.004	0.489	0.00378	0.007	0.0327	0.0158	28	1.35	6.9	0.000005	0.00019	0.00474	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011	180	0.0005	0.0016	0.00041	0.004	0.398	0.00488	0.007	0.0321	0.0159	28.1	1.08	6.8	0.000005	0.00017	0.00471	0.15
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011	99.6	0.0003	0.000347	0.00108	0.004	0.362	0.00814	0.007	0.0164	0.0078	13.2	0.404	3.9	0.000005	0.00037	0.00276	0.15
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011	146	0.0002	0.000161	0.00037	0.004	0.143	0.00441	0.007	0.0261	0.0118	25.5	0.288	5.7	0.000005	0.00024	0.00213	0.15
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011	127	0.0003	0.000208	0.00056	0.004	0.176	0.00604	0.007	0.0223	0.0103	22.1	0.281	5.0	0.000005	0.00031	0.00244	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008		0.5	0.0009	4.3	0.00005	1.6	0.269	96.6	0.000025	0.0005	0.008	0.0044	0.0002	0.132	0.277	0.0005	0.0025	0.0001	0.0031
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008		0.6	0.0007	2.35	0.00107C	0.8	0.142	56.2	0.000025	0.0005	0.0209	0.0018	0.0012	0.319J	0.115	0.0005	0.047		0.0026
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008		0.2	0.0012C	1.95	0.00036C	1.4	0.241	90.2	0.000025	0.0005	0.0086	0.0046	0.0002	0.308J	0.226	0.0005	0.011	0.001	0.0023
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008	0.014	0.2	0.0008	2.06	0.00014	1.3	0.207	89.7	0.000025	0.0005	0.0045	0.0038	0.0004	0.444J	0.203	0.0005	0.01	0.001	0.0027
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008		0.2	0.0006	2.45	0.00002	1.1	0.202	72.6	0.000025	0.0005	0.0061	0.0026	0.0002	0.272J	0.180	0.0005	0.018	0.001	0.0037
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008	0.03	0.32	0.0006	2.81	0.000005	1.2	0.182		0.000005	0.00005	0.0008	0.0032	0.00012	0.196	0.237	0.00005	0.006	0.0008	0.0024
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008	0.005	0.3	0.001	3.07	0.00013	1.28	0.183		0.000005	0.00005	0.0021	0.0029	0.00021	0.428J	0.202	0.00005	0.031	0.001	0.002
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008	0.005	0.4	0.0009	3.75	0.0002	1.36	0.204		0.000005	0.00005	0.0015	0.0035	0.0001	0.234J	0.194		0.0025	0.0011	0.0016
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008		~	~	~	~	~	~	~		~	~	~	~	~	0.234		0.0025	0.0014	0.004
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009		0.8	0.0015C	4.79	0.00002	3.4	0.286	101	0.000025	0.0005	0.0078	0.0053	0.0001	0.203	0.278	0.0005	0.015	0.0009	0.0042
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009	0.005	0.7	0.0003	3.71	0.000005	2.53	0.205	39.8	0.000005	0.00005	0.0018	0.002	0.00014	0.025	0.244	0.00005	0.0025	0.0009	0.0004
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009	0.014	0.4	0.0006	3.7	0.000005	1.39	0.205	88.1	0.000005	0.00005	0.0006	0.0039	0.00009	0.115	0.216	0.00005	0.0025	0.0013	0.003
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009	0.005	0.59	0.00018	3.45	0.0000025	4.98	0.173	37	0.000003	0.000005	0.00025	0.00125	0.0001	0.0107	0.128	0.00005	0.008	0.00011	0.00069
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009	0.016	0.44	0.00002	0.514	0.000017	0.09	0.0119	2	0.000001	0.000005	0.001	0.000052	0.0001	0.0327J	0.0075	0.00005	0.03	0.00014	0.00061
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009	0.014	0.37	0.00056	1.93	0.000063	0.94	0.148	62	0.00001	0.000005	0.0012	0.00243	0.0001	0.254J	0.136	0.00005	0.0211	0.00081	0.00384
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009	0.005	0.19	0.00088	1.88	0.0000025	1.4	0.213	93	0.000003	0.000005	0.00025	0.00421	0.0001	0.155	0.224	0.00005	0.0062	0.0004	0.00279
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009		0.25	0.00082	2.56	0.000007	1.56	0.241	116	0.000001	0.000005	0.00025	0.00477	0.0001	0.141	0.283	0.00005	0.0083	0.00031	0.00293
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009	0.005	0.35	0.00081	3.42	0.000151	1.44	0.227	117	0.000002	0.000005	0.0006	0.00449	0.0001	0.191	0.276	0.00005	0.0091	0.00029	0.00262
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009		0.33	0.00085	4.01	0.000014	1.38	0.224	111	0.000006	0.000005	0.00025	0.00426	0.0001	0.219	0.261	0.00005	0.0019	0.00036	0.00188
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009	0.004	0.38	0.00085	4.01	0.000008	1.46	0.241	115	0.000003	0.000005	0.00025	0.00428	0.0001	0.138	0.277	0.00005	0.0027	0.00035	0.00185
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009	0.006	0.41	0.00096	3.66	0.0000025	1.3	0.245	124	0.000003	0.000005	0.00025	0.00389	0.0001	0.118	0.287	0.00005	0.0019	0.00027	0.00206
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010		0.42	0.00099	4.49	0.000031	1.53	0.234	122	0.000002	0.000005	0.00025	0.00423	0.0001	0.107	0.296	0.00005	0.0624	0.00038	0.0033
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010	0.006	0.42	0.00099	4.29	0.00003	1.53	0.239	127	0.000003	0.000005	0.00025	0.00445	0.0001	0.101	0.301	0.00005	0.0112	0.00019	0.00285
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010	0.009	0.47	0.001	4.34	0.000011	1.67	0.264	137	0.000001	0.000005	0.0008	0.00456	0.0001	0.0887	0.335	0.00005	0.0018	0.00019	0.00307
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010	0.009	0.47	0.00093	3.5	0.0000025	1.57	0.252	133	0.000005	0.00009	0.00025	0.00425	0.0001	0.0985	0.317	0.00005	0.0037	0.00022	0.00333
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010		0.44	0.00061	2.3	0.000014	0.91	0.153	71	0.000003	0.000005	0.0018	0.00228	0.0001	0.133	0.147	0.00005	0.0668	0.00046	0.00405
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010	0.007	0.21	0.00077	2.19	0.0000025	1.42	0.215	119	0.000001	0.000005	0.00025	0.00366	0.0001	0.239J	0.232	0.00005	0.0047	0.00035	0.00216
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010	0.071	0.2	0.0008	2.7	0.00153C	1.21	0.227	104	0.000127	0.00004	0.01	0.00334	0.0009	0.452J	0.243	0.00005	0.0166	0.0004	0.00309
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010	0.007	0.23	0.00079	2.66	0.000017	1.47	0.234	121	0.000002	0.000005	0.00025	0.00406	0.0001	0.124	0.266	0.00005	0.0111	0.00034	0.00327
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010	0.014	0.36	0.00079	3.14	0.000027	1.48	0.22	115	0.000009	0.000005	0.001	0.00352	0.0001	0.177	0.258	0.00005	0.0046	0.0002	0.0026
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010		0.34	0.00083	3.32	0.000007	1.41	0.224	122	0.000001	0.000005	0.00025	0.00389	0.0001	0.146	0.262	0.00005	0.0054	0.00015	0.00217
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010	0.005	0.42	0.00086	4.5	0.00002	1.53	0.24	121	0.000001	0.00002	0.00025	0.00396	0.0001	0.166	0.311	0.00005	0.0024	0.00017	0.00241
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010	0.015	1.31	0.00088	4.71	0.0000025	1.64	0.278	140	0.000003	0.000005	0.00025	0.00408	0.0001	0.179	0.328	0.00005	0.0015	0.00021	0.00254
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011	0.007	0.42	0.00096	4.23	0.000016	1.61	0.245	125	0.000002	0.00001	0.00025	0.0046	0.0001	0.123	0.301	0.0004	0.0015	0.00016	0.00174
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011	0.005	0.43	0.00082	3.75	0.0000025	1.48	0.265	122	0.000003	0.000005	0.00025	0.00449	0.0001	0.101	0.316	0.00005	0.0045	0.00016	0.00271
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011	0.01	0.48	0.00088	4.82	0.00001	1.69	0.268	139	0.000001	0.000005	0.00025	0.00485	0.0001	0.103	0.370	0.00005	0.003	0.00019	0.00366
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011	0.01	0.51	0.00087	4.59	0.0000025	1.7	0.274	140	0.000001	0.000005	0.00025	0.00494	0.0001	0.104	0.363	0.00005	0.0031	0.00017	0.00338
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011	0.012	0.51	0.00066	2.92	0.00002	0.95	0.163	74	0.000003	0.000005	0.00025	0.0021	0.0001	0.19J	0.167	0.00005	0.0207	0.00041	0.00481
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011	0.005	0.21	0.00078	2.16	0.000013	1.57	0.254	135	0.000008	0.000005	0.00025	0.00432	0.0001	0.207	0.292	0.00005	0.0096	0.00032	0.00313
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011	0.008	0.17	0.00066	2.32	0.000007	1.43	0.218	108	0.000002	0.000005	0.00025	0.00364	0.0001	0.183	0.245	0.00005	0.0062	0.00036	0.00375

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008	0.077	0.00005	0.00025	0.001	0.0005J	0.000457	140	0.00025	0.0004	0.0005	0.16	0.0022	0.01	24.3	1.45		0.0005	0.0014
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008	0.04	0.00005	0.00025	0.001	0.00145J	0.000394	74	0.0005	0.0009	0.001	0.24	0.0024	0.006	11.7	0.702		0.0005	0.0035
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008	0.063	0.00005	0.00025	0.001	0.00194J	0.000457	118	0.00025	0.0002	0.0005	0.05	0.0012	0.009	21.1	0.281		0.0005	0.00025
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008	0.056	0.00005	0.00025	0.001	0.00286J	0.000457	107	0.00025	0.0002	0.0005	0.07	0.0023	0.008	20.3	0.248		0.0005	0.0006
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008	0.055	0.00005	0.00025	0.001	0.00194J	0.000457	98.4	0.00025	0.0002	0.001	0.08	0.0013	0.008	18	0.251		0.0005	0.0026
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008	0.052	0.00002		0.002	0.00157J	0.000457	127	0.0009	0.00025	0.0005	0.06	0.0009	0.007	19	0.188		0.00014	0.002
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008	0.049	0.00002		0.002	0.0028J	0.000457	108	0.0008	0.00037	0.001	0.152	0.0049	0.006	19.3	0.23		0.00016	0.003
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008	0.065	0.00002		0.002	0.00184J	0.000457	101	0.0004	0.00051	0.0005	0.042	0.0008	0.008	20.8	0.67		0.00008	0.003
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008	0.077	0.00005	0.00025	0.001	0.00093J	0.000457	121	0.00025	0.0004	0.0005	0.005	0.0159	0.009	21.9	0.859		0.0005	0.0024
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009	0.08	0.00005	0.00025	0.005	0.0003	0.000457	137	0.00025	0.0005	0.006	0.03	0.0011	0.012	26.5	1.28		0.001	0.0015
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009	0.018	0.00002	0.00005	0.002	0.00037	0.000457	136	0.0005	0.00012	0.001	0.005	0.0002	0.008	15.6	0.186		0.00114	0.001
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009	0.066	0.00002	0.00005	0.002	0.00036	0.000457	113	0.0005	0.00041	0.0005	0.11	0.0008	0.012	20.8	0.757		0.00013	0.004
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009	0.034	0.000005	0.0000025	0.025	0.000126	0.000416	89.1	0.0014	0.000098	0.00086	0.014	0.00014	0.0114	7.92	0.0722	0.000005	0.00076	0.00056
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009	0.00629	0.000005	0.0000025	0.025	0.000102J	0.0000633	6.1	0.0002	0.000028	0.00124	0.053	0.000639	0.00025	1.14	0.026	0.000005	0.00005	0.0008
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009	0.0484	0.000005	0.000021	0.025	0.00226J	0.000430	85.5	0.0003	0.000176	0.00121	0.152	0.00823	0.0069	13.7	0.296	0.000005	0.00023	0.00261
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009	0.0599	0.000005	0.0000025	0.025	0.00127J	0.000457	123	0.0002	0.000129	0.00137	0.057	0.0026	0.0085	22.2	0.276	0.000005	0.0002	0.0019
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009	0.0595	0.000005	0.0000025	0.025	0.000784J	0.000457	140	0.0002	0.0001	0.00049	0.053	0.00121	0.0119	24.6	0.232		0.00027	0.00212
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009	0.0573	0.000005	0.0000025	0.025	0.00131J	0.000457	132	0.0003	0.000128	0.00059	0.068	0.0017	0.009	22.4	0.265	0.00001	0.00023	0.00246
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009	0.0553	0.000005	0.0000025	0.025	0.00141J	0.000457	133	0.0003	0.000421	0.00036	0.045	0.000277	0.0112	22.1	0.377	0.000005	0.00053	0.00276
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009	0.0577	0.000005	0.0000025	0.025	0.00087J	0.000457	146	0.0003	0.00129	0.00021	0.089	0.000447	0.0146	23.9	1.13	0.00001	0.00051	0.00401
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009	0.0659	0.000005	0.0000025	0.025	0.000712J	0.000457	148	0.0002	0.00107	0.00018	0.093	0.000326	0.013	21.3	1.3	0.000005	0.00037	0.00289
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010	0.0679	0.000005	0.000014	0.025	0.000407	0.000457	155	0.0008	0.00135	0.00117	0.318	0.0126	0.0137	25.3	1.2		0.00026	0.00355
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010	0.0587	0.000005	0.0000025	0.025	0.000291	0.000457	159	0.0007	0.00125	0.00035	0.191	0.000535	0.0143	25.1	1.06	0.000005	0.0002	0.00323
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010	0.0569	0.000005	0.0000025	0.025	0.000232	0.000457	165	0.0003	0.00126	0.00015	0.153	0.000257	0.0154	24.5	1.09	0.000005	0.00021	0.00329
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010	0.0576	0.000005	0.0000025	0.025	0.000154	0.000457	167	0.0003	0.00151	0.00015	0.176	0.000235	0.0157	25.8	1.05	0.000005	0.0002	0.00375
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010	0.0441	0.000005	0.0000025	0.025	0.000908J	0.000447	87.4	0.0012	0.000851	0.00216	0.521	0.00595	0.0072	14	0.445		0.00023	0.00322
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010	0.0496	0.000005	0.0000025	0.025	0.00184J	0.000457	134	0.0003	0.000131	0.0005	0.045	0.000948	0.0123	21.7	0.242	0.000005	0.00029	0.00189
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010	0.0454	0.000005	0.0000025	0.025	0.00106J	0.000457	127	0.0006	0.000135	0.00195	0.085	0.00245	0.0113	22.7	0.194	0.00001	0.00024	0.00216
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010	0.0492	0.000005	0.000007	0.025	0.000832J	0.000457	143	0.0004	0.000113	0.00125	0.076	0.00174	0.0125	24.3	0.203	0.000005	0.00027	0.00221
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010	0.0449	0.000005	0.0000025	0.025	0.000788J	0.000457	138	0.0005	0.000179	0.00056	0.059	0.000871	0.0123	23.1	0.268	0.000005	0.00019	0.00237
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010	0.0467	0.000005	0.0000025	0.025	0.000764J	0.000457	134	0.0004	0.00026	0.00086	0.064	0.000489	0.0132	22.9	0.267		0.0002	0.00227
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010	0.0534	0.000005	0.000005	0.025	0.000778J	0.000457	162	0.0005	0.00136	0.0002	0.06	0.000343	0.0143	25.5	1.41	0.000005	0.00019	0.00449
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010	0.0658	0.000005	0.0000025	0.025	0.000655J	0.000457	164	0.0002	0.00131	0.00034	0.025	0.000924	0.017	28.3	1.95	0.000005	0.00021	0.00423
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011	0.0574	0.000005	0.0000025	0.025	0.000101	0.000457	149	0.0007	0.0012	0.00009	0.016	0.000171	0.0137	25.1	1	0.00002	0.00016	0.00393
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011	0.0581	0.000005	0.0000025	0.025	0.000101	0.000457	151	0.0004	0.00168	0.00018	0.029	0.000306	0.0156	26.1	1.48	0.000005	0.00021	0.00451
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011	0.064	0.000005	0.0000025	0.025	0.000215	0.000457	173	0.0005	0.00161	0.00043	0.123	0.000517	0.0162	27.3	1.35	0.000005	0.00018	0.00462
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011	0.057	0.000005	0.0000025	0.025	0.000171	0.000457	182	0.0004	0.00151	0.00032	0.095	0.000271	0.0163	27.1	1.01	0.000005	0.00017	0.00462
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011	0.0373	0.000005	0.0000025	0.025	0.00176J	0.000457	98.5	0.0004	0.000431	0.00096	0.277	0.00465	0.0082	14.1	0.476	0.000005	0.00021	0.00354
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011	0.0523	0.000005	0.0000025	0.025	0.00126J	0.000457	145	0.0003	0.000141	0.00108	0.059	0.00216	0.0115	25.1	0.258	0.000005	0.00026	0.00239
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011	0.0455	0.000005	0.0000025	0.025	0.00116J	0.000457	131	0.0003	0.00017	0.00058	0.056	0.00143	0.0098	21.9	0.257	0.000005	0.00029	0.00236

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-6	Christal Creek u/s Silver Trail Highway	09-Jan-2008		0.6	0.0009	4.36	0.00005	1.6	0.239	100	0.000025	0.0005	0.0054	0.0047	0.0002	0.104	0.044					6.5
KV-6	Christal Creek u/s Silver Trail Highway	19-May-2008		0.5	0.0004	1.9	0.00001	0.8	0.142	56	0.000025	0.0005	0.0064	0.0017	0.0001	0.245	0.024					
KV-6	Christal Creek u/s Silver Trail Highway	20-Jun-2008		0.2	0.0009	2.03	0.00008	1.2	0.21	91.4	0.000025	0.0005	0.003	0.0044	0.0001	0.287	0.027					
KV-6	Christal Creek u/s Silver Trail Highway	06-Jul-2008		0.2	0.0006	2.05	0.000005	1.4	0.208	86	0.000025	0.0005	0.0024	0.0034	0.0001	0.366	0.046					
KV-6	Christal Creek u/s Silver Trail Highway	14-Aug-2008		0.2	0.0006	2.54	0.000005	1.3	0.189	74.7	0.000025	0.0005	0.0065	0.0026	0.0001	0.264	0.035					
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2008	0.005	0.34	0.0014	2.77	0.000005	1.27	0.185		0.000005	0.00005	0.0003	0.0033	0.00022	0.194	0.070	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2008	0.005	0.4	0.0003	3.07	0.000005	1.3	0.17		0.000005	0.00005	0.0011	0.0026	0.00021	0.357	0.103	0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	12-Nov-2008	0.005	0.3	0.0011	3.46	0.000005	1.4	0.201		0.000005	0.0008	0.0005	0.0034	0.00002	0.244	0.050	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	20-Dec-2008		0.4	0.0013	3.93	0.00001	1.5	0.216	82.2		0.0005	0.0028	0.0043	0.0009	0.205	0.054					
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2009		0.8	0.0014	4.54	0.000005	3.7	0.239	94.7	0.000025	0.0005	0.0076	0.0048	0.0002	0.204	0.067					
KV-6	Christal Creek u/s Silver Trail Highway	03-Feb-2009	0.005	0.6	0.0003	3.94	0.000005	2.5	0.211	47.7	0.000005	0.00005	0.0004	0.0021	0.00006	0.024	0.033	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	10-Mar-2009	0.005	0.4	0.0012	3.4	0.000005	1.3	0.266	82.2	0.000005	0.00005	0.0004	0.0049	0.00006	0.104	0.035	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	16-Apr-2009	0.002	0.58	0.00019	3.4	0.0000025	5.07	0.176	38	0.000001	0.000005	0.00025	0.00127	0.0001	0.0071	0.016	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2009	0.009	0.44	0.00002	0.51	0.000012	0.1	0.0119	2	0.000001	0.000005	0.00025	0.000055	0.0003	0.0315	0.005	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2009	0.008	0.42	0.00057	1.89	0.000043	1	0.154	63	0.000004	0.00003	0.0007	0.00238	0.0001	0.221	0.027	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	07-Jul-2009	0.005	0.28	0.00094	2.23	0.000012	1.61	0.215	102	0.000002	0.00002	0.00025	0.00414	0.0001	0.172	0.029	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2009		0.26	0.00078	2.71	0.0000025	1.54	0.239	115	0.000001	0.00006	0.00025	0.00475	0.0001	0.12	0.025	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	09-Sep-2009	0.004	0.33	0.00077	3.4	0.000006	1.45	0.227	107	0.000001	0.000005	0.00025	0.00441	0.0001	0.192	0.046	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	07-Oct-2009	0.004	0.33	0.00072	3.37	0.0000025	1.37	0.225	108	0.000001	0.000005	0.00025	0.00432	0.0001	0.194	0.040	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	13-Nov-2009	0.003	0.4	0.00086	4.15	0.0000025	1.45	0.243	119	0.000001	0.000005	0.00025	0.00425	0.0001	0.127	0.024	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	02-Dec-2009	0.005	0.41	0.00095	3.55	0.0000025	1.26	0.241	122	0.000001	0.000005	0.00025	0.00379	0.0001	0.11	0.039	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2010		0.48	0.00101	4.54	0.000094	1.58	0.251	129	0.000005	0.00013	0.0032	0.00431	0.0001	0.108	0.028	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	11-Feb-2010	0.005	0.43	0.00087	4.21	0.0000025	1.6	0.233	124	0.000001	0.00001	0.00025	0.00446	0.0001	0.0905	0.035	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2010	0.002	0.45	0.00093	4.32	0.0000025	1.59	0.255	130	0.000001	0.00001	0.00025	0.00441	0.0001	0.078	0.043	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2010	0.003	0.46	0.00091	4.16	0.0000025	1.63	0.255	138	0.000001	0.000005	0.00025	0.00433	0.0001	0.0811	0.033	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2010		0.49	0.00061	2.32	0.000013	1.15	0.153	72	0.000004	0.00003	0.0022	0.0023	0.0001	0.136	0.024	0.0002				
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2010	0.003	0.2	0.00078	2.16	0.0000025	1.34	0.231	111	0.000001	0.000005	0.00025	0.00384	0.0001	0.224	0.037	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	08-Jul-2010	0.009	0.26	0.00072	2.51	0.000007	1.44	0.217	107	0.000002	0.00007	0.00025	0.00325	0.0001	0.146	0.033	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	04-Aug-2010	0.007	0.27	0.00079	3.16	0.000009	1.55	0.216	119	0.000001	0.00006	0.0006	0.00345	0.0001	0.116	0.074	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	14-Sep-2010	0.005	0.36	0.00079	3.33	0.000007	1.41	0.21	109	0.000001	0.00002	0.00025	0.00363	0.0001	0.144	0.125	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	05-Oct-2010		0.33	0.00082	3.69	0.0000025	1.43	0.221	111	0.000001	0.00002	0.00025	0.00353	0.0001	0.128	0.068	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	16-Nov-2010	0.003	0.44	0.00083	4.53	0.0000025	1.63	0.24	121	0.000001	0.00002	0.00025	0.00406	0.0001	0.161	0.120	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	07-Dec-2010	0.008	1.27	0.00087	4.63	0.000008	1.7	0.272	140	0.000001	0.000005	0.00025	0.00402	0.0003	0.172	0.070	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2011	0.004	0.41	0.00093	4.03	0.000025	1.61	0.239	121	0.000002	0.00001	0.00025	0.0045	0.0001	0.0982	0.043	0.0004				
KV-6	Christal Creek u/s Silver Trail Highway	08-Feb-2011	0.008	0.5	0.00084	3.48	0.000011	1.6	0.252	134	0.000002	0.000005	0.00025	0.00421	0.0001	0.0831	0.047	0.0001				
KV-6	Christal Creek u/s Silver Trail Highway	22-Mar-2011	0.005	0.55	0.00089	4.34	0.0000025	1.71	0.271	139	0.000001	0.000005	0.00025	0.00486	0.0001	0.0769	0.060	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	19-Apr-2011	0.012	0.53	0.00085	4.46	0.0000025	1.64	0.269	137	0.000001	0.000005	0.00025	0.00501	0.0001	0.0729	0.060	0.0002				
KV-6	Christal Creek u/s Silver Trail Highway	25-May-2011	0.008	0.47	0.0004	2.61	0.000018	0.97	0.16	77	0.000001	0.00002	0.0005	0.00238	0.0001	0.22	0.091	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	22-Jun-2011	0.006	0.25	0.00078	2.14	0.000012	1.63	0.245	122	0.000007	0.00011	0.00025	0.00429	0.0001	0.201	0.030	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	13-Jul-2011	0.004	0.19	0.00064	2.44	0.000006	1.41	0.212	110	0.000001	0.00001	0.00025	0.00381	0.0001	0.173	0.088	0.00005				

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
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
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
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
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
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
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
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
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
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
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
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	Creek bed rusty.	88.65	0.29	0.5	7.92	7.97	830	759	11	14.7	134	343.5	365	364	98.3
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
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012	testing functionality of flow meter	104.69	0.315												
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
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
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.			0.5	7.56	8.03	1056	941	0.6	11.86	83.2	81.1	498	494	124
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012	Returned to measure flows when data logger downloaded & winterized.	76.18													
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
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012	Ice too thick to get to water with ice auger.														
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013	Over 150 cm of ice. Could not find water.														
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013	No water found. Frozen to the ground.														
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.														
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.														
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
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
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
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
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2013		87.213	0.535	0.5	7.65	7.67	891	843	6.2	12.4	101.6	155.6	518	523	116
KV-6	Christal Creek u/s Silver Trail Highway	11-Sep-2013		91.5	0.189												
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
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
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	772	0.9	8.88	55.2	146.8	513	525	159

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
Station	Description	Sample Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011				280	429		1.64				5	0.0185	0.1	0.00032	0.00492	0.0382	0.000005	0.0000025	0.025	0.00185	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011				289	429	0.009	3.99	0.0025	0.1		1.9	0.0106	0.1	0.00028	0.00527	0.0433	0.000005	0.0000025	0.025	0.00215	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011				356	429	0.063	4.03	0.025	0.1	0.3	0.8	0.0046	0.1	0.00025	0.00361	0.053	0.000005	0.0000025	0.025	0.00132	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011				342	429	0.035	6.11	0.0025	0.177	0.269	1.7	0.0096	0.1	0.00032	0.00597	0.0585	0.000005	0.0000025	0.025	0.0014	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011				346	429	0.18	8.30	0.0025	0.234	1.2	2.1	0.011	0.1	0.00039	0.007	0.0643	0.000005	0.0000025	0.025	0.00123	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012				294	429	0.11	9.53	0.0025	0.246	0.278	0.78	0.0198	0.1	0.00026	0.00621	0.0616	0.000005	0.0000025	0.025	0.00114	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012				329	429	0.13	11.7	0.0025	0.228	0.197	1.08	0.003	0.1	0.00017	0.0103	0.0572	0.000005	0.0000025	0.025	0.000898	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012				344	429	0.12	15.1	0.025	0.27	0.10	1.57	0.0038	0.1	0.00018	0.0102	0.0585	0.000005	0.0000025	0.025	0.000818	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012				312	429	0.12	3.86	0.0025	0.259	0.144	0.9	0.009	0.1	0.00018	0.00967	0.0551	0.000005	0.0000025	0.025	0.000779	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012		0.25		196	429	0.036	3.48	0.025	1.06	0.108	10.4	0.0412	0.1	0.000375	0.00819	0.0378	0.00001	0.0000025	0.025	0.00378	0.000363
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012		1.1		185	429	0.032	1.86	0.025	0.025	0.466	8.55	0.0287	0.1	0.000522	0.00961	0.0417	0.000005	0.0000025	0.025	0.00239	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012		1.2		278	429	0.025	0.952	0.025	0.10	0.28	3.95	0.00723	0.1	0.000286	0.00369	0.0465	0.000005	0.0000025	0.025	0.000729	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012		1.3		353	429	0.059	0.793	0.025	0.10	0.22	2.55	0.00787	0.1	0.000358	0.00492	0.0451	0.000005	0.0000025	0.025	0.000742	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012		1		341	429	0.028	1.03	0.025	0.10	0.3	2.86	0.00724	0.1	0.000349	0.00521	0.0462	0.000005	0.0000025	0.025	0.00086	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012		1.2		352	429	0.012	2.14	0.025	0.10	0.23	2.81	0.00713	0.1	0.00021	0.00449	0.0478	0.000005	0.0000025	0.025	0.00108	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012		1.2		365	429	0.036	4.99	0.025	0.22	0.10	2	0.00447	0.1	0.000178	0.0036	0.0495	0.000005	0.0000025	0.025	0.000769	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012		1.8		359	429	0.057	1.90	0.025	0.32	0.10	1.35	0.0148	0.1	0.000411	0.00645	0.0687	0.000005	0.000008	0.025	0.00132	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	14-Mar-2013					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	05-Apr-2013					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2013		7.55	0.033	268	429	0.0112	3.63	0.0011	0.0381	0.917	14.8	0.221C	0.1	0.00089	0.00431	0.0416	0.00005	0.00025	0.005	0.00114	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2013		0.84	0.117	297	429	0.0186	0.837	0.0005	0.0676	0.267	7.40	0.172C	0.1	0.00058	0.0089	0.0503	0.00005	0.00025	0.005	0.000842	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Jul-2013		2.5	0.10C	397	429	0.0087	0.625	0.005	0.096	0.138	2.71	0.0184	0.1	0.00056	0.00552	0.0442	0.00005	0.00025	0.005	0.000994	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2013		2.5	0.21C	408	429	0.0025	3.73	0.005	0.136	0.129	1.64	0.0278	0.1	0.00061	0.00785	0.0535	0.00005	0.00025	0.005	0.00103	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2013		2.5	0.25C	388	429	0.0025	2.56	0.005	0.145	0.110	2.04	0.0122	0.1	0.00030	0.00611	0.0484	0.00005	0.00025	0.005	0.00103	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Sep-2013					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	10-Oct-2013		1.25	0.21C	344	429	0.0096	17.1	0.0025	0.159	0.113	2.49	0.0220	0.1	0.00034	0.0051	0.0444	0.00005	0.00025	0.005	0.00162	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2013		1.25	0.19C	356	429	0.0552	8.89	0.0025	0.238	0.078	1.43	0.0163	0.1	0.00039	0.00447	0.0588	0.00005	0.00025	0.005	0.00115	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2013		1.64	0.138C	340	429	0.0760	8.63	0.0021	0.257	0.45	1.18		0.1								0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011	138	0.0003	0.000338	0.00065	0.004	0.249	0.00846	0.007	0.0245	0.0121	24.3	0.344	5.4	0.000005	0.00024	0.00324	0.15
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011	141	0.0003	0.000439	0.00039	0.004	0.544	0.00411	0.007	0.0247	0.0135	23.1	0.441	5.5	0.000005	0.00035	0.00263	0.15
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011	159	0.00005	0.00243	0.00026	0.004	0.297	0.00243	0.007	0.0287	0.0175	27.7	1.32	6.2	0.000005	0.00023	0.0055	0.15
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011	153	0.0002	0.00242	0.00067	0.004	0.366	0.0155	0.007	0.0278	0.0158	28.2	1.64	6.0	0.000005	0.0002	0.00606	0.15
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011	159	0.0009	0.00234	0.00248	0.004	0.492	0.00752	0.007	0.0283	0.0156	26.1	1.84	6.1	0.000005	0.0002	0.00643	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012	149	0.0006	0.00187	0.00122	0.004	0.535	0.016	0.007	0.0260	0.0146	23.2	1.06	5.7	0.000005	0.00019	0.00528	0.15
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012	167	0.00005	0.0023	0.00019	0.004	0.571	0.0039	0.007	0.0296	0.0166	26.1	1.33	6.3	0.000005	0.00016	0.00597	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012	163	0.0001	0.00213	0.00024	0.004	0.48	0.00362	0.007	0.0291	0.018	26.8	1.25	6.2	0.000005	0.00015	0.00556	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012	151	0.00005	0.00219	0.00022	0.004	0.514	0.00306	0.007	0.0269	0.0175	25.5	1.07	5.9	0.000005	0.00018	0.00611	0.15
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012	86.7	0.00017	0.00145	0.00124	0.004	0.991	0.0135	0.007	0.0146	0.00789	13.2	0.703	3.5	0.000005	0.000189	0.00435	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012	88.4	0.00018	0.00124	0.00143	0.004	0.872	0.0225	0.007	0.0152	0.00773	14.8	0.719	3.6	0.000005	0.000329	0.0044	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	112	0.00019	0.000225	0.00075	0.004	0.148	0.00336	0.007	0.0199	0.0118	20.6	0.25	4.6	0.000005	0.00024	0.00294	0.15
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012	171	0.00005	0.000224	0.000872	0.004	0.21	0.00559	0.007	0.0309	0.0173	28.5	0.247	6.5	0.000005	0.000286	0.0021	0.15
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012	157	0.00005	0.000257	0.000408	0.004	0.187	0.0048	0.007	0.0281	0.0172	26.6	0.343	6.1	0.000005	0.000335	0.00284	0.15
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012	155	0.00005	0.000691	0.000277	0.004	0.314	0.00189	0.007	0.0275	0.0175	25.6	0.517	6.0	0.000005	0.000215	0.0041	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012	160	0.00026	0.000644	0.000413	0.004	0.202	0.0027	0.007	0.0279	0.017	24	0.449	6.0	0.000005	0.000195	0.00345	0.15
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012	165	0.00013	0.00194	0.00119	0.004	0.441	0.0233	0.007	0.0297	0.0157	27.5	1.69	6.3	0.000005	0.00021	0.00677	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	14-Mar-2013					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	05-Apr-2013					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2013	92.0	0.00061	0.00041	0.00408C	0.004	0.469	0.0297	0.007	0.0171	0.00873	21.2	0.201	4.0	0.000005	0.000158	0.00247	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2013	121	0.00057	0.00126	0.0010	0.004	0.999	0.0101	0.007	0.0206	0.00853	18.2	1.03	4.7	0.000005	0.000331	0.00525	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Jul-2013	166	0.00015	0.00042	0.00061	0.004	0.223	0.00626	0.007	0.0300	0.0145	28.8	0.526	6.4	0.000005	0.000351	0.00320	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2013	162	0.00017	0.00038	0.00053	0.004	0.270	0.0127	0.007	0.0298	0.0147	30.2	0.483	6.4	0.000005	0.000307	0.00328	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2013	159	0.00005	0.00031	0.00025	0.004	0.259	0.00826	0.007	0.0291	0.0130	29.4	0.358	6.2	0.000005	0.000284	0.00303	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Sep-2013					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	10-Oct-2013	146	0.00019	0.00103	0.00060	0.004	0.263	0.00540	0.007	0.0258	0.0128	24.7	1.02	5.7	0.000005	0.000226	0.00469	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2013	153	0.00015	0.00171	0.00065	0.004	0.264	0.0106	0.007	0.0274	0.0136	26.4	1.59	5.9	0.000005	0.000197	0.00540	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2013					0.004			0.007	0.0288				6.2				0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011	0.008	0.32	0.00074	3.2	0.000029	1.54	0.223	117	0.000003	0.000005	0.00025	0.00402	0.0001	0.226	0.273	0.00005	0.0087	0.00028	0.00322
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011	0.007	0.41	0.00077	3.4	0.000026	1.41	0.235	116	0.000001	0.00018	0.00025	0.00454	0.0001	0.275	0.275	0.00005	0.0048	0.00025	0.00318
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011	0.006	0.43	0.00082	4	0.00002	1.63	0.271	143	0.000001	0.00013	0.00025	0.00415	0.0001	0.218	0.323	0.00005	0.0031	0.00022	0.00201
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011	0.008	0.47	0.00096	4.1	0.0000025	1.77	0.256	131	0.000003	0.00055	0.00025	0.0046	0.0001	0.219	0.313	0.00005	0.0016	0.00023	0.00289
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011	0.007	0.61	0.00094	4.1	0.00001	1.87	0.26	122	0.00001	0.00013	0.00025	0.0039	0.0001	0.175	0.319	0.00005	0.0013	0.00022	0.00363
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012	0.024	0.46	0.00111C	4.3	0.000011	2.43	0.244	138	0.000003	0.0005	0.00025	0.00411	0.0001	0.149	0.291	0.00005	0.0051	0.00023	0.00273
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012	0.012	0.47	0.00091	4.3	0.0000025	1.6	0.244	131	0.000002	0.0001	0.00025	0.00419	0.0001	0.139	0.334	0.00005	0.0035	0.00015	0.00446
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012	0.014	0.5	0.00096	4.2	0.000008	1.7	0.248	143	0.000004	0.0001	0.00025	0.00335	0.0001	0.119	0.328	0.00005	0.0008	0.00018	0.00442
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012	0.008	0.43	0.00089	3.8	0.0000025	1.57	0.25	131	0.000003	0.0001	0.00025	0.00392	0.0001	0.117	0.302	0.00005	0.001	0.00017	0.00423
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012	0.0172	0.538	0.000553	2.47	0.000041	0.895	0.143	66	0.000005	0.00010	0.00118	0.00171	0.00010	0.364J	0.143	0.00005	0.0254	0.000265	0.00535
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012	0.0156	0.551	0.000515	2.68	0.000063	1.02	0.15	70	0.000006	0.00010	0.00071	0.0021	0.00010	0.318J	0.151	0.00013	0.0215	0.00035	0.00509
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	0.0138	0.332	0.000875	2.04	0.0000102	1.75	0.211	106	0.0000010	0.00010	0.00328	0.00378	0.00010	0.123	0.214	0.00005	0.003	0.000262	0.00257
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012	0.013	0.183	0.000758	2.46	0.0000086	1.75	0.255	152	0.0000026	0.00010	0.00025	0.00369	0.00010	0.0992	0.349	0.00005	0.00666	0.000292	0.00308
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012	0.0023	0.24	0.000745	2.62	0.00001	1.64	0.265	133	0.0000010	0.00010	0.00025	0.00361	0.00010	0.105	0.316	0.00005	0.00354	0.000303	0.00368
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012	0.0023	0.387	0.000848	3.11	0.0000025	1.53	0.274	140	0.0000010	0.00010	0.00025	0.00401	0.00010	0.163	0.309	0.00005	0.00198	0.000201	0.00252
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012	0.0044	0.407	0.000855	4.07	0.000005	1.45	0.27	144	0.000002	0.00035	0.00025	0.00393	0.00010	0.0988	0.314	0.00005	0.00152	0.000178	0.00242
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012	0.0058	0.438	0.00101C	4.2	0.000046	1.77	0.262	127	0.000007	0.00010	0.00025	0.00465	0.00022	0.173	0.334	0.00005	0.00137	0.00025	0.00216
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	14-Mar-2013															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	05-Apr-2013															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2013	0.083	2.87	0.00023	3.03	0.000382C	1.90	0.180	87.3	0.000005	0.00018	0.005	0.000641	0.0005	0.141	0.178	0.00040	0.0082	0.00055	0.00183
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2013	0.025	0.52	0.00049	2.94	0.000076	1.12	0.163	92.3	0.000005	0.00005	0.005	0.00219	0.0005	0.105	0.224	0.00040	0.0096	0.00052	0.00500
KV-6	Christal Creek u/s Silver Trail Highway	12-Jul-2013	0.025	0.21	0.00080	2.56	0.000029	1.58	0.269	131	0.000005	0.00005	0.005	0.00470	0.0005	0.160	0.339	0.00040	0.0024	0.00045	0.00403
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2013	0.025	0.32	0.00095	3.14	0.000063	1.73	0.291	134	0.000005	0.00005	0.005	0.00559	0.0005	0.159	0.337	0.00040	0.0024	0.00045	0.00513
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2013	0.025	0.40	0.00092	3.56	0.000040	1.59	0.278	128	0.000005	0.00005	0.005	0.00514	0.0005	0.143	0.328	0.00040	0.0032	0.00023	0.00419
KV-6	Christal Creek u/s Silver Trail Highway	11-Sep-2013															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	10-Oct-2013	0.025	0.44	0.00075	3.72	0.000035	1.56	0.236	110	0.000005	0.00005	0.005	0.00393	0.0005	0.261	0.289	0.00040	0.0042	0.00022	0.00282
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2013	0.025	0.42	0.00089	4.04	0.000061	1.61	0.241	114	0.000005	0.00005	0.005	0.00455	0.0005	0.152	0.308	0.00040	0.0014	0.00022	0.00222
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2013															0.325		0.0015	0.00019	0.00207

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011	0.0386	0.000005	0.0000025	0.025	0.0016J	0.000457	137	0.0003	0.000307	0.00068	0.081	0.00105	0.0118	23.9	0.303		0.00025	0.00304
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011	0.045	0.000005	0.0000025	0.025	0.00166J	0.000457	144	0.0003	0.00037	0.00032	0.072	0.000328	0.0139	22.1	0.428	0.000005	0.0004	0.00259
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011	0.0456	0.000005	0.0000025	0.025	0.00101J	0.000457	164	0.00005	0.00261	0.00015	0.124	0.000755	0.0174	28.8	1.37	0.000005	0.00022	0.00607
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011	0.0559	0.000005	0.0000025	0.025	0.000769J	0.000457	153	0.0001	0.00236	0.0003	0.067	0.000474	0.0154	27.2	1.62	0.000005	0.00018	0.00582
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011	0.0625	0.000005	0.0000025	0.025	0.000517J	0.000457	159	0.0002	0.00225	0.00066	0.163	0.00064	0.0153	26.5	1.82	0.000005	0.00018	0.00582
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012	0.054	0.000005	0.000025	0.025	0.000203	0.000457	142	0.0023	0.00191	0.0005	0.105	0.000947	0.0147	24.8	1.05	0.000005	0.00017	0.00522
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012	0.0568	0.000005	0.0000025	0.025	0.000212	0.000457	172	0.00005	0.00247	0.0001	0.149	0.000139	0.0171	27.8	1.33	0.000005	0.00016	0.00643
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012	0.0631	0.000005	0.0000025	0.025	0.000104	0.000457	169	0.00005	0.00234	0.00029	0.131	0.000088	0.019	27.9	1.34	0.000005	0.00018	0.0061
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012	0.0547	0.000005	0.0000025	0.025	0.000081	0.000457	159	0.00005	0.00207	0.0001	0.133	0.000104	0.0168	25.5	1.04	0.000005	0.00015	0.00549
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012	0.0366	0.000005	0.0000025	0.025	0.00321J	0.000441	85.1	0.00005	0.00144	0.00106	0.641	0.00296	0.0075	13.6	0.707	0.000005	0.000137	0.0044
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012	0.0406	0.000005	0.0000025	0.025	0.00183J	0.000452	91.1	0.00005	0.00122	0.00108	0.504	0.00409	0.008	14.6	0.685	0.000005	0.000205	0.00384
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	0.0457	0.000005	0.0000025	0.025	0.000608J	0.000457	111	0.00005	0.000203	0.000572	0.0336	0.000581	0.0116	21	0.245	0.000005	0.000238	0.00271
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012	0.0427	0.000005	0.0000025	0.025	0.000515J	0.000457	144	0.00005	0.000159	0.000232	0.0417	0.000569	0.0168	24.3	0.196	0.000005	0.000617	0.0021
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012	0.0456	0.000005	0.0000025	0.025	0.000612J	0.000457	125	0.00005	0.000207	0.000373	0.0518	0.00104	0.017	26.1	0.315	0.000005	0.000243	0.00281
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012	0.0457	0.000005	0.0000025	0.025	0.00065J	0.000457	169	0.00005	0.000666	0.000203	0.0639	0.000189	0.0167	25.8	0.487	0.000005	0.000217	0.00359
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012	0.0484	0.000005	0.0000025	0.025	0.000684J	0.000457	155	0.00013	0.000644	0.000308	0.059	0.000336	0.0171	25.8	0.462	0.000005	0.000159	0.00386
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012	0.0662	0.000005	0.0000025	0.025	0.000627J	0.000457	159	0.00011	0.00181	0.000392	0.111	0.000454	0.0162	28.4	1.64	0.000005	0.000244	0.0065
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	14-Mar-2013						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	05-Apr-2013						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2013	0.0333	0.00005	0.00025	0.005	0.000821J	0.000457	89.7	0.00010	0.00020	0.00261	0.028	0.00647	0.00817	20.7	0.144	0.000005	0.000116	0.00190
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2013	0.0476	0.00005	0.00025	0.005	0.000515J	0.000457	126	0.00005	0.00109	0.00069	0.242	0.00224	0.00969	18.7	1.02	0.000005	0.000335	0.00470
KV-6	Christal Creek u/s Silver Trail Highway	12-Jul-2013	0.0442	0.00005	0.00025	0.005	0.000795J	0.000457	161	0.00005	0.00038	0.00035	0.068	0.00138	0.0136	27.0	0.497	0.000005	0.000312	0.00304
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2013	0.0534	0.00005	0.00025	0.005	0.000497J	0.000457	159	0.00005	0.00032	0.00010	0.055	0.00180	0.0144	30.3	0.441	0.000005	0.000272	0.00308
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2013	0.0471	0.00005	0.00025	0.005	0.000765J	0.000457	160	0.00005	0.00027	0.00026	0.089	0.00105	0.0125	29.7	0.324	0.000005	0.000253	0.00279
KV-6	Christal Creek u/s Silver Trail Highway	11-Sep-2013						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	10-Oct-2013	0.0422	0.00005	0.00025	0.005	0.00124J	0.000457	148	0.00005	0.00096	0.00038	0.067	0.000470	0.0129	25.2	0.953	0.000005	0.000203	0.00462
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2013	0.0619	0.00005	0.00025	0.005	0.000563J	0.000457	156	0.00005	0.00168	0.00023	0.065	0.000580	0.0141	27.0	1.53	0.000005	0.000193	0.00527
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2013	0.0716	0.00005	0.00025	0.005	0.000173	0.000457	166	0.00005	0.00182	0.00010	0.088	0.000509	0.0143	26.9	2.08	0.000005	0.000172	0.00482

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-6	Christal Creek u/s Silver Trail Highway	17-Aug-2011	0.006	0.34	0.00069	3.1	0.0000025	1.51	0.229	117	0.000001	0.00001	0.00025	0.00392	0.0001	0.208	0.099	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	24-Sep-2011	0.007	0.41	0.0008	3.3	0.0000025	1.36	0.247	116	0.000001	0.0001	0.00025	0.0046	0.0001	0.262	0.083	0.0002				
KV-6	Christal Creek u/s Silver Trail Highway	29-Oct-2011	0.004	0.4	0.00092	4.1	0.0000025	1.77	0.259	141	0.000001	0.00006	0.00025	0.00436	0.0001	0.23	0.053	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2011	0.005	0.48	0.0009	3.9	0.0000025	1.71	0.25	129	0.000001	0.00052	0.00025	0.00459	0.0001	0.201	0.082	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	14-Dec-2011	0.003	0.62	0.00096	4.3	0.0000025	1.8	0.259	129	0.000001	0.00007	0.00025	0.00386	0.0001	0.145	0.099	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	15-Jan-2012	0.006	0.43	0.00106	3.8	0.000006	1.86	0.235	124	0.000001	0.0001	0.00025	0.00422	0.0001	0.129	0.070	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2012	0.007	0.5	0.0009	4.5	0.0000025	1.73	0.26	136	0.000001	0.0001	0.00025	0.00452	0.0001	0.109	0.086	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	11-Mar-2012	0.007	0.53	0.00104	4.4	0.0000025	1.83	0.286	147	0.000001	0.0001	0.00025	0.00511	0.0001	0.079	0.109	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2012	0.006	0.45	0.00094	4	0.0000025	1.57	0.248	134	0.000001	0.0001	0.00025	0.00406	0.0001	0.0817	0.054	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	01-May-2012	0.0125	0.553	0.000471	2.39	0.000007	0.945	0.144	68	0.000002	0.00010	0.00025	0.0018	0.00010	0.365	0.100	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2012	0.0103	0.553	0.000587	2.8	0.000006	1.01	0.151	75	0.000003	0.00010	0.00025	0.00188	0.00010	0.301	0.080	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2012	0.0052	0.303	0.000818	2.03	0.0000025	1.76	0.207	112	0.0000010	0.00010	0.00025	0.00369	0.00010	0.111	0.074	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	04-Jul-2012	0.0076	0.16	0.000771	1.83	0.0000025	1.47	0.243	128	0.0000010	0.00010	0.00025	0.00363	0.00010	0.0835	0.067	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2012															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2012	0.0010	0.259	0.000609	2.04	0.0000025	1.61	0.254	132	0.0000010	0.00010	0.00025	0.00356	0.00010	0.0952	0.077	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2012	0.0010	0.381	0.00083	3.5	0.0000025	1.57	0.265	136	0.0000010	0.00010	0.00025	0.00369	0.00010	0.147	0.081	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2012	0.0010	0.404	0.000855	3.99	0.0000025	1.55	0.27	152	0.0000010	0.00010	0.00025	0.00405	0.00010	0.109	0.082	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2012															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	21-Nov-2012	0.0010	0.44	0.00105	4.09	0.0000025	1.84	0.263	133	0.000002	0.00010	0.00025	0.00461	0.00010	0.155	0.049	0.00005				
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2012															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	13-Jan-2013															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	10-Feb-2013															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	14-Mar-2013															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	05-Apr-2013															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2013	0.025	2.74	0.00023	2.37	0.000027	1.90	0.174	86.5	0.000005	0.00013	0.005	0.000566	0.0005	0.115	0.126	0.00040	6.57	6.34	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2013	0.025	0.50	0.00050	2.74	0.000005	1.11	0.200	93.7	0.000005	0.00005	0.005	0.00285	0.0005	0.0882	0.099	0.00040	7.87	7.97	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jul-2013	0.025	0.18	0.00082	2.44	0.000005	1.54	0.279	128	0.000005	0.00005	0.005	0.00478	0.0005	0.154	0.060	0.00040	10.5	10.4	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2013	0.025	0.30	0.00102	3.01	0.000005	1.68	0.280	130	0.000005	0.00005	0.005	0.00555	0.0005	0.144	0.087	0.00040	10.9	10.5	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2013	0.025	0.39	0.00094	3.56	0.000005	1.56	0.277	126	0.000005	0.00005	0.005	0.00491	0.0005	0.132	0.077	0.00040	10.4	10.5	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	11-Sep-2013															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	10-Oct-2013	0.025	0.39	0.00081	3.70	0.000005	1.55	0.233	110	0.000005	0.00005	0.005	0.00383	0.0005	0.253	0.141	0.00040	9.71	9.56	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2013	0.025	0.45	0.00092	4.08	0.000005	1.69	0.243	113	0.000005	0.00005	0.005	0.00471	0.0005	0.149	0.087	0.00040	10.2	10.2	1	
KV-6	Christal Creek u/s Silver Trail Highway	06-Dec-2013	0.025	0.44	0.00107	4.46	0.000005	1.78	0.258	128	0.000005	0.00005	0.005	0.00457	0.0005	0.124	0.082	0.00040	10.3	10.7	1.02	

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
KV-6	Christal Creek u/s Silver Trail Highway	03-Jan-2014	100% ice cover. No good stretch for salt slug. Water is clear with a few particles			8.0	7.49	7.41	773.8	829	0	10.95	74.4	185.6	465	473	140
KV-6	Christal Creek u/s Silver Trail Highway	04-Feb-2014	Water is clear. 100% ice cover. Bends and pools= no salt slug			1.6	6.99	7.48	1038	770	0	13.09	87.7	87	473	488	131
KV-6	Christal Creek u/s Silver Trail Highway	24-Feb-2014	Tried salt slug- very long time to return close to original Sp. Cond. Best location we could find.				7.19		994		-0.1	11.93	81.2	52.3			
KV-6	Christal Creek u/s Silver Trail Highway	01-Mar-2014	Water is clear. 100% ice cover. Salt slug.	49.5		4.2	7.22	7.50	1083	789	-0.1	11.69	79.8	75.1	489	487	145
KV-6	Christal Creek u/s Silver Trail Highway	04-Apr-2014		51.56		3.4	7.16	7.67	875	787	0	9.94	69.1	97.7	489	502	137
KV-6	Christal Creek u/s Silver Trail Highway	10-May-2014	Turbid water.	290		16.6	7.46	7.43		297	1.5	11.13	79.1	89.7	149	155	43.0
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2014		58.8		2.6	7.69	7.93		736	9.2	10.34	91.4	222.5	474	482	121
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
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
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014		110.1515	0.202	0.5	7.75	7.96	809	758	5.6	13.08	106	272.9	459	470	128
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	Ice affected stage	102.2	0.205	0.5	7.48	7.88	757.5	826	0.3	13.67	96	138.4	475	466	140
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
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
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
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
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	4.04C	27.9	296.3	507	500	135
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
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
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
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
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
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
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015		134.5	0.298												
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
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
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
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			
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
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016		66.5		0.5	7.46	7.82	844.6	780	0	12.77	87.9	20	460	462	138
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
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
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
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
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
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
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
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-6	Christal Creek u/s Silver Trail Highway	03-Jan-2014		1.47	0.137C	326	429	0.0727	6.16	0.0013	0.253	0.123	1.21	0.0615	0.1	0.00047	0.0101	0.0667	0.00005	0.00025	0.005	0.00113	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	04-Feb-2014		1.45	0.144C	343	429	0.0777	19.4	0.0013	0.265	0.144	0.93	0.0153	0.1	0.00039	0.0065	0.0556	0.00005	0.00025	0.005	0.000945	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	24-Feb-2014					128		12.3						0.1								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	01-Mar-2014		1.71	0.156C	337	429	0.0954	11.5	0.0010	0.273	0.18	0.70	0.0385	0.1	0.00049	0.0123	0.0595	0.00005	0.00025	0.005	0.00119	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	04-Apr-2014		1.41	0.150C	325	429	0.0928	13.1	0.0005	0.272	0.380	0.99	0.0385	0.1	0.00046	0.0101	0.0551	0.00005	0.00025	0.005	0.000841	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	10-May-2014		0.25	0.071	101	309	0.0526	5.82	0.0005	0.0547	0.629	14.7	0.355C	0.1	0.00153	0.0163	0.0391	0.00005	0.00025	0.005	0.00182	0.000221
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2014		1.00	0.137C	334	429	0.0187	1.85	0.0005	0.153	0.191	2.96	0.0180	0.1	0.00055	0.00449	0.0479	0.00005	0.00025	0.005	0.000766	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014		0.97	0.120	320	429	0.0110	0.629	0.0005	0.107	0.219	3.66	0.0219	0.1	0.00063	0.00564	0.0385	0.00005	0.00025	0.005	0.000981	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014		1.26	0.129C	341	429	0.0063	2.10	0.0005	0.131	0.134	2.20	0.0314	0.1	0.00056	0.00649	0.0456	0.00005	0.00025	0.005	0.00114	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014		1.50	0.117	319	429	0.0050	2.14	0.0005	0.132	0.141	2.42	0.0142	0.1	0.00045	0.00514	0.0425	0.00005	0.00025	0.005	0.00131	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014		1.61	0.125C	310	429	0.0244	6.14	0.0005	0.221	0.108	2.05	0.0161	0.1	0.00032	0.00377	0.0511	0.00005	0.00025	0.005	0.00139	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014		1.76	0.135C	313	429	0.0511	5.88	0.0005	0.262	0.153	1.03	0.0184	0.1	0.00035	0.00428	0.0587	0.00005	0.00025	0.005	0.00118	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014		2.63	0.134C	299	429	0.0619	64.3	0.0053	0.317	0.107	1.01	0.0515C	0.005	0.00048	0.00857	0.0631	0.00005	0.00025	0.005	0.00136	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015		1.64	0.138C	320	429	0.0666	16.9	0.0005	0.319	0.108	0.84	0.0441	0.1	0.00055	0.0105	0.0597	0.00005	0.00025	0.005	0.00118	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015		1.44	0.138C	330	429	0.0676	25.4	0.0011	0.319	0.114	1.30	0.0415	0.1	0.00081	0.0144	0.0603	0.00005	0.00025	0.005	0.00131	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015		1.41	0.142C	333	429	0.0738	6.60	0.0012	0.318	0.121	0.88	0.0184	0.1	0.00026	0.0115	0.0542	0.00005	0.00025	0.005	0.000798	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015		1.45	0.156C	351	429	0.0727	0.759	0.0011	0.319	0.131	1.20	0.0133	0.1	0.00025	0.0113	0.0540	0.00005	0.000025	0.005	0.000682	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015		0.51	0.066	88.7	309	0.0430	33.0	0.0005	0.0515	0.732	17.3	0.237C	0.1	0.00175	0.0127	0.0359	0.00005	0.000025	0.005	0.00171	0.000207
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015		1.10	0.145C	369	429	0.0148	2.88	0.0005	0.160	0.179	2.69	0.0132	0.1	0.00034	0.00574	0.0538	0.00005	0.000025	0.005	0.000719	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015		1.31	0.147C	356	429	0.0073	1.32	0.0005	0.123	0.119	2.70	0.0337	0.1	0.00064	0.0077	0.0471	0.00005	0.000025	0.005	0.00118	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015		1.37	0.139C	328	429	0.0025	1.48	0.0005	0.101	0.172	3.26	0.0257	0.1	0.00052	0.00645	0.0401	0.00005	0.000025	0.005	0.00133	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015		1.29	0.124C	285	429	0.0025	3.18	0.0005	0.110	0.180	4.61	0.0517	0.1	0.00036	0.00735	0.0393	0.00005	0.000025	0.005	0.00135	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015		1.48	0.135C	331	429	0.0191	4.40	0.0005	0.221	0.100	1.74	0.0146	0.1	0.00029	0.00440	0.0491	0.00005	0.000025	0.005	0.00134	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015		2.07	0.109	306	429	0.0399	8.23	0.0005	0.310	0.158	1.33	0.0246	0.1	0.00039	0.00477	0.0614	0.00005	0.000025	0.005	0.00143	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015		2.03	0.115	310	429	0.0452	3.80	0.0005	0.325	0.082	1.05	0.0165	0.1	0.00024	0.00694	0.0683	0.00005	0.000025	0.005	0.00119	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015					128		17.7						0.1								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016		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	0.00005	0.000025	0.005	0.000959	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016		1.48	0.146C	336	429	0.0709	6.60	0.0005	0.306	0.136	0.94	0.0056	0.1	0.00015	0.00817	0.0538	0.00005	0.000025	0.005	0.00079	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016		1.52	0.174C	343	429	0.0640	5.63	0.0005	0.300	0.138	0.81	0.0154	0.1	0.00028	0.0102	0.0529	0.00005	0.000025	0.005	0.000808	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016		1.52	0.175C	358	429	0.0624	3.04	0.0005	0.284	0.200	1.26	0.0178	0.1	0.00025	0.0112	0.0522	0.00005	0.000025	0.005	0.000764	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016		0.90	0.135C	243	429	0.0242	2.15	0.0005	0.130	0.235	5.48	0.0369	0.1	0.00043	0.00981	0.0520	0.00005	0.000025	0.005	0.00128	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016		1.10	0.161C	363	429	0.0073	2.15	0.0005	0.126	0.145	2.52	0.0164	0.1	0.00038	0.00571	0.0482	0.00005	0.000025	0.005	0.000848	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016		1.17	0.158C	363	429	0.0070	1.23	0.0005	0.101	0.187	2.99	0.0306	0.1	0.00054	0.00695	0.0461	0.00005	0.000025	0.005	0.00124	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016		1.05	0.149C	299	429	0.0025	1.35	0.0005	0.0664	0.172	4.72	0.0357	0.1	0.00044	0.00518	0.0347	0.00005	0.000025	0.005	0.00226	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016		1.21	0.162C	336	429	0.0025	2.05	0.0005	0.134	0.127	3.09	0.0223	0.1	0.00027	0.00555	0.0432	0.00005	0.000025	0.005	0.00138	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016	0.125	1.25	0.16C	391	429	0.0419	4.46	0.0025	0.230	0.123	1.22	0.0105	0.1	0.00020	0.00613	0.0539	0.00005	0.000025	0.005	0.000959	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-6	Christal Creek u/s Silver Trail Highway	03-Jan-2014	146	0.00127C	0.00163	0.00075	0.004	0.966	0.0232	0.007	0.0258	0.0116	24.0	1.45	5.7	0.000005	0.000176	0.00424	0.15
KV-6	Christal Creek u/s Silver Trail Highway	04-Feb-2014	148	0.00025	0.00137	0.00025	0.004	0.383	0.00766	0.007	0.0263	0.0123	25.1	0.957	5.8	0.000005	0.000199	0.00405	0.15
KV-6	Christal Creek u/s Silver Trail Highway	24-Feb-2014					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	01-Mar-2014	155	0.00055	0.00147	0.00062	0.004	0.751	0.0132	0.007	0.0273	0.0131	25.0	1.13	5.9	0.000005	0.000201	0.00390	0.15
KV-6	Christal Creek u/s Silver Trail Highway	04-Apr-2014	155	0.00035	0.00127	0.00160	0.004	0.487	0.0104	0.007	0.0273	0.0136	24.9	0.883	5.9	0.000005	0.000228	0.00417	0.15
KV-6	Christal Creek u/s Silver Trail Highway	10-May-2014	48.0	0.00070	0.00169	0.00360C	0.00332	1.64	0.0775	0.00528	0.00860	0.00425	7.20	0.724	2.2	0.000005	0.000210	0.00435	0.129
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2014	149	0.00016	0.00033	0.00141	0.004	0.208	0.00895	0.007	0.0264	0.0123	24.7	0.302	5.8	0.000005	0.000277	0.00272	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014	141	0.00017	0.00037	0.00069	0.004	0.194	0.00964	0.007	0.0250	0.0112	24.4	0.412	5.5	0.000005	0.000257	0.00289	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014	151	0.00012	0.00034	0.00063	0.004	0.273	0.0135	0.007	0.0275	0.0131	27.9	0.347	6.0	0.000005	0.000204	0.00274	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014	143	0.00012	0.00046	0.00082	0.004	0.239	0.0106	0.007	0.0255	0.0112	25.1	0.437	5.6	0.000005	0.000197	0.00325	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	147	0.00014	0.00151	0.00108	0.004	0.256	0.00514	0.007	0.0265	0.0132	26.2	0.856	5.8	0.000005	0.000199	0.00505	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014	148	0.00028	0.00182	0.00079	0.004	0.229	0.00994	0.007	0.0267	0.0142	26.3	1.45	5.8	0.000005	0.000205	0.00556	0.15
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014	138	0.00026	0.00182	0.00111	0.004	0.826	0.018	0.007	0.0247	0.0139	24.9	1.22	5.5	0.000005	0.000198	0.00433	0.15
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015	149	0.00016	0.00195	0.00025	0.004	0.938	0.0134	0.007	0.0265	0.0126	25.2	1.21	5.8	0.000005	0.000191	0.00487	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015	148	0.00019	0.00217	0.00064	0.004	0.963	0.0246	0.007	0.0264	0.0145	25.4	1.17	5.8	0.000005	0.000204	0.00556	0.15
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015	159	0.00014	0.00204	0.00025	0.004	0.636	0.00552	0.007	0.0285	0.0157	26.4	0.999	6.1	0.000005	0.000190	0.00549	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015	163	0.00005	0.00195	0.00025	0.004	0.606	0.00368	0.007	0.0288	0.0159	25.3	0.950	6.2	0.0000025	0.000179	0.00537	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015	44.1	0.00048	0.00137	0.00322C	0.00311	1.2	0.0426	0.00479	0.00811	0.0039	6.67	0.570	2.1	0.0000268C	0.000202	0.00386	0.122
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015	167	0.00005	0.00069	0.00025	0.004	0.316	0.00502	0.007	0.0296	0.0168	25.9	0.614	6.3	0.0000025	0.000422	0.00416	0.15
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015	150	0.00012	0.00048	0.00071	0.004	0.297	0.0142	0.007	0.0268	0.0161	25.6	0.413	5.8	0.0000025	0.000310	0.00335	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015	149	0.00005	0.00057	0.00110	0.004	0.302	0.00852	0.007	0.0263	0.0141	24.5	0.492	5.8	0.0000025	0.000267	0.00370	0.15
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015	136	0.00011	0.00096	0.00074	0.004	0.504	0.00641	0.007	0.0237	0.0120	22.2	0.602	5.3	0.0000025	0.000223	0.00422	0.15
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015	156	0.00011	0.00201	0.00025	0.004	0.38	0.00298	0.007	0.0276	0.0152	25.7	0.869	6.0	0.0000025	0.000234	0.00527	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015	143	0.00028	0.00176	0.00148	0.004	0.342	0.011	0.007	0.0260	0.0119	26.7	0.866	5.7	0.0000025	0.000196	0.00447	0.15
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015	141	0.00010	0.00184	0.00025	0.004	0.5	0.00285	0.007	0.0256	0.0121	26.4	0.981	5.6	0.0000025	0.000179	0.00417	0.15
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016	161	0.00011	0.00227	0.00050	0.004	0.629	0.00263	0.007	0.0291	0.0146	28.1	1.06	6.2	0.0000025	0.000277	0.00514	0.15
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016	143	0.00005	0.00227	0.00025	0.004	0.557	0.00129	0.007	0.0255	0.0166	24.9	1.02	5.6	0.0000025	0.000193	0.00523	0.15
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016	163	0.00014	0.00231	0.00025	0.004	0.693	0.00411	0.007	0.0288	0.0151	25.7	0.974	6.2	0.0000025	0.000192	0.00561	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016	174	0.00005	0.00231	0.00025	0.004	0.817	0.00263	0.007	0.0309	0.0173	26.9	1.01	6.5	0.0000025	0.000205	0.00553	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016	112	0.00013	0.00245	0.00090	0.004	1.02	0.00871	0.007	0.0189	0.0102	16.5	1.14	4.4	0.0000025	0.000276	0.00552	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016	164	0.00005	0.00089	0.00025	0.004	0.326	0.00489	0.007	0.0293	0.0167	26.9	0.539	6.3	0.0000025	0.000307	0.00403	0.15
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016	158	0.00015	0.00059	0.00076	0.004	0.325	0.0108	0.007	0.0282	0.0154	26.5	0.526	6.1	0.0000025	0.000310	0.00353	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016	142	0.00012	0.00078	0.00099	0.004	0.323	0.0171	0.007	0.0249	0.0134	23.2	0.618	5.5	0.0000025	0.000248	0.00447	0.15
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016	155	0.00005	0.00132	0.00080	0.004	0.476	0.00234	0.007	0.0272	0.0160	24.3	0.909	5.9	0.0000025	0.000260	0.00530	0.15
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016	164	0.00005	0.00312	0.00025	0.004	0.505	0.00471	0.007	0.0299	0.0197	29.2	1.35	6.4	0.0000025	0.000239	0.00733	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-6	Christal Creek u/s Silver Trail Highway	03-Jan-2014	0.025	0.41	0.00116C	4.03	0.000190	1.61	0.239	111	0.000005	0.00005	0.005	0.00409	0.0005	0.124	0.289	0.00040	0.0013	0.00018	0.00401
KV-6	Christal Creek u/s Silver Trail Highway	04-Feb-2014	0.025	0.43	0.00120C	4.07	0.000049	1.59	0.245	116	0.000005	0.00005	0.005	0.00431	0.0005	0.114	0.295	0.00040	0.0005	0.00022	0.00275
KV-6	Christal Creek u/s Silver Trail Highway	24-Feb-2014															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	01-Mar-2014	0.025	0.48	0.00109C	4.15	0.000093	2.17	0.251	112	0.000005	0.00005	0.005	0.00418	0.0005	0.117	0.307	0.00040	0.0012	0.00021	0.00410
KV-6	Christal Creek u/s Silver Trail Highway	04-Apr-2014	0.025	0.56	0.00098	4.08	0.000057	2.10	0.247	113	0.000005	0.00005	0.005	0.00441	0.0005	0.113	0.307	0.00040	0.0012	0.00021	0.00519
KV-6	Christal Creek u/s Silver Trail Highway	10-May-2014	0.025	0.53	0.00036	2.35	0.000654C	0.619	0.0844	33.4	0.000005	0.00005	0.005	0.00104	0.0005	0.177J	0.0518	0.00040	0.0754	0.00026	0.00474
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2014	0.025	0.56	0.00085	2.79	0.000056	1.65	0.246	109	0.000005	0.00010	0.005	0.00415	0.0005	0.0957	0.296	0.00040	0.0030	0.00043	0.00329
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014	0.025	0.19	0.00083	2.57	0.000069	1.37	0.226	112	0.000005	0.00005	0.005	0.00378	0.0005	0.163	0.279	0.00040	0.0064	0.00045	0.00402
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014	0.025	0.23	0.00088	2.83	0.000098	1.50	0.266	117	0.000005	0.00005	0.005	0.00407	0.0005	0.151	0.309	0.00040	0.0037	0.00035	0.00389
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014	0.025	0.38	0.00087	3.37	0.000040	1.50	0.229	107	0.000005	0.00005	0.005	0.00373	0.0005	0.168	0.284	0.00040	0.0041	0.00027	0.00289
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	0.025	0.39	0.00105C	3.85	0.000025	1.65	0.246	110	0.000005	0.00019	0.005	0.00387	0.0005	0.213	0.296	0.00040	0.0040	0.00023	0.00223
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014	0.025	0.47	0.00100	4.20	0.000057	1.75	0.244	110	0.000005	0.00005	0.005	0.00411	0.0005	0.171	0.299	0.00040	0.0024	0.00020	0.00233
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014	0.025	0.36	0.00119C	4.08	0.000180	1.45	0.245	101	0.000005	0.00005	0.005	0.00383	0.0005	0.145	0.274	0.00040	0.0016	0.00019	0.00373
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015	0.025	0.46	0.00109C	4.27	0.000134	1.57	0.241	108	0.000005	0.00005	0.005	0.00350	0.0005	0.138	0.297	0.00040	0.0011	0.00019	0.00524
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015	0.025	0.43	0.00110C	3.98	0.000188	1.53	0.256	113	0.000005	0.00005	0.005	0.00424	0.0005	0.148	0.296	0.00040	0.0022	0.00022	0.00596
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015	0.025	0.45	0.00114C	4.13	0.000065	1.61	0.256	122	0.000005	0.00005	0.005	0.00432	0.0005	0.121	0.320	0.00040	0.0027	0.00020	0.00603
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015	0.025	0.44	0.00107C	4.10	0.000018	1.61	0.265	118	0.000005	0.00005	0.00050	0.00435	0.00025	0.117	0.324	0.00040	0.0021	0.00022	0.00603
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015	0.025	0.72	0.000336	1.94	0.000487C	0.548	0.0787	32.1	0.000005	0.00005	0.0045	0.000723	0.00063	0.169J	0.0435	0.00015	0.0545	0.00037	0.00543
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015	0.025	0.36	0.000809	3.18	0.000035	1.58	0.263	127	0.000005	0.00005	0.00045	0.00448	0.00025	0.141	0.334	0.00015	0.0018	0.00029	0.00319
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015	0.025	0.30	0.000862	3.09	0.000111	1.52	0.265	128	0.000005	0.00005	0.0006	0.00413	0.00025	0.171	0.300	0.00015	0.0023	0.00043	0.00405
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015	0.025	0.37	0.000808	3.51	0.000067	1.50	0.231	116	0.000005	0.00005	0.00045	0.00353	0.00025	0.199	0.295	0.00015	0.0068	0.00032	0.00415
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015	0.025	0.36	0.000807	3.46	0.000039	1.36	0.210	103	0.000005	0.00005	0.00096	0.00306	0.00025	0.212	0.262	0.00015	0.0129	0.00028	0.00387
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015	0.025	0.35	0.00105C	3.89	0.000030	1.65	0.246	114	0.000005	0.00005	0.00040	0.00382	0.00025	0.250	0.310	0.00015	0.0016	0.00021	0.00234
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015	0.025	0.58	0.00144C	3.98	0.000049	1.83	0.232	99.2	0.000005	0.00005	0.0006	0.00454	0.00025	0.182	0.290	0.00015	0.0014	0.00019	0.00245
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015	0.025	0.40	0.00143C	3.91	0.000019	1.68	0.236	112	0.000005	0.00005	0.00048	0.00412	0.00025	0.167	0.286	0.00015	0.0005	0.00017	0.00410
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016	0.025	0.53	0.00147C	4.33	0.000022	1.83	0.261	116	0.000005	0.00005	0.00039	0.00473	0.00025	0.168	0.328	0.00015	0.0005	0.00018	0.00530
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016	0.025	0.58	0.00112C	3.94	0.000005	1.65	0.237	112	0.000005	0.00005	0.00015	0.00410	0.00025	0.139	0.285	0.00015	0.0005	0.00013	0.00491
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016	0.025	0.42	0.00114C	4.11	0.000043	1.61	0.264	118	0.000005	0.00005	0.00043	0.00432	0.00025	0.141	0.325	0.00015	0.0005	0.00013	0.00570
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016	0.025	0.51	0.00109C	4.19	0.000021	1.75	0.260	118	0.000005	0.00005	0.00051	0.00426	0.00025	0.131	0.349	0.00015	0.0012	0.00016	0.00620
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016	0.025	0.51	0.000588	2.97	0.000067	1.04	0.179	79.6	0.000005	0.00005	0.00088	0.00246	0.00025	0.232J	0.201	0.00015	0.0047	0.00028	0.00434
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016	0.025	0.30	0.000977	2.90	0.000047	1.62	0.260	123	0.000005	0.00005	0.00044	0.00393	0.00025	0.134	0.331	0.00015	0.0018	0.00027	0.00314
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016	0.025	0.21	0.000923	3.14	0.000083	1.53	0.266	125	0.000005	0.00005	0.00079	0.00379	0.00025	0.176	0.317	0.00015	0.0037	0.00037	0.00413
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016	0.025	0.28	0.000825	3.24	0.000145	1.29	0.229	106	0.000005	0.00005	0.00080	0.00291	0.00025	0.330J	0.278	0.00015	0.0091	0.00027	0.00293
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016	0.025	0.40	0.000897	3.59	0.000018	1.59	0.257	126	0.000005	0.00005	0.00057	0.00395	0.00025	0.229	0.305	0.00015	0.0029	0.00019	0.00267
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016	0.025	0.41	0.000915	4.11	0.000005	1.73	0.275	135	0.000005	0.00005	0.00015	0.00445	0.00025	0.185	0.338	0.00015	0.0011	0.00014	0.00317

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-6	Christal Creek u/s Silver Trail Highway	03-Jan-2014	0.0633	0.00005	0.00025	0.005	0.000154	0.000457	149	0.00005	0.00144	0.00031	0.349	0.000377	0.0118	24.6	1.3	0.000005	0.000183	0.00375
KV-6	Christal Creek u/s Silver Trail Highway	04-Feb-2014	0.0562	0.00005	0.00025	0.005	0.000183	0.000457	153	0.00005	0.00127	0.00010	0.096	0.000326	0.0126	25.8	0.9	0.000005	0.000174	0.00384
KV-6	Christal Creek u/s Silver Trail Highway	24-Feb-2014						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	01-Mar-2014	0.0557	0.00005	0.00025	0.005	0.000075	0.000457	155	0.00005	0.00130	0.00010	0.143	0.000164	0.0126	24.4	1.02	0.000005	0.000179	0.00348
KV-6	Christal Creek u/s Silver Trail Highway	04-Apr-2014	0.0535	0.00005	0.00025	0.005	0.000131	0.000457	159	0.00005	0.00123	0.00010	0.187	0.000375	0.0138	25.4	0.842	0.000005	0.000183	0.00381
KV-6	Christal Creek u/s Silver Trail Highway	10-May-2014	0.0318	0.00005	0.00025	0.005	0.000322J	0.000284	49.8	0.00005	0.00121	0.00135	0.439	0.00306	0.00423	7.38	0.482	0.000005	0.000166	0.00320
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2014	0.0492	0.00005	0.00025	0.005	0.000578J	0.000457	153	0.00005	0.00029	0.00038	0.071	0.00149	0.0125	24.6	0.280	0.000005	0.000245	0.00254
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014	0.0381	0.00005	0.00025	0.005	0.000773J	0.000457	142	0.00005	0.00033	0.00054	0.058	0.00151	0.0112	24.7	0.379	0.000005	0.000242	0.00269
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014	0.0452	0.00005	0.00025	0.005	0.000726J	0.000457	154	0.00005	0.00027	0.00036	0.070	0.00621	0.0132	28.1	0.292	0.000005	0.000203	0.00260
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014	0.0411	0.00005	0.00025	0.005	0.000932J	0.000457	146	0.00005	0.00039	0.00034	0.043	0.000808	0.0108	25.3	0.398	0.000005	0.000188	0.00297
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	0.0489	0.00005	0.00025	0.005	0.00101J	0.000457	145	0.00005	0.00138	0.00035	0.063	0.000569	0.0122	25.2	0.769	0.000005	0.000163	0.00464
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014	0.0576	0.00005	0.00025	0.005	0.000720J	0.000457	149	0.00005	0.00169	0.00023	0.048	0.000445	0.0131	25.6	1.39	0.000005	0.000191	0.00524
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014	0.0607	0.00005	0.00025	0.005	0.000234	0.000457	137	0.00005	0.00162	0.00010	0.345	0.000485	0.0131	24.8	1.12	0.000005	0.000177	0.00386
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015	0.0571	0.00005	0.00025	0.005	0.000090	0.000457	150	0.00005	0.00185	0.00010	0.418	0.000307	0.0121	25.4	1.15	0.000005	0.000169	0.00449
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015	0.0591	0.00005	0.00025	0.005	0.000102	0.000457	149	0.00005	0.00207	0.00029	0.309	0.000775	0.0143	25.2	1.11	0.000005	0.000186	0.00524
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015	0.0552	0.00005	0.00025	0.005	0.000120	0.000457	157	0.00005	0.00192	0.00010	0.177	0.000691	0.0151	25.9	0.952	0.000005	0.000211	0.00518
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015	0.0525	0.00005	0.000025	0.005	0.0000979	0.000457	166	0.00005	0.00186	0.00010	0.245	0.000260	0.0149	25.2	0.912	0.0000025	0.000161	0.00519
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015	0.0317	0.00005	0.000025	0.005	0.000678J	0.000268	47.1	0.00014	0.00112	0.00170	0.446	0.00490	0.0037	6.97	0.477	0.0000138	0.000175	0.00322
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015	0.0534	0.00005	0.000025	0.005	0.000512J	0.000457	169	0.00005	0.00062	0.00023	0.063	0.000503	0.0172	25.8	0.58	0.0000025	0.000378	0.00385
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015	0.0446	0.00005	0.000025	0.005	0.000686J	0.000457	155	0.00005	0.00034	0.00030	0.054	0.00123	0.0157	26.0	0.356	0.0000025	0.000295	0.00295
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015	0.0400	0.00005	0.000025	0.005	0.00107J	0.000457	153	0.00005	0.00053	0.00051	0.066	0.000909	0.0134	24.8	0.447	0.0000025	0.000233	0.00343
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015	0.0386	0.00005	0.000025	0.005	0.00106J	0.000457	134	0.00005	0.00087	0.00052	0.089	0.000421	0.0121	21.6	0.561	0.0000025	0.000191	0.00388
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015	0.0494	0.00005	0.000025	0.005	0.00112J	0.000457	157	0.00005	0.00191	0.00010	0.066	0.000108	0.0144	25.8	0.842	0.0000025	0.000174	0.00519
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015	0.0604	0.00005	0.000025	0.005	0.00117J	0.000457	145	0.00005	0.00164	0.00037	0.089	0.000501	0.0113	26.3	0.822	0.0000025	0.000167	0.00419
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015	0.0666	0.00005	0.000025	0.005	0.000691J	0.000457	142	0.00005	0.00170	0.00010	0.217	0.000175	0.0123	26.0	0.93	0.0000025	0.000176	0.00387
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016	0.0669	0.00005	0.000025	0.005	0.000333	0.000457	159	0.00005	0.00210	0.00010	0.233	0.000071	0.0141	26.1	1.01	0.0000025	0.000179	0.00477
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016	0.0531	0.00005	0.000025	0.005	0.000456	0.000457	145	0.00005	0.00216	0.00010	0.208	0.000025	0.0157	24.3	0.987	0.0000025	0.000176	0.00495
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016	0.0513	0.00005	0.000025	0.005	0.000357	0.000457	159	0.00005	0.00212	0.00010	0.285	0.000091	0.0156	24.5	0.913	0.0000025	0.000181	0.00511
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016	0.0521	0.00005	0.000025	0.005	0.000261	0.000457	175	0.00005	0.00236	0.00027	0.354	0.000244	0.0178	26.6	1.03	0.0000025	0.000189	0.00541
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016	0.0519	0.00005	0.000025	0.005	0.000974J	0.000457	119	0.00005	0.00241	0.00056	0.282	0.000820	0.0107	17.3	1.14	0.0000025	0.000262	0.00525
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016	0.0473	0.00005	0.000025	0.005	0.000652J	0.000457	166	0.00005	0.00078	0.00028	0.052	0.000333	0.0164	26.7	0.485	0.0000025	0.000280	0.00361
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016	0.0453	0.00005	0.000025	0.005	0.000837J	0.000457	159	0.00005	0.00048	0.00041	0.062	0.00112	0.0149	26.7	0.472	0.0000025	0.000273	0.00323
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016	0.0342	0.00005	0.000025	0.005	0.00198J	0.000457	144	0.00005	0.00069	0.00059	0.061	0.000673	0.0131	23.3	0.558	0.0000025	0.000232	0.00410
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016	0.0435	0.00005	0.000025	0.005	0.00109J	0.000457	152	0.00005	0.00125	0.00026	0.051	0.000145	0.0159	25.4	0.879	0.0000025	0.000229	0.00490
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016	0.0503	0.00005	0.000025	0.005	0.000705J	0.000457	178	0.00005	0.00295	0.00010	0.182	0.000097	0.0178	30.5	1.21	0.0000025	0.000206	0.00695

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-6	Christal Creek u/s Silver Trail Highway	03-Jan-2014	0.025	0.42	0.00121	3.98	0.000005	1.57	0.232	111	0.000005	0.00028	0.005	0.00405	0.0005	0.0928	0.071	0.00040	9.66	9.59	1	
KV-6	Christal Creek u/s Silver Trail Highway	04-Feb-2014	0.025	0.43	0.00131	4.10	0.000005	1.57	0.250	119	0.000005	0.00005	0.005	0.00429	0.0005	0.0982	0.097	0.00040	9.82	9.88	1	
KV-6	Christal Creek u/s Silver Trail Highway	24-Feb-2014															0.004					
KV-6	Christal Creek u/s Silver Trail Highway	01-Mar-2014	0.025	0.45	0.00117	4.03	0.000005	1.85	0.248	108	0.000005	0.00005	0.005	0.00409	0.0005	0.0825	0.072	0.00040	10.0	9.87	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	04-Apr-2014	0.025	0.43	0.00098	4.10	0.000005	1.75	0.258	115	0.000005	0.00005	0.005	0.00451	0.0005	0.0714	0.086	0.00040	9.56	10.2	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	10-May-2014	0.025	0.53	0.00029	1.97	0.000016	0.609	0.0827	34.2	0.000005	0.00016	0.005	0.000961	0.0005	0.0731	0.081	0.00040	2.98	3.19	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2014	0.025	0.42	0.00084	2.78	0.000005	1.54	0.240	108	0.000005	0.00005	0.005	0.00428	0.0005	0.0856	0.087	0.00040	9.42	9.73	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	03-Jul-2014	0.025	0.18	0.00083	2.55	0.000005	1.37	0.220	111	0.000005	0.00005	0.005	0.00371	0.0005	0.152	0.069	0.00040	8.82	9.22	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2014	0.025	0.24	0.00087	2.79	0.000005	1.53	0.262	117	0.000005	0.00005	0.005	0.00408	0.0005	0.133	0.076	0.00040	9.47	10.1	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	19-Sep-2014	0.025	0.37	0.00094	3.38	0.000005	1.45	0.222	109	0.000005	0.00005	0.005	0.00359	0.0005	0.155	0.076	0.00040	9.26	9.48	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	19-Oct-2014	0.025	0.37	0.00103	3.74	0.000005	1.57	0.235	106	0.000005	0.00005	0.005	0.00373	0.0005	0.204	0.089	0.00040	9.31	9.42	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	15-Nov-2014	0.025	0.42	0.00108	4.08	0.000005	1.62	0.238	109	0.000005	0.00005	0.005	0.00397	0.0005	0.166	0.066	0.00040	9.55	9.68	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	16-Dec-2014	0.025	0.38	0.00120	3.93	0.000005	1.46	0.237	99.3	0.000005	0.00005	0.005	0.00371	0.0005	0.111	0.149	0.00040	9.07	9.02	1	
KV-6	Christal Creek u/s Silver Trail Highway	14-Jan-2015	0.025	0.42	0.00118	4.21	0.000005	1.57	0.237	106	0.000005	0.00005	0.005	0.00336	0.0005	0.11	0.088	0.00040	9.51	9.72	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	12-Feb-2015	0.025	0.42	0.00114	3.94	0.000005	1.61	0.255	110	0.000005	0.00019	0.005	0.00420	0.0005	0.111	0.122	0.00040	9.79	9.65	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	09-Mar-2015	0.025	0.45	0.00112	3.97	0.000005	1.69	0.246	116	0.000005	0.00005	0.005	0.00412	0.0005	0.0924	0.064	0.00040	9.69	10.1	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2015	0.025	0.48	0.00127	4.01	0.000005	1.67	0.256	113	0.000005	0.00005	0.00015	0.00417	0.00025	0.0891	0.042	0.00040	10.2	10.5	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	12-May-2015	0.025	0.71	0.000320	1.69	0.000019	0.541	0.0794	32.0	0.000005	0.00005	0.00052	0.000680	0.00025	0.123	0.154	0.00015	2.70	3.02	1.06	
KV-6	Christal Creek u/s Silver Trail Highway	03-Jun-2015	0.025	0.33	0.000863	3.14	0.000005	1.53	0.263	117	0.000005	0.00005	0.00015	0.00448	0.00025	0.132	0.090	0.00015	10.2	10.6	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	29-Jul-2015	0.025	0.29	0.000776	3.02	0.000005	1.44	0.260	125	0.000005	0.00005	0.00015	0.00399	0.00025	0.144	0.081	0.00015	9.91	9.95	1	
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2015	0.025	0.35	0.000815	3.46	0.000005	1.48	0.229	113	0.000005	0.00005	0.00015	0.00343	0.00025	0.189	0.086	0.00015	9.34	9.77	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	01-Sep-2015	0.025	0.35	0.000806	3.33	0.000005	1.37	0.206	102	0.000005	0.00005	0.00015	0.00286	0.00025	0.202	0.115	0.00015	8.31	8.54	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	18-Sep-2015															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	16-Oct-2015	0.025	0.37	0.00114	3.85	0.000005	1.61	0.245	110	0.000005	0.00005	0.00015	0.00355	0.00025	0.243	0.075	0.00015	9.55	10.1	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2015	0.025	0.41	0.00154	3.96	0.000005	1.65	0.229	99.2	0.000005	0.00005	0.00015	0.00439	0.00025	0.17	0.082	0.00015	9.30	9.55	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	17-Dec-2015	0.025	0.39	0.00142	3.89	0.000005	1.60	0.228	110	0.000005	0.00005	0.00015	0.00397	0.00025	0.156	0.057	0.00015	9.30	9.37	1	
KV-6	Christal Creek u/s Silver Trail Highway	18-Dec-2015															0.004					
KV-6	Christal Creek u/s Silver Trail Highway	06-Jan-2016	0.025	0.44	0.00144	4.18	0.000005	1.74	0.257	112	0.000005	0.00005	0.00015	0.00451	0.00025	0.156	0.042	0.00015	9.51	10.2	1.04	
KV-6	Christal Creek u/s Silver Trail Highway	02-Feb-2016	0.025	0.42	0.00114	3.88	0.000005	1.59	0.227	110	0.000005	0.00005	0.00015	0.00391	0.00025	0.132	0.066	0.00015	9.82	9.36	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	05-Mar-2016	0.025	0.39	0.00108	3.85	0.000005	1.51	0.244	110	0.000005	0.00005	0.00015	0.00408	0.00025	0.126	0.060	0.00015	9.99	10.1	1	
KV-6	Christal Creek u/s Silver Trail Highway	06-Apr-2016	0.025	0.53	0.00107	4.01	0.000005	1.78	0.258	113	0.000005	0.00005	0.00015	0.00417	0.00025	0.128	0.057	0.00015	10.6	11.1	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	03-May-2016	0.025	0.50	0.000619	3.03	0.000005	1.06	0.183	81.9	0.000005	0.00005	0.00015	0.00251	0.00025	0.222	0.101	0.00015	7.02	7.51	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	15-Jun-2016	0.025	0.24	0.00110	2.88	0.000005	1.53	0.255	123	0.000005	0.00005	0.00015	0.00378	0.00025	0.122	0.087	0.00015	9.87	10.6	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	14-Jul-2016	0.025	0.18	0.000893	3.10	0.000005	1.51	0.255	124	0.000005	0.00005	0.00015	0.00356	0.00025	0.157	0.089	0.00015	9.81	10.2	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	07-Aug-2016	0.025	0.27	0.000822	3.21	0.000005	1.26	0.228	102	0.000005	0.00005	0.00015	0.00286	0.00025	0.319	0.097	0.00015	8.44	9.19	1.04	
KV-6	Christal Creek u/s Silver Trail Highway	23-Sep-2016	0.025	0.40	0.000829	3.67	0.000005	1.55	0.251	125	0.000005	0.00005	0.00015	0.00374	0.00025	0.218	0.075	0.00015	9.49	9.81	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	22-Oct-2016	0.025	0.46	0.00102	4.13	0.000005	1.63	0.266	130	0.000005	0.00005	0.00015	0.00427	0.00025	0.175	0.064	0.00015	10.9	11.5	1.03	

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
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
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
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	4.62C	37.7	143.2	456	575	137
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
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
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
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
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
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
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
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
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.			5.1	7.78	7.94	820.6	852	0.0	11.10	85	36.2	515	493	140
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
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
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	366.1		14.8	7.1	7.60	329	344	0.0	10.46	79.3	121.5	161	179	42.4
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
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
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
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
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
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
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
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
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
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
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	41.8	484	491	136
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2019		158.7	0.354	12.3	7.43	7.87	538.3	580	8.7	10.37	89.3	109.1	292	320	65.4
KV-6	Christal Creek u/s Silver Trail Highway	06-Jun-2019	Surveyed and dewinterized logger. Downloaded logger and baro. Staff gauge below 0.3 m starting to wear, hard to read	66.7	0.249	18.1	7.80	7.99	772.0	838	11.2	8.08	73.0	184.0	444	436	113

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	0.125	1.25	0.17C	380	429	0.0664	10.2	0.0025	0.235	0.121	0.99	0.0286	0.1	0.00025	0.00691	0.0564	0.00005	0.000025	0.005	0.000838	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	0.125	1.25	0.13C	386	429	0.125	4.17	0.0025	0.263	0.236	1.32	0.0145	0.1	0.00024	0.00444	0.0677	0.00005	0.000025	0.005	0.000474	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	0.125	1.25	0.15C	406	429	0.0674	14.6	0.0025	0.301	0.115	0.88	0.0253	0.1	0.00029	0.0114	0.0585	0.00005	0.000025	0.005	0.000684	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017	0.125	1.25	0.15C	388	429	0.0731	2.89	0.0025	0.289	0.117	1.13	0.0052	0.1	0.00020	0.0091	0.0513	0.00005	0.000025	0.005	0.000579	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	0.125	1.25	0.15C	412	429	0.0748	6.91	0.0025	0.286	0.132	0.91	0.0480	0.1	0.00047	0.0177	0.0622	0.00005	0.000025	0.005	0.000853	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017	0.125	1.25	0.17C	424	429	0.0740	10.7	0.0025	0.260	0.129	0.89	0.0173	0.1	0.00022	0.0137	0.0542	0.00005	0.000025	0.005	0.000617	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	0.025	0.25	0.097	153	429	0.115	11.6	0.0005	0.0673	0.622	15.9	0.275C	0.1	0.00223	0.0193	0.0432	0.00005	0.000025	0.005	0.00134	0.000289
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017		1.00	0.142C	336	429	0.0151	3.49	0.0005	0.145	0.237	5.70	0.0309	0.1	0.00040	0.00723	0.0508	0.00005	0.000025	0.005	0.00072	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017	0.125	1.25	0.14C	409	429	0.0116	3.39	0.0025	0.118	0.171	2.51	0.0235	0.1	0.00045	0.00688	0.0446	0.00005	0.000025	0.005	0.00109	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	0.125	1.25	0.14C	404	429	0.0025	0.782	0.0025	0.118	0.068	2.26	0.0111	0.1	0.00038	0.00472	0.0499	0.00005	0.000025	0.005	0.000908	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	0.125	1.25	0.14C	396	429	0.0025	1.47	0.0025	0.128	0.094	2.77	0.0169	0.1	0.00031	0.00489	0.0424	0.00005	0.000025	0.005	0.00162	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	0.025	1.22	0.165C	395	429	0.0274	3.21	0.0005	0.223	0.108	1.37	0.0082	0.1	0.00022	0.00353	0.0482	0.00005	0.000025	0.005	0.00126	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	0.125	1.25	0.15C	371	429	0.0737	3.17	0.0025	0.237	0.131	0.85	0.0404	0.1	0.00034	0.0118	0.0641	0.00005	0.000025	0.005	0.00101	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	0.125	1.25	0.15C	382	429	0.0788	2.35	0.0025	0.254	0.127	0.96	0.0151	0.1	0.00027	0.0129	0.0678	0.00005	0.000025	0.005	0.000974	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	0.125		0.15C	382	429	0.0732	5.83	0.0025	0.253	0.287	1.29	0.129C	0.1	0.00145	0.0207	0.0630	0.00005	0.000025	0.005	0.00157	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	0.025	0.67	0.075	121	309	0.0318	15.1	0.0011	0.0398	0.703	20.1	0.187C	0.1	0.00127	0.0148	0.0322	0.00005	0.000025	0.005	0.00603	0.000235
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	0.025	0.87	0.133C	287	429	0.0268	2.16	0.0005	0.100	0.260	6.23	0.0423	0.1	0.00040	0.00869	0.0482	0.00005	0.000025	0.005	0.000994	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018	0.025	1.05	0.175C	376	429	0.0122	0.869	0.0005	0.0923	0.138	2.76	0.0118	0.1	0.00033	0.00593	0.0486	0.00005	0.000025	0.005	0.00138	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018	0.025	1.06	0.155C	344	429	0.0083	1.70	0.0005	0.0847	0.200	5.07	0.0319	0.1	0.00035	0.00555	0.0383	0.00005	0.000025	0.005	0.00143	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018	0.025	1.15	0.144C	326	429	0.0025	2.82	0.0005	0.116	0.132	2.90	0.0473	0.1	0.00150	0.0105	0.0445	0.00005	0.000025	0.005	0.00185	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018	0.125	1.25	0.13C	340	429	0.0122	5.20	0.0025	0.304	0.132	1.09	0.0156	0.1	0.00026	0.00401	0.0541	0.00005	0.000025	0.005	0.0011	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	0.025	1.33	0.146C	334	429	0.0639	3.17	0.0005	0.266	0.150	0.98	0.0556	0.1	0.00032	0.00791	0.0582	0.00005	0.000025	0.005	0.00126	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	0.125	1.25	0.14C	346	429	0.0710	11.5	0.0025	0.253	0.168	1.12	0.0219	0.1	0.00021	0.00902	0.0573	0.00005	0.000025	0.005	0.000966	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	0.125	1.25	0.16C	369	429	0.0721	13.8	0.0025	0.282	0.132	1.18	0.0205	0.1	0.00023	0.0117	0.0570	0.00005	0.000025	0.005	0.000894	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	0.125	6.5	0.15C	344	429	0.0853	7.07	0.0025	0.284	0.191	0.81	0.0336	0.1	0.00026	0.0164	0.0557	0.00005	0.000025	0.005	0.000774	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019	0.125	1.25	0.17C	340	429	0.0690	6.45	0.0025	0.269	0.198	0.77	0.311C	0.1	0.00154	0.0447	0.0661	0.00005	0.000025	0.005	0.00265	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2019	0.125	1.25	0.17C	354	429	0.0447	2.09	0.0025	0.223	0.116	1.29	0.0243	0.1	0.00037	0.0107	0.0540	0.00005	0.000025	0.005	0.000794	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2019	0.055	0.51	0.106	218	429	0.0129	3.48	0.0005	0.0768	0.370	9.03	0.102C	0.1	0.00062	0.0094	0.0420	0.00005	0.000025	0.005	0.00103	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	06-Jun-2019	0.025	0.80	0.140C	338	429	0.0217	1.23	0.0005	0.116	0.379	4.08	0.221C	0.1	0.00051	0.00936	0.0510	0.00005	0.000025	0.005	0.000745	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	162	0.00005	0.00344	0.00025	0.004	0.629	0.00486	0.007	0.0289	0.0186	26.4	1.66	6.2	0.0000025	0.000212	0.00721	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	170	0.00012	0.00318	0.00059	0.004	0.317	0.00354	0.007	0.0310	0.0179	29.8	1.85	6.6	0.0000025	0.000256	0.00652	0.15
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	172	0.00005	0.00278	0.00025	0.004	0.959	0.00571	0.007	0.0306	0.0164	26.8	1.18	6.5	0.0000025	0.00015	0.00604	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017	144	0.00005	0.00245	0.00061	0.004	0.72	0.00439	0.007	0.0253	0.0153	23.2	0.968	5.6	0.0000025	0.000188	0.00539	0.15
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	175	0.00017	0.00343	0.00052	0.004	1.58	0.0152	0.007	0.0315	0.0181	28.6	1.38	6.7	0.0000025	0.000228	0.00712	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017	187	0.00005	0.00361	0.00025	0.004	1.27	0.00420	0.007	0.0339	0.0183	30.2	1.43	7.1	0.0000025	0.000242	0.00770	0.15
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	65.8	0.00030	0.00246	0.00324	0.004	2.08	0.0785	0.007	0.0113	0.0069	10.1	1.02	2.8	0.0000093	0.000313	0.00653	0.15
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017	147	0.00020	0.00141	0.00064	0.004	0.604	0.00541	0.007	0.0255	0.0131	22.7	0.916	5.6	0.0000025	0.000305	0.00541	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017	159	0.00005	0.00079	0.00078	0.004	0.348	0.0115	0.007	0.0286	0.0141	27.6	0.735	6.2	0.0000025	0.000290	0.00393	0.15
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	168	0.00011	0.00046	0.00025	0.004	0.225	0.00296	0.007	0.0307	0.0176	29.4	0.431	6.5	0.0000025	0.000194	0.00318	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	157	0.00005	0.00074	0.00052	0.004	0.342	0.00566	0.007	0.0283	0.0163	27.2	0.620	6.1	0.0000025	0.000180	0.00408	0.15
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	141	0.00005	0.00222	0.00025	0.004	0.333	0.00254	0.007	0.0258	0.0146	27.3	1.12	5.7	0.0000025	0.000154	0.00592	0.15
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	160	0.00012	0.00240	0.00056	0.004	0.884	0.00985	0.007	0.0290	0.0143	27.9	1.42	6.2	0.0000025	0.000260	0.00515	0.15
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	178	0.00010	0.00260	0.00025	0.004	0.982	0.00692	0.007	0.0320	0.0153	28.9	1.48	6.7	0.0000025	0.000226	0.00549	0.15
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	169	0.00175C	0.00253	0.00237	0.004	1.6	0.0405	0.007	0.0297	0.0176	25.9	1.26	6.3	0.0000025	0.000267	0.00667	0.15
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	52.0	0.00045	0.00165	0.00320	0.00355	1.2	0.0732	0.00583	0.00915	0.0039	7.50	0.885	2.3	0.0000087	0.000226	0.00529	0.137
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	119	0.00018	0.00145	0.00087	0.004	0.815	0.00673	0.007	0.0205	0.0109	19.1	1.01	4.7	0.0000025	0.000243	0.00484	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018	156	0.00005	0.00082	0.00025	0.004	0.357	0.00422	0.007	0.0280	0.0159	27.1	1.02	6.0	0.0000025	0.000277	0.00461	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018	131	0.00016	0.00087	0.00085	0.004	0.38	0.00638	0.007	0.0234	0.0117	23.7	0.632	5.2	0.0000025	0.000188	0.00365	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018	141	0.00014	0.00105	0.00099	0.004	0.817	0.0375	0.007	0.0255	0.0121	26.4	0.944	5.6	0.0000025	0.000211	0.00428	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018	144	0.00012	0.00150	0.00083	0.004	0.337	0.00560	0.007	0.0261	0.0147	26.6	0.682	5.7	0.0000025	0.000201	0.00494	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	140	0.00014	0.00201	0.00056	0.004	1	0.0106	0.007	0.0252	0.0124	25.3	1.53	5.5	0.0000025	0.000243	0.00449	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	139	0.00012	0.00181	0.00025	0.004	1.07	0.00419	0.007	0.0247	0.0123	24.2	1.23	5.5	0.0000025	0.000212	0.00446	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	145	0.00005	0.00191	0.00025	0.004	0.96	0.00743	0.007	0.0261	0.0138	26.3	1.02	5.7	0.0000025	0.000223	0.00444	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	149	0.00012	0.00174	0.00086	0.004	1.19	0.00857	0.007	0.0266	0.0135	25.4	1.14	5.8	0.0000025	0.000240	0.00429	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019	145	0.00076	0.00220	0.00282	0.004	3.46	0.0637	0.007	0.0253	0.0133	23.0	1.38	5.6	0.0000054	0.000252	0.00556	0.15
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2019	152	0.00054	0.00174	0.00025	0.004	0.639	0.00617	0.007	0.0270	0.0123	25.5	1.07	5.9	0.0000025	0.000249	0.00455	0.15
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2019	94.2	0.00022	0.00119	0.00154	0.004	0.837	0.024	0.007	0.0158	0.0081	13.7	0.700	3.8	0.0000025	0.000182	0.00376	0.15
KV-6	Christal Creek u/s Silver Trail Highway	06-Jun-2019	138	0.00045	0.00131	0.00171	0.004	0.901	0.0106	0.007	0.0245	0.0137	24.0	0.953	5.4	0.0000025	0.000283	0.00443	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	0.025	0.46	0.000965	4.15	0.000037	1.74	0.265	123	0.000005	0.00005	0.00081	0.00463	0.00025	0.169	0.326	0.00015	0.0005	0.00015	0.00379
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	0.025	0.49	0.00106C	4.44	0.000014	1.78	0.276	128	0.000005	0.00005	0.00050	0.00443	0.00025	0.134	0.350	0.00015	0.0010	0.00014	0.00277
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	0.025	0.42	0.00101C	4.05	0.000043	1.66	0.276	131	0.000005	0.00005	0.00072	0.00489	0.00025	0.125	0.345	0.00015	0.0018	0.00018	0.00732
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017	0.025	0.37	0.000926	3.52	0.000005	1.45	0.236	118	0.000005	0.00005	0.00015	0.00469	0.00025	0.106	0.282	0.00015	0.0005	0.00018	0.00734
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	0.025	0.47	0.00116C	4.40	0.000147	2.26	0.279	145	0.000005	0.00005	0.00165	0.00515	0.00025	0.151	0.356	0.00015	0.0015	0.00014	0.00815
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017	0.025	0.46	0.00102C	4.12	0.000018	1.75	0.301	150	0.000005	0.00005	0.00052	0.00529	0.00025	0.149	0.384	0.00015	0.0005	0.00016	0.00919
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	0.025	0.61	0.000401	2.58	0.00136C	0.747	0.119	53.9	0.000005	0.00005	0.0030	0.00161	0.00080	0.148J	0.0945	0.00015	0.0781	0.00026	0.00672
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017	0.025	0.46	0.000797	3.27	0.000027	1.36	0.237	120	0.000005	0.00005	0.00086	0.00410	0.00025	0.114	0.285	0.00015	0.0028	0.00031	0.00286
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017	0.025	0.21	0.000779	2.95	0.000033	1.59	0.263	134	0.000005	0.00005	0.00056	0.00533	0.00025	0.165	0.322	0.00015	0.0034	0.00036	0.00379
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	0.025	0.25	0.000925	2.86	0.000022	1.60	0.292	150	0.000005	0.00005	0.00015	0.00551	0.00025	0.143	0.346	0.00015	0.0017	0.00022	0.00310
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	0.025	0.41	0.000750	3.08	0.000093	1.57	0.270	140	0.000005	0.00005	0.00045	0.00452	0.00025	0.352J	0.319	0.00015	0.0033	0.00021	0.00287
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	0.025	0.40	0.000916	4.02	0.000014	1.69	0.265	145	0.000005	0.00005	0.00015	0.00454	0.00025	0.286	0.289	0.00015	0.0011	0.00016	0.00211
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	0.025	0.42	0.00116C	4.51	0.000107	2.09	0.291	140	0.000011	0.00005	0.00045	0.00550	0.00025	0.172	0.326	0.00015	0.0005	0.00016	0.00561
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	0.025	0.47	0.00117C	4.65	0.000034	1.81	0.292	138	0.000005	0.00005	0.00015	0.00550	0.00025	0.144	0.362	0.00015	0.0005	0.00015	0.00717
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	0.025	0.50	0.000959	4.35	0.000374C		0.268	138	0.000005	0.00005	0.00339	0.00549	0.00025	0.170	0.335	0.00015	0.0005	0.00028	0.00294
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	0.052	0.72	0.000370	2.00	0.000520C	0.670	0.0948	44.1	0.000005	0.00005	0.00474	0.00101	0.00069	0.604J	0.0608	0.00015	0.0598	0.00031	0.00455
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	0.025	0.44	0.000723	3.12	0.000042	1.16	0.212	95.8	0.000005	0.00005	0.00090	0.00323	0.0005	0.253J	0.222	0.00015	0.0084	0.00031	0.00481
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018	0.025	0.27	0.000801	3.05	0.000015	1.66	0.276	146	0.000005	0.00005	0.00030	0.00483	0.00025	0.505J	0.315	0.00015	0.0020	0.00028	0.00293
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018	0.025	0.20	0.000660	2.83	0.000066	1.46	0.227	104	0.000005	0.00005	0.00045	0.00345	0.00025	0.217	0.259	0.00015	0.0086	0.00026	0.00306
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018	0.025	0.29	0.00103C	3.14	0.00158C	1.50	0.235	118	0.000005	0.00005	0.00116	0.00444	0.00025	0.288J	0.285	0.00015	0.0026	0.00019	0.00212
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018	0.025	0.41	0.00108C	3.71	0.000023	1.87	0.262	122	0.000005	0.00005	0.00044	0.00502	0.00025	0.214	0.292	0.00015	0.0005	0.00015	0.00189
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	0.025	0.39	0.00124C	4.25	0.000080	1.73	0.246	121	0.000005	0.00005	0.0012	0.00461	0.00025	0.159	0.280	0.00015	0.0005	0.00014	0.00293
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	0.025	0.40	0.00123C	4.17	0.000025	3.18	0.250	126	0.000005	0.00005	0.00059	0.00439	0.00025	0.149	0.275	0.00015	0.0015	0.00016	0.00539
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	0.025	0.41	0.00107C	3.96	0.000037	1.77	0.244	117	0.000005	0.00005	0.00045	0.00478	0.00025	0.140	0.292	0.00015	0.0005	0.00016	0.00737
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	0.025	0.41	0.000999	4.31	0.000046	2.17	0.253	129	0.000005	0.00005	0.0006	0.00498	0.00025	0.121	0.298	0.00015	0.0034	0.00017	0.00951
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019	0.025	0.46	0.00119C	4.68	0.000493C	2.22	0.272	132	0.000005	0.00005	0.00900	0.00534	0.00093	0.216	0.282	0.00015	0.0005	0.00017	0.00962
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2019	0.025	0.54	0.00104C	3.71	0.000038	1.69	0.281	125	0.000005	0.00005	0.00045	0.00473	0.00025	0.128	0.303	0.00015	0.0013	0.00020	0.00601
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2019	0.025	0.53	0.000549	2.63	0.000239	0.927	0.165	80.1	0.000005	0.00005	0.00228	0.00198	0.00025	0.0937	0.159	0.00015	0.0236	0.00028	0.00351
KV-6	Christal Creek u/s Silver Trail Highway	06-Jun-2019	0.025	0.57	0.000753	3.65	0.000061	1.65	0.245	132	0.000005	0.00005	0.00633	0.00345	0.00084	0.124	0.273	0.00015	0.0045	0.00034	0.00396

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	0.0561	0.00005	0.000025	0.005	0.000346	0.000457	173	0.00017	0.00316	0.00010	0.271	0.000146	0.0179	28.6	1.52	0.0000025	0.000207	0.00677
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	0.0667	0.00005	0.000025	0.005	0.000213	0.000457	174	0.00005	0.00312	0.00010	0.123	0.000163	0.0166	28.3	1.78	0.0000025	0.000225	0.00615
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	0.0609	0.00005	0.000025	0.005	0.000290	0.000457	176	0.00005	0.00266	0.00010	0.574	0.000306	0.0179	27.8	1.1	0.0000025	0.000209	0.00579
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017	0.0616	0.00005	0.000025	0.005	0.000109	0.000457	183	0.00005	0.00291	0.00010	0.512	0.000081	0.0179	28.7	1.16	0.0000025	0.000202	0.00611
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	0.0584	0.00005	0.000025	0.005	0.000128	0.000457	169	0.00005	0.00322	0.00010	0.672	0.000077	0.0207	28.4	1.3	0.0000025	0.000201	0.00633
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017	0.0511	0.00005	0.000025	0.005	0.000163	0.000457	169	0.00005	0.00343	0.00010	0.734	0.000140	0.0190	28.6	1.32	0.0000025	0.000230	0.00719
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	0.0333	0.00005	0.000025	0.005	0.000379J	0.000360	63.3	0.00016	0.00189	0.00122	0.613	0.00171	0.0060	8.62	0.757	0.0000025	0.000238	0.00547
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017	0.0498	0.00005	0.000025	0.005	0.000514J	0.000457	136	0.00005	0.00135	0.00044	0.074	0.000326	0.0132	22.1	0.917	0.0000025	0.000279	0.00520
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017	0.0438	0.00005	0.000025	0.005	0.000750J	0.000457	168	0.00005	0.00064	0.00033	0.055	0.000635	0.0172	28.6	0.66	0.0000025	0.000268	0.00370
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	0.0464	0.00005	0.000025	0.005	0.000687J	0.000457	144	0.00005	0.00042	0.00010	0.060	0.000480	0.0155	27.5	0.398	0.0000025	0.000164	0.00293
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	0.0424	0.00005	0.000025	0.005	0.00126J	0.000457	163	0.00005	0.00067	0.00031	0.093	0.000377	0.0155	27.8	0.567	0.0000025	0.000160	0.00404
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	0.0504	0.00005	0.000025	0.005	0.00104J	0.000457	148	0.00005	0.00219	0.00010	0.103	0.000090	0.0159	27.5	1.09	0.0000025	0.000146	0.00589
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	0.0590	0.00005	0.000025	0.005	0.000353	0.000457	155	0.00005	0.00224	0.00010	0.331	0.000212	0.0136	26.0	1.27	0.0000025	0.000205	0.00441
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	0.0622	0.00005	0.000025	0.005	0.000288	0.000457	172	0.00005	0.00243	0.00010	0.402	0.000152	0.0161	27.3	1.31	0.0000025	0.000196	0.00502
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	0.0605	0.00005	0.000025	0.005	0.000426	0.000457	155	0.00015	0.00232	0.00010	0.035	0.000082	0.0163	26.8	1.17	0.0000025	0.000210	0.00529
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	0.0301	0.00005	0.000025	0.005	0.00469J	0.000300	57.2	0.00014	0.00149	0.00202	0.431	0.00414	0.0048	8.65	0.805	0.0000025	0.000196	0.00510
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	0.0479	0.00005	0.000025	0.005	0.000849J	0.000457	119	0.00005	0.00141	0.00074	0.357	0.00148	0.0106	18.2	0.989	0.0000025	0.000234	0.00465
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018	0.0467	0.00005	0.000025	0.005	0.00108J	0.000457	155	0.00005	0.00072	0.00010	0.059	0.000364	0.0149	24.2	0.906	0.0000025	0.000277	0.00411
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018	0.0351	0.00005	0.000025	0.005	0.000957J	0.000457	125	0.00005	0.00074	0.00074	0.099	0.000594	0.0112	21.8	0.544	0.0000025	0.000184	0.00355
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018	0.0450	0.00005	0.000025	0.005	0.00101J	0.000457	150	0.00005	0.00080	0.00044	0.045	0.000198	0.0123	26.7	0.695	0.0000025	0.000226	0.00383
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018	0.0496	0.00005	0.000025	0.005	0.000811J	0.000457	129	0.00005	0.00131	0.00010	0.067	0.000118	0.0120	25.7	0.677	0.0000025	0.000157	0.00438
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	0.0577	0.00005	0.000025	0.005	0.000128	0.000457	148	0.00005	0.00188	0.00010	0.243	0.000025	0.0133	23.5	1.44	0.0000025	0.000226	0.00432
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	0.0622	0.00005	0.000025	0.005	0.000291	0.000457	148	0.00005	0.00183	0.00010	0.65	0.000108	0.0128	25.0	1.27	0.0000025	0.000226	0.00451
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	0.0645	0.00005	0.000025	0.005	0.000180	0.000457	168	0.00005	0.00223	0.00010	0.44	0.000052	0.0144	30.4	1.17	0.0000025	0.000299	0.00490
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	0.0634	0.00005	0.000025	0.005	0.000229	0.000457	167	0.00005	0.00179	0.00010	0.539	0.000054	0.0142	27.2	1.17	0.0000025	0.000224	0.00431
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019	0.0540	0.00005	0.000025	0.005	0.000273	0.000457	151	0.00005	0.00161	0.00010	0.290	0.000075	0.0136	25.3	1.07	0.0000025	0.000215	0.00388
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2019	0.0546	0.00005	0.000025	0.005	0.000423	0.000457	155	0.00005	0.00171	0.00010	0.215	0.000208	0.0119	25.0	1.02	0.0000025	0.000216	0.00431
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2019	0.0367	0.00005	0.000025	0.005	0.000376	0.000457	103	0.00005	0.00100	0.00075	0.250	0.00150	0.0078	14.9	0.66	0.0000025	0.000157	0.00337
KV-6	Christal Creek u/s Silver Trail Highway	06-Jun-2019	0.0477	0.00005	0.000025	0.005	0.000283	0.000457	139	0.00005	0.00104	0.00035	0.068	0.000852	0.0122	21.6	0.815	0.0000025	0.000267	0.00340

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-6	Christal Creek u/s Silver Trail Highway	09-Nov-2016	0.025	0.46	0.000880	4.17	0.000005	1.64	0.256	124	0.000005	0.00005	0.00015	0.00441	0.00025	0.158	0.079	0.00015	10.7	11.1	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	03-Dec-2016	0.025	0.46	0.00105	4.21	0.000005	1.71	0.272	126	0.000005	0.00005	0.00015	0.00431	0.00025	0.124	0.064	0.00015	10.8	11.2	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2017	0.025	0.43	0.00104	3.99	0.000005	1.55	0.268	125	0.000005	0.00005	0.00015	0.00485	0.00025	0.115	0.086	0.00015	11.1	11.2	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2017	0.025	0.46	0.00109	4.30	0.000005	1.73	0.276	139	0.000005	0.00005	0.00015	0.00538	0.00025	0.122	0.053	0.00015	10.8	11.7	1.04	
KV-6	Christal Creek u/s Silver Trail Highway	02-Mar-2017	0.025	0.44	0.00105	4.01	0.000005	2.28	0.277	141	0.000005	0.00005	0.00015	0.00478	0.00025	0.126	0.066	0.00015	11.5	11.0	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	08-Apr-2017	0.025	0.45	0.00139	3.83	0.000005	1.76	0.291	149	0.000005	0.00005	0.00015	0.00517	0.00025	0.14	0.077	0.00015	11.6	11.0	0.97	
KV-6	Christal Creek u/s Silver Trail Highway	14-May-2017	0.025	0.55	0.000300	1.95	0.000014	0.681	0.0993	45.5	0.000005	0.00005	0.00082	0.00123	0.00025	0.0920	0.134	0.00015	4.14	3.99	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	02-Jun-2017	0.025	0.45	0.000771	2.97	0.000005	1.44	0.237	111	0.000005	0.00005	0.00015	0.00398	0.00025	0.109	0.137	0.00015	9.27	8.71	0.97	
KV-6	Christal Creek u/s Silver Trail Highway	19-Jul-2017	0.025	0.22	0.000773	3.03	0.000005	1.50	0.266	137	0.000005	0.00005	0.00015	0.00448	0.00025	0.146	0.121	0.00015	10.9	10.9	1	
KV-6	Christal Creek u/s Silver Trail Highway	18-Aug-2017	0.025	0.26	0.000782	2.51	0.000005	1.57	0.255	132	0.000005	0.00005	0.00015	0.00476	0.00025	0.141	0.055	0.00015	10.8	9.54	0.94	
KV-6	Christal Creek u/s Silver Trail Highway	08-Sep-2017	0.025	0.43	0.000927	3.14	0.000005	1.57	0.257	146	0.000005	0.00005	0.00015	0.00436	0.00025	0.325	0.067	0.00015	10.6	10.5	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	21-Oct-2017	0.025	0.40	0.00103	4.00	0.000005	1.67	0.284	141	0.000005	0.00005	0.00015	0.00482	0.00025	0.292	0.060	0.00015	10.9	9.77	0.95	
KV-6	Christal Creek u/s Silver Trail Highway	22-Nov-2017															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	13-Dec-2017	0.025	0.38	0.00105	4.07	0.000005	1.93	0.274	135	0.000005	0.00005	0.00015	0.00522	0.00025	0.153	0.049	0.00015	10.6	10.0	0.97	
KV-6	Christal Creek u/s Silver Trail Highway	24-Jan-2018	0.025	0.45	0.00111	4.31	0.000005	1.76	0.275	127	0.000005	0.00005	0.00015	0.00509	0.00025	0.134	0.046	0.00015	10.8	11.0	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	25-Feb-2018	0.025	0.43	0.00105	4.30	0.000005		0.294	137	0.000005	0.00005	0.00015	0.00493	0.00025	0.127	0.072	0.00015	11.2	10.4	0.96	
KV-6	Christal Creek u/s Silver Trail Highway	28-Mar-2018															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	18-Apr-2018															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2018	0.025	0.73	0.000289	1.89	0.000020	0.696	0.0975	44.8	0.000005	0.00005	0.00066	0.000896	0.00025	0.548	0.140	0.00015	3.40	3.69	1.04	
KV-6	Christal Creek u/s Silver Trail Highway	05-Jun-2018	0.025	0.46	0.000699	2.80	0.000005	1.21	0.209	84.3	0.000005	0.00005	0.00015	0.00329	0.00025	0.251	0.118	0.00015	7.91	7.56	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	11-Jul-2018	0.025	0.27	0.000752	2.81	0.000005	1.52	0.271	132	0.000005	0.00005	0.00015	0.00472	0.00025	0.448	0.069	0.00015	10.3	9.86	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	11-Aug-2018	0.025	0.23	0.000766	2.80	0.000005	1.48	0.212	105	0.000005	0.00005	0.00015	0.00354	0.00025	0.183	0.105	0.00015	9.39	8.16	0.93	
KV-6	Christal Creek u/s Silver Trail Highway	03-Sep-2018	0.025	0.32	0.000947	2.92	0.000005	1.54	0.250	112	0.000005	0.00005	0.00015	0.00445	0.00025	0.239	0.082	0.00015	9.41	9.80	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	08-Oct-2018	0.025	0.38	0.00116	3.81	0.000005	1.68	0.216	126	0.000005	0.00005	0.00015	0.00446	0.00025	0.201	0.065	0.00015	9.90	8.68	0.93	
KV-6	Christal Creek u/s Silver Trail Highway	19-Nov-2018	0.025	0.41	0.00118	3.94	0.000005	1.75	0.251	115	0.000005	0.00005	0.00015	0.00444	0.00025	0.145	0.052	0.00015	9.85	9.47	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	11-Dec-2018	0.025	0.43	0.00118	4.12	0.000005	3.03	0.271	120	0.000005	0.00005	0.00015	0.00458	0.00025	0.143	0.086	0.00015	9.95	9.68	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2019	0.025	0.52	0.00122	4.63	0.000005	2.02	0.300	135	0.000005	0.00005	0.00015	0.00535	0.00025	0.153	0.094	0.00015	10.5	11.0	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	06-Feb-2019	0.025	0.47	0.00130	4.46	0.000005	2.55	0.273	131	0.000005	0.00005	0.00015	0.00542	0.00025	0.118	0.064	0.00015	10.2	10.8	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	06-Mar-2019	0.025	0.43	0.00122	4.14	0.000005	3.32	0.247	123	0.000005	0.00005	0.00015	0.00483	0.00025	0.111	0.061	0.00015	9.79	9.83	1	
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2019	0.025	0.53	0.00116	3.58	0.000005	1.65	0.254	123	0.000005	0.00005	0.00015	0.00466	0.00025	0.12	0.051	0.00015	10.1	9.94	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2019	0.025	0.52	0.000520	2.48	0.000005	0.968	0.198	74.1	0.000005	0.00005	0.00015	0.00193	0.00025	0.0720	0.135	0.00015	5.87	6.49	1.05	
KV-6	Christal Creek u/s Silver Trail Highway	06-Jun-2019	0.025	0.45	0.000720	3.14	0.000005	1.42	0.238	124	0.000005	0.00005	0.00015	0.00392	0.00025	0.0853	0.090	0.00015	9.34	8.82	0.97	

Christal Creek Attenuation Study, 2008 to 2022 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
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
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
KV-6	Christal Creek u/s Silver Trail Highway	20-Jul-2019	Water lower, stagg gauge needs to be replaced - hard to read.	73.7	0.231	22.9	8.12	8.12	869.0	914	9.6	10.12	89.0	108.1	520	532	119
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2019	staff gauge needs repair, WL measured with additional ruler.	64.7	0.225	4.7	8.10	8.10	858.0	905	9.1	10.45	91.1	161.2	489	519	122
KV-6	Christal Creek u/s Silver Trail Highway	17-Sep-2019	water low. Logger downloaded, winterized, reset. Staff gauge calculated from photo using ruler; SG worn down around water level area.	64.2	0.225	1.6	7.55	8.00	854.0	852	5.2	12.09	95.5	116.8	513	511	137
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2019	Barro and logger will be downloaded at a later date. Hard to read staff gauge - could be replaced	37.4	0.223	1.8	7.91	8.05	848.2	812	2.4	12.63	92.7	244.3	489	501	129
KV-6	Christal Creek u/s Silver Trail Highway	27-Nov-2019		74.9		8.4	7.49	7.58	897.3	884	0.1	9.87	68.1	11.5	510	506	132
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2019		74.3		5.2	8.14	7.71	862.3	945	0.0	9.87	67.9	79.3	510	547	138
KV-6	Christal Creek u/s Silver Trail Highway	31-Jan-2020	Sampled and attempted to measure flow, but d/s was not close enough to main channel and did not capture flow.			12.3	7.80	7.99	412.0	927	0.0	8.10	55.5	-51.1	568	504	143
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2020				7.8	7.89	8.14	948.0	901	-0.1	~	~	~	513	508	132
KV-6	Christal Creek u/s Silver Trail Highway	17-Mar-2020	not ideal for measuring flow			6.8	6.89	7.74	861.5	947	0.0	10.93	74.9	175.6	502	512	140
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2020		59.1		6.6	7.47	7.89	955.8	974	0	12.18	83.6	200.8	534	512	132
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2020	DO will not calibrate, membrane needs replacement. Sampled a bit upstream of SG where the water was open. Still lots of snow and ice. Barro and logger downloaded. Staff gauge in ice.	255.8		74.6	7.51	7.27	379.6	390	0.6	13.37	92.9	27.5	197	181	46.1
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2020		82.7	0.358	4.1	7.79	7.67	641.5	676	7.0	9.63	79.6	271.4	380	355	90.7
KV-6	Christal Creek u/s Silver Trail Highway	10-Jul-2020		109.8	0.285	7.3	7.81	7.92	718.0	798	11.1	10.25	104.8	225.6	464	465	110
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2020		95.6	0.305	2.6	7.60	7.93	676.9	741	8.1	10.06	86.8	86.6	426	416	115
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	LL and Baro downloaded. Benthics and sedmiment 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
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
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
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
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
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
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
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
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
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			
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
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
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
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
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
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
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
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
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
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		65.4		4.2	7.24	8.00	800.1	954	-0.2	13.19	90.9	-8.3	534	499	138

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-6	Christal Creek u/s Silver Trail Highway	20-Jul-2019	0.125	1.25	0.16C	411	429	0.0178	0.675	0.0025	0.118	0.154	2.98	0.197C	0.1	0.00036	0.00581	0.0567	0.00005	0.000025	0.005	0.00106	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2019	0.125	1.25	0.15C	403	429	0.0122	0.733	0.0025	0.122	0.125	3.11	0.0364	0.1	0.00025	0.00499	0.0503	0.00005	0.000025	0.005	0.000854	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	17-Sep-2019	0.125	1.25	0.14C	388	429	0.0077	3.50	0.0025	0.134	0.103	1.89	0.0071	0.1	0.00020	0.00380	0.0498	0.00005	0.000025	0.005	0.000931	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2019	0.125	1.25	0.13C	357	429	0.0073	1.93	0.0025	0.178	0.109	1.67	0.0084	0.1	0.00020	0.00314	0.0537	0.00005	0.000025	0.005	0.000954	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	27-Nov-2019	0.125	1.25	0.14C	387	429	0.0825	6.11	0.0025	0.231	0.125	1.45	0.0399	0.1	0.00020	0.00961	0.0598	0.00005	0.000025	0.005	0.000995	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2019	0.125	1.25	0.22C	398	429	0.0832	1.39	0.0025	0.222	0.268	2.55	0.0266	0.1	0.00019	0.0101	0.0573	0.00005	0.000025	0.005	0.000976	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	31-Jan-2020	0.125	1.25	0.16C	409	429	0.0909	3.02	0.0025	0.204	0.181	1.44	0.0447	0.1	0.00059	0.0207	0.0603	0.00005	0.000025	0.005	0.00121	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2020	0.125	1.25	0.16C	390	429	0.0968	2.46	0.0025	0.194	0.169	1.87	0.0303	0.1	0.00028	0.0122	0.0523	0.00005	0.000025	0.005	0.000948	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	17-Mar-2020	0.125	6.2	0.16C	386	429	0.0872	24.5	0.0025	0.190	0.165	1.36	0.0422	0.1	0.00023	0.0137	0.0532	0.00005	0.000025	0.005	0.00101	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2020	0.125	1.25	0.16C	425	429	0.0914	6.45	0.0025	0.181	0.215	2.07	0.0554	0.1	0.00021	0.015	0.0491	0.00005	0.000025	0.005	0.00149	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2020	0.025	0.72	0.066	139	429	0.0483	5.59	0.0005	0.0424	0.737	24.1	0.897C	0.1	0.00178	0.039	0.0526	0.00005	0.000025	0.005	0.00614	0.000278
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2020	0.125	1.25	0.118	277	429	0.0405	1.75	0.0025	0.104	0.273	7.11	0.114C	0.1	0.00032	0.00626	0.0570	0.000050	0.000025	0.005	0.00169	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	10-Jul-2020	0.125	1.25	0.134C	331	429	0.0645	1.21	0.0025	0.0985	0.262	3.94	0.0344	0.1	0.00050	0.00586	0.0590	0.000050	0.000025	0.005	0.0018	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2020	0.125	1.25	0.127C	293	429	0.0366	2.47	0.0025	0.124	0.148	2.87	0.0331	0.1	0.00044	0.00503	0.0586	0.000050	0.000025	0.005	0.00164	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	0.025	1.24	0.124C	269	429	0.0189	5.23	0.0005	0.248	0.108	2.91	0.0273	0.1	0.00026	0.00330	0.0568	0.000050	0.000025	0.005	0.00182	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	0.125	1.25	0.109	286	429	0.0438	16.5	0.0025	0.326	0.159	3.14	0.0358	0.1	0.00031	0.00327	0.0602	0.000050	0.000025	0.005	0.00176	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	0.125	1.25	0.126C	295	429	0.0652	20.4	0.0025	0.347	0.141	1.90	0.0236	0.1	0.00018	0.00398	0.0566	0.000050	0.000025	0.005	0.00112	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	0.125	1.25	0.124C	300	429	0.0587	6.75	0.0025	0.346		1.94	0.0153	0.1	0.00019	0.00568	0.0633	0.000050	0.000025	0.005	0.00107	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	0.125	1.25	0.125C	312	429	0.0580	6.30	0.0025	0.339		1.47	0.0234	0.1	0.00025	0.0074	0.0580	0.000050	0.000025	0.005	0.00106	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	0.125	1.25	0.123C	317	429	0.0777	2.70	0.0025	0.315		1.27	0.0365	0.1	0.00032	0.0115	0.0569	0.000050	0.000025	0.005	0.0011	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	0.125	1.25	0.157C	337	429	0.0602	17.3	0.0025	0.332		0.97	0.0332	0.1	0.00024	0.00943	0.0512	0.000050	0.000025	0.005	0.000794	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021	0.125	1.25	0.147C	365	429	0.0671	5.44	0.0025	0.325		1.22	0.0623	0.1	0.00025	0.0112	0.0567	0.000050	0.000025	0.005	0.000879	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	0.025	3.25	0.093	253	429	0.0527	9.08	0.0044	0.276		7.79	0.282C	0.1	0.00090	0.012	0.0544	0.000050	0.000025	0.005	0.00177	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021					128		7.55						0.1								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021	0.025	0.73	0.075	165	429	0.0305	0.781	0.0020	0.155		11.7	0.449C	0.1	0.00080	0.0114	0.0515	0.000050	0.000025	0.005	0.00165	0.000305
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	0.025	1.03	0.120	259	429	0.0216	13.7	0.0005	0.156		5.69	0.0920	0.1	0.00058	0.00767	0.0510	0.000050	0.000025	0.005	0.00115	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021	0.125	1.25	0.125C	328	429	0.0202	0.309	0.0025	0.170		3.01	0.0178	0.1	0.00040	0.00473	0.0577	0.000050	0.000025	0.005	0.000953	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	0.025	1.15	0.143C	343	429	0.0190	2.03	0.0005	0.164		2.63	0.0228	0.1	0.00049	0.00568	0.0592	0.000050	0.000025	0.005	0.00125	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	0.025	1.13	0.108	263	429	0.0090	1.15	0.0005	0.155		4.25	0.0227	0.1	0.00039	0.00447	0.0508	0.000050	0.000025	0.005	0.0012	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	0.125	1.25	0.135C	326	429	0.0073	1.75	0.0025	0.155		2.38	0.0096	0.1	0.00023	0.00347	0.0535	0.000050	0.000025	0.005	0.00172	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021	0.125	1.25	0.138C	307	429	0.0249	5.30	0.0025	0.250		2.36	0.0122	0.1	0.00029	0.00339	0.0532	0.000050	0.000025	0.005	0.00129	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	0.125	1.25	0.139C	331	429	0.0774	5.88	0.0025	0.307		2.37	0.0257	0.1	0.00037	0.00537	0.0606	0.000050	0.000025	0.005	0.00114	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	0.125	1.25	0.154C	347	429	0.0715	5.49	0.0025	0.280		3.19	0.0242	0.1	0.00029	0.00608	0.0699	0.000050	0.000025	0.005	0.00133	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022					128		0.616						NopH								NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022	0.125	1.25	0.173C	395	429	0.0676	10.9	0.0025	0.268		1.91	0.0241	0.1	0.00028	0.00935	0.0607	0.000050	0.000025	0.005	0.000858	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-6	Christal Creek u/s Silver Trail Highway	20-Jul-2019	161	0.00046	0.00082	0.00122	0.004	0.61	0.00501	0.007	0.0293	0.0149	28.5	0.730	6.3	0.0000061	0.000311	0.00376	0.15
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2019	150	0.00005	0.00053	0.00025	0.004	0.260	0.00313	0.007	0.0273	0.0140	27.6	0.750	5.9	0.0000025	0.000240	0.00288	0.15
KV-6	Christal Creek u/s Silver Trail Highway	17-Sep-2019	162	0.00011	0.00049	0.00025	0.004	0.188	0.00135	0.007	0.0288	0.0151	26.3	0.652	6.2	0.0000025	0.000347	0.00306	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2019	152	0.00005	0.00086	0.00025	0.004	0.223	0.00159	0.007	0.0273	0.0131	26.3	0.744	5.9	0.0000025	0.000199	0.00359	0.15
KV-6	Christal Creek u/s Silver Trail Highway	27-Nov-2019	157	0.00019	0.00193	0.00025	0.004	0.775	0.00451	0.007	0.0286	0.0134	28.9	1.50	6.2	0.0000025	0.000235	0.00410	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2019	158	0.00013	0.00177	0.00125	0.004	0.849	0.00236	0.007	0.0286	0.0146	27.9	1.37	6.2	0.0000025	0.000196	0.00396	0.15
KV-6	Christal Creek u/s Silver Trail Highway	31-Jan-2020	183	0.00021	0.00171	0.00150	0.004	1.29	0.0361	0.007	0.0324	0.0146	27.1	1.33	6.8	0.0000025	0.000223	0.00386	0.15
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2020	163	0.00005	0.00142	0.00063	0.004	0.807	0.01	0.007	0.0288	0.0142	25.9	1.15	6.2	0.0000025	0.000218	0.00358	0.15
KV-6	Christal Creek u/s Silver Trail Highway	17-Mar-2020	157	0.00013	0.00135	0.00057	0.004	0.977	0.00695	0.007	0.0281	0.0137	26.4	1.06	6.1	0.0000025	0.000189	0.00385	0.15
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2020	169	0.00018	0.00148	0.00053	0.004	1.09	0.00554	0.007	0.0302	0.0155	27.2	1.22	6.4	0.0000025	0.000200	0.00411	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2020	63.2	0.00165C	0.00276	0.00691C	0.004	3.79	0.112	0.007	0.0109	0.0056	9.43	1.24	2.7	0.0000025	0.000657	0.00775	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2020	122	0.00022	0.00137	0.00114	0.004	0.698	0.00417	0.007	0.0207	0.0092	18.6	1.17	4.7	0.0000025	0.000348	0.00373	0.15
KV-6	Christal Creek u/s Silver Trail Highway	10-Jul-2020	148	0.00024	0.00086	0.00090	0.004	0.375	0.00624	0.007	0.0258	0.0120	23.0	0.750	5.7	0.0000025	0.000338	0.00381	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2020	133	0.00005	0.00055	0.00063	0.004	0.341	0.00690	0.007	0.0235	0.0117	22.9	0.510	5.2	0.0000025	0.000295	0.00328	0.15
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	118	0.00005	0.00078	0.00054	0.004	0.326	0.00250	0.007	0.0210	0.0100	22.0	0.483	4.8	0.0000025	0.000231	0.00330	0.15
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	128	0.00011	0.00134	0.00051	0.004	0.331	0.00583	0.007	0.0232	0.0102	25.0	0.726	5.2	0.0000025	0.000199	0.00395	0.15
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	129	0.00005	0.00185	0.00025	0.004	0.346	0.00354	0.007	0.0229	0.0099	22.9	1.19	5.1	0.0000025	0.000194	0.00355	0.15
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	137	0.00012	0.00157	0.00025	0.004	0.523	0.00379	0.007	0.0245	0.0101	24.8	0.943	5.4	0.0000025	0.000182	0.00314	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	159	0.00005	0.00137	0.00025	0.004	0.647	0.00530	0.007	0.0278	0.0119	24.3	0.817	6.0	0.0000025	0.000205	0.00312	0.15
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	150	0.00013	0.00188	0.00025	0.004	0.933	0.013	0.007	0.0266	0.0116	24.9	1.14	5.8	0.0000025	0.000268	0.00383	0.15
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	142	0.00005	0.00131	0.00025	0.004	0.755	0.00573	0.007	0.0246	0.0112	21.9	0.783	5.4	0.0000025	0.000204	0.00317	0.15
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021	151	0.00015	0.00157	0.00052	0.004	0.918	0.00579	0.007	0.0265	0.0127	23.7	0.945	5.8	0.0000025	0.000227	0.00372	0.15
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	112	0.00054	0.00207	0.00240	0.004	1.59	0.0169	0.007	0.0188	0.0088	16.2	0.912	4.4	0.0000025	0.000283	0.00418	0.15
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021	70.0	0.00118C	0.00169	0.00391	0.004	1.62	0.0306	0.007	0.0120	0.0071	11.1	0.739	3.0	0.0000057	0.000301	0.00463	0.15
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	116	0.00025	0.00066	0.00121	0.004	0.625	0.0116	0.007	0.0200	0.0100	18.9	0.510	4.6	0.0000025	0.000374	0.00307	0.15
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021	135	0.00025	0.00046	0.00073	0.004	0.248	0.00487	0.007	0.0241	0.0144	23.9	0.454	5.3	0.0000025	0.000304	0.00286	0.15
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	150	0.00025	0.00049	0.00065	0.004	0.287	0.00928	0.007	0.0268	0.0119	25.6	0.453	5.8	0.0000025	0.000425	0.00289	0.15
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	121	0.00025	0.00039	0.00061	0.004	0.327	0.0127	0.007	0.0214	0.0097	21.7	0.393	4.8	0.0000025	0.000277	0.00256	0.15
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	138	0.00058	0.00038	0.00025	0.004	0.225	0.00227	0.007	0.0243	0.0115	23.1	0.502	5.4	0.0000025	0.000244	0.00320	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021	144	0.00025	0.00100	0.00025	0.004	0.257	0.00439	0.007	0.0257	0.0122	25.1	0.609	5.6	0.0000025	0.000198	0.00336	0.15
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	151	0.00025	0.00156	0.00096	0.004	0.43	0.0212	0.007	0.0263	0.0130	23.4	1.38	5.8	0.0000025	0.000244	0.00391	0.15
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	141	0.00025	0.00153	0.00089	0.004	0.568	0.00848	0.007	0.0253	0.0100	25.4	1.10	5.6	0.0000025	0.000196	0.00380	0.15
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022	170	0.00025	0.00119	0.00025	0.004	0.709	0.00596	0.007	0.0302	0.0128	26.6	0.990	6.4	0.0000025	0.000244	0.00325	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-6	Christal Creek u/s Silver Trail Highway	20-Jul-2019	0.025	0.28	0.000905	3.87	0.000034	1.59	0.288	145	0.000005	0.00005	0.00572	0.00483	0.00079	0.159	0.330	0.00015	0.0030	0.00026	0.00326
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2019	0.025	0.25	0.000799	3.89	0.000027	1.56	0.266	136	0.000005	0.00005	0.00119	0.00474	0.00025	0.148	0.307	0.00015	0.0020	0.00023	0.00284
KV-6	Christal Creek u/s Silver Trail Highway	17-Sep-2019	0.025	0.39	0.000969	3.70	0.000005	1.65	0.279	135	0.000005	0.00005	0.00015	0.00477	0.00025	0.180	0.325	0.00015	0.0019	0.00018	0.00262
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2019	0.025	0.39	0.00102C	3.63	0.000005	1.69	0.258	129	0.000005	0.00005	0.00015	0.00482	0.00025	0.210	0.307	0.00015	0.0023	0.00018	0.00208
KV-6	Christal Creek u/s Silver Trail Highway	27-Nov-2019	0.025	0.51	0.00102C	4.60	0.000240	1.94	0.283	145	0.000005	0.00005	0.00094	0.00493	0.00025	0.199	0.322	0.00015	0.0019	0.00012	0.00567
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2019	0.025	0.54	0.000920	4.29	0.000016	2.17	0.296	139	0.000005	0.00005	0.00058	0.00478	0.00025	0.173	0.322	0.00015	0.0030	0.00015	0.00670
KV-6	Christal Creek u/s Silver Trail Highway	31-Jan-2020	0.025	0.51	0.000834	4.38	0.000129	1.86	0.309	152	0.000005	0.00005	0.00146	0.00504	0.00025	0.167	0.366	0.00015	0.0024	0.00019	0.00958
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2020	0.025	0.47	0.000908	3.96	0.000033	1.73	0.301	141	0.000005	0.00005	0.00056	0.00485	0.00025	0.143	0.325	0.00015	0.0025	0.00016	0.00603
KV-6	Christal Creek u/s Silver Trail Highway	17-Mar-2020	0.025	0.47	0.000890	4.14	0.000034	1.64	0.280	135	0.000005	0.00005	0.00205	0.00466	0.00025	0.143	0.316	0.00015	0.0022	0.00014	0.00680
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2020	0.025	0.66	0.000790	4.05	0.000022	1.79	0.283	152	0.000005	0.00005	0.00117	0.00401	0.00025	0.168	0.340	0.00015	0.0033	0.00013	0.00780
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2020	0.112	1.12	0.000367	3.17	0.000935C	0.774	0.107	49.7	0.000013	0.00005	0.0265	0.00122	0.00259	0.554J	0.0878	0.00015	0.0424	0.00024	0.00523
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2020	0.025	0.403	0.000720	3.26	0.000025	1.32	0.212	107	0.000005	0.00005	0.00604	0.00284	0.00056	0.407J	0.225	0.00010	0.0104	0.00030	0.00352
KV-6	Christal Creek u/s Silver Trail Highway	10-Jul-2020	0.025	0.279	0.000948	2.70	0.000037	1.48	0.236	117	0.000005	0.00005	0.00120	0.00375	0.00025	0.452J	0.288	0.00010	0.0052	0.00035	0.00312
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2020	0.025	0.290	0.00112C	3.06	0.000026	1.54	0.238	104	0.000005	0.00005	0.00091	0.00371	0.00025	0.377J	0.260	0.00010	0.0047	0.00034	0.00290
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	0.025	0.339	0.00126C	3.32	0.000010	1.60	0.238	99.1	0.000005	0.00005	0.00090	0.00363	0.00025	0.316J	0.229	0.00010	0.0042	0.00023	0.00175
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	0.025	0.378	0.00123C	3.84	0.000014	1.79	0.240	102	0.000005	0.00005	0.00070	0.00355	0.00025	0.328J	0.256	0.00010	0.0026	0.00022	0.00154
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	0.025	0.378	0.00138C	3.99	0.000021	1.69	0.225	103	0.000005	0.00005	0.00062	0.00383	0.00025	0.213	0.252	0.00010	0.0016	0.00018	0.00294
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	0.025	0.402	0.00161C	4.23	0.000015	2.23	0.237	105	0.000005	0.00005	0.00030	0.00365	0.00025	0.180	0.272	0.00010	0.0016	0.00017	0.00421
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	0.025	0.435	0.00161C	4.41	0.000030	1.73	0.252	118	0.000005	0.00005	0.00070	0.00390	0.00025	0.160	0.313	0.00010	0.0013	0.00018	0.00524
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	0.025	0.492	0.00161C	4.29	0.000056	1.79	0.254	115	0.000005	0.00005	0.00090	0.00431	0.00025	0.134	0.298	0.00010	0.0005	0.00018	0.00575
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	0.025	0.430	0.00130C	4.02	0.000027	1.54	0.262	117	0.000005	0.00005	0.00111	0.00380	0.00025	0.116	0.274	0.00010	0.0022	0.00018	0.00570
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021	0.025	0.456	0.00128C	3.92	0.000026	1.56	0.268	118	0.000005	0.00005	0.00178	0.00440	0.00025	0.129	0.296	0.00010	0.0005	0.00017	0.00670
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	0.025	1.15	0.000742	3.16	0.000194	2.94	0.200	88.8	0.000005	0.00005	0.00854	0.00225	0.00090	0.209J	0.200	0.00010	0.0084	0.00056	0.00472
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021	0.025	0.542	0.000681	2.92	0.000349C	0.956	0.136	55.0	0.000005	0.00005	0.0075	0.00185	0.00147	0.226J	0.105	0.00010	0.0402	0.00032	0.00406
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	0.025	0.440	0.00109C	2.75	0.000104	1.36	0.204	95.5	0.000005	0.00005	0.00150	0.00348	0.00068	0.231J	0.215	0.00010	0.0119	0.00042	0.00371
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021	0.025	0.386	0.00120C	3.13	0.000012	1.96	0.245	115	0.000005	0.00005	0.00066	0.00452	0.00025	0.163	0.267	0.00010	0.0026	0.00032	0.00294
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	0.025	0.301	0.00115C	2.68	0.000083	1.74	0.257	118	0.000005	0.00005	0.00079	0.00445	0.00025	0.191	0.300	0.00010	0.0027	0.00031	0.00277
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	0.025	0.238	0.00107C	2.97	0.000239	1.45	0.226	93.6	0.000005	0.00005	0.00060	0.00370	0.00025	0.236J	0.233	0.00010	0.0048	0.00027	0.00251
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	0.025	0.476	0.00102C	3.66	0.000010	1.68	0.265	122	0.000005	0.00005	0.00015	0.00420	0.00025	0.407J	0.270	0.00010	0.0031	0.00018	0.00220
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021	0.025	0.331	0.00124C	3.78	0.000056	1.58	0.245	112	0.000005	0.00005	0.00043	0.00450	0.00025	0.246	0.287	0.00010	0.0017	0.00018	0.00182
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	0.025	0.543	0.00116C	4.30	0.000055	1.98	0.261	117	0.000005	0.00005	0.00078	0.00442	0.00025	0.200	0.295	0.00010	0.0019	0.00019	0.00293
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	0.025	0.727	0.00126C	4.19	0.000013	2.37	0.254	124	0.000005	0.00005	0.00045	0.00434	0.00025	0.185	0.283	0.00010	0.0021	0.00015	0.00328
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022															NoHardness				
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022	0.025	0.554	0.00141C	4.58	0.000028	1.88	0.300	128	0.000005	0.00005	0.00045	0.00516	0.00025	0.111	0.340	0.00010	0.0024	0.00015	0.00457

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-6	Christal Creek u/s Silver Trail Highway	20-Jul-2019	0.0508	0.00005	0.000025	0.005	0.000695J	0.000457	164	0.00005	0.00059	0.00046	0.084	0.000453	0.0150	29.7	0.727	0.0000025	0.000268	0.00341
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2019	0.0450	0.00005	0.000025	0.005	0.000609J	0.000457	168	0.00005	0.00047	0.00024	0.049	0.000286	0.0149	24.2	0.675	0.0000025	0.000239	0.00249
KV-6	Christal Creek u/s Silver Trail Highway	17-Sep-2019	0.0495	0.00005	0.000025	0.005	0.000740J	0.000457	161	0.00005	0.00048	0.00033	0.058	0.000200	0.0142	26.5	0.623	0.0000025	0.000243	0.00289
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2019	0.0489	0.00005	0.000025	0.005	0.000836J	0.000457	158	0.00005	0.00087	0.00010	0.058	0.000151	0.0128	25.8	0.727	0.0000025	0.000165	0.00358
KV-6	Christal Creek u/s Silver Trail Highway	27-Nov-2019	0.0579	0.00005	0.000025	0.005	0.000401	0.000457	158	0.00005	0.00176	0.00022	0.320	0.000095	0.0142	26.8	1.43	0.0000025	0.000181	0.00381
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2019	0.0622	0.00005	0.000025	0.005	0.000310	0.000457	171	0.00005	0.00180	0.00051	0.338	0.000025	0.0153	29.0	1.54	0.0000025	0.000218	0.00404
KV-6	Christal Creek u/s Silver Trail Highway	31-Jan-2020	0.0542	0.00005	0.000025	0.005	0.000451	0.000457	161	0.00005	0.00144	0.00032	0.599	0.00109	0.0146	24.9	1.12	0.0000025	0.000228	0.00320
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2020	0.0541	0.00005	0.000025	0.005	0.000469J	0.000457	162	0.00016	0.00141	0.00010	0.251	0.000275	0.0141	25.2	1.12	0.0000025	0.000206	0.00355
KV-6	Christal Creek u/s Silver Trail Highway	17-Mar-2020	0.0539	0.00005	0.000025	0.005	0.000345	0.000457	164	0.00005	0.00125	0.00010	0.349	0.000088	0.0137	25.0	0.992	0.0000025	0.000179	0.00333
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2020	0.0483	0.00005	0.000025	0.005	0.000748J	0.000457	163	0.00025	0.00137	0.00048	0.402	0.000237	0.0147	25.7	1.12	0.0000025	0.000173	0.00393
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2020	0.0246	0.00005	0.000025	0.005	0.00293J	0.000348	59.1	0.00011	0.00093	0.00181	0.558	0.00242	0.0044	8.17	0.651	0.0000025	0.000477	0.00352
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2020	0.0514	0.000050	0.000025	0.005	0.00149J	0.000457	114	0.00005	0.00123	0.00083	0.255	0.00150	0.0083	17.2	1.09	0.0000025	0.000274	0.00329
KV-6	Christal Creek u/s Silver Trail Highway	10-Jul-2020	0.0556	0.000050	0.000025	0.005	0.00145J	0.000457	148	0.00005	0.00073	0.00046	0.046	0.000650	0.0112	23.5	0.729	0.0000025	0.000297	0.00350
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2020	0.0547	0.000050	0.000025	0.005	0.00119J	0.000457	130	0.00005	0.00049	0.00041	0.055	0.000610	0.0108	22.2	0.462	0.0000025	0.000284	0.00300
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	0.0569	0.000050	0.000025	0.005	0.00157J	0.000457	125	0.00005	0.00069	0.00040	0.046	0.000254	0.0099	23.9	0.484	0.0000025	0.000207	0.00304
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	0.0580	0.000050	0.000025	0.005	0.00163J	0.000457	123	0.00005	0.00128	0.00034	0.050	0.000135	0.0108	22.2	0.66	0.0000025	0.000206	0.00382
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	0.0687	0.000050	0.000025	0.005	0.00102J	0.000457	158	0.00005	0.00206	0.00021	0.092	0.000170	0.0126	27.9	1.21	0.0000025	0.000244	0.00396
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	0.0742	0.000050	0.000025	0.005	0.000725J	0.000457	144	0.00005	0.00172	0.00020	0.231	0.000115	0.0113	27.0	1.01	0.0000025	0.000206	0.00348
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	0.0610	0.000050	0.000025	0.005	0.000575J	0.000457	158	0.00005	0.00142	0.00010	0.272	0.000096	0.0128	27.3	0.814	0.0000025	0.000193	0.00318
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	0.0584	0.000050	0.000025	0.005	0.000319	0.000457	149	0.00005	0.00181	0.00010	0.264	0.000092	0.0132	24.8	1.23	0.0000025	0.000249	0.00352
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	0.0550	0.000050	0.000025	0.005	0.000286	0.000457	143	0.00005	0.00139	0.00010	0.343	0.000090	0.0128	23.2	0.85	0.0000025	0.000206	0.00333
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021	0.0553	0.000050	0.000025	0.005	0.000397	0.000457	154	0.00005	0.00149	0.00010	0.39	0.000166	0.0126	23.7	0.925	0.0000025	0.000220	0.00337
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	0.0445	0.000050	0.000025	0.005	0.00123J	0.000457	111	0.00025	0.00160	0.00065	0.361	0.00190	0.0085	16.3	0.866	0.0000025	0.000233	0.00305
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021	0.0383	0.000050	0.000025	0.005	0.000715J	0.000378	70.2	0.00025	0.00122	0.00138	0.452	0.00342	0.0067	11.4	0.662	0.0000025	0.000201	0.00324
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	0.0509	0.000050	0.000025	0.005	0.000899J	0.000457	108	0.00025	0.00058	0.00089	0.199	0.00284	0.0098	15.6	0.478	0.0000025	0.000352	0.00295
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021	0.0554	0.000050	0.000025	0.005	0.000746J	0.000457	137	0.00025	0.00041	0.00037	0.059	0.000941	0.0106	22.5	0.423	0.0000025	0.000310	0.00252
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	0.0534	0.000050	0.000025	0.005	0.000811J	0.000457	128	0.00025	0.00038	0.00046	0.062	0.000874	0.0111	24.8	0.381	0.0000025	0.000367	0.00272
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	0.0494	0.000050	0.000025	0.005	0.000989J	0.000457	115	0.00025	0.00037	0.00046	0.066	0.000479	0.0088	21.0	0.377	0.0000025	0.000259	0.00245
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	0.0579	0.000050	0.000025	0.005	0.00164J	0.000457	145	0.00025	0.00040	0.00033	0.050	0.000228	0.0119	25.2	0.507	0.0000025	0.000338	0.00305
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021	0.0493	0.000050	0.000025	0.005	0.000944J	0.000457	129	0.00025	0.00095	0.00022	0.060	0.000150	0.0110	22.6	0.575	0.0000025	0.000188	0.00300
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	0.0666	0.000050	0.000025	0.005	0.000852J	0.000457	152	0.00025	0.00176	0.00057	0.122	0.00185	0.0113	26.9	1.45	0.0000025	0.000235	0.00394
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	0.0590	0.000050	0.000025	0.005	0.000843J	0.000457	155	0.00025	0.00152	0.00010	0.215	0.000260	0.0117	25.2	1.09	0.0000025	0.000209	0.00329
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022						NoHardness												
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022	0.0572	0.000050	0.000025	0.005	0.000390	0.000457	156	0.00025	0.00113	0.00020	0.258	0.000170	0.0123	26.6	0.943	0.0000025	0.000213	0.00288

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-6	Christal Creek u/s Silver Trail Highway	20-Jul-2019	0.025	0.26	0.000890	3.62	0.000005	1.65	0.284	150	0.000005	0.00005	0.00015	0.00472	0.00025	0.151	0.061	0.00015	11.0	10.8	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	01-Aug-2019	0.025	0.20	0.000830	3.92	0.000005	1.37	0.286	137	0.000005	0.00005	0.00015	0.00462	0.00025	0.129	0.063	0.00015	10.9	10.5	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	17-Sep-2019	0.025	0.39	0.000882	3.52	0.000005	1.62	0.276	127	0.000005	0.00005	0.00015	0.00478	0.00025	0.174	0.081	0.00015	10.8	10.3	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	03-Oct-2019	0.025	0.35	0.000868	3.76	0.000005	1.66	0.247	118	0.000005	0.00005	0.00015	0.00458	0.00025	0.202	0.058	0.00015	10.0	10.1	1	
KV-6	Christal Creek u/s Silver Trail Highway	27-Nov-2019	0.025	0.47	0.000966	4.10	0.000005	1.99	0.286	139	0.000005	0.00005	0.00015	0.00452	0.00025	0.197	0.077	0.00015	10.7	10.3	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2019	0.025	0.57	0.000988	4.69	0.000005	2.14	0.308	139	0.000005	0.00013	0.00015	0.00498	0.00025	0.193	0.057	0.00015	11.1	11.1	1	
KV-6	Christal Creek u/s Silver Trail Highway	31-Jan-2020	0.025	0.51	0.000854	4.27	0.000005	1.73	0.288	145	0.000005	0.00012	0.00015	0.00482	0.00025	0.135	0.059	0.00015	11.4	10.2	0.95	
KV-6	Christal Creek u/s Silver Trail Highway	13-Feb-2020	0.025	0.50	0.000921	3.98	0.000005	1.78	0.309	138	0.000005	0.00005	0.00015	0.00484	0.00025	0.138	0.061	0.00015	10.8	10.3	0.98	
KV-6	Christal Creek u/s Silver Trail Highway	17-Mar-2020	0.025	0.49	0.000773	3.62	0.000005	1.62	0.283	126	0.000005	0.00005	0.00015	0.00469	0.00025	0.128	0.122	0.00015	11.0	10.4	0.97	
KV-6	Christal Creek u/s Silver Trail Highway	17-Apr-2020	0.025	0.63	0.000748	3.89	0.000005	1.70	0.279	148	0.000005	0.00005	0.00015	0.00421	0.00025	0.165	0.090	0.00015	11.5	10.4	0.95	
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2020	0.025	1.02	0.000298	1.90	0.000013	0.709	0.105	47.7	0.000005	0.00005	0.00052	0.000882	0.00025	0.359	0.107	0.00015	3.84	3.75	0.99	
KV-6	Christal Creek u/s Silver Trail Highway	07-Jun-2020	0.025	0.326	0.000652	2.74	0.000005	1.18	0.212	91.4	0.000005	0.00005	0.00015	0.00277	0.00025	0.386	0.101	0.00015	7.61	7.35	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	10-Jul-2020	0.025	0.258	0.000906	2.70	0.000005	1.50	0.257	116	0.000005	0.00005	0.00015	0.00384	0.00025	0.423	0.088	0.00015	9.14	9.56	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	12-Aug-2020	0.025	0.283	0.00103	2.78	0.000005	1.53	0.249	104	0.000005	0.00005	0.00015	0.00326	0.00025	0.356	0.092	0.00015	8.45	8.53	1.00	
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2020	0.025	0.363	0.00114	3.27	0.000005	1.56	0.227	97.2	0.000005	0.00005	0.00015	0.00356	0.00025	0.288	0.108	0.00015	8.17	8.42	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	18-Oct-2020	0.025	0.392	0.00150	4.00	0.000005	1.69	0.234	108	0.000005	0.00005	0.00015	0.00378	0.00025	0.332	0.148	0.00015	8.59	8.11	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	10-Nov-2020	0.025	0.485	0.00193	4.68	0.000005	1.92	0.259	122	0.000005	0.00005	0.00015	0.00427	0.00025	0.227	0.130	0.00015	8.87	10.4	1.08	
KV-6	Christal Creek u/s Silver Trail Highway	05-Dec-2020	0.025	0.468	0.00186	4.62	0.000005	2.15	0.248	126	0.000005	0.00005	0.00015	0.00404	0.00025	0.201	0.089	0.00015	8.90	9.57	1.04	
KV-6	Christal Creek u/s Silver Trail Highway	12-Jan-2021	0.025	0.465	0.00178	4.60	0.000005	1.94	0.273	127	0.000005	0.00005	0.00015	0.00443	0.00025	0.158	0.078	0.00015	9.12	10.3	1.06	
KV-6	Christal Creek u/s Silver Trail Highway	22-Feb-2021	0.025	0.531	0.00163	4.20	0.000005	1.88	0.262	117	0.000005	0.00005	0.00015	0.00440	0.00025	0.129	0.054	0.00015	10.3	9.63	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	23-Mar-2021	0.025	0.452	0.00128	3.90	0.000005	1.70	0.273	120	0.000005	0.00005	0.00015	0.00435	0.00025	0.117	0.094	0.00015	9.59	9.18	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	13-Apr-2021	0.025	0.490	0.00150	4.13	0.000005	1.75	0.256	122	0.000005	0.00005	0.00015	0.00432	0.00025	0.114	0.069	0.00015	10.1	9.78	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	05-May-2021	0.025	1.15	0.000644	2.68	0.000011	3.04	0.194	81.8	0.000005	0.00005	0.00015	0.00213	0.00025	0.169	0.151	0.00015	7.05	7.10	1.00	
KV-6	Christal Creek u/s Silver Trail Highway	07-May-2021															0.003					
KV-6	Christal Creek u/s Silver Trail Highway	16-May-2021	0.025	0.526	0.000571	2.38	0.000015	0.997	0.140	52.5	0.000005	0.00005	0.00043	0.00174	0.00025	0.181	0.060	0.00015	4.71	4.55	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	08-Jun-2021	0.025	0.434	0.00104	2.65	0.000005	1.37	0.210	82.6	0.000005	0.00005	0.00030	0.00350	0.00025	0.222	0.198	0.00015	7.50	6.78	1.05	
KV-6	Christal Creek u/s Silver Trail Highway	28-Jun-2021	0.025	0.249	0.00105	2.99	0.000005	1.56	0.247	111	0.000005	0.00005	0.00015	0.00405	0.00025	0.146	0.061	0.00015	9.22	8.78	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	16-Jul-2021	0.025	0.299	0.00114	2.88	0.000005	1.74	0.237	119	0.000005	0.00005	0.00015	0.00442	0.00025	0.18	0.084	0.00015	9.57	8.53	1.06	
KV-6	Christal Creek u/s Silver Trail Highway	19-Aug-2021	0.025	0.261	0.00111	3.08	0.000005	1.50	0.216	90.9	0.000005	0.00005	0.00015	0.00346	0.00025	0.209	0.074	0.00015	7.80	7.56	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	22-Sep-2021	0.025	0.502	0.00128	3.84	0.000005	1.90	0.268	130	0.000005	0.00005	0.00015	0.00406	0.00025	0.422	0.063	0.00015	9.48	9.44	1.00	
KV-6	Christal Creek u/s Silver Trail Highway	15-Oct-2021	0.025	0.315	0.00123	3.69	0.000005	1.58	0.229	100	0.000005	0.00005	0.00015	0.00395	0.00025	0.244	0.090	0.00015	8.99	8.40	1.03	
KV-6	Christal Creek u/s Silver Trail Highway	11-Nov-2021	0.025	0.617	0.00123	4.33	0.000005	2.24	0.279	113	0.000005	0.00005	0.00015	0.00462	0.00025	0.193	0.092	0.00015	9.70	9.98	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	01-Dec-2021	0.025	0.423	0.00129	4.40	0.000005	1.81	0.256	120	0.000005	0.00005	0.00015	0.00405	0.00025	0.166	0.101	0.00015	9.93	9.95	1.00	
KV-6	Christal Creek u/s Silver Trail Highway	26-Jan-2022															0.002					
KV-6	Christal Creek u/s Silver Trail Highway	21-Feb-2022	0.025	0.622	0.00124	4.37	0.000005	1.79	0.286	122	0.000005	0.00005	0.00015	0.00485	0.00025	0.101	0.105	0.00015	11.0	10.1	1.04	

Christal Creek Attenuation Study, 2008 to 2022 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
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
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
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
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
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
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
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
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022		105.8		0.5	7.78	8.21	709.7	797	6.4	10.72	87.2	211.2	433	428	110
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
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
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2023				2.7	8.11	8.19	837.3	842	-0.2	11.05	75.6	218.3	432	440	124
		13-Dec-2023															
KV-49	Hinton Creek upstream Christal Creek	18-May-2008				2	7.31	6.77		30	2					19	
KV-49	Hinton Creek upstream Christal Creek	03-Oct-2008				6	7.52	7.19		119	0					61	
KV-49	Hinton Creek upstream Christal Creek	28-May-2009				3	6.64	6.6		87	2.5				38.9	40.2	
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2009				0.5	7.43	6.9		960	4.1				535	522	
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2009				0.5	8.33	6.7		982	0.8				536	542	
KV-49	Hinton Creek upstream Christal Creek	08-Jul-2010				1	6.65	7.1		941	6				488	530	
KV-49	Hinton Creek upstream Christal Creek	11-Feb-2011	no water found														
KV-49	Hinton Creek upstream Christal Creek	23-Mar-2011	no sample; frozen to ground														
KV-49	Hinton Creek upstream Christal Creek	20-Apr-2011	chipped to ground. No water														
KV-49	Hinton Creek upstream Christal Creek	26-May-2011	widely dispersed flow. Flow not taken			0.5	7.71	6.62		375	3.1				187	185	3.7
KV-49	Hinton Creek upstream Christal Creek	22-Jun-2011	no sample. Damp moss, but no water														
KV-49	Hinton Creek upstream Christal Creek	19-Jul-2011	not visited. No helper/lack of time														
KV-49	Hinton Creek upstream Christal Creek	16-Aug-2011	dry	0													
KV-49	Hinton Creek upstream Christal Creek	22-Sep-2011	marshy conditions, not enough moving water for flow metering			8	8.24	7.03	715	709	2.9				357	359	9.6
KV-49	Hinton Creek upstream Christal Creek	31-Oct-2011	Dry	0													
KV-49	Hinton Creek upstream Christal Creek	26-Nov-2011	no flow	0													
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011	dry	0													
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012	dry	0													
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012	No water observed	0													
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012	No water observed	0													
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012	No water observed	0													
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	braided, iced over - no flow measurements; no YSI for insitu			0.5		6.91		506					252	253	9.83
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	High water flowing through bushes.	6.741		0.5	6.68	6.75	540.6	492	1.8	15.7	113	314.3	219	213	6.34
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	5.56C	45.3	132.6	386	371	11.9
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	6C	51	24.6	360	359	14.2

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022	0.025	1.34	0.157C	366	429	0.0771	6.19	0.0022	0.275		1.26	0.0245	0.1	0.00024	0.0148	0.0594	0.000050	0.000025	0.005	0.00079	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	0.125	4.38	0.116	342	429	0.0892	10.1	0.0025	0.251		3.57	0.128C	0.1	0.00077	0.0264	0.0580	0.000050	0.000025	0.005	0.0014	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	0.025	1.04	0.071	104	309	0.0177	10.7	0.0005	0.0609		18.8	0.100	0.1	0.00057	0.0107	0.0297	0.000050	0.000025	0.005	0.00163	0.000232
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	0.025	0.73	0.108	225	429	0.0278	0.829	0.0005	0.126		6.41	0.0318	0.1	0.00028	0.00531	0.0440	0.000050	0.000025	0.005	0.000876	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	0.125	1.25	0.141C	340	429	0.0176	1.84	0.0025	0.148		3.87	0.0631	0.1	0.00052	0.00897	0.0638	0.000050	0.000025	0.005	0.0016	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022	0.125	1.25	0.050	353	429	0.0120	1.05	0.0025	0.156		3.18	0.0234	0.1	0.00035	0.00434	0.0596	0.000050	0.000025	0.005	0.00113	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022	0.125	1.25	0.107	352	429	0.0057	1.88	0.0025	0.151		3.34	0.0484	0.1	0.00024	0.00460	0.0584	0.000050	0.000025	0.005	0.00128	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	14-Oct-2022	0.125	1.25	0.050	291	429	0.0297	7.93	0.0025	0.254		4.91	0.0486	0.1	0.00039	0.0057	0.0546	0.000050	0.000025	0.005	0.00345	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	0.125	11.8	0.118	356	429	0.0750	4.36	0.0025	0.277		2.04	0.0435	0.1	0.00067	0.00951	0.0667	0.000050	0.000070	0.005	0.00126	0.00037
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2023	0.125	1.25	0.129C	350	429	0.0743	1.49	0.0025	0.293		2.26	0.0137	0.1	0.00017	0.00878	0.0575	0.000050	0.000025	0.005	0.000967	0.00037
		13-Dec-2023																					
KV-49	Hinton Creek upstream Christal Creek	18-May-2008					128		7.88					0.119C	0.1	0.0001	0.0004	0.017	0.00005	0.00025	0.001	0.00011	0.00004
KV-49	Hinton Creek upstream Christal Creek	03-Oct-2008					218		5.75					0.051	0.1	0.0001	0.0003	0.043	0.00002	0.00005	0.0025	0.0002	0.00011
KV-49	Hinton Creek upstream Christal Creek	28-May-2009					218		35.3					0.161C	0.1	0.00016	0.00056	0.0425	0.000005	0.0000025	0.025	0.000098	0.0000724
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2009					429		5.03					0.0193	0.1	0.0001	0.00018	0.118	0.000005	0.0000025	0.025	0.000708	0.00037
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2009					429		0.846					0.0198	0.1	0.00012	0.00024	0.0578	0.000005	0.0000025	0.025	0.000704	0.00037
KV-49	Hinton Creek upstream Christal Creek	08-Jul-2010					429		25.9					0.0535	0.1	0.00043	0.00275	0.0407	0.000005	0.0000025	0.025	0.000705	0.00037
KV-49	Hinton Creek upstream Christal Creek	11-Feb-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	23-Mar-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	20-Apr-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	26-May-2011				150	429		2.87				8.6	0.0416	0.1	0.00014	0.0002	0.0468	0.000005	0.0000025	0.025	0.000227	0.000266
KV-49	Hinton Creek upstream Christal Creek	22-Jun-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	19-Jul-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	16-Aug-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	22-Sep-2011				320	429		0.873				4.7	0.0313	0.1	0.00016	0.00066	0.0419	0.000005	0.0000025	0.025	0.000419	0.00037
KV-49	Hinton Creek upstream Christal Creek	31-Oct-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	26-Nov-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	03-May-2012		0.25		210	429		23.4				13.9	0.0516	0.1	0.000122	0.000407	0.0755	0.000005	0.0000025	0.025	0.000325	0.000341
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012		0.57		193	429		34.1				5.51	0.0218	0.1	0.000124	0.000313	0.0441	0.00001	0.0000025	0.025	0.000131	0.000304
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012		0.25		336	429		68.6				7.44	0.0402C	0.005	0.000288	0.00144	0.0497	0.000011	0.0000025	0.025	0.000485	0.00037
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012		0.25		300	429		9.01				5.65	0.0197	0.1	0.000128	0.000253	0.0438	0.000005	0.0000025	0.025	0.000366	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022	157	0.00025	0.00128	0.00025	0.004	0.993	0.00806	0.007	0.0281	0.0136	26.4	1.01	6.1	0.0000025	0.000234	0.00327	0.15
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	160	0.00025	0.00182	0.00162	0.004	1.84	0.0249	0.007	0.0286	0.0152	26.5	1.11	6.1	0.0000025	0.000302	0.00453	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	50.4	0.00025	0.00105	0.00238	0.00349	0.908	0.0211	0.00569	0.00901	0.0039	7.83	0.529	2.3	0.0000056	0.000191	0.00311	0.135
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	96.0	0.00025	0.00072	0.00091	0.004	0.582	0.00350	0.007	0.0161	0.0080	14.3	0.514	3.8	0.0000025	0.000305	0.00262	0.15
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	139	0.00025	0.00061	0.00098	0.004	0.626	0.015	0.007	0.0247	0.0096	24.3	0.489	5.5	0.0000025	0.000261	0.00290	0.15
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022	143	0.00025	0.00039	0.00055	0.004	0.298	0.00550	0.007	0.0255	0.0104	25.1	0.331	5.6	0.0000025	0.000282	0.00232	0.15
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022	134	0.00025	0.00070	0.00025	0.004	0.309	0.00209	0.007	0.0239	0.0100	24.0	0.494	5.3	0.0000025	0.000306	0.00304	0.15
KV-6	Christal Creek u/s Silver Trail Highway	14-Oct-2022	117	0.00025	0.00094	0.00079	0.004	0.422	0.00861	0.007	0.0210	0.0079	22.3	0.731	4.8	0.0000025	0.000246	0.00331	0.15
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	146	0.00174C	0.00144	0.00186	0.004	0.709	0.00951	0.007	0.0263	0.0120	26.0	1.14	5.7	0.0000025	0.000240	0.00356	0.15
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2023	135	0.00025	0.00143	0.00025	0.004	0.702	0.00278	0.007	0.0238	0.0106	23.1	0.899	5.3	0.0000025	0.000245	0.00311	0.15
		13-Dec-2023																	
KV-49	Hinton Creek upstream Christal Creek	18-May-2008	5.5	0.0007	0.0001	0.002	0.002	0.2	0.0002	0.001	0.0037	0.0005	1.1	0.014	0.75		0.0005	0.0017	0.025
KV-49	Hinton Creek upstream Christal Creek	03-Oct-2008	18.1	0.0005	0.00008	0.002	0.002	0.05	0.0002	0.0017	0.0050	0.0005	3.64	0.0028	1.2		0.00002	0.001	0.066
KV-49	Hinton Creek upstream Christal Creek	28-May-2009	12.3	0.0005	0.000151	0.00181	0.002	0.101	0.00031	0.001	0.00427	0.001	1.96	0.028	0.97	0.000005	0.00006	0.00131	0.025
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2009	175	0.0002	0.000065	0.00054	0.004	0.042	0.00024	0.007	0.0302	0.0021	23.7	0.0194	6.4	0.000005	0.000025	0.00199	0.15
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2009	174	0.0003	0.000066	0.00049	0.004	0.297	0.000227	0.007	0.0303	0.0014	24.9	0.0219	6.4		0.000025	0.00203	0.15
KV-49	Hinton Creek upstream Christal Creek	08-Jul-2010	160	0.0008	0.000201	0.0017	0.004	0.256	0.0115	0.007	0.0273	0.0018	21.7	0.084	5.9	0.000005	0.000025	0.00274	0.15
KV-49	Hinton Creek upstream Christal Creek	11-Feb-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	23-Mar-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	20-Apr-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	26-May-2011	62.2	0.0004	0.000058	0.00104	0.004	0.033	0.000714	0.007	0.0104	0.0019	7.76	0.00697	2.6	0.000005	0.000025	0.00105	0.15
KV-49	Hinton Creek upstream Christal Creek	22-Jun-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	19-Jul-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	16-Aug-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	22-Sep-2011	116	0.0004	0.000096	0.00093	0.004	0.917	0.00103	0.007	0.0194	0.0012	16.5	0.0155	4.5	0.000005	0.00013	0.00115	0.15
KV-49	Hinton Creek upstream Christal Creek	31-Oct-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	26-Nov-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	83.1	0.00005	0.000133	0.00154	0.004	0.0984	0.000419	0.007	0.0136	0.00182	10.8	0.0437	3.3	0.000005	0.000025	0.0013	0.15
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	70.9	0.00005	0.0000366	0.000874	0.004	0.02	0.000469	0.007	0.0119	0.002	10.3	0.00272	3.0	0.000005	0.000025	0.000888	0.15
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012	126	0.00017	0.000121	0.00149	0.004	0.246	0.00806	0.007	0.0211	0.0017	17.7	0.0311	4.8	0.000005	0.000025	0.00161	0.15
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012	117	0.00005	0.000064	0.00103	0.004	0.114	0.00125	0.007	0.0196	0.00147	16.6	0.00518	4.5	0.000005	0.000025	0.00126	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022	0.025	0.507	0.00124C	4.33	0.000038	1.72	0.265	125	0.000005	0.00005	0.00075	0.00486	0.00025	0.116	0.316	0.00010	0.0011	0.00016	0.00812
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	0.025	1.09	0.00124C	4.47	0.000145	3.53	0.268	120	0.000005	0.00005	0.00318	0.00459	0.00025	0.185	0.322	0.00010	0.0044	0.00037	0.00959
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	0.025	0.646	0.000409	2.18	0.000422C	0.965	0.0897	39.3	0.000005	0.00005	0.00204	0.00110	0.00025	0.238J	0.0585	0.00010	0.0282	0.00029	0.00521
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	0.025	0.349	0.000818	2.60	0.000013	1.09	0.174	79.4	0.000005	0.00005	0.00082	0.00277	0.00025	0.230J	0.164	0.00010	0.0108	0.00025	0.00371
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	0.025	0.264	0.00116C	2.97	0.000074	1.75	0.249	118	0.000005	0.00005	0.00179	0.00437	0.00025	0.245	0.275	0.00010	0.0026	0.00031	0.00301
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022	0.025	0.265	0.00125C	2.86	0.000016	1.75	0.267	126	0.000005	0.00005	0.00045	0.00400	0.00025	0.196	0.285	0.00010	0.0036	0.00026	0.00243
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022	0.025	0.421	0.00104C	2.80	0.000014	1.62	0.246	116	0.000005	0.00005	0.00058	0.00385	0.00025	0.276J	0.265	0.00010	1.89	0.00022	0.00272
KV-6	Christal Creek u/s Silver Trail Highway	14-Oct-2022	0.025	0.456	0.00118C	3.89	0.000058	1.59	0.231	109	0.000005	0.00005	0.00123	0.00361	0.00025	0.603J	0.228	0.00010	0.0072	0.00028	0.00253
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	0.025	0.605	0.00124C	4.37	0.000057	9.00	0.249	125	0.000005	0.00005	0.00132	0.00408	0.00025	0.276	0.294	0.00010	0.0020	0.00019	0.00520
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2023	0.025	0.477	0.00112C	4.14	0.000005	1.61	0.246	117	0.000005	0.00005	0.00050	0.00376	0.00025	0.128	0.264	0.00010	0.0005	0.00016	0.00514
		13-Dec-2023																			
KV-49	Hinton Creek upstream Christal Creek	18-May-2008		0.2	0.0001	1.39	0.00002	0.2	0.017	0.7	0.000025	0.0005	0.0012	0.00025	0.0002	0.02J	0.0075	0.0005	0.106		0.0004
KV-49	Hinton Creek upstream Christal Creek	03-Oct-2008	0.005	0.05	0.0003	3.33	0.00004	0.52	0.042		0.000005	0.00005	0.0012	0.0002	0.00006	0.015J	0.0075	0.0002	0.044	0.0009	0.0002
KV-49	Hinton Creek upstream Christal Creek	28-May-2009	0.026	0.36	0.00015	1.14	0.00002	0.25	0.0293	9	0.000001	0.000005	0.0017	0.000031	0.0001	0.0145J	0.0075	0.0003	0.168	0.0002	0.00064
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2009	0.004	0.09	0.00013	2.18	0.0000025	1.26	0.35	173	0.000001	0.000005	0.00025	0.00001	0.0001	0.0693	0.341	0.00005	0.0178	0.0001	0.00013
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2009		0.19	0.00015	3.16	0.0000025	1.69	0.325	183	0.000001	0.000005	0.00025	0.000005	0.0001	0.0515	0.342	0.00005	0.0135	0.00012	0.00015
KV-49	Hinton Creek upstream Christal Creek	08-Jul-2010	0.024	0.2	0.0001	2.29	0.000031	1.52	0.314	175	0.000007	0.00012	0.002	0.000021	0.0001	0.0657	0.306	0.00005	0.0162	0.00016	0.00024
KV-49	Hinton Creek upstream Christal Creek	11-Feb-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	23-Mar-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	20-Apr-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	26-May-2011	0.007	0.22	0.00021	1.9	0.000014	0.65	0.111	63	0.000001	0.000005	0.00025	0.000011	0.0001	0.0237	0.0802	0.00005	0.0423	0.00014	0.00025
KV-49	Hinton Creek upstream Christal Creek	22-Jun-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	19-Jul-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	16-Aug-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	22-Sep-2011	0.015	0.18	0.00011	3.2	0.000016	1.24	0.211	121	0.000001	0.00014	0.00025	0.000008	0.0002	0.0281	0.208	0.00005	0.011	0.00014	0.00015
KV-49	Hinton Creek upstream Christal Creek	31-Oct-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	26-Nov-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	0.0169	0.585	0.000123	1.59	0.00001	0.774	0.155	81	0.0000010	0.00010	0.00025	0.00002	0.00010	0.0333	0.129	0.00011	0.0502	0.000114	0.000443
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	0.0044	0.196	0.000254	1.79	0.0000131	0.785	0.14	83	0.0000010	0.00010	0.00025	0.0000086	0.00010	0.0212	0.104	0.00005	0.0208	0.000123	0.000309
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012	0.0197	0.077	0.000098	3.38	0.0000329	1.21	0.217	134	0.0000028	0.00010	0.00106	0.0000153	0.00010	0.0499	0.230	0.00005	0.0181	0.000116	0.000264
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012	0.0029	0.025	0.000109	2.94	0.000008	1.16	0.22	118	0.0000010	0.00010	0.00025	0.000012	0.00010	0.0348	0.210	0.00005	0.0147	0.000135	0.00023

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022	0.0551	0.000050	0.000025	0.005	0.000222	0.000457	158	0.00025	0.00121	0.00025	0.453	0.000176	0.0137	25.7	0.921	0.0000025	0.000240	0.00315
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	0.0514	0.000050	0.000025	0.005	0.000451	0.000457	155	0.00025	0.00154	0.00067	0.479	0.000698	0.0136	23.7	1.01	0.0000025	0.000256	0.00375
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	0.0274	0.000050	0.000025	0.005	0.00116J	0.000296	51.6	0.00025	0.00089	0.00170	0.451	0.00308	0.0041	8.32	0.477	0.0000025	0.000160	0.00292
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	0.0432	0.000050	0.000025	0.005	0.000799J	0.000457	96.4	0.00025	0.00066	0.00085	0.316	0.00114	0.0077	14.2	0.538	0.0000025	0.000246	0.00260
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	0.0534	0.000050	0.000025	0.005	0.000598J	0.000457	131	0.00025	0.00041	0.00046	0.034	0.000382	0.0099	24.6	0.388	0.0000025	0.000263	0.00274
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022	0.0570	0.000050	0.000025	0.005	0.000840J	0.000457	145	0.00025	0.00032	0.00041	0.053	0.000429	0.0092	25.1	0.292	0.0000025	0.000273	0.00223
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022	0.547	0.000050	0.000025	0.005	0.00112J	0.000457	132	0.00025	0.00075	0.00061	0.070	0.000577	0.0200	23.9	0.494	0.0000025	0.000370	0.00293
KV-6	Christal Creek u/s Silver Trail Highway	14-Oct-2022	0.0458	0.000050	0.000025	0.005	0.00294J	0.000457	129	0.00025	0.00084	0.00128	0.077	0.000460	0.0090	22.9	0.662	0.0000025	0.000239	0.00320
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	0.0632	0.000050	0.000025	0.005	0.000570J	0.000457	148	0.00025	0.00130	0.00053	0.279	0.000166	0.0112	26.5	1.09	0.0000025	0.000235	0.00314
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2023	0.0587	0.000050	0.000025	0.005	0.000166	0.000457	139	0.00025	0.00136	0.00010	0.291	0.000060	0.0111	22.6	0.878	0.0000025	0.000260	0.00286
		13-Dec-2023																		
KV-49	Hinton Creek upstream Christal Creek	18-May-2008	0.016	0.00005	0.00025	0.001	0.00006	0.000062	5.7	0.0005	0.00005	0.002	0.07	0.0002	0.0005	1.1	0.0025		0.0005	0.0016
KV-49	Hinton Creek upstream Christal Creek	03-Oct-2008	0.04	0.00002		0.002	0.00012	0.00015	18.4	0.0005	0.00015	0.002	0.059	0.0004	0.0005	3.67	0.0018		0.00003	0.001
KV-49	Hinton Creek upstream Christal Creek	28-May-2009	0.0413	0.000005	0.0000025	0.025	0.000087	0.000106	12.8	0.0006	0.000168	0.002	0.111	0.000778	0.0011	2	0.0322	0.00002	0.00006	0.00129
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2009	0.115	0.000005	0.0000025	0.025	0.000662J	0.000457	171	0.0002	0.000066	0.0005	0.036	0.000126	0.0025	23.3	0.0175	0.000005	0.000025	0.00188
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2009	0.0554	0.000005	0.0000025	0.025	0.000649J	0.000457	176	0.0004	0.000046	0.00048	0.038	0.000044	0.0015	25	0.0122	0.000005	0.000025	0.002
KV-49	Hinton Creek upstream Christal Creek	08-Jul-2010	0.036	0.000005	0.0000025	0.025	0.000409	0.000457	175	0.0004	0.000065	0.00072	0.054	0.000434	0.0017	22.4	0.0162	0.000005	0.000025	0.00176
KV-49	Hinton Creek upstream Christal Creek	11-Feb-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	23-Mar-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	20-Apr-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	26-May-2011	0.0457	0.000005	0.0000025	0.025	0.000228	0.000335	61.4	0.0004	0.000063	0.00107	0.028	0.000313	0.0019	7.79	0.00674	0.000005	0.00006	0.00103
KV-49	Hinton Creek upstream Christal Creek	22-Jun-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	19-Jul-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	16-Aug-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	22-Sep-2011	0.0405	0.000005	0.0000025	0.025	0.000387	0.000457	117	0.0002	0.000031	0.00062	0.018	0.000045	0.0014	15.9	0.00257	0.000005	0.000025	0.00102
KV-49	Hinton Creek upstream Christal Creek	31-Oct-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	26-Nov-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	0.0764	0.000005	0.0000025	0.025	0.000298	0.000418	83.6	0.00011	0.000131	0.00157	0.0921	0.00034	0.00263	10.7	0.0438	0.000005	0.000025	0.00128
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	0.0421	0.000005	0.0000025	0.025	0.000113	0.000377	68.2	0.00005	0.0000413	0.000886	0.0139	0.0000653	0.00215	10.4	0.00185	0.000005	0.000055	0.000992
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012	0.0478	0.000005	0.0000025	0.025	0.000373	0.000457	122	0.00005	0.0000906	0.00167	0.04	0.000149	0.00154	16.3	0.0159	0.000005	0.000025	0.00133
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012	0.0425	0.000005	0.0000025	0.025	0.000335	0.000457	116	0.00005	0.000195	0.000673	0.23	0.00022	0.00159	16.6	0.0256	0.000005	0.000074	0.00113

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-6	Christal Creek u/s Silver Trail Highway	24-Mar-2022	0.025	0.562	0.00137	4.32	0.000005	1.85	0.277	130	0.000005	0.00005	0.00015	0.00506	0.00025	0.102	0.073	0.00015	10.5	10.2	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	26-Apr-2022	0.025	1.03	0.000989	3.78	0.000005	3.31	0.248	116	0.000005	0.00005	0.00015	0.00400	0.00025	0.15	0.133	0.00015	9.77	9.92	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	15-May-2022	0.025	0.631	0.000371	1.88	0.000015	0.910	0.0916	37.1	0.000005	0.00005	0.00035	0.000973	0.00025	0.227	0.116	0.00015	3.26	3.36	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	09-Jun-2022	0.025	0.347	0.000648	2.50	0.000005	1.08	0.178	75.2	0.000005	0.00005	0.00015	0.00270	0.00025	0.226	0.065	0.00015	6.33	6.08	1.02	
KV-6	Christal Creek u/s Silver Trail Highway	28-Jul-2022	0.025	0.264	0.00111	2.90	0.000005	1.63	0.234	117	0.000005	0.00005	0.00015	0.00398	0.00025	0.192	0.093	0.00015	9.42	8.66	1.04	
KV-6	Christal Creek u/s Silver Trail Highway	03-Aug-2022	0.025	0.248	0.00111	2.43	0.000005	1.67	0.277	118	0.000005	0.00005	0.00015	0.00384	0.00025	0.173	0.073	0.00015	9.54	9.40	1.01	
KV-6	Christal Creek u/s Silver Trail Highway	15-Sep-2022	0.025	0.438	0.000986	3.10	0.000005	1.64	0.257	113	0.000005	0.00005	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	0.025	0.440	0.000934	3.59	0.000005	1.66	0.238	103	0.000005	0.00005	0.00015	0.00336	0.00025	0.583	0.136	0.00015	8.39	8.45	1.00	
KV-6	Christal Creek u/s Silver Trail Highway	23-Nov-2022	0.025	0.513	0.00135	4.76	0.000005	15.1	0.264	128	0.000005	0.00005	0.00015	0.00413	0.00025	0.231	0.078	0.00015	10.4	10.3	1.00	
KV-6	Christal Creek u/s Silver Trail Highway	12-Dec-2023	0.025	0.469	0.00112	4.18	0.000005	1.64	0.256	114	0.000005	0.00005	0.00015	0.00384	0.00025	0.126	0.055	0.00015	9.79	8.93	0.95	
		13-Dec-2023																				6.5
KV-49	Hinton Creek upstream Christal Creek	18-May-2008		0.2	0.0001	1.39	0.000005	0.2	0.016	0.7	0.000025	0.0005	0.0008	0.00025	0.0002	0.021	0.003					
KV-49	Hinton Creek upstream Christal Creek	03-Oct-2008	0.005	0.05	0.0003	3.33	0.000005	0.5	0.041		0.000005	0.00005	0.0008	0.0002	0.00008	0.013	0.007	0.0002				
KV-49	Hinton Creek upstream Christal Creek	28-May-2009	0.019	0.39	0.0002	1.21	0.000027	0.26	0.0285	11	0.000002	0.00003	0.0017	0.000031	0.0005	0.0183	0.009	0.0003				
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2009	0.003	0.09	0.00013	2.06	0.0000025	1.23	0.353	162	0.000001	0.000005	0.00025	0.000009	0.0001	0.0684	0.043	0.00005				
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2009	0.007	0.2	0.00016	3.22	0.0000025	1.68	0.328	182	0.000001	0.000005	0.00025	0.000004	0.0001	0.0459	0.024	0.00005				
KV-49	Hinton Creek upstream Christal Creek	08-Jul-2010	0.006	0.12	0.0001	2.63	0.0000025	1.5	0.306	176	0.000001	0.00003	0.00025	0.00001	0.0001	0.035	0.081	0.00005				
KV-49	Hinton Creek upstream Christal Creek	11-Feb-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	23-Mar-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	20-Apr-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	26-May-2011	0.007	0.19	0.0002	1.89	0.000006	0.66	0.108	59	0.000001	0.000005	0.00025	0.000006	0.0001	0.0247	0.063	0.00005				
KV-49	Hinton Creek upstream Christal Creek	22-Jun-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	19-Jul-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	16-Aug-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	22-Sep-2011	0.007	0.16	0.0001	3.2	0.0000025	1.16	0.217	120	0.000001	0.00005	0.00025	0.000006	0.0001	0.0275	0.066	0.0002				
KV-49	Hinton Creek upstream Christal Creek	31-Oct-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	26-Nov-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	20-Dec-2011															0.002					
KV-49	Hinton Creek upstream Christal Creek	12-Jan-2012															0.002					
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2012															0.002					
KV-49	Hinton Creek upstream Christal Creek	11-Mar-2012															0.002					
KV-49	Hinton Creek upstream Christal Creek	08-Apr-2012															0.002					
KV-49	Hinton Creek upstream Christal Creek	03-May-2012	0.0125	0.598	0.000186	1.53	0.000008	0.763	0.158	82	0.0000010	0.00010	0.00055	0.000018	0.00010	0.0337	0.196	0.00011				
KV-49	Hinton Creek upstream Christal Creek	03-Jun-2012	0.0047	0.191	0.000259	1.73	0.0000025	0.81	0.138	84	0.0000010	0.00010	0.00025	0.0000057	0.00010	0.021	0.139	0.00005				
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2012	0.0104	0.025	0.000102	3.15	0.0000025	1.05	0.218	120	0.0000010	0.00072	0.00025	0.0000092	0.00010	0.0376	0.307	0.00005				
KV-49	Hinton Creek upstream Christal Creek	01-Aug-2012	0.0010	0.025	0.000103	2.88	0.0000025	1.14	0.214	118	0.0000010	0.00010	0.00025	0.000012	0.00010	0.0308	0.172	0.00005				

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
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	6.29C	43.3		745	743	29.7
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012	No water observed.	0													
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012	No water obseved. Seems to be frozen to the ground.	0													
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013	No water found. Frozen to the ground.	0													
KV-49	Hinton Creek upstream Christal Creek	03-May-2013	Frozen to the ground.	0													
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	5.02C	41.5	127.3	361	370	15.0
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	Very little flow.			0.5	7.18	7.97	556.2	494	0	11.98	82.9	-19	284	290	18.9
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014	frozen to the ground, no water found.	0													
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
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	6.12C	49.1	182.5	210	223	20.1
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014	Frozen to the gound.	0													
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015	No water observed, frozen to the ground.	0													
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
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	0													
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	Multiple channels, no flow conducted.			0.5	6.72	6.80	328.8	364	0.2	13.2	101	239	189	193	9.7
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
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016	Site frozen to ground	0													
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017	Frozen. Chipped around area, no water found.	0													
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.			0.5	7.16	6.55	191.5	160	0.5	11.41	89	130.4	75.6	73.7	8.1
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017	Wet moss but not enough water to sample.	0													
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017				6.8	7.05	7.55	733.5	681	-0.3	5.00C	38.6	47.4	360	360	57.3
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)			0.5	6.54	6.64	163.8	172	0.0	11.89	90.4	127.4	81.8	78.2	6.7
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	Lots of water running through willow no defined channel, not possible to measure flow.			0.5	7.25	7.01	400.1	454	1.1	11.10	88.0	80.1	225	227	8.7
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			0.5	7.34	7.52	468	463		6.20C	54.0	163.4	231	220	31.7
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
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.			1.2	6.69	7.01	213.2	227	1.1	11.67	80.2	56.7	100	118	8.3
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012		0.71		309	429		0.622				5.42	0.0111	0.1	0.000112	0.000153	0.0323	0.000005	0.0000025	0.025	0.000304	0.00037
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012		0.25		701	429		49.9				3.26	0.0686	0.1	0.00016	0.00065	0.0685	0.000025	0.0000125	0.125	0.000774	0.00037
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	03-May-2013					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013		0.25	0.022	348	429		37.0	0.0005	0.0025		6.46	0.0406C	0.005	0.00022	0.00043	0.0553	0.00005	0.00025	0.005	0.000539	0.00037
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013		0.25	0.031	253	429		12.6	0.0005	0.337		6.47	0.0194	0.1	0.00015	0.00031	0.0264	0.00005	0.00025	0.005	0.000310	0.00037
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	06-May-2014		0.25	0.054	25.0	218		61.2	0.0005	0.0171		28.2	0.178C	0.005	0.00016	0.00054	0.0217	0.00005	0.00025	0.005	0.00025	0.0000774
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014		0.25	0.035	187	429		17.8	0.0005	0.0025		7.32	0.0961	0.1	0.00021	0.00101	0.0418	0.00005	0.00025	0.005	0.000364	0.000293
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-May-2015		0.25	0.057	60.3	218		168	0.0005	0.0055		22.4	0.149C	0.005	0.00013	0.00047	0.0384	0.00005	0.000025	0.005	0.000261	0.000126
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	04-May-2016		0.25	0.036	152	429		35.6	0.0005	0.0614		13.4	0.0580	0.1	0.00013	0.00036	0.0570	0.00005	0.000025	0.005	0.0000761	0.000269
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016		0.25	0.049	247	429		4.67	0.0005	0.0770		5.91	0.0129	0.1	0.00015	0.00024	0.0411	0.00005	0.000025	0.005	0.000183	0.00037
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	0.025	0.25	0.044	61.9	218		12.6	0.0005	0.0122		18.9	0.157C	0.1	0.00012	0.00043	0.0316	0.00005	0.000025	0.005	0.0000994	0.000126
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017	0.025	0.15	0.036	319	429		16.9	0.0005	0.823		5.59	0.0613	0.1	0.00022	0.00049	0.0413	0.00005	0.000025	0.005	0.000396	0.00037
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	0.025	0.25	0.058	63.3	309		54.7	0.0005	0.0112		26.8	0.194C	0.1	0.00015	0.00048	0.0288	0.00005	0.000025	0.005	0.000253	0.000134
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	0.025	0.25	0.032	218	429	0.0025	9.75	0.0005	0.0356		7.89	0.0407	0.1	0.00014	0.00030	0.0696	0.00005	0.000025	0.005	0.000200	0.000311
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	0.025	0.25	0.038	196	429		8.69	0.0005	0.0025		6.84	0.132C	0.1	0.00018	0.00034	0.0549	0.00005	0.000025	0.005	0.000264	0.000318
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	0.025	0.25	0.048	206	429	0.0025	16.2	0.0005	0.204		6.10	0.0178	0.1	0.00018	0.00028	0.0515	0.00005	0.000025	0.005	0.000242	0.000333
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	0.025	0.25	0.044	87.9	309		35.3	0.0005	0.0344		14.3	0.0943	0.1	0.00013	0.00033	0.0316	0.00005	0.000025	0.005	0.0000678	0.000158
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	0.025	0.25	0.036	246	429	0.0025	6.95	0.0012	0.134		6.36	0.0125	0.1	0.00013	0.00024	0.0370	0.00005	0.000025	0.005	0.0000642	0.000356

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012	107	0.00005	0.000033	0.000595	0.004	0.0225	0.000176	0.007	0.0182	0.00125	16.9	0.00396	4.2	0.000005	0.000025	0.000825	0.15
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012	241	0.00025	0.000394	0.00145	0.004	0.699	0.00747	0.007	0.0443	0.00125	34.8	0.0632	8.7	0.000025C	0.00096	0.00255	0.15
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	03-May-2013					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013	117	0.00019	0.00010	0.00186	0.004	0.128	0.00127	0.007	0.0196	0.00178	16.8	0.0204	4.5	0.000005	0.000025	0.00144	0.15
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	90.8	0.00013	0.00005	0.00084	0.004	0.037	0.000327	0.007	0.0153	0.00073	13.9	0.00474	3.7	0.000005	0.000025	0.00152	0.15
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	06-May-2014	14.1	0.00036	0.00023	0.00344C	0.002	0.132	0.00103	0.001	0.00437	0.00100	1.72	0.0594	1.0	0.000013	0.000025	0.00158	0.025
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014	68.8	0.00024	0.00016	0.00167	0.004	0.934	0.00261	0.007	0.0115	0.00177	9.18	0.0213	2.9	0.000005	0.000025	0.00102	0.15
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	12-May-2015	25.5	0.00035	0.00027	0.00225C	0.002	0.096	0.000469	0.00223	0.00554	0.0019	2.94	0.0787	1.4	0.0000305C	0.000025	0.00126	0.0773
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	63.7	0.00010	0.00011	0.00140	0.004	0.047	0.000126	0.007	0.0105	0.0030	7.19	0.0113	2.6	0.0000051	0.000025	0.00095	0.15
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016	98.8	0.00005	0.00005	0.00074	0.004	0.011	0.000025	0.007	0.0164	0.0014	13.6	0.00123	3.9	0.0000025	0.000025	0.00069	0.15
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	25.0	0.00025	0.00019	0.00212C	0.002	0.086	0.000255	0.00223	0.00554	0.0021	3.22	0.0235	1.4	0.0000102	0.000025	0.00114	0.0772
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017	112	0.00094	0.00013	0.00109	0.004	0.31	0.000827	0.007	0.0196	0.0005	19.4	0.0182	4.5	0.0000125	0.000099	0.00095	0.15
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	27.6	0.00039	0.00019	0.00267C	0.002	0.118	0.000335	0.00246	0.00578	0.0026	3.14	0.0376	1.4	0.0000108	0.000025	0.00134	0.0820
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	74.6	0.00013	0.00005	0.00115	0.004	0.026	0.000117	0.007	0.0122	0.0026	9.45	0.00130	3.0	0.0000025	0.000025	0.00100	0.15
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	73.4	0.00023	0.00005	0.00103	0.004	0.044	0.000269	0.007	0.0126	0.0017	11.5	0.00293	3.1	0.0000025	0.000070	0.00104	0.15
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	78.0	0.00005	0.00005	0.00080	0.004	0.079	0.000192	0.007	0.0133	0.0014	12.2	0.00388	3.2	0.0000025	0.000094	0.00072	0.15
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	33.1	0.00020	0.00012	0.00161	0.00236	0.047	0.000134	0.00318	0.00649	0.0027	4.29	0.0135	1.6	0.0000060	0.000025	0.00089	0.0955
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	84.2	0.00005	0.00005	0.00074	0.004	0.014	0.000025	0.007	0.0143	0.0019	13.2	0.00138	3.5	0.0000025	0.000064	0.00092	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012	0.0041	0.13	0.000103	2.72	0.0000025	1.2	0.2	120	0.0000010	0.00010	0.00025	0.000004	0.00010	0.0234	0.192	0.00005	0.0101	0.000109	0.00014
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012	0.014	0.26	0.00010	3.87	0.0000125	1.96	0.43	271	0.000005	0.0005	0.00125	0.000035	0.0005	0.0585	0.499	0.00025	0.0096	0.00014	0.00005
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	03-May-2013															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013	0.025	0.05	0.00005	2.76	0.000005	0.936	0.220	113	0.000005	0.00012	0.005	0.000005	0.0005	0.0458	0.211	0.00040	0.0207	0.00013	0.00024
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	0.025	0.05	0.00012	3.40	0.000005	0.901	0.152	82.5	0.000005	0.00005	0.005	0.000005	0.0005	0.0224	0.153	0.00040	0.0193	0.00013	0.00020
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	06-May-2014	0.025	0.48	0.00015	1.48	0.000055	0.309	0.0263	8.03	0.000005	0.00005	0.005	0.000038	0.0005	0.0185J	0.0075	0.00040	0.176	0.00016	0.00053
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014	0.025	0.05	0.00015	2.44	0.000020	0.778	0.126	60.5	0.000005	0.00005	0.005	0.000018	0.0005	0.0258	0.0975	0.00040	0.0196	0.00013	0.00018
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	12-May-2015	0.025	0.52	0.000105	1.23	0.000054	0.345	0.0533	21.8	0.000005	0.00005	0.00103	0.000025	0.00025	0.0224J	0.0075	0.00015	0.137	0.00011	0.00041
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	0.025	0.27	0.000132	1.79	0.000014	0.547	0.108	52.2	0.000005	0.00005	0.00045	0.000013	0.00025	0.0162	0.0818	0.00015	0.0527	0.00011	0.00032
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016	0.025	0.05	0.000275	2.80	0.000005	0.880	0.174	87.4	0.000005	0.00005	0.00015	0.000005	0.00025	0.0169	0.167	0.00015	0.0114	0.00013	0.00021
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	0.025	0.28	0.000184	1.41	0.000034	0.400	0.0524	20.8	0.000005	0.00005	0.00117	0.000026	0.00025	0.0180J	0.0075	0.00015	0.150	0.00011	0.00033
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017	0.025	0.05	0.000170	3.69	0.000005	1.22	0.217	115	0.000005	0.00005	0.0006	0.000018	0.00025	0.0260	0.210	0.00015	0.0093	0.00018	0.00018
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	0.025	0.42	0.000124	1.53	0.000038	0.443	0.0548	21.7	0.000005	0.00005	0.00188	0.000031	0.00025	0.0286J	0.0075	0.00015	0.172	0.00013	0.00043
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	0.025	0.19	0.000337	1.89	0.000005	0.678	0.159	72.7	0.000005	0.00005	0.000195	0.000005	0.00025	0.0251	0.109	0.00015	0.0321	0.00012	0.00020
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	0.025	0.05	0.000126	2.53	0.000005	0.870	0.146	70.7	0.000005	0.00005	0.00042	0.000012	0.00052	0.0306	0.113	0.00147	0.0137	0.00017	0.00020
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	0.025	0.11	0.000145	2.70	0.000005	0.862	0.148	74.1	0.000005	0.00005	0.00031	0.000019	0.00025	0.0144	0.124	0.00015	0.0104	0.00014	0.00016
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	0.025	0.20	0.000231	1.64	0.000017	0.451	0.0692	31.7	0.000005	0.00005	0.00045	0.000019	0.00025	0.0145	0.0150	0.00015	0.0896	0.00012	0.00030
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	0.025	0.05	0.000220	2.52	0.000005	0.941	0.167	93.3	0.000005	0.00005	0.00015	0.000005	0.00025	0.0137	0.139	0.00015	0.0120	0.00013	0.00019

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012	0.0332	0.000005	0.0000025	0.025	0.000294	0.000457	115	0.00005	0.000032	0.000571	0.0142	0.000086	0.00113	17.4	0.00304	0.000005	0.000025	0.000959
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012	0.0585	0.000025	0.0000125	0.125	0.000615J	0.000457	238	0.00025	0.000053	0.00062	0.015	0.000096	0.00125	36.3	0.00676	0.000025	0.000125	0.0021
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	03-May-2013						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013	0.0560	0.00005	0.00025	0.005	0.000533J	0.000457	120	0.00005	0.00005	0.00101	0.037	0.000114	0.00162	17.1	0.00817	0.000005	0.000025	0.00131
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	0.0268	0.00005	0.00025	0.005	0.000325	0.000456	92.6	0.00010	0.00005	0.00115	0.036	0.000797	0.00079	14.2	0.00765	0.000005	0.000222	0.00106
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	06-May-2014	0.0220	0.00005	0.00025	0.005	0.000242J	0.000112	14.2	0.00037	0.00023	0.00341	0.126	0.00142	0.00121	1.72	0.0614	0.000011	0.000025	0.00162
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014	0.0390	0.00005	0.00025	0.005	0.000268	0.000365	73.5	0.00005	0.00005	0.00095	0.017	0.000152	0.00102	9.56	0.000673	0.000005	0.000025	0.00074
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	12-May-2015	0.0372	0.00005	0.000025	0.005	0.000230J	0.000172	25.3	0.00028	0.00025	0.00211	0.086	0.000364	0.0018	2.93	0.0754	0.0000194	0.000025	0.00119
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	0.0562	0.00005	0.000025	0.005	0.0000760	0.000338	65.2	0.00012	0.00011	0.00129	0.045	0.000112	0.0031	7.34	0.0104	0.0000055	0.000025	0.00085
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016	0.0420	0.00005	0.000025	0.005	0.000182	0.000457	99.5	0.00005	0.00005	0.00070	0.005	0.000025	0.0005	13.8	0.00114	0.0000025	0.000025	0.00069
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	0.0314	0.00005	0.000025	0.005	0.000118	0.000172	24.3	0.00025	0.00018	0.00201	0.075	0.000286	0.0021	3.16	0.0221	0.0000088	0.000025	0.00105
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017	0.0389	0.00005	0.000025	0.005	0.000329	0.000457	113	0.00005	0.00005	0.00060	0.011	0.000025	0.0005	19.0	0.00049	0.0000025	0.000060	0.00073
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	0.0295	0.00005	0.000025	0.005	0.000236J	0.000182	26.5	0.00021	0.00019	0.00242	0.097	0.000301	0.0025	2.92	0.0344	0.0000108	0.000025	0.00141
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	0.0661	0.00005	0.000025	0.005	0.000202	0.000384	75.1	0.00013	0.00005	0.00099	0.013	0.000025	0.0025	9.49	0.00075	0.0000025	0.000025	0.00082
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	0.0538	0.00005	0.000025	0.005	0.000235	0.000392	70.8	0.00005	0.00005	0.00080	0.011	0.000025	0.0016	10.5	0.00072	0.0000025	0.000053	0.00078
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	0.0441	0.00005	0.000025	0.005	0.000218	0.000409	82.2	0.00005	0.00005	0.00080	0.005	0.000058	0.0012	14.9	0.00065	0.0000025	0.000085	0.00053
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	0.0309	0.00005	0.000025	0.005	0.0000646	0.000212	39.9	0.00020	0.00012	0.00154	0.037	0.000103	0.0027	4.41	0.0128	0.0000025	0.000025	0.00091
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	0.0420	0.00005	0.000025	0.005	0.0000655	0.000433	83.2	0.00005	0.00005	0.00061	0.016	0.000025	0.0019	12.4	0.00266	0.0000025	0.000074	0.00069

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2012	0.0010	0.158	0.000101	2.87	0.0000025	1.24	0.211	128	0.0000010	0.00010	0.00025	0.000006	0.00010	0.0248	0.070	0.00005				
KV-49	Hinton Creek upstream Christal Creek	14-Oct-2012	0.005	0.125	0.00010	3.85	0.0000125	1.65	0.411	282	0.000005	0.0005	0.00125	0.000041	0.0005	0.059	0.222	0.00025				
KV-49	Hinton Creek upstream Christal Creek	19-Nov-2012															0.002					
KV-49	Hinton Creek upstream Christal Creek	10-Dec-2012															0.002					
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2013															0.002					
KV-49	Hinton Creek upstream Christal Creek	03-May-2013															0.002					
KV-49	Hinton Creek upstream Christal Creek	06-Jul-2013	0.025	0.05	0.00005	2.77	0.000005	0.897	0.208	114	0.000005	0.00005	0.005	0.000005	0.0005	0.0432	0.290	0.00040	7.55	7.43	0.99	
KV-49	Hinton Creek upstream Christal Creek	10-Oct-2013	0.025	0.05	0.00012	3.45	0.000005	0.946	0.146	82.7	0.000005	0.00005	0.005	0.000005	0.0005	0.0246	0.132	0.00040	5.67	5.83	1.01	
KV-49	Hinton Creek upstream Christal Creek	10-Feb-2014															0.002					
KV-49	Hinton Creek upstream Christal Creek	06-May-2014	0.025	0.50	0.00013	1.53	0.000031	0.314	0.0264	8.31	0.000005	0.00005	0.005	0.000033	0.0005	0.0193	0.062	0.00040	0.75	0.91	1.09	
KV-49	Hinton Creek upstream Christal Creek	03-Jul-2014	0.025	0.05	0.00012	2.41	0.000005	0.691	0.127	63.2	0.000005	0.00005	0.005	0.000005	0.0005	0.0201	0.144	0.00040	4.30	4.49	1.02	
KV-49	Hinton Creek upstream Christal Creek	19-Oct-2014															0.002					
KV-49	Hinton Creek upstream Christal Creek	12-Feb-2015															0.002					
KV-49	Hinton Creek upstream Christal Creek	12-May-2015	0.025	0.53	0.000105	1.22	0.000018	0.333	0.0507	21.2	0.000005	0.00005	0.00086	0.000019	0.00025	0.0226	0.105	0.00015	1.43	1.56	1.04	
KV-49	Hinton Creek upstream Christal Creek	28-Jul-2015															0.002					
KV-49	Hinton Creek upstream Christal Creek	17-Oct-2015															0.002					
KV-49	Hinton Creek upstream Christal Creek	03-Feb-2016															0.002					
KV-49	Hinton Creek upstream Christal Creek	04-May-2016	0.025	0.29	0.000162	1.78	0.000005	0.537	0.108	51.2	0.000005	0.00005	0.00043	0.000012	0.00025	0.0160	0.175	0.00015	3.36	3.90	1.07	
KV-49	Hinton Creek upstream Christal Creek	15-Jul-2016	0.025	0.05	0.000264	2.85	0.000005	0.894	0.172	88.7	0.000005	0.00005	0.00015	0.000005	0.00025	0.0164	0.118	0.00015	5.80	6.14	1.03	
KV-49	Hinton Creek upstream Christal Creek	23-Oct-2016															0.002					
KV-49	Hinton Creek upstream Christal Creek	07-Feb-2017															0.002					
KV-49	Hinton Creek upstream Christal Creek	15-May-2017	0.025	0.27	0.000203	1.39	0.000017	0.383	0.0507	19.9	0.000005	0.00005	0.00108	0.000023	0.00025	0.0171	0.056	0.00015	1.45	1.52	1.02	
KV-49	Hinton Creek upstream Christal Creek	20-Jul-2017															0.002					
KV-49	Hinton Creek upstream Christal Creek	22-Oct-2017	0.025	0.05	0.000155	3.52	0.000005	1.14	0.234	110	0.000005	0.00005	0.00015	0.000014	0.00025	0.0205	0.170	0.00015	7.86	7.25	0.96	
KV-49	Hinton Creek upstream Christal Creek	25-Feb-2018															0.002					
KV-49	Hinton Creek upstream Christal Creek	15-May-2018	0.025	0.37	0.000116	1.45	0.000024	0.408	0.0521	20.5	0.000005	0.00005	0.00114	0.000032	0.00025	0.0274	0.107	0.00015	1.46	1.62	1.05	
KV-49	Hinton Creek upstream Christal Creek	06-Jun-2018	0.025	0.18	0.000343	1.81	0.000005	0.641	0.163	67.9	0.000005	0.00005	0.00015	0.000005	0.00025	0.0248	0.107	0.00015	4.72	4.57	0.98	
KV-49	Hinton Creek upstream Christal Creek	12-Jul-2018	0.025	0.05	0.000123	2.29	0.000005	0.844	0.153	65.3	0.000005	0.00005	0.00015	0.000005	0.00025	0.0192	0.091	0.00015	4.72	4.43	0.97	
KV-49	Hinton Creek upstream Christal Creek	03-Sep-2018	0.025	0.14	0.000140	2.61	0.000005	0.833	0.158	66.7	0.000005	0.00005	0.00015	0.000018	0.00025	0.0136	0.135	0.00015	5.17	5.37	1.02	
KV-49	Hinton Creek upstream Christal Creek	08-Oct-2018															0.002					
KV-49	Hinton Creek upstream Christal Creek	08-Feb-2019															0.002					
KV-49	Hinton Creek upstream Christal Creek	16-May-2019	0.025	0.20	0.000239	1.51	0.000005	0.442	0.0824	27.9	0.000005	0.00005	0.00067	0.000021	0.00025	0.0145	0.115	0.00015	2.00	2.39	1.09	
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2019	0.025	0.05	0.000224	2.34	0.000005	0.839	0.168	85.8	0.000005	0.00005	0.00015	0.000005	0.00025	0.0139	0.100	0.00015	5.63	5.21	0.96	

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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.				7.95		200.3		2.5	11.09	81.3	236.6			
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
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				2.6	7.11	6.38C	60.4	58.3	0.2	14.44	99.5	82.0	28.7	28.7	12.2
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			3.0	6.79	7.50	86.2	84.8	0.3	12.74	88.0	135.6	46.1	43.4	29.0
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022				0.5	7.41	7.98	205.7	238	5.9	9.31	74.9	32.9	121	118	76.6
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022	Seep is dry/frozen														
KV-50	Christal Creek upstream Hinton Creek	18-May-2008				13	7.22	7.33		209	0					100	
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008				3	7.19	7.86		753	5					410	
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008				17	7.32	7.38		471	1					287	
KV-50	Christal Creek upstream Hinton Creek	28-May-2009				25	6.54	7.7		430	5				206	210	
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009				13	7.44	7.9		890	3.6				492	489	
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009				2900	7.52	7.5		981	1				617	523	
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010				14	7.38	7.62		904	7.5				501	549	
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010		10		63	7.14	7.61		932	0.3				515	520	110
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														
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
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	flow not taken. Dispersed			20	7.57	7.68		1090	3				665	636	120
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	2		0.5	8.31	7.31	395	401	3				192	208	84
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
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
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
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
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
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
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
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-May-2020					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020					128		1.74						0.1								NoHardness
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020	0.025	0.25	0.062	81.7	309		11.3	0.0005	0.0025		11.8	0.0323	0.1	0.00020	0.00036	0.0323	0.000050	0.000025	0.005	0.000114	0.000198
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-May-2021		0.25		10.8	128	0.0095	14.5				22.5	0.236C	0.1	0.00019	0.00071	0.0155	0.000050	0.000025	0.005	0.000183	0.0000562
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022					128		0.616						NopH								NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-May-2022		0.25		10.1	218	0.0074	30.0				24.8	0.104C	0.1	0.00014	0.00057	0.0209	0.000050	0.000025	0.005	0.00014	0.0000833
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022		0.25		42.3	309	0.0184	4.55				8.63	0.0248	0.1	0.00030	0.00050	0.0550	0.000050	0.000025	0.005	0.000122	0.000186
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022					128		0.616						NopH								NoHardness
KV-50	Christal Creek upstream Hinton Creek	18-May-2008					309		11.5					0.31C	0.1	0.0002	0.0057	0.022	0.00005	0.00025	0.001	0.00026	0.000158
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008					429		8.12					0.0025	0.1	0.0001	0.0016	0.036	0.00005	0.00025	0.003	0.00038	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008					429		8.37					0.612C	0.1	0.0004	0.0136	0.05	0.00002	0.00005	0.0025	0.00052	0.00037
KV-50	Christal Creek upstream Hinton Creek	28-May-2009					429		36.2					0.134C	0.1	0.00031	0.0104	0.0327	0.00001	0.0000025	0.025	0.00044	0.000289
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009					429		5.12					0.115C	0.1	0.00036	0.00607	0.0466	0.000005	0.0000025	0.025	0.000623	0.00037
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009					429		5.29					7.95C	0.1	0.00126	0.096	0.264	0.00088	0.000035	0.025	0.00384	0.00037
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010					429		4.29					0.0665	0.1	0.00029	0.0146	0.0293	0.000005	0.0000025	0.025	0.00032	0.00037
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010				460	429		13.4				1.2	0.237C	0.1	0.00022	0.0323	0.0635	0.00002	0.000006	0.025	0.000839	0.00037
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011					128		0.616						NopH								NoHardness
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011					128		0.616						NopH								NoHardness
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011					128		0.616						NopH								NoHardness
KV-50	Christal Creek upstream Hinton Creek	26-May-2011				370	429		5.96				3.7	0.022	0.1	0.00017	0.0157	0.0267	0.000005	0.0000025	0.025	0.000237	0.00037
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011				460	429		3.99				2.3	0.145C	0.1	0.00036	0.0272	0.0354	0.000005	0.000006	0.025	0.000413	0.00037
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011					128		0.616						NopH								NoHardness
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011				120	429		0.739				7.9	0.742C	0.1	0.00073	0.0159	0.0568	0.00003	0.00001	0.025	0.00119	0.000272
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011				480	429		5.02				1.5	7.96C	0.1	0.00171	0.0541	0.181	0.00023	0.00019	0.025	0.00133	0.00037
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011				509	429		8.62				1.8	0.72C	0.1	0.00033	0.0347	0.0424	0.00004	0.0000025	0.025	0.000503	0.00037
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011				518	429		8.11				0.89	0.245C	0.1	0.0003	0.0309	0.0307	0.00001	0.000013	0.025	0.000372	0.00037
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011				487	429		23.7				0.9	0.083	0.1	0.00023	0.0312	0.0222	0.000005	0.0000025	0.025	0.000324	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012				498	429		18.0				1.15	0.0407	0.1	0.00018	0.032	0.0224	0.00001	0.0000025	0.025	0.000307	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012				528	429		21.6				0.25	0.028	0.1	0.00016	0.0304	0.0225	0.000005	0.0000025	0.025	0.000275	0.00037
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012				552	429		21.3				0.53	0.0326	0.1	0.00015	0.0345	0.0224	0.000005	0.0000025	0.025	0.000269	0.00037
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012				530	429		7.60				0.25	0.0304	0.1	0.00022	0.0355	0.0231	0.000005	0.0000025	0.025	0.000331	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-May-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020	42.0	0.00012	0.00005	0.00988C	0.00298	0.026	0.000025	0.00449	0.00780	0.0012	6.29	0.00138	2.0	0.0000025	0.000087	0.00108	0.117
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	07-May-2021	9.35	0.00025	0.00017	0.00222C	0.002	0.221	0.00542	0.001	0.00396	0.0005	1.31	0.0494	0.86	0.0000064	0.000082	0.00102	0.025
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-49	Hinton Creek upstream Christal Creek	15-May-2022	14.6	0.00025	0.00012	0.00272C	0.002	0.072	0.000458	0.001	0.00450	0.0013	2.34	0.0318	1.0	0.0000096	0.000082	0.00109	0.025
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022	37.9	0.00025	0.00005	0.00157	0.00278	0.035	0.00113	0.00405	0.00737	0.0005	6.45	0.00383	1.9	0.0000025	0.000152	0.00093	0.110
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	18-May-2008	31	0.0012C	0.0008	0.003C	0.00236	1.4	0.0006	0.00318	0.00649	0.004	5.8	0.168	1.6		0.0005	0.0028	0.0955
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008	123	0.00025	0.0009	0.0005	0.004	0.39	0.00005	0.007	0.0225	0.016	24.8	0.238	5.1		0.0005	0.0071	0.15
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008	85.3	0.0012C	0.00197	0.004	0.004	3.01	0.002	0.007	0.0155	0.009	16.7	0.302	3.7		0.00023	0.006	0.15
KV-50	Christal Creek upstream Hinton Creek	28-May-2009	63.9	0.0005	0.00131	0.00184	0.004	1.62	0.00112	0.007	0.0113	0.0077	11.2	0.293	2.8	0.000005	0.00019	0.00391	0.15
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009	154	0.0003	0.00169	0.00117	0.004	1.01	0.00115	0.007	0.0275	0.0172	26.1	0.413	6.0	0.000005	0.0002	0.00532	0.15
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009	198	0.016C	0.0294J	0.0668C	0.004	50.8	0.119	0.007	0.0356	0.0368	29.9	2.94	7.3		0.00197	0.0689	0.15
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010	158	0.0004	0.00493J	0.00093	0.004	2.57	0.00109	0.007	0.0281	0.024	25.9	1.32	6.1	0.000005	0.00022	0.00776	0.15
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010	163	0.0007	0.00892J	0.00474C	0.004	4.32	0.00319	0.007	0.0290	0.0236	25.9	1.66	6.2	0.000005	0.00037	0.0137	0.15
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	26-May-2011	145	0.0003	0.00473J	0.00047	0.004	2.79	0.000573	0.007	0.0252	0.0185	22.5	1.23	5.6	0.000005	0.00017	0.00848	0.15
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	211	0.0005	0.00702J	0.00186	0.004	5.77	0.00198	0.007	0.0388	0.0235	33.9	1.69	7.9	0.000005	0.00018	0.0125	0.15
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011	59.7	0.0015C	0.00291	0.0036	0.004	2.86	0.00208	0.007	0.0106	0.0084	10.5	0.425	2.7	0.000005	0.00036	0.0069	0.15
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011	192	0.0135C	0.0155J	0.0331C	0.004	23	0.0327	0.007	0.0349	0.0363	30.4	2.15	7.2	0.00003C	0.00177	0.0313	0.15
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011	208	0.0014C	0.0107J	0.00523C	0.004	7.6	0.00758	0.007	0.0383	0.0243	33.8	2.2	7.8	0.000005	0.0003	0.0178	0.15
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011	224	0.0006	0.00995J	0.00227	0.004	6.25	0.00218	0.007	0.0414	0.033	34.7	2.14	8.3	0.000010	0.00029	0.0169	0.15
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011	209	0.0001	0.00993J	0.00094	0.004	4.82	0.00222	0.007	0.0387	0.0339	34.3	2.46	7.8	0.000005	0.00025	0.0173	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012	212	0.00005	0.00922J	0.00053	0.004	5.09	0.000535	0.007	0.0386	0.0343	32.2	2.21	7.8	0.000005	0.00023	0.0157	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012	209	0.00005	0.0096J	0.0004	0.004	5.18	0.000878	0.007	0.0381	0.0332	32.1	2.22	7.8	0.000005	0.00021	0.0164	0.15
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012	218	0.0001	0.0101J	0.00049	0.004	5.33	0.00066	0.007	0.0405	0.035	35.6	2.4	8.1	0.000005	0.00021	0.017	0.15
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012	211	0.0002	0.0106J	0.00157	0.004	5.71	0.00498	0.007	0.0390	0.0345	34.1	2.38	7.9	0.000005	0.00018	0.0191	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	07-May-2020															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020	0.025	0.050	0.000233	2.54	0.000005	0.512	0.0775	27.5	0.000005	0.00005	0.00015	0.000016	0.00025	0.0111	0.0382	0.00010	0.0286	0.00018	0.00030
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	07-May-2021	0.025	0.738	0.000111	1.09	0.000156	0.188	0.0187	3.42	0.000005	0.00005	0.00315	0.000040	0.00067	0.0192J	0.0075	0.00021	0.0937	0.00012	0.00049
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022															NoHardness				
KV-49	Hinton Creek upstream Christal Creek	15-May-2022	0.025	0.393	0.000214	1.76	0.000034	0.344	0.0316	3.99	0.000005	0.00005	0.00070	0.000043	0.00025	0.0128J	0.0075	0.00023	0.0942	0.00015	0.00054
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022	0.025	0.050	0.000156	3.20	0.000005	0.655	0.0836	14.4	0.000005	0.00005	0.00030	0.000031	0.00025	0.0129	0.0308	0.00010	0.0152	0.00016	0.00029
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	18-May-2008		0.2	0.0001	2.31	0.00004	0.5	0.067	20.4	0.000025	0.0005	0.0125	0.0006	0.0006	0.061J	0.0150	0.0005	0.135		0.0017
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008		0.2	0.0006	3.77	0.000005	1.4	0.259	96.9	0.000025	0.0005	0.0105	0.0037	0.00005	0.148	0.248	0.0005	0.006	0.0012	0.0013
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008	0.035	0.4	0.0007	4.68	0.00004	1.15	0.165		0.00003	0.00005	0.0152	0.0022	0.0014	0.133	0.155	0.0005	0.033	0.0008	0.0022
KV-50	Christal Creek upstream Hinton Creek	28-May-2009	0.027	0.26	0.00034	2.94	0.000008	0.7	0.12	49	0.000014	0.000005	0.0043	0.0017	0.0003	0.0885	0.0945	0.0002	0.0465	0.00024	0.00338
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009	0.014	0.38	0.0004	4.28	0.00001	1.42	0.266	117	0.000014	0.000005	0.0031	0.00553	0.0002	0.147	0.309	0.00005	0.0039	0.00033	0.00311
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009		0.97	0.00041	14.5	0.000036	1.29	0.305	133	0.0002	0.00004	0.25	0.00608	0.0365	0.669J	0.403	0.0022	0.0122	0.00061	0.0189
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010	0.019	0.34	0.00025	3.84	0.000006	1.26	0.267	143	0.000012	0.000005	0.0022	0.00184	0.0002	0.106	0.316	0.00005	0.0036	0.00023	0.0121
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010		0.39	0.00021	4.17	0.000009	1.43	0.248	156	0.000032	0.000005	0.0101	0.00412	0.0011	0.256	0.326	0.00005	0.0049	0.00017	0.0135
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	26-May-2011	0.014	0.35	0.00017	4.03	0.000007	1.19	0.217	136	0.000007	0.000005	0.0007	0.00176	0.0001	0.133	0.281	0.00005	0.0075	0.00017	0.0148
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	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	0.439	0.00005	0.0015	0.00019	0.0131
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011	0.06	0.15	0.00093	5.1	0.000039	1	0.148	25	0.00005	0.0001	0.019	0.00042	0.0017	0.078	0.0840	0.0002	0.0274	0.00064	0.0124
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011	0.44	1.2	0.00071	14.1	0.000484C	1.7	0.295	152	0.000116	0.0003	0.192	0.00353	0.02	0.261	0.394	0.0012	0.0036	0.00038	0.0189
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011	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	0.433	0.00005	0.0596	0.00024	0.0281
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011	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	0.467	0.00005	0.0016	0.00019	0.0251
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011	0.017	0.4	0.00029	4.3	0.000016	1.72	0.31	189	0.000018	0.000005	0.0024	0.00217	0.0001	0.204	0.437	0.00005	0.001	0.00019	0.0242
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012	0.029	0.4	0.00031	4.9	0.0000025	1.52	0.291	227	0.000015	0.0001	0.0017	0.00202	0.0001	0.193	0.436	0.00005	0.001	0.00016	0.0283
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012	0.023	0.4	0.00026	4.1	0.0000025	1.52	0.293	185	0.000016	0.0001	0.001	0.00214	0.0001	0.202	0.431	0.00005	0.0015	0.00012	0.0244
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012	0.032	0.45	0.00022	4.5	0.0000025	1.78	0.291	218	0.000014	0.0001	0.0015	0.00167	0.0001	0.211	0.458	0.00005	0.0007	0.00012	0.0271
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012	0.028	0.54	0.00021	4.3	0.0000025	1.89	0.294	204	0.000013	0.0001	0.0009	0.00199	0.0001	0.219	0.440	0.00005	0.0014	0.00014	0.0265

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	07-May-2020						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020	0.0307	0.000050	0.000025	0.005	0.000118	0.000258	46.5	0.00025	0.00005	0.00136	0.023	0.000025	0.0011	6.26	0.00076	0.0000025	0.000084	0.00084
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	07-May-2021	0.0126	0.000050	0.000025	0.005	0.000150J	0.0000844	9.27	0.00025	0.00010	0.00198	0.090	0.00193	0.0005	1.36	0.0467	0.0000025	0.000066	0.00091
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022						NoHardness												
KV-49	Hinton Creek upstream Christal Creek	15-May-2022	0.0198	0.000050	0.000025	0.005	0.000128J	0.000120	13.7	0.00025	0.00010	0.00250	0.081	0.000616	0.0005	2.23	0.0295	0.0000025	0.000092	0.00108
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022	0.0524	0.000050	0.000025	0.005	0.000101	0.000243	36.9	0.00025	0.00005	0.00109	0.014	0.000066	0.0005	6.38	0.00044	0.0000025	0.000130	0.00125
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	18-May-2008	0.019	0.00005	0.00025	0.001	0.00016	0.000212	32	0.0005	0.0005	0.003	0.38	0.0006	0.003	5.9	0.143		0.0005	0.0021
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008	0.035	0.00005	0.00025	0.001	0.0003	0.000457	122	0.00025	0.0009	0.0005	0.23	0.00005	0.015	25.5	0.231		0.0005	0.0033
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008	0.03	0.00002		0.002	0.00028	0.000457	87.1	0.0005	0.00118	0.0005	0.32	0.0002	0.008	16.9	0.221		0.00016	0.004
KV-50	Christal Creek upstream Hinton Creek	28-May-2009	0.0276	0.000005	0.000008	0.025	0.000279	0.000360	65.5	0.0002	0.000973	0.0015	0.509	0.00108	0.008	11.4	0.27	0.000005	0.0002	0.00314
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009	0.0414	0.000005	0.0000025	0.025	0.000505J	0.000457	154	0.0002	0.0015	0.00034	0.364	0.000431	0.0184	25.5	0.412	0.000005	0.00035	0.00463
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009	0.0277	0.000005	0.0000025	0.025	0.000023	0.000457	171	0.0003	0.00423	0.00022	2.97	0.00018	0.0252	23.5	1.14	0.000005	0.00113	0.00556
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010	0.0257	0.000005	0.0000025	0.025	0.000206	0.000457	175	0.0004	0.00505	0.00028	1.84	0.000118	0.0239	27.4	1.34	0.000005	0.00023	0.00785
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010	0.021	0.000005	0.0000025	0.025	0.00015	0.000457	166	0.0003	0.00585	0.00046	2.15	0.000336	0.0266	25.3	1.6		0.00025	0.00902
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	26-May-2011	0.0284	0.000005	0.0000025	0.025	0.000215	0.000457	159	0.0003	0.00548	0.00031	2.58	0.000204	0.0203	25.6	1.36	0.000005	0.00018	0.00982
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	0.0284	0.000005	0.0000025	0.025	0.000283	0.000457	201	0.0002	0.00645	0.00021	2.49	0.000063	0.0246	32.7	1.55	0.000005	0.00018	0.0115
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011	0.0385	0.000005	0.0000025	0.025	0.000806J	0.000342	65.2	0.0003	0.00223	0.00114	1.14	0.000096	0.0084	11	0.401		0.00028	0.00518
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011	0.0254	0.000005	0.0000025	0.025	0.000016	0.000457	190	0.0002	0.00623	0.00005	2.29	0.000037	0.0287	26.8	1.67	0.000005	0.00076	0.00854
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011	0.0205	0.000005	0.0000025	0.025	0.000108	0.000457	204	0.0001	0.00915	0.00056	4.72	0.000673	0.0324	32.9	2.07	0.000005	0.00025	0.0136
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011	0.021	0.000005	0.0000025	0.025	0.000154	0.000457	211	0.0002	0.00941	0.00012	4.38	0.000052	0.034	35	2.14	0.000010	0.00025	0.0158
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011	0.0223	0.000005	0.0000025	0.025	0.000196	0.000457	209	0.00005	0.00913	0.00024	3.85	0.000106	0.0353	30.5	2.23	0.000005	0.00025	0.0152
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012	0.0211	0.000005	0.0000025	0.025	0.000212	0.000457	220	0.00005	0.00973	0.00011	4.19	0.000011	0.0333	35.5	2.37	0.000005	0.00026	0.0166
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012	0.0213	0.000005	0.0000025	0.025	0.0002	0.000457	220	0.00005	0.00914	0.0002	3.8	0.000006	0.0355	33.4	2.23	0.000005	0.0002	0.015
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012	0.0209	0.000005	0.0000025	0.025	0.000182	0.000457	210	0.00005	0.00985	0.000025	4.34	0.000006	0.0334	33	2.3	0.000005	0.00019	0.0169
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012	0.0208	0.000005	0.0000025	0.025	0.000244	0.000457	218	0.00005	0.0101	0.0007	4.16	0.000108	0.0355	34.1	2.29	0.000005	0.00018	0.0176

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-49	Hinton Creek upstream Christal Creek	22-Jul-2019															0.002					
KV-49	Hinton Creek upstream Christal Creek	04-Oct-2019															0.002					
KV-49	Hinton Creek upstream Christal Creek	15-Feb-2020															0.002					
KV-49	Hinton Creek upstream Christal Creek	07-May-2020															0.002					
KV-49	Hinton Creek upstream Christal Creek	07-Jun-2020															0.002					
KV-49	Hinton Creek upstream Christal Creek	11-Jul-2020	0.025	0.050	0.000185	2.48	0.000005	0.500	0.0887	25.7	0.000005	0.00005	0.00015	0.000020	0.00025	0.0100	0.094	0.00015	2.49	2.87	1.07	
KV-49	Hinton Creek upstream Christal Creek	18-Oct-2020															0.002					
KV-49	Hinton Creek upstream Christal Creek	24-Feb-2021															0.002					
KV-49	Hinton Creek upstream Christal Creek	07-May-2021	0.025	0.740	0.000112	0.830	0.000024	0.197	0.0185	3.34	0.000005	0.00005	0.00129	0.000033	0.00025	0.0153	0.026	0.00015	0.47	0.62	1.14	
KV-49	Hinton Creek upstream Christal Creek	16-Jul-2021															0.002					
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2021															0.002					
KV-49	Hinton Creek upstream Christal Creek	22-Feb-2022															0.002					
KV-49	Hinton Creek upstream Christal Creek	15-May-2022	0.025	0.362	0.000180	1.57	0.000021	0.322	0.0284	3.19	0.000005	0.00005	0.00069	0.000041	0.00025	0.0132	0.050	0.00015	0.79	0.90	1.07	
KV-49	Hinton Creek upstream Christal Creek	03-Aug-2022	0.025	0.050	0.000166	2.84	0.000005	0.536	0.0861	13.4	0.000005	0.00005	0.00015	0.000028	0.00025	0.0082	0.053	0.00015	2.41	2.39	1.00	
KV-49	Hinton Creek upstream Christal Creek	15-Oct-2022															0.002					
KV-50	Christal Creek upstream Hinton Creek	18-May-2008		0.2	0.0001	2.1	0.000005	0.5	0.059	21.1	0.000025	0.0005	0.0016	0.0005	0.0002	0.05	0.014					
KV-50	Christal Creek upstream Hinton Creek	05-Jul-2008		0.2	0.0001	4.05	0.000005	1.4	0.247	96	0.000025	0.0005	0.0029	0.0038	0.00005	0.138	0.052					
KV-50	Christal Creek upstream Hinton Creek	03-Oct-2008	0.005	0.3	0.0003	3.91	0.000005	1.1	0.144		0.000005	0.00005	0.0007	0.002	0.0001	0.089	0.034	0.00005				
KV-50	Christal Creek upstream Hinton Creek	28-May-2009	0.008	0.27	0.00035	2.73	0.00001	1.98	0.121	50	0.000008	0.00004	0.00025	0.00169	0.0001	0.0786	0.048	0.0001				
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2009	0.004	0.39	0.00039	3.95	0.0000025	1.41	0.267	115	0.00001	0.000005	0.00025	0.00558	0.0001	0.143	0.043	0.00005				
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2009	0.007	0.38	0.00026	4.72	0.0000025	1.25	0.246	140	0.000001	0.000005	0.00025	0.002	0.0001	0.0543	0.040	0.00005				
KV-50	Christal Creek upstream Hinton Creek	08-Jul-2010	0.006	0.37	0.00025	4.18	0.0000025	1.41	0.258	150	0.000002	0.000005	0.00025	0.00184	0.0001	0.103	0.045	0.00005				
KV-50	Christal Creek upstream Hinton Creek	07-Oct-2010		0.39	0.00018	4.45	0.000012	1.39	0.252	153	0.000001	0.000005	0.00025	0.0022	0.0001	0.124	0.095	0.00005				
KV-50	Christal Creek upstream Hinton Creek	11-Feb-2011															0.002					
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2011															0.002					
KV-50	Christal Creek upstream Hinton Creek	20-Apr-2011															0.002					
KV-50	Christal Creek upstream Hinton Creek	26-May-2011	0.009	0.36	0.00018	4.32	0.0000025	1.38	0.235	142	0.00001	0.00001	0.00025	0.00202	0.0001	0.146	0.130	0.00005				
KV-50	Christal Creek upstream Hinton Creek	22-Jun-2011	0.003	0.38	0.00032	4.71	0.0000025	2.26	0.321	169	0.000011	0.000005	0.00025	0.00318	0.0001	0.17	0.086	0.00005				
KV-50	Christal Creek upstream Hinton Creek	19-Jul-2011															0.002					
KV-50	Christal Creek upstream Hinton Creek	17-Aug-2011	0.01	0.25	0.00097	4.6	0.0000025	1.05	0.163	43	0.000034	0.000005	0.00025	0.00037	0.0001	0.0726	0.048	0.0001				
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2011	0.007	0.4	0.00052	4.2	0.0000025	1.46	0.281	166	0.000001	0.00001	0.00025	0.0027	0.0001	0.0809	0.076	0.0004				
KV-50	Christal Creek upstream Hinton Creek	31-Oct-2011	0.016	0.4	0.00025	4.2	0.0000025	1.67	0.306	186	0.000003	0.00006	0.0017	0.00229	0.0001	0.152	0.094	0.00005				
KV-50	Christal Creek upstream Hinton Creek	26-Nov-2011	0.012	0.42	0.00025	4.4	0.0000025	1.73	0.297	190	0.000002	0.00005	0.00025	0.00235	0.0001	0.173	0.070	0.00005				
KV-50	Christal Creek upstream Hinton Creek	20-Dec-2011	0.001	0.4	0.00034	4	0.0000025	1.61	0.314	177	0.000004	0.000005	0.00025	0.00209	0.0001	0.188	0.103	0.00005				
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2012	0.009	0.44	0.00034	4.8	0.0000025	1.61	0.302	233	0.000006	0.0001	0.00025	0.00218	0.0001	0.203	0.103	0.00005				
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2012	0.009	0.44	0.00023	4.6	0.0000025	1.6	0.304	212	0.000009	0.0001	0.00025	0.00184	0.0001	0.199	0.079	0.00005				
KV-50	Christal Creek upstream Hinton Creek	11-Mar-2012	0.009	0.41	0.00022	4.3	0.0000025	1.64	0.297	199	0.000008	0.0001	0.00025	0.00229	0.0001	0.199	0.080	0.00005				
KV-50	Christal Creek upstream Hinton Creek	08-Apr-2012	0.009	0.54	0.0002	4.4	0.0000025	1.89	0.284	203	0.000008	0.0001	0.00025	0.002	0.0001	0.203	0.055	0.00005				

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
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
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
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
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
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
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	1.8C	75	267	614	626	114
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
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
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
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
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	6.25C	48.5	-59.2	649	663	102
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-50	Christal Creek upstream Hinton Creek	03-May-2012		0.61		311	429		6.07				10.5	0.119C	0.1	0.000297	0.0212	0.0243	0.000016	0.000011	0.025	0.000273	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012		0.95		581	429		13.9				0.96	0.0978	0.1	0.00018	0.0273	0.0289	0.000025	0.0000125	0.125	0.00028	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012		0.82		524	429		7.27				1.06	0.0927	0.1	0.000285	0.0222	0.0286	0.000013	0.0000078	0.025	0.000245	0.00037
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012		0.76		498	429		3.12				1.49	0.0996	0.1	0.000248	0.0222	0.0293	0.000005	0.0000025	0.025	0.000296	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012		1.2		452	429		0.438				1.47	0.115C	0.1	0.000268	0.0214	0.0266	0.000005	0.0000025	0.025	0.0003	0.00037
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012		1.5		511	429		37.2				1.12	0.0754	0.1	0.000236	0.0263	0.0275	0.000005	0.0000025	0.025	0.000264	0.00037
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012		0.25		505	429		2.21				0.73	0.0615	0.1	0.000264	0.0291	0.0264	0.000005	0.0000025	0.025	0.000452	0.00037
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012		0.25		540	429		24.4				0.92	0.0457	0.1	0.00023	0.0284	0.0255	0.000005	0.0000025	0.025	0.000402	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013		0.92		545	429		22.6				0.77	0.0225	0.1	0.000169	0.0293	0.0226	0.000005	0.0000025	0.025	0.000258	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-May-2013		2.5	0.33C	578	429		27.6	0.005	0.100		0.80	0.450C	0.1	0.00051	0.0436	0.0318	0.00005	0.00025	0.005	0.000377	0.00037
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013		2.5	0.10C	535	429		22.2	0.005	0.116		1.44	0.323C	0.1	0.00041	0.0286	0.0349	0.00005	0.00025	0.005	0.000392	0.00037
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013		2.5	0.31C	567	429		15.9	0.005	0.025		0.90	0.150C	0.1	0.00037	0.0258	0.0247	0.00005	0.00025	0.005	0.000385	0.00037
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013		2.5	0.23C	429	429		24.2	0.005	0.126		2.05	0.104C	0.1	0.00017	0.0174	0.0222	0.00005	0.00025	0.005	0.000201	0.00037
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014		0.80	0.246C	364	429		22.3	0.0005	0.0916		1.27	0.251C	0.1	0.00020	0.0367	0.0253	0.00005	0.00025	0.005	0.000228	0.00037
KV-50	Christal Creek upstream Hinton Creek	06-May-2014		1.21	0.093	99.7	309		22.1	0.0005	0.0125		17.7	0.981C	0.1	0.00094	0.0231	0.0432	0.00005	0.00025	0.005	0.000718	0.000219
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014		2.5	0.26C	451	429		11.2	0.005	0.121		1.95	0.0558	0.1	0.00019	0.018	0.0264	0.00005	0.00025	0.005	0.000218	0.00037
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014		3.3	0.17C	403	429		15.8	0.0025	0.143		1.53	0.0759	0.1	0.00028	0.0175	0.0282	0.00005	0.00025	0.005	0.000262	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015		0.5	0.219C	447	429		20.8	0.0010	0.104		0.99	0.430C	0.1	0.00024	0.0455	0.0346	0.00005	0.00025	0.005	0.000319	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-May-2015		0.25	0.112	180	429		38.3	0.0005	0.0385		14.5	0.316C	0.1	0.00036	0.0134	0.0342	0.00005	0.000025	0.005	0.000190	0.000333
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015		0.5	0.250C	466	429		10.7	0.0010	0.100		1.51	1.60C	0.1	0.00047	0.0265	0.0809	0.00005	0.000025	0.005	0.000361	0.00037
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015		0.85	0.206C	377	429		7.04	0.0005	0.122		1.17	0.272C	0.1	0.00024	0.0214	0.0335	0.00005	0.000025	0.005	0.000242	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016		0.5	0.203C	471	429		21.6	0.0010	0.091		0.65	0.169C	0.1	0.00014	0.0283	0.0271	0.00005	0.000025	0.005	0.000173	0.00037
KV-50	Christal Creek upstream Hinton Creek	04-May-2016		0.5	0.168C	336	429		28.4	0.0010	0.073		4.65	0.211C	0.1	0.00019	0.0224	0.0311	0.00005	0.000025	0.005	0.000196	0.00037
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016		0.53	0.227C	446	429		8.37	0.0005	0.0826		1.85	0.257C	0.1	0.00024	0.0187	0.0354	0.00005	0.000025	0.005	0.000189	0.00037
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016	0.125	1.25	0.21C	477	429		23.4	0.0025	0.100		1.35	0.430C	0.1	0.00026	0.0307	0.0366	0.00005	0.000025	0.005	0.000300	0.00037
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	0.125	1.25	0.24C	483	429		13.1	0.0025	0.089		0.80	0.105C	0.1	0.00013	0.0332	0.0276	0.00005	0.000025	0.005	0.000152	0.00037
KV-50	Christal Creek upstream Hinton Creek	15-May-2017	0.125	1.25	0.19C	442	429		19.7	0.0025	0.096		5.17	0.349C	0.1	0.00020	0.0274	0.0357	0.00005	0.000025	0.005	0.000214	0.00037
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017	0.125	1.25	0.21C	506	429		11.0	0.0025	0.112		1.74	0.0976	0.1	0.00015	0.02	0.0307	0.00005	0.000025	0.005	0.000164	0.00037
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	0.125	0.69	0.25C	505	429		18.1	0.0025	0.105		1.17	0.0539	0.1	0.00013	0.0242	0.0235	0.00005	0.000025	0.005	0.000154	0.00037
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017	0.025	0.52	0.244C	427	429	0.0462	15.8	0.0005	0.115		0.78	0.282C	0.1	0.00018	0.0415	0.0316	0.00005	0.000025	0.005	0.000266	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	0.125	1.25	0.22C	426	429	0.0598	5.65	0.0025	0.120		1.10	0.0229	0.1	0.00014	0.0224	0.0233	0.00005	0.000025	0.005	0.000322	0.00037
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018	0.125	1.25	0.25C	504	429	0.0240	8.30	0.0025	0.103		0.72	0.0858	0.1	0.00012	0.032	0.0232	0.00005	0.000025	0.005	0.000162	0.00037
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018	0.125	1.25	0.24C	506	429	0.0261	10.3	0.0025	0.099	0.142	0.97	0.408C	0.1	0.00015	0.0382	0.0304	0.00005	0.000025	0.005	0.000229	0.00037
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018	0.125	1.25	0.25C	468	429	0.0244	15.4	0.0025	0.071		1.22	0.134C	0.1	0.00013	0.0309	0.0215	0.00005	0.000025	0.005	0.000148	0.00037
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018	0.125	1.25	0.27C	457	429	0.0426	10.6	0.0025	0.062		1.17	0.173C	0.1	0.00011	0.0358	0.0271	0.00005	0.000025	0.005	0.000136	0.00037
KV-50	Christal Creek upstream Hinton Creek	15-May-2018	0.025	0.25	0.083	76.3	309	0.0123	23.9	0.0005	0.0083	0.740	24.0	1.36C	0.1	0.00078	0.045	0.0555	0.00005	0.000025	0.005	0.000699	0.000188
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018	0.125	1.25	0.20C	359	429	0.0331	13.4	0.0025	0.099		4.33	0.0478	0.1	0.00018	0.0159	0.0264	0.00005	0.000025	0.005	0.000146	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	0.125	1.25	0.21C	414	429	0.0279	2.88	0.0025	0.149	0.150	1.70	0.0821	0.1	0.00020	0.0219	0.0318	0.00005	0.000025	0.005	0.000248	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-50	Christal Creek upstream Hinton Creek	03-May-2012	116	0.00025	0.00564J	0.0211C	0.004	3.8	0.00365	0.007	0.0201	0.0151	19.1	1.31	4.6	0.00001	0.000225	0.0104	0.15
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012	189	0.00025	0.00957J	0.00131	0.004	4.81	0.00152	0.007	0.0359	0.0357	36.3	2.47	7.4	0.000025C	0.000125	0.0166	0.15
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012	206	0.00023	0.00868J	0.00113	0.004	3.94	0.000947	0.007	0.0379	0.0332	33.1	2.15	7.7	0.000005	0.000296	0.0152	0.15
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012	211	0.0002	0.00895J	0.00105	0.004	4.22	0.00114	0.007	0.0389	0.0329	33.5	2.18	7.9	0.000005	0.000241	0.0163	0.15
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012	178	0.00018	0.00816J	0.000881	0.004	4.55	0.00137	0.007	0.0318	0.0301	27.7	1.84	6.7	0.000005	0.000243	0.0144	0.15
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012	203	0.00016	0.00904J	0.00109	0.004	4.77	0.000875	0.007	0.0364	0.0344	29.9	2.15	7.5	0.000005	0.000347	0.0169	0.15
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012	193	0.00005	0.00887J	0.00138	0.004	5.11	0.00106	0.007	0.0354	0.0299	31.9	2.08	7.3	0.000005	0.000243	0.0161	0.15
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012	187	0.00005	0.00897J	0.00068	0.004	4.76	0.00289	0.007	0.0341	0.0295	31	2.07	7.1	0.000005	0.00022	0.0165	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013	195	0.0001	0.0094J	0.00034	0.004	4.74	0.00058	0.007	0.0356	0.0362	31.5	2.23	7.3	0.000005	0.00022	0.0165	0.15
KV-50	Christal Creek upstream Hinton Creek	03-May-2013	225	0.00088	0.0113J	0.00199	0.004	7.76	0.00768	0.007	0.0420	0.0493	36.1	2.87	8.4	0.000005	0.000325	0.0212	0.15
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013	199	0.00063	0.00891J	0.00190	0.004	5.32	0.00317	0.007	0.0376	0.0315	36.4	2.23	7.7	0.000005	0.000249	0.0171	0.15
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013	206	0.00036	0.0104J	0.00081	0.004	6.55	0.000944	0.007	0.0377	0.0357	32.5	2.60	7.7	0.000005	0.000324	0.0185	0.15
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013	174	0.00022	0.00779J	0.00074	0.004	3.31	0.000388	0.007	0.0320	0.0254	30.9	1.84	6.7	0.000005	0.000150	0.0151	0.15
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014	160	0.00046	0.00743J	0.00120	0.004	6.32	0.00103	0.007	0.0282	0.0250	25.2	1.69	6.1	0.000005	0.000211	0.0144	0.15
KV-50	Christal Creek upstream Hinton Creek	06-May-2014	45.4	0.00179C	0.00330	0.00657C	0.00330	4.8	0.0287	0.00524	0.00856	0.00659	8.54	0.606	2.2	0.000012	0.000304	0.00744	0.129
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014	178	0.00012	0.00729J	0.00068	0.004	2.97	0.000829	0.007	0.0328	0.0218	31.5	1.73	6.9	0.000005	0.000186	0.0139	0.15
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014	163	0.00020	0.00627J	0.00065	0.004	2.75	0.00102	0.007	0.0295	0.0221	28.1	1.45	6.3	0.000005	0.000211	0.0119	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015	174	0.00082	0.00881J	0.0020	0.004	8.93	0.00227	0.007	0.0316	0.0280	29.5	1.98	6.7	0.000005	0.000245	0.0175	0.15
KV-50	Christal Creek upstream Hinton Creek	12-May-2015	77.3	0.00058	0.00397	0.00227	0.004	2.9	0.00202	0.007	0.0133	0.0120	12.7	1.06	3.2	0.0000231	0.000229	0.00793	0.15
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015	188	0.00252C	0.00860J	0.00541C	0.004	7.09	0.00468	0.007	0.0340	0.0325	30.0	1.86	7.1	0.0000089	0.000464	0.0161	0.15
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015	164	0.00047	0.00669J	0.00152	0.004	3.43	0.00115	0.007	0.0288	0.0257	25.5	1.67	6.2	0.0000025	0.000308	0.0122	0.15
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016	184	0.00039	0.00850J	0.00102	0.004	4.75	0.000825	0.007	0.0331	0.0343	29.4	1.99	6.9	0.0000025	0.000202	0.0156	0.15
KV-50	Christal Creek upstream Hinton Creek	04-May-2016	165	0.00025	0.00679J	0.00130	0.004	4.43	0.00123	0.007	0.0291	0.0258	25.6	1.64	6.2	0.0000025	0.000228	0.0122	0.15
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016	179	0.00047	0.00707J	0.00137	0.004	3.26	0.00117	0.007	0.0324	0.0256	29.5	1.71	6.8	0.0000025	0.000293	0.0125	0.15
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016	188	0.00074	0.00947J	0.00210	0.004	5.99	0.00189	0.007	0.0342	0.0316	30.8	2.04	7.1	0.0000056	0.000312	0.0166	0.15
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	192	0.00025	0.00985J	0.00090	0.004	5.42	0.000409	0.007	0.0351	0.0328	31.6	2.27	7.3	0.0000025	0.000238	0.0164	0.15
KV-50	Christal Creek upstream Hinton Creek	15-May-2017	171	0.00030	0.00921J	0.00173	0.004	5.95	0.00165	0.007	0.0309	0.0278	28.8	2.07	6.5	0.0000025	0.000264	0.0160	0.15
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017	184	0.00016	0.00842J	0.00072	0.004	3.78	0.000522	0.007	0.0339	0.0305	31.8	1.99	7.1	0.0000025	0.000213	0.0149	0.15
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	187	0.00011	0.00821J	0.00025	0.004	4.08	0.000255	0.007	0.0339	0.0317	30.0	1.95	7.1	0.0000025	0.000200	0.0148	0.15
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017	183	0.00052	0.00847J	0.00128	0.004	8.27	0.00103	0.007	0.0334	0.0257	30.9	2.00	7.0	0.0000025	0.000261	0.0151	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	162	0.00005	0.00741J	0.00025	0.004	3.48	0.000164	0.007	0.0288	0.0240	26.5	1.68	6.2	0.0000025	0.000189	0.0133	0.15
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018	212	0.00024	0.00854J	0.00087	0.004	5.71	0.000358	0.007	0.0378	0.0295	29.5	1.98	7.7	0.0000025	0.000249	0.0159	0.15
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018	189	0.00066	0.00919J	0.00169	0.004	7.35	0.00139	0.007	0.0333	0.0335	26.7	1.95	7.0	0.0000025	0.000240	0.0170	0.15
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018	179	0.00136C	0.00861J	0.00082	0.004	5.29	0.000695	0.007	0.0323	0.0282	29.3	1.91	6.8	0.0000025	0.000187	0.0170	0.15
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018	169	0.00040	0.00888J	0.00073	0.004	6.05	0.000687	0.007	0.0304	0.0299	27.8	2.03	6.5	0.0000025	0.000216	0.0158	0.15
KV-50	Christal Creek upstream Hinton Creek	15-May-2018	36.9	0.00296C	0.00415J	0.00785C	0.00282	10.6	0.0178	0.00414	0.00745	0.0065	7.63	0.626	1.9	0.0000105	0.000442	0.00964	0.112
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018	133	0.00028	0.00539J	0.00072	0.004	2.8	0.000541	0.007	0.0237	0.0195	23.7	1.33	5.3	0.0000025	0.000225	0.0101	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	147	0.00023	0.00637J	0.00071	0.004	3.24	0.000519	0.007	0.0274	0.0230	29.6	1.53	5.9	0.0000025	0.000228	0.0116	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-50	Christal Creek upstream Hinton Creek	03-May-2012	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	0.218	0.00018	0.0241	0.000224	0.0159
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012	0.027	0.4	0.00031	3.8	0.0000125	1.87	0.317	210	0.000014	0.0005	0.0041	0.00255	0.0005	0.226	0.406	0.00025	0.005	0.00018	0.0226
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012	0.032	0.375	0.000323	4.85	0.0000179	1.82	0.297	185	0.0000133	0.00010	0.0032	0.00221	0.00032	0.169	0.428	0.00005	0.00156	0.000236	0.0169
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012	0.019	0.375	0.000438	5.04	0.000005	1.69	0.314	190	0.000017	0.00010	0.00364	0.00217	0.00031	0.17	0.440	0.00005	0.00295	0.000212	0.0163
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012	0.0174	0.333	0.000299	3.9	0.00001	1.39	0.29	165	0.000013	0.00010	0.0024	0.00193	0.00010	0.159	0.359	0.00005	0.00831	0.00024	0.018
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012	0.0186	0.394	0.000283	4.65	0.0000025	1.47	0.31	211	0.000016	0.00010	0.00331	0.00226	0.00010	0.169	0.412	0.00005	0.00215	0.00021	0.0182
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012	0.0203	0.479	0.000307	3.96	0.0000025	1.76	0.288	189	0.000021	0.00010	0.00246	0.00238	0.00010	0.201	0.400	0.00005	0.0021	0.000235	0.021
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012	0.0172	0.419	0.00031	3.77	0.000011	1.62	0.3	196	0.000018	0.00010	0.00151	0.00267	0.00010	0.206	0.386	0.00014	0.00183	0.000172	0.021
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013	0.0141	0.389	0.000289	4.33	0.0000025	1.59	0.31	177	0.000013	0.00010	0.00097	0.00208	0.00010	0.208	0.403	0.00005	0.00165	0.000131	0.0224
KV-50	Christal Creek upstream Hinton Creek	03-May-2013	0.025	0.53	0.00018	5.31	0.000097	1.71	0.372	197	0.000028	0.00005	0.013	0.00282	0.0012	0.271	0.474	0.00040	0.0023	0.00019	0.0228
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013	0.025	0.47	0.00031	4.93	0.000032	1.91	0.308	174	0.000021	0.00005	0.013	0.00337	0.0005	0.201	0.425	0.00040	0.0016	0.00022	0.0147
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013	0.025	0.40	0.00005	5.13	0.000011	1.30	0.300	181	0.000018	0.00005	0.005	0.000525	0.0005	0.172	0.427	0.00040	0.0034	0.00031	0.0204
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013	0.025	0.35	0.00036	4.25	0.000005	1.62	0.246	140	0.000005	0.00005	0.005	0.00203	0.0005	0.198	0.362	0.00040	0.0107	0.00013	0.0145
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014	0.025	0.40	0.00030	4.74	0.000018	1.59	0.227	127	0.000015	0.00005	0.005	0.00169	0.0005	0.198	0.317	0.00040	0.0011	0.00012	0.0221
KV-50	Christal Creek upstream Hinton Creek	06-May-2014	0.064	0.84	0.00017	3.39	0.000303C	0.770	0.0742	32.3	0.000027	0.00012	0.034	0.000458	0.0029	0.134J	0.0510	0.00040	0.0294	0.00051	0.00793
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014	0.025	0.36	0.00034	4.16	0.000005	1.58	0.271	148	0.000005	0.00005	0.005	0.00198	0.0005	0.199	0.370	0.00040	0.0079	0.00014	0.0144
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014	0.025	0.38	0.00072	4.09	0.000005	1.61	0.257	131	0.000013	0.00005	0.005	0.00272	0.0005	0.158	0.332	0.00040	0.0049	0.00021	0.0148
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015	0.061	0.43	0.00047	4.62	0.000028	1.49	0.259	147	0.000018	0.00005	0.016	0.00211	0.0012	0.249	0.357	0.00040	0.0025	0.00011	0.0172
KV-50	Christal Creek upstream Hinton Creek	12-May-2015	0.025	0.58	0.000216	2.69	0.000037	0.663	0.122	64.4	0.000015	0.00005	0.00775	0.000839	0.00087	0.113	0.124	0.00015	0.0236	0.00031	0.00877
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015	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	0.385	0.00015	0.0037	0.00018	0.0179
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015	0.025	0.40	0.000516	4.29	0.000017	1.54	0.255	123	0.000016	0.00005	0.00730	0.00211	0.00074	0.170	0.325	0.00015	0.0032	0.00017	0.0171
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016	0.025	0.37	0.000443	4.47	0.000012	1.54	0.249	147	0.000014	0.00005	0.00594	0.00225	0.00066	0.217	0.374	0.00015	0.0011	0.00005	0.0223
KV-50	Christal Creek upstream Hinton Creek	04-May-2016	0.025	0.36	0.000340	3.90	0.000017	1.25	0.227	126	0.000011	0.00005	0.00598	0.00185	0.00060	0.183	0.328	0.00015	0.0087	0.00013	0.0185
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016	0.025	0.37	0.000397	4.18	0.000016	1.54	0.271	153	0.000011	0.00005	0.00795	0.00255	0.00071	0.160	0.366	0.00015	0.0028	0.00016	0.0128
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016	0.025	0.51	0.000321	5.44	0.000022	1.59	0.280	162	0.000022	0.00005	0.0132	0.00268	0.00119	0.233	0.387	0.00015	0.0026	0.00014	0.0251
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	0.025	0.44	0.000332	4.65	0.000013	1.65	0.287	167	0.000016	0.00005	0.00338	0.00236	0.00025	0.254	0.397	0.00015	0.0028	0.00005	0.0246
KV-50	Christal Creek upstream Hinton Creek	15-May-2017	0.025	0.51	0.000249	4.16	0.000044	1.34	0.255	151	0.000005	0.00005	0.006	0.00202	0.00112	0.253	0.349	0.00015	0.0083	0.00005	0.0197
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017	0.025	0.39	0.000305	4.48	0.000005	1.73	0.290	176	0.000013	0.00005	0.00299	0.00318	0.00025	0.243	0.383	0.00015	0.0026	0.00005	0.0132
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	0.025	0.43	0.000370	4.52	0.000005	1.71	0.314	183	0.000012	0.00005	0.00162	0.00284	0.00025	0.264	0.384	0.00015	0.0035	0.00005	0.0204
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017	0.025	0.44	0.000443	4.84	0.000017	1.69	0.281	161	0.000020	0.00005	0.0103	0.00251	0.00082	0.278	0.378	0.00015	0.0016	0.00005	0.0173
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	0.025	0.35	0.000434	4.32	0.000005	1.57	0.273	154	0.000014	0.00005	0.00042	0.00247	0.00025	0.253	0.325	0.00015	0.0005	0.00005	0.0179
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018	0.025	0.41	0.000479	4.74	0.000005	1.62	0.310	186	0.000011	0.00005	0.00265	0.00257	0.00025	0.292	0.428	0.00015	0.0012	0.00005	0.0197
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018	0.025	0.48	0.000335	4.99	0.000020	1.64	0.283	169	0.000015	0.00005	0.017	0.00239	0.00131	0.306	0.376	0.00015	0.0005	0.00005	0.0191
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018	0.025	0.46	0.000323	4.77	0.000010	1.74	0.287	173	0.000012	0.00005	0.00463	0.00212	0.00025	0.305	0.365	0.00015	0.0005	0.00005	0.0241
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018	0.025	0.47	0.000211	5.07	0.000011	1.83	0.285	166	0.000018	0.00005	0.00599	0.00220	0.00054	0.317	0.343	0.00015	0.0005	0.00005	0.0220
KV-50	Christal Creek upstream Hinton Creek	15-May-2018	0.140	0.76	0.000243	3.52	0.000192	0.682	0.0729	25.0	0.000031	0.00005	0.0379	0.000692	0.00385	0.170J	0.0322	0.00040	0.0426	0.00032	0.00463
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018	0.025	0.37	0.000515	3.85	0.000005	1.30	0.231	121	0.000005	0.00005	0.00075	0.00172	0.0005	0.179	0.262	0.00015	0.0093	0.00037	0.0136
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	0.025	0.37	0.000488	4.45	0.000005	2.16	0.278	145	0.000013	0.00005	0.00266	0.00390	0.00055	0.215	0.308	0.00015	0.0014	0.00016	0.0152

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-50	Christal Creek upstream Hinton Creek	03-May-2012	0.0195	0.000005	0.0000025	0.025	0.000149	0.000457	115	0.00005	0.00517	0.00106	2.56	0.000425	0.0177	18.5	1.27	0.000005	0.000181	0.00943
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012	0.0222	0.000025	0.0000125	0.125	0.00015	0.000457	185	0.00025	0.00885	0.00026	3.7	0.000556	0.0319	35.7	2.37	0.000025	0.000125	0.0151
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012	0.026	0.000011	0.0000025	0.025	0.0000934	0.000457	204	0.00005	0.00869	0.000139	2.82	0.0000215	0.0335	33.3	2.14	0.000005	0.000236	0.0151
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012	0.0249	0.000005	0.0000025	0.025	0.000107	0.000457	205	0.00005	0.00864	0.000191	2.83	0.00003	0.0315	33.4	2.17	0.000005	0.000232	0.0154
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012	0.0245	0.000005	0.0000025	0.025	0.000162	0.000457	182	0.00005	0.00886	0.000025	3.2	0.000088	0.0305	30.8	2.06	0.000005	0.000277	0.0157
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012	0.0234	0.000005	0.0000025	0.025	0.000099	0.000457	199	0.00005	0.00913	0.000278	3.21	0.000027	0.0331	30.8	2.16	0.000005	0.00025	0.017
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012	0.0232	0.000005	0.0000025	0.025	0.000287	0.000457	199	0.00005	0.00861	0.000777	3.45	0.000184	0.0305	31.3	2.05	0.000005	0.000273	0.0156
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012	0.0225	0.000005	0.0000025	0.025	0.000263	0.000457	184	0.00005	0.00919	0.000112	3.76	0.000062	0.0313	30.2	2.14	0.000005	0.000207	0.0168
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013	0.0202	0.000005	0.0000025	0.025	0.000182	0.000457	192	0.00005	0.00964	0.000052	3.73	0.000005	0.0344	32	2.25	0.000005	0.000224	0.0168
KV-50	Christal Creek upstream Hinton Creek	03-May-2013	0.0208	0.00005	0.00025	0.005	0.000189	0.000457	226	0.00005	0.0103	0.00079	3.98	0.000118	0.0362	35.9	2.65	0.000005	0.000203	0.0189
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013	0.0255	0.00005	0.00025	0.005	0.000167	0.000457	197	0.00005	0.00784	0.00020	2.27	0.000097	0.0296	35.7	2.02	0.000005	0.000199	0.0149
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013	0.0215	0.00005	0.00025	0.005	0.000082	0.000457	211	0.00024	0.0104	0.00010	5.28	0.000025	0.0351	32.8	2.62	0.000005	0.000317	0.0181
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013	0.0181	0.00005	0.00025	0.005	0.000143	0.000457	173	0.00005	0.00655	0.00029	2.79	0.000095	0.0255	30.5	1.61	0.000005	0.000161	0.0128
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014	0.0179	0.00005	0.00025	0.005	0.000127	0.000457	165	0.00005	0.00709	0.00010	3.04	0.000121	0.0263	25.9	1.68	0.000005	0.000167	0.0135
KV-50	Christal Creek upstream Hinton Creek	06-May-2014	0.0221	0.00005	0.00025	0.005	0.000316J	0.000282	45.5	0.00005	0.00221	0.00169	1.02	0.00568	0.00602	8.27	0.558	0.000005	0.000132	0.00454
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014	0.0243	0.00005	0.00025	0.005	0.000155	0.000457	185	0.00005	0.00685	0.00036	2.51	0.000748	0.0219	31.7	1.69	0.000005	0.000161	0.0129
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014	0.0265	0.00005	0.00025	0.005	0.000190	0.000457	167	0.00005	0.00621	0.00024	2.27	0.000025	0.0213	29.0	1.45	0.000005	0.000187	0.0116
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015	0.0226	0.00005	0.00025	0.005	0.000147	0.000457	181	0.00005	0.00767	0.00024	2.83	0.000124	0.0284	30.5	1.82	0.000005	0.000158	0.0153
KV-50	Christal Creek upstream Hinton Creek	12-May-2015	0.0253	0.00005	0.000025	0.005	0.000165	0.000409	80.0	0.00005	0.00367	0.00120	1.48	0.000489	0.0118	13.0	1.08	0.0000100	0.000179	0.00726
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015	0.0397	0.00005	0.000025	0.005	0.0000595	0.000457	192	0.00005	0.00714	0.00010	2.89	0.000062	0.0307	30.2	1.8	0.0000025	0.000282	0.0122
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015	0.0267	0.00005	0.000025	0.005	0.0000955	0.000457	168	0.00005	0.00637	0.00010	2.4	0.000301	0.0241	25.9	1.65	0.0000025	0.000244	0.0113
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016	0.0225	0.00005	0.000025	0.005	0.0000915	0.000457	193	0.00005	0.00833	0.00010	3.43	0.000025	0.0344	30.0	1.99	0.0000025	0.000182	0.0149
KV-50	Christal Creek upstream Hinton Creek	04-May-2016	0.0251	0.00005	0.000025	0.005	0.000122	0.000457	177	0.00005	0.00624	0.00050	3.6	0.000298	0.0260	27.5	1.56	0.0000025	0.000191	0.0113
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016	0.0310	0.00005	0.000025	0.005	0.0000676	0.000457	190	0.00005	0.00691	0.00020	1.76	0.000025	0.0275	31.0	1.75	0.0000025	0.000251	0.0118
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016	0.0260	0.00005	0.000025	0.005	0.000133	0.000457	194	0.00005	0.00891	0.00020	4.47	0.000208	0.0304	32.0	2.02	0.0000025	0.000247	0.0150
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	0.0243	0.00005	0.000025	0.005	0.000100	0.000457	205	0.00005	0.00920	0.00010	4.3	0.000025	0.0296	31.0	2.15	0.0000025	0.000212	0.0152
KV-50	Christal Creek upstream Hinton Creek	15-May-2017	0.0251	0.00005	0.000025	0.005	0.000115	0.000457	168	0.00005	0.00832	0.00039	4.08	0.000198	0.0270	28.5	1.97	0.0000025	0.000206	0.0140
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017	0.0272	0.00005	0.000025	0.005	0.000105	0.000457	185	0.00005	0.00814	0.00010	2.32	0.000025	0.0304	32.4	1.99	0.0000025	0.000197	0.0144
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	0.0215	0.00005	0.000025	0.005	0.000110	0.000457	184	0.00005	0.00766	0.00010	3.19	0.000025	0.0295	28.2	1.82	0.0000025	0.000190	0.0136
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017	0.0229	0.00005	0.000025	0.005	0.000111	0.000457	175	0.00005	0.00746	0.00010	3.16	0.000025	0.0247	29.6	1.88	0.0000025	0.000181	0.0130
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	0.0219	0.00005	0.000025	0.005	0.000168	0.000457	156	0.00005	0.00698	0.00010	2.79	0.000163	0.0235	25.3	1.58	0.0000025	0.000170	0.0125
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018	0.0202	0.00005	0.000025	0.005	0.0000997	0.000457	187	0.00018	0.00818	0.00010	3.49	0.000025	0.0304	27.8	1.78	0.0000025	0.000193	0.0144
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018	0.0181	0.00005	0.00005	0.005	0.0000849	0.000457	184	0.00005	0.00780	0.00010	3.35	0.000025	0.0319	29.9	1.92	0.0000025	0.00019	0.0144
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018	0.0207	0.00005	0.000025	0.005	0.0000987	0.000457	201	0.00020	0.00918	0.00010	4.07	0.000025	0.0289	29.6	2.18	0.0000025	0.000189	0.0162
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018	0.0217	0.00005	0.000025	0.005	0.0000661	0.000457	191	0.00005	0.00834	0.00010	2.97	0.000025	0.0315	29.6	2.02	0.0000025	0.000215	0.0147
KV-50	Christal Creek upstream Hinton Creek	15-May-2018	0.0169	0.00005	0.000025	0.005	0.000143	0.000246	35.8	0.00005	0.00146	0.00193	0.758	0.00231	0.0049	6.84	0.359	0.0000025	0.000149	0.00379
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018	0.0274	0.00005	0.000025	0.005	0.000172	0.000457	139	0.00027	0.00580	0.00063	2.3	0.000661	0.0189	24.2	1.4	0.0000025	0.000202	0.0104
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	0.0302	0.00005	0.000025	0.005	0.000133	0.000457	154	0.00005	0.00570	0.00010	2.16	0.000025	0.0231	26.8	1.32	0.0000025	0.000200	0.0102

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-50	Christal Creek upstream Hinton Creek	03-May-2012	0.0154	0.422	0.000174	2.8	0.0000025	1.1	0.169	106	0.000007	0.00010	0.00025	0.00112	0.00010	0.123	0.158	0.00011				
KV-50	Christal Creek upstream Hinton Creek	03-Jun-2012	0.005	0.39	0.00024	3.6	0.0000125	1.84	0.285	192	0.000005	0.0005	0.00125	0.00221	0.0011	0.211	0.095	0.00025				
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2012	0.0145	0.377	0.000294	4.52	0.0000025	1.83	0.301	186	0.0000025	0.00010	0.00025	0.00218	0.00010	0.161	0.081	0.00005				
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2012	0.0010	0.365	0.000363	4.64	0.0000025	1.68	0.295	189	0.000003	0.00010	0.00025	0.00203	0.00010	0.157	0.070	0.00005				
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2012	0.0031	0.413	0.000319	4.24	0.0000025	1.61	0.303	183	0.000004	0.00010	0.00025	0.00209	0.00010	0.159	0.046	0.00005				
KV-50	Christal Creek upstream Hinton Creek	14-Oct-2012	0.0010	0.384	0.000247	4.48	0.0000025	1.57	0.305	209	0.000008	0.00032	0.00025	0.00223	0.00010	0.161	0.132	0.00005				
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2012	0.0049	0.541	0.000289	4.33	0.0000025	1.74	0.288	186	0.000008	0.00010	0.00025	0.00237	0.00010	0.187	0.044	0.00005				
KV-50	Christal Creek upstream Hinton Creek	10-Dec-2012	0.0010	0.375	0.000351	3.75	0.0000025	1.64	0.296	170	0.000009	0.00010	0.00025	0.00247	0.00010	0.207	0.105	0.00019	14	12		
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2013	0.0010	0.377	0.000263	4.5	0.0000025	1.57	0.29	173	0.000008	0.00010	0.00025	0.00202	0.00010	0.209	0.095	0.00005	14	13		
KV-50	Christal Creek upstream Hinton Creek	03-May-2013	0.025	0.45	0.00017	4.35	0.000005	1.67	0.302	193	0.000005	0.00012	0.005	0.00207	0.0005	0.233	0.104	0.00040	14.6	14.6	1	
KV-50	Christal Creek upstream Hinton Creek	06-Jul-2013	0.025	0.39	0.00029	4.29	0.000005	1.79	0.297	168	0.000005	0.00005	0.005	0.00303	0.0005	0.167	0.137	0.00040	13.6	13.1	0.98	
KV-50	Christal Creek upstream Hinton Creek	09-Aug-2013	0.025	0.38	0.00005	4.91	0.000005	1.33	0.300	178	0.000005	0.00005	0.005	0.000481	0.0005	0.155	0.100	0.00040	13.9	13.7	0.99	
KV-50	Christal Creek upstream Hinton Creek	10-Oct-2013	0.025	0.35	0.00036	4.00	0.000005	1.55	0.226	134	0.000005	0.00005	0.005	0.00184	0.0005	0.171	0.145	0.00040	11.2	11.4	1.01	
KV-50	Christal Creek upstream Hinton Creek	10-Feb-2014	0.025	0.40	0.00030	4.36	0.000005	1.63	0.239	127	0.000005	0.00005	0.005	0.00164	0.0005	0.185	0.115	0.00040	9.77	10.7	1.04	
KV-50	Christal Creek upstream Hinton Creek	06-May-2014	0.025	0.64	0.00005	1.79	0.000011	0.755	0.0749	32.4	0.000005	0.00005	0.005	0.000352	0.0005	0.0907	0.132	0.00040	3.00	3.08	1.01	
KV-50	Christal Creek upstream Hinton Creek	03-Jul-2014	0.025	0.37	0.00030	4.16	0.000005	1.50	0.262	147	0.000005	0.00005	0.005	0.00196	0.0005	0.188	0.118	0.00040	12.0	12.1	1	
KV-50	Christal Creek upstream Hinton Creek	19-Oct-2014	0.025	0.37	0.00075	4.10	0.000005	1.58	0.259	131	0.000005	0.00005	0.005	0.00271	0.0005	0.156	0.110	0.00040	11.1	11.0	0.99	
KV-50	Christal Creek upstream Hinton Creek	12-Feb-2015	0.025	0.40	0.00043	4.05	0.000005	1.67	0.267	148	0.000005	0.00005	0.005	0.00188	0.0005	0.215	0.101	0.00040	11.8	11.9	1	
KV-50	Christal Creek upstream Hinton Creek	12-May-2015	0.025	0.59	0.000224	2.26	0.000005	0.673	0.123	64.8	0.000005	0.00005	0.00032	0.000782	0.00025	0.109	0.261	0.00015	5.02	5.23	1.02	
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2015	0.025	0.35	0.000320	4.12	0.000005	1.56	0.288	150	0.000005	0.00005	0.00015	0.00239	0.00025	0.152	0.109	0.00015	12.2	12.4	1.01	
KV-50	Christal Creek upstream Hinton Creek	17-Oct-2015	0.025	0.35	0.000507	3.95	0.000005	1.56	0.244	120	0.000005	0.00005	0.00015	0.00218	0.00025	0.146	0.075	0.00015	10.3	10.8	1.02	
KV-50	Christal Creek upstream Hinton Creek	03-Feb-2016	0.025	0.35	0.000476	4.29	0.000005	1.53	0.258	151	0.000005	0.00005	0.00015	0.00219	0.00025	0.21	0.087	0.00015	12.0	12.4	1.02	
KV-50	Christal Creek upstream Hinton Creek	04-May-2016	0.025	0.38	0.000386	3.77	0.000005	1.21	0.230	129	0.000005	0.00005	0.00015	0.00186	0.00025	0.175	0.219	0.00015	8.95	11.4	1.12	
KV-50	Christal Creek upstream Hinton Creek	15-Jul-2016	0.025	0.36	0.000413	4.02	0.000005	1.63	0.282	158	0.000005	0.00005	0.00015	0.00258	0.00025	0.15	0.115	0.00015	11.6	12.3	1.03	
KV-50	Christal Creek upstream Hinton Creek	23-Oct-2016	0.025	0.45	0.000331	4.37	0.000005	1.64	0.274	158	0.000005	0.00005	0.00015	0.00250	0.00025	0.221	0.120	0.00015	12.2	12.7	1.02	
KV-50	Christal Creek upstream Hinton Creek	07-Feb-2017	0.025	0.40	0.000314	4.48	0.000005	1.54	0.283	169	0.000005	0.00005	0.00015	0.00221	0.00025	0.253	0.079	0.00015	12.4	13.2	1.03	
KV-50	Christal Creek upstream Hinton Creek	15-May-2017	0.025	0.45	0.000199	3.58	0.000005	1.29	0.249	149	0.000005	0.00005	0.00015	0.00190	0.00025	0.231	0.199	0.00015	11.1	11.1	1	
KV-50	Christal Creek upstream Hinton Creek	20-Jul-2017	0.025	0.37	0.000307	4.17	0.000005	1.68	0.289	171	0.000005	0.00005	0.00015	0.00310	0.00025	0.225	0.116	0.00015	12.8	12.2	0.97	
KV-50	Christal Creek upstream Hinton Creek	22-Oct-2017	0.025	0.40	0.000322	4.15	0.000005	1.60	0.317	175	0.000005	0.00005	0.00015	0.00288	0.00025	0.251	0.103	0.00015	12.8	11.8	0.96	
KV-50	Christal Creek upstream Hinton Creek	24-Nov-2017	0.025	0.39	0.000396	4.24	0.000005	1.62	0.270	160	0.000005	0.00005	0.00015	0.00232	0.00025	0.243	0.084	0.00015	11.1	11.5	1.02	
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2017	0.025	0.33	0.000402	4.08	0.000005	1.59	0.265	151	0.000011	0.00005	0.00015	0.00234	0.00025	0.244	0.067	0.00015	11.1	10.2	0.96	
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2018	0.025	0.38	0.000437	3.93	0.000005	1.47	0.260	160	0.000005	0.00005	0.00015	0.00224	0.00025	0.271	0.065	0.00015	12.7	12.0	0.97	
KV-50	Christal Creek upstream Hinton Creek	25-Feb-2018	0.025	0.39	0.000320	4.32	0.000005	1.61	0.286	170	0.000005	0.00005	0.00015	0.00190	0.00025	0.272	0.079	0.00015	12.8	12.0	0.97	
KV-50	Christal Creek upstream Hinton Creek	28-Mar-2018	0.025	0.47	0.000237	4.48	0.000005	1.89	0.290	154	0.000005	0.00005	0.00015	0.00208	0.00025	0.344	0.099	0.00015	12.1	12.9	1.03	
KV-50	Christal Creek upstream Hinton Creek	18-Apr-2018	0.025	0.46	0.000243	4.75	0.000005	1.87	0.275	167	0.000012	0.00005	0.00015	0.00208	0.00025	0.271	0.086	0.00015	12.1	12.3	1.01	
KV-50	Christal Creek upstream Hinton Creek	15-May-2018	0.025	0.61	0.000130	1.55	0.000014	0.587	0.0651	24.2	0.000005	0.00005	0.00065	0.000321	0.00025	0.0636	0.118	0.00015	2.39	2.45	1.01	
KV-50	Christal Creek upstream Hinton Creek	06-Jun-2018	0.025	0.40	0.000568	3.37	0.000005	1.41	0.235	94.9	0.000005	0.00005	0.00015	0.00186	0.00025	0.2	0.162	0.00015	9.45	9.18	0.98	
KV-50	Christal Creek upstream Hinton Creek	12-Jul-2018	0.025	0.35	0.000440	3.98	0.000005	1.98	0.278	138	0.000005	0.00005	0.00015	0.00421	0.00025	0.184	0.080	0.00015	11.1	10.2	0.96	

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
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
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
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
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
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
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
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	5.79C	43.4	14.9	463	454	115
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
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
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
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
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2019	orange precipitate	15.9		6.2	7.65	8.01	910.0	956	4.5	9.12	70.8	125.6	524	539	119
KV-50	Christal Creek upstream Hinton Creek	17-Sep-2019		14.6		3.1	7.36	8.02	790.8	814	2.9	8.89	66.0	43.1	453	456	119
KV-50	Christal Creek upstream Hinton Creek	04-Oct-2019	Thin ice layer - broke through for MMB	9.6		5.6	7.19	7.44	770.6	857	0.3	7.62	52.6	125.4	486	491	122
KV-50	Christal Creek upstream Hinton Creek	28-Nov-2019		16.8		4.7	6.91	7.23	772.0	763	0.2	6.77	47.1	17.5	420	423	118
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2019	spc jumping intially	15.3		5.6	7.36	7.55	764.3	780	0.0	9.37	64.4	15.8	412	407	119
KV-50	Christal Creek upstream Hinton Creek	31-Jan-2020	Site is inaccessable without snowshoes. Too much snow.														
KV-50	Christal Creek upstream Hinton Creek	15-Feb-2020	No flow measurement. Temp outside is -40C.			5.2	7.54	8.06	804.9	785	-0.1	~	~	~	389	404	120
KV-50	Christal Creek upstream Hinton Creek	19-Mar-2020	Conditions not conducive to measureing flow. Red sediment/ particulate in the water			7.8	7.26	7.47	795.0	815	0.1	10.95	75.3	29.7	422	424	122
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2020	not ideal for flow test. Flow almost stagnant, creek meandering			5.6	7.26	7.71	764.4	773	0	8.21	56.4	118.0	395	403	117
KV-50	Christal Creek upstream Hinton Creek	07-May-2020	DO will not calibrate, membrane needs replacement. No flow - no good place for SS . Water flowing though willows and pooling . See photos			171	6.81	7.03	199.9	205	0.1	13.35	91.4	27.0	103	94.9	29.4
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2020	Sampled d/s of where flow measured.	17.2		3.0	7.55	7.37	685.5	714	4.8	8.13	63.8	121.1	394	398	100
KV-50	Christal Creek upstream Hinton Creek	11-Jul-2020		33.9		13.5	6.80	7.47	642.4	660	3.7	8.67	65.8	-7.7	357	374	104
KV-50	Christal Creek upstream Hinton Creek	12-Aug-2020		36.4		3.1	7.36	7.59	655.3	723	3.5	9.43	71.5	8.2	392	377	117
KV-50	Christal Creek upstream Hinton Creek	23-Sep-2020	Benthics and sediment collected.	45.5		6.8	7.19	8.10	684.1	720	0.5	7.64	53.3	123.6	406	410	127
KV-50	Christal Creek upstream Hinton Creek	18-Oct-2020				12.1	6.78	7.66	761.0	766	0.1	8.65	59.5	47.4	406	383	119
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2020		37.4		11.0	7.06	7.86	723.0	723	0.2	11.66	80.8	151.3	380	375	114
KV-50	Christal Creek upstream Hinton Creek	06-Dec-2020		27.8		4.1		8.03	700.3	729	0.3	10.23	70.6	92.9	412	403	113
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2021	SPC jumping, hard spike	24.6		3.7	7.14	7.31	636.8	721	0.1	9.93	68.4	63.1	426	397	113
KV-50	Christal Creek upstream Hinton Creek	21-Feb-2021	Thin slush layer to water, audible flow.			2.6	7.04	7.90	674.3	785	0.0	9.39	64.6	20.4	427	430	158
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2021	SPC jumping randomly	19.9		3.0	7.06	7.51	630.4	725	0.0	9.10	62.4	27.9	424	403	118
KV-50	Christal Creek upstream Hinton Creek	13-Apr-2021		15.3		26.8	7.36	7.55	690.7	759	0.1	9.73	67.0	-3.8	414	413	112
KV-50	Christal Creek upstream Hinton Creek	05-May-2021	no flow test initially, just sampled with site effluent discharge			7.5	7.14	7.10	524.8	576	0.2	13.21	91.1	5.7	290	295	56.8
KV-50	Christal Creek upstream Hinton Creek	07-May-2021	Samples taken on May 5, 2021 due to KV-104C discharge	51.9			6.89		415.4		1.2	12.89	91.3	52.3			
KV-50	Christal Creek upstream Hinton Creek	16-May-2021				6.1	8.20	7.68	366.6	348	5.5				161	165	46.5
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2021				6.9	6.59	7.64	720.8	743	6.2	9.84	79.8	59.2	385	375	106
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021				3.1	8.00	7.61	712.5	791	9.7				419	415	113

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	0.025	0.78	0.208C	351	429	0.0341	14.2	0.0005	0.195		2.76	0.200C	0.1	0.00019	0.0234	0.0334	0.00005	0.000025	0.005	0.000294	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	0.025	0.68	0.205C	367	429	0.0361	23.8	0.0005	0.224		1.84	0.135C	0.1	0.00022	0.0173	0.0322	0.00005	0.000025	0.005	0.000220	0.00037
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	0.125	1.25	0.20C	317	429	0.0448	19.4	0.0025	0.327	0.121	0.78	0.147C	0.1	0.00021	0.0225	0.0295	0.00005	0.000025	0.005	0.000222	0.00037
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	0.025	0.25	0.231C	326	429	0.0703	32.2	0.0005	0.208		0.99	0.0707	0.1	0.00014	0.0222	0.0228	0.00005	0.000025	0.005	0.000202	0.00037
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	0.125	1.25	0.23C	326	429	0.0615	31.5	0.0025	0.159		0.71	0.0842	0.1	0.00014	0.0242	0.0233	0.00005	0.000025	0.005	0.000207	0.00037
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	0.125	1.25	0.26C	346	429	0.0674	28.7	0.0025	0.102		1.00	0.0620	0.1	0.00011	0.0266	0.0232	0.00005	0.000025	0.005	0.000186	0.00037
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	0.125	1.25	0.27C	345	429	0.0690	13.5	0.0025	0.090	0.098	0.83	0.0252	0.1	0.00005	0.0243	0.0225	0.00005	0.000025	0.005	0.000112	0.00037
KV-50	Christal Creek upstream Hinton Creek	06-Mar-2019	0.125	1.25	0.28C	360	429	0.0277	18.1	0.0025	0.080		1.04	0.127C	0.1	0.00005	0.0304	0.0206	0.00005	0.000025	0.005	0.000116	0.00037
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2019	0.125	1.25	0.28C	338	429	0.0496	26.8	0.0025	0.057		1.08	0.0455	0.1	0.00012	0.0222	0.0223	0.00005	0.000025	0.005	0.000120	0.00037
KV-50	Christal Creek upstream Hinton Creek	16-May-2019	0.025	0.25	0.222C	261	429	0.0419	26.4	0.0005	0.0451	0.160	2.53	0.0275	0.1	0.00011	0.0179	0.0213	0.00005	0.000025	0.005	0.000130	0.00037
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2019	0.125	1.25	0.20C	433	429	0.0328	14.6	0.0025	0.083		1.26	0.0760	0.1	0.00011	0.0287	0.0247	0.00005	0.000025	0.005	0.000148	0.00037
KV-50	Christal Creek upstream Hinton Creek	22-Jul-2019	0.125	1.25	0.23C	459	429	0.0728	5.45	0.0025	0.142	0.182	1.50	0.285C	0.1	0.00013	0.0235	0.0363	0.00005	0.000025	0.005	0.000160	0.00037
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2019	0.125	1.25	0.23C	434	429	0.0408	2.94	0.0025	0.147		6.58	0.0344	0.1	0.00005	0.0191	0.0245	0.00005	0.000025	0.005	0.000107	0.00037
KV-50	Christal Creek upstream Hinton Creek	17-Sep-2019	0.125	1.25	0.22C	356	429	0.0440	6.52	0.0025	0.117		1.84	0.0126	0.1	0.00005	0.014	0.0220	0.00005	0.000025	0.005	0.0000828	0.00037
KV-50	Christal Creek upstream Hinton Creek	04-Oct-2019	0.125	1.25	0.25C	378	429	0.0357	12.0	0.0025	0.116	0.099	1.27	0.0175	0.1	0.00005	0.0194	0.0214	0.00005	0.000025	0.005	0.0000810	0.00037
KV-50	Christal Creek upstream Hinton Creek	28-Nov-2019	0.025	0.25	0.261C	312	429	0.0697	23.0	0.0005	0.127		0.95	0.0150	0.1	0.00005	0.022	0.0217	0.00005	0.000025	0.005	0.0000780	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2019	0.125	1.25	0.28C	313	429	0.0644	8.30	0.0025	0.131		1.27	0.0222	0.1	0.00005	0.0257	0.0219	0.00005	0.000025	0.005	0.000106	0.00037
KV-50	Christal Creek upstream Hinton Creek	31-Jan-2020					128		0.616						NopH								NoHardness
KV-50	Christal Creek upstream Hinton Creek	15-Feb-2020	0.125	1.25	0.33C	323	429	0.0407	5.49	0.0025	0.070	0.076	1.17	0.0015	0.1	0.00005	0.02	0.0169	0.00005	0.000025	0.005	0.0000517	0.00037
KV-50	Christal Creek upstream Hinton Creek	19-Mar-2020	0.125	1.25	0.28C	325	429	0.0517	10.4	0.0025	0.062		0.95	0.0074	0.1	0.00005	0.0242	0.0209	0.00005	0.000025	0.005	0.0000615	0.00037
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2020	0.125	1.25	0.29C	312	429	0.0505	10.4	0.0025	0.061		1.11	0.0093	0.1	0.00005	0.0246	0.0187	0.00005	0.000025	0.005	0.0000516	0.00037
KV-50	Christal Creek upstream Hinton Creek	07-May-2020	0.025	0.25	0.070	62.4	309	0.0209	29.2	0.0005	0.0313	1.01	32.2	1.06C	0.1	0.00060	0.0826	0.0573	0.00005	0.000025	0.005	0.000758	0.000162
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2020	0.125	1.25	0.218C	292	429	0.0410	3.61	0.0025	0.158		6.15	0.0326	0.1	0.00011	0.0173	0.0264	0.000050	0.000025	0.005	0.000121	0.00037
KV-50	Christal Creek upstream Hinton Creek	11-Jul-2020	0.025	0.25	0.185C	244	429	0.0265	22.1	0.0005	0.204	0.242	5.50	0.0819	0.1	0.00028	0.0128	0.0335	0.000050	0.000025	0.005	0.000252	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Aug-2020	0.125	1.25	0.191C	275	429	0.0292	6.21	0.0025	0.300		1.75	0.0548	0.1	0.00025	0.0112	0.0332	0.000050	0.000025	0.005	0.000287	0.00037
KV-50	Christal Creek upstream Hinton Creek	23-Sep-2020	0.025	0.64	0.197C	280	429	0.0424	11.8	0.0005	0.468		1.90	0.0588	0.1	0.00026	0.0136	0.0301	0.000050	0.000025	0.005	0.000309	0.00037
KV-50	Christal Creek upstream Hinton Creek	18-Oct-2020	0.125	1.25	0.187C	283	429	0.0478	31.2	0.0025	0.386	0.147	2.55	0.0797	0.1	0.00023	0.0167	0.0311	0.000050	0.000025	0.005	0.000263	0.00037
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2020	0.125	1.25	0.201C	275	429	0.0573	16.3	0.0025	0.432		1.10	0.139C	0.1	0.00019	0.0192	0.0382	0.000050	0.000025	0.005	0.000310	0.00037
KV-50	Christal Creek upstream Hinton Creek	06-Dec-2020	0.025	2.50	0.227C	278	429	0.0635	1.74	0.0005	0.328		1.14	0.0462	0.1	0.00014	0.0188	0.0230	0.000050	0.000025	0.005	0.000207	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2021	0.125	1.25	0.226C	287	429	0.0675	13.6	0.0025	0.187		1.84	0.0185	0.1	0.00016	0.0218	0.0226	0.000050	0.000025	0.005	0.000217	0.00037
KV-50	Christal Creek upstream Hinton Creek	21-Feb-2021	0.125	1.25	0.210C	291	429	0.0547	17.3	0.0025	0.141		1.68	0.0276	0.1	0.00010	0.0226	0.0228	0.000050	0.000025	0.005	0.000141	0.00037
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2021	0.125	1.25	0.247C	297	429	0.0643	16.5	0.0025	0.121		0.82	0.0180	0.1	0.00005	0.021	0.0218	0.000050	0.000025	0.005	0.000126	0.00037
KV-50	Christal Creek upstream Hinton Creek	13-Apr-2021	0.025	1.46	0.268C	306	429	0.0571	8.23	0.0005	0.119		0.64	0.215C	0.1	0.00014	0.0416	0.0285	0.000050	0.000025	0.005	0.000190	0.00037
KV-50	Christal Creek upstream Hinton Creek	05-May-2021	0.025	6.38	0.116	228	429	0.0495	13.5	0.0144	0.515		11.6	0.0989	0.1	0.00128	0.0148	0.0534	0.000050	0.000025	0.005	0.00049	0.00037
KV-50	Christal Creek upstream Hinton Creek	07-May-2021					128		22.1						0.1								NoHardness
KV-50	Christal Creek upstream Hinton Creek	16-May-2021	0.025	1.26	0.097	119	309	0.0252	0.776	0.0054	0.206		14.5	0.208C	0.1	0.00061	0.0118	0.0276	0.000050	0.000025	0.005	0.000694	0.000235
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2021	0.125	1.25	0.238C	302	429	0.0377	29.3	0.0025	0.155		3.14	0.0167	0.1	0.00016	0.0148	0.0271	0.000050	0.000025	0.005	0.000216	0.00037
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021	0.125	1.25	0.207C	323	429	0.0708	0.878	0.0025	0.173		1.32	0.0081	0.1	0.00019	0.00612	0.0253	0.000050	0.000025	0.005	0.000216	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	151	0.00039	0.00597J	0.00122	0.004	3.98	0.000902	0.007	0.0274	0.0209	27.6	1.40	6.0	0.0000025	0.000258	0.0110	0.15
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	162	0.00027	0.00538J	0.00080	0.004	2.99	0.000701	0.007	0.0293	0.0213	28.3	1.32	6.3	0.0000025	0.000235	0.00950	0.15
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	145	0.00027	0.00656J	0.00067	0.004	3.75	0.000655	0.007	0.0259	0.0227	25.2	1.55	5.7	0.0000025	0.000220	0.0114	0.15
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	132	0.00017	0.00646J	0.00025	0.004	3.19	0.000374	0.007	0.0233	0.0214	22.8	1.48	5.2	0.0000025	0.000185	0.0117	0.15
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	121	0.00017	0.00641J	0.00025	0.004	3.61	0.000659	0.007	0.0212	0.0209	20.7	1.41	4.8	0.0000025	0.000196	0.0116	0.15
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	137	0.00014	0.00694J	0.00025	0.004	3.7	0.000323	0.007	0.0242	0.0246	23.3	1.67	5.4	0.0000025	0.000206	0.0123	0.15
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	139	0.00005	0.00698J	0.00025	0.004	3.29	0.000253	0.007	0.0245	0.0232	23.5	1.77	5.4	0.0000025	0.000171	0.0126	0.15
KV-50	Christal Creek upstream Hinton Creek	06-Mar-2019	147	0.00023	0.00682J	0.00057	0.004	4.55	0.000511	0.007	0.0257	0.0246	23.2	1.76	5.6	0.0000025	0.000182	0.0129	0.15
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2019	140	0.00012	0.00711J	0.00025	0.004	2.99	0.00109	0.007	0.0245	0.0216	22.7	1.70	5.4	0.0000025	0.000204	0.0122	0.15
KV-50	Christal Creek upstream Hinton Creek	16-May-2019	114	0.00011	0.00449J	0.00025	0.004	2.8	0.000415	0.007	0.0197	0.0178	18.9	1.39	4.5	0.0000025	0.000135	0.00918	0.15
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2019	175	0.00018	0.00793J	0.00054	0.004	6	0.000436	0.007	0.0318	0.0266	30.0	2.18	6.7	0.0000025	0.000193	0.0141	0.15
KV-50	Christal Creek upstream Hinton Creek	22-Jul-2019	173	0.00042	0.00767J	0.00097	0.004	4.76	0.000720	0.007	0.0312	0.0250	28.4	1.87	6.6	0.0000061	0.000253	0.0128	0.15
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2019	165	0.00005	0.00693J	0.00025	0.004	3.14	0.000136	0.007	0.0295	0.0243	27.5	1.84	6.3	0.0000025	0.000193	0.0118	0.15
KV-50	Christal Creek upstream Hinton Creek	17-Sep-2019	143	0.00010	0.00609J	0.00025	0.004	2.16	0.000068	0.007	0.0251	0.0233	23.4	1.62	5.5	0.0000025	0.000241	0.0103	0.15
KV-50	Christal Creek upstream Hinton Creek	04-Oct-2019	153	0.00005	0.00696J	0.00025	0.004	3.08	0.000077	0.007	0.0271	0.0263	25.4	1.85	5.9	0.0000025	0.000205	0.0120	0.15
KV-50	Christal Creek upstream Hinton Creek	28-Nov-2019	131	0.00005	0.00648J	0.00025	0.004	2.88	0.000073	0.007	0.0231	0.0225	22.8	1.64	5.2	0.0000025	0.000190	0.0106	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2019	126	0.00005	0.00643J	0.00025	0.004	3.68	0.000530	0.007	0.0226	0.0227	23.7	1.56	5.1	0.0000025	0.000203	0.0107	0.15
KV-50	Christal Creek upstream Hinton Creek	31-Jan-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	15-Feb-2020	121	0.00016	0.00558J	0.00025	0.004	2.5	0.000025	0.007	0.0213	0.0218	21.0	1.38	4.8	0.0000025	0.000161	0.00988	0.15
KV-50	Christal Creek upstream Hinton Creek	19-Mar-2020	130	0.00030	0.00555J	0.00025	0.004	3.32	0.000124	0.007	0.0232	0.0216	23.4	1.49	5.2	0.0000025	0.000160	0.0105	0.15
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2020	123	0.00005	0.00522J	0.00025	0.004	3.45	0.000115	0.007	0.0216	0.0221	21.6	1.35	4.9	0.0000025	0.000141	0.00959	0.15
KV-50	Christal Creek upstream Hinton Creek	07-May-2020	31.2	0.00176C	0.00426J	0.00617C	0.00242	17	0.00753	0.00330	0.00662	0.0051	6.19	0.692	1.7	0.0000025	0.000377	0.00852	0.0977
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2020	122	0.00005	0.00475J	0.00061	0.004	2.78	0.000193	0.007	0.0215	0.0175	21.4	1.32	4.9	0.0000025	0.000253	0.00832	0.15
KV-50	Christal Creek upstream Hinton Creek	11-Jul-2020	112	0.00018	0.00356	0.00101	0.004	2.15	0.000714	0.007	0.0194	0.0158	18.8	0.917	4.5	0.0000025	0.000204	0.00650	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Aug-2020	122	0.00005	0.00382	0.00053	0.004	1.76	0.000290	0.007	0.0214	0.0166	21.5	0.933	4.9	0.0000025	0.000208	0.00702	0.15
KV-50	Christal Creek upstream Hinton Creek	23-Sep-2020	130	0.00016	0.00417J	0.00025	0.004	2.24	0.000282	0.007	0.0223	0.0190	19.9	0.900	5.0	0.0000025	0.000594	0.00768	0.15
KV-50	Christal Creek upstream Hinton Creek	18-Oct-2020	124	0.00010	0.00511J	0.00057	0.004	2.57	0.000387	0.007	0.0223	0.0182	23.2	1.25	5.0	0.0000025	0.000182	0.00893	0.15
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2020	119	0.00021	0.00548J	0.00069	0.004	3.32	0.000451	0.007	0.0207	0.0164	20.4	1.35	4.7	0.0000025	0.000180	0.00919	0.15
KV-50	Christal Creek upstream Hinton Creek	06-Dec-2020	131	0.00013	0.00528J	0.00025	0.004	2.73	0.000322	0.007	0.0226	0.0205	20.6	1.29	5.1	0.0000025	0.000166	0.00907	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2021	134	0.00005	0.00587J	0.00025	0.004	3.1	0.0105	0.007	0.0235	0.0212	22.1	1.47	5.2	0.0000025	0.000179	0.0104	0.15
KV-50	Christal Creek upstream Hinton Creek	21-Feb-2021	132	0.00005	0.00617J	0.00025	0.004	3.07	0.000489	0.007	0.0235	0.0189	23.7	1.49	5.2	0.0000025	0.000171	0.0106	0.15
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2021	133	0.00005	0.00590J	0.00025	0.004	2.79	0.000445	0.007	0.0233	0.0195	22.2	1.51	5.2	0.0000025	0.000153	0.0104	0.15
KV-50	Christal Creek upstream Hinton Creek	13-Apr-2021	128	0.00039	0.00670J	0.00084	0.004	7.11	0.000764	0.007	0.0227	0.0197	22.8	1.62	5.1	0.0000025	0.000198	0.0116	0.15
KV-50	Christal Creek upstream Hinton Creek	05-May-2021	86.0	0.00025	0.00265	0.00128	0.004	2.45	0.00225	0.007	0.0157	0.0106	18.2	0.644	3.7	0.0000025	0.000149	0.00497	0.15
KV-50	Christal Creek upstream Hinton Creek	07-May-2021					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	16-May-2021	48.4	0.00051	0.00181	0.00248	0.00355	2.06	0.0451	0.00583	0.00915	0.0065	9.68	0.446	2.3	0.0000063	0.000148	0.00438	0.137
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2021	120	0.00025	0.00475J	0.00051	0.004	2.34	0.000397	0.007	0.0210	0.0177	20.8	1.28	4.8	0.0000025	0.000187	0.00881	0.15
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021	131	0.00025	0.00469J	0.00076	0.004	1.03	0.00358	0.007	0.0230	0.0271	22.3	1.24	5.2	0.0000025	0.000158	0.00842	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	0.025	0.35	0.000496	4.32	0.000012	1.89	0.262	127	0.000017	0.00005	0.00621	0.00321	0.00063	0.196	0.308	0.00015	0.0045	0.00014	0.0148
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	0.025	0.38	0.000881	4.26	0.000013	1.68	0.273	135	0.000014	0.00005	0.00195	0.00390	0.00025	0.177	0.330	0.00015	0.0027	0.00014	0.0121
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	0.025	0.40	0.000533	4.42	0.000005	1.63	0.248	118	0.000021	0.00005	0.00505	0.00234	0.00025	0.215	0.290	0.00015	0.0010	0.00014	0.0131
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	0.025	0.34	0.000401	4.63	0.000005	1.58	0.220	116	0.000020	0.00005	0.00105	0.00190	0.00025	0.230	0.258	0.00015	0.0012	0.00005	0.0154
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	0.025	0.35	0.000353	4.31	0.000005	1.59	0.213	116	0.000018	0.00005	0.00267	0.00176	0.00025	0.220	0.231	0.00015	0.0015	0.00005	0.0181
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	0.025	0.35	0.000344	4.30	0.000005	1.60	0.216	115	0.000019	0.00005	0.00220	0.00167	0.00025	0.276J	0.268	0.00015	0.0005	0.00005	0.0183
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	0.025	0.36	0.000308	4.48	0.000005	1.63	0.212	118	0.000014	0.00005	0.00100	0.00153	0.00025	0.261	0.273	0.00015	0.0005	0.00005	0.0217
KV-50	Christal Creek upstream Hinton Creek	06-Mar-2019	0.025	0.39	0.000319	4.71	0.000005	1.62	0.249	139	0.000005	0.00005	0.00461	0.00169	0.00025	0.258	0.287	0.00015	0.0005	0.00005	0.0225
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2019	0.025	0.41	0.000175	3.95	0.000005	1.55	0.230	118	0.000013	0.00005	0.00075	0.00137	0.00025	0.254	0.272	0.00015	0.0010	0.00005	0.0209
KV-50	Christal Creek upstream Hinton Creek	16-May-2019	0.025	0.45	0.000140	3.29	0.000005	1.21	0.182	96.4	0.000005	0.00005	0.0006	0.00105	0.00025	0.188	0.212	0.00015	0.0005	0.00005	0.00544
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2019	0.025	0.39	0.000239	4.63	0.000005	1.73	0.269	179	0.000013	0.00005	0.00260	0.00154	0.00025	0.285	0.360	0.00015	0.0013	0.00005	0.0188
KV-50	Christal Creek upstream Hinton Creek	22-Jul-2019	0.025	0.39	0.000307	4.84	0.000011	1.62	0.267	154	0.000014	0.00005	0.00701	0.00208	0.00081	0.250	0.352	0.00015	0.0015	0.00005	0.0196
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2019	0.025	0.37	0.000310	4.15	0.000005	1.59	0.266	148	0.000012	0.00005	0.00113	0.00201	0.00025	0.231	0.333	0.00015	0.0005	0.00005	0.0157
KV-50	Christal Creek upstream Hinton Creek	17-Sep-2019	0.025	0.36	0.000300	4.21	0.000005	1.58	0.230	122	0.000013	0.00005	0.00044	0.00153	0.00025	0.207	0.280	0.00015	0.0013	0.00005	0.0107
KV-50	Christal Creek upstream Hinton Creek	04-Oct-2019	0.025	0.38	0.000250	4.18	0.000005	1.72	0.234	135	0.000011	0.00005	0.00040	0.00157	0.00025	0.233	0.304	0.00015	0.0022	0.00005	0.0148
KV-50	Christal Creek upstream Hinton Creek	28-Nov-2019	0.025	0.36	0.000242	4.66	0.000005	1.71	0.213	114	0.000013	0.00005	0.00045	0.00138	0.00025	0.235	0.255	0.00015	0.0005	0.00005	0.0160
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2019	0.025	0.37	0.000256	4.54	0.000005	1.76	0.217	111	0.000013	0.00005	0.00064	0.00139	0.00025	0.248	0.249	0.00015	0.0005	0.00005	0.0199
KV-50	Christal Creek upstream Hinton Creek	31-Jan-2020															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	15-Feb-2020	0.025	0.34	0.000255	3.90	0.000005	1.56	0.200	109	0.000005	0.00005	0.00015	0.00121	0.00025	0.233J	0.232	0.00015	0.0005	0.00005	0.0187
KV-50	Christal Creek upstream Hinton Creek	19-Mar-2020	0.025	0.40	0.000176	4.28	0.000005	1.66	0.213	114	0.000005	0.00005	0.00015	0.00114	0.00025	0.245	0.256	0.00015	0.0005	0.00005	0.0178
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2020	0.025	0.40	0.000148	4.10	0.000005	1.67	0.196	110	0.000005	0.00005	0.00038	0.00101	0.00025	0.197	0.236	0.00015	0.0005	0.00005	0.0200
KV-50	Christal Creek upstream Hinton Creek	07-May-2020	0.151	1.03	0.000271	3.41	0.000108	0.644	0.0618	21.0	0.000032	0.00005	0.0306	0.000632	0.00290	0.204J	0.0173	0.00042	0.0579	0.00028	0.00413
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2020	0.025	0.319	0.000324	3.93	0.000005	1.40	0.206	108	0.000005	0.00005	0.00073	0.00121	0.00025	0.167	0.236	0.00010	0.0090	0.00010	0.0148
KV-50	Christal Creek upstream Hinton Creek	11-Jul-2020	0.025	0.271	0.000720	3.83	0.000005	1.38	0.210	87.1	0.000013	0.00005	0.00182	0.00146	0.00025	0.141	0.208	0.00010	0.0141	0.00022	0.00894
KV-50	Christal Creek upstream Hinton Creek	12-Aug-2020	0.025	0.310	0.00117C	4.32	0.000005	1.56	0.237	89.7	0.000013	0.00005	0.00133	0.00234	0.00025	0.142	0.234	0.00010	0.0037	0.00024	0.00779
KV-50	Christal Creek upstream Hinton Creek	23-Sep-2020	0.025	0.339	0.00111C	4.29	0.000005	1.69	0.257	98.0	0.000016	0.00005	0.00142	0.00262	0.00025	0.163	0.244	0.00010	0.0046	0.00020	0.00950
KV-50	Christal Creek upstream Hinton Creek	18-Oct-2020	0.025	0.366	0.000703	4.28	0.000005	1.90	0.244	96.9	0.000005	0.00005	0.00198	0.00228	0.00025	0.197	0.244	0.00010	0.0026	0.00018	0.0108
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2020	0.025	0.366	0.000732	4.54	0.000005	1.73	0.212	95.4	0.000017	0.00005	0.00382	0.00257	0.00025	0.213	0.225	0.00010	0.0010	0.00016	0.0103
KV-50	Christal Creek upstream Hinton Creek	06-Dec-2020	0.025	0.349	0.00112C	4.39	0.000005	2.37	0.210	91.5	0.000016	0.00005	0.00090	0.00219	0.00025	0.206	0.249	0.00010	0.0005	0.00012	0.0148
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2021	0.025	0.404	0.000771	4.64	0.000020	1.86	0.218	105	0.000010	0.00005	0.00049	0.00179	0.00025	0.246	0.260	0.00010	0.0012	0.00005	0.0198
KV-50	Christal Creek upstream Hinton Creek	21-Feb-2021	0.025	0.393	0.000514	4.51	0.000005	1.72	0.222	103	0.000015	0.00005	0.00089	0.00174	0.00025	0.229	0.260	0.00010	0.0005	0.00005	0.0175
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2021	0.025	0.387	0.000484	4.70	0.000005	2.19	0.230	110	0.000013	0.00005	0.00081	0.00153	0.00025	0.240	0.258	0.00010	0.0024	0.00005	0.0169
KV-50	Christal Creek upstream Hinton Creek	13-Apr-2021	0.066	0.403	0.000453	4.61	0.000012	2.62	0.220	100	0.000019	0.00005	0.00555	0.00175	0.00060	0.285J	0.250	0.00010	0.0005	0.00005	0.0178
KV-50	Christal Creek upstream Hinton Creek	05-May-2021	0.025	1.48	0.000207	3.21	0.000034	5.90	0.168	78.0	0.000005	0.00005	0.00308	0.000607	0.00025	0.159J	0.158	0.00010	0.0140	0.00122	0.00771
KV-50	Christal Creek upstream Hinton Creek	07-May-2021															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	16-May-2021	0.063	0.540	0.000288	2.75	0.000261C	1.83	0.0945	39.8	0.000005	0.00005	0.00330	0.000494	0.00055	0.156J	0.0608	0.00021	0.0649	0.00030	0.00433
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2021	0.025	0.388	0.000556	4.06	0.000005	1.52	0.209	106	0.000013	0.00005	0.00036	0.00146	0.00025	0.182	0.229	0.00010	0.0044	0.00015	0.0105
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021	0.025	0.559	0.000500	4.28	0.000005	2.22	0.229	110	0.000012	0.00005	0.00030	0.00169	0.00025	0.185	0.254	0.00010	0.0018	0.00012	0.00375

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	0.0278	0.00005	0.000025	0.005	0.000154	0.000457	146	0.00005	0.00544	0.00034	2.31	0.000025	0.0199	25.2	1.25	0.0000025	0.000194	0.00935
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	0.0294	0.00005	0.000025	0.005	0.000117	0.000457	161	0.00005	0.00503	0.00024	1.87	0.000075	0.0206	28.9	1.3	0.0000025	0.000205	0.00845
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	0.0233	0.00005	0.000025	0.005	0.000117	0.000457	126	0.00005	0.00572	0.00010	1.9	0.000025	0.0186	22.8	1.38	0.0000025	0.000175	0.0102
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	0.0214	0.00005	0.000025	0.005	0.000107	0.000457	133	0.00005	0.00631	0.00010	2.05	0.000025	0.0222	23.2	1.47	0.0000025	0.000192	0.0117
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	0.0239	0.00005	0.000025	0.005	0.000157	0.000457	142	0.00005	0.00663	0.00010	2.6	0.000025	0.0222	22.7	1.54	0.0000025	0.000175	0.0118
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	0.0198	0.00005	0.000025	0.005	0.0000866	0.000457	138	0.00005	0.00673	0.00010	2.55	0.000025	0.0225	23.5	1.59	0.0000025	0.000210	0.0119
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	0.0215	0.00005	0.000025	0.005	0.0000852	0.000457	135	0.00005	0.00712	0.00010	2.89	0.000025	0.0218	24.1	1.76	0.0000025	0.000178	0.0127
KV-50	Christal Creek upstream Hinton Creek	06-Mar-2019	0.0167	0.00005	0.000025	0.005	0.0000548	0.000457	142	0.00005	0.00620	0.00010	2.7	0.000025	0.0243	23.8	1.55	0.0000025	0.000172	0.0112
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2019	0.0205	0.00005	0.000025	0.005	0.0000825	0.000457	150	0.00132	0.00707	0.00010	2.42	0.000128	0.0240	24.3	1.84	0.0000025	0.000221	0.0126
KV-50	Christal Creek upstream Hinton Creek	16-May-2019	0.0191	0.00005	0.000025	0.005	0.0000621	0.000457	128	0.00005	0.00412	0.00010	0.020	0.000025	0.0172	20.1	1.53	0.0000025	0.000158	0.00893
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2019	0.0230	0.00005	0.000025	0.005	0.0000942	0.000457	174	0.00005	0.00788	0.00010	3.56	0.000056	0.0259	27.8	1.91	0.0000025	0.000184	0.0129
KV-50	Christal Creek upstream Hinton Creek	22-Jul-2019	0.0249	0.00005	0.000025	0.005	0.0000861	0.000457	169	0.00005	0.00710	0.00010	3.52	0.000025	0.0259	27.0	1.84	0.0000025	0.000145	0.0119
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2019	0.0231	0.00005	0.000025	0.005	0.0000753	0.000457	172	0.00005	0.00693	0.00191	2.47	0.000025	0.0252	26.4	1.83	0.0000025	0.000192	0.0116
KV-50	Christal Creek upstream Hinton Creek	17-Sep-2019	0.0219	0.00005	0.000025	0.005	0.0000679	0.000457	143	0.00005	0.00581	0.00010	1.48	0.000025	0.0237	23.8	1.57	0.0000025	0.000177	0.00995
KV-50	Christal Creek upstream Hinton Creek	04-Oct-2019	0.0191	0.00005	0.000025	0.005	0.0000626	0.000457	157	0.00005	0.00668	0.00010	2.21	0.000025	0.0243	24.1	1.77	0.0000025	0.000187	0.0117
KV-50	Christal Creek upstream Hinton Creek	28-Nov-2019	0.0209	0.00005	0.000025	0.005	0.0000493	0.000457	132	0.00005	0.00621	0.00010	1.95	0.000025	0.0235	22.8	1.61	0.0000025	0.000210	0.0104
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2019	0.0223	0.00005	0.000025	0.005	0.0000518	0.000457	127	0.00005	0.00609	0.00010	2.1	0.000025	0.0218	21.8	1.5	0.0000025	0.000180	0.0101
KV-50	Christal Creek upstream Hinton Creek	31-Jan-2020						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	15-Feb-2020	0.0177	0.00005	0.000025	0.005	0.0000411	0.000457	126	0.00005	0.00576	0.00010	2.18	0.000025	0.0227	22.1	1.45	0.0000025	0.000185	0.0104
KV-50	Christal Creek upstream Hinton Creek	19-Mar-2020	0.0208	0.00005	0.000025	0.005	0.0000508	0.000457	133	0.00035	0.00541	0.00010	2.36	0.000025	0.0218	22.3	1.39	0.0000025	0.000151	0.00995
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2020	0.0184	0.00005	0.000025	0.005	0.0000481	0.000457	125	0.00005	0.00496	0.00010	2.62	0.000025	0.0213	21.8	1.37	0.0000025	0.000145	0.00940
KV-50	Christal Creek upstream Hinton Creek	07-May-2020	0.0183	0.00005	0.000025	0.005	0.000227J	0.000216	28.7	0.00016	0.00139	0.00202	0.831	0.00141	0.0038	5.66	0.359	0.0000025	0.000107	0.00340
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2020	0.0252	0.000050	0.000025	0.005	0.000102	0.000457	125	0.00005	0.00467	0.00048	2.35	0.000071	0.0167	20.9	1.29	0.0000025	0.000170	0.00818
KV-50	Christal Creek upstream Hinton Creek	11-Jul-2020	0.0300	0.000050	0.000025	0.005	0.000217	0.000457	117	0.00005	0.00358	0.00065	1.39	0.000179	0.0147	20.0	0.982	0.0000025	0.000153	0.00663
KV-50	Christal Creek upstream Hinton Creek	12-Aug-2020	0.0303	0.000050	0.000025	0.005	0.000199	0.000457	117	0.00005	0.00351	0.00026	1.07	0.000025	0.0165	20.6	0.882	0.0000025	0.000204	0.00648
KV-50	Christal Creek upstream Hinton Creek	23-Sep-2020	0.0304	0.000050	0.000025	0.005	0.000211	0.000457	126	0.00005	0.00435	0.00023	1.62	0.000025	0.0176	23.4	1.07	0.0000025	0.000183	0.00778
KV-50	Christal Creek upstream Hinton Creek	18-Oct-2020	0.0264	0.000050	0.000025	0.005	0.000145	0.000457	120	0.00005	0.00464	0.00010	1.61	0.000025	0.0189	20.4	1.15	0.0000025	0.000185	0.00819
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2020	0.0247	0.000050	0.000025	0.005	0.000151	0.000457	117	0.00005	0.00475	0.00010	1.18	0.000848	0.0182	19.9	1.11	0.0000025	0.000174	0.00819
KV-50	Christal Creek upstream Hinton Creek	06-Dec-2020	0.0266	0.000050	0.000025	0.005	0.000127	0.000457	125	0.00005	0.00567	0.00010	1.92	0.000025	0.0200	22.0	1.36	0.0000025	0.000191	0.00996
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2021	0.0209	0.000050	0.000025	0.005	0.000135	0.000457	124	0.00005	0.00568	0.00010	2.21	0.000025	0.0188	21.2	1.4	0.0000025	0.000172	0.00959
KV-50	Christal Creek upstream Hinton Creek	21-Feb-2021	0.0226	0.000050	0.000025	0.005	0.000106	0.000457	136	0.00005	0.00562	0.00010	2.17	0.000025	0.0221	21.9	1.38	0.0000025	0.000174	0.00957
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2021	0.0205	0.000050	0.000025	0.005	0.0000960	0.000457	127	0.00005	0.00568	0.00010	2.01	0.000025	0.0208	20.9	1.44	0.0000025	0.000149	0.00992
KV-50	Christal Creek upstream Hinton Creek	13-Apr-2021	0.0209	0.000050	0.000025	0.005	0.0000878	0.000457	128	0.00005	0.00586	0.00010	2.1	0.000025	0.0198	22.7	1.51	0.0000025	0.000146	0.00996
KV-50	Christal Creek upstream Hinton Creek	05-May-2021	0.0522	0.000050	0.000025	0.005	0.000407	0.000457	88.1	0.00025	0.00243	0.00086	1.17	0.000874	0.0106	18.3	0.63	0.0000025	0.000121	0.00471
KV-50	Christal Creek upstream Hinton Creek	07-May-2021						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	16-May-2021	0.0235	0.000050	0.000025	0.005	0.000466J	0.000300	50.4	0.00025	0.00153	0.00163	0.662	0.00181	0.0067	9.54	0.371	0.0000025	0.000119	0.00359
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2021	0.0246	0.000050	0.000025	0.005	0.000170	0.000457	117	0.00025	0.00467	0.00021	1.56	0.000108	0.0174	20.2	1.25	0.0000025	0.000176	0.00828
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021	0.0247	0.000050	0.000025	0.005	0.000128	0.000457	130	0.00025	0.00466	0.00010	0.432	0.000110	0.0192	21.9	1.28	0.0000025	0.000149	0.00812

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-50	Christal Creek upstream Hinton Creek	13-Aug-2018	0.025	0.34	0.000494	4.00	0.000005	1.85	0.247	123	0.000005	0.00005	0.00015	0.00316	0.00025	0.167	0.142	0.00015	9.71	9.61	0.99	
KV-50	Christal Creek upstream Hinton Creek	03-Sep-2018	0.025	0.37	0.000923	3.84	0.000005	1.66	0.278	128	0.000005	0.00005	0.00015	0.00359	0.00025	0.159	0.144	0.00015	10.2	10.6	1.02	
KV-50	Christal Creek upstream Hinton Creek	08-Oct-2018	0.025	0.33	0.000603	4.45	0.000005	1.60	0.213	126	0.000010	0.00005	0.00015	0.00237	0.00025	0.206	0.091	0.00015	8.80	8.40	0.98	
KV-50	Christal Creek upstream Hinton Creek	19-Nov-2018	0.025	0.39	0.000385	4.02	0.000005	1.71	0.216	111	0.000016	0.00005	0.00015	0.00184	0.00025	0.233	0.118	0.00015	9.02	8.82	0.99	
KV-50	Christal Creek upstream Hinton Creek	11-Dec-2018	0.025	0.39	0.000333	4.28	0.000005	1.99	0.226	108	0.000016	0.00005	0.00015	0.00189	0.00025	0.245	0.103	0.00015	9.06	9.24	1.01	
KV-50	Christal Creek upstream Hinton Creek	13-Jan-2019	0.025	0.37	0.000366	4.35	0.000005	1.59	0.227	117	0.000014	0.00005	0.00015	0.00158	0.00025	0.243	0.114	0.00015	9.46	9.08	0.98	
KV-50	Christal Creek upstream Hinton Creek	08-Feb-2019	0.025	0.38	0.000314	4.44	0.000005	1.59	0.215	114	0.000012	0.00005	0.00015	0.00143	0.00025	0.272	0.081	0.00015	9.48	9.04	0.98	
KV-50	Christal Creek upstream Hinton Creek	06-Mar-2019	0.025	0.38	0.000268	4.44	0.000005	1.63	0.220	121	0.000005	0.00005	0.00015	0.00147	0.00025	0.236	0.099	0.00015	9.81	9.36	0.98	
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2019	0.025	0.41	0.000187	4.02	0.000005	1.62	0.221	125	0.000011	0.00005	0.00015	0.00130	0.00025	0.264	0.115	0.00015	9.34	9.79	1.02	
KV-50	Christal Creek upstream Hinton Creek	16-May-2019	0.025	0.47	0.000204	3.13	0.000005	1.36	0.209	89.2	0.000005	0.00005	0.00015	0.00100	0.00025	0.152	0.172	0.00015	7.24	8.20	1.06	
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2019	0.025	0.34	0.000243	4.20	0.000005	1.51	0.268	165	0.000005	0.00005	0.00015	0.00172	0.00025	0.275	0.107	0.00015	11.3	11.3	1	
KV-50	Christal Creek upstream Hinton Creek	22-Jul-2019	0.025	0.36	0.000249	4.16	0.000005	1.55	0.267	143	0.000005	0.00005	0.00015	0.00181	0.00025	0.235	0.080	0.00015	11.9	11.0	0.96	
KV-50	Christal Creek upstream Hinton Creek	01-Aug-2019	0.025	0.34	0.000348	4.17	0.000005	1.56	0.291	149	0.000010	0.00005	0.00015	0.00193	0.00025	0.229	0.123	0.00015	11.5	11.1	0.98	
KV-50	Christal Creek upstream Hinton Creek	17-Sep-2019	0.025	0.36	0.000256	3.95	0.000005	1.56	0.230	117	0.000013	0.00005	0.00015	0.00152	0.00025	0.201	0.094	0.00015	9.81	9.34	0.97	
KV-50	Christal Creek upstream Hinton Creek	04-Oct-2019	0.025	0.34	0.000305	4.23	0.000005	1.59	0.232	118	0.000005	0.00005	0.00015	0.00148	0.00025	0.22	0.093	0.00015	10.3	10.1	0.99	
KV-50	Christal Creek upstream Hinton Creek	28-Nov-2019	0.025	0.36	0.000275	4.07	0.000005	1.80	0.219	113	0.000012	0.00005	0.00015	0.00129	0.00025	0.231	0.104	0.00015	8.88	8.72	0.99	
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2019	0.025	0.46	0.000258	4.27	0.000005	1.70	0.214	102	0.000011	0.00005	0.00015	0.00133	0.00025	0.231	0.081	0.00015	8.90	8.40	0.97	
KV-50	Christal Creek upstream Hinton Creek	31-Jan-2020															0.002					
KV-50	Christal Creek upstream Hinton Creek	15-Feb-2020	0.025	0.38	0.000197	4.13	0.000005	1.76	0.219	110	0.000005	0.00015	0.00015	0.00124	0.00025	0.242	0.068	0.00015	9.15	8.35	0.95	
KV-50	Christal Creek upstream Hinton Creek	19-Mar-2020	0.025	0.40	0.000175	3.87	0.000005	1.61	0.213	105	0.000005	0.00005	0.00015	0.00113	0.00025	0.226	0.078	0.00015	9.21	8.75	0.97	
KV-50	Christal Creek upstream Hinton Creek	17-Apr-2020	0.025	0.40	0.000134	4.02	0.000005	1.67	0.194	109	0.000005	0.00005	0.00015	0.000977	0.00025	0.203	0.083	0.00015	8.86	8.33	0.97	
KV-50	Christal Creek upstream Hinton Creek	07-May-2020	0.025	0.97	0.000200	1.61	0.000016	0.603	0.0553	22.0	0.000005	0.00005	0.00068	0.000175	0.00025	0.0829	0.103	0.00015	1.89	2.02	1.03	
KV-50	Christal Creek upstream Hinton Creek	07-Jun-2020	0.025	0.291	0.000274	3.80	0.000005	1.38	0.208	99.1	0.000005	0.00005	0.00015	0.00117	0.00025	0.166	0.129	0.00015	8.12	8.25	1.01	
KV-50	Christal Creek upstream Hinton Creek	11-Jul-2020	0.025	0.281	0.000892	3.84	0.000005	1.48	0.217	88.0	0.000005	0.00005	0.00015	0.00139	0.00025	0.139	0.215	0.00015	7.20	7.70	1.03	
KV-50	Christal Creek upstream Hinton Creek	12-Aug-2020	0.025	0.293	0.00126	4.14	0.000005	1.55	0.237	94.8	0.000005	0.00005	0.00015	0.00206	0.00025	0.131	0.087	0.00015	8.10	7.76	1.02	
KV-50	Christal Creek upstream Hinton Creek	23-Sep-2020	0.025	0.360	0.00114	4.13	0.000005	1.71	0.240	91.5	0.000005	0.00005	0.00015	0.00282	0.00025	0.168	0.109	0.00015	8.43	8.48	1.00	
KV-50	Christal Creek upstream Hinton Creek	18-Oct-2020	0.025	0.357	0.000860	4.45	0.000005	1.70	0.220	107	0.000005	0.00005	0.00015	0.00243	0.00025	0.189	0.165	0.00015	8.33	7.84	1.03	
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2020	0.025	0.363	0.000771	4.26	0.000005	1.74	0.220	90.8	0.000005	0.00005	0.00015	0.00265	0.00025	0.187	0.092	0.00015	8.07	7.67	1.03	
KV-50	Christal Creek upstream Hinton Creek	06-Dec-2020	0.025	0.411	0.00123	4.66	0.000005	2.17	0.221	106	0.000014	0.00005	0.00015	0.00239	0.00025	0.222	0.045	0.00015	8.15	8.28	1.01	
KV-50	Christal Creek upstream Hinton Creek	12-Jan-2021	0.025	0.374	0.000829	4.34	0.000005	1.62	0.224	103	0.000013	0.00005	0.00015	0.00172	0.00025	0.234	0.112	0.00015	8.26	8.15	1.01	
KV-50	Christal Creek upstream Hinton Creek	21-Feb-2021	0.025	0.395	0.000513	4.35	0.000005	1.68	0.228	105	0.000011	0.00005	0.00015	0.00166	0.00025	0.238	0.117	0.00015	9.24	8.81	1.02	
KV-50	Christal Creek upstream Hinton Creek	23-Mar-2021	0.025	0.363	0.000468	4.42	0.000005	2.08	0.229	108	0.000012	0.00005	0.00015	0.00172	0.00025	0.241	0.087	0.00015	8.56	8.29	1.02	
KV-50	Christal Creek upstream Hinton Creek	13-Apr-2021	0.025	0.394	0.000501	4.46	0.000005	1.87	0.214	104	0.000012	0.00005	0.00015	0.00154	0.00025	0.24	0.062	0.00015	8.67	8.49	1.01	
KV-50	Christal Creek upstream Hinton Creek	05-May-2021	0.025	1.55	0.000244	2.96	0.000005	6.00	0.172	74.9	0.000005	0.00005	0.00015	0.000569	0.00025	0.148	0.175	0.00015	6.10	6.28	1.01	
KV-50	Christal Creek upstream Hinton Creek	07-May-2021															0.005					
KV-50	Christal Creek upstream Hinton Creek	16-May-2021	0.025	0.549	0.000307	2.66	0.000013	1.83	0.0981	44.2	0.000005	0.00005	0.00054	0.000420	0.00025	0.135	0.049	0.00015	3.46	3.44	1.00	
KV-50	Christal Creek upstream Hinton Creek	08-Jun-2021	0.025	0.371	0.000408	4.02	0.000005	1.44	0.204	90.9	0.000012	0.00005	0.00015	0.00151	0.00025	0.181	0.205	0.00015	8.43	7.68	1.05	
KV-50	Christal Creek upstream Hinton Creek	28-Jun-2021	0.025	0.346	0.000458	4.14	0.000005	1.61	0.233	108	0.000011	0.00005	0.00015	0.00152	0.00025	0.174	0.049	0.00015	9.01	8.44	1.03	

Christal Creek Attenuation Study, 2008 to 2022 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
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
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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.	23		7.0	7.36	7.38	751.6	753	0.2	7.96	66.8	16.6	386	386	110
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
KV-51	Christal Creek d/s Hinton Creek	18-May-2008				10	7.16	7.28		214	0					100	
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008				2	7.07	7.82		751	5					407	
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008				31	7.4	7.31		447	1					260	
KV-51	Christal Creek d/s Hinton Creek	28-May-2009				8	7.72	7.4		230	3.5				109	112	
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009				15	7.51	7.9		900	3.5				507	494	
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009				2100	7.47	7.5		996	1				617	533	
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010				10	7.39	7.7		931	7.8				511	531	
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010		10		66	7.28	7.62		950	0.2				531	537	110
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			5	7.87	7.33		528	4.1				271	265	35
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)	35.26		83	7.5	7.34	1235	1160	0.7	9.39	64.8	156.8	665	651	120
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
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
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
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
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
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
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2013	Flow might not be accurate. Lots of debris and algae; back water.	40.7		10.8	6.81	7.65	995	1080	3.9	8.99	68.9	81.7	633	634	118
KV-51	Christal Creek d/s Hinton Creek	10-Oct-2013	Orange/brown precipitate.	27.36		4.6	7.11	7.59	925.6	766	0.5	10.94	76.8	-31.7	545	545	112

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021	0.025	0.74	0.240C	303	429	0.0412	6.15	0.0005	0.182		1.30	0.0103	0.1	0.00015	0.0111	0.0268	0.000050	0.000025	0.005	0.000185	0.00037
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	0.025	0.25	0.197C	244	429	0.0365	2.20	0.0005	0.109		2.89	0.0282	0.1	0.00018	0.0122	0.0287	0.000050	0.000025	0.005	0.000198	0.00037
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021	0.025	0.59	0.216C	272	429	0.0486	4.81	0.0005	0.115		1.69	0.112C	0.1	0.00029	0.0156	0.0330	0.000050	0.000025	0.005	0.000349	0.00037
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021	0.025	0.57	0.244C	264	429	0.0661	16.0	0.0005	0.107		2.18	0.0812	0.1	0.00023	0.0206	0.0283	0.000050	0.000025	0.005	0.000303	0.00037
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021	0.025	0.65	0.251C	315	429	0.0986	125	0.0005	0.120		1.18	0.0617C	0.005	0.00017	0.0231	0.0268	0.000050	0.000025	0.005	0.000226	0.00037
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	0.125	1.25	0.231C	313	429	0.0803	8.30	0.0025	0.147		1.29	0.105C	0.1	0.00023	0.0323	0.0314	0.000050	0.000025	0.005	0.000304	0.00037
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022	0.125	1.25	0.290C	338	429	0.0780	10.8	0.0025	0.101		0.82	0.0106	0.1	0.00022	0.0224	0.0237	0.000050	0.000025	0.005	0.000127	0.00037
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022	0.125	1.25	0.292C	344	429	0.0872	13.5	0.0025	0.0895		1.06	0.0640	0.1	0.00012	0.0285	0.0254	0.000050	0.000025	0.005	0.000141	0.00037
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022	0.025	0.25	0.300C	338	429	0.0970	20.8	0.0005	0.0538		0.92	0.0122	0.1	0.00005	0.0304	0.0271	0.000050	0.000025	0.005	0.000175	0.00037
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	0.025	9.65	0.212C	246	429	0.0765	11.4	0.0011	0.0596		3.65	0.744C	0.1	0.00249	0.0332	0.0543	0.000050	0.000056	0.005	0.0013	0.00037
KV-50	Christal Creek upstream Hinton Creek	15-May-2022	0.025	2.56	0.094	63.7	309	0.0185	31.2	0.0005	0.0159		22.2	0.113C	0.1	0.00037	0.00931	0.0208	0.000050	0.000025	0.005	0.000228	0.000174
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022	0.125	1.25	0.198C	304	429	0.0325	4.01	0.0025	0.0587		4.30	0.0296	0.1	0.00017	0.0174	0.0255	0.000050	0.000025	0.005	0.000171	0.00037
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022	0.125	1.25	0.232C	323	429	0.0394	8.60	0.0025	0.0434		2.51	0.0156	0.1	0.00021	0.00934	0.0312	0.000050	0.000025	0.005	0.000192	0.00037
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022	0.125	1.25	0.245C	333	429	0.0460	5.68	0.0025	0.0468		2.45	0.0263	0.1	0.00021	0.0125	0.0293	0.000050	0.000025	0.005	0.000191	0.00037
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022	0.125	1.25	0.179C	291	429	0.0748	10.6	0.0025	0.0701		3.13	0.298C	0.1	0.00018	0.0146	0.0821	0.000050	0.000025	0.005	0.000227	0.00037
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022					128		0.616						NopH								NoHardness
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	0.125	1.25	0.200C	307	429	0.0777	8.16	0.0025	0.179		1.37	0.0709	0.1	0.00024	0.0225	0.0302	0.000050	0.000025	0.005	0.000379	0.00037
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022	0.125	1.25	0.213C	306	429	0.115	4.67	0.0025	0.191		1.42	0.0677	0.1	0.00022	0.0253	0.0330	0.000050	0.000025	0.005	0.000288	0.00037
KV-51	Christal Creek d/s Hinton Creek	18-May-2008					309		13.1					0.306C	0.1	0.0002	0.0051	0.024	0.00005	0.00025	0.001	0.00025	0.000158
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008					429		10.7					0.006	0.1	0.0001	0.0019	0.035	0.00005	0.00025	0.003	0.00035	0.00037
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008					429		6.96					0.529C	0.1	0.0004	0.0112	0.048	0.00002	0.00005	0.0025	0.00045	0.000350
KV-51	Christal Creek d/s Hinton Creek	28-May-2009					309		2.72					0.156C	0.1	0.00026	0.00559	0.0396	0.00001	0.00002	0.025	0.000381	0.000170
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009					429		4.40					0.289C	0.1	0.00045	0.0208	0.0678	0.00003	0.00001	0.025	0.00126	0.00037
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009					429		5.93					5.96C	0.1	0.00167	0.093	0.232	0.00069	0.000127	0.025	0.00385	0.00037
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010					429		4.10					0.0572	0.1	0.00026	0.0119	0.029	0.000005	0.0000025	0.025	0.00031	0.00037
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010				450	429	0.035	9.81	0.0025	0.08		1.3	0.273C	0.1	0.00022	0.0297	0.0582	0.00002	0.00001	0.025	0.000843	0.00037
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	26-May-2011				200	429	0.017	1.84	0.0025	0.1		7	0.0412	0.1	0.00017	0.00513	0.0414	0.000005	0.0000025	0.025	0.000237	0.000363
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011				515	429	0.067	5.67	0.05	0.7		1.2	0.641C	0.1	0.00034	0.0343	0.0398	0.00003	0.0000025	0.025	0.000494	0.00037
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012				531	429	0.055	19.3	0.005	0.06		0.25	0.0184	0.1	0.00015	0.0286	0.0232	0.000005	0.0000025	0.025	0.000287	0.00037
KV-51	Christal Creek d/s Hinton Creek	03-May-2012		0.25		269	429	0.0054	8.18	0.025	0.56		10.8	0.129C	0.1	0.000289	0.0195	0.0304	0.000014	0.0000025	0.025	0.000308	0.00037
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2012		0.74		521	429	0.19	11.9	0.025	0.21		1.36	0.0801	0.1	0.000258	0.0178	0.027	0.000005	0.0000025	0.025	0.000191	0.00037
KV-51	Christal Creek d/s Hinton Creek	14-Oct-2012		0.9		534	429	0.059	29.8	0.025	0.10		0.86	0.0653	0.1	0.000221	0.024	0.0282	0.000005	0.0000025	0.025	0.000247	0.00037
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2013		0.9		545	429	0.039	22.6	0.0025	0.08		0.25	0.019	0.1	0.000146	0.0281	0.0212	0.000005	0.0000025	0.025	0.000238	0.00037
KV-51	Christal Creek d/s Hinton Creek	03-May-2013		2.5	0.30C	584	429	0.0298	29.2	0.005	0.096		0.92	0.531C	0.1	0.00039	0.0447	0.0329	0.00005	0.00025	0.005	0.000409	0.00037
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2013		2.5	0.20C	539	429	0.0109	21.3	0.005	0.112		1.42	0.134C	0.1	0.00033	0.0181	0.0294	0.00005	0.00025	0.005	0.000295	0.00037
KV-51	Christal Creek d/s Hinton Creek	10-Oct-2013		2.5	0.22C	426	429	0.0282	14.1	0.005	0.134		2.28	0.0959	0.1	0.00015	0.0171	0.0225	0.00005	0.00025	0.005	0.000214	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021	131	0.00025	0.00488J	0.00025	0.004	1.65	0.000248	0.007	0.0230	0.0195	22.0	1.32	5.1	0.0000025	0.000192	0.00840	0.15
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	110	0.00025	0.00405J	0.00025	0.004	2	0.000140	0.007	0.0192	0.0175	19.1	1.11	4.4	0.0000025	0.000198	0.00705	0.15
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021	116	0.00025	0.00476J	0.00091	0.004	2.82	0.00259	0.007	0.0201	0.0175	19.3	1.18	4.6	0.0000025	0.000307	0.00857	0.15
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021	121	0.00025	0.00481J	0.00051	0.004	3.61	0.000589	0.007	0.0211	0.0188	20.7	1.27	4.8	0.0000025	0.000213	0.00874	0.15
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021	141	0.00025	0.00668J	0.00025	0.004	3.69	0.000478	0.007	0.0239	0.0242	19.7	1.65	5.3	0.0000025	0.000202	0.0114	0.15
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	124	0.00025	0.00702J	0.00068	0.004	4.85	0.000722	0.007	0.0216	0.0196	20.8	1.64	4.9	0.0000025	0.000204	0.0115	0.15
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022	145	0.00025	0.00737J	0.00025	0.004	3.07	0.000209	0.007	0.0253	0.0236	22.7	1.87	5.6	0.0000025	0.000203	0.0129	0.15
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022	142	0.00025	0.00812J	0.00025	0.004	4.32	0.000372	0.007	0.0250	0.0247	23.5	2.04	5.5	0.0000025	0.000236	0.0141	0.15
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022	159	0.00025	0.00882J	0.00025	0.004	4.56	0.000069	0.007	0.0278	0.0270	24.2	2.20	6.0	0.0000025	0.000210	0.0146	0.15
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	108	0.00120C	0.00669J	0.00477C	0.004	6.64	0.106	0.007	0.0187	0.0187	18.0	1.49	4.3	0.0000025	0.000431	0.0120	0.15
KV-50	Christal Creek upstream Hinton Creek	15-May-2022	34.9	0.00025	0.00201	0.00242	0.00260	1.94	0.00625	0.00367	0.00699	0.0054	6.07	0.491	1.8	0.0000069	0.000157	0.00474	0.104
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022	123	0.00025	0.00566J	0.00061	0.004	3.58	0.000633	0.007	0.0205	0.0186	16.7	1.40	4.7	0.0000025	0.000187	0.00932	0.15
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022	140	0.00082	0.00561J	0.00025	0.004	1.56	0.000273	0.007	0.0241	0.0195	21.2	1.45	5.4	0.0000025	0.000212	0.0100	0.15
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022	146	0.00025	0.00566J	0.00025	0.004	1.94	0.000310	0.007	0.0252	0.0243	21.9	1.48	5.6	0.0000025	0.000204	0.0102	0.15
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022	130	0.00025	0.00561J	0.00051	0.004	2.51	0.000597	0.007	0.0223	0.0210	20.0	1.45	5.0	0.0000025	0.000212	0.0101	0.15
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	120	0.00025	0.00635J	0.00025	0.004	3.27	0.000412	0.007	0.0211	0.0201	20.9	1.48	4.8	0.0000025	0.000207	0.0108	0.15
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022	110	0.00025	0.00630J	0.00025	0.004	3.56	0.000527	0.007	0.0192	0.0184	19.2	1.51	4.4	0.0000025	0.000232	0.0105	0.15
KV-51	Christal Creek d/s Hinton Creek	18-May-2008	32.7	0.0011C	0.0007	0.003C	0.00236	1.3	0.0006	0.00318	0.00649	0.005	6.1	0.166	1.6		0.0005	0.0028	0.0955
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008	120	0.00025	0.0009	0.0005	0.004	0.45	0.00005	0.007	0.0223	0.017	24.2	0.245	5.0		0.0005	0.0069	0.15
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008	78.2	0.0011C	0.00171	0.004	0.004	2.5	0.0017	0.007	0.0141	0.009	15.2	0.261	3.4		0.00022	0.005	0.15
KV-51	Christal Creek d/s Hinton Creek	28-May-2009	33.9	0.0006	0.000767	0.002	0.00254	1.01	0.000889	0.00355	0.00686	0.0038	5.99	0.171	1.7	0.000005	0.00011	0.00265	0.102
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009	160	0.0005	0.00277	0.0029	0.004	4.43	0.00297	0.007	0.0285	0.0158	26	0.569	6.1	0.000005	0.00022	0.00696	0.15
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009	199	0.0121C	0.0244J	0.0829C	0.004	36.3	0.1	0.007	0.0356	0.0331	29.2	2.57	7.3		0.00256	0.055	0.15
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010	163	0.0004	0.0044J	0.00078	0.004	2.07	0.000586	0.007	0.0287	0.0214	25.5	1.19	6.2	0.00001	0.0002	0.00725	0.15
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010	169	0.0008	0.0087J	0.00486C	0.004	4.03	0.00355	0.007	0.0300	0.0246	26.5	1.7	6.4	0.000005	0.00036	0.0143	0.15
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	26-May-2011	88.5	0.0004	0.00158	0.0009	0.004	0.961	0.000324	0.007	0.0146	0.007	12.2	0.422	3.5	0.000005	0.00007	0.00347	0.15
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011	209	0.0012C	0.0106J	0.00511C	0.004	7.04	0.00595	0.007	0.0388	0.0247	34.8	2.24	7.9	0.000005	0.00034	0.0176	0.15
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012	200	0.00005	0.00963J	0.00033	0.004	4.41	0.000376	0.007	0.0365	0.0354	31.9	2.22	7.5	0.000005	0.00022	0.0167	0.15
KV-51	Christal Creek d/s Hinton Creek	03-May-2012	109	0.00027	0.00489J	0.00246	0.004	3.5	0.00259	0.007	0.0187	0.0133	17.7	1.13	4.3	0.000005	0.000198	0.00961	0.15
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2012	208	0.00017	0.00835J	0.00098	0.004	3.15	0.000889	0.007	0.0383	0.033	33.4	2.07	7.8	0.000005	0.00026	0.015	0.15
KV-51	Christal Creek d/s Hinton Creek	14-Oct-2012	198	0.00012	0.00913J	0.000709	0.004	4.23	0.000791	0.007	0.0358	0.0336	30.3	2.12	7.4	0.000005	0.000184	0.0165	0.15
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2013	197	0.00005	0.00918J	0.000268	0.004	4.39	0.000313	0.007	0.0359	0.0355	31.4	2.2	7.4	0.000005	0.000209	0.0165	0.15
KV-51	Christal Creek d/s Hinton Creek	03-May-2013	232	0.00103C	0.0117J	0.00227	0.004	8.27	0.00753	0.007	0.0434	0.0360	36.8	2.91	8.6	0.000005	0.000280	0.0216	0.15
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2013	195	0.00029	0.00822J	0.00095	0.004	3.06	0.00247	0.007	0.0367	0.0303	35.6	2.08	7.5	0.000005	0.000233	0.0158	0.15
KV-51	Christal Creek d/s Hinton Creek	10-Oct-2013	169	0.00022	0.00752J	0.00069	0.004	3.11	0.000351	0.007	0.0309	0.0257	29.8	1.75	6.5	0.000005	0.000154	0.0150	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021	0.025	0.386	0.000402	4.41	0.000005	1.69	0.222	108	0.000016	0.00005	0.00047	0.00144	0.00025	0.173	0.254	0.00010	0.0005	0.00013	0.00617
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	0.025	0.285	0.000715	4.10	0.000005	1.40	0.214	85.9	0.000013	0.00005	0.00040	0.00115	0.00025	0.159	0.205	0.00010	0.0050	0.00017	0.00939
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021	0.025	0.350	0.000558	4.32	0.000017	1.55	0.233	98.8	0.000016	0.00005	0.00288	0.00172	0.00025	0.181	0.217	0.00010	0.0039	0.00022	0.0108
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021	0.025	0.318	0.000274	4.54	0.000005	1.44	0.215	96.7	0.000017	0.00005	0.00212	0.00148	0.00025	0.185	0.230	0.00010	0.0038	0.00017	0.0104
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021	0.025	0.381	0.000136	4.95	0.000005	1.59	0.218	112	0.000021	0.00005	0.00208	0.00144	0.00025	0.270J	0.265	0.00010	0.0011	0.00014	0.0182
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	0.025	0.386	0.000230	4.69	0.000078	1.84	0.211	108	0.000023	0.00005	0.00352	0.00142	0.00025	0.270J	0.236	0.00010	0.0012	0.00013	0.0180
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022	0.025	0.390	0.000165	4.82	0.000005	1.71	0.233	111	0.000016	0.00005	0.00015	0.00125	0.00025	0.282	0.282	0.00010	0.0022	0.00011	0.0201
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022	0.025	0.398	0.000168	5.12	0.000005	1.60	0.239	116	0.000023	0.00005	0.00224	0.00135	0.00058	0.301J	0.278	0.00010	0.0012	0.00005	0.0209
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022	0.025	0.420	0.000108	5.20	0.000005	1.67	0.241	123	0.000024	0.00005	0.00061	0.00128	0.00025	0.329J	0.313	0.00010	0.0012	0.00005	0.0254
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	0.077	0.922	0.000207	4.61	0.000874C	6.06	0.178	82.6	0.000034	0.00018	0.0138	0.000918	0.00209	0.335J	0.198	0.00036	0.0040	0.00106	0.0170
KV-50	Christal Creek upstream Hinton Creek	15-May-2022	0.025	0.467	0.000087	2.14	0.000071	1.89	0.0634	24.2	0.000010	0.00005	0.00189	0.000277	0.00025	0.0864J	0.0240	0.00010	0.0474	0.00030	0.00528
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022	0.025	0.273	0.000454	3.98	0.000005	1.08	0.198	103	0.000010	0.00005	0.00076	0.000922	0.00025	0.220	0.222	0.00010	0.0092	0.00014	0.0142
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022	0.025	0.294	0.000312	4.50	0.000005	1.39	0.234	114	0.000014	0.00005	0.00030	0.00128	0.00025	0.190	0.268	0.00010	0.0020	0.00018	0.00520
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022	0.025	0.347	0.000332	4.96	0.000005	1.52	0.244	120	0.000017	0.00005	0.00045	0.00132	0.00025	0.200	0.281	0.00010	0.0016	0.00017	0.00753
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022	0.025	0.328	0.000208	4.71	0.000005	1.36	0.206	98.7	0.000016	0.00005	0.00088	0.00105	0.00025	0.209	0.245	0.00021	0.0090	0.00016	0.0131
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022															NoHardness				
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	0.025	0.352	0.000481	4.58	0.000005	1.66	0.213	104	0.000022	0.00005	0.00222	0.00136	0.00025	0.247J	0.230	0.00010	0.0025	0.00020	0.0185
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022	0.025	0.347	0.000269	4.80	0.000005	3.53	0.210	100	0.000016	0.00005	0.00192	0.00121	0.00025	0.233J	0.206	0.00010	0.0005	0.00020	0.0204
KV-51	Christal Creek d/s Hinton Creek	18-May-2008		0.2	0.0001	2.42	0.00004	0.5	0.07	21.9	0.000025	0.0005	0.008	0.0006	0.0005	0.06J	0.0150	0.0005	0.143		0.0014
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008		0.6	0.0003	3.78	0.000005	1.6	0.264	94.9	0.000025	0.0005	0.0101	0.0037	0.00005	0.154	0.245	0.0005	0.006	0.0015	0.0017
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008	0.032	0.3	0.0007	4.55	0.000005	1.07	0.15		0.00002	0.00005	0.012	0.0019	0.00116	0.114	0.135	0.0002	0.045	0.0012	0.0022
KV-51	Christal Creek d/s Hinton Creek	28-May-2009	0.028	0.32	0.00018	1.89	0.000017	0.44	0.0661	28	0.000009	0.000005	0.0024	0.000721	0.0002	0.0547J	0.0217	0.0002	0.117	0.0002	0.00167
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009	0.058	0.44	0.00041	4.57	0.000024	1.48	0.268	129	0.000024	0.000005	0.0099	0.00524	0.0008	0.195	0.320	0.00005	0.0066	0.00031	0.0026
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009		0.83	0.00045	11	0.000131	1.32	0.293	145	0.000165	0.00006	0.201	0.00505	0.0278	0.551J	0.403	0.0022	0.0077	0.00062	0.018
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010	0.015	0.31	0.00024	3.79	0.0000025	1.32	0.269	148	0.00001	0.000005	0.0027	0.00168	0.0001	0.096	0.323	0.00005	0.0057	0.00024	0.00931
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010		0.39	0.00024	4.3	0.000015	1.43	0.256	157	0.000033	0.000005	0.0094	0.00411	0.0012	0.246	0.338	0.00005	0.0036	0.00015	0.0126
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	26-May-2011	0.014	0.26	0.0002	2.6	0.000022	0.81	0.146	84	0.000003	0.000005	0.0006	0.000597	0.0001	0.0599	0.143	0.00005	0.0306	0.00015	0.00424
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011	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	0.439	0.00005	0.0034	0.00022	0.0263
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012	0.023	0.4	0.00025	3.9	0.0000025	1.49	0.31	188	0.000013	0.0001	0.0011	0.00231	0.0001	0.202	0.412	0.00005	0.0009	0.00013	0.022
KV-51	Christal Creek d/s Hinton Creek	03-May-2012	0.0471	0.458	0.000175	2.73	0.000019	1.09	0.165	101	0.000012	0.00010	0.00454	0.00103	0.0004	0.127	0.199	0.00023	0.0259	0.000212	0.0126
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2012	0.0292	0.369	0.000304	4.9	0.0000115	1.86	0.298	187	0.0000124	0.00010	0.00252	0.00219	0.00021	0.162	0.433	0.00005	0.00253	0.000244	0.0146
KV-51	Christal Creek d/s Hinton Creek	14-Oct-2012	0.0172	0.394	0.000219	4.52	0.0000025	1.52	0.316	208	0.000016	0.00010	0.00253	0.00221	0.00010	0.168	0.405	0.00005	0.00168	0.000199	0.0166
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2013	0.0126	0.384	0.00024	4.45	0.0000025	1.53	0.306	176	0.000014	0.00010	0.00095	0.00208	0.00010	0.203	0.406	0.00005	0.00149	0.000126	0.0216
KV-51	Christal Creek d/s Hinton Creek	03-May-2013	0.025	0.55	0.00021	5.60	0.000073	1.72	0.302	201	0.000024	0.00016	0.016	0.00235	0.0015	0.278	0.488	0.00040	0.0019	0.00020	0.0233
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2013	0.025	0.43	0.00026	4.51	0.000025	1.84	0.313	172	0.000016	0.00005	0.005	0.00327	0.0005	0.184	0.415	0.00040	0.0037	0.00021	0.0144
KV-51	Christal Creek d/s Hinton Creek	10-Oct-2013	0.025	0.33	0.00036	4.13	0.000005	1.58	0.250	135	0.000005	0.00005	0.005	0.00203	0.0005	0.197	0.349	0.00040	0.0143	0.00013	0.0151

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021	0.0251	0.000050	0.000025	0.005	0.000126	0.000457	116	0.00025	0.00462	0.00010	0.973	0.000025	0.0186	22.0	1.26	0.0000025	0.000152	0.00811
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	0.0282	0.000050	0.000025	0.005	0.000141	0.000457	110	0.00025	0.00405	0.00028	1.42	0.000025	0.0162	18.3	1.05	0.0000025	0.000203	0.00669
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021	0.0295	0.000050	0.000025	0.005	0.000220	0.000457	120	0.00025	0.00475	0.00024	1.81	0.000127	0.0180	19.8	1.17	0.0000025	0.000222	0.00830
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021	0.0229	0.000050	0.000025	0.005	0.000162	0.000457	112	0.00025	0.00440	0.00010	1.56	0.000025	0.0176	18.9	1.19	0.0000025	0.000172	0.00757
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021	0.0257	0.000050	0.000025	0.005	0.000159	0.000457	139	0.00025	0.00734	0.00010	2.74	0.000025	0.0208	23.6	1.78	0.0000025	0.000194	0.0119
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	0.0226	0.000050	0.000025	0.005	0.000172	0.000457	136	0.00025	0.00670	0.00010	2.58	0.000025	0.0219	21.4	1.65	0.0000025	0.000191	0.0107
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022	0.0211	0.000050	0.000025	0.005	0.000100	0.000457	136	0.00025	0.00717	0.00010	2.71	0.000220	0.0217	22.4	1.91	0.0000025	0.000186	0.0126
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022	0.0262	0.000050	0.000025	0.005	0.0000750	0.000457	147	0.00025	0.00786	0.00010	2.89	0.000025	0.0243	24.2	2.06	0.0000025	0.000194	0.0134
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022	0.0244	0.000050	0.000025	0.005	0.000111	0.000457	135	0.00025	0.00808	0.00010	3.6	0.000025	0.0244	21.7	1.96	0.0000025	0.000193	0.0134
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	0.0364	0.000050	0.000025	0.005	0.000726J	0.000457	104	0.00025	0.00602	0.00039	3	0.00380	0.0165	17.5	1.46	0.0000063	0.000280	0.00989
KV-50	Christal Creek upstream Hinton Creek	15-May-2022	0.0184	0.000050	0.000025	0.005	0.000151	0.000230	33.7	0.00025	0.00182	0.00194	1.06	0.00215	0.0050	5.87	0.456	0.0000025	0.000135	0.00431
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022	0.0239	0.000050	0.000025	0.005	0.000145	0.000457	123	0.00025	0.00563	0.00044	2.91	0.000266	0.0180	16.9	1.44	0.0000025	0.000179	0.00916
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022	0.0262	0.000050	0.000025	0.005	0.000134	0.000457	134	0.00025	0.00535	0.00024	0.93	0.000025	0.0211	21.9	1.42	0.0000025	0.000177	0.00951
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022	0.0277	0.000050	0.000025	0.005	0.000135	0.000457	146	0.00025	0.00547	0.00010	1.06	0.000025	0.0211	21.4	1.48	0.0000025	0.000204	0.00986
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022	0.0253	0.000050	0.000025	0.005	0.000158	0.000457	127	0.00025	0.00566	0.00021	1.97	0.000068	0.0187	20.5	1.63	0.0000025	0.000226	0.00958
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022						NoHardness												
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	0.0278	0.000050	0.000025	0.005	0.000282	0.000457	120	0.00025	0.00593	0.00024	2.36	0.000025	0.0186	20.9	1.43	0.0000025	0.000178	0.0103
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022	0.0305	0.000050	0.000025	0.005	0.000137	0.000457	122	0.00025	0.00599	0.00010	2.59	0.000025	0.0207	18.7	1.43	0.0000025	0.000220	0.00978
KV-51	Christal Creek d/s Hinton Creek	18-May-2008	0.019	0.00005	0.00025	0.001	0.00015	0.000212	32.2	0.0005	0.0006	0.003	0.42	0.0004	0.004	6.1	0.142		0.0005	0.0019
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008	0.036	0.00005	0.00025	0.001	0.00037	0.000457	122	0.0005	0.0009	0.0005	0.32	0.00005	0.015	24.8	0.258		0.0005	0.0031
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008	0.033	0.00002		0.002	0.00026	0.000427	78.9	0.0007	0.00113	0.001	0.316	0.0012	0.008	15.4	0.208		0.00015	0.006
KV-51	Christal Creek d/s Hinton Creek	28-May-2009	0.0355	0.000005	0.0000025	0.025	0.000405J	0.000225	35.1	0.0003	0.000637	0.00228	0.26	0.00148	0.0039	6.06	0.256	0.000005	0.00015	0.00262
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009	0.0484	0.000005	0.0000025	0.025	0.000512J	0.000457	156	0.0002	0.00134	0.00039	0.267	0.000755	0.0169	25.2	0.375	0.000005	0.00025	0.00448
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009	0.0288	0.000005	0.0000025	0.025	0.000026	0.000457	173	0.0003	0.00434	0.00016	2.78	0.000118	0.022	24.6	1.14	0.000005	0.00118	0.00572
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010	0.0267	0.000005	0.0000025	0.025	0.000212	0.000457	170	0.0003	0.00445	0.00047	1.37	0.000441	0.0214	26	1.18	0.00001	0.00021	0.00692
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010	0.0207	0.000005	0.0000025	0.025	0.000069	0.000457	171	0.0004	0.00608	0.00025	1.89	0.000106	0.027	26.4	1.69		0.00024	0.00932
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	26-May-2011	0.0404	0.000005	0.0000025	0.025	0.000231	0.000441	85.3	0.0003	0.00165	0.00093	0.724	0.00132	0.0071	12.6	0.415	0.000005	0.00008	0.00379
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011	0.0206	0.000005	0.0000025	0.025	0.000068	0.000457	207	0.00005	0.00884	0.000025	4.06	0.000312	0.0317	32.7	2.05	0.000005	0.00027	0.013
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012	0.0213	0.000005	0.0000025	0.025	0.000199	0.000457	224	0.00005	0.00878	0.000025	3.42	0.000207	0.036	31.2	2.16	0.000005	0.00019	0.0145
KV-51	Christal Creek d/s Hinton Creek	03-May-2012	0.0255	0.000005	0.0000025	0.025	0.00016	0.000457	110	0.0001	0.00456	0.00112	2.12	0.00034	0.0152	17.8	1.08	0.000005	0.000143	0.00853
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2012	0.0246	0.000005	0.0000025	0.025	0.0000772	0.000457	206	0.00005	0.0082	0.000176	2.32	0.000486	0.0319	32.3	2.06	0.000005	0.00024	0.0141
KV-51	Christal Creek d/s Hinton Creek	14-Oct-2012	0.024	0.000005	0.0000025	0.025	0.000087	0.000457	203	0.00005	0.00904	0.000197	2.81	0.000016	0.033	31	2.14	0.000005	0.000216	0.0164
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2013	0.02	0.000005	0.0000025	0.025	0.000191	0.000457	185	0.00005	0.009	0.000025	3.48	0.0000025	0.0359	30.8	2.1	0.000005	0.000229	0.0163
KV-51	Christal Creek d/s Hinton Creek	03-May-2013	0.0210	0.00005	0.00025	0.005	0.000204	0.000457	229	0.00005	0.0105	0.00010	3.9	0.000076	0.0348	36.0	2.78	0.000005	0.000191	0.0193
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2013	0.0261	0.00005	0.00025	0.005	0.000163	0.000457	195	0.00005	0.00788	0.00024	2.18	0.000234	0.0290	35.4	2	0.000005	0.000207	0.0150
KV-51	Christal Creek d/s Hinton Creek	10-Oct-2013	0.0209	0.00005	0.00025	0.005	0.000163	0.000457	169	0.00005	0.00724	0.00031	2.61	0.000069	0.0244	30.0	1.72	0.000005	0.000139	0.0140

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-50	Christal Creek upstream Hinton Creek	16-Jul-2021	0.025	0.356	0.000366	4.48	0.000005	1.63	0.209	104	0.000015	0.00005	0.00015	0.00154	0.00025	0.178	0.087	0.00015	8.69	7.77	1.06	
KV-50	Christal Creek upstream Hinton Creek	19-Aug-2021	0.025	0.307	0.000860	4.28	0.000005	1.45	0.212	84.1	0.000011	0.00005	0.00015	0.00108	0.00025	0.143	0.070	0.00015	7.36	7.16	1.01	
KV-50	Christal Creek upstream Hinton Creek	22-Sep-2021	0.025	0.359	0.000597	4.12	0.000005	1.58	0.234	91.5	0.000013	0.00005	0.00015	0.00175	0.00025	0.176	0.072	0.00015	8.14	7.81	1.02	
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2021	0.025	0.311	0.000269	4.39	0.000005	1.47	0.204	87.5	0.000013	0.00005	0.00015	0.00129	0.00025	0.178	0.114	0.00015	7.77	7.32	1.03	
KV-50	Christal Creek upstream Hinton Creek	11-Nov-2021	0.025	0.444	0.000227	4.80	0.000005	1.86	0.244	109	0.000018	0.00005	0.00015	0.00146	0.00025	0.273	0.158	0.00015	8.96	9.15	1.01	
KV-50	Christal Creek upstream Hinton Creek	01-Dec-2021	0.025	0.366	0.000288	4.73	0.000005	1.70	0.217	106	0.000017	0.00020	0.00015	0.00136	0.00025	0.252	0.081	0.00015	8.86	8.80	1.00	
KV-50	Christal Creek upstream Hinton Creek	26-Jan-2022	0.025	0.377	0.000139	4.81	0.000005	1.59	0.220	118	0.000014	0.00005	0.00015	0.00121	0.00025	0.276	0.076	0.00015	9.34	8.89	1.02	
KV-50	Christal Creek upstream Hinton Creek	22-Feb-2022	0.025	0.379	0.000147	4.91	0.000005	1.56	0.226	114	0.000021	0.00005	0.00015	0.00111	0.00025	0.307	0.089	0.00015	9.56	9.60	1.00	
KV-50	Christal Creek upstream Hinton Creek	24-Mar-2022	0.025	0.389	0.000078	4.82	0.000005	1.59	0.223	119	0.000018	0.00005	0.00015	0.00118	0.00025	0.313	0.099	0.00015	9.43	8.82	1.03	
KV-50	Christal Creek upstream Hinton Creek	26-Apr-2022	0.025	0.819	0.000082	3.47	0.000013	5.71	0.168	84.3	0.000016	0.00005	0.00015	0.000782	0.00025	0.266	0.116	0.00015	7.13	7.07	1.00	
KV-50	Christal Creek upstream Hinton Creek	15-May-2022	0.025	0.443	0.000087	1.84	0.000014	1.71	0.0644	22.0	0.000005	0.00005	0.00051	0.000216	0.00025	0.0778	0.132	0.00015	2.18	2.31	1.03	
KV-50	Christal Creek upstream Hinton Creek	09-Jun-2022	0.025	0.270	0.000420	3.79	0.000005	1.07	0.203	96.2	0.000005	0.00005	0.00015	0.000920	0.00025	0.217	0.108	0.00015	8.14	7.75	1.02	
KV-50	Christal Creek upstream Hinton Creek	28-Jul-2022	0.025	0.296	0.000295	4.66	0.000005	1.37	0.221	114	0.000016	0.00005	0.00015	0.00116	0.00025	0.191	0.127	0.00015	9.08	8.65	1.02	
KV-50	Christal Creek upstream Hinton Creek	03-Aug-2022	0.025	0.323	0.000329	4.39	0.000005	1.47	0.251	111	0.000015	0.00005	0.00015	0.00122	0.00025	0.184	0.110	0.00015	9.33	9.22	1.01	
KV-50	Christal Creek upstream Hinton Creek	16-Sep-2022	0.025	0.324	0.000175	4.48	0.000005	1.46	0.228	97.7	0.000015	0.00005	0.00015	0.000958	0.00025	0.211	0.129	0.00015	8.31	8.24	1.00	
KV-50	Christal Creek upstream Hinton Creek	15-Oct-2022															0.002					
KV-50	Christal Creek upstream Hinton Creek	23-Nov-2022	0.025	0.345	0.000458	4.77	0.000005	1.67	0.216	105	0.000016	0.00005	0.00015	0.00135	0.00025	0.23	0.081	0.00015	8.61	7.94	0.96	
KV-50	Christal Creek upstream Hinton Creek	12-Dec-2022	0.025	0.342	0.000248	4.72	0.000005	4.63	0.224	99.8	0.000015	0.00005	0.00015	0.00122	0.00025	0.238	0.066	0.00015	8.51	8.00	0.97	
KV-51	Christal Creek d/s Hinton Creek	18-May-2008		0.2	0.0001	2.1	0.000005	0.5	0.062	21.4	0.000025	0.0005	0.0016	0.0006	0.0002	0.05	0.014					
KV-51	Christal Creek d/s Hinton Creek	05-Jul-2008		0.2	0.0003	4.07	0.000005	1.4	0.248	94.3	0.000025	0.0005	0.0028	0.0036	0.00005	0.14	0.058					
KV-51	Christal Creek d/s Hinton Creek	03-Oct-2008	0.005	0.3	0.0003	3.86	0.000005	1	0.137		0.000005	0.0005	0.001	0.0018	0.00015	0.092	0.029	0.00005				
KV-51	Christal Creek d/s Hinton Creek	28-May-2009	0.016	0.36	0.00021	1.83	0.000013	0.52	0.0674	27	0.000005	0.000005	0.0009	0.0007	0.0001	0.18	0.010	0.0002				
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2009	0.008	0.37	0.00038	3.94	0.0000025	1.4	0.275	121	0.000009	0.000005	0.00025	0.00504	0.0001	0.134	0.040	0.00005				
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2009	0.002	0.37	0.00026	4.54	0.0000025	1.33	0.246	149	0.000001	0.000005	0.00025	0.00195	0.0001	0.0548	0.042	0.00005				
KV-51	Christal Creek d/s Hinton Creek	08-Jul-2010	0.008	0.34	0.00023	4.1	0.0000025	1.38	0.264	143	0.000002	0.000005	0.00025	0.00171	0.0001	0.0911	0.044	0.00005				
KV-51	Christal Creek d/s Hinton Creek	07-Oct-2010		0.37	0.00018	4.49	0.0000025	1.43	0.259	159	0.000001	0.000005	0.00025	0.00247	0.0001	0.121	0.087	0.00005				
KV-51	Christal Creek d/s Hinton Creek	11-Feb-2011															0.002					
KV-51	Christal Creek d/s Hinton Creek	26-May-2011	0.007	0.25	0.00019	2.41	0.00001	0.85	0.146	80	0.000003	0.000005	0.00025	0.000662	0.0001	0.0616	0.071	0.00005				
KV-51	Christal Creek d/s Hinton Creek	19-Jul-2011															0.002					
KV-51	Christal Creek d/s Hinton Creek	31-Oct-2011	0.01	0.38	0.00027	4.2	0.0000025	1.63	0.304	186	0.000001	0.00006	0.00025	0.00233	0.0001	0.143	0.071	0.00005				
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2012	0.008	0.42	0.00023	4.5	0.0000025	1.49	0.297	204	0.000011	0.0001	0.00025	0.00186	0.0001	0.188	0.075	0.00005				
KV-51	Christal Creek d/s Hinton Creek	03-May-2012	0.0156	0.446	0.0001	2.58	0.000006	1.07	0.164	103	0.000003	0.00010	0.00025	0.000968	0.00010	0.109	0.170	0.00005				
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2012	0.0119	0.361	0.00032	4.65	0.0000025	1.79	0.299	179	0.0000038	0.00010	0.00025	0.00223	0.00010	0.152	0.104	0.00005				
KV-51	Christal Creek d/s Hinton Creek	14-Oct-2012	0.0046	0.382	0.000209	4.51	0.0000025	1.56	0.304	210	0.00001	0.00010	0.00025	0.00216	0.00010	0.157	0.109	0.00005				
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2013	0.0010	0.358	0.000136	4.38	0.0000025	1.46	0.298	166	0.00001	0.00010	0.00025	0.00202	0.00010	0.193	0.080	0.00005	14	12		
KV-51	Christal Creek d/s Hinton Creek	03-May-2013	0.025	0.46	0.00014	4.36	0.000005	1.65	0.293	194	0.000005	0.00014	0.005	0.00208	0.0005	0.242	0.111	0.00040	14.7	14.8	1	
KV-51	Christal Creek d/s Hinton Creek	06-Jul-2013	0.025	0.38	0.00027	4.24	0.000005	1.78	0.301	167	0.000005	0.00005	0.005	0.00311	0.0005	0.17	0.132	0.00040	13.6	12.9	0.97	
KV-51	Christal Creek d/s Hinton Creek	10-Oct-2013	0.025	0.34	0.00039	3.93	0.000005	1.46	0.240	132	0.000005	0.00005	0.005	0.00194	0.0005	0.193	0.125	0.00040	11.1	11.2	1	

Christal Creek Attenuation Study, 2008 to 2022 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
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
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
KV-51	Christal Creek d/s Hinton Creek	10-Feb-2014	Water little turbid, orange muck in creek bed. Lots of branches+ de bris in creek.All samples preserved+filtered in lab.	7.1		22.0	6.96	7.20	991	752	-0.1	8.09	52.3	5.1	499	521	114
KV-51	Christal Creek d/s Hinton Creek	06-May-2014	Water orange, turbid, lots of branches in water, may affect flow reading.	49.4		41.7	7.03	7.31		216	1.5	12.3	88.6	68	113	107	33.2
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2014	Orange mud on bottom.	30.62		6.2	6.98	7.78	910	893	3	10.48	78.7	90.3	547	570	122
KV-51	Christal Creek d/s Hinton Creek	19-Oct-2014	100% open water. Red/orange sediments on bottom.	32.9		6.8	7.34	7.35		983	0.4	10.4	73.9	72.8	531	532	130
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2015	Water is clear with some kind of oily sheen on surface coming from upstream; odorless.	16.4		17.8	7.1	7.14	983	1030	0.1	9.87	68.3	89.9	563	576	120
KV-51	Christal Creek d/s Hinton Creek	12-May-2015	Salt Slug.	115.5		7.0	6.39	7.02	302.2	267	2.3	12.13	88.7	170.3	135	145	29.8
KV-51	Christal Creek d/s Hinton Creek	02-Jun-2015		35	0.417												
KV-51	Christal Creek d/s Hinton Creek	18-Jun-2015	discharge invalid due to malfunctioning YSI for conductivity measurements				7.64				6.2	9.3	75.3	158.8			
KV-51	Christal Creek d/s Hinton Creek	28-Jul-2015		26.1	0.414	56.0	7.16	7.50	840	1030	5	8.6	75	67.2	583	600	123
KV-51	Christal Creek d/s Hinton Creek	18-Sep-2015		45.7	0.481												
KV-51	Christal Creek d/s Hinton Creek	17-Oct-2015	ORP value suspect	37.5	0.418	20.0	7.64	7.73	861.7	850	0.9	10.55	73.9	-17.7	502	529	121
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			
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			
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
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			
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016		19.2			7.28		952		1.5	10.06	80	-40.7			
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
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016		46.7	0.406												
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
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016		78.9	0.513												
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			
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
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			
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			
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			
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
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			
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017		19.4			6.97		1240		0.1	10	77.3	-87.2			
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
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			
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
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017		93.2	0.306												
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			
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
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017		28.4			7.57		931.6		0.0	7.9	61	8.8			
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			
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018		11.8			7.82				-0.2	8.37	63.2	8.4			
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-51	Christal Creek d/s Hinton Creek	10-Feb-2014		0.80	0.245C	364	429	0.0264	20.8	0.0005	0.0942		2.98	0.200C	0.1	0.00019	0.0332	0.0230	0.00005	0.00025	0.005	0.000206	0.00037
KV-51	Christal Creek d/s Hinton Creek	06-May-2014		1.47	0.078	71.5	309	0.0178	15.6	0.0005	0.0245	0.995	19.3	0.831C	0.1	0.00078	0.0215	0.0395	0.00005	0.00025	0.005	0.000667	0.000175
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2014		1.25	0.21C	431	429	0.0072	15.5	0.0025	0.114	0.100	1.91	0.241C	0.1	0.00025	0.038	0.0306	0.00005	0.00025	0.005	0.000369	0.00037
KV-51	Christal Creek d/s Hinton Creek	19-Oct-2014		2.5	0.16C	400	429	0.0366	8.40	0.0025	0.146	0.095	1.59	0.0659	0.1	0.00026	0.0157	0.0280	0.00005	0.00025	0.005	0.000252	0.00037
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2015		0.5	0.217C	444	429	0.0313	15.0	0.0010	0.104	0.115	0.96	0.182C	0.1	0.00017	0.0244	0.0263	0.00005	0.00025	0.005	0.000195	0.00037
KV-51	Christal Creek d/s Hinton Creek	12-May-2015		0.25	0.078	105	309	0.0172	63.8	0.0005	0.0207	0.712	19.7	0.215C	0.005	0.00023	0.00715	0.0315	0.00005	0.000025	0.005	0.000244	0.000203
KV-51	Christal Creek d/s Hinton Creek	02-Jun-2015					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	18-Jun-2015					128		2.62						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	28-Jul-2015		0.5	0.255C	468	429	0.0735	8.70	0.0010	0.097	0.366	1.43	1.50C	0.1	0.00043	0.0252	0.0784	0.00005	0.000025	0.005	0.000333	0.00037
KV-51	Christal Creek d/s Hinton Creek	18-Sep-2015					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	17-Oct-2015		0.85	0.206C	380	429	0.0525	4.05	0.0005	0.122	0.155	1.23	0.241C	0.1	0.00025	0.0194	0.0327	0.00005	0.000025	0.005	0.000216	0.00037
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015					128		2.93						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016					128		5.24						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016		0.5	0.203C	471	429	0.0545	27.2	0.0010	0.090	0.156	0.72	0.265C	0.1	0.00016	0.031	0.0302	0.00005	0.000025	0.005	0.000218	0.00037
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016					128		9.62						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016					128		8.80						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	04-May-2016		0.25	0.126C	276	429	0.0297	14.2	0.0010	0.0651	0.321	8.90	0.210C	0.1	0.00018	0.0135	0.0437	0.00005	0.000025	0.005	0.000152	0.00037
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016		0.25	0.215C	438	429	0.0363	5.00	0.0005	0.0813	0.143	2.16	0.259C	0.1	0.00023	0.0175	0.0377	0.00005	0.000025	0.005	0.000219	0.00037
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016					128		10.3						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	0.125	1.25	0.21C	460	429	0.0669	24.2	0.0025	0.095	0.177	1.21	0.416C	0.1	0.00026	0.0301	0.0373	0.00005	0.000025	0.005	0.000281	0.00037
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016					128		10.9						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016					128		8.23						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017					128		21.8						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	0.125	1.25	0.22C	477	429	0.0799	108	0.0025	0.089	0.209	0.90	0.0714C	0.005	0.00012	0.0342	0.0298	0.00005	0.000025	0.005	0.000163	0.00037
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017					128		10.7						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017					128		20.2						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-May-2017	0.025	0.25	0.092	155	429	0.0183	6.88	0.0005	0.0225	0.484	15.6	0.334C	0.1	0.00017	0.00859	0.0356	0.00005	0.000025	0.005	0.000155	0.000274
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017					128		6.68						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017	0.125	1.25	0.22C	506	429	0.0328	7.51	0.0025	0.101	0.114	1.73	0.0985	0.1	0.00013	0.0168	0.0303	0.00005	0.000025	0.005	0.000152	0.00037
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017					128		1.27						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	0.125	0.67	0.24C	492	429	0.0525	13.0	0.0025	0.106		0.84	0.0531	0.1	0.00011	0.021	0.0228	0.00005	0.000025	0.005	0.000146	0.00037
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017					128		5.12						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017					128		11.9						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018					128		2.89						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	0.125	1.25	0.23C	483	429	0.0289	7.01	0.0025	0.092	0.187	1.14	0.832C	0.1	0.00027	0.055	0.0446	0.00005	0.000025	0.005	0.000443	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-51	Christal Creek d/s Hinton Creek	10-Feb-2014	159	0.00040	0.00730J	0.00100	0.004	5.67	0.00102	0.007	0.0279	0.0241	25.1	1.69	6.0	0.000005	0.000208	0.0140	0.15
KV-51	Christal Creek d/s Hinton Creek	06-May-2014	35.1	0.00157C	0.00256	0.00653C	0.00262	4.82	0.0273	0.00372	0.00703	0.00500	6.24	0.458	1.8	0.000012	0.000237	0.00596	0.105
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2014	170	0.00048	0.00670J	0.00152	0.004	8.3	0.00271	0.007	0.0310	0.0192	30.0	1.52	6.6	0.000005	0.000208	0.0128	0.15
KV-51	Christal Creek d/s Hinton Creek	19-Oct-2014	165	0.00017	0.00630J	0.00055	0.004	2.55	0.000530	0.007	0.0300	0.0211	28.9	1.43	6.4	0.000005	0.000203	0.0118	0.15
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2015	176	0.00045	0.00812J	0.0005	0.004	4.38	0.00108	0.007	0.0320	0.0275	29.7	1.91	6.7	0.000005	0.000203	0.0161	0.15
KV-51	Christal Creek d/s Hinton Creek	12-May-2015	43.6	0.00044	0.00173	0.00215	0.00306	1.59	0.00184	0.00466	0.00798	0.0057	6.45	0.451	2.0	0.0000279C	0.000104	0.00389	0.120
KV-51	Christal Creek d/s Hinton Creek	02-Jun-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	18-Jun-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	28-Jul-2015	184	0.00236C	0.00844J	0.00493C	0.004	6.5	0.00431	0.007	0.0333	0.0315	29.7	1.84	7.0	0.0000085	0.000444	0.0157	0.15
KV-51	Christal Creek d/s Hinton Creek	18-Sep-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	17-Oct-2015	160	0.00044	0.00646J	0.00127	0.004	3.16	0.00113	0.007	0.0281	0.0234	25.0	1.54	6.1	0.0000025	0.000272	0.0120	0.15
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016	197	0.00055	0.00929J	0.00126	0.004	5.33	0.00101	0.007	0.0358	0.0355	31.3	2.15	7.4	0.0000025	0.000239	0.0169	0.15
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	04-May-2016	117	0.00020	0.00374	0.00287	0.004	2.78	0.000967	0.007	0.0196	0.0146	16.9	0.888	4.5	0.0000025	0.000156	0.00720	0.15
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016	182	0.00047	0.00681J	0.00150	0.004	3.09	0.00124	0.007	0.0330	0.0250	29.5	1.65	6.9	0.0000025	0.000284	0.0120	0.15
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	188	0.00069	0.00943J	0.00232	0.004	5.73	0.00192	0.007	0.0341	0.0318	30.4	2.08	7.1	0.0000025	0.000316	0.0167	0.15
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	216	0.00020	0.0109J	0.00025	0.004	5.35	0.000353	0.007	0.0403	0.0374	35.5	2.57	8.1	0.0000025	0.000278	0.0181	0.15
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-May-2017	60.9	0.00035	0.00261	0.00257	0.004	2	0.00121	0.007	0.0107	0.0088	9.82	0.552	2.7	0.0000085	0.000118	0.00529	0.15
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017	184	0.00016	0.00835J	0.00060	0.004	3.28	0.000434	0.007	0.0339	0.0293	31.8	2.00	7.1	0.0000025	0.000227	0.0151	0.15
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	175	0.00005	0.00789J	0.00101	0.004	3.58	0.000228	0.007	0.0316	0.0287	29.0	1.85	6.7	0.0000025	0.000190	0.0141	0.15
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	188	0.00148C	0.00963J	0.00318	0.004	11.3	0.00259	0.007	0.0331	0.0334	26.9	1.95	6.9	0.0000025	0.000293	0.0184	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-51	Christal Creek d/s Hinton Creek	10-Feb-2014	0.025	0.39	0.00032	4.63	0.000012	1.57	0.231	125	0.000013	0.00005	0.005	0.00167	0.0005	0.191	0.314	0.00040	0.0013	0.00022	0.0214
KV-51	Christal Creek d/s Hinton Creek	06-May-2014	0.074	0.77	0.00017	2.97	0.000298C	0.692	0.0598	23.2	0.000021	0.00012	0.021	0.000365	0.0022	0.113J	0.0248	0.00040	0.0813	0.00040	0.00501
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2014	0.025	0.38	0.00031	4.46	0.000030	1.34	0.246	141	0.000013	0.00005	0.005	0.00185	0.0005	0.203	0.350	0.00040	0.0055	0.00015	0.0130
KV-51	Christal Creek d/s Hinton Creek	19-Oct-2014	0.025	0.39	0.00070	4.18	0.000005	1.62	0.260	132	0.000013	0.00005	0.005	0.00266	0.0005	0.156	0.338	0.00040	0.0045	0.00021	0.0134
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2015	0.025	0.43	0.00045	4.23	0.000018	1.57	0.261	148	0.000021	0.00005	0.005	0.00193	0.0005	0.222	0.362	0.00040	0.0035	0.00022	0.0179
KV-51	Christal Creek d/s Hinton Creek	12-May-2015	0.025	0.52	0.000158	1.76	0.000038	0.427	0.0744	36.1	0.000005	0.00005	0.00459	0.000360	0.00025	0.0611J	0.0412	0.00015	0.0876	0.00019	0.00365
KV-51	Christal Creek d/s Hinton Creek	02-Jun-2015															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	18-Jun-2015															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	28-Jul-2015	0.067	0.53	0.000420	6.27	0.000083	1.61	0.287	149	0.000036	0.00005	0.0366	0.00254	0.00385	0.187	0.377	0.00015	0.0019	0.00019	0.0166
KV-51	Christal Creek d/s Hinton Creek	18-Sep-2015															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	17-Oct-2015	0.025	0.35	0.000548	4.18	0.000012	1.54	0.245	120	0.000015	0.00005	0.00824	0.00221	0.00081	0.148	0.316	0.00015	0.0023	0.00016	0.0153
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016	0.025	0.40	0.000467	4.96	0.000016	1.64	0.278	157	0.000017	0.00005	0.00821	0.00241	0.00091	0.238	0.405	0.00015	0.0010	0.00005	0.0214
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	04-May-2016	0.025	0.33	0.000224	3.00	0.000019	0.903	0.171	90.1	0.000005	0.00005	0.00571	0.000987	0.00060	0.109	0.211	0.00015	0.0335	0.00012	0.0113
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016	0.025	0.34	0.000416	4.20	0.000019	1.53	0.273	156	0.000014	0.00005	0.00769	0.00238	0.00077	0.154	0.373	0.00015	0.0029	0.00015	0.0102
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	0.025	0.48	0.000409	5.33	0.000027	1.68	0.279	162	0.000032	0.00005	0.0125	0.00265	0.00112	0.235	0.386	0.00015	0.0024	0.00013	0.0227
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	0.025	0.46	0.000345	5.12	0.000005	1.84	0.330	186	0.000015	0.00005	0.00204	0.00268	0.00025	0.281	0.454	0.00015	0.0040	0.00005	0.0256
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	15-May-2017	0.025	0.36	0.000214	2.27	0.000040	0.645	0.106	56.6	0.000005	0.00005	0.00849	0.000558	0.00087	0.0843	0.0848	0.00015	0.114	0.00011	0.00493
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017	0.025	0.37	0.000296	4.32	0.000005	1.62	0.297	175	0.000012	0.00005	0.00245	0.00313	0.00025	0.239	0.383	0.00015	0.0027	0.00005	0.0114
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	0.025	0.42	0.000390	4.44	0.000005	1.61	0.301	180	0.000011	0.00005	0.00123	0.00273	0.00025	0.254	0.357	0.00015	0.0028	0.00005	0.0185
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	0.089	0.54	0.000350	5.88	0.000045	1.64	0.279	171	0.000023	0.00005	0.035	0.00246	0.00226	0.340	0.375	0.00040	0.0005	0.00005	0.0133

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-51	Christal Creek d/s Hinton Creek	10-Feb-2014	0.0184	0.00005	0.00025	0.005	0.000146	0.000457	166	0.00005	0.00722	0.00066	2.92	0.00124	0.0252	25.9	1.77	0.000005	0.000204	0.0143
KV-51	Christal Creek d/s Hinton Creek	06-May-2014	0.0207	0.00005	0.00025	0.005	0.000293J	0.000231	33.6	0.00022	0.00154	0.00229	0.684	0.00464	0.00444	5.74	0.383	0.000005	0.000104	0.00346
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2014	0.0284	0.00005	0.00025	0.005	0.000301	0.000457	177	0.00005	0.00750	0.00038	1.84	0.000067	0.0204	31.0	1.84	0.000005	0.000162	0.0141
KV-51	Christal Creek d/s Hinton Creek	19-Oct-2014	0.0267	0.00005	0.00025	0.005	0.000194	0.000457	164	0.00005	0.00606	0.00025	1.94	0.000157	0.0205	29.5	1.4	0.000005	0.000178	0.0115
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2015	0.0227	0.00005	0.00025	0.005	0.000140	0.000457	180	0.00005	0.00770	0.00030	2.81	0.000756	0.0281	30.7	1.83	0.000005	0.000176	0.0156
KV-51	Christal Creek d/s Hinton Creek	12-May-2015	0.0299	0.00005	0.000025	0.005	0.000214	0.000264	47.0	0.00019	0.00164	0.00170	0.646	0.000467	0.0057	6.86	0.464	0.0000189	0.000078	0.00370
KV-51	Christal Creek d/s Hinton Creek	02-Jun-2015						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	18-Jun-2015						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	28-Jul-2015	0.0384	0.00005	0.000025	0.005	0.0000598	0.000457	191	0.00005	0.00707	0.00010	2.55	0.000025	0.0302	29.7	1.79	0.0000025	0.000288	0.0121
KV-51	Christal Creek d/s Hinton Creek	18-Sep-2015						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	17-Oct-2015	0.0275	0.00005	0.000025	0.005	0.0000761	0.000457	169	0.00060	0.00633	0.00010	2.04	0.000025	0.0244	26.1	1.57	0.0000025	0.000213	0.0113
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016	0.0234	0.00005	0.000025	0.005	0.0000995	0.000457	202	0.00005	0.00891	0.00010	3.16	0.000025	0.0352	32.1	2.15	0.0000025	0.000178	0.0159
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	04-May-2016	0.0440	0.00005	0.000025	0.005	0.000111	0.000457	124	0.00005	0.00399	0.00098	1.82	0.000215	0.0155	17.9	0.992	0.0000025	0.000131	0.00750
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016	0.0323	0.00005	0.000025	0.005	0.0000593	0.000457	188	0.00005	0.00642	0.00010	1.35	0.000025	0.0255	30.3	1.64	0.0000025	0.000253	0.0112
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	0.0257	0.00005	0.000025	0.005	0.000107	0.000457	194	0.00005	0.00870	0.00010	3.93	0.000025	0.0308	31.9	2	0.0000025	0.000241	0.0147
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	0.0277	0.00005	0.000025	0.005	0.000107	0.000457	235	0.00005	0.0106	0.00010	4.37	0.000025	0.0334	35.5	2.47	0.0000025	0.000240	0.0176
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	15-May-2017	0.0286	0.00005	0.000025	0.005	0.0000940	0.000343	59.8	0.00020	0.00226	0.00157	1.01	0.000227	0.0085	9.41	0.526	0.0000053	0.000070	0.00440
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017	0.0274	0.00005	0.000025	0.005	0.0000939	0.000457	188	0.00005	0.00818	0.00010	2.04	0.000096	0.0309	32.9	2	0.0000025	0.000209	0.0143
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	0.0217	0.00005	0.000025	0.005	0.000107	0.000457	166	0.00005	0.00793	0.00010	2.67	0.000025	0.0275	29.5	1.88	0.0000025	0.000167	0.0141
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	0.0187	0.00005	0.000025	0.005	0.0000394	0.000457	175	0.00005	0.00808	0.00010	2.52	0.000025	0.0300	30.0	1.98	0.0000025	0.000135	0.0144

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-51	Christal Creek d/s Hinton Creek	10-Feb-2014	0.025	0.55	0.00029	4.40	0.000005	1.76	0.227	128	0.000005	0.00005	0.005	0.00160	0.0005	0.213	0.157	0.00040	9.89	10.7	1.04	
KV-51	Christal Creek d/s Hinton Creek	06-May-2014	0.025	0.60	0.00012	1.66	0.000020	0.957	0.0565	23.0	0.000005	0.00011	0.005	0.000226	0.0005	0.0658	0.090	0.00040	2.20	2.27	1.01	
KV-51	Christal Creek d/s Hinton Creek	03-Jul-2014	0.025	0.33	0.00032	4.02	0.000005	1.57	0.260	144	0.000005	0.00005	0.005	0.00188	0.0005	0.208	0.130	0.00040	11.4	11.6	1.01	
KV-51	Christal Creek d/s Hinton Creek	19-Oct-2014	0.025	0.35	0.00076	4.01	0.000005	1.64	0.257	131	0.000005	0.00005	0.005	0.00271	0.0005	0.151	0.090	0.00040	11.0	10.9	0.99	
KV-51	Christal Creek d/s Hinton Creek	12-Feb-2015	0.025	0.43	0.00050	4.03	0.000005	1.78	0.267	146	0.000005	0.00005	0.005	0.00187	0.0005	0.217	0.089	0.00040	11.7	11.8	1.01	
KV-51	Christal Creek d/s Hinton Creek	12-May-2015	0.025	0.55	0.000141	1.63	0.000015	0.464	0.0774	37.3	0.000005	0.00005	0.00079	0.000327	0.00025	0.0631	0.186	0.00015	2.78	3.01	1.04	
KV-51	Christal Creek d/s Hinton Creek	02-Jun-2015															0.002					
KV-51	Christal Creek d/s Hinton Creek	18-Jun-2015															0.002					
KV-51	Christal Creek d/s Hinton Creek	28-Jul-2015	0.025	0.33	0.000340	4.05	0.000005	1.55	0.290	149	0.000005	0.00005	0.00015	0.00240	0.00025	0.15	0.100	0.00015	12.2	12.3	1	
KV-51	Christal Creek d/s Hinton Creek	18-Sep-2015															0.002					
KV-51	Christal Creek d/s Hinton Creek	17-Oct-2015	0.025	0.35	0.000521	3.99	0.000005	1.54	0.250	126	0.000005	0.00005	0.00015	0.00203	0.00025	0.142	0.064	0.00015	10.4	10.8	1.02	
KV-51	Christal Creek d/s Hinton Creek	20-Dec-2015															0.002					
KV-51	Christal Creek d/s Hinton Creek	06-Jan-2016															0.003					
KV-51	Christal Creek d/s Hinton Creek	03-Feb-2016	0.025	0.36	0.000491	4.56	0.000005	1.65	0.275	161	0.000005	0.00005	0.00015	0.00234	0.00025	0.226	0.099	0.00015	12.0	13.1	1.04	
KV-51	Christal Creek d/s Hinton Creek	02-Mar-2016															0.003					
KV-51	Christal Creek d/s Hinton Creek	06-Apr-2016															0.003					
KV-51	Christal Creek d/s Hinton Creek	04-May-2016	0.025	0.33	0.000235	2.82	0.000005	1.03	0.173	92.4	0.000005	0.00005	0.00031	0.000982	0.00025	0.120	0.209	0.00015	6.91	7.87	1.06	
KV-51	Christal Creek d/s Hinton Creek	15-Jun-2016															0.002					
KV-51	Christal Creek d/s Hinton Creek	15-Jul-2016	0.025	0.33	0.000361	3.92	0.000005	1.53	0.280	157	0.000005	0.00005	0.00015	0.00236	0.00025	0.136	0.105	0.00015	11.3	12.1	1.03	
KV-51	Christal Creek d/s Hinton Creek	07-Aug-2016															0.002					
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2016															0.004					
KV-51	Christal Creek d/s Hinton Creek	23-Oct-2016	0.025	0.41	0.000343	4.35	0.000005	1.56	0.276	157	0.000005	0.00005	0.00015	0.00250	0.00025	0.212	0.117	0.00015	11.8	12.7	1.04	
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2016															0.003					
KV-51	Christal Creek d/s Hinton Creek	05-Dec-2016															0.003					
KV-51	Christal Creek d/s Hinton Creek	24-Jan-2017															0.004					
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2017	0.025	0.46	0.000339	5.16	0.000005	1.79	0.320	190	0.000005	0.00005	0.00015	0.00250	0.00025	0.288	0.142	0.00015	12.1	15.1	1.11	
KV-51	Christal Creek d/s Hinton Creek	01-Mar-2017															0.003					
KV-51	Christal Creek d/s Hinton Creek	08-Apr-2017															0.004					
KV-51	Christal Creek d/s Hinton Creek	15-May-2017	0.025	0.31	0.000167	1.90	0.000014	0.611	0.100	51.4	0.000005	0.00005	0.00045	0.000489	0.00025	0.0724	0.102	0.00015	3.83	3.88	1.01	
KV-51	Christal Creek d/s Hinton Creek	03-Jun-2017															0.003					
KV-51	Christal Creek d/s Hinton Creek	20-Jul-2017	0.025	0.36	0.000296	4.16	0.000005	1.67	0.289	173	0.000005	0.00005	0.00015	0.00308	0.00025	0.226	0.103	0.00015	12.8	12.3	0.98	
KV-51	Christal Creek d/s Hinton Creek	18-Aug-2017															0.002					
KV-51	Christal Creek d/s Hinton Creek	08-Sep-2017															0.002					
KV-51	Christal Creek d/s Hinton Creek	22-Oct-2017	0.025	0.43	0.000345	4.08	0.000005	1.65	0.293	170	0.000005	0.00005	0.00015	0.00258	0.00025	0.255	0.081	0.00015	12.6	11.0	0.94	
KV-51	Christal Creek d/s Hinton Creek	24-Nov-2017															0.003					
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2017															0.004					
KV-51	Christal Creek d/s Hinton Creek	26-Jan-2018															0.002					
KV-51	Christal Creek d/s Hinton Creek	25-Feb-2018	0.025	0.40	0.000301	4.04	0.000005	1.59	0.289	164	0.000005	0.00005	0.00015	0.00204	0.00025	0.231	0.073	0.00015	12.3	11.5	0.96	

Christal Creek Attenuation Study, 2008 to 2022 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
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
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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			
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			
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
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
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
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
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
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
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
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
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
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
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	5.84C	43.8	15.6	460	500	117
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
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
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
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
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
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
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
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
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
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.			7.3	7.85	8.05	789.9	788	-0.1	~	~	~	376	401	121
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	Conditions not conduscive 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
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
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
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
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
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
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
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
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
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018					128		8.30						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018					128		6.45						0.1								NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	0.025	0.25	0.071	70.6	309	0.0122	20.2	0.0005	0.0098	0.852	24.8	1.03C	0.1	0.00050	0.03	0.0461	0.00005	0.000025	0.005	0.000571	0.000162
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	0.025	0.25	0.101	263	429	0.0135	10.5	0.0005	0.0679		6.33	0.0462	0.1	0.00016	0.00649	0.0507	0.00005	0.000025	0.005	0.000180	0.00037
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	0.125	1.25	0.20C	416	429	0.0250	3.95	0.0025	0.141	0.122	1.72	0.0823	0.1	0.00019	0.0199	0.0308	0.00005	0.000025	0.005	0.000223	0.00037
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018	0.025	0.74	0.190C	340	429	0.0294	10.6	0.0005	0.187		3.46	0.131C	0.1	0.00018	0.0169	0.0334	0.00005	0.000025	0.005	0.000239	0.00037
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	0.025	0.70	0.200C	361	429	0.0317	27.6	0.0005	0.225		1.92	0.173C	0.1	0.00027	0.018	0.0321	0.00005	0.000025	0.005	0.000327	0.00037
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	0.125	1.25	0.22C	339	429	0.0425	19.6	0.0025	0.404	0.166	0.70	0.0585	0.1	0.00021	0.0158	0.0265	0.00005	0.000025	0.005	0.000200	0.00037
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	0.025	0.25	0.231C	327	429	0.0628	19.9	0.0005	0.211		0.84	0.0598	0.1	0.00014	0.0188	0.0224	0.00005	0.000025	0.005	0.000189	0.00037
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018	0.125	1.25	0.23C	323	429	0.0576	19.0	0.0025	0.156		0.83	0.0504	0.1	0.00013	0.0206	0.0221	0.00005	0.000025	0.005	0.000188	0.00037
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	0.125	1.25	0.25C	334	429	0.0650	10.9	0.0025	0.104		0.75	0.0672	0.1	0.00010	0.0249	0.0230	0.00005	0.000025	0.005	0.000199	0.00037
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	0.125	1.25	0.28C	340	429	0.0613	6.91	0.0025	0.088	0.092	0.73	0.0225	0.1	0.00005	0.0221	0.0213	0.00005	0.000025	0.005	0.000121	0.00037
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	0.125	1.25	0.28C	359	429	0.0269	12.6	0.0025	0.082		0.99	0.0694	0.1	0.00005	0.026	0.0185	0.00005	0.000025	0.005	0.000100	0.00037
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	0.125	1.25	0.26C	350	429	0.0411	11.7	0.0025	0.081		1.79	0.0367	0.1	0.00013	0.017	0.0329	0.00005	0.000025	0.005	0.000169	0.00037
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	0.025	0.25	0.084	123	309	0.0217	25.8	0.0005	0.0347	0.440	12.3	0.109C	0.1	0.00015	0.00584	0.0316	0.00005	0.000025	0.005	0.0000921	0.000228
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	0.125	1.25	0.20C	406	429	0.0325	11.6	0.0025	0.082		1.41	0.0548	0.1	0.00011	0.0234	0.0262	0.00005	0.000025	0.005	0.000143	0.00037
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	0.125	1.25	0.25C	462	429	0.0707	2.29	0.0025	0.131	0.188	1.34	0.263C	0.1	0.00012	0.0207	0.0351	0.00005	0.000025	0.005	0.000157	0.00037
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	0.125	1.25	0.23C	415	429	0.0473	2.69	0.0025	0.145		2.14	0.0297	0.1	0.00005	0.0149	0.0243	0.00005	0.000025	0.005	0.0000996	0.00037
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019	0.125	1.25	0.23C	348	429	0.0483	6.22	0.0025	0.119		1.32	0.0077	0.1	0.00005	0.00996	0.0213	0.00005	0.000025	0.005	0.0000876	0.00037
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	0.125	1.25	0.29C	371	429	0.0290	10.4	0.0025	0.114	0.121	1.44	0.0251	0.1	0.00005	0.0171	0.0224	0.00005	0.000025	0.005	0.0000914	0.00037
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019	0.025	0.53	0.260C	312	429	0.0705	5.03	0.0005	0.131		1.02	0.0088	0.1	0.00005	0.0177	0.0210	0.00005	0.000025	0.005	0.0000740	0.00037
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019	0.125	1.25	0.31C	315	429	0.0603	3.77	0.0025	0.127		1.35	0.0103	0.1	0.00005	0.0188	0.0216	0.00005	0.000025	0.005	0.0000711	0.00037
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020					128		0.616						NopH								NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	0.125	1.25	0.30C	322	429	0.0357	2.70	0.0025	0.070	0.089	0.92	0.0015	0.1	0.00005	0.0169	0.0162	0.00005	0.000025	0.005	0.0000423	0.00037
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	0.125	1.25	0.29C	326	429	0.0575	9.67	0.0025	0.062		1.09	0.0050	0.1	0.00005	0.0227	0.0203	0.00005	0.000025	0.005	0.0000632	0.00037
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	0.125	1.25	0.28C	314	429	0.0472	8.89	0.0025	0.064		1.16	0.0255	0.1	0.00005	0.0385	0.0198	0.00005	0.000025	0.005	0.0000864	0.00037
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	0.025	0.25	0.068	61.6	309	0.0179	17.6	0.0005	0.0323	0.992	32.3	0.816C	0.1	0.00052	0.0577	0.0435	0.00005	0.000025	0.005	0.000667	0.000164
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020	0.125	1.25	0.230C	374	429	0.0277	4.46	0.0025	0.156		4.77	0.0311	0.1	0.00010	0.0183	0.0264	0.000050	0.000025	0.005	0.000112	0.00037
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020	0.025	0.66	0.179C	236	429	0.0244	12.6	0.0005	0.200	0.238	5.68	0.0818	0.1	0.00027	0.012	0.0347	0.000050	0.000025	0.005	0.000306	0.00037
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020	0.025	0.58	0.201C	266	429	0.0383	5.66	0.0005	0.290		2.20	0.0478	0.1	0.00024	0.00987	0.0328	0.000050	0.000025	0.005	0.000277	0.00037
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	0.025	0.61	0.193C	271	429	0.0397	11.1	0.0005	0.455		2.35	0.0761	0.1	0.00024	0.0125	0.0322	0.000050	0.000025	0.005	0.000322	0.00037
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	0.125	1.25	0.186C	282	429	0.0446	21.6	0.0025	0.384	0.140	2.26	0.0857	0.1	0.00022	0.0154	0.0304	0.000050	0.000025	0.005	0.000239	0.00037
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	0.125	1.25	0.199C	276	429	0.0545	15.9	0.0025	0.430		1.19	0.0507	0.1	0.00018	0.0156	0.0267	0.000050	0.000025	0.005	0.000269	0.00037
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	0.125	1.25	0.228C	292	429	0.0543	11.1	0.0025	0.139		1.53	0.0186	0.1	0.00005	0.0191	0.0217	0.000050	0.000025	0.005	0.000137	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	31.8	0.00178C	0.00260	0.00596C	0.00242	7.13	0.00979	0.00330	0.00662	0.0049	5.81	0.353	1.7	0.0000120	0.000212	0.00624	0.0977
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	96.4	0.00026	0.00216	0.00092	0.004	1.11	0.000314	0.007	0.0164	0.0090	15.3	0.509	3.9	0.0000025	0.000096	0.00460	0.15
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	153	0.00018	0.00620J	0.00067	0.004	3.02	0.000513	0.007	0.0281	0.0234	28.7	1.46	6.1	0.0000025	0.000220	0.0113	0.15
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018	147	0.00031	0.00534J	0.00100	0.004	2.86	0.000617	0.007	0.0266	0.0196	26.5	1.27	5.8	0.0000025	0.000206	0.00906	0.15
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	158	0.00041	0.00530J	0.00148	0.004	3.27	0.00360	0.007	0.0286	0.0206	28.1	1.26	6.1	0.0000025	0.000221	0.00965	0.15
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	145	0.00014	0.00632J	0.00054	0.004	2.61	0.00125	0.007	0.0256	0.0224	24.1	1.49	5.6	0.0000025	0.000209	0.0112	0.15
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	129	0.00013	0.00623J	0.00025	0.004	2.69	0.000298	0.007	0.0228	0.0219	22.8	1.47	5.1	0.0000025	0.000198	0.0113	0.15
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018	129	0.00015	0.00631J	0.00025	0.004	2.98	0.000569	0.007	0.0226	0.0215	21.5	1.39	5.1	0.0000025	0.000180	0.0114	0.15
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	138	0.00016	0.00701J	0.00025	0.004	3.61	0.000318	0.007	0.0244	0.0249	23.1	1.63	5.4	0.0000025	0.000223	0.0124	0.15
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	138	0.00005	0.00677J	0.00025	0.004	3.02	0.000116	0.007	0.0242	0.0227	22.9	1.77	5.4	0.0000025	0.000239	0.0124	0.15
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	146	0.00014	0.00672J	0.00025	0.004	3.81	0.000341	0.007	0.0255	0.0242	23.0	1.78	5.6	0.0000025	0.000186	0.0125	0.15
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	141	0.00033	0.00619J	0.00025	0.004	2.19	0.00114	0.007	0.0250	0.0196	23.8	1.56	5.5	0.0000025	0.000179	0.0108	0.15
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	50.1	0.00031	0.00127	0.00146	0.00344	1.01	0.000320	0.00556	0.00887	0.0060	7.16	0.306	2.2	0.0000063	0.000140	0.00277	0.133
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	167	0.00017	0.00712J	0.00025	0.004	4.97	0.000347	0.007	0.0298	0.0247	27.1	1.91	6.4	0.0000025	0.000179	0.0128	0.15
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	176	0.00057	0.00759J	0.00096	0.004	4.55	0.000729	0.007	0.0316	0.0254	28.5	1.97	6.7	0.0000051	0.000232	0.0131	0.15
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	159	0.00005	0.00633J	0.00025	0.004	2.46	0.000124	0.007	0.0283	0.0227	26.2	1.70	6.1	0.0000025	0.000197	0.0110	0.15
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019	144	0.00005	0.00575J	0.00025	0.004	1.51	0.000067	0.007	0.0252	0.0233	23.2	1.57	5.6	0.0000025	0.000262	0.00989	0.15
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	157	0.00005	0.00643J	0.00025	0.004	3.01	0.000171	0.007	0.0279	0.0256	25.7	1.71	6.0	0.0000025	0.000202	0.0112	0.15
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019	130	0.00005	0.00644J	0.00025	0.004	2.2	0.000058	0.007	0.0233	0.0223	23.9	1.64	5.2	0.0000025	0.000253	0.0109	0.15
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019	127	0.00011	0.00602J	0.00025	0.004	2.52	0.000073	0.007	0.0227	0.0228	23.4	1.48	5.1	0.0000025	0.000287	0.0101	0.15
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	116	0.00005	0.00534J	0.00025	0.004	1.96	0.000059	0.007	0.0205	0.0210	20.8	1.35	4.7	0.0000025	0.000167	0.00949	0.15
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	132	0.00005	0.00540J	0.00025	0.004	3.03	0.000106	0.007	0.0236	0.0213	23.6	1.46	5.3	0.0000025	0.000149	0.0104	0.15
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	125	0.00010	0.00521J	0.00025	0.004	6.44	0.000221	0.007	0.0220	0.0218	22.1	1.38	5.0	0.0000025	0.000142	0.00980	0.15
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	31.3	0.00147C	0.00341	0.00517C	0.00244	11.7	0.00618	0.00334	0.00666	0.0048	6.17	0.604	1.7	0.0000025	0.000308	0.00700	0.0984
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020	154	0.00005	0.00631J	0.00074	0.004	3.65	0.000180	0.007	0.0271	0.0234	24.3	1.72	5.9	0.0000025	0.000513	0.00985	0.15
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020	115	0.00017	0.00352	0.00110	0.004	1.96	0.00115	0.007	0.0200	0.0148	19.4	0.948	4.6	0.0000025	0.000192	0.00660	0.15
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020	122	0.00005	0.00367	0.00051	0.004	1.57	0.000259	0.007	0.0214	0.0167	21.3	0.919	4.9	0.0000025	0.000204	0.00707	0.15
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	125	0.00016	0.00417J	0.00056	0.004	2.14	0.000390	0.007	0.0217	0.0190	20.4	0.896	4.9	0.0000025	0.000377	0.00757	0.15
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	131	0.00013	0.00486J	0.00062	0.004	2.7	0.000436	0.007	0.0230	0.0184	22.5	1.23	5.2	0.0000025	0.000158	0.00868	0.15
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	119	0.00012	0.00484J	0.00025	0.004	2.29	0.000364	0.007	0.0208	0.0162	20.8	1.23	4.7	0.0000025	0.000163	0.00873	0.15
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	133	0.00005	0.00579J	0.00025	0.004	2.57	0.00204	0.007	0.0233	0.0210	22.3	1.56	5.2	0.0000025	0.000168	0.00984	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	0.107	0.64	0.000210	2.97	0.000115	0.602	0.0639	24.2	0.000020	0.00005	0.0262	0.000432	0.00261	0.120J	0.0173	0.00038	0.0988	0.00023	0.00251
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	0.025	0.26	0.000426	2.69	0.000005	0.928	0.184	92.7	0.000005	0.00005	0.00045	0.000670	0.0005	0.0866	0.168	0.00015	0.0245	0.00014	0.00535
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	0.025	0.36	0.000483	4.40	0.000005	2.02	0.279	145	0.000012	0.00005	0.00267	0.00392	0.00054	0.208	0.316	0.00015	0.0015	0.00015	0.0135
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018	0.025	0.31	0.000461	4.06	0.000011	1.83	0.251	122	0.000014	0.00005	0.0030	0.00292	0.00025	0.174	0.298	0.00015	0.0039	0.00015	0.0112
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	0.025	0.45	0.000885	4.25	0.000027	1.77	0.269	131	0.000014	0.00005	0.00503	0.00376	0.00051	0.186	0.322	0.00015	0.0023	0.00015	0.0109
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	0.025	0.39	0.000550	4.38	0.000005	1.61	0.241	120	0.000018	0.00005	0.00216	0.00227	0.00025	0.203	0.286	0.00015	0.0010	0.00014	0.0108
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	0.025	0.33	0.000391	4.53	0.000005	1.61	0.220	118	0.000019	0.00005	0.00105	0.00185	0.00025	0.221	0.251	0.00015	0.0005	0.00005	0.0120
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018	0.025	0.37	0.000412	4.41	0.000005	1.61	0.220	119	0.000020	0.00005	0.00159	0.00178	0.00025	0.221	0.248	0.00015	0.0012	0.00005	0.0161
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	0.025	0.35	0.000346	4.49	0.000005	1.62	0.207	115	0.000016	0.00005	0.00245	0.00163	0.00025	0.269	0.271	0.00015	0.0005	0.00005	0.0171
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	0.025	0.35	0.000285	4.43	0.000005	1.59	0.213	117	0.000015	0.00005	0.00066	0.00146	0.00025	0.252	0.269	0.00015	0.0005	0.00005	0.0192
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	0.025	0.39	0.000271	4.72	0.000005	1.65	0.235	139	0.000005	0.00005	0.00218	0.00164	0.00025	0.251	0.285	0.00015	0.0005	0.00005	0.0230
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	0.025	0.44	0.000186	3.83	0.000005	1.51	0.234	126	0.000005	0.00005	0.00045	0.00118	0.00025	0.223	0.278	0.00015	0.0014	0.00005	0.0147
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	0.025	0.26	0.000216	1.99	0.000016	0.580	0.0913	43.9	0.000005	0.00005	0.00105	0.000238	0.00025	0.0542	0.0562	0.00015	0.0675	0.00011	0.00264
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	0.025	0.35	0.000230	4.34	0.000005	1.60	0.259	171	0.000012	0.00005	0.0009	0.00144	0.00025	0.261	0.336	0.00015	0.0018	0.00005	0.0160
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	0.025	0.39	0.000305	4.71	0.000013	1.63	0.284	157	0.000011	0.00005	0.00719	0.00208	0.00081	0.248	0.357	0.00015	0.0082	0.00005	0.0161
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	0.025	0.36	0.000295	3.94	0.000005	1.58	0.260	141	0.000013	0.00005	0.00080	0.00196	0.00025	0.212	0.319	0.00015	0.0010	0.00005	0.0114
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019	0.025	0.38	0.000293	4.14	0.000005	1.62	0.228	119	0.000011	0.00005	0.00015	0.00151	0.00025	0.193	0.281	0.00015	0.0014	0.00005	0.00735
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	0.025	0.40	0.000303	4.27	0.000005	1.72	0.235	137	0.000010	0.00005	0.00078	0.00162	0.00025	0.227	0.314	0.00015	0.0018	0.00005	0.00854
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019	0.025	0.39	0.000269	4.57	0.000005	1.79	0.213	117	0.000012	0.00005	0.00015	0.00139	0.00025	0.233	0.257	0.00015	0.0005	0.00005	0.0120
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019	0.025	0.37	0.000340	4.36	0.000005	1.75	0.219	110	0.000012	0.00005	0.00063	0.00143	0.00025	0.208	0.250	0.00015	0.0005	0.00005	0.0147
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020															NoHardness				
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	0.025	0.34	0.000193	3.78	0.000005	1.59	0.198	104	0.000005	0.00005	0.00015	0.00118	0.00025	0.222	0.222	0.00015	0.0005	0.00005	0.0152
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	0.025	0.40	0.000144	4.23	0.000005	1.68	0.213	114	0.000005	0.00005	0.00015	0.00117	0.00025	0.242	0.261	0.00015	0.0005	0.00005	0.0107
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	0.025	0.42	0.000161	4.25	0.000005	1.71	0.196	111	0.000005	0.00005	0.00078	0.00102	0.00025	0.207	0.242	0.00015	0.0005	0.00005	0.0165
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	0.119	1.03	0.000277	3.03	0.000092	0.652	0.0610	20.8	0.000027	0.00005	0.0239	0.000471	0.00213	0.171J	0.0180	0.00041	0.0558	0.00026	0.00380
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020	0.025	0.416	0.000355	3.85	0.000005	1.53	0.237	141	0.000005	0.00005	0.00067	0.00128	0.00025	0.215	0.304	0.00010	0.0076	0.00005	0.0151
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020	0.090	0.326	0.000889	3.97	0.000011	1.46	0.201	86.8	0.000013	0.00005	0.00200	0.00143	0.00025	0.140	0.216	0.00010	0.0122	0.00024	0.00807
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020	0.025	0.312	0.00111C	4.33	0.000005	1.57	0.234	92.0	0.000012	0.00005	0.00122	0.00223	0.00025	0.140	0.234	0.00010	0.0044	0.00023	0.00640
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	0.025	0.361	0.00112C	4.35	0.000005	1.70	0.239	95.8	0.000016	0.00005	0.00208	0.00259	0.00025	0.160	0.237	0.00010	0.0039	0.00020	0.00728
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	0.025	0.358	0.000674	4.42	0.000005	1.82	0.242	100	0.000005	0.00005	0.00259	0.00229	0.00025	0.193	0.254	0.00010	0.0019	0.00017	0.00795
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	0.025	0.365	0.000657	4.25	0.000005	2.15	0.210	95.5	0.000018	0.00005	0.00203	0.00259	0.00025	0.202	0.226	0.00010	0.0005	0.00016	0.00761
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	0.025	0.389	0.000539	4.62	0.000005	1.78	0.216	110	0.000013	0.00005	0.00064	0.00168	0.00025	0.231	0.258	0.00010	0.0005	0.00005	0.0155

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	0.0214	0.00005	0.000025	0.005	0.000164	0.000216	31.6	0.00019	0.00096	0.00206	0.447	0.00130	0.0038	5.12	0.225	0.0000062	0.000090	0.00267
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	0.0574	0.00005	0.000025	0.005	0.000243	0.000457	107	0.00012	0.00248	0.00155	0.964	0.000274	0.0095	16.3	0.58	0.0000025	0.000199	0.00614
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	0.0293	0.00005	0.000025	0.005	0.000119	0.000457	153	0.00005	0.00564	0.00010	1.87	0.000025	0.0227	27.4	1.33	0.0000025	0.000194	0.0101
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018	0.0292	0.00005	0.000025	0.005	0.000155	0.000457	139	0.00005	0.00489	0.00034	1.81	0.000051	0.0184	23.8	1.15	0.0000025	0.000177	0.00850
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	0.0297	0.00005	0.000025	0.005	0.000102	0.000457	159	0.00005	0.00507	0.00029	1.68	0.000025	0.0204	29.6	1.29	0.0000025	0.000196	0.00857
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	0.0240	0.00005	0.000025	0.005	0.0000986	0.000457	130	0.00005	0.00556	0.00010	1.55	0.000025	0.0184	22.4	1.3	0.0000025	0.000178	0.00993
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	0.0211	0.00005	0.000025	0.005	0.000119	0.000457	126	0.00005	0.00620	0.00010	1.53	0.000025	0.0218	21.7	1.44	0.0000025	0.000169	0.0116
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018	0.0232	0.00005	0.000025	0.005	0.000150	0.000457	134	0.00005	0.00647	0.00010	2.18	0.000025	0.0213	23.3	1.48	0.0000025	0.000165	0.0117
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	0.0205	0.00005	0.000025	0.005	0.0000968	0.000457	139	0.00011	0.00695	0.00010	2.31	0.000025	0.0227	23.8	1.61	0.0000025	0.000933	0.0121
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	0.0214	0.00005	0.000025	0.005	0.0000758	0.000457	134	0.00005	0.00692	0.00010	2.41	0.000025	0.0220	23.0	1.68	0.0000025	0.000184	0.0124
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	0.0182	0.00005	0.000025	0.005	0.0000616	0.000457	157	0.00005	0.00689	0.00010	2.64	0.000025	0.0261	26.3	1.72	0.0000025	0.000162	0.0124
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	0.0312	0.00005	0.000025	0.005	0.000130	0.000457	136	0.00005	0.00604	0.00010	1.71	0.000143	0.0179	22.8	1.45	0.0000025	0.000151	0.0104
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	0.0286	0.00005	0.000025	0.005	0.0000664	0.000292	56.1	0.00014	0.00114	0.00121	0.353	0.000087	0.0056	7.34	0.347	0.0000025	0.000064	0.00267
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	0.0255	0.00005	0.000025	0.005	0.0000909	0.000457	163	0.00005	0.00726	0.00010	3.31	0.000025	0.0236	26.6	1.79	0.0000025	0.000163	0.0122
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	0.0245	0.00005	0.000025	0.005	0.0000706	0.000457	170	0.00005	0.00693	0.00010	3.05	0.000025	0.0251	26.4	1.75	0.0000025	0.000146	0.0117
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	0.0228	0.00005	0.000025	0.005	0.0000863	0.000457	164	0.00005	0.00638	0.00010	1.79	0.000025	0.0242	24.6	1.76	0.0000025	0.000187	0.0107
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019	0.0207	0.00005	0.000025	0.005	0.0000666	0.000457	141	0.00005	0.00542	0.00010	1.03	0.000025	0.0234	23.2	1.49	0.0000025	0.000182	0.00916
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	0.0190	0.00005	0.000025	0.005	0.0000743	0.000457	155	0.00005	0.00627	0.00010	1.49	0.000025	0.0236	23.9	1.64	0.0000025	0.000188	0.0111
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019	0.0203	0.00005	0.000025	0.005	0.0000517	0.000457	133	0.00005	0.00602	0.00010	1.28	0.00123	0.0238	22.8	1.58	0.0000025	0.000149	0.0102
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019	0.0219	0.00005	0.000025	0.005	0.0000505	0.000457	123	0.00005	0.00607	0.00028	1.6	0.000025	0.0220	22.9	1.48	0.0000025	0.000253	0.0102
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020						NoHardness												
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	0.0170	0.00005	0.000025	0.005	0.0000525	0.000457	126	0.00005	0.00547	0.00051	1.67	0.000456	0.0225	21.1	1.38	0.0000025	0.000173	0.00995
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	0.0210	0.00005	0.000025	0.005	0.0000349	0.000457	135	0.00005	0.00534	0.00010	0.87	0.000025	0.0224	22.6	1.4	0.0000025	0.000129	0.00976
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	0.0185	0.00005	0.000025	0.005	0.0000468	0.000457	120	0.00005	0.00487	0.00010	2.08	0.000025	0.0207	20.8	1.3	0.0000025	0.000128	0.00905
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	0.0179	0.00005	0.000025	0.005	0.000217	0.000218	28.3	0.00015	0.00135	0.00207	0.774	0.00128	0.0036	5.53	0.342	0.0000025	0.000108	0.00320
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020	0.0243	0.000050	0.000025	0.005	0.0000843	0.000457	148	0.00005	0.00596	0.00038	2.96	0.000025	0.0207	23.2	1.62	0.0000025	0.000167	0.00934
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020	0.0303	0.000050	0.000025	0.005	0.000212	0.000457	112	0.00005	0.00335	0.00062	1.19	0.000095	0.0142	19.4	0.924	0.0000025	0.000195	0.00620
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020	0.0312	0.000050	0.000025	0.005	0.000200	0.000457	123	0.00005	0.00351	0.00031	0.903	0.000025	0.0169	20.2	0.871	0.0000025	0.000205	0.00649
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	0.0298	0.000050	0.000025	0.005	0.000209	0.000457	122	0.00005	0.00413	0.00024	1.3	0.000025	0.0172	22.8	1.04	0.0000025	0.000190	0.00743
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	0.0278	0.000050	0.000025	0.005	0.000139	0.000457	121	0.00005	0.00459	0.00022	1.28	0.000025	0.0193	20.7	1.14	0.0000025	0.000166	0.00804
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	0.0270	0.000050	0.000025	0.005	0.000145	0.000457	117	0.00005	0.00440	0.00010	0.866	0.00102	0.0169	21.3	1.01	0.0000025	0.000184	0.00810
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	0.0215	0.000050	0.000025	0.005	0.000103	0.000457	133	0.00005	0.00558	0.00010	1.84	0.000025	0.0213	21.6	1.42	0.0000025	0.000161	0.00951

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-51	Christal Creek d/s Hinton Creek	28-Mar-2018															0.003					
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2018															0.003					
KV-51	Christal Creek d/s Hinton Creek	15-May-2018	0.025	0.51	0.000124	1.52	0.000030	0.507	0.0590	22.8	0.000005	0.00005	0.00045	0.000189	0.00025	0.0471	0.095	0.00015	1.97	2.08	1.03	
KV-51	Christal Creek d/s Hinton Creek	06-Jun-2018	0.025	0.32	0.000403	2.47	0.000005	1.09	0.199	75.4	0.000005	0.00005	0.00015	0.000735	0.00025	0.101	0.144	0.00015	6.37	6.84	1.04	
KV-51	Christal Creek d/s Hinton Creek	12-Jul-2018	0.025	0.36	0.000405	3.91	0.000005	1.99	0.271	137	0.000005	0.00005	0.00015	0.00400	0.00025	0.181	0.078	0.00015	10.9	10.2	0.96	
KV-51	Christal Creek d/s Hinton Creek	13-Aug-2018	0.025	0.31	0.000522	3.91	0.000005	1.74	0.238	116	0.000005	0.00005	0.00015	0.00295	0.00025	0.149	0.140	0.00015	9.34	9.14	0.99	
KV-51	Christal Creek d/s Hinton Creek	03-Sep-2018	0.025	0.39	0.000908	3.89	0.000005	1.73	0.275	125	0.000005	0.00005	0.00015	0.00353	0.00025	0.162	0.153	0.00015	10.1	10.6	1.03	
KV-51	Christal Creek d/s Hinton Creek	08-Oct-2018	0.025	0.32	0.000794	4.59	0.000005	1.61	0.216	132	0.000011	0.00005	0.00015	0.00222	0.00025	0.201	0.087	0.00015	9.22	8.53	0.96	
KV-51	Christal Creek d/s Hinton Creek	19-Nov-2018	0.025	0.35	0.000396	4.05	0.000005	1.60	0.215	112	0.000015	0.00005	0.00015	0.00180	0.00025	0.232	0.094	0.00015	9.05	8.32	0.96	
KV-51	Christal Creek d/s Hinton Creek	11-Dec-2018	0.025	0.37	0.000369	4.37	0.000005	1.64	0.219	113	0.000016	0.00005	0.00015	0.00178	0.00025	0.237	0.092	0.00015	8.98	8.88	0.99	
KV-51	Christal Creek d/s Hinton Creek	13-Jan-2019	0.025	0.37	0.000309	4.46	0.000005	1.61	0.222	121	0.000015	0.00005	0.00015	0.00162	0.00025	0.254	0.072	0.00015	9.24	9.18	1	
KV-51	Christal Creek d/s Hinton Creek	07-Feb-2019	0.025	0.37	0.000293	4.37	0.000005	1.55	0.217	115	0.000012	0.00005	0.00015	0.00144	0.00025	0.267	0.061	0.00015	9.36	8.83	0.97	
KV-51	Christal Creek d/s Hinton Creek	06-Mar-2019	0.025	0.42	0.000280	4.74	0.000005	1.85	0.229	134	0.000005	0.00005	0.00015	0.00156	0.00025	0.261	0.085	0.00015	9.83	10.3	1.02	
KV-51	Christal Creek d/s Hinton Creek	18-Apr-2019	0.025	0.43	0.000149	3.53	0.000005	1.47	0.212	118	0.000005	0.00005	0.00015	0.00110	0.00025	0.219	0.105	0.00015	9.54	8.91	0.97	
KV-51	Christal Creek d/s Hinton Creek	16-May-2019	0.025	0.25	0.000225	1.87	0.000005	0.585	0.107	40.6	0.000005	0.00005	0.00045	0.000215	0.00025	0.0527	0.142	0.00015	3.09	3.48	1.06	
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2019	0.025	0.32	0.000260	4.07	0.000005	1.54	0.262	164	0.000005	0.00005	0.00015	0.00154	0.00025	0.255	0.100	0.00015	10.6	10.6	1	
KV-51	Christal Creek d/s Hinton Creek	22-Jul-2019	0.025	0.35	0.000248	4.08	0.000005	1.51	0.263	143	0.000005	0.00005	0.00015	0.00188	0.00025	0.227	0.057	0.00015	11.9	11.0	0.96	
KV-51	Christal Creek d/s Hinton Creek	01-Aug-2019	0.025	0.33	0.000348	4.14	0.000005	1.55	0.272	141	0.000011	0.00005	0.00015	0.00187	0.00025	0.208	0.075	0.00015	11.0	10.5	0.97	
KV-51	Christal Creek d/s Hinton Creek	17-Sep-2019	0.025	0.35	0.000264	4.01	0.000005	1.54	0.229	115	0.000011	0.00005	0.00015	0.00151	0.00025	0.184	0.081	0.00015	9.61	9.13	0.97	
KV-51	Christal Creek d/s Hinton Creek	04-Oct-2019	0.025	0.34	0.000263	4.24	0.000005	1.58	0.237	122	0.000005	0.00005	0.00015	0.00155	0.00025	0.209	0.092	0.00015	10.2	9.94	0.99	
KV-51	Christal Creek d/s Hinton Creek	28-Nov-2019	0.025	0.37	0.000264	4.12	0.000005	1.84	0.216	112	0.000012	0.00005	0.00015	0.00128	0.00025	0.225	0.063	0.00015	8.94	8.74	0.99	
KV-51	Christal Creek d/s Hinton Creek	12-Dec-2019	0.025	0.43	0.000289	4.40	0.000005	1.83	0.210	103	0.000010	0.00005	0.00015	0.00136	0.00025	0.223	0.063	0.00015	8.98	8.29	0.96	
KV-51	Christal Creek d/s Hinton Creek	31-Jan-2020															0.002					
KV-51	Christal Creek d/s Hinton Creek	15-Feb-2020	0.025	0.46	0.000193	4.10	0.000005	1.82	0.214	111	0.000005	0.00005	0.00015	0.00123	0.00025	0.237	0.048	0.00015	9.15	8.25	0.95	
KV-51	Christal Creek d/s Hinton Creek	19-Mar-2020	0.025	0.42	0.000137	3.72	0.000005	1.63	0.215	104	0.000005	0.00005	0.00015	0.00109	0.00025	0.22	0.081	0.00015	9.29	8.80	0.97	
KV-51	Christal Creek d/s Hinton Creek	17-Apr-2020	0.025	0.39	0.000113	3.93	0.000005	1.63	0.195	107	0.000005	0.00005	0.00015	0.00101	0.00025	0.196	0.077	0.00015	8.88	7.95	0.94	
KV-51	Christal Creek d/s Hinton Creek	07-May-2020	0.025	0.95	0.000138	1.50	0.000018	0.604	0.0543	20.6	0.000005	0.00005	0.00056	0.000172	0.00025	0.0816	0.085	0.00015	1.85	1.98	1.03	
KV-51	Christal Creek d/s Hinton Creek	07-Jun-2020	0.025	0.296	0.000252	3.61	0.000005	1.35	0.238	124	0.000005	0.00005	0.00015	0.00118	0.00025	0.205	0.123	0.00015	9.83	9.65	1.01	
KV-51	Christal Creek d/s Hinton Creek	11-Jul-2020	0.025	0.261	0.000754	3.72	0.000005	1.46	0.216	81.8	0.000010	0.00005	0.00015	0.00140	0.00025	0.134	0.170	0.00015	6.96	7.42	1.03	
KV-51	Christal Creek d/s Hinton Creek	12-Aug-2020	0.025	0.300	0.00126	4.12	0.000005	1.53	0.236	95.5	0.000012	0.00005	0.00015	0.00207	0.00025	0.133	0.096	0.00015	7.87	8.01	1.01	
KV-51	Christal Creek d/s Hinton Creek	23-Sep-2020	0.025	0.341	0.00104	4.18	0.000005	1.68	0.231	92.4	0.000010	0.00005	0.00015	0.00274	0.00025	0.161	0.116	0.00015	8.09	8.20	1.01	
KV-51	Christal Creek d/s Hinton Creek	18-Oct-2020	0.025	0.376	0.000853	4.40	0.000005	1.75	0.228	104	0.000005	0.00005	0.00015	0.00247	0.00025	0.184	0.139	0.00015	8.28	7.92	1.02	
KV-51	Christal Creek d/s Hinton Creek	11-Nov-2020	0.025	0.376	0.000658	4.19	0.000005	1.91	0.203	93.5	0.000013	0.00005	0.00015	0.00238	0.00025	0.174	0.095	0.00015	8.13	7.76	1.02	
KV-51	Christal Creek d/s Hinton Creek	24-Feb-2021	0.025	0.408	0.000520	4.23	0.000005	1.68	0.228	106	0.000010	0.00005	0.00015	0.00163	0.00025	0.235	0.103	0.00015	8.40	8.62	1.01	

Christal Creek Attenuation Study, 2008 to 2022 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
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
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021		28.4	0.321	0.5	7.45	7.78	627.1	733	7.9	9.78	84.6	-88.2	415	374	115
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
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
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
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
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-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
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	1.26C	9.0	44.2	104	108	76.9
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
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
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
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
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				7.75		147.8		0.1	10.25	70.3	52.3			
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.			2.7	7.07	7.03	79.0	81.5	0.1	13.62	93.7	16.8	44.4	42.1	19.8
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
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
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
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
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
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			1.5	7.05	8.02	379.0	466	0.6	10.06	70.2	109.0	228	249	87.9
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
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
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
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
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
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
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022	Frozen														

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	0.025	2.77	0.076	135	429	0.0293	14.4	0.0056	0.246		16.6	0.218C	0.1	0.00086	0.0202	0.0386	0.000050	0.000025	0.005	0.00057	0.000261
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021	0.025	0.72	0.237C	288	429	0.0191	3.54	0.0005	0.177		1.32	0.0052	0.1	0.00017	0.00664	0.0256	0.000050	0.000025	0.005	0.000154	0.00037
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	0.025	0.58	0.245C	267	429	0.0511	8.89	0.0005	0.108		2.34	0.0893	0.1	0.00022	0.0215	0.0282	0.000050	0.000025	0.005	0.000312	0.00037
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	0.125	6.56	0.299C	351	429	0.0837	22.3	0.0025	0.130		1.08	0.108C	0.1	0.00018	0.0506	0.0291	0.000050	0.000025	0.005	0.000210	0.00037
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	0.025	1.96	0.087	51.9	309	0.0156	17.1	0.0005	0.0330		22.7	0.102C	0.1	0.00033	0.00718	0.0201	0.000050	0.000025	0.005	0.000203	0.000151
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022	0.125	1.25	0.242C	343	429	0.0387	2.04	0.0025	0.0478		2.29	0.0174	0.1	0.00019	0.00861	0.0284	0.000050	0.000025	0.005	0.000175	0.00037
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2022					128		0.616						NopH								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	0.025	0.25	0.171C	91.7	309	0.0788	12.1	0.0005	0.0119		3.49	0.319C	0.1	0.00029	0.0168	0.0411	0.00005	0.000025	0.005	0.000315	0.000245
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	0.025	0.25	0.080	20.4	309	0.0092	15.3	0.0013	0.0025		16.2	0.0227	0.1	0.00016	0.00381	0.0354	0.00005	0.000025	0.005	0.0000289	0.000164
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	0.025	0.25	0.222C	144	429	0.330	3.91	0.0005	0.0131		2.28	1.97C	0.1	0.00046	0.027	0.129	0.00005	0.000025	0.005	0.000537	0.000311
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	0.025	0.25	0.236C	142	429	0.168	4.90	0.0005	0.0103	0.279	2.98	0.119C	0.1	0.00020	0.0156	0.0494	0.00005	0.000025	0.005	0.000202	0.000306
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019	0.025	0.25	0.230C	143	429	0.154	6.27	0.0005	0.0183	0.277	2.18	0.0483	0.1	0.00014	0.0129	0.0469	0.00005	0.000025	0.005	0.000186	0.000314
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	0.025	0.25	0.228C	150	429	0.163	9.53	0.0005	0.0205		1.89	0.202C	0.1	0.00018	0.017	0.0550	0.00005	0.000025	0.005	0.000263	0.000329
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019					128		0.616						NopH								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019					128		3.36						0.1								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020					128		0.616						NopH								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020					128		0.616						NopH								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020					128		0.616						NopH								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020					128		0.616						NopH								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	0.025	0.25	0.038	13.4	218	0.0113	16.0	0.0005	0.0025		33.9	0.124C	0.1	0.00025	0.00367	0.0179	0.00005	0.000025	0.005	0.000154	0.0000808
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	0.025	0.25	0.181C	99.1	309	0.105	4.31	0.0005	0.0114	0.386	9.95	0.111C	0.1	0.00026	0.0169	0.0467	0.000050	0.000025	0.005	0.000194	0.000253
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020	0.025	0.25	0.154C	109	429	0.0384	21.9	0.0005	0.0360		7.93	0.339C	0.1	0.00051	0.0141	0.0534	0.000050	0.000025	0.005	0.000464	0.000290
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020	0.025	0.25	0.174C	134	429	0.0633	5.87	0.0005	0.0520	0.165	2.78	0.279C	0.1	0.00052	0.0102	0.0544	0.000050	0.000025	0.005	0.000656	0.000330
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020	0.025	0.25	0.188C	134	429	0.0737	13.5	0.0005	0.0870	0.211	2.48	0.0900	0.1	0.00056	0.0112	0.0435	0.000050	0.000025	0.005	0.000632	0.000314
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	0.025	0.25	0.189C	134	429	0.0858	17.7	0.0010	0.0466		2.96	0.150C	0.1	0.00049	0.0126	0.0446	0.000050	0.000025	0.005	0.00061	0.000305
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020					128		0.616						NopH								NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	0.025	0.58	0.265C	150	429	0.138	16.1	0.0005	0.0174		0.70	0.0015	0.1	0.00024	0.00107	0.0331	0.000050	0.000025	0.005	0.000145	0.000314
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	0.025	0.98	0.064	25.0	218	0.0534	28.4	0.0005	0.0147		21.4	0.847C	0.1	0.00095	0.036	0.0464	0.000050	0.000025	0.005	0.000865	0.000100
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	0.025	0.25	0.204C	138	429	0.0730	5.11	0.0005	0.0112		1.78	0.0191	0.1	0.00037	0.00694	0.0382	0.000050	0.000025	0.005	0.000436	0.000312
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021	0.025	0.25	0.215C	134	429	0.128	15.2	0.0005	0.0338		2.33	0.382C	0.1	0.00049	0.0216	0.0502	0.000050	0.000025	0.005	0.000779	0.000305
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	0.125	1.25	0.265C	296	429	0.117	13.1	0.0050	0.0408		0.92	0.0066	0.1	0.00014	0.019	0.0284	0.000050	0.000025	0.005	0.000104	0.00037
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	0.025	0.25	0.072	24.7	218	0.0101	26.6	0.0005	0.0065		22.4	0.255C	0.1	0.00052	0.00946	0.0293	0.000050	0.000025	0.005	0.000284	0.000104
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	0.025	0.25	0.175C	129	429	0.0897	4.51	0.0021	0.0249		3.92	0.708C	0.1	0.00066	0.0494	0.0702	0.000050	0.000025	0.005	0.000849	0.000298
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022					128		0.616						NopH								NoHardness

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	54.3	0.00025	0.00240	0.00204	0.004	3.76	0.00539	0.007	0.0101	0.0068	11.2	0.564	2.5	0.0000062	0.000139	0.00446	0.15
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021	130	0.00025	0.00450J	0.00025	0.004	0.988	0.000271	0.007	0.0228	0.0193	21.9	1.23	5.1	0.0000025	0.000201	0.00795	0.15
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	121	0.00025	0.00477J	0.00057	0.004	3.81	0.000710	0.007	0.0211	0.0182	20.4	1.27	4.8	0.0000025	0.000210	0.00865	0.15
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	140	0.00025	0.00834J	0.00056	0.004	8.6	0.00108	0.007	0.0249	0.0249	24.3	2.06	5.5	0.0000025	0.000232	0.0146	0.15
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	29.6	0.00025	0.00156	0.00244C	0.00225	1.48	0.00538	0.00296	0.00628	0.0043	5.02	0.378	1.6	0.0000064	0.000122	0.00396	0.0916
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022	144	0.00025	0.00542J	0.00025	0.004	1.39	0.000211	0.007	0.0248	0.0254	21.4	1.41	5.5	0.0000025	0.000210	0.00988	0.15
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2022					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	51.9	0.00050	0.00233	0.00126	0.00370	2.79	0.00131	0.00620	0.00952	0.0080	9.48	0.797	2.4	0.0000025	0.000302	0.00420	0.142
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	29.8	0.00011	0.00572J	0.00075	0.00244	1.52	0.000573	0.00334	0.00666	0.0026	7.15	1.20	1.7	0.0000052	0.000221	0.00311	0.0984
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	67.6	0.00326C	0.00591J	0.00671C	0.004	8.02	0.00436	0.007	0.0122	0.0133	13.6	1.38	3.0	0.0000025	0.000520	0.0101	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	66.8	0.00021	0.00431J	0.00059	0.004	2.41	0.000414	0.007	0.0120	0.0113	13.1	1.29	3.0	0.0000025	0.000346	0.00614	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019	70.1	0.00016	0.00455J	0.00025	0.004	2.73	0.000236	0.007	0.0124	0.0118	12.8	1.46	3.1	0.0000025	0.000389	0.00635	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	72.8	0.00040	0.00464J	0.00087	0.004	3.93	0.000862	0.007	0.0131	0.0121	14.5	1.45	3.2	0.0000025	0.000315	0.00685	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	13.2	0.00024	0.00078	0.00192	0.002	0.929	0.003	0.001	0.00444	0.0014	2.75	0.180	1.0	0.0000025	0.000120	0.00235	0.025
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	53.2	0.00028	0.00319	0.00130	0.00383	2.7	0.000751	0.00653	0.00985	0.0082	10.5	0.923	2.5	0.0000025	0.000367	0.00522	0.147
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020	62.9	0.00060	0.00196	0.00199	0.004	2.28	0.00136	0.007	0.0113	0.0081	12.1	0.496	2.8	0.0000025	0.000274	0.00440	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020	74.4	0.00048	0.00254	0.00114	0.004	1.72	0.00118	0.007	0.0131	0.0102	13.7	0.563	3.2	0.0000025	0.000322	0.00530	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020	72.8	0.00017	0.00258	0.00084	0.004	1.62	0.000687	0.007	0.0124	0.0110	11.2	0.520	3.1	0.0000025	0.000638	0.00505	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	68.1	0.00038	0.00268	0.00096	0.004	2.1	0.000910	0.007	0.0120	0.0095	12.3	0.564	3.0	0.0000025	0.000247	0.00563	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	69.9	0.00005	0.00371	0.00025	0.004	0.057	0.00473	0.007	0.0124	0.0142	12.9	1.05	3.1	0.0000025	0.000211	0.00709	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	17.2	0.00153C	0.00240	0.00548C	0.002	7.42	0.0331	0.001	0.00489	0.0033	3.56	0.459	1.2	0.0000083	0.000391	0.00574	0.025
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	69.2	0.00025	0.00339	0.00052	0.004	1.14	0.000926	0.007	0.0123	0.0118	12.8	0.942	3.0	0.0000025	0.000274	0.00585	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021	67.2	0.00068	0.00368	0.00165	0.004	4.7	0.00210	0.007	0.0120	0.0115	12.7	0.895	3.0	0.0000025	0.000303	0.00684	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	114	0.00025	0.00666J	0.00025	0.004	3.53	0.000071	0.007	0.0196	0.0224	18.2	1.73	4.5	0.0000025	0.000245	0.00958	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	18.0	0.00054	0.00112	0.00338C	0.002	2.15	0.014	0.00167	0.00499	0.0028	3.75	0.252	1.2	0.0000075	0.000206	0.00378	0.0651
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	64.6	0.00124C	0.00420J	0.00309	0.004	10.5	0.00698	0.007	0.0117	0.0109	12.7	1.08	2.9	0.0000052	0.000439	0.00760	0.15
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	0.056	1.05	0.000201	2.47	0.000086	2.76	0.112	46.7	0.000013	0.00005	0.00315	0.000470	0.00068	0.146J	0.0765	0.00010	0.0278	0.00070	0.00584
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021	0.025	0.389	0.000461	4.38	0.000005	1.75	0.216	106	0.000048	0.00005	0.00015	0.00149	0.00025	0.158	0.251	0.00010	0.0012	0.00012	0.00353
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	0.025	0.340	0.000286	4.70	0.000005	1.44	0.222	102	0.000014	0.00005	0.00218	0.00149	0.00025	0.189	0.230	0.00010	0.0031	0.00016	0.00790
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	0.025	0.409	0.000172	5.36	0.000013	5.14	0.235	117	0.000023	0.00005	0.00364	0.00144	0.00059	0.323J	0.278	0.00010	0.0010	0.00005	0.0155
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	0.025	0.448	0.000083	2.12	0.000063	1.42	0.0566	19.4	0.000005	0.00005	0.00154	0.000222	0.00025	0.0685J	0.0109	0.00010	0.0607	0.00026	0.00394
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022	0.025	0.333	0.000340	4.79	0.000005	1.46	0.259	119	0.000016	0.00005	0.00030	0.00130	0.00025	0.191	0.276	0.00010	0.0015	0.00016	0.00507
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2022															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	0.025	0.46	0.000101	3.68	0.000023	0.995	0.125	30.6	0.000027	0.00005	0.00994	0.000187	0.00087	0.0594	0.0668	0.00015	0.0030	0.00012	0.00541
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	0.025	0.38	0.000117	2.64	0.000005	0.681	0.0731	11.1	0.000005	0.00005	0.00046	0.000161	0.00025	0.0245J	0.0180	0.00015	0.0130	0.00019	0.00296
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	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	0.132J	0.109	0.00046	0.0033	0.00021	0.0160
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	0.025	0.29	0.000052	4.83	0.000005	1.31	0.157	47.0	0.000044	0.00005	0.00405	0.000150	0.00025	0.103	0.106	0.00015	0.0038	0.00016	0.0124
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019	0.025	0.29	0.000058	4.79	0.000005	1.30	0.156	48.8	0.000037	0.00005	0.00139	0.000145	0.00025	0.122J	0.111	0.00015	0.0020	0.00013	0.00900
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	0.025	0.32	0.000062	5.16	0.000017	1.37	0.158	52.0	0.000036	0.00012	0.00651	0.000153	0.00084	0.131J	0.121	0.00015	0.0024	0.00011	0.00747
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	0.025	0.77	0.000110	1.45	0.000043	0.266	0.0315	4.64	0.000005	0.00005	0.00165	0.000040	0.00025	0.0383J	0.0075	0.00015	0.0519	0.00024	0.00219
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	0.025	0.260	0.000127	4.19	0.000012	1.02	0.124	35.4	0.000028	0.00005	0.00323	0.000135	0.00025	0.0863J	0.0720	0.00010	0.0122	0.00024	0.0131
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020	0.025	0.231	0.00133C	4.59	0.000021	1.11	0.161	39.9	0.000026	0.00005	0.00940	0.000340	0.00094	0.0658	0.0952	0.00022	0.0180	0.00040	0.00613
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020	0.025	0.282	0.00147C	5.15	0.000016	1.28	0.205	45.8	0.000033	0.00005	0.00405	0.000561	0.00084	0.0904	0.122	0.00010	0.0057	0.00050	0.00611
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020	0.025	0.271	0.00153C	4.72	0.000005	1.20	0.204	49.4	0.000032	0.00005	0.00296	0.000561	0.00025	0.0946	0.111	0.00010	0.0047	0.00046	0.00665
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	0.025	0.269	0.000626	5.04	0.000005	1.23	0.179	45.7	0.000026	0.00005	0.00255	0.000327	0.00025	0.114J	0.105	0.00010	0.0042	0.00045	0.00527
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020															NoHardness				
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	0.025	0.349	0.000025	5.12	0.000035	1.74	0.151	50.2	0.000033	0.00005	0.00015	0.000079	0.00025	0.159J	0.111	0.00010	0.0005	0.00022	0.00093
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	0.122	0.862	0.000182	2.92	0.000392C	0.821	0.0430	8.97	0.000041	0.00005	0.0218	0.000148	0.00227	0.106J	0.0075	0.00033	0.0423	0.00032	0.00354
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	0.025	0.324	0.000052	5.17	0.000005	1.32	0.159	46.6	0.000043	0.00005	0.00063	0.000120	0.00025	0.0997	0.110	0.00010	0.0010	0.00034	0.00336
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021	0.025	0.310	0.000214	5.65	0.000024	1.24	0.166	46.3	0.000042	0.00005	0.0101	0.000239	0.00114	0.133J	0.105	0.00010	0.0044	0.00035	0.00693
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	0.025	0.370	0.000025	5.33	0.000005	1.45	0.196	103	0.000027	0.00005	0.00015	0.000402	0.00025	0.236J	0.210	0.00010	0.0016	0.00012	0.0175
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	0.053	0.410	0.000185	2.30	0.000168	0.466	0.0467	8.72	0.000005	0.00005	0.00345	0.000064	0.00073	0.0459J	0.0075	0.00026	0.0552	0.00036	0.00342
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	0.112	0.335	0.000612	6.51	0.000070	1.36	0.182	44.1	0.000053	0.00005	0.0190	0.000345	0.00210	0.131J	0.101	0.00010	0.0038	0.00035	0.00793
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022															NoHardness				

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	0.0309	0.000050	0.000025	0.005	0.000402J	0.000329	54.9	0.00025	0.00186	0.00108	0.928	0.00120	0.0067	11.3	0.501	0.0000025	0.000115	0.00368
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021	0.0242	0.000050	0.000025	0.005	0.000125	0.000457	114	0.00025	0.00427	0.00010	0.612	0.000025	0.0183	21.6	1.16	0.0000025	0.000172	0.00766
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	0.0222	0.000050	0.000025	0.005	0.000142	0.000457	116	0.00025	0.00429	0.00010	1.19	0.000025	0.0177	19.1	1.16	0.0000025	0.000170	0.00740
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	0.0280	0.000050	0.000025	0.005	0.0000995	0.000457	154	0.00025	0.00811	0.00010	1.85	0.000025	0.0258	25.3	2.1	0.0000025	0.000183	0.0136
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	0.0180	0.000050	0.000025	0.005	0.000143	0.000203	29.1	0.00025	0.00140	0.00203	0.82	0.00194	0.0041	5.01	0.357	0.0000025	0.000113	0.00374
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022	0.0273	0.000050	0.000025	0.005	0.000135	0.000457	151	0.00025	0.00537	0.00021	0.774	0.000025	0.0212	21.9	1.48	0.0000025	0.000192	0.00962
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2022						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	0.0336	0.00005	0.000025	0.005	0.000107	0.000311	51.3	0.00005	0.00206	0.00023	0.591	0.000213	0.0083	10.2	0.914	0.0000025	0.000070	0.00460
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	0.0427	0.00005	0.000025	0.005	0.0000179	0.000218	31.1	0.00005	0.00692	0.00059	0.993	0.000132	0.0026	7.40	1.55	0.0000025	0.000283	0.00306
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	0.0435	0.00005	0.000025	0.005	0.0000976	0.000384	62.9	0.00005	0.00396	0.00010	2.3	0.000051	0.0103	13.2	1.21	0.0000025	0.000375	0.00465
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	0.0436	0.00005	0.000025	0.005	0.000120	0.000379	67.9	0.00005	0.00417	0.00246	1.41	0.000144	0.0112	13.2	1.29	0.0000025	0.000315	0.00596
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019	0.0451	0.00005	0.000025	0.005	0.000143	0.000388	72.0	0.00005	0.00430	0.00010	1.85	0.000025	0.0126	13.1	1.39	0.0000025	0.000321	0.00585
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	0.0461	0.00005	0.000025	0.005	0.000169	0.000404	71.4	0.00005	0.00441	0.00021	1.73	0.000071	0.0115	13.4	1.47	0.0000025	0.000246	0.00616
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	0.0162	0.00005	0.000025	0.005	0.000129J	0.000116	12.3	0.00014	0.00078	0.00174	0.462	0.00147	0.0014	2.77	0.183	0.0000025	0.000072	0.00232
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	0.0414	0.000050	0.000025	0.005	0.000147	0.000321	51.0	0.00005	0.00294	0.00085	1.64	0.000223	0.0076	10.4	0.9	0.0000025	0.000284	0.00475
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020	0.0388	0.000050	0.000025	0.005	0.000302	0.000361	57.9	0.00005	0.00153	0.00094	0.653	0.000222	0.0070	10.8	0.446	0.0000025	0.000252	0.00327
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020	0.0415	0.000050	0.000025	0.005	0.000410J	0.000405	70.4	0.00005	0.00206	0.00037	0.61	0.000165	0.0093	12.3	0.493	0.0000025	0.000303	0.00418
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020	0.0405	0.000050	0.000025	0.005	0.000447J	0.000388	74.0	0.00005	0.00257	0.00025	0.9	0.000025	0.0104	14.1	0.618	0.0000025	0.000266	0.00489
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	0.0394	0.000050	0.000025	0.005	0.000408J	0.000378	67.2	0.00005	0.00250	0.00062	0.732	0.000732	0.0102	11.9	0.563	0.0000025	0.000218	0.00489
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020						NoHardness												
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	0.0391	0.000050	0.000025	0.005	0.000151	0.000388	76.6	0.00005	0.00394	0.00010	0.005	0.000173	0.0154	14.1	1.16	0.0000025	0.000228	0.00775
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	0.0228	0.000050	0.000025	0.005	0.000206J	0.000141	17.1	0.00025	0.00123	0.00165	0.831	0.00377	0.0022	3.52	0.386	0.0000025	0.000144	0.00283
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	0.0378	0.000050	0.000025	0.005	0.000311	0.000385	72.1	0.00025	0.00319	0.00010	0.533	0.000113	0.0121	12.7	0.928	0.0000025	0.000255	0.00586
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021	0.0343	0.000050	0.000025	0.005	0.000395J	0.000378	69.0	0.00086	0.00313	0.00010	1.09	0.000067	0.0111	12.7	0.846	0.0000025	0.000274	0.00520
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	0.0285	0.000050	0.000025	0.005	0.0000825	0.000457	115	0.00025	0.00671	0.00010	3.05	0.000025	0.0230	18.5	1.79	0.0000025	0.000201	0.00954
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	0.0226	0.000050	0.000025	0.005	0.000131	0.000146	18.7	0.00025	0.00073	0.00251	0.818	0.00360	0.0028	3.91	0.220	0.0000025	0.000180	0.00308
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	0.0429	0.000050	0.000025	0.005	0.000274	0.000370	68.3	0.00025	0.00250	0.00024	1.42	0.000298	0.0103	11.3	0.822	0.0000025	0.000330	0.00424
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022						NoHardness												

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-51	Christal Creek d/s Hinton Creek	07-May-2021	0.025	1.07	0.000156	2.08	0.000016	2.90	0.104	44.7	0.000005	0.00005	0.00034	0.000390	0.00025	0.121	0.136	0.00015	3.77	3.88	1.01	
KV-51	Christal Creek d/s Hinton Creek	16-Jul-2021	0.025	0.353	0.000378	4.46	0.000005	1.66	0.200	97.6	0.000015	0.00005	0.00015	0.00148	0.00025	0.163	0.072	0.00015	8.34	7.62	1.05	
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2021	0.025	0.324	0.000260	4.46	0.000005	1.43	0.205	89.7	0.000005	0.00005	0.00015	0.00128	0.00025	0.174	0.098	0.00015	7.83	7.52	1.02	
KV-51	Christal Creek d/s Hinton Creek	22-Feb-2022	0.025	0.397	0.000186	4.85	0.000005	16.3	0.237	113	0.000022	0.00005	0.00032	0.00128	0.00025	0.294	0.108	0.00015	9.90	10.6	1.03	
KV-51	Christal Creek d/s Hinton Creek	15-May-2022	0.025	0.433	0.000116	1.80	0.000015	1.35	0.0560	17.9	0.000005	0.00005	0.00058	0.000172	0.00025	0.0625	0.091	0.00015	1.87	1.99	1.03	
KV-51	Christal Creek d/s Hinton Creek	03-Aug-2022	0.025	0.317	0.000364	4.35	0.000005	1.41	0.260	111	0.000013	0.00005	0.00015	0.00124	0.00025	0.179	0.074	0.00015	9.54	9.50	1.00	
KV-51	Christal Creek d/s Hinton Creek	15-Oct-2022															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	19-May-2019	0.025	0.45	0.000081	3.42	0.000005	1.01	0.114	30.6	0.000005	0.00005	0.00015	0.000159	0.00025	0.0507	0.065	0.00015	3.27	3.52	1.04	
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2019	0.025	0.64	0.000110	2.45	0.000005	0.742	0.0811	7.35	0.000005	0.00005	0.00015	0.000197	0.00025	0.0159	0.084	0.00015	1.96	2.32	1.08	
KV-117	Christal Creek u/s Flame & Moth discharge	22-Jul-2019	0.025	0.29	0.000025	5.07	0.000005	1.33	0.152	48.7	0.000005	0.00005	0.00015	0.000148	0.00025	0.0715	0.051	0.00015	4.67	4.48	0.98	
KV-117	Christal Creek u/s Flame & Moth discharge	01-Aug-2019	0.025	0.28	0.000025	5.17	0.000005	1.33	0.159	51.0	0.000034	0.00005	0.00015	0.000148	0.00025	0.0946	0.067	0.00015	4.74	4.68	0.99	
KV-117	Christal Creek u/s Flame & Moth discharge	17-Sep-2019	0.025	0.29	0.000087	4.71	0.000005	1.33	0.157	47.6	0.000038	0.00005	0.00015	0.000144	0.00025	0.112	0.060	0.00015	4.77	4.90	1.01	
KV-117	Christal Creek u/s Flame & Moth discharge	04-Oct-2019	0.025	0.28	0.000025	4.71	0.000005	1.30	0.149	44.7	0.000028	0.00039	0.00015	0.000133	0.00025	0.118	0.060	0.00015	4.95	4.89	0.99	
KV-117	Christal Creek u/s Flame & Moth discharge	28-Nov-2019															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	13-Dec-2019															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	31-Jan-2020															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	15-Feb-2020															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	19-Mar-2020															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	17-Apr-2020															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2020	0.025	0.75	0.000061	1.35	0.000018	0.272	0.0295	5.26	0.000005	0.00005	0.00063	0.000038	0.00025	0.0343	0.038	0.00015	0.68	0.91	1.15	
KV-117	Christal Creek u/s Flame & Moth discharge	07-Jun-2020	0.025	0.220	0.000104	3.83	0.000005	1.03	0.127	32.4	0.000023	0.00005	0.00015	0.000115	0.00025	0.0787	0.079	0.00015	3.72	3.61	1.02	
KV-117	Christal Creek u/s Flame & Moth discharge	11-Jul-2020	0.025	0.151	0.00115	3.98	0.000005	1.05	0.149	37.1	0.000016	0.00005	0.00015	0.000322	0.00025	0.0549	0.134	0.00015	4.07	3.91	1.02	
KV-117	Christal Creek u/s Flame & Moth discharge	12-Aug-2020	0.025	0.225	0.00145	4.22	0.000005	1.18	0.199	44.7	0.000023	0.00005	0.00015	0.000477	0.00025	0.0752	0.064	0.00015	4.90	4.66	1.03	
KV-117	Christal Creek u/s Flame & Moth discharge	23-Sep-2020	0.025	0.276	0.00140	4.48	0.000005	1.27	0.196	46.3	0.000027	0.00005	0.00015	0.000563	0.00025	0.0952	0.082	0.00015	4.80	5.03	1.02	
KV-117	Christal Creek u/s Flame & Moth discharge	18-Oct-2020	0.025	0.311	0.000573	4.44	0.000005	1.27	0.180	44.9	0.000026	0.00005	0.00015	0.000304	0.00025	0.112	0.083	0.00015	4.59	4.46	1.01	
KV-117	Christal Creek u/s Flame & Moth discharge	11-Nov-2020															0.002					
KV-117	Christal Creek u/s Flame & Moth discharge	26-Mar-2021	0.025	0.380	0.000025	5.60	0.000005	1.87	0.169	56.9	0.000036	0.00005	0.00015	0.000088	0.00025	0.178	0.053	0.00015	4.91	5.13	1.02	
KV-117	Christal Creek u/s Flame & Moth discharge	07-May-2021	0.025	0.841	0.000094	1.52	0.000019	0.880	0.0409	8.34	0.000011	0.00005	0.00050	0.000047	0.00025	0.0537	0.062	0.00015	1.14	1.26	1.05	
KV-117	Christal Creek u/s Flame & Moth discharge	16-Jul-2021	0.025	0.313	0.000025	5.10	0.000005	1.35	0.167	47.1	0.000037	0.00005	0.00015	0.000131	0.00025	0.0955	0.059	0.00015	4.64	4.77	1.01	
KV-117	Christal Creek u/s Flame & Moth discharge	15-Oct-2021	0.025	0.289	0.000207	5.02	0.000005	1.23	0.166	45.8	0.000029	0.00005	0.00015	0.000188	0.00025	0.111	0.074	0.00015	4.56	4.63	1.01	
KV-117	Christal Creek u/s Flame & Moth discharge	22-Feb-2022	0.025	0.364	0.000025	5.07	0.000005	1.50	0.195	98.2	0.000022	0.00005	0.00015	0.000365	0.00025	0.25	0.077	0.00015	8.28	7.52	1.05	
KV-117	Christal Creek u/s Flame & Moth discharge	15-May-2022	0.025	0.413	0.000213	1.83	0.000041	0.487	0.0456	8.55	0.000005	0.00005	0.00087	0.000048	0.00025	0.0321	0.075	0.00015	1.17	1.33	1.06	
KV-117	Christal Creek u/s Flame & Moth discharge	03-Aug-2022	0.025	0.268	0.000484	4.83	0.000005	1.28	0.172	43.0	0.000024	0.00005	0.00015	0.000261	0.00025	0.0640	0.069	0.00015	4.69	4.49	1.02	
KV-117	Christal Creek u/s Flame & Moth discharge	16-Oct-2022															0.002					

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
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	3.83C	26.6	-12.7	337	347	111
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	5.59C	38.9	-97.0			
KV-121	Christal Seep	06-Mar-2019	flowing well	11.6		11.3	6.99	7.27	869.9	863	-0.6	4.36C	32.9	10.4	420	471	117
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
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	3.61C	25.7	4.80	634	652	154
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	6.20C	44.3	12.5	527	443	124
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	4.31C	30.9	42.5	604	618	135
KV-121	Christal Seep	01-Aug-2019	Flow measured d/s.	11.7		7.1	7.46	8.21	1079	1120	1.4	4.80C	34.5	94.6	637	637	139
KV-121	Christal Seep	17-Sep-2019	Took two sets of additional insitu readings nearby; both are u/s of KV-121.	11.3		0.5	7.38	7.60	688.7	584	1.5	8.31	60.0	75.0	345	323	111
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
KV-121	Christal Seep	28-Nov-2019		16.7		3.7	7.22	7.07	767.6	749	0.6	6.30C	44.3	14.7	427	432	120
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
KV-121	Christal Seep	31-Jan-2020	Too much snow to access site. Need snowshoes to break initial trail.														
KV-121	Christal Seep	15-Feb-2020	no flow not suitable			42.0	7.77	7.99	905.1	864	-0.1	~	~	~	471	488	153
KV-121	Christal Seep	18-Mar-2020	Flow appears decreased. Little disturbance to clear snow. Waited to clear			5.7	7.09	7.37	879.2	898	0.1	2.52C	17.3	122.1	512	514	155
KV-121	Christal Seep	17-Apr-2020				6.0	7.23	7.81	885.2	894	0.2	3.43C	23.9	199.4	528	482	156
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.			0.5	6.92	7.26	936.7	342	0.4	1.90C	13.3	7.7	150	147	40.1
KV-121	Christal Seep	07-Jun-2020				4.8	7.27	7.18	988.0	989	1.0	3.66C	25.8	42.1	537	558	134
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
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
KV-121	Christal Seep	23-Sep-2020				2.3	6.90	8.12	891.7	953	1.0	5.62C	40.3	63.5	493	564	170
KV-121	Christal Seep	18-Oct-2020				5.1	6.76	7.84	949.0	977	0.5	6.27C	43.6	20.3	536	592	153
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
KV-121	Christal Seep	24-Mar-2021	No flow measurement, condtions not ideal. ORP slow to climb			0.5	6.95	8.09	571.7	675	0.6	8.13	58.2	27.1	347	351	121
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
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
KV-121	Christal Seep	15-Oct-2021				19.3	6.97	6.89	908.5	1190	0.1	4.49C	35.0	8.6	685	691	152
KV-121	Christal Seep	22-Feb-2022	sample only			8.2	6.88	8.12	934.5	982	-0.2	6.12C	43.1	-49.8	545	585	153
KV-121	Christal Seep	15-May-2022				10.8	6.45C	8.19	925.0	808	1.4	3.72C	26.5	164.6	455	498	110
KV-121	Christal Seep	09-Jun-2022				3.5	6.97	8.17	1275	537	1.7	1.95C	14.0	-66.8	510	504	107
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
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

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-121	Christal Seep	10-Feb-2019	0.125	1.25	0.14C	245	429	0.0076	20.2	0.0025	0.290		0.71	0.0981	0.1	0.00011	0.0383	0.0256	0.00005	0.000025	0.005	0.000363	0.00037
KV-121	Christal Seep	12-Feb-2019					128		14.0						0.1								NoHardness
KV-121	Christal Seep	06-Mar-2019	0.125	1.25	0.26C	361	429	0.0283	19.4	0.0025	0.067		1.67	0.0259	0.1	0.00005	0.0269	0.0188	0.00005	0.000025	0.005	0.0000812	0.00037
KV-121	Christal Seep	18-Apr-2019	0.125	1.25	0.28C	333	429	0.0540	25.0	0.0025	0.049		1.19	0.0191	0.1	0.00011	0.0256	0.0231	0.00005	0.000025	0.005	0.0000855	0.00037
KV-121	Christal Seep	19-May-2019	0.125	1.25	0.34C	458	429	0.0535	26.0	0.0025	0.058		1.12	0.0031	0.1	0.00005	0.0308	0.0112	0.00005	0.000025	0.005	0.000150	0.00037
KV-121	Christal Seep	07-Jun-2019	0.125	1.25	0.14C	384	429	0.0100	15.2	0.0025	0.300		1.12	0.0015	0.1	0.00005	0.018	0.0186	0.00005	0.000025	0.005	0.000182	0.00037
KV-121	Christal Seep	22-Jul-2019	0.125	1.25	0.23C	523	429	0.0190	4.97	0.0025	0.175		1.22	0.0055	0.1	0.00005	0.0356	0.0158	0.00005	0.000025	0.005	0.000122	0.00037
KV-121	Christal Seep	01-Aug-2019	0.125	1.25	0.28C	536	429	0.0206	5.87	0.0025	0.129		2.37	0.0015	0.1	0.00005	0.043	0.0140	0.00005	0.000025	0.005	0.000128	0.00037
KV-121	Christal Seep	17-Sep-2019	0.025	0.87	0.082	215	429	0.0106	6.99	0.0005	0.416		1.11	0.0015	0.1	0.00005	0.00676	0.0167	0.00005	0.000025	0.005	0.000121	0.00037
KV-121	Christal Seep	04-Oct-2019	0.125	1.25	0.26C	375	429	0.0863	14.6	0.0025	0.0125		1.51	0.0364	0.1	0.00005	0.0225	0.0297	0.00005	0.000025	0.005	0.0000847	0.00037
KV-121	Christal Seep	28-Nov-2019	0.025	0.25	0.259C	306	429	0.0715	10.9	0.0005	0.127		0.98	0.0136	0.1	0.00005	0.0251	0.0219	0.00005	0.000025	0.005	0.0000763	0.00037
KV-121	Christal Seep	14-Dec-2019	0.125	1.25	0.19C	253	429	0.0253	1.98	0.0025	0.293		1.13	0.0015	0.1	0.00005	0.0228	0.0147	0.00005	0.000025	0.005	0.000104	0.00037
KV-121	Christal Seep	31-Jan-2020					128		0.616						NopH								NoHardness
KV-121	Christal Seep	15-Feb-2020	0.125	1.25	0.37C	339	429	0.0263	3.24	0.0025	0.074		0.83	0.0015	0.1	0.00005	0.0459	0.0100	0.00005	0.000025	0.005	0.0000649	0.00037
KV-121	Christal Seep	18-Mar-2020	0.125	1.25	0.36C	342	429	0.0375	15.3	0.0025	0.049		1.61	0.0048	0.1	0.00005	0.0468	0.00991	0.00005	0.000025	0.005	0.0000767	0.00037
KV-121	Christal Seep	17-Apr-2020	0.125	1.25	0.39C	359	429	0.0279	11.0	0.0025	0.049		0.89	0.0053	0.1	0.00005	0.0465	0.0100	0.00005	0.000025	0.005	0.0000720	0.00037
KV-121	Christal Seep	07-May-2020	0.025	1.08	0.084	115	309	0.0083	22.1	0.0005	0.0218		17.3	0.0147	0.1	0.00068	0.00788	0.0201	0.00005	0.000025	0.005	0.00345	0.000222
KV-121	Christal Seep	07-Jun-2020	0.125	1.25	0.314C	447	429	0.0264	9.39	0.0025	0.186		1.17	0.0015	0.1	0.00005	0.0407	0.0166	0.000050	0.000025	0.005	0.000128	0.00037
KV-121	Christal Seep	11-Jul-2020	0.125	1.25	0.293C	496	429	0.0240	38.2	0.0025	0.199		8.49	0.0015	0.1	0.00005	0.0446	0.0185	0.000050	0.000025	0.005	0.000184	0.00037
KV-121	Christal Seep	12-Aug-2020	0.125	1.25	0.306C	465	429	0.0311	12.0	0.0025	0.272		0.81	0.0037	0.1	0.00005	0.0456	0.0182	0.000050	0.000025	0.005	0.000158	0.00037
KV-121	Christal Seep	23-Sep-2020	0.025	1.05	0.262C	382	429	0.0267	22.0	0.0013	0.393		1.28	0.0015	0.1	0.00005	0.0256	0.0211	0.000050	0.000025	0.005	0.000162	0.00037
KV-121	Christal Seep	18-Oct-2020	0.125	1.25	0.269C	427	429	0.0200	31.6	0.0025	0.272		1.19	0.0015	0.1	0.00005	0.0374	0.0163	0.000050	0.000025	0.005	0.000133	0.00037
KV-121	Christal Seep	11-Nov-2020	0.125	1.25	0.050	245	429	0.0075	20.6	0.0025	1.01		1.53	0.0015	0.1	0.00005	0.0117	0.0238	0.000050	0.000025	0.005	0.000181	0.00037
KV-121	Christal Seep	24-Mar-2021	0.125	1.25	0.132C	242	429	0.0066	20.3	0.0025	0.304		1.30	0.0035	0.1	0.00005	0.013	0.0177	0.000050	0.000025	0.005	0.000162	0.00037
KV-121	Christal Seep	07-May-2021	0.025	10.8	0.134C	378	429	0.0159	40.7	0.0342	1.07		6.11	0.0085	0.1	0.00246	0.0186	0.0880	0.000050	0.000025	0.005	0.00282	0.00037
KV-121	Christal Seep	16-Jul-2021	0.025	0.95	0.243C	258	429	0.0112	13.8	0.0005	0.232		0.70	0.0056	0.1	0.00026	0.0262	0.0144	0.000050	0.000025	0.005	0.000121	0.00037
KV-121	Christal Seep	15-Oct-2021	0.125	1.25	0.346C	554	429	0.0363	20.2	0.0025	0.0125		1.14	0.0048	0.1	0.00005	0.062	0.00836	0.000050	0.000025	0.005	0.0000729	0.00037
KV-121	Christal Seep	22-Feb-2022	0.125	1.25	0.378C	394	429	0.0330	25.0	0.0025	0.160		0.88	0.0055	0.1	0.00016	0.0472	0.0125	0.000050	0.000025	0.005	0.000120	0.00037
KV-121	Christal Seep	15-May-2022	0.125	1.25	0.245C	335	429	0.0272	59.9	0.0025	0.0125		4.57	0.0136C	0.005	0.00017	0.0475	0.00932	0.000050	0.000025	0.005	0.000285	0.00037
KV-121	Christal Seep	09-Jun-2022	0.025	1.71	0.114	180	429	0.0325	17.7	0.0005	0.409		2.05	0.0015	0.1	0.00005	0.0422	0.0198	0.000050	0.000025	0.005	0.000117	0.00037
KV-121	Christal Seep	03-Aug-2022	0.125	1.25	0.178C	372	429	0.0133	16.1	0.0025	0.149		1.24	0.0065	0.1	0.00005	0.02	0.0269	0.000050	0.000025	0.005	0.00092	0.00037
KV-121	Christal Seep	16-Oct-2022	0.125	1.25	0.268C	549	429	0.0316	1.67	0.0025	0.0668		0.92	0.0118	0.1	0.00005	0.069	0.0107	0.000050	0.000025	0.005	0.000166	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-121	Christal Seep	10-Feb-2019	97.7	0.00029	0.00286	0.00143	0.004	3.29	0.000556	0.007	0.0183	0.0128	22.7	0.563	4.3	0.0000025	0.000125	0.00675	0.15
KV-121	Christal Seep	12-Feb-2019					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-121	Christal Seep	06-Mar-2019	132	0.00025	0.00611J	0.00025	0.004	3.78	0.000220	0.007	0.0231	0.0228	21.7	1.38	5.2	0.0000025	0.000174	0.0112	0.15
KV-121	Christal Seep	18-Apr-2019	139	0.00005	0.00740J	0.00025	0.004	3.43	0.000918	0.007	0.0243	0.0233	23.0	1.85	5.4	0.0000025	0.000207	0.0122	0.15
KV-121	Christal Seep	19-May-2019	202	0.00005	0.0106J	0.00025	0.004	2.66	0.000025	0.007	0.0367	0.0272	31.8	2.35	7.5	0.0000025	0.000180	0.0216	0.15
KV-121	Christal Seep	07-Jun-2019	155	0.00005	0.00562J	0.00025	0.004	1.97	0.000025	0.007	0.0297	0.0177	34.3	1.18	6.3	0.0000025	0.000084	0.0123	0.15
KV-121	Christal Seep	22-Jul-2019	189	0.00005	0.00853J	0.00025	0.004	3.95	0.000025	0.007	0.0347	0.0260	31.9	1.71	7.2	0.0000025	0.000122	0.0181	0.15
KV-121	Christal Seep	01-Aug-2019	202	0.00013	0.0100J	0.00025	0.004	4.93	0.000025	0.007	0.0369	0.0296	32.1	1.99	7.6	0.0000025	0.000152	0.0208	0.15
KV-121	Christal Seep	17-Sep-2019	98.0	0.00012	0.00157	0.00025	0.004	0.703	0.000025	0.007	0.0187	0.0116	24.3	0.324	4.3	0.0000025	0.000102	0.00351	0.15
KV-121	Christal Seep	04-Oct-2019	158	0.00017	0.00772J	0.00025	0.004	5.14	0.000207	0.007	0.0274	0.0285	23.6	2.21	6.0	0.0000025	0.000247	0.0111	0.15
KV-121	Christal Seep	28-Nov-2019	132	0.00005	0.00633J	0.00025	0.004	3.57	0.000066	0.007	0.0235	0.0243	23.4	1.59	5.2	0.0000025	0.000173	0.0107	0.15
KV-121	Christal Seep	14-Dec-2019	126	0.00005	0.00420J	0.00025	0.004	1.89	0.000025	0.007	0.0229	0.0162	24.9	0.930	5.1	0.0000025	0.000132	0.00877	0.15
KV-121	Christal Seep	31-Jan-2020					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-121	Christal Seep	15-Feb-2020	149	0.00005	0.00768J	0.00025	0.004	3.81	0.000083	0.007	0.0262	0.0241	24.1	1.53	5.7	0.0000025	0.000282	0.0155	0.15
KV-121	Christal Seep	18-Mar-2020	160	0.00005	0.00811J	0.00025	0.004	3.72	0.000025	0.007	0.0288	0.0229	27.1	1.81	6.2	0.0000025	0.000209	0.0166	0.15
KV-121	Christal Seep	17-Apr-2020	170	0.00005	0.00773J	0.00025	0.004	3.63	0.000115	0.007	0.0298	0.0264	25.4	1.70	6.4	0.0000025	0.000217	0.0161	0.15
KV-121	Christal Seep	07-May-2020	44.2	0.00005	0.00112	0.00200	0.00334	0.554	0.000935	0.00533	0.00865	0.0048	9.53	0.237	2.2	0.0000025	0.000096	0.00301	0.130
KV-121	Christal Seep	07-Jun-2020	165	0.00005	0.00848J	0.00025	0.004	3.87	0.000025	0.007	0.0304	0.0241	30.1	1.78	6.5	0.0000025	0.000164	0.0170	0.15
KV-121	Christal Seep	11-Jul-2020	193	0.00005	0.00962J	0.00025	0.004	4.42	0.000025	0.007	0.0363	0.0290	35.4	2.10	7.4	0.0000025	0.000194	0.0197	0.15
KV-121	Christal Seep	12-Aug-2020	196	0.00005	0.00854J	0.00025	0.004	4.52	0.000025	0.007	0.0348	0.0272	28.2	1.75	7.2	0.0000025	0.000158	0.0173	0.15
KV-121	Christal Seep	23-Sep-2020	152	0.00005	0.00567J	0.00025	0.004	2.6	0.000025	0.007	0.0276	0.0203	27.6	1.20	6.0	0.0000025	0.000106	0.0117	0.15
KV-121	Christal Seep	18-Oct-2020	169	0.00015	0.00819J	0.00025	0.004	3.6	0.000025	0.007	0.0303	0.0250	27.3	1.66	6.4	0.0000025	0.000158	0.0167	0.15
KV-121	Christal Seep	11-Nov-2020	109	0.00005	0.00242	0.00025	0.004	1.15	0.000073	0.007	0.0201	0.0111	23.4	0.543	4.6	0.0000025	0.000086	0.00539	0.15
KV-121	Christal Seep	24-Mar-2021	102	0.00005	0.00244	0.00025	0.004	1.2	0.000213	0.007	0.0188	0.0114	22.4	0.516	4.4	0.0000025	0.000103	0.00525	0.15
KV-121	Christal Seep	07-May-2021	127	0.00025	0.00322	0.00064	0.004	1.54	0.00945	0.007	0.0239	0.0146	28.1	0.683	5.3	0.0000025	0.000067	0.00696	0.15
KV-121	Christal Seep	16-Jul-2021	162	0.00025	0.00514J	0.00025	0.004	3	0.00209	0.007	0.0292	0.0228	27.8	1.33	6.3	0.0000025	0.000106	0.0114	0.15
KV-121	Christal Seep	15-Oct-2021	221	0.00025	0.0143J	0.00025	0.004	6.87	0.000025	0.007	0.0402	0.0398	32.4	2.93	8.1	0.0000025	0.000157	0.0291	0.15
KV-121	Christal Seep	22-Feb-2022	170	0.00025	0.0106J	0.00025	0.004	5.18	0.00258	0.007	0.0309	0.0284	29.2	2.08	6.5	0.0000025	0.000216	0.0208	0.15
KV-121	Christal Seep	15-May-2022	145	0.00025	0.0104J	0.00050	0.004	5.14	0.000824	0.007	0.0252	0.0240	22.6	2.16	5.6	0.0000025	0.000146	0.0207	0.15
KV-121	Christal Seep	09-Jun-2022	155	0.00025	0.0105J	0.00025	0.004	5.6	0.000063	0.007	0.0286	0.0217	29.9	2.32	6.2	0.0000025	0.000207	0.0195	0.15
KV-121	Christal Seep	03-Aug-2022	146	0.00025	0.00615J	0.00025	0.004	2.49	0.000970	0.007	0.0269	0.0206	28.6	1.48	5.9	0.0000025	0.000217	0.0136	0.15
KV-121	Christal Seep	16-Oct-2022	217	0.00025	0.0139J	0.00025	0.004	6.92	0.000072	0.007	0.0397	0.0341	33.2	2.94	8.0	0.0000025	0.000154	0.0284	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), 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
CCME-Aquatic (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-121	Christal Seep	10-Feb-2019	0.025	0.39	0.000935	3.79	0.000019	1.66	0.205	87.6	0.000005	0.00005	0.00315	0.00307	0.00025	0.154	0.193	0.00015	0.0005	0.00005	0.00942
KV-121	Christal Seep	12-Feb-2019															NoHardness				
KV-121	Christal Seep	06-Mar-2019	0.025	0.39	0.000274	4.45	0.000005	1.65	0.215	126	0.000010	0.00005	0.0006	0.00157	0.00025	0.242	0.255	0.00015	0.0012	0.00005	0.0287
KV-121	Christal Seep	18-Apr-2019	0.025	0.41	0.000166	4.32	0.000005	1.50	0.210	123	0.000013	0.00005	0.00030	0.00113	0.00025	0.257	0.270	0.00015	0.0011	0.00005	0.0250
KV-121	Christal Seep	19-May-2019	0.025	0.50	0.000169	4.08	0.000005	2.07	0.310	164	0.000018	0.00005	0.00015	0.00257	0.00025	0.420J	0.416	0.00015	0.0005	0.00005	0.0399
KV-121	Christal Seep	07-Jun-2019	0.025	0.41	0.000742	3.91	0.000005	2.35	0.290	145	0.000005	0.00005	0.00015	0.00346	0.00025	0.258	0.335	0.00015	0.0005	0.00005	0.00795
KV-121	Christal Seep	22-Jul-2019	0.025	0.39	0.000442	4.01	0.000005	1.82	0.300	174	0.000012	0.00005	0.00015	0.00305	0.00025	0.371	0.393	0.00015	0.0005	0.00005	0.0351
KV-121	Christal Seep	01-Aug-2019	0.025	0.40	0.000427	4.30	0.000005	1.76	0.292	181	0.000005	0.00005	0.00015	0.00287	0.00025	0.387	0.418	0.00015	0.0005	0.00005	0.0395
KV-121	Christal Seep	17-Sep-2019	0.025	0.36	0.000972	3.68	0.000005	1.94	0.216	87.0	0.000005	0.00005	0.00015	0.00268	0.00025	0.0878	0.199	0.00015	0.0005	0.00005	0.00519
KV-121	Christal Seep	04-Oct-2019	0.025	0.35	0.000025	4.93	0.000012	1.37	0.231	142	0.000013	0.00005	0.00100	0.000449	0.00025	0.220	0.308	0.00015	0.0025	0.00005	0.0152
KV-121	Christal Seep	28-Nov-2019	0.025	0.35	0.000253	4.41	0.000005	1.69	0.209	113	0.000012	0.00005	0.00035	0.00135	0.00025	0.234	0.260	0.00015	0.0012	0.00005	0.0223
KV-121	Christal Seep	14-Dec-2019	0.025	0.37	0.000641	3.86	0.000005	1.98	0.207	95.3	0.000005	0.00005	0.00015	0.00226	0.00025	0.187	0.253	0.00015	0.0011	0.00005	0.0174
KV-121	Christal Seep	31-Jan-2020															NoHardness				
KV-121	Christal Seep	15-Feb-2020	0.025	0.38	0.000178	3.81	0.000005	2.01	0.235	125	0.000017	0.00005	0.00015	0.00217	0.00025	0.305J	0.293	0.00015	0.0016	0.00005	0.0406
KV-121	Christal Seep	18-Mar-2020	0.025	0.38	0.000133	3.77	0.000005	2.15	0.239	128	0.000012	0.00014	0.00015	0.00197	0.00025	0.320	0.324	0.00015	0.0020	0.00005	0.0457
KV-121	Christal Seep	17-Apr-2020	0.025	0.41	0.000214	3.82	0.000005	2.09	0.218	129	0.000016	0.00005	0.00015	0.00211	0.00025	0.314	0.336	0.00015	0.0011	0.00005	0.0455
KV-121	Christal Seep	07-May-2020	0.025	1.40	0.000206	1.55	0.000042	1.43	0.0775	37.2	0.000005	0.00005	0.00015	0.000397	0.00025	0.626J	0.0525	0.00015	0.0146	0.00063	0.00863
KV-121	Christal Seep	07-Jun-2020	0.025	0.404	0.000288	4.18	0.000005	2.02	0.276	164	0.000010	0.00005	0.00015	0.00259	0.00025	0.373J	0.343	0.00010	0.0005	0.00005	0.0395
KV-121	Christal Seep	11-Jul-2020	0.025	0.424	0.000558	4.28	0.000005	1.92	0.296	185	0.000014	0.00005	0.00015	0.00294	0.00025	0.380	0.410	0.00010	0.0012	0.00005	0.0402
KV-121	Christal Seep	12-Aug-2020	0.025	0.379	0.000711	4.26	0.000005	1.80	0.298	156	0.000011	0.00005	0.00015	0.00377	0.00025	0.346	0.394	0.00010	0.0017	0.00005	0.0278
KV-121	Christal Seep	23-Sep-2020	0.025	0.406	0.00108C	3.94	0.000005	2.32	0.269	130	0.000010	0.00005	0.00015	0.00544	0.00025	0.256	0.310	0.00010	0.0005	0.00005	0.0386
KV-121	Christal Seep	18-Oct-2020	0.025	0.403	0.000692	4.60	0.000005	1.91	0.271	147	0.000005	0.00005	0.00015	0.00465	0.00025	0.341	0.342	0.00010	0.0005	0.00005	0.0436
KV-121	Christal Seep	11-Nov-2020	0.025	0.393	0.00148C	3.55	0.000005	2.49	0.216	86.3	0.000005	0.00005	0.00015	0.00498	0.00025	0.131	0.217	0.00010	0.0005	0.00005	0.0135
KV-121	Christal Seep	24-Mar-2021	0.025	0.369	0.00118C	3.56	0.000005	2.68	0.202	84.4	0.000005	0.00005	0.00015	0.00269	0.00025	0.124	0.200	0.00010	0.0005	0.00005	0.0120
KV-121	Christal Seep	07-May-2021	0.025	2.65	0.000128	3.69	0.000078	9.30	0.243	148	0.000005	0.00005	0.00015	0.000840	0.00025	0.521J	0.265	0.00010	0.0030	0.00235	0.0170
KV-121	Christal Seep	16-Jul-2021	0.025	0.460	0.000510	3.86	0.000005	2.03	0.244	123	0.000005	0.00005	0.00015	0.00257	0.00025	0.234	0.329	0.00010	0.0016	0.00005	0.0203
KV-121	Christal Seep	15-Oct-2021	0.025	0.421	0.000025	4.76	0.000005	1.63	0.315	190	0.000023	0.00005	0.00015	0.00263	0.00025	0.627J	0.454	0.00010	0.0029	0.00005	0.0592
KV-121	Christal Seep	22-Feb-2022	0.025	0.464	0.000284	5.23	0.000038	2.27	0.261	159	0.000022	0.00005	0.00015	0.00309	0.00025	0.431J	0.349	0.00010	0.0005	0.00005	0.0464
KV-121	Christal Seep	15-May-2022	0.025	0.556	0.000052	3.92	0.000019	1.69	0.223	133	0.000016	0.00005	0.00032	0.00190	0.00025	0.469J	0.281	0.00010	0.0028	0.00018	0.0436
KV-121	Christal Seep	09-Jun-2022	0.025	0.466	0.000268	5.04	0.000005	1.85	0.260	144	0.000026	0.00005	0.00015	0.00322	0.00025	0.382J	0.322	0.00010	0.0011	0.00005	0.0391
KV-121	Christal Seep	03-Aug-2022	0.025	0.360	0.000563	4.73	0.000005	1.95	0.258	135	0.000010	0.00005	0.00015	0.00432	0.00025	0.293	0.302	0.00010	0.0016	0.00005	0.0175
KV-121	Christal Seep	16-Oct-2022	0.025	0.419	0.000156	4.71	0.000005	1.95	0.291	190	0.000021	0.00005	0.00032	0.00286	0.00025	0.602J	0.448	0.00010	0.0082	0.00005	0.0564

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-121	Christal Seep	10-Feb-2019	0.0168	0.00005	0.000025	0.005	0.000134	0.000457	102	0.00005	0.00205	0.00030	0.928	0.000025	0.0126	22.7	0.463	0.0000025	0.000076	0.00481
KV-121	Christal Seep	12-Feb-2019						NoHardness												
KV-121	Christal Seep	06-Mar-2019	0.0184	0.00005	0.000025	0.005	0.0000619	0.000457	148	0.00019	0.00662	0.00024	3.65	0.000025	0.0248	24.4	1.67	0.0000025	0.000149	0.0117
KV-121	Christal Seep	18-Apr-2019	0.0219	0.00005	0.000025	0.005	0.0000767	0.000457	138	0.00025	0.00727	0.00010	3.19	0.000149	0.0238	23.6	1.81	0.0000025	0.000232	0.0122
KV-121	Christal Seep	19-May-2019	0.0110	0.00005	0.000025	0.005	0.000144	0.000457	208	0.00005	0.0101	0.00010	3.47	0.000121	0.0259	31.9	2.3	0.0000025	0.000172	0.0209
KV-121	Christal Seep	07-Jun-2019	0.0203	0.00005	0.000025	0.005	0.000173	0.000457	131	0.00005	0.00223	0.00010	0.819	0.000025	0.0125	28.3	0.464	0.0000025	0.000063	0.00525
KV-121	Christal Seep	22-Jul-2019	0.0157	0.00005	0.000025	0.005	0.000121	0.000457	193	0.00005	0.00868	0.00010	3.96	0.000025	0.0245	33.1	1.77	0.0000025	0.000124	0.0181
KV-121	Christal Seep	01-Aug-2019	0.0146	0.00005	0.000025	0.005	0.000119	0.000457	204	0.00005	0.00965	0.00010	4.34	0.000118	0.0291	31.2	1.92	0.0000025	0.000144	0.0202
KV-121	Christal Seep	17-Sep-2019	0.0165	0.00005	0.000025	0.005	0.000129	0.000457	91.3	0.00005	0.00112	0.00026	0.474	0.000025	0.0097	23.1	0.243	0.0000025	0.000078	0.00260
KV-121	Christal Seep	04-Oct-2019	0.0287	0.00005	0.000025	0.005	0.0000398	0.000457	157	0.00005	0.00793	0.00010	3.54	0.000025	0.0266	21.9	2.31	0.0000025	0.000232	0.0112
KV-121	Christal Seep	28-Nov-2019	0.0214	0.00005	0.000025	0.005	0.0000438	0.000457	134	0.00005	0.00635	0.00010	2.87	0.000025	0.0225	23.5	1.62	0.0000025	0.000182	0.0104
KV-121	Christal Seep	14-Dec-2019	0.0145	0.00005	0.000025	0.005	0.000107	0.000457	121	0.00005	0.00353	0.00010	1.4	0.000025	0.0146	23.7	0.777	0.0000025	0.000114	0.00772
KV-121	Christal Seep	31-Jan-2020						NoHardness												
KV-121	Christal Seep	15-Feb-2020	0.0101	0.00005	0.000025	0.005	0.0000646	0.000457	153	0.00005	0.00800	0.00010	3.53	0.000079	0.0244	25.8	1.76	0.0000025	0.000230	0.0162
KV-121	Christal Seep	18-Mar-2020	0.00978	0.00005	0.000025	0.005	0.0000482	0.000457	161	0.00005	0.00787	0.00010	3.59	0.000025	0.0244	27.4	1.77	0.0000025	0.000232	0.0162
KV-121	Christal Seep	17-Apr-2020	0.0100	0.00005	0.000025	0.005	0.0000656	0.000457	149	0.00005	0.00788	0.00024	3.5	0.000056	0.0255	26.7	1.66	0.0000025	0.000216	0.0157
KV-121	Christal Seep	07-May-2020	0.0190	0.00005	0.000025	0.005	0.00296J	0.000285	43.0	0.00005	0.00138	0.00183	0.636	0.000819	0.0058	9.59	0.306	0.0000025	0.000058	0.00351
KV-121	Christal Seep	07-Jun-2020	0.0170	0.000050	0.000025	0.005	0.000122	0.000457	174	0.00005	0.00792	0.00010	3.61	0.000025	0.0257	30.4	1.73	0.0000025	0.000167	0.0160
KV-121	Christal Seep	11-Jul-2020	0.0171	0.000050	0.000025	0.005	0.000180	0.000457	187	0.00005	0.00900	0.00010	3.96	0.000025	0.0266	30.5	1.78	0.0000025	0.000165	0.0184
KV-121	Christal Seep	12-Aug-2020	0.0229	0.000050	0.000025	0.005	0.000175	0.000457	154	0.00005	0.00570	0.00040	2.69	0.000065	0.0203	28.7	1.18	0.0000025	0.000106	0.0121
KV-121	Christal Seep	23-Sep-2020	0.0171	0.000050	0.000025	0.005	0.000137	0.000457	180	0.00005	0.00875	0.00010	3.96	0.000025	0.0249	27.7	1.82	0.0000025	0.000142	0.0178
KV-121	Christal Seep	18-Oct-2020	0.0157	0.000050	0.000025	0.005	0.000132	0.000457	191	0.00005	0.00925	0.00010	4.18	0.000052	0.0301	28.0	1.92	0.0000025	0.000190	0.0189
KV-121	Christal Seep	11-Nov-2020	0.0230	0.000050	0.000025	0.005	0.000149	0.000457	119	0.00005	0.00330	0.00023	1.07	0.000025	0.0133	23.5	0.677	0.0000025	0.000106	0.00704
KV-121	Christal Seep	24-Mar-2021	0.0179	0.000050	0.000025	0.005	0.000139	0.000457	102	0.00005	0.00258	0.00022	1.07	0.000025	0.0123	23.3	0.541	0.0000025	0.000080	0.00544
KV-121	Christal Seep	07-May-2021	0.0950	0.000050	0.000025	0.005	0.00287J	0.000457	130	0.00025	0.00317	0.00057	1.41	0.00144	0.0135	28.9	0.67	0.0000025	0.000065	0.00681
KV-121	Christal Seep	16-Jul-2021	0.0193	0.000050	0.000025	0.005	0.000123	0.000457	99.6	0.00025	0.00414	0.00022	2.08	0.000025	0.0134	22.5	0.958	0.0000025	0.000114	0.00783
KV-121	Christal Seep	15-Oct-2021	0.00843	0.000050	0.000025	0.005	0.0000827	0.000457	224	0.00025	0.0146	0.00010	6.72	0.000025	0.0379	31.9	2.91	0.0000025	0.000159	0.0290
KV-121	Christal Seep	22-Feb-2022	0.0130	0.000050	0.000025	0.005	0.000114	0.000457	183	0.00025	0.0108	0.00021	5	0.000348	0.0260	31.1	2.27	0.0000025	0.000189	0.0209
KV-121	Christal Seep	15-May-2022	0.00943	0.000050	0.000025	0.005	0.000250	0.000457	157	0.00025	0.0109	0.00039	4.97	0.000095	0.0253	25.8	2.31	0.0000025	0.000181	0.0216
KV-121	Christal Seep	09-Jun-2022	0.0189	0.000050	0.000025	0.005	0.000112	0.000457	154	0.00025	0.0110	0.00076	5.88	0.000142	0.0221	29.1	2.39	0.0000025	0.000154	0.0193
KV-121	Christal Seep	03-Aug-2022	0.0212	0.000050	0.000025	0.005	0.000292	0.000457	154	0.00025	0.00543	0.00023	2.27	0.000025	0.0203	26.8	1.21	0.0000025	0.000152	0.0113
KV-121	Christal Seep	16-Oct-2022	0.00975	0.000050	0.000025	0.005	0.000141	0.000457	249	0.00025	0.0135	0.00010	6.1	0.000025	0.0359	33.1	2.9	0.0000025	0.000175	0.0268

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	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	CCME
			mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-121	Christal Seep	10-Feb-2019	0.025	0.40	0.000896	3.59	0.000005	1.73	0.208	88.9	0.000005	0.00005	0.00015	0.00268	0.00025	0.108	0.077	0.00015	7.35	7.09	0.98	
KV-121	Christal Seep	12-Feb-2019															0.004					
KV-121	Christal Seep	06-Mar-2019	0.025	0.45	0.000227	4.68	0.000005	1.91	0.218	129	0.000005	0.00005	0.00015	0.00125	0.00025	0.251	0.122	0.00015	9.88	9.77	0.99	
KV-121	Christal Seep	18-Apr-2019	0.025	0.41	0.000195	4.19	0.000005	1.47	0.215	123	0.000012	0.00005	0.00015	0.00110	0.00025	0.264	0.117	0.00015	9.19	9.17	1	
KV-121	Christal Seep	19-May-2019	0.025	0.48	0.000252	3.87	0.000005	2.04	0.305	157	0.000016	0.00005	0.00015	0.00258	0.00025	0.425	0.119	0.00015	12.6	13.4	1.03	
KV-121	Christal Seep	07-Jun-2019	0.025	0.39	0.000954	3.63	0.000005	2.17	0.269	118	0.000005	0.00005	0.00015	0.00371	0.00025	0.133	0.099	0.00015	10.5	9.01	0.92	
KV-121	Christal Seep	22-Jul-2019	0.025	0.39	0.000555	4.25	0.000005	1.77	0.292	173	0.000012	0.00005	0.00015	0.00339	0.00025	0.357	0.068	0.00015	13.6	12.7	0.97	
KV-121	Christal Seep	01-Aug-2019	0.025	0.40	0.000448	4.17	0.000005	1.64	0.292	173	0.000014	0.00005	0.00015	0.00279	0.00025	0.393	0.096	0.00015	14.0	13.1	0.97	
KV-121	Christal Seep	17-Sep-2019	0.025	0.31	0.000928	3.41	0.000005	1.86	0.208	78.7	0.000005	0.00005	0.00015	0.00252	0.00025	0.0732	0.062	0.00015	6.76	6.58	0.99	
KV-121	Christal Seep	04-Oct-2019	0.025	0.33	0.000025	4.67	0.000005	1.30	0.227	116	0.000005	0.00005	0.00015	0.000476	0.00025	0.212	0.107	0.00015	10.0	10.0	1	
KV-121	Christal Seep	28-Nov-2019	0.025	0.38	0.000281	4.33	0.000005	1.72	0.213	109	0.000014	0.00019	0.00015	0.00141	0.00025	0.231	0.082	0.00015	8.80	8.94	1.01	
KV-121	Christal Seep	14-Dec-2019	0.025	0.36	0.000687	3.65	0.000005	1.92	0.204	88.0	0.000005	0.00005	0.00015	0.00223	0.00025	0.165	0.047	0.00015	7.75	8.18	1.03	
KV-121	Christal Seep	31-Jan-2020															0.002					
KV-121	Christal Seep	15-Feb-2020	0.025	0.42	0.000173	3.87	0.000005	2.23	0.228	121	0.000016	0.00005	0.00015	0.00224	0.00025	0.338	0.049	0.00015	10.1	10.1	1	
KV-121	Christal Seep	18-Mar-2020	0.025	0.38	0.000169	3.76	0.000005	2.17	0.239	127	0.000013	0.00005	0.00015	0.00203	0.00025	0.31	0.111	0.00015	10.2	10.6	1.02	
KV-121	Christal Seep	17-Apr-2020	0.025	0.40	0.000153	3.80	0.000005	2.05	0.212	122	0.000014	0.00013	0.00015	0.00199	0.00025	0.332	0.078	0.00015	10.6	9.98	0.97	
KV-121	Christal Seep	07-May-2020	0.025	1.24	0.000185	1.63	0.000027	1.36	0.0740	38.9	0.000005	0.00005	0.00015	0.000474	0.00025	0.547	0.127	0.00015	3.23	3.09	0.98	
KV-121	Christal Seep	07-Jun-2020	0.025	0.409	0.000410	4.10	0.000005	1.92	0.272	159	0.000010	0.00005	0.00015	0.00242	0.00025	0.333	0.084	0.00015	12.0	11.6	1.02	
KV-121	Christal Seep	11-Jul-2020	0.025	0.365	0.000456	4.05	0.000005	1.81	0.275	167	0.000014	0.00005	0.00015	0.00321	0.00025	0.391	0.315	0.00015	13.1	12.3	1.03	
KV-121	Christal Seep	12-Aug-2020	0.025	0.497	0.00142	4.14	0.000005	2.23	0.278	139	0.000010	0.00005	0.00015	0.00513	0.00025	0.264	0.081	0.00015	12.5	10.4	1.09	
KV-121	Christal Seep	23-Sep-2020	0.025	0.401	0.000521	3.93	0.000005	1.93	0.274	140	0.000014	0.00005	0.00015	0.00442	0.00025	0.373	0.118	0.00015	11.4	11.8	1.02	
KV-121	Christal Seep	18-Oct-2020	0.025	0.441	0.000557	4.19	0.000005	1.86	0.303	154	0.000017	0.00005	0.00015	0.00472	0.00025	0.407	0.128	0.00015	12.0	12.2	1.01	
KV-121	Christal Seep	11-Nov-2020	0.025	0.414	0.00160	3.67	0.000005	2.23	0.245	92.4	0.000005	0.00005	0.00015	0.00490	0.00025	0.159	0.120	0.00015	7.91	8.03	1.01	
KV-121	Christal Seep	24-Mar-2021	0.025	0.412	0.00105	3.59	0.000005	2.78	0.207	80.4	0.000005	0.00005	0.00015	0.00289	0.00025	0.134	0.101	0.00015	7.48	7.20	1.02	
KV-121	Christal Seep	07-May-2021	0.025	2.77	0.000132	3.42	0.000005	9.61	0.242	137	0.000005	0.00005	0.00015	0.000764	0.00025	0.643	0.272	0.00015	9.45	9.45	0.005	
KV-121	Christal Seep	16-Jul-2021	0.025	0.381	0.000770	4.05	0.000005	1.77	0.196	86.9	0.000012	0.00005	0.00015	0.00266	0.00025	0.165	0.070	0.00015	7.90	7.02	1.06	
KV-121	Christal Seep	15-Oct-2021	0.025	0.434	0.000025	4.83	0.000005	1.62	0.318	195	0.000022	0.00005	0.00015	0.00257	0.00025	0.647	0.106	0.00015	14.6	14.2	1.01	
KV-121	Christal Seep	22-Feb-2022	0.025	0.481	0.000287	4.95	0.000005	2.13	0.266	151	0.000019	0.00005	0.00015	0.00305	0.00025	0.436	0.103	0.00015	11.3	12.1	1.03	
KV-121	Christal Seep	15-May-2022	0.025	0.578	0.000109	3.71	0.000005	1.63	0.226	124	0.000017	0.00005	0.00015	0.00186	0.00025	0.49	0.271	0.00015	9.18	10.3	1.06	
KV-121	Christal Seep	09-Jun-2022	0.025	0.464	0.000178	5.01	0.000005	1.88	0.282	138	0.000025	0.00005	0.00015	0.00312	0.00025	0.385	0.134	0.00015	5.97	10.5	1.28	
KV-121	Christal Seep	03-Aug-2022	0.025	0.366	0.000558	4.29	0.000005	2.04	0.268	123	0.000005	0.00005	0.00015	0.00449	0.00025	0.253	0.107	0.00015	10.8	10.1	1.03	
KV-121	Christal Seep	16-Oct-2022	0.025	0.420	0.000153	4.43	0.000005	1.70	0.327	179	0.000019	0.00005	0.00015	0.00291	0.00025	0.589	0.040	0.00015	14.3	15.6	1.04	

Christal Creek Attenuation Study, 2008 to 2022 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
				L/s	m	mg/L	pH units	pH units	µS/cm	µS/cm	C	mg/L	%	mV	mg/L	mg/L	mg/L
CCME-Aquatic (C)							6.5-9	6.5-9				6.5					
BC-MOE-Max Aquatic Life (J)																	
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021		8.98			9.19C		1832		1.4						
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021		8.53		11.7	9.27C	7.72	1815	1340	2.5				712	679	33.0
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021		5.23		2.6	9.32C	7.95	1133	1160	3.1				601	600	34.4

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Bromide	Chloride	Fluoride	Sulphate, dissolved	Calculated SO4-D BC-MOE	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 (d), total	Calculated Cd-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				120	0.12			*		0.06	3.0			*			0.005				1.5	*	
BC-MOE-Max Aquatic Life (J)						*										0.009							
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021					128		0.125						0.1								NoHardness
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021	0.125	33.7	0.050	662	429	2.51C	0.0983	0.212C	3.61C		2.54	0.0071	0.1	0.0102J	0.0117	0.0215	0.000050	0.000025	0.034	0.000221	0.00037
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021	0.125	6.99	0.050	580	429	3.25C	0.0858	0.277C	4.94C		1.59	0.0153	0.1	0.0107J	0.013	0.0138	0.000050	0.000025	0.040	0.000164	0.00037

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Calcium (Ca), total	Chromium (Cr), total	Cobalt (Co), total	Copper (Cu), total	Calculated Cu-T CCME PAL	Iron (Fe), total	Lead (Pb), total	Calculated Pb-T CCME PAL	Calculated Pb-T BC-MOE	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Calculated Mn-T BC-MOE	Mercury (Hg), total	Molybdenum (Mo), total	Nickel (Ni), total	Calculated Ni-T CCME PAL
			mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)				0.001		*		0.3	*							0.000026	0.073	*	
BC-MOE-Max Aquatic Life (J)					0.004			1.0	*					*					
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021					NoHardness			NoHardness	NoHardness				NoHardness				NoHardness
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021	194	0.00620C	0.00044	0.00102	0.004	0.010	0.00625	0.007	0.0420	0.0176	55.3	0.131	8.4	0.0000025	0.00681	0.00407	0.15
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021	164	0.00216C	0.00022	0.00025	0.004	0.020	0.00560	0.007	0.0345	0.0184	46.5	0.0488	7.2	0.0000025	0.00420	0.00288	0.15

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

			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	Calculated Zn-T BC-MOE	Zirconium (Zr), total	Aluminum (Al), dissolved	Antimony (Sb), dissolved	Arsenic (As), dissolved
Station	**Description**	**Sample Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	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 (C)					0.001		0.00025				0.0008			0.015							
BC-MOE-Max Aquatic Life (J)					0.002											*					
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021															NoHardness				
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021	0.025	4.85	0.000356	5.80	0.000017	26.9	0.692	252	0.000057	0.00005	0.00030	0.00872	0.00220	0.0133	0.474	0.00010	0.0026	0.0106	0.0115
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021	0.025	3.03	0.000320	5.85	0.000016	10.9	0.597	200	0.000054	0.00005	0.00015	0.00857	0.00205	0.0094	0.391	0.00010	0.0048	0.0105	0.0128

Christal Creek Attenuation Study, 2008 to 2022 Water Quality

Station	Description	Sample Date	Barium (Ba), dissolved	Beryllium (Be), dissolved	Bismuth (Bi), dissolved	Boron (B), dissolved	Cadmium (Cd), dissolved	Calculated Cd-D BC-MOE	Calcium (Ca), dissolved	Chromium (Cr), dissolved	Cobalt (Co), dissolved	Copper (Cu), dissolved	Iron (Fe), dissolved	Lead (Pb), dissolved	Lithium (Li), dissolved	Magnesium (Mg), dissolved	Manganese (Mn), dissolved	Mercury (Hg), dissolved	Molybdenum (Mo), dissolved	Nickel (Ni), 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
CCME-Aquatic (C)																	0.43			
BC-MOE-Max Aquatic Life (J)							*						0.35							
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021						NoHardness												
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021	0.0220	0.000050	0.000025	0.030	0.000133	0.000457	182	0.00597	0.00040	0.00075	0.011	0.00472	0.0182	54.6	0.118	0.0000025	0.00684	0.00378
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021	0.0135	0.000050	0.000025	0.039	0.000152	0.000457	163	0.00216	0.00021	0.00039	0.005	0.00335	0.0184	46.8	0.0483	0.0000025	0.00398	0.00289

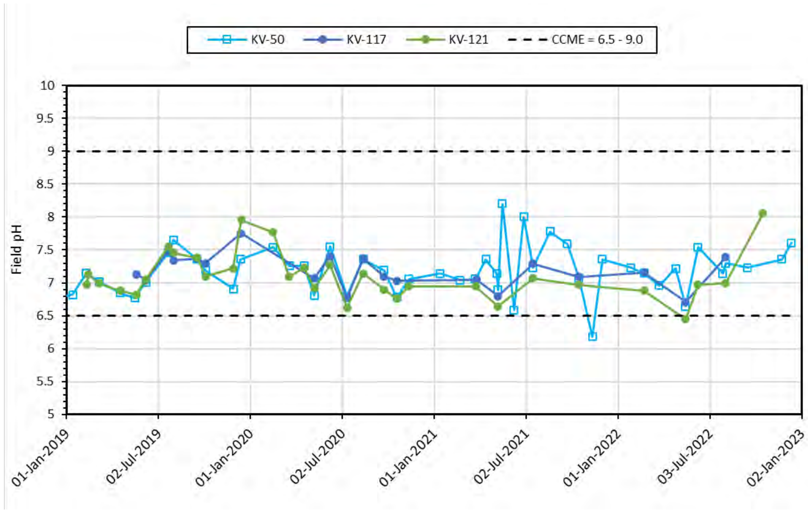
Christal Creek Attenuation Study, 2008 to 2022 Water Quality

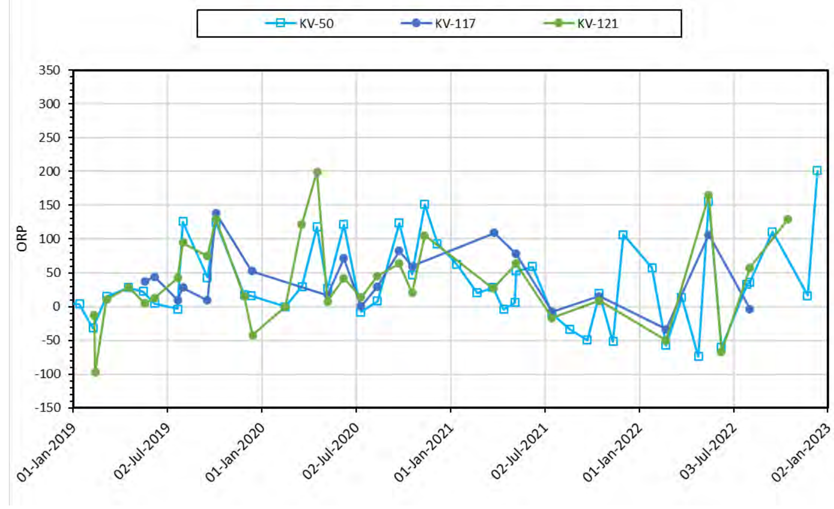
			Phosphorus (P), dissolved	Potassium (K), dissolved	Selenium (Se), dissolved	Silicon (Si), dissolved	Silver (Ag), dissolved	Sodium (Na), dissolved	Strontium (Sr), dissolved	Sulphur (S), dissolved	Thallium (Tl), dissolved	Tin (Sn), dissolved	Titanium (Ti), dissolved	Uranium (U), dissolved	Vanadium (V), dissolved	Zinc (Zn), dissolved	Calculated Zn-D CCME PAL	Zirconium (Zr), dissolved	Total Anion Sum	Total Cation Sum	Ion Balance	CCME
Station	**Description**	**Sample Date**	mg/L	mg/L	mg/L	mg/L	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 (C)																*						
BC-MOE-Max Aquatic Life (J)																						
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	02-May-2021															0.002					
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	03-May-2021	0.025	4.91	0.000320	5.57	0.000005	27.2	0.627	233	0.000060	0.00005	0.00015	0.00798	0.00200	0.0085	0.057	0.00015	15.7	15.1	1.02	
KV-104C	Flame and Moth Effluent Discharged to Christal Creek	16-May-2021	0.025	3.12	0.000314	5.70	0.000005	10.8	0.593	194	0.000053	0.00005	0.00015	0.00861	0.00195	0.0078	0.047	0.00015	13.3	12.8	1.02	

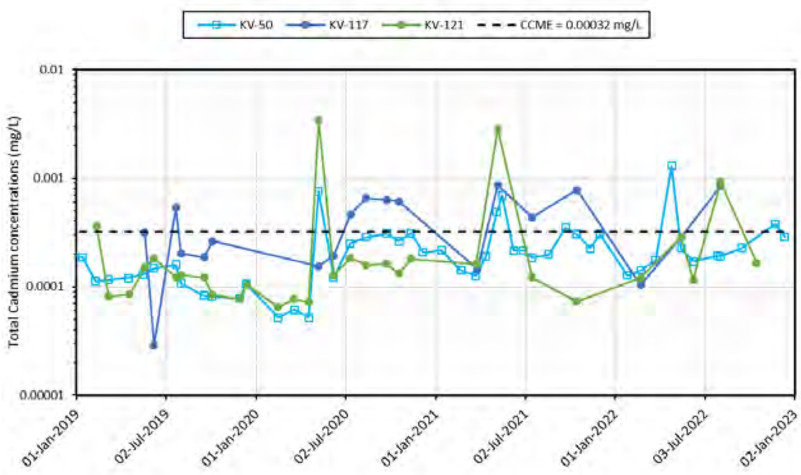
APPENDIX C:

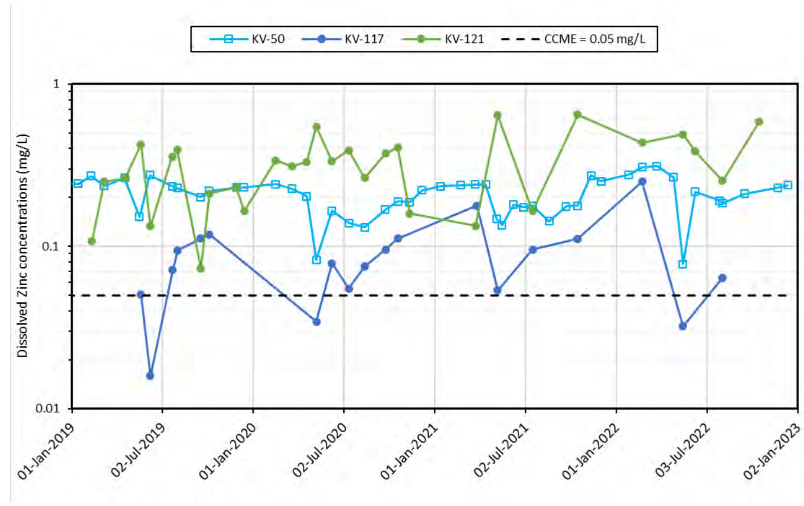
WATER QUALITY COMPARATIVE PLOTS

Plots of KV-117, KV-121 and KV-50

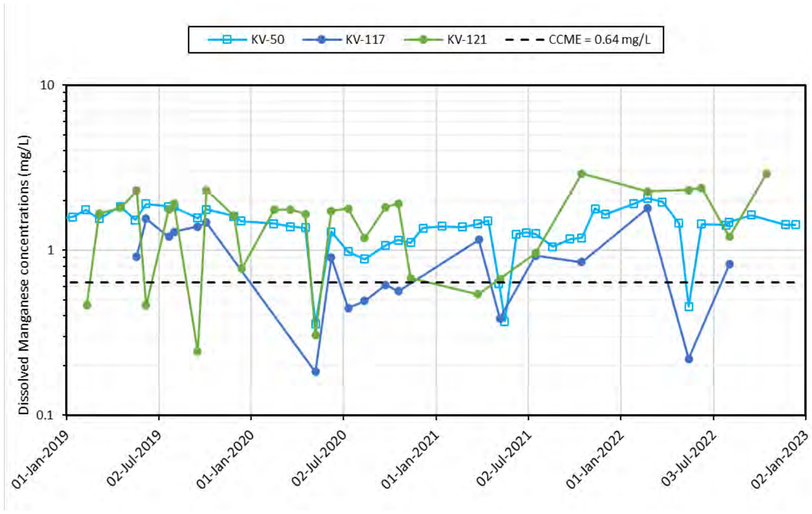


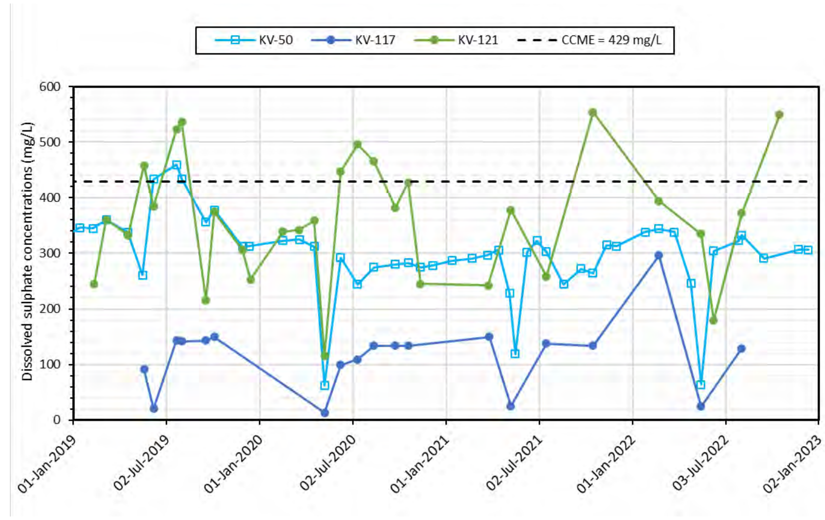


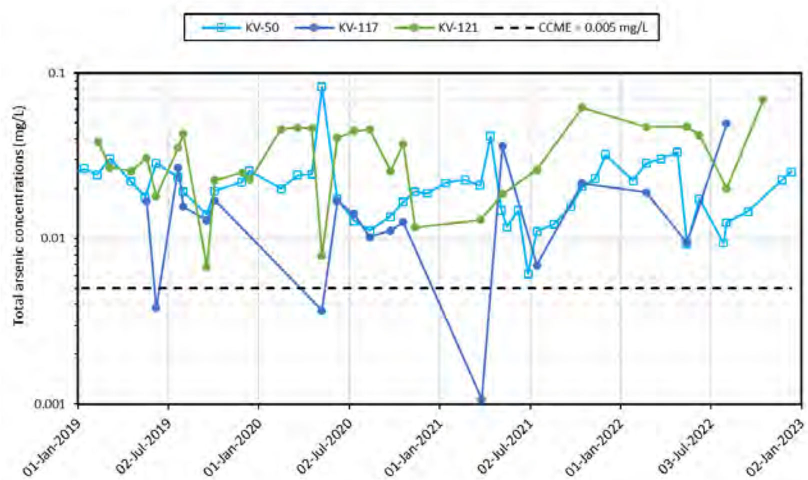


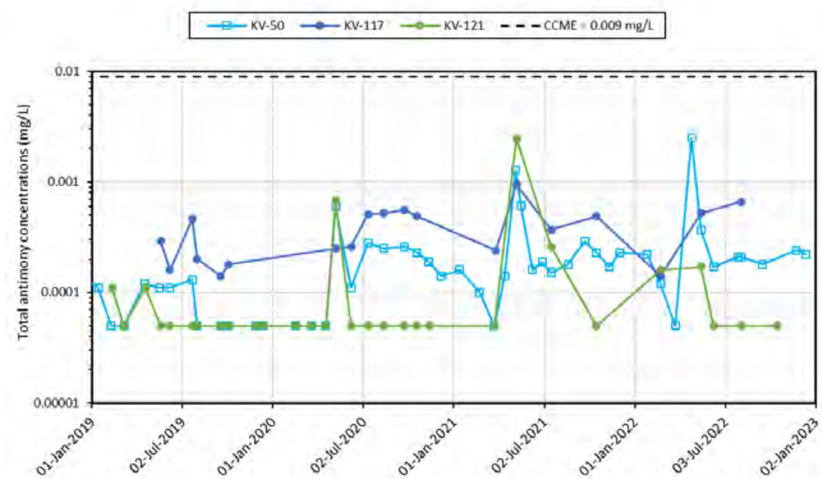


Plots of KV-117, KV-121 and KV-50

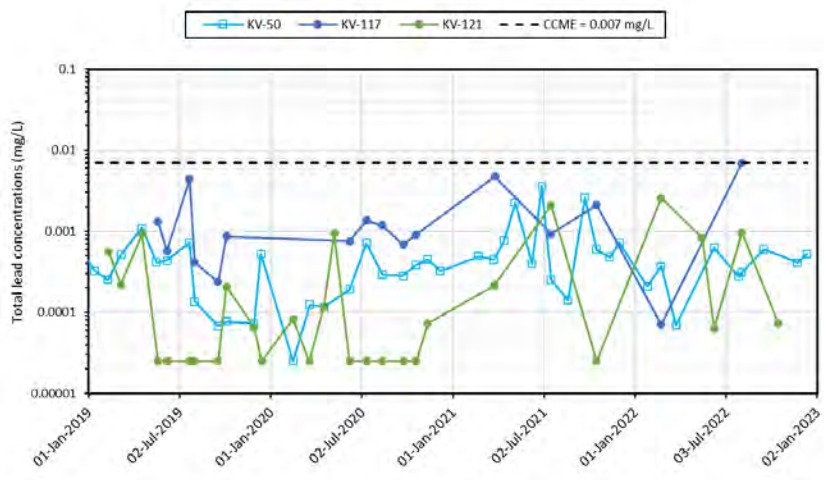


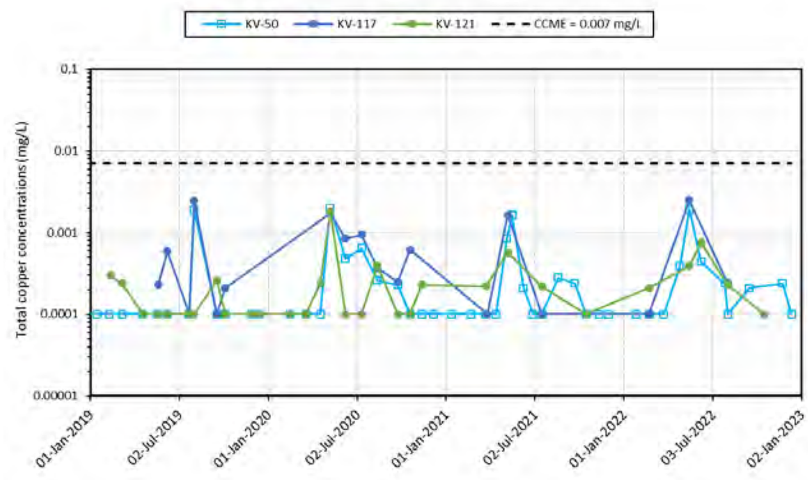


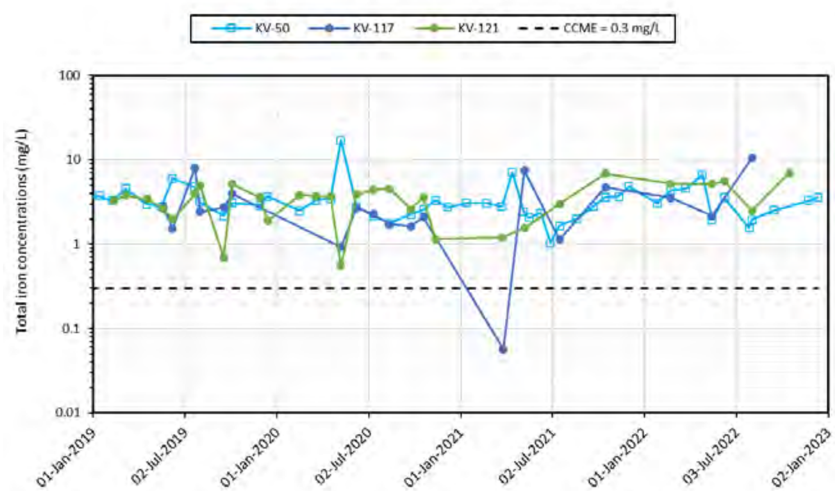




Plots of KV-117, KV-121 and KV-50







Appendix 2

Supporting Environmental Data

KENO HILL SILVER DISTRICT
QML-0009 SITE CHARACTERIZATION REPORT

FINAL REPORT

Prepared for:

ALEXCO KENO HILL MINING CORP.

Date:

February 28, 2023

ENSERO solutions

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

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 QML-0009 Site Characterization Report issued March 31, 2020. All Project areas are in the Traditional Territory of the First Nation of Na-cho Nyak Dun (FNNND).

The KHSD has a long mining history and is a brownfields site. AKHM develops the mineral resources, operates the KHSD mines and undertakes receiving environmental monitoring and treatment of mine discharge waters. Hecla Yukon's wholly owned subsidiary Elsa Reclamation and Development Company Ltd. (ERDC) undertakes care and maintenance, environmental monitoring and water treatment of historic adit drainages, district-wide closure planning, studies, and remediation of the historic environmental liabilities.

1.1 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. 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). These three prominent hills lie to the south of the broad McQuesten River valley. The New Bermingham mine is located on Galena Hill. The Lucky Queen and Onek 990 mines are located on Keno Hill, while the Bellekeno mine is located on Sourdough Hill. The Flame & Moth mine and the District Mill are located at the base of the three hills.

1.2 PERMITTING CONDITIONS

Currently licenced mines under the Quart Mining License (QML-0009) include the Bellekeno deposit, Dry Stack Tailings Facility (DSTF) phase 1, and District Mill operation (Type A Water Licence QZ09-092), the Onek 990 and Lucky Queen mines (Water Licence amendment QZ12-053), the Flame & Moth mine and the DSTF expansion (phase 2) (Water Licence amendment QZ09-092-2) and the New Bermingham mine (Water Licence renewal QZ18-044) (Table 1-1). The Onek 990 and Lucky Queen mines are excluded from the current reporting Water Licence, QZ18-044. The Type B Water Licence (QZ17-076, renewal of QZ17-084) was issued for the purpose of care and maintenance activities for the Keno Hill Silver District. Monitoring locations under both the Type A and Type B Water Licence are included in this report.

Table 1-1: Keno Hill Silver District Mining Operations Permitting Timeline

Mine	Date
Bellekeno	2009
District Mill and DSTF	2009
Onek	2013
Lucky Queen	2013
Flame & Moth	2016
New Bermingham	2019

1.3 KENO HILL SILVER DISTRICT MINING OPERATIONS

A summary of KHSD mining operations is provided in Table 1-2.

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

Mines / Ore Deposits	Bellekeno (Production 2010 – 2013, suspended 2013 – 2020, production resumed in Q4 of 2020, temporary closure December 15 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 location at Flame & Moth Mine area (Constructed 2010, operated 2010 – 2013, suspended 2013 – 2020, operated December 2020 – 2022, suspended 2022) Tailings placed in Dry Stack Tailings Facility (Established 2010, no deposition of tails during suspension of mill operations)

1.4 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.

1.4.1 MINE INFRASTRUCTURE

In 2022, the Flame & Moth ventilation raise was completed.

Surface construction activities at New Bermingham included the continued deposition of N-AML waste rock in the destinated disposal area adjacent the portal.

1.4.2 ROAD CONSTRUCTION

Christal Lake Road was resurfaced in 2022. No major upgrades occurred on the roads to New Bermingham, Lucky Queen, or the Lightning Creek Bypass, or the Bellekeno Haul Road in 2022. Standard maintenance occurred throughout the year.

1.4.3 MILL SITE CONSTRUCTION

In 2022, a tress and an earthen mound located between the District Mill, Mobile Maintenance Shop, and the Flame & Moth Portal was removed. The soil was utilized to resurface the Christal Lake Road and District Mill parking areas.

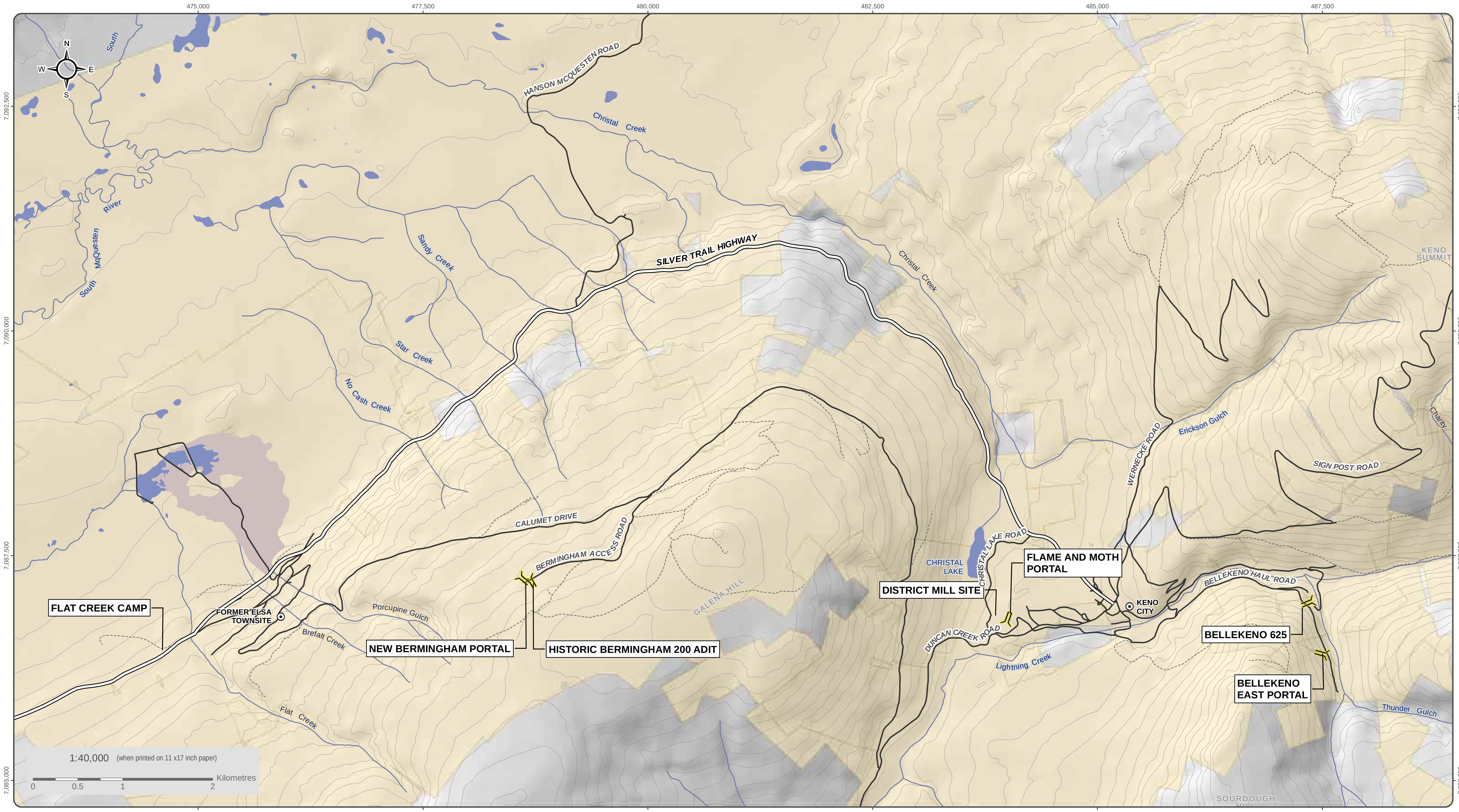
Ditches and culverts at the mill yard continued to be maintained to facilitate channeling melt water in the spring and storm events into to sediment basins. Organics from the removal of the earthen mound were used on the DSTF or stockpiled.

1.4.4 DRY STACK TAILINGS FACILITY

In 2022, the footprint for Phase 1 DSTF was expanded by removing trees and overburden. Liner was laid for additional tailings placement in accordance with the phase 1 DSTF design. Maintenance of the ditches and sumps were made. Additional maintenance activities were completed in response to recommendations from the annual geotechnical inspection.

1.4.5 FLAT CREEK (ELSA) CAMP UPGRADES

In 2022, upgrades included: the installation of additional boardwalks and the construction of a smoking shelter.



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

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

HECLA KENO HILL

FIGURE 1-1

KENO HILL SILVER DISTRICT MINING OPERATIONS OVERVIEW

NOVEMBER 2022

D:\Project\AllProjects\Keno_Area_Mines\ALL-SITES\02-Map\01_Overview\01-Property Overview\01-District_Wide\Overview_20221115.mxd
(*Last edited by: fsparling;11/22/2022/10:33 AM*)

2 GEOLOGY AND SOILS

The KHSD has been subject to numerous faulting and folding events that have shaped the district's geology and mineralogy, and therefore 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 KHSD originates from infiltrated meteoric water, which migrates within unconsolidated glacial deposits and through fractures in metamorphic rocks (SRK, 2014).

2.1 REGIONAL DESCRIPTION

The KHSD is located within the northwestern part of the Selwyn Basin, in an area characterized by the Robert Service and Tombstone Thrust Sheets that are overlapping and trend northwest. This area is underlain by Upper Proterozoic to Mississippian sedimentary rocks deposited in a shelf environment during the formation of the northern Cordilleran continental margin. The KHSD geology is dominated by the Mississippian Keno Hill Quartzite comprising the Basal Quartzite Member and conformably overlying Sourdough Hill Member. The unit is overthrust in the south by the Upper Proterozoic Hyland Group Yusezyu Formation and is conformably underlain in the north by the Devonian Earn Group (McOnie and Read, 2009). The area underwent regional compressive tectonic stresses during the Jurassic and the Cretaceous, producing thrusts, folds and penetrative fabrics of various scales.

The Yusezyu Formation of the Precambrian Hyland Group comprises greenish quartz-rich chlorite-muscovite schist with locally clear and blue quartz-grain gritty schist and is separated from the Keno Hill sequence by the regionally extensive Robert Service Thrust Fault that occurs immediately south of the area. The Tombstone Thrust Sheet that lies to the north.

2.2 PROPERTY GEOLOGY

The Earn Group, formerly mapped as the "lower schist formation" (Boyle, 1965), is typically composed of recessive weathering grey graphitic schist and green chlorite-sericite schist with an upper siliceous graphitic schist found locally.

Within the Keno Hill Quartzite Formation, the Basal Quartzite Member that is the dominant host to the silver mineralization, comprises commonly calcareous, thick to thin-bedded quartzite and graphitic schist and may be up to approximately 1,100 m thick where structurally thickened. The overlying Sourdough Hill Member, formerly mapped as the "upper schist formation" (Boyle, 1965), is up to approximately 900 m in thickness and comprises predominantly graphitic and sericitic schist, chloritic quartz augen schist some of which may be of volcanogenic origin, and minor thin bedded limestone. The geology of the KHSD is shown in Figure 2-1.

The Earn Group and Keno Hill Quartzite are locally intruded by stratigraphically conformable, although lensoidal, Middle Triassic greenstone sills, for which any feeder dykes are unrecognizable. The sequence was metamorphosed to greenschist facies assemblages during Cretaceous regional deformation at about 100 My, and subsequently intruded by aplite sills or dikes considered to be related to the Tombstone intrusive suite.

Three phases of folding are identified with the two earliest phases consisting of isoclinal folding with subhorizontal, east or west trending fold axes, the axial plane forming the dominant regional foliation. The later fold phase displays subvertical axial planes and moderate southeast-trending and plunging fold axes. The first phases of folding formed structurally dismembered isoclinal folds of which the Basal Quartzite Member outlines synforms at Monument Hill where the Lucky Queen mine is located and at Caribou Hill, while between Galena Hill and Sourdough Hill the Bellekeno, Flame & Moth, and New Bermingham mines are located on the upper limb of a large-scale anticline that closes to the north.

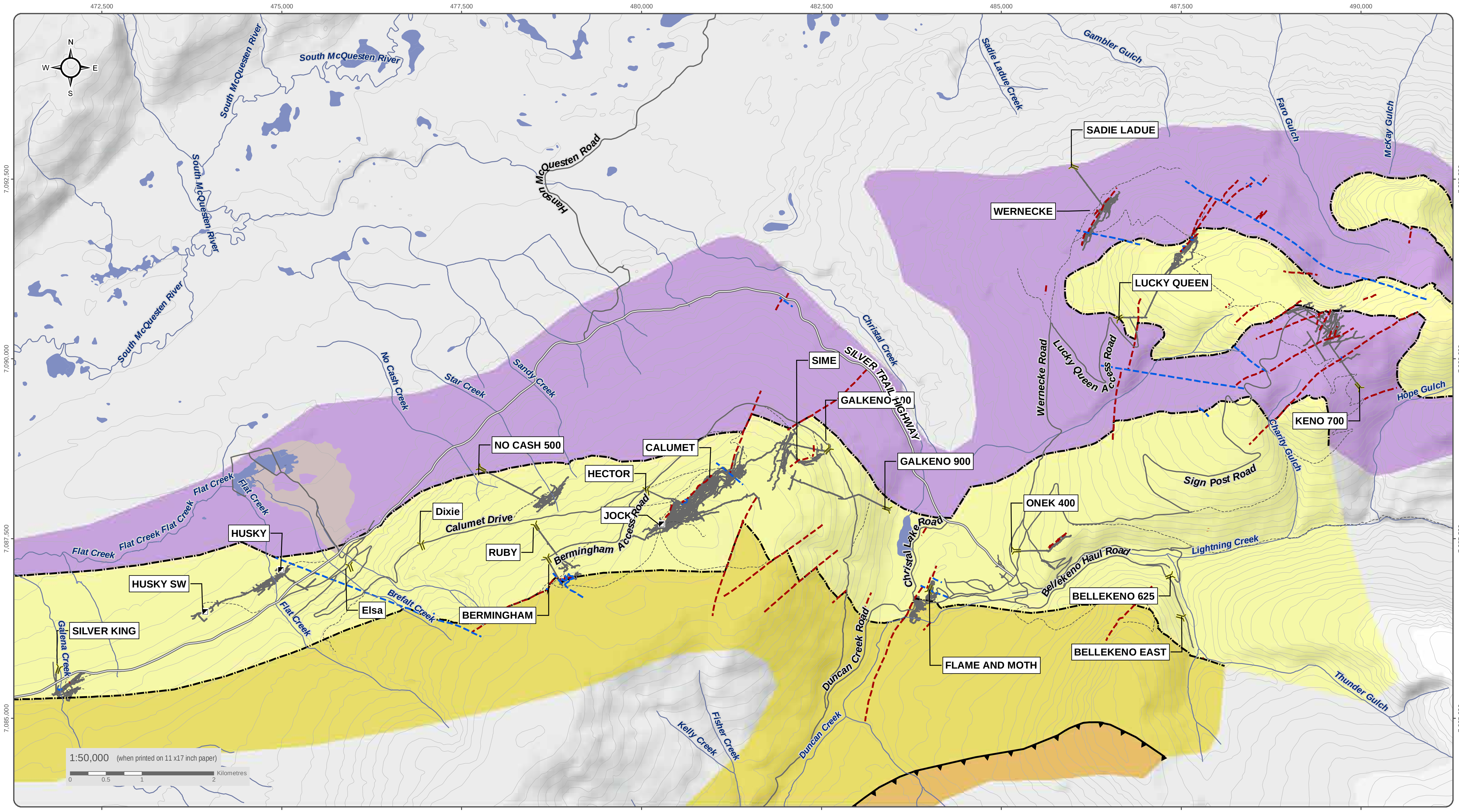
Up to four main periods of faulting are recognized with the oldest fault set consisting of south dipping foliation parallel structures that developed contemporaneously with the first phases of folding, sometimes shown as "low angle bedding faults". The Robert Service Thrust Fault truncates the top of the Keno Hill Quartzite Formation and sets the Precambrian schist of the Yusezyu Formation above the Mississippian Sourdough Hill Member. The silver mineralization in the KHSD is hosted by a series of northeast oriented, southeasterly dipping veins formed in pre- and synmineral faults referred to as vein-faults (Boyle, 1965) that display left lateral normal oblique displacement. There are two related sets locally recognized as either a more easterly trending "longitudinal" vein set that, depending on the competency of the host rock, can form up to a 30 m wide zone of anastomosing subparallel veins, or a more northerly trending "transverse" vein set that can reach up to 5 m in thickness.

The mineralized vein-faults are commonly offset by northwest striking, steeply southwest dipping, post-mineral cross faults, that display right lateral normal oblique displacement.

Mineralization is of the polymetallic silver-lead-zinc vein type that typically exhibits a succession of hydrothermally precipitated minerals from the vein wall towards the vein centre. However, in the KHSD, multiple pulses of hydrothermal fluids or fluid boiling, probably related to repeated reactivation and breccia formation along the host fault structures, have formed a series of vein stages with differing mineral assemblages and textures. Supergene alteration may have further changed the nature of the mineralogy in the veins. Much of the supergene zone may have been removed due to glacial erosion.

In general, common gangue minerals include (manganiferous) siderite and, to a lesser extent, quartz and calcite. Silver predominantly occurs in argentiferous galena and argentiferous tetrahedrite (freibergite). In some assemblages, silver is also found as native silver, in polybasite, stephanite, and pyrargyrite. Lead occurs in galena and zinc in sphalerite, which at the KHSD can be either an iron-rich or iron-poor variety. Other sulphides include pyrite, pyrrhotite, arsenopyrite, and chalcopyrite.

The Keno Hill mining camp has long been recognized as a polymetallic silver-lead-zinc vein district with characteristics possibly similar to other well-known mining districts in the world. The largest accumulation of minerals of economic interest occurs in areas of increased hydrothermal fluid flow in structurally prepared competent rocks such as the Basal Quartzite Member and Triassic Greenstone. Incompetent rocks like phyllites tend to produce fewer and smaller (if any) open spaces, limiting fluid flow and resulting mineral precipitation.



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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 2-1
KHSD GEOLOGICAL FORMATIONS AND FAULTS

FEBRUARY 2023

2.3 PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The KHSD lies within the northeastern part of the Yukon Plateau, and is characterised by mountainous terrain, with elevations that range from 610 masl (metres above sea level) (McQuesten River valley) to 1,848 masl (Summit of Keno Hill). The KHSD has been shaped by several glacial advances, notably the McConnell glaciation (approximately twenty thousand years ago (Ka)) and the Reid glaciation (approximately 200 Ka-300 Ka) (Lipovsky et al., 2001). The Reid glaciation almost completely covered the KHSD, with the exception of the peaks of Keno Hill, while the McConnell glaciation was not as extensive, with the peak extent of glaciation reaching an approximate elevation of 1,100 masl. There is less evidence of the Reid glaciation 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. The valleys are broad, glacially scoured and typically boggy with thick peat deposits. The lower slopes of Galena and Keno Hills have a variety of sand, gravel, and silt deposits, including kames and terraces, that were deposited off 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 through the KHSD are striated with lenses dominated by gravel or sand within a silt matrix. These were used during construction and mining as foundation and road material and are considered good borrow sources for covers and other reclamation activities. Keno City is underlain by 85 m of sand and gravel. At higher elevations, above the last glaciated extents, are thin layers of colluviated sediments and soils with exposed bedrock along ridge-tops, gulches, and cirques (LeBarge et al., 2002). Freeze-thaw cycles for over 300,000 years have created frost-shattered bedrock boulder fields running down the higher elevation hillsides of Keno and Galena hills. A map of the surficial geology of the KHSD is provided on Figure 2-2.

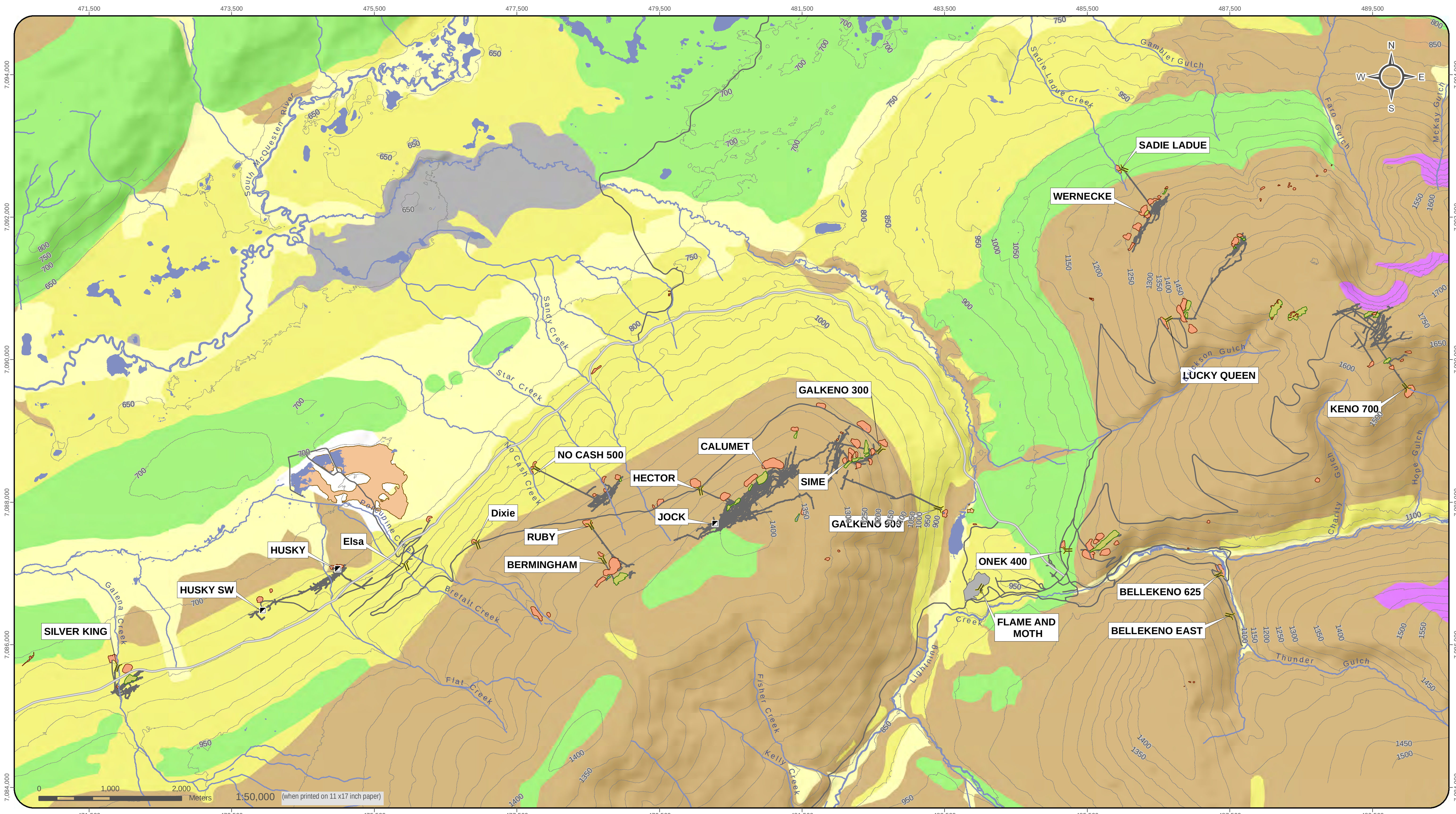
Galena Hill trends northeast between Duncan Creek and the McQuesten River valley. It has an elevation of 1444 masl, a moderately steep southwestern slope, and steeper north, northwestern, and southeastern slopes. The terrain above 1310 masl is relatively flat and rolling, and marked by several level grassy meadows. The north, northwestern, and southeastern slopes of the hill 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. Keno Hill trends northeast and lies between the Keno Ladue-McQuesten River valley and Allen, Faith, Lightning, and Christal Creeks. The hill has relatively gentle southern and southeastern slopes and a precipitous northern slope, marked by two cirques, Faro Gulch and Silver Basin Gulch. The terrain above 1372 masl is relatively flat and rolling with five prominent rocky knolls known as Keno, Minto, Monument (the highest point on Keno Hill, elevation 1848masl), Caribou, and Beauvette. On the slopes of the hill several streams follow steep gulches in the rock strata, the principal ones being Gambler, Faro, McKay, and Silver Basin on the northern slope, Faith, Hope, and Charity on the northeastern and southern slopes, and Erickson on the western slope.

Sourdough Hill lies southwest of Keno Hill and trends north between Thunder, Lightning, and Duncan Creeks. The part of the hill described in this report is on the northern and northwestern slopes, which are gentle up to 1280m and from there rise abruptly to a steep rocky hogsback that trends southwest for some 1828 masl.

Extensive rock outcrops are uncommon on Galena, Keno, and Sourdough hills, and with the exception of the gulches and cirques where relatively good geological sections are present, detailed mapping can only be done by observing float. Below an elevation of 1341 masl rock outcrops are sparse, and the slopes are covered with till, soil, rock debris, much, and muskeg, in which conifers, birch, aspen, Arctic black-birch, and other vegetation grow abundantly. Above this elevation the soil is thin, outcrops are more numerous, the ground is covered with local rock float, the terrain is treeless, and the vegetation is limited to alpine species and grassy meadows.

The lower slopes of the hills were severely glaciated during Pleistocene time 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 of the hills and floor the valleys. The deposits in the KHSD are generally 1.5 to 6m thick, but in some areas as on the southern slope of Keno Hill facing Lightning Creek and north of Christal Lake, they are 9 to 15 m thick or more.



Anthropogenic	Adit	Watercourse
Colluvium	Shaft	Waterbody
Fluvial (Active)	Underground Workings	District Mill
Fluvial (Glacial)	Silver Trail Highway	Open Pit
Morainal	Secondary Road	Waste Rock Dump
Organic	Contours (50 meter)	Tailings
Bedrock		

* Only showing mine sites referenced in document

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

Hecla KENO HILL

ENSERO solutions

KENO HILL SILVER DISTRICT
CHARACTERIZATION REPORT

FIGURE 2-2
KHSD SURFICIAL GEOLOGY

APRIL 2016

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2.4 PERMAFROST

The KHSD area is in the region of discontinuous permanently frozen ground. The permafrost is irregularly distributed, and its occurrence is dependent upon the elevation, hillside exposure, depth of overburden, 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.

On Keno Hill, the mine workings on the top of the hill and on the northern slope encountered permafrost some 120 m below the surface. On the northern slopes of Sourdough Hill and Galena Hill a similar situation prevails, and frost and ice lenses have been encountered at depths of 76 m or more in the mine workings. On the lower southern slope of Keno Hill, however, the workings of the Onek and Keno 700 mines show little evidence of permafrost. In places where surface and underground water are flowing the permafrost has been thawed out and frost-free windows and strips are present. These provide access and egress for waters that are oxidizing the lodes.

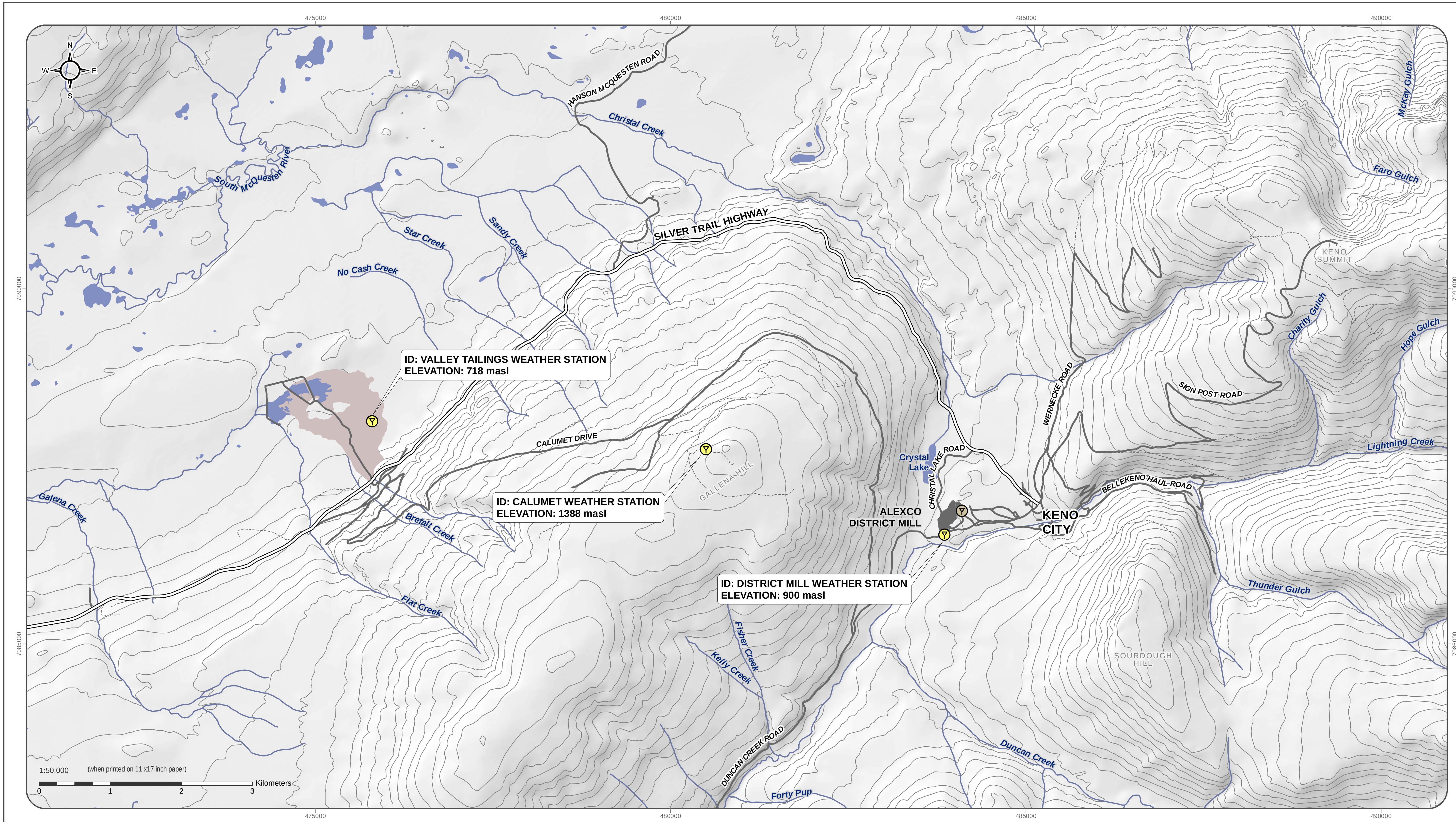
The effects of frost action, soil creep, and slope wash are marked on the hills, particularly at the higher elevations. Frost action is responsible for features such as stone rings and stripes, and produces a general ‘boiling action’ that brings rock float, mineralized float, and soil from deeper layers to the surface, thus facilitating the mapping of both the underlying bedrock and the tracing of vein faults. On steep slopes, however, frost action and land creep have transported float downhill places, 30m or more, making the accurate mapping of contacts and vein faults difficult.

3 CLIMATE, AIR QUALITY, AND NOISE

The KHSD falls within the subarctic clime 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. The wet season occurs in summer/fall with dryer winters. The District Mill sits at 913 masl and typically gets more precipitation than Mayo. The 1991-2020 Canadian Climate Normals had not been published at the time of the report.

3.1 METEOROLOGICAL STATIONS

This section describes the meteorological data collected for the KHSD area since 2007 at the Calumet meteorological station on Galena Hill, since 2011 at the District Mill meteorological station, and since 2012 at the Valley Tailings meteorological station. The location for the District Mill weather was changed in 2022 and it is now located adjacent the Duncan Creek Road at the Flame & Moth mine vent raise. The District Mill meteorological station was previously located within the DSTF phase 1 footprint. The locations of the three weather stations are shown on Figure 3-1. A summary of the climate information available is presented in the following sections.



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

- Weather Station
- Weather Station, Discontinued
- Tailings Area
- Waterbody
- Watercourse
- Mill Site Footprint
- Silver Trail Highway
- Road
- Limited-Use Road
- Contours (100 ft)

Hecla KENO HILL

ELSA RECLAMATION AND DEVELOPMENT COMPANY

FIGURE 3-1

KENO METEOROLOGICAL STATIONS

FEBRUARY 2023

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3.1.1 CALUMET WEATHER STATION

This station is an automated Onset HOBO meteorological station installed on Galena Hill at 1380 masl in June 2007 (UTM coordinates: 08 V 480377 7087790). Table 3-1 provides a list of the station's complete component list.

Table 3-1: Calumet HOBO Meteorological Station

Component	Model	Serial Number
Datalogger	HOBO Weather Logger	1153440
Temp & RH Sensor	S-THB-XXXX	10064003
Soil Temp 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
BP 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 3-2 and Table 3-3, respectively below.

Table 3-2: Monthly Values for Average Temperature Collected at the Calumet Station (2007-2012)

Month	Average Temperature (°C)															
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
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]*
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
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
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
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
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
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
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
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
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
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
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

Notes:

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.

Table 3-3: Monthly Values for Total Rainfall Collected at the Calumet Station (2007-2022)

Month	Total Rainfall (mm)															
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
January	-	-	-	-	-	-	-	[7]	0	*0.01*[9]	*0.02*[11]	5.1	[13]	[15]	[16]	*0.0*[17]
February	-	-	-	-	1.8[4]	[5]	-	-	0.2	0.3	[11]	0.3	[13]	[15]	[16]	1.0
March	-	-	-	-	0.5[4]	[5]	0.6	-	2.8	2.8	*0.8*[11]	1.3	[13]	*0*[15]	[16]	2.2
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
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
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
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
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
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
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
November	-	-	-	-	-	0.2	-	0.2	[9]	0	0	3.3	[15]	[16]	[17]	0.0
December	-	-	-	-	-	-	*0.1*[7]	-	[9]	0	0	*0.5*[13]	[15]	[16]	[17]	0.0
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**

Notes:

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.

3.1.2 DISTRICT MILL WEATHER STATION

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 phase 1 of the DSTF footprint. All the District Mill meteorological station components are present in Table 3-4.

Table 3-4: District Mill Campbell Scientific Meteorological Station

Component	Model	Serial Number
Air Temperature and Relative Humidity Sensor	HMP45C212	n/a
Tipping Bucket Rain Gauge	TE525M	45303-910
Wind Speed and Direction Sensor	05103AP-10-L	WM105907
Solar Panel	SX320J	T21008289B30EC8
Datalogger	CR800	16119
Battery	PS-12120 F2	06299-HC
Pyranometer	SP Lite2	125766
Barometric Pressure	PTB110 1B0CA	P3220823

Monthly averages since 2011 were calculated from hourly values recorded by the datalogger (averaged values from a 10 seconds sampling interval) for the following parameters: temperature, daily maximum temperature, daily minimum temperature, relative humidity, wind speed, maximum wind speed, barometric pressure, and solar radiation. Annual temperature, humidity, windspeed, solar radiation wind speed and direction, and total rainfall are shown on Table 3-5 below. The barometric pressure has not been corrected for elevation and therefore represents the absolute pressure.

Wind data from time of commissioning to the end of May 2022 are also depicted in the wind rose presented in Figure 3-2, 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.

Table 3-5: Monthly values for meteorological parameters collected at District Mill Weather Station 2011-2022

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. (mm)	Average Wind Speed (m/s) [1]	Extreme Max. Wind Speed (m/s) [1]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
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
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
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

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. (mm)	Average Wind Speed (m/s) [1]	Extreme Max. Wind Speed (m/s) [1]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m^2)	Total Evapo-transpiration (mm)[8]
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
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

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. (mm)	Average Wind Speed (m/s) [1]	Extreme Max. Wind Speed (m/s) [1]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m^2)	Total Evapo-transpiration (mm)[8]
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
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

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. (mm)	Average Wind Speed (m/s) [1]	Extreme Max. Wind Speed (m/s) [1]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
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
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

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. (mm)	Average Wind Speed (m/s) [1]	Extreme Max. Wind Speed (m/s) [1]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m^2)	Total Evapo-transpiration (mm)[8]
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*
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

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. (mm)	Average Wind Speed (m/s) [1]	Extreme Max. Wind Speed (m/s) [1]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
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
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]												
Jul-22 [11]												
Aug-22 [1]												
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[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

Notes:

Values in grey italics indicate a partial month.

[1] Wind Sensor was not operating properly:

- *January 2012 – 25 days of complete wind data*
- *February 2012 – 28 days of complete wind data*
- *March 2012 – 30 days of complete wind data*
- *December 2012 – 15 days of complete wind data*
- *January 2013 – 21 days of complete wind data*

[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

Notes:

- *February 2013 – 26 days of complete wind data*
- *November 2013 – 24 days of complete wind data*
- *December 2013 – 20 days of complete wind data*
- *January 2014 – 9 days of complete wind data*
- *November 2014 – 23 days of complete wind data*
- *December 2014 - days of complete wind data*
- *January 2015 – 24 days of complete wind data*
- *August 2015 - days of complete wind data*
- *October 2015 – 29 days of complete wind data*
- *November 2015 – 9 days of complete wind data*
- *December 2015 – 0 days of complete wind data*
- *January 2016 – 16 days of complete wind data*
- *November 2016 – 23 days of complete wind data*
- *December 2016 - 22 days of complete wind data*
- *January 2017 – 25 days of complete wind data*
- *October 2017 – 28 days of complete wind data*
- *November 2017 – 19 days of complete wind data*
- *January 2018 – 19 days of complete wind data*
- *February 2018 – 27 days of complete wind data*
- *March 2018 – 30 days of complete wind data*
- *September 2018 – 13 days of complete wind data*
- *October 2018 – 21 days of complete wind data*
- *November 2018 – 20 days of complete wind data*
- *December 2018 – 29 days of complete wind data*
- *January 2019 – 15 days of complete wind data*
- *October 2019 – 29 days of complete wind data*
- *January 2021 – 25 days of complete wind data*
- *February 2021 – 27 days of complete wind data*
- *September 2021 – 28 days of complete wind data*
- *October 2021 – 23 days of complete wind data*
- *December 2021 – 21 days of complete wind data*
- *January 2022 – 22 days of complete wind data*
- *February 2022 – 26 days of complete wind data*
- *May 2022 – 22 days of complete wind data*
- *November 2022 – 5 days of complete wind 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.*

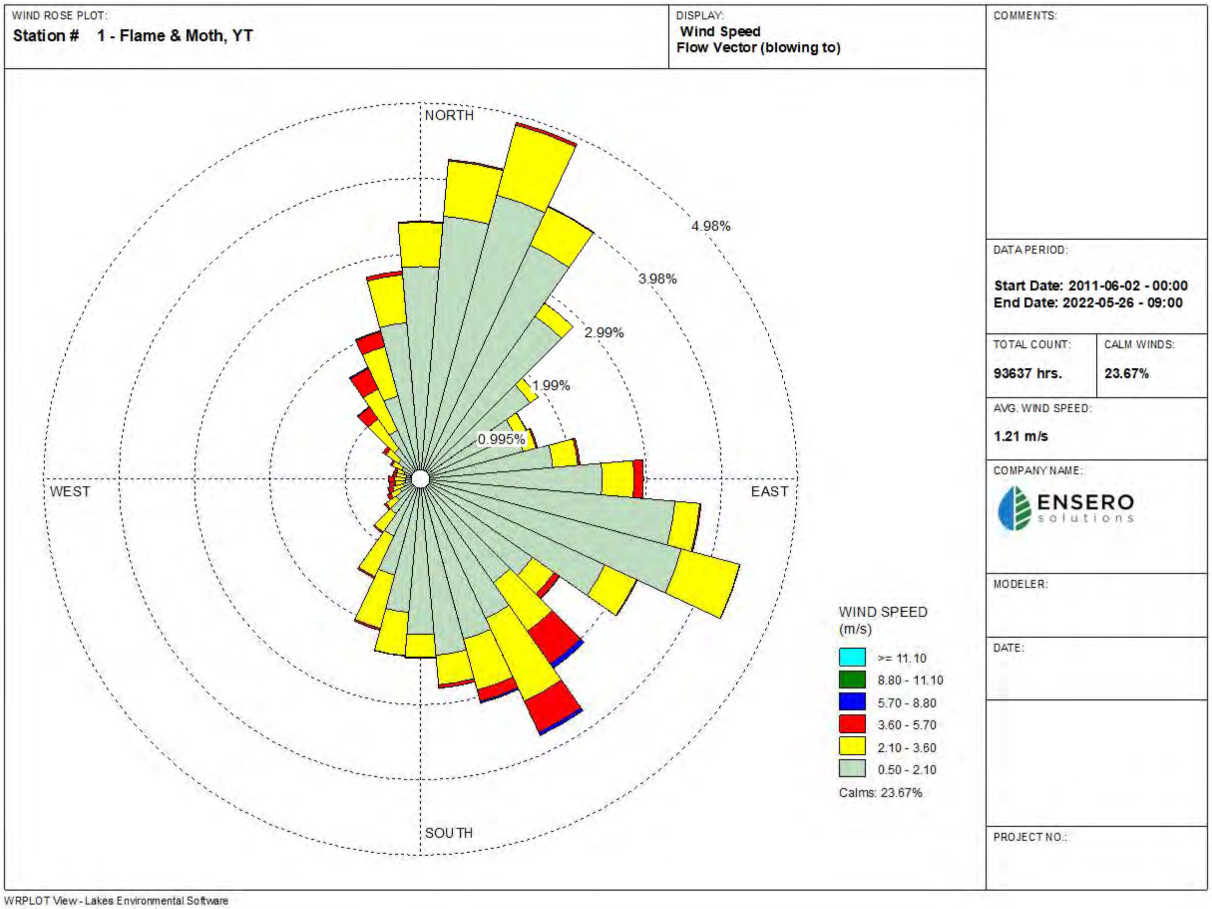


Figure 3-2: District Mill Wind Rose, June 2011 to May 2022

Evapotranspiration rates were not calculated for 2011 and 2012 as the pyranometer was only installed in December 2012. Estimates for evapotranspiration were developed previously from the 1996 data set using the computer program WREVAP developed by Environment Canada's National Hydrology Research Institute (Access, 1996). Since 2013, evapotranspiration is calculated in the datalogger program from local meteorological parameters. During fall 2019 winterization, a change in the program code affected the evapotranspiration rate calculations, and thus the evapotranspiration rates calculated by the program from September 2019 are erroneous. Given the program code error, evapotranspiration for September 2019 to December 2019, and 2020-2022 were manually calculated using RefET, using the ASCE Penman-Monteith Standardized Form of Evapotranspiration Reference (ETr). RefET calculates reference evapotranspiration from the measured daily precipitation, relative humidity, solar radiation, and atmospheric pressure like how the program code previously did. Due to the station being down from May to November 2022, there is no representative data for the year 2022.

The Campbell Scientific station at the District Mill historically has performed well and has comparable results to the Mayo A station (Figure 3-3, Figure 3-4). The location for the District Mill weather was changed in 2022 and it is now located near the Flame & Moth vent raise on the Duncan Creek. The station was previously located within the DSTF phase 1 footprint.

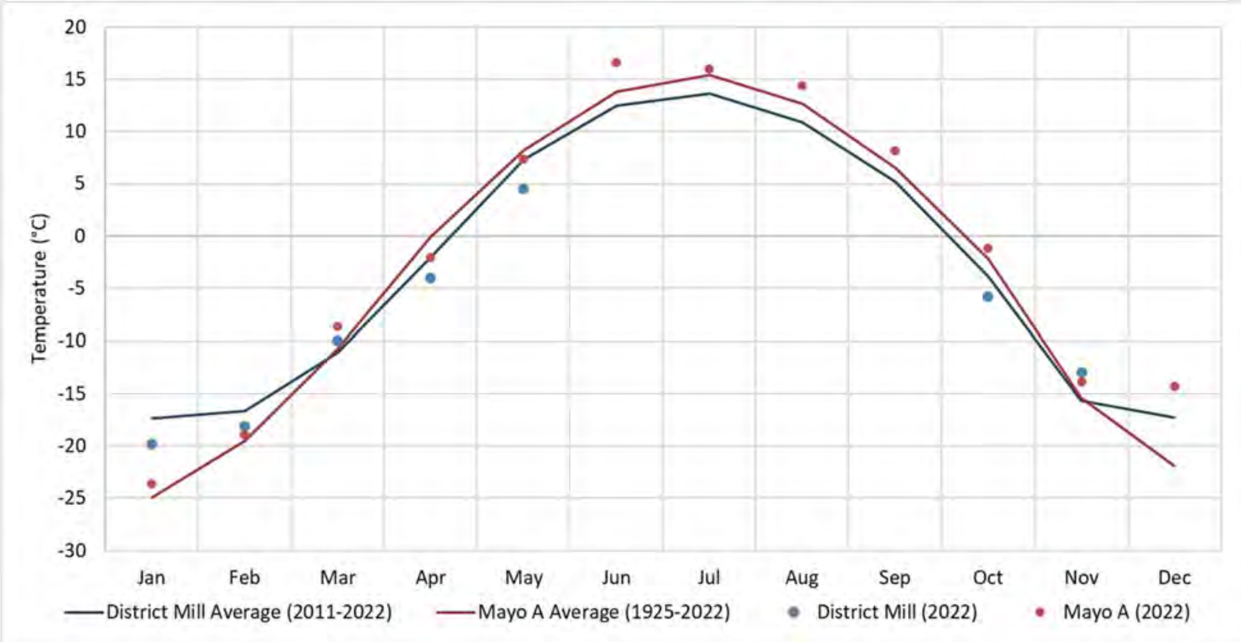


Figure 3-3: Monthly Temperature Trends, District Mill and Mayo A Stations

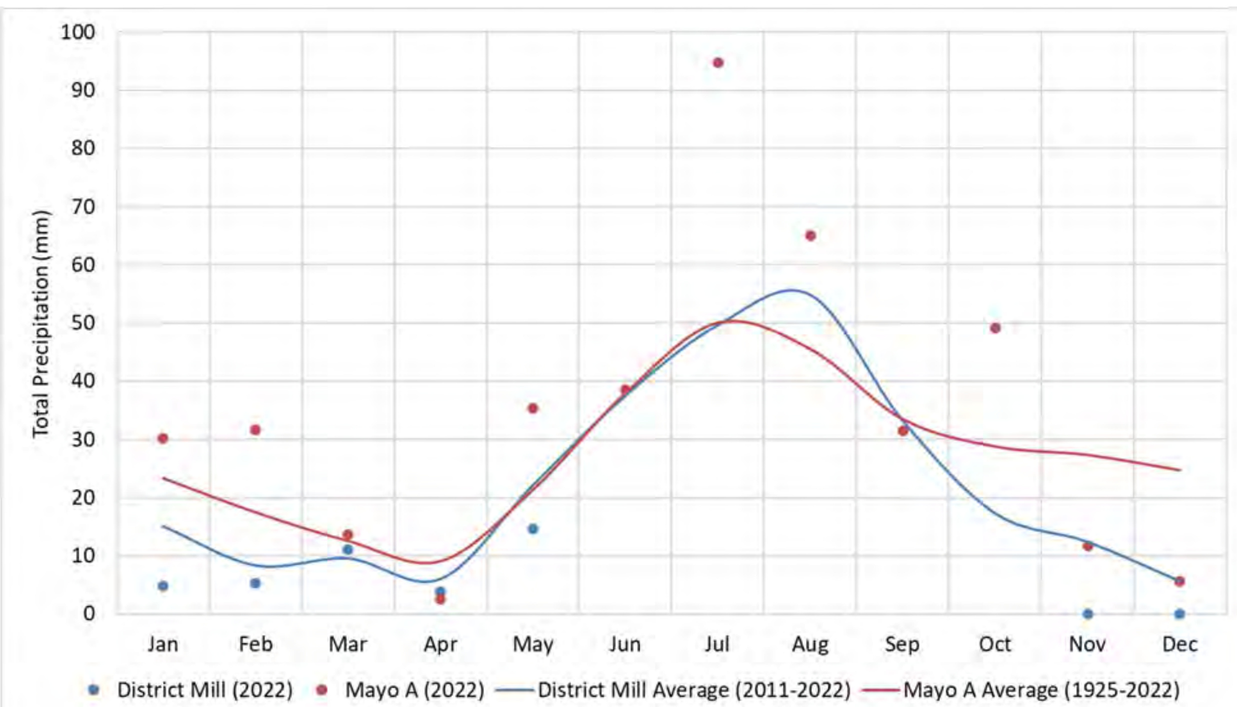


Figure 3-4: Monthly Total Precipitation Trends, District Mill and Mayo A stations

3.1.3 VALLEY TAILINGS WEATHER STATION

The Valley Tailings Onset HOBO automated meteorological station is located near the Valley Tailings at UTM coordinates: 08 V 0475799 7088130 and at an elevation of 718 masl. All components of the station are presented in Table 3-6.

Table 3-6: Valley Tailings HOBO Meteorological Station

Component	Model	Serial Number
Datalogger	U30 NRC	10231016
Input Expander kit		
Solar Panel	SOLAR-6W Installed August 3, 2019: SOLAR-15W	
AC Power Adaptor	120V - 60Hz	
HOBOware	Pro	2580 2976 6309 4793
Temp & RH Sensor	THB-M002	10220040
Solar Radiation Shield	RS3	
Pyranometer	LIB-M003	10191222
Rain Gauge	RGB-M002	10222664
Light Sensor Bracket	LBB	
Light Sensor Level	LLA	
Wind Speed & Direction Sensor	WSET-A	10233230
Full Cross Arm	CAA	
Barometric Pressure	BPB-CM50	10212093
Soil Moisture Sensor	SMC-M005	10225679
Tripod	TPA-KIT 3m	

Monthly averages from installation to December 2022 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 3-7 below. The barometric pressure has not been corrected for elevation and therefore represents the absolute pressure.

Table 3-7: Monthly Values for Meteorological Parameters Collected at Valley Tailings Station

Date	Extreme Min. Temp. (ºC)	Average Min. Temp. (ºC)	Average Temp. (ºC)	Average Max. Temp. (ºC)	Extreme Max. Temp. (ºC)	Average Relative Humidity (%)	Max. Relative Humidity (%)	Min. Relative Humidity (%)	Total Rain (mm)[2]	Average Wind Speed (m/s)[3]	Average Max. Wind Speed (m/s)[3]	Extreme Max. Wind Speed (m/s)[3]	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]															
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
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

Date	Extreme Min. Temp. (ºC)	Average Min. Temp. (ºC)	Average Temp. (ºC)	Average Max. Temp. (ºC)	Extreme Max. Temp. (ºC)	Average Relative Humidity (%)	Max. Relative Humidity (%)	Min. Relative Humidity (%)	Total Rain (mm)[2]	Average Wind Speed (m/s)[3]	Average Max. Wind Speed (m/s)[3]	Extreme Max. Wind Speed (m/s)[3]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content (%)[4]
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
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]															
May-18 [6]															
Jun-18 [6]															
Jul-18 [6]															

Date	Extreme Min. Temp. (ºC)	Average Min. Temp. (ºC)	Average Temp. (ºC)	Average Max. Temp. (ºC)	Extreme Max. Temp. (ºC)	Average Relative Humidity (%)	Max. Relative Humidity (%)	Min. Relative Humidity (%)	Total Rain (mm)[2]	Average Wind Speed (m/s)[3]	Average Max. Wind Speed (m/s)[3]	Extreme Max. Wind Speed (m/s)[3]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m^2)	Soil Average Water Content (%)[4]
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
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	*-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															
Jun-19															
Jul-19															
Aug-19	*-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
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	*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															
Aug-20	*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	*-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															
Dec-20															
Jan-21	-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
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

Date	Extreme Min. Temp. (ºC)	Average Min. Temp. (ºC)	Average Temp. (ºC)	Average Max. Temp. (ºC)	Extreme Max. Temp. (ºC)	Average Relative Humidity (%)	Max. Relative Humidity (%)	Min. Relative Humidity (%)	Total Rain (mm)[2]	Average Wind Speed (m/s)[3]	Average Max. Wind Speed (m/s)[3]	Extreme Max. Wind Speed (m/s)[3]	Average Baro-metric Pressure (kPa)	Average Solar Radiation (W/m²)	Soil Average Water Content (%)[4]
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															
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

Notes:

Values in grey italics indicate a partial month.

Cells highlighted grey indicate station was down and no data are available.

[3] Wind Sensor was not operating properly:

- *October 2012 has 2 days of complete and 11 days of partial wind data*
- *November 2012 has 5 days of complete and 24 days of partial wind data*
- *December 2012 has 2 days of complete and 16 days of partial wind data*
- *January 2013 has 5 days of complete and 16 days of partial wind data*
- *February 2013 has 2 days of complete and 26 days of partial wind data*
- *March 2013 has 4 days of complete and 27 days of partial wind data*
- *April 2013 has 14 days of complete and 16 days of partial wind data*
- *May 2013 has 15 days of complete and 16 days of partial wind data*
- *June 2013 has 29 days of complete and 1 day of partial wind data*
- *August 2013 has 29 days of complete and 2 days of partial wind data*
- *September 2013 has 15 days of complete and 15 days of partial wind data*
- *October 2013 has 6 days of complete and 25 days of partial wind data*
- *November 2013 has 1 day of complete and 28 days of partial wind data*
- *December 2013 has 2 days of complete and 23 days of partial wind data*
- *January 2014 has 0 days of complete and 12 days of partial wind data*
- *February 2014 has 0 days of complete and 13 days of partial wind data*
- *March 2014 has 1 days of complete and 30 days of partial wind data*
- *April 2014 has 10 days of complete and 20 days of partial wind data*
- *May 2014 has 21 days of complete and 10 days of partial wind data*
- *December 2014 has 3 days of complete and 12 days of partial wind data*
- *January 2015 has 0 days of complete and 14 days of partial wind data*
- *February 2015 has 1 day of complete and 17 days of partial wind data*
- *March 2015 has 5 days of complete and 26 days of partial wind data*
- *April 2015 has 12 days of complete and 18 days of partial wind data*
- *May 2015 has 27 days of complete and 4 days of partial wind data*
- *August 2015 has 29 days of complete and 2 days of partial wind data*

[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

[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

Notes:

- *September 2015 has 14 days of complete and 16 days of partial wind data*
- *October 2015 has 12 days of complete and 19 days of partial wind data*
- *November 2015 has 1 day of complete and 23 days of partial wind data*
- *December 2015 has 0 day of complete and 9 days of partial wind data*
- *January 2016 has 4 days of complete and 19 days of partial wind data*
- *February 2016 has 2 days of complete and 17 days of partial wind data*
- *March 2016 has 8 days of complete and 23 days of partial wind data*
- *April 2016 has 22 days of complete and 4 days of partial wind data*
- *May 2016 has 30 days of complete and 1 day of partial wind data*
- *September 2016 has 22 days of complete and 8 days of partial wind data*
- *October 2016 has 4 days of complete and 27 days of partial wind data*
- *November 2016 has 3 days of complete and 11 days of partial wind data*
- *December 2016 has 0 day of complete and 18 days of partial wind data*
- *January 2017 has 0 day of complete and 17 days of partial wind data*
- *February 2017 has 6 days of complete and 21 days of partial wind data*
- *March 2017 has 15 days of complete and 16 days of partial wind data*
- *April 2017 has 17 days of complete and 13 days of partial wind data*
- *May 2017 has 24 days of complete and 7 days of partial wind data*
- *September 2017 has 25 days of complete and 5 days of partial wind data*
- *October 2017 has 3 days of complete and 22 days of partial wind data*
- *November 2017 has 0 day of complete and 1 day of partial wind data*
- *December 2017 has 1 day of complete and 6 days of partial wind data*
- *January 2018 has 12 days of partial wind data*
- *February 2018 has 28 days of partial wind data*
- *March 2018 has 13 days of partial wind data*
- *August 2018 has 17 days of partial wind data*
- *March 2017 has 15 days of complete and 16 days of partial wind data*
- *April 2017 has 17 days of complete and 13 days of partial wind data*
- *May 2017 has 24 days of complete and 7 days of partial wind data*
- *September 2017 has 25 days of complete and 5 days of partial wind data*
- *October 2017 has 3 days of complete and 22 days of partial wind data*
- *November 2017 has 0 day of complete and 1 day of partial wind data*
- *December 2017 has 1 day of complete and 6 days of partial wind data*
- *January 2018 has 12 days of partial wind data*
- *February 2018 has 28 days of partial wind data*
- *March 2018 has 13 days of partial wind data*
- *August 2018 has 17 days of partial wind data*
- *September 2018 only has 16 days of partial wind data*
- *October 2018 only has 23 days of partial wind data*
- *November 2018 has 30 days of partial wind data*
- *December 2018 only has 18 days of partial wind data*
- *January 2019 only has 3 days of partial wind data*
- *February 2019 only has 19 days of partial wind data*
- *March 2019 has 8 days of complete and 23 days of partial wind data*
- *April 2019 has 7 days of complete and 13 days of partial wind data*
- *August 2019 has 16 days of complete and 12 days of partial wind data*
- *September 2019 has 9 days of complete and 21 days of partial wind data*
- *October 2019 has 1 day of complete and 30 days on partial wind data*
- *November 2019 has 2 days of complete and 13 days of partial wind data*
- *January 2020 has 6 days of partial wind data*
- *February 2020 has 18 days of partial wind data*
- *March 2020 has 28 days of partial wind data and 1 complete day*
- *April 2020 has 27 days of partial wind data and 3 complete days*
- *March 2017 has 15 days of complete and 16 days of partial wind data*
- *April 2017 has 17 days of complete and 13 days of partial wind data*
- *May 2020 has 18 days of partial wind data and 13 complete days*
- *June 2020 has 19 days of partial wind data and 7 complete days*
- *August 2020 has 20 days of partial wind data and 1 complete day*
- *September 2020 has 25 days of partial wind data and 5 complete days*
- *October 2020 has 9 days of partial wind data and 2 complete days*
- *January 2022 has 3 days of complete and 27 days of partial wind data*
- *February 2022 has 28 days of complete and 9 days of partial wind data*
- *March 2022 has 31 days of complete and 7 days of partial wind data*
- *April 2022 has 30 days of complete and 2 days of partial wind data*
- *May 2022 has 11 days of complete and 20 days of partial wind data*
- *June 2022 has 20 days of complete and 10 days of partial wind data*
- *July 2022 has 31 days of complete and 3 days of partial wind data*
- *August 2022 has 1 days of complete and 3 days of partial wind data*
- *September 2022 has 30 days of complete and 7 days of partial wind data*

Notes:

- *October 2022 has 31 days of complete and 10 days of partial wind data*
- *November 2022 has 22 days of complete and 19 days of partial wind data*

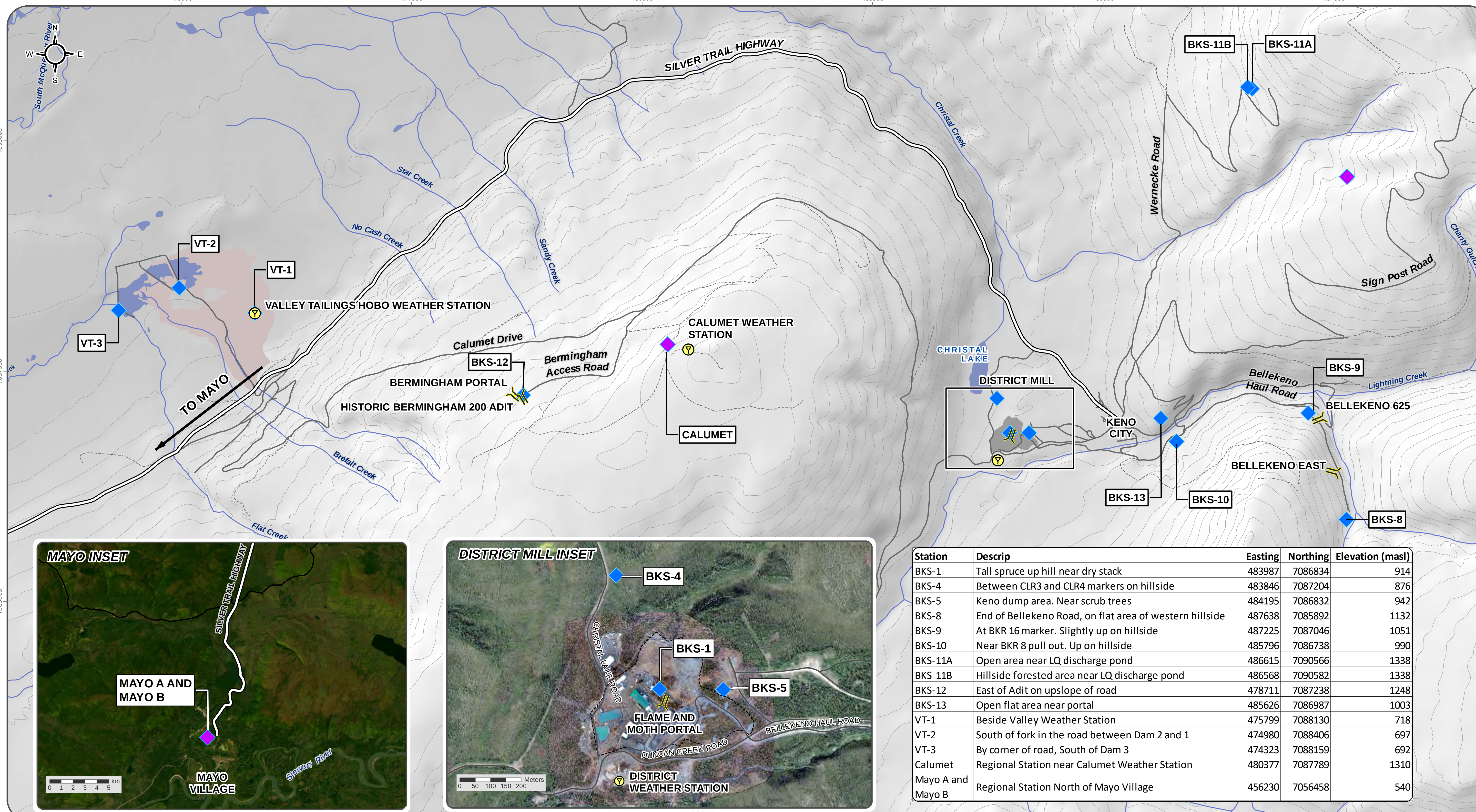
3.1.4 SNOW SURVEYS

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 located in the Village of Mayo at an elevation of 540 masl and Calumet is on Galena Hill, near Keno City at an elevation of 1310 masl. The March and April monthly snow water equivalent (SWE) statistics for the three regional sites are shown in Table 3-8.

Table 3-8: Regional Snow Survey Station Values

Station	Elevation (masl)	Period	Month	Min	Max (mm)	Average (mm)
Mayo A	540	1968-2022	March	30	160	92
		n = 51	April	10	176	96
Mayo B	540	1987-2022	March	52	172	96
		n = 32	April	48	192	108
Calumet	1310	1975-2022	March	94	298	176
		n = 44	April	95	305	197

The locations of the snow survey stations are shown on Figure 3-5. The annual snow water equivalent (SWE) results for each of the 13 KHSD snow survey stations are presented in Table 3-9.



Station	Descrip	Easting	Northing	Elevation (masl)
BKS-1	Tall spruce up hill near dry stack	483987	7086834	914
BKS-4	Between CLR3 and CLR4 markers on hillside	483846	7087204	876
BKS-5	Keno dump area. Near scrub trees	484195	7086832	942
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

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Satelite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on February 03 2023
Datum: NAD 83; Map Projection: UTM Zone 8N

1:40,000 (when printed on 11 x17 inch paper)

0 500 1,000 1,500 2,000 Meters

- ERDC Snow Monitoring Station
- Regional Snow Monitoring Stations
- Audit
- AKHM District Mill
- Tailings Area
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Contours (100 ft)

HECLA KENO HILL

FIGURE 3-5

METEOROLOGICAL STATIONS AND SNOW SURVEY STATIONS LOCATION

FEBRUARY 2023

Table 3-9: Snow Survey (SWE) Results (mm)

Station	BKS-1	BKS-2	BKS-3	BKS-4	BKS-5.0	BKS-5.1	BKS-6	BKS-7	BKS-8	BKS-9	BKS-10	BKS-11	BKS-12	BKS-13	Monthly Mean	Mayo A	Mayo B	Calumet
Elevation (m)	914	907	878	876	942	942	938	1032	1132	1051	990	1338	1248	1003		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. Near scrub trees	Keno dump area. On sloping hillside	Uphill from Bellekeno treatment pond	Far end of Bellekeno East. Nr 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		Mayo Airport	Mayo Airport	Calumet Hill
Jan-11	7.6	7.6	7.6	7.6	5.1	-	2.5	7.6	7.6	7.6	10.1	-	-	-	7.1	-	-	-
Feb-11	7.6	7.6	10.2	7.6	7.6	-	2.5	10.2	7.6	10.2	7.6	-	-	-	7.9	-	-	-
Mar-11	5.1	7.6	7.6	7.6	5.1	-		7.6	5.1	10.2	5.1	-	-	-	6.1	9.0	8.4	13.9
Jan-12	6.0	12.2	9.6	8.5	13.7	-	11.2	12.5	9.9	12.4	13.3	-	-	-	10.9	-	-	-
Feb-12	16.1	13.6	12.5	17.6	-	11.3	12.6	13.6	13.8	13.3	16.5	-	-	-	14.1	-	-	-
Mar-12	18.7	9.3	4.4	12.3	-	12.2	14.8	4.8	17.6	17.1	27.7	-	-	-	13.9	7.8	10.0	15.1
Apr-12	8.7	20.8	7.7	8.8	-	9.6	19.8	8.5	19.5		10.7	-	-	-	11.4	14.4	15.6	18.0
Jan-13	7.3	9.3	7.3	9.3	-	6.7	6.7	6.7	8.0	7.3	9.3	-	-	-	7.8	-	-	-
Feb-13	11.3	10.7	10.0	11.7	-	9.7	9.2	11.0	10.0	10.0	10.0	-	-	-	10.4	-	-	-
Mar-13	13.0	11.7	14.3	18.3	-	13.3	12.0	10.3	18.5	15.0	12.3	-	-	-	13.9	12.9	8.0	15.8
Apr-13	15.0	13.8	14.7	14.3	-	13.0	11.3	13.7	19.7	14.0	14.3	-	-	-	14.4	12.0	-	18.6
Jan-14	12.3	10.3	13.0	12.7	-	11.0	10.7	13.3	9.3	12.3	14.0	-	-	-	11.9	-	-	-
Feb-14	14.0	10.7	12.3	12.0	-	12.0	10.3	13.0	12.7	11.7	15.7	-	-	-	12.4	-	-	-
Mar-14	12.3	10.0	11.0	11.7	-	10.7	8.7	13.0	12.7	11.3	14.3	-	-	-	11.6	10.3	12.0	18.9
Apr-14	9.7	7.7	9.7	7.3	-	8.7	8.3	10.0	10.7	9.0	7.0	-	-	-	8.8	12.3	12.6	20.7
Feb-15	8.0	9.0	9.3	3.7	-	8.3	7.3	9.0	6.7	7.7	10.0	-	-	-	7.9	-	-	-
Mar-15	9.3	10.3	7.0	8.7	-	10.7	8.7	12.7	17.0	10.7	10.0	-	-	-	10.5	7.6	9.0	18.4
Apr-15	8.7	9.0	10.7	7.3	-	12.0	9.0	14.0	12.3	8.3	12.0	-	-	-	10.3	10.3	11.8	23.2
Feb-16	4.0	8.0	8.0	10.0	-	10.0	8.0	7.3	7.3	7.3	10.7	20.3	-	-	8.1	-	-	-
Mar-16	8.7	11.0	9.3	8.7	-	8.7	8.0	7.0	9.3	7.0	6.0	20.7	-	-	8.4	11.3	10.4	20.2
Apr-16	7.7	10.3	10.7	12.3	-	10.7	8.3	11.3	-		11.7	15.0	23.3	-	9.8	7.0	4.8	18.1
Feb-17	5.7	6.7	4.0	5.7	-	5.7	7.3	7.0	7.7	7.0	6.0	11.0	7.0	3.0	6.4	-	-	-
Mar-17	8.7	9.3	9.3	10.3	-	8.3	8.0	8.3	10.7	7.3	9.3	16.0	8.7	4.0	9.1	3.8	4.2	15.0
Apr-17	9.3	11.7	13.0	11.3	-	10.7	9.3	11.0	13.0	6.7	6.7	18.0	14.3		10.4	8.8	8.0	16.5
Jan-18	4.3	6.0	6.3	6.3	-	6.0	5.7	5.7	9.0	8.0	8.7	8.7	6.3	6.3	6.7	-	-	-
Feb-18	6.7	7.3	10.0	8.7	-	9.3	8.0	8.7	10.7	10.0	10.0	11.7	11.0	6.0	9.1	-	-	-
Mar-18	8.7	10.0	10.0	10.7	-	13.3	11.3	11.3	11.3	13.3	12.0	18.0	-	-	10.0	4.8	6.5	14.2
Apr-18	4.0	4.3	4.0	5.0	-	5.0	5.0	5.0	5.7	4.3	4.7	-	4.3	5.3	4.4	5.6	6.4	17.2
Jan-19	4.7	4.7	6.0	6.7	-	4.0	4.0	7.6	5.3	6.0	5.3	6.7	10.7	4.7	6.0	-	-	-
Feb-19	6.0	6.0	6.0	6.0	-	8.0	8.0	6.0	8.0	8.0	7.3	8.0	-	6.0	7.4	-	-	-
Mar-19	5.3	4.7	5.3	5.3	-	5.3	5.3	5.3	6.7	6.7	6.7	-	10.0	-	6.6	6.8	6.0	13.0
Apr-19	-	-	-	-	-	-	-	-	9.3	7.3	8.0	-	14.0	-	9.7	0.0	0.0	9.5 Estimated
Jan-20	-	-	5.3	7.3	-	6.7	12.0	-	-	-	-	-	11.3	-	10.0	-	-	-
Feb-20	-	16.0	15.3	14.0	-	16.0	14.0	12.0	15.3	15.3	16.7	-	16.7	-	15.1	-	-	-

Station	BKS-1	BKS-2	BKS-3	BKS-4	BKS-5.0	BKS-5.1	BKS-6	BKS-7	BKS-8	BKS-9	BKS-10	BKS-11	BKS-12	BKS-13	Monthly Mean	Mayo A	Mayo B	Calumet
Elevation (m)	914	907	878	876	942	942	938	1032	1132	1051	990	1338	1248	1003		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. Near scrub trees	Keno dump area. On sloping hillside	Uphill from Bellekeno treatment pond	Far end of Bellekeno East. Nr 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		Mayo Airport	Mayo Airport	Calumet Hill
Mar-20	17.0	17.3	15.3	18.0	-	11.3	15.7	14.0	21.3	23.3	19.3	-	-	-	17.5	15.4	15.0	27.7
Apr-20	18.7	17.0	16.0	20.7	-	19.3	16.7	15.3	-	26.0	23.3	11.3	27.3	-	19.9	17.3	16.6	30.5
Feb-21	8.0	-	-	6.3	-	8.7	-	-	8.7	12.0	8.3	-	12.3	-	10.0	-	-	-
Mar-21	10.0	-	-	9.3	-	10.0	-	-	12.3	13.7	11.0	19.3	16.7	11.0	13.4	9.8	9.0	16.7
Apr-21	13.0	-	-	13.7	-	14.0	-	-	15.0	13.3	13.3	-	18.7	-	14.9	7.9	13.8	18.4
Feb-22	10.7	-	-	15.7		9	-	-	7.7	14	10.3	15.3	20.7	11.3	10.3	-	-	21.3
Mar-22	14.0	-	-	17.0	-	10.0	-	-	18.7	9.3	16.3	18.0	25.3	15.3	15.8	16.0	17.2	24.6
Apr-22	19.3	-	-	14.3	-	16.0	-	-	16.3	15.7	19.7	-	26.7	-	18.9	16.7e	18.0	27.3

Manual snow surveys have been conducted in the KHSD since 2011 at ten monitoring stations in order to represent the varying snow conditions as a function of aspect and elevation. Two additional stations (BKS-11 Lucky Queen and BKS-12 Bermingham) were established in 2016 and a third one (BKS-13 Onek) was established in 2017. In April 2020, snow surveys were also conducted in the Valley Tailings area in three new locations; data is presented in Table 3-10 below.

Table 3-10: Valley Tailings Snow Survey Stations SWE (cm)

Station	VT-1	VT-2	VT-3
Elevation (masl)	718	697	692
Description	*Located at the Valley Tailing Weather Station*	*South of the middle pond on the Valley Tailings Road*	*West of Valley Tailings Dam facility*
Apr-20	16.7	19.3	17.3
Feb-21	7.7	9.0	10.3
Mar-21	11.0	11.3	14.3
Apr-21	12.7	12.7	15.3
Feb-22	9.7	17.7	11.7
Mar-22	18.3	17	18
Apr-22	15	15.3	15.3

In 2022, surveys were conducted on February 17-22, March 30, and April 27-28. Site stations are presented for comparison with the regional stations in Figure 3-6. Station BKS-1 is at 914 masl and is an open space near the DSTF above the Flame & Moth mine. Station BKS-3 is located on the Christal Lake Road at an elevation of 878 masl, and station BKS-4 is also on Christal Lake Road, between kilometer 3 and 4 markers on the uphill side of the road. Station BKS-5.1, at 942 masl, is located near the Keno transfer station just up the hill from KV-87N at 876 masl. Station BKS-7 is uphill form the Bellekeno treatment pond at an elevation of 1032 masl, and BKS-8 is at the far end of Bellekeno East at an elevation of 1132 masl. BKS-10 is at 990 masl and is on the uphill side of the Bellekeno road at the kilometer 8 pullout. BKS-12 is at 1248 masl and is located near KV-78B. Mayo A and B are collected at the Mayo airport at an elevation of 540 masl and finally Calumet station is found near the Galena Hill weather station at 1310 masl. These stations were chosen based on elevation variation and their recorded SWE over the surveyed period.

Figure 3-7 presents SWE as a function of elevation, as predicted the higher the elevation, the more snow is accumulated. The highest station, BKS-12 at 1248 masl, has shown the highest SWE for 2022 in February, March, and April. The measured SWE of BKS-12 is comparable to Calumet station SWE which has a similar northwest aspect and elevation of 1310 masl. In March 2022, BKS-12 SWE measurement was 114.5% higher than the average historical SWE at this site. BKS-12 has showed the highest SWE consistently from 2016 to 2022. The lowest SWE of 2022 was recorded at station BKS-9 which has an elevation of 1051 masl and is comparable to BKS-5.1 SWE at 942 masl, regardless of elevation difference. BKS-4 March SWE measurement is 24.6% below March historical average at this site. April showed a decrease in average SWE by 26.4%c compared to the 2021 increase of 18.7% across all surveyed sites, showing a total decrease in accumulated SWE around the Keno Valley.

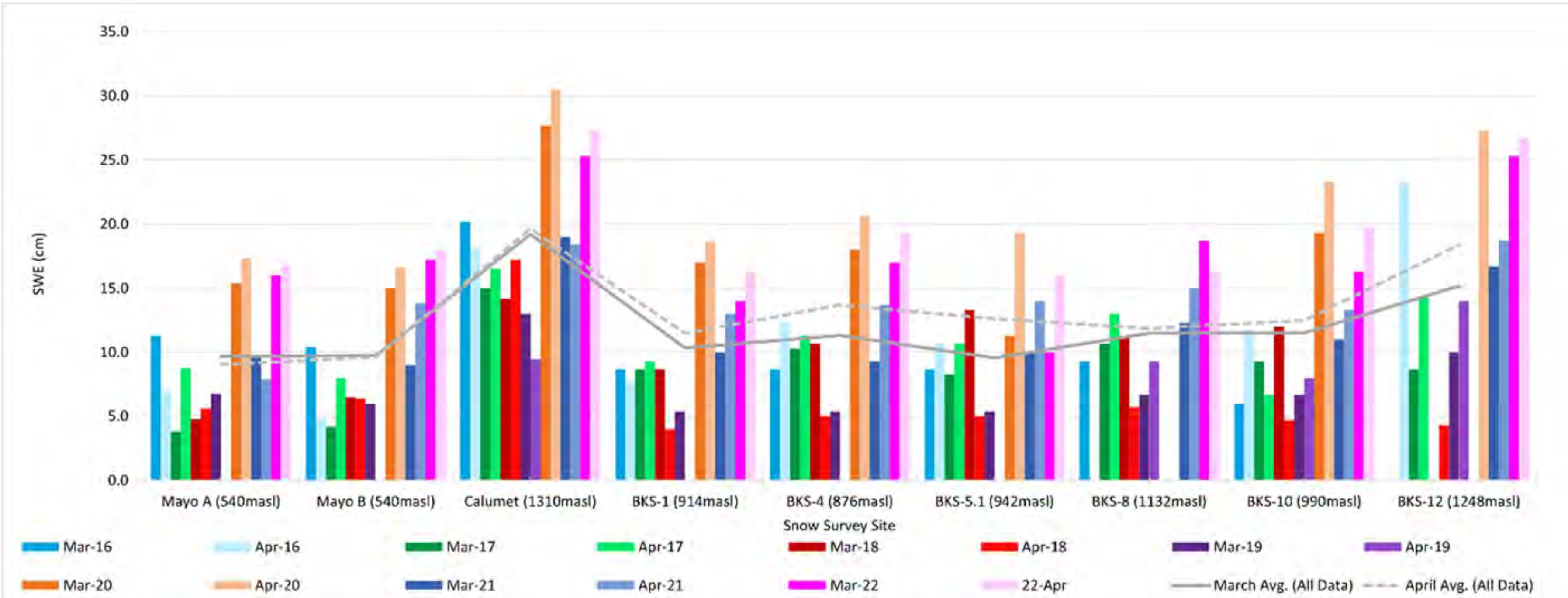


Figure 3-6: Regional Snow Water Equivalents Compared to BKS-1, 4, 5.1, 8, 10, and 12 for 2016-2022

Figure 3-7: March Snow Water Equivalent as a Function of Elevation

3.1.5 MEAN ANNUAL PRECIPITATION (MAP)

Mean annual precipitation (MAP) within a mountainous region typically increases with increasing elevation. The significant relief over which the KHSD area spans is well represented by two historical weather stations with Elsa at 814 masl and the Keno Hill weather station at 1472 masl. In 1996, Clearwater Consultants Ltd. (CCL) used data from these two stations as well as from Environment Canada's station located at Mayo airport (504 masl.) to derive a relationship between MAP and elevation (Access, 1996). Assuming a linear relationship, a line was fitted to the data of these stations. Figure 3-8 was reproduced (Access, 1996) and updated to include the three stations in this memo and including more recent data where available. The slope of this line indicates that MAP increases by an average of 27 mm for every 100 m of ascent, a value not too dissimilar from that observed values in other regions of the Yukon interior.

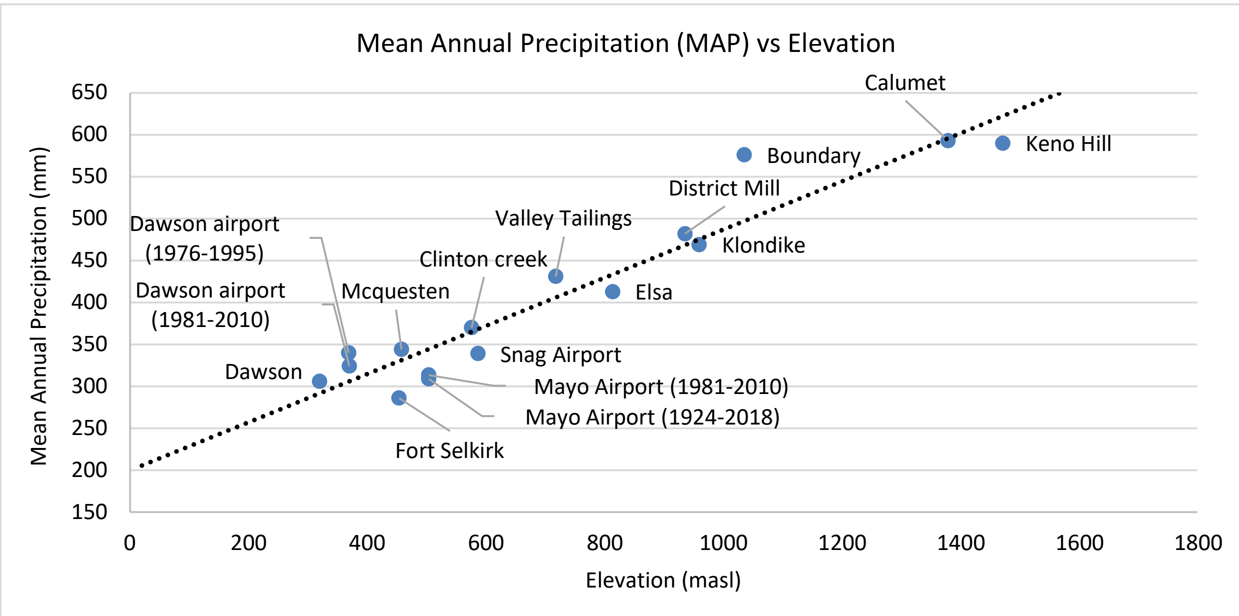


Figure 3-8: Mean Annual Precipitation as a Function of Elevation

3.1.5.1 MONTHLY PRECIPITATION

As with MAP, the seasonal or monthly distribution is influenced by elevation. To demonstrate this influence, the monthly distributions for Elsa, Keno Hill and Mayo Airport have been plotted in Figure 3-9, which was part of the same assessment conducted by CCL in 1996 (Access, 1996), but with Mayo Airport updated to include recent data. The proportion of total precipitation which falls as rain decreases as elevation increases (53% of total precipitation at Elsa, 1% at Keno Hill and 60% at Mayo Airport). Again, a simple linear relationship can be derived, and the slope indicates that the proportion of total precipitation that falls as rain decreases by about 2% for every 100 m ascent.

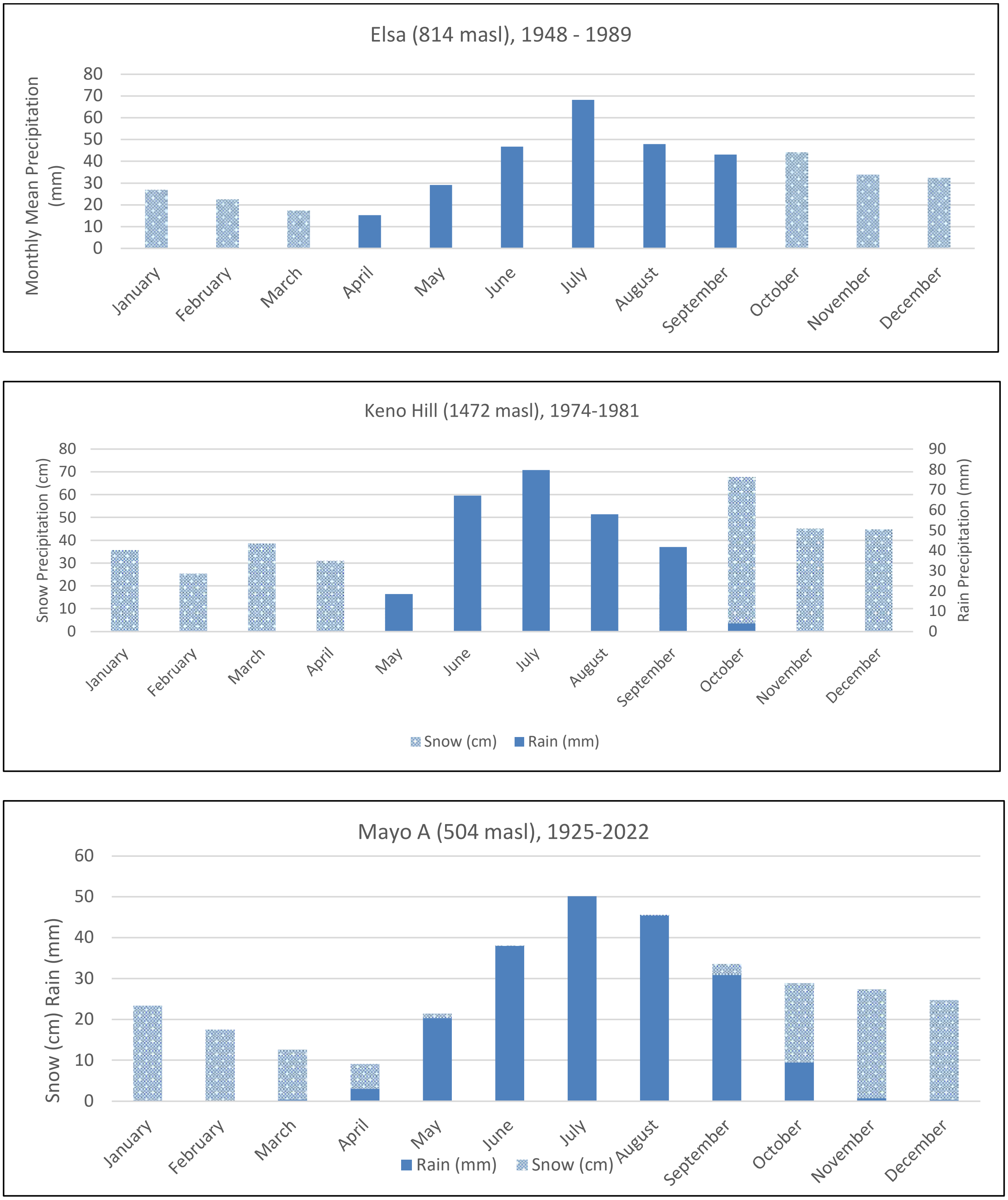


Figure 3-9: Mean Monthly Precipitation

Note: Reproduced from Access (1996) with Mayo Airport updated to include more recent data

3.1.5.2 MAYO A RECENT PRECIPITATION AND TEMPERATURE COMPARISON TO SITE STATIONS

Recent precipitation data from Mayo A, Calumet, District Mill, and the Valley Tailings weather stations were used to verify the empirical relationships presented above. Validated precipitation data at Mayo A are available until December 12, 2022, with the exception of the year 2013, which is missing. Therefore, the periods of overlap between the Calumet station (2007-2022), the District Mill station (2012-2022), and the Valley Tailings (2014-2022) were used for this comparison. Mayo A reports both rain and total precipitation, while Calumet and the Valley Tailings weather stations record rainfall only. Table 3-11 presents the proportion of total precipitation that fell as rain for the 2007-2022 period at Mayo A. The District Mill weather station recorded rainfall only in 2012 and 2013 and total precipitation since 2014. Additionally, the District Mill station did not record precipitation between May and November 2022, therefore only a partial data set for 2022 and not representative for the year.

Table 3-11: Annual Precipitation at Mayo A and District Mill Station, 2007-2022

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
2013	226.3	144.1	359.2	63.0	400.0
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	56.7
AVG	**246.9**	**150.1**	**350.3**	**69.9**	**258.7**

For this 15-year period, the average proportion of total precipitation that fell as rain was 69.4%, which is slightly higher than the original estimate of 60%. 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. Figure 3-12 shows the temperature trend at Mayo A since 1925. Maximum, minimum, and mean temperatures recorded over the 1925-2022 period all show an increasing trend, though the minimum temperatures are seeing the greatest increase.

As seen in Figure 3-10 and Figure 3-11, there continues to be a difference between the precipitation collected at the District Mill Weather Station (936 masl until November 2022, 900 masl thereafter) and the Mayo A Station (504 masl). The rain data correlates well for months that the station was in working order. The general trend of snowfall data between the District station and Mayo A are similar; however, the amount is significantly different for months January to March. It is worth noting the precipitation equipment is prone to freezing in the winter and has not always provided reliable data, additionally, a snow fall adapter was only installed in 2013.

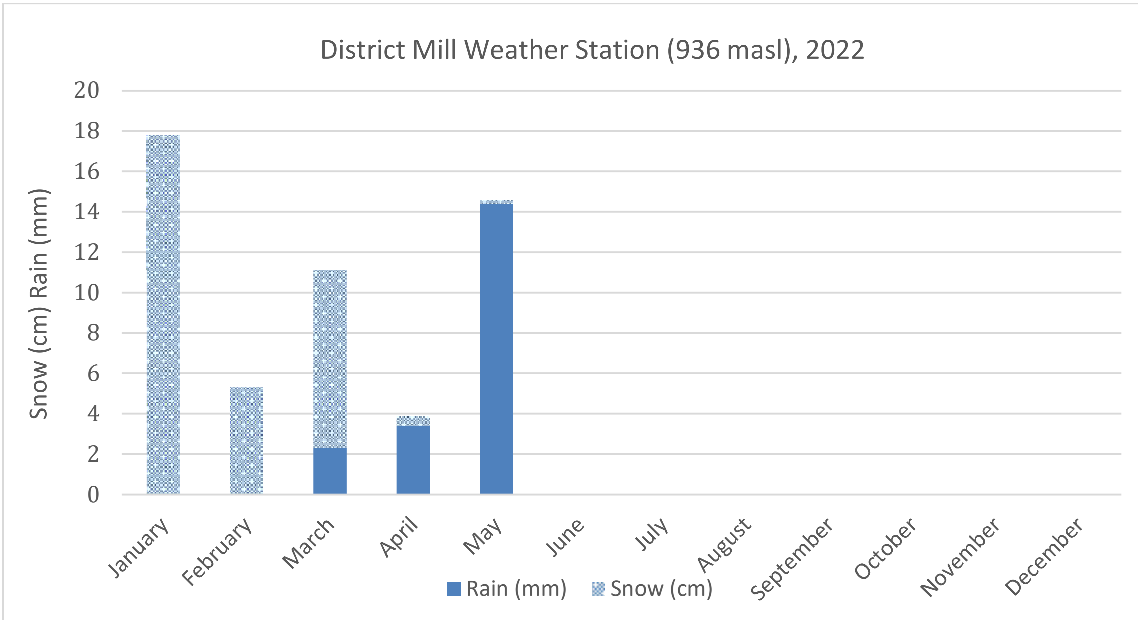


Figure 3-10: Precipitation at District Mill Weather Station

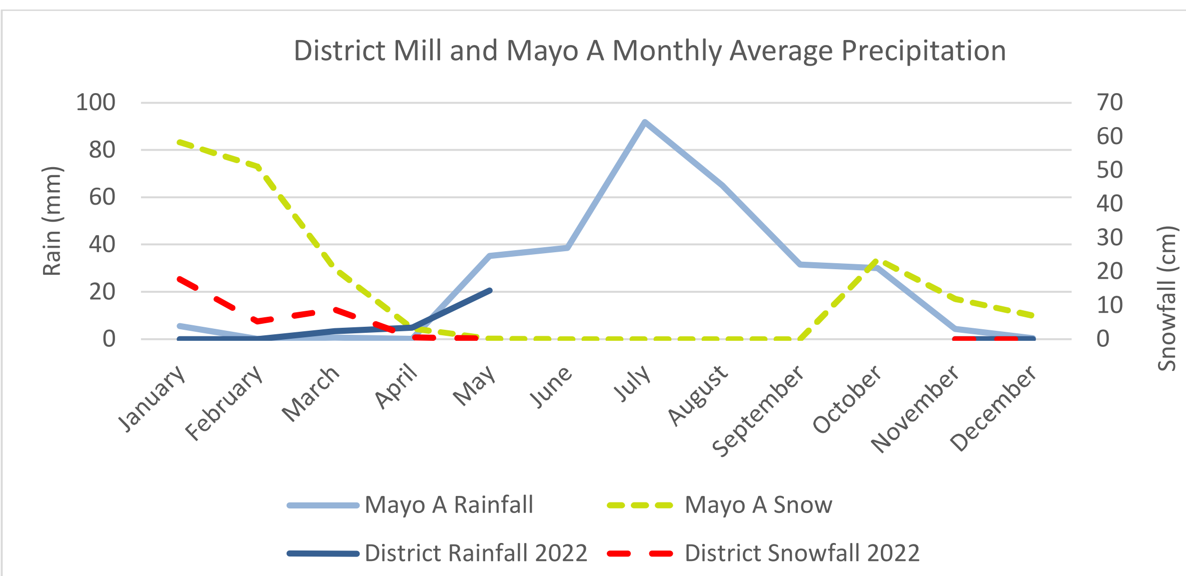


Figure 3-11: District Mill and Mayo A Average Monthly Precipitation Comparison

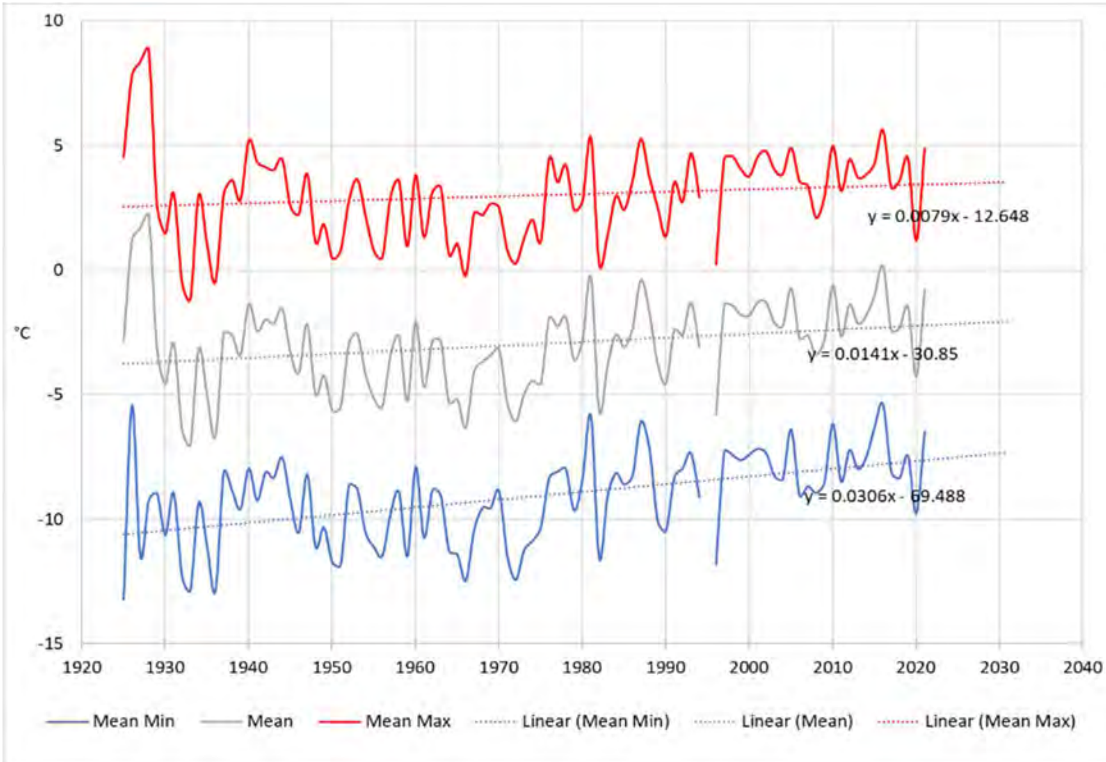


Figure 3-12: Mayo A Annual Temperatures, 1925-2022

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 2022 (Figure 3-12), predicted total rainfall is compared to total rainfall measured at Calumet, District Mill, and Valley Tailings (Table 3-12). Note that Calumet observed rainfall data for 2016 and 2017 are largely incomplete and those years were therefore not included in the comparison below. As the District Mill station was not operational from May to November 2022, the precipitation data collected at that station are not representative of the year.

Table 3-12: Predicted Versus Measured Total Rain (mm)

Year	Predicted Annual Total Precipitation (mm)	Predicted Total Rain (mm)	Measured Total Precipitation (mm)	Actual - Predicted	% Difference
Calumet (1380 masl)					
2007	582.3	263.1	*276.4*	13.3	5%
2008	665.8	300.8	363.6	62.8	17%
2009	540.8	244.3	*196.4*	-48.0	-24%
2010	530.2	239.6	462.2	222.7	48%
2011	689.4	311.5	*305.5*	-6.0	-2%
2012	512.6	231.6	*137.0*	-94.6	-69%
2013	595.7	269.1	200.6	-68.5	-34%
2014	612.8	276.9	264.4	-12.5	-5%
2015	645.2	291.5	*339.7*	48.2	14%
2016	552.5	249.6	*76.9*	-172.7	-225%
2017	549.2	248.1	-	-	-
2018	574.5	259.6	430.9	171.3	40%
2019	485.8	219.5	*216.2*	-3.3	-2%
2020	672.1	303.7	*489.7*	186.1	38%
2021	532.7	240.7	*297.8*	57.1	19%
2022	646.5	292.1	*254.6*	-37.5	-15%
AVG	**586.8**	**264.9**	**289.2**	**23.0**	**-15%**
District Mill (936 masl)					
2012	392.7	212.3	217.5	5.2	2%
2013	475.8	257.2	400.0	142.8	36%
2014	492.9	266.5	292.6	-200.3	-68%
2015	525.3	284.0	296.9	-228.4	-77%
2016	432.6	233.9	277.7	-154.9	-56%
2017	429.3	232.1	267.3	-162.0	-61%
2018	454.6	245.8	344.9	-109.7	-32%
2019	365.9	197.8	127.0	-238.9	-188%
2020	552.2	298.5	287.7	-264.5	-92%
2021	412.8	223.2	278.6	-134.2	-48%
2022	526.6	284.7	-	-	-
AVG	**466.9**	**247.6**	**279.1**	**-134.6**	**-58%**
Valley Tailings (718 masl)					
2014	57.8	33.8	*112.4*	78.6	70%
2015	57.8	33.8	272.2	238.4	88%
2016	57.8	33.8	226.6	192.8	85%

Year	Predicted Annual Total Precipitation (mm)	Predicted Total Rain (mm)	Measured Total Precipitation (mm)	Actual - Predicted	% Difference
2017	57.8	33.8	269.20	235.4	87%
2018	57.8	33.8	*75.60*	41.8	55%
2019	57.8	33.8	*69.40*	35.6	51%
2020	57.8	33.8	*94.40*	60.6	64%
2021	57.8	33.8	*137.83*	104.1	76%
2022	57.8	33.8	*232.40*	198.6	85%
AVG	**57.8**	**33.8**	**157.2**	**126.2**	**72%**

Values in grey italics indicate that total precipitation is not from the entire year (i.e., some data missing due to weather station malfunctions).

3.1.5.3 DISCUSSION BETWEEN PREDICTED AND OBSERVED PRECIPITATION

Some years have incomplete rain data at Calumet (refer to Table 3-3 for specific details) and Valley Tailings (refer to Table 3-7), and this could explain the negative difference between actual and predicted rainfall in 2009, 2011-2012, and 2019-2020 at the Calumet station, 2022 at the District Mill station and 2014 and 2018-2021 at the Valley Tailings station (Table 3-7). In other cases, however, the difference is positive even though the Calumet dataset is incomplete (e.g., 2015 and 2021). 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), and 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 CCL (Access, 1996) might underestimate total precipitation increase with elevation. A confounding factor is the assumed relationship between the proportion of total precipitation that falls as rain and elevation, which may also need to be refined. 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).

In the case of the District Mill, there is good agreement between predicted and measured total rain for the year 2012. From 2014 to 2022, however, comparison is made for total precipitation since a snowfall conversion adaptor was installed in 2013. In that case, the measured amount is considerably less than the predicted amount, indicating probable under catch of the snowfall conversion adaptor. Literature reports a cumulative winter catch efficiency of 0.66 for a Campbell Scientific TE525 tipping bucket gauge with a CS705 snow fall adaptor and alter screen (MacDonald and Pomeroy, 2007). Total precipitation data (2014-2019) from October through April were therefore corrected using this factor. Also, because the use of an alter screen for wind deflection has a documented improvement of 10 to 16% in snow collection efficiency and 6% to 10% for all types of precipitation (Belfort Instrument, 2013), average correction factors of 8% and 13% for summer and winter months respectively were applied to precipitation data collected prior to the installation of the alter screen in June 2015. Corrected total precipitation data are still 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. Refinement of the MAP-elevation relationship derived by CCL (Access, 1996) will be possible as more years of data become available at Calumet and at the District Mill, and as total precipitation data become available at the District Mill weather station.

3.2 AIR QUALITY

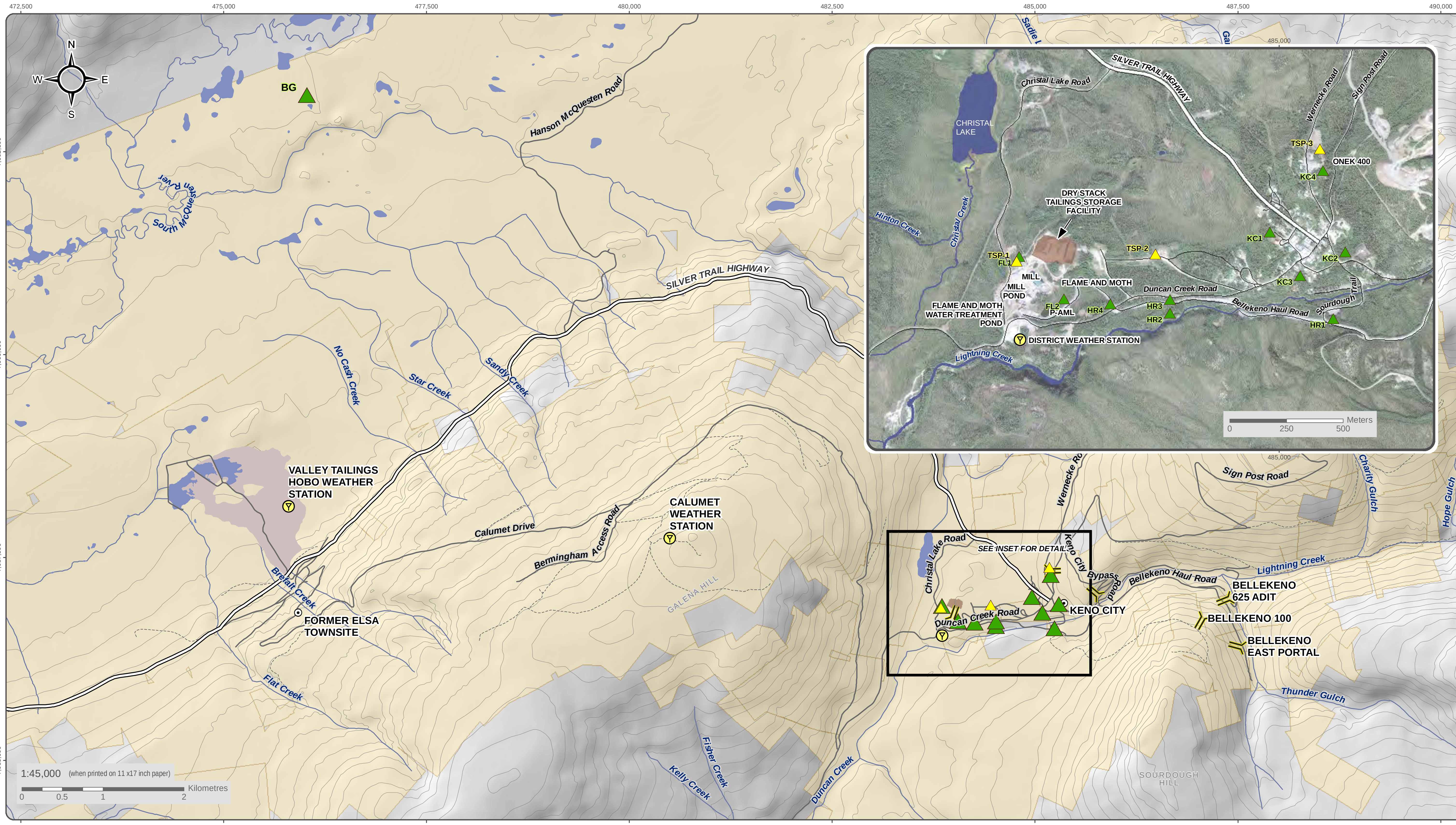
AKHM established an air quality monitoring program in 2009. To assess potential effects of particulate matter, discrete receptors in Keno City were used in the modelling. Ambient concentrations were predicted at six discrete receptors in Keno City (Figure 3-13). Air quality monitoring undertaken by AKHM during periods of suspension of operations of the District Mill represent either ambient conditions or low levels of activity.

Air quality was monitored using dustfall monitoring stations installed at four locations near the District Mill site (2011). Bergerhoff dust monitoring gauges were utilized to carry out this initial program. The Bergerhoff deposit dust gauge is designed to measure dust deposition, which can be reported as a weight per unit area over unit time.

The monitoring program was amended in 2012 to measure total particulates per volume of air for select size fractions (total suspended particulates (TSP)). Total suspended particulates (TSP) and total metal monitoring was undertaken using BGI Omni Ambient Air Quality Samplers at two locations near the District Mill site in August 2012. A third sampler (TSP-3), located in Keno City, was commissioned in December 2014. Additional sampling for coarse and fine fractions of particulate matter (PM_{10} and $PM_{2.5}$, respectively) was instigated in August 2015. In January 2021, the BGI Omni sampler located east of the mill and crusher (TSP-1) was rendered unsalvageable. In 2022 it was replaced at a new location in Keno City. Currently there are three air quality sampling stations in use for the project.

The goal of the current sampling program is to collect samples from three locations (TSP-1, TSP-2, TSP-3: see Figure 3-13) each month, to capture variability in air quality from various weather conditions. Potential dust sources include the DSTF, the crusher, and unpaved access roads.

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 $\mu g/m^3$ for TSP; 50 $\mu g/m^3$ for PM_{10}; and 27 $\mu g/m^3$ for $PM_{2.5}$.



Satellite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2023

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

- Alexco TSP Monitoring Stations
- YG PM10 Monitoring Sites 2013
- Weather Station
- Adit
- Mine Feature Footprint
- Current DSTF
- Tailings Area
- Waterbody
- Alexco/ERDC Quartz Claims
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

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HECLA KENO HILL

FIGURE 3-13

METEOROLOGICAL AND AIR QUALITY MONITORING STATIONS LOCATION

FEBRUARY 2023

3.2.1 AIR PARTICULATE

Summary statistics for 2012-2022 are presented in Table 3-13 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.

The air quality monitors established in 2012 were located 160 m (TSP-1) and 46 m (TSP-2) away from the DSTF and 163 m (TSP-1) and 240 m (TSP-2) away from the crusher, two of the main potential dust sources. The nearest residence is 710 m from the DSTF and 860 m from the crusher. TSP levels experienced at the nearest residence are better approximated by levels observed at air quality monitor TSP-3, located in Keno City. TSP-3 was installed in 2014 950 m from the DSTF and 1240 m from the crusher.

To provide better understanding of how ambient concentrations vary throughout Keno City, in Q2 2022 the following changes were made to the air quality monitoring stations:

- The dust monitor previously located at the north side of Keno City (TSP-3) was relocated adjacent the Onek 400 water treatment plant (near receptor R04). TSP-3 is now 1275 m from the DSTF and 1410 m from the crusher; and
- A third sampler (TSP-1) was installed at the eastern end of Keno City (near noise receptor R01); however, in response to concerns raised by local residents about the noise the sampler generated it was relocated the Keno City Ball Diamond (approximately 300 m west of noise receptor R05).

The sampler at the toe of the DSTF (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. Operations of the District Mill were suspended between September 2013 and December 2020 and again in June 2022 to date.

Table 3-13: Total Suspended Particulates, Coarse and Fine Particulate Matter Summary Statistics 2012 – 2022

	TSP (µg/m³)			PM$_{10}$ (µg/m³)			PM$_{2.5}$ (µg/m³)		
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	6.1	6.8	6	5.2	5.5	4.5	4	4.5	4.3
Count	330	358	270	223	249	252	211	252	251
Minimum	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Maximum	93.5	106.8	88.2	**134.2**	**151.4**	40.7	28.2	**40.7**	21.2
Geometric Mean	4.3	4.6	4.3	3.7	3.9	3.7	3.4	3.7	3.7
Count <DL	0	0	0	0	0	0	0	0	0
Standard Deviation	8	9.5	8.5	10.1	10.6	4.6	3.3	4.6	3.1
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	7	7.2	6.4	2.8	2.8	2.8	2.8	2.8	5.6
Count Over Standard	0	0	0	1	1	3	1	3	0

	TSP (µg/m³)			PM_{10} (µg/m³)			$PM_{2.5}$ (µg/m³)		
% Over Standard	0	0	0	0.4	0.4	1.2	0.5	1.2	0

Note: Bold = exceedance of YAAQS
** Two outliers removed (TSP-1 976.4 µg/m³* on July 1, 2015; TSP-3 65 µg/m³ on July 15, 2017)

From 2012-2022, the greatest average TSP concentration was measured at TSP-2 (6.8 µg/m³; Table 3-14). Concentrations of TSP at stations TSP-1 and TSP-3 measured 6.1 and 6.0 µg/m³ respectively; however, the difference is not statistically significant, and concentrations are less than the YAAQS. For coarse particulate matter (PM_{10}), the greatest average concentration was recorded at TSP-2 (5.5 µg/m³) and the lowest average at TSP-3 (4.5 µg/m³). For fine particulate matter ($PM_{2.5}$), the greatest average concentration was recorded at TSP-2 (4.5 µg/m³) and the lowest average at TSP-1 (4.0 µg/m³). These results do not greatly deviate from the 2019 results. In 2022, exceedances were recorded for PM_{10} concentrations at monitoring location TSP-1 (May 17, 2022), TSP-2 (November 7, 2022 due to cold weather), TSP-3 (October 9, 2022). Exceedances of $PM_{2.5}$ concentrations were recorded at location TSP-2 (June 16 and 18, 2022 due to forest fires); however, all of the exceedances coincide with local forest fires or significantly colder weather in 2022; all other results were less than the YAAQS.

Table 3-14: Total Suspended Particulates, Coarse, and Fine Particulate Matter Summary Statistics 2012 – 2022

	TSP (µg/m³)			PM_{10} (µg/m³)			$PM_{2.5}$ (µg/m³)		
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	6.1	6.8	6	5.2	5.5	4.5	4	4.5	4.3
Count	330	358	270	223	249	252	211	252	251
Minimum	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Maximum	93.5	106.8	88.2	**134.2**	**151.4**	40.7	28.2	**40.7**	21.2
Geometric Mean	4.3	4.6	4.3	3.7	3.9	3.7	3.4	3.7	3.7
Count <DL	0	0	0	0	0	0	0	0	0
Standard Deviation	8	9.5	8.5	10.1	10.6	4.6	3.3	4.6	3.1
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	7	7.2	6.4	2.8	2.8	2.8	2.8	2.8	5.6
Count Over Standard	0	0	0	1	1	3	1	3	0
% Over Standard	0	0	0	0.4	0.4	1.2	0.5	1.2	0

Note: bold = exceedance of YAAQS
** Two outliers removed (TSP-1 976.4 µg/m3 on July 1, 2015; TSP-3 65 µg/m3 on July 14, 2017)*

3.2.2 METAL SPECIATION

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-hour average concentrations for metals.

Table 3-15 presents the summary statistics for 2012 to 2022 for metal concentrations from samples TSP-1, TSP-2, and TSP-3, while the complete result tables are presented in Attachment A3 to A5. When results were below the detection limit a value of half the detection limit was used to calculate the statistics.

All parameters met AAQC criteria except for cadmium (TSP-2 – 0.6% of samples; TSP-3 – 0.7% of samples), lead (TSP-1 – 0.6% of samples; TSP-2 – 0.3% of samples), and manganese (TSP-2 – 1.1% of samples).

Table 3-15: Metal Concentrations Summary Statistics (24-hour) 2012 – 2022

	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	0.155	0.0983	0.03951	0.0025	0.00403	0.023	0.00989	0.36	0.0752	0.02465	0.025	0.173	0.04718	0.034	0.009	0.02463	0.02501	0.163	0.51	0.0249	0.413	0.01482	0.238	0.00269	20	0.04016	0.014	0.019	0.0322	0.026
Count	331	331	331	331	331	331	331	331	329	331	331	331	331	331	331	331	331	331	331	331	265	327	329	331	328	331	331	331	331	331
Minimum	0.014	0.00035	0.00035	0.0003	0.00035	0.021	0.00007	0.069	0.0208	0.00035	0	0.021	0.00035	0.021	0	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	0.03472	0.03472	0.208	1.035	0.07917	3.875	0.02083	2.444	0.04097	69.4	0.19306	0.042	0.021	0.8167	0.035
Geometric Mean	0.099	0.02439	0.01371	0.0021	0.00247	0.021	0.00378	0.237	0.0708	0.00903	0.016	0.102	0.02362	0.027	0.006	0.00803	0.01379	0.142	0.311	0.00907	0.262	0.00492	0.208	0.00189	0.7	0.01289	0.014	0.019	0.0189	0.017
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	0.411	0.06314	0.02499	0.0024	0.00237	0.019	0.00622	0.71	0.0235	0.01567	0.015	0.233	0.07548	0.04	0.023	0.01569	0.0151	0.069	0.294	0.01616	0.61	0.0094	0.19	0.00347	31.4	0.02751	0.002	0.003	0.0656	0.015
1st Quartile	0.06	0.00035	0.00094	0.0021	0.00035	0.021	0.0004	0.139	0.0608	0.00035	0.004	0.051	0.01051	0.021	0.006	0.00021	0.00209	0.056	0.074	0.00035	0.208	0.00014	0.208	0.00152	0.1	0.00035	0.014	0.014	0.0139	0.003
Median	0.139	0.13889	0.05556	0.0021	0.00556	0.021	0.01389	0.139	0.0736	0.03472	0.035	0.086	0.05556	0.021	0.006	0.03472	0.03472	0.208	0.694	0.03472	0.208	0.02083	0.208	0.00208	0.1	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	0.431	0.0889	0.03472	0.035	0.266	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	0.0292	0.035
Count Exceeding Standard	0	0	0	0	0	0	0	0	0	0	0	0	2	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	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSP-2																														
Average	0.119	0.08474	0.03438	0.0024	0.00352	0.022	0.00878	0.334	0.0762	0.02126	0.022	0.223	0.05118	0.04	0.021	0.02122	0.02197	0.148	0.446	0.02126	0.402	0.01296	0.208	0.00223	26.7	0.03402	0.014	0.018	0.043	0.022
Count	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	298	356	360	360	355	360	360	360	360	360
Minimum	0.014	0.00035	0.00035	0.0003	0.00035	0.021	0.00007	0.069	0.0208	0.00035	0	0.021	0.00035	0.021	0	0.00021	0.00081	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	0.05556	0.0476	0.00556	0.099	**0.04028**	3.472	0.1889	0.03472	0.035	2.778	**0.73611**	0.468	**0.651**	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	0.4819	0.035
Geometric Mean	0.087	0.01499	0.01008	0.002	0.00188	0.021	0.00294	0.256	0.0713	0.00576	0.012	0.128	0.02728	0.031	0.008	0.00488	0.01038	0.124	0.236	0.00574	0.253	0.00369	0.189	0.00171	1.4	0.00809	0.014	0.018	0.0251	0.013
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	0.13	0.06758	0.02649	0.0031	0.00255	0.006	0.00692	0.301	0.0254	0.0168	0.016	0.274	0.06176	0.042	0.061	0.01684	0.01627	0.074	0.316	0.0168	0.621	0.00997	0.109	0.0025	33.7	0.0269	0.001	0.003	0.0581	0.016
1st Quartile	0.05	0.00035	0.00076	0.0017	0.00035	0.021	0.00042	0.139	0.0597	0.00035	0.003	0.061	0.0158	0.021	0.006	0.00021	0.00165	0.056	0.035	0.00035	0.139	0.00014	0.194	0.00111	0.1	0.00035	0.014	0.014	0.0139	0.003
Median	0.139	0.13889	0.05556	0.0021	0.00556	0.021	0.01389	0.285	0.075	0.03472	0.035	0.118	0.05556	0.021	0.006	0.03472	0.03472	0.208	0.694	0.03472	0.208	0.02083	0.208	0.00208	0.1	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	0.458	0.0922	0.03472	0.035	0.334	0.05556	0.046	0.012	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	0.0484	0.035

	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 Exceeding Standard	0	0	0	0	0	0	2	0	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Exceeding Standard	0	0	0	0	0	0	0.6	0	0	0	0	0	0.3	0	1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSP-3																														
Average	0.127	0.0679	0.02734	0.0021	0.00289	0.023	0.00772	0.394	0.0738	0.01709	0.018	0.091	0.02931	0.036	0.005	0.01704	0.01767	0.13	0.369	0.01709	0.338	0.01023	0.2	0.00383	35	0.02733	0.014	0.017	0.0332	0.019
Count	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	261	273	273	273	270	273	273	273	273	273
Minimum	0.014	0.00035	0.00035	0.0003	0.00035	0.021	0.00007	0.069	0.0208	0.00035	0	0.021	0.00035	0.021	0	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	0.1583	0.03472	0.035	0.514	0.06903	0.553	0.07	0.03472	0.03472	0.208	1.006	0.03472	3.25	0.02083	1.472	0.175	69.4	0.05556	0.014	0.021	0.6472	0.035
Geometric Mean	0.078	0.00675	0.00444	0.0017	0.00135	0.022	0.00152	0.273	0.0707	0.00329	0.008	0.067	0.01071	0.027	0.004	0.00264	0.00664	0.106	0.168	0.00329	0.231	0.00165	0.177	0.0015	2.8	0.00446	0.014	0.017	0.0178	0.01
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	0.277	0.06932	0.02756	0.0023	0.00261	0.019	0.01225	0.657	0.0212	0.01721	0.016	0.084	0.0263	0.055	0.006	0.01726	0.01665	0.076	0.325	0.01721	0.502	0.01035	0.117	0.01703	34.7	0.02757	0	0.004	0.0645	0.016
1st Quartile	0.043	0.00035	0.00035	0.0013	0.00035	0.021	0.00017	0.139	0.0597	0.00035	0.002	0.046	0.00207	0.021	0.002	0.00021	0.00135	0.056	0.035	0.00035	0.139	0.00014	0.167	0.00088	0.1	0.00035	0.014	0.014	0.0139	0.003
Median	0.139	0.00138	0.00294	0.0021	0.00035	0.021	0.00974	0.361	0.0743	0.00035	0.008	0.065	0.02569	0.021	0.006	0.00062	0.00299	0.056	0.3	0.00035	0.208	0.00051	0.208	0.00208	69.4	0.00185	0.014	0.014	0.0139	0.003
3rd Quartile	0.139	0.13889	0.05556	0.0021	0.00556	0.021	0.01389	0.458	0.0843	0.03472	0.035	0.096	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	0.0262	0.035
Count Exceeding Standard	0	0	0	0	0	0	2	0	0	0	0	0	0	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	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

"n/a" was used to signify when no Ontario Ambient Air Quality Criteria (µg/m³) exists for specific metals.

Half the reportable detection limit (RDL) was used to calculate averages for samples that were below the RDL. 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 2022 data only and medians of data from all years (2012 – 2022) at a significance level (p) of 0.05 (Attachment B). The concentrations of total metals were significantly different ($p<<0.05$) between stations for aluminum, antimony, arsenic, copper, iron, lead, manganese, silver, and zinc in 2022. Slight differences ($0.01<p<0.05$) in metal concentrations were also detected between stations for cadmium and nickel. No detectable differences were found for all other analytes in 2022. Concentrations of total metals measured at TSP-1, TSP-2, and TSP-3 from 2012 to 2022 were significantly different ($p<<0.05$) for aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, phosphorous, potassium, selenium, silver, sodium, strontium, sulfur, tin, vanadium, zinc, and zirconium. Slight differences ($0.01<p<0.05$) in metal concentrations were also detected between stations for calcium. Dunn's pairwise post-hoc test was used to determine between which stations (TSP-1, TSP-2, or TSP-3) analytes significantly differed. Usually, concentrations of total metals were greater at TSP-1 (located closest to mining activity) and TSP-2 compared to TSP-3 (located furthest from mining activity). Slight differences ($0.01<p<0.05$) were detected for barium, magnesium, and sodium, and no detectable differences were seen for boron, chromium, and titanium.

Dust originating from the DSTF may contain arsenic, aluminum, calcium, iron, magnesium, manganese, lead, and zinc, based on metal characterization analyses of the tailings conducted from 2012 to 2013 and 2021 to 2022. From the wind direction distribution, TSP-2 is more frequently located downwind of the DSTF than TSP-1 and may be expected to record concentrations of the above metals. This was observed for historical maximum lead (August 2012) and manganese (March 2013) concentrations; however, the current average concentrations of these parameters remain below identified standards (Ontario AAQC).

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 eventually 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. Operations of the District Mill were suspended between September 2013 and December 2020 and again in June 2022 to date.

3.2.3 WIND ANALYSIS

Hourly wind speed and direction was recorded between November 2011 and May 2022, at the District Mill weather station. The wind rose plot shown in Section 3.1.2 depicts this information based on 36 wind direction categories. The average wind speed is 1.21 m/s and winds are calm 23.7% 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 3-16 below, and are based on eight wind direction categories, and six wind speed categories.

Table 3-16: Wind Frequency Distribution District Mill, June 2011 – May 2022

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	12.34	3.21	0.26	0.01	0.00	0.00	15.82
NE	10.33	1.29	0.03	0.00	0.00	0.00	11.64
E	11.43	1.85	0.19	0.00	0.00	0.00	13.46
SE	9.43	3.19	1.15	0.12	0.00	0.00	13.89
S	8.79	2.30	0.17	0.02	0.00	0.00	11.29
SW	2.40	1.38	0.15	0.00	0.00	0.00	3.94
W	0.92	0.59	0.27	0.02	0.00	0.00	1.80
NW	2.17	1.64	0.64	0.04	0.00	0.00	4.49
Sub-Total	57.81	15.45	2.84	0.22	0.01	0.00	76.32
					Calm		23.67
					Total		100

The dominant wind direction is from the north (approximately 16% of the time), followed by the southeast (approximately 14%). When the predominant wind direction is from the northeast or southeast, air quality station TSP-2 is located downwind of the DSTF and the crusher. Given these generalities TSP-2 may capture influences from facilities when predominant winds are a blowing from the SE and NE. TSP-1 station is adjacent to the dominant winds and likely will only capture influences when the wind is blowing from the southwest or west directions. Air quality station TSP-3, located on the north side of Keno City, is east of these potential dust sources. Based on

Table 3-16, westerly winds only occur about 2% of the time (or roughly 10% 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).

3.2.4 PM_{10} SAMPLING BY YUKON GOVERNMENT

Independent PM_{10} sampling was conducted by Yukon Government in 2013 at the locations shown in Figure 3-13. The station labelled BG represents background (8 km outside of Keno), stations labelled KC are in Keno City, stations labelled HR are along the Bellekeno Haul Road and stations labelled FL are fence line stations and correspond to TSP-1 (prior to the relocation of this station to the ball diamond) and TSP-2 locations. 5-minute data averaged over the different sampling periods are presented in Table 3-17 below. The sampling period varies between sites (ranges from about 14 to 53 hours) but for comparison purposes, the average results are all below the 24-hour YAAQS of 50 µg/m^3. Note that in some cases the measured background PM_{10} concentration is higher than that measured at some of the receptors, for example during the July 15-17 sampling event site HR1 measured coarse particulate matter at 5.2 µg/m^3 and the background at 10.2 µg/m^3. This suggests there is some variability in the data and that the difference between background and receptors sites may not be significant. Results are generally comparable to the PM_{10} concentrations measured by AKHM at stations TSP-1, TSP-2, and TSP-3 (August 2015 to December 2017).

Table 3-17: Average Coarse Particulate Matter (PM_{10}) concentrations

	PM_{10} (µg/m^3)		
Site Locations	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

Source: Yukon Government, 2014
NS: Not Sampled

3.3 NOISE MONITORING

AKHM has monitored noise at the five locations selected in the Noise Impact Assessment (NIA; PAAE, 2014) as being potential noise receptors within a 2 km radius study area around Keno City. Since November 2013, noise has also been monitored at a sixth location, the Keno City Campground. These monitoring locations are listed in Table 3-18 and shown in Figure 3-14.

Table 3-18: Representative Locations Assessed in Keno City

Monitoring Location	GPS Location	Description
R01	N63.90827 W135.29599	East end Residence, north side of Lightning Creek Road
R02	N63.91019 W135.29968	Residence, east side of Sign Post Road
R03	N63.91023 W135.30205	Town Center, north from the Snack Bar
R04	N63.91239 W135.30376	Residence, west side of Wernecke Road
R05	N63.90851 W135.30993	Residence, about 850 m east from the Mill
Campground	N63.90772 W135.29998	Keno City campground

The background noise levels at each monitoring location vary considerably and depend on climate parameters like relative humidity, temperature, and temperature inversions. These parameters influence how the receptors interpret sound level and propagation. For example, sound travels faster through hot air since hot air is less dense, resulting in different noise readings compared to a station 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 drier.

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2020

Datum: NAD 83; Projection: UTM Zone 8N

1:6,000 *(when printed on 11 x17 inch paper)*

0 50 100 150 200 250 Meters

Noise Monitoring Station

Adit

Current DSTF

Pond

Mine Feature Footprint

Watercourse

Silver Trail Highway

Secondary Road

HECLA KENO HILL

FIGURE 3-14

NOISE MONITORING STATIONS

FEBRUARY 2023

D:\Project\AllProjects\Keno_Area_Mines\ALL-SITES\02-Map\04-Studies\Air_Noise_Dust\Air_Quality_NOise_Mill_20190328.mxd
(*Last edited by: amatlashevska;2020-02-21/13:32 PM*)

3.3.1 MONITORING EQUIPMENT

The noise monitoring profiles collected between April 2013 and November 2014 were measured using an Extech Integrating Sound Level Datalogger (Model 407780) to capture average decibels A (dBA) over a single ten-minute period. Starting in December 2014, noise monitoring readings were collected with a Casella CEL-63X Sound Level Meter and a Casella CEL-495 Microphone. In 2022, a Larson Davis Soundtrack LxT device replaced the broken Casella CEL-63X device. Both the Casella and Larson Davis devises utilize a microphone mounted on a tripod at approximately 1.5 meters above ground and fitted with a windscreen to reduce wind impacts. During periods of extended low temperatures (i.e., below -30 C), when the noise monitoring equipment is operating outside of manufacture recommended temperatures, the data collection may be limited.

Wind speed, wind direction, temperature, and precipitation from the District Mill meteorological station are summarised alongside each noise monitoring event because weather can influence measured noise levels. Any noise sources associated with the monitoring event were also documented where possible.

Additional details on sampling events that occurred each year since noise monitoring began are outlined below.

- In 2015, 24-hr period data were collected in January, as well as August through November. Equipment issues prevented the collection of 24-hr period data for the remainder of the year.
- In 2016, 24-hr period data were collected every month; however, not all stations could be monitored every month due to battery or other equipment issues, or the temperature being below operating conditions for the equipment.
- In 2017, a combination of equipment malfunction, equipment vandalism, and very cold temperatures only allowed for 24-hr period noise data collection in June, July, and November.
- In 2018, similar issues were encountered early in the year, samples were collected from March to December 2018.
- In 2019, 57 successful recording were captured from January to December 2019. Some recordings were missed due to battery issues, cold temperatures, and technical difficulties.
- In 2020, 38 recordings were captured from January to December 2020. 24-hr period data were collected every month except for September, October, and November; however, not all stations could be monitored every month due to battery issues, or the temperature being below operating conditions for the equipment.
- In 2021, a Larson Davis Soundtrack LxT device was purchased to replace the broken Casella CEL-63X device. Monitoring resumed in October 2021. Factory calibration of the Larson Davis sound meter was relied on in 2021 due to supply chain issues associated with acquiring the calibration device.
- In 2022, 66 successful recordings were captured from January to September. The device malfunctioned in July, however, the malfunction was not noticed until late fall when it was taken out of service, thus leaving a data gap from July 15, 2022 to December 31, 2022. The Larson Davis sound meter was calibrated in 2022.

3.3.2 RESULT

Table 3-19 presents all 24-hr period noise data available from 2014 through 2022 (all data runs with <24-hr have been excluded), and associated meteorological parameters obtained from the District Mill meteorological station (averaged from hourly data for the corresponding 24-hr period). Since noise monitoring began, the LAeq has exceeded the LAF 10 approximately 34% of the time, indicating that the majority of noise measured on site to date can be attributed to general background noise.

The difference between the LAeq and the LAF 90 (the sound level exceeded for 90% of the measurement period – quieter sounds) also indicates if the LAeq has been influenced by short term noise events. If the difference between LAeq and the LAF 90 is greater than 10 dB, then the LAeq is influenced by short-term noise events. However, if the difference between LAeq and the LAF 90 is less than 5 dB, then the LAeq indicates a uniform background level of noise. In 2022, there were no monitoring events where the difference between LAeq and the LAF 90 was greater than 10 dB. From 2014 through 2022, the difference between the LAeq and the LAF 90 was greater than 10 dB 33% of the time, indicating that the LAeq is generally influenced by short-term noise events.

All 24-hr noise recording results from 2014 to 2022 are presented in Figure 3-15 with the NIA values that were calculated in 2014 by PAAE. PAAE estimated that the Predicted Sound Levels with both ambient and day-time activities associated with the mine would be from 32 dBA at R03 to a maximum of 39 dBA at R01. PAAE also predicted an increase above current sound levels associated with the activity changes in Flame & Moth to be a maximum of 2 dB at R04 for both daytime and nighttime conditions. NIA is presented in all the following figures as a minimum of 32 dBA and a maximum of 39 dBA. Throughout 2022 there were no recordings that exceeded the maximum predicted levels from the NIA (39 dB), while all measurements were below the minimum predicted levels from the NIA (32 dB). From 2014 through 2022, approximately 32% of measurements have exceeded the maximum predicted level (39 dB).

Table 3-19: 24-hr Noise Data and Corresponding Meteorological Data, 2014 to 2022

Station	Start Date	LAeq (dB)	LAF 10% (dB)*	LAF 90% (dB)*	LAeq > LAF 10	LAeq - LAF 90% (dB)	Lzeq (dB)	LAIeq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Calibration Drift (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	-4.8	-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	-4.8	-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	-4.8	-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	-4.8	-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	-4.8	-9.6	93.8	n/a
R01	2015-01-10	28.8	N/A	N/A			38.2	33.4	78.2	35.6	6.8	-4.8	-10.2	93.7	n/a
R02	2015-01-11	33.8	N/A	N/A			43.8	36.0	83.2	40.3	6.5	-4.8	-10.1	93.3	n/a
R03	2015-01-13	28.6	N/A	N/A			40.7	31.6	78.0	37.9	9.3	---.-	-7.3	95.3	n/a
R04	2015-01-14	36.5	N/A	N/A			51.4	41.8	85.9	47.6	11.1	-4.8	-9.4	93.9	n/a
R05	2015-01-15	37.5	N/A	N/A			47.8	42.1	86.9	41.1	3.6	-4.8	-1.8	99.0	0.52
Campground	2015-01-22	23.2	N/A	N/A			28.0	23.4	72.6	22.5	-0.7	---.-	-9.8	93.6	0.47
R05	2015-11-14	32.8	17.0	15.0	Yes	17.8	42.4	33.6	82.2	39.2	6.4	0.3	-18.4	86.5	n/a
R01	2015-11-16	34.7	19.5	16.0	Yes	18.7	51.2	37.0	84.0	49.2	14.5	0.3	-17.4	87.3	n/a
R04	2015-11-17	21.3	18.0	15.5	Yes	5.8	46.4	27.3	70.6	36.3	15.0	0.3	-21.0	83.9	n/a
R02	2015-11-19	33.1	16.0	15.5	Yes	17.6	46.9	40.3	82.4	44.2	11.1	0.3	-28.4	76.7	n/a
R03	2015-11-21	39.7	17.5	16.0	Yes	23.7	47.8	46.0	89.0	46.3	6.6	0.3	-9.0	94.0	n/a
Campground	2016-01-07	23.2	20.0	15.5	Yes	7.7	38.1	30.2	72.5	75.8	7.8	0.1	-16.1	81.8	0.63
R03	2016-01-08	28.3	19.5	16.5	Yes	11.8	40.0	35.9	77.7	74.6	4.5	-0.2	-11.5	90.4	0.44
R01	2016-01-09	39.0	20.0	15.5	Yes	23.5	48.9	41.7	88.4	79.3	6.4	-0.2	-14.6	89.7	0.51
R05	2016-01-10	30.6	20.5	15.5	Yes	15.1	44.1	35.5	80.0	71.6	5.7	-0.2	-18.2	86.5	0.33
R04	2016-02-15	25.5	19.0	15.5	Yes	10	48.5	33.9	74.9	68.1	6.3	0.3	-7.8	89.0	1.12
R03	2016-02-17	23.9	19.0	15.0	Yes	8.9	40.3	30.2	73.3	66.8	11.6	-2.1	-22.9	77.9	0.45
Ball Diamond	2016-02-25	---.-	18.5	15.5	Yes		43.7	24.4	69.3	56.2	9.2	-0.2	-5.5	81.4	1.27
Campground	2016-02-26	21.4	21.5	16.0	No	5.4	43.9	26.0	68.9	57.0	9.3	0.2			
R01	2016-02-28	22.4	20.5	16.5	Yes	5.9	55.1	26.1	71.8	65.0	15.6	-0.5	-2.8	85.0	0.92
R04	2016-03-12	37.5	25.0	15.5	Yes	22	56.9	44.4	86.8	82.0	3.8	0.4	-5.3	62.8	1.03
R05	2016-03-15	26.1	22.0	17.0	Yes	9.1	56.1	32.5	75.5	65.4	13.8	-0.1	-6.2	91.4	0.86
R03	2016-03-17	111.8	115.5	45.5	No	66.3	127.7	120.4	161.2	136.7	7.8	-0.1	-4.9	70.9	1.09
Campground	2016-03-18	27.7	30.5	18.5	No	9.2	57.5	31.3	77.1	63.7	12.9	-0.1	-7.8	72.8	1.89
R05	2016-04-15	31.9	30.0	18.0	Yes	13.9	54.3	34.4	81.2	67.1	9.1	-0.1	3.2	63.6	1.51
R03	2016-04-16	41.0	34.5	17.0	Yes	24	60.8	43.7	90.4	75.3	12.1	----	3.7	57.2	1.56
R04	2016-04-18	28.0	27.0	17.0	Yes	11	56.3	36.1	77.4	72.0	11.9	-0.1	0.5	64.2	1.73
R02	2016-04-23	29.1	28.5	16.5	Yes	12.6	65.9	38.0	78.5	66.9	20.1	0.1	7.3	59.3	1.44
Campground	2016-04-24	35.2	34.5	27.5	Yes	7.7	52.4	36.9	84.5	67.9	14.3	-0.1	7.6	59.9	1.28
R01	2016-04-25	39.1	39.5	36.5	No	2.6	55.1	39.5	88.4	73.4	13.5	-0.1	5.7	57.5	1.78

Station	Start Date	LAeq (dB)	LAF 10% (dB)*	LAF 90% (dB)*	LAeq > LAF 10	LAeq - LAF 90% (dB)	Lzeq (dB)	LAIeq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Calibration Drift (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R01	2016-05-15	49.3	50.5	48.0	No	1.3	57.5	49.7	98.7	66.3	3.3	-0.1	12.2	47.4	2.3
R02	2016-05-16	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	2016-05-18	38.7	38.5	24.5	Yes	14.2	60.2	40.4	88.1	76.9	13.6	0.1	7.5	66.6	1.88
R04	2016-05-19	39.2	34.0	21.5	Yes	17.7	59.5	46.8	88.6	81.0	6.3	-0.2	10.3	56.7	1.57
Campground	2016-05-21	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
R05	2016-05-22	41.0	44.0	30.5	No	10.5	52.8	42.8	90.4	69.9	10.3	-0.2	9.9	66.2	1.72
R01	2016-06-13	50.9	51.0	50.0	No	0.9	53.8	54.5	100.2	85.4	2.5	----	11.1	78.0	1.63
R05	2016-06-19	39.7	42.5	31.5	No	8.2	53.0	41.6	89.1	70.4	7.5	0.1	19.6	26.9	2.28
R04	2016-06-20	38.5	34.0	21.0	Yes	17.5	55.6	48.8	87.9	82.7	10.0	0.1	10.3	79.6	1.47
R03	2016-06-29	48.0	44.0	22.5	Yes	25.5	61.0	53.6	97.3	91.1	10.8	-0.2	15.5	67.8	1.35
Campground	2016-06-30	51.1	51.0	15.5	Yes	35.6	57.0	60.1	100.5	95.4	5.0	0.1	12.7	83.3	0.69
R05	2016-07-17	40.5	42.0	30.5	No	10	52.9	43.3	89.9	75.8	8.9	----	14.8	64.6	2.5
Campground	2016-07-18	48.3	46.5	44.5	Yes	3.8	54.1	56.6	97.6	90.1	4.7	-0.1	11.2	82.5	1.61
R03	2016-07-30	40.3	38.5	27.0	Yes	13.3	61.1	46.4	89.7	84.8	14.0	----	13.7	69.0	2
R01	2016-07-31	91.0	92.5	61.5	No	29.5	105.5	97.9	140.3	128.2	5.4	0.2	12.5	65.7	1.93
Campground	2016-09-21	44.3	46.0	40.5	No	3.8	59.3	47.9	93.7	77.5	5.1	----	10.1	36.8	2.63
R01	2016-09-22	46.5	47.0	45.0	No	1.5	64.8	46.9	95.8	72.8	5.2	0.1	7.2	56.4	2.47
R04	2016-09-23	33.9	33.5	23.5	Yes	10.4	57.2	38.1	83.3	72.0	13.8	-0.1	4.1	59.1	1.85
R05	2016-09-24	77.2	73.5	39.5	Yes	37.7	89.3	89.8	126.6	122.1	4.5	0.2	0.9	94.4	0.88
Campground	2016-11-09	34.2	34.0	32.5	Yes	1.7	56.4	39.5	69.2	68.0	6.3	0.1			
R05	2016-11-10	45.6	48.5	31.0	No	14.6	72.7	53.3	94.7	85.5	13.4	----			
R01	2016-11-11	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
R05	2018-06-14	42.4					38.6	28.9	71.5	37.4	11.4	-5.7	10.4	53.0	1.74
R02	2018-06-19	26.8					40.9	26.9	69.2	34.7	10.5	-5.7	17.4	45.1	2.11
R05	2018-06-21	34.5					50.6	51.3	84.0	49.4	10.1	-5.7	16.9	55.8	1.47
R01	2018-06-26	39.2					51.3	38.0	79.5	50.0	15.5	0.0	11.3	71.8	1.38
R05	2018-07-19	24.2					43.4	31.4	72.1	40.6	13.8	-3.1	11.6	64.2	1.3
Campground	2018-07-24	26.0					73.5	49.0	85.9	66.1	23.7	0.1	17.3	52.9	1.17
R04	2018-08-29	37.1	32.5	23.5	Yes	13.6	62.3	41.1	86.4	50.5	13.4	0.1	8.3	75.5	1.4
R01	2018-08-30	53.1	53.5	52.5	No	0.6	57.4	54.6	102.4	55.9	12.8	-0.1	6.7	74.7	1.46
R03	2018-08-31	47.4	46.0	29.5	Yes	17.9	65.9	55.2	96.8	60.0	12.6	-0.1	4.1	90.7	0.98
Campground	2018-09-05	48.4	47.5	47.0	No	1.4	56.8	53.3	97.8	54.2	5.8	-0.1	7.1	73.0	1.37
R03	2018-09-06	42.2	42.0	25.5	Yes	16.7	65.5	52.2	94.5	56.6	11.4	0.0	5.0	89.4	0.6
R01	2018-09-07	46.8	47.0	45.0	No	1.8	62.7	47.6	96.2	55.1	8.3	0.0	4.7	85.5	1.07
R02	2018-09-09	31.0	30.5	20.5	Yes	10.5	59.1	36.3	80.4	49.2	18.2	-0.1	4.7	65.2	2.25
R05	2018-09-10	35.7	36.5	24.5	Yes	11.2	63.1	38.5	85.1	50.0	14.3	0.2	5.6	57.2	1.2
R03	2018-10-07	45.9	40.5	21.0	Yes	24.9	64.7	53.1	95.3	63.3	17.4	-0.2	-3.5	53.8	2.26

Station	Start Date	LAeq (dB)	LAF 10% (dB)*	LAF 90% (dB)*	LAeq > LAF 10	LAeq - LAF 90% (dB)	Lzeq (dB)	LAleq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Calibration Drift (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
Campground	2018-10-08	127.8	129.5	124.0	No	3.8	131.1	128.5	177.1	129.3	1.5	0.3	-7.2	65.2	1.29
Campground	2019-01-25	22.5	22.0	17.0	Yes	5.5	44.6	28.0	71.9	37.9	15.4	-0.3	-10.1	92.8	0.00
Campground	2019-02-23	20.5	19.0	17.0	Yes	3.5	37.2	23.7	69.8	31.1	10.6	0.1	-21.5	77.9	0.95
Campground	2019-05-10	48.5	44.5	42.0	Yes	6.5	63.9	58.8	97.8	53.7	5.2	0.0	9.7	34.5	2.51
Campground	2019-07-11	53.5	40.0	37.0	Yes	16.5	67.9	62.3	102.9	65.9	12.4	-0.1	13.6	77.2	1.23
Campground	2019-10-31	34.4	35.0	32.5	No	1.9	42.2	36.9	83.8	38.4	4.0	-0.4	-4.6	95.9	0.93
Campground	2019-11-14	21.0	23.0	17.0	No	4.0	41.8	24.8	70.4	32.6	11.6	0.2	-17.3	84.4	0.90
R01	2019-01-29	40.6	41.0	40.0	No	0.6	50.1	40.8	84.2	39.6	-1.0	-0.2	-16.4	87.8	0.41
R01	2019-02-24	43.2	43.5	42.0	No	1.2	51.5	43.2	92.5	41.5	-1.7	0.1	-18.4	77.8	0.75
R01	2019-04-25	41.8	40.5	18.5	Yes	23.3	59.6	43.6	91.1	58.6	16.8	0.2	-3.4	63.4	1.63
R01	2019-05-01	34.8	38.0	21.0	No	13.8	55.9	38.8	84.2	48.1	13.3	0.1	5.2	33.9	2.95
R01	2019-07-16	37.7	38.5	26.5	No	11.2	52.6	39.8	87.0	50.3	12.6	-0.1	14.8	64.7	1.54
R01	2019-09-24	38.3	39.0	26.5	No	11.8	50.5	39.7	87.7	49.4	11.1	-0.1	2.3	71.9	1.30
R01	2019-10-23	49.8	40.0	39.0	Yes	10.8	53.9	51.1	99.1	51.1	1.3	-0.1	-5.5	91.5	1.02
R02	2019-08-28	45.5	44.0	43.0	Yes	2.5	60.3	47.2	91.1	52.9	7.4	0.0	8.4	61.0	1.56
R02	2019-09-27	45.8	45.5	44.5	Yes	1.3	61.1	46.7	84.8	51.0	5.2	0.4	-1.2	64.2	1.42
R03	2019-03-05	41.3	44.0	17.5	No	23.8	52.2	42.2	89.0	45.0	3.7	-0.9	-16.2	65.0	0.92
R03	2019-03-07	37.5	41.5	17.0	No	20.5	53.1	38.6	75.1	44.6	7.1	-0.9	-14.9	57.5	0.92
R03	2019-02-22	40.3	31.0	17.5	Yes	22.8	55.6	41.6	82.2	53.7	13.4	-0.4	-19.3	73.1	1.33
R03	2019-03-07	28.3	21.0	17.0	Yes	11.3	48.8	30.4	70.6	45.4	17.1	0.2	-14.7	61.6	1.20
R03	2019-04-20	45.1	39.5	21.5	Yes	23.6	65.3	48.4	94.5	58.8	13.7	-0.1	0.4	56.1	1.84
R03	2019-05-23	56.4	45.5	27.0	Yes	29.4	83.2	68.8	105.7	74.6	18.2	0.0	14.0	44.2	1.57
R03	2019-08-27	39.1	39.0	23.5	Yes	15.6	60.7	42.6	84.8	53.6	14.5	-0.1	8.1	61.7	1.89
R03	2019-09-19	43.4	45.5	24.5	No	18.9	67.9	51.8	92.7	62.4	19.0	0.1	5.4	93.5	1.03
R03	2019-10-25	24.3	22.5	19.0	Yes	5.3	42.6	32.6	71.8	38.9	14.6	0.1	-5.0	91.2	0.98
R03	2019-11-20	40.6	23.5	17.5	Yes	23.1	47.3	43.6	89.9	44.3	3.7	0.1	-6.0	95.5	0.80
R03	2019-12-17	42.4	45.0	17.5	No	24.9	50.6	42.4	91.7	42.2	-0.2	-0.3	-21.4	83.3	0.21
R04	2019-01-31	39.4	40.0	39.0	No	0.4	50.0	39.5	76.4	39.9	0.5	1.0	-14.2	86.1	1.62
R04	2019-02-26	31.4	21.0	17.5	Yes	13.9	41.6	34.7	80.7	38.5	7.1	-0.2	-14.4	78.2	0.60
R04	2019-04-16	27.0	30.0	20.5	No	6.5	52.3	31.3	63.3	44.7	17.7	0.1	0.0	69.5	1.11
R04	2019-04-19	39.2	35.5	21.5	Yes	17.7	61.8	42.6	88.5	55.7	16.5	-0.4	2.2	60.1	2.27
R04	2019-05-09	33.6	34.0	20.5	No	13.1	67.4	35.7	82.9	52.5	18.9	0.1	8.4	50.1	2.35
R04	2019-06-26	38.3	33.5	21.5	Yes	16.8	58.1	42.9	87.6	46.4	8.1	0.2	15.2	49.4	1.96
R04	2019-07-04	39.4	32.5	20.5	Yes	18.9	53.9	47.1	88.7	43.0	3.6	0.1	15.7	67.6	1.42
R04	2019-08-23	39.2	33.0	22.5	Yes	16.7	55.0	43.0	83.5	46.4	7.2	0.1	8.5	61.0	1.22
R04	2019-09-18	59.8	58.5	22.5	Yes	37.3	69.7	72.4	109.1	63.1	3.3	-0.3	5.1	86.0	1.53
R04	2019-10-17	29.6	28.5	20.5	Yes	9.1	46.8	35.4	79.0	40.4	10.8	-0.3	-3.2	88.3	0.77

Station	Start Date	LAeq (dB)	LAF 10% (dB)*	LAF 90% (dB)*	LAeq > LAF 10	LAeq - LAF 90% (dB)	Lzeq (dB)	LAIeq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Calibration Drift (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R04	2019-11-15	43.4	45.0	18.5	No	24.9	50.9	44.5	92.8	42.5	-0.9	0.1	-21.2	80.8	0.69
R04	2019-12-13	64.5	66.0	59.0	No	5.5	67.0	71.5	85.3	66.0	1.5	0.3	-11.1	89.6	0.35
R05	2019-01-23	19.8	19.5	17.0	Yes	2.8	37.7	22.9	69.2	29.1	9.3	-0.2	-23.9	80.8	0.00
R05	2019-02-21	24.3	27.0	17.0	No	7.3	47.4	26.0	73.1	32.6	8.3	-0.4	-16.9	82.0	1.66
R05	2019-04-15	115.0	117.5	110.0	No	5.0	124.2	117.6	164.4	120.2	5.2	-0.3	-0.6	66.6	1.37
R05	2019-05-07	33.0	35.0	19.0	No	14.0	54.7	35.3	82.4	43.6	10.6	0.1	8.3	53.5	1.82
R05	2019-06-27	35.5	39.0	23.5	No	12.0	50.3	36.3	81.1	40.9	5.4	-0.2	15.4	29.8	1.64
R05	2019-08-22	35.4	39.0	19.5	No	15.9	49.2	37.0	79.0	42.7	7.3	0.0	4.8	66.0	1.20
R05	2019-10-22	23.7	26.0	19.0	No	4.7	43.8	26.5	73.1	30.7	7.0	0.1	-3.1	90.4	0.93
Campground	2020-01-30	19.4	18.5	17.0	Yes	2.4	45.2	23.8	68.7	27.8	8.4	-0.2	-12.0	90.3	0.74
R01	2020-02-21	19.3	20.0	17.0	No	2.3	45.3	21.5	66.7	32.9	13.6	0.1	-3.4	59.2	0.33
R01	2020-03-31	44.2	47.5	17.5	No	26.7	56.2	44.2	93.5	43.7	-0.5	0.0	-12.5	31.6	2.27
R01	2020-06-25	53.3	54.0	52.5	No	0.8	64.0	53.8	102.7	56.8	3.5	-0.1	10.4	72.7	1.27
R02	Station was not monitored in 2020.														
R03	2020-02-20	44.2	48.0	18.0	No	26.2	77.8	46.0	93.6	65.3	21.1	0.1	-5.8	63.7	2.44
R03	2020-03-12	43.4	45.5	18.0	Yes	25.4	52.7	43.9	92.7	46.0	2.6	-0.2	-21.2	57.1	0.99
R03	2020-05-06	40.9	34.5	20.0	Yes	20.9	56.2	47.6	90.3	50.4	9.5	0.0	10.0	32.4	2.27
R03	2020-06-23	53.2	54.0	33.0	No	20.2	60.6	65.5	102.6	56.8	3.6	-0.2	5.7	94.3	1.76
R04	2020-01-31	47.7	46.0	45.5	Yes	2.2	58.8	50.0	97.0	51.8	4.1	0.4	-13.0	89.6	0.54
R04	2020-02-18	110.7	114.0	103.0	No	7.7	123.4	116.2	160.1	116.2	5.5	-0.4	-21.3	80.3	0.52
R04	2020-03-09	34.6	31.0	19.5	Yes	15.1	62.8	41.0	83.9	47.8	13.2	0.2	-10.5	83.3	1.01
R04	2020-05-07	31.8	33.0	23.5	Yes	8.3	55.0	36.3	76.0	41.5	9.7	-0.1	10.4	35.4	0.97
R04	2020-06-30	44.4	42.5	30.0	Yes	14.4	51.9	53.5	93.7	50.3	5.9	0.1	11.7	72.0	2.48
R05	2020-01-23	19.4	20.0	17.5	No	1.9	47.5	23.3	59.5	27.9	8.5	0.1	-11.9	90.4	0.04
R05	2020-02-26	33.8	19.5	17.0	Yes	16.8	44.3	41.3	83.1	41.5	7.7	-0.3	-18.6	83.5	1.20
R05	2020-03-26	44.4	47.5	21.0	No	23.4	74.6	44.9	93.8	59.7	15.3	0.3	-5.0	67.6	3.03
R05	2020-05-22	41.8	36.5	28.5	Yes	13.3	60.1	46.5	80.1	52.2	10.4	0.0	16.8	21.7	2.05
R05	2020-06-24	51.1	43.5	27.0	Yes	24.1	55.9	63.2	100.5	53.3	2.2	0.1	7.2	91.8	1.38
R03	2021-11-10	33.1	33.2	27.2	No	5.9	82.4	44.1	11.0	39.8	33.1	N/A	-13.7	83.2	1.69
Campground	2021-11-11	37.3	39.7	26.4	No	10.9	86.7	39.8	2.5	41.5	37.3	N/A	-10.0	91.9	1.01
R04	2021-11-12	37.6	31.9	26.8	Yes	10.8	87.0	46.7	9.1	46.5	37.6	N/A	-12.9	86.9	0.79
R02	2021-11-13	31.8	28.2	26.6	Yes	5.2	81.2	42.6	10.8	40.7	31.8	N/A	-11.3	87.1	0.68
R01	2021-11-14	38.2	28.9	26.5	Yes	11.7	87.6	51.7	13.4	45.4	38.2	N/A	-11.8	90.1	0.67
R05	2021-11-16	33.2	27.3	26.5	Yes	6.7	82.6	46.0	12.8	42.8	33.2	N/A	-19.8	84.1	0.21
R01	2021-12-02	38.9	27.2	26.5	Yes	12.4	88.3	38.9	8.9	47.5	38.9	N/A	-18.1	86.1	0.36
R02	2021-12-07	70.1	71.9	54.4	No	15.7	93.3	82.4	12.3	81.9	70.1	N/A	-27.4	76.9	0.38
R03	2021-12-08	29.3	29.4	29.3	No	0.0	78.7	29.7	0.4	29.5	29.3	N/A	-17.6	86.3	0.33

Station	Start Date	LAeq (dB)	LAF 10% (dB)*	LAF 90% (dB)*	LAeq > LAF 10	LAeq - LAF 90% (dB)	Lzeq (dB)	LAIeq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Calibration Drift (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
R04	2021-12-09	29.4	29.5	29.3	No	0.1	78.8	29.7	0.3	29.6	29.4	N/A	-17.3	86.7	0.38
R05	2021-12-10	29.5	29.5	29.4	No	0.1	78.8	29.8	0.3	29.6	29.4	N/A	-20.5	83.8	0.18
Campground	2021-12-18	30.4	30.6	30.2	No	0.2	79.8	31.4	1.0	31.2	30.4	N/A	-26.2	78.2	0.11
R04	2021-12-19	30.4	30.6	30.3	No	0.1	79.8	31.6	1.1	31.4	30.4	N/A	-24.0	80.3	0.18
R02	2021-12-20	30.4	30.6	30.3	No	0.1	79.8	31.5	1.1	31.3	30.4	N/A	-24.2	80.2	0.13
R03	2021-12-21	30.1	30.6	29.3	No	0.8	79.4	30.9	0.9	30.8	30.1	N/A	-18.9	85.1	0.60
R03	2021-12-24	29.4	29.6	29.2	No	0.2	78.7	29.7	0.3	29.6	29.4	N/A	-27.1	77.3	0.39
R05	2021-12-25	29.2	29.3	29.1	No	0.1	78.5	29.5	0.4	29.4	29.2	N/A	-26.9	77.3	0.71
Campground	2021-12-27	29.5	29.7	29.4	No	0.1	78.9	29.8	0.3	29.7	29.5	N/A	-29.3	75.0	0.07
R04	2021-12-28	29.5	29.5	29.4	No	0.1	78.8	29.8	0.3	29.6	29.4	N/A	-23.0	81.4	0.39
R02	2021-12-30	29.4	29.5	29.4	No	0.0	78.8	29.7	0.3	29.6	29.4	N/A	-18.7	85.4	0.02
RO1	2022-01-01	29.3	29.4	29.2	No	0.1	78.7	29.3	0.3	29.5	29.3	N/A	-24.2	80.3	0.00
RO3	2022-01-02	29.2	29.3	29.1	No	0.1	78.6	29.5	0.3	29.4	29.2	N/A	-25.7	77.4	1.37
RO2	2022-01-15	29.7	29.8	29.5	No	0.2	79.0	29.7	0.4	29.9	29.7	N/A	-7.2	91.6	1.44
RO1	2022-01-16	29.5	29.6	29.4	No	0.1	78.9	29.5	0.3	29.7	29.5	N/A	-10.2	92.6	0.38
RO3	2022-01-17	29.4	29.5	29.3	No	0.1	78.8	29.7	0.3	29.6	29.4	N/A	-12.4	90.8	1.60
RO5	2022-01-18	29.4	29.5	29.3	No	0.1	78.8	29.8	0.3	29.6	29.4	N/A	-21.0	83.5	0.54
Cmapground	2022-01-20	29.4	29.5	29.4	No	0.0	78.8	29.7	0.3	29.6	29.4	N/A	-20.7	83.9	0.28
RO4	2022-01-21	29.5	29.6	29.4	No	0.1	78.7	29.8	0.3	29.7	29.5	N/A	-20.0	84.2	0.27
RO2	2022-01-22	29.6	29.7	29.6	No	0.0	79.0	30.0	0.4	29.8	29.6	N/A	-21.0	83.4	0.23
RO3	2022-01-23	29.6	29.7	29.5	No	0.1	78.9	30.0	0.4	29.8	29.6	N/A	-9.0	93.3	0.21
RO1	2022-01-24	29.6	29.6	29.5	No	0.1	78.9	29.6	0.4	29.8	29.6	N/A	-5.2	96.1	0.49
RO5	2022-01-25	29.6	29.7	29.6	No	0.0	79.0	30.0	0.4	29.8	29.6	N/A	-7.3	94.8	0.35
RO2	2022-01-27	29.6	29.6	29.5	No	0.1	78.9	29.9	0.3	29.8	29.6	N/A	-9.1	92.4	1.09
RO3	2022-01-30	29.3	29.4	29.2	No	0.1	78.7	29.6	0.3	29.5	29.3	N/A	-19.7	84.6	1.35
RO5	2022-02-15	29.6	29.8	29.5	No	0.1	79.0	29.9	0.3	29.8	29.7	N/A	-12.7	89.2	1.05
RO3	2022-02-16	29.5	29.6	29.4	No	0.1	78.9	29.8	0.3	29.7	29.5	N/A	-15.8	87.3	0.55
RO1	2022-02-17	29.5	29.5	29.4	No	0.1	78.8	29.8	0.3	29.7	29.5	N/A	-17.7	86.6	0.99
RO3	2022-02-18	29.4	29.5	29.4	No	0.0	76.7	29.7	0.3	29.6	29.4	N/A	-20.1	83.5	1.35
RO5	2022-02-25	29.6	29.8	29.4	No	0.2	79.0	30.0	0.4	29.8	29.6	N/A	-14.1	88.2	0.52
RO3	2022-02-27	29.7	29.9	29.6	No	0.1	28.2	30.0	0.3	30.0	29.7	N/A	-8.2	83.3	0.77
RO4	2022-03-03	29.6	29.8	29.4	No	0.2	79.0	30.0	0.4	29.8	29.6	N/A	-5.7	89.4	0.52
RO5	2022-03-04	29.6	29.8	29.4	No	0.2	78.8	29.9	0.3	29.8	29.6	N/A	-7.0	89.4	0.77
RO1	2022-03-05	29.7	29.8	29.5	No	0.2	79.0	30.0	0.4	29.8	29.7	N/A	-11.1	79.9	1.33
RO2	2022-03-08	29.6	29.7	29.4	No	0.2	78.9	29.9	0.4	29.7	29.6	N/A	-11.8	71.1	1.54
RO2	2022-03-10	29.6	29.7	29.4	No	0.2	79.0	30.0	0.4	29.8	29.6	N/A	-12.1	73.5	0.73
RO4	2022-03-13	29.4	29.6	29.2	No	0.2	78.8	29.8	0.3	29.6	29.4	N/A	-21.8	56.9	3.01

Station	Start Date	LAeq (dB)	LAF 10% (dB)*	LAF 90% (dB)*	LAeq > LAF 10	LAeq - LAF 90% (dB)	Lzeq (dB)	LAIeq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Calibration Drift (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
RO1	2022-04-01	29.8	30.1	29.5	No	0.3	79.1	30.2	0.4	30.0	29.8	N/A	-13.3	55.2	2.87
RO2	2022-04-02	29.7	29.9	29.6	No	0.1	78.9	30.2	0.4	29.9	29.7	N/A	-17.5	44.2	1.67
RO3	2022-04-04	6.7	7.0	6.5	No	0.2	56.1	7.1	0.4	6.9	6.7	N/A	-7.3	84.1	1.04
RO4	2022-04-05	6.7	6.9	6.5	No	0.2	56.0	7.1	0.4	6.9	6.7	N/A	-2.7	73.8	1.25
RO5	2022-04-06	29.8	30.0	29.6	No	0.2	79.2	30.2	0.4	30.0	29.8	N/A	-2.9	68.6	2.17
RO3	2022-04-14	29.9	30.0	29.7	No	0.2	69.0	30.3	0.4	30.0	29.9	N/A	-8.3	48.2	1.66
RO2	2022-04-15	29.7	29.9	29.5	No	0.2	79.1	30.1	0.4	29.9	29.7	N/A	-4.5	49.3	1.73
RO4	2022-04-16	29.6	29.8	29.4	No	0.2	79.0	30.0	0.3	29.8	29.6	N/A	-8.2	49.1	3.65
RO2	2022-04-17	29.7	30.0	29.5	No	0.2	79..1	30.1	0.4	29.9	29.7	N/A	-11.8	42.1	1.87
RO5	2022-04-18	29.7	29.9	29.5	No	0.2	79.1	30.1	0.4	29.9	29.7	N/A	-10.9	39.7	1.68
RO2	2022-04-22	29.9	30.1	29.7	No	0.2	79.2	30.2	0.4	30.1	29.9	N/A	-2.4	48.7	1.17
RO4	2022-04-23	29.9	30.1	29.7	No	0.2	79.3	30.3	0.4	30.1	29.9	N/A	1.8	45.6	1.97
RO5	2022-05-01	29.9	30.1	29.7	No	0.2	79.3	30.3	0.4	30.1	29.9	N/A	4.6	48.7	2.28
RO5	2022-05-02	29.9	30.1	29.7	No	0.2	79.3	30.3	0.4	30.1	29.9	N/A	5.1	49.2	4.13
RO3	2022-05-05	29.9	30.1	29.7	No	0.2	79.3	30.3	0.4	30.1	29.9	N/A	4.3	51.6	2.18
RO2	2022-05-08	30.0	30.1	29.7	No	0.3	79.3	30.3	0.4	30.1	29.9	N/A	3.2	59.7	1.50
RO5	2022-05-09	29.9	30.0	29.7	No	0.2	79.2	30.2	0.4	30.1	29.9	N/A	3.3	55.5	2.05
Campground	2022-05-13	29.9	30.1	29.7	No	0.2	79.3	30.3	0.4	30.1	29.9	N/A	3.5	63.6	1.91
RO4	2022-05-14	29.9	30.1	29.7	No	0.2	79.3	30.3	0.4	30.1	29.9	N/A	5.2	47.1	2.07
RO5	2022-05-16	29.9	30.1	29.8	No	0.1	79.3	30.3	0.4	30.1	29.9	N/A	4.5	63.4	2.52
Campground	2022-05-19	29.9	30.1	29.7	No	0.2	76.3	30.3	0.4	30.1	29.9	N/A	Flame & Moth Meteorological Station was dissasembled between May and November 2022; therefore, no data are available.		
RO2	2022-05-20	30.0	30.2	29.8	No	0.2	79.3	30.4	0.4	30.2	30.0	N/A			
RO2	2022-05-21	30.0	30.2	29.8	No	0.2	79.4	30.4	0.4	30.2	30.0	N/A			
RO2	2022-05-27	30.0	30.2	29.8	No	0.2	79.3	30.4	0.4	30.2	30.0	N/A			
RO3	2022-05-29	30.1	30.3	29.9	No	0.2	79.4	30.5	0.4	30.3	30.1	N/A			
RO3	2022-06-02	30.1	30.3	29.9	No	0.2	79.5	30.6	0.4	30.3	30.1	N/A			
RO2	2022-06-03	30.1	30.3	29.9	No	0.2	79.5	30.5	0.4	30.3	30.1	N/A			
RO4	2022-06-05	30.1	30.3	29.9	No	0.2	79.4	30.5	0.4	30.3	30.1	N/A			
RO5	2022-06-07	30.1	30.3	29.9	No	0.2	79.4	30.5	0.4	30.3	30.1	N/A			
RO2	2022-06-09	30.1	30.2	29.9	No	0.2	80.5	30.5	0.4	30.2	30.1	N/A			
Campground	2022-06-11	30.0	30.1	29.8	No	0.2	79.4	30.4	0.4	30.2	30.0	N/A			
RO2	2022-06-18	30.1	30.3	29.9	No	0.2	79.5	30.6	0.4	30.3	30.1	N/A			
RO2	2022-06-24	30.2	30.4	30.0	No	0.2	79.6	30.6	0.4	30.4	30.2	N/A			
RO3	2022-06-26	30.3	30.5	30.1	No	0.2	79.6	30.7	0.4	30.5	30.3	N/A			
RO5	2022-06-27	30.3	30.5	30.1	No	0.2	80.8	30.7	0.4	30.5	30.3	N/A			
RO3	2022-07-05	30.3	30.5	30.1	No	0.2	79.6	30.7	0.4	30.5	30.3	N/A			
RO4	2022-07-07	30.2	30.4	30.0	No	0.2	79.6	30.6	0.4	30.4	30.2	N/A			

Station	Start Date	LAeq (dB)	LAF 10% (dB)*	LAF 90% (dB)*	LAeq > LAF 10	LAeq - LAF 90% (dB)	Lzeq (dB)	LAIeq (dB)	LAE (dB)	LCeq (dB)	LCeq-LAeq (dB)	Calibration Drift (dB)	Temp. (˚C)	R.H. (%)	Avg. WS (m/s)
RO5	2022-07-08	30.3	30.4	30.1	No	0.2	79.6	30.7	0.4	30.5	30.3	N/A			
RO2	2022-07-11	30.2	30.3	30.0	No	0.2	79.6	30.6	0.4	30.4	30.2	N/A			
RO5	2022-07-14	30.2	30.4	30.0	No	0.2	79.5	30.6	0.4	30.4	30.2	N/A			

**Data in 2021 termed LAS 10 and LAS 90.*

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
Red	Calibration drift greater than 3.0 dB

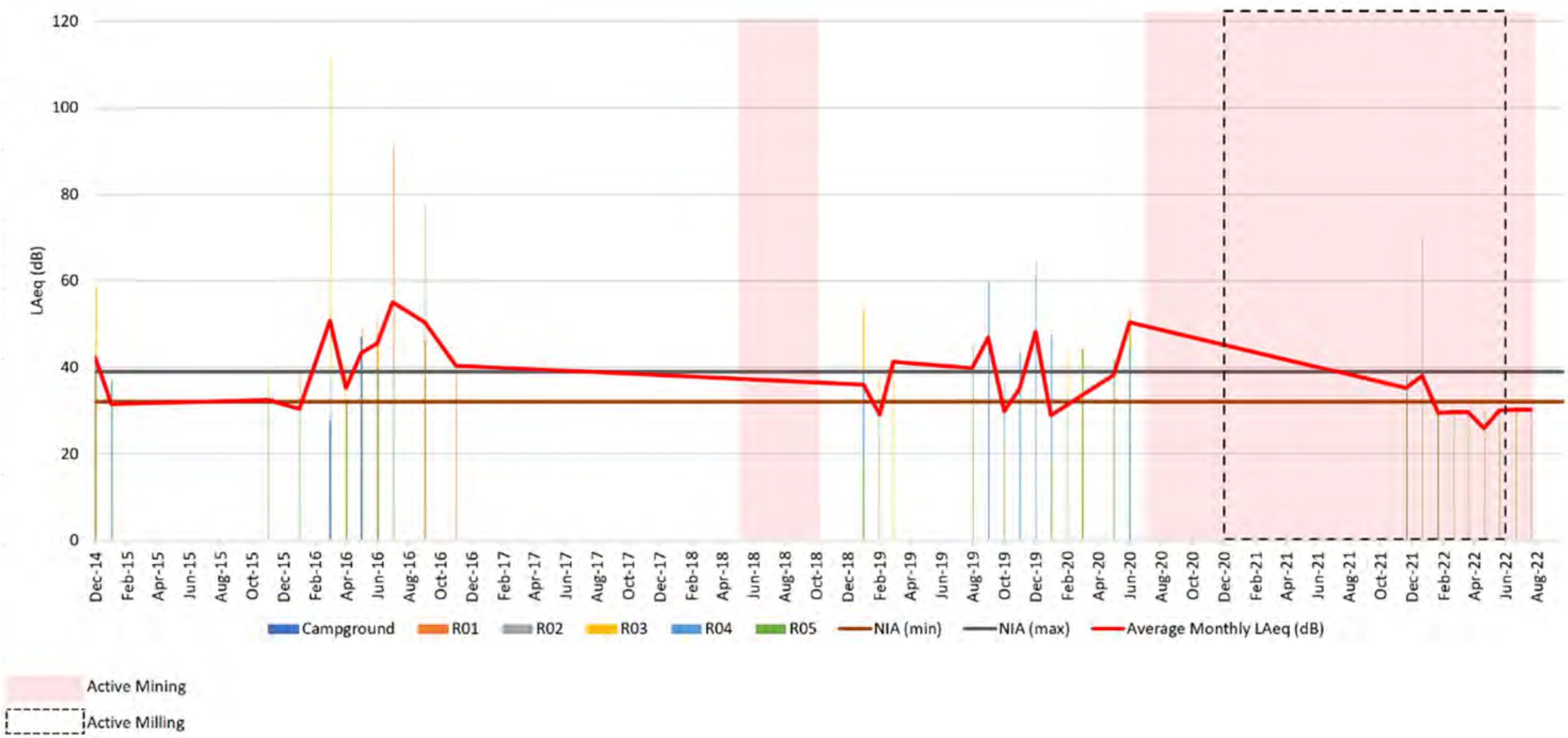


Figure 3-15: 24-hr Noise Results from 2014-2022 Presented with the Noise Impact Assessment (NIA) Values

4 SURFACE WATER

4.1 HYDROLOGY

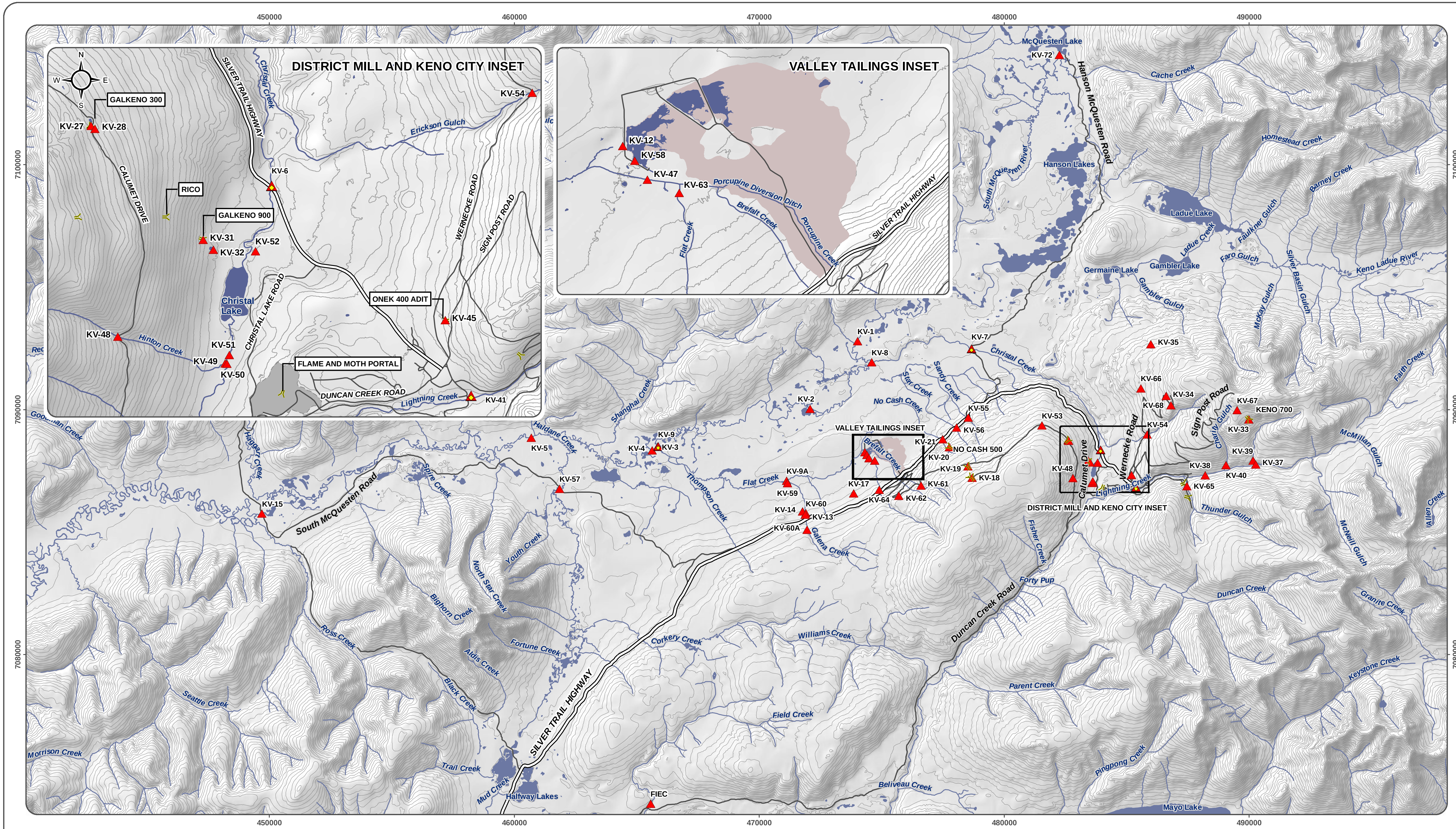
Maximum daily flows typically occur in spring in response to snowmelt and rain on snow events. However, summer and fall rainstorms can produce large events which can in some cases be the maximum annual flood. Large increases in flow in response to rain events is common in the small streams of the area. There are many historical adits in the region, some of which are free draining.

Open water season is typically late May until mid-October. Ice cover can be several feet in some locations and most streams continue to flow year-round though flows may become very low. Low flows typically occur in March-April as the water table drops over the winter.

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. There is one routine sampling station on No Cash Creek, located just above the Silver Trail Highway (KV-21). Located within the No Cash Creek catchment are the historical Bermingham 200 adit (KV-18), Ruby 400 (KV-19) and No Cash 500 (KV-20) adit discharges monitored by ERDC. The monitoring stations currently monitored in the KHSD are shown on Figure 4-1.

As part of Water Licence QZ18-044 continuous water levels are recorded during the open water season at fifteen minute intervals using Solinst water level recorders at stations KV-6, KV-7, and KV-41 (Figure 4-1). Discharge measurements and staff gauge observations are taken at regular intervals during the open water season, approximately once per month. Occasionally, salt slugs are used to determine flow when conditions do not permit regular velocity-area discharge measurements. These data have been used together to develop rating curves which facilitate the translation of continuous water level data into continuous discharge. Discharge measurements are taken in winter when conditions permit using the salt dilution gauging method.

For the period 2004 to 2009, CCL processed the water level data to produce a flow record on behalf of Access Consulting Group (now Ensero Solutions Canada Inc. [Ensero]) on behalf of the client AKHM. CCL have patched the data record over the winter months when gauging data were not collected and have shown through regional analysis that this practice gives realistic values for the purpose of calculating mean and annual and monthly runoff (CCL, 2008) These data are summarized in memorandums CCL-UKHM-1 and CCL-UKHM2. Since 2010 data have been managed by Ensero.



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

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1:145,000

0 1 2 3 4 5 Kilometers

Automatic Hydrometric Monitoring Stations with Barologger

Instantaneous Hydrometric Monitoring Stations

Adit

Valley Tailings

Silver Trail Highway

Other Road

Watercourse

Waterbody

Hecla KENO HILL

HECLA KENO HILL

FIGURE 4-1

KHSD DISCHARGE MONITORING LOCATIONS

FEBRUARY 2023

4.1.1 REGIONAL HYDROLOGY

The closest and most relevant hydrometric station in the region is the Water Survey of Canada operated McQuesten River near the Mouth (Stn. # 09DD004) which has been monitored for flow and level from 1979 to present. The drainage area is 4,750 km^2 and includes the towns of Keno and Elsa and Christal Creek. The mean annual discharge for the McQuesten River is 3,303,500 m^3/d (38.2m^3/s) or 8.0 L/s/km^2 and the mean annual runoff (MAR) is 253.8 mm. Table 4-1 presents the mean daily as well as mean low flow and mean daily high flow for the 1979 to 2019 at McQuesten River near the mouth.

Table 4-1: 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

Return periods for high flow were calculated for this record using the Log Pearson Type III distribution chosen as it is the recommended technique for flood frequency from the US Water Advisory Committee on Water Data (1982). The return periods for low flows were calculated with the Weibull distribution. The results of this analysis are shown in Table 4-2 in both discharge and unit runoff.

Table 4-2: High and Low Flow for Various Return Periods (Tp) for McQuesten River Near the Mouth

	Annual Daily Peak Flow			Annual Daily Low Flow		
T_p[1]	m^3/d	m^3/s	L/s/km^2	m^3/d	m^3/s	L/s/km^2
2	20,364,624	235.7	49.6	639,908	7.4	1.6
10	30,429,766	352.2	74.1	409,771	4.7	1.0
50	39,305,725	454.9	95.8	179,634	2.1	0.4
s100	43,136,166	499.3	105.1	80,520	0.9	0.2

[1] Return period (T_p) are in years.

The mean monthly flow distribution is typical of the region and Yukon in general, exhibiting a snowmelt dominated freshet period. 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 4-2). The McQuesten River mean flow data presented below include all available mean monthly flow data including 1979 to 2019.

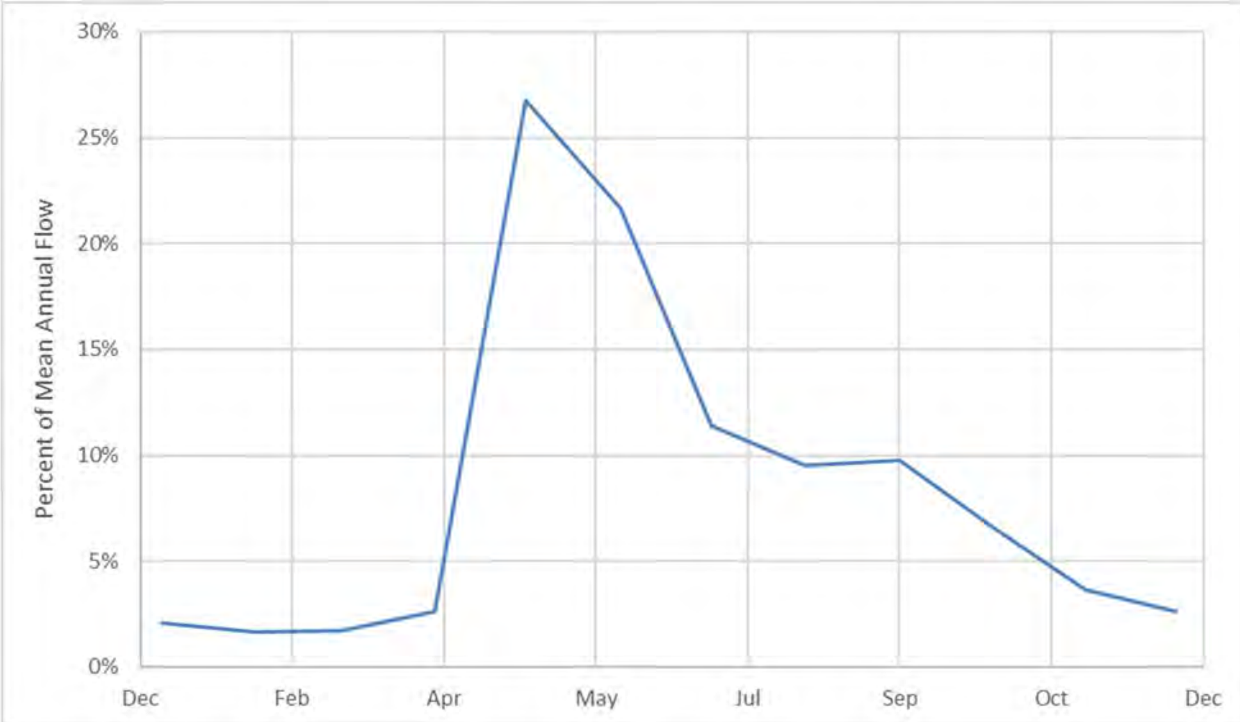


Figure 4-2: Annual Flow Distribution at McQuesten River Near the Mouth (09DD004)

McQuesten mean flow data available from 1979 to 2019.

4.1.2 HYDROMETRIC MONITORING STATIONS

Figure 4-1 shows the hydrometric monitoring stations in the KHSD. The following sections discuss the stations on No Cash Creek, Christal Creek, and Lightning Creek. A summary of the hydrometric stations is provided in Table 4-3.

Table 4-3: Keno Hill Silver District Hydrometric Stations Summary

Site	Description	Sampling Schedule	Continuous (Y/N)	Drainage Area (km^2)	Median Elevation (masl)	Station Elevation (masl)	Max Elevation (masl)	Instrumentation	Measurement Frequency	Accuracy (+/- %FS)[1]	Number of Benchmarks
KV-6	Christal Creek at Silver Trail Highway	Monthly	Y	6.1	1002	855	1350	Solinst M5	15 min	0.05	3
KV-7	Christal Creek at Hanson Road	Monthly	Y	35.8	970	675	1685	Solinst M5	15 min	0.05	3
KV-9	Flat Creek upstream of South McQuesten River	Quarterly	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-41	Lightning Creek upstream of bridge at Keno City	Monthly	Y	59	1400	935	1988	Solinst M2	15 min	0.05	3
KV-51	Christal Creek downstream of Hinton Creek	Quarterly	Y	2.8	1172	861	1443	Solinst M2	15 min	0.05	3
KV-60	Galena Creek upstream of Silver King Adit	Quarterly	N discontinued	9.4	997	739	1400	Solinst M2	15 min	0.05	3
KV-64	Flat Creek at Silver Trail Highway	Quarterly	N discontinued	4.4	1159	818	1412	Solinst M2	15 min	0.05	3

[1] % FS is Percentage of Foresight.

4.1.2.1 KV-21 NO CASH CREEK AT THE SILVER TRAIL HIGHWAY

No Cash Creek flows just northeast of the former townsite of Elsa and has a catchment area of ~1.4 km^2 at the Silver Trail Highway (KV-21). The median elevation is ~1,212 masl and includes the No Cash 500 adit (KV-20), which is free draining. In June of 2015, a V-notch weir to gather continuous data was installed on No Cash Creek; 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.

Average flows for each month for KV-21 were originally established from the monthly discrete discharge measurements using data that was filtered to have less than 15% relative percent difference during field data collection measurements. The mean monthly values have been updated since using a new synthetic, continuous dataset for KV-21 which covers the period from June 2014 to October 2022. The continuous KV-21 synthetic dataset was derived by reviewing and selecting instantaneous discharge measurements with good quality assurance/quality control values collected at KV-21 between June 2014 to October 2022. A relationship between these KV-21 field discharge measurements and the KV-9 continuous discharge dataset was established. The KV-9 continuous data was used as this station has open water year-round and has a reliable continuous discharge dataset from June 2014 to October 2022. The relationship established between the KV-21 field discharge measurements and the KV-9 continuous discharge data was then applied to the entire KV-9 continuous dataset to create a synthetic KV-21 continuous discharge record. The revised monthly values are shown in Table 4-4.

Table 4-4: KV-21 Mean Monthly Discharge (m^3/s) of Synthetic Dataset

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	0.0042	0.0034	0.0028	0.0031	0.0322	0.0210	0.0137	0.0214	0.0176	0.0154	0.0067	0.0059
2015	0.0047	0.0037	0.0036	0.0049	0.0511	0.0234	0.0184	0.0210	0.0282	0.0188	0.0086	0.0071
2016	0.0057	0.0053	0.0053	0.0103	0.0423	0.0320	0.0214	0.0274	0.0208	0.0083	0.0073	0.0059
2017	0.0046	0.0038	0.0036	0.0049	0.0393	0.0207	0.0131	0.0093	0.0186	0.0200	0.0072	0.0055
2018	0.0026	0.0037	0.0029	0.0044	0.0574	0.0233	0.0118	0.0171	0.0100	0.0043	0.0022	0.0023
2019	0.0024	0.0023	0.0024	0.0049	0.0148	0.0065	0.0022	0.0022	0.0029	0.0029	0.0020	0.0014
2020	0.0017	0.0013	0.0012	0.0072	0.1017	0.0378	0.0265	0.0236	0.0217	0.0134	0.0094	0.0097
2021	0.0097	0.0094	0.0093	0.0097	0.0688	0.0126	0.0054	0.0033	0.0036	0.0083	0.0039	0.0036
2022	0.0044	0.0050	0.0056	0.0059	0.0781	0.0249	0.0099	0.0085	0.0117	0.0292	[1]	[1]
Average	0.0044	0.0042	0.0041	0.0061	0.0540	0.0225	0.0136	0.0149	0.0150	0.0134	0.0059	0.0052
Standard Deviation	0.0024	0.0023	0.0024	0.0025	0.0261	0.0093	0.0076	0.0093	0.0086	0.0085	0.0029	0.0027
95% Confidence Limit	0.0015	0.0015	0.0016	0.0016	0.0171	0.0061	0.0050	0.0060	0.0056	0.0055	0.0020	0.0019

[1] KV-9 is a quarterly visited site, because the data has not been downloaded since October 2022, no synthetic data could be extrapolated for KV-21 in November and December 2022.

4.1.2.2 KV-6 CHRISTAL CREEK ABOVE SILVER TRAIL HIGHWAY

The hydrometric station on Christal Creek at KV-6 is above the Silver Trail Highway and several hundred meters downstream of Christal Lake. That catchment area is 6.1 km^2 with a median elevation of 1,002 masl.

A Solinst water level recorder was deployed at KV-6 in a stilling well on July 20, 2011 and retrieved on October 23, 2011. Instantaneous discharge measurements have been collected since June 2008 on a monthly basis as often as possible. There was one discharge measurement taken during the continuous water level record, but no staff gauge was installed at that time.

The 2012 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.

In 2013 the 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.

Reliable stage records began at the new location in late May 2014 and a derived discharge record has been produced continuously since that time. In March 2018, there was an error with the barologger causing it to stop logging. A new Solinst M5 logger was installed in September 2018, as the old logger data was showing signs of drift and needing calibration. On July 16, 2021, the staff gauge ruler was changed as the previous ruler was worn out and, therefore, it was unable to be read accurately.

Winter records are approximated by drawing a line through discrete measurements as appropriate or manipulation of the record relative to the discrete measurements. The peak annual discharge from 2015 to 2022 is presented below in Table 4-5.

Table 4-5: Peak Annual Discharge at KV-6

Year	Date	Peak Annual Discharge (m^3/s)	Peak Annual Discharge (m^3/d)
2015	11-May-2015	0.343	29,635
2016	27-Apr-2016	0.280	24,192
2017	13-May-2017	0.264	22,810
2018	10-May-2018	0.608	52,531
2019	11-May-2019	0.144	12,442
2020	10-May-2020	0.897	77,501
2021	7-May-2021	0.582	50,285
2022	15-May-2022	0.246	21,254

4.1.2.2.1 Mean Monthly Flow

The mean measured discharge at KV-6 is 7,957.2 m^3/d (0.092 m^3/s) or 15.1 $L/s/km^2$ and yields a MAR of 476 mm (Table 4-6). The highest flows tend to be in May and September as a result of snowmelt and late summer rainstorms, respectively. May is assumed to be the least representative of the true monthly mean since discharge fluctuates the greatest in this month. Based on other sites in the region these numbers are not in line with a catchment of the calculated size and median elevation. It is possible that additional water is being delivered by adits within the catchment or simply that the record is not representative of the true mean. Figure 4-3 shows the mean monthly flow distribution based on the discrete measurement record.

Table 4-6: Mean Monthly Discharge at KV-6, Christal Creek Below Christal Lake, for Months Where Continuous Data are Available (m^3/d)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012					10,721	7,679	8,802					
2013												
2014					5,422	8,314	6,299	10,112	9,967	9,258	6,977	6,675
2015	7,937	6,697	5,733	7,242	15,977	9,519	10,275	10,594	11,051	9,990	9,920	9,256
2016	8,728	7,808	6,263	9,977	10,933	9,471	11,718	13,338	10,854	9,761	8,851	8,026
2017	7,266	6,639	6,098	6,102	12,872	9,025	9,675	5,853	6,654	6,182	5,147	6,059
2018	5,691	4,297	3,738	6,325	23,224	12,785	9,981	13,151	10,631	7,881	7,327	6,771
2019	6,283	5,853	5,452	5,067	7,018	6,312	5,734	5,348	4,800	3,381	2,692	1,971
2020	1,237	528	838	2,216	20,594	8,973	11,774	12,867	12,974	7,843	4,006	3,833
2021	3,657	3,489	3,322	6,998	20,896	7,755	6,588	7,804	7,466	6,924	5,217	5,547
2022	5,650	5,094	4,665	4,957	11,462	9,580	9,186	8,884	8,980			
Mean	5,806	5,051	4,514	6,110	13,912	8,941	9,003	9,772	9,264	7,653	6,267	6,017
Standard Deviation	2,419	2,297	1,832	2,225	6,057	1,703	2,160	3,043	2,547	2,188	2,447	2,296
95% Confidence Limit	1,676	1,592	1,269	1,542	3,754	1,056	1,339	1,988	1,664	1,516	1,695	1,591

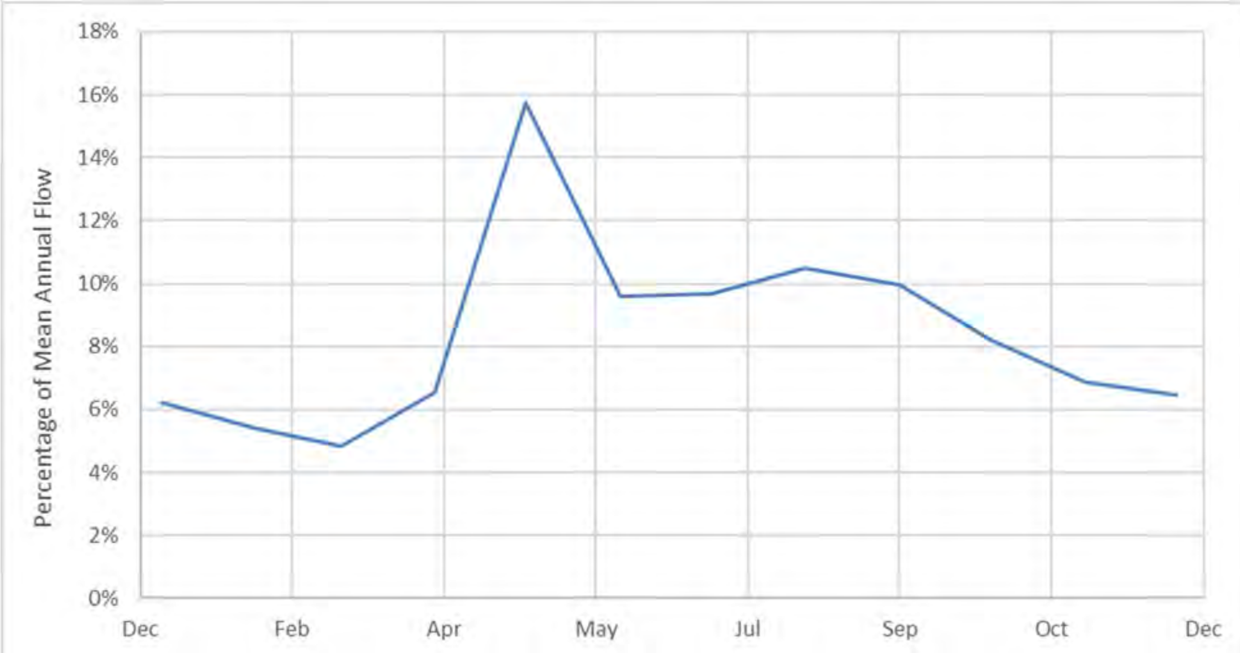


Figure 4-3: Annual Flow Distribution at KV-6 Christal Creek

KV-6 flow data available from 2014 to 2022.

Although some continuous data were obtained in 2012, the station was unsuccessful until its establishment at the current location in 2014. Since that time reliable continuous data have been obtained with winter data filled in by extrapolation between discrete winter measurements. The MAR for the continuous data is 7,907.3 m^3/d (0.0915 m^3/s), which is equivalent to 473 mm.

4.1.2.2.2 Winter Low Flows

The lake and bog area may have the effect of creating a more stable annual flow regime so that winter low flows do not drop nearly as low as a catchment of similar size due to the lake storage. Typically, base flows slowly drop over the winter and the lowest flows occur in March or April. Since 2012 April discrete measurements have been relatively consistent ranging from 4,493 m^3/d (0.052 m^3/s) to 6,480 m^3/d (0.075 m^3/s) with a mean of 5,443 m^3/d (0.063 m^3/s) or 10.3 L/s/km^2. As such 6,110 m^3/d (0.070 m^3/s) is considered a good estimate of mean winter low flow, and it does appear that the lake allows KV-6 to maintain a much higher unit runoff baseflow than KV-7.

4.1.2.2.3 Peak Flow

Given that KV-6 is the outlet of the lake and wetland area with little long-term data it is not possible to produce a proxy record with which to conduct a return period analysis. May 2018 has the highest measured peak discharge to date at 31,622 m^3/d (0.366 m^3/s) for the discrete measurement with a derived continuous record peak of 52,531 m^3/d (0.608 m^3/s). It is worth noting, the derived peak flow in May 2020 was 77,501 m^3/d (0.897 m^3/s), but the instantaneous measurement was collected later in May 2020, when freshet was decreasing.

4.1.2.3 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 km^2 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 1 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. It includes both a major east facing slope of Galena Hill and west facing aspects of Sourdough Hill. The MAR at KV-7 is 252.9 mm or 24,812 m^3/d (0.287 m^3/s; 8.0 L/s/km^2) using the available continuous data and discrete measurements as a measure of mean monthly for winter months. MAR calculated in 2008 was 221 mm and 26,300 m^3/d (0.304 m^3/s; CCL, 2008), based on a different catchment area. Recalculating for our new catchment area that would be 268 mm. The MAR estimates in the initial hydrology study found in UKM/96/01 (Access Mining Consultants, 1996) was 230 mm. The continuous data show that the original estimates were appropriate, but the new mean is considered the best estimate.

4.1.2.3.1 Mean Monthly Flow

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 4-7.

Table 4-7: Mean Monthly Discharge at KV-7, Christal Creek at Hanson-McQuesten Road Bridge (m^3/d)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003								36,000	44,000			

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004			13,000	14,000	100,000	27,000	10,000	9,700	14,000	12,000	8,900	8,700
2005		11,000	9,700	34,000	130,000	23,000	25,000	34,000	29,000	22,000	16,000	13,000
2006					103,026	44,813	34,332	24,033	35,812	33,375	16,147	12,264
2007	13,039	10,326		73,654	65,410	28,136	46,757	18,815	28,969	13,460		
2008								37,000	29,000	30,000		12,000
2009	6,800	5,900	4,100	6,400	97,000	29,000	8,800	16,000	32,000			
2010					27,000	21,000	31,000	20,000	20,000	16,000		
2011					110,000	12,000	43,000	36,000	23,000	15,000	11,000	
2012	13,000	6,700			62,946	22,280	34,598	18,712	23,100	17,317		
2013	6,500	5,700				25,563	10,900	6,917	28,763	19,586	12,121	9,502
2014	8,355	8,870	7,428	6,628	63,896	37,177	16,889	49,543	30,305	18,977	15,244	12,357
2015	11,110	9,074	7,260	14,170	90,038	14,884	28,882	40,811	48,518	21,100	15,261	14,484
2016	12,590	11,048	8,699	21,804	45,779	20,687	44,566	54,872	41,383	20,922	13,462	11,814
2017	10,538	10,414	7,663	10,211	53,741	21,111	13,876	10,730	28,986	11,694	8,532	7,131
2018	6,027	7,961	6,777	5,114	99,205	55,674	23,640	37,194	23,180	13,238	12,788	13,369
2019	9,449	7,534	6,428	7,266	19,806	13,580	11,024	7,977	10,150	10,665	9,709	8,831
2020	9,246	8,631	8,059	7,515	74,876	46,586	47,189	38,241	39,443	27,680	13,320	13,089
2021	12,853	12,630	12,406	14,206	59,659	26,296	16,188	31,700	26,084	23,574	16,602	
2022				45,464	88,561	52,716	26,256					
Mean	10,001	9,399	8,320	20,033	75,938	28,972	26,272	27,802	29,247	19,329	13,007	11,378
Standard Deviation	2,477	1,907	2,585	20,061	29,977	13,121	13,341	14,280	9,715	6,833	2,810	2,270
95% Confidence Limit	1,535	1,127	1,528	10,905	14,250	6,061	6,163	6,421	4,368	3,348	1,528	1,285

Note: Grey numbers are discrete discharge measurements and are not used in the statistical analyses.
Grey cells are discharge measurements obtained from the Clearwater Consultants Ltd. reports.

Figure 4-4 shows the distribution of flow annually by month. The distribution is dominated by the snow melt driven high flows occurring in May, with flow throughout the rest of the open water season driven by precipitation events and a slow decline through the winter with lows typically reached in February or March. However, the lowest winter flows could also result in early April. It is likely then that the April mean flows are overestimated by discrete measurements late in the month.

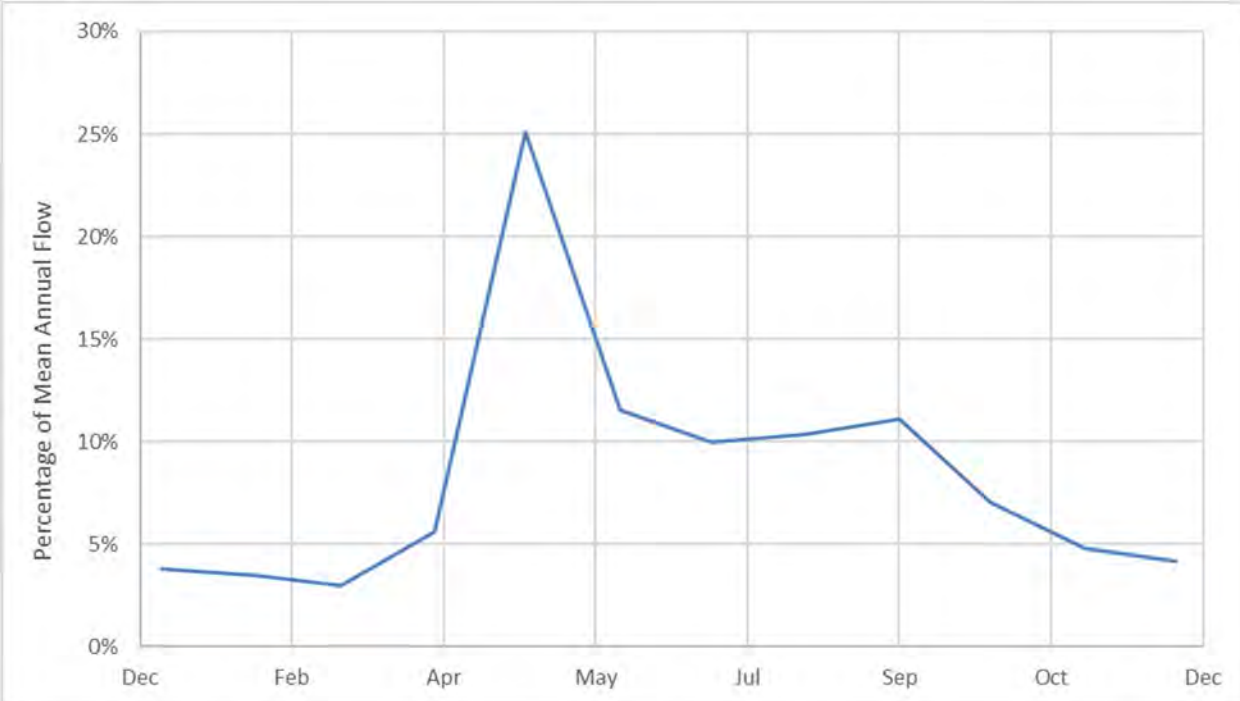


Figure 4-4: Annual Flow Distribution at KV-7 Christal Creek

KV-7 flow data available from 2005 to 2022.

4.1.2.3.2 Winter Low Flows

Typically, runoff decreases steadily over the winter months assuming there is no major thaw, rain, or snow event. 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. More recent data gathered since 2017 shows an average winter low flow (March) of 8,266 m^3/d (0.096 m^3/s) while the long-term mean is 8,090 m^3/d (0.094 m^3/s), suggesting that the last five years are representative of the overall average discharge observed.

4.1.2.3.3 Peak Flow

There are thirteen years of flow data at KV-7 from which peak flows can be taken; however, it is important to note that since peak flows can occur when ice is still impacting the water level it is possible that the true peak may not have been captured in the continuous record for some years. Nonetheless, a frequency analysis was carried out on peak instantaneous and daily flows using the Log Pearson Type III distribution to predict L-moments and yielded the results in Table 4-8. The maximum daily calculation yields higher discharge rates as the instantaneous flows don't always capture the annual peak discharge rate.

Table 4-8: Peak Instantaneous and Daily Flows for Various Return Periods (Tp) at KV-7, Christal Creek

	Instantaneous			Max Daily		
T_p[1]	m^3/d	m^3/s	$L/s/km^2$	m^3/d	m^3/s	$L/s/km^2$
2	52,156	0.604	16.9	134,015	1.551	43.23

	Instantaneous			Max Daily		
10	137,817	1.595	44.6	237,166	2.745	76.7
25	200,647	2.322	64.9	284,224	3.290	91.9
50	257,001	2.975	83.1	317,071	3.670	102.5

[1] Return period (T_p) are in years.

4.1.2.4 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. Unfortunately, the KV-51 station is subject to heavy icing in winter months causing data loss in low flow conditions and late freshet peak flows. Table 4-9 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.

Table 4-9: Mean Monthly Discharge 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						2,059	2,481	2,946	3,909	3,285	3,061	2,933
2016	2,823	2,680	2,643	3,114	4,553	3,730	4,454	5,794	4,416			
2017	1,358	1,254	1,156	1,060	6,971	2,005	1,883	1,336	1,290			
2018				346	17,794	7,497	3,175	5,181	5,019			
2019	1,268	1,238	1,206	1,173	2,719	1,533	1,538	1,339	1,533	1,313	1,236	3,503
2020	14,670	26,311	37,952	49,787	61,622	24,936	2,810	2,903	2,881	2,029	1,386	893
2021	1,736	2,486		1,811	4,896	2,887	2,818	3,852	3,677	2,807		
2022				5,494	5,711	4,086	3,068	2,715				
Mean	4,371	6,794	10,739	8,969	14,895	6,092	2,778	3,258	3,246	2,359	1,894	2,443
Standard Deviation	5,790	10,931	18,155	18,080	21,190	7,844	885	1,620	1,416	868	1,013	1,372
95% Confidence limit	5,075	9,581	17,792	13,394	15,698	5,436	613	1,123	1,049	851	1,146	1,553

4.1.2.5 KV-41 LIGHTNING CREEK AT KENO CITY BRIDGE

Lightning Creek at KV-41 has a catchment area of 59 km^2 and a median catchment elevation of approximately 1,400 masl. Lightning Creek originates to the east of Keno City and drains the southern flank of Keno Hill and the northern flank of Mount Hinton. Lightning Creek flows to the south of Galena hill into Duncan Creek. Within the Lightning Creek watershed are multiple adits including Keno 200 and 700, multiple old surface workings, active mining at Bellekeno East and placer mining on Thunder Gulch.

Hydrometric station KV-41 is located on Lightning Creek above the Keno City Bridge and downstream of the Bellekeno mine and local placer mining activity. 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.

MAR at KV-41 is 338 mm, 54,576 m^3/d (0.632 m^3/s), or 10.7 L/s/km^2. This is similar to earlier estimates by CCL of 344 mm or 55,700 m^3/d (0.645 m^3/s). Unit runoff is much higher on Lightning Creek as compared to Christal Creek. This is likely due to less vegetative cover compared to Christal Creek owing to the higher elevations and steeper rocky terrain characterising Lightning Creek.

4.1.2.5.1 Mean Monthly Flow

Table 4-10 shows the mean monthly discharge record with some winter months estimated with discrete measurements. Data from 2013 was lost due to a failure with the logger and while discrete measurements are shown they are not used to calculate the means in summer months. Monthly means are used to calculate a percentage of total annual flow by month (Figure 4-5). Peak flows occur slightly later at this site than in Christal Creek, presumably due to the higher median elevation delivering a more temporally spread-out spring snowmelt and holding high elevation snowpack longer. Flows then decrease throughout the summer and into winter with low flows occurring March or early April.

Table 4-10: Mean Monthly Discharge at KV-41, Lightning Creek Above Keno City Bridge (m^3/d)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004								37,000	27,000	21,000	13,000	11,000
2005	8,500	5,800	4,800	11,000	160,000	120,000	85,000	96,000	83,000	55,000	39,000	26,000
2006	19,000	17,000	17,000	24,000	69,000	170,000	110,000	80,000	94,000	77,000	48,000	39,000
2007					110,000	170,000	100,000					
2008								98,000	67,000	89,000		
2009		9,500	11,000	6,000	140,000	140,000						
2010					100,000	120,000	87,000	66,000	49,000	39,000		
2011						62,004	92,291	78,682	54,083			23,000
2012	21,686	13,738	15,725		74,823	102,157	69,623	35,954	43,899	32,081		
2013						164,160	61,344	37,757	47,174	66,182	36,374	15,034
2014	12,874	10,886	8,277	44,842	91,626	85,729	35,727	62,766	43,001	29,360	21,883	19,968
2015	18,099	16,395	14,766	13,160	179,539	97,523	82,490	95,163	98,315	48,648	14,126	7,498
2016	3,541	3,215	2,450	6,331	62,526	134,234	85,439	106,918	79,057	47,012	22,417	21,106
2017	16,571	13,930	12,949	11,920	88,692	107,048	53,088	39,921	74,424	56,616	40,037	32,276
2018	17,037	20,812	23,999	23,028	143,712	221,603	97,903	125,159	82,347	40,543	33,878	26,973
2019	20,682	15,473	15,103	15,599	93,236	51,010	27,049	25,303	25,012	19,759	12,020	9,936
2020	8,928	8,934	8,941	8,948	98,614	185,371	82,936	118,554	119,798	48,184	25,934	27,047
2021	28,200	29,317	30,456	32,538	80,235	128,463	69,337	88,609	75,536	60,756	29,829	23,588
2022	22,686	20,715	18,524	16,665	44,233	169,132	97,762	91,442	89,544	95,533	73,107	

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	16,324	14,645	14,544	15,381	102,416	129,017	78,376	77,842	69,064	50,633	31,103	22,282
Standard Deviation	7,384	7,536	8,078	8,223	36,692	44,492	22,914	29,657	25,819	21,953	16,755	8,875
95% Confidence Limit	4,577	4,453	4,774	4,859	18,569	21,801	11,596	14,532	12,651	11,109	9,480	5,021

Note: Grey numbers are discrete discharge measurements and are not used in the statistical analyses.
Grey cells are discharge measurements obtained from the Clearwater Reports.

Figure 4-5: Annual Flow Distribution at KV-41 Lightning Creek

KV-41 flow data available from 2004 to 2022.

4.1.2.5.2 Winter Low Flows

The lowest mean monthly measured flow on record was in March 2016 at 2449.9 m^3/d (0.028 m^3/s) or 0.48 $L/s/km^2$ followed by February 2016 at 3,215 m^3/d (0.037 m^3/s) or 0.630 $L/s/km^2$. The lowest flows are generally observed in the January to April period.

4.1.2.5.3 Peak Flow

There are twelve years of continuous flow data from which peak flows can be taken at KV-41; however, it is important to note that since peak flows can occur when ice is still impacting the water level it is possible that the true peak may not have been captured in the continuous record for some years. Nonetheless, a frequency analysis was carried out on peak instantaneous and daily flows using the Log Pearson Type III distribution to predict moments and yielded the results in Table 4-11.

Table 4-11: Peak Instantaneous and Daily Flows for Various Return Periods (Tp) at KV-41, Lightning Creek

	Instantaneous			Daily		
T_p[1]	m^3/d	m^3/s	$L/s/km^2$	m^3/d	m^3/s	$L/s/km^2$
2	148,595	1.7	29.2	261,145	3.0	84.4
10	224,320	2.6	44.0	385,261	4.5	124.6
25	236,784	2.7	46.5	436,544	5.1	141.1
50	241,588	2.8	47.4	470,981	5.5	152.3

[1] *Return period (T_p) are in years.*

The unit runoff of peak flows is similar between KV-7, KV-41, and McQuesten River at the mouth for the 2-year mean daily peak flow which may also be considered the mean annual discharge. The value at Lightning Creek is highest followed by Christal Creek and then McQuesten River. This is the expected trend as we move to lower median catchment elevations. The size of the McQuesten River watershed will also dampen peak flows. As return period increases so too does the gap between the estimates at the McQuesten River and the smaller Christal and Lightning Creeks. This may be explained by the smaller watersheds having more distinct physiography and shorter lag times to event responses. In other words, less storage means a proportionally larger (flashier) response to melt and precipitation events of combinations of in smaller catchments.

4.2 WATER QUALITY

The KHSD lies along the broad McQuesten River valley with three prominent hills to the south of the valley, Galena Hill, Sourdough Hill, and Keno Hill. It is surrounded by three major watersheds: the McQuesten River watershed, the Mayo River watershed, and the Keno Ladue Watershed. For this report, surface water quality results are discussed, focussing on those watercourses potentially impacted by KHSD Mining Operations, including 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 4-6.

Water quality for watercourses in the KHSD have been thoroughly assessed over the last fifteen years (Minnow, 2008; 2011; 2013; 2014; 2015; 2017; 2018; 2020). These reports provided: a data quality review, identified contaminants of concern (COCs), potential contaminants of concern (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 for background stations, Lightning Creek, Christal Creek, No Cash Creek, Flat Creek and the South McQuesten River. The following 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. Unless otherwise noted, only total cadmium and dissolved zinc are discussed since these reflect the fractions that have Canadian Council of Ministers of the Environment (CCME) cadmium and zinc long-term guidelines for the protection of aquatic life (PAL).

The following sections describe an overview of results of the KHSD water quality sampling program from 2007 to 2022, including the surface water quality monitoring stations at 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 4-6 and in Table 4-12 and Table 4-13.

Table 4-12: Keno Hill Silver District Surface Water Quality Monitoring Stations

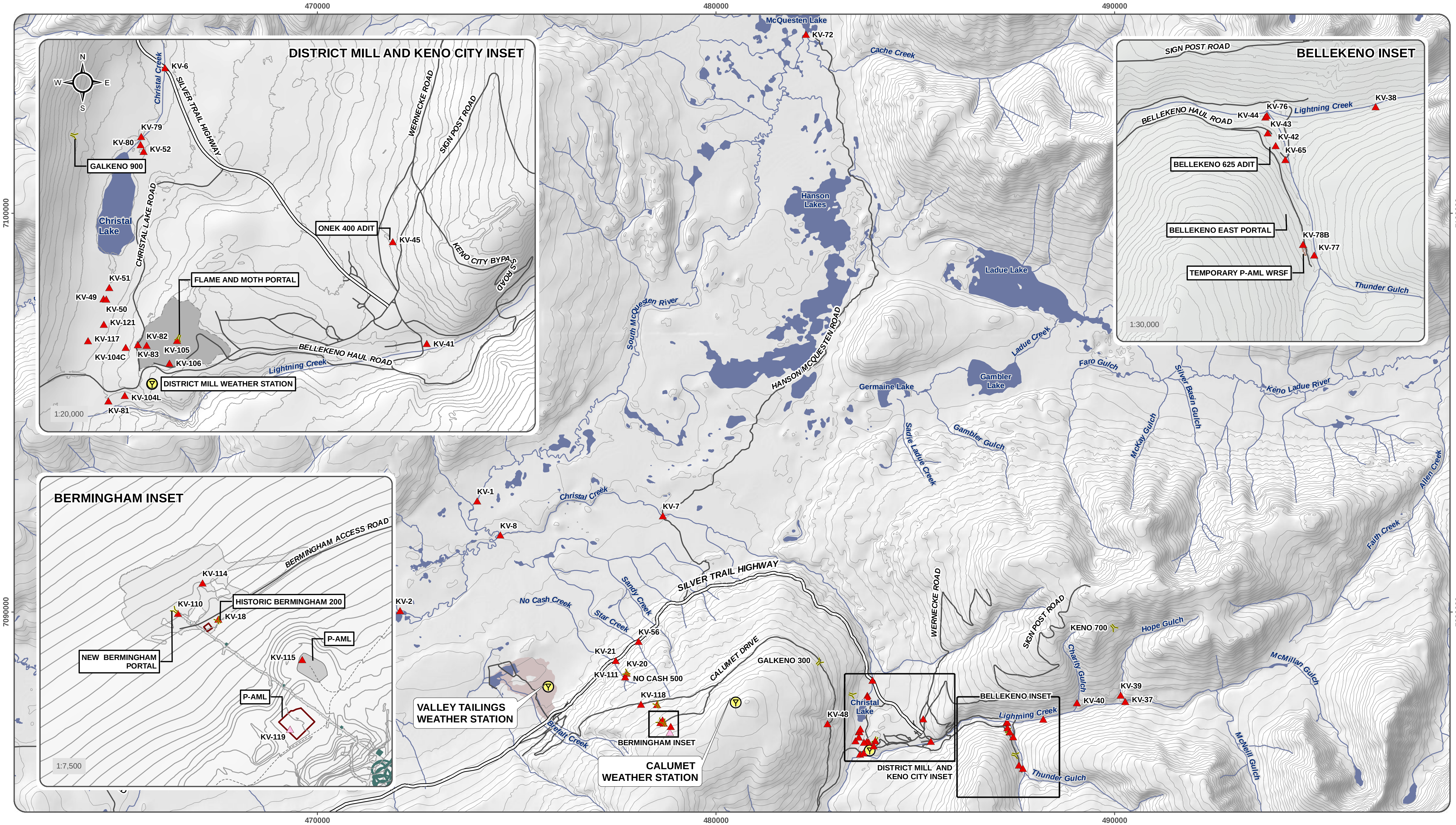
Site*	Description
Mayo River Watershed	
Lightning Creek	
KV-37	Lightning Creek upstream of Hope Gulch
KV-38	Lightning Creek upstream of Thunder Gulch
KV-41	Lightning Creek upstream of bridge at Keno City
KV-65	Thunder Gulch upstream of Bellekeno East Portal
KV-76	Thunder Gulch downstream of Bellekeno 625 Adit
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

** CCME-PAL is applied to the above monitoring sites*

Table 4-13: 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
KV-19	Ruby 400 Adit
KV-20	No Cash 500 Adit
KV-110	New Bermingham Portal discharge
KV-114*	New Bermingham Treatment Pond Decant

** Effluent Quality Standard (EQS) is applied under Type A Water Licence QZ18-044*
*** EQS is applied under Type B Water Licence QZ17-076*



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

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0 1 2 3 4 5 Kilometers

- Active Surface Water Quality Station
- Pending/Proposed Water Quality Station
- Weather Station
- Adit
- As Built Mine Feature
- Valley Tailings
- Silver Trail Highway
- Other Road
- Watercourse
- Waterbody

HECLA KENO HILL

FIGURE 4-6
SURFACE WATER QUALITY STATION LOCATIONS

DECEMBER 2022

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(*Last edited by: amatlashevska; 2022-12-08/15:01 PM*)

4.2.1 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.

4.2.1.1 SOUTH MCQUESTEN RIVER

Water quality stations installed along the South McQuesten River have been monitored by AKHM (2008 to 2022) 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 4-7). Approximately 91% of samples at station KV-1 had exceedances of CCME-PAL total cadmium guideline and 88% at station KV-2. Similarly, 67% of samples at KV-2 and 87% of samples at KV-1 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.

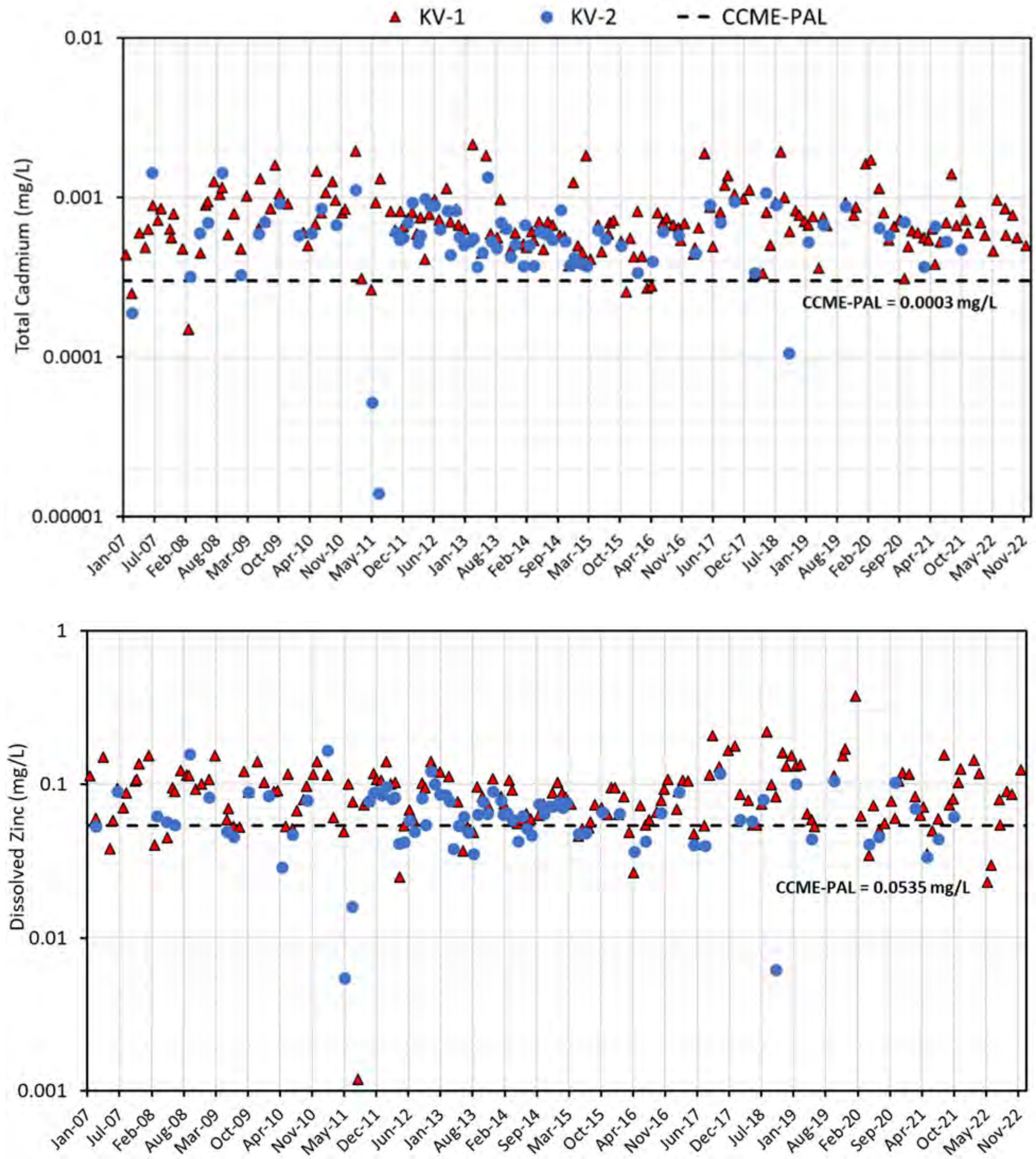


Figure 4-7: Total Cadmium and Dissolved Zinc Concentrations at Stations KV-1 and KV-2 in the South McQuesten River

4.2.1.2 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.

4.2.1.2.1 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.

4.2.1.2.2 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 district mill pond in 2017.

On June 18 2018, water started being discharged from the District Mill pond with periodic discharges occurring in July, August, October, and November. No discharge from the District Mill Pond to the environment occurred in 2019 to 2022. Approximately 10% and 18% of non-discharge samples from the District Mill Pond (station KV-82) had exceedances of total cadmium and zinc EQS from 2015 to 2021, while no samples had exceedances of cadmium and zinc in 2022. Only one sample had exceedance of zinc EQS at the District Mill Pond discharge (station KV-83) from

2015 to 2018 (Figure 4-8); no subsequent samples have been collected at KV-83 due to lack of discharge from the District Mill Pond.

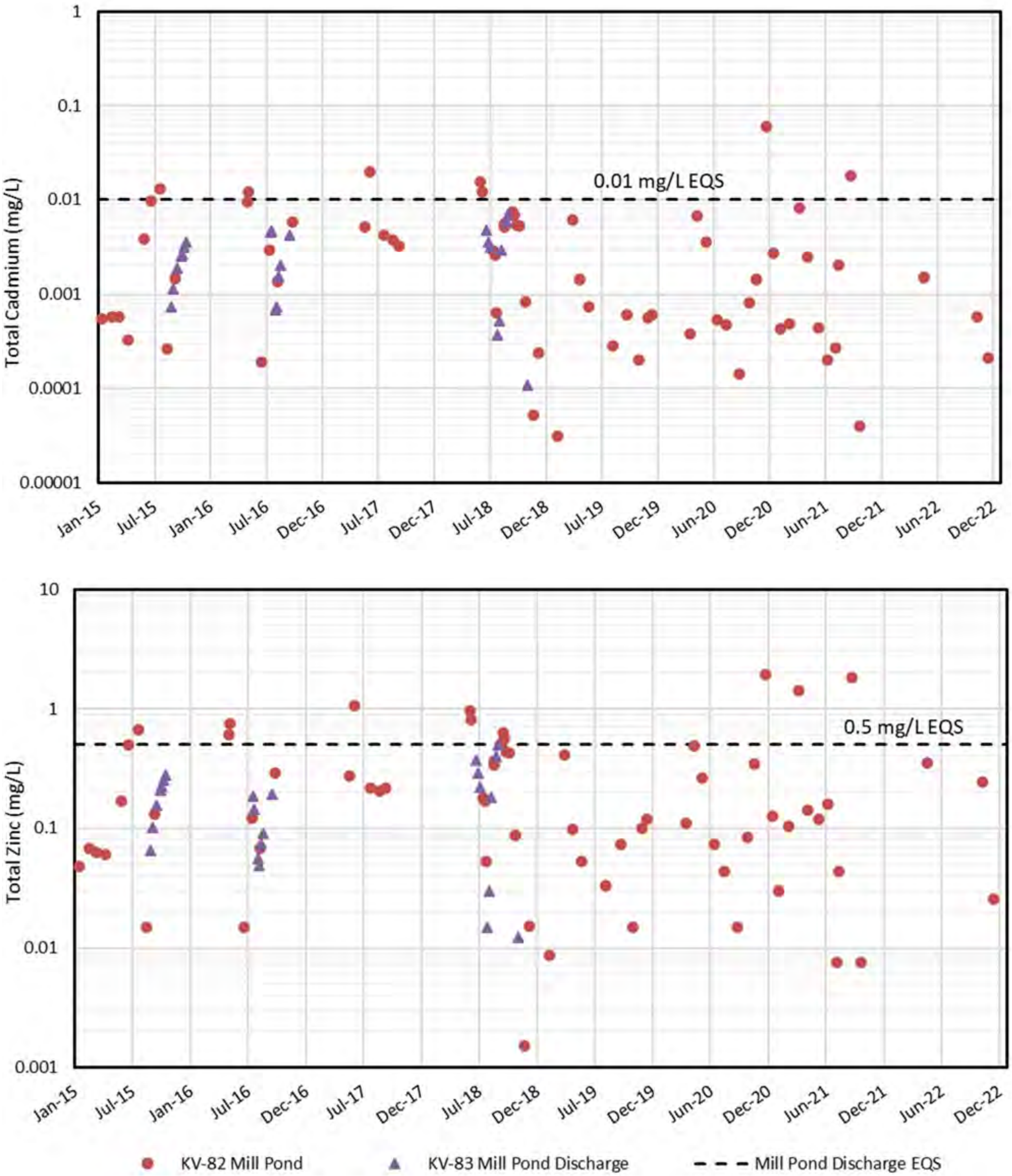


Figure 4-8: Total Cadmium and Zinc Concentrations in the District Mill Pond

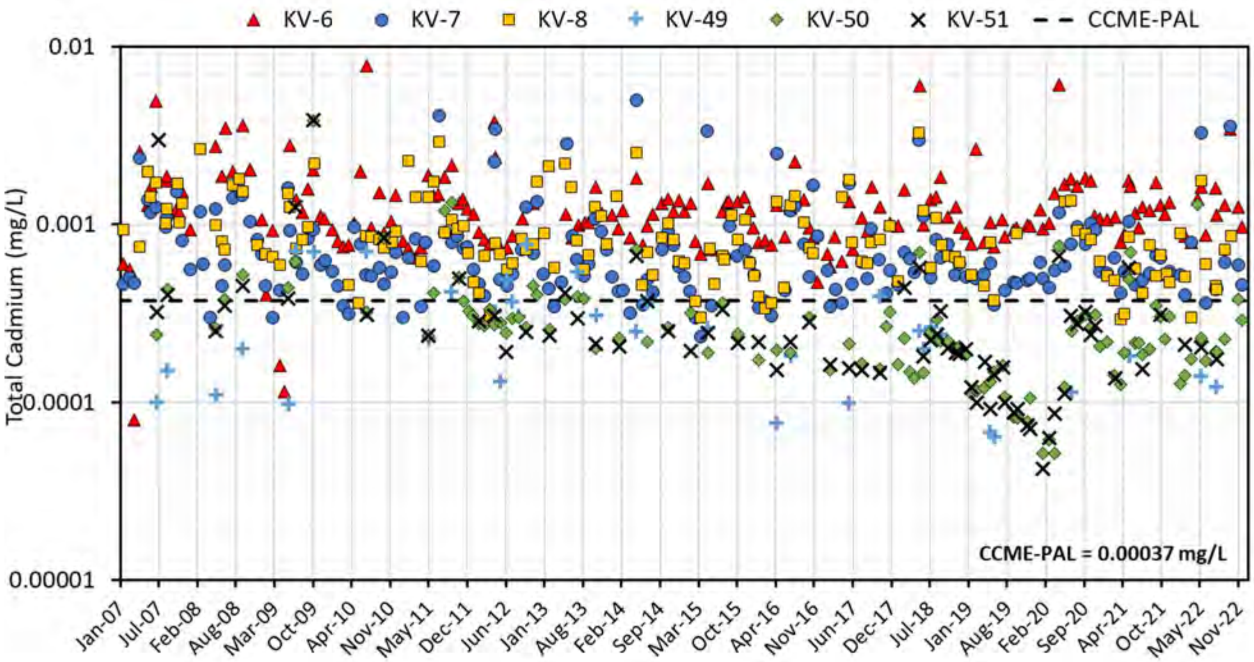
4.2.1.2.3 Christal Creek

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 4-9. The CCME cadmium guideline is hardness-dependent; for reference, the CCME guideline displayed in Figure 4-9 is calculated based on the median hardness for all samples (KV-6, KV-7, KV-8, KV-49, KV-50, KV-51) collected in the Christal Creek catchment (420 mg/L). Similarly, the CCME dissolved zinc guideline is hardness, pH, and dissolved organic carbon (DOC) dependent; for reference, the CCME guideline displayed in Figure 4-9 is calculated based on the median hardness, pH, and DOC for all samples (KV-6, KV-7, KV-8, KV-49, KV-50, KV-51) collected in the Christal Creek catchment (420 mg/L, pH 7.40, and 1.83 mg/L, respectively).

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 22% of samples at KV-50, 21% at KV-51, and 49% at KV-49. On the other hand, in lower Christal Creek, 94%, 85%, and 89% of samples at KV-6, KV-7, KV-8 had exceedances of the total cadmium CCME-PAL guideline, respectively. 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 90% of samples at KV-50 and 83% of samples at KV-51. However, dissolved zinc concentrations were relatively low at station KV-49, showing 20% 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, 86% at KV-7, and 85% 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.



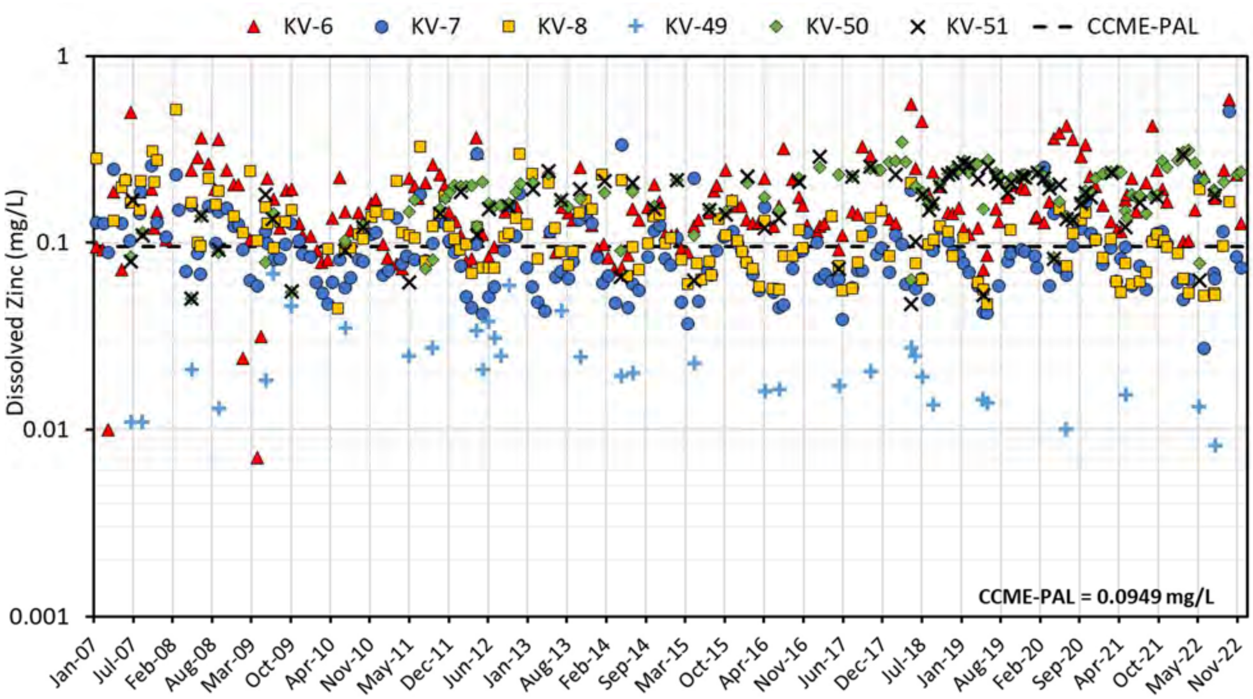


Figure 4-9: Total Cadmium and Dissolved Zinc Concentrations in Christal Creek

4.2.1.3 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.

4.2.1.3.1 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.

Total cadmium and dissolved zinc concentrations in the New Bermingham portal discharge (station KV-110) were relatively high from November 2017 to June 2018 (Figure 4-10) as water was pumped from the historical Bermingham 200 adit for decline excavation purposes. Concentrations decreased markedly in the fall of 2018 as portal development was suspended during that time. Between September 2018 and May 2020, total cadmium (median 0.000063 mg/L) and dissolved zinc (median 0.010 mg/L) concentrations were between one and two orders of magnitude lower, reflecting local groundwater baseline concentrations. The total cadmium and dissolved zinc concentrations increased from May 2020 to December 2022. Total cadmium and dissolved zinc concentrations in the New Bermingham WTP Pond Decant (KV-114) were one to two orders of magnitude lower than those in the portal discharge (KV-110), ranging from 0.000009 to 0.00275 mg/L (median 0.0002 mg/L) for total cadmium and from less than 0.001 to 0.0965 mg/L (median 0.001 mg/L) for dissolved zinc.

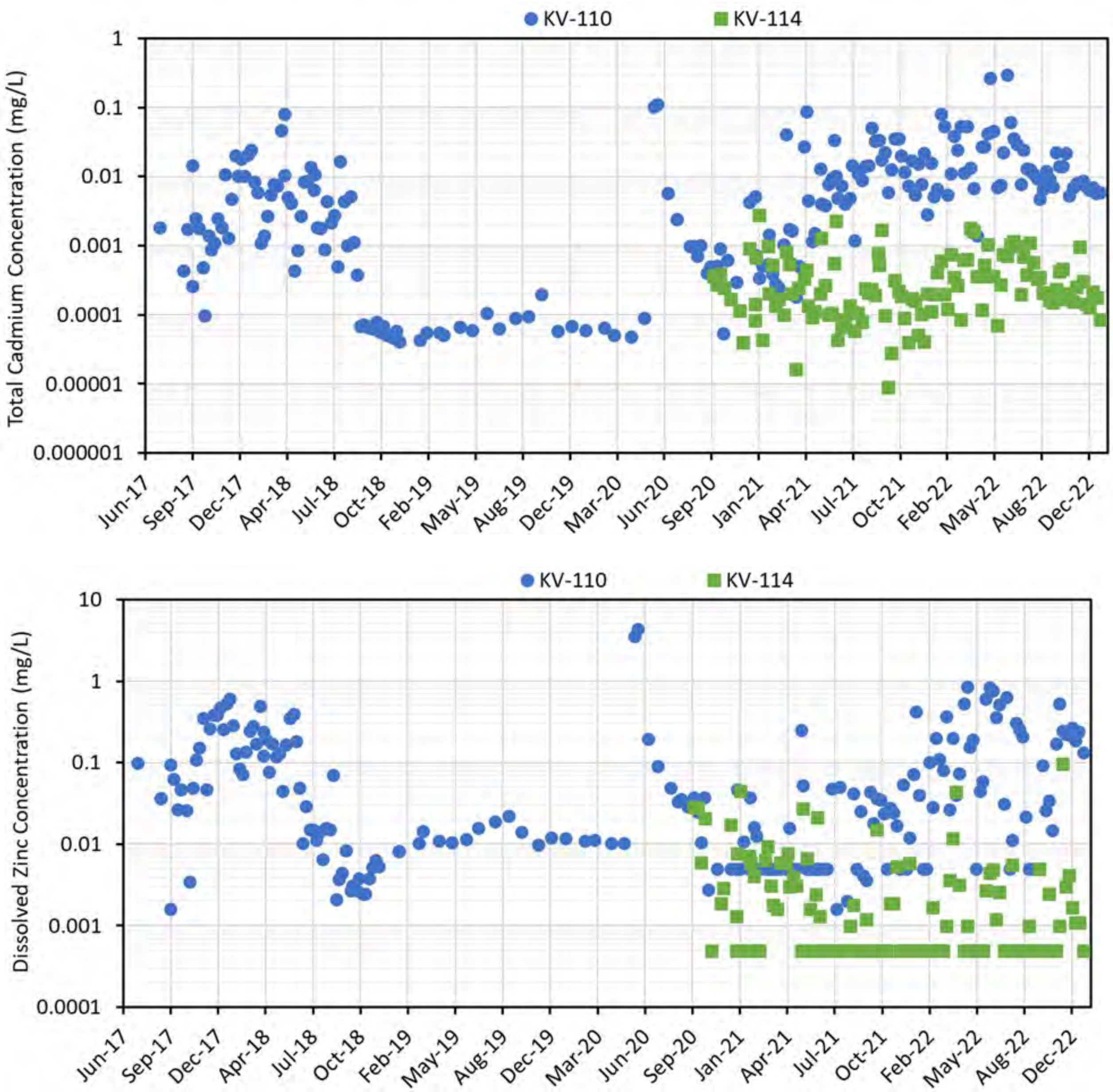


Figure 4-10: **Total Cadmium and Dissolved Zinc Concentrations in New Bermingham Portal Discharge (KV-110) and New Bermingham Pond Decant (KV-114)**

4.2.1.3.2 No Cash Creek

Water quality in No Cash Creek is monitored at stations:

- KV-21, located at the Silver Trail Highway, 500 m downstream of No Cash 500 adit;
- KV-111, located immediately upstream of the No Cash 500 adit; and
- KV-118, located upper No Cash Creek at Calumet Drive and upstream of KV-111

Water at stations KV-118 and KV-111 only flows seasonally and is typically dry/frozen to ground between October and March. Station KV-21 has the longest water quality data record (regular monitoring since 2008), whereas monitoring at KV-111 and KV-117 was initiated more recently, beginning September 2017 and July 2018, respectively.

All samples exceeded the CCME-PAL guidelines for total cadmium and dissolved zinc at both KV-21 and KV-118, whereas 11% and 25% of samples exceeded the guideline for total cadmium and dissolved zinc at KV-111, respectively. Cadmium and zinc concentrations displayed little seasonality at station KV-118, although the highest concentrations tended to occur in late fall or winter (Figure 4-11), likely due to contributions from the historical Bermingham 200 and/or Ruby 400 adit flow that travels farther over frozen ground. Changes in total cadmium and dissolved zinc concentrations at KV-118 did not correlate with those at KV-111. At KV-111, total cadmium and dissolved zinc concentrations were relatively higher in April and May, then declined through the year. Total cadmium and dissolved zinc concentrations at KV-111 were approximately two orders of magnitude lower than those at downstream station KV-21, reflecting the contribution of the No Cash 500 adit discharge to KV-21. Peak concentrations of total cadmium were normally observed in May and October at KV-21. The highest dissolved zinc concentrations were generally observed in the fall at KV-21.

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).

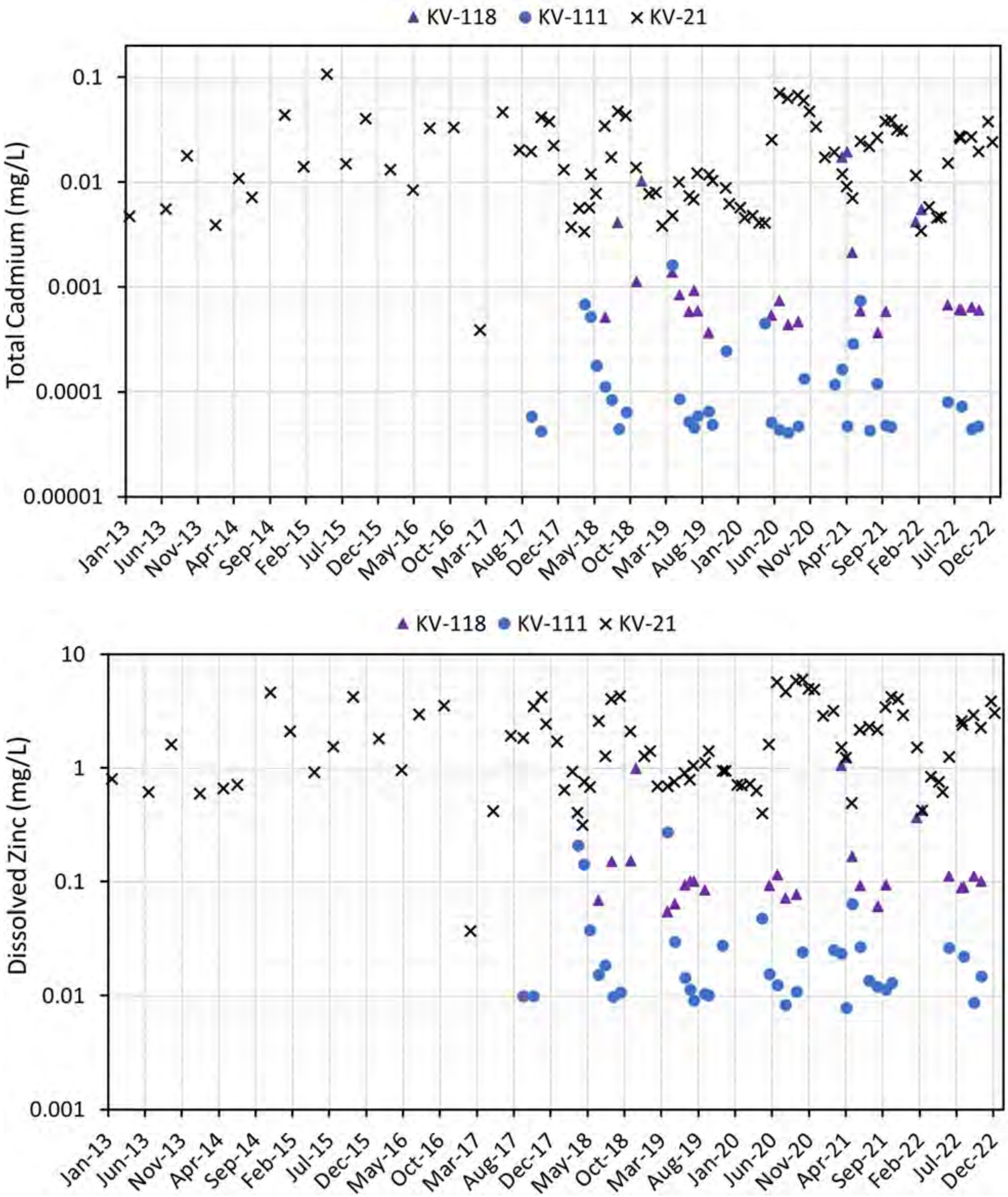


Figure 4-11: **Total Cadmium and Dissolved Zinc Concentrations at stations KV-118, KV-111, and KV-21 in No Cash Creek**

4.2.2 MAYO RIVER DRAINAGE

4.2.2.1 LIGHTNING CREEK CATCHMENT

Lightning Creek is a mountainous alpine stream flowing within a narrow valley with a steep gradient from the north side of Sourdough Hill into Duncan Creek, which drains into the Mayo River. Historically several mines have been in operation in the Lightning Creek catchment of which the Keno 700 adit is the primary source of metal load. Habitat within Lightning Creek is heavily impacted by historical and ongoing placer mining activities that have been active on the stream and its tributary, Thunder Gulch, since the 1960s. Placer mining operations have had a significant effect on water quality with respect to suspended solids.

Of the KHSD Mining Operations components, the Bellekeno 625 WTP pond decant (KV-43) and Flame & Moth WTP effluent discharged to Lightning Creek (KV-104L) are currently regulated under the Type A Water Licence (QZ18-044).

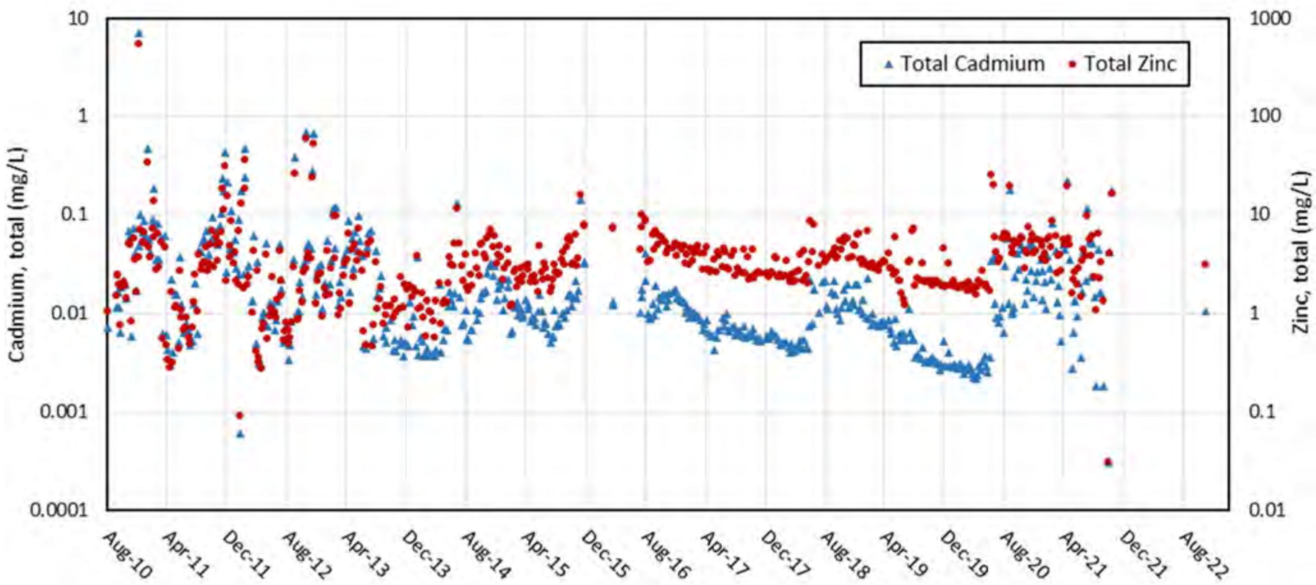
4.2.2.1.1 Bellekeno Water Treatment Plant

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 Treatment Facility. Bellekeno 625 WTP decant water is discharged east of the treatment facility and reports to ground, eventually flowing via a diffuse surface pathway into Lightning Creek, downstream of Thunder Gulch.

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.

Discharge at the Bellekeno 625 adit has been monitored since at least 1984. Discharges occurred from August 2010 to October 2021 (with exception of time in 2015 and 2016 when part of the mine was allowed to flood) and no discharge from Bellekeno 625 adit has occurred since October 2021 when the mine was allowed to flood when put into temporary closure. Discharge from Bellekeno 625 adit is expected to resume in by May 2023. The trends in total zinc and cadmium concentrations are similar in the Bellekeno 625 adit discharge (Figure 4-12), reflecting a common source such as sphalerite. Of the EQS-regulated parameters, total zinc concentrations were constantly above the EQS of 0.5 mg/L throughout the monitoring period, ranging from 0.03 to 547 mg/L (median 2.9 mg/L). Over the same period, total cadmium concentrations typically remained comparable with or below the EQS of 0.01 mg/L (median 0.011 mg/L; Figure 4-12).

Total zinc concentrations and pH of the treated decant water at Bellekeno are shown in Figure 4-12. Total zinc concentrations in the treated decant typically remained well below the EQS (0.5 mg/L) with median concentrations being around 0.06 mg/L. Occasional marginal exceedances (e.g., November 24, 2015, January 17, 2017, October 31, 2019, September 8, 2020) were related to elevated particulates in the sample or power outages resulting in the suspension of lime addition.



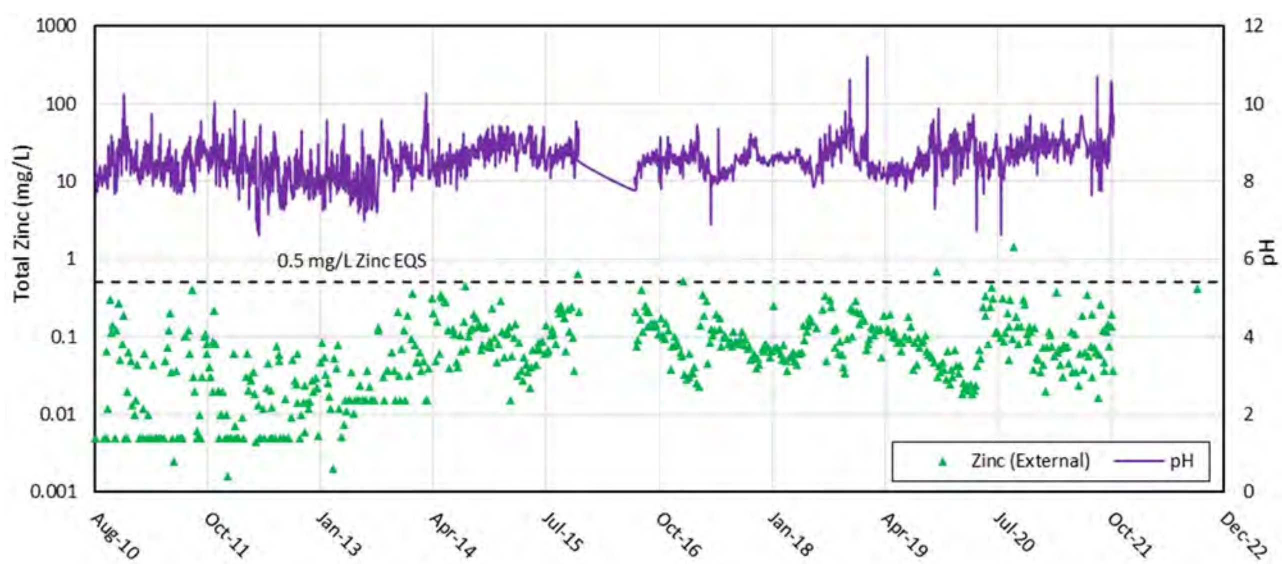


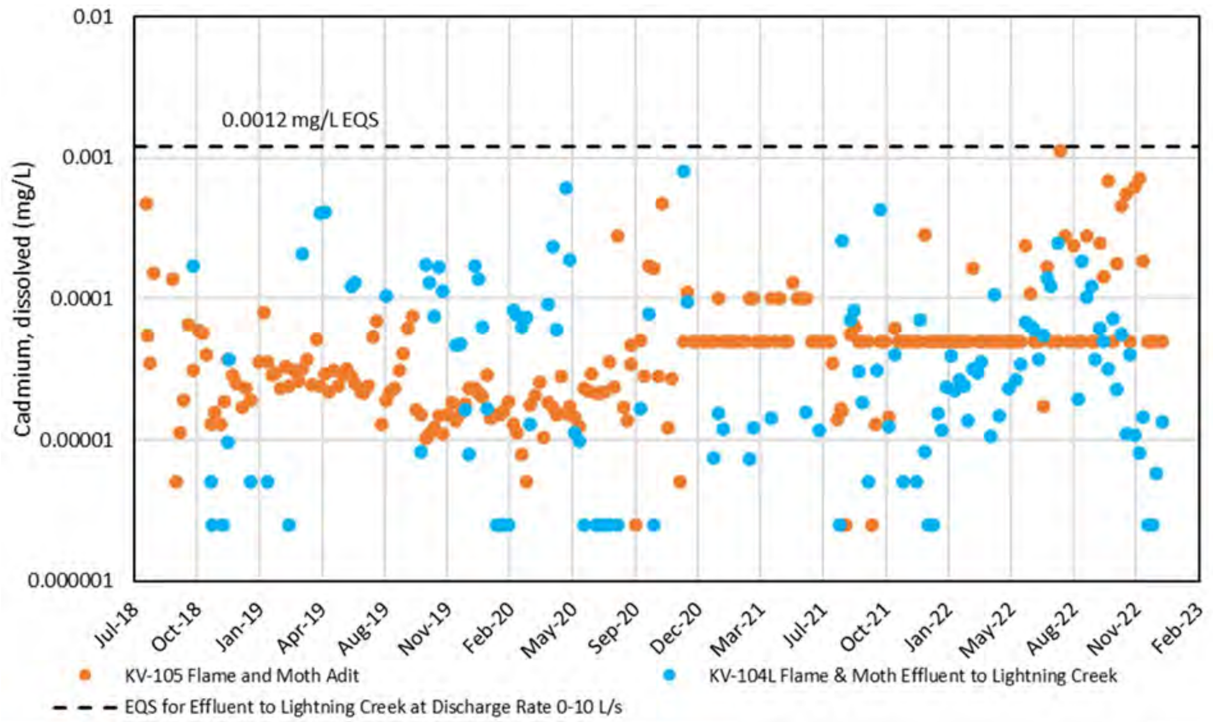
Figure 4-12: Total Cadmium and Zinc Concentrations in the Untreated Bellekeno 625 Adit Discharge (top) and Treated Bellekeno 625 WTP Decant pH and Zinc Concentrations (bottom)

4.2.2.1.2 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 further defined by the discharge rate, with four ranges identified in Part G, Clause 65 and 66 of Water Licence QZ18-044.

Continuous water sampling was conducted at the Flame & Moth adit (KV-105) from July 2018 to December 2022, with discharge going to the WTP. Effluent discharge occurred periodically to the Lightning Creek watershed (<10 L/s); discharge to Christal Creek was limited to 9 days in 2021 (Section 4.2.1.2.1). Water samples were collected at the Flame & Moth WTP effluent to Lightning Creek (KV-104L) from October 2018 to December 2022. Discharge to KV-104L or KV-104C is manually controlled and non-discharge from the Flame & Moth WTP is station KV-104ND,

Monitoring from 2018 to 2022 show cadmium and zinc concentrations in the Flame & Moth adit (KV-105) typically below EQS prior to treatment (Figure 4-13). Dissolved cadmium concentrations at the Flame & Moth adit (KV-105) and WTP effluent to Lightning Creek (KV-104L) were below the EQS at all time points, ranging from less than 0.000005 to 0.001 mg/L. All water samples at the Flame & Moth WTP discharge (KV-104L) had dissolved zinc concentrations below the EQS, ranging from less than 0.001 to 0.08 mg/L.



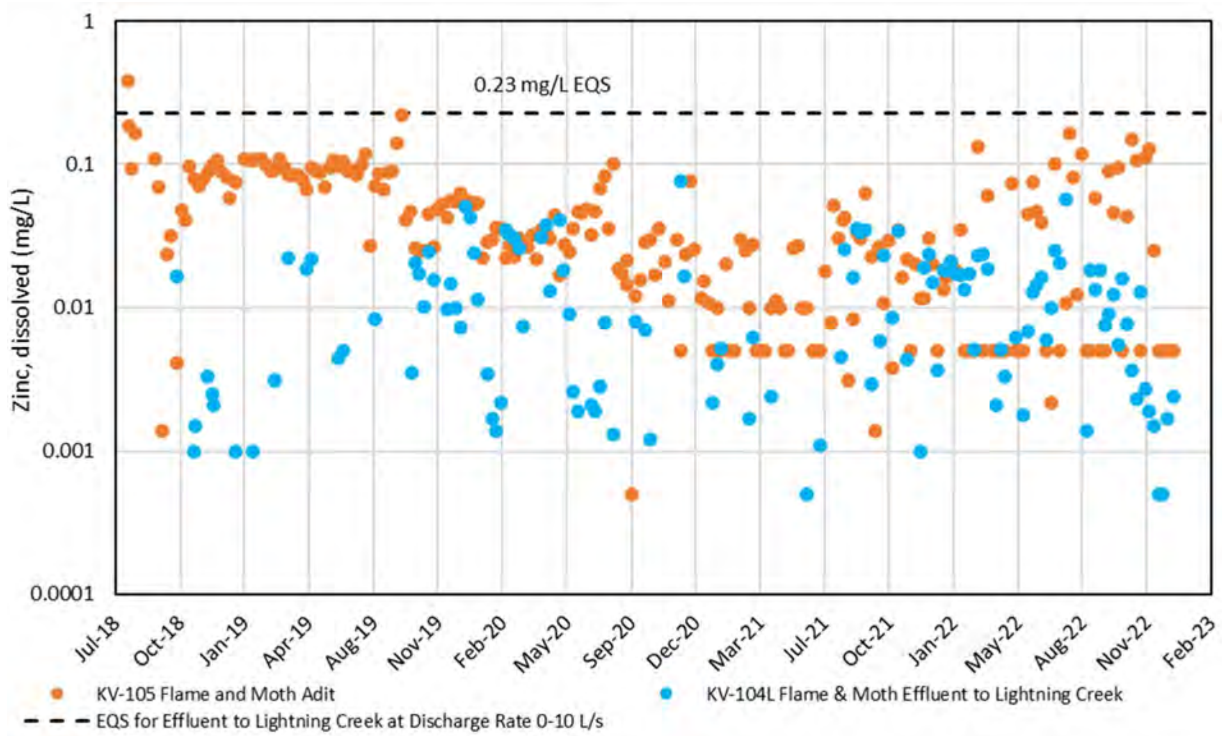


Figure 4-13: Dissolved Cadmium and Zinc Concentrations in Flame & Moth Discharge

4.2.2.1.3 Lightning Creek

There are nine regularly monitored sites 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.

Time series of total cadmium and dissolved zinc concentrations at each site in the Lightning Creek catchment are shown in Figure 4-14. The CCME cadmium guideline is hardness-dependent; for reference, the CCME guideline displayed in Figure 4-14 is calculated based on the median hardness for all samples (KV-37, KV-38, KV-41, KV-65, KV-76, KV-81) collected in the Lightning Creek catchment (106 mg/L). Similarly, the CCME dissolved zinc guideline is hardness, pH, and DOC dependent. For reference, the CCME guideline displayed in Figure 4-14 is calculated based on the median hardness, pH and DOC for all samples (KV-37, KV-38, KV-41, KV-65, KV-76, KV-81) collected in the Lightning Creek catchment.

The median total cadmium concentration was lowest at the sites upstream of mine inputs (i.e., KV-37, 0.000018 mg/L and KV-65, 0.00006 mg/L). The highest median cadmium concentrations were observed at KV-76 (0.00013 mg/L) and KV-38 (0.00012 mg/L). KV-38 had the second highest median total cadmium concentration within the Lightning Creek catchment due to load contributions from the upstream untreated Keno 700 adit. Of the samples collected at KV-38, 42% exceeded the CCME-PAL cadmium guideline compared to 12% at KV-37, located upstream of the Keno 700 adit contribution in lower Lightning Creek. Similarly, the median dissolved zinc concentration observed at KV-38 (0.0111 mg/L; 37% samples exceeded CCME-PAL) was highest, whereas the median dissolved zinc concentration observed farther upstream at KV-37 (0.002 mg/L; 9% samples exceeded CCME-PAL) was the lowest within the entire catchment. CCME PAL exceedances were normally observed in May during freshet, coincident with the lowest hardness levels and therefore lower hardness dependent calculated CCME-PAL guideline. That KV-38 generally returned the highest dissolved zinc concentrations is due to the Keno 700 adit discharge, which contains elevated zinc (median 1.6 mg/L) and flows into Hope Gulch, which in turn discharges to Lightning Creek just upstream of KV-38.

At Thunder Gulch, the median total cadmium concentration at KV-76 (0.00013 mg/L) was approximately double that observed at KV-65 (0.00006 mg/L). CCME-PAL exceedances for total cadmium were commensurately higher at KV-76 (44% of samples) than KV-65 (25%). The total cadmium concentrations gradually increased at both sites from 2008 to 2014, then fluctuated from 2015 to 2022, exhibiting a seasonal variability in which higher concentrations occurred in spring/summer and lower concentrations in winter, likely due to freshet. Over the monitoring period from 2008 to 2022, total cadmium concentrations at KV-65 ranged from lower than 0.00001 to 0.00795 mg/L (median 0.00006 mg/L). Total cadmium concentrations at station KV-76 ranged from 0.00002 to 0.011 mg/L (median

0.00013 mg/L) over the 2008 to 2022 period. Most of the CCME-PAL exceedances at the Thunder Gulch sampling locations occurred through May to July, which coincides with spring freshet and periods when placer mining is active on Thunder Gulch.

Over the monitoring period from 2008 to 2022, the dissolved zinc concentration at KV-65 ranged from less than 0.001 to 0.019 mg/L (median 0.0021 mg/L). Approximately 3% samples from KV-65 collected during the monitoring period exceeded the CCME-PAL guideline for dissolved zinc. Dissolved zinc concentrations were slightly higher at the station KV-76 downstream of KV-65, ranging from less than 0.001 to 0.0235 mg/L (median 0.0052 mg/L). Approximately 13% of samples from KV-76 exceeded the CCME-PAL guideline. Most of the exceedances occurred May to August. Seasonal variations also occurred with peak concentrations observed during the same period.

KV-41 and KV-81 had 29% and 25% of samples that exceeded the cadmium CCME-PAL guideline, respectively. Total cadmium concentrations at KV-41 and KV-81 were generally similar with exceedances and annual peaks occurring May to September. At lower Lightning Creek, KV-81 had the second highest median dissolved zinc concentration (0.0085 mg/L) of the catchment and 10% of samples exceeded the CCME-PAL dissolved zinc guideline. The dissolved zinc concentrations were slightly decreased at KV-41, farther upstream of KV-81, with a median of 0.0076 mg/L. KV-41 had 10% of samples that exceeded the CCME-PAL dissolved zinc guideline. Dissolved zinc concentration at KV-41 and KV-81 were similar with annual peaks normally occurring in May (during freshet). Overall, concentrations have not shown much change since the start of the Flame & Moth WTP discharge to Lightning Creek from 2018 to 2022, suggesting that it has not had a material effect on Lightning Creek water quality.

It should be noted that the median dissolved cadmium concentrations were generally lower than the median total cadmium concentrations within the Lightning Creek catchment, suggesting that the cadmium in this catchment had a significant particulate component. This reflects the influence of placer mining activities and associated raised TSS levels, which in turn result in elevated total cadmium concentrations. The number of dissolved cadmium samples that exceeded the CCME-PAL cadmium guideline was much lower at each site (i.e., 2.5% of samples exceeded the guideline at KV-65, 28% at KV-76, 9% at KV-37, 37% at KV-38, 10% at KV-41, and 13% at KV-81 respectively).

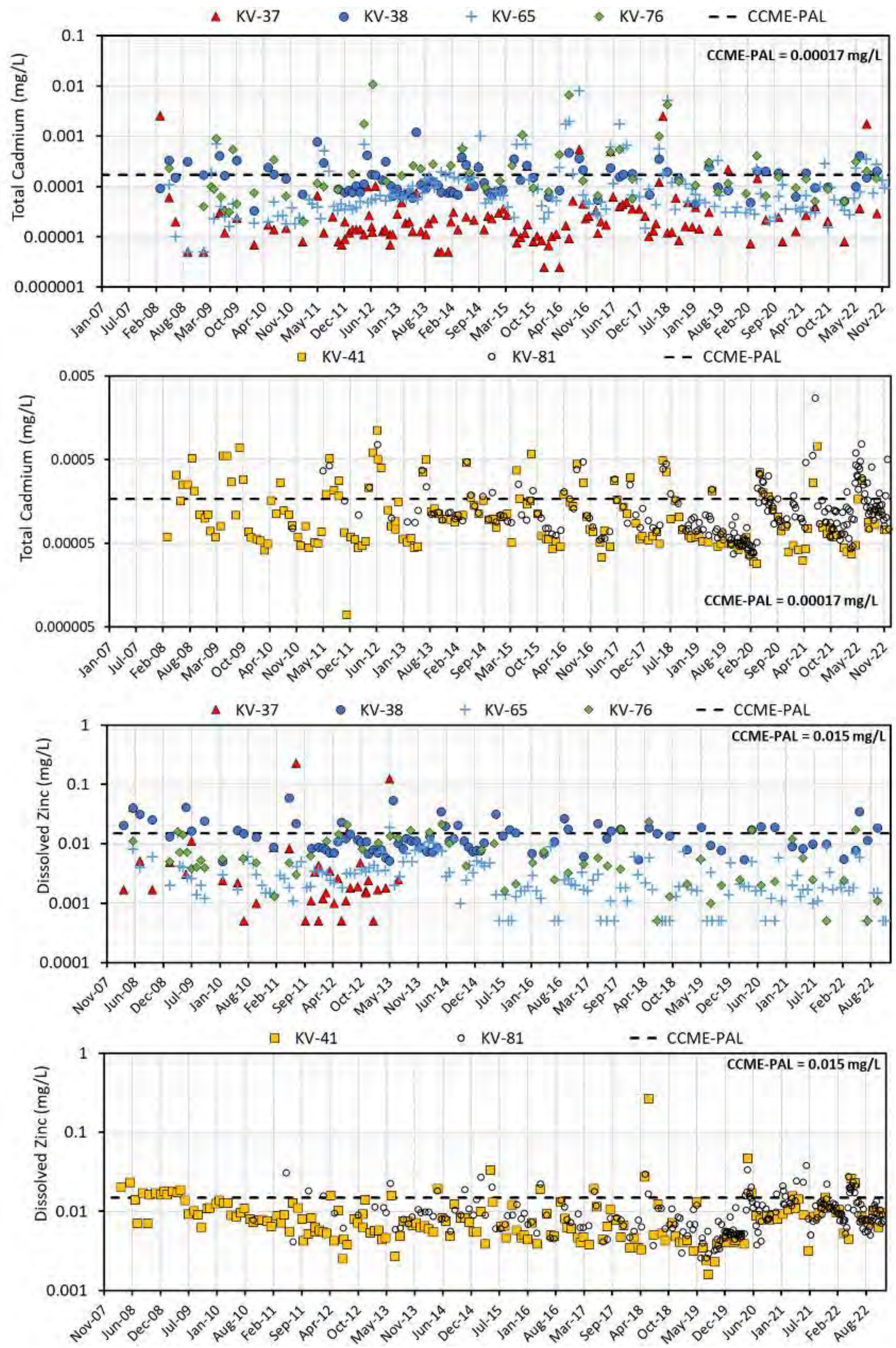


Figure 4-14: Cadmium and Zinc Concentrations in Lightning Creek (KV-37, KV-38, KV-41, and KV-81) and Thunder Gulch (KV-65 and KV-76)

5 GROUNDWATER

5.1 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.

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.

Groundwater flow is concentrated in higher permeability geologic materials, which include overburden (where present) and shallow bedrock (which tends to be more fractured).

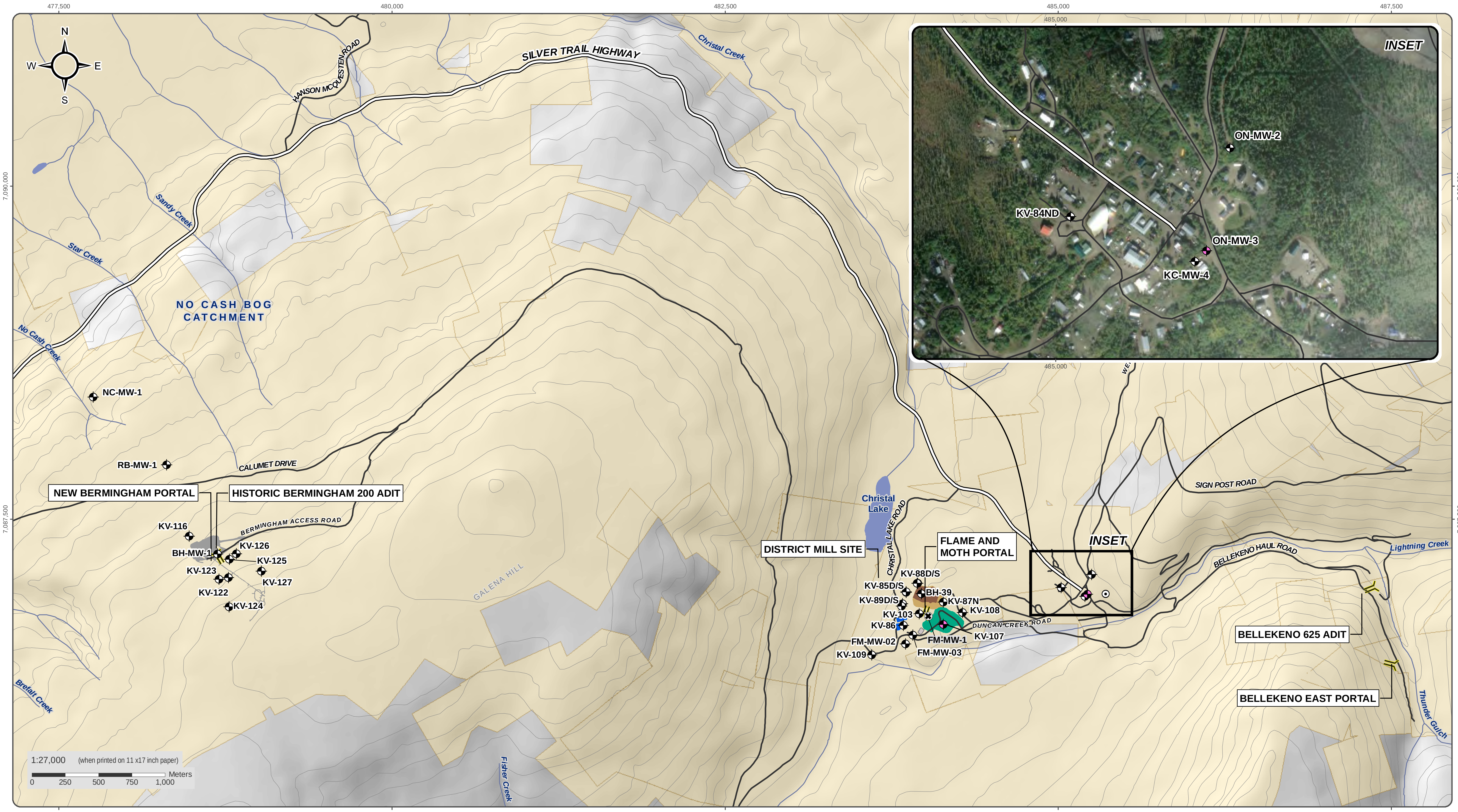
The groundwater monitoring well locations for the proposed and existing KHSD Mining Operations are described by catchment in Table 5-1, and the locations of the wells are shown on Figure 5-1 to Figure 5-3.

Table 5-1: Keno Hill Silver District Groundwater Monitoring Well Network

Site	Description	Total Depth (m)	Screen Length (m)	Geology/lithology of screened interval	Monitoring Date Range
BH-MW-1[1]	Well d/g of the historical Bermingham 200 Adit	21.34	3.0	Graphitic Schist/Quartzite	September 2013 – Present
RB-MW-1	Well d/g of the Ruby 400 Adit and WRSA	13.41	3.0	Gravel, Sand, Silt and Cobble/Graphitic Schist	September 2013 – Present
NC-MW-1	Well u/g of the NC 500 Adit	35.7	12.0	Bedrock	December 2020 – Present
KV-116	New Bermingham Waste Rock Disposal Area	12.9	6.0	Bedrock	November 2020 – Present
KV-122	New Bermingham Waste Rock Disposal Area	26.70	6.0	Bedrock	November 2020- Present
KV-123	New Bermingham Waste Rock Disposal Area	44.56	6.0	Bedrock	November 2020- Present
KV-124	New Bermingham Waste Rock Disposal Area	15.83	6.0	Bedrock	November 2020- Present
KV-125	New Bermingham Waste Rock Disposal Area	59.16	6.0	Bedrock	January 2021- Present
KV-126	New Bermingham Waste Rock Disposal Area	71.24	7.0	Bedrock	December 2020 - Present
KV-127	New Bermingham Waste Rock Disposal Area	27.61	9.0	Bedrock	November 2020- Present
KV-84ND	Bedrock well on Keno Firehall lot to replace KV-84	88.39	12.0	Graphite/Schist/Quartzite/Muscovite/Sericite Schist/Pyrite	2013 – Present
KV-85D[2]	DSTF and Mill Site Groundwater Well #1 (PH2) Deep	42.7	3.0	Bedrock	2010 – 2022
KV-85S	DSTF and Mill Site Groundwater Well #1 (Shallow)	4.03	1.5	Gravel and Silt	October 2011 – Present
KV-86[2]	DSTF and Mill Site Groundwater Well #2 (PH5)	36	3.0	Fine gravel and coarse sand	2010 – Present
KV-87	DSTF and Mill Site Groundwater Well #3 (PH6)	57.9	3.1	Bedrock	2010 – May 2018
KV-87N	New 2020 Flame & Moth Site Groundwater Well #3	94.8	21.0	Bedrock	December 2020 – Present

Site	Description	Total Depth (m)	Screen Length (m)	Geology/lithology of screened interval	Monitoring Date Range
KV-88D[2]	DSTF and Site Groundwater Well #4 (Deep)	50.1	15	Bedrock	October 2011 – Present
KV-88S	DSTF and Mill Site Groundwater Well #4 (Shallow)	4.11	1.5	Sand/Gravel/Silt/Bedrock	October 2011 – Present
KV-89D[2]	Flame & Moth Site Groundwater Well #5 (Deep)	38.3	10	Bedrock	October 2011 – Present
KV-89S	DSTD and Mill Site Groundwater Well #5 (Shallow)	4.8	1.5	overburden	October 2011 – Present
KV-103	Mill Supply Well	82.3	n/a	Sand with Gravel/Glitstone (Shale)	November 2015 - Present
KV-107	Proposed DSTF expansion area	TBD	TBD	TBD	TBD
KV-108	Upgradient of DSTF expansion area	94.3	12.0	Bedrock	December 2020 – Present
BH-39	Phase I of DSTF	7.5	7.5	Tailings	2012 – Present
FM-MW-1[2,3]	Flame & Moth Well #1 (KAR-01)	182.3	12.2 12.2	Quartzite/Schist/Graphite Schist/Sericite Schist Greenstone/Mineralized Vein	August 2013 – 2020
FM-MW-2[3]	Flame & Moth Well #2 (KAR-02)	244.4	12.2 12.2	Quartzite Quartzite/Stringer Zone	August 2013 – Present
FM-MW-3	Flame & Moth Well #3 (KAR-16)	195.7	12.2	Quartzite/Graphics Schist	September 2013 – Present
KC-MW-4[2]	Well south of Onek 400 Adit	82.3	2.2	Gravel/Sand/Boulder/Cobble	2011 – 2014
ON-MW-2	Onek Monitoring Well #1 d/g Project Facilities	66.3	6.0	Bedrock/quartzite/graphitic schist	August 2012 – Present
ON-MW-3	Proposed Well south of Onek 400 Adit	TBD	TBD	TBD	TBD
KV-109	Flame & Moth Lightning Creek Discharge area near KV-81	27.6	3.1	Schist/Quartzite	July 2018 – Present

**TBD – To be determined, these wells are proposed.*
[1] Well has been dry since October 2017.
[2] Well is broken. KV-85D – frost jacked; KV-86 – flattened by loader and therefore not monitored in 2022; KV-88D – well kinked at 10 m; KV-89D – logger is stuck in the well; FM-MW-1 – well compromised by on-site equipment; KC-MW-4 – broken.
[3] These wells have two sections of screen. Screen lengths and lithology values are presented in order of upper screen and lower screen.



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- Proposed Monitoring Well
- Monitoring Well
- Decomissioned Monitoring Well
- Adit
- As-Built MIne Footprint
- Pond
- DSTF 322k Tonnes Design
- Current DSTF
- To Be Constructed Mine Features
- Alexco/ERDC Quartz Claims
- Silver Trail Highway
- Other Road

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FIGURE 5-1

KHSD GROUNDWATER MONITORING LOCATIONS

FEBRUARY 2023

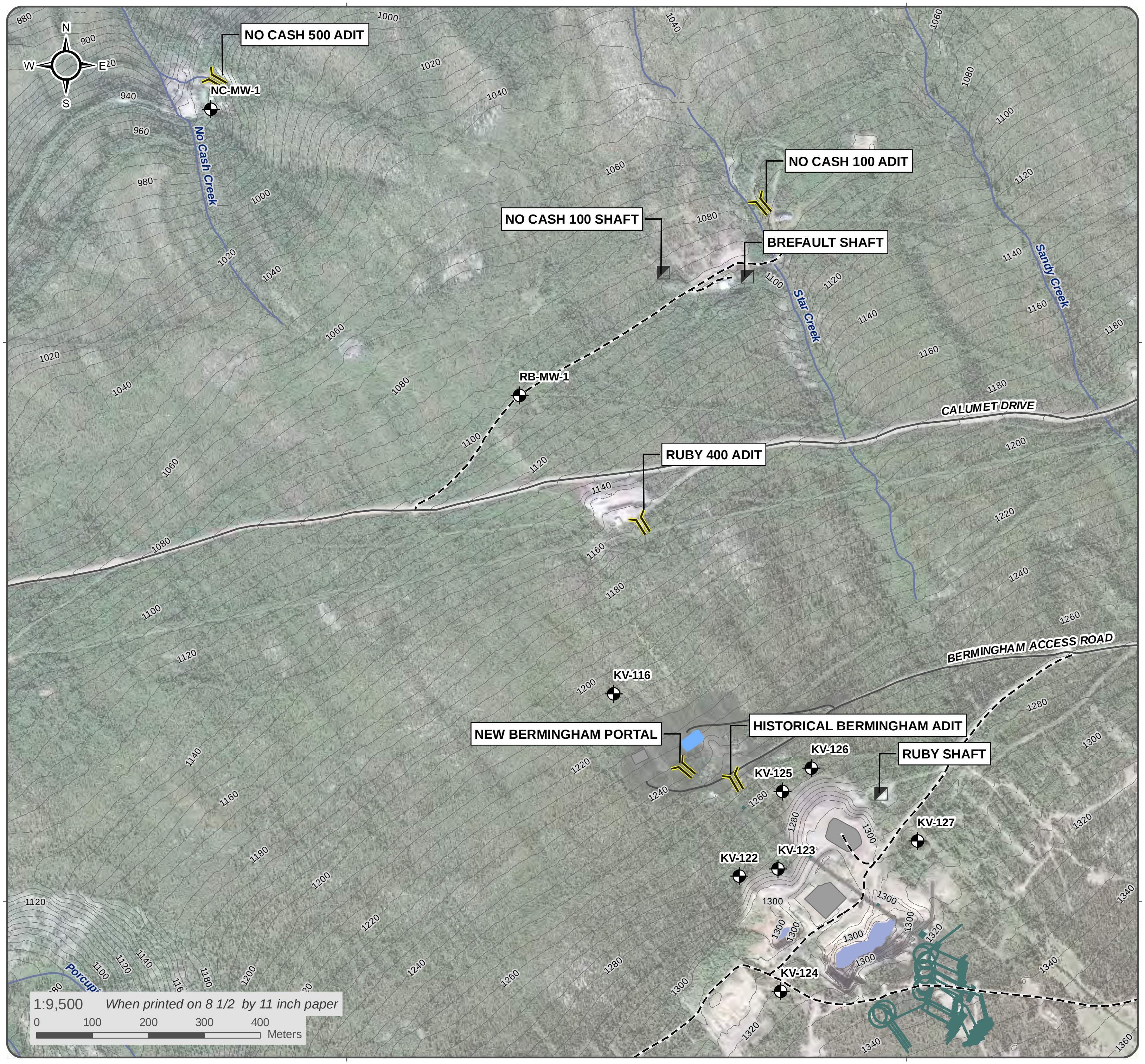

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FIGURE 5-2

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

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

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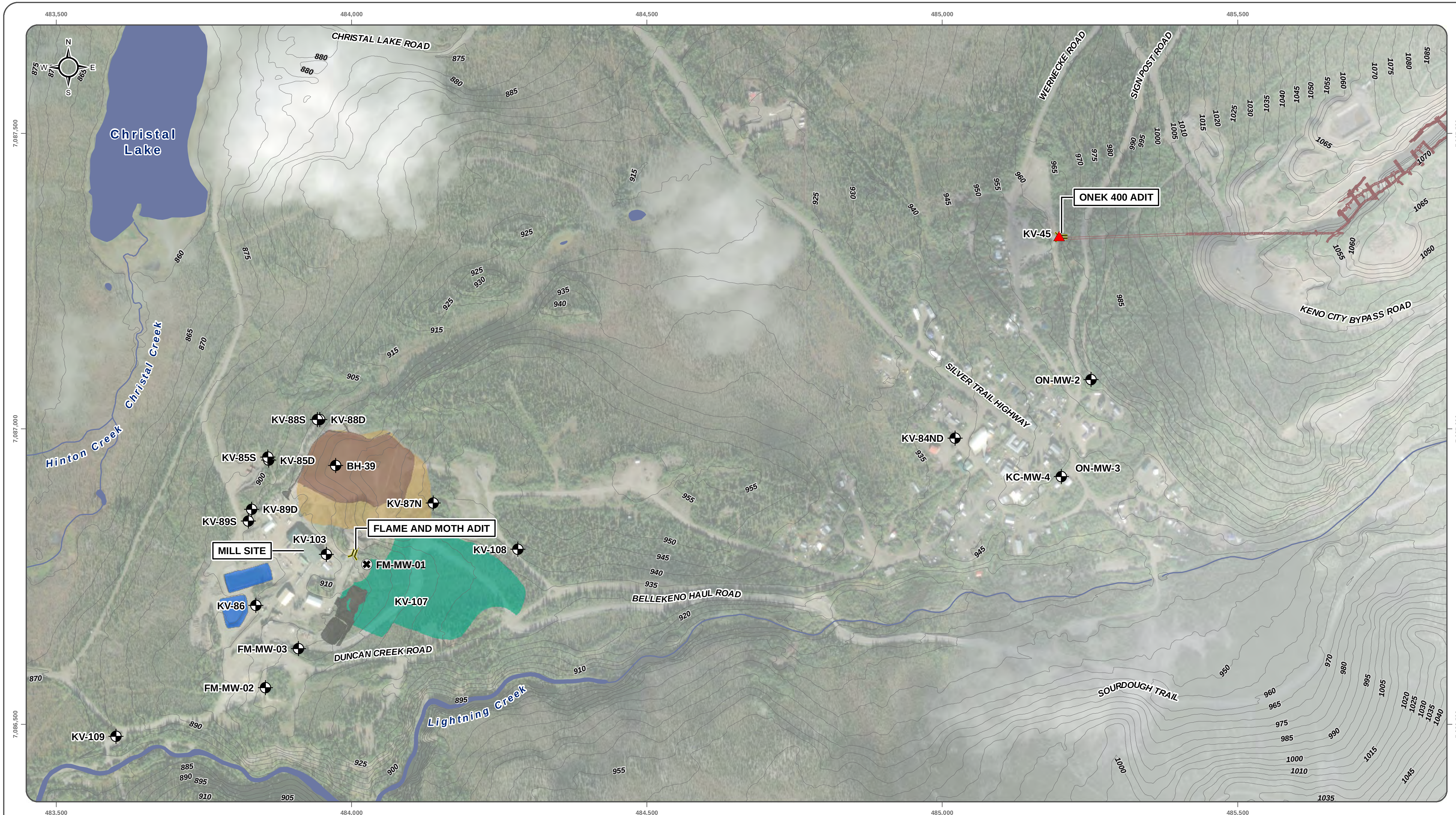

Satelite imagery obtained from ESRI Imagery map service http://goto.arcgisonline.com/maps/World_Imagery on February 2023

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

- 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)

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FIGURE 5-3

GROUNDWATER MONITORING LOCATIONS AT DISTRICT MILL SITE, FLAME AND MOTH, ONEK 990 AND KENO CITY

FEBRUARY 2023

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(Last edited by: amalfashevska;2023-02-22/09:02 AM)

5.2 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.

Additional characterization work was done around some mines where mine dewatering rates needed to be estimated. Air lift testing was conducted at the New Bermingham and Flame & Moth mine sites during drilling of new monitoring wells.

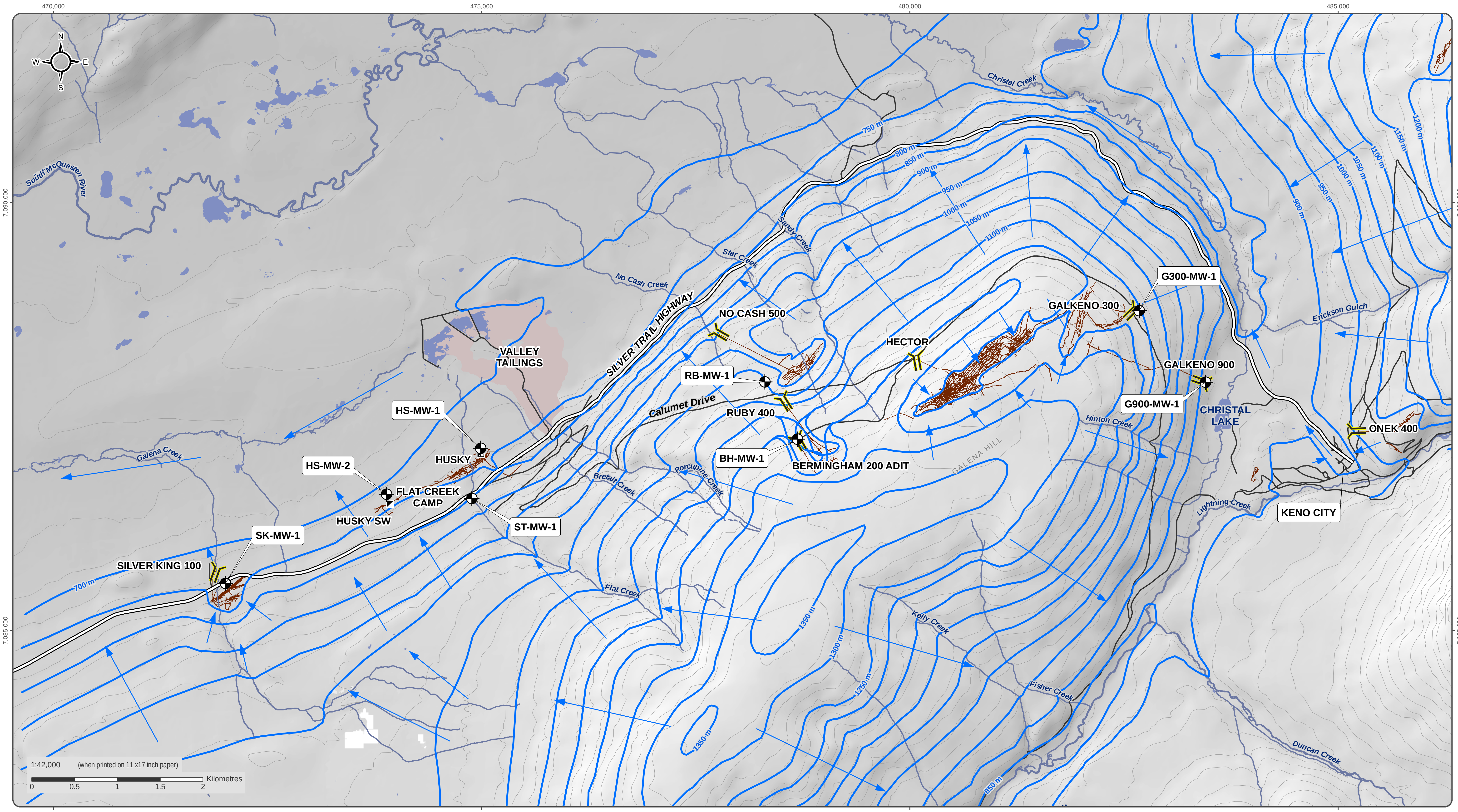
Figure 5-4 presents conceptual groundwater level contours and groundwater flow directions for Galena Hill. The contours were constructed so that water levels were:

- 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’s to 100’s m/year in the sand and gravel overburden and 1’s m/day to 10’s m/year 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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Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on December 2021

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

- Monitoring Well
- Adit
- Shaft
- Valley Tailings Area
- Underground Mine Workings
- Groundwater Flow Direction
- Groundwater Contour (50m Intervals)
- Waterbodies
- Watercourses
- Silver Trail Highway
- Secondary Road
- Contours (100 ft intervals)

* Only showing mine sites referenced in document

* * Depth to water table displayed in MASL when used for contour interpretation

*** GW Contours provided by Rod Smith

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KENO HILL SILVER DISTRICT

FIGURE 5-4

GALENA HILL GROUNDWATER CONTOURS

DECEMBER 2021

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5.2.1 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).

Water levels are collected during monitoring of the Ruby and New Bermingham groundwater wells and are shown on Figure 5-5. The well BH-MW-1 adjacent to the historical Bermingham 200 adit has not had sufficient water to sample since October 2017, the July 2017 measurement, the lowest recorded since installation, shows the decline of the groundwater elevation due to the development of the New Bermingham decline (Figure 5-5).

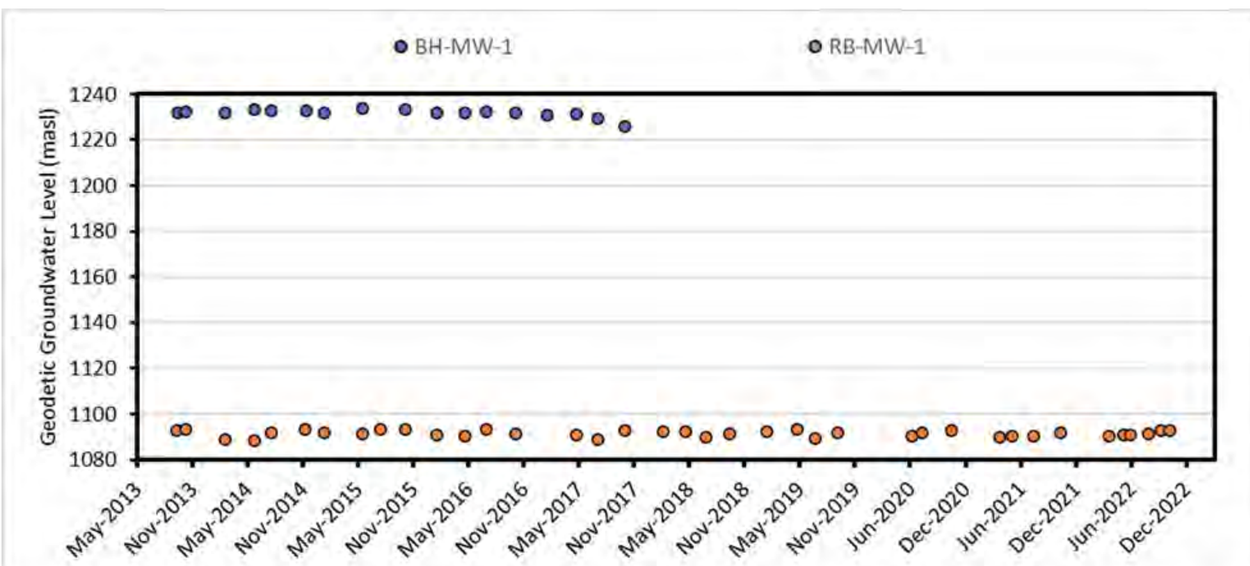

Figure 5-5: Groundwater Level (masl) in No Cash Creek Catchment Wells

5.2.2 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 5-6 and Figure 5-7 are interpreted groundwater elevation contour maps of the Bermingham area in June and October 2022, respectively. Shown on the maps are 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.

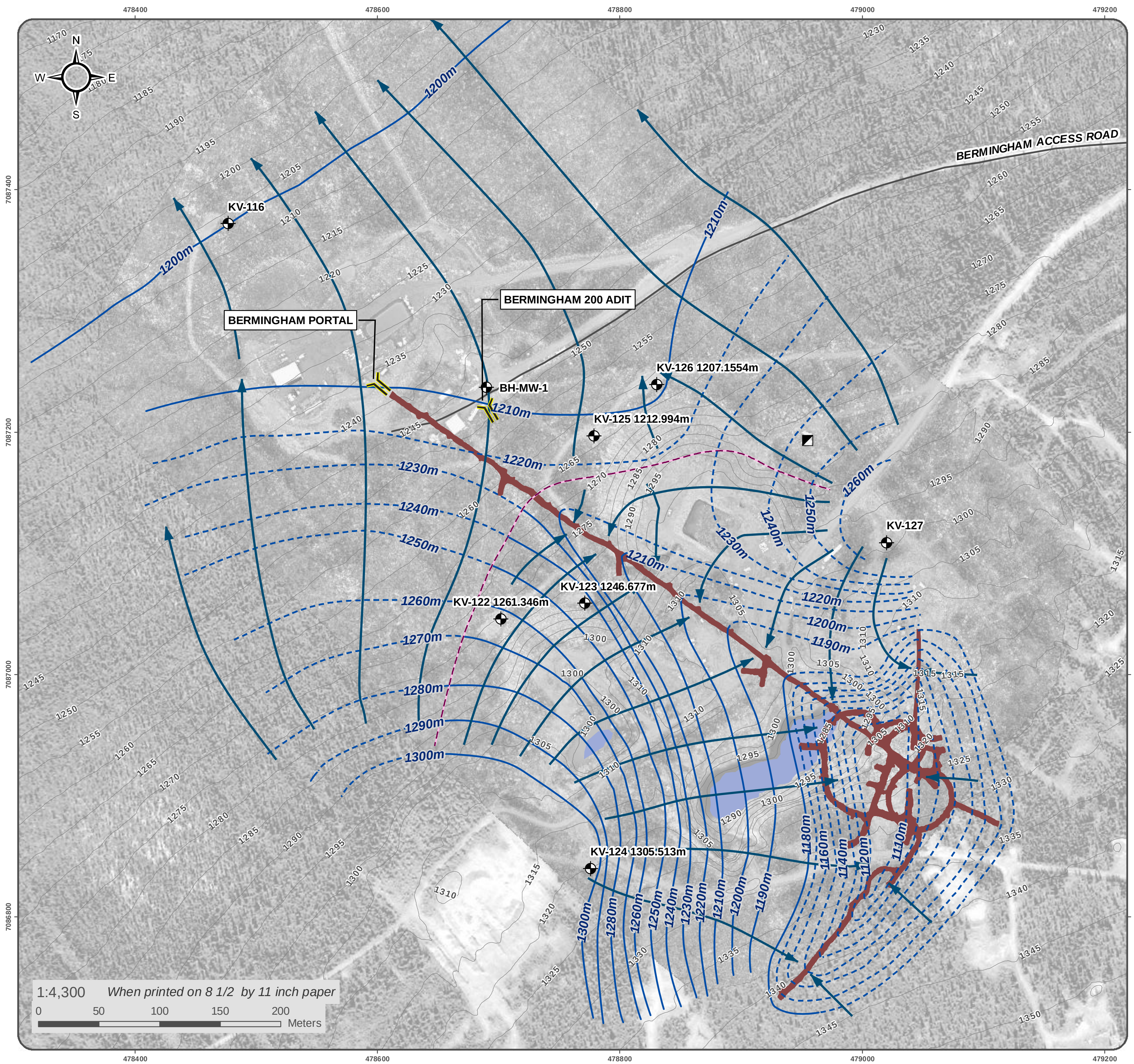

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FIGURE 5-6

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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Satellite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on January 2023

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

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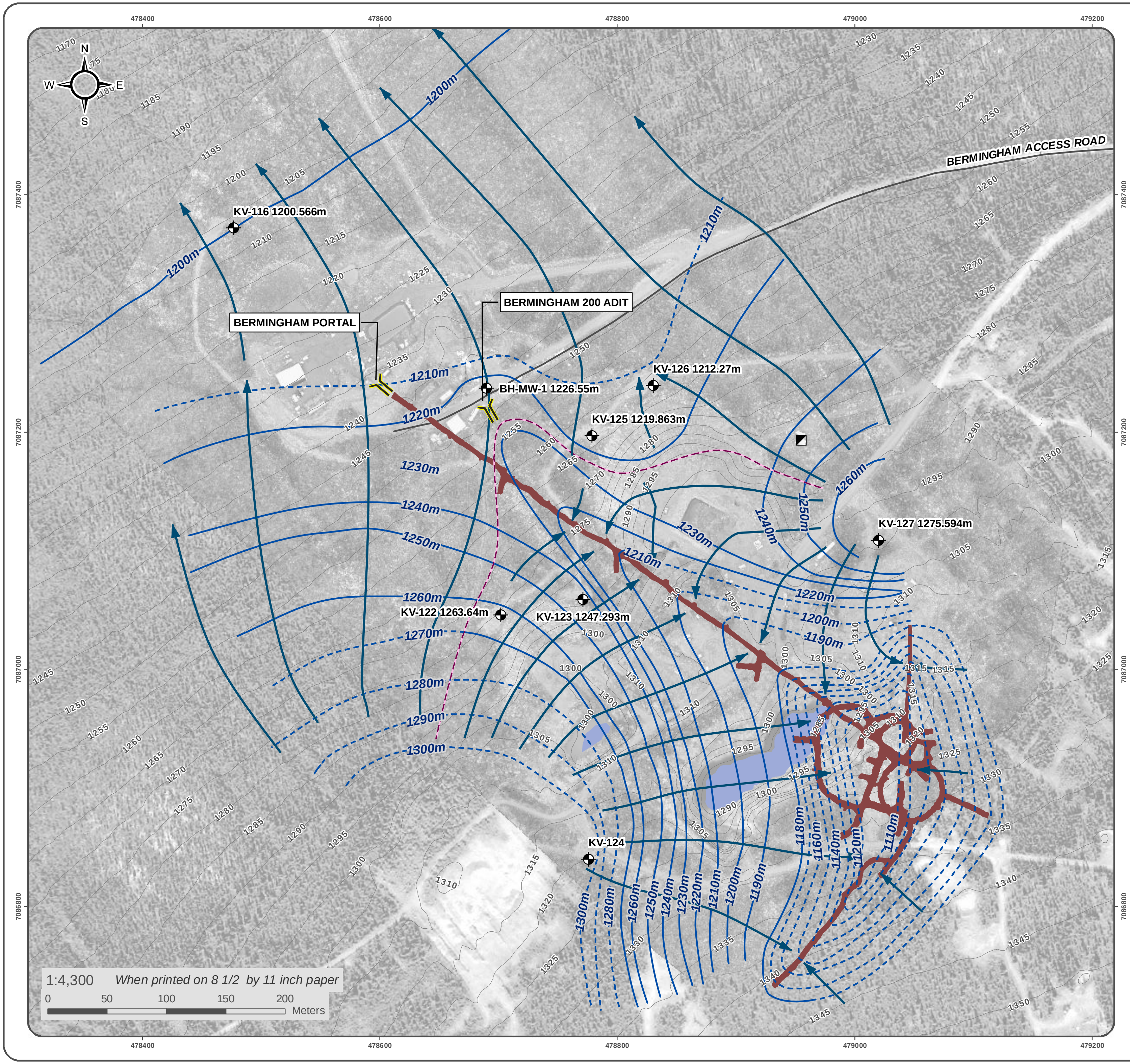

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FIGURE 5-7

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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5.2.3 CHRISTAL CREEK

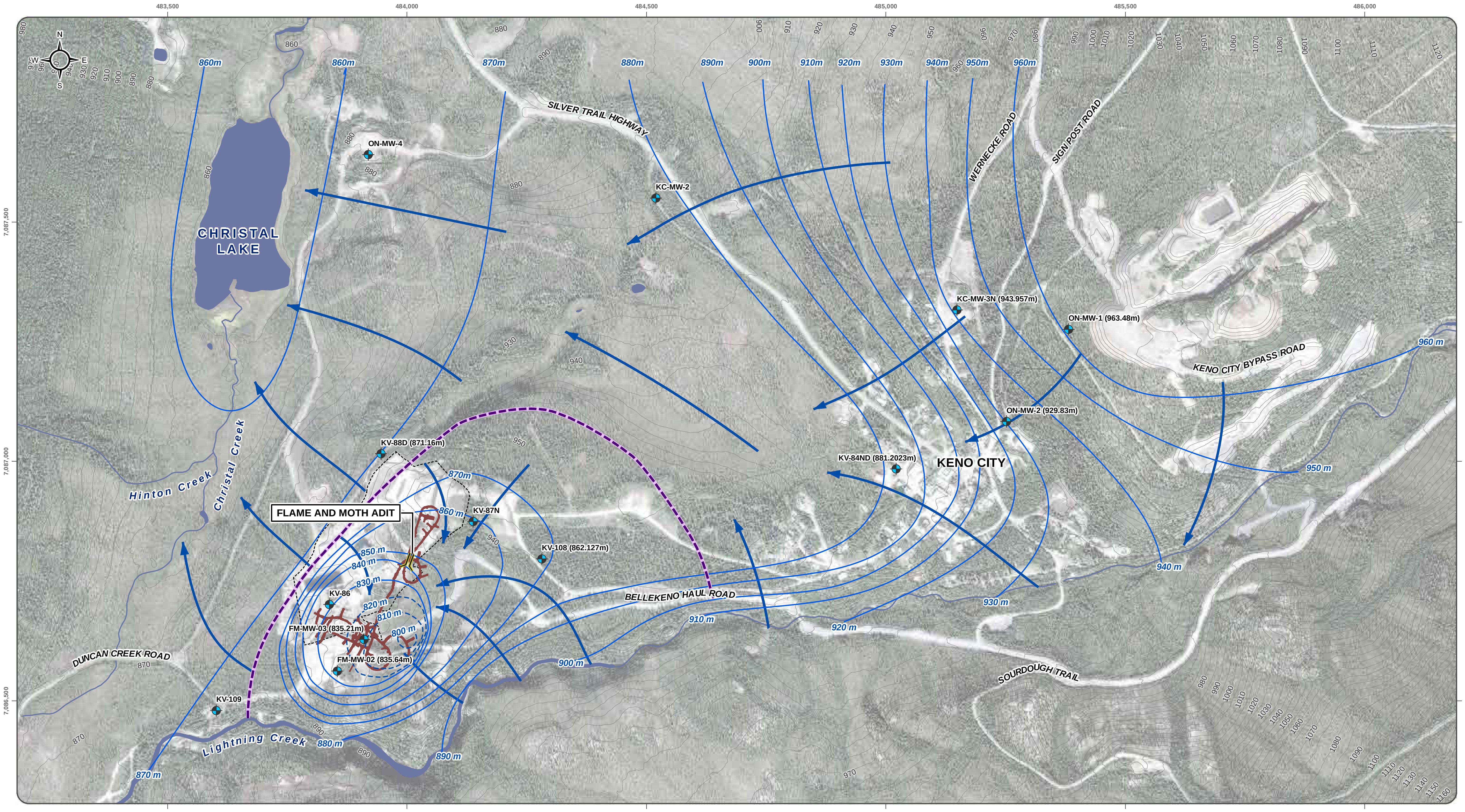
The 2016 preliminary groundwater modelling and particle tracking conducted by Piteau indicated that groundwater from the area of the historical Onek 400 mine workings flows towards the upper reaches of Christal Creek (Piteau, 2016). The Keno City conceptual groundwater model conducted by Interralogic 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.

A groundwater flow directional map for Keno City is presented in Figure 5-8 and Figure 5-9. These groundwater contours were created using water level measurements taken in June and October 2022, respectively. 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 5-10 presents water level elevations for the bedrock wells in the District Mill area. Water elevations around the District Mill have been recorded between ~835.21 to 963.48 masl. Generally, this equates to being approximately 10 to 56 m below ground surface. The groundwater elevation for the Flame & Moth portal location was estimated to be 840 masl from Figure 5-10, compared to the surface elevation of the portal at 910 masl (a difference of 70 m). The water level elevation at KV-87N is between ~850 to 900 masl while the level at KV-87 is between ~750 and 800 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).

The groundwater levels 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.



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

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

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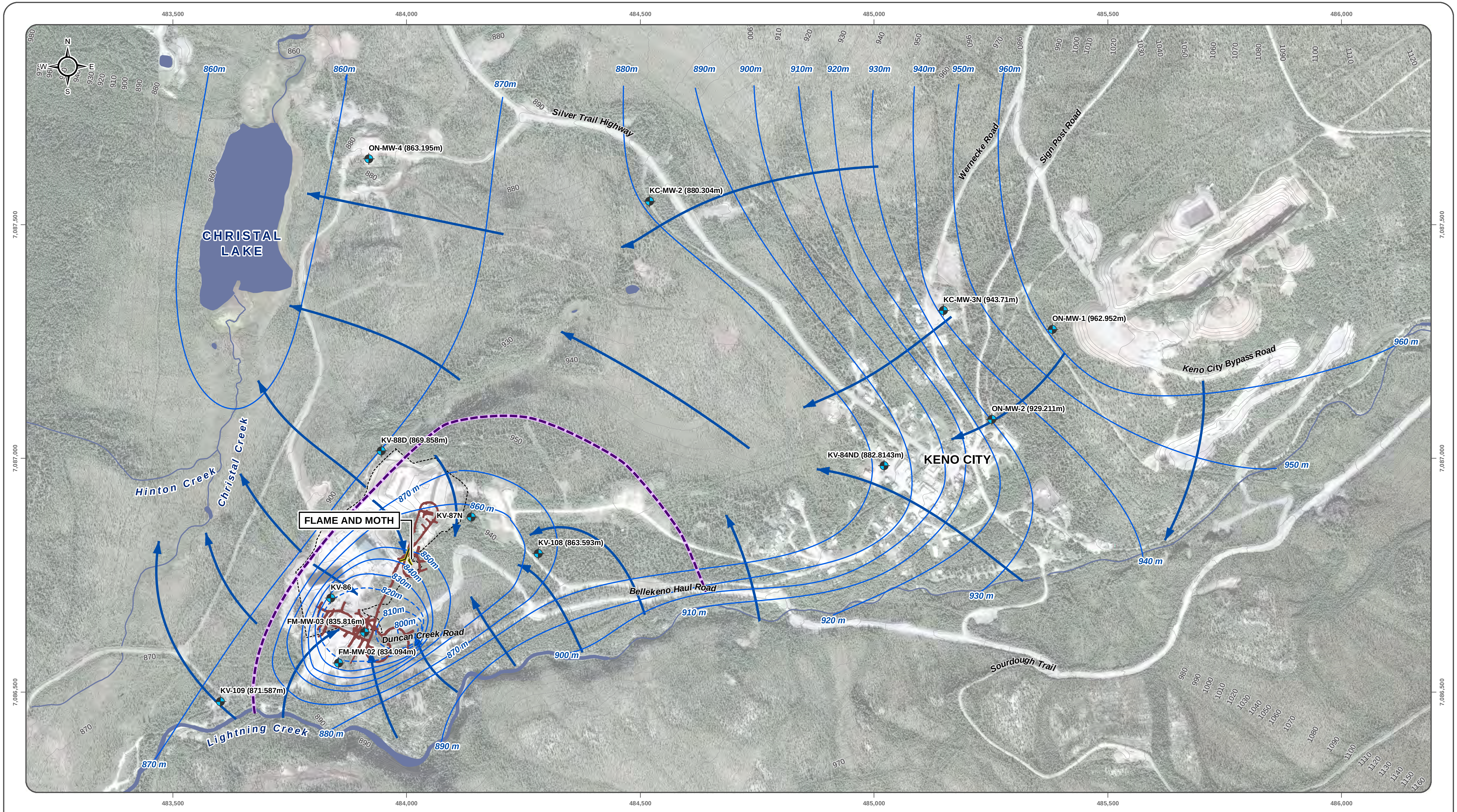
FIGURE 5-8
KENO CITY JUNE 2022 GROUNDWATER LEVEL CONTOUR MAP

JANUARY 2023



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

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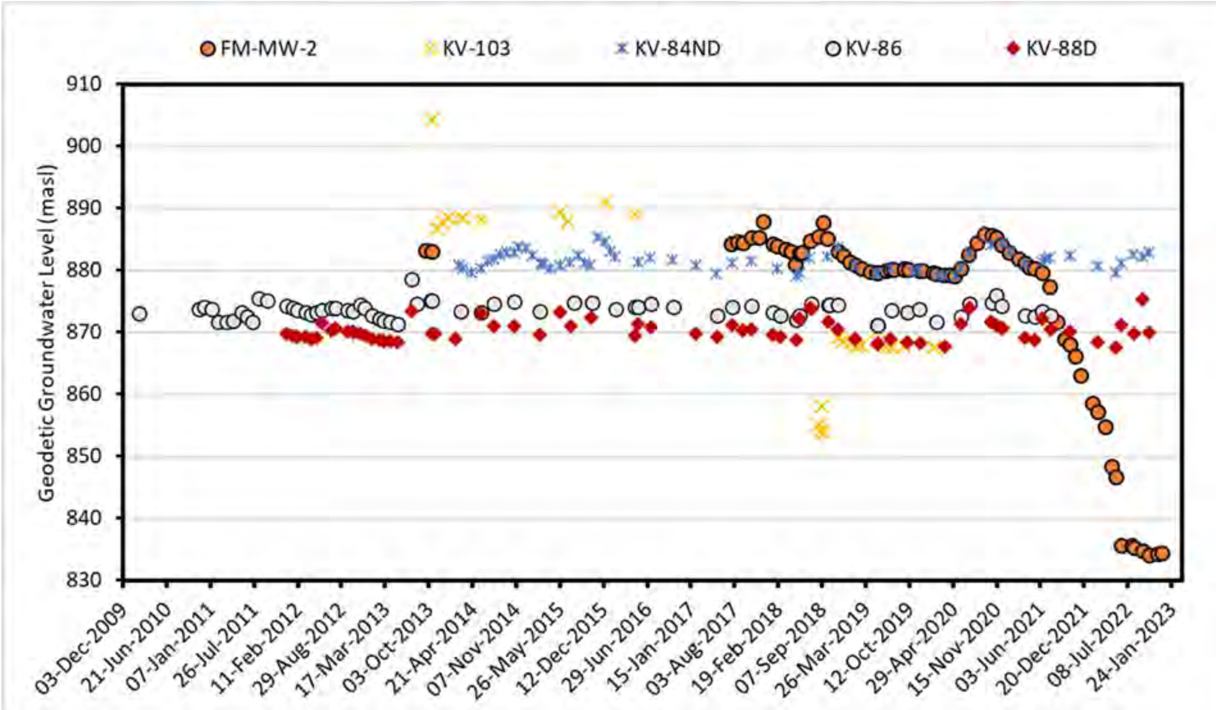
FIGURE 5-9
KENO CITY OCTOBER 2022 GROUNDWATER LEVEL CONTOUR MAP

JANUARY 2023



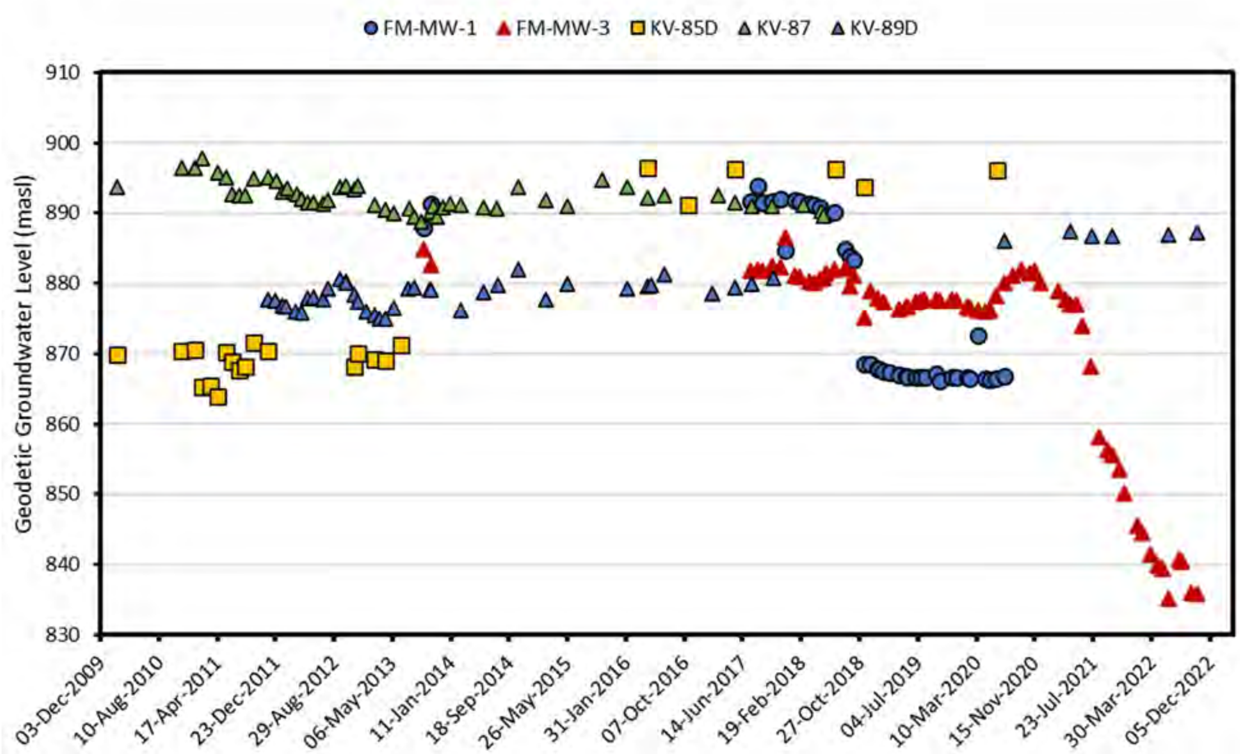


Figure 5-10: District Mill Area Groundwater Water Levels

5.2.4 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. Figure 5-11 presents water level elevations for KV-109.

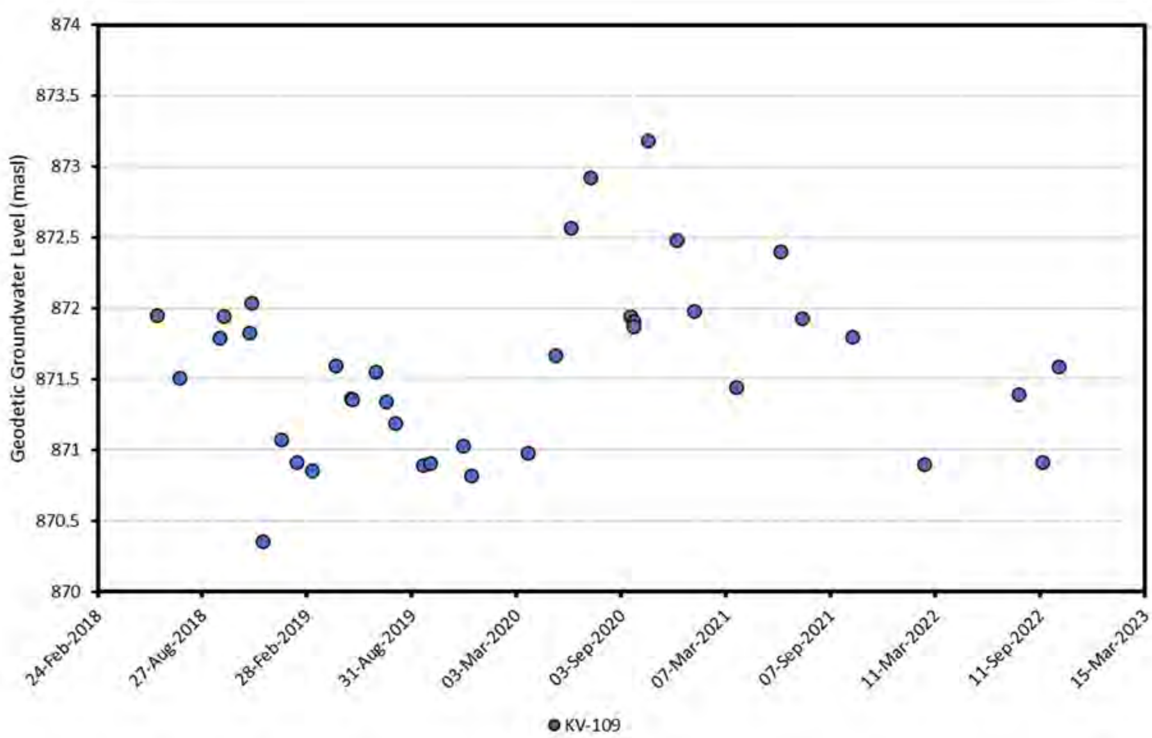


Figure 5-11: Lightning Creek Groundwater Levels

5.3 GROUNDWATER QUALITY

The groundwater monitoring well network (Table 5-1) 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.

5.3.1 NO CASH CREEK

Dissolved cadmium and zinc concentrations in monitoring wells RB-MW-1 and BH-MW-1 are presented in Figure 5-12 and Figure 5-13, respectively. Since October 2017 there has not been sufficient water to collect a sample at well BH-MW-1 due to water level drawdown as the New Bermingham mine has advanced. Prior to October 2017 there were no exceedances of dissolved cadmium or zinc relative to the Yukon Contaminated Sites Regulation standards for aquatic life (YCSR-AL). Dissolved cadmium concentrations RB-MW-1 were variable with the maxima observed in July 2014 and 2015. There have been no exceedances of the dissolved zinc YSCR-AL at well RB-MW-1.

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 0.000052 mg/L) and zinc (0.015 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.

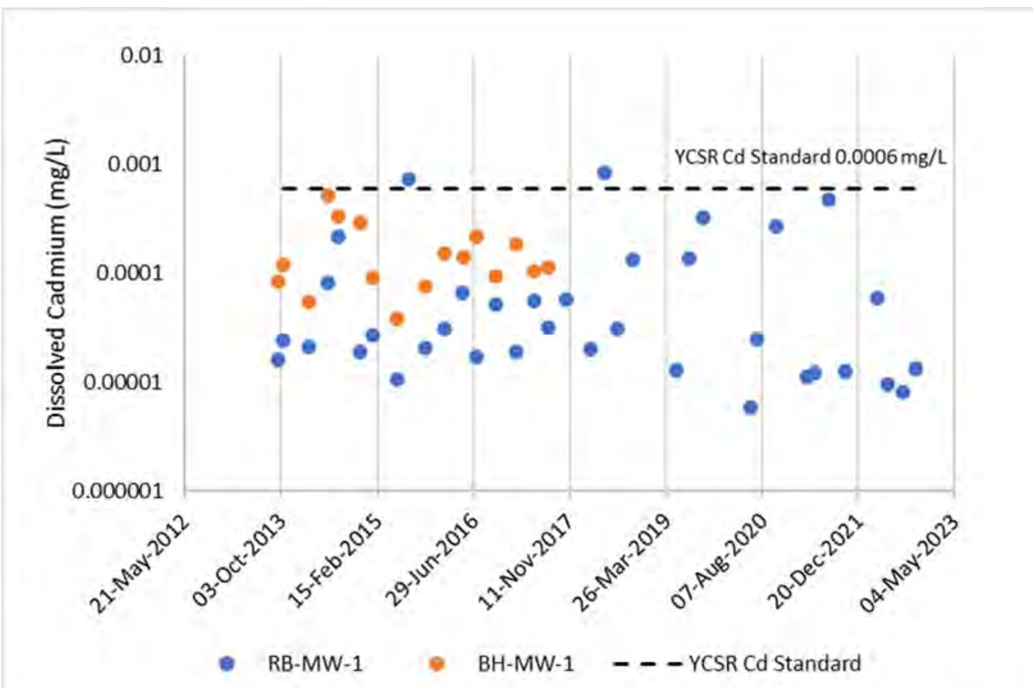


Figure 5-12: Dissolved Cadmium in No Cash Creek Catchment Wells

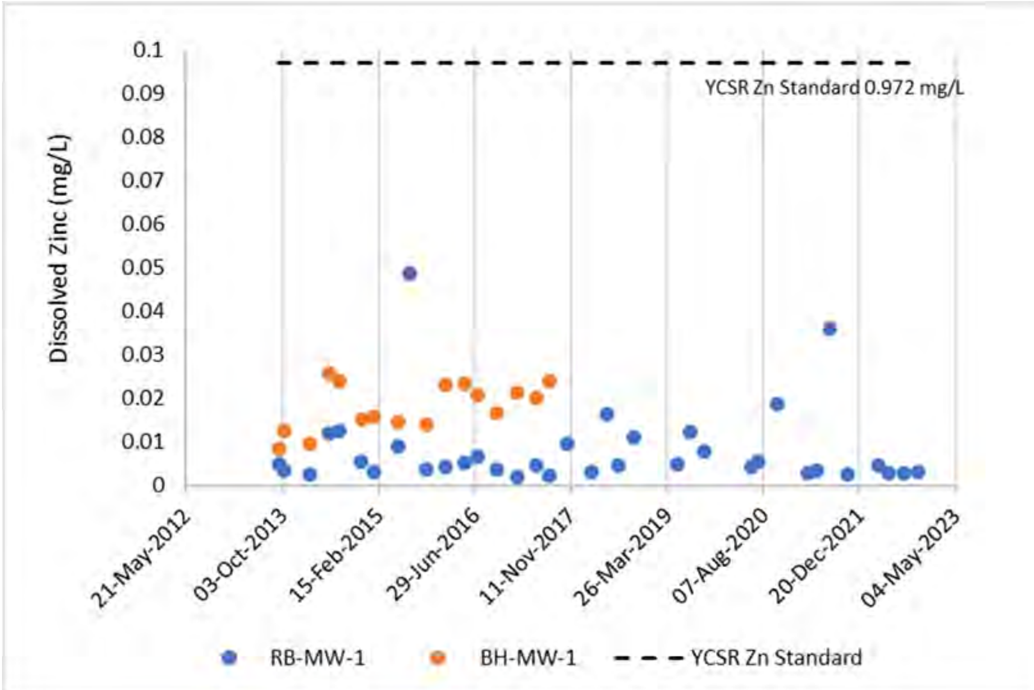


Figure 5-13: Dissolved Zinc in No Cash Creek Catchment Wells

5.3.2 NEW BERMINGHAM

The 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-116, KV-122 through KV-127, and NC-MW-1; all nine wells were completed in the bedrock aquifer. WL QZ18-044 requires new groundwater monitoring wells be sampled on a monthly basis for the first twelve months following installation, after which the frequency can be reduced to quarterly sampling. WL QZ18-044 Clauses 82 and 83 require a comparison of groundwater quality with YCSR-AL. Since no drinking water wells exist within a 1.5 km radius of the Bermingham mine workings and open pits, comparison to YCSR drinking water standards is not required.

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.

As shown in Figure 5-2, the monitoring wells are:

- KV-124 installed upgradient of Bermingham SW pit.
- KV-122 and KV-123 installed downgradient of Bermingham Southwest pit.
- KV-127 installed upgradient of the New Bermingham P-AML waste rock storage facility.
- KV-125 and KV-126 installed downgradient of the New Bermingham P-AML waste rock storage facility.

- KV-116 installed downgradient of the N-AML waste rock disposal area in order to monitor groundwater downgradient of the N-AML waste rock disposal area and the water treatment discharge location.
- NC-MW-1 was installed to monitor groundwater downgradient of the underground mine workings at New Bermingham.
- KV-108 installed upgradient of DSTF expansion area in 2020.

Monitoring well KV-123 was consistently elevated compared to the YCSR-AL standard for dissolved cadmium (0.0003 mg/L), and exhibited the highest dissolved cadmium concentrations of the Bermingham monitoring wells (median 0.013 mg/L; Figure 5-14). 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 and NC-MW-1 exhibited the lowest concentrations of dissolved cadmium with median concentrations of 0.000021 mg/L and 0.000014 mg/L, respectively. Monitoring wells KV-116, KV-122, KV-123 (downgradient of Bermingham Southwest pit), and KV-124 (upgradient of Bermingham Southwest pit), exhibited relatively stable concentrations of dissolved cadmium. Three monitoring wells located downgradient of the rock storage facility and underground mine workings, KV-125, KV-126, and NC-MW-1 exhibited marked variability of dissolved cadmium concentration values during which NC-MW-1, KV-108 and KV-126 showed notably low concentrations of dissolved cadmium during the last groundwater monitoring event. Overall, between May 2012 to October 2022 there has been minimal change in dissolved zinc and cadmium concentrations compared to initial concentrations for wells located both up and downgradient of the mine workings.

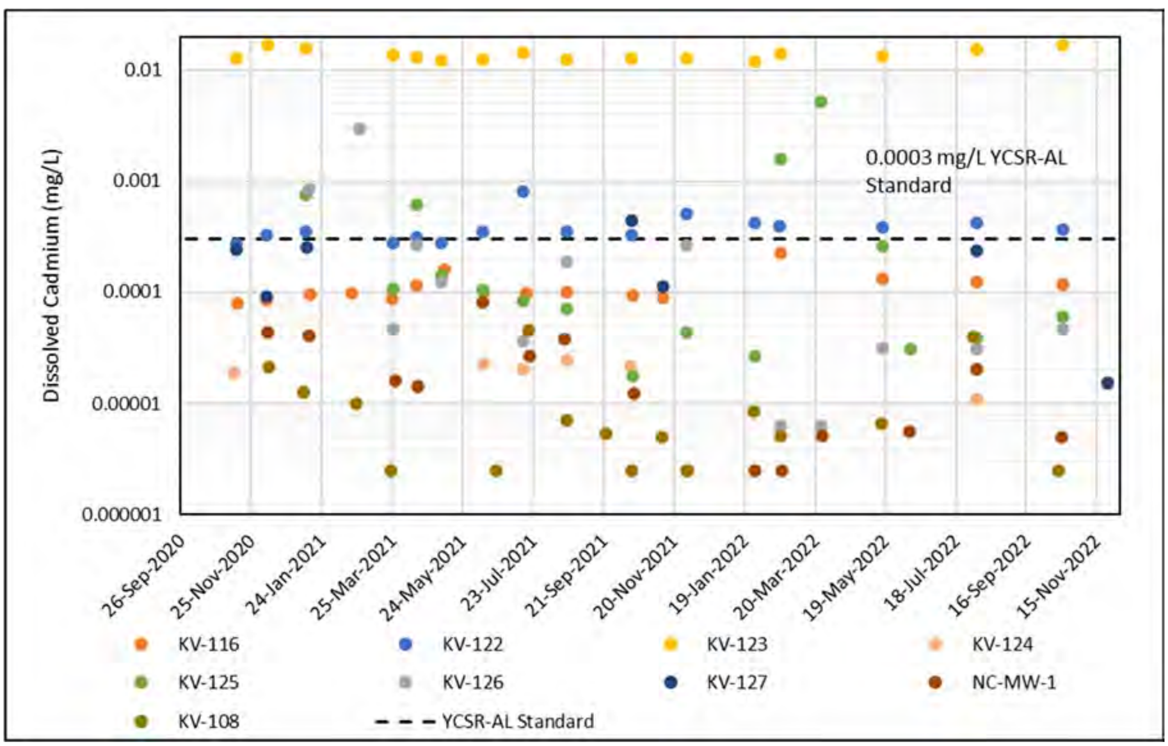


Figure 5-14: Dissolved Cadmium in Bermingham Groundwater Monitoring Wells

Monitoring well KV-123 exhibited the highest dissolved zinc concentrations of the Bermingham monitoring wells (median 1.17 mg/L) and was the only well that consistently exceeded the YCSR-AL standard (0.075 mg/L; Figure

5-15). Results from monitoring wells KV-116, KV-124, and KV-125 for dissolved zinc were consistently below the YCSR-AL standard, with KV-116 and KV-124 exhibiting the lowest dissolved zinc concentrations of the Bermingham monitoring wells (median concentrations of 0.0034 mg/L and 0.0013 mg/L respectively). Concentrations of dissolved cadmium and zinc have generally remained the same throughout the monitoring period for wells located downgradient of mine infrastructure (Figure 5-14 and Figure 5-15).

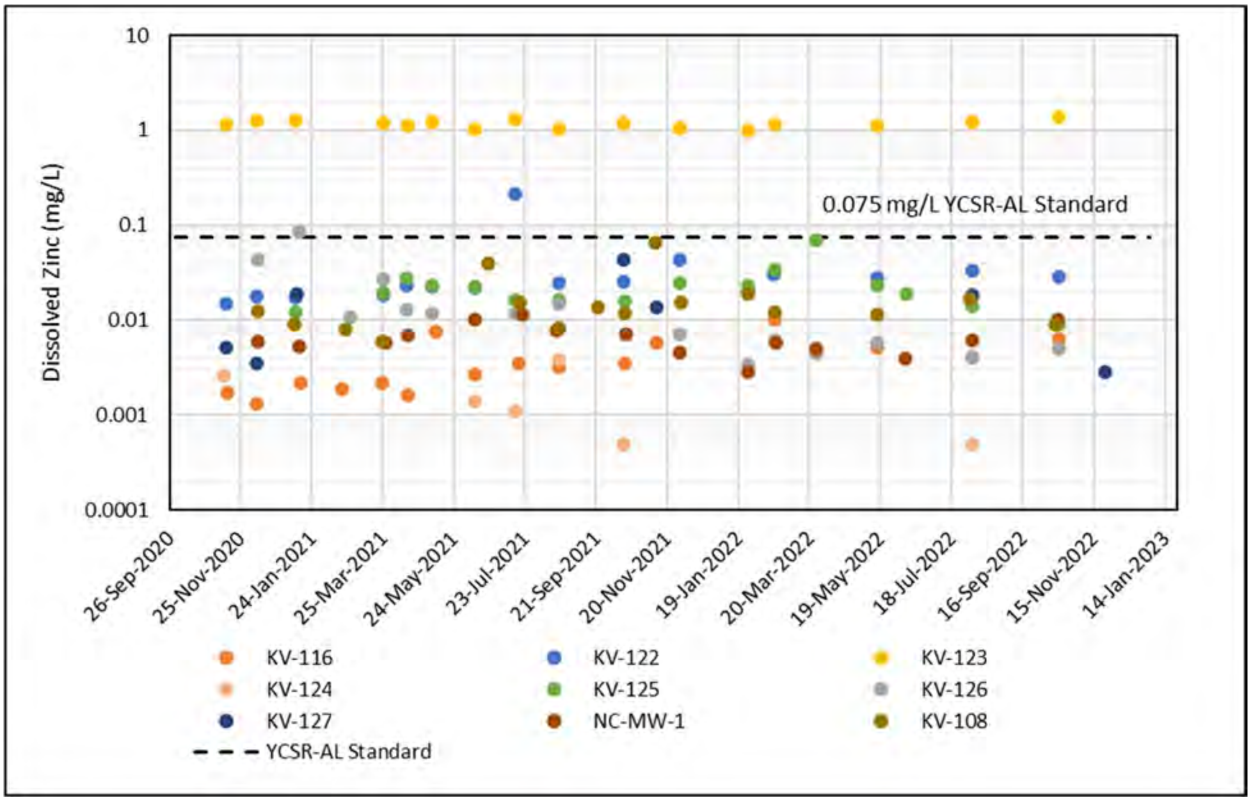


Figure 5-15: Dissolved Zinc in Bermingham Groundwater Monitoring Wells

5.3.3 CHRISTAL CREEK

Figure 5-16 to Figure 5-19 presents the dissolved cadmium and zinc concentrations, respectively, for the bedrock wells in the Christal Creek catchment.

The deep groundwater boreholes (FM-MW-1, FM-MW-2, and FM-MW-3) were sampled following airlifting 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 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. 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 from May 2011 to October 2022 have not exceeded the YCSR-Al standard for dissolved zinc however prior to 2015 dissolved cadmium was found to exceed the YCSR-Al standard (0.0006 mg/L) consistently (Figure 5-16). Since 2015, dissolved cadmium has been exceeded twice, well KV-89D on July 10, 2015 (0.0010 mg/L) and KV-86 on October 2, 2019 (0.000803 mg/L).

Monitoring wells near Keno City from May 2011 to October 2022 were found to be below the YCSR-AL standards except for the following exceedances. Well ON-MW-4 has exceedances of dissolved zinc on February 25, 2018 (2.57 mg/L), May 15, 2021 (2.91 mg/L), February 20, 2022 (2.51 mg/L) and dissolved cadmium on October 13, 2021 (0.00092). KV-84ND exceeded the YCSR-AL standard for dissolved cadmium on June 27, 2014 (0.00062) and KC-MW-4 which consistently exceeded the YCSR-AL standard for dissolved cadmium the years it was sampled (2011 to 2014). The concentrations of dissolved cadmium at wells KV-84ND, ON-MW-2, and KC-MW-4 ranged from <0.000010 to 0.00062 mg/L, <0.000025 to 0.00092 mg/L, and 0.00084 to 0.00495 mg/L, respectively. Dissolved zinc concentrations were higher in the Keno City wells compared to the deep Flame & Moth wells. Monitoring wells ON-MW-2 and KV-84ND had median values of 2.14 and 0.67 mg/L, respectively, while KC-MW-4 between February 2012 and March 2014 had a median value of 0.0515 mg/L. Well KC-MW-4 has not been monitored since 2014.

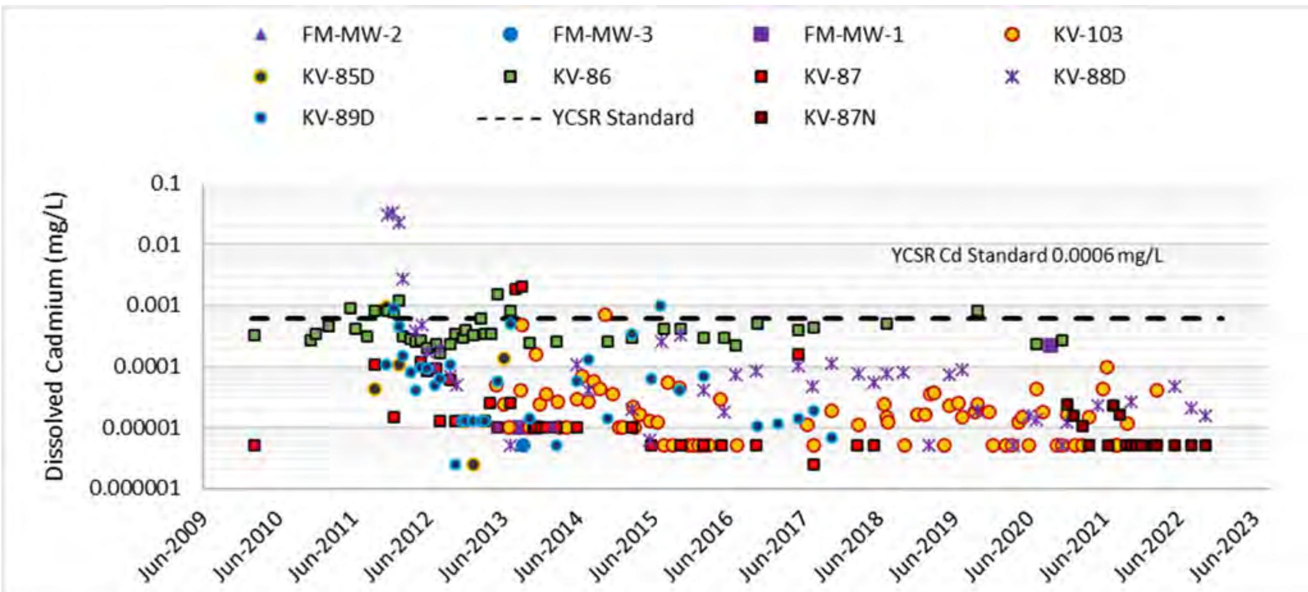


Figure 5-16: Dissolved Cadmium in Christal Creek Wells near the District Mill

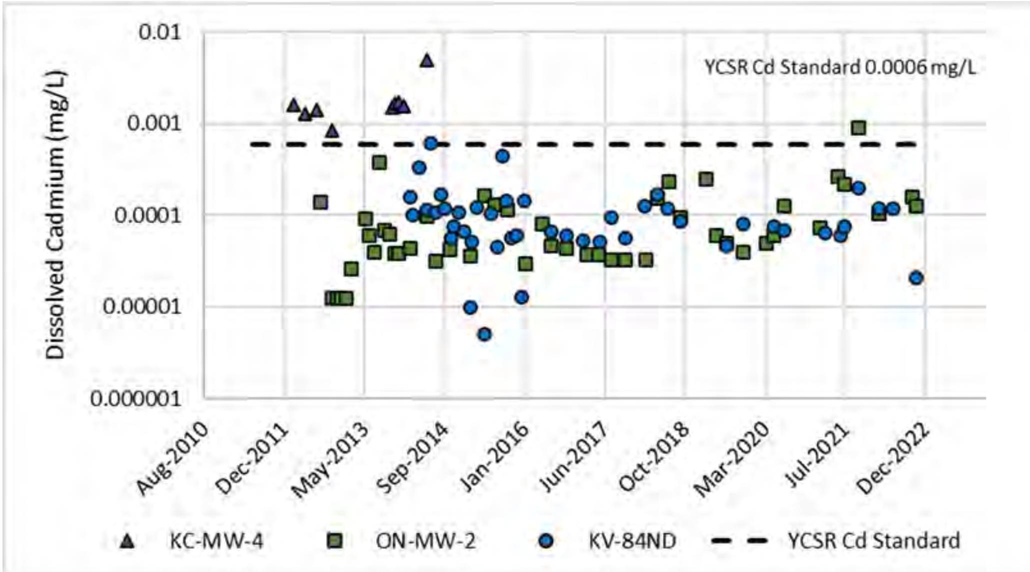


Figure 5-17: Dissolved Cadmium in Christal Creek Wells near Keno City

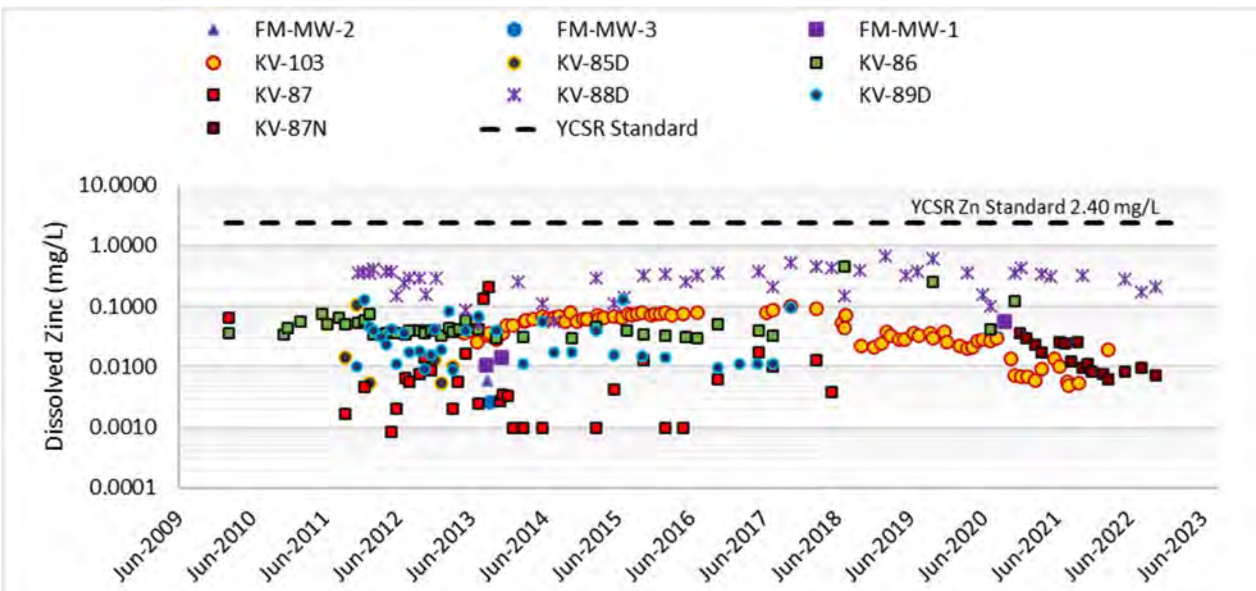


Figure 5-18: Dissolved Zinc in Christal Creek Wells near the District Mill

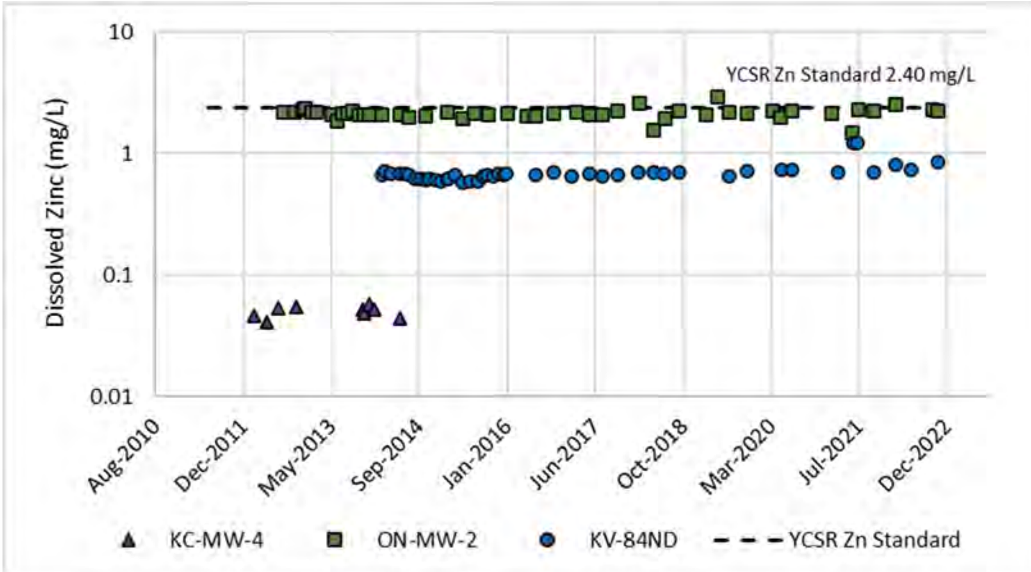


Figure 5-19: Dissolved Zinc in Christal Creek Wells near Keno City

5.3.4 LIGHTNING CREEK

Following development of the KV-109 monitoring well on June 8, 2018, water quality samples were collected to characterize groundwater chemistry. The concentration of dissolved cadmium ranged from below detection limit (0.000005 to 0.000095 mg/L, and dissolved zinc ranged from 0.017 to 0.039 mg/L, as shown in Figure 5-20 and Figure 5-21, respectively. Neither dissolved zinc or cadmium were found to exceed the YCSR-AL standards and in the case of zinc, results were an order of magnitude below the standard (2.4 mg/L). While there were no defined seasonal trends for these two parameters, the concentration of dissolved cadmium decreased over time whereas dissolved zinc increased.

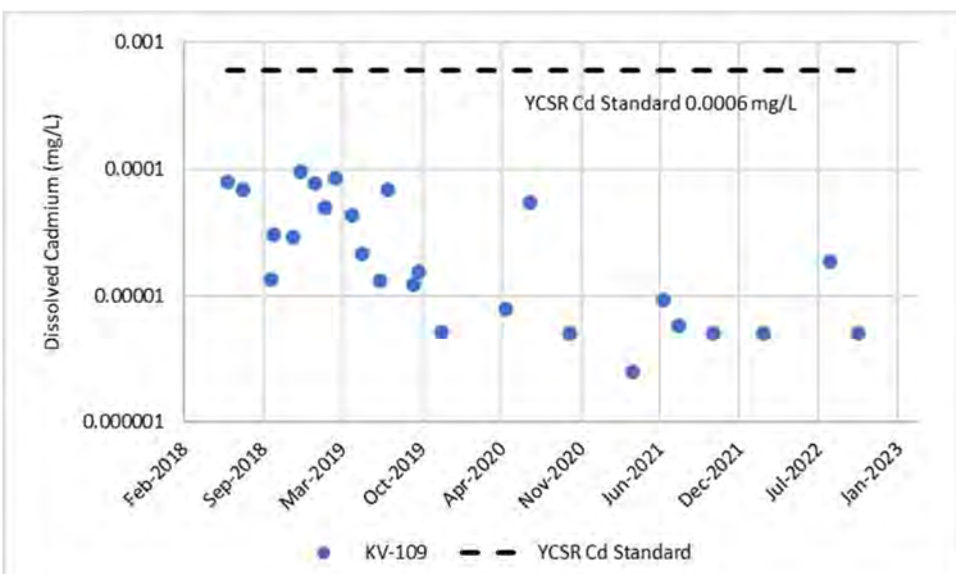


Figure 5-20: Dissolved Cadmium in Lightning Creek Catchment Wells

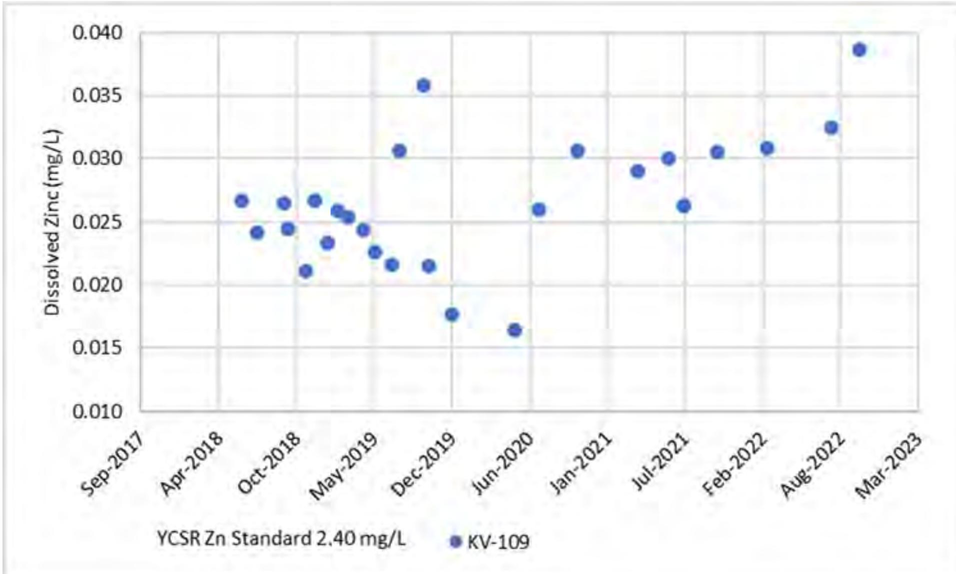


Figure 5-21: Dissolved Zinc in Lightning Creek Catchment Wells

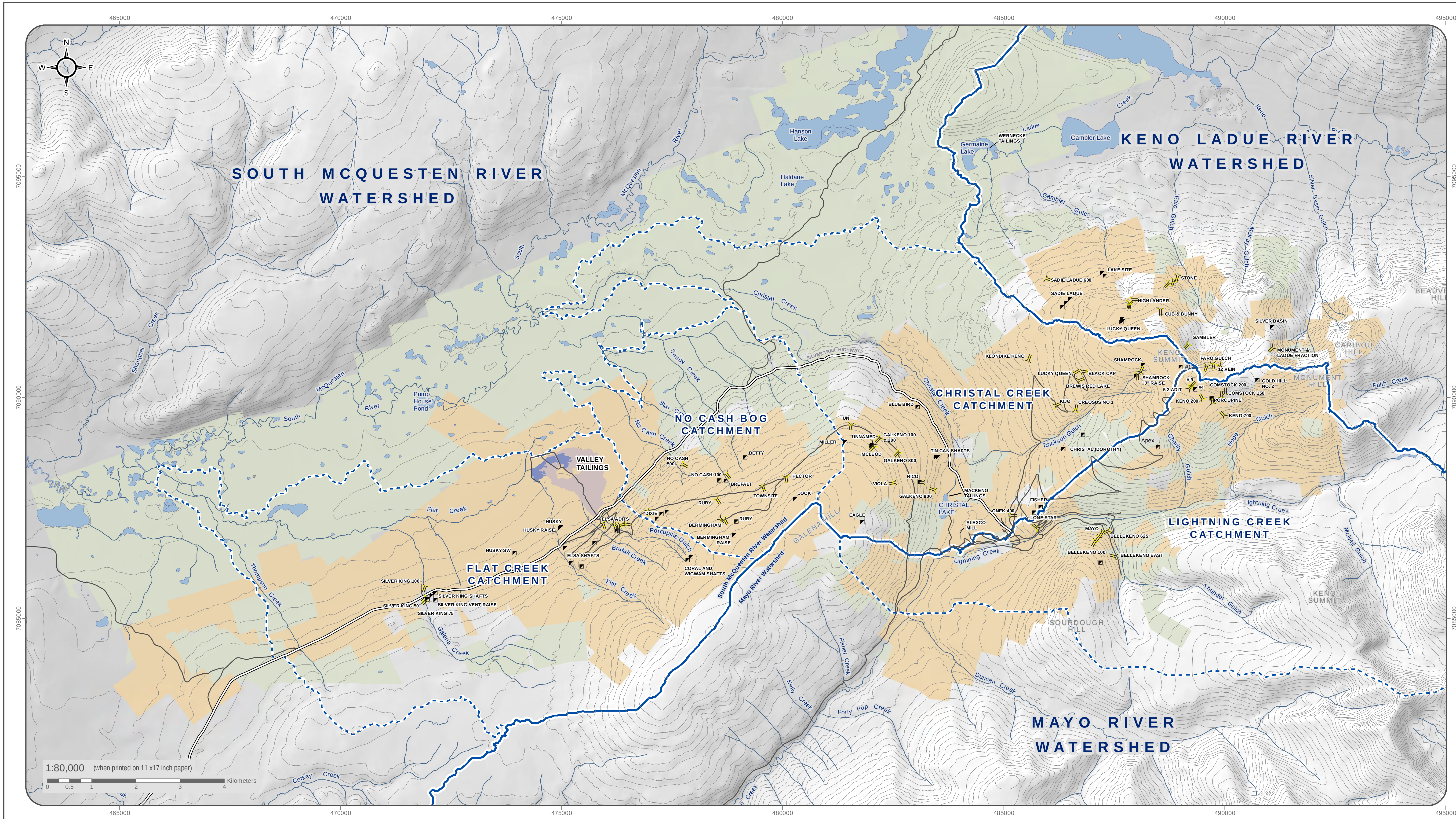
6 BIOLOGY

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, wildlife, and vegetation.

6.1 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 (Figure 6-1) 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.



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 boundaries and ownership are current as of March 2017; obtained from Geomatics Yukon, Government of Yukon. Satellite 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 6-1

KENO HILL WATERSHED OVERVIEW

FEBRUARY 2023

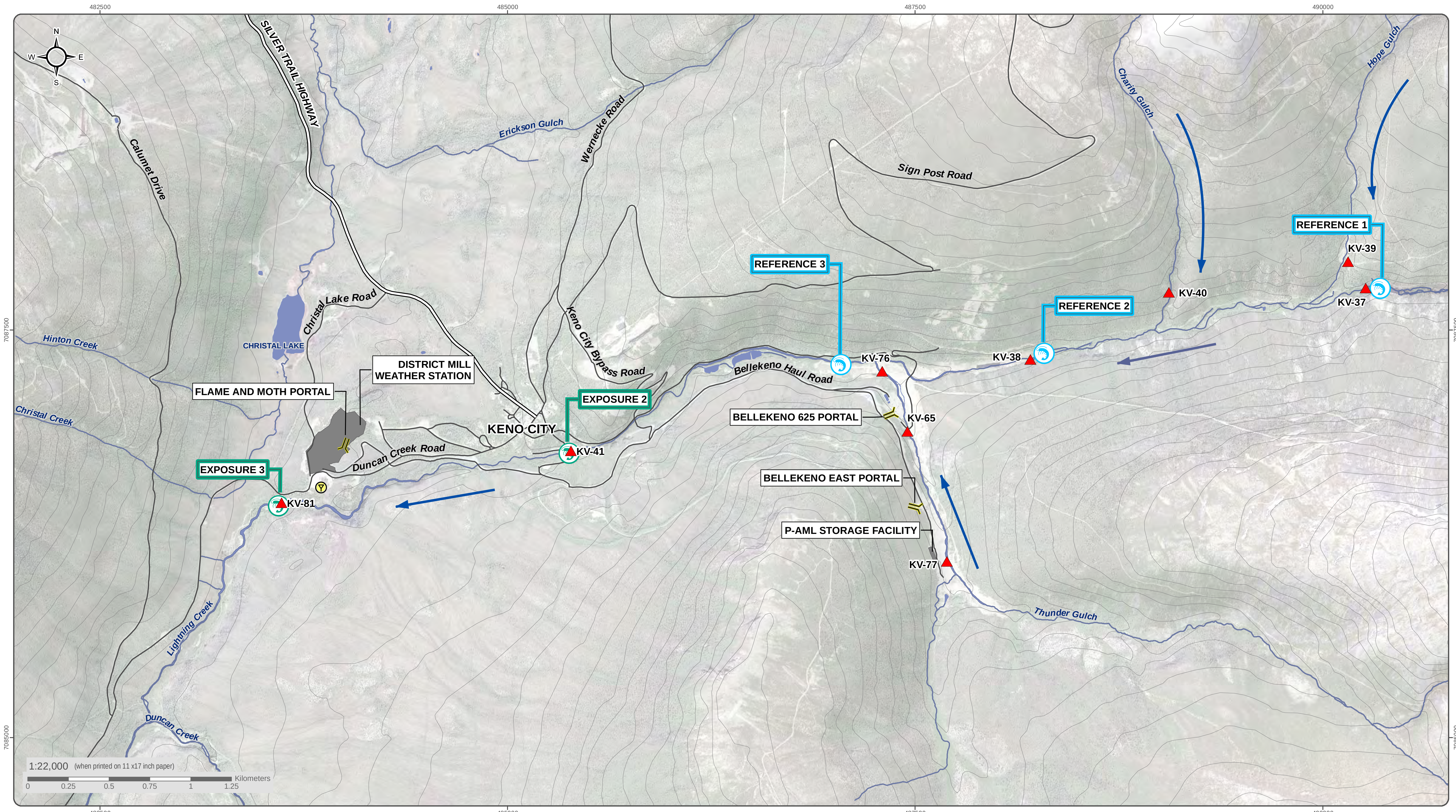
6.1.1 FISHERIES

Historical fisheries resource data for Lightning Creek and surrounding drainages (Figure 6-1) 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 2021 (Ensero, 2022c; Figure 6-2).

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 *(Thymallus arcticus)* (most abundant), slimy sculpin *(Cottus cognatus)* (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*).

The fish laboratory exposure study was conducted as part of the EEM Cycle 4 using Kokanee Salmon, allowed 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.

The Cycle 5 EEM Study Design was submitted in January 2023, with the biological survey scheduled to be conducted in summer 2023. Specifically, the laboratory-based exposure study with Kokanee salmon will be conducted commencing in August 2023 and will continue for six weeks.



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

- 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

HECLA KENO HILL
BELLEKENO MINE PROJECT

FIGURE 6-2

EEM AQUATIC SAMPLE LOCATIONS

JANUARY 2023

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(*Last edited by: amatlashevska;2023-01-18/14:48 PM*)

6.1.2 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. More recent investigations have been conducted as part of EEM for the Bellekeno mine, completed in 2018 and 2021 (AEG 2019d; Ensero, 2022c), and the Flame & Moth mine, completed in 2021 (data to be submitted as part of the Flame & Moth mine EEM Cycle 1 Interpretive Report in November 2023).

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 Lighting 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 benthics, 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 will be conducted during Cycle 5 EEM which will focus 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). If exposure stations tend to separate from reference stations based on mine indicators (i.e., chloride, nitrate, sulphate, zinc, lead, silver, and dissolved metals), then mine effluent may explain the difference in the B-C index between reference and exposure groups. However, if there is no correlation between benthic communities and water quality parameters, then placer mining may explain the difference in the B-C index between reference and exposure groups.

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 effluent. It is suggested that standard monitoring continue for subsequent biological monitoring, in addition to the IOC study noted above for Cycle 5 EEM.

6.1.3 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. 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 6-1; Table 6-2), 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 6-3). In Flat Creek, arsenic, cadmium, lead, and zinc all exceeded the PEL at KV-9 (Table 6-4). Copper exceeded the PEL once and exceeded the ISQG for the remainder of the samples. No Cash drainage 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 6-6). 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 6-1: 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**

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 6-2: 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**

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 6-3: Metal Concentration 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	8-Aug-09	13-Jul-10	30-Aug-11	21-Aug-12	26-Aug-14	1-Sep-15	23-Sep-16	8-Sep-18	20-Sep-20	17-Sep-22	31-Jul-07	22-Aug-09	13-Jul-10	21-Aug-13	4-Sep-15	8-Sep-18	24-Sep-21	9-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	26.0	29.9	34.3	33.8	**63.0**
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*	0.090	**0.214**	**0.294**	0.068	0.1	0.025	0.051	0.047	0.026	0.040	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**

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 6-4: 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	3-Sep-15	7-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**	0.150	**0.340**	0.156	**0.309**	0.140	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**

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 6-5: Metal Concentrations in No Cash Sediment at KV-21 and KV-56, 2018-2022

Total Metal Concentration	Lab MDL	Guideline		KV-21				KV-56
mg/kg		CCME ISQG	CCME PEL	9-Sep-18	24-Sep-20	22-Sep-21	17-Sep-22	9-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	0.50	2.36	0.71	0.61
Silver	0.1	-	-	58.6	10.9	100.7	22.0	0.34
Zinc	10	123	315	**10363**	**5662**	**13380**	**8035**	**192.7**

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 6-6: Metal Concentration in South McQuesten Sediment at KV-1, KV-3, and KV-4, 2007-2021

Total Metal	Lab MDL	Guideline		KV-1						KV-3							KV-4						
Concentration mg/kg		CCME ISQG	CCME PEL	31-Jul-07	23-Aug-09	1-Sep-11	21-Aug-12	8-Sep-18	24-Sep-21	31-Jul-07	22-Aug-09	1-Sep-11	22-Aug-12	3-Sep-15	6-Oct-18	24-Sep-21	31-Jul-07	22-Aug-09	31-Aug-11	22-Aug-12	3-Sep-15	7-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	24.0	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**	**44.0**	**41.5**	**37.3**	**67**	**67.1**	**42.2**	**45.2**	**53.6**	**59**	**57.1**	**39.9**	**40.7**	**37.6**	22.6	**105.0**
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	1.30	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**

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).

6.2 WILDLIFE

The KHSD supports a variety of wildlife including ungulates, fur-bearers, small mammals, upland game birds and waterfowl. Moose (*Alces alces*) are the most common and important sustenance animal in the area, with woodland caribou and sheep no longer present in the area. Repeated survey work over the last 15 years has indicated a healthy, stable moose population that depend on the KHSD for important habitat. For example, 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 Facility areas are important calving and post calving areas (O'Donoghue, pers. comm. as cited in Lortie, 2009). In 2011, Environment Yukon noted in their draft report that the moose population in the Mayo-Elsa-Keno area are experiencing a slight decline in population numbers compared to previous surveys. It is suspected that overharvesting may have been the main cause for lower numbers of moose. A late winter survey was conducted in 2014 for the Mayo Moose Management Unit, which includes the project area (O'Donoghue et al., 2016). This survey found that the highest densities of moose were found in areas with abundant willows along rivers and creeks and in lowland burns, especially in the lowland burns near Keno City. Recruitment rate (i.e., the ratio of calves to cows) was found to be at or slightly below average.

Black Bear (*Ursus americanus*) and Grizzly Bear (*Ursus arctos*; listed as 'Special Concern' by the Committee on the Status of Endangered Wildlife in Canada; COSEWIC) are common in the area. The remaining large mammals being carnivores are generally considered Fur Bearers: wolves (*Canis lupus*), coyotes (*Canis latrans*), foxes (*Vulpes vulpes*), marten (*Martes Americana)*, mink (*Neovison vison)*, lynx (*Lynx canadensis*), wolverine (*Gulo gulo*) and river otter (*Lontra canadensis*) are, to varying degrees, all indigenous to the area. Beaver and muskrat are also economically important and common in aquatic habitats in the region. Other small mammals common to the area include Ground Squirrel *(Marmotini),* Red Squirrel *(Sciurus vulgaris),* varying hare, Weasel *(Mustela),* Vole *(Cricetidae),* and Shrew *(Soricidae).* Less common are Porcupine *(Erethizon dorsatum)* and Chipmunk *(Tamias).* Alpine areas have local populations of Hoary Marmot (*Marmota caligata*) and Pika (*Ochotona*).

The KHSD is also host to a diverse community of birds including both waterfowl and songbirds, three species which are COSEWIC listed as threatened (common nighthawk), or of special concern (rusty blackbird and olive-sided flycatcher). A thorough and comprehensive narrative of birds in the area can be found within Heart of the Yukon (Bleiler et al., 2006). Additionally, a report on the recent site specific waterbird use of the Christal Creek area jointly produced by Ducks Unlimited and the FNNND was conducted in 2004 (Leach and Hogan, 2005).

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 and incidental sediments, and beaver may be exposed to elevated levels of arsenic, lead and selenium from Christal Creek and Christal Lake.

6.3 VEGETATION

Three bioclimatic zones exist within the general KHSD study area: Boreal High, Boreal Subalpine, and Alpine, described in Table 6-7. 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.

Table 6-7: 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 supports 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 krummholtz 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 krummholtz that exist in small microsites where they can receive enough moisture and nutrients to grow. This bioclimatic zone is present only on Keno Hill.

An assessment of disturbance mine site areas completed by AEG (2016c) focused on historical waste rock pits, dumps, and trenching. Photo records kept of natural revegetation at historical disturbed waste rock storage and pit sites (No Cash mine) provided examples of the level of 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 diversity of species. Several sites showed evidence of more than one factor that would limit successful revegetation such as: 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 optimizing revegetation of disturbed sites including scarifying the disturbance with machinery to add microsite conditions, applying a seed mix and fertilizer amendment, and adding natural growth media in the form of organic material or coarse woody fragments.

The most vegetation disturbance at sites was generally around access roads, adits, waste rock pits, and tailings storage. Most disturbed sites that dated back 45 years were observed to support plant communities consistent with early stage serial succession. There was noticeable change in natural revegetation over a six-year period at No Cash 100 waste rock storage and pit (disturbed from 1948 to 1975). The trial sites show that once initial vegetation was established on site, it created microsites and increased surface organics which promoted growing conditions for additional species. Furthermore, the vegetation within the KHSD provided an abundant seed source that, if the right conditions exist, naturally established primary colonizing species. 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 seemed to have less of an impact the second year after application. Establishing significant vegetation cover will need time similar to natural revegetation.

Results of terrestrial effects assessments done by Environmental Dynamics Inc. (EDI, 2008; 2009; 2010) concluded there was aerial contamination of metals to lichens but was limited to the eastern portion of the Valley Tailings Facility (2007). Other results showed evidence of elevated heavy metal concentrations in some medicinal plants used by FNNND as compared to control sites, particularly near the tailings (2008). 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 (2009).

7 SOCIAL ENVIRONMENT

The KHSD lies within the traditional territory of the 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 ever since. 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 KHSD. Mayo has a population of approximately 188 people (YG, 2022) and serves as a distribution and service centre for the surrounding area, supporting mineral development, tourism, and other activities. Mayo is also the administrative centre for the FNNND. In addition to being a tourist destination, the community is a base for wilderness and mining tourism, canoeing, hiking, big-game hunting and fly-in fishing.

8 GEOCHEMISTRY

8.1 ORE

AKHM has not conducted geochemical testing to assess the potential for acid rock drainage and metal leaching (ARD/ML) related to the ore. Testing has instead focused on the tailings produced and waste rock extracted to access the ore.

8.2 WASTE ROCK

AKHM conducted waste rock geochemical characterization studies throughout the KHSD and specifically within each of the mineralized target zones (Bellekeno, Onek 990, Lucky Queen, Flame & Moth, and New Bermingham) to understand the weathering behavior and potential for acid rock drainage and metal leaching (ARD/ML) potential related to the rocks. These characterization studies have been ongoing since AKHM initiated exploration in 2006. The results of these studies were summarized in AEG (2019a) reports for each deposit were compiled as appendices to the New Bermingham Water Use Licence application (AEG, 2019b), and as updated in subsequent annual reports filed under WL QZ18-044.

8.2.1 LABORATORY TEST PROGRAM

The samples were sourced from exploration drill holes from Bellekeno, Lucky Queen, Onek, Flame & Moth, Silver King, and New Bermingham and routine development and production underground sampling from 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 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).

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).

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.

Table 8-1 lists the number of samples tested per production zone. Table 8-2 provides a description of each lithology code, while Table 8-3 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 8-1: Number of ARD/ML Samples per ARD/ML Test and per Production Zone

Production Zone	ARD/ML Test				
	Acid Base Accounting	Elemental Analysis	Shake Flask Extraction	Humidity Cell	Field Bin
Bellekeno	71	6478	12	-	-
Onek and Lucky Queen	74	7507	17	-	-
Silver King	24	24	-	-	-
Flame & Moth	230	188	81	1	5
New Bermingham	173	479	113	2	-
Total	**572**	**14676**	**223**	**3**	**5**

ARD/ML – acid rock drainage and metal leaching

Table 8-2: Lithology Description and Code

Description	Code
Chlorotic Schist	CHSCH
Calcareous Quartzite	CQTZT
Calcareous Schist	CQZT
interbedded Carbonaceous Quartzite and Schist	ICQS
Greenstone	GNST
Graphitic Schist	GSCH
Quartzite	QTZT
Schist, Undifferentiated	SCH
Sericite Schist	SSCH
Thin Bedded Quartzite	TQZT

Table 8-3: 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
Silver King	1	2	7	3	7	4	0	0	0	24
Flame & Moth	1	17	118	16	14	0	10	6	1	183
New Bermingham	6	91	243	6	73	0	11	2	0	422
Total	**24**	**139**	**410**	**44**	**103**	**4**	**33**	**10**	**1**	**758**

ARD/ML – acid rock drainage and metal leaching

8.2.2 RESULTS

8.2.2.1 STATIC TESTING

8.2.2.1.1 Acid-Base Accounting

ABA is used to quantify the acid potential (AP) and neutralization (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 8-1 presents NP values versus AP values for all the KHSD waste rock samples. NP values were plotted versus AP values for each major lithology from Figure 8-2 to Figure 8-6.

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%, 76%, 49%, 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 waste rock from the deposits located in the western portion of the KHSD (i.e., Silver King and New Bermingham), consistent with ABA characterization of historical KHSD waste rock (SRK, 2009). Silver King had the most samples with high potential for ARD (i.e., NPR<1; 68%), largely due to their low NP content of the samples (Figure 8-1). Approximately 33% and 19% 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 (11% to 31% PAG; 44% to 76% non-PAG), consistent with the numerical dominance of these lithologies. The GNST and SSCH samples were predominantly non-PAG (Figure 8-2 to Figure 8-6).

8.2.2.1.2 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 8-7.

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, Lucky Queen, and Silver King. 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 Bellekeno or Onek waste rock and the poor detection limits (10 ppm) used for Lucky Queen and Silver King 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.

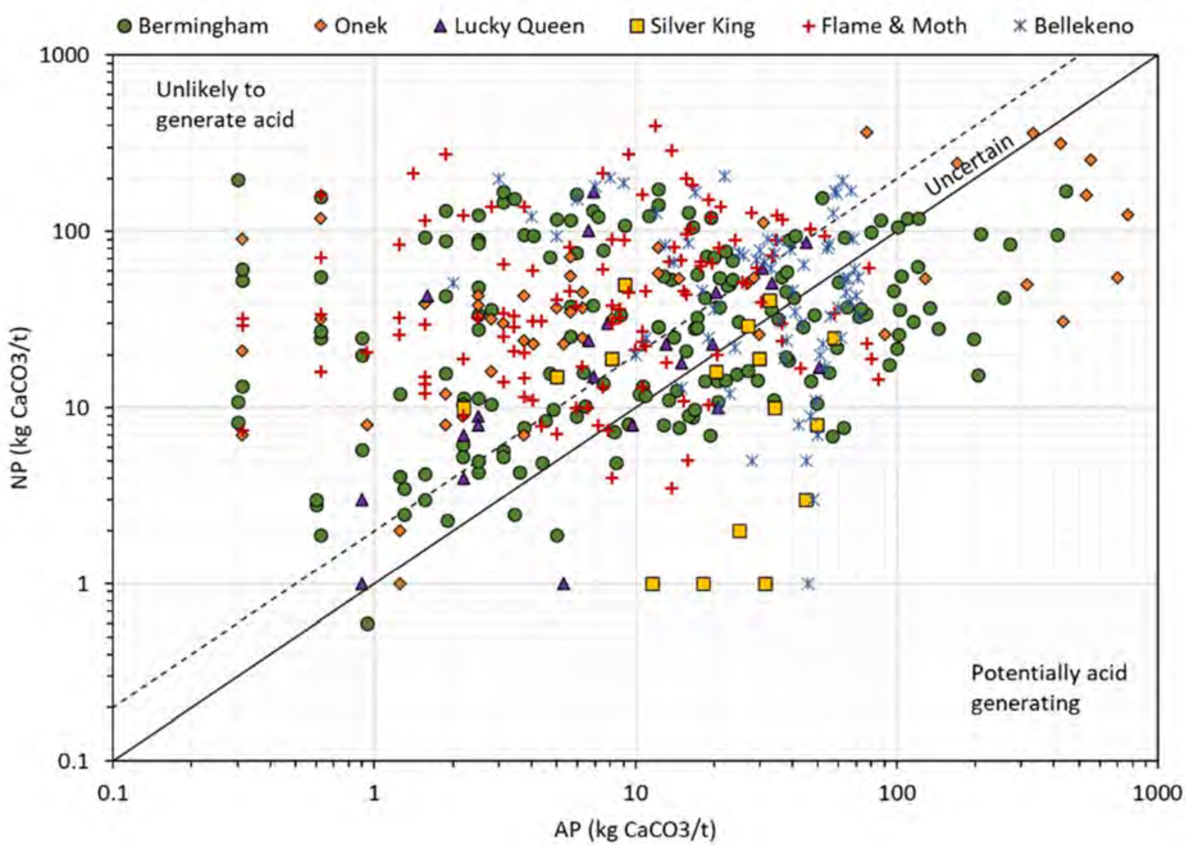

Figure 8-1: Variability in NP and AP of Waste Rock Samples from Keno Hill Silver District Deposits

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

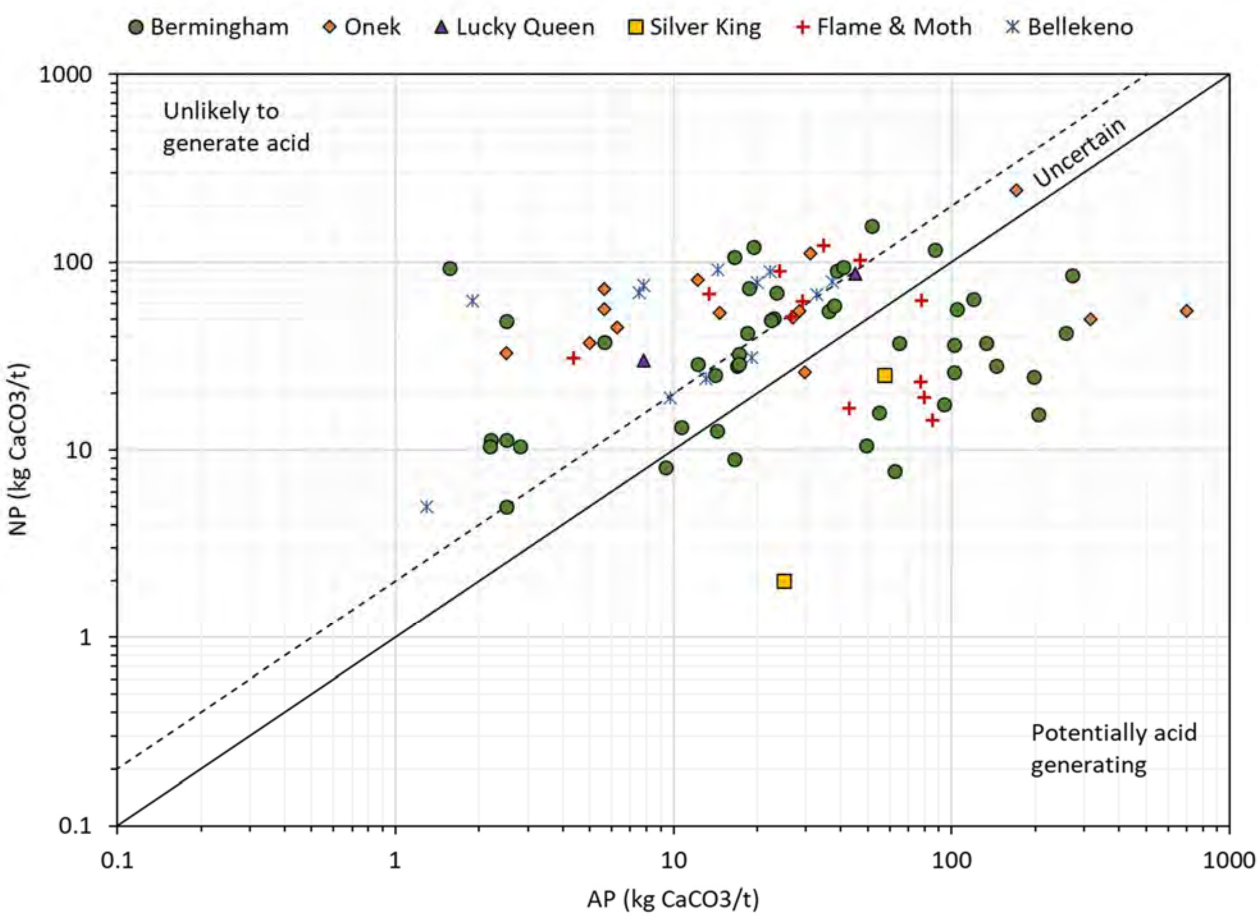

Figure 8-2: Variability in NP and AP of GSCH Lithology Waste Rock Samples from Keno Hill Silver District Deposits

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

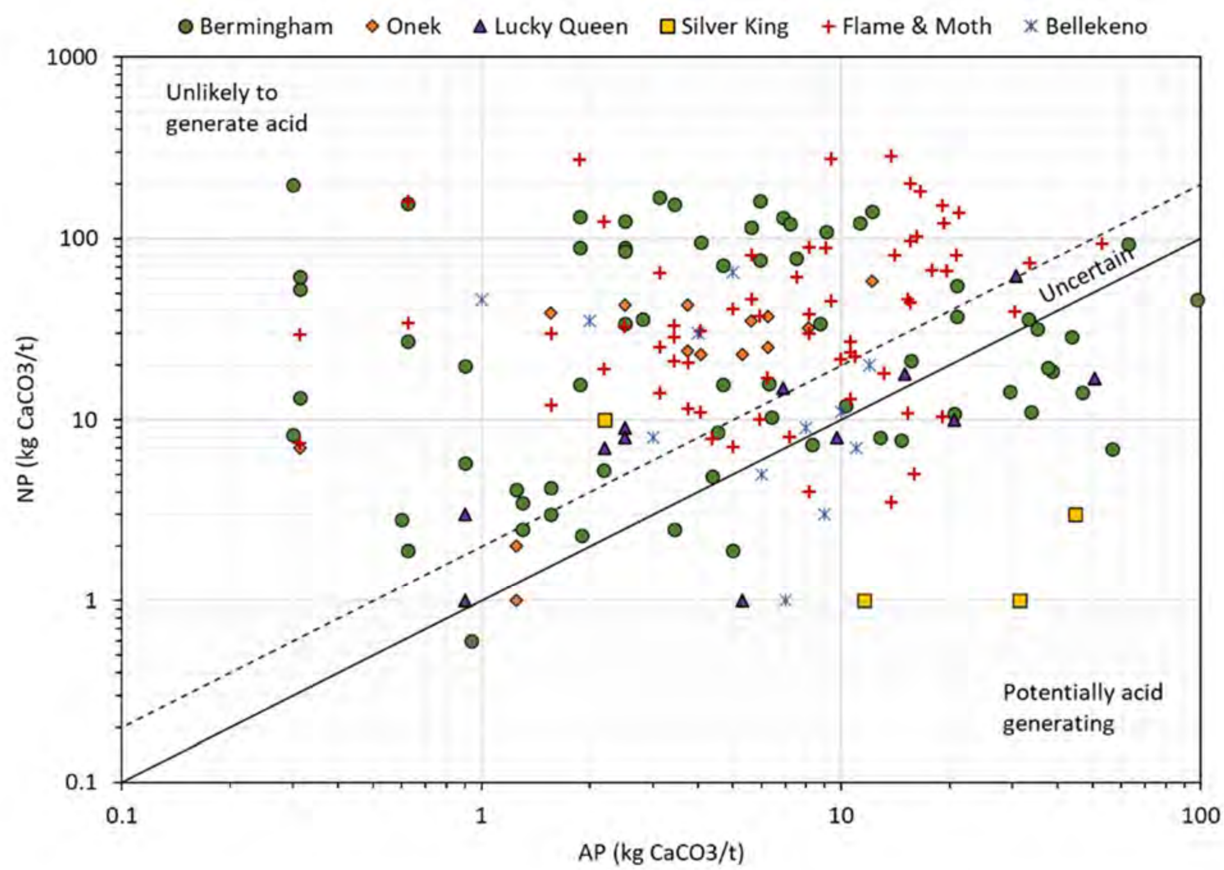

Figure 8-3: Variability in NP and AP of QTZT Lithology Waste Rock Samples from Keno Hill Silver District Deposits

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

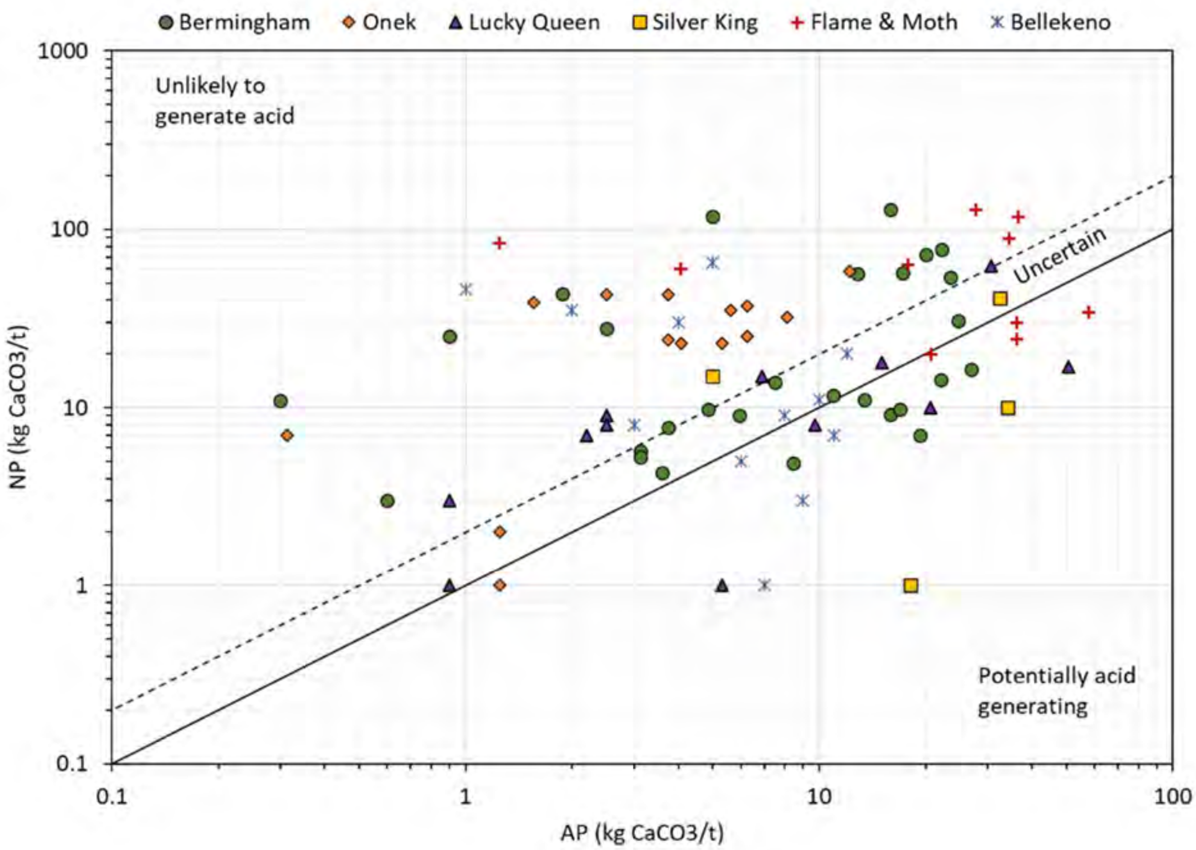

Figure 8-4: Variability in NP and AP of TQTZT Lithology Waste Rock Samples from Keno Hill Silver District Deposits

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

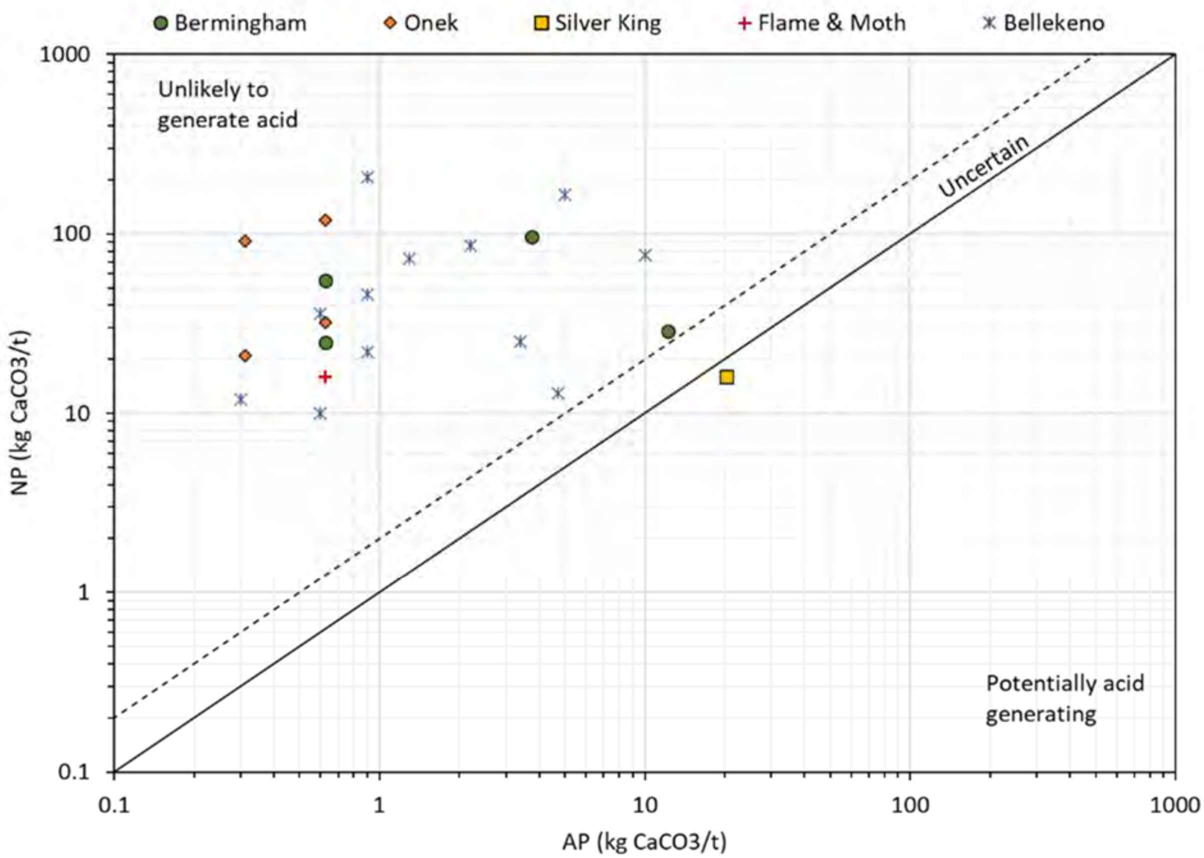

Figure 8-5: Variability in NP and AP of GNST Lithology Waste Rock Samples from Keno Hill Silver District Deposits

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

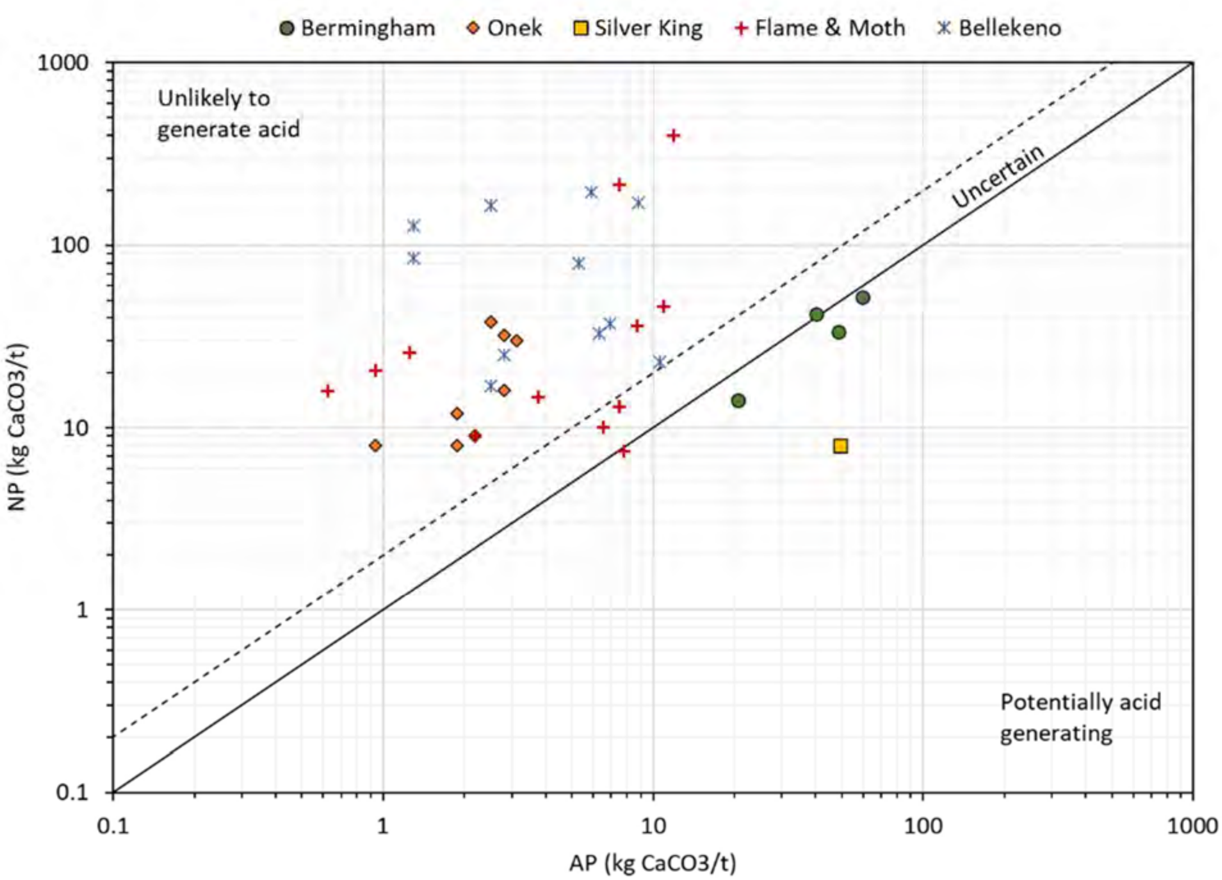

Figure 8-6: Variability in NP and AP of SSCH Lithology Waste Rock Samples from Keno Hill Silver District Deposits

NP – neutralization potential; AP – acid potential; NPR – neutralization potential ratio. Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

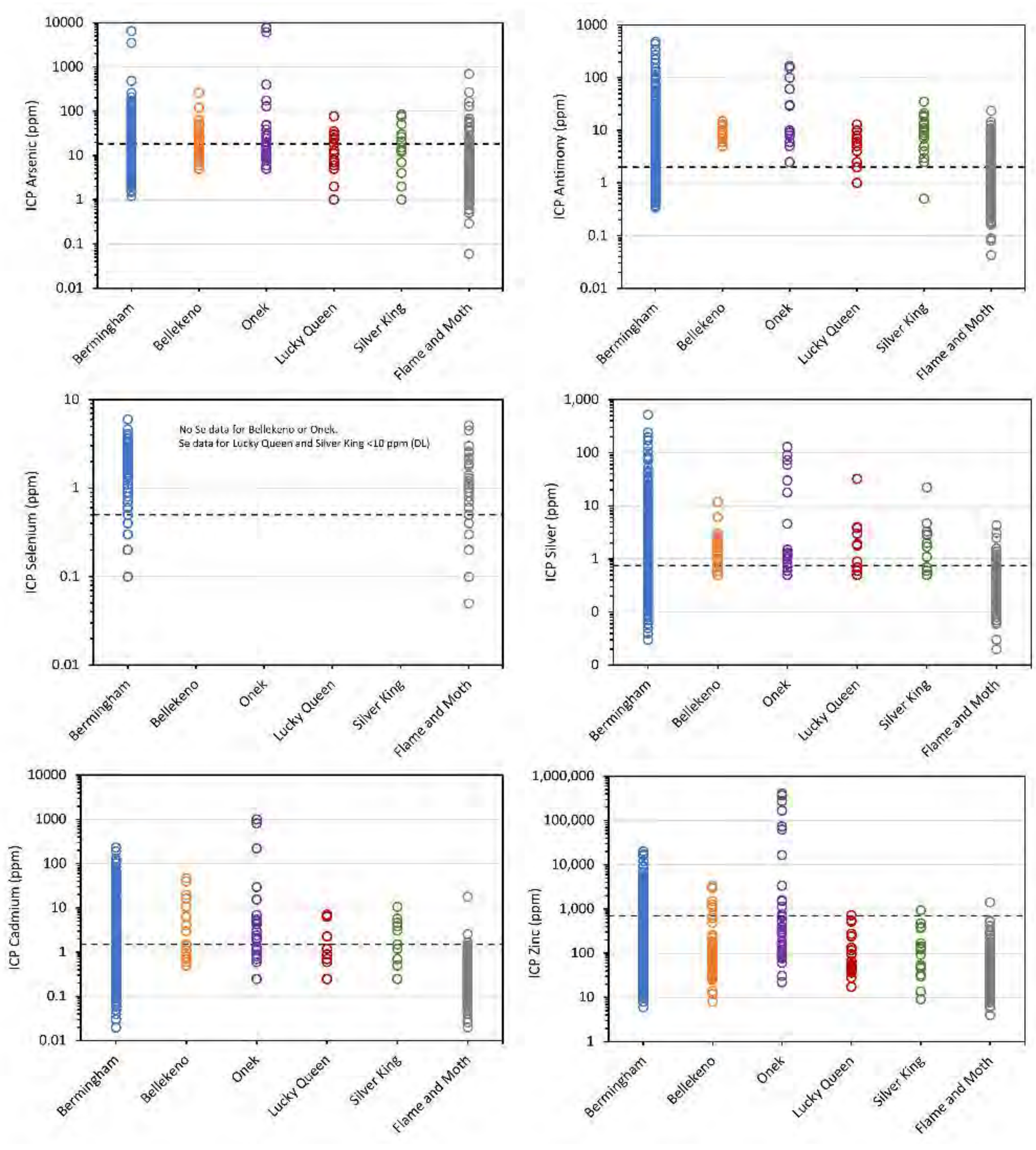

Figure 8-7: Elemental Concentrations of Antimony, Arsenic, Selenium, Silver, Cadmium, and Zinc by Deposit

Dashed line represents 10x crustal abundance.

8.2.2.1.3 Shake Flask Extraction

SFE provides an indication of readily soluble elements in a sample that may be mobilized/solubilized under the 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 8-4 and Table 8-5, 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 and/or for constituents that had SFE results that were elevated relative to CCME (CCME, 2022) or British Columbia Ministry of the Environment (BCMOE, 2021) long-term water quality guidelines for the protection of freshwater aquatic life. The most recent of the two generic guidelines was used in the analysis as it represents the most up to date scientific data with respect to environmental risk assessment. This comparison aids in the identification of potentially elevated concentrations of soluble constituents and is strictly for reference purposes and does not indicate compliance or otherwise with respect to CCME or BCMOE guidelines.

The SFE pH of Flame & Moth and New Bermingham samples was circumneutral to alkaline, with five samples (three New Bermingham and two Flame & Moth) having pH higher than the upper CCME pH guideline (pH 9.0). Also, four New Bermingham samples had SFE pH lower than the CCME pH lower guideline (pH 6.5). 92% and 76% of samples from Flame & Moth exceeded fluoride and aluminum CCME guidelines (0.12 mg/L and 0.1 mg/L), respectively, whereas a lower proportion of exceedances for the same elements were obtained from New Bermingham samples (45% and 31% for fluoride and aluminum, respectively).

A high proportion of SFE antimony concentrations exceeded the BCMOE guideline (0.009 mg/L; 78% of samples) in the Flame & Moth dataset, whereas only 21% of New Bermingham samples exceeded despite higher bulk antimony concentrations in the New Bermingham waste rock samples (Figure 8-7). Conversely, a higher proportion of New Bermingham samples had SFE arsenic concentrations above 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 elemental arsenic in New Bermingham samples compared to Flame & Moth (Figure 8-7). On the other hand, a similar proportion samples from both Flame & Moth and New Bermingham had SFE selenium concentrations that exceeded the BCMOE guideline for selenium (0.002 mg/L; 46% and 45% of samples, respectively) consistent with their comparable bulk selenium content.

In summary, the same constituents (fluoride and selenium) were observed at elevated levels in the SFE leachate in samples from both New Bermingham and Flame & Moth. The main differences were arsenic concentrations above the CCME guideline in 41% of the New Bermingham samples and 6% of the Flame & Moth samples, and antimony and aluminum concentrations above the guidelines in over 75% of Flame & Moth samples and less than 32% of the New Bermingham samples.

Table 8-4: Comparison of SFE Data from Flame & Moth 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%

SFE – shake flask extraction. Results exceeding CCME/BCMOE are presented in red.

Table 8-5: Comparison of SFE Data from New Bermingham 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 >CCME/BCMOE	24%	45%	31%	21%	41%	3%	45%

SFE – shake flask extraction. Results exceeding CCME/BCMOE are presented in red.

8.2.2.2 KINETIC TESTING

The results of completed laboratory humidity cell and ongoing 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. The EQS set out in water licence QZ17-076, water quality objectives (WQO) at KV-21 for Bermingham, and CCME or BCMOE water quality guidelines are used for comparison with leachate chemistry. The hardness, DOC, and pH of nearest receiving environment was used to calculate the guidelines for hardness-, DOC- and pH-dependent elements. Station KV-51 in Christal Creek and Station KV-21 in No Cash Creek were used as the nearest receiving environment stations for the Flame & Moth and Bermingham datasets, respectively.

8.2.2.2.1 Humidity Cell

8.2.2.2.1.1 Flame & Moth

Figure 8-8 to Figure 8-10 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 $CaCO_3$ at week 1 and stabilized around 50 – 60 mg/L $CaCO_3$ since week 60. While acidity was not measured during the first 9 weeks of humidity cell operations, acidity was 17 mg/L $CaCO_3$ at the initial sampling at week 10 then remained below 6 mg/L $CaCO_3$ during the reminder of the test (Figure 8-8).

Dissolved sulphate concentrations were below the BCMOE 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 8-8 and Figure 8-9).

The concentrations of antimony were highest during the initial rinse (0.011 mg/L), marginally above the BCMOE WQG (0.009 mg/L), then gradually declined over time, stabilizing below 0.001 mg/L since week 41 (Figure 8-10). 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 8-10). Arsenic concentration was 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 8-10). 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 BCMOE guideline of 0.002 mg/L after week 12).

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.

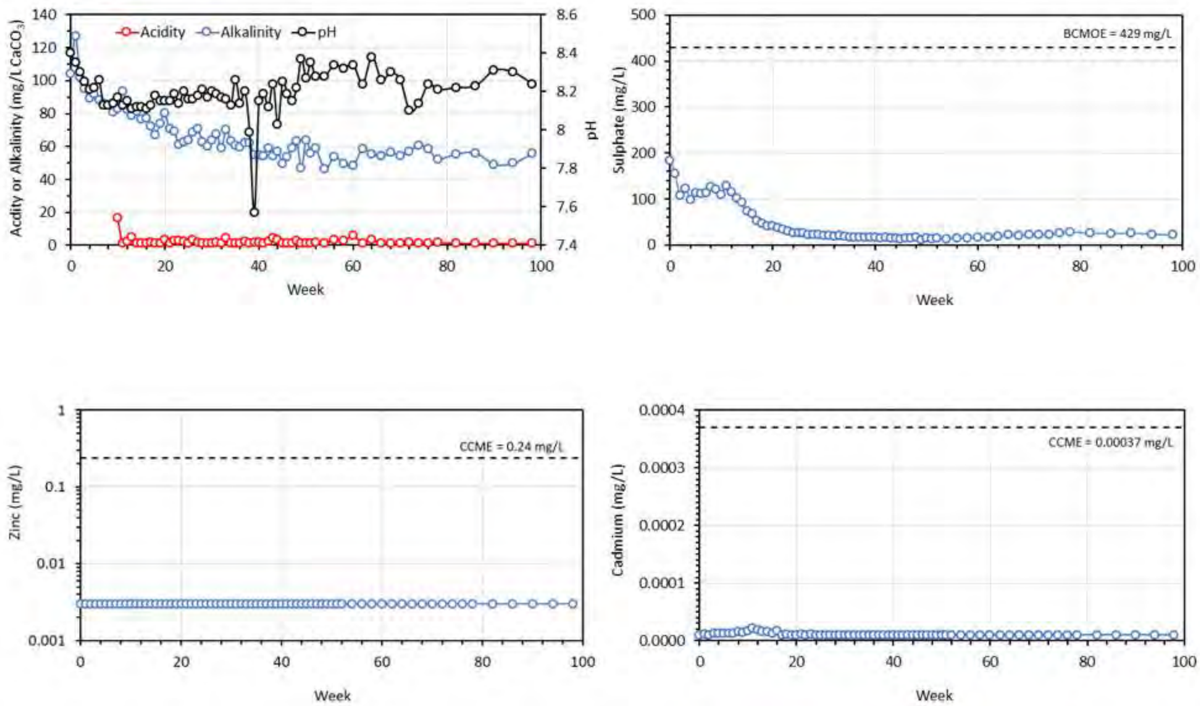

Figure 8-8: Acidity, Alkalinity, pH, Sulphate, Zinc and Cadmium Trends of Flame & Moth Humidity Cell

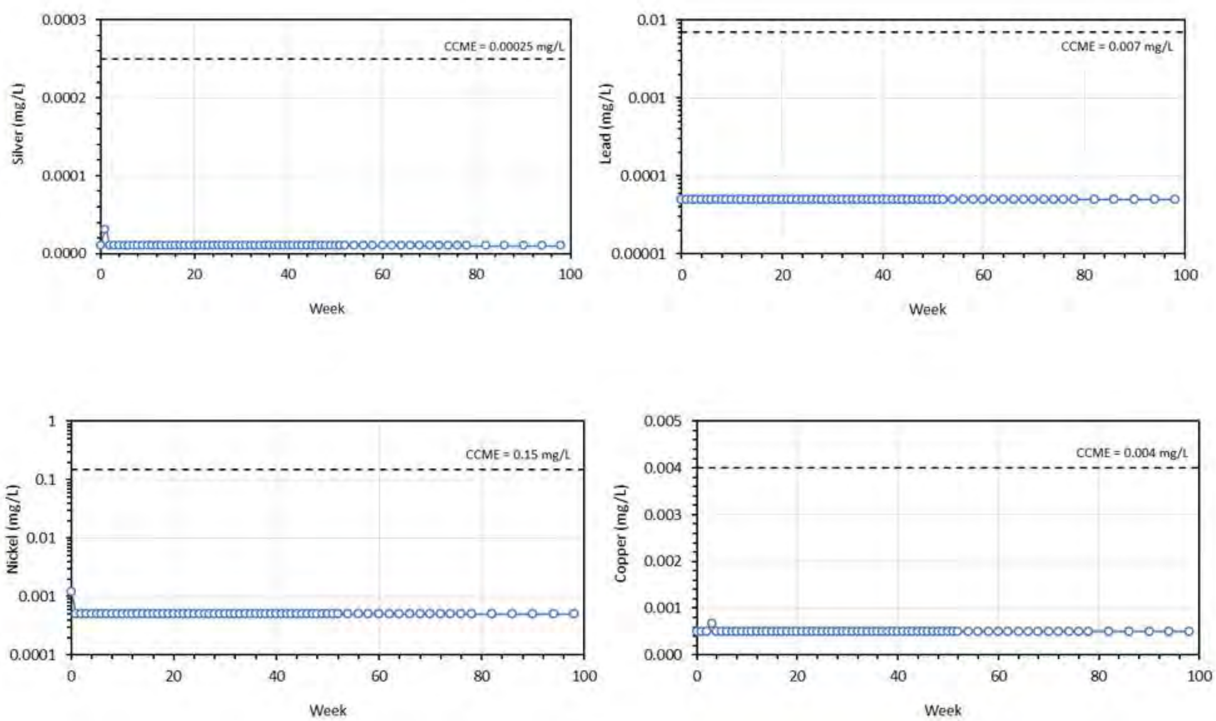

Figure 8-9: Silver, Lead, Nickel, and Copper Trends of Flame & Moth Humidity Cell

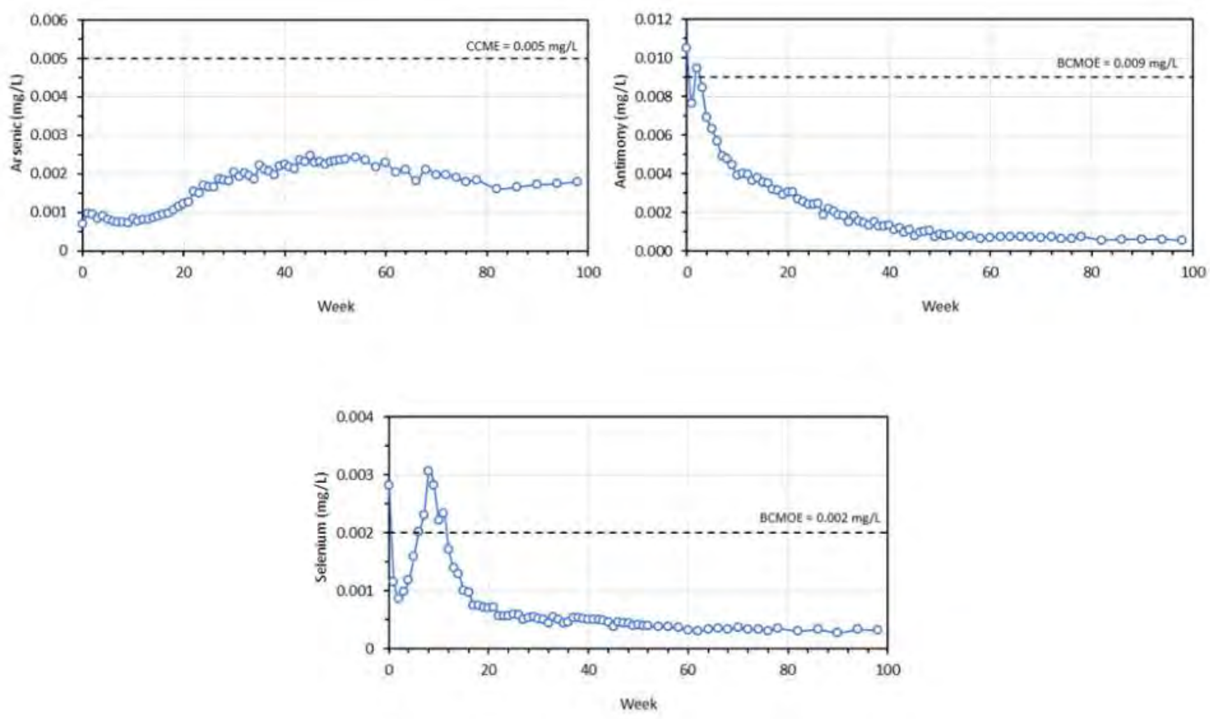

Figure 8-10: Arsenic, Antimony and Selenium Trends of Flame & Moth Humidity Cell

8.2.2.2.1.2 New Bermingham

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 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 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 78th percentile, NP close to the 87th percentile, AP close to the 79th percentile 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 trace metal content close to the 90th percentile of the elemental data and operated for 107 weeks. Figure 8-11 to Figure 8-13 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 8-11), 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 (2.5 to 15.3 mg/L) and much lower than the sulphate WQO (524 mg/L; Figure 8-11).

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 $CaCO_3$) and negligible acidity (<0.5 to 1.1 mg/L $CaCO_3$). 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 WQO (Figure 8-11).

Constituents of Interest

Aside from selenium in HC-01 and antimony and copper 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 WQO, EQS, CCME, or BCMOE values (Figure 8-11 to Figure 8-13). 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 11 (0.0018 mg/L) below the BCMOE guideline (0.002 mg/L). Selenium concentrations in HC-03 had a similar trend as HC-01, though concentrations remained consistently below the BCMOE. Cadmium concentrations of HC-01 and HC-03 were comparable and more than two orders of magnitude lower than the EQS (0.01 mg/L). Arsenic concentrations in HC-01 and HC-03 were relatively low and also more than an order of magnitude lower than the WQO (0.025 mg/L) (Figure 8-13).

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 more than an order of magnitude below their respective WQO (Figure 8-11 and Figure 8-12). Silver was below the detection limit in all 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.

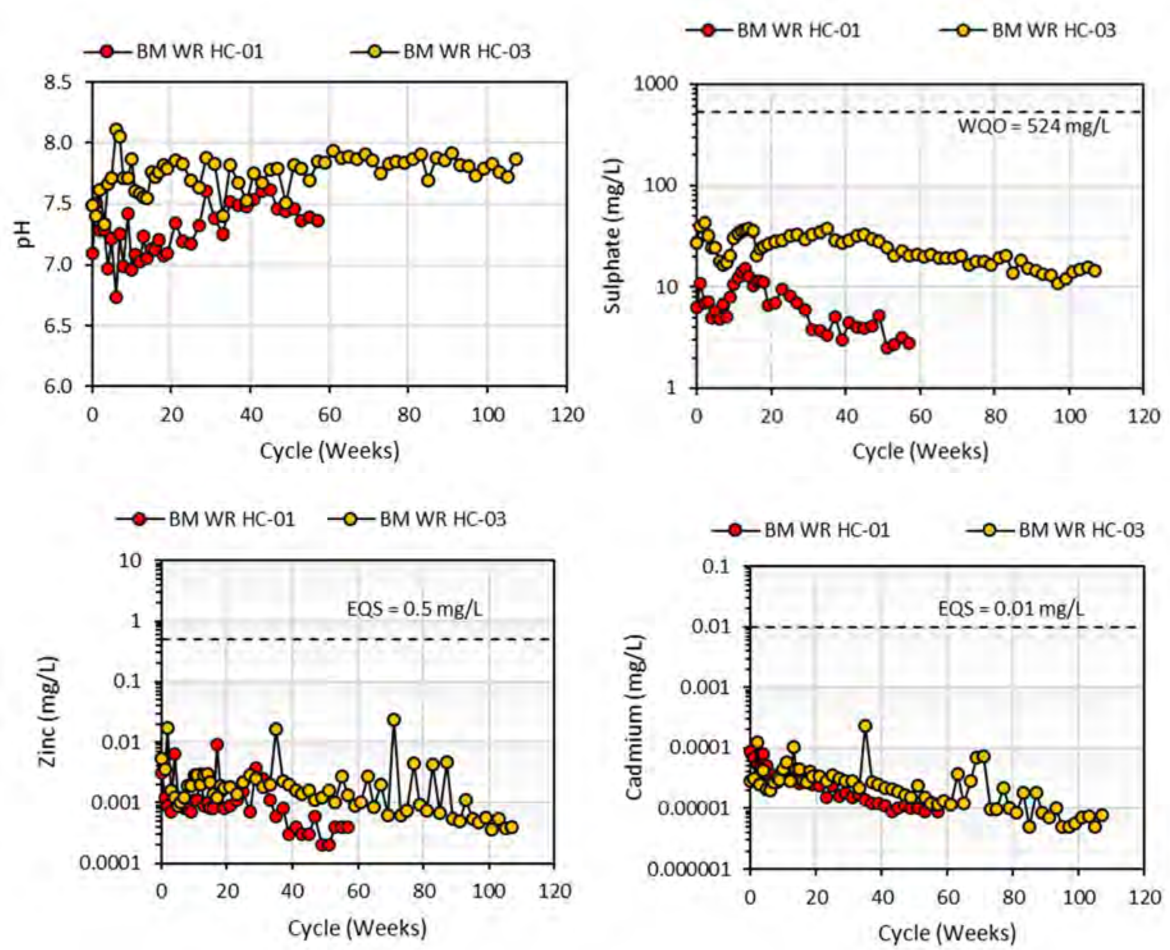

Figure 8-11: pH, Sulphate, Zinc, and Cadmium Trends within the New Bermingham N-AML Waste Rock Humidity Cells

N-AML – non-acid generating/metal leaching; BM WR – New Bermingham waste rock.

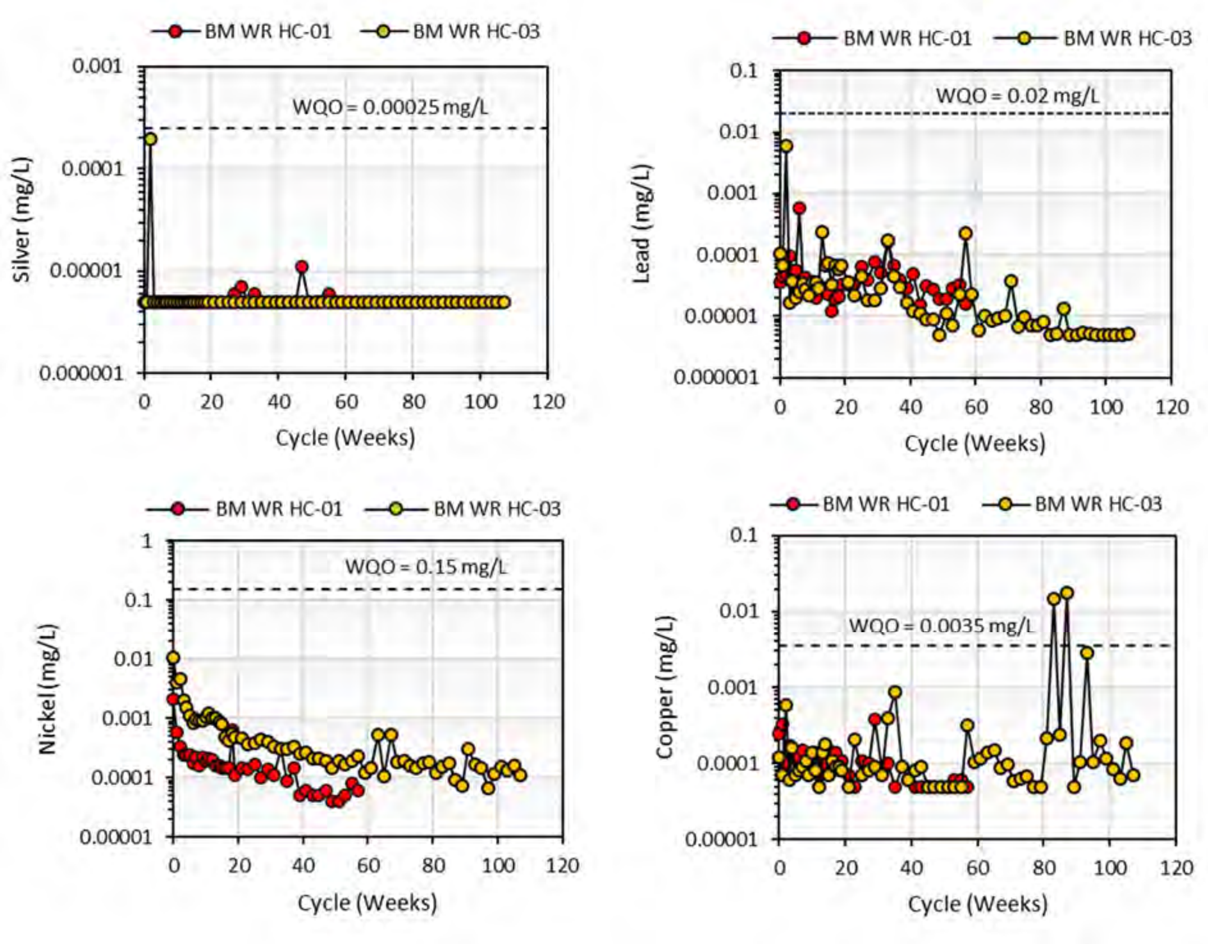

Figure 8-12: Silver, Lead, Nickel, and Copper Trends within the New Bermingham N-AML Waste Rock Humidity Cells

N-AML – non-acid generating/metal leaching; BM WR – New Bermingham waste rock.

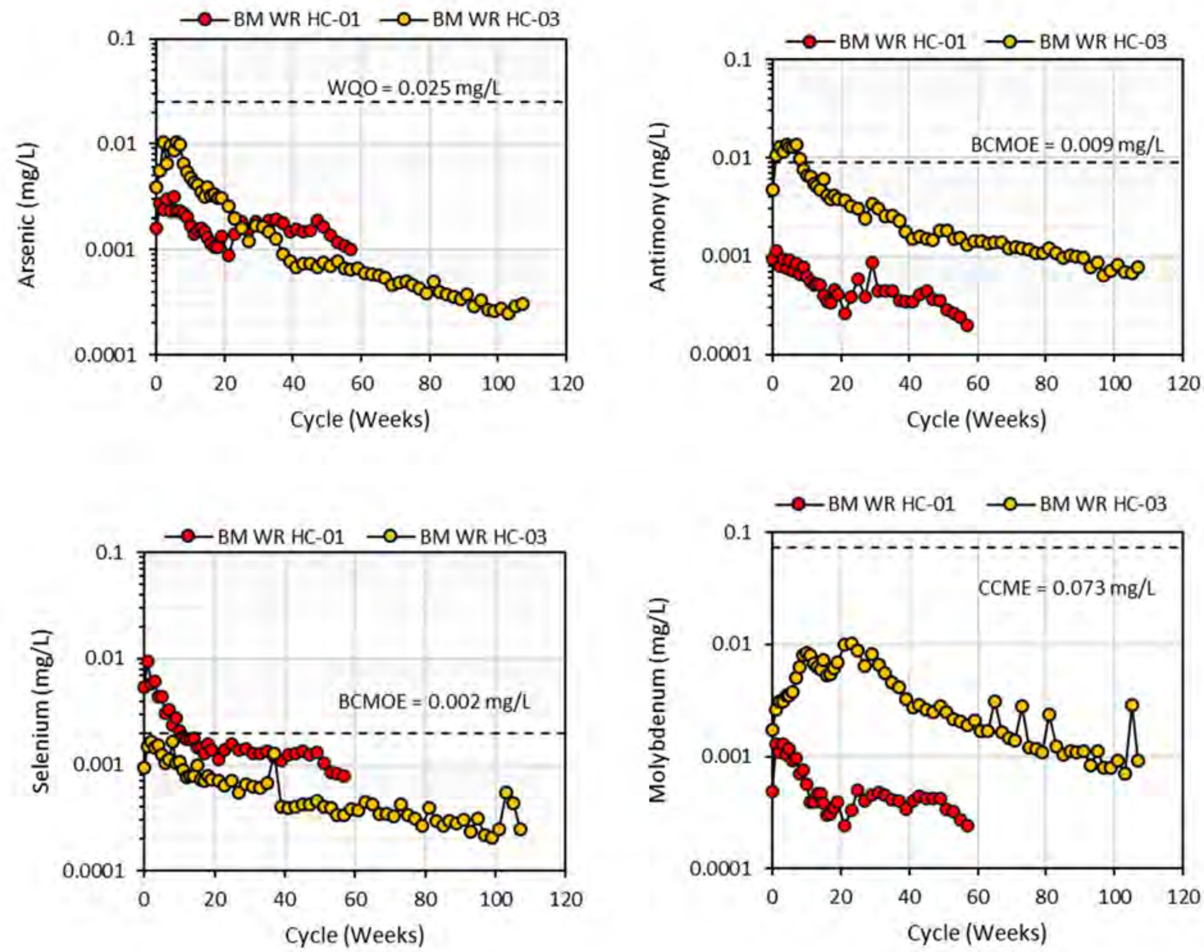

Figure 8-13: Arsenic, Antimony, Selenium, and Molybdenum Trends within the New Bermingham N-AML Waste Rock Humidity Cells

N-AML – non-acid generating/metal leaching; BM WR –New Bermingham waste rock.

8.2.2.2.2 Field Leach 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 (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 maximum 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.

pH, Acidity, Alkalinity and Sulphate

Leachates from FMB1 to FMB4 had circumneutral to slightly alkaline pH during the monitoring period until 2016. Since 2016, leachate pH below 6.5 was observed in FMB1 and occasionally observed in seven sampling events for FMB2, five times for FMB3, and eight events for 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). The highest pH values were often recorded in the leachate from FMB3 although its pH intermittently decreased below 6.5 from September 2018 to 2022 samplings events. All N-AML barrels showed intermittent low pH (<6.5) during the September 2018 and 2022 sampling events (Figure 8-14).

FMB1 exhibited higher acidity (<1.0 – 1560 mg/L $CaCO_3$) than observed for FMB2, FMB3 and FMB4 (<1.0 – 42 mg/L $CaCO_3$). The difference between the leachate acidity from P-AML (FMB1) and the N-AML barrels (FMB2 to FMB4) decreased since July 2020 (Figure 8-14). The September 2019 acidity result for FMB1 was unusually high (1560 mg/L $CaCO_3$) 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 stabilizing 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. After the initial reduction in alkalinity in the 2013 sampling event, the leachate alkalinity fluctuated but appeared to be relatively stable for FMB2 to FMB4 from 2014 to 2022.

FMB1 showed the highest dissolved sulphate concentrations, ranging from 415 to 4930 mg/L with a median of 1710 mg/L (Figure 8-14). FBM2 to FMB4 had comparable dissolved sulphate concentrations with median values ranging from 301 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, except for the 2017 and 2018 datasets, which showed a general increase in sulphate concentrations through the year. Sulphate concentrations in all the FMB1 leachate samples exceeded the BCMOE guideline of 429 mg/L. Sulphate concentrations in the FMB2, FMB3, and FMB4 leachates were intermittently above the BCMOE guideline. All field barrel samples exceeded the BCMOE sulphate guidelines in September 2019, 2021, and 2022, likely due to the build up of soluble products in the field barrels between May and July and subsequent flushing in September.

Constituents of Interest

The trends of trace element broadly reflected the P-AML/N-AML classification of the barrels. FMB1 was composed of PAG material and the leachate from it regularly contained the highest concentrations of zinc, cadmium, nickel, lead, copper, and silver (Figure 8-15 and Figure 8-16). FMB1 showed cadmium and zinc concentrations constantly exceeding the EQS and nickel and copper concentrations in exceedance from August 2016 to September 2019. FMB2, FMB3, and FMB4 were primarily composed of waste rock with low potential for ARD. These field barrels generally exhibited zinc, cadmium, nickel, lead, copper, and silver leachate concentrations below the EQS, with several exceptions. The exceptions include eight copper exceedances in FMB4, one copper and one zinc exceedance in FMB2, and one copper, two cadmium and three zinc exceedances in FMB3 (Figure 8-15 and Figure 8-16). 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 of oxyanions under acidic conditions of the P-AML rock drainage compared with circumneutral N-AML drainage. Additionally, concentrations of cadmium, copper, lead, nickel, silver, and zinc were markedly lower in FMB1 leachate since September 2019, coincident with the increased pH recorded during this period.

Zinc

The zinc concentrations were consistently below the CCME guideline in the N-AML FMB4 leachate, showing the lowest zinc concentrations than other three field barrels (Figure 8-15). Zinc concentrations of FMB2 leachate were also below the CCME guideline but higher than FMB4. Zinc concentrations from FMB3 were higher than FMB2 and mostly lower than the EQS for zinc (0.5 mg/L), except for the sampling events in September 2019 and 2022, coinciding with the high sulphate and lower pH measurements. Most FMB1 samples collected during 2013 to 2019 had zinc concentrations above the EQS for zinc, approximately one to two orders of magnitude higher than the zinc levels in the other field barrels. 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 or lower since 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.

The zinc concentration in leachate collected from the N-AML field leach barrels FMB2, FMB3, and FMB4 have remained below the EQS. The high zinc releases observed in September 2019 and September 2022 coincided with the high sulphate releases, indicating a common source, likely the flushing of soluble weathering products stored in the field barrels between May and September.

Cadmium

Cadmium concentrations had very similar trends to those of zinc (Figure 8-15). 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, above or comparable to the EQS of 0.01 mg/L, reflective of the metal-leaching nature of P-AML material. Cadmium concentrations in FMB4 leachates were regularly lower or just slightly above CCME, except for five occasions in August of 2021 and 2022 and September of 2019, 2021, and 2022 when concentrations were approximately one order of magnitude higher than the CCME guideline. Like zinc, cadmium concentrations in FMB1 leachate exhibited an increasing trend from 2013 to 2019, then decreased and stabilized since September 2020. 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.

The other three N-AML field barrels (FMB2 to FMB4) contained cadmium levels below the EQS, except for FMB3, which showed concentrations above the EQS threshold in September of 2019 and 2022. The high cadmium releases observed in these two months coincided with the high sulphate releases, indicating a common source, likely the flushing of soluble weathering products stored in the field barrels between May and September.

Nickel

Nickel concentrations were highest in P-AML FMB1 leachate collected from 2013 to 2020, consistently exceeding the CCME threshold of 0.15 mg/L and intermittently exceeding the EQS of 0.5 mg/L (Figure 8-15). 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 higher pH observed for this period.

Nickel concentrations in leachate from FMB2, FMB3, and FMB4 were consistently lower than the CCME guideline and EQS, except for FMB3, showing elevated nickel concentrations above the CCME and EQS threshold in September 2022. Like zinc and cadmium, the high nickel releases observed in September 2022 coincided with elevated sulphate, indicating a common source, likely the flushing of soluble weathering products stored in the field barrels between May and September. Like zinc, sulphate, and cadmium, nickel concentrations were relatively higher in September 2019 and 2022 than other months for FMB2 to FMB4, likely due to accumulation of soluble nickel-bearing weathering products over the summer.

Lead

FMB1 generally contained the highest lead concentrations (0.0013 – 0.74 mg/L) from 2013 to 2019, consistently above the CCME threshold (0.007 mg/L) between August 2016 and September 2019. Lead concentrations in FMB1 also exceeded the EQS (0.2 mg/L) in July 2018 and September 2019 (Figure 8-15), 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.

Lead concentrations from the three N-AML field barrels (FMB2, FMB3, and FMB4) were typically below the CCME guideline of 0.007 mg/L (Figure 8-15) except in a few instances for FMB2 and one instance for FMB4. The highest lead concentrations were recorded in September of 2019 and 2022, likely due to flushing of soluble lead-bearing weathering products accumulated over the summer.

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 EQS (0.1 mg/L) for the first three sampling events in 2013 and most sampling events between 2017 and 2019 (Figure 8-16). Copper concentrations in FMB1 leachates decreased and then stabilized from 2020 to 2022. Copper concentrations in N-AML FMB3 remained below both the EQS and CCME guideline for most sampling events since late 2014 except in August 2018, and September 2019 and 2022. Conversely, FMB2 exceeded the copper EQS once in 2017. The copper concentrations from both FMB2 and FMB4 frequently exceeded the CCME threshold since the beginning of each test (Figure 8-16). Like all previous metals, an unusually high copper concentration was measured in FMB1 in September 2019 due to flushing of accumulated weathering products. The copper concentrations observed in the leachate from the N-AML field barrels in September 2019 were broadly consistent with historical levels.

Silver

FMB1 displayed the highest silver concentration of all field leach barrels (<0.00005 – 0.001 mg/L). Silver concentrations in P-AML FMB1 were comparable to the N-AML field barrels (<0.00001 – 0.0001 mg/L; Figure 8-16) until September 2017, after which the silver concentrations in the leachate from N-AML field barrels fell 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 event (0.00046 and 0.001 mg/L, respectively) of FMB1 exceeded the silver CCME guideline (0.00025 mg/L; Figure 8-16). The silver levels in leachate from 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 had 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 (Figure 8-16). Arsenic concentrations in 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 guideline for most samples (Figure 8-16). Arsenic concentrations in FMB2 leachate gradually decreased since May 2016 and stabilized to levels below the CCME guideline since September 2017. The arsenic concentrations in all the field barrel leachates were well below the EQS (0.1 mg/L). Unlike all constituents of interests discussed thus far, no increase of arsenic concentration was observed in any of the N-AML field barrels in September 2019 or 2022, except for FMB1 in September 2019 and FMB3 in September 2022.

Antimony

All field barrels exhibited a decreasing trend in the antimony concentrations during the monitoring period (Figure 8-16). The lowest antimony concentrations were observed in leachates from FMB1 and FMB3 (0.0013 – 0.026 mg/L), in which the majority of the samples were comparable to or below the BCMOE working guideline (0.009 mg/L) (Figure 8-16). The antimony concentrations in the FMB4 and FMB2 were the highest and above or comparable to the BCMOE guideline, with the latter field barrel showing the highest antimony concentrations (0.01 – 0.07 mg/L).

Selenium

Selenium concentrations exceeded the BCMOE guideline (0.002 mg/L) in most leachate samples from all field barrels (Figure 8-17). 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.

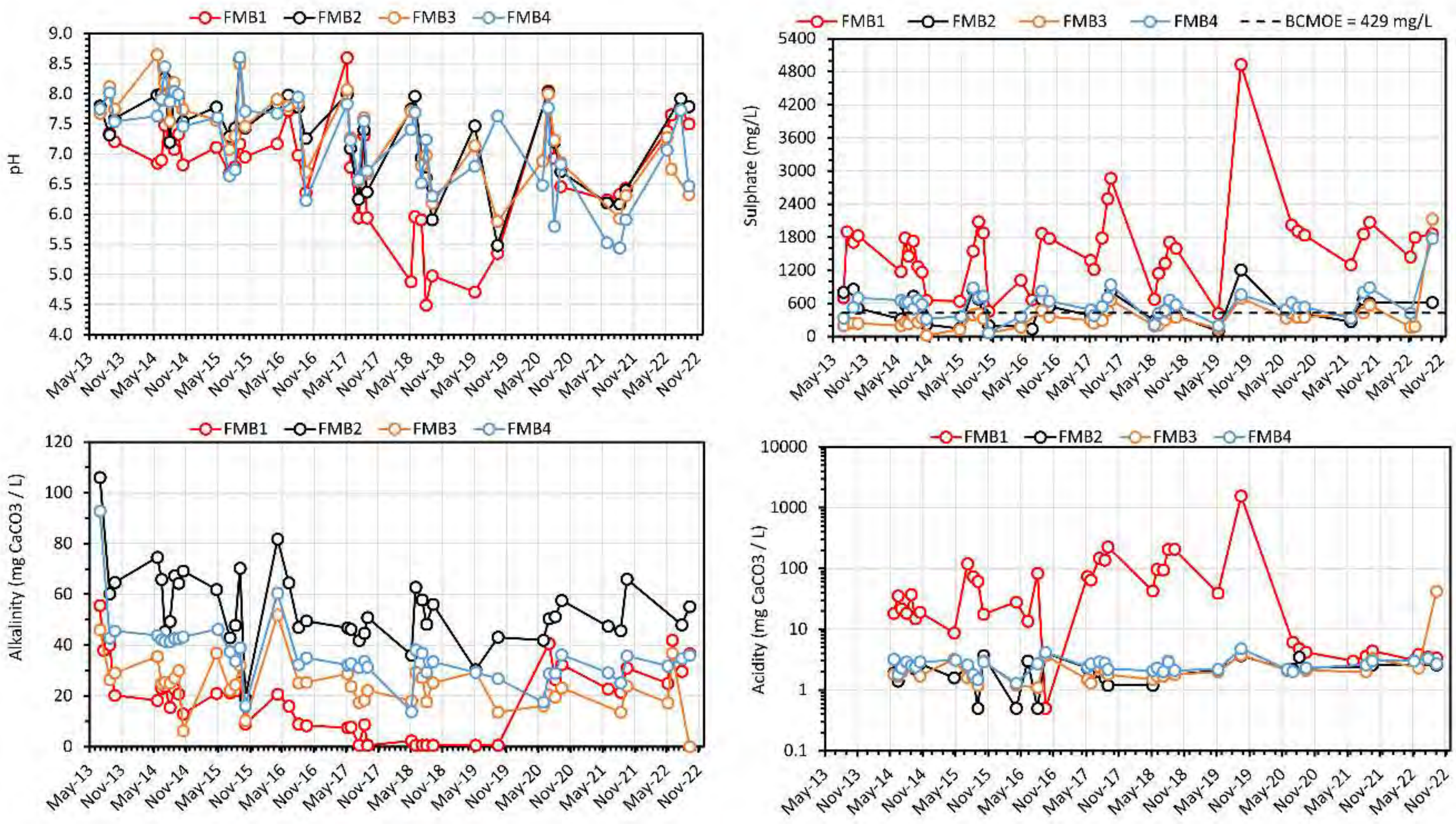

Figure 8-14: Trends of pH, Sulphate, Alkalinity and Acidity in Flame & Moth Field Barrels

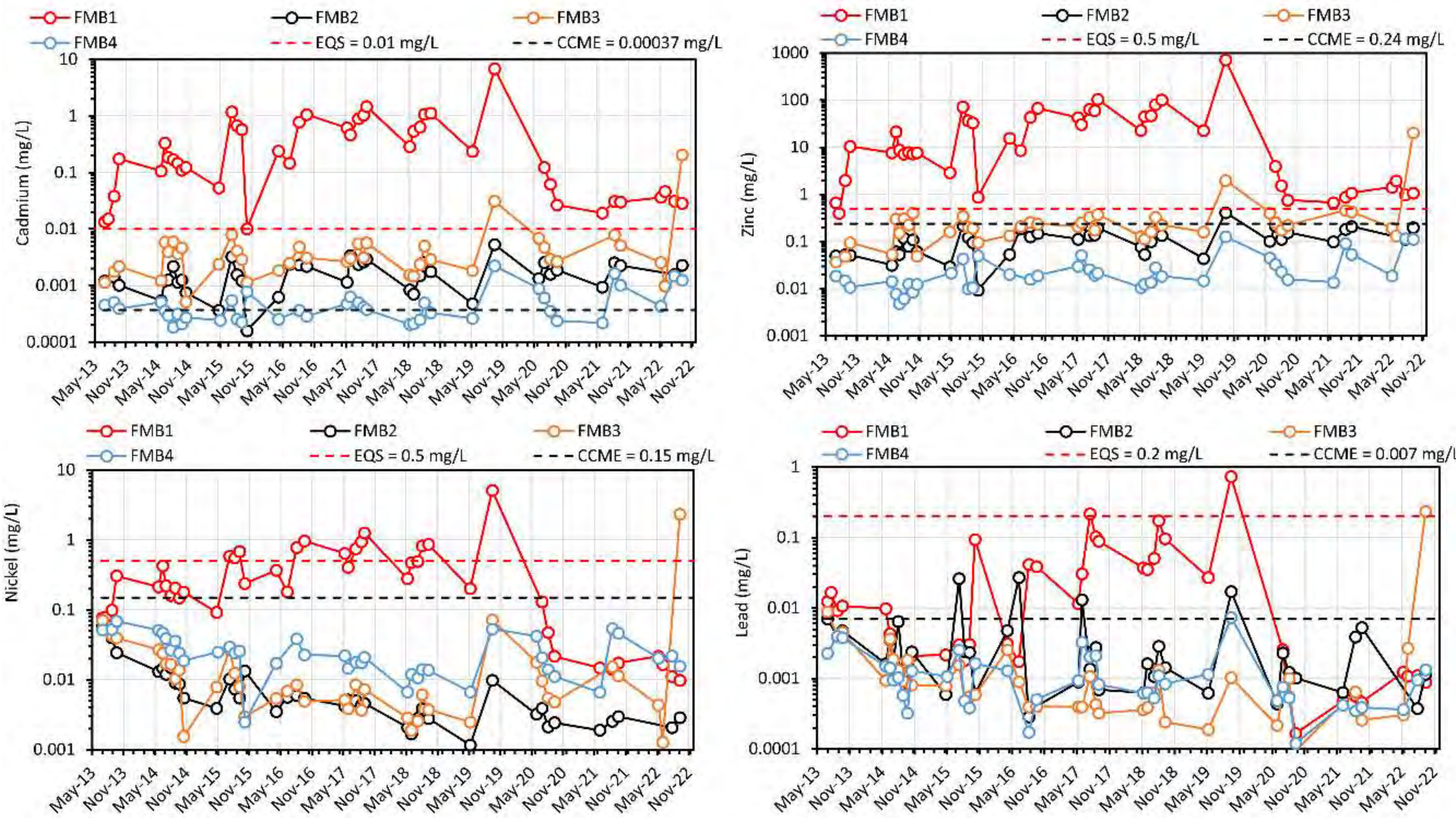

Figure 8-15: Trends of Cadmium, Zinc, Nickel, and Lead Concentration in Flame & Moth Field Barrels

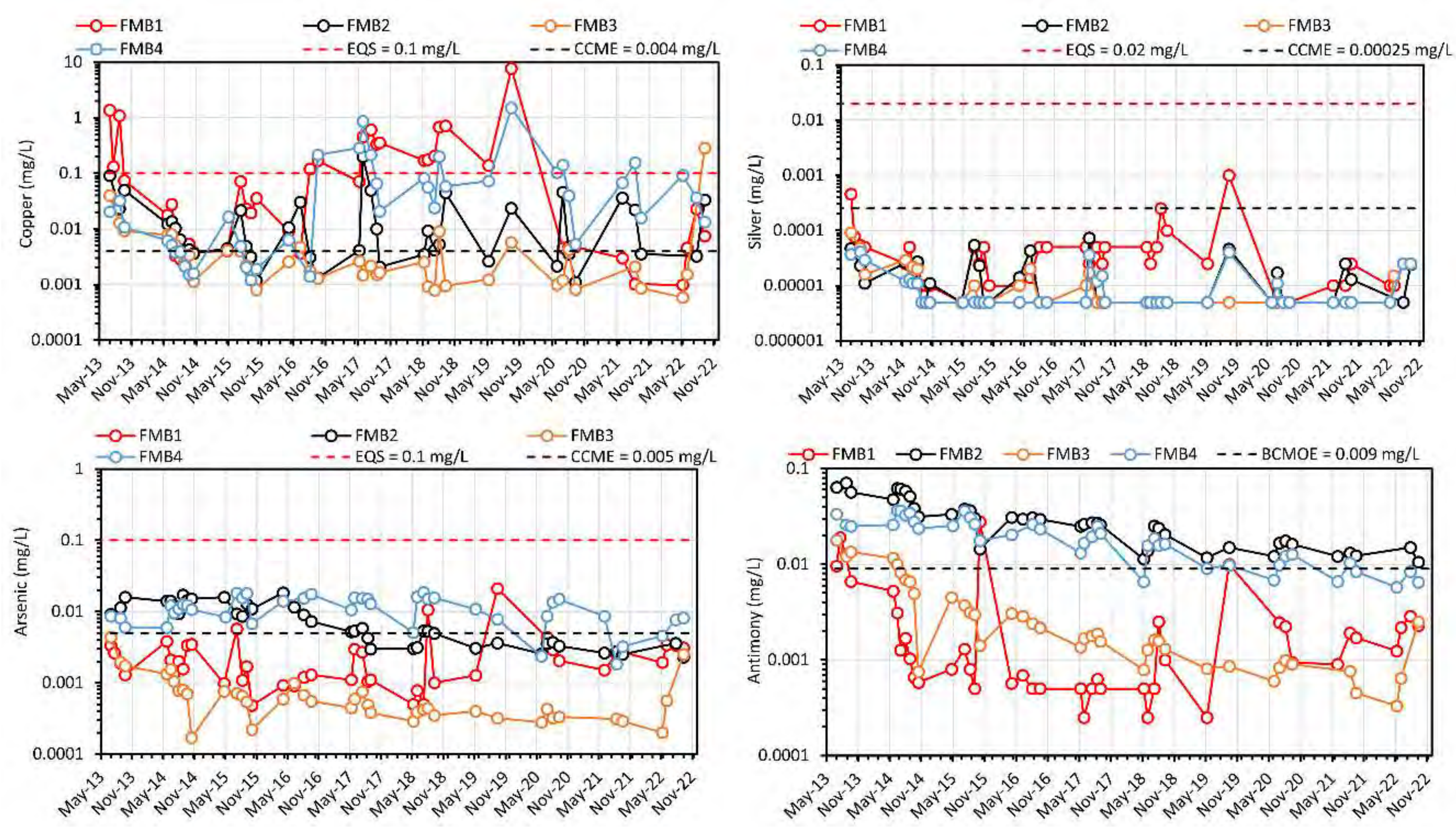

Figure 8-16: Trends Copper, Silver, Arsenic, and Antimony Concentrations in Flame & Moth Field Barrels

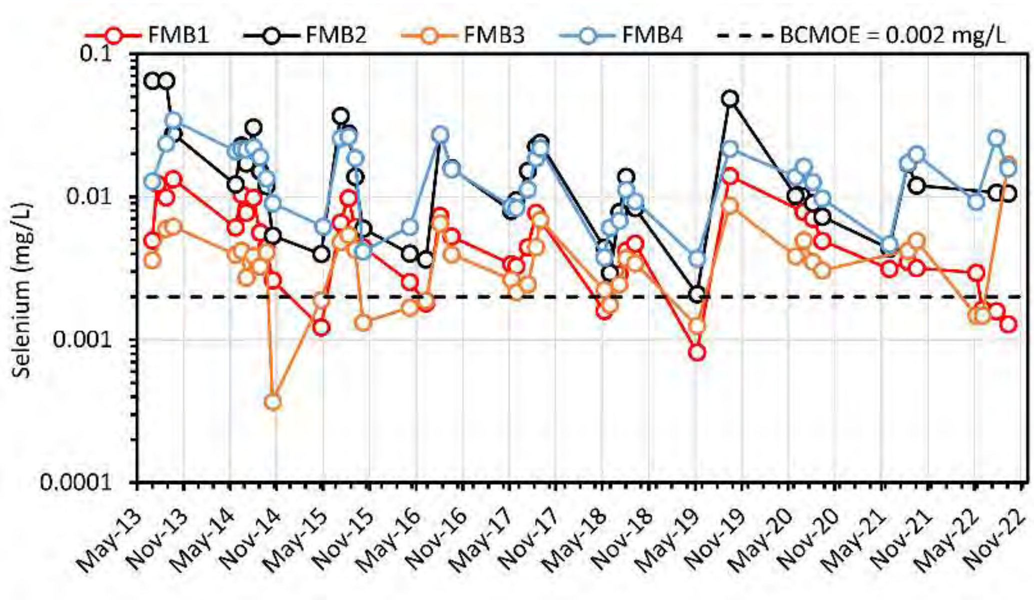

Figure 8-17: Trends of Selenium Concentrations in Flame & Moth Field Barrels

8.3 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 (2019c), Bellekeno and New Bermingham in Ensero (2022a), and New Bermingham and Flame & Moth are summarized herein. This section also provides a comparison of the main geochemical characteristics of the tailings from Flame & Moth, Bellekeno, Lucky Queen, Onek, and New Bermingham.

8.3.1 LABORATORY TEST PROGRAM

The laboratory test program included static and kinetic tests. The static testing consisted of:

- Acid-base accounting;
- Elemental analysis;
- Shake flask extraction (MEND SFE);
- Net acid generating (NAG); and
- Mineralogy by X-ray diffraction (XRD) with Rietveld refinement.

The kinetic testing consisted of standard laboratory humidity cell as follow:

- Flame & Moth tailings (113 weeks, completed);
- Bellekeno tailings (208 weeks, completed); and
- New Bermingham tailings (103 weeks, completed).

8.3.2 RESULTS

8.3.2.1 STATIC TESTING

8.3.2.1.1 Acid-Base Accounting

Table 8-6 presents the ABA testing results of the New Bermingham Locked Cycle Test (LCT), Flame & Moth F4+F5 composite tailings, Onek F7+F8 tailings, and Lucky Queen F9+F10 tailings, as well as the averages of the results from Bellekeno tailings, New Bermingham tailings, and New Bermingham and Flame & Moth mixed tailings, and New Bermingham and Bellekeno mixed tailings between 2011 and 2022.

The tailings from the deposits had circumneutral to slightly alkaline paste pH (7.4 to 8.2). New Bermingham LCT tailings, Flame & Moth F4+F5 composite tailings, and Bellekeno tailings showed relatively high carbonate NP, ranging from 152 to 389 kg $CaCO_3$/t, significantly higher than the siderite-corrected bulk NP of 50.5 to 129 kg $CaCO_3$/t. The much higher carbonate NP than siderite-corrected NP indicates that iron and/or manganese carbonates such as siderite ($FeCO_3$) comprise a substantial portion of the carbonate mineralogy of the tailings. On the other hand, New Bermingham tailings, mixture of New Bermingham and Bellekeno tailings, and mixture of New Bermingham and Flame & Moth Tailings had relatively low carbonate NP, ranging from 54 to 77 kg $CaCO_3$/t, lower than the siderite-corrected bulk NP of 72 to 85 kg $CaCO_3$/t. For these tailings, the bulk of the NP is derived from carbonate NP, supplemented by a smaller amount of NP from non-carbonate minerals such as aluminosilicates, which provide a slower reacting source of acid neutralization than carbonate minerals.

ABA shows that the New Bermingham LCT tailings have a slightly alkaline paste pH (7.6 – 8.2), a very high carbonate neutralization potential (carbonate-NP; 184-204 kg $CaCO_3$/t) and relatively low bulk neutralization potential (bulk NP; 50.5 – 56.3 kg $CaCO_3$/t). The carbonate-NP was nearly four times higher than the bulk NP due to the anticipated presence of iron and/or manganese carbonates (i.e., siderite and ankerite) that do not contribute to the net acid neutralization. The sulphate content of the tailings samples was at the detection limit of 0.01 wt. % indicating that the bulk of total sulphur consisted of sulphide-sulphur (1.29 -1.38 wt.%).

The sulphate contents of the tailings from New Bermingham, Flame & Moth, Bellekeno, Lucky Queen, and Onek were also extremely low (maximum = 0.1 wt. %), indicating that sulphide-sulphur was the primary form of sulphur. The mixtures of New Bermingham and Bellekeno tailings had the highest sulphide-sulphur content (6.8 wt.%), followed by the mixture of New Bermingham and Flame & Moth (4.7 wt.%), Bermingham tailings (2.5 wt.%), Bellekeno tailings (2.2 wt.%), and New Bermingham LCTs (1.29 to 1.38 wt.%). The tailings from the Flame & Moth, Lucky Queen, and Onek had sulphide-sulphur concentrations less than 0.5 wt.%.

The NPR, calculated as the ratio of the (siderite-corrected) NP to AP, indicates that the New Bermingham and Bellekeno tailings were classified as “Uncertain” with an NPR of 1.4 and 1.9, respectively. New Bermingham and Bellekeno tailings mixture and New Bermingham and Flame & Moth tailings mixture had NPR values less than 1, classified as PAG. Onek, Lucky Queen, and Flame & Moth tailings had NPR values larger than 4, defined as non-PAG.

ABA data indicate Uncertain potential for ARD for New Bermingham and Bellekeno tailings and further testing are needed to provide a final ARD classification of the material. The bulk NP may be underestimated due to the oxidation of Mn (II) during the siderite-corrected NP method. Mn(II) is metastable in oxidizing environments and can provide NP under mildly reducing conditions. Furthermore, while pyrite contributes acid upon oxidation, galena and sphalerite oxidation by oxygen is not an acid generating process. Therefore, significant galena and/or sphalerite contributions to the sulphide-sulphur content of the tailings may also result in an overestimate of their acid generating potential. This is supported by detailed mineralogical examination of historical tailings deposited in the KHSD in which material initially classified as PAG by conventional ABA analysis was found to be non-PAG when its manganese carbonate and non-pyrite sulphide content was included in the NPR calculation (SRK, 2009).

Table 8-6: Averages of Acid Base Accounting Results for Tailings from New Bermingham LCT, Flame & Moth, Bellekeno, Lucky Queen, Onek, New Bermingham, Mixture of New Bermingham and Bellekeno, and Mixture of New Bermingham and Flame & Moth

Sample	Paste pH	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	CO_2	CO_3-NP	Siderite-Corrected NP	AP	NPR
	-	Wt. %	Wt. %	Wt. %	Wt. %	kg $CaCO_3$/t			-
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	-	-	31.4	3.8	8.4
Lucky Queen F9 + F10 average	7.9	0.19	0.04	0.15	-	-	19.1	4.5	4.2

Sample	Paste pH	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	CO_2	CO_3-NP	Siderite-Corrected NP	AP	NPR
Flame & Moth F4+F5 Composite	8.0	0.45	0.02	0.43	17.1	389	100	14.1	7.1
Bellekeno Tailings	8.1	2.3	0.04	2.2	11.6	152	129	70.6	1.9
New Bermingham Tailings	7.7	2.5	0.05	2.5	-	54	85	75.6	1.4
New Bermingham and Bellekeno Mixed Tailings	7.4	6.9	0.1	6.8	-	47	78	210.9	0.7
New Bermingham and Flame & Moth Mixed Tailings	7.6	4.8	0.1	4.7	-	77	72	146.6	0.6

AP – acid potential; NP – neutralization potential; NPR – neutralization potential ratio

8.3.2.1.2 Sequential NAG

The NAG test is commonly used to determine the potential for net acid generation of geologic material or as a cross check on the ABA results. During the NAG test, hydrogen peroxide rapidly oxidizes the sulphide minerals in the sample. The NAG test was only done on the New Bermingham LCT tailings and was performed sequentially such that four successive NAG cycles were conducted on the same sample to ensure the oxidation of all sulphide-sulphur. The pH of the NAG leachate after each cycle provides an indication of the capacity of the acid neutralizing of the sample to buffer the acid produced from sulphide oxidation. The NAG test indicates that a sample is non-PAG if the NAG pH is greater than 4.5 and PAG if the NAG pH is less than 4.5.

Table 8-7 shows 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 that the sulphides in the tailings are not reactive. The potential for acid generation is considered low because the NAG pH was greater than 4.5 during the four cycles. 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 New Bermingham tailings.

Table 8-7: Results of Sequential NAG for New Bermingham LCT 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	-	0.1	0.1	-	0.192
	Cycle 2	7.81	-	-	0.1	-	-
	Cycle 3	8.28	-	-	0.1	-	-
	Cycle 4	7.81	-	-	0.1	-	-

8.3.2.1.3 Mineralogy

The results of the XRD reported in Table 8-8 show that the New Bermingham LCT, Flame & Moth, and Bellekeno tailings are mainly composed of quartz (SiO_2; 45.2 to 63.2 wt. %) and calcium rich siderite ($FeCO_3$; 21.2 to 45.3 wt. % as calcian siderite). The New Bermingham LCT tailings contain pyrite (FeS_2; 1.6 to 2.2 wt. %) as the main sulphide and sphalerite (ZnS; 0.3 to 0.6 wt. %) and galena (PbS; 0.3 to 0.8 wt. %) as secondary. The Bellekeno tailings had 2.3 wt.% of pyrite, 2.4 wt.% of sphalerite, and 0.6 wt.% of galena. The Flame & Moth tailings had a lower content in pyrite (0.7 wt.%) and were devoid of sphalerite and galena. The mixture of New Bermingham and Flame & Moth tailings had 5.5 wt.% of pyrite and 1.3 wt.% of sphalerite, with no detection of galena.

New Bermingham tailings contained another carbonate mineral with no effective buffering capacity under oxidizing conditions, ankerite (Ca (Fe, Mg, Mn) $(CO_3)_2$; 1.0 to 1.4 wt. %). Ankerite was also found in the Bellekeno tailings (0.4 wt.%) but was not in the Flame & Moth composite. Flame & Moth and Bellekeno tailings contained 1.2 and 3.2 wt.% calcite, respectively, but no calcite ($CaCO_3$) was detected in the New Bermingham tailings.

These XRD data indicate that the KHSD Mining Operations tailings consist predominantly of geochemically inert silica and iron and manganese carbonate minerals. The major difference between the four tailings is the lack of calcite in the New Bermingham LCT tailings and absence of sphalerite and galena in the Flame & Moth tailings. Iron and manganese carbonates provide no net neutral buffering capacity under aerobic conditions as the acidity consumed by carbonate is equivalent of the acidity produced by the subsequent oxidation and hydrolysis of iron or manganese. 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 potential AP of New Bermingham LCT tailings estimated from the pyrite content of the tailings is approximately 37 kg $CaCO_3$/t, slightly lower than the AP estimated from the ABA of average 42 kg $CaCO_3$/t. This suggests that the sulphide-sulphur of 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 also corroborate the New Bermingham LCT tailings ABA showing that the low bulk NP is due to the deficiency in calcite. The higher AP values for the Bellekeno tailings and New Bermingham and Flame & Moth mixed tailings reflects their higher pyrite and sphalerite contents and the presence of trace chalcopyrite and wurtzite. The low sulphide mineral content (0.7 wt.% as pyrite) of the Flame & Moth sample confirms its low AP.

Table 8-8: Averages of XRD Results for Tailings from New Bermingham LCT, Flame & Moth, Bellekeno, and Mixture of New Bermingham and Flame & Moth

Mineral	Unit	Bermingham LCT1	Bermingham LCT2	Flame & Moth F4 + F5 Composite	Bellekeno Tailings	Bermingham and Flame & Moth Mixed Tailings
Ankerite – Dolomite	wt. %	1.4	1.0	-	0.4	0.4
Calcite, Magnesian		-	-	1.2	3.2	1.5
Cassiterite		-	-	0.5	-	-
Clinochlore		-	-	1.3	0.4	1.2
Dravite		-	-	3.2	-	2.3
Galena		0.8	0.3	-	0.6	-
Gypsum		-	-	-	-	0.9
Illite-Muscovite 2M1		9.6	8.2	2.5	6.6	6.7
Kaolinite		1.0	0.9	-	-	-
Pyrite		1.6	2.2	0.7	2.3	5.5
Quartz		63.2	59.3	45.2	52.6	65.6

Mineral	Unit	Bermingham LCT1	Bermingham LCT2	Flame & Moth F4 + F5 Composite	Bellekeno Tailings	Bermingham and Flame & Moth Mixed Tailings
Rutile		0.6		-	0.3	0.4
Siderite, calcian		21.2	27.8	45.3	29.8	14.6
Sphalerite		0.6	0.3	-	2.4	1.3
Plagioclase		-	-	-	0.8	-
Gahnite		-	-	-	0.2	-
Chalcopyrite		-	-	-	0.1	-
Wurtzite		-	-	-	0.2	-
K-Feldspar		-	-	-	0.3	-
Total		100	100	100	100	100

8.3.2.1.4 Elemental Chemistry

Table 8-9 presents the elemental analysis results of the New Bermingham LCT, Flame & Moth F4+F5 composite tailings, Onek F7+F8 tailings, and Lucky Queen F9+F10 tailings, as well as the averages of the results from Bellekeno tailings, New Bermingham tailings, New Bermingham and Flame & Moth mixed tailings, and New Bermingham and Bellekeno mixed tailings between 2011 and 2022.

The screening of the tailings metal content against the 10x their crustal abundance (CRC, 2005) indicates that antimony, arsenic, bismuth, cadmium, copper, iron, lead, manganese, molybdenum, 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 Bellekeno tailings generally had the higher or highest concentrations of lead and zinc, corroborating the presence of sphalerite, galena, chalcopyrite, and wurtzite suggested by XRD results. The Bellekeno tailings also had the higher concentrations of arsenic, antimony, and cadmium.

Lucky Queen tailings had the lowest arsenic content (17.5 ppm). The New Bermingham LCT, Onek, New Bermingham, and Flame and Moth tailings had arsenic content ranging from 369 to 816 ppm. Tailings from Bellekeno, mixture of New Bermingham and Bellekeno and New Bermingham, and mixture of New Bermingham and Flame and Moth had the highest arsenic content of over 1,800 ppm. The high concentration of arsenic is likely due to its known presence as trace element in sulphidic ore.

Antimony was found higher in tailings from Bellekeno, mixture of New Bermingham and Bellekeno and New Bermingham, and mixture of New Bermingham and Flame and Moth, ranging from 83.1 to 114.5 ppm. Onek and Lucky Queen had the lowest antimony content below 10 ppm. Cadmium was higher in tailings from Bellekeno, New Bermingham, mixture of New Bermingham and Bellekeno, and mixture of New Bermingham and Flame & Moth, ranging from 92 to 505 ppm. Onek and New Bermingham LCTs tailings had cadmium content ranging from 23 to 73 ppm. The lowest cadmium was found in Lucky Queen and Flame & Moth tailings, showing cadmium content lower than 8 ppm.

Zinc content was higher in tailings from Onek, Bellekeno, mixture of New Bermingham and Bellekeno, and mixture of Bermingham and Flame & Moth, ranging from 8,784 to 15,750 ppm. New Bermingham LCTs, New Bermingham, and Flame & Moth tailings had the second highest zinc contents, ranging from 1,265 to 5,382 ppm. The lowest zinc was found in Lucky Queen tailings, showing zinc content lower than 600 ppm. Lead content was higher in tailings from Bermingham LCTs, Bellekeno, New Bermingham, mixture of New Bermingham and Bellekeno, and mixture of New Bermingham and Flame & Moth, ranging from 2,200 to 7,460 ppm. Tailings from Onek, Lucky Queen, and Flame & Moth exhibited lower content in lead, ranging from 413 to 789 ppm.

Selenium contents were comparable in all tailings samples, ranging 0.1 to 0.9 ppm. Silver content was found comparable in tailings from New Bermingham LCTs, Bellekeno, New Bermingham, mixture of Bermingham and Bellekeno, and mixture of New Bermingham and Flame & Moth, ranging from 33.1 to 99.6 ppm. Tailings from Flame & Moth, Onek, and Lucky Queen had relatively low silver content, ranging from 6.4 to 12.4 ppm.

Table 8-9: Averages of Elemental Metal Results for Tailings from New Bermingham LCT, Flame & Moth, Bellekeno, Lucky Queen, Onek, New Bermingham, Mixture of New Bermingham and Bellekeno, and Mixture of New Bermingham and Flame & Moth

Element	Unit	Berm LCT1	Berm LCT2	Onek F7 + F8 average	Lucky Queen F9 + F10 average	Flame & Moth F4+F5 Composite	Bellekeno Tailings	Bermingham Tailings	Bellekeno and Bermingham Mixed Tailings	Bermingham and Flame & Moth Mixed Tailings	10x Crustal Abundance
Silver (Ag)	ppm	99.6	56.4	6.4	16.4	12.35	48.5	33.1	43.15	53.9	0.075
Aluminum (Al)	%	0.15	0.16	0.36	0.74	0.2	1,077	0.43	0.25	0.3	8.23
Arsenic (As)	ppm	369	401	375	17.5	699	2,126	816	1,809	3,263	1.8
Barium (Ba)	ppm	30	30	24	125	11.5	19.0	34.1	31	34.8	425
Bismuth (Bi)	ppm	0.06	0.04	<2	<2	6.59	1.80	1.9	5.0	10.4	0.0085
Calcium (Ca)	%	0.63	0.73	0.47	0.38	0.59	10,134	1.19	1.12	1.1	4.15
Cadmium (Cd)	ppm	46.1	23.4	72.8	3.95	7.19	158	92.1	505.5	151.7	0.15
Cobalt (Co)	ppm	4.3	4.3	2	3	2.7	9.7	6.0	7.4	5.8	25
Chromium (Cr)	ppm	133	115	174	265.5	185.5	11.4	163.3	71.5	71.8	102
Copper (Cu)	ppm	60.8	57.5	377	254	565	245	87.4	345.2	161.5	60
Iron (Fe)	%	6.35	7.07	18.6	6.4	16.3	67,270	7.6	9.33	8.2	5.63
Mercury (Hg)	ppm	0.19	0.13	-	-	0.055	0.18	38.46	0.90	0.35	0.085
Potassium (K)	%	0.07	0.08	0.08	0.275	0.03	233	0.11	0.07	0.06	2.09
Magnesium (Mg)	%	0.32	0.36	0.47	0.34	0.31	2,097	0.41	0.29	0.31	2.33
Manganese (Mn)	%	37,900	4.43	5.19	2.47	4.28	21,434	19,364	8,153	19,802	0.095
Molybdenum (Mo)	ppm	2.06	2.02	<1	2	3.74	1.16	1.31	1.31	1.4	1.2
Sodium (Na)	%	<0.01	<0.01	0.02	0.025	0.006	90.0	0.013	0.01	0.01	2.36
Nickel (Ni)	ppm	49.8	49.1	44	51	86.6	19.3	23	22.3	18.75	84
Lead (Pb)	ppm	7,460	2,330	413	555	789	6,236	2,189	4,350	2,540	14
Antimony (Sb)	ppm	99.8	44.6	<5	9	41	114.5	41.9	83.1	103.8	0.2
Selenium (Se)	ppm	0.9	0.8	-	-	0.1	0.5	0.7	0.9	0.58	0.05
Tin (Sn)	ppm	2.7	2	-	-	32.9	17.0	15.1	78.15	68.8	2.3
Strontium (Sr)	ppm	14.3	15	11	15	4.81	27.4	32.05	21.45	18.5	370
Titanium (Ti)	%	<0.005	<0.005	<0.01	0.02	0.001	15.5	<0.005	<0.005	<0.005	0.56
Thallium (Tl)	ppm	0.78	1.9	17.5	11	0.652	0.13	0.38	0.28	0.27	9.6
Uranium (U)	ppm	0.39	0.38	-	-	0.406	1.02	0.57	0.645	0.61	2.7
Vanadium (V)	ppm	6	5	5.5	12.5	9.4	5.3	12.3	7	7.17	120
Zinc (Zn)	ppm	3,510	2,080	8,784	557	1,265	12,043	5,382	15,750	7,029	70

*Note: **r**esults **that** exceed 10X crustal abundance values are highlighted in red.*

8.3.2.1.5 Shake Flask Extraction

SFE test results provide an indication of the soluble metal load that may be released in the short term due to the leaching of excavated material by meteoric water. The SFE test results were therefore used to screen for potential exceedances of water quality objectives, discharge standards or generic water quality guidelines. The SFE data were compared to the District Mill Site pond EQS at KV-83. This comparative assessment is not and should not be used as a measure of compliance with site water quality standards and objectives. It rather provides a guide for assessing for constituents of potential concern in drainage from the tailings.

Table 8-10 presents the data averaged from SFE results of tailings from New Bermingham LCT, Flame & Moth, Lucky Queen, Bellekeno, mixture of New Bermingham and Bellekeno, and mixture of New Bermingham and Flame & Moth, as well as the EQS at KV-83. With two exceptions, all tailings had a circumneutral pH (pH 7.0 – 8.1) within the EQS range and were consistent with the ABA paste pH values. Tailings from mixture of New Bermingham and Bellekeno and mixture of New Bermingham and Flame & Moth had mildly acidic pH of 6.8 and 6.3, respectively. The pH of the New Bermingham and Flame & Moth mixed tailings was lower than the EQS at KV-83. This likely reflects the overall higher acid potential (AP) tested by ABA and higher content in sulphide minerals identified by XRD. The mildly acidic pH values of the mixed tailings are consistent with the ABA paste pH values.

New Bermingham LCT tailings had very low leachable sulphate content (19.1- 46.1 mg/L) and extremely low acidity (often less than the method detection limit of 0.5 mg/L $CaCO_3$). The leachable sulphate content in tailings from Flame & Moth, Lucky Queen, and New Bermingham was higher than New Bermingham LCTs, ranging from 162 to 312 mg/L. Tailings from Bellekeno, mixture of New Bermingham and Bellekeno, and mixture of New Bermingham and Flame & Moth showed higher leachable sulphate, ranging from 603 to 1,174 mg/L.

With the exceptions of cadmium and zinc, the screening of the SFE data against the Mill pond EQS indicates that none of the regulated elements exceeded the Mill pond EQS. Leachable cadmium concentration was higher than the EQS of 0.01 mg/L in tailings from Lucky Queen, mixture of New Bermingham and Bellekeno, and mixture of New Bermingham and Flame & Moth, ranging from 0.026 to 0.25 mg/L. Leachable zinc concentrations were higher than the EQS value of 0.5 mg/L in the New Bermingham and Bellekeno mixed tailings and the New Bermingham and Flame & Moth mixed tailings (9 mg/L and 1.3 mg/L, respectively). As discussed, bulk cadmium and zinc exceeded their respective 10X crustal abundance in the mixed tailings.

Table 8-10: Averages of SFE Results for Tailings from New Bermingham LCT, Flame & Moth, Bellekeno, Lucky Queen, New Bermingham, Mixture of New Bermingham and Bellekeno, and Mixture of New Bermingham and Flame & Moth

Leachable Metals	Unit	Berm LCT1	Berm LCT2	Flame & Moth F4+F5 Composite	Lucky Queen F9+F10	Bellekeno Tailings	Bermingham Tailings	Bellekeno and Bermingham Mixed Tailings	Bermingham and Flame & Moth Mixed Tailings	KHSD Mill Site EQS (KV-83)
pH	-	7.3	8.2	7.9	8.1	8.1	7	6.8	6.3	6.5-9.5
EC	uS/cm	154.5	97.1	547	393	-	-	-	-	-
SO_4	mg/L	46.1	19.1	245	162	603	312	1173.5	874.9	-
Acidity to pH 4.5	mg/L	<0.5	<0.5	-	-	-	-	-	-	-
Acidity to pH 8.3	mg/L	2.1	<0.5	-	-	12.4	31.2	28.1	15.2	-
Total Alkalinity	mg/L	11	14	39.9	26.7	41.0	N/D	32.9	22.2	-
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	0.19	0.057	0.8	0.09	0.6	0.1	-
Hardness $CaCO_3$	mg/L	55.6	35	-	181	627.0	322	845.5	695.5	-
Aluminum (Al)-Leachable	mg/L	0.0061	0.021	0.011	<0.0005	0.024	0.011	0.012	0.004	-
Antimony (Sb)-Leachable	mg/L	0.0042	0.0111	0.0217	0.014	0.039	0.0156	0.014	0.019	
Arsenic (As)-Leachable	mg/L	0.00022	0.00033	0.006	<0.001	0.007	0.0006	0.0032	0.0119	0.1
Barium (Ba)-Leachable	mg/L	0.0354	0.0134	0.0253	0.041	0.03	0.0189	0.05	0.03	-
Beryllium (Be)-Leachable	mg/L	<0.00001	<0.00001	<0.0005	<0.0005	<0.0001	<0.0001	<0.0001	<0.00001	-
Bismuth (Bi)-Leachable	mg/L	<0.000005	<0.000005	<0.0005	<0.0005	<0.0001	<0.0001	<0.0001	<0.00001	-
Boron (B)-Leachable	mg/L	<0.05	<0.05	0.071	0.0195	0.09	0.07	0.09	0.1	-
Cadmium (Cd)-Leachable	mg/L	0.0027	0.00031	0.0024	0.026	0.005	0.0025	0.25	0.028	0.01
Calcium (Ca)-Leachable	mg/L	18.7	12.4	105	67.3	146.8	109	320.5	267.0	-
Chromium (Cr)-Leachable	mg/L	<0.0001	<0.0001	<0.0005	<0.0005	0.0	<0.0005	0.0005	0.0002	-
Cobalt (Co)-Leachable	mg/L	0.00093	0.0001	0.0004	0.0036	0.0003	0.0007	0.0083	0.0032	-
Copper (Cu)-Leachable	mg/L	0.00012	0.00033	0.027	0.04	0.0079	0.0007	0.0053	0.0007	0.1
Iron (Fe)-Leachable	mg/L	0.0022	<0.001	<0.030	<0.03	<0.01	<0.01	<0.01	0.0022	-
Lead (Pb)-Leachable	mg/L	0.0607	0.0188	0.0144	0.065	0.0791	0.0094	0.138	0.0427	0.2
Lithium (Li)-Leachable	mg/L	0.00339	0.00294	0.0071	<.0.005	0.0328	0.0222	0.0306	0.0129	-
Magnesium (Mg)-Leachable	mg/L	2.15	0.988	6.9	3.1	6.1	12.2	11.0	6.7	-
Manganese (Mn)-Leachable	mg/L	2.28	0.445	1.95	0.95	0.8	1.84	7.6	3.6	-
Mercury (Hg)-Leachable	mg/L	<0.00005	<0.00005	0.0001	<0.00005	<0.00005	<0.05	0.00004	<0.00002	-

Leachable Metals	Unit	Berm LCT1	Berm LCT2	Flame & Moth F4+F5 Composite	Lucky Queen F9+F10	Bellekeno Tailings	Bermingham Tailings	Bellekeno and Bermingham Mixed Tailings	Bermingham and Flame & Moth Mixed Tailings	KHSD Mill Site EQS (KV-83)
Molybdenum (Mo)-Leachable	mg/L	0.000225	0.00093	0.0024	0.002	0.01	0.0043	0.0026	0.0026	-
Nickel (Ni)-Leachable	mg/L	0.0021	0.00037	0.0012	0.0016	0.001	0.003	0.0126	0.0066	0.5
Phosphorus (P)-Leachable	mg/L	0.05	0.041	<0.3	<0.3	0.2	0.2	0.2	0.1	-
Potassium (K)-Leachable	mg/L	1.89	1.7	2.04	2.9	11.5	5.78	21.8	7.2	-
Selenium (Se)-Leachable	mg/L	0.00006	0.00004	0.0009	0.0067	0.001	<0.0005	0.0	0.0	-
Silicon (Si)-Leachable	mg/L	0.42	0.45	1.55	1.51	3.3	0.76	1.3	0.7	-
Silver (Ag)-Leachable	mg/L	<0.000005	0.00003	0.0009	0.003	0.0024	0.00002	0.0018	0.0001	0.02
Sodium (Na)-Leachable	mg/L	0.854	0.596	2.36	5.4	23.1	5.44	9.0	9.7	-
Strontium (Sr)-Leachable	mg/L	0.0261	0.0172	0.38	0.17	0.5	0.249	0.6	0.5	-
Thallium (Tl)-Leachable	mg/L	0.000335	0.000177	0.0001	0.0001	0.0002	0.00036	0.0007	0.0006	-
Tin (Sn)-Leachable	mg/L	<0.0002	<0.0002	<0.0005	<0.0005	0.0005	<0.0005	0.0001	<0.00005	-
Titanium (Ti)-Leachable	mg/L	<0.0005	<0.0005	0.01	<0.01	0.0093	<0.0005	<0.005	<0.0002	-
Uranium (U)-Leachable	mg/L	<0.000002	<0.000002	0.00005	0.00001	0.0013	0.00018	0.0002	0.0001	-
Vanadium (V)-Leachable	mg/L	<0.0002	<0.0002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Zinc (Zn)-Leachable	mg/L	0.142	0.017	0.156	0.057	0.1	0.079	9.0	1.3	0.5

Notes: results that exceed KHSD Mill Site EQS (KV-83) are highlighted in red.

8.3.2.2 KINETIC TESTING

One tailings humidity cell (HC) was operated for each of the following deposit: Flame & Moth, Bellekeno, and New Bermingham LCT. Flame & Moth, Bellekeno, and New Bermingham LCT tailings cells were terminated after 113, 208, and 103 weeks of testing, respectively. To compare the geochemical properties of the tailings from the KHSD Mining Operations sites, the same period from the beginning to the 103rd week (cycle) of New Bermingham LCT, Flame & Moth, and Bellekeno kinetic data are discussed herein.

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 8-18 , Figure 8-19, and Figure 8-20, and discussed to assess the long-term ARD/ML potential. The Mill Pond EQS are also plotted for comparative purposes only rather than an assessment of compliance with site water quality standards.

The pH, acidity, alkalinity, and sulphate released from the leachate of the New Bermingham LCT during the tests are plotted in Figure 8-18 . All the tailings HCs had neutral pH within the EQS range (6.5 - 9.5), 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 $CaCO_3$. On the other hand, the alkalinity of each cell was sufficient to buffer the acidity released, showing a maximum of 39.6 mg/L $CaCO_3$ and a median of 20.8 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 LCT humidity cell were lower than those observed in the Flame & Moth and Bellekeno tailings HCs (Figure 8-18), 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 LCT leachate and decreased from 1,150 to 158 mg/L in the Bellekeno HC. The sulphate concentrations were markedly lower in the New Bermingham LCT HC than those observed in the Bellekeno HC. Then, sulphate concentrations from both New Bermingham LCT 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 LCT 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 LCT and Bellekeno HCs continued to slowly decrease (Figure 8-18).

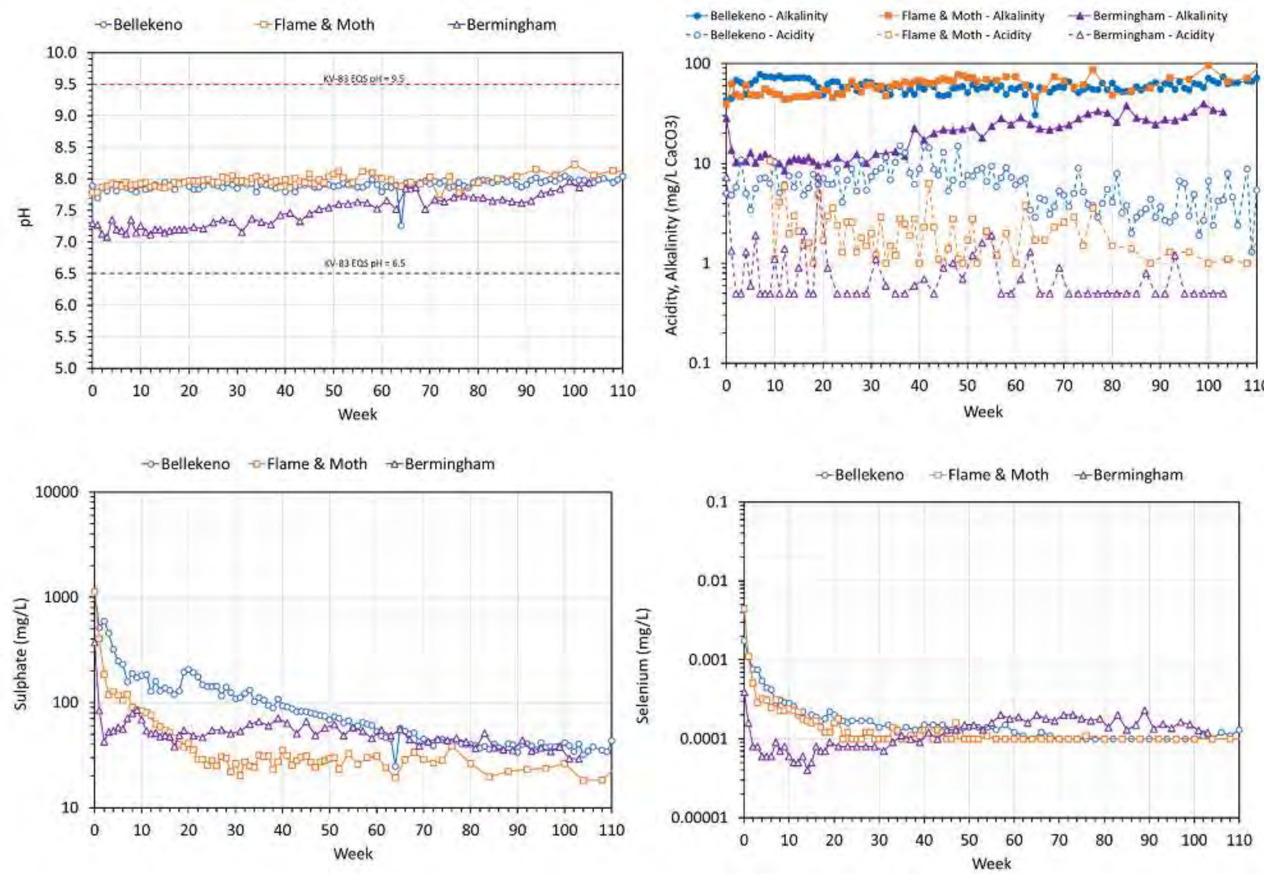

Figure 8-18: pH (top left), Acidity and Alkalinity (top right), Sulphate (bottom left), and Selenium (bottom right) of the New Bermingham LCT, Flame & Moth, and Bellekeno Tailings Humidity Cells

Figure 8-19 presents the time series of arsenic, antimony, cadmium, and copper, and Figure 8-20 displays the time series of lead, nickel, silver, and zinc. Only cadmium and zinc of the Bellekeno HC were regularly above their respective EQSs. 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 LCT 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 LCT 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 LCT 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 LCT 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 LCT 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 LCT HC were markedly lower by up to two orders of magnitudes than those of the Bellekeno HC. Except for 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. These trends likely reflect the higher contents of zinc and cadmium in the Bellekeno tailings bulk elemental composition (Table 8-9).

Lead concentrations in the New Bermingham LCT 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 LCT 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 LCT 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 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 LCT 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 LCT 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 LCT 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 LCT 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; Table 8-9).

Selenium concentrations in the leachate of the New Bermingham LCT humidity cell exhibited a pattern different from all the parameters of interest (Figure 8-18). 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 LCT HC leachate after the first 20 cycles, varying from 0.00008 to 0.0002 mg/L.

The tailings kinetic test results indicate that the trace element release rates for New Bermingham LCT were lower than the effluent quality standards (EQS) at KV-83, the KHSD Mill Site. It is worth noting that trace element concentrations released from the Bellekeno and Flame and Moth tailings HC were also lower than the EQS at KV-83 with the exception of zinc and cadmium in Bellekeno (Figure 8-19 and Figure 8-20). 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 New Bermingham LCT 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 New Bermingham LCT, Bellekeno, and Flame & Moth tailings, consistent with the sequential NAG and SFE results.

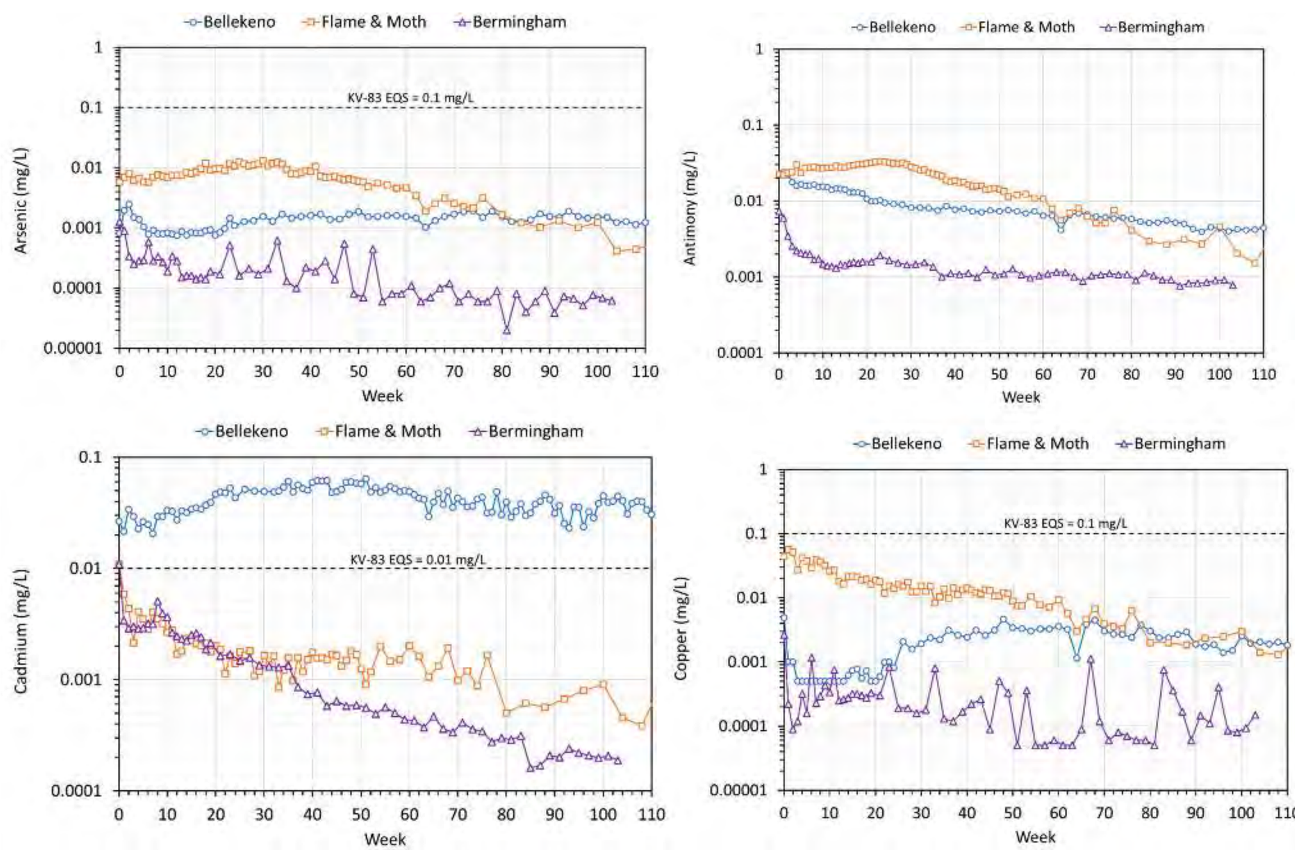

Figure 8-19: Arsenic (top left), Cadmium (bottom left), Antimony (top right), and Copper (bottom right) Trends of the New Bermingham LCT, Flame & Moth, and Bellekeno Tailings Humidity Cells

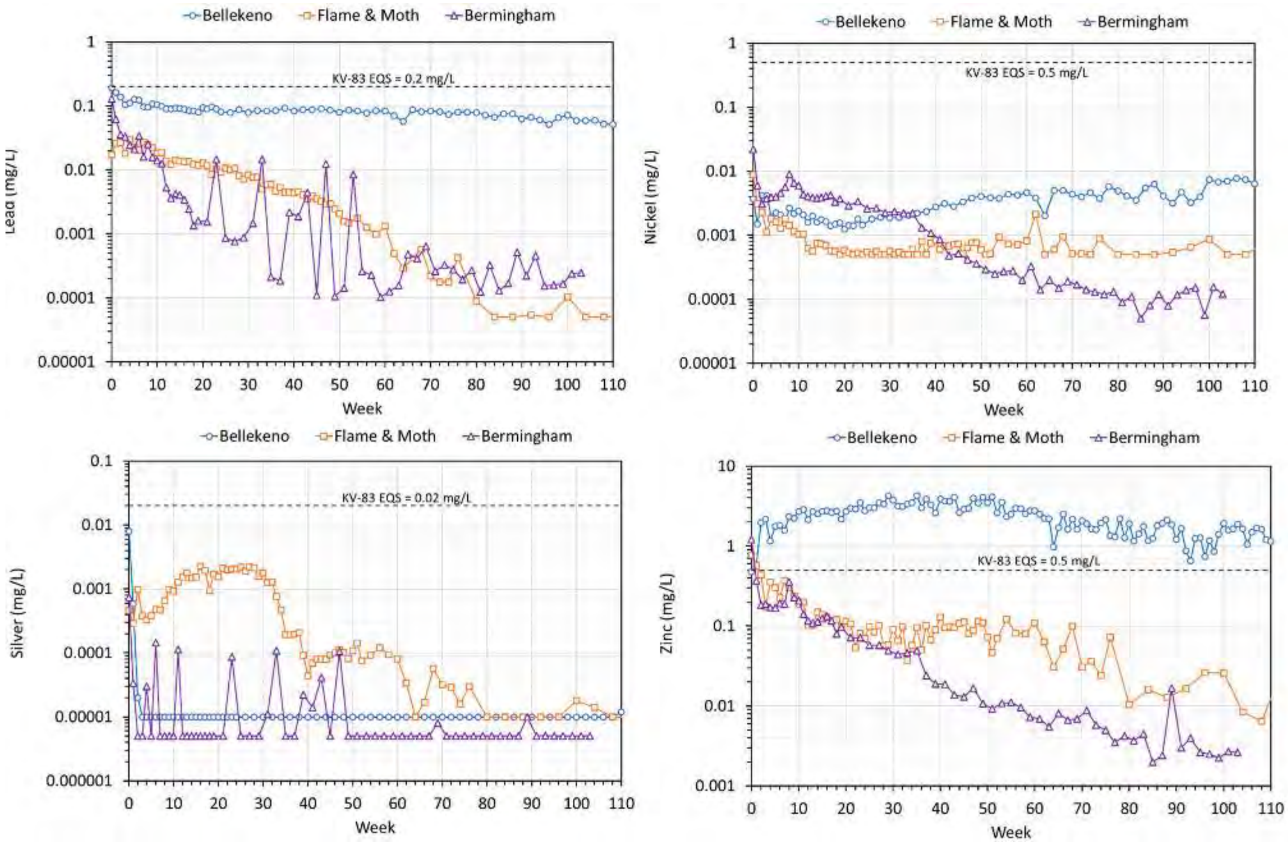

Figure 8-20: Lead (top left), Silver (bottom left), Nickel (top right), and Zinc (bottom right) Trends of the New Bermingham LCT, Flame & Moth, and Bellekeno Tailings Humidity Cells

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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		

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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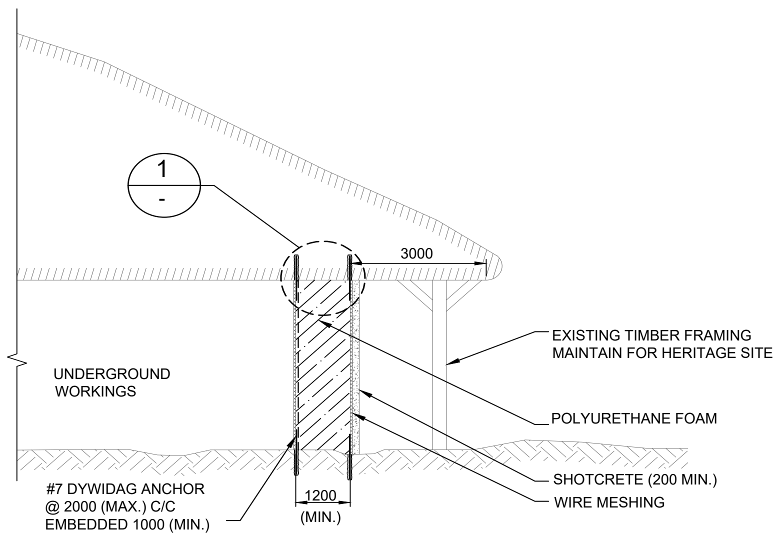

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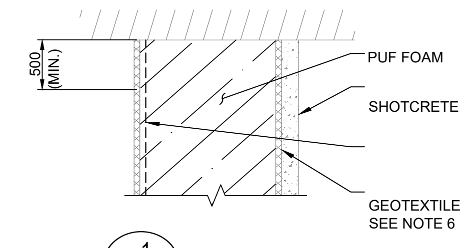

1 / - DETAIL 1

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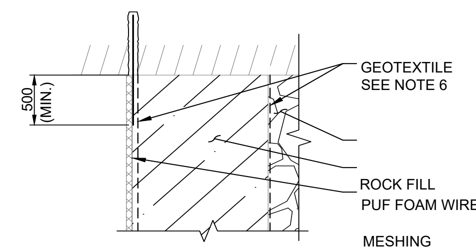
SEE NOTE 7 FOR CONSTRUCTION SEQUENCE



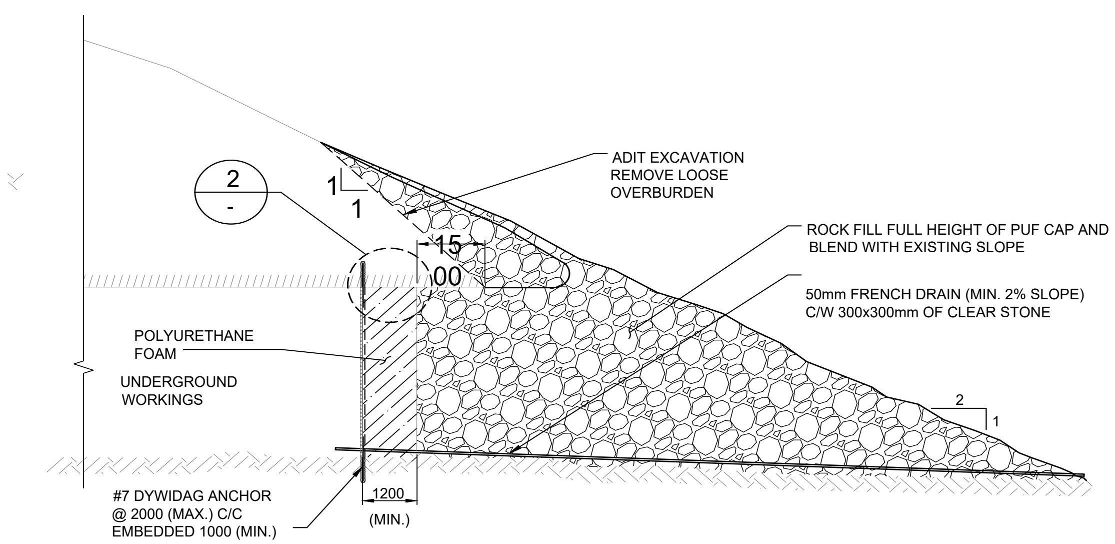
2 / - DETAIL 2

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.



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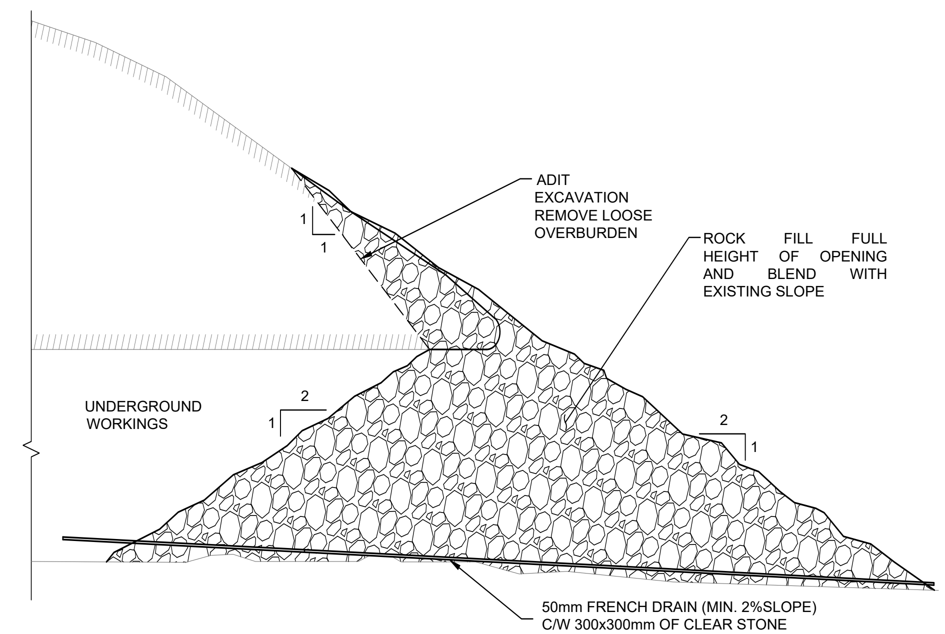


TYPICAL ADIT CLOSURE TYPE 3

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

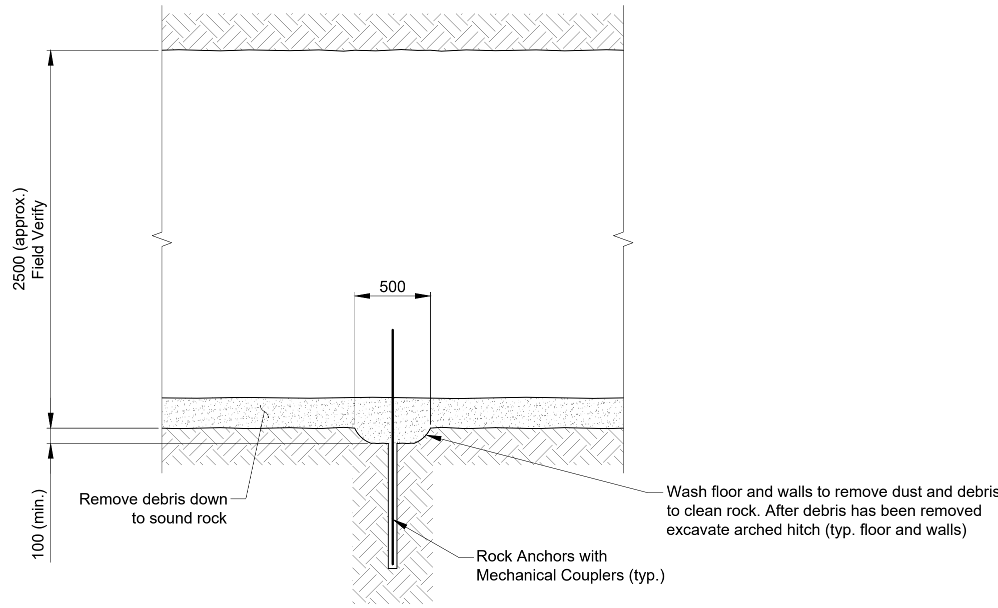
AKHM

TETRA TECH EBA

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No:
AKHM-13-01-S-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
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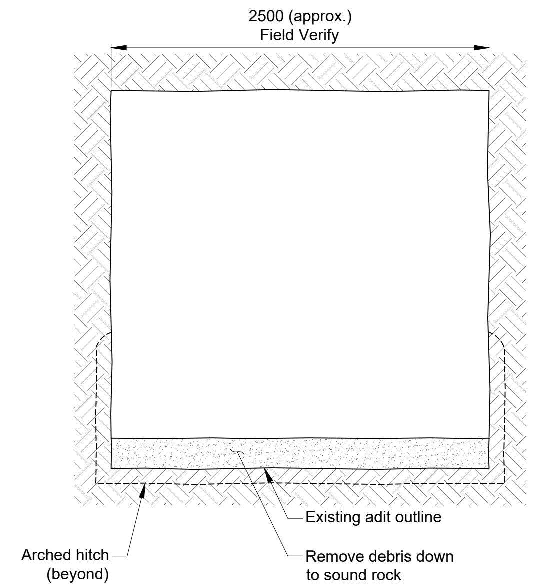

A ADIT CROSS SECTION
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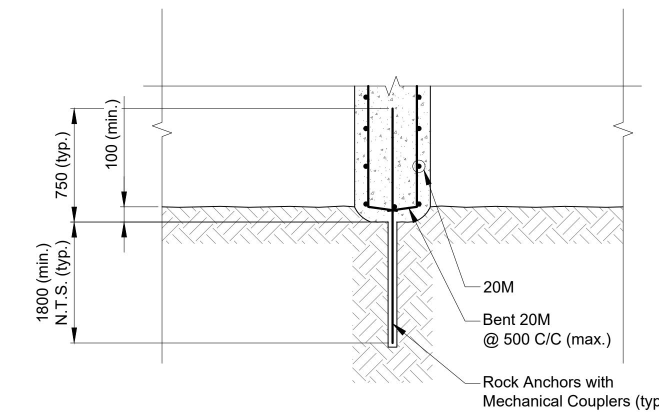
*Rock anchors not shown for clarity



3 ARCHED HITCH DETAIL (TYP. ALL SIDES)
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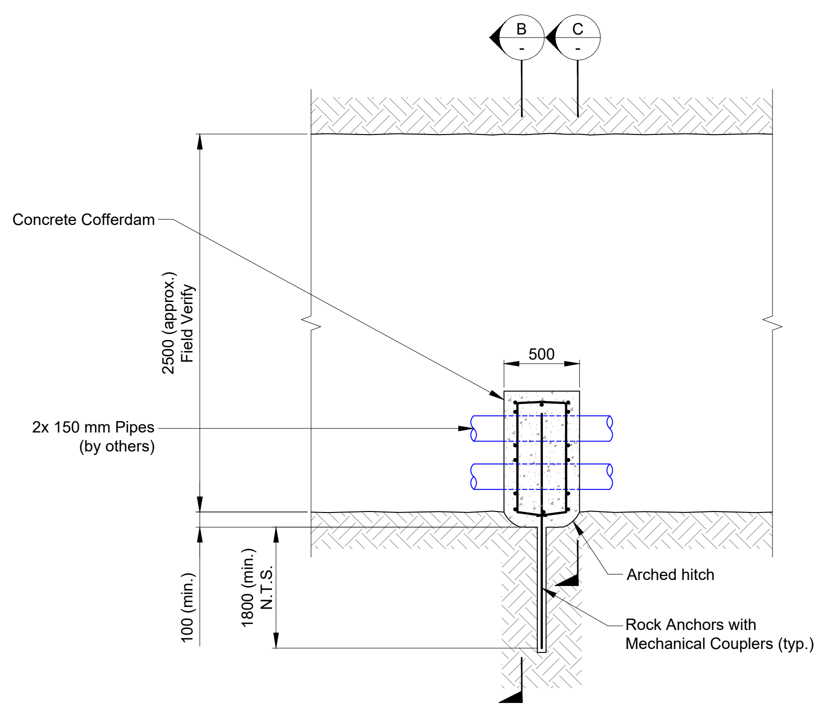

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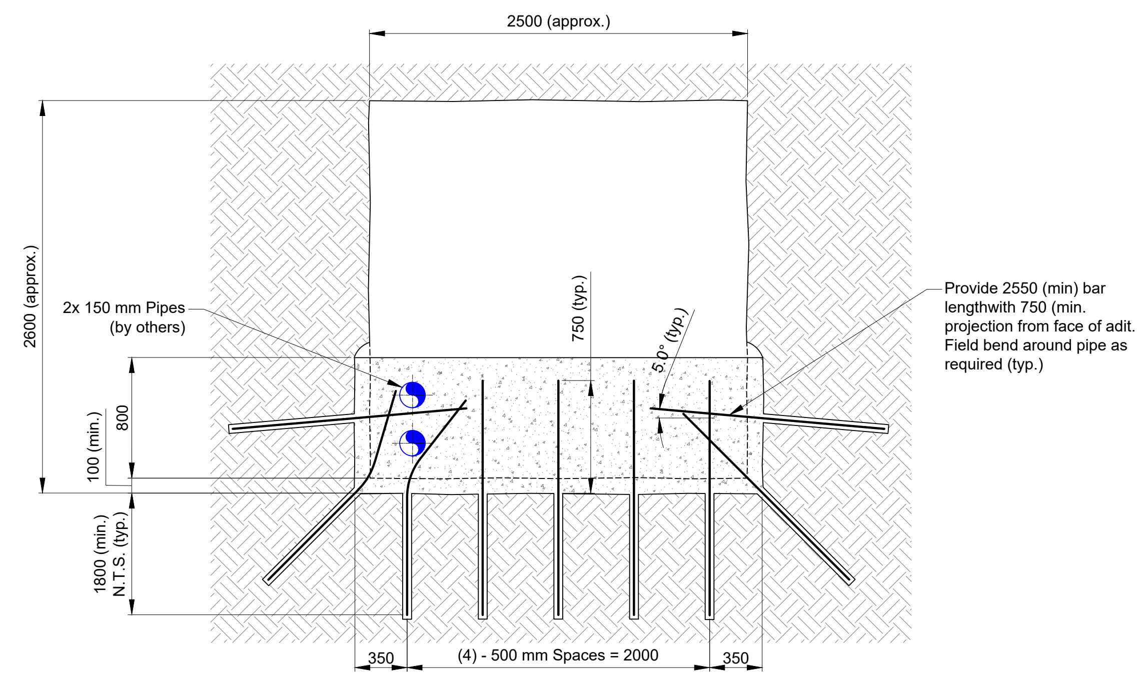

B COFFERDAM - TRANSVERSE SECTION
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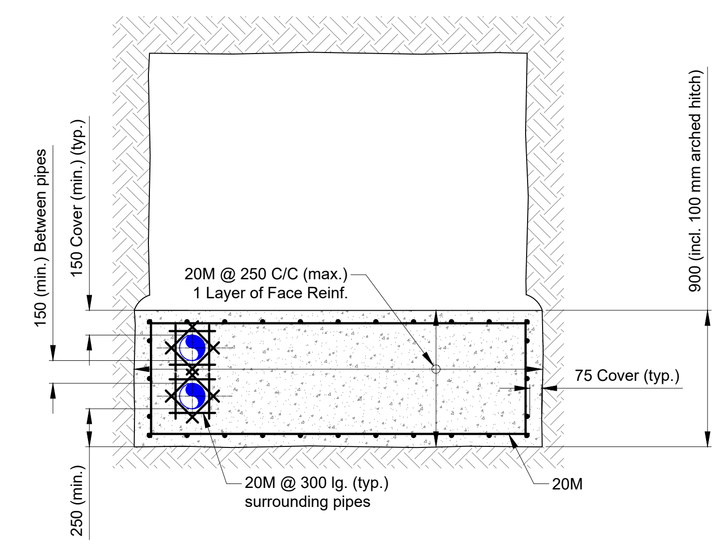

C COFFERDAM - TRANSVERSE SECTION
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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2021-11-18	Draft for review	A	KAB	--

DRAFT
NOT FOR
CONSTRUCTION

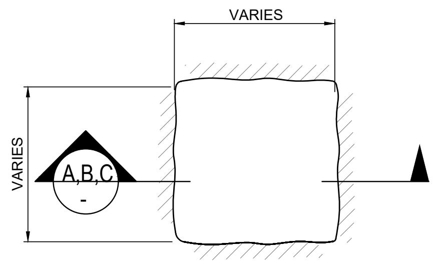
ENSERO solutions

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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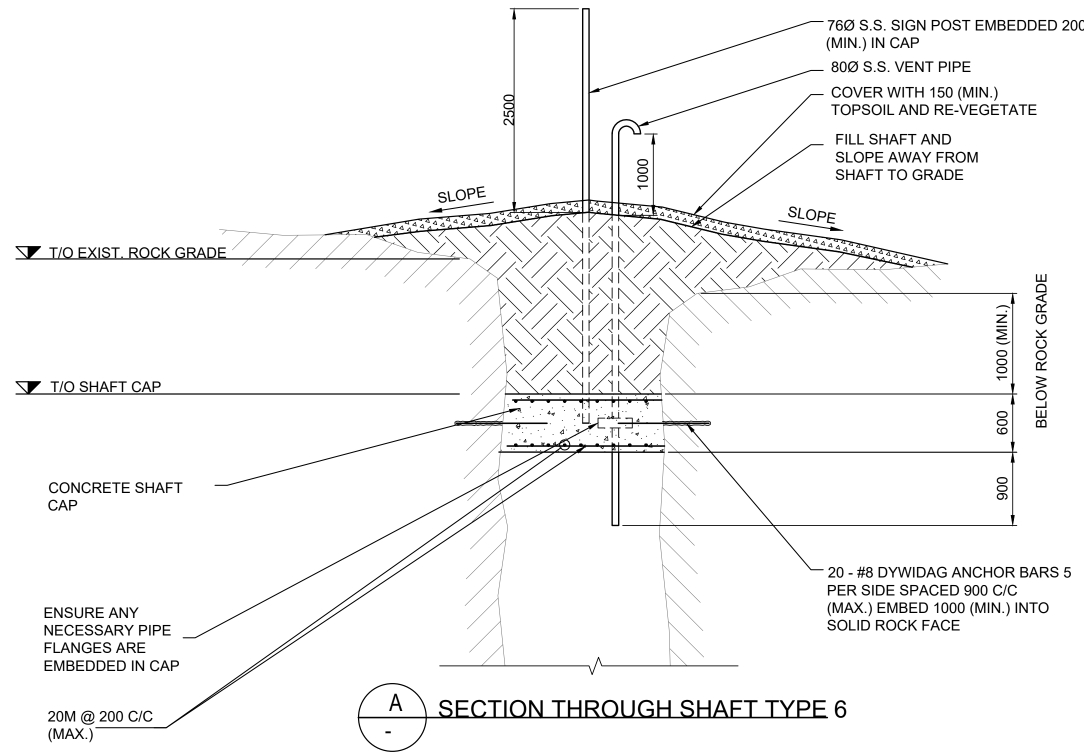

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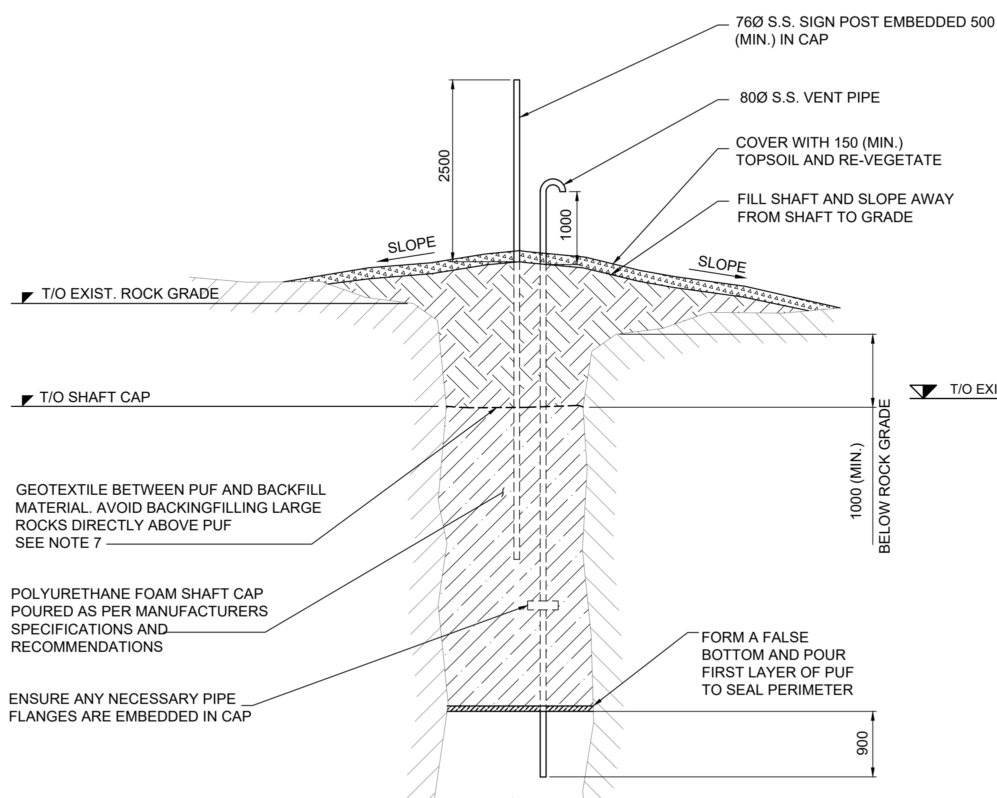

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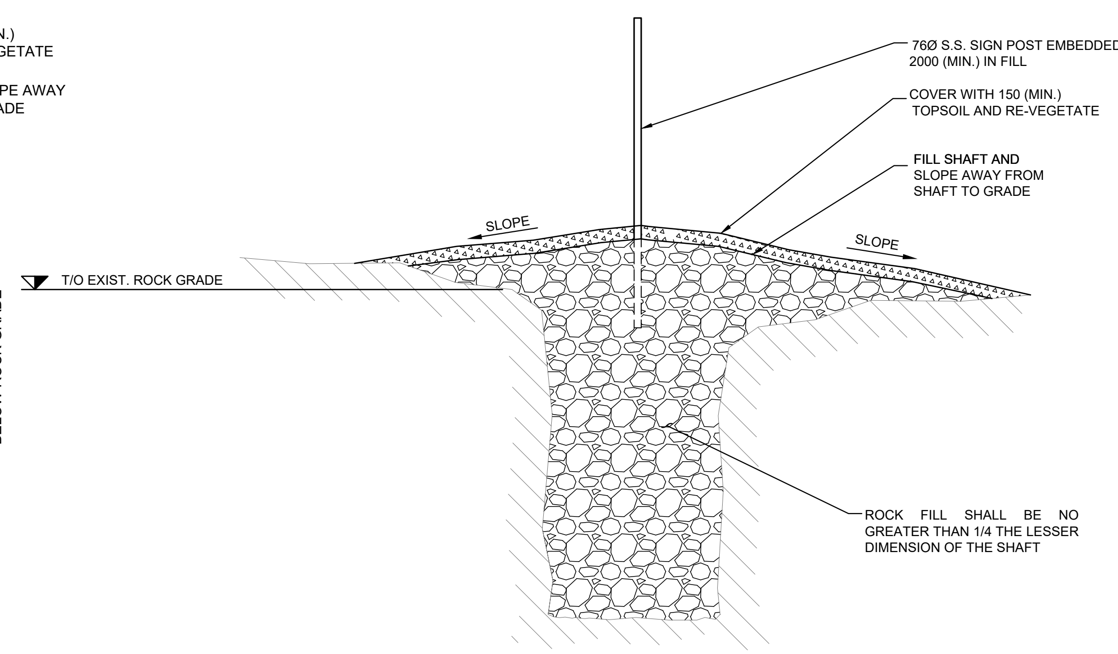


C / - SECTION THROUGH SHAFT TYPE 2 & 3

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.

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

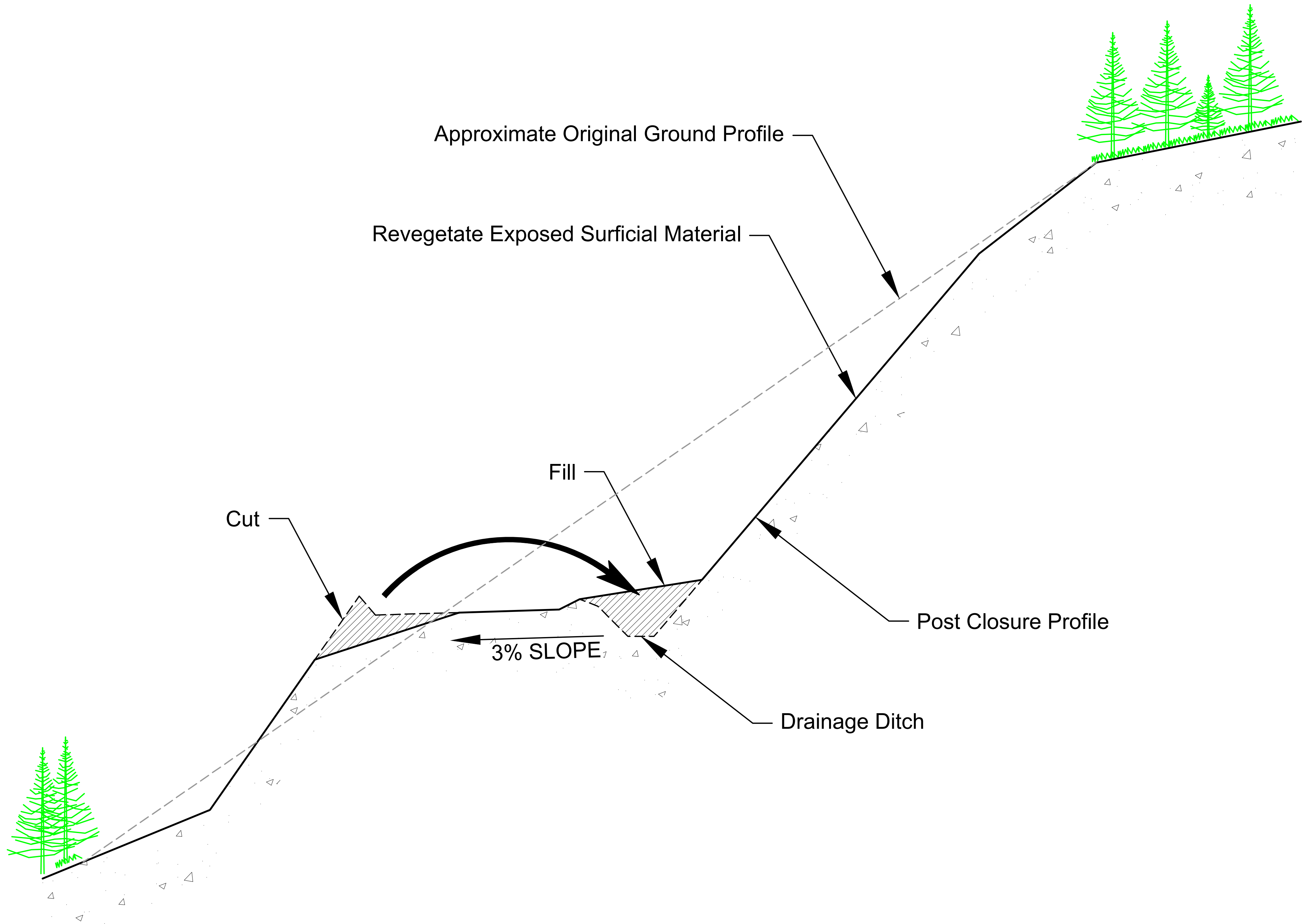
Keno District Mine Operations
Reclamation and Closure Plan
Drawing No:
AKHM-13-01-S-0303

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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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
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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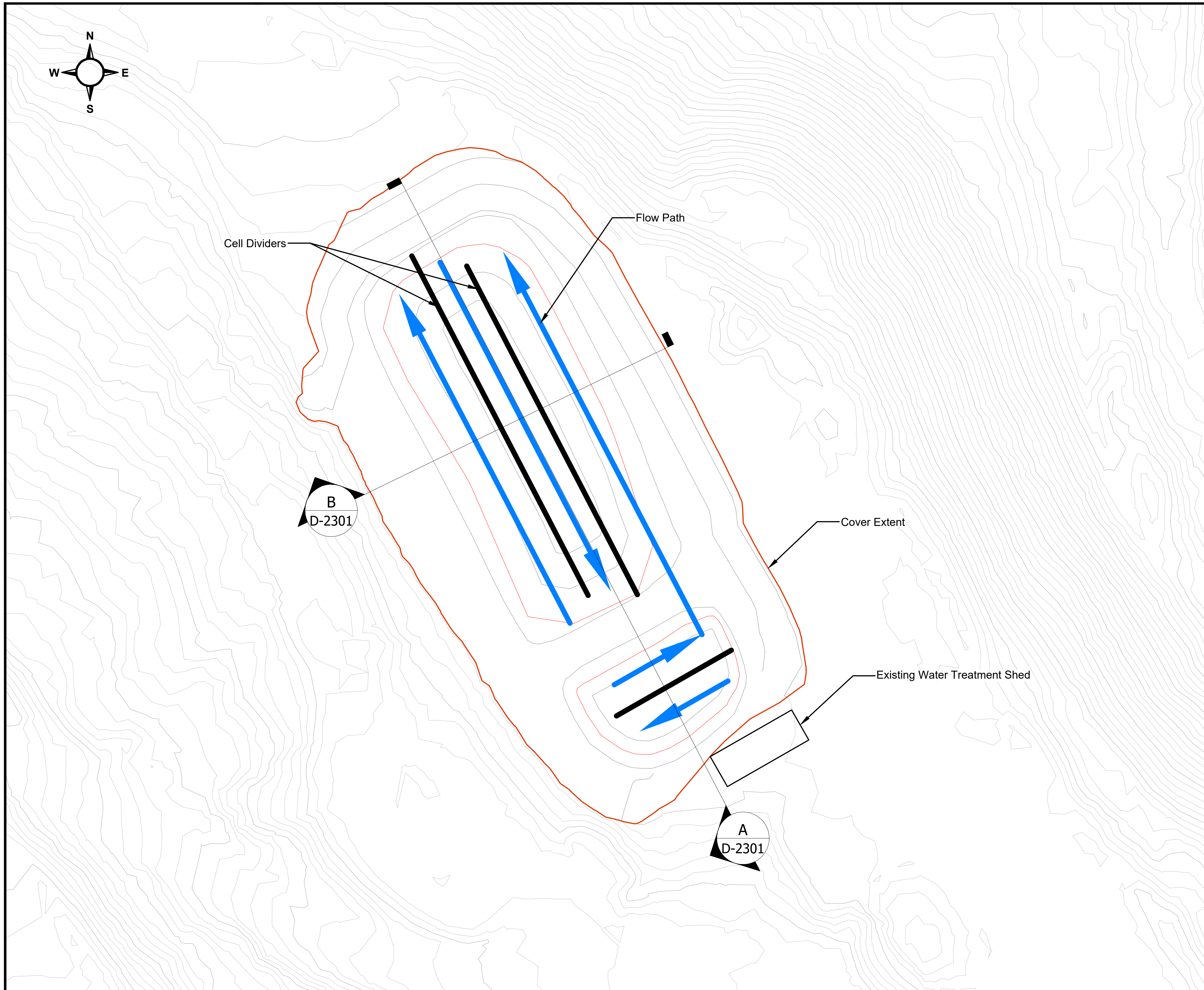

Notes:

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

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
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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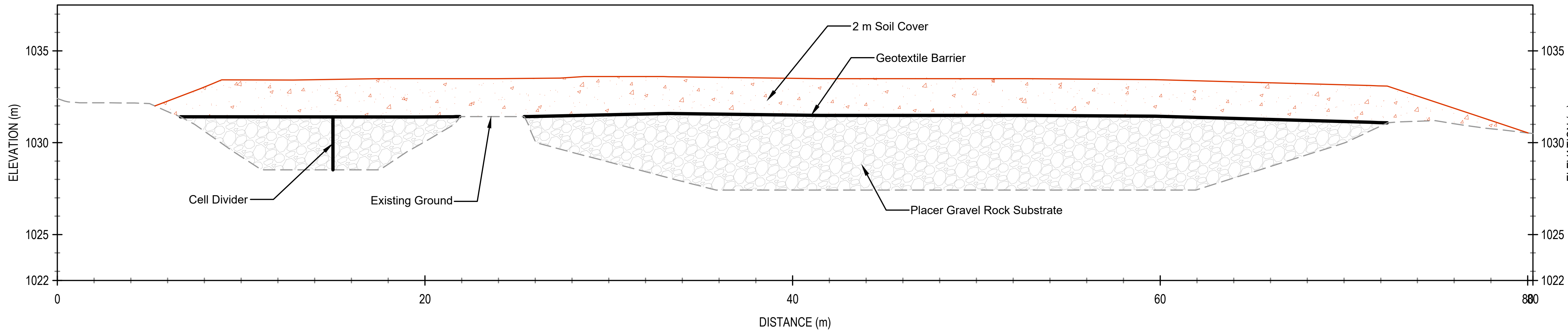
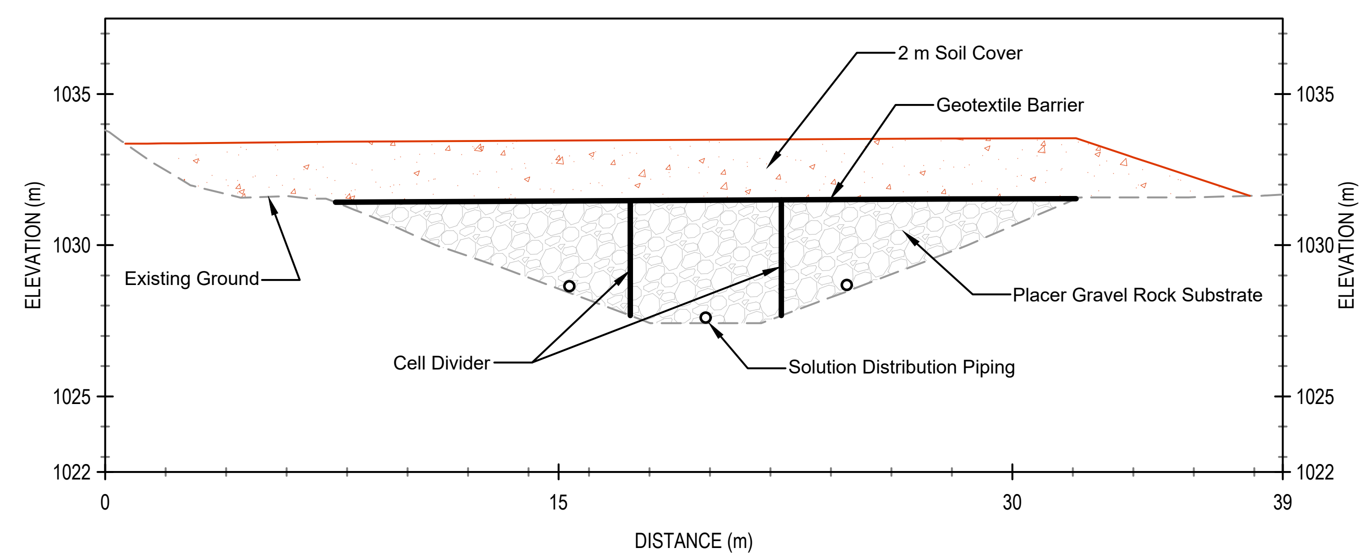


Section A



Section B

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
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-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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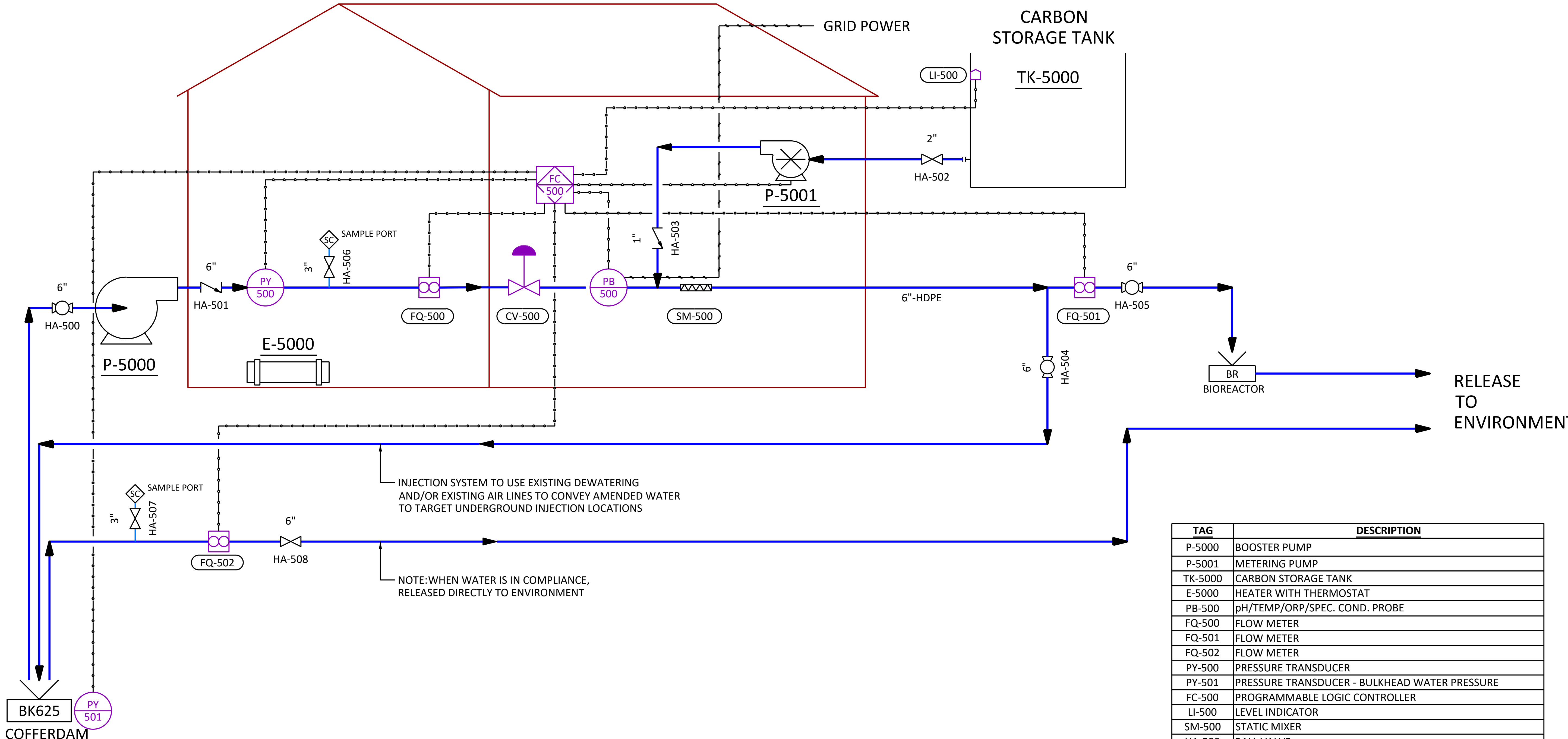

TAG	DESCRIPTION
P-5000	BOOSTER PUMP
P-5001	METERING PUMP
TK-5000	CARBON STORAGE TANK
E-5000	HEATER WITH THERMOSTAT
PB-500	pH/TEMP/ORP/SPEC. COND. PROBE
FQ-500	FLOW METER
FQ-501	FLOW METER
FQ-502	FLOW METER
PY-500	PRESSURE TRANSDUCER
PY-501	PRESSURE TRANSDUCER - BULKHEAD WATER PRESSURE
FC-500	PROGRAMMABLE 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

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.

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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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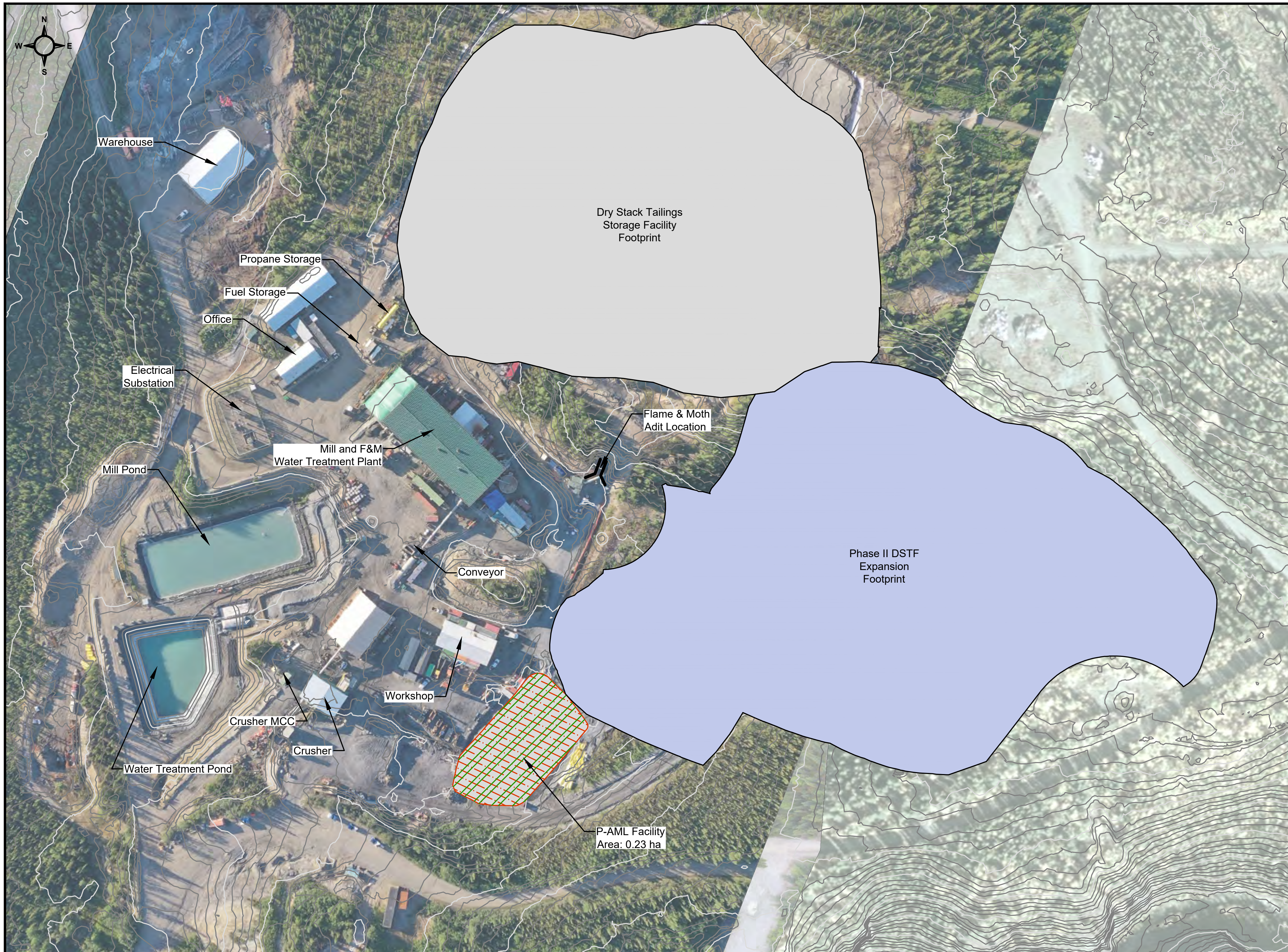

Notes:

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.

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

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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

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

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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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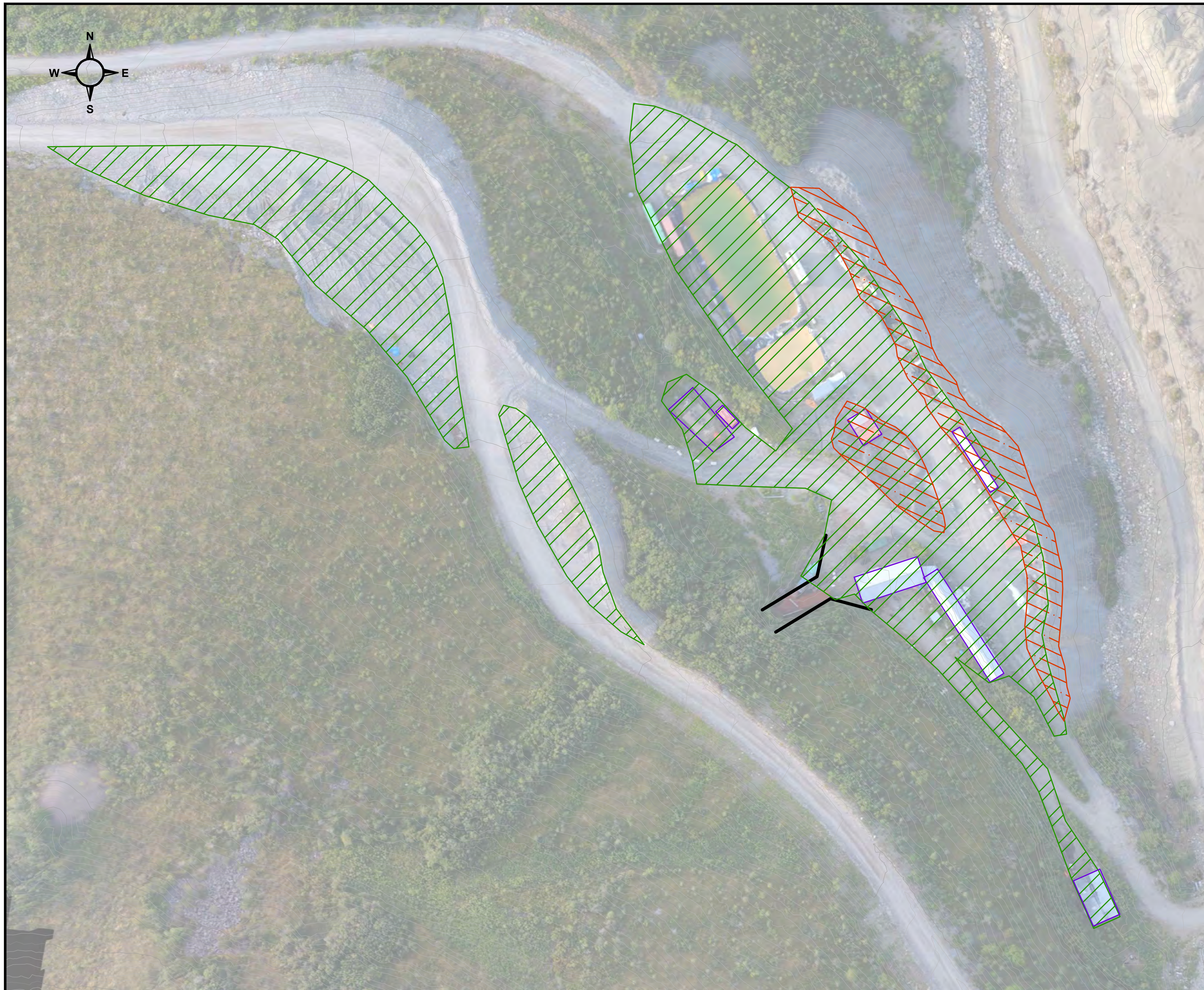

Notes:

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

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

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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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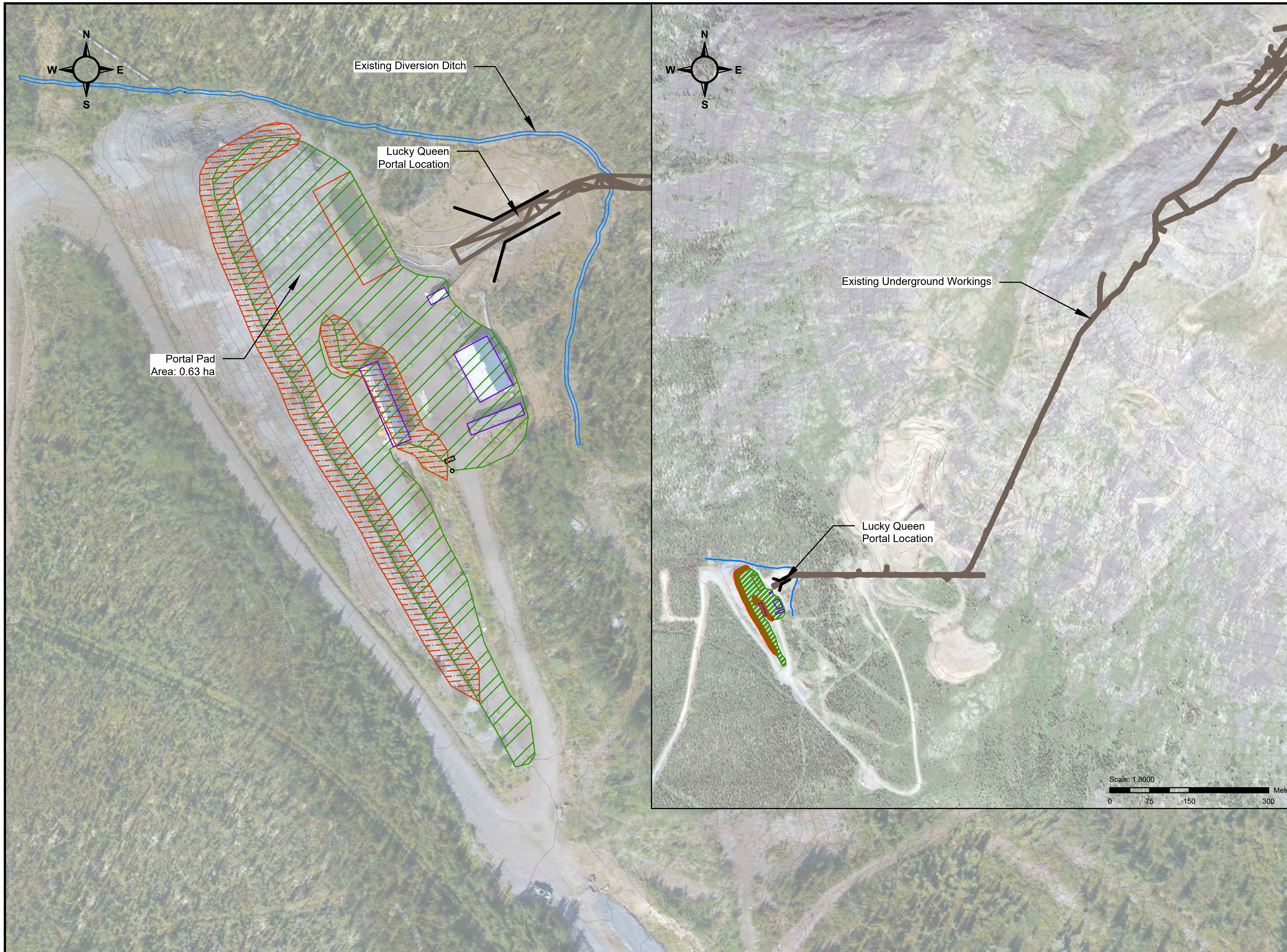

Notes:

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

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
0 10 20 40 Meters

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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

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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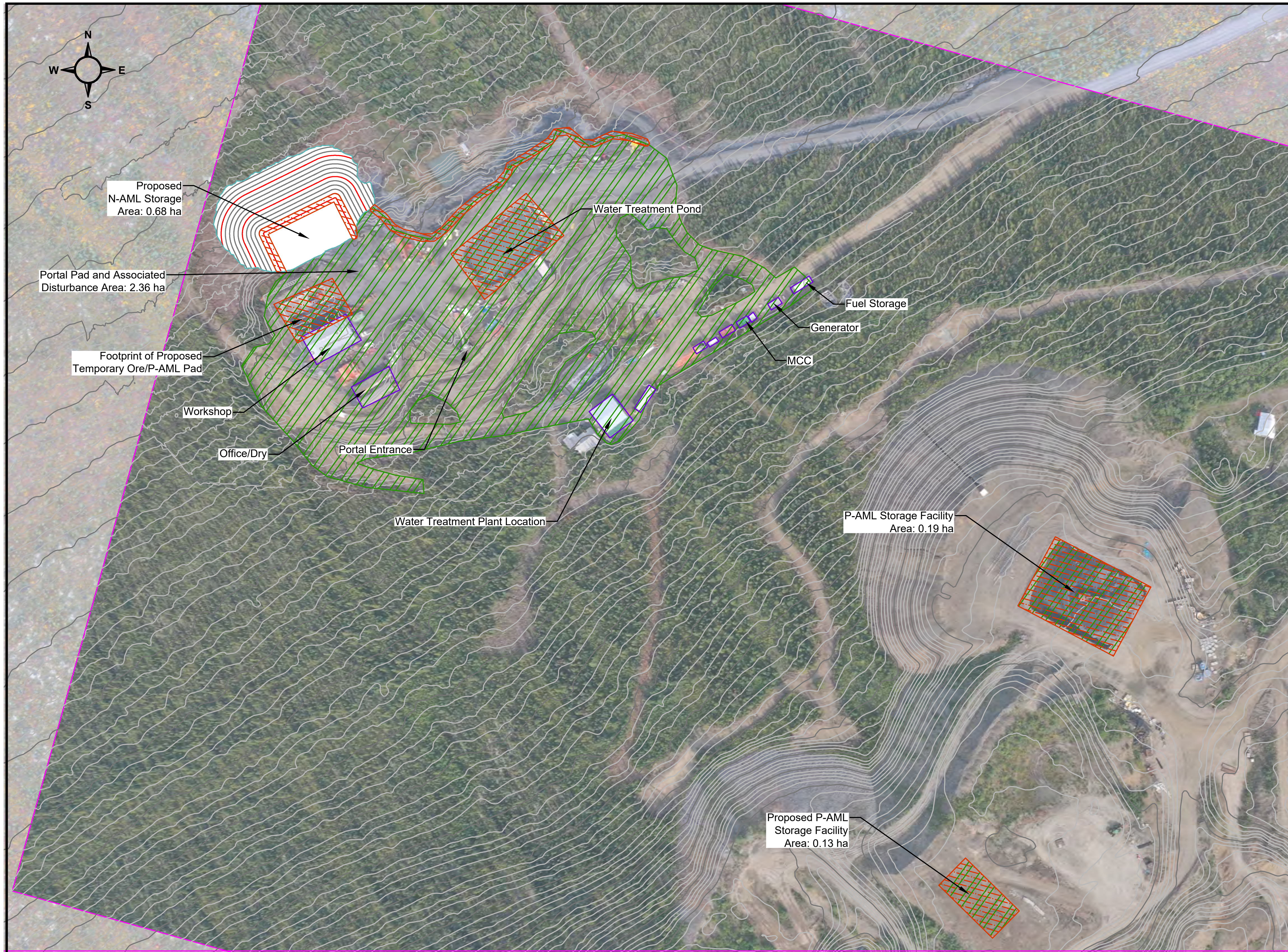

Notes:

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

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

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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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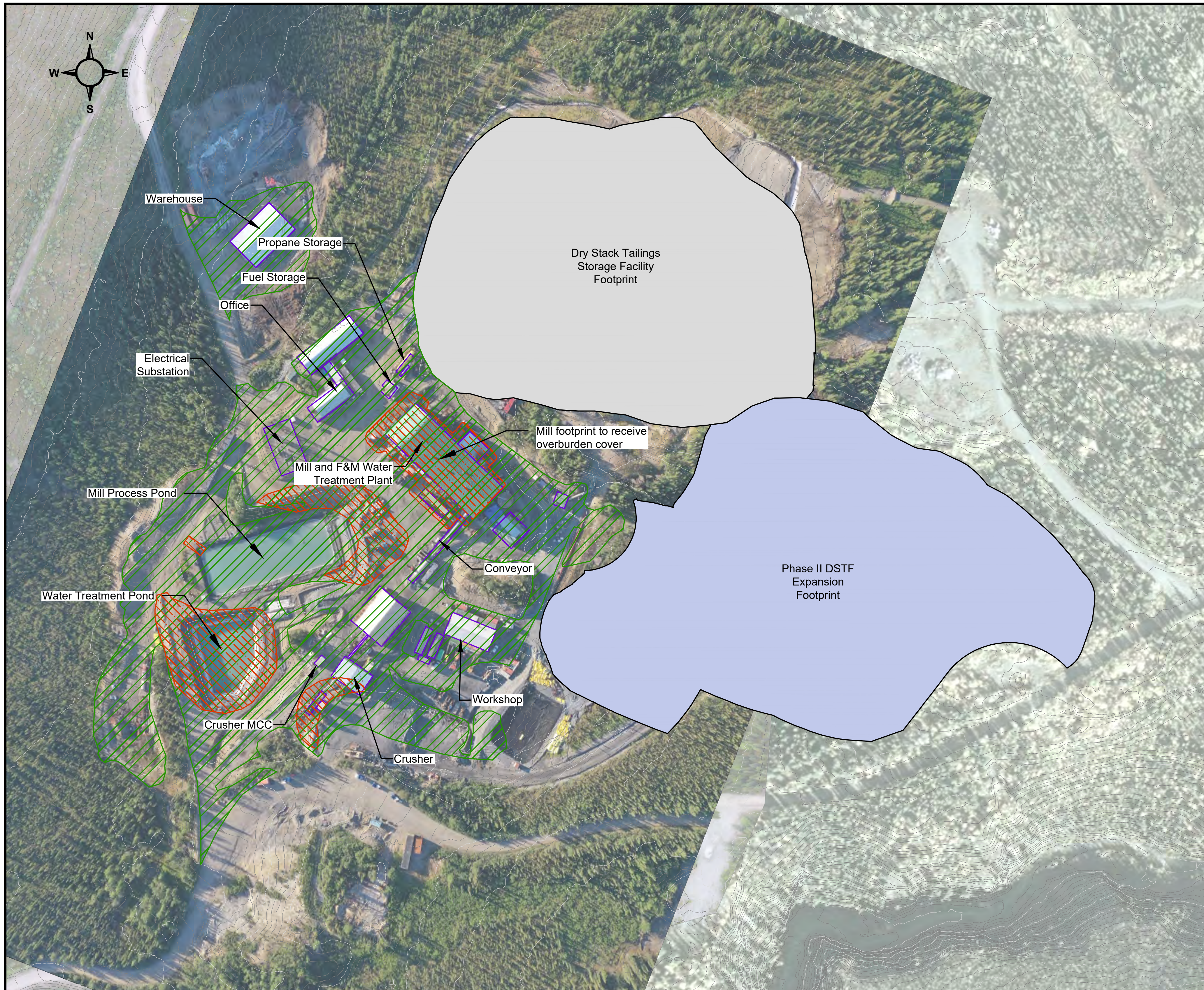


Notes:

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

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

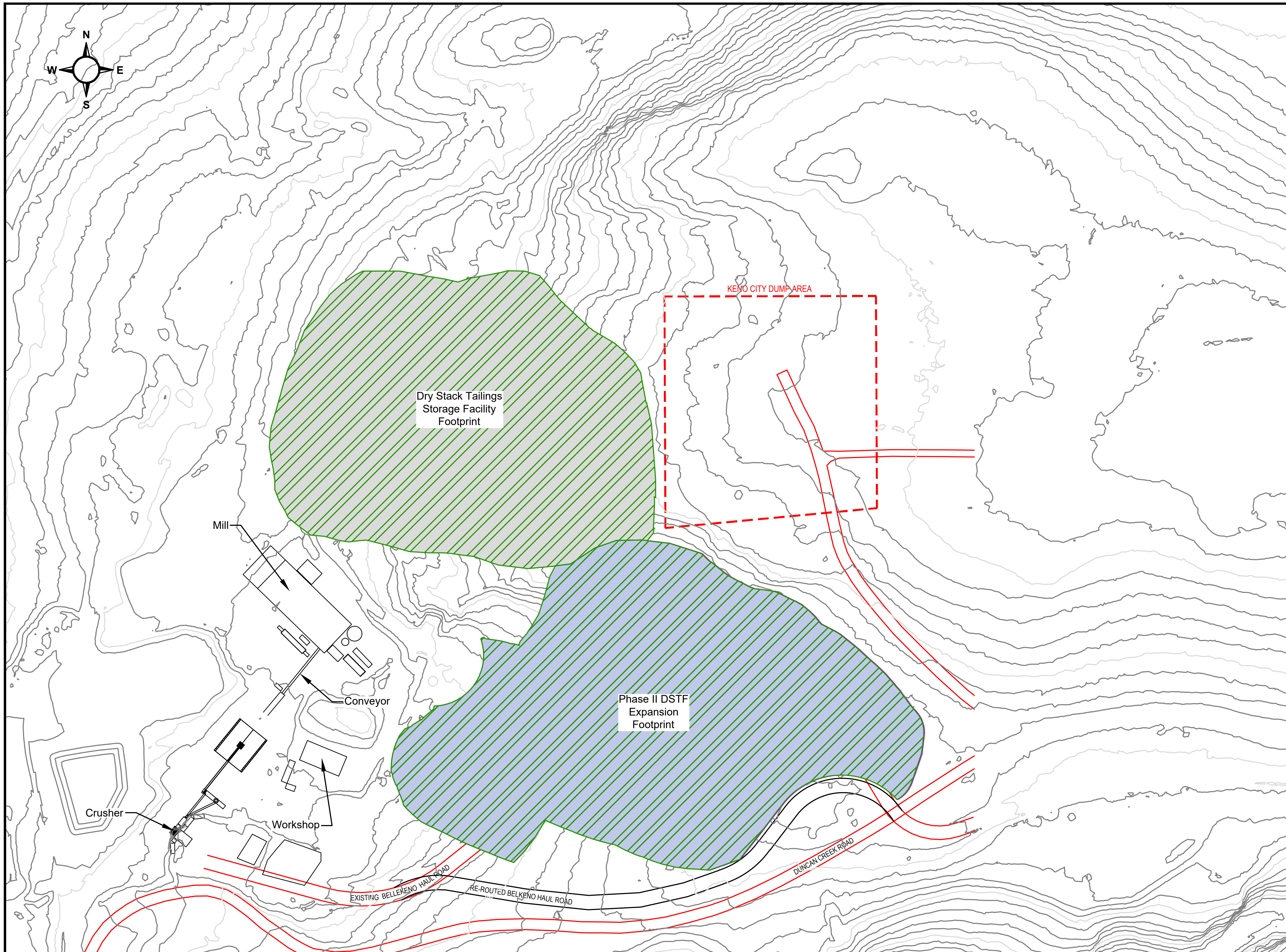
D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\6-Mill Site\C-Civil\AKHM-13-01-C-6401-MillSiteLayout.dwg (last edited by: KBoldt; 2021/11/26 - 1:28 PM

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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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

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\7-DSTF\C-Civil\AKHM-13-01-C-7401-DSTFLayout.dwg (last edited by: KBoldt; 2021/11/26 - 12:41 PM

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.

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

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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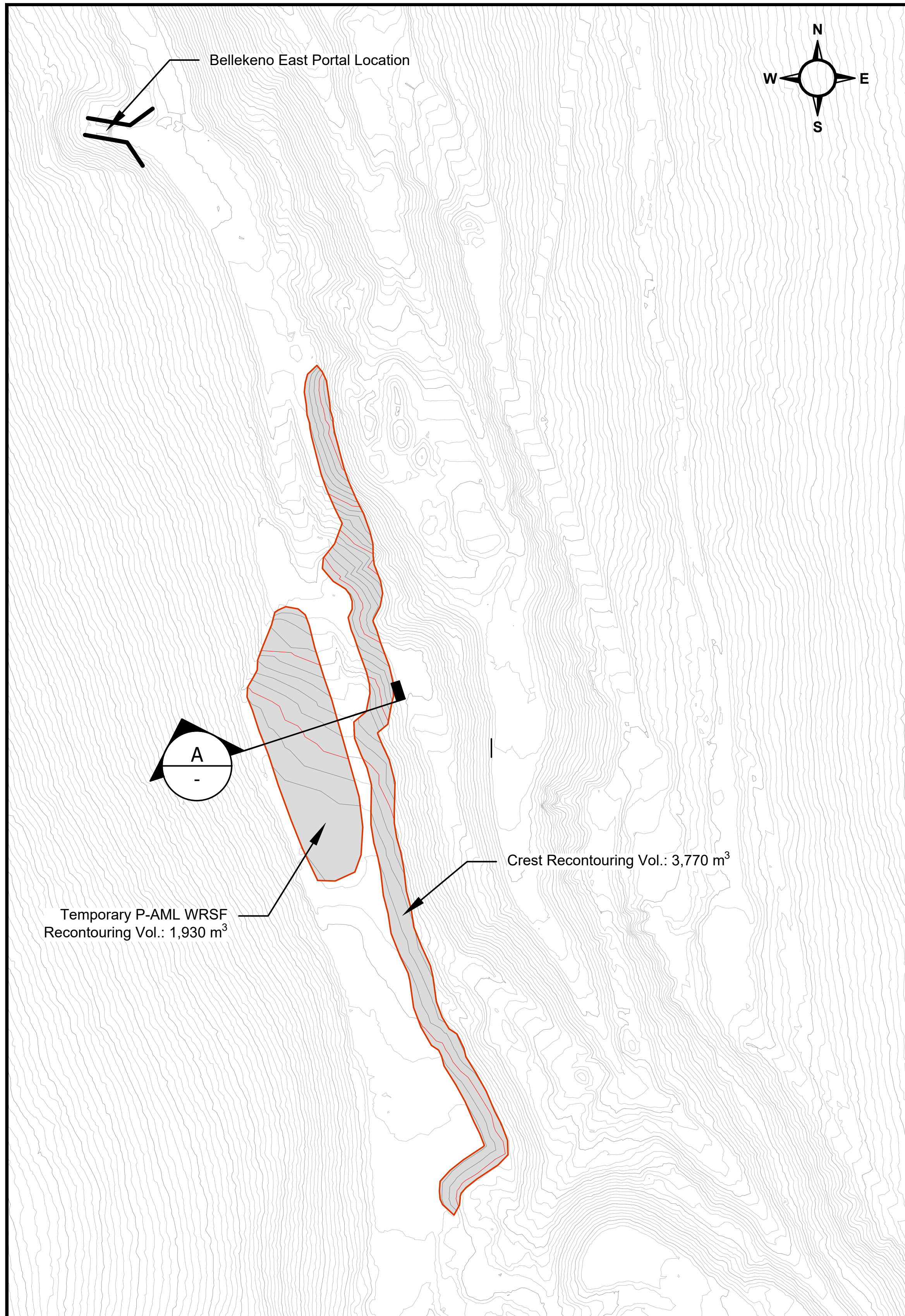
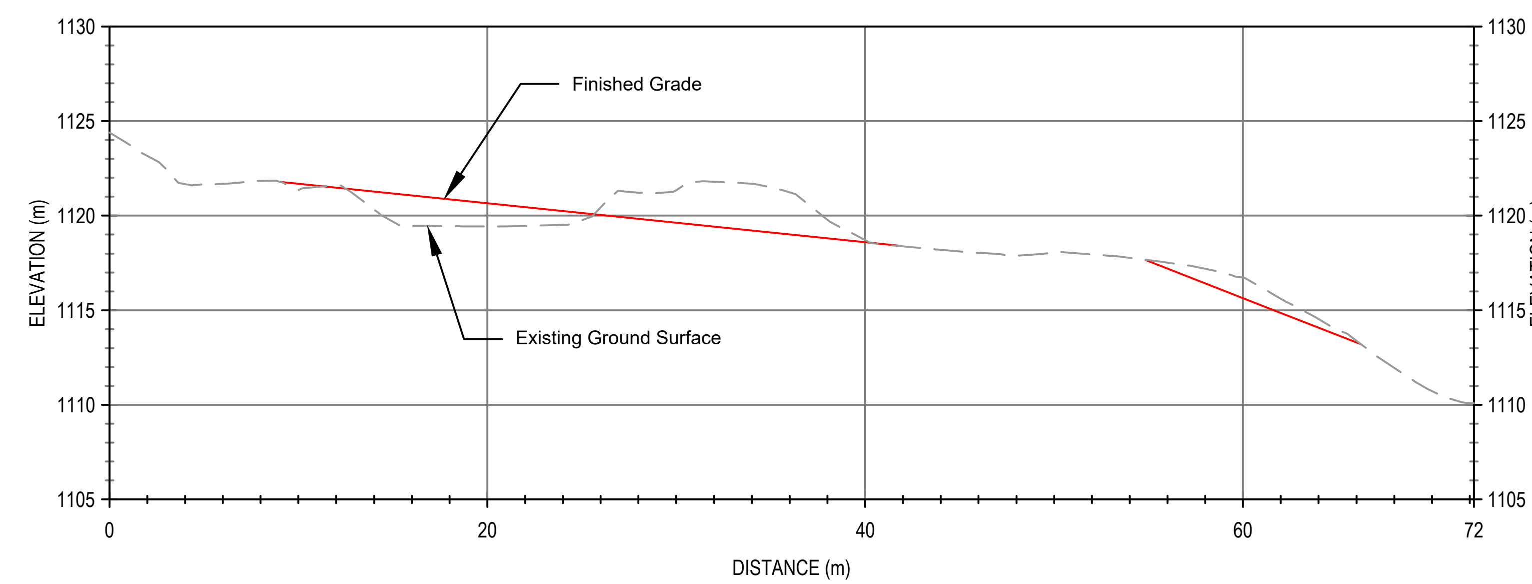


Notes:

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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2018-02-01	Draft for review	A	KAB	--

Scale: 1:2500

0 20 40 80 Meters

ENSERO solutions

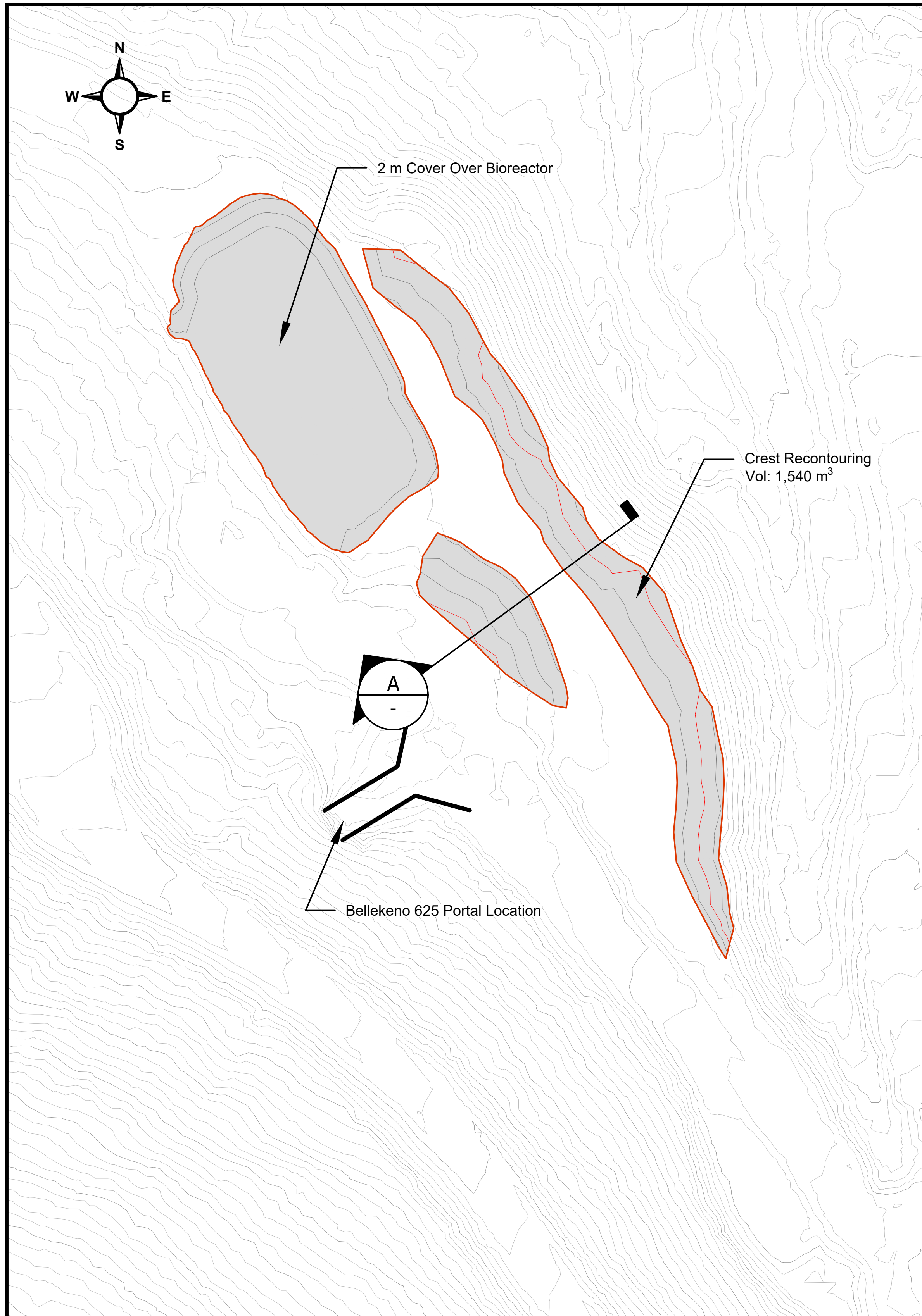
AKHM

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



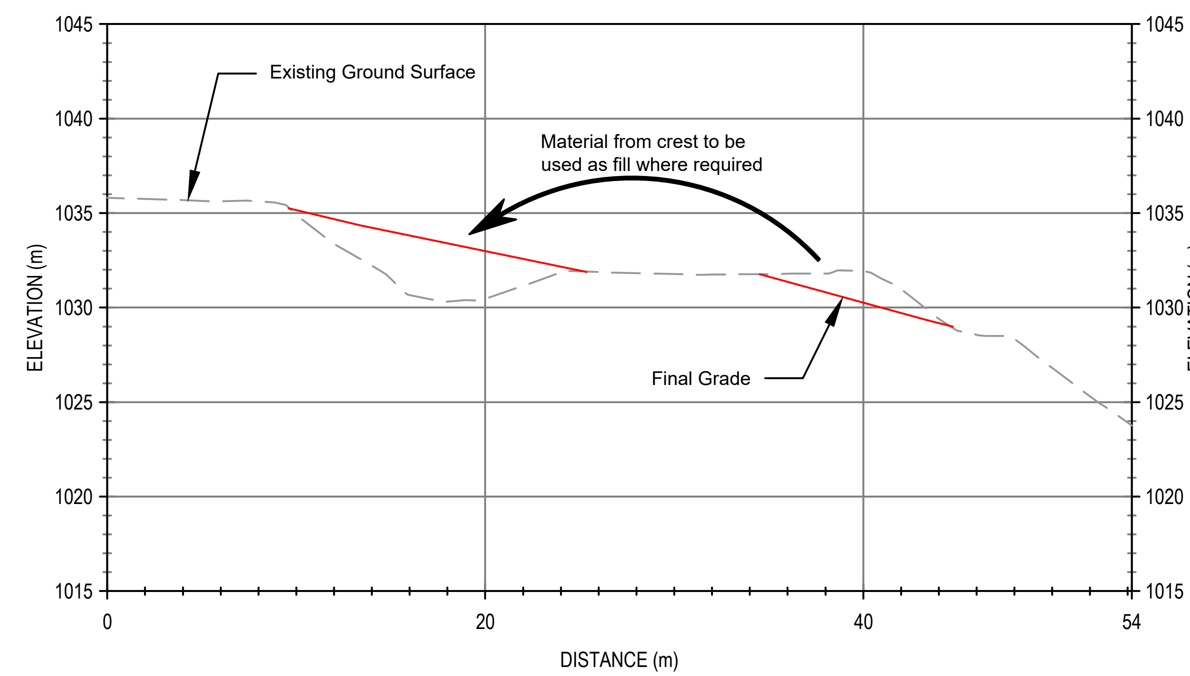
Notes:

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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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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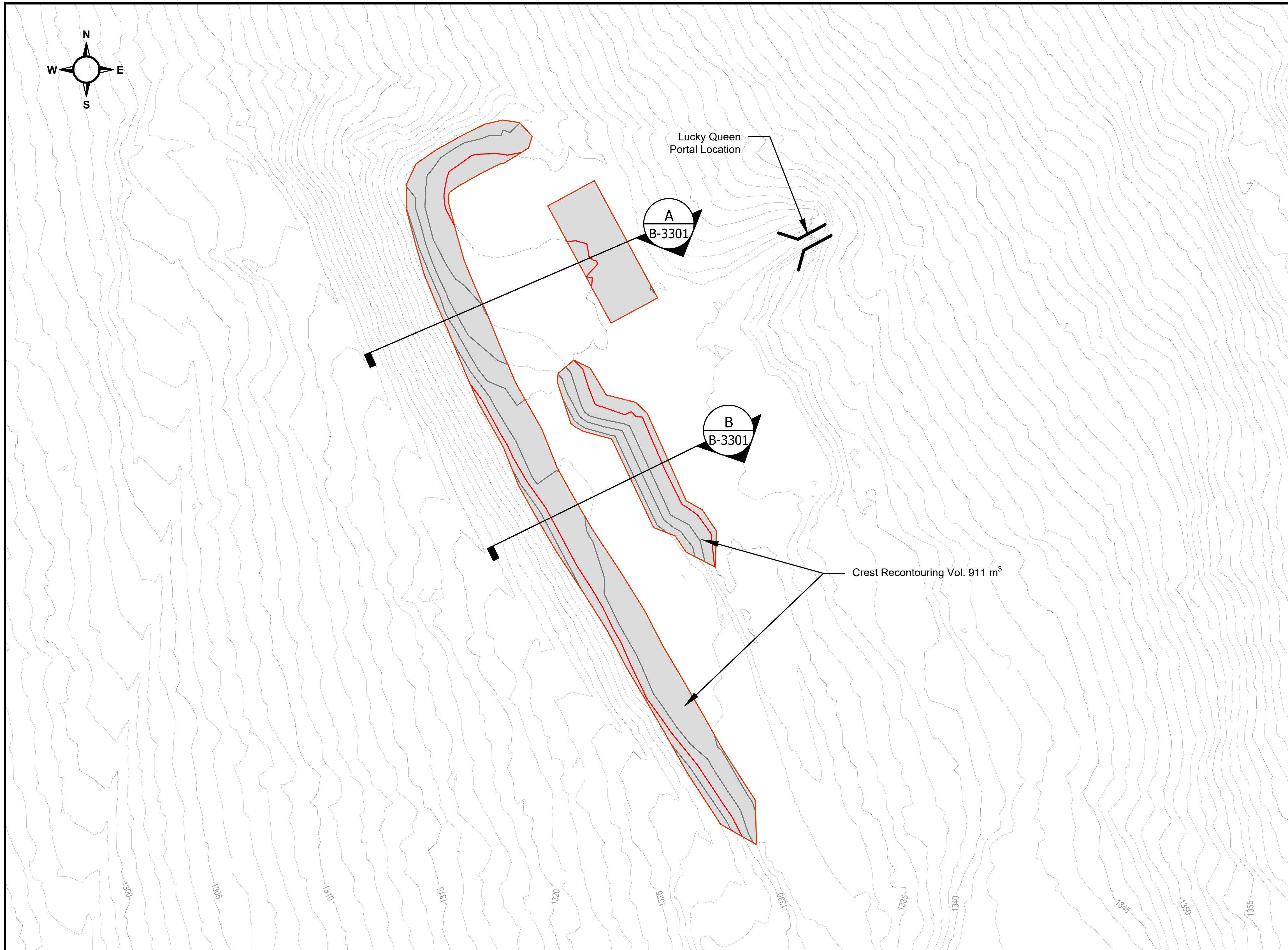
Notes:

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



DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-30	Draft for review	A	KAB	--

Scale: 1:1000

0 10 20 40 m

ENSERO solutions

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

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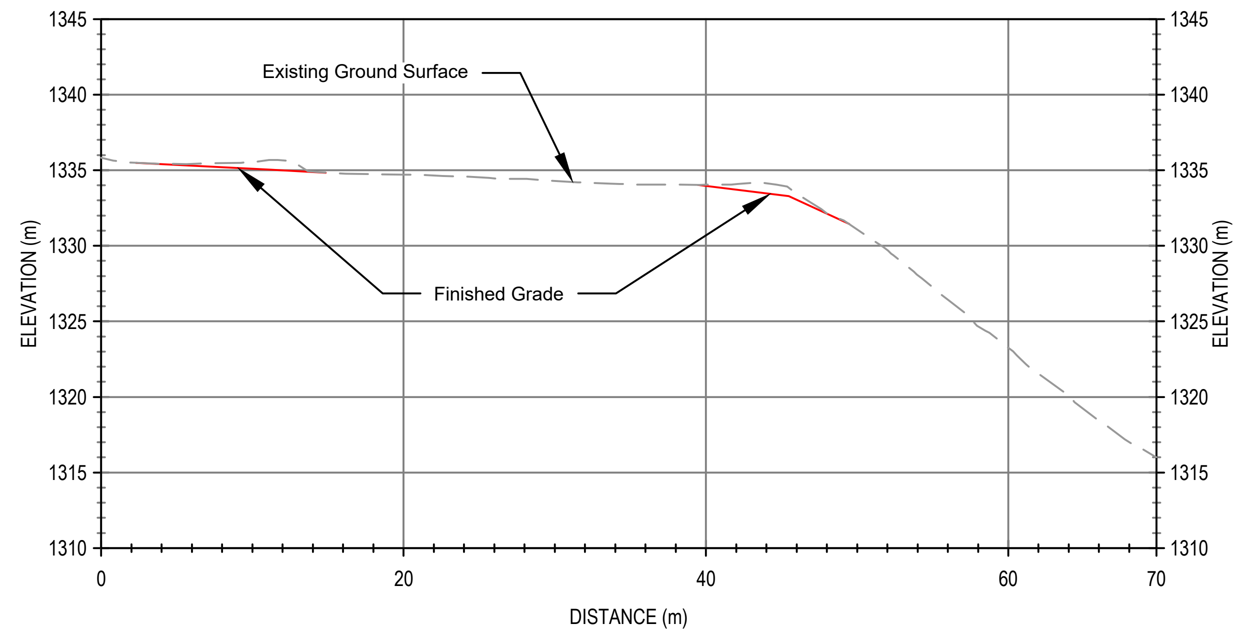

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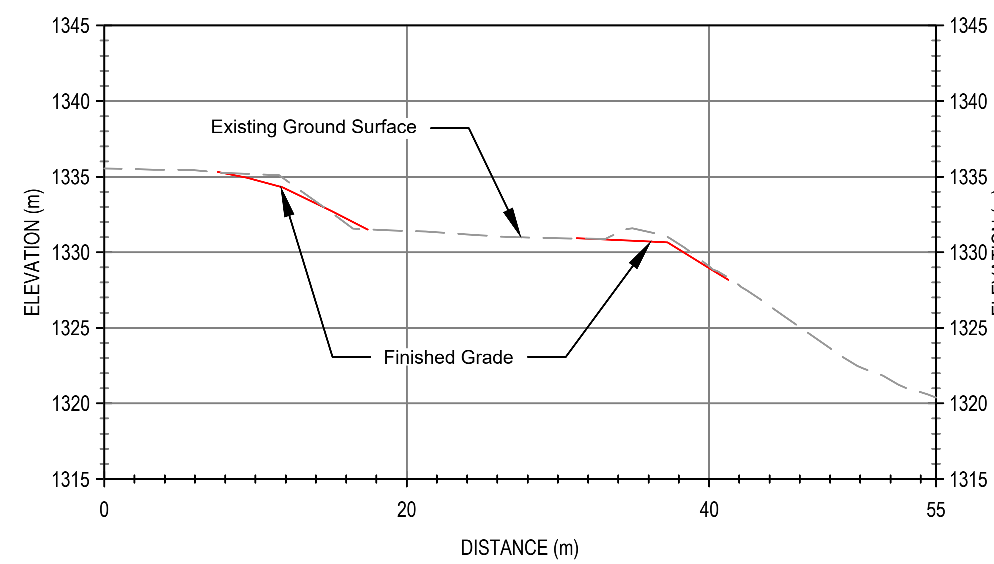

Section B

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-30	Draft for review	A	KAB	--

Scale: 1:500

0 5 10 20 m

ENSERO solutions

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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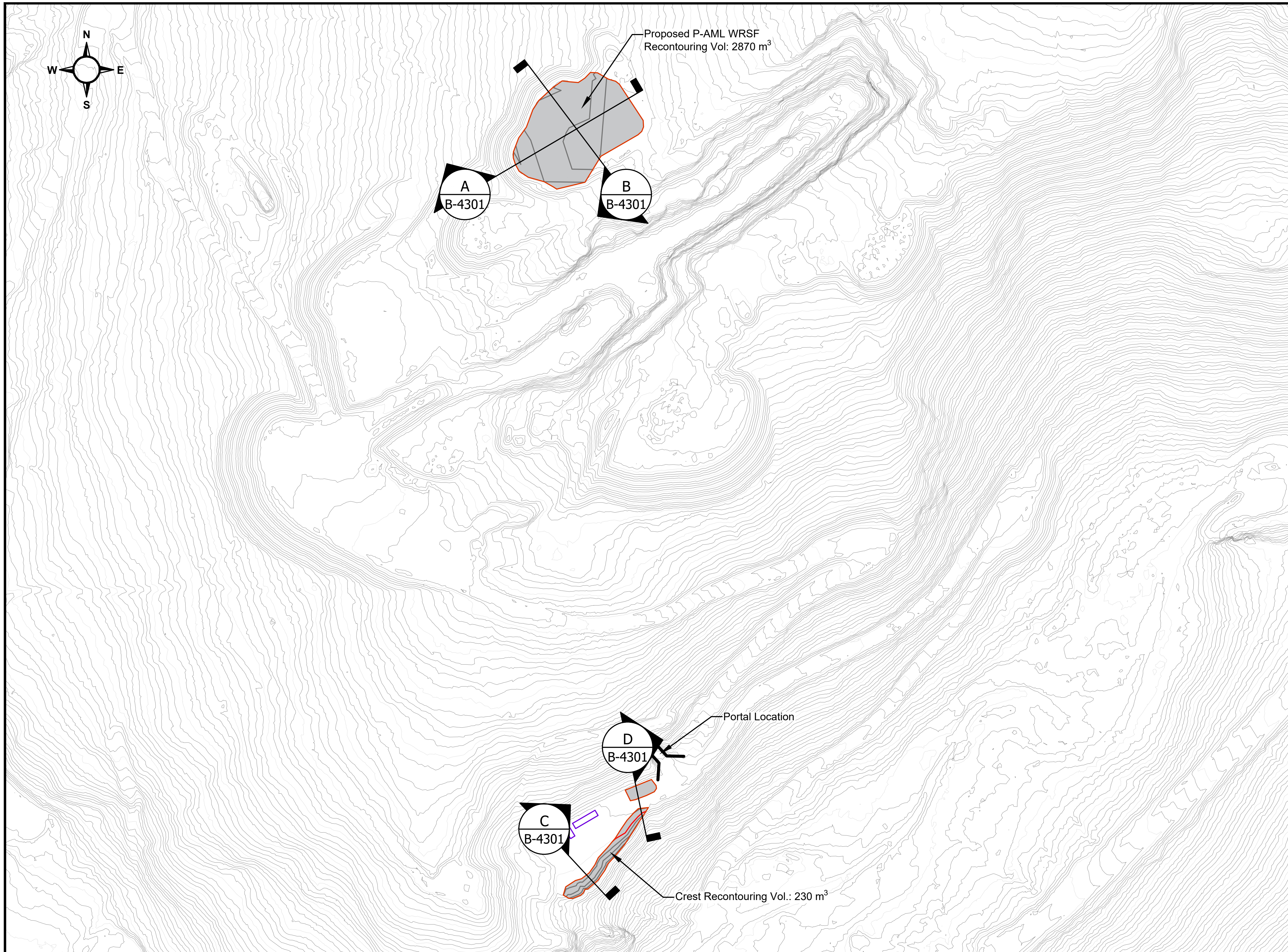

Notes:

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

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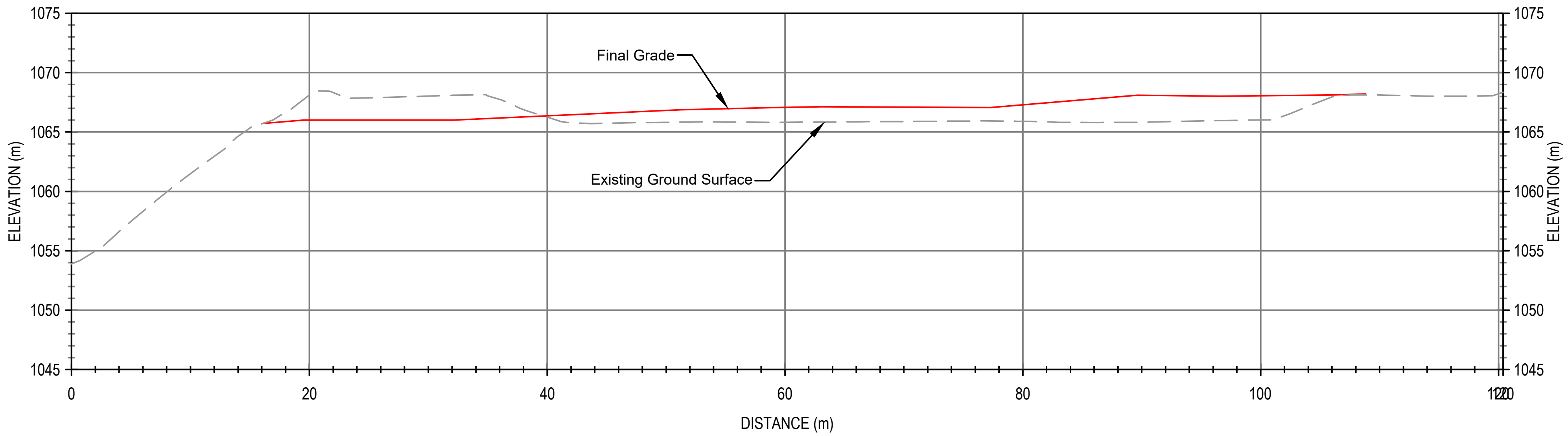

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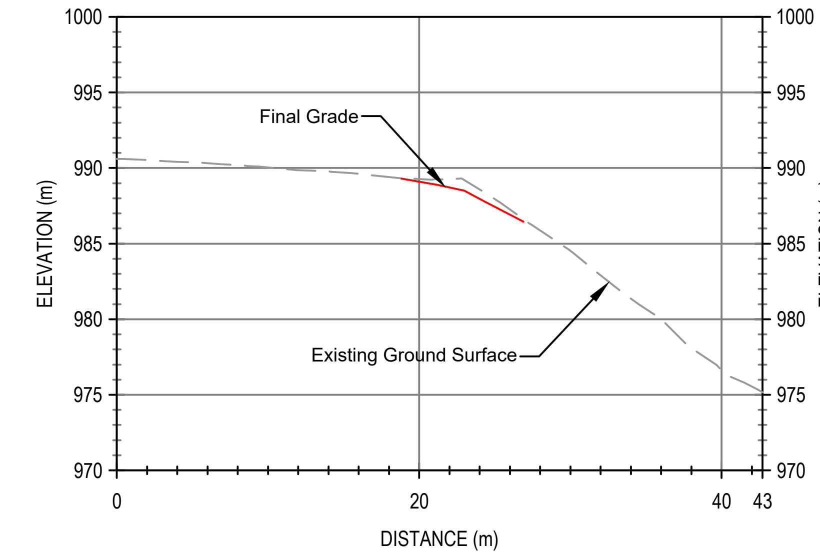

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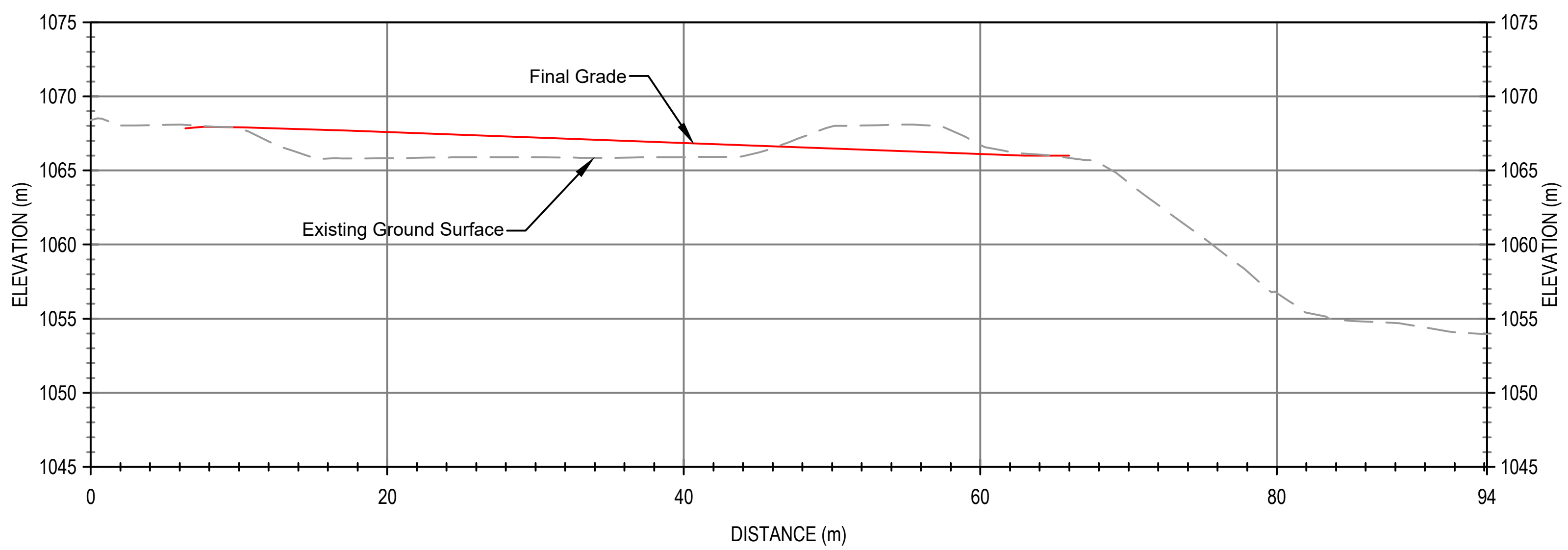

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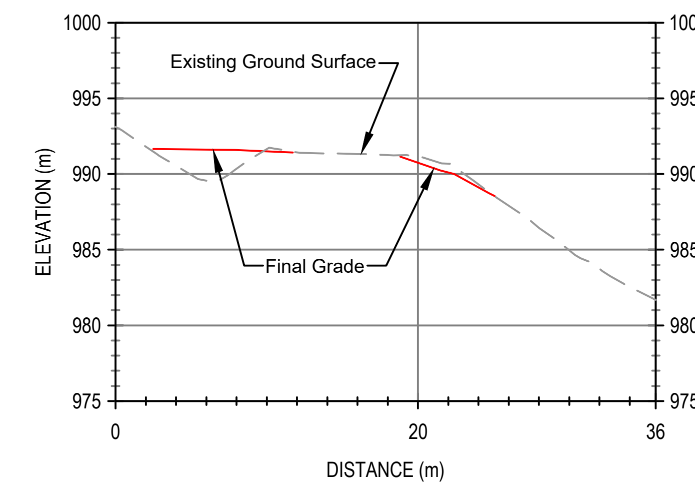

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DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-25	Draft for review	B	KAB	--
2018-01-31	Draft for review	A	KAB	--

ENSERO solutions

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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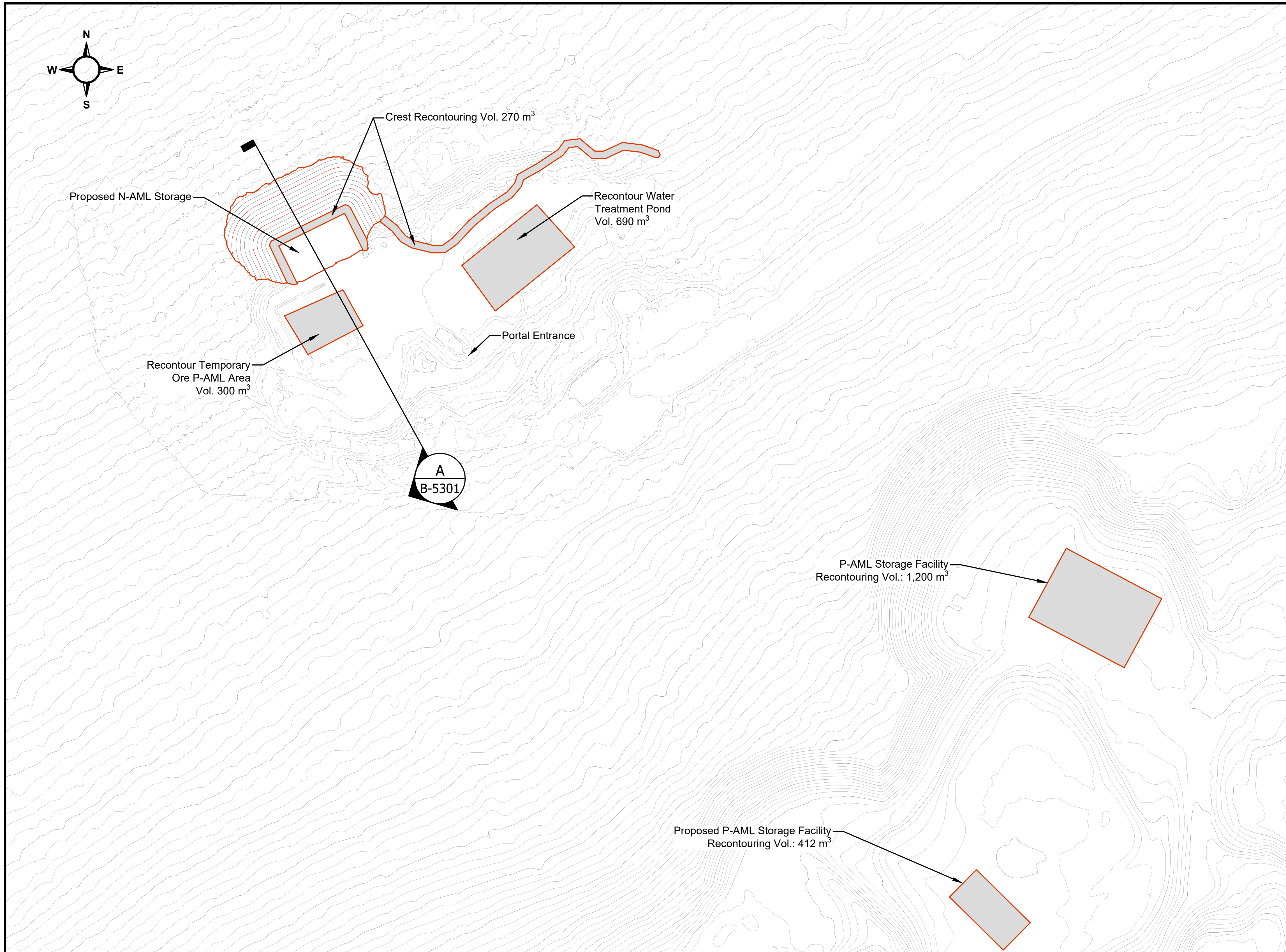

Notes:

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

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-26	Draft for review	B	KAB	--
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Scale: 1:2000
0 12.5 25 50 m

ENSERO solutions

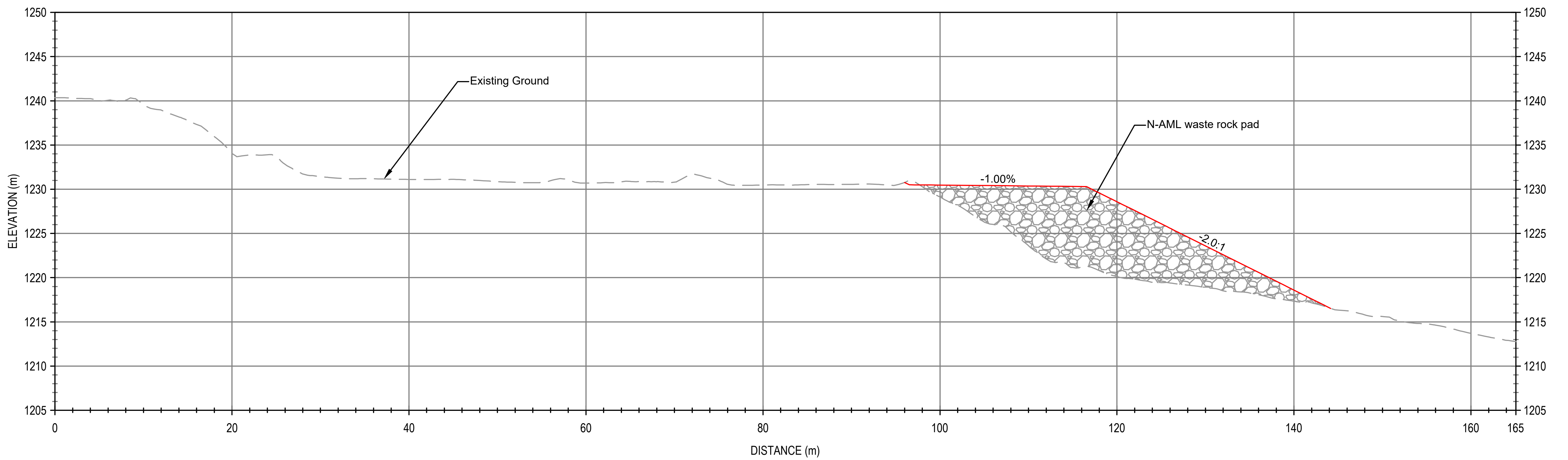
AKHM

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

D:\Users\KBoldt\Projects\Alexco-Keno Mines\Production Drawings\5-Bermingham\B-Geotech\AKHM-13-01-B-5101-BermGrading.dwg (last edited by: KBoldt; 2021/11/26 - 5:10 PM)



Section A

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-26	Draft for review	B	KAB	--
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ENSERO solutions

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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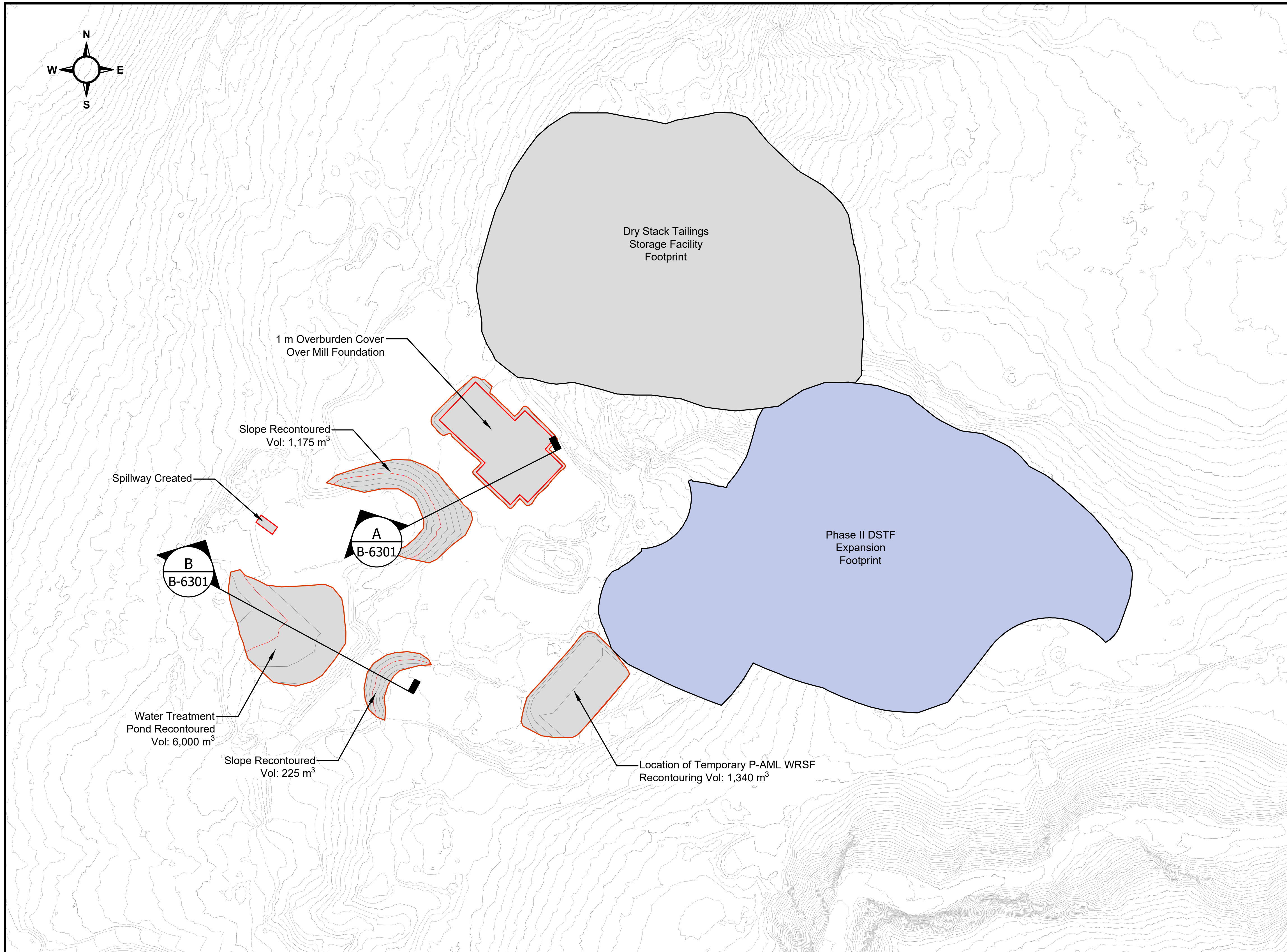

Notes:

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

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2021-11-26	Draft for review	B	KAB	--
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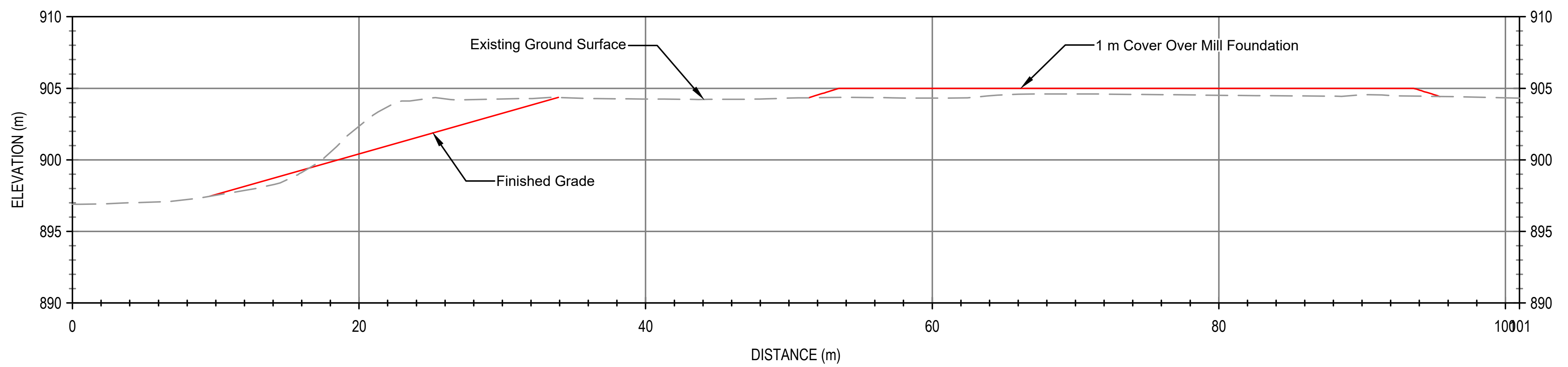
AKHM

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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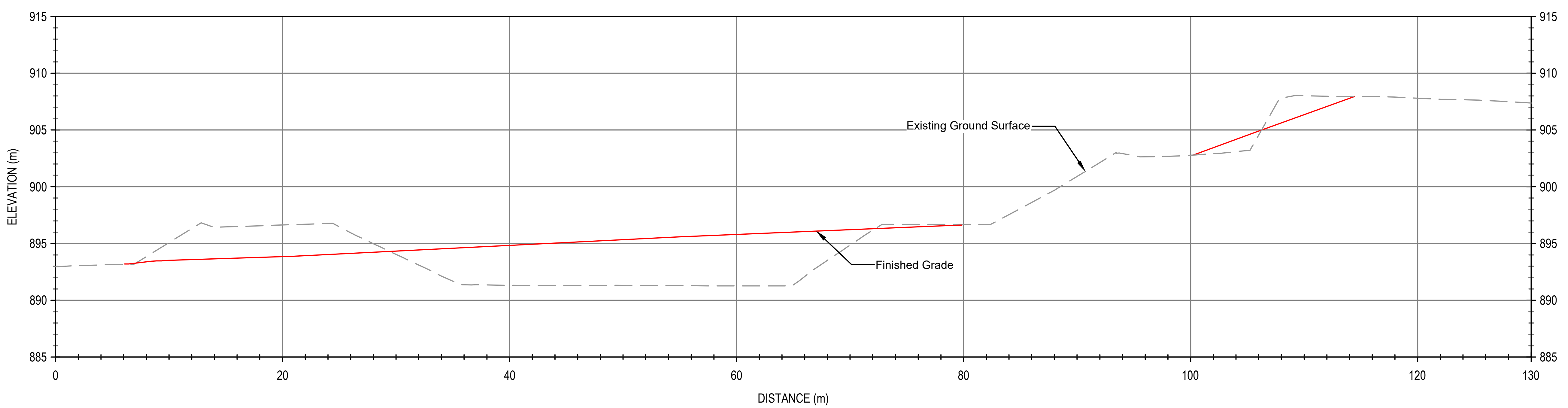

Section B

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

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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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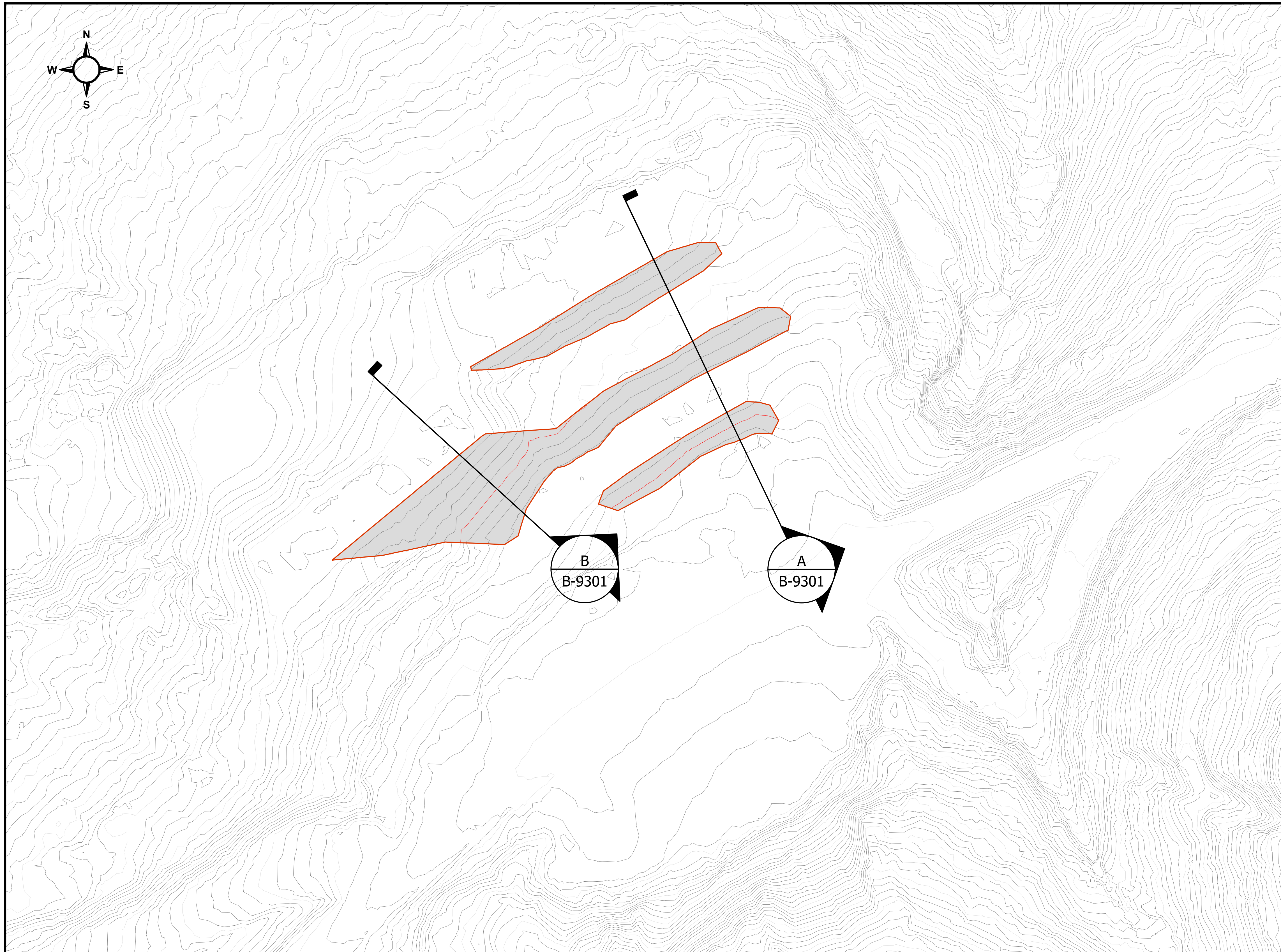

Notes:

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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2018-01-18	Draft for review	A	KAB	--

ENSERO solutions

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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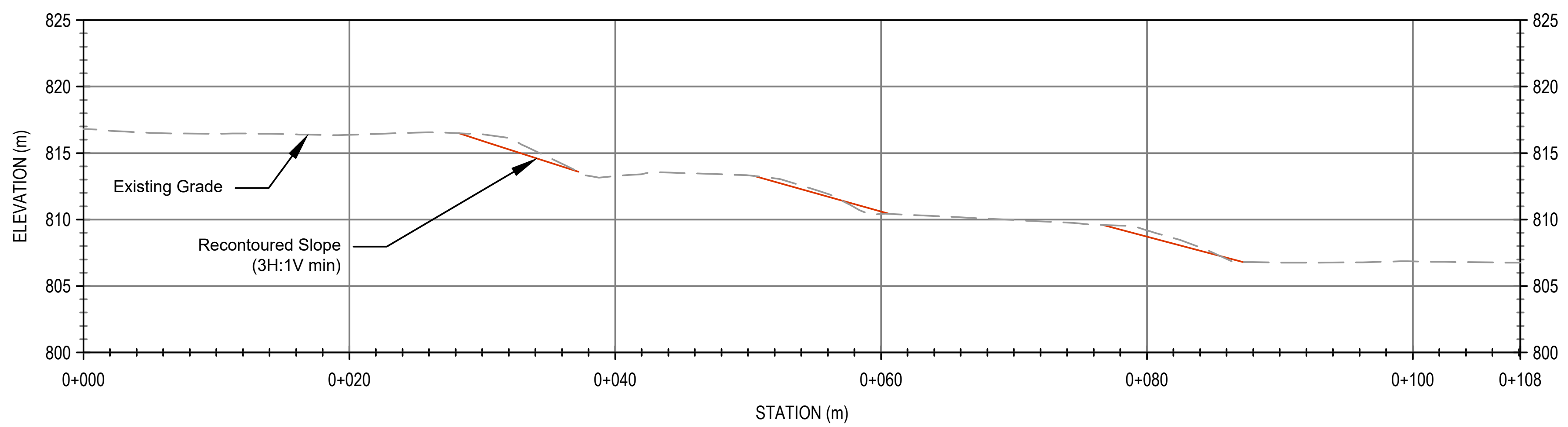
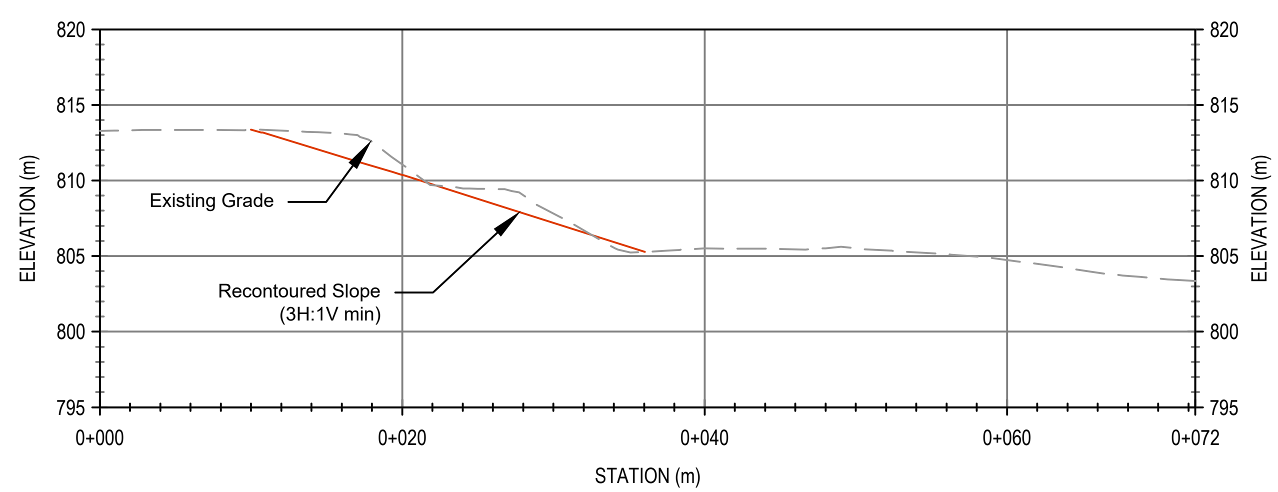
Notes:
1. Slopes will be recontoured as required for a 3H:1V slope.
2. Buildings and infrastructure will be removed for salvage or reuse.
3. Contaminated soil will be removed and treated in a land treatment facility.

Quantities:



Alignment-A



Alignment-B

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2021-11-26	Draft for review	B	KAB	--
2018-01-18	Draft for review	A	KAB	--

ENSERO solutions

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

APPENDICES

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/m². 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/m²

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.

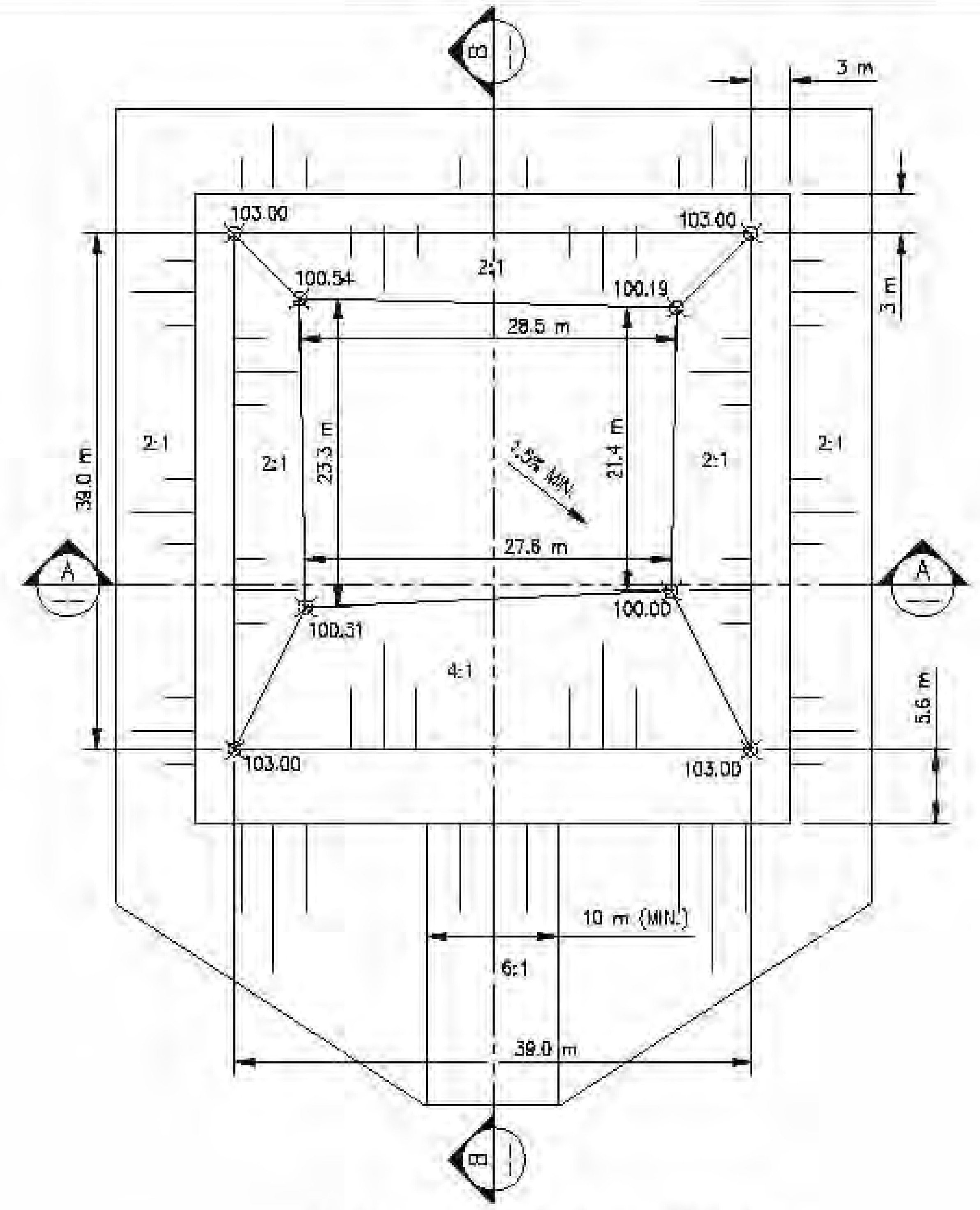
.4 The vegetative cover must have sufficient density and species diversity to stabilize the surface against the effects of long term erosion.

.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

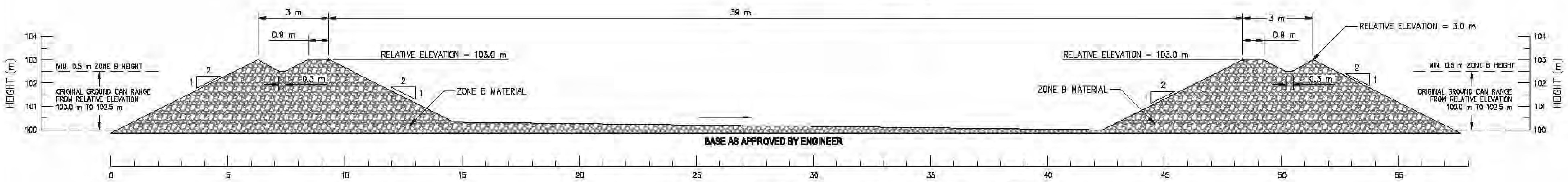
APPENDIX

APPENDIX A CONSTRUCTION DRAWINGS



PLAN – ZONE B MATERIAL

SCALE: 1 : 400



CROSS–SECTION A

SCALE: 1 : 100

CROSS–SECTION B

SCALE: 1 : 100

ISSUED FOR CONSTRUCTION

NOTES

1. CONTAINMENT FACILITY SIZED FOR 1600 m² OF GEOMEMBRANE. CONFIGURATION OF BASE AREA CAN BE MODIFIED SHOULD SITE CONDITIONS WARRANT. HOWEVER, SPECIFIED BERM CROSS-SECTION, FILL MATERIALS, 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

NUM	DATE	DWN	CKD	APR	DESCRIPTION

DRAWING STATUS

NUM	DATE	APR	DESCRIPTION
B	08/07/08	JPS	ISSUED FOR CONSTRUCTION
A	08/06/26	JPS	ISSUED FOR REVIEW

ORIGINAL
SIGNED AND SEALED

Permit: J. Richard Trimble, P.Eng.
Date: July 8, 2008

Seal: Jason Berkers, P.Eng.
Date: July 9, 2008

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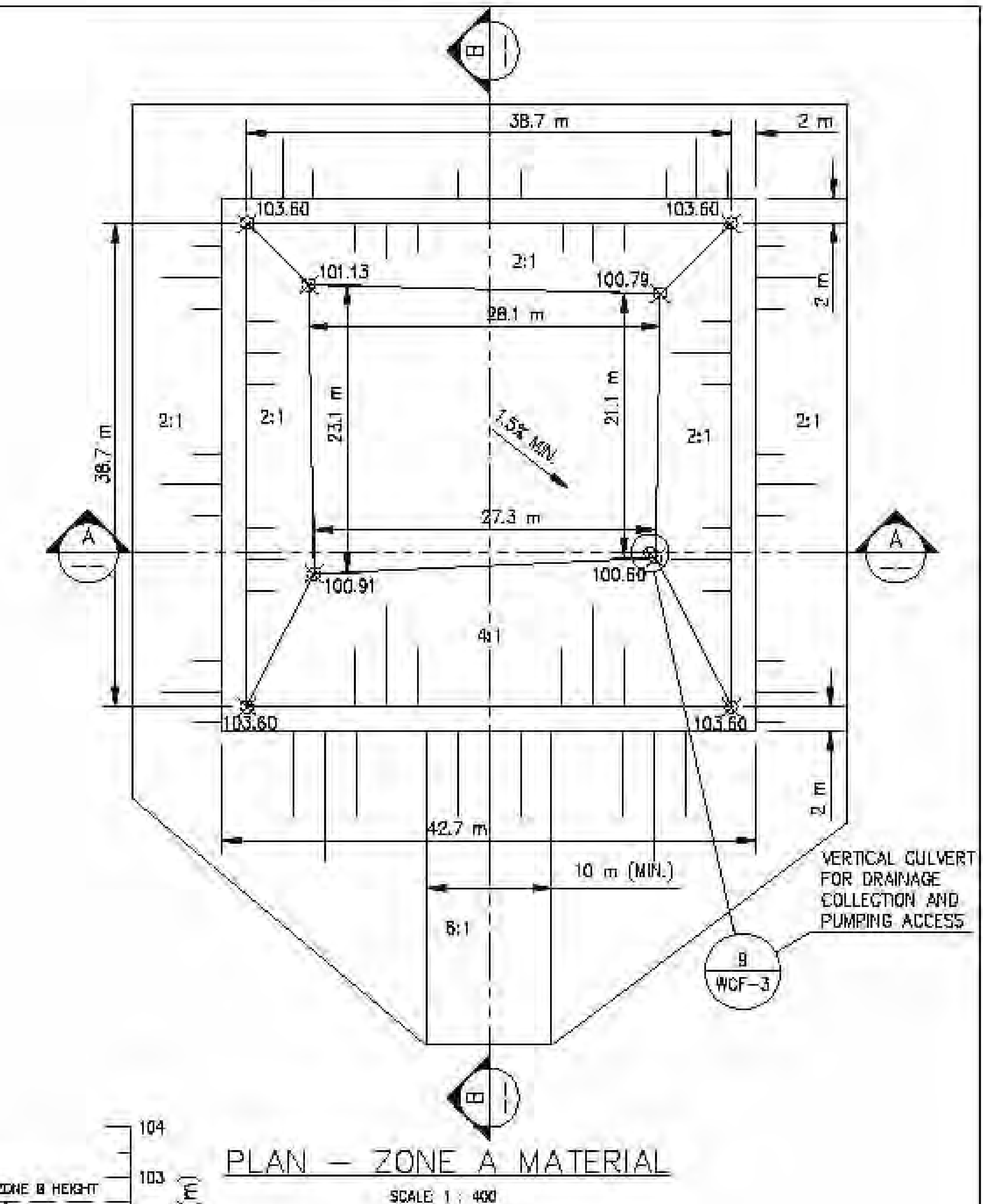
TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

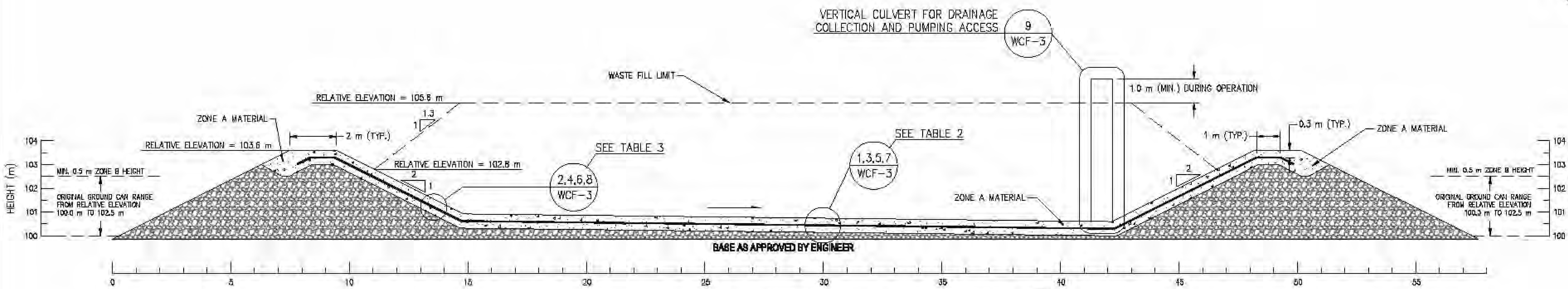
ZONE B MATERIAL PLAN & CROSS SECTIONS

PROJECT No.	OFFICE	DSR	CKD	REV	DRAWING
W14101142	WHSE	JTP	JPS	0	WCF-1
DATE	SHEET No.	DWN	APP	STATUS	
June 26, 2008	1 of 4	KJT	JRT	B	



PLAN – ZONE A MATERIAL

SCALE 1 : 400



CROSS–SECTION A

SCALE 1 : 100

CROSS–SECTION B

SCALE 1 : 100

ISSUED FOR CONSTRUCTION

NOTES

1. CONTAINMENT FACILITY SIZED FOR 1600 m² 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.
3. ALL ELEVATIONS ON PLAN ARE FOR TOP OF ZONE A MATERIAL.

REVISIONS

NUM	DATE	DWN	CKD	APR	DESCRIPTION

DRAWING STATUS

NUM	DATE	APR	DESCRIPTION
B	08/07/08	JPS	ISSUED FOR CONSTRUCTION
A	08/06/26	JPS	ISSUED FOR REVIEW

ORIGINAL
SIGNED AND SEALED

Permit: J. Richard Trimble, P.Eng. Date: July 9, 2008

Seal: Jason Berkers, P.Eng. Date: July 9, 2008

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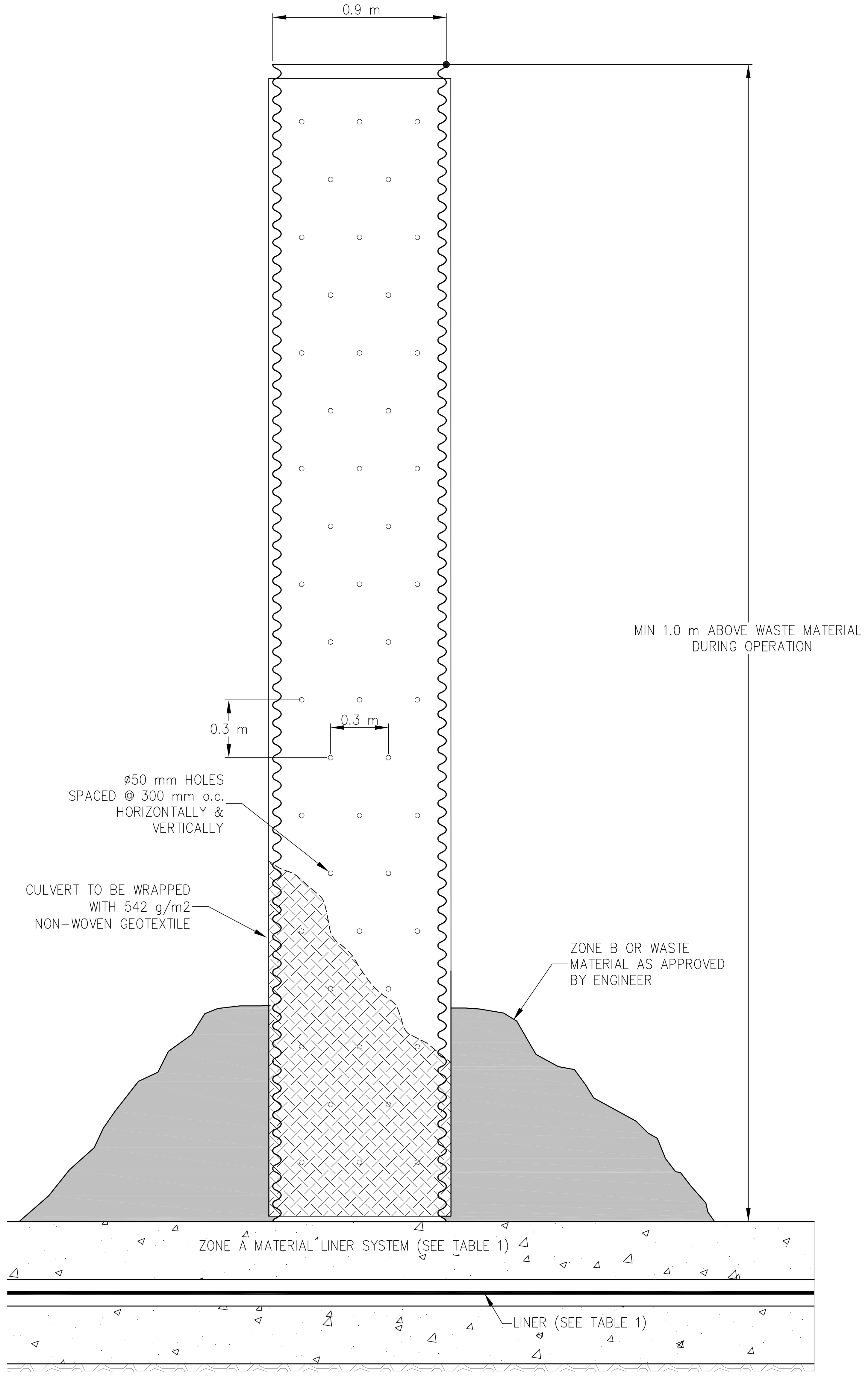
TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

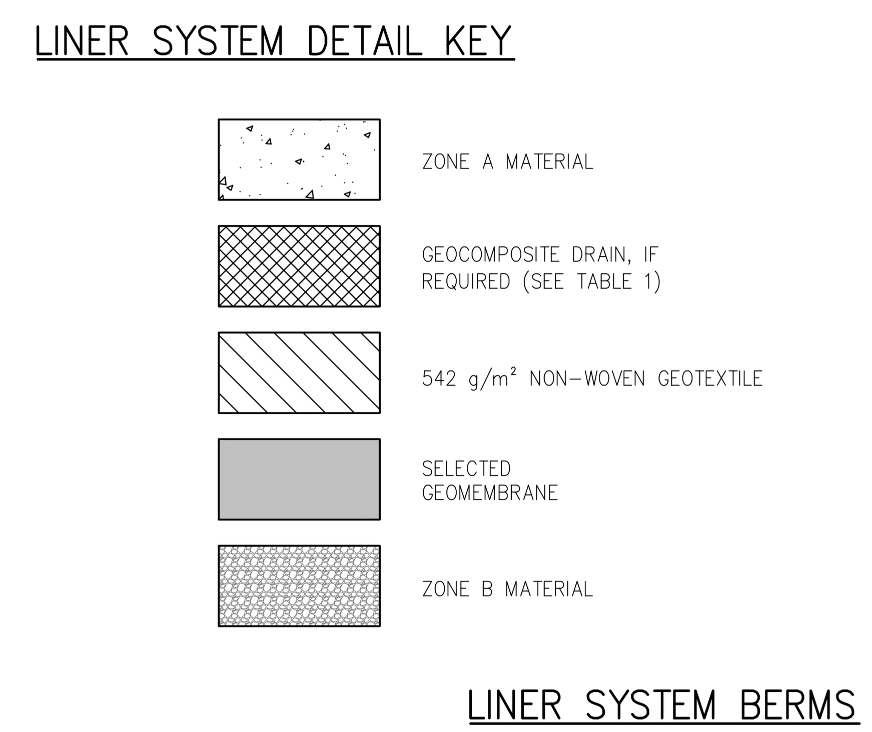
ZONE A MATERIAL PLAN & CROSS SECTIONS

PROJECT No.	OFFICE	DSN	CKD	REV	DRAWING
W14101142	WHSE	JTP	JPS	0	WCF-2
DATE	SHEET No.	DWN	APP	STATUS	
June 26, 2008	2 of 4	KJT	JRT	B	



DETAIL 1 – VERTICAL CULVERT 9 WCF-1

SCALE: 1 : 20



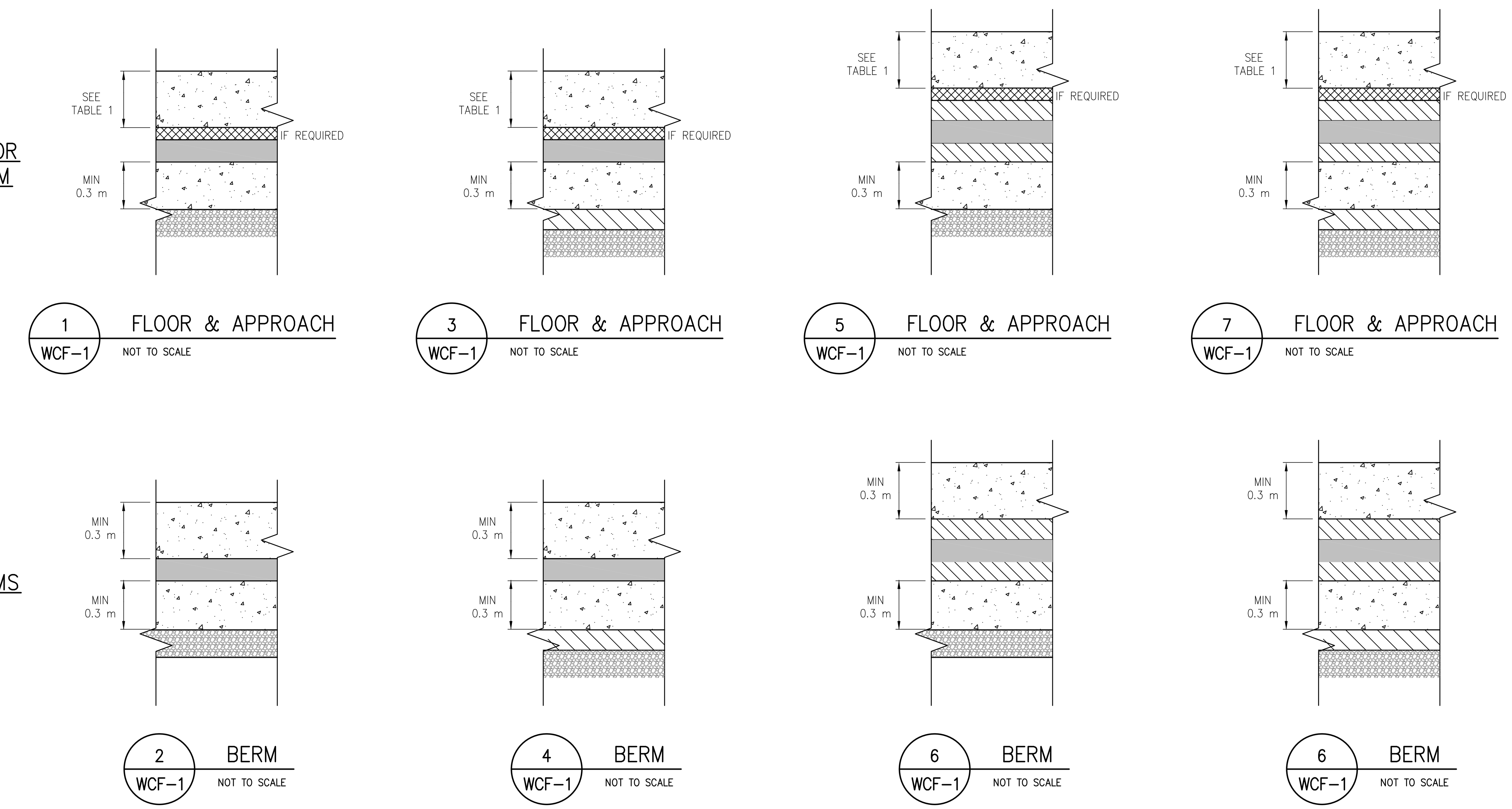


Table 1: Recommended Minimum Cover Thicknesses

Liner Material	Drainage Composite	Minimum Required Thickness
Enviro Liner® 4040 (Without Geocomposite)	Not Required	1.3 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
	Gradation Below Fine Limit	Detail 3	Detail 3	Detail 3
	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
	Gradation Below Fine Limit	Detail 3	Detail 3	Detail 3
	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

ISSUED FOR CONSTRUCTION

NOTES

1. CONTAINMENT FACILITY SIZED FOR 1900 m² 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.
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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

ORIGINAL SIGNED AND SEALED

Permit: J. Richard Trimble, P.Eng. Date: July 8, 2008

Seal: Jason Berkers, P.Eng. Date: July 8, 2008

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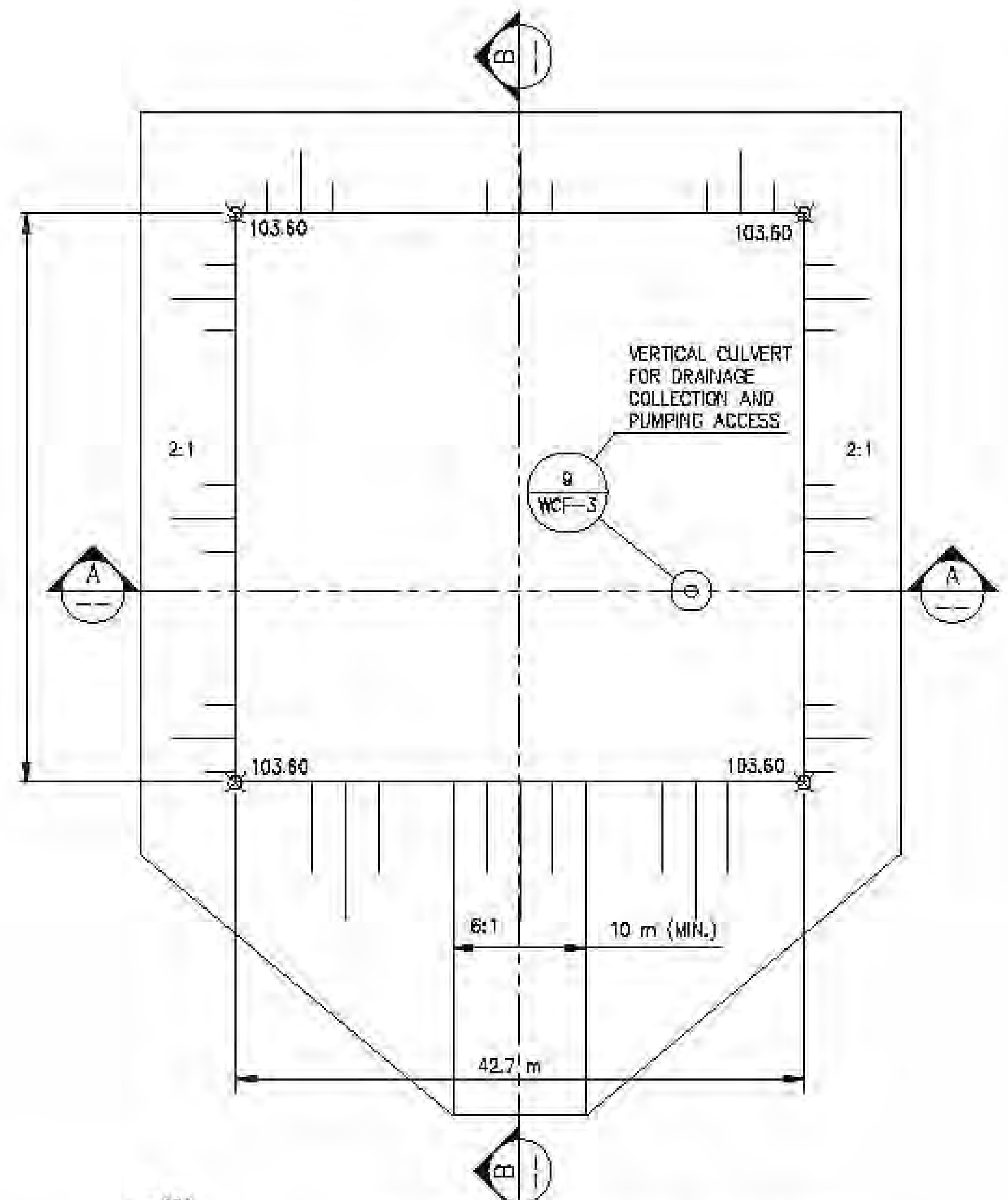
TYPICAL WASTE CONTAINMENT FACILITY DESIGN KENO HILL SILVER DISTRICT, YT

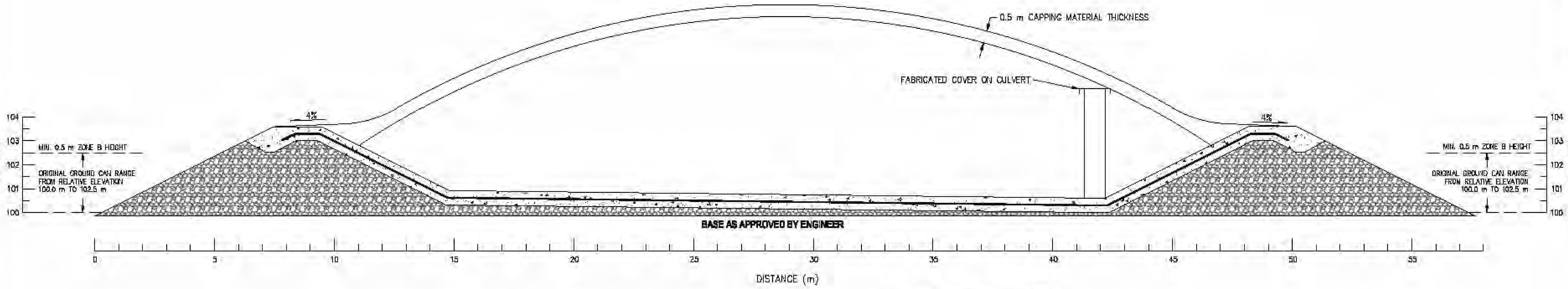
DETAILS

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
W14101142	WHSE	JTP	JPB	0	WCF-3
DATE: JUNE 25, 2008	SHEET No. 3 of 4	DWN KJT	APP JRT	STATUS B	



PLAN – FACILITY CLOSURE

SCALE: 1 : 400



CROSS–SECTION A

SCALE: 1 : 100

CROSS–SECTION B

SCALE: 1 : 100

ISSUED FOR CONSTRUCTION

NOTES

1. CONTAINMENT FACILITY SIZED FOR 1600 m² 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 CONSTUCTION.

REVISIONS

NUM	DATE	DWN	CKD	APR	DESCRIPTION

DRAWING STATUS

NUM	DATE	APR	DESCRIPTION
2	08/07/08	JPB	ISSUED FOR CONSTRUCTION
1	08/06/26	JPS	ISSUED FOR REVIEW

ORIGINAL
SIGNED AND SEALED

Permit: J. Richard Trimble, P.Eng.
Date: July 8, 2008

Seal: Jason Berkers, P.Eng.
Date: July 9, 2008

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CLIENT: ALEXCO

EBA Engineering Consultants Ltd.

TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

FACILITY CLOSURE PLAN & CROSS SECTIONS

PROJECT No.	OFFICE	DSR	CKD	REV	DRAWING
W14101142	WHSE	JTP	JPB	0	WCF-4
DATE	SHEET No.	DWN	APP	STATUS	
June 26, 2008	4 of 4	KJT	JRT	B	

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:

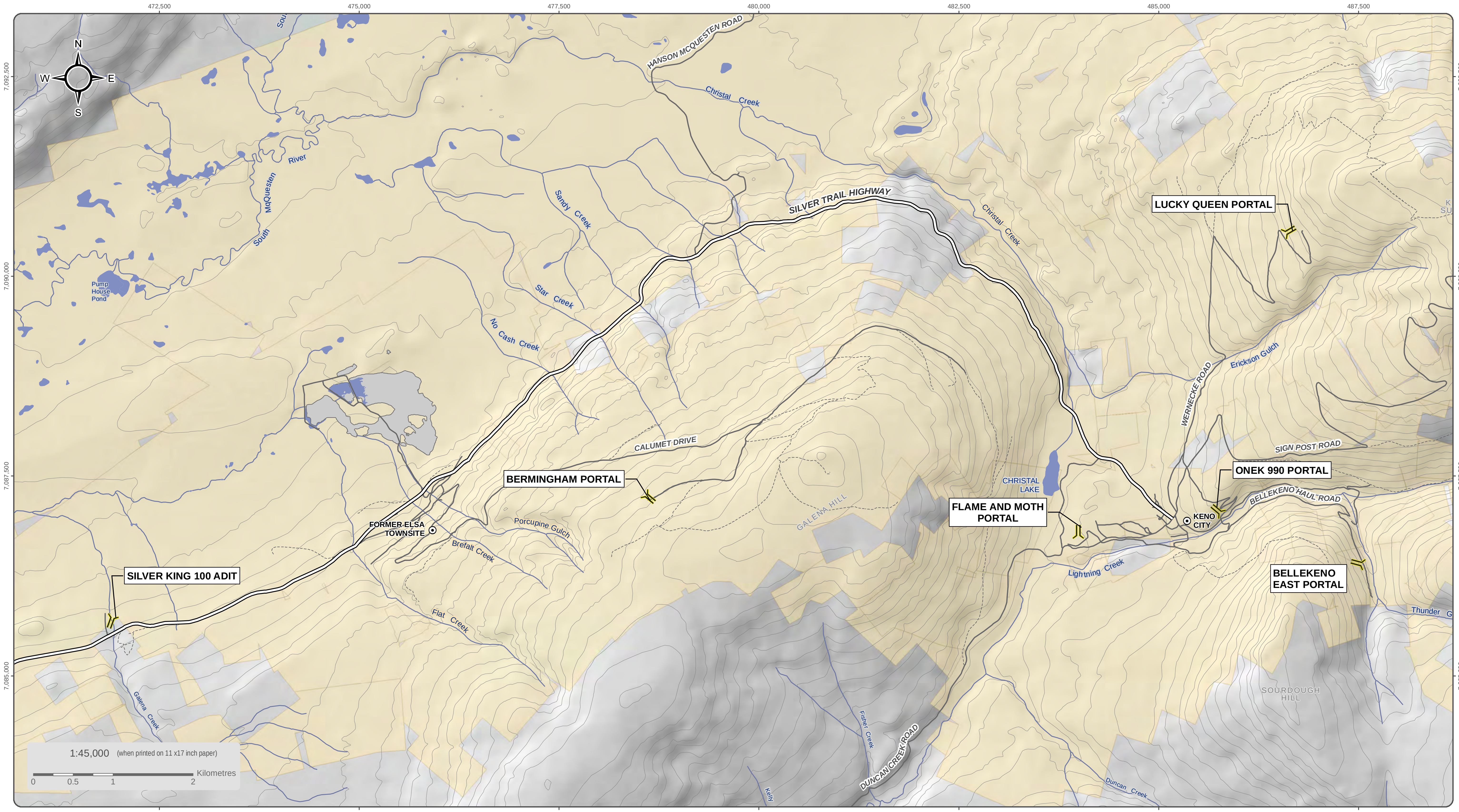
- Bellekeno (Altura, 2008);
- Onek (ACG, 2011a);
- Lucky Queen (ACG, 2011b);
- Silver King (ACG, 2011c);
- Flame & Moth (AEG, 2016b); and
- Bermingham zones (AEG, 2018).

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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Symbol	Legend
⊙	Place of Interest
Adit symbol	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

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).

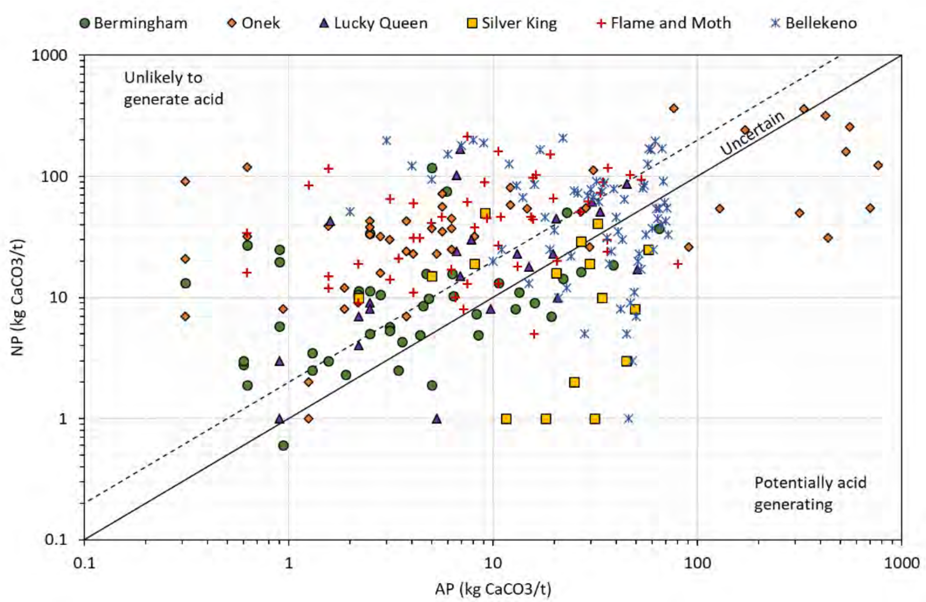
Broken down by major lithology, the QTZT, TQTZT, and GSCH samples broadly reflected the general NPR sample distribution (11% to 31% PAG samples; 44% to 76% non-PAG; Figure 4-3 to Figure 4-5), consistent with the numerical dominance of these lithologies. The GNST and SSCH samples are predominantly non-PAG (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.

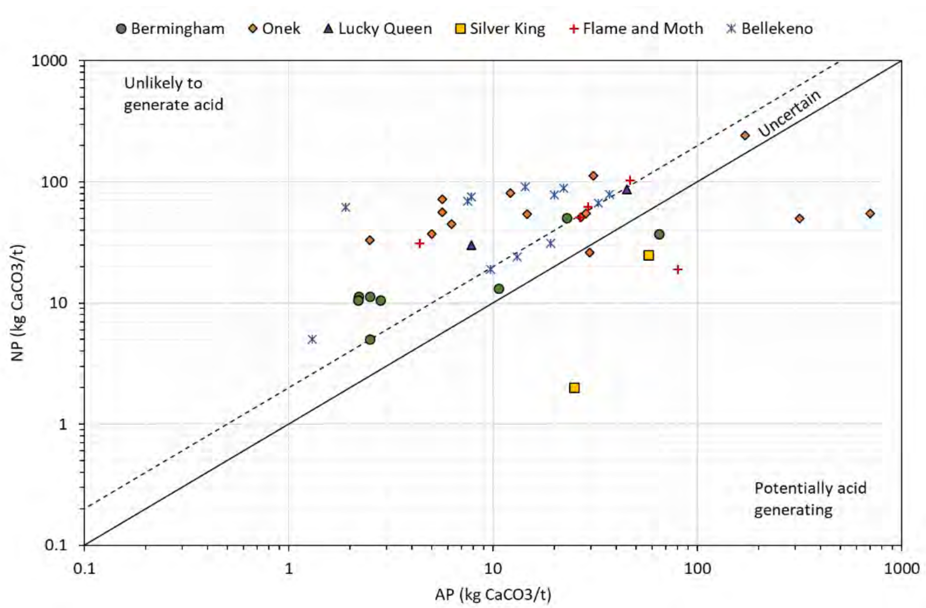
Bulk antimony and silver concentrations were higher than their respective 10x crustal abundance (2 and 0.85 ppm, respectively) for the majority of waste rock samples from Bermingham, Bellekeno, Onek, Lucky Queen, and Silver King. Lower concentrations were observed for Flame & Moth waste rock. Bulk selenium 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.



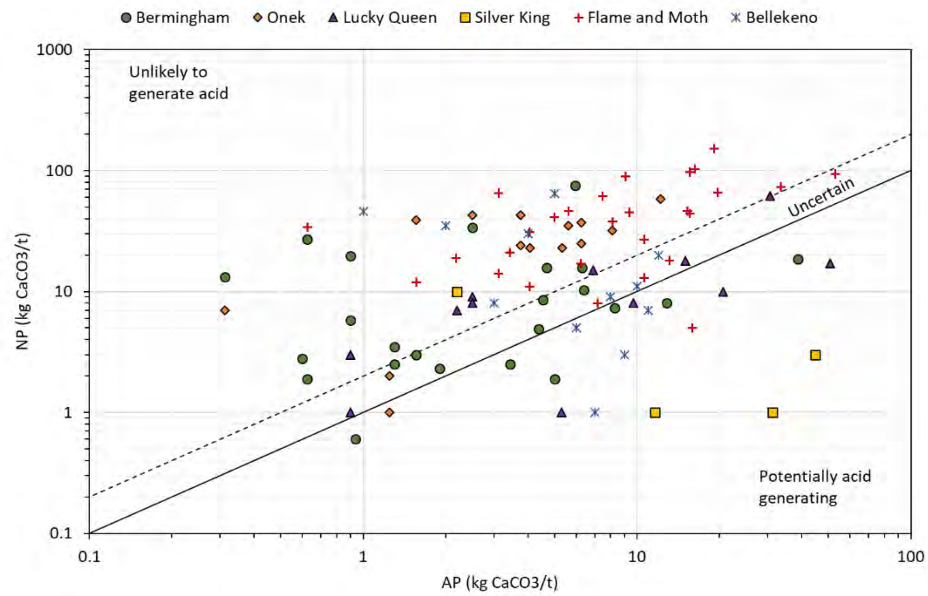
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-2: Variability in NP and AP of Waste Rock Samples from KHSD Deposits



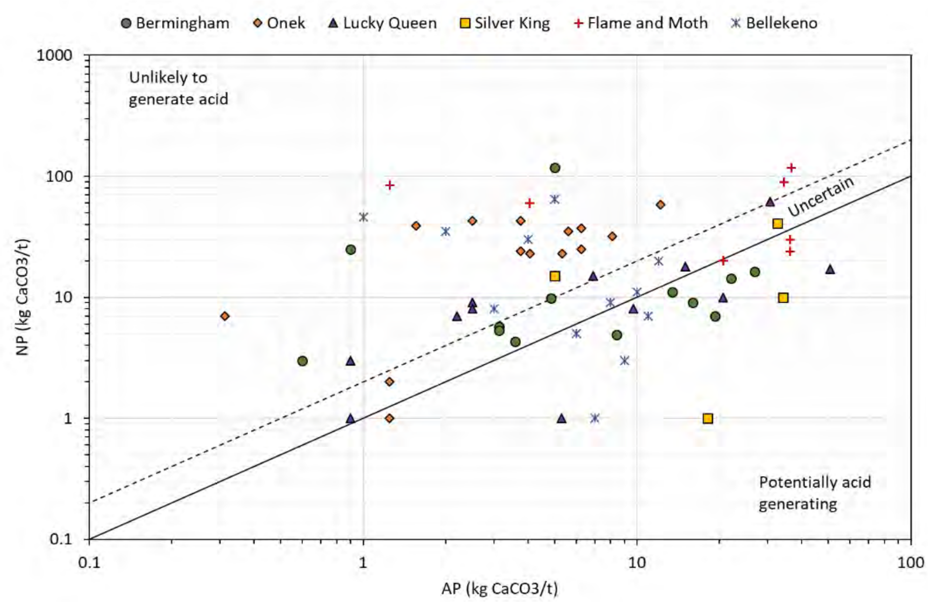
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-3: Variability in NP and AP of GSCH Lithology Waste Rock Samples from KHSD Deposits



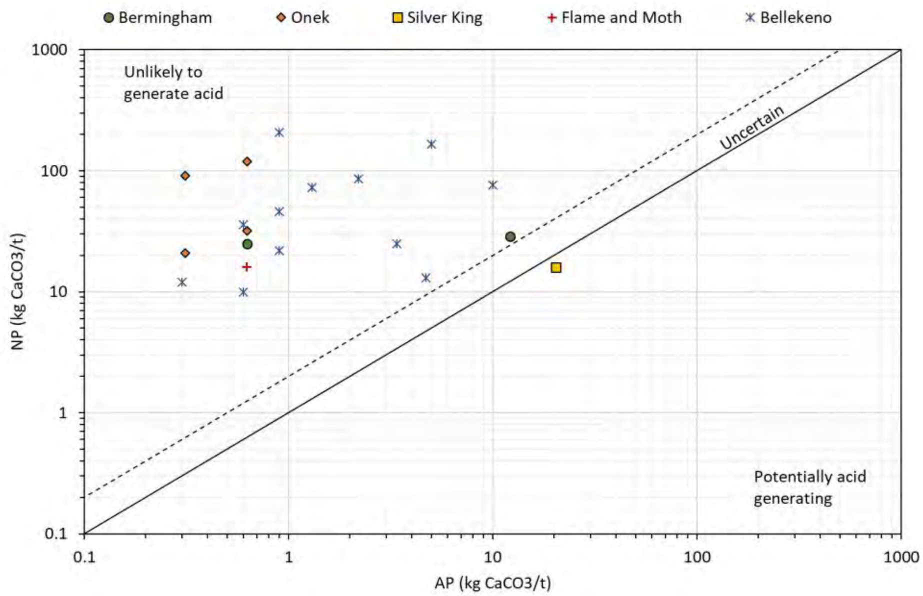
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-4: Variability in NP and AP of QTZT Lithology Waste Rock Samples from KHSD Deposits



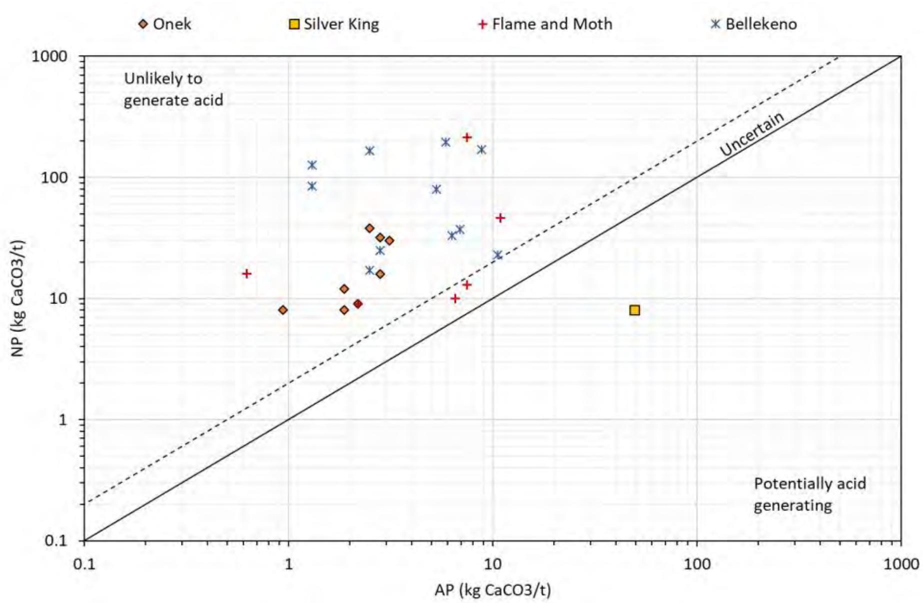
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

Figure 4-5: Variability in NP and AP of TQTZT Lithology Waste Rock Samples from KHSD Deposits



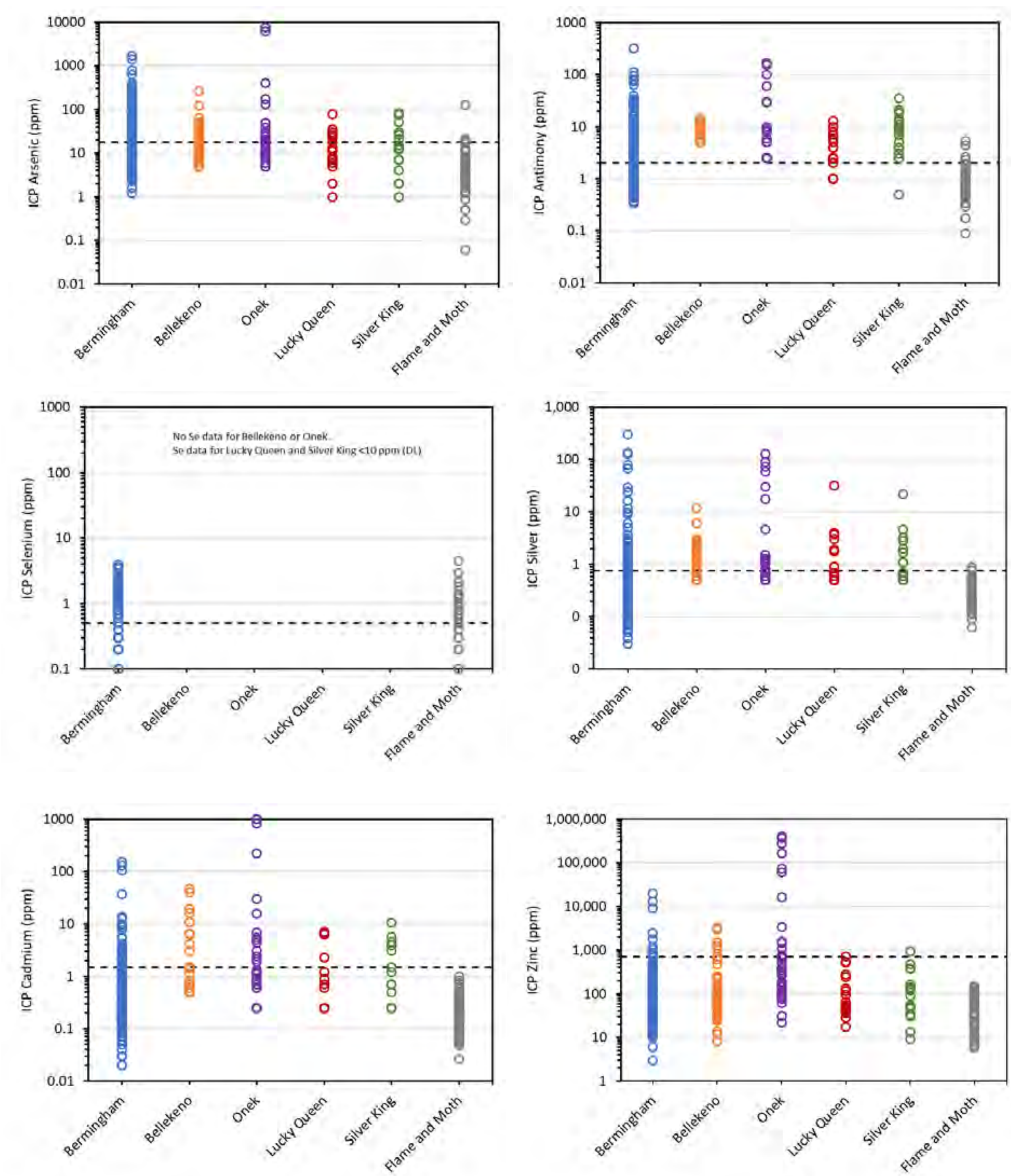
Solid and dashed lines indicate NPR = 1 and NPR = 2, respectively.

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

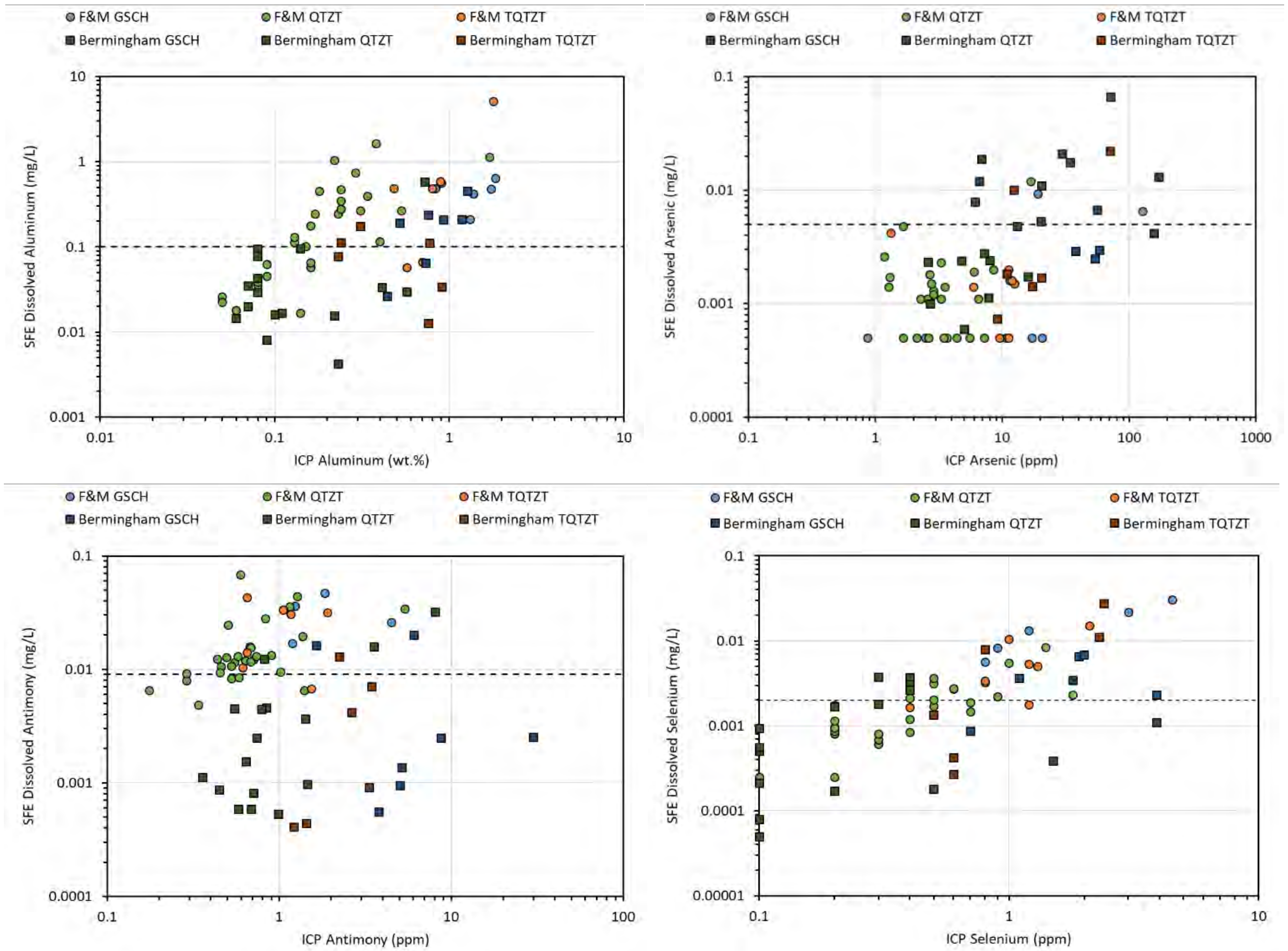


Figure 4-9: Comparison of SFE Leachable and Aqua Regia Bulk Concentrations of Aluminum, Antimony, Arsenic, and Selenium for the main lithologies in Bermingham (squares) and Flame & Moth (circles)

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).

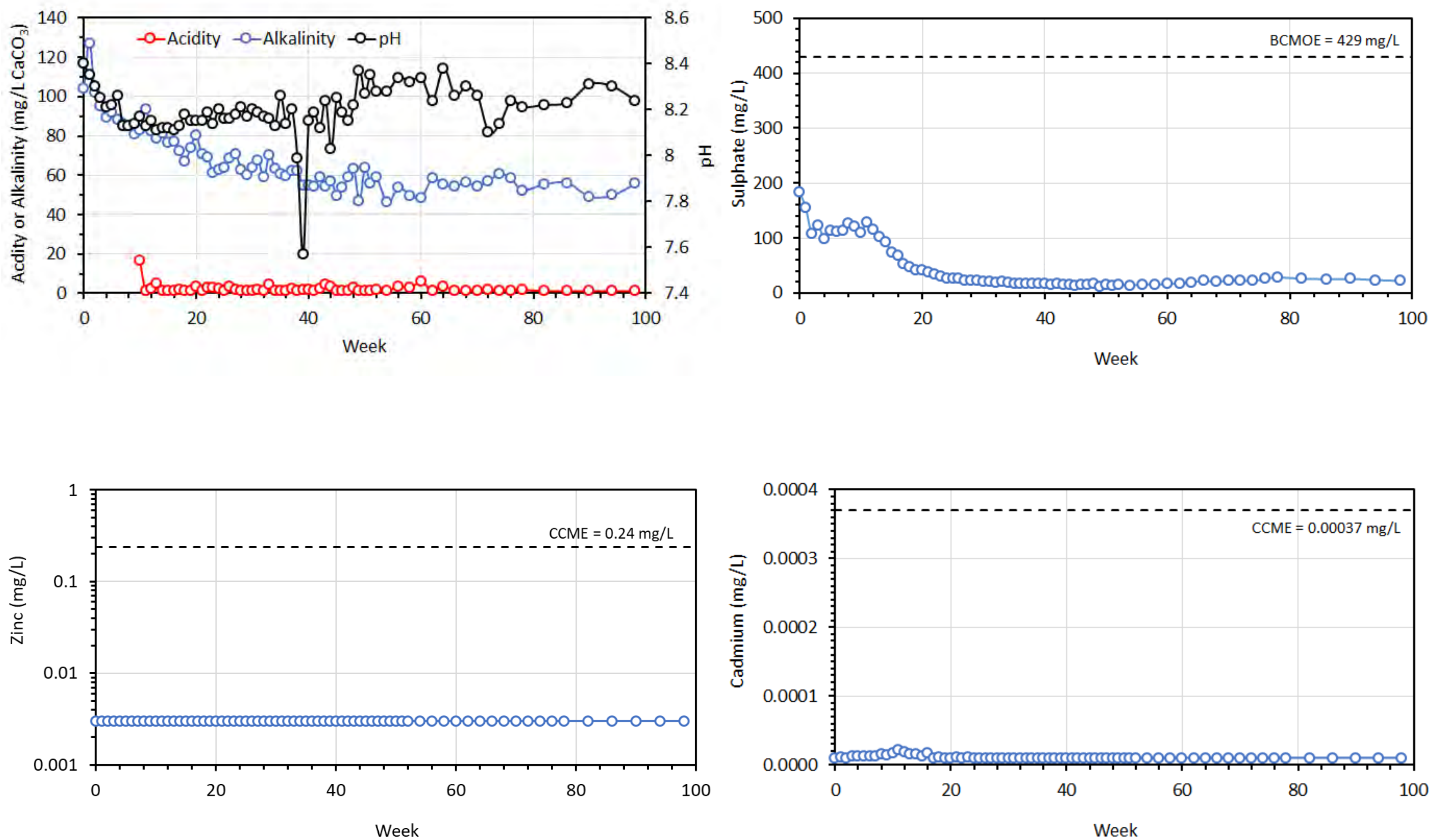


Figure 5-1: Acidity, Alkalinity, pH, Sulphate, Zinc and Cadmium Trends within the Flame & Moth N-AML Waste Rock Humidity Cell

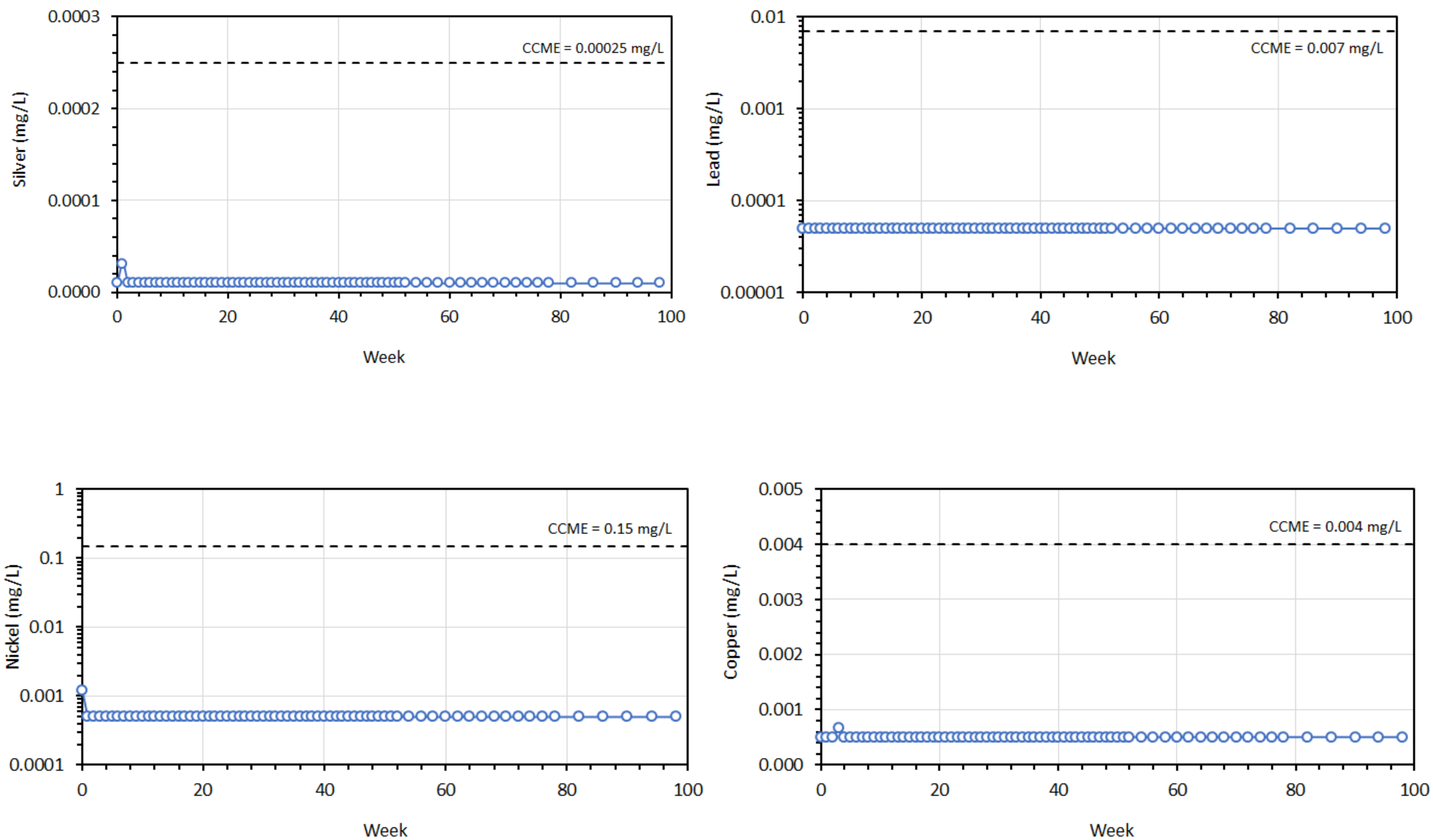


Figure 5-2: Silver, Lead, Nickel, and Copper Trends within the Flame & Moth N-AML Waste Rock Humidity Cell

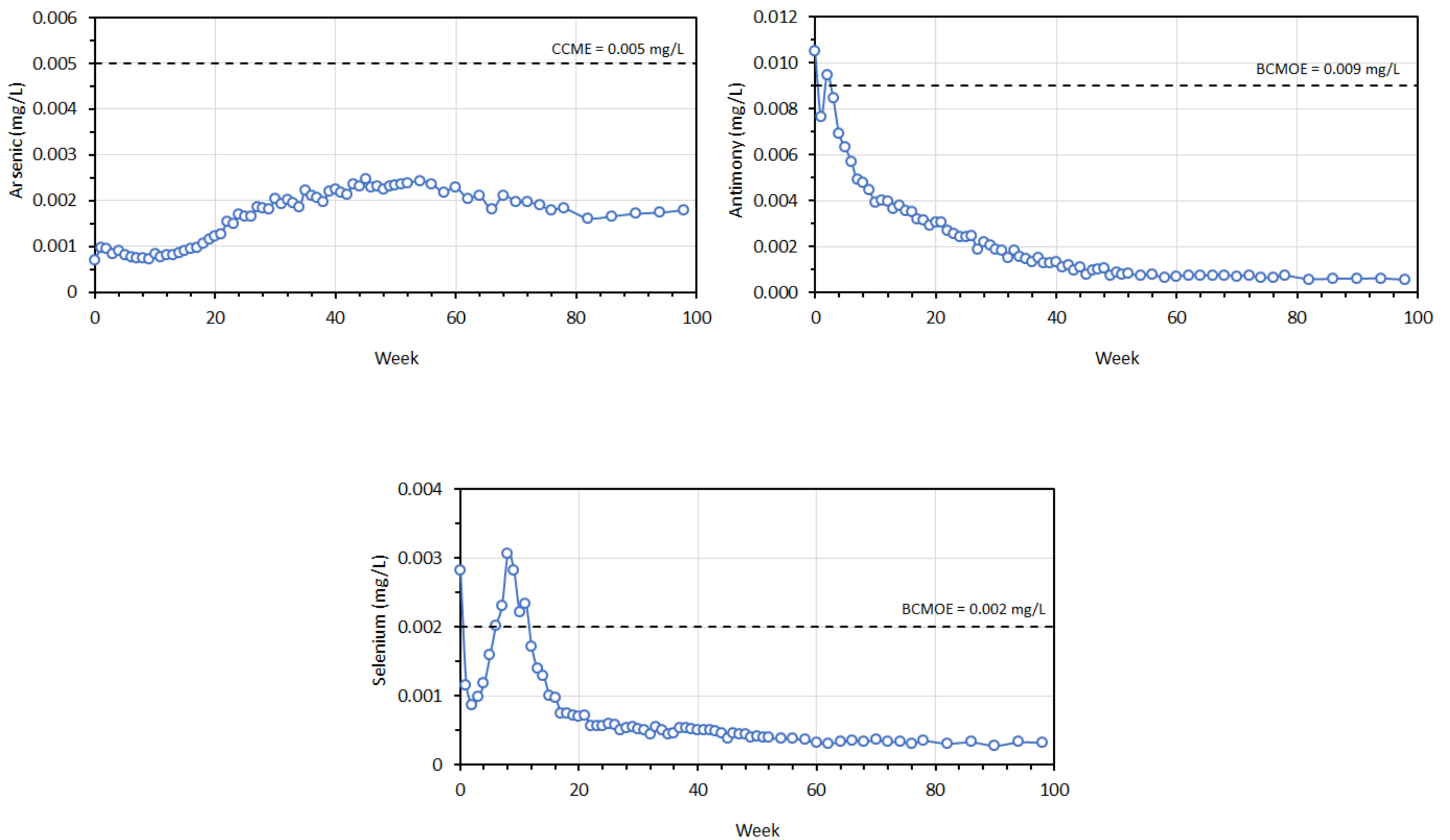


Figure 5-3: Arsenic, Antimony and Selenium Trends within the Flame & Moth N-AML Waste Rock Humidity Cell

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

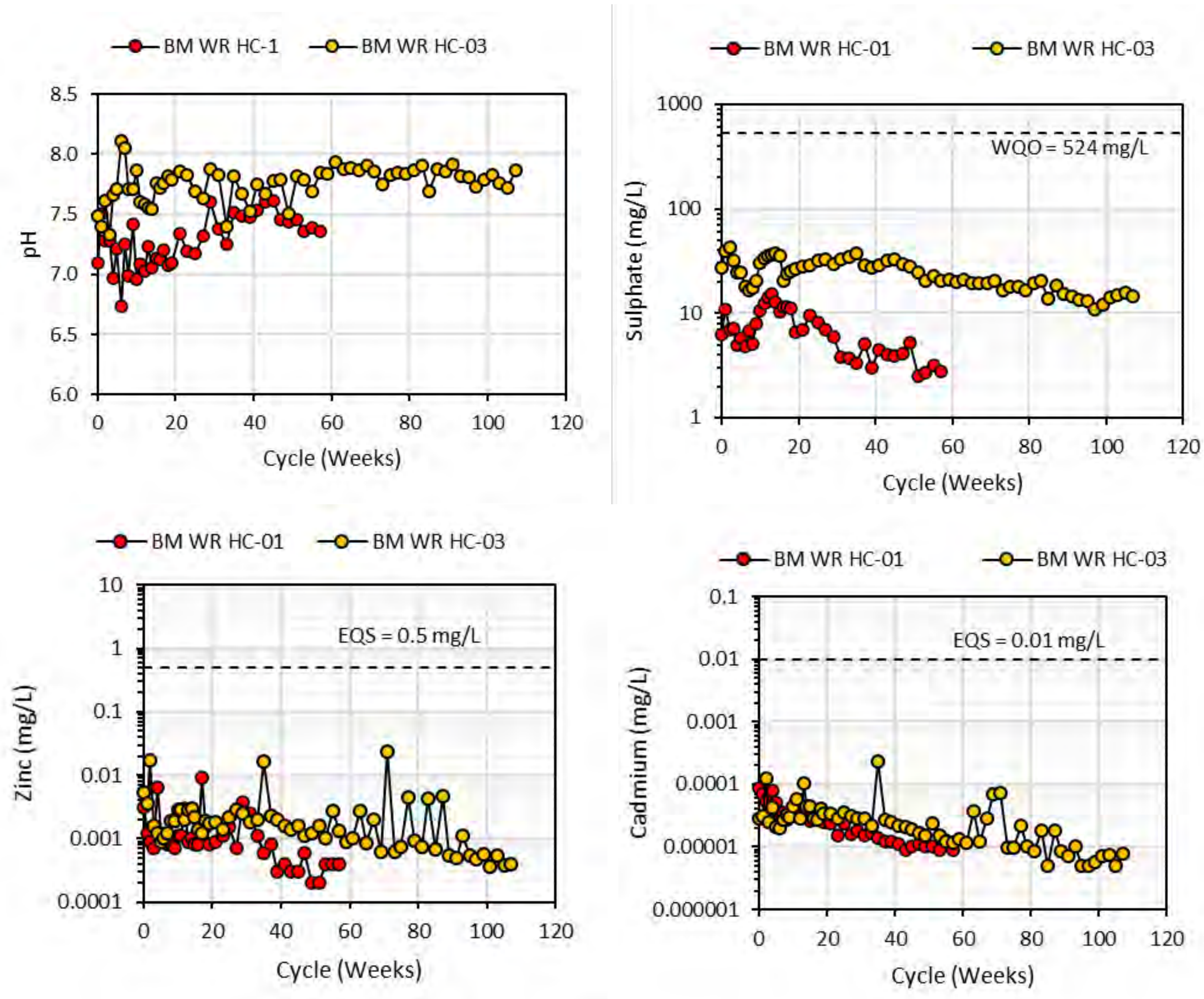


Figure 5-4: pH, Sulphate, Zinc and Cadmium Trends within the Bermingham N-AML Waste Rock Humidity Cells

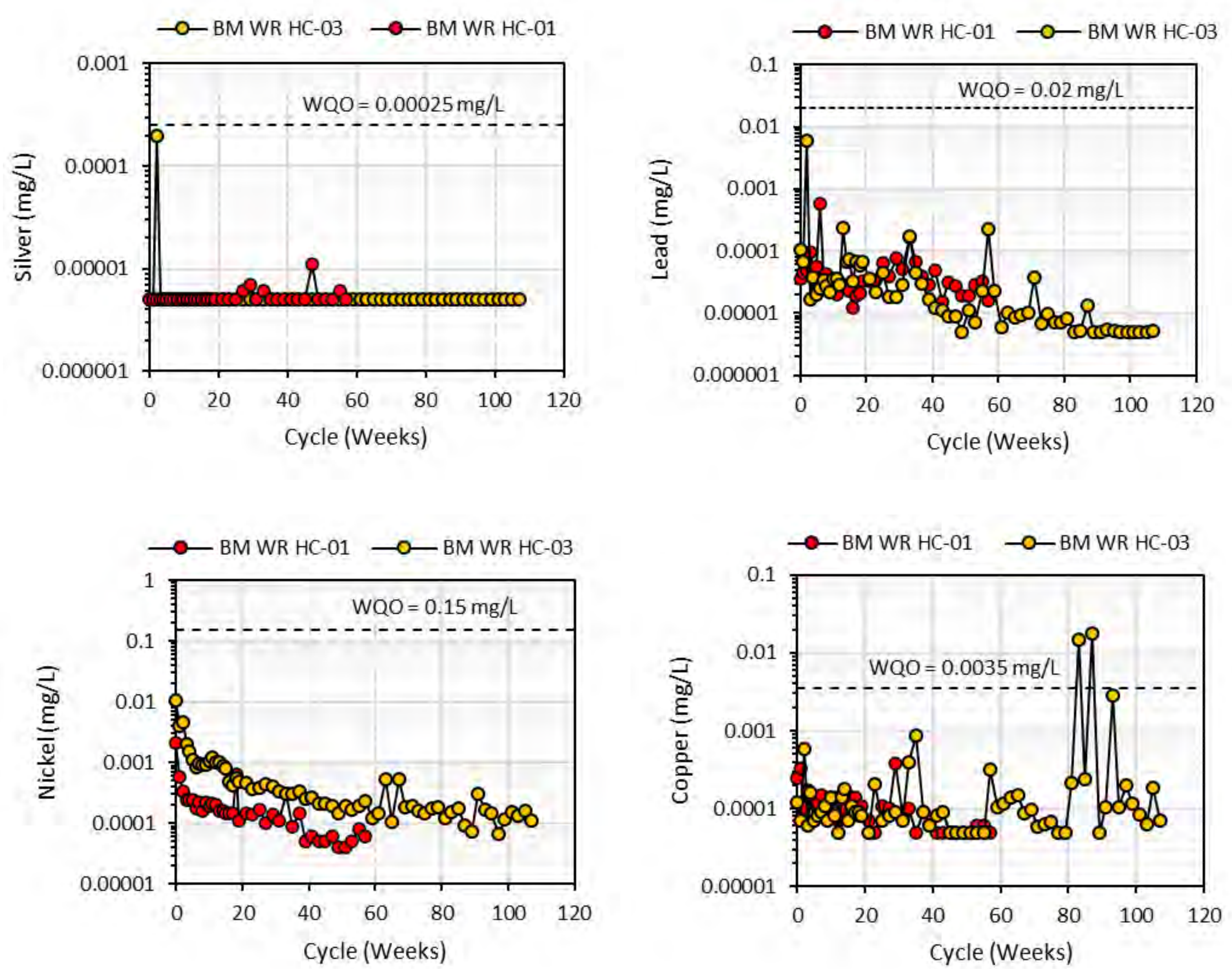


Figure 5-5: Silver, Lead, Nickel, and Copper Trends within the Bermingham N-AML Waste Rock Humidity Cells

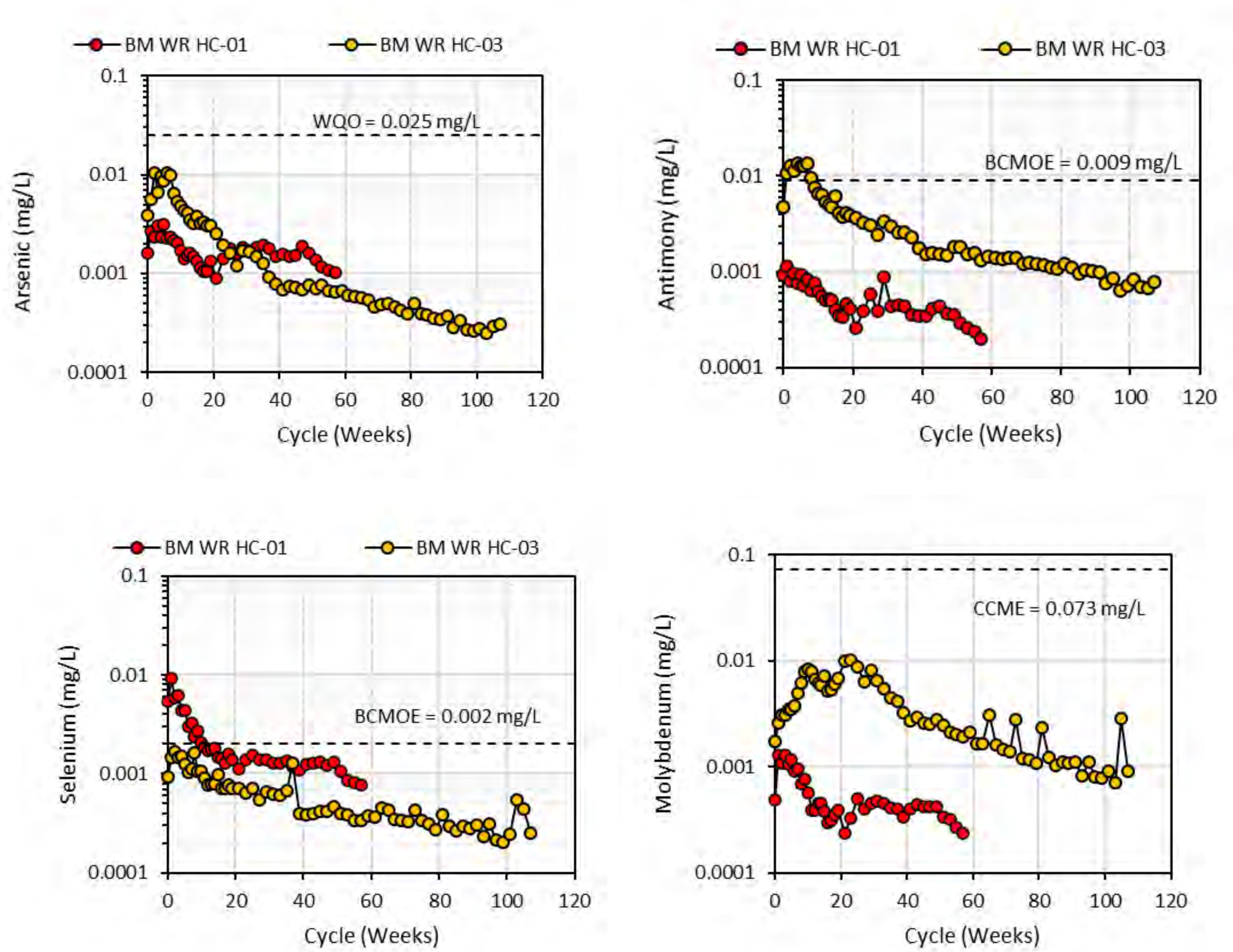


Figure 5-6: Arsenic, Antimony Selenium and Molybdenum Trends within the Bermingham N-AML Waste Rock Humidity Cells

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.

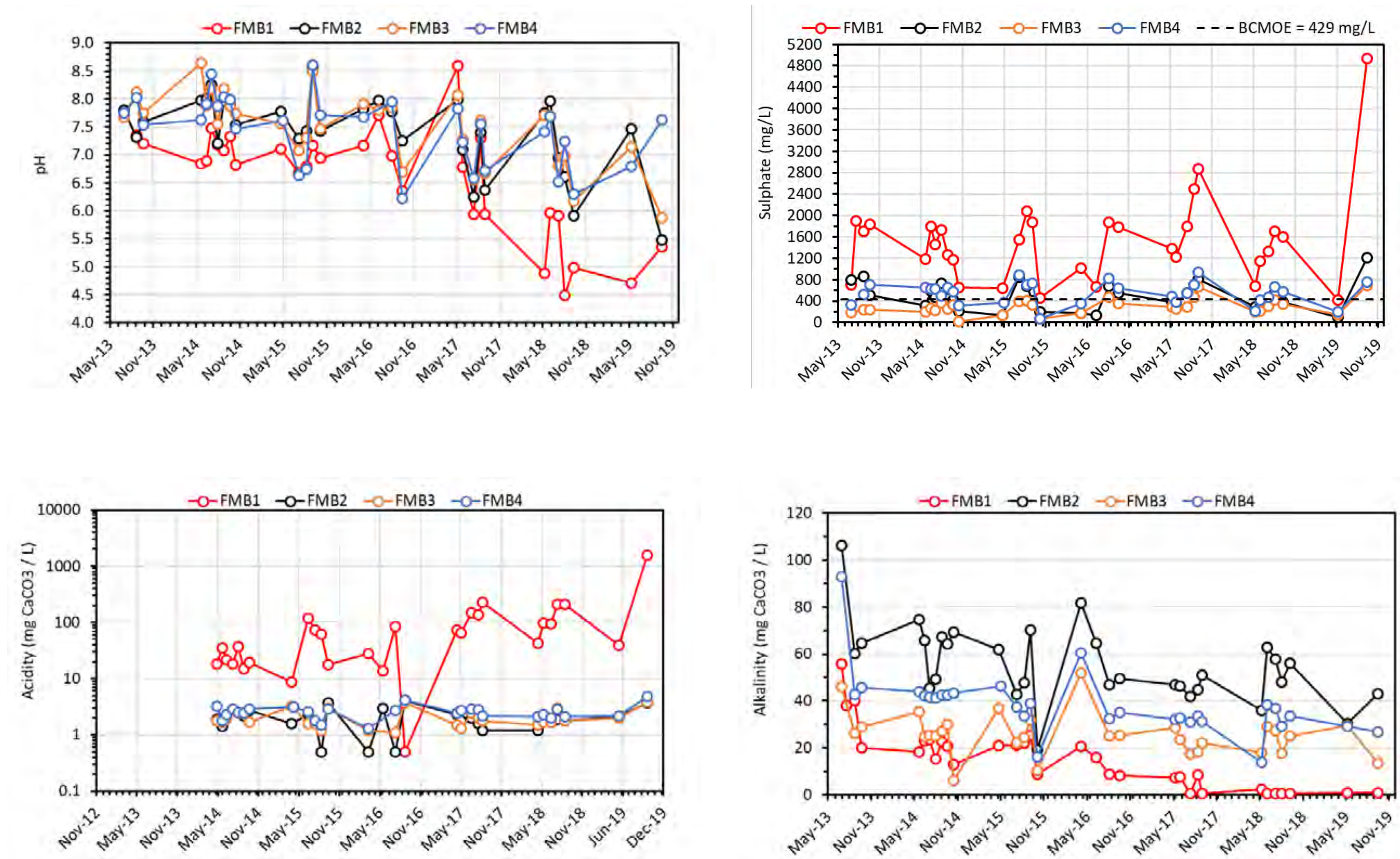


Figure 5-7: Trends in Flame & Moth Waste Rock Field Barrel pH, Sulphate, Alkalinity and Acidity Levels

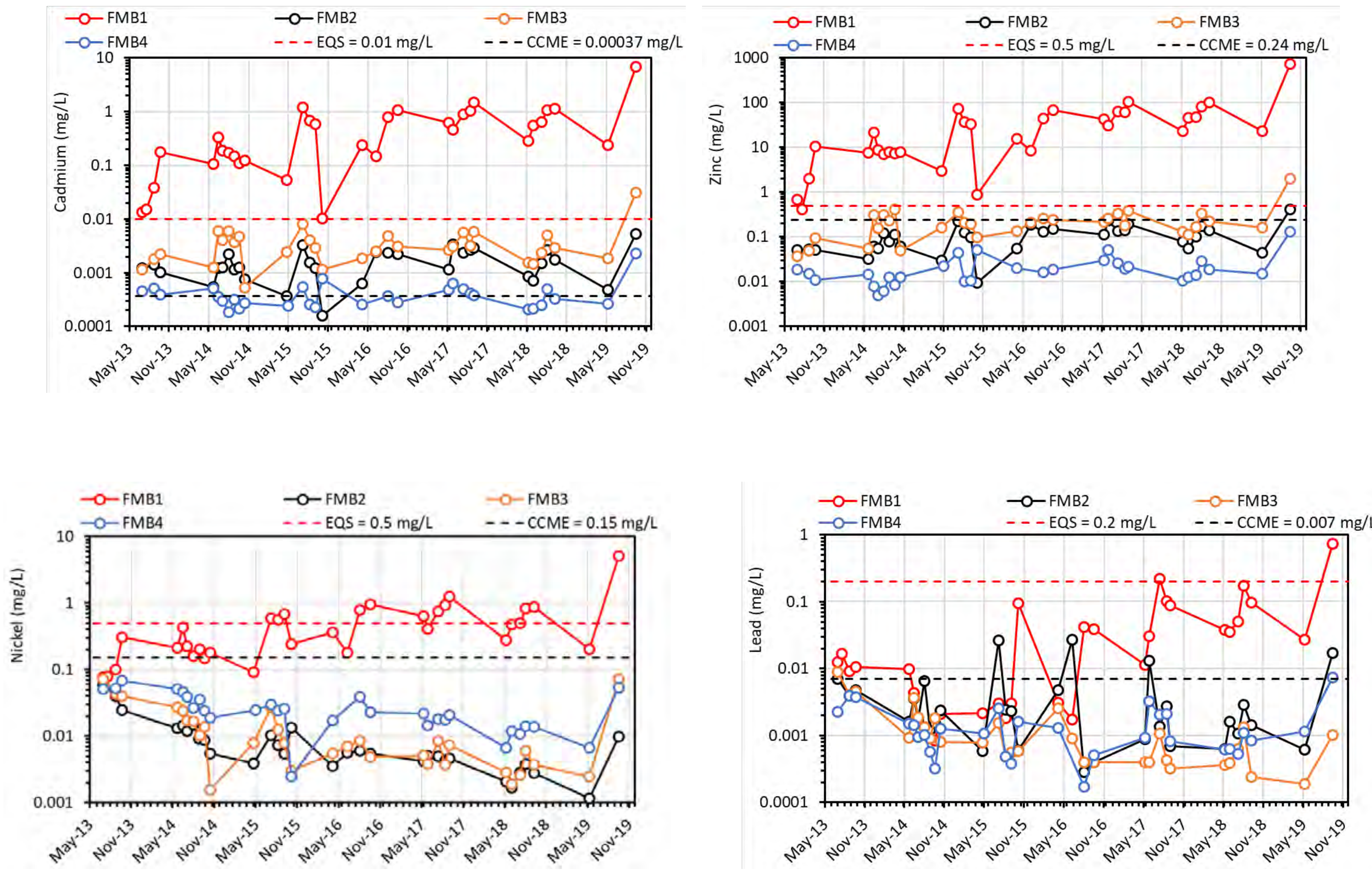


Figure 5-8: Trends in Flame & Moth Waste Rock Field Barrel Cadmium, Zinc, Nickel, and Lead Concentration

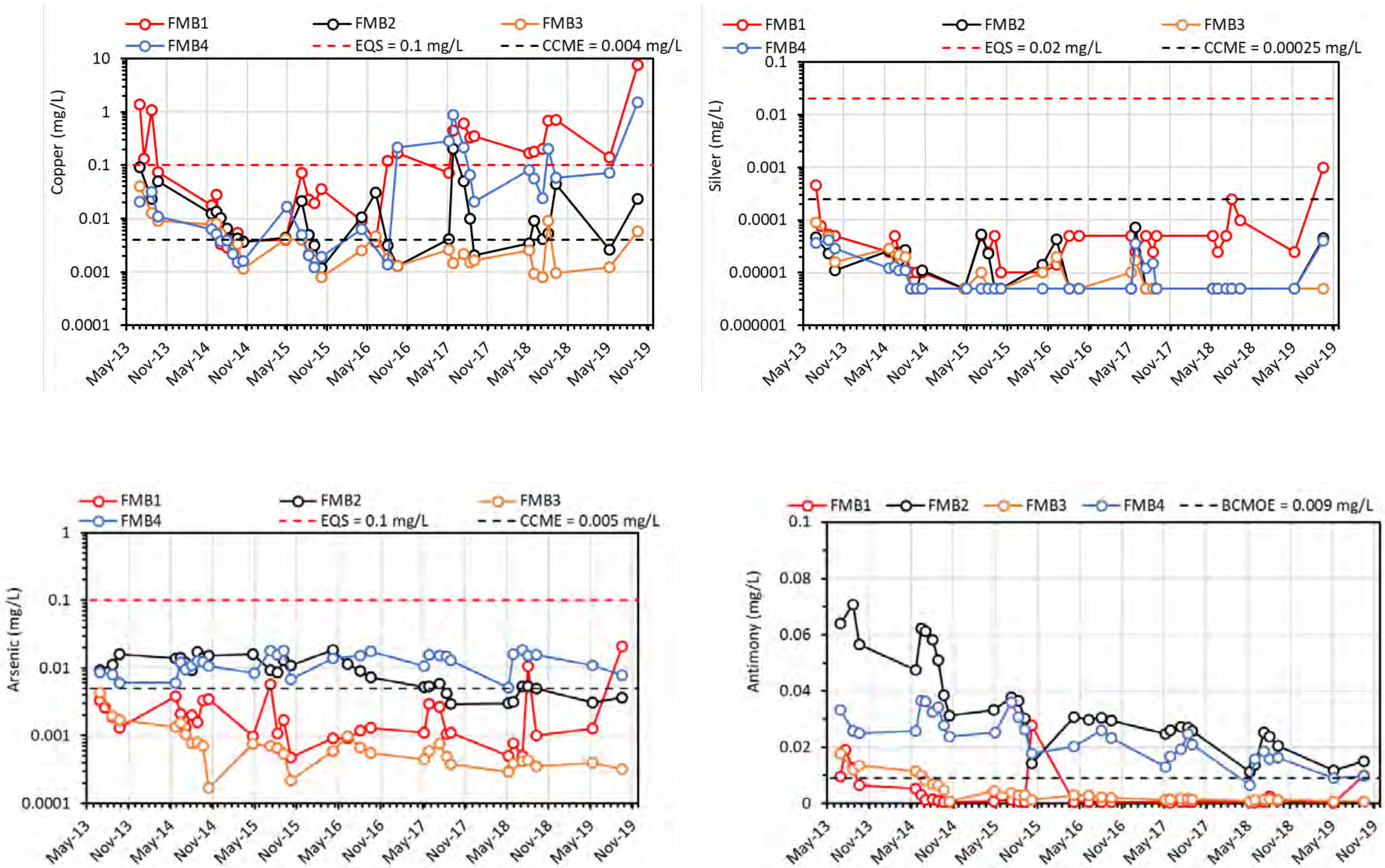


Figure 5-9: Trends in Flame & Moth Waste Rock Field Barrel Copper, Silver, Arsenic, and Antimony Concentrations

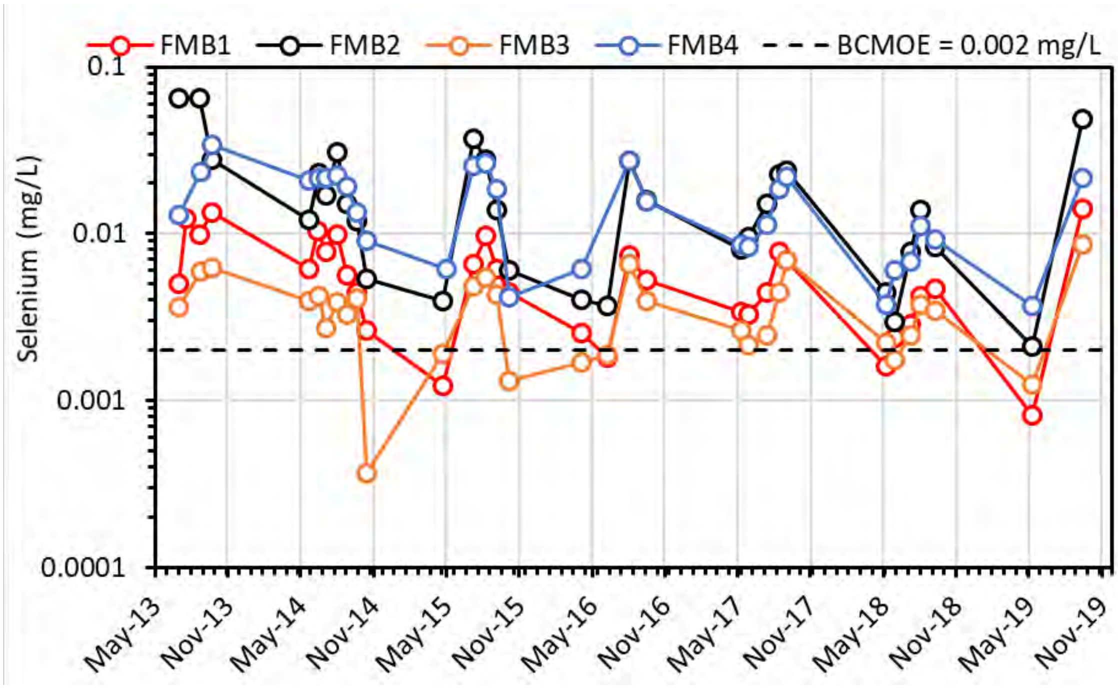


Figure 5-10: Trends in Flame & Moth Waste Rock Field Barrel Selenium Concentrations

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).

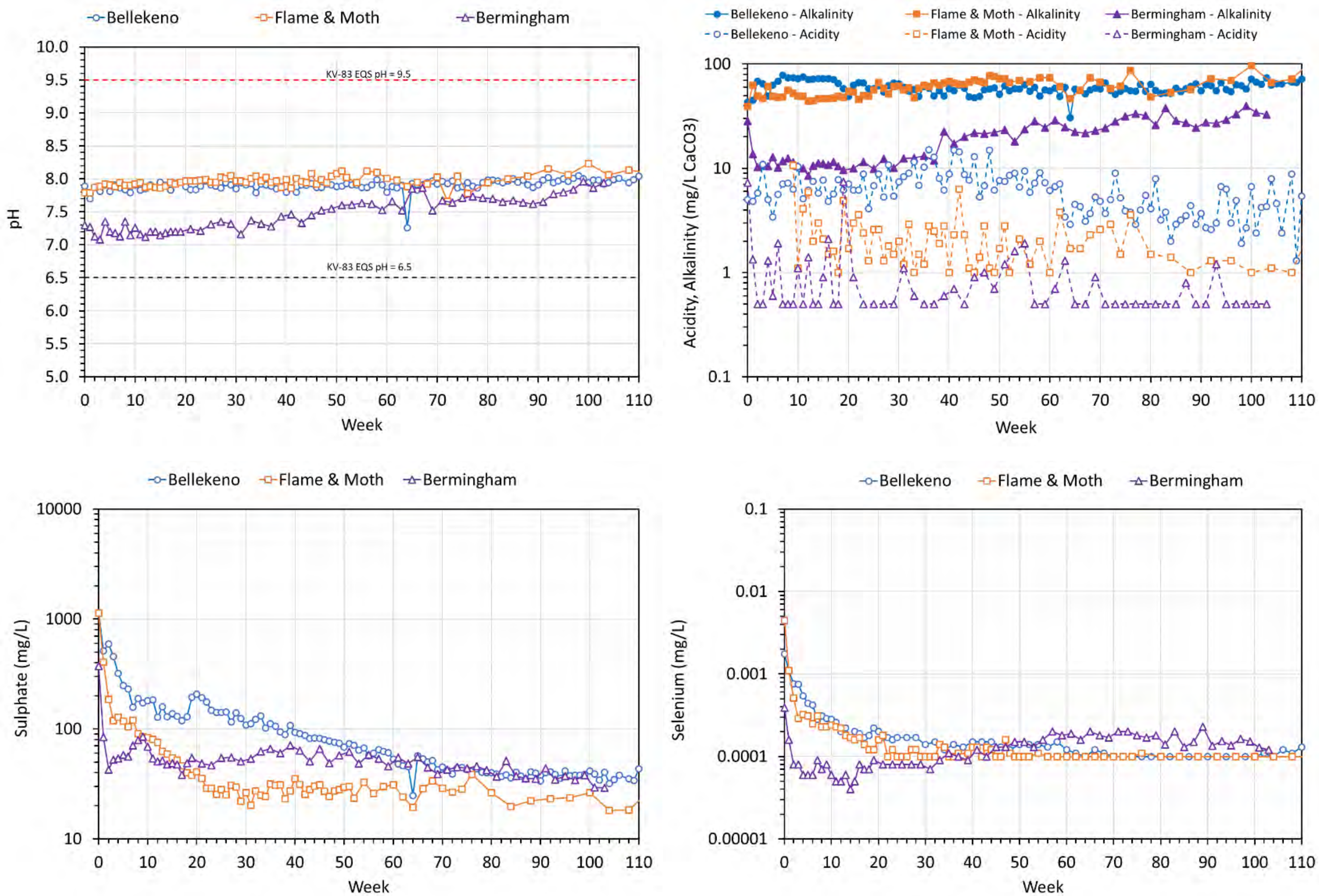

Figure 4-1: pH (top left), Acidity and Alkalinity (top right), Sulphate (bottom left) and Selenium (bottom right) Trends within the Bermingham LC, Flame and Moth and Bellekeno Tailings Humidity Cells

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.

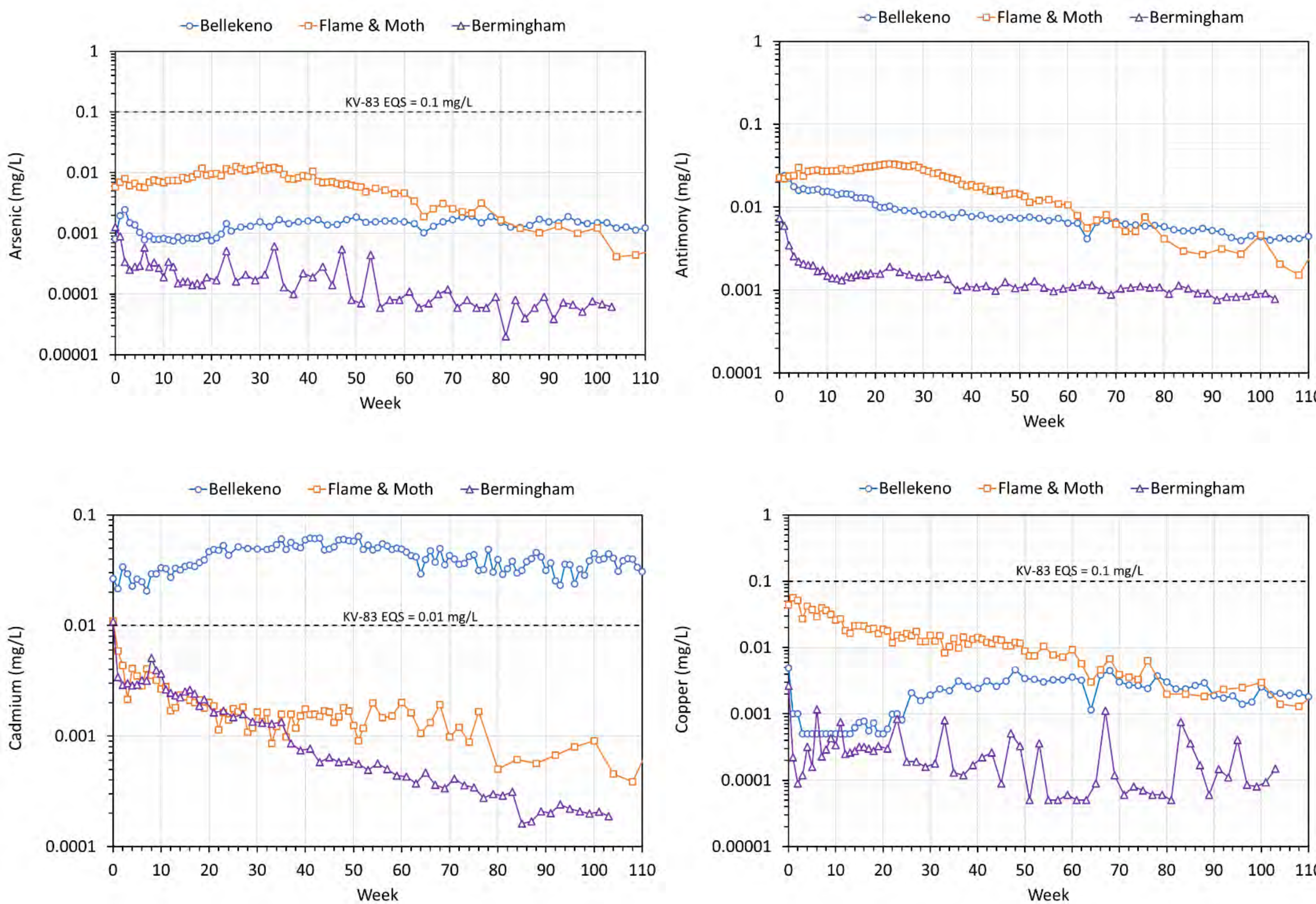

Figure 4-2: Arsenic (top left), Cadmium (bottom left), Antimony (top right), and Copper (bottom right) Trends within the Bermingham LC, Flame and Moth and Bellekeno Tailings Humidity Cells

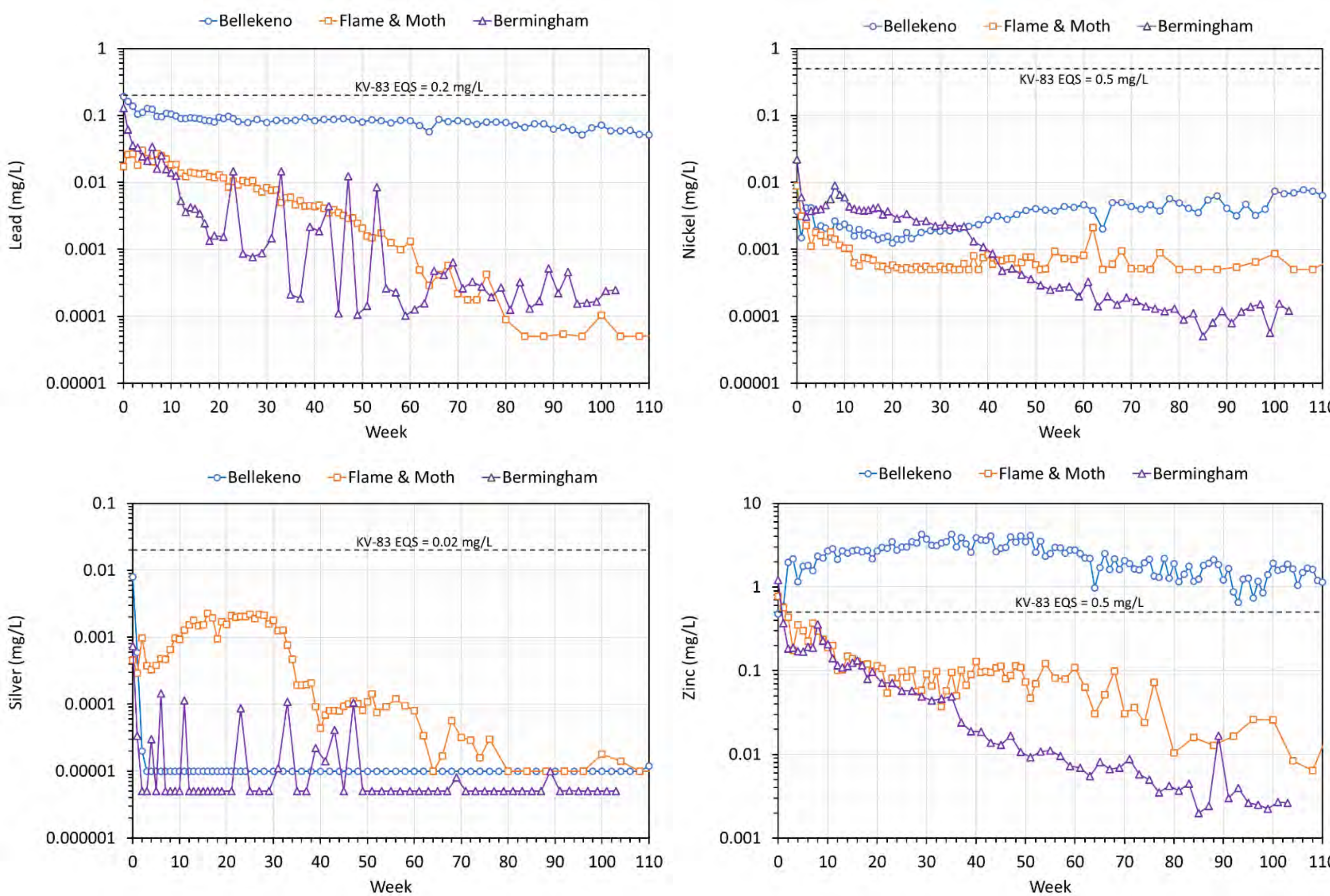

Figure 4-3: Lead (top left), Silver (bottom left), Nickel (top right), and Zinc (bottom right) Trends within the Bermingham LC, Flame and Moth and Bellekeno Tailings Humidity Cells

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.

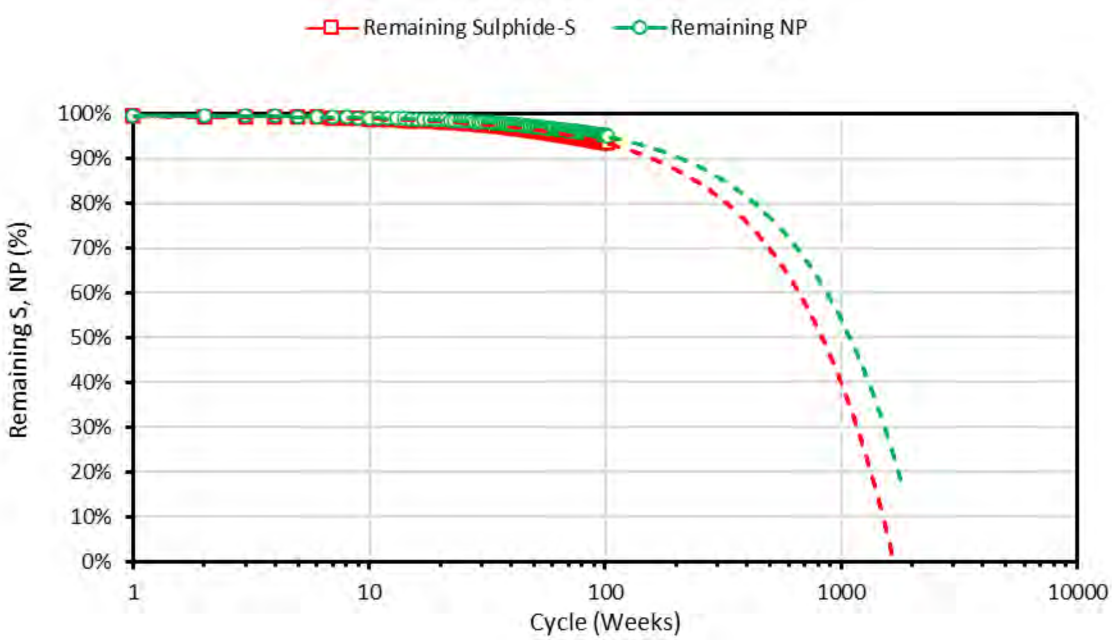

Figure 4-4: Calculations of Sulphide Sulphur and NP Depletion in Bermingham Tailings Humidity Cell

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 Storage Facility 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 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

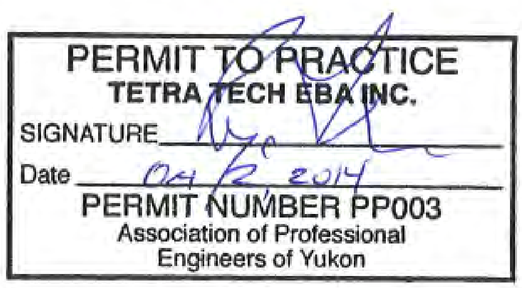
This report and its contents are intended for the sole use of Alexco Resource Corp and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report 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).

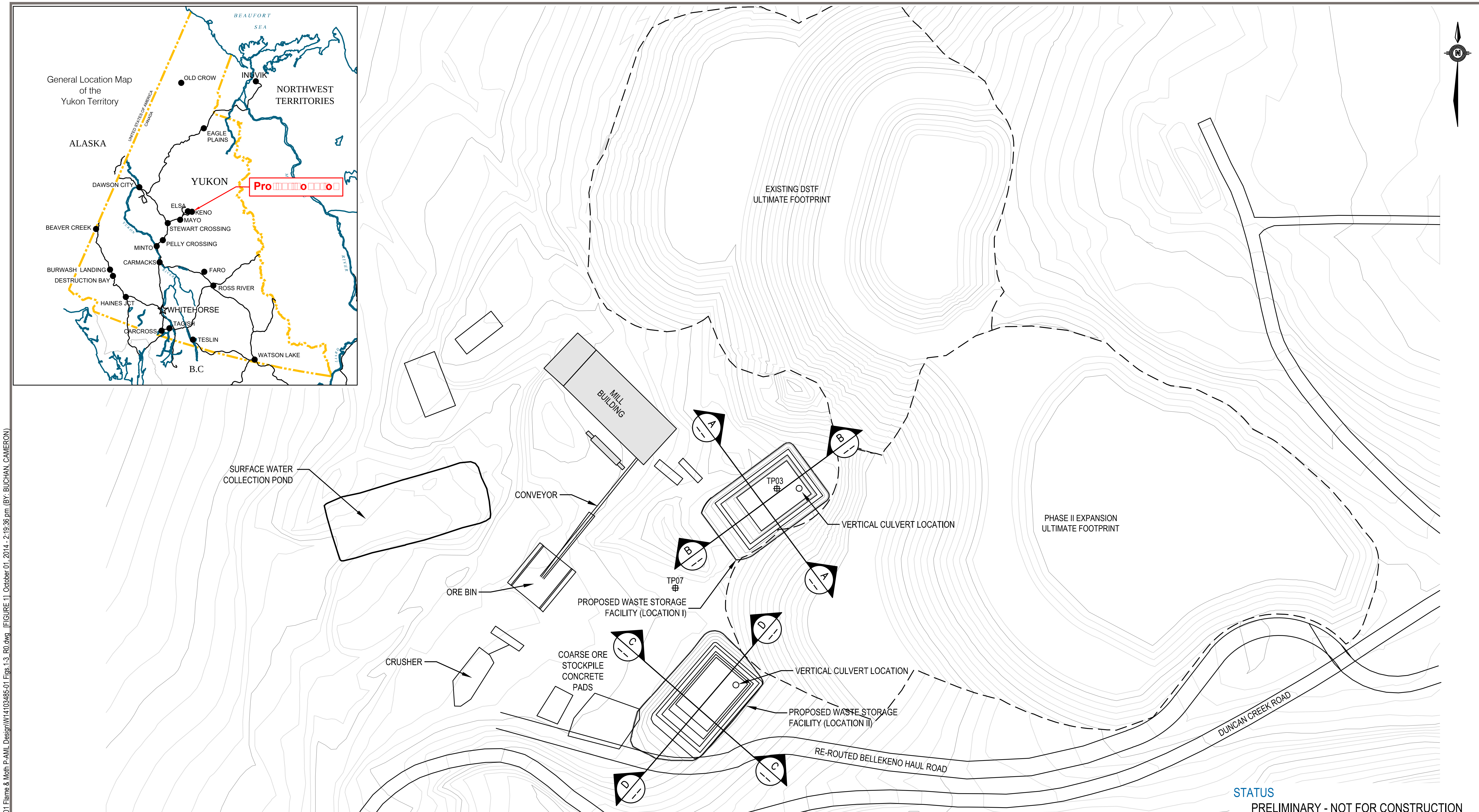
REFERENCES

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



STATUS

PRELIMINARY - NOT FOR CONSTRUCTION

LEGEND

- TESTPIT LOCATION (2009)

0 100 m

Scale: 1 : 1750 @ 11"x17"

CLIENT

ALEXCO

TETRA TECH EBA

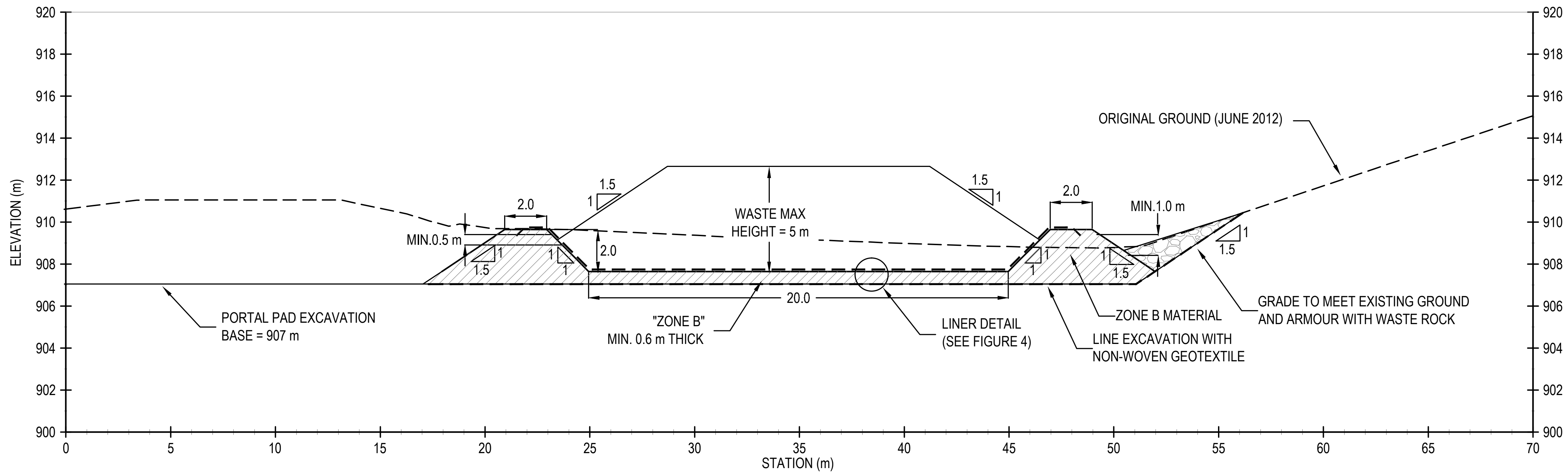
FLAME AND MOTH WASTE STORA E FACILITY
KENO HILL DISTRICT YUKON

SITE PLAN

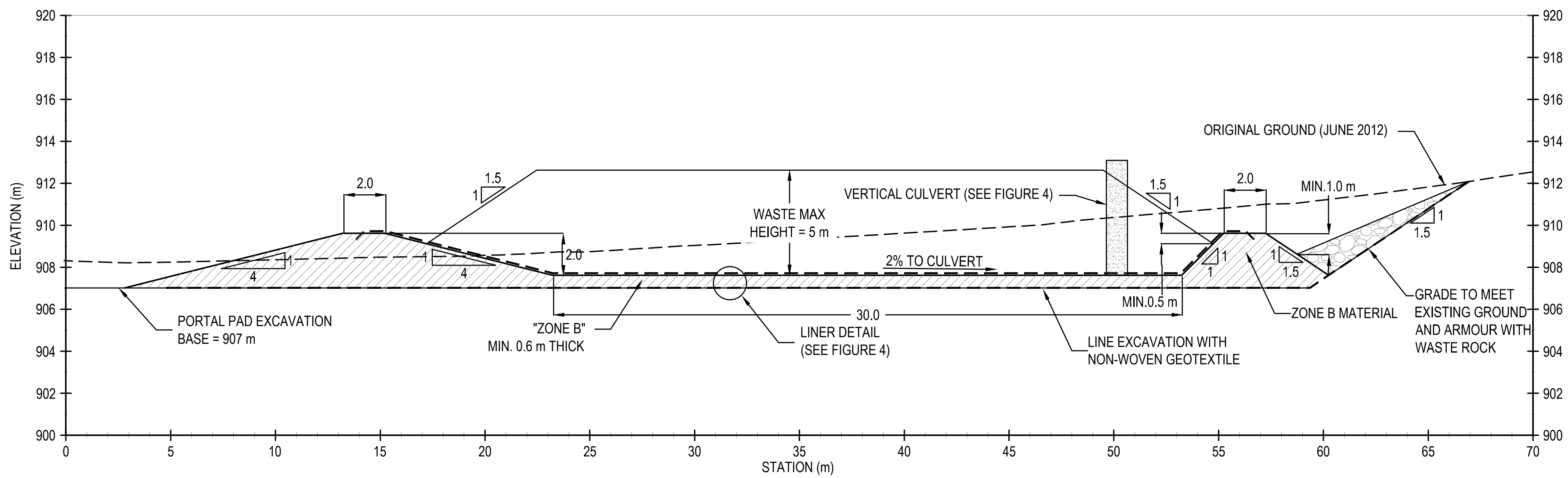
PROJECT NO.	DWN	CKD	REV
W14103485-01	CB	JTP	0

OFFICE	DATE
EBA-WHSE	September 25, 2014

Q:\Whitehorse\Data\0201drawings\Keno\W14103485-01 Flame & Moth P-AML Design\W14103485-01 Figs 1-3_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

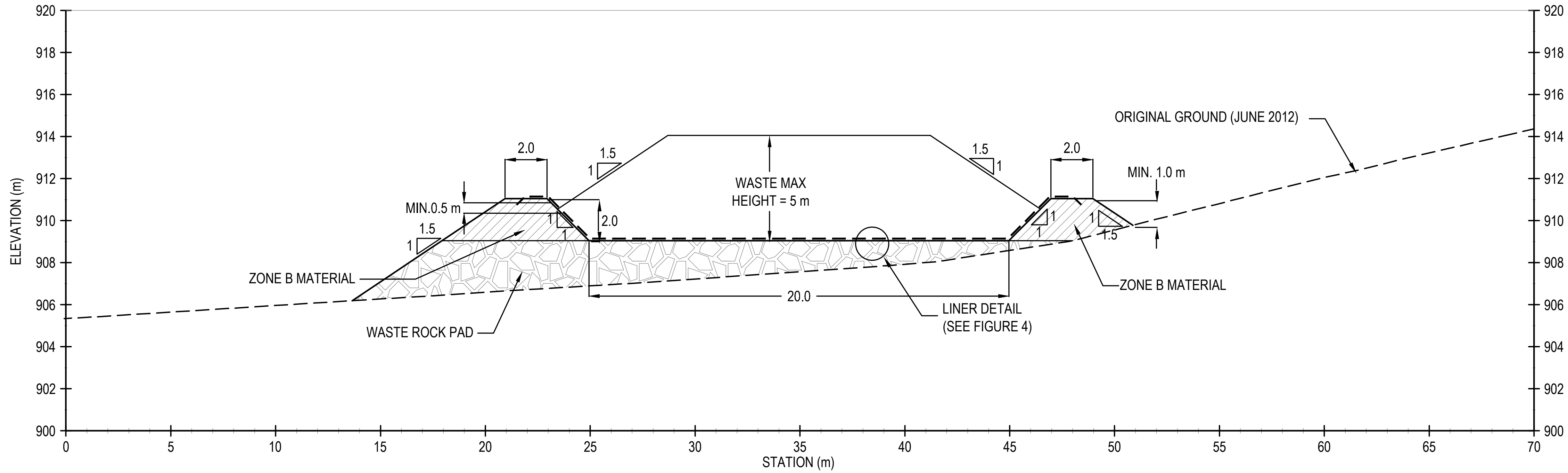
FLAME AND MOTH WASTE STORAGE FACILITY
KENO HILL DISTRICT, YUKON

LOCATION 1 CROSS SECTIONS

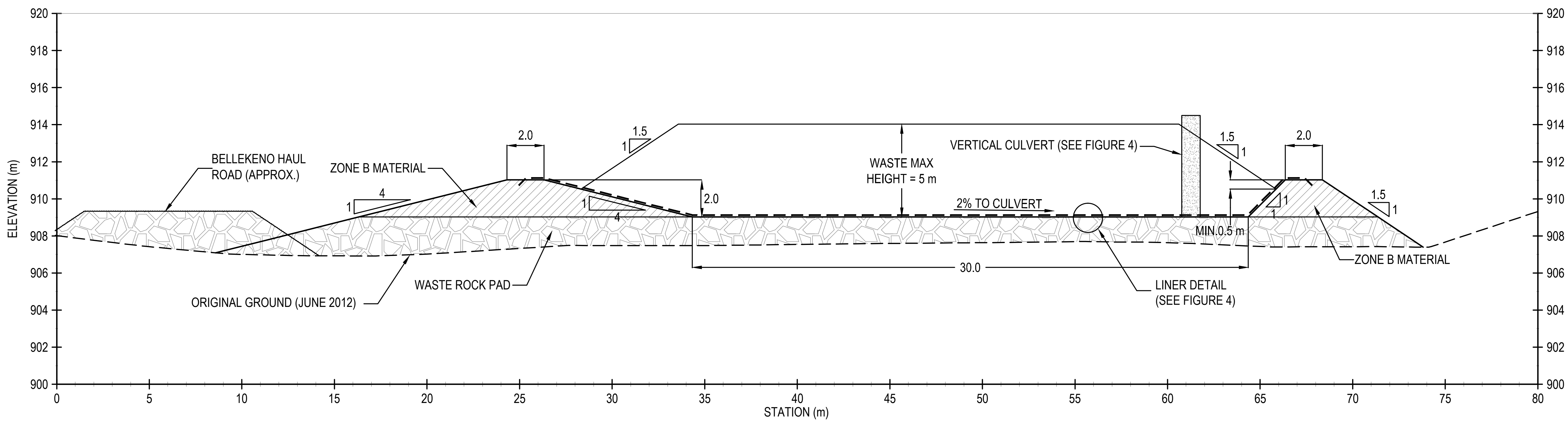
PROJECT NO.	DWN	CKD	REV
W14103485-01	CB	JTP	0

OFFICE	DATE
EBA-WHSE	September 25, 2014

F[illegible]



SECTION C - C'



SECTION D - D'

STATUS

PRELIMINARY - NOT FOR CONSTRUCTION

0 10 m

Scale: 1:250 @ 11"x17"

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)

CLIENT: ALEXCO

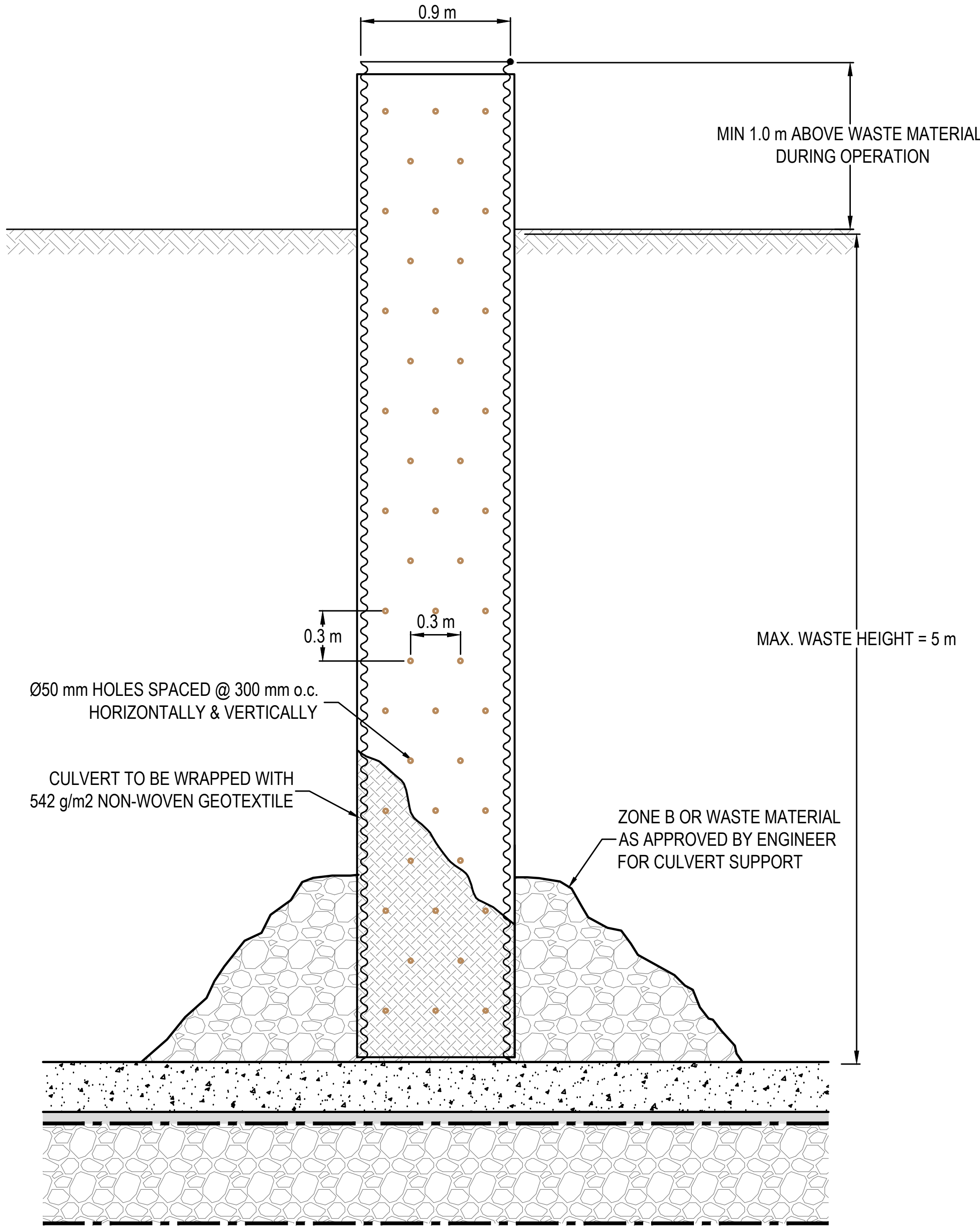
TETRA TECH EBA

FLAME AND MOTH WASTE STORA E FACILITY
KENO HILL DISTRICT YUKON

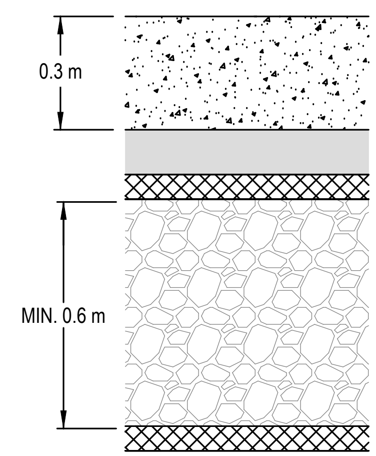
LOCATION II CROSS SECTIONS

PROJECT NO.	DWN	CKD	REV
W14103485-01	CB	JTP	0
OFFICE	DATE		
EBA-WHSE	September 25, 2014		

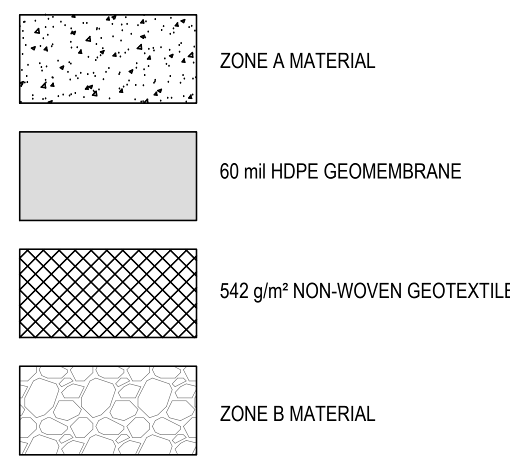
Figure



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	DATE
EBA-WHSE	September 26, 2014

Figure 4

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
1		Disturbed	SA01		M.C. 354		
							906.0
		Disturbed	SA02		M.C. 1158		
2							
							905.0
3	SILT - some sand, trace clay, soft (est.), low-plastic, massive, frozen, olive grey	Disturbed	SA03	-1.7		Vs (35%) ice lens up to 10cm thick	
							904.0
	SAND - silty, gravelly, trace clay, firm (est.), non-plastic, massive, frozen, olive grey	Disturbed	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	Disturbed	SA01				
	SAND - gravelly, trace cobbles, trace silt,, compact (est.), medium grained, well graded, damp to moist, brown, sub-rounded						906.0
1		Disturbed	SA02				
						Unfrozen	905.0
2	- seepage					Frozen Nbn	
	SILT - sandy, some gravel, trace clay, stiff (est.), low plastic, massive, olive grey						904.0
3		Disturbed	SA03	-0.1	H	Vx, Vc (<5%)	
						Unfrozen	903.0
4							
		Disturbed	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

DSTF RISK ASSESSMENT

Bellekeno Mine - Dry Stack Failure Modes and Effects Analysis
Final Draft

Prepared for

Alexco Resource Corp.

Prepared by

srk consulting

SRK Consulting (Canada) Inc.
1CA009.006
July 2013

Bellekeno Mine - Dry Stack Failure Modes and Effects Analysis
Final Draft

July 2013

Prepared for

Alexco Resource Corp.
Suite 1150 – 200 Granville Street
Vancouver, B.C. V6C 1S4
Canada

Tel: +1 604 633 4388
Web: www.alexcoresource.com

Prepared by

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2
Canada

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

srk consulting

Table of Contents

List of Tables

List of Appendices

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, 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.

Appendix A: Introductory PowerPoint Presentations

DSTF Risk Assessment

- Introductions
- Participants
- Objectives
- Risk Assessment Process Overview
- DSTF Overview
- DSTF Risk Assessment

Keno District Timeline

ALEXCO

- **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

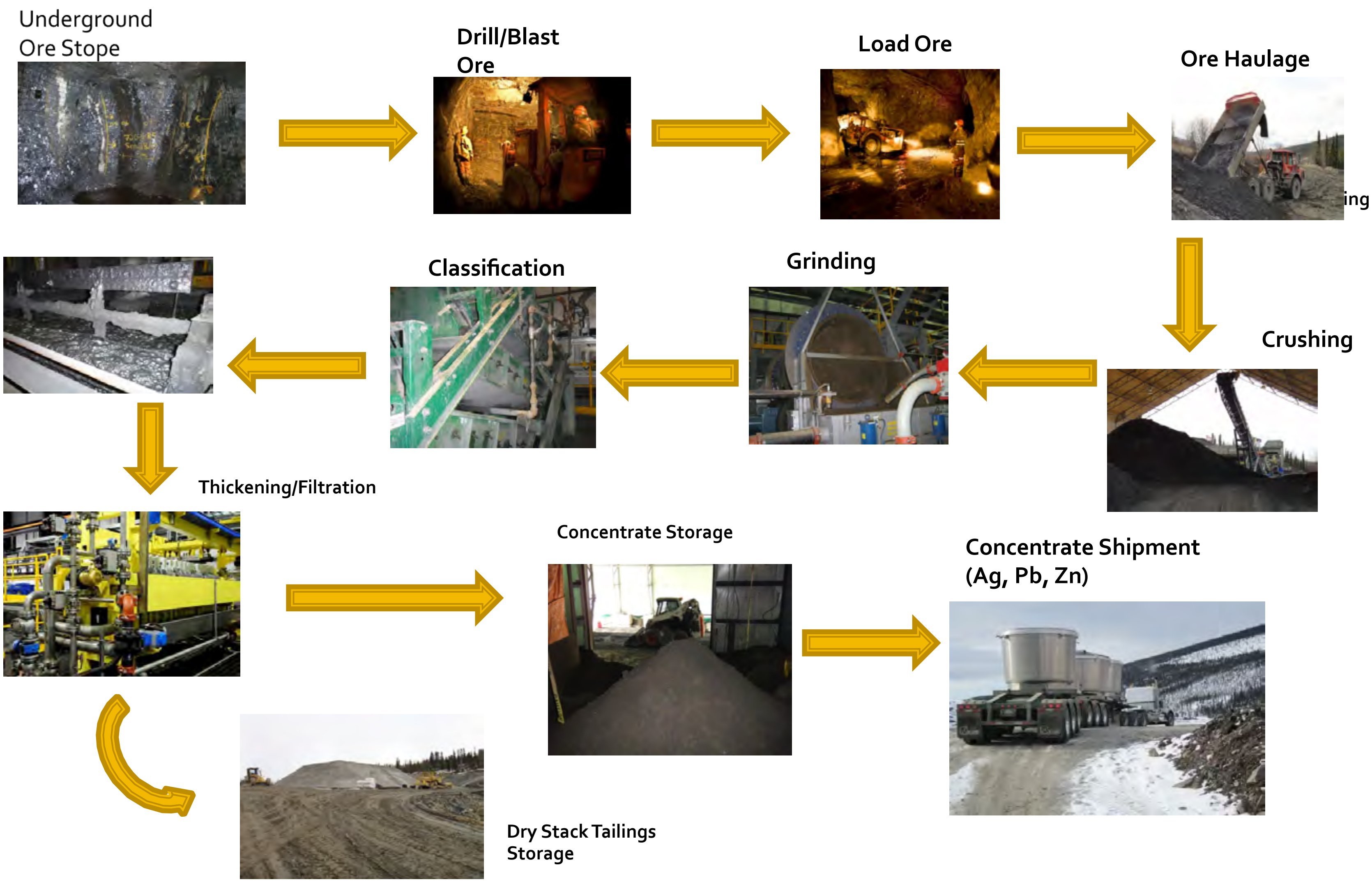
- **Advantages**
  - Reduced makeup water – increased recycle
  - Progressive reclamation enhanced
  - Decreased footprint from higher compaction, stack heights
  - Higher geotechnical stability if constructed appropriately
  - Pore water seepage significantly reduced – groundwater contamination eliminated 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

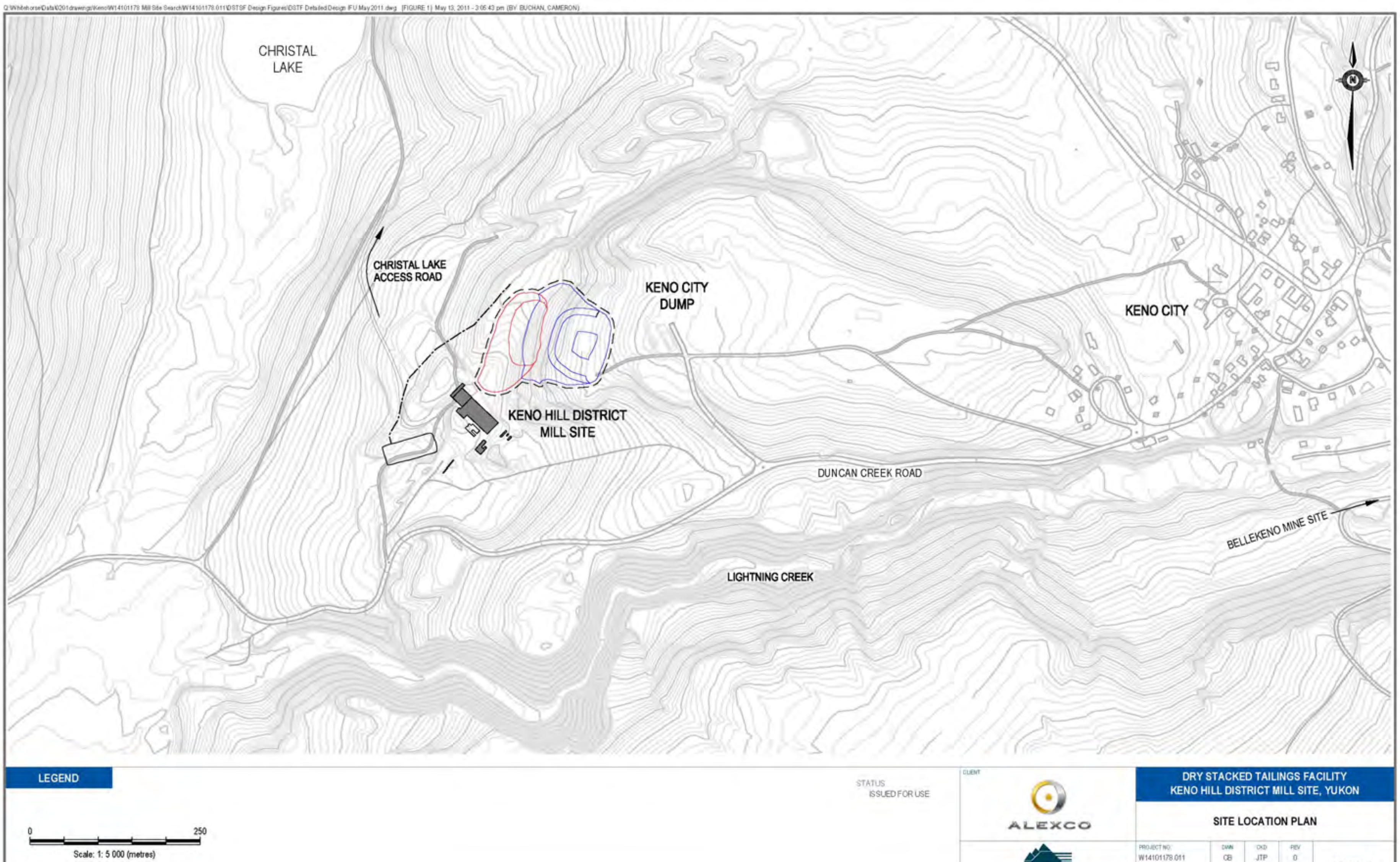
Mill Area Layout

Mill Process Flowsheet

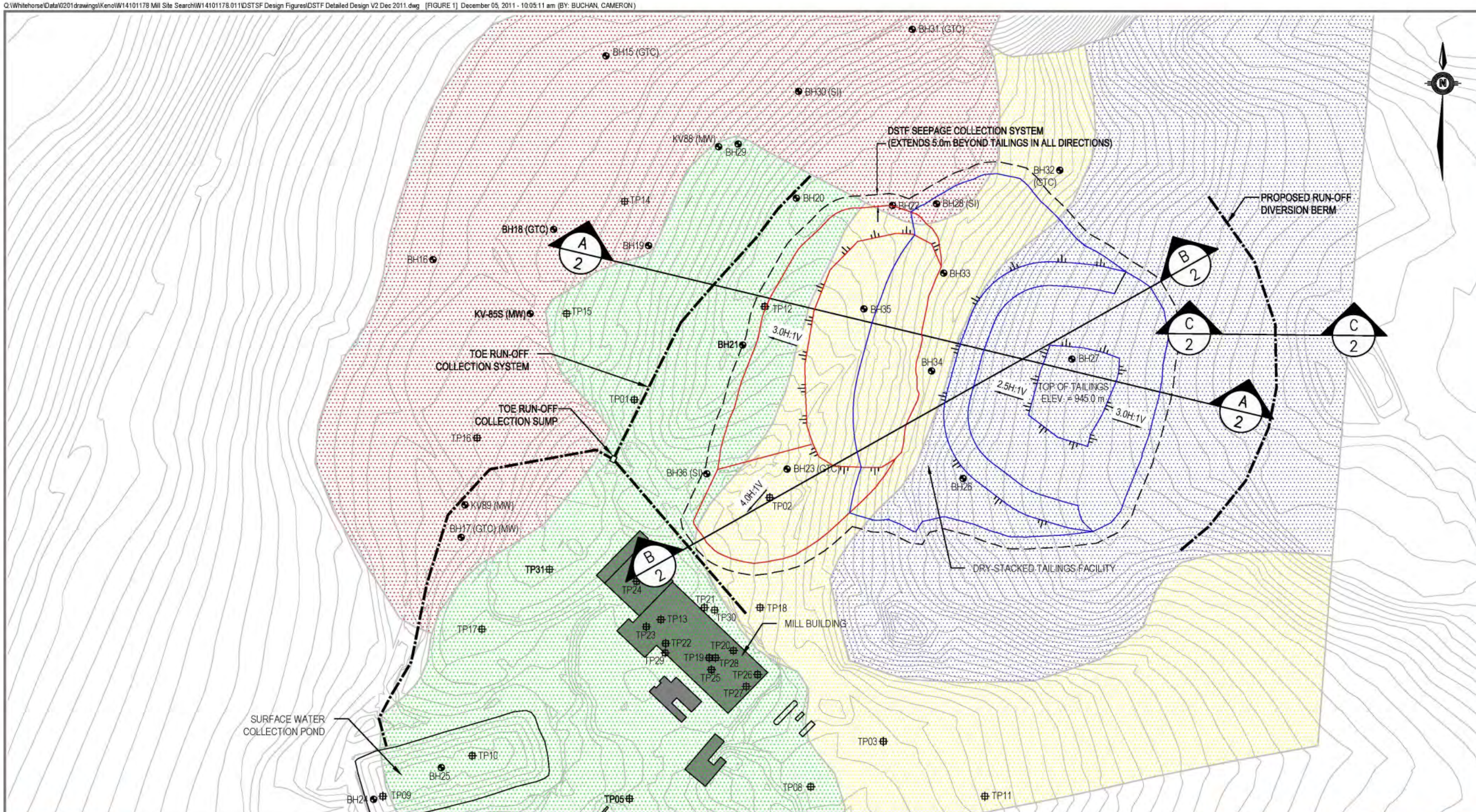


DSTF Design

ALEXCO



DSTF Design



LEGEND

- BOREHOLE LOCATION (CONFIRMATORY DRILLING)
- TESTPIT LOCATION
- GRAVEL
- MASSIVE ICE
- ICE RICH SILT TILL
- SHALLOW BEDROCK

STATUS
ISSUED FOR USE

Scale: 1: 1 500 (metres)

DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

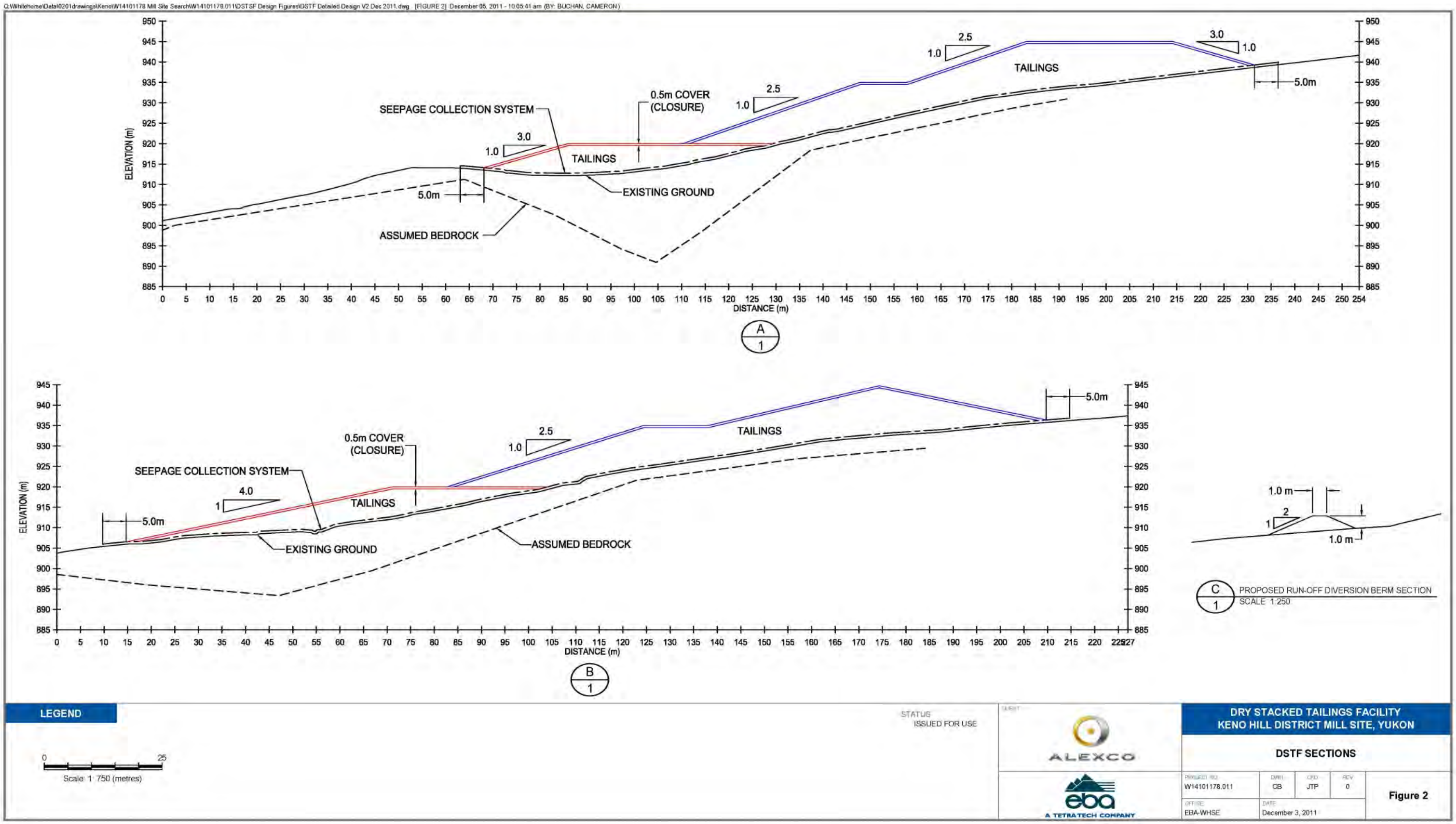
SITE PLAN SHOWING BOREHOLE LOCATIONS AND ASSUMED SUBSURFACE CONDITIONS

PROJECT NO	DWN	CKD	REV
W14101178.011	CB	JTP	0

OFFICE: EBA-WHSE
DATE: December 3, 2011

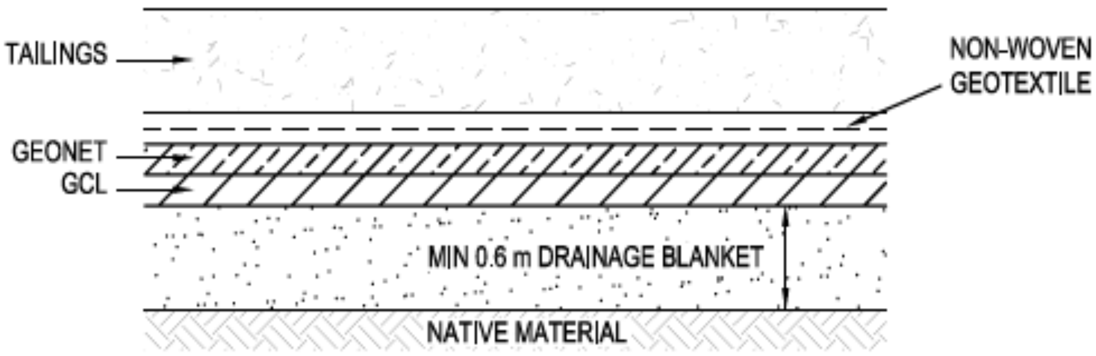
Figure 1

DSTF Design



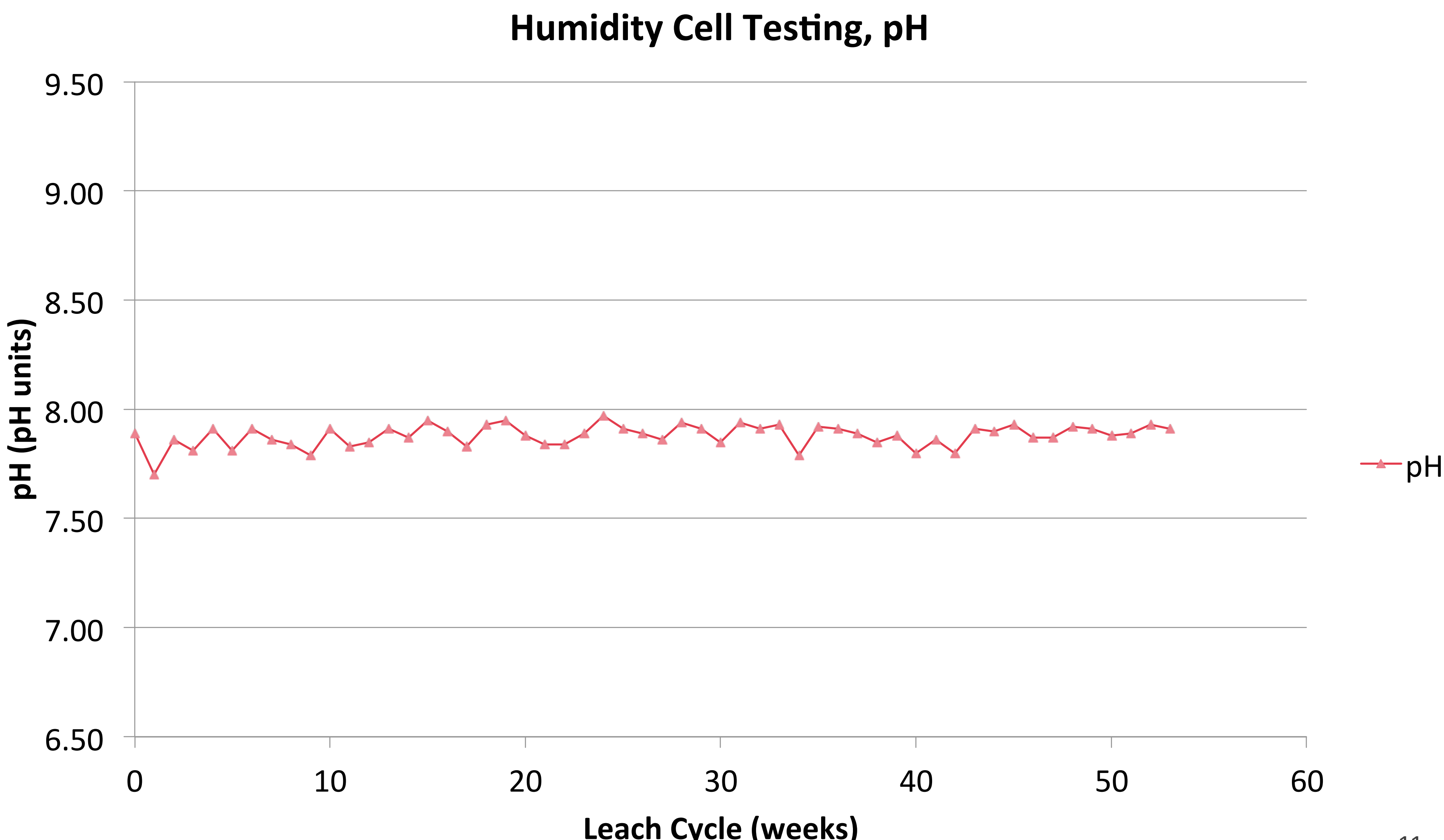
SEEPAGE COLLECTION SYSTEM
0.5m COVER (CLOSURE)
TAILINGS
EXISTING GROUND
ASSUMED BEDROCK
5.0m
ELEVATION (m)
DISTANCE (m)
A 1
B 1
C 1
PROPOSED RUN-OFF DIVERSION BERM SECTION
SCALE 1:250
LEGEND
Scale 1:750 (metres)
STATUS
ISSUED FOR USE
DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON
DSTF SECTIONS
W14101178.011
CB
JTP
0
EBA-WHSE
December 3, 2011
Figure 2

DSTF Design



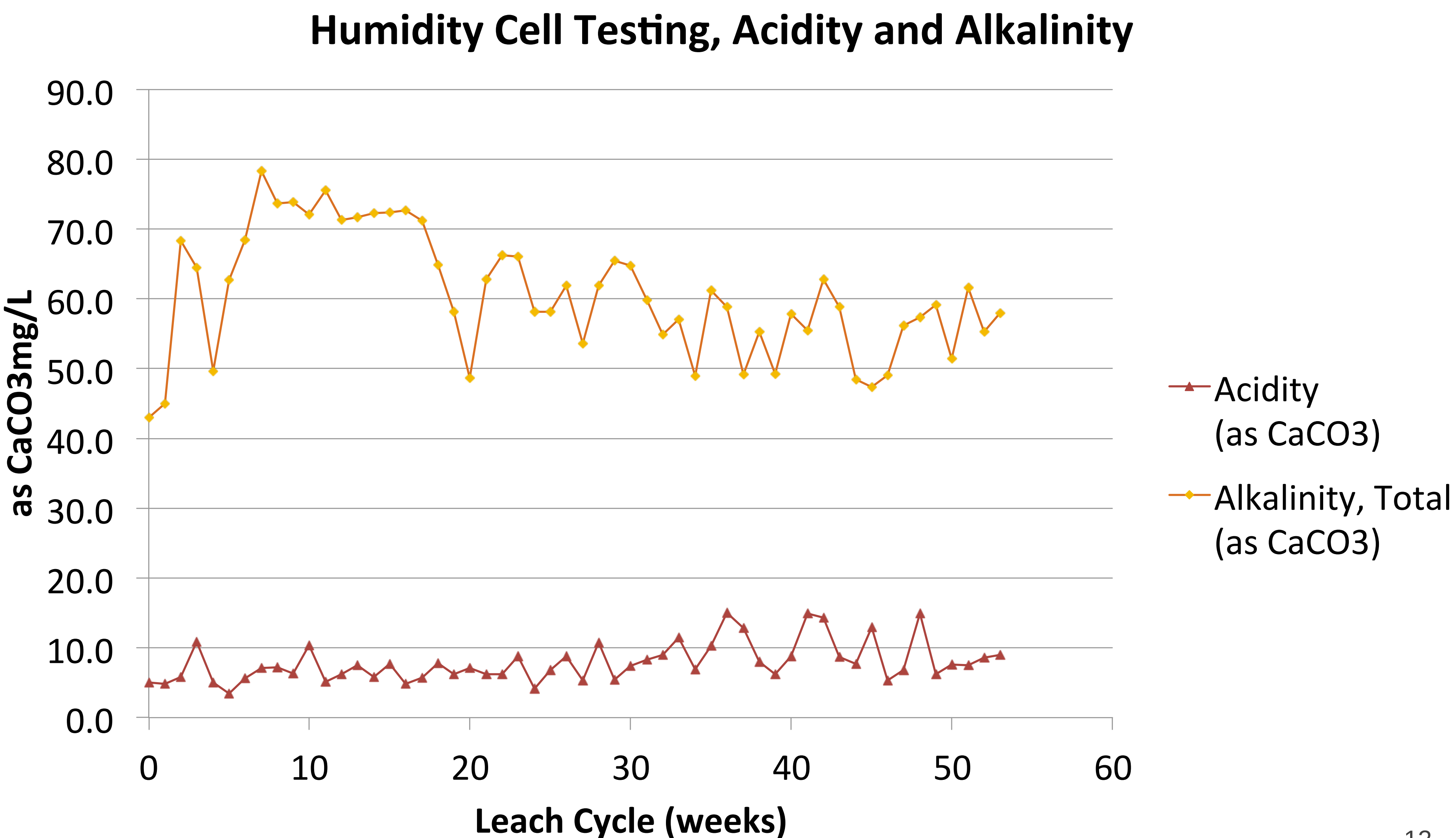
SEEPAGE COLLECTION SYSTEM DETAIL

DSTF Performance

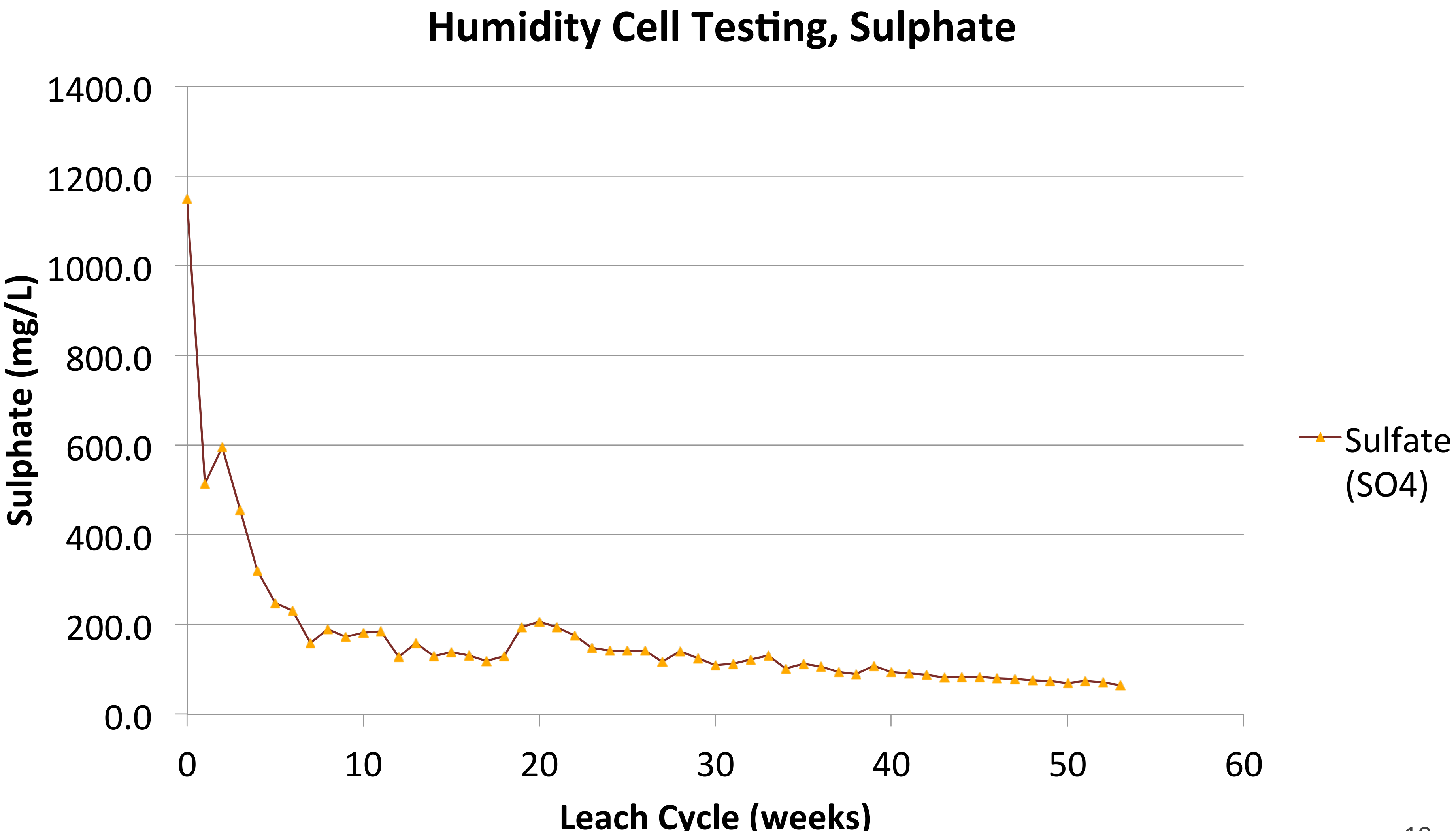


DSTF Performance

ALEXCO

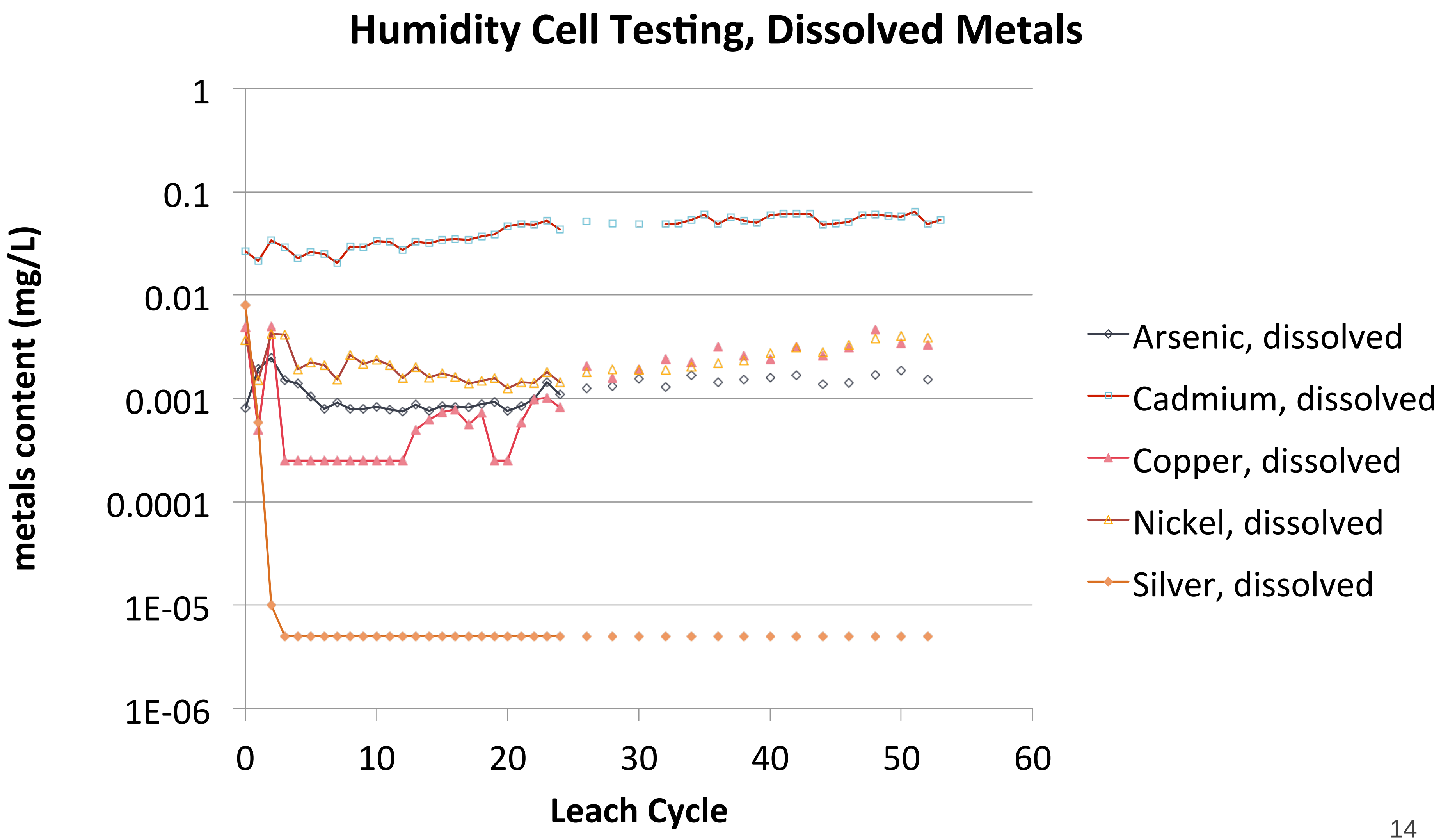


DSTF Performance

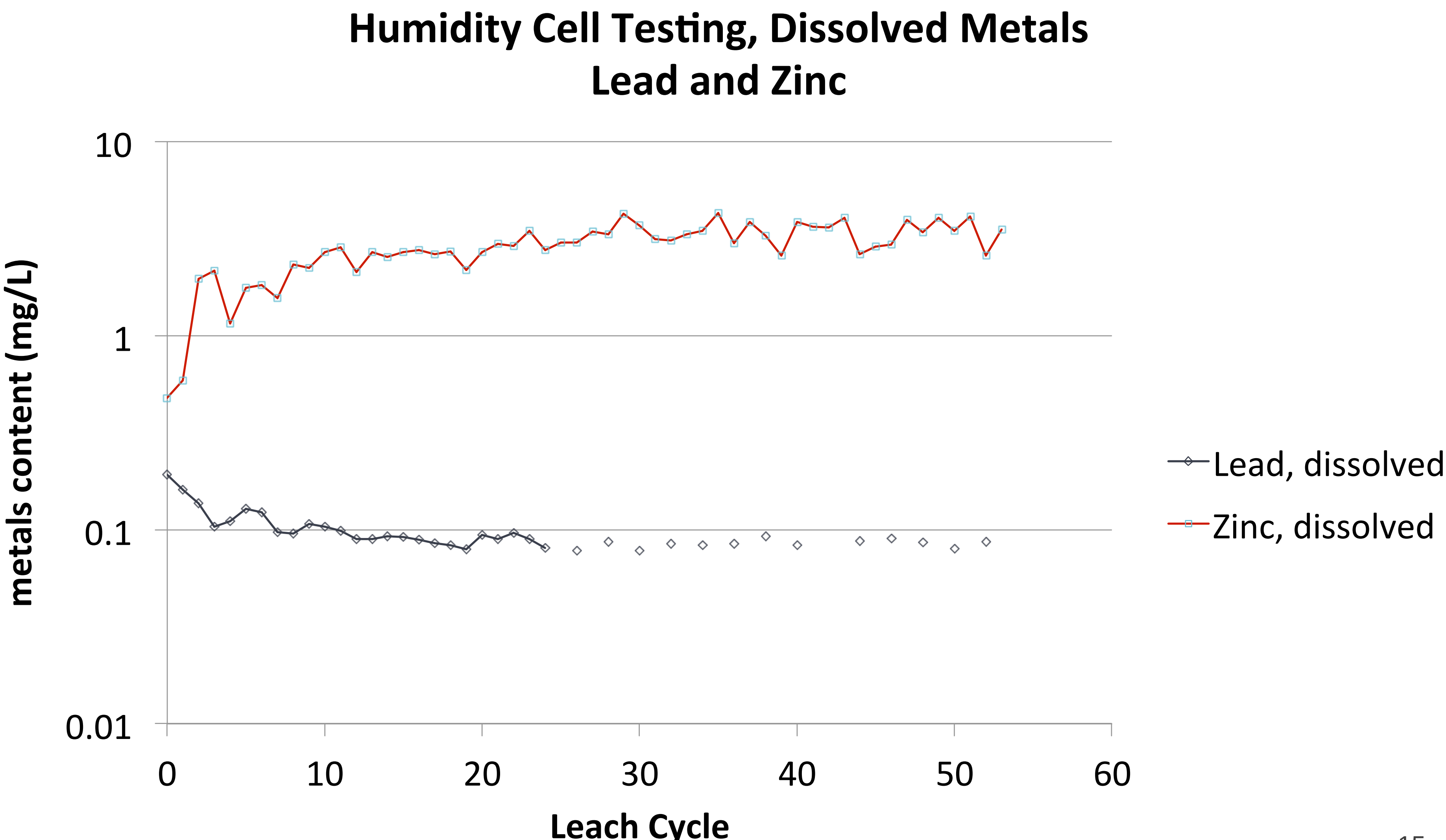


DSTF Performance

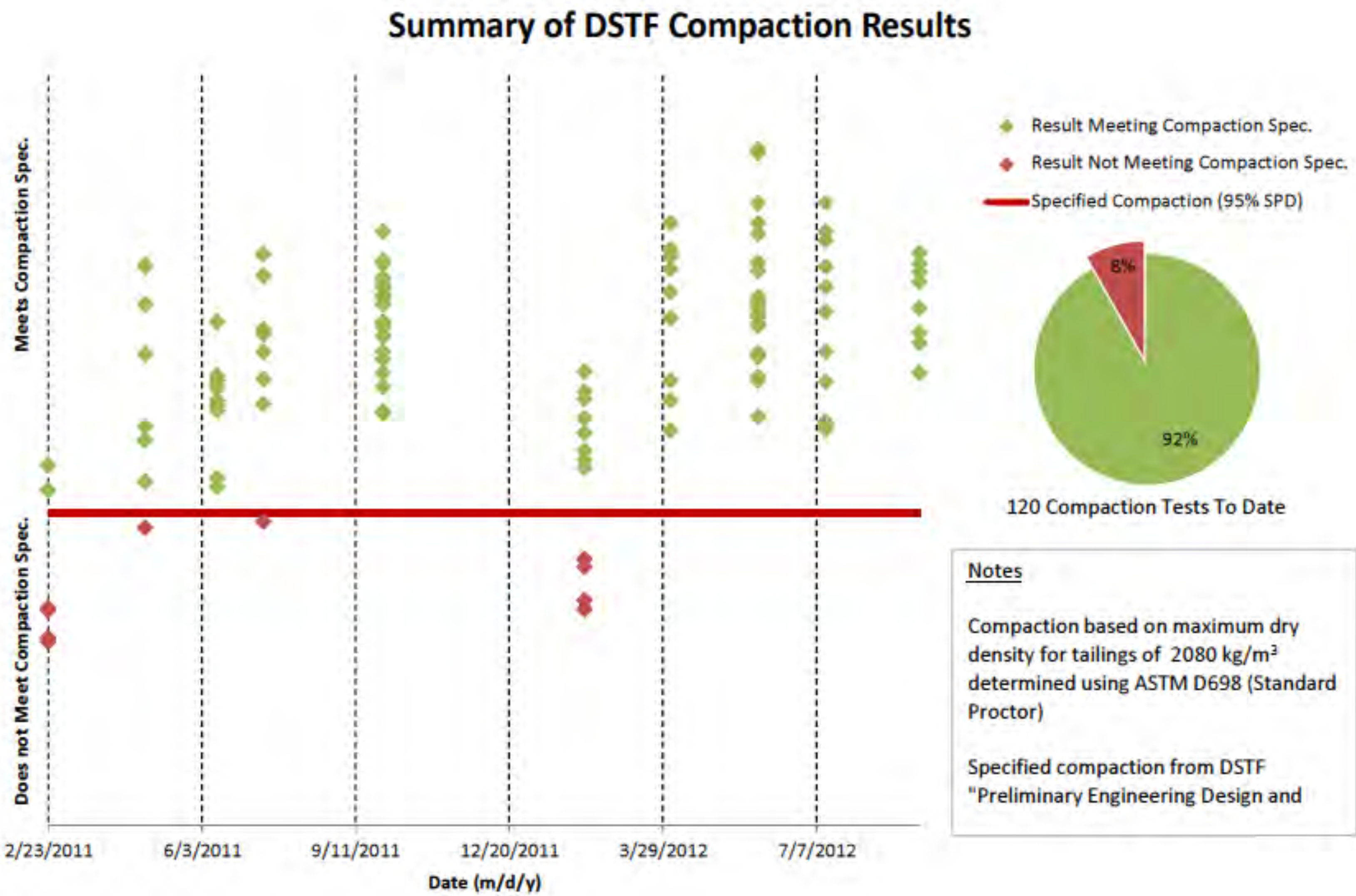
ALEXCO



DSTF Performance

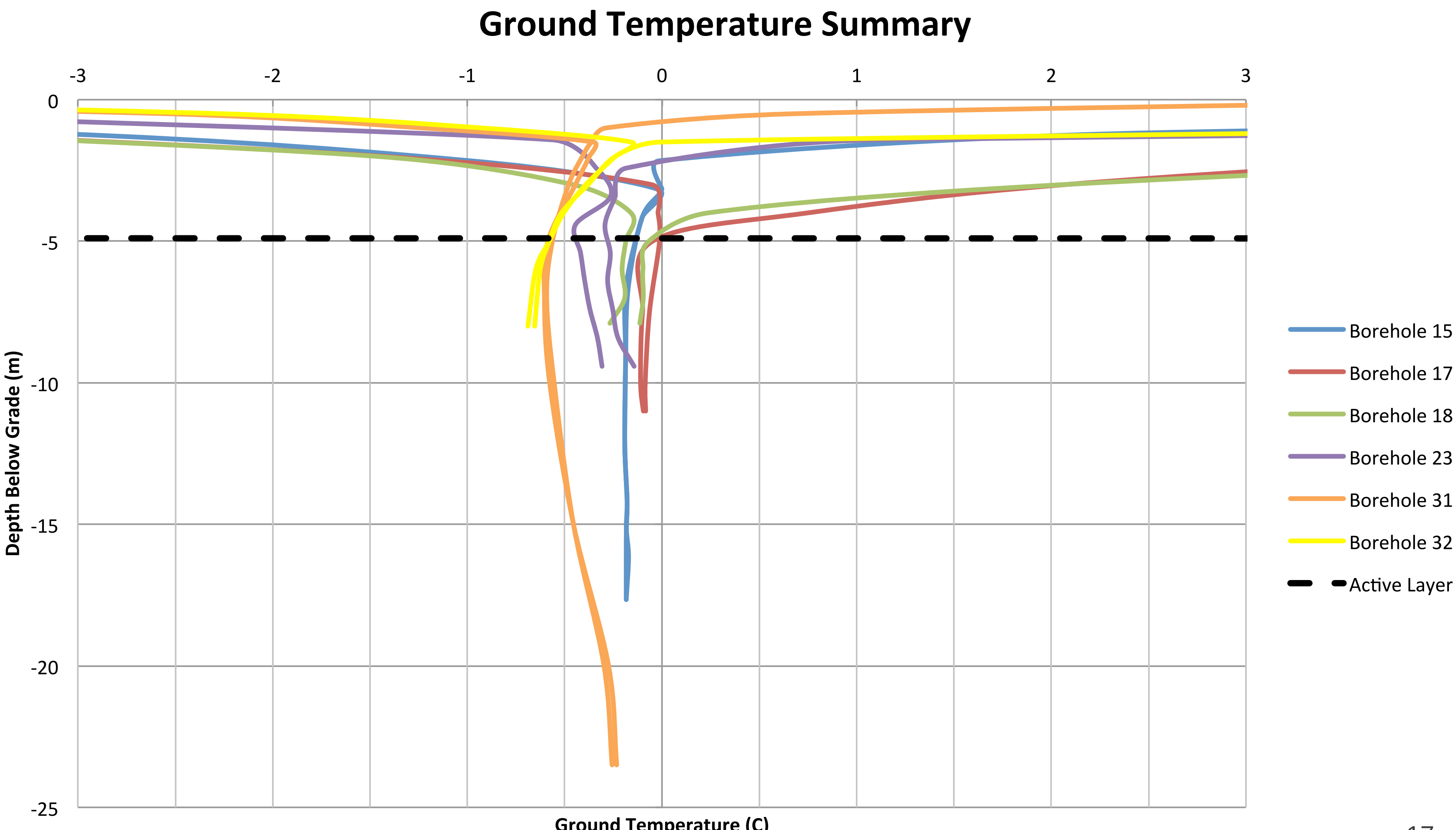


DSTF Performance - Compaction



DSTF Performance - Temperature

ALEXCO



DSTF Progressive Reclamation

ALEXCO

DSTF Progressive Reclamation

ALEXCO

DSTF Progressive Reclamation

Appendix 3.6

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

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF APPENDICES

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

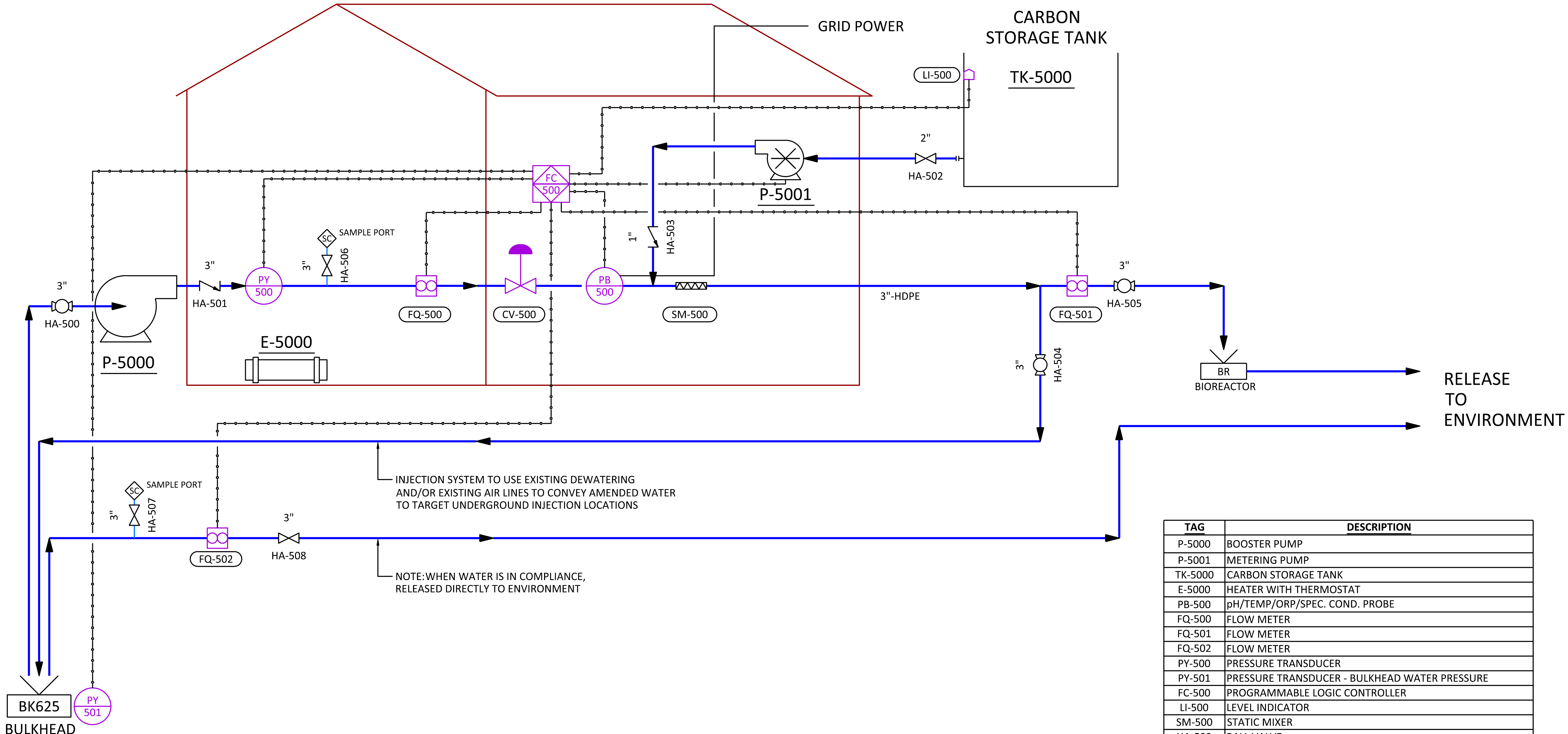
The existing settling ponds at the Bellekeno 625 mine site will be retained at closure and will be converted to use as secondary treatment as a bioreactor. This secondary treatment is discussed further in the BDOP as required under Clause 55 of the Water Licence.

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

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

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 3.7

Bioreactor Design and Operation Plan

KENO HILL SILVER DISTRICT MINING OPERATIONS

BIOREACTOR DESIGN AND OPERATION PLAN

November 2023

Prepared for:

HECLA YUKON

Prepared by:

ENSERO solutions

AKHM

Table of Contents

LIST OF FIGURES

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.

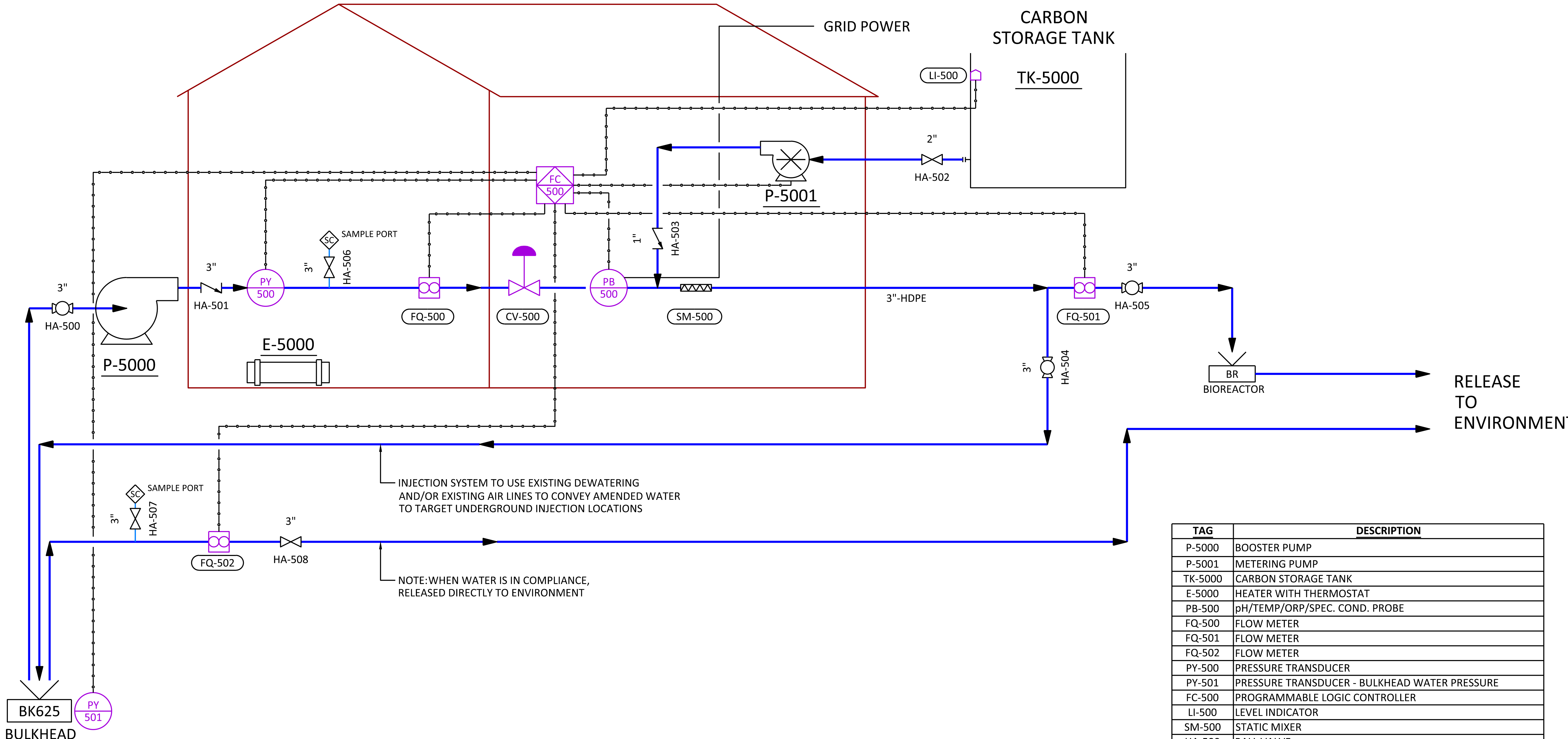
Water quality will be monitored at both the outlet from the underground for assessment of treatment effectiveness, as well as the final point of discharge from the pond.

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

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.

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AKHM

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No.: AKHM-13-01-D2601

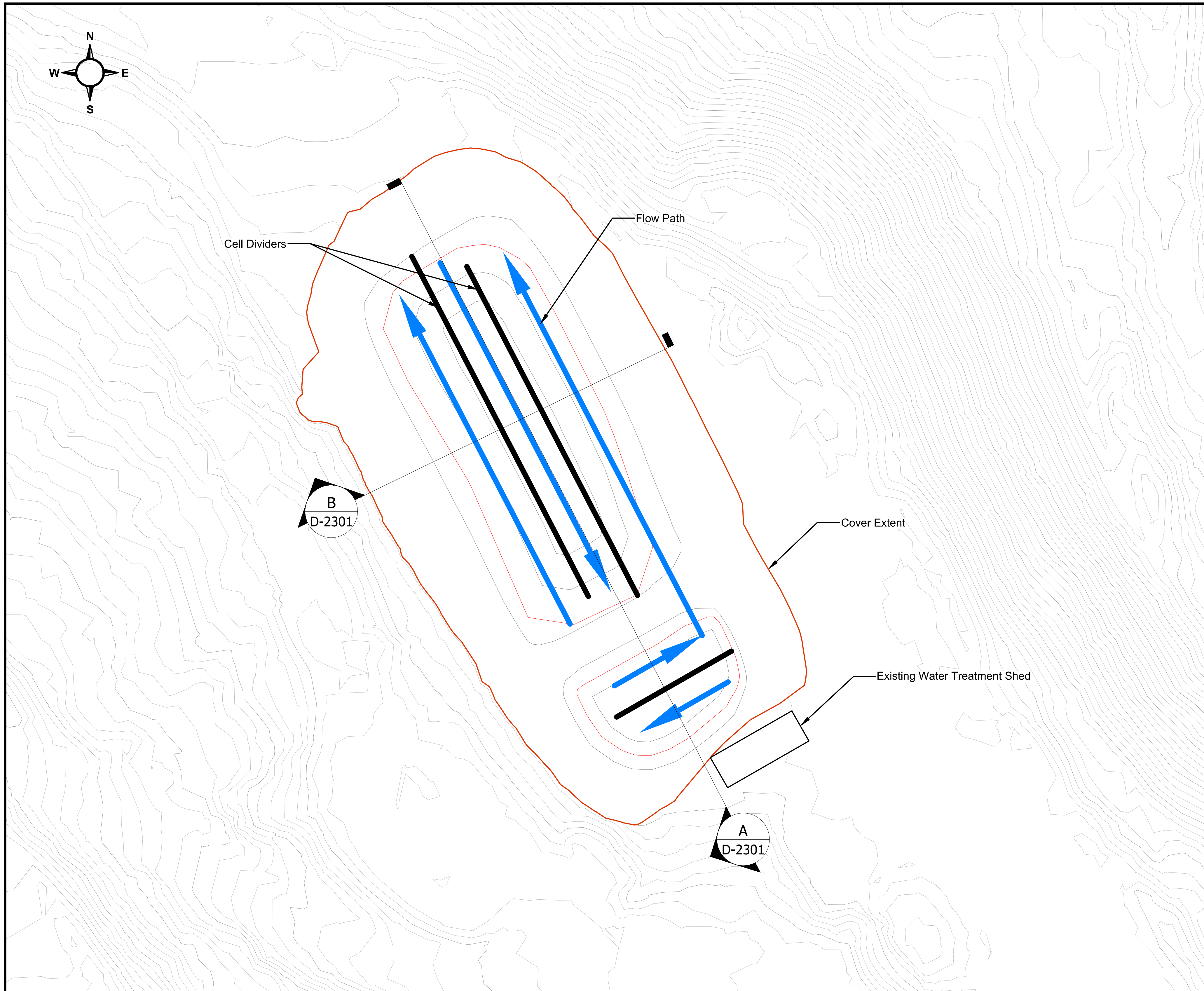
Bellekeno Closure Treatment System

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

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-02-01	Draft for review	A	KAB	--

ALEXCO ENVIRONMENTAL GROUP

AKHM

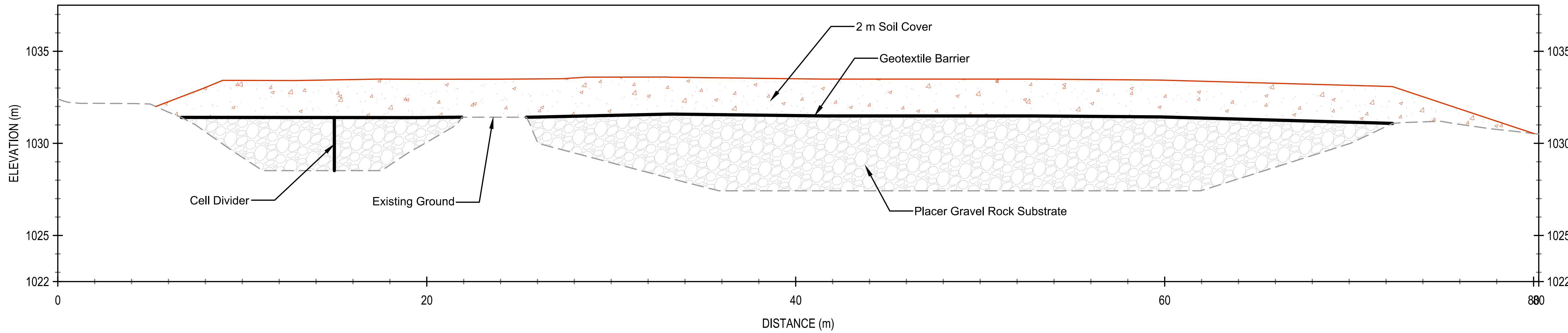
Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-D-2102

Figure 4-2

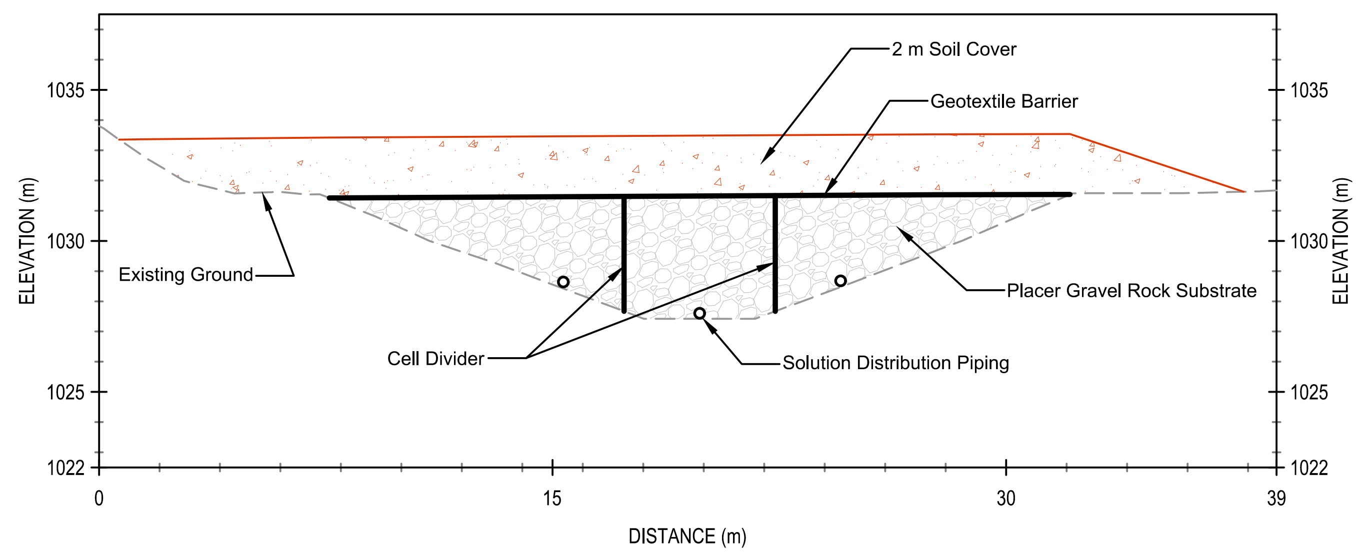
Bellekeno 625
Bioreactor Design

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

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-02-01	Draft for review	A	KAB	--

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

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.

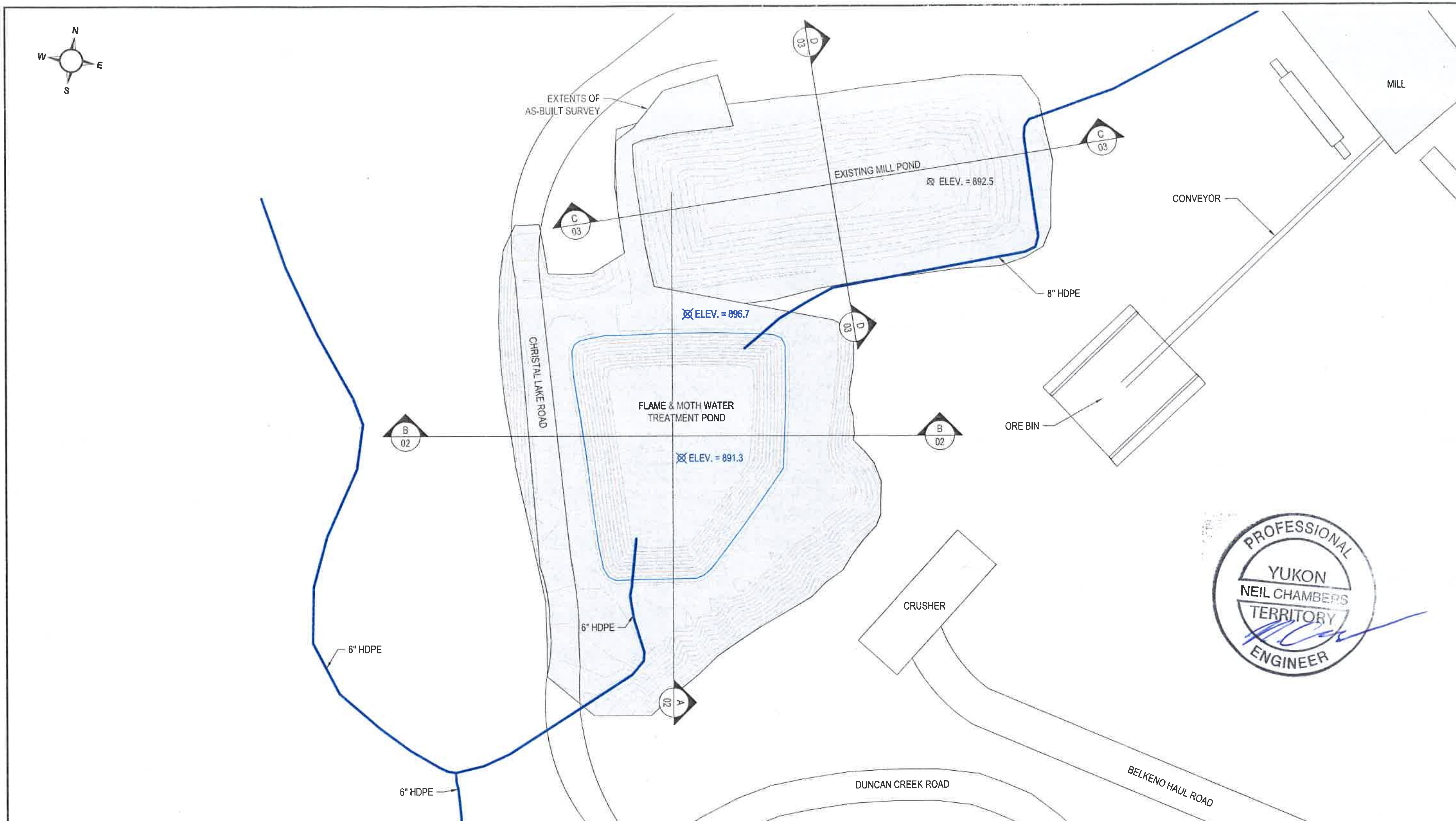
4.2.2 SCHEDULE

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	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

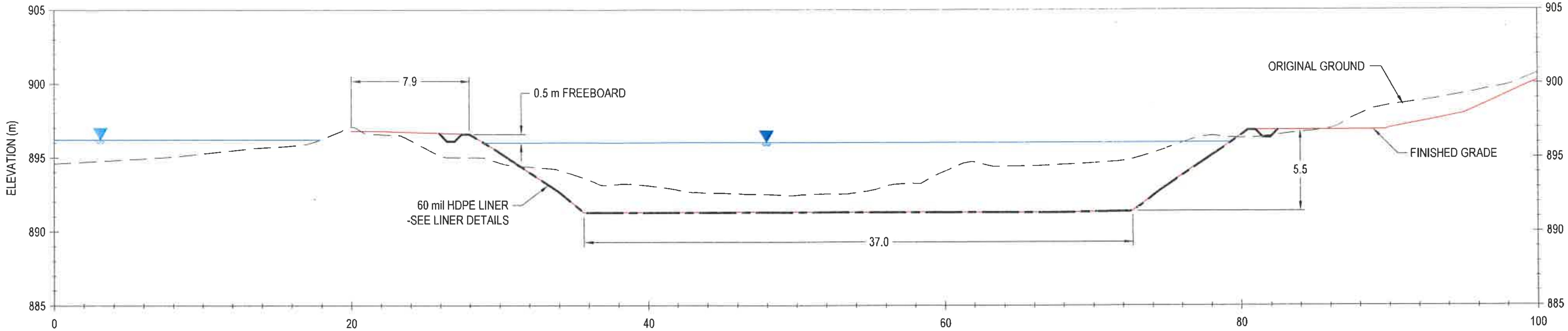
ORIGINAL GROUND CONTOURS FROM LIDAR DATA (DATED NOVEMBER 2014)

ALEXCO

Flame & Moth
Water Use License
Drawing No: ALEX-13-NMP-02-0C102.01

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



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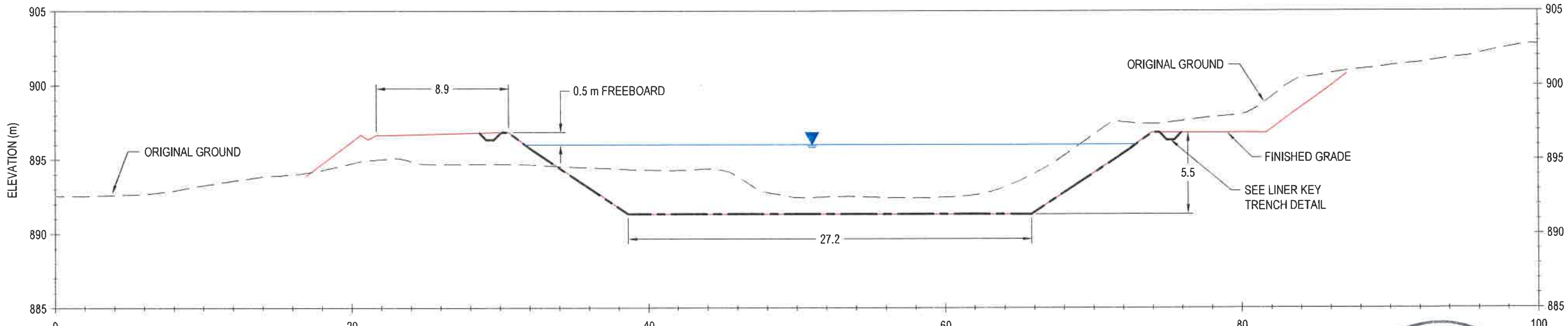
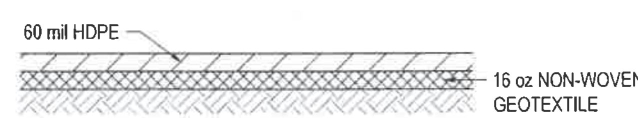


SECTION B - B'

PROFESSIONAL ENGINEER
YUKON TERRITORY
NEIL CHAMBERS



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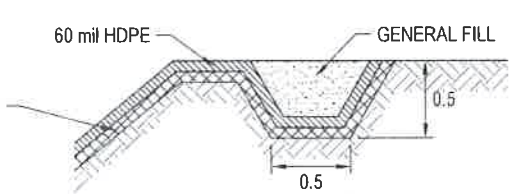

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2019-04-18	Draft for review	B	KB	KW
2019-04-17	Draft for review	A	KB	KW

0 15m
Scale: 1:300 @ 11"x17"

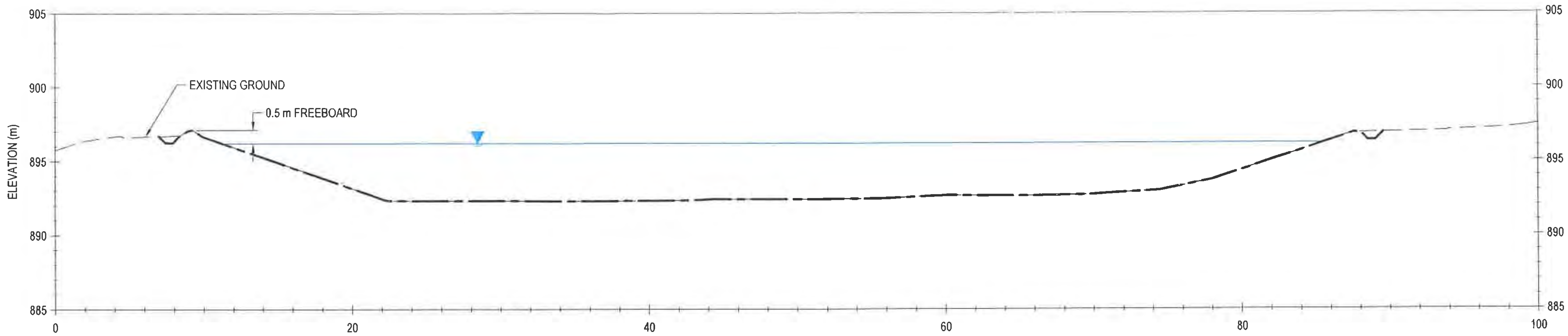
NOTE: DETAILS NOT TO SCALE
ALL DIMENSIONS IN METERS UNLESS OTHERWISE DENOTED

ALEXCO

Flame & Moth
Water Use License
Drawing No: ALEX-13-NMP-02-0C102.02

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



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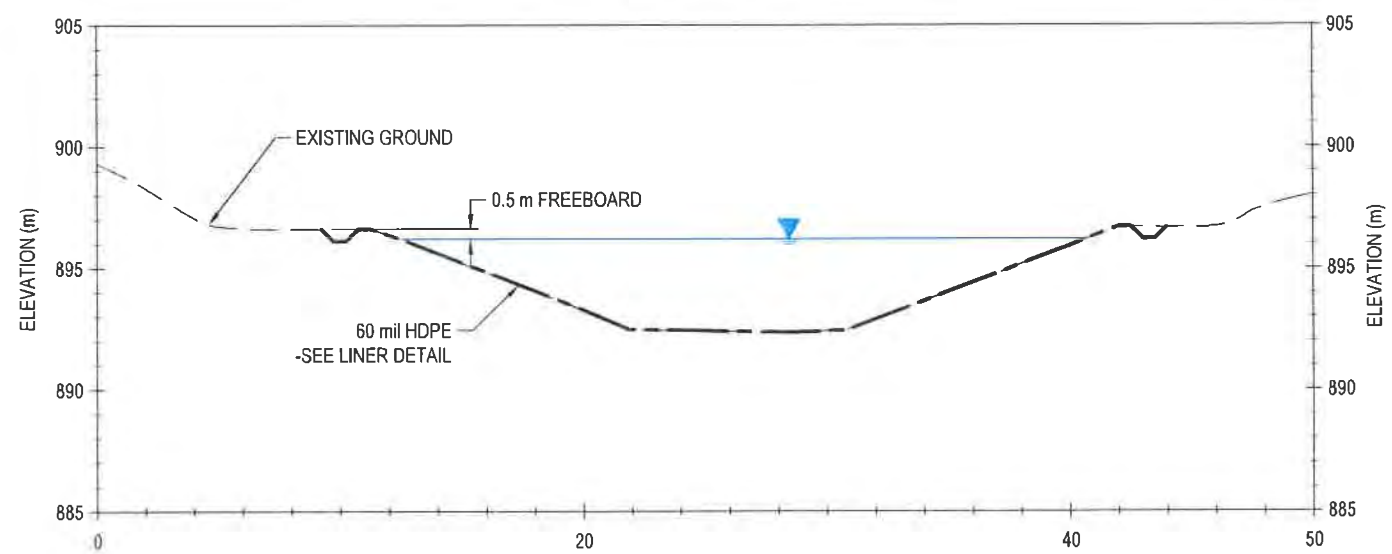

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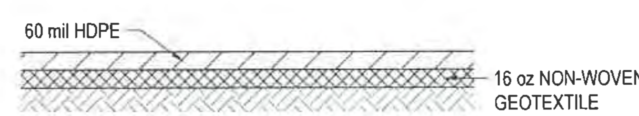


LINER DETAIL

PROFESSIONAL
YUKON
NEIL CHAMBERS
TERRITORY
ENGINEER

DATE	ISSUE/REVISION	REV No	DRW.	APP.
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"

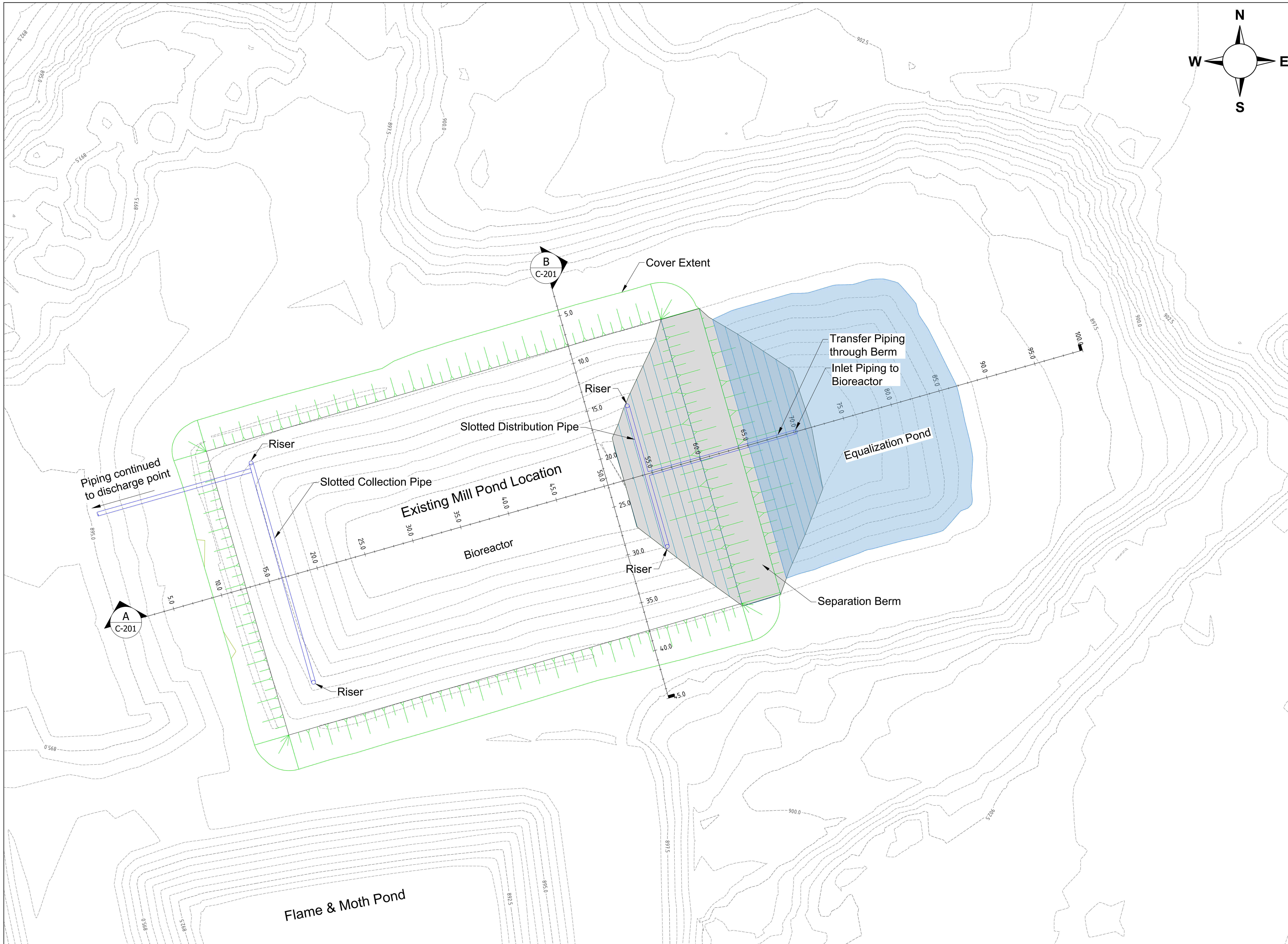
ALEXCO

Flame & Moth
Water Use License
Drawing No: ALEX-13-NMP-02-0C102.03

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

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.



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

0 5 10 20 Meters

Revision History		
A	Draft for review	2023-11-02
Rev.	Description	Date

Engineer's Seal

	Name	Date
Design	K. Boldt	2023-10-06
Drawn	K. Boldt	2023-11-02
Checked	A. Gault	--
Approved	J. Harrington	--

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

ENSERO solutions
#3 Calcite Business Centre, 151 Industrial Road
Whitehorse, YT Y1A 2V3

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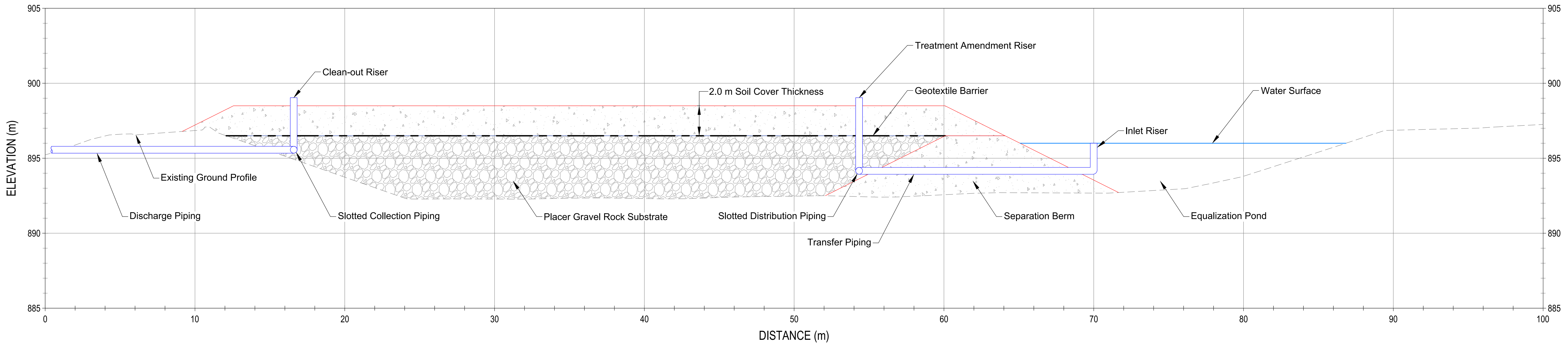
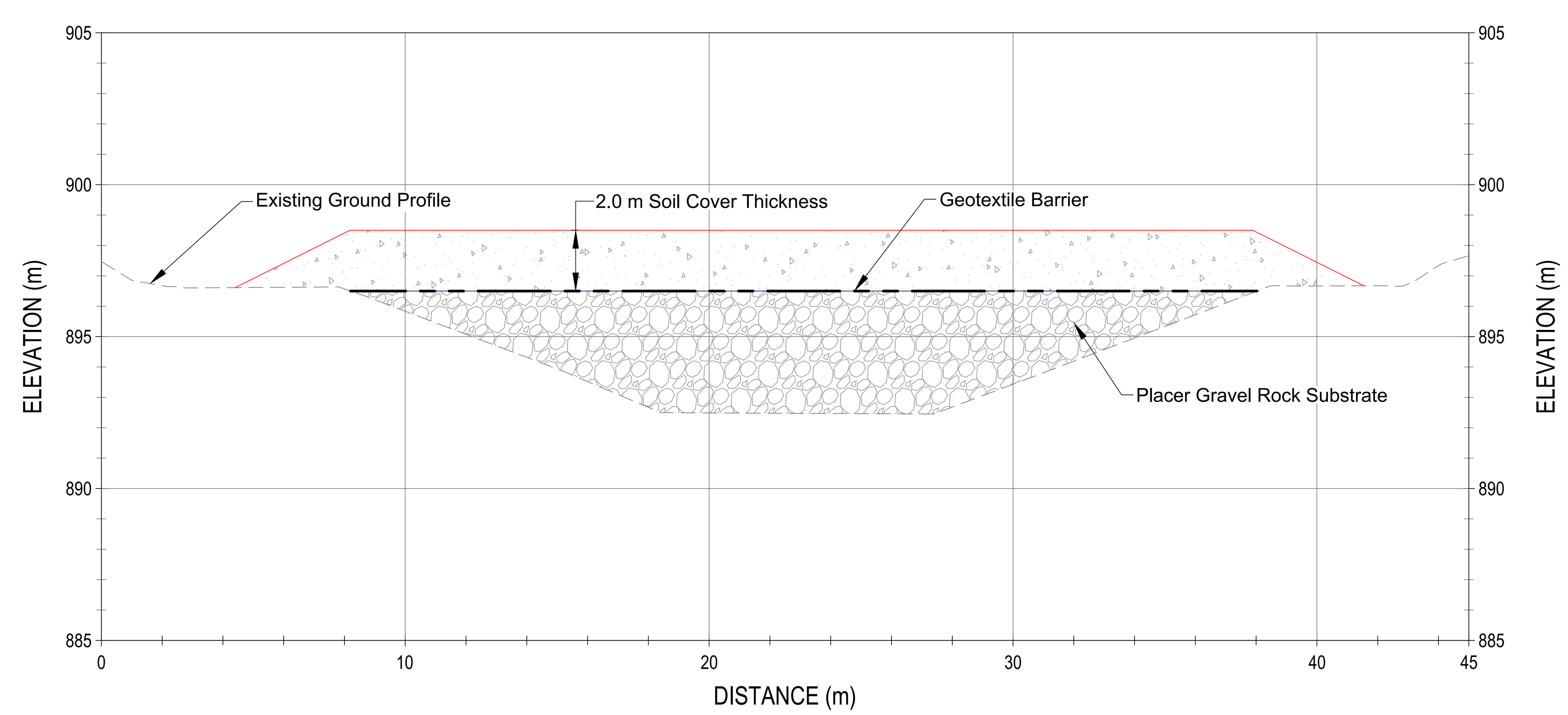


Section A



Section B

Revision History		
A	Draft for review	2023-11-02
Rev.	**Description**	**Date**

Engineer's Seal

DRAFT
NOT FOR
CONSTRUCTION

	Name	Date
Design	K. Boldt	2023-10-06
Drawn	K. Boldt	2023-11-02
Checked	A. Gault	--
Approved	J. Harrington	--

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

ENSERO solutions
#3 Calcite Business Centre, 151 Industrial Road
Whitehorse, YT Y1A 2V3

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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*.

Alexco Keno Hill Mining Corp. (AKHM), 2021. *Reclamation and Closure Plan Keno District Mine Operations Keno Hill Silver District, Rev 6*.

Alexco Keno Hill Mining Corp. (AKHM), 2020a. *Keno Hill In Situ System Operations and Maintenance Plan October 2020,* prepared by AKHM and Ensero Solutions.

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.