

Minto Mine

Water Licence QZ14-031

Quartz Mining Licence QML-0001

2019 Annual Report

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Minto Mine
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Appendix M – Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment 2019 Update

Appendix N – Minto Creek Fish Monitoring Program Review and Recommendations

Appendix O – Waste Rock Verification and ABA Program Results

Appendix P – Leach Pad Sampling Program Results

Appendix Q – Wildlife and Hazing Tracking Report

Appendix R – Vegetation Metal Uptake Program Report

Appendix S – 2019 Update Minto Mine Constructed Wetland Treatment Research Program

Appendix T - 2019 Annual Socio-Economic Monitoring Report

List of Acronyms

Acronym	Definition
ABA	Acid-Base Accounting
AMP	Adaptive Management Plan
AP	Acid Potential
CWTS	Constructed Wetland Treatment System
DSTSF	Dry Stack Tailings Storage Facility
EEM	Environmental Effects Monitoring
EMSRP	Environmental Monitoring, Surveillance and Reporting Plan
GCL	Geosynthetic Clay Liner
GPS	Global Positioning System
HDPE	High Density Polyethylene
LTF	Land Treatment Facility
MCDS	Minto Creek Detention Structure
Minto	Minto Explorations Ltd.
MMER	Metal Mining Effluent Regulations
MPTMF	Main Pit Tailings Management Facility
MVF	Mill Valley Fill
MVFE	Mill Valley Fill Extension
MWD	Main Waste Dump
NP	Neutralizing Potential
NPR	Neutralizing Potential Ratio
QA/QC	Quality Assurance and Quality Control

QML	Quartz Mining Licence QZ-0001
ROD	Reclamation Overburden Dump
SAT	Waste material destined for subaqueous long term storage
SECP	Sediment and Erosion Control Plan
SDD	South Diversion Ditch
SMP	Seepage Monitoring Plan
SOP	Standard Operating Procedure
SWD	Southwest Dump
TDD	Tailings Diversion Ditch
TDS	Total dissolved solids
TSS	Total suspended solids
UG	Underground
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984
WSP	Water Storage Pond
WUL	Water Use Licence QZ14-031
YWB	Yukon Water Board

List of Units

Unit	Definition
BCM	Bank cubic meter
BTU	British Thermal Unit
dmt	Dry metric tonnes
g/t	Gram per tonne
kg	kilogram
L	Litre
m	meter
m^2	Square meter
m^3	Cubic meter
mg/m^2	Milligrams per square meter
Mlb	Million pounds
Mt	Million tonnes
oz	ounce
V	Volt

1 Introduction

This Annual Report has been prepared by Minto Explorations Ltd. (Minto) for the 2019 calendar year, as required by Type A Water Use Licence (WUL) QZ14-031-01 and Quartz Mining Licence (QML) QML-0001. Specific requirements for the Annual Report, as outlined in the respective licences, are summarized in Table 1-1.

This report provides a summary of activities at Minto Mine for the reporting year, including production summaries, construction activities, environmental monitoring studies, physical stability monitoring, water management, and progressive reclamation.

An satellite photo taken in August 2017, with updated site infrastructure labeled, is presented in Figure 1-1.

Table 1-1: Reporting Requirements as per WUL and QML (2019)

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031				
WUL QZ14-031	16		Summary of the review of the *Spill Contingency Plan* including any changes needed.	2.5.4 App. B
WUL QZ14-031	18		Summary list of all spills for 2019.	2.5.3
WUL QZ14-031	25		The Licensee shall submit Annual Reports to the Board no later than March 31 of the year following the reporting period. The reporting period is January 1 to December 31 of each year.	All
WUL QZ14-031	26	a	Summary of all data collected as per the EMSRP, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance.	5-8, 11-14
		b	Summary of actions as per the Operations Adaptive Management Plan, including analysis and interpretation by a qualified party and a discussion of any variances from baseline conditions, from previous years' data, and from expected performance.	10 App. I, J
		c	A record of any major maintenance carried out on any physical works.	2.2
		d	Detailed data on the volume of water used during the year including water withdrawal from each water source, water routed around and through the site as part of the water conveyance system, water diverted around the site, water routed for storage in the pits, water deposited with mine wastes in waste storage facilities, water routed to the Water Storage Pond, water routed to the treatment plant and water discharged to Minto Creek.	8

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031		e	Detailed data on tailings deposition in each of the tailings management facilities, including volume and tonnage of tailings slurry deposited, cumulative volume of tailings solids stored in the pits, tailings solids surface elevation and pit water elevation.	2.3.4
		f	Details of updates to the Water Balance and Water Quality Model.	8.2.4 App. F
		g	Results and interpretations of the QA/QC Program.	5.1.2
		h	Any other reports that are required to be submitted as part of the Annual Report by this Licence.	See Below
WUL QZ14-031	70		The Licensee shall monitor, sample. and report on the maintenance and performance of the Mill Water Pond, in accordance with the procedures that are detailed in the Physical Monitoring Program, and include in the Annual Report	9
WUL QZ14-031	86		The Licensee shall include data relating to the Surface Water Surveillance Program in the Monthly and Annual Reports.	5.3
WUL QZ14-031	89		The results of these studies and programs in clauses 87 and 88 shall be submitted to the Board as part of the Annual Report along with and any additional studies or revisions to studies required under the MDMER.	11 App. L
WUL QZ14-031	93		The results of the seepage program shall be compared to the source terms used in the Water Balance and Water Quality Model Report and summarized in the Annual Report.	7 App. F
WUL QZ14-031	95		The Licensee shall implement the updated Geochemical Monitoring Program, including the Waste Rock Verification Program, and the results from this program are to be included in the Annual Report.	13 App. O
WUL QZ14-031	97	h	Reporting of all data obtained using physical monitoring instrumentation as a part of the Physical Monitoring Program in Monthly and Annual Reports.	9
WUL QZ14-031	98		The Physical Monitoring Program shall be updated annually to reflect the installation of new instrumentation, replacement of damaged instrumentation, and changes in monitoring methods and procedures. The updated Physical Monitoring Program shall be provided as part of the Annual Report, along with a summary table outlining revisions to the plan from previous versions.	App. H
WUL QZ14-031	99	b	The Licensee shall submit these Geotechnical Engineer's Inspection and Data Reviews as part of the Annual Report.	9.2

Licence	Section	Clause	Requirement	Annual Report Section
WUL QZ14-031	100	f	For each operating year, the following information shall be provided as part of the Annual Report for the Physical Monitoring Program: i. interpretation of physical monitoring data, and summary of the stability, integrity and status of all the inspected structures, works, and installations inspected by the Professional Engineer; ii. a list of each of the Professional Engineer's recommendations for remedial action; iii. an explanation of how and when each recommendation was addressed, including supporting documentation, and iv. a list of outstanding recommendations (including previous inspection reports) and associated approach and timelines to address them.	9.1 9.2 9.2 Table 9-1 Table 9-1
WUL QZ14-031	102		The Licensee shall review and evaluate the Aquatic Environmental Monitoring Program design every three (3) years and submit the findings to the Board, along with any recommendations for further refinements, as part of the Annual Report, starting in 2016.	11.4
WUL QZ14-031	104		Results and interpretations of the QA/QC program shall be provided in the Annual Report.	5.1.2
WUL QZ14-031	108	a	The Licensee shall submit an updated Water Balance and Water Quality Model as part of the Annual Report. The updated models shall include without limitation all model assumptions.	App. F
		b	Updated site data collected as per the EMSRP including: i. water quality results and water levels from all groundwater monitoring wells; ii. the most current climatic, environmental and operational conditions and data; iii. surface water quality and quantity data; iv. seepage monitoring quality and quantity data, and v. geochemical source terms from tailings and waste rock.	6 12 5.3 7 App. F
		c	A comparison of the updated geochemistry for Phase V/VI tailings and waste rock with that of previously-produced tailings and waste rock, and a comparison of model source term chemistry with equivalent operation monitoring results.	13 App. O App. F
		d	Updated predictions for operations and Permanent Closure water quality, including discussion of any variances identified and associated implications on site water management.	App. F
WUL QZ14-031	109		Specifications for the Annual Report to include but not be limited to: i. activities undertaken in relation to the Adaptive Management Plan; ii. trend analysis and water levels in Minto and McGinty creeks; iii. proposed updates and revisions to the Adaptive Management Plan, and iv. any other revisions necessary to comply with the conditions of this Licence.	10 8.5 App. I, J Through out
WUL QZ14-031	114	a	Annual reporting on reclamation research activities.	16.2 App. S

Licence	Section	Clause	Requirement	Annual Report Section
QML-0001				
QML-0001	13.5		On or before March 31 of each year of the term of this License, the Licensee must submit an annual report, in writing, containing the information set out in Schedule D, covering the period of January 1 to December 31 of the prior year	This Report
QML-0001	D (Site Activities)	a	Summary of construction activities associated with the Undertaking	2.2
		b	Summary of mining activities	2.3
		c	Map showing the status of all structures, works, and installations associated with the Undertaking	Fig 1-1
		d	total amount of ore and waste removed from the underground workings and open pits for the year and for the life of the Undertaking	2.3
		e	Total amount and the average head grade of ore milled	2.3.6
		f	Total amount of concentrate produced and removed from the Undertaking	2.3.6
		g	Total amount of tailings deposited in each of the tailings facilities	2.3.4
		h	Total amount of waste rock removed from the mine and the amount deposited into each deposit location	2.3.3
		i	Total amount of waste rock stored in each waste rock storage facility;	2.3.3
		j	Details respecting any action taken as a result of the recommendations made by the engineer in relation to the inspection referred to in 13.2 of QML -0001	9.2
		k	Summary of any updates to estimates of ore reserves and the life of the mine, including reserve category, tonnage and grade	4
		l	Total amount and the average grade of each ore stockpiled	2.3.5
		m	remaining reserve life of the mine	4
QML-0001	D (As-built Drawings)	a	as-built drawings of the open pit and underground mines and of all engineered structures, works, and installations constructed or altered at the Undertaking during the year	2.2 App. A
		b	as-built drawing report of the 220 kW vertical stirred mill rougher/scavenger concentrate regrinding system the year following the installation	N/A
QML-0001	D (Environmental Monitoring)	a	Summary of the programs undertaken for environmental monitoring and surveillance as outlined in the *Environmental Monitoring, Surveillance and Reporting Plan* and the 2014 Wildlife Protection Plan, including an analysis of these data and any action taken or adaptive management strategies implemented to monitor or address any changes in environmental performance	5-9 11-14 10
		b	any update to the *Site Characterization Report* referred to in 13.1 of QML-0001	15
		c	summary of invasive plants that have been identified on site and measures taken to control or remove invasive plants	14.3

Licence	Section	Clause	Requirement	Annual Report Section
		d	summary of spills and accidents that occurred at the site and measures taken respond to any spills or accidents	2.5
		e	summary of the level of traffic, access control issues, wildlife incidents and other accidents, and any upgrade or maintenance work planned for the upcoming year	2.4
QML-0001		f	summary of any site improvements undertaken to address sediment and erosion control	14.2
QML-0001	D	a	summary of any underground stability incidents	2.3.2
	(Physical Monitoring)	b	summary of data collected to date as part of the Physical Monitoring Program	9
		c	details of results, including data collected, for the physical monitoring program	9
QML-0001	D (Reclamation and Closure)	a	any temporary closure or permanent closure that has occurred during the year	16
		b	summary of activities related to care and maintenance of the Undertaking, including any temporary closure activities if applicable	16
		c	summary of progressive and ongoing reclamation activities	16
		d	summary of proposed development and production and reclamation activities for the coming year	3 16.3
		e	summary of reclamation research and results	16.2 App. S
QML-0001	D (Socio-Economic Monitoring)	a	summary of action taken by the Licensee with respect to implementation of "Minto Socio-Economic Monitoring Program Framework" (the "Framework')	17 App. T
		b	a copy of the annual report prepared by Minto Explorations Ltd., identified in paragraph 6.1 of the Framework	App. T
		c	a summary of action taken by the Licensee with respect to implementing an approved socio-economic adjustment measures plan, as identified in the Framework	App. T



MINTO MINE

WATER LICENSE QZ14-031/QML-0001

2019 ANNUAL REPORT

FIGURE 1-1

SITE CONFIGURATION AND EXISTIG INFRASTRUCTURE

FEBRUARY 2020

MINTO EXPLORATIONS
A PEMBRIDGE RESOURCES COMPANY

1:18,000 *when printed on 8x11 inch paper*

0 100 200 300 400 500 Meters

ENSERO solutions

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

Datum: NAD 83 Projection: UTM Zone 8N

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2 Site Activities

Operations at the Minto Mine transitioned in 2019 from a temporary care and maintenance period, back into production following the sale of the mine in June. Production from underground mining began on September 2, 2019, and milling began on October 10, 2019. During this production period the operation produced 4.9 million pounds (Mlb) of copper from the milling of 104,006 tonnes (dmt) of ore.

Underground mining took place in the Minto East zone during 2019. The Minto East zone is in the Minto South Underground.

Waste rock produced from mining activities was hauled to surface for use as construction grade material, for ramp repair, or in the case of potentially acid generating waste rock, to be processed through the mill. Milling was run-of-mine ore from underground operations, as well as ore stockpiled from previous mining.

Tailings produced from the milling process were deposited into the Area 2 Pit Tailings Management Facility as per the licensed Tailings Management Plan.

2.1 Exploration

2.1.1 In-Fill Drilling

The 2019-2020 infill-drilling campaign consist of 14,000 meters diamond drilling, targeting various ore lenses within the mine area with the aim to upgrade the current resources and reserves and to gain geological confidence for the optimization of the mine design.

The surface program includes 33 drill holes, totaling 12,6146 meters. These diamond drill holes target the Copper Keel North, West, South and Minto East II lenses. The surface program commenced in November 2019 and expected to finish by the end of July 2020.

Five holes, totaling 3,319 meters of drilling was conducted from November 2019 to January 2020 targeting gaps of coverage in the Copper Keel West ore lens. The Copper Keel North drilling campaign began in February 2020. A total of 10 drill holes, 3,802 meters were drilled at the Copper Keel North area with the aim to define and expand this lens towards the north. One hole was drilled to test the ground conditions in advance of the planned Copper Keel ventilation raise. The Copper Keel South drill targets consist of 10 drill holes, totaling 2,350 meters. This program commenced in late March and expected to finish in mid-April 2020.

The Minto East II surface drill program comprises 14 drill holes and a total of 7,015 meters. This program is planned to commence in late April 2020 for the duration of 110 days. Due to difficult ground conditions and overburden this program may be substituted with another area and delayed, to be drilled from underground when development to this area becomes available.

The UG drill program targets the Minto East mining area and the Copper Keel West and North ore lenses. A total of 20 underground holes and 1533 meters of drilling is planned for the Copper Keel West and North lenses. The total meterage for the underground drilling within the Minto East mining area has not been finalized. The aim behind the Minto East underground drilling is to test the extension of the ore body and thus lengthen the mine life. The drill holes are planned to target the area north of K-stope, and underneath to the west of H-G-F-E stopes. In addition, holes are planned to test the lateral and upward continuation of the Minto East ore lens to the south. The drilling for this area will be conducted from the 505A stope cross-cuts.

2.1.2 Exploration

Exploration within the mine area entailed an aerial UAV MAGTM drone survey to aid targeting during the infill-drill program and to identify new areas for exploration drilling. Pioneer Aerial Surveys Ltd. completed an airborne magnetic survey (UAV-MAGTM) using an Unmanned Aerial Vehicle (UAV), Matrice 600 Pro UAV drone within the mine area from mid-September to early October 2019. The completed survey covered an area of approximately 24 km2 and 610 km-lines with line spacing of 50 metres and 500 m perpendicular tie lines at an azimuth 065°. Most of the takeoff locations were accessed by truck, with one location accessed by helicopter. The nominal altitude above ground level (AGL) was set to 50 meters for this survey. The nominal production groundspeed was 10 m/s for flat topography with no wind. The average distance covered by each flight was approximately 6-10-line km of data acquisition.

The final magnetic data has been presented in the form of several different magnetic maps, which are used to identify geological structures and other features. In addition to the UAV Drone Magnetic survey, Pioneer Aerial Surveys Ltd. was also tasked to reprocess the already existing Titan 24 DC-IP (Direct Current-Induced Polarization) geophysical survey data into a 3D inversion model. The inversion methodology will allow for the integration of Titan 24 DC-IP data with the newly collected magnetic data in a 3D space.

2.2 Maintenance, Infrastructure and Construction Projects

There were no major maintenance activities conducted in 2019 on the physical works.

2.3 Mining Activities

Section 2.3 discusses the mining activities for 2019 including underground mining, waste rock and tailings management, ore stockpiles, operating results, and concentrate shipments.

2.3.1 Open Pit Mining

There was no open pit mining conducted in 2019.

2.3.2 Underground Mining

Mining Activities were suspended for the majority of 2019 with drilling and production starting in Minto East Zone in October of 2019, and the development of Copper Keel starting in November of 2019.

In total Minto East Zone produced 104,244 tonnes of ore to surface in Q4.

During November and December there was a total of 55m of development in Copper Keel and 34.8m of development in Minto East.

4,900 tonnes of waste rock were hauled to surface in 2019. See Appendix A for the underground development map.

2.3.3 Waste Rock Management

Since the closure of the Capstone Minto Mine in October 2018, the property has not added to the waste rock dumps and stockpiles by year end in 2019. Mining operations recommenced in October 2019, but have focused on internal ore development during the later part of the year. Waste development completed as part of the Copper Keel development plan was stockpiled and used underground for construction projects. To this end, stockpile volumes remain unchanged from 2018 year end reporting. Current waste rock inventory in the various waste rock and overburden dumps at the Minto Mine site are summarized in Table 2-3.

Table 2-1: Waste Rock Destination and Volumes (2019)

Material Type	Destination	In Situ (m3))
Waste – Construction Grade	UG construction	1,632
Waste – Construction Grade	Tailings Diversion Ditch	0
Waste	Main Pit Dump	0
Waste	Main Waste Dump	0
Waste Rock – SAT	Main Pit Buttress	0
Waste Rock – SAT	A2S2 In Pit	0
Total		1,632

Table 2-2: Waste Dump Location and Storage Volumes (unchanged since 2018)

Dump Location	Quantity Stored as of December 31, 2017 (m^3)
Main Pit Buttress	4,230,000
A2S2 In – Pit	70,000
Main Pit Dump	1, 480,000
South West Dump	12,120,000
Mill Valley Fill Extension	1,440,000
Reclamation Overburden Dump	4,300,000
Main Waste Dump	8,360,000
Main Waste Dump Expansion	3,810,000
Mill Valley Fill Extension 2	1,360,000
Total Waste Dumped	**37,170,000**

2.3.4 Tailings Management

All tailings produced in 2019 were deposited in the Area 2 Pit Tailings Management Facility (A2PTMF). Table 2-3 lists the deposition schedule.

Table 2-3: Tailings Deposition Schedule in 2019

Tailings Management Facility	Date Range	Quantity Deposited (dry metric tonnes)
A2PTMF	October – December	98,095
Total 2019 Tailings		**98,095**

A total of 98,095 dry metric tonnes (dmt) of tailings were discharged to the A2PTMF in 2019. Since November 2012, the Main Pit Tailings Management Facility (MPTMF) has received 3,346,606 tonnes of tailings. Since March 2015, the Area 2 Pit has received 4,733,960 tonnes of tailings.

Deposition to the A2PTMF is from a point at the northeast corner of the pit. A discharge line runs from the pit crest at the 806m elevation to a point on the highwall past the overburden contact, at 787m: this ensures that the tailings stream runs down solid rock and does not cause erosion. As of year-end, the highest point of the tailings beach is at the 777.0m elevation and the water level in A2PTMF was 777.2m.

Deposition in the MPTMF is possible from two locations, near the middle of the pit via a floating tailings line and near the north wall of the pit. The highest point of the tailings beach is at 787.5m elevation. At year-end, the water level was measured at 784.3m. No tailings were deposited into MPTMF in 2019.

Due to the temporary closure of the mine, tailings deposition in 2019 did not begin until October when operations recommenced.

2.3.5 Surface Ore Stockpiles

Eight ore stockpile exist on the property in the vicinity of the mill. Within the ROM pad boundaries; four (4) run of mine stockpiles exist:

- Mill Pond Pad – also known as the Live Pile. Crushed material actively being fed into the mill, dominantly underground material.
- East Stockpile – Sulphide and partially oxidized run of pit (ROP) stockpile.
- South Stockpile – Partially oxidized run of pit (ROP) stockpile.
- UG Stockpile – active ore stockpile holding Underground material transported from the Portal Ore Pad (POP).

Additional stockpiles include the Portal Ore Pad, West of the Main Pit (ROP), adjacent to the Main Waste Dump (ROP) and the Top of the World stockpiles (ROP) consisting of partially oxidized run of pit (ROP).

Historically the ore pads were categorized by copper grades. This material was assigned to colour coded material bins described by the solubility of the contained copper.

The stockpile areas are displayed in Figure 2-1.

Ore is segregated by copper grade and percentage of acid-soluble copper as shown in Table 2-4.

Table 2-4: Ore Stockpiles

Material Type	Copper Grade Range	Soluble Copper
Blue Sulfide Ore	0.50 – 1.00% Cu	<15.0%
Green Sulfide Ore	1.00 – 2.00% Cu	<15.0%
Yellow Sulfide Ore	>2.00% Cu	<15.0%
Partially Oxidized Ore (POX)	>1.50% Cu	>15.0%
Low-Grade Partially Oxidized Ore (LG POX)	0.80 – 1.50% Cu	>15.0%

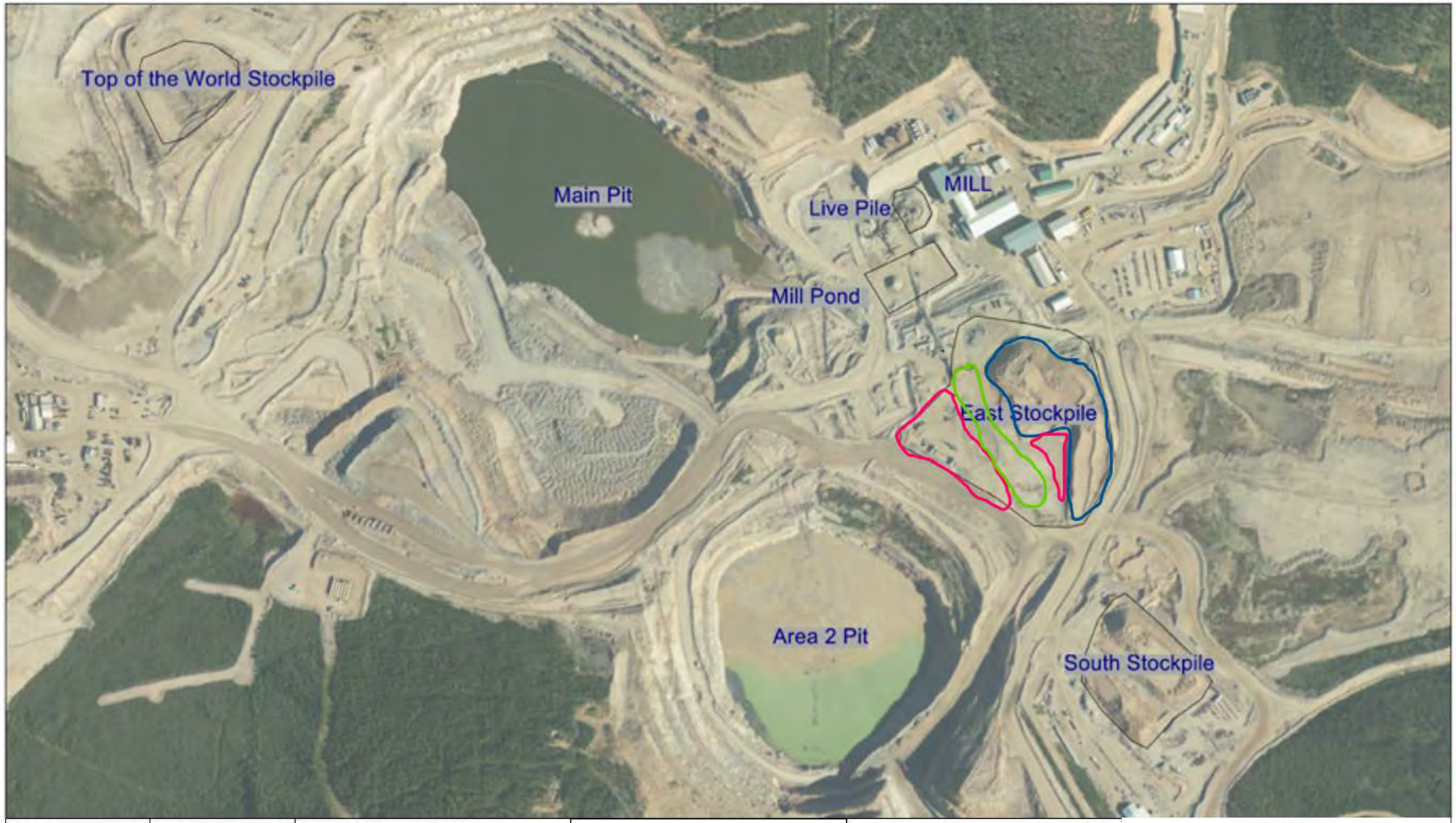
The Blue, Green and Yellow ore categories are typically boulders of open pit and underground material too large for the crushers on site. The large material is set to the side, and gradually broken into manageable sized fragments that can be fed into the crushers with a rock breaker. The partially oxidized (POX) and low grade oxidized(LG POX) material of the open pits was set aside to help maintain mill recovery and the higher grade pit ores were fed into the mill as they were mined to maintain the highest possible head grades. The lower grade and partially oxidized stockpiles were depleted gradually and are used to supplement mill feed during periods of open pit waste stripping or low underground production.

Table 2-5: Stockpile Inventory

	December 31, 2018			**December 31, 2019**	
Material Category	**Tonnes**	**Cu %**		**Tonnes**	**Cu %**
Yellow		-		-	-
Green	14, 173	1.38		10, 384	1.38
Blue	28, 556	0.61		10, 142	0.61
POX	217, 792	1.57		227, 608	1.57
LG POX	140, 021	0.66		126, 729	0.66
Portal Ore Pad	4, 430	2.84			-
Live Pile				366	2.56
Total Ore					

Table 2-6: Ore Stockpile by Geographic Location

Location	**Tonnes**	**Cu (%)**	**Dominant Material**
ROM OS	33, 804	1.13	Blue, Green, Yellow, POX
ROM A2S3	139, 976	0.66	POX >> Yellow
ROM UG ore	20, 064	2.31	Yellow
South	181, 106	0.93	POX < LG POX
TOTW	25, 986	0.81	Blue, Green, Yellow, POX
Live	366	2.56	Yellow



DRAWN BY: R Pharand	SCALE: 1:4416	Minto Stockpiles 2019	ROM Oversize		MINTO EXPLORATIONS
	DATE: 03 Feb 2020	**Figure 2-1**	ROM A2S3		
			ROM UG Ore		

2.3.6 Operating Results

Ore processing and metal production results for the 2019 calendar year are summarized in Table 2-7, below. Mill operations were suspended in late 2018 and did not resume until October 2019.

Table 2-7: Operating Results (2019)

Metal Production	Quantity
Copper (t)	2,247.2
Gold (kg)	68.4
Silver (kg)	555.4
Ore Milled	
Ore processed (dmt)	104,006
Copper grade (%)	2.27
Gold grade (g/t)	0.86
Silver grade (g/t)	5.84
Recoveries	
Copper (%)	95.1
Gold (%)	76.1
Silver (%)	91.5
Concentrates Produced	
Copper concentrate (dmt)	6,436.4
Copper (%)	34.9
Gold (g/t)	10.63
Silver (g/t)	86.29

2.3.7 Concentrate Shipments

Minto produced 7,167.4 wet metric tonnes of concentrate at 10.20% moisture content, which corresponds to 6,436.4 dmt. The average concentrate grades are listed in Table 2-7, above. No truckloads of concentrate were shipped from Minto in 2019.

2.4 Mine Access Road

2.4.1 Traffic

From January 7th to March 27th, 2019, access across the Yukon River was over an ice bridge during which time heavy trucks made 334 round trips, medium trucks made 22.5 round trips, and light vehicles made 140 round trips across the ice bridge. Between March 27th and June 17th, 2019 there was no land access to the mine site. On June 26th, 2019, the summer tug and barge operation started for the season. During the barge operating season, heavy trucks made 14.5 round trips, medium trucks made 100 round trips, and light vehicles made 227.5 round trips to the Minto Mine via the mine access road. The barge operating season ended October 19th, 2019. Establishment of the 2020 ice bridge started in December 2019.

2.4.2 Access Control Issues

In early January, a contractor employee took a vehicle from site and crossed the ice bridge without authorization. The ice bridge was not yet formally open to traffic; however, the employee in question had been working on the ice bridge's construction and knew that it was safe to cross. They also had access to the key to open the ice bridge gate. This was an isolated incident where the individual acted without consideration of consequences due to personal and emotion issues. The event was reported to police and the individual was permanently removed from site.

2.4.3 Planned Access Road Maintenance for 2020

Beyond routine maintenance work, no major projects or upgrades are planned for 2020 regarding the access road.

2.5 Accidents and Incidents

2.5.1 Incidents

In 2019, Minto Mine experienced one lost time accident, one medical aid and one serious incident reported to the Yukon Workers Compensation Health and Safety Board for the reporting period. In order to respond to incidents on site, Minto maintains a current Emergency Response Plan supported by a complement of emergency response personnel trained and certified in advanced first aid, firefighting and mine rescue along with equipment required for all response types. In addition, reporting and investigation of incidents is standard practice at the site.

2.5.2 Wildlife Incidents

Three separate reportable wildlife incidents took place on site in 2019.

- On August 4th, a deceased duck was found next to the con shed near the main entrance to the mill. Between consultation with the Carmacks District Conservation Officer and Minto staff, it was decided that the duck died of natural causes (parasite infestation) and the carcass was disposed of in the incinerator.

- On August 10th, a snowshoe hare was struck and killed by a vehicle on Km 4 of the access road. The CO was notified and the carcass was disposed of deep in the adjacent forest.
- On December 21st, a coyote was discovered sleeping under the steps of one of the main camp entrances. It was in poor condition, with porcupine quills lodged in its face and body, and would not leave the area when hazed by environmental staff. The Carmacks CO recommended leaving it in place to let nature take its course or having someone capable put it down. After several days, the coyote had not left and maintenance staff required access beneath the building it was next to. On December 23rd, the coyote was removed to a safe location using a pole snare and put down by environmental staff. The CO was informed and instructed staff to incinerate the carcass.

2.5.3 Reportable Spills

There was one reportable spill that occurred at Minto Mine during 2019. The volume and causes of the spill are summarized below in Table 2-8.

Table 2-8: Reportable Spills (2019)

Date	Amount	Substance	Cause and clean up
30-Dec-19	20-40 L	ATF Hydraulic Oil	While plowing ice to prepare the Yukon River for ice bridge construction, the Cobalt Snow Cat developed a leak in one of the hydraulic components when a fitting was contacted by ice. This resulted in a fine spray of oil on the ice as the Snow Cat moved to the shoreline. A skid-steer was brought to site to assist with clean-up. Impacted ice and snow were removed, placed on containment, and hauled by truck to the Minto LTF for disposal/treatment. (YG -ENV Relocation Permit # 4202-22-013)."

The spill in Table 2-7 was reported as per the *Spills Regulations* of the Yukon Environment Act. The follow up spill report was submitted within 10-days of the occurrence. Additionally, non-reportable spills were tracked internally as per the WUL. Spills on site were cleaned up with a variety of methods including, but not limited to, absorbent spills pads, soil excavation, soil treatment in the LTF, and disposal in the Main Pit dump.

2.5.4 Spill Contingency Plan Review

A review and update to the Minto Mine Spill Contingency Plan is required annually as part of the Annual Report and the updated 2020 Minto Mine Spill Contingency Plan is provided in Appendix B. the plan was changed to incorporate operational conditions from the Care and Maintenance version submitted with the 2018 Annual Report.

3 Proposed Mining for 2020

Section 3 discusses the proposed mining for 2020 at the Minto Mine.

3.1 Proposed Open Pit Mining for 2020

There is no Open Pit mining planned for 2020.

3.2 Proposed Underground Mining for 2020

Mining of Minto East will continue, with completion expected in Q2. Copper Keel development continues all year, with development in Q1/Q2, and production of the Copper Keel stope commencing in Q2.

4 Mineral Resources and Reserves

Minto Mine's updated mineral resources and reserves are provided in Tables 4-1 and 4-2 respectively, below. The most recent update is from December 31, 2018. There were no updates in 2019.

Table 4-1: Updated Mineral Resources for Minto Mine (most recent Dec. 31, 2018)

	Measured	Indicated	Inferred	Total (M+I+I)
Opening Balance				
Tonnes (kt)	3,904	12,644	6,147	22,695
Cu Grade (%)	1.20	1.48	1.42	1.42
Cu Metal (kt)	47	188	87	322
Production Depletion				
Tonnes (kt)	-14	-1,160	-30	-1,205
Cu Grade (%)	1.31	1.71	1.69	1.70
Cu Metal (kt)	-0	-20	0	-21
Resource Updates				
Tonnes (kt)	-	-19	-	-19
Cu Grade (%)	-	3.73	-	3.73
Cu Metal (kt)	-	-1	-	-1
Cut-off Grade Change				
Tonnes (kt)	-	-	-	-
Cu Grade (%)	-	-	-	-
Cu Metal (kt)	-	-	-	-
Resource Condemnation				
Tonnes (kt)	-39	-222	-17	-278
Cu Grade (%)	1.20	1.30	1.13	1.28
Cu Metal (kt)	-0	-3	-0	-4
Stockpile Change				
Tonnes (kt)	-56	-	-	-56
Cu Grade (%)	0.30	-	-	0.30
Cu Metal (kt)	0	-	-	0
Closing Balance				
Tonnes (kt)	3,795	11,243	6,100	21,138
Cu Grade (%)	1.21	1.46	1.42	1.40
Cu Metal (kt)	46	164	86	297

Table Notes:

1. Open-pit and underground mineral resources are reported above a 0.5% and 1.0% Cu cut-off-grades respectively.

Table 4-2: Updated Mineral Reserves for Minto Mine (most recent Dec. 31, 2018)

	Proven	Probable	Proven + Probable
Opening Balance			
Tonnes (kt)	469	2,975	3,444
Cu Grade (%)	1.02	1.69	1.60
Cu Metal (kt)	5	50	55
Reserves Updates			
Tonnes (kt)	-	-42	-42
Cu Grade (%)	-	2.07	2.07
Cu Metal (kt)	-	-1	-1
Production Depletion			
Tonnes (kt)	-1	-982	-983
Cu Grade (%)	0.76	1.47	1.47
Cu Metal (kt)	-0	-14	-14
Stockpile Change			
Tonnes (kt)	-56	-	-56
Cu Grade (%)	0.30	-	0.30
Cu Metal (kt)	0	-	0
Closing Balance			
Tonnes (kt)	412	1,951	2,363
TCu Grade (%)	1.20	1.79	1.69
Cu Metal (kt)	5	35	40

Table Notes:

1. Open-pit and underground mineral reserves are reported above a 0.5% and 1.2% Cu cut-off-grades respectively.

5 Surface Water Quality Monitoring

Environmental monitoring programs are outlined in the *Environmental Monitoring, Surveillance and Reporting Plan* (EMSRP2016-02) and the results for the surface water quality monitoring conducted in 2019 are provided in this section. Where possible, the 2019 results have been compared to historical results to identify trends and compare 2019 values with previous values.

5.1 Surface Water Quality Program

Details of the Surface Water Surveillance Program, including sampling station locations and monitoring frequency, are outlined in the EMSRP2016-02 and the results are presented in this section for water quality stations outlined in the WUL. Water quality result statistics including the mean, minimum and maximum are presented in summary tables. For the purposes of calculating the mean, minimum and maximum concentrations, values less than the detection limit were taken to be half of the detection limit.

The WUL effluent quality standards were compared to the water quality result statistic summaries at stations W16, W16A, W17, W50 and WTP/RO. The WUL water quality objectives were compared to the water quality result statistic summary at station W2, and at W50 when W35 and W15 are frozen.

As water quality stations, may be adjusted from year-to-year because of environmental changes or modifications to infrastructure, an update to the water quality station locations listed in the WUL is provided in Table 5-1 below. All surveillance monitoring sites in use in 2019 are confirmed with a Global Positioning System (GPS) unit to determine current UTM coordinates. Coordinates presented in Table 5-1 are associated with the World Geodetic System 1984 (WGS 84) coordinate system.

Table 5-1: Water Quality Site Descriptions and UTM Coordinates

Station	Description	UTM Coordinates – Zone 8	
		Easting	Northing
W1	Lower Reach of Minto Creek	392445	6948251
W2	Minto Creek, upstream of the Minto Creek/Yukon River confluence where the access road crosses Minto Creek	392584	6948402
W3	Minto Creek, at the federal MMER compliance point	387000	6945778
W4	Yukon River, upstream of the confluence with Minto Creek	394070	6948203
W5	Yukon River, downstream of the confluence with Minto Creek	392583	6949119
W6	Tributary on the North side of Minto Creek	387583	6946392
W7	Mouth of the tributary on the south side of Minto Creek, approximately 0.8 km downstream of W3	387546	6946034
W8	Western collection sump from the DSTSF	385629	6945076
W8A	Eastern collection sump from the DSTSF	385716	6945012
W10	Headwaters of Minto Creek (south-west fork at headwaters)	383855	6943364
W12	Main Pit and Main Pit Tailings Management Facility	384544	6945137
W12A	Discharge from Main pit	*	*
W14	Tailings thickener overflow	385223	6945089
W15	Upper Minto Creek storm water collection sump, downstream of the overburden dump, just upstream of Main Pit	384181	6944708
W16	Water Storage Pond	386402	6945559
W16A	Discharge from the Water Storage Pond	386679	6945664
W17	Water Storage Pond dam seepage	386679	6945664
W30	Headwaters Minto Creek (north-west fork)	383693	6945026
W33	Up-gradient of South Diversion Ditch	385351	6944072
W35	South Diversion Ditch	385223	6944427
W36	Minto Creek detention structure (MCDS) – Decommissioned in 2015	385892	6945191
W37	100 m downstream of MCDS (W36 collection sump) and upstream of Water Storage Pond – Decommissioned in 2015	386180	6945294
W45	Area 2 Pit and Area 2 Pit Tailings Management Facility	384912	6944068
W46	Minto Creek, downstream of W7 and W6 tributaries	387873	6946301
W47	Area 118 Pit water	384775	6944153
W50	Minto Creek, approximately 50 m downstream of the toe of the Water Storage Pond Dam and downstream of the inflow of the treated water	386747	6945682
MC-1	Minto Creek upstream of Canyon	390967	6947528
WTP	Treated water from water treatment plant when RO not operating	385126	6945154
RO	Treated water from RO	385126	6945154
W51	Area 2 Stage 3 Pit	385160	6944240
W52	Ridgetop North Pit and Ridgetop North Pit Tailings Management Facility	*	*

Station	Description	UTM Coordinates – Zone 8	
		Easting	Northing
W53	Ridgetop South Pit	*	*
W54	Main Dam seepage	*	*
W55	Tailings Diversion Ditch	386209	6945007
W62	MVFES2 Collection Sump	386079	6945335
C4	Tributary on the south side of Minto Creek, downstream of W3	388407	6946571
C10	Tributary on the south side of Minto Creek, downstream of W3	391868	6947914
MN	Minto North pit water	384342	6946090
MN-0.2	Upper west arm of McGinty Creek (Reference Station)	382267	6947299
MN-0.5	West arm of McGinty Creek just upstream of the confluence with the east arm	385251	6951262
MN-1.5	Upper east arm of McGinty Creek downstream of the Minto North deposit	384473	6947055
MN-2.5	East arm of McGinty Creek just upstream of confluence with the west arm	385493	6950788
MN-4.5	Lower mainstream McGinty Creek near confluence with Yukon River	386231	6952851
UG 1	Minto South underground mine dewatering	384916	6944098
UG 2	Wildfire underground mine dewatering	*	*
UG 3	Copper Keel underground mine dewatering	*	*
UG 4	Minto East underground mine dewatering	384961	6945020

*Water quality sites not developed

5.1.1 Water Quality Monitoring Conformance

2019 conformance with the external water sampling requirements is summarized in Table 5-2, below. Flow monitoring at water quality surveillance sites is highly variable because of site and seasonal conditions and is not presented in Table 5-2, however, full details were provided in the Monthly Reports submitted to the YWB. Additionally, the specifics of non-conformance in relation to external and internal water sampling requirements are included in the Monthly Reports. Quality Assurance and Quality Control (QA/QC) sampling is not included in sampling events described in Table 5-2, but is provided in section 5.1.2.

Table 5-2: Water Quality Sampling Monitoring Conformance Summary (2019)

Site Name	2019 WQ sampling events	2019 Reason(s) for non-conformance events
W1	N/A	N/A
W2	35	Site was frozen during the first quarter, and dry for the third and fourth quarters. Sampled as per schedule for remainder of 2019.
W3	55	Sampled as per schedule.
W4	4	Sampled as per schedule.
W5	4	Sampled as per schedule.
W6	6	Site frozen for 6 months of the year. Sampled as per schedule for remainder of 2019.
W7	7	Site frozen for 5 months of the year. Sampled as per schedule for remainder of 2019.
W8	0	Site destroyed in 2017.
W8A	9	Site was dry during the second, third and fourth quarters. Sampled as per schedule otherwise.
W10	11	Site not sampled in November due to human error. Sampled as per schedule otherwise.
W12	12	Sampled as per schedule.
W12A	0	No discharge from W12A in 2019.
W14	4	Mill/tailings shutdown through August 2019. Sampled as per schedule beginning in September.
W15	14	Site frozen in February. Sampled as per schedule otherwise.
W16	35	Sampled as per schedule.
W16a	0	No discharge from W16a in 2019.
W17	52	Sampled as per schedule.
W30	7	Site was frozen during first quarter 2019, and in November and December. Sampled as per schedule otherwise.
W33	0	Site destroyed in 2017, replaced with W33s.
W33s	4	Site was frozen from January-April and October-December. Dry in August. Sampled as per schedule otherwise.
W35	11	Site frozen for 4 months of 2019. Sampled as per schedule otherwise.
W36	0	Decommissioned in 2015.
W37	0	Decommissioned in 2015.
W45	5	Site was not sampled for 7 months due to freezing and/or unsafe conditions.
W46	8	Site frozen for four months. Sampled as per schedule for remainder of 2019.
W47	0	Decommissioned and backfilled in 2017.
W50	4	Site dry most of year; no discharge from mine site. Sampled as scheduled otherwise.
MC-1	29	Site frozen through first quarter, and December-November. Sampled as per schedule for remainder of 2019.
WTP	0	No treatment or discharge in 2019.
RO		
W51	6	Site frozen/inaccessible through January-April and November-December. Samples as per schedule for remainder of 2019.
W52	0	Site not established.

Site Name	2019 WQ sampling events	2019 Reason(s) for non-conformance events
W53	0	Site not established.
W54	0	Site not established.
W55	2	Flow present in June. Site dry or frozen for remainder of 2019.
W62	12	Sampled as per schedule.
C4	6	Site frozen for 6 months. Sampled as per schedule for remainder of 2019.
C10	1	Site frozen or dry except in April 2019.
MN	6	Site frozen for 6 months. Sampled as per schedule for remainder of 2019.
MN-0.2	7	Site frozen for 5 months. Sampled as per schedule for remainder of 2019.
MN-0.5	7	Site frozen for 5 months. Sampled as per schedule for remainder of 2019.
MN-1.5	6	Site frozen for 6 months. Sampled as per schedule for remainder of 2019.
MN-2.5	7	Site frozen for 5 months. Sampled as per schedule for remainder of 2019.
MN-4.5	5	Site frozen or dry for 7 months. Sampled as per schedule for remainder of 2019.
UG1	12	Sampled as per schedule.
UG4	12	Sampled as per schedule.

5.1.2 Quality Assurance and Quality Control Program

As required by Clause 104 of the WUL, Minto is required to submit the results and interpretations of the Quality Assurance and Quality Control Program (QA/QC Program). The QA/QC program is directed through the EMSRP. Implementation of the Minto QA/QC Program occurred since November 2012.

The primary objective of the QA/QC Program is to ensure that data collected, analyzed and evaluated through the environmental monitoring programs at Minto are representative of the environmental conditions present at the time of sample collection.

The QA/QC Program has been developed using recognized QA/QC protocols. Specific procedures for data collection at the Minto Mine are detailed in Standard Operating Procedures (SOPs). SOPs are internal documents to the Minto Mine that may be modified or improved as required.

The main components of the QA/QC Program presented in the following sections include QA/QC with regards to water quality monitoring, external and on-site laboratory reporting, and environmental programs monitoring. QA/QC results and interpretations are presented in each Monthly Report.

5.1.2.1 Water Quality QA/QC

Procedures for water quality monitoring at the Minto Mine are described in the EMSRP and further detailed in the Minto Mine Surface Water Quality Monitoring Standard Operating Procedure. The SOP is reviewed at the start of each field season and signed off by Minto Environment department staff to help ensure consistency in sampling procedures.

In 2019, 689 water quality samples (surface and groundwater) were collected for the water quality monitoring programs. QC samples represented 20.6% of the total number of samples collected in 2019,

and included 96 field duplicates, 12 field blanks, 4 trip blanks, and 41 field splits. The Minto Mine Surface Water Quality Monitoring Standard Operating Procedure describes a 1:10 quality control to routine sampling ratio and this ratio was achieved in 2019.

5.1.2.2 External Laboratory QA/QC

The 2019 external laboratory water quality analysis were performed by ALS Environmental in Burnaby, BC. As described in the EMSRP, all results provided by the external laboratory were accompanied by a Quality Control Report. If procedural deviations or exceedances in standard holding time occurred, the details of such nonconformities were included in each report. Additionally, each report contained QC batch numbers enhancing sample result traceability.

5.1.2.3 On-site Laboratory QA/QC

Procedures for analyzing water samples at the on-site laboratory are detailed in a variety of SOPs such as, but not limited to: The Laboratory QA/QC Guidelines SOP; Preparation of Dissolved and Total Metals (Cu, Al, Cd) SOP; Preparation of Dissolved and Total Selenium SOP; and Total Dissolved Solids SOP. All on-site laboratory equipment was calibrated per the manufacturer's specifications in 2018.

On-site laboratory analysis of water quality samples occurred at W2, W3, W8A, W16, W17 and W50 as per the WUL Schedule 1 – Part 2 monitoring requirements, as environmental conditions allowed. No internal samples were provided to the internal laboratory from W8 as the site was destroyed in 2017. Additionally, the on-site laboratory analyzed water from sites W15 and W35 during freshet to determine where best to route the run-off water.

The 2019 QC procedures performed by the on-site laboratory included spiked blanks and calibration checks. If two or more QC failures occurred, the 2019 QC procedures involved re-analyzing the entire batch of samples. Additionally, one replicate sample is analyzed for each batch analysis. In the event the replicate sample results do not match; the entire batch is reanalyzed.

QA/QC results such as duplicates, field splits, trip blanks and field blanks are verified monthly. Results are compared and reported internally to improve on sampling and analysis.

On-site and external laboratory water quality results for water quality sites W2, W3, W8A, W16, W16A and W50 are presented in each Monthly Report submitted to the Water Board. In monthly reports, it was noted that discrepancies in results from the external and on-site laboratories occurred and were likely a result of different methods and/or equipment utilized in analyzing water samples, different processing times between sampling and processing the samples, and the associated use of non-preserved versus preserved samples.

5.2 Compliance

5.2.1 Discharge Compliance – WQ Effluent Standards

5.2.1.1 W16A – EQS Compliance Point

There was no discharge from W16A in 2019.

5.2.1.2 W50 – EQS Compliance Point

The Effluent Quality Standards (EQS) (Clause 9 of the WUL) were applied and met at W50 for the months of June, October, and November 2019, the only periods when water was encountered. The water quality statistics for 2019 where W50 was the EQS compliance point are summarized below in Table 5-3. The summary from 2009 to 2018 has some exceeded parameters, those were triggered prior to 2015, with different standards. There were exceedances for Total Suspended Solids (TSS) and Cadmium (Cd) in 2019. Both occurred on the same sample date, July 15th, when very little water was available and no flow was recorded. This may explain the high values, which are still below the maximum historical values for those parameters. The summary for dissolved aluminum, copper, cadmium and selenium are also presented graphically in Figure 5-1 and 5-2 below.

Table 5-3: W50 Water Quality Results Summary (2009-2019)

W50	Water Quality Objective (WUL Clause 9)	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters		Mean	Min	Max	Mean	Min	Max
pH	6.0-9.0	8.05	6.82	8.4	8.16	7.82	8.35
TSS (mg/L)	15	5.01	0.5	42	5.07	1.5	10.2
Nutrients (mg/L)							
Ammonia Nitrogen	0.75	0.07976	0.0025	1.0000	0.233	0.173	0.2820
Nitrite Nitrogen	0.18	0.02455	0.0025	0.1580	0.0012	0.0005	0.0024
Nitrate Nitrogen	27.3	3.6602	0.01	16.2000	0.01888	0.0025	0.0355
Dissolved Metals (mg/L)							
Aluminum	0.3	0.0152	0.0013	0.12	0.0094	0.0069	0.0127
Arsenic	0.015	0.000353	0.00012	0.0008	0.00042	0.00038	0.00047
Cadmium	0.00015*	0.00001342	0.0000025	0.00028	0.0000917	0.0000236	**0.000239**
Chromium	0.003	0.000415	0.00005	0.0017	0.00029	0.00023	0.00037
Copper	0.039	0.01647	0.0005	0.075	0.00298	0.00126	0.0048
Iron	3.3	0.05103	0.0025	0.3	0.036	0.015	0.053
Lead	0.012	0.0001314	0.000025	0.0008	0.000025	0.000025	0.000025
Molybdenum	0.219	0.00573	0.0005	0.019	0.00532	0.00442	0.00585
Nickel	0.33	0.000885	0.00025	0.003	0.00799	0.0052	0.0102
Selenium	0.006	0.001152	0.00005	0.0049	0.00027	0.000211	0.000343
Zinc	0.09	0.00252	0.0005	0.018	0.00165	0.0005	0.0026

Bold values indicate exceedances of the current WUL standards
***Based on measured hardness**

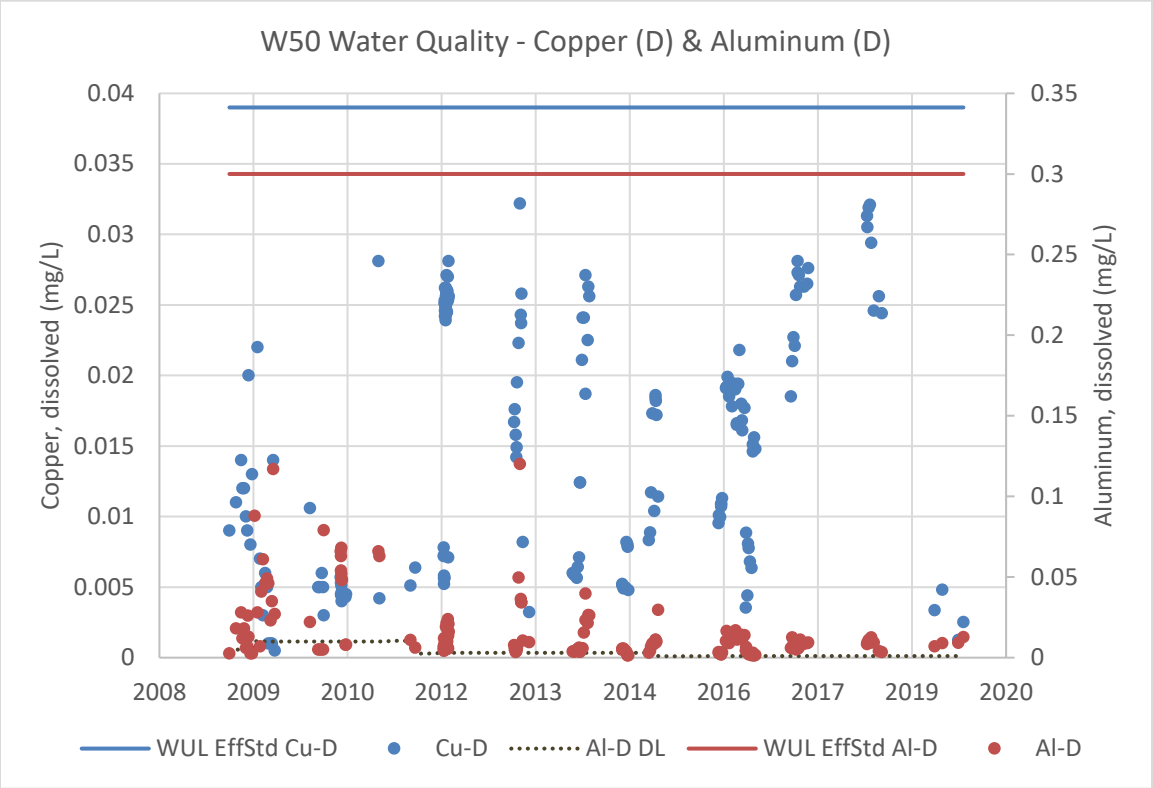
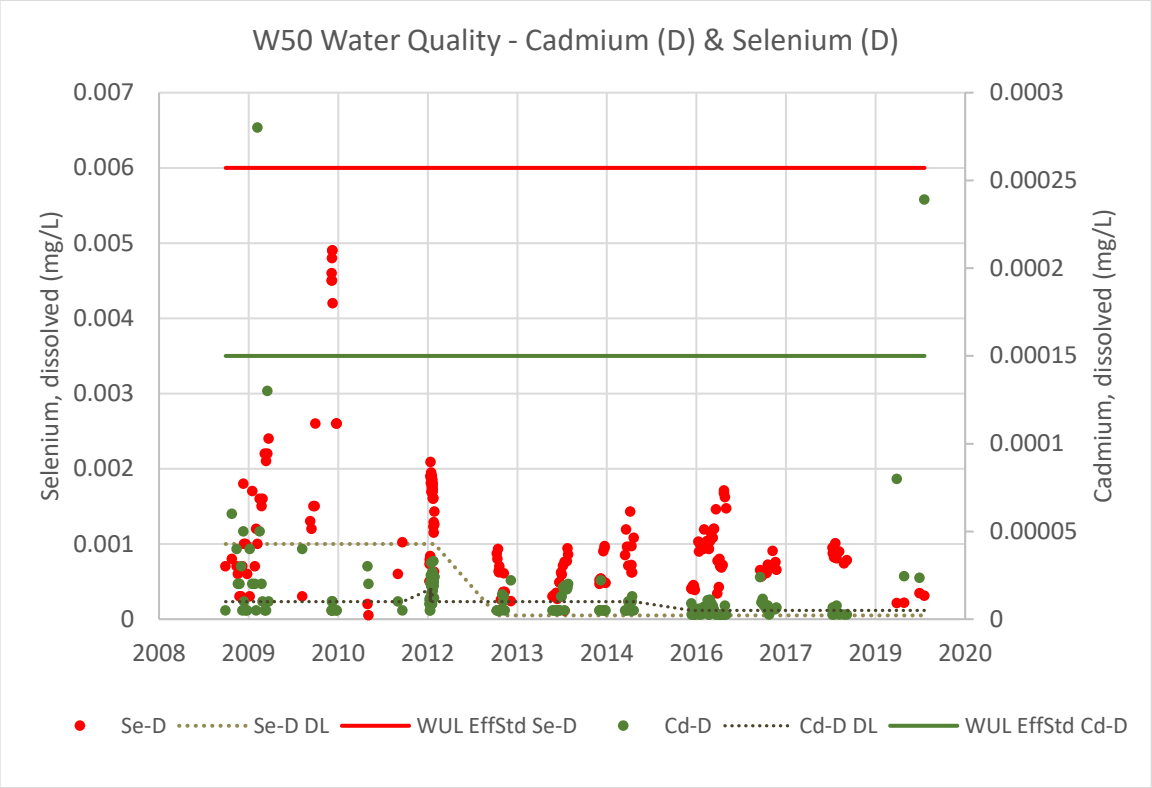


Figure 5-1: W50 Copper and Aluminum Concentrations (2009-2019)
DL is Analytical Detection Limit



***Note that the cadmium standard is based on a hardness of 63 mg/L which is a conservative estimate of hardness at the WQO station.**

Figure 5-2: W50 Cadmium and Selenium Concentrations (2009-2019)

DL is Analytical Detection Limit

5.2.1.3 W17 – EQS Compliance Point

During 2019, there was no water discharged from W17 to the Minto Creek, therefore EQS were not applied to this station.

5.2.1.4 WTP – EQS Compliance Point

The WTP did not operate in 2019, therefore EQS were not applied to this station.

5.2.2 Discharge Compliance – Bioassays

Monthly and quarterly bioassays are conducted at several surface water quality sites, as per WUL requirements. These tests are to ensure the water is not toxic for aquatic organisms.

All quarterly LC50 and Ra226 tests were conducted, and passed, at W3 during 2019. The third quarter algae growth sample (MDMER) did not arrive to the lab in time and was not able to be tested. Quarterly Lab results were submitted with the respective monthly reports. Annual MDMER sub-lethal tests were conducted in November. Both tests passed and the results were included in the December monthly report.

At W2 station, bioassay sampling was not completed in the first quarter of 2019, as the water quality station was frozen until April, and hence did not allow for the quarterly 30-day CT test to be conducted in Q1. CT-30 day, CA-72A and CD-7 day tests were completed and passed in Q2, however the site went dry in Quarters 3 and 4.

Due to lack of water, monthly bioassay testing at W50 could only be completed in June. The 48- and 96-hour LT50, and Cd-7d tests passed for the month of June. Since Minto did not actively discharge in 2019, monthly bioassays were not required for W2, W16a, and W3.

5.2.3 Discharge Compliance – RO

There was no RO discharge in 2019, therefore no samples were taken.

5.2.4 Water Quality Objectives Compliance – Minto Creek

5.2.4.1 W2 – WQO Compliance Point

As of April 22nd, W15 and W35 were no longer frozen and W2 became the WQO station until W15 and W35 froze again on October 19th, 2019. Following the date in October W50 became the WQO station, however no samples were taken at W50 in November and December due to it being frozen and/or dry.

The Water Quality Objectives (WQO) (Clause 11 of the WUL) were met at the W2 during the period between April 22nd and June 18th, 2019. The water quality statistics during the period where W2 was the WQO compliance point are summarized below in Table 5-4. Dissolved copper and aluminum at W2 are illustrated in Figure 5-3, and dissolved cadmium and selenium in Figure 5-4, below.

Table 5-4: **W2 Water Quality Results Summary (2019)**

W2	Water Quality Objective	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**(WUL Clause 11)**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	6.0-9.0	8.11	7.03	8.52	8.29	8.12	8.46
TSS (mg/L)		50.96	0.5	2600	10.46	<3.0	75.7
Nutrients (mg/L)							
Ammonia Nitrogen	0.25	0.0333	0.001	0.83	0.00711	<0.0050	0.0174
Nitrite Nitrogen	0.06	0.00659	0.0005	0.125	0.00129	<0.0010	0.0032
Nitrate Nitrogen	9.1	1.34746	0.0025	8.9	0.02072	<0.0050	0.0987
Dissolved Metals (mg/L)							
Aluminum	0.1	0.01854	0.0015	0.201	0.00739	0.0041	0.0227
Arsenic	0.005	0.000498	0.0001	0.00122	0.00045	0.00038	0.00063
Cadmium	0.00015*	1.185E-05	0.0000025	0.00026	6.83E-06	<0.0000050	0.0000135
Chromium	0.001	0.000407	0.00005	0.0069	0.0002	0.00014	0.00037
Copper	0.013 ([DOC] ≤ 10mg/L) 0.02 ([DOC] > 10mg/L)	0.00328	0.0005	0.0227	0.00269	0.00191	0.00707
Iron	1.1	0.1565	0.01	0.905	0.053	0.018	0.187
Lead	0.004	0.0000899	0.000025	0.0009	0.00005	<0.000050	<0.000050
Molybdenum	0.073	0.002626	0.00018	0.015	0.001318	0.000962	0.00208
Nickel	0.11	0.001083	0.00025	0.004	0.000741	<0.00050	0.00161
Selenium	0.002	0.00054	0.00005	0.0026	0.000185	0.000089	0.000537
Zinc	0.03	0.00249	0.0005	0.02	0.00106	<0.0010	0.0015

***Based on measured hardness**

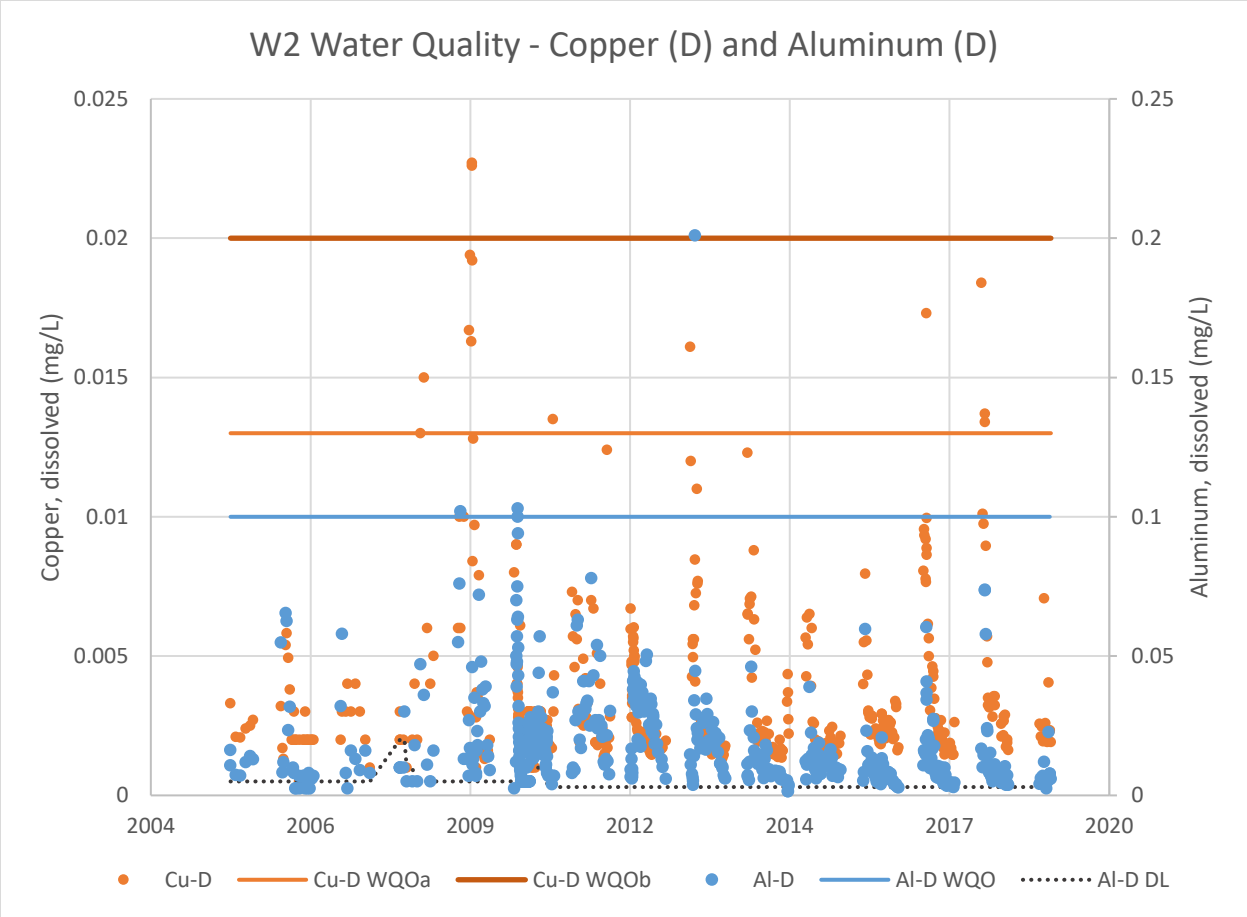


Figure 5-3: W2 Copper and Aluminum Concentrations (2005-2019)
DL is Analytical Detection Limit

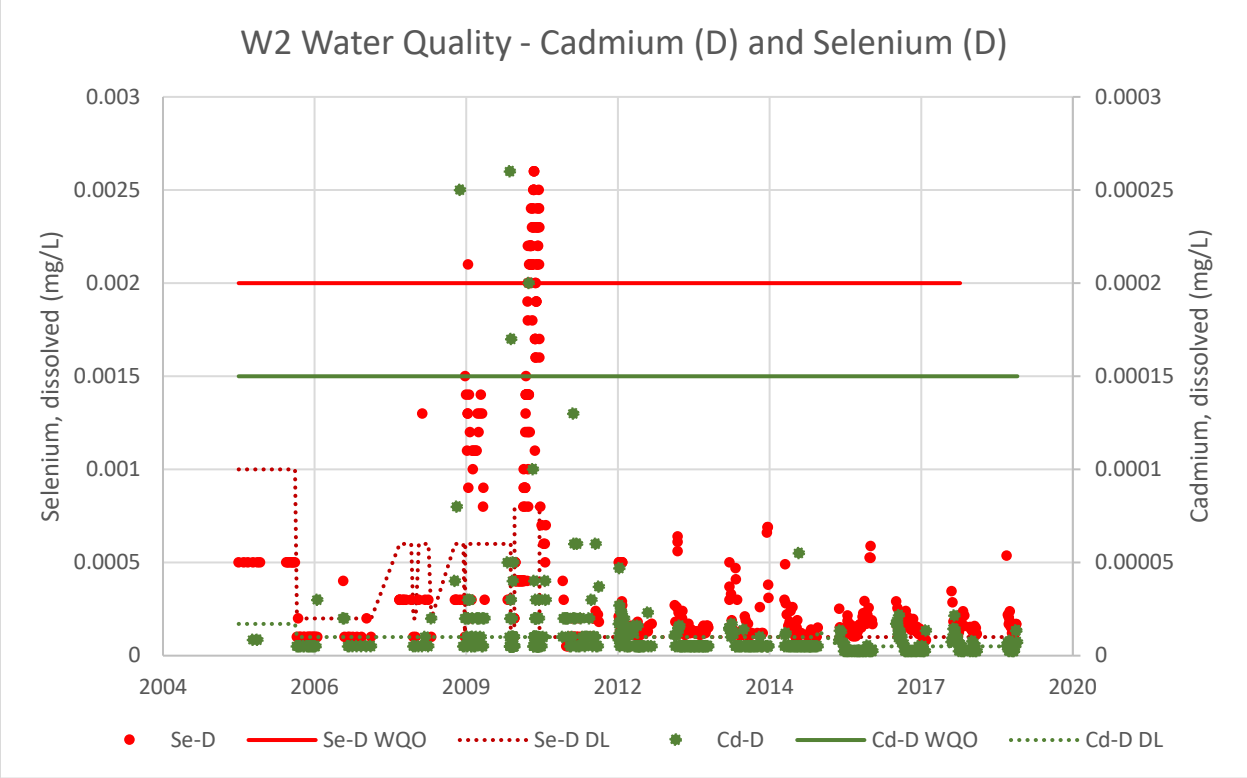


Figure 5-4: W2 Cadmium and Selenium Concentrations (2005-2019)
DL is Analytical Detection Limit

5.2.4.1 W50 – WQO Compliance Point

W50 was the WQO station during the first quarter as W15 and W35 were frozen but no samples were taken as W50 was frozen as well. As of April 22nd, W15 and W35 were no longer frozen and W2 became the WQO station until W15 and W35 froze again on October 19th, 2018. Following the date in October W50 became the WQO station, however no samples were taken at W50 in November and December due to it being frozen and/or dry.

5.3 Surface Water Quality Surveillance Stations

5.3.1 W2 – Minto Creek at Lower Road Crossing Water Quality

The water quality statistics for W2 from 2007 to 2018 are presented in Section 5.2.3.1 above.

5.3.2 W3 – Minto Creek, at the Federal (MDMER) Compliance Point

The water quality statistics for W3 from 2007 to 2019 are summarized below in Table 5-6. A total of 55 routine samples were collected from station W3 during the 2019 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W3 from 2007 to 2019 are also presented in Figure 5-7 and Figure 5-8 below. Three outlier data points dating from 2009 and early 2010 were removed from the W3 Cadmium and Selenium graph to better show the dataset on the graph (5/27/2009, 12/15/2009 and 1/11/2010).

Table 5-5: W3 Water Quality Results Summary (2007-2019)

W3	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.11	7.4	8.6	8.3	7.77	8.62
TSS (mg/L)	6.93	<1.0	985	4.55	<3.0	33.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.0493	-0.0100	0.6200	0.0174	<0.0050	0.1310
Nitrite Nitrogen	0.02387	<0.0010	0.347	0.00141	<0.0010	<0.010
Nitrate Nitrogen	2.4957	<0.020	18.7	0.09942	<0.0050	0.168
Dissolved Metals (mg/L)						
Aluminum	0.01838	<0.0010	0.373	0.00248	<0.0010	0.0221
Arsenic	0.00033	0.00012	0.0014	0.00028	0.00016	0.00166
Cadmium	0.00076585	<0.0000050	0.565	0.00001272	<0.0000050	0.0000759
Chromium	0.000762	<0.00010	0.0039	0.00013	<0.00010	0.00164
Copper	0.00536	<0.001	0.067	0.00338	0.00163	0.0212
Iron	0.0428	<0.005	0.7500	0.0273	<0.010	0.2000
Lead	0.0002362	0.000009	0.0603	0.0000502	<0.000050	0.000064
Molybdenum	0.00548	0.00066	0.103	0.00509	0.00185	0.00592
Nickel	0.001098	<0.00050	0.006	0.000934	<0.00050	0.00246
Selenium	0.0009263	<0.000050	0.0348	0.000312	0.000074	0.000445
Zinc	0.0049	0.0007	0.1430	0.0059	<0.0010	0.2340

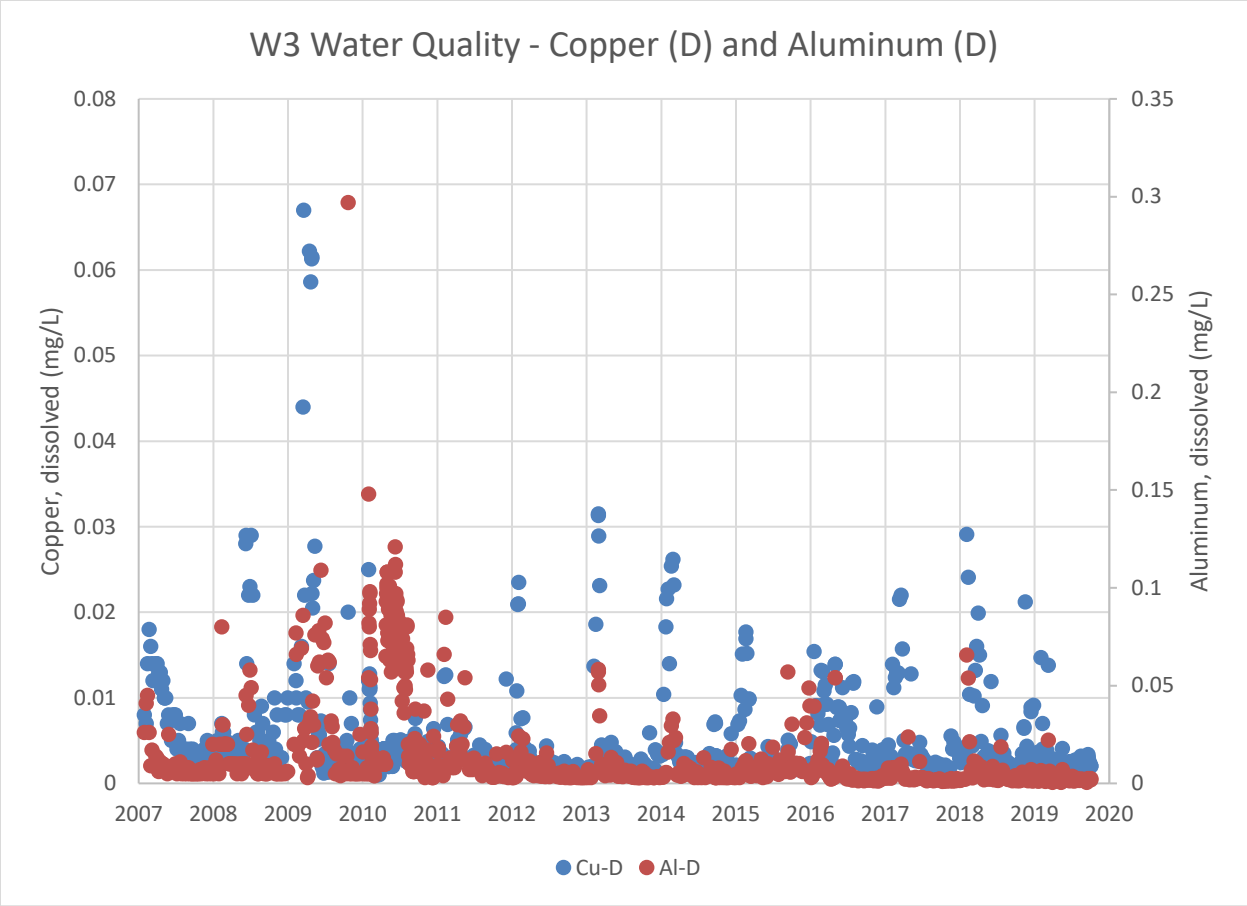


Figure 5-5: W3 Copper and Aluminum Concentrations (2007-2019)

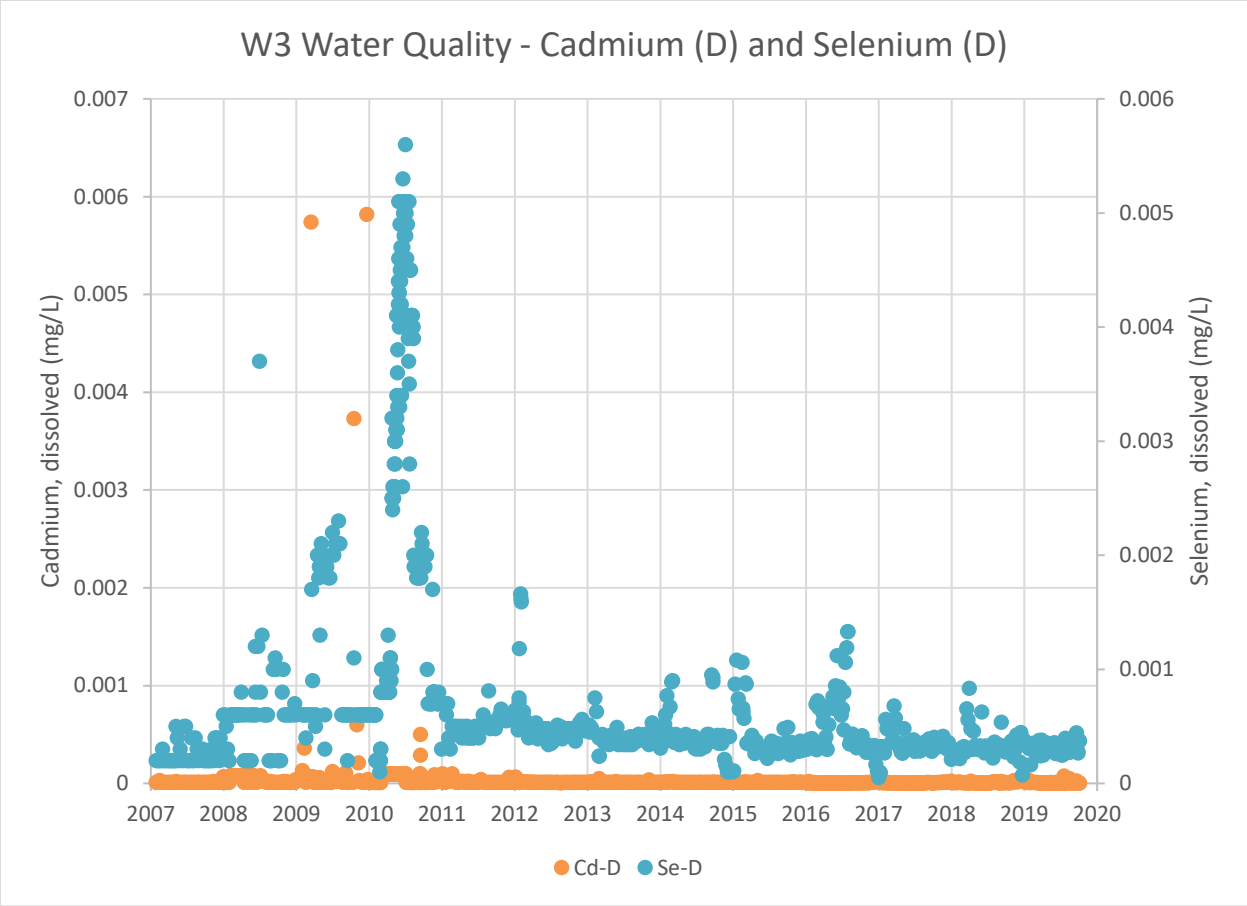


Figure 5-6: W3 Cadmium and Selenium Concentrations (2007-2019)

5.3.3 W4 – Yukon River, Upstream of the confluence with Minto Creek

The water quality statistics for W4 from 2007 to 2019 are summarized below in Table 5-7. A total of four routine samples were collected from station W4 during the 2019 monitoring period.

Table 5-6: W4 Water Quality Results Summary (2007-2019)

W4	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.93	5.48	8.26	8.10	8	8.24
TSS (mg/L)	21.03	<1.0	270	14.22	<3.0	28.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.03535	<0.0050	2.4	0.00552	<0.0050	0.0071
Nitrite Nitrogen	0.00588	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.07326	<0.0050	0.849	0.0721	0.0115	0.167
Dissolved Metals (mg/L)						
Aluminum	0.01384	<0.0010	0.167	0.0071	<0.0010	0.0138
Arsenic	0.000451	<0.00010	0.00105	0.00046	0.00041	0.00054
Cadmium	1.753E-05	<0.0000050	0.0014	6.85E-06	<0.0000050	0.0000094
Chromium	0.000955	<0.00010	<0.0020	0.000135	<0.00010	0.00017
Copper	0.001092	<0.00020	0.00819	0.00066	0.00031	0.00105
Iron	0.03628	<0.0050	0.307	0.018	0.011	0.025
Lead	0.0001955	<0.000050	<0.00050	0.0000500	<0.000050	<0.000050
Molybdenum	0.001081	0.000581	0.0021	0.000983	0.00039	0.00127
Nickel	0.000993	<0.00050	0.00200	0.00053	<0.00050	0.00062
Selenium	0.000167	<0.00010	<0.0010	0.00017	0.000116	0.000221
Zinc	0.00491	<0.0010	0.0278	0.00163	<0.0010	0.0035

5.3.4 W5 – Yukon River, Downstream of the Confluence with Minto Creek

The water quality statistics for W5 from 2007 to 2019 are summarized below in Table 5-8. A total of four routine samples were collected from station W5 during the 2018 monitoring period.

Table 5-7: W5 Water Quality Results Summary (2007-2019)

W5	2005 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.96	7.58	8.25	8.04	7.94	8.1
TSS (mg/L)	36.03	<1.0	340	14.2	3.5	28.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.02408	<0.0050	0.382	0.00775	<0.0050	0.0136
Nitrite Nitrogen	0.00594	<0.0010	<0.050	0.00110	<0.0010	0.0014
Nitrate Nitrogen	0.0576	0.0057	<0.4	0.0411	0.0067	0.122
Dissolved Metals (mg/L)						
Aluminum	0.01427	<0.0030	0.0637	0.0091	0.0062	0.0146
Arsenic	0.000497	0.00036	0.00086	0.00047	0.00042	0.00053
Cadmium	1.195E-05	<0.0000050	<0.000050	5.865E-05	<0.0000050	0.000213
Chromium	0.000946	<0.00010	<0.0010	0.000138	<0.00010	0.00021
Copper	0.00134	0.00047	0.00694	0.00202	0.00049	0.00554
Iron	0.0859	0.009	0.712	0.019	0.013	0.027
Lead	0.0001962	<0.000050	<0.00050	0.0000500	<0.000050	<0.000050
Molybdenum	0.001149	0.000868	0.0018	0.00131	0.001	0.00159
Nickel	0.001001	<0.00050	0.002	0.000512	<0.00050	0.00055
Selenium	0.00018	<0.00010	<0.0010	0.000159	0.000141	0.000181
Zinc	0.00508	<0.0010	0.0355	0.01068	<0.0010	0.0322

5.3.5 W6 – Tributary on the North side of Minto Creek

The water quality statistics for W6 from 2007 to 2019 are summarized below in Table 5-9. A total of six routine samples were collected from station W6 during the 2019 monitoring period.

Table 5-8: W6 Water Quality Results Summary (2007-2019)

W6	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.02	7.34	8.4	8.15	7.91	8.34
TSS (mg/L)	74.02	<1.0	1160	15.92	<3.0	63.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.02901	<0.0050	0.17	0.0078	0.0052	0.0100
Nitrite Nitrogen	0.00581	<0.0010	0.07	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.28401	<0.0050	8.09	0.00965	<0.0050	0.0226
Dissolved Metals (mg/L)						
Aluminum	0.01274	<0.0030	0.097	0.0054	0.004	0.0072
Arsenic	0.00046	0.0002	0.00081	0.00050	0.00041	0.0006
Cadmium	0.00001267	<0.0000050	0.00023	0.000005	<0.0000050	<0.0000050
Chromium	0.00034	0.00017	0.0013	0.00021	0.00018	0.00024
Copper	0.00249	0.0008	0.043	0.00134	0.00098	0.00157
Iron	0.0708	0.01	0.2	0.058	0.049	0.072
Lead	0.0001649	<0.000050	0.0005	0.0000500	<0.000050	<0.000050
Molybdenum	0.001238	0.000247	0.015	0.000544	0.000371	0.000705
Nickel	0.0012	<0.0010	0.002	0.0014	0.00105	0.00166
Selenium	0.000192	0.000057	0.002	0.000075	0.000056	0.000094
Zinc	0.00441	<0.0010	0.049	0.00100	<0.0010	<0.0010

5.3.6 W7 – North Flowing Tributary to Minto Creek

The water quality statistics for W7 from 2007 to 2019 are summarized below in Table 5-9. A total of seven routine samples were collected from station W7 during the 2019 monitoring period.

Table 5-9: W7 Water Quality Results Summary (2007-2019)

W7	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.99	5.51	8.41	8.3	8.06	8.42
TSS (mg/L)	31.65	<1.0	400	18.65	<3.0	64.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.02895	<0.0050	0.34	0.0191	0.0107	0.0504
Nitrite Nitrogen	0.01182	<0.0010	0.14	0.00112	<0.0010	0.0022
Nitrate Nitrogen	0.1088	0.0050	0.324	0.13057	<0.0050	0.186
Dissolved Metals (mg/L)						
Aluminum	0.0185	<0.0030	0.096	0.0047	0.003	0.0087
Arsenic	0.00044	<0.0002	0.001	0.00042	0.00037	0.00057
Cadmium	0.00001208	<0.0000050	0.00008	0.00000768	<0.0000050	0.0000318
Chromium	0.00082	0.00013	0.002	0.00016	0.00012	0.00025
Copper	0.00204	0.00063	0.0154	0.00112	0.00066	0.00281
Iron	0.1893	0.0102	1.06	0.089	0.056	0.21
Lead	0.0001754	<0.000050	0.0017	0.0000500	<0.000050	<0.000050
Molybdenum	0.001288	0.00013	0.002	0.001420	0.00105	0.0016
Nickel	0.00121	<0.0005	0.004	0.00068	0.00053	0.00101
Selenium	0.000191	0.000092	0.0022	0.000208	0.000169	0.000254
Zinc	0.00422	<0.0010	0.0302	0.00111	<0.0010	0.0021

5.3.7 W8A – Eastern Collection Sump from DSTSF

W8A was collected on a weekly basis per WUL requirements, a total of 9 samples were collected during the 2019 monitoring period; the sump has been dry since mid-March. Water quality statistics from 2009 to 2019 are summarized below in Table 5-10. Furthermore, trend analyses for seepage parameters results are presented in the Seepage section 7.1.

Table 5-10: Water Quality Result Summary (2009-2019)

Station Name	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.96	5.04	8.6	7.7	7.58	7.81
TSS (mg/L)	45.05	<1.0	6540	35.1	16.2	52.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.1503	0.007	1.6	0.513	0.467	0.58
Nitrite Nitrogen	0.1267	<0.0010	1.18	0.462	0.224	0.885
Nitrate Nitrogen	8.6448	<0.0050	72.00	1.49	1.05	2.07
Dissolved Metals (mg/L)						
Aluminum	0.01227	0.00262	0.157	0.0072	0.0052	0.0106
Arsenic	0.000544	<0.00010	0.00145	0.00072	0.00054	0.00094
Cadmium	0.000189	<0.000010	0.0013	0.000202	0.000135	0.000278
Chromium	0.000848	0.0001	0.002	0.00072	0.00066	0.0008
Copper	0.100662	<0.00020	0.272	0.0505	0.0398	0.057
Iron	0.2699	<0.0050	7.00	0.917	0.282	2.18
Lead	0.000159	0.000013	0.00102	0.00005	<0.000050	<0.000050
Molybdenum	0.01057	0.00033	0.049	0.00962	0.00908	0.0102
Nickel	0.001508	0.000677	0.006	0.00161	0.00143	0.00183
Selenium	0.006105	<0.00010	0.018	0.00283	0.00201	0.00383
Zinc	0.5548	<0.001	5.17	0.566	0.276	0.983

5.3.8 W10 – Minto Creek Headwaters (South-West Fork)

The water quality statistics for W10 from 2007 to 2019 are summarized below in Table 5-11. A total of eleven routine samples were collected from station W10 during the 2019 monitoring period.

Table 5-11: W10 Water Quality Results Summary (2007-2019)

W10	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.48	6.00	8.57	7.89	6.89	8.53
TSS (mg/L)	22.46	<1.0	390	86.58	<3.0	948
Nutrients (mg/L)						
Ammonia Nitrogen	0.18052	<0.0050	3.25	0.3022	0.014	1.72
Nitrite Nitrogen	0.01677	<0.0010	0.148	0.03652	<0.0010	0.248
Nitrate Nitrogen	1.59187	<0.0050	19.8	12.47728	<0.0050	41.4
Dissolved Metals (mg/L)						
Aluminum	0.10786	0.0023	0.418	0.0094	0.0017	0.0477
Arsenic	0.000488	<0.00010	0.00268	0.000273	<0.00010	0.00065
Cadmium	0.00003643	<0.0000050	0.0007	0.00001328	<0.0000050	0.0000666
Chromium	0.000844	<0.00010	0.00241	0.000136	<0.00010	0.00032
Copper	0.029314	<0.00020	0.138	0.00491	0.00073	0.018
Iron	3.26112	<0.0050	76.5	0.7915	<0.010	4.53
Lead	0.0001732	<0.000050	0.0022	0.00005	<0.000050	<0.000050
Molybdenum	0.000836	0.00003	0.00493	0.000734	0.000239	0.00249
Nickel	0.00147	<0.00050	0.00573	0.00075	<0.00050	0.00207
Selenium	0.0002518	<0.000050	<0.001	0.0001567	<0.000050	0.000334
Zinc	0.00676	<0.0010	0.062	0.00382	<0.0010	0.0132

5.3.9 W12 – Water in the Main Pit

The water quality statistics for W12 from 2007 to 2019 are summarized below in Table 5-12. A total of twelve routine samples were collected from station W12 during the 2019 monitoring period. As evident from the Table 5-12, parameters like TSS, nitrogen species, and several metals had significant reductions in concentration from the cessation of mining activities in the underground workings during temporary closure. This supports the idea that upon closure and the cessation of mining-impacted water reporting to the pit, that pit water quality will improve relatively quickly.

Table 5-12: W12 Water Quality Results Summary (2007-2019)

W12	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.06	6.20	10.60	8.24	8.06	8.41
TSS (mg/L)	17.02	<1.0	251	4.05	<3.0	7.7
Nutrients (mg/L)						
Ammonia Nitrogen	2.76146	<0.0050	24	0.24676	<0.0050	0.529
Nitrite Nitrogen	1.59884	<0.0050	8.78	0.1261	<0.010	0.289
Nitrate Nitrogen	18.9609	<0.01	141	9.24	3.32	28.1
Dissolved Metals (mg/L)						
Aluminum	0.01905	0.0016	0.124	0.00394	0.0018	0.0101
Arsenic	0.000634	<0.00010	0.003	0.00062	0.00032	0.00103
Cadmium	0.00006485	<0.0000050	0.00049	0.0000835	<0.000010	0.000217
Chromium	0.000759	<0.00010	0.0025	0.000138	<0.00010	0.0002
Copper	0.05333	0.00046	0.476	0.0758	0.0237	0.22
Iron	0.03755	<0.0050	0.386	0.0132	<0.010	0.022
Lead	0.0001912	<0.000050	0.00208	0.0000625	<0.000050	<0.00010
Molybdenum	0.05138	<0.0010	0.0975	0.02518	0.00826	0.034
Nickel	0.00211	<0.0005	0.0065	0.00098	<0.00050	0.00152
Selenium	0.007871	<0.00010	0.0207	0.00516	0.001660	0.0106
Zinc	0.00561	0.001	0.031	0.0036	<0.0010	0.0132

5.3.10 W12A – Discharge from the Main Pit

There was no discharge from the Main Pit in 2019 and no discharge from the Main Pit in previous years.

5.3.11 W14 – Tailings Thickener Overflow

The water quality statistics for W14 from 2007 to 2019 are summarized below in Table 5-13. A total of 4 routine samples were collected from station W14 during the 2019 monitoring period as the mill was shut down until September 2019.

Table 5-13: W14 Water Quality Results Summary (2007-2019)

W14	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.00	7.29	8.69	8.14	8.04	8.29
TSS (mg/L)	112.2	<5	1120	72.9	3.5	134
Nutrients (mg/L)						
Ammonia Nitrogen	3.827	<0.05	13	1.56	0.439	2.7
Nitrite Nitrogen	1.8055	0.0183	8.42	0.216	0.066	0.325
Nitrate Nitrogen	33.7	11.1	86.7	10.98	6.64	14.8
Dissolved Metals (mg/L)						
Aluminum	0.1071	0.0078	1.91	0.0147	0.0051	0.0273
Arsenic	0.00057	<0.0002	0.0052	0.00046	0.0004	0.00052
Cadmium	0.00004656	<0.0000050	0.0003	0.0001252	<0.000030	0.000302
Chromium	0.000758	<0.00010	0.0036	0.000162	0.0001	<0.00020
Copper	0.01309	0.0002	0.723	0.03575	0.00087	0.09510
Iron	0.07906	<0.0050	4.8	0.0275	0.017	0.053
Lead	0.0001886	<0.000050	0.0011	0.000075	<0.000050	<0.00010
Molybdenum	0.1012	0.0458	0.181	0.0482	0.0309	0.0707
Nickel	0.00188	<0.0005	0.0109	0.00458	0.00197	0.0084
Selenium	0.02983	0.00166	0.229	0.00653	0.00501	0.0107
Zinc	0.00452	<0.0010	0.028	0.00373	<0.0020	0.0064

5.3.12 W15 – Upper Minto Creek Stormwater Collection Point

The water quality statistics for W15 from 2007 to 2019 are summarized below in Table 5-14. A total of fourteen routine samples were collected from station W15 during the 2019 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W15 from 2007 to 2019 are also presented in Figure 5-7 and Figure 5-8 below. The higher TSS values seen in the table below are indicative of a single sample collected through the ice in January, when the effort of collecting the sample resulted in disturbed sediments getting into the sample.

Table 5-14: W15 Water Quality Results Summary (2007-2019)

W15	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.96	6.11	8.48	8.25	7.63	8.55
TSS (mg/L)	17.05	<1.0	370	63.19	<3.0	878
Nutrients (mg/L)						
Ammonia Nitrogen	0.1171	<0.0050	5.3	0.0805	0.0192	0.474
Nitrite Nitrogen	0.10009	0.0034	3.78	0.0874	0.0055	0.529
Nitrate Nitrogen	12.3053	<0.01	265	9.8	1.14	56.8
Dissolved Metals (mg/L)						
Aluminum	0.0479	0.0019	2.65	0.0131	0.0043	0.0467
Arsenic	0.000519	<0.00010	0.0022	0.00049	0.00033	0.00102
Cadmium	0.00003548	<0.0000050	0.00234	0.00002155	<0.0000050	0.0000773
Chromium	0.000836	<0.00010	0.0053	0.000191	<0.00010	0.00037
Copper	0.023892	<0.00020	0.415	0.0343	0.013	0.172
Iron	0.35724	<0.0050	6.48	0.108	0.01	0.33
Lead	0.0001836	0.000031	0.0027	0.00005	<0.000050	<0.000050
Molybdenum	0.00399	0.0001	0.113	0.00384	0.00186	0.00945
Nickel	0.00125	<0.00050	0.008	0.00093	<0.00050	0.00217
Selenium	0.002936	<0.00010	0.0504	0.004343	0.000509	0.0273
Zinc	0.00511	<0.0010	0.041	0.00239	<0.0010	0.0124

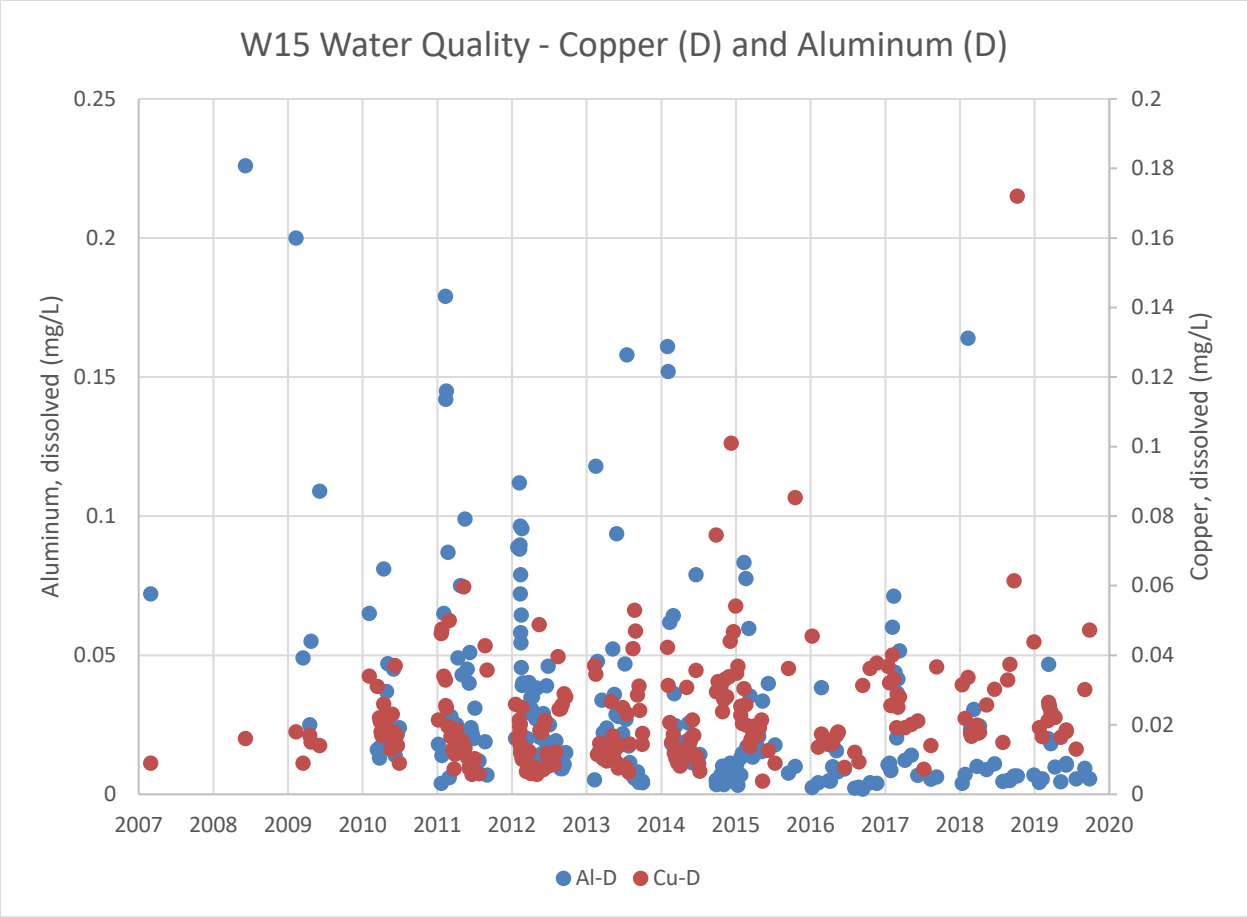


Figure 5-7: W15 Copper and Aluminum Concentrations (2007-2019)

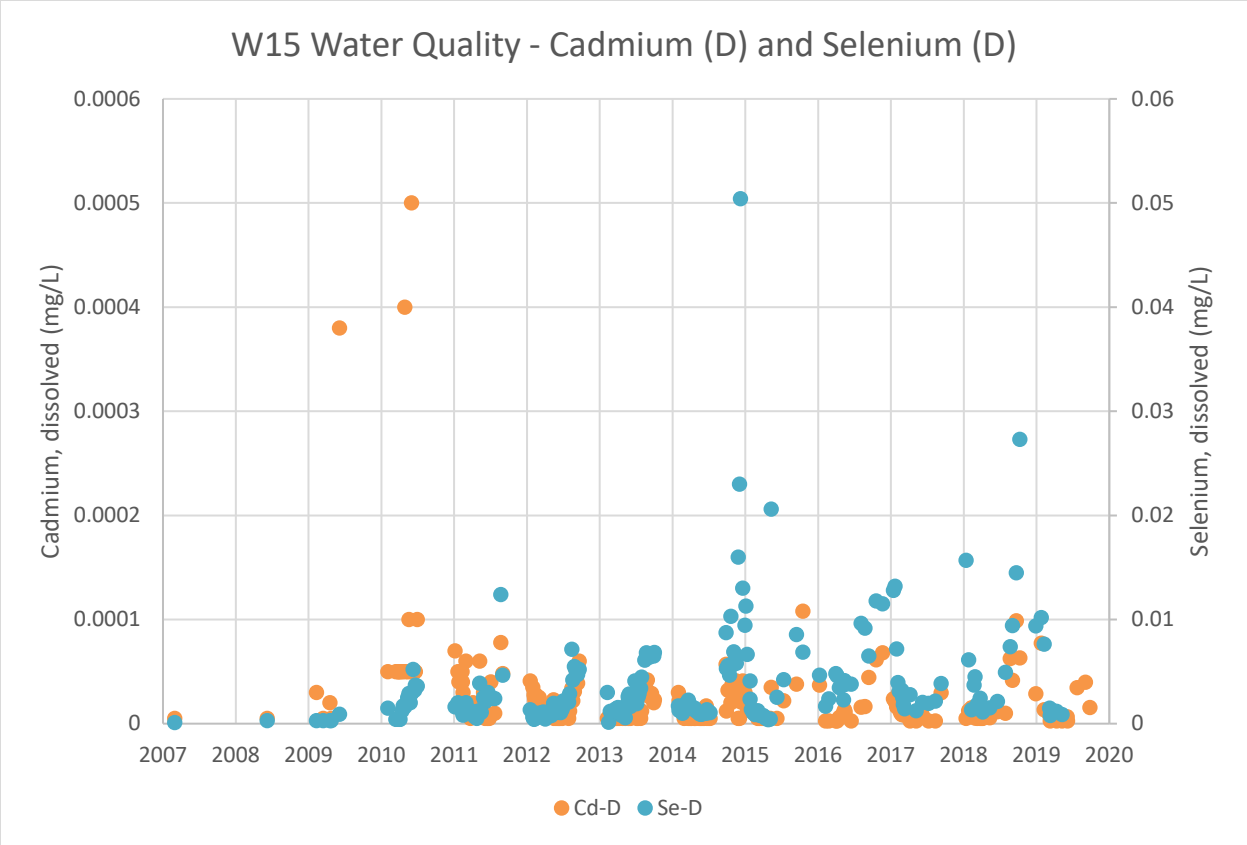


Figure 5-8: W15 Cadmium and Selenium Concentrations (2007-2019)

5.3.13 W16 – Water Storage Pond

The water quality statistics for W16 from 2007 to 2019 are summarized below in Table 5-15. A total of 35 routine samples were collected from station W16 during the 2019 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W16 from 2007 to 2019 are also presented in Figure 5-9 and Figure 5-10 below. An outlier in cadmium concentration for W16 collected on 5/5/2009 was removed for presenting the dataset in Figure 5-10.

Table 5-15: W16 Water Quality Results Summary (2007-2019)

W16	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.02	6.74	8.81	8.31	7.93	8.54
TSS (mg/L)	7.96	<1.0	181	8.1	<3.0	53.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.12852	<0.0050	2.00	0.02348	<0.0050	0.07
Nitrite Nitrogen	0.09152	<0.0010	8.62	0.00207	<0.0010	<0.010
Nitrate Nitrogen	3.3113	0.01	35	0.27997	<0.0050	1.06
Dissolved Metals (mg/L)						
Aluminum	0.01647	0.0013	0.234	0.0028	0.0011	0.0085
Arsenic	0.000407	<0.00010	0.0015	0.000463	<0.00010	0.00062
Cadmium	0.00003259	<0.0000050	0.00557	0.00003479	<0.0000050	0.000181
Chromium	0.00083	<0.00010	0.0172	0.000116	<0.00010	0.00019
Copper	0.02475	0.00158	0.123	0.01593	0.00754	0.0238
Iron	0.1108	0.0066	1.36	0.0166	<0.010	0.05
Lead	0.0001815	0.000020	<0.0010	0.0000523	<0.000050	0.000082
Molybdenum	0.005347	0.000653	0.0271	0.003287	0.000781	0.00385
Nickel	0.00120	<0.00050	0.009	0.00066	<0.00050	0.00099
Selenium	0.001129	<0.00010	0.0064	0.000458	0.000211	0.000744
Zinc	0.00559	<0.0010	0.0281	0.00536	<0.0010	0.0249

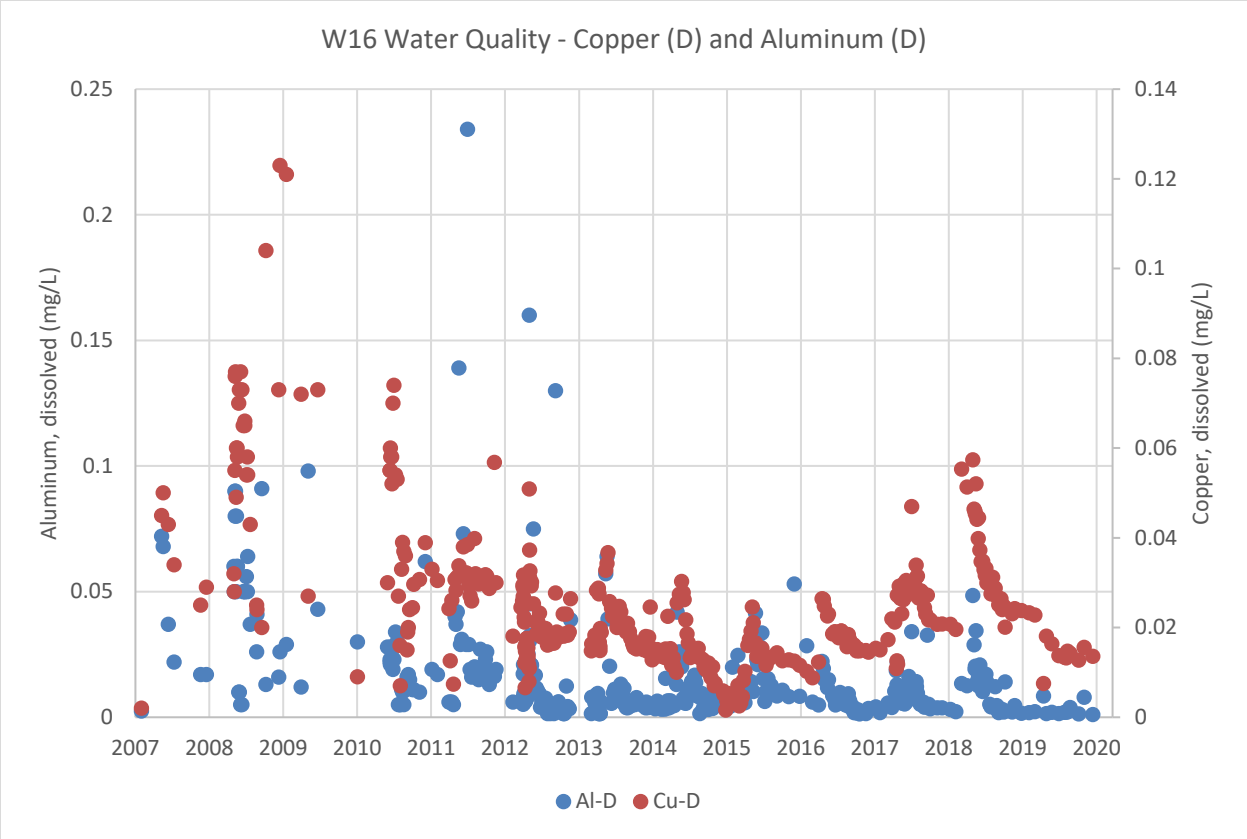


Figure 5-9: W16 Copper and Aluminum Concentrations (2007-2019)

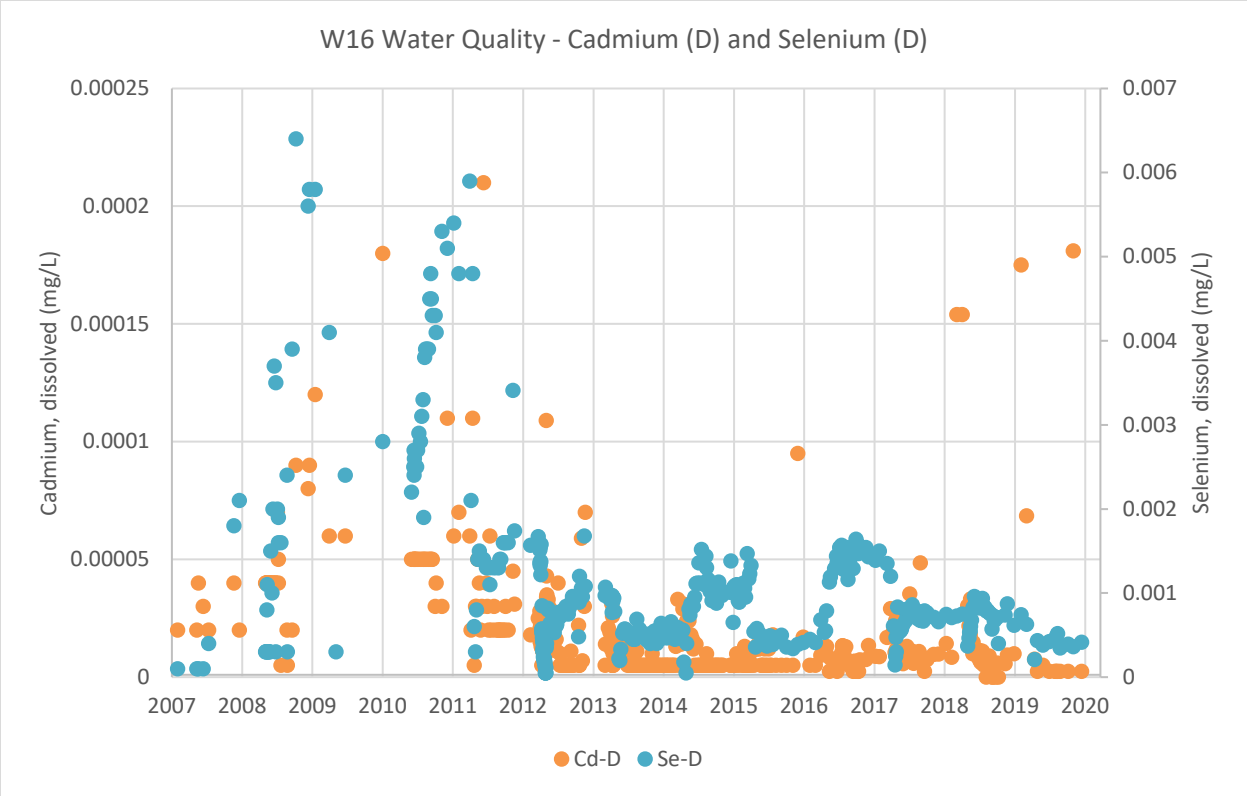


Figure 5-10: W16 Cadmium and Selenium Concentrations (2007-2019)

5.3.14 W17 – Water Storage Pond Dam Seepage

The summary results for this station are presented in the seepage section 7.4 along with trend analyses for dissolved copper, aluminum, cadmium and selenium concentrations throughout the years. A total of 52 samples were collected at this station during the 2019 monitoring period.

5.3.15 W30 – Headwaters Minto Creek (northwest fork)

The water quality statistics for W30 from 2009 to 2019 are summarized below in Table 5-16. A total of seven routine samples were collected from station W30 during the 2019 monitoring period.

Table 5-16: W30 Water Quality Results Summary (2009-2019)

W30	2007 - 2019 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.84	6.15	8.43	8.3	8.05	8.42
TSS (mg/L)	16.77	<1.0	1110	4.96	<3.0	9.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.1052	<0.005	0.85	0.0168	0.0076	0.0275
Nitrite Nitrogen	0.02889	<0.0010	0.579	0.00350	<0.0010	0.0113
Nitrate Nitrogen	3.17603	<0.0050	78.6	0.13736	<0.0050	0.345
Dissolved Metals (mg/L)						
Aluminum	0.05182	<0.001	0.217	0.0038	0.001	0.0076
Arsenic	0.000585	0.000054	0.00132	0.00069	0.00054	0.00087
Cadmium	0.00139368	<0.0000050	0.143	0.0000064	<0.0000050	<0.000010
Chromium	0.000838	<0.00010	0.0149	0.0001	<0.00010	<0.00010
Copper	0.03231	0.0067	0.179	0.01513	0.00994	0.0205
Iron	0.1946	<0.001	0.783	0.054	0.013	0.101
Lead	0.0001757	<0.000050	0.001	0.0000500	<0.000050	<0.000050
Molybdenum	0.00232	<0.0002	0.0098	0.00625	0.00467	0.00922
Nickel	0.001124	<0.00050	0.024	0.000533	<0.00050	0.00067
Selenium	0.0049	0.0004	0.343	0.00192	0.00118	0.00285
Zinc	0.00449	<0.0010	0.0164	0.001	<0.0010	<0.0010

5.3.16 W33/W33s – Above Tailings Diversion Ditches

The water quality statistics for W33 from 2009 to 2019 are summarized below in Table 5-17. A total of seven routine samples were collected from station W33 during the 2017 monitoring period. W33 was buried during construction at the end of December 2017. In 2018, the water was found seeping out of the road construction about 50 meters north of the original site and the samples were collected from that site onward.

Table 5-17: W33 Water Quality Results Summary (2009-2019)

W33	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.67	5.98	8.25	8.02	7.9	8.13
TSS (mg/L)	10.7	<1.0	218	20.92	<3.0	74.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.0563	<0.0050	<0.5	0.2516	0.0056	0.976
Nitrite Nitrogen	0.03142	<0.0010	1.28	3.87615	<0.0010	15.5
Nitrate Nitrogen	4.7362	<0.01	139	8.74368	<0.0050	34.9
Dissolved Metals (mg/L)						
Aluminum	0.0575	<0.0030	1.13	0.0211	0.0073	0.0343
Arsenic	0.00037	<0.00010	<0.001	0.00053	0.00031	0.00109
Cadmium	0.00002896	<0.0000050	0.000103	0.00001653	<0.0000050	0.0000468
Chromium	0.00104	0.00027	0.0022	0.00031	0.00019	0.00045
Copper	0.015545	<0.00020	0.136	0.0234	0.0067	0.0627
Iron	0.16369	<0.0050	1.4	0.154	0.044	0.30
Lead	0.0001826	<0.000050	0.000834	0.00005	<0.000050	<0.000050
Molybdenum	0.001034	0.0002	0.0101	0.00288	0.000494	0.00989
Nickel	0.00149	<0.0010	0.003	0.00147	0.00107	0.00162
Selenium	0.000414	<0.00010	0.006	0.000875	0.000087	0.00316
Zinc	0.00531	<0.0010	<0.01	0.00165	<0.0010	0.0024

5.3.17 W35 – Storm Water Collection Point – South Diversion Ditch

The water quality statistics for W35 from 2012 to 2019 are summarized below in Table 5-18. It should be noted that the location of W35 changed in 201, with the construction of the Tailings Diversion Ditch intake structure. The water reporting to W35 also changed from a primarily unimpacted water to water potentially impacted from blast residues from the new Fresh Air Raise access road, as well as water running off the portal access road.

A total of eleven routine samples were collected from station W35 during the 2019 monitoring period. The results for dissolved copper, dissolved aluminum, dissolved cadmium, and dissolved selenium for W35 from 2012 to 2019 are also presented in Figure 5-11 and Figure 5-12 below. Depending on water quality the water is re-routed to the TDD or to the A2 Pit.

Table 5-18: W35 Water Quality Results Summary (2012-2019)

W35	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.91	6.77	8.26	8.15	7.87	8.48
TSS (mg/L)	20.17	<1.0	465	20.6	<3.0	197
Nutrients (mg/L)						
Ammonia Nitrogen	0.0435	0.0059	0.303	0.0206	0.006	0.0516
Nitrite Nitrogen	0.0301	0.0012	0.335	0.0239	0.0018	0.076
Nitrate Nitrogen	6.833	<0.020	89.8	17.585	0.52	90.8
Dissolved Metals (mg/L)						
Aluminum	0.0271	0.0061	0.104	0.017	0.0034	0.0456
Arsenic	0.00036	0.00023	0.00066	0.00037	0.00026	0.00051
Cadmium	0.00001249	<0.0000050	0.000046	0.000018	0.0000086	0.0000373
Chromium	0.000648	<0.00010	<0.0010	0.00022	<0.00010	0.00041
Copper	0.0376	0.017	0.0911	0.0611	0.0157	0.109
Iron	0.0825	0.0144	0.323	0.0505	<0.010	0.085
Lead	0.0001245	<0.000050	<0.00020	0.00005	<0.000050	<0.000050
Molybdenum	0.001509	0.000378	0.00741	0.002659	0.000867	0.00828
Nickel	0.001212	<0.00050	0.00178	0.00096	0.00064	0.00153
Selenium	0.000269	<0.00010	0.00197	0.000603	0.000157	0.00255
Zinc	0.0038	<0.0010	0.0280	0.0013	<0.0010	0.0018

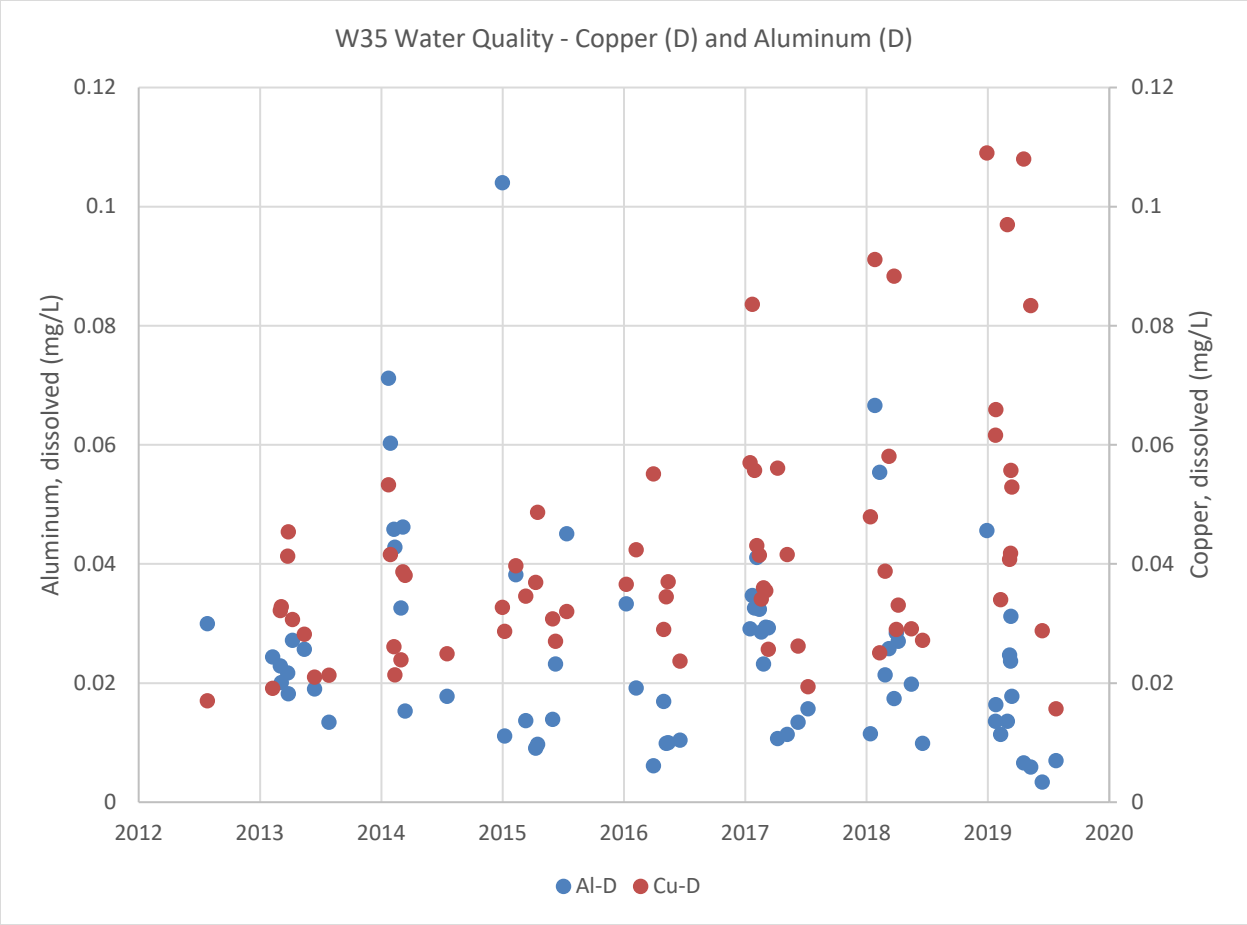


Figure 5-11: W35 Copper and Aluminum Concentrations (2012-2019)

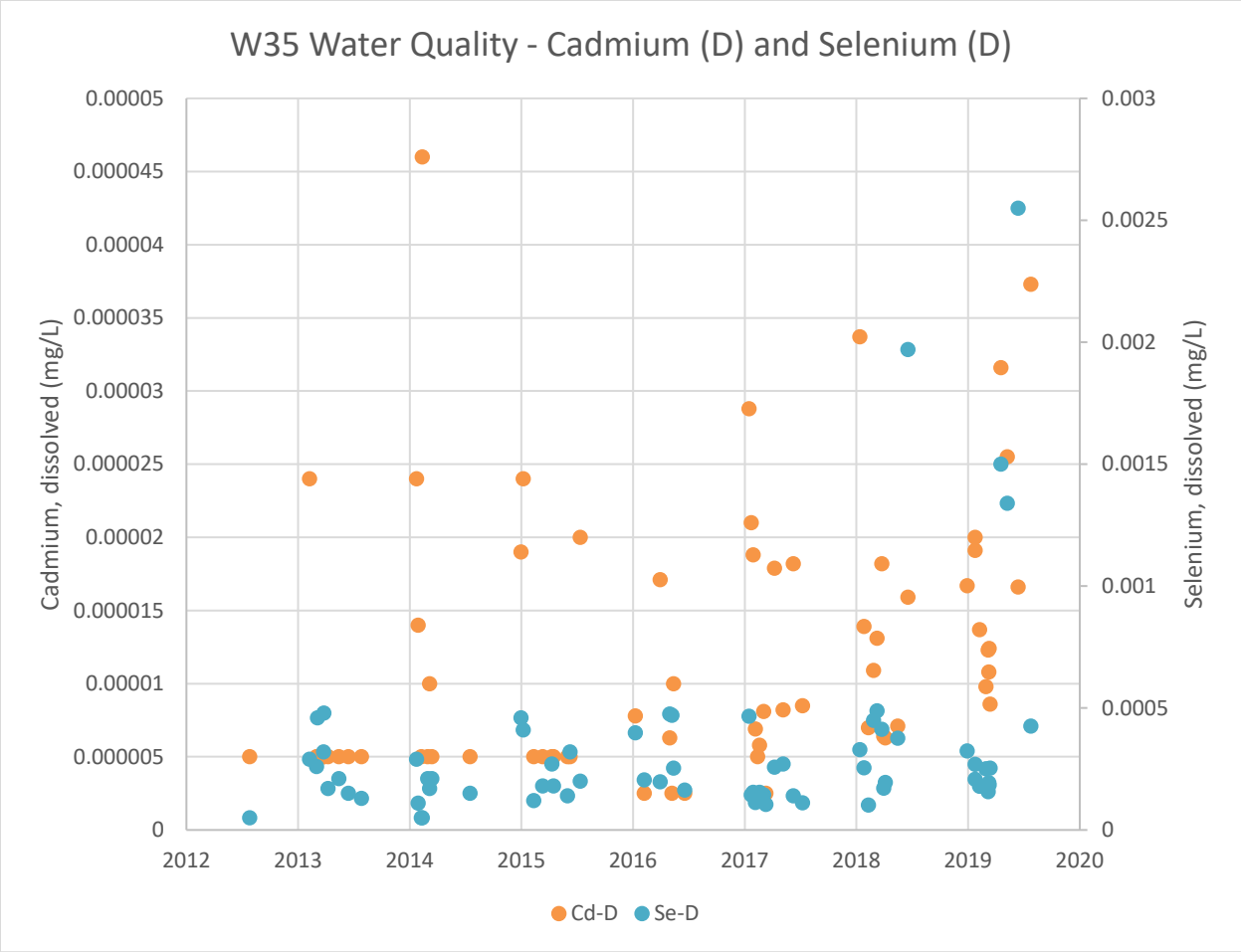


Figure 5-12: W35 Cadmium and Selenium Concentrations (2012-2019)

5.3.18 W36 – Minto Creek Detention Structure Pond

W36 was decommissioned during the construction of the Mill Valley Fill Extension Phase 2 (MVFE2) in 2015. As such, no samples were taken in 2019.

5.3.19 W37 – 100 m downstream of MCDS (W37 Collection Sump) and upstream of Water Storage Pond

W37 was decommissioned during the construction of the Mill Valley Fill Extension Phase 2 (MVFE2) in 2015 and replaced by W62. As such, no samples were taken in 2019.

5.3.20 W45– Area 2 Pit

The water quality statistics for W45 from 2012 to 2019 are summarized below in Table 5-19. A total of five routine samples were collected from station W45 during the 2019 monitoring period. The sampling

site was frozen or unsafe to access due to wet tailings deposits for much of the year. Area 2 began receiving mill water and tailings in September 2019.

As evident from the Table, parameters like nitrogen species and several metals had significant reductions in concentration from the cessation of mining activities in the underground workings, along with the cessation of tailings placement during Temporary Closure. This supports the idea that upon closure and the cessation of mining-impacted water and new tailings reporting to the pit, that pit water quality will improve relatively quickly.

Table 5-19: W45 Water Quality Results Summary (2012-2019)

W45	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.03	7.76	8.27	8.04	7.89	8.14
TSS (mg/L)	42.57	<1.0	291	57.3	9.5	111
Nutrients (mg/L)						
Ammonia Nitrogen	5.886	0.072	37	3.39	1.83	4.24
Nitrite Nitrogen	2.6524	0.0223	11.4	0.0806	<0.020	0.287
Nitrate Nitrogen	22.2	1.65	77.2	2.754	0.39	11.2
Dissolved Metals (mg/L)						
Aluminum	0.0173	0.0032	0.337	0.0081	0.0032	0.0124
Arsenic	0.00081	0.00032	0.00234	0.00021	<0.00010	0.00038
Cadmium	0.00010385	<0.0000050	0.000517	0.0000454	<0.000030	0.0000512
Chromium	0.000589	<0.00010	<0.0010	0.000160	<0.00010	<0.00020
Copper	0.04394	0.00025	0.276	0.00294	0.00109	0.00603
Iron	0.05863	<0.0050	0.726	0.0160	<0.010	<0.020
Lead	0.0001555	<0.000050	0.00066	0.00008	<0.000050	<0.00010
Molybdenum	0.0692	0.0033	0.134	0.0311	0.0162	0.0645
Nickel	0.00341	<0.0010	0.0095	0.00343	0.00183	0.0073
Selenium	0.0101	0.00048	0.0298	0.00218	0.00095	0.0066
Zinc	0.00926	<0.0010	0.0851	0.00182	<0.0010	0.0029

5.3.21 W46 – Minto Creek, Downstream of W7 and W6

The water quality statistics for W46 from 2012 to 2019 are summarized below in Table 5-20. A total of eight routine samples were collected from station W46 during the 2019 monitoring period.

Table 5-20: W46 Water Quality Results Summary (2012-2019)

W46	2012-2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.1	7.49	8.37	8.32	8.14	8.48
TSS (mg/L)	41.75	<1.0	693	3.11	<3.0	4.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.0278	0.0062	0.16	0.00946	<0.0050	0.0171
Nitrite Nitrogen	0.00408	<0.0010	0.0242	0.00131	<0.0010	0.0028
Nitrate Nitrogen	0.3212	0.0130	3.28	0.07429	<0.0050	0.158
Dissolved Metals (mg/L)						
Aluminum	0.00941	<0.0030	0.0449	0.00410	0.0027	0.0056
Arsenic	0.00046	0.0003	0.00078	0.0004	0.00035	0.00046
Cadmium	0.0000093	<0.0000050	0.0000217	0.00000856	<0.0000050	0.0000238
Chromium	0.000658	<0.00010	<0.0010	0.00013	0.00011	0.00016
Copper	0.00265	0.00089	0.0108	0.00194	0.00137	0.00329
Iron	0.1714	0.0183	0.646	0.091	0.022	0.125
Lead	0.0001382	<0.000050	0.00022	0.00005	<0.000050	<0.000050
Molybdenum	0.00205	<0.0010	0.007	0.0022	0.00125	0.00275
Nickel	0.00109	0.00068	0.0021	0.000764	<0.00050	0.00094
Selenium	0.00022	<0.00010	0.000887	0.000221	0.00016	0.00033
Zinc	0.00378	<0.0010	0.015	0.00102	<0.0010	0.0012

5.3.22 W47 – Area 118 Pit Water

W47 was decommissioned and backfilled during the construction of the Area 2 Stage 3 pit in January 2017. As such, no samples were taken in 2019.

5.3.23 W50 – Minto Creek, 50m Downstream of the Toe of the Water Storage Pond Dam

The water quality statistics for W50 are presented in Section 5.2.1.2 above.

5.3.24 W51 – Area 2 Stage 3 Pit

The water quality statistics for W51 from 2019 are summarized below in Table 5-21. W51 was developed in 2017 with the mining activities in the Area 2 Stage 3 pit. A total of six routine samples were collected from station W51 during the 2019 monitoring period. No other samples were collected because the pit was inaccessible for safety reasons.

Table 5-21: W51 Water Quality Results Summary (2017-2019)

W51	2017-2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.14	7.88	8.41	8.28	8.15	8.39
TSS (mg/L)	143.6	3.1	505	5.44	<3.0	20.9
Nutrients (mg/L)						
Ammonia Nitrogen	4.625	0.627	12.2	3.5	2.19	4.82
Nitrite Nitrogen	0.754	0.126	1.51	2.536	0.558	3.11
Nitrate Nitrogen	17.17	4.13	34.8	6.7	3.08	7.89
Dissolved Metals (mg/L)						
Aluminum	0.0034	0.0012	0.0055	0.0035	0.0014	0.0044
Arsenic	0.00091	0.00028	0.00169	0.00044	0.00037	0.0005
Cadmium	0.0000986	0.0000142	0.00023	0.0000936	<0.000070	0.000146
Chromium	0.000126	<0.00010	<0.00020	0.000163	<0.00010	<0.00020
Copper	0.1034	0.0354	0.161	0.0215	0.017	0.0247
Iron	0.0234	<0.010	0.067	0.0162	<0.010	<0.020
Lead	0.000084	<0.000050	0.00022	0.0000813	<0.000050	<0.00010
Molybdenum	0.02703	0.00436	0.0411	0.0396	0.0367	0.0435
Nickel	0.00073	<0.00050	0.0013	0.00329	0.0027	0.0038
Selenium	0.00398	0.002730	0.00551	0.00378	0.00342	0.0046
Zinc	0.00624	<0.0010	0.0222	0.00356	0.0019	0.0072

5.3.25 W52 – Ridgetop North Pit

The Ridgetop North Pit was not developed in 2019; therefore, water quality results are not available.

5.3.26 W53 – Ridgetop South Pit

The Ridgetop South Pit was not developed in 2019; therefore, water quality results are not available.

5.3.27 W54 – Main Pit Dam Seepage

The Main Pit Dam was not developed in 2019; therefore, water quality results are not available.

5.3.28 W55 – Tailings Diversion Ditch

The water quality statistics for W55 from 2016 and 2019 are summarized below in Table 5-22. Two routine samples were collected from station W55 during the 2019 monitoring period.

Table 5-22: W55 Water Quality Results Summary (2016-2019)

W55	2016 -2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.97	7.52	8.31	7.98	7.92	8.04
TSS (mg/L)	8.3	<3.0	43.3	6.6	5.6	7.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.0212	0.0067	0.0819	0.0536	0.0287	0.0784
Nitrite Nitrogen	0.01295	<0.0010	0.1440	0.0042	0.0042	0.0042
Nitrate Nitrogen	5.76857	<0.0050	20.9	0.513	0.487	0.539
Dissolved Metals (mg/L)						
Aluminum	0.0347	0.0116	0.0691	0.0455	0.0396	0.0514
Arsenic	0.00059	0.00044	0.00114	0.00082	0.00074	0.0009
Cadmium	0.0000138	0.0000056	0.0000339	0.0000262	0.0000119	0.0000404
Chromium	0.00034	0.0002	0.00047	0.00038	0.00037	0.00039
Copper	0.0607	0.0149	0.140	0.0862	0.0624	0.11
Iron	0.094	0.023	0.338	0.119	0.112	0.126
Lead	0.0000551	<0.000050	0.000104	0.001275	0.00008	0.00247
Molybdenum	0.001546	0.000633	0.00297	0.0029	0.00237	0.00343
Nickel	0.00143	0.00080	0.00219	0.00162	0.00154	0.00169
Selenium	0.000452	0.000158	0.000985	0.001244	0.000729	0.00176
Zinc	0.00160	<0.0010	0.0047	0.00240	0.0018	0.003

5.3.29 W62 – Mill Valley Fill Extension Phase 2 Collection Sump

The water quality statistics for W62 from 2016 to 2019 are summarized below in Table 5-23. A total of twelve routine samples were collected from station W62 during the 2019 monitoring period.

Table 5-23: W62 Water Quality Results Summary (2016-2019)

W62	2016-2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.26	7.89	8.46	8.24	8.16	8.32
TSS (mg/L)	8.71	<3.0	58	6.65	<3.0	19.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.0208	<0.0050	0.23	0.0109	0.0077	0.0142
Nitrite Nitrogen	0.03599	<0.0010	0.119	0.00937	<0.0050	0.0257
Nitrate Nitrogen	7.5287	0.0084	26.5	8.67	6.32	11.1
Dissolved Metals (mg/L)						
Aluminum	0.0051	0.0017	0.0308	0.0037	0.0021	0.0178
Arsenic	0.00041	0.00011	0.00072	0.0005	0.00041	0.0006
Cadmium	0.00002331	<0.0000050	0.0000798	0.0000245	0.0000167	0.0000479
Chromium	0.000213	<0.00010	<0.0010	0.00022	0.00017	0.00031
Copper	0.04997	0.00195	0.0711	0.0523	0.0407	0.058
Iron	0.0348	<0.010	0.072	0.032	0.021	0.074
Lead	0.0000587	<0.000050	<0.00020	0.00005	<0.000050	<0.000050
Molybdenum	0.007068	0.00042	0.0138	0.00818	0.00629	0.0109
Nickel	0.00107	0.00074	0.00161	0.00113	0.00091	0.00123
Selenium	0.00342	0.000095	0.0115	0.00357	0.002430	0.00519
Zinc	0.1271	0.0018	0.799	0.0355	0.0062	0.0945

5.3.30 MC-1 – Minto Creek Upstream of Canyon near Km 8 on Mine Access Road

The water quality statistics for MC-1 from 2009 to 2019 are summarized below in Table 5-24. A total of 29 routine samples were collected from station MC-1 during the 2019 monitoring period.

Table 5-24: MC-1 Water Quality Results Summary (2009-2019)

MC1	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.17	5.27	8.54	8.38	8.1	8.55
TSS (mg/L)	51.34	<1.0	793	22.13	<3.0	202
Nutrients (mg/L)						
Ammonia Nitrogen	0.02797	<0.0050	0.36	0.00873	<0.0050	0.033
Nitrite Nitrogen	0.00486	<0.0010	0.0342	0.0011	<0.0010	0.0025
Nitrate Nitrogen	0.38213	<0.0050	7.3	0.05787	<0.0050	0.128
Dissolved Metals (mg/L)						
Aluminum	0.01524	<0.0010	0.07	0.0055	0.0027	0.0222
Arsenic	0.00057	<0.00010	0.00125	0.00052	0.00034	0.00067
Cadmium	0.00001153	<0.0000050	0.0002	0.00000622	<0.0000050	0.0000359
Chromium	0.000227	<0.00010	0.0021	0.000191	<0.00010	<0.00080
Copper	0.002926	<0.00020	0.0138	0.00182	0.00115	0.0041
Iron	0.2035	<0.010	1.11	0.062	0.02	0.201
Lead	0.0001578	<0.000050	<0.00050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0017191	<0.000050	0.008	0.001782	0.000917	0.00311
Nickel	0.001221	<0.00050	0.004	0.000773	<0.00050	0.00171
Selenium	0.0002473	<0.000050	0.0022	0.00017	0.000109	0.000332
Zinc	0.00393	<0.0010	0.0334	0.00104	<0.0010	0.0021

5.3.31 WTP and RO – Treated Water

The WTP was not operational in 2019, therefore no samples were taken.

5.3.32 C4 – Tributary on the south side of Minto Creek

The water quality statistics for C4 from 2012 to 2018 are summarized below in Table 5-25. A total of six routine samples were collected from station C4 during the 2019 monitoring period.

Table 5-25: C4 Water Quality Results Summary (2012-2019)

C4	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.08	7.59	8.53	8.15	7.82	8.4
TSS (mg/L)	145.39	2.3	1260	13.39	<3.0	62.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.06639	<0.0050	0.36	0.0122	0.0057	0.0179
Nitrite Nitrogen	0.00424	<0.0010	0.0229	0.00111	<0.0010	0.0018
Nitrate Nitrogen	0.09296	<0.0050	2.31	0.0176	<0.0050	0.0447
Dissolved Metals (mg/L)						
Aluminum	0.0205	0.0048	0.0622	0.0082	0.0042	0.0142
Arsenic	0.00119	0.00029	0.00559	0.00063	0.00046	0.00077
Cadmium	0.00000981	<0.0000050	0.0000337	0.00000554	<0.0000050	0.000007
Chromium	0.000685	<0.00010	0.0013	0.00032	0.0002	0.00041
Copper	0.00209	0.00087	0.0102	0.00155	0.00082	0.00271
Iron	1.1	0.015	14.2	0.252	0.208	0.296
Lead	0.0001254	<0.000050	0.00022	0.0000500	<0.000050	<0.000050
Molybdenum	0.001102	0.000379	0.0068	0.000524	0.000439	0.000648
Nickel	0.002145	<0.00050	0.0061	0.00168	0.00121	0.00202
Selenium	0.000127	0.000065	0.00068	0.000084	0.000056	0.000118
Zinc	0.00138	<0.0010	0.0031	0.0017	<0.0010	0.0059

5.3.33 C10 – Tributary on the south side of Minto Creek

The water quality statistics for C10 from 2012 to 2019 are summarized below in Table 5-26. Though the site was monitored six times during the 2019 monitoring period, due to the absence of water due to unusually dry conditions only one sample was collected, on April 23rd.

Table 5-26: C10 Water Quality Results Summary (2012-2019)

C10	2012 - 2018 Summary Statistics			2019 Summary Results
Parameters	**Mean**	**Min**	**Max**	**23-Apr-2019 Results**
pH	8.17	7.73	8.52	8
TSS (mg/L)	266.91	<1.0	2210	3.2
Nutrients (mg/L)				
Ammonia Nitrogen	0.06102	<0.0050	0.2	0.0068
Nitrite Nitrogen	0.00756	<0.0010	0.0344	0.001
Nitrate Nitrogen	0.1189	<0.0050	0.417	0.005
Dissolved Metals (mg/L)				
Aluminum	0.2292	0.0075	5.84	0.0066
Arsenic	0.00116	0.0004	0.00551	0.0004
Cadmium	0.00002203	<0.0000050	0.000344	0.0000098
Chromium	0.00107	0.00017	0.0093	0.00018
Copper	0.00293	0.00091	0.0339	0.00159
Iron	1.392	0.027	19.9	0.095
Lead	0.0004336	<0.000050	0.00772	0.0000500
Molybdenum	0.001061	0.000384	0.0019	0.000326
Nickel	0.00253	0.0007	0.0215	0.00098
Selenium	0.000111	0.000063	0.000294	0.000051
Zinc	0.00588	<0.0010	0.0603	0.0012

5.3.34 MN – Minto North Pit Water

The water quality statistics for MN from 2015 to 2019 are summarized below in Table 5-27. Six routine samples were collected from station MN during the 2019 monitoring period, once safe access to the pit water could be established. The water was frozen as of November, 2019.

Table 5-27: MN Water Quality Results Summary (2015-2019)

MN	2015 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.92	7.56	8.23	8.16	8.1	8.25
TSS (mg/L)	137.55	<3.0	1040	4.48	<3.0	10.8
Nutrients (mg/L)						
Ammonia Nitrogen	8.53	0.166	51	0.0336	0.0204	0.05
Nitrite Nitrogen	3.177	0.03	14.7	0.0385	0.0126	0.0674
Nitrate Nitrogen	94.55	7.71	342	16.40	14	20.2
Dissolved Metals (mg/L)						
Aluminum	0.0079	0.0018	0.0266	0.0077	0.0046	0.0139
Arsenic	0.00054	0.0002	0.00142	0.00050	0.00046	0.00057
Cadmium	0.0000654	<0.000010	0.000283	0.0000683	0.0000329	0.000152
Chromium	0.000272	<0.00010	<0.0010	0.000100	<0.00010	<0.00010
Copper	0.1071	0.00837	0.562	0.0186	0.0104	0.037
Iron	0.067	<0.010	0.449	0.0112	<0.010	0.014
Lead	0.0002453	<0.000050	0.00225	0.0000565	<0.000050	0.000089
Molybdenum	0.0208	0.0077	0.0384	0.0226	0.0213	0.0239
Nickel	0.000995	<0.00050	0.0041	0.000500	<0.00050	<0.00050
Selenium	0.01494	0.00385	0.0627	0.0169	0.0136	0.0191
Zinc	0.00916	<0.0010	0.0884	0.0029	<0.0010	0.0067

5.3.35 MN-0.2 – Upper West Arm of McGinty Creek

The water quality statistics for MN-0.2 from 2009 to 2019 are summarized below in Table 5-28. A total of seven routine samples were collected from station MN-0.2 during the 2019 monitoring period.

Table 5-28: MN-0.2 Water Quality Results Summary (2011-2019)

MN-0.2	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.37	6.55	7.85	7.63	7.18	7.91
TSS (mg/L)	23.22	<1.0	395	4.75	<3.0	18.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.01974	<0.0050	0.11	0.01185	<0.0050	0.0282
Nitrite Nitrogen	0.00721	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.03002	<0.0020	0.23	0.00539	<0.0050	0.0072
Dissolved Metals (mg/L)						
Aluminum	0.078	0.0337	0.199	0.0733	0.0178	0.169
Arsenic	0.000544	0.00025	0.00388	0.0005	0.00018	0.00078
Cadmium	0.00001129	<0.0000050	0.000053	0.00000602	<0.0000050	0.0000116
Chromium	0.000653	0.0002	0.0011	0.00046	0.00021	0.00064
Copper	0.00274	0.00128	0.00842	0.00223	0.00112	0.00428
Iron	0.586	0.084	10.3	0.576	0.126	1.65
Lead	0.000098	0.000009	0.000271	0.0000566	<0.000050	0.000103
Molybdenum	0.000458	<0.00005	<0.0010	0.00022	0.000143	0.000267
Nickel	0.00157	0.00102	0.00272	0.00127	0.00052	0.00158
Selenium	0.0000821	<0.000040	0.00012	0.0000803	<0.000050	0.000123
Zinc	0.00319	0.0001	0.0131	0.0016	<0.0010	0.0063

5.3.36 MN-0.5 – West Arm of McGinty Creek

The water quality statistics for MN-0.5 from 2009 to 2019 are summarized below in Table 5-29. A total of seven routine samples were collected from station MN-0.5 during the 2019 monitoring period.

Table 5-29: MN-0.5 Water Quality Results Summary (2009-2019)

MN-0.5	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.89	7.1	8.27	8.24	7.99	8.42
TSS (mg/L)	63.13	<1.0	737	10.6	<3.0	43.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.02551	<0.0050	0.33	0.00602	<0.0050	0.0132
Nitrite Nitrogen	0.00666	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.0814	<0.0050	1.69	0.04279	<0.0050	0.0889
Dissolved Metals (mg/L)						
Aluminum	0.03518	<0.0030	0.580	0.0079	0.0032	0.0287
Arsenic	0.000435	0.00026	0.00089	0.00034	0.00026	0.00041
Cadmium	0.00001368	<0.0000050	0.000186	0.00000561	<0.0000050	0.000008
Chromium	0.000539	<0.0001	0.0016	0.000169	<0.00010	0.00047
Copper	0.00212	0.00071	0.0264	0.00106	0.00074	0.00247
Iron	0.1601	0.0062	0.929	0.0336	<0.010	0.147
Lead	0.0001123	0.000006	0.000991	0.0000500	<0.000050	<0.000050
Molybdenum	0.000927	0.00011	0.00143	0.001314	0.000852	0.00169
Nickel	0.00116	0.00048	0.00432	0.00066	<0.00050	0.00125
Selenium	0.000192	0.00005	0.00063	0.000229	0.000148	0.000372
Zinc	0.00343	0.00016	0.0459	0.00125	<0.0010	0.002

5.3.37 MN-1.5 – Upper East Arm of McGinty Creek

The water quality statistics for MN-1.5 from 2009 to 2019 are summarized below in Table 5-30. A total of six routine samples were collected from station MN-1.5 during the 2019 monitoring period.

Table 5-30: MN-1.5 Water Quality Results Summary (2010-2019)

MN-0.5	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.41	6	8.1	7.86	7.66	8.07
TSS (mg/L)	233.4	<1	8200	21.80	5.4	69.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.04999	<0.0050	0.66	0.0103	0.0067	0.0158
Nitrite Nitrogen	0.00643	<0.0010	0.053	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.03349	<0.0050	0.2	0.00672	<0.0050	0.0126
Dissolved Metals (mg/L)						
Aluminum	0.0994	0.0282	0.259	0.0415	0.0232	0.1050
Arsenic	0.000490	0.00015	0.00113	0.0004	0.00026	0.00057
Cadmium	0.00001668	<0.0000050	0.000106	0.00000663	<0.0000050	0.0000144
Chromium	0.00051	0.0002	0.0009	0.000380	0.0003	0.00057
Copper	0.0059	0.00278	0.00983	0.00434	0.00281	0.00877
Iron	0.571	0.074	1.62	0.31	0.083	0.637
Lead	0.0000605	0.000008	0.000527	0.0000500	<0.000050	<0.000050
Molybdenum	0.000352	0.00008	0.000924	0.000334	0.000215	0.000484
Nickel	0.00124	0.00078	0.00233	0.00102	0.00081	0.0013
Selenium	0.000079	<0.00004	0.00015	0.0000675	<0.000050	0.000085
Zinc	0.00333	0.0003	0.012	0.00102	<0.0010	0.0011

5.3.38 MN-2.5 – East Arm of McGinty Creek

The water quality statistics for MN-2.5 from 2009 to 2019 are summarized below in Table 5-31. A total of seven routine samples were collected from station MN-2.5 during the 2019 monitoring period.

Table 5-31: MN-2.5 Water Quality Results Summary (2010-2019)

MN-2.5	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.88	7.1	8.5	8.14	7.91	8.32
TSS (mg/L)	37.79	<1.0	350	10.27	<3.0	51.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.02755	<0.0050	0.3	0.00671	<0.0050	0.0123
Nitrite Nitrogen	0.00625	<0.0010	<0.050	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.04011	<0.0050	<0.20	0.01137	<0.0050	0.0211
Dissolved Metals (mg/L)						
Aluminum	0.0216	0.0050	0.112	0.013	0.0053	0.0393
Arsenic	0.000406	0.00016	0.00149	0.00031	0.00025	0.00037
Cadmium	0.00001247	<0.0000050	0.000075	0.00001993	<0.0000050	0.0001090
Chromium	0.00047	<0.00010	<0.0010	0.00022	0.0001	0.00046
Copper	0.00207	0.00071	0.00463	0.00307	0.00104	0.0122
Iron	0.188	0.0225	0.867	0.055	0.019	0.129
Lead	0.0000984	<0.000005	0.000822	0.0000857	<0.000050	0.0003
Molybdenum	0.000718	0.00011	0.00117	0.000682	0.000502	0.000897
Nickel	0.001236	0.0007	0.00376	0.000954	<0.00050	0.00146
Selenium	0.0000909	0.00004	0.00038	0.000086	0.000066	0.00011
Zinc	0.00272	0.0004	0.0061	0.00211	<0.0010	0.0088

5.3.39 MN-4.5 – McGinty Creek near confluence with Yukon River

The water quality statistics for MN-4.5 from 2009 to 2019 are summarized below in Table 5-32. A total of five routine samples were collected from station MN-4.5 during the 2019 monitoring period.

Table 5-32: MN-4.5 Water Quality Results Summary (2010-2019)

MN-4.5	2009- 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.91	7.1	8.26	8.13	8.03	8.28
TSS (mg/L)	35.29	<1.0	570	4.5	<3.0	10.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.02174	<0.0050	0.27	0.00625	<0.0050	0.011
Nitrite Nitrogen	0.00376	<0.0010	0.017	0.00100	<0.0010	<0.0010
Nitrate Nitrogen	0.07288	<0.0050	0.323	0.0362	<0.0050	0.127
Dissolved Metals (mg/L)						
Aluminum	0.0252	0.0044	0.174	0.0092	0.0041	0.0253
Arsenic	0.000398	0.00019	0.00065	0.00032	0.00027	0.0004
Cadmium	0.00001243	<0.0000050	0.000135	0.00000533	<0.0000050	0.0000064
Chromium	0.000287	<0.00010	<0.0010	0.000155	<0.00010	0.00031
Copper	0.0021	0.00113	0.00511	0.00159	0.00101	0.00336
Iron	0.1276	<0.010	0.562	0.0383	<0.010	0.124
Lead	0.0000645	<0.000005	0.000467	0.0000500	<0.000050	<0.000050
Molybdenum	0.000809	0.00017	0.00122	0.000958	0.000791	0.00117
Nickel	0.001136	0.00054	0.00188	0.000733	<0.00050	0.00143
Selenium	0.000154	0.00006	0.000366	0.000232	0.000145	0.000444
Zinc	0.00202	0.0002	0.0144	0.001	<0.0010	<0.0010

5.3.40 UG1 – Minto South Underground Mine Dewatering

The water quality statistics for UG1 from 2015 to 2019 are summarized below in Table 5-33. A total of 12 routine samples were collected from station UG1 during the 2019 monitoring period.

Table 5-33: UG1 Water Quality Results Summary (2015-2018)

UG1	2015 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.89	7.70	8.14	7.99	7.83	8.23
TSS (mg/L)	159.6	3.8	886	67.5	3	469
Nutrients (mg/L)						
Ammonia Nitrogen	16.58	1.69	75	1.642	0.404	6.18
Nitrite Nitrogen	1.185	0.313	3.18	0.153	0.014	0.598
Nitrate Nitrogen	29.98	2.33	81.9	2.5	1.32	9.78
Dissolved Metals (mg/L)						
Aluminum	0.0256	0.0048	0.51	0.0098	0.0024	0.0609
Arsenic	0.00113	0.00056	0.0026	0.00083	0.00042	0.00319
Cadmium	0.0001466	<0.000010	0.000398	0.0003785	0.0000617	0.000732
Chromium	0.00046	<0.00010	0.00261	0.00016	<0.00010	0.00029
Copper	0.0225	0.00374	0.178	0.0763	0.0133	0.158
Iron	0.0424	0.0052	1.16	0.0148	<0.010	<0.020
Lead	0.0001216	<0.000050	0.00063	0.0000708	<0.000050	<0.00010
Molybdenum	0.0208	0.0083	0.0394	0.0166	0.0145	0.0203
Nickel	0.00260	0.00061	0.007	0.00081	<0.00050	0.00142
Selenium	0.001181	0.000220	0.00557	0.00145	0.001040	0.00226
Zinc	0.01519	0.0015	0.134	0.0312	0.0051	0.0854

5.3.41 UG2 – Wildfire Underground Mine Dewatering

This station was not established in 2019.

5.3.42 UG3 – Copper Keel Underground Mine Dewatering

This station was not established in 2019.

5.3.43 UG4 – Minto East Underground Mine Dewatering

This station was established in 2018, and a total of twelve routine samples were collected in 2019. Water quality statistics from 2018 and 2019 are summarized in Table 5-34 below.

Table 5-34: UG4 Water Quality Results Summary (2018-2019)

UG4	2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.00	7.90	8.10	8.10	7.91	8.32
TSS (mg/L)	399.3	7.2	1230	65.46	<3.0	458
Nutrients (mg/L)						
Ammonia Nitrogen	3.1967	0.097	15.1	2.6497	0.0556	31.8
Nitrite Nitrogen	0.294	0.066	0.642	0.0696	<0.010	0.454
Nitrate Nitrogen	5.751	0.439	25.9	3.789	0.258	40.2
Dissolved Metals (mg/L)						
Aluminum	0.0081	0.0022	0.0154	0.00455	<0.0010	0.0149
Arsenic	0.00103	0.00094	0.00134	0.00087	0.00055	0.00116
Cadmium	0.0001134	0.0000398	0.000234	0.000165	0.000103	0.000258
Chromium	0.000119	<0.00010	0.00023	0.000173	<0.00010	0.00038
Copper	0.03123	0.00167	0.0753	0.02684	0.00545	0.047
Iron	0.0159	<0.010	0.037	0.0195	<0.010	0.051
Lead	0.000147	<0.000050	0.000626	0.0001141	<0.000050	0.000389
Molybdenum	0.021	0.0182	0.0241	0.0169	0.0153	0.0199
Nickel	0.00132	<0.00050	0.0032	0.00078	<0.00050	0.00139
Selenium	0.00342	0.001350	0.00855	0.00125	0.000900	0.00163
Zinc	0.0045	0.0018	0.0083	0.0119	0.0041	0.0344

6 Groundwater Monitoring Program

Groundwater monitoring program details are provided in section 2.2 of the Minto Mine Environmental Monitoring, Surveillance and Reporting Plan. The primary monitoring objective of the groundwater monitoring program is to identify potential impacts on groundwater from Minto Mine.

Mine facilities that are monitored for groundwater impacts include, but are not limited to the DSTSF, Mill area, Main Pit, Area 2 Pit, Minto North Pit, waste rock dumps, and the Water Storage Pond. The Groundwater Monitoring Program is comprised of operational and baseline monitoring. Water quality samples for the program are collected per standard procedures such as those summarized in the ASTM (2007*) Standard Guide for Sampling Ground-Water Monitoring Wells*. The main components of the groundwater monitoring program include groundwater quality, vibrating wire piezometers, and ground temperature cable monitoring.

In 2017, five new West-bay multi-port groundwater monitoring wells, and three new drive point wells were installed and developed. Groundwater samples were collected and the data analysis was conducted by an external lab.

Also in 2017, four Lysimeter installations were completed within each of the following facilities: Main Waste Dump, Southwest Dump, Dry Stack Tailings Storage Facility, and Mill Valley Fill. The Lysimeters record temperature and groundwater infiltration on a continual basis.

6.1 Groundwater Quality Monitoring Conformance

Minto's 2019 conformance with groundwater sampling requirements is summarized in Table 6-1, below. Quality Assurance and Quality Control (QA/QC) sampling is not included in Table 6-1, but is described in Section 6-2.

Sampling of wells and drive points was conducted as per the EMSRP and GW Plan 2016-02 requirements and the Adaptive Management Plan for groundwater as monthly or quarterly frequency. Groundwater AMP exceedances are discussed in Sections 10.3 and 10.4 of this report, and the Qualified Professional Quarterly interpretations and advice is provided in Appendix J.

Table 6-1: Groundwater Quality Monitoring Conformance Summary (2019)

Mine Project Component	Monitoring Installation	Quality	Level	Monitoring Frequency	2018 Groundwater Compliance
Up-gradient of Mine Activities	MW17-08-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-08-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-08-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-08-04	X	X	Quarterly	No samples collected. Port was found dry throughout 2019.
Southwest Waste Dump	MW12-DP1	X	X	Quarterly	No samples collected. Destroyed in August 2017.
	MW12-DP2	X	X	Quarterly	No samples collected. DP was dry in 2019.
	MW12-DP3	X	X	Quarterly	No samples collected. DP was dry in 2019.
	MW17-09-01	X	X	Quarterly	No samples collected. Well was frozen from Q1 to Q2 and may have been damaged. Westbay probe could not reach ports in Q3 & Q4.
Main Waste Dump	MW09-01-01	X	X	Quarterly	Since MW09-01 has been dry since October 2014 it was replaced by MW17-10.
	MW09-01-02	X	X	Quarterly	Since MW09-01 has been dry since October 2014 it was replaced by MW17-10.
	MW09-01-03	X	X	Quarterly	Since MW09-01 has been dry since October 2014 it was replaced by MW17-10.
	MW17-10-1	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-10-2	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-10-3	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-10-4	X	X	Quarterly	No samples were collected. Port was found dry throughout 2019
Dry Stack Tailings Storage Facility and Mill Valley Fill Expansion	MW12-06-01		X	Quarterly	3 of 4 collected. Q1 sample contaminated with glycol from well casing.
	MW12-06-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-06-03		X	Quarterly	4 of 4 collected. Sampled as per AMP schedule.
	MW12-06-04	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-06-05		X	Quarterly	4 of 4 collected. Sampled as per AMP schedule.
	MW12-06-06	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
Main Pit	MW12-07-01	X	X	Monthly	No samples collected. Port is likely damaged, as all samples contaminated with glycol.
	MW12-07-02	X	X	Monthly	12 of 12 samples collected
	MW12-07-03		X	Monthly	No samples were collected. The port was found dry during all of 2019.
	MW17-DP01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-DP02	X	X	Quarterly	3 of 4 collected. Well dry or frozen in Q1.
	MW17-DP03	X	X	Quarterly	3 of 4 collected. Could not collect in Q2.

Mine Project Component	Monitoring Installation	Quality	Level	Monitoring Frequency	2018 Groundwater Compliance
Minto North Pit	MW09-03-01	X	X	Monthly	12 of 12 collected as per the AMP schedule.
	MW09-03-02	X	X	Monthly	12 of 12 collected as per the AMP schedule.
	MW09-03-03	X	X	Monthly	No samples were collected. Port found dry throughout 2019.
	MW17-11-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-11-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-11-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-11-04	X	X	Quarterly	3 of 4 collected. Port found dry in Q3.
	MW17-11-05	X	X	Quarterly	1 of 4 collected. Port found dry except in Q2.
Water Storage Pond	MW12-05-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-04	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-05	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-06	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW12-05-07	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-01	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-02	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-03	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-04	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-05	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-06	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-07	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.
	MW17-12-08	X	X	Quarterly	4 of 4 collected. Sampled as per schedule.

6.2 Groundwater Quality Control and Assurance

In 2019, 152 groundwater samples were taken at Minto. A total of 17 duplicate QC samples were taken from groundwater sampling sites, representing 11.18% of the total number of samples collected in 2019.

The EMSRP recommends field duplicate sampling be conducted at a frequency of one field duplicate sample per ten groundwater monitoring samples. The recommended rate of field duplicate sampling was achieved in 2019.

Minto currently employs compliance management system software to track programs and actions that meet licence requirements. To achieve the QA/QC objective of 1:10 samples, the compliance system was updated in 2016 and used successfully in the following years to ensure that environmental staff completed the required field duplicates.

6.3 Groundwater Monitoring Stations

The EMSRP details the groundwater wells at the Minto Mine, including operative and inoperative wells. Figure 6-1 shows a location map of the operative wells. Stations that were collected more than twice in 2019 have results presented as follows: Mean, Minimum and Maximum values and are compared to their historical results ranging in active years.

Wells MW11-02, MW11-03, MW11-04A did not produce water during 2019 sampling events to sample, thus no results are presented.

Complete results for the 2019 Groundwater Monitoring Program groundwater wells are presented in Appendix C.



Figure 6-1: Minto Mine Groundwater Well Locations (2019)

6.3.1 MW09-03

Groundwater well MW09-03 water quality results from 2019 are summarized in Table 6-2 and Table 6-3, and compared to historical data. MW09-03 produced results from sampling zones 01 and 02, while zone 03 produced no water during 2019. As such, only results for zones 01 and 02 are presented below. Per the AMP plan, this well is sampled monthly.

Table 6-2: MW09-03-01 Water Quality Results Summary (2009 - 2019)

MW09-03-01	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.2	7.94	8.86	8.32	8	8.41
TDS (mg/L)	197	146	652	172.6	162	186
Sulfate-dissolved (mg/L)	22.48	0.53	117	18.2	17.6	19
Nutrients (mg/L)						
Ammonia Nitrogen	0.0501	0.024	0.17	0.0391	0.0312	0.0476
Nitrate Nitrogen	0.05007	<0.0050	0.669	0.01432	<0.0050	0.0397
Nitrite Nitrogen	0.534	0.0261	9.27	0.3608	0.0378	2.040
Dissolved Metals (mg/L)						
Silver	0.0000143	<0.0000050	0.00005	0.00001	<0.000010	<0.000010
Aluminum	0.00496	0.0014	0.0198	0.0024	0.0013	0.0052
Arsenic	0.000751	0.000037	0.00933	0.00115	0.00068	0.00407
Cadmium	0.0000487	<0.0000050	0.000683	0.00005894	<0.0000050	0.000336
Chromium	0.000477	<0.00010	0.00111	0.000105	<0.00010	0.00016
Copper	0.00134	<0.00020	0.019	0.000463	<0.00020	0.0013
Lead	0.0001277	0.000036	0.0011	0.00005	<0.000050	<0.000050
Molybdenum	0.00782	0.0035	0.0806	0.00518	0.00448	0.00596
Nickel	0.00153	0.00067	0.008	0.000684	<0.00050	0.00113
Selenium	0.0003267	<0.000050	0.008	0.0001299	<0.000050	0.000326
Zinc	0.01701	0.0033	0.0913	0.0382	0.0062	0.0964

Table 6-3: MW09-03-02 Water Quality Results Summary (2009-2019)

MW09-03-02	2009 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.09	7.59	8.32	8.27	7.83	8.42
TDS (mg/L)	336	146	716	207	145	354
Sulfate-dissolved (mg/L)	10.113	<0.50	110	5.54	4.61	6.69
Nutrients (mg/L)						
Ammonia Nitrogen	0.08133	<0.0050	0.33	0.00845	<0.0050	0.017
Nitrate Nitrogen	1.69922	<0.0050	8.02	7.94	3.29	19.1
Nitrite Nitrogen	0.2448	0.0339	1.93	0.1556	0.026	0.321
Dissolved Metals (mg/L)						
Silver	0.0000149	<0.000010	0.00004	0.00001	<0.000010	<0.000010
Aluminum	0.00452	<0.0010	0.0187	0.00253	<0.0010	0.0119
Arsenic	0.000381	<0.00010	0.0012	0.000225	<0.00010	0.00140
Cadmium	0.00004941	<0.0000050	0.00072	0.0001237	0.0000275	0.000459
Chromium	0.000443	<0.00010	0.0013	0.000122	<0.00010	0.0002
Copper	0.002579	<0.00020	0.022	0.00216	0.00137	0.00438
Lead	0.0001039	<0.000050	0.0003	0.0000603	<0.000050	0.000184
Molybdenum	0.01306	0.00322	0.101	0.00417	0.00266	0.00577
Nickel	0.00091	<0.00050	0.004	0.0005	<0.00050	<0.00050
Selenium	0.0004723	<0.000050	0.0067	0.000314	0.000151	0.000635
Zinc	0.02473	<0.0050	0.105	0.0524	0.0194	0.164

6.3.2 MW11-02

MW11-02 was dry during the 2019 sampling events, thus water quality results are not presented.

6.3.3 MW11-03

MW11-03 was dry during the 2019 sampling events, thus water quality results are not presented.

6.3.4 MW11-04A

MW11-04A was dry during the 2019 sampling events. The results presented below in Table 6-3 are the outcomes of the 2012-2017 sampling seasons.

Table 6-4: MW11-04A Water Quality Results Summary (2012 – 2017)

MW11-04A	2012 - 2017 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	11.19	10.3	11.7
TDS (mg/L)	196	148	396
Sulfate-dissolved (mg/L)	5.40	3.47	7.7
Nutrients (mg/L)			
Ammonia Nitrogen	0.2953	0.0191	1.5
Nitrate Nitrogen	1.28	1	1.64
Nitrite Nitrogen	0.0140	0.0071	0.0234
Dissolved Metals (mg/L)			
Silver	0.0000177	<0.000010	0.000035
Aluminum	0.759	0.142	1.68
Arsenic	0.00254	0.00043	0.00433
Cadmium	0.00001163	<0.0000050	0.000045
Chromium	0.00302	0.0017	0.008
Copper	0.0691	0.0119	0.137
Lead	0.0001471	<0.000050	<0.00020
Molybdenum	0.00293	0.0019	0.01
Nickel	0.000822	<0.00050	<0.0010
Selenium	0.00238	0.00175	0.00334
Zinc	0.00404	0.0016	<0.0050

6.3.5 MW12-DP1

MW12-DP1 was destroyed in August 2017 when the permafrost into which the well had been installed, degraded; compromising the ground integrity and the well. As such, water quality results are not presented.

6.3.6 MW12-DP2

MW12-DP2 was dry or frozen during the 2019 sampling events, thus water quality results are not presented.

6.3.7 MW12-DP3

MW12-DP3 was dry or frozen during the 2019 sampling events, thus water quality results are not presented.

6.3.8 MW12-05

Groundwater well MW12-05 water quality results from 2019 are summarized in Table 6-5 through Table 6-11, and compared to historical data. Zones 01, 03, 05 and 07 were sampled and analyzed during 2019

under the Groundwater Monitoring Plan, while Zones 02, 04, and 06 were also sampled in response to the Adaptive Management Plan. Ongoing AMP results are discussed in Section 10.3 and Appendix J.

Table 6-5: MW12-05-01 Water Quality Results Summary (2012 - 2019)

MW12-05-01	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.01	7.69	8.31	8.09	7.93	8.25
TDS (mg/L)	1466	706	1840	1930	1850	1990
Sulfate-dissolved (mg/L)	904	350	1240	1264.0	1200	1330
Nutrients (mg/L)						
Ammonia Nitrogen	0.09868	<0.0050	0.602	0.056	0.0131	0.174
Nitrate Nitrogen	0.045	<0.010	0.368	0.0857	<0.050	<0.10
Nitrite Nitrogen	0.0742	0.0082	0.427	0.0239	<0.020	0.042
Dissolved Metals (mg/L)						
Silver	0.0000172	<0.000010	<0.000020	0.0000200	<0.000020	<0.000020
Aluminum	0.0066	0.0031	0.0182	0.0044	0.0035	0.0049
Arsenic	0.00104	0.00059	0.00498	0.00064	0.00053	0.00074
Cadmium	0.00001656	<0.0000050	0.00014	0.0000639	<0.000010	0.000192
Chromium	0.00067	0.00014	<0.0010	0.00026	0.00021	0.00034
Copper	0.000785	<0.00020	0.00836	0.000400	<0.00040	<0.00040
Lead	0.0001379	<0.000050	<0.00020	0.0001000	<0.00010	<0.00010
Molybdenum	0.00105	0.000125	0.012	0.00024	0.00014	0.0004
Nickel	0.000979	<0.00050	0.0043	0.001000	<0.0010	<0.0010
Selenium	0.000506	0.000083	0.00239	0.002929	<0.00010	0.00951
Zinc	0.00529	<0.0010	0.0402	0.00281	<0.0020	0.0039

Table 6-6: MW12-05-02 Water Quality Results Summary (2016-2019)

MW12-05-02	2016 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.14	7.89	8.43	8.24	8.1	8.37
TDS (mg/L)	1532	389	1870	2160	1830	3080
Sulfate-dissolved (mg/L)	936.5	41.2	1210	1475	1120	2400
Nutrients (mg/L)						
Ammonia Nitrogen	0.0791	0.0095	0.642	0.0251	0.0177	0.029
Nitrate Nitrogen	0.045	<0.0050	<0.10	0.0688	<0.025	<0.10
Nitrite Nitrogen	0.0704	0.0114	0.377	0.0182	<0.010	0.0227
Dissolved Metals (mg/L)						
Silver	0.0000162	<0.000010	<0.000050	0.00002	<0.000020	<0.000020
Aluminum	0.005	0.0036	0.0088	0.0049	0.0044	0.0052
Arsenic	0.000496	<0.00020	0.0019	0.00033	0.00024	0.00042
Cadmium	0.00000808	<0.0000050	<0.000025	0.0000112	<0.000010	0.000014
Chromium	0.00036	0.00015	0.00093	0.000303	<0.00020	0.00037
Copper	0.000338	<0.00020	<0.0010	0.000400	<0.00040	<0.00040
Lead	0.0000808	<0.000050	<0.00025	0.0001	<0.00010	<0.00010
Molybdenum	0.000467	0.00014	0.00112	0.00025	0.00019	0.0004
Nickel	0.000808	<0.00050	<0.0025	0.001	<0.0010	<0.0010
Selenium	0.0006296	<0.000050	0.00275	0.00063	<0.00010	0.00172
Zinc	0.00605	<0.0010	0.0261	0.00228	<0.0020	0.0031

Table 6-7: MW12-05-03 Water Quality Results Summary (2012 - 2019)

MW12-05-03	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.06	7.72	8.31	8.24	8.03	8.32
TDS (mg/L)	1329	880	1570	1431.0	1350	1490
Sulfate-dissolved (mg/L)	747	456	883	849	782	897
Nutrients (mg/L)						
Ammonia Nitrogen	0.03787	<0.0050	0.11	0.0196	0.0158	0.0316
Nitrate Nitrogen	0.033	<0.010	0.105	0.05	<0.025	<0.10
Nitrite Nitrogen	0.0696	0.0119	0.372	0.01652	<0.0050	0.044
Dissolved Metals (mg/L)						
Silver	0.0000158	0.000005	0.000021	0.0000138	<0.000010	<0.000020
Aluminum	0.00653	0.0011	0.0233	0.0051	0.0035	0.0095
Arsenic	0.000377	0.00017	0.0022	0.000185	0.00014	0.00020
Cadmium	0.00002697	<0.0000050	0.000324	0.00001082	<0.0000050	0.000023
Chromium	0.000548	<0.00010	<0.0010	0.000223	0.00015	0.00028
Copper	0.00069	<0.00020	0.00579	0.000445	<0.00020	0.00127
Lead	0.0001528	<0.000050	0.000665	0.0000667	<0.000050	<0.00010
Molybdenum	0.001724	0.00017	0.0121	0.000274	0.00019	0.00041
Nickel	0.000972	<0.00050	0.00328	0.000667	<0.00050	<0.0010
Selenium	0.000146	<0.000050	0.000562	0.000763	<0.000050	0.004080
Zinc	0.00688	<0.0010	0.0312	0.00312	0.0014	0.0084

Table 6-8: MW12-05-04 Water Quality Results Summary (2016 - 2019)

MW12-05-04	2016 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.14	7.87	8.41	8.36	8.02	8.56
TDS (mg/L)	283.5	262	296	302	296	312
Sulfate-dissolved (mg/L)	35.4	25.2	47.3	46.2	44.4	47.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.02821	<0.0050	0.144	0.0184	0.0113	0.033
Nitrate Nitrogen	0.0198	<0.0050	0.0677	0.01803	<0.0050	0.0476
Nitrite Nitrogen	0.0625	<0.0010	0.320	0.00375	<0.0010	0.0072
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0059	0.0021	0.0338	0.0031	0.0022	0.0038
Arsenic	0.000343	<0.00010	0.0033	0.00012	0.00010	0.00016
Cadmium	0.00000554	<0.0000050	0.0000114	0.00007147	<0.0000050	0.000251
Chromium	0.000135	<0.00010	0.00023	0.00015	<0.00010	0.00023
Copper	0.000353	<0.00020	0.00171	0.0003	0.00027	0.00036
Lead	0.0000536	<0.000050	0.000104	0.00005	<0.000050	<0.000050
Molybdenum	0.00355	0.00142	0.00508	0.00281	0.0021	0.00392
Nickel	0.000500	<0.00050	<0.00050	0.000500	<0.00050	<0.00050
Selenium	0.0004293	<0.000050	0.00171	0.001462	0.000154	0.00328
Zinc	0.004	<0.0010	0.0141	0.00155	<0.0010	0.0026

Table 6-9: MW12-05-05 Water Quality Results Summary (2012 - 2019)

MW12-05-05	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.09	7.79	8.37	8.34	7.95	8.56
TDS (mg/L)	283.7	252	338	310.2	300	325
Sulfate-dissolved (mg/L)	46.5	33.3	62.4	54	51.9	60
Nutrients (mg/L)						
Ammonia Nitrogen	0.01929	<0.0050	0.054	0.01174	<0.0050	0.0141
Nitrate Nitrogen	0.2834	0.0147	0.817	0.00928	<0.0050	0.0183
Nitrite Nitrogen	0.0871	0.0051	0.398	0.0147	0.0041	0.0282
Dissolved Metals (mg/L)						
Silver	0.00001328	<0.0000050	<0.000020	0.0000100	<0.000010	<0.000010
Aluminum	0.00424	0.002	0.0106	0.0029	0.0020	0.004
Arsenic	0.000348	<0.00010	0.00151	0.00015	0.00013	0.00016
Cadmium	0.00001042	<0.0000050	0.00003	0.0000126	0.0000064	0.0000223
Chromium	0.000389	<0.00010	<0.0010	0.0001	<0.00010	<0.00010
Copper	0.00111	0.00034	0.00360	0.00102	0.00069	0.00142
Lead	0.0000982	<0.000050	<0.00020	0.0000500	<0.000050	<0.000050
Molybdenum	0.00452	0.0035	0.0153	0.00505	0.00471	0.00542
Nickel	0.000779	<0.00050	0.0019	0.000532	<0.00050	0.00064
Selenium	0.0001693	<0.000050	0.00112	0.00026	<0.000050	0.000727
Zinc	0.0217	0.0032	0.118	0.0082	0.0026	0.0137

Table 6-10: MW12-05-06 Water Quality Results Summary (2016 – 2019)

MW12-05-06	2016 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.08	7.87	8.35	8.33	7.97	8.55
TDS (mg/L)	280.4	265	302	309.4	301	318
Sulfate-dissolved (mg/L)	46.6	41.9	51.8	55.1	53.7	56.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.00601	<0.0050	0.0181	0.00598	<0.0050	0.0074
Nitrate Nitrogen	0.2707	0.051	0.463	0.0413	0.0246	0.0559
Nitrite Nitrogen	0.0302	0.0073	0.0663	0.0103	0.0024	0.0218
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0104	0.002	0.0808	0.0026	0.0017	0.0041
Arsenic	0.0002	0.00011	0.00054	0.00016	0.00015	0.00017
Cadmium	0.00001352	<0.0000050	0.0000209	0.0000284	0.0000142	0.0000453
Chromium	0.000104	<0.00010	0.00015	0.000100	<0.00010	<0.00010
Copper	0.00256	0.00087	0.0148	0.00158	0.00118	0.00236
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00391	0.00331	0.00521	0.0048	0.00452	0.00504
Nickel	0.000806	<0.00050	0.00195	0.000860	0.00069	0.00099
Selenium	0.000154	0.000070	0.000376	0.000237	0.000095	0.0006
Zinc	0.0338	0.0066	0.115	0.0128	0.0054	0.0216

Table 6-11: MW12-05-07 Water Quality Results Summary (2012 - 2019)

MW12-05-07	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.17	7.76	8.45	8.26	7.96	8.52
TDS (mg/L)	292	252	362	316.4	313	320
Sulfate-dissolved (mg/L)	33.1	11.4	52	56.2	55.6	56.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.09057	<0.0050	0.465	0.31800	0.298	0.335
Nitrate Nitrogen	0.02711	<0.0050	<0.20	0.00608	<0.0050	0.0104
Nitrite Nitrogen	0.17003	<0.0010	2.91	0.00374	<0.0010	0.0124
Dissolved Metals (mg/L)						
Silver	0.0000133	<0.0000050	<0.000020	0.0000100	<0.000010	<0.000010
Aluminum	0.00504	0.0018	0.016	0.0034	0.0018	0.0072
Arsenic	0.000432	0.00022	0.00115	0.00153	0.00131	0.00165
Cadmium	0.00000716	<0.0000050	0.000019	0.00001176	<0.0000050	0.00003
Chromium	0.000464	<0.00010	<0.0010	0.000210	0.00012	0.00049
Copper	0.000391	<0.00020	0.00186	0.00042	0.00025	0.00078
Lead	0.0001189	0.000039	0.00055	0.0000500	<0.000050	<0.000050
Molybdenum	0.00246	0.00109	0.0038	0.00314	0.00288	0.0035
Nickel	0.00074	<0.00050	0.0015	0.000568	<0.00050	0.00074
Selenium	0.0003686	<0.000050	0.001680	0.000161	0.000058	0.000487
Zinc	0.00381	<0.0010	0.0136	0.0077	0.004	0.011

6.3.9 MW12-06

Groundwater well MW12-06 water quality results from 2019 are summarized in Table 6-12 through Table 6-17, and compared to historical data. Zones 02, 04, and 06 were sampled and analyzed during 2019 under the Groundwater Monitoring Plan, while Zones 01, 03, and 05 were also sampled in response to the Adaptive Management Plan.

Table 6-12: MW12-06-01 Water Quality Results Summary (2016 - 2019)

MW12-06-01	2016 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.94	7.4	8.33	7.9	7.62	8.26
TDS (mg/L)	428	387	499	555.5	531	609
Sulfate-dissolved (mg/L)	2.27	0.42	<5.0	14.45	<1.5	53.3
Nutrients (mg/L)						
Ammonia Nitrogen	0.2182	0.0067	0.955	0.38650	0.0682	1.17
Nitrate Nitrogen	0.1563	0.0139	0.82	0.155	0.0510	0.421
Nitrite Nitrogen	0.5977	0.0379	3.31	0.434	0.143	1.22
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000142	<0.000010	0.000027
Aluminum	0.0186	0.0148	0.0277	0.0241	0.0222	0.0253
Arsenic	0.00728	0.00571	0.0095	0.00939	0.0078	0.0106
Cadmium	0.00001049	<0.0000050	0.0000248	0.0000219	0.0000091	0.0000327
Chromium	0.00364	0.00312	0.00449	0.004800	0.00451	0.00504
Copper	0.000933	<0.00020	0.00337	0.000277	<0.00020	0.00045
Lead	0.0000556	<0.000050	0.000085	0.0000500	<0.000050	<0.000050
Molybdenum	0.001106	0.000867	0.00172	0.00128	0.00102	0.00189
Nickel	0.0006	<0.00050	0.00086	0.000580	<0.00050	0.00069
Selenium	0.000989	0.000170	0.003740	0.003246	0.000612	0.00632
Zinc	0.00529	0.0023	0.0155	0.0044	0.0022	0.0075

Table 6-13: MW12-06-02 Water Quality Results Summary (2012 - 2019)

MW12-06-02	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.01	7.65	8.23	7.93	7.7	8.13
TDS (mg/L)	646.6	612	693	638.2	621	654
Sulfate-dissolved (mg/L)	208.6	177	227	215	211	218
Nutrients (mg/L)						
Ammonia Nitrogen	0.0405	0.0074	0.075	0.05060	0.041	0.0694
Nitrate Nitrogen	0.1573	0.0105	1.83	0.028	<0.025	0.031
Nitrite Nitrogen	0.5976	0.0401	7.21	0.0802	0.0498	0.103
Dissolved Metals (mg/L)						
Silver	0.0000160	0.000008	<0.000050	0.0000150	<0.000010	<0.000020
Aluminum	0.00318	<0.0010	0.0102	0.0024	0.0015	0.0031
Arsenic	0.00437	0.00227	0.00664	0.00353	0.00344	0.00362
Cadmium	0.00001722	<0.0000050	0.00016	0.00001125	<0.0000050	<0.000020
Chromium	0.000448	<0.00010	<0.0010	0.000158	<0.00010	<0.00020
Copper	0.001143	<0.00020	0.0202	0.00032	<0.00020	0.00048
Lead	0.0001151	0.000029	<0.00025	0.0000750	<0.000050	<0.00010
Molybdenum	0.00801	0.0051	0.0164	0.00948	0.00879	0.0101
Nickel	0.0009	<0.00050	<0.0025	0.000750	<0.00050	<0.0010
Selenium	0.0002062	<0.000050	0.000740	0.000281	<0.00010	0.000531
Zinc	0.00561	0.0016	0.0111	0.0035	0.0022	0.0047

Table 6-14: MW12-06-03 Water Quality Results Summary (2016 - 2019)

MW12-06-03	2016 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.06	7.74	8.34	8.02	7.82	8.22
TDS (mg/L)	638.2	615	671	636.2	630	647
Sulfate-dissolved (mg/L)	206.4	175	221	203.8	196	209
Nutrients (mg/L)						
Ammonia Nitrogen	0.0476	0.0076	0.0791	0.06280	0.0315	0.0849
Nitrate Nitrogen	0.0875	0.0094	0.269	0.0252	<0.025	0.026
Nitrite Nitrogen	0.3447	0.0342	1.07	0.067	0.0475	0.0839
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.00297	<0.0010	0.0177	0.0011	<0.0010	0.0014
Arsenic	0.00076	0.00052	0.00156	0.00058	0.00053	0.0007
Cadmium	0.00000679	<0.0000050	0.0000247	0.000005	<0.0000050	0.000005
Chromium	0.00022	<0.00010	0.00039	0.000180	0.00012	0.00022
Copper	0.000435	<0.00020	0.00267	0.0002	<0.00020	<0.00020
Lead	0.0000507	<0.000050	0.000058	0.0000500	<0.000050	<0.000050
Molybdenum	0.00243	0.00155	0.004	0.00202	0.00118	0.00342
Nickel	0.0005	<0.00050	<0.00050	0.000500	<0.00050	<0.00050
Selenium	0.0001416	<0.000050	0.000447	0.000238	0.000062	0.000358
Zinc	0.00547	0.002	0.0096	0.00192	<0.0010	0.0024

Table 6-15: MW12-06-04 Water Quality Results Summary (2012 - 2019)

MW12-06-04	2016 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.1	7.76	8.37	8.09	7.84	8.2
TDS (mg/L)	629	594	735	629.2	624	635
Sulfate-dissolved (mg/L)	175.8	159	197	187.8	181	196
Nutrients (mg/L)						
Ammonia Nitrogen	0.01298	<0.0050	0.028	0.00940	0.0071	0.0119
Nitrate Nitrogen	0.1992	0.0089	2	0.025	<0.025	<0.025
Nitrite Nitrogen	0.7821	0.0352	7.92	0.0582	0.0473	0.0677
Dissolved Metals (mg/L)						
Silver	0.0000152	<0.0000050	<0.000020	0.0000100	<0.000010	<0.000010
Aluminum	0.00347	<0.0010	0.012	0.0017	0.0013	0.0027
Arsenic	0.00244	0.00163	0.00515	0.00241	0.00226	0.00261
Cadmium	0.00000981	<0.0000050	0.000039	0.00001002	<0.0000050	0.0000162
Chromium	0.000495	<0.00010	<0.0010	0.000178	<0.00010	0.0003
Copper	0.002679	0.000106	0.0722	0.0002	<0.00020	<0.00020
Lead	0.0001160	0.000031	<0.00020	0.0000500	<0.000050	<0.000050
Molybdenum	0.0084	0.0074	0.0102	0.00848	0.00826	0.00884
Nickel	0.000737	<0.00050	0.0011	0.000500	<0.00050	<0.00050
Selenium	0.0001981	<0.000050	0.001010	0.000211	0.000066	0.000346
Zinc	0.01602	<0.0050	0.0686	0.0098	0.0058	0.0139

Table 6-16: MW12-06-05 Water Quality Results Summary (2016 - 2019)

MW12-06-05	2016 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.07	7.73	8.37	8.08	7.78	8.26
TDS (mg/L)	629	610	646	612	541	641
Sulfate-dissolved (mg/L)	182.4	176	190	164.8	98.3	189
Nutrients (mg/L)						
Ammonia Nitrogen	0.00688	<0.0050	0.0131	0.00770	0.0059	0.0088
Nitrate Nitrogen	0.0418	0.0155	0.255	0.025	<0.025	<0.025
Nitrite Nitrogen	0.134	0.0252	1	0.0432	0.0373	0.0567
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.00174	<0.0010	0.0029	0.0016	0.0011	0.0021
Arsenic	0.00086	0.00058	0.00146	0.00057	0.00052	0.00068
Cadmium	0.00000733	<0.0000050	0.0000187	0.0000121	0.0000074	0.0000163
Chromium	0.000103	<0.00010	0.00014	0.000123	<0.00010	0.00019
Copper	0.000235	<0.00020	0.00041	0.0002	<0.00020	<0.00020
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00914	0.00833	0.00993	0.00966	0.00921	0.0103
Nickel	0.000601	<0.00050	0.00083	0.000640	0.00057	0.0007
Selenium	0.0000677	<0.000050	0.000183	0.000168	0.000074	0.000238
Zinc	0.0211	0.0094	0.0637	0.016	0.0105	0.0269

Table 6-17: MW12-06-06 Water Quality Results Summary (2012 - 2019)

MW12-06-06	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.12	7.75	8.39	8.2	7.92	8.58
TDS (mg/L)	517	472	538	525	513	533
Sulfate-dissolved (mg/L)	153.3	143	171	153.2	148	157
Nutrients (mg/L)						
Ammonia Nitrogen	0.01336	<0.0050	0.085	0.00695	<0.0050	0.0091
Nitrate Nitrogen	1.019	0.45	1.31	0.852	0.7440	0.917
Nitrite Nitrogen	0.1015	0.0455	0.499	0.0852	0.0459	0.124
Dissolved Metals (mg/L)						
Silver	0.0000131	<0.0000050	<0.000020	0.0000100	<0.000010	<0.000010
Aluminum	0.00337	<0.0010	0.0142	0.0019	<0.0010	0.0045
Arsenic	0.00015	0.00009	0.00065	0.000108	<0.00010	0.00011
Cadmium	0.00001666	<0.0000050	0.000124	0.0000608	0.0000093	0.000196
Chromium	0.000407	<0.00010	<0.0010	0.000102	<0.00010	0.00011
Copper	0.000414	<0.00020	0.00155	0.000655	<0.00020	0.00187
Lead	0.0001005	<0.000050	<0.00020	0.0000500	<0.000050	<0.000050
Molybdenum	0.00569	0.0048	0.0066	0.0058	0.00563	0.006
Nickel	0.000667	<0.00050	<0.0010	0.000500	<0.00050	<0.00050
Selenium	0.000286	0.000150	0.000511	0.000426	0.000377	0.000513
Zinc	0.02336	0.00312	0.0827	0.026	0.0163	0.0427

6.3.10 MW12-07

Groundwater obtained from Zone 1 (01) was contaminated with glycol from the Westbay well casing during all sampling sessions in 2019, indicating a possible damaged sampling port. Historical results for Zone 1 are summarized in Table 6-18. Groundwater quality results for Zone 2 (02) in 2019 are summarized in Table 6-19 and compared to historical data.

Table 6-18: MW12-07-01 Water Quality Results Summary (2012 - 2018)

MW12-07-01	2012 - 2018 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**
pH	7.99	7.38	8.38
TDS (mg/L)	926	599	1400
Sulfate-dissolved (mg/L)	280.9	12.4	640
Nutrients (mg/L)			
Ammonia Nitrogen	0.49822	<0.0050	1.91
Nitrate Nitrogen	5.228	0.044	53.5
Nitrite Nitrogen	1.2697	<0.050	4.96
Dissolved Metals (mg/L)			
Silver	0.0000165	<0.000010	0.000037
Aluminum	0.00916	0.0015	0.0377
Arsenic	0.00109	0.00034	0.00573
Cadmium	0.00005324	<0.0000050	0.000633
Chromium	0.00083	0.00015	0.00216
Copper	0.005103	<0.00020	0.077
Lead	0.0002096	<0.000050	0.00104
Molybdenum	0.006605	0.000252	0.0223
Nickel	0.00116	<0.00050	0.0051
Selenium	0.004295	<0.00010	0.034700
Zinc	0.05672	<0.0010	1.24

Table 6-19: MW12-07-02 Water Quality Results Summary (2012 – 2019)

MW12-07-02	2012 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.97	7.68	8.24	8.24	8.02	8.41
TDS (mg/L)	1025	551	1180	591.1	563	636
Sulfate-dissolved (mg/L)	616	283	756	313	283	638
Nutrients (mg/L)						
Ammonia Nitrogen	0.09649	<0.0050	0.61	0.02240	0.0087	0.158
Nitrate Nitrogen	0.518	0.06	21.3	0.986	0.6380	1.33
Nitrite Nitrogen	0.4198	0.0453	1.47	0.4132	0.0562	3.37
Dissolved Metals (mg/L)						
Silver	0.0000195	<0.000010	0.000217	0.0000101	<0.000010	0.000011
Aluminum	0.00684	0.0014	0.0215	0.0026	0.0015	0.0062
Arsenic	0.0015	0.00024	0.00592	0.00065	0.00022	0.00515
Cadmium	0.00002043	<0.0000050	0.000269	0.00009839	<0.0000250	0.000191
Chromium	0.000598	<0.00010	0.0011	0.000103	<0.00010	0.00014
Copper	0.00118	<0.00020	0.0217	0.003119	<0.00020	0.00911
Lead	0.0001451	<0.000050	0.00056	0.0000528	<0.000050	0.000094
Molybdenum	0.0203	0.0019	0.0373	0.0231	0.0208	0.0264
Nickel	0.000833	<0.00050	0.0017	0.000500	<0.00050	<0.00050
Selenium	0.000515	0.000055	0.014800	0.00072	0.00045	0.00208
Zinc	0.024	0.0016	0.375	0.067	0.0253	0.152

6.3.11 MW17-08

This well was installed in July 2017 to monitor groundwater up-gradient of the Southwest Waste Dump and other mine activities. Three zones were sampled and analyzed in 2019, the results are summarized in Table 6-20 to 6-23 below alongside historical results. The highest zone, MW17-08-04, was found to be dry throughout 2019. Well 17-08 was installed to monitor the background water quality.

Table 6-20: **MW17-08-01 Water Quality Results Summary (2017 - 2019)**

MW17-08-01	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.15	7.81	8.47	8.19	7.95	8.57
TDS (mg/L)	261	224	281	253.1	200	270
Sulfate-dissolved (mg/L)	39.1	36.9	43.1	34.5	32.9	38.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.00559	<0.0050	0.0073	0.03591	<0.0050	0.201
Nitrate Nitrogen	0.367	0.329	0.387	0.30814	<0.0050	0.453
Nitrite Nitrogen	0.00344	<0.0010	0.0136	0.00423	<0.0010	0.0163
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000116	<0.000010	<0.000020
Aluminum	0.00183	<0.0010	0.0029	0.0046	<0.0010	0.0152
Arsenic	0.00133	0.00013	0.00523	0.000396	<0.00010	0.00157
Cadmium	0.0000697	0.0000294	0.000201	0.0005375	0.0000098	0.00325
Chromium	0.000113	<0.00010	0.00019	0.000181	<0.00010	0.00057
Copper	0.00065	0.00033	0.00129	0.00164	0.0002	0.0062
Lead	0.0000500	<0.000050	<0.000050	0.0000616	<0.000050	<0.00010
Molybdenum	0.0082	0.00525	0.00908	0.00955	0.00861	0.0135
Nickel	0.000553	<0.00050	0.00087	0.000859	<0.00050	0.00166
Selenium	0.00061	0.000399	0.001160	0.000569	0.000084	0.000938
Zinc	0.0361	0.0297	0.0539	0.034	0.0026	0.0692

Table 6-21: MW17-08-02 Water Quality Results Summary (2017 - 2019)

MW17-08-02	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.2	7.93	8.42	8.25	8.09	8.47
TDS (mg/L)	164.5	138	180	167	162	171
Sulfate-dissolved (mg/L)	11.8	11.4	12	10.8	10.2	11.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00708	<0.0050	0.0133
Nitrate Nitrogen	0.681	0.657	0.71	0.684	0.6780	0.693
Nitrite Nitrogen	0.0016	<0.0010	0.0045	0.00215	<0.0010	0.0035
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0024	0.0019	0.0038	0.0020	0.0014	0.0027
Arsenic	0.00084	0.00019	0.00479	0.00024	0.00014	0.00033
Cadmium	0.0000251	0.0000114	0.0000458	0.0000729	0.0000099	0.000234
Chromium	0.00019	<0.00010	0.00082	0.000100	<0.00010	0.0001
Copper	0.00233	0.00175	0.00271	0.00243	0.00225	0.00259
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0032	0.00299	0.00372	0.00299	0.00289	0.00308
Nickel	0.000525	<0.00050	0.0007	0.000500	<0.00050	<0.00050
Selenium	0.000736	0.000514	0.001270	0.000668	0.000546	0.000791
Zinc	0.0183	0.0084	0.0313	0.0198	0.0095	0.036

Table 6-22: MW17-08-03 Water Quality Results Summary (2017 - 2019)

MW17-08-03	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.18	8.09	8.37	8.14	7.92	8.24
TDS (mg/L)	146.1	140	160	122.6	98.3	145
Sulfate-dissolved (mg/L)	5.3	5.08	5.7	3.45	2.43	4.53
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00692	<0.0050	0.0127
Nitrate Nitrogen	0.798	0.771	0.851	0.726	0.6630	0.789
Nitrite Nitrogen	0.0021	<0.0010	0.0042	0.001	<0.0010	0.001
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0039	0.0031	0.0048	0.0054	0.0030	0.0094
Arsenic	0.00064	0.00015	0.00332	0.000165	<0.00010	0.00021
Cadmium	0.00001554	<0.0000050	0.0000369	0.0000614	0.0000112	0.000172
Chromium	0.0001	<0.00010	<0.00010	0.000128	<0.00010	0.00021
Copper	0.00061	0.00044	0.00073	0.00084	0.00044	0.0014
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.001049	0.000941	0.00116	0.000826	0.000774	0.000906
Nickel	0.0005	<0.00050	<0.00050	0.000500	<0.00050	<0.00050
Selenium	0.000458	0.000287	0.000682	0.00038	0.00026	0.000557
Zinc	0.0166	0.0068	0.0381	0.0161	0.012	0.0262

Table 6-23: MW17-08-04 Water Quality Results Summary (2017 - 2018)

MW17-08-04	2017 Summary Statistics			2018 Summary Statistics		
Parameters	**Mean**			**Mean**	**Min**	**Max**
pH	8.07			8.04	8.03	8.05
TDS (mg/L)	71.2			81.3	81.0	81.6
Sulfate-dissolved (mg/L)	<5.0			2.26	2.20	2.33
Nutrients (mg/L)						
Ammonia Nitrogen	<0.005			0.0184	0.0184	0.0184
Nitrate Nitrogen	0.618			0.598	0.594	0.603
Nitrite Nitrogen	0.0051			0.00150	<0.0010	0.0020
Dissolved Metals (mg/L)						
Silver	0.00001	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0047	0.0038	0.0056	0.0036	0.0035	0.0037
Arsenic	0.0002	0.00013	0.00028	0.00251	0.00013	0.00489
Cadmium	0.000048	<0.0000050	0.000091	0.0000314	0.0000227	0.0000402
Chromium	0.00014	<0.00010	0.00017	0.000100	<0.00010	<0.00010
Copper	0.00046	0.00038	0.00053	0.00066	0.00036	0.00096
Lead	0.00005	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.000607	0.0005	0.000714	0.000498	0.000433	0.000562
Nickel	0.00075	<0.00050	0.001	0.000640	<0.00050	0.00078
Selenium	0.000436	0.000213	0.000659	0.000233	0.000158	0.000308
Zinc	0.0708	0.0045	0.137	0.0226	0.0085	0.0367

6.3.12 MW17-09

This well was installed in July 2017 to monitor groundwater down-gradient of the Southwest Waste Dump. One zone was identified below an ice-rich layer, it was sampled and analyzed once in 2017. In 2018 the well was frozen in Q1 and Q2 and was found dry during the Q3 and Q4 sampling events. In 2019, the groundwater probe could not reach the sampling port. It is likely that the well has been destroyed.

6.3.13 MW17-10

This well was installed in July 2017 to monitor groundwater down-gradient of the Main Waste Dump. All three ports were sampled in 2019, the results are summarized in Table 6-24 to 6-26 below alongside historical results.

Table 6-24: MW17-10-01 Water Quality Results Summary (2017 - 2019)

MW17-10-01	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.13	8.07	8.19	8.12	7.96	8.24
TDS (mg/L)	224.6	191	245	251.8	233	269
Sulfate-dissolved (mg/L)	56.4	52.9	61.9	47.4	41.8	50.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.02077	<0.0050	0.0438	0.02410	<0.0050	0.0588
Nitrate Nitrogen	5.44	1.96	8.45	12	10.6000	13.4
Nitrite Nitrogen	0.0934	0.0014	0.476	0.0061	0.0024	0.0121
Dissolved Metals (mg/L)						
Silver	0.0000126	<0.000010	0.000017	0.0000155	<0.000010	0.000028
Aluminum	0.0059	0.0041	0.0084	0.0040	0.0036	0.0042
Arsenic	0.00066	0.00014	0.00244	0.00034	0.00016	0.00069
Cadmium	0.0000605	<0.000015	0.000196	0.0004402	0.0000351	0.0015
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00411	0.00321	0.00448	0.00495	0.00356	0.0089
Lead	0.0000500	<0.000050	<0.000050	0.0000665	<0.000050	0.000116
Molybdenum	0.0276	0.0193	0.0381	0.0161	0.0149	0.0171
Nickel	0.01129	0.0089	0.0137	0.010610	0.00944	0.0119
Selenium	0.001269	0.000718	0.002900	0.001095	0.000899	0.00133
Zinc	0.0266	0.0133	0.0463	0.0325	0.0243	0.0377

Table 6-25: MW17-10-02 Water Quality Results Summary (2017 - 2019)

MW17-10-02	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.09	7.94	8.22	8.16	8	8.29
TDS (mg/L)	256.9	234	271	292.4	263	308
Sulfate-dissolved (mg/L)	24.5	23.7	25.9	29.2	22.1	49.9
Nutrients (mg/L)						
Ammonia Nitrogen	0.0051	<0.0050	0.0055	0.02512	<0.0050	0.0831
Nitrate Nitrogen	19.2	15.6	22.5	25.2	13.0000	29.4
Nitrite Nitrogen	0.0024	0.0011	0.0045	0.00412	<0.0010	0.0135
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.003	0.0023	0.0044	0.0025	0.0019	0.0041
Arsenic	0.00098	0.00012	0.00654	0.00014	<0.00010	0.0002
Cadmium	0.0000429	0.00001	0.000164	0.0000953	0.000012	0.000336
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00303	0.00172	0.00524	0.00195	0.00107	0.0041
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00839	0.00753	0.00942	0.00913	0.00694	0.0165
Nickel	0.00489	0.00284	0.0106	0.003890	0.00112	0.0119
Selenium	0.00151	0.001180	0.001850	0.00229	0.00113	0.00317
Zinc	0.0316	0.0163	0.0475	0.032	0.0195	0.0629

Table 6-26: MW17-10-03 Water Quality Results Summary (2017 - 2019)

MW17-10-03	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.09	7.97	8.14	7.96	7.67	8.21
TDS (mg/L)	259.4	240	274	309.5	297	320
Sulfate-dissolved (mg/L)	22.9	22.3	23.3	23.6	21.9	25.2
Nutrients (mg/L)						
Ammonia Nitrogen	0.00733	<0.0050	0.0172	0.01582	<0.0050	0.0432
Nitrate Nitrogen	20.9	17.4	24.4	29.2	28.4000	30.4
Nitrite Nitrogen	0.00363	<0.0010	0.0062	0.00375	<0.0010	0.0113
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0036	0.0021	0.0077	0.0017	0.0014	0.0023
Arsenic	0.000824	<0.00010	0.00502	0.000163	<0.00010	0.00022
Cadmium	0.000023	0.0000092	0.0000561	0.0000743	0.0000261	0.000166
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00255	0.00173	0.00371	0.00133	0.00111	0.00162
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00823	0.00675	0.00966	0.0068	0.00648	0.00714
Nickel	0.00526	0.00319	0.00805	0.002400	0.00169	0.00275
Selenium	0.00152	0.001190	0.002060	0.00304	0.00262	0.00354
Zinc	0.0359	0.0174	0.0568	0.0539	0.0242	0.116

6.3.14 MW17-11

This well was installed in July 2017 to monitor groundwater down-gradient of the Minto North Pit. Ports 01, 02, 03 and 04 were sampled as per scheduled while port 05 was found dry in Q1, Q3 and Q4. The results are summarized in Table 6-27 to 6-31 below.

Table 6-27: MW17-11-01 Water Quality Results Summary (2017 - 2019)

MW17-11-01	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.22	8.08	8.27	8.24	7.96	8.42
TDS (mg/L)	185.3	171	191	206.8	189	261
Sulfate-dissolved (mg/L)	37.8	36	39.5	38.2	35.9	40.1
Nutrients (mg/L)						
Ammonia Nitrogen	0.00843	<0.0050	0.0202	0.00917	<0.0050	0.0206
Nitrate Nitrogen	0.0635	<0.0050	0.339	0.08163	<0.0050	0.446
Nitrite Nitrogen	0.0151	0.0010	0.0435	0.00232	<0.0010	0.0042
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0091	0.0054	0.0229	0.0044	0.0011	0.0057
Arsenic	0.00122	0.00063	0.0019	0.001498	<0.00010	0.00219
Cadmium	0.00012737	<0.0000050	0.000673	0.00005	0.0000052	0.000118
Chromium	0.000126	<0.00010	0.00021	0.000100	<0.00010	<0.00010
Copper	0.000961	<0.00020	0.00317	0.000332	<0.00020	0.00055
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.0215	0.0167	0.0273	0.01188	0.00911	0.0135
Nickel	0.000747	<0.00050	0.0012	0.000500	<0.00050	<0.00050
Selenium	0.0002091	<0.000050	0.000596	0.000488	0.000058	0.00125
Zinc	0.0209	0.0099	0.0429	0.0184	0.0094	0.0384

Table 6-28: MW17-11-02 Water Quality Results Summary (2017 - 2019)

MW17-11-02	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.18	8.08	8.28	8.22	7.92	8.44
TDS (mg/L)	192.6	178	199	195.2	181	203
Sulfate-dissolved (mg/L)	34.2	28.7	39.2	41.2	36.2	43.4
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00620	<0.0050	0.0087
Nitrate Nitrogen	0.02496	<0.0050	0.0872	0.00742	<0.0050	0.0126
Nitrite Nitrogen	0.00185	<0.0010	0.0053	0.00103	<0.0010	0.0011
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0043	0.0021	0.007	0.0024	0.0018	0.0033
Arsenic	0.00092	0.00054	0.00183	0.00086	0.00075	0.00101
Cadmium	0.00001924	<0.0000050	0.0000633	0.0000405	0.0000056	0.000128
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.000352	<0.00020	0.00065	0.000248	<0.00020	0.00038
Lead	0.0000550	<0.000050	0.000082	0.0000500	<0.000050	<0.000050
Molybdenum	0.0064	0.00586	0.00743	0.00584	0.00572	0.00594
Nickel	0.000641	<0.00050	0.00099	0.000500	<0.00050	<0.00050
Selenium	0.000448	<0.000050	0.002610	0.000068	<0.000050	0.000117
Zinc	0.0224	0.0121	0.0656	0.0204	0.0157	0.0256

Table 6-29: MW17-11-03 Water Quality Results Summary (2017 - 2019)

MW17-11-03	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.22	8.18	8.32	8.27	8.02	8.46
TDS (mg/L)	176.2	160	194	167	162	170
Sulfate-dissolved (mg/L)	20.5	16.9	23.8	16.9	15.7	18.6
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.11433	<0.0050	0.335	0.00728	<0.0050	0.0109
Nitrite Nitrogen	0.02463	<0.0010	0.103	0.00103	<0.0010	0.0011
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0049	0.0038	0.0057	0.0053	0.0044	0.0066
Arsenic	0.00044	0.00021	0.00068	0.0003	0.00027	0.00032
Cadmium	0.00000912	<0.0000050	0.000019	0.0000944	<0.000010	0.000347
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.000263	<0.00020	0.00036	0.000677	<0.00020	0.00211
Lead	0.0000500	<0.000050	<0.000050	0.0000515	<0.000050	0.000056
Molybdenum	0.0058	0.00406	0.00789	0.00456	0.00419	0.00493
Nickel	0.000793	<0.00050	0.00154	0.000500	<0.00050	<0.00050
Selenium	0.0001612	<0.000050	0.000586	0.0000802	<0.000050	0.000128
Zinc	0.0116	0.0063	0.0166	0.0232	0.0146	0.0307

Table 6-30: MW17-11-04 Water Quality Results Summary (2017 - 2019)

MW17-11-04	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.07	7.81	8.31	7.99	7.62	8.24
TDS (mg/L)	360	197	557	329	301	359
Sulfate-dissolved (mg/L)	15.9	6.3	29	17.7	16.3	18.8
Nutrients (mg/L)						
Ammonia Nitrogen	0.02703	<0.0050	0.106	0.07980	0.043	0.145
Nitrate Nitrogen	6.8463	0.0173	11.1	6.7	6.4200	7.22
Nitrite Nitrogen	0.0131	0.0020	0.0316	0.0036	0.0022	0.0063
Dissolved Metals (mg/L)						
Silver	0.0000159	<0.000010	0.000033	0.0000167	<0.000010	0.000027
Aluminum	0.004	0.003	0.0057	0.0053	0.0029	0.0087
Arsenic	0.00031	0.0001	0.00067	0.00024	0.00017	0.00038
Cadmium	0.000033	0.0000062	0.0000707	0.0001713	0.0000188	0.000472
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.00538	0.0008	0.01	0.00274	0.00176	0.00381
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00931	0.00407	0.0198	0.00941	0.00721	0.0111
Nickel	0.003234	<0.00050	0.00823	0.002570	0.0017	0.00377
Selenium	0.000384	0.000133	0.000929	0.000283	0.000227	0.000327
Zinc	0.0353	0.0137	0.0834	0.0416	0.0282	0.0528

Table 6-31: MW17-11-05 Water Quality Results Summary (2017 - 2019)

MW17-11-05	2017 - 2018 Summary Statistics			2019 Sample Results
Parameters	**Mean**			**10-May**
pH	7.68	7.47	8.28	7.41
TDS (mg/L)	766	305	971	903
Sulfate-dissolved (mg/L)	13.2	4.7	17.8	11.8
Nutrients (mg/L)				
Ammonia Nitrogen	0.01302	<0.0050	0.0334	0.05940
Nitrate Nitrogen	20.31	9.2300	29	29.7
Nitrite Nitrogen	0.0112	0.0045	0.0227	0.51
Dissolved Metals (mg/L)				
Silver	0.0000456	0.000011	0.000063	0.0000270
Aluminum	0.0028	0.0014	0.0053	0.0016
Arsenic	0.000372	0.0001	0.00054	0.00026
Cadmium	0.000043	0.0000083	0.0000834	0.0000381
Chromium	0.000180	<0.00010	<0.00050	0.000100
Copper	0.00438	0.00229	0.0093	0.00493
Lead	0.0000900	<0.000050	<0.00025	0.0000500
Molybdenum	0.00563	0.00114	0.00952	0.00755
Nickel	0.004960	0.00067	0.00789	0.004500
Selenium	0.001104	0.000349	0.00155	0.00089
Zinc	0.0739	0.045	0.101	0.0396

6.3.15 MW17-12

This well was installed in July 2017 to monitor groundwater down-gradient of the Dry Stack Tailing Storage Facility (DSTSF) and all other mine activities. All eight zones were sampled and analyzed in 2019, the results are summarized in Table 6-32 to 6-39 below alongside historical results.

Table 6-32: MW17-12-01 Water Quality Results Summary (2017 - 2019)

MW17-12-01	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	7.91	7.68	8.11	8.04	7.76	8.27
TDS (mg/L)	2115	2040	2170	2010	1940	2050
Sulfate-dissolved (mg/L)	1345	1300	1410	1267	1210	1320
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00560	0.005	0.0062
Nitrate Nitrogen	0.0833	<0.050	<0.10	0.0875	<0.050	<0.10
Nitrite Nitrogen	0.0213	<0.010	0.044	0.0175	<0.010	0.02
Dissolved Metals (mg/L)						
Silver	0.0000217	<0.000010	<0.000050	0.0000200	<0.000020	<0.000020
Aluminum	0.0048	0.0023	0.0157	0.0026	0.0024	0.0029
Arsenic	0.00272	0.00223	0.00425	0.00251	0.00234	0.00274
Cadmium	0.0000306	0.0000087	0.000067	0.000119	0.000018	0.000211
Chromium	0.000217	<0.00010	<0.00050	0.000200	<0.00020	<0.00020
Copper	0.000733	<0.00020	0.0028	0.00043	<0.00040	0.00052
Lead	0.0001083	<0.000050	<0.00025	0.0001000	<0.00010	<0.00010
Molybdenum	0.0078	0.00689	0.00839	0.00784	0.00744	0.00815
Nickel	0.001135	<0.00050	<0.0025	0.001000	<0.0010	<0.0010
Selenium	0.000127	0.000060	<0.00025	0.000368	<0.00010	0.00096
Zinc	0.0362	0.0164	0.0574	0.0483	0.0223	0.0621

Table 6-33: MW17-12-02 Water Quality Results Summary (2017 - 2019)

MW17-12-02	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8	7.8	8.19	8.03	7.78	8.25
TDS (mg/L)	1760	1670	1840	1767	1670	1840
Sulfate-dissolved (mg/L)	1083	1020	1140	1082	1020	1130
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.0625	<0.025	<0.10	0.075	<0.050	<0.10
Nitrite Nitrogen	0.0125	<0.0050	<0.020	0.015	<0.010	<0.020
Dissolved Metals (mg/L)						
Silver	0.0000217	<0.000010	<0.000050	0.0000250	<0.000010	<0.000050
Aluminum	0.0044	0.0022	0.0134	0.0031	0.0012	<0.0050
Arsenic	0.00232	0.00157	0.00405	0.00247	0.00237	0.0026
Cadmium	0.0000147	0.000006	<0.000025	0.000036	0.000015	0.0000541
Chromium	0.000217	<0.00010	<0.00050	0.000250	<0.00010	<0.00050
Copper	0.000433	<0.00020	<0.0010	0.0005	<0.00020	<0.0010
Lead	0.0001083	<0.000050	<0.00025	0.0001250	<0.000050	<0.00025
Molybdenum	0.00789	0.00732	0.0084	0.00792	0.00757	0.00828
Nickel	0.001163	<0.00050	<0.0025	0.001250	<0.00050	<0.0025
Selenium	0.0001127	<0.000050	<0.00025	0.000343	0.000091	0.00093
Zinc	0.0296	0.0127	0.0468	0.0638	0.0418	0.0893

Table 6-34: MW17-12-03 Water Quality Results Summary (2017 - 2019)

MW17-12-03	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.09	7.85	8.34	8.17	7.93	8.38
TDS (mg/L)	542	522	561	521.8	513	535
Sulfate-dissolved (mg/L)	138.2	133	142	121.4	112	128
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00522	<0.0050	0.0061
Nitrate Nitrogen	0.0629	0.006	0.274	0.025	<0.025	<0.025
Nitrite Nitrogen	0.00512	0.0016	0.0091	0.00616	<0.0050	0.0108
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0038	0.0019	0.0106	0.0026	0.0019	0.0036
Arsenic	0.00114	0.00097	0.00149	0.00162	0.00158	0.00165
Cadmium	0.00000835	<0.0000050	0.0000136	0.0000235	0.0000097	0.0000437
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	<0.00010
Copper	0.000395	<0.00020	0.00137	0.000206	<0.00020	0.00023
Lead	0.0000500	<0.000050	<0.000050	0.0000658	<0.000050	0.000129
Molybdenum	0.00572	0.00521	0.0062	0.00583	0.00556	0.00613
Nickel	0.000915	<0.00050	0.00186	0.000500	<0.00050	<0.00050
Selenium	0.0000617	<0.000050	0.000120	0.000188	<0.000050	0.000647
Zinc	0.0227	0.0103	0.048	0.0404	0.0247	0.0648

Table 6-35: MW17-12-04 Water Quality Results Summary (2017 - 2019)

MW17-12-04	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.14	7.86	8.46	8.31	8.07	8.54
TDS (mg/L)	448.3	423	480	452	443	459
Sulfate-dissolved (mg/L)	105.6	93.6	126	100	95.6	103
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	0.005
Nitrate Nitrogen	0.265	0.222	0.335	0.184	0.1590	0.223
Nitrite Nitrogen	0.00343	<0.0010	<0.0050	0.0045	0.0011	0.0069
Dissolved Metals (mg/L)						
Silver	0.0000117	<0.000010	0.000015	0.0000190	0.000016	0.000026
Aluminum	0.003	0.0023	0.0035	0.0030	0.0018	0.0053
Arsenic	0.00064	0.00018	0.00226	0.00017	0.00014	0.0002
Cadmium	0.0000143	0.0000052	0.0000212	0.000034	0.000011	0.0000542
Chromium	0.0001	<0.00010	<0.00010	0.000100	<0.00010	0.0001
Copper	0.00234	0.00123	0.00374	0.00088	0.00077	0.00094
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00653	0.00526	0.0089	0.00519	0.00497	0.00562
Nickel	0.001018	<0.00050	0.00272	0.000500	<0.00050	<0.00050
Selenium	0.000691	0.000569	0.000994	0.000694	0.000423	0.000965
Zinc	0.0375	0.0105	0.101	0.0366	0.028	0.0477

Table 6-36: MW17-12-05 Water Quality Results Summary (2017 - 2019)

MW17-12-05	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.18	7.94	8.48	8.29	8.05	8.51
TDS (mg/L)	462.5	441	486	452	443	461
Sulfate-dissolved (mg/L)	97.1	87.5	120	90.3	85.7	92.5
Nutrients (mg/L)						
Ammonia Nitrogen	0.00517	<0.0050	0.006	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.287	0.199	0.415	0.237	0.2010	0.27
Nitrite Nitrogen	0.00625	<0.0010	0.0165	0.00415	<0.0010	0.0056
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0065	0.0026	0.0177	0.0028	0.0026	0.0031
Arsenic	0.000238	<0.00010	0.00047	0.00012	<0.00010	0.00014
Cadmium	0.0000234	0.0000151	0.0000348	0.0000348	0.0000208	0.0000505
Chromium	0.0001	<0.00010	<0.00010	0.000420	<0.00010	0.00138
Copper	0.00193	0.00086	0.00318	0.00339	0.0032	0.00347
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.01254	0.00474	0.0207	0.0158	0.0126	0.0196
Nickel	0.00258	0.00117	0.0043	0.003200	0.00278	0.00363
Selenium	0.000422	0.000255	0.000588	0.000348	0.000213	0.000643
Zinc	0.0354	0.013	0.0737	0.0441	0.0389	0.0497

Table 6-37: MW17-12-06 Water Quality Results Summary (2017 - 2019)

MW17-12-06	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.2	7.94	8.48	8.38	8.04	8.52
TDS (mg/L)	451	422	466	451.4	440	459
Sulfate-dissolved (mg/L)	93.4	88.2	101	90.3	88	92
Nutrients (mg/L)						
Ammonia Nitrogen	0.00912	<0.0050	0.0253	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.11108	<0.0050	0.247	0.258	0.2460	0.281
Nitrite Nitrogen	0.00895	0.0015	0.0152	0.0038	<0.0010	0.0062
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000100	<0.000010	<0.000010
Aluminum	0.0047	0.0024	0.0093	0.0027	0.0024	0.0029
Arsenic	0.000257	<0.00010	0.00058	0.000122	<0.00010	0.00016
Cadmium	0.0000346	0.0000223	0.0000598	0.0000382	0.0000227	0.0000481
Chromium	0.0001	<0.00010	<0.00010	0.000104	<0.00010	0.00012
Copper	0.00164	0.00062	0.00296	0.00324	0.003	0.00347
Lead	0.0000510	<0.000050	0.000056	0.0000500	<0.000050	<0.000050
Molybdenum	0.0353	0.0216	0.0607	0.0199	0.0189	0.0224
Nickel	0.00366	0.00268	0.00457	0.002660	0.00254	0.00286
Selenium	0.000466	0.000197	0.000850	0.000248	0.000136	0.000515
Zinc	0.1005	0.011	0.524	0.047	0.0157	0.107

Table 6-38: MW17-12-07 Water Quality Results Summary (2017 - 2019)

MW17-12-07	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.15	7.96	8.42	8.32	8.06	8.49
TDS (mg/L)	326.4	304	343	328.8	314	337
Sulfate-dissolved (mg/L)	62.7	60.6	67.4	64.1	62.8	65
Nutrients (mg/L)						
Ammonia Nitrogen	0.005	<0.0050	<0.0050	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.845	0.739	0.997	0.634	0.5500	0.692
Nitrite Nitrogen	0.0016	<0.0010	0.0027	0.00122	<0.0010	0.0019
Dissolved Metals (mg/L)						
Silver	0.0000100	<0.000010	<0.000010	0.0000105	<0.000010	0.000012
Aluminum	0.0048	0.0023	0.0135	0.0022	0.0019	0.0023
Arsenic	0.00027	<0.00010	0.00048	0.00014	0.00011	0.00017
Cadmium	0.00001458	<0.0000050	0.0000379	0.0000253	0.0000125	0.0000489
Chromium	0.0001	<0.00010	<0.00010	0.000110	<0.00010	0.00013
Copper	0.00109	0.00078	0.00207	0.00064	0.00056	0.00074
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.00714	0.00626	0.00966	0.00612	0.00588	0.00672
Nickel	0.000531	<0.00050	0.00068	0.000500	<0.00050	<0.00050
Selenium	0.000332	0.000219	0.000809	0.000366	0.00024	0.000686
Zinc	0.0527	0.0108	0.281	0.0513	0.0169	0.0957

Table 6-39: MW17-12-08 Water Quality Results Summary (2017 - 2019)

MW17-12-08	2017 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	8.23	8.05	8.52	8.37	8.15	8.52
TDS (mg/L)	348	321	477	332.5	326	339
Sulfate-dissolved (mg/L)	65.8	60.8	95.4	64.3	62.6	65.7
Nutrients (mg/L)						
Ammonia Nitrogen	0.00512	<0.0050	0.0061	0.00500	<0.0050	<0.0050
Nitrate Nitrogen	0.793	0.1	0.963	0.646	0.5620	0.702
Nitrite Nitrogen	0.00358	<0.0010	0.0124	0.002	<0.0010	0.0038
Dissolved Metals (mg/L)						
Silver	0.0000101	<0.000010	0.000011	0.0000100	<0.000010	<0.000010
Aluminum	0.0053	0.002	0.0113	0.0017	0.0013	0.0019
Arsenic	0.000217	<0.00010	0.00069	0.000132	<0.00010	0.00016
Cadmium	0.00001139	<0.0000050	<0.000025	0.0000265	0.0000136	0.0000471
Chromium	0.0001	<0.00010	<0.00010	0.000105	<0.00010	0.00012
Copper	0.00175	0.00082	0.00494	0.0007	0.00061	0.00076
Lead	0.0000500	<0.000050	<0.000050	0.0000500	<0.000050	<0.000050
Molybdenum	0.01204	0.00787	0.0279	0.0074	0.00712	0.00811
Nickel	0.001597	<0.00050	0.00438	0.000500	<0.00050	<0.00050
Selenium	0.00028	0.000224	0.000347	0.000349	0.000231	0.000569
Zinc	0.0235	0.0099	0.0628	0.0723	0.0166	0.165

6.4 Vibrating Wire Piezometers

There are currently 21 operating vibrating wire piezometers installed on site, listed in Table 6-40. DSP-5A became inoperative in February 2019, there were no other changes to the operational status of any piezometers in 2019. Summaries of data collected from each piezometer are provided in the following sections.

Table 6-40: Vibrating Wire Piezometer Summary

Vibrating Wire Piezometer	Location	Operational Status
DSP-5	DSTSF	5A - Inoperative (2019)
DSP-6	DSTSF	6A - Inoperative (2018)
DSP-7	DSTSF	7-2 – Inoperative (2018)
DSP-8	DSTSF	Operational: 1, 3, 4, 6 Inoperative: 2 (2018), 5 (2018)
DSP-9	DSTSF	Inoperative (2016)
DSP-10	DSTSF	Operational
SDP-2	Southwest Dump	2A - Inoperative (2017)
SDP-3	Southwest Dump	Operational
SDP-4	Southwest Dump	Operational
WDP-2	Water Storage Pond Dam	Operational
WDP-3A	Water Storage Pond Dam	Operational
WDP-3	Water Storage Pond Dam	Operational
WDP-4	Water Storage Pond Dam	Operational
WDP-5	Water Storage Pond Dam	Operational
WDP-6	Water Storage Pond Dam	Operational
WDP-7	Water Storage Pond Dam	Operational
WDP-8	Water Storage Pond Dam	Operational
WDP-9	Water Storage Pond Dam	Operational
WDP-10	Water Storage Pond Dam	Operational
WDP-11	Water Storage Pond Dam	Operational
WDP-12	Water Storage Pond Dam	Operational
WDP-13	Water Storage Pond Dam	Operational

6.4.1 DSTSF Piezometers

Data collected from DSTSF vibrating wire piezometers are presented in Figure 6-2 to 6-5. Sensor DSP-6A is reading negative pressures and has not been included in the figure.

Pore water pressures in DSP-5A and DSP-5B have been gradually increasing since installation in 2013. Analysis carried out by SRK Consulting in 2015 to consider the increasing pressures indicated high FOS values (FOS>2) even without consideration of the constructed MVFE2. DSP-7, DSP-8 and DSP-10 water pressures generally increased during construction and closure works between 2015 and 2018 and were generally steady in 2019. Review of the data by SRK Consulting in 2018 identified no stability concern.

DSTSF piezometer readings are collected quarterly.

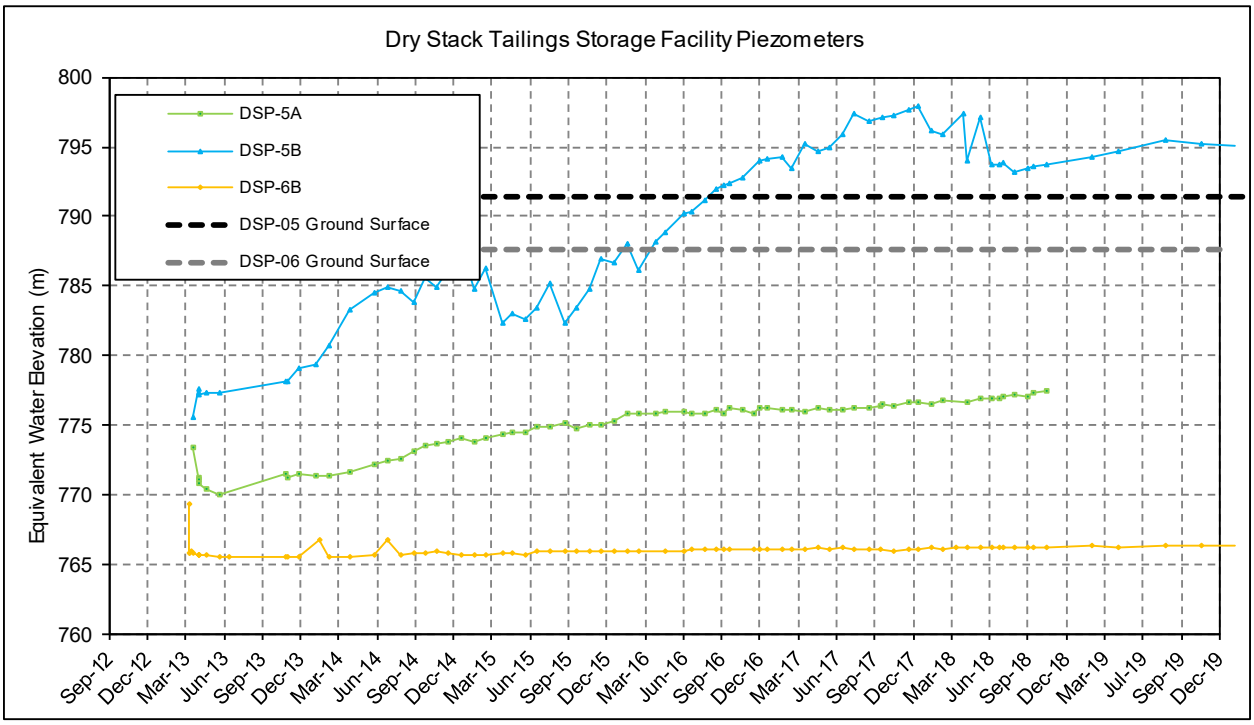


Figure 6-2: DSTSF Piezometer Data – DSP-05 and DSP-06 (2013-2019)

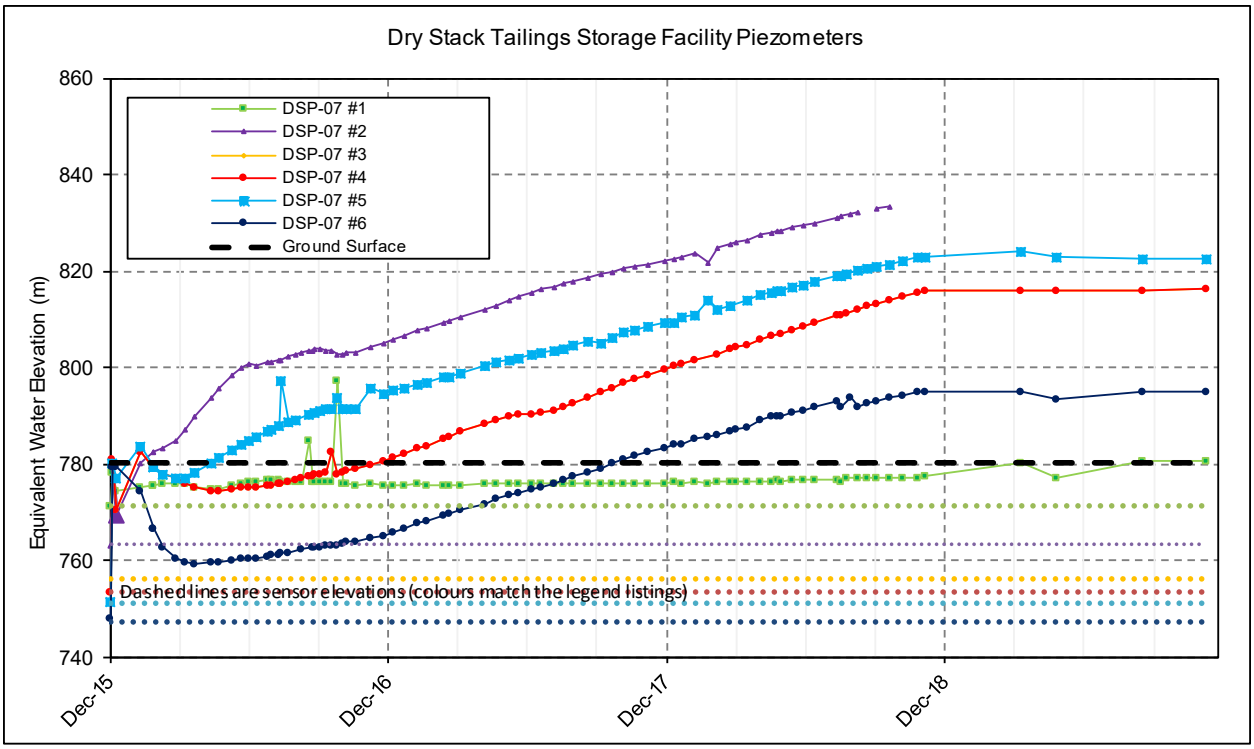


Figure 6-3: DSTSF Piezometer Data – DSP-07 (2015-2019)

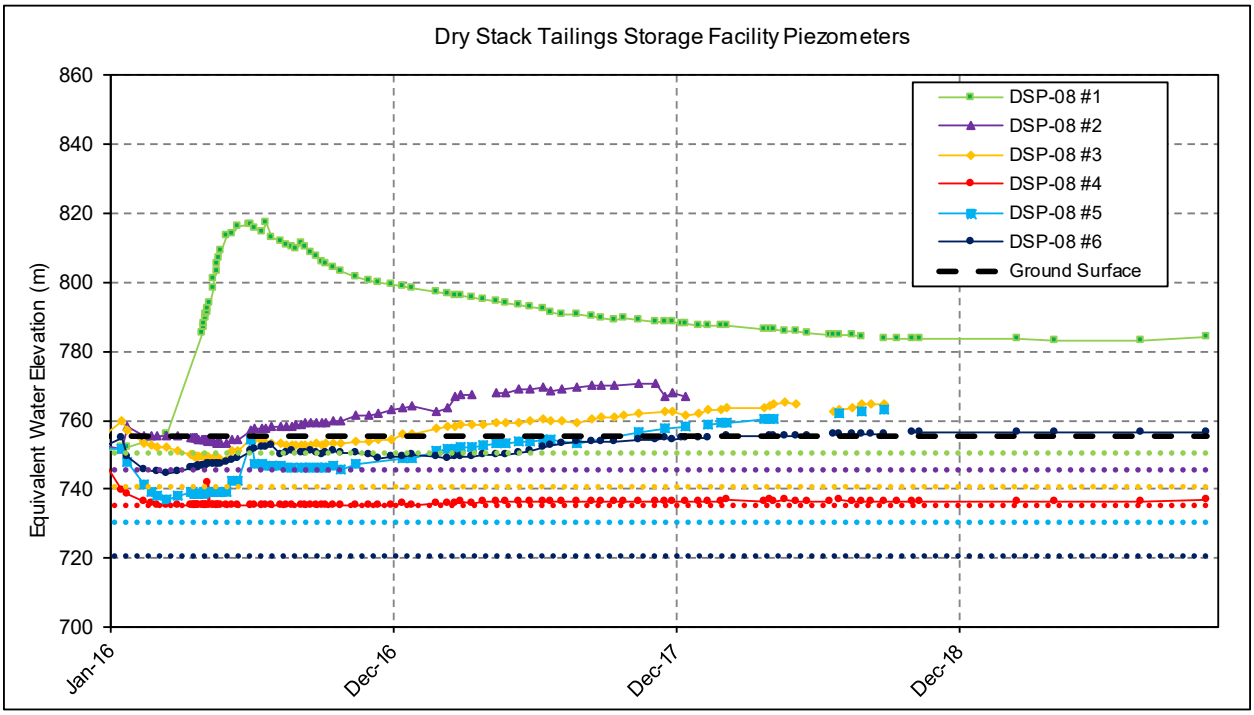


Figure 6-4: DSTSF Piezometer Data – DSP-08 (2015-2019)

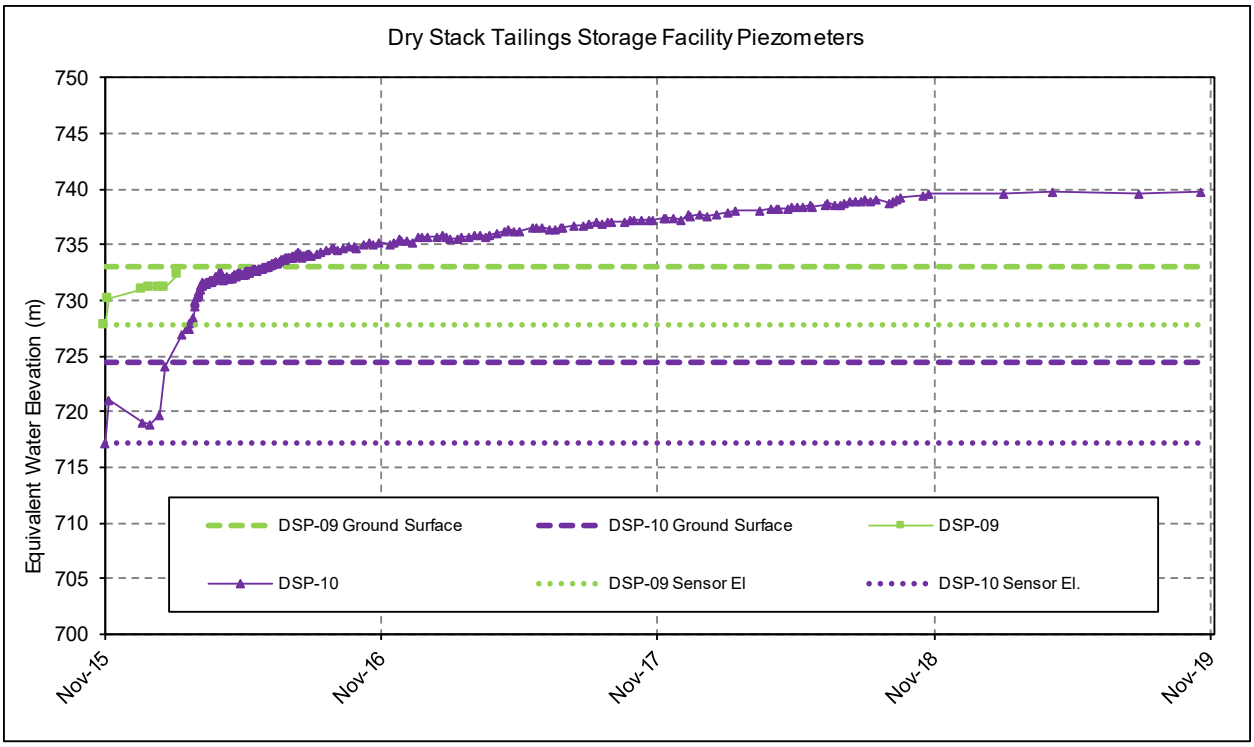


Figure 6-5: DSTSF Piezometer Data – DSP-09 and DSP-10 (2015-2019)

6.4.2 Southwest Dump Piezometers

Data collected from Southwest Dump vibrating wire piezometers are presented in Figure 6-6. Sensors SDP-3A and SDP-3B are reading negative pressures and have not been included in the figure. Data are collected quarterly. Data indicates stable conditions with some seasonal changes in pore pressure in 2019.

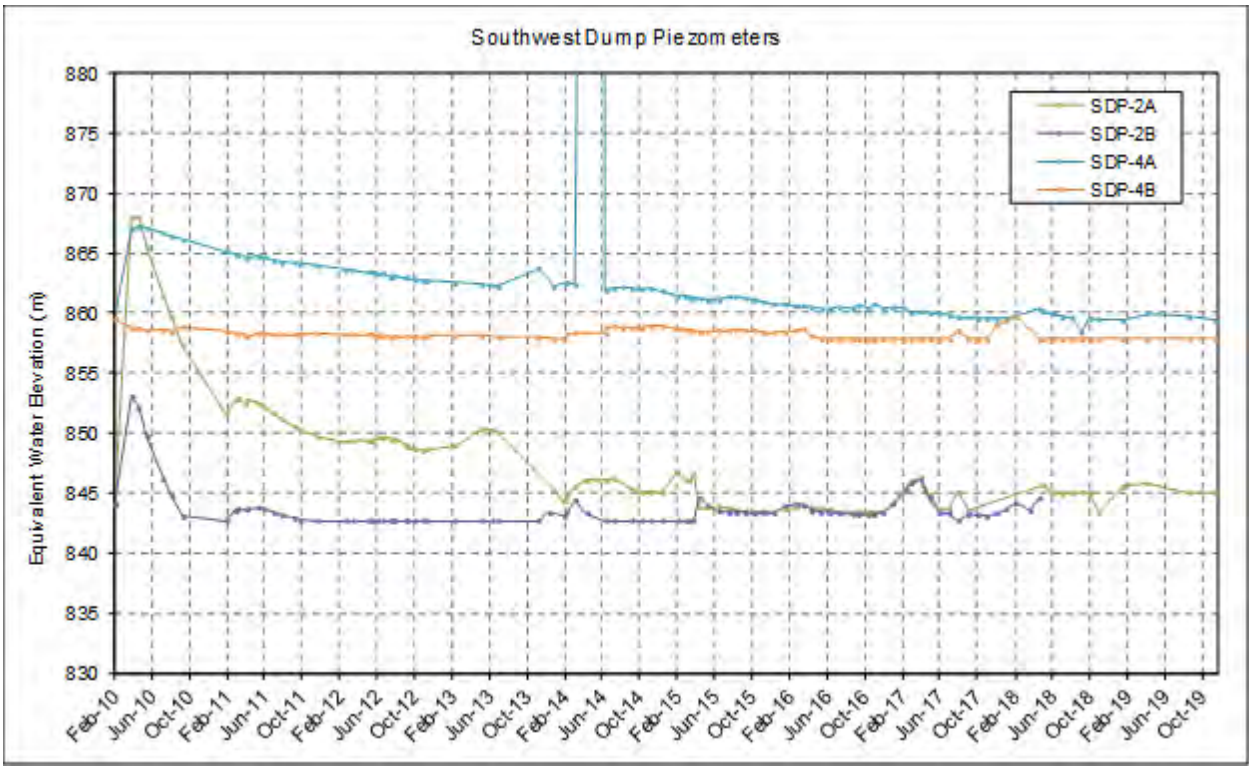


Figure 6-6: Southwest Dump Piezometer Data (2010-2019)

6.4.3 Water Storage Pond Dam Piezometers

Data collected from WSP Dam vibrating wire piezometers are presented in Figure 6-7. WDP-2, WDP-3, WDP-5, and WDP-11 are reading negative pressures and have not been included in the figure. Data are collected monthly. Pressures in 2019 generally followed the trend of the water level in the water storage pond as in previous years.

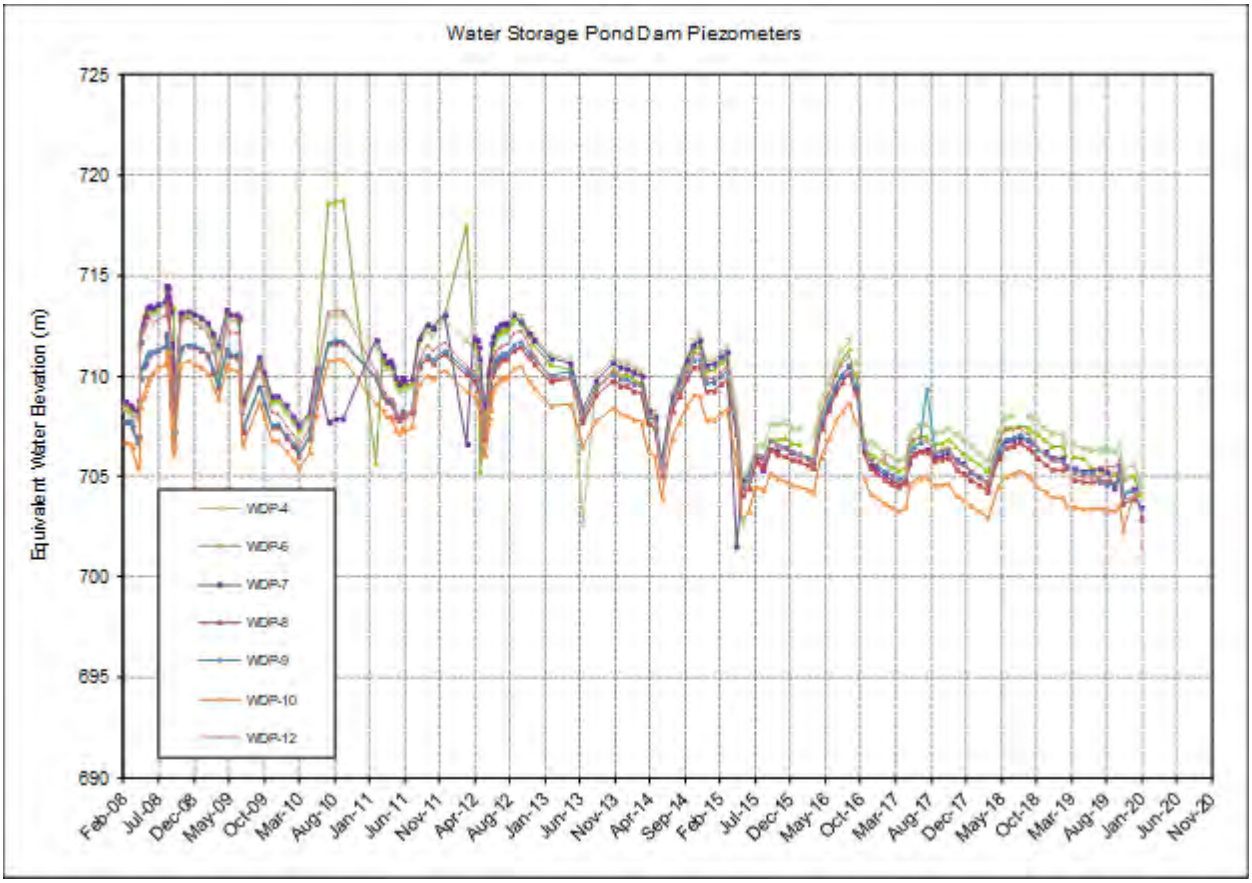


Figure 6-7: WSP Dam Piezometer Data (2008-2019)

6.5 Ground Temperature Cables

There are currently 22 operating thermistors (ground temperature cables) installed on site, listed in Table 6-41. There were no changes to the operational status of any of the existing thermistors in 2019. Summaries of data collected from each thermistor are contained in the following sections.

Table 6-41: Thermistor Summary (2019)

Thermistor	Location	Operational Status
A2T-1	DSTSF	Operational
DST-10	DSTSF	Operational
DST-11	DSTSF	Operational
DST-13	DSTSF	Operational
DST-14	DSTSF	Operational
DST-15	DSTSF	Operational
MW-11-02	Ridgetop	Operational
MW-11-03	Ridgetop	Operational
SDT-1	Southwest Dump	Operational
SDT-2	Southwest Dump	Operational
SDT-3	Southwest Dump	Operational
SDT-4	Southwest Dump	Operational
WDT – 1	Water Storage Pond Dam	Operational
WDT – 2	Water Storage Pond Dam	Operational
WDT – 3	Water Storage Pond Dam	Operational
WDT – 4	Water Storage Pond Dam	Operational
WDT – 5	Water Storage Pond Dam	Operational
WDT – 6	Water Storage Pond Dam	Operational
WDT – 7	Water Storage Pond Dam	Operational
WDT – 8	Water Storage Pond Dam	Operational

6.5.1 DSTSF Thermistors

Data collected from DSTSF thermistors are presented in Figure 6-8 through Figure 6-13. Data are collected quarterly. No major changes to ground temperatures at the DSTSF were observed in 2017.

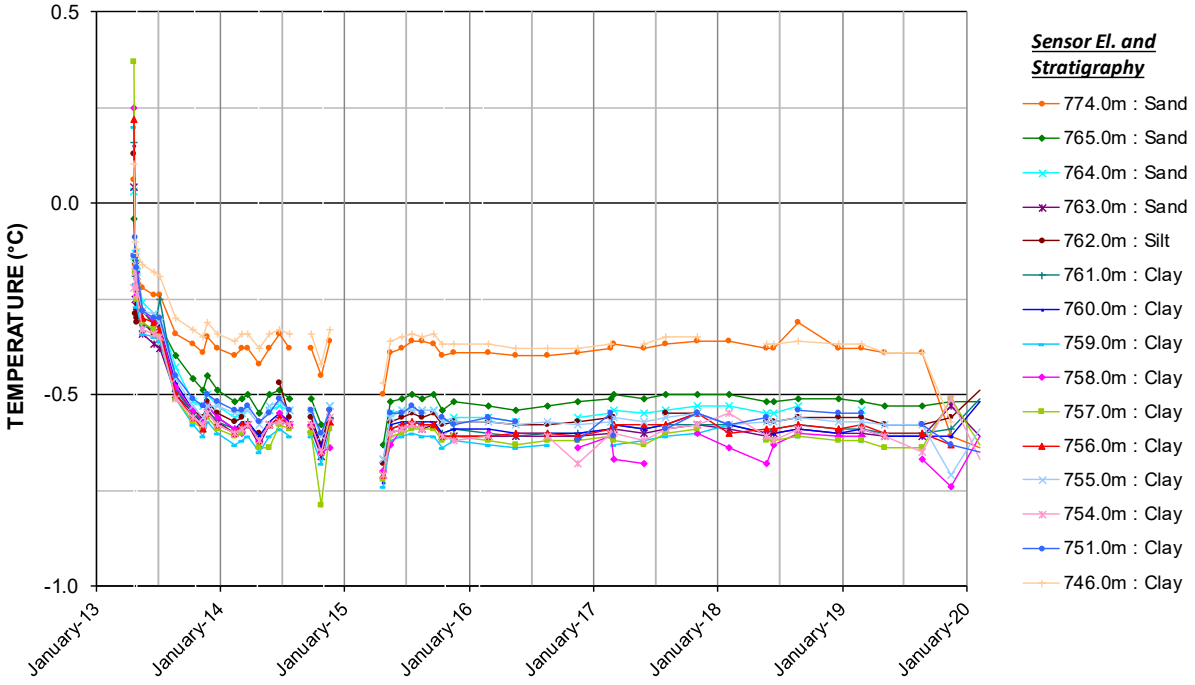


Figure 6-8: Thermistor DST-10 (2015-2019)

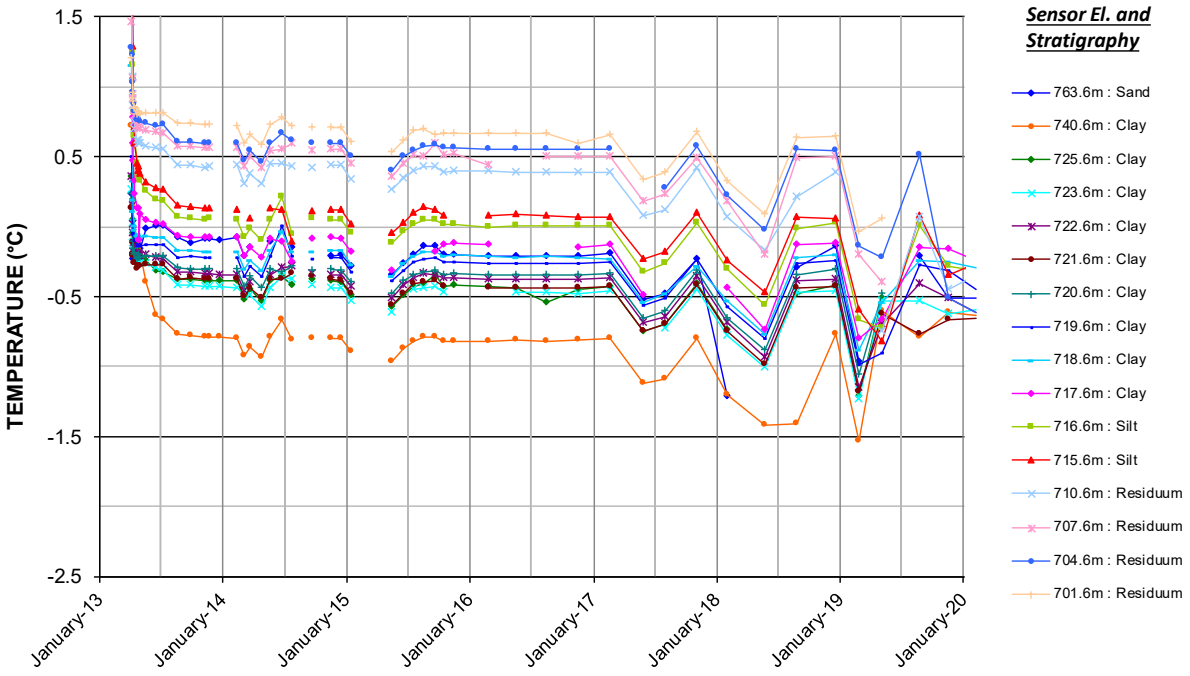


Figure 6-9: Thermistor DST-11 (2015-2019)

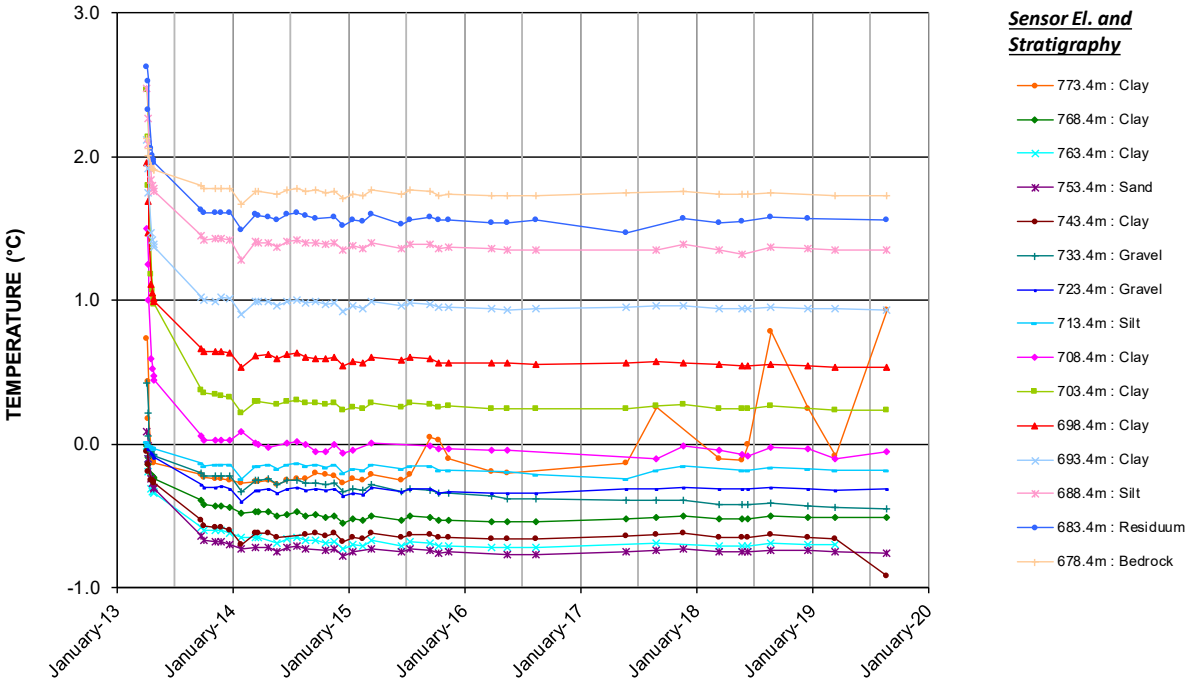


Figure 6-10: Thermistor DST-13 (2015-2019)

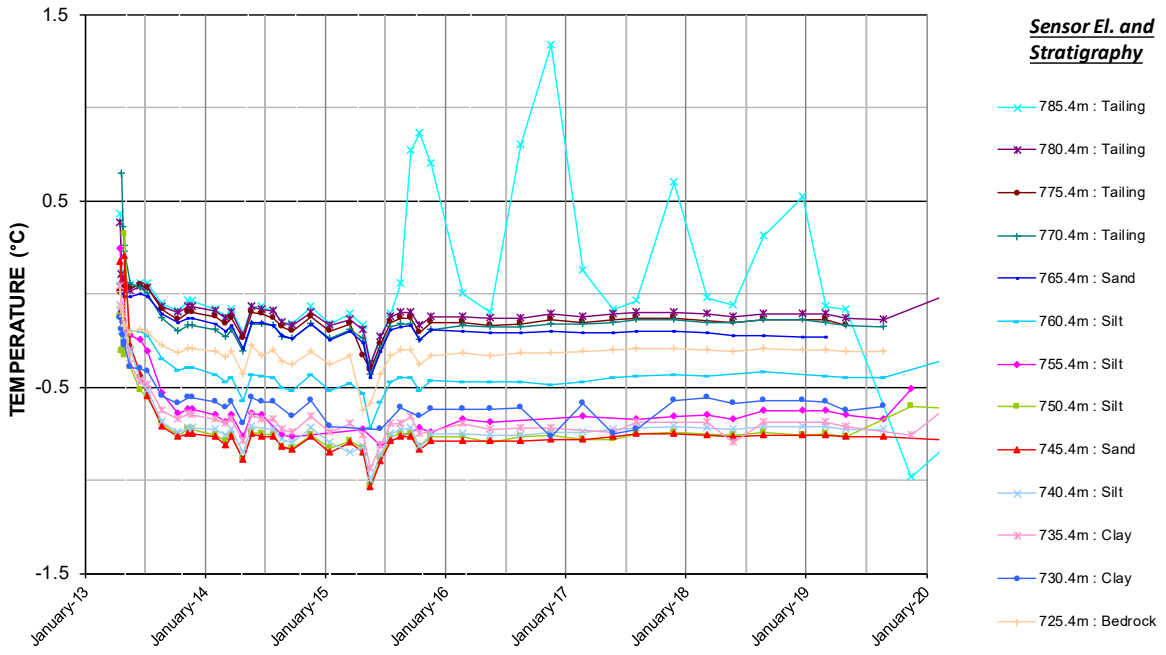


Figure 6-11: Thermistor DST-14 (2015-2019)

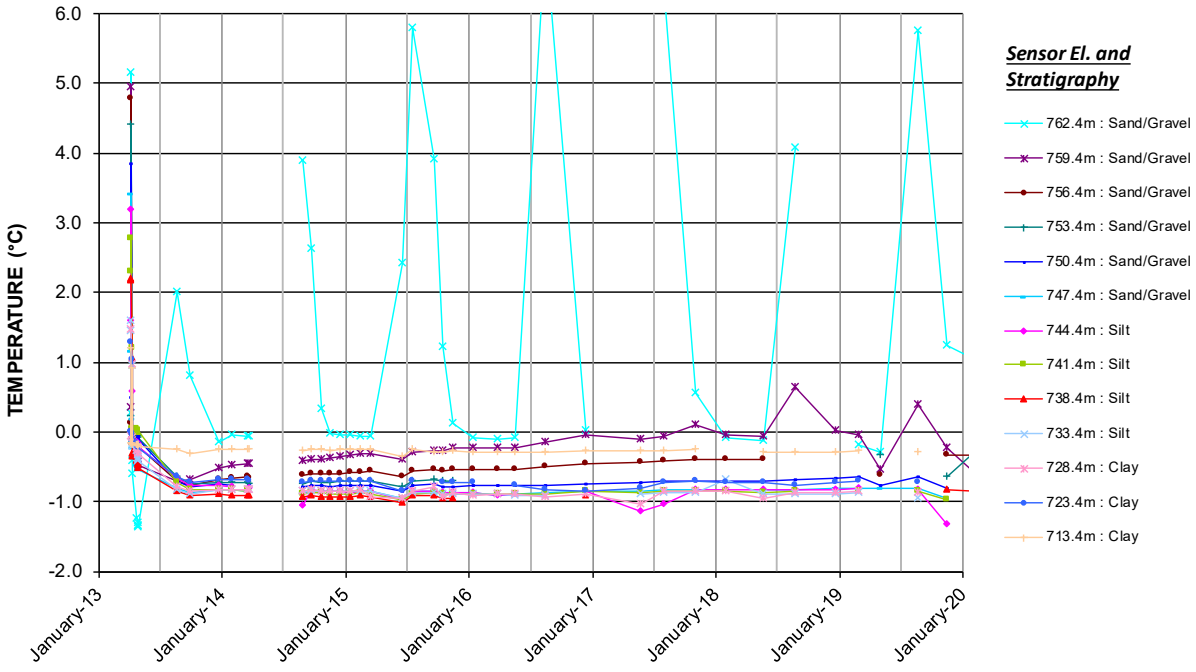


Figure 6-12: Thermistor DST-15 (2015-2019)

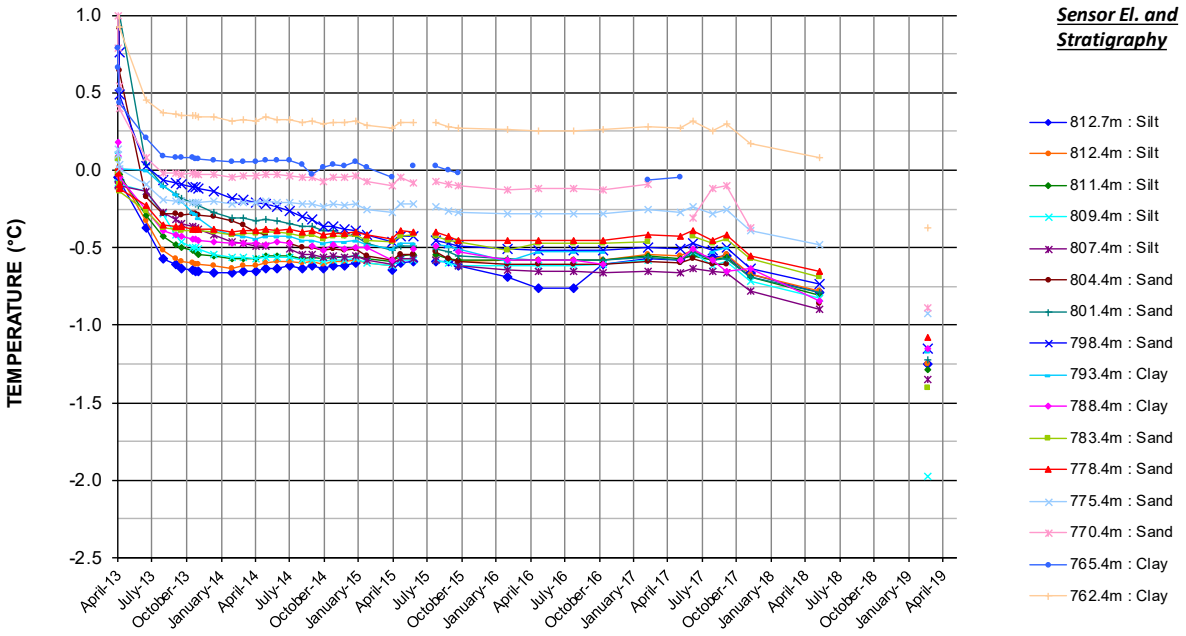


Figure 6-13: Thermistor AT2-1 (2015-2019)

6.5.2 Ridgetop Thermistors

Data collection has reduced to annually for both Ridgetop thermistors. No major changes to ground temperatures at the Ridgetop were observed in 2019.

6.5.3 Southwest Dump Thermistors

Data collected from SWD thermistors are presented in Figures 6-14 through 6-17. Data are collected quarterly. No major changes to ground temperatures at the SWD were observed in 2019.

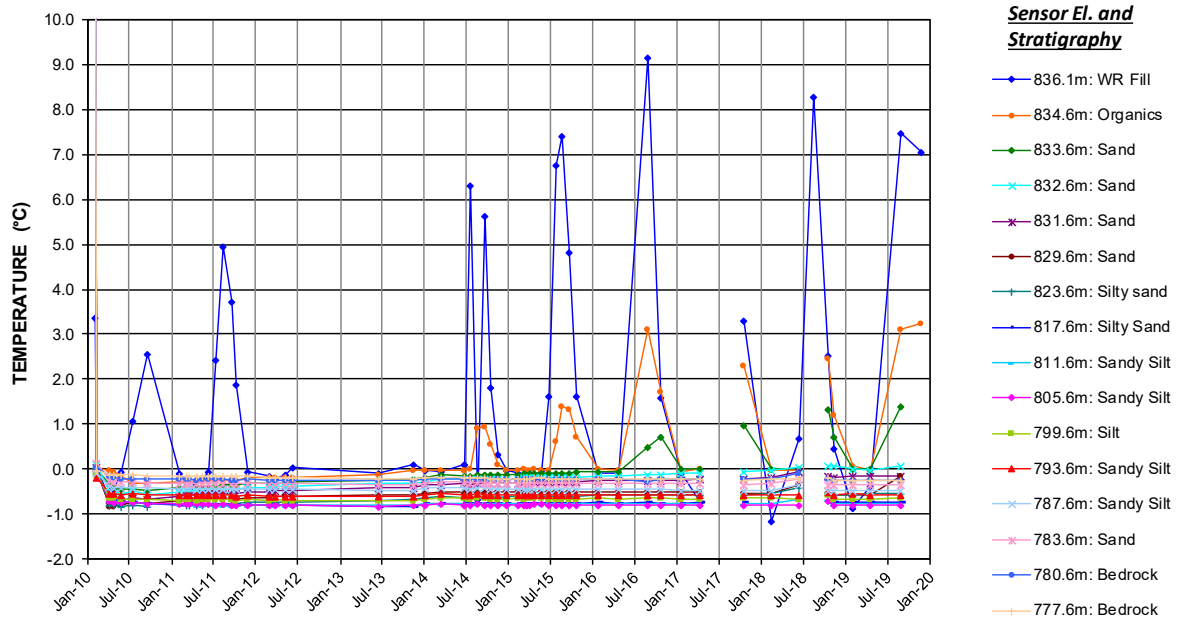


Figure 6-14: Thermistor SDT-1 (2015-2019)

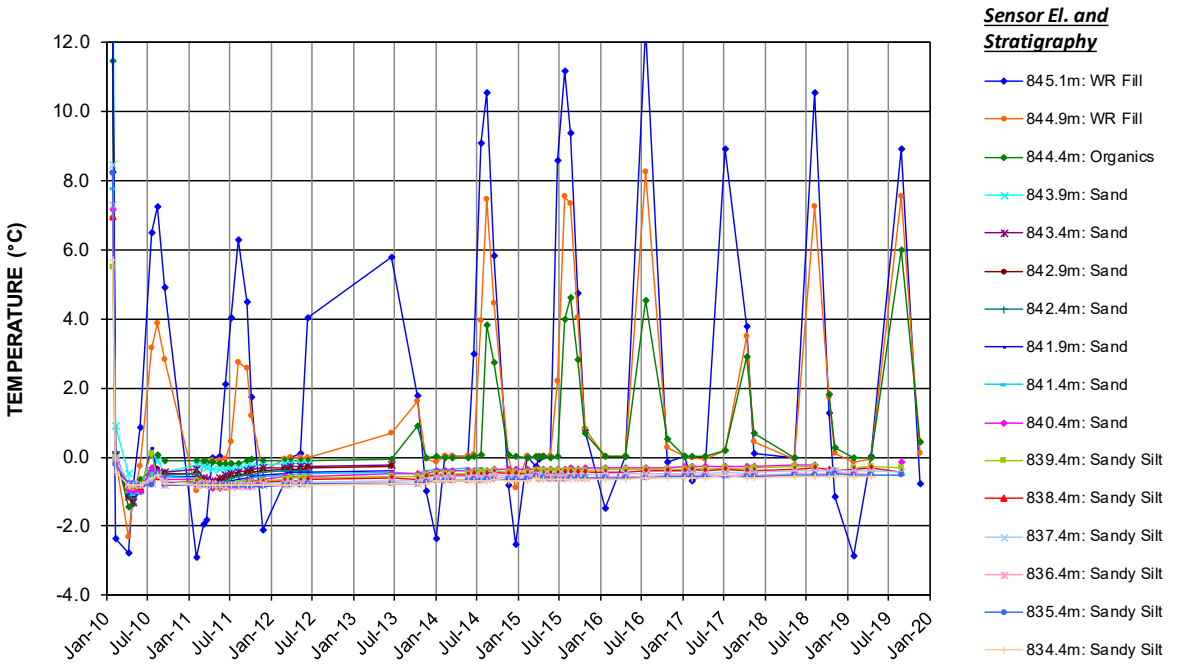


Figure 6-15: Thermistor SDT-2 (2015-2019)

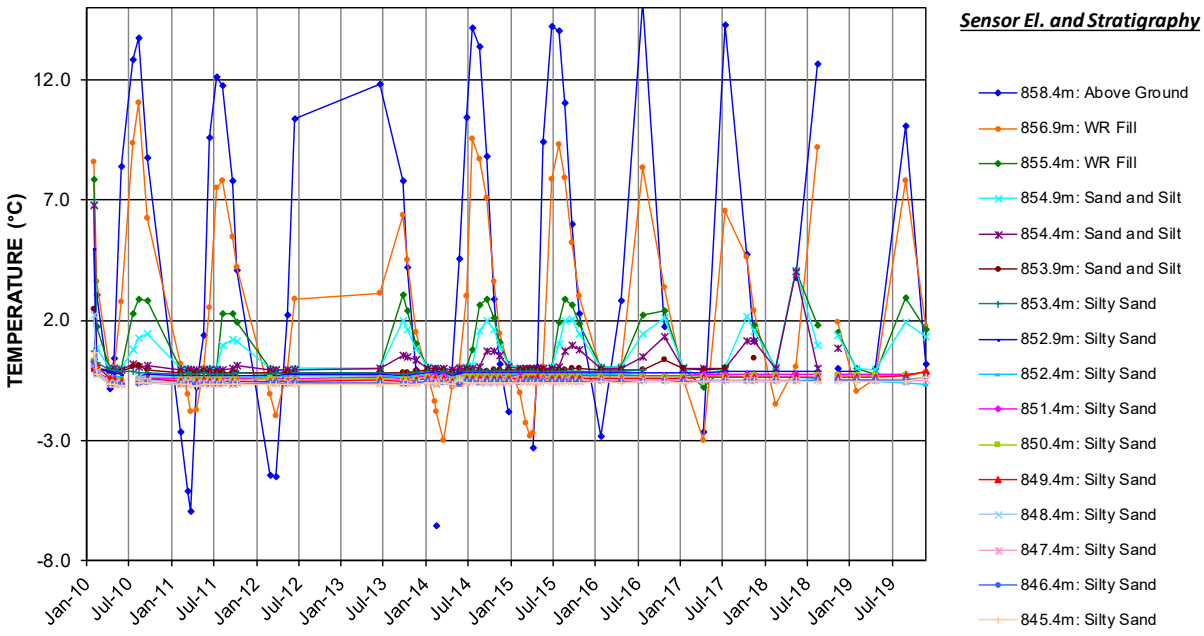


Figure 6-16: Thermistor SDT-3 (2015-2019)

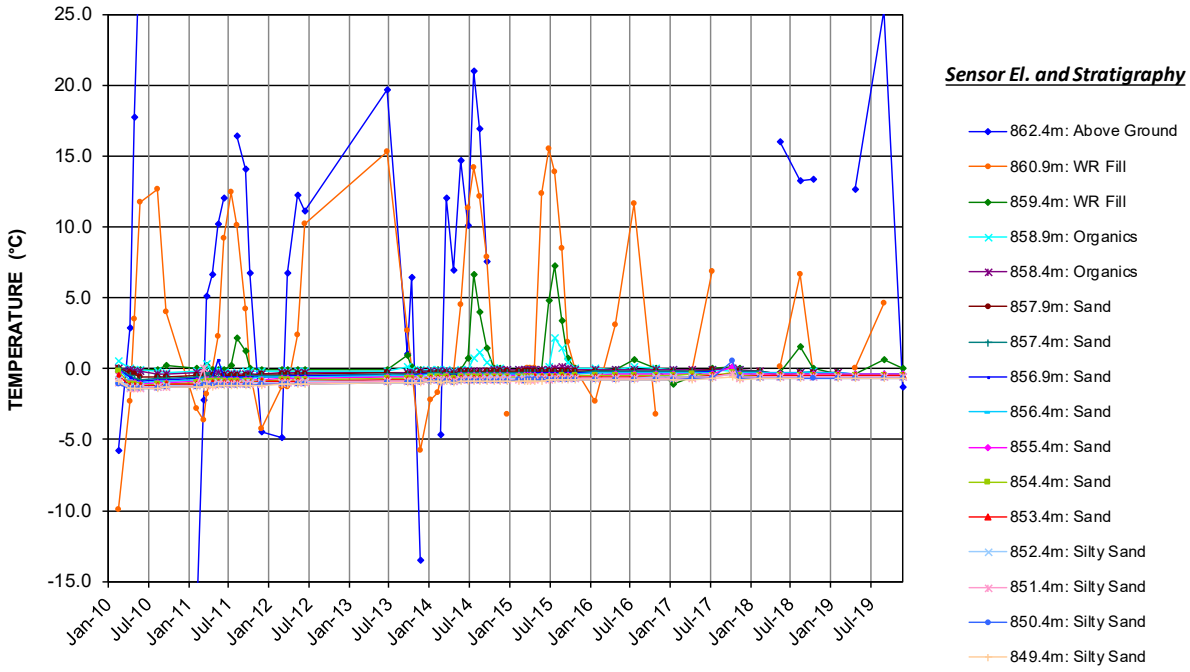


Figure 6-17: Thermistor SDT-4 (2014-2019)

6.5.4 Water Storage Pond Dam Thermistors

Data are collected monthly from all water retention dam thermistors. All thermistors continue to show temperatures well above zero since installation.

7 Seepage Water Quality Monitoring Program

Minto Mine implements a Seepage Monitoring Plan (SMP) to assess acid rock drainage and metal leaching conditions from several sources, including: pit wall seepage, ore stockpile areas, overburden dumps, waste rock dumps, DSTSF, Mill Valley Fill Extension 1 and 2, the mill area and other seepage locations.

Seepage monitoring conducted in 2019 was carried out in accordance with the EMSRP. The EMSRP states that seepage surveys will be conducted twice a year, during spring runoff and in early fall, by walking the toe of each waste dump, stockpile or other areas of interest. The survey route for each seepage monitoring event are recorded using the tracking function of a GPS. A map showing the 2019 survey routes and monitoring locations can be found in Figure 7-1.

WUL QZ14-031 identifies a Surface Water Surveillance Program which requires regular monitoring of seepage at several permanent seepage water quality stations. These stations include: W8 (Destroyed in 2017), W8A, W17, (W36, W37 – destroyed in 2016), and W62. Prior to WUL QZ14-031, Minto operated under WUL QZ96-006 which included seepage monitoring sites W32, W38, W39 and W40 in the Surface Water Surveillance Program. The water quality results for these permanent seepage quality stations are additionally reported to the Yukon Water Board (YWB) monthly. Other seepage sites that have been located have been recorded by GPS to ensure continued monitoring. These additional sites are visited during the spring and fall and, if water is present, a sample is collected. Substantial variability in flow presence and/or volume has been observed at many seepage sites. All lab results for 2019 spring and fall seepage monitoring programs are provided in Appendix D.

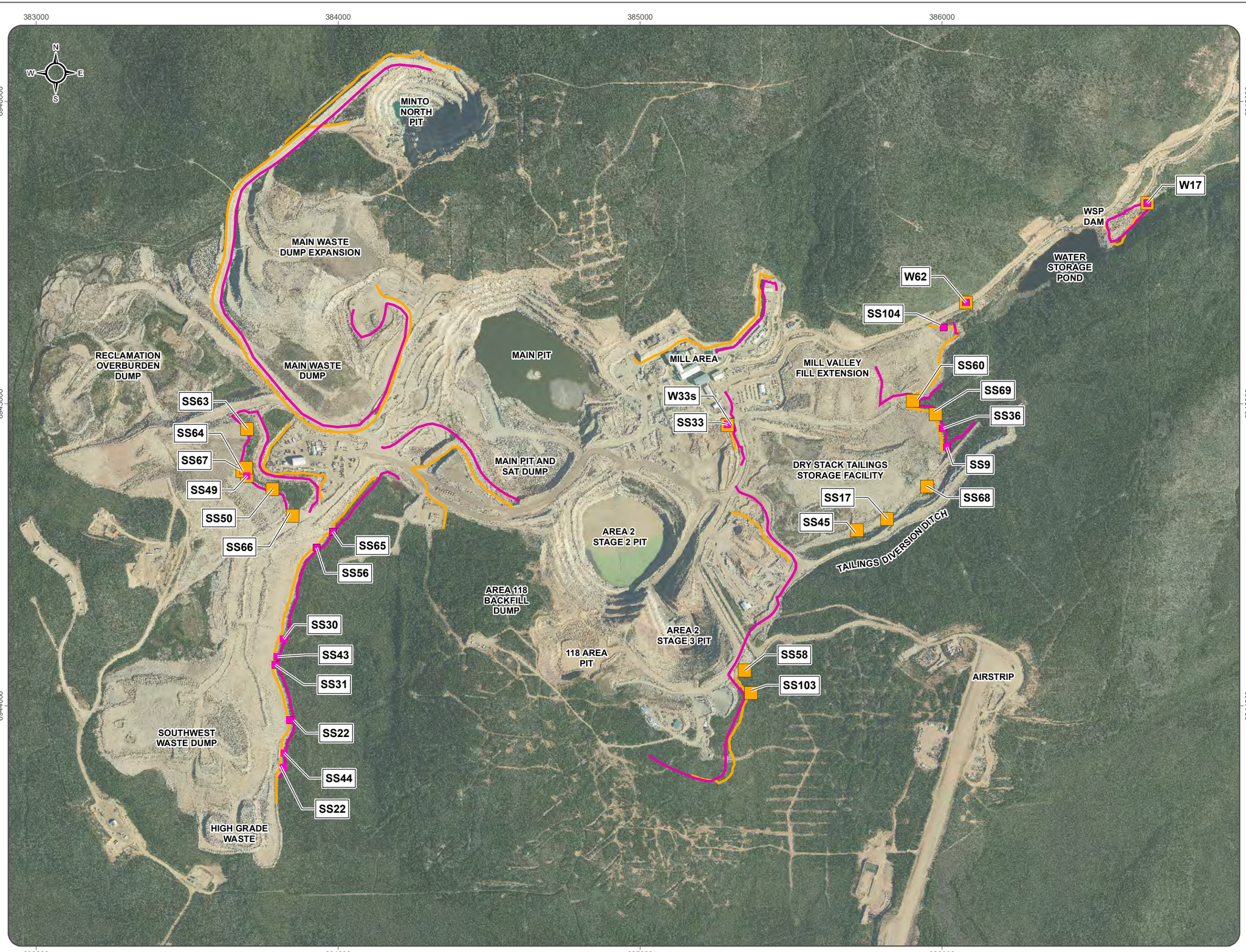
Seepage site locations are marked by GPS and data is stored in the Minto Mine Water Quality Database, along with results from WUL sampling stations. A GPS malfunction caused the loss of the new seepage sites waypoints and some of the tracks in 2019, such as SS53, SS66 to SS69, and SS103 to SS104. Though the area at which the seeps were known, the exact GPS location is lost. Minto Environment hopes to be able to recognize the new sites identified in 2019 during the spring 2020 seepage survey. Minto will continue to monitor these seepage areas and monitor the site workings for seeps on a semi-annual basis.

Observations from the 2019 Seepage Monitoring Program indicate that many seepage sites identified are seasonally variable. It has also been observed that weather patterns have an impact, where snow melt or rain contribute to observable flows that are absent during warm, dry weather. Analysis of seepage results and water quality analysis assists in improving understanding of water chemistry, load, and water balance issuing from waste dumps, overburden dumps, ore stockpiles, and tailings facilities.

Constituents of concern, namely dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, ammonia, nitrate, and nitrite have been graphed below for each site sampled. In the event of results below the detection limit, the limit is plotted and the results are presented with a 0.5 factor. In cases where a graph's trend is skewed due to visual outliers (i.e. data points that are larger than the mean by an order of magnitude), a second graph with outliers removed is provided and labelled as "Reduced Concentration."

Per current EMSRP, field data and observations including coordinates, weather, field measurements (pH, conductivity and temperature), a sketch of the location, water conditions and colour of sediment and

number of filters used. The original field sheets are presented with the pictures that were obtained at each site in Appendix E.



MINTO MINE

SEEPAGE MONITORING PROGRAM
2019 ANNUAL REPORT

FIGURE 7-1

2019 SEEPAGE MONITORING PROGRAM

FEBRUARY 2020

MINTO EXPLORATIONS
A PEMBRIDGE RESOURCES COMPANY

- Spring 2019 Seepage Survey Monitoring Stations
- Fall 2019 Seepage Survey Monitoring Stations
- Spring 2019 Seep Survey Lines
- Fall 2019 Seep Survey Lines

1:12,000 *when printed on 11 x 17 inch paper*

0 200 400 600
Meters

ENSERO solutions

Aerial imagery obtained from Challenger Geomatics. Imagery acquired August 9rd 2017.

Datum: NAD 83 Projection: UTM Zone 8N

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7.1 Mill Valley Fill

The first phase of the Mill Valley Fill (MVF) was completed in 2012 and vertical culverts were installed at both W8 and W8A to enable water quality monitoring at these locations. Obtaining water samples at W8 has been sporadic since the installation of the vertical culvert. The last time this station produced water was in late 2013. The second phase of the Mill Valley Fill Extension was completed in early 2016. Additional extensions were added to the vertical culverts of W8 and W8A to preserve the sampling stations. In fall 2017, W8 culvert was covered during reclamation operations and could no longer be accessed. In 2019, W8A was collected until March and has since been dry. Water quality results for W8 and W8A are outlined in Figure 7-2 through 7-10 and include 2019 results as well as historic data for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

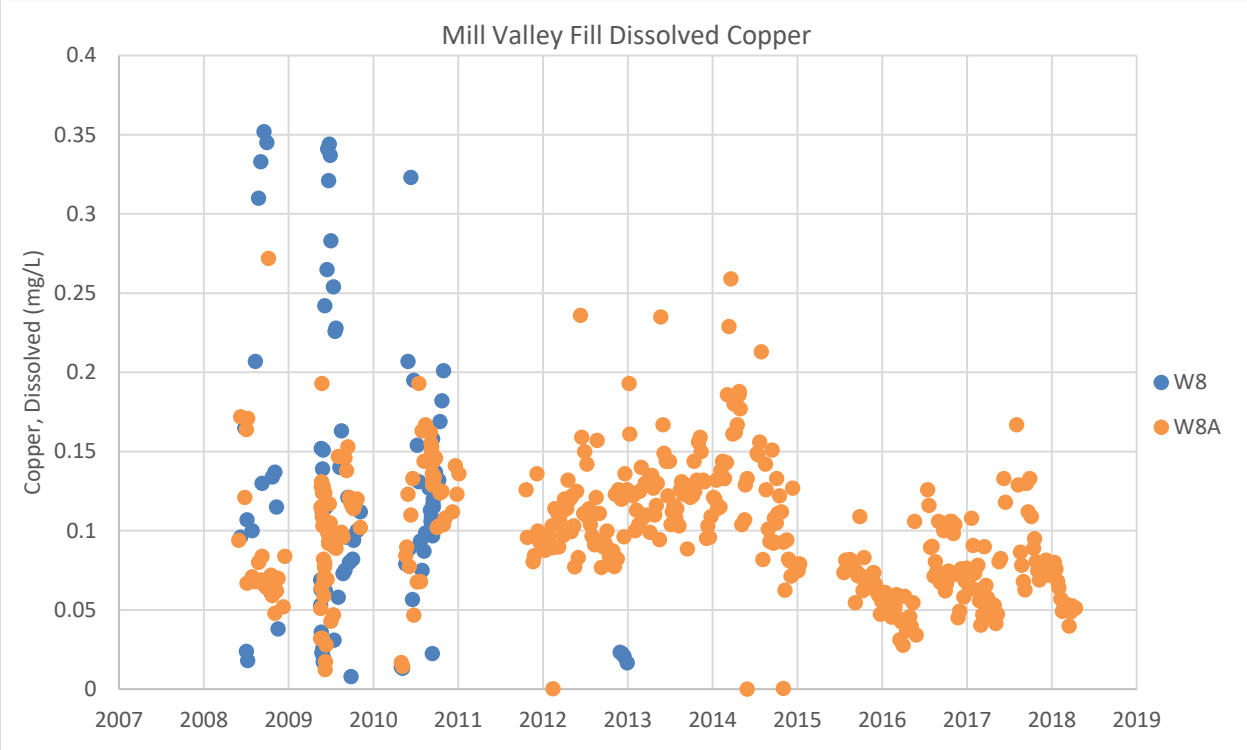


Figure 7-2: Mill Valley Fill Dissolved Copper

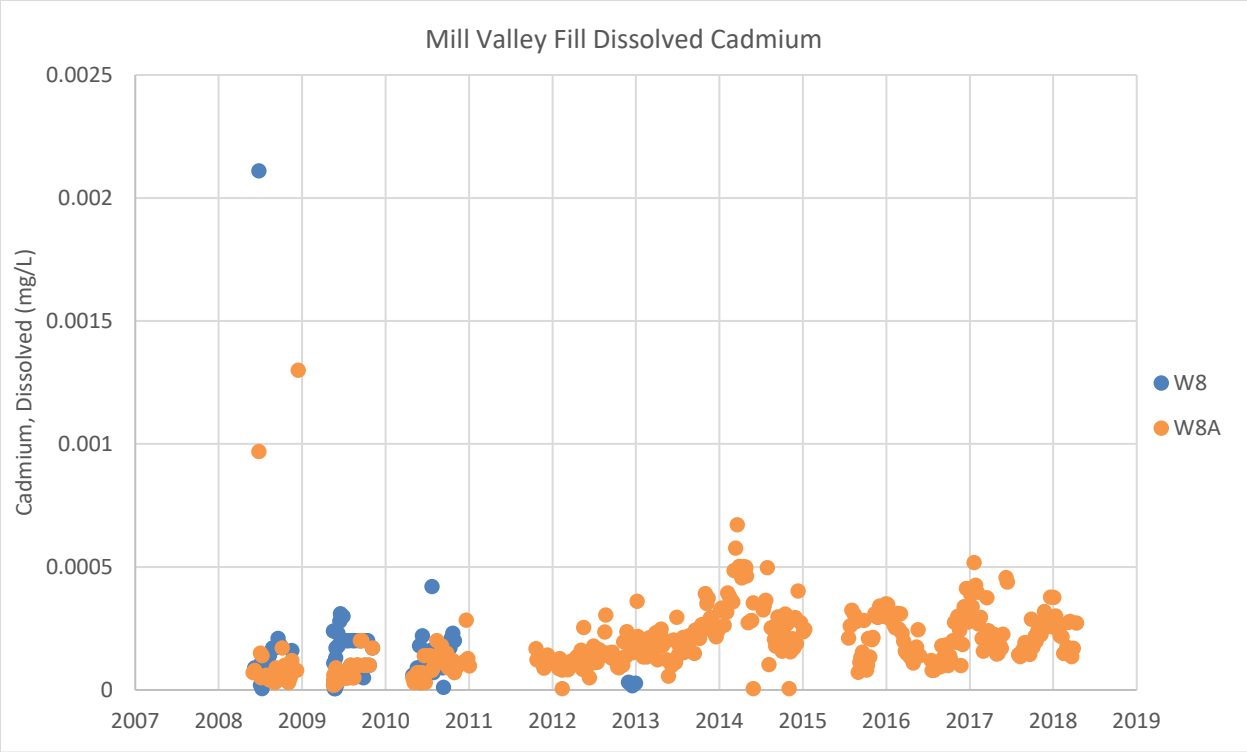


Figure 7-3: Mill Valley Fill Dissolved Cadmium

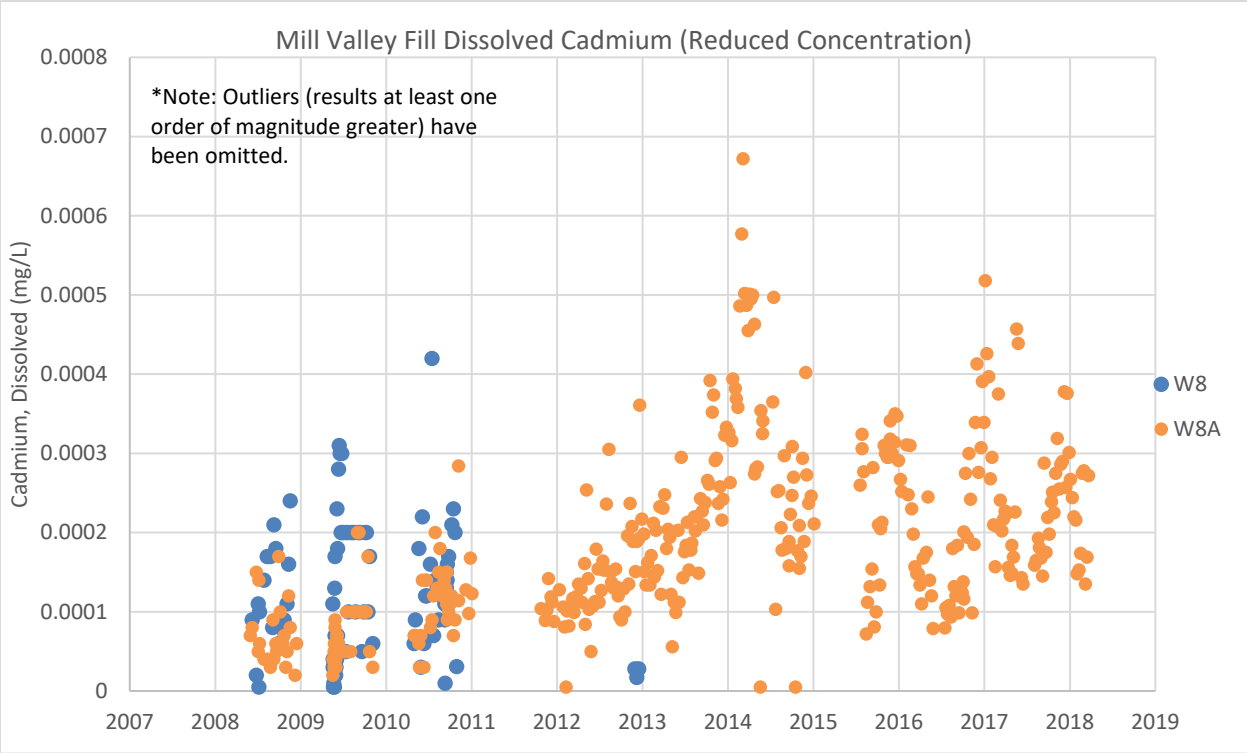


Figure 7-4: Mill Valley Fill Dissolved Cadmium (Reduced Concentration)

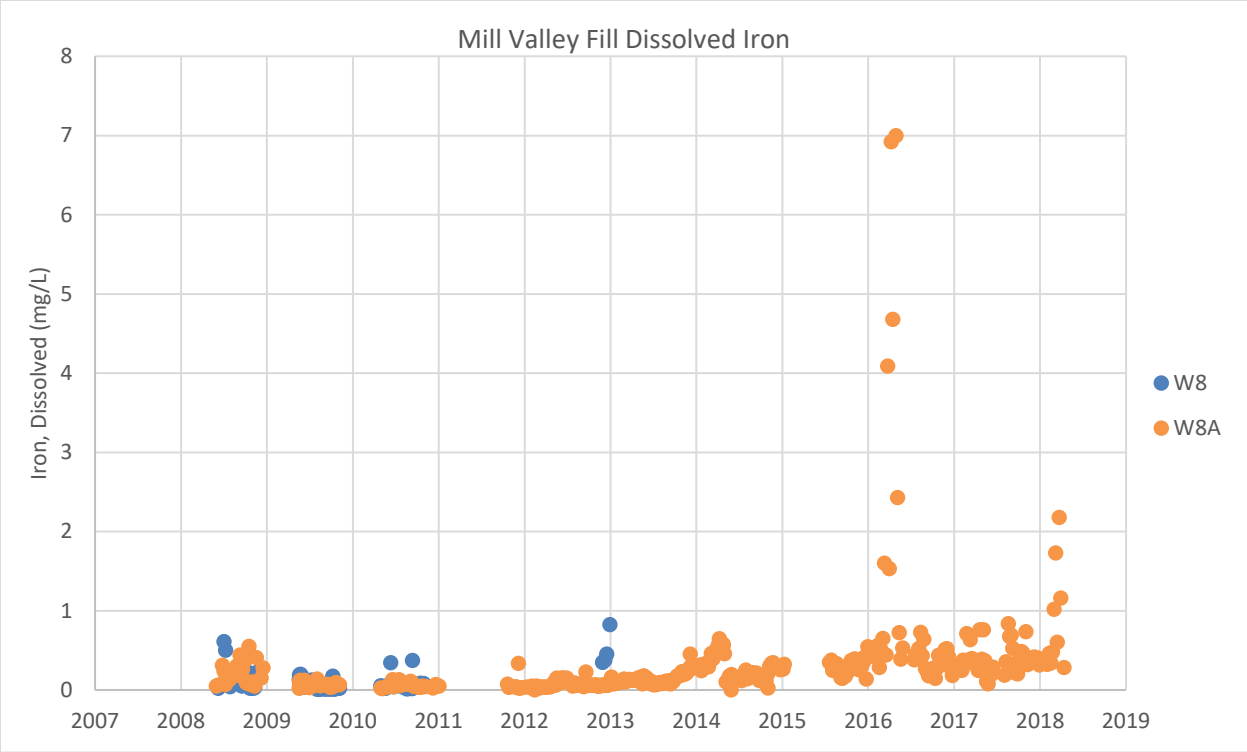


Figure 7-5: Mill Valley Fill Dissolved Iron

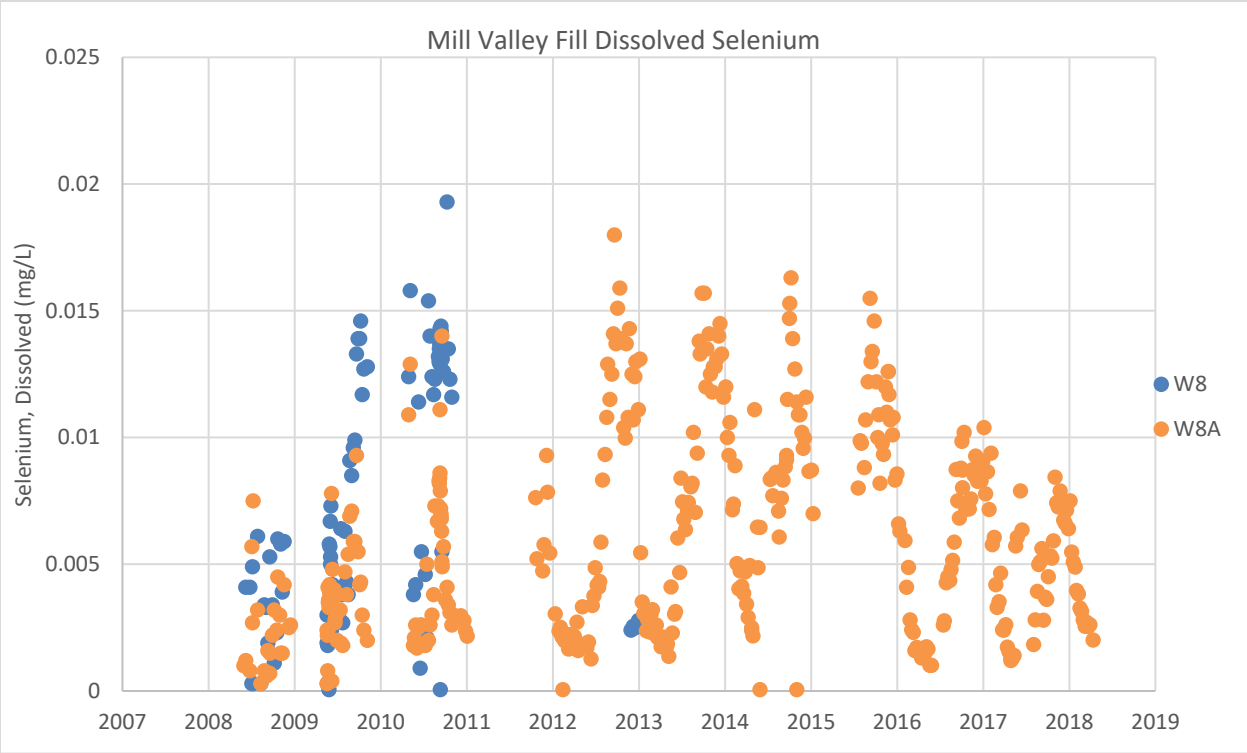


Figure 7-6: Mill Valley Fill Dissolved Selenium

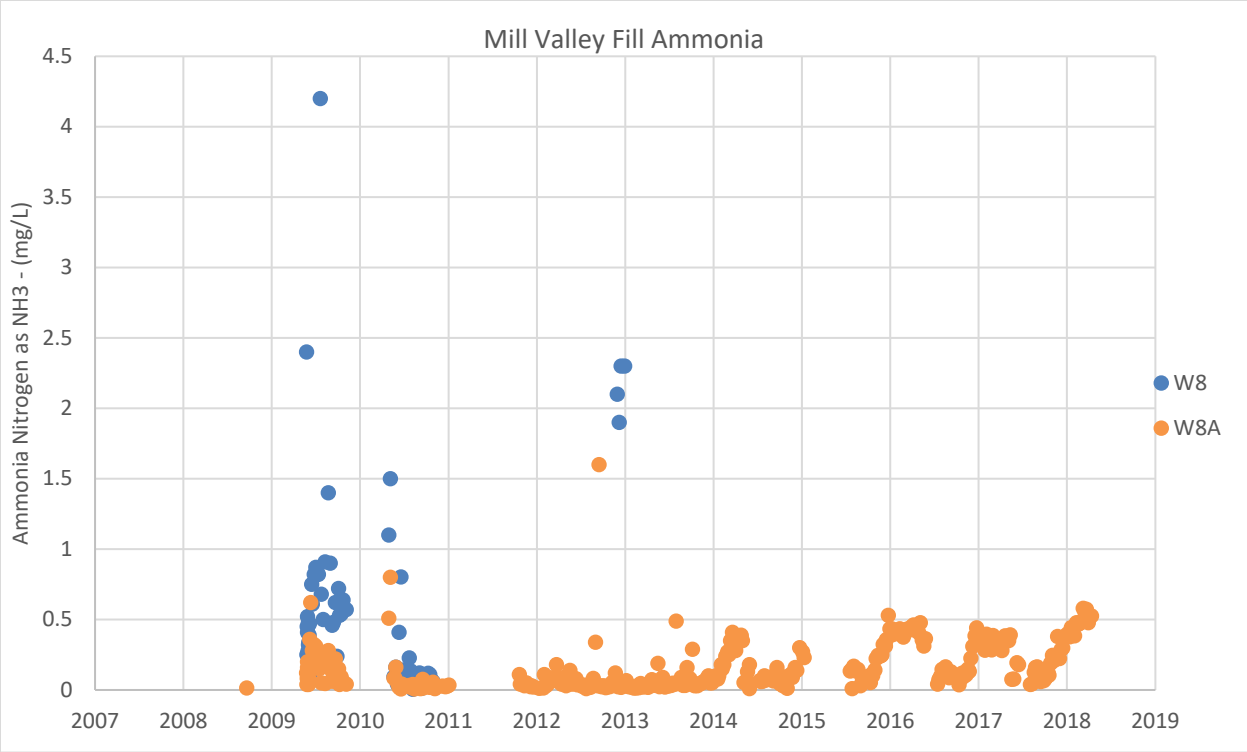


Figure 7-7: Mill Valley Fill Ammonia

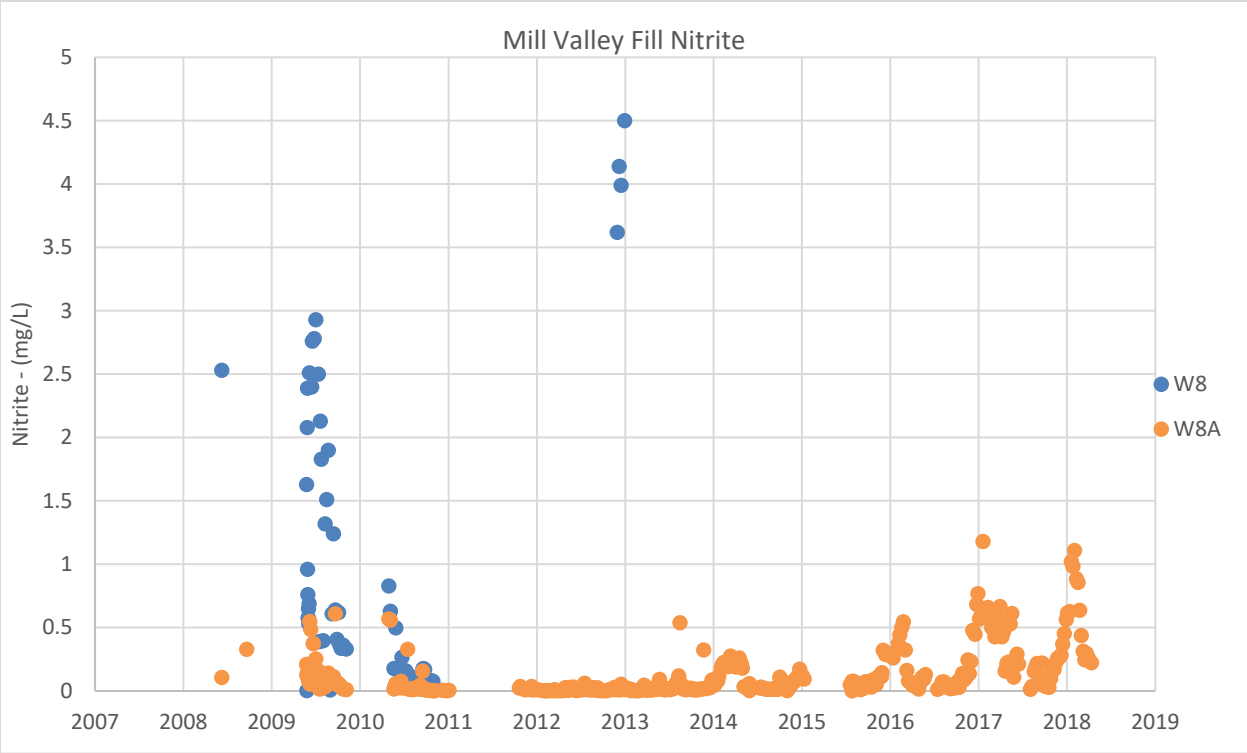


Figure 7-8: Mill Valley Fill Nitrite

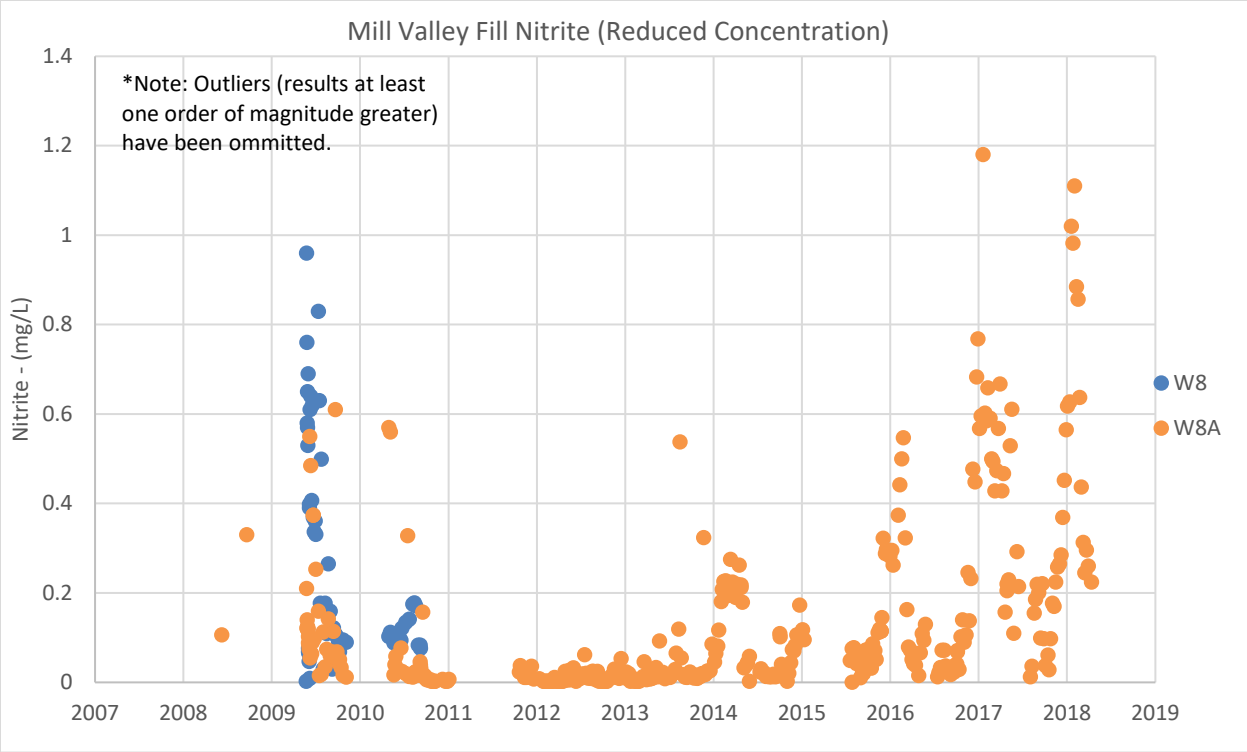


Figure 7-9: Mill Valley Fill Nitrite (Reduced Concentration)

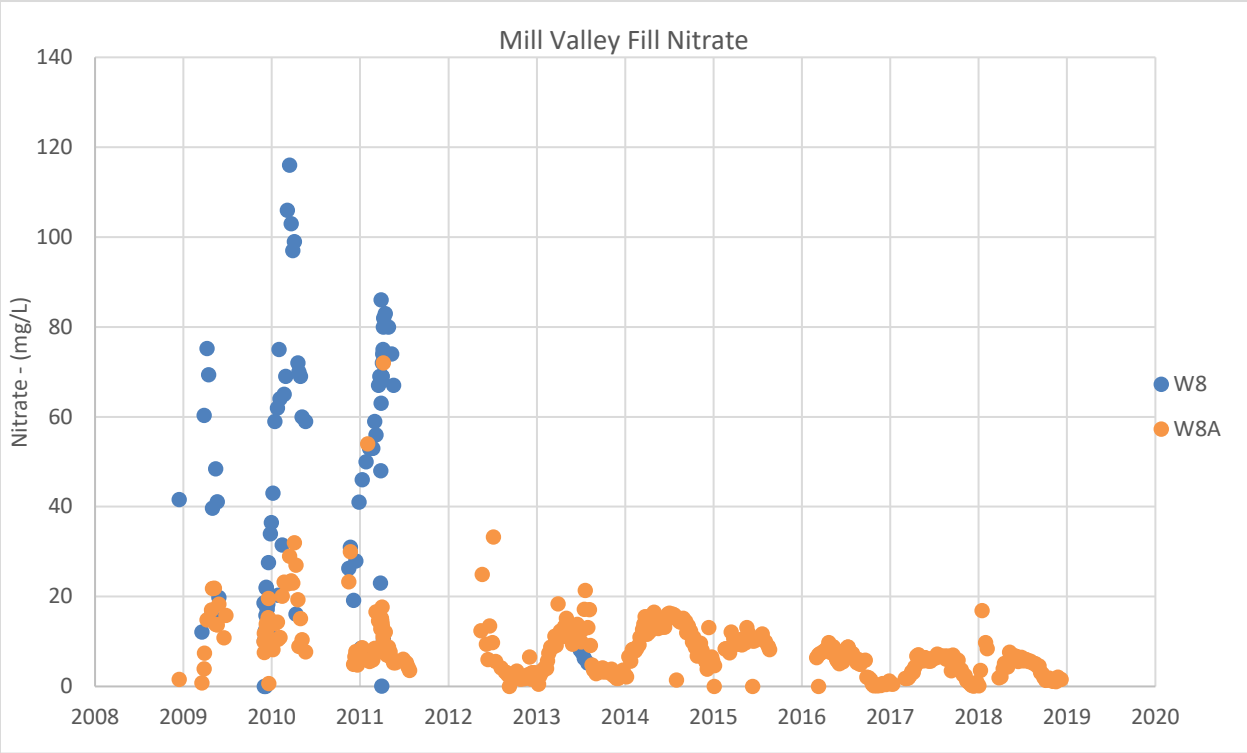


Figure 7-10: Mill Valley Fill Nitrate

7.2 Southwest Dump

Seepage samples were collected from the Southwest Dump area at sites SS22, SS30, SS31, SS43, SS44, SS52, SS56 and SS65 during the fall survey, no seeps were observed in the spring seepage survey. The ice-rich overburden dump was surveyed and in the spring, sites SS39, SS49, SS50, SS63 and SS64 additionally SS66 and SS67 are new seeps in the ice-rich overburden area. Due to GPS failure, the sites' locations were lost, Minto Environment is hoping to be able to identify them during the spring 2020 seepage survey.

Samples are taken within ±5m of the original GPS point. If there is no seepage within the 5m buffer, the site is considered dry during that sampling session.

Historical water quality results for W38 and W39, as well as W32 and W40, are presented in Figure 7-11 to 7-19. Historical data and 2019 seepage water quality results for SS1, SS13, SS21, SS22, SS28, SS29, SS30, SS31, SS39, SS43, SS44, SS48, SS49, SS50, SS51, SS52, SS54, SS556, SS57, SS65, SS66 and SS67 are summarized in Figure 7-20 to Figure 7-40. Data was separated between the north (SS1, SS21, SS28, SS29, SS54, SS56, SS65), the south end of the southwest dump (SS13, SS22, SS30, SS31, SS43, SS44, SS51, SS52, and SS57) and the ice rich overburden dump seep (SS48, SS49, SS50, SS63, SS64, SS66 and SS67). The figures include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

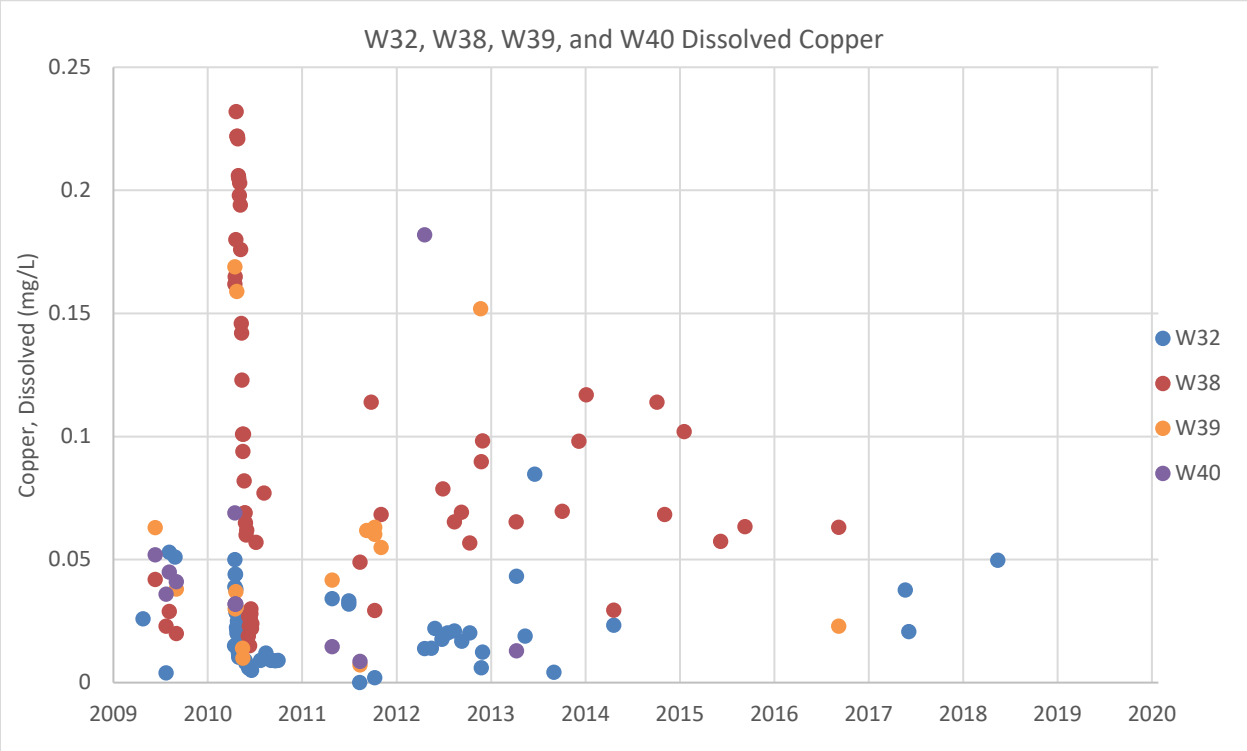


Figure 7-11: W32, W38, W39, and W40 Dissolved Copper

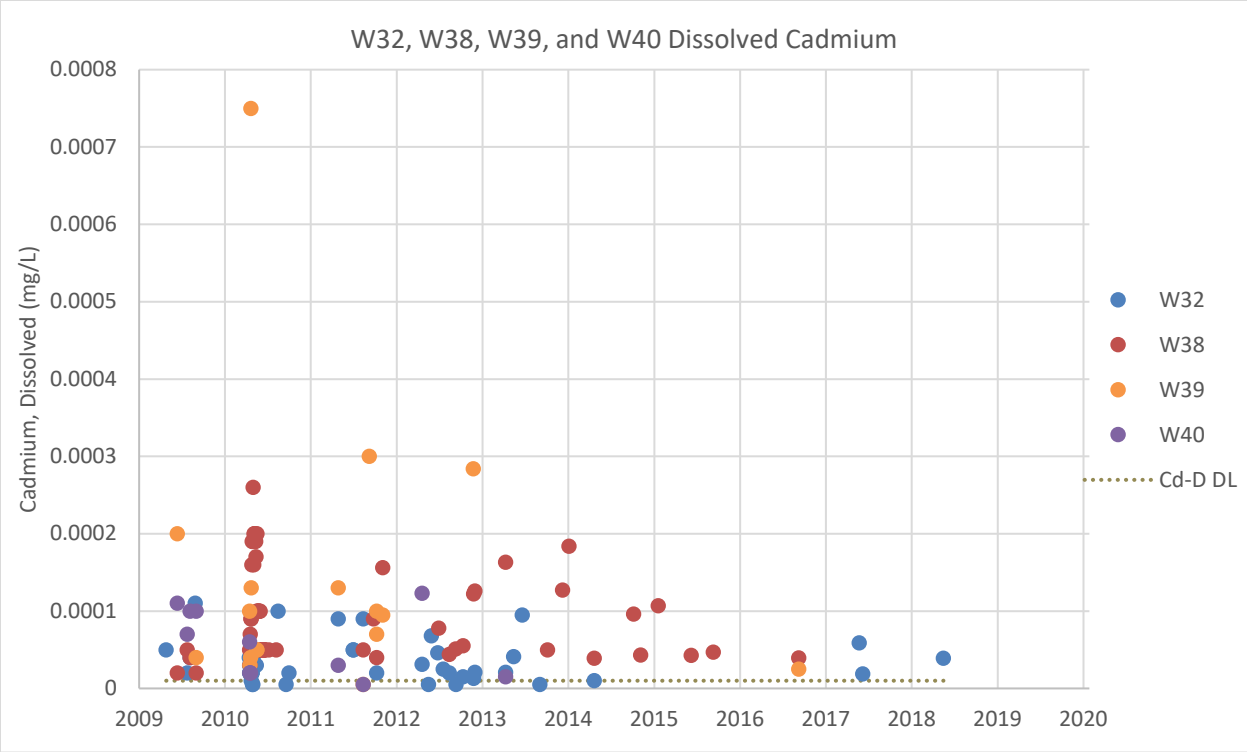


Figure 7-12: W32, W38, W39, and W40 Dissolved Cadmium
DL is Analytical Detection Limit

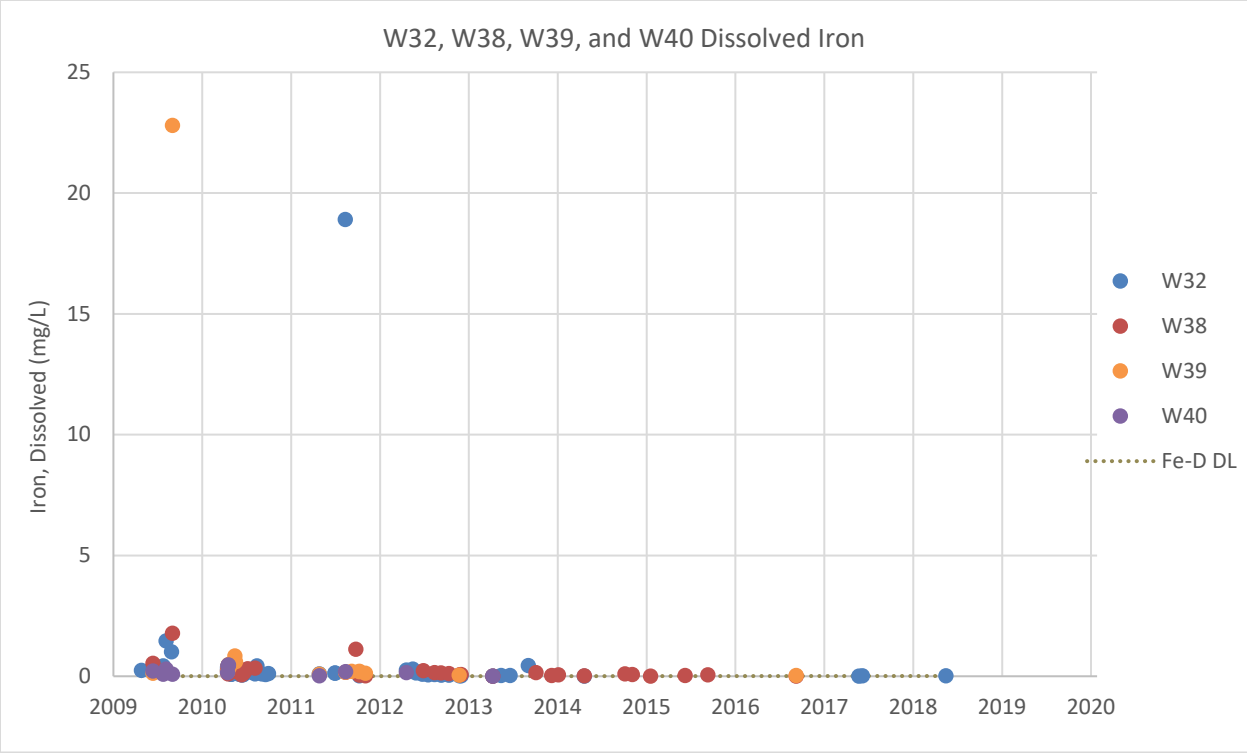


Figure 7-13: W32, W38, W39, and W40 Dissolved Iron
DL is Analytical Detection Limit

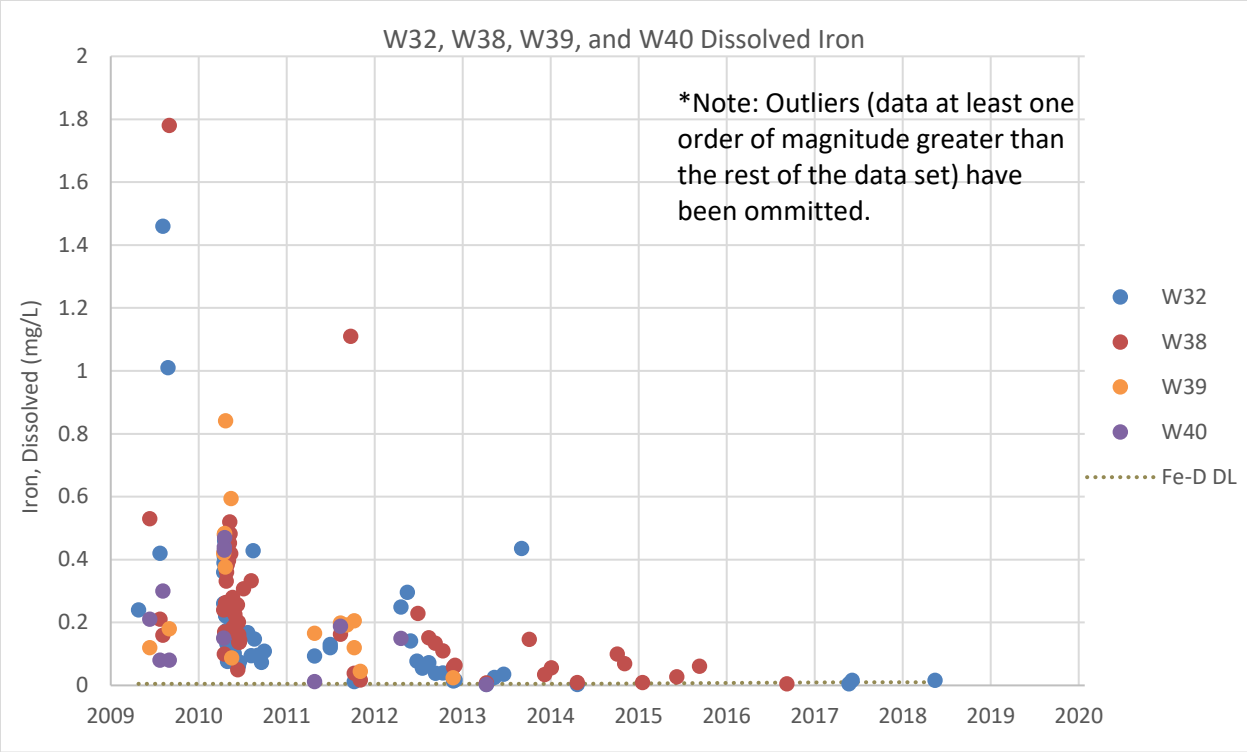


Figure 7-14: W32, W38, W39, and W40 Dissolved Iron (Reduced Concentration)

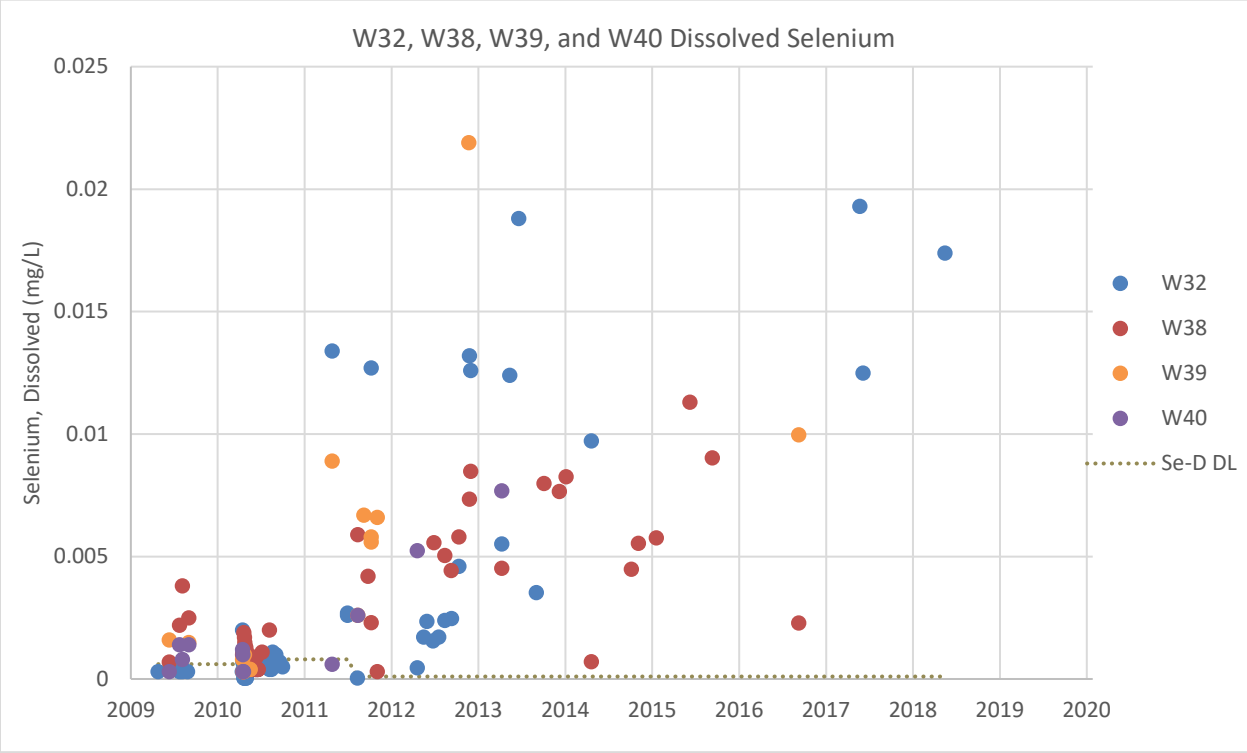


Figure 7-15: W32, W38, W39, and W40 Dissolved Selenium

DL is Analytical Detection Limit

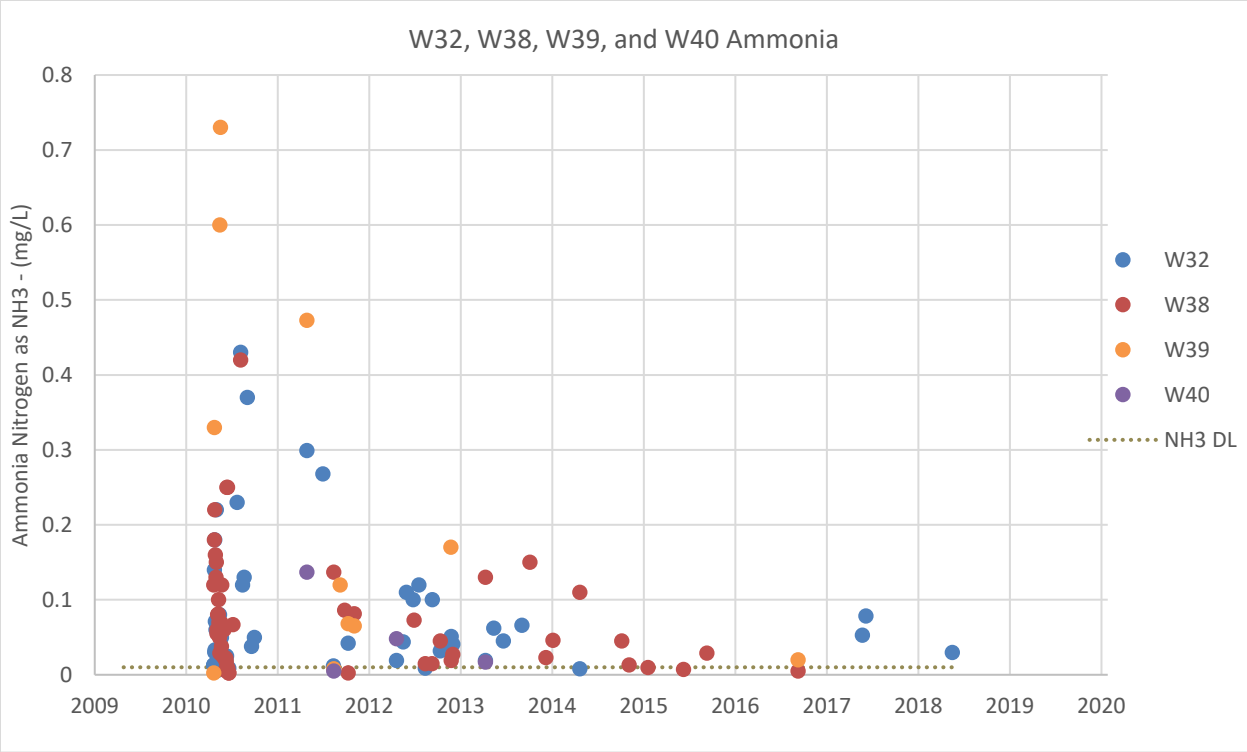


Figure 7-16: W32, W38, W39, and W40 Ammonia
DL is Analytical Detection Limit

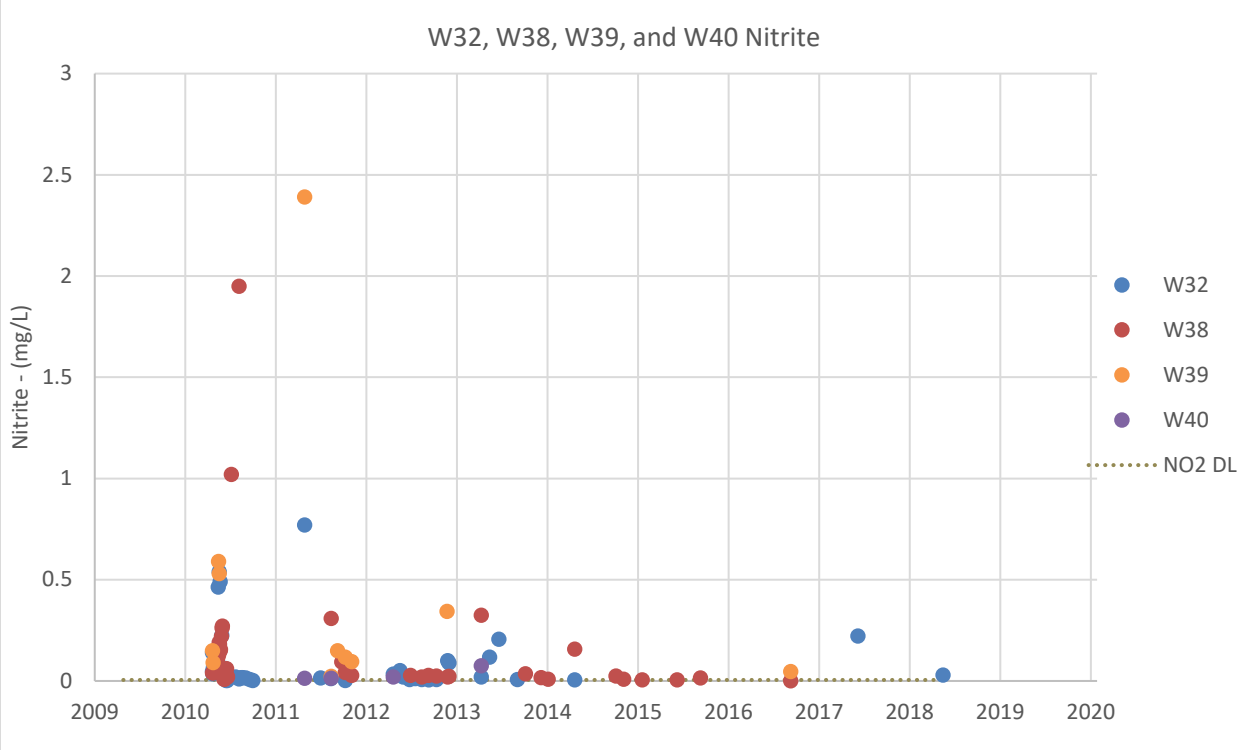


Figure 7-17: W32, W38, W39, and W40 Nitrite
DL is Analytical Detection Limit

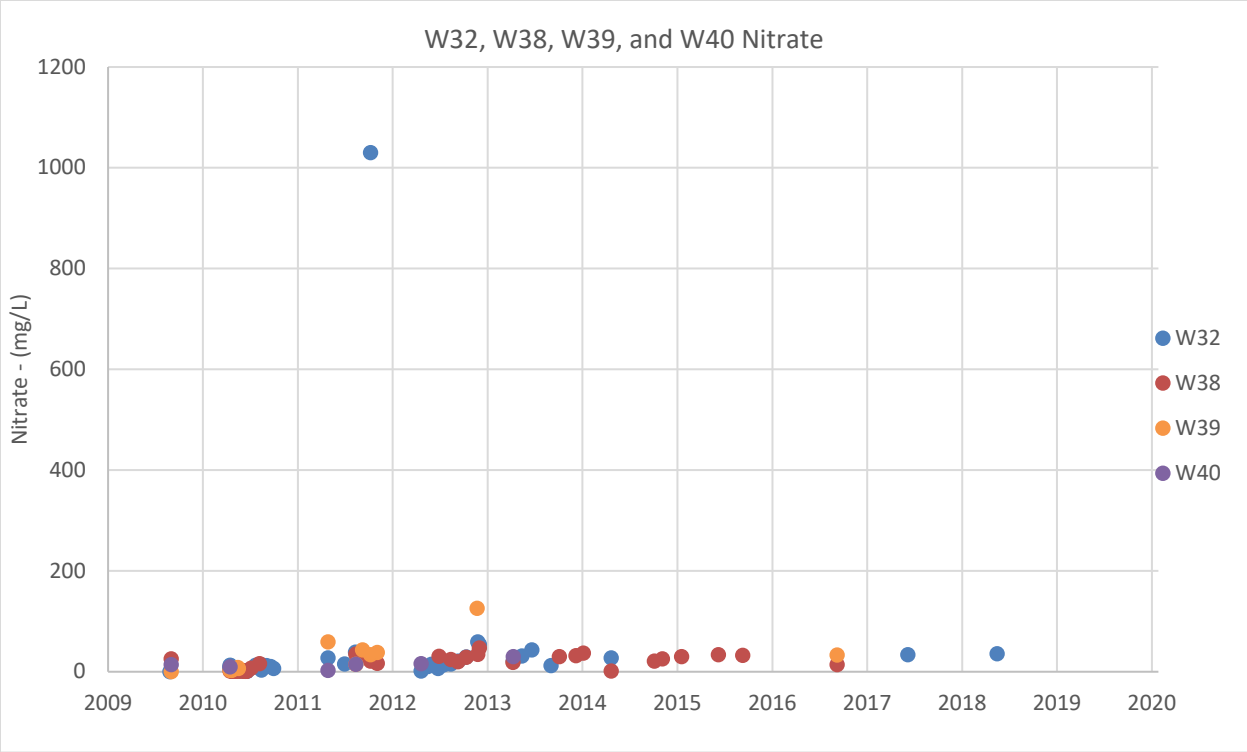


Figure 7-18: W32, W38, W39, and W40 Nitrate

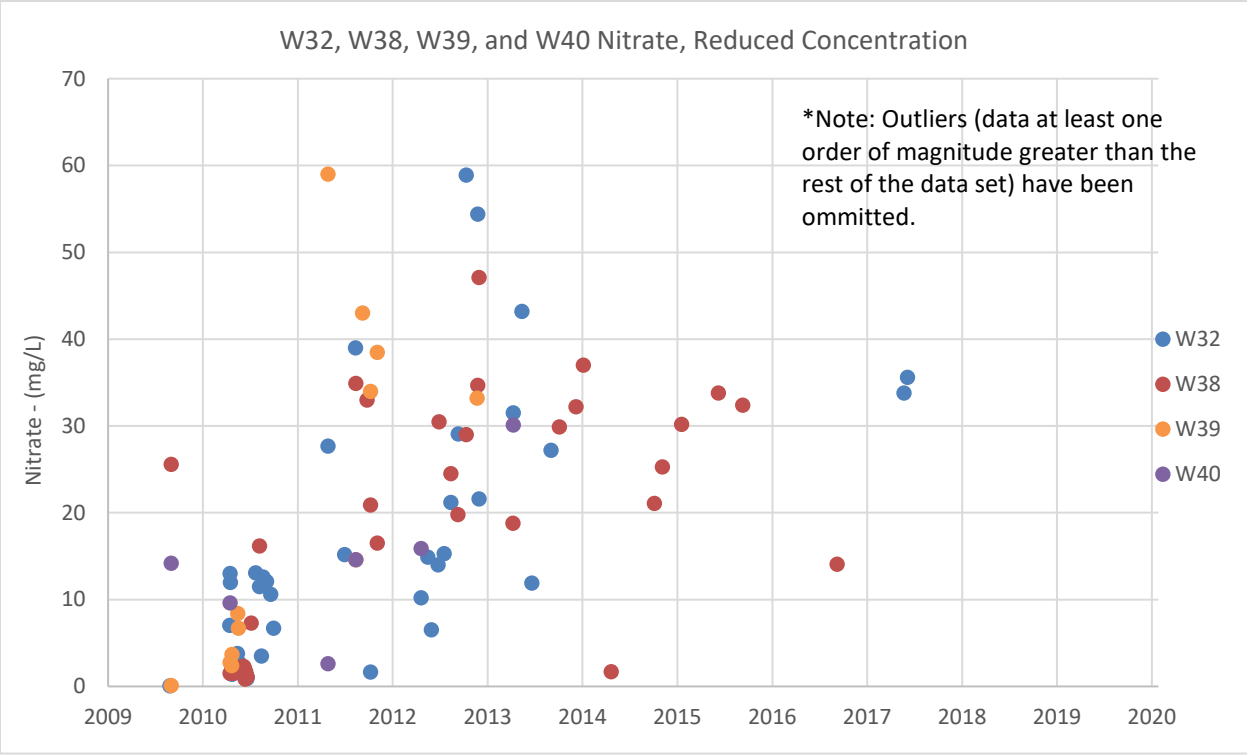


Figure 7-19: W32, W38, W39, and W40 Nitrate, Reduced Concentration

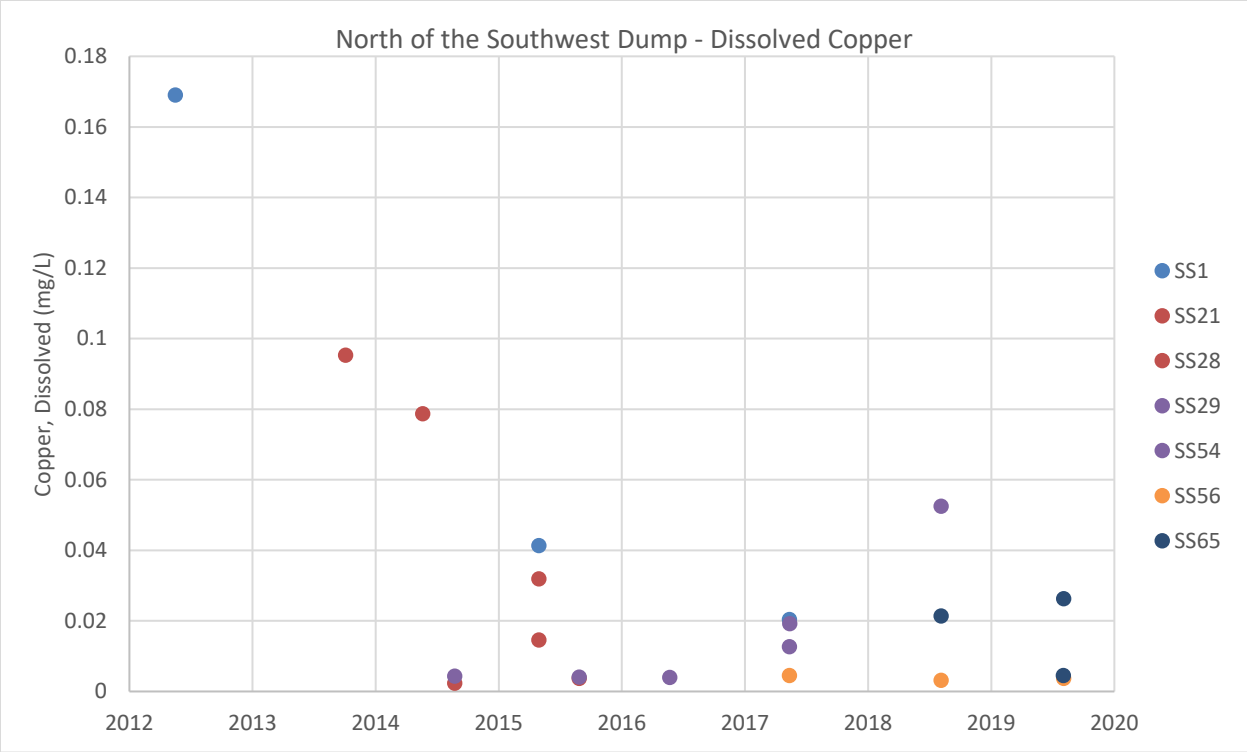


Figure 7-20: North of the Southwest Dump, Dissolved Copper

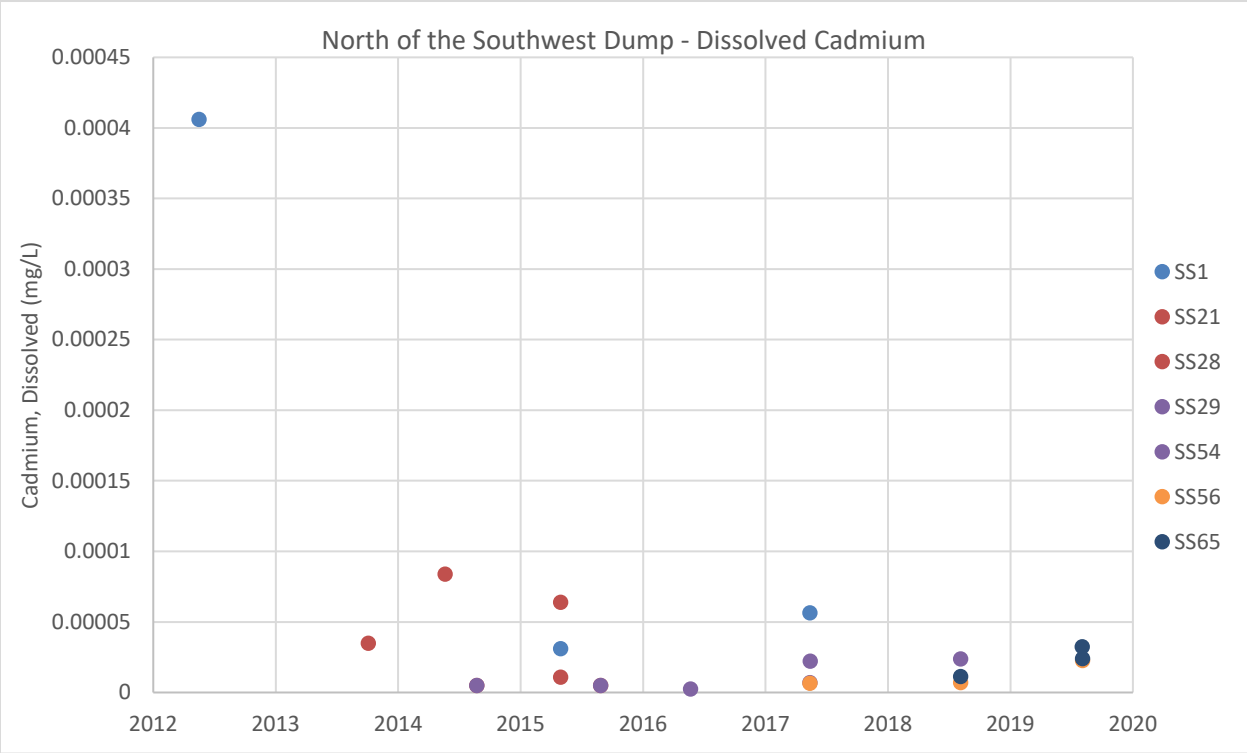


Figure 7-21: North of the Southwest Dump, Dissolved Cadmium

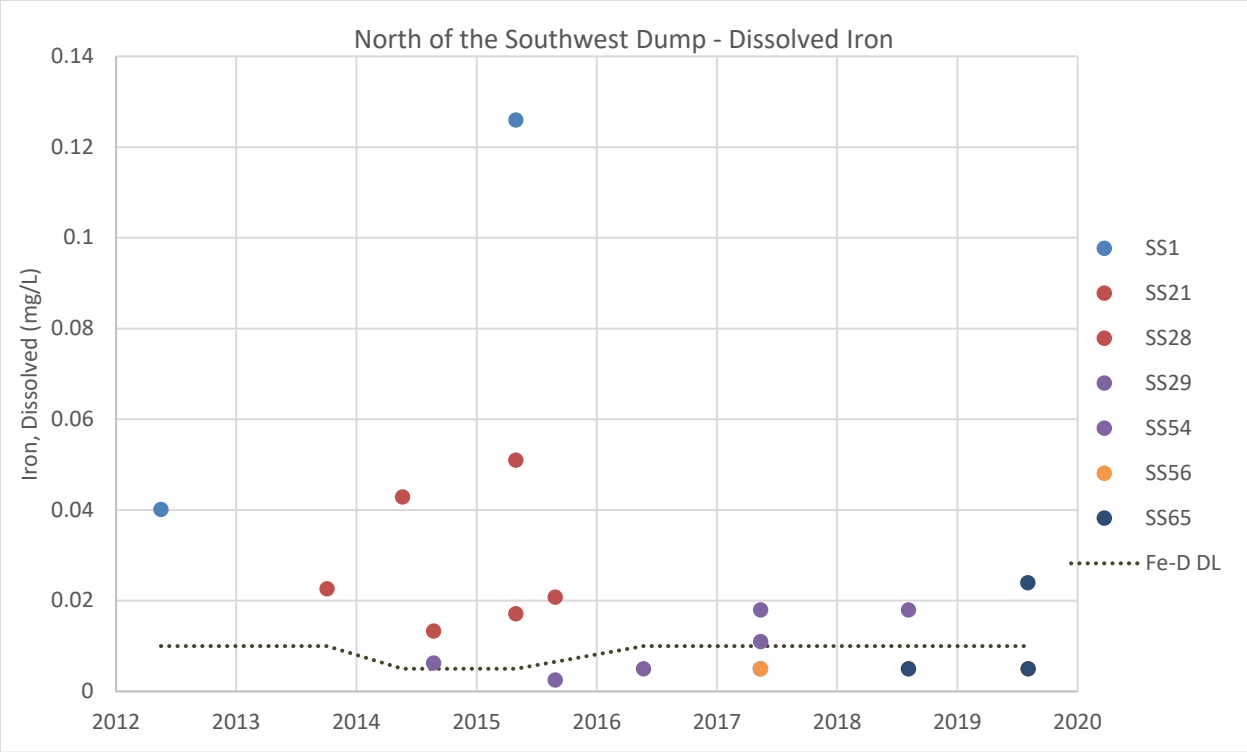


Figure 7-22: North of the Southwest Dump, Dissolved Iron
DL is Analytical Detection Limit

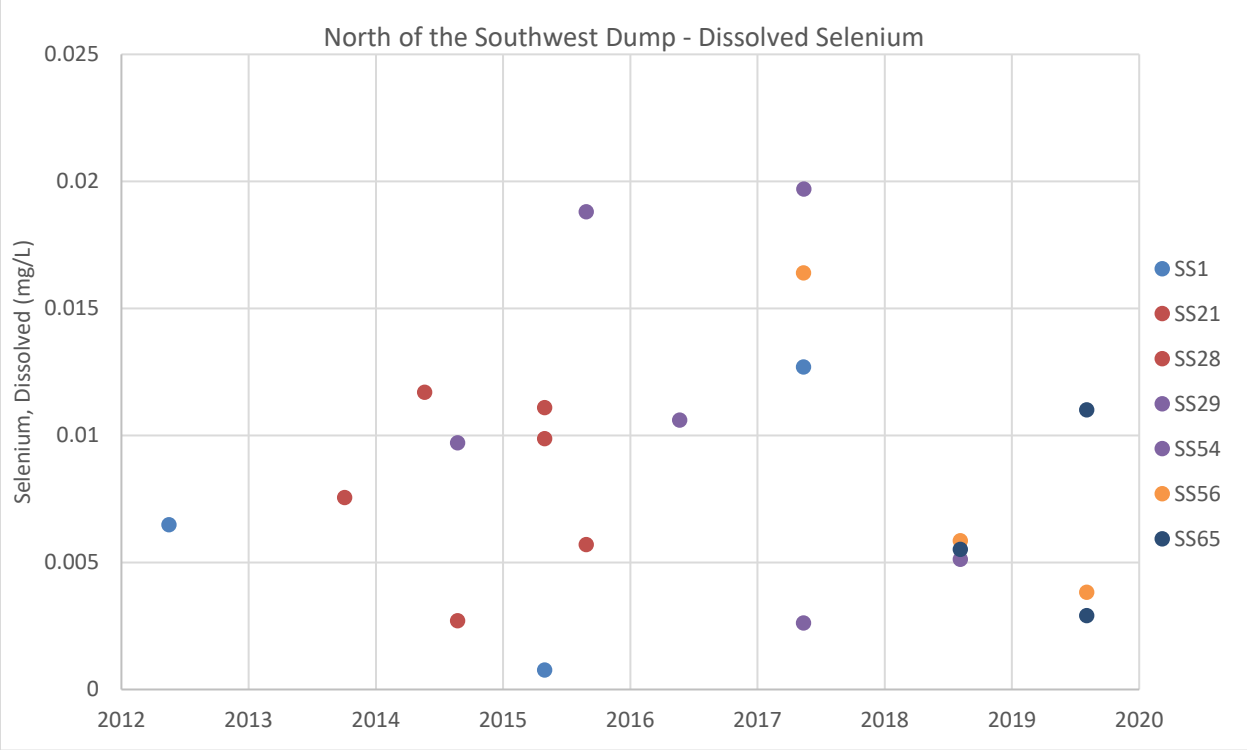


Figure 7-23: North of the Southwest Dump, Dissolved Selenium

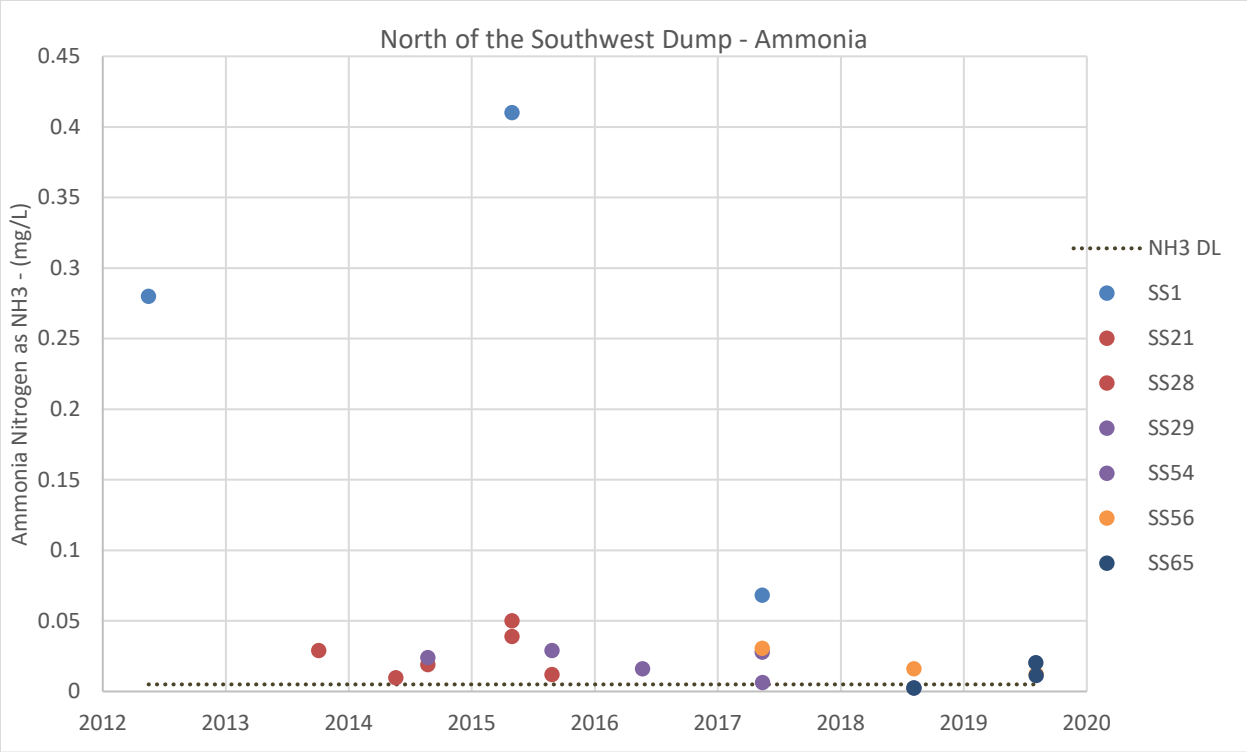


Figure 7-24: North of the Southwest Dump, Ammonia
DL is Analytical Detection Limit

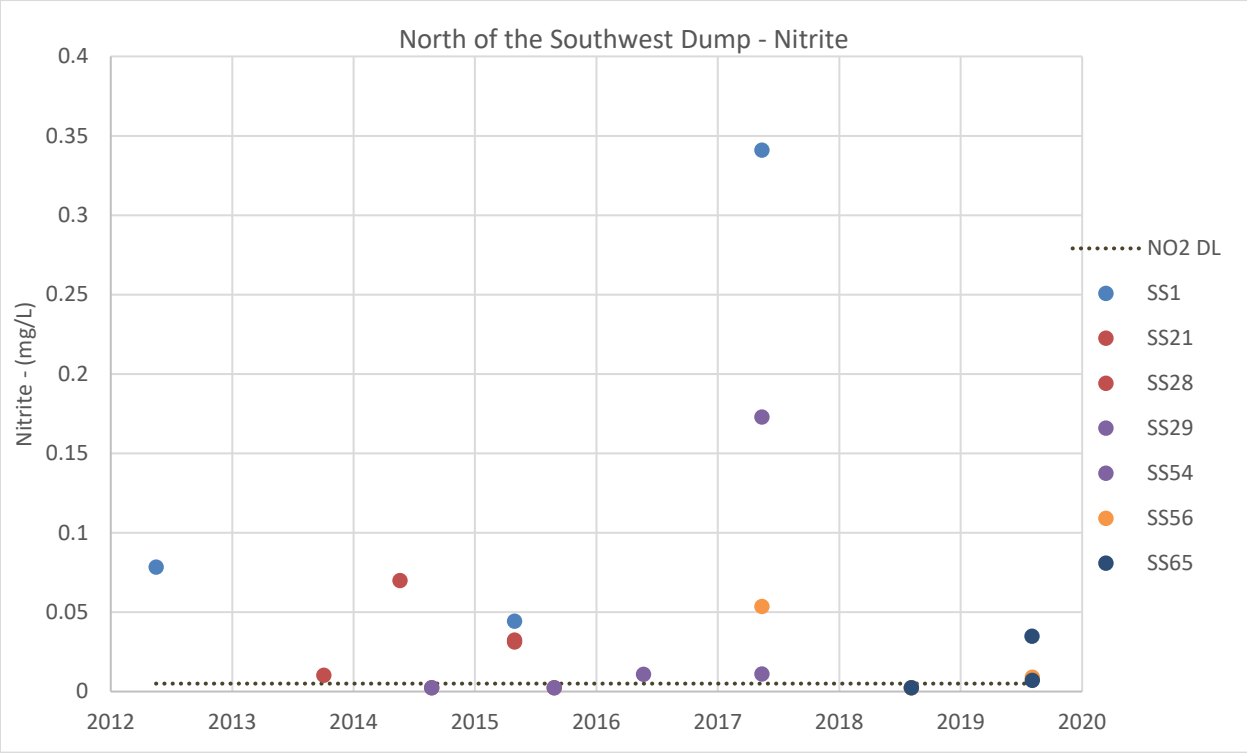


Figure 7-25: North of the Southwest Dump, Nitrite
DL is Analytical Detection Limit

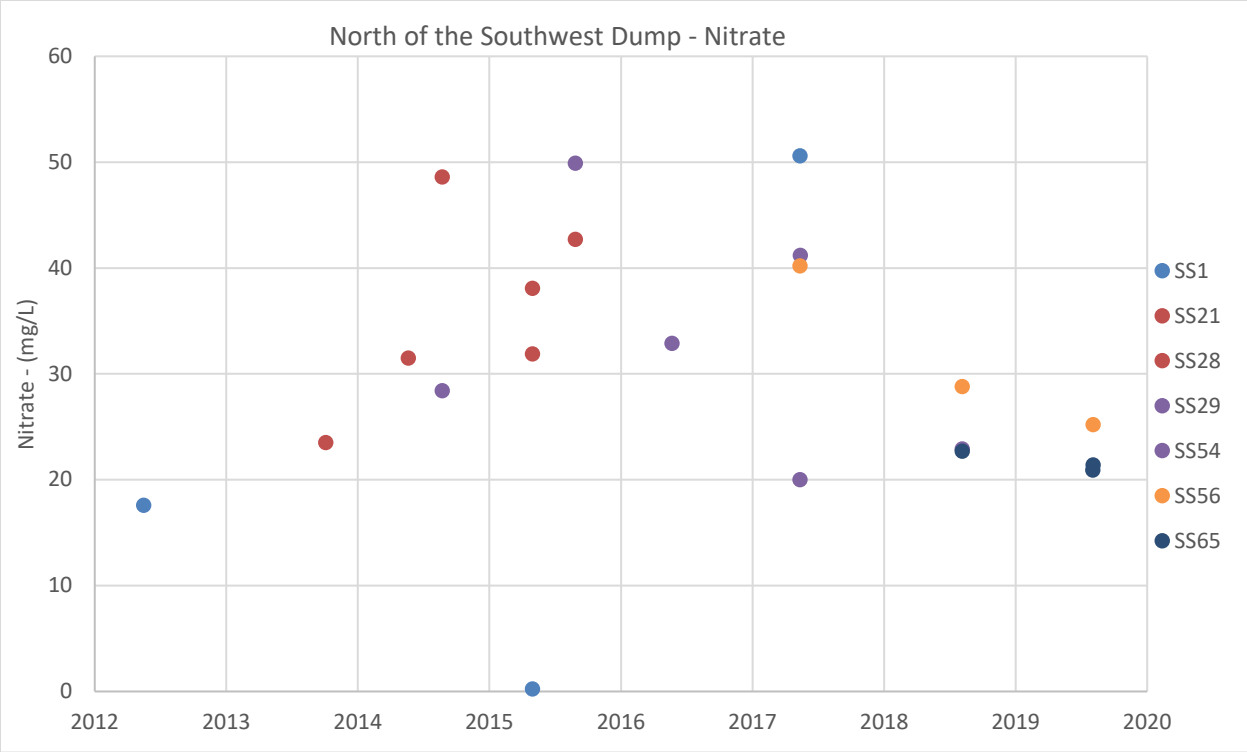


Figure 7-26: North of the Southwest Dump, Nitrate

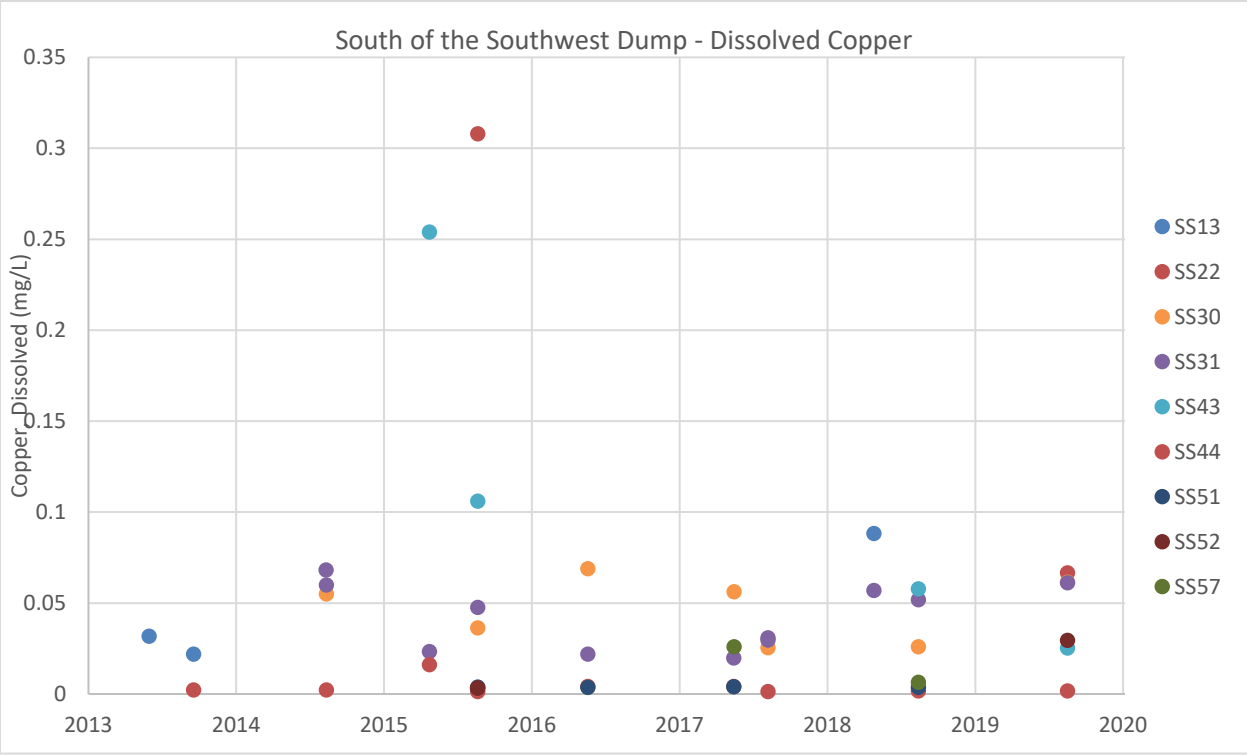


Figure 7-27: South of the Southwest Dump, Dissolved Copper

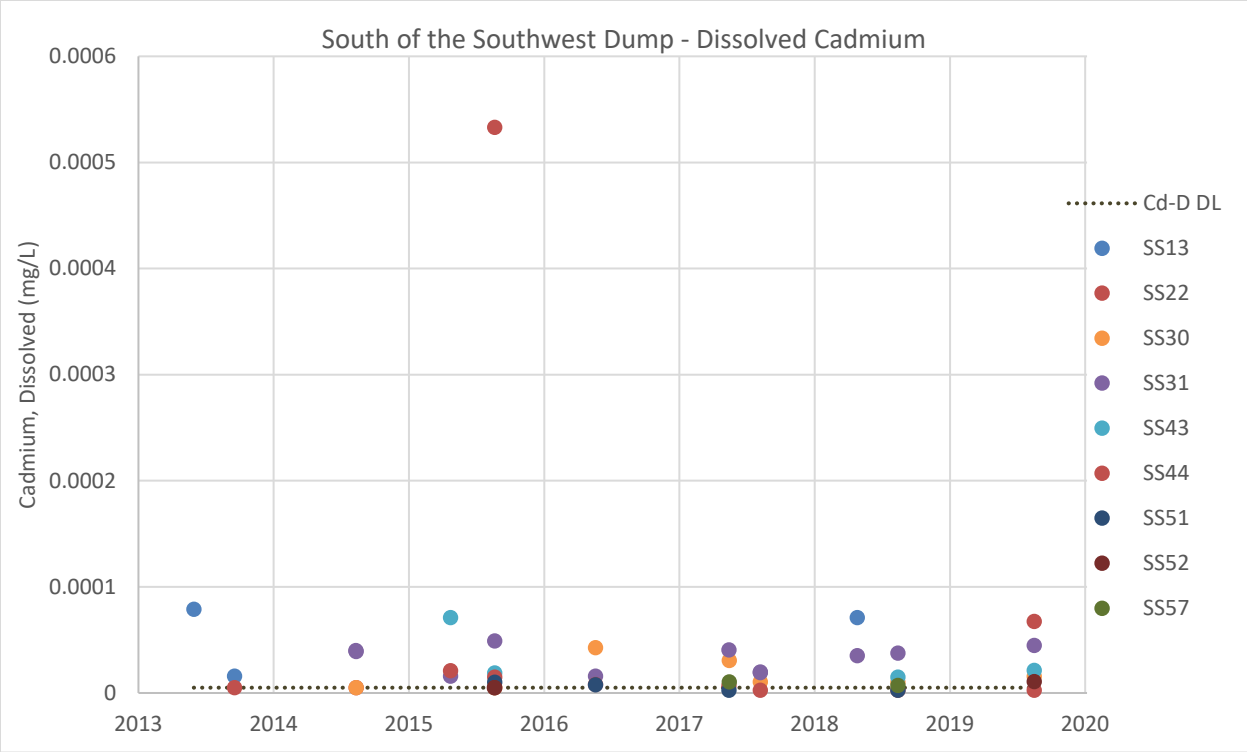


Figure 7-28: South of the Southwest Dump, Dissolved Cadmium
DL is Analytical Detection Limit

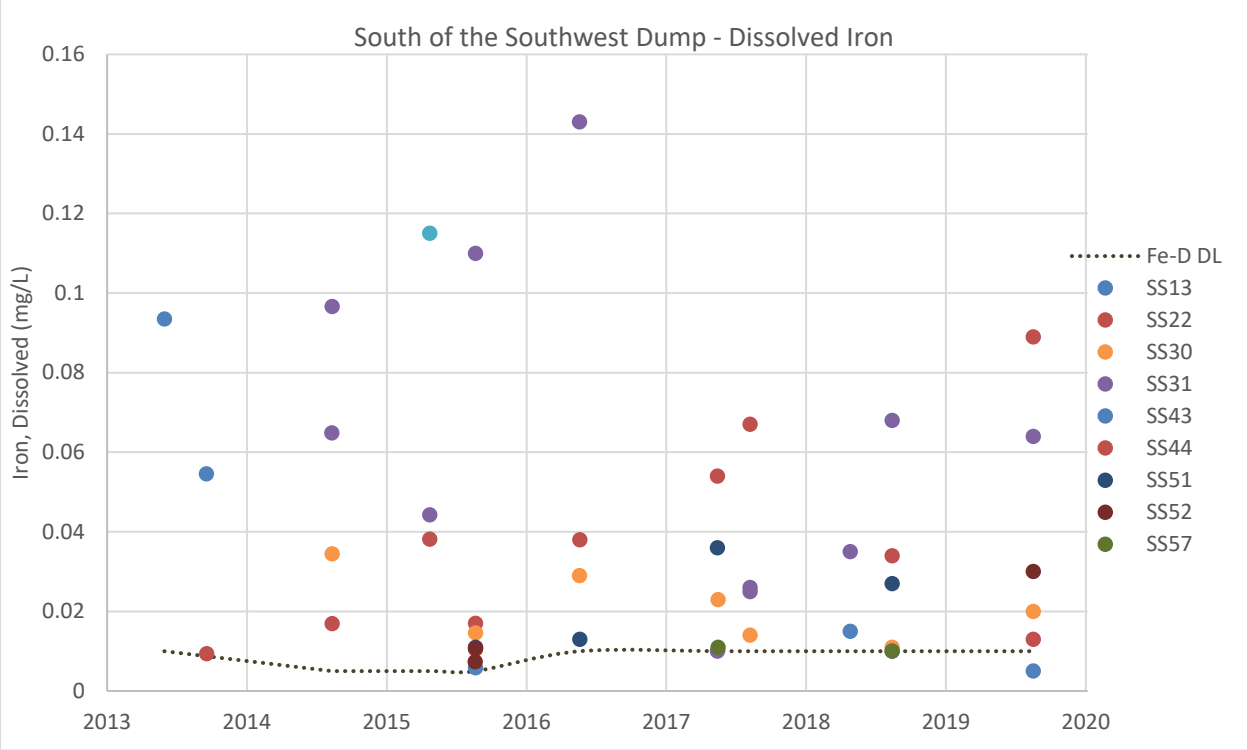


Figure 7-29: South of the Southwest Dump, Dissolved Iron
DL is Analytical Detection Limit

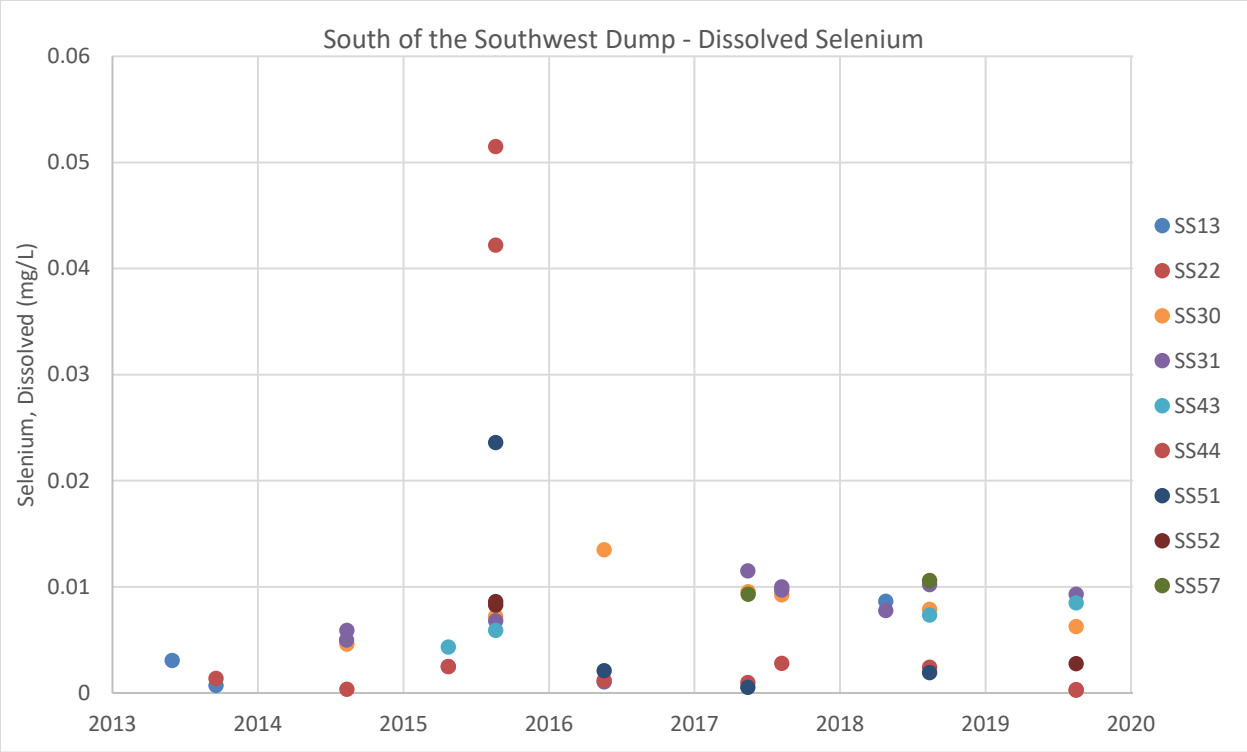


Figure 7-30: South of the Southwest Dump, Dissolved Selenium

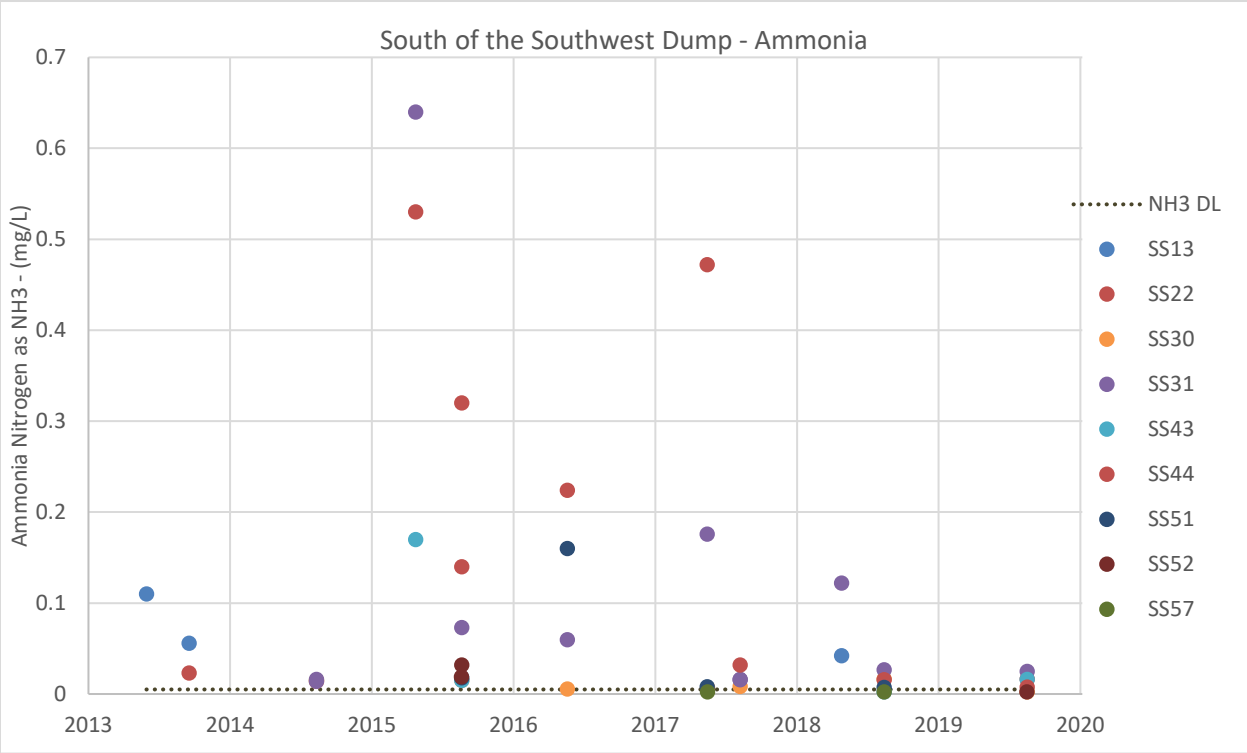


Figure 7-31: South of the Southwest Dump, Ammonia

DL is Analytical Detection Limit

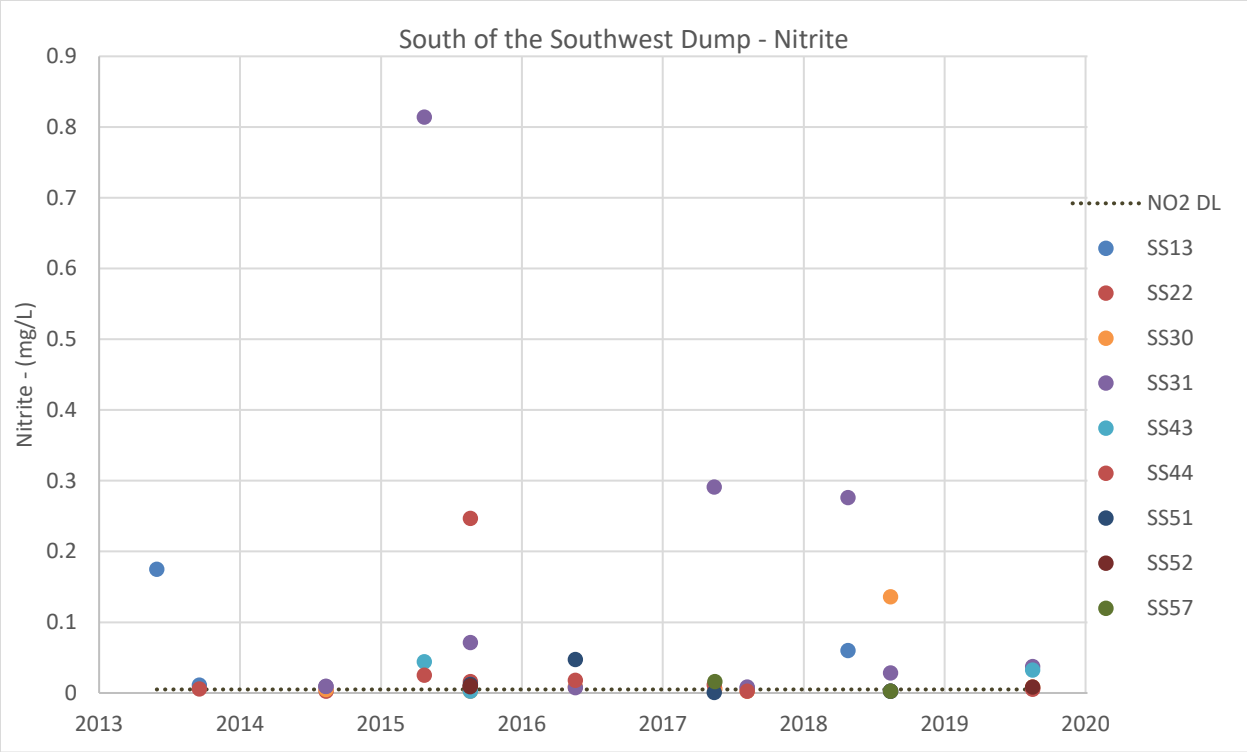


Figure 7-32: South of the Southwest Dump, Nitrite
DL is Analytical Detection Limit

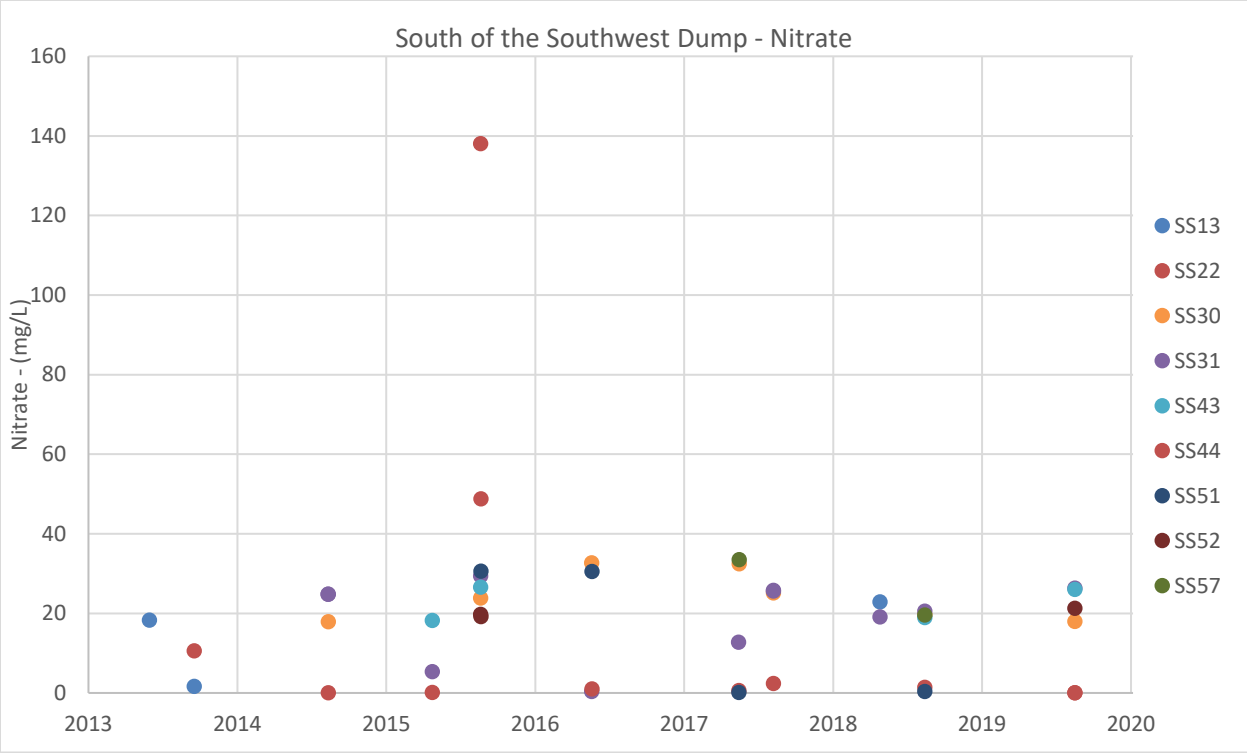


Figure 7-33: South of the Southwest Dump, Nitrate

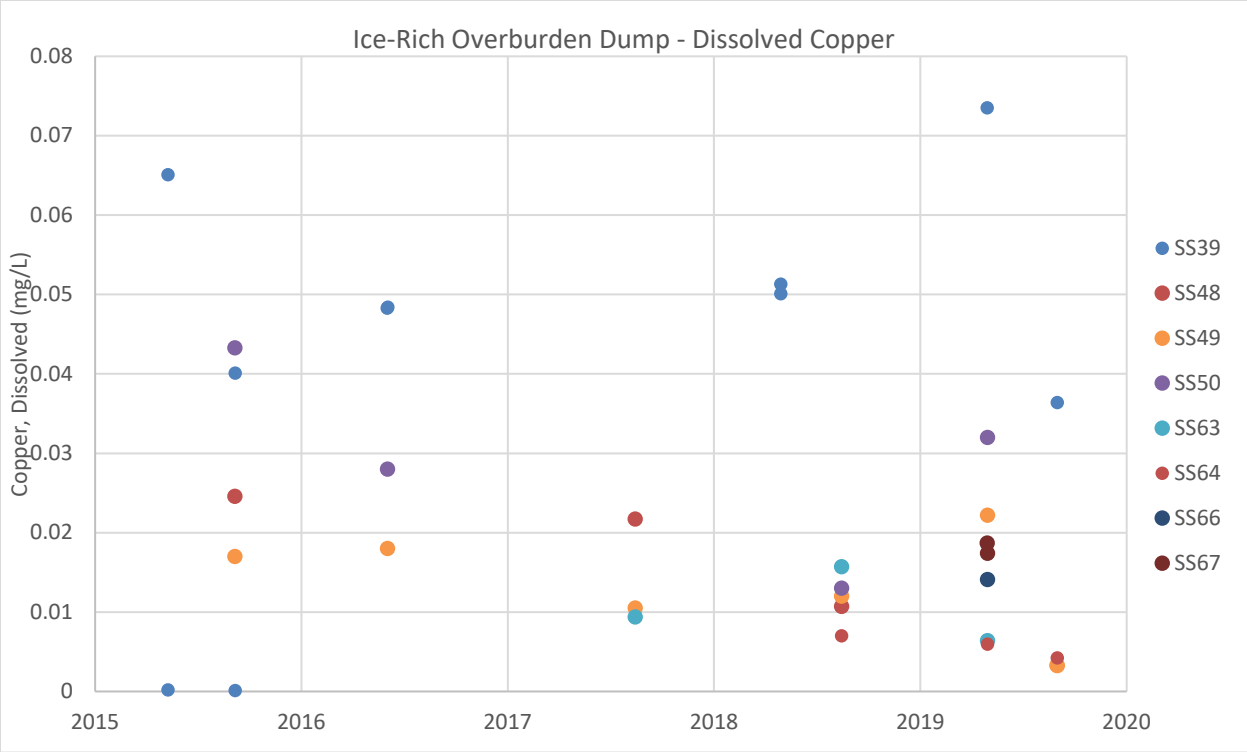


Figure 7-34: Ice-Rich Overburden Dump, Dissolved Copper

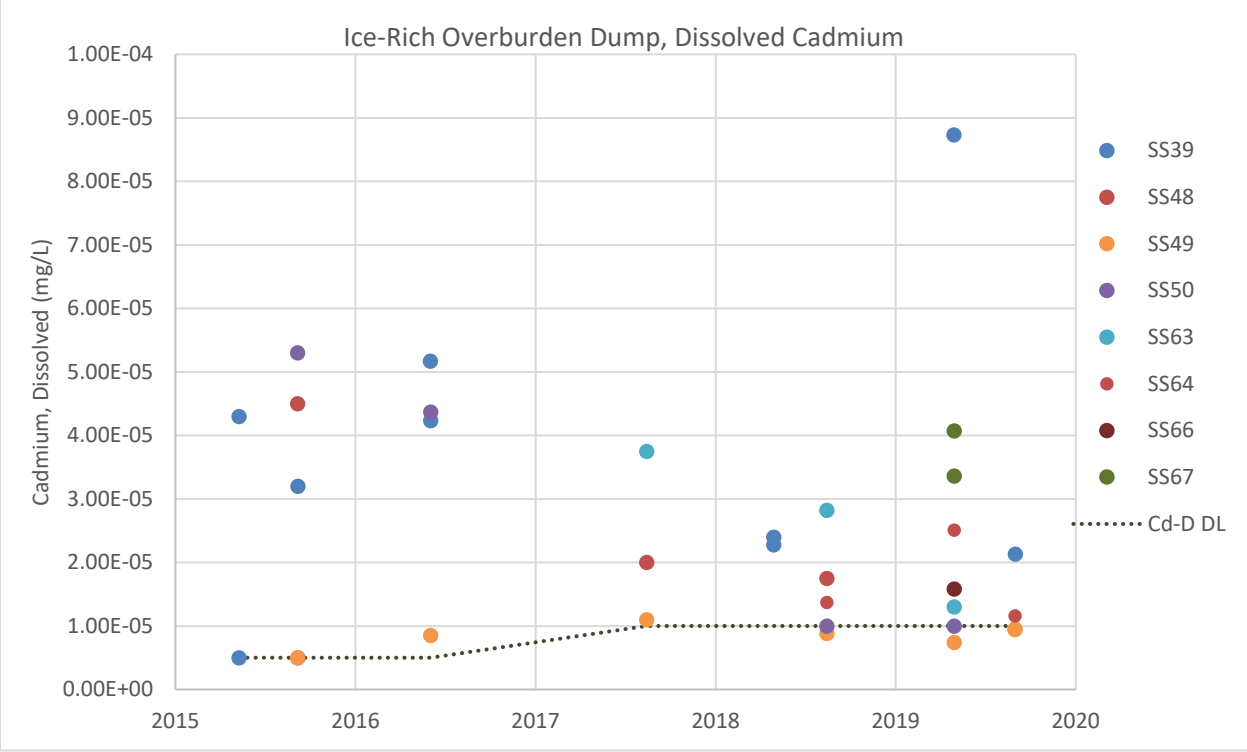


Figure 7-35: Ice-Rich Overburden Dump, Dissolved Cadmium

DL is Analytical Detection Limit

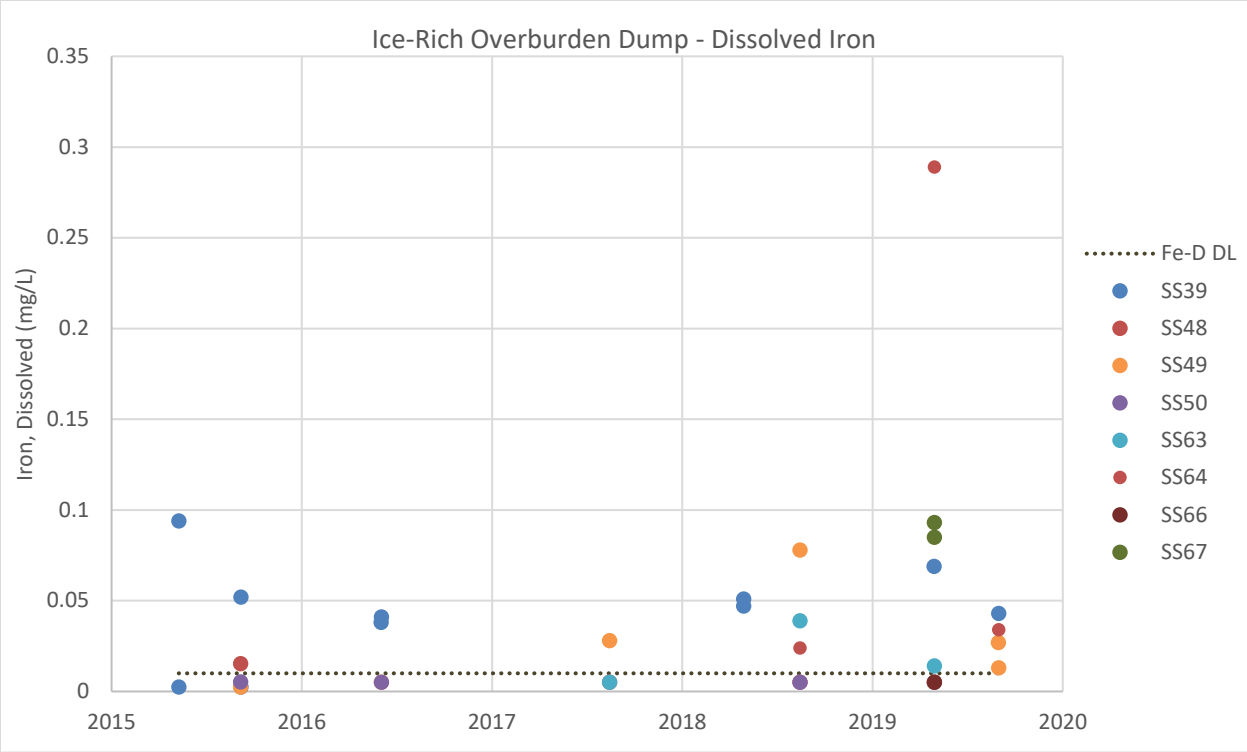


Figure 7-36: Ice-Rich Overburden Dump, Dissolved Iron
DL is Analytical Detection Limit

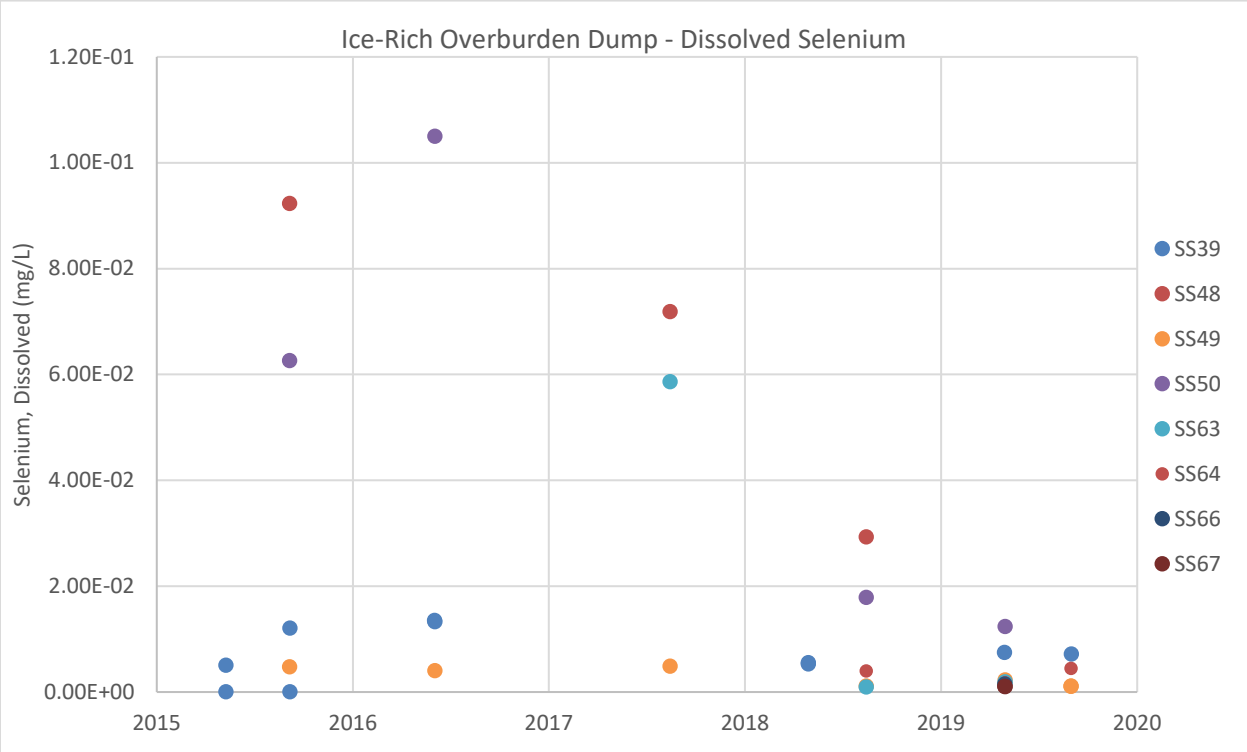


Figure 7-37: S Ice-Rich Overburden Dump, Dissolved Selenium

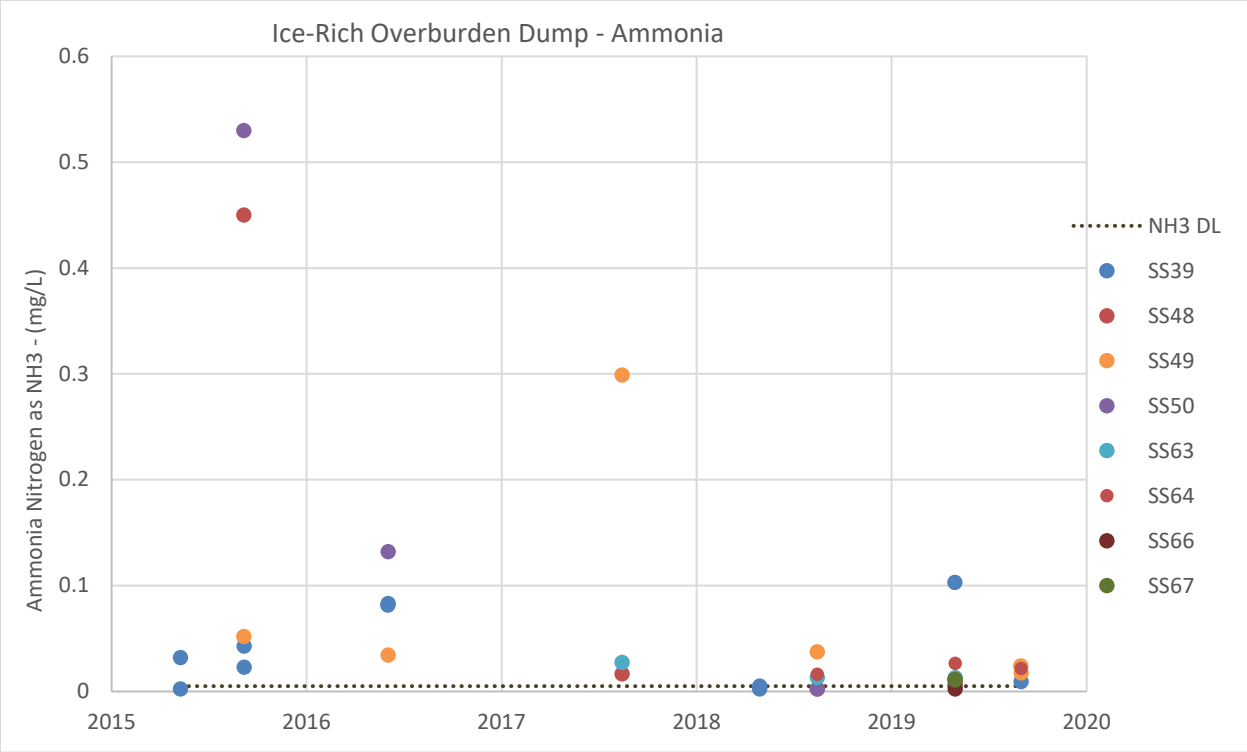


Figure 7-38: SS39, SS48, SS49, SS50, SS63 and SS64 Dissolved Ammonia
DL is Analytical Detection Limit

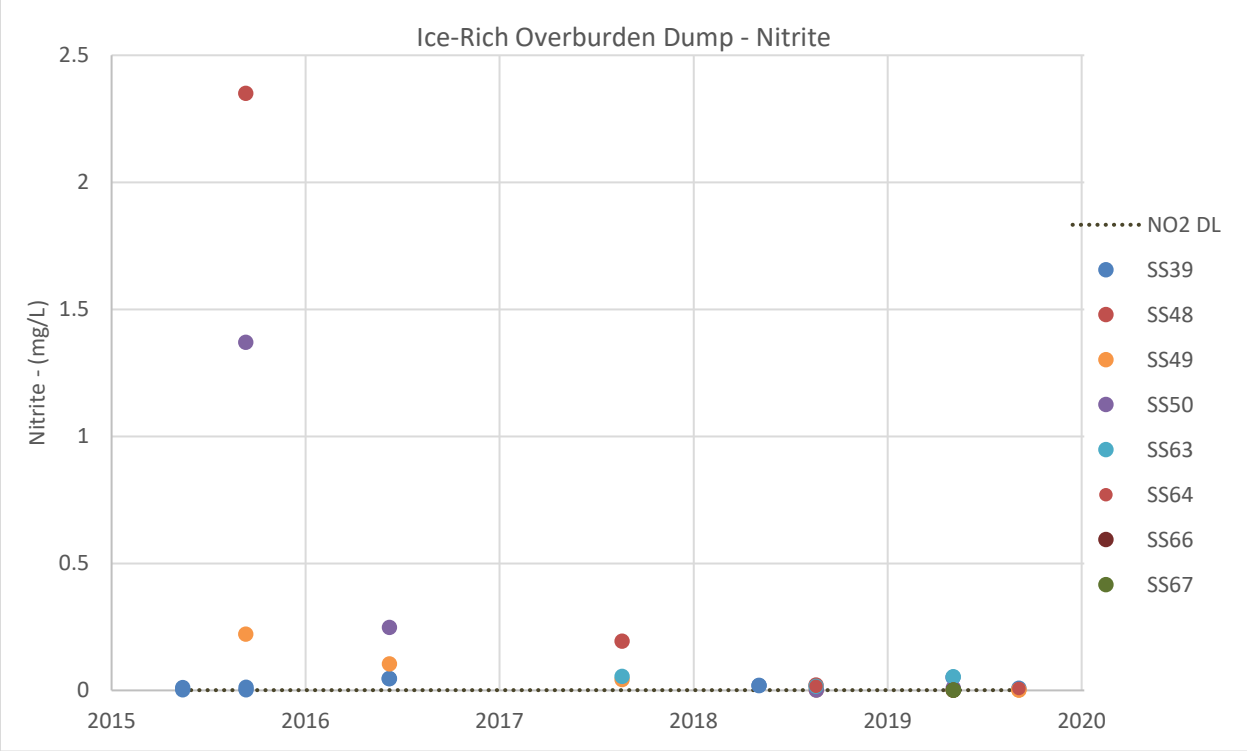


Figure 7-39: Ice-Rich Overburden Dump, Dissolved Nitrite
DL is Analytical Detection Limit

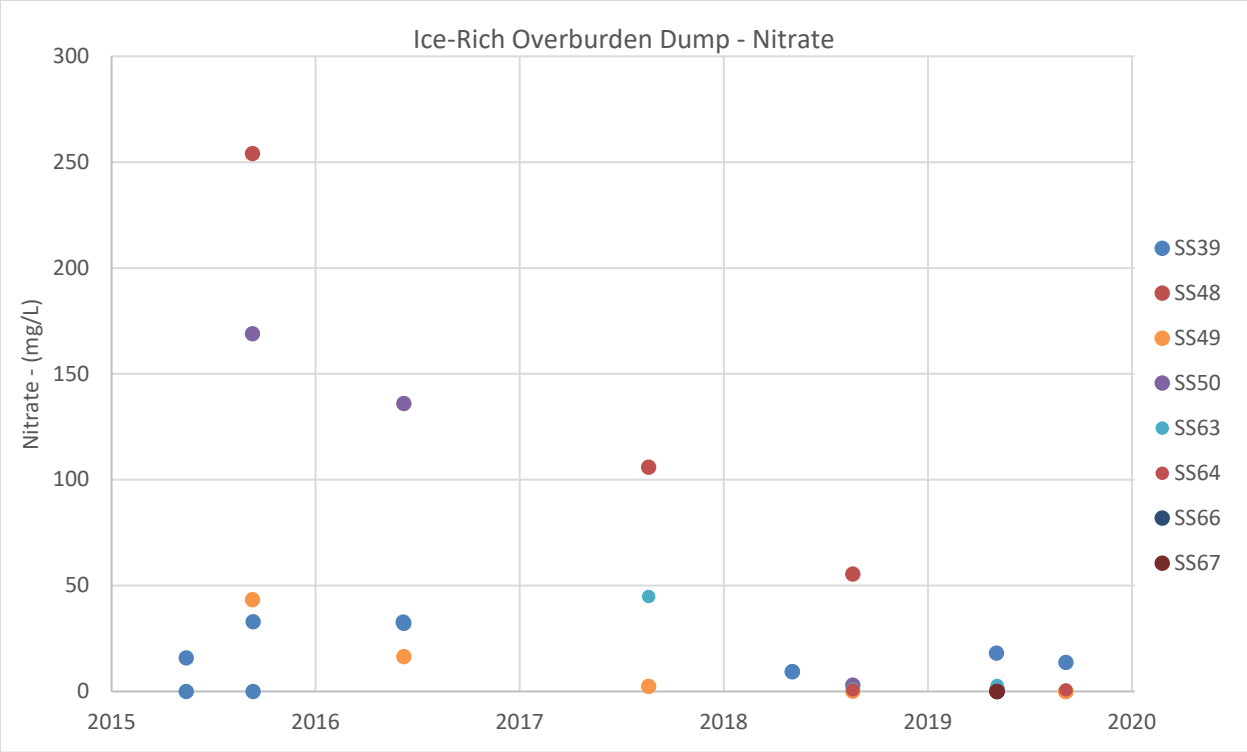


Figure 7-40: Ice-Rich Overburden Dump, Dissolved Nitrate

7.3 Minto Creek Detention Structure (MCDS) and Water Storage Pond

The Mill Valley Fill Extension Stage 2 (MVFE2) collection sump (W62) was constructed during the period of November 9, 2015 to February 7, 2016 as a replacement for the Minto Creek Detention Structure (W37) used prior to 2016. W37 was decommissioned and buried in February, 2016 as part of the MVFE2 construction. W62 is approximately 30m downslope from W37 and collects runoff and seepage from the Dry Stack Tailing Storage Facility and the Mill Valley Fill. W62 is collected on a monthly frequency as part of the WUL.

Water collected at W62 is pumped to the Main Pit. Water quality results for W37 (historical) and W62 are outlined in Figure 7-41 through Figure 7-47 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate. This site is collected all year.

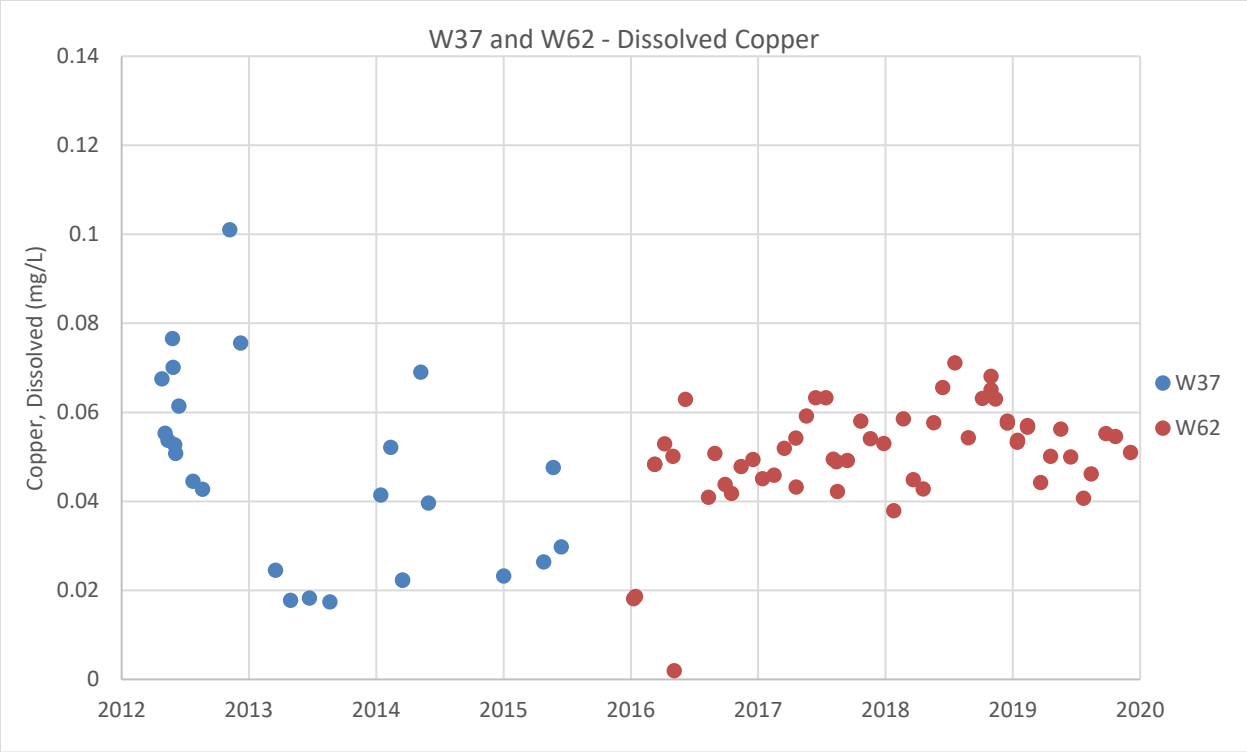


Figure 7-41: W37 and W62 Dissolved Copper

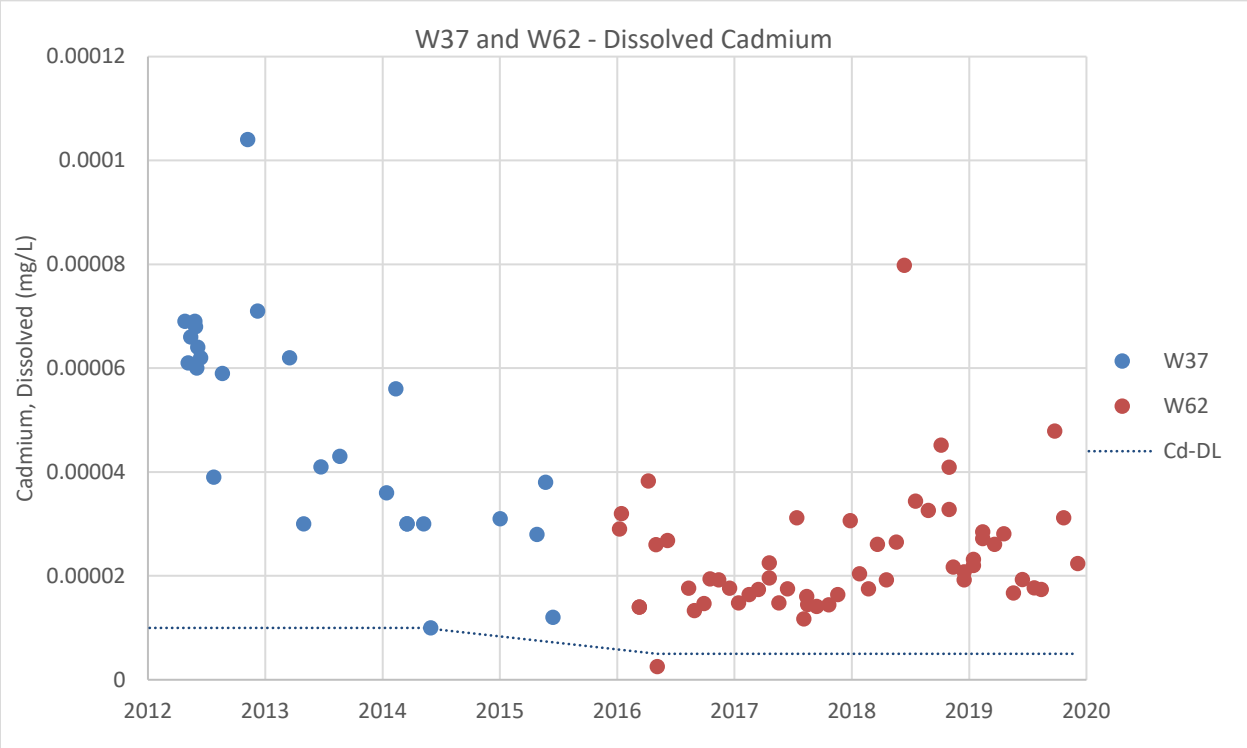


Figure 7-42: W37 and W62 Dissolved Cadmium

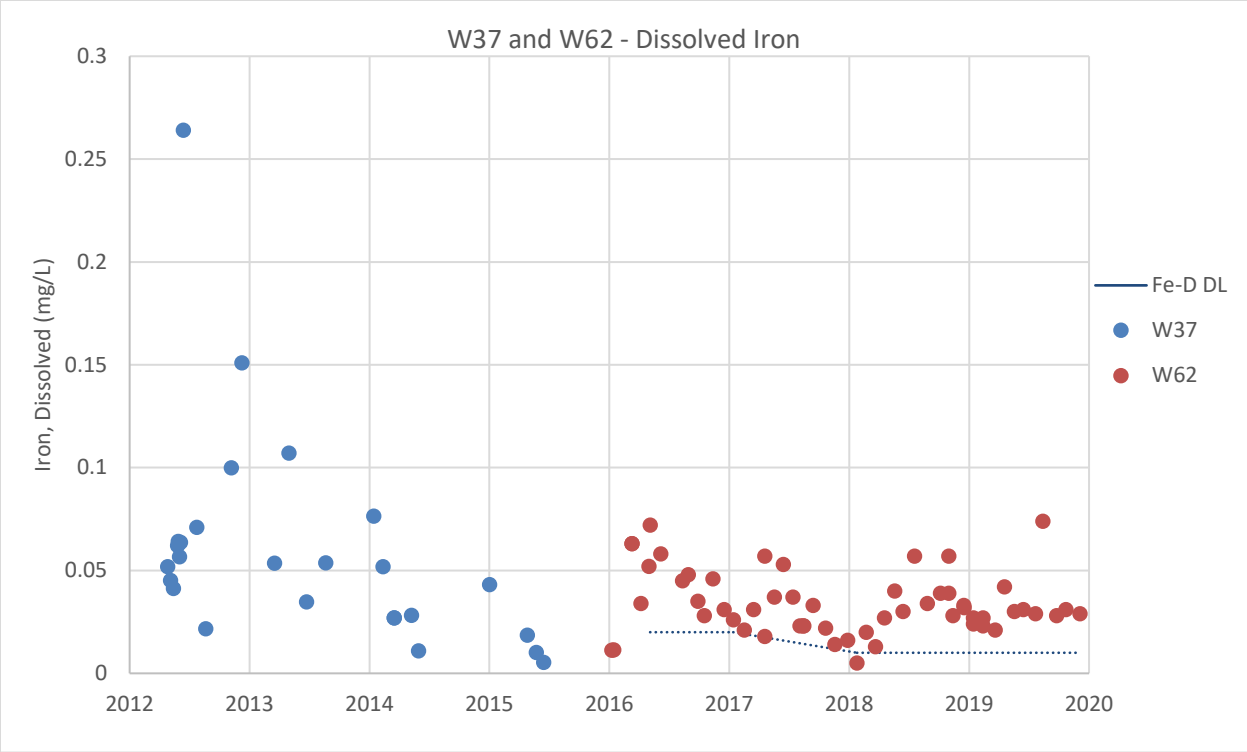


Figure 7-43: W37 and W62 Dissolved Iron

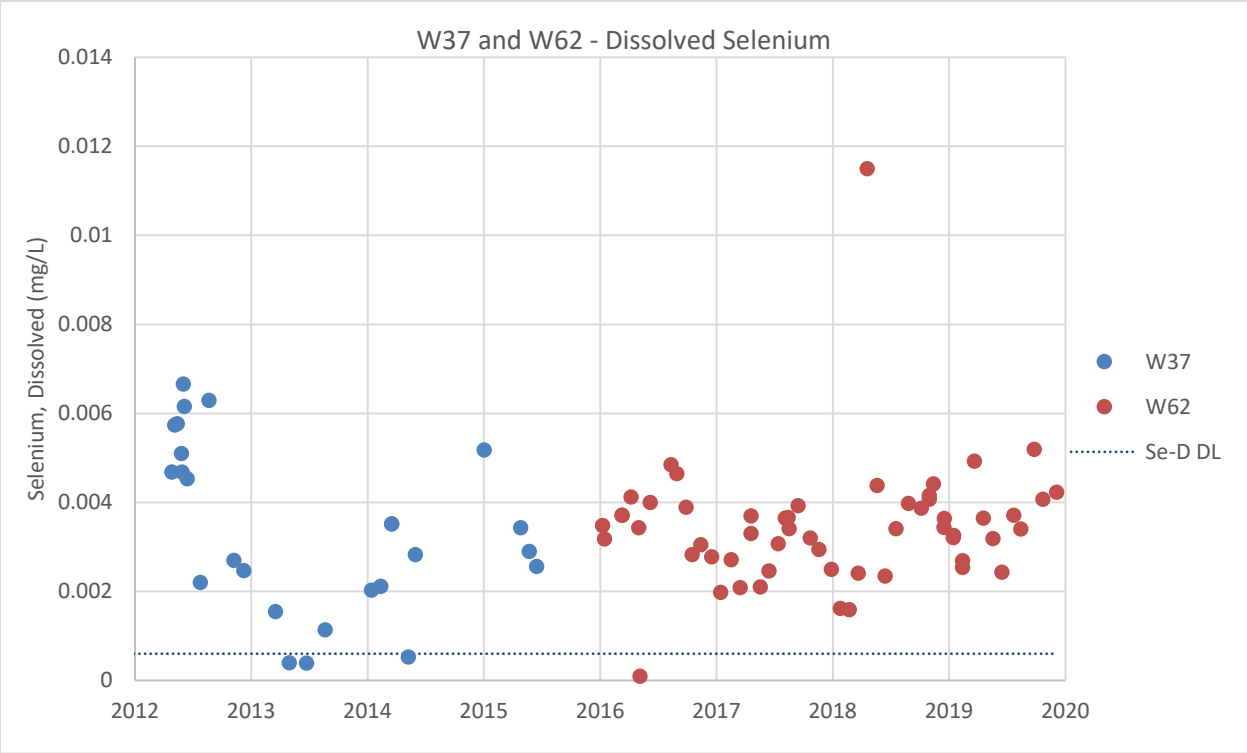


Figure 7-44: W37 and W62 Dissolved Selenium

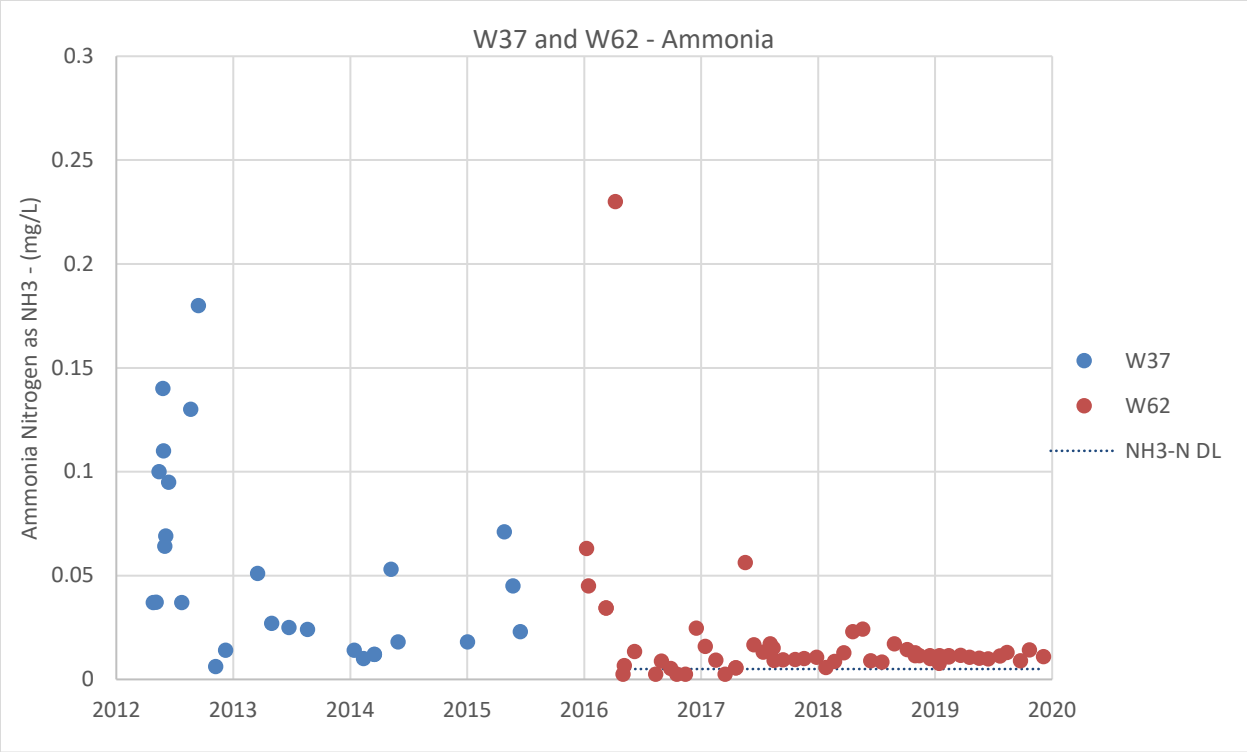


Figure 7-45: W37 and W62 Ammonia

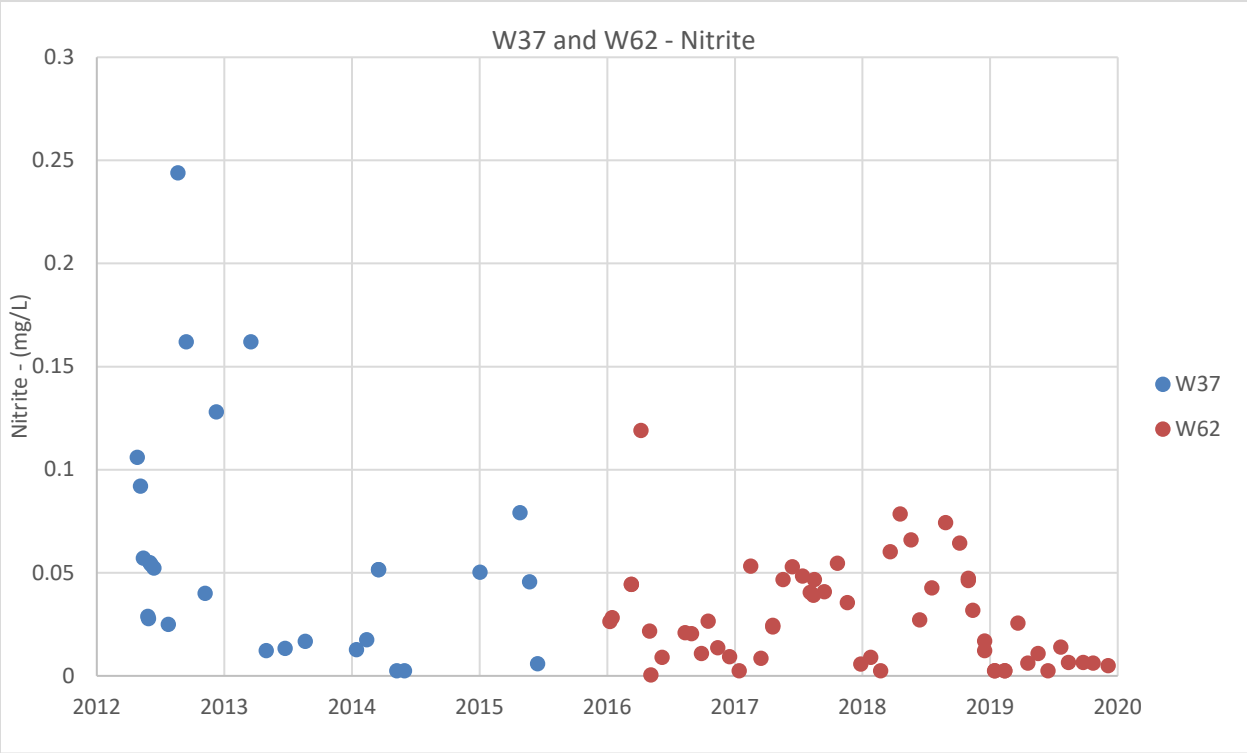


Figure 7-46: W37 and W62 Nitrite

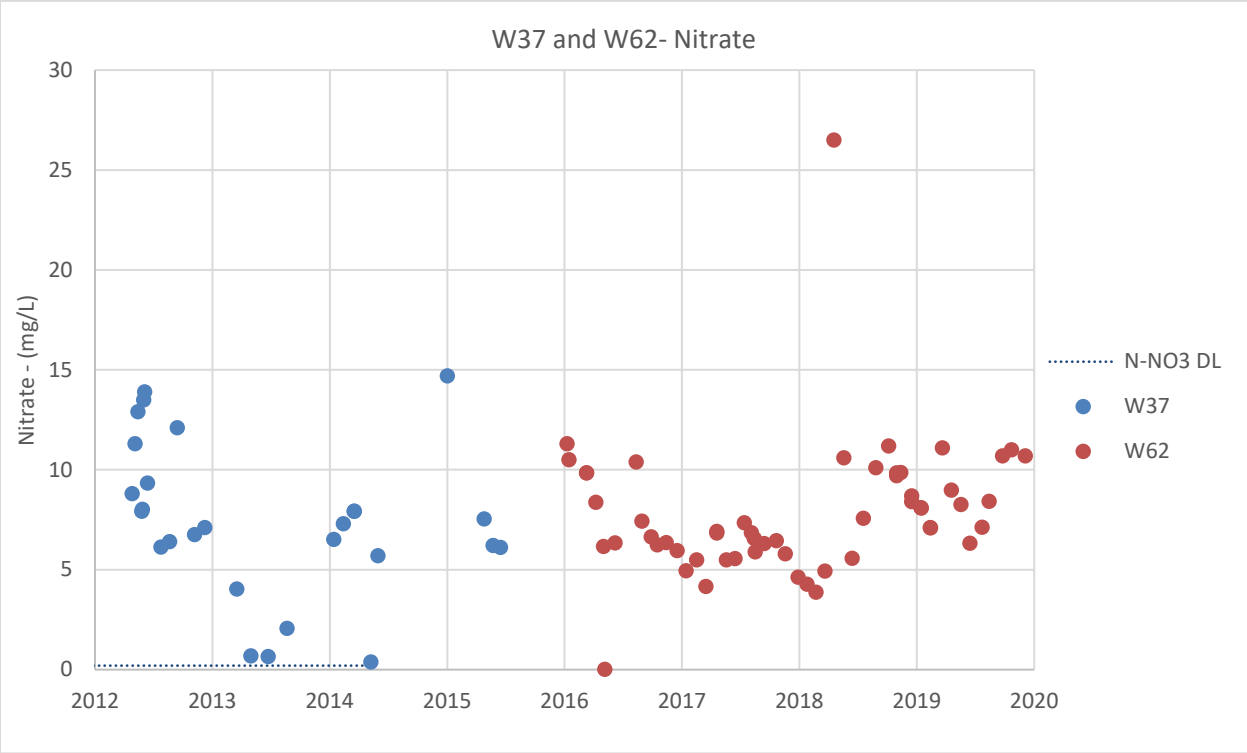


Figure 7-47: W37 and W62 Nitrate

7.4 Water Storage Pond Dam Seep

Seepage water quality at the Water Storage Pond Dam is represented by station W17. Water quality at station W17 is relatively consistent due to its being fed by a large stable body of water (Water Storage Pond). All dam seepage is collected in a vertical culvert and pumped back to the WSP via a 4" insulated heat traced pipe. Water quality statistics for station W17 from 2007 to 2019 are summarized below in Table 7-1. A total of 20 W17 samples were collected in the 2019 monitoring period. Water quality results for W17 are further outlined in Figure 7-47 through Figure 7-55 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

Table 7-1: W17 Water Quality Results Summary (2007-2019)

W17	Effluent Quality Standards	2007 - 2018 Summary Statistics			2019 Summary Statistics		
Parameters	**(WUL Clause 9)**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
pH	6.0-9.0	8.15	1.7	8.52	8.32	7.99	8.59
TSS (mg/L)	15	3	0.5	267	4.86	<3.0	25.8
Nutrients (mg/L)							
Ammonia	0.75	0.02668	-0.01	0.85	0.01142	<0.0050	0.0923
Nitrite Nitrogen	0.18	0.03742	<0.0010	7.85	0.00135	<0.0010	<0.010
Nitrate Nitrogen	27.3	3.49454	<0.0050	12.4	0.03134	<0.0050	0.0568
Dissolved Metals (mg/L)							
Aluminum	0.3	0.00594	<0.0010	0.255	0.0025	<0.0010	0.0339
Arsenic	0.015	0.000403	<0.00010	0.0037	0.00042	0.00033	0.0007
Cadmium	0.004104*	2.538E-05	<0.0000050	0.00278	1.041E-05	<0.0000050	0.0000745
Chromium	0.003	0.000815	<0.00010	**0.008**	0.000123	<0.00010	0.00041
Copper	0.039	0.006514	<0.00020	0.0371	0.00809	0.00472	0.0161
Iron	3.3	0.01737	0.0033	0.45	0.0664	<0.010	0.556
Lead	0.012	0.0001832	0.000009	<0.0010	0.0000586	<0.000050	0.000651
Molybdenum	0.219	0.0063733	<0.000050	0.0224	0.00615	0.00347	0.00741
Nickel	0.33	0.001188	<0.00050	0.011	0.00091	0.00063	0.00148
Selenium	0.006	0.0010257	<0.000050	0.005	0.000338	0.000163	0.000664
Zinc	0.09	0.00555	0.00062	0.043	0.002	<0.0010	0.0187

Bold values indicate exceedances of the WUL standards

***Based on measured hardness**

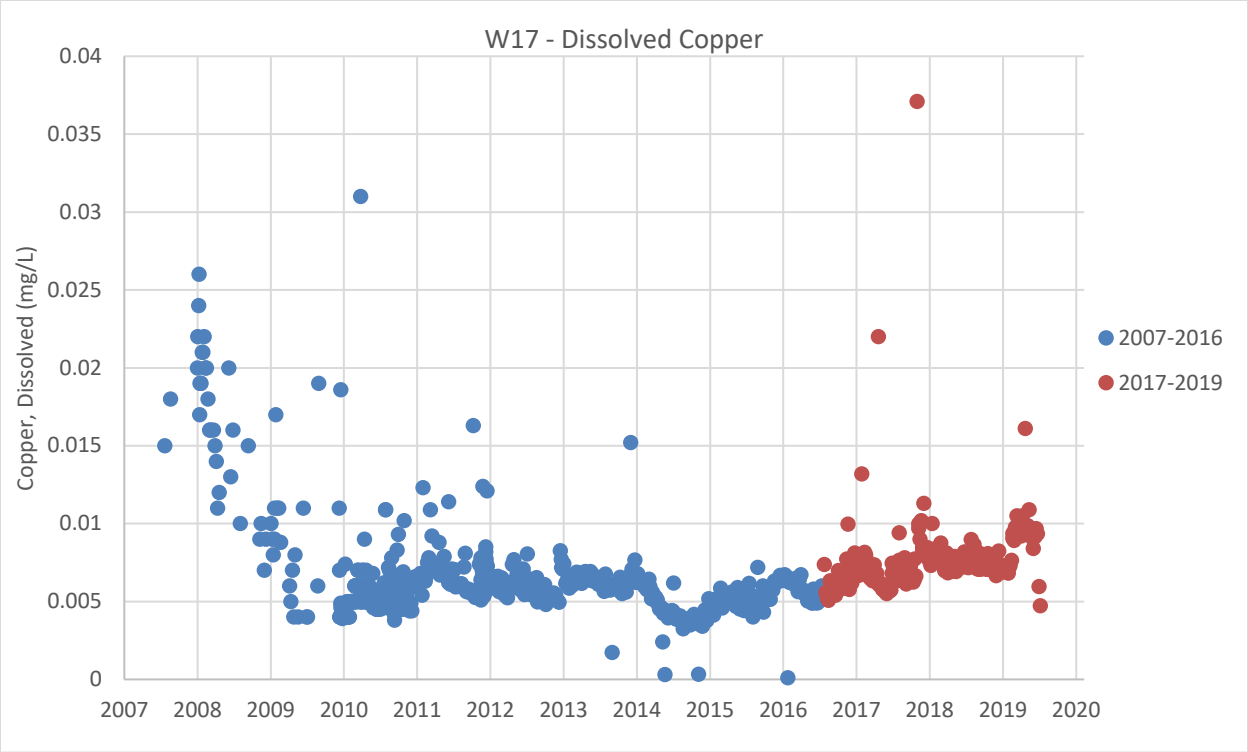


Figure 7-48: W17 Dissolved Copper

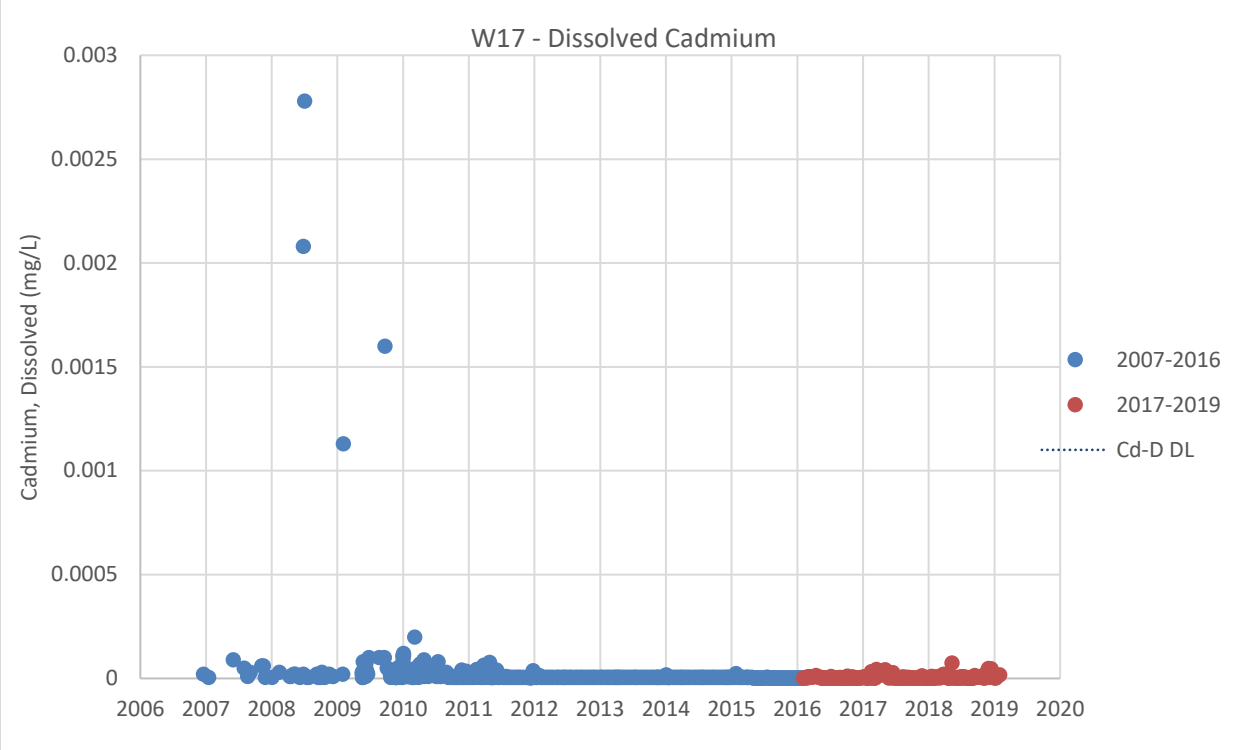


Figure 7-49: W17 Dissolved Cadmium

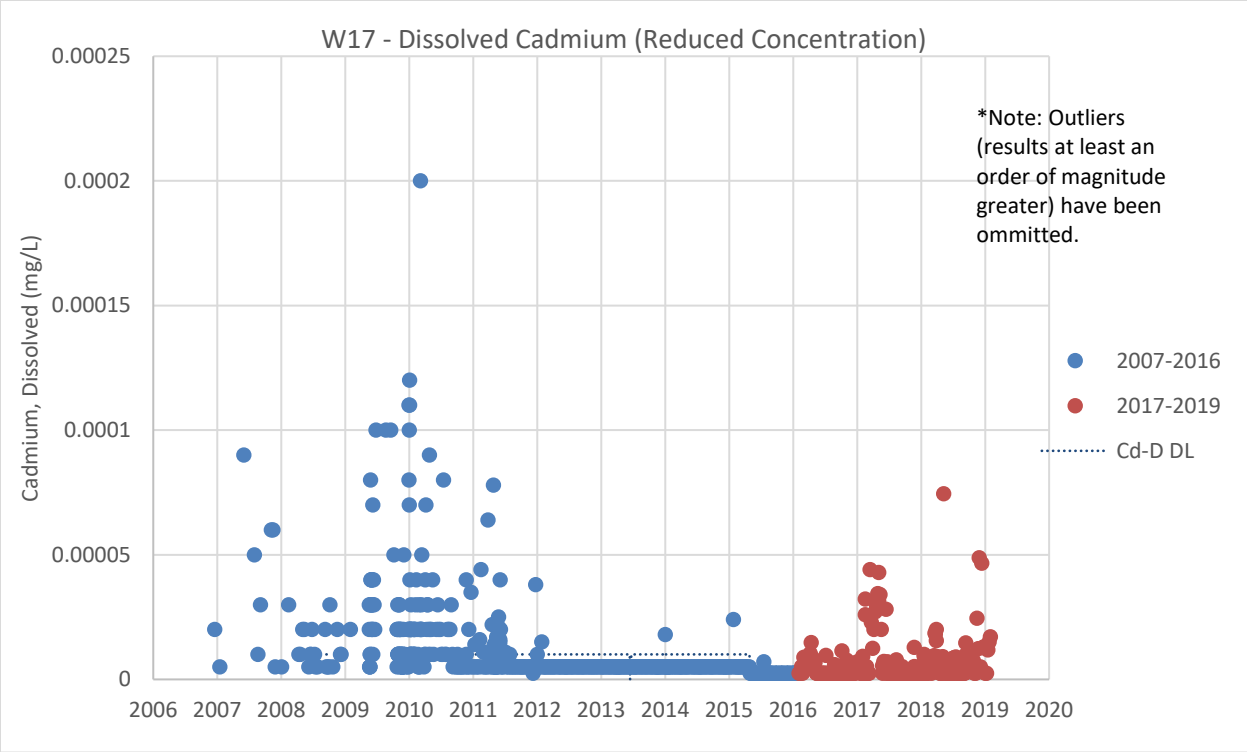


Figure 7-50: W17 Dissolved Cadmium (Reduced Concentration)

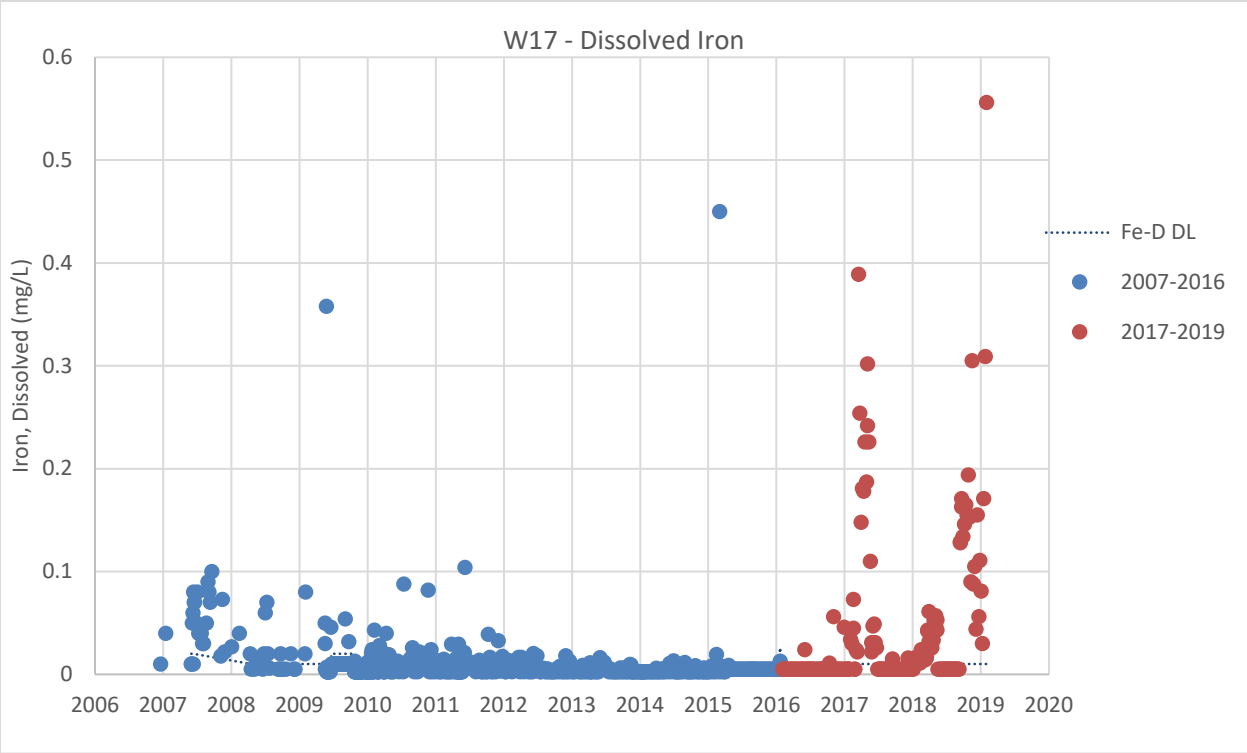


Figure 7-51: W17 Dissolved Iron

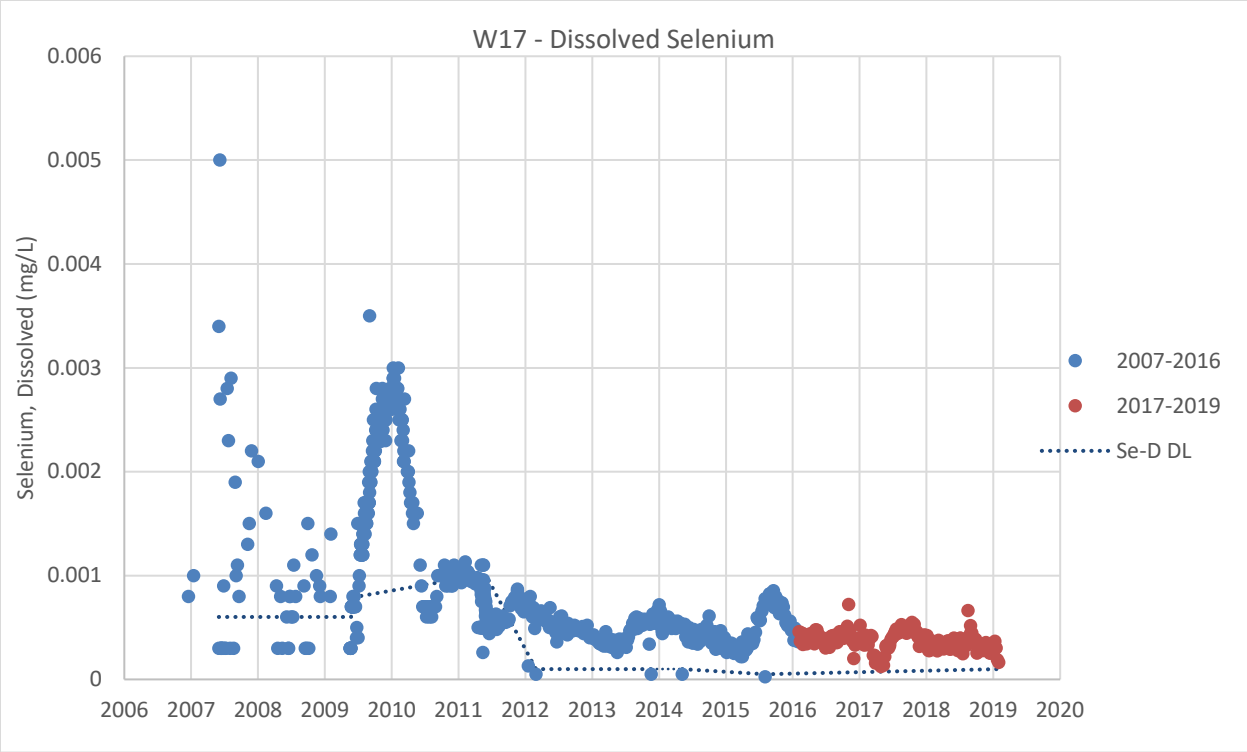


Figure 7-52: W17 Dissolved Selenium

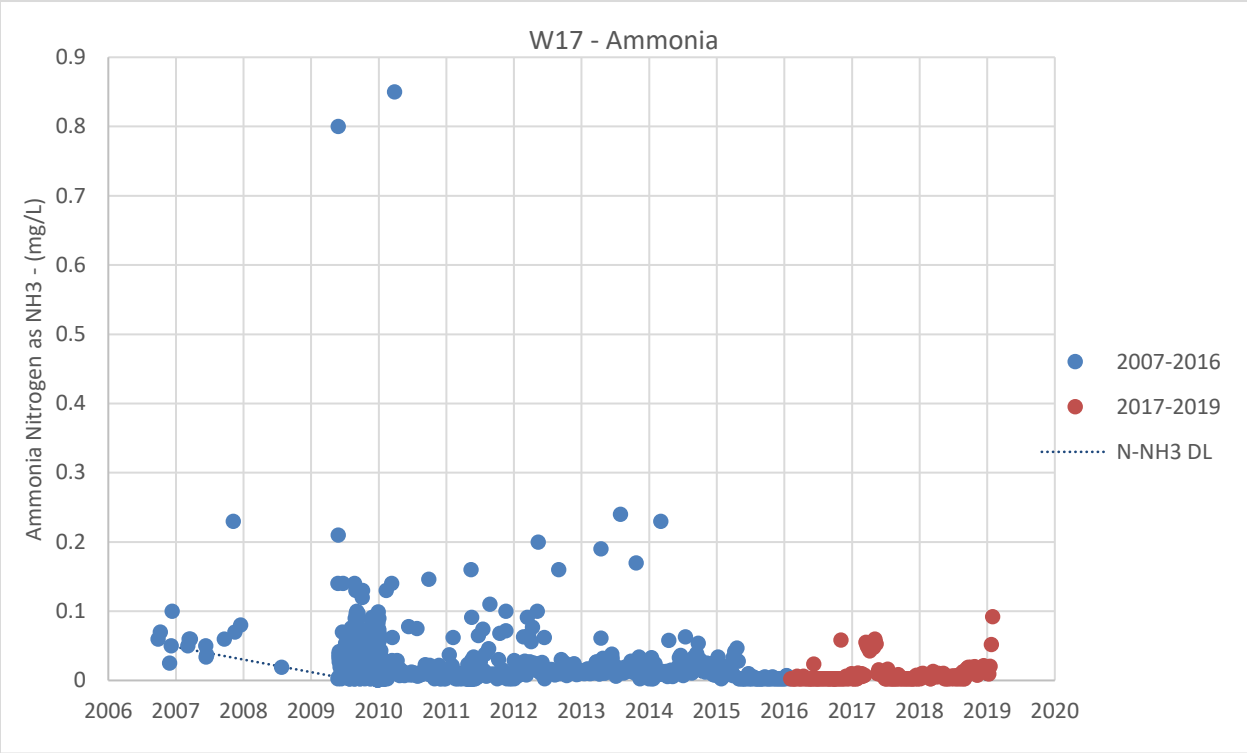


Figure 7-53: W17 Ammonia

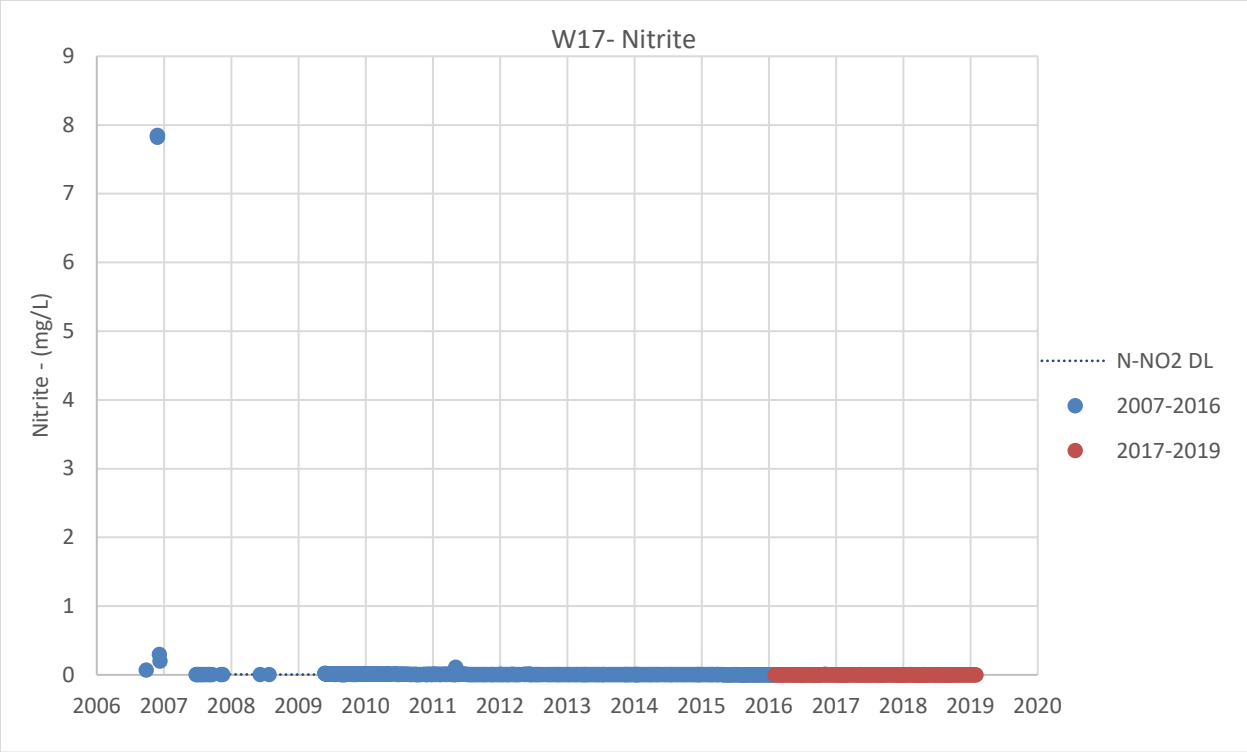


Figure 7-54: W17 Nitrite

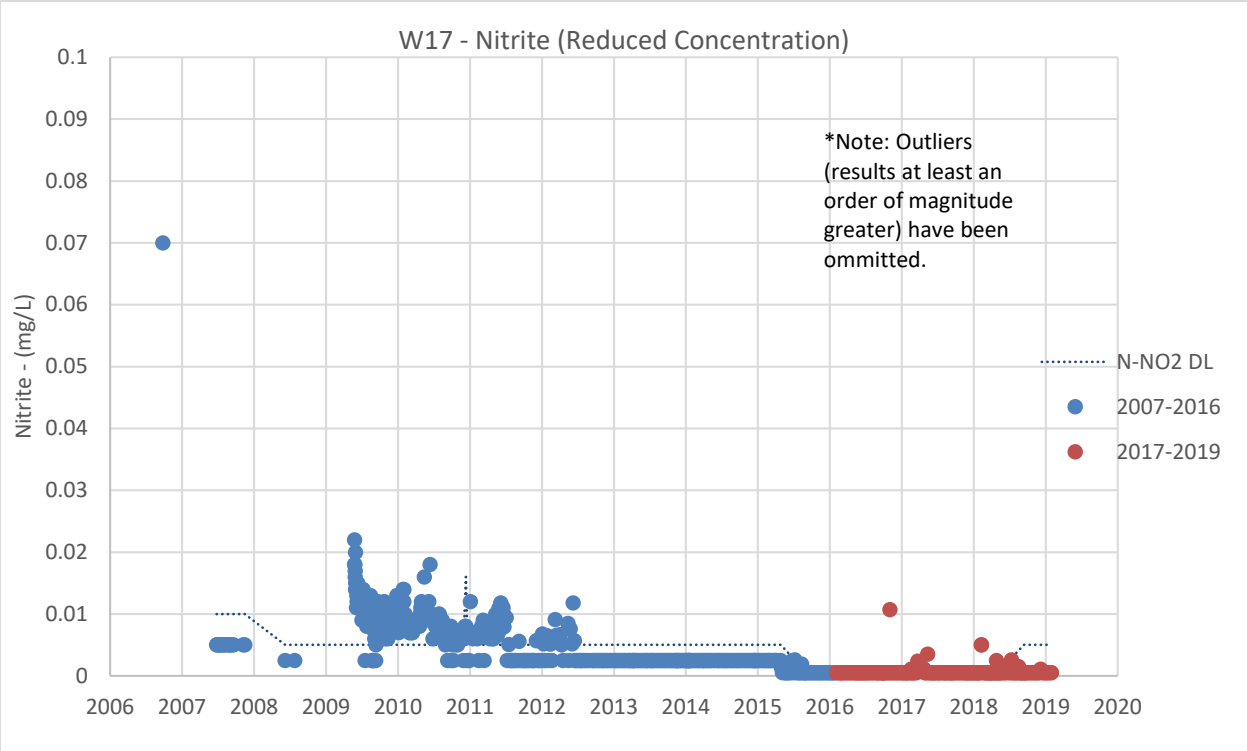


Figure 7-55: W17 Nitrite (Reduced Concentration)

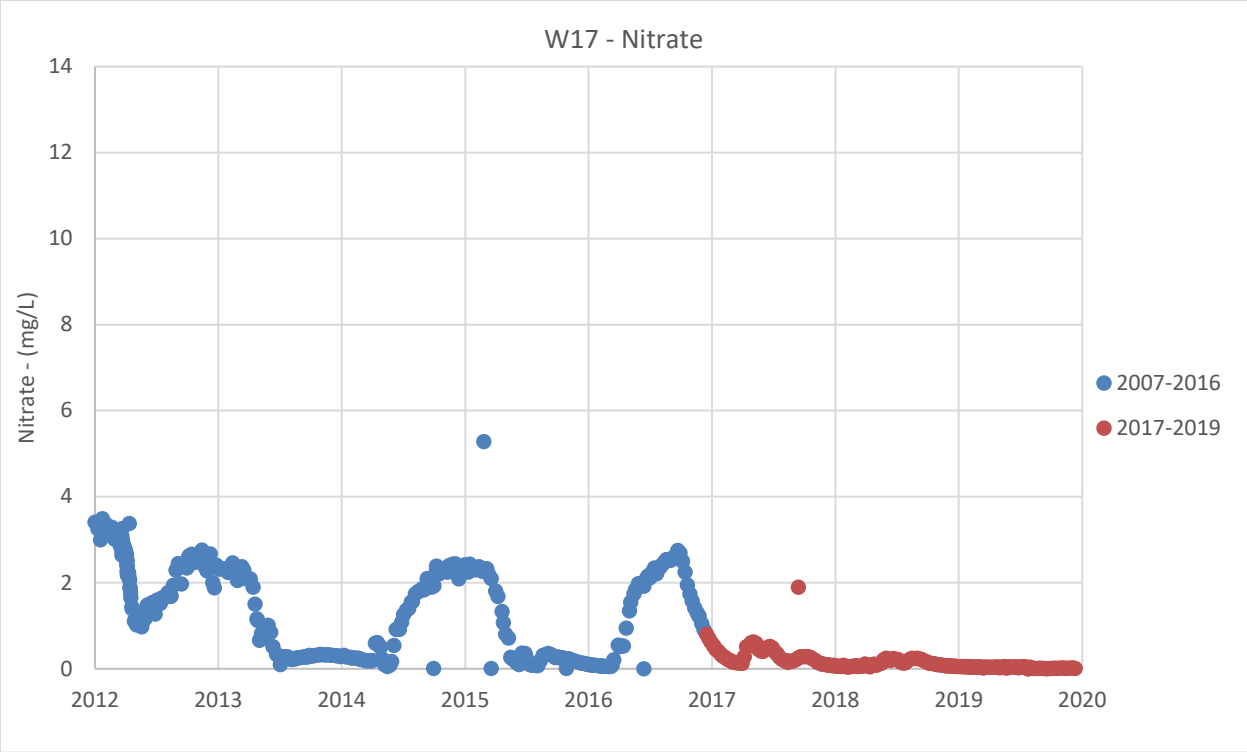


Figure 7-56: W17 Dissolved Nitrate

7.5 Dry Stack Tailings Storage Facility (DSTSF)

During spring 2019, two recurring sites were observed flowing, SS17, SS45 and SS60, additionally two new stations were identified SS68 and SS69. During the fall survey, water was found active only at SS9 and SS53. Due to unpredicted data loss in the GPS device the new locations could not be recorded, Minto Environment is hoping to be able to find the sites during the 2020 seepage survey. Previously, water has flowed along the tailings diversion ditch road and down the toe of the south side of the DSTSF. Historical water quality results and 2019 seepage surveys results for the DSTSF-associated seepage sites (SS9, SS10, SS17, SS18, SS19, SS34, SS35, SS36, SS45, SS60, SS61, SS100 and SS104) are outlined in Figure 7-57 through Figure 7-63 and include results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate. The DSTSF were in process of progressive reclamation in summer 2018 which might have changed the flow paths in this area.

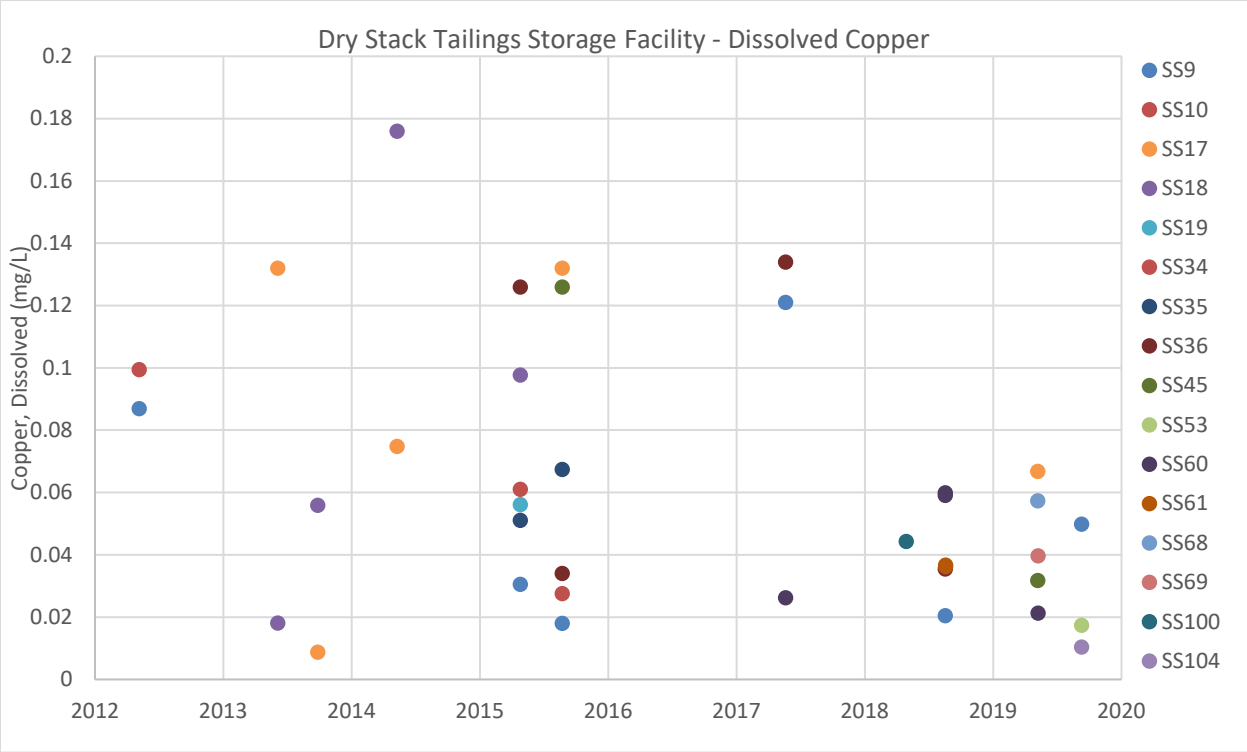


Figure 7-57: Dry Stack Tailings Storage Facility Seepage Sites - Dissolved Copper

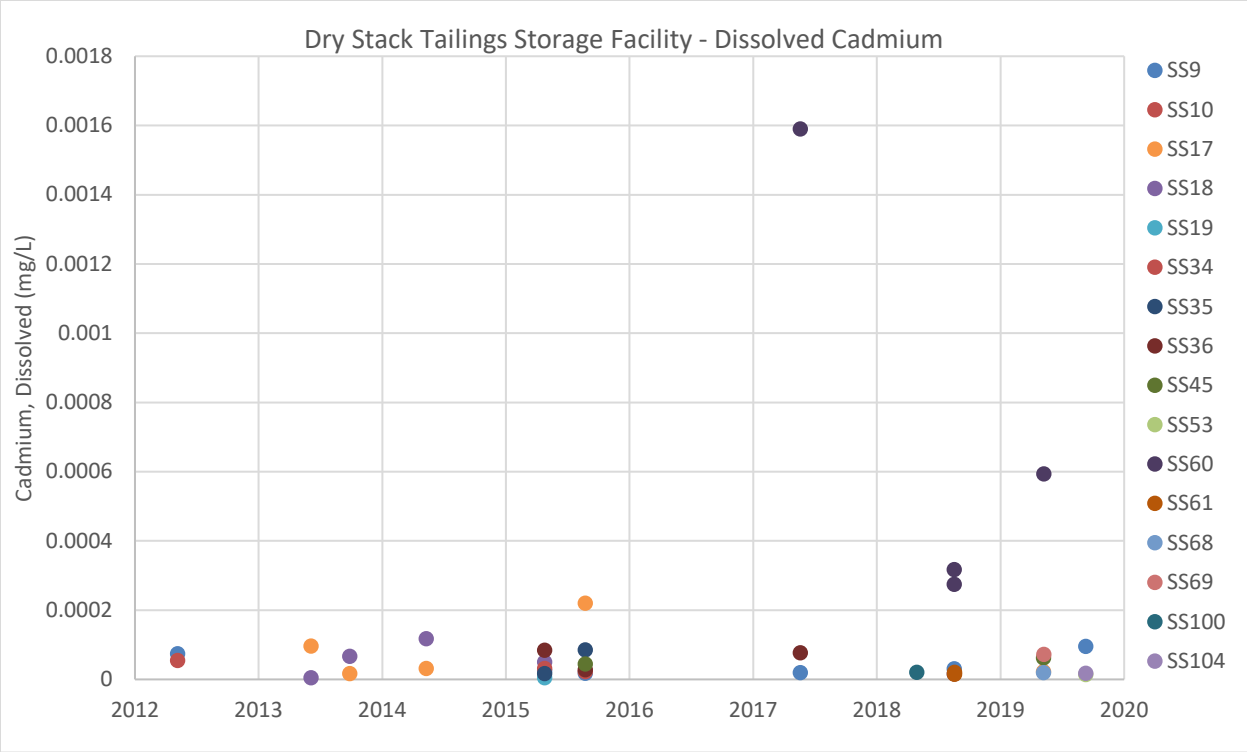


Figure 7-58: Dry Stack Tailings Storage Facility Seepage Sites - Dissolved Cadmium

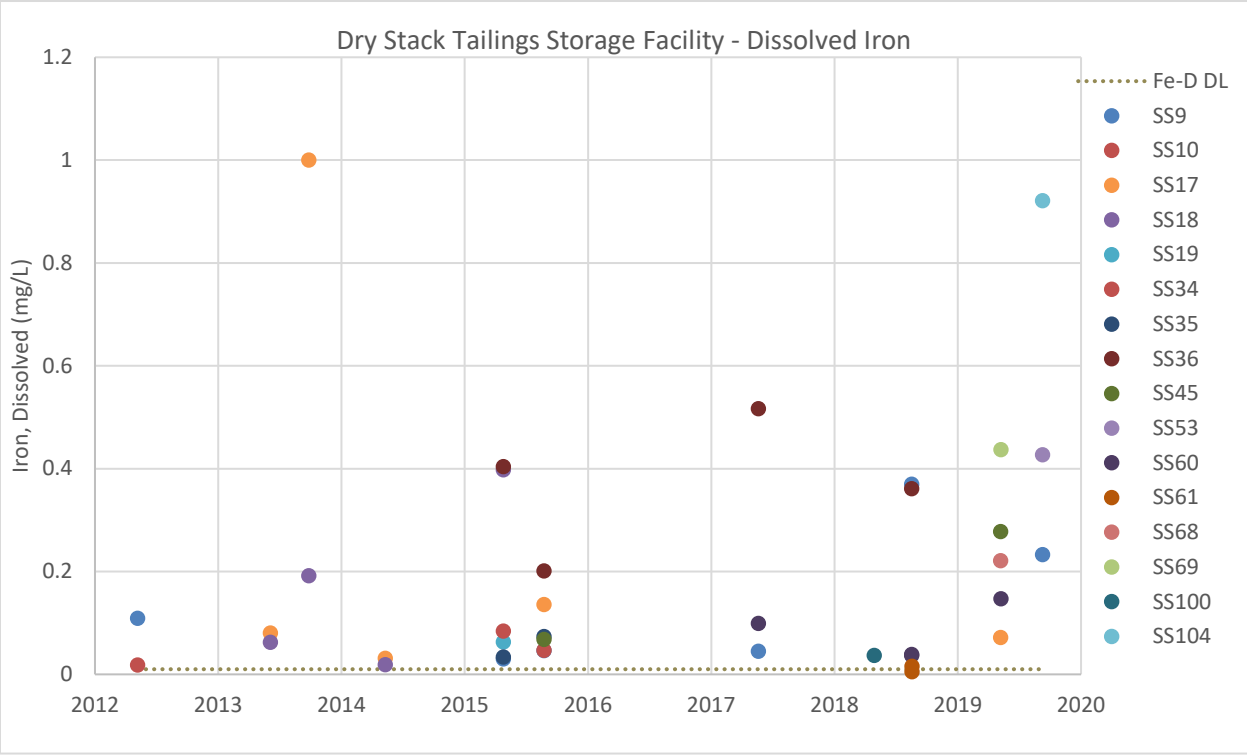


Figure 7-59: Dry Stack Tailings Storage Facility Seepage Sites - Dissolved Iron

DL is Analytical Detection Limit

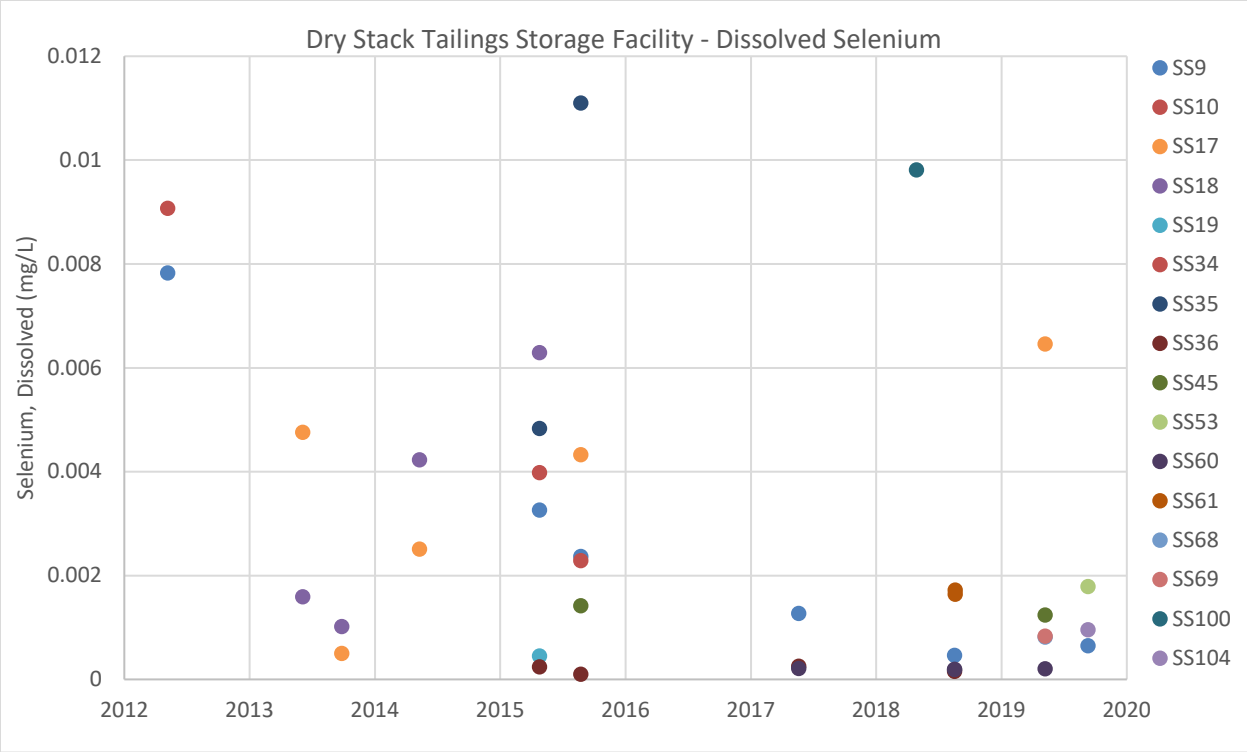


Figure 7-60: Dry Stack Tailings Storage Facility Seepage Sites – Dissolved Selenium

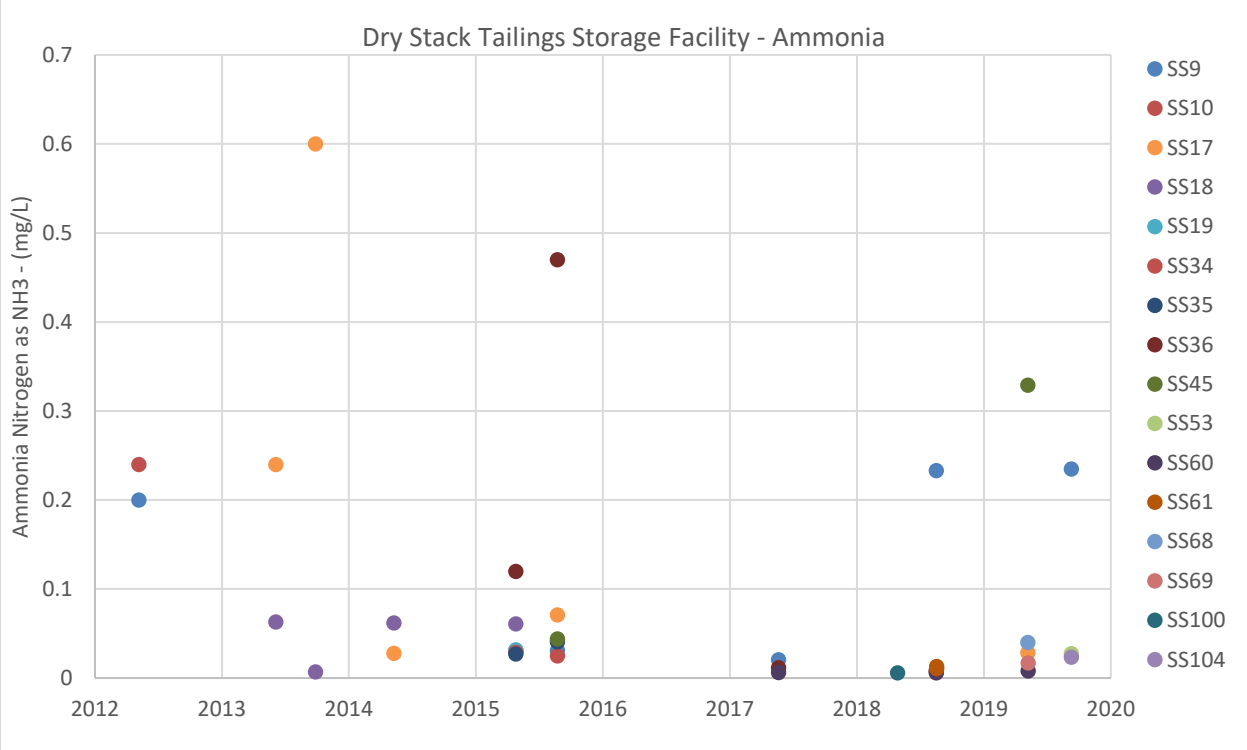


Figure 7-61: Dry Stack Tailings Storage Facility Seepage Sites – Ammonia

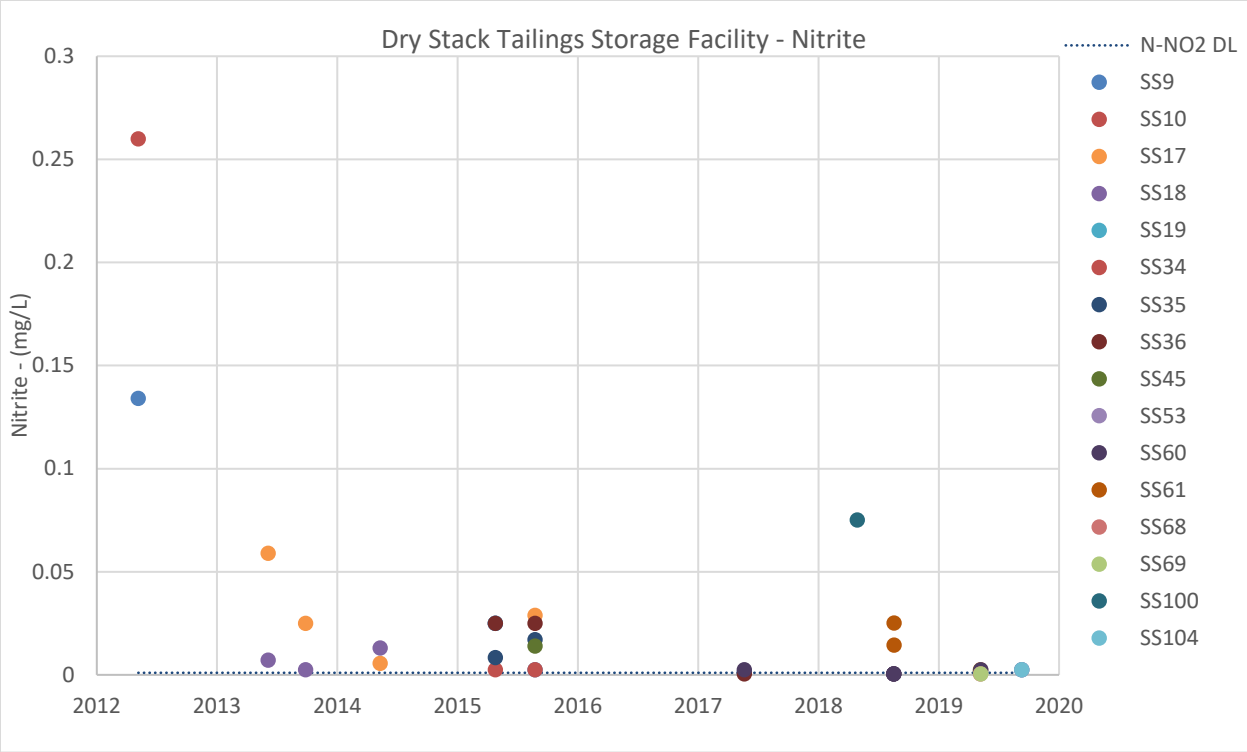


Figure 7-62: Dry Stack Tailings Storage Facility Seepage Sites – Nitrite
DL is Analytical Detection Limit

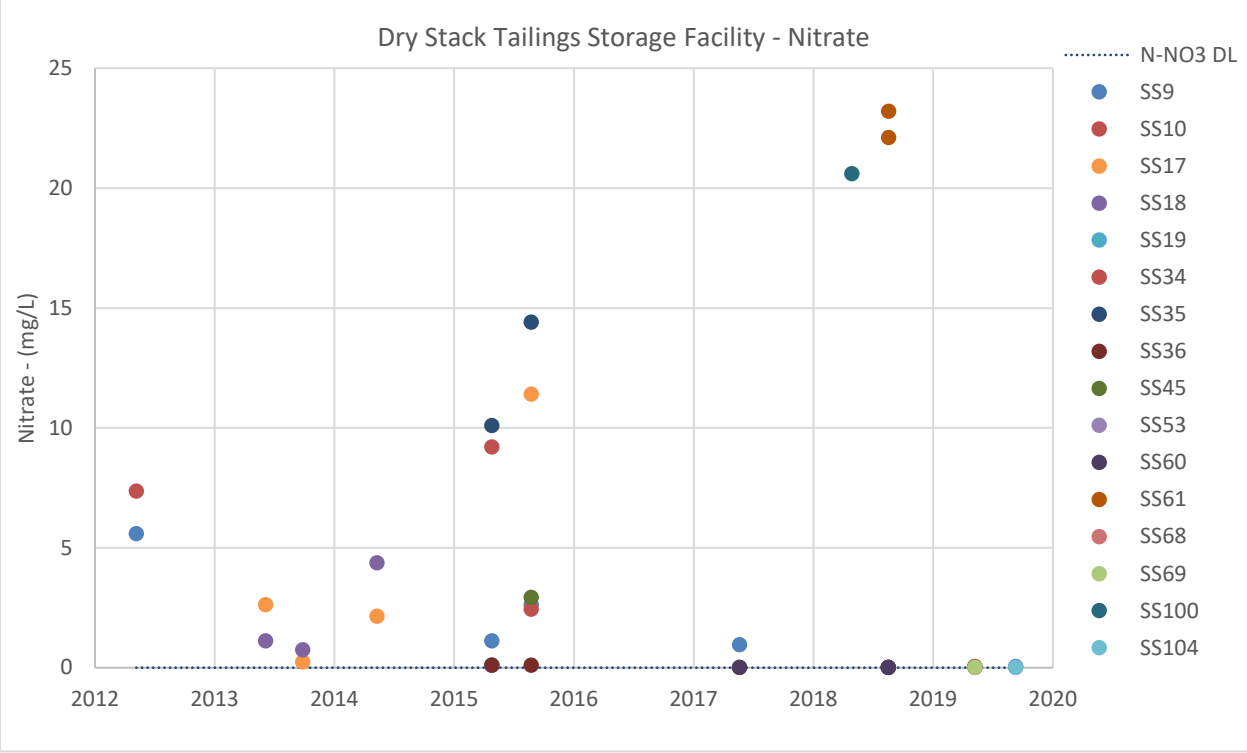


Figure 7-63: Dry Stack Tailings Storage Facility Seepage Sites – Nitrate
DL is Analytical Detection Limit

7.6 Ore Stockpiles

Surface seepage runs along the toe of the west ore stockpile and into the ditch parallel to the heavy vehicle road. All seeps in this area drain into the west ore stockpile sump and are pumped to the Main pit. Only Seepage monitoring stations SS33 was sampled from the stockpile during spring and fall sampling programs, the remaining stations were found dry. Seepage sites SS46 and SS47 at the toe of the underground ore stockpiles were discovered and added to the network in the fall of 2015. Water quality results are outlined in Figure 7-64 through Figure 7-71 and include historic water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

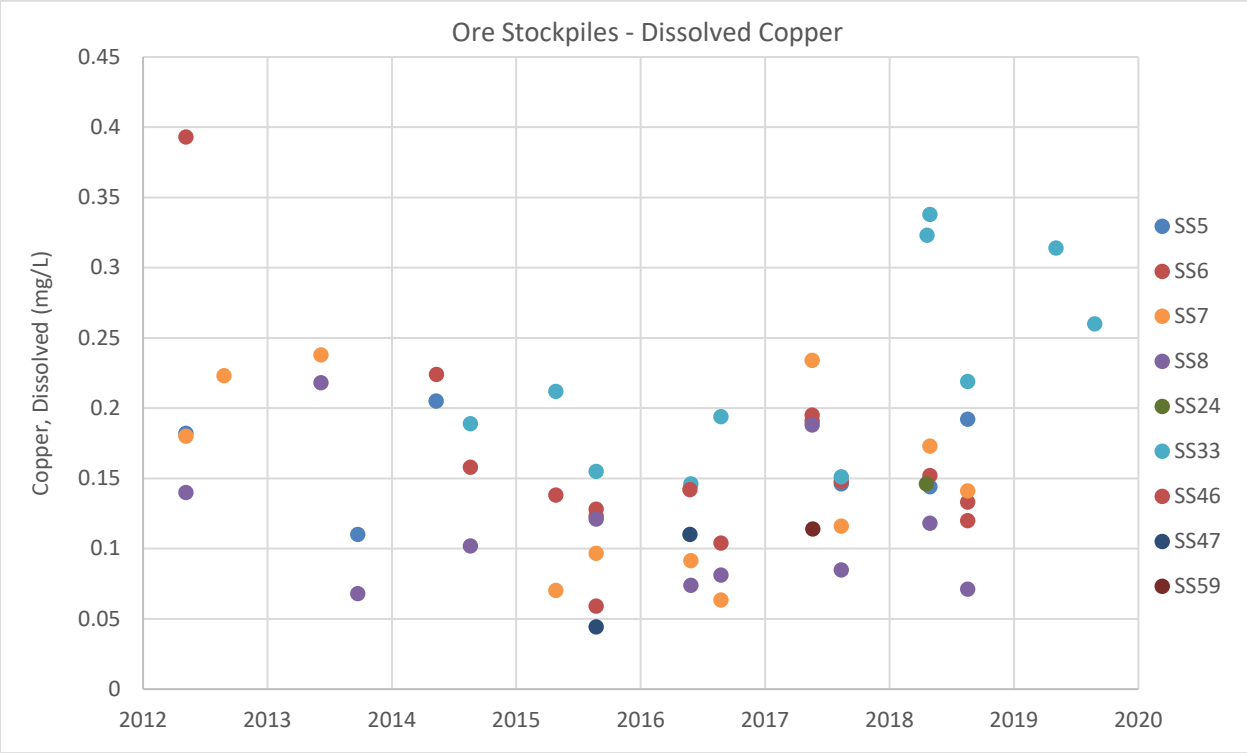


Figure 7-64: Ore Stockpile Sites - Dissolved Copper

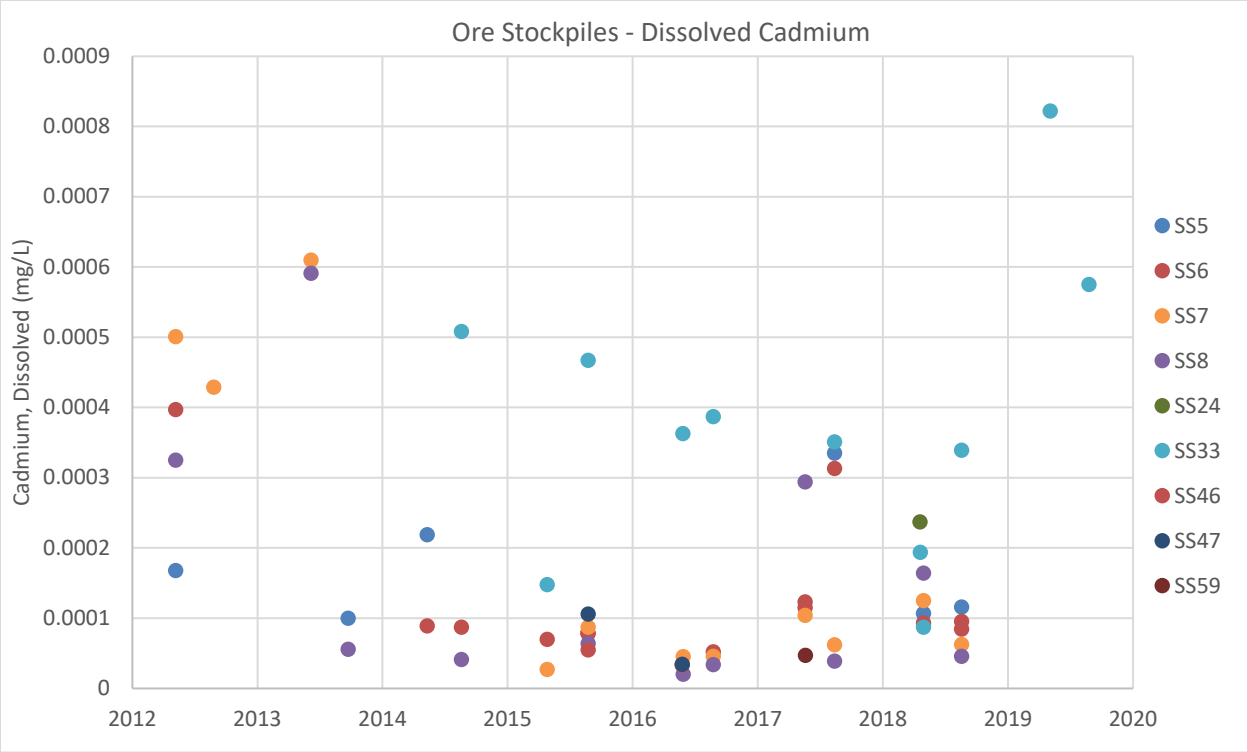


Figure 7-65: Ore Stockpile Sites - Dissolved Cadmium

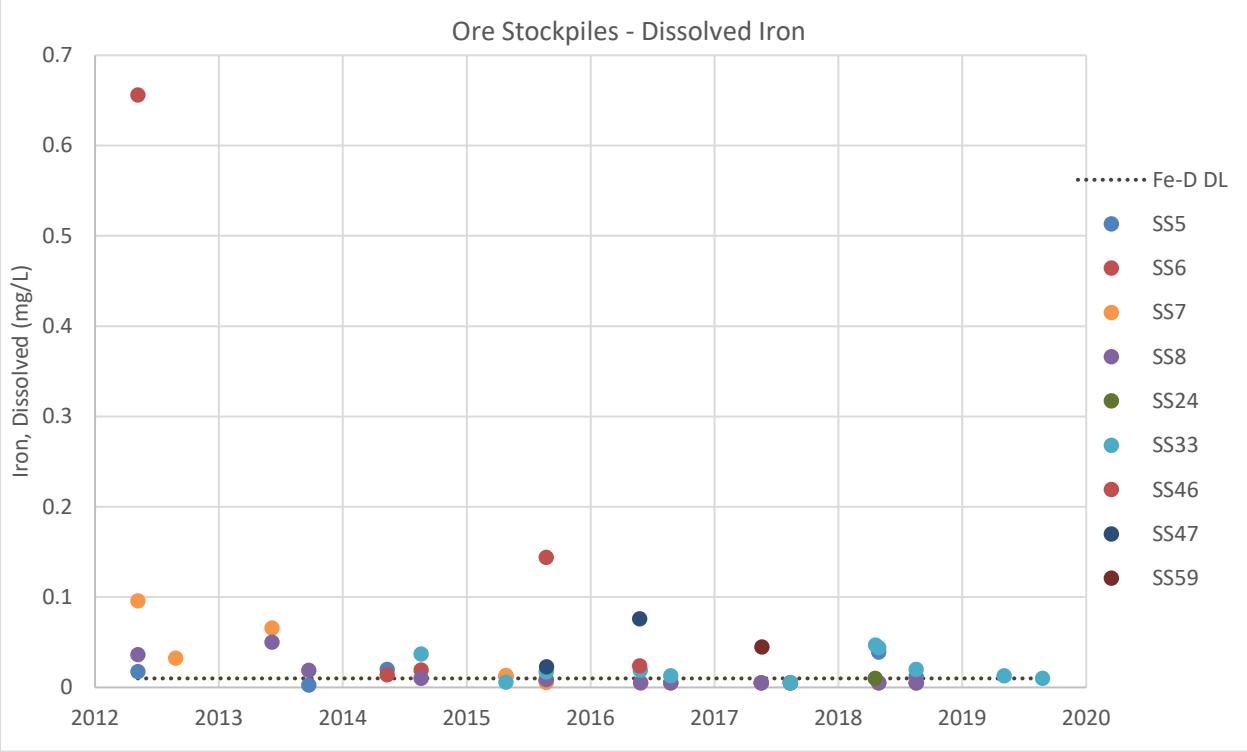


Figure 7-66: Ore Stockpile Sites - Dissolved Iron
DL is Analytical Detection Limit

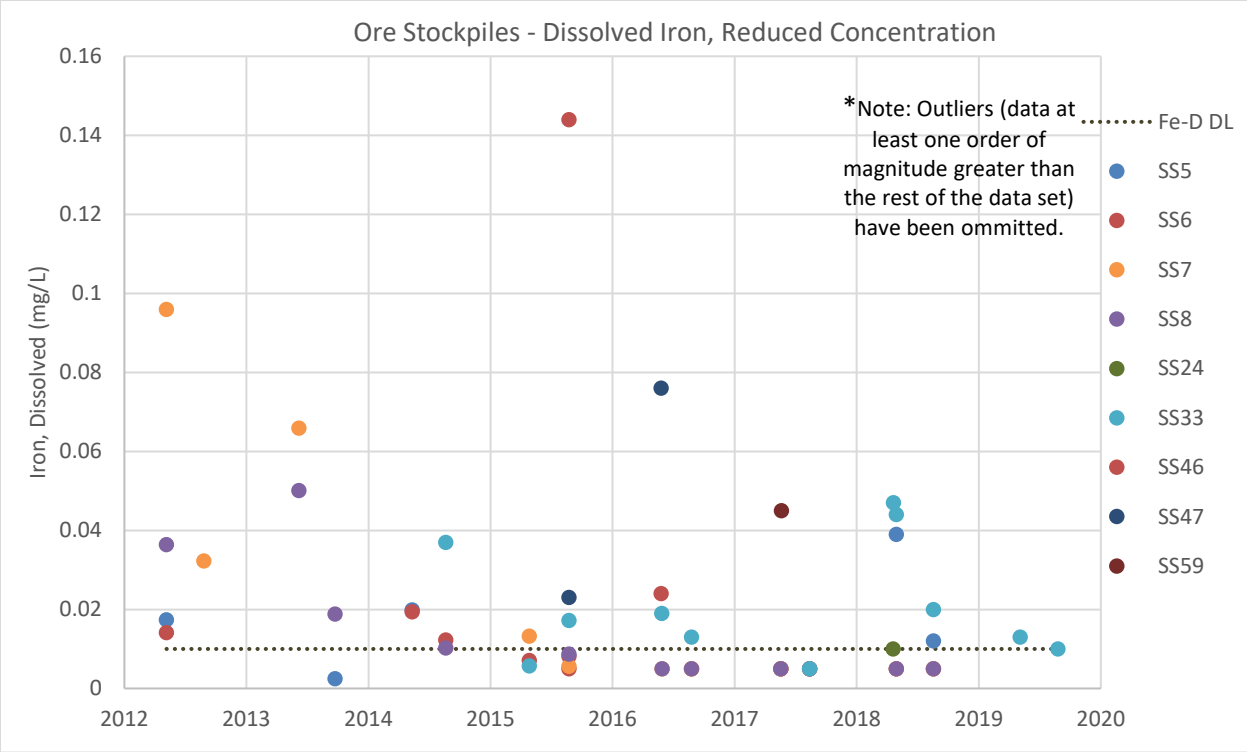


Figure 7-67: Ore Stockpile Sites - Dissolved Iron (Reduced Concentration)
DL is Analytical Detection Limit

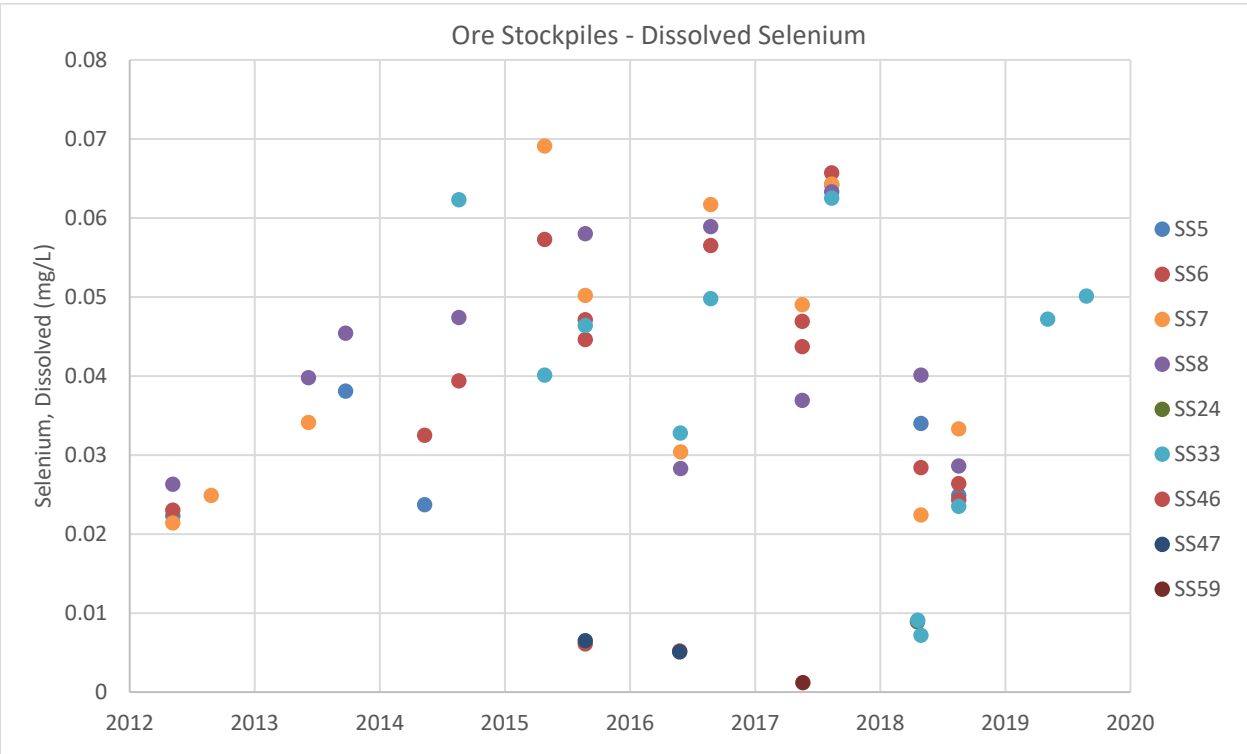


Figure 7-68: Ore Stockpile Sites - Dissolved Selenium

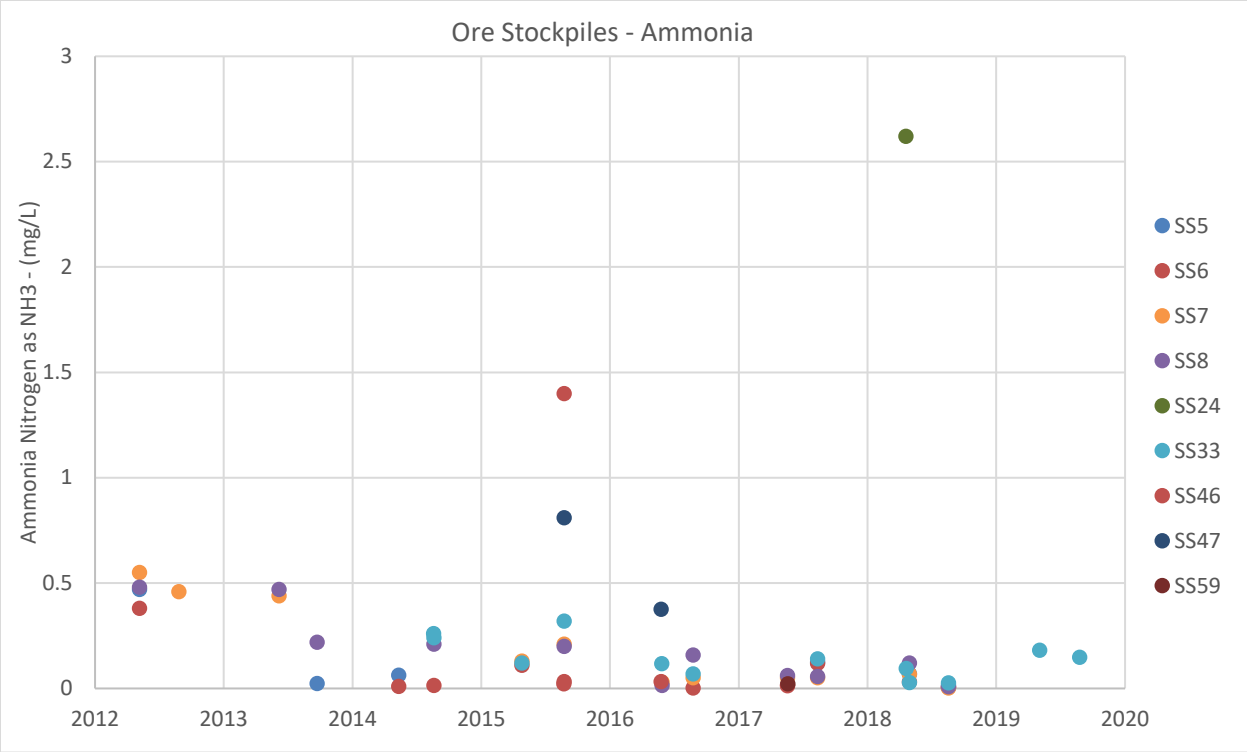


Figure 7-69: Ore Stockpile Sites - Ammonia

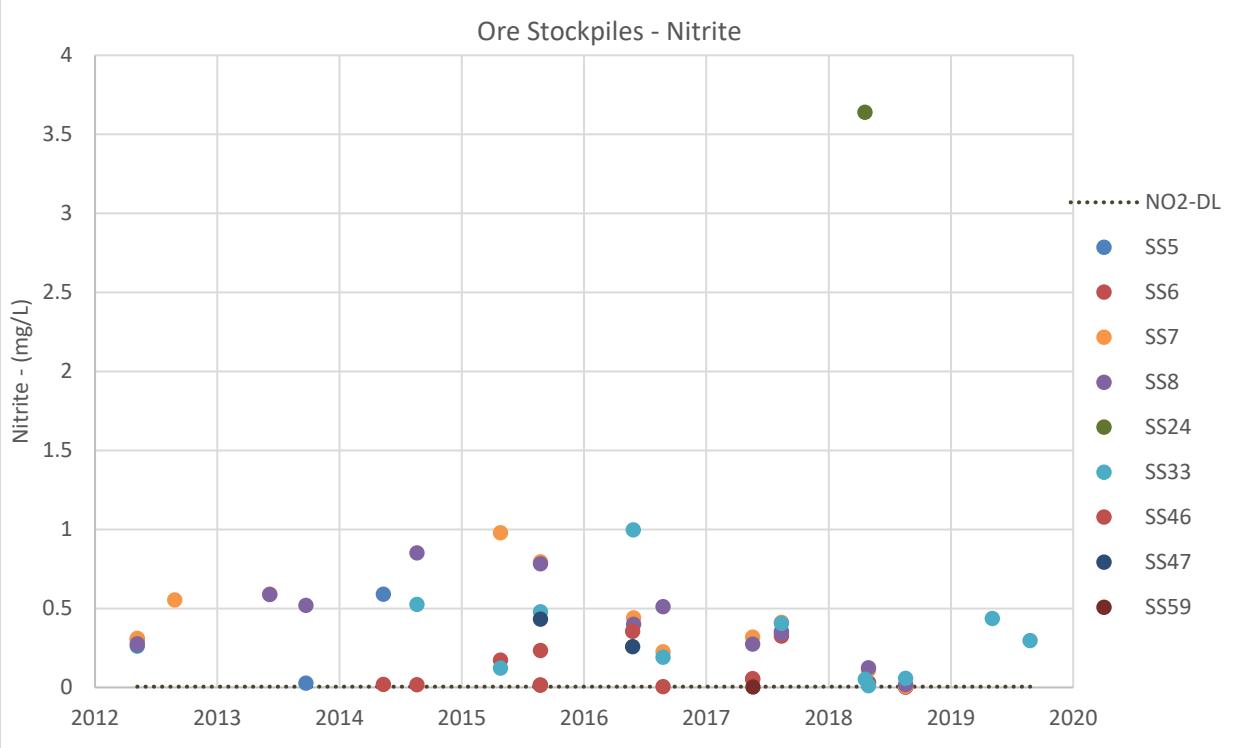


Figure 7-70: Ore Stockpile Sites - Nitrite
DL is Analytical Detection Limit

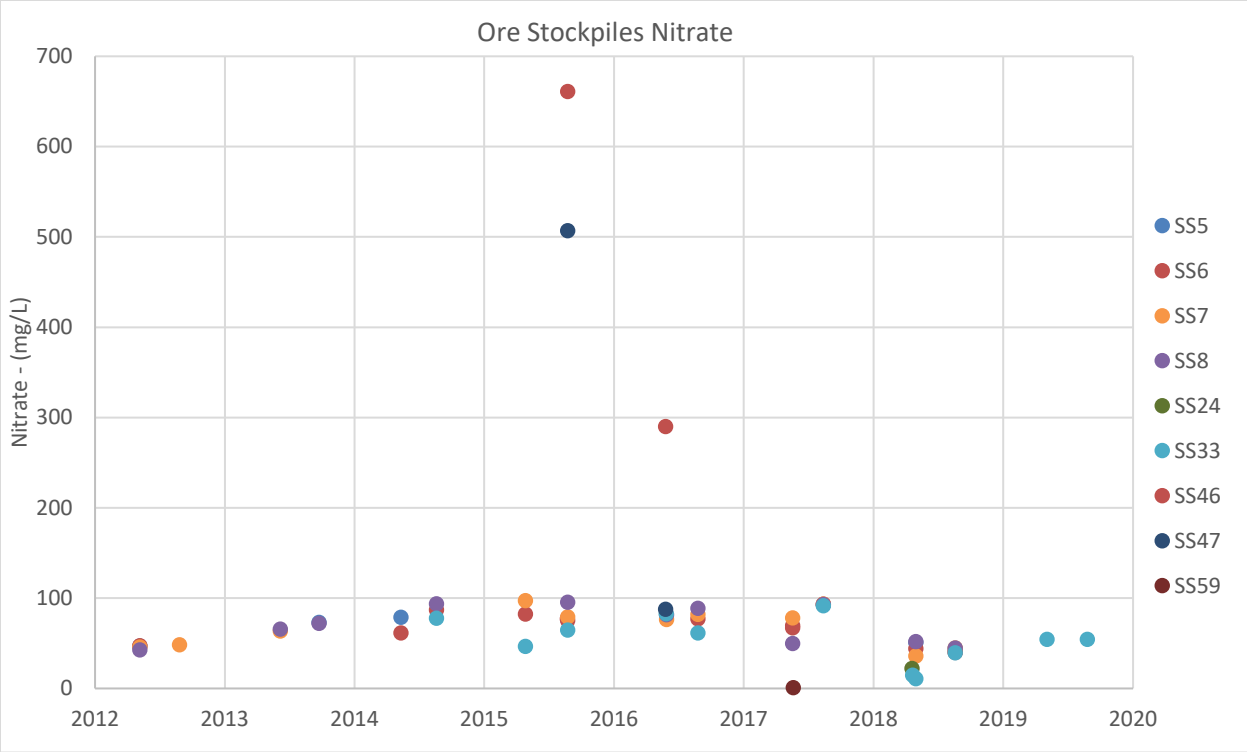


Figure 7-71: Ore Stockpile Sites - Nitrate

7.7 Reclamation Overburden Dump (ROD)

In the 2017 Seepage Monitoring Survey, no water samples were collected from sites SS2, SS3, SS11, SS14, and SS15. All sites along the ROD were observed to be dry during the 2014, 2015, 2016 and 2017 surveys. The survey here was proposed to be canceled and therefore, in 2018 and 2019 the ROD was not surveyed.

7.8 Main Waste Dump and Minto North

SS101 was active during spring 2019, and SS102 was active during fall 2019. The other existing seep (SS12) was observed to be dry during both sampling events in 2019. Historical data is presented in Figure 7-72 through Figure 7-78 and include water quality results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate.

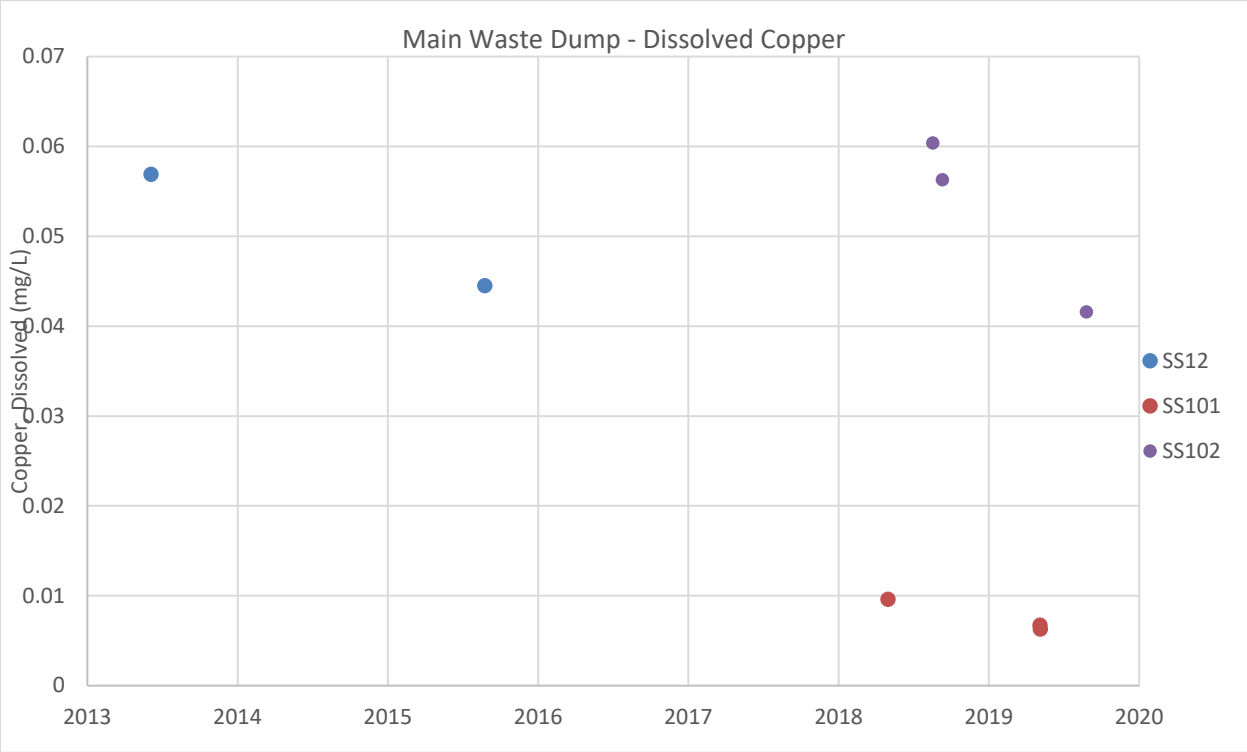


Figure 7-72: Main Waste Dump Sites - Dissolved Copper

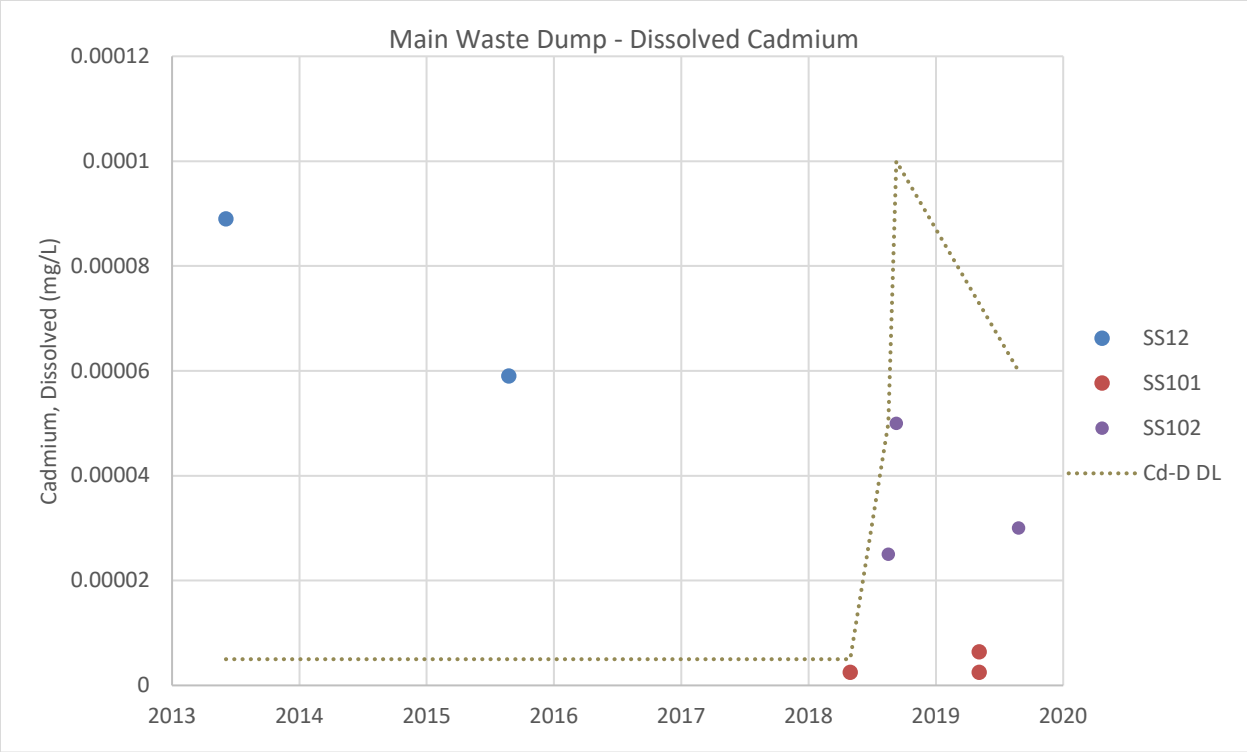


Figure 7-73: Main Waste Dump Sites - Dissolved Cadmium
DL is Analytical Detection Limit

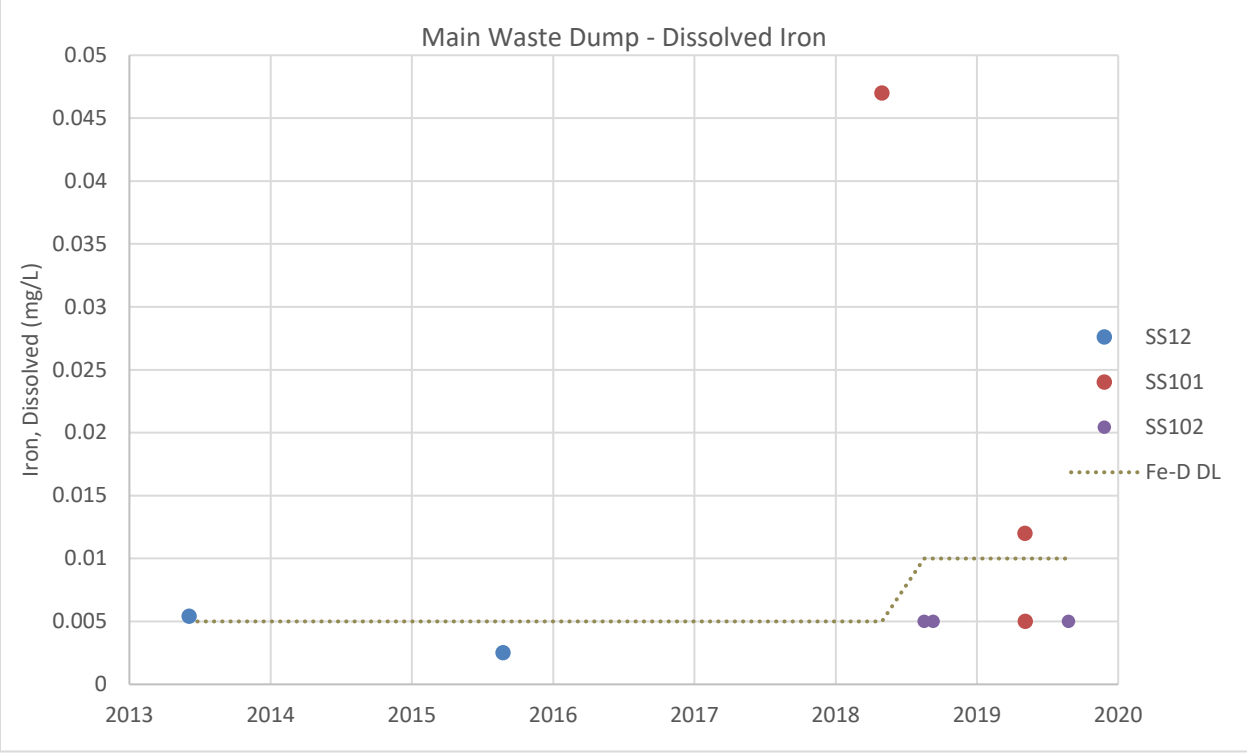


Figure 7-74: Main Waste Dump Sites - Dissolved Iron
DL is Analytical Detection Limit

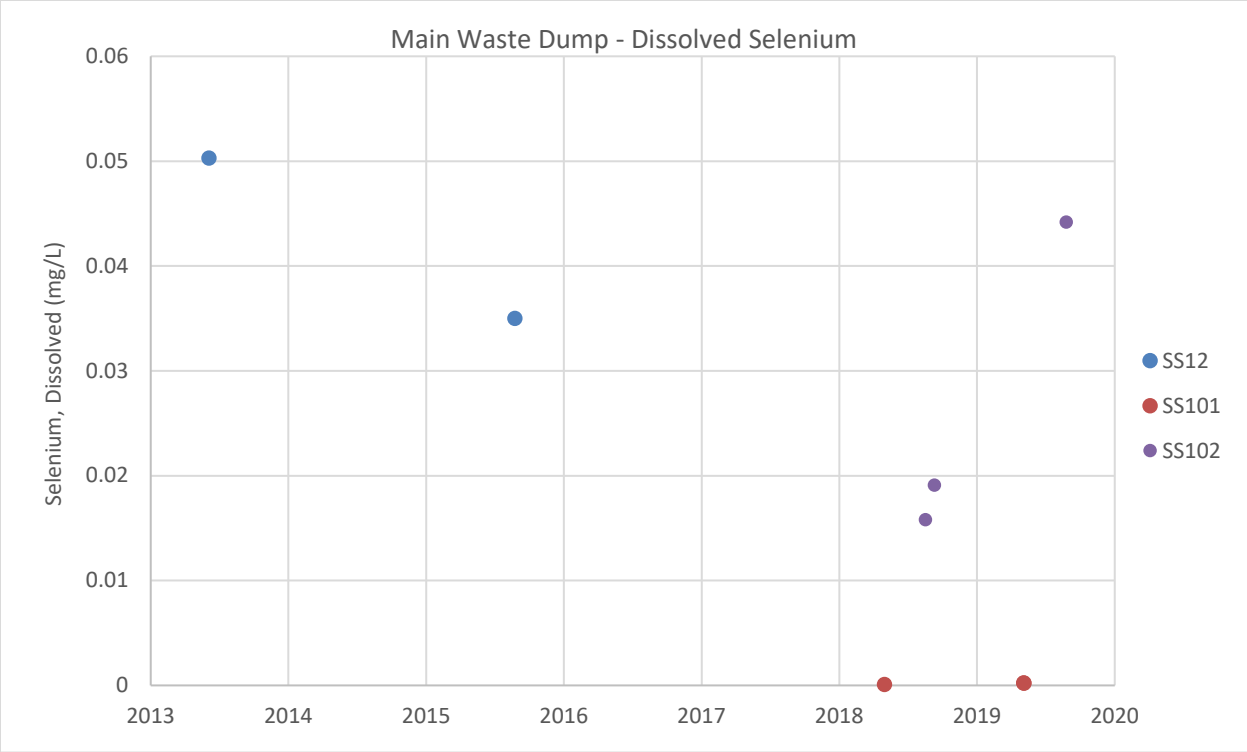


Figure 7-75: Main Waste Dump Sites - Dissolved Selenium

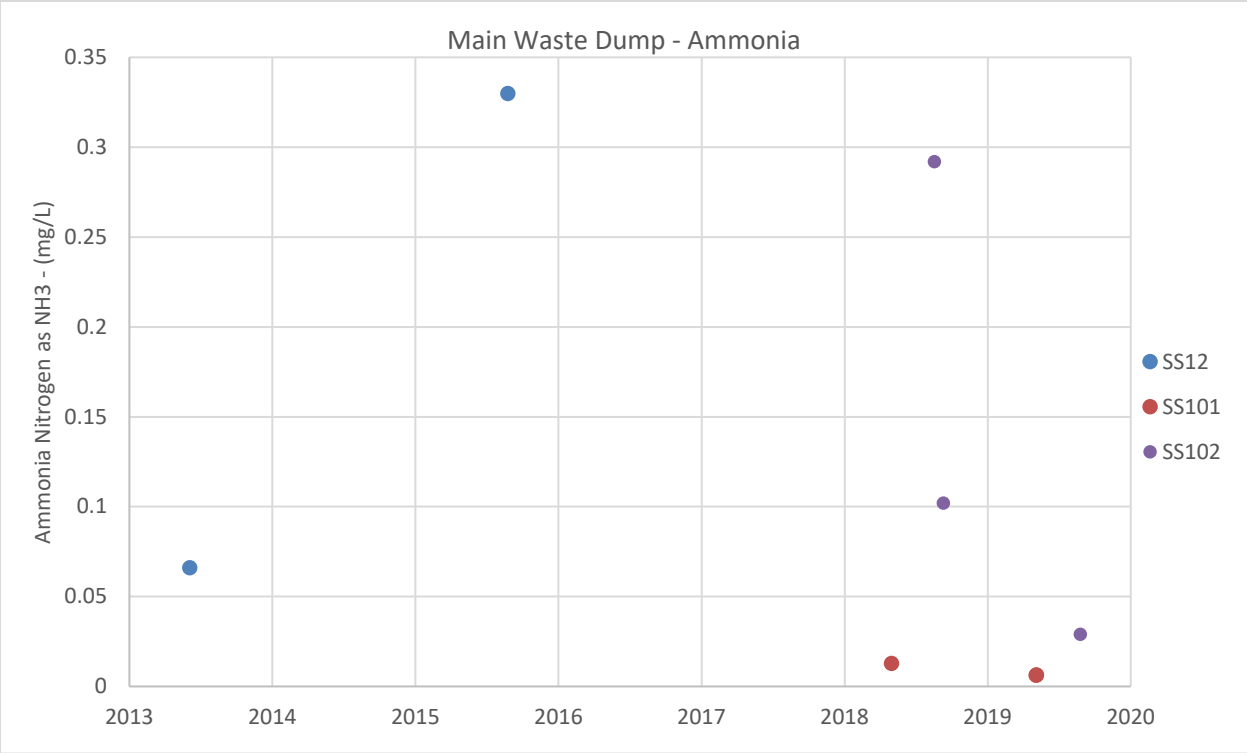


Figure 7-76: Main Waste Dump Sites - Ammonia

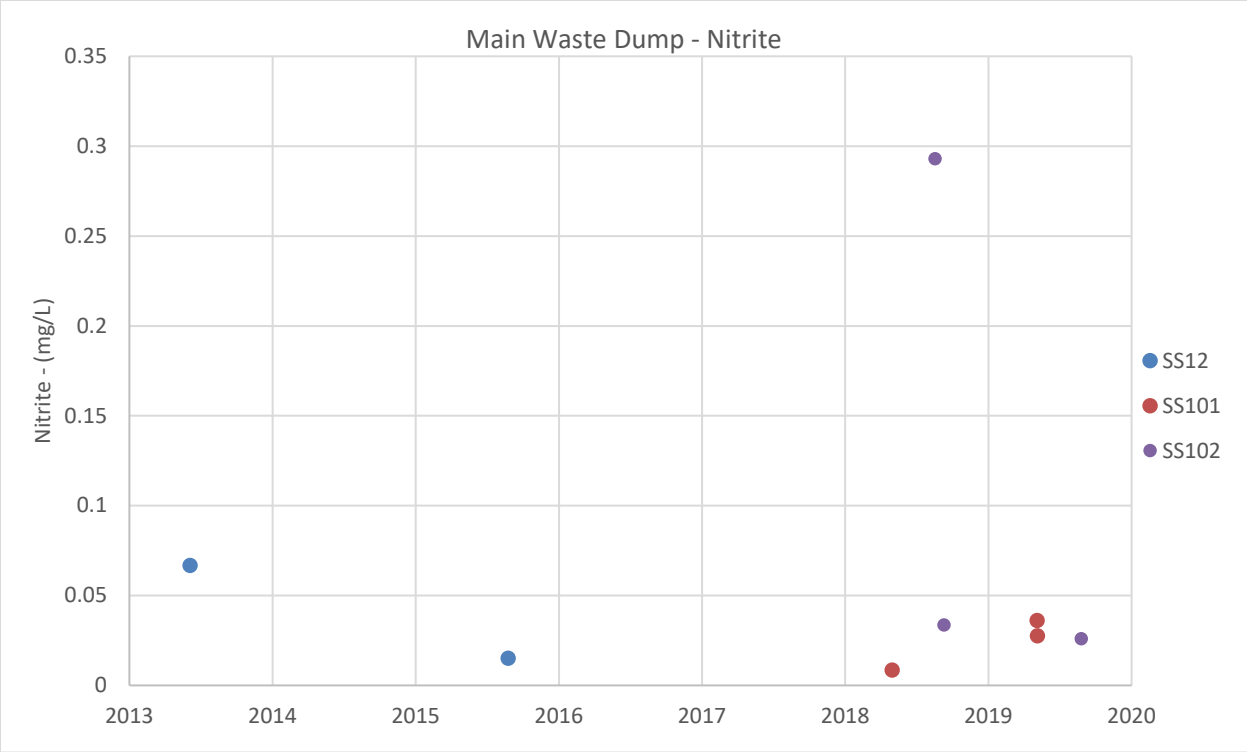


Figure 7-77: Main Waste Dump Sites - Nitrite

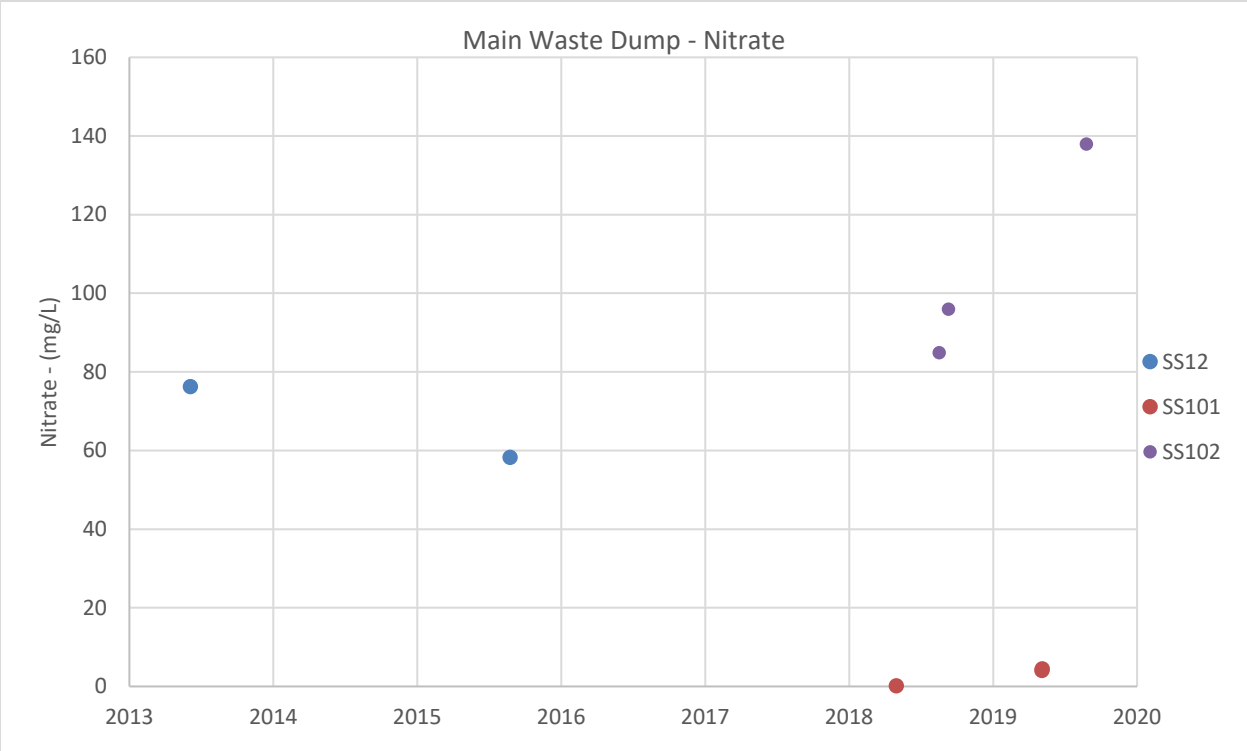


Figure 7-78: Main Waste Dump Sites - Nitrate

7.9 Mill Area

SS32 was discovered in 2014 behind the camp along the mill area survey route. SS32 was sampled in both the spring and fall of 2019 and the results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate are displayed in Figure 7-79 through Figure 7-85 along with historical results. No other seeps were identified along the toe of the north ridge behind the camp and mill.

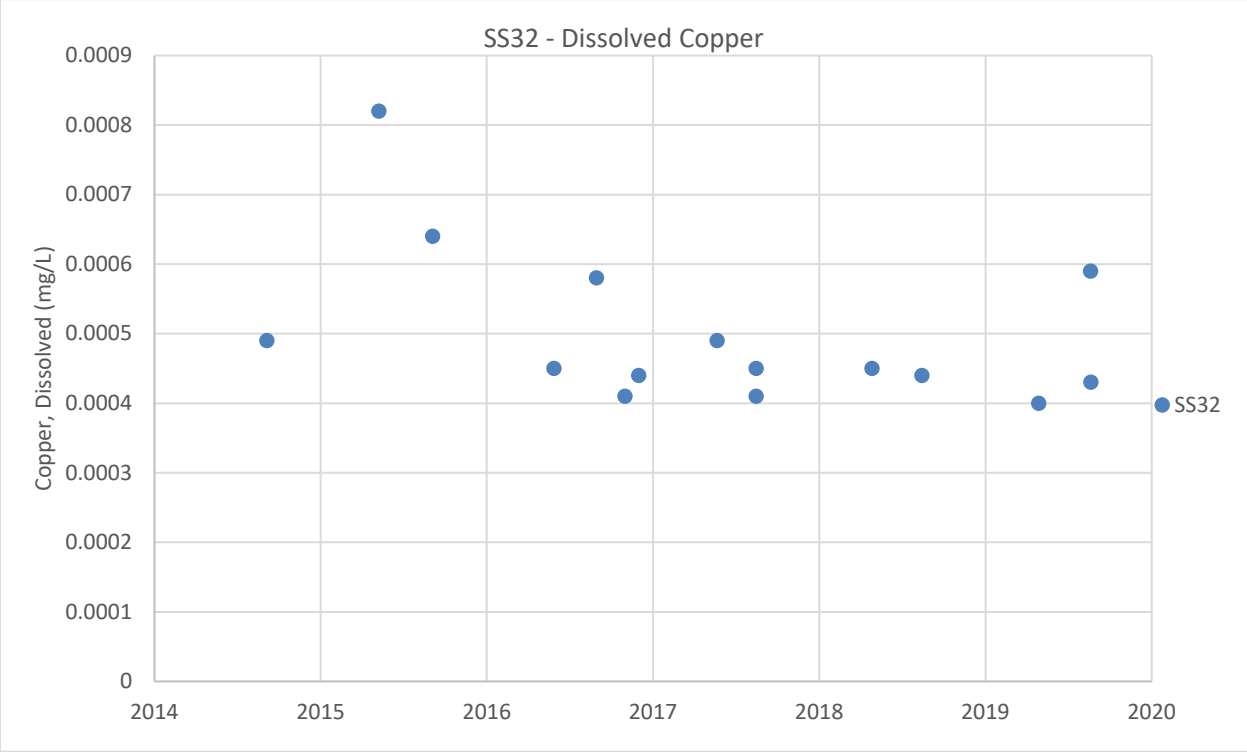


Figure 7-79: SS32 Dissolved Copper

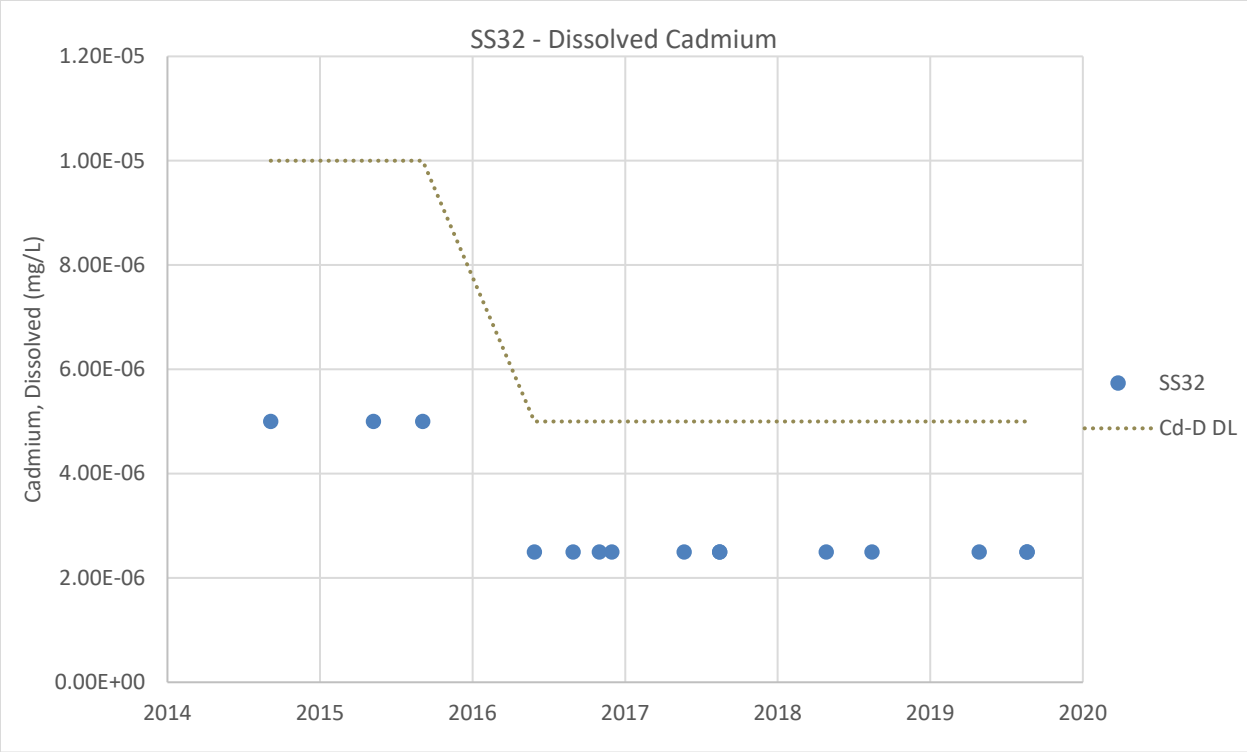


Figure 7-80: SS32 Dissolved Cadmium

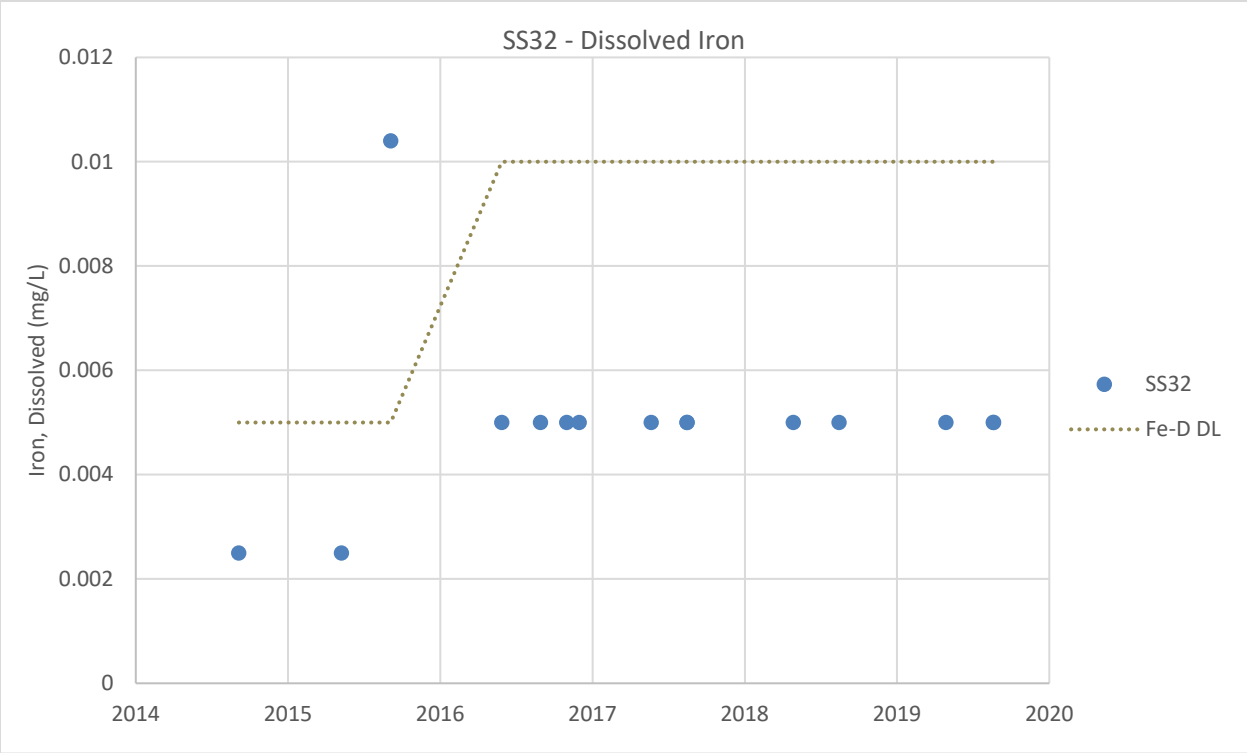


Figure 7-81: SS32 Dissolved Iron

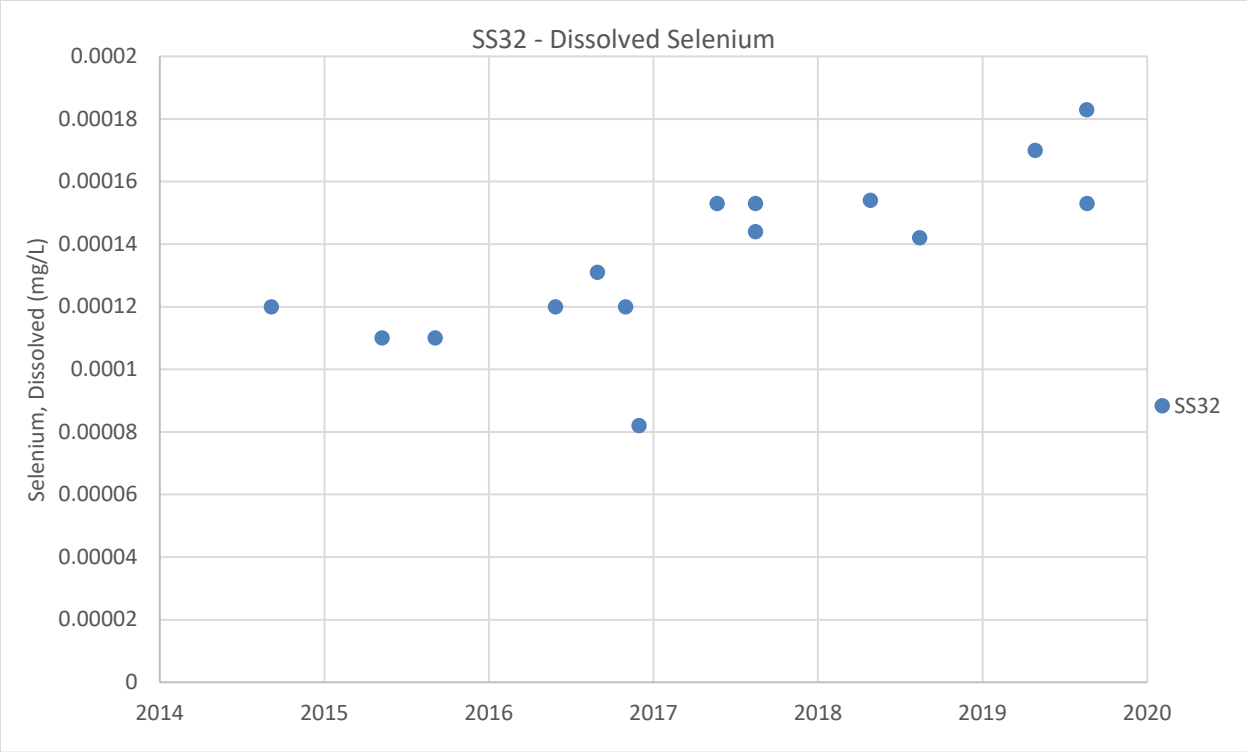


Figure 7-82: SS32 Dissolved Selenium

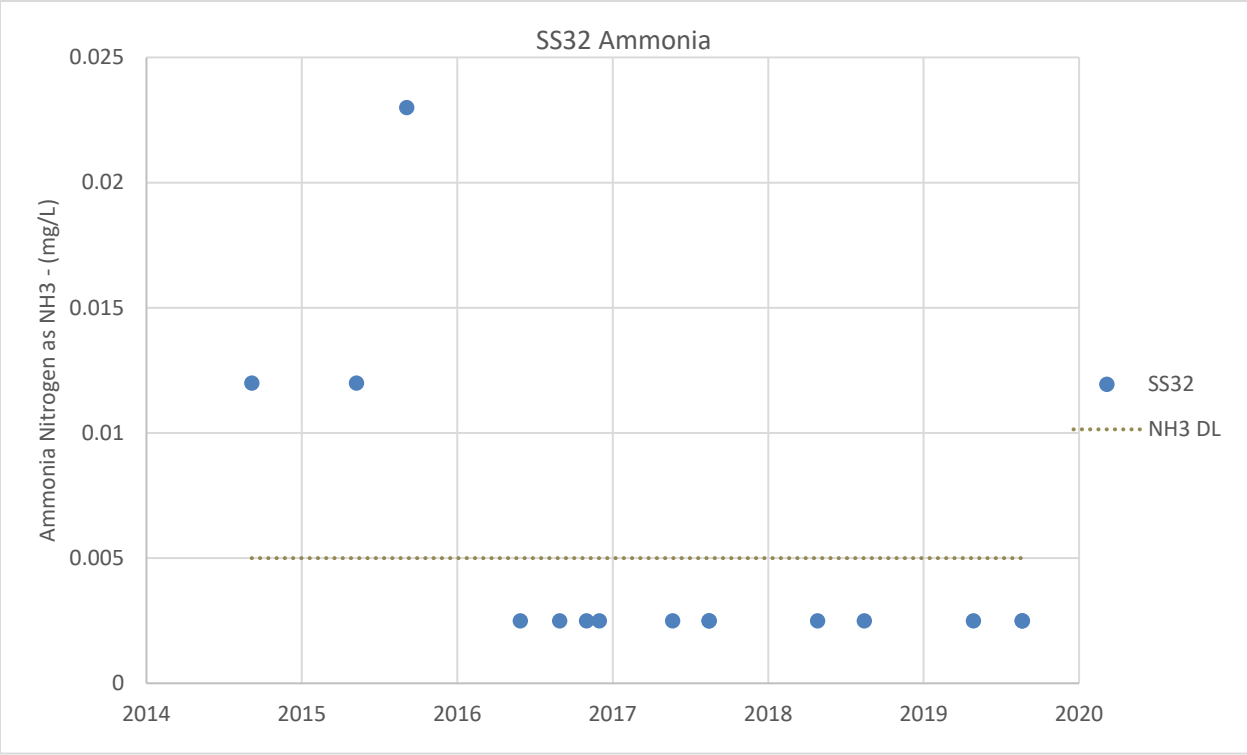


Figure 7-83: SS32 Ammonia
DL is Analytical Detection Limit

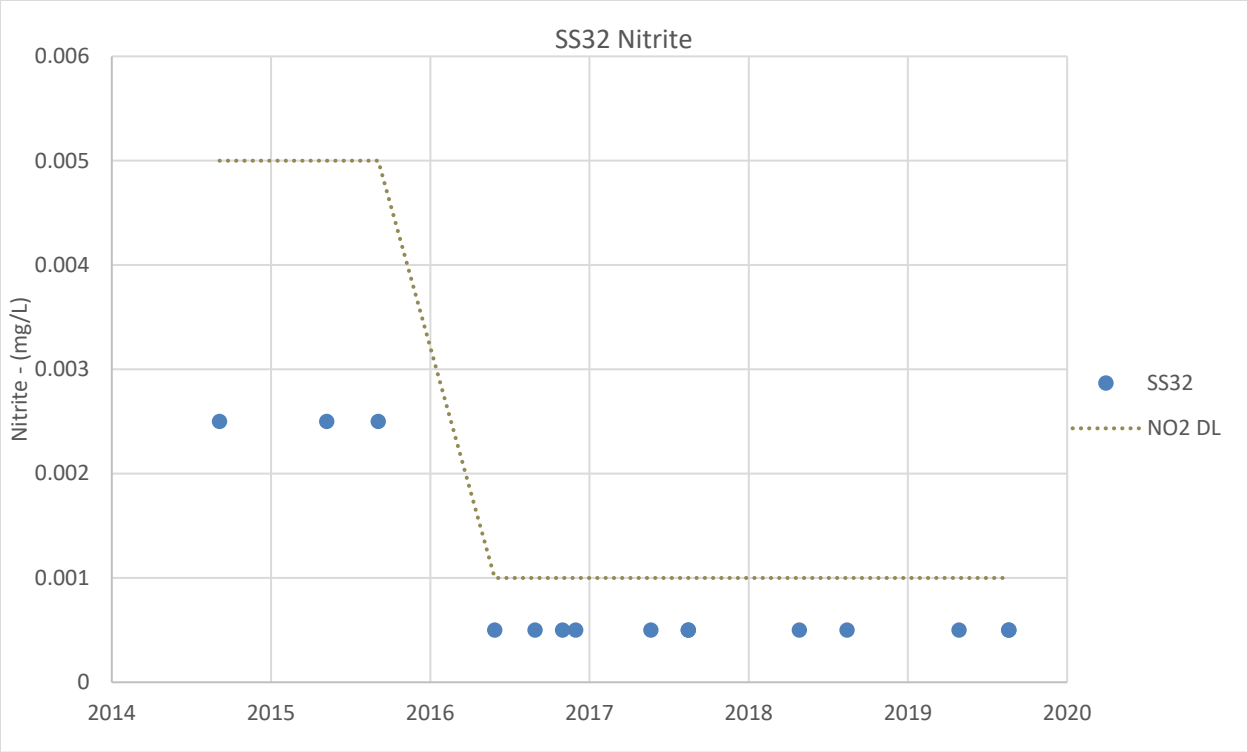


Figure 7-84: SS32 Nitrite
DL is Analytical Detection Limit

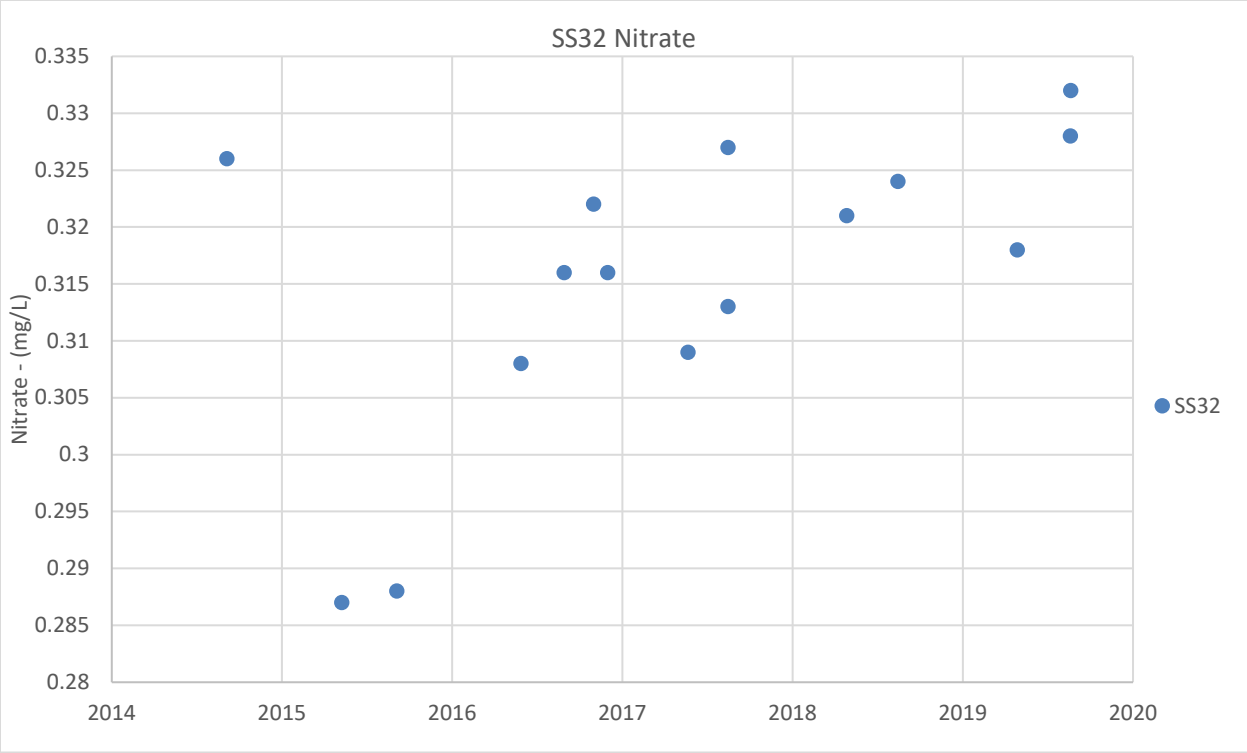


Figure 7-85: SS32 Nitrate

7.10 Ridgetop Road

A survey was conducted along the toe of the new Ridgetop Road, site SS58 was found flowing during the spring survey. SS103 was identified in spring towards the top of the road. W33s is seep which is thought to be replacing the dried W33 site, this site was observed throughout the open-water season. The results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate are displayed in Figure 7-86 through Figure 7-93 along with historical results of other sites within this area. No other seeps were identified along the toe of the road.

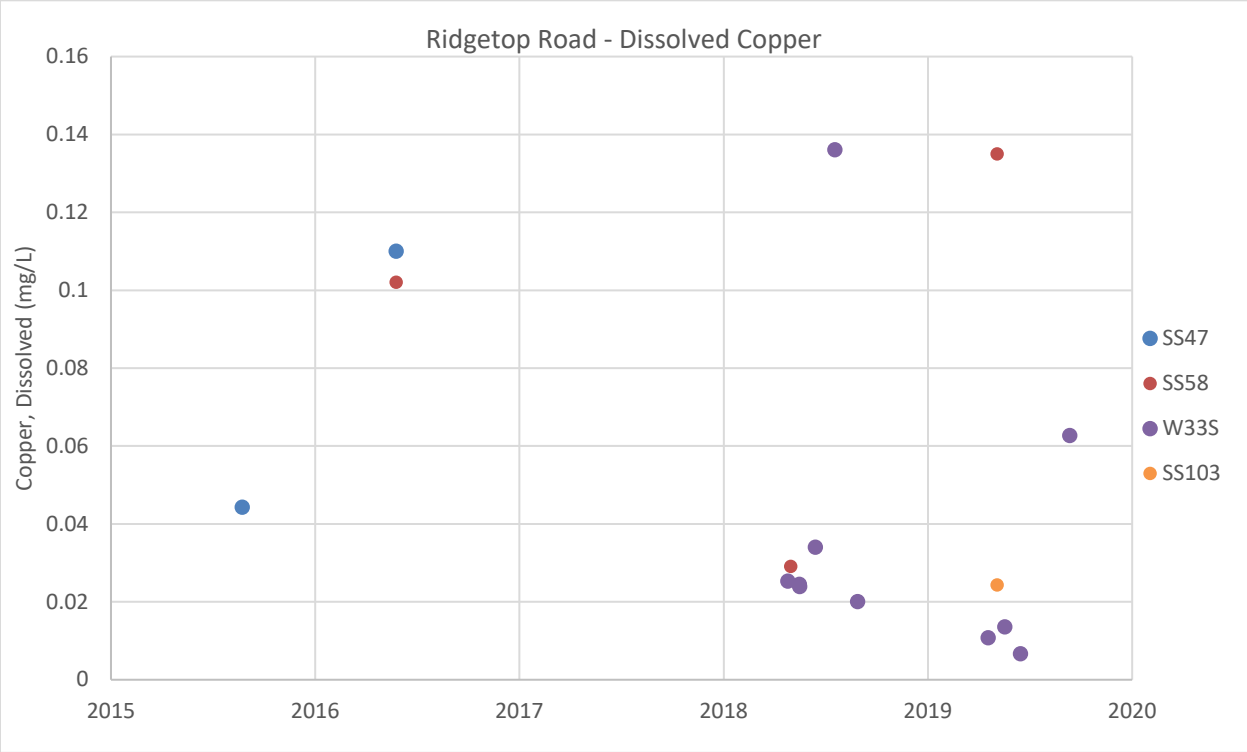


Figure 7-86: Ridgetop Road Sites - Dissolved Copper

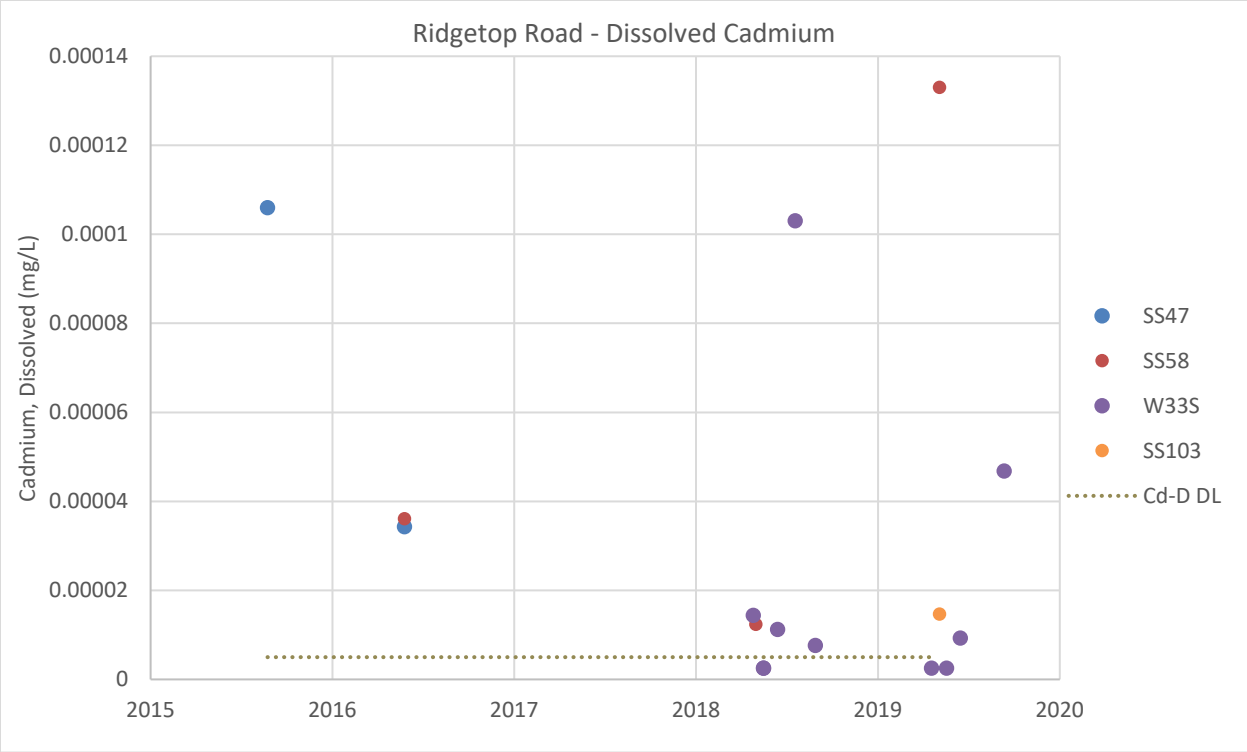


Figure 7-87: Ridgetop Road Sites - Dissolved Cadmium
DL is Analytical Detection Limit

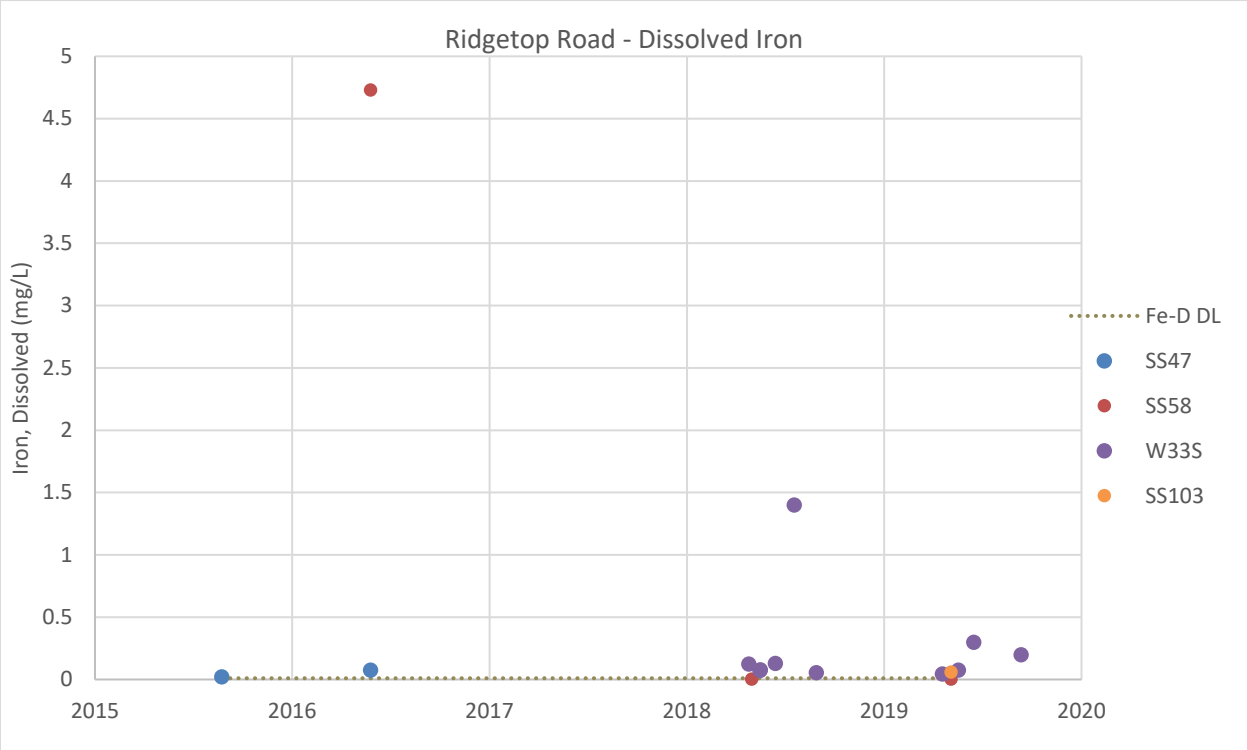


Figure 7-88: Ridgetop Road Sites - Dissolved Iron
DL is Analytical Detection Limit

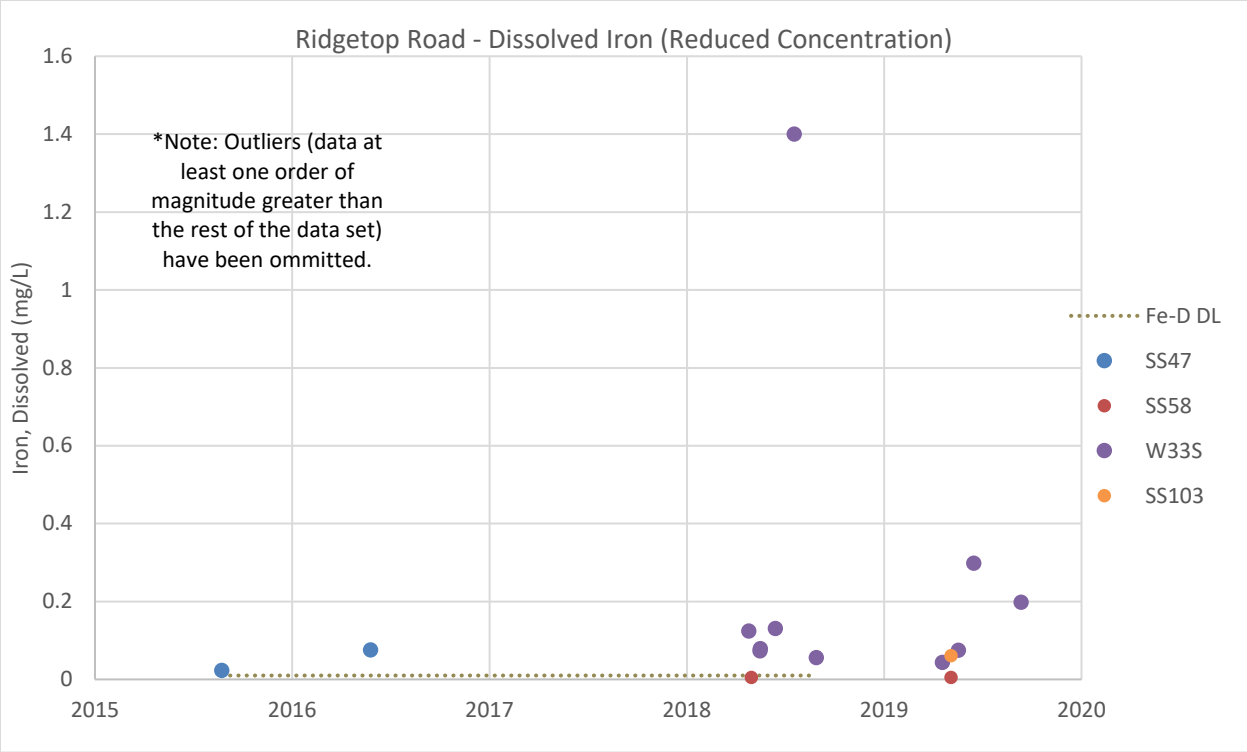


Figure 7-89: Ridgetop Road Sites - Dissolved Iron (Reduced Concentration)
DL is Analytical Detection Limit

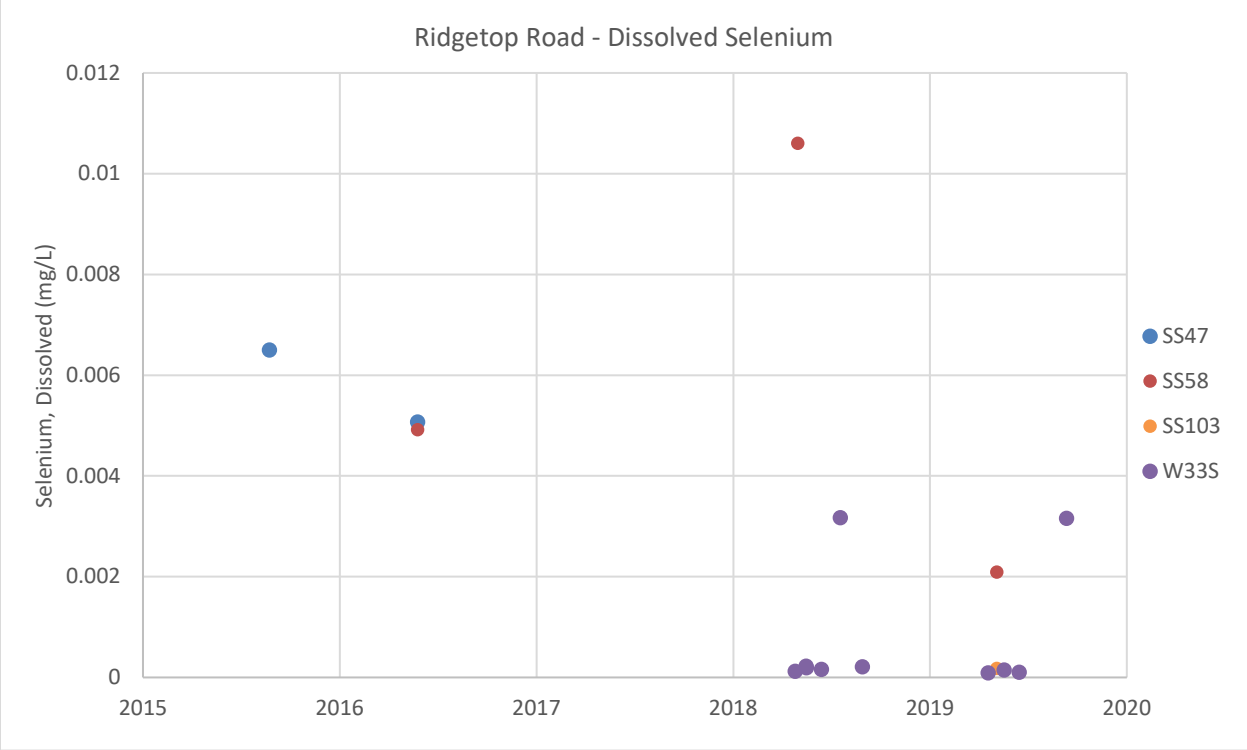


Figure 7-90: Ridgetop Road Sites - Dissolved Selenium

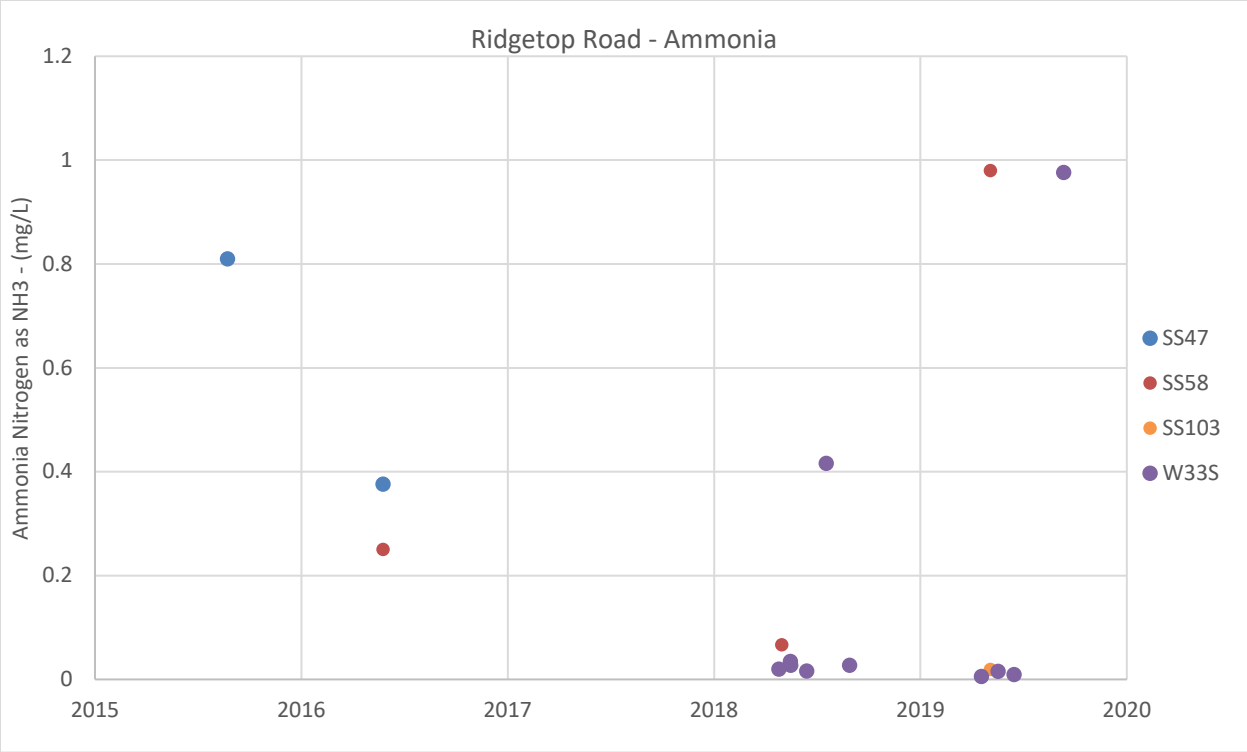


Figure 7-91: Ridgetop Road Sites – Ammonia

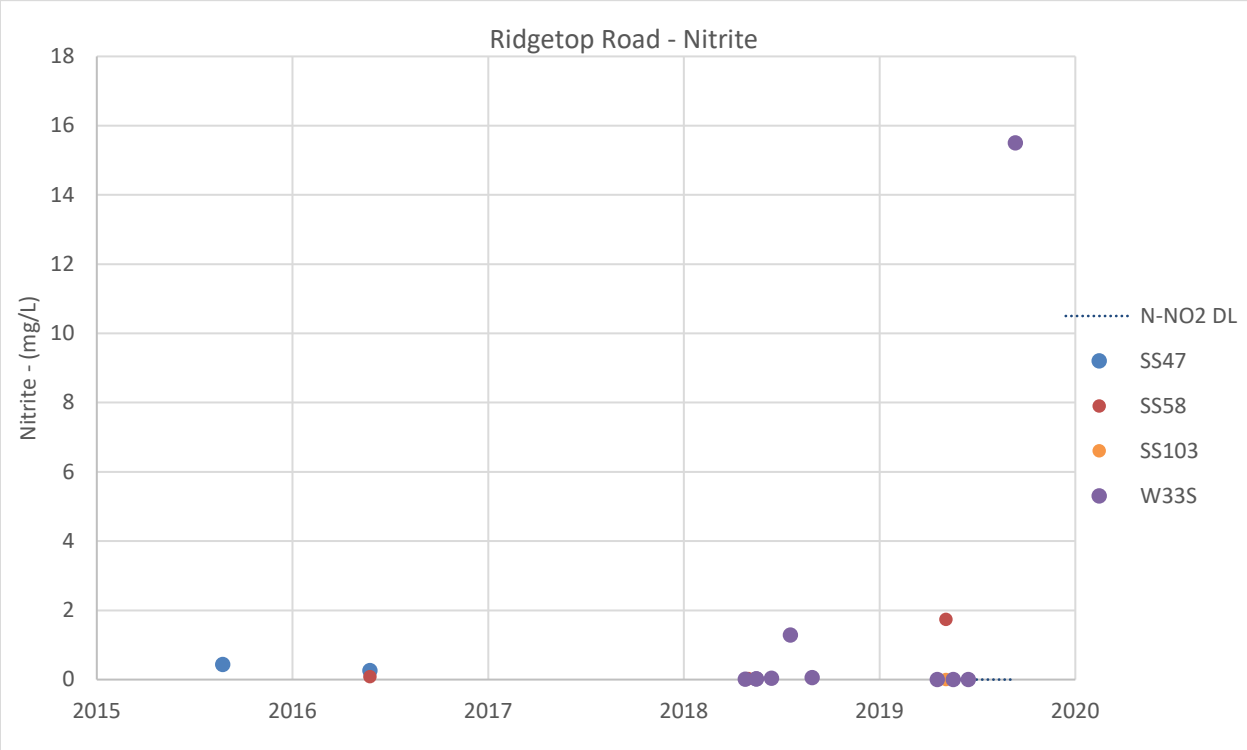


Figure 7-92: Ridgetop Road Site - Nitrite

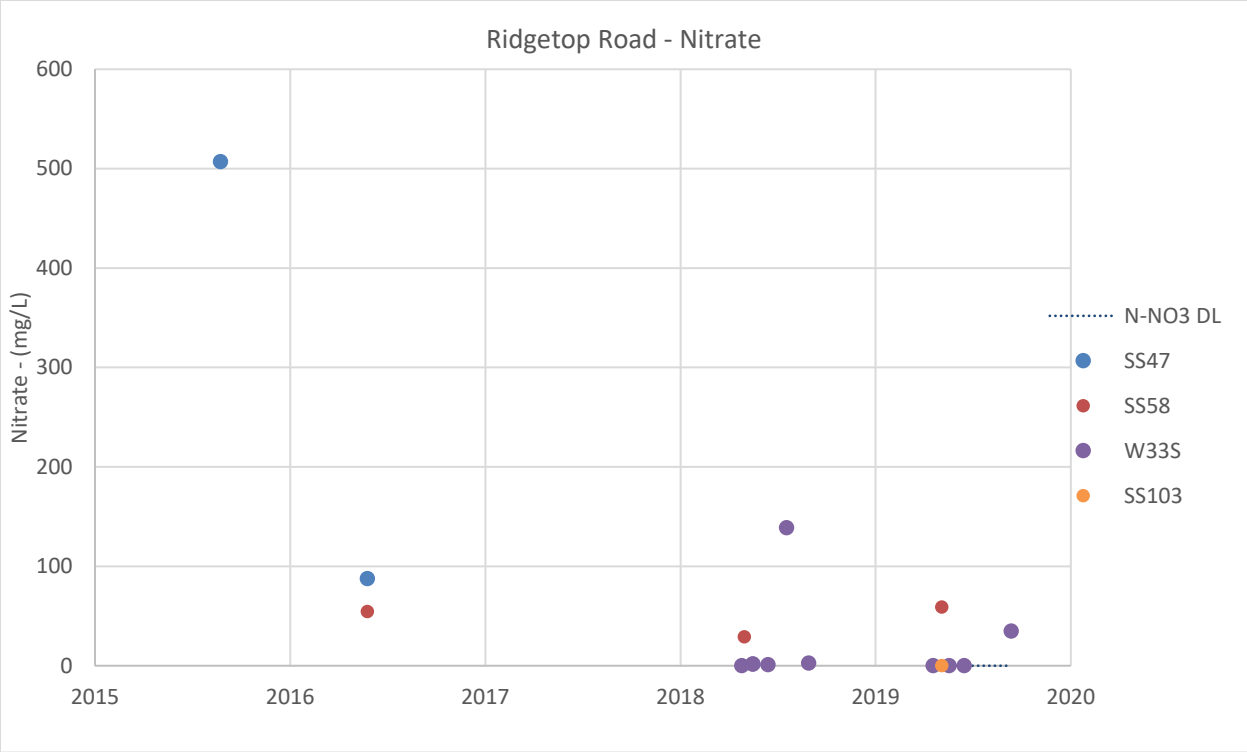


Figure 7-93: Ridgetop Road Sites - Nitrate

7.11 Minto North

Due to concerns regarding blasting residue in the waste rock used in its construction, a seepage survey route around the northern edge of the Minto North haul road was initiated in 2017. In 2019, one seep (SS101) was sampled during the spring survey and no seeps were found to contain water during the fall survey. The 2018 and 2019 results for dissolved copper, dissolved cadmium, dissolved iron, dissolved selenium, and nutrient levels for ammonia, nitrite, and nitrate are displayed in Tables 7-94 to 7-100, below.

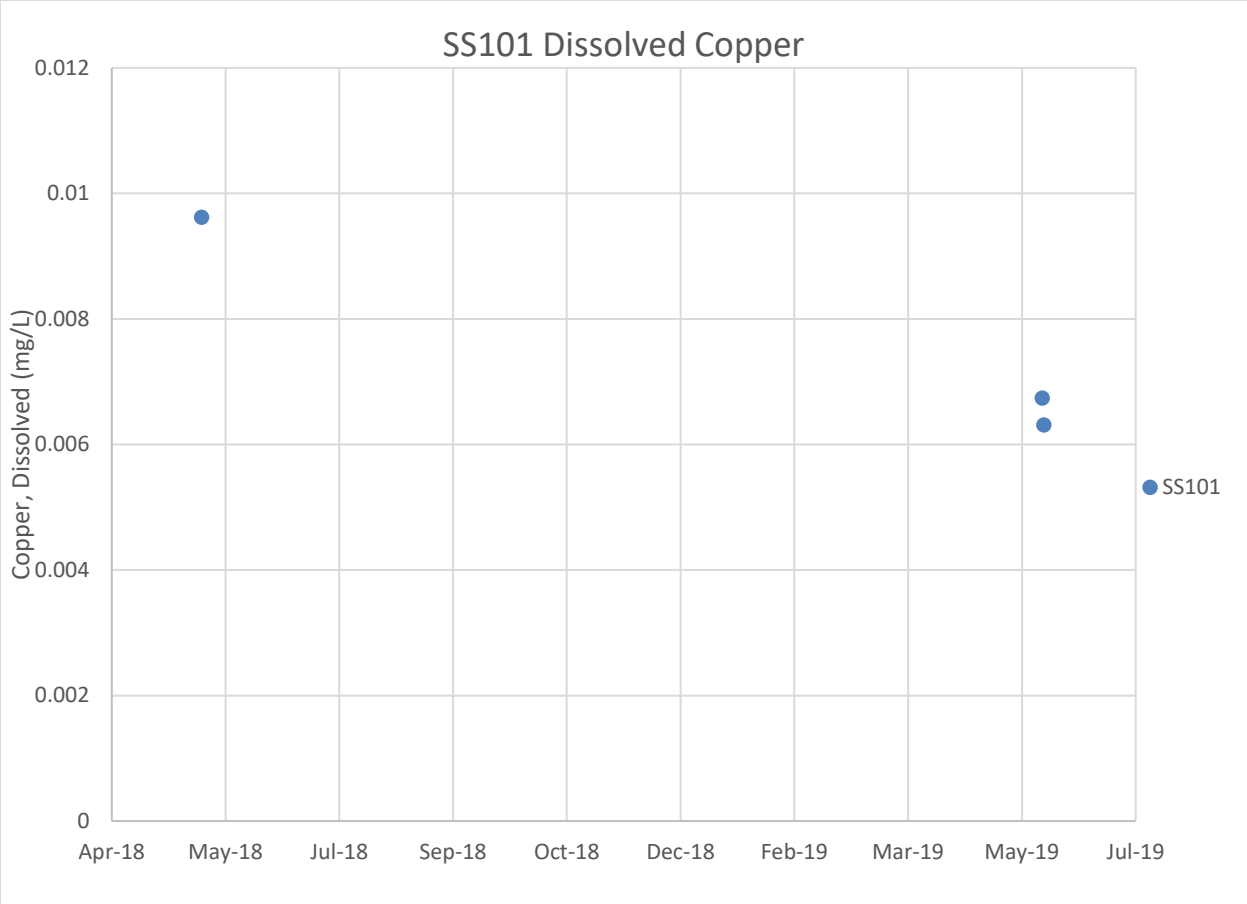


Figure 7-94: Minto North SS101 – Dissolved Copper

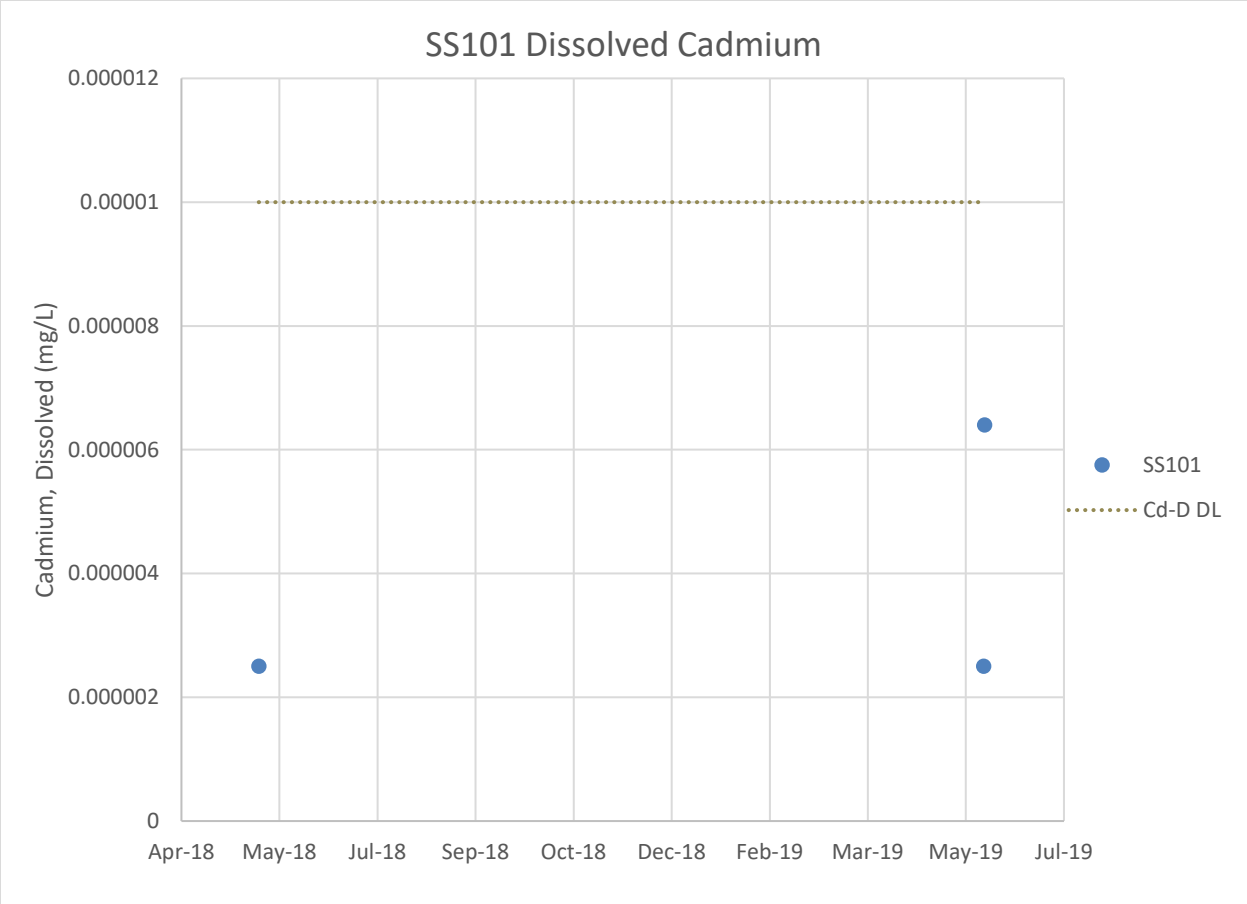


Figure 7-95: Minto North SS101 - Dissolved Cadmium

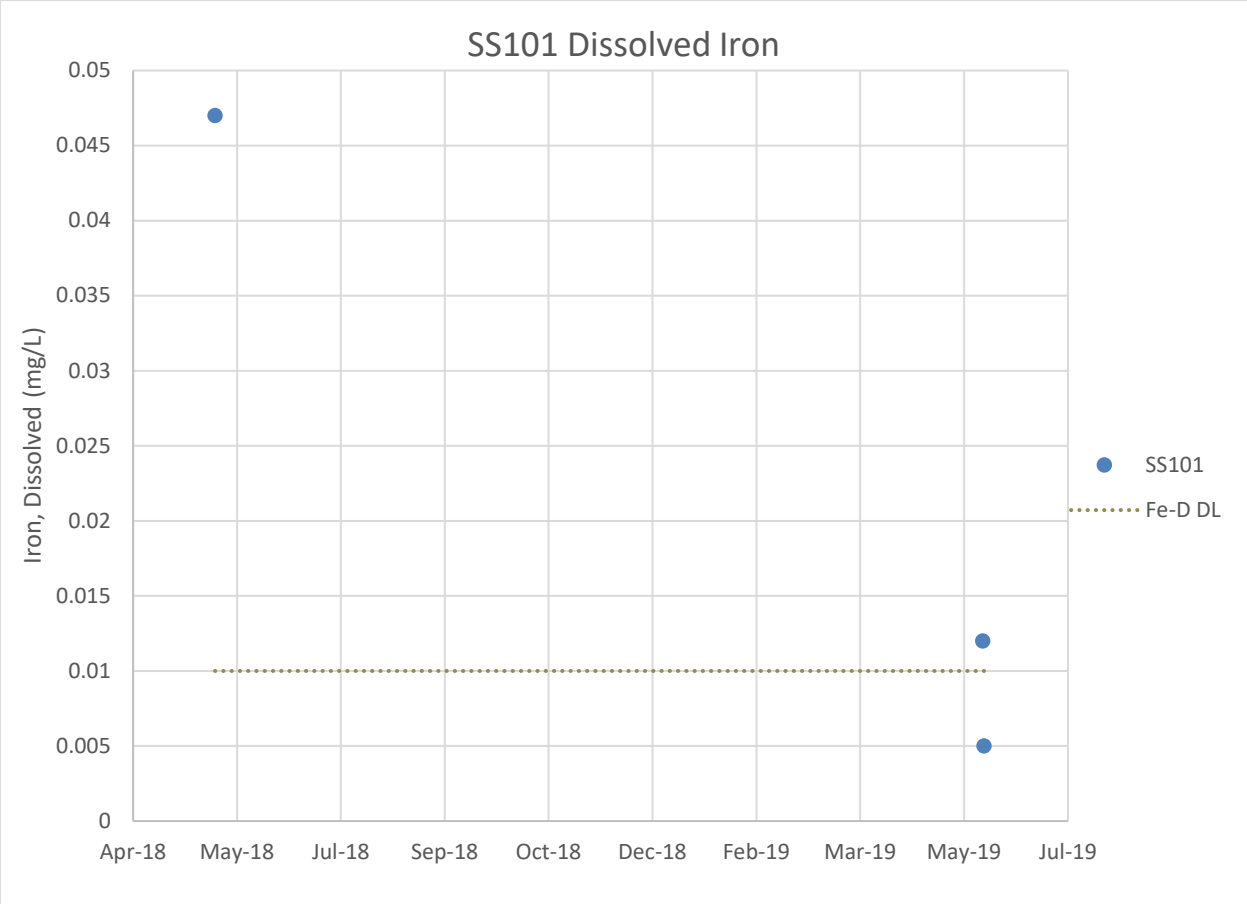


Figure 7-96: Minto North SS101 - Dissolved Iron

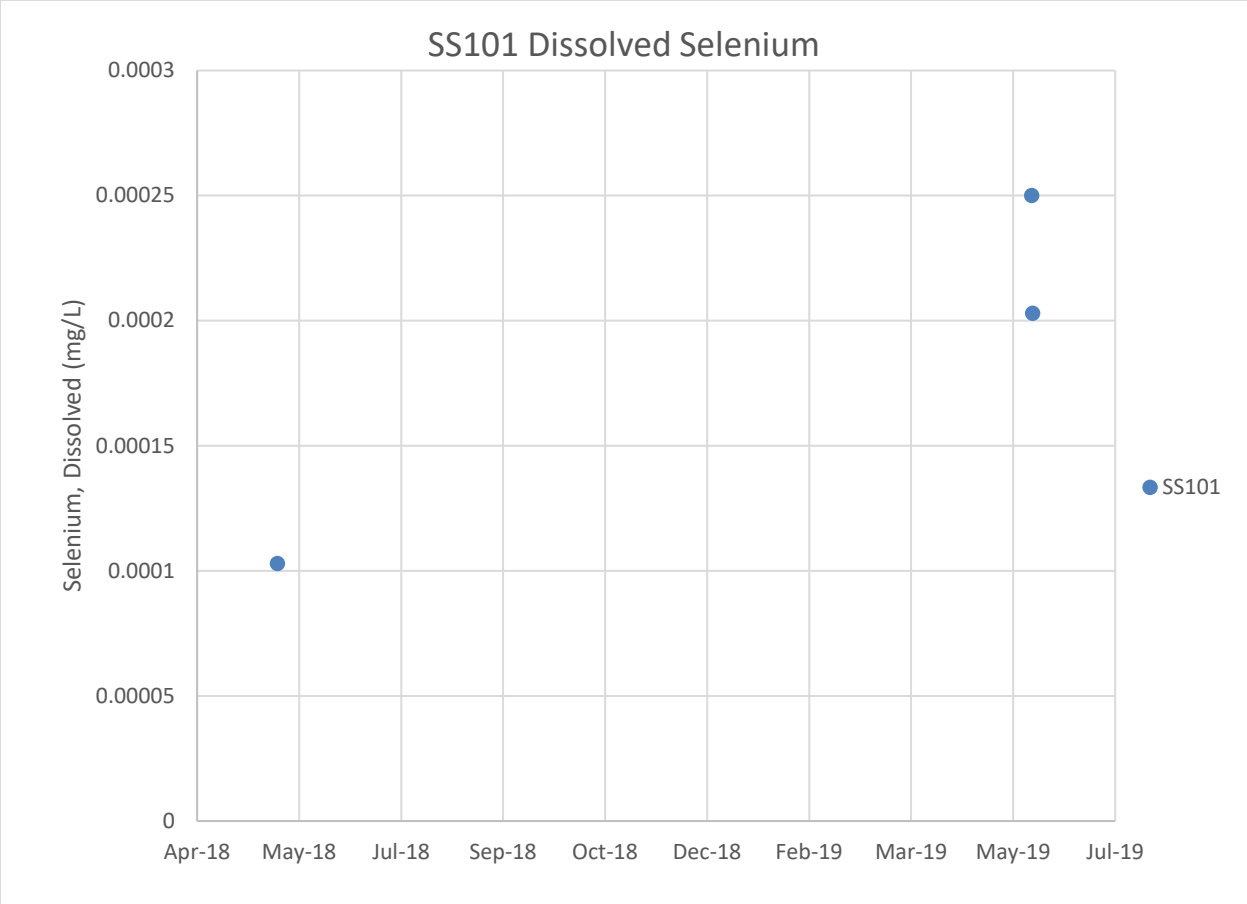


Figure 7-97: Minto North SS101 – Dissolved Selenium

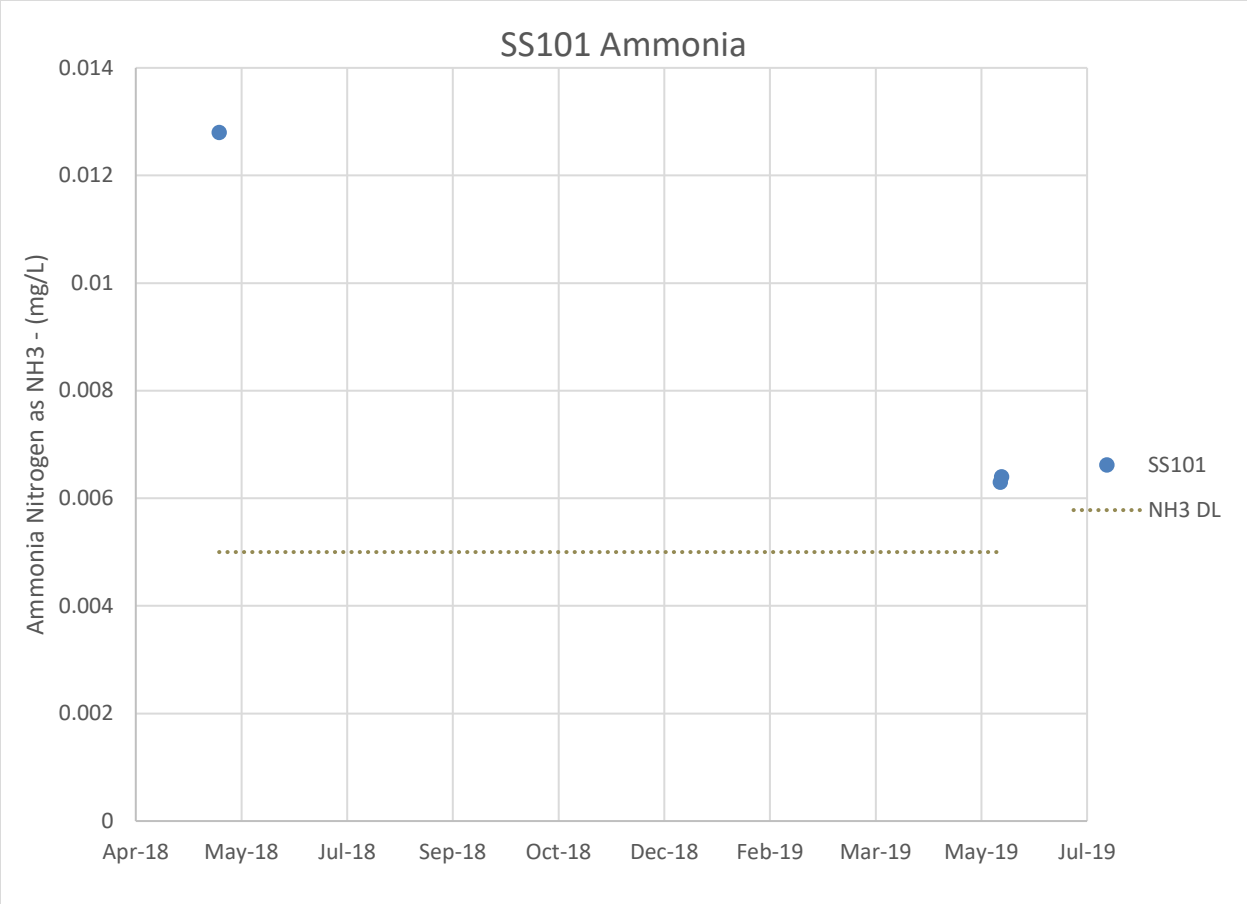


Figure 7-98: Minto North SS101 – Ammonia

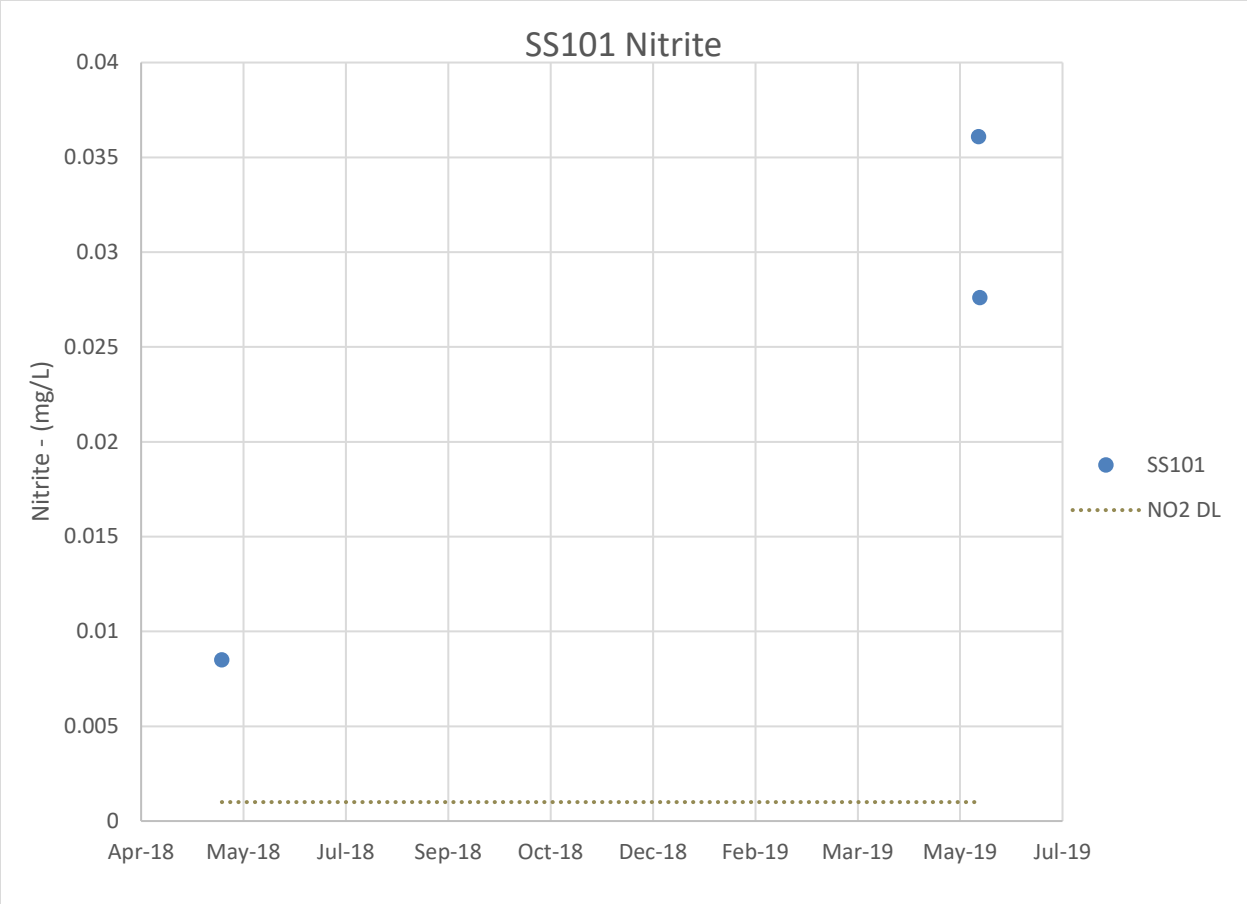


Figure 7-99: Minto North SS101 – Nitrite

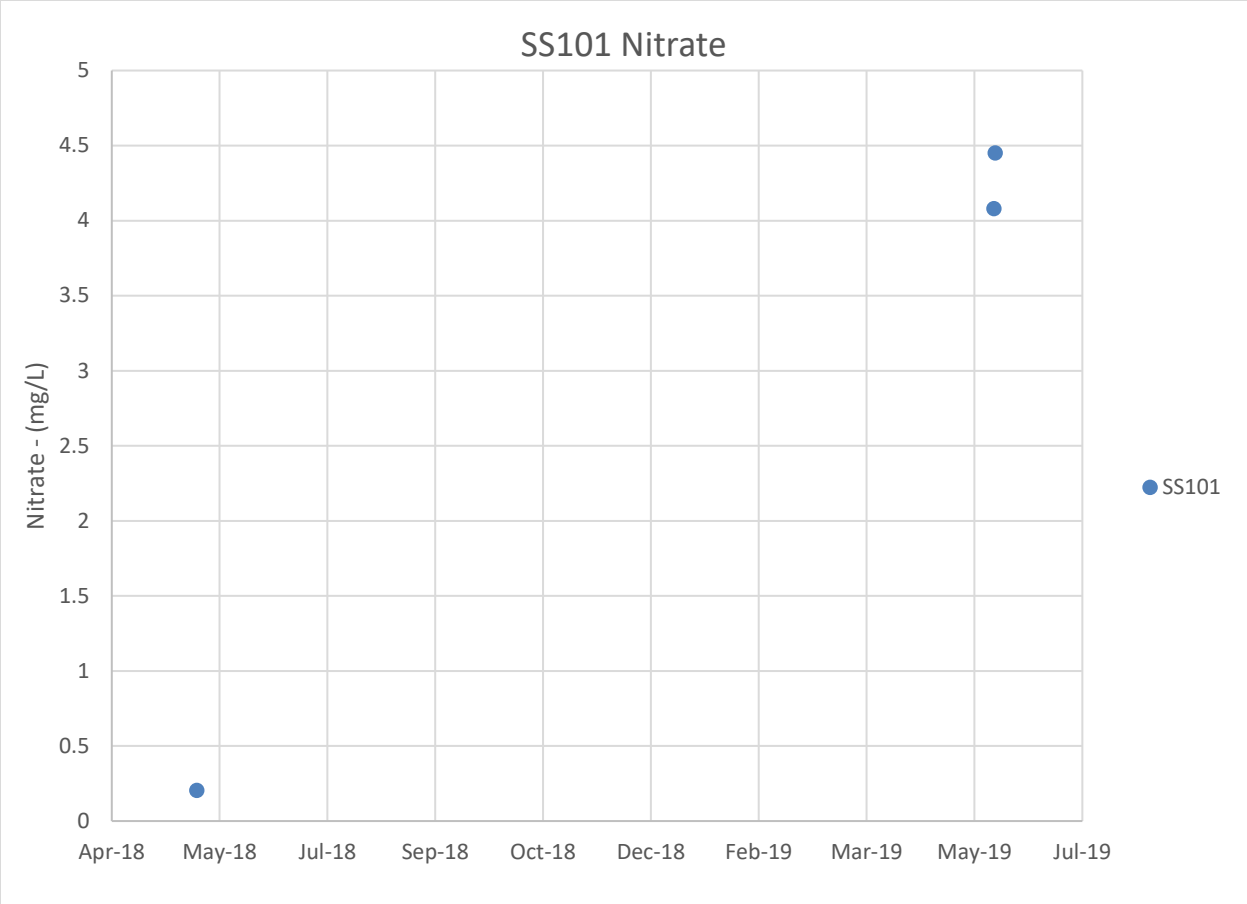


Figure 7-100: Minto North SS101 - Nitrate

7.12 Walls

Seepage monitoring could not be conducted at the pit walls of the Main Pit, Area 2 Pit, and Minto North Pit; all pits were too unsafe to access during the 2019 surveys due to geotechnical instability. Records were taken for each pit where seeps were observable from a distance. See Appendix D for photographic records.

8 Water Management

The water balance for the Minto Mine forms the basis of the water management strategy at the site. The water management strategy at the site is for conveyance structures to either divert or release clean surface water or direct impacted water to the Main Pit and eventually treatment.

The Minto Mine generally has a positive water balance, meaning that the site-wide annual runoff is greater than the volume of water required to operate the mine. Therefore, it is necessary to release water to Minto Creek. In the event surface runoff does not meet the discharge limits stipulated in the WUL, Minto Mine has the ability to treat and release water using a combination of active treatment, conveyance structures and water storage features. The following sections will summarize water treatment, conveyance and storage during the reporting period.

8.1 Water Storage and Conveyance Network

There were no major changes to Minto's conveyance structures in 2019. Pumping to return water from A2S4 pit to the main pit was re-established after the mine was restarted.

The strategy for managing the mine water inventory was unchanged in 2019, and the water conveyance network is illustrated in Figure 8-1. Compliant (clean) surface water would normally be collected and diverted to the WSP, but due to a very dry year, all water was collected and stored in the Main Pit and Area 2 Pit. No water was discharged to Minto Creek in 2019. Runoff from developed mine areas (mine water) was collected and stored in the Main Pit and Area 2 Pit, and once operations resumed in October, was used for ore processing, and deposition of tailings.

Water and tailings volume change over 2019 is presented in section 8.2.

MINTO MINE

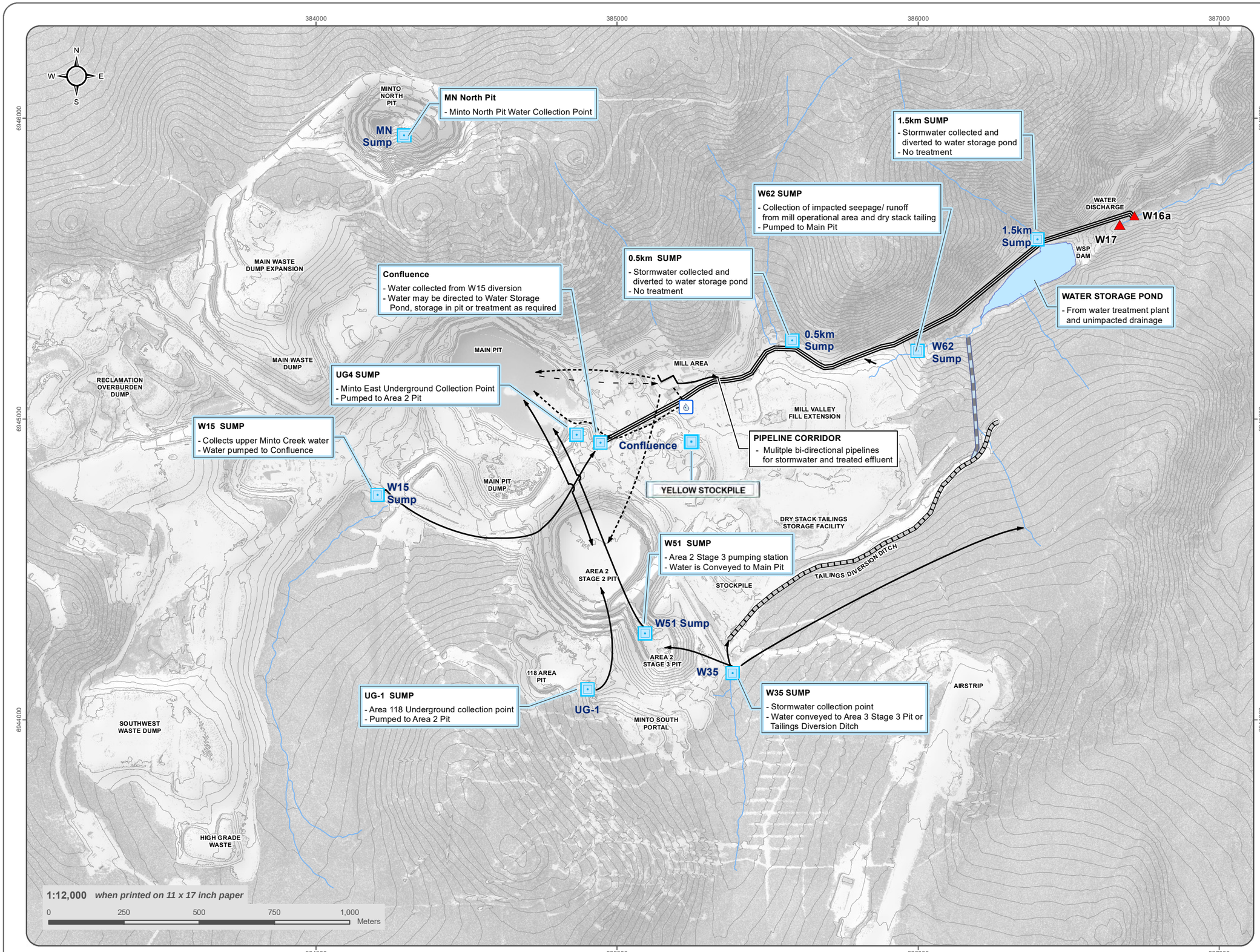
WATER LICENSE QZ14-031/QML-0001
2019 ANNUAL REPORT

FIGURE 8-1
OPERATIONAL WATER MANAGEMENT

FEBRUARY 2020

MINTO EXPLORATIONS

ENSERO solutions



- Water Treatment Plant
- Collection Point
- Monitoring Location
- Mill Water Reclaim Line
- Pipe Alignment
- Piping Corridor
- Tailings Slurry Discharge
- Tailings Diversion Ditch
- Tailings Diversion Ditch Extension, To Be Constructed

Aerial imagery obtained from Challenger Geomatics. Imagery acquired Sept 9th 2014.
Site contours derived from 2014 aerial imagery obtained from Challenger Geomatics.

Hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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(Last edited by: amatlashevska;2020-02-26;9:02 PM)

8.2 Water Storage Volumes Movement and Tracking

Water movement is tracked with flow meters on site, monitored and inspected on a weekly basis. Table 8-1 to 8-5 provide a summary of water volumes moved by conveyance structures around site in 2019. Please note that the total and net volume for each facility (WSP, MPTMF, A2PTMF) in the following tables only account for flow meter totals and do not account for evaporation and other losses/inputs. The Water Treatment Plant was not operational in 2019, and no discharge to the environment occurred during the year.

Table 8-1: Water Storage Pond (WSP) Conveyance for 2019

WSP		
Input Volume (m^3)		**Total**
W15	0	18,821
W35	0	
WTP	0	
W17	18,821	
Output Volume (m^3)		**Total**
WTP	0	18,821
W17 Seep	0	
Minto Creek (Environment)	18,821	
Net		0

Table 8-2: Main Pit Conveyance for 2019

Main Pit		
Input Volume (m^3)		**Total**
W62	67,023	382,674
Minto North	0	
W15	29,510	
UG4	283,511	
Mill	0	
Area 2 Pit	1,741	
Yellow Stock Pile	889	
Output Volume (m^3)		**Total**
Mill	276,076	276, 076
WTP	0	
Net		106,598

Table 8-3: Area 2 Pit Conveyance for 2019

Area 2 Pit		
Input Volume (m^3)		**Total**
UG1	117,884	394,780
Mill	274,678	
W51	0	
W35 (TDD)	2,218	
Output Volume (m^3)		**Total**
Main Pit	1,741	1,741
Net		393,039

Table 8-4: Water Truck Deliveries on Site for 2019

Water Trucks		Total (m^3)
Drills	1,397*	1,397

** The reported volumes are estimates only.*

Table 8-5: Well Usage in 2019

Wells		Total (m^3)
Camp	3017	4,198
ERT	1181	

8.2.1 Water Conveyance Tracking

Diversion of W35 water (TDD): Water was diverted from the south catchment (collected at station W35) to the Area 2 Stage 3 pit and the WSP. An estimated total of 2,218m^3 moved through the TDD to the A2S3 Pit in 2019 as measured by a Mace FloSeries® 3 open pipe flow measuring device.

Diversion of W15 water: The W15 sump collects surface runoff from adjacent undisturbed catchments, the SWD and part of the MWD. A total of 29,510 m^3 was conveyed through the W15 conveyance structure in 2019. The W15 flows were measured and recorded using a Seametrics® mag flow meter with digital head relay module. No flow from W15 was diverted to the WSP, due to low Pit levels and a desire to maximize the amount of available water for mill re-start.

Pump Back of W62 water (MVFES2 Sump): Water collected downstream of the mill area, ore stockpiles and DSTSF is collected at the MVFES2 Sump (which replaced the MCDS in 2016) and pumped back to the Main Pit for treatment. A total of 67,023 m^3 was conveyed through this structure in 2019. The flow volumes were measured and recorded using a Seametrics® mag flow meter with digital head relay module.

8.2.2 Water Storage Tracking

Water storage on site is monitored for Minto reservoirs which include the Main Pit, the Area 2 Pit, their respective tailings management facilities, the Water Storage Pond (WSP), the Minto North Pit, and the Area 2 Stage 3. Appendix F provides a more comprehensive analysis of water movement, but presented below, Tables 8-6 to 8-10 provide a summary of their year-end storage volumes and the site-wide water yield.

Main Pit: The Main Pit was used as a reservoir to support the following: water use for the Mill process; collection of impacted runoff; supply feed water to the water treatment plant; and receive water from Area 2 Pit and underground de-watering.

Area 2 Pit: The Area 2 Pit was used to support the following: supply water to the Mill via the Main Pit; collection of impacted site water; receiving water from underground de-watering; receiving water/tailings from the Mill.

WSP: The WSP worked effectively as a storage location for un-impacted water and maintained the water quality below effluent quality standards.

Table 8-6: Main Pit Storage Inventory, 2019

Date	MPTMF Volume Occupied (Water + Tailings)	Change in MPTMF Water Inventory	Tailings Solids Deposition in MPTMF
Month-Year	m^3	m^3/month	BCM/month
Jan-19	771,481	18,624	0
Feb-19	789,106	17,625	0
Mar-19	820,719	31,613	0
Apr-19	844,895	24,176	0
May-19	880,870	35,975	0
Jun-19	901,719	20,849	0
Jul-19	**917,254**	**15,535**	**0**
Aug-19	**932,886**	**15,632**	**0**
Sep-19	**953,238**	**20,352**	**0**
Oct-19	901,613	-51,625	0
Nov-19	813,559	-88,054	0
Dec-19	749,908	-63,651	0
SUM		**-2,949**	**0**

The internal maximum Main Pit water volume (with freeboard) is 916,686 m^3. The maximum QML volume (associated with an elevation of 791 MASL) is 1,580,747 m^3. While the internal maximum volume was exceeded during the months of July to September, this was deliberately allowed to maximize the amount of water available for milling operations until the A2S3 return water line to the main pit could be established. The exceedance of the elevation had no impact on the environment because the freeboard for the main pit remains at two meters above 791 MASL and no water escaped pit containment during this period.

The Area 2 Pit was not accessible for surveying due to safety concerns from August 3 to September 29, the volume corresponding for August was obtained August 3 as seen in Table 8-6b. In 2019, the Mill was only active from October to December 2019.

Table 8-7: Area 2 Pit Storage Inventory, 2019

Date	A2PTMF Volume Occupied (Water + Tailings)	Change in A2PTMF Water Inventory	Tailings Solids Deposition in A2PTMF
Month-Year	m^3	m^3/month	BCM/month
Jan-19	1,585,838	-11,801	0
Feb-19	1,584,112	-1,726	0
Mar-19	1,602,192	18,080	0
Apr-19	1,597,846	-4,346	0
May-19	1,573,407	-24,439	0
Jun-19	1,557,029	-16,379	0
Jul-19	1,546,726	-10,303	0
Aug-19	1,549,285	2,559	0
Sep-19	1,579,002	29,717	0
Oct-19	1,605,226	26,224	31,817
Nov-19	1,626,244	21,017	29,719
Dec-19	1,673,392	47,149	36,735
SUM		**75,753**	**98,270**

Table 8-8: WSP Storage Inventory, 2019

Date	WSP Volume	Change in WSP Water Inventory
Month-Year	m^3	m^3/month
Jan-19	78,389	-2,486
Feb-19	74,028	-4,361
Mar-19	69,468	-4,560
Apr-19	65,916	-3,552
May-19	66,324	408
Jun-19	57,390	-8,934
Jul-19	52,225	-5,165
Aug-19	46,754	-5,471
Sep-19	41,094	-5,660
Oct-19	38,543	-2,551
Nov-19	37,013	-1,530
Dec-19	31,292	-5,721
SUM		**-49,583**

2019 was an exceptionally dry year, so fresh water from W15 and W35 was not diverted to the WSP, but allowed to remain flowing into the Main pit (W15) and Area 2 Stage 3 Pit (W35) for the limited time that these sources did flow. This ensured enough process water remained in the pits to enable operations to resume in October. Because of this fact, evaporation in the WSP exceeded inputs from natural flows in 2019, resulting in a significant reduction in volume.

Three methods for measuring water levels were used during 2019; surveying, scanning and direct measurement. This may have caused minor discrepancies is consistency of data as seen in Table 8-9.

Table 8-9: Area 2 Stage 3 Pit Storage Inventory, 2019

Date	A2S3PTMF Volume Occupied (Water + Tailings)	Change in A2S3PTMF Water Inventory
Month-Year	m^3	m^3/month
Jan-19	512,254	5,150
Feb-19	512,309	55
Mar-19	527,171	14,862
Apr-19	504,379	-22,792
May-19	543,338	38,959
Jun-19	580,597	37,259
Jul-19	566,364	-14,233
Aug-19	573,974	7,610
Sep-19	589,124	15,150
Oct-19	598,023	8,899
Nov-19	696,968	98,945
Dec-19	795,259	98,291
SUM		**288,155**

Despite variations in the accuracy of elevations due to different methods employed and safe access issues, Area 2 Stage 3 Pit increased in volume throughout 2019, largely because of the continual input of underground dewatering water from area 118 (UG1), and well as some natural inputs from seeps in the pit walls. Additionally, once production resumed in October, water drawn from the Main Pit and processed through the mill as either mill balance water or tailings were added to A2S3 Pit.

Table 8-10: Water Balance Summary for the Minto Mine Site 2019 (Jan to Dec)

	Units	Main Pit TMF	Area 2 Pit TMF	WSP	Area 2 Stage 3
Volume Change 2019 (water + tailings)	m^3	-2,949	75,753	-49,583	288,155
Tailings Deposited, total	BCM	-	98,270	-	-
Water Volume Change 2019	m^3	-2,949	-22,517	-49,583	288,155
Estimated Groundwater Inflow	m^3	-	30,000	-	-
Total Water Inventory Increase in 2019	**m^3**	213,106			
Total Water Discharged to Minto Creek	m^3	0			
Total Site-Wide Yield in 2019	**m^3**	**213,106**			

8.2.3 Water Conveyance Construction

Maintenance activities consisted of routine maintenance on water conveyance structures. New conveyance infrastructure was installed to pump water from the A2S3 pit to the Main Pit in December, 2019.

8.2.4 Water Balance and Water Quality Predictions Modeling

As per the WUL Clause 108, Minto is required to update the Water Balance and Water Quality Model. Minto retained SRK Consulting to complete a 2019 site water balance and water quality prediction model update. An updated 2019 Water Balance and Water Quality Model Summary for the Minto Mine is provided by SRK Consulting in Appendix F.

8.3 Water Treatment

All surface runoff was directed to the Main Pit through the W15 Pipeline, via the W62 pump back pipeline, or to A2S3 Pit from the W35 Pipeline.

Minto has the option of treating for:

- Total suspended solids (TSS) only: clarification;
- TSS, copper and cadmium: clarification and chemical precipitation; or
- All water quality parameters present in the Main Pit: clarification and reverse osmosis (RO).

Water treatment by-products including TSS sludge and RO reject are pumped back to the Main Pit.

8.3.1 Operations Overview

The Water Treatment Plant did not operate and no water was treated or released in 2019.

8.4 Water Discharge

8.4.1 Discharge Volumes

Minto Mine did not discharge to the environment in 2019.

8.5 Hydrology

In 2019, as part of the EMSRP, Minto monitored hydrological conditions at water quality stations including the following: stations within the operational mine area; stations downstream from the mine operational area that are influenced by mine effluent discharge; and reference stations downstream from the mine operational area that are not exposed to effluent. Hydrological monitoring is performed using a variety of methods including: manual discrete discharge measurements with combinations of flow meters, continuous stage measurements through the deployment of Solinst Level Loggers and Barometric Loggers and monitoring of an engineered flume.

The 2019 open water season was characterized by very low flows, partly due to an unusually small snow pack and low precipitations. No mine discharge occurred in 2019 from the Water Storage Pond nor the Water Treatment Plant.

8.5.1 Minto Creek Hydrology

Hydrological monitoring on Minto Creek is conducted in accordance with the requirements outlined in the WUL. During the 2019 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along Minto Creek.

- W3: Flume downstream of the Water Storage Pond (WSP);
- MC-1: Located in Minto Canyon – mid-catchment;
- W1: Located approximately 1 km upstream of Yukon River – lower catchment; and
- W7: Tributary on the south side of Minto Creek.

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates.

For details on the 2019 results of Minto Creek hydrology see the *Summary of Minto and McGinty Creek 2019 Surface Hydrology Memo* in Appendix G.

8.5.2 McGinty Creek Hydrology

In 2019, hydrological monitoring on McGinty Creek was conducted as per the schedule outlined in the EMSRP. In 2018, Minto Mine added a hydrometric station at MN-1.5. During the 2019 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along McGinty Creek.

- MN-0.5: West Tributary of McGinty Creek
- MN-1.5: Upper East arm of McGinty Creek
- MN-2.5: East Tributary of McGinty Creek
- MN-4.5: McGinty Creek near the Mouth

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates.

For details on the 2019 results of McGinty Creek hydrology see the *Summary of Minto and McGinty Creek 2019 Surface Hydrology Memo* in Appendix G.

8.5.3 Hydrology QA/QC

Detailed procedures for hydrology monitoring at the Minto Mine are detailed in the *Minto Mine Surface Water Hydrology* SOP. Few changes were made in the hydrology SOP, to ensure duplicate measurements were done on a 1:10 ratio as well as some changes to staff gauge measurements that would ensure consistency between users.

9 Physical Monitoring Program

Minto's physical monitoring program consists of a combination of instrumentation and visual inspections. Site wide inspections are carried out semi-annually - May/June post thaw and September pre- freeze-up. Q2 inspection must be completed by an external geotechnical engineering consultant in accordance with Clause 13.2 of the QML. As specified in the WUL and *Minto Physical Monitoring Plan*, the following additional inspections are also performed:

- Static waste rock and overburden dumps – Semi-Annually;
- Static open pits – Semi-Annually;
- Diversion ditch – Semi-Annually, (Daily during water conveyance);
- Dry Stack Tailings Storage Facility, Mill Valley Fill Extension and Mill Valley Fill Extension 2 – Quarterly;
- Main Pit and Area 2 Pit tailings storage facilities – Quarterly; and
- WSP dam – Weekly (seepage), Monthly (stability).

Deformation monitoring instrumentation includes survey hubs and borehole inclinometers, described in the following sections. A layout of physical monitoring instrumentation is provided in Figure 9-1, below. There were no changes required to the existing *Physical Monitoring Program* in 2019, because our operation has become solely underground mining based, therefore new pits and waste dumps are no longer being created every year. The current *Physical Monitoring Plan* can be found in Appendix H.

MWDH04
MWDH03
MWDH05
MWDH06
MDI-2
MWDH02
MWDH01
M84
M83
M80
M98
M82
M81
M79
M88
M94
M97
M93
M92
M95
M89
A217
A216
A218
A215
M96
A210
A219
SDT-1
SWD-06
SWD-01
SWD-07
SDT-3
SDP-2A
SDP-2B
SWD-08
SWD-11
SDP-3B
SWD-12
SDT-2
SDP-3A
SDP-4A
SDP-4B
SDT-4
SWD-09
SWD-10
MV1
MV2
DSP-10
DSSH-29
DSSH-19
DSSH-18
DSSH-20
DSP-08
DSSH-28
DSSH-31
DSP-07
DSSH-10
DSSH-32
DSI-24
DSSH-06
DSSH-15
DSSH-12
DSSH-14
13-DST-11
13-DSP-6
DSSH-30
13-DST-13
13-DSP-5
13-DST-14
DSSH-24
DSSH-27
DSSH-26
13-DST-10
DS1
DS3
DS4
SH06
SH05
13-A2I-1
13-A2T-1
WSP1
WDP-2
WDP-5
WDP-9
WDP-7
WDP-1
WDP-4
WDP-8
WDP-6
WDP-10
WSP3
WDT-8
WDT-3
WDT-4
WSP4
WDT-2
WDP-13
WDT-1
WDP-11
WDP-12
WDT-5
WDT-6
WSP2

DRAWN BY: R Phaarand	SCALE: Not to scale	Monitoring Instrumentation 2019		Figure 9-1	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY
	DATE: 03 Feb 2020				

9.1 Physical Deformation Monitoring Instrumentation

9.1.1 Survey Hubs

Physical deformation monitoring consists of survey hubs at the Main Pit, Area 2 Pit, DSTSF, SWD, MWD Wrap, and WSP dam. Table 1-1 summarizes the data collection frequencies for each facility. The monitoring results are summarized in the following subsections.

Table 9-1: Survey Hub Data Collection Frequency

Facility	Reading Frequency	Survey Hub
Main Pit/South Wall Buttress	Monthly	M83, M88, M98
	Quarterly	M82, M84, M93, M94, M95, M97
	Annually	M79, M80, M92, M96
Area 2 Pit	Weekly (during operations)	DS01, DS02, DS03, DS04
	Quarterly	A210, A215, A216, A217, A218, A219
DSTSF	Monthly	DSSH06, DSSH12, DSSH28
	Quarterly	DSSH19, DSSH20, DSSH24, DSSH26, DSSH27, MV2
	Annually	DSSH10, DSSH14, DSSH15, DSSH18, DSSH29, DSSH31, DSSH32, MV1
SWD	Quarterly	SWD01, SWD06, SWD07, SWD08, SWD09, SWD10, SWD11, SWD12
MWD Wrap	Quarterly	MWDH01, MWDH02, MWDH03, MWDH04, MWDH05, MWDH06
WSP Dam	Monthly	WSP1, WSP3, WSP4, WSP5

9.1.1.1 Main Pit/South Wall Buttress Survey Hubs

There are currently 14 operating survey hubs on the Main Pit south wall buttress with the Data collected presented in Figure 9-2.

In 2017, M82 and M83 saw an increase in movement in May during construction of the Main Pit Dump (MPD), prompting the installation of additional hubs and review of the data by the SRK Consulting (the Engineer of Record). This movement was associated with settlement of the in-pit dump, not part of the South Wall Buttress. In 2018, the M82, M83, M93, and M94 still show higher rates of movement with a decreasing trend. The movement rates are significantly less than those observed in survey hubs prior to the south wall failure and are not considered to be a stability concern. Four additional hubs were installed in May 2018 following completion of the MPD (to monitor movement rates due to the construction of the Main Pit Dump. The readings from these new hubs show no movement or decreasing movement trends and are not considered to be a stability concern. Movement rates in 2019 showed similar decreasing movement trends.

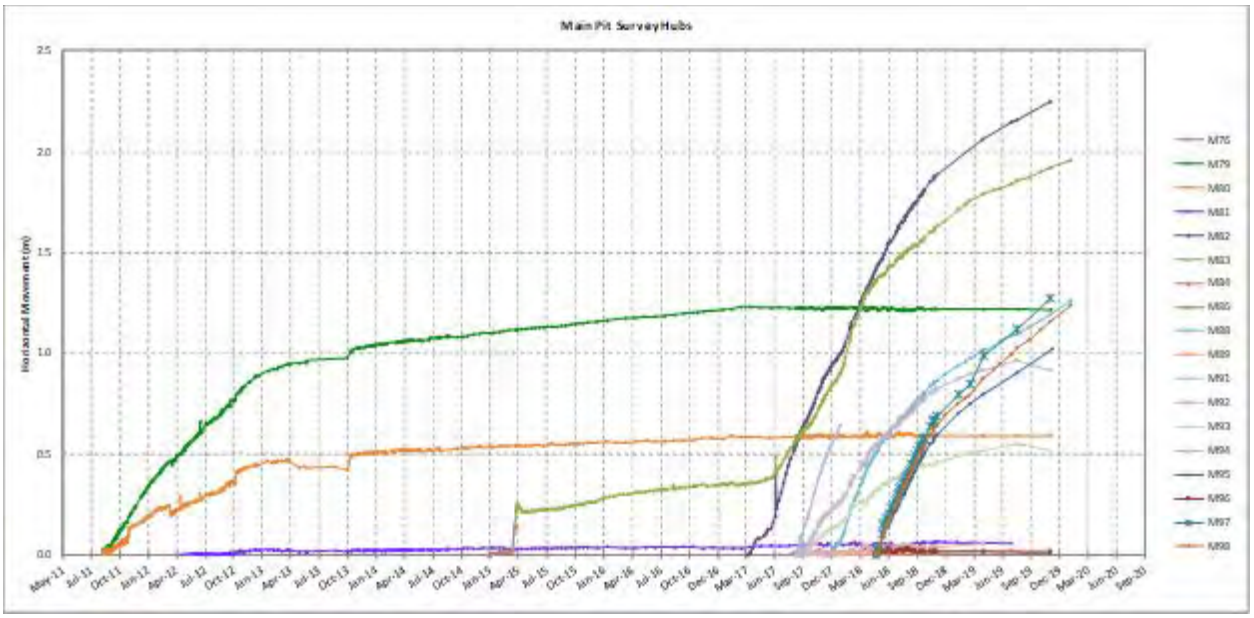


Figure 9-2: Main Pit/South Wall Buttress Survey Hub Data (2011-2019)

9.1.1.2 Area 2 Pit

There are currently 10 operating survey hubs located around the perimeter of the Area 2 Pit. Figure 9-3 presents the survey hub data for four of the hubs that are located on the east crest between the pit and the Underground Shop. The survey reading frequency of these hubs were increased to weekly since the resumption of mining. The 2019 results show a slight movement at DS04 at 0.2 mm/day, with no significant movement at the other hubs.

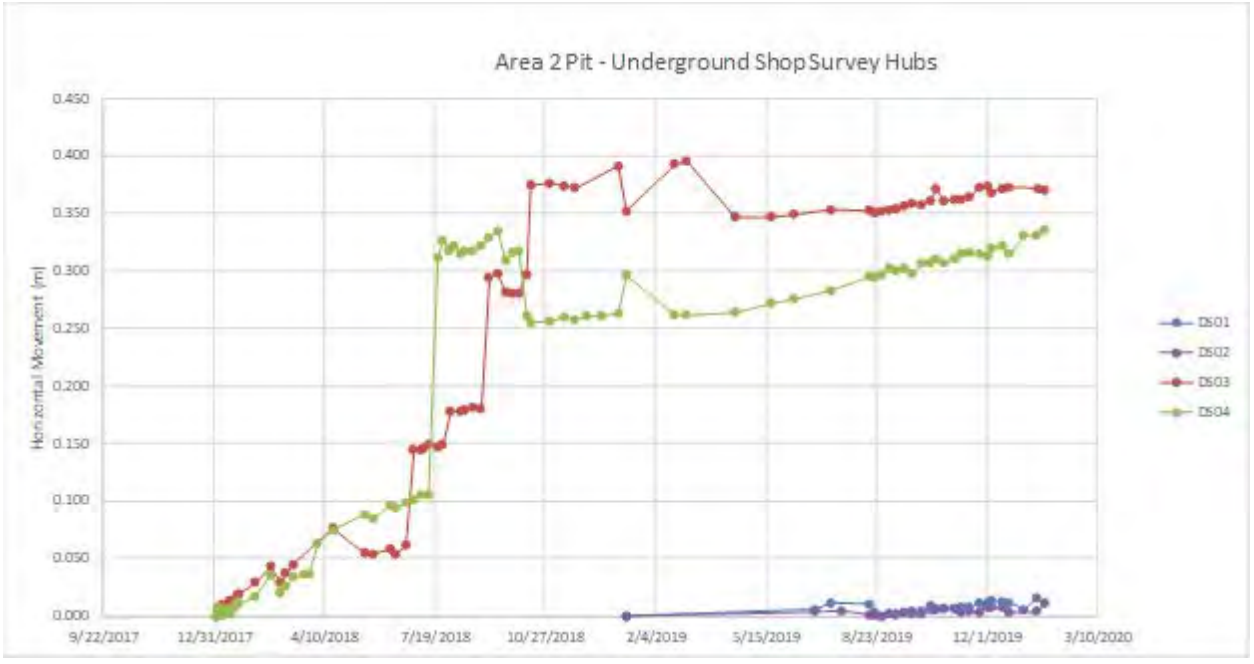


Figure 9-3: Area 2 Pit Survey Hub Data (2011-2019)

9.1.1.3 Dry Stack Tailings Storage Facility/Mill Valley Fill Survey Hubs

There are currently 17 operating survey hubs on the DSTSF and MVFE2. Data collected are presented in Figures 9-4. All hubs indicated a continued gradual decrease in movement rates in 2018, with some seasonal variation in movement rates observed at survey hubs installed over the DSTSF cover. Most hubs have shown a decrease in movement rate since the construction of the MVFE2 in summer, 2016.

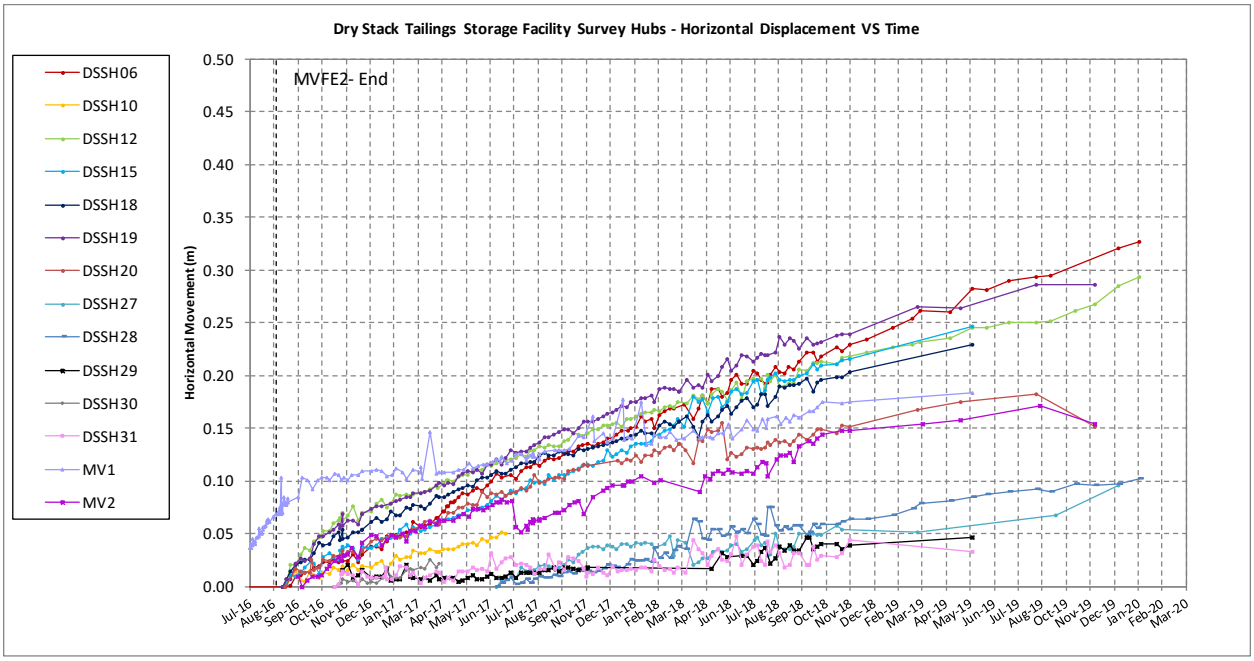


Figure 9-4: DSTSF Survey Hub Data (2016-2019)

9.1.1.4 Southwest Dump Survey Hubs

There are currently 8 operating survey hubs on the SWD. Data collected are presented in Figure 9-5. The hub indicated relatively consistent or decelerating movement rates in 2019.

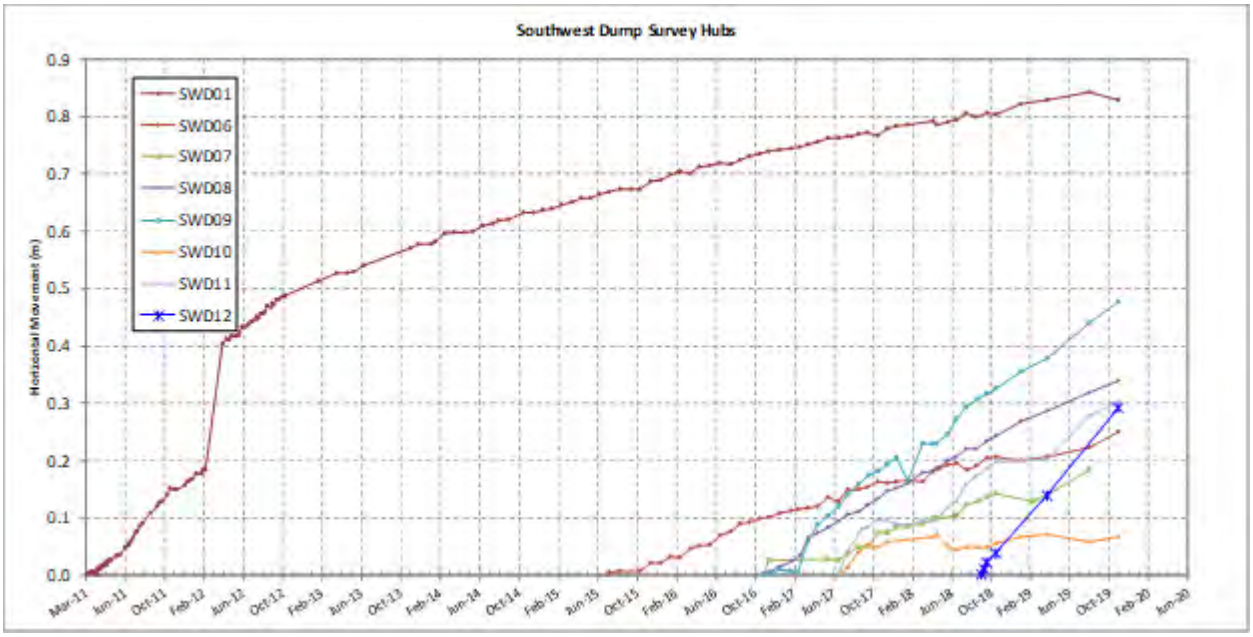


Figure 9-5: SWD Survey Hub Data (2011-2019)

9.1.1.5 Main Waste Dump Wrap Survey Hubs

Six survey hubs were installed on the Main Waste Dump Wrap in August 2018. Data collected are presented in Figure 9-6. Most hubs have shown no movement, or a decrease in movement rate since the construction of the dump was completed.

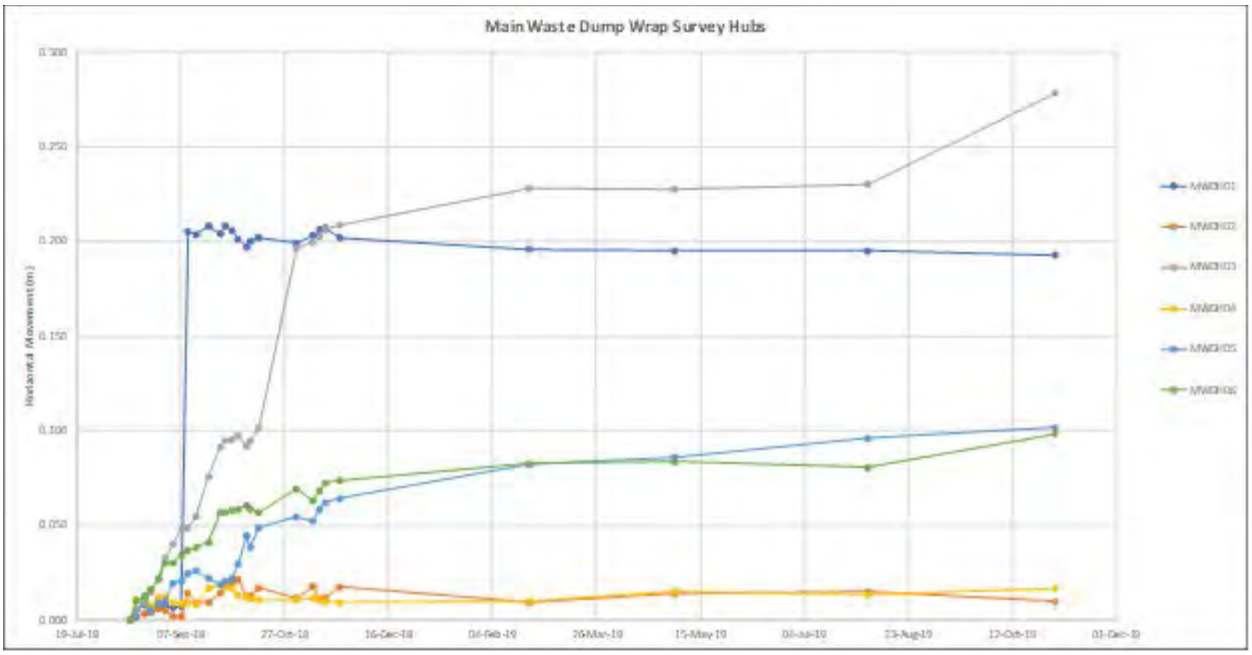


Figure 9-6: Main Waste Dump Survey Hub Data (2018-2019)

9.1.1.6 Water Storage Pond Dam Survey Hubs

There are currently four operating survey hubs on the WSP dam. There was no change to the operational status of any the hubs in 2018. Data collected are presented in Figure 9-7. Data continues to indicate no movement.

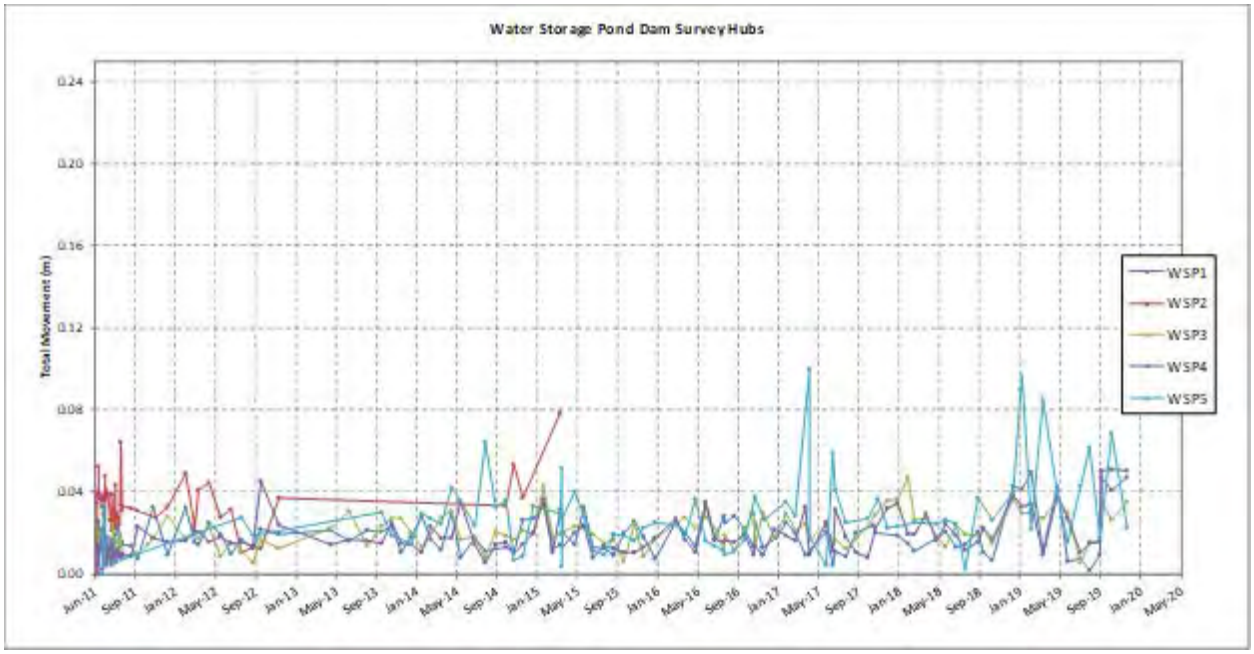


Figure 9-7: Water Storage Pond Dam Survey Hub Data (2011-2019)

9.1.2 Inclinometers

Physical deformation monitoring consists of monitoring of inclinometers at the DSTSF, Area 2 Stage 3 Pit and Main Pit. The monitoring results are summarized below.

9.1.2.1 DSTSF Inclinometer

There is currently one operating inclinometer (DSI-24) in the DSTSF area. DSI-24 is monitored monthly and the cumulative displacement data collected is presented in Figure 9-8. The profile plot indicates a main shear zone at a depth of 53 m, with the time plot data indicating a decelerating trend with a movement rate of approximately 0.07 mm/day in 2019. The displacement rate is similar to those observed at neighboring survey hubs.

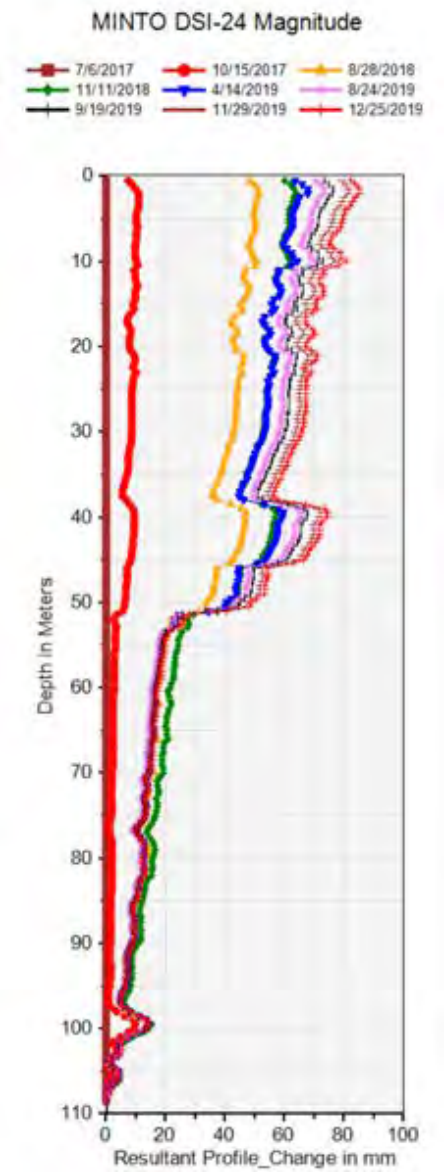


Figure 9-8: DSTSF Inclinometer DSI-24 (2017-2019)

9.1.2.2 Area 2 Stage 3 Inclinometer

There is currently one operating inclinometer (A2I-1) in the Area 2 Stage 3 Pit area that was installed in 2013 prior to development of the Area 2 Stage 3 Pit. A2I-1 is monitored quarterly with the cumulative displacement data presented in Figure 9-9. The displacement rate increased during mining of the pit in late 2017 and early 2018. Since completion of the pit, the movement rate has slowed and is not considered to be a stability concern.

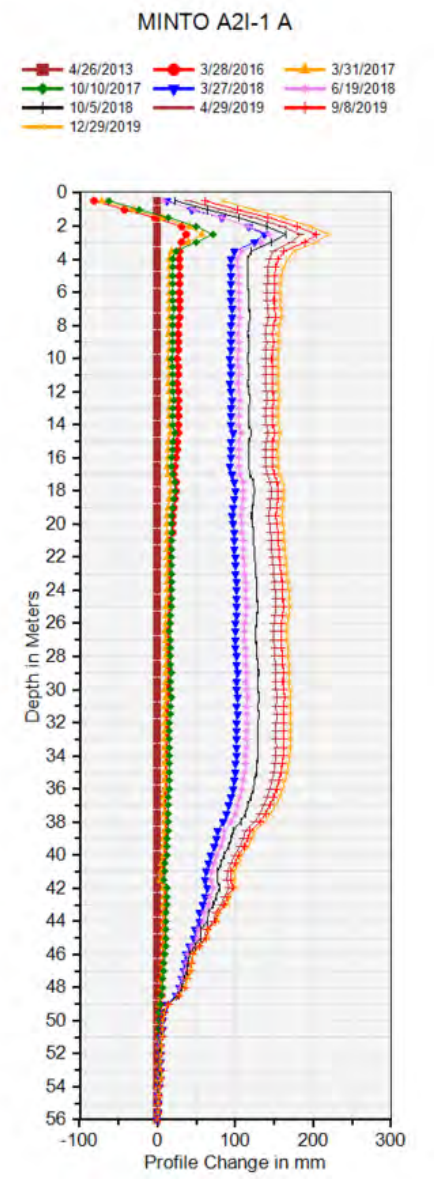


Figure 9-9: Area 2 Stage 3 Pit Inclinometer A2I-1 (2013-2019)

9.1.2.3 Main Pit Inclinometer

There is currently one operating inclinometer (MDI-2) in the Main Pit west wall area. Readings have been collected since 2010. Data are collected quarterly. Data collected are presented in Figure 9-10. Displacements in MDI-2 increased during the winter of 2017-18, with a movement rate of approximately 0.07 mm/day primarily occurring between the depths of 22 and 28 m below ground surface. The displacement is likely related to the construction of the MWD Wrap which occurred during the same time period. The movement rate has slowed since completion of the dump, with a rate <0.02 mm/day in 2019.

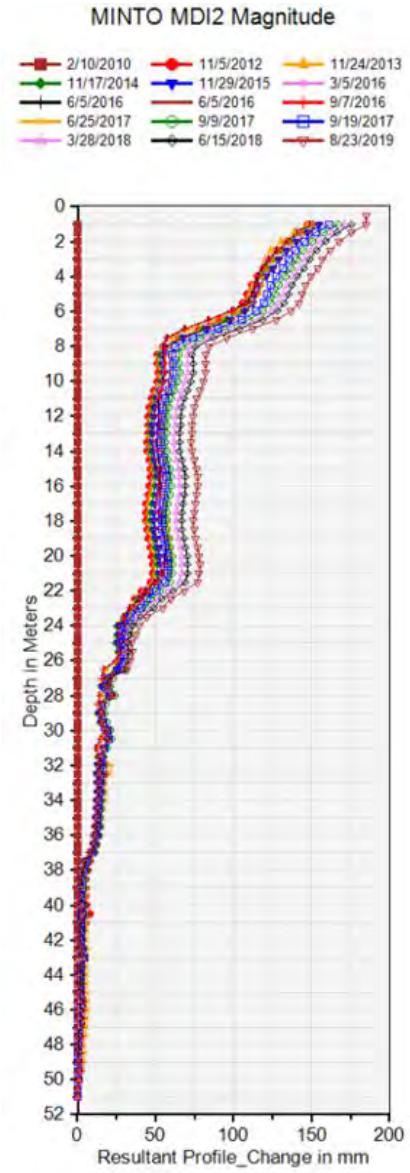


Figure 9-10: Main Pit Inclinometer MDI-2 (2010-2019)

9.2 Engineer's Annual Physical Inspection Reports

As required by the WUL and QML, the following structures are inspected semi-annually by Minto's geotechnical engineer and annually by an external geotechnical engineering consultant:

- Big Creek Bridge;
- Mill and camp site;
- Dry Stack Tailings Storage Facility and Mill Valley Fill Extension (Stage 1 and 2);
- Fuel containment facility;
- Main Waste Dump;
- Ore stockpiles;
- Reclamation Overburden Dump;
- Ice Rich Overburden Dump;
- South Diversion Ditch;
- Tailings Diversion Ditch
- Southwest Waste Dump;
- Main Pit including South Wall Buttress and In-Pit Dumps;
- Water Storage Dam;
- Area 118 and Area 2 Pit; and,
- Minto North Pit.

Table 9-1 summarizes the recommendations from the most recent external inspection conducted June 19-21, 2019 and the associated planned actions.

Table 9-2: Annual Physical Inspection Report Summary (2019)

Area	Recommendation	Action
Instrumentation	A review of the survey reading methodology for the survey hubs located at the WSP is recommended to reduce reading variability. Potential changes to consider include longer duration readings and/or use of an extension rod with the GSP receiver.	Extension rod used to gain accuracy.
DSTSF and MVFE	As part of the routine visual inspections, continue to monitor the following for any changes in condition: - identified slump at the south end of the DSTSF to determine if any slope stabilization measures are required. - the cracking present at the south end of the DSTSF, as well as - erosion gullies observed in the cover material on the northern and eastern slopes.	Ongoing Monitoring

Area	Recommendation	Action
Tailings Diversion Ditch	The vegetation in the western portion of the Tailings Diversion Ditch should be cleared and the channel armored with rip rap where required.	Completed November 2019
	Obstructions within the Overflow Spillway should be removed to ensure that the flow capacity is not impeded if the spillway is utilized.	Completed November 2019
	Construction of the Inlet Channel should be completed in a manner that meets all design requirements documented in the SRK design memo that include minimum channel dimensions, grades, rip-rap gradations and thicknesses. During construction, survey and visual inspections of the channel should be implemented to confirm adequate rip-rap gradations.	To complete summer 2020
	Remaining construction should be completed prior to snowfall in order to be in-place by the 2020 freshet. If construction is not able to be completed in 2019, a management plan must be developed to ensure water does not overflow the channel during 2020 freshet, and the construction works must then be completed in 2020. The management plan should ensure that appropriate resources are available during freshet that would be able to manage the freshet flows (pumps, heavy equipment to construct temporary berms or diversions channels) to prevent overtopping of water towards the DSTSF.	Management Plan developed, communicated, and ready for implementation if required.
MWD	Continue to monitor the crests and slopes as part of the monthly visual inspection for signs of worsening cracking and/or increased sinkholes to determine if any slope stabilization measures are required.	Ongoing
SWD	Continue to monitor the cracking upslope of the overburden stockpiles as part of the routine inspections. Should the crack appear to length or widen, install in extensometer to track the crack width with monthly data readings.	Ongoing
Mill Site	Backfill the over-steepened slope at the toe of the highwall immediately north of the mill to ensure that the original design requirements are met (EBA 1994). Continue to place concrete jersey barriers as a protection barrier against minor rockfall.	Completed October 2019
Camp Site	Continue to monitor the erosion channels below the camp pad as part of the routine visual inspections and following larger rainfall events. If erosion continues, implement	To continue monitoring

Area	Recommendation	Action
	mitigation measures. Measures to consider include surface regrading, fill placement to direct flow away from the slope, installation of a sump/drainage system.	
WSP Dam	During routine instrumentation readings, inspect and photograph the identified potential sinkhole located 5 m NW of WSPT-8 (See Photo 72 in Appendix A) to monitor for any change in condition.	Implemented
Big Creek Bridge	Continue regular annual monitoring of sediment accumulation in the culverts and clean out if sediments continue to accumulate. Limit the material graded from the road at the culvert locations, or muck out some of the gravel buildup, taking care not to damage the culvert. If the alignment of Big Creek changes and it appears that the culverts may be utilized, tree clearing and sediment removal immediately upstream and downstream of the culverts is recommended.	To be monitored and Implemented as necessary.
Main Pit, SAT Dump & In-Pit Dumps	As part of the routine visual inspections, continue to monitor the extent of the long crack in the Main Pit Dump Ramp for any changes in condition	Ongoing
Area 2 Pit	Stage 2 Continue to monitor the crests and slopes as part of the monthly visual inspection for signs of worsening cracking to determine if any slope stabilization measures are required.	Ongoing
	Stage 3 Implement measures to redirect runoff from the Underground Access Road away from the erosion gully that has formed into the pit (e.g. regrade the road). Longer-term, the erosion gully should be stabilized and armored.	Re-Grading project underway March 2020.
	When the Underground Shop begins to be used again, the inspection frequency of the "Dumas Shop" survey hubs (DS-1 to DS-4) should be increased to weekly. Hubs DS-1 and DS-2 need to be repaired and recommissioned for use.	DS-1 – DS-4 monitoring frequency increased to weekly
	The Underground Shop should be inspected by a suitably qualified structural engineer to ensure it remains suitable for use.	Underground shop inspection planned for 2020
	Continue to monitor the pit for any changes i.e. further slumping/cracking due to permafrost thaw and further instability at the area of the historical rockfall.	Pit monitoring in ongoing.

10 Adaptive Management Plan - Operations

The Operations Adaptive Management Plan has been in use since WUL QZ14-031 became active. Adaptive Management Plan 2017-01 (AMP 2017-01) is currently approved by Energy, Mines and Resources (EMR) under the current Quartz Mining License (QML-0001); while the Adaptive Management Plan 2017-02 (AMP 2017-02) is approved under by the Yukon Water Board under the current Water Use Licence (QZ41-031). This section includes the assessment to the AMP of 2017-02 specific thresholds.

The comparative tables and associated trigger levels for the adaptive management stations and the required trend analyses are included in the monthly WUL reports.

A summary of the AMP 2017-02 exceedances is included in the sections below. Not all threshold concentration exceedances result in the triggering of AMP responses, as determined by the AMP2017-02.

Quarterly Qualified Professional interpretations of AMP exceedances and their recommended responses are presented in Appendices I and J.

10.1 Surface Water Quality – Minto Creek

In 2019, AMP thresholds were triggered in April and June only.

10.1.1 Minto Creek – W2

A summary of the W2 exceedances of the AMP are discussed below in Table 10-1. Trend analysis, evaluations and data has been presented in the monthly reports.

Table 10-1: Minto Creek Surface Water threshold exceedances, Station W2

Date	Parameter	Exceedance Threshold Triggered	Context
9-Apr-19	Mo-D	SPT3	3 of 11 samples exceeded threshold concentration
11-Jun-19	Mo-D	SPT3	
18-Jun-19	Mo-D	SPT3	

Ongoing events are addressed specifically as follows:

Dissolved molybdenum exceeded predicted worst-case maximum concentrations at Minto Creek Station W2 and the source was determined to be groundwater inputs, but these inputs were consistent with natural groundwater inputs. Dissolved molybdenum concentrations at all surface and groundwater stations were well below Minto's Mine WQO and below natural conditions, so effects to aquatic life would not be expected.

It is recommended that sampling continue as scheduled since concentrations are not expected to affect aquatic life. Increased monitoring frequency is not required at this time.

10.1.2 Minto Creek – W50

Minto monitored the specific performance thresholds for surface water quality in Minto Creek at WQO station W50 until November 4th, 2019; there was no water and therefore no samples collected after this time. No adaptive management was required.

10.2 Surface Water Quality – McGinty Creek

Minto monitored the specific performance thresholds for surface water quality in McGinty Creek.

A summary of the MN-4.5 exceedances of the AMP are discussed below. Trend analysis and data has been presented in the monthly reports.

Not all threshold concentration exceedances result in the triggering of AMP responses.

Table 10-2: McGinty Creek Surface Water threshold exceedances, MN-4.5

Date	Parameter	Exceedance Threshold Triggered	Context
17-May-19	Se-D	ST1	3 of 5 samples exceeded threshold concentration
8-Jun-19	Cu-D	ST1	1 of 5 samples exceeded threshold concentration
8-Jun-19	Se-D	ST1	3 of 5 samples exceeded threshold concentration
18-Aug-19	Mo-D	ST1	2 of 5 samples exceeded threshold concentration
12-Oct-19	Mo-D	ST1	2 of 5 samples exceeded threshold concentration
12-Oct-19	Se-D	ST1	3 of 5 samples exceeded threshold concentration

Ongoing events are addressed specifically as follows:

Dissolved copper and selenium exceeded the ST-2 and ST-3 objectives at MN-4.5, but the source was unrelated to the Minto Mine and consistent with historical concentrations before the Minto North Pit was operational. Dissolved copper and selenium were well below Minto's SSWQO, so effects to aquatic life would not be expected.

Three investigations show that dissolved selenium consistently triggers either the ST-2 or the ST-3 objective but that exceedances were unrelated to the mine. These consistent exceedances could be due to the appropriateness of using MN-4.5 as the station which thresholds are based on. Station MN-4.5 receives influence from a mix of the west and the east arms (Figure 1). Station MN-0.5 would be more appropriate to use as the basis for the thresholds as it is influenced by a greater proportion of the west arm (reference arm) and would serve as a good comparison to MN-2.5 which is influenced by most of the east arm (exposed arm; Figure 1). It is recommended that the development of Specific Thresholds using station MN-0.5 should be considered. Accordingly, draft thresholds were developed for MN-0.5 (for all analytes) using the same methodology as current thresholds and based on all available data from 2009 to 2018. Data for MN-0.5 was used to develop ST-1 (0.23 µg/L), ST-2 (0.26 µg/L), and ST-3 (0.21 µg/L) selenium thresholds. Draft selenium thresholds were evaluated against raw data and 12-month rolling average calculations. This interpretation is discussed in greater detail in Appendix I, *Evaluation of Dissolved Copper and Selenium AMP Threshold Exceedances in McGinty Creek - Minnow*.

It is recommended that sampling continue as scheduled since the exceedance of dissolved copper and selenium were unrelated to the mine. It is recommended that Minto Mine seek approval to use the draft thresholds. Increased monitoring frequency is not required at this time.

10.3 Groundwater Quality – Minto Creek

Various exceedances of AMP levels triggered a review of the groundwater data by the qualified professional. All groundwater data was forwarded to SRK Consulting for review and recommendations. See Appendix J, *2019 Minto Groundwater Quality AMP Review Memo - SRK,* for details.

10.4 Groundwater Quality - McGinty Creek

Minto monitored the specific performance thresholds for McGinty Creek groundwater. Various exceedances of AMP levels triggered a review of the groundwater data by the qualified professional. All groundwater data was forwarded to SRK Consulting for review and recommendations. See Appendix J, *2019 Minto Groundwater Quality AMP Review Memo - SRK,* for details. The Annual Review of AMP Exceedances for 2019 will include a comprehensive water and load balance for McGinty Creek and is expected later in the year, and will be submitted separately.

10.5 Water Management AMP

Water storage capacity in the Main Pit Tailings Management Facility and the Area 2 Pit Tailings Management Facility exceeded 1,000,000 m^3 during the operational period and as such, no responses from the adaptive management plan were applied.

10.6 Physical Monitoring Program AMP

The results of the Physical Monitoring Program are compared to the thresholds set out in the 2018 Adaptive Management Plan (AMP). Table 10-3 and 10-4 below, summarize the threshold statuses for the Category 1 and Category 2 facilities. Please note that the table also includes historical context for some Thresholds.

Category 1 facilities are those found in areas of ice-rich periglacial foundations that have previously experienced deep-seated foundation movement and include the Dry Stack Tailings Storage Facility, Mill Valley Fill Extension (Stages 1 and 2), Southwest Waste Dump, and South Wall Buttress/Main Pit Dump. Category 2 facilities are all other waste rock dumps, including the Main Waste Dump and Main Waste Dump Expansion, Reclamation Overburden Dump, and Ice-rich Overburden Dump.

Table 10-3: Category 1 Facilities – Threshold Status, December 2019

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 1 • Observation of unusual occurrence including: • tension cracks, settlement, or sloughing; • a seismic event that exceeds the 1:475 return period event[1]; • abnormal seepage from any area of the slopes; • increased turbidity from seepage;	None	N/A

[1] This size of a seismic event would be felt by most people on site. It would shake buildings, and rattle or break dishes, hanging objects, etc. Earthquake information may also be found online at: http://www.earthquakescanada.nrcan.gc.ca/index-eng.php

Specific Performance Thresholds	Thresholds Exceeded	Response
• Physical damage.		
Specific Threshold 2 • One survey hub or inclinometer reading indicating an increase in the movement rate greater than the long-term trend and outside the range of instrumentation error.	MWDH03	November 2019: MWDH03 reading shows an acceleration trend greater than the long-term trend and outside range of instrumentation error. Reading was retaken and the area inspected with no obvious signs of movement. Additional reading taken in December 2019 shows movement rate similar to that observed previously. Issue considered **CLOSED**.
	DSSH-12	Small increase in movement beginning in December 2019 from 0.1 mm/day to 0.4 mm/day. The movement rate is low compared to historical dates. Nearby hubs read on a quarterly basis are due to be read in February and the data will be checked to see if other hubs in the area show similar movement trends. **March 23, 2020**: Movement rate since slowed and nearby survey hubs show no indication of accelerating movement. Area to be inspected following snowmelt.
Specific Threshold 3 • For DSTSF and MVFE piezometers 13-DSP-05a, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru[2] exceeds 0.40. • For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 3 m above the original ground surface. Or	DSP-07 (2, 3, 4, 5, and 6)	December 2015: DSP-07 has displayed Ru values higher than 0.40 for sensors 2, 3, 4 and 5 since installation. This piezometer is outside the MVFE2 footprint and is not considered a stability concern. Reading frequency was increased to every two weeks (from monthly). High initial values may have been due to grout curing or freeze-induced pressure. Current conditions: Discussed in Threshold 4

[2] Ru is the pore water pressure coefficient which is the ratio of piezometric pressure to the overburden pressure. A pore water pressure ratio of 0.5 would be similar to the effect of a groundwater table at surface. Conversions from Ru to equivalent water elevation are contained in Table 2-15 of the AMP.

Specific Performance Thresholds	Thresholds Exceeded	Response
Temperature greater than zero at a depth of 2 m below original ground *(all SWD ground temperature cables, and DSTSF ground temperature cables DST-10, DST-11, and DST-14 only)*	DSP-08 (1)	April 2016: DSP-08 displayed Ru values higher than 0.4 for sensor 1 (@5m depth). The design engineer was notified. No instability was noted during inspections. Reading frequency was increased to bi-weekly (from monthly), and increased to daily while dumping in the immediate vicinity. Current conditions: Ru value is still >0.40, however, has been decreasing since June 2016.
	DSP-08 (2, 3, 5 and 6)	May 31, 2016: An additional spike was noted on sensors 2, 3, 5 and 6. Again, the design engineer was notified and no instability was noted on inspection. Current conditions: no change, readings have been slowly increasing. Sensors 2, 3, 5, and 6 have Ru values >0.40.
	DSP-10	DSP-10 has displayed a water elevation >1m above ground surface depth since March 8th, 2016. The design engineer was contacted, and reading frequencies were immediately increased to weekly. Reading frequency was further increased to daily on March 14. See response to Specific Threshold 4 for more details.
Specific Threshold 4 • For DSTSF and MVFE piezometers 13-DSP-05, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in piezometric pressures under unfrozen or thawing conditions such that Ru exceeds 0.6. • For MVFE2 piezometer 15-DSP-10, an increase in piezometric pressures under unfrozen or thawing conditions such that the equivalent water elevation is 10 m above the original ground surface	DSP-07 (2, 3, 4, 5, and 6)	February 3, 2016: DSP-07 sensors 2 and3 are above the 0.6 threshold. May 15, 2016: DSP-07 sensor 5 is above the 0.6 threshold. January 14, 2017: DSP-07 sensor 4 is above the 0.6 threshold. December 5, 2017: DSP-07 sensor 6 is above the 0.6 threshold. This piezometer is outside the MVFE2 footprint and is not considered a stability concern.

Specific Performance Thresholds	Thresholds Exceeded	Response
		Current conditions: Readings appear to have stabilized in 2019, sensors 2-6 continue to have an Ru >0.60.
	DSP-05B	August 23, 2019: Sensor exceeded Ru 0.6 threshold. This sensor has exceeded this threshold in the past and the current pressure is less than the historical maximum. A review of nearby survey hubs shows no increase in movement rates. Piezometer to be continued to be monitored as per schedule.
	DSP-10	DSP-10 has displayed an equivalent water level >3m above ground surface depth since April 1st, 2016. Since September 2016 the equivalent water level has been >10m above ground surface. Summary of actions below: • April 1, 2016: Design engineer notified. Inspection frequency increased to daily. Dumping on the lower tier was suspended. • April 4, 2016: Two survey hubs were installed on the eastern slope to monitor for movement with a daily reading frequency. • April 5, 2016: The lower tier was re-opened for dumping after stabilization of piezometer values. Going forward, piezometer data was reviewed prior to dumping each subsequent lift. • May 3, 2016: Inspections were reduced to weekly, with a daily review of monitoring data. • When working along the eastern edge of the final lift, a daily inspection was conducted. • August 25, 2016: Survey hub reading frequency reduced to weekly as construction was complete. • Sept 1: Piezometer reading frequency was reduced to weekly as the data had stabilized and construction was complete. • Once the facility construction was complete, the inspections were reduced back to monthly. Piezometer readings remain on a weekly schedule. Current conditions: equivalent water level is >10m and is still very gradually increasing. Reading have

Specific Performance Thresholds	Thresholds Exceeded	Response
		been reduced to quarterly as the readings have stabilized and survey hub data indicates decelerating movement.
Specific Threshold 5 • Three consecutive survey hub or inclinometer readings indicating an increase in the movement rate movement greater than the long-term trend. Or • Three consecutive survey hub readings indicating a change in horizontal direction of movement greater than 15 degrees from the long-term trend,	None	N/A

Table 10-4: Category 2 Facilities – Threshold Status, December 2019

Specific Performance Thresholds	Thresholds Exceeded	Response
Specific Threshold 1 • Observation of unusual occurrence including: • tension cracks, settlement, or sloughing; • a seismic event that exceeds the 1:475 return period event; • abnormal seepage from any area of the slopes; • increased turbidity from seepage; • physical damage.	None	N/A
Specific Threshold 2 **WSP Dam:** • One survey hub reading indicating an increase of movement outside range of instrumentation error. **All other Category 2 Facilities:** • Survey hub cumulative displacements between 150 mm and 500 mm.	None	N/A
Specific Threshold 3 **WSP Dam:** • One piezometer reading outside of its long-term trend (in comparison to the reservoir pond elevation). **All other Category 2 Facilities:** • Survey hub cumulative displacements greater than 500 mm.	None	N/A
Specific Threshold 4 **WSP Dam:** • Three consecutive survey hub readings indicating increase in movement outside range of instrumentation error.	None	N/A

11 Aquatic Environmental Monitoring Program

The Aquatic Environmental Monitoring Program (AEMP) is composed of Minto's requirements under the MMER and biological monitoring of sediment, benthic invertebrates, fish and fish habitat. Monitoring under the MMER is presented in Section 11.1 and the biological monitoring of sediment, benthic invertebrates, fish and fish habitat is presented in Section 11.2.

11.1 Metal and Diamond Mining Effluent Regulations Monitoring Programs

The Metal and Diamond Mining Effluent Regulations (MDMER) outline requirements for monitoring and reporting of discharged effluent volume and quality under the MDMER to Environment Canada. Details of the Metal and Diamond Mining Effluent Program, including sampling station locations and monitoring frequency, are outlined in the EMSRP and the results are submitted on a quarterly and annual basis to Environment Canada.

11.1.1 Effluent Monitoring Program

The MDMER Program requires effluent monitoring and sampling at the final discharge point (FDP) station W3, downstream of the end of pipe discharge. The W3 sampling station is collected when there is a discharge of water at W3; testing occurs weekly for deleterious substances.

Weekly effluent monitoring samples are tested for the deleterious substances as described in the MDMER including total metals (arsenic, copper, lead, nickel and zinc), total suspended solids (TSS), and pH. Weekly samples are collected at least 24 hours apart and not more than 7 days apart. Minto is striving for consistency and has internally scheduled MDMER sampling to occur on Tuesdays.

Radium 226 and acute lethality tests are conducted quarterly due to the reduced frequency guidelines outlined in the MDMER.

The Effluent Monitoring Program results are submitted to Environment Canada quarterly and are presented in Appendix K.

11.1.2 Environmental Effects Monitoring Water Quality Monitoring

The EEM Water Quality Monitoring Program is designed to characterize water quality at the exposure area, the receiving environment and in reference (un-impacted) area. Water quality samples must be collected four times a year, not less than one month apart, while the mine is discharging effluent at the Final Discharge Point (FDP) of W3. Samples are collected at the exposure area (W3), receiving environment station (W2) and reference station (W7). Effluent toxicity testing is required annually using a total of four tests; one each of a fish, invertebrate, algae and plant species.

The EEM Water Quality Monitoring Program results submitted to Environment Canada annually, are presented in Appendix K.

11.1.3 Environmental Effects Monitoring Biological Monitoring

The EEM Biological Monitoring Program outlines fish population, fish tissue and benthic invertebrate tests conducted under Schedule 5, Part 2 of the MDMER. Minto Mine has submitted the results of the Phase 5 EEM Study Design Report as required to Environment Canada in January 2018. The *Phase 5 EEM Interpretive Report* is due November 30, 2020. The Phase 5 EEM Study Design is included in Appendix L.

11.2 Biological Monitoring Program

Clause 71 and 72 of the WUL requires an Annual Biological Monitoring Program that includes monitoring of sediment, periphyton, benthic invertebrates, fish, and fish habitat.

In 2019, only upper Minto Creek and the corresponding reference (upper McGinty Creek) were sampled as part of the field program. There was no water in lower Minto Creek and therefore it was not sampled (and therefore nor were corresponding reference areas). Sampling from a dry creek bed was considered of limited value as dry sediment chemistry and toxicity testing would be of little biological relevance and a dry creek bed does not support periphyton or aquatic benthic invertebrate communities comparable to previous years or to reference.

The following sections summarize the monitoring programs and more detailed reports can be found in Appendix M and Appendix N. Appendix M contains information with respect to the sediment, periphyton, and benthic invertebrate monitoring programs and Appendix N contains information relative to the fish monitoring programs.

11.2.1 Sediment Monitoring Program

Given the above background, the objectives of the 2019 monitoring program were to characterize sediment quality and supporting measures of upper Minto Creek relative to the corresponding reference (McGinty Creek) and to compare those to historical conditions.

Surface water quality

In situ surface water quality measurements (meter measures) collected in September 2019 at the time of sediment sampling, indicated relatively good water quality in Minto Creek. The influence of the Minto Mine was primarily evident in higher specific conductance relative to the reference creek (Table 11-1).

Table 11-1: Summary of *in situ* water quality statistical comparisons between upper McGinty Creek (reference and Upper Minto Creek (Mine-Exposed)

Endpoint	Data Transformation	Test	Test P-value	MCT[a]		MOD[b] (%)
				Upper McGinty	Upper Minto	
Temperature (°C)	log10	tequal	0.001	1.09	2.76	153
Dissolved Oxygen (mg/L)	log10	tequal	0.004	10.3	12.2	18.4
Dissolved Oxygen (%)	log10	tequal	0.042	75.8	89.0	17.4
pH	none	tequal	<0.001	7.8	8.2	4.86
Specific Conductance (µS/cm)	log10	tequal	<0.001	242	567	134

P-value < 0.05.

[a] MCT Measure of Central Tendency is the mean for parameters where statistics were conducted on the raw scale and the geometric mean when statistics were log10 transformed to meet the assumtions of normality.

[b] MOD magnitude of difference

Data quality review indicated that water chemistry data collected during the sediment sampling were of good quality (Appendix D). Laboratory reporting limits for all analytes were suitable for project purposes. Differences (evaluated as Relative Percent Difference; RPD) between analyte concentrations in duplicates demonstrated acceptable precision (<40% RPD) for analytes of interest (mine influence indicators or potential toxicity modifying factors). Total copper, a mine influence indicator of interest, had an RPD of 41%. This is considered relatively good in terms of field precision which measures natural and sampling variability. Dissolved metal duplicates all demonstrated low RPDs and therefore high field precision. Other analytes of interest were associated with high precision. Strong agreement (<20% RPD) was achieved between laboratory duplicate samples for all analytes (Appendix D) indicating high analytical precision.

Hardness, total dissolved solids, total alkalinity, and total inorganic carbon concentrations in fall 2019 were generally higher in upper Minto Creek than in upper McGinty Creek (Appendix D). Concentrations of total and dissolved organic carbon (TOC and DOC) were similar in upper Minto Creek and upper McGinty Creek. Higher hardness, alkalinity, and organic carbon can modify (reduce) the bioavailability and toxicity of certain metals (e.g., copper).

Nutrient (i.e., total phosphorus (TP), total dissolved phosphorus (TDP) and nitrogen species [nitrate, nitrite, ammonia]) concentrations were relatively low at both the upper exposure and reference areas. Both systems are defined as oligotrophic (based only on total phosphorus, < 0.025 mg/L) in terms of trophic classification (Dodds et al. 1988; Appendix D). Upper McGinty Creek would be defined as slightly more productive than upper Minto Creek based on fall 2019 TP and nitrate concentrations.

All analytes were below the CWQG during the sediment sampling in September 2019 in both Upper Minto and the reference creek except for fluoride. Fluoride exceeded the interim CWQG in both upper Minto Creek and upper McGinty Creek (Appendix D) suggesting a regional and non-mine related influence. The

total copper concentration of 0.0039 mg/L was just below the CWQG of 0.004 mg/L for the protection of aquatic life using the corresponding sample hardness of 277 mg/L as $CaCO_3$ in the guideline equation CCME (1999). In addition, the fall 2019 dissolved copper concentration (0.0023 mg/L), was well below the WUL site specific water quality objective[3] (Appendix D). The relatively higher copper concentrations in upper Minto Creek relative to McGinty Creek suggest an influence of the mine. Higher boron and lithium concentrations observed in upper Minto Creek in 2019 compared to the reference creek suggest a high groundwater contribution, consistent with dry conditions observed in 2019.

Sediment quality

The sediment monitoring program characterized sediment particle size, total organic carbon content, and concentrations of metals, metalloids, and nutrients in sediments. Sediments collected in 2019, were largely composed of fine particles of silt/clay (>15%) and sand (>60%). Organic content measured by mean loss on ignition (LOI), total organic carbon (TOC), and total carbon were slightly higher at upper Minto Creek than in upper McGinty Creek sediments (Table 11-1), but the difference was not significant. However, inorganic carbon was significantly higher at upper Minto Creek relative to the reference location (0.15% vs 0.063%).

Sediment concentrations of several metals were found to be significantly higher in upper Minto Creek than in upper McGinty Creek, suggesting a geological influence or a mine influence (Table 11-1). Highest magnitudes of difference were observed for copper (1,208%), molybdenum (446%), and cadmium (221%). Mean concentrations of copper also exceeded the Interim Sediment Quality Guidelines (ISQG) for the protection of aquatic life (CCME 1999) in the upper effluent-exposed area (Table 11-1; Appendix D). Copper concentrations measured in one sediment sample was above the probable effect level (PEL). Arsenic concentrations measured in both upper Minto Creek and the reference area were also above the ISQG indicating that arsenic was associated with a more regional influence and not the Minto Mine.

Historically, copper concentrations reported in both upper and lower Minto Creek sediments have been higher than reference (Figure 11-1; Minnow 2019a). Average copper concentrations in upper Minto Creek have historically (2018, 2016) exceeded the probable effect level (Figure 11-1). Mean copper concentrations have also been historically greater than the ISGQ in lower Minto Creek sediment during most years (Table 11-1; Figure 11-1; Appendix M).

Low sediment volume and predominantly erosional habitat limits the exposure of aquatic biota to sediment in upper Minto Creek (Minnow 2019). Environmental Effects Monitoring (EEM) is conducted in this reach of the creek but is reported elsewhere (Minnow 2018). EEM monitoring was completed in this reach in 2016 (Minnow 2018) and 2019 (data interpretation pending). In lower Minto Creek, fine sediment deposits are more common along with higher trophic organisms (fish). For this reason, the AEMP is focused on biological monitoring and toxicity work in lower Minto Creek to monitor for potential adverse impacts of elevated copper concentrations and other mine parameter influences.

[3] The WUL objective is 0.013 mg/L when dissolved organic carbon is ≤ 10 mg/L and 0.020 mg/L when dissolved organic carbon is > 10 mg/L.

Sediment toxicity tests were not conducted in 2019 due to low flows, however, past sediment toxicity testing of *Chironomus dilutus* found adverse effects to survival (but not growth) in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek) (Minnow 2019). No effects to *Hyalella azteca* were observed in 2018 nor in previous testing (Minnow 2019).

Table 11-2: Sediment Chemistry Data Collected at Exposed and Reference Areas, Minto Mine (2019)

Analytes		Units	CSQG [a]		Upper McGinty Creek (Reference)				Upper Minto Creek (Exposed)			
			ISQG	PEL	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
Particle size, TKN, carbon analytes and pH	Loss on Ignition	%	-	-	4.0	0.7	3.0	5	5.4	2.3	3.0	8
	pH (1:2 soil:water)	pH units	-	-	7.09	0.58	6.46	7.63	8.26	0.15	8.07	8.42
	Total Kjeldahl Nitrogen	%	-	-	0.09	0.02	0.067	0.12	0.16	0.081	0.082	0.27
	Inorganic Carbon	%	-	-	0.064	0.010	0.052	0.07	0.18	0.124	0.074	0.38
	Inorganic Carbon (as $CaCO_3$ Equivalent)	%	-	-	0.53	0.09	0.43	0.6	1.5	1.03	0.62	3.2
	Total Carbon by Combustion	%	-	-	1.8	0.3	1.3	2.2	2.6	1.2	1.1	3.9
	Total Organic Carbon	%	-	-	1.7	0.3	1.3	2.1	2.4	1.1	1.0	3.5
Total Metals	Aluminum (Al)	mg/kg	-	-	6,558	1,279	4,870	8,220	9,982	2,127	7,060	12,900
	Antimony (Sb)	mg/kg	-	-	0.26	0.062	0.21	0.36	0.45	0.13	0.34	0.61
	Arsenic (As)	mg/kg	5.9	17	7.7	2.8	3.9	11	6.2	1.5	4.8	8.3
	Barium (Ba)	mg/kg	-	-	131	21	105	152	332	200	137	625
	Beryllium (Be)	mg/kg	-	-	0.21	0.038	0.17	0.27	0.40	0.079	0.28	0.48
	Bismuth (Bi)	mg/kg	-	-	< 0.2	-	<0.2	<0.2	< 0.2	-	<0.2	<0.2
	Boron (B)	mg/kg	-	-	< 5.0	-	< 5.0	< 5.0	< 5.0	-	< 5.0	< 5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.08	0.014	0.055	0.09	0.24	0.13	0.11	0.39
	Calcium (Ca)	mg/kg	-	-	4,560	632	3,500	5,070	8,964	1,937	6,870	11,200
	Chromium (Cr)	mg/kg	37	90	13	3.5	9	16	25	6.7	13	30
	Cobalt (Co)	mg/kg	-	-	6.1	1.0	4.6	7	11	1.7	8.9	13
	Copper (Cu)	mg/kg	36	197	10	2.1	8	13	131	61	66	200
	Iron (Fe)	mg/kg	-	-	19,620	3,304	15,200	24,300	23,060	4,711	15,900	27,900
	Lead (Pb)	mg/kg	35	91	2.8	0.36	2.4	3.3	5.4	1.24	3.7	6.6
	Lithium (Li)	mg/kg	-	-	4.1	0.8	3.1	5.2	6.8	1.4	5.0	9
	Magnesium (Mg)	mg/kg	-	-	2,836	605	2,020	3,540	5,996	1,193	4,210	7,550
	Manganese (Mn)	mg/kg	-	-	587	282	297	979	5,761	5,398	847	13,900
	Mercury (Hg)	mg/kg	0.17	0.49	0.017	0.004	0.012	0.02	0.021	0.0086	0.013	0.033
	Molybdenum (Mo)	mg/kg	-	-	0.45	0.094	0.37	0.61	2.5	1.84	0.86	5.0
	Nickel (Ni)	mg/kg	-	-	10	2.2	7	13	27	4.0	22	31
	Phosphorus (P)	mg/kg	-	-	743	127	554	905	897	191	590	1,070
	Potassium (K)	mg/kg	-	-	416	84	310	490	1,250	232	1,010	1,580
	Selenium (Se)	mg/kg	-	-	0.33	0.09	0.22	0.44	0.51	0.25	0.20	0.74
	Silver (Ag)	mg/kg	-	-	< 0.10	-	<0.10	<0.10	< 0.10	-	< 0.10	0.11
	Sodium (Na)	mg/kg	-	-	136	32	93	170	299	47	223	342
	Strontium (Sr)	mg/kg	-	-	42	3	37	45	108	37	69	153
	Thallium (Tl)	mg/kg	-	-	<0.050	0.000	< 0.050	0.050	0.078	0.016	0.060	0.10
	Tin (Sn)	mg/kg	-	-	<2.0	-	<2.0	< 2.0	<2.0	-	<2.0	< 2.0
	Titanium (Ti)	mg/kg	-	-	427	108	307	550	618	142	377	741
	Uranium (U)	mg/kg	-	-	0.6	0.08	0.49	0.7	0.70	0.14	0.58	0.9
	Vanadium (V)	mg/kg	-	-	34	5.5	26	39	52	10.6	35	64
	Zinc (Zn)	mg/kg	123	315	27	5.0	21	33	59	11	47	72

Indicates sediment concentration exceeding CSQG ISQG.
Indicates sediment concentration exceeding CSQG PEL.
Indicates sediment concentration exceeding higher reference mean by more than two times.
Indicates sediment concentration exceeding higher reference mean by more than two times and higher than CSQG ISQG ar

Note: '- = no guideline or not possible to calculate from non detectable data

[a] Canadian Sediment Quality Guidelines: ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

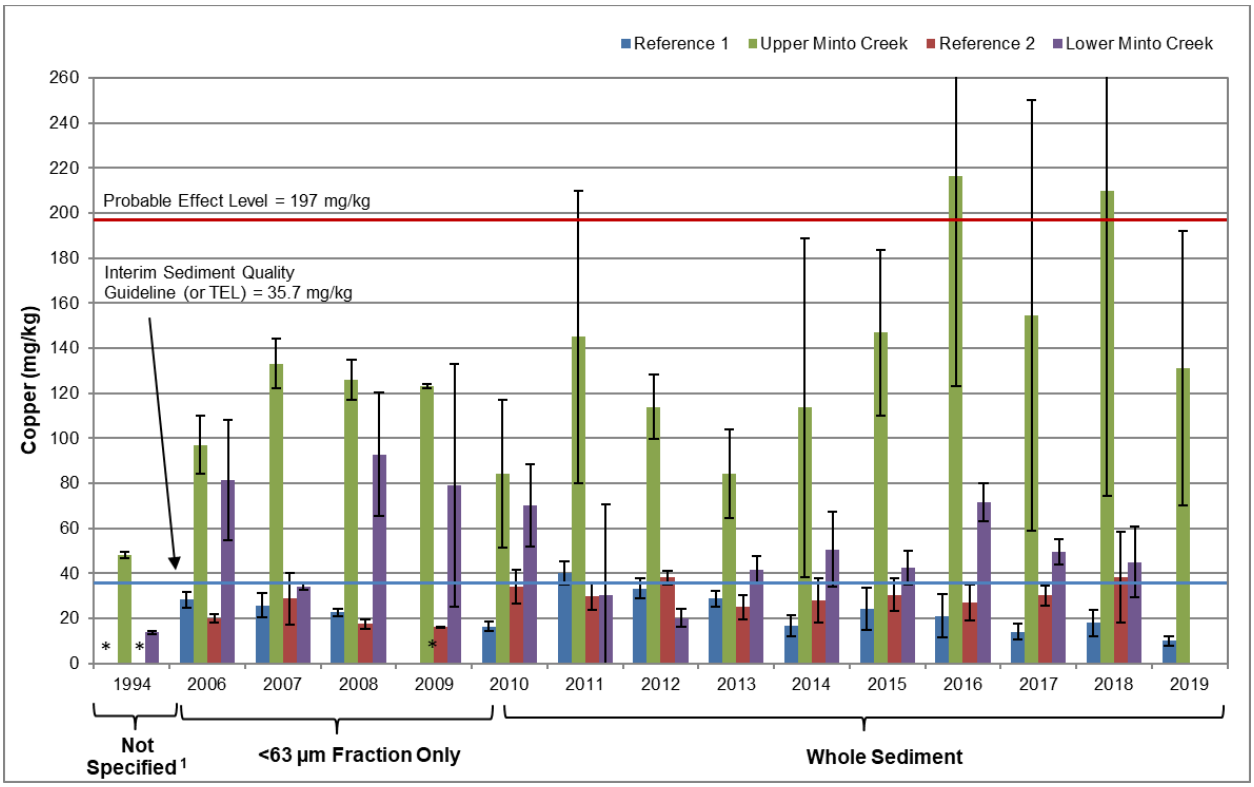


Figure 11-1: Copper Concentrations (Mean ± Standard Deviation) in Sediment Collected in Minto Creek and Reference Locations, 1994 to 2019 [2]

Notes: * = no data, TEL = Threshold Effect Levels.
[1] Methods were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994).
[2] Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2019;
Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2018.

11.2.2 Periphyton Monitoring

No periphyton production and community data were collected at lower Minto and lower Wolverine creeks in 2019 due to dry conditions. Productivity was previously assessed through measurements of chlorophyll-a in periphyton (used as a surrogate for the productivity of photosynthetic organisms). Previously, concentrations of periphyton chlorophyll a were not significantly different between lower Minto Creek (55 mg/m^2) and lower reference, Wolverine Creek (43 mg/m^2) and both were below the British Columbia Water Quality Guideline (BCWQG) of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985; Minnow 2019).

11.2.3 Benthic Invertebrate Community Monitoring

Historically, benthic invertebrate communities are sampled at erosional areas of lower Minto Creek and erosional reference areas of lower Wolverine Creek and lower Big Creek to evaluate any potential mine-related effects. In 2019 they were not sampled due to dry conditions. However, monitoring completed in 2018 indicated that benthic invertebrate community metrics of density, number of taxa, and Simpson's Diversity, and Simpson's Evenness in lower Minto Creek did not differ from reference (Minnow 2019), suggesting limited mine influence. Some subtle community-level differences were apparent (e.g., more sensitive mayfly/stonefly/caddisfly taxa), but were not indicative of a mine related effect. This was supported by the EEM finding that benthic invertebrate communities of upper Minto Creek were within reference condition for all four primary EEM metrics (density, taxon richness, Simpson's evenness, and Bray Curtis [BC] distance [also known as the BC index of dissimilarity]; Minnow 2018).

11.2.4 Fisheries Monitoring Program

The objectives of the 2019 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during open water season, and to provide data allowing interpretation of the potential role and influence of the Minto Mine on the fish community. The 2019 fisheries program was a continuation of the previous year's components, and targeted all species that have previously been encountered as well as any new species. As part of the 2019 monitoring program, assessments at Big Creek were made concurrently with sampling in Minto Creek, to compare fish use in a neighbouring system relative to Minto Creek. Fish monitoring studies were conducted as per the EMSRP.

Fish monitoring of Minto Creek and Big Creek was conducted monthly during open water season, from June to September 2017, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2016 fish monitoring programs. Capture effort included the use of Gee-type Minnow traps with 0.635 cm wire mesh size baited with Yukon River origin Chinook salmon roe. Up to fifteen minnow traps were set in Minto Creek during sampling events, depending on water levels and availability of pools and backwater areas. Three to four traps were set each time in Big Creek, near the Minto road bridge.

All fish captured were identified, enumerated and measured for fork length or total length (± 1 mm), inspected for abnormalities, and released near their trapping location. Juvenile Chinook Salmon were also weighed (± 0.1g) prior to being released.

Additional supporting information collected included photo documentation of the creek, water level readings at W1 staff gauge, in situ water parameters in Minto Creek, Big Creek and the Yukon River (temperature, dissolved oxygen, conductivity, pH, Oxidation-Reduction Potential), discharge at W1, as well as weather conditions at time of sampling. Supporting variables also included monitoring of the previously identified fish barrier (1.2 km upstream of the Yukon River confluence) and/or any new barriers that may have developed.

For details on the 2019 results of Fisheries Monitoring Program see Appendix N.

11.3 Copper Toxicity Study

The copper toxicity study was initiated in 2015, due to a mild freshet and no major rainfalls, a turbid flow sampling could not be completed in 2016. The turbid flow sample was successfully collected in 2017 as such the program was completed.

11.4 Aquatic Environmental Monitoring Program (AEMP) Review

As required by clause 102 of the WUL, a review and evaluation of the AEMP program was completed in March 2020. The objectives of the AEMP are to evaluate the influence of the Minto Mine on Minto Creek. Findings that support the program review for: 1) sediment (chemistry and toxicity testing); 2) periphyton (chlorophyll-a and community); and 3) benthic invertebrate community are found in Appendix M. Findings that support the fisheries program review are found in Appendix N. Recommendations made in 2016 were considered and incorporated in this review.

Recommendations:

1. It is recommended that both lower Wolverine Creek and lower Big Creek continue to be sampled as reference areas for the benthic invertebrate community assessment to provide better perspective on whether any of the observed differences are due to mine influence or simply due to natural differences among creeks.
2. It is recommended that sediment toxicity testing is completed at a three-year frequency (next monitoring in 2020 to make up for dry conditions encountered in 2019) or in response to meaningful increase in concentrations of copper (or other mine-related analytes) identified in annual reporting.
3. It is recommended that periphyton community monitoring is removed from the WUL monitoring program as results are highly variable and are not effective in determining potential mine-related effects.
4. It is recommended that the fisheries monitoring program be reduced from an annual frequency to a three-year frequency in association with EEM, with consideration of additional monitoring in response to meaningful changes to effluent discharge (quantity or quality).
5. It is recommended that a flow response contingency plan is developed to provide guidance on how the AEMP should respond to dry conditions in lower Minto Creek (as encountered in 2019) or to unusually wet conditions.
6. It is recommended that an evaluation is completed to characterize the relationship between seasonal fish use of lower Minto Creek and flow/temperature over time. A relationship, if present, could be used to refine monitoring program frequency.
7. Lastly, recommendations for interpretive reporting of future AEMP data are provided.
    a. It is recommended that hydrology, discharge volumes, and seasonal chemistry are integrated into the future AEMP program interpretations to provide additional context on the range of physical and chemical conditions experienced by biota and supporting indicators over the year.
    b. It is recommended that trend analysis of sediment quality is completed in upper and lower Minto Creek to determine if concentrations of analytes of interest have been increasing and if so, to determine the magnitude of increase.

12 Meteorological Monitoring Program

Meteorological monitoring at the Minto Mine consists of data collection for the following parameters: rainfall, snowfall, temperature, evaporation, wind speed and direction, barometric pressure, relative humidity, and solar radiation (incoming and reflected). The Meteorological Monitoring Program includes the Climate Monitoring Program (EMSRP Section 4.1) and the Snow Survey Program (EMSRP Section 4.2). Data collected under the Meteorological Monitoring Program, along with baseline climatic data, provides input for the following mine projects:

- Site water management;
- Prediction for yearly water events (e.g. freshet);
- Design of water storage, conveyance and discharge systems; and
- Design of flood control structures on the road network.

12.1 Climate Monitoring Program

The 2019 Climate Monitoring Program data are presented below in Figure 12-1 through Figure 12-7. During 2019, Minto Mine had one meteorological station located approximately 70 m northeast of the north end of the airstrip, in an area that allows ample meteorological exposure from all directions. Trees are cleared for a radius of 30 m from the meteorology station and beyond that radius is a sparse growth of 2 m tall conifers.

The meteorology station is a research grade Campbell Scientific station that records the following parameters: maximum wind speed, minimum wind speed, average wind speed, wind direction, precipitation (rain and snow), temperature, relative humidity, pan evaporation, barometric pressure, solar radiation, and calculated evapotranspiration. Data are averaged over the one-hour archiving period and then saved to the datalogger.

The evaporation pan was operation from May 20th through to September 28th. The Relative humidity sensor stopped working on September 29th 2018 and was repaired on March 8th 2019 hence data is shown from here through to the end of the year.

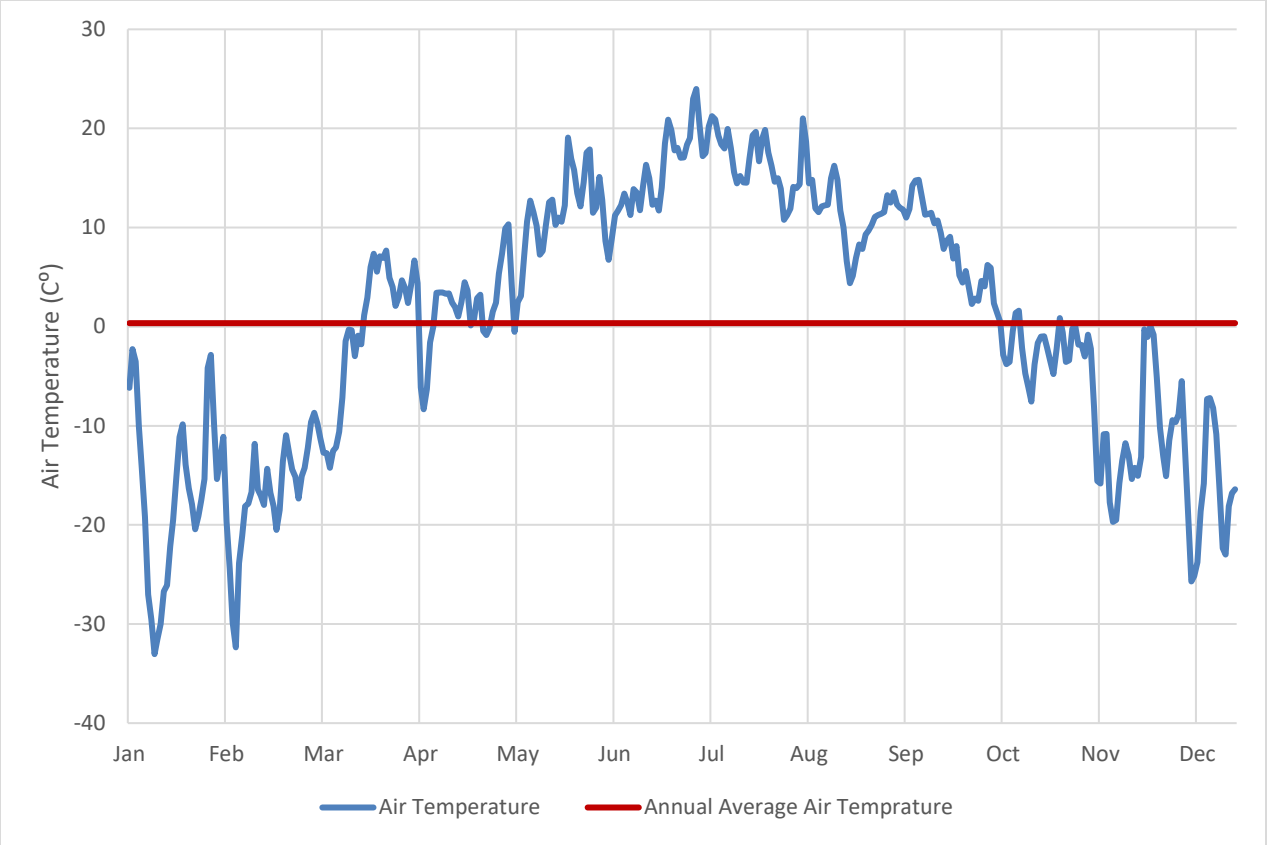


Figure 12-1: Annual Air Temperature (2019)

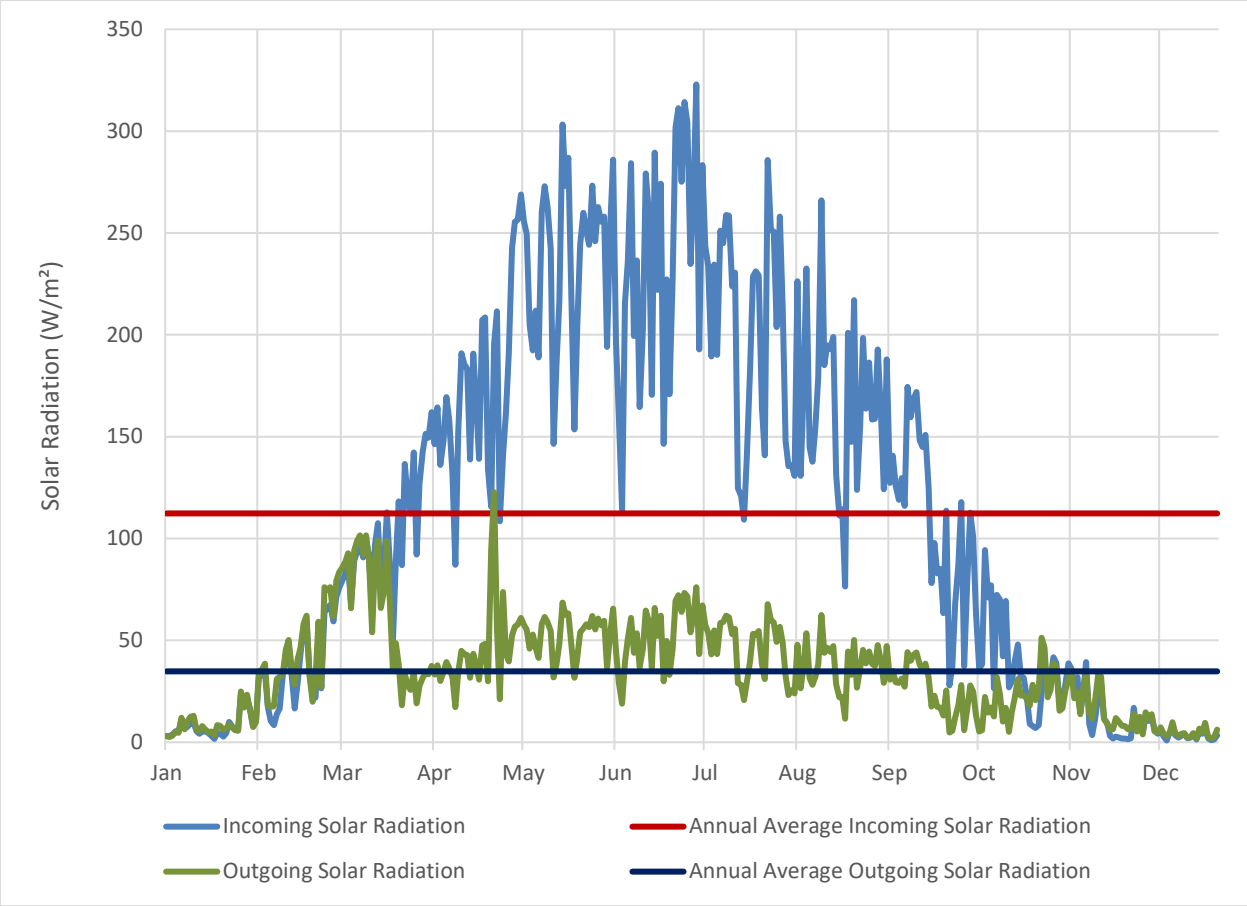


Figure 12-2: Annual Solar Radiation (2019)

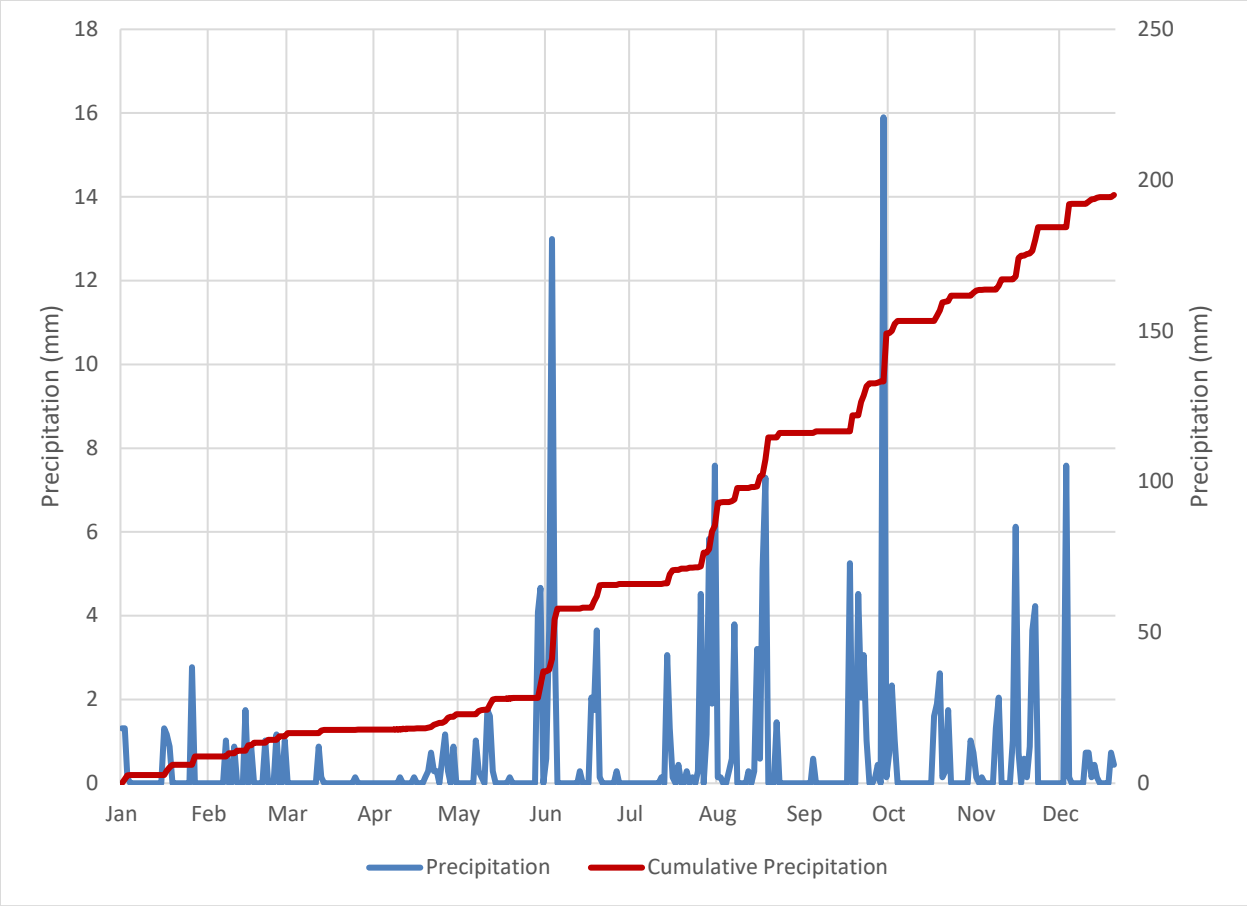


Figure 12-3: Annual Precipitation (2019)

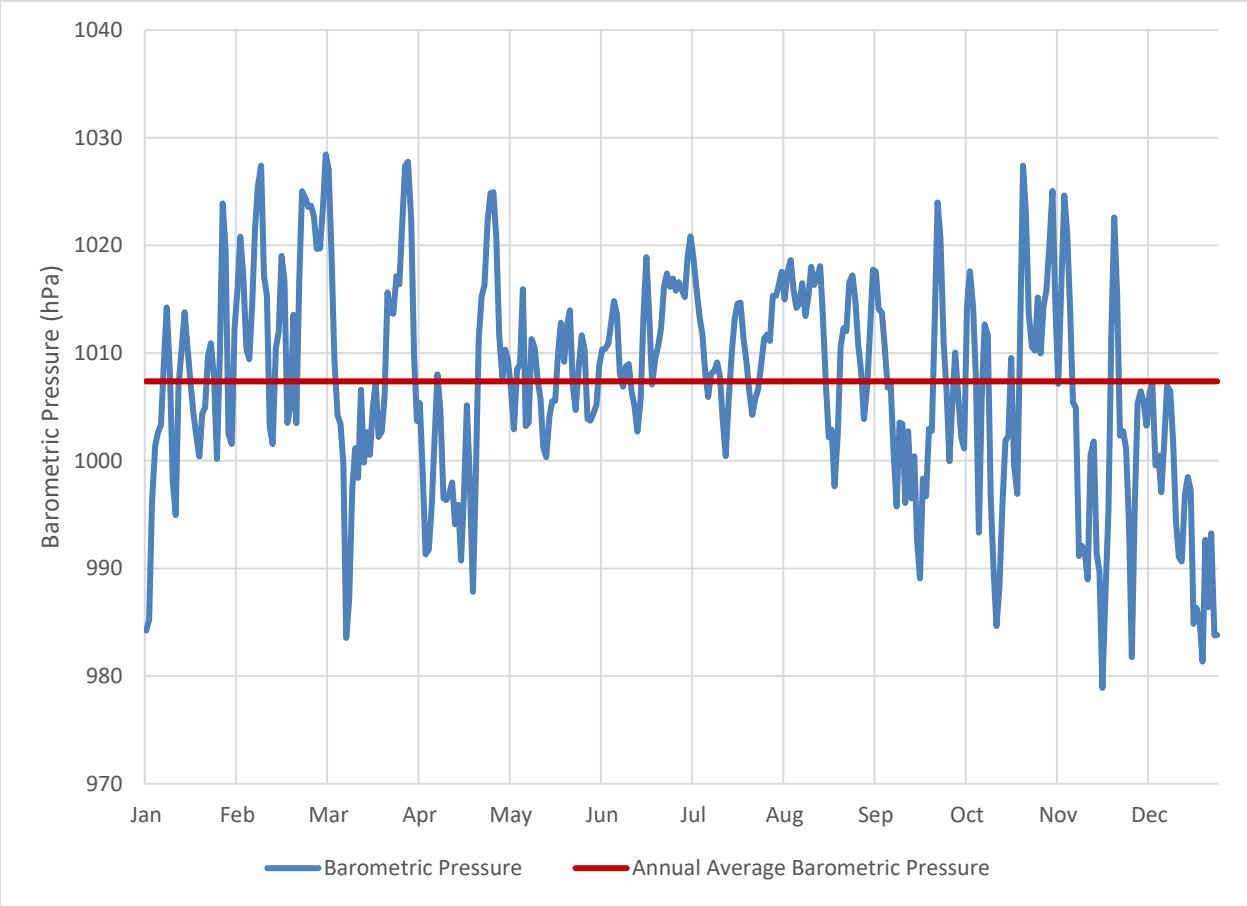


Figure 12-4: Annual Barometric Pressure (2019)

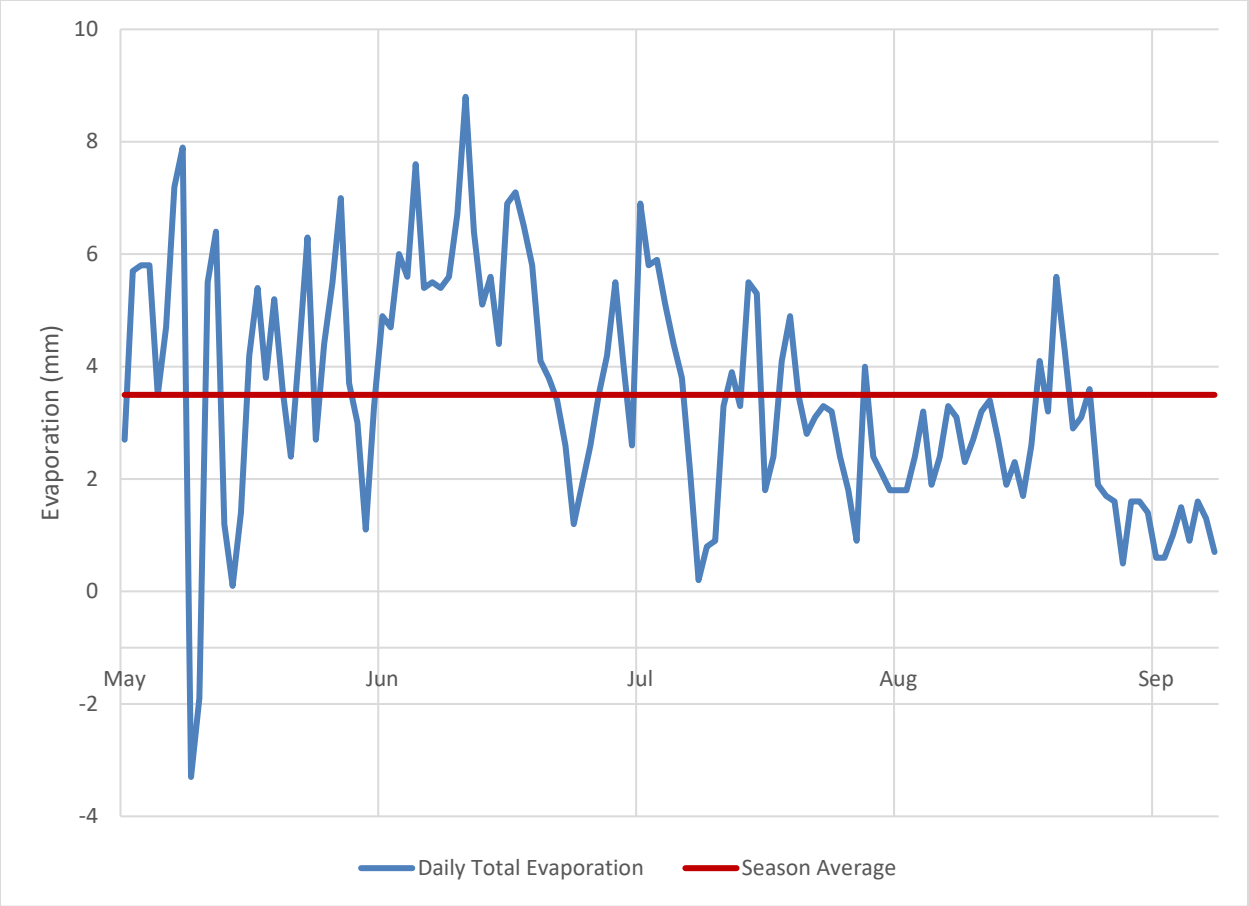


Figure 12-5: Evaporation (May 20thth- September 28th 2019)

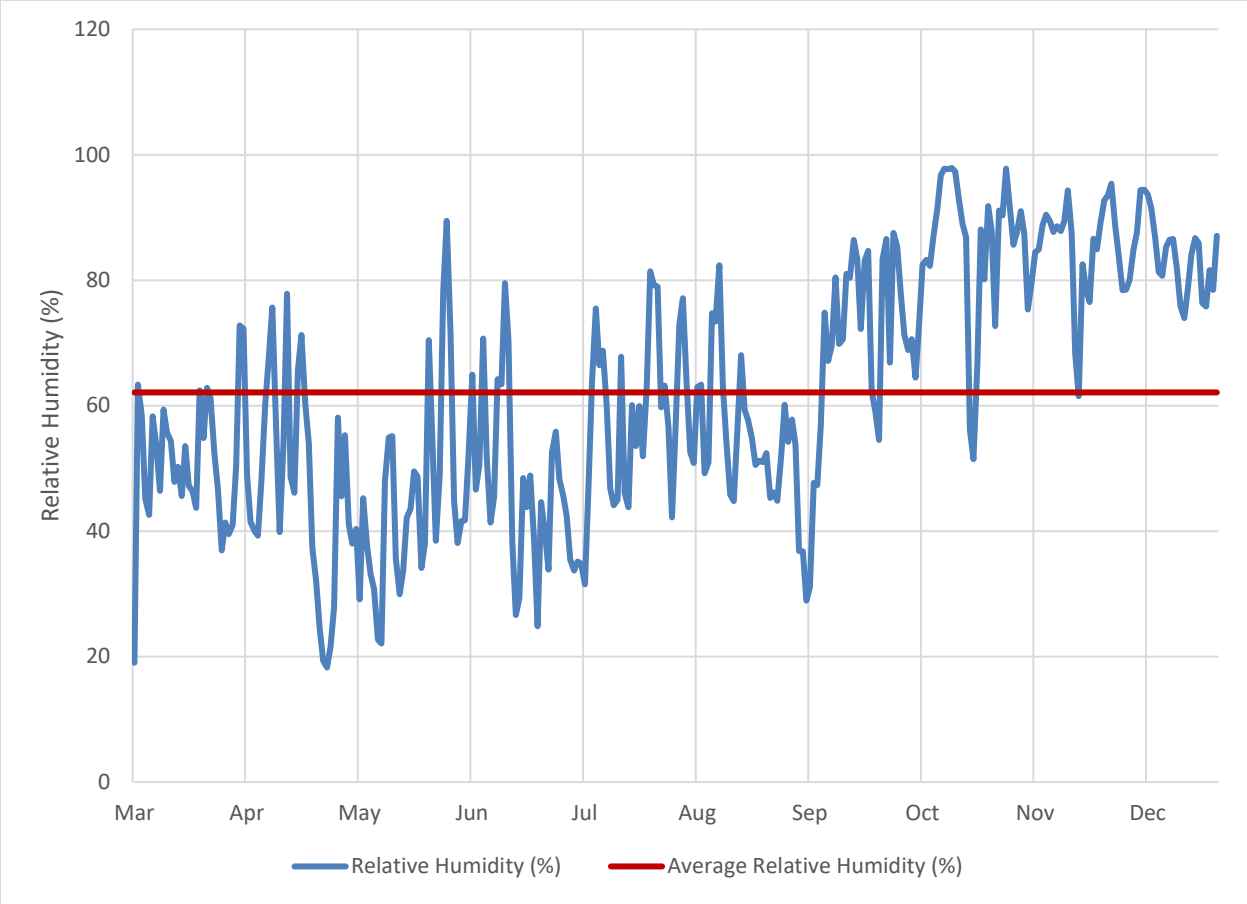


Figure 12-6: Relative Humidity (March 8th - December 31st 2019)

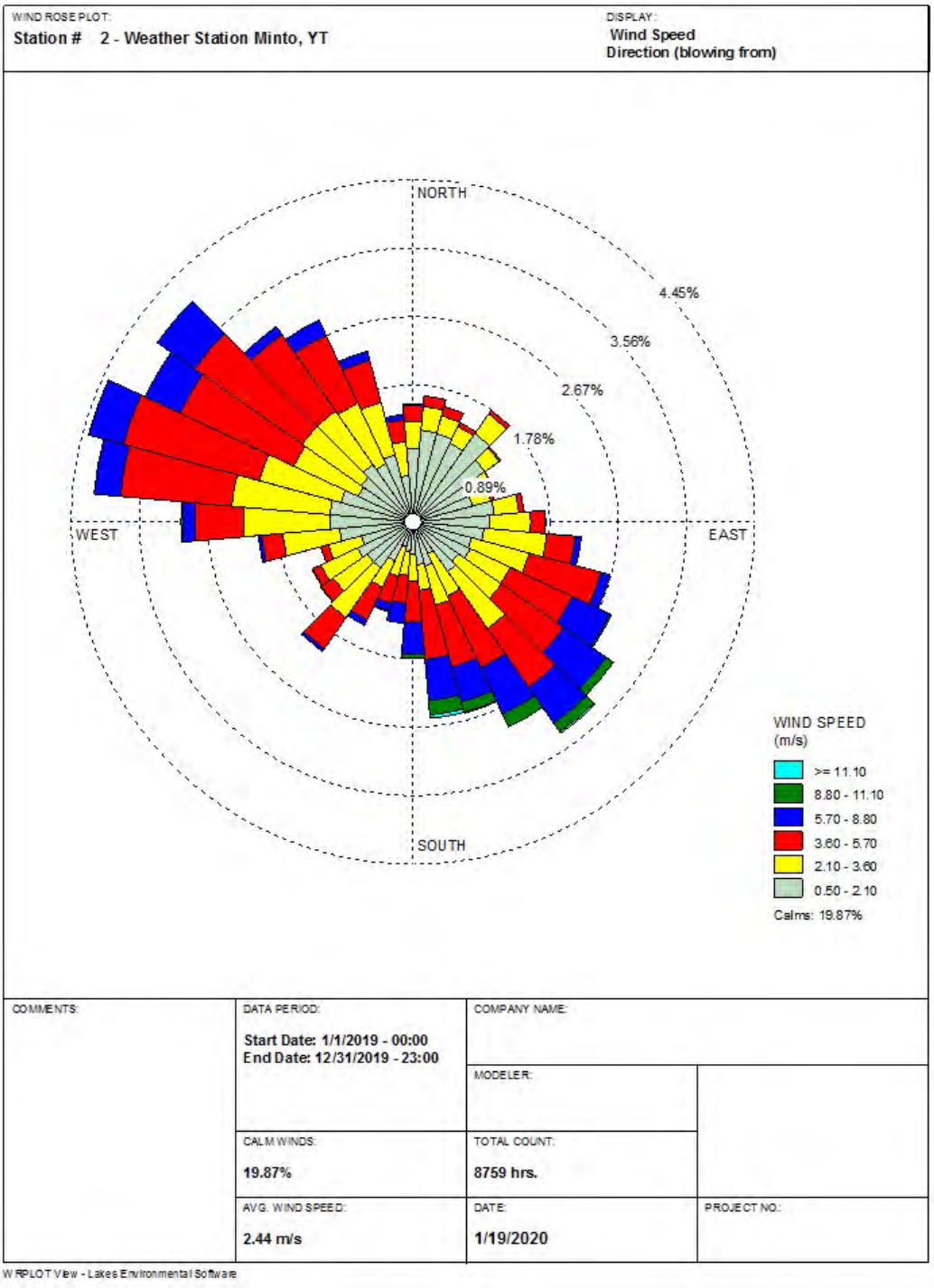


Figure 12-7: Wind Speed and Direction Events (2019) – WRPLOT View – Lake Environmental Software

12.2 Snow Survey Program

As required by the WUL Clause 96 and as part of the EMSRP, Minto collects snow data at the mine. The objective of the Snow Survey Program is to collect data used for calculating the snow water equivalent at the Minto Mine site. Snow water equivalents are inputs for the Minto Mine Site Water Balance models. Four courses are surveyed during the first week of February, March & April each year. If conditions permit, Minto will additionally survey the snow courses in May. These courses are East-facing (near the Dyno compound), North-facing (near the airstrip), South-facing (above the Tank Farm) and flat (Dry Stack Tailings), as detailed in Table 12-1. Along each course, ten stations are sampled using a machined core tube with cutting end and scale assembly. The parameters collected during the surveys include snow depth, core length, core weight, snow density, weather, site conditions, snowpack conditions, crust layers, and snow temperature. Multi-year results to 2019 (averaged across the four snow courses) are presented in Appendix F – 2019 Water Balance and Water Quality Model Summary for the Minto Mine.

Table 12-1: Snow Survey Course Locations

Course Location	Description	Aspect	UTM	
			Easting	Northing
Dyno	East of the Dyno compound on an east facing slope along a cut line surrounded by moderately densely tree area.	East Facing	8V 383 594	694 3377
Fuel Farm	North of the Minto Mine fuel farm on a south facing slope in a sparse to moderately densely treed area.	South Facing	8V 385 061	694 5318
Airstrip	Northeast of the Minto Mine airstrip on a north facing slope in a sparsely treed area.	North Facing	8V 386 255	694 4284
Dry stack Tailings facility	Directly on top of the Dry stack storage facility.	Flat	8V 385 525	694 4786

12.3 Meteorology QA/QC

Procedures for meteorology monitoring at the Minto Mine are detailed in the Meteorology Station Standard Operating Procedures. Minto has installed a satellite connection to the Met Station 2 to enable real time viewing of the weather station data. The meteorology data is downloaded and reviewed twice monthly by Environmental Department staff and routine visual inspections of the monitoring stations occur on a weekly basis.

13 Geochemistry

13.1 Waste Rock Verification Program

The Waste Rock Verification program implemented by Capstone in 2014, continues to be used after Minto reopened under Minto Exploration Ltd. Detailed records continue to track material type, volumes and deposition location in conjunction with monitoring and verification requirements. Combined these documents are in line with the Waste Rock and Overburden Management plan and the Water Use License, clause 95.

A detailed sampling program is in place between the Minto Underground geology department, and the Mining contractors, to sample and track material extraction. Comparable to ore samples, all waste samples are assayed and recorded in the production database systems. Waste material is typically sorted in the underground workings in re-mucks separate from ore grade material. Material dispatch and volumes are based on Mining contractor load counts and then corrected at each month end to the extraction void in the underground workings. To date, all underground material classified as waste has been crushed, screened and taken back underground for construction activities. This material meets that Construction material cut off of 0.3% S, even though it is being used underground.

During 2019, one sample was composited representing 50m of line development and sent to ALS Environmental in North Vancouver for external analyses to verify the underground sorting procedures. This composite sample represents approximately 3, 300 tonnes of waste material. On site testing for preliminary screening was done using a total copper, sulphur and carbon analyses from the Eltra CS-800 induction furnace. Sulphur and inorganic carbon values were used to generate an equivalent Acid Potential (AP) and Neutralizing Potential (NP). The ratio of NP:AP was used to segregate material, with values greater than 3:1 being considered neutralizing, based upon the Minto WRMP. Sample duplicates that were air dried in the lab, were sent off site to ALS Environmental, for additional testing, including the Sobek Siderite correction. Check results showed on site methods were over reporting the potential acid generating material (PAG or SAT). All check assay results returned as NAG.

Table 13-1: Waste Rock Management Verification Program Summary (2019)

Average ABA Parameter Values: Month by Location (2019)								
Location	Month	Waste Type	Cu %	C% (Tot)	S% (Tot)	NP	AP	NP:AP
UG Const	Dec	NAG	0.039	0.27	0.27	34	8.4	4.03

13.2 Acid-Base Accounting Program

The Acid – Base accounting program is part of the EMSRP reporting requirements on an annual basis. Sampling program is more advanced than the on-site screening, taking in to account MPA, NNP and NP:MPA ratios, which are generally shown to be a more accurate predictor of water quality. The current procedures use a modified Sobek Siderite correction for waste rock and overburden, to support the on-site screening NPR. Site specific testing has shown a 3:1 ratio should not generate acidic by-products. A separate program also exists for the tailings solids.

During 2019, one (1) sample was composited and sent off site for ABA testing. This sample was a composite of the underground development waste from the Copper Keel access ramp. Material was screened, crushed, and taken back to the underground for construction projects. The composited sample was built as 15 x 150g crushed, homogenized material taken from air dried, NP:AP development duplicates from each of the development rounds that formed the 50 m development. The sample was sent to ALS Environmental, an accredited laboratory for ABA accounting analyses, as noted in the EMSRP.

Sample results show the material meets the surface construction grade waste material classifications. The NP:MPA (Neutralizing Potential: Maximum Potential Acid) ratio was 4. 03. Analyses contained 0.039% copper, 0.27% carbon, and 0.27% sulphide. Paste pH value was 8.2. A full report containing lab results and analyses can be found in Appendix O.

13.3 Leach Pads

In 2017, two field scale leach pads were constructed and filled with Partially Oxidized Ore (POX – Leach Pad #1) and Low-Grade Sulfide Ore (Green sulfide ore – Leach Pad #2), as per the EMSRP. The Pads were constructed in October 2017, and the first leachate samples were collected in May 2018. In 2019, samples were collected monthly when water was available, resulting in 8 sampling events through the non-frozen months of 2019. Results from the leach pad samples are provided in the monthly reports. A summary report including the sampling methodology and sample results of the 2018 and 2019 sampling seasons is included in Appendix P.

14 Terrestrial Monitoring Programs

14.1 Wildlife Monitoring Program

The *Minto Mine Wildlife Protection Plan* (a component of the EMSRP) establishes guidelines for minimizing wildlife disturbance at the Minto Mine site and along the development corridor, and includes a monitoring program to yield information about wildlife use in the area. The 2019 activities under the Wildlife Monitoring Program including the area and frequency of monitoring, are summarized in Table 14-1, below. There were 3 notable Wildlife incidents in 2019 as previously outlined in Section 2.5.2.

Table 14-1: Wildlife Monitoring Activities (2019)

Area Monitored	Monitoring Activities	Frequency
Wildlife Monitoring	Wildlife monitoring consists of maintaining a wildlife observation log onsite and reporting wildlife encounters, as per the Wildlife Act. Environmental personnel on site will monitor project activities and modify operations to address wildlife concerns.	Ongoing
Migratory Birds	Monitoring to determine if waterfowl and shorebirds settle on impacted water bodies, such as the Main or Area 2 Pits. Environmental personnel on site will monitor project activities and modify operations to address wildlife concerns.	Seasonal, Daily during migratory periods
Species at risk/ of concern	Any caribou observations will be reported to the Conservation Officer in Carmacks. Bank swallows have been observed to nest in residuum piles in the summer months, in which case these piles are cordoned off and left undisturbed until after the late summer migration, or re-sloped prior to nesting season to deter nesting.	As necessary

In addition to the Wildlife Monitoring Activities listed in Table 14-1, the Minto Environmental Department gathered observations from mine site staff with Wildlife Observation forms. These forms were posted at many accessible locations around site and employees were encouraged to record all wildlife observations. The forms were collected periodically and the sightings entered in a wildlife tracking sheet, which is included as Appendix Q.

In 2019, 76 wildlife sightings were recorded, with thirty-six sightings involving bears, thirteen involving foxes, four involving deer, six involving moose, three involving wolves, and one involving lynxes. Other animals observed on site included but were not limited to, hares, ermine, grouse, ptarmigan, sheep, dunlin, eagles, ducks, porcupine, coyote, cougar and geese.

The most active month of the year for wildlife observations was May, with fourteen reportable sightings. Active hazing was most frequent in July.

Additional activities that took place on site included wildlife education (including bear awareness training) and occasional information broadcasting known as safety flashes concerning the prevention of wildlife habituation to all staff working on site.

14.2 Erosion and Sedimentation Monitoring Program

As part of the EMSRP, Minto has developed and implemented a *Sediment and Erosion Control Plan* (SECP). The objective of the SECP is to minimize local site impacts from erosion and prevent sedimentation to the receiving environment of Minto Creek. The 2019 activities associated with the Erosion and Sedimentation Monitoring Program are identified in Table 14-2, below. While there was some erosion visible on the newly sloped, covered and revegetated Mill Valley Fill Extension, the erosion gullies appear to be self-armouring. These areas were treated with extra seed to establish root binding of the finer material in these designed run-off areas, and will continue to be monitored as the reclaimed MVFE matures. There were no other significant issues in 2019.

Table 14-2: Erosion and Sedimentation Monitoring Activities (2019)

Activity	Location	Frequency
Visual inspections	Bottoms of slopes and depressions of large structures.	As needed following heavy rain events, and during freshet.
	Road routes: ditches and outlets of culverts and pipes.	As needed following heavy rain events, and during freshet.
Water quality monitoring for total suspended solids (TSS)	Water quality monitoring stations W2, W3, W50 and W17	Weekly and during heavy runoff periods.
Physical inspection of surface facilities by a Yukon registered Engineer.	Water Storage Pond Dam, Mill Water Pond, all waste rock and overburden dumps, all water diversion and conveyance structures and the dry stack tailings storage facility.	After the spring thaw period in May/June of each year and again prior to the on-set of winter in September of each year

14.3 Invasive Plant Species Monitoring Program

As part of the EMSRP, Minto developed an Invasive Species Monitoring Standard Operating Procedure in 2015. The Invasive Species Monitoring Plan, created in 2014, was the basis for the SOP. The SOP details how the monitoring program will be conducted.

The 2019 invasive species program took place between August 10 and August 14, 2019. The program consists of surveys in areas on site which are affected by high traffic such as the Waste Management Area, the Dry Stack Tailing Facility (by the haul road), the Fuel Farm, the road towards the Dyno plant and the Pelly Yard. Area with lower visitor traffic such as the newly finished Southwest Dump, the Minto North road, the W15 wetland area. The access road was surveyed for consistency and continuation in this monitoring. The survey focused on the high-risk species as listed by the Yukon Invasive Species Council (YISC) (Table 14-3). During the survey, a few high-risk species were observed growing along the access road and sparsely on site in surveyed areas. As per the EMSRP, the observed high-risk species were reported to the Yukon Invasive Species Council (YISC) Spotter's Network.

In accordance with the EMSRP, invasive plant surveys will be continuing through 2019, particularly along invasive species pathways such as roads with high visitor traffic, recently exposed areas, and areas that have been recently reclaimed. Coordinated photos for long term photographic monitoring will be continued.

Table 14-3: High Priority Invasive Species as determined by the YISC, 2019

Common Name	Latin Name
Bird vetch	*Vicia cracca*
Dalmatica toadflax	*Linaria dalmatica*
Smooth brome	*Bromus inermis*
Crested sweetgrass	*Agropyron pectiniforme*
Quackgrass	*Elytrigia repens*
Altai wild rye	*Leymus angustus*
Reed canary grass	*Phalaris arundinacea*
Narrowleaf hawksbeard	*Crepis tectorum*
Common tansy	*Tanacetum vulgare*
Creeping thistle	*Cirsium arvense*
Hawkweeds	*Crepis tectorum*
Lucerne	*Medicago falcata*
Yellow & White sweetclover	*Melilotus*
Leafy spurge	*Euphorbia esula*
Oxeye daisy	*Leucanthemum vulgare*
Perennial sow-thistle	*Sonchus arvensis*
Scentless chamomile	*Tripleurospermum perforata*
Greater butter and eggs	*Linaria vulgaris*
Spotted knapweed	*Centaurea stoebe*

14.3.1 Meandering surveys

Meandering surveys consist of a walk around in high visitor traffic areas and identification of invasive species observed during each survey. Each area surveyed was also set up with a long term coordinate to allow for photos to be taken annually for long term observation. All soil texture was coarse; no over-burden piles or organic materials were surveyed and all proposed activities were man-related activities. The area and density of each plot was categorized per cubic meter. For species identified in each area, see table 2 below and each route mapped can be observed in Figure 14-1.

Previously monitored high traffic areas such as the Pelly Yard and the Dyno Road were not monitored during the 2019 summer as Minto Mine was not experiencing high traffic in those areas. The Southwest Dump and the Fuel Farm areas were not monitored due to human error; however, the propane farm area was surveyed for invasive species. The Waste Management Area was moved since the 2018 location was excavated to become a new dump.

Table 14-4: Meandering Survey Results

Area	Invasive Species	Waypoint Number	Area (% coverage)	Distr. Code	Density Code	Abundance	Comments
Minto North	White Sweetclover	N62° 37.674' W137° 15.385'	0-10	2	1	Sporadic	Unchanged from 2018
Camp Area	White Sweetclover	N62° 36.210’ W137° 13.270’	0-10	1	1	Sporadic	Unchanged from 2018
	Smooth Brome	N62° 37.181’ W137° 14.127’	0-10	1	1	Sporadic	New species identified in 2019
Main Waste Dump	Narrowleaf Hawksbeard	N62°36.520’ W137°16.160’	0.10	1	1	Rare	First Survey
Propane Farm	Perennial Sow Thistle	N62° 36.668’ W137° 13.322’	0-10	2	1	Rare	First survey
Waste Management Area	Smooth Brome	N62° 36.563’ W137° 9.771’	0-10	2	1	Sporadic	New area surveyed in 2019, the 2018 area became the new dump.
DSTF*	Narrowleaf Hawksbeard	N62° 36.878' W137° 13.943'	0-10	2	1	Sporadic	Unchanged from 2019
	Smooth brome	N62° 36.873' W137° 13.925'	0-10	2	1	Sporadic	Unchanged from 2019
Access Road (barge parking)	White Sweetclover	N62° 35.231' W136° 52.804'	0-10	2	1	Sporadic	Unchanged from 2019
Access Road (barge parking)	Narrowleaf Hawksbeard	N62° 35.231' W136° 52.809'	0-10	2	1	Continuous	Unchanged from 2019

*Note: DSTF is the Dry Stack Tailing Facility



MINTO MINE

WATER LICENSE QZ14-031/QML-0001
2019 ANNUAL REPORT

FIGURE 14-1
2019 INVASIVE SPECIES MONITORING PROGRAM

FEBRUARY 2020

MINTO EXPLORATIONS

- Narrowleaf Hawksbeard
- Smoothe Brome
- White Sweetclover
- Long Term Monitoring Photo Location
- Invasive Species Survey Track

* *Numbers within Invasive Species Observation Location symbol represent density code*

1:13,000 *when printed on 11 x 17 inch paper*

0 100 200 300 400 500 Meters

ENSERO solutions

Aerial imagery obtained from Challenger Geomatics. Imagery acquired August 9rd 2017.

Datum: NAD 83 Projection: UTM Zone 8N

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14.3.2 Access Road survey

For this continuous survey, Minto Environment staff drove the length of the access road (27km) at low speed to observe any invasive species growing on the road. In addition, coordinated photos for long term photographic monitoring were done at kilometers 5, 10.5, 12, 15, 17, 18, 20, 24, and 26.

Narrowleaf Hawksbeard was visible throughout the length of the road in single plants. White Sweetclover was also visible in sporadic yet continuous from kilometre 12 to 27. As with the 2018 survey, a heavily dense patch of White Sweetclover from kilometre 15.5 to 16.5 was observed.

The overall findings of all surveys continue to show the same types and general extent of invasive plants as seen in previous years. Additionally, it should be noted that all invasive plants found on the site are commonly found elsewhere in disturbed areas within the Yukon Territory.

14.4 Vegetation Metal Uptake Program

The VMU program was initiated in 2016, when sixteen exposure sites and five control sites were established. Samples were collected from key soil horizons and key plant species that could be vectors to humans or wildlife (blueberry, horsetail, Labrador tea, lichen, and willow). These monitoring sites were sampled again in 2019.

Overall, results indicate higher concentrations of COPCs in vegetation from exposure sites, and an increase in concentration from 2016 to 2019 in lichen for all COPCs and some COPCs in other vegetation species. The increase in concentration in exposure sites and with time could be due to airborne particulates from the Minto Mine though continued monitoring is needed to determine whether the increases in 2019 are part of a trend. Subsequent studies will help establish a trend and provide ongoing evaluation of the extent and degree that metals from mining activity may be affecting vegetation in the proximity of the project site.

The Vegetation Metal Uptake Monitoring Report is included as Appendix R.

15 Site Characterization Report

The last Site Characterization Report was submitted to EMR in January 2018. As per Clause 13.1 of the QML, the report will be updated in three years from the effective date of the licence. The submission date for the update was December 2017. An extension was granted to January to ensure a comprehensive report was completed. This report was also submitted to the Yukon Water Board in January 2018. The next Site Characterization Report is due December 2020.

16 Reclamation

Minto Mine was under Temporary Closure and Care and Maintenance for part of 2019, until the sale of the mine in June, when activities started to ramp up to resume production. Production from underground and the mill resumed on September 2 and October 10, respectively.

Reclamation activities at Minto Mine that were planned for continuation in 2019 were halted due to the sale of the mine in June 2019 and financial complications associated with large scale reclamation contracts for July-September. Activities for 2019 were limited to monitoring of the vegetation growth on the final contoured Mill Valley Fill Extension Stage 2 (MVFES2) and Dry Stack Tailings Storage Facility (DSTSF). Due to the revegetation strategy employed, seed that was planted in October 2018, germinated and began growing in the spring.

Spring runoff and a large rainfall event in July resulted in some channelized erosion of the cover material in several locations on the north and east slopes of the MVFES2. The erosion channels are quite deep, however are self-armouring as the finer material is washed away and the larger rocks fall into the channels formed. These rundown areas are mostly where water is designed to run down the face and will not be repaired, however they may have additional armouring added if needed in the coming years.

Reclamation research regarding the use of constructed wetland treatment systems as a closure water treatment option continued throughout the year. Details regarding the program for 2019 can be found in Section 16.2 or Appendix P.

16.1 Progressive Reclamation Activities on MVFE2 and DSTSF

As seen in Figure 16-1, the Cover and seeding of MVFES2 was completed in 2018. The final contouring, cover specifications and revegetation objectives of the Mill Valley Fill Extension 2 (MVFE2) and part of the Dry Stack Tailing Storage Facility (DSTSF) were met in 2018, both areas of concern are visible in Figure 16-3. In 2019 some erosional channels were formed during spring runoff, but they are as-designed, and have proven to be self-armouring with the larger cover materials remaining as finer material is washed away (see figure 16-2).

Figure 16-4 and 16-5 highlight those areas where contouring and overburden placement took place in 2017. These areas will be targeted for final grading and cover placement in 2020, as time and budgets allow. Figure 16-6 presents the site overview from the south of Minto Mine site.



Figure 16-1: Minto Mine – Mill Valley Fill Extension Stage 2 completed in 2016, final cover placed in 2018.



Figure 16-2: Minto Mine –MVFE and DSTSF self-armouring run-down channels developed after spring runoff and heavy rainfall 2019.



Figure 16-3: Minto Mine - MVFE and DSTSF progressive reclamation, (2017 overburden placement highlighted in red).



Figure 16-4: Minto Mine – Southwest dump progressive reclamation, 2017 overburden placement and stockpiling (highlighted in red).



Figure 16-5: Minto Mine – MWDE and Low Grade Waste progressive reclamation, overburden cover placement 2017 (highlighted in red).



Figure 16-6: Minto Mine – Site overview, all facilities.

16.2 2019 Reclamation Research

Reclamation research in 2019 focused primarily on carryover research of passive treatment technologies which started in 2014 and carried through 2019.

16.2.1 Passive Water Treatment

The demonstration-scale CWTS was constructed at Minto in 2014, commissioned from 2015 through mid-2017 and transitioned into the operational period in August 2017. In 2018 the demonstration-scale CWTS was tested for its ability to recover and perform under the unintentionally imposed stresses of a winter/freshet drought and elevated nitrate concentrations in the inflow water. The CWTS demonstrated successful recovery and in 2019 the operational period had the primary objective of assessing performance under conditions that would be similar to the full-scale CWTS. This primary objective was developed as a response to lines of questioning in preliminary regulatory review of closure planning documents.

Various aspects of the system were measured in 2019 and have been detailed under a separate report including operating conditions, water treatment performance, fate and distribution of treated metals, detritus decomposition and accretion rates, carbon demand, extent of nitrate removal (concentration (mg/L) achieved at the outflow of the CWTS) and microbial community characterization, microbial community characterization (catalyzing treatment reactions), and pest control. The key findings of each phase of this research project are presented in table 16-1 below. A full detailed report can be found in Appendix S.

Table 16-1: Demonstration Scale Constructed Wetland 2019 Work Summary

Item	Date	Activites	Actual
Construction	2014	Identify potential location for demonstration scale CWTS (Contango site visit – 1 scientist)	Completed June 2014
		Engineering and geotechnical (Minto)	Completed July 2014
		Construction (Minto)	Completed July 2014
		Planting and bringing system online (Contango site visit – 1 scientist, 1 technologist), coordinate for local students to assist	Completed August 2014 (no students available, brought 2 technologists)
Commissioning	2014	Acclimation and maturation at constant flow rate, ~20 hr HRT	Completed
		September - Contango site visit/checkup (1 technologist, 1 scientist)	Did not occur because construction was last week of August
	2015	Continued commissioning. Operation at constant flow rate, ~20 hr HRT	Completed (at shorter HRT)
		Spring – Contango site visit/checkup (1 technologist, 1 scientist), includes micro sampling	Completed
		Summer - Increase depth from 10 cm to 20 cm (1 technologist), includes micro sampling	Completed (scientist)
		Fall – Contango site visit/checkup (1 technologist), includes micro sampling	Completed (scientist)
	2016	Minto to add sandbags prior to first site visit and begin W15 creek monitoring	Completed May/June 2016
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. HRT tracer study completed, outlined in section 7 of report.	Completed June 2016
		Summer - Contango site visit/checkup (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. Evapotranspiration study completed as outlined in section 9 of report. Organics were added to the CWTS as outlined in section 5.1 of report.	Completed July 2016
		Fall - Contango site visit/checkup (1 technologist), includes microbial sampling and tasks outlined in Table 5 of report	Completed September 2016
	2017	Continued commissioning operations at constant flow rate.	Completed May 2017
		Two evapotranspiration studies were completed	Completed May/June 2017
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Appendix A of report. Completed HRT tracer study. Sample for AVS to assess if the added organics are having the desired effect.	Completed June 2017

Item	Date	Activites	Actual
		Summer - Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Appendix A of report.	Completed July 2017. Seasonal water sampling was not completed due to flow interruptions. Seasonal water sampling was completed by Minto in August.
Commissioning		Minto added sandbags to outflows of CWTS cells to increase water depth	Completed August 2017
		Commissioning completed and beginning of operational period	Completed August 2017
Operations		Fall – Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Table 5 of report.	Completed by Minto, after being taught microbial sampling by Contango. No site visit needed by Contango.
		Monitor soil redox. Determine when it consistently reaches targeted range.	Completed throughout 2017
Performance monitoring	2018	Develop a sampling plan, and aphid control and monitoring plan for 2018	Completed March, 2018
Drought recovery		Start water flow to CWTS; add sandbags to end and along perimeter of each CWTS cell to increase water depth by 1 to 5 cm; aphid control using more powerful insecticide on a routine schedule	Completed May 2018
		Assess recovery of CWTS from drought	Completed throughout 2018
		Summer – Contango site visit (1 scientist); conduct a vegetation plot harvest and assessment of biomass produced; collect one bag of *C. aquatilis* and one bag of polyester filter foam from each CWTS cell; replant *C. aquatilis* in areas with sparse vegetation	Completed July 2018
		Iron added to Series 1	Completed July 2018
		Two evapotranspiration studies were attempted (were not informative due to precipitation during trials)	Completed July/August 2018
Performance monitoring	2019	Fluctuate flow rates, based on expected amount of water for full-scale wetland (scaled to size). Evaluate performance of CWTS at different key periods. Fertilize plants (if necessary).	Completed throughout 2019. It was not necessary to fertilize plants.
Operations		Develop a flow rate schedule and sampling plan for 2019	Completed May 2019
		Provision of updated standard operating procedures for new staff responsible for monitoring and sampling CWTS	
		Start water flow to CWTS	Completed May 2019
		Continue aphid control using insecticide on a routine schedule	Completed May-September 2019

Item	Date	Activites	Actual
		Spring – Contango site visit; training of new staff responsible for monitoring and sampling CWTS, monitor for presence of aphids, add iron to Series 1, collect one bag of *C. aquatilis* and one bag of polyester filter foam from each CWTS cell	Completed May 2019. Iron addition to Series 1 was not completed due to prioritizing testing HRTs relevant to full-scale.
		Summer – Contango site visit; conduct a vegetation plot harvest and assessment of biomass produced; conduct evapotranspiration trial for warmer months	Completed July 2019. Vegetation plot harvest was not completed during the summer site visit as it was completed during the fall site visit. Evapotranspiration trial was not completed due to prioritizing testing HRTs relevant to full-scale.
		Fall – Contango site visit (if necessary), replanting if needed, soil harvesting for additional off-site stress tests, final sampling event.	Completed September 2019. Soil harvesting for additional off-site stress tests was not completed due to stress tests such as freezing occurring naturally each season. Replanting was not completed as it was not needed. Moss was added to the A cells during the spring site visit.
Maintenance and Operations	2020	Add tote to the inflow of the CWTS to simulate a forebay where a carbon source (straw) can be added. This will refine the full-scale design for early closure where higher nitrate loads may be present.	May 2020
		Test straw at the beginning and end of the operating season to evaluate depletion rates.	May 2020
		Develop a sampling plan for monthly monitoring of the CWTS performance through 2020.	April/May 2020
		Operate the CWTS at a hydraulic residence time (HRT) that mimics the full-scale system.	Throughout 2020
Reporting	Feb 2021	Memorandum to update on 2020 activities	On Schedule

Table 16-2: Passive Water Treatment Research Key Findings (2019)

Key Findings
• **Lower DO and ORP measurements were achieved in 2019, likely from improved placement of the YSI unit probe below the dense mats of vegetation that had developed as the CWTS matured, allowing for measurements to be taken at the base of the CWTS where treatment was occurring.** • **Soil redox was unaffected by the increased flow rates in 2019, indicating that reducing conditions can be maintained in the substrate while flowing at rates expected for the full-scale CWTS.** • **Redox-active metals, such as manganese and iron, showed no increases in dissolved concentrations in the water for most of 2019, indicating that sulphide reduction likely was not maintained likely due to a lack of carbon.**
• **Decomposition of C. aquatilis occurs quickly when initially submerged in the CWTS with 48% decomposition occurring in 82 days (1 operating season). Decomposition remains stable around 55% decomposition after 82 days throughout the 768 day study (including two winter seasons/freezing periods).** • **The partial decomposition of C. aquatilis biomass from the previous year results in accumulation of organic matter over time (accretion) which is an important process in the CWTS as it buries treated minerals making them more stable.** • **Testing in 2019 has identified that the carbon demand for the CWTS may be greater than what is available through annual C. aquatilis growth when nitrate loads are high. As high nitrate loads may be experienced during early closure, it is recommended a forebay be evaluated for the full-scale CWTS design for carbon supplementation.**
• **Load removed per day of all COC was higher in 2019 compared to other operational years.** • **The extent of removal (concentration (mg/L) achieved at the outflow of the CWTS) and removal rate coefficients of cadmium, copper, and zinc were similar to previous years despite less reducing conditions.** • **Molybdenum and selenium (somewhat) treatment was impacted by the less reducing conditions and decreased nitrate removal in the CWTS.** • **No leachable copper was observed in the water column in 2019.** • **The lowest concentration consistently achievable for the treatment design (performance limit) appears to have been reached for dissolved cadmium after 1.5 days. However, the performance limit identification is challenging as cadmium consistently achieved low concentrations in the demonstration-scale CWTS, where greater variability (i.e., fluctuation) is expected with decreased analytical precision. Performance limits have historically been met for cadmium, copper, zinc, and nitrate, indicating the full-scale CWTS could be larger if there is available space.** • **Removal rate coefficients developed throughout operations of the demonstration-scale CWTS will be used to advance the full-scale design. Increased flow rates allowed for better resolution of treatment kinetics for cadmium and zinc in 2019.**
• **In 2019 leachable copper concentrations in soils remained low in the top 0-10 cm, while total copper concentrations were within ranges previously measured.** • **Since commissioning, most constituents (including copper), have shifted primarily into stable reduced and residual minerals fractions in the soil.** • **COC loads into the CWTS have been treated with minimal uptake by plant and moss.**

Key Findings
• **Acid volatile sulphides (AVS) was detected for the first time in 2017 and continued to be detected in 2019; however, concentrations have remained low in 2019**
• **An aphid infestation occurred in 2016 and 2017 likely due to the isolated location of the demonstration-scale CWTS. There was impact observed on the above water biomass in July 2017 due to aphids. Aphids were controlled through routine application of insecticidal soap and plants have predominantly recovered.** • **Pesticide application is not expected to be needed in the full-scale CWTS as it will not be in an isolated location (Contango, 2017b)**
• **A robust population of sulphide-producing, denitrifying, and selenium-reducing bacteria have been found associated with all sample types in the demonstration-scale CWTS, and quantities have remained stable despite less reducing conditions in 2019 than previous years.** • **The denitrifying bacterial population has demonstrated the capacity to remove higher nitrate loads through 2019.**

16.3 Proposed Reclamation for 2020

Proposed reclamation for 2020 includes the following:

- Finalize contouring work on soil cover on the Dry Stack Tailings Storage Facility;
- Contouring work on soil cover on the Southwest Waste Rock Dump;
- Contouring work on soil cover on the Main Waste Dump Expansion;
- Minor recontouring work as required;
- Phase 2 seeding of soil cover;
- Continuation of the Passive Water Treatment Research; and
- Bench-scale in-situ pit lake treatment testing.

17 Socio-Economic Monitoring Program

The Minto Mine Socio-Economic Monitoring Program defines a framework for monitoring direct and indirect socio-economic effects from the Minto Mine. As stated elsewhere, the Minto Mine was in temporary Care and Maintenance for much of 2019, and in June following the sale of the mine and announcement of plans to re-open, staffing and procurement increased steadily until and past the official production re-start date of October 10.

During this period of increasing activity, as well as prior, as per the framework, Minto tracked and collected administrative data and other information relating to the mine's direct employment, training and procurement; worker safety; and Minto contributions to cultural well-being and community wellness.

Unfortunately, at the time of writing, due to the COVID-19 Pandemic, certain information was not available from Minto and its' partner contractors. In order to provide a complete and accurate report, the 2019 socio-economic report will be sent at a later date as Appendix T. Minto will endeavor to provide this information in a timely manner as soon as this information becomes available.

18 Closure

Minto trusts this document fulfills the 2019 annual reporting requirements of Minto Mine's WUL and QM, including reporting required during both temporary closure (Care and Maintenance) and operating periods.

19 References

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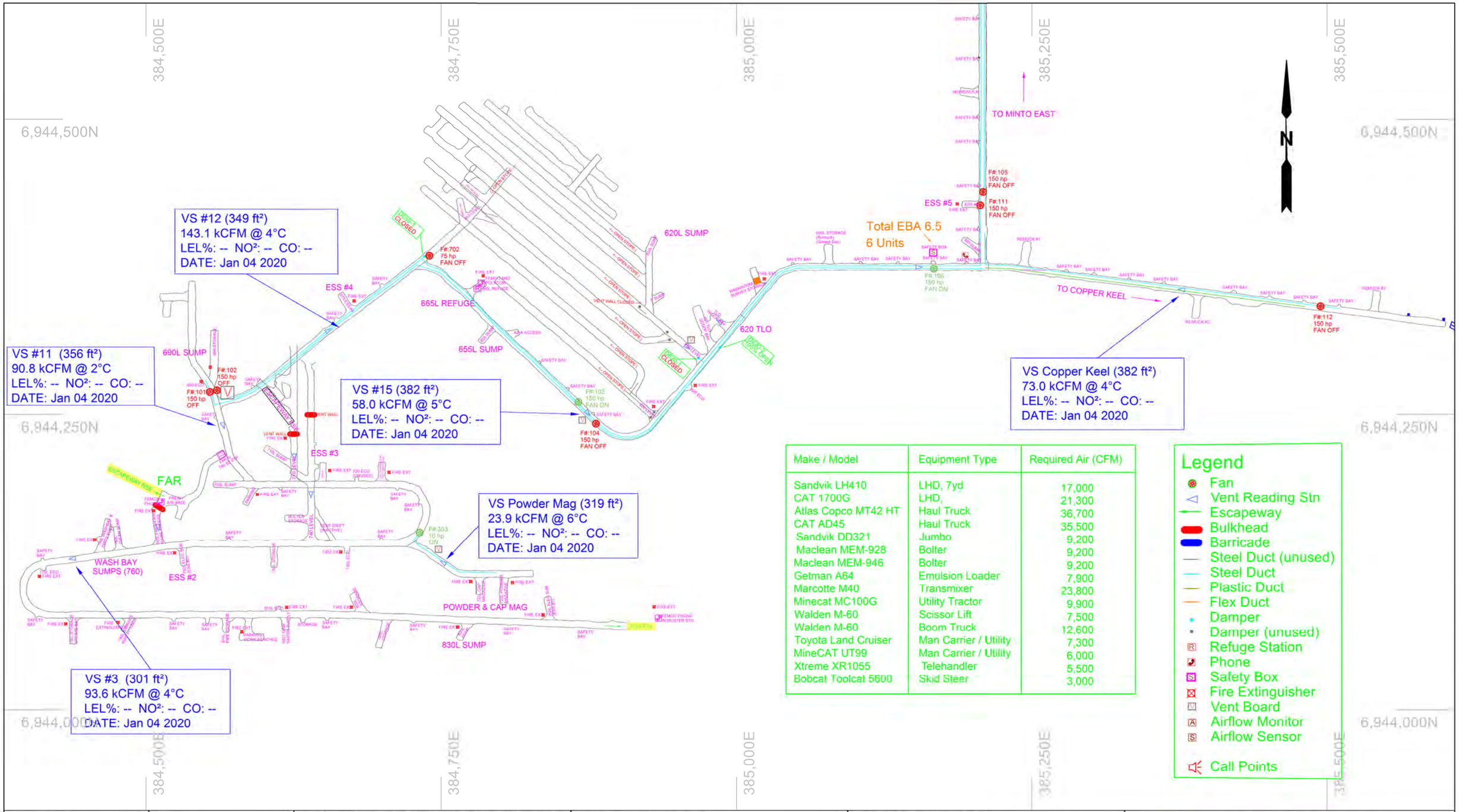
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Appendix A – Minto Mine Underground Development Map

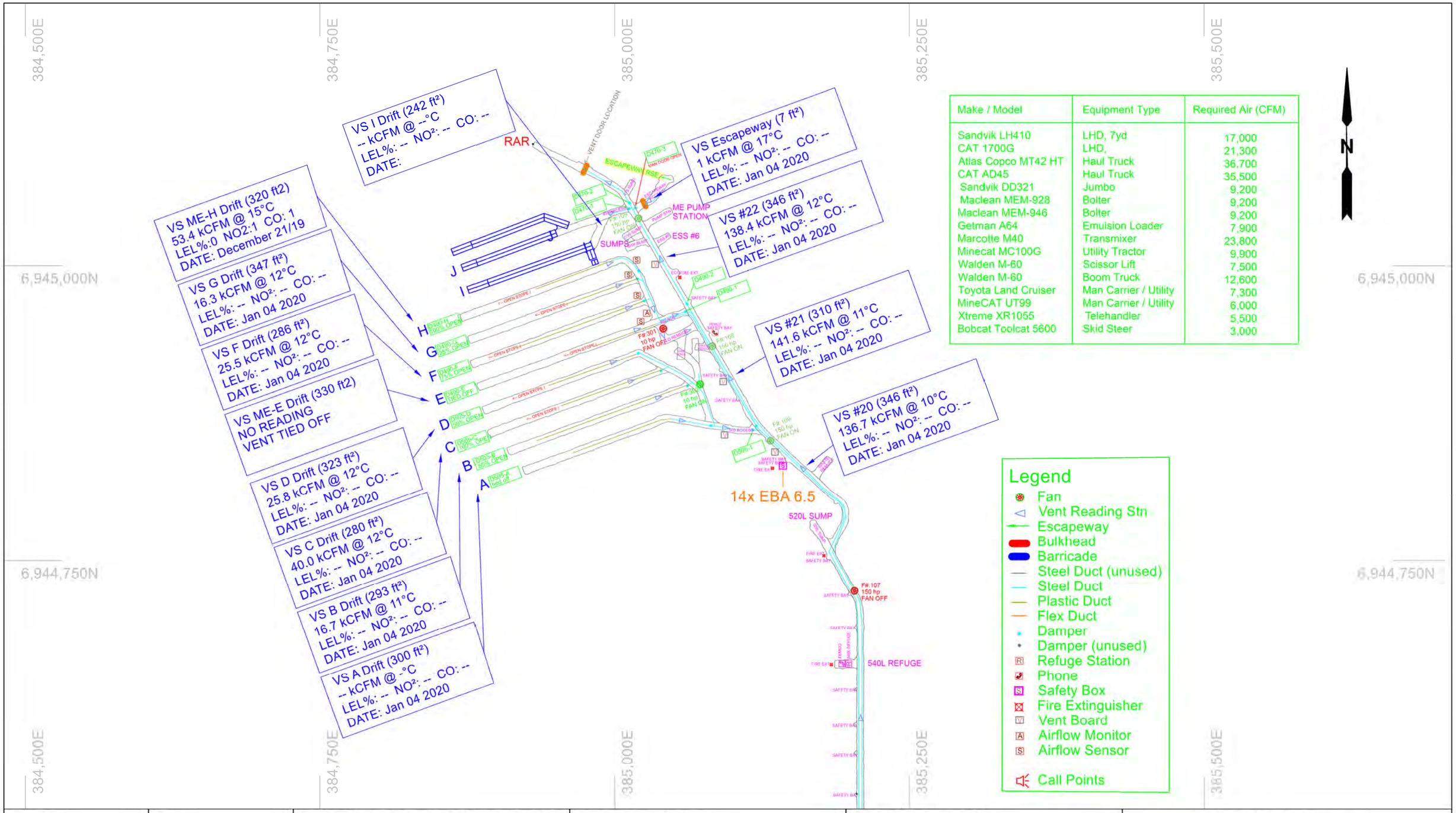


Make / Model	Equipment Type	Required Air (CFM)
Sandvik LH410	LHD, 7yd	17,000
CAT 1700G	LHD,	21,300
Atlas Copco MT42 HT	Haul Truck	36,700
CAT AD45	Haul Truck	35,500
Sandvik DD321	Jumbo	9,200
Maclean MEM-928	Bolter	9,200
Maclean MEM-946	Bolter	9,200
Getman A64	Emulsion Loader	7,900
Marcotte M40	Transmixer	23,800
Minecat MC100G	Utility Tractor	9,900
Walden M-60	Scissor Lift	7,500
Walden M-60	Boom Truck	12,600
Toyota Land Cruiser	Man Carrier / Utility	7,300
MineCAT UT99	Man Carrier / Utility	6,000
Xtreme XR1055	Telehandler	5,500
Bobcat Toolcat 5600	Skid Steer	3,000

Legend

- Fan
- Vent Reading Stn
- Escapeway
- Bulkhead
- Barricade
- Steel Duct (unused)
- Steel Duct
- Plastic Duct
- Flex Duct
- Damper
- Damper (unused)
- Refuge Station
- Phone
- Safety Box
- Fire Extinguisher
- Vent Board
- Airflow Monitor
- Airflow Sensor
- Call Points

DRAWN BY: Rob Pharand	SCALE: 1:3000	VENTILATION & EMERGENCY	SURVEY PERFORMED BY: H Duffty	VENTILATION INSTRUMENT: Velocicalc 9545	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY
	DATE PLOTTED: 04 Jan 2020		SURVEY DATE: January 04/20	GAS MONITOR: None Available	



Make / Model	Equipment Type	Required Air (CFM)
Sandvik LH410	LHD, 7yd	17,000
CAT 1700G	LHD,	21,300
Atlas Copco MT42 HT	Haul Truck	36,700
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Legend
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- Vent Reading Stn
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DRAWN BY: R Pharand	SCALE: 1:3000	VENTILATION & EMERGENCY	SURVEY PERFORMED BY: H Duffty	VENTILATION INSTRUMENT: Velocicalc 9545	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY
	DATE PLOTTED: Sat 04 Jan 2020		SURVEY DATE: January 04/20	GAS MONITOR: None Available	

Appendix B – Minto Mine Spill Contingency Plan

Minto Mine

2020 Spill Contingency Plan

Prepared by:

Minto Explorations Ltd.

Minto Mine

March 2020

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Appendix C: ERT Response to HazMat Spills

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1 Introduction

This Spill Contingency Plan (SCP) is an update to the previous SCP, drafted in March 2019. The content of this SCP is derived from the *Plan Requirement Guidance for Quartz Mining Projects* (Yukon Government, 2013). The SCP has been updated annually and submitted as part of Minto's Water Use Licence and Quartz Mining Licence annual reports.

The purpose of the SCP is to establish guidelines for staff, contractors, and suppliers working at the site with a formal framework of actions to be taken when responding to spills during mine operation. The SCP includes practices and planning of future efforts to further reduce the potential for environmental contamination and other spill-related impacts. The SCP describes the following;

- fuels, chemicals, and other materials used at the Minto Mine;
- reporting thresholds for those materials;
- a spill action plan for responding to unintentional spills of those materials;
- reporting sequences and forms;
- training requirements;
- spill prevention activities;
- routine monitoring and maintenance.

1.1 Project Description

Minto Explorations Ltd. (Minto), a wholly owned subsidiary of Pembridge Resources, owns and operates the Minto Mine Project located 240 km (150 miles) northwest of Whitehorse, Yukon. Operations started in October 2007. The mineral deposits mined at the site were identified during exploration programs occurring in the area in the 1970's; exploration activities occurred sporadically since that time until construction of the mine and related facilities began in earnest in 2006.

The Project area encompasses the Minto Creek Valley which collects and drains in to the Yukon River (Figure 1-1). An overview of major infrastructure at the Minto Mine is shown on Figure 1-2 below.

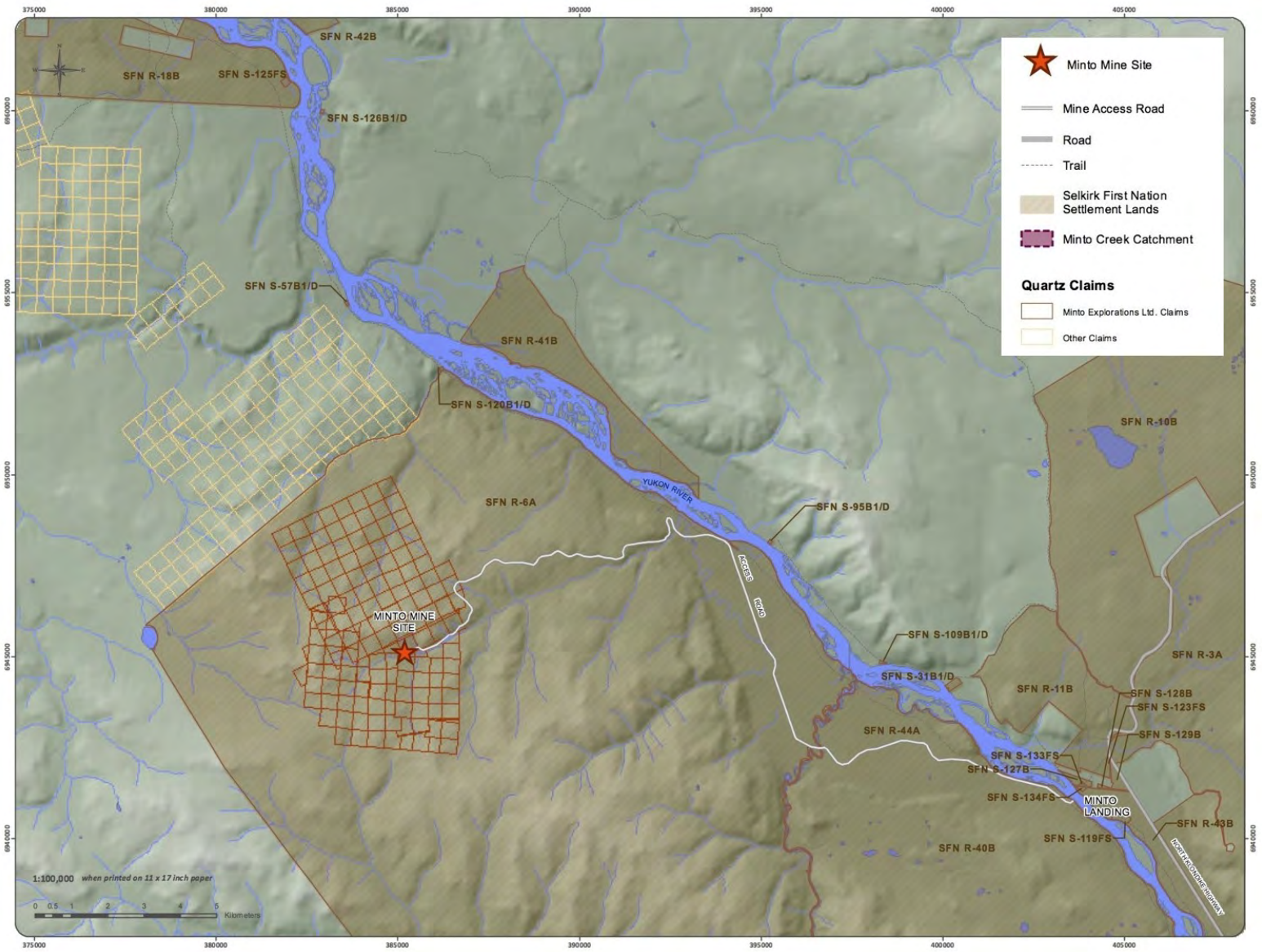


Figure 1-1: Minto Mine Area Overview



Figure 1-2: Minto Mine Area Overview – Existing Infrastructure

2 Definitions

The following definitions apply to the components of the SCP outlined herein.

Dangerous Good - A product, substance, or organism included by its nature or by the regulations in any of the classes listed in the schedule to the act (*Yukon Transportation of Dangerous Goods Act)*.

Deposit out of the normal course of events - A deposit that can reasonably be expected to occur at the mine and that can reasonably be expected to result in damage or danger to fish habitat or fish or the use by man of fish, and the identification of the damage or danger (*Metal Mining Effluent Regulations, Part 3, SOR/2002-222)*.

Discoverer - The person that discovers an incident that could possibly result in a spill or has resulted in a spill.

Spill - A release of a substance into the natural environment that is abnormal in quantity or quality in light of all circumstances of the release; or is in excess of an amount specified in the regulations (*Yukon Environment Act, Part 11*):

> **Emergency Spill -** A release of a hazardous product where there is potential for that product to enter a waterway or cause significant danger to life, health or environment.
>
> **Non-Emergency Spill -** All spills that do not meet criteria of an *emergency spill* and that the responsible party is competent to manage safely and efficiently in terms of assessment, prevention, containment and clean-up.

Substance - A hazardous substance, pesticide, contaminant or special waste often referred to as a "**deleterious substance".**

3 Purpose and Scope

Minto will ensure that all requirements related to Spill Response and reporting within these documents are implemented throughout the property for the life of the mine. If statutory and regulatory responsibilities change over time, the plan will be updated accordingly.

This SCP is prepared in support of:

- Minto's Type "A" Water Use License QZ14-031 (WUL) and Type "B" Water Use License MS15-094, which state that:

  "The Licensee shall apply the relevant procedures in the Spill Contingency Plan. The Licensee shall review the spill contingency plan annually and shall provide a summary of that review, including any revisions to the plan, as a component of the annual report."

- *Part 3 – Unauthorized Deposits*, Section 30 of the *Metal and Diamond Mining Effluent Regulations* (MDMER), which indicates that:

  "The owner or operator of a mine shall prepare an emergency response that describes the measures to be taken in respect of a deleterious substance within the meaning of subsection 34(1) of the Act to prevent any unauthorized deposits of such a substance or to mitigate the effects of such a deposit."

- *Part 7 – Emergency Response Assistance Plans and Security Plans of* the *Transportation of Dangerous Goods Act*:

  "*No person shall import, offer for transport, handle or transport dangerous goods in a quantity or concentration that is specified by regulation — or that is within a range of quantities or concentrations that is specified by regulation — unless the person has an emergency response assistance plan that is approved under this section."*

- Satisfying the requirements of the Quartz Mining License QML-0001 Schedule B, that requires:

  "A *plan that describes the measures designed to minimize the potential impact to the environment following a fuel or chemical spill."*

The SCP will apply to Minto Mine and the main access route for one year, whereby the owner or operator shall update and test the SCP to ensure it continues to meet the requirements of both the WUL, subsection 30(2) of the MDMER, and the QML.

3.1 Purpose

The purpose of the SCP is to outline a general set of procedures to be followed to assess, prevent, contain and clean-up a spill at the Minto Mine. For procedures to be effective, Minto must ensure that employees and contractors, through experience and training, possess the skills necessary to safely assess, prevent,

contain and clean-up a spill or potential spill. These procedures are necessary to ensure continuity and develop the foundation for a robust and effective SCP. The SCP is also designed to establish clear reporting and clean-up procedures as they apply to emergency and non-emergency spills and incidents.

This document also addresses opportunities to improve spill preparedness, response, and mitigation for deposits out of the normal course of events that have the potential to impact the Yukon River and its tributaries within the project site.

All Minto employees and contract staff must be familiar with the general spill reporting procedures outlined in this document and will be introduced to them as part of their site orientation.

3.2 Scope

The objectives of the SCP are to:

- identify potentially hazardous materials located on site;
- identify spill prevention measures;
- establish a high order of preparedness if a spill occurs;
- ensure an orderly and timely decision-making, response and reporting process; and
- describe current and planned protective measures for all areas of the Mine Site

The *Minto Mine Emergency Response Plan* (Minto, 2019) contains other information that relates to Emergency spill procedures. The Emergency Response Team (ERT) and members of the Environmental Department have been trained on responding to Hazmat Spills. It is beyond the scope of this document to define the specific Spill Response Procedures and decision loops involved in an ERT response. Any details pertaining to a response from ERT to assess, prevent, contain and clean-up a spill at a spill incident is the responsibility of the Site Safety Lead. General procedures for spill response procedures to emergency spills will be detailed herein.

3.2.1 Hardcopy Locations

Copies of the SCP are kept on-site in the following locations:

- Site Safety Office/ERT Building;
- Environmental Office
- Site Manager's Office

- Copper Queen Tug.

Contact information is provided in Table 4.2

4 Communication and Spill Reporting

Any spill that occurs at the Minto Mine site must be reported through the internal reporting chain of command and follow the procedures for assessment, prevention, containment and clean-up and reporting. Should a spill exceed the thresholds set by the Yukon Government (Table 4-1) then it must be reported to external authorities.

A spill that is in excess of the thresholds outlined in Table 4-1 or any spill that is abnormal in quality or quantity is considered a "reportable spill" under the *Yukon Spill Regulations* (O.I.C. 1996/193), pursuant to the *Environment Act*.

Table 4-1: Reportable Spill Thresholds

Product	TDG[1.] Code	Threshold Quantity
Explosives	1	Any amount
Flammable gases	2.1	> 100 litres
Non-flammable gases	2.2	> 100 litres
Poisonous gases	2.3	Any amount
Corrosive gases	2.4	Any amount
Flammable liquids	3	> 200 litres
Flammable solids	4	> 25 kg
Spontaneously combustibles	4	> 25 kg
Dangerous when wet	4	> 25 kg
Oxidizers	5.1	> 50 kg or 50 litres
Organic peroxides	5.2	> 1 kg or 1 litre
Poisonous substances	6.1	> 5 kg or 5 litres
Corrosive materials	8	> 5 kg or 5 litres
Miscellaneous Dangerous Goods	9.1	> 50 kg or 50 litres
Special wastes	9.3	> 5 kg or 5 litres

1. TDG = *Transportation of Dangerous Goods Regulations* (Government of Canada, 1985)

4.1 Internal Reporting (All Spills)

All spills (whether externally reportable or not) must be reported by the discoverer to their immediate supervisor and then to the Environmental Department by radio or telephone following assessment of the scene. The supervisor of the responsible department will issue an Environmental Incident Notification, with assistance from the Environment department, to notify the site and its directors, including senior management. This typically occurs concurrently with spill response (prevention, containment, and clean-up) activities.

Following the spill response, responsible department supervisors are required to document the spill on an Environmental Incident Report, available through the Environmental Department, and provided in Appendix A. The report requires inclusion of photos, a description of clean-up activities, subsequent actions, and identifies the root cause and determines any necessary corrective actions.

4.2 External Reporting (Reportable Spills Only)

Under federal and territorial regulations, the environmental lead will call the 24-hour Yukon Spill Report line should a spill of a reportable quantity occur (Table 4-1). Although several government agencies at

the federal, territorial and municipal levels may ultimately be informed, only the Yukon 24-Hour Spill Report line is required for reporting purposes. The environmental lead will ensure that the appropriate information is collected before reporting to the Spill Report line and the report will be filed within 24 hours.

Any spill of an amount greater than those listed in Table 4-1 or a spill of any amount that enters the Yukon River or a tributary of the river is a "reportable spill".

The following information should be provided to the 24-Hour Spill Report line:

- Name
- Phone number
- Product spilled
- Quantity spilled
- Quality of product (thin, viscous etc.)
- Location of spill
- Distance to water
- Distance to drinking water wells
- What happened
- Responsible party
- Actions to contain the spill

When reporting the spill to the Spill Report line, the environment lead will obtain the Environment Yukon Spill Reporting Number and first/last name of the person whom the report has been made to (in the event of a reporting discrepancy).

Minto will also contact: the Selkirk First Nation Lands Director; and Energy Mines and Resources Client Services and Inspections via email or phone after discovery of a reportable spill. Should the spill enter a waterway or be categorized as a major spill, Minto will also contact Environment Canada. A detailed written report will be submitted to the regulatory authorities within 10 days after the event. The contact information for the various Minto employees, emergency response and external reporting personnel is provided in Table 4-2 below.

Table 4-2: Contact Information for Minto Personnel and External Agencies

Minto Mine Contact List		
Department Heads	**Email**	**Contact Number**
Health and Safety Manager- Kevin Rookes	kevinr@mintomine.com	604-759-4644
Environment Manager- Todd Swenson	todds@mintomine.com	604-759-4659
General Manager- Sebastien Tolgyesi	sebastient@mintomine.com	604-759-4639
Emergency Phone Contacts		
Yukon 24- Hour Spill Line		867 667-7244
CANUTEC-Dangerous Goods Help (Transport Canada)		1-888-CANUTEC or 613 996-6666
Fire Department – Pelly Crossing (Emergency)		867 537-3000
Police – Pelly Crossing		867 537-5555
Health Centre - Carmacks		867 863-4444
Hospital – Whitehorse		867 667-8700
Fire Department – Whitehorse		867 668-8699 or 668-2462
Police – Whitehorse		867 667-5555
YG Department of Environment, Water Resources Branch		867 667-3227
YG Environmental Protection Branch		867 667-3436
Selkirk First Nation, Betty Baptiste, Lands Manager		867 537-3331
YG EMR, Client Services and Inspections		867 667-3199
External Reporting and Contacts for Submission of Spill Reports		
YG EMR, Matthew Jenner, NRO - Mining	Matthew.Jenner@gov.yk.ca	867-863-5271
SFN, Betty Baptiste, Lands Manager	landsmgr@selkirkfn.com	867 537-3331 ext. 603
YG EHS, Craig Van Lankveld, Environmental Health Officer	craig.vanlankveld@gov.yk.ca	867 667-8316
Environment Canada, Travis Teel, Enforcement Officer	Travis.Teel@ec.gc.ca	867-393-6705

5 Spill Action Plan

Implementation of the spill action plan requires knowledge of spill response supplies and locations, spill response procedures (Sections 5.1 and 5.2) and clean-up protocols (Section 5.3). In addition to the internal and external reporting requirements, spills must further be categorized as "emergency" or "non-emergency" incidents as the action plans and reporting requirements will differ according to the type of spill.

5.1 Spill Response Procedures: Non-Emergency

The majority of spills that are likely to occur on the Minto Mine Site will include a simple stepwise process initiated by the discoverer. If the safety at the scene is in doubt, then it is imperative that the Site Safety Lead is notified immediately. A "non-emergency" spill is defined as a spill of any product that the discoverer, or other personnel within close proximity of the incident can competently, safely, and efficiently manage in terms of assessment, prevention, containment, and clean-up. This typically includes fuels, blasting agents, oils, lubricants or coolants, and many of the reagents involved in mill operations. Once the scene is assessed for safety by the discoverer or supervisor and deemed a non-emergency, they will prevent, contain, and clean-up the spill, while also contacting the environmental team as soon as practical. If assistance is required to deal with the incident, the environmental team is to be notified by radio/telephone immediately.

A complete inventory of Dangerous Goods stored and used at the Minto Mine, including details on material handling and clean-up, reporting thresholds, special precautions, PPE requirements, and disposal methods is provided for reference during spill response activities (Appendix B).

5.2 Spill Response Procedures: Emergency

An "emergency spill" is a release of a hazardous product where there is potential for that product to enter a waterway or cause significant danger to life, health or environment. When a spill is discovered, the first step is to assess the scene for safety and, **if safe to do so,** immediately control and contain the spill by any means necessary. If the discoverer or other personnel within close proximity of the incident do not have the required training, resources, or equipment to deal with the incident then the individual must report a "Code 1" callout. This protocol will initiate response of the Safety Lead, Environmental Lead, and the

Emergency Response Team. The Emergency Spill Response Command Structure and General Spill Procedure are detailed in Figure 5-1 and Figure 5-2, respectively. If the scene is safe and the discoverer and the immediate supervisor have the means necessary to control, contain, and recover the spill then they should proceed as such.

Once called via a "Code 1" the Safety Lead will respond to the scene and conduct an initial assessment and assume command of the scene. If the Safety Lead/Medic is required to treat patients, command is transferred to the Emergency Response Team Captain. Unified Command Structure will be initiated once the Site Manager or Environmental Lead is on scene. The Unified Command Structure is a cooperative effort command between the Site Manager, Health and Safety Lead, and the Environmental Lead. Transfer of command includes a detailed verbal report of the incident and activities conducted and underway.

A "Code 1" Protocol initiated by an emergency spill will trigger the specific spill response procedure based on the product type, quantity and environmental and safety conditions.

Initial spill response will be conducted in accordance to *Transport Canada's 2016 Emergency Response Guidebook* (Transport Canada, 2016). This Guidebook will assist Incident Command with information to identify the material, use the guide to reference potential hazards, public safety and emergency response information. The *Table of Initial Isolation and Protective Action Distances* will be used to dictate isolation and protection for both large and small spills. However, this is not a comprehensive spill mitigation and response document and will only assist responders in making initial decisions upon arriving at the scene of a dangerous goods incident. It should not be considered as a substitute for emergency response training, knowledge, or sound judgment. The *Emergency Response Guidebook* does not address all possible circumstances that may be associated with a dangerous goods incident. The 2019 *Minto Mine Emergency Response Plan* has additional specific procedures for responding to the most commonly transported and hazardous materials including Nitric Acid, Gasoline, Diesel, Ammonium Nitrate, Sodium Sulfide, and Propane.

In addition to on-site response Minto, through its carriers of dangerous goods, has contracts in place with spill responders. These are full service response agencies that have commitments to mobilize fully trained emergency response teams and equipment 24 hours a day, 7 days a week.

5.2.1 CANUTEC Transport Canada

In the event that a spill requires additional technical resources Minto is registered with CANUTEC, a division of Transport Canada, for 24-hour Spill Response support and information to deal with emergency situations. If a spill occurs beyond the boundaries of the Minto property, the owner of the transportation firm and the owner or consignor of the dangerous goods will communicate with the regulators. For incidents that occur on the Minto property, the Environmental Department will ensure reporting to regulators is performed accordingly.

5.2.2 Surrounding and Downstream Communities

Notification of downstream water users of a spill, if required, is the responsibility of the Yukon Government Environmental Protection Branch. Minto will additionally notify the authorities including police and fire departments and the Selkirk First Nation community of Pelly Crossing.

5.2.3 Public Relations

The Site Manager is the designated spokesperson for Minto. The Site Manager may delegate their responsibility for public relations if required to do so by the scale of the incident.

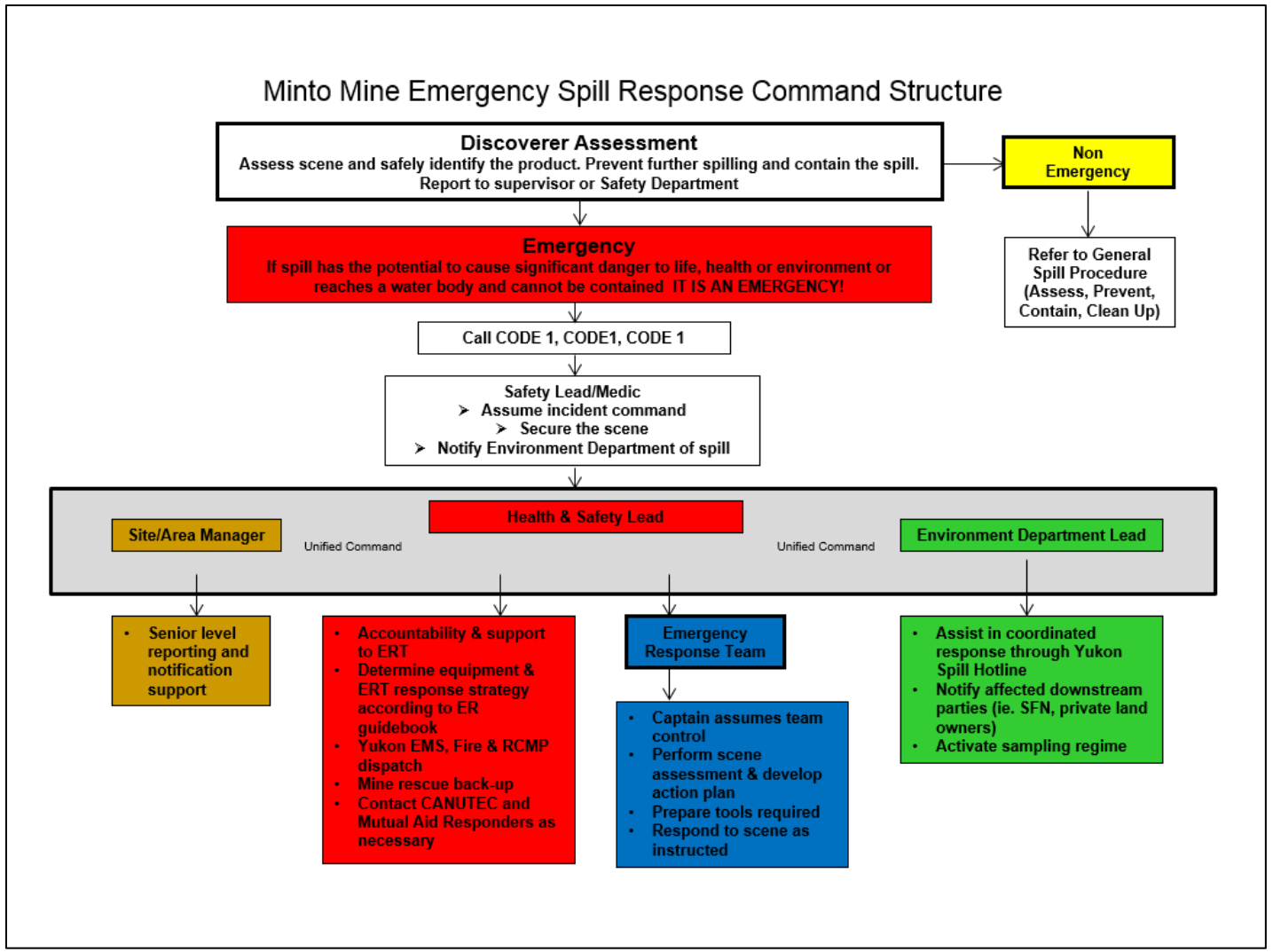


Figure 5-1: Minto Mine Emergency Spill Response Command Structure

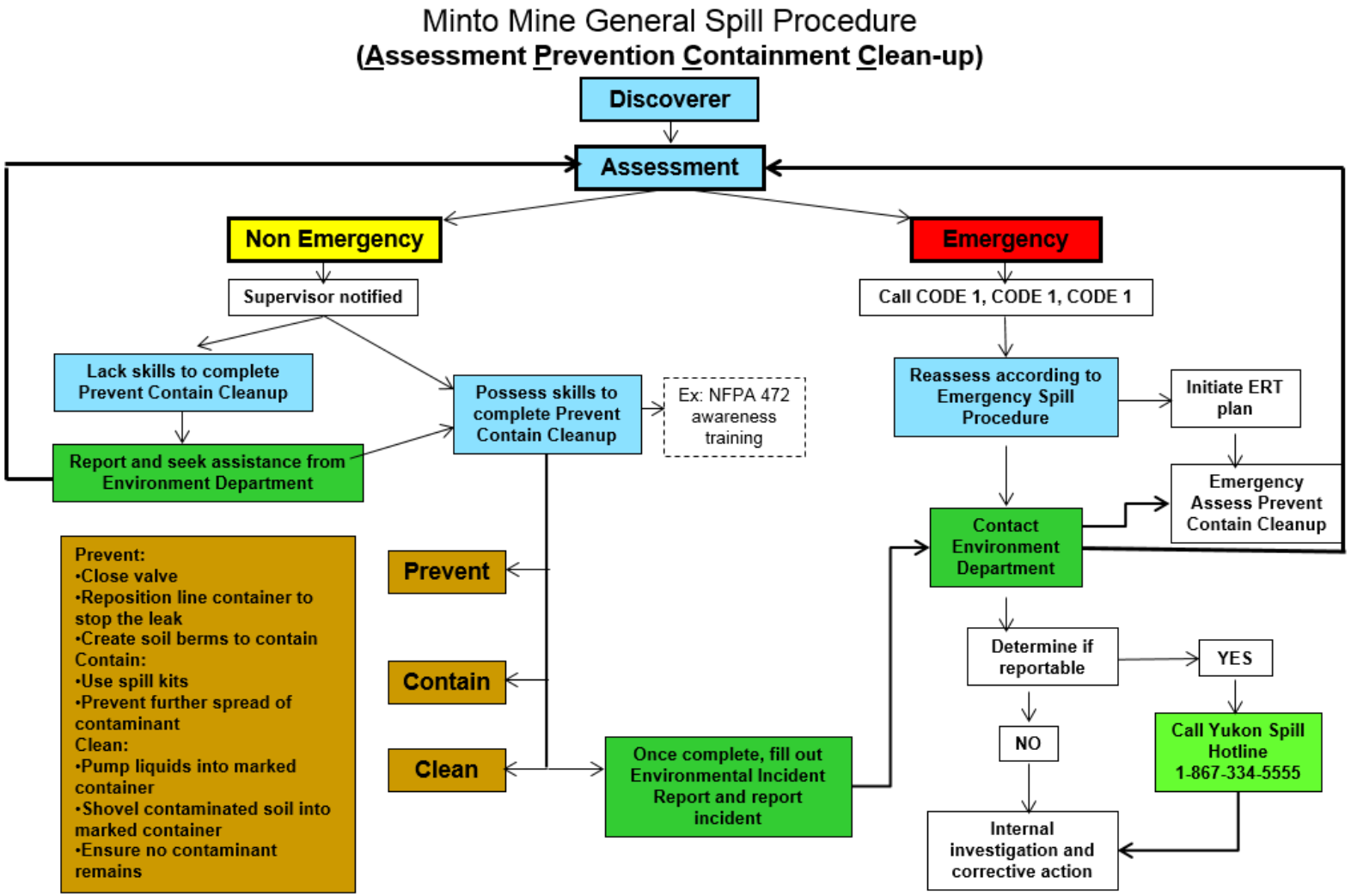


Figure 5-2: Minto Mine General Spill Procedure

5.3 Disposal and clean-up

Disposal and treatment methods of contaminated material are outlined below, and are further detailed in the *Minto Mine Spill Response Procedure: Non-emergency spills on soil* and the *Minto Mine Land Treatment Facility Standard Operating Procedure* documents. The Minto Mine Site has a Land Treatment Facility to accept incoming contaminated material from petroleum hydrocarbon and ethylene glycol spills. Depending on the state and substrate of the surface material, the clean-up and disposal location will differ. Brief practical descriptions of the clean-up procedures are summarized in Table 5-1.

Table 5-1: Disposal and Movement of Contaminated Material from Spill Sites

WASTE TYPE	DESCRIPTION	MOVEMENT OF MATERIAL FROM SPILLS
Oil or Glycol Contaminated Soil	Soil, Organics, and granular material (avoid coarse rock) contaminated as a result of a hydrocarbon or glycol spill	Contaminated soil will be transferred to the Land Treatment Facility. Contaminated soil will first be placed in the staging cell and labelled to be later categorized and treated. Contact Environment dept. before dropping off material in the Land Treatment Facility. Small spills will be stored in a composite pile in the staging area. Larger spills will be stored separately in staging while waiting for lab results.
Oil or Glycol Contaminated Rock	Blasted rock and coarse material and/or bedrock, contaminated as result of a hydrocarbon spill or glycol spill	If blasted rock contains ore and has been cleared by Mill operations ore will be processed through the mill. Non-ore containing rock will be placed in the main pit and in-situ bioremediation will be applied to the pile.
Oil or Glycol Contaminated Snow/ Ice/Water	Snow, Ice, and/or Water that has been contaminated as a result of a hydrocarbon spill or glycol spill	Contaminated snow/water will be transferred to the Land Treatment Facility. The contaminated product will be placed in a separate pile in the cell.

**** Any amount of material that has more than 30,000 ppm oil or glycol is considered special waste and must be disposed of off-site to a Special Waste Facility**

6 Spill Response Supplies

Spill kits (yellow and blue drums) are located throughout the Minto Mine Property at locations indicated in Figure 6-1. Additionally, there are blue drums located at the km 12 gravel pit, Big Creek and at the east and west terminals of Minto Landing. The contents of the yellow and blue barrels are summarized in Table 6-1. Spill kits are also supplied for each heavy and light truck at the Minto Mine. Contractor supervisor trucks have spill kits permanently affixed to the truck body. All contract trucking agencies travelling to the mine are required to carry spill kits within or affixed to the truck. Spill kits are loaned to short term visitors if required.

Table 6-1: Spill Kit Contents

Spill Kit Item	Yellow Barrel	Blue Barrel	Yellow Truck Bag	Loaner Spill Kit (20 L Pail)
Tyvek splash suits	2	2		
Chemical master gloves	2	2	1	2
Garbage bags with ties	5	5	3	1
Oil only booms (5” x 10’)	2	4	1	
Oil only mats (16” x 20”)	50	50		10
Universal sorbent mat	20	20	10	5
Sorbent socks	10	10		1
Tarp	1	1		
Duct tape	1	1		
Utility knife	1	1		
Field notebook and pencil	1	1		
Instruction sheet (laminated)	1	1	1	1

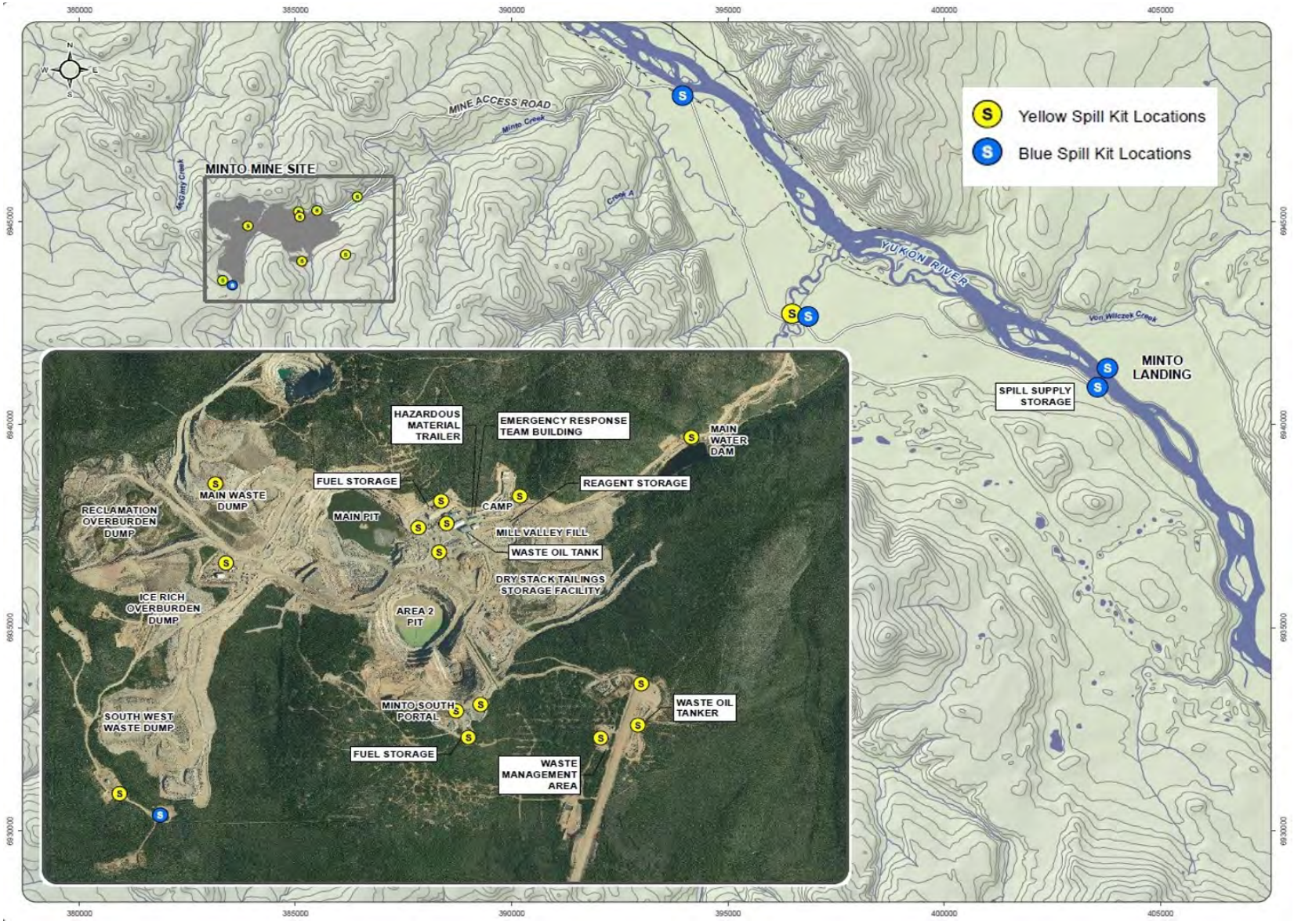


Figure 6-1: Minto Mine Area Overview – Hazmat Storage and Spill Supplies

Heavy machinery at the mine site is available for use in spill response and clean-up, as required under contract. Additionally, Minto has a 1991 Chevrolet Top Kick Fire truck with a 3200 litre/minute pump with a 3800-litre supply tank and a 3000-litre drop tank. This truck can support all spill response activities with SCBA, Class A and B foam capabilities, decontamination needs, as well as fire suppression/protection tools and equipment common to a truck of this nature. All ERT members are competent with the operation of this fire truck and related equipment in accordance with NFPA standards.

In 2013, Minto, on advice from Emergency Response Action Plan providers, procured a 20-foot Hazmat trailer and a helicopter-portable In-Viro-Drum vacuum unit (Figure 6-2) capable of being transported to locations not reachable with a vacuum truck. It has a liquid cooled three cylinder Kubota diesel engine and 250 CFM non-sparking blower, which makes it safe to vacuum flammable liquids and solids from water or dry land. It comes with a Double Port Vac Drum that allows for transfer of product from the drum to one of our 9500 litre bladders, while the drum continues to be filled. This system allows for quick, efficient and effective clean-up of hazardous products from hard to reach locations.

In 2016, Minto purchased a S.S. Alpha Adjustable Folding Weir Skimmer. Weir skimmers float on the surface of water and are designed to remove pollutants from the surface of calm or sheltered waters and shore line areas. Connected to a shore-based portable pump (e.g. Honda), contaminants can be removed from the water surface and transferred to a drum or another container for proper disposal.

Figure 6-2: In-Viro Drum and vacuum unit, 24' Packman vessel, and Alpha Skimmer for spill response operations.



Minto Mine also acquired a 24-foot Packman man boat, which is described, further in the "Barge Emergency Contingency Plan" (Appendix D).

Spill contingency equipment and earth moving equipment located at Minto Mine are listed in Table 6-2. Contractor Reclamation and Revegetation equipment is available for use in spills and clean-up operations.

Table 6-2: Spill contingency equipment located at Minto Mine

Quantity of Units	Equipment		Quantity of Units	Equipment
1	430 Backhoe		1	Assorted Wooden Plugs
1	3800 Litre Vacuum Truck		1	Large Haul Truck
Various	Dozers, Excavator, Loaders		1	Hazmat trailer 20'
1	In-Viro Drum Portable Vacuum unit		1	Top Kick fire truck
2	9500 Litre bladders		500'	Sorbent Boom (various sizes)
1	24' Packman Response Vessel		1	Storage Sea Can at Landing
1	Roll Over Kit		3	Trash pumps
1	Pipe Plug kit		1	S.S. Alpha Adjustable Folding Weir Skimmer Pump

7 Spill Prevention and Response Training

Education and training are critical to the success of any site-wide initiative, and the most important tool to ensuring the success of the SCP. Minto has a comprehensive training program in place that ensures all workers and supervisors are aware of their responsibilities and the practices that personnel and contractors must adhere to. Records are kept of the names of all employees or contractors that receive training, tracked though the either the Simply Safety software program or in the Environmental Department tracking sheets. Annual re-training is scheduled for all Minto employees.

7.1 Existing Spill Prevention and Response Training

Employees are trained to understand the potentially hazardous situations that spills can create with respect to the health and safety of workers and the environment. They are trained to understand responsibilities as employees to Assess, Prevent, Contain, Clean-up, and Report any spills. The SCP is made available to all employees and employees will be advised of revisions or changes to the SCP.

7.1.1 Orientation

Employees and visitors are required to sign off on the environmental policy as part of the employee, contractor, and visitor orientations that include a summary of the response required when a spill has occurred. The orientation has a strong focus on ensuring proper reporting of spills, so that the appropriate response and clean-up can occur.

7.1.2 "Big 7" Training

As part of the orientation, all Minto employees and major contractors receive training that is a computer based PowerPoint presentation, followed by a written test. The "Big 7" package focuses on some of the most common safety training required for site, which includes WHMIS (Workplace Hazardous Material Information System), fall protection, confined spaces, lock out, hot work, Explosives awareness training, and Environmental Awareness. The Environmental Awareness portion of the training is comprised of four modules, with one module dedicated specifically to Spill Response, covering the reporting and basic steps for assessing, preventing, containing, and cleaning up of spills.

7.1.3 Targeted Practical Training

Training sessions are put on by the Environmental Department, and efforts are made to tailor the training to the attending group (i.e. underground miners, surface contractors, site services, etc.). Smaller groups are identified and targeted for specialised spill prevention training that is more job-specific. These include, but are not be limited to; maintenance personnel (mechanics), waste and water truck operators, fuelling personnel, and warehouse workers. Training in smaller groups focusses on specific spill prevention techniques.

7.1.4 Training for Fuel Handling Employees

Currently there are Safe Work Practices (SWP) designed for bulk fueling at the fuel farm and for fueling of equipment in the field. These SWPs include descriptions of the stepwise procedure for safely performing the task and includes steps to take for emergency shut-off. Both the procedure and the equipment are audited during Workplace Inspections and Planned Job Observations by immediate supervisors and the Environmental Department.

7.1.5 ERT Training

An Emergency Response Team (ERT) has been established to, among other duties, respond to emergency spills. The Emergency Response Team periodically receives training to the National Fire Protection Association (NFPA) 472 Hazardous Material awareness level, and are required to thoroughly understand this document in order to respond to spills or incidents of a specific nature. This training is required as a foundation to develop site specific contingency planning for response tactics in areas specific to the Minto Mine associated activities that present a risk to the Yukon River and its tributaries.

7.1.6 Emergency Spill Response Drills

Table top exercises and/or field drills will help to prepare the ERT and other mine staff to respond to a major spill safely by identifying any deficiencies in the equipment or processes in place.

On November 7, 2018, a table top exercise was conducted to assess the SCP's response to a large propane leak.

The scenario was as follows:

- A cloud of vapour was seen by employee conducting daily propane checks at the underground mine-heater propane farm.

The table-top exercise identified ready-made responses in keeping with the information from the Canutec Emergency Response Guidebook. Items for discussion and follow-up included:

- While the SCP/E2 plan calls for ground monitor water fog to dissipate a vapour cloud, there is insufficient water volume on the truck to effectively do so.
- There is an LEL alarm and nitrogen switch that will shut off gas supply in the event of a large gas leak, therefore it is important to ensure this switch is maintained and tested regularly (confirmed with propane supplier).

On October 26th, 2014, a combined field and table top exercise took place with the following objectives:

- Help individuals become more knowledgeable with the ERP and SCP;
- Identify gaps in the plan;
- Improve communication between stakeholders and departments; and
- Learn new ways and better ways to execute the plan.

The announced exercise was initiated to test part of the Emergency Response Plan as it applies to Spills and the SCP. It focused on the crisis, interaction and escalation of problems within:

- Administrative;
- Operational;
- Managerial; and
- Facilities.

The scenario was as follows:

- A tanker truck with pup and trailer of diesel overturns on Oct 26th on icy roads at 3:20pm at south end of Big Creek. It is still dark and it is a Sunday and roads are icy and snowing lightly.

The exercise lasted approximately 2 hours and involved management staff onsite and offsite, the ERT, major contractors, The Yukon Spill Hotline, CANUTEC, Transnorth Helicopters, WCB, Parkland Fuel, and

Quantum Murray. A post–incident debrief revealed both opportunities and successes at the field operations and management level.

7.1.7 Training KPI's

Individuals who receive training are tracked, and training numbers are used as a key performance indicator (KPI) with annual targets. In addition, tracking is used to ensure annual retraining is delivered and statistics measured against key performance indicators.

8 Routine Maintenance and Monitoring

The Fuel Farm is visually inspected weekly for any leakages. An overfill protection system is installed on the two main diesel tanks using a visual indicator and a relay to the control room that will alarm on the HMI to alert maintenance personnel. The area also receives inspections by a qualified engineer and recommendations are recorded and deficiencies corrected as per the *CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* (Canadian Council of Ministers of the Environment, 2003).

The tug and barge receive frequent inventory inspections for spill equipment and have had major overhauls in the last few years to ensure that the operation is continually improving. Maintenance activities are also carried out regularly and systems are inspected as per Transport Canada Regulations. The daily start-up procedure includes checking for leaks and ensuring all systems are performing to specifications. Annual maintenance activities have included the following: propeller repairs, controls work, system checks and repairs. Substantive refits have included: cylinder heads, exhaust manifold seals, motor mounts, transmission mounts and replacement of water pumps. A new transmission, propulsion seals and propellers have been installed and aligned. Other improvements have included welding reinforcements on the bow of the barge for landings, electrical upgrades, and the installation of an anchor with hawser.

All fuel trucks receive a daily walk-around inspection to ensure emergency shutoffs and hatches and tank valves are operating properly and are free of leaks. These are recorded daily.

The Environment Department is directly responsible for the administration, compliance, and procedures associated with the management of waste. They are also responsible for providing education, support, and any necessary assistance required to prepare shipments for backhauling, and to ensure the Waste Management Area (WMA) is maintained in accordance with the Commercial Dump Permit (# 81-005).

The WMA is inspected weekly by Environment staff to ensure employees and contractors are following the site protocols for waste segregation, incineration, special waste handling, and landfilling. Any issues regarding these protocols are brought to the attention of all involved staff and/or contractors and the Environment Department has the right and ability to limit all access to the WMA if issues persist after they have been discussed.

9 References

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Appendix A: Spill Report and Environmental Incident Report Forms

MINTO EXPLORATIONS LTD.
A SUBSIDIARY OF PEMBRIDGE RESOURCES, PLC
MINTO MINE

Environmental Incident Investigation Report		**EIR-19-0XX**	
Date of Incident:		Time of Incident:	
Date reported:		Time reported:	
Contaminant Type:		Volume of Spill (L):	
Location of Incident:		Equipment (Type/#)	
Responsible Dept.		Supervisor	

Incident Type

Non-Reportable Spill	**X**	Reportable Spill	
Non-Reportable Wildlife		Reportable Wildlife	
Non-Reportable Incident		Reportable Incident	

Detailed but brief description of *What, Where, When, Why*
What were they doing? **What was the cause?**
What was the initial response? **What is the current status?**
Make sure you have defined the "Direct Cause" of the incident in the statement below.

Photos

Photo 1:	***Photo 2:***

Appendix B: Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Acetone	2-Propanone	Anachemia	Liquid	3	B-2, D-2B	1, 3, 0	200 L	Solvent	Extremely Flammable	Goggles, gloves. SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant foam. Do not allow into waterway or drains. Contain spread of spill and soak up with absorb all, absorbant pads. Clear up using non-sparking tools. Place liquid and absorbents into tighly sealed container, label clearly and dispose of as hazardous waste offsite.
Acetylene	C_2H_2	AIRGAS INC	Pressurized gas dissolved	2.1	A, B-1, F	1, 4, 3	any if container larger than 100 L	Welding/cutting gas	Extremely flammable, pressurized gas dissolved in an extremely flammable liquid (Acetone)	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition, if possible without risk, shut off bottles. If bottle is ruptured after the gas has been expelled, the bottle will release the Acetone. At that point treat as an Acetone spill.
AERO 6493 Promoter	Alkyl hydroxamate	Cytec Canada	Liquid above 15C	9		2, 1, 2	5 L	Metal flotation in mill			Soak up with absorbent (do NOT use sawdust. Use PLASTIC tools). In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Place recovered spilt liquid in labelled drums for disposal as Special waste. Incinerate used absorbent pads.
AERO MX-5149	Modified Thionocarbamate 15-40%Xanthate esther 40-70%	Cytec Canada	Liquid	3	B3, D-1B, D-2B	3,2,0	200 L	Metal flotation in mill	Flammable	Closed system, safety glasses, gloves	Remove sources of ignition. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush spill area with water.
Aerodri 100 Dewatering Agent		Cytec Canada	Liquid	3	B3, B-2, D-2A	2, 3, 0	200 L		Avoid contact with strong oxidizers or acids.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste. Soak up with absorbent materials and dispose of offsite in clearly labeled containers
Alconox		Anachemia	solid	not regulated	D-2B	1, 0, 0	50 kg			Safety Glasses, Gloves	Clean up uncontaminated material for reuse. Incinerate waste.
ALIQUAT 336	Methytrioctyl-ammonium Chloride	Sigma-Aldrich Canada	Liquid	6	D-2B	2, 1, 1	5 kg		Toxic if swallowed. Very corrosive. Will burn skin and eyes. Avoid contact with strong oxidizers. Hygroscopic: avoid contact with moist air.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
AlphaSolve II	>50% Sodium Hydroxide <50% Silicate	Alpha Resources	Solid						Avoid contact with strong oxidizers.	Safety Glasses, Impervious Gloves.	Highly caustic. Will produce heat and steam on contact with water. May boil and spatter. May generate hydrogen gas on contact with metals. Sweep or vaccum and, if not re-useable, send offsite as hazardous waste, in tightly closed, well labeled containers.
Aluminex 5	Aluminum Chloride Hydroxide Sulphate 15%	NALCO	Liquid	8	E		5 L	Coagulant		Safety Glasses, Gloves	Soak up with absorbent materials. These can be incinerated. Any remaining spilt liquid should be stored in closed container, labelled and disposed of off-site as Special Waste.
Aluminum Standard - AA		Anachemia	Liquid	8	E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
AM28 Flotation Reagent	Mixture of Potassium Hydroxide Alkyl hydroxamate	Axis House (Pty) Ltd.	Liquid	not regulated	D-2B	2,1,0		Floatation Reagent	corrosive solid.	Safety Glasses, Gloves	Soak up with absorbent (do NOT use sawdust. Use PLASTIC tools). In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Place recovered spilt liquid in labelled drums for disposal as Special waste. Incinerate used absorbent pads.
Amco Clear Turbidity Standard		GFS Chemicals	Liquid	not regulated	not regulated					Safety Glasses, Gloves	Contain spill. Incinerate waste or place in landfill
Ammonia, Refrigerant	Ammonia, Anhydrous	GT&S, INC	Liquefied Gas	2.3, 8	does not appear classified??	3, 0, 0	any amount		Liquefied gas, will produce extreme cold when released. Death has occurred at 5000ppm exposure for 5 minutes. Evacuate release area upwind and avoid low areas.	Goggles, gloves. SCBA.	Toxic gas and will react with a large number of substances, many in a violent manner, Gas will dissipate quickly in air. Small spills can be dissolved in water at ratio of 1:10 Not very flammable. Do not attempt to neutralise.

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Ammonium Nitrate prill	Ammonium Nitrate	Agrium	solid	5.1	C, D-2B	1.0.3	50 kg		Oxidizing material, does not burn but may contribute to combustion of materials that can burn	Safety Glasses, Gloves	In case of fire, cool containing vessels with water jet in order to prevent pressure build-up/explosion. Use flooding quantities of water. Evacuate surrounding area. If fumes or gases present, fire fighters should wear self-contained breathing apparatus. In event of spill, prevent from entering waterways. Will dissolve and disperse in water.
Ammonium Nitrate Emulsion	Ammonium Nitrate Emulsion	on-site	Liquid	5.1		2,0,3	50 kg	Explosive	Oxidizing material, does not burn but may contribute to combustion of materials that can burn	Safety Glasses, Gloves, chemical suits, SCBA may be required	In case of fire, cool containing vessels with water jet in order to prevent pressure build-up/explosion. Use flooding quantities of water. Evacuate surrounding area. If fumes or gases present, fire fighters should wear self-contained breathing apparatus. In event of spill, prevent from entering waterways. Use non-combustible material to soak up.
Arsenic Standard - AA		Anachemia	Liquid	8	D-2A, E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Ascorbic Acid	L-Ascorbic Acid (Vitamin C)	Anachemia	solid	not regulated	not regulated	1, 1, 1	5 kg		also known as Vitamin C	Safety Glasses, Gloves	Contain spill. Incinerate waste or place in landfill
Brake & Electrical Parts Kleen	CO_2 aerosol of Heptane and Isopropyl alcohol	Kleen-Flo Tumbler Industries	aerosol	Limited quantity	Consumer commodity; A, B5, D2-B	1, 3, 0			Highly flammable	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Buffer Solution pH 10		Anachemia	Liquid	not regulated	D-2A	1, 0, 0		Analytical Lab use	Dilute Sodium Hydroxide	Safety Glasses, Gloves	Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste.
Buffer Solution pH 4		Anachemia	Liquid	not regulated	not regulated	1, 0, 0		Analytical Lab use		Safety Glasses, Gloves	Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste.
Buffer Solution pH 7		Anachemia	Liquid	not regulated	not regulated	1, 0, 0		Analytical Lab use		Safety Glasses, Gloves	Contain spill. Absorb with sand, vermiculite or sorbal. Incinerate waste.
Cadmium Standard - AA		Anachemia	Liquid	8	D-2A, E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use flooding quantities of water. Contributes to combustion of other materials. Neutralize with soda ash or lime. Contain spill, keep from entering ground water. Neutralized spill can be pumped to the pit or tailings system.
Calcium Chloride		J.T. Baker	solid	not regulated	D-2B	1, 0, 2, 3	any amount		Road Salt, will corrode metals	Safety Glasses, Gloves	Sweep up spilled material and it my be deposed of in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Carbon Dioxide in Argon		Mittler Supply Inc.	Pressurized gas	2.2	A, D-2B	1, 0, 0	any if container larger then 100 L		Non-Flammable but will replace the O_2 in confined space	Goggles, gloves. SCBA if in confined space	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Caustic Soda (solid)	Sodium Hydroxide	Fisher Scientific	solid	8	E	3, 0, 1	5 kg		very corrosive solid	Safety Glasses, Gloves	Sweep up spilled material for reuse. In case of fire use appropriate measures for the surrounding fire. Minimise direct water spray on material. This material melts and 318^{o}C and when molten reacts violently with water. Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system.
Caustic Soda (solution)		DOW	Liquid	8	E	3, 0, 1	5 L		very corrosive liquid	Safety Glasses, Gloves	Contain spill and pump to plastic barrel for re-use. In case of fire use appropriate measures for the surrounding fire. Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system.
Caustic Potash	Potassium Hydroxide	Brenntag Canada	Solid	8	D-1B, E	3,0,1	5 kg		water reactive, contact with metals may evolve flammable hydrogen gas.	Safety Glasses, Gloves, fume hood	Sweep up or vacuum spillage, collect in suitable container for disposal. Avoid dust formation.
Chevron 2-Cycle Oil		Chevron Lubricants Canada	Liquid	not regulated	B-3	1, 2, 0	100 L		flammable oil for 2-storke fuel	Safety Glasses, Gloves	contain spill and use absorbent and incinerate waste
Chevron ATF+3 Automatic Transmission Fluid		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Automatic Transmission Fluid MD-3		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Chevron Clarity Synthetic Machine Oil		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Compressor Oil 260		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Coupling Grease	Grease	Chevron Lubricants Canada	Semi-Solid	not regulated	not regulated	1, 1, 0	100 L or 100 kg			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chevron Delo 300 Motor Oil		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Delo Grease EP	Grease	Chevron Lubricants Canada	Semi-Solid	not regulated	not regulated	1, 1, 0	100 L or 100 kg			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chevron Diesel Engine Oil Delo 6170 CFO		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Drive Train Fluid HD		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron ECO Hydraulic Oil AW		Chevron Lubricants Canada	Liquid	not regulated	not regulated	0, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Gas Engine Oil 930 and 940		Chevron Lubricants Canada	Liquid	not regulated	not regulated	0, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Mid-grade unleaded gasoline		Chevron Products	Liquid	3	B-2, D-2A, D-2B	2, 3, 0	200 L		Extremely Flammable, Vapours are harmful and they may be explosive. Non-sparking tools required. Vapours will collect in low areas and travel along the ground to an ignition source.	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Dike the spill and pump to containers for recycling. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Allow waste absorbent to evaporate and then Incinerate waste.
Chevron NWS Manual Transmission Fluid 6044GR		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron RPM Universal Gear Lubricant		Chevron Lubricants Canada	Liquid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Chevron Supreme Antifreeze/Coolant	Ethylene Glycol	Chevron Lubricants Canada	Liquid	not regulated under 5000 lb.	D-2A	1, 1, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chevron Ulti-Plex® Grease EP		Chevron Lubricants Canada	Semi-Solid	not regulated	not regulated	1, 1, 0	100 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Chloramine T	Chloramine-T trihydrate	Fisher	solid	8	D-2A, E	3, 1, 1	5 kg		Container may explode under fire conditions. Will release toxic fumes with fire or when mixed with strong oxidizers or acids	Goggles, gloves. SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. In case of fire. Material by itself is non-flammable, may decompose violently >100^{o}C, use dry chemical, CO_2 foam or water spray. DISPOSAL mix with flammable solvent and incinerate.
Chromium Standard - AA		Anachemia	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Citric Acid	Citric Acid, Monohydrate	Anachemia	solid	not regulated	E	2, 1, 0	5 L		Will cause severe eye damage. Avoid oxidizers, acids, bases and bleach.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. In case of fire, use flooding quantities of water. Will decompose at high temperatures and emit acrid smoke and fumes.
Copper Standard - AA		Anachemia	Liquid	8	E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.

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Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Crystal 78	Sodium Silicate	Quadra Chemicals	Liquid	not regulated	D-2B		25 L		Caustic solution. Avoid mixing with strong acids. Contact with metals such as aluminum, tin, lead and zinc generates hydrogen gas.	Goggles, gloves. Respirator	solution can be pumped into plastic drum and possibly recycled in mill circuit, or shipped off site. In case of fire use appropriate measures for surrounding fire.
Cyquest DP-6	Sodium polyacrylate in water	Cytec Canada	Liquid	not regulated	not regulated	1,1,0		Mill reagent	Slippery	Goggles, Impervious gloves	Soak up with absorbent materials. These can be incinerated. Any remaining spilt liquid should be stored in closed container, labelled and disposed of off-site as Special Waste.
Delo Diesel Fuel System Cleaner		Chevron Lubricants Canada	Liquid	3	B-3, D-2A, D-2B		200 L			Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Diesel Fuel No. 2		Chevron Products Company	Liquid	3	B-3, D-2A, D-2B	0, 2, 0	200 L			Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
DIISOBUTYL KETONE	2,6-Dimethyl-4-heptanone	J.T. Baker	Liquid	3	B-2, D-2A	2, 2, 0	200 L		Avoid contact with strong oxidizers or acids.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Drierite, indicating		Anachemia	solid	not regulated	D-2A	1, 0, 1				Safety Glasses, Gloves	Eliminate all sources of ignition. In case of fire use measures dictated by surrounding fire. Will decompose at 1450^{o}C liberating Cl_2 and SO_2. This product can be dried and reused, recycled.
Envirobind KFZ		Power Chemicals Ltd.	Liquid	not regulated	not regulated	1, 0, 0		Dust Suppression	Avoid contact with oxidizing agents or strong acids.	Goggles, Gloves	Do not use absorbents. Contain spill using noncombustible materials such as vermiculite, earth or sand.
Envirobind KTF		Power Chemicals Ltd.	Liquid	not regulated	not regulated	1, 0, 0		Dust Suppression	Avoid contact with oxidizing agents or strong acids.	Goggles/Glasses, Gloves	Do not use absorbents. Contain spill using noncombustible materials such as vermiculite, earth or sand.
Envirobind PCW		Power Chemicals Ltd.	Liquid	not regulated	not regulated	1, 0, 0		Dust Suppression	Avoid contact with strong oxidizing materials.	Goggles/Glasses, Gloves	Dike or contain. Absorb irrecoverable material onto inert oil absorbent medium, package, and label for legal disposal. Wash hard surfaces with water. Contaminated absorbent material may be disposed of in an approved landfill
FLEET CHARGE 50/50 Antifreeze	Ethylene Glycol	OLD WORLD INDUSTRIES	Liquid	9	D-2A	1, 1, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Fleet Charge PG Antifreeze/Coolant	Propylene Glycol	OLD WORLD INDUSTRIES	Liquid	not regulated	not regulated	0, 1, 0	25 L			Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Flomin C 3505 Collector	Potassium amyl xanthate (PAX)	Flomin Inc.	solid	4	not regulated	2, 2, 1	25 kg		Product is spontaneously combustible. Avoid contact with heat, moist air, and water.	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. Solutions of product my be deposed of on the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Flomin F 500 Frother	4-METHYL-2-PENTANOL (Methyl isobutyl carbinol - MIBC)	Flomin Inc.	Liquid	3	B-2, D-2B	2, 2, 0	200 L		Acids, acid chlorides, alkalis, oxidizing agents. Will attack some forms of plastics, rubber and coatings	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Floran Catalyst	Proprietary Inorganic Peroxide Blend	Floran Technologies	Liquid	5	C, D-2B	2, 0, 1, OX	50 L		Non-Flammable but will aid combustion of other materials	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use flooding quantities of water. Contributes to combustion of other materials. Contain spill, keep from entering ground water. Absorbed pill can be disposed in the pit or tailings system.
Frost Killer (Tannergas)	Methyl alcohol	TANNER SYSTEMS, INC.	Liquid	3, 6.1	B-2, D-1B, D-2A,D-2B	1, 3, 0	200 L		Extremely Flammable, Vapours are harmful and solution is poisonous	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
FUEL INJECTOR CLEANER		Radiator Specialty Co	Liquid	3	B-3, D-2A, D-2B		200 L			Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Gasoline, Unleaded		Petro-Canada	Liquid	3	B-2, D-2A, D-2B	2, 3, 0	200 L		Extremely Flammable, Vapours are harmful and they may be explosive. Non-sparking tools required. Vapours will collect in low areas and travel along the ground to an ignition source.	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Dike the spill and pump to containers for recycling. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Allow waste absorbent to evaporate and then Incinerate waste.

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Glycerin	IPAC	Power Chemicals Ltd.	Liquid	Not regulated	Not regulated				Avoid contact with reducing agents and oxidizing agents.	Goggles, gloves.	Dike spilled product to prevent runoff
Havoline DEX-COOL Extended Life 50/50 Anti-Freeze/Coolant	Ethylene Glycol	Chevron Lubricants Canada	Liquid	not regulated	D-1b, D-2A	2, 0, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
HAVOLINE DEX-COOL extended life anti-freeze/coolant-B	Ethylene Glycol	Chevron Lubricants Canada	Liquid	not regulated	D-1b, D-2A	2, 1, 0	25 L		may be fatal by ingestion	Safety Glasses, Gloves	contain spill. Can be pumped, filtered and reused. Small amounts can use absorbent and incinerate waste. Larger absorbent material in plastic drums and shipped off site for disposal.
Havoline Power Steering Fluid		Chevron Products	Liquid	not regulated	not regulated	0, 1, 0				Safety Glasses, Gloves	contain spill. Small amounts can use absorbent and incinerate waste. Larger material pumped into plastic drums and used in a waste oil heating system.
Hot 4-in-1 Heating Oil Treatment	Proprietary Blend	FPPF Chemical Company, Inc.	Liquid	3	B-3, D-1A, D-2A, D-2B	3, 2, 0	200 L		Fuel Additive, fumes will collect in low area's.	Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Hydrated Lime	$Ca(OH)_2$	Chemical Lime Company of Canada Inc.	Solid	not regulated	D-2A, E				Will cause severe caustic burns. Avoid strong acids, and aluminum	Safety Glasses, Gloves	sweep up uncontaminated material for reuse. Neutralize with dilute acid and may be disposed of in pit or tailings system.
Hydraulic Oil SAE 10W		EXXON MOBIL	Liquid	not regulated	not regulated	0, 1, 0	200 L			Safety Glasses, Gloves	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.
Hydrex 3223		Veolia	Liquid	8	E	1, 0, 0	5kg or 5L	Coagulant in the WTP		Safety glasses with side shields or goggles, face shield, chemical resistant gloves. Suitable respiratory equipment in poorly ventilated areas.	Contain spill. Ventilate area if required. Use absorbent. Place contaminated materials in sealed container for disposal and dispose of via a licensed waste disposal contractor.
Hydrex 6186		Veolia	Solid	not regulated	not regulated	0, 1, 0		Flocculant in the WTP		Safety glasses with side shields or goggles.	Sweep or vacuum spilled material. Do not get water on spilled material. Flush area with water after product recovery. Place recovered material in sealed container and dispose of via a licensed waste disposal contractor.
Hydrochloric Acid		Anachemia	Liquid	8	D-1A, E	3, 0, 1	5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind	Goggles, gloves. Respirator or SCBA if in confined space	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Hydrofluoric acid, 47 - 51%		Fisher	Liquid	8, 6.1	D-1A, D-2A, E	4, 0, 1	5 L		**Extremely corrosive and Toxic acid. Causes very severe acid burns with symptoms being delayed. Skin contact of <10% can be fatal from cardio-pulmonary problems. IMMEDIATE medical attention is required for all exposures.**	**Goggles, gloves. Respirator or SCBA if in confined space (Actually SCBA should be used anywhere unless spill is in a fumehood)**	Neutralize with soda ash. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to a plastic barrel and then disposed of in the pit or tailings system.
IPAC 6832		Quadra Chemicals	Liquid	not regulated	not regulated				water soluble	Safety Glasses, Gloves	No special clean up procedures,
Iron Standard - AA		Anachemia	Liquid	8	E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Isopropylxanthic acid sodium salt (SIPX)		Quadra Chemicals Ltd.	Solid	4.2	B-6, D-1B, D-2B		25 kg	Collector in Mill	Keep away from water - contact with water liberates extremely flammable gases. Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Use only with adequate ventilation.	Goggles, Gloves, Respirator (air-purifying or air-fed)	Move containers from spill area. Avoid allowing the spilled material to get wet or using water to clean up spillages or residues, unless the quantity remaining is very small. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.
Javex Liquid Bleach	NaOCl	Colgate Palmolive	Liquid	not regulated	E, D-2B, C				Self heating and may catch fire.	Safety Glasses, Gloves, SCBA	Ventilate area and allow qualified personnel to stop/control spill. Small spills: flush area with plenty of water and mop up. Large spills: dike the ingredient and transfer to appropiate containers. Consult Federal, Provincial and Municipal regulations for disposal. May be neutralized with sodium bisulphite or dilute hydrogen preoxide.

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KAX 51	Proprietary Blend (mix of isoamyl alohol, potassium amyl xanthate, and potassium hydroxide)	Prospec Chemicals	Solid	4.2	B-6, D-1B, E		25 kg	Collector in Mill		Safety Glasses. Face Shield, Gloves, SCBA	If in the liquid state: Stop spill at source. Contain any spilled material to prevent discharge into the environment. Eliminate all sources of ignition. Persons not wearing protective equipment should be excluded from the area. Absorb with inert dry material. Put into an approved metal salvage drum for disposal. If in the solid state: Eliminate all sources of ignition. Restrict access to area until completion of clean-up. Ensure clean-up is conducted by trained personnel only. Do not touch spilled material. Do not use water on spilled material as heat will be generated. Put spilled material into approved salvage drums for disposal. Flush cleaned area with water, making sure no water enters xanthate containers.
KOPR-KOTE	Graphite, Cu & MoS_2 mixture	Jet-Lube of Canada	paste	not regulated	not regulated	1,1,1				Safety Glasses, Gloves	Wipe up spill with rages and incinerate waste.
Lead Standard - AA		Anachemia	Liquid	8	D-2A, E	4, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Lime		Chemical Lime Company of Canada Inc.	powder	not regulated	E	3, 0, 1			Will cause severe caustic burns. Avoid strong acids, and aluminum	Safety Glasses, Gloves	sweep up uncontaminated material for reuse. Neutralize with dilute acid and may be disposed of in pit or tailings system.
Liquid Nitrogen	Nitrogen	Praxair Canada Inc.	Liquefied Gas	2.2 Non-flammable gas	A	3, 0, 2	any if container larger then 100 L		Use air supplied respirator when working in confined space, Loose-fitting cryogenic gloves, Metatarsal shoes for cylinder handling. Protective clothing where needed. Cuff less trousers should be worn outside of shoes	Extremely cold liquefied gas, Will cause severe frost bite Use SCBA when working in confined space,	Evacuate all personnel from danger area. Allow spilled liquid to evaporate. Use self-contained breathing apparatus where needed. Shut off flow if you can do so without risk. Ventilate area or move cylinder to a well-ventilated area. Test for sufficient oxygen, especially in confined spaces, before allowing re-entry
LIQUID WRENCH SUPER LUBRICANT (AEROSOL)	Proprietary Blend	Radiator Specialty Co	aerosol	2.1	A, B5, D-1A, D2-B		any if container larger then 100 L		containers may rupture if exposed to high temperatures.	Safety Glasses, Gloves	Allow container to completely discharge while eliminating ignitions sources. Wipe up spill with rages and incinerate waste.
Loctite Belt Dressing	Proprietary Blend t	Henkel Canada, Inc.	aerosol	2.2	A, D-2A, D-2B		any if container larger then 100 L		containers may rupture if exposed to high temperatures.	Safety Glasses, Gloves	Allow container to completely discharge Wipe up spill with rags and incinerate waste.
LPS 2 Spray Lubricant	Proprietary Blend	LPS Laboratories	aerosol	2.2	A, D-2A, D-2B		any if container larger then 100 L		containers may rupture if exposed to high temperatures.	Safety Glasses, Gloves	Allow container to completely discharge Wipe up spill with rages and incinerate waste.
Magnesium Nitrate Matrix Modifier		Spex CertiPrep	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
MAXGOLD™ 900 Promoter	Proprietary Blend	Cytec Canada	Liquid	3	B-3, D-2A	3, 2, 0	200 L		slightly yellow liquid that has a slight sulphur smell. In confined space use respirator with organic vapour cartridges	Goggles, gloves. Respirator or SCBA if in confined space	eliminate ignition sources, use absorbent on small spills, for large spill pump to plastic drum for shipment off site. In case of fire use dry chemical extinguisher, CO_2 or foam. Water likely not effective.
MERCSORB Mercury Amalgamation Powder		NPS Corporation	solid	4		0, 1, 1	25 kg		Dry zinc dust will not ignite spontaneously, but once ignited, it may burn readily in air	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. In case of fire use appropriate measures for surrounding fire.
Mercury Indicator Powder	Proprietary Blend	NPS Corporation	solid	not regulated		2, 1, 0			Odorless, yellowish-tan to gray powder. Dust may form a flammable or explosive mixture in air. When heated to decomposition, toxic fumes of sulfur oxides are produced	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. In case of fire use appropriate measures for surrounding fire. This product in itself is considered to be non-hazardous.
Mercury Standard - AA		Anachemia	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Mercury Vapor Suppressor	Proprietary Blend	NPS Corporation	solid	not regulated		2, 1, 0			Odorless, black, irregular, dry granular solid. Wet activated carbon removes oxygen from the air causing a severe hazard to workers in confined space.	Safety Glasses, Gloves	Sweep up spilled material and place in closed container for reuse. Contaminated waste can be incinerated. In case of fire use appropriate measures for surrounding fire. This product in itself is considered to be non-hazardous.
Methanol		Anachemia	Liquid	3, 6.1	B-2, D-1B, D-2A,D-2B	1, 3, 0	200 L		Extremely Flammable, Vapours are harmful and solution is poisonous	Goggles, gloves. Respirator or SCBA if in confined space	Eliminate all sources of ignition. Ventilate area if required. Use absorbent. In case of fire, use dry chemical, CO2, Alcohol-resistant Foam or water spray. Incinerate waste.

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Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
MIBC	Methyl Isobutyl Carbinol	Flomin Inc.	Liquid	3		2, 2, 0	200 L	Frother in Mill	Product liquid and vapor are flammable. Keep away from heat and sources of ignition. Product vapors or mist may be irritating to eyes and respiratory system. Product liquid may cause eye and skin burns. Harmful if swallowed.	Googles or Face Shield, Gloves, Respirator (NIOSH/MSA)	Dike spill and collect for disposal or reuse. Use adsorbents on residual material. Flush spill area with water. Keep flush material out of waterways. Dispose of cleanup material in an approved manner.
MIBK	4-Methyl-2-pentanone	Fisher Scientific	Liquid	3	B-2	2, 3, 0	200 L		clear liquid that has a slightly sweet smell. In confined space use respirator with organic vapour cartridges	Safety Glasses, Gloves	Clear liquid that is immiscible with water. Use absorbent for small spills and incinerate waste. Large spills, eliminate ignitions sources and pump to plastic drum for shipment off site.
Molybdenum Standard - AA		Anachemia	Liquid	not regulated	not regulated	0, 0, 0				Safety Glasses, Gloves	Contain spill. Incinerate waste or place in landfill
Mucasol universal detergent		Sigma-Aldrich Canada	Liquid	not regulated	D-2B	2, 0, 0				Safety Glasses, Gloves	
Nickel Standard - AA		Anachemia	Liquid	8	D-2A, E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Nitric Acid		Anachemia	Liquid	8	C, D-1A, E	4, 0, 0, OX	5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind. **Strong Oxidizer**	Goggles, gloves. Respirator or SCBA if in confined space	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Nitric Acid 40%		Quadra Chemicals	Liquid	8	C, D-1A, E	4, 0, 0, OX	5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind. **Strong Oxidizer**	Goggles, gloves. Respirator or SCBA if in confined space	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Oxygen		BOC Canada Limited (Linde)	Pressurized gas	2.2	A, C	0, 3, 0, OX	any if container larger then 100 L		Strong Oxidizer will Contribute to combustion of other materials.	Safety Glasses, Gloves	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Oxygen Refrigerant		Air Liquide Canada	Liquefied Gas	2.2	A, C	0, 3, 0, OX	any if container larger then 100 L		Strong Oxidizer will Contribute to combustion of other materials. Liquefied gas, will produce extreme cold when released.	Safety Glasses, Gloves	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Palladium Nitrate Matrix Modifier		Spex CertiPrep	Liquid	8	D-2A, E	3, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Phosphoric acid		Sigma-Aldrich Canada	Liquid	8	D-1A, D-2B, E		5 L		Concentrated acid, Extremely corrosive. Ventilate or stay upwind.	Goggles, gloves. Respirator	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Pine Oil (Terpene SW Blend)		Quadra Chemicals Ltd.	Liquid	not regulated	B-3, D-2B			Frother in Mill	Combustible liquid and vapor. Causes respiratory tract, eye and skin irritation. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling. Avoid oxidizing materials.	Goggles, Gloves, Respirator (air-purifying or air-fed)	Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.
PAX	Potassium Amyl Xanthate	Quadra Chemicals Ltd.	Solid	4.2	B-6, D-2B		25 kg	Collector in Mill	Keep away from water - contact with water liberates extremely flammable gases. Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Use only with adequate ventilation.	Goggles, Gloves, Respirator (air-purifying or air-fed)	Move containers from spill area. Avoid allowing the spilled material to get wet or using water to clean up spillages or residues, unless the quantity remaining is very small. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.
Polyclear A2501		Quadra Chemicals Ltd.	Solid	not regulated	not regulated			Tailings thickener flocculant	Keep away from heat, sparks and flame - fine dust clouds may form explosive mixtures with air. Take precautionary measures against electrostatic discharges.Use only with adequate ventilation. Avoid oxidizing materials.	Safety Glasses, Gloves	Move containers from spill area. Vacuum or sweep up material and place in a designated, labeled waste container. Use spark-proof tools and explosion-proof equipment. In case of fire use appropriate measures for surrounding fire. Place in sealed container and dispose of via a licensed waste disposal contractor.
Polyclear 2528	Polyclear Floc	Quadra Chemicals Ltd.	solid	not regulated	not regulated				concentrated solution is extremely slippery, use caution	Safety Glasses, Gloves, respiratory equipment if risk assesment deems necesarry	Sweep up spilled material and it my be deposed of in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Polyclear 31080C		Quadra Chemicals Ltd.	Liquid	9	D-2B			Dewatering Aid in Mill	Use only with adequate ventilation. Avoid contact with strong oxidizers or halogens	Goggles, Gloves, Respirator (air-purifying or air-fed)	Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Minto Mine - Inventory of Dangerous Goods

Reporting Threshold, Special Precautions, PPE Requirements, and Cleanup and Disposal Methods

Common Name (Synonyms)	Chemical Name	Manufacture / Supplier	Phase	TDG Class	WHMIS Class	NFPA Rating	Reporting Threshold	Use	Special Precautions	PPE Required	Special Cleanup and Disposal Info
Polyfroth W31		Quadra Chemicals Ltd.	Liquid	not regulated	not regulated			Frother in Mill	Harmful or fatal if swallowed. Can enter lungs and cause damage. May cause target organ damage	Goggles, Gloves, Respirator (air-purifying or air-fed)	Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
Potassium hydroxide	KOH	Science lab	Solid	8	D-1B	3, 0, 1	5 kg		very corrosive solid	Safety Glasses, Gloves	Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.
Potassium Iodide		Anachemia	solid	not regulated	D-2A	1, 1, 1			light and water exposure will cause breakdown	Safety Glasses, Gloves	Eliminate all sources of ignition. In case of fire use measures dictated by surrounding fire. Will decompose at high temperatures and emit toxic I_2 fumes. Use appropriate SCBA.
Potassium permanganate		CAIROX	Solid	5.1	C, E	1, 0, 0, OX	50 kg		corrosive solid. Oxidizing solid	Safety Glasses, Gloves	Sweep up solid spill for possible reuse. If necessary reduce material in aqueous solution with sodium thiosulfate (hypo), In case of fire use flooding quantities of water, material will contribute to combustion.
Propane		Superior Propane	Liquefied Gas	2.1	A, B-1		any if container larger then 100 L		Extremely flammable. Liquefied gas, will produce extreme cold when released.	Goggles, gloves. SCBA if in confined space	close valve if possible without risk, or allow the vent. In case of fire use any media suitable for surrounding fire. Use water spray to cool fire exposed containers.
Selenium Standard - AA		Anachemia	Liquid	8	E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.
Sodium Borohydride		Anachemia	solid	4.3	B-6, B-4, D-1B, E	3, 1, 2	25 kg		Flammable solid. Reacts violently with water and acids to produce flammable H_2 gas. Strong reducing agent.	Safety Glasses, Gloves	Eliminate ignition sources, sweep up dry material. In case of fire use only dry chemical extinguisher, DO NOT USE WATER OR CO_2
Sodium Hydroxide Solutions (various strengths)	NaOH (The Anachemia MSDS is current, treat all solutions in the same manner regardless of strength.)	Various Suppliers	Liquid	8	E	3, 0, 1	5 L		Caustic solution. Avoid mixing with strong acids. Contact with metals such as aluminum, tin, lead and zinc generates hydrogen gas.	Safety Glasses, Gloves	Neutralize the residue with a dilute solution of acetic acid. Neutralized solution can be disposed of in the pit or tailings system.
Sodium Nitrite		Anachemia	solid	5.1, 6.1	C, D-1B, D-2A	3, 0, 2, OX	50 kg		**Strong Oxidizer** will Contribute to combustion of other materials.	Safety Glasses, Gloves	Eliminate all sources of ignition. In case of fire, use flooding quantities of water. Will decompose at high temperatures and emit acrid smoke. Strong oxidizer, may form compound that are sensitive to shock, friction. Sweep up solid spill for disposal. Dispose of contaminated solution in the pit or tailings system.
sodium sulphide Flakes	Sodium sulphide Hydrated	Quadra Chemicals	solid	8	D-1B, E		5 kg		caustic, very corrosive solid	Goggles, gloves. And a respirator, avoid creating dust and avoid any acids. Contact with acids liberate toxic H_2S	Sweep up spilled material an place in plastic sealed container for shipment off site.
TMT 15%	trisodium salt	Quadra Chemicals	Liquid	not regulated (treated as Cl. 9 Miscellaneous)	D-2B		25 L		water soluble	Safety Glasses, Gloves	No special clean up procedures, treated as Class 9 Miscellaneous as product does not meet Class 6 Toxicity standards but is an environmental hazard.
Urea	Carbamide	Anachemia	solid	not regulated	not regulated	1, 0, 0			Avoid contact with strong oxidizers. In fire conditions it can produce oxides of nitrogen. Also ammonia, and HCN	Safety Glasses, Gloves	Sweep up spilled material and it my be deposed of in dilute form to the pit or tailings system. In case of fire use appropriate measures for surrounding fire.
Vitec 7000		Avista Technologies	Liquid	not regulated	2A	1, 0, 0		Antiscalant in WTP	Avoid mixing with strong bases, strong oxidizers, very strong acids, water reactive materials	SCBA or SABA in confined space, Safety goggles/glasses, Chemical impervious gloves	Soak up or wet vacuum spilled liquid. Neutralize residue with sodium bicarbonate or other neutralizing agent for very dilute acids.Decontaminate the area thoroughly. Place all spill residues in suitable container and dispose of via a licensed waste disposal contractor.
VARSOL 3139 SOLVENT	Petroleum Hydrocarbons	Imperial Oil Chemicals	Liquid	3	B-3, D-2B	1, 2, 0	200 L		Flammable solvent	Safety Glasses, Gloves	Clean up uncontaminated material for reuse. Incinerate waste.
VoltEsso 35		Imperial Oil Chemicals	Liquid	not regulated	not regulated	1, 1, 0			electrical insulating oil	Safety Glasses, Gloves	Clean up uncontaminated material for reuse. Incinerate waste.
Zinc Standard - AA		Anachemia	Liquid	8	E	1, 0, 0	5 L		Dilute Nitric Acid <5%	Safety Glasses, Gloves	Neutralize with soda ash or lime. Contain spill, **do not** allow un-neutralized acid to enter water systems. Neutralized spill can be pumped to the pit or tailings system.

Appendix C: ERT Response to HazMat Spills

ERT Response to Hazmat Spill

Spill Contact: Yukon Territory Spill Line 1-867-667-7244

Canutec: 1-613-996-6666 Cell: *666

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1.0 Overall HAZMAT Response Procedures

1.1 Site Management and Control

Initial responders will :

- Approach the scene from uphill and upwind.
- Establish command uphill and upwind of spill at an appropriate distance.
- Establish 2 isolation perimeters: one that separates the hot zone from the warm zone and another that separates the warm zone from the cold zone. Emergency Response Guide or Canutec shall be referenced for perimeter size.
- Evacuate affected area or 'protect in place', as req'd. Emergency Response Guide or Canutec shall be referenced for evacuation zone.
- Identify contaminated persons and ensure they remain isolated until they can be decontaminated.
- Establish a staging area.
- Designate an information officer.
- Possible unification of command.

1.2 Identification of the problem

I/C will identify the:

- Spilled product, as per witness testimony, placards, labels, bill of lading, type of container, etc. If product cannot be identified from command position, then a recon team will be tasked with identification.
- Size of container.
- Size and nature of release.
- Conditions and # of victims at accident site.
- Topography of area, and exposures threatened.

1.3 Hazard &Risk Evaluation

A risk evaluation will be conducted, taking into consideration:

- Product hazards
- Access & Egress
- Size of Spill
- Condition of container
- Proximity of exposures
- Personnel available to perform operations, and their level of training/experience
- Information from MSDS, ERG, Canutec, etc., minimum 3 sources

1.4 Personal Protective Equipment

PPE will be selected for Ops, RIT, and Decon teams, considering:

- Flammability/explosiveness of product
- Toxicity of product
- Route of entry of product
- Permeation rate of PPE
- Breakthrough time of PPE
- Availability of PPE
- Visibility and workability while wearing PPE

1.5 Information Management and Resource Coordination

The information officer will begin to gather information about the product once it has been identified. The information officer can use the MSDS, ERG, Canutec, or many other resources to gather information, such as:

- Properties of the product
- Hazards of the product
- Expected travel of product released
- Populations/ environment in jeopardy
- PPE req'd by responders
- Decontamination requirements

Command will prioritize the information and ensure that the correct people receive the correct information.

1.6 Implementing Response Objectives

Command will develop an overall strategy, which may be offensive (entry of hot zone to gain quick control), defensive (contain from the cold zone to prevent spread), or passive (isolate only, and wait for incident to run its course), considering:

- Life safety
- Incident stabilization
- Environmental protection
- Property salvage

Command will delegate tactics to operations teams, such as:

- Reconnaissance for unknown product
- Evacuation for toxic gas leak, fire, or explosive hazard
- Fire control for flammable gas, flammable liquid, or oxidizer
- Search and rescue
- Leak control
- Neutralization of corrosives
- Deployment of boom, drain covers, etc.
- Building of dams, dykes, etc.

To follow: specific tactic options will be discussed in more detail, pertaining to hazardous materials that are commonly found in large quantities at the Minto Mine.

Entry teams will enter with a clear objective, but must assess for the next team's objective. For example, the 1st entry team may be tasked with rescuing the driver of a fuel truck that rolled down a bank and is spilling fuel. Although their objective is to rescue, while they are on scene they should observe where the leak is, consider what could be used to stop it, where the fuel is going, and what is needed to contain it. They should bring a camera, so that pictures can be brought back to command. This will give command crucial information and better prepare the next team for their task.

1.7 Decontamination

Considerations for decontamination should begin at the outset of the incident. A decontamination construct will exist in the warm zone prior to any team entering the hot zone. It will typically consist of a large berm fashioned out of a large chemical resistant tarp, wrapped over a charged 2 ½" hose-line. There will be a charged 1 ½" hose-line nearby for emergency decontamination. Within the berm, there will be a series of smaller berms, in which, personnel will stand while being decontaminated. Personnel conducting the decontamination will be wearing the appropriate PPE (typically 1 class below ops) and will use detergent and water to gently scrub and rinse ops personnel and rescuees as they exit the hot zone. Tools and anything else exiting the hot zone will be decontaminated as well.

Once decontamination is complete, all product collected by the berms, will be handled as per the MSDS.

1.8 Termination

Once emergency operations are complete, the scene will be handed over to clean-up & recovery operations. Command will ensure that the hand-off includes all pertinent information about the spilled product:

- Properties
- Hazards
- Location
- Safe-handling
- Exposure signs and symptoms
- Req'd PPE
- Disposal procedures

Command will conduct an on-site debrief. As well, a more formal debrief will be conducted, with all parties involved, at a later time. The incident will be documented, including exposure records for all personnel that entered the warm and/or hot zones.

2.0 Specific Chemical Responses

2.1 Emulsion

Site management and control

- Consider initial perimeter of 800m.
- Command, staging, & decon shall be positioned upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel, product carrier (if spill occurs during delivery to mine).

Identification



- UN# 0332.
- Viscous liquid.
- Pink, opaque.
- Slight fuel oil odour.
- Shipped in bulk by tanker truck.

Hazard & risk evaluation

- Emulsion explosives.
- Stable under normal conditions.
- May explode under fire conditions.
- Eye & skin irritant.
- Slight ingestion & inhalation hazard.
- Avoid contact with corrosives.
- Is there threat to a stream?

PPE

- Class C suit with long sleeves.
- Standard PPE

Information management and resource coordination

- See MSDS for product information.
- Work closely with Dyno.

- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Fire-fighting: If fire reaches cargo, DO NOT ATTEMPT TO FIGHT FIRE. Cargo may explode. Evacuate in all directions for 1600m.
- Prevent from entering streams.
- If possible, stop anymore product from being spilled.
- Follow Dyno's recommendations for recovery and clean-up of product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, clean out berms under direction of Dyno.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief.

2.2 Diesel, Kerosene, CFE 150

Note: LEL sensor will not detect presence of long-chain hydrocarbon vapour. Photo-ionization detector (PID) should be used, if available.

Site management and control

- Set up perimeter with at least 50m radius.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept, Dyno Nobel (if spilled product is CFE 150), product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1202.
- Liquid state.
- Colour varies.
- Petroleum odour.
- Transported by B-train, tidy-tanks.
- Stored in 5 large tanks at fuel farm (total volume of 3,282,000 L), one 70,000 l Tank by UG portal, and one tank at Dyno (45,000 L).
- What is downhill from spill??
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Combustible liquid.
- Vapour could be ignited by any source of ignition.
- Extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Ambient temperature relevant.
- Irritant to eyes and skin
- Ingestion and inhalation hazard
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
  Otherwise
- For offensive strategies, such as rescue or plugging, full turn-out gear with SCBA
- For defensive strategies, such as diverting, damming, booming, diking, class B suit.

- Respirator with OV cartridges.
- Oil resistant gloves & boots

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Standard decon set-up will be constructed.
- Ensure tools are cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd.
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured personnel.
- Consider using fog stream to protect rescuers.
- Fire-fighting: Use dry chemical, CO2, Class B foam, or water with fog pattern.
- If using fog, considering increased run-off hazard
- Prevent from entering streams.
- If possible, stop the leak: close valves, use plugs, plug n' dyke, gaskets, straps, jacks, cribbing, etc.
- Containment berm at source, 'Surrey Condom'.
- If possible, contain by covering drains/culverts, diking, diverting to a berm, absorbing, etc.
- If product has entered a stream, use booms, hydrocarbon-only absorbent socks and pads, under-flow dams, diversion-booms, skimmers to contain and extract, as per instructions found later in this document.
- If transfer of product req'd, ensure entire system is bonded/grounded.
- Use non-sparking tools, such as pneumatics.
- Site Services Vac-truck is an option for cleaning up product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

2.3 Gasoline

Note: Minto gas detectors are calibrated to pentane and are suitable for use during gasoline spill mitigation

Site management and control

- Set up perimeter. Consider radius up to 800m depending on amount of product and level of explosion hazard.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1203.
- Liquid state.
- Colourless to slightly yellow.
- Recognizable odour.
- Transported by B-train, tidy-tanks.
- Stored in 2 tank at fuel farm (34,150 L combined).
- What is downhill from spill??
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Flammable liquid. Extremely flammable in presence of ignition source, at nearly any temperature.
- Vapour could be ignited by any source of ignition.
- Vapour is heavier than air and may travel considerable distance to an ignition source, and flash back.
- Product extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Explosion hazard where flame impingement on tank.
- Irritant to eyes.
- Ingestion and inhalation hazard
- Toxic to aquatic life.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear with SCBA.
  Otherwise
- For offensive strategies, such as rescue or plugging, full turn-out gear with SCBA
- For defensive strategies, such as diverting, damming, booming, diking, fire resistant class B suit.
- Respirator with OV cartridges, only if LEL's are being monitored, otherwise, do not dampen sense of smell. Rather, move upwind of product vapour.

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Standard decon set-up will be constructed.
- Ensure tools are cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Offensive tactics for rescue of injured personnel only.
- Consider blanketing affected area with class B foam, prior to rescuers entering hot zone.
- Use fog stream to suppress vapours and protect rescuers.
- Rescuers will carry intrinsically-safe radios and gas-detector.
- Prevent from entering streams
- If possible, stop the leak.
- If possible, contain by covering drains/culverts, diking, diverting to a berm, absorbing, etc.
- If product can or has has entered a stream, use booms, hydrocarbon-only absorbent socks and pads, under-flow dams, diversion-booms, as per instructions found later in this document.
- Safe handling and disposal of all waste product.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, safe disposal of decon berm contents
- Safe and proper disposal of all spent PPE
- Hand-over command of operation to Environmental Dept.
- Debrief

2.4 LPG (Propane)

Note: Minto gas detectors are calibrated to pentane, and require no correction prior to use during propane leak mitigation.

Site management and control

- Set up initial perimeter of at least 100m. For large tank where there is fire, set up perimeter of at least 1600m.
- Command, staging, & decon shall be positioned uphill and upwind.
- Eliminate sources of ignition.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1075
- Colourless liquid and vapour while stored under pressure.
- Colourless and odourless gas in natural state at any concentration.
- Commercial propane has an odorant added which is commonly ethyl.
- Transported by tanker truck.
- Stored in 6 113,000L tanks West of the Main Pit, One 12,000L tank at the refill station near the airport, twin 3,000L tanks at Pelly, and twin 18,000L tanks at Km 0 of the access road.
- What is downhill from spill?
- Is there threat to life?
- Is there threat to a stream?

Hazard & risk evaluation

- Extremely flammable gas.
- Vapour could be ignited by any source of ignition.
- Vapour is heavier than air and may travel considerable distance to an ignition source, and flash back.
- Stored under pressure, as a liquid.
- Product extraction methods could create static if not bonded/grounded, and serve as an ignition source.
- Massive explosion hazard where flame impingement on tank.

PPE

- Full turn-out gear with SCBA.

Information management and resource coordination

- See SDS for product information.
- Consider contacting Canutec.
- Know the product's route of travel.
- Ensure tools are cribbed for entry teams.
- Have fire truck at scene and ambulance in staging area, as req'd

Implementing Response Objectives Leak in an enclosed space

- Evacuate structure.
- Close supply valve remotely if possible.
- Eliminate any source of ignition.
- Use positive pressure to ventilate space, ensure that it is exhausting to safe location.

If no remote isolation valve:

- Entry team (2 ERT members) & RIT team (2 ERT members) will don full turn-out gear & SCBA.
- Any electronic equipment being carried, such as radio or gas detector, must be intrinsically safe.
- Entry team will enter with charged 1 ½" hose-line and gas detector equipped with LEL sensor, while RIT stages in the cold zone .
- Once entry team is at 'reach of stream' distance from the leak, the nozzleman (Entry member 1) will set-up, with nozzle fixed on Entry member 2. Entry member 2 will continue toward valve, with gas detector.

If LEL sensor rises above 20%, entry team will retreat until ventilation can be made adequate.

- Once Entry member 2 reaches the valve, he will close the valve, then back away until he reaches entry member 1.
- Entry team will exit the structure, until it has been adequately ventilated.
- Once adequately ventilated, ERT members, wearing appropriate PPE, will sweep the structure with gas detector(s), to ensure there are no pockets of gas, before deeming the structure 'safe to enter'.

****** If no remote shut-off is available or accessible, the main propane lines can be shut off by cutting the Underground Power feed in the Tailings Building.***

2.5.1 LPG line on fire, with no impingement

Note: a propane leak that is burning is safer than one that is not burning, as long as there is no impingement on a tank or structure. Therefore, in this scenario, gas will be allowed to burn until the valve can be shut off.

- Evacuate immediate area.
- If possible, close isolation valve from remote location.

If no remote isolation valve:

- Eliminate any further source of ignition.
- 2 or more ERT members in full turn-out gear & SCBA will be on 1 ½" hose-line.
- Nozzle will be turned to full fog, which will create a water-curtain between the fire and the fire fighters.
- The fire team will approach the isolation valve, keeping the water-curtain between themselves and the fire at all times, being careful not to put the fire out with the stream
- When the valve is reached by the team, the 2nd member on the line will let go of the hose and approach the valve, while the nozzleman maintains the water-curtain between the fire and the valve/fire team.
- The 2nd member will close the valve then back away from the fire until he regains his position on the hose.
- The team will maintain the water-curtain while they back away from the damaged gas-line.
- Once the team is at a safe distance, a 45 degree pattern can be fixed on the broken gas-line to cool it, and disperse any residual gases.

2.5.2 LPG leak, not enclosed, not on fire

Note: LPG has a very high vapour pressure (1013 kPa) so it wants to be a gas, a high vapour density (1.52) so it's heavier than air, and a low flash point (-103.4 C). This combination means that it can form an explosive gas cloud that will stay close to the ground, may linger in incident area, or migrate downwind and/or downhill, possibly settling in low lying areas.

- Evacuate immediate area as well as areas downwind/downhill as per ERG recommendations.
- If possible, close isolation valve from remote location.
- From 'reach of stream', set up ground monitor and fix a 45 degree fog pattern on area of concern. This will push gas cloud away from area and disperse it. Be sure to push it to a safe location.

If no remote isolation valve:

- Entry team (2 ERT members) & RIT team (2 ERT members) will don full turn-out gear & SCBA.
- Any electronic equipment being carried, such as radio or gas detector, must be intrinsically safe.
- Entry team will enter with charged 1 ½" hose-line and gas detector equipped with LEL sensor, while RIT stages in the cold zone.
- While ground monitor continues to 'make it rain' in the hot zone, nozzleman (entry member 1) will fix nozzle on entry member 2, as entry member 2 approaches the isolation valve, with gas detector.

If LEL sensor rises above 20%, entry team will retreat until water stream can be made more effective

- Once Entry member 2 reaches the valve, he will close the valve, then back away until he reaches entry member 1.
- Entry team will retreat to the cold zone until gases are adequately dispersed
- Once the gas is adequately dispersed, ERT members, wearing appropriate PPE, will sweep the area with gas detector(s), including low-lying areas where gas may have migrated to, before deeming the area 'safe to enter'.

2.5.3 Fire where there is flame impingement on LPG tank

- Evacuate all non-ERT members for at least 1,800 m where there is flame impingement on either the 12,000 L tank or the tandem 18,000 L tanks.
- Command will know and understand the signs of imminent BLEVE.
- If Command witnesses signs of imminent BLEVE from an upright tank, there shall be no attempt made to cool tanks, rather, all focus shall be on a rapid evacuation of all personnel, at least 1,800m.
- If tank has been knocked over, there may be little or no warning signs of BLEVE, therefore no attempt shall be made to cool, rather, all focus shall be on a rapid evacuation of all personnel, at least 1,800m.
- If a BLEVE is not imminent, an attempt will be made to connect a ground monitor to the stand-pipe at the Tailings bldg.
- A narrow fog stream will be fixed on the tank at the area of flame impingement.
- The monitor will be left unmanned and the remaining ERT will evacuate at least 1,800m.

Where a tanker truck carrying propane has over-turned on the access road, causing damage to the tank trailer and subsequent rapid release of propane, the strategy for the hazmat portion of the incident response, will be passive and conducted from an upwind/uphill location, at a safe distance, as per the ERG. Transfer of residual product for the scenario, will be conducted by outside resource.

Decontamination

- 1 ½" charged hose-line, as emergency decon

Termination

- Debrief

BW GasAlert Micro 5 is intrinsically safe, as per: *http://directories.csa-international.org/xml_transform.asp?xml=certxml%5C080259_0_000-4828-82.xml&xsl=xsl/certrec.xsl*

- GasAlert Micro 5 Portable Gas Detector, Model M5-xwt1t2-r-p-d-a-b-cc & M5PID-xwt1t2-r-p-d-a-b-cc; utilizing electrochemical, catalytic bead and photo-ionization sensors; Intrinsically Safe when powered by one of the following AA Size Batteries / Battery Pack
  - Duracell MN1500; T-Code T4; Ambient -20 to +40°C; T-Code 139.8°C (T3C); Ambient -20 to +50°C
  - Energizer E91; T-Code 153°C(T3C); Ambient -20 to +40°C; T-Code 163°C (T3B); Ambient -20 to +50°C
  - NiMH Rechargeable Battery Pack "M5-BAT01"; T-code T4; Ambient -20 to +50°C
  - Lithium Polymer Rechargeable Battery pack "M5-BAT07B"; T-Code T4; Ambient -20 to +50°C

2.5 Nitric Acid 40%

Note: when it comes to corrosives such as Nitric Acid, the solution to pollution is NOT dilution. For a spill of 1 45 gal drum, it would take over 450,000 gal of pure water to make the solution habitable for fish. It would take over 45,000,000 gal of pure water to neutralize it.

Site management and control

- Set up perimeter with at least 50m radius.
- Command, staging, & decon shall be positioned uphill.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product Carrier (if spill occurs during delivery to mine).

Identification



- UN# 2031
- Liquid state
- Colourless to yellow
- Transported in 45 gallon drums
- # of 45 gal drums possibly damaged will help estimate size of spill.
- What is downhill from spill? Could acid reach a stream?

Hazard & risk evaluation

- Strong acid, very corrosive.
- Severely hazardous to eyes and skin
- Ingestion could cause death
- Inhalation hazard, although low vapour pressure 1.3kPa (wants to be a liquid).
- Could be devastating to stream life.
- Strong oxidizer, could have explosive reaction with organic or combustible materials

PPE

- If there is a fire situation, PPE will consist of full turn-out gear and SCBA.
  Otherwise
- Know and heed permeability rate and breakthrough times of all PPE.
- Acid resistant, class B suit with hood.
- Full-face respirator with appropriate chemical cartridges.
- Chemical resistant gloves & boots
- Chemical resistant tape used to seal between boots/suit, gloves/suit, and mask/hood.

Information management and resource coordination

- See MSDS for product information.
- Know the product's route of travel.
- Was anyone exposed?
- Will non-human life be exposed?
- Standard decon set-up will be constructed.
- Have tools cribbed for entry teams.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is enough neutralizing agent at the site to complete the task. ***See below for chart***
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured/exposed personnel.
- Prevent from entering streams
- Prevent from contacting combustibles and organics.
- If possible, stop the leak.
- If possible, contain by covering drains/culverts, damming, diverting to a berm, etc.
- Use over-pack to contain leaking drums that still contain product.
- Neutralize spilled product with weak caustic – primary neutralizing agent is Ansul Spill X-A, alternatively hydrated lime or baking soda (if available). Be cautious of chemical reaction.
- Use Litmus paper to test for pH when neutralizing with lime or baking soda.
- Site Services Vac-truck is an option for cleaning up product before or after neutralized, as necessary.

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, vac-truck can be utilized to clean up solution contained with the decon berms.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

2.5.1 Chart for Estimating Caustic Req'd to Neutralize 40% Nitric Acid

For **Spill X-A**, use 1:1 ratio by volume, or 10lbs Spill X-A per 1 gal Nitric Acid.

Amount of Nitric Acid Spilled (in Gal.)	Amount of Baking Soda Req'd (in Lbs.)
1	5.6
2	11
5	28
10	56
20	110
45	252
90	504
135	756
180	1,008

Amount of Nitric Acid Spilled (in Gal.)	Amount of Lime Req'd (in Lbs.)
1	2.4
2	4.8
5	12
10	24
20	48
45	108
90	216
135	324
180	432

Charts derived from formulas below

Specific Gravity Nitric Acid: 1.2455

Concentration: 40%

1 gal HNO_3 x 1.24 x 8.34 lbs/gal x 0.40 = 4.14 lbs HNO_3

$HNO_3 + NaHCO_3 \rightarrow NaNO_3 + H_2O + CO_2$ Therefore 1 mol Nitric Acid per 1 mol Sodium Bicarb (Baking Soda)

$2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$ Therefore 2 mol Nitric Acid per 1 mol Calcium Hydroxide (Lime)

HNO_3 = 63 amu

$NaHCO_3$ = 85 amu

$Ca(NO_3)_2$ = 74 amu

(4.14 lbs HNO_3/63 amu-HNO_3) x 85 amu-$NaHCO_3$ = 5.6 lbs $NaHCO_3$

Therefore 1 gallon of Nitric Acid req's 5.6 lbs of baking soda

(4.14 lbs HNO_3/2(63) amu-HNO_3) x 74 amu-$Ca(OH)_2$ = 2.4lbs $Ca(NO_3)_2$

Neutralization Formulas and Quick Access Charts Formulas

The key to effective and efficient neutralization, is knowing how to use the following formulas.

1. The first formula indicates how much acid is spilled in weight.

Step #1- Determine the quantity of acid spilled, usually in gallons.
Step #2- Determine the specific gravity of the acid usually provided in MSDS.
Step #3- Determine the concentration of the acid spilled usually in %.
Step #4- The weight of water is 8.34 pounds per gallon.

After the above figures are known plug them into the following formula:

Quantity of spill X specific gravity X weight of water X concentration
= weight of the spill

Example:
One gallon of sulfuric X 1.84 X 8.34 X 98% = 15.04 pounds of sulfuric

2. The second formula will determine the quantity of the neutralizer needed. The type of neutralizer needs to be selected based on costs and availability. Plug numbers into the following formula:

Weight of the acid spilled X number in the chart for the selected neutralizer.

Example :

15.04 pounds of sulfuric X 1.06 for Soda Ash = 15.94 pounds of Soda Ash

Determination through Chemistry

To calculate the amount of neutralization agent needed the balanced chemical reaction must be written and the equivalent weights of acid and base determined.

Example: 1,000 gallons of 38% hydrochloric acid will be neutralized with lime.

Step #1 – Write the complete balanced neutralization reaction:
$2HCl + CaO \rightarrow CaCl_2 + H_2O$
This equation shows that 2 moles of HCl are required in the reaction with one mole of calcium oxide (lime).

Step #2 – Calculate the molecular weight of each compound:
HCl – H = 1, Cl = 35.5, Total = 36.5 amu
CaO – Ca = 40, O = 16, Total = 56

Step #3 – Calculate the weight of the HCl spill:
1,000 gallons X 1.20 X 8.34 X 0.38 = 3,803.04 pounds of HCl
Step #4 – Calculate the amount of neutralizer needed:
From Step #1 it was found that 2 moles of HCl are needed to react with 1 mole of CaO. From Step #2 it was found that 1 mole of HCl weighs 36.5 amu's so 2 moles weigh 73.0 amu's. The formula is**; weight of acid/formula weight of acid X formula weight of base = pounds of the neutralizer needed.**
3,803.04/73 X 56 = 2,917.4 pounds of lime

Finer Points
The final amount is an approximation and in actual practice more neutralizing agent should be obtained. The neutralization process needs to be checked at several spots to assure pH levels are acceptable and uniform.

Neutralization Precautions
Remember, the neutralization process is exothermic and it may involve splashing of product. Safety is paramount and proper protective equipment is very important. Also, the neutralizer is hazardous in its own right and needs to be handled with care. Consider expense and availability in selecting neutralizer. Other weak bases that may be used and their molecular weights are; sodium bicarbonate ($NaHCO_3$)- 85, and magnesium hydroxide ($Mg(OH)_2$)-58.

Neutralization Chart Information
Acids

Hydrochloric Acid, HCl, MW = 36.5, density/specific gravity is 1.19, weight of a gallon is 3.77 pounds at 38% concentration. Synonyms are chlorohydric acid and muriatic acid.

Nitric Acid, HNO_3, MW = 63, density/specific gravity is 1.41, weight of a gallon is 8.23 pounds at 70% concentration. Synonyms are Aqua Fortis and Azotic Acid. (Aqua Regia is a mixture of nitric and hydrochloric acids).

Phosphoric Acid, H_3PO_4, MW = 98, density/specific gravity is 1.69, weight of a gallon is 11.98 pounds at 85% concentration. Synonyms are orthophosphoric acid.

Sulfuric Acid, H_2SO_4, MW = 98, density/specific gravity is 1.84, weight of a gallon is 15.04 pounds at 98% concentration. Synonyms are Oil of vitriol and "oleum" is fuming sulfuric acid.

Bases

Ammonium hydroxide, NH_4OH, MW = 35, clear solution, synonyms are ammonia solution and aqua ammonia. Strong ammonia odor evolves from liquid. High vapor pressure.
Calcium carbonate, $CaCO_3$, MW = 100, white powder, synonyms are crushed limestone and dolomite. Low heat of reaction that gives off carbon dioxide gas.
Calcium hydroxide, $Ca(OH)_2$, MW = 74, white powder, synonyms are slaked lime, hydrated lime, and calcium hydrate.
Calcium oxide, CaO, MW = 56, white powder, synonyms are quicklime, lime, and unslaked lime. Most economical, lowest cost, neutralizer. **Best choice!** Maximum pH is 12.45 at 25C.
Magnesium carbonate, $MgCO_3$, MW = 84, synonyms are magnesia alba and carbonate magnesium.
Magnesium hydroxide, $Mg(OH)_2$, MW = 58, white powder, synonyms are milk of magnesia and magnesia hydrate. Good neutralization agent. Maximum pH is 10.6 at 25C.
Potassium hydroxide, KOH, MW = 56, white flakes, synonyms are caustic potash. High heat of reaction with toxic fumes. Maximum pH is 14 at 25C.
Sodium bicarbonate, $NaHCO_3$, MW = 85, white powder, synonyms are baking soda and sodium acid carbonate. Low heat of reaction with carbon dioxide gas evolution.
Sodium Carbonate, Na_2CO_3, MW = 106, white powder, synonyms are soda ash. **Second most economical neutralization agent next to lime.** Maximum pH is approximately 11 at 25C.
Sodium hydroxide, NaOH, MW = 40, white powder, synonyms are caustic soda, soda lye, caustic, and lye. High heat of reaction with toxic fumes. Maximum pH is 14 at 25C.

2.5.2 Quick Access Charts for Neutralizing Various Acids with Baking Soda

2.5.2.1 Sulfuric Acid neutralization using Baking Soda (Sodium Bicarbonate)

Amount of Sulfuric Acid spilled	Amount of Baking Soda needed in pounds
1 gallon	25.6
2 gallons	51.2
3 gallons	76.8
4 gallons	102.4
5 gallons	128.0
10 gallons	256.0
50 gallons	1280.0
55 gallons	1408.0
100 gallons	2560.0

2.5.2.2 Hydrochloric Acid neutralization using Baking Soda

Amount of Hydrochloric Acid spilled	Amount of Baking Soda needed in pounds
1 gallon	5.5
2 gallons	11.0
3 gallons	16.5
4 gallons	22.0
5 gallons	27.5
10 gallons	55.0
50 gallons	275.0
55 gallons	302.5
100 gallons	550.0

2.5.2.3 Nitric Acid neutralization using Baking Soda

Amount of Nitric Acid spilled	Amount of Baking Soda needed in pounds
1 gallon	7.4
2 gallons	14.8
3 gallons	22.2
4 gallons	29.6
5 gallons	37.0
10 gallons	74.0
50 gallons	370.0
55 gallons	407.0
100 gallons	740.0

2.6 Sodium Sulphide

Site management and control

- Set up perimeter with at least 50m radius if water introduced, or 25m if solid.
- Command, staging, & decon shall be position upwind and uphill.
- Unify command with Safety Superintendent, Mine Manager, Environmental Dept., product carrier (if spill occurs during delivery to mine).

Identification



- UN# 1849
- Solid state
- Yellow
- Smell sulfurous or like rotten eggs with introduction of moisture.
- Transported in 1000 Kg 'Super-Sacks'.
- # of super-sacks possibly damaged, will help estimate size of spill.
- Is water being introduced to the spill? If so, what is downhill form the spill? Could run-off reach a stream?
- Are corrosives being introduced to spill? If so, what is downwind?

Hazard & risk evaluation

- Strong caustic.
- Severely corrosive to digestive tract, respiratory system, eyes, and skin.
- Dust is powerful systemic poison. Inhalation could cause headache, dizziness, unconsciousness, pulmonary edema, asphyxiation, death.
- Contact with acid releases toxic and flammable Hydrogen Sulfide.
- Routes of entry include absorption, inhalation, and ingestion.
- Keep spilled product dry
- If water introduced, avoid run-off, contact with soil, waterways.

PPE

- If there is a fire situation, PPE will consist of full turn-out gear and SCBA.
  Otherwise
- Know and heed permeability rate and breakthrough times of all PPE.
- SCBA if significant H2S release, otherwise, full-face respirator & OV cartridges with pre-filter.
- Corrosive resistant, class B suit with hood.
- Chemical resistant gloves & boots
- Chemical resistant tape used to seal between boots/suit, gloves/suit, and mask/suit.

Information management and resource coordination

- See MSDS for product information.
- Was anyone exposed?
- Will non-human life be exposed?
- Standard decon set-up will be constructed.
- Have tools cribbed for entry team.
- Ensure there is enough PPE at the site to complete the task.
- Ensure there is drinking water for responders.
- Have hazmat trailer, ambulance & fire truck in staging area, as req'd
- Have Site Services staged for digging, damming, product extraction, as req'd.

Implementing Response Objectives

- Rescue injured/exposed personnel.
- Keep product dry.
- Monitor atmosphere for H2S and SO2.
- If water introduced, contain run-off by covering drains/culverts, damming, diverting to a berm, etc. Solution collected can be mixed with oxidizing agent, such as hydrogen peroxide or sodium hypochlorite to prevent evolution of H2S.
- If product has entered a stream, consider using over-flow dams to contain product, for extraction.
- Vacuum or sweep up dry product
- Disposal as per Environmental Dept. recommendations

Decontamination

Standard decon set-up will be utilized in warm zone:

- Large berm fashioned out of large chemical resistant tarp, wrapped over charged 2 ½" hose-line, 2 small berms, will be in series, within the large berm.
- Decon personnel shall don class C suits without need for respiratory or splash protection, other than safety glasses.
- Ensure all personnel that entered hot zone are properly decontaminated.
- Ensure that all tools that entered the hot zone are properly decontaminated.

Termination

- Once operation complete, solution in decon berms to be disposed of, as per Environmental recommendations.
- Safe and proper disposal of all spent PPE.
- Transition of command.
- Debrief

Appendix D: Tug and Barge Emergency Contingency Plan

Minto Mine

Tug and Barge Emergency Contingency Plan

2019-09

Prepared by:

Minto Explorations Ltd.

Minto Mine

September 2019

First Issue: January 15, 2013

Revision History

Revision Number	Issue Date	Description and Revisions Made
2013-01	January 2013	First Issue
2017-01	February 2017	Review, revision of document and update of information: • Revised format of document (added revision history and table of contents); • Section 2.0 and 3.1 - Removed references to JDS and mutual aid agreement (not in place); • Section 4.0 - updated level of NFPA training for ERT (472 HazMat awareness level); • Section 4.0 - updated reference to 2014 field and table top exercise.
2019-09	September 2019	Changed ownership from Capstone to Pembridge Resources.

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4 Minto Mine Training ..... Error! Bookmark not defined.

List of Appendices

Appendix A: Man Boat Specifications

Appendix B: Safe Job Procedure for Loading and Unloading the Barge.

1 Introduction

Minto Mine (Minto), a subsidiary of Pembridge Resources, is pleased to submit the following contingency plan (plan) as per requirements of the Selkirk First Nation Access and Land Use Permit "Minto Landing Ice Bridge and Marshalling Area and West Side Barge Landing and Marshalling Area" (the permit). It is Minto's intention that this plan will fulfill the requirement as stated in Schedule 2, Section 9.0 Contingency Plan of the permit. It is not Minto's objective for this plan to mitigate all possible accidents or malfunction in regards to the in-stream operation of the Copper Queen tug and barge.

The plan, as prepared, is adaptive and will be amended as is practicable. This plan is intended to deliver the best possible means of mitigating an accident or malfunction of the loading/unloading or in-stream operation of the tug and barge with the resources available at Minto. Preventing such an occurrence requires a combination of procedural and engineering controls, based on an awareness of at risk conditions. These documents exist in the form of the Spill Contingency Plan, Emergency Response Plan, and any procedures or plans on the tug or barge from Site Services. This document serves as a contingency plan in the event that an accident or malfunction occurs when loading, unloading, and during in-stream operations of the Copper Queen tug and barge (CQTB).

2 General Procedures

Any response to an emergency condition will be based on a priority sequence of Life, Environment, and Property. Every event will be regarded with these priorities in mind. Initial on scene assessment of the accident or malfunction will be called out on channel one as a "Code 1". The Emergency Response Team (ERT) will be dispatched, communication established, and the barge operator and deckhand will respond to control the scene.

Deckhands will mitigate all emergencies on the barge to the best of their ability given the resources available. The general procedure in the event of an emergency would have the barge move to the west landing if possible or practical, unless otherwise communicated to the barge captain. To mitigate an emergency in offloading or loading vehicles onto the barge the deckhand will utilize the anchor points on both landings. Slack will be left in the rope to ensure the barge captain can maneuver when docked at the

landing. Tying off to the anchor points will mitigate complete catastrophe if the barge loses power during loading and offloading and will be discussed further under the specific procedures section of this plan.

3 Specific Procedures

Below is a list of the current on-site procedures for dealing with various emergencies in regards to the CQTB at Minto Mine.

- Emergency Response to Sinking
- Emergency Response to Loss of Power or Control
- Emergency Response to Fire Onboard
- Emergency Response to Man Overboard
- Emergency Response to Freight or Vehicle Overboard
- Emergency Response to Medical Emergency on Board of the Barge
- Emergency Response to Spill Response

3.1 Emergency Response to Sinking of CQTB

1. The activation of Emergency Protocols onboard the CQTB, starting with calling “Code 1” to initiate an ERT response.
2. The Captain and deckhand will deploy Canadian Coast Guard approved life rafts.
3. As per the Emergency Response Plan, Incident Command (IC) will communicate with the deckhand by radio to determine any further details of events, number of injured or trapped people, and any risks to property and environment.
4. IC will respond to the scene in an emergency vehicle ahead of remaining ERT members. IC will, upon arrival, provide initial scene assessment and gather any additional information available. A minimum ERT response will include; a full ERT member compliment, an environmental lead, the hazardous materials response trailer, the fire truck, the ambulance, and all associated equipment. All ERT operations will be under the control of the ERT Captain. Additional response needs based on initial assessment and evaluation by IC will be communicated to the Emergency Communications Center (ECC), as per the Emergency Response Plan.

5. Incident Accountability will be established and adhered to throughout the operation.
6. IC will determine the need for necessary rescue of people downstream. The option to deploy rescue ropes via launcher will be considered for KM 12.
7. Alternate access to river will be determined by the nature of the incident (KM 20 provides a second potential access point). All other access would require trail cutting, which is possible, but would take more time.
8. The IC, ERT Captain, and Environmental Lead (Unified Incident Command Support) will assess the ongoing situation and potential need for additional resources.
9. The alternate Man-boat (see Appendix A for details on Man-boat) will be deployed from the landing as needed to support rescue and/or to gain more information regarding the location of the sunken vessel and determine a possible plan for retrieval/securing of the vessel. The Man-boat operator will work under the direction of IC.
10. Once rescued, all patients will be treated as per OFA3/EMR protocols, transported as per Yukon EMS dispatch, and confirmation will be aligned with the Minto Emergency Response Plan.

3.2 Emergency Response to Loss of Power or Control of CQTB

The tug operates on two engines so a total loss of power is unlikely; however, it is still possible and below is the emergency procedure that would be activated in the event that the total loss of control of the CQTB was to occur.

1. The activation of Emergency Protocols on board the CQTB, starting with calling a “Code 1” to initiate an ERT response. The Captain will also communicate freight details and passenger numbers on board.
2. Passengers and crew will follow instructions from the Captain and will remain on board if deemed safe to do so. The Captain and deckhand will follow MED protocol in decision making, in regards to passenger safety.
3. The Captain and deckhand will deploy Canadian Coast Guard approved life rafts if the Captain deems it unsafe to stay on board.

4. IC will respond to the scene (or as close to it as possible) in an emergency vehicle ahead of the remaining ERT members. IC will, upon arrival to scene, provide initial scene assessment and gather any additional information available. A minimum ERT response will include a full ERT member compliment, an Environmental Lead, the Hazardous materials response trailer, the fire truck, the ambulance, and all associated equipment. The ERT operations will be under the control of the ERT Captain. Any additional response needs, necessary downstream communications, and reporting requirements will be based on the initial assessment and evaluation by the IC and will be communicated to the Emergency Communications Center (ECC), as per the Emergency Response Plan.
5. Incident Accountability will be established and adhered to throughout the operation.
6. The Captain will navigate, to the best of their ability, to the safest downstream location possible.
7. The Captain will communicate the location and condition of the vessel and people, and will assist in determining plans for further action.
8. Once the vessel is secured to shore (or where landed in river), the Man boat will be deployed to assist with additional securing and the removal of non-essential people to a location where they can be transferred back to site or to an alternate safe location.
9. A plan for retrieval will be based on the conditions and location of the vessel. The plan will be developed cooperatively between the Barge Captain, Minto ECC, and Mutual Aid resources. Equipment and additional resources will be sourced through the ECC, as per the Minto Emergency Response Plan.

3.3 Emergency Response to Fire on the CQTB

1. The activation of Emergency Protocols onboard CQTB, starting with calling a “Code 1” to initiate an ERT response.
2. If safe to do so, the deckhand will attempt to supress the fire using equipment on board following the Marine Emergency Duty (MED) protocol.

3. The Captain and deckhand will deploy Canadian Coast Guard approved life rafts if vessel in immediate danger. If possible and practical, the Captain will position barge so that the wind is blowing port to starboard, attempting to keep smoke/flames away from the life raft.
4. If possible, the Barge will cross to the West Bank of crossing and continue to use barge supplied fire suppression equipment. All passengers will disembark under direction of the deckhand.
5. The IC will respond to the scene in an emergency vehicle ahead of the remaining ERT members. IC will, upon arrival to scene, provide initial scene assessment and gather any additional information available. A minimum ERT response will include a full ERT member compliment, an Environmental Lead, the Hazardous materials response trailer, the fire truck, the ambulance, and all associated equipment. ERT operations are to be under the control of the ERT Captain. Additional response needs based on the initial assessment and evaluation by the IC will be communicated to the Emergency Communications Center (ECC), as per the Emergency Response Plan.
6. Incident Accountability will be established and adhered to throughout the operation.
7. Once IC is on scene and the vessel is safely secured, fire suppression will be conducted under the direction of the IC, following NFPA 1081 standards (Industrial Fire Brigade).
8. The consideration of environmental sensitivity will be considered by IC in cooperation with the Environmental Lead (unified incident command support).
9. Defensive spill containment methods will be utilized to control run off and any releases from firefighting operations. This may include (but are not limited to) tactics such as extinguishing agent selection, damming and/or berming on the barge, the placement of a boom around the vessel, and the removal of burning equipment once the fire is controlled, etc.

3.4 Emergency Response to Man Overboard

1. The activation of the Emergency Protocol onboard CQTB, beginning with calling “Code 1” to initiate an ERT response.

2. The Captain and deckhand will throw out provided Canadian Coast Guard approved life-rings to all personnel overboard. The response from the barge crew will conducted as per their MED training.
3. If able to successfully rescue person overboard, the deckhand will treat person(s) based on marine first aid protocols, awaiting response by the ERT and site Medic.
4. If unable to successfully achieve a rescue, the vessel will continue to the West landing and the Man boat will be deployed for a downstream rescue (Communication to IC on Radio Channel 1 must be available at all times). The Man boat operation will be conducted under the direction of the IC, once in place.
5. The Captain will communicate to IC of any possible downstream rescue requirement.
6. IC will instruct the ERT to stage at KM 12, with the option to deploy rescue ropes via launcher considered.
7. Incident Accountability will be established and adhered to throughout the operation.
8. IC will stage the ambulance for patient pick up.
9. IC will communicate the need for mutual aid to ECC, who will follow the Minto ERP by contacting local agencies for assistance on the East side of the river.
10. Once rescued, all patients will be treated as per OFA3/EMR protocols and transported, as per Yukon EMS dispatch confirmation, aligning with the Minto Emergency Response Plan.

3.5 Emergency Response to Freight or Vehicle Overboard of the CQTB

1. The activation of Emergency Protocols onboard CQTB, starting with calling a “Code 1” to initiate an ERT response. The Captain will also communicate freight details and passenger numbers on board.
2. Passengers and crew will follow instructions from the Captain (the Captain will respond as per MED training) and will remain on board, if deemed safe to do so.
3. The Captain and deckhand will deploy Canadian Coast Guard approved life rafts if it is deemed unsafe to stay on board, and passengers will be offloaded to a safe location on shore.

4. IC will respond to the scene (or as close to it as possible) in an emergency vehicle, ahead of the remaining ERT members. IC will, upon arrival, provide initial scene assessment and gather any additional information available. A minimum ERT response will include a full ERT member compliment, an environmental lead, the hazardous materials response trailer, the fire truck, the ambulance, and all associated equipment. Any ERT operations will be under the control of the ERT Captain. Additional response needs, downstream communications, and reporting requirements based on the initial assessment and evaluation by the IC will be communicated to the Emergency Communications Center (ECC), as per the Emergency Response Plan.
5. Incident Accountability will be established and adhered to throughout the operation.
6. The captain will navigate, to the best of their ability, to the landing (preferably the west landing).
7. Once the vessel is secured to shore, the man boat will be deployed by the deckhand or ERT members to assist with any additional securing of the vessel/freight and for the deployment of containment booms, which are located at the landing and on the vessel itself. All Man boat operation will be under the direction of the IC, once in place.
8. A plan for retrieval of freight will be determined appropriate to the condition and location of freight. The plan will be developed cooperatively by the Barge Captain, Minto ECC, and Mutual Aid resources.
9. Equipment and additional resources will be sourced through the ECC, as per the Minto Emergency Response Plan, including (but not limited to) manpower, expertise, and heavy equipment.
10. Additional external support in the event of an incident occurring on the East side of the river will include (but is not limited to) Yukon Emergency Measures Organization, local first responders, and alternate equipment operation contractors.

3.6 Emergency Response to Medical Emergency on board CQTB

1. The activation of the Emergency Protocols onboard the CQTB, starting with calling a “Code 1” to initiate an ERT response.
2. For a serious injury, as defined in the ERP, Yukon EMS will be notified immediately.
3. The deckhand will treat the patient per Marine Emergency First Aid protocols.

4. The Captain will navigate the barge to the west bank of the Yukon River (if possible) and all vehicles will offload on west bank, giving clear passage for Ambulance.
5. An ERT response will include the medic, ambulance, fire truck and a full compliment of team members to assist with any necessary patient transfer and packaging.
6. Incident Accountability will be established and adhered to throughout the operation.
7. Yukon EMS dispatch will be updated of situation once history and assessment is confirmed.
8. Upon arrival, the Minto Medic will take control of the scene and advise the ERT Captain of resources needed on scene.
9. Upon assessment, the patient will be treated, packaged, and transported, as per Yukon EMS dispatch confirmation, aligned with the Minto Emergency Response Plan.

3.7 Emergency Response to a Spill

1. The activation of the Emergency Protocol onboard the CQTB, starting with calling a “Code 1” to initiate an ERT response.
2. The deckhand will attempt to contain the spill using the onboard spill kit to prevent the spill from entering the Yukon River.
3. IC will respond to the scene in an emergency vehicle, ahead of the remaining ERT members. IC will, upon arrival, provide initial scene assessment and gather any additional information available. A minimum ERT response will include a full ERT member compliment, an Environmental Lead, the Hazardous materials response trailer, the fire truck, the ambulance, and all associated equipment. All ERT operations will be under the control of the ERT Captain. Additional response needs, downstream communication, communication with CANUTEC, and reporting requirements based on initial assessment and evaluation by IC will be communicated to the ECC, as per the Emergency Response Plan and Spill Contingency Plan.
4. Incident Accountability will be established and adhered to throughout the operation.
5. If practical, the barge captain will navigate the barge to the west landing.
6. All passengers will disembark vessel.

7. All vehicles and machinery that are not in the spill zone will also disembark.
8. The deckhand and ERT members, under the direction of IC, will use the Man boat to deploy the containment booms around the barge.
9. IC, with advice from the Environment Lead, will develop and implement the SCP for stopping the spill if possible.
10. If the spill cannot be stopped, a plan to mitigate the quantity of contaminant that reaches the environment will be developed and implemented.
11. If safe and practical to do so, the Environment Lead will deploy environment staff to sample downstream of spill to measure the contamination.
12. IC, with advice from the Environment Lead, will oversee cleanup of the spill.

Appendix A: Man Boat Specifications



Brand/Model: Munson Packman Landing Craft

- **Hull Length:** 24 feet (7.3 meters)
- **Beam:** 8 feet 6 inches (2.6 meters)
- **Hull Type:** Packman mono hull
- **Power:** Twin Yamaha 150hp
- **Propulsion:** Outboard (25” shaft)
- **Outfitting:** 52” bow door

Appendix B: Safe Work Procedure for Loading and Unloading the Barge.

Capstone Minto Safe Work Practice

Barge Loading and Offloading

Purpose: To ensure the safe practice of loading and offloading the barge at the Yukon River. To educate workers on the hazards of loading and offloading the barge, and working on landings.

Scope: This Safe Work Practice pertains to the Captain and the crew of the Minto Mine property who are exposed to operating the barge for transport across river.

Definitions:

Certified Flotation Device – Personal Flotation Devices marked "Approved by Department of Transport Canada" or "Approved by Canadian Coast Guard, Department of Fisheries and Oceans"

Hypothermia - A potentially fatal condition that occurs when the body core temperature falls below 95°F (35°C). This can occurs quickly when immersed in cold water.

Responsibilities

Employer / Supervisor Responsibilities

- Make sure appropriate training and assistance are provided to crew.
- Make sure appropriate rescue devices such as a life hook and floatation devices are available to workers

Safety Department Responsibilities

- Ensure this SWP is in alignment with the Yukon Health and Safety Act and Regulations

Worker Responsibilities

- Read, understand, and follow this safe work practice
- If unsure then stop work and ask for assistance
- Wear appropriate PPE defined to their work area.
- Provide training for proper use of PFD to passangers

Reference to Legislative and Site Requirements

- Yukon Occupational Health and Safety Regulations – Part 1 – section 1.34 – Each worker shall be provided with and be required to use an appropriate personal flotation device with the required buoyancy where a worker is employed in a situation where there is a risk of drowning

Safe Work Practice:

The captain and crew will give direction in regards to the following.

1. Landings.

1.1. Assess landing and vehicles to be loaded and unloaded. The use of wooden ramps may be needed. (For more information reference safe work practice for wooden ramps.)

1.2. Use gauge on apron ram to determine the need for landing to be rebuilt. This gauge is located on the ram closest to deckhand shed and has a max angle marked on the gauge. If the apron should go past the marked max angle stop and fix landing. (For more information reference safe work practice for landing maintenance and apron angle.)

2. Transportation.

2.1. Due to landing and vehicle loads ask driver to back on or drive on. This may be determined by many factors, such as:

- Angle and length of landing
- Apron angle and how it contacts the landing
- Underwater debris
- Drivers skill
- Extra low trailers
- Frozen or icy landings
- Load weights

2.2. Deckhand must communicate with captain any concerns about previously mention conditions. It is ultimately the captains' decision on how the barge is loaded.

3. Priority Boarding

3.1. Emergency vehicles on medical runs are given the top priority. Compassionate reasons or special circumstances are considered when loading vehicle traffic. The bus will also be given high priority

along with con trucks. Loading priority will be determined by the Captain or the Supervisor.

3.2. Priority may change from day to day and we ask that drivers cooperate and be patient. Ultimately the captain will make the decision based on information available at the time.

4. Communication.

4.1. Drivers are given a handout of standard hand signals as endorsed by WCB and a signature logbook is maintained to who has received the handout and when.

4.2. The deckhand is in charge of directing and communicating with all traffic. Radios, hand signals, face to face communication are all used. An air horn is used as warning to stop the drivers quickly.

5. Hazards.

5.1. Working at or near water has its inherent risks. A JHA should be conducted for any new or unusual work being conducted on or near the water. Some hazards to be aware of are:

- Exposure to the environmental elements of the season
- Slips, trips and falls on uneven ground
- Slipping on slippery rocks and surfaces
- Eroding shore line sloughing or slipping on ice along shoreline
- Falling into cold water
- Ice flows and ice jams
- Swift current
- Drowning
- Hypothermia
- Wildlife
- Slippery deck

6. Emergency Equipment.

6.1. Life ring with rope and pole must be available on the barge. An emergency response container complete with first aid kit, oxygen therapy unit, spare dry coveralls and several blankets is located on the tug. This container is used to reduce the effects of hypothermia until emergency response arrives.

6.2. As the river is 27kms from the mine site emergency response will take at least 40 minutes to arrive at the scene. Deckhands should have marine first aid training and clear knowledge of where all safety equipment is and its condition.

6.3. Honda pump & fire hose along with fire extinguishers are also in place. Deckhands should be well train in this area and will instruct people as needed on what to do in case of an emergency.

7. Training.

7.1. All workers must be trained and competent to operate or run any equipment that pertains to their job.

7.2. At least one worker must have a valid marine first aid ticket in the event of an emergency due to the location of this worksite and the anticipated delay on response time by ERT.

SWP Development and Approval

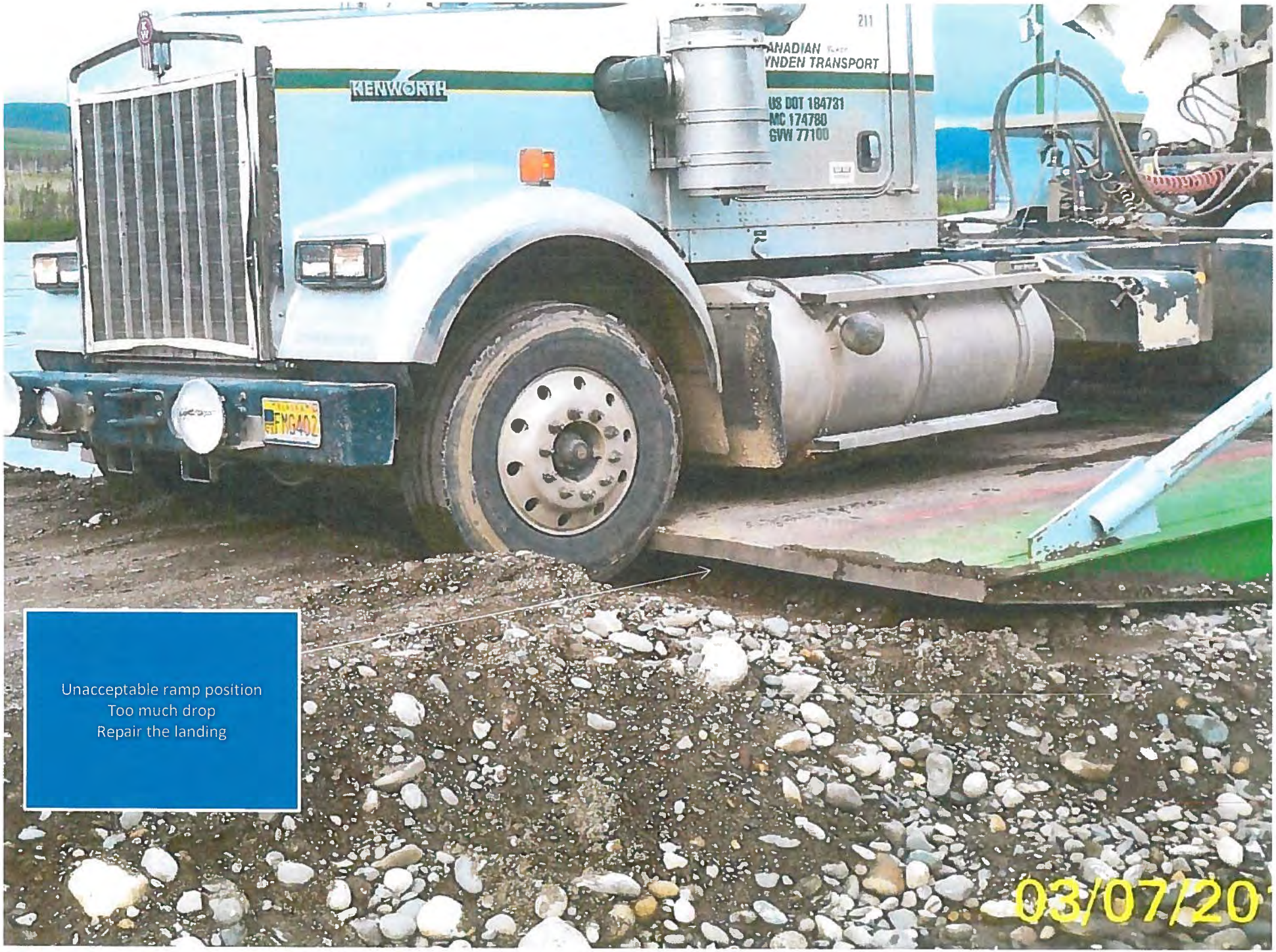
	Print: Developed/ Revised by:	DD/MM/YYYY
Worker:		**Date:**
Worker:		**Date:**
JOHSC Representative:	Siana mills	**Date:24/08/2012**
Supervisor:	Stephen Maunder	**Date:26/08/2012**
Supervisor:	Captain Dave Johnstone	**Date: :26/08/2012**
Supervisor:	Jeff Billings	**Date: :26/08/2012**
Supervisor:		**Date:**
JOHSC Representative:		**Date:**
Senior Supervisor:		**Date:**
Senior Supervisor:		**Date:**
Departmental Manager:		**Date:**
	Print & Sign: Reviewed By:	
Safety Department:	MARK GOEBEL	
Safety Department:		**Date:** Sept 19/12
	Print & Sign: Approved By: **Determined by Safety Dept. Enter NA if not applicable.**	**Date:**
Departmental Manager:	stephen maunder	**Date:** 19/09/12
General Manager:		**Date:** 9.20.2012

Clarification of this safe work practice can be directed to the Safety Department.

Name of SWP:
Location: X:\Health & Safety\Safety Public\Procedures and Safe Work Procedures
Last revision date: April 21 2012


Ideal Ramp Position for Loading


Good Ramp
Position


KENWORTH
US DOT 184731
MC 174780
GVW 77100
Unacceptable ramp position
Too much drop
Repair the landing
03/07/20


Ramp Angle Gauge
Minimum and Maximum
Ramp Angle Indicators


Ramp Angle Gauge
Minimum and Maximum Ramp Angle Indicators

Appendix C – Groundwater Quality Monitoring Program Laboratory Results

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 23-JAN-19
Report Date: 01-FEB-19 17:06 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2224095

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-01-23 B
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2224095-1	L2224095-2	L2224095-3		
	Description	Water	Water	Water		
	Sampled Date	19-JAN-19	19-JAN-19	20-JAN-19		
	Sampled Time	15:10	17:10	14:20		
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	329	303	813		
	Hardness (as CaCO3) (mg/L)	140	145	369		
	pH (pH)	8.41	8.12	8.12		
	Total Suspended Solids (mg/L)	3.6	<3.0	<3.0		
	TDS (Calculated) (mg/L)	180	177	579		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	150	150	164		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	6.4	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	157	150	164		
	Ammonia, Total (as N) (mg/L)	0.0359	0.0170	0.0130		
	Chloride (Cl) (mg/L)	<0.50	0.64	4.6		
	Nitrate and Nitrite (as N) (mg/L)	2.04	3.99	1.45		
	Nitrate (as N) (mg/L)	0.0063	3.79	0.783		
	Nitrite (as N) (mg/L)	2.04	0.194	0.666		
	Sulfate (SO4) (mg/L)	18.8	4.80	301		
	Anion Sum (meq/L)	3.67	3.40	9.78		
	Cation Sum (meq/L)	3.23	3.29	8.96		
	Cation - Anion Balance (%)	-6.3	-1.7	-4.4		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0018	0.0021	0.0017		
	Antimony (Sb)-Dissolved (mg/L)	0.00015	0.00041	0.00014		
	Arsenic (As)-Dissolved (mg/L)	0.00068	0.00024	0.00071		
	Barium (Ba)-Dissolved (mg/L)	0.0603	0.0192	0.0214		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.325	0.634	0.292		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000136	0.0000714		
	Calcium (Ca)-Dissolved (mg/L)	38.6	48.7	106		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00017	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00025		
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00203	0.00089		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0034	0.0012	0.0162		
	Magnesium (Mg)-Dissolved (mg/L)	10.6	5.73	25.3		
	Manganese (Mn)-Dissolved (mg/L)	0.0809	0.00298	0.643		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2224095-1	L2224095-2	L2224095-3		
	Description	Water	Water	Water		
	Sampled Date	19-JAN-19	19-JAN-19	20-JAN-19		
	Sampled Time	15:10	17:10	14:20		
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00513	0.00577	0.0240		
	Nickel (Ni)-Dissolved (mg/L)	0.00071	<0.00050	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.99	2.12	2.61		
	Selenium (Se)-Dissolved (mg/L)	0.000128	0.000316	0.000861		
	Silicon (Si)-Dissolved (mg/L)	5.19	5.21	6.09		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	8.71	7.39	34.4		
	Strontium (Sr)-Dissolved (mg/L)	0.901	0.293	3.03		
	Sulfur (S)-Dissolved (mg/L)	5.73	1.39	97.4		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00016	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.000902	0.00208	0.00308		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0392	0.164	0.150		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<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	Barium (Ba)-Dissolved	MS-B	L2224095-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2224095-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2224095-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2224095-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2224095-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2224095-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
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.

ANIONS-N+N-CALC-VA Water Nitrite & Nitrate in Water (Calculation) EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA Water Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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.

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-01-23 B

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2224095-COFC

COC Number: 2019-01-23 B

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax mintoenvironment@mintomine.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax ap@mintomine.com

Email 2

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	229097 (GW)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: CR/CB

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals (TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
					P	F/P	P	F/P	P	F/P								
	MW09-03-01	19-Jan-19	15:10	Water		R		R	R		R							4
	MW09-03-02	19-Jan-19	17:10	Water		R		R	R		R							4
	MW12-07-02	20-Jan-19	14:20	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☑ | SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
-2.7					4

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-01-23	Time:	Received by: EF	Date: 23 Jan 2019	Time: 11:50	Received by: HA	Date: 1/24	Time: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 13-FEB-19
Report Date: 22-FEB-19 17:27 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2232404

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-02-13 A
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2232404-1	L2232404-2	L2232404-3	L2232404-4	
Description	Water	Water	Water	Water	
Sampled Date	08-FEB-19	08-FEB-19	08-FEB-19	08-FEB-19	
Sampled Time	10:55	13:55	14:30		
Client ID	MW12-07-02	MW09-03-01	MW09-03-02	DUP	
Grouping	**Analyte**				
WATER					
Physical Tests	Conductivity (uS/cm)	823	295	296	822	
	Hardness (as CaCO3) (mg/L)	403	144	149	395	
	pH (pH)	8.02	8.00	7.83	8.03	
	Total Suspended Solids (mg/L)	4.7	24.9	3.9	3.9	
	TDS (Calculated) (mg/L)	591	165	168	585	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	159	140	140	161	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	159	140	140	161	
	Ammonia, Total (as N) (mg/L)	0.0099	0.0414	0.0101	0.0177	
	Chloride (Cl) (mg/L)	4.9	<0.50	0.61	4.9	
	Nitrate and Nitrite (as N) (mg/L)	0.904	0.154	3.74	0.794	
	Nitrate (as N) (mg/L)	0.660	0.0123	3.55	0.638	
	Nitrite (as N) (mg/L)	0.245	0.141	0.189	0.155	
	Sulfate (SO4) (mg/L)	303	18.6	4.65	301	
	Anion Sum (meq/L)	9.69	3.20	3.17	9.69	
	Cation Sum (meq/L)	9.74	3.35	3.24	9.50	
	Cation - Anion Balance (%)	0.2	2.3	1.1	-1.0	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0024	0.0013	0.0013	0.0020	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00017	0.00011	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00028	0.00089	<0.00010	0.00024	
	Barium (Ba)-Dissolved (mg/L)	0.0250	0.0638	0.0189	0.0242	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.156	0.420	0.178	0.158	
	Cadmium (Cd)-Dissolved (mg/L)	0.000143	<0.0000050	0.0000850	<0.00015 DLM	
	Calcium (Ca)-Dissolved (mg/L)	116	38.7	50.1	114	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00024	<0.00010	<0.00010	0.00024	
	Copper (Cu)-Dissolved (mg/L)	0.00911	<0.00020	0.00210	0.00732	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.138	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0172	0.0036	0.0012	0.0172	
	Magnesium (Mg)-Dissolved (mg/L)	27.9	11.6	5.76	27.0	
	Manganese (Mn)-Dissolved (mg/L)	0.694	0.0825	0.00235	0.663	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2232404-1	L2232404-2	L2232404-3	L2232404-4	
	Description	Water	Water	Water	Water	
	Sampled Date	08-FEB-19	08-FEB-19	08-FEB-19	08-FEB-19	
	Sampled Time	10:55	13:55	14:30		
	Client ID	MW12-07-02	MW09-03-01	MW09-03-02	DUP	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0264	0.00574	0.00427	0.0262	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00082	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.86	1.98	2.08	2.71	
	Selenium (Se)-Dissolved (mg/L)	0.000511	0.000082	0.000194	0.000631	
	Silicon (Si)-Dissolved (mg/L)	6.36	5.34	5.17	6.32	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	36.4	9.35	4.93	34.7	
	Strontium (Sr)-Dissolved (mg/L)	3.36	0.957	0.301	3.33	
	Sulfur (S)-Dissolved (mg/L)	102	6.12	1.62	103	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.00338	0.000908	0.00222	0.00343	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0570	0.0327	0.0493	0.0524	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<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	Boron (B)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2232404-1, -2, -3, -4
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2232404-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-02-13 A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2232404-COFC

COC Number: 2019-02-13 A

Page 1 of 1

Report To	Contact and companyname below will appear on the final report	Report Format / Distribution	Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply
Company:	Minto Explorations Ltd.	Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4] ☐ / 3 day [P3] ☐ / 2 day [P2] ☐ — EMERGENCY: 1 Business day [E1] ☐ / Same Day, Weekend or Statutory holiday [E0] ☐
Phone:	1-604-759-4659	☑ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	2100-510 West Georgia St.	Email 1 or Fax: mintoenvironment@mintomine.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Vancouver, British Columbia	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	V6B 0M3	Email 3	
Invoice To	Same as Report To ☐ YES ☑ NO	**Invoice Distribution**	Analysis Request
	Copy of Invoice with Report ☐ YES ☑ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	Minto Explorations Ltd.	Email 1 or Fax: ap@mintomine.com	
Contact:	Ruth Cayetano	Email 2	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	229097 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		**ALS Contact:**	**Sampler:** CR/IS

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)	Number of Containers
					P	F/P	P	F/P	P	F/P			
	MW12-07-02	8-Feb-19	10:35	Water		R		R	R		R		4
	MW09-03-01	8-Feb-19	13:55	Water		R		R	R		R		4
	MW09-03-02	8-Feb-19	14:30	Water		R		R	R		R		4
	DUP	8-Feb-19		Water		R		R	R		R		4

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice Packs	☑	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
5.0			7°C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-02-13	Time:	Received by: EF	Date: 13 Feb 2019	Time: 13:30	Received by:	Date: Feb 14, 2019	Time: 1:16pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-FEB-19
Report Date: 01-MAR-19 17:23 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2234945

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-02-20 A 1 of 2, 2019-02-20 A 2 of 2
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2234945-1 Water 14-FEB-19 10:45 MW12-05-01	L2234945-2 Water 14-FEB-19 11:45 MW12-05-02	L2234945-3 Water 14-FEB-19 14:05 MW12-05-03	L2234945-4 Water 14-FEB-19 14:40 MW12-05-04	L2234945-5 Water 14-FEB-19 15:30 MW12-05-05
WATER						
Physical Tests	Conductivity (uS/cm)	2270	2130	1800	517	518
	Hardness (as CaCO3) (mg/L)	1080	1150	934	245	261
	pH (pH)	7.93	8.10	8.03	8.02	7.95
	Total Suspended Solids (mg/L)	6.6	9.4	7.8	<3.0	<3.0
	TDS (Calculated) (mg/L)	1940	1830	1450	296	300
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	125	184	249	241	231
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	125	184	249	241	231
	Ammonia, Total (as N) (mg/L)	0.0133	0.0262	0.0189	0.0114	0.0136
	Chloride (Cl) (mg/L)	14.1	12.5	9.2	5.01	5.05
	Nitrate and Nitrite (as N) (mg/L)	<0.051	<0.025	<0.025	<0.0051	0.0237
	Nitrate (as N) (mg/L)	<0.050 DLDS	<0.025 DLDS	<0.025 DLDS	<0.0050	0.0060
	Nitrite (as N) (mg/L)	0.042	0.0227	<0.0050 DLDS	<0.0010	0.0176
	Sulfate (SO4) (mg/L)	1270	1120	846	44.4	51.9
	Anion Sum (meq/L)	29.3	27.4	22.8	5.88	5.83
	Cation Sum (meq/L)	29.2	30.2	23.9	5.84	6.02
	Cation - Anion Balance (%)	-0.1	4.9	2.2	-0.3	1.5
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0047	0.0052	0.0039	0.0022	0.0020
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00053	0.00037	0.00020	0.00010	0.00013
	Barium (Ba)-Dissolved (mg/L)	0.0338	0.0718	0.0437	0.0443	0.0711
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 DLA	<0.000040 DLA	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 DLA	<0.00010 DLA	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.079	0.080	0.066	0.029	0.028
	Cadmium (Cd)-Dissolved (mg/L)	0.000026	<0.000010 DLA	<0.0000050	0.0000176	0.0000086
	Calcium (Ca)-Dissolved (mg/L)	361	356	237	50.1	54.9
	Chromium (Cr)-Dissolved (mg/L)	0.00034	<0.00020 DLA	0.00015	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00040 DLA	<0.00040 DLA	<0.00020	0.00028	0.00069
	Iron (Fe)-Dissolved (mg/L)	0.046	0.033	0.331	0.043	0.075
	Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.00010 DLA	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0078	0.0053	0.0042	0.0032	0.0036
	Magnesium (Mg)-Dissolved (mg/L)	42.8	63.6	82.9	29.2	30.1
	Manganese (Mn)-Dissolved (mg/L)	0.164	0.849	2.24	0.144	0.158

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2234945-6	L2234945-7	L2234945-8	L2234945-9	L2234945-10
Description	Water	Water	Water	Water	Water
Sampled Date	14-FEB-19	14-FEB-19	15-FEB-19	15-FEB-19	15-FEB-19
Sampled Time	15:50	16:30	10:25	11:00	11:35
Client ID	MW12-05-06	MW12-05-07	MW17-12-01	MW17-12-02	MW17-12-03
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	519	542	2480	2190	853
Hardness (as CaCO3) (mg/L)	258	263	938	757	348
pH (pH)	7.97	7.96	7.76	7.78	7.93
Total Suspended Solids (mg/L)	<3.0	3.0	9.2	10.8	<3.0
TDS (Calculated) (mg/L)	303	315	2050	1740	535
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	233	243	210	229	363
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	233	243	210	229	363
Ammonia, Total (as N) (mg/L)	0.0061	0.322	0.0050	<0.0050	<0.0050
Chloride (Cl) (mg/L)	4.89	4.71	13.0	11.7	<2.5 DLDS
Nitrate and Nitrite (as N) (mg/L)	0.0631	<0.0051	<0.051	<0.051	<0.025
Nitrate (as N) (mg/L)	0.0559	<0.0050	<0.050 DLDS	<0.050 DLDS	<0.025 DLDS
Nitrite (as N) (mg/L)	0.0072	0.0015	<0.010 DLDS	<0.010 DLDS	<0.0050 DLDS
Sulfate (SO4) (mg/L)	53.7	56.2	1320	1070	128
Anion Sum (meq/L)	5.92	6.16	32.1	27.2	9.93
Cation Sum (meq/L)	5.99	6.17	29.6	25.6	9.96
Cation - Anion Balance (%)	0.6	0.1	-4.1	-3.2	0.2
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0024	0.0019	0.0024	0.0028	0.0024
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 DLA	<0.00020 DLA	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00017	0.00165	0.00274	0.00242	0.00163
Barium (Ba)-Dissolved (mg/L)	0.0582	0.0887	0.00719	0.00638	0.0158
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	0.000084	0.000045	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA	<0.000050
Boron (B)-Dissolved (mg/L)	0.028	0.025	0.180	0.160	0.060
Cadmium (Cd)-Dissolved (mg/L)	0.0000231	0.0000070	0.000018	0.000021	0.0000111
Calcium (Ca)-Dissolved (mg/L)	54.9	57.8	289	229	84.7
Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00049	<0.00020 DLA	<0.00020 DLA	<0.00010
Cobalt (Co)-Dissolved (mg/L)	0.00013	0.00010	<0.00020 DLA	<0.00020 DLA	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00118	0.00034	<0.00040 DLA	<0.00040 DLA	<0.00020
Iron (Fe)-Dissolved (mg/L)	0.018	1.20	2.78	1.98	0.132
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0034	0.0032	0.0146	0.0141	0.0089
Magnesium (Mg)-Dissolved (mg/L)	29.5	28.8	52.3	44.6	33.1
Manganese (Mn)-Dissolved (mg/L)	0.140	0.160	0.0920	0.0486	0.0970

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2234945-11	L2234945-12	L2234945-13	L2234945-14	L2234945-15
Description	Water	Water	Water	Water	Water
Sampled Date	15-FEB-19	15-FEB-19	15-FEB-19	15-FEB-19	15-FEB-19
Sampled Time	14:10	14:35	14:50	15:10	15:25
Client ID	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07	MW17-12-08
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)	749	760	738	560	559
Hardness (as CaCO3) (mg/L)	351	381	365	279	284
pH (pH)	8.07	8.05	8.04	8.06	8.15
Total Suspended Solids (mg/L)	<3.0	<3.0	3.8	<3.0	<3.0
TDS (Calculated) (mg/L)	448	461	440	314	326
Anions and Nutrients Alkalinity, Bicarbonate (as CaCO3) (mg/L)	327	349	322	217	233
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	327	349	322	217	233
Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloride (Cl) (mg/L)	1.76	2.53	2.71	4.66	4.65
Nitrate and Nitrite (as N) (mg/L)	0.224	0.218	0.246	0.692	0.702
Nitrate (as N) (mg/L)	0.223	0.218	0.246	0.692	0.702
Nitrite (as N) (mg/L)	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
Sulfate (SO4) (mg/L)	99.5	92.5	92.0	64.7	64.2
Anion Sum (meq/L)	8.67	8.99	8.45	5.86	6.16
Cation Sum (meq/L)	8.66	9.11	8.80	6.58	6.73
Cation - Anion Balance (%)	-0.1	0.6	2.0	5.8	4.4
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0053	0.0027	0.0026	0.0023	0.0019
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00019	0.00014	0.00016	0.00014	0.00016
Barium (Ba)-Dissolved (mg/L)	0.0225	0.0643	0.0548	0.0216	0.0231
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.043	0.039	0.037	0.029	0.032
Cadmium (Cd)-Dissolved (mg/L)	0.0000542	<0.000040 DLM	<0.000040 DLM	0.0000188	0.0000213
Calcium (Ca)-Dissolved (mg/L)	64.3	68.7	63.9	49.8	50.9
Chromium (Cr)-Dissolved (mg/L)	0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00025	0.00022	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00091	0.00320	0.00300	0.00056	0.00076
Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0073	0.0092	0.0090	0.0060	0.0062
Magnesium (Mg)-Dissolved (mg/L)	46.1	50.8	49.8	37.6	38.1
Manganese (Mn)-Dissolved (mg/L)	0.00191	0.218	0.128	0.00187	0.00133

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2234945-16				
	Description	Water				
	Sampled Date	15-FEB-19				
	Sampled Time					
	Client ID	DUP				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	835				
	Hardness (as CaCO3) (mg/L)	361				
	pH (pH)	8.02				
	Total Suspended Solids (mg/L)	3.2				
	TDS (Calculated) (mg/L)	524				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	349				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	349				
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Chloride (Cl) (mg/L)	<2.5 DLDS				
	Nitrate and Nitrite (as N) (mg/L)	<0.025				
	Nitrate (as N) (mg/L)	<0.025 DLDS				
	Nitrite (as N) (mg/L)	<0.0050 DLDS				
	Sulfate (SO4) (mg/L)	122				
	Anion Sum (meq/L)	9.51				
	Cation Sum (meq/L)	10.2				
	Cation - Anion Balance (%)	3.4				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0036				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00158				
	Barium (Ba)-Dissolved (mg/L)	0.0157				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.065				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000097				
	Calcium (Ca)-Dissolved (mg/L)	89.0				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	<0.00020				
	Iron (Fe)-Dissolved (mg/L)	0.130				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0097				
	Magnesium (Mg)-Dissolved (mg/L)	33.7				
	Manganese (Mn)-Dissolved (mg/L)	0.0983				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2234945-1	L2234945-2	L2234945-3	L2234945-4	L2234945-5
Description	Water	Water	Water	Water	Water
Sampled Date	14-FEB-19	14-FEB-19	14-FEB-19	14-FEB-19	14-FEB-19
Sampled Time	10:45	11:45	14:05	14:40	15:30
Client ID	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05
Grouping **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000066	0.0000099
Molybdenum (Mo)-Dissolved (mg/L)	0.00021	0.00040	0.000300	0.00392	0.00485
Nickel (Ni)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	3.85	4.39	4.43	2.30	2.27
Selenium (Se)-Dissolved (mg/L)	<0.00010 DLA	0.00014	<0.000050	0.000154	<0.000050
Silicon (Si)-Dissolved (mg/L)	7.96	8.10	7.97	6.25	6.16
Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000020 DLA	0.000013	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	174	162	115	20.1	16.9
Strontium (Sr)-Dissolved (mg/L)	9.99	13.3	8.47	0.952	0.863
Sulfur (S)-Dissolved (mg/L)	487	513	282	16.5	16.9
Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000020 DLA	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00060 DLA	<0.00060 DLA	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000825	0.000858	0.000993	0.00265	0.00306
Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0034	<0.0020 DLA	0.0014	0.0014	0.0026
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2234945-6 Water 14-FEB-19 15:50 MW12-05-06	L2234945-7 Water 14-FEB-19 16:30 MW12-05-07	L2234945-8 Water 15-FEB-19 10:25 MW17-12-01	L2234945-9 Water 15-FEB-19 11:00 MW17-12-02	L2234945-10 Water 15-FEB-19 11:35 MW17-12-03
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000096	0.0000095	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00504	0.00350	0.00815	0.00828	0.00613
	Nickel (Ni)-Dissolved (mg/L)	0.00069	0.00074	<0.0010 DLA	<0.0010 DLA	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.066	<0.10 DLA	<0.10 DLA	<0.050
	Potassium (K)-Dissolved (mg/L)	2.22	2.18	3.40	3.19	3.10
	Selenium (Se)-Dissolved (mg/L)	0.000118	0.000075	<0.00010 DLA	<0.00010 DLA	<0.000050
	Silicon (Si)-Dissolved (mg/L)	6.12	7.02	7.57	7.54	8.14
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA	<0.000010
	Sodium (Na)-Dissolved (mg/L)	17.5	17.7	244	236	67.2
	Strontium (Sr)-Dissolved (mg/L)	0.873	0.846	9.54	9.53	4.00
	Sulfur (S)-Dissolved (mg/L)	17.7	18.7	487	398	41.8
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 DLA	<0.00020 DLA	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00032	<0.00060 DLA	<0.00060 DLA	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00345	0.00140	0.000234	0.000473	0.00386
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0010 DLA	<0.0010 DLA	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0129	0.0050	0.0223	0.0418	0.0294
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2234945-11	L2234945-12	L2234945-13	L2234945-14	L2234945-15
Description	Water	Water	Water	Water	Water
Sampled Date	15-FEB-19	15-FEB-19	15-FEB-19	15-FEB-19	15-FEB-19
Sampled Time	14:10	14:35	14:50	15:10	15:25
Client ID	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07	MW17-12-08
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	0.0000067	0.0000061	0.0000070	0.0000079
Molybdenum (Mo)-Dissolved (mg/L)	0.00562	0.0196	0.0224	0.00672	0.00811
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00363	0.00286	<0.00050	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	3.19	4.48	4.49	2.81	2.91
Selenium (Se)-Dissolved (mg/L)	0.000683	0.000213	0.000233	0.000268	0.000288
Silicon (Si)-Dissolved (mg/L)	7.15	6.86	7.03	6.55	6.75
Silver (Ag)-Dissolved (mg/L)	0.000019	<0.000010	<0.000010	0.000012	<0.000010
Sodium (Na)-Dissolved (mg/L)	36.2	31.6	32.1	21.4	22.5
Strontium (Sr)-Dissolved (mg/L)	1.42	1.77	1.58	1.12	1.10
Sulfur (S)-Dissolved (mg/L)	34.3	30.6	31.0	21.2	21.6
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	0.00048	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00368	0.00334	0.00344	0.00246	0.00241
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00055	0.00065	0.00071
Zinc (Zn)-Dissolved (mg/L)	0.0300	0.0497	0.0470	0.0471	0.165
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2234945-16				
	Description	Water				
	Sampled Date	15-FEB-19				
	Sampled Time					
	Client ID	DUP				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000072				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00604				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	3.17				
	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	8.25				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	66.3				
	Strontium (Sr)-Dissolved (mg/L)	3.89				
	Sulfur (S)-Dissolved (mg/L)	41.7				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00387				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0247				
	Zirconium (Zr)-Dissolved (mg/L)	<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)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
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**
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-02-20 A 1 of 2 2019-02-20 A 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2234945-COFC

COC Number: 2019-02-20 A

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax mintoenvironment@mintomine.com
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax ap@mintomine.com
Email 2

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	229097 (GW)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:** CR/CB

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P	F/P	P	F/P	P	F/P								Number of Containers
					Total Metals(TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						
	MW12-05-01	14-Feb-19	10:45	Water		R		R	R		R							4
	MW12-05-02	14-Feb-19	11:45	Water		R		R	R		R							4
	MW12-05-03	14-Feb-19	14:05	Water		R		R	R		R							4
	MW12-05-04	14-Feb-19	14:40	Water		R		R	R		R							4
	MW12-05-05	14-Feb-19	15:30	Water		R		R	R		R							4
	MW12-05-06	14-Feb-19	15:50	Water		R		R	R		R							4
	MW12-05-07	14-Feb-19	16:30	Water		R		R	R		R							4
	MW17-12-01	15-Feb-19	10:25	Water		R		R	R		R							4
	MW17-12-02	15-Feb-19	11:00	Water		R		R	R		R							4
	MW17-12-03	15-Feb-19	11:35	Water		R		R	R		R							4
	MW17-12-04	15-Feb-19	14:10	Water		R		R	R		R							4
	MW17-12-05	15-Feb-19	14:35	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C			
5°	6°				

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-02-20	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: Feb 20, 2019	Time: 14:22

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If anywater samples are taken from a Regulated Drinking Water (DW) System, please submit using anAuthorized DW COC form.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2234945-COFC

COC Number: 2019-02-20 A

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	229097 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: CR/CB

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW17-12-06	15-Feb-19	14:50	Water		R		R	R		R							4
	MW17-12-07	15-Feb-19	15:10	Water		R		R	R		R							4
	MW17-12-08	15-Feb-19	15:25	Water		R		R	R		R							4
	DUP	15-Feb-19		Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C			
5°	6°				

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-02-20	Time:	Received by:	Date: Feb 20, 2019	Time: 14:22	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 27-FEB-19
Report Date: 18-MAR-19 18:18 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2237857

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-02-27 A 1 of 2, 2019-02-27 A 2 of 2
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2237857-1 Water 23-FEB-19 10:30 MW17-11-01	L2237857-2 Water 23-FEB-19 11:05 MW17-11-02	L2237857-3 Water 23-FEB-19 11:30 MW17-11-03	L2237857-4 Water 23-FEB-19 11:50 MW17-11-04	L2237857-5 Water 23-FEB-19 14:30 MW17-08-01
WATER						
Physical Tests	Conductivity (uS/cm)	345	321	306	537	477
	Hardness (as CaCO3) (mg/L)	129	143	136	327	237
	pH (pH)	7.96	7.92	8.02	7.62	8.01
	Total Suspended Solids (mg/L)	9.2	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	189	181	162	327	258
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	138	125	147	241	227
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	138	125	147	241	227
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.145	<0.0050
	Chloride (Cl) (mg/L)	0.51	<0.50	<0.50	0.88	<0.50
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0066	0.0053	6.42	0.408
	Nitrate (as N) (mg/L)	<0.0050	0.0066	0.0053	6.42	0.408
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.0022	<0.0010
	Sulfate (SO4) (mg/L)	37.1	36.2	15.7	16.3	33.9
	Anion Sum (meq/L)	3.55	3.26	3.26	5.63	5.27
	Cation Sum (meq/L)	3.54	3.64	3.16	7.26	5.09
	Cation - Anion Balance (%)	-0.2	5.6	-1.5	12.7	-1.7
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0046	0.0021	0.0044	0.0029	0.0028
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00140	0.00075	0.00027	0.00018	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.0447	0.0430	0.0614	0.189	0.0146
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.020	0.019	<0.010	0.012	0.023
	Cadmium (Cd)-Dissolved (mg/L)	0.0000052	0.0000056	0.0000100	0.0000230	0.0000487
	Calcium (Ca)-Dissolved (mg/L)	35.2	39.5	36.3	99.0	50.0
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00030	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	0.00266	0.00036
	Iron (Fe)-Dissolved (mg/L)	0.315	0.083	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0055	0.0054	0.0040	0.0071	0.0021
	Magnesium (Mg)-Dissolved (mg/L)	9.99	10.9	10.9	19.5	27.3
	Manganese (Mn)-Dissolved (mg/L)	0.0460	0.0469	0.108	0.110	0.00171

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2237857-6 Water 23-FEB-19 15:35 MW17-08-02	L2237857-7 Water 23-FEB-19 16:00 MW17-08-03	L2237857-8 Water 23-FEB-19 DUP	L2237857-9 Water 25-FEB-19 09:00 MW12-06-02	L2237857-10 Water 25-FEB-19 09:30 MW12-06-03
WATER						
Physical Tests	Conductivity (uS/cm)	296	256	446	1010	1010
	Hardness (as CaCO3) (mg/L)	155	132	241	467	489
	pH (pH)	8.15	8.15	8.04	7.70	7.82
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	17.6	<3.0
	TDS (Calculated) (mg/L)	162	139	253	621	630
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	152	135	217	340	377
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	152	135	217	340	377
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0446	0.0849
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<2.5 DLDS	<2.5 DLDS
	Nitrate and Nitrite (as N) (mg/L)	0.678	0.768	0.415	0.134	0.058
	Nitrate (as N) (mg/L)	0.678	0.768	0.415	0.031	<0.025 DLDS
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.103	0.0580
	Sulfate (SO4) (mg/L)	10.6	4.19	33.8	211	201
	Anion Sum (meq/L)	3.30	2.84	5.07	11.2	11.7
	Cation Sum (meq/L)	3.31	2.82	5.16	11.1	11.5
	Cation - Anion Balance (%)	0.3	-0.3	1.0	-0.6	-1.2
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0019	0.0030	<0.0010	0.0015	<0.0010
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00014	<0.00010	<0.00010	0.00358	0.00057
	Barium (Ba)-Dissolved (mg/L)	0.0915	0.0897	0.00908	0.0275	0.0228
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	0.000039	0.000022
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.010	<0.010	0.022	0.139	0.130
	Cadmium (Cd)-Dissolved (mg/L)	0.0000099	0.0000112	0.0000466	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	36.9	33.7	49.9	128	111
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00022
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00225	0.00044	0.00027	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	1.07	0.928
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	0.0020	0.0079	0.0076
	Magnesium (Mg)-Dissolved (mg/L)	15.2	11.6	28.3	35.8	51.5
	Manganese (Mn)-Dissolved (mg/L)	0.00084	0.00016	0.00046	0.0252	0.0147

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2237857-11	L2237857-12	L2237857-13	L2237857-14	
	Description	Water	Water	Water	Water	
	Sampled Date	25-FEB-19	25-FEB-19	25-FEB-19	25-FEB-19	
	Sampled Time	10:05	10:25	10:50		
	Client ID	MW12-06-04	MW12-06-05	MW12-06-06	DUP	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1000	1020	849	1020	
	Hardness (as CaCO3) (mg/L)	510	508	413	509	
	pH (pH)	7.84	7.78	7.92	7.82	
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	
	TDS (Calculated) (mg/L)	624	541	513	639	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	395	397	309	371	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	395	397	309	371	
	Ammonia, Total (as N) (mg/L)	0.0119	0.0059	0.0051	0.0367	
	Chloride (Cl) (mg/L)	<2.5 DLDS	<2.5 DLDS	7.6	<2.5 DLDS	
	Nitrate and Nitrite (as N) (mg/L)	0.068	0.040	0.941	0.072	
	Nitrate (as N) (mg/L)	<0.025 DLDS	<0.025 DLDS	0.895	<0.025 DLDS	
	Nitrite (as N) (mg/L)	0.0677	0.0402	0.0459	0.0723	
	Sulfate (SO4) (mg/L)	181	98.3	148	207	
	Anion Sum (meq/L)	11.7	9.98	9.55	11.7	
	Cation Sum (meq/L)	11.9	11.8	9.76	11.9	
	Cation - Anion Balance (%)	1.0	8.5	1.1	0.9	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0021	<0.0010	<0.0010	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00261	0.00068	<0.00010	0.00055	
	Barium (Ba)-Dissolved (mg/L)	0.0167	0.0393	0.0130	0.0202	
	Beryllium (Be)-Dissolved (mg/L)	0.000035	<0.000020	<0.000020	0.000024	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.109	0.126	0.063	0.073	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000078	0.0000163	0.0000139	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	104	104	78.7	110	
	Chromium (Cr)-Dissolved (mg/L)	0.00021	<0.00010	<0.00010	0.00015	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00116	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Iron (Fe)-Dissolved (mg/L)	0.841	0.122	<0.010	1.22	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0067	0.0065	0.0052	0.0077	
	Magnesium (Mg)-Dissolved (mg/L)	60.7	60.3	52.6	56.9	
	Manganese (Mn)-Dissolved (mg/L)	0.0424	0.421	0.0282	0.0147	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2237857-1	L2237857-2	L2237857-3	L2237857-4	L2237857-5
Description	Water	Water	Water	Water	Water
Sampled Date	23-FEB-19	23-FEB-19	23-FEB-19	23-FEB-19	23-FEB-19
Sampled Time	10:30	11:05	11:30	11:50	14:30
Client ID	MW17-11-01	MW17-11-02	MW17-11-03	MW17-11-04	MW17-08-01
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.0135	0.00594	0.00419	0.0111	0.00870
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00377	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	1.98	2.15	2.15	6.04	1.57
Selenium (Se)-Dissolved (mg/L)	0.00125	<0.000050	<0.000050	0.000296	0.000938
Silicon (Si)-Dissolved (mg/L)	5.34	5.31	4.82	10.5	5.30
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000013	0.000011
Sodium (Na)-Dissolved (mg/L)	20.4	16.5	9.09	12.7	7.14
Strontium (Sr)-Dissolved (mg/L)	0.901	0.968	0.894	1.13	6.12
Sulfur (S)-Dissolved (mg/L)	13.6	14.6	5.94	7.24	12.7
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000154	0.000284	0.00161	0.00491	0.000308
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0094	0.0166	0.0146	0.0438	0.0383
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2237857-6	L2237857-7	L2237857-8	L2237857-9	L2237857-10
Description	Water	Water	Water	Water	Water
Sampled Date	23-FEB-19	23-FEB-19	23-FEB-19	25-FEB-19	25-FEB-19
Sampled Time	15:35	16:00		09:00	09:30
Client ID	MW17-08-02	MW17-08-03	DUP	MW12-06-02	MW12-06-03
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00296	0.000906	0.00861	0.00879	0.00140
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	0.92	0.96	1.57	3.40	3.79
Selenium (Se)-Dissolved (mg/L)	0.000727	0.000557	0.000847	0.000314	0.000331
Silicon (Si)-Dissolved (mg/L)	4.65	4.41	5.12	10.0	9.44
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	4.63	3.63	7.09	36.8	35.3
Strontium (Sr)-Dissolved (mg/L)	0.981	0.653	6.37	9.30	4.44
Sulfur (S)-Dissolved (mg/L)	4.15	1.92	12.8	74.7	70.1
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00012
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000162	0.000131	0.000245	0.00257	0.00211
Vanadium (V)-Dissolved (mg/L)	0.00075	0.00065	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0095	0.0120	0.0218	0.0047	0.0022
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2237857-11	L2237857-12	L2237857-13	L2237857-14	
Description	Water	Water	Water	Water	
Sampled Date	25-FEB-19	25-FEB-19	25-FEB-19	25-FEB-19	
Sampled Time	10:05	10:25	10:50		
Client ID	MW12-06-04	MW12-06-05	MW12-06-06	DUP	
Grouping **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved (mg/L)	0.00826	0.00921	0.00577	0.00342	
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00063	<0.00050	<0.00050	
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved (mg/L)	3.91	3.94	3.61	4.10	
Selenium (Se)-Dissolved (mg/L)	0.000207	0.000161	0.000377	0.000062	
Silicon (Si)-Dissolved (mg/L)	9.07	8.69	7.10	9.57	
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved (mg/L)	35.9	35.8	32.5	36.8	
Strontium (Sr)-Dissolved (mg/L)	3.01	2.72	1.56	4.88	
Sulfur (S)-Dissolved (mg/L)	65.0	65.7	53.3	71.9	
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Uranium (U)-Dissolved (mg/L)	0.00527	0.00567	0.00382	0.00249	
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Zinc (Zn)-Dissolved (mg/L)	0.0139	0.0269	0.0163	0.0024	
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<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)
Method Blank	Alkalinity, Total (as CaCO3)	B	L2237857-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2237857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Boron (B)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2237857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2237857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2237857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2237857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2237857-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2237857-11, -12, -13, -14
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2237857-11, -12, -13, -14

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

Reference Information

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.

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.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-02-27 A 1 of 2 2019-02-27 A 2 of 2

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2237857-COFC

COC Number: 2019-02-27A

Page 1 of 2

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals (TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
					P	F/P	P	F/P	P	F/P								
	MW17-11-01	23-Feb-19	10:30	Water		R		R	R		R							4
	MW17-11-02	23-Feb-19	11:05	Water		R		R	R		R							4
	MW17-11-03	23-Feb-19	11:30	Water		R		R	R		R							4
	MW17-11-04	23-Feb-19	11:50	Water		R		R	R		R							4
	MW17-08-01	23-Feb-19	14:30	Water		R		R	R		R							4
	MW17-08-02	23-Feb-19	15:35	Water		R		R	R		R							4
	MW17-08-03	23-Feb-19	16:00	Water		R		R	R		R							4
	DUP	23-Feb-19		Water		R		R	R		R							4
	MW12-06-02	25-Feb-19	9:00	Water		R		R	R		R							4
	MW12-06-03	25-Feb-19	9:30	Water		R		R	R		R							4
	MW12-06-04	25-Feb-19	10:05	Water		R		R	R		R							4
	MW12-06-05	25-Feb-19	10:25	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations Yes ☐	No ☐
Ice Packs ☐	Ice Cubes ☐	Custody seal intact Yes ☐	No ☐
Cooling Initiated ☑			

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C	
4°			5.4	6.9

SHIPMENT RELEASE (client use)		
Released by: Chad Bustin	Date: 2019-02-27	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: Feb 27/19.	Time: 14:55

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 28/2	Time: 2:40p

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2237857-COFC

COC Number: 2019-02-27A

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice To		
	Same as Report To	☐ YES ☑ NO
	Copy of Invoice with Report	☐ YES ☑ NO
Company:	Minto Explorations Ltd.	
Contact:	Ruth Cayetano	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P	F/P	P	F/P	P	F/P								Number of Containers
					Total Metals(TM)	Disolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						
	MW12-06-06	25-Feb-19	10:50	Water		R		R	R		R							4
	DUP	25-Feb-19		Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
				5.4	6.9

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chad Bustin	Date: 2019-02-27	Time:	Received by:	Date:	Time:	Received by: LTA	Date: 28/2	Time: 2140p

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-MAR-19
Report Date: 22-MAR-19 18:07 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2245032

Project P.O. #: 232818 (GW)
Job Reference:
C of C Numbers: 2019-03-13 B
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2245032-1	L2245032-2	L2245032-3	L2245032-4	L2245032-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	09-MAR-19	09-MAR-19	09-MAR-19	09-MAR-19	09-MAR-19
	Sampled Time	10:30	12:45	13:15	13:45	15:45
	Client ID	MW12-07-02	MW17-10-01	MW17-10-02	MW17-10-03	MW09-03-1
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	823	402	457	471	304
	Hardness (as CaCO3) (mg/L)	361	178	198	199	135
	pH (pH)	8.26	8.24	8.21	8.21	8.34
	Total Suspended Solids (mg/L)	<3.0	3.6	3.6	4.8	3.4
	TDS (Calculated) (mg/L)	563	242	291	297	162
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	168	121	112	113	139
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	2.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	168	121	112	113	142
	Ammonia, Total (as N) (mg/L)	0.0105	0.0068	<0.0050	0.0053	0.0377
	Chloride (Cl) (mg/L)	5.3	0.79	1.00	1.19	<0.50
	Nitrate and Nitrite (as N) (mg/L)	0.870	10.7	27.4	28.6	0.322
	Nitrate (as N) (mg/L)	0.698	10.6	27.4	28.6	0.0154
	Nitrite (as N) (mg/L)	0.172	0.0121	0.0020	0.0017	0.307
	Sulfate (SO4) (mg/L)	289	50.1	24.2	23.6	17.6
	Anion Sum (meq/L)	9.57	4.25	4.74	4.82	3.22
	Cation Sum (meq/L)	8.73	3.98	4.29	4.31	3.16
	Cation - Anion Balance (%)	-4.6	-3.3	-4.9	-5.6	-0.9
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0021	0.0042	0.0019	0.0016	0.0052
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00016
	Arsenic (As)-Dissolved (mg/L)	0.00024	0.00016	<0.00010	0.00013	0.00084
	Barium (Ba)-Dissolved (mg/L)	0.0239	0.0247	0.0326	0.0342	0.0623
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.178	0.035	<0.010	0.011	0.362
	Cadmium (Cd)-Dissolved (mg/L)	0.0000390	0.0000788	0.0000666	0.0000389	0.0000090
	Calcium (Ca)-Dissolved (mg/L)	103	44.3	52.5	54.1	36.3
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00023	0.00040	0.00050	0.00045	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00112	0.00358	0.00113	0.00111	0.00067
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	0.255
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0154	0.0017	0.0011	0.0011	0.0034
	Magnesium (Mg)-Dissolved (mg/L)	25.0	16.3	16.3	15.5	10.7
	Manganese (Mn)-Dissolved (mg/L)	0.618	0.0388	0.00282	0.00198	0.0752

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2245032-6	L2245032-7	L2245032-8		
	Description	Water	Water	Water		
	Sampled Date	09-MAR-19	10-MAR-19	10-MAR-19		
	Sampled Time	16:30	10:50	11:45		
	Client ID	MW09-03-2	MW17-DP01	MW17-DP03		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	279	1050	1400		
	Hardness (as CaCO3) (mg/L)	128	240	518		
	pH (pH)	8.25	8.29	8.14		
	Total Suspended Solids (mg/L)	3.2	19.2	142		
	TDS (Calculated) (mg/L)	158	677	1020		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	135	209	131		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	135	209	131		
	Ammonia, Total (as N) (mg/L)	0.0093	2.15	5.12		
	Chloride (Cl) (mg/L)	0.63	25.8	27.7		
	Nitrate and Nitrite (as N) (mg/L)	3.56	<0.025	<0.025		
	Nitrate (as N) (mg/L)	3.29	<0.025 DLDS	<0.025 DLDS		
	Nitrite (as N) (mg/L)	0.270	<0.0050 DLDS	<0.0050 DLDS		
	Sulfate (SO4) (mg/L)	5.20	297	597		
	Anion Sum (meq/L)	3.08	11.1	15.8		
	Cation Sum (meq/L)	2.86	10.7	15.4		
	Cation - Anion Balance (%)	-3.6	-1.8	-1.4		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0021	<0.0010	0.0037		
	Antimony (Sb)-Dissolved (mg/L)	0.00018	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00065	0.00033		
	Barium (Ba)-Dissolved (mg/L)	0.0190	0.0212	0.0230		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.344	0.085	0.152		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000476	0.000457	0.000521		
	Calcium (Ca)-Dissolved (mg/L)	42.5	60.6	160		
	Chromium (Cr)-Dissolved (mg/L)	0.00020	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00142	0.00065		
	Copper (Cu)-Dissolved (mg/L)	0.00173	0.142	0.0413		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000059	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0011	0.0058	0.0060		
	Magnesium (Mg)-Dissolved (mg/L)	5.40	21.4	28.9		
	Manganese (Mn)-Dissolved (mg/L)	0.00250	0.912	0.886		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2245032-1	L2245032-2	L2245032-3	L2245032-4	L2245032-5
Description	Water	Water	Water	Water	Water
Sampled Date	09-MAR-19	09-MAR-19	09-MAR-19	09-MAR-19	09-MAR-19
Sampled Time	10:30	12:45	13:15	13:45	15:45
Client ID	MW12-07-02	MW17-10-01	MW17-10-02	MW17-10-03	MW09-03-1
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.0242	0.0171	0.00734	0.00688	0.00525
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00944	0.00217	0.00266	0.00113
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	2.53	1.42	1.57	1.62	1.97
Selenium (Se)-Dissolved (mg/L)	0.000450	0.000899	0.00218	0.00262	0.000073
Silicon (Si)-Dissolved (mg/L)	6.02	5.20	4.92	5.01	5.15
Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000014	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	32.9	8.89	6.56	6.61	9.14
Strontium (Sr)-Dissolved (mg/L)	3.32	1.24	0.997	0.892	0.937
Sulfur (S)-Dissolved (mg/L)	96.7	16.7	7.73	7.78	5.86
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00339	0.00238	0.00115	0.00109	0.000892
Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00094	<0.00050	0.00053	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0479	0.0243	0.0629	0.116	0.0317
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2245032-6	L2245032-7	L2245032-8		
	Description	Water	Water	Water		
	Sampled Date	09-MAR-19	10-MAR-19	10-MAR-19		
	Sampled Time	16:30	10:50	11:45		
	Client ID	MW09-03-2	MW17-DP01	MW17-DP03		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00456	0.0347	0.0272		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00565	0.00328		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.94	28.5	40.2		
	Selenium (Se)-Dissolved (mg/L)	0.000220	0.000612	0.000785		
	Silicon (Si)-Dissolved (mg/L)	4.85	2.96	4.04		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000015		
	Sodium (Na)-Dissolved (mg/L)	5.69	115	83.5		
	Strontium (Sr)-Dissolved (mg/L)	0.291	5.09	14.2		
	Sulfur (S)-Dissolved (mg/L)	1.70	101	212		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000015	0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00014	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00183	0.000469	0.000943		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0449	0.0027	0.0056		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<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	Barium (Ba)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Boron (B)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2245032-1, -2, -3, -4, -5, -6, -7, -8

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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-03-13 B

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2245032-COFC

COC Number: 2019-03-13 B

Page 1 of 2

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	
ALS Lab Work Order # (lab use only)	

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: mintoenvironment@mintomine.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: ap@mintomine.com

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Contact: Sampler: CR/IS

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)	Number of Containers
					P	F/P	P	F/P	P	F/P			
1	MW12-07-02	9-Mar-19	10:30	Water		R		R	R		R		4
2	MW17-10-01	9-Mar-19	12:45	Water		R		R	R		R		4
3	MW17-10-02	9-Mar-19	13:15	Water		R		R	R		R		4
4	MW17-10-03	9-Mar-19	13:45	Water		R		R	R		R		4
5	MW09-03-01	9-Mar-19	15:45	Water		R		R	R		R		4
6	MW09-03-02	9-Mar-19	16:30	Water		R		R	R		R		4
7	MW17-DP01	10-Mar-19	10:50	Water		R		R	R		R		4
8	MW17-DP03	10-Mar-19	11:45	Water		R		R	R		R		4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
8.0					9

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-03-13	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: EF	Date: 13 MAR 2019	Time: 14:50

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 3/14	Time: 11:40 am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-APR-19
Report Date: 03-MAY-19 16:21 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2262463

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-04-24 A
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2262463-1	L2262463-2	L2262463-3	L2262463-4	L2262463-5
Description	Water	Water	Water	Water	Water
Sampled Date	19-APR-19	19-APR-19	19-APR-19	22-APR-19	19-APR-19
Sampled Time	14:15	15:40	16:40	08:05	
Client ID	MW12-07-02	MW09-03-01	MW09-03-02	BAR-10	DUP
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	847	318	276		850
Hardness (as CaCO3) (mg/L)	384	141	126	88.7	374
pH (pH)	8.15	8.31	8.21		8.19
Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0		<3.0
TDS (Calculated) (mg/L)	572	173	154		571
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	173	148	128		176
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	4.2	<1.0		<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		<1.0
Alkalinity, Total (as CaCO3) (mg/L)	173	152	128		176
Ammonia, Total (as N) (mg/L)	0.0122	0.0476	0.0061		0.0098
Chloride (Cl) (mg/L)	5.84	<0.50	0.67		6.06
Nitrate and Nitrite (as N) (mg/L)	1.11	0.669	3.80		0.936
Nitrate (as N) (mg/L)	0.844	0.0178	3.56		0.809
Nitrite (as N) (mg/L)	0.267	0.651	0.244		0.127
Sulfate (SO4) (mg/L)	283	17.9	6.28		285
Anion Sum (meq/L)	9.59	3.45	2.97		9.69
Cation Sum (meq/L)	9.29	3.31	2.81		9.04
Cation - Anion Balance (%)	-1.6	-2.1	-2.8		-3.5
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0039	0.0019	<0.0010	0.0027	0.0022
Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00020	0.00016	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00029	0.00090	0.00010	0.00058	0.00026
Barium (Ba)-Dissolved (mg/L)	0.0232	0.0660	0.0163	0.0400	0.0241
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.174	0.483	0.296	<0.010	0.167
Cadmium (Cd)-Dissolved (mg/L)	0.0000431	0.0000115	0.0000372	<0.000045 DLM	0.0000541
Calcium (Ca)-Dissolved (mg/L)	109	38.5	41.7	23.9	106
Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00016	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	0.00030	<0.00010	<0.00010	<0.00010	0.00027
Copper (Cu)-Dissolved (mg/L)	0.00159	<0.00020	0.00137	0.0442	0.00161
Iron (Fe)-Dissolved (mg/L)	<0.010	0.284	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000100	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0164	0.0037	0.0012	0.0018	0.0169
Magnesium (Mg)-Dissolved (mg/L)	27.3	10.9	5.30	7.06	26.6
Manganese (Mn)-Dissolved (mg/L)	0.658	0.0813	0.00188	0.00108	0.659

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2262463-1	L2262463-2	L2262463-3	L2262463-4	L2262463-5
Description	Water	Water	Water	Water	Water
Sampled Date	19-APR-19	19-APR-19	19-APR-19	22-APR-19	19-APR-19
Sampled Time	14:15	15:40	16:40	08:05	
Client ID	MW12-07-02	MW09-03-01	MW09-03-02	BAR-10	DUP
Grouping **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.0217	0.00574	0.00476	0.0455	0.0240
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00052	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	2.74	1.99	1.96	3.03	2.78
Selenium (Se)-Dissolved (mg/L)	0.00067	0.000237	0.000443	0.00582	0.000705
Silicon (Si)-Dissolved (mg/L)	6.55	5.32	4.89	1.98	6.36
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000024	<0.000010
Sodium (Na)-Dissolved (mg/L)	35.0	9.69	5.48	3.76	33.8
Strontium (Sr)-Dissolved (mg/L)	2.99	0.943	0.289	1.60	3.23
Sulfur (S)-Dissolved (mg/L)	104	5.96	2.17	6.69	101
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	0.00031	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00297	0.000784	0.00157	0.00290	0.00340
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00056	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0363	0.0072	0.0230	0.0022	0.0253
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<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	Barium (Ba)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2262463-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-04-24 A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2262463-COFC

COC Number: 2019-04-24 A

Page 1 of 1

Report To	Contact and companyname below will appear on the final report	Report Format / Distribution	Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply
Company:	Minto Explorations Ltd.	Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4] ☐ / 3 day [P3] ☐ / 2 day [P2] ☐ — EMERGENCY: 1 Business day [E1] ☐ / Same Day, Weekend or Statutory holiday [E0] ☐
Phone:	1-604-759-4659	☑ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	2100-510 West Georgia St.	Email 1 or Fax mintoenvironment@mintomine.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Vancouver, British Columbia	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	V6B 0M3	Email 3	
Invoice To	Same as Report To ☐ YES ☑ NO	**Invoice Distribution**	**Analysis Request**
	Copy of Invoice with Report ☐ YES ☑ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com	
Contact:	Ruth Cayetano	Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: PM/CR

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)	Number of Containers
	MW12-07-02	19-Apr-19	14:15	Water		R		R	R		R		4
	MW09-03-01	19-Apr-19	15:40	Water		R		R	R		R		4
	MW09-03-02	19-Apr-19	16:40	Water		R		R	R		R		4
	BAR-10	22-Apr-19	8:05	Water		R		R					2
	DUP	19-Apr-19		Water		R		R	R		R		4

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C
3°			5°

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Patrick McGinty	Date: 2019-04-24	Time:	Received by:	Date: APR 24, 2019.	Time: 14:40	Received by:	Date: Apr 25	Time: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 08-MAY-19
Report Date: 17-MAY-19 14:51 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2269943

Project P.O. #: 232818 (GW)
Job Reference:
C of C Numbers: 2019-05-08 C
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2269943-1	L2269943-2	L2269943-3	L2269943-4	L2269943-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	04-MAY-19	04-MAY-19	04-MAY-19	04-MAY-19	04-MAY-19
	Sampled Time	09:45	11:50	14:10	14:30	15:10
	Client ID	MW12-05-01	MW12-05-03	MW12-05-05	MW12-05-06	MW12-05-07
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	2270	1780	523	528	537
	Hardness (as CaCO3) (mg/L)	1060	875	256	256	262
	pH (pH)	8.10	8.26	8.36	8.35	8.15
	Total Suspended Solids (mg/L)	3.8	3.6	4.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	1860	1350	301	301	315
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	124	247	231	228	245
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	5.8	5.4	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	124	247	237	233	245
	Ammonia, Total (as N) (mg/L)	0.0131	0.0184	0.0121	0.0062	0.316
	Chloride (Cl) (mg/L)	12	8.0	4.83	4.81	4.87
	Nitrate and Nitrite (as N) (mg/L)	<0.10	<0.051	0.0354	0.0673	0.0124
	Nitrate (as N) (mg/L)	<0.10 DLDS	<0.050 DLDS	0.0073	0.0455	<0.0050
	Nitrite (as N) (mg/L)	0.025	0.044	0.0282	0.0218	0.0124
	Sulfate (SO4) (mg/L)	1210	782	52.2	54.2	56.0
	Anion Sum (meq/L)	28.0	21.4	5.97	5.92	6.20
	Cation Sum (meq/L)	28.5	22.2	5.89	5.88	6.11
	Cation - Anion Balance (%)	0.9	1.6	-0.7	-0.4	-0.7
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0035	0.0035	0.0026	0.0017	0.0019
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00061	0.00017	0.00016	0.00015	0.00154
	Barium (Ba)-Dissolved (mg/L)	0.0318	0.0402	0.0681	0.0533	0.0869
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 DLA	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.081	0.073	0.044	0.048	0.043
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010 DLA	<0.0000050	0.0000064	0.0000142	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	355	223	53.2	54.7	57.5
	Chromium (Cr)-Dissolved (mg/L)	0.00022	0.00024	<0.00010	<0.00010	0.00012
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	0.00014	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00040 DLA	<0.00020	0.00083	0.00165	0.00032
	Iron (Fe)-Dissolved (mg/L)	0.043	0.411	0.074	0.014	1.31
	Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0078	0.0041	0.0037	0.0036	0.0032
	Magnesium (Mg)-Dissolved (mg/L)	42.8	77.3	29.9	29.1	28.7
	Manganese (Mn)-Dissolved (mg/L)	0.159	2.20	0.165	0.149	0.157

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2269943-6 Water 05-MAY-19 08:45 MW17-12-01	L2269943-7 Water 05-MAY-19 09:00 MW17-12-02	L2269943-8 Water 05-MAY-19 09:45 MW17-12-03	L2269943-9 Water 05-MAY-19 10:15 MW17-12-04	L2269943-10 Water 05-MAY-19 10:30 MW17-12-05
WATER						
Physical Tests	Conductivity (uS/cm)	2420	2190	836	740	738
	Hardness (as CaCO3) (mg/L)	960	793	341	345	357
	pH (pH)	7.88	7.84	8.22	8.15	8.20
	Total Suspended Solids (mg/L)	8.2	5.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	1940	1670	514	443	443
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	211	227	371	335	354
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	211	227	371	335	354
	Ammonia, Total (as N) (mg/L)	0.0058	<0.0050	<0.0050	0.0050	<0.0050
	Chloride (Cl) (mg/L)	11	<10 DLDS	<2.5 DLDS	<2.5 DLDS	<2.5 DLDS
	Nitrate and Nitrite (as N) (mg/L)	<0.10	<0.10	<0.025	0.174	0.201
	Nitrate (as N) (mg/L)	<0.10 DLDS	<0.10 DLDS	<0.025 DLDS	0.174	0.201
	Nitrite (as N) (mg/L)	<0.020 DLDS	<0.020 DLDS	<0.0050 DLDS	<0.0050 DLDS	<0.0050 DLDS
	Sulfate (SO4) (mg/L)	1210	1020	112	95.6	85.7
	Anion Sum (meq/L)	29.7	25.7	9.76	8.70	8.87
	Cation Sum (meq/L)	29.6	25.6	9.52	8.49	8.51
	Cation - Anion Balance (%)	-0.1	-0.1	-1.3	-1.2	-2.1
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0029	0.0033	0.0027	0.0025	0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00254	0.00237	0.00162	0.00020	0.00013
	Barium (Ba)-Dissolved (mg/L)	0.0100	0.00634	0.0140	0.0203	0.0606
	Beryllium (Be)-Dissolved (mg/L)	0.000085	0.000046	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 DLA	<0.00010 DLA	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.173	0.146	0.054	0.039	0.034
	Cadmium (Cd)-Dissolved (mg/L)	0.000070	0.000015	0.0000229	0.0000110	0.0000208
	Calcium (Ca)-Dissolved (mg/L)	298	242	81.9	61.3	62.6
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00010	0.00021
	Copper (Cu)-Dissolved (mg/L)	0.00052	<0.00040 DLA	<0.00020	0.00094	0.00346
	Iron (Fe)-Dissolved (mg/L)	2.82	2.04	0.130	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.00010 DLA	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0152	0.0147	0.0091	0.0071	0.0091
	Magnesium (Mg)-Dissolved (mg/L)	52.7	45.8	33.2	46.6	48.8
	Manganese (Mn)-Dissolved (mg/L)	0.0951	0.0499	0.0837	0.00244	0.199

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2269943-11 Water 06-MAY-19 10:30 MW17-12-06	L2269943-12 Water 06-MAY-19 10:55 MW17-12-07	L2269943-13 Water 06-MAY-19 11:20 MW17-12-08	L2269943-14 Water 06-MAY-19 13:40 MW12-07-02	L2269943-15 Water 04-MAY-19 DUP
WATER						
Physical Tests	Conductivity (uS/cm)	770	593	589	873	2220
	Hardness (as CaCO3) (mg/L)	366	273	274	392	1070
	pH (pH)	8.31	8.28	8.32	8.21	7.93
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	452	328	328	577	1850
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	342	249	243	171	124
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.6	<1.0	4.6	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	347	249	248	171	124
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0130	0.0272
	Chloride (Cl) (mg/L)	2.76	4.63	4.59	6.2	12
	Nitrate and Nitrite (as N) (mg/L)	0.253	0.663	0.662	1.03	<0.10
	Nitrate (as N) (mg/L)	0.251	0.663	0.662	0.895	<0.10 DLDS
	Nitrite (as N) (mg/L)	0.0018	<0.0010	<0.0010	0.135	<0.020 DLDS
	Sulfate (SO4) (mg/L)	90.1	62.8	62.6	288	1200
	Anion Sum (meq/L)	8.92	6.47	6.44	9.66	27.8
	Cation Sum (meq/L)	8.75	6.40	6.42	9.37	28.4
	Cation - Anion Balance (%)	-0.9	-0.5	-0.1	-1.5	1.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0029	0.0022	0.0019	0.0033	0.0036
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Arsenic (As)-Dissolved (mg/L)	0.00015	0.00017	0.00015	0.00029	0.00061
	Barium (Ba)-Dissolved (mg/L)	0.0476	0.0198	0.0211	0.0232	0.0305
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 DLA
	Boron (B)-Dissolved (mg/L)	0.036	0.026	0.026	0.170	0.082
	Cadmium (Cd)-Dissolved (mg/L)	0.0000227	0.0000210	0.0000241	0.000169	<0.000010 DLA
	Calcium (Ca)-Dissolved (mg/L)	64.0	49.2	49.3	113	358
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00011	<0.00010	<0.00010	0.00023
	Cobalt (Co)-Dissolved (mg/L)	0.00019	<0.00010	<0.00010	0.00027	<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)	0.00300	0.00074	0.00069	0.00275	<0.00040 DLA
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	0.045
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 DLA
	Lithium (Li)-Dissolved (mg/L)	0.0093	0.0060	0.0061	0.0167	0.0078
	Magnesium (Mg)-Dissolved (mg/L)	49.9	36.5	36.7	26.6	41.6
	Manganese (Mn)-Dissolved (mg/L)	0.119	0.00172	0.00082	0.662	0.162

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2269943-16				
	Description	Water				
	Sampled Date	06-MAY-19				
	Sampled Time					
	Client ID	DUP				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	871				
	Hardness (as CaCO3) (mg/L)	391				
	pH (pH)	8.22				
	Total Suspended Solids (mg/L)	<3.0				
	TDS (Calculated) (mg/L)	576				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	169				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	169				
	Ammonia, Total (as N) (mg/L)	0.0145				
	Chloride (Cl) (mg/L)	6.2				
	Nitrate and Nitrite (as N) (mg/L)	1.26				
	Nitrate (as N) (mg/L)	0.946				
	Nitrite (as N) (mg/L)	0.310				
	Sulfate (SO4) (mg/L)	286				
	Anion Sum (meq/L)	9.59				
	Cation Sum (meq/L)	9.44				
	Cation - Anion Balance (%)	-0.8				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0019				
	Antimony (Sb)-Dissolved (mg/L)	0.00013				
	Arsenic (As)-Dissolved (mg/L)	0.00038				
	Barium (Ba)-Dissolved (mg/L)	0.0228				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.342				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000763				
	Calcium (Ca)-Dissolved (mg/L)	112				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00025				
	Copper (Cu)-Dissolved (mg/L)	0.00182				
	Iron (Fe)-Dissolved (mg/L)	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0165				
	Magnesium (Mg)-Dissolved (mg/L)	26.9				
	Manganese (Mn)-Dissolved (mg/L)	0.672				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2269943-1 Water 04-MAY-19 09:45 MW12-05-01	L2269943-2 Water 04-MAY-19 11:50 MW12-05-03	L2269943-3 Water 04-MAY-19 14:10 MW12-05-05	L2269943-4 Water 04-MAY-19 14:30 MW12-05-06	L2269943-5 Water 04-MAY-19 15:10 MW12-05-07
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00020	0.000230	0.00489	0.00452	0.00307
	Nickel (Ni)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	0.00051	0.00082	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.10 DLA	<0.050	<0.050	<0.050	0.073
	Potassium (K)-Dissolved (mg/L)	3.53	3.90	2.08	2.00	2.02
	Selenium (Se)-Dissolved (mg/L)	0.00951	0.00408	0.000727	0.000600	0.000487
	Silicon (Si)-Dissolved (mg/L)	7.70	7.95	6.42	6.28	7.02
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	164	103	16.2	16.1	16.8
	Strontium (Sr)-Dissolved (mg/L)	9.96	8.37	0.876	0.843	0.801
	Sulfur (S)-Dissolved (mg/L)	500	317	19.1	19.5	20.0
	Thallium (Tl)-Dissolved (mg/L)	0.000050	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 DLA	<0.00030	<0.00030	<0.00030	0.00030
	Uranium (U)-Dissolved (mg/L)	0.000908	0.00128	0.00343	0.00374	0.00146
	Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0020 DLA	0.0032	0.0089	0.0216	0.0075
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2269943-6	L2269943-7	L2269943-8	L2269943-9	L2269943-10
Description	Water	Water	Water	Water	Water
Sampled Date	05-MAY-19	05-MAY-19	05-MAY-19	05-MAY-19	05-MAY-19
Sampled Time	08:45	09:00	09:45	10:15	10:30
Client ID	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05
Grouping **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00744	0.00764	0.00556	0.00497	0.0166
Nickel (Ni)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.00050	0.00331
Phosphorus (P)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	3.36	3.20	2.86	2.88	3.95
Selenium (Se)-Dissolved (mg/L)	0.00096	0.00093	0.000647	0.000965	0.000643
Silicon (Si)-Dissolved (mg/L)	7.70	7.75	8.01	7.24	7.16
Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000020 DLA	<0.000010	0.000026	<0.000010
Sodium (Na)-Dissolved (mg/L)	233	221	60.1	35.0	28.9
Strontium (Sr)-Dissolved (mg/L)	9.75	9.74	3.70	1.37	1.67
Sulfur (S)-Dissolved (mg/L)	483	381	42.3	36.4	32.7
Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000020 DLA	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00060 DLA	<0.00060 DLA	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000270	0.000519	0.00413	0.00394	0.00376
Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0538	0.0893	0.0648	0.0477	0.0488
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2269943-11 Water 06-MAY-19 10:30 MW17-12-06	L2269943-12 Water 06-MAY-19 10:55 MW17-12-07	L2269943-13 Water 06-MAY-19 11:20 MW17-12-08	L2269943-14 Water 06-MAY-19 13:40 MW12-07-02	L2269943-15 Water 04-MAY-19 DUP
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0197	0.00594	0.00712	0.0233	0.00023
	Nickel (Ni)-Dissolved (mg/L)	0.00274	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10 DLA
	Potassium (K)-Dissolved (mg/L)	4.17	2.54	2.56	2.67	3.57
	Selenium (Se)-Dissolved (mg/L)	0.000515	0.000686	0.000569	0.00105	0.00887
	Silicon (Si)-Dissolved (mg/L)	7.31	6.68	6.56	6.44	7.58
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000010	<0.000010	<0.000010	<0.000020 DLA
	Sodium (Na)-Dissolved (mg/L)	30.7	20.1	20.1	33.0	161
	Strontium (Sr)-Dissolved (mg/L)	1.51	0.977	0.971	3.27	9.87
	Sulfur (S)-Dissolved (mg/L)	32.8	22.9	22.2	104	485
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00060 DLA
	Uranium (U)-Dissolved (mg/L)	0.00378	0.00270	0.00276	0.00355	0.000937
	Vanadium (V)-Dissolved (mg/L)	0.00051	0.00059	0.00063	<0.00050	<0.0010 DLA
	Zinc (Zn)-Dissolved (mg/L)	0.107	0.0957	0.0601	0.0701	0.0026
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2269943-16				
	Description	Water				
	Sampled Date	06-MAY-19				
	Sampled Time					
	Client ID	DUP				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0235				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	2.69				
	Selenium (Se)-Dissolved (mg/L)	0.00208				
	Silicon (Si)-Dissolved (mg/L)	6.35				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	35.0				
	Strontium (Sr)-Dissolved (mg/L)	3.27				
	Sulfur (S)-Dissolved (mg/L)	104				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.00350				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0778				
	Zirconium (Zr)-Dissolved (mg/L)	<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)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.

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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-05-08 C

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2269943-COFC

COC Number: 2019-05-08 C

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: CR/IS

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P	F/P	P	F/P	P	F/P								Number of Containers
					Total Metals(TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						
	MW12-05-01	4-May-19	9:45	Water		R		R	R		R							4
	MW12-05-03	4-May-19	11:50	Water		R		R	R		R							4
	MW12-05-05	4-May-19	14:10	Water		R		R	R		R							4
	MW12-05-06	4-May-19	14:30	Water		R		R	R		R							4
	MW12-05-07	4-May-19	15:10	Water		R		R	R		R							4
	MW17-12-01	5-May-19	8:45	Water		R		R	R		R							4
	MW17-12-02	5-May-19	9:00	Water		R		R	R		R							4
	MW17-12-03	5-May-19	9:45	Water		R		R	R		R							4
	MW17-12-04	5-May-19	10:15	Water		R		R	R		R							4
	MW17-12-05	5-May-19	10:30	Water		R		R	R		R							4
	MW17-12-06	6-May-19	10:30	Water		R		R	R		R							4
	MW17-12-07	6-May-19	10:55	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☑ NO

Are samples for human drinking water use?
☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C			
13°	14°				9

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-05-08	Time:	Received by:	Date:	Time:	Received by: HA	Date: 5/9	Time: 11:30am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2269943-COFC

COC Number: 2019-05-08 C

Page 2 of 2

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:** CR/IS

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW17-12-08	6-May-19	11:20	Water		R		R	R		R							4
	MW12-07-02	6-May-19	13:40	Water		R		R	R		R							4
	DUP	4-May-19		Water		R		R	R		R							4
	DUP	6-May-19		Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
13	14				9

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-05-08	Time:	Received by:	Date:	Time:	Received by: HR	Date: 5/9	Time: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-MAY-19
Report Date: 04-JUN-19 11:39 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2274002

Project P.O. #: 232818 (GW)
Job Reference:
C of C Numbers: 2019-05-15A
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274002-1	L2274002-2	L2274002-3	L2274002-4	L2274002-5
Description	Water	Water	Water	Water	Water
Sampled Date	09-MAY-19	09-MAY-19	09-MAY-19	09-MAY-19	09-MAY-19
Sampled Time	13:30	14:30	14:45	15:00	15:25
Client ID	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	990	1010	1020	987	1020
Hardness (as CaCO3) (mg/L)	441	475	503	516	512
pH (pH)	7.78	8.06	8.14	8.19	8.07
Total Suspended Solids (mg/L)	<3.0	43.6	<3.0	<3.0	3.8
TDS (Calculated) (mg/L)	537	642	647	625	641
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	501	364	384	393	410
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	501	364	384	393	410
Ammonia, Total (as N) (mg/L)	0.0682	0.0472	0.0315	0.0071	0.0076
Chloride (Cl) (mg/L)	5.2	<2.5 DLDS	<2.5 DLDS	<2.5 DLDS	<2.5 DLDS
Nitrate and Nitrite (as N) (mg/L)	0.265	0.092	0.109	0.058	0.038
Nitrate (as N) (mg/L)	0.059	<0.025 DLDS	0.026	<0.025 DLDS	<0.025 DLDS
Nitrite (as N) (mg/L)	0.206	0.0922	0.0839	0.0578	0.0384
Sulfate (SO4) (mg/L)	<1.5 DLDS	218	209	183	189
Anion Sum (meq/L)	10.2	11.8	12.0	11.7	12.1
Cation Sum (meq/L)	11.9	11.2	11.8	11.9	11.8
Cation - Anion Balance (%)	7.6	-2.8	-0.8	1.1	-1.4
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0243	0.0029	0.0011	0.0014	0.0013
Antimony (Sb)-Dissolved (mg/L)	0.00016	<0.00020 DLA	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00780	0.00349	0.00053	0.00226	0.00052
Barium (Ba)-Dissolved (mg/L)	0.385	0.0307	0.0233	0.0175	0.0392
Beryllium (Be)-Dissolved (mg/L)	0.000160	<0.000040 DLA	0.000028	0.000025	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.213	0.181	0.086	0.097	0.067
Cadmium (Cd)-Dissolved (mg/L)	0.0000091	<0.000010 DLA	<0.0000050	<0.0000050	0.0000074
Calcium (Ca)-Dissolved (mg/L)	132	126	110	106	111
Chromium (Cr)-Dissolved (mg/L)	0.00491	<0.00020 DLA	0.00022	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	0.00113
Copper (Cu)-Dissolved (mg/L)	0.00026	0.00048	<0.00020	<0.00020	<0.00020
Iron (Fe)-Dissolved (mg/L)	0.434	1.04	1.06	0.805	0.113
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0111	0.0084	0.0073	0.0066	0.0063
Magnesium (Mg)-Dissolved (mg/L)	26.9	38.7	55.7	61.1	57.0
Manganese (Mn)-Dissolved (mg/L)	0.302	0.0268	0.0153	0.0434	0.385

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2274002-6	L2274002-7	L2274002-8	L2274002-9	L2274002-10
	Description	Water	Water	Water	Water	Water
	Sampled Date	09-MAY-19	10-MAY-19	10-MAY-19	10-MAY-19	10-MAY-19
	Sampled Time	16:00	09:00	09:50	10:05	13:30
	Client ID	MW12-06-06	MW17-08-01	MW17-08-02	MW17-08-03	MW17-11-01
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	858	470	310	271	345
	Hardness (as CaCO3) (mg/L)	424	256	161	135	136
	pH (pH)	8.21	8.32	8.31	8.24	8.32
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	5.6
	TDS (Calculated) (mg/L)	532	267	170	145	196
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	321	223	154	142	135
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	6.4	4.8	<1.0	5.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	321	230	159	142	141
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	0.0062
	Chloride (Cl) (mg/L)	8.3	<0.50	<0.50	<0.50	0.53
	Nitrate and Nitrite (as N) (mg/L)	1.01	0.452	0.693	0.790	0.0074
	Nitrate (as N) (mg/L)	0.917	0.445	0.689	0.789	0.0057
	Nitrite (as N) (mg/L)	0.0961	0.0068	0.0035	0.0010	0.0018
	Sulfate (SO4) (mg/L)	155	35.7	11.5	4.53	38.5
	Anion Sum (meq/L)	9.95	5.37	3.47	2.98	3.62
	Cation Sum (meq/L)	10.0	5.50	3.48	2.90	3.79
	Cation - Anion Balance (%)	0.4	1.2	0.2	-1.4	2.2
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	<0.0010	0.0021	0.0051	0.0050
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00011	0.00012	0.00028	0.00017	0.00151
	Barium (Ba)-Dissolved (mg/L)	0.0140	0.00726	0.0915	0.0831	0.0444
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.075	0.032	0.012	<0.010	0.022
	Cadmium (Cd)-Dissolved (mg/L)	0.0000093	0.0000159	0.0000150	0.0000151	0.0000298
	Calcium (Ca)-Dissolved (mg/L)	79.8	50.0	37.3	34.7	36.6
	Chromium (Cr)-Dissolved (mg/L)	0.00011	<0.00010	0.00010	0.00021	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00023	0.00239	0.00073	0.00030
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	0.288
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0048	0.0020	<0.0010	<0.0010	0.0056
	Magnesium (Mg)-Dissolved (mg/L)	54.5	31.8	16.6	11.8	10.8
	Manganese (Mn)-Dissolved (mg/L)	0.0331	0.00178	0.00071	0.00041	0.0454

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274002-11	L2274002-12	L2274002-13	L2274002-14	L2274002-15
Description	Water	Water	Water	Water	Water
Sampled Date	10-MAY-19	10-MAY-19	10-MAY-19	10-MAY-19	11-MAY-19
Sampled Time	14:15	14:30	15:20	15:50	15:05
Client ID	MW17-11-02	MW17-11-03	MW17-11-04	MW17-11-05	MW09-03-01
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	357	320	532	1250	315
Hardness (as CaCO3) (mg/L)	149	139	256	972	147
pH (pH)	8.29	8.35	8.24	7.41	8.31
Total Suspended Solids (mg/L)	<3.0	<3.0	4.0	<3.0	<3.0
TDS (Calculated) (mg/L)	203	169	301	903	169
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	141	144	245	584	143
Alkalinity, Carbonate (as CaCO3) (mg/L)	3.4	6.0	<1.0	<1.0	4.6
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	144	150	245	584	147
Ammonia, Total (as N) (mg/L)	0.0061	<0.0050	0.0513	0.0594	0.0349
Chloride (Cl) (mg/L)	<0.50	<0.50	0.98	<2.5 DLDS	<0.50
Nitrate and Nitrite (as N) (mg/L)	0.0055	0.0079	6.48	30.3	0.0691
Nitrate (as N) (mg/L)	0.0055	0.0079	6.47	29.7	0.0127
Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0022	0.510	0.0563
Sulfate (SO4) (mg/L)	43.4	18.6	18.8	11.8	17.9
Anion Sum (meq/L)	3.78	3.39	5.79	14.1	3.32
Cation Sum (meq/L)	3.83	3.24	5.64	20.9	3.37
Cation - Anion Balance (%)	0.6	-2.3	-1.2	19.4	0.8
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0033	0.0066	0.0087	0.0016	0.0031
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00034	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00077	0.00031	0.00017	0.00026	0.00090
Barium (Ba)-Dissolved (mg/L)	0.0426	0.0609	0.166	0.992	0.0682
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.018	0.011	<0.010	0.019	0.133
Cadmium (Cd)-Dissolved (mg/L)	0.0000189	0.0000105	0.0000188	0.0000381	0.0000085
Calcium (Ca)-Dissolved (mg/L)	40.8	36.4	74.1	338	40.4
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00017	0.00095	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00021	<0.00020	0.00176	0.00493	<0.00020
Iron (Fe)-Dissolved (mg/L)	0.094	0.013	0.018	<0.010	0.351
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0053	0.0046	0.0059	0.0195	0.0036
Magnesium (Mg)-Dissolved (mg/L)	11.5	11.6	17.2	30.9	11.2
Manganese (Mn)-Dissolved (mg/L)	0.0515	0.0945	0.109	0.0229	0.0827

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274002-16	L2274002-17	L2274002-18	L2274002-19	
Description	Water	Water	Water	Water	
Sampled Date	11-MAY-19	09-MAY-19	10-MAY-19	10-MAY-19	
Sampled Time	15:40				
Client ID	MW09-03-02	DUP	DUP	DUP	
Grouping	**Analyte**				
WATER					
Physical Tests	Conductivity (uS/cm)	277	990	346	469	
	Hardness (as CaCO3) (mg/L)	134	430	136	242	
	pH (pH)	8.28	7.96	8.34	8.36	
	Total Suspended Solids (mg/L)	<3.0	<3.0	4.2	<3.0	
	TDS (Calculated) (mg/L)	154	531	200	261	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	122	503	142	221	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	5.2	8.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	122	503	147	229	
	Ammonia, Total (as N) (mg/L)	<0.0050	0.210	<0.0050	<0.0050	
	Chloride (Cl) (mg/L)	0.83	5.3	0.53	<0.50	
	Nitrate and Nitrite (as N) (mg/L)	4.08	0.216	<0.0051	0.448	
	Nitrate (as N) (mg/L)	4.00	0.051	<0.0050	0.446	
	Nitrite (as N) (mg/L)	0.0857	0.165	<0.0010	0.0022	
	Sulfate (SO4) (mg/L)	6.25	<1.5 DLDS	38.1	35.9	
	Anion Sum (meq/L)	2.87	10.2	3.74	5.36	
	Cation Sum (meq/L)	2.93	11.5	3.79	5.15	
	Cation - Anion Balance (%)	1.0	5.8	0.6	-2.0	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0012	0.0222	0.0076	0.0011	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00017	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	<0.00010	0.0102	0.00157	<0.00010	
	Barium (Ba)-Dissolved (mg/L)	0.0180	0.427	0.0427	0.00626	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000170	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.113	0.336	0.024	0.023	
	Cadmium (Cd)-Dissolved (mg/L)	0.000459	0.0000143	0.0000098	0.0000212	
	Calcium (Ca)-Dissolved (mg/L)	43.9	130	36.9	49.1	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00476	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00143	<0.00020	0.00020	0.00022	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.348	0.300	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0108	0.0057	0.0021	
	Magnesium (Mg)-Dissolved (mg/L)	5.90	25.3	10.7	28.9	
	Manganese (Mn)-Dissolved (mg/L)	0.00140	0.297	0.0451	0.00040	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2274002-1 Water 09-MAY-19 13:30 MW12-06-01	L2274002-2 Water 09-MAY-19 14:30 MW12-06-02	L2274002-3 Water 09-MAY-19 14:45 MW12-06-03	L2274002-4 Water 09-MAY-19 15:00 MW12-06-04	L2274002-5 Water 09-MAY-19 15:25 MW12-06-05
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00102	0.00947	0.00239	0.00884	0.00951
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.00050	<0.00050	0.00057
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 DLA	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.20	3.37	3.98	3.61	3.68
	Selenium (Se)-Dissolved (mg/L)	0.000612	0.00018	0.000139	0.000066	0.000074
	Silicon (Si)-Dissolved (mg/L)	8.30	9.71	9.21	8.21	8.53
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	67.1	35.5	37.4	34.1	33.6
	Strontium (Sr)-Dissolved (mg/L)	5.38	9.78	4.59	3.16	2.85
	Sulfur (S)-Dissolved (mg/L)	20.6	69.2	67.3	58.2	63.3
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00017	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00409	<0.00060 DLA	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000609	0.00240	0.00217	0.00537	0.00554
	Vanadium (V)-Dissolved (mg/L)	0.0192	<0.0010 DLA	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0022	0.0032	0.0019	0.0111	0.0139
	Zirconium (Zr)-Dissolved (mg/L)	0.00121	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2274002-6 Water 09-MAY-19 16:00 MW12-06-06	L2274002-7 Water 10-MAY-19 09:00 MW17-08-01	L2274002-8 Water 10-MAY-19 09:50 MW17-08-02	L2274002-9 Water 10-MAY-19 10:05 MW17-08-03	L2274002-10 Water 10-MAY-19 13:30 MW17-11-01
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00563	0.00873	0.00302	0.000837	0.0125
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.64	1.66	0.97	0.98	2.12
	Selenium (Se)-Dissolved (mg/L)	0.000383	0.000485	0.000607	0.000363	0.000098
	Silicon (Si)-Dissolved (mg/L)	6.97	5.17	4.67	4.27	5.49
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	34.0	7.88	5.42	3.94	23.0
	Strontium (Sr)-Dissolved (mg/L)	1.48	6.54	1.01	0.653	0.938
	Sulfur (S)-Dissolved (mg/L)	51.8	11.9	3.96	1.68	12.4
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00361	0.000232	0.000151	0.000126	0.000150
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00079	0.00068	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0427	0.0239	0.0152	0.0138	0.0099
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274002-11	L2274002-12	L2274002-13	L2274002-14	L2274002-15
Description	Water	Water	Water	Water	Water
Sampled Date	10-MAY-19	10-MAY-19	10-MAY-19	10-MAY-19	11-MAY-19
Sampled Time	14:15	14:30	15:20	15:50	15:05
Client ID	MW17-11-02	MW17-11-03	MW17-11-04	MW17-11-05	MW09-03-01
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00585	0.00493	0.00721	0.00755	0.00466
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00170	0.00450	0.00062
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	2.28	2.50	4.38	14.6	1.98
Selenium (Se)-Dissolved (mg/L)	0.000055	0.000128	0.000227	0.000890	<0.000050
Silicon (Si)-Dissolved (mg/L)	5.15	4.80	7.81	21.5	5.11
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000027	<0.000010
Sodium (Na)-Dissolved (mg/L)	17.9	9.18	9.48	24.1	8.25
Strontium (Sr)-Dissolved (mg/L)	0.956	0.950	0.961	1.40	0.977
Sulfur (S)-Dissolved (mg/L)	13.5	5.71	6.29	7.20	5.45
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00028	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00063	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000258	0.00186	0.00336	0.0123	0.000810
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00095	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0157	0.0234	0.0282	0.0396	0.0062
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274002-16	L2274002-17	L2274002-18	L2274002-19	
Description	Water	Water	Water	Water	
Sampled Date	11-MAY-19	09-MAY-19	10-MAY-19	10-MAY-19	
Sampled Time	15:40				
Client ID	MW09-03-02	DUP	DUP	DUP	
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved (mg/L)	0.00418	0.00113	0.0135	0.00911	
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved (mg/L)	1.99	2.98	2.05	1.52	
Selenium (Se)-Dissolved (mg/L)	0.000330	0.00127	0.000084	0.000479	
Silicon (Si)-Dissolved (mg/L)	4.70	8.11	5.41	4.96	
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved (mg/L)	4.70	63.8	22.9	6.57	
Strontium (Sr)-Dissolved (mg/L)	0.290	5.46	0.947	6.67	
Sulfur (S)-Dissolved (mg/L)	1.93	15.4	12.4	11.6	
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00016	<0.00010	<0.00010	
Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00384	0.00030	<0.00030	
Uranium (U)-Dissolved (mg/L)	0.00161	0.000684	0.000163	0.000217	
Vanadium (V)-Dissolved (mg/L)	<0.00050	0.0183	<0.00050	<0.00050	
Zinc (Zn)-Dissolved (mg/L)	0.0194	0.0023	0.0026	0.0138	
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00116	<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	Calcium (Ca)-Dissolved	MS-B	L2274002-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2274002-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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)

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-05-15A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2274002-COFC

COC Number: 2019-05-15 A

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: mintoenvironment@mintomine.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: ap@mintomine.com

Email 2:

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: CR/IS

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW12-06-01	9-May-19	13:30	Water		R		R	R		R							4
	MW12-06-02	9-May-19	14:30	Water		R		R	R		R							4
	MW12-06-03	9-May-19	14:45	Water		R		R	R		R							4
	MW12-06-04	9-May-19	15:00	Water		R		R	R		R							4
	MW12-06-05	9-May-19	15:25	Water		R		R	R		R							4
	MW12-06-06	9-May-19	16:00	Water		R		R	R		R							4
	MW17-08-01	10-May-19	9:00	Water		R		R	R		R							4
	MW17-08-02	10-May-19	9:50	Water		R		R	R		R							4
	MW17-08-03	10-May-19	10:05	Water		R		R	R		R							4
	MW17-11--01	10-May-19	13:30	Water		R		R	R		R							4
	MW17-11--02	10-May-19	14:15	Water		R		R	R		R							4
	MW17-11--03	10-May-19	14:30	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☑ | Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
8.0					10

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-05-15	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: EP	Date: 15 May 2019	Time: 15:30

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 5/16	Time: 12:25 pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2274002-COFC

COC Number: 2019-05-15 A

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: CR/CB

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury: Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW17-11-04	10-May-19	15:20	Water		R		R	R		R							4
	MW17-11-05	10-May-19	15:50	Water		R		R	R		R							4
	MW09-03-01	11-May-19	15:05	Water		R		R	R		R							4
	MW09-03-02	11-May-19	15:40	Water		R		R	R		R							4
	DUP	9-May-19		Water		R		R	R		R							4
	DUP	10-May-19		Water		R		R	R		R							4
	DUP	10-May-19		Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations	Yes ☐ No ☐
Ice Packs ☑	Ice Cubes ☐	Custody seal intact	Yes ☐ No ☐
Cooling Initiated ☑			

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
8.0					10

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-05-15	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: EF	Date: 15 May 2019	Time: 15:30

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: HK	Date: 5/16	Time: 12:25

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-MAY-19
Report Date: 03-JUN-19 18:16 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2277369

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-05-22 A
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2277369-1	L2277369-2	L2277369-3	L2277369-4	L2277369-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	15-MAY-19	15-MAY-19	15-MAY-19	16-MAY-19	16-MAY-19
	Sampled Time	13:40	14:10	14:30	08:05	08:40
	Client ID	MW17-10-01	MW17-10-02	MW17-10-03	MW12-05-01	MW12-05-02
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	377	473	481	2220	2170
	Hardness (as CaCO3) (mg/L)	196	216	230	1070	1080
	pH (pH)	8.20	8.20	8.21	8.11	8.22
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	233	294	307	1920	1850
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	109	110	112	125	170
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	109	110	112	125	170
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0692	0.0273
	Chloride (Cl) (mg/L)	0.71	1.00	1.04	13.5	12.5
	Nitrate and Nitrite (as N) (mg/L)	10.8	27.2	28.4	<0.051	<0.051
	Nitrate (as N) (mg/L)	10.8	27.2	28.4	<0.050 DLDS	<0.050 DLDS
	Nitrite (as N) (mg/L)	0.0029	<0.0010	0.0010	0.020	<0.010 DLDS
	Sulfate (SO4) (mg/L)	41.8	24.0	23.6	1250	1190
	Anion Sum (meq/L)	3.84	4.66	4.79	28.9	28.4
	Cation Sum (meq/L)	4.34	4.64	4.95	29.0	28.0
	Cation - Anion Balance (%)	6.1	-0.3	1.6	0.1	-0.7
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0040	0.0021	0.0023	0.0048	0.0052
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 DLA	0.00026
	Arsenic (As)-Dissolved (mg/L)	0.00025	<0.00010	<0.00010	0.00070	0.00028
	Barium (Ba)-Dissolved (mg/L)	0.0273	0.0325	0.0366	0.0336	0.0739
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 DLA	<0.000040 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA
	Boron (B)-Dissolved (mg/L)	0.019	<0.010	<0.010	0.167	0.078
	Cadmium (Cd)-Dissolved (mg/L)	0.000147	0.0000420	0.0000662	0.000189	<0.000010 DLA
	Calcium (Ca)-Dissolved (mg/L)	48.8	58.0	62.4	359	333
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00034	0.00035
	Cobalt (Co)-Dissolved (mg/L)	0.00048	0.00050	0.00042	<0.00020 DLA	<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)	0.00375	0.00139	0.00148	<0.00040 DLA	<0.00040 DLA
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.013	0.045	0.022
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA
	Lithium (Li)-Dissolved (mg/L)	0.0016	0.0011	0.0011	0.0078	0.0051
	Magnesium (Mg)-Dissolved (mg/L)	17.9	17.2	18.1	43.3	59.3
	Manganese (Mn)-Dissolved (mg/L)	0.0313	0.00188	0.00120	0.166	0.784

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2277369-6 Water 16-MAY-19 09:20 MW12-05-03	L2277369-7 Water 16-MAY-19 09:35 MW12-05-04	L2277369-8 Water 16-MAY-19 10:00 MW12-05-05	L2277369-9 Water 16-MAY-19 10:15 MW12-05-06	L2277369-10 Water 16-MAY-19 10:40 MW12-05-07
WATER						
Physical Tests	Conductivity (uS/cm)	1750	510	520	519	531
	Hardness (as CaCO3) (mg/L)	891	259	259	274	267
	pH (pH)	8.30	8.41	8.40	8.37	8.35
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	1410	296	301	308	313
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	239	225	227	223	234
	Alkalinity, Carbonate (as CaCO3) (mg/L)	3.2	7.0	6.6	6.2	5.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	242	232	234	229	239
	Ammonia, Total (as N) (mg/L)	0.0162	0.0178	0.0141	<0.0050	0.298
	Chloride (Cl) (mg/L)	9.0	4.88	4.85	5.06	4.98
	Nitrate and Nitrite (as N) (mg/L)	<0.025	0.0218	<0.0051	0.0415	<0.0051
	Nitrate (as N) (mg/L)	<0.025 DLDS	0.0145	<0.0050	0.0307	<0.0050
	Nitrite (as N) (mg/L)	0.0071	0.0072	0.0041	0.0108	0.0018
	Sulfate (SO4) (mg/L)	834	45.2	52.5	56.6	55.6
	Anion Sum (meq/L)	22.5	5.72	5.90	5.90	6.08
	Cation Sum (meq/L)	22.5	6.14	5.98	6.33	6.24
	Cation - Anion Balance (%)	0.2	3.5	0.7	3.5	1.3
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0038	0.0032	0.0028	0.0041	0.0041
	Antimony (Sb)-Dissolved (mg/L)	0.00052	0.00012	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	<0.00020 DLA	0.00011	0.00015	0.00015	0.00131
	Barium (Ba)-Dissolved (mg/L)	0.0405	0.0551	0.0673	0.0573	0.0942
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 DLA	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.071	0.044	0.053	0.041	0.024
	Cadmium (Cd)-Dissolved (mg/L)	0.000017	0.0000123	0.0000223	0.0000453	0.0000300
	Calcium (Ca)-Dissolved (mg/L)	229	52.0	53.5	55.4	57.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 DLA	0.00016	<0.00010	<0.00010	0.00017
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	0.00011	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00040 DLA	0.00027	0.00102	0.00236	0.00039
	Iron (Fe)-Dissolved (mg/L)	0.471	0.045	0.043	<0.010	1.37
	Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0042	0.0031	0.0036	0.0035	0.0031
	Magnesium (Mg)-Dissolved (mg/L)	77.6	31.4	30.6	33.1	29.9
	Manganese (Mn)-Dissolved (mg/L)	2.13	0.198	0.147	0.118	0.164

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2277369-11	L2277369-12			
	Description	Water	Water			
	Sampled Date	16-MAY-19	16-MAY-19			
	Sampled Time	15:00	15:40			
	Client ID	MW17-DP01	MW17-DP02			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	873	1180			
	Hardness (as CaCO3) (mg/L)	199	351			
	pH (pH)	8.38	8.30			
	Total Suspended Solids (mg/L)	22.6	50.2			
	TDS (Calculated) (mg/L)	545	814			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	187	182			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.6	2.6			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	193	185			
	Ammonia, Total (as N) (mg/L)	2.00	7.27			
	Chloride (Cl) (mg/L)	24.4	21.6			
	Nitrate and Nitrite (as N) (mg/L)	<0.025	<0.025			
	Nitrate (as N) (mg/L)	<0.025 DLDS	<0.025 DLDS			
	Nitrite (as N) (mg/L)	<0.0050 DLDS	<0.0050 DLDS			
	Sulfate (SO4) (mg/L)	209	411			
	Anion Sum (meq/L)	8.90	12.8			
	Cation Sum (meq/L)	9.06	12.7			
	Cation - Anion Balance (%)	0.9	-0.4			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0043	<0.0050 DLA			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00050 DLA			
	Arsenic (As)-Dissolved (mg/L)	0.00057	0.00076			
	Barium (Ba)-Dissolved (mg/L)	0.0184	0.0169			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.00010 DLA			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00025 DLA			
	Boron (B)-Dissolved (mg/L)	0.068	0.133			
	Cadmium (Cd)-Dissolved (mg/L)	0.000453	0.000322			
	Calcium (Ca)-Dissolved (mg/L)	51.7	88.9			
	Chromium (Cr)-Dissolved (mg/L)	0.00039	<0.00050 DLA			
	Cobalt (Co)-Dissolved (mg/L)	0.00060	0.00085			
	Copper (Cu)-Dissolved (mg/L)	0.125	0.167			
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.050 DLA			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00025 DLA			
	Lithium (Li)-Dissolved (mg/L)	0.0046	0.0074			
	Magnesium (Mg)-Dissolved (mg/L)	17.1	31.2			
	Manganese (Mn)-Dissolved (mg/L)	0.500	0.396			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2277369-1 Water 15-MAY-19 13:40 MW17-10-01	L2277369-2 Water 15-MAY-19 14:10 MW17-10-02	L2277369-3 Water 15-MAY-19 14:30 MW17-10-03	L2277369-4 Water 16-MAY-19 08:05 MW12-05-01	L2277369-5 Water 16-MAY-19 08:40 MW12-05-02
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0149	0.00694	0.00648	0.00040	0.00019
	Nickel (Ni)-Dissolved (mg/L)	0.0105	0.00200	0.00252	<0.0010 DLA	<0.0010 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.10 DLA	<0.10 DLA
	Potassium (K)-Dissolved (mg/L)	1.51	1.62	1.81	3.74	3.98
	Selenium (Se)-Dissolved (mg/L)	0.00105	0.00213	0.00274	0.00114	0.00172
	Silicon (Si)-Dissolved (mg/L)	5.59	5.29	5.33	7.87	7.49
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA
	Sodium (Na)-Dissolved (mg/L)	8.99	6.53	6.98	171	147
	Strontium (Sr)-Dissolved (mg/L)	1.14	0.972	0.927	10.0	11.8
	Sulfur (S)-Dissolved (mg/L)	15.9	7.86	7.61	440	399
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 DLA	<0.00020 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00060 DLA	<0.00060 DLA
	Uranium (U)-Dissolved (mg/L)	0.00232	0.00121	0.00125	0.000909	0.000556
	Vanadium (V)-Dissolved (mg/L)	0.00101	0.00054	0.00061	<0.0010 DLA	<0.0010 DLA
	Zinc (Zn)-Dissolved (mg/L)	0.0377	0.0244	0.0349	0.0036	<0.0020 DLA
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2277369-6	L2277369-7	L2277369-8	L2277369-9	L2277369-10
Description	Water	Water	Water	Water	Water
Sampled Date	16-MAY-19	16-MAY-19	16-MAY-19	16-MAY-19	16-MAY-19
Sampled Time	09:20	09:35	10:00	10:15	10:40
Client ID	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07
Grouping / **Analyte**					
WATER					
Dissolved Metals					
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00041	0.00210	0.00471	0.00461	0.00288
Nickel (Ni)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	0.00083	0.00051
Phosphorus (P)-Dissolved (mg/L)	<0.10 DLA	<0.050	<0.050	<0.050	0.069
Potassium (K)-Dissolved (mg/L)	3.96	2.26	2.22	2.33	2.15
Selenium (Se)-Dissolved (mg/L)	<0.00010 DLA	0.00328	0.000299	0.000248	0.000097
Silicon (Si)-Dissolved (mg/L)	8.21	6.62	6.51	6.23	7.11
Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	104	20.5	16.8	18.0	17.3
Strontium (Sr)-Dissolved (mg/L)	8.48	1.04	0.860	0.886	0.796
Sulfur (S)-Dissolved (mg/L)	285	26.9	17.7	17.2	18.1
Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00060 DLA	<0.00030	<0.00030	<0.00030	<0.00060 DLM
Uranium (U)-Dissolved (mg/L)	0.000892	0.00271	0.00334	0.00357	0.00144
Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	0.00054	0.00051	<0.00050	0.00053
Zinc (Zn)-Dissolved (mg/L)	0.0022	0.0012	0.0101	0.0164	0.0040
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2277369-11	L2277369-12			
	Description	Water	Water			
	Sampled Date	16-MAY-19	16-MAY-19			
	Sampled Time	15:00	15:40			
	Client ID	MW17-DP01	MW17-DP02			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0324	0.0974			
	Nickel (Ni)-Dissolved (mg/L)	0.00417	<0.0025 DLA			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.25 DLA			
	Potassium (K)-Dissolved (mg/L)	26.0	50.5			
	Selenium (Se)-Dissolved (mg/L)	0.000686	0.00090			
	Silicon (Si)-Dissolved (mg/L)	2.87	2.69			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000050 DLA			
	Sodium (Na)-Dissolved (mg/L)	97.6	89.9			
	Strontium (Sr)-Dissolved (mg/L)	3.79	13.6			
	Sulfur (S)-Dissolved (mg/L)	74.1	141			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000050 DLA			
	Tin (Sn)-Dissolved (mg/L)	0.00012	<0.00050 DLA			
	Titanium (Ti)-Dissolved (mg/L)	<0.00090 DLM	<0.0015 DLA			
	Uranium (U)-Dissolved (mg/L)	0.000293	0.00217			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.0025 DLA			
	Zinc (Zn)-Dissolved (mg/L)	0.0033	<0.0050 DLA			
	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	Nitrate (as N)	MS-B	L2277369-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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)

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-05-22 A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2277369-COFC

COC Number: 2019-05-22 A

Page of

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: Sampler:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW17-10-01	15-May-19	13:40	Water		R		R	R		R							4
	MW17-10-02	15-May-19	14:10	Water		R		R	R		R							4
	MW17-10-03	15-May-19	14:30	Water		R		R	R		R							4
	MW12-05-01	16-May-19	8:05	Water		R		R	R		R							4
	MW12-05-02	16-May-19	8:40	Water		R		R	R		R							4
	MW12-05-03	16-May-19	9:20	Water		R		R	R		R							4
	MW12-05-04	16-May-19	9:35	Water		R		R	R		R							4
	MW12-05-05	16-May-19	10:00	Water		R		R	R		R							4
	MW12-05-06	16-May-19	10:15	Water		R		R	R		R							4
	MW12-05-07	16-May-19	10:40	Water		R		R	R		R							4
	MW17-DP01	16-May-19	15:00	Water		R		R	R		R							4
	MW17-DP02	16-May-19	15:40	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
		5.1			

SHIPMENT RELEASE (client use)		
Released by: Chad Bustin	Date: 2019-05-22	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: May 22, 2019	Time: 13:45

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-MAY-19
Report Date: 07-JUN-19 19:04 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2281696

Project P.O. #: 232818 (GW)
Job Reference:
C of C Numbers: 2019-05-29 C
Legal Site Desc:

Comments:
7-JUN-2019 Report with revised sample ID as per email request.

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2281696-1				
	Description	Water				
	Sampled Date	27-MAY-19				
	Sampled Time	11:35				
	Client ID	MW17-DP03				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1700				
	Hardness (as CaCO3) (mg/L)	636				
	pH (pH)	8.08				
	Total Suspended Solids (mg/L)	24.7				
	Total Dissolved Solids (mg/L)	1250				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	209				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	209				
	Ammonia, Total (as N) (mg/L)	8.08				
	Chloride (Cl) (mg/L)	27.3				
	Nitrate and Nitrite (as N) (mg/L)	0.038				
	Nitrate (as N) (mg/L)	0.038				
	Nitrite (as N) (mg/L)	<0.0050 DLDS				
	Sulfate (SO4) (mg/L)	697				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0033				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00026				
	Barium (Ba)-Dissolved (mg/L)	0.0170				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.239				
	Cadmium (Cd)-Dissolved (mg/L)	0.000610				
	Calcium (Ca)-Dissolved (mg/L)	195				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00098				
	Copper (Cu)-Dissolved (mg/L)	0.0608				
	Iron (Fe)-Dissolved (mg/L)	0.022				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0113				
	Magnesium (Mg)-Dissolved (mg/L)	36.4				
	Manganese (Mn)-Dissolved (mg/L)	0.843				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00840				
	Nickel (Ni)-Dissolved (mg/L)	0.00441				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2281696-1				
	Description	Water				
	Sampled Date	27-MAY-19				
	Sampled Time	11:35				
	Client ID	MW17-DP03				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	31.4				
	Selenium (Se)-Dissolved (mg/L)	0.000669				
	Silicon (Si)-Dissolved (mg/L)	4.97				
	Silver (Ag)-Dissolved (mg/L)	0.000011				
	Sodium (Na)-Dissolved (mg/L)	77.2				
	Strontium (Sr)-Dissolved (mg/L)	9.93				
	Sulfur (S)-Dissolved (mg/L)	225				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.000541				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0029				
	Zirconium (Zr)-Dissolved (mg/L)	<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	Barium (Ba)-Dissolved	MS-B	L2281696-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2281696-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2281696-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2281696-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2281696-1

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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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.

Reference Information

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.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-05-29 C

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2281696-COFC

COC Number: 2019-05-29 C

Page 1 of 1

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax mintoenvironment@mintomine.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax ap@mintomine.com

Email 2

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	
ALS Lab Work Order # (lab use only)	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW17-DP3	27-May-19	11:35	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
6°			7		

SHIPMENT RELEASE (client use)		
Released by: Ian Smith	Date: 29-May-19	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: May 29/19	Time: 14:25

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: JC	Date: MAY 30 2019	Time: 11:53

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-JUN-19
Report Date: 28-JUN-19 12:48 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2290535

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-06-12 D
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2290535-1	L2290535-2	L2290535-3		
	Description	Water	Water	Water		
	Sampled Date	07-JUN-19	07-JUN-19	07-JUN-19		
	Sampled Time	10:05	11:05	14:45		
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	297	241	813		
	Hardness (as CaCO3) (mg/L)	140	117	403		
	pH (pH)	8.35	8.26	8.32		
	Total Suspended Solids (mg/L)	<3.0	3.7	<3.0		
	TDS (Calculated) (mg/L)	170	145	583		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	146	116	170		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	3.6	<1.0	3.6		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	149	116	174		
	Ammonia, Total (as N) (mg/L)	0.0402	0.0104	0.0134		
	Chloride (Cl) (mg/L)	<0.50	0.76	6.5		
	Nitrate and Nitrite (as N) (mg/L)	0.322	3.97	1.24		
	Nitrate (as N) (mg/L)	<0.0050	3.72	1.00		
	Nitrite (as N) (mg/L)	0.322	0.248	0.243		
	Sulfate (SO4) (mg/L)	18.1	6.61	285		
	Anion Sum (meq/L)	3.38	2.75	9.66		
	Cation Sum (meq/L)	3.30	2.64	9.69		
	Cation - Anion Balance (%)	-1.2	-2.1	0.1		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0028	0.0040	0.0062		
	Antimony (Sb)-Dissolved (mg/L)	0.00023	0.00021	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00089	0.00010	0.00022		
	Barium (Ba)-Dissolved (mg/L)	0.0620	0.0171	0.0245		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.530	0.335	0.125		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000274	0.0000695	0.0000769		
	Calcium (Ca)-Dissolved (mg/L)	38.1	37.9	115		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00030		
	Copper (Cu)-Dissolved (mg/L)	0.00070	0.00169	0.00310		
	Iron (Fe)-Dissolved (mg/L)	0.215	0.010	0.012		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000094		
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0012	0.0168		
	Magnesium (Mg)-Dissolved (mg/L)	10.9	5.49	28.2		
	Manganese (Mn)-Dissolved (mg/L)	0.0860	0.00293	0.692		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2290535-1	L2290535-2	L2290535-3		
	Description	Water	Water	Water		
	Sampled Date	07-JUN-19	07-JUN-19	07-JUN-19		
	Sampled Time	10:05	11:05	14:45		
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00596	0.00535	0.0236		
	Nickel (Ni)-Dissolved (mg/L)	0.00062	<0.00050	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.03	1.93	2.93		
	Selenium (Se)-Dissolved (mg/L)	0.000326	0.000635	0.000535		
	Silicon (Si)-Dissolved (mg/L)	5.37	4.75	6.41		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000011		
	Sodium (Na)-Dissolved (mg/L)	9.92	5.63	35.5		
	Strontium (Sr)-Dissolved (mg/L)	0.995	0.311	3.50		
	Sulfur (S)-Dissolved (mg/L)	6.18	2.06	99.3		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00030	<0.00060 DLM		
	Uranium (U)-Dissolved (mg/L)	0.000717	0.00139	0.00345		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0245	0.0382	0.0364		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<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	Barium (Ba)-Dissolved	MS-B	L2290535-1, -2, -3
Matrix Spike	Boron (B)-Dissolved	MS-B	L2290535-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2290535-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2290535-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2290535-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2290535-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2290535-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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.

		Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

NO2-L-IC-N-VA	Water		

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-06-12 D

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2290535-COFC

COC Number: 2019-06-12 D

Page 1 of 1

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: mintoenvironment@mintomine.com
Email 2:
Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: ap@mintomine.com
Email 2:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: DJ-CR

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW09-03-01 ✓	7-Jun-19	10:05	Water		R		R	R		R							4
	MW09-03-02 ✓	7-Jun-19	11:05	Water		R		R	R		R							4
	MW12-07-02 ✓	7-Jun-19	14:25	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			9		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: DAWN JOHNNY	Date: 12-06-19	Time:	Received by:	Date:	Time:	Received by: SP	Date: 6/13/19	Time: 12pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 11-JUL-19
Report Date: 23-JUL-19 14:51 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2308028

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-07-10 A
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2308028-1	L2308028-2	L2308028-3		
	Description	Water	Water	Water		
	Sampled Date	05-JUL-19	05-JUL-19	05-JUL-19		
	Sampled Time	10:25	10:50	14:40		
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	307	273	845		
	Hardness (as CaCO3) (mg/L)	145	125	387		
	pH (pH)	8.39	8.34	8.38		
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0		
	TDS (Calculated) (mg/L)	169	152	580		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	141	118	166		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	3.6	2.8	4.8		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	144	121	171		
	Ammonia, Total (as N) (mg/L)	0.0379	0.0085	0.0087		
	Chloride (Cl) (mg/L)	<0.50	1.06	7.4		
	Nitrate and Nitrite (as N) (mg/L)	0.286	4.07	1.26		
	Nitrate (as N) (mg/L)	0.0103	3.75	1.06		
	Nitrite (as N) (mg/L)	0.276	0.321	0.206		
	Sulfate (SO4) (mg/L)	17.9	6.69	289		
	Anion Sum (meq/L)	3.27	2.87	9.73		
	Cation Sum (meq/L)	3.42	2.80	9.31		
	Cation - Anion Balance (%)	2.2	-1.3	-2.2		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0015	0.0020	0.0024		
	Antimony (Sb)-Dissolved (mg/L)	0.00019	0.00019	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00090	0.00017	0.00044		
	Barium (Ba)-Dissolved (mg/L)	0.0660	0.0195	0.0257		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.413	0.302	0.153		
	Cadmium (Cd)-Dissolved (mg/L)	0.000107	0.000210	0.000152		
	Calcium (Ca)-Dissolved (mg/L)	40.1	41.1	112		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00014	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00028		
	Copper (Cu)-Dissolved (mg/L)	0.00064	0.00171	0.00377		
	Iron (Fe)-Dissolved (mg/L)	0.336	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0012	0.0155		
	Magnesium (Mg)-Dissolved (mg/L)	11.0	5.42	26.2		
	Manganese (Mn)-Dissolved (mg/L)	0.0877	0.00218	0.634		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2308028-1	L2308028-2	L2308028-3		
	Description	Water	Water	Water		
	Sampled Date	05-JUL-19	05-JUL-19	05-JUL-19		
	Sampled Time	10:25	10:50	14:40		
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00582	0.00495	0.0227		
	Nickel (Ni)-Dissolved (mg/L)	0.00054	<0.00050	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.22	2.08	3.56		
	Selenium (Se)-Dissolved (mg/L)	0.000162	0.000401	0.000518		
	Silicon (Si)-Dissolved (mg/L)	5.60	5.19	6.59		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	10.2	5.68	33.6		
	Strontium (Sr)-Dissolved (mg/L)	0.987	0.308	3.28		
	Sulfur (S)-Dissolved (mg/L)	6.28	2.58	102		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.000770	0.00179	0.00369		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0160	0.0383	0.0655		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<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	Boron (B)-Dissolved	MS-B	L2308028-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2308028-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2308028-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2308028-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2308028-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
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.

ANIONS-N+N-CALC-WR Water Nitrite & Nitrate Nitrogen EPA 300.1

Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.

BE-D-L-CCMS-VA Water Diss. Be (low) 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.

CL-IC-N-WR 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.

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 CaCO3 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.

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.

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-WR 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-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Reference Information

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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-07-10 A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2308028-COFC

COC Number: 2019-07-10 A

Page 1 of 1

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:**

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW09-03-01	5-Jun-19	10:25	Water		R		R	R		R							4
	MW09-03-02	5-Jun-19	10:50	Water		R		R	R		R							4
	MW12-07-02	5-Jun-19	14:40	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☒	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
		3.8	9 Aug		

SHIPMENT RELEASE (client use)		
Released by: Chad Bustin	Date: 2019-07-10	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: JJ	Date: July 10, 2019	Time: 4:50

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: SQ	Date: 7/12/19	Time: 12pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-AUG-19
Report Date: 19-AUG-19 17:54 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2324402

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-08-07 E
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2324402-1	L2324402-2	L2324402-3	L2324402-4	L2324402-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	01-AUG-19	01-AUG-19	01-AUG-19	02-AUG-19	02-AUG-19
	Sampled Time	08:55	13:45	15:15	08:45	10:20
	Client ID	MW12-07-02	MW09-03-01	MW09-03-02	MW12-05-01	MW12-05-02
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	875	315	298	2330	2240
	Hardness (as CaCO3) (mg/L)	414	153	144	1090	1110
	pH (pH)	8.33	8.34	8.40	8.25	8.37
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	602	183	170	1970	1880
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	177	161	128	123	164
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.2	3.6	7.8	<1.0	13.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	182	164	136	123	177
	Ammonia, Total (as N) (mg/L)	0.0155	0.0351	0.0125	0.174	0.0290
	Chloride (Cl) (mg/L)	7.8	<0.50	0.78	14	14
	Nitrate and Nitrite (as N) (mg/L)	1.29	0.229	4.39	<0.10 DLDS	<0.10 DLDS
	Nitrate (as N) (mg/L)	1.12	0.0180	4.12	<0.10 DLDS	<0.10 DLDS
	Nitrite (as N) (mg/L)	0.175	0.211	0.273	<0.020 DLDS	<0.020 DLDS
	Sulfate (SO4) (mg/L)	291	17.9	6.53	1300	1190
	Anion Sum (meq/L)	10.0	3.67	3.18	29.8	28.8
	Cation Sum (meq/L)	10.0	3.57	3.23	29.3	29.1
	Cation - Anion Balance (%)	0.0	-1.4	0.7	-0.9	0.5
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0025	0.0025	0.0030	0.0045	0.0049
	Antimony (Sb)-Dissolved (mg/L)	0.00011	0.00014	0.00025	<0.00020 DLA	<0.00020 DLA
	Arsenic (As)-Dissolved (mg/L)	0.00046	0.00091	0.00014	0.00066	0.00024
	Barium (Ba)-Dissolved (mg/L)	0.0264	0.0648	0.0209	0.0300	0.0666
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 DLA	<0.000040 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA
	Boron (B)-Dissolved (mg/L)	0.229	0.229	0.373	0.071	0.078
	Cadmium (Cd)-Dissolved (mg/L)	0.000191	0.000127	0.000179	<0.000010 DLA	0.000014
	Calcium (Ca)-Dissolved (mg/L)	119	42.0	47.4	365	349
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00013	0.00028	0.00029
	Cobalt (Co)-Dissolved (mg/L)	0.00032	<0.00010	<0.00010	<0.00020 DLA	<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)	0.00316	0.00130	0.00203	<0.00040 DLA	<0.00040 DLA
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.347	<0.010	0.061	0.046
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA
	Lithium (Li)-Dissolved (mg/L)	0.0168	0.0036	0.0012	0.0078	0.0052
	Magnesium (Mg)-Dissolved (mg/L)	28.3	11.7	6.27	42.2	58.0
	Manganese (Mn)-Dissolved (mg/L)	0.693	0.0966	0.00481	0.171	0.835

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2324402-6 Water 02-AUG-19 11:20 MW12-05-03	L2324402-7 Water 02-AUG-19 13:20 MW12-05-04	L2324402-8 Water 02-AUG-19 14:05 MW12-05-05	L2324402-9 Water 02-AUG-19 14:40 MW12-05-06	L2324402-10 Water 02-AUG-19 15:40 MW12-05-07
WATER						
Physical Tests	Conductivity (uS/cm)	1830	527	533	537	547
	Hardness (as CaCO3) (mg/L)	902	253	262	275	266
	pH (pH)	8.22	8.56	8.56	8.55	8.52
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	1450	304	324	318	320
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	219	222	244	222	228
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	21.2	21.6	21.4	19.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	219	243	266	243	248
	Ammonia, Total (as N) (mg/L)	0.0316	0.0113	<0.0050	0.0052	0.335
	Chloride (Cl) (mg/L)	9.7	4.87	4.97	5.03	5.62
	Nitrate and Nitrite (as N) (mg/L)	<0.051	0.0534	0.0155	0.0589	<0.0051
	Nitrate (as N) (mg/L)	<0.050 DLDS	0.0476	0.0098	0.0496	<0.0050
	Nitrite (as N) (mg/L)	0.013	0.0058	0.0057	0.0093	0.0020
	Sulfate (SO4) (mg/L)	871	47.1	53.5	55.5	56.5
	Anion Sum (meq/L)	22.8	5.98	6.57	6.16	6.29
	Cation Sum (meq/L)	23.3	6.06	6.08	6.36	6.23
	Cation - Anion Balance (%)	1.1	0.7	-3.9	1.5	-0.4
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0066	0.0030	0.0040	0.0028	0.0072
	Antimony (Sb)-Dissolved (mg/L)	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00020	0.00010	0.00015	0.00016	0.00161
	Barium (Ba)-Dissolved (mg/L)	0.0410	0.0458	0.0679	0.0651	0.0869
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.101	0.027	0.033	0.028	0.036
	Cadmium (Cd)-Dissolved (mg/L)	0.0000229	<0.0000050	0.0000162	0.0000196	0.0000118
	Calcium (Ca)-Dissolved (mg/L)	234	51.4	56.5	59.8	58.8
	Chromium (Cr)-Dissolved (mg/L)	0.00028	0.00011	<0.00010	<0.00010	0.00012
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00019	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00127	0.00036	0.00142	0.00143	0.00078
	Iron (Fe)-Dissolved (mg/L)	0.525	0.038	0.030	0.035	1.36
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0043	0.0033	0.0036	0.0037	0.0033
	Magnesium (Mg)-Dissolved (mg/L)	77.2	30.2	29.5	30.5	28.8
	Manganese (Mn)-Dissolved (mg/L)	2.36	0.142	0.155	0.212	0.171

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2324402-11	L2324402-12	L2324402-13	L2324402-14	
Description	Water	Water	Water	Water	
Sampled Date	06-AUG-19	06-AUG-19	06-AUG-19	02-AUG-19	
Sampled Time	10:10	11:30	13:35		
Client ID	MW17-08-01	MW17-08-02	MW17-08-03	DUP	
Grouping	**Analyte**				
WATER					
Physical Tests	Conductivity (uS/cm)	458	306	195	2330
	Hardness (as CaCO3) (mg/L)	252	158	103	1070
	pH (pH)	8.57	8.47	8.23	8.16
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	270	171	108	1980
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	217	154	104	123
	Alkalinity, Carbonate (as CaCO3) (mg/L)	19.8	10.4	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	237	164	104	123
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0247
	Chloride (Cl) (mg/L)	0.53	<0.50	<0.50	15
	Nitrate and Nitrite (as N) (mg/L)	0.469	0.695	0.684	<0.10 DLDS
	Nitrate (as N) (mg/L)	0.453	0.693	0.684	<0.10 DLDS
	Nitrite (as N) (mg/L)	0.0163	0.0023	<0.0010	<0.020
	Sulfate (SO4) (mg/L)	33.9	10.7	2.65	1290
	Anion Sum (meq/L)	5.49	3.55	2.18	29.8
	Cation Sum (meq/L)	5.43	3.41	2.22	29.8
	Cation - Anion Balance (%)	-0.5	-2.0	0.9	0.1
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0019	0.0027	0.0094	0.0049
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Arsenic (As)-Dissolved (mg/L)	0.00027	0.00033	0.00021	0.00061
	Barium (Ba)-Dissolved (mg/L)	0.00891	0.0857	0.0606	0.0312
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA
	Boron (B)-Dissolved (mg/L)	0.031	0.013	<0.010	0.084
	Cadmium (Cd)-Dissolved (mg/L)	0.0000448	0.0000327	0.0000473	<0.000010 DLA
	Calcium (Ca)-Dissolved (mg/L)	51.2	37.1	27.1	358
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00021
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)	0.00142	0.00250	0.00140	<0.00040 DLA
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.059
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA
	Lithium (Li)-Dissolved (mg/L)	0.0020	<0.0010	<0.0010	0.0079
	Magnesium (Mg)-Dissolved (mg/L)	30.2	15.8	8.50	43.5
	Manganese (Mn)-Dissolved (mg/L)	0.00279	0.00131	0.00165	0.173

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2324402-1 Water 01-AUG-19 08:55 MW12-07-02	L2324402-2 Water 01-AUG-19 13:45 MW09-03-01	L2324402-3 Water 01-AUG-19 15:15 MW09-03-02	L2324402-4 Water 02-AUG-19 08:45 MW12-05-01	L2324402-5 Water 02-AUG-19 10:20 MW12-05-02
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0232	0.00522	0.00513	0.00018	0.00021
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00069	<0.00050	<0.0010 DLA	<0.0010 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.10 DLA	<0.10 DLA
	Potassium (K)-Dissolved (mg/L)	2.98	2.24	2.27	3.64	3.98
	Selenium (Se)-Dissolved (mg/L)	0.000626	0.000111	0.000566	<0.00010 DLA	<0.00010 DLA
	Silicon (Si)-Dissolved (mg/L)	6.73	5.68	5.28	7.89	7.83
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA
	Sodium (Na)-Dissolved (mg/L)	37.3	9.73	6.62	173	156
	Strontium (Sr)-Dissolved (mg/L)	3.43	1.07	0.334	10.2	12.3
	Sulfur (S)-Dissolved (mg/L)	100	6.63	2.39	474	456
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 DLA	<0.00020 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00060 DLA	<0.00060 DLA
	Uranium (U)-Dissolved (mg/L)	0.00364	0.000791	0.00188	0.000911	0.000860
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010 DLA	<0.0010 DLA
	Zinc (Zn)-Dissolved (mg/L)	0.152	0.0710	0.0745	<0.0020 DLA	0.0031
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00040 DLA	<0.00040 DLA

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2324402-6 Water 02-AUG-19 11:20 MW12-05-03	L2324402-7 Water 02-AUG-19 13:20 MW12-05-04	L2324402-8 Water 02-AUG-19 14:05 MW12-05-05	L2324402-9 Water 02-AUG-19 14:40 MW12-05-06	L2324402-10 Water 02-AUG-19 15:40 MW12-05-07
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000307	0.00292	0.00542	0.00495	0.00321
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00064	0.00099	0.00059
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	0.069
	Potassium (K)-Dissolved (mg/L)	4.17	2.24	2.19	2.21	2.13
	Selenium (Se)-Dissolved (mg/L)	0.000131	0.00164	0.000128	0.000095	0.000088
	Silicon (Si)-Dissolved (mg/L)	8.52	6.82	6.30	6.52	7.26
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	116	21.8	17.8	18.4	17.7
	Strontium (Sr)-Dissolved (mg/L)	8.86	1.03	0.874	0.919	0.801
	Sulfur (S)-Dissolved (mg/L)	313	21.1	17.6	19.0	19.2
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00100
	Uranium (U)-Dissolved (mg/L)	0.00149	0.00310	0.00358	0.00379	0.00149
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00057	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0084	<0.0010	0.0056	0.0054	0.0109
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2324402-11 Description: Water Sampled Date: 06-AUG-19 Sampled Time: 10:10 Client ID: MW17-08-01	Sample ID: L2324402-12 Description: Water Sampled Date: 06-AUG-19 Sampled Time: 11:30 Client ID: MW17-08-02	Sample ID: L2324402-13 Description: Water Sampled Date: 06-AUG-19 Sampled Time: 13:35 Client ID: MW17-08-03	Sample ID: L2324402-14 Description: Water Sampled Date: 02-AUG-19 Client ID: DUP	
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00922	0.00308	0.000786	0.00014	
	Nickel (Ni)-Dissolved (mg/L)	0.00166	<0.00050	<0.00050	DLA <0.0010	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	DLA <0.10	
	Potassium (K)-Dissolved (mg/L)	1.65	0.99	0.93	3.72	
	Selenium (Se)-Dissolved (mg/L)	0.000720	0.000791	0.000260	DLA <0.00010	
	Silicon (Si)-Dissolved (mg/L)	5.52	4.90	4.04	8.27	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	DLA <0.000020	
	Sodium (Na)-Dissolved (mg/L)	7.87	5.29	3.41	191	
	Strontium (Sr)-Dissolved (mg/L)	6.83	1.10	0.472	9.75	
	Sulfur (S)-Dissolved (mg/L)	11.8	4.04	1.01	502	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	DLA <0.000020	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	DLA <0.00020	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00047	DLA <0.00060	
	Uranium (U)-Dissolved (mg/L)	0.000249	0.000166	0.000106	0.000893	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00074	0.00089	DLA <0.0010	
	Zinc (Zn)-Dissolved (mg/L)	0.0692	0.0360	0.0262	0.0022	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	DLA <0.00040	

* 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	Barium (Ba)-Dissolved	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfate (SO4)	MS-B	L2324402-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
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.

ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1

Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

CL-IC-N-WR	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.

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 CaCO3 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.

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)

Reference Information

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.

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-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-08-07 E

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2324402-COFC

COC Number: 2019-08-07 E

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler: CR/DJ

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW12-07-02	1-Aug-19	8:55	Water		R		R	R		R							4
	MW09-03-01	1-Aug-19	13:45	Water		R		R	R		R							4
	MW09-03-02	1-Aug-19	15:15	Water		R		R	R		R							4
	MW12-05-01	2-Aug-19	8:45	Water		R		R	R		R							4
	MW12-05-02	2-Aug-19	10:20	Water		R		R	R		R							4
	MW12-05-03	2-Aug-19	11:20	Water		R		R	R		R							4
	MW12-05-04	2-Aug-19	13:20	Water		R		R	R		R							4
	MW12-05-05	2-Aug-19	14:05	Water		R		R	R		R							4
	MW12-05-06	2-Aug-19	14:40	Water		R		R	R		R							4
	MW12-05-07	2-Aug-19	15:40	Water		R		R	R		R							4
	MW17-08-01	6-Aug-19	10:00	Water		R		R	R		R							4
	MW17-08-02	6-Aug-19	11:30	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
6.5			8	18	cooler

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-08-07	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: CC	Date: Aug 7 2019	Time: 3:38pm

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: BC	Date: 9/8/19.	Time: 11:50

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2324402-COFC

COC Number: 2019-08-07 E

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:** CR/DJ

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P	F/P	P	F/P	P	F/P								Number of Containers
					Total Metals(TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						
	MW17-08-03	6-Aug-19	13:35	Water		R		R	R		R							4
	Dup	2-Aug-19		Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
6.5			8	18	

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-08-07	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: Aug 7 2019	Time: 3:35pm

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 9/8/19	Time: 10:50

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 14-AUG-19
Report Date: 30-AUG-19 16:30 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2329555

Project P.O. #: 232818 (GW)
Job Reference:
C of C Numbers:
Legal Site Desc:

Comments:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2329555-1	L2329555-2	L2329555-3	L2329555-4	L2329555-5
	Description					
	Sampled Date	10-AUG-19	10-AUG-19	10-AUG-19	11-AUG-19	11-AUG-19
	Sampled Time	14:40	15:15	15:45	11:45	12:00
	Client ID	MW17-11-01	MW17-11-02	MW17-11-03	MW17-DP02	MW17-DP01
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	340	338	293	1440	1200
	Hardness (as CaCO3) (mg/L)	131	142	141	438	357
	pH (pH)	8.42	8.44	8.46	8.23	8.23
	Total Suspended Solids (mg/L)	8.0	<3.0	<3.0	10.2	16.2
	Total Dissolved Solids (mg/L)	199	198	167	1060	878
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	148	142	139	181	212
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.2	7.6	8.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	155	149	147	181	212
	Ammonia, Total (as N) (mg/L)	0.0132	<0.0050	<0.0050	6.60	2.51
	Bromide (Br) (mg/L)	0.269	<0.050	<0.050	<0.25 DLDS	<0.25 DLDS
	Chloride (Cl) (mg/L)	0.51	<0.50	<0.50	25.5	26.9
	Fluoride (F) (mg/L)	2.23	2.27	1.78	1.19	2.09
	Nitrate and Nitrite (as N) (mg/L)	0.0176	0.0136	0.0121	<0.025	<0.025
	Nitrate (as N) (mg/L)	0.0139	0.0126	0.0109	<0.025 DLDS	<0.025 DLDS
	Nitrite (as N) (mg/L)	0.0037	0.0011	0.0011	<0.0050 DLDS	<0.0050 DLDS
	Sulfate (SO4) (mg/L)	40.1	43.0	17.0	622	428
	Anion Sum (meq/L)	4.06	4.00	3.38	17.3	14.0
	Cation Sum (meq/L)	3.66	3.61	3.30	15.1	13.7
	Cation - Anion Balance (%)	-5.2	-5.2	-1.1	-6.9	-1.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0049	0.0018	0.0044	0.0046	0.0065
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	0.00019	0.00012
	Arsenic (As)-Dissolved (mg/L)	0.00183	0.00091	0.00032	0.00062	0.00074
	Barium (Ba)-Dissolved (mg/L)	0.0429	0.0414	0.0605	0.0259	0.0227
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.045	0.018	0.010	0.122	0.084
	Cadmium (Cd)-Dissolved (mg/L)	0.0000776	0.0000097	<0.000010 DLM	0.000388	0.000722
	Calcium (Ca)-Dissolved (mg/L)	34.8	37.6	36.4	115	90.1
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00081	0.00106
	Copper (Cu)-Dissolved (mg/L)	0.00055	<0.00020	<0.00020	0.0899	0.109
	Iron (Fe)-Dissolved (mg/L)	0.259	0.104	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0057	0.0052	0.0042	0.0077	0.0077

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2329555-6				
	Description					
	Sampled Date	11-AUG-19				
	Sampled Time	12:15				
	Client ID	MW17-DP03				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1710				
	Hardness (as CaCO3) (mg/L)	609				
	pH (pH)	8.00				
	Total Suspended Solids (mg/L)	69.0				
	Total Dissolved Solids (mg/L)	1390				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	190				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	190				
	Ammonia, Total (as N) (mg/L)	9.56				
	Bromide (Br) (mg/L)	<0.50 DLDS				
	Chloride (Cl) (mg/L)	30.6				
	Fluoride (F) (mg/L)	0.95				
	Nitrate and Nitrite (as N) (mg/L)	0.551				
	Nitrate (as N) (mg/L)	0.509 HTD				
	Nitrite (as N) (mg/L)	0.042				
	Sulfate (SO4) (mg/L)	762				
	Anion Sum (meq/L)	20.6				
	Cation Sum (meq/L)	17.2				
	Cation - Anion Balance (%)	-9.0				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0036				
	Antimony (Sb)-Dissolved (mg/L)	0.00017				
	Arsenic (As)-Dissolved (mg/L)	0.00038				
	Barium (Ba)-Dissolved (mg/L)	0.0271				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.231				
	Cadmium (Cd)-Dissolved (mg/L)	0.000980				
	Calcium (Ca)-Dissolved (mg/L)	186				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00487				
	Copper (Cu)-Dissolved (mg/L)	0.0462				
	Iron (Fe)-Dissolved (mg/L)	0.026				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0251				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2329555-1	L2329555-2	L2329555-3	L2329555-4	L2329555-5
Description					
Sampled Date	10-AUG-19	10-AUG-19	10-AUG-19	11-AUG-19	11-AUG-19
Sampled Time	14:40	15:15	15:45	11:45	12:00
Client ID	MW17-11-01	MW17-11-02	MW17-11-03	MW17-DP02	MW17-DP01
Grouping / **Analyte**					
WATER					
Dissolved Metals Magnesium (Mg)-Dissolved (mg/L)	10.6	11.6	12.2	36.8	32.0
Manganese (Mn)-Dissolved (mg/L)	0.0427	0.0457	0.0981	0.422	1.15
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.0120	0.00584	0.00445	0.0720	0.0326
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00206	0.00712
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	1.99	2.09	2.31	49.0	35.8
Selenium (Se)-Dissolved (mg/L)	0.000166	0.000050	0.000053	0.00123	0.000845
Silicon (Si)-Dissolved (mg/L)	5.69	5.50	5.22	3.01	3.77
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	22.5	16.5	9.59	106	126
Strontium (Sr)-Dissolved (mg/L)	0.920	0.974	0.947	16.3	6.53
Sulfur (S)-Dissolved (mg/L)	14.1	14.5	6.04	189	150
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000027	0.000021
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00017	0.00015
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000220	0.000268	0.00166	0.00554	0.00132
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0384	0.0256	0.0239	0.0036	0.0050
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2329555-6				
	Description					
	Sampled Date	11-AUG-19				
	Sampled Time	12:15				
	Client ID	MW17-DP03				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	35.3				
	Manganese (Mn)-Dissolved (mg/L)	2.19				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0146				
	Nickel (Ni)-Dissolved (mg/L)	0.00617				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	33.3				
	Selenium (Se)-Dissolved (mg/L)	0.000332				
	Silicon (Si)-Dissolved (mg/L)	4.96				
	Silver (Ag)-Dissolved (mg/L)	0.000012				
	Sodium (Na)-Dissolved (mg/L)	78.4				
	Strontium (Sr)-Dissolved (mg/L)	10.2				
	Sulfur (S)-Dissolved (mg/L)	234				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.000718				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0114				
	Zirconium (Zr)-Dissolved (mg/L)	<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	Barium (Ba)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2329555-6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2329555-6
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2329555-6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2329555-6
Matrix Spike	Nickel (Ni)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2329555-6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2329555-6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2329555-1, -2, -3, -4, -5
Matrix Spike	Sulfate (SO4)	MS-B	L2329555-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
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.			
ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1
Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.			
BR-L-IC-N-WR	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.			
CL-IC-N-WR	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-WR	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 CaCO3 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)

Reference Information

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.

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.

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-WR 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-WR 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-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2329555-COFC

COC Number: 2019-08-14 B

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)					Number of Containers
	MW17-11-01	10-Aug-19	14:40			R		R	R		R						4
	MW17-11-02	10-Aug-19	15:15			R		R	R		R						4
	MW17-11-03	10-Aug-19	15:45			R		R	R		R						4
	MW17-DP02	11-Aug-19	11:45			R		R	R		R						4
	MW17-DP01	11-Aug-19	12:00			R		R	R		R						4
	MW17-DP03	11-Aug-19	12:15			R		R	R		R						4

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☑	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
6.5			11 Aug		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chad Bustin	Date: 2019-08-14	Time:	Received by:	Date: Aug 14 2019	Time: 16:50	Received by:	Date: Aug 8/16/19	Time: 12pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 22-AUG-19
Report Date: 10-SEP-19 18:35 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2333885

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-08-21 B 1 of 2, 2019-08-21 B 2 of 2
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2333885-1	L2333885-2	L2333885-3	L2333885-4	L2333885-5
Description	Water	Water	Water	Water	Water
Sampled Date	15-AUG-19	15-AUG-19	15-AUG-19	15-AUG-19	15-AUG-19
Sampled Time	11:35	13:10	13:35	14:10	14:40
Client ID	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	973	956	954	965	886
Hardness (as CaCO3) (mg/L)	437	488	508	512	506
pH (pH)	8.26	8.13	8.22	8.20	8.26
Total Suspended Solids (mg/L)	4.0	4.2	<3.0	<3.0	<3.0
TDS (Calculated) (mg/L)	545	636	634	633	632
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	521	342	363	385	402
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	521	342	363	385	402
Ammonia, Total (as N) (mg/L)	0.0980	0.0410	0.0770	0.0090	0.0084
Chloride (Cl) (mg/L)	4.8	<2.5 DLDS	<2.5 DLDS	<2.5 DLDS	<2.5 DLDS
Nitrate and Nitrite (as N) (mg/L)	0.231	0.050	0.073	0.047	0.037
Nitrate (as N) (mg/L)	0.088	<0.025 DLDS	0.025	<0.025 DLDS	<0.025 DLDS
Nitrite (as N) (mg/L)	0.143	0.0498	0.0475	0.0473	0.0373
Sulfate (SO4) (mg/L)	<1.5 DLDS	218	206	196	186
Anion Sum (meq/L)	10.6	11.4	11.5	11.8	11.9
Cation Sum (meq/L)	11.7	11.6	11.9	11.9	11.8
Cation - Anion Balance (%)	5.1	1.0	1.8	0.7	-0.5
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0253	0.0031	0.0014	0.0013	0.0019
Antimony (Sb)-Dissolved (mg/L)	0.00021	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00894	0.00362	0.00053	0.00238	0.00053
Barium (Ba)-Dissolved (mg/L)	0.373	0.0284	0.0243	0.0176	0.0405
Beryllium (Be)-Dissolved (mg/L)	0.000161	0.000041	0.000024	0.000027	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.307	0.120	0.097	0.106	0.086
Cadmium (Cd)-Dissolved (mg/L)	0.0000327	<0.000020 DLM	0.0000050	0.0000162	0.0000156
Calcium (Ca)-Dissolved (mg/L)	132	130	112	106	105
Chromium (Cr)-Dissolved (mg/L)	0.00504	0.00013	0.00019	0.00030	0.00019
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00111
Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Iron (Fe)-Dissolved (mg/L)	0.307	1.07	0.822	0.784	0.119
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0115	0.0077	0.0074	0.0063	0.0062
Magnesium (Mg)-Dissolved (mg/L)	26.3	39.7	55.3	60.0	59.1
Manganese (Mn)-Dissolved (mg/L)	0.276	0.0255	0.0145	0.0464	0.396

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2333885-6	L2333885-7	L2333885-8	L2333885-9	L2333885-10
Description	Water	Water	Water	Water	Water
Sampled Date	15-AUG-19	16-AUG-19	16-AUG-19	16-AUG-19	16-AUG-19
Sampled Time	15:10	12:15	15:30	15:50	16:10
Client ID	MW12-06-06	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	814	2390	2200	814	754
Hardness (as CaCO3) (mg/L)	413	960	852	340	349
pH (pH)	8.58	8.27	8.25	8.31	8.54
Total Suspended Solids (mg/L)	<3.0	7.8	6.8	<3.0	<3.0
TDS (Calculated) (mg/L)	533	2040	1820	513	458
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	308 RRV	228	228	343	313
Alkalinity, Carbonate (as CaCO3) (mg/L)	17.4	<1.0	<1.0	4.6	27.2
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	325 RRV	228	228	347	340
Ammonia, Total (as N) (mg/L)	0.0086	0.0052	<0.0050	0.0061	<0.0050
Chloride (Cl) (mg/L)	8.0	13	12	<2.5 DLDS	<2.5 DLDS
Nitrate and Nitrite (as N) (mg/L)	0.976	<0.10	<0.10	<0.025	0.179
Nitrate (as N) (mg/L)	0.853	<0.10 DLDS	<0.10 DLDS	<0.025 DLDS	0.179
Nitrite (as N) (mg/L)	0.124	<0.020 DLDS	<0.020 DLDS	<0.0050 DLDS	<0.0050 DLDS
Sulfate (SO4) (mg/L)	157	1280	1110	121	102
Anion Sum (meq/L)	10.1	31.5	28.0	9.46	8.93
Cation Sum (meq/L)	9.79	30.6	27.9	9.76	8.75
Cation - Anion Balance (%)	-1.4	-1.4	-0.2	1.6	-1.0
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0045	0.0026	<0.0050 DLA	0.0019	0.0023
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00050 DLA	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00011	0.00234	0.00260	0.00161	0.00016
Barium (Ba)-Dissolved (mg/L)	0.0151	0.00948	0.00823	0.0149	0.0217
Beryllium (Be)-Dissolved (mg/L)	<0.000020	0.000072	0.000042	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.00025 DLA	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.095	0.193	0.167	0.059	0.042
Cadmium (Cd)-Dissolved (mg/L)	0.000196	0.000211	0.000054	0.0000301	0.0000170
Calcium (Ca)-Dissolved (mg/L)	79.4	296	263	80.4	61.4
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00050 DLA	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00050 DLA	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00187	<0.00040 DLA	<0.0010 DLA	<0.00020	0.00077
Iron (Fe)-Dissolved (mg/L)	0.020	2.85	2.01	0.122	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.00025 DLA	0.000129	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0050	0.0152	0.0156	0.0091	0.0072
Magnesium (Mg)-Dissolved (mg/L)	52.2	53.4	47.6	33.7	47.6
Manganese (Mn)-Dissolved (mg/L)	0.0409	0.0965	0.0539	0.0922	0.00215

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2333885-11	L2333885-12	L2333885-13	L2333885-14	L2333885-15
Description	Water	Water	Water	Water	Water
Sampled Date	16-AUG-19	16-AUG-19	16-AUG-19	16-AUG-19	17-AUG-19
Sampled Time	16:30	16:45	17:00	17:20	14:55
Client ID	MW17-12-05	MW17-12-06	MW17-12-07	MW17-12-08	MW17-10-01
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	750	751	577	572	431
Hardness (as CaCO3) (mg/L)	362	361	277	274	199
pH (pH)	8.41	8.52	8.49	8.52	8.07
Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	3.0
TDS (Calculated) (mg/L)	449	452	337	337	263
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	311	320	237	237	126
Alkalinity, Carbonate (as CaCO3) (mg/L)	29.8	28.4	18.8	18.8	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	341	349	256	256	126
Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	0.0258
Chloride (Cl) (mg/L)	2.9	3.1	5.08	4.96	0.84
Nitrate and Nitrite (as N) (mg/L)	0.270	0.281	0.629	0.659	13.1
Nitrate (as N) (mg/L)	0.270	0.281	0.629	0.657	13.1
Nitrite (as N) (mg/L)	<0.0050 DLDS	<0.0050 DLDS	<0.0010	0.0022	0.0024
Sulfate (SO4) (mg/L)	91.3	89.9	65.0	64.7	49.5
Anion Sum (meq/L)	8.81	8.94	6.66	6.65	4.50
Cation Sum (meq/L)	8.72	8.71	6.52	6.50	4.44
Cation - Anion Balance (%)	-0.5	-1.3	-1.0	-1.2	-0.6
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0031	0.0024	0.0023	0.0016	0.0041
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	<0.00010	0.00069
Barium (Ba)-Dissolved (mg/L)	0.0588	0.0504	0.0212	0.0220	0.0271
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.036	0.036	0.027	0.027	0.018
Cadmium (Cd)-Dissolved (mg/L)	0.0000277	0.0000334	0.0000125	0.0000136	0.0000351
Calcium (Ca)-Dissolved (mg/L)	63.2	63.0	48.6	48.3	50.2
Chromium (Cr)-Dissolved (mg/L)	0.00138	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	0.00019	0.00018	<0.00010	<0.00010	0.00052
Copper (Cu)-Dissolved (mg/L)	0.00347	0.00328	0.00060	0.00061	0.00356
Iron (Fe)-Dissolved (mg/L)	0.018	<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0085	0.0092	0.0060	0.0061	0.0016
Magnesium (Mg)-Dissolved (mg/L)	49.7	49.4	37.7	37.2	18.0
Manganese (Mn)-Dissolved (mg/L)	0.169	0.114	0.00201	0.00054	0.0293

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2333885-16	L2333885-17	L2333885-18		
	Description	Water	Water	Water		
	Sampled Date	17-AUG-19	17-AUG-19	17-AUG-19		
	Sampled Time	15:40	16:00			
	Client ID	MW17-10-02	MW17-10-03	DUP		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	494	507	424		
	Hardness (as CaCO3) (mg/L)	222	237	202		
	pH (pH)	8.12	7.77	8.29		
	Total Suspended Solids (mg/L)	3.6	<3.0	<3.0		
	TDS (Calculated) (mg/L)	308	320	263		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	112	118	124		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	112	118	124		
	Ammonia, Total (as N) (mg/L)	0.0145	0.0098	0.0180		
	Chloride (Cl) (mg/L)	1.05	1.09	0.80		
	Nitrate and Nitrite (as N) (mg/L)	29.0	29.6	13.0		
	Nitrate (as N) (mg/L)	29.0	29.6	13.0		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0031		
	Sulfate (SO4) (mg/L)	25.6	25.2	49.9		
	Anion Sum (meq/L)	4.88	5.02	4.47		
	Cation Sum (meq/L)	4.80	5.10	4.47		
	Cation - Anion Balance (%)	-0.8	0.7	0.0		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0019	0.0014	0.0041		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00015	0.00020	0.00020		
	Barium (Ba)-Dissolved (mg/L)	0.0348	0.0392	0.0267		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	0.014		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000120	0.0000261	<0.000020 DLM		
	Calcium (Ca)-Dissolved (mg/L)	59.3	65.0	51.0		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	0.00054	0.00042	0.00055		
	Copper (Cu)-Dissolved (mg/L)	0.00107	0.00111	0.00410		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0012	0.0016		
	Magnesium (Mg)-Dissolved (mg/L)	17.9	18.1	18.1		
	Manganese (Mn)-Dissolved (mg/L)	0.00178	0.00089	0.0307		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2333885-1	L2333885-2	L2333885-3	L2333885-4	L2333885-5
Description	Water	Water	Water	Water	Water
Sampled Date	15-AUG-19	15-AUG-19	15-AUG-19	15-AUG-19	15-AUG-19
Sampled Time	11:35	13:10	13:35	14:10	14:40
Client ID	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05
Grouping **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00106	0.00958	0.00118	0.00830	0.00964
Nickel (Ni)-Dissolved (mg/L)	0.00063	<0.00050	<0.00050	<0.00050	0.00064
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	3.12	3.71	4.06	3.85	3.83
Selenium (Se)-Dissolved (mg/L)	0.00632	0.000531	0.000358	0.000346	0.000238
Silicon (Si)-Dissolved (mg/L)	8.46	10.2	9.48	8.70	8.40
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	65.2	38.6	37.6	35.9	35.7
Strontium (Sr)-Dissolved (mg/L)	5.13	9.19	4.69	3.13	2.79
Sulfur (S)-Dissolved (mg/L)	35.0	74.4	68.5	65.8	65.5
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	0.00019	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	0.00448	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000736	0.00289	0.00222	0.00629	0.00641
Vanadium (V)-Dissolved (mg/L)	0.0192	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0055	0.0038	<0.0010	0.0083	0.0105
Zirconium (Zr)-Dissolved (mg/L)	0.00117	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2333885-6	L2333885-7	L2333885-8	L2333885-9	L2333885-10
	Description	Water	Water	Water	Water	Water
	Sampled Date	15-AUG-19	16-AUG-19	16-AUG-19	16-AUG-19	16-AUG-19
	Sampled Time	15:10	12:15	15:30	15:50	16:10
	Client ID	MW12-06-06	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00582	0.00783	0.00817	0.00579	0.00507
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.0025 DLA	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 DLA	<0.25 DLA	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.71	3.59	3.23	2.97	3.15
	Selenium (Se)-Dissolved (mg/L)	0.000513	0.00027	<0.00025 DLA	0.000143	0.000705
	Silicon (Si)-Dissolved (mg/L)	7.50	7.70	7.45	7.99	7.39
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000050 DLA	<0.000010	0.000017
	Sodium (Na)-Dissolved (mg/L)	33.0	257	246	66.3	38.8
	Strontium (Sr)-Dissolved (mg/L)	1.58	9.60	11.3	3.63	1.38
	Sulfur (S)-Dissolved (mg/L)	57.7	489	381	42.0	36.7
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000050 DLA	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00014	<0.00020 DLA	<0.00050 DLA	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00034	<0.00060 DLA	<0.0015 DLA	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00441	0.000295	0.000466	0.00452	0.00431
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.0025 DLA	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0284	0.0549	0.0743	0.0411	0.0408
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00040 DLA	<0.0010 DLA	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2333885-11	L2333885-12	L2333885-13	L2333885-14	L2333885-15
Description	Water	Water	Water	Water	Water
Sampled Date	16-AUG-19	16-AUG-19	16-AUG-19	16-AUG-19	17-AUG-19
Sampled Time	16:30	16:45	17:00	17:20	14:55
Client ID	MW17-12-05	MW17-12-06	MW17-12-07	MW17-12-08	MW17-10-01
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.0144	0.0193	0.00596	0.00717	0.0164
Nickel (Ni)-Dissolved (mg/L)	0.00307	0.00254	<0.00050	<0.00050	0.0106
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	4.06	4.23	2.70	2.77	1.50
Selenium (Se)-Dissolved (mg/L)	0.000310	0.000203	0.000268	0.000308	0.00110
Silicon (Si)-Dissolved (mg/L)	7.09	7.29	6.72	6.67	5.36
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	31.5	31.9	21.2	22.0	9.54
Strontium (Sr)-Dissolved (mg/L)	1.59	1.50	0.980	0.983	1.30
Sulfur (S)-Dissolved (mg/L)	32.5	31.9	22.0	21.7	17.0
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00409	0.00403	0.00296	0.00295	0.00224
Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00055	0.00059	0.00064	0.00074
Zinc (Zn)-Dissolved (mg/L)	0.0389	0.0157	0.0169	0.0166	0.0325
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2333885-16	L2333885-17	L2333885-18		
	Description	Water	Water	Water		
	Sampled Date	17-AUG-19	17-AUG-19	17-AUG-19		
	Sampled Time	15:40	16:00			
	Client ID	MW17-10-02	MW17-10-03	DUP		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00752	0.00714	0.0165		
	Nickel (Ni)-Dissolved (mg/L)	0.00112	0.00169	0.0119		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.69	1.76	1.48		
	Selenium (Se)-Dissolved (mg/L)	0.00283	0.00324	0.00113		
	Silicon (Si)-Dissolved (mg/L)	5.20	5.28	5.47		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	7.26	7.34	9.21		
	Strontium (Sr)-Dissolved (mg/L)	1.09	1.02	1.31		
	Sulfur (S)-Dissolved (mg/L)	8.83	8.97	17.6		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00122	0.00119	0.00226		
	Vanadium (V)-Dissolved (mg/L)	0.00062	0.00062	0.00084		
	Zinc (Zn)-Dissolved (mg/L)	0.0195	0.0242	0.0204		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<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	Barium (Ba)-Dissolved	MS-B	L2333885-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2333885-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2333885-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2333885-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2333885-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

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.

ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1

Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

CL-IC-N-WR	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.

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 CaCO3 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.

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.

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

Reference Information

al.

NO2-L-IC-N-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-08-21 B 1 of 2 2019-08-21 B 2 of 2

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental — Canada Toll Free: 1 800 668 9878 — www.alsglobal.com

L2333885-COFC

COC Number: 2019-08-21 B

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax mintoenvironment@mintomine.com
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax ap@mintomine.com
Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)			EMERGENCY	
	4 day [P4]	☐		1 Business day [E1] ☐
	3 day [P3]	☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:**

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Disolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW12-06-01	15-Aug-19	11:35 ✓	Water		R		R	R		R							4
	MW12-06-02	15-Aug-19	13:10 ✓	Water		R		R	R		R							4
	MW12-06-03	15-Aug-19	13:35 ✓	Water		R		R	R		R							4
	MW12-06-04	15-Aug-19	14:10 ✓	Water		R		R	R		R							4
	MW12-06-05	15-Aug-19	14:40 ✓	Water		R		R	R		R							4
	MW12-06-06	15-Aug-19	15:10 ✓	Water		R		R	R		R							4
	MW17-12-01	16-Aug-19	12:15 ✓	Water		R		R	R		R							4
	MW17-12-02	16-Aug-19	15:30 ✓	Water		R		R	R		R							4
	MW17-12-03	16-Aug-19	15:50 ✓	Water		R		R	R		R							4
	MW17-12-04	16-Aug-19	16:10 ✓	Water		R		R	R		R							4
	MW17-12-05	16-Aug-19	16:30 ✓	Water		R		R	R		R							4
	MW17-12-06	16-Aug-19	16:45 ✓	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	
	7.1		6

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chad Bustin	Date: 2019-08-21	Time:	Received by:	Date: Aug 22	Time: 9:30	Received by:	Date: 8/23	Time: 12 pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW)** System, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental — Canada Toll Free: 1 800 668 9878 — www.alsglobal.com

L2333885-COFC

COC Number: 2019-08-21 B

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		**ALS Contact:**	**Sampler:**

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P	F/P	P	F/P	P	F/P							Number of Containers
					Total Metals(TM)	Disolved Metals (DM)	Total Mercury. Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)					
	MW17-12-07	16-Aug-19	17:00 ✓			R		R	R		R						4
	MW17-12-08	16-Aug-19	17:20 ✓			R		R	R		R						4
	MW17-10-01	17-Aug-19	14:55 ✓			R		R	R		R						4
	MW17-10-02	17-Aug-19	15:40 ✓			R		R	R		R						4
	MW17-10-03	17-Aug-19	16:00 ✓			R		R	R		R						4
	DUP	17-Aug-19	✓			R		R	R		R						4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chad Bustin	Date: August 21st, 2019	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 18-SEP-19
Report Date: 30-SEP-19 17:40 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2350215

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-09-18 B
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2350215-1	L2350215-2	L2350215-3		
	Description	Water	Water	Water		
	Sampled Date	12-SEP-19	13-SEP-19	13-SEP-19		
	Sampled Time	09:30	16:40	16:50		
	Client ID	MW12-07-02	MW09-03-01	MW09-03-02		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	891	311	524		
	Hardness (as CaCO3) (mg/L)	411	144	252		
	pH (pH)	8.31	8.35	8.40		
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0		
	TDS (Calculated) (mg/L)	618	170	307		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	193	142	213		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.8	6.6	12.8		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	199	148	226		
	Ammonia, Total (as N) (mg/L)	0.0198	0.0312	0.0063		
	Chloride (Cl) (mg/L)	8.28	0.45	1.25		
	Nitrate and Nitrite (as N) (mg/L)	1.31	0.0907	14.0		
	Nitrate (as N) (mg/L)	1.19	0.0164	13.9		
	Nitrite (as N) (mg/L)	0.124	0.0743	0.0656		
	Sulfate (SO4) (mg/L)	299	18.0	4.84		
	Anion Sum (meq/L)	10.5	3.36	5.65		
	Cation Sum (meq/L)	9.86	3.37	5.40		
	Cation - Anion Balance (%)	-3.3	0.2	-2.3		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0027	0.0021	0.0013		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00058	0.00407	0.00140		
	Barium (Ba)-Dissolved (mg/L)	0.0250	0.0691	0.0309		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.173	0.079	0.096		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000070 DLM	0.000336	0.000229		
	Calcium (Ca)-Dissolved (mg/L)	118	37.0	82.7		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	0.00032	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00210	0.00079	0.00321		
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.370	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0160	0.0038	0.0015		
	Magnesium (Mg)-Dissolved (mg/L)	28.5	12.6	11.1		
	Manganese (Mn)-Dissolved (mg/L)	0.653	0.0936	0.00387		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2350215-1	L2350215-2	L2350215-3		
	Description	Water	Water	Water		
	Sampled Date	12-SEP-19	13-SEP-19	13-SEP-19		
	Sampled Time	09:30	16:40	16:50		
	Client ID	MW12-07-02	MW09-03-01	MW09-03-02		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0217	0.00492	0.00332		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00066	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.89	2.76	3.14		
	Selenium (Se)-Dissolved (mg/L)	0.000581	0.000063	0.000225		
	Silicon (Si)-Dissolved (mg/L)	6.57	5.32	5.77		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	35.7	8.96	6.31		
	Strontium (Sr)-Dissolved (mg/L)	3.34	0.975	0.513		
	Sulfur (S)-Dissolved (mg/L)	102	6.37	1.88		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00365	0.000668	0.00375		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0585	0.0219	0.0525		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<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	Arsenic (As)-Dissolved	MS-B	L2350215-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2350215-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2350215-2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2350215-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2350215-2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2350215-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2350215-2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2350215-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2350215-2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2350215-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2350215-2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2350215-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2350215-2, -3
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2350215-1
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2350215-2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	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.

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 CaCO3 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.

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]

Reference Information

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.

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-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-09-18 B

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.

L2350215-COFC

# of Custody (COC) / Analytical Request Form

anada Toll Free: 1 800 668 9878

L2350215-COFC

COC Number: 2019-09-18 B

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:**

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW12-07-02	12-Sep-19	9:30	Water		R		R	R		R							4
	MW09-03-01	13-Sep-19	16:40	Water		R		R	R		R							4
	MW09-03-02	13-Sep-19	16:50	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
4.3	4.8				4

SHIPMENT RELEASE (client use)		
Released by: Chad Bustin	Date: 2019-09-18	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: Sept 18, 2019	Time: 5:00

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 9/20	Time: 11:15

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 10-OCT-19
Report Date: 22-OCT-19 15:56 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2363786

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-10-09 B
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2363786-1	L2363786-2	L2363786-3	L2363786-4	L2363786-5
Description	Water	Water	Water	Water	Water
Sampled Date	03-OCT-19	03-OCT-19	03-OCT-19	04-OCT-19	04-OCT-19
Sampled Time	08:00	08:40	14:05	09:30	10:30
Client ID	MW09-03-01	MW09-03-02	MW12-07-02	MW12-05-01	MW12-05-02
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	308	561	875	2330	2250
Hardness (as CaCO3) (mg/L)	151	281	418	1060	1070
pH (pH)	8.36	8.42	8.35	8.13	8.27
Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	4.0	5.0
TDS (Calculated) (mg/L)	172	342	605	1990	3080
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	143	215	176	125	172
Alkalinity, Carbonate (as CaCO3) (mg/L)	6.8	14.2	8.8	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	150	229	185	125	172
Ammonia, Total (as N) (mg/L)	0.0393	<0.0050	0.0142	0.0706	0.0177
Chloride (Cl) (mg/L)	<0.50	1.36	8.7	13	25
Nitrate and Nitrite (as N) (mg/L)	0.0660	19.2	1.47	<0.10	<0.10
Nitrate (as N) (mg/L)	0.0129	19.1	1.24	<0.10 DLDS	<0.10 DLDS
Nitrite (as N) (mg/L)	0.0531	0.0271	0.229	<0.020 DLDS	<0.020 DLDS
Sulfate (SO4) (mg/L)	17.6	4.61	292	1330	2400
Anion Sum (meq/L)	3.37	6.08	10.1	30.5	54.2
Cation Sum (meq/L)	3.48	5.96	10.0	28.8	28.1
Cation - Anion Balance (%)	1.6	-1.0	-0.5	-2.9	-31.7
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0020	<0.0010	0.0019	0.0047	0.0044
Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010	0.00011	<0.00020 DLA	<0.00020 DLA
Arsenic (As)-Dissolved (mg/L)	0.00085	0.00012	0.00033	0.00074	0.00042
Barium (Ba)-Dissolved (mg/L)	0.0651	0.0310	0.0242	0.0306	0.0656
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000040 DLA	<0.000040 DLA
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA
Boron (B)-Dissolved (mg/L)	0.112	0.041	0.234	0.113	0.075
Cadmium (Cd)-Dissolved (mg/L)	0.0000217	0.0000275	0.000105	0.000192	0.000011
Calcium (Ca)-Dissolved (mg/L)	39.9	93.2	118	354	328
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	0.00022	0.00037
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00030	<0.00020 DLA	<0.00020 DLA
Copper (Cu)-Dissolved (mg/L)	0.00022	0.00239	0.00365	<0.00040 DLA	<0.00040 DLA
Iron (Fe)-Dissolved (mg/L)	0.429	0.016	<0.010	0.050	0.029
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.00010 DLA	<0.00010 DLA
Lithium (Li)-Dissolved (mg/L)	0.0037	0.0016	0.0170	0.0080	0.0054
Magnesium (Mg)-Dissolved (mg/L)	12.5	11.8	30.0	43.7	60.3
Manganese (Mn)-Dissolved (mg/L)	0.0891	0.00516	0.624	0.163	0.774

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2363786-6 Water 04-OCT-19 10:40 MW12-05-03	L2363786-7 Water 04-OCT-19 15:35 MW12-05-04	L2363786-8 Water 04-OCT-19 11:40 MW12-05-05	L2363786-9 Water 04-OCT-19 16:00 MW12-05-06	L2363786-10 Water 04-OCT-19 12:10 MW12-05-07
WATER						
Physical Tests	Conductivity (uS/cm)	1840	523	540	534	543
	Hardness (as CaCO3) (mg/L)	905	260	276	269	269
	pH (pH)	8.32	8.43	8.41	8.40	8.31
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	5.0
	TDS (Calculated) (mg/L)	1440	312	325	317	319
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	236	238	236	236	242
	Alkalinity, Carbonate (as CaCO3) (mg/L)	6.8	14.4	13.4	12.4	5.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	243	253	250	248	247
	Ammonia, Total (as N) (mg/L)	0.0166	0.0330	0.0139	0.0074	0.318
	Chloride (Cl) (mg/L)	<10 DLDS	4.97	5.06	5.03	5.41
	Nitrate and Nitrite (as N) (mg/L)	<0.10	<0.0051	0.0363	0.0270	0.0104
	Nitrate (as N) (mg/L)	<0.10 DLDS	<0.0050	0.0183	0.0246	0.0104
	Nitrite (as N) (mg/L)	<0.020 DLDS	<0.0010	0.0180	0.0024	<0.0010
	Sulfate (SO4) (mg/L)	868	47.9	60.0	55.6	56.6
	Anion Sum (meq/L)	22.9	6.19	6.38	6.26	6.26
	Cation Sum (meq/L)	23.1	6.20	6.37	6.20	6.31
	Cation - Anion Balance (%)	0.3	0.1	-0.1	-0.5	0.4
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0095	0.0038	0.0029	0.0021	0.0018
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	<0.00020 DLA	0.00016	0.00016	0.00016	0.00155
	Barium (Ba)-Dissolved (mg/L)	0.0377	0.0517	0.0643	0.0708	0.0899
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 DLA	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.070	0.055	0.050	0.037	0.038
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010 DLA	0.000251	0.0000096	0.0000400	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	229	50.3	56.7	54.9	56.2
	Chromium (Cr)-Dissolved (mg/L)	0.00022	0.00023	<0.00010	<0.00010	0.00015
	Cobalt (Co)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	0.00026	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00040 DLA	0.00031	0.00114	0.00126	0.00025
	Iron (Fe)-Dissolved (mg/L)	0.473	0.055	0.025	0.046	1.50
	Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0046	0.0033	0.0039	0.0037	0.0034
	Magnesium (Mg)-Dissolved (mg/L)	80.8	32.5	32.6	32.1	31.1
	Manganese (Mn)-Dissolved (mg/L)	2.21	0.148	0.157	0.273	0.166

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2363786-11	L2363786-12	L2363786-13	L2363786-14	L2363786-15
Description	Water	Water	Water	Water	Water
Sampled Date	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19
Sampled Time	08:15	08:40	09:05	11:05	11:20
Client ID	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)	2430	2200	821	745	739
Hardness (as CaCO3) (mg/L)	962	868	347	359	375
pH (pH)	8.25	8.25	8.38	8.49	8.51
Total Suspended Solids (mg/L)	3.2	7.4	<3.0	<3.0	49.0
TDS (Calculated) (mg/L)	2010	1840	523	459	455
Anions and Nutrients Alkalinity, Bicarbonate (as CaCO3) (mg/L)	217	227	341	314	322
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	14.8	23.4	24.8
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	217	227	356	337	346
Ammonia, Total (as N) (mg/L)	0.0062	<0.0050	<0.0050	<0.0050	<0.0050
Chloride (Cl) (mg/L)	13	11.5	<2.5 DLDS	<2.5 DLDS	2.9
Nitrate and Nitrite (as N) (mg/L)	<0.10	<0.051	<0.025	0.166	0.266
Nitrate (as N) (mg/L)	<0.10 DLDS	<0.050 DLDS	<0.025 DLDS	0.159	0.260
Nitrite (as N) (mg/L)	0.020	<0.010 DLDS	0.0108	0.0069	0.0056
Sulfate (SO4) (mg/L)	1260	1130	124	103	91.6
Anion Sum (meq/L)	30.9	28.3	9.70	8.89	8.93
Cation Sum (meq/L)	30.2	28.3	9.83	8.93	8.96
Cation - Anion Balance (%)	-1.2	-0.1	0.7	0.2	0.2
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0025	0.0012	0.0023	0.0018	0.0026
Antimony (Sb)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00242	0.00249	0.00165	0.00014	0.00011
Barium (Ba)-Dissolved (mg/L)	0.0110	0.00714	0.0142	0.0204	0.0545
Beryllium (Be)-Dissolved (mg/L)	0.000078	0.000050	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.167	0.143	0.055	0.040	0.033
Cadmium (Cd)-Dissolved (mg/L)	0.000177	0.0000541	0.0000437	0.0000536	0.0000505
Calcium (Ca)-Dissolved (mg/L)	296	264	82.2	62.5	64.3
Chromium (Cr)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	0.00017
Copper (Cu)-Dissolved (mg/L)	<0.00040 DLA	<0.00020	0.00023	0.00089	0.00342
Iron (Fe)-Dissolved (mg/L)	2.86	2.22	0.129	<0.010	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0157	0.0151	0.0093	0.0073	0.0085
Magnesium (Mg)-Dissolved (mg/L)	54.1	50.5	34.4	49.2	52.0
Manganese (Mn)-Dissolved (mg/L)	0.0984	0.0569	0.0940	0.00297	0.147

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2363786-16 Water 05-OCT-19 11:40 MW17-12-06	L2363786-17 Water 05-OCT-19 12:30 MW17-12-07	L2363786-18 Water 05-OCT-19 12:45 MW17-12-08	L2363786-19 Water 04-OCT-19 DUP	L2363786-20 Water 05-OCT-19 DUP
WATER						
Physical Tests	Conductivity (uS/cm)	735	572	575	1830	741
	Hardness (as CaCO3) (mg/L)	377	282	285	925	378
	pH (pH)	8.52	8.44	8.48	8.31	8.49
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	454	336	339	1490	459
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	318	241	238	233	324
	Alkalinity, Carbonate (as CaCO3) (mg/L)	27.4	15.8	16.8	6.4	24.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	346	257	255	239	349
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0158	<0.0050
	Chloride (Cl) (mg/L)	3.0	4.96	5.07	9.7	3.2
	Nitrate and Nitrite (as N) (mg/L)	0.251	0.552	0.566	<0.051 DLDS	0.267
	Nitrate (as N) (mg/L)	0.251	0.550	0.562	<0.050 DLDS	0.261
	Nitrite (as N) (mg/L)	<0.0050 DLDS	0.0019	0.0038	<0.010 DLDS	0.0062
	Sulfate (SO4) (mg/L)	88.0	63.8	65.7	897	91.3
	Anion Sum (meq/L)	8.84	6.64	6.64	23.7	8.98
	Cation Sum (meq/L)	9.06	6.61	6.72	23.7	9.04
	Cation - Anion Balance (%)	1.2	-0.2	0.6	-0.1	0.3
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0027	0.0019	0.0013	0.0036	0.0027
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00013	0.00012	0.00014	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.0507	0.0206	0.0213	0.0394	0.0510
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.032	0.025	0.026	0.060	0.033
	Cadmium (Cd)-Dissolved (mg/L)	0.0000469	0.0000489	0.0000471	<0.0000050	0.0000481
	Calcium (Ca)-Dissolved (mg/L)	65.0	48.3	49.1	234	64.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00013	0.00012	0.00025	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00020	<0.00010	<0.00010	<0.00010	0.00020
	Copper (Cu)-Dissolved (mg/L)	0.00347	0.00065	0.00073	<0.00020	0.00343
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.548	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0093	0.0059	0.0061	0.0043	0.0093
	Magnesium (Mg)-Dissolved (mg/L)	52.2	39.1	39.4	82.4	52.3
	Manganese (Mn)-Dissolved (mg/L)	0.121	0.00219	0.00090	2.31	0.118

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2363786-1	L2363786-2	L2363786-3	L2363786-4	L2363786-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	03-OCT-19	03-OCT-19	03-OCT-19	04-OCT-19	04-OCT-19
	Sampled Time	08:00	08:40	14:05	09:30	10:30
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02	MW12-05-01	MW12-05-02
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00448	0.00266	0.0217	0.00033	0.00021
	Nickel (Ni)-Dissolved (mg/L)	0.00063	<0.00050	<0.00050	<0.0010 DLA	<0.0010 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.10 DLA	<0.10 DLA
	Potassium (K)-Dissolved (mg/L)	2.25	3.11	3.09	3.84	4.20
	Selenium (Se)-Dissolved (mg/L)	0.000096	0.000151	0.000718	0.00068	0.00056
	Silicon (Si)-Dissolved (mg/L)	5.72	6.10	6.59	8.03	7.64
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA
	Sodium (Na)-Dissolved (mg/L)	8.50	5.99	35.8	170	152
	Strontium (Sr)-Dissolved (mg/L)	0.958	0.551	3.33	9.90	11.9
	Sulfur (S)-Dissolved (mg/L)	5.98	1.53	98.2	485	449
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 DLA	<0.000020 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 DLA	<0.00020 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00060 DLA	<0.00060 DLA
	Uranium (U)-Dissolved (mg/L)	0.000740	0.00426	0.00406	0.000957	0.000747
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010 DLA	<0.0010 DLA
	Zinc (Zn)-Dissolved (mg/L)	0.0839	0.0343	0.0714	0.0039	<0.0020 DLA
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00040 DLA	<0.00040 DLA

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2363786-6 Water 04-OCT-19 10:40 MW12-05-03	L2363786-7 Water 04-OCT-19 15:35 MW12-05-04	L2363786-8 Water 04-OCT-19 11:40 MW12-05-05	L2363786-9 Water 04-OCT-19 16:00 MW12-05-06	L2363786-10 Water 04-OCT-19 12:10 MW12-05-07
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00019	0.00230	0.00538	0.00488	0.00302
	Nickel (Ni)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	0.00051	0.00095	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.10 DLA	<0.050	<0.050	<0.050	0.070
	Potassium (K)-Dissolved (mg/L)	4.18	2.45	2.41	2.28	2.25
	Selenium (Se)-Dissolved (mg/L)	0.00014	0.000773	0.000096	0.000125	0.000058
	Silicon (Si)-Dissolved (mg/L)	8.59	6.85	6.61	6.68	7.40
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	110	21.5	18.3	17.3	17.7
	Strontium (Sr)-Dissolved (mg/L)	8.56	0.993	0.936	0.860	0.816
	Sulfur (S)-Dissolved (mg/L)	324	21.9	19.4	18.3	18.6
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00090 DLM	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00166	0.00326	0.00366	0.00378	0.00151
	Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	0.00054	0.00053	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0020 DLA	0.0026	0.0137	0.0079	0.0110
	Zirconium (Zr)-Dissolved (mg/L)	<0.00040 DLA	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2363786-11	L2363786-12	L2363786-13	L2363786-14	L2363786-15
Description	Water	Water	Water	Water	Water
Sampled Date	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19	05-OCT-19
Sampled Time	08:15	08:40	09:05	11:05	11:20
Client ID	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05
Grouping / **Analyte**					
WATER					
Dissolved Metals					
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00792	0.00757	0.00565	0.00510	0.0126
Nickel (Ni)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	0.00278
Phosphorus (P)-Dissolved (mg/L)	<0.10 DLA	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	3.68	3.86	3.07	3.28	4.20
Selenium (Se)-Dissolved (mg/L)	0.00014	0.000091	<0.000050	0.000423	0.000224
Silicon (Si)-Dissolved (mg/L)	8.24	8.27	8.54	7.60	7.51
Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	0.000016	<0.000010
Sodium (Na)-Dissolved (mg/L)	247	246	64.7	38.6	31.2
Strontium (Sr)-Dissolved (mg/L)	9.55	10.4	3.61	1.41	1.61
Sulfur (S)-Dissolved (mg/L)	457	390	43.2	34.8	30.4
Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00060 DLA	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000292	0.000505	0.00429	0.00411	0.00407
Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0621	0.0499	0.0421	0.0280	0.0389
Zirconium (Zr)-Dissolved (mg/L)	<0.00040 DLA	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2363786-16 Water 05-OCT-19 11:40 MW17-12-06	L2363786-17 Water 05-OCT-19 12:30 MW17-12-07	L2363786-18 Water 05-OCT-19 12:45 MW17-12-08	L2363786-19 Water 04-OCT-19 DUP	L2363786-20 Water 05-OCT-19 DUP
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0189	0.00588	0.00722	0.000204	0.0190
	Nickel (Ni)-Dissolved (mg/L)	0.00259	<0.00050	<0.00050	<0.00050	0.00259
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	4.55	2.76	2.85	4.52	4.42
	Selenium (Se)-Dissolved (mg/L)	0.000136	0.000240	0.000231	0.000077	0.000155
	Silicon (Si)-Dissolved (mg/L)	7.53	6.97	7.08	8.48	7.72
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	32.2	21.0	21.8	114	31.7
	Strontium (Sr)-Dissolved (mg/L)	1.52	0.973	1.01	8.89	1.53
	Sulfur (S)-Dissolved (mg/L)	43.5	21.8	21.9	311	31.0
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00389	0.00289	0.00289	0.00162	0.00387
	Vanadium (V)-Dissolved (mg/L)	0.00053	0.00058	0.00066	<0.00050	0.00056
	Zinc (Zn)-Dissolved (mg/L)	0.0326	0.0456	0.0475	0.0015	0.0325
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<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)
Method Blank	Nitrite (as N)	B	L2363786-10, -11, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2363786-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2363786-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2363786-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2363786-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2363786-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2363786-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L2363786-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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]

Reference Information

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.

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-10-09 B

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2363786-COFC

COC Number: 2019-10-09 B

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Disolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW09-03-01	3-Oct-19	8:00	Water		R		R	R		R							4
	MW09-03-02	3-Oct-19	8:40	Water		R		R	R		R							4
	MW12-07-02	3-Oct-19	14:05	Water		R		R	R		R							4
	MW12-05-01	4-Oct-19	9:30	Water		R		R	R		R							4
	MW12-05-02	4-Oct-19	10:30	Water		R		R	R		R							4
	MW12-05-03	4-Oct-19	10:40	Water		R		R	R		R							4
	MW12-05-04	4-Oct-19	15:35	Water		R		R	R		R							4
	MW12-05-05	4-Oct-19	11:40	Water		R		R	R		R							4
	MW12-05-06	4-Oct-19	16:00	Water		R		R	R		R							4
	MW12-05-07	4-Oct-19	12:10	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
6°					4°

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Ian Smith	Date: 2019-10-09	Time:	Received by:	Date: OCT 9/19	Time: 15:05	Received by: RD	Date: Oct 10, 19	Time: 11:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2363786-COFC

COC Number: 2019-10-09 B

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)			EMERGENCY	
	4 day [P4]	☐	1 Business day [E1]	☐
	3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
	2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232818 (GW)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)	Number of Containers
	MW17-12-01	5-Oct-19	8:15	Water		R		R	R		R		4
	MW17-12-02	5-Oct-19	8:40	Water		R		R	R		R		4
	MW17-12-03	5-Oct-19	9:05	Water		R		R	R		R		4
	MW17-12-04	5-Oct-19	11:05	Water		R		R	R		R		4
	MW17-12-05	5-Oct-19	11:20	Water		R		R	R		R		4
	MW17-12-06	5-Oct-19	11:40	Water		R		R	R		R		4
	MW17-12-07	5-Oct-19	12:30	Water		R		R	R		R		4
	MW17-12-08	5-Oct-19	12:45	Water		R		R	R		R		4
	DUP	4-Oct-19		Water		R		R	R		R		4
	DUP	5-Oct-19		Water		R		R	R		R		4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
8					4°

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Ian Smith	Date: 2019-10-09	Time:	Received by:	Date: OCT 9/19.	Time: 15:05	Received by: RD	Date: Oct 10, 19	Time: 11:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 16-OCT-19
Report Date: 28-OCT-19 17:49 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2366479

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-10-16 C
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2366479-1 Water 14-OCT-19 10:20 MW17-11-01	L2366479-2 Water 14-OCT-19 11:00 MW17-11-02	L2366479-3 Water 14-OCT-19 11:20 MW17-11-03	L2366479-4 Water 14-OCT-19 13:40 MW17-11-04	L2366479-5 Water 15-OCT-19 17:00 MW17-DP02
WATER						
Physical Tests	Conductivity (uS/cm)	331	334	294	542	1960
	Hardness (as CaCO3) (mg/L)	137	145	144	345	969
	pH (pH)	8.23	8.22	8.26	8.11	8.04
	Total Suspended Solids (mg/L)	3.6	<3.0	<3.0	<3.0	22.0
	TDS (Calculated) (mg/L)	201	199	170	359	1670
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	146	146	152	271	176
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	146	146	152	271	176
	Ammonia, Total (as N) (mg/L)	0.0206	0.0087	<0.0050	0.0430	6.89
	Chloride (Cl) (mg/L)	0.72	0.42	0.40	1.14	27.5
	Nitrate and Nitrite (as N) (mg/L)	0.0185	<0.0051	<0.0051	7.22	1.70
	Nitrate (as N) (mg/L)	0.0142	<0.0050	<0.0050	7.22	1.48
	Nitrite (as N) (mg/L)	0.0042	<0.0010	0.0010	0.0063	0.228
	Sulfate (SO4) (mg/L)	38.9	42.1	16.2	17.9	974
	Anion Sum (meq/L)	3.76	3.81	3.39	6.33	24.7
	Cation Sum (meq/L)	3.83	3.66	3.38	7.66	27.5
	Cation - Anion Balance (%)	1.0	-2.1	-0.2	9.5	5.4
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0057	0.0026	0.0057	0.0042	0.016
	Antimony (Sb)-Dissolved (mg/L)	0.00013	<0.00010	<0.00010	0.00015	<0.0010 DLA
	Arsenic (As)-Dissolved (mg/L)	0.00219	0.00101	0.00032	0.00038	<0.0010 DLA
	Barium (Ba)-Dissolved (mg/L)	0.0404	0.0385	0.0590	0.194	0.0046
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050 DLA
	Boron (B)-Dissolved (mg/L)	0.036	0.019	0.011	0.015	0.15
	Cadmium (Cd)-Dissolved (mg/L)	0.000118	0.000128	0.000347	0.000472	0.000888
	Calcium (Ca)-Dissolved (mg/L)	37.3	39.1	38.3	103	265
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.0010 DLA
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00027	0.0024
	Copper (Cu)-Dissolved (mg/L)	0.00048	0.00038	0.00211	0.00381	0.116
	Iron (Fe)-Dissolved (mg/L)	0.241	0.106	0.012	<0.010	<0.10 DLA
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000056	<0.000050	<0.00050 DLA
	Lithium (Li)-Dissolved (mg/L)	0.0061	0.0055	0.0045	0.0088	0.018
	Magnesium (Mg)-Dissolved (mg/L)	10.7	11.4	11.9	21.3	74.4
	Manganese (Mn)-Dissolved (mg/L)	0.0438	0.0474	0.101	0.124	1.20

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2366479-6	L2366479-7	L2366479-8		
	Description	Water	Water	Water		
	Sampled Date	15-OCT-19	15-OCT-19	14-OCT-19		
	Sampled Time	17:15	17:25			
	Client ID	MW17-DP01	MW17-DP03	DUP		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	915	1680	325		
	Hardness (as CaCO3) (mg/L)	300	808	136		
	pH (pH)	8.23	7.90	8.16		
	Total Suspended Solids (mg/L)	12.8	5.8	<3.0		
	TDS (Calculated) (mg/L)	640	1390	195		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	209	153	141		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	209	153	141		
	Ammonia, Total (as N) (mg/L)	2.32	4.69	<0.0050		
	Chloride (Cl) (mg/L)	25.4	27.8	0.48		
	Nitrate and Nitrite (as N) (mg/L)	<0.025	7.17	<0.0051		
	Nitrate (as N) (mg/L)	<0.025 DLDS	7.15	<0.0050 HTD		
	Nitrite (as N) (mg/L)	<0.0050 DLDS	0.019	<0.0010		
	Sulfate (SO4) (mg/L)	244	821	38.8		
	Anion Sum (meq/L)	9.98	21.4	3.63		
	Cation Sum (meq/L)	11.5	20.6	3.71		
	Cation - Anion Balance (%)	6.9	-2.0	1.1		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0056	0.0073	0.0052		
	Antimony (Sb)-Dissolved (mg/L)	<0.00020 DLA	<0.00050 DLA	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00064	<0.00050 DLA	0.00196		
	Barium (Ba)-Dissolved (mg/L)	0.0223	0.0234	0.0410		
	Beryllium (Be)-Dissolved (mg/L)	<0.000040 DLA	<0.00010 DLA	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.00010 DLA	<0.00025 DLA	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.103	0.181	0.022		
	Cadmium (Cd)-Dissolved (mg/L)	0.000952	0.00162	0.0000481		
	Calcium (Ca)-Dissolved (mg/L)	77.8	254	37.5		
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 DLA	<0.00050 DLA	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	0.00046	0.00158	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.0751	0.109	0.00024		
	Iron (Fe)-Dissolved (mg/L)	<0.020 DLA	<0.050 DLA	0.254		
	Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.00025 DLA	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0084	0.0125	0.0061		
	Magnesium (Mg)-Dissolved (mg/L)	25.6	42.5	10.3		
	Manganese (Mn)-Dissolved (mg/L)	0.886	1.50	0.0413		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2366479-1	L2366479-2	L2366479-3	L2366479-4	L2366479-5
Description	Water	Water	Water	Water	Water
Sampled Date	14-OCT-19	14-OCT-19	14-OCT-19	14-OCT-19	15-OCT-19
Sampled Time	10:20	11:00	11:20	13:40	17:00
Client ID	MW17-11-01	MW17-11-02	MW17-11-03	MW17-11-04	MW17-DP02
Grouping / **Analyte**					
WATER					
Dissolved Metals					
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.0121	0.00572	0.00465	0.00991	0.0728
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00224	<0.0050 DLA
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.50 DLA
Potassium (K)-Dissolved (mg/L)	2.01	2.16	2.50	8.09	66.8
Selenium (Se)-Dissolved (mg/L)	0.000878	0.000117	0.000090	0.000327	0.00229
Silicon (Si)-Dissolved (mg/L)	5.49	5.24	4.88	10.9	3.51
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000027	<0.00010 DLA
Sodium (Na)-Dissolved (mg/L)	23.5	16.2	9.66	12.7	136
Strontium (Sr)-Dissolved (mg/L)	0.928	0.965	0.979	1.44	31.1
Sulfur (S)-Dissolved (mg/L)	13.5	13.4	5.54	7.11	375
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.00010 DLA
Tin (Sn)-Dissolved (mg/L)	0.00012	<0.00010	0.00010	0.00018	<0.0010 DLA
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.0030 DLA
Uranium (U)-Dissolved (mg/L)	0.000260	0.000269	0.00182	0.00536	0.0259
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0050 DLA
Zinc (Zn)-Dissolved (mg/L)	0.0245	0.0238	0.0307	0.0528	<0.010 DLA
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.0020 DLA

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2366479-6	L2366479-7	L2366479-8		
	Description	Water	Water	Water		
	Sampled Date	15-OCT-19	15-OCT-19	14-OCT-19		
	Sampled Time	17:15	17:25			
	Client ID	MW17-DP01	MW17-DP03	DUP		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0354	0.0303	0.0121		
	Nickel (Ni)-Dissolved (mg/L)	0.0062	0.0079	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.10 DLA	<0.25 DLA	<0.050		
	Potassium (K)-Dissolved (mg/L)	38.3	43.4	1.96		
	Selenium (Se)-Dissolved (mg/L)	0.00057	0.00278	0.000058		
	Silicon (Si)-Dissolved (mg/L)	3.47	5.22	5.42		
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000050 DLA	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	98.6	68.0	21.3		
	Strontium (Sr)-Dissolved (mg/L)	5.47	10.0	0.928		
	Sulfur (S)-Dissolved (mg/L)	101	264	12.8		
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000050 DLA	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	0.00041	<0.00050 DLA	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 DLA	<0.0015 DLA	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.000857	0.00361	0.000217		
	Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	<0.0025 DLA	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0082	0.0279	0.0146		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00040 DLA	<0.0010 DLA	<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	Barium (Ba)-Dissolved	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Nitrate (as N)	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfate (SO4)	MS-B	L2366479-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	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.

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 CaCO3 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.

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.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

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-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-10-16 C

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2366479-COFC

COC Number: 2019-10-16 C

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax mintoenvironment@mintomine.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax ap@mintomine.com

Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:

Job #:

PO / AFE: 232818 (GW)

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#

Major/Minor Code: | Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: | **Sampler:**

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Disolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)	Number of Containers
	MW17-11-01	14-Oct-19	10:20	WATER		R		R	R		R		4
	MW17-11-02	14-Oct-19	11:00	WATER		R		R	R		R		4
	MW17-11-03	14-Oct-19	11:20	WATER		R		R	R		R		4
	MW17-11-04	14-Oct-19	13:40	WATER		R		R	R		R		4
	MW17-DP02	15-Oct-19	17:00	WATER		R		R	R		R		4
	MW17-DP01	15-Oct-19	17:15	WATER		R		R	R		R		4
	MW17-DP03	15-Oct-19	17:25	WATER		R		R	R		R		4
	DUP	14-Oct-19		WATER		R		R	R		R		4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
4°				8°	10°

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chad Bustin	Date: 2019-10-16	Time:	Received by:	Date: OCT 16 /19	Time: 15:40	Received by: RD	Date: Oct 18, 19	Time: 11:05

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 23-OCT-19
Report Date: 04-NOV-19 18:00 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2370996

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-10-23 C 1 of 2, 2019-10-23 C 2 of 2
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2370996-1 Water 17-OCT-19 09:30 MW12-06-01	L2370996-2 Water 17-OCT-19 10:20 MW12-06-02	L2370996-3 Water 17-OCT-19 10:45 MW12-06-03	L2370996-4 Water 17-OCT-19 11:05 MW12-06-04	L2370996-5 Water 17-OCT-19 11:25 MW12-06-05
WATER						
Physical Tests	Conductivity (uS/cm)	1080	1010	998	1010	1010
	Hardness (as CaCO3) (mg/L)	463	501	481	492	508
	pH (pH)	7.62	7.83	8.12	8.13	8.22
	Total Suspended Solids (mg/L)	<3.0	21.5	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	609	654	631	635	637
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	495	368	390	407	408
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	495	368	390	407	408
	Ammonia, Total (as N) (mg/L)	1.17	0.0694	0.0840	0.0098	0.0088
	Chloride (Cl) (mg/L)	4.67	0.82	0.60	0.59	0.56
	Nitrate and Nitrite (as N) (mg/L)	1.65	0.107	0.073	0.060	0.057
	Nitrate (as N) (mg/L)	0.421	0.031	<0.025 DLDS	<0.025 DLDS	<0.025 DLDS
	Nitrite (as N) (mg/L)	1.22	0.0760	0.0731	0.0600	0.0567
	Sulfate (SO4) (mg/L)	53.3	213	196	191	186
	Anion Sum (meq/L)	11.3	11.8	11.9	12.1	12.0
	Cation Sum (meq/L)	12.7	11.8	11.3	11.5	11.8
	Cation - Anion Balance (%)	5.9	0.1	-2.5	-2.6	-1.1
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0247	<0.0020 DLA	<0.0010	0.0027	0.0011
	Antimony (Sb)-Dissolved (mg/L)	0.00060	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.0106	0.00344	0.00070	0.00238	0.00055
	Barium (Ba)-Dissolved (mg/L)	0.333	0.0251	0.0246	0.0171	0.0400
	Beryllium (Be)-Dissolved (mg/L)	0.000190	0.000060	0.000034	0.000036	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	1.29	0.109	0.112	0.070	0.086
	Cadmium (Cd)-Dissolved (mg/L)	0.0000313	<0.000010 DLA	<0.0000050	0.0000111	0.0000091
	Calcium (Ca)-Dissolved (mg/L)	141	137	106	100	108
	Chromium (Cr)-Dissolved (mg/L)	0.00451	<0.00020 DLA	0.00012	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	0.00116
	Copper (Cu)-Dissolved (mg/L)	0.00045	<0.00040 DLA	<0.00020	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	0.178	1.04	0.789	0.763	0.108
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0116	0.0083	0.0070	0.0061	0.0063
	Magnesium (Mg)-Dissolved (mg/L)	26.7	38.5	52.2	58.8	58.0
	Manganese (Mn)-Dissolved (mg/L)	0.269	0.0240	0.0169	0.0465	0.395

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2370996-6	L2370996-7	L2370996-8	L2370996-9	L2370996-10
	Description	Water	Water	Water	Water	Water
	Sampled Date	17-OCT-19	18-OCT-19	17-OCT-19	17-OCT-19	19-OCT-19
	Sampled Time	11:45	10:35	10:55	11:20	09:55
	Client ID	MW12-06-06	MW17-10-01	MW17-10-02	MW17-10-03	MW17-08-01
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	853	440	506	500	451
	Hardness (as CaCO3) (mg/L)	402	201	213	221	238
	pH (pH)	8.08	7.96	8.00	7.67	7.95
	Total Suspended Solids (mg/L)	<3.0	3.3	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	522	269	306	314	263
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	324	125	115	117	233
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	324	125	115	117	233
	Ammonia, Total (as N) (mg/L)	0.0091	0.0588	0.0831	0.0432	0.201
	Chloride (Cl) (mg/L)	7.34	0.92	1.25	1.28	0.56
	Nitrate and Nitrite (as N) (mg/L)	0.819	13.5	29.4	30.4	0.0160
	Nitrate (as N) (mg/L)	0.744	13.4	29.4	30.4	0.0160
	Nitrite (as N) (mg/L)	0.0746	0.0069	0.0135	0.0113	<0.0010
	Sulfate (SO4) (mg/L)	153	48.2	22.1	21.9	33.4
	Anion Sum (meq/L)	9.92	4.48	4.89	5.00	5.38
	Cation Sum (meq/L)	9.48	4.64	4.64	4.78	5.27
	Cation - Anion Balance (%)	-2.3	1.8	-2.6	-2.3	-1.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	0.0036	0.0026	0.0014	0.0025
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00017	<0.00010	<0.00010	<0.00020 DLA
	Arsenic (As)-Dissolved (mg/L)	0.00011	0.00025	0.00015	0.00022	0.00051
	Barium (Ba)-Dissolved (mg/L)	0.0133	0.0265	0.0328	0.0355	0.00814
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 DLA
	Boron (B)-Dissolved (mg/L)	0.078	0.023	0.010	<0.010	0.026
	Cadmium (Cd)-Dissolved (mg/L)	0.0000241	0.00150	0.000336	0.000166	0.00325
	Calcium (Ca)-Dissolved (mg/L)	79.0	50.6	56.4	60.1	46.8
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00052	0.00062	0.00039	<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)	0.00035	0.00890	0.00204	0.00162	0.00620
	Iron (Fe)-Dissolved (mg/L)	0.011	<0.010	<0.010	<0.010	<0.020 DLA
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000116	<0.000050	<0.000050	<0.00010 DLA
	Lithium (Li)-Dissolved (mg/L)	0.0049	0.0017	0.0012	0.0012	0.0021
	Magnesium (Mg)-Dissolved (mg/L)	49.7	18.1	17.5	17.2	29.5
	Manganese (Mn)-Dissolved (mg/L)	0.0323	0.0305	0.00331	0.00221	0.00364

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2370996-11	L2370996-12	L2370996-13		
Description	Water	Water	Water		
Sampled Date	19-OCT-19	19-OCT-19	19-OCT-19		
Sampled Time	10:45	11:00			
Client ID	MW17-08-02	MW17-08-03	DUP		
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	297	182	450		
Hardness (as CaCO3) (mg/L)	148	86.6	241		
pH (pH)	8.09	7.92	8.09		
Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0		
TDS (Calculated) (mg/L)	165	98.3	261		
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	159	97.6	232		
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
Alkalinity, Total (as CaCO3) (mg/L)	159	97.6	232		
Ammonia, Total (as N) (mg/L)	0.0133	0.0127	0.0254		
Chloride (Cl) (mg/L)	0.44	0.37	0.43		
Nitrate and Nitrite (as N) (mg/L)	0.680	0.663	0.417		
Nitrate (as N) (mg/L)	0.678	0.663	0.415		
Nitrite (as N) (mg/L)	0.0018	<0.0010	0.0025		
Sulfate (SO4) (mg/L)	10.2	2.43	32.9		
Anion Sum (meq/L)	3.45	2.06	5.37		
Cation Sum (meq/L)	3.21	1.89	5.18		
Cation - Anion Balance (%)	-3.6	-4.4	-1.8		
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0041	0.0152		
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
Arsenic (As)-Dissolved (mg/L)	0.00021	0.00018	<0.00010		
Barium (Ba)-Dissolved (mg/L)	0.0809	0.0496	0.00710		
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
Boron (B)-Dissolved (mg/L)	0.010	<0.010	0.023		
Cadmium (Cd)-Dissolved (mg/L)	0.000234	0.000172	0.000347		
Calcium (Ca)-Dissolved (mg/L)	33.5	23.2	48.2		
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00057		
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
Copper (Cu)-Dissolved (mg/L)	0.00259	0.00079	0.00281		
Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.029		
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000081		
Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	0.0020		
Magnesium (Mg)-Dissolved (mg/L)	15.6	6.97	29.2		
Manganese (Mn)-Dissolved (mg/L)	0.00106	0.00039	0.00157		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2370996-1 Water 17-OCT-19 09:30 MW12-06-01	L2370996-2 Water 17-OCT-19 10:20 MW12-06-02	L2370996-3 Water 17-OCT-19 10:45 MW12-06-03	L2370996-4 Water 17-OCT-19 11:05 MW12-06-04	L2370996-5 Water 17-OCT-19 11:25 MW12-06-05
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00189	0.0101	0.00170	0.00851	0.0103
	Nickel (Ni)-Dissolved (mg/L)	0.00069	<0.0010 DLA	<0.00050	<0.00050	0.00070
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 DLA	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	4.94	3.56	3.93	3.88	3.88
	Selenium (Se)-Dissolved (mg/L)	0.00478	<0.00010 DLA	0.000301	0.000226	0.000201
	Silicon (Si)-Dissolved (mg/L)	8.18	10.6	9.41	9.13	8.47
	Silver (Ag)-Dissolved (mg/L)	0.000027	<0.000020 DLA	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	73.0	38.4	36.1	35.3	34.5
	Strontium (Sr)-Dissolved (mg/L)	6.02	9.54	4.82	3.07	3.05
	Sulfur (S)-Dissolved (mg/L)	86.2	74.9	69.8	68.7	65.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00033	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00353	<0.00060 DLA	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000745	0.00280	0.00214	0.00578	0.00661
	Vanadium (V)-Dissolved (mg/L)	0.0182	<0.0010 DLA	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0075	0.0022	0.0021	0.0058	0.0127
	Zirconium (Zr)-Dissolved (mg/L)	0.00122	<0.00040 DLA	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2370996-6 Water 17-OCT-19 11:45 MW12-06-06	L2370996-7 Water 18-OCT-19 10:35 MW17-10-01	L2370996-8 Water 17-OCT-19 10:55 MW17-10-02	L2370996-9 Water 17-OCT-19 11:20 MW17-10-03	L2370996-10 Water 19-OCT-19 09:55 MW17-08-01
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00600	0.0159	0.00733	0.00671	0.00910
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.0119	0.00227	0.00275	0.0014
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.293	0.288	0.658	3.55
	Potassium (K)-Dissolved (mg/L)	3.49	5.36	1.95	1.92	2.79
	Selenium (Se)-Dissolved (mg/L)	0.000430	0.00133	0.00317	0.00354	0.00044
	Silicon (Si)-Dissolved (mg/L)	7.12	5.68	5.49	5.40	5.37
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000028	<0.000010	<0.000010	<0.000020 DLA
	Sodium (Na)-Dissolved (mg/L)	31.2	11.1	7.65	7.20	9.67
	Strontium (Sr)-Dissolved (mg/L)	1.64	1.26	1.04	0.950	6.36
	Sulfur (S)-Dissolved (mg/L)	54.2	16.9	8.93	8.45	11.3
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00023	<0.00010	<0.00010	<0.00020 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00060 DLA
	Uranium (U)-Dissolved (mg/L)	0.00409	0.00260	0.00138	0.00133	0.000260
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00060	0.00057	0.00060	<0.0010 DLA
	Zinc (Zn)-Dissolved (mg/L)	0.0168	0.0356	0.0326	0.0406	0.0468
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00040 DLA

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2370996-11	L2370996-12	L2370996-13		
	Description	Water	Water	Water		
	Sampled Date	19-OCT-19	19-OCT-19	19-OCT-19		
	Sampled Time	10:45	11:00			
	Client ID	MW17-08-02	MW17-08-03	DUP		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00289	0.000774	0.00900		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00095		
	Phosphorus (P)-Dissolved (mg/L)	0.086	0.063	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.36	0.75	1.66		
	Selenium (Se)-Dissolved (mg/L)	0.000546	0.000338	0.000466		
	Silicon (Si)-Dissolved (mg/L)	4.68	3.90	5.34		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	5.14	3.11	7.34		
	Strontium (Sr)-Dissolved (mg/L)	1.05	0.348	6.53		
	Sulfur (S)-Dissolved (mg/L)	3.74	1.14	11.9		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00081		
	Uranium (U)-Dissolved (mg/L)	0.000160	0.000095	0.000230		
	Vanadium (V)-Dissolved (mg/L)	0.00077	0.00095	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0184	0.0125	0.0357		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00049		

* 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)
Duplicate	Selenium (Se)-Dissolved	DUP-H	L2370996-1
Duplicate	Sulfur (S)-Dissolved	DUP-H	L2370996-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2370996-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2370996-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2370996-1
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2370996-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2370996-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2370996-1
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2370996-1
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2370996-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	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.

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 CaCO3 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.

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.

Reference Information

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-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-10-23 C 1 of 2 2019-10-23 C 2 of 2

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2370996-COFC

COC Number: 2019-10-23 C

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice To		
	Same as Report To	☐ YES ☑ NO
	Copy of Invoice with Report	☐ YES ☑ NO
Company:	Minto Explorations Ltd.	
Contact:	Ruth Cayetano	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: CB

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW12-06-01	17-Oct-19	9:30	Water		R		R	R		R							4
	MW12-06-02	17-Oct-19	10:20	Water		R		R	R		R							4
	MW12-06-03	17-Oct-19	10:45	Water		R		R	R		R							4
	MW12-06-04	17-Oct-19	11:05	Water		R		R	R		R							4
	MW12-06-05	17-Oct-19	11:25	Water		R		R	R		R							4
	MW12-06-06	17-Oct-19	11:45	Water		R		R	R		R							4
	MW17-10-01	18-Oct-19	10:35	Water		R		R	R		R							4
	MW17-10-02	18-Oct-19	10:55	Water		R		R	R		R							4
	MW17-10-03	18-Oct-19	11:20	Water		R		R	R		R							4
	MW17-08-01	19-Oct-19	9:55	Water		R		R	R		R							4
	MW17-08-02	19-Oct-19	10:45	Water		R		R	R		R							4
	MW17-08-03	19-Oct-19	11:00	Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	
9.7	7.7	2.9	

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-10-23	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: OCT 23/19	Time: 16:26

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 23 OCT 19	Time: 11:40AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System; please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

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L2370996-COFC

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Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice To		
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	Copy of Invoice with Report	☐ YES ☑ NO
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					P	F/P	P	F/P	P	F/P								
	DUP	19-Oct-19		Water		R		R	R		R							4

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Are samples for human drinking water use?
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Cooling Initiated ☐

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SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-10-23	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:

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Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 06-NOV-19
Report Date: 20-NOV-19 14:16 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2378300

Project P.O. #: 232818 (GW)
Job Reference:
C of C Numbers: 2019-11-05 B
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2378300-1	L2378300-2	L2378300-3	L2378300-4	
	Description	Water	Water	Water	Water	
	Sampled Date	02-NOV-19	02-NOV-19	02-NOV-19	02-NOV-19	
	Sampled Time	11:00	11:25	14:35		
	Client ID	MW09-03-01	MW09-03-02	MW12-07-02	DUP	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	308	526	877	879	
	Hardness (as CaCO3) (mg/L)	144	244	391	406	
	pH (pH)	8.37	8.37	8.38	8.41	
	Total Suspended Solids (mg/L)	3.2	<3.0	<3.0	<3.0	
	Total Dissolved Solids (mg/L)	186	354	629	636	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	145	213	178	176	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.6	6.4	7.8	9.8	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	150	219	185	186	
	Ammonia, Total (as N) (mg/L)	0.0453	0.0065	0.0144	0.0137	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	0.78	1.29	8.97	9.08	
	Fluoride (F) (mg/L)	1.79	0.334	0.742	0.746	
	Nitrate (as N) (mg/L)	<0.0050	18.3	1.30 RRV	1.26 RRV	
	Nitrite (as N) (mg/L)	0.0378	0.0260	0.131	0.0562	
	Sulfate (SO4) (mg/L)	19.0	4.93	291	293	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0022	0.0119	0.0022	0.0033	
	Antimony (Sb)-Dissolved (mg/L)	0.00012	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00099	0.00014	0.00028	0.00022	
	Barium (Ba)-Dissolved (mg/L)	0.0634	0.0293	0.0233	0.0232	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.129	0.097	0.126	0.090	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000380	0.0000551	0.000133	0.0000754	
	Calcium (Ca)-Dissolved (mg/L)	38.1	80.3	107	114	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00014	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00034	0.00029	
	Copper (Cu)-Dissolved (mg/L)	0.00024	0.00438	0.00442	0.00330	
	Iron (Fe)-Dissolved (mg/L)	0.456	0.037	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000184	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0036	0.0015	0.0165	0.0169	
	Magnesium (Mg)-Dissolved (mg/L)	11.9	10.6	29.8	29.7	
	Manganese (Mn)-Dissolved (mg/L)	0.0900	0.00499	0.647	0.645	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00469	0.00280	0.0214	0.0217	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2378300-1 Water 02-NOV-19 11:00 MW09-03-01	L2378300-2 Water 02-NOV-19 11:25 MW09-03-02	L2378300-3 Water 02-NOV-19 14:35 MW12-07-02	L2378300-4 Water 02-NOV-19 DUP	
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.00077	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.054	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	2.01	2.72	2.74	2.80	
	Selenium (Se)-Dissolved (mg/L)	0.000078	0.000186	0.000543	0.000574	
	Silicon (Si)-Dissolved (mg/L)	5.56	6.03	6.95	6.64	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	8.20	5.86	34.6	34.5	
	Strontium (Sr)-Dissolved (mg/L)	0.930	0.499	3.11	3.20	
	Sulfur (S)-Dissolved (mg/L)	6.47	1.93	106	102	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00115	<0.00030	<0.00030	
	Uranium (U)-Dissolved (mg/L)	0.000641	0.00352	0.00361	0.00385	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0964	0.0489	0.0299	0.0254	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<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	Barium (Ba)-Dissolved	MS-B	L2378300-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2378300-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2378300-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2378300-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2378300-1, -2, -3, -4
Matrix Spike	Nitrate (as N)	MS-B	L2378300-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

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.

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

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.

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

Reference Information

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.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-11-05 B

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Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax mintoenvironment@mintomine.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax ap@mintomine.com

Email 2

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Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						Number of Containers
	MW09-03-01	2-Nov-19	11:00	Water		R		R	R		R							4
	MW09-03-02	2-Nov-19	11:25	Water		R		R	R		R							4
	MW12-07-02	2-Nov-19	14:35	Water		R		R	R		R							4
	DUP	2-Nov-19		Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
		1°C			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Ian Smith	Date: 2019-11-05	Time:	Received by:	Date:	Time:	Received by: YY	Date: NOV 6	Time: 11:25

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **VA19A0292**	Page	: 1 of 4
Client	: **Minto Exploration Ltd.**	Laboratory	: Vancouver - Environmental
Contact	: Minto Environment - Coordinator	Account Manager	: Heather McKenzie
Address	: Suite 2100- 510 West Georgia St Vancouver BC Canada V6B 0M3	Address	: 8081 Lougheed Highway Burnaby BC Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: Minto Mine Monitoring	Date Samples Received	: 04-Dec-2019 14:00
PO	: 232818 (GW)	Date Analysis Commenced	: 05-Dec-2019
C-O-C number	: 2019-12-03 B	Issue Date	: 12-Dec-2019 16:16
Sampler	: ----		
Site	: ----		
Quote number	: Q54721-Standing Offer		
No. of samples received	: 4		
No. of samples analysed	: 4		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Brieanna Allen	Department Manager - Organics	Inorganics - Water Quality, Burnaby, British Columbia
Brieanna Allen	Department Manager - Organics	Metals, Burnaby, British Columbia
Cindy Tang	Team Leader - Inorganics	Inorganics - Water Quality, Burnaby, British Columbia
Ilnaz Badbezanchi	Team Leader - Metals preparation	Metals, Burnaby, British Columbia
Kevin Duarte	Team Leader - Inorganics	Inorganics - Water Quality, Burnaby, British Columbia
Kinny Wu	Laboratory Analyst	Metals, Burnaby, British Columbia
Lindsay Gung	Supervisor - Water Chemistry	Inorganics - Water Quality, Burnaby, British Columbia
Robin Weeks	Team Leader - Metals	Metals, Burnaby, British Columbia

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
µS/cm	Microsiemens per centimetre
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in reports identified as "Preliminary Report" are considered authorized for use.

Qualifiers

Qualifier	*Description*
DLM	*Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).*

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	MW09-03-01	MW09-03-02	MW12-07-01	DUP	----
					Client sampling date / time	02-Dec-2019 09:00	02-Dec-2019 09:15	02-Dec-2019 14:00	02-Dec-2019	----
						VA19A0292-001	VA19A0292-002	VA19A0292-003	VA19A0292-004	--------
						Result	Result	Result	Result	----
Physical Tests										
alkalinity, total (as CaCO3)	----	E290-L	1.0	mg/L		152	214	129	225	----
conductivity	----	E100-L	2.0	µS/cm		302	428	1310	427	----
hardness (as CaCO3), dissolved	----	EC100	0.60	mg/L		144	217	598	215	----
pH	----	E108	0.10	pH units		8.26	8.32	8.18	8.30	----
solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L		188	288	1050	295	----
solids, total suspended [TSS]	----	E160-H	3.0	mg/L		5.5	<3.0	8.9	<3.0	----
alkalinity, hydroxide (as CaCO3)	----	E290-L	1.0	mg/L		<1.0	<1.0	<1.0	<1.0	----
alkalinity, carbonate (as CaCO3)	----	E290-L	1.0	mg/L		<1.0	6.2	<1.0	4.8	----
alkalinity, bicarbonate (as CaCO3)	----	E290-L	1.0	mg/L		152	208	129	220	----
Anions and Nutrients										
ammonia, total (as N)	7664-41-7	E298-L	0.0050	mg/L		0.0422	0.0060	0.158	0.0072	----
chloride	16887-00-6	E235.Cl-L	0.10	mg/L		1.30	1.01	1.80	0.99	----
nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L		0.0397	11.0	1.33	11.1	----
nitrate + nitrite (as N)	----	EC235.N+N	0.50	mg/L		<0.50	11.1	4.70	11.1	----
nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L		0.160	0.0432	3.37	0.0367	----
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L		18.8	5.39	638	5.24	----
Dissolved Metals										
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L		0.0023	0.0010	0.0015	<0.0010	----
antimony, dissolved	7440-36-0	E421	0.00010	mg/L		0.00011	<0.00010	0.00018	<0.00010	----
arsenic, dissolved	7440-38-2	E421	0.00010	mg/L		0.00097	0.00012	0.00515	<0.00010	----
barium, dissolved	7440-39-3	E421	0.00010	mg/L		0.0632	0.0268	0.0206	0.0217	----
beryllium, dissolved	7440-41-7	E421	0.000020	mg/L		<0.000020	<0.000020	<0.000020	<0.000020	----
bismuth, dissolved	7440-69-9	E421	0.000050	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	----
boron, dissolved	7440-42-8	E421	0.010	mg/L		0.167	0.048	0.490	0.099	----
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L		0.0000112	0.0000324	<0.0000250 DLM	0.0000406	----
calcium, dissolved	7440-70-2	E421	0.050	mg/L		39.0	72.5	201	72.6	----
chromium, dissolved	7440-47-3	E421.Cr-L	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	----
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	----
copper, dissolved	7440-50-8	E421	0.00020	mg/L		<0.00020	0.00193	<0.00020	0.00213	----
iron, dissolved	7439-89-6	E421	0.010	mg/L		0.410	0.020	0.282	<0.010	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	MW09-03-01	MW09-03-02	MW12-07-01	DUP	----
					Client sampling date / time	02-Dec-2019 09:00	02-Dec-2019 09:15	02-Dec-2019 14:00	02-Dec-2019	----
						VA19A0292-001	VA19A0292-002	VA19A0292-003	VA19A0292-004	--------
						Result	Result	Result	Result	----
Dissolved Metals										
lead, dissolved	7439-92-1	E421	0.000050	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	----
lithium, dissolved	7439-93-2	E421	0.0010	mg/L		0.0037	0.0015	0.0203	0.0014	----
magnesium, dissolved	7439-95-4	E421	0.100	mg/L		11.3	8.66	23.0	8.28	----
manganese, dissolved	7439-96-5	E421	0.00010	mg/L		0.0865	0.00701	0.0891	0.00128	----
mercury, dissolved	7439-97-6	E509	0.0000050	mg/L		<0.0000050	<0.0000050	<0.0000050	<0.0000050	----
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L		0.00456	0.00316	0.0208	0.00326	----
nickel, dissolved	7440-02-0	E421	0.00050	mg/L		<0.00050	<0.00050	<0.00050	<0.00050	----
phosphorus, dissolved	7723-14-0	E421	0.050	mg/L		<0.050	<0.050	<0.050	<0.050	----
potassium, dissolved	7440-09-7	E421	0.100	mg/L		2.12	2.67	2.48	2.62	----
selenium, dissolved	7782-49-2	E421	0.000050	mg/L		0.000153	0.000189	0.000468	0.000223	----
silicon, dissolved	7440-21-3	E421	0.050	mg/L		5.39	5.63	6.49	5.70	----
silver, dissolved	7440-22-4	E421	0.000010	mg/L		<0.000010	<0.000010	<0.000010	<0.000010	----
sodium, dissolved	7440-23-5	E421	0.050	mg/L		9.27	5.55	84.4	5.80	----
strontium, dissolved	7440-24-6	E421	0.00020	mg/L		0.991	0.457	9.56	0.443	----
sulfur, dissolved	7704-34-9	E421	0.50	mg/L		5.97	2.02	229	1.80	----
thallium, dissolved	7440-28-0	E421	0.000010	mg/L		<0.000010	<0.000010	<0.000010	<0.000010	----
tin, dissolved	7440-31-5	E421	0.00010	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	----
titanium, dissolved	7440-32-6	E421	0.00030	mg/L		<0.00030	<0.00030	<0.00030	<0.00030	----
uranium, dissolved	7440-61-1	E421	0.000010	mg/L		0.000662	0.00304	0.000173	0.00316	----
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L		<0.00050	<0.00050	<0.00050	<0.00050	----
zinc, dissolved	7440-66-6	E421	0.0010	mg/L		0.0282	0.0488	0.116	0.0456	----
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L		<0.00020	<0.00020	<0.00020	<0.00020	----
dissolved mercury filtration location	----	EP509	-	-		Field	Field	Field	Field	----
dissolved metals filtration location	----	EP421	-	-		Field	Field	Field	Field	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

Appendix D – Seepage Monitoring Program Laboratory Results

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 29-MAY-19
Report Date: 10-JUN-19 16:07 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2281685

Project P.O. #: 232824 (Seepage)
Job Reference:
C of C Numbers: 2019-05-29 A
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2281685-1 Water 23-MAY-19 09:35 SS33	L2281685-2 Water 23-MAY-19 10:35 SS32	L2281685-3 Water 23-MAY-19 16:30 SS58	L2281685-4 Water 23-MAY-19 17:00 SS103	L2281685-5 Water 24-MAY-19 14:10 SS101
WATER						
Physical Tests	Conductivity (uS/cm)	1710	202	1400	190	168
	Hardness (as CaCO3) (mg/L)	914	93.3	633	92.3	67.6
	pH (pH)	8.16	8.24	8.44	8.10	7.94
	Total Suspended Solids (mg/L)	4.4	<3.0	16.8	4.2	<3.0
	TDS (Calculated) (mg/L)	1260	109	972	101	95.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	388	106	294	95.3	54.7
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	15.2	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	388	106	309	95.3	54.7
	Ammonia, Total (as N) (mg/L)	0.182	<0.0050	0.980	0.0191	0.0064
	Chloride (Cl) (mg/L)	15.1	<0.50	7.5	1.23	1.04
	Nitrate and Nitrite (as N) (mg/L)	54.9	0.318	61.0	0.0335	4.48
	Nitrate (as N) (mg/L)	54.4	0.318	59.2	0.0320	4.45
	Nitrite (as N) (mg/L)	0.436	<0.0010	1.74	0.0015	0.0276
	Sulfate (SO4) (mg/L)	389	5.59	227	4.69	10.9
	Anion Sum (meq/L)	20.2	2.26	15.5	2.04	1.67
	Cation Sum (meq/L)	20.7	2.05	15.2	2.06	1.56
	Cation - Anion Balance (%)	1.1	-4.8	-0.7	0.5	-3.4
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0025	<0.0010	0.0039	0.0137	0.0234
	Antimony (Sb)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00042	0.00013	0.00056	0.00040	0.00029
	Barium (Ba)-Dissolved (mg/L)	0.155	0.0164	0.104	0.0440	0.0324
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.079	<0.010	0.281	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000822	<0.0000050	0.000133	0.0000147	0.0000064
	Calcium (Ca)-Dissolved (mg/L)	256	28.7	171	25.4	21.5
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00022	0.00026	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00017	<0.00010	0.00016	0.00016	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.314	0.00040	0.135	0.0243	0.00631
	Iron (Fe)-Dissolved (mg/L)	0.013	<0.010	<0.010	0.061	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0056	<0.0010	0.0026	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	66.7	5.24	50.3	7.05	3.40
	Manganese (Mn)-Dissolved (mg/L)	0.828	<0.00010	0.284	0.0554	0.00518

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2281685-6 Water 24-MAY-19 15:30 SS39	L2281685-7 Water 25-MAY-19 10:25 SS66	L2281685-8 Water 25-MAY-19 10:40 SS50	L2281685-9 Water 25-MAY-19 10:55 SS49	L2281685-10 Water 25-MAY-19 11:05 SS64
WATER						
Physical Tests	Conductivity (uS/cm)	965	304	657	507	665
	Hardness (as CaCO3) (mg/L)	530	134	260	198	325
	pH (pH)	8.39	8.21	8.34	8.40	8.47
	Total Suspended Solids (mg/L)	8.3	<3.0	12.7	<3.0	<3.0
	TDS (Calculated) (mg/L)	647	170	401	307	405
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	338	123	208	169	316
	Alkalinity, Carbonate (as CaCO3) (mg/L)	10.4	<1.0	4.2	4.4	13.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	349	123	213	174	330
	Ammonia, Total (as N) (mg/L)	0.103	<0.0050	0.0062	0.0080	0.0267
	Chloride (Cl) (mg/L)	4.3	1.45	1.91	1.91	2.59
	Nitrate and Nitrite (as N) (mg/L)	18.1	0.0491	1.00	0.0324	<0.0051
	Nitrate (as N) (mg/L)	18.1	0.0491	0.995	0.0324	<0.0050
	Nitrite (as N) (mg/L)	0.0513	<0.0010	0.0093	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	141	37.6	145	99.7	62.1
	Anion Sum (meq/L)	11.3	3.28	7.40	5.60	7.96
	Cation Sum (meq/L)	11.7	3.14	6.51	5.28	7.91
	Cation - Anion Balance (%)	1.6	-2.2	-6.4	-2.9	-0.3
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0034	0.0054	0.0022	0.0012	0.0033
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00043	0.00059	0.00072	0.00039	0.00173
	Barium (Ba)-Dissolved (mg/L)	0.147	0.0821	0.0540	0.0937	0.124
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.024	0.030	0.113	0.170	0.088
	Cadmium (Cd)-Dissolved (mg/L)	0.0000873	0.0000158	<0.000020 DLM	0.0000074	0.0000251
	Calcium (Ca)-Dissolved (mg/L)	145	32.6	62.9	46.9	73.0
	Chromium (Cr)-Dissolved (mg/L)	0.00013	0.00013	<0.00010	<0.00010	0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00013	<0.00010	<0.00010	<0.00010	0.00024
	Copper (Cu)-Dissolved (mg/L)	0.0735	0.0141	0.0320	0.0222	0.00594
	Iron (Fe)-Dissolved (mg/L)	0.069	<0.010	<0.010	<0.010	0.289
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0029	0.0026	0.0064	0.0060	0.0040
	Magnesium (Mg)-Dissolved (mg/L)	41.1	12.6	25.1	19.5	34.8
	Manganese (Mn)-Dissolved (mg/L)	0.400	0.00333	0.0181	0.00198	0.298

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2281685-11 Water 25-MAY-19 11:20 SS63	L2281685-12 Water 25-MAY-19 11:45 SS67	L2281685-13 Water 26-MAY-19 14:00 SS45	L2281685-14 Water 26-MAY-19 14:15 SS17	L2281685-15 Water 26-MAY-19 14:40 SS68
WATER						
Physical Tests	Conductivity (uS/cm)	279	387	434	816	515
	Hardness (as CaCO3) (mg/L)	112	175	190	343	247
	pH (pH)	8.24	8.39	8.02	8.28	8.38
	Total Suspended Solids (mg/L)	41.3	<3.0	4.7	3.1	<3.0
	TDS (Calculated) (mg/L)	159	222	261	538	314
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	118	174	127	179	211
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	3.8	<1.0	<1.0	5.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	118	178	127	179	216
	Ammonia, Total (as N) (mg/L)	0.0129	0.0108	0.329	0.0285	0.0401
	Chloride (Cl) (mg/L)	0.71	3.30	3.25	<2.5 DLDS	2.92
	Nitrate and Nitrite (as N) (mg/L)	2.86	<0.0051	0.0454	0.048	0.0179
	Nitrate (as N) (mg/L)	2.80	<0.0050	0.0432	0.048	0.0179
	Nitrite (as N) (mg/L)	0.0530	<0.0010	0.0021	<0.0050 DLDS	<0.0010
	Sulfate (SO4) (mg/L)	20.9	34.9	93.7	264	71.2
	Anion Sum (meq/L)	3.02	4.38	4.59	9.06	5.88
	Cation Sum (meq/L)	2.81	4.06	4.67	8.88	5.80
	Cation - Anion Balance (%)	-3.5	-3.7	0.9	-1.0	-0.6
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0039	0.0012	0.0237	0.0033	0.0082
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00018	0.00018	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00062	0.00152	0.00177	0.00141	0.00082
	Barium (Ba)-Dissolved (mg/L)	0.0807	0.0551	0.0603	0.0617	0.0900
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.035	0.021	<0.010	0.030	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000130	0.0000336	0.0000622	0.0000226	0.0000192
	Calcium (Ca)-Dissolved (mg/L)	31.5	44.2	48.8	84.4	71.1
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00031	0.00021	0.00020
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00042	<0.00010	0.00011
	Copper (Cu)-Dissolved (mg/L)	0.00639	0.0174	0.0318	0.0668	0.0574
	Iron (Fe)-Dissolved (mg/L)	0.014	0.085	0.278	0.072	0.221
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000071	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0022	0.0014	0.0016	0.0042	0.0020
	Magnesium (Mg)-Dissolved (mg/L)	8.20	15.7	16.6	32.1	17.0
	Manganese (Mn)-Dissolved (mg/L)	0.00314	0.0137	0.292	0.0543	0.262

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2281685-16	L2281685-17	L2281685-18	L2281685-19	
Description	Water	Water	Water	Water	
Sampled Date	27-MAY-19	27-MAY-19	24-MAY-19	25-MAY-19	
Sampled Time	10:00	10:25			
Client ID	SS69	SS60	DUP	DUP	
Grouping / **Analyte**					
WATER					
Physical Tests					
Conductivity (uS/cm)	452	972	161	387	
Hardness (as CaCO3) (mg/L)	198	367	64.8	178	
pH (pH)	8.09	7.37	7.95	8.38	
Total Suspended Solids (mg/L)	<3.0	<3.0	3.3	3.5	
TDS (Calculated) (mg/L)	262	439	90.4	221	
Anions and Nutrients					
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	148	27.8	53.8	170	
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	3.8	
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
Alkalinity, Total (as CaCO3) (mg/L)	148	27.8	53.8	174	
Ammonia, Total (as N) (mg/L)	0.0171	0.0081	0.0063	0.0114	
Chloride (Cl) (mg/L)	6.47	254	1.06	3.34	
Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.025 DLDS	4.11	<0.0051	
Nitrate (as N) (mg/L)	<0.0050	<0.025 DLDS	4.08	<0.0050	
Nitrite (as N) (mg/L)	<0.0010	<0.0050	0.0361	<0.0010	
Sulfate (SO4) (mg/L)	80.0	17.9	9.54	35.8	
Anion Sum (meq/L)	4.80	8.09	1.60	4.31	
Cation Sum (meq/L)	4.65	8.10	1.50	4.11	
Cation - Anion Balance (%)	-1.6	0.1	-3.0	-2.4	
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
Aluminum (Al)-Dissolved (mg/L)	0.0892	0.107	0.0269	0.0019	
Antimony (Sb)-Dissolved (mg/L)	0.00029	<0.00010	<0.00010	<0.00010	
Arsenic (As)-Dissolved (mg/L)	0.00194	0.00057	0.00031	0.00155	
Barium (Ba)-Dissolved (mg/L)	0.144	0.395	0.0327	0.0565	
Beryllium (Be)-Dissolved (mg/L)	0.000032	0.000027	<0.000020	<0.000020	
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.020	
Cadmium (Cd)-Dissolved (mg/L)	0.0000725	0.000594	<0.0000050	0.0000407	
Calcium (Ca)-Dissolved (mg/L)	56.5	103	20.6	45.6	
Chromium (Cr)-Dissolved (mg/L)	0.00090	0.00048	<0.00010	<0.00010	
Cobalt (Co)-Dissolved (mg/L)	0.00049	0.00282	<0.00010	<0.00010	
Copper (Cu)-Dissolved (mg/L)	0.0397	0.0213	0.00674	0.0187	
Iron (Fe)-Dissolved (mg/L)	0.437	0.147	0.012	0.093	
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
Lithium (Li)-Dissolved (mg/L)	0.0013	0.0017	<0.0010	0.0014	
Magnesium (Mg)-Dissolved (mg/L)	13.8	26.3	3.27	15.5	
Manganese (Mn)-Dissolved (mg/L)	0.0676	0.890	0.00501	0.0151	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2281685-1 Water 23-MAY-19 09:35 SS33	L2281685-2 Water 23-MAY-19 10:35 SS32	L2281685-3 Water 23-MAY-19 16:30 SS58	L2281685-4 Water 23-MAY-19 17:00 SS103	L2281685-5 Water 24-MAY-19 14:10 SS101
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	0.0000070	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0124	0.00296	0.0107	0.000991	0.00308
	Nickel (Ni)-Dissolved (mg/L)	0.00061	<0.00050	0.00107	0.00148	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	7.76	1.17	8.72	1.16	1.99
	Selenium (Se)-Dissolved (mg/L)	0.0472	0.000170	0.00209	0.000177	0.000203
	Silicon (Si)-Dissolved (mg/L)	6.84	5.93	5.14	4.08	3.41
	Silver (Ag)-Dissolved (mg/L)	0.000058	<0.000010	0.000020	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	49.1	3.65	52.5	4.07	3.56
	Strontium (Sr)-Dissolved (mg/L)	7.03	0.151	2.14	0.133	0.116
	Sulfur (S)-Dissolved (mg/L)	154	2.18	86.6	2.07	4.04
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00041	0.00075
	Uranium (U)-Dissolved (mg/L)	0.00791	0.000378	0.00773	0.000072	0.000390
	Vanadium (V)-Dissolved (mg/L)	0.00071	0.00060	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0039	<0.0010	0.0017	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2281685-6 Water 24-MAY-19 15:30 SS39	L2281685-7 Water 25-MAY-19 10:25 SS66	L2281685-8 Water 25-MAY-19 10:40 SS50	L2281685-9 Water 25-MAY-19 10:55 SS49	L2281685-10 Water 25-MAY-19 11:05 SS64
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00551	0.00622	0.0357	0.0151	0.0141
	Nickel (Ni)-Dissolved (mg/L)	0.00058	<0.00050	<0.00050	<0.00050	0.00127
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	4.89	3.33	8.42	8.50	6.47
	Selenium (Se)-Dissolved (mg/L)	0.00747	0.00150	0.0124	0.00227	0.00173
	Silicon (Si)-Dissolved (mg/L)	6.67	3.41	3.37	4.79	3.34
	Silver (Ag)-Dissolved (mg/L)	0.000014	<0.000010	0.000011	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	21.4	8.83	25.1	25.7	28.0
	Strontium (Sr)-Dissolved (mg/L)	2.50	0.989	1.70	1.72	1.27
	Sulfur (S)-Dissolved (mg/L)	56.5	14.2	47.7	34.8	23.1
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.00477	0.00260	0.00474	0.00450	0.00283
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00101	0.00076	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0029	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2281685-11 Water 25-MAY-19 11:20 SS63	L2281685-12 Water 25-MAY-19 11:45 SS67	L2281685-13 Water 26-MAY-19 14:00 SS45	L2281685-14 Water 26-MAY-19 14:15 SS17	L2281685-15 Water 26-MAY-19 14:40 SS68
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0102	0.00619	0.00199	0.0101	0.00201
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00194	0.00099	0.00083
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	0.063	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.91	8.96	5.08	8.71	7.23
	Selenium (Se)-Dissolved (mg/L)	0.00189	0.00102	0.00124	0.00646	0.000814
	Silicon (Si)-Dissolved (mg/L)	1.95	11.3	3.03	3.95	1.95
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	0.000017	0.000017	<0.000010
	Sodium (Na)-Dissolved (mg/L)	10.6	7.56	15.7	41.3	14.9
	Strontium (Sr)-Dissolved (mg/L)	0.656	0.612	0.205	3.01	0.665
	Sulfur (S)-Dissolved (mg/L)	7.56	12.9	34.1	95.0	25.8
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00033	<0.00030	0.00174	<0.00030	0.00050
	Uranium (U)-Dissolved (mg/L)	0.00246	0.00124	0.000305	0.00349	0.000283
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00091	0.00077	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0011	0.0040	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	0.00044	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2281685-16	L2281685-17	L2281685-18	L2281685-19	
Description	Water	Water	Water	Water	
Sampled Date	27-MAY-19	27-MAY-19	24-MAY-19	25-MAY-19	
Sampled Time	10:00	10:25			
Client ID	SS69	SS60	DUP	DUP	
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	0.0000052	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved (mg/L)	0.00218	0.000301	0.00316	0.00632	
Nickel (Ni)-Dissolved (mg/L)	0.00475	0.00837	<0.00050	<0.00050	
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved (mg/L)	2.96	7.33	1.93	8.88	
Selenium (Se)-Dissolved (mg/L)	0.000836	0.000202	0.000250	0.00109	
Silicon (Si)-Dissolved (mg/L)	8.61	4.69	3.53	11.1	
Silver (Ag)-Dissolved (mg/L)	0.000018	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved (mg/L)	13.4	12.2	3.57	7.43	
Strontium (Sr)-Dissolved (mg/L)	0.284	0.545	0.111	0.612	
Sulfur (S)-Dissolved (mg/L)	29.6	7.40	3.68	12.7	
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Titanium (Ti)-Dissolved (mg/L)	0.00234	0.00105	0.00085	<0.00030	
Uranium (U)-Dissolved (mg/L)	0.000631	0.000052	0.000400	0.00126	
Vanadium (V)-Dissolved (mg/L)	0.00136	0.00061	<0.00050	0.00050	
Zinc (Zn)-Dissolved (mg/L)	0.0031	0.0154	<0.0010	0.0013	
Zirconium (Zr)-Dissolved (mg/L)	0.00078	0.00049	<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)
Method Blank	Conductivity	B	L2281685-15
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2281685-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

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.

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 CaCO3 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.

IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E

Reference Information

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.

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-05-29 A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2281685-COFC

COC Number: 2019-05-29 A

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232824 (Seepage)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions							Number of Containers
1	SS33	23-May-19	9:35	Water		R		R	R		R							4
2	SS32	23-May-19	10:35	Water		R		R	R		R							4
3	SS58	23-May-19	16:30	Water		R		R	R		R							4
4	SS103	23-May-19	17:00	Water		R		R	R		R							4
5	SS101	24-May-19	14:10	Water		R		R	R		R							4
6	SS39	24-May-19	15:30	Water		R		R	R		R							4
7	SS66	25-May-19	10:25	Water		R		R	R		R							4
8	SS50	25-May-19	10:40	Water		R		R	R		R							4
9	SS49	25-May-19	10:55	Water		R		R	R		R							4
10	SS64	25-May-19	11:05	Water		R		R	R		R							4
				Water														
				Water														

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
5°					8

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Todd Swenson	Date: 29-May-19	Time:	Received by:	Date: May 29/19	Time: 14:25	Received by: HA	Date: 5/30	Time: 11:53

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2281685-COFC

COC Number: 2019-05-29 A

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232824 (Seepage)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		**ALS Contact:**	**Sampler:**

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4]	☐	1 Business day [E1]	☐
3 day [P3]	☐	Same Day, Weekend or Statutory holiday [E0]	☐
2 day [P2]	☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Dissolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions							Number of Containers
11	SS63	25-May-19	11:20	Water		R		R	R		R							4
12	SS67	25-May-19	11:45	Water		R		R	R		R							4
13	SS45	26-May-19	14:00	Water		R		R	R		R							4
14	SS17	26-May-19	14:15	Water		R		R	R		R							4
15	SS68	26-May-19	14:40	Water		R		R	R		R							4
16	SS69	27-May-19	10:00	Water		R		R	R		R							4
17	SS60	27-May-19	10:25	Water		R		R	R		R							4
18	DUP	24-May-19		Water		R		R	R		R							4
19	DUP	25-May-19		Water		R		R	R		R							4
				Water														
				Water														
				Water														

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
					8

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Todd Swenson	Date: 29-May-19	Time:	Received by:	Date:	Time:	Received by: HA	Date: 5/30	Time: 11:53a

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-SEP-19
Report Date: 23-SEP-19 17:22 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2346211

Project P.O. #: 232818
Job Reference:
C of C Numbers: 2019-09-11 D
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2346211-1 Water 09-SEP-19 14:10 SS52	L2346211-2 Water 09-SEP-19 14:30 SS44	L2346211-3 Water 09-SEP-19 14:50 SS22	L2346211-4 Water 09-SEP-19 15:05 SS31	L2346211-5 Water 09-SEP-19 15:20 SS43
WATER						
Physical Tests	Conductivity (uS/cm)	1330	838	1130	1160	1120
	Hardness (as CaCO3) (mg/L)	725	436	605	667	659
	pH (pH)	8.28	8.05	7.93	8.09	8.15
	Total Suspended Solids (mg/L)	9.6	8.0	29.0	3.4	12.2
	TDS (Calculated) (mg/L)	965	579	807	814	799
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	396	173	300	410	387
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	396	173	300	410	387
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0075	0.0163	0.0249	0.0162
	Chloride (Cl) (mg/L)	4.27	<0.50 DLDS	<0.50 DLDS	3.41	3.56
	Nitrate and Nitrite (as N) (mg/L)	21.3	<0.025	<0.025	26.4	26.1
	Nitrate (as N) (mg/L)	21.3	<0.025 DLDS	<0.025 DLDS	26.3	26.0
	Nitrite (as N) (mg/L)	0.0086	0.0066	0.0054	0.0374	0.0322
	Sulfate (SO4) (mg/L)	335	301	385	189	193
	Anion Sum (meq/L)	16.5	9.73	14.0	14.1	13.7
	Cation Sum (meq/L)	16.2	9.84	13.3	14.2	14.0
	Cation - Anion Balance (%)	-1.1	0.6	-2.7	0.2	0.9
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0166	0.0137	0.0079	0.0070	0.0054
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00036	0.00017	0.00055	0.00028	0.00031
	Barium (Ba)-Dissolved (mg/L)	0.0783	0.0744	0.124	0.118	0.0814
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.028	<0.010	<0.010	0.013	0.014
	Cadmium (Cd)-Dissolved (mg/L)	0.0000107	<0.0000050	0.0000675	0.0000447	0.0000212
	Calcium (Ca)-Dissolved (mg/L)	197	104	169	193	190
	Chromium (Cr)-Dissolved (mg/L)	0.00030	<0.00010	<0.00010	<0.00010	0.00019
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00052	0.00020	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0295	0.00171	0.0666	0.0611	0.0253
	Iron (Fe)-Dissolved (mg/L)	0.030	0.013	0.089	0.064	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000100	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0029	0.0030	0.0044	0.0026	0.0026
	Magnesium (Mg)-Dissolved (mg/L)	56.5	43.0	44.5	44.8	44.8
	Manganese (Mn)-Dissolved (mg/L)	0.00279	0.117	0.357	0.377	0.0585

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2346211-6	L2346211-7	L2346211-8	L2346211-9	
Description	Water	Water	Water	Water	
Sampled Date	09-SEP-19	09-SEP-19	09-SEP-19	09-SEP-19	
Sampled Time	15:35	16:00	16:15		
Client ID	SS30	SS56	SS65	DUP	
Grouping	**Analyte**				
WATER					
Physical Tests	Conductivity (uS/cm)	1090	1380	1300	884	
	Hardness (as CaCO3) (mg/L)	646	765	739	445	
	pH (pH)	8.22	8.29	8.34	8.41	
	Total Suspended Solids (mg/L)	37.4	16.0	<3.0	95.4	
	TDS (Calculated) (mg/L)	773	1040	972	595	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	431	370	383	272	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	9.0	11.4	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	431	370	392	284	
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0123	0.0113	0.0204	
	Chloride (Cl) (mg/L)	5.16	4.54	4.50	1.74	
	Nitrate and Nitrite (as N) (mg/L)	18.0	25.2	21.4	20.9	
	Nitrate (as N) (mg/L)	18.0	25.2	21.4	20.9	
	Nitrite (as N) (mg/L)	0.0086	0.0091	0.0070	0.0350	
	Sulfate (SO4) (mg/L)	179	389	337	160	
	Anion Sum (meq/L)	13.8	17.4	16.5	10.6	
	Cation Sum (meq/L)	13.8	17.2	16.4	9.45	
	Cation - Anion Balance (%)	-0.1	-0.8	-0.3	-5.5	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0110	0.0081	0.0037	0.0078	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00030	0.00025	0.00038	0.00017	
	Barium (Ba)-Dissolved (mg/L)	0.0716	0.0667	0.0791	0.107	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.018	0.032	0.027	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000156	0.0000226	0.0000240	0.0000324	
	Calcium (Ca)-Dissolved (mg/L)	183	209	203	123	
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00032	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0615	0.00368	0.0263	0.00450	
	Iron (Fe)-Dissolved (mg/L)	0.020	<0.010	<0.010	0.024	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0027	0.0031	0.0028	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	45.8	59.2	56.3	33.7	
	Manganese (Mn)-Dissolved (mg/L)	0.00335	0.00414	0.00174	0.0104	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2346211-1 Water 09-SEP-19 14:10 SS52	L2346211-2 Water 09-SEP-19 14:30 SS44	L2346211-3 Water 09-SEP-19 14:50 SS22	L2346211-4 Water 09-SEP-19 15:05 SS31	L2346211-5 Water 09-SEP-19 15:20 SS43
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00749	0.000099	0.000835	0.00203	0.00191
	Nickel (Ni)-Dissolved (mg/L)	0.00053	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	6.34	1.92	3.07	5.46	5.90
	Selenium (Se)-Dissolved (mg/L)	0.00276	0.000269	0.000309	0.00932	0.00850
	Silicon (Si)-Dissolved (mg/L)	8.00	6.13	8.07	8.09	8.00
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	34.8	24.8	25.2	15.3	14.7
	Strontium (Sr)-Dissolved (mg/L)	2.76	1.58	2.86	1.07	1.08
	Sulfur (S)-Dissolved (mg/L)	128	118	143	68.9	69.5
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00122	<0.00060 DLM	<0.00060 DLM	0.00061	0.00041
	Uranium (U)-Dissolved (mg/L)	0.00499	0.000044	0.000119	0.00611	0.00573
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0011	0.0019	0.0079	0.0017	0.0025
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2346211-6	L2346211-7	L2346211-8	L2346211-9	
Description	Water	Water	Water	Water	
Sampled Date	09-SEP-19	09-SEP-19	09-SEP-19	09-SEP-19	
Sampled Time	15:35	16:00	16:15		
Client ID	SS30	SS56	SS65	DUP	
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved (mg/L)	0.00334	0.00967	0.00744	0.00104	
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00054	0.00052	<0.00050	
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved (mg/L)	5.47	6.39	6.53	2.06	
Selenium (Se)-Dissolved (mg/L)	0.00625	0.00383	0.00291	0.0110	
Silicon (Si)-Dissolved (mg/L)	8.62	7.55	7.97	5.14	
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved (mg/L)	16.1	39.4	33.9	11.5	
Strontium (Sr)-Dissolved (mg/L)	1.28	2.97	2.81	1.49	
Sulfur (S)-Dissolved (mg/L)	67.5	147	123	61.0	
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Titanium (Ti)-Dissolved (mg/L)	0.00076	0.00061	<0.00030	<0.00030	
Uranium (U)-Dissolved (mg/L)	0.00644	0.00669	0.00478	0.00100	
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Zinc (Zn)-Dissolved (mg/L)	0.0015	0.0014	0.0011	0.0021	
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<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	Barium (Ba)-Dissolved	MS-B	L2346211-1, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2346211-1, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2346211-1, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2346211-1, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2346211-1, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2346211-1, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2346211-1, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2346211-2, -3, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2346211-2, -3, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	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.

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 CaCO3 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.

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.

Reference Information

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.

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-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-09-11 D

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2346211-COFC

COC Number: 2019-09-11 D

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: mintoenvironment@mintomine.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: ap@mintomine.com

Email 2:

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232818 (GW)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: CR/IS

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	P	F/P	P	F/P	P	F/P								Number of Containers
					Total Metals(TM)	Dissolved Metals (DM)	Total Mercury, Hardness	Dissolved Mercury	Ammonia (Total Nutrients)	Dissolved Organic Carbon (DOC)	pH, Cond., TSS, TDS, Alkalinity, Anions	Dissolved Bromide (Br-D)						
	SS52	9-Sep-19	14:10	Water		R		R	R		R							4
	SS44	9-Sep-19	14:30	Water		R		R	R		R							4
	SS22	9-Sep-19	14:50	Water		R		R	R		R							4
	SS31	9-Sep-19	15:05	Water		R		R	R		R							4
	SS43	9-Sep-19	15:20	Water		R		R	R		R							4
	SS30	9-Sep-19	15:35	Water		R		R	R		R							4
	SS56	9-Sep-19	16:00	Water		R		R	R		R							4
	SS65	9-Sep-19	16:15	Water		R		R	R		R							4
	DUP	9-Sep-19		Water		R		R	R		R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☑ | Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
9.7	7.8	8.1			10°

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-09-11	Time:	Received by:	Date: Sept 12	Time: 10:15	Received by: RD	Date: Sep 13, 19	Time: 12:00 pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1] If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 18-SEP-19
Report Date: 01-OCT-19 15:40 (MT)
Version: FINAL REV. 2

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2350250

Project P.O. #: 232824
Job Reference:
C of C Numbers: 2019-09-18 C
Legal Site Desc:

Comments:

1-OCT-2019
This report is revised to list the sample ID for L2350250-1 as SS102.

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2350250-1	L2350250-2	L2350250-3	L2350250-4	
	Description	Water	Water	Water	Water	
	Sampled Date	13-SEP-19	13-SEP-19	16-SEP-19	16-SEP-19	
	Sampled Time	16:40	17:30	16:00		
	Client ID	SS102	SS33	SS32	DUP	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1910	1580	200	196	
	Hardness (as CaCO3) (mg/L)	941	871	99.6	100	
	pH (pH)	8.03	7.84	7.75	7.79	
	Total Suspended Solids (mg/L)	14.8	<3.0	<3.0	<3.0	
	TDS (Calculated) (mg/L)	1480	1200	111	109	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	89.5	313	104	99.7	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	89.5	313	104	99.7	
	Ammonia, Total (as N) (mg/L)	0.0291	0.148	<0.0050	<0.0050	
	Chloride (Cl) (mg/L)	7.0	12.0	0.30	0.30	
	Nitrate and Nitrite (as N) (mg/L)	139	54.6	0.332	0.328	
	Nitrate (as N) (mg/L)	138	54.3	0.332	0.328	
	Nitrite (as N) (mg/L)	0.026	0.297	<0.0010	<0.0010	
	Sulfate (SO4) (mg/L)	440	397	5.57	5.56	
	Anion Sum (meq/L)	21.0	18.7	2.23	2.14	
	Cation Sum (meq/L)	21.3	19.4	2.18	2.19	
	Cation - Anion Balance (%)	0.8	1.7	-1.2	1.1	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0028	<0.0010	0.0025	
	Antimony (Sb)-Dissolved (mg/L)	0.00040	<0.00020 DLA	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00035	0.00036	0.00012	0.00013	
	Barium (Ba)-Dissolved (mg/L)	0.0483	0.115	0.0172	0.0173	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000040 DLA	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.182	0.071	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.000060 DLM	0.000575	<0.0000050	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	184	251	31.1	31.1	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.0416	0.260	0.00043	0.00059	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.020 DLA	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0149	0.0056	<0.0010	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	117	59.4	5.36	5.43	
	Manganese (Mn)-Dissolved (mg/L)	0.0330	0.629	<0.00010	0.00014	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2350250-1 Description: Water Sampled Date: 13-SEP-19 Sampled Time: 16:40 Client ID: SS102	Sample ID: L2350250-2 Description: Water Sampled Date: 13-SEP-19 Sampled Time: 17:30 Client ID: SS33	Sample ID: L2350250-3 Description: Water Sampled Date: 16-SEP-19 Sampled Time: 16:00 Client ID: SS32	Sample ID: L2350250-4 Description: Water Sampled Date: 16-SEP-19 Sampled Time: Client ID: DUP	
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0659	0.0136	0.00284	0.00283	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.10 DLA	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	12.4	7.35	1.25	1.29	
	Selenium (Se)-Dissolved (mg/L)	0.0442	0.0501	0.000153	0.000183	
	Silicon (Si)-Dissolved (mg/L)	3.82	6.42	6.27	6.26	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000041	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	51.2	40.7	3.59	3.54	
	Strontium (Sr)-Dissolved (mg/L)	4.15	6.21	0.153	0.159	
	Sulfur (S)-Dissolved (mg/L)	158	140 DLA	1.98	2.10	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00060 DLA	<0.00030	0.00035	
	Uranium (U)-Dissolved (mg/L)	0.00368	0.00674	0.000374	0.000373	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	0.00065	0.00066	
	Zinc (Zn)-Dissolved (mg/L)	0.0010	0.0065	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00040 DLA	<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)
Method Blank	Alkalinity, Total (as CaCO3)	B	L2350250-2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2350250-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2350250-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

CL-L-IC-N-WR	Water	Chloride in Water by IC (Low Level)	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.

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 CaCO3 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.

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)

Reference Information

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.

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-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-09-18 C

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

L2350250-COFC

)C) / Analytical orm

800 668 9878

L2350250-COFC

COC Number: 2019-09-18 C

Page 1 of 1

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Report To	Contact and company name below	Report Format / Distribution	Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply
Company:	Minto Explorations Ltd.	Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY [Business Days]: 4 day [P4] ☐ / 3 day [P3] ☐ / 2 day [P2] ☐ — EMERGENCY: 1 Business day [E1] ☐ / Same Day, Weekend or Statutory holiday [E0] ☐
Phone:	1-604-759-4659	☑ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	2100-510 West Georgia St.	Email 1 or Fax mintoenvironment@mintomine.com	Date and Time Required for all E&P TATs:
City/Province:	Vancouver, British Columbia	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	V6B 0M3	Email 3	

Invoice To	Same as Report To ☐ YES ☑ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☐ YES ☑ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com	
Contact:	Ruth Cayetano	Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232824 (Seepage)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Disolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions							Number of Containers
	SS103	13-Sep-19	16:40	Water		R		R	R		R							4
	SS33	13-Sep-19	17:30	Water		R		R	R		R							4
	SS32	16-Sep-19	16:00	Water		R		R	R		R							4
	DUP	16-SEP-19		Water		R		R	R		R							4
				Water														
				Water														
				Water														
				Water														
				Water														
				Water														
				Water														
				Water														
				Water														

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C			
4.3	4.5				4

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chad Bustin	Date: 2019-09-18	Time:	Received by:	Date: Sept 18, 2019	Time: 5:00	Received by: HM	Date: 9/20	Time: 9:15 am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-OCT-19
Report Date: 15-OCT-19 18:23 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2359056

Project P.O. #: 232824
Job Reference:
C of C Numbers: 2019-10-02 B
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2359056-1 Water 27-SEP-19 09:20 SS49	L2359056-2 Water 27-SEP-19 09:35 SS64	L2359056-3 Water 27-SEP-19 10:10 SS39	L2359056-4 Water 28-SEP-19 10:10 SS9	L2359056-5 Water 28-SEP-19 10:40 SS104
WATER						
Physical Tests	Conductivity (uS/cm)	533	651	970	751	978
	Hardness (as CaCO3) (mg/L)	218	289	486	320	529
	pH (pH)	8.08	7.95	7.97	7.34	7.54
	Total Suspended Solids (mg/L)	3.3	6.3	3.3	614	119
	TDS (Calculated) (mg/L)	368	387	611	475	556
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	256	239	334	208	556
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	256	239	334	208	556
	Ammonia, Total (as N) (mg/L)	0.0174	0.0216	0.0094	0.235	0.0235
	Chloride (Cl) (mg/L)	1.85	1.71	3.23	1.37	3.76
	Nitrate and Nitrite (as N) (mg/L)	0.0422	0.768	13.8	0.054	<0.025 DLDS
	Nitrate (as N) (mg/L)	0.0422	0.762	13.8	0.054 DLDS	<0.025 DLDS
	Nitrite (as N) (mg/L)	<0.0010	0.0069	0.0088	<0.0050	<0.0050
	Sulfate (SO4) (mg/L)	105	108	154	199	14.8
	Anion Sum (meq/L)	7.35	7.14	10.9	8.33	11.5
	Cation Sum (meq/L)	5.67	7.06	10.6	7.99	11.8
	Cation - Anion Balance (%)	-12.9	-0.6	-1.7	-2.1	1.2
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	<0.0010	0.0050	0.0136	0.0148
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00017	0.00030
	Arsenic (As)-Dissolved (mg/L)	0.00073	0.00062	0.00032	0.00076	0.00141
	Barium (Ba)-Dissolved (mg/L)	0.0717	0.0703	0.152	0.118	0.140
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.171	0.130	0.019	<0.010	0.027
	Cadmium (Cd)-Dissolved (mg/L)	0.0000095	0.0000116	0.0000213	0.0000958	0.0000180
	Calcium (Ca)-Dissolved (mg/L)	51.2	71.3	135	87.0	116
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00113	0.00027	0.00111
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00043	0.00247
	Copper (Cu)-Dissolved (mg/L)	0.00325	0.00421	0.0364	0.0499	0.0104
	Iron (Fe)-Dissolved (mg/L)	0.013	0.034	0.043	0.233	0.921
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0053	0.0040	0.0023	0.0027	0.0017
	Magnesium (Mg)-Dissolved (mg/L)	21.9	27.0	36.2	24.9	58.1
	Manganese (Mn)-Dissolved (mg/L)	0.0159	0.0306	0.0164	0.398	2.94

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359056-6	L2359056-7			
	Description	Water	Water			
	Sampled Date	28-SEP-19	27-SEP-19			
	Sampled Time	11:10				
	Client ID	SS53	DUP			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1110	496			
	Hardness (as CaCO3) (mg/L)	590	207			
	pH (pH)	7.93	8.22			
	Total Suspended Solids (mg/L)	9.3	<3.0			
	TDS (Calculated) (mg/L)	774	322			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	457	193			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	457	193			
	Ammonia, Total (as N) (mg/L)	0.0275	0.0242			
	Chloride (Cl) (mg/L)	11.9	1.81			
	Nitrate and Nitrite (as N) (mg/L)	<0.025	0.0465			
	Nitrate (as N) (mg/L)	<0.025 DLDS	0.0450			
	Nitrite (as N) (mg/L)	<0.0050 DLDS	0.0015			
	Sulfate (SO4) (mg/L)	247	103			
	Anion Sum (meq/L)	14.6	6.05			
	Cation Sum (meq/L)	13.4	5.39			
	Cation - Anion Balance (%)	-4.3	-5.8			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0042	0.0044			
	Antimony (Sb)-Dissolved (mg/L)	0.00023	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00270	0.00077			
	Barium (Ba)-Dissolved (mg/L)	0.146	0.0705			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.024	0.163			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000138	0.0000094			
	Calcium (Ca)-Dissolved (mg/L)	139	47.8			
	Chromium (Cr)-Dissolved (mg/L)	0.00028	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	0.00067	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.0174	0.00330			
	Iron (Fe)-Dissolved (mg/L)	0.427	0.027			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0031	0.0050			
	Magnesium (Mg)-Dissolved (mg/L)	59.2	21.2			
	Manganese (Mn)-Dissolved (mg/L)	0.433	0.0214			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2359056-1	L2359056-2	L2359056-3	L2359056-4	L2359056-5
Description	Water	Water	Water	Water	Water
Sampled Date	27-SEP-19	27-SEP-19	27-SEP-19	28-SEP-19	28-SEP-19
Sampled Time	09:20	09:35	10:10	10:10	10:40
Client ID	SS49	SS64	SS39	SS9	SS104
Grouping / Analyte					
WATER					
Dissolved Metals					
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000055	0.0000051
Molybdenum (Mo)-Dissolved (mg/L)	0.00821	0.0146	0.00494	0.00110	0.00706
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00127	0.00698
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	9.79	5.77	4.30	4.32	3.30
Selenium (Se)-Dissolved (mg/L)	0.00116	0.00443	0.00718	0.000649	0.000955
Silicon (Si)-Dissolved (mg/L)	1.09	1.12	7.00	8.19	5.74
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	24.4	25.9	17.5	33.1	22.9
Strontium (Sr)-Dissolved (mg/L)	1.38	1.86	1.87	1.42	1.38
Sulfur (S)-Dissolved (mg/L)	37.8	39.5	57.2	69.1	7.32
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00072	0.00138
Uranium (U)-Dissolved (mg/L)	0.00248	0.00264	0.00436	0.000674	0.00258
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00066	0.00079
Zinc (Zn)-Dissolved (mg/L)	0.0010	0.0014	0.0010	0.0025	0.0014
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00111

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2359056-6	L2359056-7			
	Description	Water	Water			
	Sampled Date	28-SEP-19	27-SEP-19			
	Sampled Time	11:10				
	Client ID	SS53	DUP			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00394	0.00822			
	Nickel (Ni)-Dissolved (mg/L)	0.00372	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	14.0	9.31			
	Selenium (Se)-Dissolved (mg/L)	0.00179	0.00107			
	Silicon (Si)-Dissolved (mg/L)	5.48	1.16			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	27.8	23.5			
	Strontium (Sr)-Dissolved (mg/L)	1.39	1.32			
	Sulfur (S)-Dissolved (mg/L)	95.8	36.8			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 DLM	<0.00030			
	Uranium (U)-Dissolved (mg/L)	0.00517	0.00239			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0021	<0.0010			
	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)
Method Blank	Alkalinity, Total (as CaCO3)	B	L2359056-6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2359056-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA Water Nitrite & Nitrate in Water (Calculation) EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA Water Diss. Be (low) 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.

CL-L-IC-N-WR Water Chloride in Water by IC (Low Level) 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.

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 CaCO3 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.

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.

Reference Information

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-WR	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-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-10-02 B

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.

Chain of Custody (COC) / Analytical Request Form

L2359056-COFC

COC Number: 2019-10-02 B

Page 1 of 1

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232824 (Seepage)
LSD:	

ALS Lab Work Order # (lab use only)

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: mintoenvironment@mintomine.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: ap@mintomine.com

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: **Sampler:** CR/IS

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total Metals(TM) P	Disolved Metals (DM) F/P	Total Mercury, Hardness P	Dissolved Mercury F/P	Ammonia (Total Nutrients) P	Dissolved Organic Carbon (DOC) F/P	pH, Cond., TSS, TDS, Alkalinity, Anions R	Number of Containers
	SS49	27-Sep-19	9:20	Water		R		R	R		R	4
	SS64	27-Sep-19	9:35	Water		R		R	R		R	4
	SS39	27-Sep-19	10:10	Water		R		R	R		R	4
	SS9	28-Sep-19	10:10	Water		R		R	R		R	4
	SS104	28-Sep-19	10:40	Water		R		R	R		R	4
	SS53	28-Sep-19	11:10	Water		R		R	R		R	4
	Dup	27-Sep-19		Water		R		R	R		R	4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
2.8	2.3		7°C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-10-02	Time:	Received by:	Date: Oct 3, 2019	Time: 10:30	Received by:	Date: 4 Oct 19	Time: 12:30PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Appendix E – Seepage Survey Documentation

1. Seepage Site GPS Coordinates

ID	Coordinates		Spring 2019	Fall 2019
	Northing	Easting		
Mill Valley Fill Extension				
SS9	N62° 37.007'	W137° 13.296'		x
SS10	N62° 37.025'	W137° 13.315'		
SS17	N62° 36.876'	W137° 13.518'	x	
SS36	N62° 37.040'	W137° 13.313'		
SS53				x
SS60	N62° 37.088'	W137° 13.432'	x	
SS61	N62° 37.202'	W137° 13.266'		
SS100	N62° 37.225'	W137° 13.305'		
SS104	N62° 61.468'	W137° 22.569'		x
W8A	N62° 37.089'	W137° 13.650'		
W62	N62° 37.223'	W137° 13.279'	x	x
Dry Stack Tailings Facility				
SS45	N62° 36.853'	W137° 13.632'	x	
SS68			x	
SS69			x	
Southwest Dump				
SS1	N62° 36.872'	W137° 15.589'		
SS13	N62° 36.539'	W137° 15.840'		
SS21	N62° 36.775'	W137° 15.747'		
SS22	N62° 36.480'	W137° 15.801'		x
SS28	N62° 36.802'	W137° 15.695'		
SS29	N62° 36.758'	W137° 15.764'		
SS30	N62° 36.625'	W137° 15.836'		x
SS31	N62° 36.570'	W137° 15.858'		x
SS43	N62° 36.592'	W137° 15.857'		x
SS44	N62° 36.421'	W137° 15.818'		x
SS51	N62° 36.463'	W137° 15.793'		
SS52	N62° 36.395'	W137° 15.818'		x
SS54	N62° 36.857'	W137° 15.607'		
SS56	N62° 36.789'	W137° 15.719'		x
SS57	N62° 36.637'	W137° 15.830'		
SS65	N62° 36.818'	W137° 15.658'		x
W32	N62° 36.811'	W137° 15.694'		
ID	**Coordinates**		**Spring 2019**	**Fall 2019**
	Northing	**Easting**		
W38	N62° 36.886'	W137° 15.564'		

Water Storage Pond Dam				
W17	N62° 37.454'	W137° 12.551'	x	x
Ore Stockpile				
SS5	N62° 37.034'	W137° 14.133'		
SS6	N62° 37.025'	W137° 14.122'		
SS7	N62° 36.999'	W137° 14.108'		
SS8	N62° 36.985'	W137° 14.101'		
SS33	N62° 37.034'	W137° 14.147'	x	x
SS59	N62° 36.967'	W137° 14.099'		
Main Waste Dump				
SS102	N62° 37.010’	W137° 15.597		x
Pit Walls				
SS62 (A2S3 Pit)	N62° 36.878'	W137° 14.656'		
Camp				
SS32	N62° 37.302'	W137° 14.032'	x	x
Minto North				
SS101	N62° 37.598’	W137° 15.710	x	
Ice-Rich Overburden Dump (Pelly)				
SS39	N62° 36.976'	W137° 15.886'	x	x
SS48	N62° 36.953'	W137° 16.005'		
SS49	N62° 36.912'	W137° 16.000'	x	x
SS50	N62° 36.890'	W137° 15.900'	x	
SS63	N62° 36.937'	W137° 16.014'	x	
SS64	N62° 36.921'	W137° 16.017'	x	x
SS66			x	
SS67			x	
Ridgetop Road				
SS58	N62° 36.597'	W137° 14.048'	x	
SS103			x	
W33s			x	x

2. Seepage Site Photos

2.1 Mill Valley Fill

2.1.1 SS19



Figure 2-1: SS9 Sampling Site (Fall 2019)

2.1.2 SS17



Figure 2-2: SS17 Upstream (Spring 2019)



Figure 2-3: SS17 Sampling Site (Spring 2019)



Figure 2-4: SS17 Downstream (Spring 2019)

2.1.3 SS53



Figure 2-5: SS17 Upstream (Fall 2019



Figure 2-6: SS17 Downstream and Sampling Site (Fall 2019)

2.1.4 SS60



Figure 2-7: SS60 Upstream (Spring 2019)



Figure 2-8: SS60 Sampling Site (Spring 2019)



Figure 2-9: SS60 Downstream (Spring 2019)

2.1.5 SS104



Figure 2-10: SS104 Upstream (Fall 2019)



Figure 2-11: SS104 Sampling Site (Fall 2019)



Figure 2-12: SS104 Downstream (Fall 2019)

2.2 Dry Stack Tailings Facility

2.2.1 SS45



Figure 2-13: SS45 Upstream (Spring 2019)



Figure 2-14: SS45 Sampling Site (Spring 2019)



Figure 2-15: SS45 Downstream (Spring 2019)

2.2.2 SS68



Figure 2-16: SS68 Upstream (Spring 2019)



Figure 2-17: SS68 Sampling Site (Spring 2019)



Figure 2-18: SS68 Downstream (Spring 2019)

2.2.3 SS69



Figure 2-19: SS69 Upstream (Spring 2019)



Figure 2-20: SS69 Sampling Site (Spring 2019)



Figure 2-21: SS69 Downstream (Spring 2019)

2.3 Southwest Dump

2.3.1 SS22



Figure 2-22: SS22 Upstream (Fall 2019)



Figure 2-23: SS22 Sampling Site (Fall 2019)



Figure 2-24: SS22 Downstream (Fall 2019)

2.3.2 SS30



Figure 2-25: SS30 Upstream (Fall 2019)



Figure 2-26: SS30 Sampling Site (Fall 2019)



Figure 2-27: SS30 Downstream (Fall 2019)

2.3.3 SS31



Figure 2-28: SS31 Sampling Site (Fall 2019)

2.3.4 SS43



Figure 2-29: SS43 Upstream (Fall 2019)



Figure 2-30: SS43 Sampling Site & Downstream (Fall 2019)

2.3.5 SS44



Figure 2-31: SS44 Sampling Site (Fall 2019)

2.3.6 SS52



Figure 2-32: SS52 Upstream (Fall 2019)



Figure 2-33: SS52 Sampling Site (Fall 2019)



Figure 2-34: SS52 Downstream (Fall 2019)

2.3.7 SS56



Figure 2-35: SS56 Sampling Site (Fall 2019)

2.3.8 SS65



Figure 2-36: SS65 Sampling Site (Fall 2019)

2.4 Ore Stockpile

2.4.1 SS33



Figure 2-37: SS33 Sampling Site (Spring 2019)

2.5 Main Waste Dump

2.5.1 SS102



Figure 2-38: SS102 Upstream (Spring 2019)



Figure 2-39: SS102 Sampling Site (Spring 2019)



Figure 2-40: SS102 Downstream (Spring 2019)

2.6 Camp

2.6.1 SS32



Figure 2-41: SS32 Upstream (Spring 2019)



Figure 2-42: SS32 Sampling Site (Spring 2019)



Figure 2-43: SS32 Downstream (Spring 2019)

2.7 Minto North

2.7.1 SS101



Figure 2-44: SS101 Upstream (Spring 2019)



Figure 2-45: SS101 Sampling Site (Spring 2019)

2.8 Ice-Rich Overburden Dump (Pelly)

2.8.1 SS39



Figure 2-46: SS39 Upstream (Spring 2019)



Figure 2-47: SS39 Sampling Site (Spring 2019)



Figure 2-48: SS39 Downstream (Spring 2019)

2.8.2 SS49



Figure 2-49: SS49 Upstream (Spring 2019)



Figure 2-50: SS49 Sampling Site (Spring 2019)

2.8.3 SS50



Figure 2-51: SS50 Upstream (Spring 2019)



Figure 2-52: SS50 Sampling Site (Spring 2019)



Figure 2-53: SS50 Downstream (Spring 2019)

2.8.4 SS64



Figure 2-54: SS64 Upstream (Spring 2019)



Figure 2-55: SS64 Sampling Site (Spring 2019)



Figure 2-56: SS64 Downstream (Spring 2019)

2.8.5 SS66



Figure 2-57: SS66 Upstream (Spring 2019)



Figure 2-58: SS66 Sampling Site (Spring 2019)



Figure 2-59: SS66 Downstream (Spring 2019)

2.8.6 SS67

2.9 Ridgetop Road

2.9.1 SS58



Figure 2-60: SS58 Upstream (Spring 2019)



Figure 2-61: SS58 Sampling Site (Spring 2019)



Figure 2-62: SS58 Downstream (Spring 2019)

2.9.2 SS103



Figure 2-63: SS103 Upstream (Spring 2019)



Figure 2-64: SS103 Sampling Site (Spring 2019)



Figure 2-65: SS103 Downstream (Spring 2019)

2.10 Minto North Pit



Figure 2-66: Minto North Pit Seepage (Spring 2019)

2.11 A2S3 Pit



Figure 2-67: A2S3 Pit Seepage (Spring 2019)

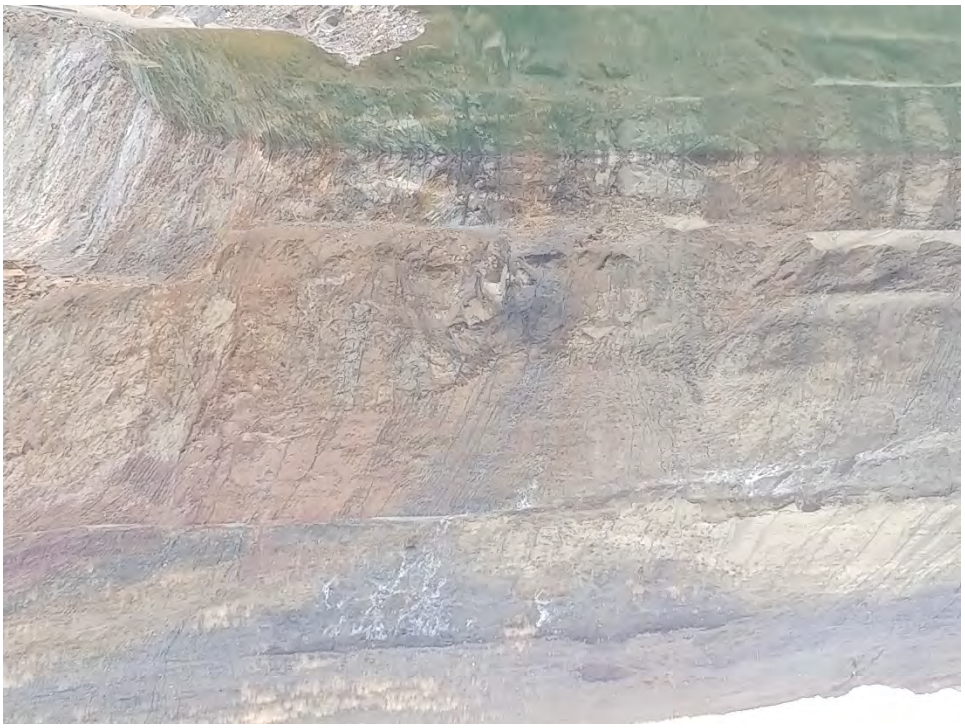


Figure 2-68: A2S3 Pit Seepage (Fall 2019)

3. Field Sheets

a. Spring Seepage Survey (APPENDIX A)

b. Fall Seepage Survey (APPENDIX B)

Appendix A – SPRING FIELD SHEETS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS 33	23-MAY-19	9:35	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp:

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N E S (W) Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
1.6	82.7	6.83	1855	1047	7.64		

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

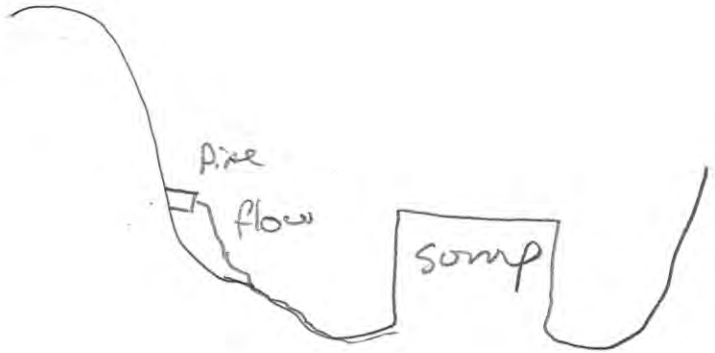
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

Clear water flowing out of pipe.

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): JS

1. Sample Site:	Date:	Time:	Sampler(s):
SS 32	23-MAY-19	10:35	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 14

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N E S W (Var)

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
2.9	91.1	12.64	232.0	134.3	8.03		

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

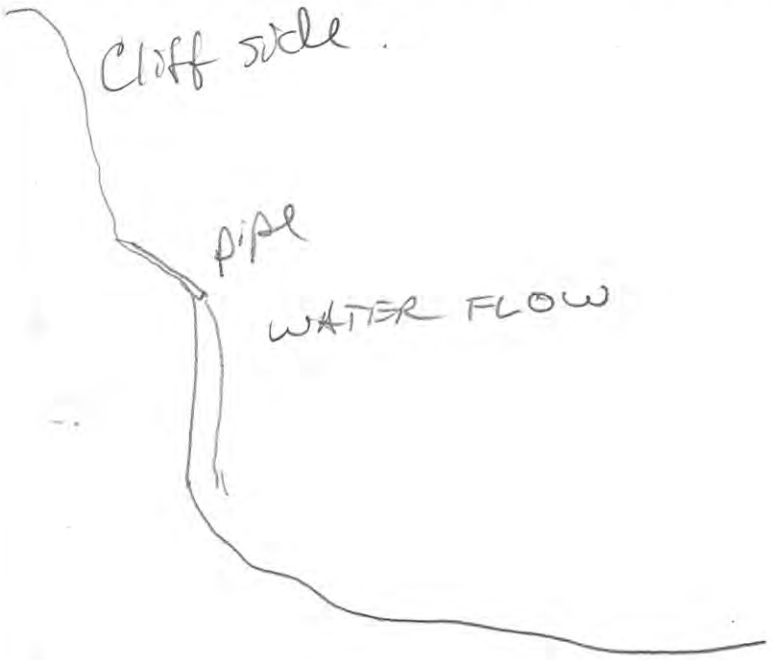
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

Crystal Clear

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used:

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): JS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS58	23-MAY-19	16:30	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 18

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N E S W (Var)

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
12.0	55.0	5.89	1437	1078	7.90	158.9	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

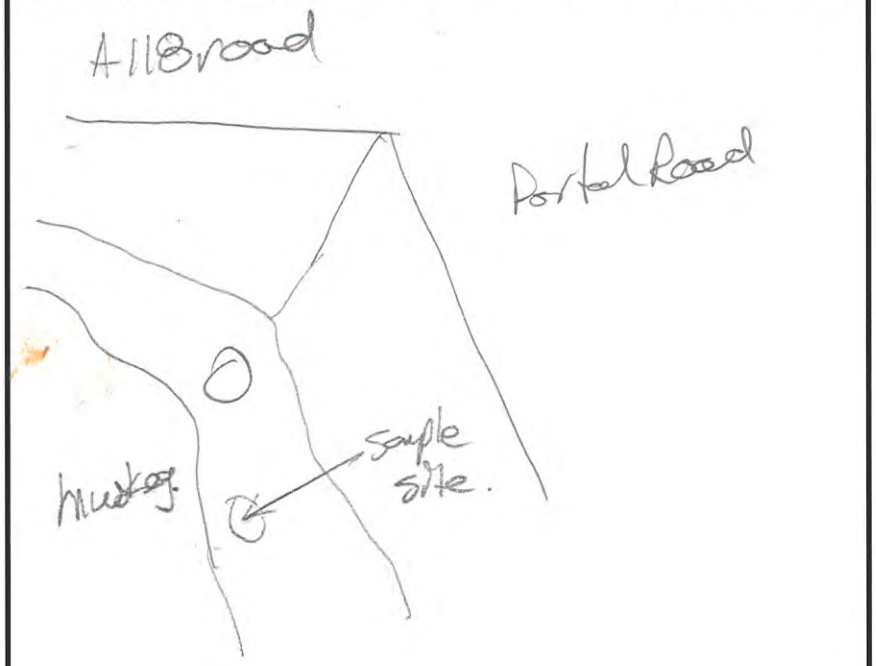
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

Clear

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used:

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): IS

1. Sample Site:	Date:	Time:	Sampler(s):
SS102	23-MAY-19	17:00	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 18

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N E S W (Var)

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
4.2	52.9	7.51	199.5	119.7	8.10	145.6	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? (Y) N IF Yes, Record GPS Coordinates IN GPS

Photos: Close-up ☑ Upstream ☑ Downstream ☑

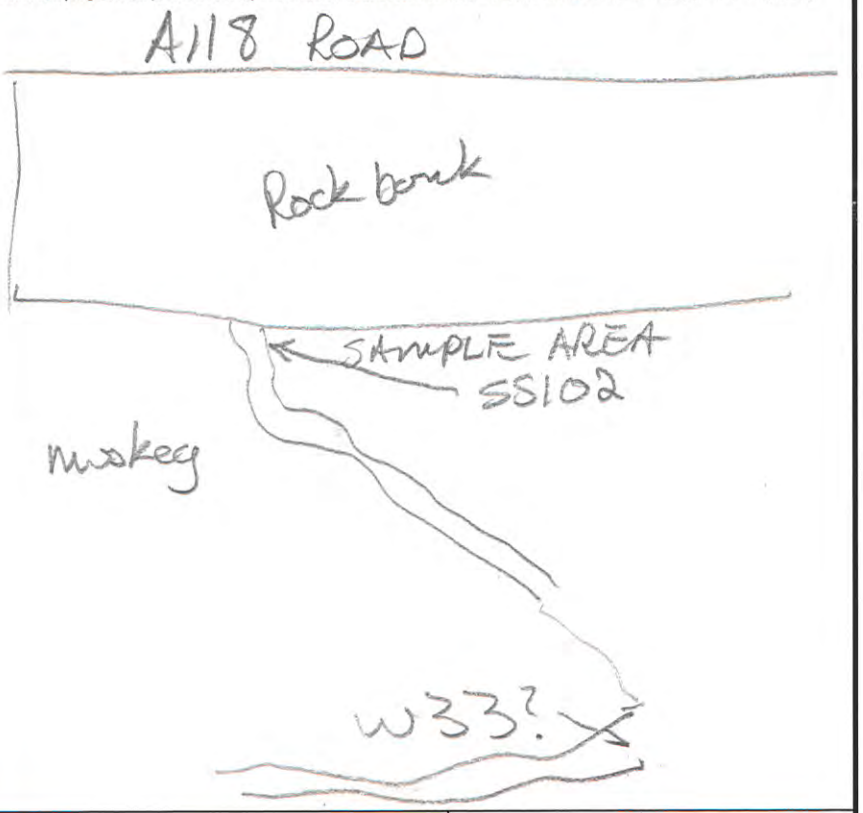
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

Clear

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used:

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): IS

Seepage Water Quality Field Sheets

TS

1. Sample Site:	Date:	Time:	Sampler(s):
SS101	24-MAY-19	14:10	TS/IS

Sky:	Temp:	Precip:	Wind:
Clear, (P.Cloudy), O/cast, Fog, Haze, Other	15°	(Nil), Light, Mod, Strong, Rain, Snow, Other	Calm, (Light), Mod, Strong, N, E, S, W, (Var)

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
7.4	95.3	11.4	1645	1094	8.18	222	

QA/QC? (Y) / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

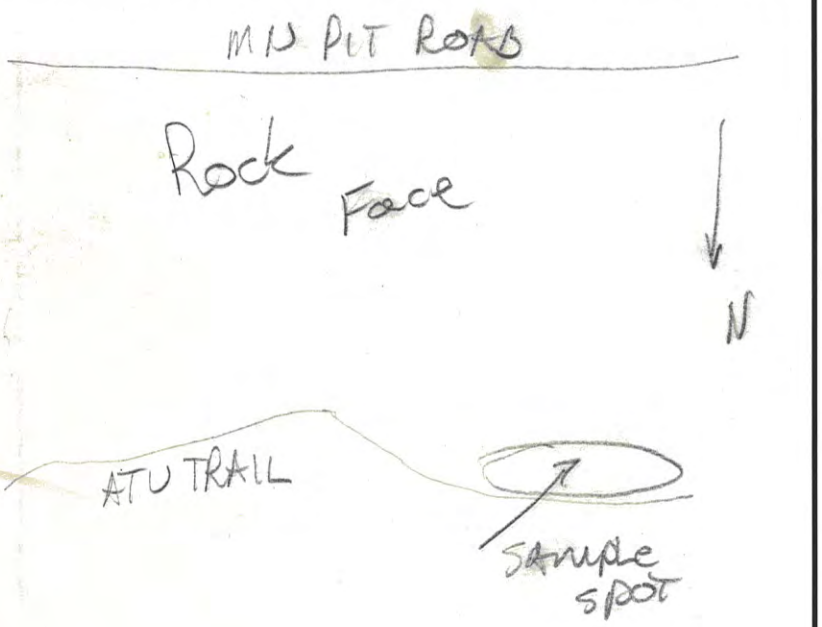
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

SLIGHTLY CLOUDY

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 3

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): IS

1. Sample Site:	Date:	Time:	Sampler(s):
~~SS06~~ SS39	24-MAY-19	15:30	TS IS

Sky:	Temp:	Precip:	Wind:
Clear, (P.Cloudy), O/cast, Fog, Haze, Other	16°	(Nil), Light, Mod, Strong, Rain, Snow, Other	Calm, (Light), Mod, Strong, N, E, S, W, (Var)

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
8.9	56.0	6.22	1074	736	7.10	270.9	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? (Y) N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

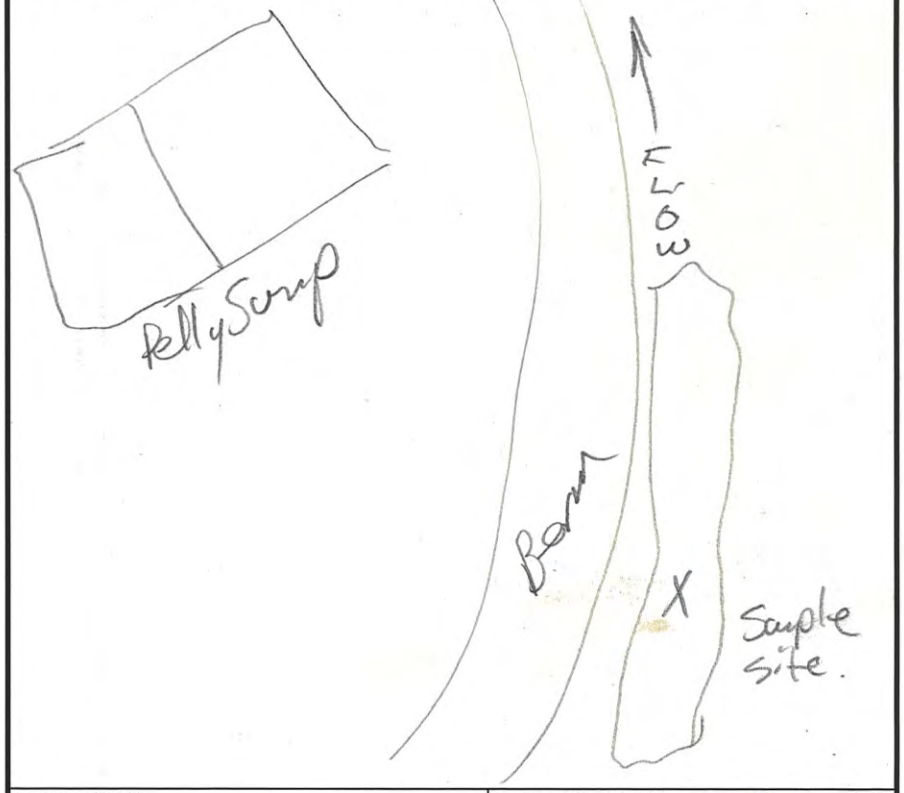
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

Clear, slightly green

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 2

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): IS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS66	25-MAY-19	10:25	TS/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other | Temp: 15 | Precip: (Nil) Light Mod Strong Rain Snow Other | Wind: (Calm) Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
6.4	78.5	9.24	300.6	1354	8.09	198.3	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? (Y) / N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

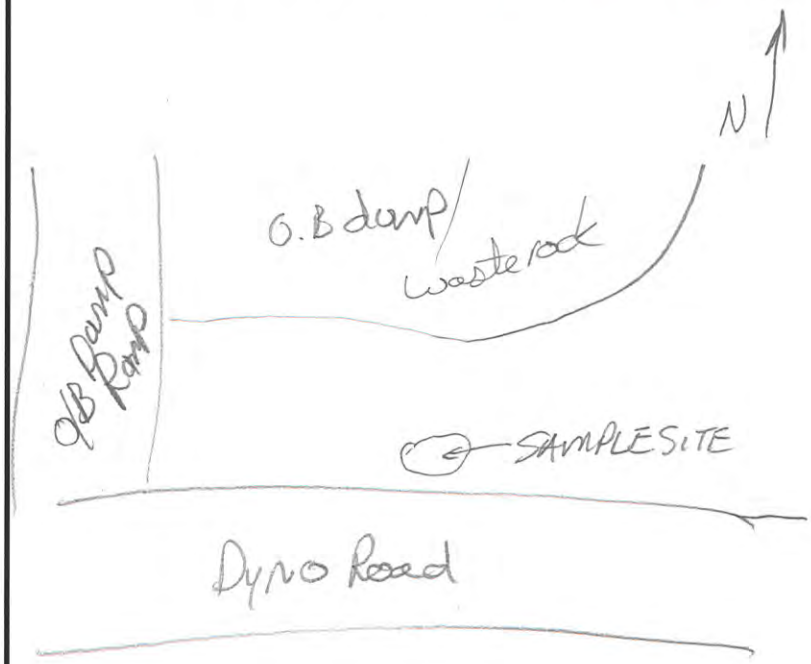
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

Clear No Apparent Flow, But water is clean.

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: (1)

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): TS

1. Sample Site:	Date:	Time:	Sampler(s):
SS50	25-MAY-19	10:40	TS/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other | Temp: 15 | Precip: (Nil) Light Mod Strong Rain Snow Other | Wind: (Calm) Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
4.7	84.8	10.95	650.3	396.6	7.17	221.2	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

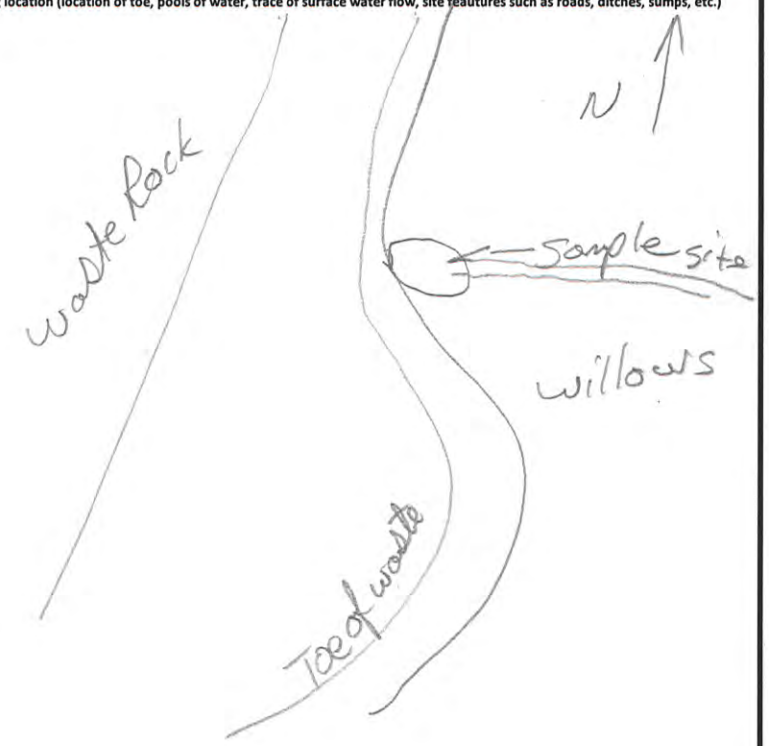
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

Clear.

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: (1)

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): TS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS 49	25-MAY-19	10:55	TS/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 16

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: (Calm) Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
8.3	76.8	8.87	453.5	294.2	7.79	219.6	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

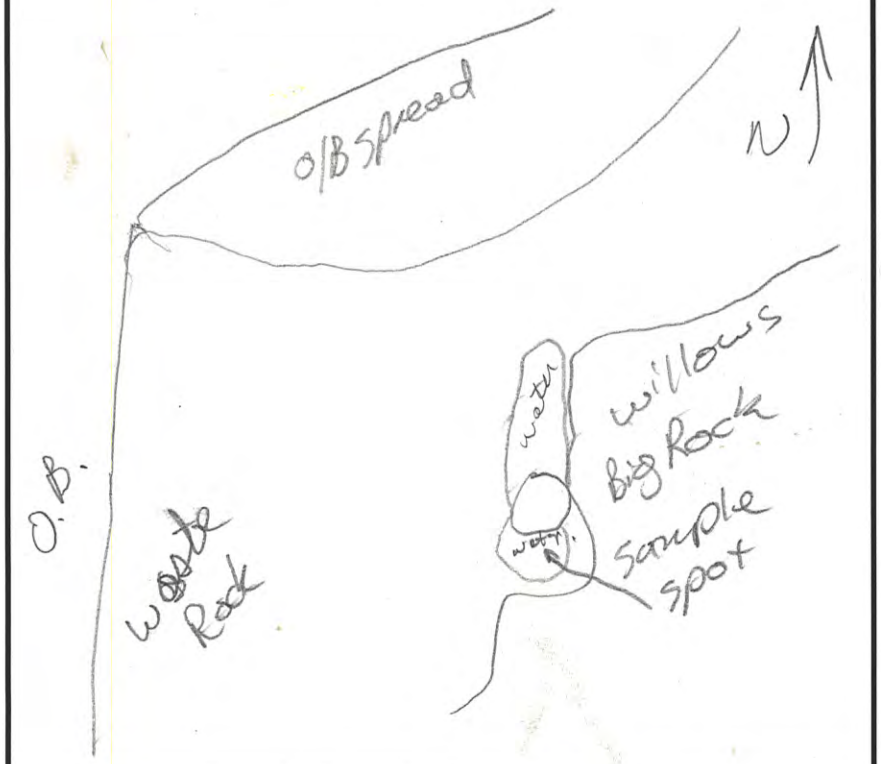
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

CLEAR

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 0

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): TS

1. Sample Site:	Date:	Time:	Sampler(s):
SS64	25-MAY-19	11:05	TS/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 16

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: (Calm) Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
11.1	92.7	2.50	724	553	7.32	215.3	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

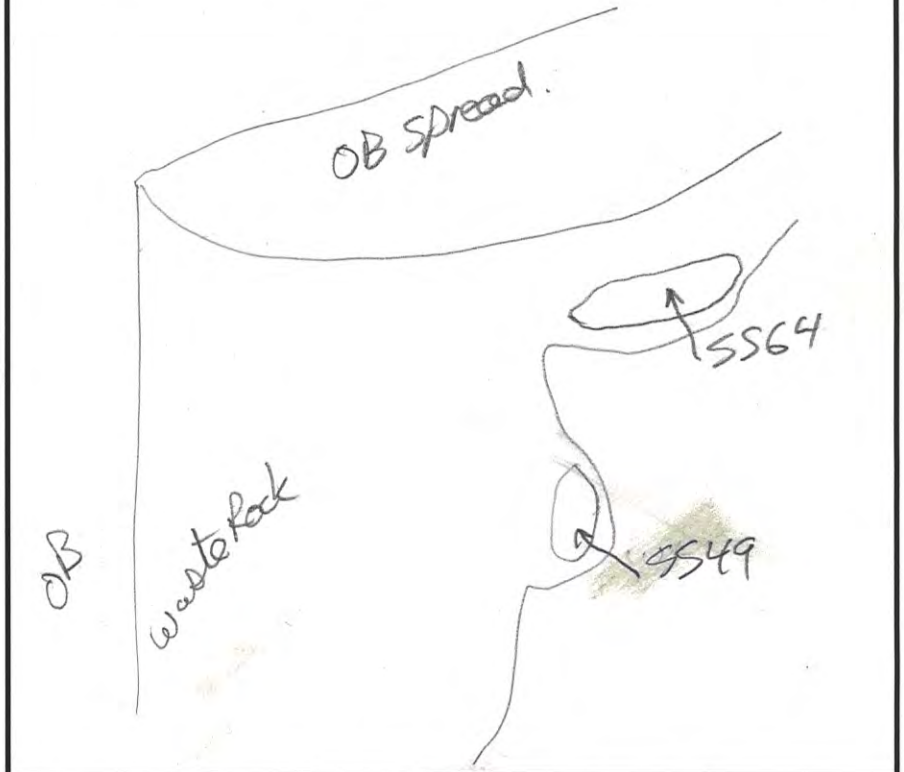
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

CLEAR/GREEN LOTS OF INSECT LARVAE

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 0

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): TS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS 63	25-MAY-19	11:20	TS / IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 18°

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: (Calm) Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
17.1	129.4	12.42	268.4	227.2	8.20	180.7	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

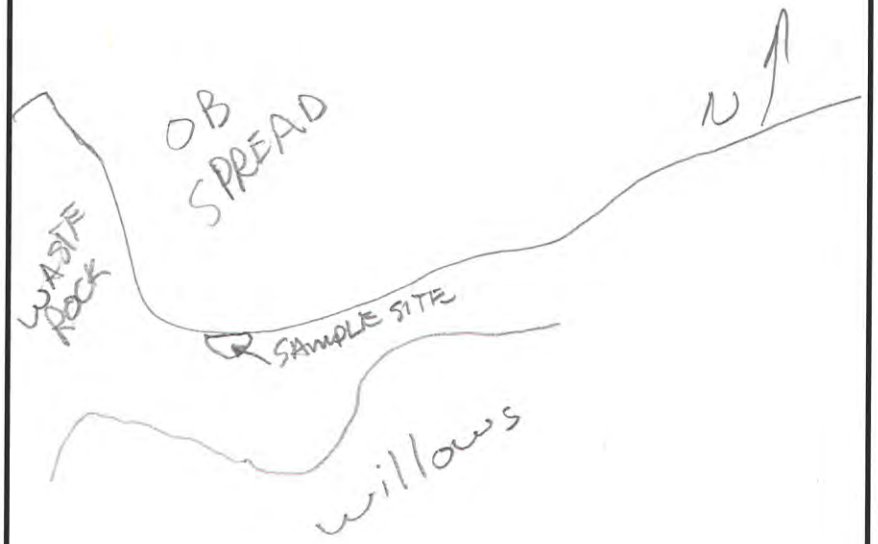
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

CLEAR SINKING INTO GROUND

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: ~~1~~ 2

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): TS

1. Sample Site:	Date:	Time:	Sampler(s):
SS 67	25-MAY-19	11:45	TS / IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 18

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: (Calm) Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
14.7	84.9	8.59	385.0	308.9	7.81	207.3	

QA/QC? (Y) / N

Note: 1 every 10 samples must be dumped

New Sample ? (Y) / N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

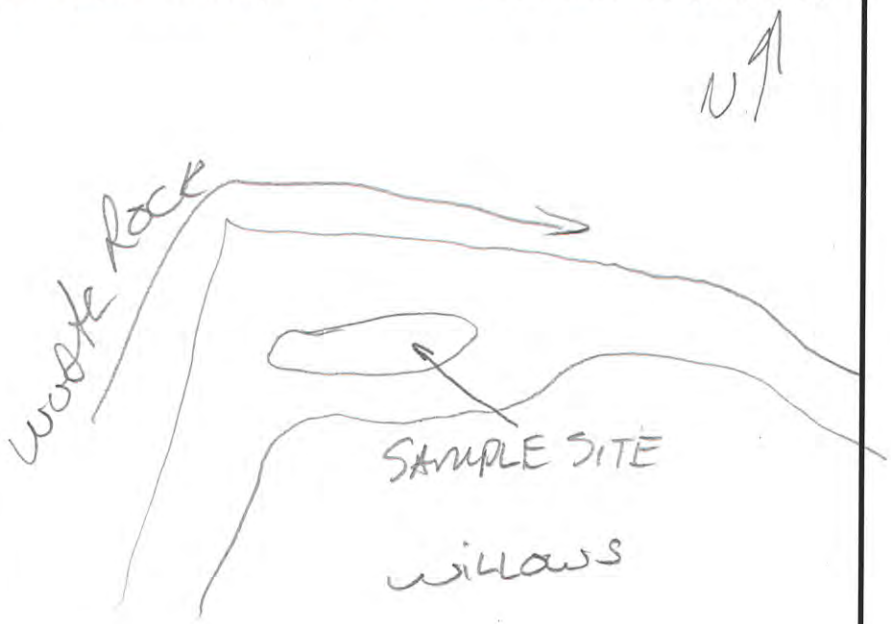
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

GREEN, MURKY - NO APPARENT FLOW

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 2

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): TS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS45	26-MAY-19	14:00	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 25

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N (E) S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
13.3	70.3	7.31	455.3	361.9	7.01	120.2	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

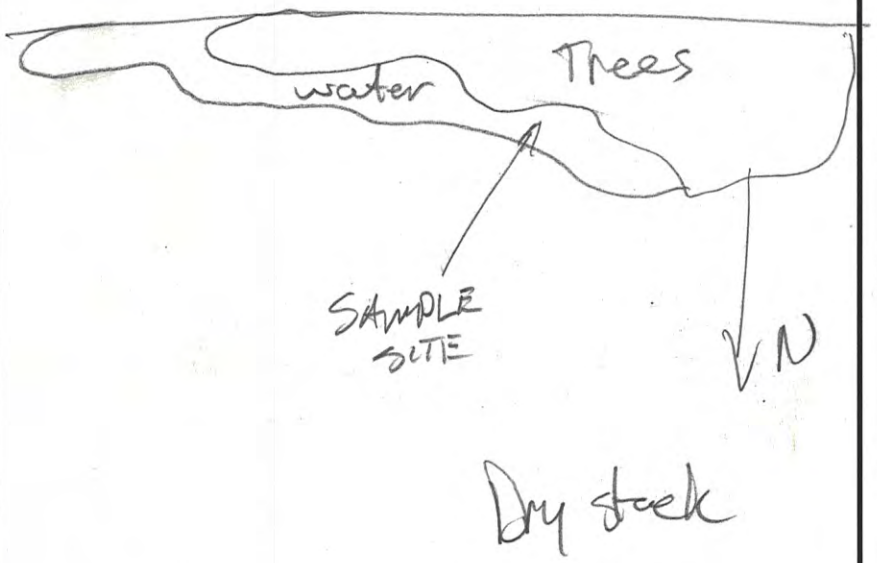
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

BROWN "TEA" LOTS OF INSECTS, NO FLOW

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): IS

1. Sample Site:	Date:	Time:	Sampler(s):
SS17	26-MAY-19	12:15	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 25

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N (E) S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
12.8	100.2	10.51	837	642	7.52	141.6	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

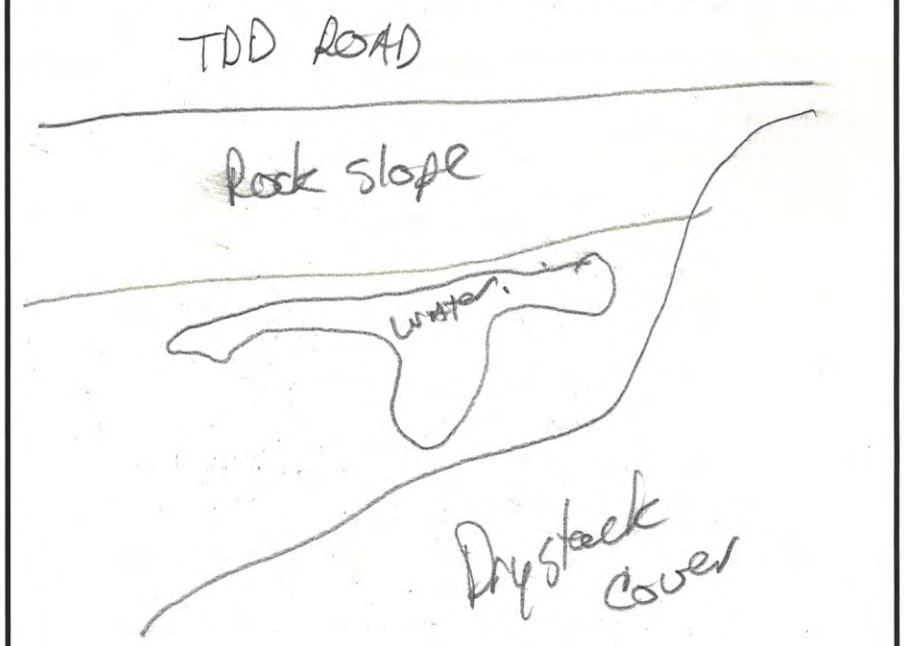
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

CLEAR, GREEN, INSECTS, NO FLOW

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): IS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS68	26-MAY-19	14:40	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 25

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N (E) S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
15.5	69.7	6.71	646.7	1445.2	7.55	172.7	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? (Y) N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

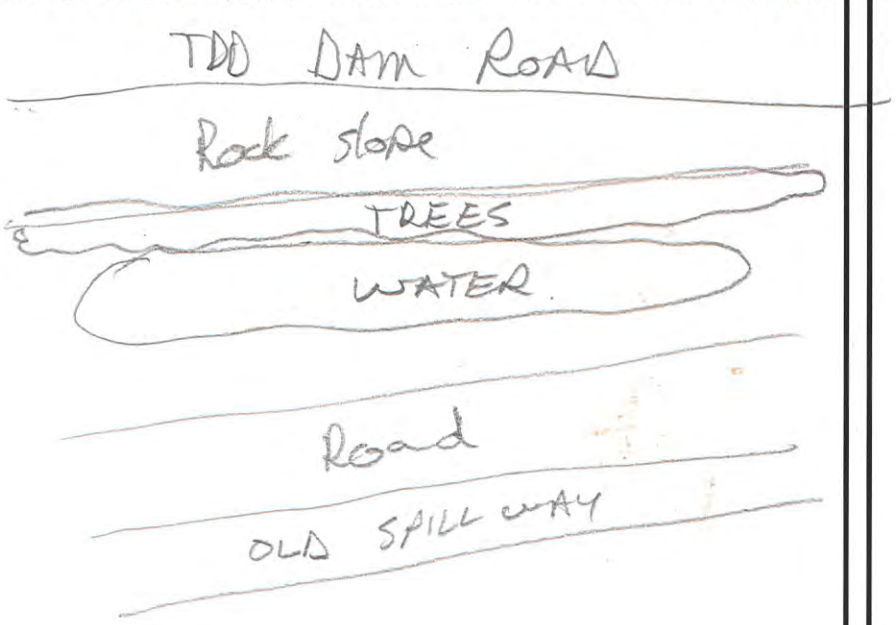
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

CLEAR TEA NO FLOW

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): DS

1. Sample Site:	Date:	Time:	Sampler(s):
SS69	27-MAY-19	10:00	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 18

Precip: Nil Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong (N) E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
12.2	65.5	7.17	482.7	359.3	7.61	201.4	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? (Y) N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

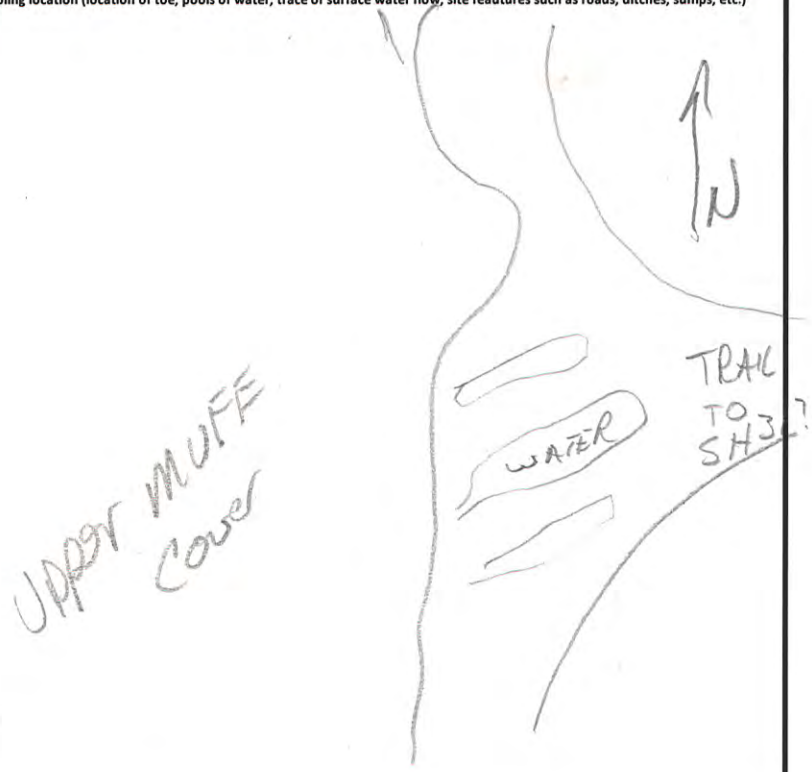
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

CLEAR, TEA-COLOURED, NO FLOW

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): DS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS60	27-MAY-19	10:25	TS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 18

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N (E) S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
9.1	51.9	5.96	1011	704	6.98	160.8	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

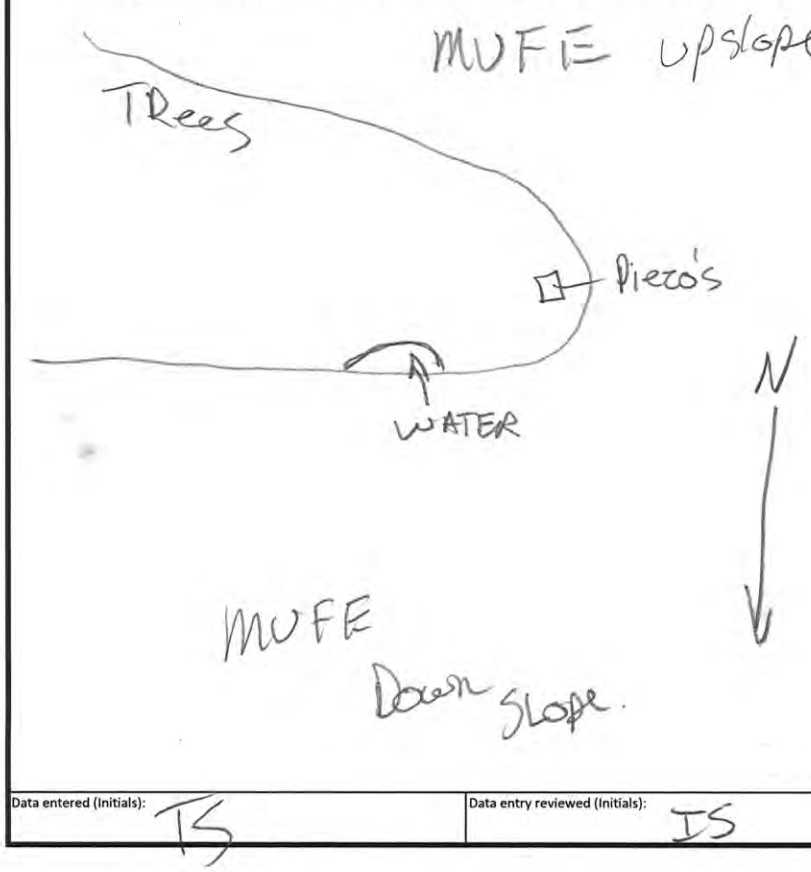
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

CLEAR Sub surface flow

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: (1)

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): IS

1. Sample Site:	Date:	Time:	Sampler(s):

Sky: Clear P.Cloudy O/cast Fog Haze Other

Temp:

Precip: Nil Light Mod Strong Rain Snow Other

Wind: Calm Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU

QA/QC? Y / N

Note: 1 every 10 samples must be dumped

New Sample ? Y / N IF Yes, Record GPS Coordinates

Photos: Close-up ☐ Upstream ☐ Downstream ☐

Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
				# of Filters Used:

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)

Data entered (Initials):

Data entry reviewed (Initials):

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):

Sky: Clear P.Cloudy O/cast Fog Haze Other	Temp:	Precip: Nil Light Mod Strong Rain Snow Other	Wind: Calm Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU

QA/QC? Y / N	Photos: Close-up ☐
Note: 1 every 10 samples must be dumped	Upstream ☐
New Sample ? Y / N IF Yes, Record GPS Coordinates	Downstream ☐

Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
				# of Filters Used:

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)

Data entered (Initials):	Data entry reviewed (Initials):

1. Sample Site:	Date:	Time:	Sampler(s):

Sky: Clear P.Cloudy O/cast Fog Haze Other	Temp:	Precip: Nil Light Mod Strong Rain Snow Other	Wind: Calm Light Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU

QA/QC? Y / N	Photos: Close-up ☐
Note: 1 every 10 samples must be dumped	Upstream ☐
New Sample ? Y / N IF Yes, Record GPS Coordinates	Downstream ☐

Water Colour? Turbidity, Precipitates? Description of Sampling Conditions

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter:
				# of Filters Used:

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)

Data entered (Initials):	Data entry reviewed (Initials):

Appendix B – FALL FIELD SHEETS

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS52	2019.09.09	14:10	CR/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 16

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
3.2	64.6	8.61	1011	590	7.40	279	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

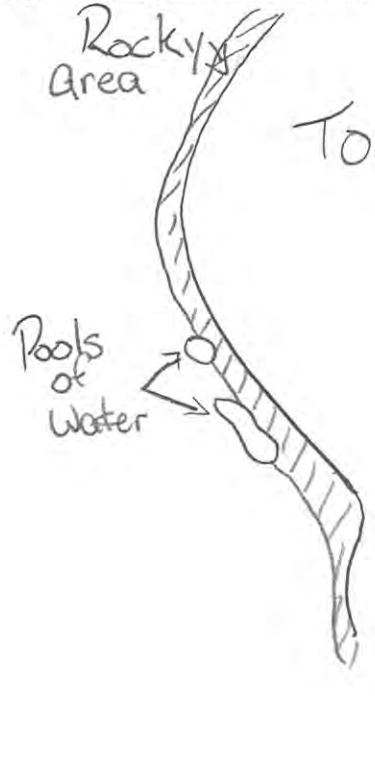
Photos: Close-up ☑ Upstream ☐ Downstream ☐

Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:
greenish water (pretty clear)

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: Green
✓	✓	✓	✓	# of Filters Used: 3

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): CR

1. Sample Site:	Date:	Time:	Sampler(s):
SS44	2019.09.09	14:30	CR/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other

Temp: 16

Precip: (Nil) Light Mod Strong Rain Snow Other

Wind: Calm (Light) Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
4.4	52.6	6.71	902	548	7.04	282	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

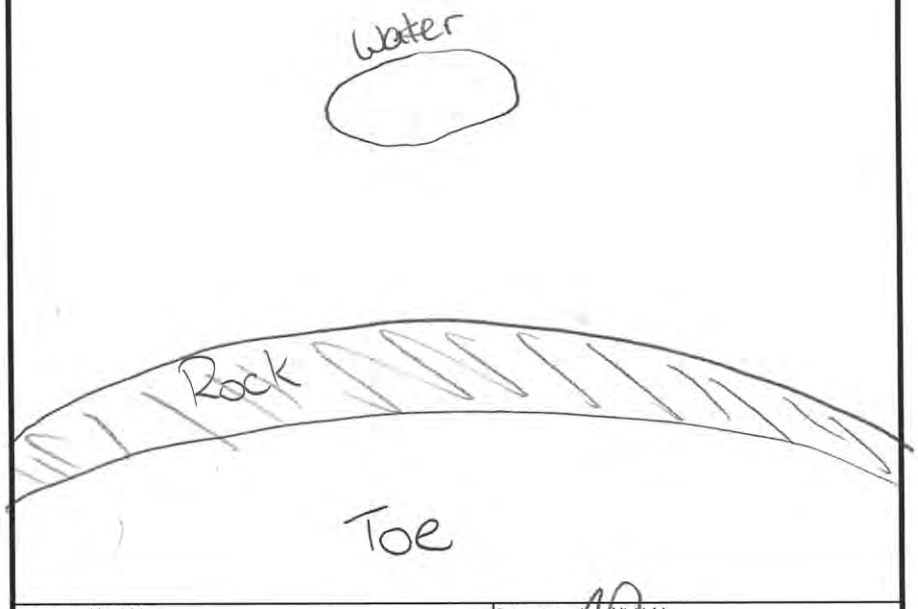
Photos: Close-up ☐ Upstream ☐ Downstream ☐

Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:
Clear / [redacted]

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: 3

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): CR

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS22	2019.09.09	14:50	CR/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other — Temp: 16 — Precip: (Nil) Light Mod Strong Rain Snow Other — Wind: Calm (Light) Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
5.7	30	3.63	1204	764	6.90	257.8	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / N IF Yes, Record GPS Coordinates

Photos: Close-up ☐ Upstream ☐ Downstream ☐

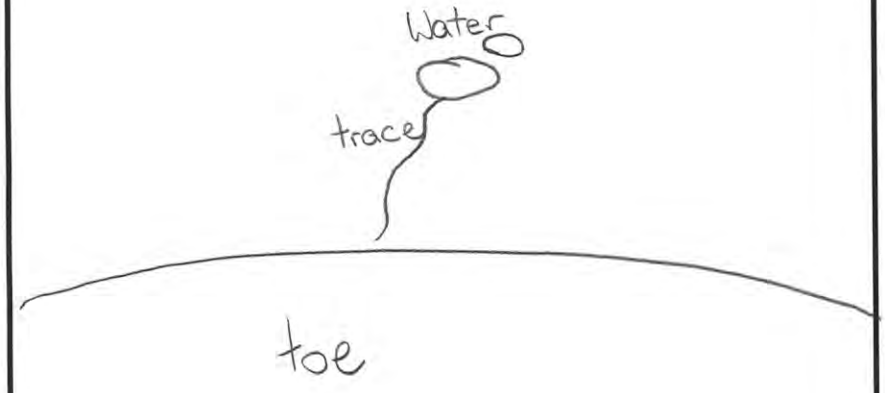
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

greenish colour - lots of leaves on surface - Clear

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter: Clear
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS — Data entry reviewed (Initials): CR

1. Sample Site:	Date:	Time:	Sampler(s):
SS31	2019.09.09	15:05	CR/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other — Temp: 16 — Precip: (Nil) Light Mod Strong Rain Snow Other — Wind: Calm (Light) Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
3.9	91.4	11.85	1439	858	7.15	259.2	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

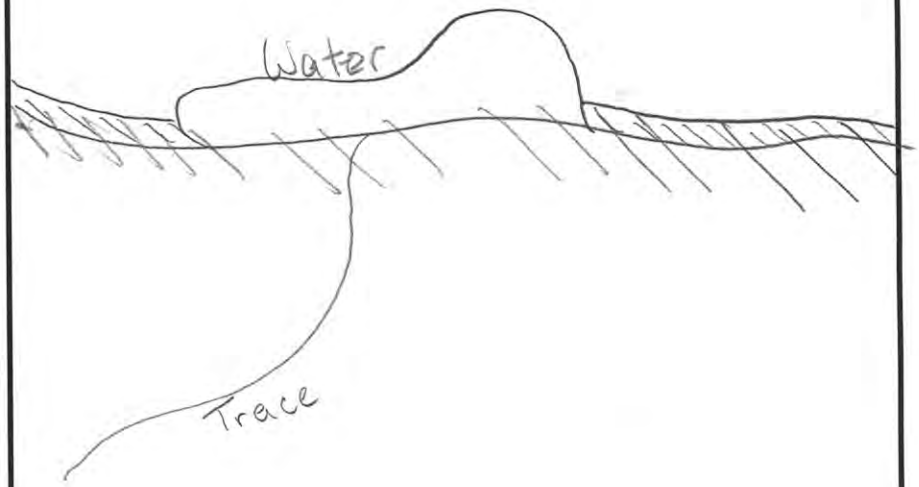
Photos: Close-up ☐ Upstream ☐ Downstream ☐

Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter: Clear
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS — Data entry reviewed (Initials): CR

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS43	2019-09-09	15:20	CR / IS

Sky:	Precip:	Wind:
Clear / P.Cloudy / O/cast / Fog / Haze / Other	Nil / Light / Mod / Strong / Rain / Snow / Other	Calm / Light / Mod / Strong / N / E / S / W / Var
Temp: 16		

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
5.0	28	3.55	1267	779	7.34		

QA/QC? Y / N

Note: 1 every 10 samples must be dumped

New Sample ? Y / N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☐ Downstream ☑

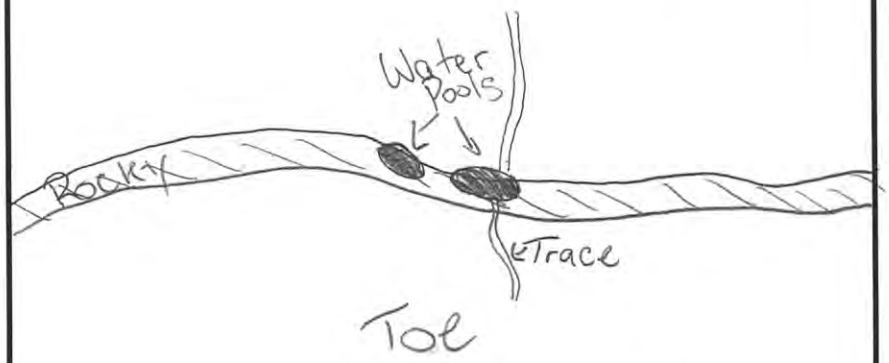
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

Clear

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: 1 2 5
✓	✓	✓	✓	# of Filters Used: Clear

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): CR

1. Sample Site:	Date:	Time:	Sampler(s):
SS30	2019-09-09	15:35	CR / IS

Sky:	Precip:	Wind:
Clear / P.Cloudy / O/cast / Fog / Haze / Other	Nil / Light / Mod / Strong / Rain / Snow / Other	Calm / Light / Mod / Strong / N / E / S / W / Var
Temp: 16		

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
8.5	75	8.57	1222	838	7.71	240	

QA/QC? Y / N

Note: 1 every 10 samples must be dumped

New Sample ? Y / N IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☐ Downstream ☐

Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

Clear / Very little Water

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter: Clear
✓	✓	✓	✓	# of Filters Used: 2

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): CR

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
3556	2019-09-09	16:00	CR/IS

Sky:	Temp:	Precip:	Wind:
(Clear) P.Cloudy O/cast Fog Haze Other	16	(Nil) Light Mod Strong Rain Snow Other	Calm (Light) Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
4.9	50.2	6.35	1529	932	7.48	251.1	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☐ Downstream ☑

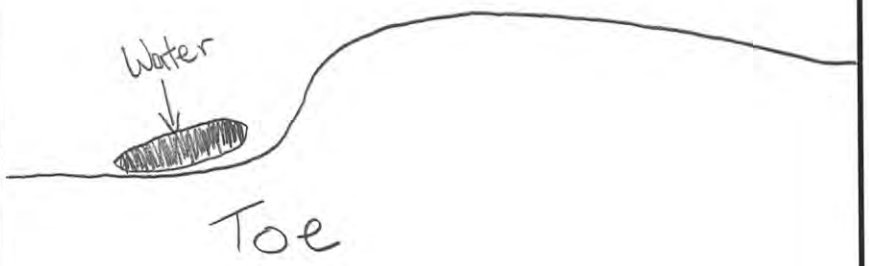
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

Clear

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter: Clear
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): CR

1. Sample Site:	Date:	Time:	Sampler(s):
3565	2019-09-09	16:15	CR/IS

Sky:	Temp:	Precip:	Wind:
(Clear) P.Cloudy O/cast Fog Haze Other	16	(Nil) Light Mod Strong Rain Snow Other	Calm (Light) Mod Strong N E S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
4.8	37.9	4.71	1446	886	7.50	254.5	

QA/QC? (Y) / (Dup)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

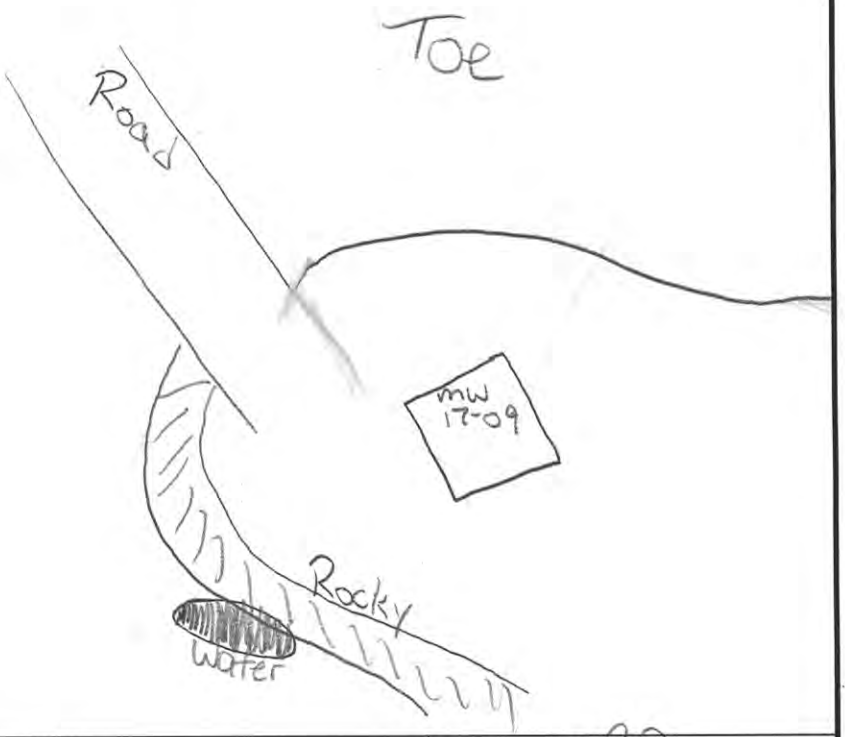
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

- some shine on the water
- lots of leaves on surface

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120ml	D-Hg (40ml)	Colour of Sediment on filter: Clear
✓	✓	✓	✓	# of Filters Used: 1

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): IS

Data entry reviewed (Initials): CR

Seepage Water Quality Field Sheets

1. Sample Site:	Date:	Time:	Sampler(s):
SS 102	Sept 13, 2019	16:40	

Sky: Clear / O/cast / Fog / (P.Cloudy) / Haze / Other

Temp:

Precip: (Nil) / Light / Mod / Strong / Rain / Snow / Other

Wind: Calm / Light (Mod) / Strong / N (E) S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
14.4 °C	74.4	7.53	1965	1668	8.11	280.0	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☑ Upstream ☑ Downstream ☑

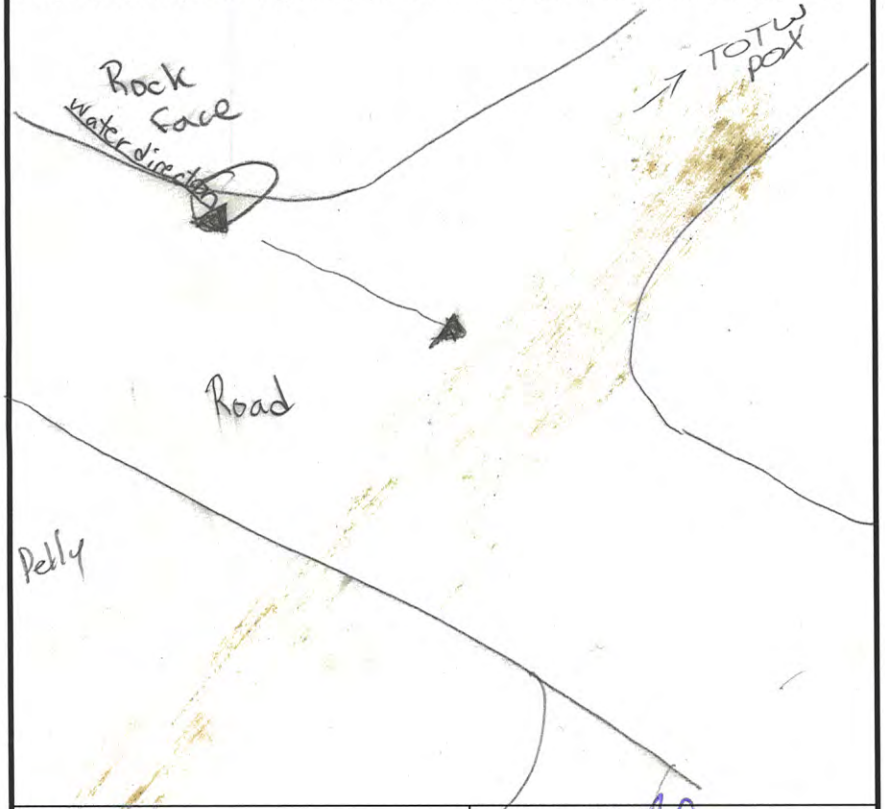
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

clear

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: /

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): CR

1. Sample Site:	Date:	Time:	Sampler(s):
SS 33	13-Sep-19	17:30	TS

Sky: Clear / O/cast / Fog / (P.Cloudy) / Haze / Other

Temp: 10.6

Precip: (Nil) / Light / Mod / Strong / Rain / Snow / Other

Wind: Calm / Light (Mod) / Strong / N (E) S W Var

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
1.6	85.5	11.69	1790	978	7.58	269.3	

QA/QC? Y / (N)

Note: 1 every 10 samples must be dumped

New Sample ? Y / (N) IF Yes, Record GPS Coordinates

Photos: Close-up ☐ Upstream ☐ Downstream ☐

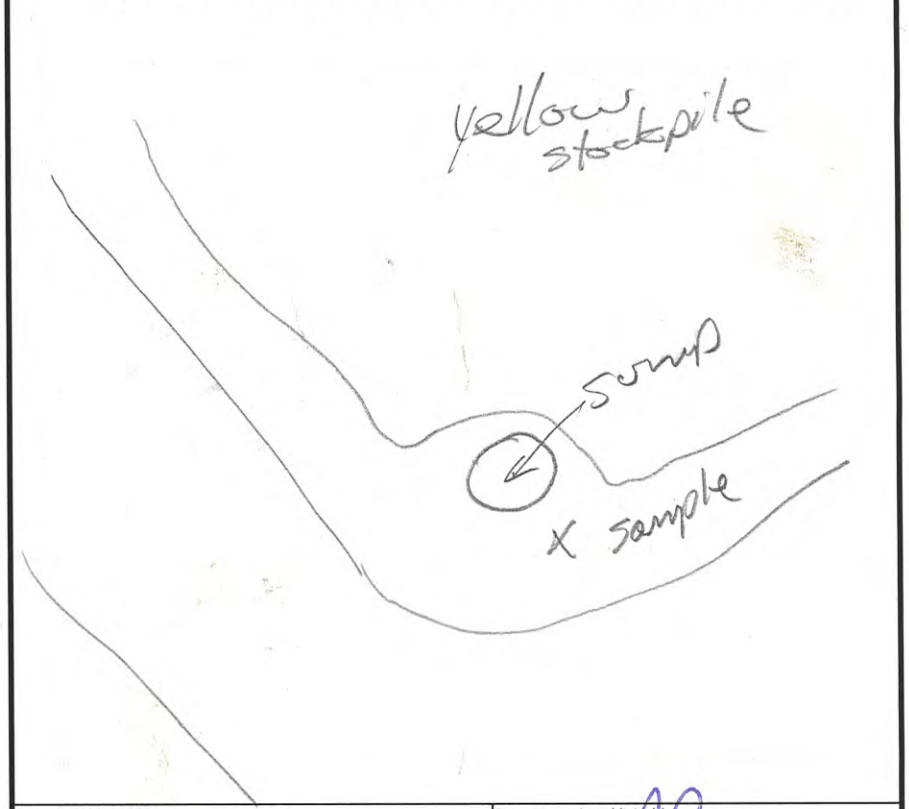
Water Colour? Turbidity, Precipitates? Description of Sampling Conditions:

clean.

DM 120 ml	GENERAL 500 ml	TOTAL Nutrients 120 ml	D-Hg (40 ml)	Colour of Sediment on filter:
✓	✓	✓	✓	# of Filters Used: /

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

SKETCH of Sampling location (location of toe, pools of water, trace of surface water flow, site feautures such as roads, ditches, sumps, etc.)



Data entered (Initials): TS

Data entry reviewed (Initials): CR

2019 Water Quality Field Sheets

1. Sample Site: SS49 | **Date:** 27/9/19 | **Time:** 7:20 | **Sampler(s):** CR/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other | Temp: 0°C | Precip: (Nil) Light Mod Strong Rain Snow Other | Wind: Calm (Light) Mod Strong N E S W Var

Lab Analysis? (E) I | QA/QC? Y / N DUP T-BL F-BL FS | Photos? (Y) N | YSI Calibration? (Y) N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)
	✓		✓	✓			✓	

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
3.6	92.4	12.07	540.0	518.5	7.19	183.6	

Flow Recorded? Y N | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)
no flow, iced over slightly
1 filter, clear



Data entered (Initials): IS | Data entry reviewed (Initials): CR

2. Sample Site: SS64 | **Date:** 27/9/19 | **Time:** 9:35 | **Sampler(s):** CR/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other | Temp: 0°C | Precip: (Nil) Light Mod Strong Rain Snow Other | Wind: (Calm) Light Mod Strong N E S W Var

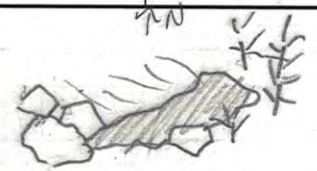
Lab Analysis? (E) I | QA/QC? Y / (N) DUP T-BL F-BL FS | Photos? (Y) N | YSI Calibration? (Y) N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)
	✓		✓	✓			✓	

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
4.6	47.7	6.15	716.4	437.3	7.16	176.8	

Flow Recorded? Y (N) | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)
3 filters, clear,
no flow, iced over slightly



Data entered (Initials): IS | Data entry reviewed (Initials): CR

3. Sample Site: SS39 | **Date:** 27/9/19 | **Time:** 10:10 | **Sampler(s):** CR/IS

Sky: (Clear) P.Cloudy O/cast Fog Haze Other | Temp: 0°C | Precip: (Nil) Light Mod Strong Rain Snow Other | Wind: Calm (Light) Mod Strong N E S W Var

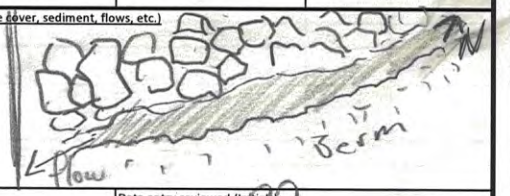
Lab Analysis? (E) I | QA/QC? Y / (N) DUP T-BL F-BL FS | Photos? (Y) N | YSI Calibration? (Y) N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)
	✓		✓	✓			✓	

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
2.4	77.5	10.50	981	558	7.57	166.9	

Flow Recorded? Y (N) | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)
frozen in places,
lots of algae,
floating garbage
clear, 1 filter



Data entered (Initials): IS | Data entry reviewed (Initials): CR

4. Sample Site: | **Date:** | **Time:** | **Sampler(s):**

Sky: Clear P.Cloudy O/cast Fog Haze Other | Temp: | Precip: Nil Light Mod Strong Rain Snow Other | Wind: Calm Light Mod Strong N E S W Var

Lab Analysis? E I | QA/QC? Y / N DUP T-BL F-BL FS | Photos? Y N | YSI Calibration? Y N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU

Flow Recorded? Y N | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

Data entered (Initials): | Data entry reviewed (Initials):

2019 Water Quality Field Sheets

1. Sample Site: SS9 | **Date:** 28/9/19 | **Time:** 10:10 | **Sampler(s):** CR/IS

Sky: Clear / P.Cloudy / O/cast / Fog / Haze / Other | Temp: 0 | Precip: Nil / Light / Mod / Strong / Rain / Snow / Other | Wind: Calm / Light / Mod / Strong N E S W Var

Lab Analysis? E / I | QA/QC? Y / N — DUP / T-BL / F-BL / FS

Photos? Y / N | YSI Calibration? Y / N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)
	✓		✓	✓			✓	

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
0.8	243	3.51	753.2	402.5	7.08	163.2	

Flow Recorded? Y / N | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

no flow, clear to start, got muddy during sampling (shallow) iced over, 4 filters



Data entered (Initials): IS | Data entry reviewed (Initials): CR

2. Sample Site: SS104 | **Date:** 28/9/19 | **Time:** 10:40 | **Sampler(s):** CR/IS

Sky: Clear / P.Cloudy / O/cast / Fog / Haze / Other | Temp: 0 | Precip: Nil / Light / Mod / Strong / Rain / Snow / Other | Wind: Calm / Light / Mod / Strong N E S W Var

Lab Analysis? E / I | QA/QC? Y / N — DUP / T-BL / F-BL / FS

Photos? Y / N | YSI Calibration? Y / N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)
	✓		✓	✓			✓	

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
1.5	4.2	0.69	980	541	7.03	-15.9	

Flow Recorded? Y / N | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

no flow, frozen over hard, yellowish-clear, ~30cm deep 3 filters



Data entered (Initials): IS | Data entry reviewed (Initials): CR

3. Sample Site: SS53 | **Date:** 28/9/19 | **Time:** 11:10 | **Sampler(s):** CR/IS

Sky: Clear / P.Cloudy / O/cast / Fog / Haze / Other | Temp: 0 | Precip: Nil / Light / Mod / Strong / Rain / Snow / Other | Wind: Calm / Light / Mod / Strong N E S W Var

Lab Analysis? E / I | QA/QC? Y / N — DUP / T-BL / F-BL / FS

Photos? Y / N | YSI Calibration? Y / N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)
	✓		✓	✓			✓	

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU
1.4	46.4	6.29	1138	624	7.52	89.2	

Flow Recorded? Y / N | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

no flow, frozen over clear, brownish tint 3 filters



Data entered (Initials): IS | Data entry reviewed (Initials): CR

4. Sample Site: | **Date:** | **Time:** | **Sampler(s):**

Sky: Clear / P.Cloudy / O/cast / Fog / Haze / Other | Temp: | Precip: Nil / Light / Mod / Strong / Rain / Snow / Other | Wind: Calm / Light / Mod / Strong N E S W Var

Lab Analysis? E / I | QA/QC? Y / N — DUP / T-BL / F-BL / FS

Photos? Y / N | YSI Calibration? Y / N

RAW 1L	GENERAL 500 ml	TM 120 ml	DM 120 ml	TOTAL Nutrients 120ml	DOC 120 ml	T-Hg (40ml)	D-Hg (40ml)	Other (list in notes)

Temp C	DO %	DO mg/L	SPC µs/cm	EC µs/cm	pH	ORP mv	Turb NTU

Flow Recorded? Y / N | Staff Gauge (m): | Flume RIGHT (ft): | Flume LEFT (L/S):

Notes (site conditions or variations from normal, i.e. ice cover, sediment, flows, etc.)

Data entered (Initials): | Data entry reviewed (Initials):

Appendix F – 2019 Water Balance and Water Quality Model Summary for the Minto Mine

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Memo

To:	Todd Swenson	**Client:**	Minto Explorations Ltd.
From:	Soren Jensen	**Project No:**	1CM002.065
Cc:		**Date:**	March 27, 2020
Subject:	2019 Water Balance and Water Quality Model Summary for the Minto Mine Site		

1 Introduction and Background

This memorandum provides a summary of the 2019 water balance and water quality model updates for the Minto Mine site. The update covers the period January 1, 2019 through December 31, 2019.

The water balance update includes a review and summary of precipitation, flow and water inventory data for the Mine site. The water quality update includes a comparison of water quality data collected in 2019 to water quality model predictions for Phase VII of the Mine development. Water quality predictions for the Main Pit Tailings Management Facility (MPTMF) and the Water Storage Pond (WSP) are provided for 2019 and for the post-closure period when predicted concentrations are the same from year to year (steady state concentrations).

In October 2018, Minto ended the mill operation and commenced care and maintenance of the mine. The mine resumed operations a year later in October 2019.

2 Water Balance Update

2.1 Precipitation

Table 1 shows a summary of monthly precipitation measured at the Mine site between October 2018 and December 2019 along with precipitation data from the regional station at Carmacks, YT (Climate ID: 2100301)[1], which is located 77 km Southwest of the Minto Mine. In the past, the meteorological station at Pelly Ranch (Climate ID 2100880)[1] located 25 km north of Minto was used as a regional reference station. However, the published data record from Pelly Ranch ends in March 2015 so the Carmacks Station was used instead.

Minto's Campbell Scientific meteorological station measures total precipitation using a Geonor gauge and a tipping bucket rain gauge. From October through May, the tipping bucket is equipped with a snowfall conversion adaptor, which allows it to measure snowfall as snow water equivalent. The Geonor precipitation gauge collects precipitation in a bucket and records

[1] Data obtained from Meteorological Service of Canada, Environment Canada.

precipitation by measuring the weight of the bucket. In the winter months, the bucket is partially filled with an antifreeze solution that melts any snow collected. In 2019, the total precipitation measurement collected by the Geonor gauge were functional but the analogue signal from the vibrating wire load cell was noisy, which means that the amount of total precipitation in any given month was difficult to estimate accurately. Total precipitation for the year was estimated at about 230 mm, although this estimate is uncertain. Precipitation measurements by the tipping bucket rain gauge is lower than the total precipitation measured by the Geonor at approximately 163 mm for the 2019 hydrological year. Precipitation was recorded at Carmacks until July 2019 after which time the record indicates missing measurements (reason not indicated).

Table 1: Precipitation Records for the Minto Mine Site and Carmacks

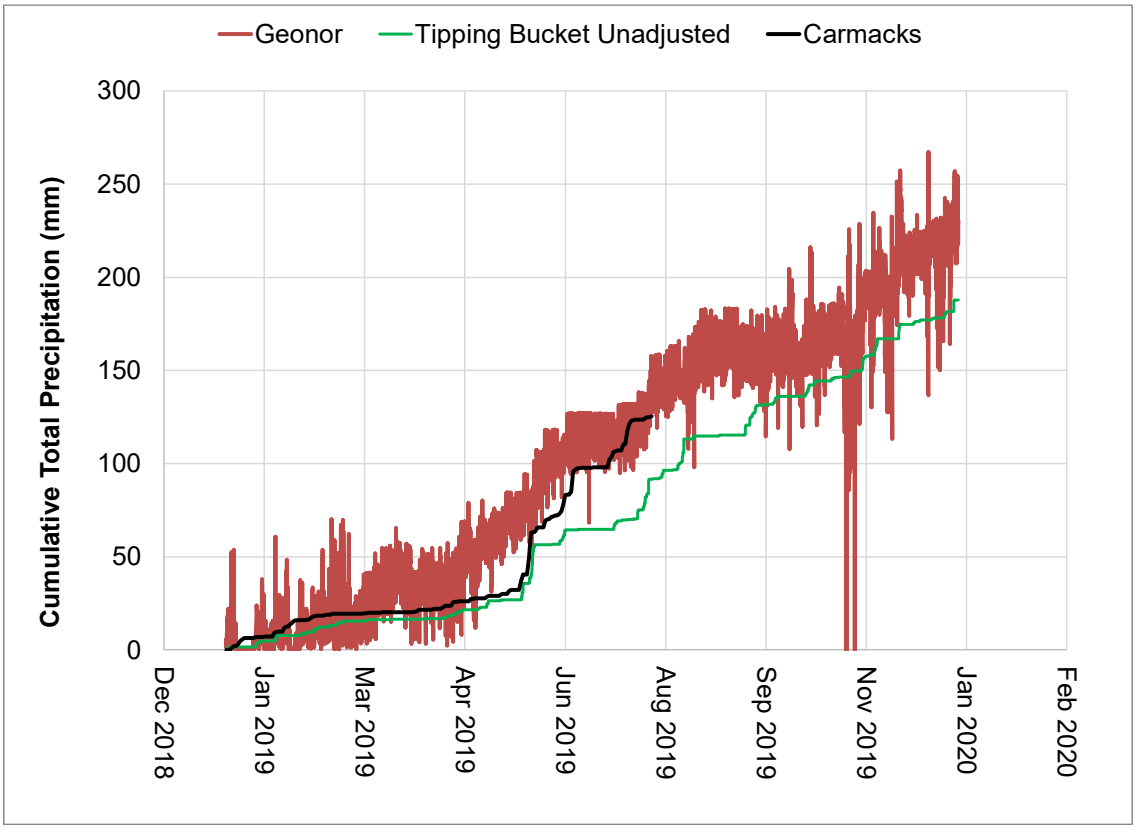
		Campbell Scientific Station (Minto) Mine)		
Year	**Month**	**Tipping Bucket Gauge**	**Geonor Gauge[A]**	**Carmacks Ranch[B] (Climate ID 2100301)**
		mm/month	mm/month	mm/month
2018	Oct	10.6	n/a	15
2018	Nov	8.6	n/a	8.9
2018	Dec	6.7	n/a	3.2
2019	Jan	8.9	Total Precip Approximately 230 mm in 2019	12.5
2019	Feb	7.7		7
2019	Mar	1.2		0.8
2019	Apr	5.1		7.1
2019	May	14.7		35.9
2019	Jun	28.5		32.3
2019	Jul	26.8		27.6
2019	Aug	23.2		n/a
2019	Sept	17.3		n/a
2019	Oct	14.1		n/a
2019	Nov	21.0		n/a
2019	Dec	20.6		n/a
SUM Hydrological Nov. 2018 to Oct.		162.8		

Source: Minto Site Data: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2015_Water_Balance_Update\Minto Water Balance\2017 Met Station Data Summary.xlsx

Notes:
A: Data obtained from Meteorological Service of Canada, Environment Canada.

The roughly 163 mm of precipitation measured at the Mine site in the 2019 hydrological year, which was, if accurate, substantially lower than total precipitation measured in 2017 (210 mm) and 2018 (192 mm). Total annual precipitation of 163 mm is substantially drier than a 1 in 100 dry year, which is estimated at 190 mm/year total precipitation. This is the sixth year in a row that total annual precipitation at Minto has been lower than average, which could indicate that the frequency analysis for total precipitation at the mine site generally overestimates annual total precipitation intensities. It could also be an indication that the climate is gradually changing in the area.

The pattern of precipitation measured by the tipping bucket gauge at Minto and total precipitation measurement at Carmacks are generally in good agreement considering that the stations are located 77 km apart although the station at Carmacks recorded more precipitation in June 2019 (Figure 1). The fact that the Geonor gauge at Minto indicated a similar magnitude of precipitation in June as the station at Carmacks could suggest inconsistent measurements by the tipping bucket over that period. Actual annual total precipitation at Minto in 2019 is likely closer to 200 mm than 163 mm as indicated by the tipping bucket gauge.



X:\01 SITES\Minto\1CM002.024 Water Balance Support\2019 Water Balance Update\2019 Met Station Data Summary.xlsx

Figure 1: 2019 Total Precipitation Measurements at Minto and at Carmacks

2.2 Snow Course Data

Snow course surveys were completed at three snow survey stations at the Mine site in 2019. Table 2 shows a summary of the snow survey data (i.e. an average of the results from the three stations) from 2009 to 2019. The measured snow-pack in March 2019 is the lowest recorded at Minto since 2009.

The depth and water equivalent of the snow-pack provides an indication of the volume of surface runoff that must be managed the following freshet. In March, April and May 2019, approximately 140,000 m^3 of surface runoff was collected from catchments at the Mine site upstream of the Water Storage Dam. This volume corresponds to roughly 14 mm of runoff, which is much less than runoff associated with the 2018 freshet, which amounted to approximately 320,000 m^3 (about 30 mm). The lower recorded runoff volume in 2019 is likely a reflection of the record-low snow-pack. In 2017, approximately 20 mm of runoff was collected during freshet, which is

consistent with the fact that the April 2017 snowpack was 40% lower than the April 2018 snowpack.

Table 2: Summary of Snow Survey Data for the Minto Mine Site

Year	February	March	April
	Water Equivalent (mm)	Water Equivalent (mm)	Water Equivalent (mm)
2009	92.7	110.0	150.7
2010	107.7	120.7	56.0
2011	106.0	141.7	111.7
2012	111.0	127.0	132.7
2013	91.3	106.0	62.7
2014	84.3	99.7	67.3
2015	90.3	76.6	67.8
2016	80.3	80.7	n/a
2017	79.0	72.7	59.3
2018	60.0	69.4	101.1
2019	51.7	51.3	No Survey

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2019 Water Balance Update\2019 Snow Survey Field Data.xlsx

2.3 Water Management

Water that is suitable for release into Minto Creek is conveyed to the Water Storage Pond (WSP), while water collected from active mine areas is routed to the Main Pit Tailings Management Facility (MPTMF) or the Area 2 Pit Tailings Management Facility (A2PTMF). Since November 2012, the MPTMF has also been used for subaqueous deposition of tailings. Deposition of mine water and tailings (subaqueous) to the A2PTMF commenced in April 2015.

Other water management features on the Mine site include:

- WSP: reservoir for water that meets discharge criteria and is destined for discharge to Minto Creek.
- W15 sump: collects surface runoff and seepage from:
  - The Southwest Waste Dump;
  - Part of the Main Waste Dump; and
  - Adjacent undisturbed catchments.

  In 2019, water collected at W15 was routed to the Main Pit TMF from late the beginning of March until September 29 when the pump was pulled for the season.
- W35 sump: collects surface runoff from the minimally disturbed southern catchments. Water collected at W35 in 2019 was piped to the Area 2 Pit TMF from late march until June when the sump dried up. The flow meter was retrieved in early September 2019.

- W62 sump (formerly known as W36 or W37 sump): collects surface runoff and seepage from the mill valley, including contributions from the Dry Stack Tailings Storage Facility. Water collected at the W62 sump is pumped to the MPTMF.
- South Diversion Ditch: diverts water from (W35 Sump) minimally disturbed southern catchments to the WSP (can also be routed to the MPTMF).

2.4 2019 Water Balance

Table 3 summarizes the monthly water and tailings inventory in Minto's MPTMF and A2PTMF as well as water inventory in the WSP. In 2019, the water inventory in the MPTMF increased by approximately 71,000 m^3, while the water inventory in A2PTMF increased by roughly 315,000 m^3. The WSP water inventory decreased by about 50,000 m^3 between January 1 and December 31, 2019.

Table 4 shows a summary of the 2019 water balance for the Mine site. Volume estimates were rounded to the nearest 1,000 m^3 to indicate that precision of the estimates generally is on that order of magnitude or lower. The total surface runoff collected on site was estimated to be 336,000 m^3 based on the change in the water inventory. No water was released to Minto Creek from site. The total catchment upstream of the Water Storage Dam measures approximately 1,040 ha. Therefore, 336,000 m^3 of runoff from 1,040 ha gives a unit yield of approximately 32 mm/year.

The water and load balance model used for forecasting surface runoff volumes uses a site-wide annual average runoff coefficient, which has been derived based on previous years' water balance results. The runoff coefficient is estimated based on the total annual precipitation as follows:

- For dry years with less than 190 mm total precipitation: runoff coefficient = 0.15.
- For average to wet years with more than 309 mm total precipitation: runoff coefficient = 0.30.
- Runoff coefficients for years with total precipitation between 190 mm and 309 mm: interpolated values between 0.15 and 0.30.

In 2019 (hydraulic year) the estimated total precipitation was 163 mm (Table 1), which corresponds to a modelled runoff coefficient of 0.15. The site-wide runoff coefficient, based on the 2017 water balance (measured flows, water inventory and total precipitation), is:

Annual Yield/ Total Annual Precipitation = Runoff Coefficient → *32mm/163 mm =* ***0.20***

The calculated value for the annual site-wide runoff coefficient is higher than the runoff coefficient estimated by the water balance model. However, if the actual annual total precipitation was closer to 200 mm the site-wide runoff coefficient would be 0.16. In previous years, the calculated runoff coefficients have ranged from 0.25 to 0.30. The method used by the water balance model to estimate runoff in dry years is conservative (i.e. conservatively dry) but assumed runoff coefficients appear to be in the appropriate range.

Table 3: 2019 Water Inventory and Release to Minto Creek

Month/	MPTMF Volume Occupied (Water + Tailings)[A]	Change in MPTMF Water Inventory	Tailings Solids Deposition in MPTMF	A2 Stage1/2 TMF Volume Occupied (Water + Tailings)[A]	Change in A2 Stage 1/2 TMF Water Inventory	A2 Stage3 TMF Volume Occupied (Water + Tailings)[A]	Change in A2 Stage 3 TMF Water Inventory	Tailings Solids Deposition in A2PTMF	WSP Volume[A]	Change in WSP Water Inventory
Year	m^3	m^3/month	BCM/month	m^3	m^3/month	m^3	m^3/month	BCM/month	m^3	m^3/month
1-Jan-2019	752,857	18,624	0	1,597,639	-3,728	509,679	2,600	0	80,875	-2,487
1-Feb-2019	771,481	17,624	0	1,593,911	-6,071	512,279	7,458	0	78389	-1,208
1-Mar-2019	789,106	31,613	0	1,587,840	14,352	519,737	-3,962	0	77181	-7,713
1-Apr-2019	820,719	24,378	0	1,602,192	-4,346	515,775	-23,002	0	69468	-3,552
1-May-2019	845,097	35,773	0	1,597,846	-24,439	492,773	69,194	0	65916	408
1-Jun-2019	880,870	20,849	0	1,573,407	-16,378	561,967	18,630	0	66324	-8,934
1-Jul-2019	901,719	9,832	0	1,557,029	-7,744	580,597	-11,093	0	57390	-6,466
1-Aug-2019	911,551	21,335	0	1,549,285	0	569,504	12,045	0	50924	-4,170
1-Sep-2019	932,886	52,170	0	1,549,285	34,344	581,549	13,129	0	46754	-4,102
1-Oct-2019	985,056	-83,443	0	1,583,629	74,389	594,678	63,677		42652	-4,109
1-Nov-2019	901,613	-88,054	0	1,658,017	-21,862	658,355	85,288	36,197	38543	-1,530
1-Dec-2019	813,559	10,412	0	1,636,156	37,236	743,643	41,007		37013	-5,721
1-Jan-2020	823,971			1,673,392		784,650			31292	
SUM		71,114			75,753		274,971	36,197		-49,583
								Total Inventory Change	336,058	m^3

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2019_Water_Balance_Update\2012019 Water Balance Update REV00 SRJ.xlsx

Notes:

A – on the first day of the month.

Table 4: Water Balance Summary of the Minto Mine Site, 2019 (Jan to Dec)

	Units	Main Pit TMF	Area 2 Pit TMF	WSP
Volume Change 2019 (water + tailings)	m^3	71,000	351,000	-50,000
Tailings Deposited, total	BCM	-	36,000	-
Water Volume Change 2019	m^3	71,000	315,000	-50,000
Estimated Groundwater Inflow	m^3	-	-	-
Total Water Inventory Increase in 2019	**m^3**	336,000		
Total Water Discharged to Minto Creek	m^3	0		
Total Site-Wide Yield in 2019	**m^3**	**336,000**		

Source: X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2019_Water_Balance_Update\2019 Water Balance Update REV00 KNK.xlsx

3 Water Quality Model Update

3.1 Solid Phase Geochemistry

The neutralization potential ratio (NPR) and copper content of waste rock and tailings have been relatively consistent since 2012 (Figures 2 to 5). Because the mine was on care and maintenance for most of 2019, no further evaluation of 2019 solid phase geochemistry was warranted. Historically, measured NPR was greater than 3 for all tailings samples, which indicates that the tailings are not potentially acid generating.

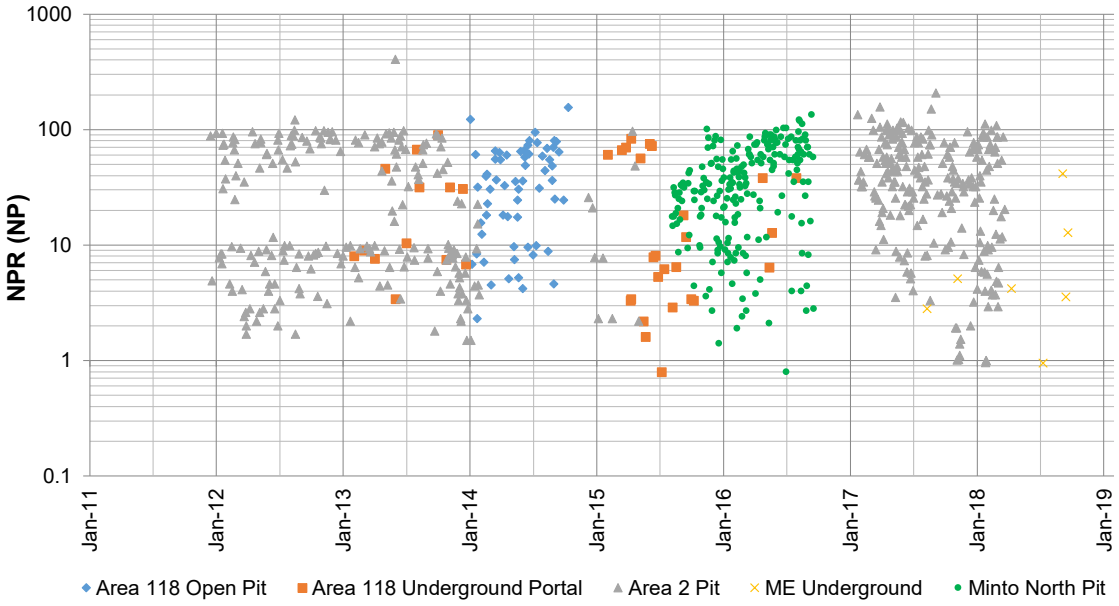


Figure 2: Waste Rock Neutralization Potential Ratio over Time

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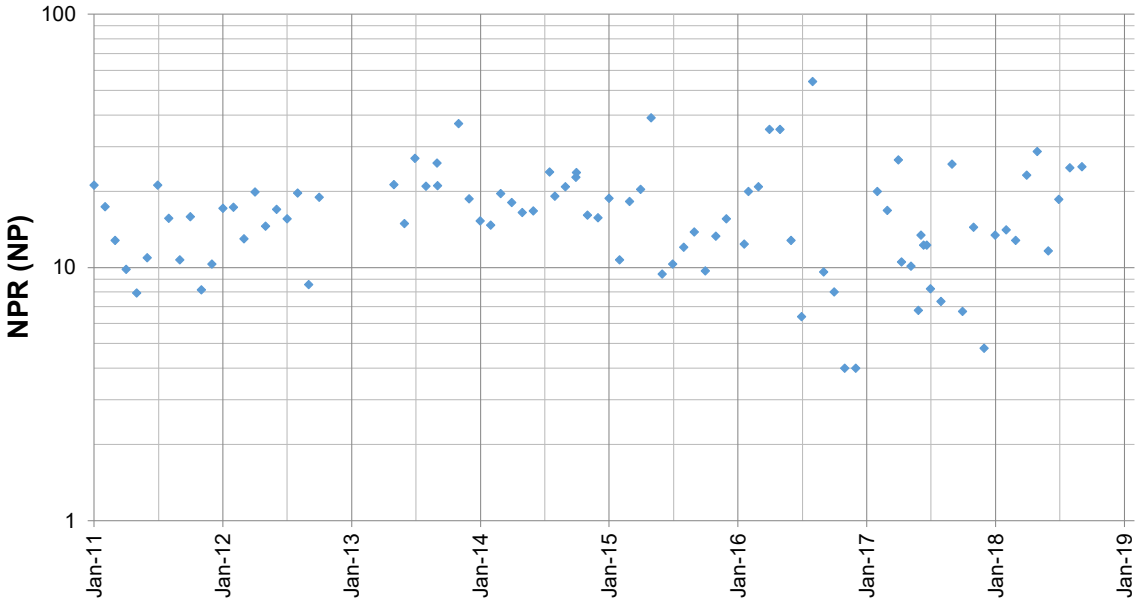


Figure 3: Tailings Neutralization Potential Ratio over Time

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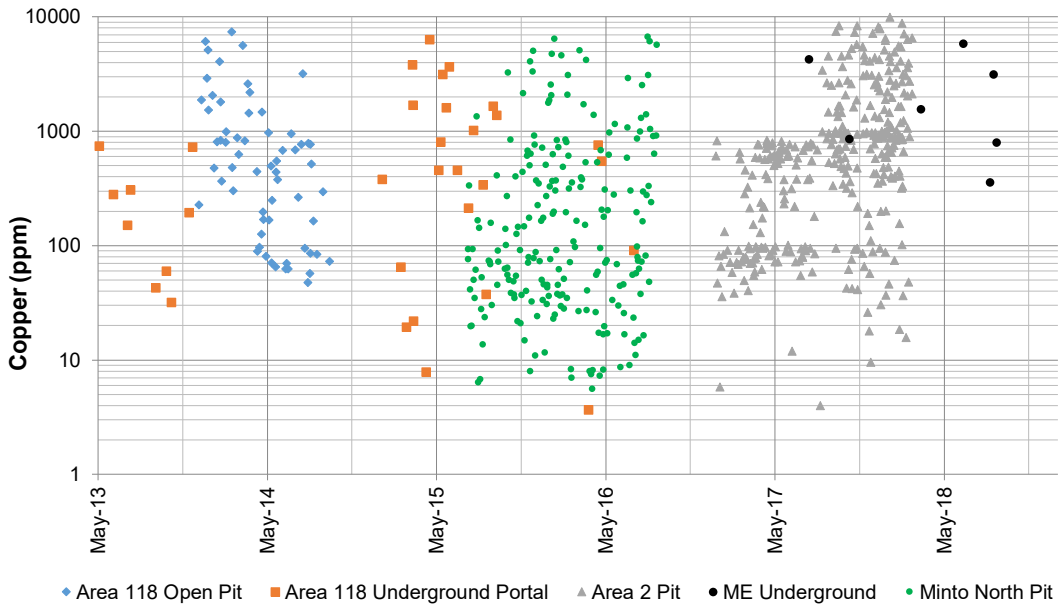


Figure 4: Waste Rock Copper Concentration over Time

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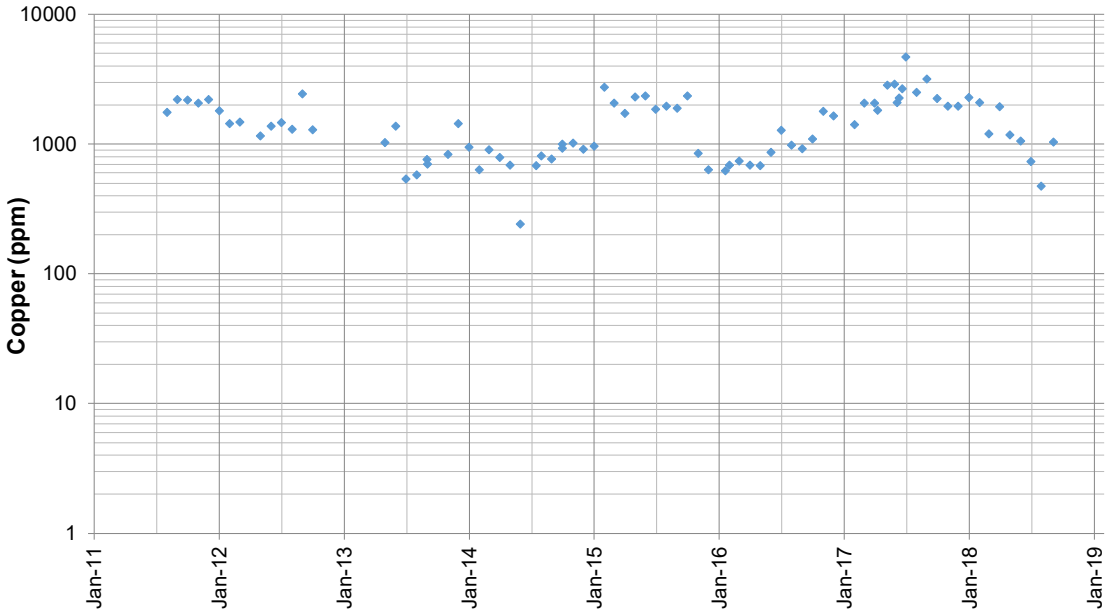


Figure 5: Tailings copper concentration over time

X:\01_SITES\Minto\1CM002.024_Water_Balance_Support\2018 Water Balance Update\ ABACharts_Cu_NPR_2018_1CM002.024_REV00_SRJ.xlsx

3.2 Comparison of Measured Water Quality Data to Source Terms

3.2.1 Source Terms – Dry Stack Tailings Storage Facility

The Dry Stack Tailings Storage Facility (DSTSF) source terms used in the water and load balance model for the Minto were developed based on the observed water chemistry of samples collected at station W8 and W8A. This station was chosen because it had the highest concentrations of copper, cadmium, selenium, and sulfate during the period of record. The following points describe the source terms:

- Best Estimate source term: 50th percentile dissolved concentrations from W8A;
- Reasonable Worst Case source term: 95th percentile dissolved concentrations from W8A.

The Best Estimate and Reasonable Worst Case source terms were updated to include data to 2019 for comparison to the existing source terms. It was found that the updated source terms did not differ from the source terms used in the latest model revision, which included data up to and including 2016. Therefore, for consistency the original DSTSF source terms was used in this 2019 update of the water balance and water quality model.

3.2.2 Source Terms – Waste Rock

The Main Waste Dump and the Southwest Waste Dump source terms used in the water and load balance model were defined based on observed water chemistry at station W15, which collects runoff from the Southwest Waste Dump. The latest model revision assigned Best Estimate waste rock source term as the 50th percentile dissolved concentrations at W15 until the end of 2016 and

the Reasonable Worst Case waste rock source term was the 95th percentile dissolved concentrations. Water quality data collected at W15 in 2019 followed the same trends as the historical data. Therefore, the original source term was used for the updated predictions presented here.

3.2.3 Source Term – Tailings Slurry

Minto did not operate for most of 2019. Throughout 2019, sulfate concentrations in the Area 2 and Main Pit water remained relatively constant but increased slightly when operations resumed in October 2019. The increase in sulphate concentrations were consistent with the existing source term used for the tailings slurry.

3.3 Water Quality Model Results

Table 5 and 6 show revised model outputs from the water and load balance model for water quality in the Water Storage Pond (WSP) for 2019 and post-closure (best estimate and worst case) along with concentrations measured in 2019. Table 7 and 8 show revised model predictions of water quality in the MPTMF for 2019 and post-closure. Predictions for post-closure were selected to provide representative long-term indications of water quality trends. Predictions are for average precipitation conditions. The Water Use Licence (QZ14-031) effluent limits are also listed in the tables. Model runs started on 1 January 2016 and ended on 1 January 2045, at which point concentrations in the model roughly have reached steady state.

Water collected in the WSP includes clean (non-contact) runoff and effluent from Minto's water treatment plant. Median measured concentrations in the WSP in 2019 were lower than or comparable to the revised model predictions using best estimate source terms (Table 5), except for dissolved copper, for which the measured median concentration was 14 µg/L compared to expected median concentrations of approximately 7 µg/L for the Best Estimate model scenario, but equal to the predicted median concentration of 14 µg/L for the Reasonable Worse Case scenario (Table 6).

Dissolved copper concentrations in the WSP increased between 2015 and mid-2018 and then decrease markedly (Figure 6). The increase in copper concentrations in the WSP in 2018 was due to a reduction in the volume of treated MPTMF water that was pumped to the WSP. MPTMF water is treated using reverse osmosis, which removes nearly all dissolved copper.

Revised model predictions using reasonable worst case source terms are generally higher than comparable median and maximum measured values for the WSP, except for copper (Table 6).

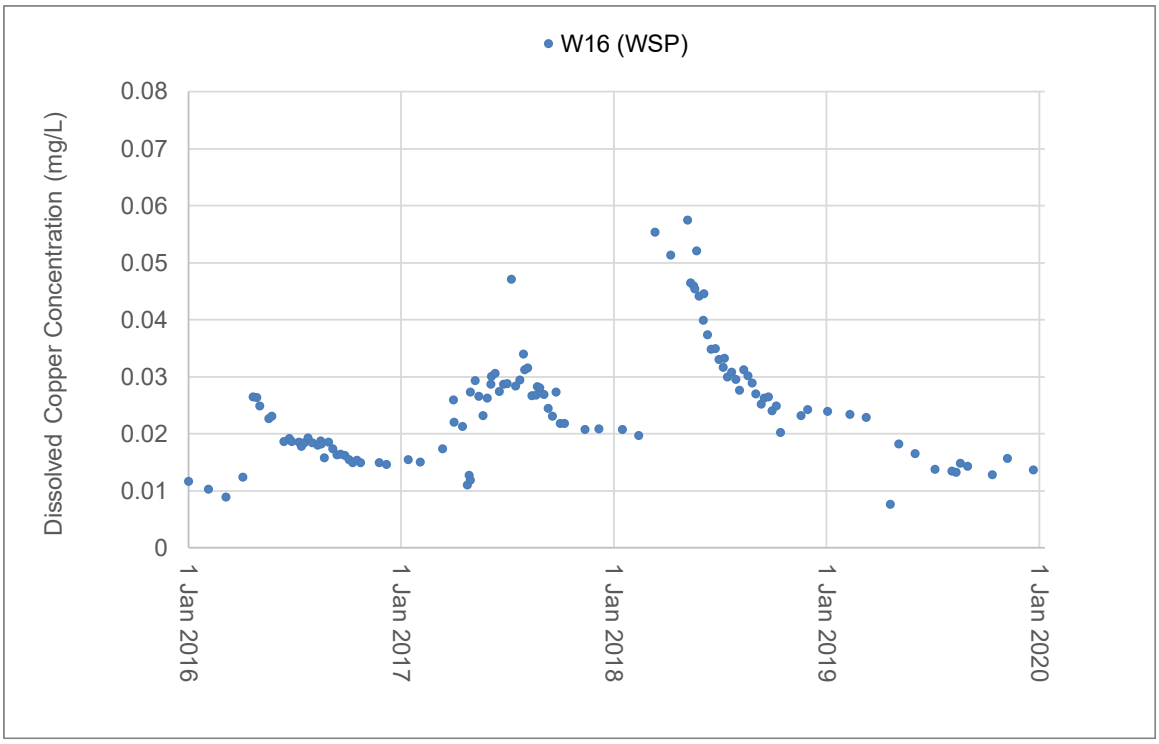


Figure 6 Dissolved Copper Concentrations in WSP (Station W16)

The MPTMF was historically the primary water reservoir on site. In the model, the free water in the MPTMF and A2PTMF are more or less considered to belong to the same reservoir due to the high rate of flow between the two reservoirs while the mill was operating. During the care and maintenance phase, concentrations in the MPTMF and the A2PTMF changed independently but concentrations of most parameters remained in a similar range (data not shown).

For 2019, a comparison of measured MPTMF water quality with concentrations predicted for pit water for the Phase V/VI environmental assessment provides a good measure of actual vs. expected geochemical performance of the site. The median of measured concentrations in the MPTMF are generally at or below predicted median values except for dissolved copper and cadmium which were about 50% greater than expected (Table 7). Water quality model predictions using reasonable worst-case source terms are higher than measured median concentrations (Table 8).

The overall favorable agreement in the results tables below indicates that the existing source terms are appropriate for describing the existing geochemical performance and the actual water management practices on site. Best estimate source terms are intended to provide an indication of the general trend in water quality parameter concentrations but are not intended to capture maximum or outlier concentration values. Therefore, the median values of best estimate model predictions are compared to measured median values.

Table 5: WSP Water Quality Model Predictions and Measured Concentrations in 2019, Best Estimate

		WUL Effluent Limits (QZ14-031)	WSP Measured Water Quality (Station W16)	Modelling Predictions of Quality in WSP (Station W16)	
Year			2019	2019	Post-Closure
			Median	Median	Median
Ammonia	mg/L	0.75	0.015	0.053	0.23
$N\text{-}NO_2$	mg/L	0.18	0.0014	0.017	0.059
$N\text{-}NO_3$	mg/L	27.3	0.058	1.3	1.2
Ag-Dissolved	Mg/L	0.0003	0.00001	0.000012	0.000049
Al-Dissolved	mg/L	0.3	0.002	0.032	0.28
As-Dissolved	mg/L	0.015	0.00051	0.00048	0.0021
Cd-Dissolved	mg/L	0.0014a	0.000005	0.00002	0.000022
Cr-Dissolved	mg/L	0.003	0.0001	0.00066	0.0019
Cu-Dissolved	mg/L	0.06/0.039b	0.014	0.0066	0.013
Fe-Dissolved	mg/L	3.3	0.014	0.31	0.59
Pb-Dissolved	mg/L	0.012	0.00005	0.00014	0.00042
Mo-Dissolved	mg/L	0.219	0.0035	0.0012	0.0097
Ni-Dissolved	mg/L	0.33	0.00062	0.0012	0.0024
Se-Dissolved	mg/L	0.006	0.00043	0.00046	0.002
Zn-Dissolved	mg/L	0.09	0.0012	0.0041	0.0035

Source: SRK, C:\Users\sjensen\Desktop\2019 Water Balance Update\Model_Results_20200325_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

a) at 50 mg/L hardness.

b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 6: WSP Water Quality Model Predictions and Measured Concentrations in 2019, Reasonable Worst Case

		WUL Effluent Limits (QZ14-031)	WSP Measured Water Quality (Station W16)		Modelling Predictions of Quality in WSP (Station W16)			
Year			2019		2019		Post-Closure	
			Median	Max	Median	Max	Median	Max
Ammonia	mg/L	0.75	0.015	0.074	0.09	0.1	0.23	0.43
N-NO2	mg/L	0.18	0.0014	0.01	0.073	0.096	0.059	0.11
N-NO3	mg/L	27.3	0.058	1.1	8.2	11	1.2	2.3
Ag-Dissolved	Mg/L	0.0003	0.00001	0.00001	0.00003	0.000037	0.000049	0.00013
Al-Dissolved	mg/L	0.3	0.002	0.0085	0.064	0.072	0.28	0.57
As-Dissolved	mg/L	0.015	0.00051	0.00062	0.00059	0.00063	0.0021	0.005
Cd-Dissolved	mg/L	0.0014a	0.000005	0.00018	0.000039	0.000044	0.000022	0.000062
Cr-Dissolved	mg/L	0.003	0.0001	0.00019	0.00087	0.00099	0.0019	0.0052
Cu-Dissolved	mg/L	0.06/0.039b	0.014	0.024	0.014	0.017	0.013	0.029
Fe-Dissolved	mg/L	3.3	0.014	0.05	0.47	0.54	0.59	1.5
Pb-Dissolved	mg/L	0.012	0.00005	0.000082	0.00014	0.00015	0.00042	0.0011
Mo-Dissolved	mg/L	0.219	0.0035	0.0039	0.0022	0.0026	0.0097	0.024
Ni-Dissolved	mg/L	0.33	0.00062	0.00099	0.0016	0.0017	0.0024	0.0064
Se-Dissolved	mg/L	0.006	0.00043	0.00074	0.0018	0.0023	0.002	0.0037
Zn-Dissolved	mg/L	0.09	0.0012	0.025	0.0052	0.0056	0.0035	0.0084

Source: SRK, Source: SRK, C:\Users\sjensen\Desktop\2019 Water Balance Update\Model_Results_20200325_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

a) at 50 mg/L hardness.

b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 7: MPTMF Water Quality Model Predictions and Measured Concentrations in 2019, Best Estimate

		WUL Effluent Limits (QZ14-031)	MPTMF Measured Water Quality (Station W12)	Modelling Predictions of Quality in MPTMF (Station W12)	
Year			2019	2019	Post-Closure
			Median	Median	Median
Ammonia	mg/L	0.75	0.24	1.4	0.079
N-NO2	mg/L	0.18	0.1	0.56	0.017
N-NO3	mg/L	27.3	7.5	13	0.38
Ag-Dissolved	Mg/L	0.0003	0.00001	0.000043	0.000057
Al-Dissolved	mg/L	0.3	0.0027	0.17	0.26
As-Dissolved	mg/L	0.015	0.00058	0.0015	0.0021
Cd-Dissolved	mg/L	0.0014a	0.000073	0.000055	0.00006
Cr-Dissolved	mg/L	0.003	0.00012	0.0018	0.0023
Cu-Dissolved	mg/L	0.06/0.039b	0.054	0.031	0.035
Fe-Dissolved	mg/L	3.3	0.01	0.47	0.71
Pb-Dissolved	mg/L	0.012	0.00005	0.00041	0.00051
Mo-Dissolved	mg/L	0.219	0.027	0.033	0.011
Ni-Dissolved	mg/L	0.33	0.001	0.0023	0.0028
Se-Dissolved	mg/L	0.006	0.0046	0.0074	0.0034
Zn-Dissolved	mg/L	0.09	0.0025	0.0094	0.012

Source: SRK, Source: SRK, C:\Users\sjensen\Desktop\2019 Water Balance Update\Model_Results_20200325_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

a) at 50 mg/L hardness.

b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

Table 8: MPTMF Water Quality Model Predictions and Measured Concentrations in 2019, Reasonable Worst Case

		WUL Effluent Limits (QZ14-031)	MPTMF Measured Water Quality (Station W12)		Modelling Predictions of Quality in MPTMF (Station W12)			
Year			2019		2019		Post-Closure	
			Median	Max	Median	Max	Median	Max
Ammonia	mg/L	0.75	0.24	0.53	2.2	3	0.28	0.45
N-NO2	mg/L	0.18	0.1	0.29	1	1.3	0.037	0.057
N-NO3	mg/L	27.3	7.5	28	43	52	1.1	1.7
Ag-Dissolved	Mg/L	0.0003	0.00001	0.00002	0.00014	0.00016	0.000089	0.00012
Al-Dissolved	mg/L	0.3	0.0027	0.01	0.42	0.46	0.53	0.83
As-Dissolved	mg/L	0.015	0.00058	0.001	0.003	0.0034	0.0049	0.0063
Cd-Dissolved	mg/L	0.0014a	0.000073	0.00022	0.0002	0.00022	0.00031	0.00037
Cr-Dissolved	mg/L	0.003	0.00012	0.0002	0.0036	0.0041	0.0038	0.0048
Cu-Dissolved	mg/L	0.06/0.039b	0.054	0.22	0.079	0.087	0.077	0.098
Fe-Dissolved	mg/L	3.3	0.01	0.022	1.2	1.3	1.9	2.3
Pb-Dissolved	mg/L	0.012	0.00005	0.0001	0.0012	0.0013	0.0017	0.0025
Mo-Dissolved	mg/L	0.219	0.027	0.034	0.049	0.063	0.031	0.037
Ni-Dissolved	mg/L	0.33	0.001	0.0015	0.0049	0.0055	0.0067	0.0074
Se-Dissolved	mg/L	0.006	0.0046	0.011	0.015	0.019	0.008	0.01
Zn-Dissolved	mg/L	0.09	0.0025	0.013	0.019	0.021	0.03	0.036

Source: SRK, Source: SRK, C:\Users\sjensen\Desktop\2019 Water Balance Update\Model_Results_20200325_REV00_SRJ.xlsx

Notes:

Analytical data from Minto's water quality monitoring program.

a) at 50 mg/L hardness.

b) Cu effluent standard is 0.06 when [DOC] @ W2 > 10 mg/L and 0.039 when [DOC] @ W2 ≤ 10 mg/L.

4 Closing

The summary of the updated water balance and water quality model for the Minto Mine was prepared in support of annual reporting. SRK would be pleased to address any questions or comments.

Appendix G – Minto and McGinty Creek 2019 Surface Hydrology Update

Summary of Minto and McGinty Creek 2019 Surface Hydrology Memo

1 Introduction

In 2019, as part of the EMSRP, Minto monitored hydrological conditions at water quality stations including the following: stations within the operational mine area; stations downstream from the mine operational area that are influenced by mine effluent discharge; and reference stations downstream from the mine operational area that are not exposed to effluent. Hydrological monitoring is performed using a variety of methods including: manual discrete discharge measurements with combinations of flow meters, continuous stage measurements through the deployment of Solinst Level Loggers and Barometric Loggers and monitoring of an engineered flume.

Minto maintained and monitored 8 hydrometric stations located on Minto Creek and McGinty Creek as listed below and shown in Figure 2.

- Minto Creek
    1. W3: Flume downstream of the Water Storage Pond (WSP);
    2. MC1: Located in Minto Canyon – mid-catchment;
    3. W1: Located approximately 1 km upstream of Yukon River – lower catchment; and
    4. W7: Tributary on the south side of Minto Creek.
- McGinty Creek
    5. MN-0.5: West Tributary of McGinty Creek
    6. MN-1.5: Upper East Arm of McGinty Creek
    7. MN-2.5: East Tributary of McGinty Creek
    8. MN-4.5: McGinty Creek near the Mouth

The 2019 open water season was characterized by very low flows, partly due to an unusually small snow pack and low precipitations. No mine discharge occurred in 2019 from the Water Storage Pond nor the Water Treatment Plant.

The following sections will present the methods used to measure flow at the hydrometric program, the summary of each station's hydrometric program and recommendations for future monitoring.

2 Methods

Minto personnel conduct regular discrete discharge measurements and maintenance at the stations listed below. Additionally, these stations are equipped with Solinst Level Logger and Barometric Logger for continuous measurements. Table 2-1 provides an overview of instrumentation available and discrete measurement frequency at these stations.

Table 2-1: Summary of Hydrometric Program

Station	Watershed	Years Monitored	Frequency of Discrete Measurement	Instrumentation Available
W3	Minto Creek	2012-2019	Weekly	Flume, Data Logger
MC1	Minto Creek	2012-2019	Weekly	Staff Gauge, Data Logger
W1	Minto Creek	2012-2019	Weekly	Staff Gauge, Data Logger
W7	Minto Creek	2013-2019	Monthly	Staff Gauge, Data Logger
MN-0.5	McGinty Creek	2014-2019	Monthly	Staff Gauge, Data Logger
MN-1.5	McGinty Creek	2018-2019	Monthly	Staff Gauge, Data Logger
MN-2.5	McGinty Creek	2014-2019	Monthly	Staff Gauge, Data Logger
MN-4.5	McGinty Creek	2011-2019	Monthly	Staff Gauge, Data Logger

Stream-gauge data is collected and managed throughout the open water season by the Minto personnel. Velocities are measured using a Hach FH950 handheld electromagnetic flowmeter. Velocity and water depth measurements are converted to flows using the area-velocity relationship methods. All hydrometric data, calculated flows and the time-series of recorded water levels and temperature data from the loggers were processed by Minto personnel under AEG guidance.

Level logger data were compared to the staff gauge readings, logger records for water level may have shifted over the course of the season due to repositioning, and data were corrected to match staff gauge measurements.

Stage-discharge relationships (rating curves) were created with discrete flow measurements and staff gauge readings. Ice affected readings or readings that were far outliers that could not be confirmed by photography may have been removed from the stage-discharge curves.

3 Minto Creek

3.1 Station W3 – Flume below the Water Storage Pond Dam

W3 is located about 500 meters downstream of the water storage pond dam and consist of a built flume. Solinst loggers record water levels and atmospheric pressure every 30 minutes, in addition water levels at the flume are recorded weekly for most of the year. Late in 2018 the flume area had begun to freeze and overflow, hence created a glacier over the creek and structures as seen in Figure 1 below. The building on the right has the flume structure which contains the levelogger. Heater and pump systems were installed to purge the flume prior to sampling to ensure a proper sample, but hydrometric measurements were unreliable during this period. The flume did not flow freely until June 18, 2019.



Figure 1: W3 Station Ice Cover on March 16, 2019

A summary of the level and flow data recorded at W3 are presented in Figure 3 to Figure 6. This data provided the necessary information to correct the recorded stage data and in turn generate a stage discharge relationship which is used to calculate the creek discharge, the stage-discharge relationship is presented in Figure 5. Figure 3 presents recorded water level for 2019 (January 1 to November 10, 2019, it is evident that the pressure recorded from January to June is not accurate due to the freeze-thaw nature of the season, therefore a second hydrograph is presented on Figure 4 with June to November data

presented. Overflow at the flume during the colder months creates a pressure on the Levelogger that is not representative of the actual discharge occurring, making it difficult to obtain accurate water level readings for the months of November to March. The levelogger was preemptively removed for the winter on November 10, 2019.

W3 is directly influenced by discharge from the Water Storage Pond to Minto Creek, though during the 2019 open-water season no discharge occurred from the Water Storage Pond. Figure 6 shows the 2019 hydrograph and discrete flow measurements conducted during the reliable recorded dataset. A large peak can be observed on October 28, 2019, signifying possible ice within the logger casing, which is supported by a steep decrease in temperature (Figure 4). The gradual decrease in temperature beginning September 23, 2019 indicates a freezing of the creek and eventually the flume area, data from September 23 to November 10 is suspicious but presented below.

Table 3-1 provides a summary of the average water temperature, flow and total flow volume in 2019. Table 3-2 summarizes the historical mean monthly flows to previous years of the hydrometric program.

Table 3-1: W3 2019 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m^3/s)	Total Flow (m^3)
Jan[1]	31	1.06		
Feb[1]	28	0.04		
Mar[1]	31	0.43		
Apr[1]	30	-0.46		
May[1]	31	-0.24		
Jun[1]	30	2.71	0.0028	3041.0
Jul	31	6.54	0.0027	7359.4
Aug	31	4.72	0.0025	6779.7
Sep[2]	30	2.79	0.0028	7232.6
Oct[2]	31	0.22	0.0036	9749.5
Nov[2]	11	0.83	0.0033	2740.5
Dec[3]	No data collected			

Shaded cells indicate incomplete months of data

1. Station iced over, not reliable logger data
2. Logger affected by ice and cold conditions
3. Logger removed pre-emptively for winter 2020

Table 3-2: W3 Historical Mean Monthly Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012[1]	-	-	-	-	-	0.005	0.005	0.006	0.005	-	-	-
2013[1]	-	-	-	-	-	0.003	0.004	0.004	0.004	-	-	-
2014[1]	-	-	-	-	-	<0.001	<0.001	0.002	0.003	0.003	0.006	0.004
2015[1]	0.003	0.006	0.006	0.057	0.086	0.003	0.003	0.003	0.004	0.004	0.006	0.026
2016[1]	-	-	-	0.022	0.052	0.003	0.003	0.004	0.004	0.004	0.003	0.004
2017	0.030	0.020	0.010	0.010	0.016	0.018	0.006	0.008	0.007	0.012	0.010	0.015
2018	-	-	-	-	-	0.028	0.022	0.015	0.013	0.012	-	-
2019	-	-	-	-	-	0.003	0.003	0.003	0.003	0.004	0.003	-

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

3.2 MC1 - Minto Creek Mid-Catchment

The hydrometric station MC1 on Minto Creek is located downstream of the W3 Flume and immediately upstream of the canyon along Minto Creek. The pressure transducer installed at this station recorded temperature and water levels at 30 minute intervals from May 28 to October 8 (134 days). Figure 7 shows water level and temperature data for Minto Creek at MC1 during the open-water season. As of September 16, the logger provides unstable data corresponding to a logger out of the water due to low water levels, as such Figure 9 and Figure 10 only present reliable data, May 28 to September 16, 2019.

Over the course of the hydrometric program in 2019, numerous discrete discharge measurements were recorded in conjunction with water level readings recorded by both the pressure transducer and the staff gauge. This data provides the information necessary to generate a stage-discharge relationship which enables the computation of creek discharge for the recorded stage data. The stage-discharge relationship is presented in Figure 8.

The 2019 hydrograph and discrete measurements for MC1 are shown in Figure 9. In 2019, the maximum measured flow of 0.104 m^3/s occurred on June 3, 2019 following a heavy rain event. The levelogger was moved on June 11 and again removed on July 7 and replaced July 9, this changed the logger's depth twice during the season as observed in Figure 10.

Table 3-3 provides a summary of the average water temperature, flow and total flow volume in 2019. The negative temperatures recorded in June and October indicate the end of spring and start of the freeze-up period. Table 3-4 summarizes the historical mean monthly flows to previous years of the hydrometric program.

Table 3-3: MC1 2019 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m^3/s)	Total Flow (m3)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	4	-1.30	0.029	3925.9
Jun	30	1.27	0.027	34892.9
Jul	31	7.12	0.009	10759.1
Aug	31	3.38	0.007	8896.3
Sep[1]	30	1.40	0.021	26961.6
Oct[1]	3	-1.44	0.212	60394.8
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

1. Logger affected by ice and cold conditions, unreliable data

Table 3-4: MC1 Historical Mean Monthly Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012[1]	-	-	-	-	0.179	0.065	0.052	0.041	0.108	-	-	-
2013[1]	-	-	-	-	0.358	0.085	0.103	0.44	0.089	0.064	-	-
2014[1]	-	-	-	-	0.187	0.028	0.031	0.036	0.028	0.033	-	-
2015[1]	-	-	-	-	0.862	0.014	0.028	0.042	0.035	0.031	-	-
2016[1]	-	-	-	-	-	0.029	0.036	0.048	0.076	-	-	-
2017[1]	-	-	-	-	0.102	0.074	0.018	0.010	0.028	0.029	-	-
2018	-	-	-	-	-	0.072	0.016	0.025	0.021	0.012	-	-
2019	-	-	-	-	0.029	0.027	0.009	0.007	0.021[2]	0.212[2]		

Note: Shaded cells indicate incomplete months of data

1. Data based on previous Annual Surface water Hydrology Analysis.
2. Logger affected by ice and cold conditions, unreliable data

a. W1 – Lower Minto Creek above Road Crossing

W1 station is located on the lower reach of Minto Creek before flowing into the Yukon River. In 2019, water level and temperature data were continuously measured and recorded every 15 minutes by the pressure transducer/data logger. Figure 9 shows Minto Creek at W1 water level and temperature data for the 154-day record from May 7 to October 8, 2019. During the summer 2019, this station dried up June 23 and did not recover for the rest of the season. The entire dataset is presented in the Stage and Water temperature hydrograph (Figure 11), but for ease of presentation the dry period was omitted from the remaining figures (Figure 13 and Figure 14).

The stage-discharge relationship for W1 is presented in Figure 12; 2019 measurements are well within the curves' range but are not consistent. The staff gauge should be re-levelled in 2020 to ensure consistent readings. The 2019 hydrograph and discrete measurements for W1 are shown in Figure 13. In 2019, the maximum measured flow was 0.337 m^3/s occurred on June 3, 2019 following a heavy rain event. Figure 14 shows W1 and MC1 flows, W1 is located downstream of MC1 and it is expected that flows would be larger because it has a much larger catchment area than MC1. The surface area at W1 is wider and at low flows the HACH sensor is not covered leading to skewed discrete flow measurement. It was observed that flows during late spring were much higher at W1 and lower leading into fall which is consistent with the 2018 hydrograph as well. Water downstream of MC1 passes through a preferential pathway and by-passes W1.

Table 3-5 provides a summary of the average water temperature, flow and total flow volume in 2019. Table 3-6 summarizes the historical mean monthly flows to previous years of the hydrometric program. The history shows that freeze-up begins in October and that freshet typically occurs in April/May.

Table 3-5: W1 2019 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m^3/s)	Total Flow (m^3)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	24	1.107	0.042	87948.8
Jun	23	3.253	0.034	67513.8
Jul	No Data			
Aug	No Data			
Sep	No Data			
Oct	No Data			
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 3-6: W1 Historical Mean Monthly Flow

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012[1]	-	-	-	-	0.296	0.073	0.052	0.051	0.078	0.056	-	-
2013[1]	-	-	-	-	0.485	0.064	0.065	0.044	0.85	0.059	-	-
2014[1]	-	-	-	-	0.138	0.022	0.02	0.014	0.31	0.025	-	-
2015[1]	-	-	-	-	0.117	0.01	0.01	0.03	0.24	0.02	-	-
2016[1]	-	-	-	0.252	0.047	0.02	0.017	0.024	0.043	0.026	-	-
2017[1]	-	-	-	-	0.085	0.074	0.014	0.011	0.017	0.031	-	-
2018	-	-	-	-	0.132	0.093	0.039	0.009	0.006	0.002	-	-
2019	-	-	-	-	0.042	0.034	-	-	-	-	-	-

Note: Shaded cells indicate incomplete months of data

1. Data based on previous Annual Surface water Hydrology Analysis.

3.3 W7 – Tributary of Minto Creek

A staff gauge was installed at this station in the summer of 2013. Before the installation of the staff gauge, this station was regularly monitored for surface water quality. The staff gauge was damaged during the winter 2014 and repaired for the hydrometric program running in 2015. In 2016, no stage measurements were continuously recorded but several discrete discharge measurements were conducted during the open water season. In early June 2017, a staff gauge and loggers were installed at this site, which was continued since; a continuous water level and water temperature were recorded from June 30 to October 7, 2019 as presented in Figure 15. The logger was exposed to cold conditions on September 28, 2019 and it stopped recording reliable data, hence the discharge and discrete measurement hydrograph, Figure 17, omitted the unreliable data. Table 3-7 provides a summary of the average water temperature, flow and total flow volume in 2019.

Table 3-8 presents the summary of historically measured flows at W7, based on discrete measurements before 2017, and based on continuous pressure readings for 2017 to 2019. A rating curve was initiated in the 2017 hydrometric season, with limited data points from 2017 to 2019 the curve is rudimentary but was used to determine discharge at this site as seen in Figure 16. It is hoped that with more data being collected the curve will become more accurate over the years.

It is recommended in the 2020 open-water season that the hydrometric measurements at W7 should be conducted on a bi-weekly frequency to improve the rating curve.

Table 3-7: W7 2019 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m^3/s)	Total Flow (m^3)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	No Data			
Jun	1	2.01	0.010	65.58
Jul	31	1.98	0.003	7485.3
Aug	31	2.05	0.003	9091.9
Sep[1]	30	1.11	0.004	11059.1
Oct[1]	7	0.003	0.005	2681.7
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

1. Logger affected by ice and cold conditions, unreliable data

Table 3-8: W7 Historical Mean Monthly Flow (m3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013[1]	-	-	-	-	-	-	0.013	0.031	0.019	0.006	-	-
2014[1]	-	-	-	-	0.112	-	-	-	-	-	-	-
2015[1]	-	-	-	-	-	0.006	0.004	0.011	0.011	0.029	-	-
2016[1]	-	-	-	-	-	0.006	0.010	0.010	0.013	0.010	-	-
2017[1]	-	-	-	-	-	0.002	0.003	0.003	0.004	0.004	-	-
2018	-	-	-	-	-	-	0.006	0.007	0.007	-	-	-
2019	-	-	-	-	-	0.010	0.003	0.003	0.004[2]	0.005[2]	-	-

Note: Shaded cells indicate incomplete months of data

1. Data based on previous Annual Surface water Hydrology Analysis.

2. Logger affected by ice and cold conditions, unreliable data

4 McGinty Creek Hydrology

In 2019, hydrological monitoring on McGinty Creek was conducted as per the schedule outlined in the EMSRP. Station MN-1.5 was added to the monitoring schedule with continuous measurements. During the 2019 monitoring period, Minto Mine maintained and collected data from the following four hydrometric stations along McGinty Creek: MN-0.5, MN-1.5, MN-2.5, and MN-4.5.

At the hydrometric stations, Solinst Level Loggers and Barometric Loggers were used in conjunction with staff gauge readings and manual flow measurements to produce volumetric flow rates. Manual flow measurements were conducted monthly during flow season.

4.1 Station MN-0.5 – West Tributary of McGinty Creek

MN-0.5 station is located on the upper west stem of McGinty Creek. In 2019, water level and temperature data were continuously measured and recorded every 30 minutes by a pressure transducer/data logger. Figure 18 shows McGinty Creek at MN-0.5 water level and temperature data for the 127-day record from June 8 to September 21, 2019.

A stage-discharge relationship was established for MN-0.5 but it has limited flow data and corresponding staff gauge reading, hence is was not very accurate. The stage curve is presented in Figure 19. Additional flow measurements through the years will be required to establish a stage-discharge curve for the station with greater accuracy. Additionally, the staff gauge has been observed to have a varying creek bottom throughout the open-water season, it has been recommended to measure the staff gauge with a ruler for the 2020 season to ensure better staff gauge measurement, and a more accurate stage curve.

Table 4-1 provides a summary of the average water temperature, flow and total flow volume in 2019 while Table 4-2 provides a summary historical measured flows at MN-0.5. These flows are based on discrete measurements only.

Table 4-1: MN-0.5 2019 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m^3/s)	Total Flow (m^3)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	No Data			
Jun	22	1.575	0.0183	35095.1
Jul	31	4.932	0.0079	21092.7
Aug	31	3.199	0.0066	17733.3
Sep	21	1.813	0.0083	14730.3
Oct	No Data			
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 4-2: MN-0.5 Historical Mean Monthly Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014[1]	-	-	-	-	0.045	-	-	-	-	-	-	-
2015[1]	-	-	-	-	0.035	0.013	0.054	0.098	0.029	0.025	-	-
2016[1]	-	-	-	-	0.28	0.016	0.01	0.016	0.035	0.018	-	-
2017[1]	-	-	-	-	-	0.017	0.023	0.020	0.017	0.019	-	-
2018	-	-	-	-	-	0.030	0.016	0.021	0.025	0.040	-	-
2019	-	-	-	-	-	0.018	0.008	0.007	0.008	-	-	-

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.

Note: Shaded cells indicate incomplete months of data

4.2 Station MN-1.5 – Upper East Tributary of McGinty Creek

The station MN-1.5 was set-up with a continuous monitoring station for the 2019 season. MN-1.5 is marshy area with a small stream collecting water which flows into McGinty creek. A levelogger and a barologger were launched on May 19, 2019. This station is monitored monthly for sampling and discrete hydrometric measurements.

The staff gauge was installed on July 5, 2018. As a newly monitored station the rating curve had a large error; as monitoring continues the stage curve will become more accurate. The stage and water temperature hydrograph for continuous monitoring throughout the 2019 season are presented in Figure 20, MN-1.5 experiences higher water temperatures due to the stagnant nature of this site. Only one discharge flow measurement was captured during the 2019 open-water season in June, this measurement consisted of only 2 points and hence not a reliable measurement. The hydrometric data and temperature for the season at MN-1.5 is presented below in Table 4-3. The stream froze over around September 21, 2019 which is consistent with the remainder of the McGinty Creek sites.

Table 4-3: MN-1.5 2019 Recorded Discrete Flow Measurement (m^3/s)

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m^3/s)	Total Flow (m^3)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	12	2.45	0.002	1588.1
Jun	30	4.44	0.001	3527.6
Jul	31	8.60	0.001	3100.2
Aug	31	5.71	0.002	4181.1
Sep[1]	30	3.06	0.002	4188.6
Oct[1]	12	0.554	0.002	2006.7
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

1. Data not reliable beyond September 21, 2019

4.2 Station MN-2.5 – East Tributary of McGinty Creek

MN-2.5 station is located on the lower stem of McGinty Creek. In 2019, water level and temperature data were continuously measured and recorded every 30 minutes by a pressure transducer/data logger. Figure 19 shows McGinty Creek at MN-2.5 water level and temperature data for the 99-day record from June 8th to October 12th, 2019. Though the data presented is continuous to September 20, following this day the creek may have experienced frost and icing causing an unreliable dataset.

A stage-discharge relationship was established for MN-2.5 but due to limited data flow and corresponding staff gauge reading it is not an accurate curve, with continuous monitoring more data will fill the curve and improve the accuracy. For 2019, a curve fitting only 2019 data was used to provide more accurate results as seen in Figure 24.

Table 4-4 provides a summary of historical measured flows at MN-2.5. These flows are based on discrete measurements until 2016, the pressure loggers were used from 2017 to 2019.

Table 4-4: MN-2.5 Historical Mean Monthly Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014[1]	-	-	-	-	0.032	-	-	-	-	-	-	-
2015[1]	-	-	-	-	0.015	0.003	0.011	0.038	0.01	0.01	-	-
2016[1]	-	-	-	0.034	0.008	-	-	0.009	0.014	0.003	-	-
2017[1]	-	-	-	-	-	0.011	0.010	0.007	0.004	0.013	-	-
2018	-	-	-	-	-	-	0.011	0.014	0.014	0.019	-	-
2019	-	-	-	-	-	0.006	0.006	0.006	0.006[2]	0.007[2]	-	-

Note: Shaded cells indicate incomplete months of data

1. Data based on previous Annual Surface water Hydrology Analysis.
2. Data affected by freeze-thaw, not reliable

4.3 Station MN-4.5 -McGinty Creek near the Mouth

MN-4.5 station is located on the lower reach of McGinty Creek before flowing into the Yukon River. In 2019, water level and temperature data were continuously measured and recorded every 30 minutes by a pressure transducer/data logger. Figure 25 shows McGinty Creek at MN-4.5 water level and temperature data for the 47-day record from May 17 to July 4, 2019.

The stage-discharge relationship for MN-4.5 is presented in Figure 26. The 2019 hydrograph and discrete measurements for MN-4.5 are shown in Figure 27. In 2019, the maximum measured flow of 0.526 m^3/s occurred on June 3, 2019 following a heavy storm event. Upon analysis of the temperature and flow variance and site visits, the creek level was very low from July 4, 2019 until the end of the open water season. Data obtained after July 4 is not reliable; it is partly presented in Figure 27.

Table 4-5 provides a summary of the average water temperature, flow and total flow volume in 2019. Table 4-6 summarizes the historical mean monthly flows to previous years of the hydrometric program.

Table 4-5: MN-4.5 2019 Hydrometric Data and Temperature Summary

Month	Period of Record (Day)	Mean Water Temperature (°C)	Mean Flow (m^3/s)	Total Flow (m^3)
Jan	No Data			
Feb	No Data			
Mar	No Data			
Apr	No Data			
May	13	0.867	0.0246	30124
Jun	30	0.902	0.0638	165588
Jul	4	0.892	0.0127	3786
Aug	Dry Creek			
Sep	Dry Creek			
Oct	Dry Creek			
Nov	No Data			
Dec	No Data			

Note: Shaded cells indicate incomplete months of data

Table 4-6: MN-4.5 Historical Mean Monthly Flow (m^3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011[1]	-	-	-	-	0.444	0.093	0.125	0.134	0.068	0.045	-	-
2012[1]	-	-	-	0.212	0.023	0.18	0.082	0.053	0.109	-	-	-
2013[1]	-	-	-	-	-	0.054	0.103	0.093	0.116	-	-	-
2014[1]	-	-	-	-	0.23	0.041	0.037	0.026	0.046	-	-	-
2015[1]	-	-	-	-	-	0.013	0.046	0.049	0.029	0.029	-	-
2016[1]	-	-	-	-	0.017	0.015	0.026	0.028	0.028	0.01	-	-
2017[1]	-	-	-	-	0.079	0.12	0.027	0.003	0.012	0.079	-	-
2018	-	-	-	-	0.031	0.021	0.006	0.021	0.022	0.006	-	-
2019	-	-	-	-	0.025	0.064	0.013	-	-	-	-	-

Note: 1 - Data based on previous Annual Surface water Hydrology Analysis.
Note: Shaded cells indicate incomplete months of data

5 Hydrology QA/QC

Detailed procedures for hydrology monitoring at the Minto Mine are detailed in the *Minto Mine Surface Water Hydrology* SOP. In 2019, Minto environmental staff conducted a duplicate of hydrometric measurements at random station every week, to reach a 10% QAQC.

Figures

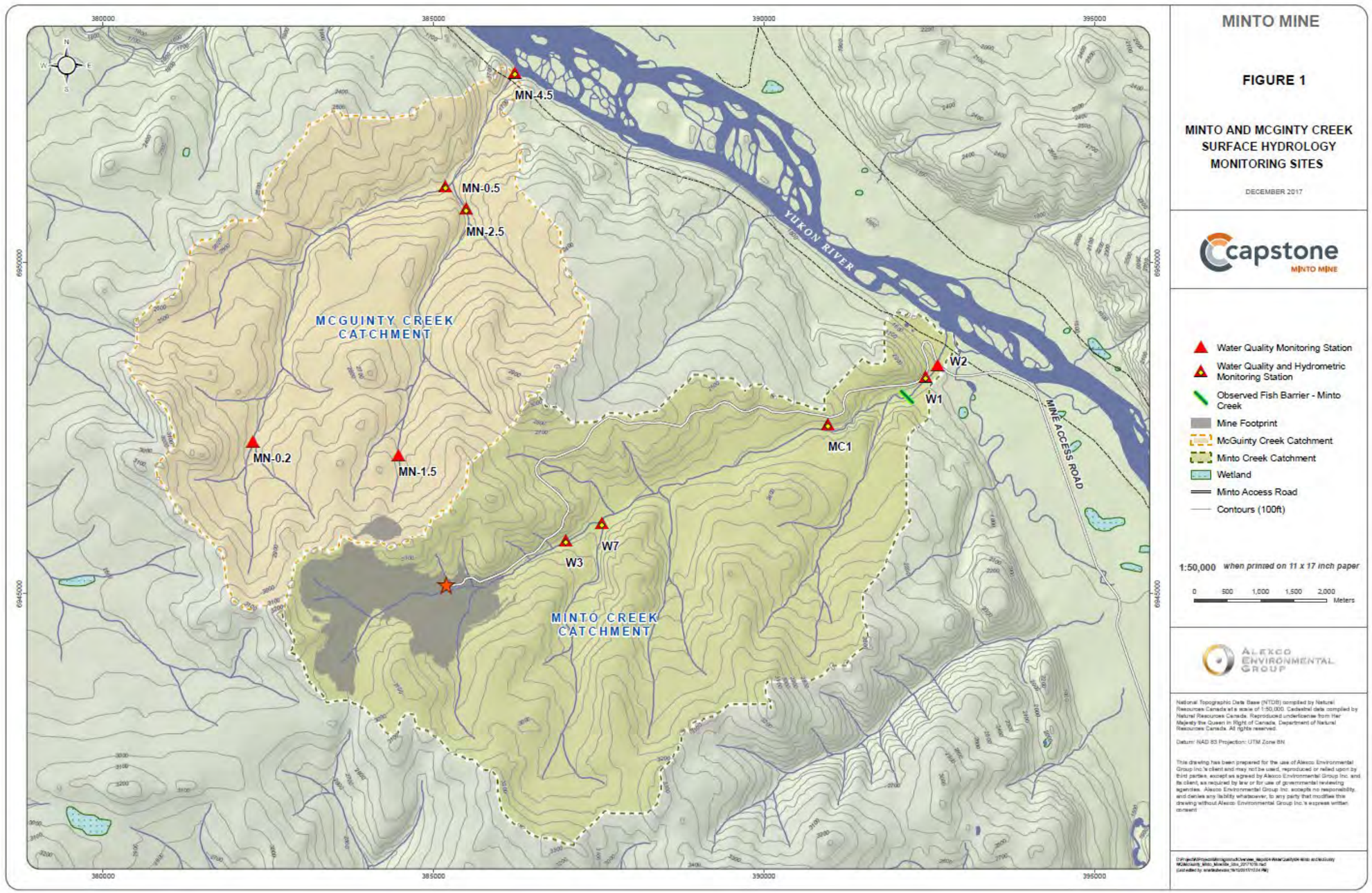


Figure 2. Minto and McGinty Creek Hydrology Surface Map

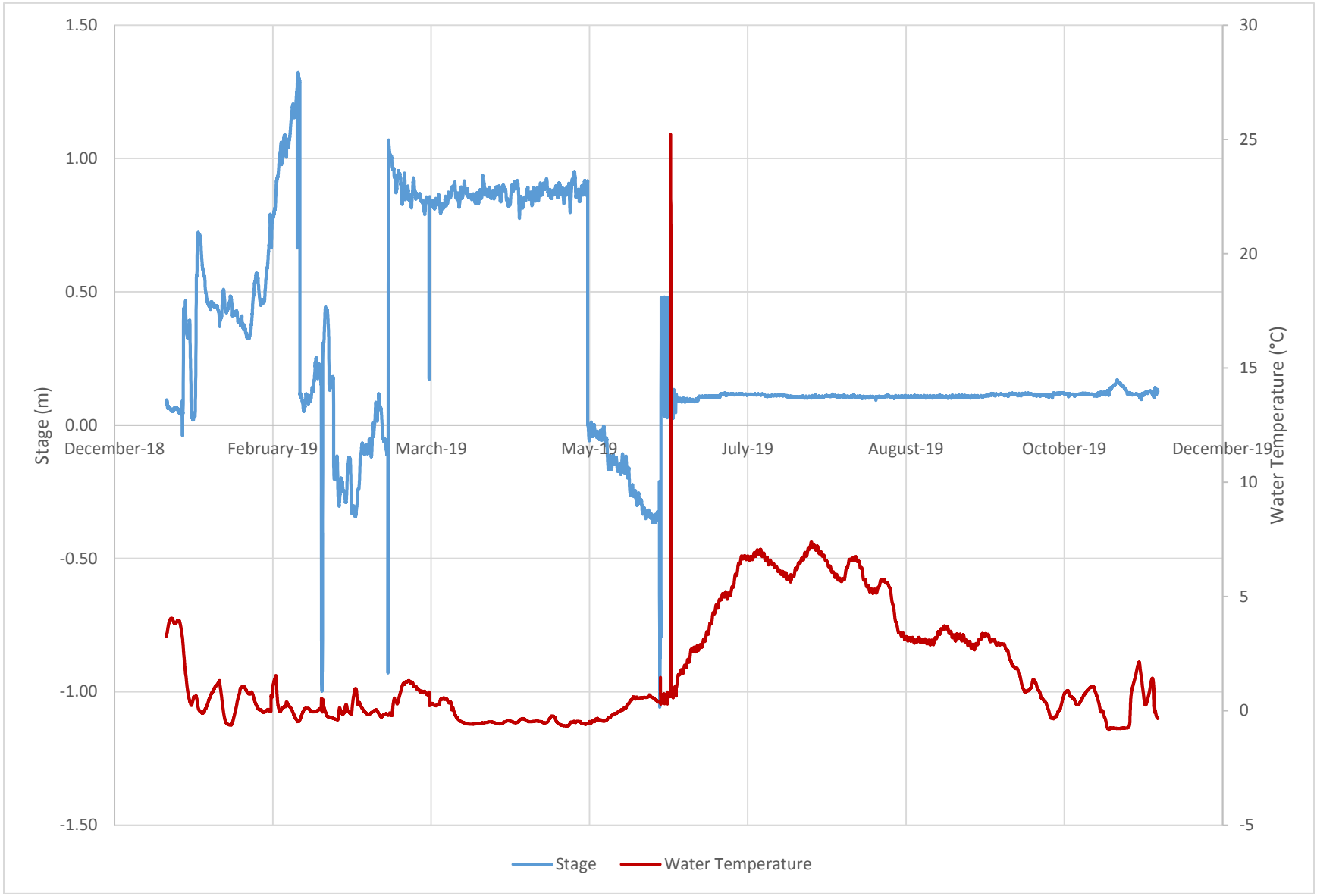


Figure 3. W3 Hydrograph Stage and Water Temperature, December to November 2019

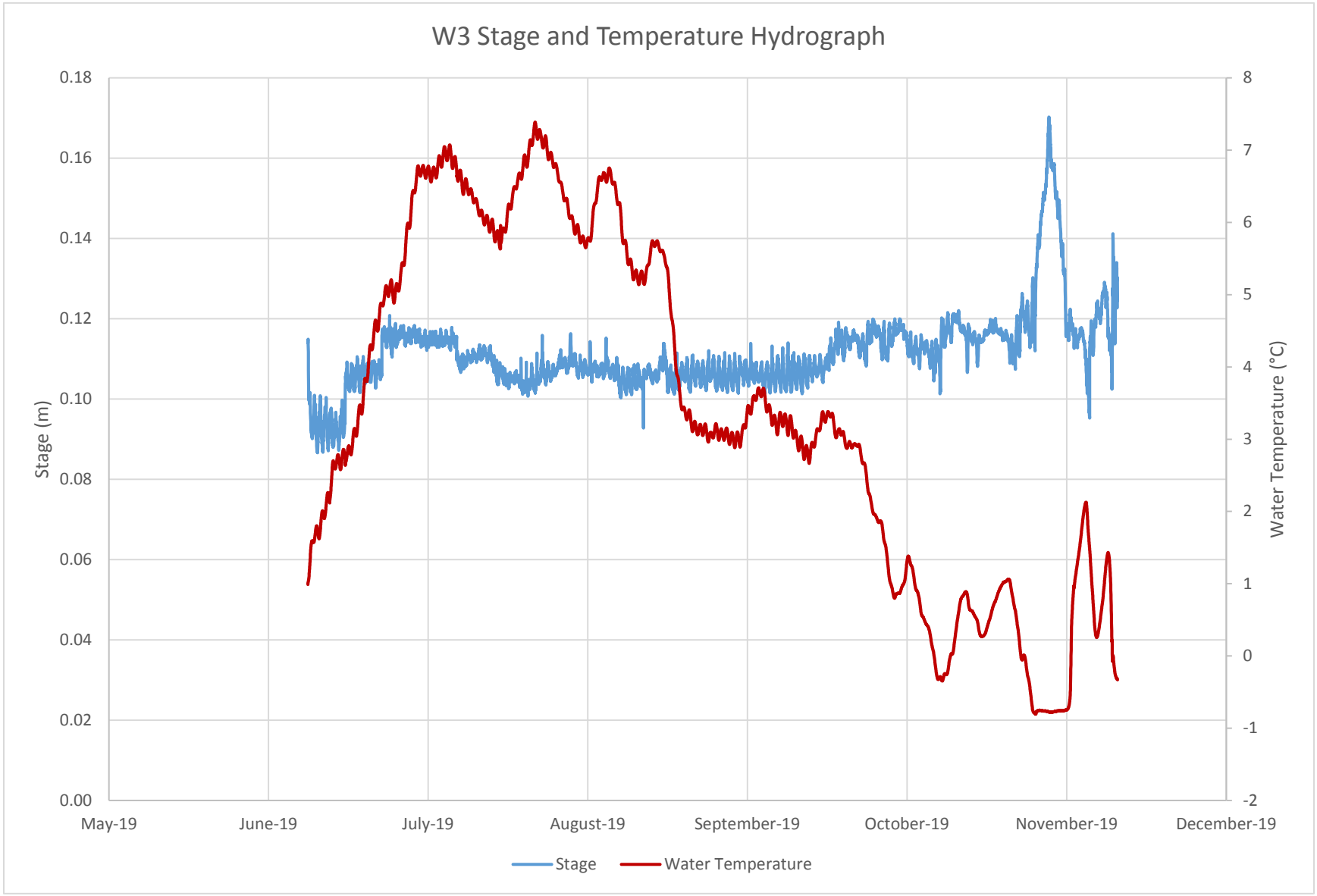


Figure 4: W3 Stage and Temperature Hydrograph, June-November 2019

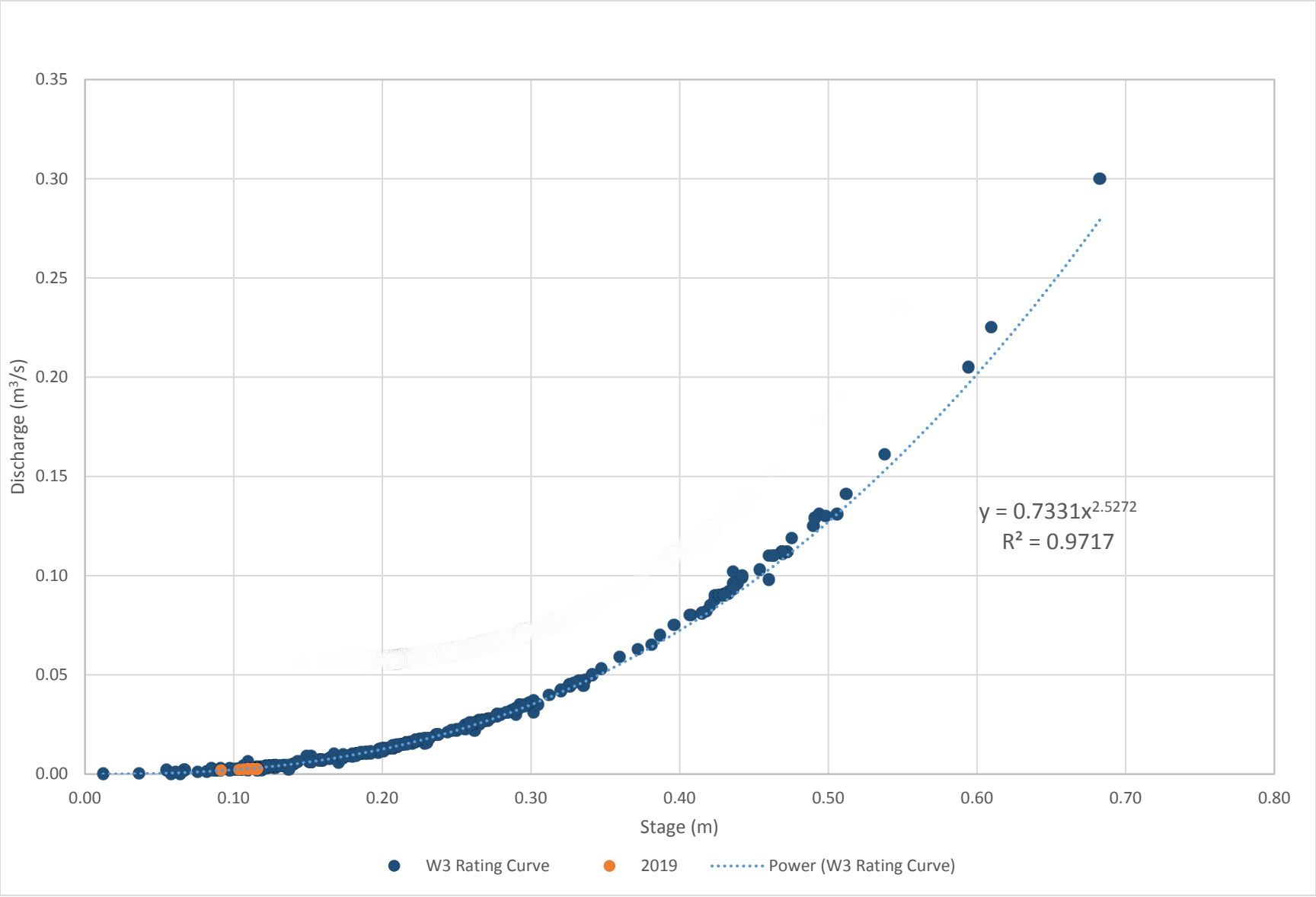


Figure 5: W3 Rating Curve

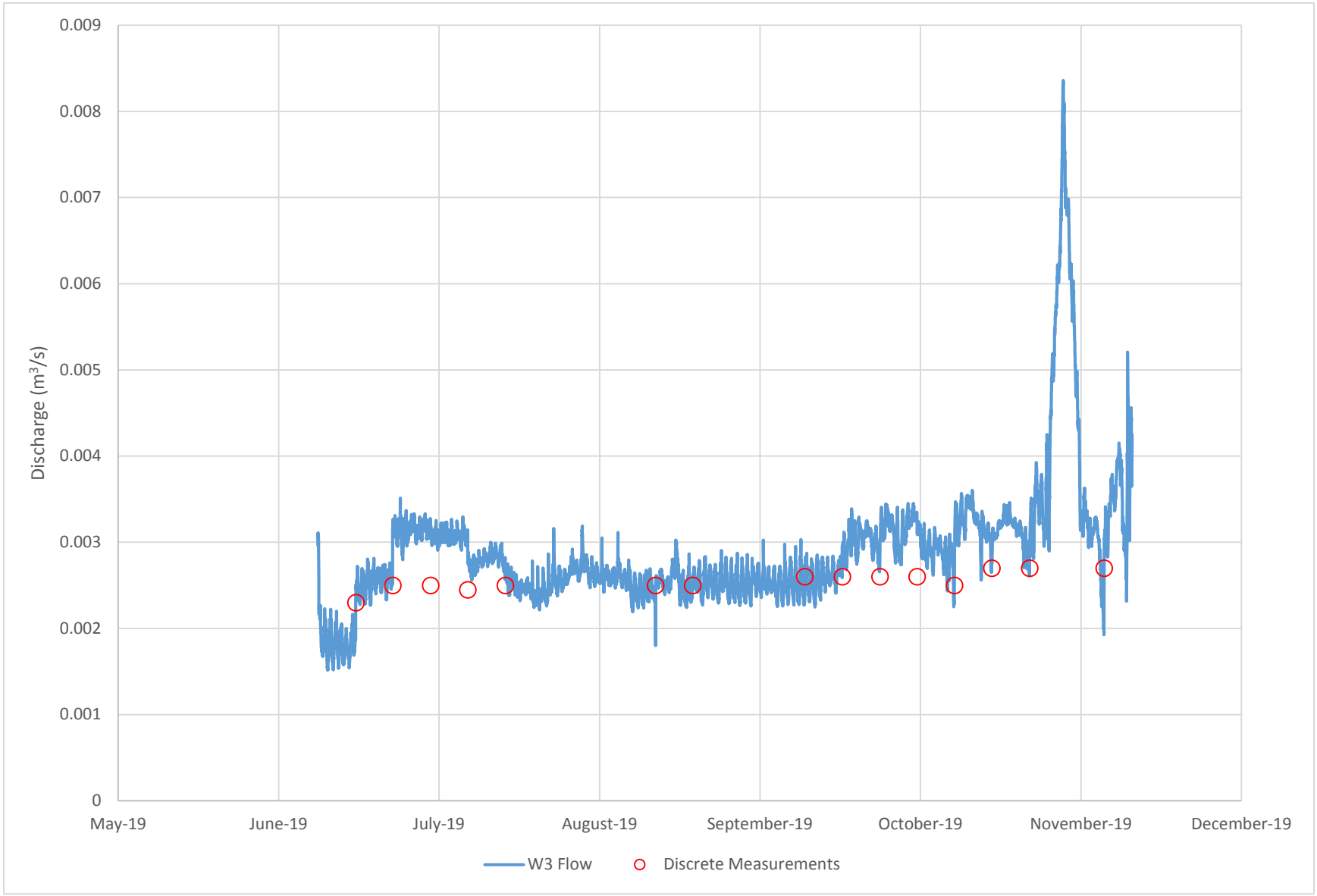


Figure 6. W3 Flow Hydrograph (with discrete measurements)

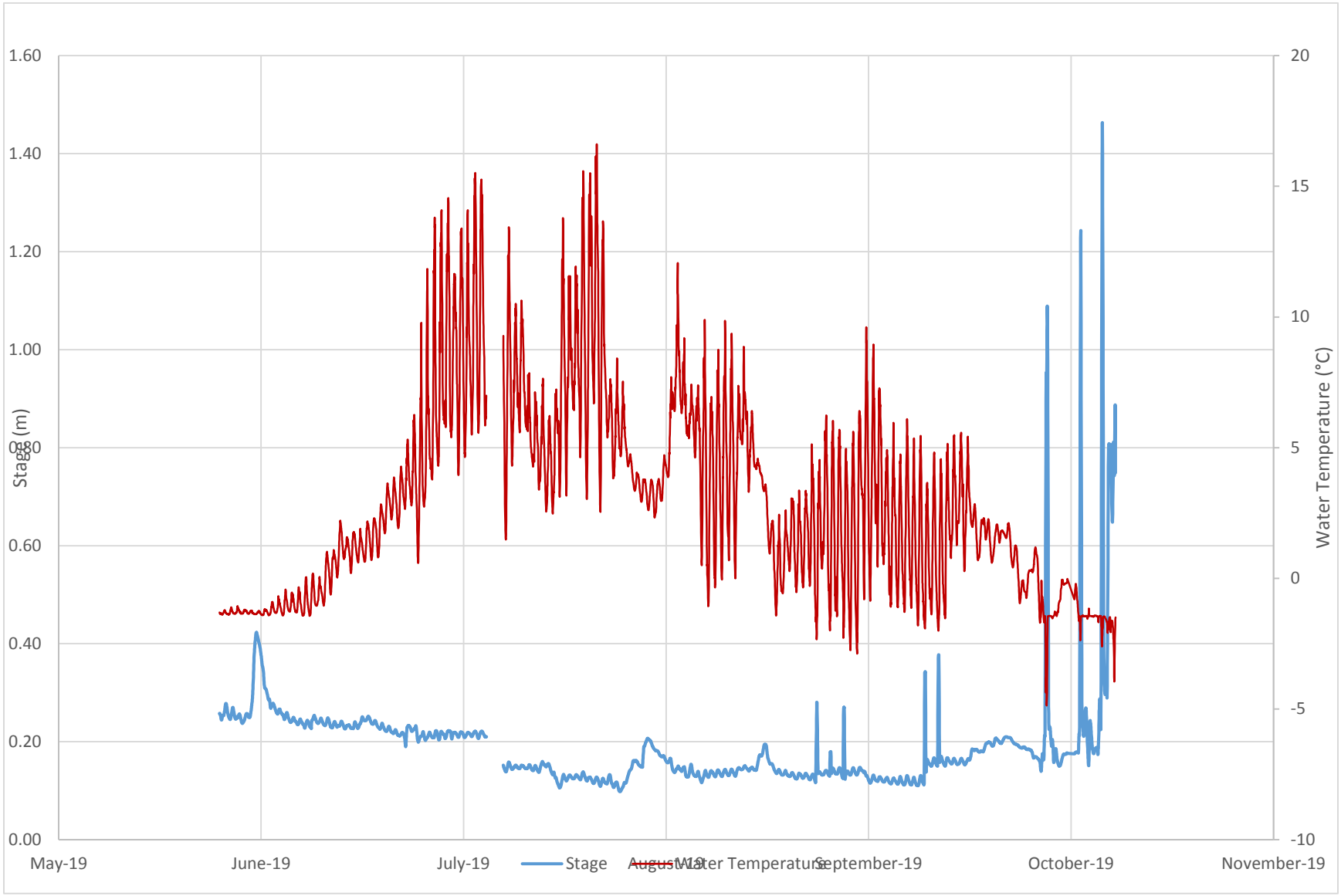


Figure 7: MC1 Stage and Temperature Hydrograph

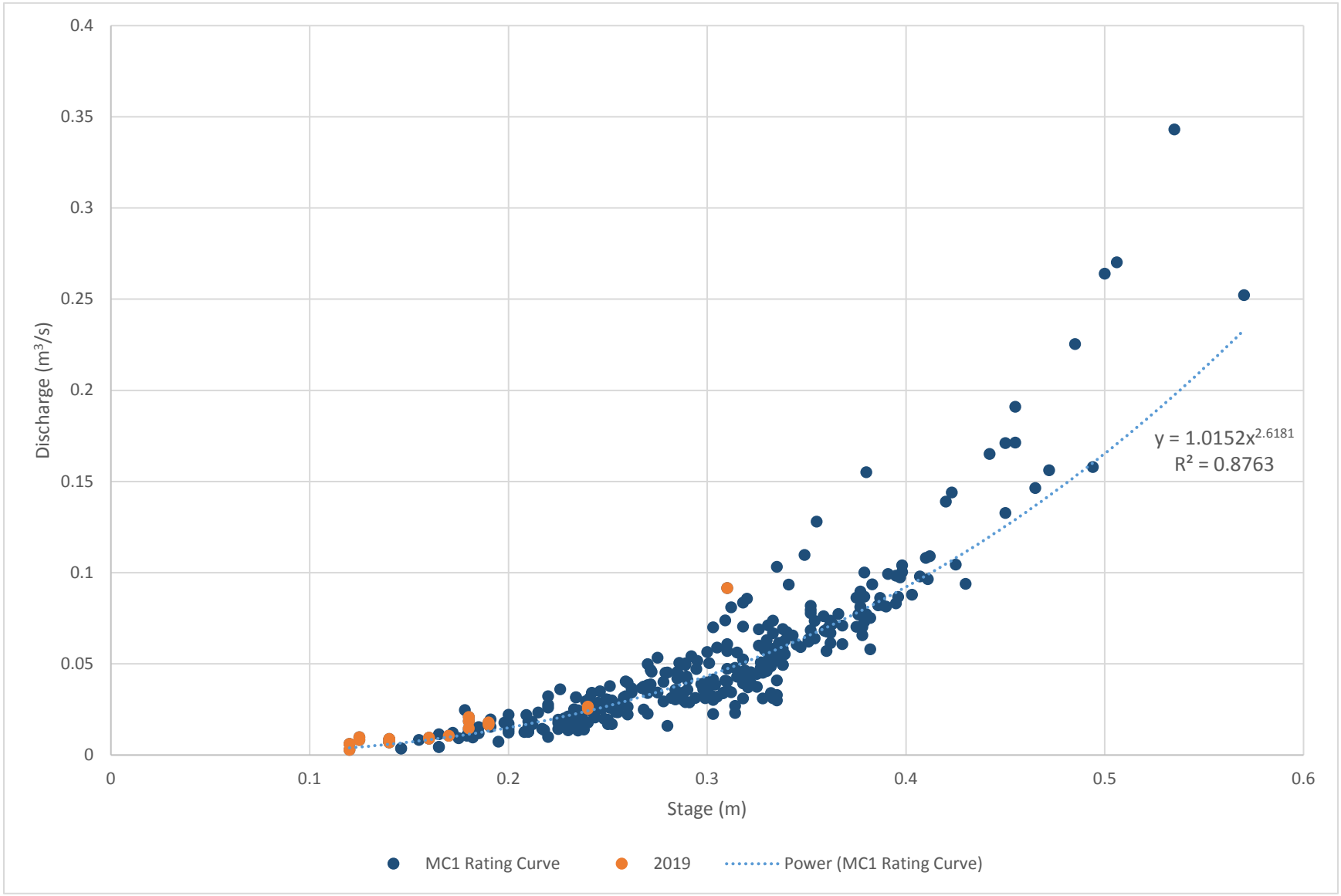


Figure 8: MC1 Rating Curve

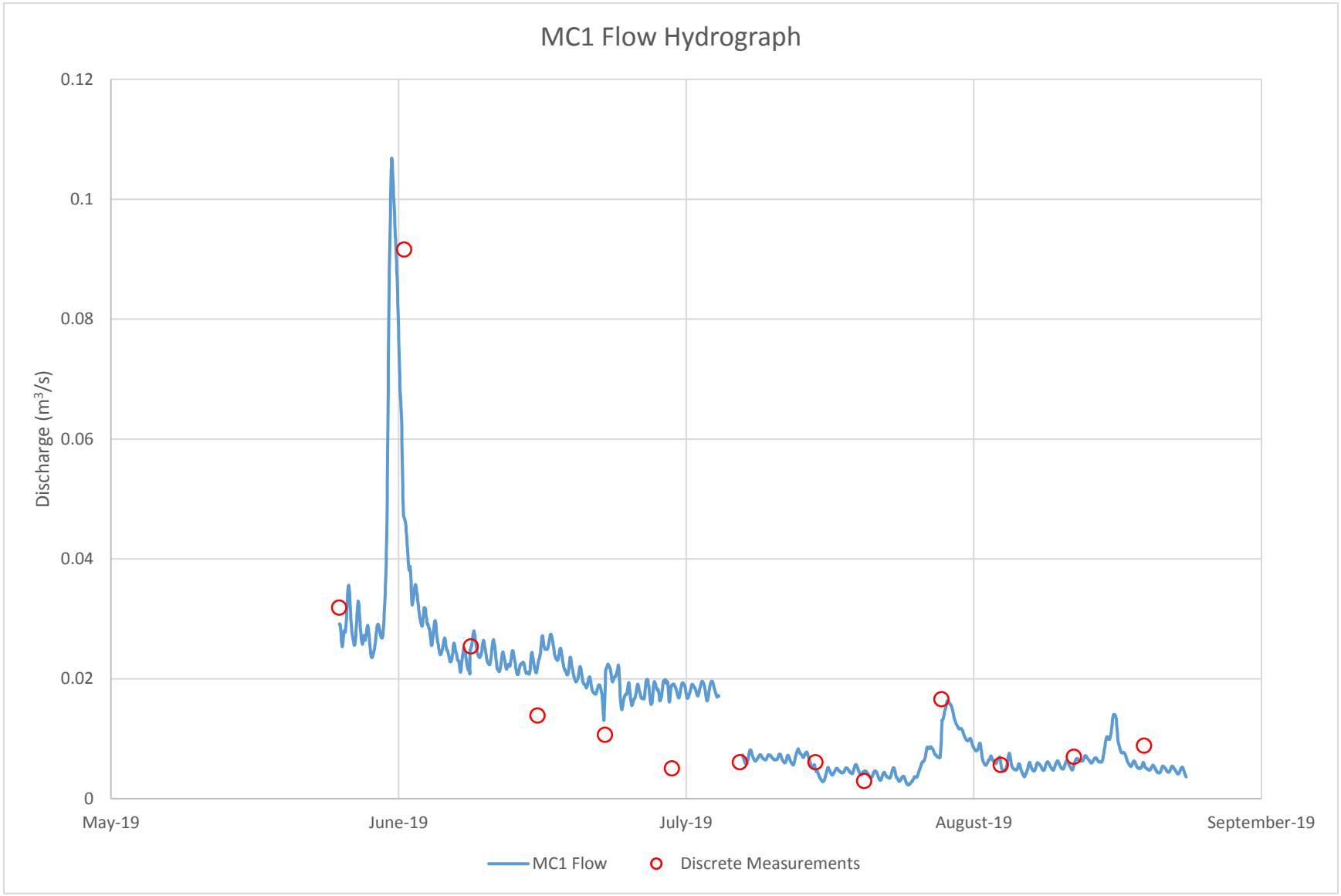


Figure 9: MC1 Discharge and Discrete Measurement Hydrograph

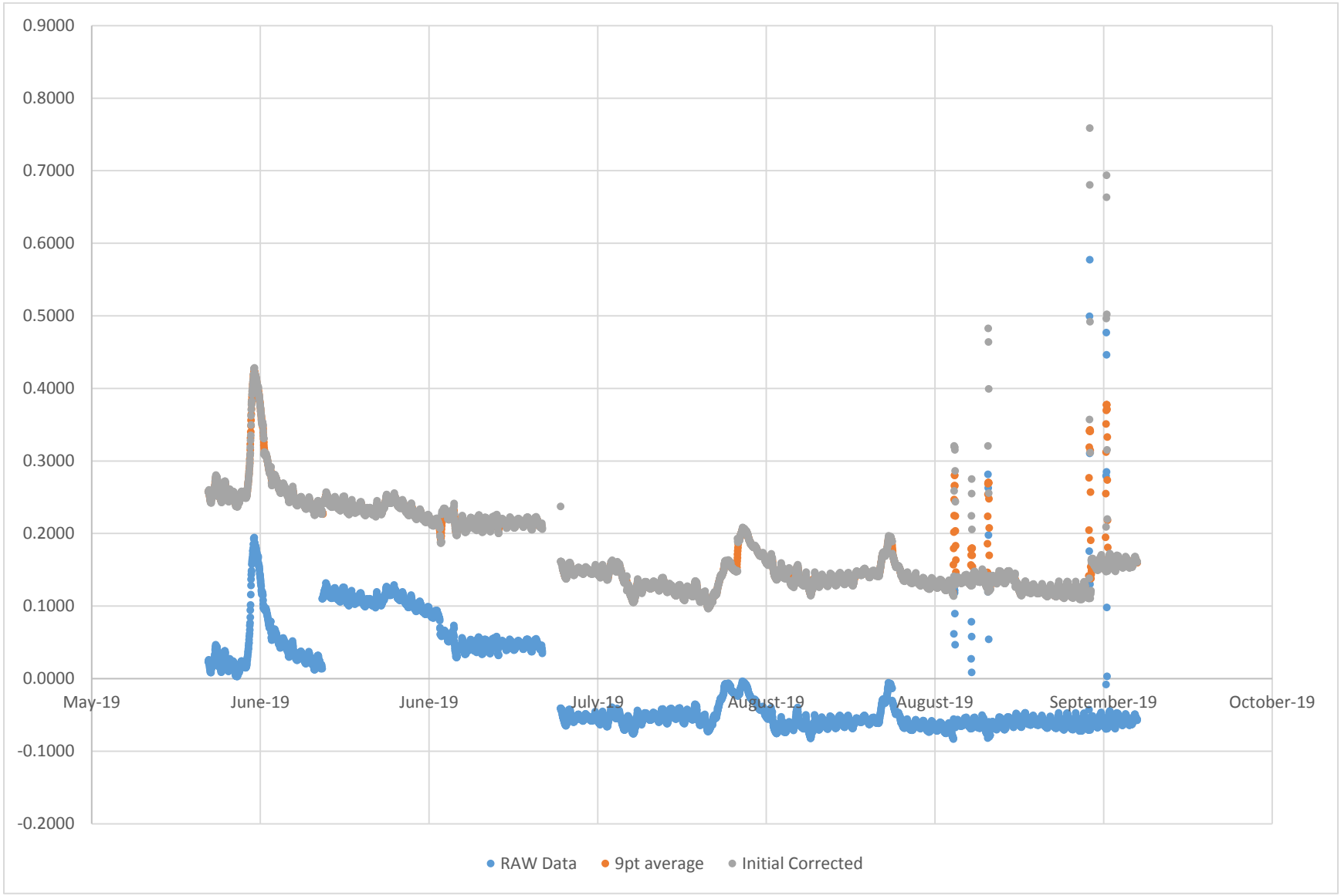


Figure 10: MC1 Water Level Corrections

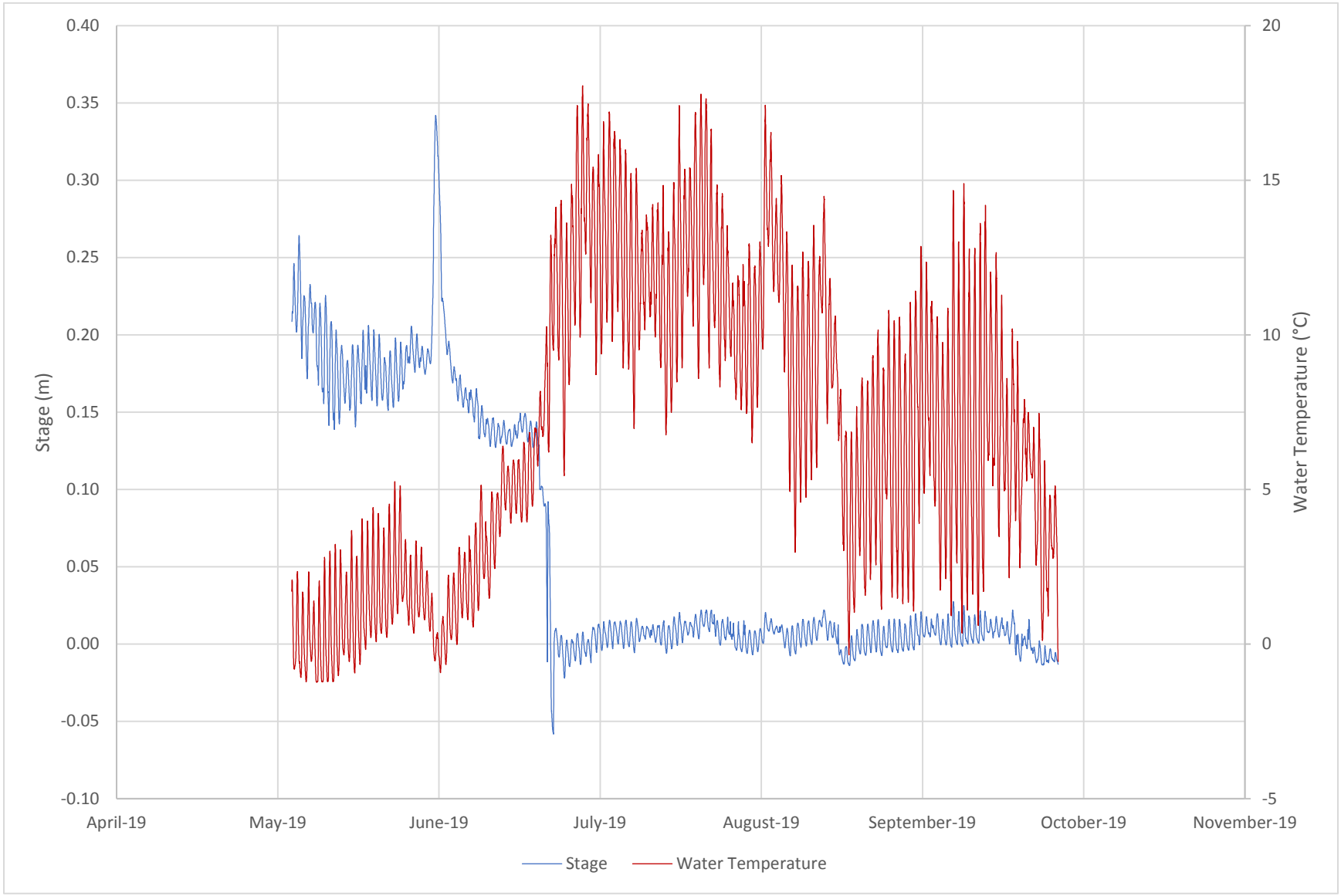


Figure 11: W1 Stage and Temperature Hydrograph

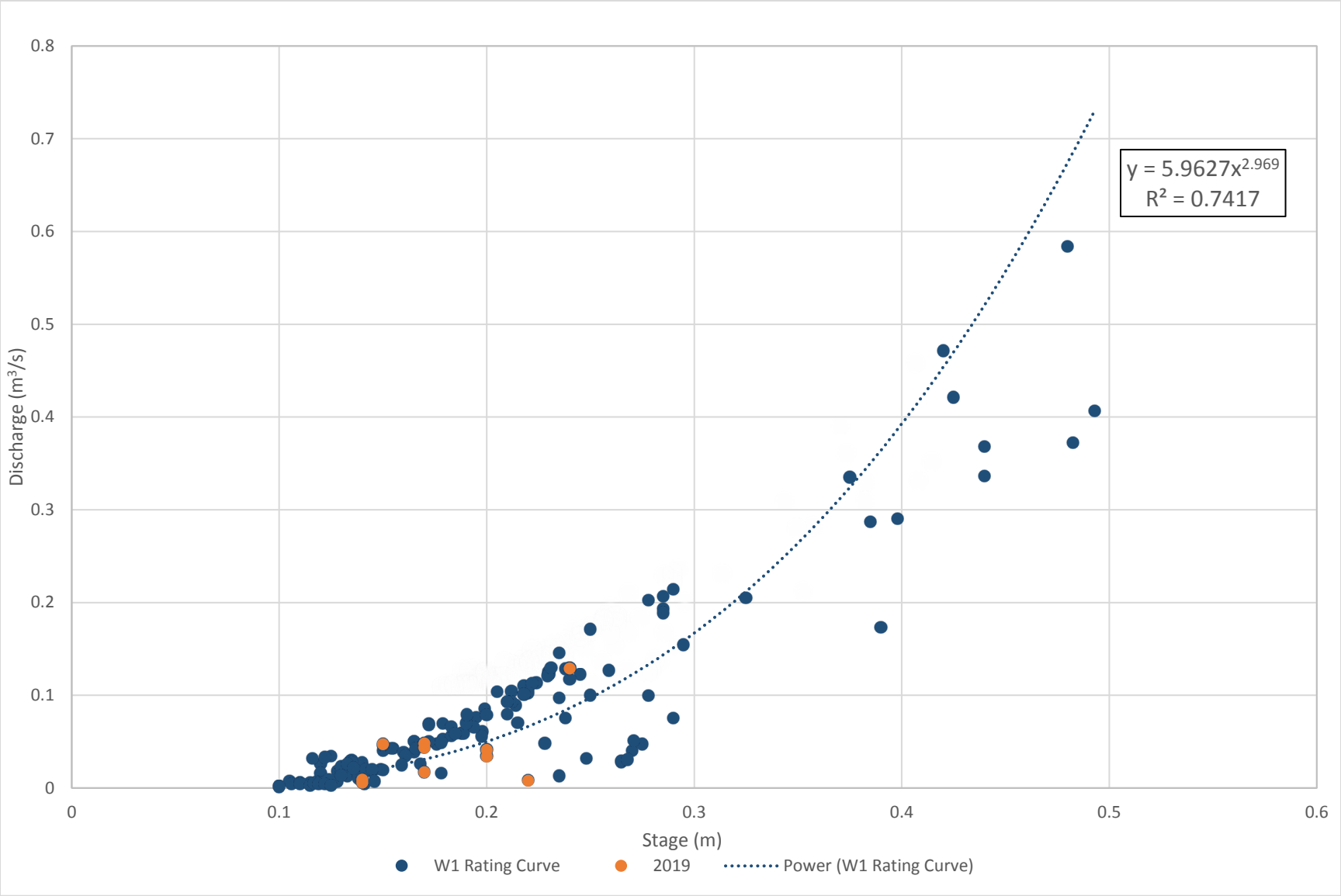


Figure 12: W1 Rating Curve

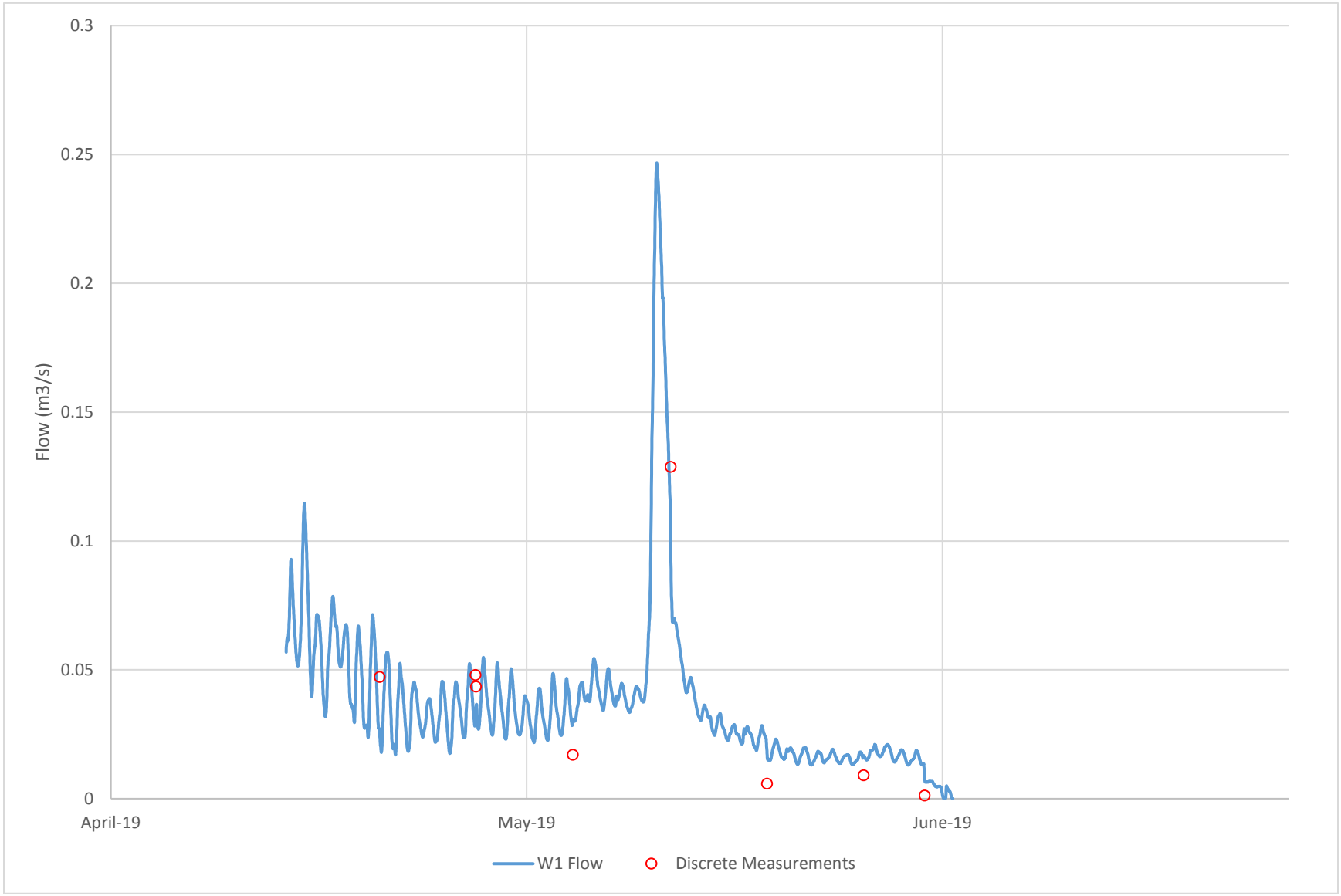


Figure 13: W1 Flow Hydrograph

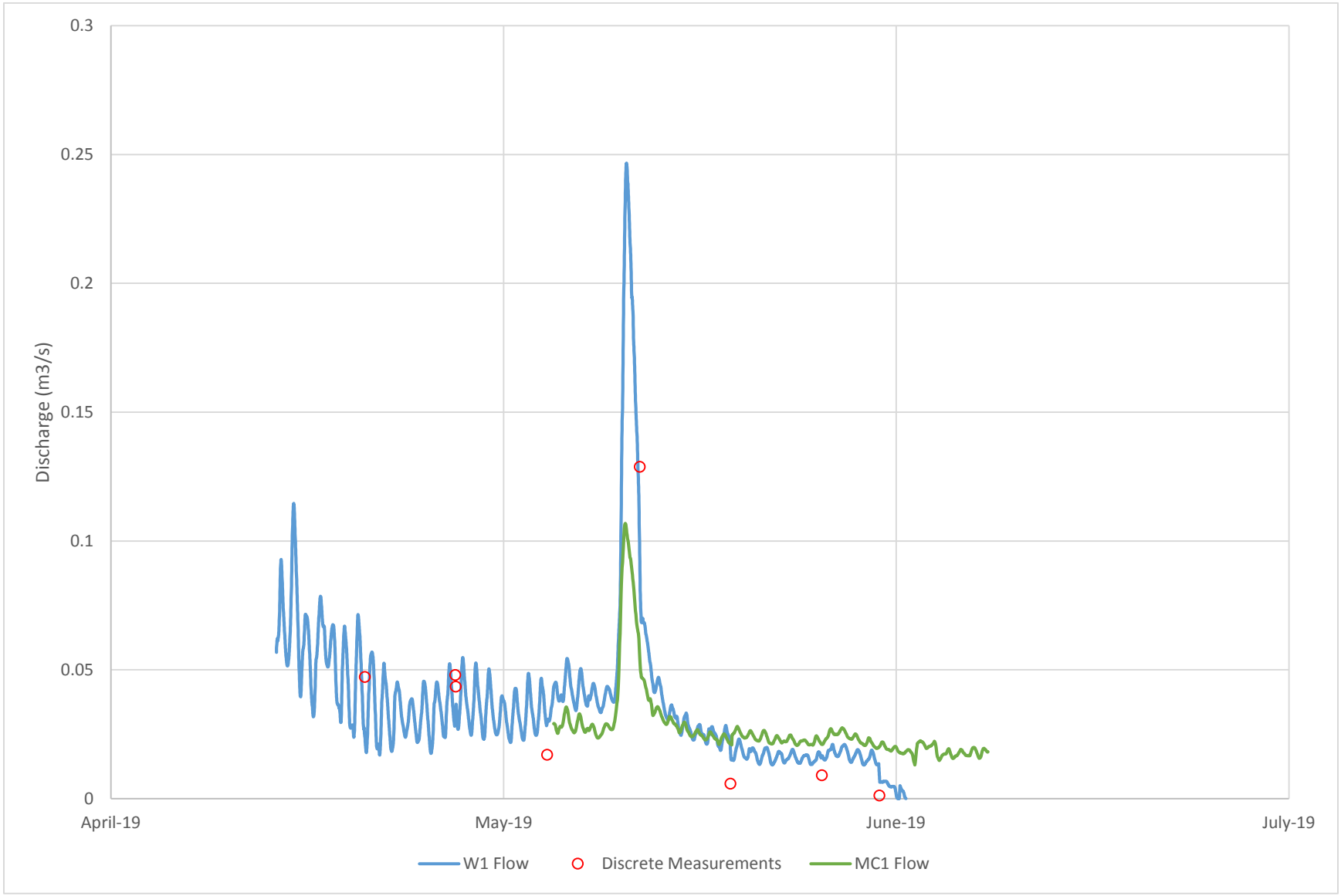


Figure 14: W1 Flow Hydrograph Comparison with MC1 Flow

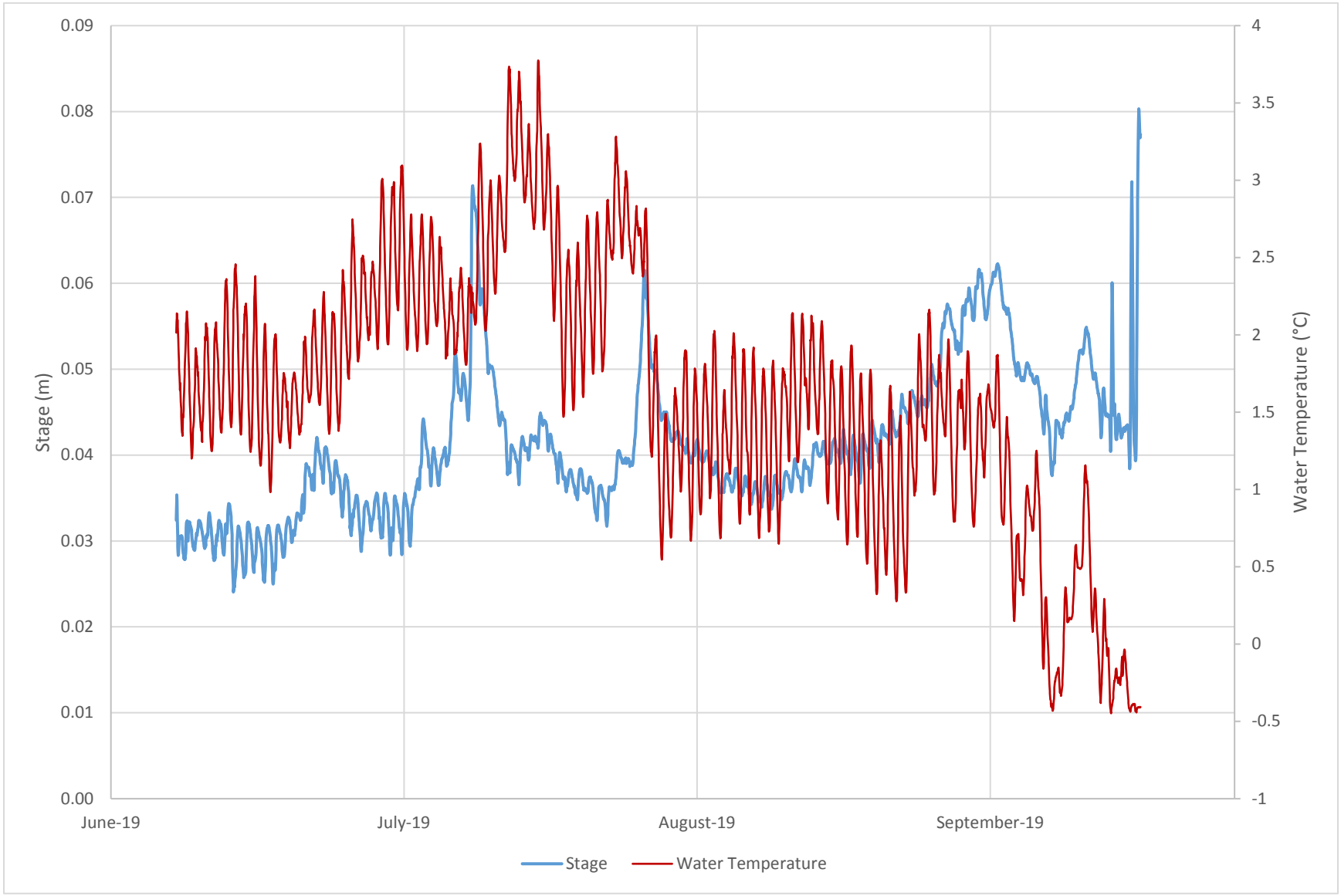


Figure 15: W7 Stage and Temperature Hydrograph

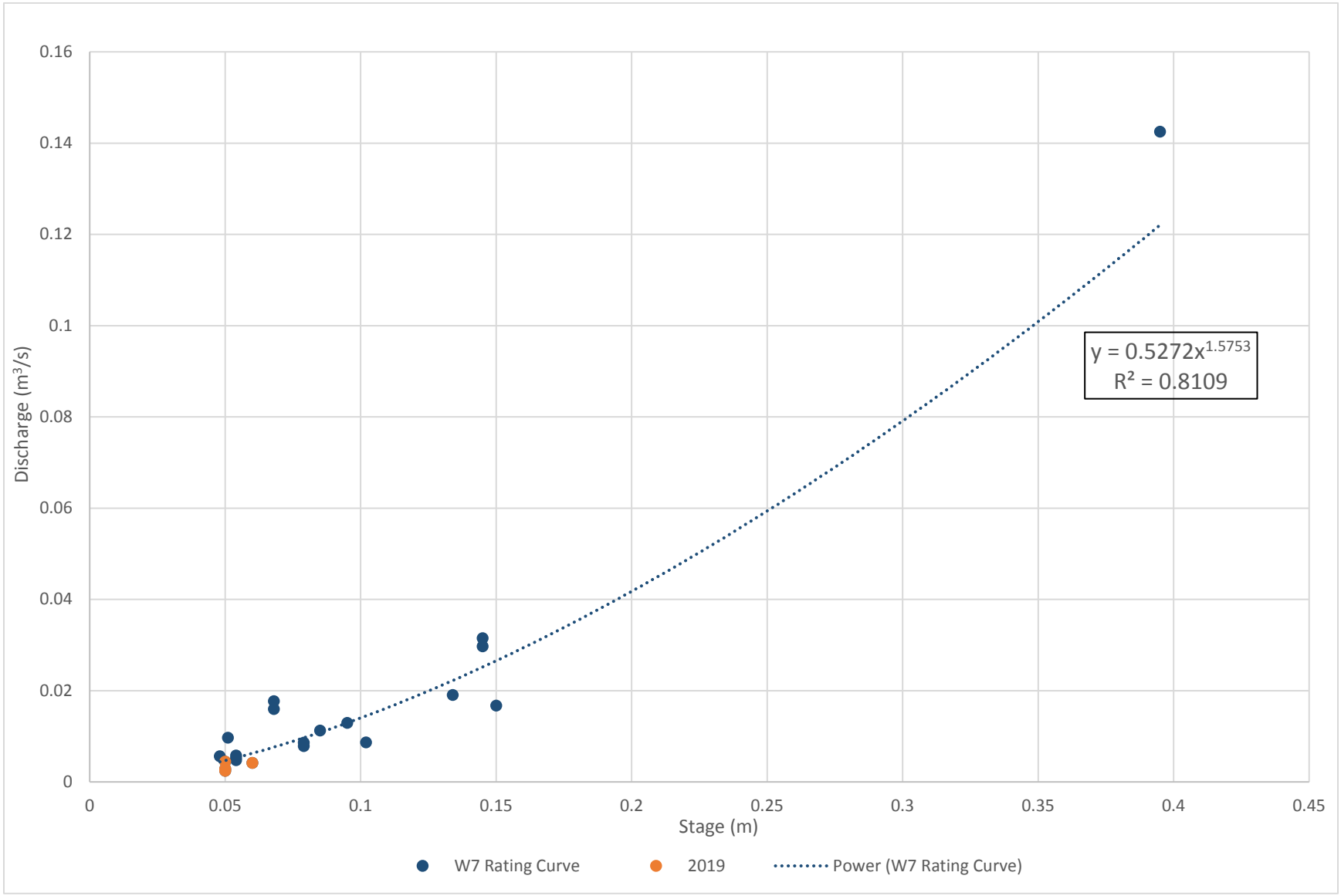


Figure 16: W7 Rating Curve

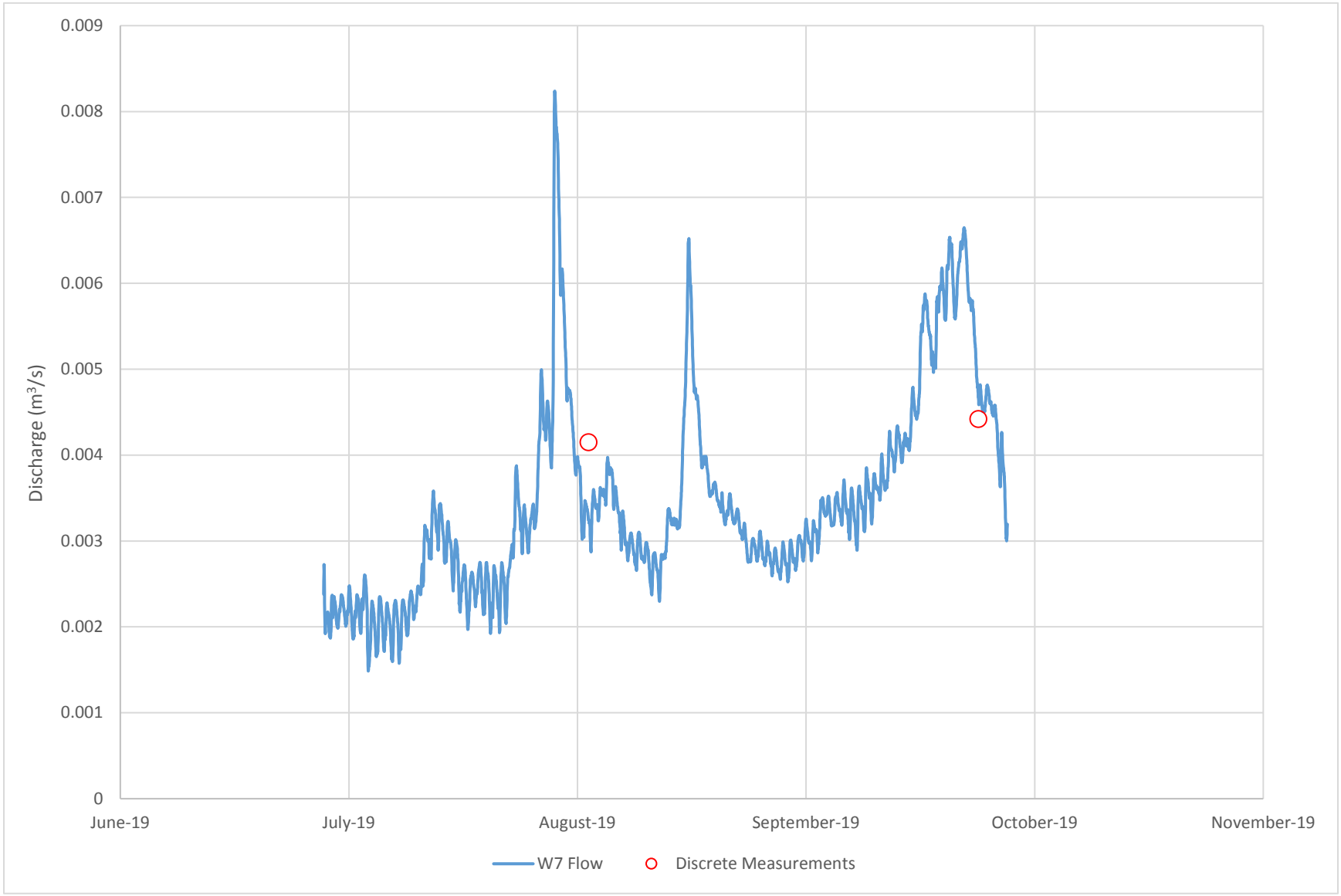


Figure 17: W7 Flow Hydrograph

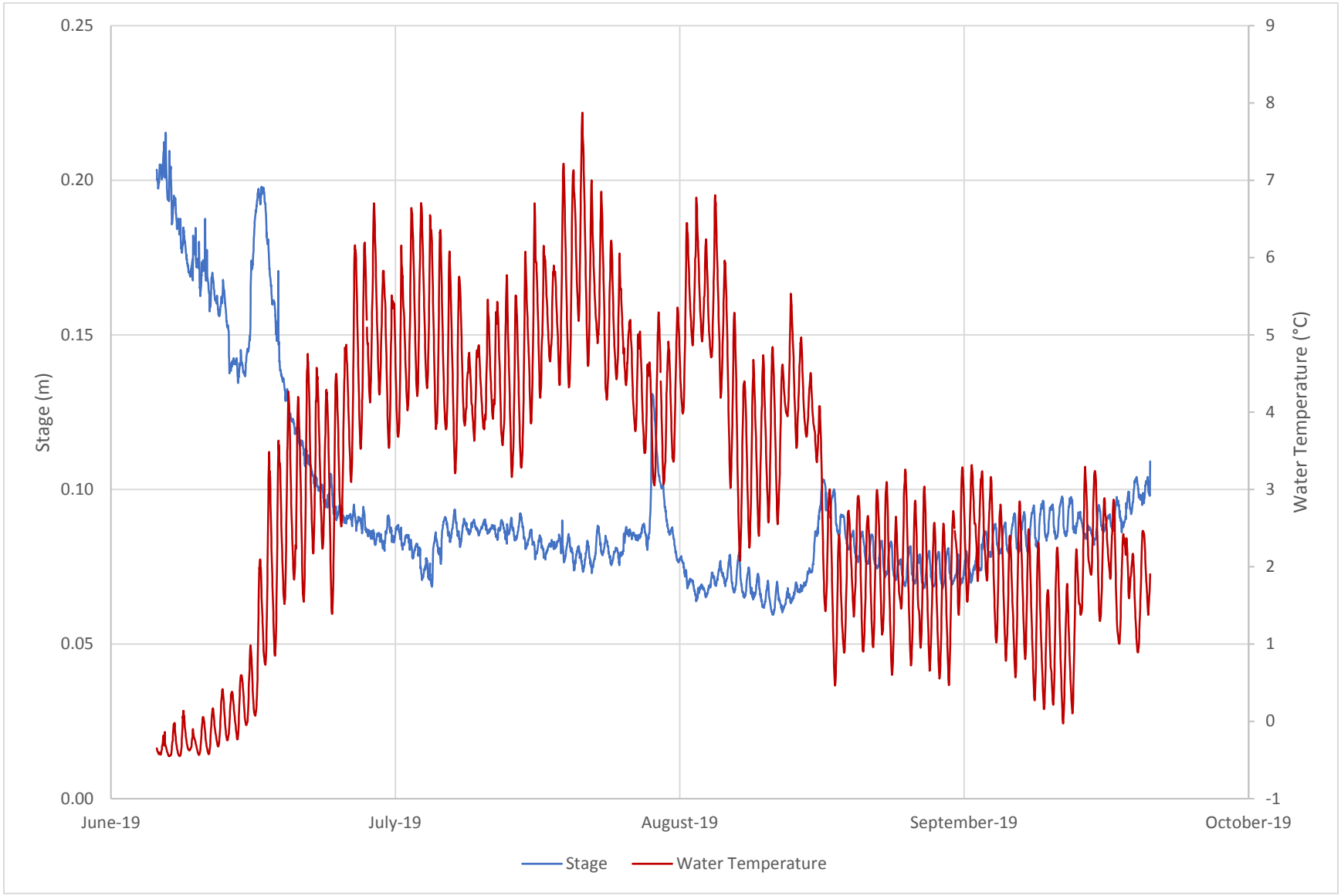


Figure 18: MN-0.5 Stage and Temperature Hydrograph

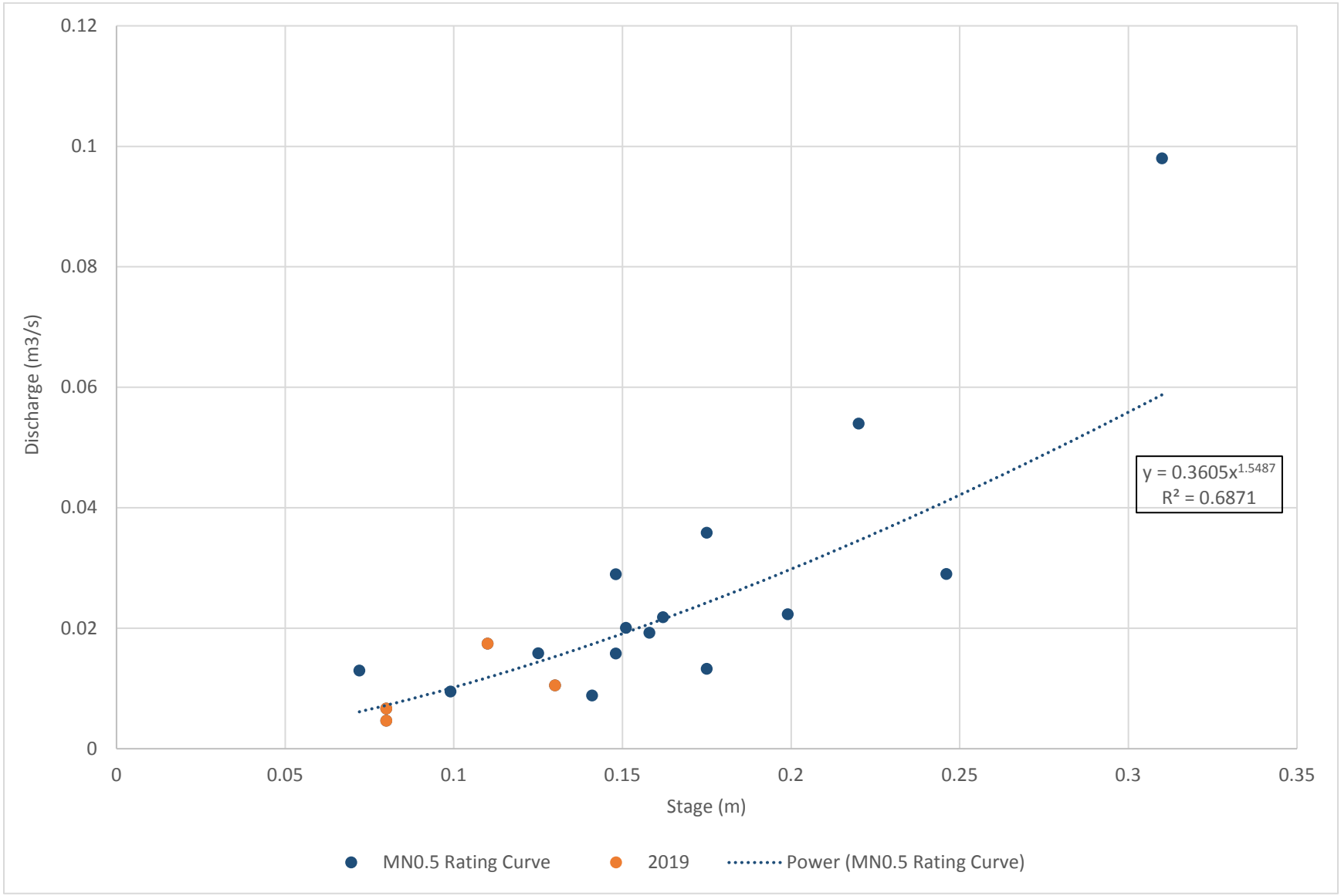


Figure 19: MN-0.5 Rating Curve

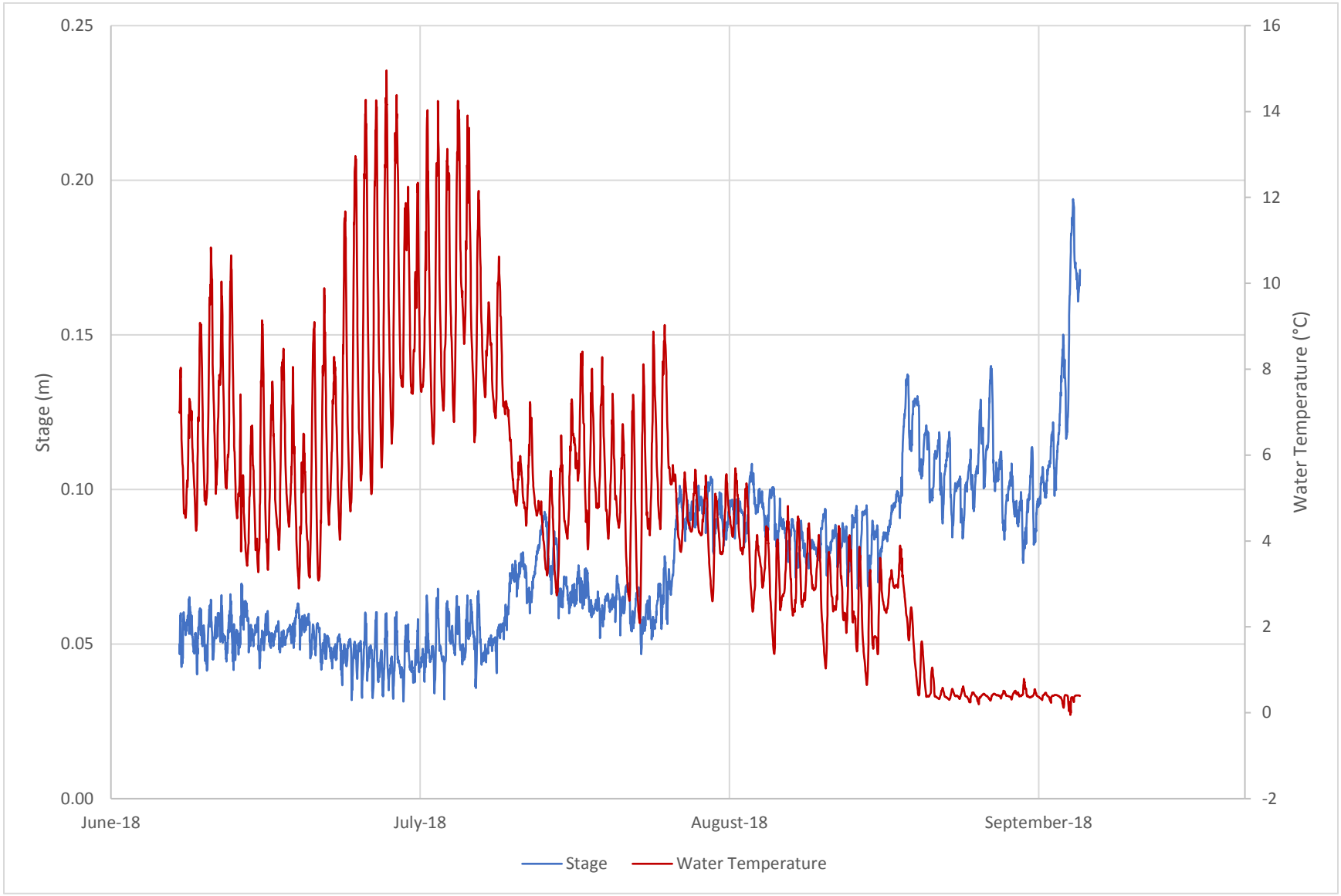


Figure 20: MN-1.5 Stage and Temperature Hydrograph

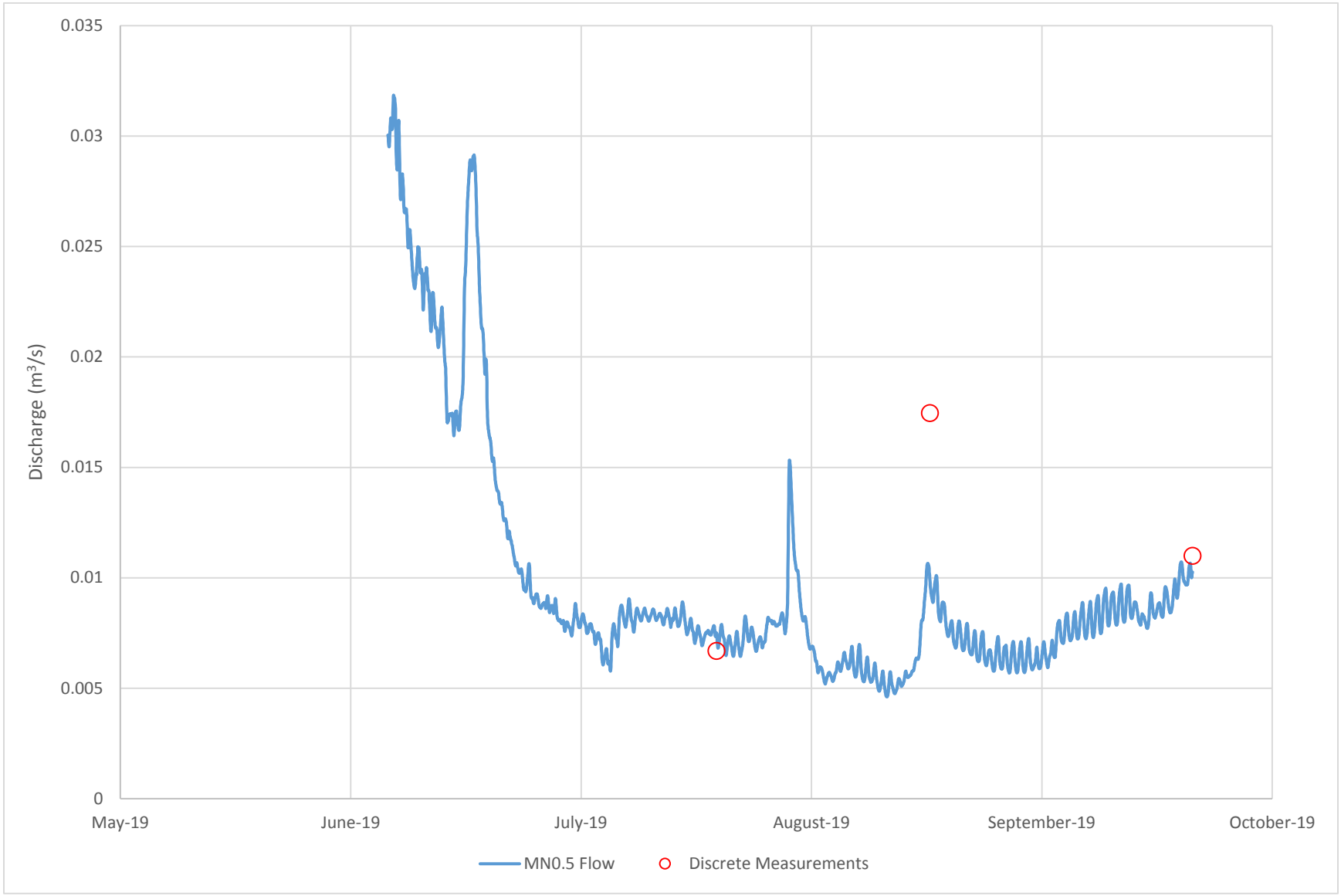


Figure 21: MN-0.5 Discharge and Discrete Measurement Hydrograph

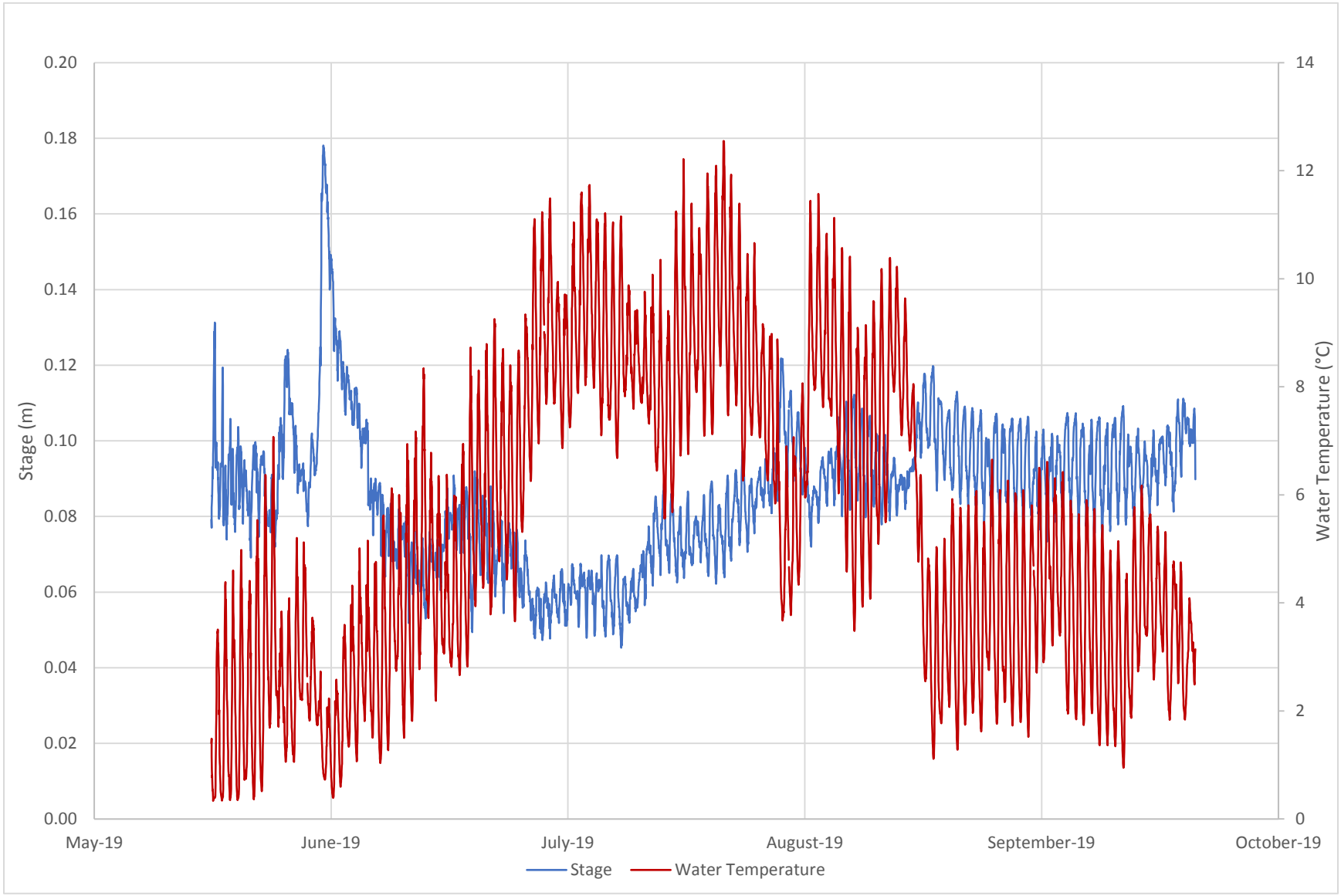


Figure 22: MN-1.5 Stage and Water Temperature Hydrograph

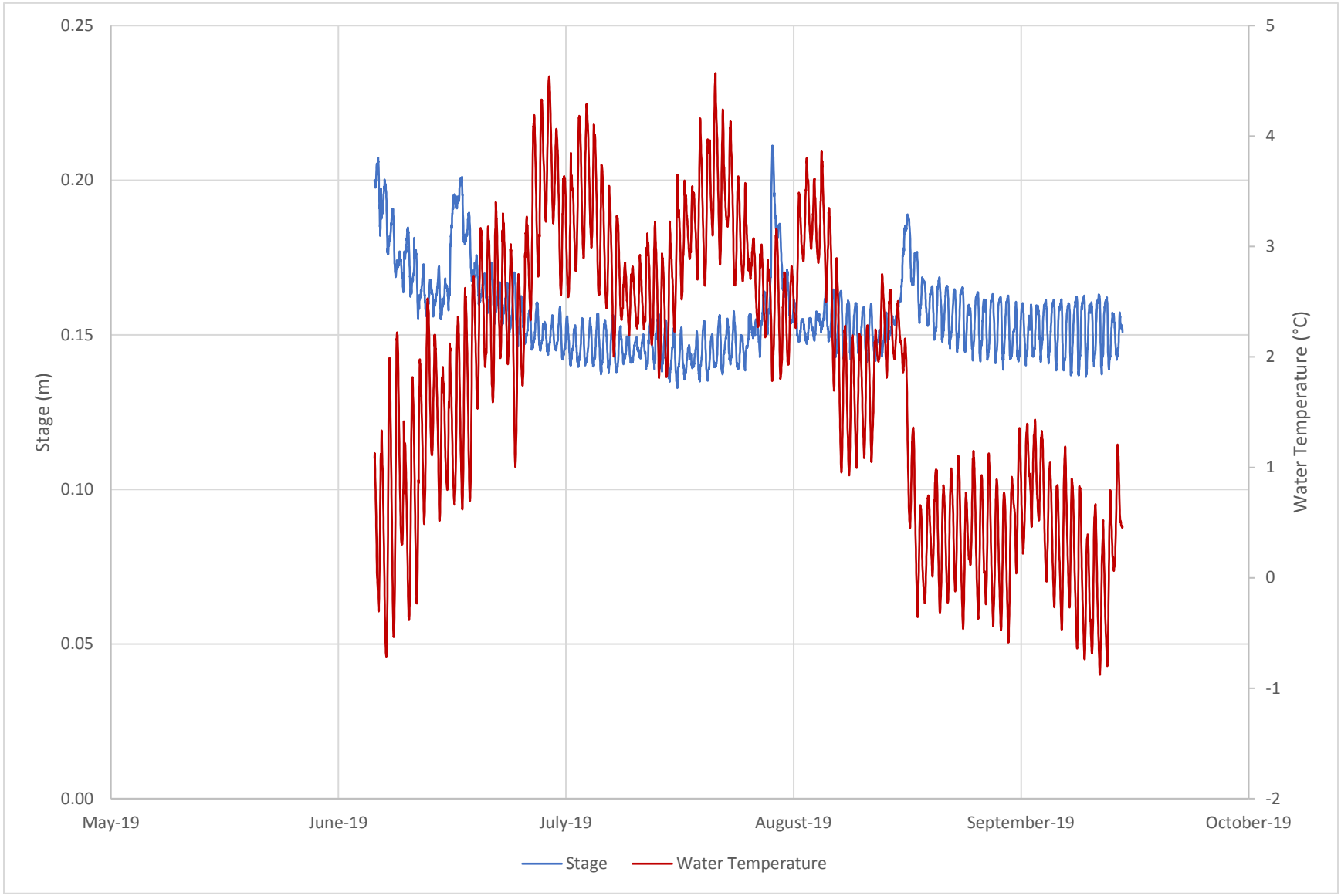


Figure 23: MN-2.5 Stage and Temperature Hydrograph

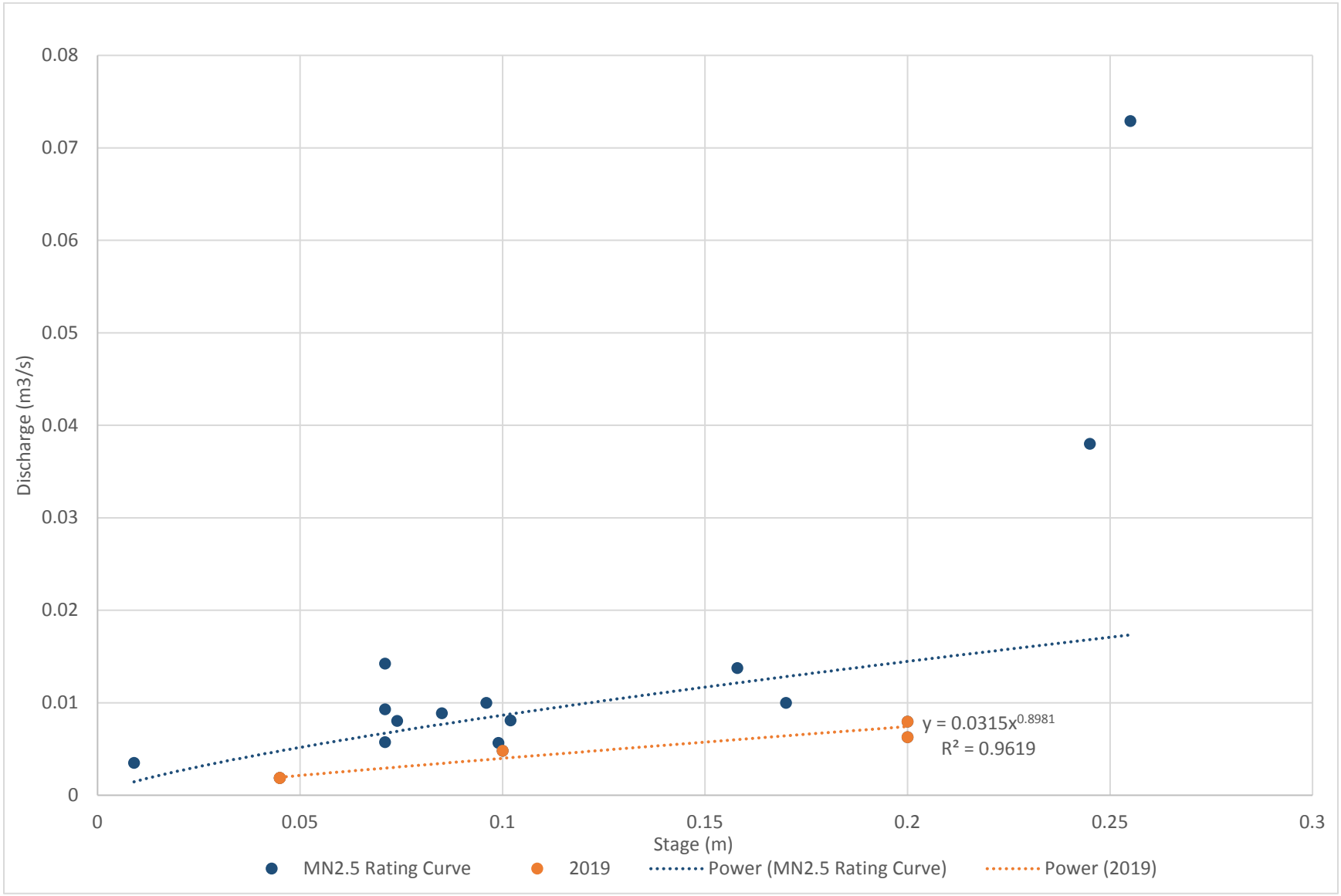


Figure 24: MN-2.5 Rating Curve

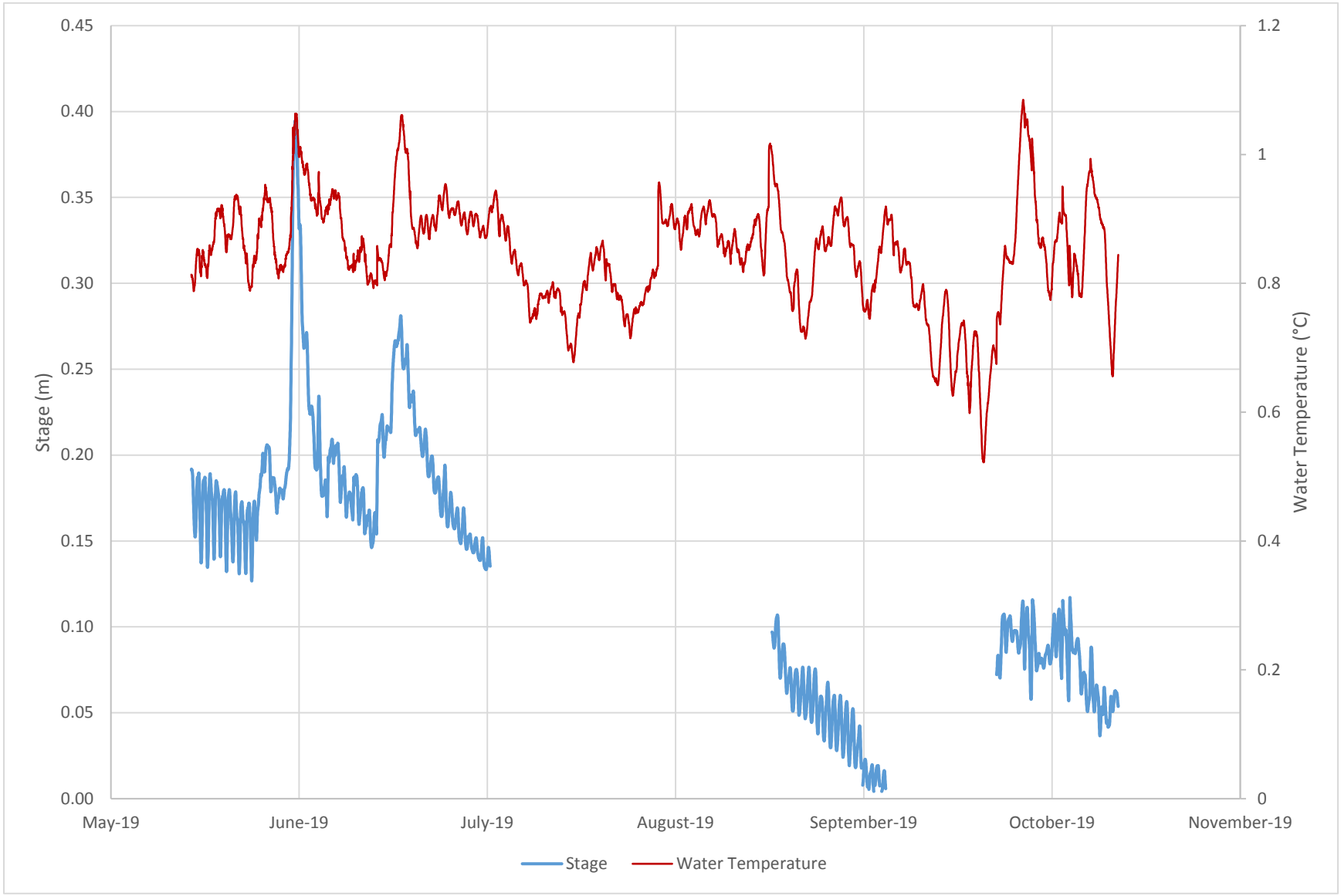


Figure 25: MN-4.5 Stage and Temperature Hydrograph

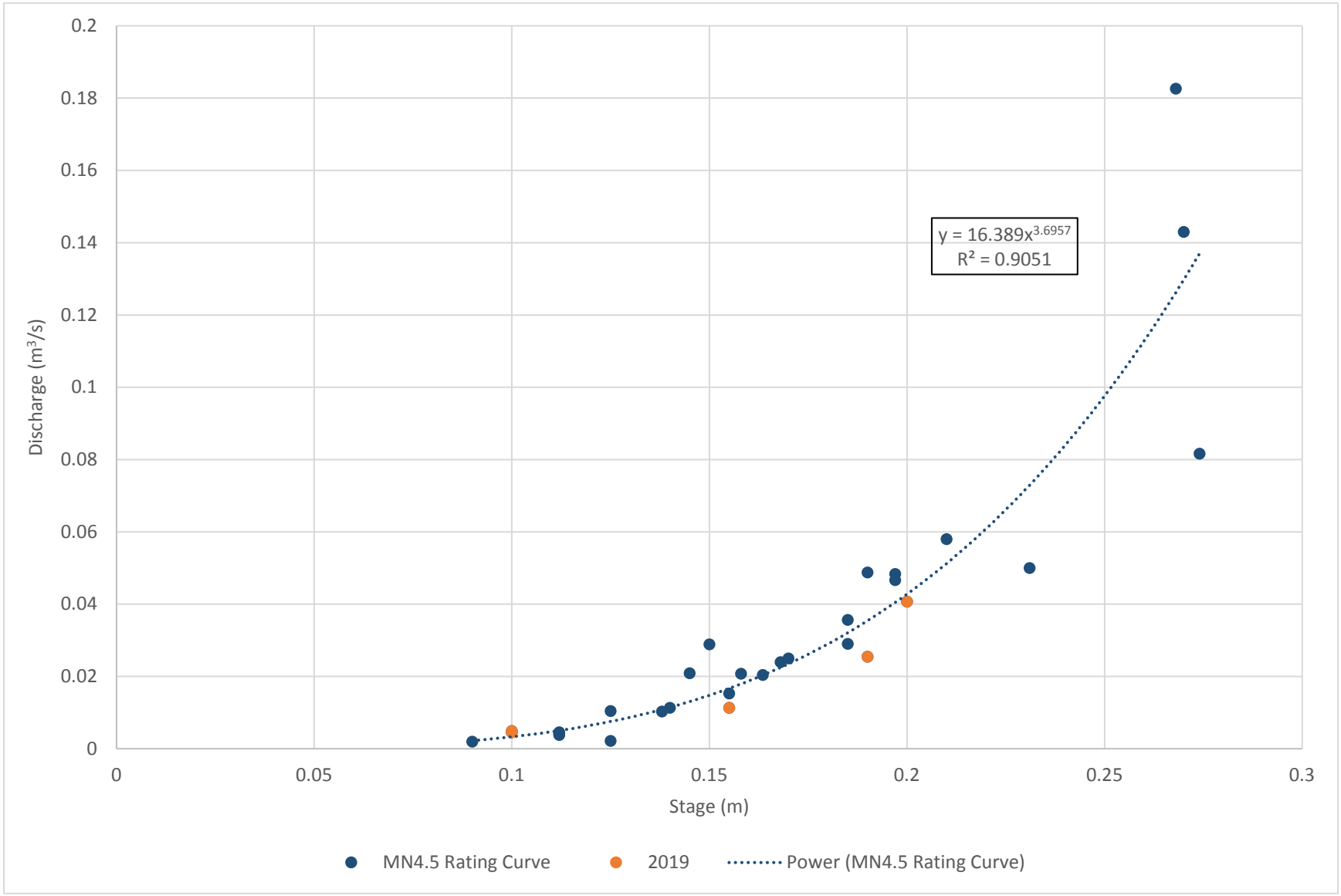


Figure 26: MN-4.5 Rating Curve

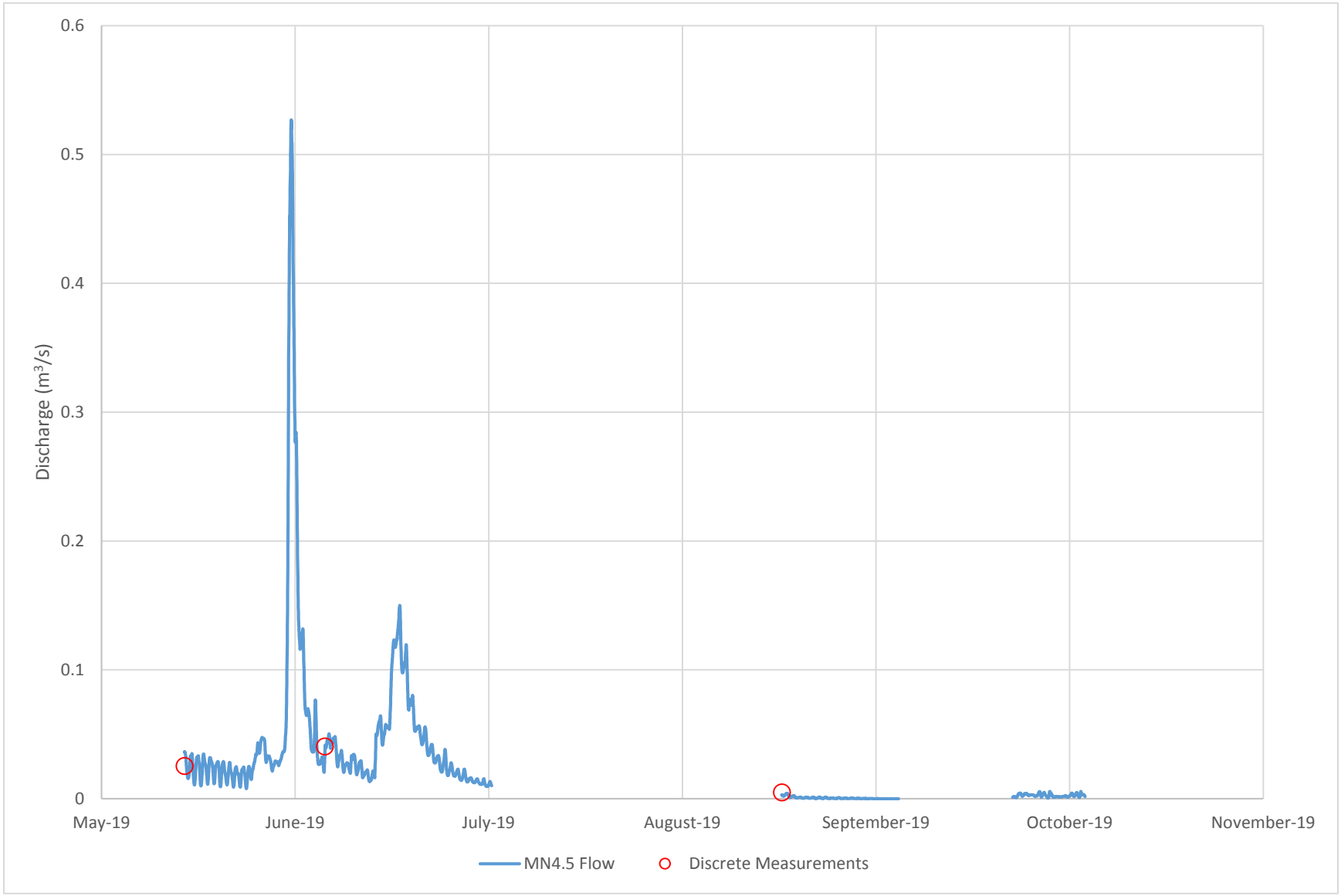


Figure 27: MN-4.5 Flow Hydrograph

Appendix H – 2019 Physical Monitoring Plan

Revision 2018-1
Physical Monitoring Plan
Minto Mine, YT

Prepared by:
Minto Explorations Ltd.
Minto Mine
December 2018

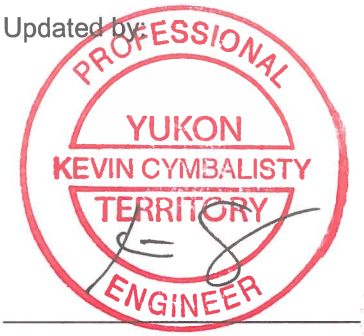
Minto Mine Physical Monitoring Plan

First Issue: June 2014

REVISION INFORMATION

Rev. Number	Issue Date	Description & Revisions Made
-	June, 2014	First issue
2015-1	November, 2015	Annual update of existing instrumentation and monitoring frequencies. Instruments Added: A215, A216, A217, A218, A2RAMP01, A2RAMP02, A2RAMP03, A2RAMP04, DSSH-26, DSSH-27, M82, M83, M84, M85, M86, M87, SWD06 Instruments Removed: DSI-14, DSI-21, DSSH-21, DSSH-22, DSSH-23, DSSH-25, WSP2
2016-1	December, 2016	Annual update of existing instrumentation and monitoring frequencies. Instruments Added: DSP-07, DSP-08, DSP-10, DSI-22, DSI-23, DSSH-28, DSSH-29, DSSH-30, DSSH-31, MV1, MV2, SWD-07, SWD-08, SWD-09 Instruments Replaced: DSSH-06, DSSH-10, DSSH-15, DSSH-18, DSSH-19, DSSH-20 Instruments Removed: A2RAMP01, A2RAMP02, A2RAMP03, A2RAMP04, SWD-02, SWD-02A, SWD-04A, SWD-05A, DSP-09
2017-1	November, 2017	Annual update of existing instrumentation and monitoring frequencies. Instruments Added: DSI-24, DSSH-32, M88, M89, M91, M92, M93, M94, SWD10, SWD11 Instruments Replaced: DSSH-17, DSSH-27, M82, M76, M86 Instruments Removed: DSI-23, DSSH-20, DSSH-29, M73, M75, M87
2018-1	December, 2018	Updated for care & maintenance. Inspection and monitoring frequencies revised. Instruments Added: DS1, DS3, DS4, MWDH1, MWDH2, MWDH3, MWDH4, MWDH5, MWDH6, M81, M95, M95, M97, M98, SWD12 Instruments Removed: M76, M85, M86, M91, SWD05A, SDI-3

Updated by:



Kevin Cymbalisty, P.Eng.

Mine Manager

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Appendix A: Instrumentation Map
Appendix B: Data Collection and Input Manuals

1 Introduction

The following document describes the instrumentation and monitoring program currently in place at Minto to monitor the stability of mining structures including waste rock, tailings, and water storage facilities. The program consists of two main components: instrumentation to measure ground conditions and deformation, and regular geotechnical inspections. The following sections summarize inspection and data collection frequencies, instrument installation details and locations, and data collection procedures.

Mining and monitoring activities at Minto included in this plan are licensed under the following:

- Type A Water Licence QZ14-031, August, 2015
- Type B Water Licence MS15-094, July 2016
- Quartz Mining Licence QML-0001, December, 2014

Existing mine structures at Minto are shown in Figure 1-1, and described in the following section. As of October, 2018 the mine has been placed in care and maintenance and no active mining is taking place.



Figure 1-1: Minto site plan (August 2017)

2 Mine Structures

Mine structures currently being monitored at Minto are listed in Table 1.

Table 1: Description of Mine Structures at Minto

Structure	Description	Instrumentation
Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF)	The Area 2 Pit was completed in 2015 to the extents licensed under Phase IV (Stages 1 and 2); the pit was extended to the south as part of Phase V/VI (Stage 3 and Stage 3 Expansion), completed in 2018. Tailings deposition into Area 2 Stage 2 pit (A2S2) began in March, 2015 and the pit is now maintained as a tailings management facility. Tailings deposition ceased in October 2018 when the mine was placed into care and maintenance. Dumping of NP:AP<3 waste rock (SAT) into the Stage 2 and Stage 3 pits, below the final water table at closure, took place in 2017 and 2018.	• Survey hubs
Area 2 Underground	The Area 2 underground began development in 2016 and is accessed by the Minto South portal and decline south of the Area 2 and Area 118 Pits. Production mining ceased in October, 2018 and the mine is now accessed to maintain dewatering only.	None
Area 118 Pit	Mining of the Area 118 Pit was carried out in 2014. As part of Area 2 Stage 3 pit mining, overburden was dispatched to the pit, referred to as the Area 118 Backfill Dump.	None
Area 118 Backfill Dump	The Area 118 Backfill Dump is included in the Phase V/VI licence. Overburden was dispatched to the pit in 2017 as part of Area 2 pit mining.	None
Area 118 Underground	The Area 118 underground began development in 2013 and was completed in 2016. It is accessed by the Minto South portal and decline south of the Area 2 and Area 118 Pits. Production mining took place using a longhole stoping method.	None
Big Creek Bridge	Bridge on the Minto access road crossing Big Creek, located at Km 19. Licenced under Type B water licence MS15-094.	None
Barge Landings	Barge landings on the Minto access road at the Yukon river. Licensed under Type B water license MS15-094.	None
Camp	The camp consists of several connected bunkhouse buildings (Sherwood, Minto, Selkirk), a kitchen building, and several separate buildings including the gym and Site Services offices.	None
Copper Keel and Wildfire Underground	The Copper Keel and Wildfire underground are in the phase V/VI mining plan and have not commenced yet.	N/A
Dry Stack Tailings Storage Facility (DSTSF)	Construction of the DSTSF with filtered tailings placement was carried out from 2007 to November 2011. As part of progressive reclamation activities in 2012-2013, the DSTSF was covered with a layer of overburden approximately one to four meters thick. The DSTSF began showing deformation in 2009, interpreted as primarily horizontal sliding towards the north/northeast on an ice-rich layer in the underlying overburden, several meters above bedrock. The movement has continued since then but at a decreasing rate in response to construction of both the Mill Valley Fill waste rock buttress and the Mill Valley Fill Extension 2 waste rock buttress. Resloping and overburden cover	• Survey hubs • Thermistors • Inclinometers • Piezometers

Structure	Description	Instrumentation
	placement took place in 2017 and 2018 as part of progressive reclamation activities.	
Ice Rich Overburden Dump (IROD)	Originally constructed as a free-standing rockfill structure to contain ice-rich overburden. The IROD is no longer active and is now entirely surrounded by the Southwest Waste Dump rockfill. The area has been reclaimed with the Southwest Waste Dump in 2017.	None
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	Mining in the Main Pit was completed in 2011. Instability in the south wall of the pit occurred in 2009 during mining of Stage 3 of the pit, and subsequently a larger failure occurred in 2011 after completion of Stage 5. Continued sloughing and creep movement of the south wall led to the design and construction of a waste rock buttress, known as the South Wall Buttress, completed in 2013. Slurry tailings deposition into the pit began in 2012 and the pit is now maintained as a tailings management facility.	• Survey hubs • Inclinometer
Main Pit Dump	The Main Pit Dump is included in the Phase V/VI licence. Construction commenced in 2017 and ceased in 2018 when the mine placed in care and maintenance. The dump is located on the southwest side of the Main Pit.	• Survey hubs
Main Waste Dump (MWD)	The Main Waste Dump stores waste rock released during the mining of the first three stages of the Main Pit. The dump is no longer active.	• Survey hubs • Inclinometer
Main Waste Dump Expansion (MWDE)	This dump is an extension of the MWD that stores waste rock released from the Minto North Pit. The dump is no longer active. Reclamation re-sloping began in 2016.	None
Main Waste Dump Wrap (MWDW)	This dump is a reclamation feature to shallow the slopes of the Main Waste Dump for reclamation purposes. The dump is no longer active.	• Survey hubs
Mill Site	The mill site consists of the mill building, crusher and crusher stockpile pad.	None
Mill Valley Fill Extension (MFVE)	A waste rock buttress to the north of the DSTSF, constructed from January 2012 to March 2013 to prevent or decrease movement of the DSTSF. Resloping and overburden cover placement were carried out as part of progressive reclamation activities in 2017 and 2018.	• Survey hubs
Mill Valley Fill Extension 2 (MVFE2)	An extension of the MVFE waste rock buttress to the northeast, constructed from November 2015 to August 2016 to further decrease movement of the DSTSF. Resloping and overburden cover placement were carried out as part of progressive reclamation activities in 2017 and 2018.	• Piezometers • Survey hubs • Inclinometers
Mill Valley Fill Extension 2 Collection Sump	A replacement sump for the Minto Creek Detention Structure (MCDS), constructed in 2016. It detains surface water considered impacted from upstream sub-catchment areas and directs it to the MPTMF or water treatment plant.	None
Minto Access Road	Road from the Yukon River barge crossing to the mine site. Licenced under Type B water licence MS15-094.	None
Minto East Underground	Accessed by the Minto South portal and decline south of the Area 2 and Area 118 Pits. Production was underway at the time the mine was placed in care and maintenance in October 2018.	None

Structure	Description	Instrumentation
Minto North Pit	Mining of the North Pit was completed in September 2016. The pit is currently inactive and the access is barricaded.	None
Ore Stockpiles	There are two primary ore stockpiles on site – North and South stockpile. These are located south of the crusher and east of the Area 2 pit.	None
Reclamation Overburden Dump (ROD)	Received the bulk of the overburden released as part of Phase IV and earlier mining of the Main Pit. The material in the ROD is available for use in reclamation of the mine at closure.	None
South Diversion Ditch	This structure was decommissioned in 2017 to allow for Area 2 Stage 3 Expansion mining activities.	None
South Wall Buttress (SWB)	Waste rock buttress constructed against the Main Pit south wall from 2009-2011 as a result of instability in the south wall of the pit. Now covered by the Main Pit Dump.	• Survey hubs
Southwest Waste Dump (SWD)	The Southwest Waste Dump (SWD) stores waste rock released during phase IV mining. The dump is no longer active. Resloping and overburden cover placement were carried out as part of progressive reclamation activities in 2016-2018.	• Survey hubs • Inclinometers • Thermistors • Piezometers
Tailings Diversion Ditch (TDD)	A diversion ditch located south of the DSTSF to divert unimpacted water around the tailings facility. The intake structure was extended in 2017 and 2018 to allow for the decommissioning of the South Diversion Ditch for A2S3 Expansion mining.	None
Water Storage Pond Dam (WSP)	The Water Storage Pond and Dam are located east of the mine along Minto Creek. The dam was constructed in 2006 as a clay-core water retention dam for collecting precipitation and surface water runoff at the site. Maximum depth of water at the face of the dam is approximately 15 m.	• Survey hubs • Thermistors • Piezometers

3 Design and Monitoring References

Table 2 lists the design reports for each structure and the monitoring/inspection guidance reports used to develop the inspection (Section 5) and instrumentation (Section 6) programs for each structure.

Table 2: Design Documents and Monitoring/Inspection Guidance Documents

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF)	*Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.* SRK, December 2009. *Review of Minto Area 2 West Wall Stability*. SRK, September 11, 2012. *Review of Minto Area 2 West Wall Stability-April 2013*. SRK, April 18, 2013. *Review of Minto Area 2 West Wall Stability-September 2013*. SRK, September 30, 2013. *Main Dam – Area 2 Pit Stability Assessment.* SRK Consulting Project: 1CM002.003.0701, February, 2015.	*Operation, Maintenance, and Surveillance Manual - Area 2 Pit Tailings Management Facility* Revision 2015-2. Minto, December 2015. *Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, 2018.
Area 2 Stage 3 Pit and Area 2 Stage 3 Expansion	*Pit Slope Stability Evaluation, Minto Mine, Area 2 Pit – Stage 3.* SRK Consulting Project: 219500.190, August 2015. *Geotechnical Review of Saddle Between Area 2 Stage 2 and Area 2 Stage 4 Open Pits.* JDS Energy & Mining Inc., August 24, 2017.	*Minto Mine Ground Control Plan – Open Pit Operations.* Minto, 2017.
Area 2 Underground	*Area 2 Mining Stability Assessment Summary*. Golder Associates, June, 2016. *Area 2 Mining Stability Assessment Summary*. Golder Associates, December, 2016.	*Minto Mine Ground Control Plan – Underground Operations.* Minto, 2017. *Inspection of Physical Stability of Underground Workings at Minto Mine, Yukon*. Golder Associates, August 2017. *Minto Mine Geotechnical Mapping Program Memo Review.* Golder Associates, September 2017. *Independent Review of Blasting Impacting Between Minto Surface and Underground Operations*. Golder Associates, September 2017. *Inspection of Physical Stability of Underground Workings at Minto Mine*. Golder Associates, August 2018.
Area 118 Pit	*Prefeasibility Geotechnical Evaluation, Phase IV, Minto Mine.* SRK, December 2009. *Review of Final Area 118 Pit Design*. SRK Consulting, Project: 219500.070. January, 2015.	-

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Area 118 Backfill Dump	*Phase V/IV Ridgetop South and Area 118 Backfill Dumps Physical Stability Assessment.* SRK, October 2013.	-
Area 118 Underground	*Minto 118-Zone – FLAC3D Analysis of the Longhole Base Case Option.* Itasca, August 2014. *Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas.* Golder Associates File: 1528754-002-R-Rev0-3000. July 30, 2015. *Longhole Open Stope Stability Addendum – Revised Mining Heights.* Golder Associates, File 1528754-006-TM-Rev0-3000, November 2015. *Area 118 Plunge Mining Stability Assessment Summary.* Golder Associates, File: 1528754-008-PP-Rev0-5000, December 2015	*Minto Mine Ground Control Plan – Underground Operations.* Minto, 2016. *Ground Control Management Plan Review.* Golder Associates, File 1528754-007-TM-Rev0-1000. September 2015.
Big Creek Bridge	-	-
Camp	-	-
Dry Stack Tailings Storage Facility (DSTSF)	*Geotechnical Design Report, Dry Stack Tailings Storage Facility, Minto Mine, Yukon*. EBA File: 1200173. January 2007.	*Operation, Maintenance, and Surveillance Manual, Dry Stack Tailings Storage Facility, Minto Mine, YT.* Revision 2014-1 Minto, November 2014. *Minto Mine Operations Adaptive Management Plan.* Revision 2018-01. Minto, 218.
Ice Rich Overburden Dump (IROD)	*Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.* EBA file: 1200173. January 2006. *Ice-Rich Overburden Dump Containment Berm Inspection Report, Minto Mine Site, Minto Yukon.* EBA File: 1200173.001. June 19, 2007.	*Geotechnical Design Ice-Rich Overburden Dump, Minto Mine, Minto, YT.* EBA file: 1200173. January 2006. EBA, 2007.
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	*Pit Slope Evaluation for Area 1 Open Pit.* SRK Consulting, Project: 2CM022.03, July 2007. *SAT Dump on Tailings.* SRK Consulting Project: 1CM002.043, March 2016.	*Operation, Maintenance, and Surveillance Manual - Main Pit Tailings Management Facility*. Revision 2015-2 Minto, December, 2015. *Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, 2018.

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Main Pit Dump	*Phase V/VI Main Pit Dump Physical Stability Assessment.* SRK Consulting Project: 1CM002.003.0701, November, 2013. *Update to the Main Pit Dump Physical Stability Assessment.* SRK Consulting Project: 1CM002.003.0701. February, 2015. M*ain Pit Dump (Revision 5.6) Stability Analysis*. SRK Consulting, Project 1CM002-053, July, 2017.	-
Main Waste Dump (MWD)	*Geotechnical Evaluation Proposed Main Waste Dump Minto Mine, Minto, YT.* EBA. April, 1998.	*Geotechnical Evaluation Proposed Main Waste Dump Minto Mine, Minto, YT.* EBA. April, 1998. *Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, 2018.
Main Waste Dump Expansion (MWDE)	*Minto Mine Phase V/VI Expansion Waste Rock and Overburden Management Plan.* Minto. June, 2014. *Phase V/VI Main Waste Dump Expansion – Physical Stability Assessment.* SRK Consulting Project: 1CM002.012.012, November, 2013	*Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, 2018.
Main Waste Dump Wrap (MWDW)	*Main Waste Dump Stability Analysis.* SRK Consulting Project: 1CM002-049, April, 2017.	-
Mill Site	-	-
Mill Valley Fill Extension (MFVE)	*Waste Rock and Overburden Management Plan, Phase IV Development, Minto Mine YT.* EBA File: W14101068.015. September 9, 2011. *Upstream Water Management for the Mill Valley Fill Expansion and Dry Stack Tailings Storage Facility.* EBA File: W14101168.013. September 14, 2011.	*Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, May, 2018.
Mill Valley Fill Extension 2 (MVFE2)	*Mill Valley Fill Extension Stage 2 Preliminary Design Report.* SRK Consulting Project: 1CM002.015. March, 2014 *Minto Mine Phase V/VI Expansion Waste Rock and Overburden Management Plan.* Minto. June, 2014. *Mill Valley Fill Extension Stage 2 Final Design Report.* SRK Consulting Project: 1CM002.040. September, 2015. *Mill Valley Fill Extension Stage 2 Record of Construction.* Minto. November, 2016.	*Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, 2018. *Mill Valley Fill Extension Stage 2 – Expected Performance and Evaluation Criteria.* SRK Consulting Project: 1CM002.050, November, 2016. *Mill Valley Fill Extension Stage 2 Inclinometer Installations Field Report*. SRK Consulting Project: 1CM002.052. June 2017.

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Mill Valley Fill Extension 2 Collection Sump	*Design for the MVFE Stage 2 Collection Sump.* SRK Consulting Project: 1CM002.020. June, 2015. *Mill Valley Fill Extension Stage 2 Colleciton Sump Record of Construction*. Minto. April, 2016.	-
Minto Access Road	-	-
Minto East Underground	*Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas,* Golder Associates, Reference No. 1528754-002-R-Rev0-3000, July, 2015. *Minto East – Revised Longhole Open Stope Stability.* Golder Associates, File: 1528754-009-TM-Rev0-6000, January, 2016. *Minto East Raise Geotechnical Investigation and Hydrogeological Testing Program Study*. Golder Associates, October, 2017. *Minto East Stability Assessment Update - Draft.* Golder Associates, September 2018.	*Minto Mine Ground Control Plan – Underground Operations.* Minto, 2017. *Minto Mine Underground Ground Control Audit.* Golder Associates, January 2018. *Inspection of Physical Stability of Underground Workings at Minto Mine*. Golder Associates, August 2018.
Copper Keel, Wildfire Underground	*Minto Phase VI Underground Geotech Evaluation*, SRK Consulting Project: 2UC031.005, February, 2012. *Geotechnical Characterization of Existing and Proposed Longhole Open Stope Mining Areas,* Golder Associates, Reference No. 1528754-002-R-Rev0-3000, July, 2015. *Minto Mine Underground Reserve Update Geotechnical Input*, Golder Associates, Reference No. 1528754-003-R-Rev0-3000, July, 2015. *Wildfire Proposed Underground Mine Area – Geotechnical Characterization and Long Hole Open Stope Stability Assessment.* Golder Associates, September, 2016.	-
Minto North Pit	*Minto Phase VI Preliminary Feasibility Study Technical Report.* SRK, January 2012. *Review of Minto North Wall Stability.* SRK, May, 2016. *Site Visit and Review of North Pit – South Wall.* BGC Engineering, July, 2016. *Minto North South Wall Wedge Analysis.* SRK, August, 2016.	*Minto Open Pit Ground Control Plan_Rev0.* Minto, 2016.
Ore Stockpiles	-	-

Structure	Design Reports	Monitoring/Inspection Guidance Reports
Reclamation Overburden Dump (ROD)	*Geotechnical Design Proposed Reclamation Overburden Dump, Minto Mine, Yukon.* EBA File: W14101068.004. February 2008. *Reclamation Overburden Dump Expansion Geotechnical Design Report.* EBA File: W14101068.0040. June 29, 2010.	*Reclamation Overburden Dump Expansion Geotechnical Design Report.* EBA File: W14101068.0040. June 29, 2010. *Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, 2018.
Ridgetop Pit (Ridgetop North Pit, Ridgetop South Pit)	*Pre-Feasibility Geotechnical Evaluation Phase IV Minto Mine,* SRK Consulting Project: 2CM022.006, December, 2009. *Ridgetop North Pit TMF Stability Assessment,* SRK Consulting Project: 1CM002.003.710, February, 2015.	-
Ridgetop Waste Dump	*Phase V/VI Ridgetop Waste Dump Physical Stability Assessment.* SRK Consulting Project: 1CM002.012.0.12, November, 2013.	-
South Diversion Ditch (SDD)	*Phase 1 – Preliminary Engineering, Stormwater Diversion Ditches Minto Mine, YT,* EBA File: W14101068.013	-
South Wall Buttress	*Area 1 South Wall Buttress Design Report, Minto Mine, Yukon.* EBA File: W141010668.012, July 2011.	-
Southwest Waste Dump (SWD)	*Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.* EBA File: W14101068.005. September 2008.	*Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon.* EBA File: W14101068.005. September 2008. *Minto Mine Operations Adaptive Management Plan* Revision 2018-01. Minto, 2018.
Tailings Diverion Ditch (TDD)	*Preliminary Design of the Tailings Diversion Ditch Upgrade,* SRK Consulting Project: 1CM002.012.006, November, 2013. *Area 2 Stage 3 Pit Expansion – Intake Strucutre and Overflow Spillway – Final Design*, SRK Consulting Project: 1CM002.056, May 2017.	-
Water Storage Pond Dam (WSP)	*Geotechnical Design Tailings/Water Dam, Minto Project, Yukon.* EBA File: 0201-95-11509. Dec. 1995. *As-built Construction Report, Water Retention Dam, Minto Mine, Minto, YT.* EBA File: 1200173.001. April 2008.	*Operation, Maintenance and Surveillance Manual, Water Retention Dam, Minto Mine, Minto, YT.* EBA File: W14103414-01. August 2014.

4 Roles and Responsbilities

Table 3 lists the roles and responsibilites for physical monitoring on the site. The list below has been updated to reflect the care and maintenance workforce.

Table 3: Roles and Responsibilities

Role	Responsibilities
Environmental Monitors	• Collect instrumentation data at specified frequencies • Input data into monitoring spreadsheets/databases • Internal reporting of monitoring data • Maintain equipment
Environmental Officers	• Ensure compliance with license requirements • Compile monthly and annual Water Licence reports • Visual inspections at specified frequencies • Communicate with consultants as required
External Geotechnical Consultant	• Review monthly and annual Water Licence reports • Review and update Physical Monitoring Plan • Site inspections at specified frequencies

5 Inspections

Table 4 lists the regular, required inspections.

Table 4: Inspections

Structure	Frequency	Description
Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF)	Quarterly	Visual inspection and review of monitoring data as per OMS Manual. Two of the inspections by a professional engineer.
Area 2 Underground	N/A	No longer accessible.
Area 118 Pit	N/A	No longer accessible.
Area 118 Backfill Dump	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Area 118 Underground	N/A	No longer accessible.
Big Creek Bridge	Annually	Visual inspection by a professional engineer as per MS15-094.
Camp	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Copper Keel, Wildfire Underground	N/A	N/A – structure does not exist yet.
Dry Stack Tailings Storage Facility (DSTSF)	Quarterly	Visual inspection and review of monitoring data as per OMS Manual. Two of the inspections by a professional engineer.
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	Quarterly	Visual inspection and review of monitoring data as per OMS Manual. Two of the inspections by a professional engineer.
Main Pit Dump	Quarterly	Visual inspection and review of monitoring data. Two of the inspections by a professional engineer.
Main Waste Dump (MWD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.

Structure	Frequency	Description
Main Waste Dump Expansion (MWDE)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Main Waste Dump Wrap (MWDW)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Mill Site	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Mill Valley Fill Extension (MFVE)	NA	Covered by MVFE2.
Mill Valley Fill Extension 2 (MVFE2)	Quarterly	Visual inspection and review of monitoring data. Two of the inspections by a professional engineer.
Mill Valley Fill Extension 2 Collection Sump	Monthly	Visual inspection. Semi-annual inspections by a professional engineer.
Minto Access Road	Annually	Visual inspection by a professional engineer as per MS15-094.
Minto East Underground	Semi-annually	Visual inspection by a professional engineer as per Underground Ground Control Plan.
Minto North Pit	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Ore Stockpiles	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Reclamation Overburden Dump (ROD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Ridgetop Waste Dump	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.

Structure	Frequency	Description
South Wall Buttress (SWB)	NA	Covered by Main Pit Dump.
Southwest Waste Dump (SWD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Tailings Diversion Ditch (TDD)	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year.
Water Storage Pond Dam (WSP)	Monthly	Visual inspection and review of monitoring data. Semi-annual inspections by a professional engineer.

6 Instrumentation

A map of site wide active instrumentation is shown in Appendix A. Installation information and data collection schedules are contained in the following sections. Instruments with a strikethrough shown were destroyed in 2018 or are no longer operational.

Inclinometers

Inclinometers are used to measure lateral, differential ground movement in a borehole. Inclinometer stations consist of grouted, slotted PVC pipe into which the inclinometer probe is lowered and deflection is measured at 0.5m intervals. The current probe used on site is an RST digital MEMS inclinometer system.

Table 5: Inclinometers

Area	ID	Northing (m)	Easting (m)	Elevation (m)	A0 Azimuth	Hole Depth (m)	Date Installed	Reading Frequency
Area 2 Pit	A2I-1	6944164.73	385298.95	822.46	302	55.5	2013-04-26	Semi-annually
Dry Stack Tailings Storage Facility and Mill Valley Fill Extension 2	DSI-22	6945229	386043.4	723.471	034	14	2016-12-12	Quarterly
Dry Stack Tailings Storage Facility and Mill Valley Fill Extension 2	DSI-24	6944971	385951.4	774.416	005	108	2017-02-01	Monthly
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	MDI -2	6945013.08	384217.20	858.67	93	50.5	2010-02-10	Quarterly
~~Southwest Waste Dump~~	~~SDI-3~~	~~6944591.11~~	~~383966.00~~	~~847.42~~	~~90~~	~~46.5~~	~~2010-02-11~~	~~Quarterly~~

Survey Hubs

Survey hubs are used to monitor surface movement of structures and are comprised of steel posts cemented into waste rock or bedrock and equipped with a threaded base to which a high precision RTK-corrected GPS instrument is attached. The GPS currently used on site is a Trimble R8.

Table 6: Survey Hubs

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Frequency
Area 2 Pit	A210	6944268	384935	861	7/1/2011	Quarterly
Area 2 Pit	A215	6944649	385155	809	9/17/2015	Quarterly
Area 2 Pit	A216	6944749	385046	806	9/17/2015	Quarterly
Area 2 Pit	A217	6944757	384853	807	9/17/2015	Quarterly
Area 2 Pit	A218	6944707	384783	807	9/17/2015	Quarterly
Area 2 Pit	A219	6944082	385159	846	9/15/2017	Quarterly
Area 2 Pit	DS1	6944400	385310	810	1/2/2018	Monthly
Area 2 Pit	DS3	6944365	385320	811	1/2/2018	Monthly
Area 2 Pit	DS4	6944339	385323	811	1/2/2018	Monthly
Dry Stack Tailings Storage Facility	ASH05	6944281	385831	850	3/7/2011	Annually
Dry Stack Tailings Storage Facility	ASH06	6944332	385624	824	3/7/2011	Annually
Dry Stack Tailings Storage Facility	DSSH-06	6944971	385553	784	8/21/2016	Monthly
Dry Stack Tailings Storage Facility	DSSH-10	6944993	385806	769	8/21/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-12	6944947	385707	778	8/16/2016	Monthly
Dry Stack Tailings Storage Facility	DSSH-14	6944920	385607	783	4/21/2012	Annually
Dry Stack Tailings Storage Facility	DSSH-15	6944944	385490	785	8/16/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-18	6945071	385513	782	8/16/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-19	6945110	385575	781	8/16/2016	Quarterly
Dry Stack Tailings Storage Facility	DSSH-20	6945072	385754	776	8/21/2016	Quarterly
Dry Stack Tailings Storage Facility	DSSH-24	6944758	385712	792	2/28/2014	Quarterly
Dry Stack Tailings Storage Facility	DSSH-26	6944601	385491	796	7/28/2015	Quarterly
Dry Stack Tailings Storage Facility	DSSH-27	6944757	385884	792	6/25/2017	Quarterly
Dry Stack Tailings Storage Facility	DSSH-28	6945045	385930	768	6/25/2017	Monthly
Dry Stack Tailings Storage Facility	DSSH-29	6945162	385834	766	8/21/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-30	6944883	385890	789	8/21/2016	Annually
Dry Stack Tailings Storage Facility	DSSH-31	6945031	386041	776	11/1/2016	Annually

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Frequency
Dry Stack Tailings Storage Facility	DSSH-32	6944985	385896	773	9/10/2017	Annually
Dry Stack Tailings Storage Facility	MV1	6945250	386021	728	4/4/2016	Annually
Dry Stack Tailings Storage Facility	MV2	6945217	385979	740	4/4/2016	Quarterly
~~Main Pit~~	~~M76~~	~~6944610~~	~~384539~~	~~836~~	~~5/23/2011~~	~~Monthly~~
Main Pit	M79	6944847	384209	848	9/4/2011	Annually
Main Pit	M80	6944932	384256	842	9/4/2011	Annually
~~Main Pit~~	~~M81~~	~~6944972~~	~~384890~~	~~807~~	~~5/8/2012~~	~~Monthly~~
Main Pit	M82	6944891	384526	807	4/5/2017	Quarterly
Main Pit	M83	6944948	384476	809	1/8/2015	Monthly
Main Pit	M84	6945021	384445	807	1/8/2015	Quarterly
~~Main Pit~~	~~M85~~	~~6944847~~	~~384316~~	~~826~~	~~7/27/2015~~	~~Monthly~~
~~Main Pit~~	~~M86~~	~~6944636~~	~~384408~~	~~839~~	~~9/12/2017~~	~~Monthly~~
Main Pit	M88	6944873	384377	838	9/4/2017	Monthly
Main Pit	M89	6944688	384284	843	9/4/2017	Annually
~~Main Pit~~	~~M91~~	~~6944830~~	~~384398~~	~~850~~	~~9/4/2017~~	~~Monthly~~
Main Pit	M92	6944785	384707	801	9/14/2017	Annually
Main Pit	M93	6944779	384621	801	9/14/2017	Quarterly
Main Pit	M94	6944827	384583	801	9/14/2017	Quarterly
Main Pit	M95	6944727	384535	833	5/7/2018	Quarterly
Main Pit	M96	6944505	384520	866	5/14/2018	Annually
Main Pit	M97	6944782	384380	859	5/14/2018	Quarterly
Main Pit	M98	6944887	384510	808	5/14/2018	Monthly
Main Waste Dump Wrap	MWDH01	6944932	383931	872	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH02	6944957	384113	861	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH03	6945127	384204	878	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH04	6945146	384183	881	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH05	6945044	384037	901	8/13/2018	Quarterly
Main Waste Dump Wrap	MWDH06	6945024	383937	904	8/13/2018	Quarterly
Southwest Waste Dump	SWD01	6944761	384078	859	3/7/2011	Quarterly
~~Southwest Waste Dump~~	~~SWD05A~~	~~6943940~~	~~383838~~	~~869~~	~~3/7/2011~~	~~Monthly~~

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Date Installed	Frequency
Southwest Waste Dump	SWD06	6944762	384189	836	7/27/2015	Quarterly
Southwest Waste Dump	SWD07	6944743	384112	840	11/21/2016	Quarterly
Southwest Waste Dump	SWD08	6944560	383883	867	11/21/2016	Quarterly
Southwest Waste Dump	SWD09	6944163	383791	862	11/21/2016	Quarterly
Southwest Waste Dump	SWD10	6943943	383838	868	7/10/2017	Quarterly
Southwest Waste Dump	SWD11	6944512	383916	850	7/10/2017	Quarterly
Southwest Waste Dump	SWD12	6944335	383818	864	9/28/2018	Quarterly
Water Storage Pond Dam	WSP1	6945613	386481	723	6/9/2011	Monthly
Water Storage Pond Dam	WSP3	6945552	386549	720	6/9/2011	Monthly
Water Storage Pond Dam	WSP4	6945532	386555	720	6/9/2011	Monthly
Water Storage Pond Dam	WSP5	6945505	386560	721	6/9/2011	Monthly

Thermistors

Thermistor strings are used to measure ground temperature profiles in boreholes, and in particular permafrost conditions at Minto. Thermistor strings consist of multiple temperature sensor nodes distributed along a single multi-conductor cable, installed within or attached to the outside of grouted PVC pipe. EBA and RST thermistor strings have been installed on site. EBA thermistors are read using a basic ohmmeter and RST thermistors are read using a RST TH2016B readout unit.

Table 7: Thermistors

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Thermistor String No.	Nodes	Hole Depth (m)	Date Installed	Reading Frequency
Area 2 Pit	A2T-1	6944162	385306	822.39	3491	16	63.4	2013-04-21	Quarterly
Dry Stack Tailings Storage Facility	DST-10	6944584	385489	797.13	3492	16	63.4	2013-04-17	Quarterly
Dry Stack Tailings Storage Facility	DST-11	6944900	385539	787.66	3494	16	86.9	2013-04-05	Quarterly
Dry Stack Tailings Storage Facility	DST-13	6945015	386271	777.01	3495	16	101.5	2013-04-02	Quarterly
Dry Stack Tailings Storage Facility	DST-14	6944769	385713	791.47	3497	16	66.5	2013-04-12	Quarterly
Dry Stack Tailings Storage Facility	DST-15	6945034	385958	764.51	3493	16	64.0	2013-03-25	Quarterly
Water Storage Pond	WDT-1	6945523	386551	720.03	2072	16	42.49	2007-11-16	Monthly
Water Storage Pond	WDT-2	6945533	386575	713.66	2073	6	44.50	2007-11-07	Monthly
Water Storage Pond	WDT-3	6945544	386544	719.78	2074	16	49.42	2007-11-11	Monthly
Water Storage Pond	WDT-4	6945535	386548	719.85	2075	16	49.42	2007-11-10	Monthly
Water Storage Pond	WDT-5	6945505	386558	721.03	2076	16	35.13	2007-11-13	Monthly
Water Storage Pond	WDT-6	6945506	386556	721.03	2077	16	33.72	2007-11-13	Monthly
Water Storage Pond	WDT-7	6945505	386556	721.08	2078	16	33.92	2007-11-13	Monthly

Water Storage Pond	WDT-8	6945533	386575	713.66	2079	16	34.14	2007-11-07	Monthly
Southwest Waste Dump	SDT-1	6944767	384779	836.36	2220	16	59.1	2010-02-04	Quarterly
Southwest Waste Dump	SDT-2	6944595	383971	847.11	2221	16	14.6	2010-01-31	Quarterly
Southwest Waste Dump	SDT-3	6944334	383825	860.17	2222	16	15.8	2010-01-28	Quarterly
Southwest Waste Dump	SDT-4	6944164	383784	860.99	2223	16	13.1	2010-01-30	Quarterly

Vibrating Wire Piezometers

Vibrating wire piezometer strings are used to measure piezometric pressure profiles in boreholes. They consist of multiple vibrating wire sensors installed on PVC pipe in grouted boreholes. RST vibrating wire piezometers are installed on site and data is collected with an RST VW2106 readout unit.

Table 8: Vibrating Wire Piezometers

Area	ID	Northing (m)	Easting (m)	Elevation (m)	Sensor	No.	Sensor Elevation (m)	Date Installed	Reading Frequency
Dry Stack Tailings Storage Facility	DSP-5	6944769	385713	791.47	DSP-5A	VW24851	765.47	2013-04-16	Quarterly
					DSP-5B	VW24853	761.47		
Dry Stack Tailings Storage Facility	DSP-6	6944900	385539	787.66	DSP-6A	VW24850	769.56	2013-04-05	Quarterly
					DSP-6B	VW24852	765.56		
Dry Stack Tailings Storage Facility	DSP-7	6944990	385390	780.404	DSP-7-1	VW34657	771.404	2015-12-09	Quarterly
					DSP-7-2	VW34658	763.404	2015-12-09	Quarterly
					DSP-7-3	VW34659	756.404	2015-12-09	Quarterly
					DSP-7-4	VW34660	753.404	2015-12-09	Quarterly
					DSP-7-5	VW34661	751.404	2015-12-09	Quarterly
					DSP-7-6	VW34662	747.404	2015-12-09	Quarterly
Dry Stack Tailings Storage Facility	DSP-8	6945058	385872	755.548	DSP-8-1	VW34663	750.548	2015-12-10	Quarterly
					DSP-8-2	VW34664	745.548	2015-12-10	Quarterly
					DSP-8-3	VW34665	740.548	2015-12-10	Quarterly
					DSP-8-4	VW34666	735.458	2015-12-10	Quarterly
					DSP-8-5	VW34667	730.458	2015-12-10	Quarterly
					DSP-8-6	VW34668	720.458	2015-12-10	Quarterly

Dry Stack Tailings Storage Facility	DSP-10	6945223	385944	724.509	DSP-10	VW34617	717.209	2015-11-27	Quarterly
Southwest Waste Dump	SDP-2	6944595.06	383971.30	843.41	SDP-2A	VW12912	843.414	2010-01-31	Quarterly
					SDP-2B	VW12911	842.714		
Southwest Waste Dump	SDP-3	6944333.87	383824.67	854.27	SDP-3A	VW12906	854.266	2010-01-28	Quarterly
					SDP-3B	VW12907	853.566		
Southwest Waste Dump	SDP-4	6944163.62	383783.54	858.49	SDP-4A	VW12908	858.494	2010-01-30	Quarterly
					SDP-4B	VW12909	857.794		
Water Storage Pond	WDP-2	6945632	386545	701.67	WDP-2	VW7212	701.67	2007-11-04	Monthly
Water Storage Pond	WDP-3A	6945618	386498	712.62	WDP-3A	VW7557	712.62	2007-11-28	Monthly
Water Storage Pond	WDP-3	6945609	386500	712.60	WDP-3	VW7202	712.60	2007-11-12	Monthly
Water Storage Pond	WDP-4	6945609	386500	702.60	WD -4	VW7210	702.60	2007-11-14	Monthly
Water Storage Pond	WDP-5	6945605	386526	712.35	WDP-5	VW7204	712.35	2007-11-20	Monthly
Water Storage Pond	WDP-6	6945605	386526	701.50	WDP-6	VW7214	701.50	2007-11-20	Monthly
Water Storage Pond	WDP-7	6945605	386526	689.20	WDP-7	VW7208	689.20	2007-11-20	Monthly
Water Storage Pond	WDP-8	6945554	386542	693.10	WDP-8	VW7200	693.10	2007-11-18	Monthly
Water Storage Pond	WDP-9	6945554	386542	687.93	WDP-9	VW7206	687.93	2007-11-18	Monthly
Water Storage Pond	WDP-10	6945554	386542	676.17	WDP-10	VW7211	676.17	2007-11-18	Monthly
Water Storage Pond	WDP-11	6945523	386551	712.96	WDP-11	VW7201	712.96	2007-11-16	Monthly
Water Storage Pond	WDP-12	6945523	386551	694.64	WDP-12	VW7209	694.64	2007-11-16	Monthly
Water Storage Pond	WDP-13	6945533	386578	684.55	WDP-13	VW7205	684.55	2007-11-07	Monthly

7 Instrumentation Procedures and Documentation

Data collection manuals for all monitoring devices are included in Appendix B.

After collection, data is input into a series of spreadsheets and databases used for storing, tracking and interpreting instrumentation data. Instructions for data input are contained in the instrumentation manuals in Appendix B.

8 Quality Assurance/Quality Control

Planned job observations (PJO's) are routinely performed and documented on Environmental Monitors to verify data collection is consistent with the designed procedures.

Data collection equipment is returned to the manufacturers as per their recommended calibration schedules.

All data is reviewed and summarized by a Geotechnical Engineer monthly as part of the Water Licence reporting.

9 Reporting

Regular processing and review of monitoring data is completed and presented in the following documents.

Table 9: Reporting

Report	Frequency	Submission
Minto Mine Type A Water Licence QZ14-031 Monthly Report (Clause 4.4)	Monthly	Submitted to Yukon Water Board maximum 30 days following each month
DSTSF Inspection Reports	Quarterly	Filed internally within one week of the inspection
Water Storage Pond Dam Inspection Reports	Monthly	Filed internally within one week of the inspection
Area 2 and Main Pit Tailings Storage Facility Inspection Reports	Quarterly	Filed internally within one month of the inspection
Semi-Annual Site-wide Geotechnical Inspection Report	After spring melt (May/June) and before freeze-up (September)	Submitted to Yukon Water Board within 60 days of inspection.
Minto Mine Type A Water Licence QZ14-031 Annual Report (Clause 4.5)	Annually	Submitted to Yukon Water Board by March 31 each year
Minto Mine Type B Water Licence MS15-094 Annual Inspection Report (Clause 34)	Annually	Submitted to Yukon Water Board with the Annual Report

Appendix A: Instrumentation Map

384000 385000 386000 387000

6945000

6944000

MDI-2 M84 M80 M83 M82 M88 M79 M91 M94 M81 M93 M92 A217 A216 A218 M89 M86 M76 A215 SDT-1 SWD-01 SWD-06 SWD-07 SDT-2 SDP-2A SDP-2B SWD-08 SWD-11 SDP-3B SDT-3 SDP-3A SDI-3 SDP-4A SDT-4 SDP-4B SWD-09 SWD-10 A210 A219 13-A2I-1 13-A2T-1 ASH06 ASH05 DSP-10 MV1 DSI-22 MV2 DSSH-29 DSSH-19 DSSH-18 DSSH-20 DSSH-28 13-DST-15 DSP-08 DSSH-31 13-DST-13 DSP-07 DSSH-6 DSSH-15 DSSH-12 DSSH-14 13-DST-11 13-DSP-6 DSSH-10 DSSH-32 DSI-24 13-DSP-5 13-DST-14 DSSH-24 DSSH-27 DSSH-26 13-DST-10 WSP1 WDP-2 WDP-5 WDP-6 WDP-7 WDP-3 WDP-4 WSP3 WDT-8 WDP-8 WDP-9 WDP-10 WDT-3 WDT-4 WSP4 WDT-2 WDP-13 WDT-1 WDP-11 WDP-12 WDT-5 WDT-6 WDT-7 WSP5

DESIGNED BY: DH	DATE PLOTTED: 15-Nov-2017	Monitoring Instrumentation 2017	LEGEND	capstone MINTO MINE
CHECKED BY:	SCALE:	Comments:	SURVEY HUBS, THERMISTORS, PIEZOMETERS, INCLINOMETERS	

Appendix B: Data Collection and Input Manuals

Inclinometer Measurements

Please refer to RST MEMS Digital Inclinometer System Instruction Manual for complete instruction.

System Overview:



Figure 1 – System Overview

1. Soft Shell Case
2. Digital Inclinometer Probe (w/ protective end cap)
3. Reel Battery Charger
4. 70mm/2.75" OD Cable Grip
5. 85mm/3.34" OD Cable Grip
6. Ultra-Rugged Field PC
7. 12V DC car adapter for Reel Battery Charger or Ultra-Rugged Field PC
8. Spare Reel Battery
9. Silicone Lubricant (for use on connectors)
10. USB Cable for Ultra-Rugged Field PC
11. AC Adapter (110-240V) for Reel Battery Charger
12. AC Adapter (110-240V) for Ultra-Rugged Field PC
13. Cable Reel with Wireless Communication System and protective end cap
14. Reel Carrying Case

1. Make sure the battery for the reel and the Field PC are charged.
2. Lift up protective box with two hands and put it on side as a work bench.



3. Remove cap from inclinometer casing and look for A_0 marking (black mark).





4. Remove excess water inside the probe and the cable connector.
   Probe is very sensitive and susceptible to vibration. **DO NOT BANG THE PROBE**. Use a paper towel to wipe it.

5. Apply silicon lubricant to probe and cable connector when needed.



6. Connect the inclinometer cable to the probe by aligning the keyways and threading the connector onto the probe. Turn the threaded ring, but not the cable.



7. Turn on the power of the reel. A green light indicates that the power is on. This energizes the accelerometers and makes them less susceptible to shock.



8. Check the depth of the hole. Turn on Field PC and select the hole you are going to measure.



9. Always start with **UPPER** Wheel in the A_0 direction.



10. Lower the probe gently and carefully. When it gets close to the bottom lower it very gently to avoid bouncing the probe off the bottom of the hole. The cable has aluminum sleeve marks which are spaced at 0.5m and it has a red measure mark with label every 5m.



11. Lower the probe gently to ensure the bottom of the hole is encountered. (Slightly passed the designated depth). Double check your correct depth by pulling out reel to the next 5m mark and counting back each 0.5m for each increment.

12. Place the cable grip on top of the casing and hang the cable by the aluminum crimps.



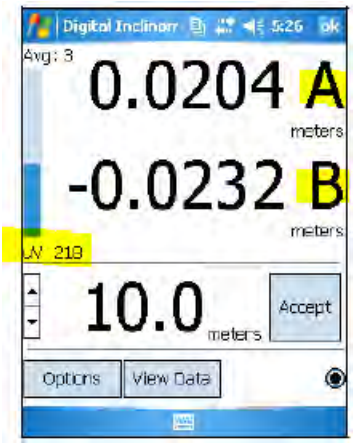
13. Connect the Field PC to the reel. Use the pen attached to the field PC and press "*Connections".*



14. Once connected, hit "*Readings*".




15. At each depth allow the A and B readings as well as the noise level become stabilized before you accept the readings. Ideally noise level should be at or below 30 μV.

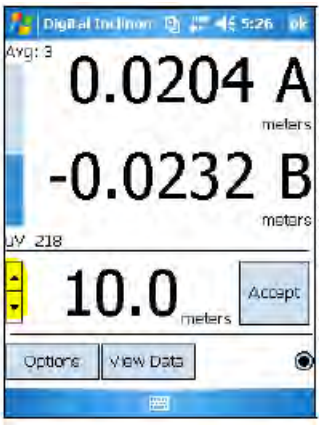


16. Wear gloves as the Envirobind inside the inclinometer casing can be sticky and irritable. Pull up gently to the next marker and let the aluminum crimp to sit on the metal grip. Wait for the readings and noise level to stabilize and then hit *"Accept"*.




17. If you accidentally pull the probe too far (more than an inch), lower the probe back down to the previous bead then pull up to the bead you want to measure. This will ensure that the readings remain consistent.

18. At each 5m mark, check that you are at the right location. If you miss or overpass a reading, go back to the previous 5m depth. For examples, if something goes wrong at 41.5m, go back to 45m and drop the cable to 45.5m. Then gently pull up to 45m and hit *"Accept"* again. There are arrow keys on the Field PC which allow you to adjust your depth.



19. Once the last reading (0.5m) is taken, gently take out the probe and turn it 180° so that the **Lower** wheel is now in the A_0 direction.



20. Go back gently to the bottom of hole and take the second set of readings.

21. During the measurement of the second set of readings, checksum data will appear in a smaller font below the current readings. Checksum should be reasonably small and consistent. Ideally it should be somewhere between -0.0035m to +0.0045m.

22. If the checksum is large (> 0.01m) and inconsistent, check the following:
    - Is the probe at the right depth?
    - Is the probe in the correct direction?
    - Lower the probe to the previous depth and retake the reading again.

    It is possible that checksum is high due to differential pressure in the ground. In that case continue measurement and keep monitoring checksum.

23. Once readings are completed, take out the probe and wipe away the Envirobind gently. Put the caps back onto the probe and connector.



Data Input

Note: Windows Mobile Device Center must be installed on the computer in order to collect the readout unit to the computer.



1. Connect the USB cable from the readout unit to the computer and turn the power on.
2. Open DMM for Windows



3. *File – Open – Project Database*
   The database for all inclinometer data is stored here:
   X:\Mine Technical\03 - Monitoring\! Inclinometers\Master Database

4. *File – Import – Import RPP file*
   Navigate to the mobile device and select the .rpp file for the appropriate monitoring station and date. The data will then import and save in the database automatically.

Thermistor Readings

Two different types of thermistors are currently installed on site – RST and EBA thermistors.

To read RST thermistors:

1. Connect adapter cord to the TH2016B Readout Box.
2. Record the resistivity (Ohms) for each thermistor node on paper or store the data in the readout box with the following steps:
    a. Scroll with the Up/Down arrows to the ***Memory*** screen and press enter (arrow key)



    b. Scroll with the Up/Down arrows to the ***Store Data*** screen and press enter



    c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading



    d. The data is now stored and the readbox can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.



To read EBA thermistors:

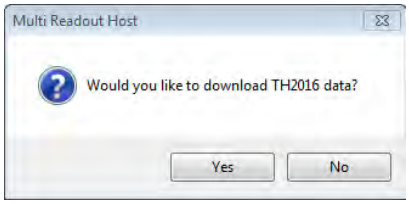
1. Connect the EBA 16 Point Ground Temperature Dial into the thermistor cable.
2. Connect the multi-meter to the EBA 16 Point Ground Temperature Dial.
3. Record on paper the resistance in Ohm's (Ω) for each point.

Data Downloading

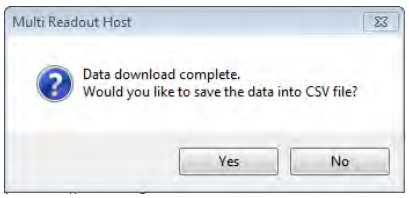
1. Connect USB cord from computer to the readout box.
2. Open the software Multi Readout Host.



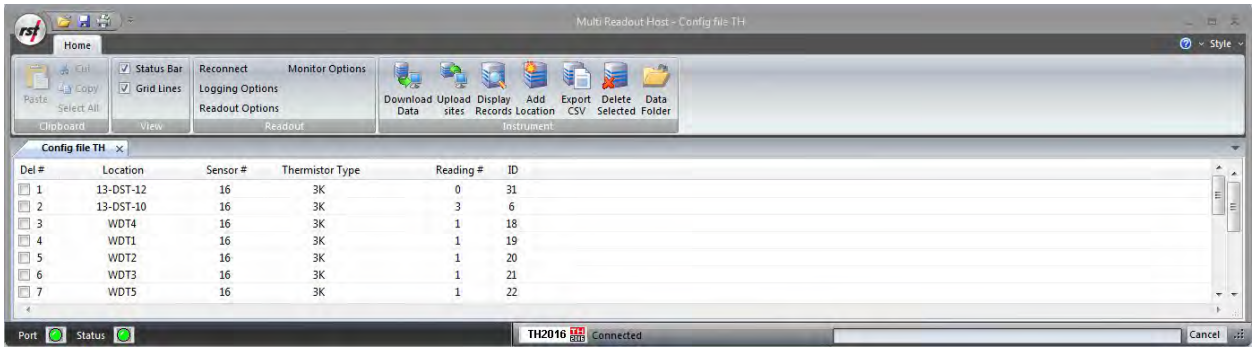
3. Turn on the power on the readout box.
4. The software will recognize the readout unit and prompt to download data. Choose “Yes” to download the data from the readout unit.



5. Once data is downloaded you will have the option to save all data as .csv file. Choose “Yes” and the data will be stored in My Documents in a folder named “TH2016data”.



6. The software can be used to setup new locations or view data but no further steps are required.

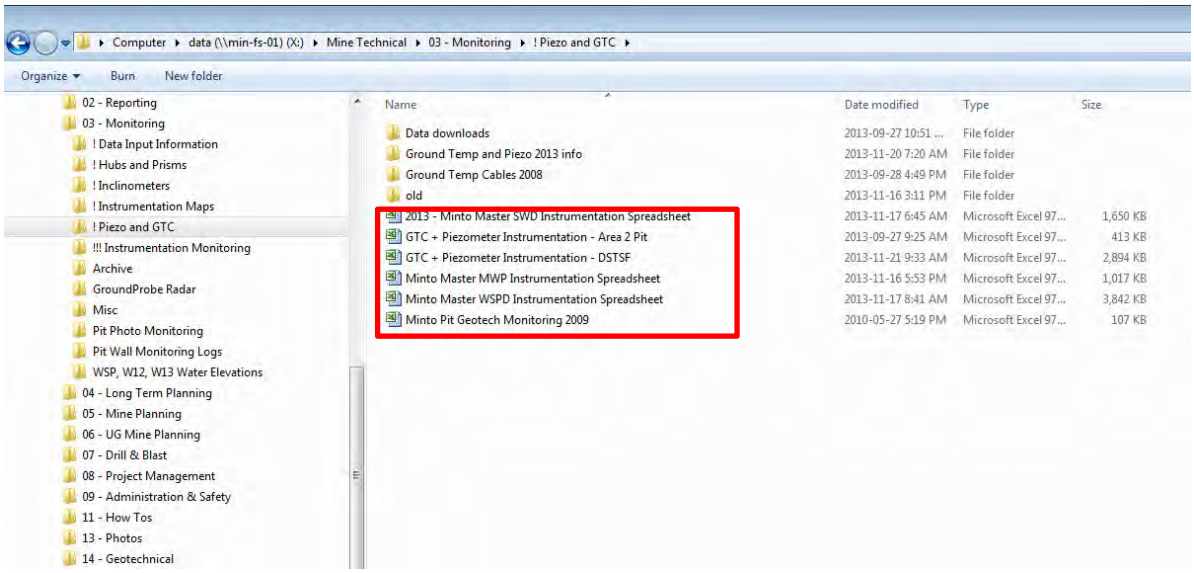


Data Input

Spreadsheets for piezometer data input and tracking are stored here:

X:\Mine Technical\03 - Monitoring\! Piezo and GTC

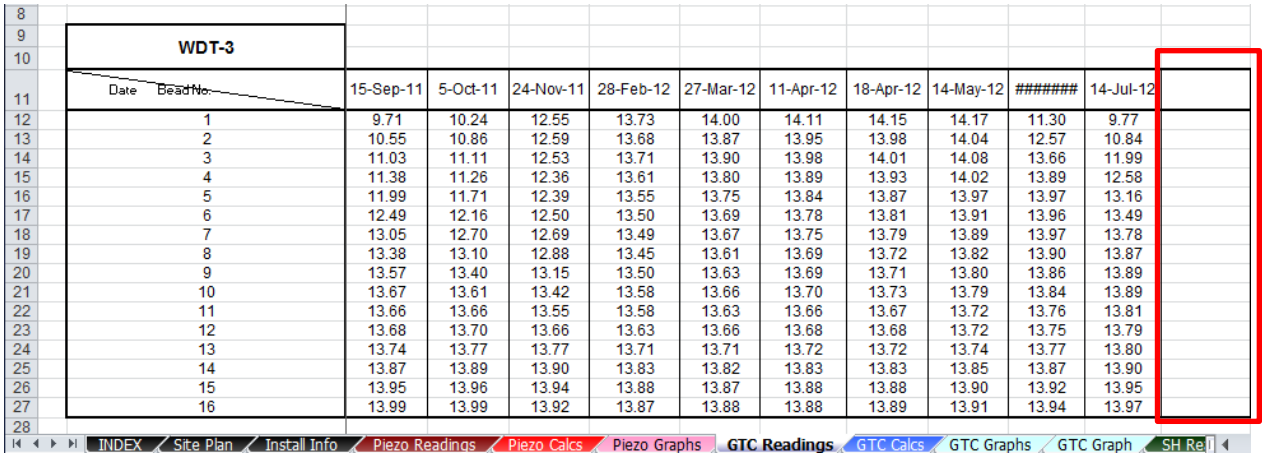
1. Open the spreadsheet for the area monitored



2. Open the tab “GTC Readings”



3. In a new column enter the date and copy the resistivity data (Ohms) from the paper records, or from the .csv file saved in either “TH2016data” or “VW2016data” saved in My Documents.



WDT-3											
Date / Bead No.	15-Sep-11	5-Oct-11	24-Nov-11	28-Feb-12	27-Mar-12	11-Apr-12	18-Apr-12	14-May-12	#######	14-Jul-12	
1	9.71	10.24	12.55	13.73	14.00	14.11	14.15	14.17	11.30	9.77	
2	10.55	10.86	12.59	13.68	13.87	13.95	13.98	14.04	12.57	10.84	
3	11.03	11.11	12.53	13.71	13.90	13.98	14.01	14.08	13.66	11.99	
4	11.38	11.26	12.36	13.61	13.80	13.89	13.93	14.02	13.89	12.58	
5	11.99	11.71	12.39	13.55	13.75	13.84	13.87	13.97	13.97	13.16	
6	12.49	12.16	12.50	13.50	13.69	13.78	13.81	13.91	13.96	13.49	
7	13.05	12.70	12.69	13.49	13.67	13.75	13.79	13.89	13.97	13.78	
8	13.38	13.10	12.88	13.45	13.61	13.69	13.72	13.82	13.90	13.87	
9	13.57	13.40	13.15	13.50	13.63	13.69	13.71	13.80	13.86	13.89	
10	13.67	13.61	13.42	13.58	13.66	13.70	13.73	13.79	13.84	13.89	
11	13.66	13.66	13.55	13.58	13.63	13.66	13.67	13.72	13.76	13.81	
12	13.68	13.70	13.66	13.63	13.66	13.68	13.68	13.72	13.75	13.79	
13	13.74	13.77	13.77	13.71	13.71	13.72	13.72	13.74	13.77	13.80	
14	13.87	13.89	13.90	13.83	13.82	13.83	13.83	13.85	13.87	13.90	
15	13.95	13.96	13.94	13.88	13.87	13.88	13.88	13.90	13.92	13.95	
16	13.99	13.99	13.92	13.87	13.88	13.88	13.89	13.91	13.94	13.97	

INDEX | Site Plan | Install Info | Piezo Readings | Piezo Calcs | Piezo Graphs | GTC Readings | GTC Calcs | GTC Graphs | GTC Graph | SH Re

Vibrating Wire Piezometer Readings

1. Connect adapter cord to the VW2106 Readout Box.
2. Connect the coloured wires to the correct wire clips on the extension cable. Make sure the wires do not touch each other.
3. Record the **DATE** and **TIME** as barometric pressure will be needed to calibrate the water level.
4. Record the measurement (between 7000B to 9000B) and the temperature (°C) for each piezometer. The piezometer ID should be labeled on the wire (eg. P5a and P5b).



5. Alternatively the data can be stored in the readout box:

    a. Scroll with the Up/Down arrows to the ***Memory*** screen and press enter (arrow key)



    b. Scroll with the Up/Down arrows to the ***Store Data*** screen and press enter



c. Scroll with the Up/Down arrows to the station being monitored and press enter to store the reading



d. The data is now stored and the readout box can be turned off by pressing the escape button (ESC) three times to get back to the main menu and scrolling to Power Off.

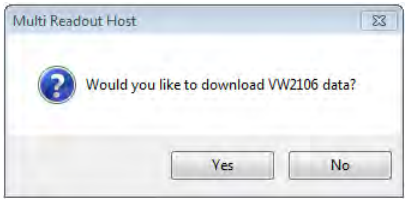


Data Downloading

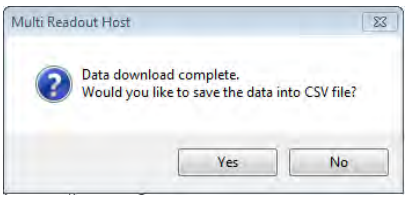
7. Connect USB cord from computer to the readout box.
8. Open the software Multi Readout Host.



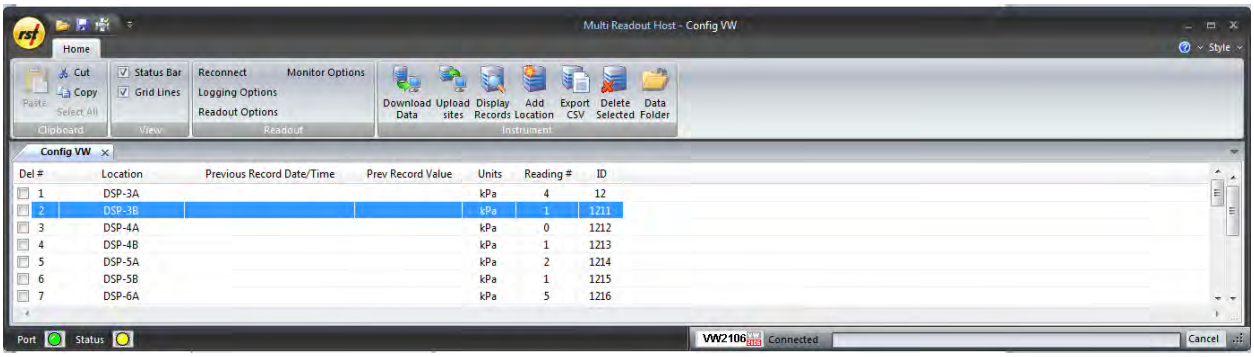
9. Turn on the power on the readout box.
10. The software will recognize the readout unit and prompt to download data. Choose “Yes” to download the data from the readout unit.



11. Once data is downloaded you will have the option to save all data as .csv file. Choose “Yes” and the data will be stored in My Documents in a folder named “VW2016data”.



12. The software can be used to setup new locations or view data but no further steps are required.

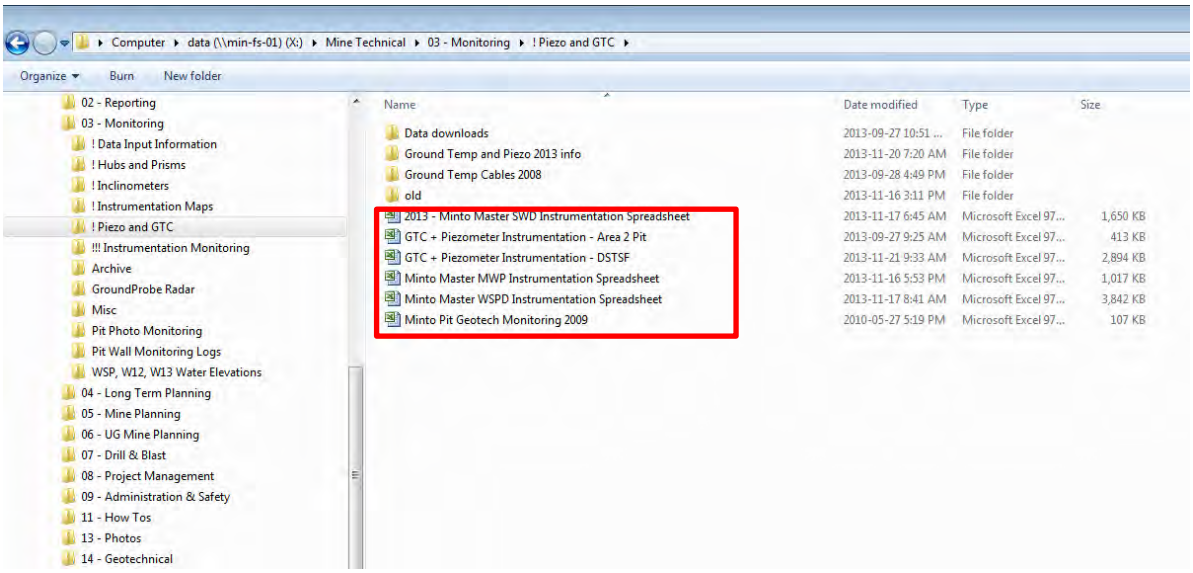


Data Input

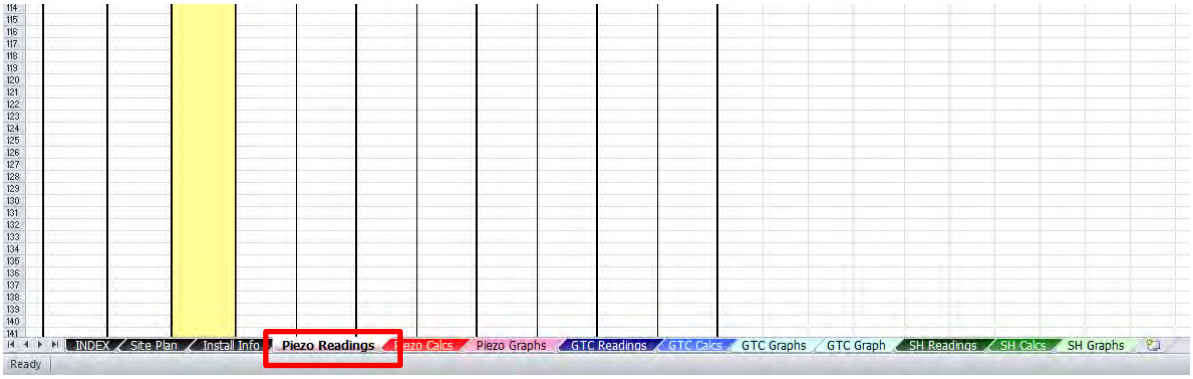
Spreadsheets for piezometer data input and tracking are stored here:

X:\Mine Technical\03 - Monitoring\! Piezo and GTC

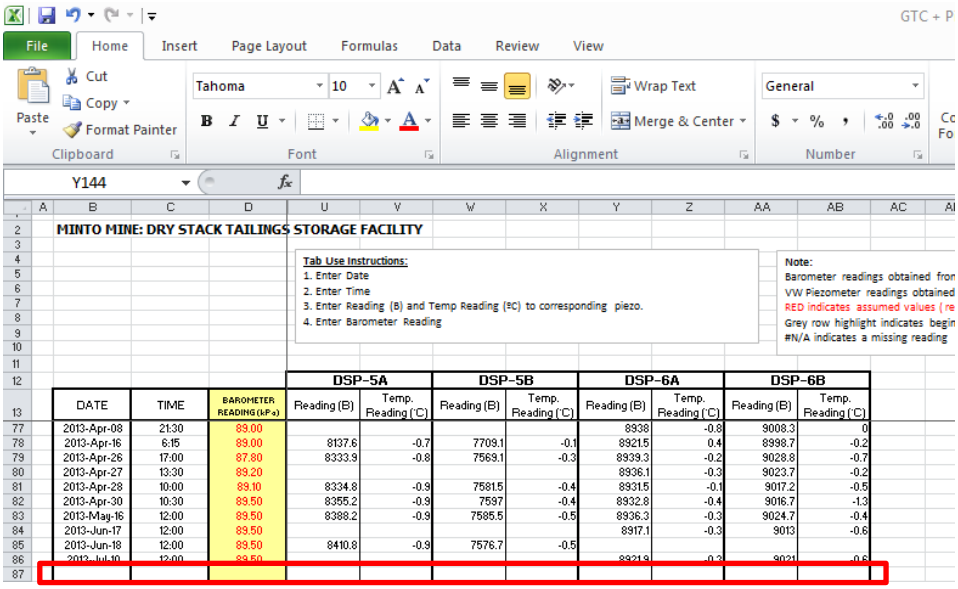
4. Open the spreadsheet for the area monitored



5. Open the tab “Piezo Readings”



6. In a new row, input the date, time, barometric pressure, B-unit and temperature readings for each instrument.



	DSP-5A		DSP-5B		DSP-6A		DSP-6B	
DATE	TIME	BAROMETER READING (kPa)	Reading (B)	Temp. Reading (˚C)	Reading (B)	Temp. Reading (˚C)	Reading (B)	Temp. Reading (˚C)	Reading (B)	Temp. Reading (˚C)
2013-Apr-08	21:30	89.00					8938	-0.8	9008.3	0
2013-Apr-16	6:15	89.00	8137.6	-0.7	7709.1	-0.1	8921.5	0.4	8998.7	-0.2
2013-Apr-26	17:00	87.80	8333.9	-0.8	7569.1	-0.3	8939.3	-0.2	9028.8	-0.7
2013-Apr-27	13:30	89.20					8936.1	-0.3	9023.7	-0.2
2013-Apr-28	10:00	89.10	8334.8	-0.9	7581.5	-0.4	8931.5	-0.1	9017.2	-0.5
2013-Apr-30	10:30	89.50	8355.2	-0.9	7597	-0.4	8932.8	-0.4	9016.7	-1.3
2013-May-16	12:00	89.50	8388.2	-0.9	7585.5	-0.5	8936.3	-0.3	9024.7	-0.4
2013-Jun-17	12:00	89.50					8917.1	-0.3	9013	-0.6
2013-Jun-18	12:00	89.50	8410.8	-0.9	7576.7	-0.5				
2013-Jul-10	12:00	89.50					8921.9	-0.3	9021	-0.6

Barometric pressure can be obtained from the site's weather monitoring stations. Data is stored here:

X:\Environmental\Environmental Monitoring Program\1_MASTER LOGS\Meteorology Station Data\Met Station 1 and 2 Data Summary.xlsx

Appendix I – 2019 AMP Surface Water Minnow Memos

minnow
environmental inc.
A Trinity Consultants Company
204-1006 Fort Street
Victoria, British Columbia
V8V 3K4
Tel: (250) 595-1627
Fax: (250) 595-1625

March 19, 2019

Ms. Deborah Flemming
Environmental Manager
Minto Mine
PO Box 11
Whitehorse Central PO
Whitehorse, Yukon
Y1A 2V3

Dear Ms. Flemming,

Re: Evaluation of Dissolved Copper and Selenium AMP Threshold Exceedances in McGinty Creek

DRAFT

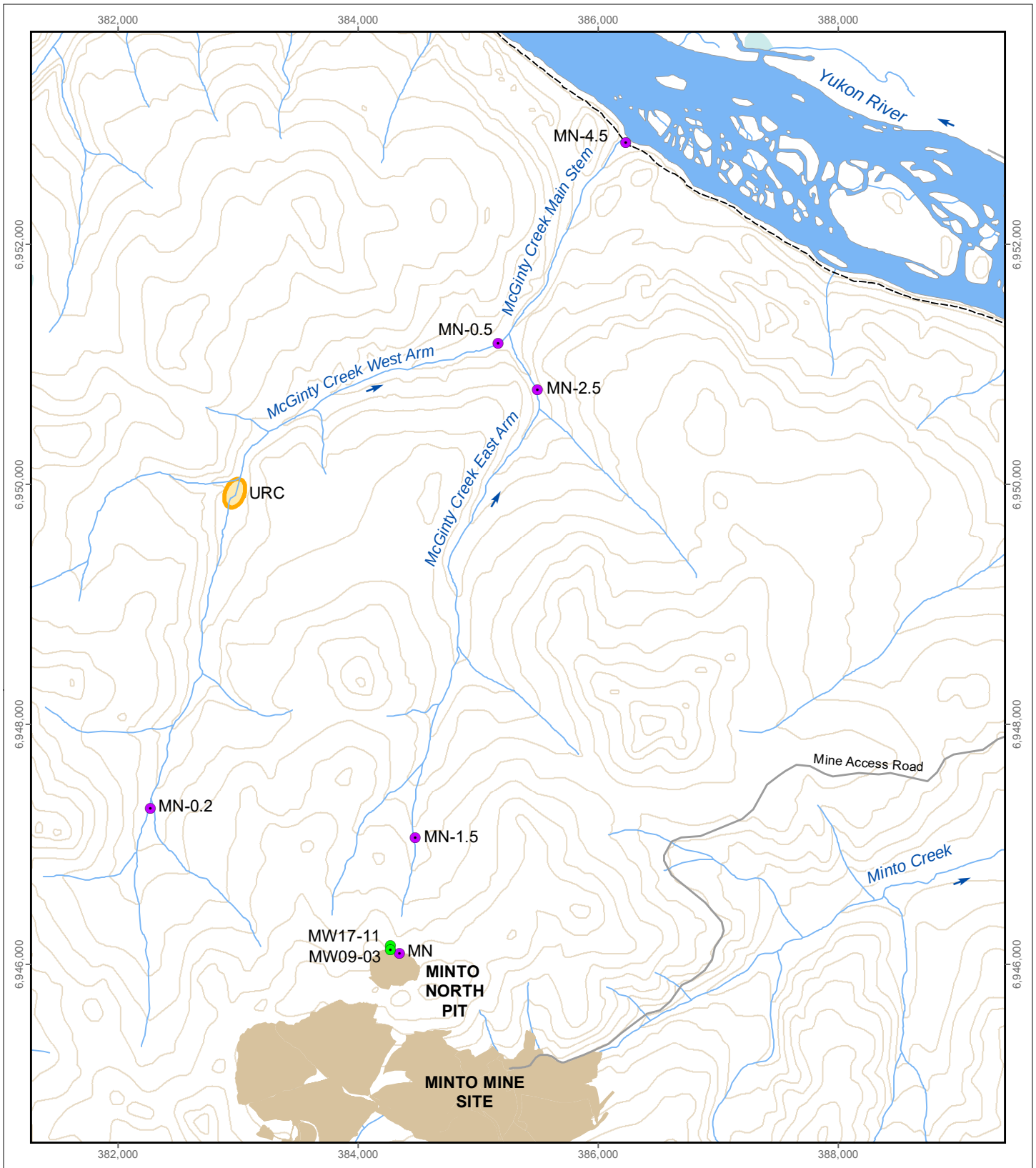
The Minto Mine (Minto) engaged Minnow Environmental Inc. (Minnow) as Qualified Professionals (QP) to evaluate exceedances of AMP thresholds for dissolved copper and selenium. These thresholds were described in Minto's Operations Adaptive Management Plan (AMP; Minto 2017). The exceedances occurred on October 13, 2018 at McGinty Creek Station MN-4.5 (Figure 1). As required under the AMP, this brief letter report determines if the exceedances were mine-related and whether the exceedances were likely to have affected aquatic resources.

Background

Exploration drilling within the McGinty Creek watershed began in 2009 around a single continuous zone of high-grade ore (Minto North Pit; Figure 1) located northeast of Minto's Main Waste Dump. Pit-stripping and road construction began in August 2015 following approval under Minto's Water Use Licence (WUL; QZ14-031). The Minto North Pit is located within the catchment of McGinty Creek's east arm, which travels 9.5 km to the Yukon River (Figure 1). Effluent was never directly released from the Minto North Pit to McGinty Creek. Operations in the Minto North Pit continued until October 1, 2016.

Yukon Government Energy, Mines, and Resources (EMR) approved Minto's AMP 2017-01 under the current Quartz Mining License (QML-0001). The Yukon Water Board approved the updated AMP (AMP 2017-02) under the current Water Use Licence (QZ41-031). This assessment is relative to the AMP 2017-02 specific thresholds.

As described in an evaluation of exceedances that occurred in November 2017 (Minnow 2018a), the AMP includes three Specific Thresholds (ST) and three Specific Performance Thresholds (SPT) for surface waters. Analytes that exceed a ST objective at MN-4.5 trigger a SPT. Each SPT is associated with response steps, including notification, review, evaluation, and actions. Two consecutive samples exceeding the ST-1 objective triggers SPT-1. Analytes exceeding ST-2 and/or ST-3 objectives will trigger SPT-2 (Figure 2) and two consecutive samples exceeding either ST-2 or ST-3 objectives will trigger SPT-3 (only if the first exceedance was confirmed to have been due to mine loading; Figure 2).



LEGEND

- Groundwater Station
- Water Quality Monitoring Station
- Minnow WUL Water and Sediment Quality Reference Area
- Mine Footprint

Water Quality Monitoring on McGinty Creek

0 0.75 1.5 3 km

Projection: North American Datum 1983 UTM Zone 8V

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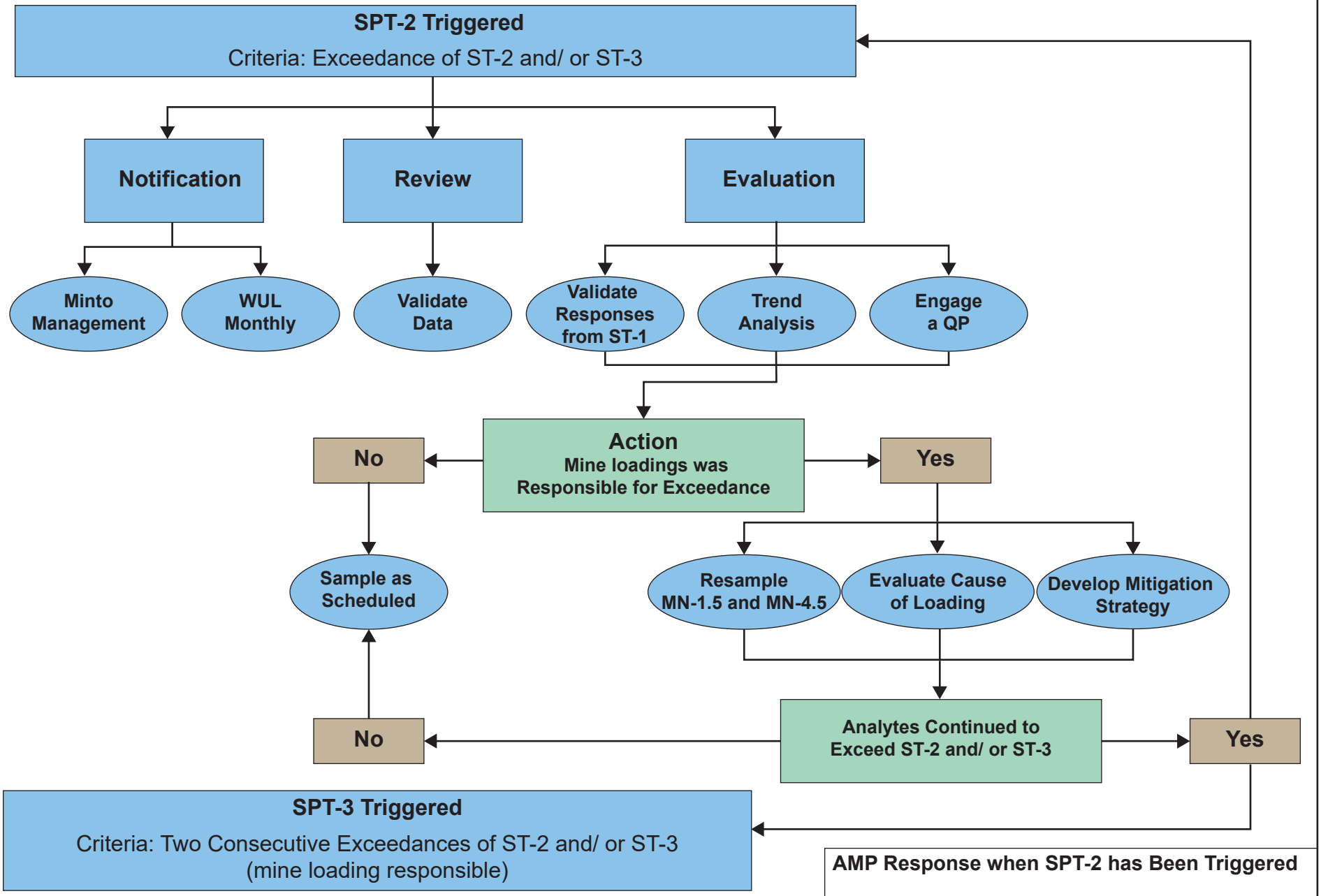
N W E S

Date March 2019
Project 177202.0047

minnow environmental inc.

Figure 1

Document Path: S:\Projects\177202\177202.0047 - Minto Mine Phase 7 Permitting\GIS\Memo - AMP Exceedance Trigger\17-47 Figure 1 McGinty Creek.mxd



AMP Response when SPT-2 has Been Triggered

Notes:
SPT - Specific Performance Threshold
ST - Specific Threshold
QP - Qualified Professional
WUL - Water Use Licence

Date: February 2019
Project 177202.0047

minnow environmental inc.

Figure 2

Document Path: S:\Projects\177202\177202.0047 - Minto Mine Phase 7 Permitting\Graphics\AMP Memo

Concentrations of nitrate and dissolved selenium previously exceeded ST-2 and/or ST-3 objectives at MN-4.5 on November 10, 2017 and dissolved selenium exceeded ST-3 objectives on May 26, 2018 (Minnow 2018a,b). Exceedances were determined to be unrelated to the mine as concentrations were higher than ST-2 objectives prior to the operation of the mine at MN-4.5 (dissolved selenium) and at other upstream locations (nitrate and dissolved selenium; Minnow 2018a,b). Concentrations of nitrate and dissolved selenium were well below applicable guidelines for the protection of aquatic life and effects to aquatic life were not expected (Minnow 2018a,b).

Methods

Water quality monitoring stations are located on the west and east arms of McGinty Creek (considered as "reference" and "exposed" arms, respectively) and near the mouth as it flows into the Yukon River (Figure 1). Review of historical and current conditions (2009 to 2018) included data from these stations as well as those from an additional monitoring area associated with the sediment, periphyton, and benthic invertebrate community monitoring that has been implemented annually since 2011 (URC; Figure 1; e.g., Minnow 2018c, 2019 in preparation).

Individual grab samples for dissolved copper and selenium were compared to the ST-2 objective (0.0035 and 0.00020 milligrams per litre [mg/L], respectively; Table 1). The 12-month rolling averages (average of the current sample and the previous 364 days of samples for dissolved copper and selenium were calculated and compared to the ST-3 objective (0.0028 and 0.00016 mg/L, respectively; Table 1). Dissolved copper and selenium were also compared to Minto Site Specific Water Quality Objectives (SSWQO) of 0.020 and 0.0020 mg/L, respectively. The dissolved copper SSWQO is based on a dissolved organic carbon (DOC) concentration greater than 10 mg/L. A lower SSWQO (0.013 mg/L) applies when DOC concentration is < 10 mg/L.

Statistical comparisons of monthly mean concentrations of dissolved copper and dissolved selenium were conducted to assess differences among time periods (before, during, and after operations) and between stations (exposed and reference arms of McGinty Creek). The statistical comparisons were conducted on the differences between monthly mean concentrations, calculated as log10[exposed] − log10[reference]. The differences in monthly means were used to remove the influence of seasonality. When calculating the differences, values reported as less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL (i.e., considered missing data because no estimate of the difference can be obtained).

Changes in the calculated differences through time were tested using a one-way ANOVA with factor *Period*. Subsequently, the difference between exposed and reference concentrations were tested using a one-sample t-test that tested if the mean differences were equal to zero (i.e., exposed and reference means are equal). If *Period* in the ANOVA model was significant ($\alpha = 0.05$), the one sample t-tests were conducted separately for each period.

When the differences in monthly mean concentrations between exposed and reference stations were significant ($\alpha = 0.05$) the magnitude of difference (MOD) was calculated as:

$$MOD = \frac{(10^{mean_{exposed}} - 10^{mean_{reference}})}{10^{mean_{reference}}} \times 100\%$$

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Table 1: Specific Thresholds for McGinty Creek, Station MN-4.5

Analytes	Units	Specific Threshold 1 (85th percentile)	Water Quality Objectives	
			Specific Threshold 2 Individual Data Point Evaluator (95th percentile)	Specific Threshold 3 Central Tendency Evaluator (95th percentile of annual medians)
Total Suspended Solids	mg/L	52	269	32
Ammonia	mg/L	0.040	0.12	0.046
Nitrite	mg/L	0.0060	0.050	0.0050
Nitrate	mg/L	0.20	0.23	0.083
Dissolved Aluminum	µg/L	49	135	47
Dissolved Arsenic	µg/L	0.55	0.61	0.54
Dissolved Cadmium	µg/L	0.026	0.041	0.015
Dissolved Chromium	µg/L	1.0	1.0	1.0
Dissolved Copper	µg/L	2.9	3.5	2.8
Dissolved Iron	µg/L	334	403	358
Dissolved Lead	µg/L	0.20	0.20	0.20
Dissolved Molybdenum	µg/L	1.0	1.0	1.0
Dissolved Nickel	µg/L	1.6	1.8	1.6
Dissolved Selenium	µg/L	0.17	0.20	0.16
Dissolved Silver	µg/L	0.020	0.020	0.020
Dissolved Zinc	µg/L	5.0	5.2	5.0

Note: Reproduced from Table 2-4 in the Operational AMP (Minto 2017).

where means are calculated in log10-transformed units using only data that were included in the statistical comparisons (i.e., when exposed and reference monthly means were both < LRL for the calculation of the difference between means, these values were excluded from the calculation of the mean values for each area).

Temporal comparisons were conducted on log10–transformed concentrations of dissolved copper and dissolved selenium at station MN-4.5 using a two-way ANOVA with factors Month and Period with interaction *Month* × *Period*. If *Period* was significant, statistical comparisons were conducted among all periods using a Tukey's honestly significant differences method. For significant comparisons the magnitude of difference was calculated as:

$$MOD = \frac{(10^{mean_{after}} - 10^{mean_{before}})}{10^{mean_{before}}} \times 100\%$$

where means are calculated in log10-transformed units. All statistical analyses were conducted using R statistical software (R Core Team 2017).

Results

Dissolved Copper

Dissolved copper exceeded the ST-2 objective at MN-4.5 (lower McGinty Creek) on October 13, 2018 (0.0051 mg/L; Table 2, Figure 3), triggering SPT-2. Concentrations of dissolved copper previously exceeded ST-2 objectives at MN-4.5 once in August 2015 (during operations) and once in each of 2009 and 2010 before operations began (Table 2, Figure 3). Exceedances occurred at MN-1.5 (exposed arm) numerous times before, during, and after operations at the Minto North Pit (Table 2, Figure 3). Prior to operations, dissolved copper at MN-2.5 (exposed arm) exceeded ST-2 objectives once in each of 2009 and 2010 and twice in 2011. Concentrations in the reference arm exceeded the ST-2 objective eight times at MN-0.2 and seven times at MN-0.5 before, during, and after Minto North Pit operations (Table 2, Figure 3). The calculated 12-month rolling average of dissolved copper did not exceed the ST-3 objective at MN-4.5 but did at both reference (MN-0.2 and MN-0.5) and exposed (MN-1.5) arms (Table 3, Figure 4).

Exceedances were unrelated to mine activities as dissolved copper exceeded ST-2 and ST-3 objectives before operations began at the Minto North Pit. Dissolved copper exceeded ST-2 and ST-3 objectives more consistently at MN-1.5 which is downgradient of the Minto North Pit. Dissolved copper concentrations at MN-1.5 were significantly greater than at MN-0.2 during all time periods (before, during, and after operations; Table 4). However, exceedances were unrelated to the mine since concentrations have always exceeded thresholds and were higher at MN-1.5 than MN-0.2 even before operations began. One incident of dissolved copper exceeding Minto's SSWQO at MN-0.5 (reference arm) occurred on July 7, 2017 (Table 2). Differences between the upstream arms disappeared further downstream as no significant differences between MN-2.5 and MN-0.5 were observed over any time period. (Table 4). Exceedances of Minto's SSWQO did not occur at MN-4.5 (Tables 2, 3, and 5), thus no effect to aquatic resources at MN-4.5 would be expected.

Dissolved Selenium

Dissolved selenium exceeded the ST-2 objective at MN-4.5 on October 13, 2018 (0.00021 mg/L; Table 6, Figure 5), triggering SPT-2. There have been previous exceedances at MN-4.5 but only once (September 21, 2015) during Minto North Pit operations (Table 6, Figure 5). Most of the dissolved selenium exceedances of ST-2 objectives occurred on the reference arm at MN-0.5

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Table 2: Dissolved Copper (mg/L) Grab Samples at Water Quality Stations on McGinty Creek, Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2009	3-May-09	-	0.0029	0.0079	0.0025	-
	3-May-09	-	-	-	-	-
	6-May-09	-	0.0031	0.0077	0.0028	0.0030
	6-May-09	-	-	-	-	-
	13-May-09	0.0043	0.0032	0.0087	0.0041	0.0036
	13-May-09	-	-	-	-	-
	21-May-09	-	0.0019	0.0065	0.0029	0.0025
	28-May-09	0.0036	0.0022	0.0062	0.0026	0.0026
	25-Jun-09	0.0027	0.0016	0.0058	0.0020	0.0020
	28-Jul-09	-	0.0012	0.0053	0.0016	0.0018
	29-Aug-09	-	0.0017	0.0055	0.0019	0.0017
	29-Sep-09	-	0.0014	0.0050	0.0014	0.0019
	23-Oct-09	-	0.00086	0.0035	0.0013	0.0012
	23-Oct-09	-	-	-	-	-
	27-Nov-09	-	0.00075	0.0032	0.0012	0.0018
	27-Nov-09	-	-	-	-	-
	15-Dec-09	-	0.0012	0.0030	0.0016	-
2010	25-Jan-10	-	0.0010	0.0082	0.0045	-
	25-Jan-10	-	-	-	-	-
	21-Apr-10	-	-	0.0078	-	-
	22-Apr-10	-	0.0040	-	0.0029	0.0047
	22-Apr-10	-	-	-	-	-
	28-May-10	-	0.0016	0.0045	0.0015	0.0011
	28-May-10	-	-	-	-	-
	28-Jun-10	-	0.0013	0.0061	0.0016	0.0017
	21-Jul-10	-	-	0.0064	0.0030	0.0024
	21-Jul-10	-	-	-	-	0.0024
	18-Aug-10	-	0.0032	0.0078	0.0031	0.0029
	18-Aug-10	-	-	-	-	0.0027
	15-Sep-10	-	0.0026	0.0064	0.0028	0.0023
	21-Oct-10	-	0.0018	0.0048	0.0019	0.0017
	21-Oct-10	-	-	-	-	0.0018
2011	11-Jan-11	-	-	-	0.0016	-
	11-Jan-11	-	-	-	0.0016	-
	29-Apr-11	0.0053	0.0027	0.0065	0.0019	0.0026
	29-Apr-11	-	-	-	0.0017	-
	19-May-11	0.0028	0.0026	0.0076	0.0041	0.0031
	28-Jun-11	0.0028	0.0038	0.0071	0.0027	0.0031
	28-Jun-11	0.0028	-	-	-	-
	15-Jul-11	0.0034	0.0039	0.0081	0.0046	0.0035
	15-Jul-11		0.0034	-	-	-
	10-Aug-11	0.0026	0.0027	0.0068	0.0030	0.0029
	10-Aug-11	-	-	0.0068	-	-
	28-Oct-11	0.0025	0.0013	0.0036	0.0015	0.0015
	28-Oct-11	-	-	-	-	0.0016
2012	19-Apr-12	0.0050	0.0029	0.0073	0.0018	0.0026
	24-May-12	0.0025	0.0018	0.0067	0.0025	0.0019
	14-Jun-12	0.0029	0.0025	0.0069	0.0026	0.0027
	12-Jul-12	0.0025	0.0018	0.0065	0.0021	0.0020
	6-Aug-12	0.0025	0.0016	0.0058	0.0017	0.0017
	6-Aug-12	-	-	-	0.0018	-
	7-Sep-12	0.0023	0.0023	0.0062	0.0028	0.0017
	7-Sep-12	-	0.0017	-	-	-
	1-Oct-12	0.0028	0.0026	0.0053	0.0019	0.0023
	1-Oct-12	-	0.0019	-	-	-
2013	27-May-13	0.0029	0.0018	0.0057	0.0026	0.0019
	27-May-13	-	0.0018	-	-	-
	17-Jun-13	0.0024	0.0015	0.0073	0.0019	0.0015
	17-Jun-13	-	-	-	0.0018	-
	15-Jul-13	0.0022	0.0017	0.0066	0.0016	-
	15-Jul-13		0.0013	-	-	-
	28-Aug-13	0.0020	0.0020	0.0067	0.0031	0.0022
	11-Sep-13	0.0019	0.0017	0.0058	0.0020	0.0018
	11-Sep-13	-	0.0018	-	-	-
	16-Oct-13	0.0018	0.0018	0.0051	0.0018	0.0019
2014	16-May-14	0.0025	0.0019	0.0071	0.0025	0.0022
	16-May-14	-	-	-	-	0.0022
	3-Jun-14	0.0030	0.0016	0.0065	0.0022	0.0020
	3-Jun-14	-	-	-	-	0.0019
	26-Jul-14	0.0023	0.0014	0.0077	0.0015	0.0016
	26-Jul-14	-	0.0014	-	-	-
	17-Aug-14	-	0.0013	0.0058	0.0013	0.0015
	20-Sep-14	0.0029	0.0012	0.0047	0.0014	0.0020
	20-Sep-14	-	0.0012	-	-	-
	10-Oct-14	-	0.0016	-	-	0.0015
	11-Oct-14	0.0019	-	0.0044	0.0015	-
	11-Oct-14	-	-	0.0044	-	-
	4-Dec-14	-	-	-	0.0017	-

Notes: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-2) for dissolved copper (0.0035 mg/L).

Shading indicates the value exceeded Minto Mine's Site Specific Water Quality Objective for dissolved copper (0.020 mg/L when DOC is > 10 mg/L).

Table 2: Dissolved Copper (mg/L) Grab Samples at Water Quality Stations on McGinty Creek, Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2015	2-Mar-15	-	0.00090	-	-	-
	2-Mar-15	-	0.00094	-	-	-
	26-May-15	-	0.00074	-	0.0016	0.0012
	26-May-15	-	0.00071	-	-	-
	30-May-15	0.0024	-	0.0055	-	-
	23-Jun-15	-	0.00072	-	0.0010	0.0012
	23-Jun-15	-	-	-	0.0011	-
	30-Jun-15	0.0020	-	0.0062	-	-
	13-Jul-15	0.0024	0.0019	0.0069	0.0017	0.0017
	29-Aug-15	-	-	0.0096	-	-
	29-Aug-15	-	-	0.0094	-	-
	30-Aug-15	-	0.0040	-	0.0034	0.0038
	31-Aug-15	0.0032	-	-	-	-
	20-Sep-15	-	0.0015	0.0061	0.0019	0.0018
	21-Sep-15	0.0019	-	-	-	-
	18-Oct-15	-	0.0016	-	0.0016	0.0014
	18-Oct-15	-	0.0014	-	-	-
	19-Oct-15	0.0017		0.0047	-	-
	26-Nov-15		0.0044	-	0.00071	-
	6-Dec-15	0.0020	-	-	-	-
	19-Dec-15	-	-	-	0.0021	-
2016	29-Apr-16	-	0.0021	-	0.0035	0.0024
	30-Apr-16	0.0045	-	0.0098	-	-
	30-Apr-16	0.0045	-	-	-	-
	26-May-16	0.0024	-	-	-	-
	28-May-16	-	0.0014	-	0.0018	0.0015
	29-May-16	-	-	0.0056	-	-
	20-Jun-16	0.0021	-	-	-	-
	21-Jun-16	-	0.0015	0.0048	0.0018	0.0018
	21-Jun-16	-	0.0017	-	-	-
	4-Jul-16	-	0.0012	0.0032	0.0012	0.0015
	4-Jul-16	-	-	0.0033	-	-
	30-Jul-16	0.0028	-	-	-	-
	4-Aug-16	-	0.0016	-	0.0015	0.0012
	4-Aug-16	-	-	-	-	0.0017
	7-Aug-16	-	-	0.0051	-	-
	15-Aug-16	0.0025	-	-	-	-
	3-Sep-16	-	0.0019	0.0052	0.0016	0.0019
	3-Sep-16	-	0.0016	-	-	-
	5-Sep-16	0.0026	-	-	-	-
	7-Oct-16	0.0014	-	-	-	-
	10-Oct-16	-	0.0012	-	0.0020	0.0018
	10-Nov-16	-	0.00084	-	-	0.0015
	12-Nov-16	-	-	-	0.0013	-
	2-Dec-16	-	0.0012	-	-	-
	2-Dec-16	-	0.0012	-	-	-
2017	26-May-17	-	0.0026	0.0092	0.0034	0.0033
	27-May-17	0.0047	-	-	-	-
	24-Jun-17	-	0.0020	0.0054	0.0022	0.0022
	24-Jun-17	-	0.0020	-	-	-
	25-Jun-17	0.0029	-	-	-	-
	6-Jul-17	0.0033	-	-	-	-
	7-Jul-17	-	0.026	0.0038	0.0017	0.0024
	7-Jul-17	-	-	0.0040	-	-
	16-Aug-17	0.0013	-	-	-	-
	19-Aug-17	-	-	0.0032	-	-
	19-Aug-17	-	-	0.0032	-	-
	21-Aug-17	-	0.0010	-	0.0012	0.0013
	16-Sep-17	-	0.0012	0.0041	0.0013	0.0013
	18-Sep-17	0.0015	-	-	-	-
	18-Sep-17	0.0015	-	-	-	-
	21-Oct-17	-	0.00095	0.0028	0.0012	0.0013
	22-Oct-17	0.0013	-	-	-	-
	22-Oct-17	0.0013	-	-	-	-
	10-Nov-17	-	0.0010	-	0.0017	0.0022
	10-Nov-17	-	-	-	0.0016	-
2018	30-Apr-18	0.0084	0.0037	-	0.0026	-
	30-Apr-18	-	-	-	0.0026	-
	26-May-18	0.0028	0.0011	0.0062	0.0023	0.0017
	26-May-18	0.0029	-	-	-	-
	11-Jun-18	0.0027	0.0019	-	0.0022	0.0017
	11-Jun-18	-	-	-	-	0.0019
	16-Jun-18	-	-	0.0052	-	-
	5-Jul-18	0.0027	-	0.0057	-	-
	5-Jul-18	0.0026	-	-	-	-
	6-Jul-18	-	0.0018	-	0.0016	0.0018
	29-Aug-18	-	0.0020	0.0059	0.0021	0.0020
	29-Aug-18	-	-	-	-	0.0020
	30-Aug-18	0.0025	-	-	-	-
	8-Sep-18	0.0020	0.0016	0.0047	0.0015	0.0016
	8-Sep-18	-	0.0016	-	-	-
	13-Oct-18	-	0.0022	0.0051	0.0014	0.0051
	13-Oct-18	-	-	-	0.0018	-

Notes: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-2) for dissolved copper (0.0035 mg/L).

Shading indicates the value exceeded Minto Mine's Site Specific Water Quality Objective for dissolved copper (0.020 mg/L when DOC is > 10 mg/L).

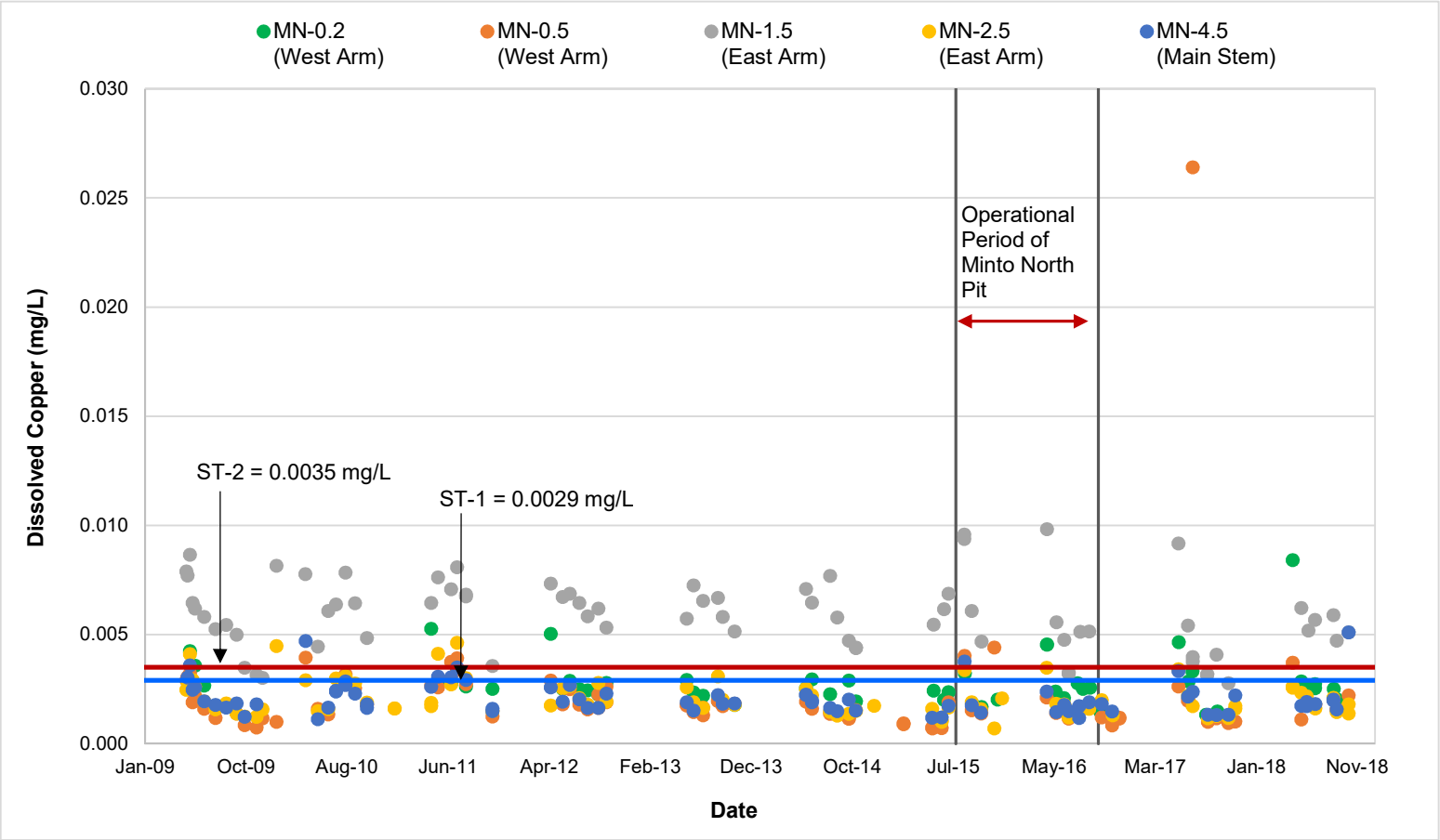


Figure 3: Dissolved Copper (mg/L) Water Quality Grab Samples on McGinty Creek, Minto Mine, 2009 to 2018

Notes: Unfilled circles are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

Table 3: Twelve Month Rolling Average of Dissolved Copper (mg/L) for Water Quality Stations on McGinty Creek, Minto Mine, 2016 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2010	25-Jan-10	0.0035	0.0018	0.0059	0.0023	0.0022
	25-Jan-10	0.0035	0.0018	0.0059	0.0023	0.0022
	21-Apr-10	0.0035	0.0018	0.0060	0.0023	0.0022
	22-Apr-10	0.0035	0.0019	0.0060	0.0024	0.0024
	22-Apr-10	0.0035	0.0019	0.0060	0.0024	0.0024
	28-May-10	0.0027	0.0015	0.0052	0.0020	0.0020
	28-May-10	0.0027	0.0015	0.0052	0.0020	0.0020
	28-Jun-10	-	0.0015	0.0052	0.0019	0.0020
	21-Jul-10	-	0.0015	0.0053	0.0020	0.0020
	21-Jul-10	-	0.0015	0.0053	0.0020	0.0021
	18-Aug-10	-	0.0017	0.0055	0.0022	0.0022
	18-Aug-10	-	0.0017	0.0055	0.0022	0.0022
	15-Sep-10	-	0.0018	0.0056	0.0022	0.0023
	21-Oct-10	-	0.0018	0.0056	0.0023	0.0023
	21-Oct-10	-	0.0018	0.0056	0.0023	0.0022
2011	11-Jan-11	-	0.0022	0.0065	0.0025	0.0024
	11-Jan-11	-	0.0022	0.0065	0.0024	0.0024
	29-Apr-11	0.0053	0.0022	0.0061	0.0021	0.0022
	29-Apr-11	0.0053	0.0022	0.0061	0.0021	0.0022
	19-May-11	0.0041	0.0022	0.0063	0.0023	0.0022
	28-Jun-11	0.0036	0.0028	0.0067	0.0024	0.0025
	28-Jun-11	0.0034	0.0028	0.0067	0.0024	0.0025
	15-Jul-11	0.0034	0.0029	0.0068	0.0026	0.0026
	15-Jul-11	0.0034	0.0030	0.0068	0.0026	0.0026
	10-Aug-11	0.0033	0.0030	0.0069	0.0026	0.0026
	10-Aug-11	0.0033	0.0030	0.0069	0.0026	0.0026
	28-Oct-11	0.0032	0.0029	0.0066	0.0025	0.0028
	28-Oct-11	0.0032	0.0029	0.0066	0.0025	0.0026
2012	19-Apr-12	0.0034	0.0029	0.0067	0.0027	0.0026
	24-May-12	0.0031	0.0028	0.0066	0.0027	0.0024
	14-Jun-12	0.0031	0.0028	0.0067	0.0027	0.0025
	12-Jul-12	0.0031	0.0025	0.0066	0.0026	0.0023
	06-Aug-12	0.0029	0.0021	0.0063	0.0022	0.0021
	06-Aug-12	0.0029	0.0021	0.0063	0.0021	0.0021
	07-Sep-12	0.0029	0.0020	0.0061	0.0021	0.0020
	07-Sep-12	0.0029	0.0020	0.0061	0.0021	0.0020
	01-Oct-12	0.0029	0.0020	0.0060	0.0021	0.0020
	01-Oct-12	0.0029	0.0020	0.0060	0.0021	0.0020
2013	27-May-13	0.0026	0.0020	0.0061	0.0022	0.0020
	27-May-13	0.0026	0.0020	0.0061	0.0022	0.0020
	17-Jun-13	0.0025	0.0019	0.0061	0.0021	0.0018
	17-Jun-13	0.0025	0.0019	0.0061	0.0021	0.0018
	15-Jul-13	0.0025	0.0019	0.0061	0.0020	0.0018
	15-Jul-13	0.0025	0.0018	0.0061	0.0020	0.0018
	28-Aug-13	0.0024	0.0018	0.0063	0.0023	0.0019
	11-Sep-13	0.0023	0.0018	0.0062	0.0021	0.0020
	11-Sep-13	0.0023	0.0018	0.0062	0.0021	0.0020
	16-Oct-13	0.0022	0.0017	0.0062	0.0021	0.0019
2014	16-May-14	0.0022	0.0017	0.0063	0.0022	0.0019
	16-May-14	0.0022	0.0017	0.0063	0.0022	0.0020
	03-Jun-14	0.0022	0.0017	0.0064	0.0021	0.0020
	03-Jun-14	0.0022	0.0017	0.0064	0.0021	0.0020
	26-Jul-14	0.0022	0.0018	0.0065	0.0022	0.0020
	26-Jul-14	0.0022	0.0017	0.0065	0.0022	0.0020
	17-Aug-14	0.0022	0.0017	0.0064	0.0021	0.0019
	20-Sep-14	0.0025	0.0015	0.0061	0.0018	0.0019
	20-Sep-14	0.0025	0.0015	0.0061	0.0018	0.0019
	10-Oct-14	0.0025	0.0015	0.0061	0.0018	0.0019
	11-Oct-14	0.0024	0.0015	0.0059	0.0017	0.0019
	11-Oct-14	0.0024	0.0015	0.0057	0.0017	0.0019
	04-Dec-14	0.0025	0.0014	0.0058	0.0017	0.0019
2015	02-Mar-15	0.0025	0.0014	0.0058	0.0017	0.0019
	02-Mar-15	0.0025	0.0013	0.0058	0.0017	0.0019
	26-May-15	0.0025	0.0012	0.0056	0.0016	0.0017
	26-May-15	0.0025	0.0012	0.0056	0.0016	0.0017
	30-May-15	0.0025	0.0012	0.0056	0.0016	0.0017
	23-Jun-15	0.0024	0.0011	0.0054	0.0014	0.0015
	23-Jun-15	0.0024	0.0011	0.0054	0.0014	0.0015
	30-Jun-15	0.0023	0.0011	0.0055	0.0014	0.0015
	13-Jul-15	0.0023	0.0012	0.0057	0.0014	0.0015
	29-Aug-15	0.0023	0.0011	0.0059	0.0014	0.0015
	29-Aug-15	0.0023	0.0011	0.0064	0.0014	0.0015
	30-Aug-15	0.0023	0.0014	0.0064	0.0017	0.0019
	31-Aug-15	0.0025	0.0014	0.0064	0.0017	0.0019
	20-Sep-15	0.0024	0.0014	0.0065	0.0017	0.0019
	21-Sep-15	0.0023	0.0014	0.0065	0.0017	0.0019
	18-Oct-15	0.0024	0.0014	0.0073	0.0017	0.0019
	18-Oct-15	0.0024	0.0014	0.0073	0.0017	0.0019
	19-Oct-15	0.0023	0.0014	0.0069	0.0017	0.0019
	26-Nov-15	0.0023	0.0017	0.0069	0.0016	0.0019
	06-Dec-15	0.0022	0.0017	0.0069	0.0016	0.0019
	19-Dec-15	0.0022	0.0017	0.0069	0.0017	0.0019

Notes: Values are a rolling average of the previous 12 months of data, see Table 2 for actual sample days for each station. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-3) for dissolved copper (0.0028 mg/L).

Shading indicates the value exceeded Minto Mine's Site Specific Water Quality Objective for dissolved copper (0.020 mg/L when DOC is > 10 mg/L).

Table 3: Twelve Month Rolling Average of Dissolved Copper (mg/L) for Water Quality Stations on McGinty Creek, Minto Mine, 2016 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2016	29-Apr-16	0.0022	0.0019	0.0069	0.0019	0.0019
	30-Apr-16	0.0025	0.0019	0.0073	0.0019	0.0019
	30-Apr-16	0.0027	0.0019	0.0073	0.0019	0.0019
	26-May-16	0.0027	0.0022	0.0073	0.0019	0.0021
	28-May-16	0.0027	0.0021	0.0073	0.0019	0.0020
	29-May-16	0.0027	0.0021	0.0071	0.0019	0.0020
	20-Jun-16	0.0027	0.0021	0.0073	0.0019	0.0020
	21-Jun-16	0.0027	0.0021	0.0070	0.0019	0.0019
	21-Jun-16	0.0027	0.0020	0.0070	0.0019	0.0019
	4-Jul-16	0.0027	0.0021	0.0067	0.0020	0.0020
	4-Jul-16	0.0027	0.0021	0.0063	0.0020	0.0020
	30-Jul-16	0.0028	0.0021	0.0063	0.0020	0.0020
	4-Aug-16	0.0028	0.0020	0.0063	0.0019	0.0019
	4-Aug-16	0.0028	0.0020	0.0063	0.0019	0.0019
	7-Aug-16	0.0028	0.0020	0.0061	0.0019	0.0019
	15-Aug-16	0.0028	0.0020	0.0061	0.0019	0.0019
	3-Sep-16	0.0027	0.0018	0.0053	0.0018	0.0017
	3-Sep-16	0.0027	0.0018	0.0053	0.0018	0.0017
	5-Sep-16	0.0027	0.0018	0.0053	0.0018	0.0017
	7-Oct-16	0.0027	0.0019	0.0052	0.0018	0.0017
	10-Oct-16	0.0027	0.0018	0.0052	0.0018	0.0017
	10-Nov-16	0.0028	0.0018	0.0053	0.0018	0.0017
	12-Nov-16	0.0028	0.0018	0.0053	0.0018	0.0017
	2-Dec-16	0.0028	0.0015	0.0053	0.0019	0.0017
	2-Dec-16	0.0028	0.0014	0.0053	0.0019	0.0017
2017	26-May-17	0.0023	0.0015	0.0052	0.0018	0.0018
	27-May-17	0.0027	0.0015	0.0052	0.0018	0.0018
	24-Jun-17	0.0028	0.0015	0.0052	0.0019	0.0019
	24-Jun-17	0.0028	0.0016	0.0052	0.0019	0.0019
	25-Jun-17	0.0028	0.0016	0.0052	0.0019	0.0019
	6-Jul-17	0.0029	0.0016	0.0062	0.0020	0.0019
	7-Jul-17	0.0029	0.0039	0.0057	0.0020	0.0020
	7-Jul-17	0.0029	0.0039	0.0054	0.0020	0.0020
	16-Aug-17	0.0027	0.0041	0.0055	0.0020	0.0022
	19-Aug-17	0.0027	0.0041	0.0051	0.0020	0.0022
	19-Aug-17	0.0027	0.0041	0.0048	0.0020	0.0022
	21-Aug-17	0.0027	0.0038	0.0048	0.0019	0.0021
	16-Sep-17	0.0027	0.0040	0.0047	0.0019	0.0020
	18-Sep-17	0.0025	0.0040	0.0047	0.0019	0.0020
	18-Sep-17	0.0024	0.0040	0.0047	0.0019	0.0020
	21-Oct-17	0.0025	0.0039	0.0044	0.0018	0.0019
	22-Oct-17	0.0023	0.0039	0.0044	0.0018	0.0019
	22-Oct-17	0.0022	0.0039	0.0044	0.0018	0.0019
	10-Nov-17	0.0022	0.0040	0.0044	0.0018	0.0020
	10-Nov-17	0.0022	0.0040	0.0044	0.0017	0.0020
2018	30-Apr-18	0.0029	0.0045	0.0044	0.0019	0.0020
	30-Apr-18	0.0029	0.0045	0.0044	0.0020	0.0020
	26-May-18	0.0029	0.0044	0.0041	0.0018	0.0018
	26-May-18	0.0029	0.0044	0.0041	0.0018	0.0018
	11-Jun-18	0.0027	0.0041	0.0041	0.0019	0.0018
	11-Jun-18	0.0027	0.0041	0.0041	0.0019	0.0018
	16-Jun-18	0.0027	0.0041	0.0042	0.0019	0.0018
	5-Jul-18	0.0027	0.0047	0.0042	0.0018	0.0017
	5-Jul-18	0.0027	0.0047	0.0042	0.0018	0.0017
	6-Jul-18	0.0026	0.0043	0.0042	0.0018	0.0018
	29-Aug-18	0.0028	0.0017	0.0050	0.0019	0.0018
	29-Aug-18	0.0028	0.0017	0.0050	0.0019	0.0018
	30-Aug-18	0.0027	0.0017	0.0050	0.0019	0.0018
	8-Sep-18	0.0027	0.0017	0.0049	0.0019	0.0018
	8-Sep-18	0.0027	0.0017	0.0049	0.0019	0.0018
	13-Oct-18	0.0029	0.0018	0.0051	0.0019	0.0021
	13-Oct-18	0.0029	0.0018	0.0051	0.0019	0.0021

Notes: Values are a rolling average of the previous 12 months of data, see Table 2 for actual sample days for each station. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-3) for dissolved copper (0.0028 mg/L).

Shading indicates the value exceeded Minto Mine's Site Specific Water Quality Objective for dissolved copper (0.020 mg/L when DOC is > 10 mg/L).

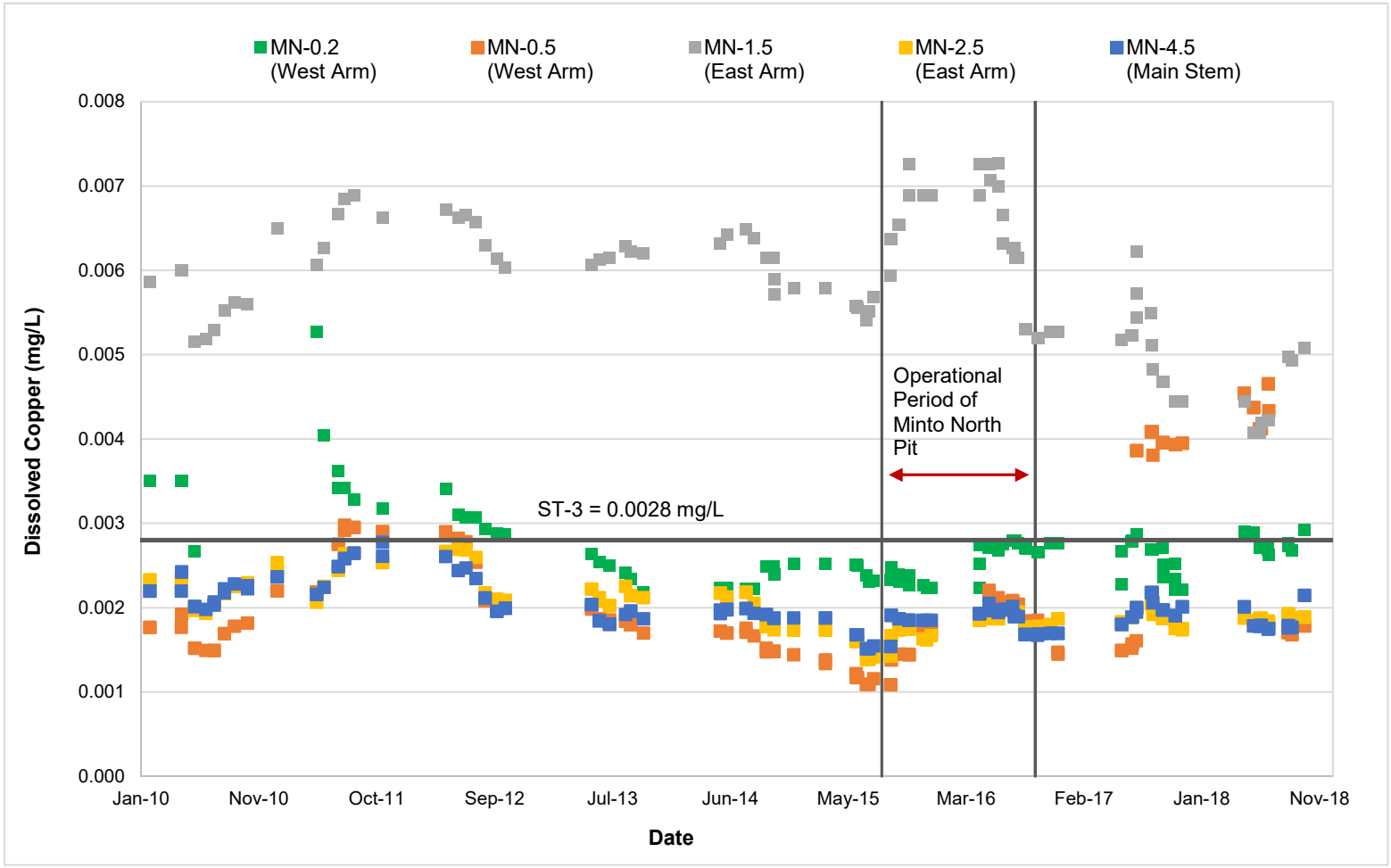


Figure 4: Dissolved Copper (mg/L) Twelve Month Rolling Average Water Quality Samples on McGinty Creek, Minto Mine, 2016 to 2018

Notes: See Table 2 for actual sampling days. West Arm = "reference" and East Arm = "exposed". Elevated concentrations of copper at MN-0.5 were influenced by a high concentration of copper on 7-Jul-17 and has leveraged the 12-month rolling average from 7-Jul-17 till 6-Jul-18.

Table 4: Statistical Comparisons for the Difference in Monthly Mean Concentrations of Water Quality Parameters Between McGinty Creek West and East Arms, Minto Mine

Comparison	Parameter	H_0: Does the Difference Between West and East Arms Vary Among Time Periods (Before, During, and After Mine Operations)?				H_1: Is There a Difference Between East and West Arms?		
		ANOVA Model [a]				Post-hoc T-Test [b]: P-value (MOD) [c]		
		Model Term	DF	F	P-value	Before	During	After
MN-1.5 (East Arm) ["exposed"] vs. MN-0.2 (West Arm) ["reference"]	Dissolved Copper	Period	2	1.07	0.353	<0.001 (128%)		
		Error	46	-				
	Dissolved Selenium	Period	2	11	<0.001	<0.001 (36%)	0.693 (-3.2%)	0.185 (-10%)
		Error	30	-				
MN-0.5 (East Arm) ["exposed"] vs. MN-2.5 (West Arm) ["reference"]	Dissolved Copper	Period	2	1.5	0.237	0.195 (8.4%)		
		Error	66	-				
	Dissolved Selenium	Period	2	2.6	0.081	<0.001 (-52%)		
		Error	65	-				

P-value < 0.05.

Positive magnitude of difference (MOD): significantly higher concentration of parameter at mine-exposed area relative to reference.

Negative magnitude of difference (MOD): significantly lower concentration of parameter at mine-exposed area relative to reference.

[a] One way Analysis of Variance (ANOVA) conducted on the relative differences between areas, calculated as $\log_{10}$(reference) − $\log_{10}$(exposed) with period. Values less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL. Only comparisons with more than three difference values for all time periods were included.

[b] Post-hoc analysis calculated as a one-sample t-test on the relative differences between areas [log10(exposed) − log10(reference)]. Conducted separately by period when there was a significant Period term in the ANOVA model.

[c] Magnitude of difference (MOD) calculated as: [10^($Mean_{exposed}$) − 10^($Mean_{reference}$)]/10^($Mean_{reference}$) × 100%, where Mean is the mean in log10-units.

[d] Sixteen values at the exposed site with a high LRL (<0.001) were excluded from the calculation of the MOD to avoid biasing the result.

Table 5: Dissolved Copper and Selenium (mg/L) Minnow Spot Samples on McGinty Creek, Minto Mine, 2011 to 2018 [a]

Date	Dissolved Copper	Dissolved Selenium
2011	0.0019	0.00020
2012	0.0015	0.00029
2013	0.0016	0.00025
2014	0.0013	0.00028
2015	0.0021	0.00022
2016	0.0013	0.00030
2017	0.00032	0.00086
2018	0.0014	0.00028

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

Shading indicates the value exceeded the Specific Threshold (ST-2) for dissolved copper (0.0035 mg/L) and dissolved selenium (0.00020 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved copper (0.020 mg/L when DOC is > 10 mg/L).

[a] Spot samples were collected during the annual Sediment, Periphyton, and Benthic Invertebrate Community Monitoring Programs, 2011 to 2018.

Table 6: Dissolved Selenium (mg/L) Grab Samples at Water Quality Stations on McGinty Creek, Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2009	3-May-09	-	0.000090	0.000060	0.000070	-
	6-May-09	-	0.000050	**0.000020**	0.000040	0.000060
	13-May-09	0.000050	0.00010	0.000060	0.000080	0.00010
	21-May-09	-	0.00014	0.000040	0.000080	0.00012
	28-May-09	0.000070	0.00013	0.000070	0.000070	0.00013
	25-Jun-09	0.000060	0.00019	0.000080	0.000080	0.00015
	28-Jul-09	-	0.00021	0.000070	0.000060	0.00016
	29-Aug-09	-	0.00018	0.000080	0.000080	0.00013
	29-Sep-09	-	0.00017	0.000070	0.000060	0.00013
	23-Oct-09	-	0.00023	0.000070	0.000080	0.00017
	27-Nov-09	-	0.00024	0.000060	0.000070	0.00020
	15-Dec-09	-	0.00023	0.000050	0.000060	-
2010	25-Jan-10	-	0.00040	0.00015	0.00038	-
	23-Feb-10	-	-	-	-	-
	22-Mar-10	-	-	-	-	-
	21-Apr-10	-	-	0.000070	-	-
	22-Apr-10	-	0.000090	-	0.000070	0.000090
	28-May-10	-	0.00021	0.000070	0.000070	0.00017
	28-Jun-10	-	0.00016	0.000070	0.000070	0.00014
	21-Jul-10	-	-	0.000080	0.000070	0.00015
	18-Aug-10	-	0.00018	0.000090	0.00010	0.00013
	15-Sep-10	-	0.00020	0.000090	0.00010	0.00013
	21-Oct-10	-	0.00018	0.000070	0.000070	0.00017
2011	11-Jan-11	-	-	-	0.000060	-
	29-Apr-11	0.000040	0.000090	0.000060	0.000060	0.000090
	19-May-11	0.000050	0.00010	0.000060	0.000080	0.00010
	28-Jun-11	0.000070	0.00017	0.000090	0.00011	0.00014
	15-Jul-11	0.000090	0.00014	0.000080	0.000090	0.00013
	10-Aug-11	0.000050	0.00014	0.000080	0.000080	0.00011
	28-Oct-11	0.000050	0.00022	0.000080	0.000090	0.00017
2012	19-Apr-12	**0.000020**	0.000099	0.000050	0.000060	0.000096
	24-May-12	0.000050	0.00017	0.00010	0.00013	0.00013
	14-Jun-12	0.000069	0.00013	0.000092	0.000094	0.00014
	12-Jul-12	0.000066	0.00020	0.000093	0.00010	0.00015
	6-Aug-12	0.000062	0.00022	0.000078	0.00013	0.00018
	7-Sep-12	**0.000050**	0.00024	**0.000050**	**0.000050**	0.00016
	1-Oct-12	**0.000050**	0.00017	**0.000050**	**0.000050**	0.00017
2013	27-May-13	**0.000050**	0.00013	**0.000050**	**0.000050**	**0.000050**
	17-Jun-13	**0.000050**	0.00016	**0.000050**	**0.000050**	0.00017
	15-Jul-13	**0.000050**	0.00021	**0.000050**	**0.000050**	-
	28-Aug-13	0.000066	0.00019	0.00013	0.000099	0.00013
	11-Sep-13	**0.000050**	0.00023	0.00012	0.00010	0.00016
	16-Oct-13	**0.000050**	0.00019	**0.000050**	**0.000050**	0.00013
2014	16-May-14	**0.000050**	0.00023	**0.000050**	0.00012	0.00017
	3-Jun-14	**0.000050**	0.00020	0.00011	**0.000050**	0.00020
	26-Jul-14	**0.000050**	0.00016	**0.000050**	**0.000050**	0.00014
	17-Aug-14	**-**	0.00018	**0.000050**	**0.000050**	0.00015
	18-Aug-14	-	-	**-**	**-**	-
	20-Sep-14	**0.000050**	0.00017	**0.000050**	**0.000050**	0.00012
	10-Oct-14	**-**	0.00017	**-**	**-**	0.00015
	11-Oct-14	**0.000050**	-	**0.000050**	**0.000050**	-
	4-Dec-14	**-**	-	**-**	-	-
	4-Dec-14	**-**	-	**-**	**0.000050**	-
	7-Dec-14	**-**	-	-	**-**	-
2015	02-Mar-15	-	0.00063	-	-	-
	02-Mar-15	-	0.00063	-	-	-
	26-May-15	-	0.00028	-	**0.000050**	0.00021
	26-May-15	-	0.00028	-	-	-
	30-May-15	**0.000050**	-	**0.000050**	-	-
	23-Jun-15	-	0.00021	-	**0.000050**	0.00017
	23-Jun-15	-	-	-	**0.000050**	-
	30-Jun-15	**0.000050**	-	**0.000050**	-	-
	13-Jul-15	**0.000050**	0.00015	**0.000050**	**0.000050**	0.00013
	29-Aug-15	-	-	**0.000050**	-	-
	29-Aug-15	-	-	**0.000050**	-	-
	30-Aug-15	-	**0.000050**	-	**0.000050**	0.00012
	31-Aug-15	0.00012	-	-	-	-
	20-Sep-15	-	0.00021	**0.000050**	**0.000050**	0.00023
	21-Sep-15	**0.000050**	-	-	-	-
	18-Oct-15	-	0.00017	-	**0.000050**	0.00015
	18-Oct-15	-	0.00015	-	-	-
	19-Oct-15	0.00010	-	**0.000050**	-	-
	26-Nov-15	-	**0.000050**	-	0.00019	-
	06-Dec-15	**0.000050**	-	-	-	-
	19-Dec-15	-	-	-	**0.000050**	-

Notes: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-2) for dissolved selenium (0.00020 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

Table 6: Dissolved Selenium (mg/L) Grab Samples at Water Quality Stations on McGinty Creek, Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2016	29-Apr-16	-	0.00018	-	0.000093	0.00012
	30-Apr-16	0.000081	-	0.00011	-	-
	30-Apr-16	0.000081	-	0.00011	-	-
	26-May-16	0.000082	-	-	-	-
	28-May-16	-	0.00025	-	0.000087	0.00014
	29-May-16	-	-	0.000078	-	-
	20-Jun-16	0.000093	-	-	-	-
	21-Jun-16	-	0.00018	0.000062	0.000083	0.00014
	21-Jun-16	-	0.00019	-	-	-
	04-Jul-16	-	0.00016	0.000078	0.000065	0.00016
	04-Jul-16	-	-	0.000079	-	-
	30-Jul-16	0.000090	-	-	-	-
	04-Aug-16	-	0.00019	-	0.000072	0.00015
	04-Aug-16	-	-	-	-	0.00015
	07-Aug-16	-	-	0.000098	-	-
	15-Aug-16	0.000095	-	-	-	-
	03-Sep-16	-	0.00017	0.00013	0.00011	0.00016
	03-Sep-16	-	0.00020	-	-	-
	05-Sep-16	0.00011	-	-	-	-
	07-Oct-16	0.000074	-	-	-	-
	10-Oct-16	-	0.00020	-	0.000083	0.00016
	10-Nov-16	-	0.00024	-	-	0.00021
	12-Nov-16	-	-	-	0.000056	-
	02-Dec-16	-	0.00027	-	-	-
	02-Dec-16	-	0.00026	-	-	-
2017	26-May-17	-	0.00015	0.00012	0.00010	0.00016
	27-May-17	0.000091	-	-	-	-
	24-Jun-17	-	0.000097	0.000078	0.000095	0.00020
	24-Jun-17	-	0.00025	-	-	-
	25-Jun-17	0.000096	-	-	-	-
	06-Jul-17	0.000092	-	-	-	-
	07-Jul-17	-	0.00019	0.000075	0.000080	0.00018
	07-Jul-17	-	-	0.000078	-	-
	16-Aug-17	0.000082	-	-	-	-
	19-Aug-17	-	-	0.000051	-	-
	19-Aug-17	-	-	0.000056	-	-
	21-Aug-17	-	0.00018	-	0.000065	0.00016
	16-Sep-17	-	0.00017	0.000064	0.000062	0.00013
	18-Sep-17	0.000062	-	-	-	-
	18-Sep-17	0.000068	-	-	-	-
	21-Oct-17	-	0.00023	0.000051	**0.000025**	0.00017
	22-Oct-17	**0.000025**	-	-	-	-
	22-Oct-17	0.000057	-	-	-	-
	10-Nov-17	-	0.00024	-	0.000078	0.00037
	10-Nov-17	-	-	-	0.000078	-
2018	30-Apr-18	0.000069	0.00017	-	0.00013	-
	30-Apr-18	-	-	-	0.000090	-
	26-May-18	0.000060	0.00020	0.000087	0.000076	0.00019
	26-May-18	0.000089	-	-	-	-
	11-Jun-18	0.00010	0.00017	-	0.000092	0.00016
	11-Jun-18	-	-	-	-	0.00020
	16-Jun-18	-	-	0.000064	-	-
	05-Jul-18	0.00010	-	0.000078	-	-
	05-Jul-18	0.000079	-	-	-	-
	06-Jul-18	-	0.00021	-	0.000083	0.00017
	29-Aug-18	-	0.00017	0.000063	0.000096	0.00012
	29-Aug-18	-	-	-	-	0.00016
	30-Aug-18	0.000080	-	-	-	-
	08-Sep-18	0.000078	0.00020	0.000091	0.000097	0.00015
	08-Sep-18	-	0.00016	-	-	-
	13-Oct-18	-	0.00019	0.000069	0.000067	0.00021
	13-Oct-18	-	-	-	0.000076	-

Notes: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-2) for dissolved selenium (0.00020 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

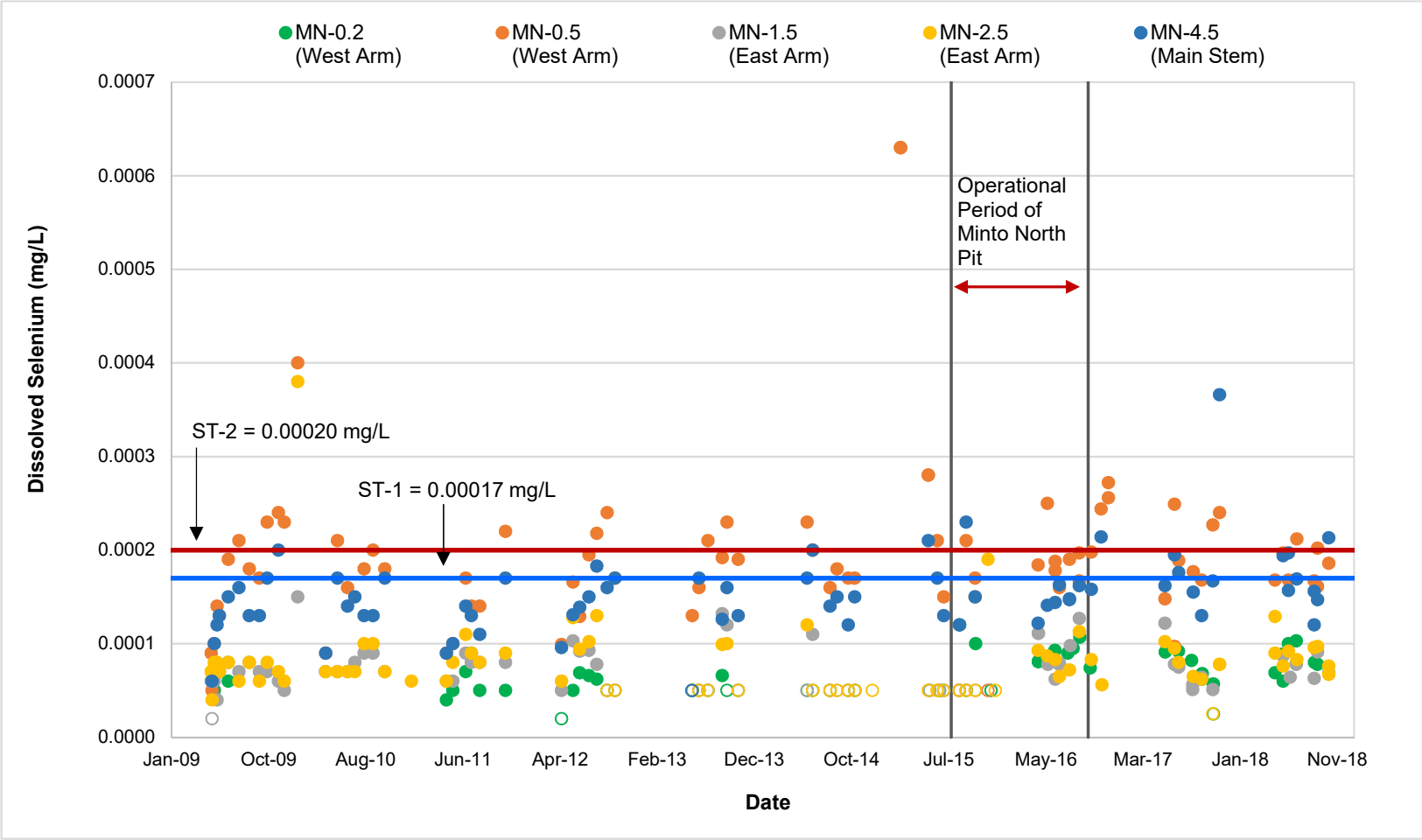


Figure 5: Dissolved Selenium (mg/L) Water Quality Grab Samples on McGinty Creek, Minto Mine, 2009 to 2018

Notes: Unfilled circles are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

(Table 6, Figure 5). Further upstream on the reference arm, dissolved selenium exceeded ST-2 objectives at URC from 2012 to 2018 (Table 5). The 12-month rolling average was calculated for dissolved selenium and exceedances of ST-3 were observed briefly in 2016, most of 2017, and all of 2018 at MN-4.5 (Table 7, Figure 6). Higher concentrations of dissolved selenium were observed at MN-0.5 (reference arm) and exceeded the ST-3 objective more often than at MN-4.5 (Table 7, Figure 6).

Dissolved selenium concentrations were compared among time periods (before, during, and after operations) for MN-4.5 and significant differences were only observed between before and after operations (MOD = 26%; Table 8). Significant differences were not observed between the operational period and either before or after operations; this as well as historical concentrations indicate that exceedances of dissolved selenium at MN-4.5 were unrelated to the mine. Concentrations of dissolved selenium in the east arm (exposed) were below the ST-2 objectives except once in 2010 at MN-2.5 (0.00038 mg/L; Table 6, Figure 5). Differences between MN-2.5 and MN-0.5 were similar over time (before, during, or after operations) and dissolved selenium was significantly lower at MN-2.5 compared to MN-0.2 (Table 4). Since concentrations of dissolved selenium were lower in the exposed arm, exceedances were unrelated to the mine. Further up the arms, dissolved selenium concentration at MN-1.5 was significantly higher than at MN-0.2 but only before operations (Table 4), indicating that higher concentrations of dissolved selenium were unrelated to the mine. Any potential mine-related influence on dissolved selenium would be on the east arm of McGinty Creek, as this area is downgradient of the Minto North Pit. Lastly, all concentrations of dissolved selenium were well below Minto's SSWQO of 0.0020 mg/L, thus no effect on the aquatic resources at MN-4.5 would be expected (Tables 5 to 7).

Conclusions and Recommendations

Dissolved copper and selenium exceeded the ST-2 and ST-3 objectives at MN-4.5, but the source was unrelated to the Minto Mine and consistent with historical concentrations before the Minto North Pit was operational. Dissolved copper and selenium were well below Minto's SSWQO, so effects to aquatic life would not be expected.

Three investigations show that dissolved selenium consistently triggers either the ST-2 or the ST-3 objective but that exceedances were unrelated to the mine. These consistent exceedances could be due to the appropriateness of using MN-4.5 as the station which thresholds are based on. Station MN-4.5 receives influence from a mix of the west and the east arms (Figure 1). Station MN-0.5 would be more appropriate to use as the basis for the thresholds as it is influenced by a greater proportion of the west arm (reference arm) and would serve as a good comparison to MN-2.5 which is influenced by most of the east arm (exposed arm; Figure 1). It is recommended that the development of Specific Thresholds using station MN-0.5 should be considered. Accordingly, draft thresholds were developed for MN-0.5 (for all analytes) using the same methodology as current thresholds (Table 9; Minto 2017) and based on all available data from 2009 to 2018. Data for MN-0.5 (Attachment Table A.1) was used to develop ST-1 (0.23 µg/L), ST-2 (0.26 µg/L), and ST-3 (0.21 µg/L) selenium thresholds (Table 9). Draft selenium thresholds were evaluated against raw data and 12-month rolling average calculations (Attachment Tables A.2 and A.3).

It is recommended that sampling continue as scheduled since the exceedance of dissolved copper and selenium were unrelated to the mine. It is recommended that Minto Mine seek approval to use the draft thresholds. Increased monitoring frequency is not required at this time.

DRAFT

Table 7: Twelve Month Rolling Average of Dissolved Selenium (mg/L) for Water Quality Stations on McGinty Creek, Minto Mine, 2016 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2010	25-Jan-10	0.000060	0.00018	0.000068	0.000093	0.00014
	23-Feb-10	0.000060	0.00018	0.000068	0.000093	0.00014
	22-Mar-10	0.000060	0.00018	0.000068	0.000093	0.00014
	21-Apr-10	0.000060	0.00018	0.000068	0.000093	0.00014
	22-Apr-10	0.000060	0.00018	0.000068	0.000091	0.00013
	28-May-10	0.000060	0.00022	0.000077	0.00010	0.00015
	28-Jun-10	-	0.00021	0.000076	0.00010	0.00015
	21-Jul-10	-	0.00021	0.000076	0.000097	0.00015
	18-Aug-10	-	0.00021	0.000078	0.00010	0.00015
	15-Sep-10	-	0.00021	0.000079	0.00010	0.00015
	21-Oct-10	-	0.00021	0.000079	0.00010	0.00015
2011	11-Jan-11	-	0.00020	0.000086	0.00011	0.00014
	29-Apr-11	0.000040	0.00017	0.000076	0.000075	0.00014
	19-May-11	0.000045	0.00016	0.000074	0.000076	0.00014
	28-Jun-11	0.000053	0.00015	0.000077	0.000081	0.00013
	15-Jul-11	0.000063	0.00015	0.000078	0.000082	0.00013
	10-Aug-11	0.000060	0.00015	0.000078	0.000083	0.00013
	28-Oct-11	0.000058	0.00014	0.000075	0.000081	0.00012
2012	19-Apr-12	0.000055	0.00014	0.000073	0.000085	0.00012
	24-May-12	0.000055	0.00016	0.000081	0.000093	0.00013
	14-Jun-12	0.000057	0.00015	0.000082	0.000093	0.00013
	12-Jul-12	0.000056	0.00016	0.000083	0.000092	0.00013
	06-Aug-12	0.000052	0.00017	0.000082	0.000098	0.00014
	07-Sep-12	0.000052	0.00018	0.000078	0.000093	0.00015
	01-Oct-12	0.000052	0.00018	0.000075	0.000088	0.00015
2013	27-May-13	0.000058	0.00018	0.000069	0.000079	0.00014
	17-Jun-13	0.000055	0.00019	0.000062	0.000072	0.00015
	15-Jul-13	0.000052	0.00019	0.000055	0.000063	0.00015
	28-Aug-13	0.000053	0.00018	0.000064	0.000058	0.00014
	11-Sep-13	0.000053	0.00018	0.000075	0.000067	0.00014
	16-Oct-13	0.000053	0.00019	0.000075	0.000067	0.00013
2014	16-May-14	0.000052	0.00012	0.00011	0.000097	0.00010
	03-Jun-14	0.000052	0.00013	0.00011	0.00010	0.00011
	26-Jul-14	0.000053	0.00013	0.00011	0.00010	0.00011
	17-Aug-14	0.000053	0.00013	0.00011	0.00010	0.00011
	18-Aug-14	0.000053	0.00013	0.00011	0.00010	0.00011
	20-Sep-14	0.000050	0.00013	0.00010	0.000092	0.00010
	10-Oct-14	0.000050	0.00013	0.00011	0.000095	0.00011
	11-Oct-14	0.000050	0.00012	0.00010	0.000090	0.00010
	04-Dec-14	0.000050	0.00012	0.00010	0.000091	0.00010
	04-Dec-14	0.000050	0.00012	0.00010	0.000089	0.00010
	07-Dec-14	0.000050	0.00012	0.00010	0.000089	0.00010
2015	02-Mar-15	0.000050	0.00017	0.00013	0.00011	0.00012
	02-Mar-15	0.000050	0.00020	0.00016	0.00013	0.00014
	26-May-15	0.000050	0.00022	0.00017	0.00014	0.00014
	26-May-15	0.000050	0.00022	0.00018	0.00014	0.00015
	30-May-15	0.000050	0.00021	0.00017	0.00014	0.00014
	23-Jun-15	0.000050	0.00022	0.00018	0.00014	0.00014
	23-Jun-15	0.000050	0.00022	0.00018	0.00014	0.00014
	30-Jun-15	0.000050	0.00021	0.00016	0.00013	0.00014
	13-Jul-15	0.000050	0.00020	0.00015	0.00012	0.00013
	29-Aug-15	0.000050	0.00021	0.00016	0.00013	0.00014
	29-Aug-15	0.000050	0.00021	0.00016	0.00013	0.00013
	30-Aug-15	0.000050	0.00020	0.00015	0.00012	0.00013
	31-Aug-15	0.000062	0.00020	0.00015	0.00012	0.00013
	20-Sep-15	0.000064	0.00021	0.00016	0.00013	0.00013
	21-Sep-15	0.000062	0.00020	0.00015	0.00012	0.00013
	18-Oct-15	0.000064	0.00021	0.00016	0.00013	0.00014
	18-Oct-15	0.000064	0.00021	0.00016	0.00013	0.00014
	19-Oct-15	0.000070	0.00020	0.00015	0.00013	0.00013
	26-Nov-15	0.000070	0.00019	0.00015	0.00013	0.00013
	06-Dec-15	0.000067	0.00018	0.00015	0.00013	0.00013
	19-Dec-15	0.000067	0.00018	0.00015	0.00012	0.00013

Notes: Values are a rolling average of the previous 12 months of data, see Table 4 for actual sample days for each station. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-3) for dissolved selenium (0.00016 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

Table 7: Twelve Month Rolling Average of Dissolved Selenium (mg/L) for Water Quality Stations on McGinty Creek, Minto Mine, 2016 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2016	29-Apr-16	0.000067	0.00017	0.000050	0.000068	0.00016
	30-Apr-16	0.000069	0.00017	0.000058	0.000068	0.00016
	30-Apr-16	0.000070	0.00017	0.000064	0.000068	0.00016
	26-May-16	0.000071	0.00015	0.000064	0.000070	0.00015
	28-May-16	0.000071	0.00016	0.000064	0.000072	0.00015
	29-May-16	0.000071	0.00016	0.000065	0.000072	0.00015
	20-Jun-16	0.000076	0.00016	0.000067	0.000072	0.00015
	21-Jun-16	0.000076	0.00016	0.000066	0.000073	0.00015
	21-Jun-16	0.000076	0.00016	0.000066	0.000073	0.00015
	04-Jul-16	0.000079	0.00016	0.000069	0.000077	0.00015
	04-Jul-16	0.000079	0.00016	0.000070	0.000077	0.00015
	30-Jul-16	0.000083	0.00016	0.000072	0.000080	0.00015
	04-Aug-16	0.000083	0.00016	0.000072	0.000079	0.00015
	04-Aug-16	0.000083	0.00016	0.000072	0.000079	0.00015
	07-Aug-16	0.000083	0.00016	0.000074	0.000079	0.00015
	15-Aug-16	0.000084	0.00016	0.000074	0.000079	0.00015
	03-Sep-16	0.000080	0.00017	0.000084	0.000085	0.00016
	03-Sep-16	0.000080	0.00017	0.000084	0.000085	0.00016
	05-Sep-16	0.000083	0.00017	0.000084	0.000085	0.00016
	07-Oct-16	0.000085	0.00017	0.000088	0.000089	0.00015
	10-Oct-16	0.000085	0.00017	0.000088	0.000089	0.00015
	10-Nov-16	0.000084	0.00018	0.000093	0.000093	0.00016
	12-Nov-16	0.000084	0.00018	0.000093	0.000089	0.00016
	02-Dec-16	0.000084	0.00020	0.000093	0.000078	0.00016
	02-Dec-16	0.000084	0.00021	0.000093	0.000078	0.00016
2017	26-May-17	0.000092	0.00020	0.000092	0.000083	0.00016
	27-May-17	0.000092	0.00020	0.000092	0.000083	0.00016
	24-Jun-17	0.000091	0.00019	0.000097	0.000084	0.00017
	24-Jun-17	0.000091	0.00020	0.000097	0.000084	0.00017
	25-Jun-17	0.000092	0.00020	0.000097	0.000084	0.00017
	06-Jul-17	0.000092	0.00020	0.000106	0.000087	0.00017
	07-Jul-17	0.000092	0.00020	0.000100	0.000086	0.00017
	07-Jul-17	0.000092	0.00020	0.000096	0.000086	0.00017
	16-Aug-17	0.000090	0.00020	0.000096	0.000088	0.00018
	19-Aug-17	0.000090	0.00020	0.000089	0.000088	0.00018
	19-Aug-17	0.000090	0.00020	0.000084	0.000088	0.00018
	21-Aug-17	0.000090	0.00020	0.000084	0.000085	0.00017
	16-Sep-17	0.000087	0.00020	0.000075	0.000078	0.00017
	18-Sep-17	0.000083	0.00020	0.000075	0.000078	0.00017
	18-Sep-17	0.000081	0.00020	0.000075	0.000078	0.00017
	21-Oct-17	0.000082	0.00020	0.000072	0.000069	0.00017
	22-Oct-17	0.000074	0.00020	0.000072	0.000069	0.00017
	22-Oct-17	0.000072	0.00020	0.000072	0.000069	0.00017
	10-Nov-17	0.000072	0.00020	0.000072	0.000070	0.00019
	10-Nov-17	0.000072	0.00020	0.000072	0.000071	0.00019
2018	30-Apr-18	0.000071	0.00018	0.000072	0.000079	0.00019
	30-Apr-18	0.000071	0.00018	0.000072	0.000080	0.00019
	26-May-18	0.000070	0.00019	0.000074	0.000080	0.00019
	26-May-18	0.000072	0.00019	0.000074	0.000080	0.00019
	11-Jun-18	0.000073	0.00019	0.000068	0.000079	0.00019
	11-Jun-18	0.000073	0.00019	0.000068	0.000079	0.00019
	16-Jun-18	0.000073	0.00019	0.000067	0.000079	0.00019
	05-Jul-18	0.000073	0.00019	0.000067	0.000078	0.00019
	05-Jul-18	0.000074	0.00019	0.000067	0.000078	0.00019
	06-Jul-18	0.000074	0.00019	0.000067	0.000078	0.00019
	29-Aug-18	0.000071	0.00019	0.000068	0.000079	0.00018
	29-Aug-18	0.000071	0.00019	0.000068	0.000079	0.00018
	30-Aug-18	0.000072	0.00019	0.000068	0.000079	0.00018
	08-Sep-18	0.000073	0.00019	0.000071	0.000082	0.00018
	08-Sep-18	0.000073	0.00019	0.000071	0.000082	0.00018
	13-Oct-18	0.000074	0.00019	0.000072	0.000083	0.00019
	13-Oct-18	0.000074	0.00019	0.000072	0.000082	0.00019

Notes: Values are a rolling average of the previous 12 months of data, see Table 4 for actual sample days for each station. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-3) for dissolved selenium (0.00016 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

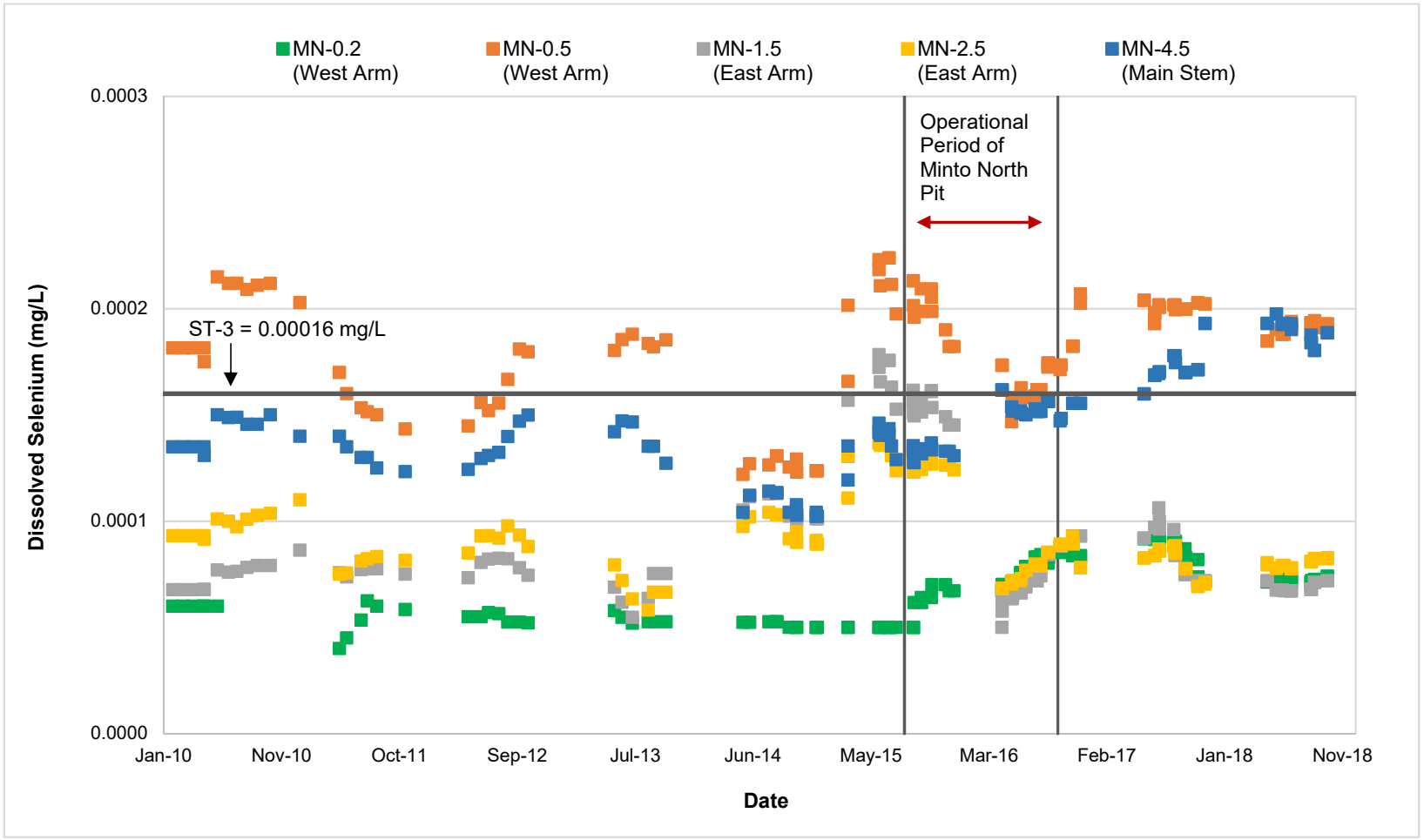


Figure 6: Dissolved Selenium (mg/L) Twelve Month Rolling Average Water Quality Samples on McGinty Creek, Minto Mine, 2016 to 2018

Notes: See Table 4 for actual sampling days. West Arm = "reference" and East Arm = "exposed".

Table 8: Temporal Comparisons of Monthly Mean Values for MN-4.5 (Main-Stem) Among Time Periods (Before, During, and After Mine Operations), Minto Mine

Parameter	ANOVA Model [a]				Post-Hoc Contrasts [b] and Magnitude of Difference (MOD)					
					Before vs During		Before vs After		During vs After	
	Model Term	DF	F	P-value	P-value	MOD	P-value	MOD [c]	P-value	MOD
Dissolved Copper (mg/L)	Month	7	1.1	0.353	-					
	Period	2	0.37	0.693						
	Month×Period	12	0.59	0.835						
	Error	43	-							
Dissolved Selenium (mg/L)	Month	7	6.5	0.000	-					
	Period	2	4.4	0.018	0.240	-	0.019	26%	0.817	-
	Month×Period	12	0.86	0.593	-					
	Error	43	-							

P-value for Period < 0.05.

[a] Two-way analysis of variance (ANOVA) conducted on $\log_{10}$-transformed concentrations.

[b] Post-hoc contrasts conducted on all pairwise comparisons with Tukey's honestly significant differences method.

[c] Magnitude of difference (MOD) calculated as: $[10^{(Mean_{after})} - 10^{(Mean_{before})}]/10^{(Mean_{before})} \times 100\%$, where Mean is the mean in $\log_{10}$-units.

Table 9: Draft Specific Thresholds for McGinty Creek Developed from Station MN-0.5 Data

Analytes	Units	Specific Threshold 1 (85th percentile)	Water Quality Objectives	
			Specific Threshold 2 Individual Data Point Evaluator (95th percentile)	Specific Threshold 3 Central Tendency Evaluator (95th percentile of annual medians)
Total Suspended Solids	mg/L	67	297	86
Ammonia	mg/L	0.039	0.077	0.037
Nitrite	mg/L	0.0025	0.0037	0.0025
Nitrate	mg/L	0.11	0.14	0.075
Dissolved Aluminum	µg/L	48	85	87
Dissolved Arsenic	µg/L	0.60	0.65	0.58
Dissolved Cadmium	µg/L	0.018	0.034	0.027
Dissolved Chromium	µg/L	0.50	0.60	0.50
Dissolved Copper	µg/L	2.7	3.9	4.0
Dissolved Iron	µg/L	335	444	363
Dissolved Lead	µg/L	0.093	0.13	0.14
Dissolved Molybdenum	µg/L	1.2	1.3	1.1
Dissolved Nickel	µg/L	1.5	2.0	1.6
Dissolved Selenium	µg/L	0.23	0.26	0.21
Dissolved Silver	µg/L	0.0050	0.0065	0.0065
Dissolved Zinc	µg/L	2.5	4.4	5.2

Sincerely,

Minnow Environmental Inc.

Lisa Bowron, M.Sc., R.P.Bio.

Aquatic Toxicologist

cc: Pierre Stecko, M.Sc., R.P.Bio., EP

Senior Aquatic Scientist / Principal Consultant

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DRAFT

ATTACHMENT A
DRAFT THRESHOLDS FOR SELENIUM

Table A.1: Dissolved Selenium (mg/L) Water Quality Data from MN-0.5, 2009 to 2018

Year	Date	MN-0.5 (West Arm)
2009	3-May-09	0.000090
	6-May-09	0.000050
	13-May-09	0.00010
	21-May-09	0.00014
	28-May-09	0.00013
	25-Jun-09	0.00019
	28-Jul-09	0.00021
	29-Aug-09	0.00018
	29-Sep-09	0.00017
	23-Oct-09	0.00023
	27-Nov-09	0.00024
	15-Dec-09	0.00023
2010	25-Jan-10	0.00040
	22-Apr-10	0.000090
	28-May-10	0.00021
	28-Jun-10	0.00016
	18-Aug-10	0.00018
	15-Sep-10	0.00020
	21-Oct-10	0.00018
2011	29-Apr-11	0.000090
	19-May-11	0.00010
	28-Jun-11	0.00017
	15-Jul-11	0.00014
	10-Aug-11	0.00014
	28-Oct-11	0.00022
2012	19-Apr-12	0.000099
	24-May-12	0.00017
	14-Jun-12	0.00013
	12-Jul-12	0.00020
	6-Aug-12	0.00022
	7-Sep-12	0.00024
	1-Oct-12	0.00017
2013	27-May-13	0.00013
	17-Jun-13	0.00016
	15-Jul-13	0.00021
	28-Aug-13	0.00019
	11-Sep-13	0.00023
	16-Oct-13	0.00019
2014	16-May-14	0.00023
	3-Jun-14	0.00020
	26-Jul-14	0.00016
	17-Aug-14	0.00018
	20-Sep-14	0.00017
	10-Oct-14	0.00017
2015	2-Mar-15	0.00063
	2-Mar-15	0.00063
	26-May-15	0.00028
	26-May-15	0.00028
	23-Jun-15	0.00021
	13-Jul-15	0.00015
	30-Aug-15	**0.000050**
	20-Sep-15	0.00021
	18-Oct-15	0.00017
	18-Oct-15	0.00015
	26-Nov-15	**0.000050**
2016	29-Apr-16	0.00018
	28-May-16	0.00025
	21-Jun-16	0.00018
	21-Jun-16	0.00019
	04-Jul-16	0.00016
	04-Aug-16	0.00019
	03-Sep-16	0.00017
	03-Sep-16	0.00020
	10-Oct-16	0.00020
	10-Nov-16	0.00024
	02-Dec-16	0.00027
	02-Dec-16	0.00026
2017	26-May-17	0.00015
	24-Jun-17	0.000097
	24-Jun-17	0.00025
	07-Jul-17	0.00019
	21-Aug-17	0.00018
	16-Sep-17	0.00017
	21-Oct-17	0.00023
	10-Nov-17	0.00024
2018	30-Apr-18	0.00017
	26-May-18	0.00020
	11-Jun-18	0.00017
	06-Jul-18	0.00021
	29-Aug-18	0.00017
	08-Sep-18	0.00020
	08-Sep-18	0.00016
	13-Oct-18	0.00019

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

Table A.2: Dissolved Selenium (mg/L) Grab Samples at Water Quality Stations on McGinty Creek using Draft Thresholds based on MN-0.5 Data , Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2009	3-May-09	-	0.000090	0.000060	0.000070	-
	6-May-09	-	0.000050	**0.000020**	0.000040	0.000060
	13-May-09	0.000050	0.00010	0.000060	0.000080	0.00010
	21-May-09	-	0.00014	0.000040	0.000080	0.00012
	28-May-09	0.000070	0.00013	0.000070	0.000070	0.00013
	25-Jun-09	0.000060	0.00019	0.000080	0.000080	0.00015
	28-Jul-09	-	0.00021	0.000070	0.000060	0.00016
	29-Aug-09	-	0.00018	0.000080	0.000080	0.00013
	29-Sep-09	-	0.00017	0.000070	0.000060	0.00013
	23-Oct-09	-	0.00023	0.000070	0.000080	0.00017
	27-Nov-09	-	0.00024	0.000060	0.000070	0.00020
	15-Dec-09	-	0.00023	0.000050	0.000060	-
2010	25-Jan-10	-	0.00040	0.00015	0.00038	-
	23-Feb-10	-	-	-	-	-
	22-Mar-10	-	-	-	-	-
	21-Apr-10	-	-	0.000070	-	-
	22-Apr-10	-	0.000090	-	0.000070	0.000090
	28-May-10	-	0.00021	0.000070	0.000070	0.00017
	28-Jun-10	-	0.00016	0.000070	0.000070	0.00014
	21-Jul-10	-	-	0.000080	0.000070	0.00015
	18-Aug-10	-	0.00018	0.000090	0.00010	0.00013
	15-Sep-10	-	0.00020	0.000090	0.00010	0.00013
	21-Oct-10	-	0.00018	0.000070	0.000070	0.00017
2011	11-Jan-11	-	-	-	0.000060	-
	29-Apr-11	0.000040	0.000090	0.000060	0.000060	0.000090
	19-May-11	0.000050	0.00010	0.000060	0.000080	0.00010
	28-Jun-11	0.000070	0.00017	0.000090	0.00011	0.00014
	15-Jul-11	0.000090	0.00014	0.000080	0.000090	0.00013
	10-Aug-11	0.000050	0.00014	0.000080	0.000080	0.00011
	28-Oct-11	0.000050	0.00022	0.000080	0.000090	0.00017
2012	19-Apr-12	**0.000020**	0.000099	0.000050	0.000060	0.000096
	24-May-12	0.000050	0.00017	0.00010	0.00013	0.00013
	14-Jun-12	0.000069	0.00013	0.000092	0.000094	0.00014
	12-Jul-12	0.000066	0.00020	0.000093	0.00010	0.00015
	6-Aug-12	0.000062	0.00022	0.000078	0.00013	0.00018
	7-Sep-12	**0.000050**	0.00024	**0.000050**	**0.000050**	0.00016
	1-Oct-12	**0.000050**	0.00017	**0.000050**	**0.000050**	0.00017
2013	27-May-13	**0.000050**	0.00013	**0.000050**	**0.000050**	**0.000050**
	17-Jun-13	**0.000050**	0.00016	**0.000050**	**0.000050**	0.00017
	15-Jul-13	**0.000050**	0.00021	**0.000050**	**0.000050**	-
	28-Aug-13	0.000066	0.00019	0.00013	0.000099	0.00013
	11-Sep-13	**0.000050**	0.00023	0.00012	0.00010	0.00016
	16-Oct-13	**0.000050**	0.00019	**0.000050**	**0.000050**	0.00013
2014	16-May-14	**0.000050**	0.00023	**0.000050**	0.00012	0.00017
	3-Jun-14	**0.000050**	0.00020	0.00011	**0.000050**	0.00020
	26-Jul-14	**0.000050**	0.00016	**0.000050**	**0.000050**	0.00014
	17-Aug-14	**-**	0.00018	**0.000050**	**0.000050**	0.00015
	18-Aug-14	-	-	**-**	**-**	-
	20-Sep-14	**0.000050**	0.00017	**0.000050**	**0.000050**	0.00012
	10-Oct-14	**-**	0.00017	**-**	**-**	0.00015
	11-Oct-14	**0.000050**	-	**0.000050**	**0.000050**	-
	4-Dec-14	**-**	-	**-**	-	-
	4-Dec-14	**-**	-	**-**	**0.000050**	-
	7-Dec-14	**-**	-	-	**-**	-
2015	02-Mar-15	-	0.00063	-	-	-
	02-Mar-15	-	0.00063	-	-	-
	26-May-15	-	0.00028	-	**0.000050**	0.00021
	26-May-15	-	0.00028	-	-	-
	30-May-15	**0.000050**	-	**0.000050**	-	-
	23-Jun-15	-	0.00021	-	**0.000050**	0.00017
	23-Jun-15	-	-	-	**0.000050**	-
	30-Jun-15	**0.000050**	-	**0.000050**	-	-
	13-Jul-15	**0.000050**	0.00015	**0.000050**	**0.000050**	0.00013
	29-Aug-15	-	-	**0.000050**	-	-
	29-Aug-15	-	-	**0.000050**	-	-
	30-Aug-15	-	**0.000050**	-	**0.000050**	0.00012
	31-Aug-15	0.00012	-	-	-	-
	20-Sep-15	-	0.00021	**0.000050**	**0.000050**	0.00023
	21-Sep-15	**0.000050**	-	-	-	-
	18-Oct-15	-	0.00017	-	**0.000050**	0.00015
	18-Oct-15	-	0.00015	-	-	-
	19-Oct-15	0.00010	-	**0.000050**	-	-
	26-Nov-15	-	**0.000050**	-	0.00019	-
	06-Dec-15	**0.000050**	-	-	-	-
	19-Dec-15	-	-	-	**0.000050**	-

Notes: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-2) for dissolved selenium (0.00026 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

Table A.2: Dissolved Selenium (mg/L) Grab Samples at Water Quality Stations on McGinty Creek using Draft Thresholds based on MN-0.5 Data , Minto Mine, 2009 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	MN-0.5 (West Arm)	MN-1.5 (East Arm)	MN-2.5 (East Arm)	MN-4.5 (Main Stem)
2016	29-Apr-16	-	0.00018	-	0.000093	0.00012
	30-Apr-16	0.000081	-	0.00011	-	-
	30-Apr-16	0.000081	-	0.00011	-	-
	26-May-16	0.000082	-	-	-	-
	28-May-16	-	0.00025	-	0.000087	0.00014
	29-May-16	-	-	0.000078	-	-
	20-Jun-16	0.000093	-	-	-	-
	21-Jun-16	-	0.00018	0.000062	0.000083	0.00014
	21-Jun-16	-	0.00019	-	-	-
	04-Jul-16	-	0.00016	0.000078	0.000065	0.00016
	04-Jul-16	-	-	0.000079	-	-
	30-Jul-16	0.000090	-	-	-	-
	04-Aug-16	-	0.00019	-	0.000072	0.00015
	04-Aug-16	-	-	-	-	0.00015
	07-Aug-16	-	-	0.000098	-	-
	15-Aug-16	0.000095	-	-	-	-
	03-Sep-16	-	0.00017	0.00013	0.00011	0.00016
	03-Sep-16	-	0.00020	-	-	-
	05-Sep-16	0.00011	-	-	-	-
	07-Oct-16	0.000074	-	-	-	-
	10-Oct-16	-	0.00020	-	0.000083	0.00016
	10-Nov-16	-	0.00024	-	-	0.00021
	12-Nov-16	-	-	-	0.000056	-
	02-Dec-16	-	0.00027	-	-	-
	02-Dec-16	-	0.00026	-	-	-
2017	26-May-17	-	0.00015	0.00012	0.00010	0.00016
	27-May-17	0.000091	-	-	-	-
	24-Jun-17	-	0.000097	0.000078	0.000095	0.00020
	24-Jun-17	-	0.00025	-	-	-
	25-Jun-17	0.000096	-	-	-	-
	06-Jul-17	0.000092	-	-	-	-
	07-Jul-17	-	0.00019	0.000075	0.000080	0.00018
	07-Jul-17	-	-	0.000078	-	-
	16-Aug-17	0.000082	-	-	-	-
	19-Aug-17	-	-	0.000051	-	-
	19-Aug-17	-	-	0.000056	-	-
	21-Aug-17	-	0.00018	-	0.000065	0.00016
	16-Sep-17	-	0.00017	0.000064	0.000062	0.00013
	18-Sep-17	0.000062	-	-	-	-
	18-Sep-17	0.000068	-	-	-	-
	21-Oct-17	-	0.00023	0.000051	**0.000025**	0.00017
	22-Oct-17	**0.000025**	-	-	-	-
	22-Oct-17	0.000057	-	-	-	-
	10-Nov-17	-	0.00024	-	0.000078	0.00037
	10-Nov-17	-	-	-	0.000078	-
2018	30-Apr-18	0.000069	0.00017	-	0.00013	-
	30-Apr-18	-	-	-	0.000090	-
	26-May-18	0.000060	0.00020	0.000087	0.000076	0.00019
	26-May-18	0.000089	-	-	-	-
	11-Jun-18	0.00010	0.00017	-	0.000092	0.00016
	11-Jun-18	-	-	-	-	0.00020
	16-Jun-18	-	-	0.000064	-	-
	05-Jul-18	0.00010	-	0.000078	-	-
	05-Jul-18	0.000079	-	-	-	-
	06-Jul-18	-	0.00021	-	0.000083	0.00017
	29-Aug-18	-	0.00017	0.000063	0.000096	0.00012
	29-Aug-18	-	-	-	-	0.00016
	30-Aug-18	0.000080	-	-	-	-
	08-Sep-18	0.000078	0.00020	0.000091	0.000097	0.00015
	08-Sep-18	-	0.00016	-	-	-
	13-Oct-18	-	0.00019	0.000069	0.000067	0.00021
	13-Oct-18	-	-	-	0.000076	-

Notes: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-2) for dissolved selenium (0.00026 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

Table A.3: Twelve Month Rolling Average of Dissolved Selenium (mg/L) for Water Quality Stations on McGinty Creek using Draft Thresholds based on MN-0.5 Data , Minto Mine, 2010 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	**MN-0.5 (West Arm)**	**MN-1.5 (East Arm)**	**MN-2.5 (East Arm)**	**MN-4.5 (Main Stem)**
2010	25-Jan-10	0.000060	0.00018	0.000068	0.000093	0.00014
	23-Feb-10	0.000060	0.00018	0.000068	0.000093	0.00014
	22-Mar-10	0.000060	0.00018	0.000068	0.000093	0.00014
	21-Apr-10	0.000060	0.00018	0.000068	0.000093	0.00014
	22-Apr-10	0.000060	0.00018	0.000068	0.000091	0.00013
	28-May-10	0.000060	0.00022	0.000077	0.00010	0.00015
	28-Jun-10	-	0.00021	0.000076	0.00010	0.00015
	21-Jul-10	-	0.00021	0.000076	0.000097	0.00015
	18-Aug-10	-	0.00021	0.000078	0.00010	0.00015
	15-Sep-10	-	0.00021	0.000079	0.00010	0.00015
	21-Oct-10	-	0.00021	0.000079	0.00010	0.00015
2011	11-Jan-11	-	0.00020	0.000086	0.00011	0.00014
	29-Apr-11	0.000040	0.00017	0.000076	0.000075	0.00014
	19-May-11	0.000045	0.00016	0.000074	0.000076	0.00014
	28-Jun-11	0.000053	0.00015	0.000077	0.000081	0.00013
	15-Jul-11	0.000063	0.00015	0.000078	0.000082	0.00013
	10-Aug-11	0.000060	0.00015	0.000078	0.000083	0.00013
	28-Oct-11	0.000058	0.00014	0.000075	0.000081	0.00012
2012	19-Apr-12	0.000055	0.00014	0.000073	0.000085	0.00012
	24-May-12	0.000055	0.00016	0.000081	0.000093	0.00013
	14-Jun-12	0.000057	0.00015	0.000082	0.000093	0.00013
	12-Jul-12	0.000056	0.00016	0.000083	0.000092	0.00013
	06-Aug-12	0.000052	0.00017	0.000082	0.000098	0.00014
	07-Sep-12	0.000052	0.00018	0.000078	0.000093	0.00015
	01-Oct-12	0.000052	0.00018	0.000075	0.000088	0.00015
2013	27-May-13	0.000058	0.00018	0.000069	0.000079	0.00014
	17-Jun-13	0.000055	0.00019	0.000062	0.000072	0.00015
	15-Jul-13	0.000052	0.00019	0.000055	0.000063	0.00015
	28-Aug-13	0.000053	0.00018	0.000064	0.000058	0.00014
	11-Sep-13	0.000053	0.00018	0.000075	0.000067	0.00014
	16-Oct-13	0.000053	0.00019	0.000075	0.000067	0.00013
2014	16-May-14	0.000052	0.00012	0.00011	0.000097	0.00010
	03-Jun-14	0.000052	0.00013	0.00011	0.00010	0.00011
	26-Jul-14	0.000053	0.00013	0.00011	0.00010	0.00011
	17-Aug-14	0.000053	0.00013	0.00011	0.00010	0.00011
	18-Aug-14	0.000053	0.00013	0.00011	0.00010	0.00011
	20-Sep-14	0.000050	0.00013	0.00010	0.000092	0.00010
	10-Oct-14	0.000050	0.00013	0.00011	0.000095	0.00011
	11-Oct-14	0.000050	0.00012	0.00010	0.000090	0.00010
	04-Dec-14	0.000050	0.00012	0.00010	0.000091	0.00010
	04-Dec-14	0.000050	0.00012	0.00010	0.000089	0.00010
	07-Dec-14	0.000050	0.00012	0.00010	0.000089	0.00010
2015	02-Mar-15	0.000050	0.00017	0.00013	0.00011	0.00012
	02-Mar-15	0.000050	0.00020	0.00016	0.00013	0.00014
	26-May-15	0.000050	0.00022	0.00017	0.00014	0.00014
	26-May-15	0.000050	0.00022	0.00018	0.00014	0.00015
	30-May-15	0.000050	0.00021	0.00017	0.00014	0.00014
	23-Jun-15	0.000050	0.00022	0.00018	0.00014	0.00014
	23-Jun-15	0.000050	0.00022	0.00018	0.00014	0.00014
	30-Jun-15	0.000050	0.00021	0.00016	0.00013	0.00014
	13-Jul-15	0.000050	0.00020	0.00015	0.00012	0.00013
	29-Aug-15	0.000050	0.00021	0.00016	0.00013	0.00014
	29-Aug-15	0.000050	0.00021	0.00016	0.00013	0.00013
	30-Aug-15	0.000050	0.00020	0.00015	0.00012	0.00013
	31-Aug-15	0.000062	0.00020	0.00015	0.00012	0.00013
	20-Sep-15	0.000064	0.00021	0.00016	0.00013	0.00013
	21-Sep-15	0.000062	0.00020	0.00015	0.00012	0.00013
	18-Oct-15	0.000064	0.00021	0.00016	0.00013	0.00014
	18-Oct-15	0.000064	0.00021	0.00016	0.00013	0.00014
	19-Oct-15	0.000070	0.00020	0.00015	0.00013	0.00013
	26-Nov-15	0.000070	0.00019	0.00015	0.00013	0.00013
	06-Dec-15	0.000067	0.00018	0.00015	0.00013	0.00013
	19-Dec-15	0.000067	0.00018	0.00015	0.00012	0.00013

Notes: Values are a rolling average of the previous 12 months of data, see Table 4 for actual sample days for each station. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-3) for dissolved selenium (0.00021 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

Table A.3: Twelve Month Rolling Average of Dissolved Selenium (mg/L) for Water Quality Stations on McGinty Creek using Draft Thresholds based on MN-0.5 Data , Minto Mine, 2010 to 2018

Year	Date	Station				
		MN-0.2 (West Arm)	**MN-0.5 (West Arm)**	**MN-1.5 (East Arm)**	**MN-2.5 (East Arm)**	**MN-4.5 (Main Stem)**
2016	29-Apr-16	0.000067	0.00017	0.000050	0.000068	0.00016
	30-Apr-16	0.000069	0.00017	0.000058	0.000068	0.00016
	30-Apr-16	0.000070	0.00017	0.000064	0.000068	0.00016
	26-May-16	0.000071	0.00015	0.000064	0.000070	0.00015
	28-May-16	0.000071	0.00016	0.000064	0.000072	0.00015
	29-May-16	0.000071	0.00016	0.000065	0.000072	0.00015
	20-Jun-16	0.000076	0.00016	0.000067	0.000072	0.00015
	21-Jun-16	0.000076	0.00016	0.000066	0.000073	0.00015
	21-Jun-16	0.000076	0.00016	0.000066	0.000073	0.00015
	04-Jul-16	0.000079	0.00016	0.000069	0.000077	0.00015
	04-Jul-16	0.000079	0.00016	0.000070	0.000077	0.00015
	30-Jul-16	0.000083	0.00016	0.000072	0.000080	0.00015
	04-Aug-16	0.000083	0.00016	0.000072	0.000079	0.00015
	04-Aug-16	0.000083	0.00016	0.000072	0.000079	0.00015
	07-Aug-16	0.000083	0.00016	0.000074	0.000079	0.00015
	15-Aug-16	0.000084	0.00016	0.000074	0.000079	0.00015
	03-Sep-16	0.000080	0.00017	0.000084	0.000085	0.00016
	03-Sep-16	0.000080	0.00017	0.000084	0.000085	0.00016
	05-Sep-16	0.000083	0.00017	0.000084	0.000085	0.00016
	07-Oct-16	0.000085	0.00017	0.000088	0.000089	0.00015
	10-Oct-16	0.000085	0.00017	0.000088	0.000089	0.00015
	10-Nov-16	0.000084	0.00018	0.000093	0.000093	0.00016
	12-Nov-16	0.000084	0.00018	0.000093	0.000089	0.00016
	02-Dec-16	0.000084	0.00020	0.000093	0.000078	0.00016
	02-Dec-16	0.000084	0.00021	0.000093	0.000078	0.00016
2017	26-May-17	0.000092	0.00020	0.000092	0.000083	0.00016
	27-May-17	0.000092	0.00020	0.000092	0.000083	0.00016
	24-Jun-17	0.000091	0.00019	0.000097	0.000084	0.00017
	24-Jun-17	0.000091	0.00020	0.000097	0.000084	0.00017
	25-Jun-17	0.000092	0.00020	0.000097	0.000084	0.00017
	06-Jul-17	0.000092	0.00020	0.000106	0.000087	0.00017
	07-Jul-17	0.000092	0.00020	0.000100	0.000086	0.00017
	07-Jul-17	0.000092	0.00020	0.000096	0.000086	0.00017
	16-Aug-17	0.000090	0.00020	0.000096	0.000088	0.00018
	19-Aug-17	0.000090	0.00020	0.000089	0.000088	0.00018
	19-Aug-17	0.000090	0.00020	0.000084	0.000088	0.00018
	21-Aug-17	0.000090	0.00020	0.000084	0.000085	0.00017
	16-Sep-17	0.000087	0.00020	0.000075	0.000078	0.00017
	18-Sep-17	0.000083	0.00020	0.000075	0.000078	0.00017
	18-Sep-17	0.000081	0.00020	0.000075	0.000078	0.00017
	21-Oct-17	0.000082	0.00020	0.000072	0.000069	0.00017
	22-Oct-17	0.000074	0.00020	0.000072	0.000069	0.00017
	22-Oct-17	0.000072	0.00020	0.000072	0.000069	0.00017
	10-Nov-17	0.000072	0.00020	0.000072	0.000070	0.00019
	10-Nov-17	0.000072	0.00020	0.000072	0.000071	0.00019
2018	30-Apr-18	0.000071	0.00018	0.000072	0.000079	0.00019
	30-Apr-18	0.000071	0.00018	0.000072	0.000080	0.00019
	26-May-18	0.000070	0.00019	0.000074	0.000080	0.00019
	26-May-18	0.000072	0.00019	0.000074	0.000080	0.00019
	11-Jun-18	0.000073	0.00019	0.000068	0.000079	0.00019
	11-Jun-18	0.000073	0.00019	0.000068	0.000079	0.00019
	16-Jun-18	0.000073	0.00019	0.000067	0.000079	0.00019
	05-Jul-18	0.000073	0.00019	0.000067	0.000078	0.00019
	05-Jul-18	0.000074	0.00019	0.000067	0.000078	0.00019
	06-Jul-18	0.000074	0.00019	0.000067	0.000078	0.00019
	29-Aug-18	0.000071	0.00019	0.000068	0.000079	0.00018
	29-Aug-18	0.000071	0.00019	0.000068	0.000079	0.00018
	30-Aug-18	0.000072	0.00019	0.000068	0.000079	0.00018
	08-Sep-18	0.000073	0.00019	0.000071	0.000082	0.00018
	08-Sep-18	0.000073	0.00019	0.000071	0.000082	0.00018
	13-Oct-18	0.000074	0.00019	0.000072	0.000083	0.00019
	13-Oct-18	0.000074	0.00019	0.000072	0.000082	0.00019

Notes: Values are a rolling average of the previous 12 months of data, see Table 4 for actual sample days for each station. West Arm = "reference" and East Arm = "exposed".

Shading indicates the value exceeded the Specific Threshold (ST-3) for dissolved selenium (0.00021 mg/L).

Shading indicates the value exceeded the Minto Mine's Site Specific Water Quality Objective for dissolved selenium (0.0020 mg/L).

minnow environmental inc.
A Trinity Consultants Company
204-1006 Fort Street
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January 20, 2020

Mr. Todd Swenson
Environmental Manager
Minto Mine
PO Box 11
Whitehorse Central PO
Whitehorse, Yukon
Y1A 2V3

Dear Mr. Swenson,

Re: Technical Evaluation of Exceedances of Predicted Worst-Case Maximum Dissolved Molybdenum Concentrations at Minto Creek Station W2

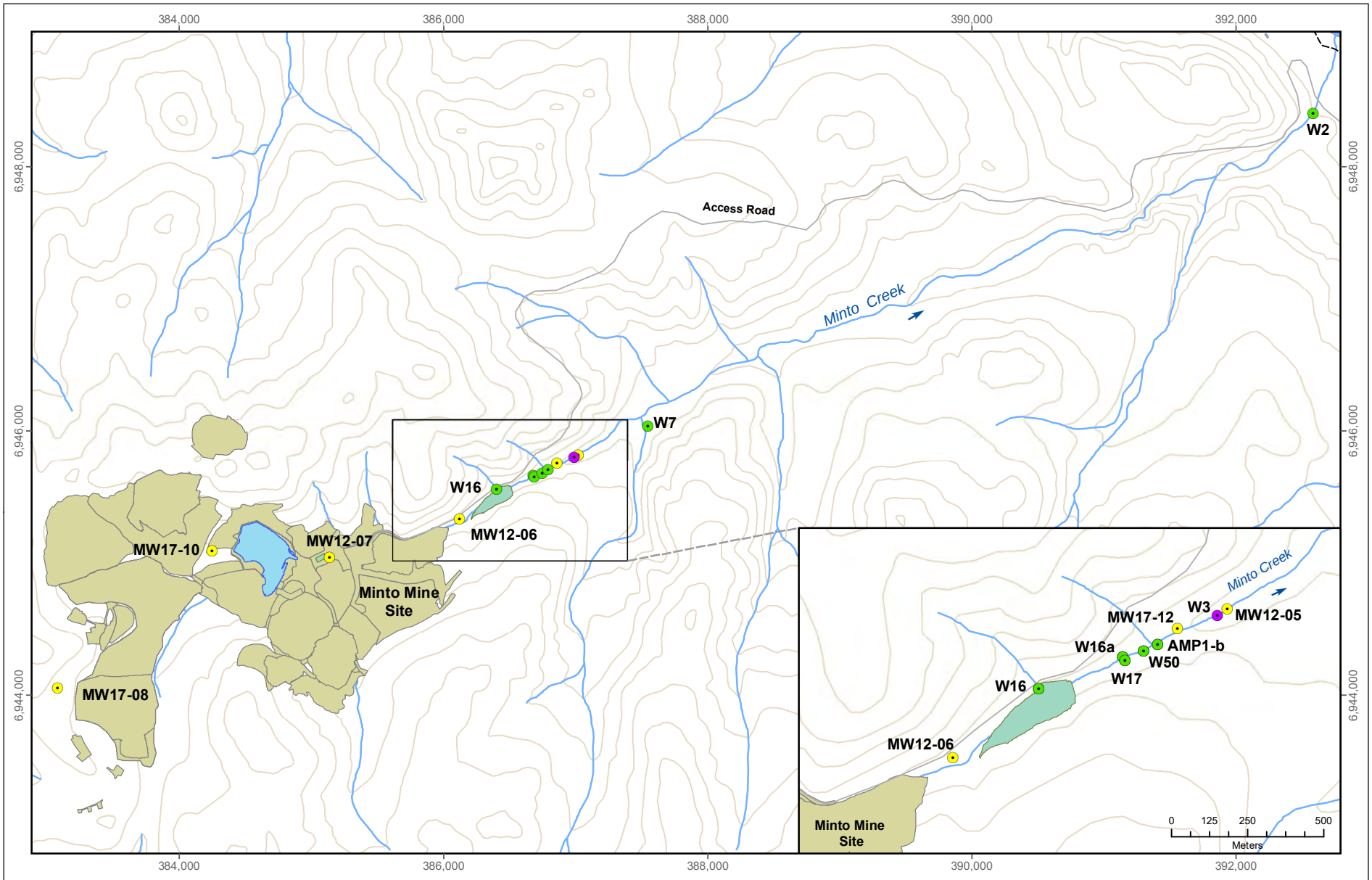
The Minto Mine (Minto) retained Minnow Environmental Inc. (Minnow) as Qualified Professionals (QP) to evaluate exceedances of predicted worst-case maximum concentrations for dissolved molybdenum. These predictions were described in the Minto Mine's "Operations Adaptive Management Plan" (AMP; Minto 2017). The exceedances occurred on June 11 and 18, 2019 at Minto Creek Station W2 (Figure 1). As required under the AMP, this brief letter report provides an evaluation of whether the exceedances were mine-related and whether the exceedances were likely to have affected aquatic resources.

Background

The Minto Mine is a high-grade copper mine located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R-6A approximately 240 km northwest of Whitehorse, Yukon (62°37'N latitude and 137°15'W longitude; Figure 1). Mine development was initiated in 1997, commercial operations started in October 2007, and the mine entered temporary care and maintenance on October 19, 2018. Treated mine-impacted water and non-impacted water are collected in a Water Storage Pond (WSP) and periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL) QZ14-031 (August 2015). Minto Creek, in turn, flows into the Yukon River approximately 7.7 km south-east of the WSP (Figure 1).

Yukon Government Energy, Mines, and Resources (EMR) approved Minto's AMP 2017-01 under the current Quartz Mining License (QML-0001). The Yukon Water Board approved the updated AMP (AMP 2017-02) under the current Water Use Licence (QZ41-031). This assessment is relative to the AMP 2017-02 specific thresholds.

The AMP for Minto Creek includes the following specific thresholds: 1) water quality objectives (WQO); 2) expected case water quality predictions; and 3) worst-case water quality predictions at Station W2. When these WQO or predictions are exceeded, they trigger Specific Performance Thresholds (SPT). Each SPT is associated with response steps, including notification, review, evaluation, and action. For example, exceedances of the predicted worst-case maximum or WQO



LEGEND

- Effluent Quality Monitoring Station
- Water Quality Monitoring Station
- Groundwater Quality Monitoring Station
- Water Storage Pond
- Main Pit Lake
- Mine Footprint

0 0.5 1 2 km

N W E S

Datum: NAD 83 Map Projection: UTM Zone 8V Data Source: National Topographic Data Base (NTDB) compiled by Department of Natural Resources Canada at a scale of 1:50,000. All rights reserved.

Minto Mine Water Quality Monitoring Stations

Date January 2020
Project 197202.0050

minnow environmental inc. A Trinity Consultants Company

Figure 1

Document Path: S:\Projects\197202\197202.0050 - Minto Adaptive Management Plan 2019\4 - GIS\Water Quality Map\19-50 Fig 1 Minto Water Quality Stations.mxd

at Station W2 in a single sample trigger SPT-3. Two consecutive samples exceeding the predicted worst-case maximum at W2 triggers SPT-4. A WQO or a predicted no effect concentration (PNEC; the latter of which apply only to dissolved copper and selenium) exceeded in two consecutive samples at W2 triggers SPT-5.

Methods

The Minto Mine's water quality monitoring program includes stations in upper and lower Minto Creek (Figure 1). Minto Mine compared the results of individual grab samples to specific thresholds of the AMP and identified exceedances for dissolved molybdenum. Further evaluation included the comparison of dissolved molybdenum concentrations at Station W2 to the WQO (0.073 mg/L) and the predicted worst-case maximum concentration (0.0015 mg/L, Table 1). There were no associated expected case water quality predictions for dissolved molybdenum. Dissolved molybdenum concentrations at Station W2 were also compared to Station W3 (effluent discharge point) to determine if mine loading had caused exceedances. Historical and current conditions (2016 to 2019) at W2 and W3 were also reviewed. Concentrations were also compared to other surface water stations (W16, W16a, and W50), groundwater or groundwater- influenced stations (MW17-08, MW17-10, MW12-07, MW17-12, MW12-06, W17, AMP1-b, and MW12-05), as well as reference stations (W7; tributary) in upper Minto Creek (Figure 1).

Results

Dissolved Molybdenum

Concentrations of dissolved molybdenum exceeded the predicted worst-case maximum at Minto Creek Station W2 on June 11 and 18, 2019 (0.0015 mg/L; Table 2, Figure 2), triggering SPT-4. Concentrations of dissolved molybdenum previously exceeded the predicted worst-case maximum concentration at W2 at a frequency of 33% (35 exceedances out of 105 measurements; Table 2, Figure 2).

Concentrations of dissolved molybdenum were higher at Station W3 (the effluent discharge point) than at Station W2 (Table 2, Figure 2). Dilution from reference tributaries caused the concentration of dissolved molybdenum to decrease moving downstream to W2. Reference Station W7 was located on a tributary of upper Minto Creek and associated concentrations of dissolved molybdenum were lower than the predicted worst-case maximum (Table 2, Figure 2). Dissolved molybdenum at the water storage pond (WSP; Station W16) was lower in concentration than at W3 (WSP would be the expected source of W3). Other stations (W16a and W50) upstream of W3 also had lower dissolved molybdenum concentrations than W3. Therefore, surface water quality concentrations do not appear to be the source of higher dissolved molybdenum at Stations W3 and W2. Higher concentrations of dissolved molybdenum have been found in groundwater or at groundwater-influenced surface water stations upstream of W3 (MW17-08, MW17-10, MW12-07, MW12-06, WSP, W17, W50, AMP1-b, and MW17-12; see Figure 1 for locations).

Surface water stations upgradient of W3 (Figure 1) had lower concentrations of dissolved molybdenum than W3. Conversely, groundwater stations (or stations that have groundwater/seepage influence) had higher dissolved molybdenum concentrations than Station W3 (Table 2, Figures 2 and 3). At specific depths (Table 3), groundwater monitoring Station MW12-06 (upstream of the WSP) had concentrations of dissolved molybdenum that were higher than at W3 (MW12-06-4 and MW12-06-5; Table 2, Figure 2). Downstream of the WSP (WSP concentrations were lower than W3), concentrations of dissolved molybdenum were higher at Station W17 (seepage from the WSP) than at W3 (Table 2, Figures 2 and 3). In addition,

Table 1: Specific Thresholds for Minto Creek, Station W2

Analytes		Units	W2 Water Quality Objective	Expected Case Water Quality Predictions at W2	Worst Case Water Quality Predictions at W2
Ammonia		mg/L	0.25	0.057	0.250
Nitrite		mg/L	0.060	0.015 [a]	0.057 [a]
Nitrate		mg/L	9.1	1.1	5.1
Dissolved Aluminum		mg/L	0.10	0.057	0.077
Dissolved Arsenic		mg/L	0.0050	n/a	0.00070
Dissolved Cadmium		mg/L	$e^{(0.736(\ln(\text{hardness})-4.943)}$	0.027	0.040
Dissolved Chromium		mg/L	0.0010	0.00062	0.00082
Dissolved Copper	When DOC at W2 > 10 mg/L	mg/L	0.020	0.0092	0.014
	When DOC at W2 ≤ 10 mg/L	mg/L	0.013	0.0092	0.014
Dissolved Iron		mg/L	1.1	n/a	0.37
Dissolved Lead		mg/L	0.0040	n/a	0.00044
Dissolved Molybdenum		mg/L	0.073	n/a	0.0015
Dissolved Nickel		mg/L	0.11	n/a	0.0021
Dissolved Selenium		mg/L	0.0020	0.00055	0.00087
Dissolved Silver		mg/L	0.00010	n/a	0.000042
Dissolved Zinc		mg/L	0.030	n/a	0.0065

Notes: Reproduced from Table 2-3 in the Operational AMP (Minto 2017). n/a = no action will be taken on expected case predictions.

[a] Prediction reduced by 75% to account for expected nitrification in Minto Creek.

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
28-Feb-16	-	-	-	-	-	-	-	**0.00050**	0.01930	-	-	-	-	-	-	-	-
23-Apr-16	-	-	-	-	-	-	-	0.00055	0.01920	-	-	-	-	-	-	-	-
23-Apr-16	-	-	-	-	-	-	-	-	0.01940	-	-	-	-	-	-	-	-
13-May-16	-	-	-	-	-	-	-	0.00128	0.01970	-	-	-	-	-	-	-	-
22-May-16	-	-	-	-	-	-	-	0.00100	0.01910	-	-	-	-	-	-	-	-
25-Jun-16	-	-	-	-	-	-	-	0.00107	0.01730	-	-	-	-	-	-	-	-
2-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Sep-16	-	-	-	-	-	-	-	0.00076	0.01810	-	-	-	-	-	-	-	-
2-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).

Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Oct-16	-	-	-	-	-	-	-	0.00090	0.01970	-	-	-	-	-	-	-	-
23-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Nov-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Dec-16	-	-	-	-	-	-	-	0.00058	0.01950	0.03220	-	-	-	-	-	-	-
23-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Jan-17	-	-	-	-	-	-	-	0.00060	0.01910	-	-	-	-	-	-	-	-
31-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Feb-17	-	-	-	-	-	-	-	0.00055	0.01890	-	-	-	-	-	-	-	-
18-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).

Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
20-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Mar-17	-	-	-	-	-	-	-	0.00037	0.01880	-	-	-	-	-	-	-	-
2-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Apr-17	-	-	-	-	-	-	-	0.00035	0.02040	-	-	-	-	-	-	-	-
22-Apr-17	-	-	-	-	-	-	-	-	0.01960	-	-	-	-	-	-	-	-
23-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-May-17	-	-	-	-	-	-	-	0.00048	0.01810	-	-	-	-	-	-	-	-
22-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).
Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
12-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Jun-17	-	-	-	-	-	-	-	0.00089	0.01820	-	-	-	-	-	-	-	-
23-Jun-17	-	-	-	-	-	-	-	0.00082	-	-	-	-	-	-	-	-	-
26-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Jul-17	-	-	-	-	-	-	-	0.00047	0.01920	-	-	-	-	-	-	-	-
31-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Aug-17	-	-	-	-	-	-	-	0.00025	0.01780	-	-	-	-	-	-	-	-
15-Aug-17	-	-	-	-	-	-	-	-	0.01790	-	-	-	-	-	-	-	-
21-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Aug-17	-	-	-	-	-	-	-	-	-	-	0.00689	0.00732	0.00620	0.00890	0.00880	0.06070	0.00966
27-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Aug-17	0.00525	0.00336	0.00116	0.00050	0.03690	0.00931	0.00966	-	-	-	-	-	-	-	-	-	-
28-Aug-17	-	-	0.00116	-	-	-	0.00934	-	-	-	-	-	-	-	-	-	-
29-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).
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Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
11-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Oct-17	-	-	-	-	-	-	-	0.00084	0.01800	-	-	-	-	-	-	-	-
22-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Nov-17	-	-	-	-	-	-	-	0.00097	0.01940	-	-	-	-	-	-	-	-
11-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Nov-17	-	-	-	-	-	-	-	-	-	-	0.00748	0.00840	0.00601	0.00711	0.00780	0.04480	0.00801
13-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Nov-17	0.00908	0.00372	0.00114	0.00071	0.03810	0.00910	0.00902	-	-	-	-	-	-	-	-	-	-
20-Nov-17	-	-	-	-	-	0.00942	-	-	-	-	-	-	-	-	-	-	-
21-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-18	-	-	-	-	-	-	-	0.00169	0.02930	-	-	-	-	-	-	-	-
16-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
16-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-18	-	-	-	-	-	-	-	0.00141	0.02990	-	-	-	-	-	-	-	-
24-Feb-18	-	-	-	-	-	-	-	-	0.02890	-	-	-	-	-	-	-	-
26-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Mar-18	-	-	-	-	0.02900	0.00806	0.00802	-	-	-	-	-	-	-	-	-	-
2-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Mar-18	-	-	-	-	-	-	-	-	-	-	0.00808	0.00781	0.00563	0.00641	0.00474	0.03300	0.00676
5-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Mar-18	0.00820	0.00306	0.00099	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Mar-18	-	-	-	-	-	-	-	0.00224	0.03730	-	-	-	-	-	-	-	-
20-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Apr-18	-	-	-	-	-	-	-	0.00708	0.03710	-	-	-	-	-	-	-	-
17-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-May-18	-	-	-	-	-	-	-	-	0.03310	-	-	-	-	-	-	-	-
6-May-18	-	-	-	-	0.02580	0.00771	0.00775	-	-	-	-	-	-	-	-	-	-
7-May-18	0.00868	0.00321	0.00097	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-May-18	-	0.00312	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-May-19	-	-	-	-	-	-	-	-	-	-	0.00839	0.00827	0.00592	0.00616	0.01310	0.02980	0.00695
11-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
14-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jun-18	-	-	-	-	-	-	-	-	0.03140	-	-	-	-	-	-	-	-
4-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Aug-18	-	-	-	-	0.02240	0.00822	-	-	-	-	-	-	-	-	-	-	-
14-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Aug-18	-	-	-	-	0.02180	0.00775	0.00675	-	-	-	-	-	-	-	-	-	-
19-Aug-18	-	-	-	-	-	-	-	-	0.03040	-	-	-	-	-	-	-	-
20-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
24-Aug-18	-	-	-	-	-	-	-	-	-	-	0.00792	0.00780	0.00521	0.00532	0.02070	0.02200	0.00651
24-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00656
25-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Aug-18	0.00870	0.00299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Aug-18	-	0.00301	0.00098	0.00043	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Sep-18	-	-	-	-	-	-	-	-	0.02870	-	-	-	-	-	-	-	-
1-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Oct-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Oct-18	-	-	-	-	-	-	-	-	0.02790	-	-	-	-	-	-	-	-
22-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Oct-18	-	-	-	-	-	-	-	-	-	-	0.00801	0.00775	0.00536	0.00526	0.02010	0.02160	0.00642
23-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00626
25-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Oct-18	0.00876	0.00309	0.00094	0.00056	0.01930	0.00753	0.00706	-	-	-	-	-	-	-	-	-	-
26-Oct-18	0.00873	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
18-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Jan-19	-	-	-	-	-	-	-	-	0.02400	-	-	-	-	-	-	-	-
22-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Feb-19	-	-	-	-	-	-	-	-	0.02620	-	-	-	-	-	-	-	-
8-Feb-19	-	-	-	-	-	-	-	-	0.02640	-	-	-	-	-	-	-	-
11-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Feb-19	-	-	-	-	-	-	-	-	-	-	0.00815	0.00828	0.00604	0.00562	0.01960	0.02240	0.00672
15-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	0.00613	-	-	-	-
19-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Feb-19	0.00861	0.00296	0.00091	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Feb-19	0.00870	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-19	-	-	-	-	0.01710	0.00734	0.00688	-	0.02420	-	-	-	-	-	-	-	-
11-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.
Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).
Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																
	MW17-08-01	MW17-08-02	MW17-08-03	MW17-08-04	MW17-10-01	MW17-10-02	MW17-10-03	MW12-07-01	MW12-07-02	MW12-07-03	MW17-12-01	MW17-12-02	MW17-12-03	MW17-12-04	MW17-12-05	MW17-12-06	MW17-12-07
16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Apr-19	-	-	-	-	-	-	-	-	0.02400	-	-	-	-	-	-	-	-
19-Apr-19	-	-	-	-	-	-	-	-	0.02170	-	-	-	-	-	-	-	-
22-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-May-19	-	-	-	-	-	-	-	-	-	-	0.00744	0.00764	0.00556	0.00497	0.01660	-	-
6-May-19	-	-	-	-	-	-	-	-	0.02350	-	-	-	-	-	-	0.01970	0.00594
6-May-19	-	-	-	-	-	-	-	-	0.02330	-	-	-	-	-	-	-	-
7-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-May-19	0.01350	0.00302	0.00084	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-May-19	0.00873	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-May-19	-	-	-	-	0.01490	0.00694	0.00648	-	-	-	-	-	-	-	-	-	-
16-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Jun-19	-	-	-	-	-	-	-	-	0.02360	-	-	-	-	-	-	-	-
10-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).

Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																					
	MW17-12-08	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05	MW12-06-06	W16	W16a	W17	W50	AMP1-b	W3	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07	W7	W2
28-Feb-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jun-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jul-16	-	-	-	-	-	-	-	-	-	0.0054	-	-	-	-	-	-	-	-	-	-	-	-
2-Jul-16	-	-	-	-	-	-	-	-	-	**0.000025**	-	-	-	-	-	-	-	-	-	-	-	-
5-Jul-16	-	-	-	-	-	-	-	-	-	-	-	0.0062	0.0053	-	-	-	-	-	-	-	-	-
5-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	0.0050	-	-	-	-	-	-	-	-	-
6-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00035	0.0011	0.00068	0.0048	-	0.0036	0.0022	0.0016	-
7-Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0015
10-Jul-16	-	-	-	-	-	-	-	0.0051	0.0035	0.0055	0.0033	-	-	-	-	-	-	-	-	-	-	-
10-Jul-16	-	-	-	-	-	-	-	-	-	-	0.0033	-	-	-	-	-	-	-	-	-	-	-
12-Jul-16	-	-	-	-	-	-	-	-	-	-	0.0034	0.0063	0.0048	-	-	-	-	-	-	-	-	0.0017
14-Jul-16	-	-	-	-	-	-	-	0.0049	0.0033	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
19-Jul-16	-	-	-	-	-	-	-	-	0.0033	-	0.0030	0.0061	0.0044	-	-	-	-	-	-	-	0.0015	0.0013
19-Jul-16	-	-	-	-	-	-	-	-	-	-	0.0031	-	-	-	-	-	-	-	-	-	-	-
20-Jul-16	-	-	-	-	-	-	-	0.0042	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
26-Jul-16	-	-	-	-	-	-	-	0.0038	0.0032	-	0.0031	0.0059	0.0035	-	-	-	-	-	-	-	-	0.0012
26-Jul-16	-	-	-	-	-	-	-	0.0038	0.0032	-	0.0031	-	0.0035	-	-	-	-	-	-	-	-	0.0012
27-Jul-16	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
27-Jul-16	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
2-Aug-16	-	-	-	-	-	-	-	0.0037	0.0034	0.0053	0.0032	0.0061	0.0041	-	-	-	-	-	-	-	-	0.0016
9-Aug-16	-	-	-	-	-	-	-	-	0.0036	0.0053	-	-	0.0043	-	-	-	-	-	-	-	-	0.0016
9-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0016
11-Aug-16	-	-	-	-	-	-	-	0.0035	-	-	0.0037	-	-	-	-	-	-	-	-	-	-	-
15-Aug-16	-	-	-	-	-	-	-	-	0.0036	-	0.0036	-	0.0043	-	-	-	-	-	-	-	-	0.0016
17-Aug-16	-	-	-	-	-	-	-	0.0036	0.0036	0.0055	0.0035	-	0.0041	-	-	-	-	-	-	-	0.0015	0.0015
17-Aug-16	-	-	-	-	-	-	-	0.0038	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Aug-16	-	-	-	-	-	-	-	0.0039	0.0037	0.0053	-	-	0.0043	-	-	-	-	-	-	-	-	0.0017
28-Aug-16	-	-	-	-	-	-	-	-	-	-	0.0039	-	-	-	-	-	-	-	-	-	-	-
30-Aug-16	-	-	-	-	-	-	-	0.0040	0.0038	0.0057	-	-	0.0046	-	-	-	-	-	-	-	-	-
31-Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0018
1-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Sep-16	-	-	0.0067	0.0019	0.0085	0.0086	0.0055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Sep-16	-	-	-	-	-	-	-	-	-	-	0.0010	-	-	-	-	-	-	-	-	-	-	-
5-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00033	0.0011	0.00046	-	-	-	-	-	-
6-Sep-16	-	-	-	-	-	-	-	-	0.0041	0.0061	0.0022	-	0.0026	-	-	-	-	-	-	-	0.0013	0.0019
6-Sep-16	-	-	-	-	-	-	-	0.0041	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0020
13-Sep-16	-	-	-	-	-	-	-	0.0037	-	0.0056	0.0018	-	0.0027	-	-	-	-	-	-	-	-	0.0017
15-Sep-16	-	-	-	-	-	-	-	-	0.0037	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-16	-	-	-	-	-	-	-	-	-	-	0.0019	-	-	-	-	-	-	-	-	-	-	-
19-Sep-16	-	-	-	-	-	-	-	0.0040	-	0.0059	-	-	-	-	-	-	-	-	-	-	-	-
20-Sep-16	-	-	-	-	-	-	-	-	0.0037	-	0.0019	-	0.0023	-	-	-	-	-	-	-	-	0.0016
27-Sep-16	-	-	-	-	-	-	-	-	0.0034	0.0053	0.0016	0.0064	0.0021	-	-	-	-	-	-	-	-	0.0014
27-Sep-16	-	-	-	-	-	-	-	0.0035	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0014

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Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).

Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																				
	MW17-12-08	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05	MW12-06-06	W16	W16a	W17	W50	AMP1-b	W3	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07	W7	W2
30-Sep-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0050	0.0039	0.0037	0.0025	-	-
3-Oct-16	-	-	-	-	-	-	-	-	0.0034	0.0050	-	-	0.0019	-	-	-	-	-	-	-	-	0.0014
4-Oct-16	-	-	-	-	-	-	-	0.0035	-	-	0.0014	-	0.0030	-	-	-	-	-	-	-	-	-
10-Oct-16	-	-	-	-	-	-	-	0.0035	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
11-Oct-16	-	-	-	-	-	-	-	-	0.0035	-	-	0.0063	0.0040	-	-	-	-	-	-	-	-	-
12-Oct-16	-	-	-	-	-	-	-	-	-	-	0.0035	-	-	-	-	-	-	-	-	-	0.0012	0.0015
12-Oct-16	-	-	-	-	-	-	-	-	-	-	0.0036	-	-	-	-	-	-	-	-	-	-	-
17-Oct-16	-	-	-	-	-	-	-	0.0033	-	0.0048	-	-	-	-	-	-	-	-	-	-	-	-
18-Oct-16	-	-	-	-	-	-	-	-	0.0035	-	0.0035	-	0.0037	-	-	-	-	-	-	-	-	0.0019
21-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00028	0.00056	0.00057	0.0044	0.0037	0.0035	0.0024	-	-
22-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	0.0038	-	-	-	-	-	-	-	0.0012	0.0020
24-Oct-16	-	-	-	-	-	-	-	0.0035	0.0036	-	-	-	-	-	-	-	-	-	-	-	-	0.0020
24-Oct-16	-	-	-	-	-	-	-	0.0035	0.0036	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Oct-16	-	0.0017	0.0065	0.0024	-	0.0088	0.0056	-	-	0.0051	0.0038	-	0.0040	-	-	-	-	-	-	-	-	-
31-Oct-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0012
1-Nov-16	-	-	-	-	-	-	-	-	-	0.0049	-	-	0.0048	-	-	-	-	-	-	-	-	-
1-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	-	-
3-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0012	-
6-Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0011
8-Nov-16	-	-	-	-	-	-	-	-	-	0.0050	-	-	0.0048	-	-	-	-	-	-	-	-	-
15-Nov-16	-	-	-	-	-	-	-	-	-	0.0049	-	-	0.0047	-	-	-	-	-	-	-	-	-
22-Nov-16	-	-	-	-	-	-	-	-	-	0.0049	-	-	0.0047	-	-	-	-	-	-	-	-	-
25-Nov-19	-	-	-	-	-	-	-	0.0039	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Nov-16	-	-	-	-	-	-	-	-	-	0.0048	-	-	0.0046	-	-	-	-	-	-	-	-	-
6-Dec-16	-	-	-	-	-	-	-	-	-	0.0049	-	-	0.0049	-	-	-	-	-	-	-	-	-
7-Dec-16	-	-	-	-	-	-	-	0.0040	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-16	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-16	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	-	-	-	-	-
13-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	0.0046	-	-	-	-	-	-	-	-	-
20-Dec-16	-	-	-	-	-	-	-	-	-	0.0048	-	-	0.0044	-	-	-	-	-	-	-	-	-
23-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00031	0.00041	0.00043	0.0051	0.0038	0.0034	0.0015	-	-
23-Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0044	-	-	-	-	-
27-Dec-16	-	-	-	-	-	-	-	-	-	0.0049	-	-	0.0045	-	-	-	-	-	-	-	-	-
29-Dec-16	-	0.00087	0.0063	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-16	-	-	-	0.0020	0.0076	0.0083	0.0052	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jan-17	-	-	-	-	-	-	-	-	-	0.0051	-	-	0.0045	-	-	-	-	-	-	-	-	-
10-Jan-17	-	-	-	-	-	-	-	-	-	0.0054	-	-	0.0048	-	-	-	-	-	-	-	-	-
13-Jan-17	-	-	-	-	-	-	-	0.0037	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jan-17	-	-	-	-	-	-	-	-	-	0.0052	-	-	0.0044	-	-	-	-	-	-	-	-	-
24-Jan-17	-	-	-	-	-	-	-	-	-	0.0055	-	-	0.0043	-	-	-	-	-	-	-	-	-
24-Jan-17	-	-	-	-	-	-	-	-	-	0.0055	-	-	-	-	-	-	-	-	-	-	-	-
30-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jan-17	-	-	-	-	-	-	-	-	-	0.0055	-	-	0.0045	-	-	-	-	-	-	-	-	-
31-Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	-
3-Feb-17	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Feb-17	-	-	-	-	-	-	-	-	-	0.0058	-	-	0.0045	-	-	-	-	-	-	-	-	-
14-Feb-17	-	-	-	-	-	-	-	-	-	0.0055	-	-	0.0041	-	-	-	-	-	-	-	-	-
16-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Feb-17	-	-	0.0070	-	0.0078	-	0.0057	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Feb-17	-	-	-	-	0.0085	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).

Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																				
	MW17-12-08	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05	MW12-06-06	W16	W16a	W17	W50	AMP1-b	W3	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07	W7	W2
20-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00031	0.00039	0.00076	0.0041	0.0037	0.0035	0.0022	-	-
21-Feb-17	-	-	-	-	-	-	-	-	-	0.0056	-	-	0.0038	-	-	-	-	-	-	-	-	-
28-Feb-17	-	-	-	-	-	-	-	-	-	0.0061	-	-	0.0046	-	-	-	-	-	-	-	-	-
28-Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	-
7-Mar-17	-	-	-	-	-	-	-	-	-	0.0062	-	-	0.0044	-	-	-	-	-	-	-	-	-
14-Mar-17	-	-	-	-	-	-	-	0.0042	-	0.0054	-	-	0.0036	-	-	-	-	-	-	-	-	-
21-Mar-17	-	-	-	-	-	-	-	-	-	0.0059	-	-	0.0036	-	-	-	-	-	-	-	-	-
21-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0037	-	-	-	-	-	-	-	-	-
28-Mar-17	-	-	-	-	-	-	-	-	-	0.0056	-	-	0.0034	-	-	-	-	-	-	-	-	-
30-Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Apr-17	-	-	-	-	-	-	-	0.0048	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Apr-17	-	-	-	-	-	-	-	0.0046	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Apr-17	-	-	-	-	-	-	-	-	-	0.0063	-	-	0.0034	-	-	-	-	-	-	-	-	-
6-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0036	-	-	-	-	-	-	-	-	-
11-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	0.0011
12-Apr-17	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
16-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00085
17-Apr-17	-	-	-	-	-	-	-	0.0020	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Apr-17	-	-	-	-	-	-	-	-	-	0.0059	-	-	0.0046	-	-	-	-	-	-	-	-	0.0010
18-Apr-17	-	-	-	-	-	-	-	-	-	0.0058	-	-	-	-	-	-	-	-	-	-	-	-
22-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00022	0.00021	0.00083	0.0025	0.0039	0.0037	0.0022	-	-
23-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0026	-	-	-	-	-
24-Apr-17	-	0.0010	0.0074	0.0020	0.0084	0.0091	0.0058	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Apr-17	-	-	-	-	-	0.0091	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Apr-17	-	-	-	-	-	-	-	0.00065	-	0.0054	-	-	0.0042	-	-	-	-	-	-	-	-	0.00096
25-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00086
27-Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00053
28-Apr-17	-	-	-	-	-	-	-	0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Apr-17	-	0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Apr-17	-	-	-	-	-	-	-	0.0020	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00052
1-May-17	-	-	-	-	-	-	-	0.0012	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00045
2-May-17	-	-	-	-	-	-	-	-	0.0024	0.0055	0.0034	-	0.0053	-	-	-	-	-	-	-	-	0.00053
2-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00055
8-May-17	-	-	-	-	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-17	-	-	-	-	-	-	-	-	0.0028	0.0058	0.0028	-	0.0035	-	-	-	-	-	-	-	-	0.00076
9-May-17	-	-	-	-	-	-	-	-	-	0.0060	-	-	-	-	-	-	-	-	-	-	-	-
15-May-17	-	-	-	-	-	-	-	0.0026	-	0.0056	-	0.0054	-	-	-	-	-	-	-	-	-	-
16-May-17	-	-	-	-	-	-	-	-	0.0028	-	0.0030	-	0.0033	-	-	-	-	-	-	-	0.00085	0.0011
16-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0011
21-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-May-17	-	-	-	-	-	-	-	0.0026	-	0.0056	-	-	-	-	-	-	-	-	-	-	-	-
23-May-17	-	-	-	-	-	-	-	-	0.0027	-	0.0027	-	0.0035	-	-	-	-	-	-	-	-	-
23-May-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0036	-	-	-	-	-	-	-	-	-
24-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0016
29-May-17	-	-	-	-	-	-	-	0.0028	-	0.0058	-	-	-	-	-	-	-	-	-	-	-	-
29-May-17	-	-	-	-	-	-	-	-	-	0.0059	-	-	-	-	-	-	-	-	-	-	-	-
30-May-17	-	-	-	-	-	-	-	-	0.0027	-	0.0027	-	0.0037	-	-	-	-	-	-	-	-	-
30-May-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0037	-	-	-	-	-	-	-	-	-
31-May-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0017
5-Jun-17	-	-	-	-	-	-	-	0.0027	-	0.0048	-	-	-	-	-	-	-	-	-	-	-	-
5-Jun-17	-	-	-	-	-	-	-	0.0025	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Jun-17	-	-	-	-	-	-	-	-	0.0022	-	0.0022	-	0.0027	-	-	-	-	-	-	-	-	0.0017
6-Jun-17	-	-	-	-	-	-	-	-	0.0023	-	0.0023	-	-	-	-	-	-	-	-	-	-	-

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Date	Station																				
	MW17-12-08	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05	MW12-06-06	W16	W16a	W17	W50	AMP1-b	W3	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07	W7	W2
12-Jun-17	-	-	-	-	-	-	-	0.0024	-	0.0050	-	-	-	-	-	-	-	-	-	-	-	-
13-Jun-17	-	-	-	-	-	-	-	-	0.0024	-	0.0024	-	0.0026	-	-	-	-	-	-	-	-	0.0014
13-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0014
19-Jun-17	-	-	-	-	-	-	-	0.0025	-	0.0054	-	-	-	-	-	-	-	-	-	-	-	-
20-Jun-17	-	-	-	-	-	-	-	-	0.0022	-	0.0022	-	0.0030	-	-	-	-	-	-	-	-	0.0016
20-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-
23-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Jun-17	-	-	-	-	-	-	-	0.0023	-	0.0047	-	-	-	-	-	-	-	-	-	-	-	-
27-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0040	-	-	-	-	-	-	-	0.0014	0.0016
27-Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0016
28-Jun-17	-	-	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	-	-
3-Jul-17	-	-	-	-	-	-	-	0.0025	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
4-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	0.0016	0.0014
4-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0016	-
10-Jul-17	-	-	-	-	-	-	-	0.0026	-	0.0058	-	-	0.0044	-	-	-	-	-	-	-	-	-
11-Jul-17	-	-	-	-	-	-	-	-	0.0025	-	0.0024	-	0.0047	-	-	-	-	-	-	-	-	0.0015
14-Jul-17	-	-	-	-	-	-	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	-	-
17-Jul-17	-	-	-	-	-	-	-	0.0024	-	0.0048	-	-	-	-	-	-	-	-	-	-	-	-
18-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	0.0012
18-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0012
24-Jul-17	-	-	-	-	-	-	-	0.0027	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Jul-17	-	-	-	-	-	-	-	-	-	0.0054	-	-	0.0046	-	-	-	-	-	-	-	-	-
25-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	-
27-Jul-17	-	-	-	-	-	-	-	-	0.0025	-	0.0027	-	-	-	-	-	-	-	-	-	-	0.0015
28-Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jul-17	-	-	-	-	-	-	-	0.0027	-	0.0052	-	-	-	-	-	-	-	-	-	-	-	-
31-Jul-17	-	-	-	-	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	-	-	-	-
1-Aug-17	-	-	-	-	-	-	-	-	0.0026	-	0.0027	-	0.0039	-	-	-	-	-	-	-	0.0013	0.0018
2-Aug-17	-	-	-	-	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Aug-17	-	-	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	-	-
7-Aug-17	-	-	-	-	-	-	-	0.0026	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
8-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	0.0013
8-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0044	-	-	-	-	-	-	-	-	-
14-Aug-17	-	-	-	-	-	-	-	0.0027	-	0.0052	-	-	-	-	-	-	-	-	-	-	-	-
15-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	0.0012
15-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0042	-	-	-	-	-	-	-	-	-
21-Aug-17	-	-	-	-	-	-	-	0.0027	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Aug-17	-	-	-	-	-	-	-	-	-	0.0051	-	-	0.0043	-	-	-	-	-	-	-	-	0.0014
22-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	-
23-Aug-17	-	-	-	-	-	-	-	0.0027	-	0.0051	-	0.0059	0.0047	-	-	-	-	-	-	-	-	0.0014
24-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00013	0.00015	0.00041	0.0014	0.0038	0.0037	0.0011	-	-
24-Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00013	0.00015	0.00041	0.0014	0.0037	-	-	-	-
27-Aug-17	0.01370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Aug-17	0.01330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Aug-17	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
28-Aug-17	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	-	-	-	-
29-Aug-17	-	0.0010	0.0072	0.0017	0.0077	0.0085	0.0051	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	-	0.0013
29-Aug-17	-	-	-	-	-	-	0.0054	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Sep-17	-	-	-	-	-	-	-	-	-	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
4-Sep-17	-	-	-	-	-	-	-	0.0028	-	0.0053	-	0.0058	-	-	-	-	-	-	-	-	-	-
5-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	0.0014
8-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0016	-
8-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0014	-

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11-Sep-17	-	-	-	-	-	-	-	0.0029	-	0.0055	-	-	-	-	-	-	-	-	-	-	-	-
12-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0046	-	-	-	-	-	-	-	-	0.0015
18-Sep-17	-	-	-	-	-	-	-	0.0027	-	0.0052	-	-	-	-	-	-	-	-	-	-	-	-
19-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	0.0013
25-Sep-17	-	-	-	-	-	-	-	0.0028	-	0.0056	-	-	-	-	-	-	-	-	-	-	-	-
26-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	0.0014
26-Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	-
2-Oct-17	-	-	-	-	-	-	-	0.0027	-	0.0052	-	-	-	-	-	-	-	-	-	-	-	-
2-Oct-17	-	-	-	-	-	-	-	0.0051	-	0.0029	-	-	-	-	-	-	-	-	-	-	-	-
3-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0046	-	-	-	-	-	-	-	0.0014	0.0013
4-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0014
9-Oct-17	-	-	-	-	-	-	-	0.0027	-	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0044	-	-	-	-	-	-	-	-	-
11-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0013
11-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0013
16-Oct-17	-	-	-	-	-	-	-	-	-	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
17-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0044	-	-	-	-	-	-	-	-	0.0013
17-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0046	-	-	-	-	-	-	-	-	-
20-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	-	-
23-Oct-17	-	-	-	-	-	-	-	-	-	0.0058	-	-	-	-	-	-	-	-	-	-	-	-
24-Oct-17	-	-	-	-	-	-	-	-	-	-	-	0.0044	0.0043	-	-	-	-	-	-	-	-	0.0011
30-Oct-17	-	-	-	-	-	-	-	-	-	0.0055	-	-	-	-	-	-	-	-	-	-	-	-
31-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	-	-
6-Nov-17	-	-	-	-	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	-	-	-	-
7-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	-
9-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00013	0.00023	0.00023	0.0031	0.0037	0.0038	0.0025	-	-
12-Nov-17	0.01100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Nov-17	-	-	-	-	-	-	-	0.0032	-	0.0059	-	-	-	-	-	-	-	-	-	-	-	-
14-Nov-17	-	0.00095	0.0079	0.0035	0.0087	0.0097	0.0057	-	-	-	-	-	0.0046	-	-	-	-	-	-	-	-	-
14-Nov-17	-	-	-	-	0.0088	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0012	-
20-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Nov-17	-	-	-	-	-	-	-	-	-	0.0061	-	-	0.0046	-	-	-	-	-	-	-	-	-
28-Nov-17	-	-	-	-	-	-	-	-	-	0.0058	-	-	0.0043	-	-	-	-	-	-	-	-	-
4-Dec-17	-	-	-	-	-	-	-	-	-	0.0053	-	-	-	-	-	-	-	-	-	-	0.0010	-
5-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0039	-	-	-	-	-	-	-	-	-
7-Dec-17	-	-	-	-	-	-	-	0.0031	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Dec-17	-	-	-	-	-	-	-	-	-	0.0060	-	-	-	-	-	-	-	-	-	-	-	-
11-Dec-17	-	-	-	-	-	-	-	-	-	0.0060	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	0.0042	-	-	-	-	-	-	-	-	-
19-Dec-17	-	-	-	-	-	-	-	-	-	0.0056	-	-	0.0043	-	-	-	-	-	-	-	-	-
26-Dec-17	-	-	-	-	-	-	-	-	-	0.0053	-	-	0.0041	-	-	-	-	-	-	-	-	-
26-Dec-17	-	-	-	-	-	-	-	-	-	0.0055	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-17	-	0.0010	0.0078	0.0040	0.0091	0.0099	0.0061	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-17	-	-	-	-	-	0.0095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Jan-18	-	-	-	-	-	-	-	-	-	0.0059	-	-	0.0062	-	-	-	-	-	-	-	-	-
2-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	-	-
8-Jan-18	-	-	-	-	-	-	-	-	-	0.0057	-	-	-	-	-	-	-	-	-	-	-	-
9-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0044	-	-	-	-	-	-	-	-	-
13-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Jan-18	-	-	-	-	-	-	-	0.0034	-	0.0058	-	-	0.0048	-	-	-	-	-	-	-	-	-

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16-Jan-18	-	-	-	-	-	-	-	-	-	0.0059	-	-	-	-	-	-	-	-	-	-	-	-
23-Jan-18	-	-	-	-	-	-	-	-	-	0.0055	-	-	0.0042	-	-	-	-	-	-	-	-	-
23-Jan-18	-	-	-	-	-	-	-	-	-	0.0055	-	-	-	-	-	-	-	-	-	-	-	-
30-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	-
30-Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0048	-	-	-	-	-	-	-	-	-
31-Jan-18	-	-	-	-	-	-	-	-	-	0.0058	-	-	-	-	-	-	-	-	-	-	-	-
6-Feb-18	-	-	-	-	-	-	-	-	-	0.0052	-	-	0.0040	-	-	-	-	-	-	-	-	-
13-Feb-18	-	-	-	-	-	-	-	0.0032	-	0.0054	-	-	0.0033	-	-	-	-	-	-	-	-	-
13-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0034	-	-	-	-	-	-	-	-	-
20-Feb-18	-	-	-	-	-	-	-	-	-	0.0043	-	-	0.0036	-	-	-	-	-	-	-	-	-
20-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0037	-	-	-	-	-	-	-	-	-
24-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Feb-18	-	-	-	-	-	-	-	-	-	0.0037	-	-	-	-	-	-	-	-	-	-	-	-
27-Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-
1-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00021	0.00025	0.00025	0.0032	0.0039	0.0042	0.0034	-	-
2-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0039	-	-	-	-
5-Mar-18	0.00883	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Mar-18	0.00891	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-Mar-18	-	-	-	-	-	-	-	-	-	0.0040	-	-	-	-	-	-	-	-	-	-	-	-
6-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0031	-	-	-	-	-	-	-	-	-
8-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Mar-18	-	0.00094	0.0078	0.0024	0.0085	0.0093	0.0056	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Mar-18	-	-	-	-	-	0.0088	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Mar-18	-	-	-	-	-	-	-	0.0040	-	0.0038	-	-	0.0037	-	-	-	-	-	-	-	-	-
13-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-
16-Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Mar-18	-	-	-	-	-	-	-	-	-	0.0047	-	-	0.0041	-	-	-	-	-	-	-	-	-
27-Mar-18	-	-	-	-	-	-	-	-	-	0.0046	-	-	0.0045	-	-	-	-	-	-	-	-	-
3-Apr-18	-	-	-	-	-	-	-	-	-	0.0046	-	-	0.0046	-	-	-	-	-	-	-	-	-
3-Apr-18	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	-	-	-	-	-
9-Apr-18	-	-	-	-	-	-	-	0.0039	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Apr-18	-	-	-	-	-	-	-	0.0038	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Apr-18	-	-	-	-	-	-	-	-	-	0.0050	-	-	0.0043	-	-	-	-	-	-	-	-	0.0022
10-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0042	-	-	-	-	-	-	-	-	-
13-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Apr-18	-	-	-	-	-	-	-	-	-	0.010	-	-	0.0049	-	-	-	-	-	-	-	-	0.0013
17-Apr-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	-	-
24-Apr-18	-	-	-	-	-	-	-	-	-	0.0054	-	-	0.0043	-	-	-	-	-	-	-	-	0.00077
24-Apr-18	-	-	-	-	-	-	-	-	-	0.0056	-	-	-	-	-	-	-	-	-	-	-	-
1-May-18	-	-	-	-	-	-	-	-	-	0.0062	-	-	0.0026	-	-	-	-	-	-	-	-	0.00037
1-May-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0029	-	-	-	-	-	-	-	-	0.00040
5-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-May-18	-	-	-	-	-	-	-	0.0015	-	0.0060	-	-	0.0028	-	-	-	-	-	-	-	-	0.00038
8-May-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	-	-	-	-
9-May-18	-	0.0015	0.0084	0.0032	0.0085	0.0095	0.0057	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-18	-	-	-	-	0.0084	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-May-18	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00016	0.00026	0.00018	0.0042	0.0041	0.0043	0.0026	-	-
11-May-19	0.02790	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-May-19	0.00879	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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14-May-18	-	-	-	-	-	-	-	0.0021	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
14-May-18	-	-	-	-	-	-	-	-	-	0.0060	-	-	-	-	-	-	-	-	-	-	-	-
15-May-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	0.00070	0.00080
19-May-18	-	-	-	-	-	-	-	0.0023	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-May-18	-	-	-	-	-	-	-	0.0022	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
22-May-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0050	-	-	-	-	-	-	-	-	0.0011
24-May-18	-	-	-	-	-	-	-	0.0023	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-May-18	-	-	-	-	-	-	-	-	-	-	-	0.0055	-	-	-	-	-	-	-	-	-	-
28-May-18	-	-	-	-	-	-	-	0.0023	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
29-May-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	0.0011
29-May-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0044	-	-	-	-	-	-	-	-	0.0014
1-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Jun-18	-	-	-	-	-	-	-	0.0026	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-Jun-18	-	-	-	-	-	-	-	0.0025	-	0.0065	-	-	-	-	-	-	-	-	-	-	0.0012	0.0013
5-Jun-18	-	-	-	-	-	-	-	-	-	0.0066	-	-	-	-	-	-	-	-	-	-	-	-
10-Jun-18	-	-	-	-	-	-	-	-	0.0025	-	0.0029	-	-	-	-	-	-	-	-	-	-	-
12-Jun-18	-	-	-	-	-	-	-	0.0025	0.0026	0.0067	0.0027	-	-	-	-	-	-	-	-	-	-	-
12-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	0.0020
12-Jun-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0041	-	-	-	-	-	-	-	-	0.0020
18-Jun-18	-	-	-	-	-	-	-	0.0026	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
19-Jun-18	-	-	-	-	-	-	-	-	0.0026	-	0.0028	0.0053	0.0038	-	-	-	-	-	-	-	-	0.0021
25-Jun-18	-	-	-	-	-	-	-	0.0027	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
25-Jun-18	-	-	-	-	-	-	-	0.0027	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Jun-18	-	-	-	-	-	-	-	-	0.0027	-	0.0027	-	0.0038	-	-	-	-	-	-	-	-	0.0022
2-Jul-18	-	-	-	-	-	-	-	0.0027	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
3-Jul-18	-	-	-	-	-	-	-	-	0.0027	-	0.0026	-	0.0046	-	-	-	-	-	-	-	0.0012	0.0018
9-Jul-18	-	-	-	-	-	-	-	0.0028	-	0.0068	-	-	-	-	-	-	-	-	-	-	-	-
10-Jul-18	-	-	-	-	-	-	-	-	-	-	-	0.0053	0.0048	-	-	-	-	-	-	-	-	-
11-Jul-18	-	-	-	-	-	-	-	0.0026	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
16-Jul-18	-	-	-	-	-	-	-	0.0026	-	0.0062	-	-	-	-	-	-	-	-	-	-	-	-
17-Jul-18	-	-	-	-	-	-	-	-	0.0025	-	0.0026	-	0.0044	-	-	-	-	-	-	-	-	-
17-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0048	-	-	-	-	-	-	-	-	-
23-Jul-18	-	-	-	-	-	-	-	0.0028	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jul-18	-	-	-	-	-	-	-	-	-	0.0063	-	-	0.0048	-	-	-	-	-	-	-	-	-
24-Jul-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0050	-	-	-	-	-	-	-	-	-
30-Jul-18	-	-	-	-	-	-	-	0.0028	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-Jul-18	-	-	-	-	-	-	-	-	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
31-Jul-18	-	-	-	-	-	-	-	-	-	0.0063	-	-	-	-	-	-	-	-	-	-	-	-
6-Aug-18	-	-	-	-	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Aug-18	-	-	-	-	-	-	-	-	-	0.0064	-	-	0.0050	-	-	-	-	-	-	-	-	-
7-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	-	0.0019
11-Aug-18	-	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-18	-	-	-	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-	-	-
13-Aug-18	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Aug-18	-	-	-	-	-	-	-	-	-	0.0065	-	-	0.0049	-	-	-	-	-	-	-	-	0.0014
14-Aug-18	-	-	-	-	-	-	-	-	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
18-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Aug-18	-	-	-	-	-	-	-	0.0031	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Aug-18	-	-	-	-	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Aug-18	-	-	-	-	-	-	-	-	-	0.0064	-	-	-	-	-	-	-	-	-	-	0.0015	-
21-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0015	-
23-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00022	**0.00013**	0.00017	0.0023	0.0046	0.0052	0.0027	-	-
23-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0048	-	-	-	-

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Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																					
	MW17-12-08	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05	MW12-06-06	W16	W16a	W17	W50	AMP1-b	W3	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07	W7	W2
24-Aug-18	0.00803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Aug-18	-	0.00095	0.0086	0.0016	0.0082	0.0095	0.0061	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Aug-18	-	-	-	-	-	-	-	0.0023	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28-Aug-18	-	-	-	-	-	-	-	-	0.0028	0.0064	0.0028	0.0049	0.0036	-	-	-	-	-	-	-	-	0.0015
28-Aug-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0044	-	-	-	-	-	-	-	-	0.0016
3-Sep-18	-	-	-	-	-	-	-	0.0028	-	0.0066	-	-	-	-	-	-	-	-	-	-	0.0015	-
3-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0014	-
4-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	0.0013
11-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	-	0.0014
12-Sep-18	-	-	-	-	-	-	-	0.0030	-	0.0066	-	-	-	-	-	-	-	-	-	-	-	-
17-Sep-18	-	-	-	-	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Sep-18	-	-	-	-	-	-	-	-	-	0.0064	-	-	0.0048	-	-	-	-	-	-	-	-	0.0012
24-Sep-18	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Sep-18	-	-	-	-	-	-	-	-	-	0.0061	-	0.0049	0.0048	-	-	-	-	-	-	-	-	0.0013
25-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0047	-	-	-	-	-	-	-	-	-
28-Sep-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Oct-18	-	-	-	-	-	-	-	0.0028	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Oct-18	-	-	-	-	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Oct-18	-	-	-	-	-	-	-	-	-	0.0057	-	-	0.0050	-	-	-	-	-	-	-	-	-
5-Oct-19	-	-	-	-	-	-	-	-	-	-	-	0.0048	-	-	-	-	-	-	-	-	-	-
8-Oct-18	-	-	-	-	-	-	-	0.0031	-	-	-	-	-	-	-	-	-	-	-	-	0.0013	-
9-Oct-18	-	-	-	-	-	-	-	-	-	0.0062	-	-	0.0052	-	-	-	-	-	-	-	-	-
9-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	-
15-Oct-18	-	-	-	-	-	-	-	0.0021	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Oct-18	-	-	-	-	-	-	-	-	-	0.0060	-	-	0.0052	-	-	-	-	-	-	-	-	-
16-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	-
20-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00023	0.00014	0.00021	0.0022	0.0043	0.0051	0.0027	-	-
23-Oct-18	0.00787	-	-	-	-	-	-	-	-	0.0061	-	-	0.0051	-	-	-	-	-	-	-	-	-
23-Oct-18	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
25-Oct-18	-	0.0011	0.0092	0.0020	0.0083	0.0092	0.0057	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Oct-18	-	-	-	-	-	0.0093	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Oct-18	-	-	-	-	-	-	-	-	-	0.0060	-	-	0.0051	-	-	-	-	-	-	-	-	-
30-Oct-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0045	-	-	-	-	-	-	-	-	-
6-Nov-18	-	-	-	-	-	-	-	-	-	0.0059	-	-	0.0047	-	-	-	-	-	-	-	-	-
6-Nov-18	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
13-Nov-18	-	-	-	-	-	-	-	-	-	0.0057	-	-	0.0046	-	-	-	-	-	-	-	-	-
13-Nov-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0048	-	-	-	-	-	-	-	-	-
19-Nov-18	-	-	-	-	-	-	-	0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-Nov-18	-	-	-	-	-	-	-	-	-	0.0058	-	-	0.0049	-	-	-	-	-	-	-	-	-
20-Nov-18	-	-	-	-	-	-	-	-	-	0.0059	-	-	-	-	-	-	-	-	-	-	-	-
27-Nov-18	-	-	-	-	-	-	-	-	-	0.0060	-	-	0.0049	-	-	-	-	-	-	-	-	-
27-Nov-18	-	-	-	-	-	-	-	-	-	0.0060	-	-	0.0052	-	-	-	-	-	-	-	-	-
1-Dec-18	-	-	-	-	-	-	-	0.0033	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Dec-18	-	-	-	-	-	-	-	-	-	0.0058	-	-	0.0055	-	-	-	-	-	-	-	-	-
4-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	-	-
11-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	-
12-Dec-18	-	-	-	-	-	-	-	-	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
12-Dec-18	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-

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Date	Station																				
	MW17-12-08	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05	MW12-06-06	W16	W16a	W17	W50	AMP1-b	W3	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07	W7	W2
18-Dec-18	-	-	-	-	-	-	-	-	-	0.0065	-	-	0.0053	-	-	-	-	-	-	-	-	-
18-Dec-18	-	-	-	-	-	-	-	-	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
25-Dec-18	-	-	-	-	-	-	-	-	-	0.0063	-	-	0.0052	-	-	-	-	-	-	-	-	-
25-Dec-18	-	-	-	-	-	-	-	-	-	-	-	-	0.0058	-	-	-	-	-	-	-	-	-
31-Dec-18	-	-	-	-	-	-	-	-	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-18	-	-	-	-	-	-	-	-	-	0.0062	-	-	-	-	-	-	-	-	-	-	-	-
1-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0050	-	-	-	-	-	-	-	-	-
4-Jan-19	-	-	-	-	-	-	-	0.0034	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Jan-19	-	-	-	-	-	-	-	-	-	0.0062	-	-	0.0052	-	-	-	-	-	-	-	-	-
8-Jan-19	-	-	-	-	-	-	-	-	-	0.0062	-	-	-	-	-	-	-	-	-	-	-	-
15-Jan-19	-	-	-	-	-	-	-	-	-	0.0061	-	-	0.0049	-	-	-	-	-	-	-	-	-
15-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0054	-	-	-	-	-	-	-	-	-
20-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jan-19	-	-	-	-	-	-	-	-	-	0.0060	-	-	0.0053	-	-	-	-	-	-	-	-	-
22-Jan-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0053	-	-	-	-	-	-	-	-	-
29-Jan-19	-	-	-	-	-	-	-	-	-	0.0059	-	-	0.0046	-	-	-	-	-	-	-	-	-
29-Jan-19	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
5-Feb-19	-	-	-	-	-	-	-	-	-	0.0060	-	-	0.0045	-	-	-	-	-	-	-	-	-
5-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0055	-	-	-	-	-	-	-	-	-
8-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Feb-19	-	-	-	-	-	-	-	0.0036	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Feb-19	-	-	-	-	-	-	-	-	-	0.0064	-	-	0.0039	-	-	-	-	-	-	-	-	-
12-Feb-19	-	-	-	-	-	-	-	-	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
14-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00021	0.00040	0.00030	0.0039	0.0049	0.0050	0.0035	-	-
15-Feb-19	0.00811	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Feb-19	-	-	-	-	-	-	-	-	-	0.0064	-	-	0.0038	-	-	-	-	-	-	-	-	-
19-Feb-19	-	-	-	-	-	-	-	-	-	0.0062	-	-	-	-	-	-	-	-	-	-	-	-
23-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Feb-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Feb-19	-	-	0.0088	0.0034	0.0083	0.0092	0.0058	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25-Feb-19	-	-	-	0.0014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Feb-19	-	-	-	-	-	-	-	-	-	0.0062	-	-	0.0036	-	-	-	-	-	-	-	-	-
26-Feb-19	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
4-Mar-19	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
4-Mar-19	-	-	-	-	-	-	-	-	-	0.0059	-	-	-	-	-	-	-	-	-	-	-	-
5-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	-	-
9-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Mar-19	-	-	-	-	-	-	-	0.0034	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Mar-19	-	-	-	-	-	-	-	-	-	0.0066	-	-	0.0046	-	-	-	-	-	-	-	-	-
12-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0037	-	-	-	-	-	-	-	-	-
19-Mar-19	-	-	-	-	-	-	-	-	-	0.0063	-	-	0.0045	-	-	-	-	-	-	-	-	-
19-Mar-19	-	-	-	-	-	-	-	-	-	0.0062	-	-	-	-	-	-	-	-	-	-	-	-
25-Mar-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0038	-	-	-	-	-	-	-	-	-
26-Mar-19	-	-	-	-	-	-	-	-	-	0.0065	-	-	0.0050	-	-	-	-	-	-	-	-	-
26-Mar-19	-	-	-	-	-	-	-	-	-	0.0067	-	-	-	-	-	-	-	-	-	-	-	-
2-Apr-19	-	-	-	-	-	-	-	-	-	0.0063	-	-	0.0049	-	-	-	-	-	-	-	-	-
2-Apr-19	-	-	-	-	-	-	-	-	-	0.0063	-	-	-	-	-	-	-	-	-	-	-	-
9-Apr-19	-	-	-	-	-	-	-	-	-	0.0064	-	-	0.0052	-	-	-	-	-	-	-	-	0.0021
9-Apr-19	-	-	-	-	-	-	-	-	-	0.0066	-	-	-	-	-	-	-	-	-	-	-	-
15-Apr-19	-	-	-	-	-	-	-	-	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).

Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

Table 2: **Dissolved Molybdenum (mg/L) in Minto Mine Effluent, Groundwater, and Surface Water Samples, 2016 to 2019**

Date	Station																				
	MW17-12-08	MW12-06-01	MW12-06-02	MW12-06-03	MW12-06-04	MW12-06-05	MW12-06-06	W16	W16a	W17	W50	AMP1-b	W3	MW12-05-01	MW12-05-02	MW12-05-03	MW12-05-04	MW12-05-05	MW12-05-06	MW12-05-07	W7	W2
16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	0.0015
16-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0049	-	-	-	-	-	-	-	-	-
19-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Apr-19	-	-	-	-	-	-	-	0.00078	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
23-Apr-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0019	-	-	-	-	-	-	-	-	0.0010
30-Apr-19	-	-	-	-	-	-	-	-	-	0.0066	-	-	0.0047	-	-	-	-	-	-	-	-	0.00099
4-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00023	-	0.00023	-	0.0049	0.0045	0.0031	-	-
4-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00020	-	-	-	-	-	-	-	-
5-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6-May-19	0.00712	-	-	-	-	-	-	0.0027	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
6-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-May-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0050	-	-	-	-	-	-	-	-	0.0012
7-May-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0059	-	-	-	-	-	-	-	-	-
9-May-19	-	0.0011	0.0095	0.0024	0.0088	0.0095	0.0056	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-May-19	-	0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-May-19	-	-	-	-	-	-	-	-	-	0.0070	-	-	-	-	-	-	-	-	-	-	-	-
14-May-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0050	-	-	-	-	-	-	-	0.0011	0.0012
15-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-May-19	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00040	0.00019	0.00041	0.0021	0.0047	0.0046	0.0029	-	-
20-May-19	-	-	-	-	-	-	-	-	-	0.0063	-	-	-	-	-	-	-	-	-	-	-	-
20-May-19	-	-	-	-	-	-	-	-	-	0.0064	-	-	-	-	-	-	-	-	-	-	-	-
21-May-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0054	-	-	-	-	-	-	-	-	0.0010
27-May-19	-	-	-	-	-	-	-	-	-	-	-	0.0052	-	-	-	-	-	-	-	-	-	-
28-May-19	-	-	-	-	-	-	-	-	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	0.0010
3-Jun-19	-	-	-	-	-	-	-	0.0032	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-19	-	-	-	-	-	-	-	-	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
4-Jun-19	-	-	-	-	-	-	-	-	-	-	0.0059	-	0.0040	-	-	-	-	-	-	-	-	-
4-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0057	-	-	-	-	-	-	-	-	0.0011
7-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Jun-19	-	-	-	-	-	-	-	-	-	0.0061	-	-	-	-	-	-	-	-	-	-	-	-
11-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0055	-	-	-	-	-	-	-	-	0.0013
11-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0054	-	-	-	-	-	-	-	-	0.0014
17-Jun-19	-	-	-	-	-	-	-	-	-	0.0063	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-19	-	-	-	-	-	-	-	-	-	0.0065	-	-	-	-	-	-	-	-	-	-	-	-
18-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0051	-	-	-	-	-	-	-	-	0.00096
24-Jun-19	-	-	-	-	-	-	-	-	-	0.0059	-	-	-	-	-	-	-	-	-	-	-	-
25-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0053	-	-	-	-	-	-	-	-	0.0016
25-Jun-19	-	-	-	-	-	-	-	-	-	-	-	-	0.0053	-	-	-	-	-	-	-	-	0.0018

Note: Bolded values are less than the laboratory reporting limit (LRL) and presented as 1/2x LRL.

Shading indicates that the value exceeded the worst case water quality predictions (0.0015 mg/L).

Shading indicates that the value exceeded the water quality objectives (0.073 mg/L).

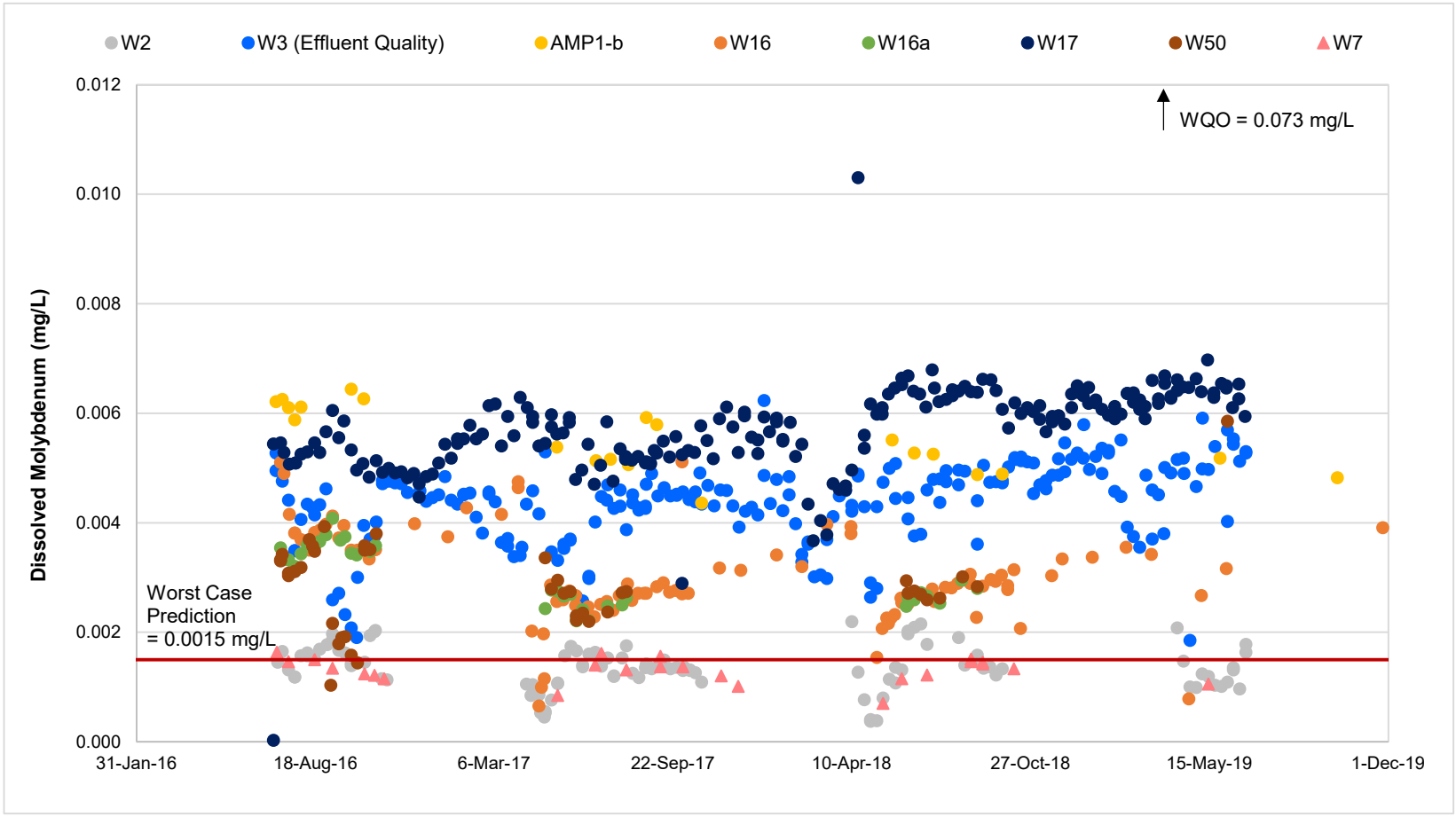


Figure 2: Dissolved Molybdenum Concentrations (mg/L) in Effluent and Surface Water Samples, Minto Mine, 2016 to 2019

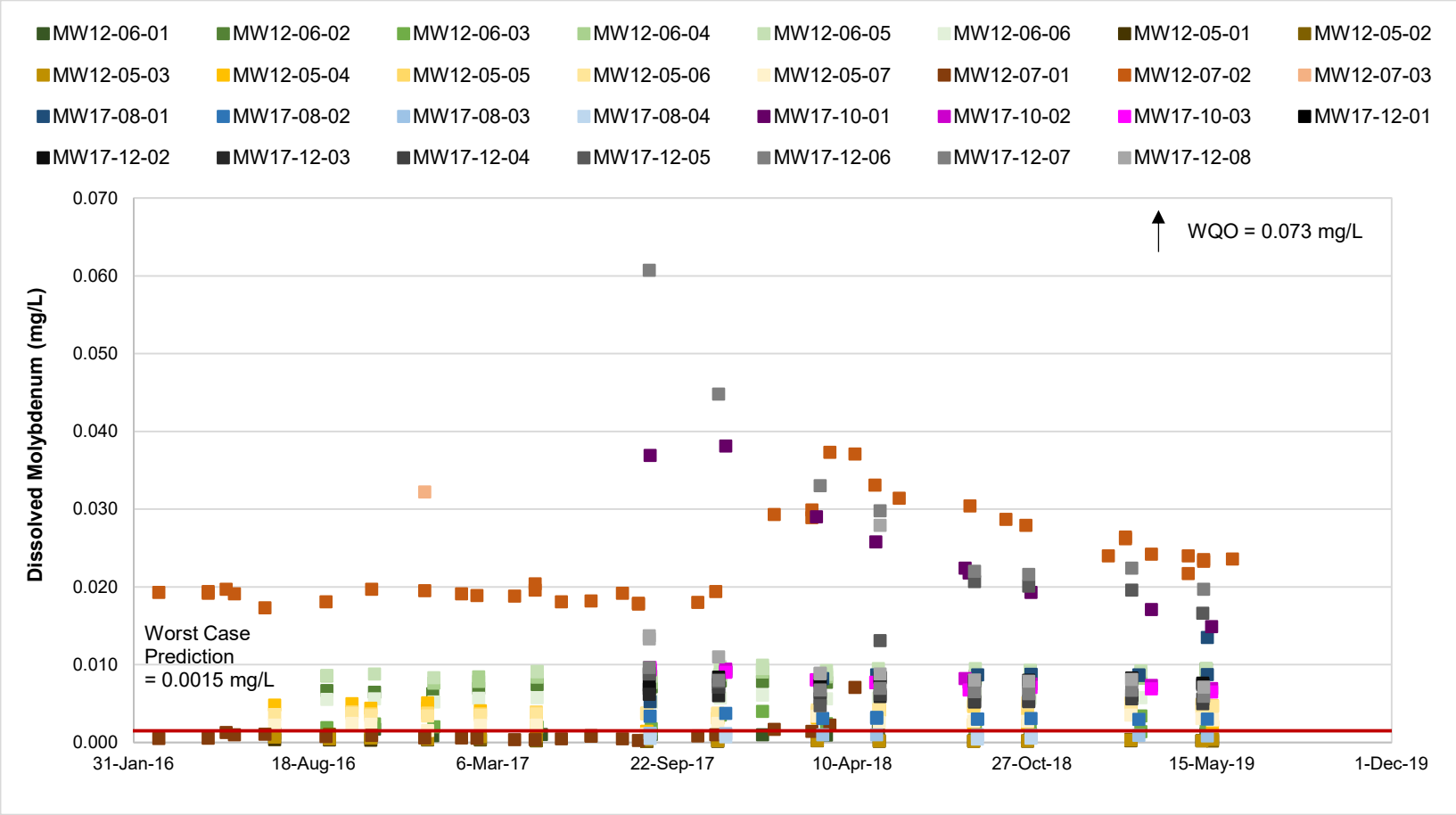


Figure 3: Dissolved Molybdenum Concentrations (mg/L) in Groundwater Water Samples, Minto Mine, 2016 to 2019

Table 3: Sampling Depths (m) from Surface at Groundwater Wells

Groundwater Station		Sampling Depth from Surface (m)
MW17-08	1	44.0
	2	33.0
	3	22.5
	4	7.5
MW17-10	1	85.5
	2	75.0
	3	61.0
MW12-07	1	115.2
	2	87.5
	3	66.3
MW12-06	1	142.3
	2	122.5
	3	92.6
	4	66.1
	5	35.0
	6	18.2
MW17-12	1	140.5
	2	127.0
	3	109.0
	4	98.5
	5	79.0
	6	68.5
	7	47.0
	8	34.0
MW12-05	1	132.5
	2	109.7
	3	94.4
	4	65.5
	5	48.7
	6	25.6
	7	14.9

dissolved molybdenum concentrations at groundwater upwell Station AMP1-b, were higher than concentrations at Station W3 (Table 2, Figures 2 and 3). This also occurred at groundwater stations MW17-12 and MW17-08 (Tables 2, Figures 2 and 3). Dissolved molybdenum concentrations at groundwater Station MW12-05 (downstream of Station W3) were below the expected case water quality predictions at the lowest depths (from surface) but were similar to those at Station W3 at higher depths (Tables 2 and 3, Figures 2 and 3).

Collectively, the analysis of spatial and temporal patterns of dissolved molybdenum in surface water and groundwater reporting to Minto Creek suggest that the source of elevated concentrations of dissolved molybdenum is groundwater influence. Furthermore, it appears that the elevated concentrations of molybdenum in groundwater may not be due to mine influence as elevated concentrations were observed in groundwater monitoring wells that are considered not to have been influenced by the mine. For example, Station AMP1-b is not mine-influenced; rather it is a natural groundwater spring that daylights north of Minto Creek. Similarly, Station MW17-12 located near Minto Creek is also considered a regional well that would represent natural groundwater conditions for the area. Station MW17-08 (at the well's lowest depth of 44.0 m) also had molybdenum concentrations greater than those at Station W3 and was considered a regional natural groundwater station. All of these associated molybdenum concentrations were higher than concentrations at Station W2 and were considered to be natural. Lastly, it is noted that concentrations of dissolved molybdenum at all sources were lower than Minto Mine's WQO (0.073 mg/L; Figure 2) indicating that the observed exceedances of predicted worst-case maximum concentrations would have no ecological impacts on the environment.

Conclusions and Recommendations

Dissolved molybdenum exceeded predicted worst-case maximum concentrations at Minto Creek Station W2 and the source was determined to be groundwater inputs, but these inputs were consistent with natural groundwater inputs. Dissolved molybdenum concentrations at all surface and groundwater stations were well below Minto's Mine WQO and below natural conditions, so effects to aquatic life would not be expected.

It is recommended that sampling continue as scheduled since concentrations are not expected to affect aquatic life. Increased monitoring frequency is not required at this time.

Sincerely,

Minnow Environmental Inc.



Lisa Bowron, M.Sc., R.P.Bio.

Aquatic Toxicologist

cc: Pierre Stecko, M.Sc., R.P.Bio., EP

Senior Aquatic Scientist / Managing Principal

References

Minto (Minto Explorations Ltd.). 2017. Minto Mine Operations Adaptive Management Plan 2017-01. Prepared on January 2017.

Appendix J – 2019 AMP Groundwater SRK Memos

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January 17, 2020
Project No: 1CM002.055

Pembridge Resources PLC
Minto Mine
PO Box 11
Whitehorse, YT Y1A5X9

Attention: Todd Swenson, Environmental Manager

Dear Todd:

Subject: 2019 Q1 (January - March) Groundwater AMP Events

The Minto Mine Operational Adaptive Management Plan was updated in 2018 for groundwater monitoring, with the review frequency for groundwater triggers changed from monthly to quarterly, at the recommendation of the qualified professional (QP). As per AMP2017-02, all data concerning trigger exceedances are sent to the QP within a week of discovery and included in the subsequent review. This letter is the first 2019 quarterly review under the updated reporting schedule.

As part of the Minto Mine Operational Adaptive Management Plan, Minto Mine has collected and reviewed groundwater quality data. Minto completed an initial review of data collected at the McGinty Creek groundwater monitoring station (MW09-03) and Minto Creek groundwater monitoring stations MW12-05 and MW12-06 for the first quarter of 2019 (January - March) and compared results to specific performance thresholds (SPT) defined in the Minto Mine Operations Adaptive Management Plan (MEL, 2017-02). McGinty Creek monitoring stations are required to be sampled monthly while the Minto Creek stations are sampled quarterly. MW12-06 was not sampled in Q1 due to the presence of glycol in the well. For Minto Creek stations, MEL identified exceedances of certain thresholds for sampling rounds conducted in January, February and March of 2019 and, as per the plan, has contracted a QP to review those data and provide recommendations. SRK Consulting (Canada) Inc. was contacted by Minto environmental staff on April 1, 2019 to provide QP review. This letter presents results of that review and recommendations.

SRK compared data against the 2017-02 AMP thresholds, historical data and data from surface water at station MN4.5 in lower McGinty Creek and surface water stations W3 and MC1 in Minto Creek. Groundwater SPT exceedances (events) have occurred for a limited number of parameters and do not necessarily correlate with distance from mining activities. Some of these events may reflect elevated background concentrations that were not identified prior to start of mining because monitoring wells were not in place at that time. Table 1 (Appendix A) summarizes exceedances, observations on the data, interpretation and recommendations. Figures are included with this review to illustrate the current physical (i.e., water level) setting compared to the Minto North pit (Appendix B). Graphs are included for each parameter exceeding thresholds and includes the full range of data collected to date.

Key conclusions and recommendations are summarized below. Table 1 (Appendix A) summarizes observations and recommendations for all parameters.

For MW09-03 (McGinty Creek):

- The Minto Pit is not a source of water to the groundwater monitored at this station; water levels in the monitoring well are higher than the pit water level. Water levels in the pit have been increasing slowly but remain well below the monitoring well water levels. These data continue to show no hydraulic gradient from the pit towards the monitoring well.
- Water levels at this station have been affected by the mining of Minto North, but the groundwater divide between Minto North and McGinty Creek remains, somewhere in the vicinity of MW09-03.
- Water levels in MW17-11 are generally lower than in MW09-03, with the exception of zone 5 which is screened shallower than zones 1 and 2 in MW09-03. Water levels in MW17-11 and MW09-03 indicate an overall downward gradient between the shallow-most zone and the remaining deeper zones. Differences in water level between deep zones are less pronounced, and a vertical gradient is not clear.
  - Recommendation: continue collecting water level/pressure profiles at this well according to the routine schedule.
- Concentrations of dissolved arsenic at MW09-03-01 have consistently exceeded SPT 1 since summer of 2016, and inconsistently exceeded thresholds in MW-09-02 in the same period. High variability is observed, but relatively recent data in MW09-03-01 exceeds thresholds more frequently than in the past and the most recent value in MW09-03-01 from October 2018 was nearly an order of magnitude higher than every previously measured value. Since then, concentrations have decreased to the historic range, suggesting the value from October 2018 was an outlier. High concentrations do not correlate exactly with seasonal changes in groundwater level but may indicate an influence from seasonal variation (in recharge, flow, etc.). Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during freshet, possibly suggesting greater mobilization of trace elements when higher volumes of water could infiltrate through the unsaturated zone and mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.
- Concentrations of dissolved cadmium at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 in the past with high variability in the observed data. Recent cadmium data exceed thresholds more frequently in 2017 and 2018 than in the past and while average concentrations have increased beginning in 2017, there is no consistent increasing trend with many values in the last two years below the threshold. No exceedances were detected in MW09-03-01 in Q1 2019, but all three months of Q1 2019 had concentrations that exceeded SPT 1 in MW09-03-02. Seasonal variability seems to be present, with highest concentrations occurring in Q1 and Q2. Cadmium concentrations in McGinty Creek remain low and stable, showing no impact from the groundwater.
- Concentrations of dissolved zinc at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 and SPT 2 thresholds since the summer of 2016. High variability is observed in the data, but relatively recent data exceeds thresholds more frequently than in the past. Peak concentrations were reached in Q1 2018 but have since decreased. High concentrations do not correlate exactly with

seasonal changes in groundwater level but may indicate an influence from seasonal variation. Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during freshet when higher volumes of water infiltrate through the unsaturated zone and mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  – Recommendation: Although concentrations have been increasing in the recent past, Water Quality Objectives defined for McGinty Creek are two or three orders of magnitude higher than the thresholds defined for groundwater (Table 2.5 - Minto Mine Operations Adaptive Management Plan, 2018-01) and the overall risk posed by groundwater loading remains low. Due to this, limited actions are recommended at this time. Continue monitoring as per schedule. Continue to look for seeps from the haul road that can be used for comparison. Compare vertical concentration profiles in MW17-11 as more annual data becomes available.

- Concentrations of dissolved nitrate at MW09-03-02 have exceeded SPT 2 since the fall of 2016 but remain stable and below both SPTs in the deeper zone, MW09-03-01. Concentrations showed an increasing trend from October 2016 to December 2017, showed the potential for a decreasing trend in Q1 of 2018 but increased in the latter half of 2018. Values in Q1 2019 are lower than 2018, when peak concentrations were measured. As the Minto North Pit acts as a hydraulic sink, the likely source of nitrate to the groundwater is flushing of blast residuals from the rock used to construct the mine haul road on the topographically downgradient side of the Minto North Pit. The effect is expected to be relatively short lived, as the blasting residuals will flush out over time. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  – Recommendation: Due to the low potential loading of groundwater into McGinty Creek limited action is recommended at this time, but will be discussed in more detail in the 2019 annual report. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road and continue to compare data from MW09-03-02 and MN-4.5 to confirm low nitrate concentrations persist in McGinty Creek.

For MW12-05 and MW12-06 (Minto Creek):

- Water level data in the deepest zone of MW12-06 decreased sharply between November 2017 and March 2018, which coincides with development of the Minto East underground. Water levels in the deepest zone increased again between May and August 2018, when development of the underground stopped. The same trend was not observed in MW12-05 or MW17-12, suggesting these wells are currently outside the area of groundwater affected by the development of the underground. Seasonal fluctuations are apparent in MW12-05, with peak water levels occurring in Q2 of the past 2 years.

  – Recommendation: continue collecting water level/pressure profiles at this well according to the routine schedule. Continue to monitor changes in groundwater pressure as system equilibrates following the cessation of Minto East underground development.

- Concentrations of sulphate at MW12-05-1 and MW12-05-02 continue to be elevated above SPT 2. Concentrations at MW12-05-01 and MW12-05-02 were increasing historically but show signs of stabilization after August 2017, suggesting sulphate concentrations may be approaching equilibrium.

The most recent data point from February 2019 is the highest recorded in MW12-05-01 but does not show the same rate of increase as was observed prior to 2017. Sulphate exceedances have been restricted to the deeper zones, which monitor depths greater than 85 meters below ground surface (mbgs). Shallower zones and surface water stations in Minto Creek, downstream of the mine footprint, display stable trends in sulphate at far lower concentrations than Zone 1 and 2. While concentrations have been increasing in both MW12-05 and the Main Pit, the rate and timing of increase differs with a slow increase in the Main Pit until Q3 of 2016 when concentrations jumped over 1000 mg/L within a year and a consistent steady increase in MW12-05 that began to level off in Q1 2017. Additionally, chloride concentrations (another conservative tracer) also changed at different rates and times in the Main Pit and MW12-05. Chloride at the Main Pit has been decreasing since 2018, while concentrations at MW12-05 have remained stable at lower concentrations than the pit. Observed concentrations of sulphate at MW12-05 may not be related to water in the Main Pit. For comparison, sulphate concentrations in MW17-12 exhibit increasing concentration with depth but no increasing trend over time. Minto Creek continues to indicate no trends in sulphate concentration that can clearly be related to changes in groundwater concentrations

– Recommendation: continue monitoring as per schedule and continue with investigations as part of the overall review of site groundwater quality.

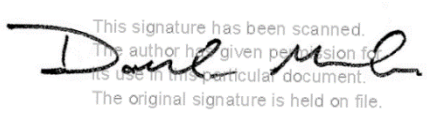
Sincerely,

SRK Consulting (Canada) Inc.



Laura Volden, MSc, GIT
Consultant

Reviewed by



Daniel Mackie, PGeo
Principal Consultant

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Minto Explorations Ltd.. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data

Appendix A: Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

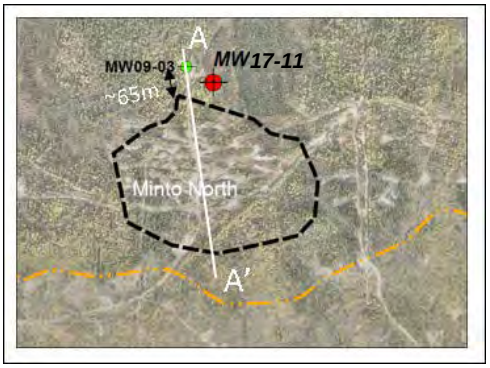
Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
McGinty Creek Catchment								
MW09-03-01 Figure A-1, A-2		As-D	mg/L		**Water Level (Figure A-1):** Water levels in MW09-03 Zone 1 and Zone 2 started declining when mining started in Minto North. Declining trend decreased about 6 months after mining completed. Water levels remain higher than pit bottom. Water levels increased between July and September 2016 before returning to previous trend. Similar trend occurred in 2017 when water levels increased between April and September, declined until May 2018 and increased again until September. Water levels have been declining in Q1 2019 as part of a seasonal trend with highest water levels occurring in the fall each year. Minto North pit continues to act as a hydraulic sink, and has lowered groundwater levels. Water levels at MW09-03 suggest the presence of a groundwater divide somewhere north of the pit. Late summer 2016 and 2017 and Q2 of 2018 water level increase suggests some influence from recharge. **Water Quality (Figure A-2):** Concentration in October 2018 much higher than all previous data but has since decreased in Q1 2019. Seasonal variations appear to be present, with highest values occurring the summer months the last 2 years, with the exception of October 2018. No data are available for Q1 2019 but As-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	While data from late summer 2015 to August 2017 showed signs of an increasing trend, values exhibit significant variability throughout the year. Peak values during Q2 and Q3 suggest a seasonal trend related to freshet may be present. Elevated value in October 2018 was an isolated occurrence and have since gone back down to normal ranges.	Lack of any clear upwards trend in McGinty Creek, as measured at MN-4.5, suggests currently no impact. Water quality objective at MN-4.5 is 3 orders of magnitude higher than SPT 2. Overall risk of arsenic loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	January	1/19/2019	0.00068	0.00011 (SPT 1)				
	February	2/2/2019	0.00089	0.00081 (SPT 2)				
	March	3/9/2019	0.00084	0.00081 (SPT 2)				
MW09-03-01 Figure A-1, A-3		Mo-D	mg/L		**Water Level (Figure A-1):** see previous section. Water Quality (Figure A-3): Exceedances to SPT 1 have been occurring consistently in the past with highest concentrations detected in 2016. Since then, concentrations have been lower and less variable with values that are near SPT 1 in Q1 2019. No data are available for Q1 2019 but Mo-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Peak values near the end of Q2/start of Q3 suggest a seasonal trend related to freshet may be present.	Lack of any clear upwards trend in McGinty Creek, as measured at MN-4.5, suggests currently no impact. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of molybdenum loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	January	1/19/2019	0.00513	0.005 (SPT 1)				
	February	2/2/2019	0.00574	0.005 (SPT 1)				
	March	3/9/2019	0.00525	0.005 (SPT 1)				
MW09-03-01 Figure A-1, A-3		Se-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-3)**: Exceedances to SPT 1 have been occurring sporadically since 2016. Concentrations in Q1 of 2019 are generally lower than in Q1 2018 with only one exceedance in January. No data are available for Q1 2019 but Se-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in 2018 were more variable than past years but with no discernable trend. Values in Q1 2019 showed less variability with only one exceedance to SPT 1. Elevated concentrations in Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of selenium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	January	1/19/2019	0.000128	0.0001 (SPT 1)				
	February	-	-					
	March	-	-					
MW09-03-01 Figure A-1, A-4		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations sporadically exceed SPT 1 and SPT 2 but with overall lower values in 2019 than previous 2 years. No data are available for Q1 2019 but Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations from Q1 2019 are lower than peak concentrations measured in Q1 2018 by approximately half. Potential increasing trend for late winter low flow period but values are back below SPT 1 in May and June 2018. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low due to low K. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of zinc loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	January	1/19/2019	0.0392	0.022 (SPT 2)				
	February	2/2/2019	0.0327	0.022 (SPT 2)				
	March	3/9/2019	0.0317	0.022 (SPT 2)				
MW09-03-02 Figure A-1, A-2		Cd-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** While values have been decreasing in Q1 2019, the highest concentration to date was recorded in January 2019. Value from March 2019 is below the average value in 2018. No data are available for Q1 2019 but Cd-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	No identifiable consistent trend in Cd-D. Although annual average is increasing, values within Q1 2019 decreased significantly from January to March. Peak concentrations during late Q1/early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of cadmium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	January	1/19/2019	0.000136	0.000031 (SPT 1)				
	February	2/2/2019	0.000085	0.000031 (SPT 1)				
	March	3/9/2019	0.0000476	0.000031 (SPT 1)				
MW09-03-02 Figure A-1, A-4		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations sporadically exceed SPT 1 and SPT 2 but with overall lower values in 2019 than previous 2 years. No data are available for Q1 2019 but Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations from Q1 2019 are lower than peak concentrations measured in Q1 2018 by approximately half. Potential increasing trend for late winter low flow period but values are back below SPT 1 in May and June 2018. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low due to low K. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of zinc loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	January	1/19/2019	0.164	0.015 (SPT 2)				
	February	2/2/2019	0.0493	0.015 (SPT 2)				
	March	3/9/2019	0.0449	0.015 (SPT 2)				
MW09-03-02 Figure A-1, A-4		NO_3^--D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-5):** Values decreasing in Q1 of 2019 and lower than October 2018 which had a concentration that was the highest on record and almost two orders of magnitude higher than SPT 2. No data are available for Q1 2019 but NO_3^--D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Clear upward trend from May 2015-December 2017. Higher variability in 2018 but with highest value recorded occurring in October. Values in Q1 2019 have been decreasing, but still significantly higher than SPT 2.	McGinty Creek, as observed at MN-4.5, does not show increasing or decreasing trends similar to MW09-03-02. Considering the small catchment area for MW09-03-02, even if the well is affected by local recharge, potential loading to McGinty Creek via this groundwater is likely low.	Limited action at this time. Continue monitoring as per routine schedule, continue to look for opportunities to collect samples from surface seeps emanating from haul road and continue to compare data from MW09-03-02 and MN-4.5 to confirm low nitrate concentrations persist in McGinty Creek.
	January	1/19/2019	3.79	0.07 (SPT 2)				
	February	2/2/2019	3.55	0.07 (SPT 2)				
	March	3/9/2019	3.29	0.07 (SPT 2)				

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
Minto Creek Catchment								
MW12-05-01 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1):** Water levels show increasing trends in the fall to late winter seasons, followed by a decrease throughout the summer. Water levels in Q1 are similar to levels at the same time of year in 2018. While more data is needed to be certain, the trends are likely due to a seasonal fluctuation. Overall vertical gradient remains downward, with a noticeable difference in water levels occurring between zones 4 and 5. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, stabilized around 1200 mg/L for the majority of 2018 but are showing an increasing trend since Q4 2018. No data are available from Q1 2019 but SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Previously observed upwards trend shows signs of stabilization after August 2017 with a slight increase again since Q4 2018. Most recent concentrations are highest detected, but not significantly increased from previous sampling event. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but not likely connected to groundwater at MW12-05.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	January	N/A	N/A					
	February	2/14/2019	1270	1000 (SPT 2)				
	March	N/A	N/A					
MW12-05-02 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1):** see previous section. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, since then values have stabilized. October 2018 concentration was higher than previously in 2018 but has since decreased in Q1 2019. No data are available from Q1 2019 but SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Concentrations appeared to be increasing in 2018 but with a decrease in the most recent value. Values are slightly lower than MW12-05-01. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but not likely connected to groundwater at MW12-05.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	January	N/A	N/A					
	February	2/14/2019	1120	1000 (SPT 2)				
	March	N/A	N/A					

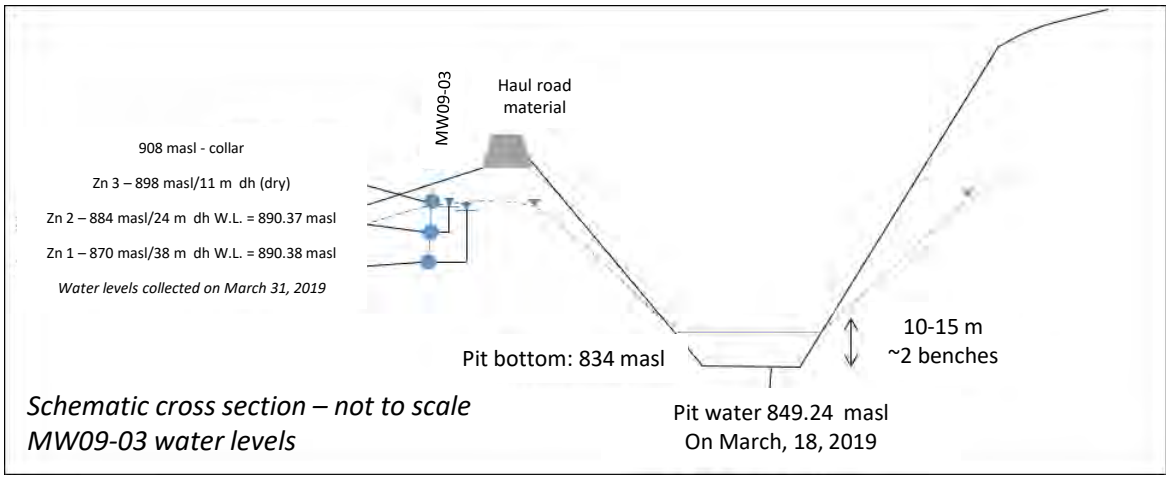
Notes:
'N/A' indicates no sample was taken for that month
'-' indicates value for that month did not trigger a response
Zones with no data or no exceedances: MW09-03-03 (dry), MW12-05-03, MW12-05-04, MW12-05-05, MW12-05-06, MW12-05-07, MW12-06-01, MW12-06-02, MW12-06-03, MW12-06-04, MW12-06-05, MW12-06-06

Appendix B: Figures Illustrating Current Physical Settings Compared to Minto North pit

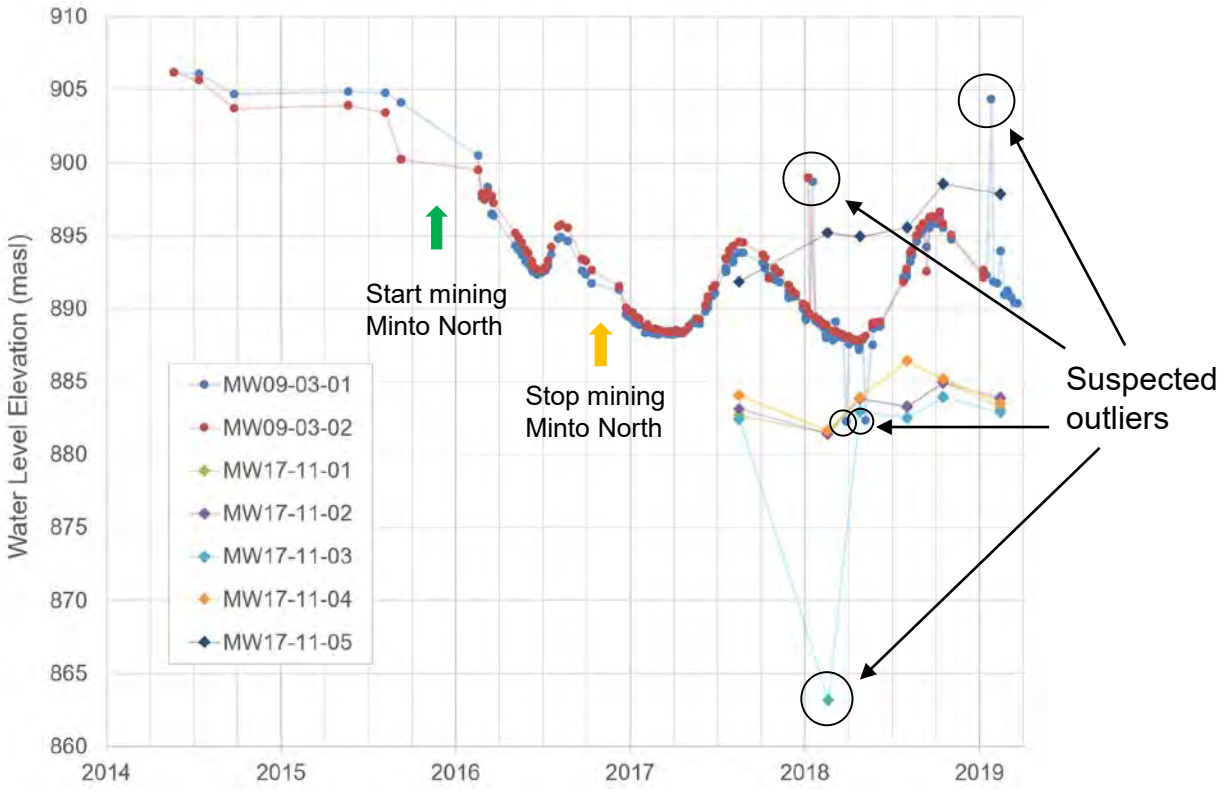




A A'

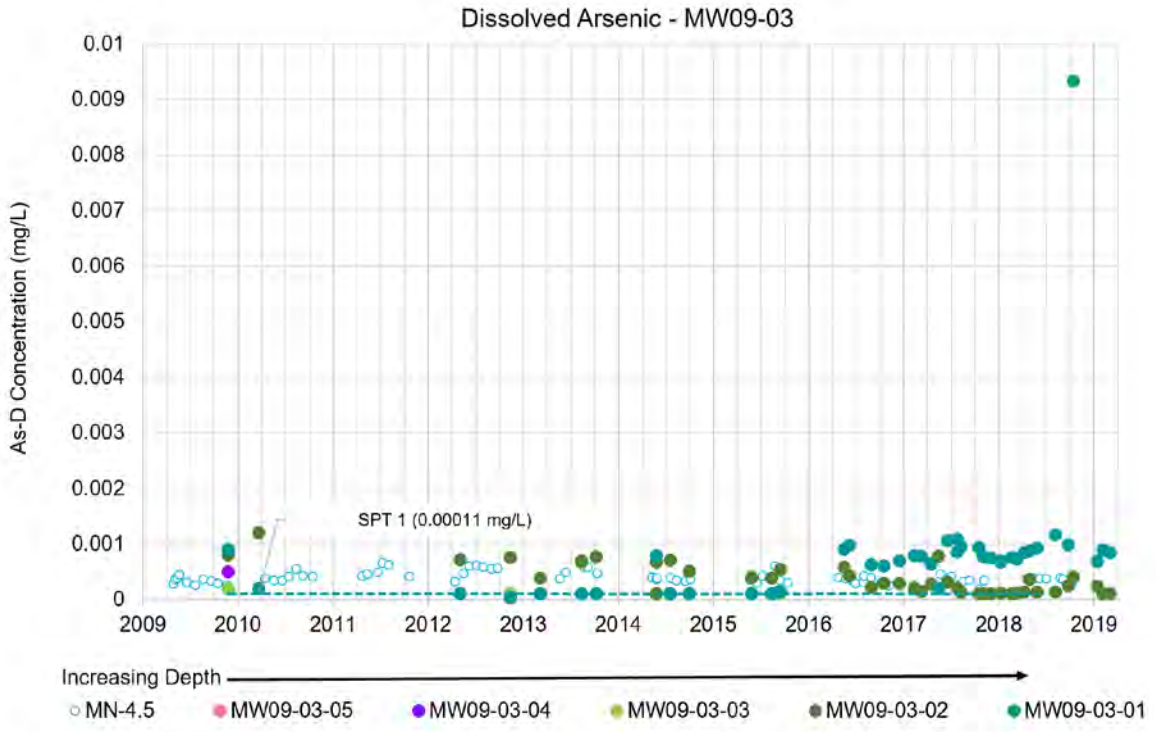


Schematic cross section – not to scale
MW09-03 water levels

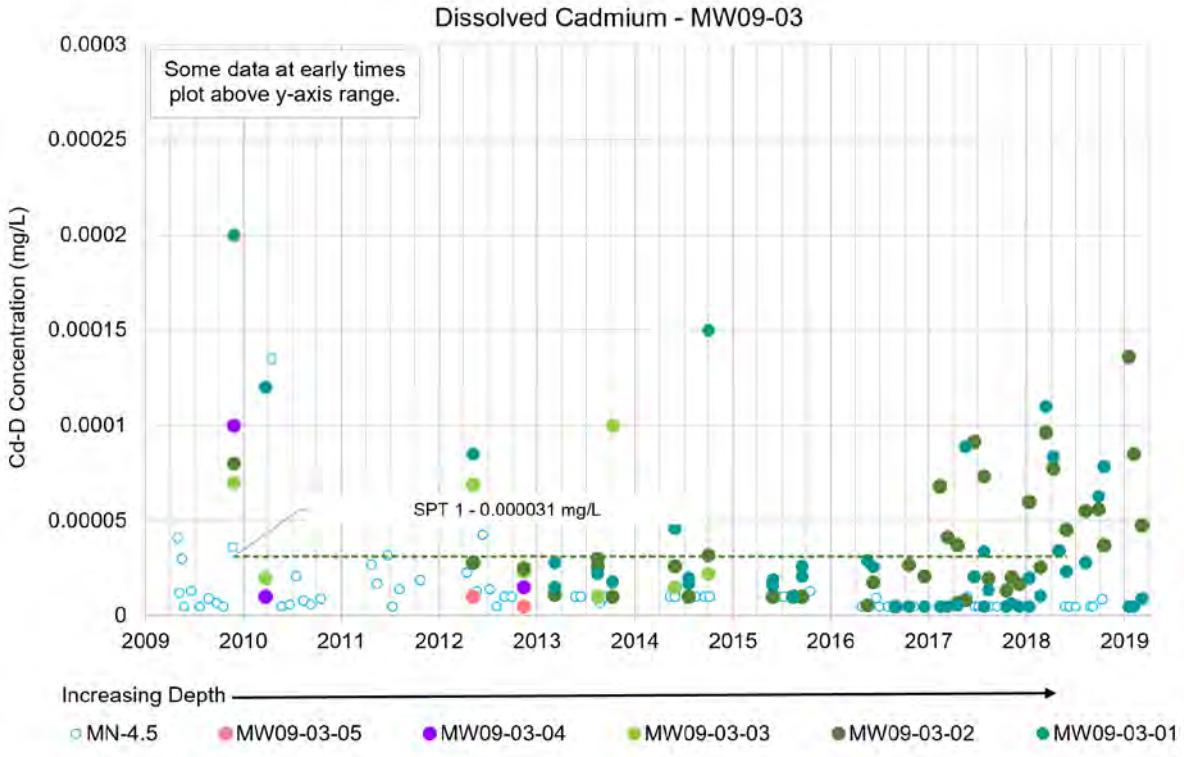


srk consulting	capstone MINTO MINE OPERATED BY MINTO EXPLORATIONS LTD.	Minto Mine Adaptive Management		
		Minto North Pit: Physical setting and water levels		
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: May 2019	Approved: DCM	Figure: **A-1**

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MW09-03-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q1 of 2019 shown on graph (applies to MW09-03-01 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q1 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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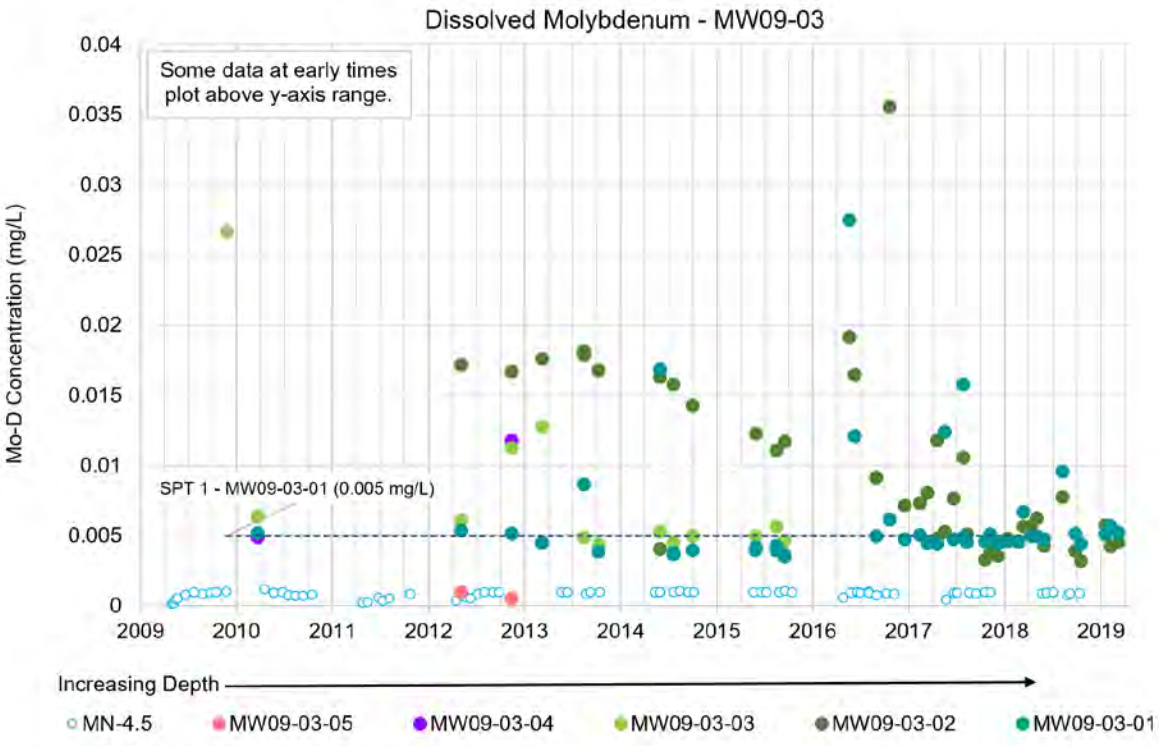
Minto Mine Adaptive Management

MW09-03
As-D & Cd-D SPT Exceedances

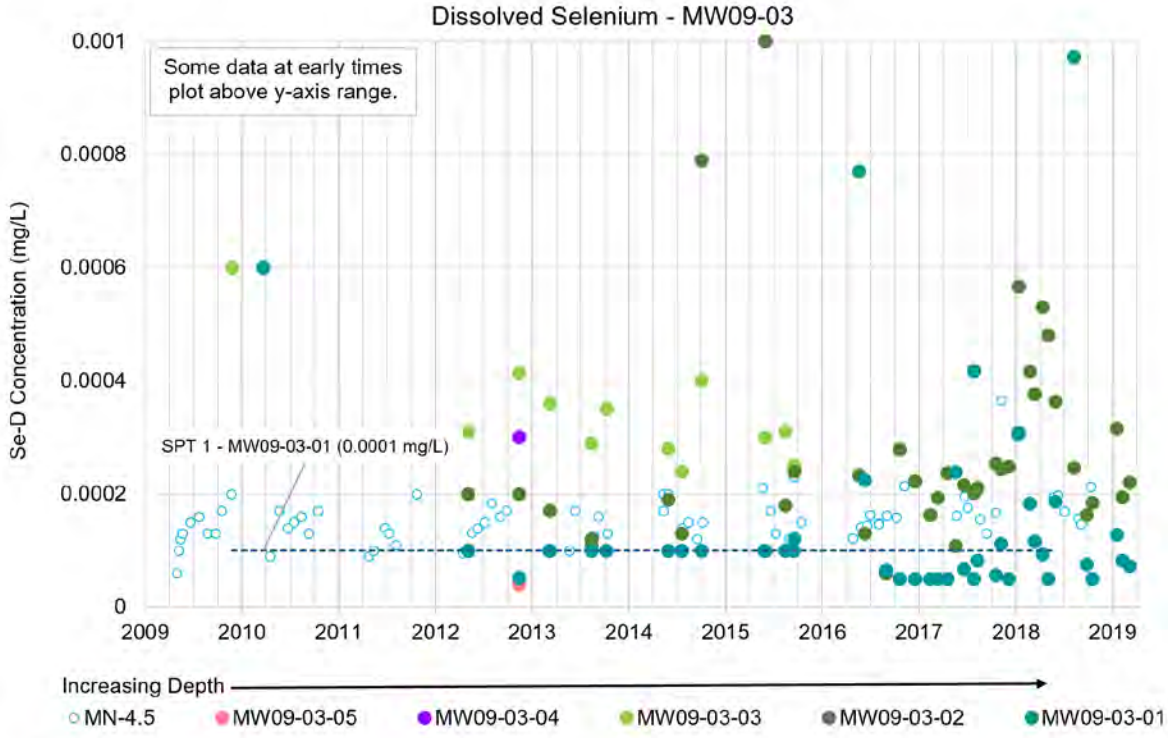
Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date:	Approved:	Figure:
May 2019	DCM	A-2



MW09-03-01 is the only sampling point to trigger a response
Only SPTs exceeded in Q1 of 2019 shown on graph (applies to MW09-03-01 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q1 of 2019 shown on graph (applies to MW09-03-01 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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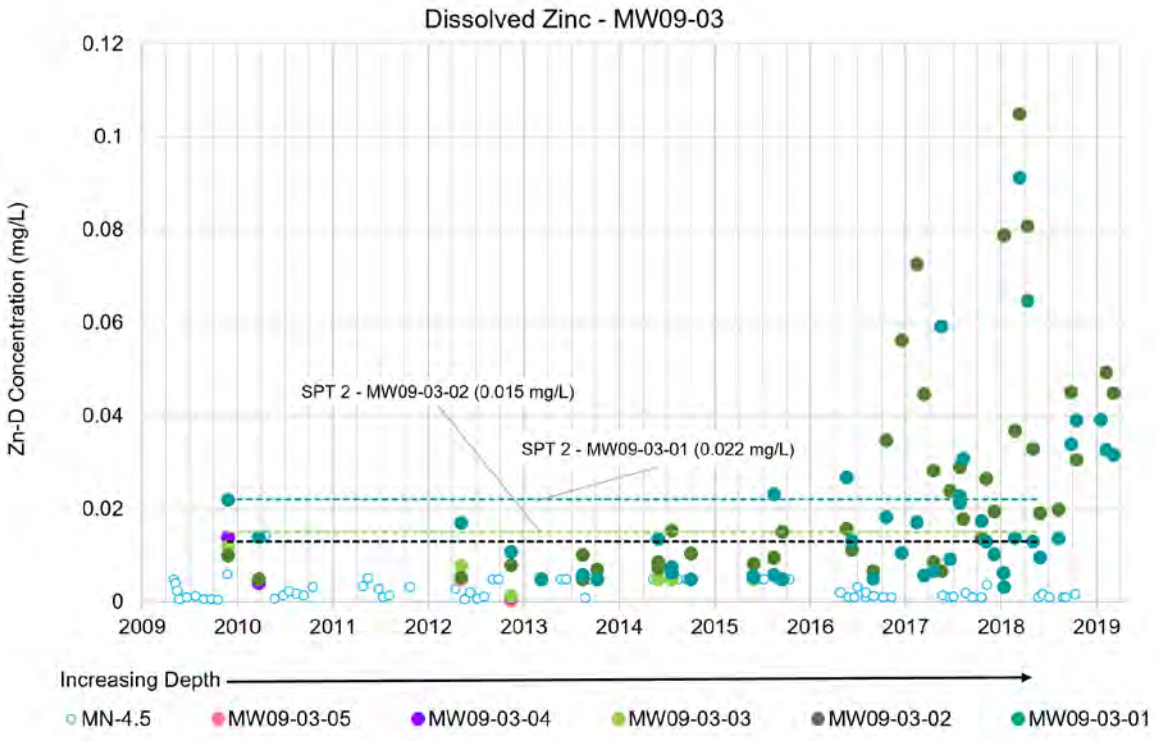
Minto Mine Adaptive Management

MW09-03
Mo-D & Se-D SPT Exceedances

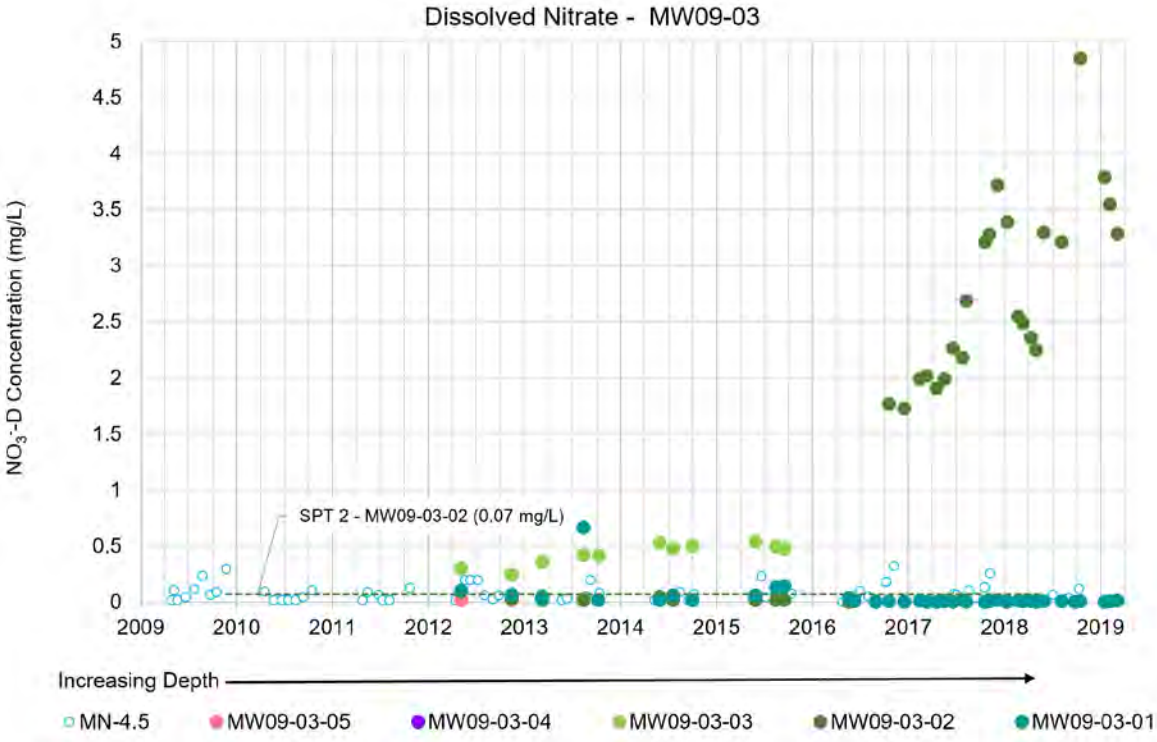
Job No: 1CM002.055
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Minto Mine

Date:	Approved:	Figure:
May 2019	DCM	A-3



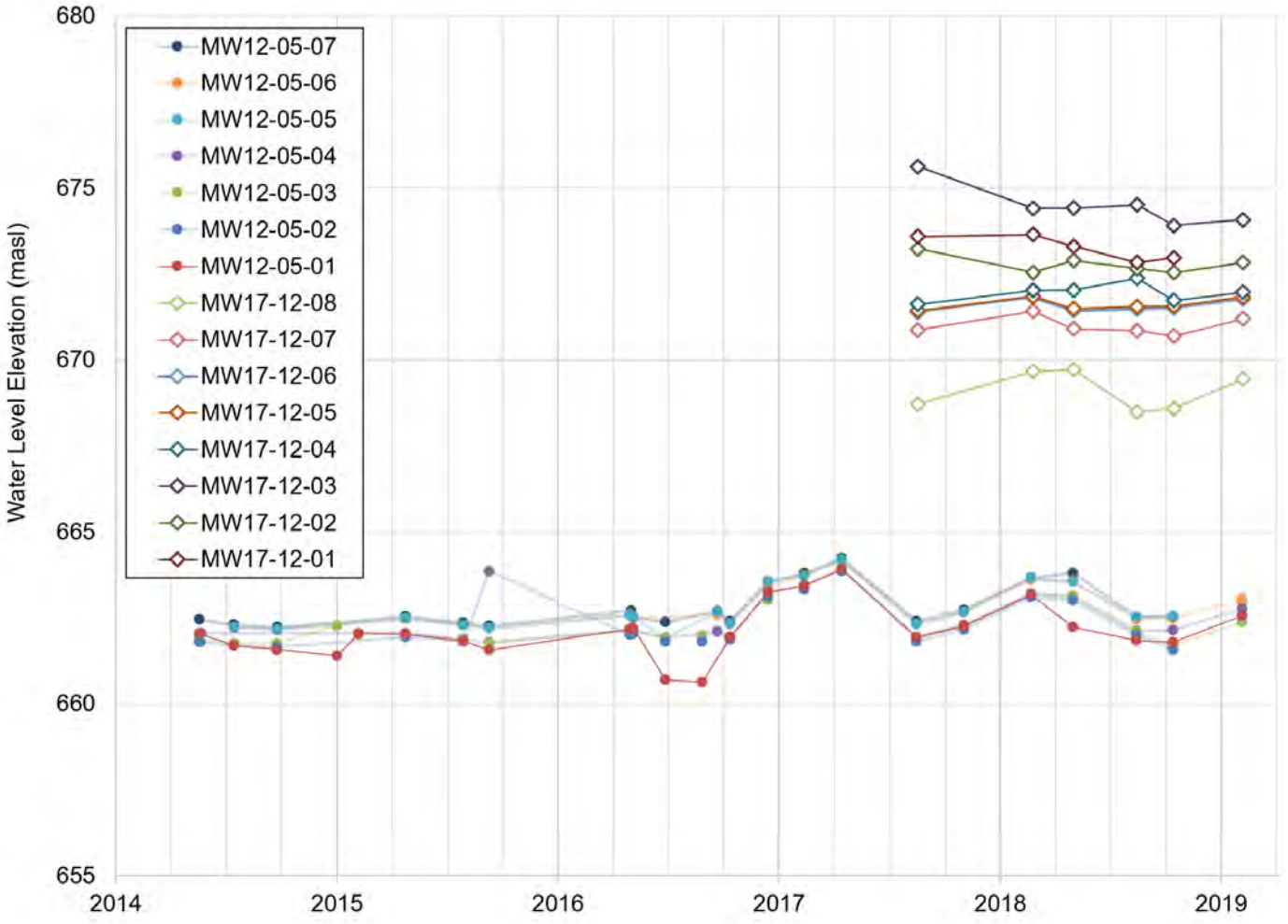
MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q1 of 2019 shown on graph (applies to MW09-03-01 and MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q1 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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		MW09-03 Zn-D & NO_3^--D SPT Exceedances
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: May 2019 / Approved: DCM / Figure: **A-4**

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Minto Mine Adaptive Management

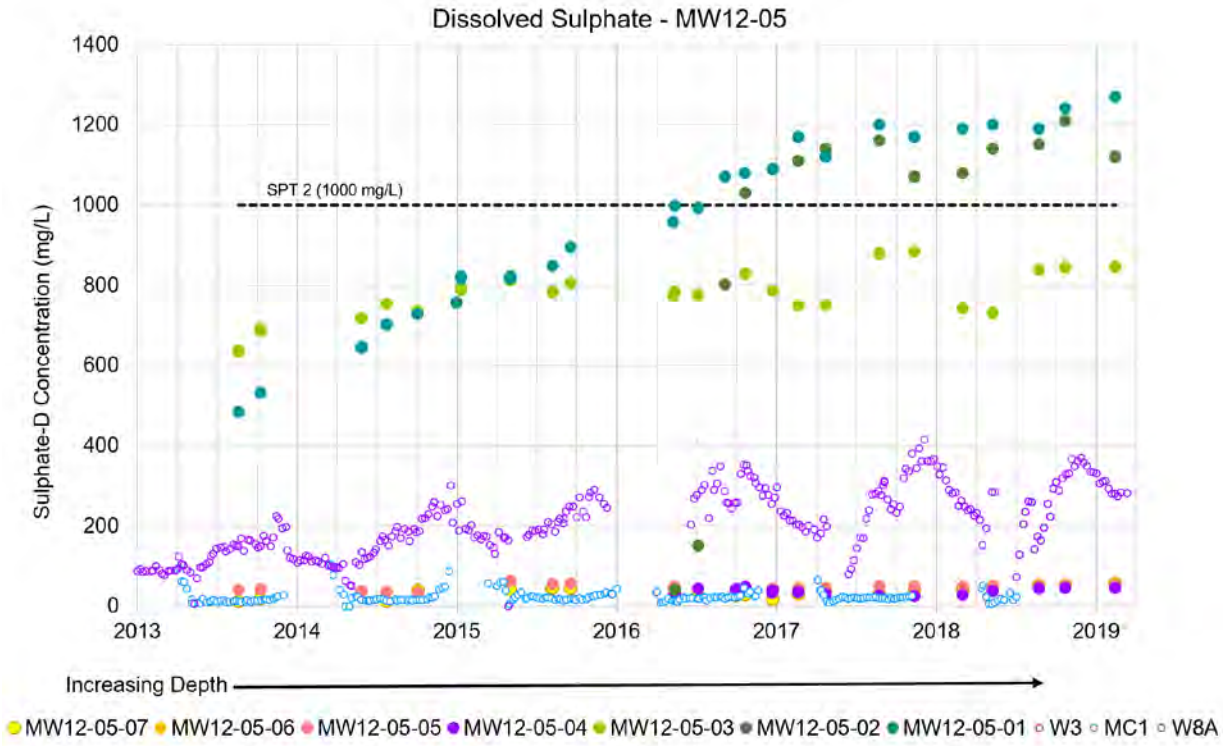
MW12-05 Water Level Data

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

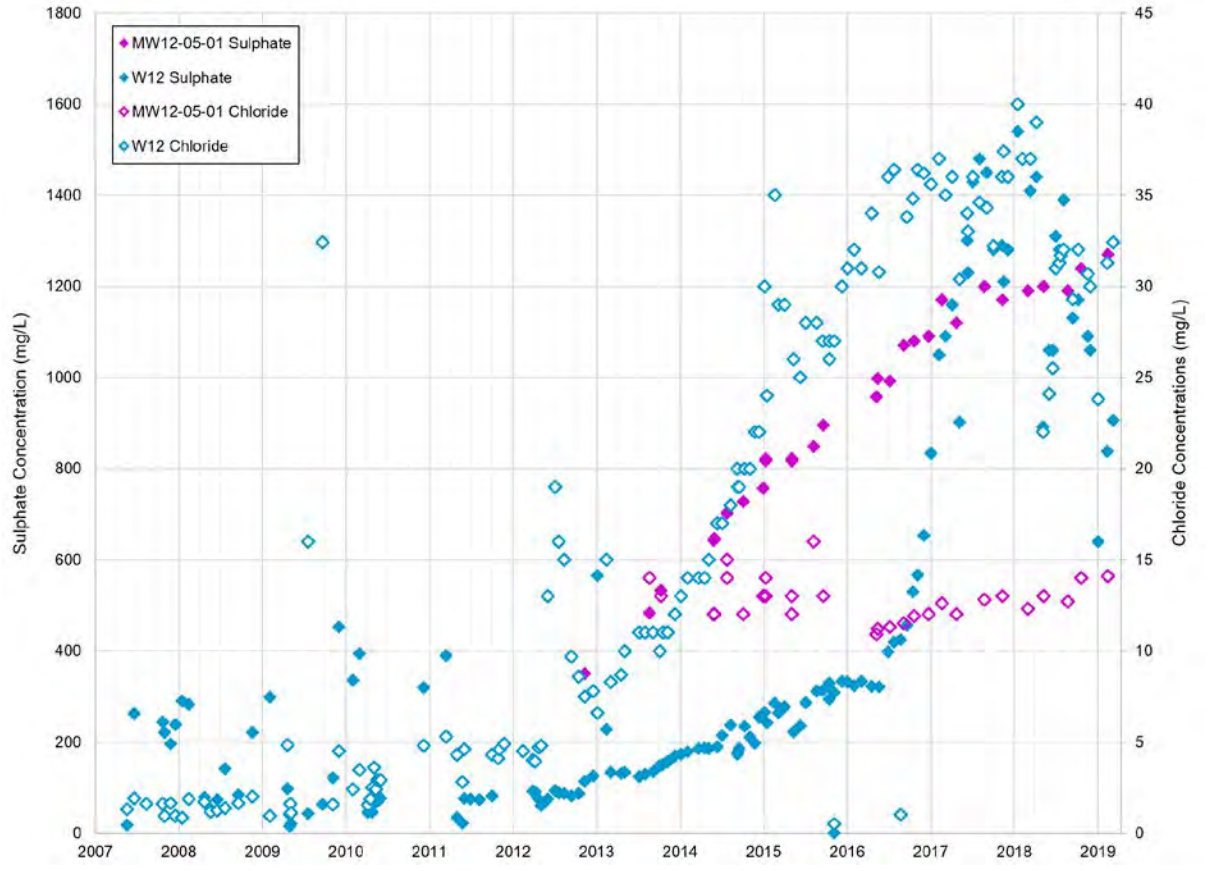
Minto Mine

Date:	Approved:	Figure:
May 2019	DCM	B-1

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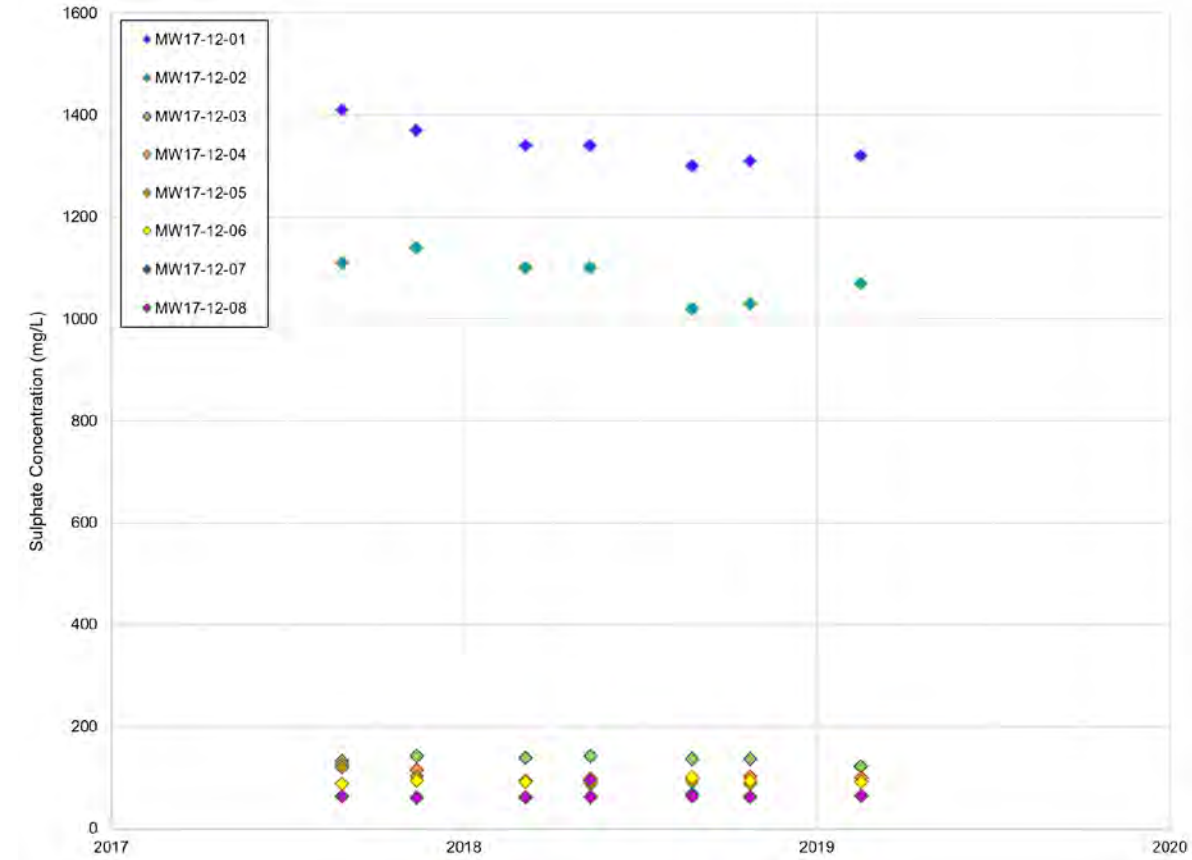


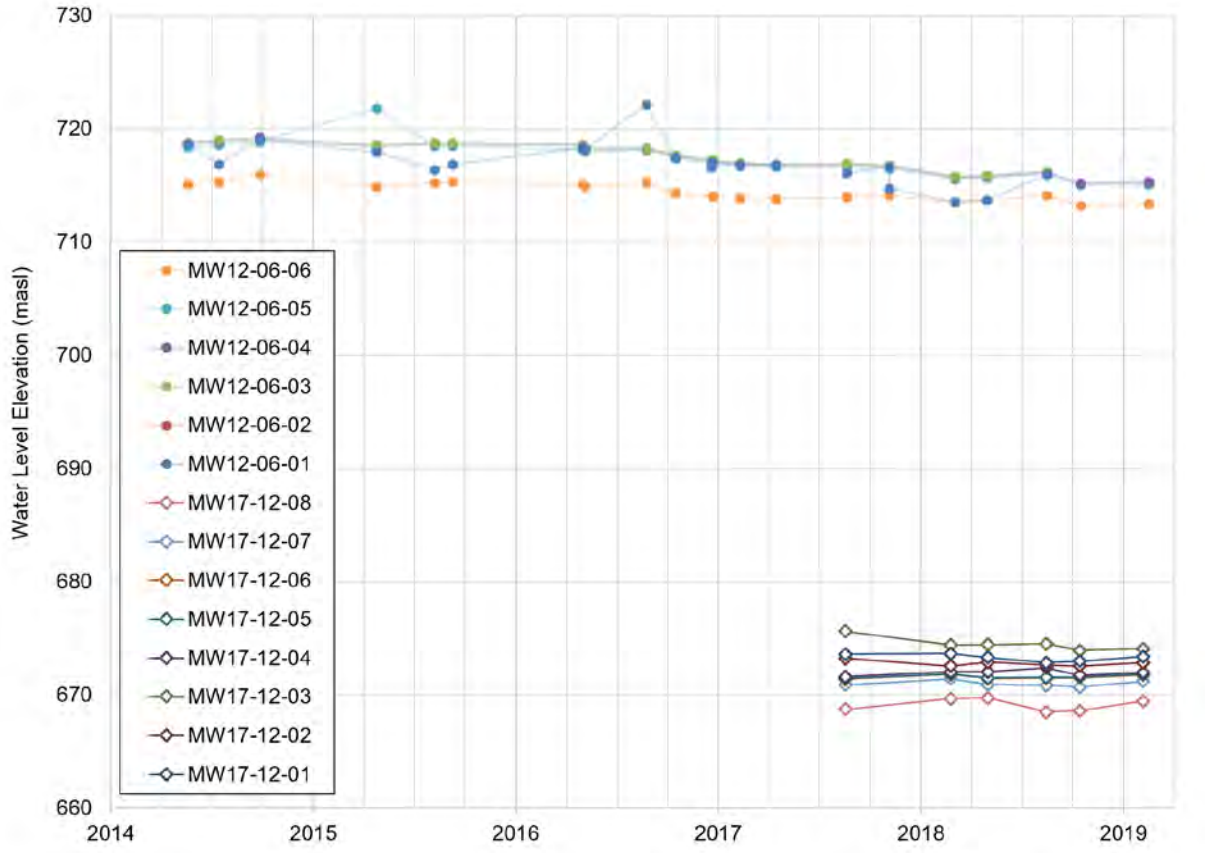
MW12-05-01 and MW12-05-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q1 of 2019 shown in graph (applies to MW12-05-01 and MW12-05-02 only)
WC and MC1 are SW monitoring points in Minto Creek



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		MW12-05 SO_4^{2-}-D SPT Exceedances & MW12-05 and W12 (Main Pit) SO_4^{2-}-D and Cl-D Concentrations	
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: May 2019	Approved: DCM / Figure: B-2

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Minto Mine Adaptive Management

MW17-12 SO_4^{2-} Concentrations and MW12-06, MW17-12 Water Level Data

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: May 2019
Approved: DCM
Figure: **C-1**

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January 17, 2020
Project No: 1CM002.055

Minto Explorations - A Pembridge Resources Company
Minto Mine
PO Box 11
Whitehorse, YT Y1A5X9

Attention: Todd, Minto Explorations - A Pembridge Resources Company

Dear Todd:

Subject: 2019 Q2 (April - June) Groundwater AMP Events

The Minto Mine Operational Adaptive Management Plan was updated in 2018 for groundwater monitoring, with the review frequency for groundwater triggers changed from monthly to quarterly, at the recommendation of the qualified professional (QP). As per AMP2017-02, all data concerning trigger exceedances are sent to the QP within a week of discovery and included in the subsequent review. This letter is the review for the second quarter of 2019 under the updated reporting schedule.

As part of the Minto Mine Operational Adaptive Management Plan, Minto Mine has collected and reviewed groundwater quality data. Minto completed an initial review of data collected at the McGinty Creek groundwater monitoring station (MW09-03) and Minto Creek groundwater monitoring stations MW12-05 and MW12-06 for the second quarter of 2019 (April-June) and compared results to specific performance thresholds (SPT) defined in the Minto Mine Operations Adaptive Management Plan (MEL, 2017-02). McGinty Creek monitoring stations are required to be sampled monthly while the Minto Creek stations are sampled quarterly. For Minto Creek MEL identified exceedances of certain thresholds for sampling rounds conducted in April, May and June of 2019 and, as per the plan, has contracted a QP to review those data and provide recommendations. SRK Consulting (Canada) Inc. was contacted by Minto environmental staff on June 12, 2019 to provide QP review. This letter presents results of that review and recommendations.

SRK compared data against the 2017-02 AMP thresholds, historical data and data from surface water at station MN4.5 in lower McGinty Creek and surface water stations W3 and MC1 in Minto Creek. Groundwater SPT exceedances (events) have occurred for a limited number of parameters and do not necessarily correlate with distance from mining activities. Some of these events may reflect elevated background concentrations that were not identified prior to start of mining because monitoring wells were not in place at that time. Table 1 (Appendix A) summarizes exceedances, observations on the data, interpretation and recommendations. Figures (Appendix B) are included with this review to illustrate the current physical (i.e., water level) setting compared to the Minto North pit. Graphs are included for each parameter exceeding thresholds and include the full range of data collected to date.

During the May sampling event at MW12-05, issues with sampling equipment were encountered which resulted in a re-sampling event later in the month. Therefore, data are available from May 4th and May 16th, 2019. Both sampling events were evaluated against the thresholds and any identified exceedances are included in this memo.

Key conclusions and recommendations are summarized below. Table 1 (Appendix A) summarizes observations and recommendations for all parameters.

For MW09-03 (McGinty Creek):

- The Minto Pit is not a source of water to the groundwater monitored at this station; water levels in the monitoring well are higher than the pit water level. Water levels in the pit have been increasing slowly but remain well below the monitoring well water levels. These data continue to show no hydraulic gradient from the pit towards the monitoring well.
- Water levels at this station have been affected by the mining of Minto North, but the groundwater divide between Minto North and McGinty Creek remains, somewhere in the vicinity of MW09-03.
- Water levels in MW17-11 are generally lower than in MW09-03, with the exception of zone 5 which is screened shallower than zones 1 and 2 in MW09-03. Water levels in MW17-11 and MW09-03 indicate an overall downward gradient between the shallow-most zone and the remaining deeper zones. Differences in water level between deep zones are less pronounced, and a vertical gradient is not clear.
  - Recommendation: continue collecting water level/pressure profiles at this well according to the routine schedule.
- Concentrations of dissolved arsenic at MW09-03-01 have consistently exceeded SPT 1 since summer of 2016, and inconsistently exceeded thresholds in MW-09-02 in the same period. High variability is observed, but relatively recent data in MW09-03-01 exceeds thresholds more frequently than in the past and the most recent value in MW09-03-01 from October 2018 was nearly an order of magnitude higher than every previously measured value. Since then concentrations have decreased to the historic range, suggesting the value from October 2018 was an outlier. High concentrations do not correlate exactly with seasonal changes in groundwater level but may indicate an influence from seasonal variation (in recharge, flow, etc.). Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during freshet, possibly suggesting greater mobilization of trace elements when higher volumes of water could infiltrate through the unsaturated zone and mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.
- Concentrations of dissolved cadmium at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 in the past with high variability in the observed data. Recent cadmium data exceed thresholds more frequently since 2017 and while average concentrations have increased beginning in 2017, there is no consistent increasing trend with many values in the last two years below the threshold. No exceedances were detected in MW09-03-01 in Q2 2019 but all three months had concentrations that exceeded SPT 1 in MW09-03-02. The highest concentration to date was measured in January 2019, but values have since decreased. Seasonal variability seems to be

present, with highest concentrations occurring in Q1 and Q2, potentially related to freshet. Cadmium concentrations in McGinty Creek remain low and stable, showing no impact from the groundwater.

- Concentrations of dissolved molybdenum in MW09-03-01 and MW09-03-02 have exceeded SPT 1 thresholds sporadically since sampling began, with peak concentrations measured in 2016. Since then, concentrations have decreased, and have been considerably less variable in 2019 with values very near SPT 1 (0.005 mg/L). Measured values in MW09-03-01 exceeded SPT 1 in April and May but show no increasing trend. Dissolved molybdenum values in McGinty Creek remain in the range of historic data and no evidence of impacts to surface water are observed.

- Concentrations of dissolved selenium in MW09-03-01 and MW09-03-02 have exceeded thresholds sporadically in the last few years, with increased variability in the data beginning in 2017. Average annual concentrations in MW09-03-02 have been higher in 2018 and 2019 than past years, but do not demonstrate a consistent increasing trend. Peak concentrations in Q1 and Q2 of these years indicate a seasonal variation may be present. Dissolved selenium in McGinty Creek remain in the range of historic data and no evidence of impacts to surface water are observed.

- Concentrations of dissolved zinc at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 and SPT 2 thresholds since the summer of 2016. High variability is observed in the data, but relatively recent data exceeds thresholds more frequently than in the past. Highest concentrations were detected in Q1 and Q2 2018 but have since decreased. High concentrations do not correlate exactly with seasonal changes in groundwater level but may indicate an influence from seasonal variation. Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during freshet when higher volumes of water infiltrate through the unsaturated zone and mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  – Recommendation: Although concentrations have been increasing in the recent past, Water Quality Objectives defined for McGinty Creek are two or three orders of magnitude higher than the thresholds defined for groundwater (Table 2.5 - Minto Mine Operations Adaptive Management Plan, 2018-01) and the overall risk posed by groundwater loading remains low. Due to this, limited actions are recommended at this time. Continue monitoring as per schedule. Continue to look for seeps from the haul road that can be used for comparison. Compare vertical concentration profiles in MW09-03 and MW17-11 as more annual data becomes available from MW17-11.

- Concentrations of dissolved nitrate at MW09-03-02 have exceeded SPT 2 since the fall of 2016 but remain stable and below both SPTs in the deeper zone, MW09-03-01. Concentrations showed an increasing trend from October 2016 to December 2017, showed the potential for a decreasing trend in Q1 of 2018 but were higher in the latter half of 2018. Concentrations in 2019 have been relatively stable, slightly higher than 2018 values but lower than the peak concentration from Q4 2018. As the Minto North Pit acts as a hydraulic sink, the likely source of nitrate to the groundwater is flushing of blast residuals from the rock used to construct the mine haul road on the topographically downgradient side of the Minto North Pit. The effect is expected to be relatively short lived, as the blasting residuals will flush out over time. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  - Recommendation: Due to the low potential loading of groundwater into McGinty Creek limited action is recommended at this time but will be discussed in more detail in the 2019 annual report. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road and continue to compare data from MW09-03-02 and MN-4.5 to confirm low nitrate concentrations persist in McGinty Creek.

For MW12-05 and MW12-06 (Minto Creek):

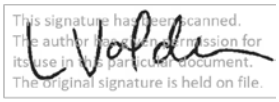
- Water level data in the deepest zone of MW12-06 decreased sharply between November 2017 and March 2018, which coincides with development of the Minto East underground (Figure C-1 (Appendix B)). Water levels in the deepest zone increased again between May and August 2018, when development of the underground stopped. The same trend was not observed in MW12-05 or MW17-12, suggesting these wells are currently outside the area of groundwater affected by the development of the underground (Figure B-1 (Appendix B)). Seasonal fluctuations are apparent in MW12-05, with peak water levels occurring in Q2 of the past 2 years.
  - Recommendation: continue collecting water level/pressure profiles at this well according to the routine schedule. Continue to monitor changes in groundwater pressure as system equilibrates following the cessation of Minto East underground development.
- Concentrations of dissolved chromium in MW12-06-01 have exceeded SPT 3 since October 2016 and while they are variable, average concentrations have been increasing since Q4 2016. Elevated Cr-D is isolated to MW12-06-01, the deepest zone in this well (142.3 meters below ground surface). While in the range of historic data, concentrations of Cr-D exceeded SPT 1 in MW12-05-02, indicating a notable change from the previous monitoring event. The exceedance was isolated, and concentrations remain an order of magnitude lower than SPT 2. While there may be seasonal trends in Minto Creek, variability within the data is very low and shows no trends that can be clearly related to groundwater concentrations.
- Concentrations of dissolved selenium exceeded SPT 1 in three of the four deepest zones in MW12-05 in Q2 2019. Exceedances have not occurred regularly in the past, and the most recent monitoring event registered some of the highest values to date. Peak concentrations have been measured in late Q1 or Q2 each year since 2016, suggesting a seasonal trend is present. The same variability is not observed in Minto Creek, and no trends are present that suggest any impacts to surface water from groundwater.
- Concentrations of sulphate at MW12-05-01 and MW12-05-02 continue to be elevated above SPT 2. Concentrations at MW12-05-01 and MW12-05-02 were increasing historically but show signs of stabilization after August 2017, suggesting sulphate concentrations may be approaching equilibrium. While concentrations are still increasing, data do not show the same rate of increase as was observed prior to 2017. Sulphate exceedances have been restricted to the deeper zones, which monitor depths greater than 85 meters below ground surface (mbgs). Shallower zones and surface water stations in Minto Creek, downstream of the mine footprint, display stable trends in sulphate at far lower concentrations than Zone 1 and 2. While concentrations have been increasing in both MW12-05 and the Main Pit, the rate and timing of increase differs with a slow increase in the Main Pit until Q3 of 2016 when concentrations jumped over 1000 mg/L in less than one year and a consistent steady increase in MW12-05 that started earlier than this then began to level off in Q1 2017.

Additionally, chloride concentrations (another conservative tracer) also changed at different rates and times in the Main Pit and MW12-05. Chloride at the Main Pit has been decreasing since 2018, while concentrations at MW12-05 have remained stable at lower concentrations than the pit. Observed concentrations of sulphate at MW12-05 may not be related to water in the Main Pit. For comparison, sulphate concentrations in MW17-12 exhibit increasing concentration with depth but no increasing trend over time. Minto Creek continues to indicate no trends in sulphate concentration that can clearly be related to changes in groundwater concentrations

– Recommendation: continue monitoring as per schedule and continue with investigations as part of the overall review of site groundwater quality.

Sincerely,

SRK Consulting (Canada) Inc.



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Consultant (Hydrogeochemistry)

Reviewed by



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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data

Appendix A: Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

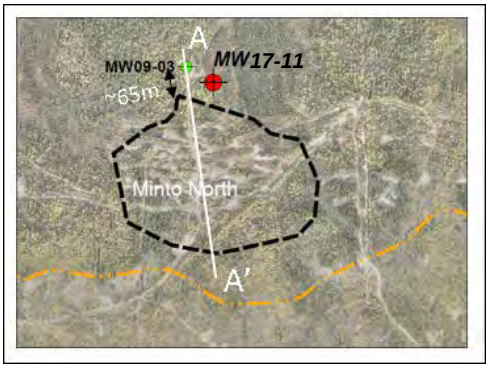
Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
McGinty Creek Catchment								
MW09-03-01 Figure A-1, A-2		As-D	mg/L		**Water Level (Figure A-1):** Water levels in MW09-03 Zone 1 and Zone 2 started declining when mining started in Minto North. Declining trend decreased about 6 months after mining completed. Water levels remain higher than pit bottom. Water levels increased between July and September 2016 before returning to previous trend. Similar trend occurred in 2017 when water levels increased between April and September, declined until May 2018 and increased again until September. Water levels show signs of increasing in Q2 2019, consistent with previous seasonal trends. Minto North pit continues to act as a hydraulic sink, and has lowered groundwater levels. Water levels at MW09-03 suggest the presence of a groundwater divide somewhere north of the pit. Seasonal fluctuations indicate some influence from recharge. **Water Quality (Figure A-2):** Concentration in October 2018 much higher than all previous data but has since decreased, suggesting the data point is an outlier. Seasonal variations appear to be present, with highest values occurring the summer months the last 2 years, with the exception of October 2018. As-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	While data from late summer 2015 to August 2017 showed signs of an increasing trend, values exhibit significant variability throughout the year. Peak values during Q2 and Q3 suggest a seasonal trend related to freshet may be present. Elevated value in October 2018 was an isolated occurrence and have declined back to historical ranges.	Lack of any clear upwards trend in McGinty Creek, as measured at MN-4.5, suggests currently no impact. Water quality objective at MN-4.5 is 3 orders of magnitude higher than SPT 2. Overall risk of arsenic loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	April	4/19/2019	0.0009	0.00011 (SPT 1)				
	May	5/11/2019	0.0009	0.00081 (SPT 2)				
	June	6/7/2019	0.00089	0.00081 (SPT 2)				
MW09-03-01 Figure A-1, A-3		Mo-D	mg/L		**Water Level (Figure A-1):** see previous section. Water Quality (Figure A-3): Exceedances to SPT 1 have been occurring consistently in the past with highest concentrations detected in 2016. Since then, concentrations have been lower and less variable with values that are near SPT 1 in Q1 and Q2 2019. Mo-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Peak values near the end of Q2/start of Q3 suggest a seasonal trend related to freshet may be present.	Lack of any clear upwards trend in McGinty Creek, as measured at MN-4.5, suggests currently no impact. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of molybdenum loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	April	4/19/2019	0.00574	0.005 (SPT 1)				
	May	-	-	-				
	June	6/7/2019	0.00596	0.005 (SPT 1)				
MW09-03-01 Figure A-1, A-3		Se-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-3)**: Exceedances to SPT 1 have been occurring sporadically since 2016. Concentrations in Q2 are higher than Q1. Se-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in 2018 were more variable than past years but with no discernable trend. Exceedences to SPT 1 are not consistent. Elevated concentrations in Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of selenium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	April	4/19/2019	0.000237	0.0001 (SPT 1)				
	May	-	-					
	June	6/7/2019	0.000326	0.0001 (SPT 1)				
MW09-03-01 Figure A-1, A-4		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations sporadically exceed SPT 1 and SPT 2 but with overall lower values in 2019 than previous 2 years. Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations from Q2 2019 are lower than peak concentrations measured in Q1 2018 by more than half. Potential increasing trend for late winter low flow period but values are back below SPT 1 in May and June 2018. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low based on low K. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of zinc loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	April	-	-	-				
	May	-	-	-				
	June	6/7/2019	0.0245	0.022 (SPT 2)				
MW09-03-02 Figure A-1, A-2		Cd-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations in 2019 have been more sporadic than the past, with the highest concentration measured in January 2019. Concentrations have generally been decreasing since. Cd-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	No identifiable consistent trend in Cd-D. Although annual average is increasing, values in 2019 have not been increasing. Peak concentrations during late Q1/early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of cadmium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	April	4/19/2019	0.0000372	0.000031 (SPT 1)				
	May	5/11/2019	0.000459	0.000031 (SPT 1)				
	June	6/7/2019	0.0000695	0.000031 (SPT 1)				
MW09-03-02 Figure A-1, A-3		Se-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-3)**: Exceedances to SPT 1 have been occurring sporadically since 2016. Average annual concentrations are higher in 2018 and 2019 than previous years, but do not consistently exceed SPT 1. Se-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in 2019 were more variable than past years but with no clear increasing trend. Exceedances to SPT 1 are not consistent, and only occurred once in Q2 2019. Elevated concentrations in Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of selenium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	April	-	-	-				
	May	-	-	-				
	June	6/7/2019	0.000635	0.0005 (SPT 1)				
MW09-03-02 Figure A-1, A-4		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations sporadically exceed SPT 1 and SPT 2 but with overall lower values in 2019 than previous 2 years. Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations from Q2 2019 are lower than peak concentrations measured in Q1 2018 by approximately half. Potential increasing trend for late winter low flow period but values are back below SPT 1 in May and June 2018. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low based on low K. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of zinc loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	April	4/19/2019	0.023	0.015 (SPT 2)				
	May	5/11/2019	0.0194	0.015 (SPT 2)				
	June	6/7/2019	0.0382	0.015 (SPT 2)				
MW09-03-02 Figure A-1, A-4		NO_3-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-5):** Values in 2019 and lower than October 2018 which had a concentration that was the highest on record and almost two orders of magnitude higher than SPT 2. A general intreasing trend since 2017 is present. NO_3-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Clear upward trend from May 2015-December 2017. Higher variability in 2018 but with highest value recorded occurring in October. Values within 2019 have not bee increasing, but still significatly higher than SPT 2.	McGinty Creek, as observed at MN-4.5, does not show increasing or decreasing trends similar to MW09-03-02. Considering the small catchment area for MW09-03-02, even if the well is affected by local recharge, potential loading to McGinty Creek via this groundwater is likely low.	Limited action at this time. Continue monitoring as per routine schedule, continue to look for opportunities to collect samples from surface seeps emanating from haul road and continue to compare data from MW09-03-02 and MN-4.5 to confirm low nitrate concentrations persist in McGinty Creek.
	April	4/19/2019	3.56	0.07 (SPT 2)				
	May	5/11/2019	4	0.07 (SPT 2)				
	June	6/7/2019	3.72	0.07 (SPT 2)				

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
Minto Creek Catchment								
MW12-05-01 Figure B-1, B-2		Se-D	mg/L		**Water Level (Figure B-1):** Water levels show increasing trends in the fall to late winter seasons, followed by a decrease throughout the summer. Water levels in Q2 are similar to levels at the same time of year in 2018. While more data is needed to be certain, the trends are likely due to a seasonal fluctuation. Overall vertical gradient remains downward. **Water Quality (Figure B-1):** Concentrations in Q2 2019 are the highest recorded to date, with the selenium value almost an order of magnitude higher in Q2 than Q1. Se-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Average annual concentrations are increasing, with the highest values recorded in 2019. Peak concentrations are measured in Q2 each year, suggesting a seasonal influence. Timing and relative magnitude does not compare to W8A, however, suggesting the influences are not related.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule.
	April	N/A	N/A					
	May	5/16/2019	0.00114	0.22 (SPT 1)				
	June	N/A	N/A					
MW12-05-01 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1):** see previous section. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, stabilized around 1200 mg/L for the majority of 2018 but are showing an increasing trend since Q4 2018. SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Previously observed upwards trend shows signs of stabilization after August 2017 with a slight increase again since Q4 2018. Most recent concentrations are highest detected, but not significantly increased from previous sampling event. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but not likely connected to groundwater at MW12-05.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	April	N/A	N/A					
	May	5/16/2019	1250	1000 (SPT 2)				
	June	N/A	N/A					
MW12-05-02 Figure B-1		Cr-D	mg/L		**Water Level (Figure B-1):** see previous section. **Water Quality (Figure B-1):** Concentrations are within the range of past data, however the May monitoring event triggered SPT 1, as the concentration was detectable, where the previous monitoring event was non-detect. Values are still an order of magnitude lower than SPT 2. Cr-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Concentrations do not appear to be increasing, are within the range of historic values and are an order of magnitude less than SPT 2. No upwards trend observed in Minto Creek.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule.
	April	N/A	N/A					
	May	5/16/2019	0.00035	0.201 (SPT 1)				
	June	N/A	N/A					
MW12-05-02 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1):** see previous section. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, since then values have stabilized. October 2018 concentration was higher than previously in 2018 but 2019 monitoring points have been lower. SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Concentrations appeared to be increasing in 2018 but 2019 values have been lower. Values are slightly lower than MW12-05-01. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but not likely connected to groundwater at MW12-05.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	April	N/A	N/A					
	May	5/16/2019	1190	1000 (SPT 2)				
	June	N/A	N/A					
MW12-05-03 Figure B-1, B-2		Se-D	mg/L		**Water Level (Figure B-1):** see previous section. **Water Quality (Figure B-1):** Concentrations in Q2 2019 are the highest recorded to date, with the selenium value almost an order of magnitude higher in Q2 than Q1. Peak concentrations have been measured in Q2 of each year since 2016. Se-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Average annual concentrations are increasing, with the highest values recorded in 2019. Peak concentrations are measured in Q2 each year, suggesting a seasonal influence. Timing and relative magnitude does not compare to W8A, however, suggesting the influences are not related.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule.
	April	N/A	N/A					
	May	5/4/2019	0.00408	2.11 (SPT 1)				
	June	N/A	N/A					
MW12-05-04 Figure B-1, B-2		Se-D	mg/L		**Water Level (Figure B-1):** see previous section. **Water Quality (Figure B-1):** Concentrations in Q2 2019 are the highest recorded to date, with the selenium value almost an order of magnitude higher in Q2 than Q1. Peak concentrations have been measured in Q2 of each year since 2016. Se-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Average annual concentrations are increasing, with the highest values recorded in 2019. Peak concentrations are measured in Q2 each year, suggesting a seasonal influence. Timing and relative magnitude does not compare to W8A, however, suggesting the influences are not related.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule.
	April	N/A	N/A					
	May	5/16/2019	0.00328	1.15 (SPT 1)				
	June	N/A	N/A					
MW12-06-01 Figure C-1		Cr-D	mg/L		**Water Level (Figure C-1):** Water level data show overall decreasing trend since March 2014. Deepest zone (1) shows steeper decrease in water level between November 2017 and March 2018. This drop is consistent with a decrease in water level in MW12-07 which coincides with development of the Minto East underground. Water level in the deepest zone, MW12-06-01, has shown in increase between Q2 and Q3 2018. Overall gradient in bottom zones is upwards; shallow-most zone has lowest water level. Complex multi-directional gradient is present. **Water Quality (Figure B-1):** Values at other depths in this well are at or below detection. Sampling in zone 1 only began in Oct 2016 but samples have consistently been above SPT 3 with an overall increasing trend. Cr-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Since the fall of 2016 elevated concentrations have been observed in MW12-06-01 and, to a lesser extent, W8A. Concentration during winter low flow period has increased over last two years. High frequency sampling at W8A shows seasonal variability that may also be reflected in the groundwater chemistry, with highest Cr-D observed in the late winter and the lowest in late summer.	While elevated concentrations of Cr-D have been continually detected in MW12-06-01, they have been isolated to the deepest zone and elevated concentrations have not been detected in the receiving environment (Minto Creek, down gradient wells, etc.). In addition, elevated Cr-D has not been detected in the mine pits, the underground dewatering pond or any other major sources of contaminated water on site. Currently, the risk posed by elevated Cr-D in MW12-06 is low.	No further action at this time. Continue monitoring as per routine schedule.
	April	N/A	N/A					
	May	5/9/2019	0.00491	0.003 (SPT 3)				
	June	N/A	N/A					

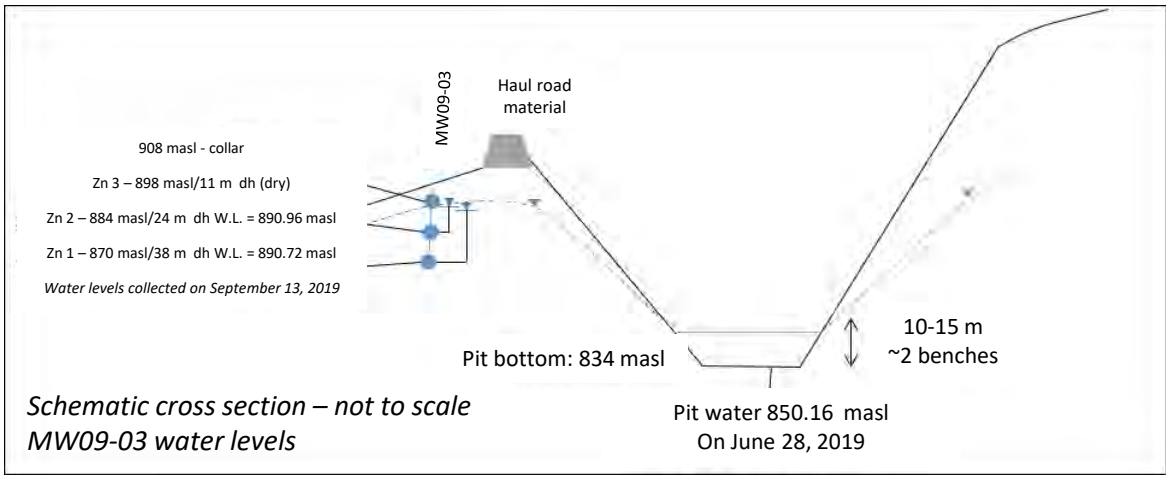
Notes:
'N/A' indicates no sample was taken for that month
'-' indicates value for that month did not trigger a response
Zones with no data or no exceedances: MW09-03-03 (dry), MW12-05-05, MW12-05-06, MW12-05-07, MW12-06-02, MW12-06-03, MW12-06-04, MW12-06-05, MW12-06-06

Appendix B: Figures to Illustrate Current Physical Setting Compared to Minto North Pit

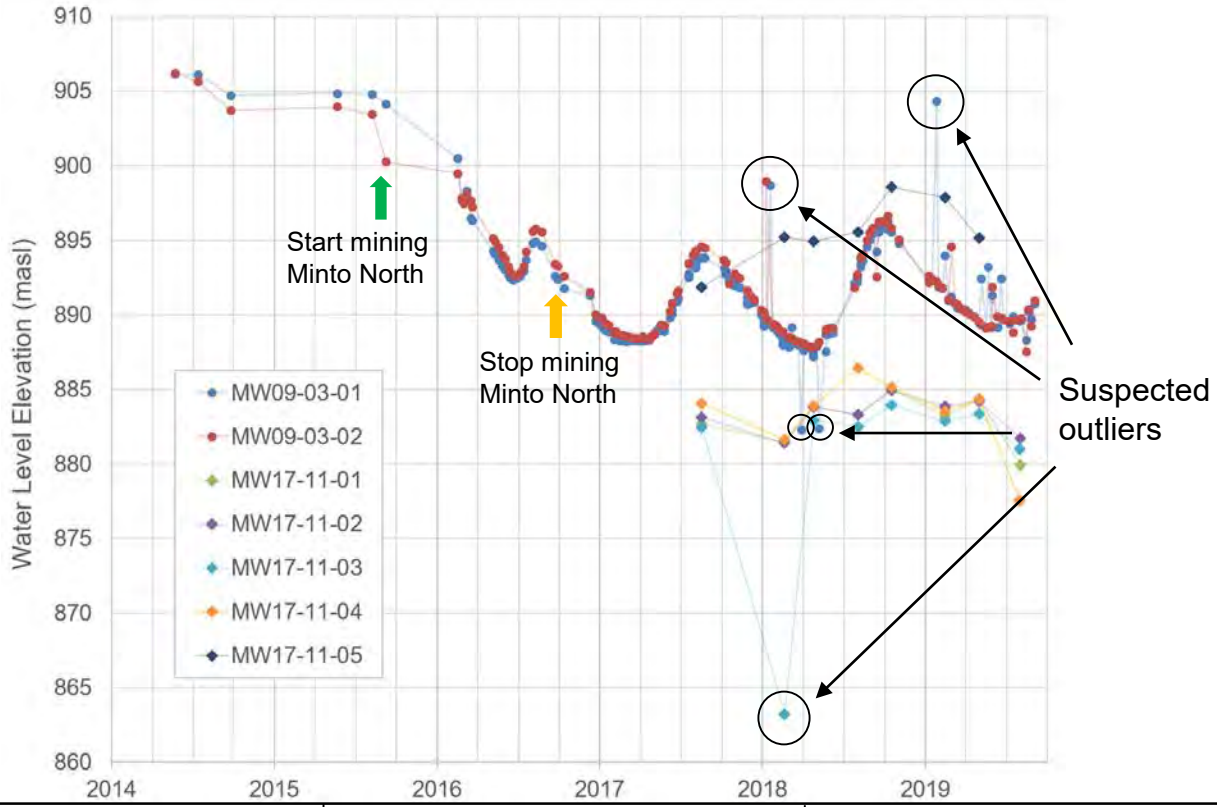




A A'



Schematic cross section – not to scale
MW09-03 water levels



srk consulting

MINTO EXPLORATIONS
A PEMBRIDGE RESOURCES COMPANY

Minto Mine Adaptive Management

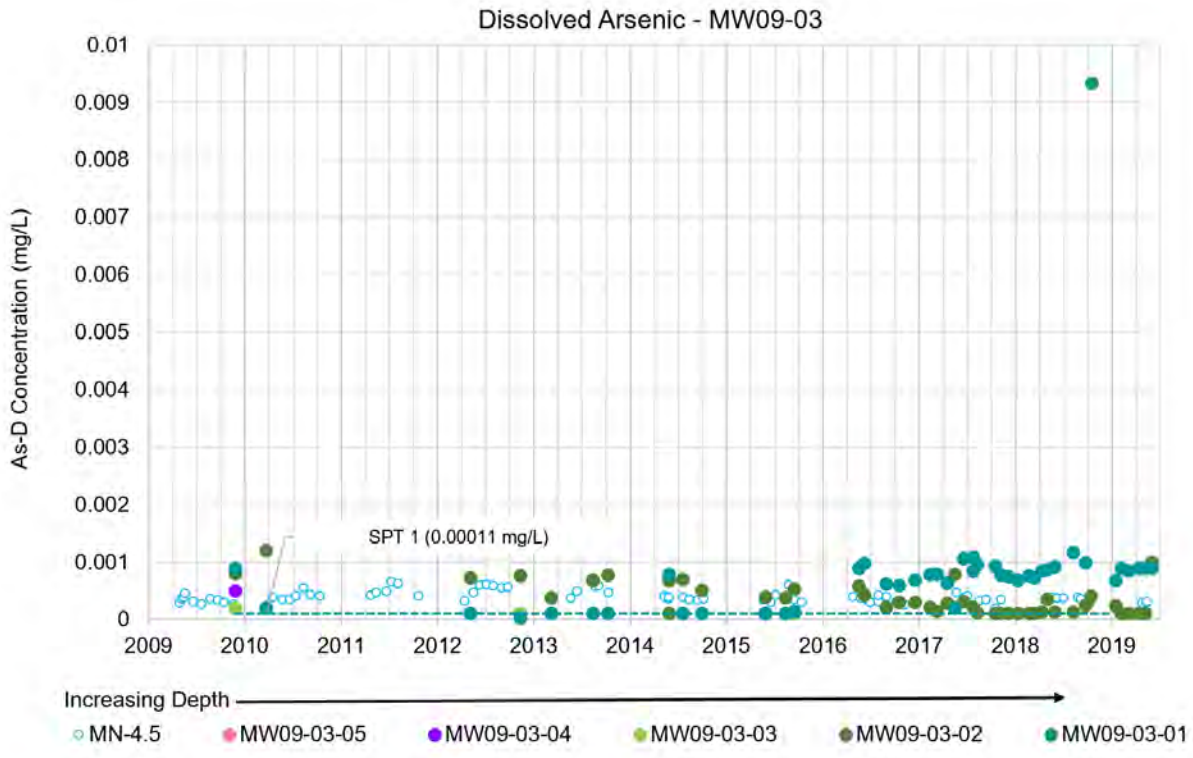
Minto North Pit: Physical setting and water levels

Job No: 1CM002.055
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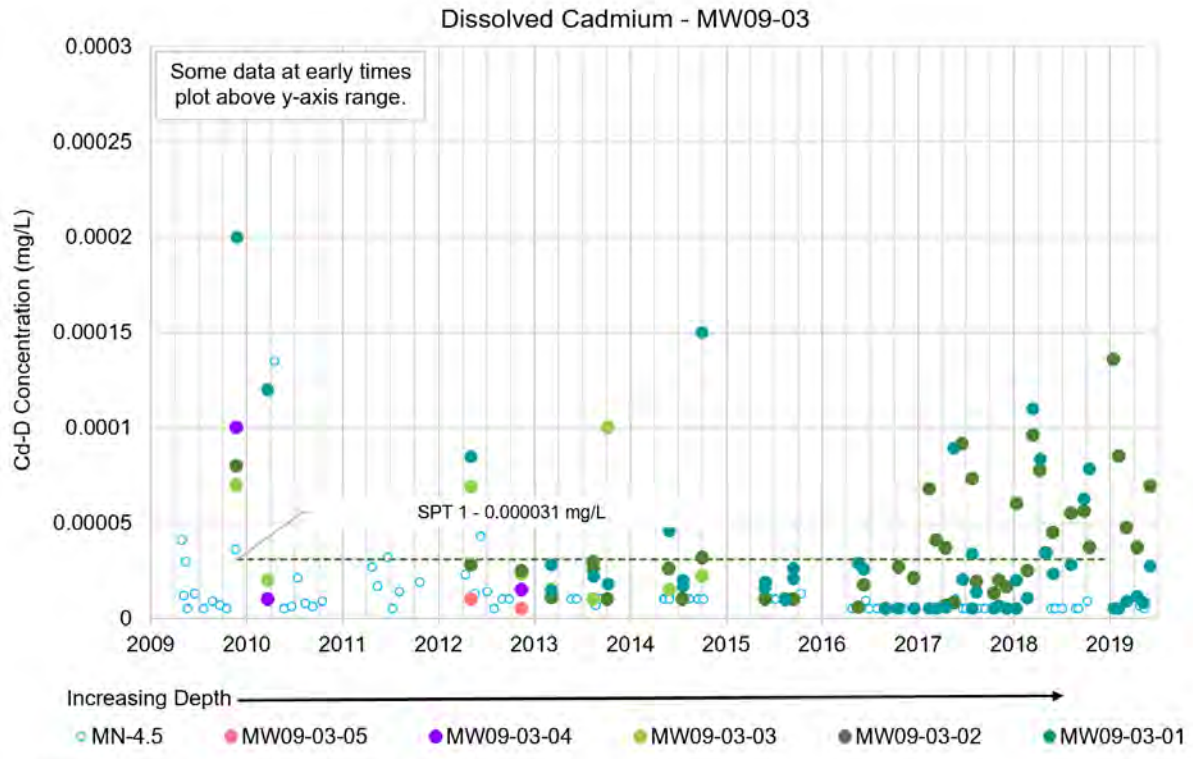
Minto Mine

Date: October 2019
Approved: DCM
Figure: A-1

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MW09-03-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q2 of 2019 shown on graph (applies to MW09-03-01 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q2 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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Minto Mine Adaptive Management

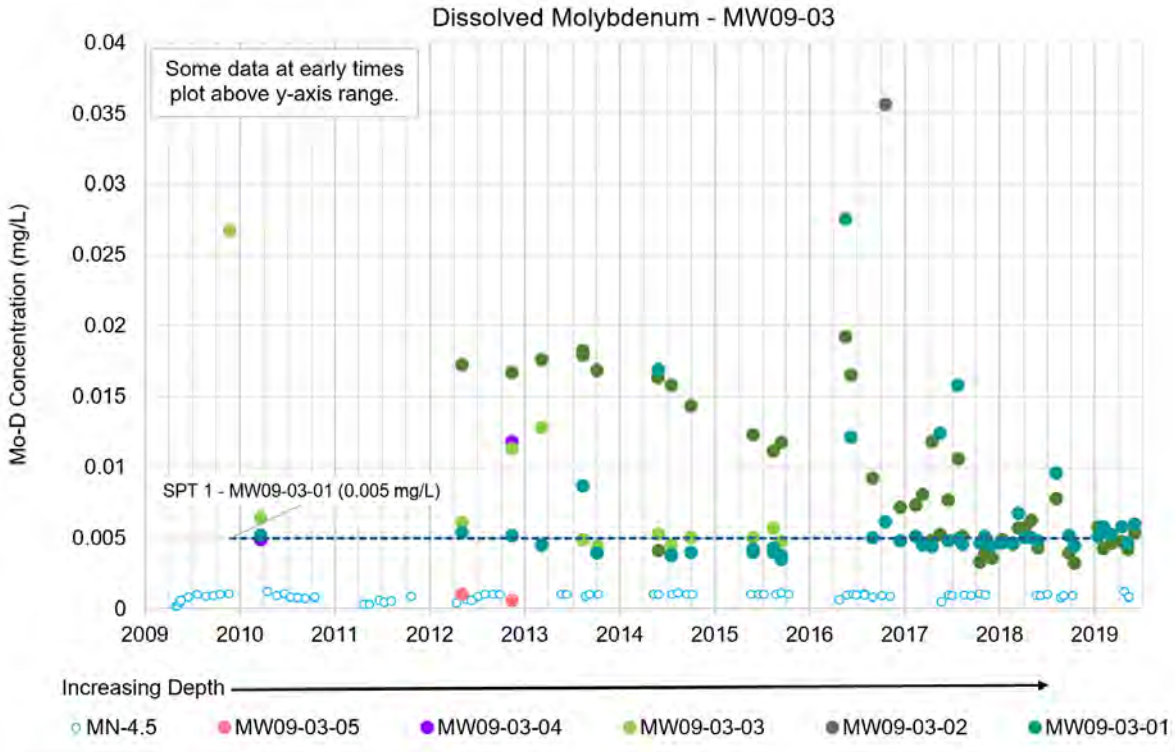
MW09-03
As-D & Cd-D SPT Exceedances

Job No: 1CM002.055
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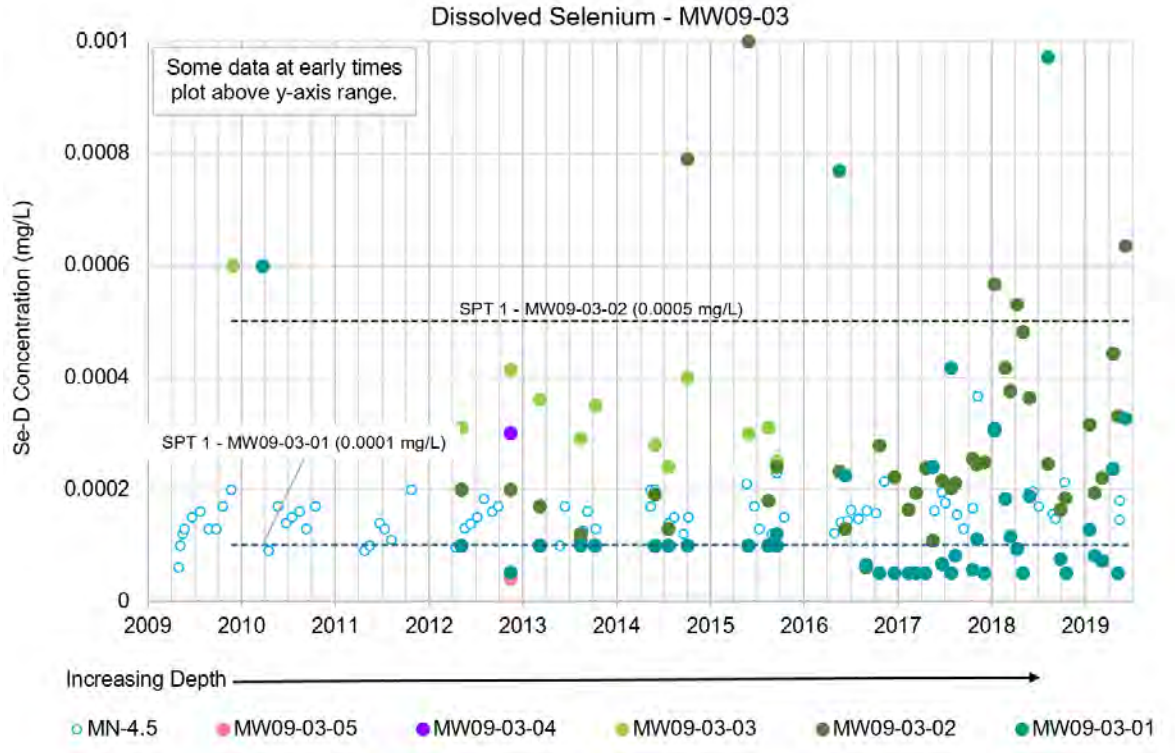
Minto Mine

Date: October 2019
Approved: DCM
Figure: A-2

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MW09-03-01 is the only sampling point to trigger a response
Only SPTs exceeded in Q2 of 2019 shown on graph (applies to MW09-03-01 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q2 of 2019 shown on graph (applies to MW09-03-01 & MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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Minto Mine Adaptive Management

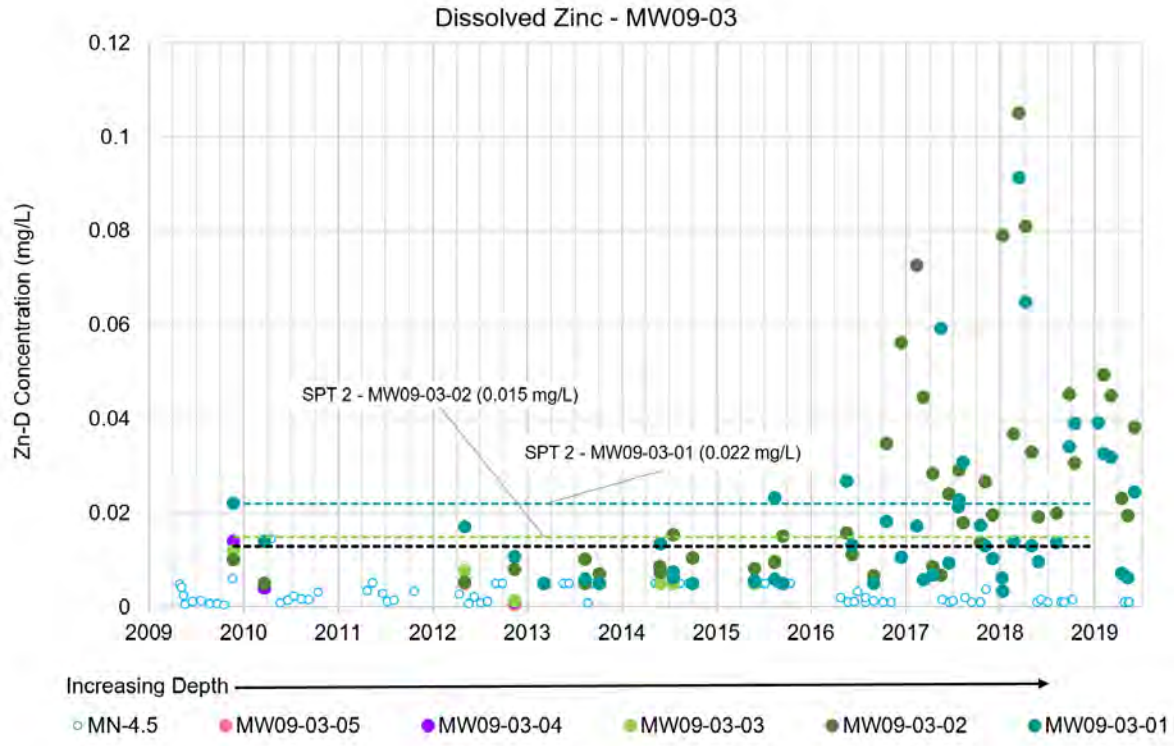
MW09-03
Mo-D & Se-D SPT Exceedances

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

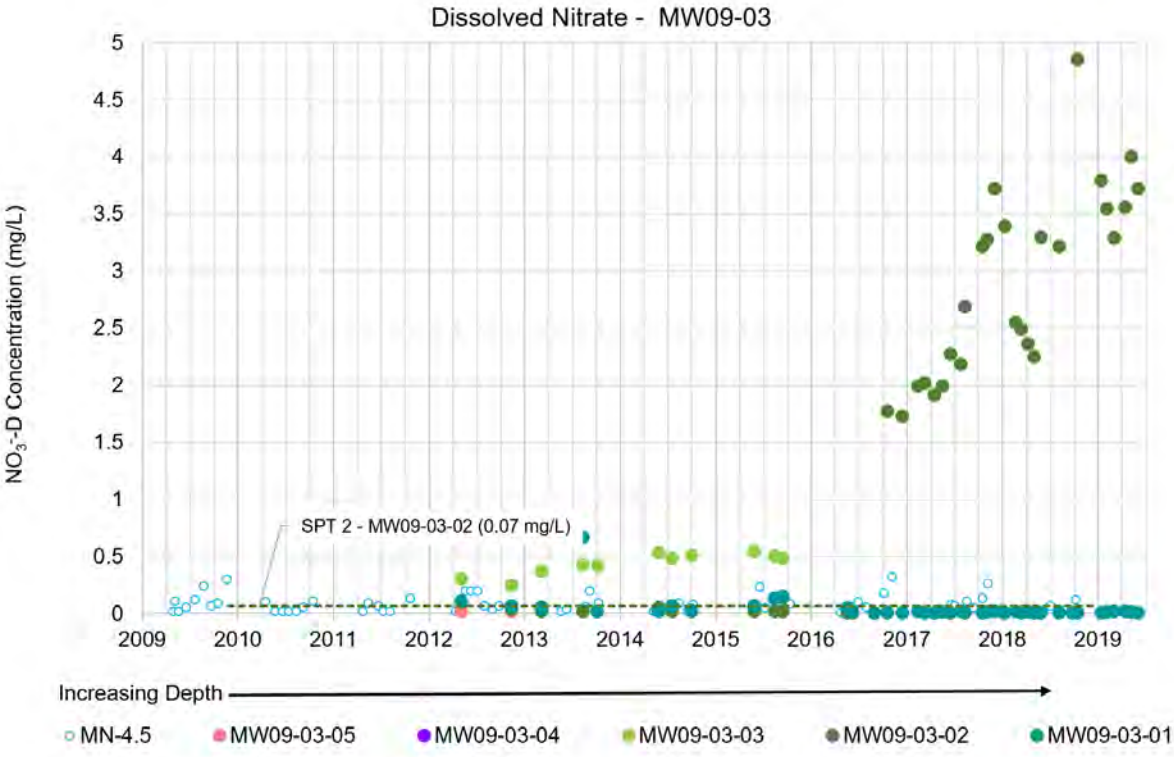
Minto Mine

Date: October 2019
Approved: DCM
Figure: A-3

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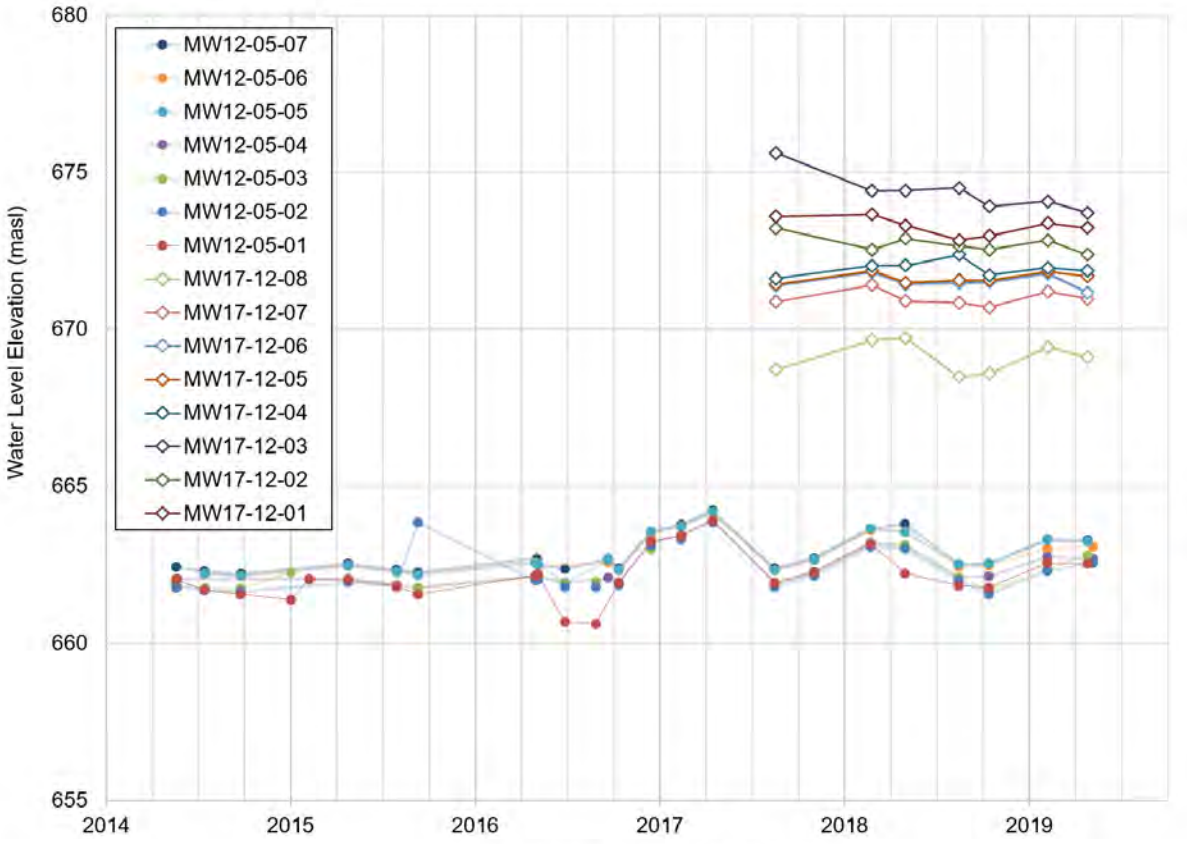
MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q2 of 2019 shown on graph (applies to MW09-03-01 and MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

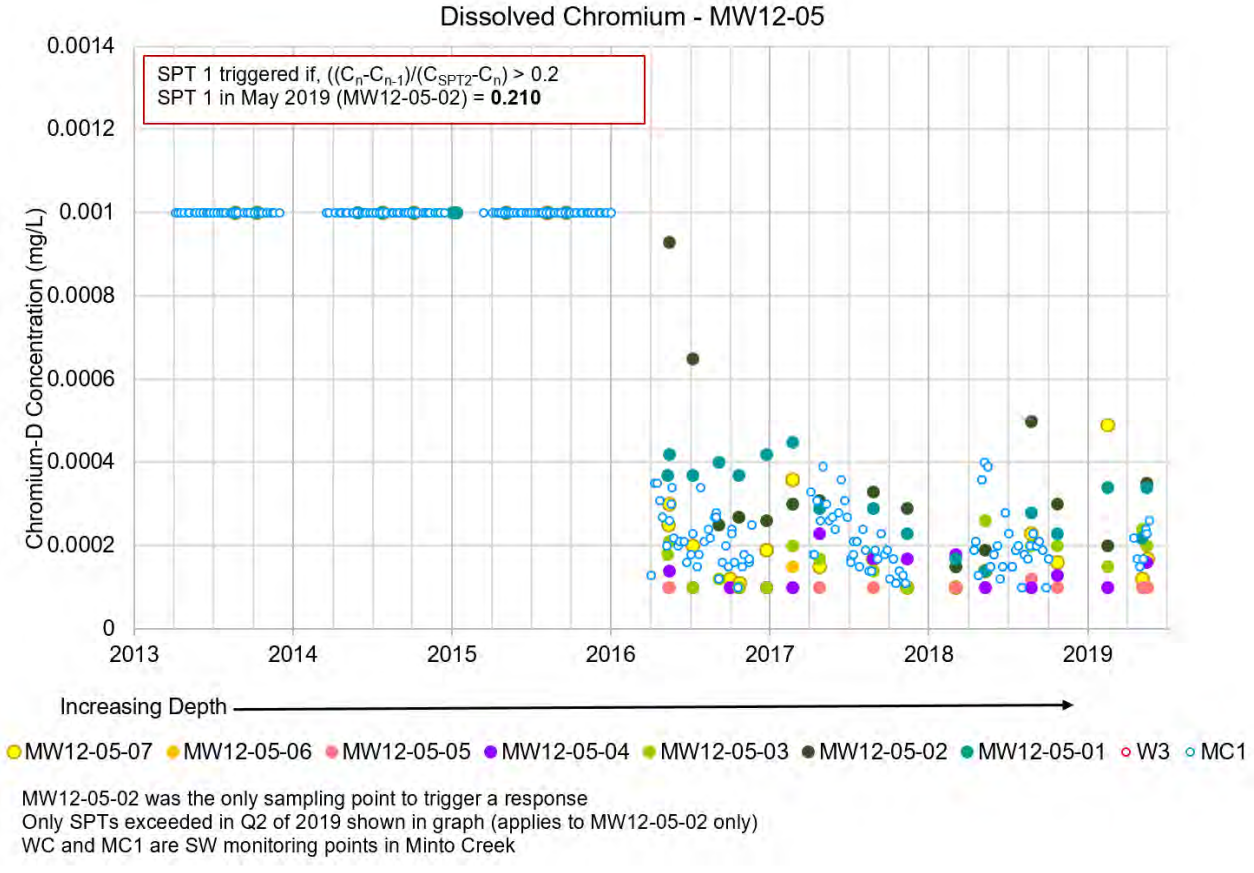


MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q2 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

srk consulting	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY	Minto Mine Adaptive Management
		MW09-03 Zn-D & NO_3^--D SPT Exceedances
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: October 2019 / Approved: DCM / Figure: **A-4**

\\srk.addfs\na\van\Projects\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20180601_June_Q2_AMP_Review\02_Analysis&Charts\Minto_AMPResponse-2018Q2_McGintyCreekGW_rev00_lv.xlsx

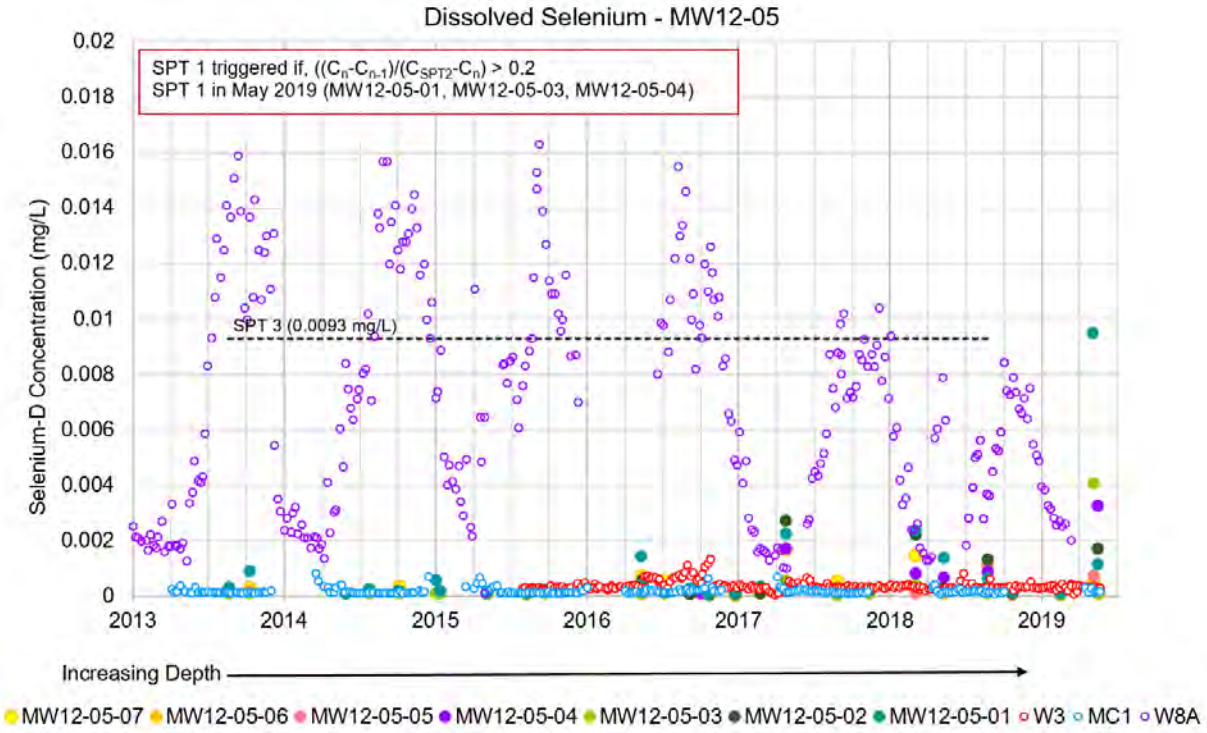




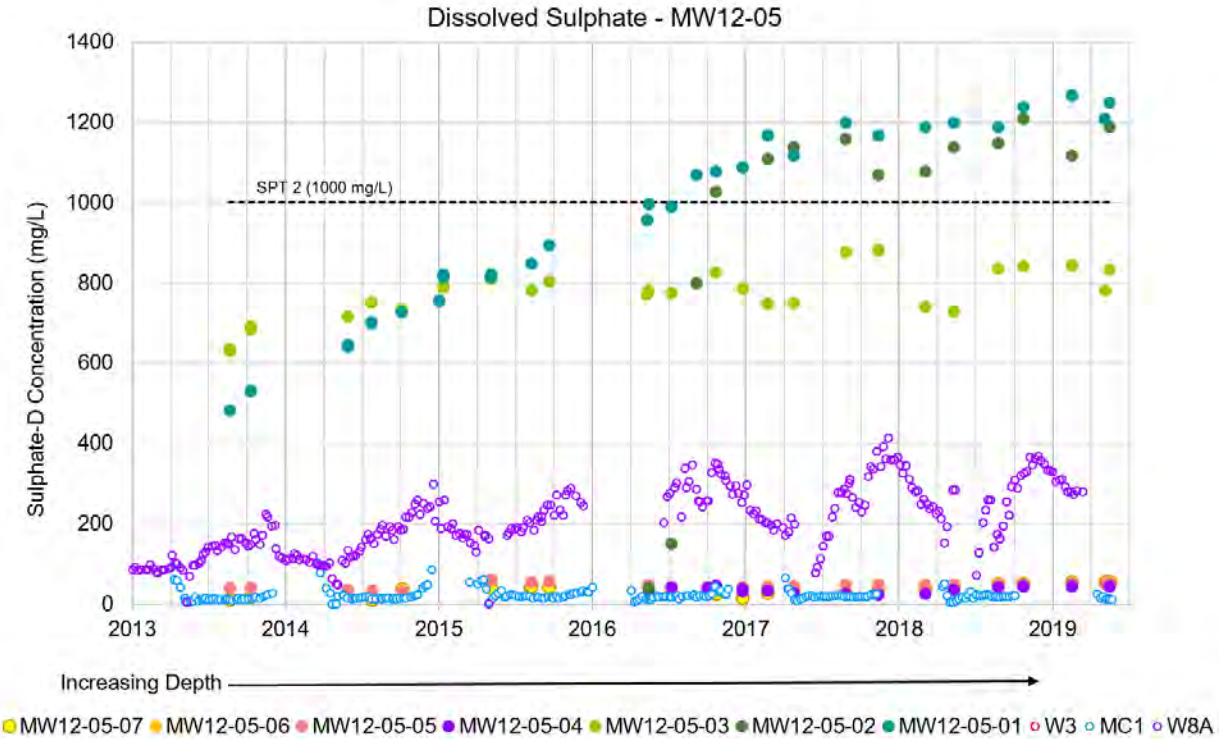
MW12-05-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q2 of 2019 shown in graph (applies to MW12-05-02 only)
WC and MC1 are SW monitoring points in Minto Creek

srk consulting	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY	Minto Mine Adaptive Management MW12-05 Water Level Data & MW12-05 Cr-D SPT Exceedances
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: October 2019 | Approved: DCM | Figure: **B-1**

\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20180601_June_Q2_AMP_Review\02_Analysis&Charts\Minto_AMPResponse_2018Q2_MintoCreekGW_rev00_lv.xlsx



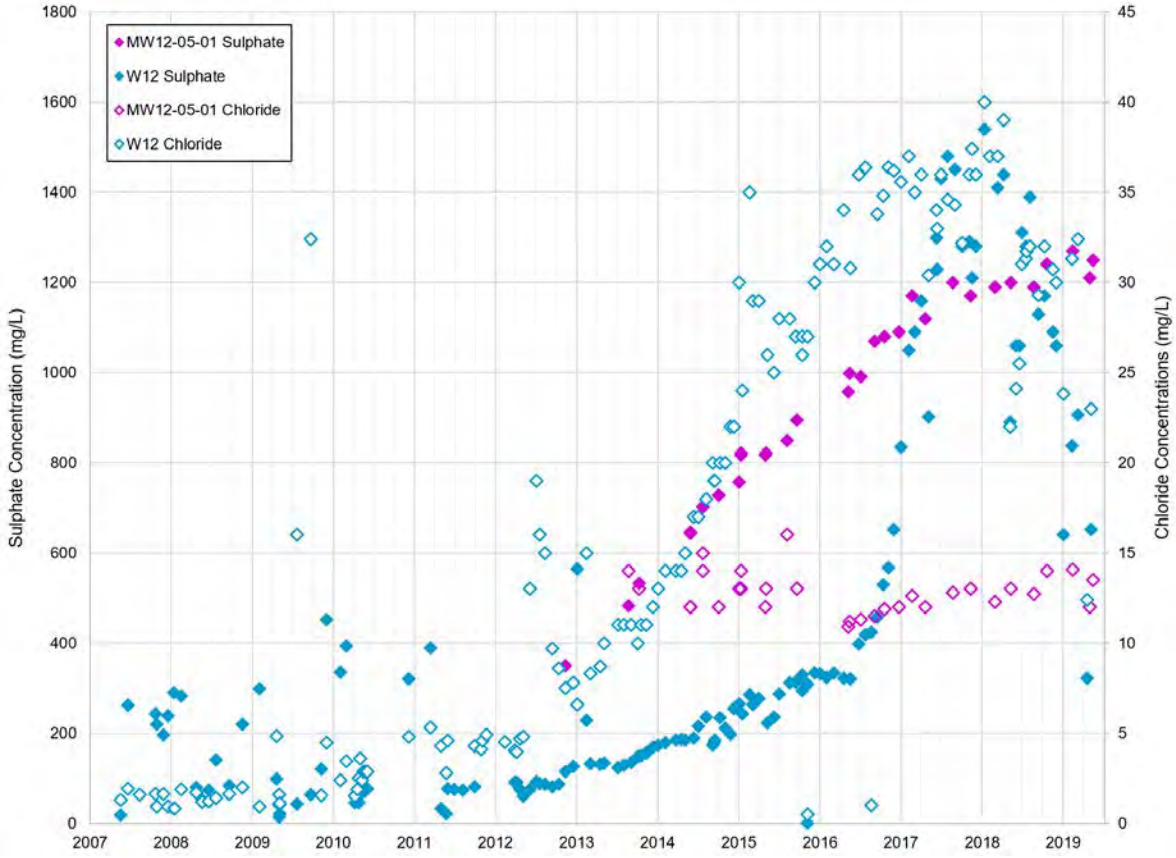
MW12-05-01, MW12-05-03 and MW12-05-04 were the only sampling points to trigger a response (SPT 1)
Only SPTs exceeded in Q2 of 2019 shown in graph
WC and MC1 are SW monitoring points in Minto Creek

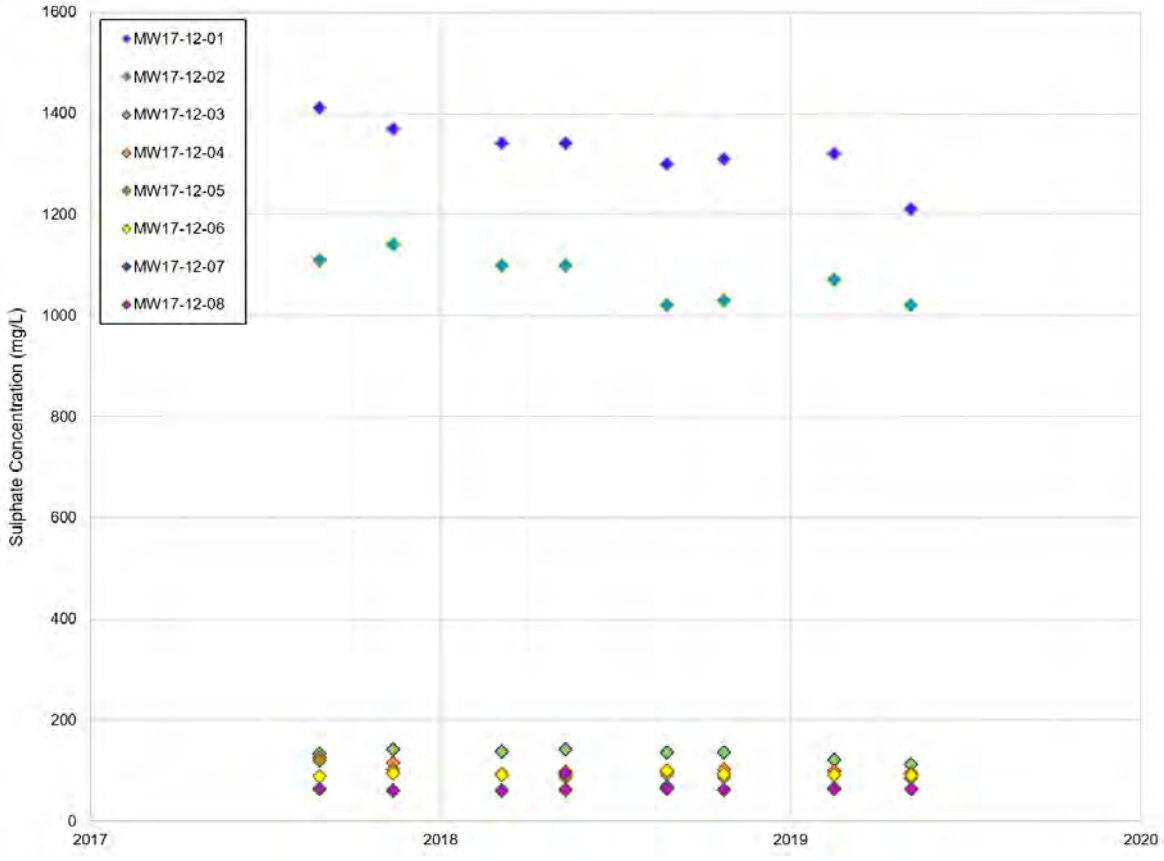


MW12-05-01 and MW12-05-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q2 of 2019 shown in graph (applies to MW12-05-01 and MW12-05-02 only)
WC and MC1 are SW monitoring points in Minto Creek

srk consulting	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY	Minto Mine Adaptive Management
		MW12-05 Se-D and SO_4^{2-}D SPT Exceedances
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: October 2019 / Approved: DCM / Figure: **B-2**

\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20180601_June_Q2_AMP_Review\02_Analysis&Charts\Minto_AMPResponse_2018Q2_MintoCreekGW_rev00_lv.xlsx





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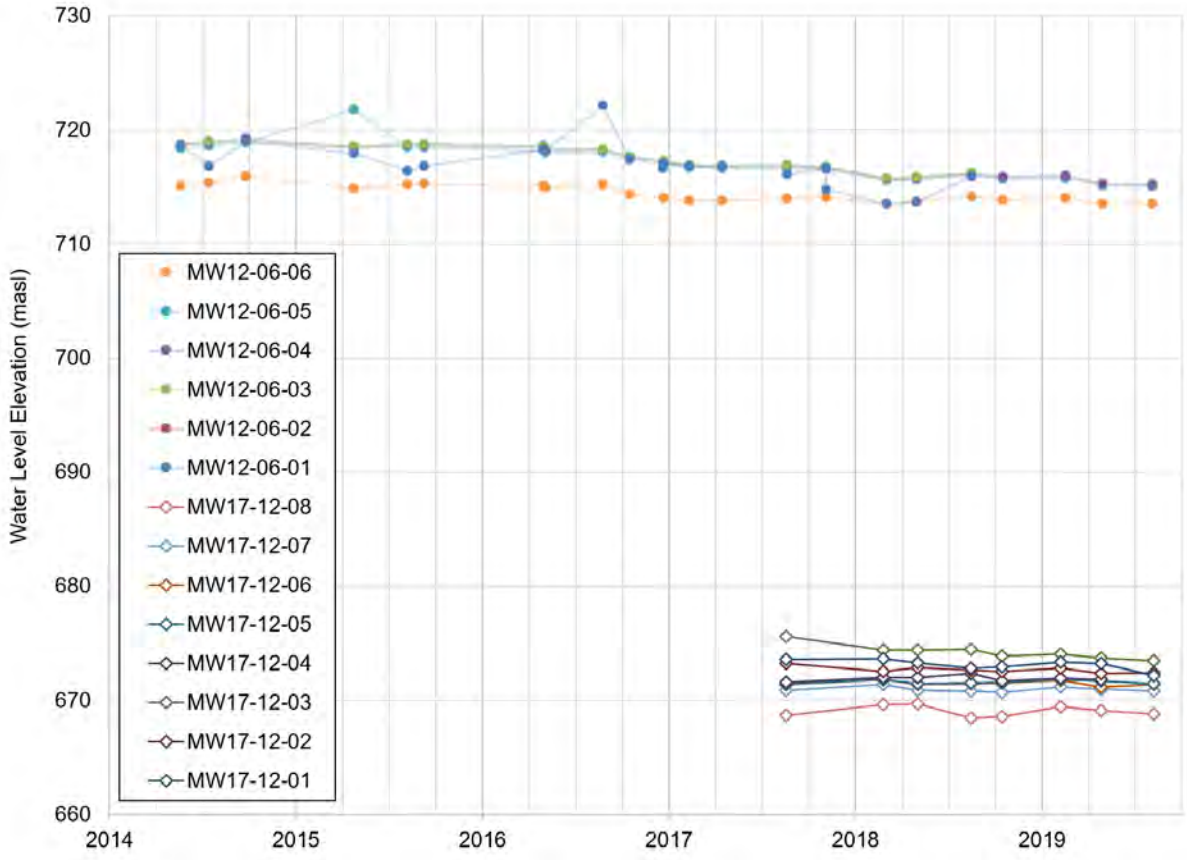
Minto Mine Adaptive Management

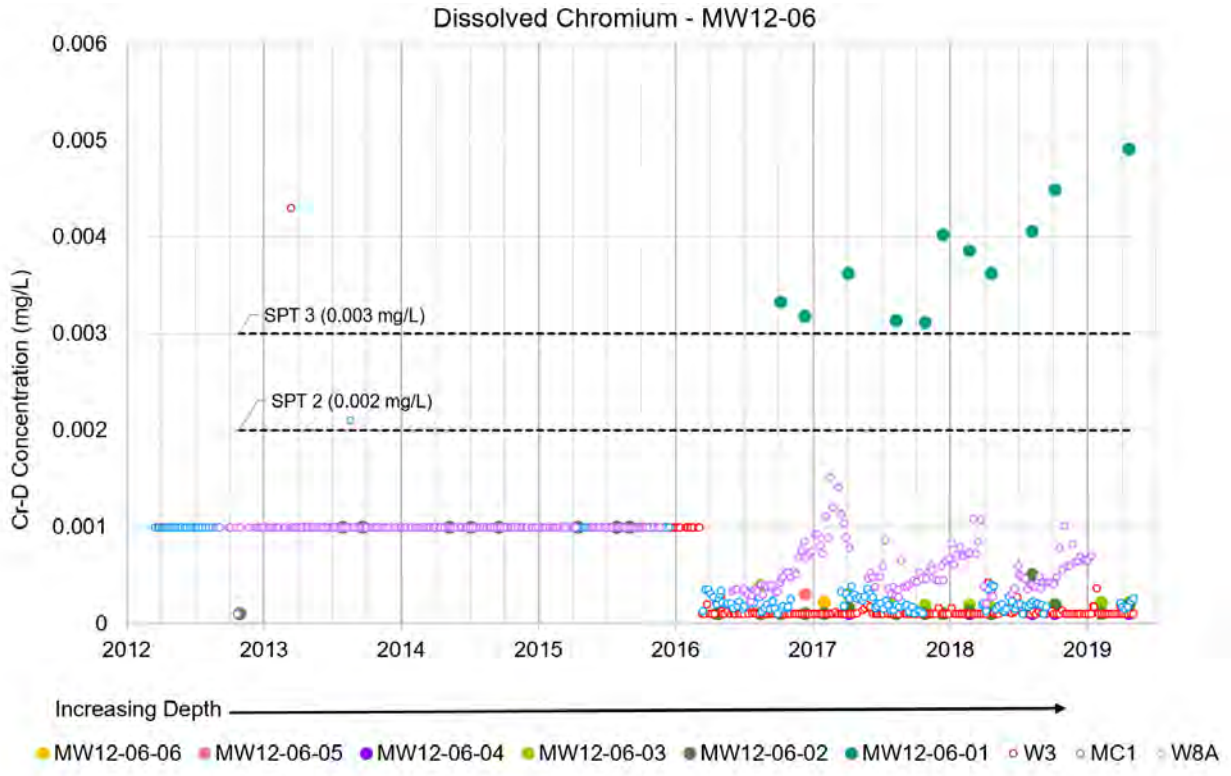
MW12-05 and W12 (Main Pit) SO_4^{2-}-D and Cl-D Concentrations and MW17-12 SO_4^{2-}D Concentrations

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: October 2019
Approved: DCM
Figure: **B-2**





MW12-06-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q2 of 2019 shown in graph (applies to MW12-06-01 only)
WC, W8A and MC1 are SW monitoring points in Minto Creek

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A PEMBRIDGE RESOURCES COMPANY

Minto Mine Adaptive Management

MW12-06 Cr-D SPT Exceedances and MW12-06, MW17-12 Water Level Data

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date:	Approved:	Figure:
October 2019	DCM	C-1

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www.srk.com

January 17, 2020
Project No: 1CM002.055

Minto Explorations - A Pembridge Resources Company
Minto Mine
PO Box 11
Whitehorse, YT Y1A5X9

Attention: Todd Swenson, Environmental Manager (Minto Explorations - A Pembridge Resources Company)

Dear Todd:

Subject: 2019 Q3 (July - September) Groundwater AMP Events

The Minto Mine Operational Adaptive Management Plan was updated in 2018 for groundwater monitoring, with the review frequency for groundwater triggers changed from monthly to quarterly, at the recommendation of the qualified professional (QP). As per AMP2017-02, all data concerning trigger exceedances are sent to the QP within a week of discovery and included in the subsequent review. This letter is the 2019 Q3 quarterly review (July to September 2019) under the updated reporting schedule.

As part of the Minto Mine Operational Adaptive Management Plan, Minto Mine has collected and reviewed groundwater quality data. Minto completed an initial review of data collected at the McGinty Creek groundwater monitoring station (MW09-03) and Minto Creek groundwater monitoring stations MW12-05 and MW12-06 for the third quarter of 2019 (July-September) and compared results to specific performance thresholds (SPT) defined in the Minto Mine Operations Adaptive Management Plan (MEL, 2017-02). McGinty Creek monitoring stations are required to be sampled monthly, while the Minto Creek stations are sampled quarterly. For Minto Creek MEL identified exceedances of certain thresholds for sampling rounds conducted in July and August of 2019. For McGinty Creek, MEL identified exceedances of certain thresholds for sampling rounds in July, August and September 2019. As per the plan, MEL has contracted a QP to review those data and provide recommendations. SRK Consulting (Canada) Inc. was contacted by Minto environmental staff on October 1, 2019 to provide QP review. This letter presents results of that review and recommendations.

SRK compared data against the 2017-02 AMP thresholds, historical data and data from surface water at station MN4.5 in lower McGinty Creek and surface water stations W3 and MC1 in Minto Creek. Groundwater SPT exceedances (events) have occurred for a limited number of parameters and do not necessarily correlate with distance from mining activities. Some of these events may reflect elevated background concentrations that were not identified prior to start of mining because monitoring wells were not in place at that time. Table 1 (Appendix A) summarizes exceedances, observations on the data, interpretation and recommendations. Figures (Appendix B) are included with this review to illustrate the

current physical (i.e., water level) setting at the Minto North pit. Graphs are included for each parameter exceeding thresholds and include the full range of data collected to date.

Key conclusions and recommendations are summarized below. Table 1 (Appendix A) summarizes observations and recommendations for all parameters.

For MW09-03 (McGinty Creek):

- The Minto Pit is not a source of water to the groundwater monitored at this station; water levels in the monitoring well continue to be higher than the pit water level. Water levels in the pit have been increasing slowly but remain well below the monitoring well water levels. These data continue to show no hydraulic gradient from the pit towards the monitoring well.
- Water levels at this station have been affected by the mining of Minto North, but the groundwater divide between Minto North and McGinty Creek remains, somewhere in the vicinity of MW09-03.
- Water levels in MW17-11 are generally lower than in MW09-03, with the exception of zone 5 which is screened shallower than zones 1 and 2 in MW09-03. Water levels in MW17-11 and MW09-03 indicate an overall downward gradient between the shallow-most zone and the remaining deeper zones. Differences in water level between deep zones are less pronounced; there may be an overall downwards vertical gradient, assuming that the shallow zone at MW17-11 is representative of all local conditions, but gradients at depth in this well and MW09-03 are not clear.
  - Recommendation: continue collecting water level/pressure profiles at this well according to the routine schedule.
- Concentrations of dissolved arsenic at MW09-03-01 have consistently exceeded SPT 1 since summer of 2016, and inconsistently exceeded thresholds in MW-09-02 in the same period. High variability is observed, but relatively recent data in MW09-03-01 exceeds thresholds more frequently than in the past and the most recent value in MW09-03-01 from October 2018 was nearly an order of magnitude higher than all previously measured values. Another anomalous value was detected in September 2019, but at less than half the value of the previous anomaly. Since then concentrations have decreased to the historic range, suggesting the anomalous values may be outliers. High concentrations do not correlate exactly with seasonal changes in groundwater level but may indicate an influence from seasonal variation (in recharge, flow, etc.). Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during freshet, possibly suggesting greater mobilization of trace elements when higher volumes of water could infiltrate through the unsaturated zone and mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.
- Concentrations of dissolved cadmium at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 in the past with high variability in the observed data. Cadmium data exceeded thresholds more frequently since 2017 and while average concentrations have increased beginning in 2017, with qualitative trends of overall increasing concentrations. These trends are not consistent year-to-year, nor between seasons on different years. All three sampling events in Q3 exceeded thresholds in both MW09-03-01 and MW09-03-02, but with high variability and lowest values for the

year during the most recent sampling event. Seasonal variability may be present, but highest concentrations occur in different quarters each year. Cadmium concentrations in McGinty Creek remain low and stable, showing no significant change over time.

- Concentrations of dissolved copper have exceeded SPT 1 sporadically in MW09-03-02 since late 2016. While all three monitoring events exceeded thresholds in Q3, data remain highly variable and no year-over-year increasing trend is present. The highest values were detected in MW09-03-02 during the first half of 2018 and have since been lower. Dissolved copper values in McGinty Creek remain in the range of historic data and no evidence of significant change is present.

- Concentrations of dissolved molybdenum in MW09-03-01 and MW09-03-02 have exceeded SPT 1 thresholds sporadically since sampling began, with peak concentrations measured in 2016. Since then, concentrations have decreased, and have been considerably less variable in 2019 with values very near SPT 1 (0.005 mg/L). Measured values in MW09-03-01 exceeded SPT 1 in July and August but show no increasing trend, while none of the sampling points exceeded thresholds in MW09-03-02 in Q3. Dissolved molybdenum values in McGinty Creek remain in the range of historic data and no evidence of significant change is present.

- Concentrations of dissolved selenium in MW09-03-01 and MW09-03-02 have exceeded thresholds sporadically in the last few years, with increased variability in the data beginning in 2017. Average annual concentrations in MW09-03-02 have been higher in 2018 and 2019 than past years, but do not demonstrate a consistent increasing trend. Peak concentrations in Q1 and Q2 of these years indicate potential seasonal variation. Dissolved selenium in McGinty Creek remain in the range of historic data and no evidence of consistent significant change is present.

- Concentrations of dissolved zinc at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 and SPT 2 thresholds since the summer of 2016. High variability is observed in the data, but relatively recent data exceeds thresholds more frequently than in the past. High concentrations do not correlate exactly with seasonal changes in groundwater level but may indicate an influence from seasonal variation. Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during freshet when higher volumes of water infiltrate through the unsaturated zone and mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  – Recommendation: Although concentrations have been increasing in the recent past, Water Quality Objectives defined for McGinty Creek are two or three orders of magnitude higher than the thresholds defined for groundwater (Table 2.5 - Minto Mine Operations Adaptive Management Plan, 2018-01) and the overall risk posed by groundwater loading remains low. Due to this, limited actions are recommended at this time. Continue monitoring as per schedule. Continue to look for seeps from the haul road that can be used for comparison. Compare vertical concentration profiles in MW09-03 and MW17-11 as more annual data becomes available from MW17-11.

- Concentrations of dissolved nitrate at MW09-03-02 have exceeded SPT 2 since the fall of 2016 but remain stable and below both SPTs in the deeper zone, MW09-03-01. Concentrations showed an increasing trend from October 2016 to December 2017, showed the potential for a decreasing trend in Q1 of 2018 but were higher in the latter half of 2018. Concentrations in 2019 showed a relatively

slower increasing trend, with the exception of the most recent monitoring event from September 2019, when the concentration rose nearly three times the previous data. As the Minto North Pit acts as a hydraulic sink, the likely source of nitrate to the groundwater is flushing of blast residuals from the rock used to construct the mine haul road on the topographically downgradient side of the Minto North Pit. The effect is expected to be relatively short lived, as the blasting residuals will flush out over time. Concentrations will be closely monitored to determine if a meaningful increasing trend is present and a more detailed review of nitrate behavior will be provided in the 2019 Annual Report. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  – Recommendation: Due to the low potential loading of groundwater into McGinty Creek limited action is recommended at this time. Continue monitoring as per routine schedule. Review nitrate data in comparison to other analogous areas to advance assessment of potential that this is related to nitrate leaching from residual explosives in the haul road materials. Continue to look for opportunities to collect samples from surface seeps emanating from haul road and continue to compare data from MW09-03-02 and MN-4.5 to confirm low nitrate concentrations persist in McGinty Creek.

For MW12-05 and MW12-06 (Minto Creek):

- Water level data in the deepest zone of MW12-06 decreased sharply between November 2017 and March 2018, which coincides with development of the Minto East underground (Figure C-1 (Appendix B)). Water levels in the deepest zone increased again between May and August 2018, when development of the underground stopped. The same trend was not observed in MW12-05 or MW17-12, suggesting these wells are currently outside the area of groundwater affected by the development of the underground (Figure B-1 (Appendix B)). Seasonal fluctuations are apparent in MW12-05, with peak water levels occurring in Q2 of the past 2 years.

  – Recommendation: continue collecting water level/pressure profiles at these wells according to the routine schedule.

- Concentrations of sulphate at MW12-05-01 and MW12-05-02 continue to be elevated above SPT 2 (1,000 mg/L). Concentrations at MW12-05-01 and MW12-05-02 have been increasing since well installation but show signs of stabilization after August 2017, suggesting sulphate concentrations may be approaching equilibrium. While concentrations are still increasing, data do not show the same rate of increase as was observed prior to 2017. Sulphate exceedances have been restricted to the deeper zones, which monitor depths greater than 85 meters below ground surface (mbgs). Shallower zones and surface water stations in Minto Creek, downstream of the mine footprint, display stable trends in sulphate at far lower concentrations than Zone 1 and 2. While concentrations have been increasing in both MW12-05 and the Main Pit, the rate and timing of increase differs with a slow increase in the Main Pit until Q3 of 2016 when concentrations jumped over 1000 mg/L in less than one year and a consistent steady increase in MW12-05 that started earlier than this then began to level off in Q1 2017.

  Additionally, chloride concentrations (another conservative tracer) also changed at different rates and times in the Main Pit and MW12-05. Chloride at the Main Pit has been decreasing since 2018, while concentrations at MW12-05 have remained stable at lower concentrations than the pit. Observed

concentrations of sulphate at MW12-05 may not be related to water in the Main Pit. For comparison, sulphate concentrations in MW17-12 exhibit increasing concentration with depth but no increasing trend over time. Minto Creek continues to indicate no trends in sulphate concentration that can clearly be related to changes in groundwater concentrations

  - Recommendation: continue monitoring as per schedule and continue with investigations as part of the overall review of site groundwater quality.

- Concentrations of dissolved chromium in MW12-06-01 have exceeded SPT 3 since October 2016 and average concentrations have been increasing since Q4 2016. Elevated Cr-D is isolated to MW12-06-01, the deepest zone in this well (142.3 meters below ground surface). While there may be seasonal trends in Minto Creek, variability within the data is very low and shows no trends that can be clearly correlated to groundwater concentrations.
- Concentrations of dissolved selenium do not regularly exceed thresholds, and in Q3 of 2019 only exceeded SPT 3 in MW12-06-01. With the exception of what appear to be three outliers since 2016, peak concentrations have been measured in late Q1 or Q2 each year since 2016, suggesting a seasonal trend is present. The same variability is not observed in Minto Creek, and no trends are present that suggest any impacts to surface water from groundwater.

Sincerely,

SRK Consulting (Canada) Inc.



Laura Volden, MSc
Consultant (Hydrogeochemistry)

Reviewed by



Daniel Mackie, PGeo
Principal Consultant (Hydrogeology)

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Minto Explorations Ltd.. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data

Appendix A: Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

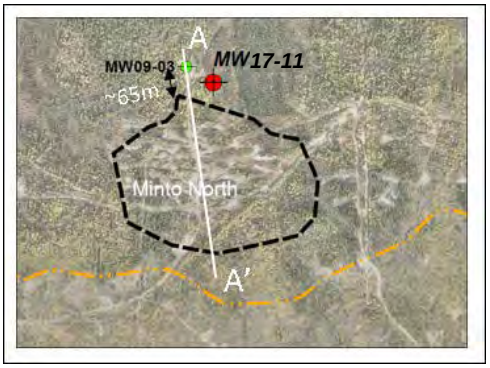
Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
McGinty Creek Catchment								
MW09-03-01 Figure A-1, A-2		As-D	mg/L		**Water Level (Figure A-1):** Water levels in MW09-03 Zone 1 and Zone 2 started declining when mining started in Minto North. Declining trend decreased about 6 months after mining completed. Water levels remain higher than pit bottom. Water levels increased between July and September 2016 before returning to previous trend. Similar trend occurred in 2017 when water levels increased between April and September, declined until May 2018 and increased again until September. Water levels show signs of increasing in Q3 2019, consistent with previous seasonal trends. Minto North pit continues to act as a hydraulic sink, and has lowered groundwater levels. Water levels at MW09-03 suggest the presence of a groundwater divide somewhere north of the pit. Seasonal fluctuations indicate some influence from recharge. **Water Quality (Figure A-2):** Concentration in September 2019 much higher than previous data, with the exception of one point in October 2018, suggesting the data point is an outlier. Seasonal variations appear to be present, with highest values occurring the summer months the last 2 years (with the exception of outliers). As-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	While data from late summer 2015 to August 2017 showed signs of an increasing trend, values exhibit significant variability throughout the year. Peak values during Q2 and Q3 suggest a seasonal trend related to freshet may be present. Elevated values are isolated to October 2018 and September 2019 and appear to be outliers.	Lack of any clear upwards trend in McGinty Creek, as measured at MN-4.5, suggests currently no impact. Water quality objective at MN-4.5 is 3 orders of magnitude higher than SPT 2. Overall risk of arsenic loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.0009	0.00081 (SPT 2)				
	August	8/2/2019	0.0009	0.00081 (SPT 2)				
	September	9/13/2019	0.0041	0.00081 (SPT 2)				
MW09-03-01 Figure A-1, A-2		Cd-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations in 2019 have been more sporadic than the past, with the highest concentration measured in August 2019. While annual peak concentrations have been increasing, the trend is consistent between months of different years. Cd-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Possible year-to-year increasing trend. Annual average is increasing, but values in 2019 have not been increasing.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of cadmium loading to McGinty Creek from groundwater is considered low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.000107	0.000075 (SPT 1)				
	August	8/2/2019	0.000127	0.000075 (SPT 1)				
	September	9/13/2019	0.000336	0.000075 (SPT 1)				
MW09-03-01 Figure A-1, A-3		Mo-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-3)**: Exceedances to SPT 1 have been occurring sporadically in the past with highest concentrations detected in 2016. Since then, concentrations have been lower and less variable with values that are near SPT 1 in 2019. Mo-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Peak values near the end of Q2/start of Q3 suggest a seasonal trend related to freshet may be present. No increasing trend is identified, most recent data point is below threshold.	Lack of any clear upwards trend in McGinty Creek, as measured at MN-4.5, suggests currently no impact. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of molybdenum loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.00582	0.005 (SPT 1)				
	August	8/2/2019	0.00522	0.005 (SPT 1)				
	September	-	-	-				
MW09-03-01 Figure A-1, A-4		Se-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-3)**: Exceedances to SPT 1 have been occurring sporadically since 2016. Concentrations in Q3 are generally lower than Q2 with the most recent data point below the threshold. Se-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in 2019 were more variable than past years but with no discernable year-to-year trend. Exceedences to SPT 1 are not consistent. Elevated concentrations in Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of selenium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.000162	0.0001 (SPT 1)				
	August	8/2/2019	0.000111	0.0001 (SPT 1)				
	September	-	-	-				
MW09-03-01 Figure A-1, A-4		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations sporadically exceed SPT 1 and SPT 2 with the most recent value lower than previous Q3 samples. Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in Q3 are higher than previously in 2019, but with no consistent upwards trend. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low due to low K. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of zinc loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.016	0.022 (SPT 2)				
	August	8/2/2019	0.071	0.022 (SPT 2)				
	September	9/13/2019	0.0219	0.013 (SPT 1)				
MW09-03-02 Figure A-1, A-2		As-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations have been consistently below threshold with the excetion of one point measured in September 2019. As-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	No increasing trend in As-D is present. Elevated value measured in September 2019 is isolated, and more data is needed to determine if it is an outlier.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 3 orders of magnitude higher than SPT 2. Overall risk of arsenic loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	-	-				
	August	8/2/2019	-	-				
	September	9/13/2019	0.0014	0.00092 (SPT 2)				
MW09-03-02 Figure A-1, A-2		Cd-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations in 2019 have been more sporadic than the past, with the highest concentration measured in September 2019. Cd-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Highest concentrations measured to date have been in Q3 of 2019, but are not consistently increasing.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of cadmium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.00021	0.000031 (SPT 1)				
	August	8/2/2019	0.000179	0.000031 (SPT 1)				
	September	9/13/2019	0.000229	0.000031 (SPT 1)				
MW09-03-02 Figure A-1, A-3		Cu-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations have been sporadically exceeding SPT 1 since late 2016. While concentrations in 2019 exceed thresholds, they are on average lower than 2018 values. Cu-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	No consistent trend in Cu-D. Highest values were detected in the first half of 2018 and have been consistently lower since.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of copper loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.00171	0.00155 (SPT 1)				
	August	8/2/2019	0.00203	0.00155 (SPT 1)				
	September	9/13/2019	0.00321	0.00155 (SPT 1)				
MW09-03-02 Figure A-1, A-4		Se-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-3)**: Exceedances to SPT 1 have been occurring sporadically since 2016. Average annual concentrations are higher in 2018 and 2019 than previous years, but do not consistently exceed SPT 1. Se-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in 2019 were more variable than past years but with no clear increasing trend. Exceedances of SPT 1 are not consistent, and only occurred once in Q3 2019. Elevated concentrations in Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of selenium loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	-	-				
	August	8/2/2019	0.000566	0.0005 (SPT 1)				
	September	-	-	-				
MW09-03-02 Figure A-1, A-4		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations in Q3 2019 consistently exceed SPT but do not demonstrate a clear increasing trend. Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in Q3 are higher than previously in 2019, but with no consistent upwards trend. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low due to low K. Water quality objective at MN-4.5 is 2 orders of magnitude higher than SPT 2. Overall risk of zinc loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	July	7/5/2019	0.0383	0.015 (SPT 2)				
	August	8/2/2019	0.0745	0.015 (SPT 2)				
	September	9/13/2019	0.0525	0.015 (SPT 2)				
MW09-03-02 Figure A-1, A-5		NO_3-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-5):** Values in 2019 are on average higher than previous years, with the most recent point almost three times higher than concentrations measured previously in 2019. NO_3-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Clear upward trend from May 2015-December 2017. Higher variability in 2018 but with highest value recorded occurring in October. Values within 2019 show a slight increasing trend, with a large increase in September 2019. More monitoring is required to determine if concentrations will continue to increase at that rate.	McGinty Creek, as observed at MN-4.5, does not show increasing or decreasing trends similar to MW09-03-02. Considering the small catchment area for MW09-03-02, even if the well is affected by local recharge, potential loading to McGinty Creek via this groundwater is likely low.	Limited action at this time. Continue monitoring as per routine schedule, continue to look for opportunities to collect samples from surface seeps emanating from haul road and continue to compare data from MW09-03-02 and MN-4.5 to confirm low nitrate concentrations persist in McGinty Creek.
	July	7/5/2019	3.75	0.07 (SPT 2)				
	August	8/2/2019	4.12	0.07 (SPT 2)				
	September	9/13/2019	13.9	0.07 (SPT 2)				

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
Minto Creek Catchment								
MW12-05-01 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1):** Water levels show increasing trends in the fall to late winter seasons, followed by a decrease throughout the summer. Water levels in Q2 are similar to levels at the same time of year in 2018. While more data is needed to be certain, the trends are likely due to a seasonal fluctuation. Overall vertical gradient remains downward. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, stabilized around 1200 mg/L for the majority of 2018 but are showing an increasing trend since Q4 2018. SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Previously observed upwards trend shows signs of stabilization after August 2017 with a slight increase again since Q4 2018. Most recent concentrations are highest detected, but not significantly increased from previous sampling event. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but not likely connected to groundwater at MW12-05.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	July	7/5/2019	N/A					
	August	8/2/2019	1300	1000 (SPT 2)				
	September	N/A	N/A					
MW12-05-02 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1):** see previous section. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, and have since stabilized around 1200 mg/L. SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Previously observed upwards trend shows signs of stabilization after August 2017 with higher variability since Q1 2018. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but not likely connected to groundwater at MW12-05.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	July	7/5/2019	N/A					
	August	8/2/2019	1190	1000 (SPT 2)				
	September	N/A	N/A					
MW12-06-01 Figure C-1		Cr-D	mg/L		**Water Level (Figure C-1):** Water level data show overall decreasing trend since March 2014. Deepest zone (1) shows steeper decrease in water level between November 2017 and March 2018. This drop is consistent with a decrease in water level in MW12-07 which coincides with development of the Minto East underground. Water level in the deepest zone, MW12-06-01, has shown in increase between Q2 and Q3 2018. Overall gradient in bottom zones is upwards; shallow-most zone has lowest water level. Complex multi-directional gradient is present. **Water Quality (Figure B-1):** Values at other depths in this well are at or below detection. Sampling in zone 1 only began in Oct 2016 but samples have consistently been above SPT 3 with an overall increasing trend. Cr-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Since the fall of 2016 elevated concentrations have been observed in MW12-06-01 and, to a lesser extent, W8A. Concentration during winter low flow period has increased over last two years. High frequency sampling at W8A shows seasonal variability that may also be reflected in the groundwater chemistry, with highest Cr-D observed in the late winter and the lowest in late summer.	While elevated concentrations of Cr-D have been continually detected in MW12-06-01, they have been isolated to the deepest zone and elevated concentrations have not been detected in the receiving environment (Minto Creek, down gradient wells, etc.). In addition, elevated Cr-D has not been detected in the mine pits, the underground dewatering pond or any other major sources of contaminated water on site. Currently, the risk posed by elevated Cr-D in MW12-06 is considered low.	No further action at this time. Continue monitoring as per routine schedule.
	July	7/5/2019	N/A					
	August	8/2/2019	0.00504	0.003 (SPT 3)				
	September	N/A	N/A					
MW12-06-01 Figure C-1, C-2		Se-D	mg/L		**Water Level (Figure C-1):** see previous section. **Water Quality (Figure B-1):** Concentrations that exceed the thresholds are isolated, with only two recorded to date. The highest point was observed in August 2019, but subseqent monitoring events have been below SPT 2. Se-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Concentrations have been stable at low concentrations with the exception of three isolated points, occuring in either Q3 or Q4 of 2016, 2018 and 2019. More data needs to be collected to determine if a trend is present.	Exceedances are isolated, and no impacts are observed at monitoring stations in Minto Creek.	No further action at this time. Continue monitoring as per routine schedule.
	July	7/5/2019	N/A					
	August	8/2/2019	0.00632	0.006 (SPT 2)				
	September	N/A	N/A					

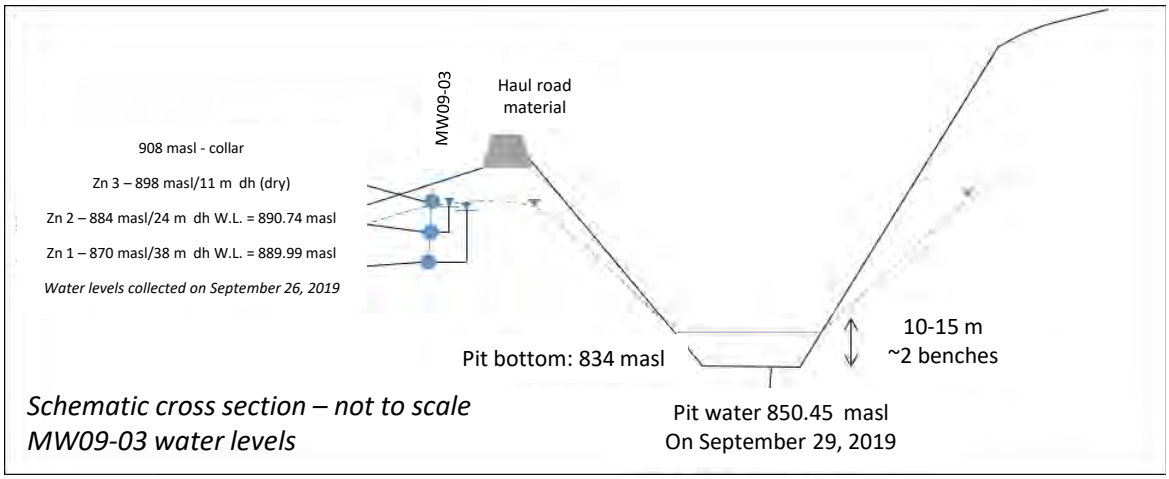
Notes:
'N/A' indicates no sample was taken for that month
'-' indicates value for that month did not trigger a response
Zones with no data or no exceedances: MW09-03-03 (dry), MW12-05-03, MW12-05-04, MW12-05-05, MW12-05-06, MW12-05-07, MW12-06-02, MW12-06-03, MW12-06-04, MW12-06-05, MW12-06-06

Appendix B: Figures to Illustrate Current Physical Setting at Minto North Pit

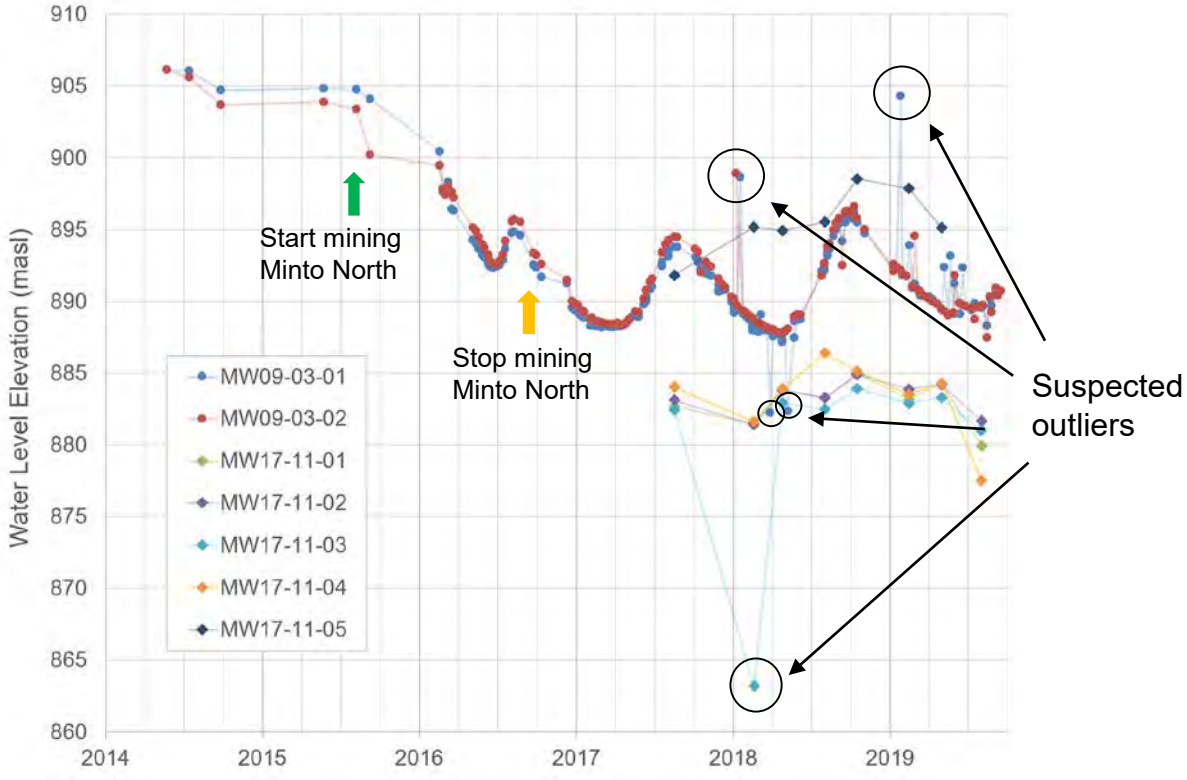




A A'



Schematic cross section – not to scale
MW09-03 water levels



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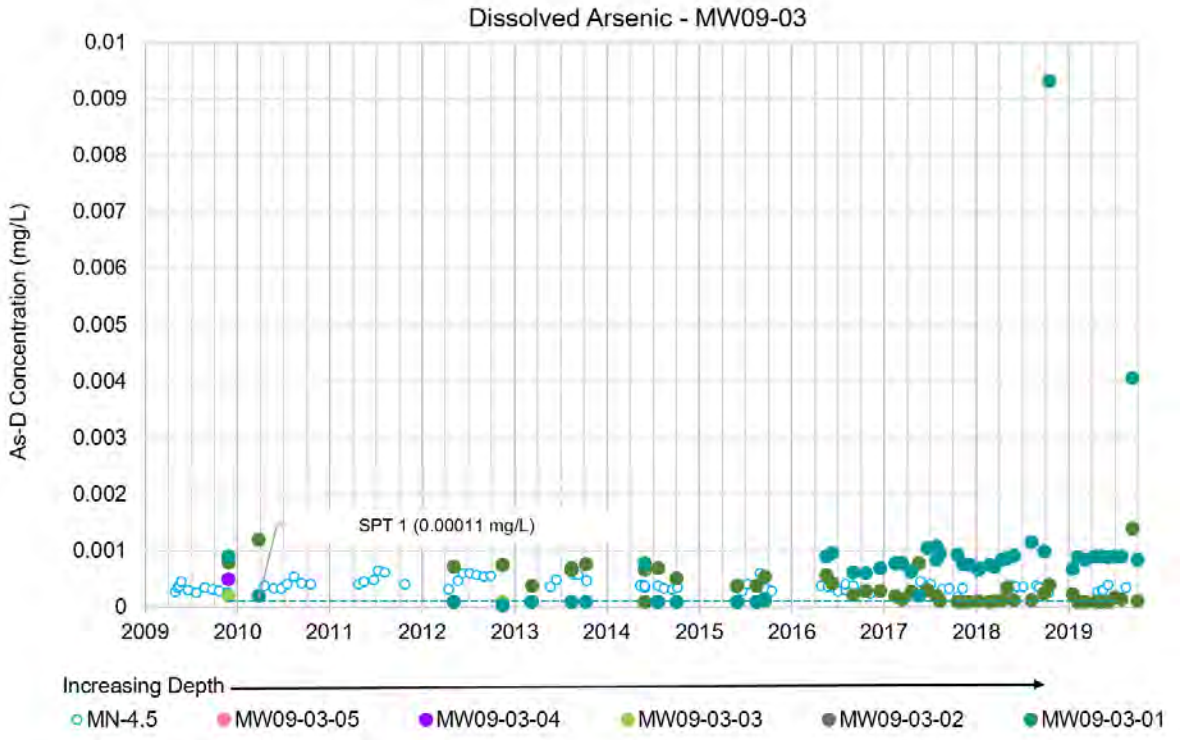
Minto North Pit: Physical setting and water levels

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

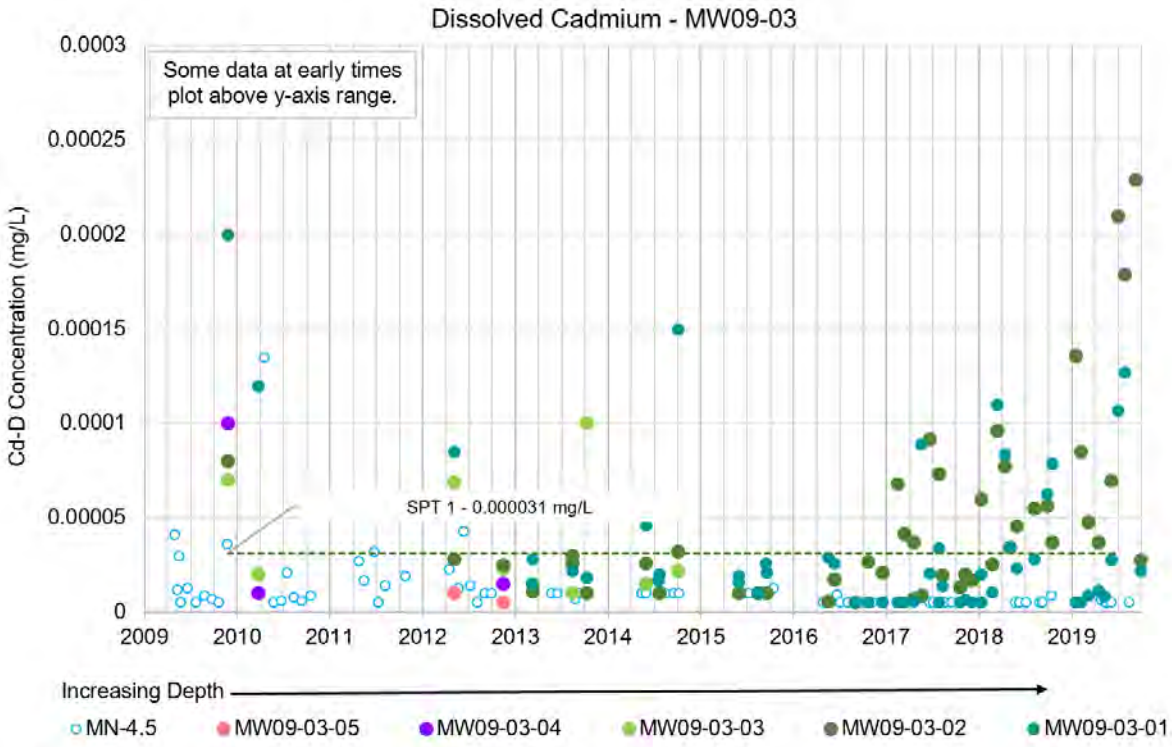
Minto Mine

Date: December 2019
Approved: DCM
Figure: A-1

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MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q3 of 2019 shown on graph (applies to MW09-03-01/02 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q3 of 2019 shown on graph (applies to MW09-03-01/02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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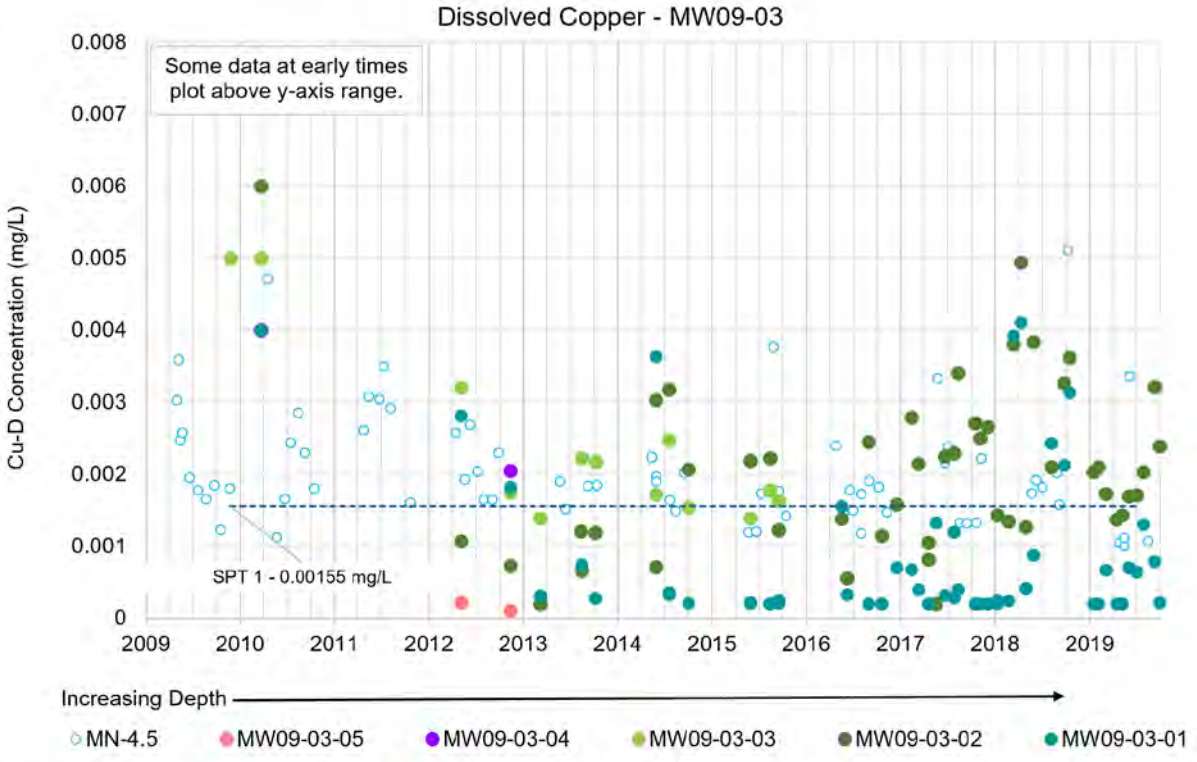
MW09-03
As-D & Cd-D SPT Exceedances

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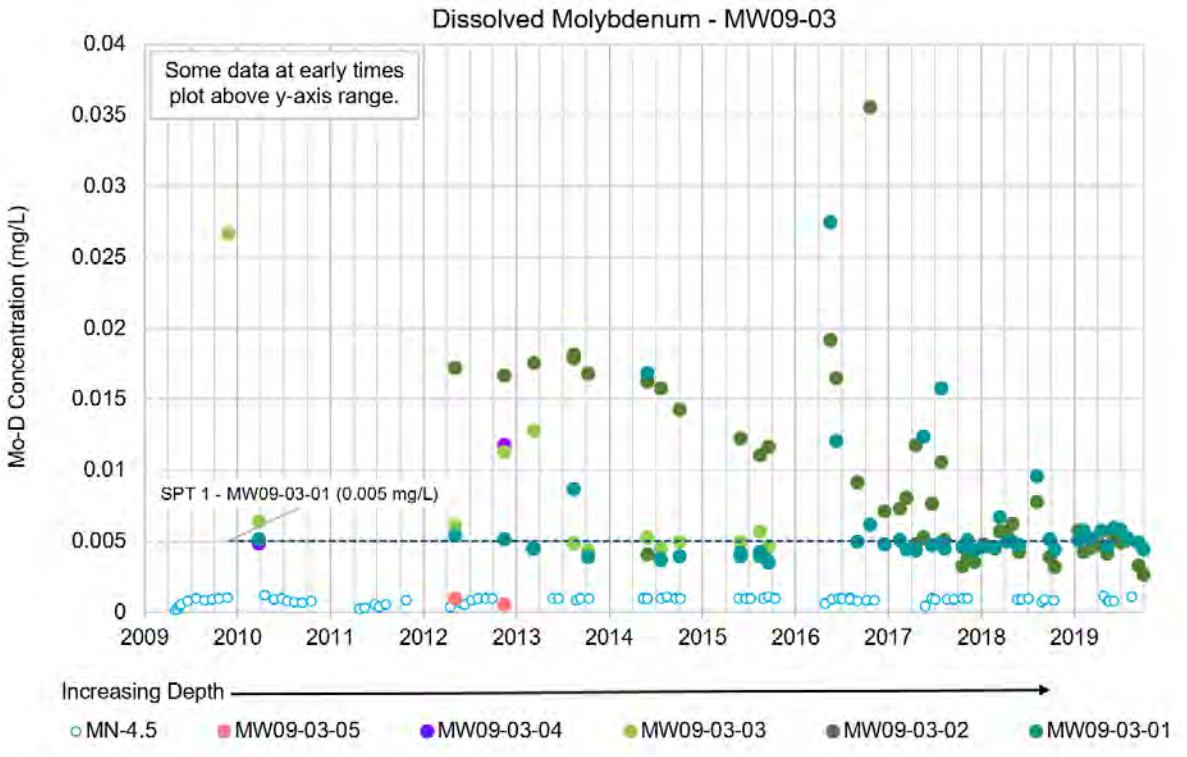
Minto Mine

Date: December 2019
Approved: DCM
Figure: A-2

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MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q3 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-01 is the only sampling point to trigger a response
Only SPTs exceeded in Q3 of 2019 shown on graph (applies to MW09-03-01 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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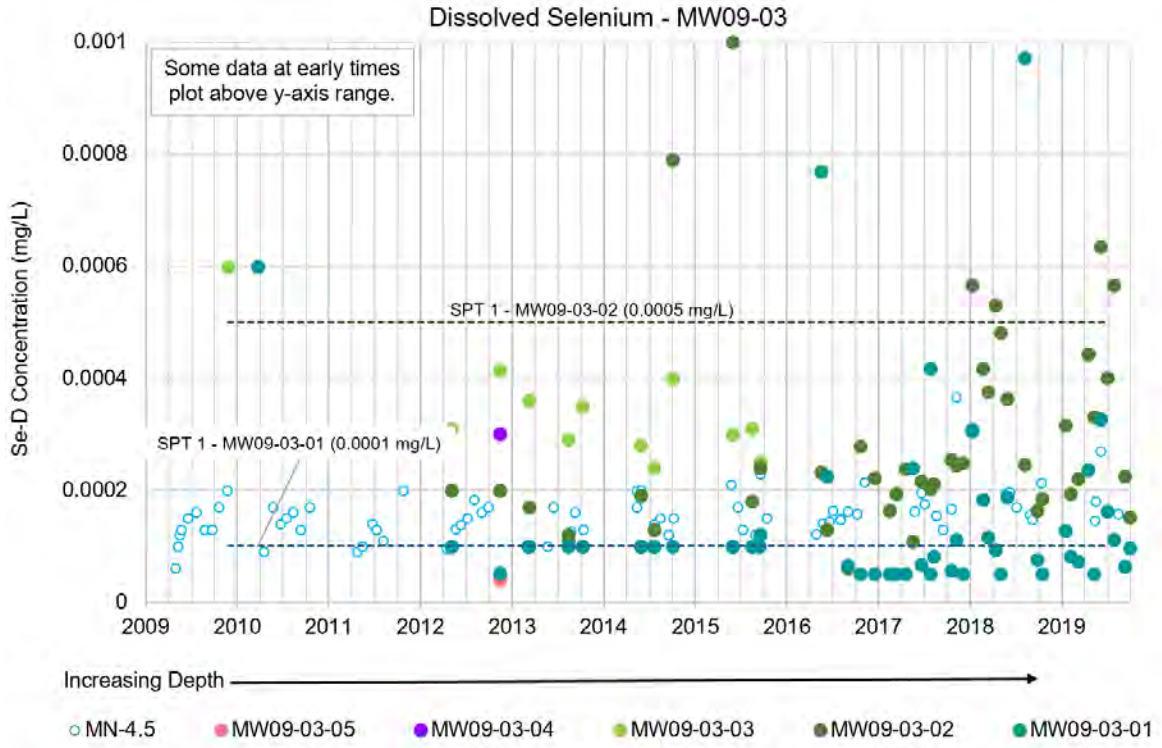
Minto Mine Adaptive Management

MW09-03
Cu-D & Mo-D SPT Exceedances

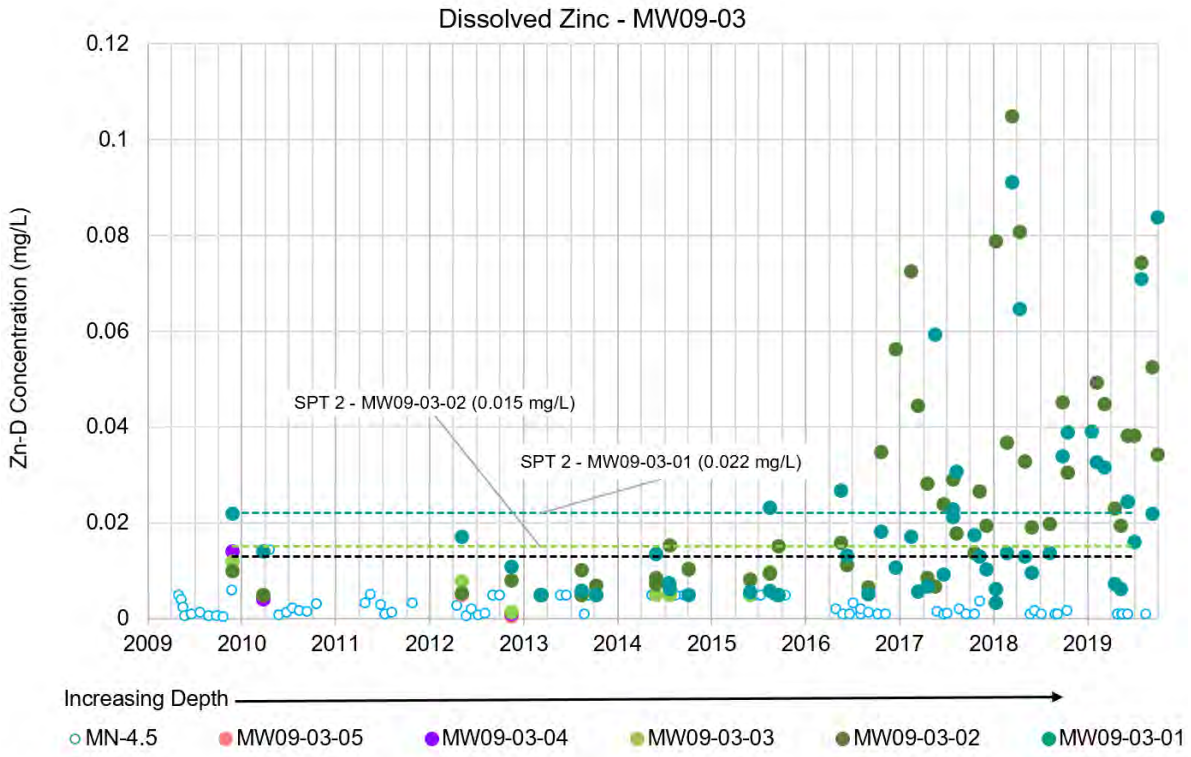
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Minto Mine

Date: December 2019
Approved: DCM
Figure: A-3



MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q3 of 2019 shown on graph (applies to MW09-03-01 & MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q3 of 2019 shown on graph (applies to MW09-03-01 and MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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Minto Mine Adaptive Management

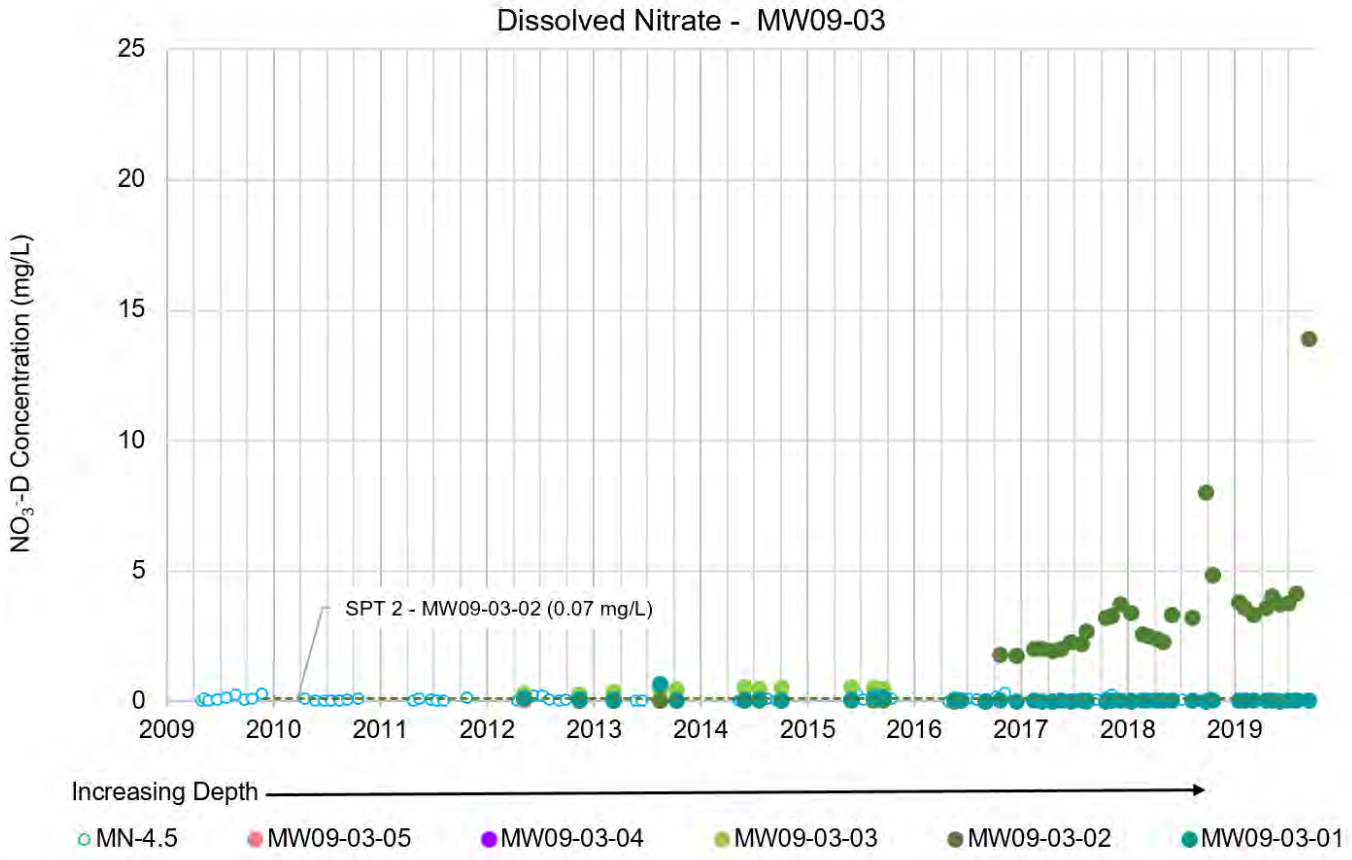
MW09-03
Se-D & Zn-D SPT Exceedances

Job No: 1CM002.055
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Minto Mine

Date: December 2019
Approved: DCM
Figure: A-4

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MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q3 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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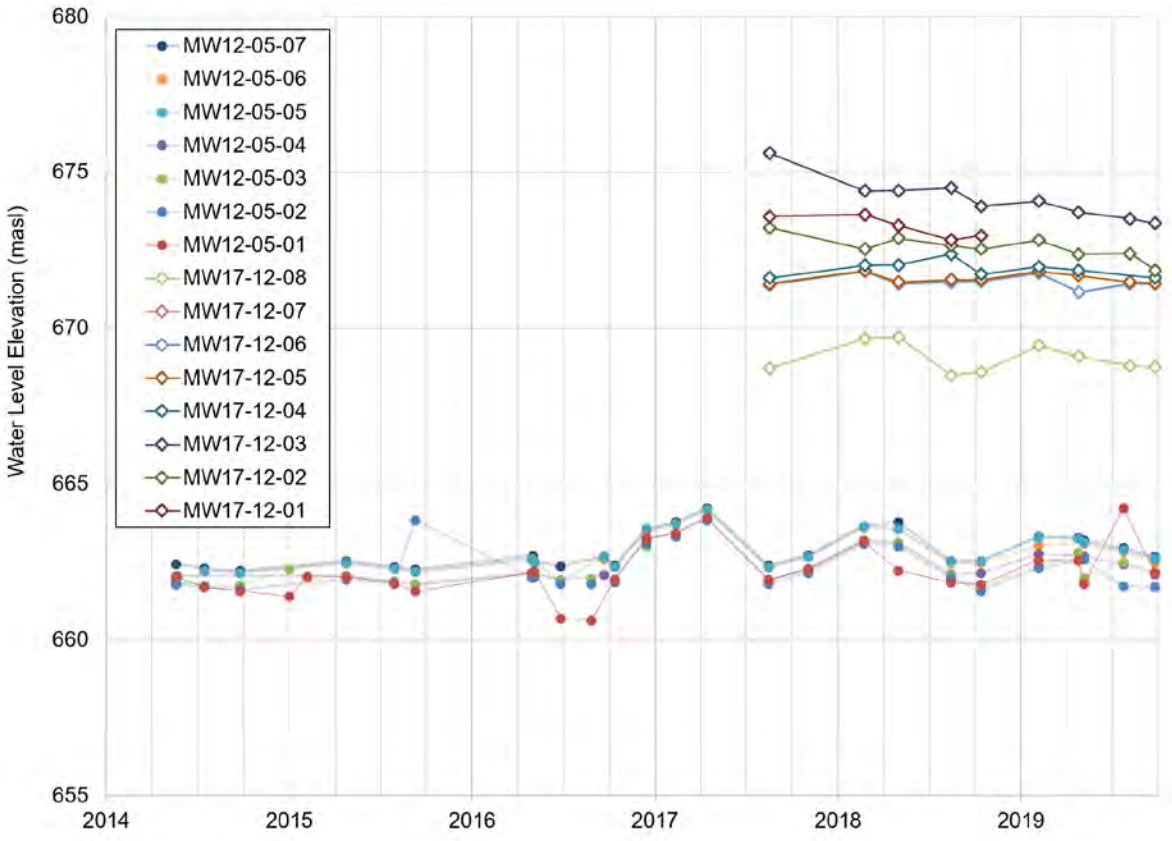
Minto Mine Adaptive Management

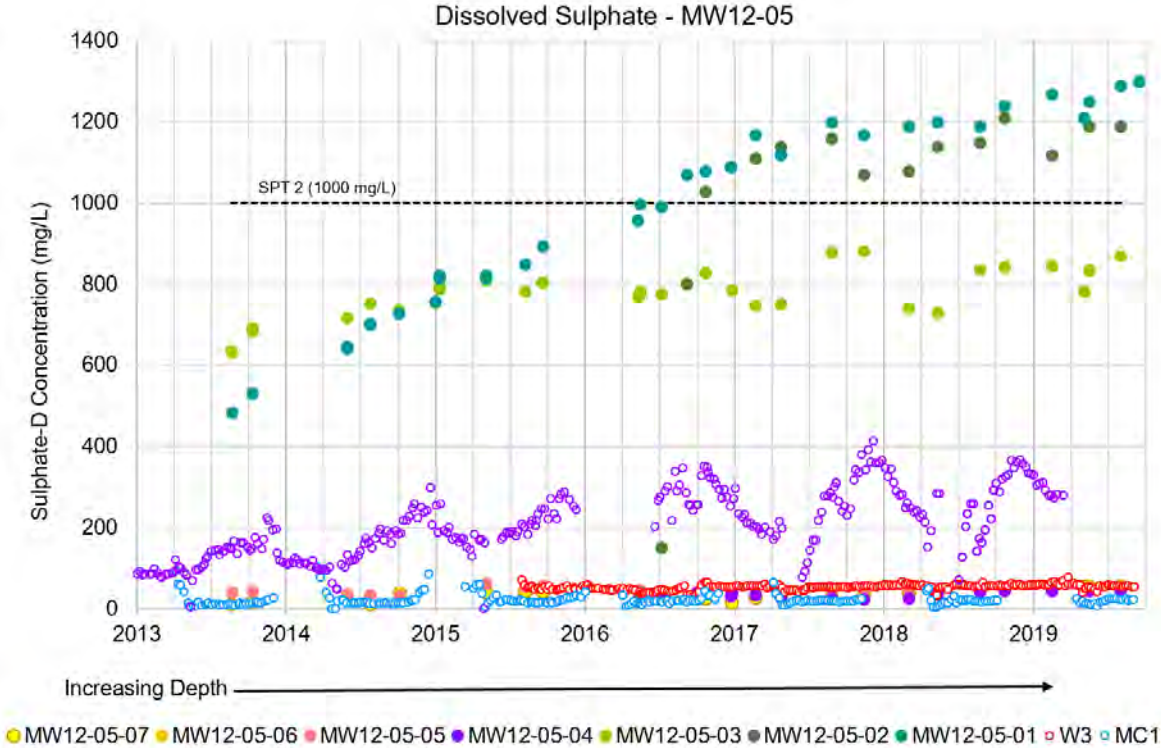
MW09-03
NO_3^--D SPT Exceedances

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: December 2019
Approved: DCM
Figure: **A-5**

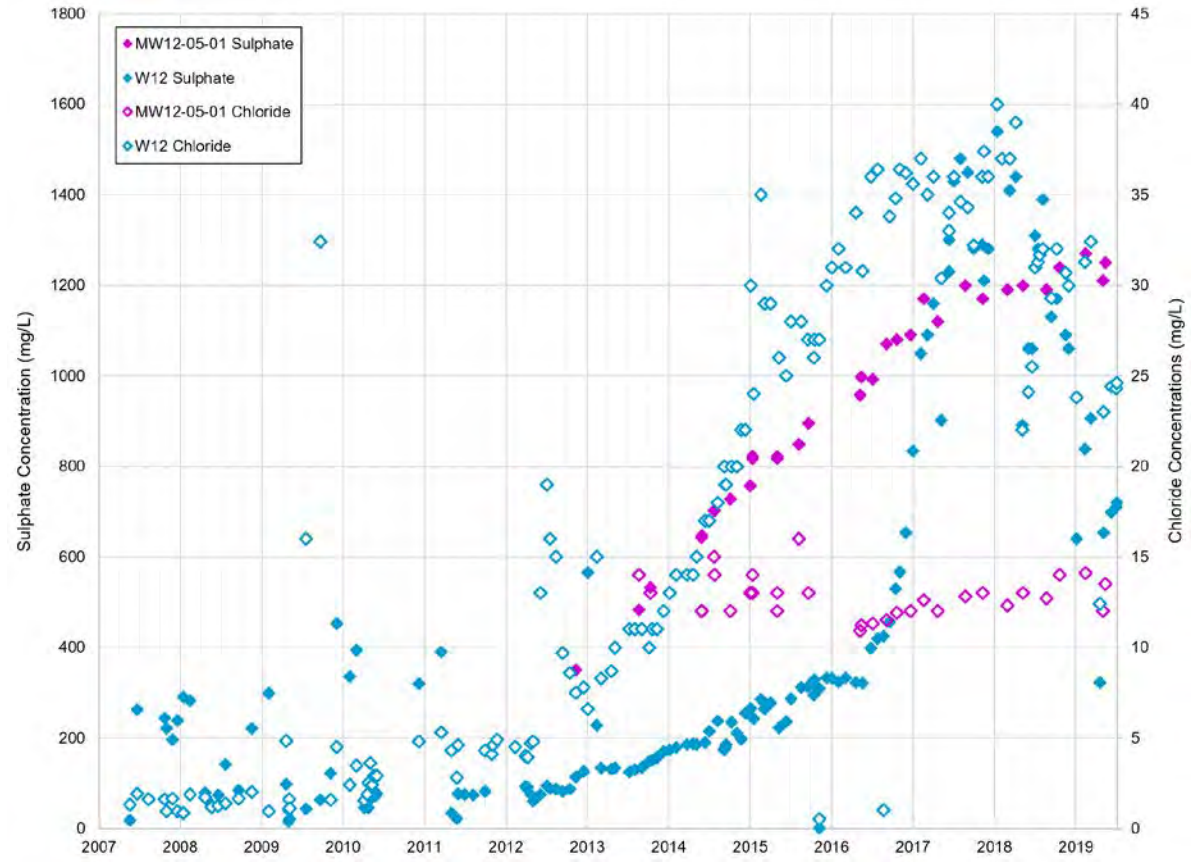


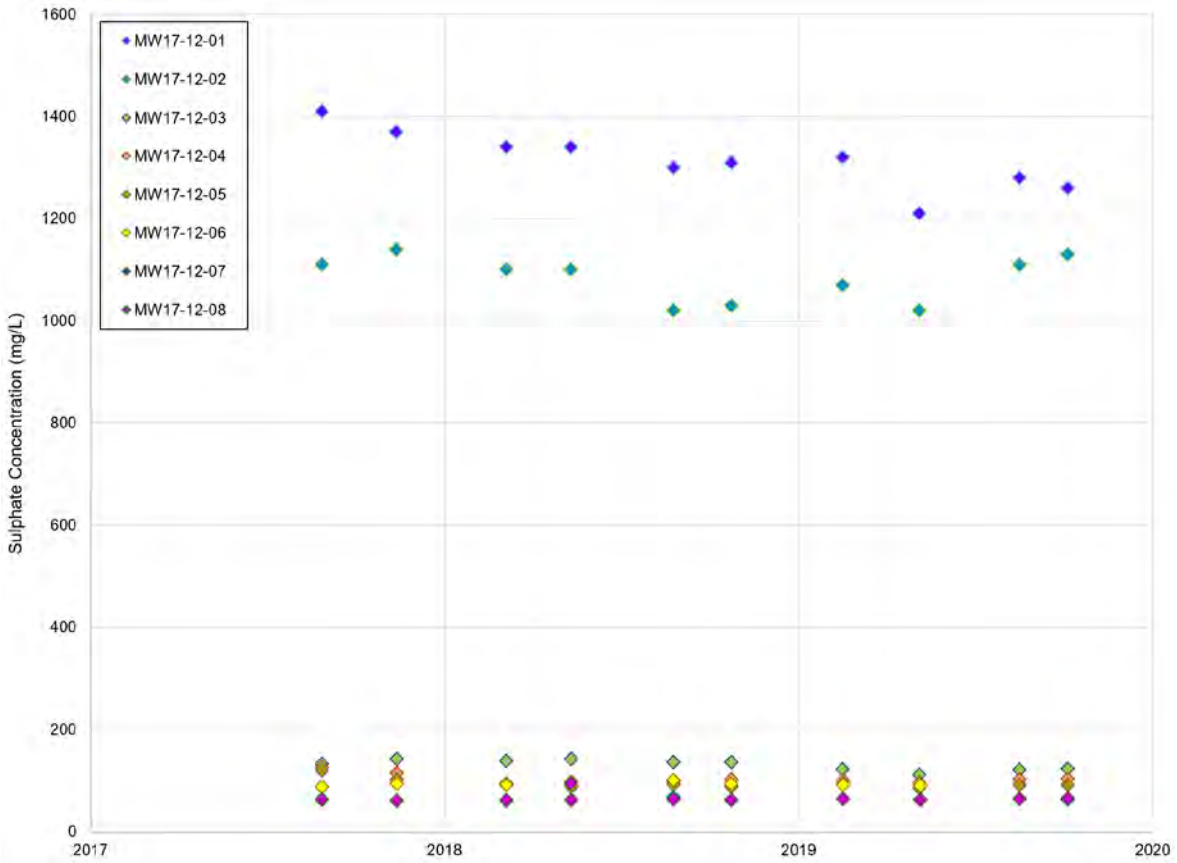


MW12-05-01 and MW12-05-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q3 of 2019 shown in graph (applies to MW12-05-01 and MW12-05-02 only)
WC and MC1 are SW monitoring points in Minto Creek

srk consulting	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY	Minto Mine Adaptive Management
		MW12-05 Water Level Data & MW12-05 SO_4^{2-}-D SPT Exceedances
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: December 2019 | Approved: DCM | Figure: **B-1**

\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20180601_June_Q2_AMP_Review\02_Analysis&Charts\Minto_AMPResponse_2018Q2_MintoCreekGW_rev00_lv.xlsx





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MINTO EXPLORATIONS
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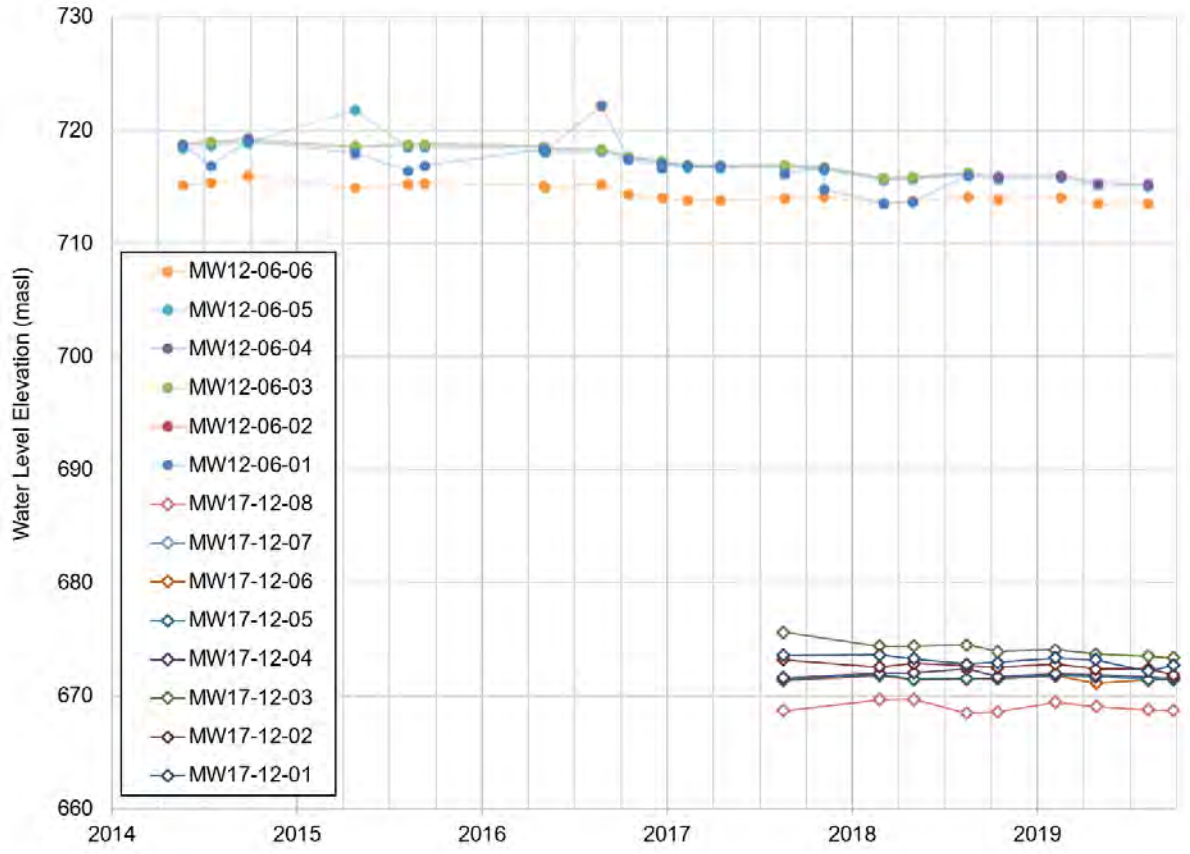
Minto Mine Adaptive Management

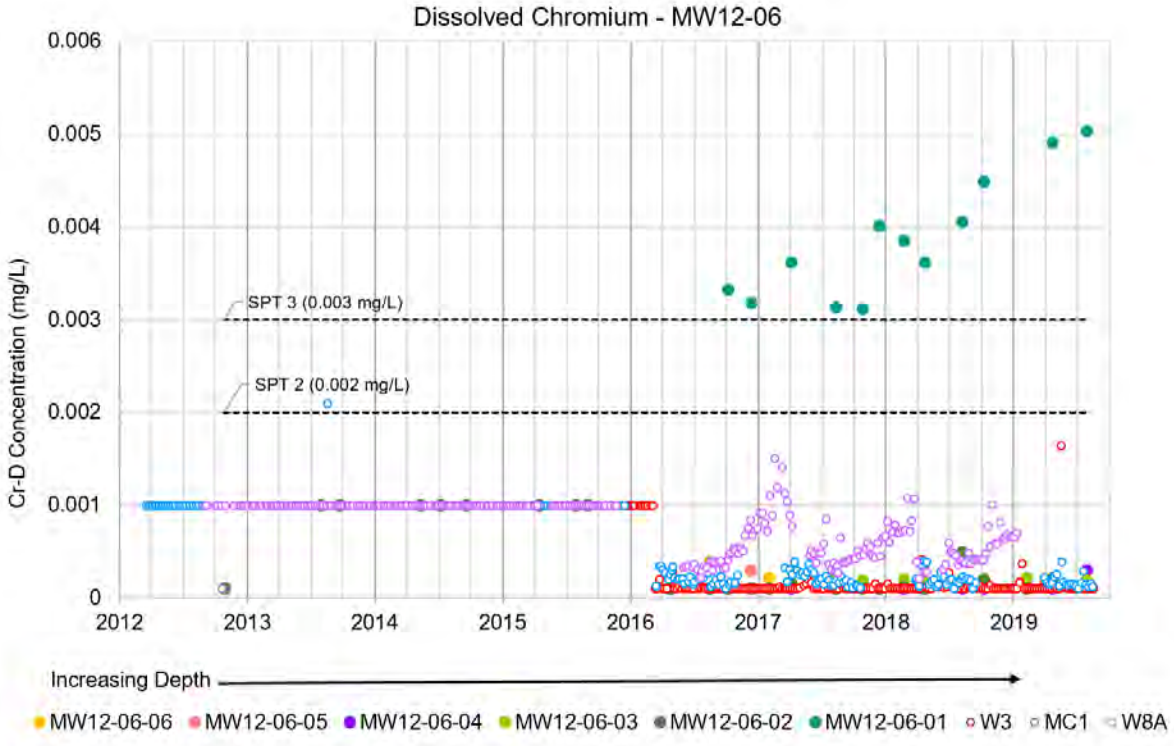
MW12-05 and W12 (Main Pit) SO_4^{2-}-D and Cl-D Concentrations and MW17-12 SO_4^{2-}D Concentrations

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: December 2019
Approved: DCM
Figure: **B-2**





MW12-06-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q3 of 2019 shown in graph (applies to MW12-06-01 only)
WC, W8A and MC1 are SW monitoring points in Minto Creek

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Minto Mine Adaptive Management

MW12-06 Cr-D SPT Exceedances and MW12-06, MW17-12 Water Level Data

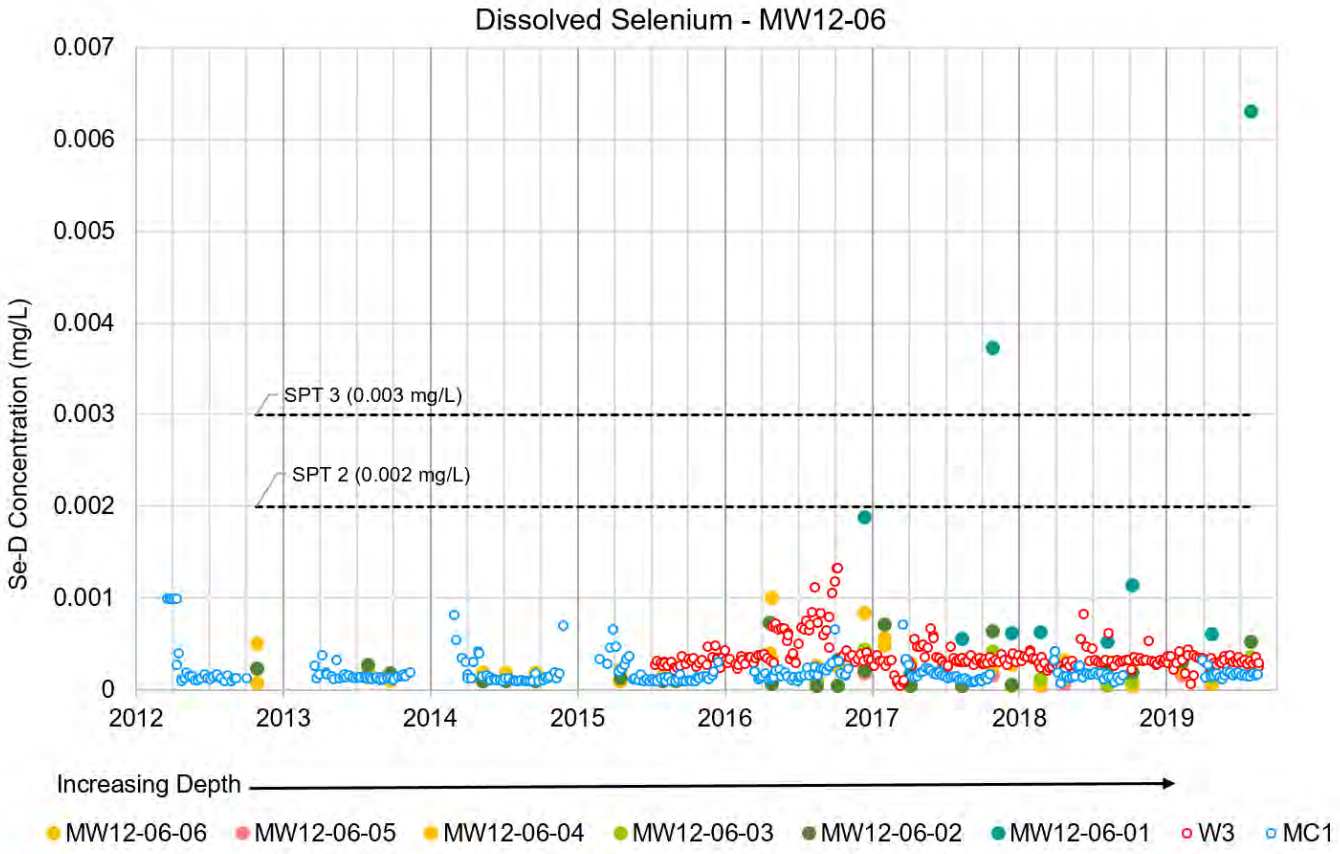
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Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: December 2019

Approved: DCM

Figure: C-1



MW12-06-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q3 of 2019 shown in graph (applies to MW12-06-01 only)
WC, W8A and MC1 are SW monitoring points in Minto Creek

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MINTO EXPLORATIONS
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Minto Mine Adaptive Management

MW12-06 Se-D SPT Exceedances

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date:	Approved:	Figure:
December 2019	DCM	C-2

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March 26, 2020
Project No: 1CM002.055

Minto Mine
Minto Explorations Ltd.
PO Box 11
Whitehorse, YT Y1A5X9

Attention: Todd Swenson, Environmental Manager

Dear Todd:

Subject: 2019 Q4 (October - December) Groundwater AMP Events

The Minto Mine Operational Adaptive Management Plan was updated in 2018 for groundwater monitoring, with the review frequency for groundwater triggers changed from monthly to quarterly, at the recommendation of the qualified professional (QP). As per AMP2017-02, all data concerning trigger exceedances are sent to the QP within a week of discovery and included in the subsequent review. This letter is the second quarterly review under the updated reporting schedule.

As part of the Minto Mine Operational Adaptive Management Plan, Minto Mine has collected and reviewed groundwater quality data. Minto completed an initial review of data collected at the McGinty Creek groundwater monitoring station (MW09-03) and Minto Creek groundwater monitoring stations MW12-05 and MW12-06 for the fourth quarter of 2019 (October - December) and compared results to specific performance thresholds (SPT) defined in the Minto Mine Operations Adaptive Management Plan (MEL, 2017-02). McGinty Creek monitoring stations are required to be sampled monthly while the Minto Creek stations are sampled quarterly. For Minto Creek and McGinty Creek, MEL identified exceedances of certain thresholds for sampling rounds conducted in October, November and December of 2019 and, as per the plan, has contracted a QP to review those data and provide recommendations. SRK Consulting (Canada) Inc. was contacted by Minto environmental staff on January 15, 2020 to provide QP review. This letter presents results of that review and recommendations.

SRK compared data against the 2017-02 AMP thresholds, historical data and data from surface water at station MN4.5 in lower McGinty Creek and surface water stations W3 and MC1 in Minto Creek. Table 1 summarizes exceedances, observations on the data, interpretation and recommendations. Figures are included with this review to illustrate the current physical (i.e., water level) setting compared to the Minto North pit. Graphs are included for each parameter exceeding thresholds and includes the full range of data collected to date.

Key conclusions and recommendations are summarized below. Table 1 summarizes observations and recommendations for all parameters.

For MW09-03 (McGinty Creek):

- The Minto Pit is not a source of water to the groundwater monitored at this station; water levels in the monitoring well are higher than the pit water level. Water levels in the pit have been increasing slowly but remain well below the monitoring well water levels. These data continue to show no hydraulic gradient from the pit towards the monitoring well.
- Water levels at this station have been affected by the mining of Minto North, but the groundwater divide between Minto North and McGinty Creek remains, somewhere in the vicinity of MW09-03.
- Water levels in MW17-11 are generally lower than in MW09-03, with the exception of zone 5, which is screened shallower than zones 1 and 2 in MW09-03 and had higher water levels than all other monitoring points until August 2019 when the port was discovered dry. Water levels in MW17-11 and MW09-03 indicate an overall downward gradient between the shallow-most zone and the remaining deeper zones. Differences in water level between deep zones are less pronounced, and a vertical gradient is not clear.
  - Recommendation: continue collecting water level/pressure profiles at this well according to the routine schedule.
- Concentrations of dissolved aluminum have been consistently below thresholds with the exception of one isolated value in November 2019 which was measured at an order of magnitude higher than historic concentrations in MW09-03-02. The subsequent sampling event measured concentrations in the range of historic values, below thresholds. There is no evidence of impact to McGinty Creek and further monitoring is required to determine if the datapoint is an outlier.
- Concentrations of dissolved arsenic at MW09-03-01 have consistently exceeded SPT 1 since summer of 2016, and inconsistently exceeded thresholds in MW-09-02 in the same period. High variability is observed, but relatively recent data in MW09-03-01 exceeds thresholds more frequently than in the past. Two anomalous values were detected in October 2018 and September 2019, at nearly an order of magnitude more than recent average concentrations. Since then concentrations have decreased to the historic range, suggesting the anomalous values are outliers. High concentrations do not correlate exactly with seasonal changes in groundwater level but may indicate an influence from seasonal variation (in recharge, flow, etc.). Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during low flow periods or freshet, possibly suggesting greater mobilization of trace elements when higher volumes of water could infiltrate through the unsaturated zone and mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data at MN-4.5.
  - Recommendation: while arsenic concentrations have remained relatively stable since 2016, review McGinty Creek water and load balance and compare with estimated groundwater flow and load to update risk assessment of As loading to McGinty Creek. Include in the 2019 Review of AMP Exceedances.

- Concentrations of dissolved cadmium at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 in he past with high variability in the observed data. Cadmium data exceed thresholds more frequently since 2017 and while average concentrations have increased beginning in 2017, there is no consistent increasing trend with many values in the last two years below the threshold. Only two sampling events in Q4 exceeded thresholds in MW09-03-02 and none in MW09-03-01, indicating the inconsistencies in exceedances. Seasonal variability seems to be present, with highest concentrations occurring in Q1 and Q2, potentially related to freshet. Cadmium concentrations in McGinty Creek remain low and stable, showing no impact from the groundwater.
  - Recommendation: due to potential increasing Cd trend, review McGinty Creek water and load balance and compare with estimated groundwater flow and load to update risk assessment of Cd loading to McGinty Creek. Include in the 2019 Review of AMP Exceedances.
- Concentrations of dissolved copper have exceeded SPT 1 sporadically in MW09-03-02 since late 2016. While all three monitoring events exceeded thresholds in Q3, only one Q4 sampling event in November 2019 exceeded thresholds. The highest values were detected in MW09-03-02 during the first half of 2018 and have since been lower. Dissolved copper values in McGinty Creek remain in the range of historic data and no evidence of surface water impacts are present.
  - Recommendation: due to potential increasing Cu trend, review McGinty Creek water and load balance and compare with estimated groundwater flow and load to update risk assessment of Cu loading to McGinty Creek. Include in the 2019 Review of AMP Exceedances.
- Concentrations of dissolved lead have been consistently below thresholds as well as the detection limit since monitoring began, with the exception of one sampling event in November 2019 in MW09-03-02. Subsequent data points have been below the laboratory detection limit and more monitoring is needed to determine if a trend is present. Dissolved lead in McGinty Creek remain in the range of historic data and no evidence of surface water impacts are present.
- Concentrations of dissolved selenium in MW09-03-01 and MW09-03-02 have exceeded thresholds sporadically in the last few years, with increased variability in the data beginning in 2017. Average annual concentrations in MW09-03-02 have been higher in 2018 and 2019 than past years, but do not demonstrate a consistent increasing trend. Only one monitoring event in Q4 exceeded thresholds in MW09-03-01 and none in MW09-03-02. Peak concentrations in Q1 and Q2 of these years indicate a season variation may be present. Dissolved selenium in McGinty Creek remain in the range of historic data and no evidence of surface water impacts are present.
  - Recommendation: include Se in review of McGinty Creek water and load balance and compare with estimated groundwater flow and load to update risk assessment of Se loading to McGinty Creek. Include in the 2019 Review of AMP Exceedances.
- Concentrations of dissolved zinc at MW09-03-01 and MW09-03-02 have inconsistently exceeded SPT 1 and SPT 2 thresholds since the summer of 2016. High variability is observed in the data, but relatively recent data exceeds thresholds more frequently than in the past. High concentrations do not correlate exactly with seasonal changes in groundwater level but may indicate an influence from seasonal variation. Vertical profiles and timing of peak concentrations suggest increased loading may be occurring during freshet when higher volumes of water infiltrate through the unsaturated zone and

mobilize trace elements. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  – Recommendation: include Zn in review of McGinty Creek water and load balance and compare with estimated groundwater flow and load to update risk assessment of Zn loading to McGinty Creek. Include in the 2019 Review of AMP Exceedances.

- Concentrations of dissolved nitrate at MW09-03-02 have exceeded SPT 2 since the fall of 2016. Concentrations showed an increasing trend from October 2016 to December 2017, showed the potential for a decreasing trend in Q1 of 2018 but were higher in the latter half of 2018. Concentrations in 2019 were relatively stable, until September 2019 when concentrations increased by nearly 3 times the previous values. Concentrations have remained high in subsequent monitoring events, but with the most recent value decreasing to almost half the concentration of the highest recorded in October 2019. Concentrations will be closely monitored to determine if a meaningful increasing trend is present and a more detailed review of nitrate behavior will be provided in the 2019 annual report. While there is some seasonal variability in McGinty Creek chemistry, surface water concentrations are not increasing and remain in the range of baseline data.

  – Recommendation: include NO_3 in review of McGinty Creek water and load balance and compare with estimated groundwater flow and load to update risk assessment of NO_3 loading to McGinty Creek. Include in the 2019 Review of AMP Exceedances.

For MW12-05 and MW12-06 (Minto Creek):

- Water level data in the deepest zone of MW12-06 decreased sharply between November 2017 and March 2018, which coincides with development of the Minto East underground. Water levels in the deepest zone increased again between May and August 2018, when development of the underground stopped. More recently, the water level in the deepest zone, MW12-06-01, decreased between Q2 and Q4 2019 which changed the overall vertical gradient from upwards to downwards, although there still exists a complex multidirectional vertical gradient between other zones. The decrease in water level coincides with the re-start of underground development in September 2019, and while dewatering was continued throughout the temporary underground closure, the increased activity could potentially have had an effect on the deep groundwater levels. The same trend was not observed in MW12-05 or MW17-12, suggesting these wells are currently outside the area of groundwater affected by the development of the underground. Seasonal fluctuations are apparent in MW12-05, with peak water levels occurring in Q2 of the past 2 years.

  – Recommendation: continue collecting water level/pressure profiles at this well according to the routine schedule. Continue to monitor changes in groundwater pressure as system equilibrates following the cessation of Minto East underground development. Continue to monitor complex multidirectional vertical gradient in MW12-06.

- Concentrations of dissolved chromium in MW12-06-01 have exceeded SPT 3 since October 2016 and while they are variable, average concentrations have been increasing since Q4 2016. Elevated Cr-D is isolated to MW12-06-01, the deepest zone in this well (142.3 meters below ground surface). While there may be seasonal trends in Minto Creek, variability within the data is very low and shows no trends that can be clearly related to groundwater concentrations.

  - Recommendation: review potential Cr sources, considering any changes to mine plans or waste management and update risk assessment of Cr loading to Minto Creek. Include in the 2019 Review of AMP Exceedances.

- Concentrations of ammonia have consistently been below thresholds in the past with one isolated exceedance in December 2019 which was measured at an order of magnitude higher than the majority of concentrations in the deepest zone (MW12-06-01). There is no evidence of impact to Minto Creek and further monitoring is required to determine if the datapoint is an outlier.

- Concentrations of sulphate at MW12-05-01 and MW12-05-02 continue to be elevated above SPT 2. Concentrations at MW12-05-01 and MW12-05-02 were increasing historically but show signs of stabilization after August 2017. While concentrations are still increasing, data do not show the same rate of increase as was observed prior to 2017, with the exception of the most recent observation in MW12-05-02, which had a measured concentration of 2400 mg/L, nearly double the previous sampling event. As this concentration is isolated, and appears to be an outlier, it could potentially be due to sampling error/contamination and more measurements are need to confirm an increase in concentrations. While concentrations have been increasing in both MW12-05 and the Main Pit, the rate and timing of increase differs with a slow increase in the Main Pit until Q3 of 2016 when concentrations jumped over 1000 mg/L within a year and a consistent steady increase in MW12-05 that began to level off in Q1 2017. Additionally, while chloride continues to increase in discharge from the Main Pit, concentrations have been stable at lower concentrations in MW12-05. Observed concentrations may not be related to water in the Main Pit. Sulphate concentrations in MW17-12 exhibit an increasing gradient with depth but no increasing trend temporally. Minto Creek continues to indicate no trends in sulphate concentration that can clearly be related to changes in groundwater concentrations

  - Recommendation: continue monitoring as per schedule and review/update investigations as to potential sources of SO_4 as part of the overall review of site groundwater quality. Include in the 2019 Review of AMP Exceedances.

Sincerely,

SRK Consulting (Canada) Inc.



Laura Volden, MSc, PGeo
Consultant (Hydrogeochemistry)

Reviewed by



Daniel Mackie, PGeo
Principal Consultant (Hydrogeology)

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Minto Explorations Ltd.. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data

Tables

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

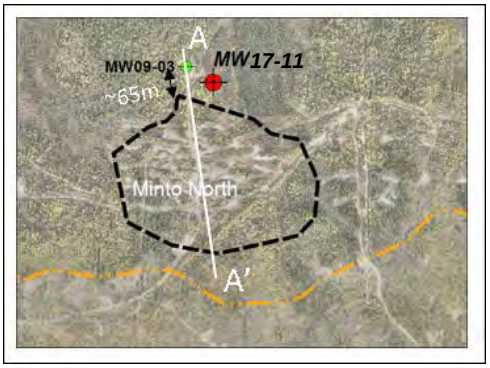
Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
McGinty Creek Catchment								
MW09-03-01 Figure A-1, A-2		As-D	mg/L		**Water Level (Figure A-1):** Water levels in MW09-03 Zone 1 and Zone 2 started declining when mining started in Minto North. Declining trend decreased about 6 months after mining completed. Water levels remain higher than pit bottom. Water levels increased between July and September 2016 before returning to previous trend. Similar trend occurred in 2017 when water levels increased between April and September, declined until May 2018 and increased again until September. Water levels show signs of decreasing in Q4 2019, follwed by a peak in annual water levels at the end of Q3, consistent with previous seasonal trends. Minto North pit continues to act as a hydraulic sink, and has lowered groundwater levels. Water levels at MW09-03 suggest the presence of a groundwater divide somewhere north of the pit. Seasonal fluctuations indicate some influence from recharge. Loading to McGinty Creek could only occur from haul road material along the pit perimeter **Water Quality (Figure A-2):** Concentration in September 2019 much higher than previous data, with the exception of one point in October 2018, suggesting the data point is an outlier. Seasonal variations appear to be present, with highest values occurring the summer months the last 2 years (with the exception of outliers). Values have since decreased to historic range since September 2019. As-D values for MN-4.5 in McGinty Creek have been stable in the historic range.	While data from late summer 2015 to August 2017 showed signs of an increasing trend, values exhibit significant variability throughout the year. Peak values during Q2 and Q3 suggest a seasonal trend related to freshet may be present. Elevated values are isolated to October 2018 and September 2019 and appear to be outliers. Concentrations from 2016 to 2018 showed potential seasonal variability, becoming relatively stable in 2019. Concentrations from 2016 thru 2019 remained relatively steady.	Lack of any clear upwards trend in McGinty Creek, as measured at MN-4.5, suggests currently no impact. Minto North represents only 0.4% of the McGinty Creek total watershed. Assuming that groundwater flows are proportional to surface water flows (load can only be coming from haul road, not pit leakage) groundwater concentrations would need to be at least 10x higher to result in MN4.5 As concentrations reaching MN4.5 SPT1. Overall risk of arsenic loading to McGinty Creek from groundwater is low at this time.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road. Review McGinty Creek load balance and risk assessment as part of the 2019 Annual Review of AMP Exceedances.
	October	10/3/2019	0.00085	0.00081 (SPT 2)				
	November	11/2/2019	0.00099	0.00081 (SPT 2)				
	December	12/2/2019	0.00097	0.00081 (SPT 2)				
MW09-03-01 Figure A-1, A-2		Se-D	mg/L		**Water Level (Figure A-1):** see previous section. Water Quality (Figure A-3): Exceedances to SPT 1 have been occurring sporadically since 2016. Concentrations in Q4 are generally lower than the first half of the year with only one exceedance in the last quarter. Se-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in 2019 were more variable than past years with possible trend related to winter low flow or pre-freshet periods. Exceedences to SPT 1 are not consistent during all quarters.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road. Include in annual review noted in MW09-03 As review
	October	-	-	-				
	November	-	-	-				
	December	12/2/2019	0.000153	0.0001 (SPT1)				
MW09-03-01 Figure A-1, A-3		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations sporadically exceed SPT 1 and SPT 2 with the most recent value lower than previous Q4 samples. Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in Q3 and Q4 are higher than previously in 2019, but with no consistent upwards trend. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to low flow periods or freshet.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low based on low K.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road. Include in annual review noted in MW09-03 As review
	October	10/3/2019	0.0839	0.022 (SPT 2)				
	November	11/2/2019	0.0964	0.022 (SPT 2)				
	December	12/2/2019	0.0282	0.022 (SPT 2)				
MW09-03-02 Figure A-1, A-3		Al-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations have been more sporadic since the beginning of 2018 with intermittent exceedances to SPT 2. Only one data point exceeded the threshold in Q4, and no increasing trend was observed. Al-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Potential, though inconsistent, seasonal trend related to increased loading due to either high infiltration and trace element mobilizing during freshet or low flow periods (Q1-Q2).	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Water quality objective at MN-4.5 is nearly 5 times higher than SPT 2. Overall risk of aluminum loading to McGinty Creek from groundwater is low.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road. Include in annual review noted in MW09-03 As review
	October	-	-	-				
	November	11/2/2019	0.0119	0.0095 (SPT2)				
	December	-	-	-				
MW09-03-02 Figure A-1, A-4		Cd-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations in 2019 have been more sporadic than the past, with the highest concentration measured in September 2019. While most recent data points exceed thresholds, concentrations are considerably lower than Q3. Cd-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Highest concentrations measured to date have been in Q3 of 2019, but are not increasing consistently year-over-year, and show potential seasonal variability. Subjective trend is increasing concentrations.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road. Include in annual review noted in MW09-03 As review
	October	-	-	-				
	November	11/2/2019	0.0000551	0.000031 (SPT 1)				
	December	12/2/2019	0.0000324	0.000031 (SPT 1)				
MW09-03-02 Figure A-1, A-4		Cu-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-2):** Concentrations have been sporadically exceeding SPT 1 since late 2016. While concentrations in 2019 exceed thresholds, they are on average lower than 2018 values and only one value exceeded thresholds in Q4. Cu-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	No consistent trend in Cu-D. Highest values were detected in the first half of 2018 and have been consistently lower since with the exception of Q3 and Q4 of 2019.	No clear upwards trend in McGinty Creek, as measured at MN-4.5, and high quarterly variability since measurements began suggests no current impact to surface water.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road. Include in annual review noted in MW09-03 As review
	October	-	-	-				
	November	11/2/2019	0.00438	0.00263 (SPT1)				
	December	-	-	-				
MW09-03-02 Figure A-1, A-5		Pb-D	mg/L		**Water Level (Figure A-1):** see previous section. Water Quality (Figure A-3): November 2019 was the first and only monitoring point to exceed thresholds since monitoring began. Concentrations have been consistently below detection in the past, with only sporadic measurements. Most recent value is below laboratory detection limit. Pb-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations are generally below detection limits, with sporadic measurements and only one concentration that exceeded thresholds. No increasing trend is present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road.
	October	-	-	-				
	November	11/2/2019	0.000184	0.0001 (SPT1)				
	December	-	-	-				
MW09-03-02 Figure A-1, A-3		Zn-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-4):** Increased variability in measurements starting in August 2015. Concentrations in Q4 2019 consistently exceed SPT but do not demonstrate a clear increasing trend. Values in Q4 are lower than highest observed value in Q3. Zn-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Concentrations in Q4 are consistent with observations throughout 2019 with potential year-over-year increasing trend. Concentrations in 2019 were all above SPT 2. Peak concentrations during late Q1 and early Q2 suggest a seasonal trend related to freshet may be present.	Lack of any upwards trend in McGinty Creek, as measured at MN-4.5, suggests no current impact to surface water. Groundwater flux in this zone expected to be low based on low K.	Limited action at this time. Continue monitoring as per routine schedule. Continue to look for opportunities to collect samples from surface seeps emanating from haul road. Include in annual review noted in MW09-03 As review
	July	10/3/2019	0.0343	0.015 (SPT 2)				
	August	11/2/2019	0.0489	0.015 (SPT 2)				
	September	12/2/2019	0.0488	0.015 (SPT 2)				
MW09-03-02 Figure A-1, A-5		NO_3-D	mg/L		**Water Level (Figure A-1):** see previous section. **Water Quality (Figure A-5):** Values in 2019 are on average higher than previous years, with last sampling event of Q3 and all Q4 concentrations considerably higher than previously measured. NO_3-D values have been stable in the historic range for MN-4.5 in McGinty Creek.	Clear upward trend from May 2015-December 2017. Higher variability in 2018 but with highest value recorded occurring in October 2019. Values within 2019 show an increasing trend, with a large increase in September 2019. Q4 concentration is approximately half the previously measured value. 2020 monitoring will allow assessment of potential for concentrations to continue at high rate of increase observed between Q2 and Q3.	McGinty Creek, as observed at MN-4.5, does not show increasing or decreasing trends similar to MW09-03-02. Considering the small catchment area for MW09-03-02, even if the well is affected by local recharge, potential loading to McGinty Creek via this groundwater is potentially low.	Limited action at this time. Continue monitoring as per routine schedule, continue to look for opportunities to collect samples from surface seeps emanating from haul road and continue to compare data from MW09-03-02 and MN-4.5 to confirm low nitrate concentrations persist in McGinty Creek. Include in annual review noted in MW09-03 As review.
	October	10/3/2019	19.1	0.07 (SPT 2)				
	November	11/2/2019	18.3	0.07 (SPT 2)				
	December	12/2/2019	11	0.07 (SPT 2)				

Table 1. Summary of Groundwater Quality Data, AMP Thresholds, Observations and Recommendations

Location	Month	Parameter & Concentration Data		Threshold Exceeded	Observations	Trends	Risk Narrative	Recommendation
Minto Creek Catchment								
MW12-05-01 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1):** Water levels show increasing trends in the fall to late winter seasons, followed by a decrease throughout the summer. Water levels in Q4 are similar to levels at the same time of year in 2018. While more data is needed to be certain, the trends are likely due to a seasonal fluctuation. Overall vertical gradient remains downward. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, stabilized around 1200 mg/L for the majority of 2018 but are showing an increasing trend since Q4 2018. SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Previously observed upwards trend shows signs of stabilization after August 2017 with a slight increase again since Q4 2018. Most recent concentrations are highest detected, with potential increasing trend. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but much lower concentration than, and not considered likely to be connected to groundwater at MW12-05 as high concentrations at MW12-05 are at significant depth while W8A was a shallow DSTF monitoring point.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	October	10/4/2019	1330	1000 (SPT2)				
	November	N/A	N/A					
	December	N/A	N/A					
MW12-05-02 Figure B-1, B-2		SO_4^{2-}-D	mg/L		**Water Level (Figure B-1): s**ee previous section. **Water Quality (Figure B-1):** Concentrations linearly increased until August 2017, and have since stabilized around 1200 mg/L. SO_4^{2-}-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Previously observed upwards trend shows signs of stabilization after August 2017 with higher variability since Q1 2018. Most recent concentration is the highest detected, at nearly double the previous sampling event. While this point is isolated, it may be due to sampling error and more data are needed to verify. No upwards trend observed in Minto Creek. Seasonal variation evident at W8A, but not likely connected to groundwater at MW12-05.	Minto Creek, as observed at W3 and MC1, do not show any upwards trend similar to MW12-05. Downwards gradient in MW12-05 and low flux (low hydraulic conductivity) suggest groundwater discharge not currently reaching creek or groundwater load small compared to surface water load.	No further action at this time. Continue monitoring as per routine schedule. Continue investigation into sulphate source and causes.
	October	10/4/2019	2400	1000 (SPT2)				
	November	N/A	N/A					
	December	N/A	N/A					
MW12-06-01 Figure C-1		Cr-D	mg/L		**Water Level (Figure C-1):** Water level data show overall decreasing trend since March 2014. Deepest zone (1) shows steeper decrease in water level between November 2017 and March 2018. This drop is consistent with a decrease in water level in MW12-07 which coincides with development of the Minto East underground. Water level in the deepest zone, MW12-06-01, has decreased between Q2 and Q4 2019 and is now the lowest waterlevel, creating a downwards gradient to that zone which has changed since the last update. Complex multi-directional gradient is present. **Water Quality (Figure B-1):** Values at other depths in this well are at or below detection. Sampling in zone 1 only began in Oct 2016 but samples have consistently been above SPT 3 with an overall increasing trend. The most recent chromium value has decreased since Q3, and may be due to the change in vertical gradient. More data are needed to confirm this relationship. Cr-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Since the fall of 2016 elevated concentrations have been observed in MW12-06-01 and, to a lesser extent, W8A. Concentration during winter low flow period has increased over last two years. High frequency sampling at W8A shows seasonal variability that may also be reflected in the groundwater chemistry, with highest Cr-D observed in the late winter and the lowest in late summer.	While elevated concentrations of Cr-D have been continually detected in MW12-06-01, they have been isolated to the deepest zone and elevated concentrations have not been detected in the receiving environment (Minto Creek, down gradient wells, etc.). In addition, elevated Cr-D has not been detected in the mine pits, the underground dewatering pond or any other major sources of contaminated water on site. Currently, the risk posed by elevated Cr-D in MW12-06 is considered low.	No further action at this time. Continue monitoring as per routine schedule. Include in annual review noted in MW09-03 As review
	October	10/17/2019	0.00451	0.003 (SPT 3)				
	November	N/A	N/A					
	December	N/A	N/A					
MW12-06-01 Figure C-1, C-2		NH_3-D	mg/L		**Water Level (Figure C-1):** see previous section. **Water Quality (Figure B-1):** Concentrations have been below thresholds in the past, with the first exceedance recorded in October 2019. Measured value increased by an order of magnitude, but is an isolated occurrence at the moment. NH_3-D values have been stable in the historic range at W3 and MC1 in Minto Creek.	Concentrations have been stable at low concentrations with the exception of the most recent monitoring event, where the concentration increased by an order of magnitude. The occurrence is isolated and further monitoring is needed to determine if there's a trend.	Exceedances are isolated, and no impacts are observed at monitoring stations in Minto Creek.	No further action at this time. Continue monitoring as per routine schedule.
	October	10/17/2019	1.17	1.0 (SPT3)				
	November	N/A	N/A					
	December	N/A	N/A					

Notes:
'N/A' indicates no sample was taken for that month
'-' indicates value for that month did not trigger a response
Zones with no data or no exceedances: MW09-03-03 (dry), MW12-05-03, MW12-05-04, MW12-05-05, MW12-05-06, MW12-05-07, MW12-06-02, MW12-06-03, MW12-06-04, MW12-06-05, MW12-06-06

Figures





A A'

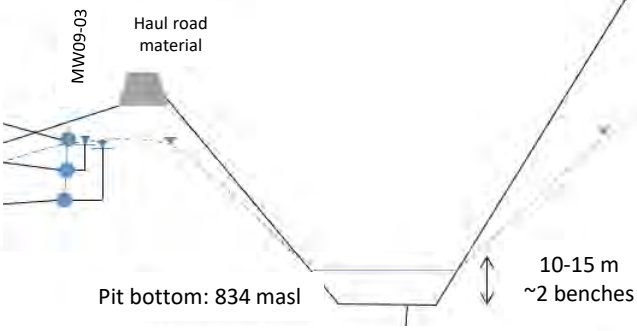
908 masl - collar

Zn 3 – 898 masl/11 m dh (dry)

Zn 2 – 884 masl/24 m dh W.L. = 891.01 masl

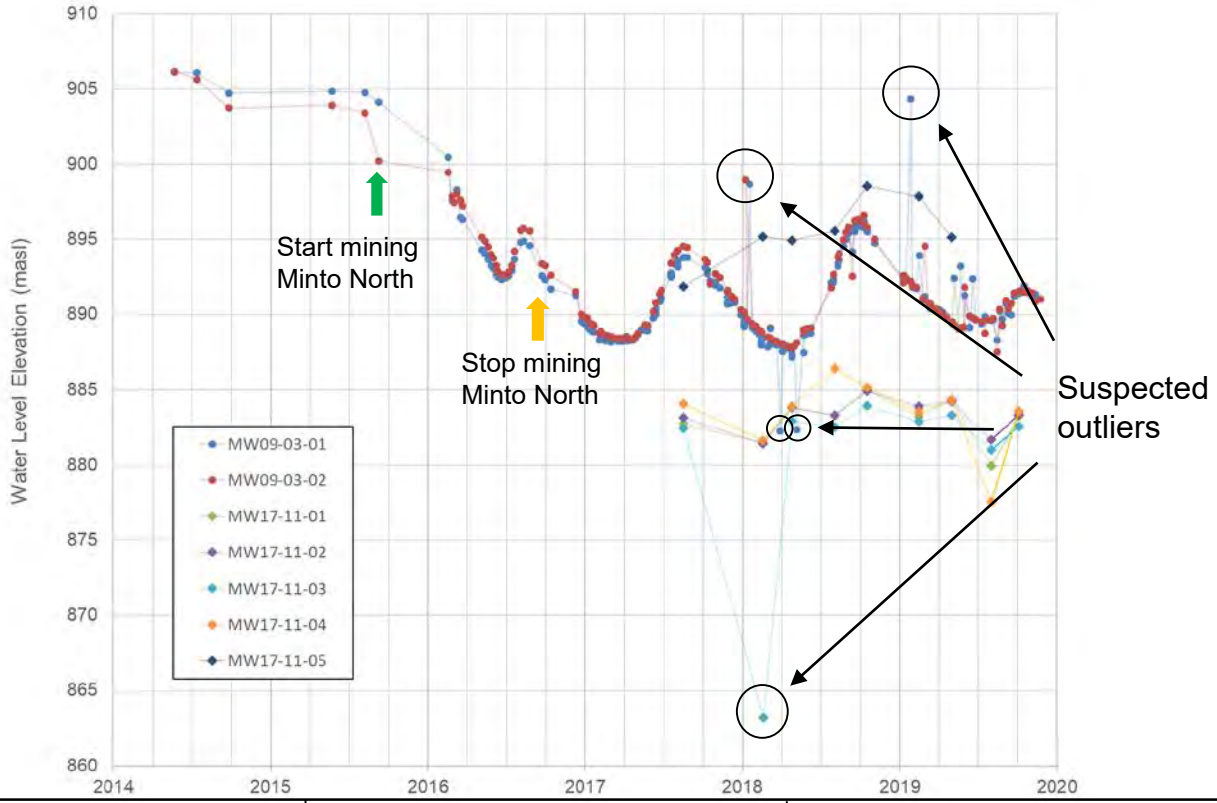
Zn 1 – 870 masl/38 m dh W.L. = 891.01 masl

Water levels collected on December 2, 2019



Schematic cross section – not to scale
MW09-03 water levels

Pit water 850.03 masl
On December 21, 2019



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Minto Mine Adaptive Management

Minto North Pit: Physical setting and water levels

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

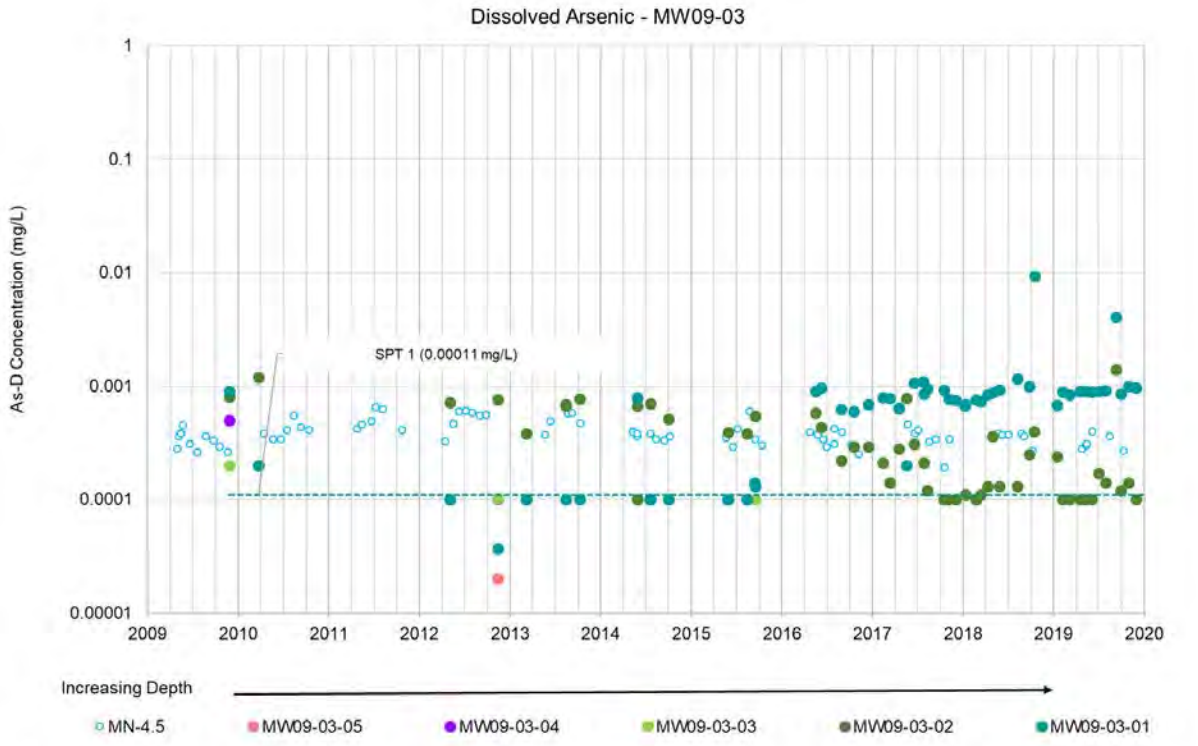
Minto Mine

Date: March 2020

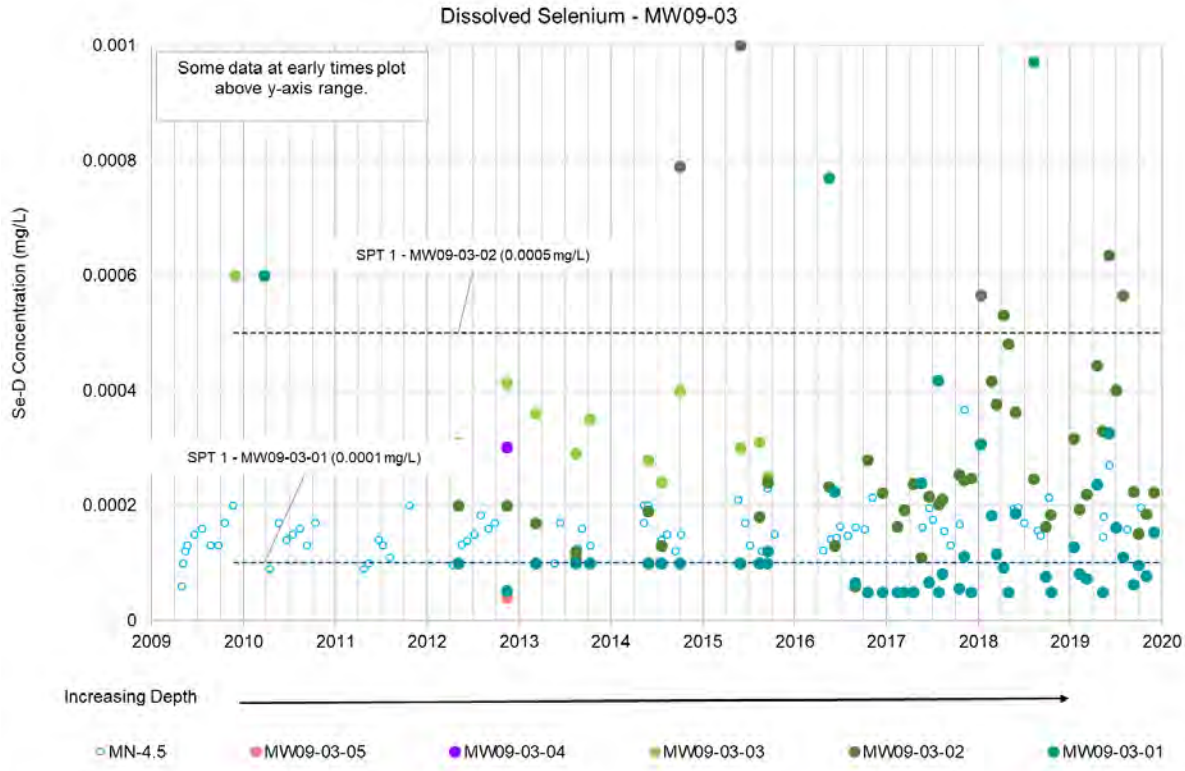
Approved: DCM

Figure: **A-1**

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MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-01/02 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-01 & MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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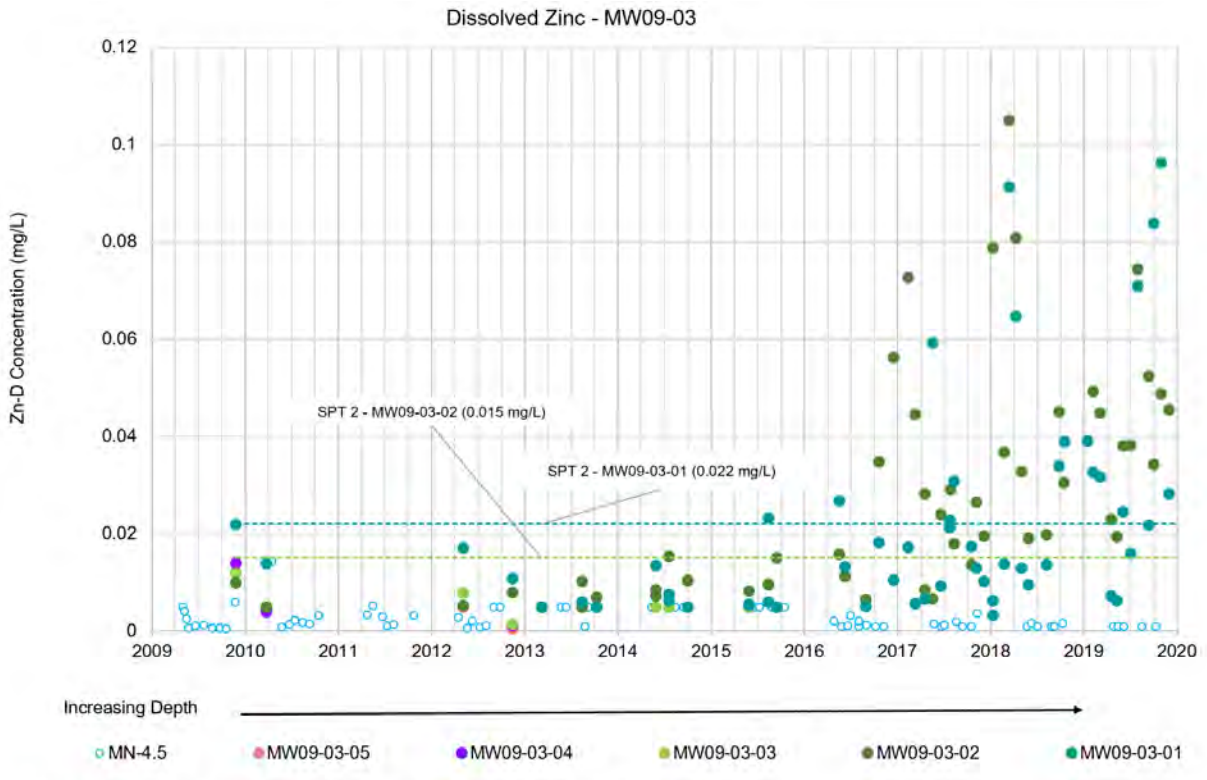
MW09-03
As-D & Se-D SPT Exceedances

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

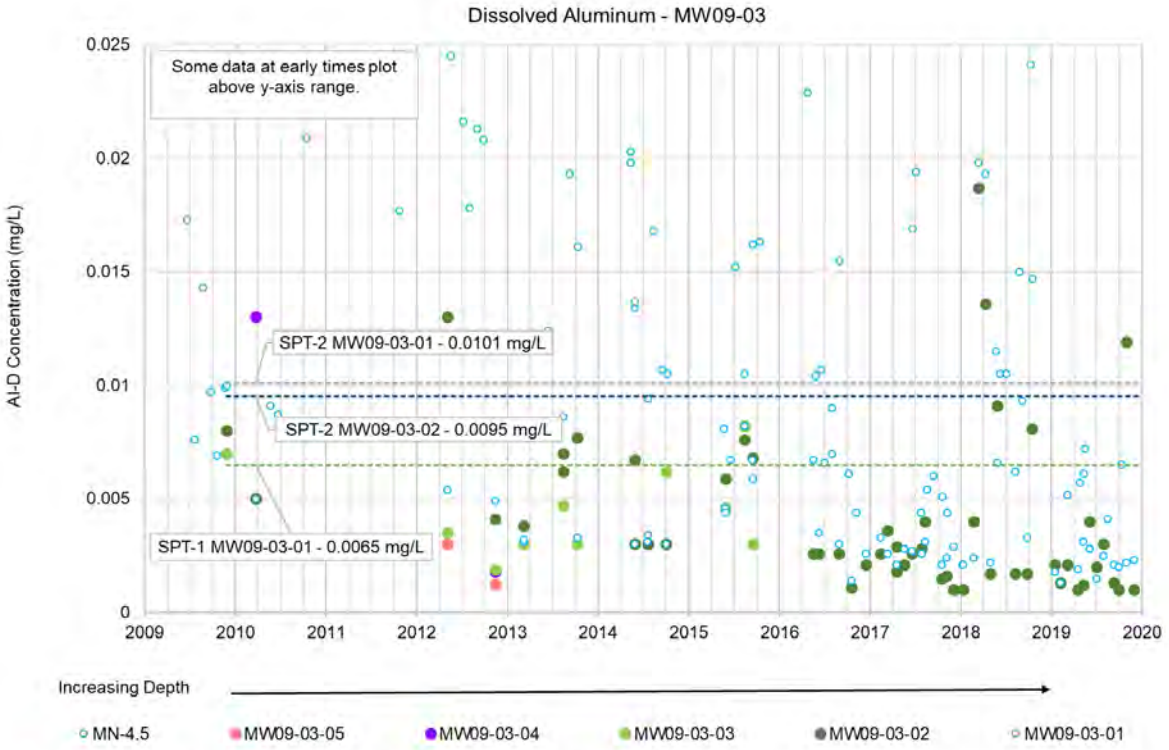
Minto Mine

Date: March 2020
Approved: DCM
Figure: A-2

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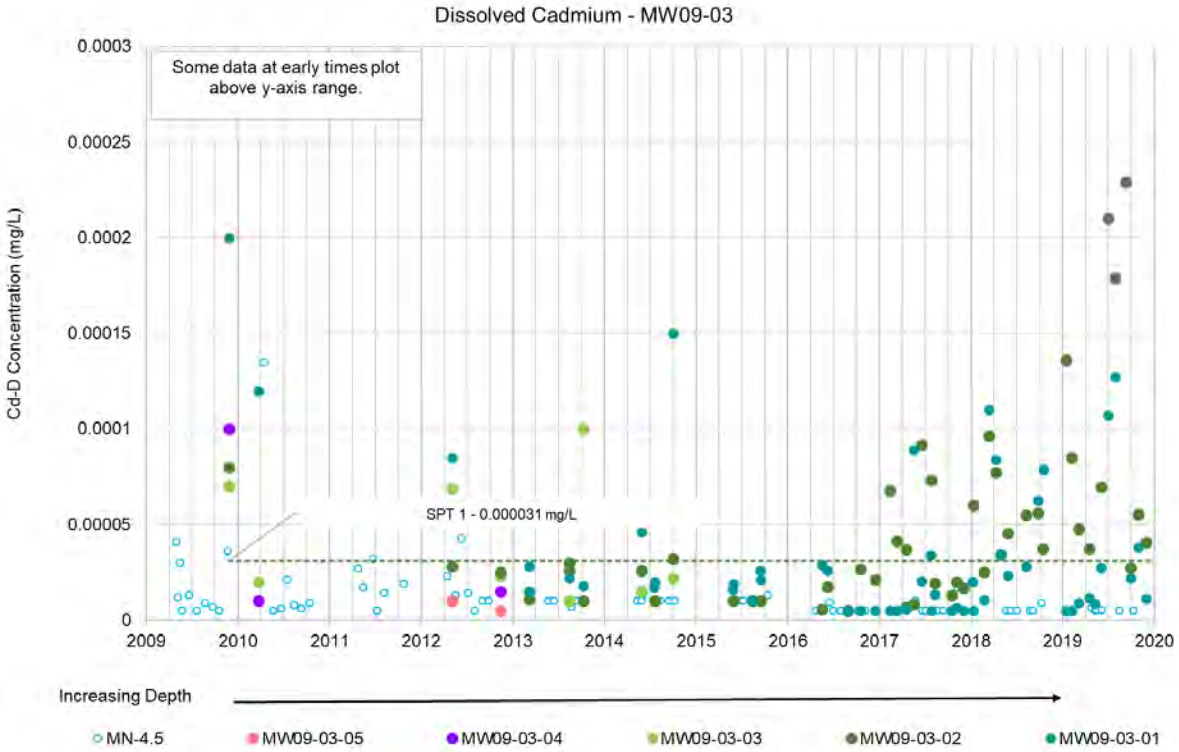
MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-01 and MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek



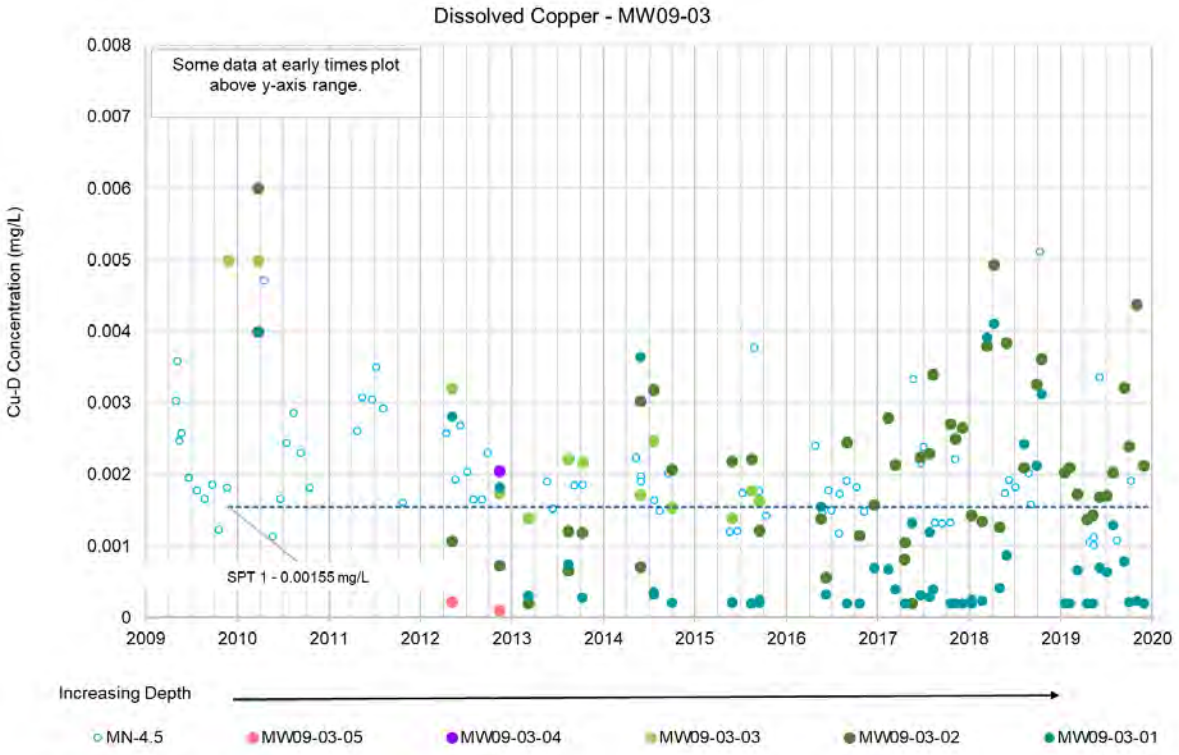
MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-01/02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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srk consulting	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY	Minto Mine Adaptive Management MW09-03 Zn-D & Al-D SPT Exceedances
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	Date: March 2020 | Approved: DCM | Figure: A-3



MW09-03-01 and MW09-03-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-01/02 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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Minto Mine Adaptive Management

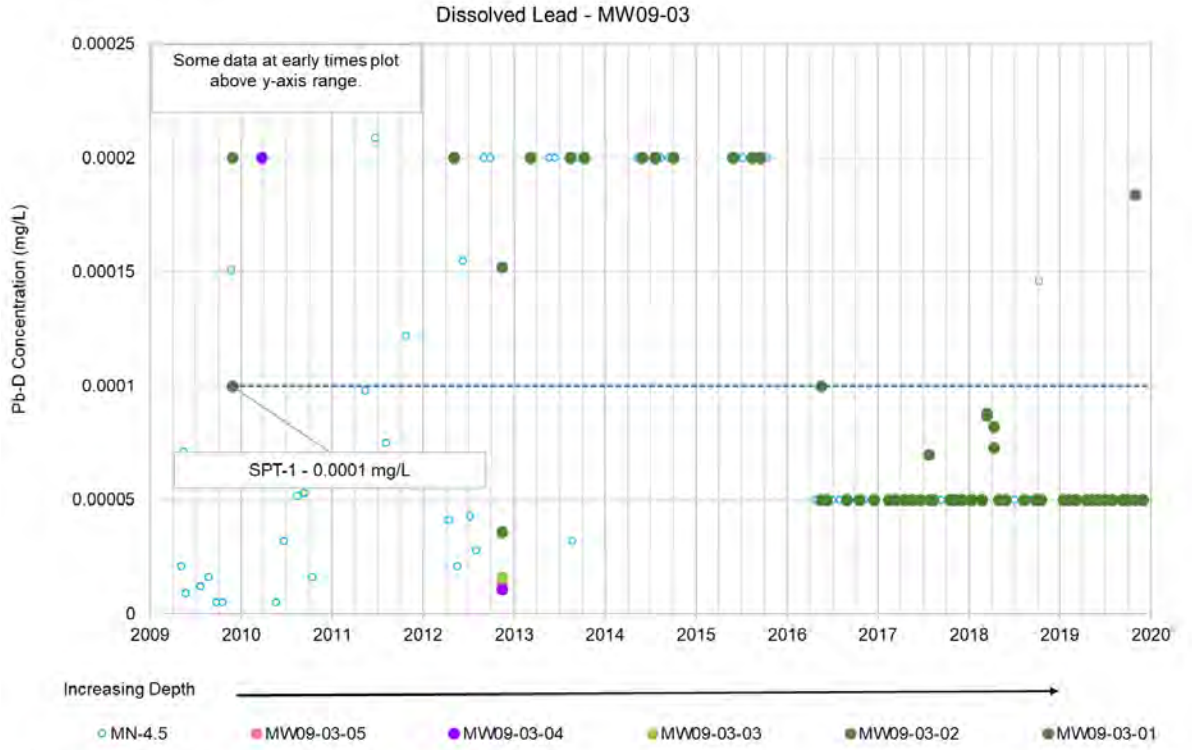
MW09-03
Cd-D & Cu-D SPT Exceedances

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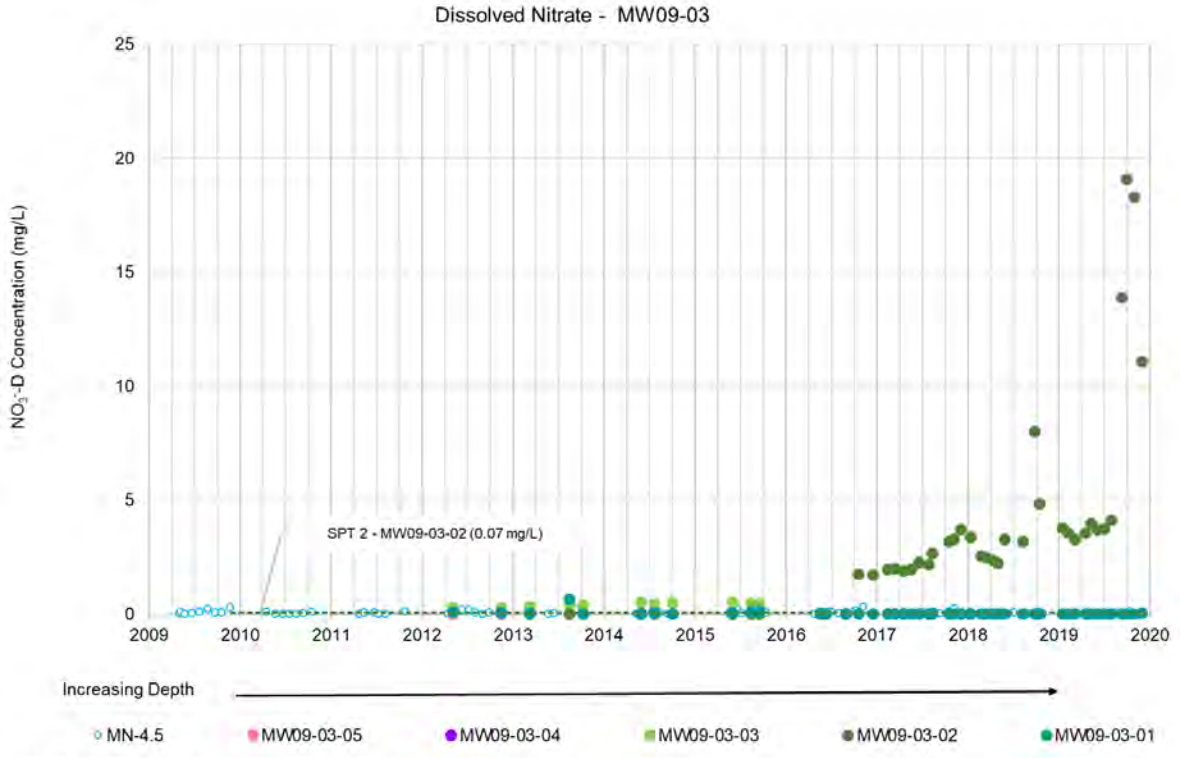
Minto Mine

Date:	Approved:	Figure:
March 2020	DCM	A-4

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MW09-03-01 is the only sampling point to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-01 only)
MN-4.5 is a SW monitoring point in McGinty Creek



MW09-03-02 was the only sampling point to trigger a response
Only SPTs exceeded in Q4 of 2019 shown on graph (applies to MW09-03-02 only)
MN-4.5 is a SW monitoring point in McGinty Creek

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Minto Mine Adaptive Management

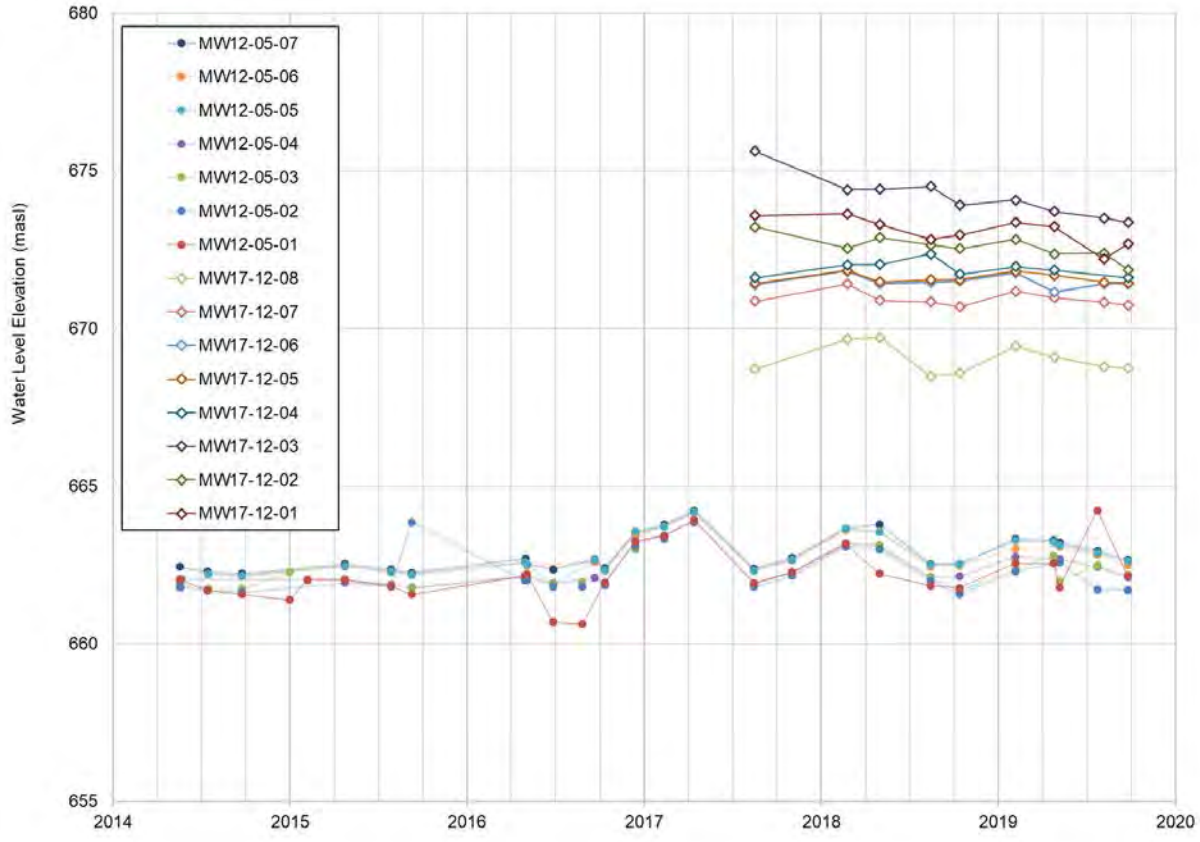
MW09-03
Pb-D & NO_3^--D SPT Exceedances

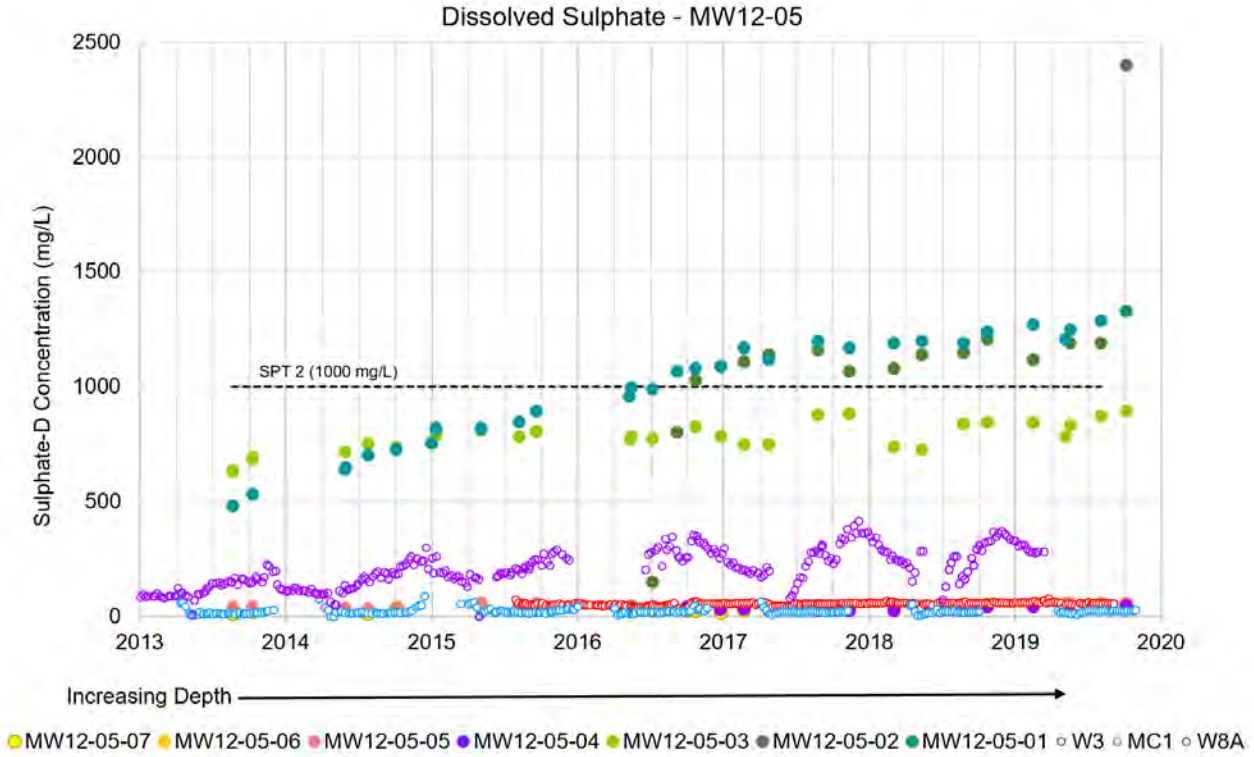
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Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: March 2020
Approved: DCM
Figure: A-5

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MW12-05-01 and MW12-05-02 were the only sampling points to trigger a response
Only SPTs exceeded in Q4 of 2019 shown in graph (applies to MW12-05-01 and MW12-05-02 only)
WC and MC1 are SW monitoring points in Minto Creek
W8A dry since March 2019

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Minto Mine Adaptive Management

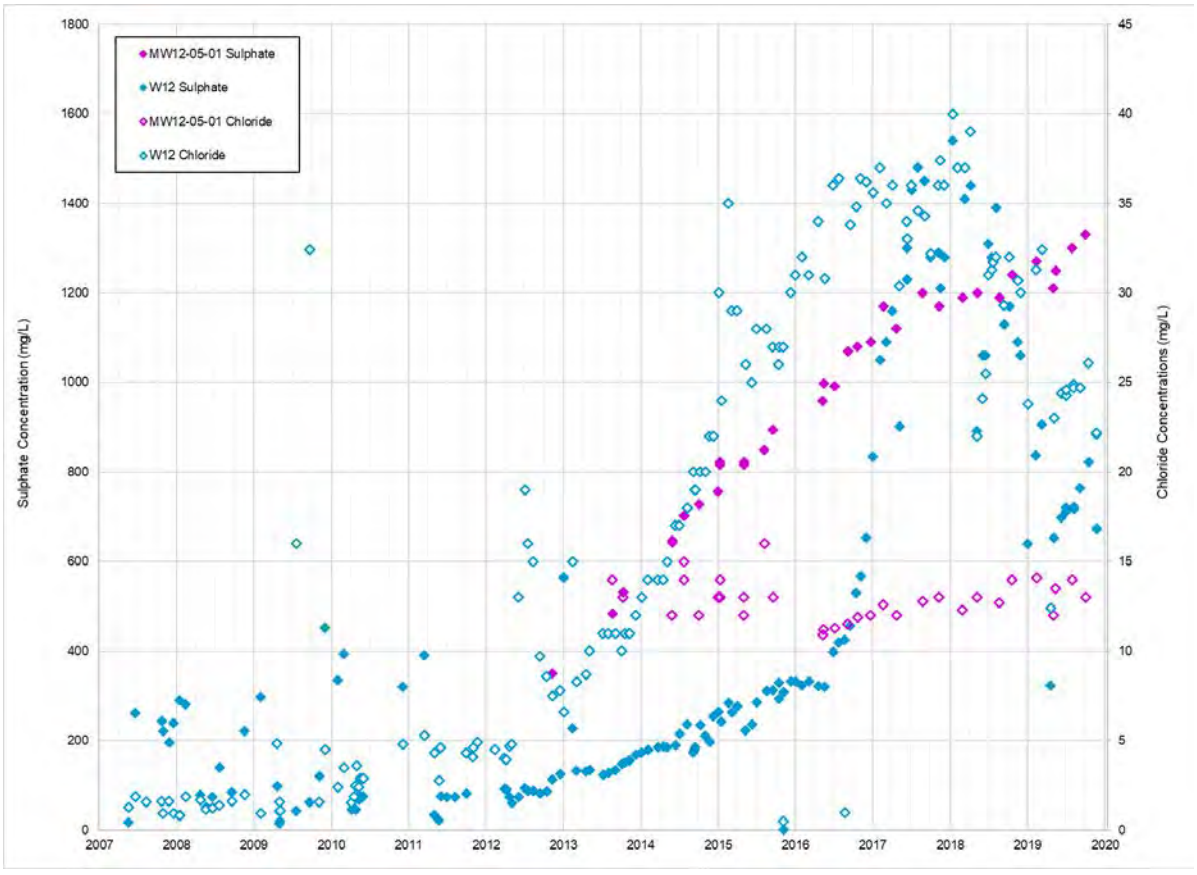
MW12-05 Water Level Data & SO_4^{2-}-D SPT Exceedances

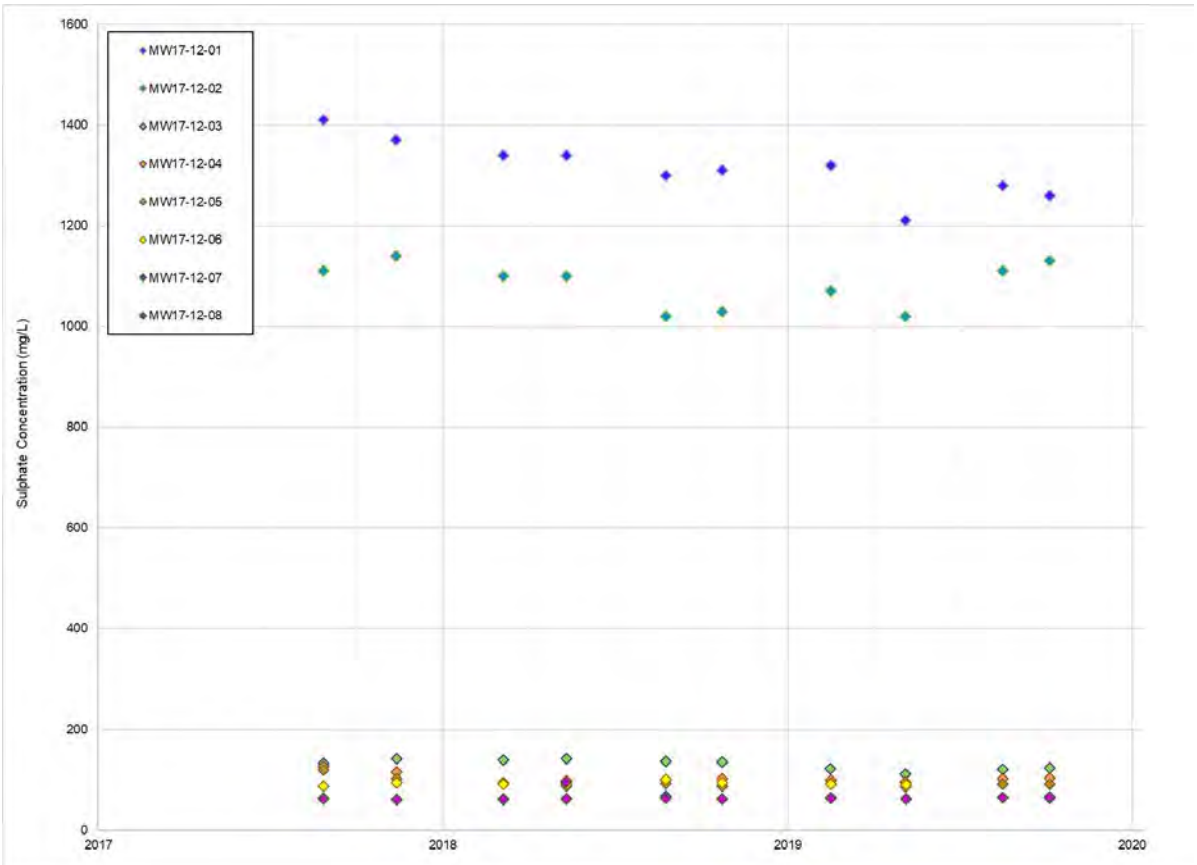
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Minto Mine

Date: March 2020
Approved: DCM
Figure: **B-1**

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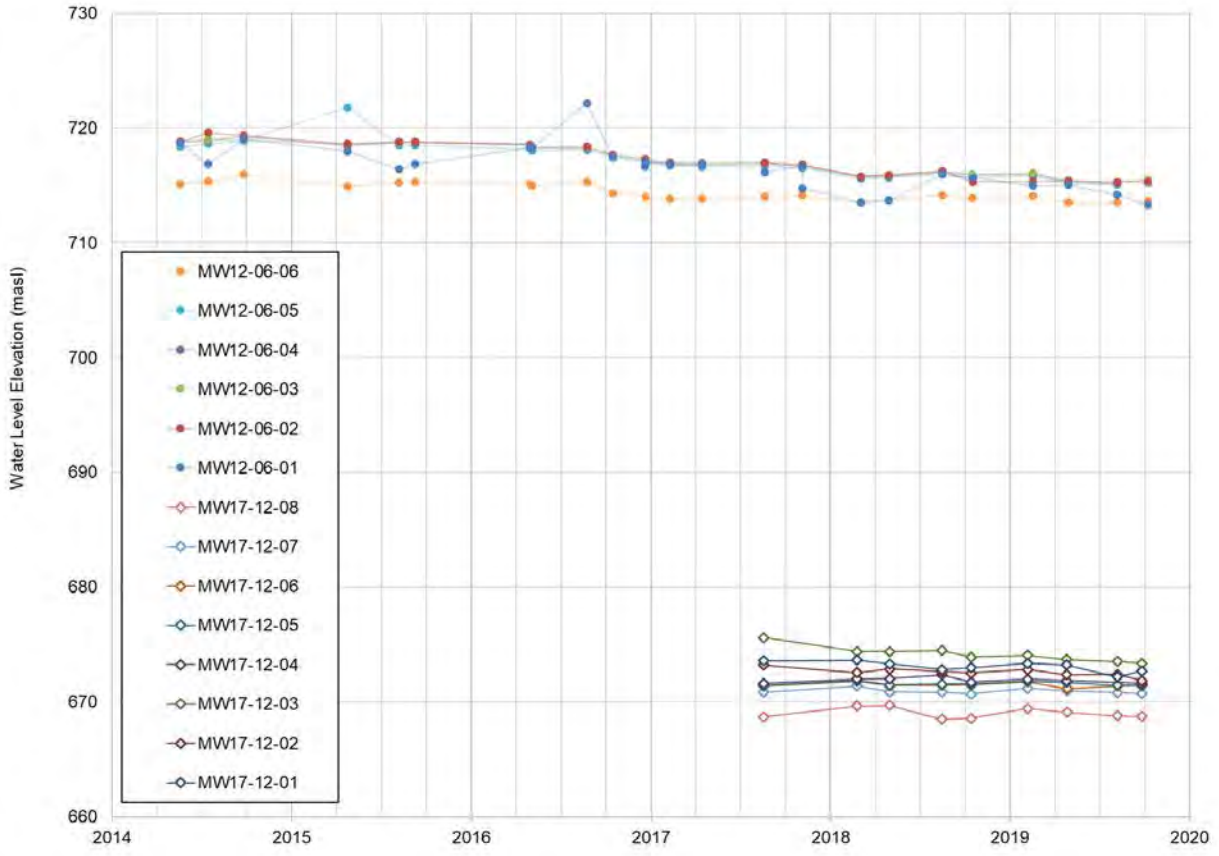
Minto Mine Adaptive Management

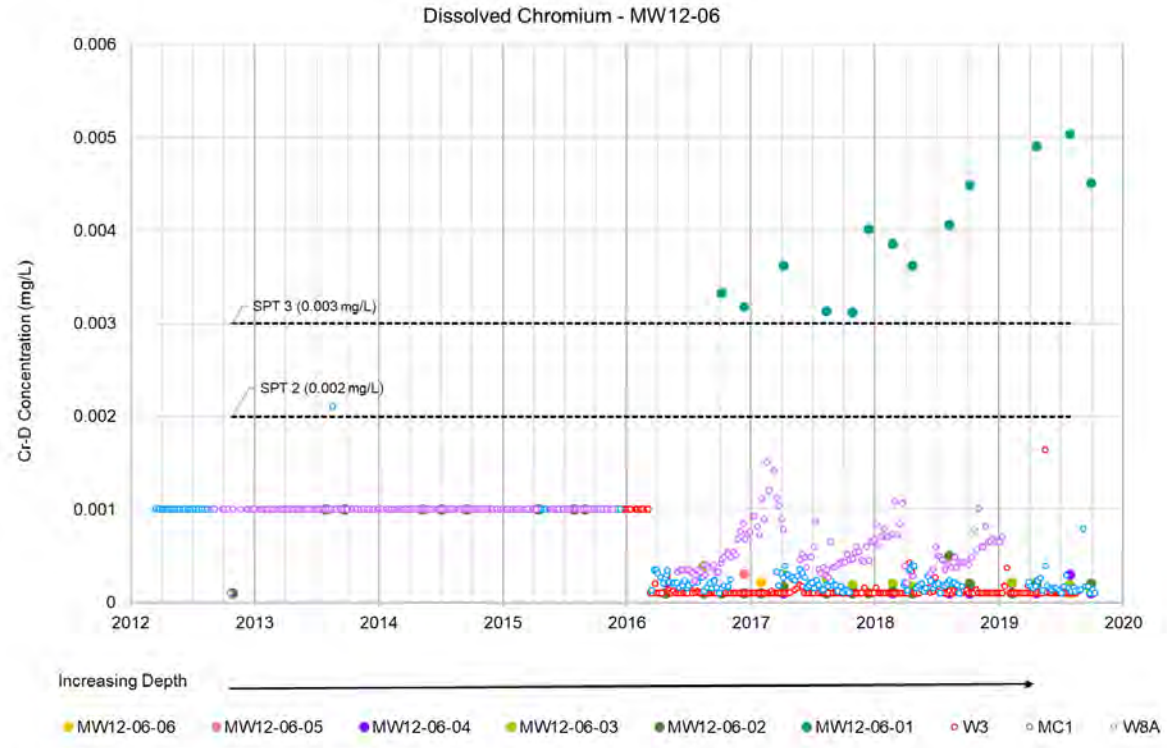
MW12-05-01 and W12 (Main Pit) SO_4^{2-}-D and Cl-D Concentrations and MW17-12 SO_4^{2-}-D Concentrations

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: March 2020
Approved: DCM
Figure: **B-2**





MW12-06-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q4 of 2019 shown in graph (applies to MW12-06-01 only)
WC, W8A and MC1 are SW monitoring points in Minto Creek
W8A has been dry since March 2019

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A PEMBRIDGE RESOURCES COMPANY

Minto Mine Adaptive Management

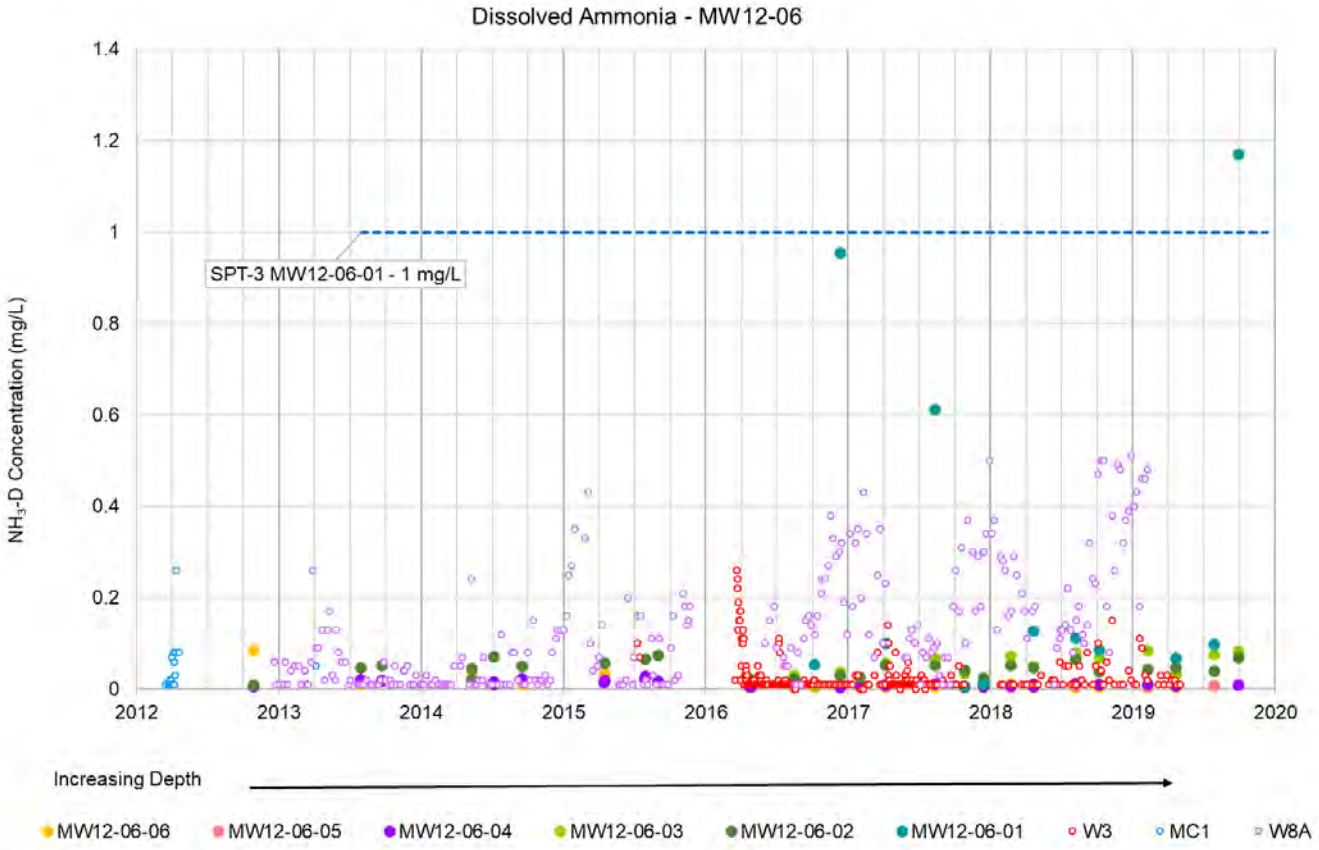
MW12-06, MW17-12 Water Level Data and MW12-06 Cr-D SPT Exceedances

Job No: 1CM002.055
Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx

Minto Mine

Date: March 2020
Approved: DCM
Figure: C-1

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MW12-06-01 was the only sampling point to trigger a response
Only SPTs exceeded in Q4 of 2019 shown in graph (applies to MW12-06-01 only)
WC, W8A and MC1 are SW monitoring points in Minto Creek
W8A has been dry since March 2019

\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20180601_June_Q2_AMP_Review\02_Analysis&Charts\Minto_AMPResponse_2018Q2_MintoCreekGW_rev00_lv.xlsx

srk consulting	MINTO EXPLORATIONS A PEMBRIDGE RESOURCES COMPANY	Minto Mine Adaptive Management		
Job No: 1CM002.055 Filename: 1CM002-055_2018Q4_GW-AMP_Response_Figures_REV00-lv.pptx	Minto Mine	MW12-06 NH_3-D Exceedances		
		Date: March 2020	Approved: DCM	Figure: **C-2**

Appendix K – MMER Effluent Monitoring and Environmental Effects Monitoring Water Quality 2019 Submissions



Minto Mine
MMER – EEM Annual Report
SWIM Upload

Prepared by:
Minto Explorations Ltd.
Minto Mine
February 12th, 2020

Note:

Due to unforeseen variability in creek flow, the exposure site (W2) was dry from June 23rd onward. Since the reference site (W7) did not thaw until May this meant we were only able to collect samples from all three stations for two of the required four EEM sampling occasions. Data below includes some sample days when only two of three stations could be sampled.

Data Summary

Station Name		W3	W3	W3	W3	W3
Smpl Date		4/23/2019 7:35	5/14/2019 9:25	6/18/2019 9:50	9/24/2019 10:05	11/5/2019 7:55
Lab Report No		L2262467	L2274006	L2295065	L2354299	L2378301
Hard-D	mg/L	258	273	266	291	294
Alk-T	mg/L	268	256	248	275	278
N-NH3	mg/L	0.0159	0.0111	0.0066	0.0061	0.0111
N-NO3	mg/L	0.0793	0.0652	0.1	0.0788	0.101
Chlord	mg/L	4.33	4.89	4.82	5.19	5.19
C-DOC	mg/L	5.08	5.73	6.23	6.08	5.64
TSS	mg/L	4.3	<3.0	<3.0	<3.0	<3.0
pH-F	mg/L	7.4400	7.5	7.7100	7.8800	7.76
Temp-F	mg/L	0.1000	0.4	1.7	0.6	0
O-DO	mg/L	11.46	10.37	11.55	12.23	10.62
Cond-F	mg/L	296.80000	286.6	308.90000	323.60000	347.10000
Al-D	mg/L	0.0013	0.0017	0.002600	0.001600	0.0015
As-T	mg/L	0.00025	0.00032	0.00031	0.00028	0.00026
Ca-T	mg/L	57.6	57.4	58.4	62.1	68.1
Cd-T	mg/L	0.0000142	0.0	0.0000055	0.0000063	0.0000244
Cu-T	pH units	0.00307	0.00709	0.0031	0.0024	0.00288
Fe-T	C	0.047	0.103	0.038	0.013	0.037
Hg-T	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Mg-T	mg/L	29.5	29.9	28.1	31.2	33.5
Mn-T	µS/cm	0.231	0.377	0.0482	0.0367	0.0438
Mo-D	mg/L	0.0049	0.00591	0.00543	0.00541	0.00512
Na-T	mg/L	18.8	18.3	17	19.3	21.7
Ni-T	mg/L	0.00073	0.00103	0.00109	0.00091	0.00109
P-T	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
Pb-T	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Se-T	mg/L	<0.00030	0.0002	0.000255	0.000274	0.000318
Tl-T	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
U-T	mg/L	0.00315	0.00293	0.00315	0.00324	0.00313
Zn-T	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Station Name		W7	W7	W7	W7	W7
Smpl Date		4/23/2019 16:20	5/14/2019 11:00	6/30/2019 13:50	9/24/2019 13:50	11/5/2019 8:40
Lab Report No		Frozen	L2274006	L2303254	L2354299	L2378301
Hard-D	mg/L	*	101	137	148	169
Alk-T	mg/L	*	111	150	163	203
N-NH3	mg/L	*	0.0109	0.0197	0.0142	0.0504
N-NO3	mg/L	*	<0.0050	0.186	0.0867	0.144
Chlord	mg/L	*	0.81	0.53	0.43	0.55
C-DOC	mg/L	*	11.4	5.79	5.42	5.36
TSS	mg/L	*	<3.0	10.4	3.1	64.2
pH-F	mg/L	*	7.63	8.3100	7.6400	7.77
Temp-F	mg/L	*	0	2.2	0.9	0.2
O-DO	mg/L	*	14.15	11.4	12.42	9.12
Cond-F	mg/L	*	110	152.80000	173.90000	186.30000
Al-D	mg/L	*	0.0087	0.004000	0.003600	0.0048
As-T	mg/L	*	0.00054	0.00045	0.0004	0.00113
Ca-T	mg/L	*	25.4	40.2	37.5	44.9
Cd-T	mg/L	*	0.0	0.0000067	<0.0000050	0.0000405
Cu-T	pH units	*	0.00347	0.0011	0.00074	0.00707
Fe-T	C	*	0.205	0.29	0.087	1.69
Hg-T	mg/L	*	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Mg-T	mg/L	*	9.85	12.9	14	16
Mn-T	µS/cm	*	0.0307	0.0548	0.0306	0.147
Mo-D	mg/L	*	0.00105	0.00147	0.0016	0.00121
Na-T	mg/L	*	5.88	8.26	8.51	10.1
Ni-T	mg/L	*	0.00113	0.0011	0.00067	0.00207
P-T	mg/L	*	<0.050	<0.050	<0.050	0.101
Pb-T	mg/L	*	<0.000050	0.000094	<0.000050	0.000272
Se-T	mg/L	*	0.0002	0.000208	0.000141	0.000227
Tl-T	mg/L	*	<0.000010	<0.000010	<0.000010	<0.000010
U-T	mg/L	*	0.000769	0.00197	0.00167	0.00151
Zn-T	mg/L	*	<0.0030	<0.0030	<0.0030	0.0048

Station Name		W2	W2	W2
Smpl Date		4/23/2019 8:40	5/14/2019 8:55	6/18/2019 7:45
Lab Report No		L2262467	L2274006	L2295065
Hard-D	mg/L	124	109	160
Alk-T	mg/L	133	114	159
N-NH3	mg/L	0.0052	0.0061	0.0075
N-NO3	mg/L	<0.0050	<0.0050	0.0987
Chlord	mg/L	1.42	1.35	1.75
C-DOC	mg/L	9.65	9.06	7.97
TSS	mg/L	<3.0	3.2	6.7
pH-F	mg/L	8.04	7.6800	7.65
Temp-F	mg/L	0.1	0.2	6.2
O-DO	mg/L	16.26	14.11	10.78
Cond-F	mg/L	140.6	121.10000	213.70000
Al-D	mg/L	0.0051	0.006300	0.0059
As-T	mg/L	0.00041	0.00046	0.00045
Ca-T	mg/L	30.9	26.4	40.4
Cd-T	mg/L	0.0	<0.0000050	<0.0000050
Cu-T	pH units	0.00249	0.00281	0.00239
Fe-T	C	0.078	0.096	0.069
Hg-T	mg/L	<0.0000050	<0.0000050	<0.0000050
Mg-T	mg/L	11.3	9.64	13.6
Mn-T	µS/cm	0.0143	0.00667	0.0143
Mo-D	mg/L	0.000992	0.00101	0.00178
Na-T	mg/L	7.23	6.28	9.17
Ni-T	mg/L	0.00059	0.00079	0.00097
P-T	mg/L	<0.050	<0.050	<0.050
Pb-T	mg/L	<0.000050	<0.000050	<0.000050
Se-T	mg/L	<0.00020	0.000118	0.000142
Tl-T	mg/L	<0.000010	<0.000010	<0.000010
U-T	mg/L	0.00121	0.000912	0.00181
Zn-T	mg/L	<0.0030	<0.0030	<0.0030

Effluent Characterization

Certificates of Analysis (COA's)

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 24-APR-19
Report Date: 03-MAY-19 16:43 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2262467

Project P.O. #: 232817
Job Reference:
C of C Numbers: 2019-04-24 E
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2262467-1 Water 23-APR-19 07:35 W3	L2262467-2 Water 23-APR-19 08:40 W2	L2262467-3 Water 23-APR-19 15:00 C10	L2262467-4 Water 23-APR-19 16:00 MC1	L2262467-5 Water 23-APR-19 DUP1
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
WATER						
Physical Tests	Conductivity (uS/cm)	567	273	171	256	270
	Hardness (as CaCO3) (mg/L)	258	124	79.3	121	128
	pH (pH)	8.13	8.22	7.99	8.22	8.21
	Total Suspended Solids (mg/L)	4.3	<3.0	<3.0	4.2	<3.0
	TDS (Calculated) (mg/L)	331	149	90.5	141	150
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	268	133	81.8	122	131
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	268	133	81.8	122	131
	Ammonia, Total (as N) (mg/L)	0.0159	0.0052	0.0067	<0.0050	<0.0050
	Chloride (Cl) (mg/L)	4.33	1.42	1.40	1.44	1.42
	Nitrate and Nitrite (as N) (mg/L)	0.0793	<0.0051	<0.0051	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	0.0793	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	58.9	15.4	3.79	15.5	15.7
	Anion Sum (meq/L)	6.72	3.01	1.75	2.80	2.98
	Cation Sum (meq/L)	6.03	2.88	1.86	2.80	2.96
	Cation - Anion Balance (%)	-5.4	-2.3	2.9	0.0	-0.4
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	5.08	9.65	17.6	10.8	9.59
Total Metals	Aluminum (Al)-Total (mg/L)	0.0075	0.0257	0.0454	0.0195	0.0253
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00025	0.00041	0.00043	0.00035	0.00046
	Barium (Ba)-Total (mg/L)	0.0660	0.0479	0.0312	0.0454	0.0479
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.026	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000142	0.0000128	0.0000195	0.0000133	0.0000122
	Calcium (Ca)-Total (mg/L)	57.6	30.9	22.6	28.3	30.9
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00021	0.00027	0.00026	0.00024
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00018	<0.00010	0.00010
	Copper (Cu)-Total (mg/L)	0.00307	0.00249	0.00310	0.00329	0.00256
	Iron (Fe)-Total (mg/L)	0.047	0.078	0.192	0.072	0.083
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000068
	Lithium (Li)-Total (mg/L)	0.0038	0.0017	0.0020	0.0014	0.0017
	Magnesium (Mg)-Total (mg/L)	29.5	11.3	5.61	10.8	11.3
	Manganese (Mn)-Total (mg/L)	0.231	0.0143	0.0564	0.0124	0.0144

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2262467-6				
	Description	Water				
	Sampled Date	23-APR-19				
	Sampled Time					
	Client ID	DUP2				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	171				
	Hardness (as CaCO3) (mg/L)	81.8				
	pH (pH)	8.02				
	Total Suspended Solids (mg/L)	3.4				
	TDS (Calculated) (mg/L)	91.4				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	81.5				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	81.5				
	Ammonia, Total (as N) (mg/L)	0.0068				
	Chloride (Cl) (mg/L)	1.40				
	Nitrate and Nitrite (as N) (mg/L)	<0.0051				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Sulfate (SO4) (mg/L)	3.83				
	Anion Sum (meq/L)	1.75				
	Cation Sum (meq/L)	1.91				
	Cation - Anion Balance (%)	4.5				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	18.4				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0230				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00038				
	Barium (Ba)-Total (mg/L)	0.0301				
	Beryllium (Be)-Total (mg/L)	<0.000020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	0.0000073				
	Calcium (Ca)-Total (mg/L)	22.4				
	Chromium (Cr)-Total (mg/L)	0.00025				
	Cobalt (Co)-Total (mg/L)	0.00017				
	Copper (Cu)-Total (mg/L)	0.00165				
	Iron (Fe)-Total (mg/L)	0.144				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0020				
	Magnesium (Mg)-Total (mg/L)	5.66				
	Manganese (Mn)-Total (mg/L)	0.0514				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2262467-1 Water 23-APR-19 07:35 W3	L2262467-2 Water 23-APR-19 08:40 W2	L2262467-3 Water 23-APR-19 15:00 C10	L2262467-4 Water 23-APR-19 16:00 MC1	L2262467-5 Water 23-APR-19 DUP1
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00549	0.00113	0.000351	0.000981	0.00104
	Nickel (Ni)-Total (mg/L)	0.00073	0.00059	0.00121	0.00056	0.00072
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	0.081	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.47	2.63	4.32	2.63	2.66
	Selenium (Se)-Total (mg/L)	<0.00030 DLB	<0.00020 DLB	<0.00010 DLB	<0.00025 DLB	<0.00020 DLB
	Silicon (Si)-Total (mg/L)	6.42	5.58	4.58	5.18	5.47
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	18.8	7.23	3.41	6.81	7.24
	Strontium (Sr)-Total (mg/L)	0.880	0.333	0.158	0.315	0.333
	Sulfur (S)-Total (mg/L)	22.5	5.83	1.69	5.55	5.98
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00047	<0.0018 DLM	0.00163	<0.0012 DLM	<0.0018 DLM
	Uranium (U)-Total (mg/L)	0.00315	0.00121	0.000374	0.00100	0.00126
	Vanadium (V)-Total (mg/L)	<0.00050	0.00054	<0.00050	<0.00050	0.00054
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0013	0.0051	0.0064	0.0049	0.0053
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00022	0.00040	0.00039	0.00036	0.00041
	Barium (Ba)-Dissolved (mg/L)	0.0686	0.0496	0.0304	0.0468	0.0505
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.023	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000061	<0.0000050	0.0000089	0.0000057	0.0000064
	Calcium (Ca)-Dissolved (mg/L)	56.4	31.0	22.7	30.4	31.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00017	0.00019	0.00017	0.00017
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00014	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00264	0.00246	0.00152	0.00323	0.00249
	Iron (Fe)-Dissolved (mg/L)	0.034	0.042	0.095	0.042	0.044
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0034	0.0015	0.0018	0.0013	0.0015
	Magnesium (Mg)-Dissolved (mg/L)	28.5	11.3	5.47	11.0	11.7
	Manganese (Mn)-Dissolved (mg/L)	0.232	0.0108	0.0419	0.0102	0.0106

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2262467-6				
	Description	Water				
	Sampled Date	23-APR-19				
	Sampled Time					
	Client ID	DUP2				
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.000341				
	Nickel (Ni)-Total (mg/L)	0.00116				
	Phosphorus (P)-Total (mg/L)	0.073				
	Potassium (K)-Total (mg/L)	4.37				
	Selenium (Se)-Total (mg/L)	<0.00010 DLB				
	Silicon (Si)-Total (mg/L)	4.57				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	3.45				
	Strontium (Sr)-Total (mg/L)	0.156				
	Sulfur (S)-Total (mg/L)	1.75				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.00090 DLM				
	Uranium (U)-Total (mg/L)	0.000346				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00030				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0067				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00040				
	Barium (Ba)-Dissolved (mg/L)	0.0326				
	Beryllium (Be)-Dissolved (mg/L)	<0.000020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000108				
	Calcium (Ca)-Dissolved (mg/L)	23.4				
	Chromium (Cr)-Dissolved (mg/L)	0.00016				
	Cobalt (Co)-Dissolved (mg/L)	0.00016				
	Copper (Cu)-Dissolved (mg/L)	0.00166				
	Iron (Fe)-Dissolved (mg/L)	0.095				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0018				
	Magnesium (Mg)-Dissolved (mg/L)	5.66				
	Manganese (Mn)-Dissolved (mg/L)	0.0453				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2262467-1	L2262467-2	L2262467-3	L2262467-4	L2262467-5
Description	Water	Water	Water	Water	Water
Sampled Date	23-APR-19	23-APR-19	23-APR-19	23-APR-19	23-APR-19
Sampled Time	07:35	08:40	15:00	16:00	
Client ID	W3	W2	C10	MC1	DUP1
Grouping / **Analyte**					
WATER					
Dissolved Metals					
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00490	0.000992	0.000330	0.000917	0.00100
Nickel (Ni)-Dissolved (mg/L)	0.00067	<0.00050	0.00094	<0.00050	0.00052
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	2.55	2.79	4.38	2.78	2.80
Selenium (Se)-Dissolved (mg/L)	0.000306	0.000204	0.000052	0.000146	0.000169
Silicon (Si)-Dissolved (mg/L)	5.89	5.37	4.33	4.96	5.33
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	18.2	7.38	3.50	7.04	7.58
Strontium (Sr)-Dissolved (mg/L)	0.797	0.303	0.142	0.294	0.305
Sulfur (S)-Dissolved (mg/L)	19.4	5.23	1.25	5.17	5.12
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00282	0.00112	0.000328	0.000949	0.00114
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	0.0014	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2262467-6				
	Description	Water				
	Sampled Date	23-APR-19				
	Sampled Time					
	Client ID	DUP2				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.000321				
	Nickel (Ni)-Dissolved (mg/L)	0.00101				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	4.54				
	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	4.31				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	3.53				
	Strontium (Sr)-Dissolved (mg/L)	0.141				
	Sulfur (S)-Dissolved (mg/L)	1.39				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Uranium (U)-Dissolved (mg/L)	0.000326				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<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)
Method Blank	Selenium (Se)-Total	MB-LOR	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Dissolved Organic Carbon	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Aluminum (Al)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Copper (Cu)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2262467-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfate (SO4)	MS-B	L2262467-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

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

Reference Information

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

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 CaCO3 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.

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.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

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.

** 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:

Reference Information

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-04-24 E

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2262467-COFC

COC Number: 2019-04-24 E

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232817 (WUL)
LSD:	
ALS Lab Work Order # (lab use only)	

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax mintoenvironment@mintomine.com
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax ap@mintomine.com
Email 2

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: Shane Stack **Sampler:** PM/CR/CB

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	P Total Metals (TM), Hardness	F/P Dissolved Metals (DM)(filtered and preserved	P Total Mercury, Hardness	F/P Dissolved Mercury [1] (Filtered + preserved)	P Total Nutrients (Ammonia)	F/P Dissolved Organic Carbon (DOC)	Number of Containers
	W3	23-Apr-19	7:35	Water	R	R	R	R	R	R	R	R	R	7
	W2	23-Apr-19	8:40	Water	R	R	R	R	R	R	R	R	R	7
	C10	23-Apr-19	15:00	Water	R	R	R	R	R	R	R	R	R	7
	MC1	23-Apr-19	16:00	Water	R	R	R	R	R	R	R	R	R	7
	DUP1	23-Apr-19		Water	R	R	R	R	R	R	R	R	R	7
	DUP2	23-Apr-19		Water	R	R	R	R	R	R	R	R	R	7

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
7.8			5.0 (and 0.9)		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Patrick McGinty	Date: 4/24/2019	Time:	Received by:	Date: APR 24, 2019	Time: 14:40	Received by: TC	Date: Apr 25	Time: 11:30am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-MAY-19
Report Date: 29-MAY-19 17:15 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2274006

Project P.O. #: 232817 (WUL)
Job Reference:
C of C Numbers: 2019-05-15B
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2274006-1	L2274006-2	L2274006-3	L2274006-4	L2274006-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	13-MAY-19	13-MAY-19	13-MAY-19	13-MAY-19	14-MAY-19
	Sampled Time	09:20	15:05	15:35	16:00	09:25
	Client ID	W17	C4	W46	W6	W3
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	547	124	238	117	558
	Hardness (as CaCO3) (mg/L)	272	60.2	114	56.6	273
	pH (pH)	8.33	7.82	8.15	7.91	8.42
	Total Suspended Solids (mg/L)	<3.0	14.0	4.2	6.4	<3.0
	Total Dissolved Solids (mg/L)	361	121	149	96	360
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	230	59.5	112	59.7	242
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.2	<1.0	<1.0	<1.0	13.8
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	234	59.5	112	59.7	256
	Ammonia, Total (as N) (mg/L)	0.0054	0.0179	0.0056	0.0077	0.0111
	Chloride (Cl) (mg/L)	7.08	0.85	1.39	0.92	4.89
	Nitrate and Nitrite (as N) (mg/L)	0.0443	<0.0051	<0.0051	<0.0051	0.0652
	Nitrate (as N) (mg/L)	0.0443	<0.0050	<0.0050	<0.0050	0.0652
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	59.8	3.50	14.1	0.53	56.7
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	10.1	15.8	9.28	9.38	5.73
Total Metals	Aluminum (Al)-Total (mg/L)	0.0167	0.0470	0.0261	0.0447	0.0463
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00041	0.00076	0.00039	0.00057	0.00032
	Barium (Ba)-Total (mg/L)	0.0773	0.0379	0.0458	0.0301	0.0739
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.021	<0.010	<0.010	<0.010	0.022
	Cadmium (Cd)-Total (mg/L)	0.0000077	0.0000105	0.0000062	0.0000074	0.0000102
	Calcium (Ca)-Total (mg/L)	72.6	15.5	27.3	15.2	57.4
	Chromium (Cr)-Total (mg/L)	0.00012	0.00050	0.00018	0.00024	0.00014
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00031	<0.00010	0.00013	0.00017
	Copper (Cu)-Total (mg/L)	0.00917	0.00285	0.00368	0.00197	0.00709
	Iron (Fe)-Total (mg/L)	0.027	0.477	0.105	0.156	0.103
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0016	<0.0010	<0.0010	<0.0010	0.0032
	Magnesium (Mg)-Total (mg/L)	23.2	5.18	11.0	4.24	29.9
	Manganese (Mn)-Total (mg/L)	0.133	0.199	0.0660	0.0600	0.377
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00685	0.000545	0.00123	0.000359	0.00603
	Nickel (Ni)-Total (mg/L)	0.00083	0.00200	0.00067	0.00109	0.00103

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2274006-6 Water 14-MAY-19 08:55 W2	L2274006-7 Water 14-MAY-19 10:05 MC1	L2274006-8 Water 14-MAY-19 11:00 W7	L2274006-9 Water 13-MAY-19 DUP	L2274006-10 Water 14-MAY-19 DUP
WATER						
Physical Tests	Conductivity (uS/cm)	235	252	216	125	252
	Hardness (as CaCO3) (mg/L)	109	117	101	59.3	117
	pH (pH)	8.27	8.28	8.24	7.86	8.29
	Total Suspended Solids (mg/L)	3.2	<3.0	<3.0	4.4	<3.0
	Total Dissolved Solids (mg/L)	176	172	169	105	180
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	114	122	111	58.9	120
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	114	122	111	58.9	120
	Ammonia, Total (as N) (mg/L)	0.0061	<0.0050	0.0109	0.0169	0.0054
	Chloride (Cl) (mg/L)	1.35	1.42	0.81	0.86	1.42
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051	<0.0051	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	12.8	13.8	7.31	3.45	13.8
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.06	10.0	11.4	16.6	10.2
Total Metals	Aluminum (Al)-Total (mg/L)	0.0249	0.0176	0.0194	0.0642	0.0192
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00011	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00046	0.00057	0.00054	0.00077	0.00053
	Barium (Ba)-Total (mg/L)	0.0451	0.0489	0.0534	0.0410	0.0467
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000059	0.0000094	0.0000111	0.0000063
	Calcium (Ca)-Total (mg/L)	26.4	29.7	25.4	15.5	28.8
	Chromium (Cr)-Total (mg/L)	0.00029	0.00026	0.00032	0.00048	0.00027
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00011	0.00033	<0.00010
	Copper (Cu)-Total (mg/L)	0.00281	0.00355	0.00347	0.00329	0.00320
	Iron (Fe)-Total (mg/L)	0.096	0.122	0.205	0.513	0.114
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0010	0.0012	<0.0010	<0.0010	0.0011
	Magnesium (Mg)-Total (mg/L)	9.64	11.5	9.85	5.39	11.7
	Manganese (Mn)-Total (mg/L)	0.00667	0.00997	0.0307	0.201	0.00630
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00103	0.00109	0.000945	0.000455	0.00105
	Nickel (Ni)-Total (mg/L)	0.00079	0.00106	0.00113	0.00218	0.00099

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274006-1	L2274006-2	L2274006-3	L2274006-4	L2274006-5
Description	Water	Water	Water	Water	Water
Sampled Date	13-MAY-19	13-MAY-19	13-MAY-19	13-MAY-19	14-MAY-19
Sampled Time	09:20	15:05	15:35	16:00	09:25
Client ID	W17	C4	W46	W6	W3
Grouping / **Analyte**					
WATER					
Total Metals Phosphorus (P)-Total (mg/L)	<0.050	0.051	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	3.85	1.01	1.28	0.69	2.30
Selenium (Se)-Total (mg/L)	0.000295	0.000066	0.000171	0.000072	0.000231
Silicon (Si)-Total (mg/L)	5.99	4.33	4.60	4.37	6.19
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	15.7	3.68	6.71	2.83	18.3
Strontium (Sr)-Total (mg/L)	0.838	0.106	0.321	0.0735	0.842
Sulfur (S)-Total (mg/L)	21.7	1.39	4.88	<0.50	19.5
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00109	<0.0021 DLM	0.00098	<0.0021 DLM	0.00209
Uranium (U)-Total (mg/L)	0.00244	0.000198	0.00101	0.000097	0.00293
Vanadium (V)-Total (mg/L)	0.00072	0.00090	0.00085	0.00093	0.00076
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0014	0.0140	0.0056	0.0057	0.0017
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00039	0.00060	0.00038	0.00046	0.00029
Barium (Ba)-Dissolved (mg/L)	0.0738	0.0373	0.0456	0.0293	0.0737
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.021	<0.010	<0.010	<0.010	0.022
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000063	0.0000054	<0.0000050	0.0000104
Calcium (Ca)-Dissolved (mg/L)	69.9	15.5	27.7	15.4	58.3
Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00037	0.00015	0.00020	0.00011
Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00027	<0.00010	<0.00010	0.00013
Copper (Cu)-Dissolved (mg/L)	0.00704	0.00271	0.00327	0.00156	0.00307
Iron (Fe)-Dissolved (mg/L)	<0.010	0.247	0.058	0.050	0.027
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0016	<0.0010	0.0010	<0.0010	0.0033
Magnesium (Mg)-Dissolved (mg/L)	23.7	5.21	11.0	4.41	30.8
Manganese (Mn)-Dissolved (mg/L)	0.0456	0.194	0.0589	0.0439	0.376
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00697	0.000531	0.00125	0.000371	0.00591
Nickel (Ni)-Dissolved (mg/L)	0.00082	0.00199	0.00062	0.00105	0.00102

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274006-6	L2274006-7	L2274006-8	L2274006-9	L2274006-10
Description	Water	Water	Water	Water	Water
Sampled Date	14-MAY-19	14-MAY-19	14-MAY-19	13-MAY-19	14-MAY-19
Sampled Time	08:55	10:05	11:00		
Client ID	W2	MC1	W7	DUP	DUP
Grouping / **Analyte**					
WATER					
Total Metals Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	1.30	1.54	1.17	1.10	1.54
Selenium (Se)-Total (mg/L)	0.000118	0.000167	0.000181	0.000071	0.000085
Silicon (Si)-Total (mg/L)	4.43	4.77	4.92	4.32	4.63
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	6.28	6.95	5.88	3.57	7.28
Strontium (Sr)-Total (mg/L)	0.295	0.297	0.242	0.0954	0.298
Sulfur (S)-Total (mg/L)	4.42	4.70	2.55	1.20	4.65
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00109	<0.0012 DLM	0.00085	0.00269	<0.00090 DLM
Uranium (U)-Total (mg/L)	0.000912	0.00104	0.000769	0.000188	0.00101
Vanadium (V)-Total (mg/L)	0.00076	0.00083	0.00103	0.00105	0.00085
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0063	0.0065	0.0087	0.0142	0.0065
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00042	0.00052	0.00047	0.00058	0.00053
Barium (Ba)-Dissolved (mg/L)	0.0430	0.0461	0.0526	0.0376	0.0470
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000070	<0.0000050
Calcium (Ca)-Dissolved (mg/L)	27.1	28.5	24.7	15.4	28.3
Chromium (Cr)-Dissolved (mg/L)	0.00018	0.00023	0.00025	0.00041	0.00024
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00025	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00259	0.00275	0.00281	0.00266	0.00276
Iron (Fe)-Dissolved (mg/L)	0.055	0.077	0.140	0.229	0.078
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0011	0.0012	<0.0010	<0.0010	0.0012
Magnesium (Mg)-Dissolved (mg/L)	10.2	11.1	9.47	5.05	11.3
Manganese (Mn)-Dissolved (mg/L)	0.00120	0.00642	0.0271	0.186	0.00359
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00101	0.00108	0.00105	0.000512	0.00110
Nickel (Ni)-Dissolved (mg/L)	0.00081	0.00098	0.00101	0.00202	0.00092

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274006-1	L2274006-2	L2274006-3	L2274006-4	L2274006-5
Description	Water	Water	Water	Water	Water
Sampled Date	13-MAY-19	13-MAY-19	13-MAY-19	13-MAY-19	14-MAY-19
Sampled Time	09:20	15:05	15:35	16:00	09:25
Client ID	W17	C4	W46	W6	W3
Grouping / **Analyte**					
WATER					
Dissolved Metals Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	3.85	1.04	1.32	0.71	2.53
Selenium (Se)-Dissolved (mg/L)	0.000392	0.000104	0.000198	0.000075	0.000296
Silicon (Si)-Dissolved (mg/L)	6.16	4.39	4.64	4.48	6.28
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	15.0	3.55	6.42	2.79	17.8
Strontium (Sr)-Dissolved (mg/L)	0.824	0.105	0.322	0.0740	0.861
Sulfur (S)-Dissolved (mg/L)	21.3	1.47	4.89	<0.50	19.3
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00051	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00246	0.000191	0.000988	0.000087	0.00292
Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00059	0.00058	0.00060	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2274006-6	L2274006-7	L2274006-8	L2274006-9	L2274006-10
Description	Water	Water	Water	Water	Water
Sampled Date	14-MAY-19	14-MAY-19	14-MAY-19	13-MAY-19	14-MAY-19
Sampled Time	08:55	10:05	11:00		
Client ID	W2	MC1	W7	DUP	DUP
Grouping / **Analyte**					
WATER					
Dissolved Metals					
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	1.34	1.43	1.11	1.03	1.44
Selenium (Se)-Dissolved (mg/L)	0.000121	0.000167	0.000181	0.000101	0.000169
Silicon (Si)-Dissolved (mg/L)	4.52	4.81	5.08	4.37	4.82
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	6.22	6.73	5.74	3.39	6.77
Strontium (Sr)-Dissolved (mg/L)	0.281	0.320	0.267	0.102	0.321
Sulfur (S)-Dissolved (mg/L)	4.33	4.80	2.70	1.37	4.74
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00037	0.00049	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000895	0.00106	0.000847	0.000206	0.00109
Vanadium (V)-Dissolved (mg/L)	0.00050	0.00057	0.00076	0.00056	0.00059
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<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	L2274006-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2274006-10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2274006-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2274006-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2274006-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2274006-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2274006-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2274006-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2274006-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2274006-10, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2274006-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2274006-10, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2274006-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2274006-10, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2274006-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2274006-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2274006-10, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2274006-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2274006-10, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2274006-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

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.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Reference Information

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 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.

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.

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.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-05-15B

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2274006-COFC

COC Number: 2019-05-15 B

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax mintoenvironment@mintomine.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax ap@mintomine.com

Email 2

Project Information

ALS Account # / Quote #:

Job #:

PO / AFE: 232817 (WUL)

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Shane Stack Sampler: CR/CB/DF

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	P Total Metals (TM), Hardness	F/P Dissolved Metals (DM) (filtered and preserved)	P Total Mercury, Hardness	F/P Dissolved Mercury [1] (Filtered + preserved)	P Total Nutrients (Ammonia)	F/P Dissolved Organic Carbon (DOC)					Number of Containers
	W17	13-May-19	9:20	Water	R	R	R	R	R	R	R	R	R					7
	C4	13-May-19	15:05	Water	R	R	R	R	R	R	R	R	R					7
	W46	13-May-19	15:35	Water	R	R	R	R	R	R	R	R	R					7
	W6	13-May-19	16:00	Water	R	R	R	R	R	R	R	R	R					7
	W3	14-May-19	9:25	Water	R	R	R	R	R	R	R	R	R					7
	W2	14-May-19	8:55	Water	R	R	R	R	R	R	R	R	R					7
	MC1	14-May-19	10:05	Water	R	R	R	R	R	R	R	R	R					7
	W7	14-May-19	11:00	Water	R	R	R	R	R	R	R	R	R					7
	DUP	13-May-19		Water	R	R	R	R	R	R	R	R	R					7
	DUP	14-May-19		Water	R	R	R	R	R	R	R	R	R					7

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
8.0					10

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-05-15	Time:	Received by: EF	Date: 15 May 2019	Time: 15:30	Received by: HA	Date: 5/16	Time: 12125 PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 19-JUN-19
Report Date: 04-JUL-19 16:16 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2295065

Project P.O. #: 232817 (WUL)
Job Reference:
C of C Numbers: 2019-06-19 A
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2295065-1 Water 15-JUN-19 09:20 C4	L2295065-2 Water 15-JUN-19 10:05 W46	L2295065-3 Water 15-JUN-19 10:50 W6	L2295065-4 Water 17-JUN-19 08:10 W17	L2295065-5 Water 17-JUN-19 10:30 W15
WATER						
Physical Tests	Conductivity (uS/cm)	232	325	165	532	427
	Hardness (as CaCO3) (mg/L)	119	162	84.1	263	222
	pH (pH)	8.17	8.28	8.04	8.35	8.21
	Total Suspended Solids (mg/L)	<3.0	<3.0	9.8	<3.0	<3.0
	TDS (Calculated) (mg/L)	131	191	88.6	320	268
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	122	161	84.6	237	151
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	3.2	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	122	161	84.6	240	151
	Ammonia, Total (as N) (mg/L)	0.0106	0.0062	0.0100	<0.0050	0.0346
	Chloride (Cl) (mg/L)	<0.50	2.12	1.51	7.20	1.28
	Nitrate and Nitrite (as N) (mg/L)	0.0311	0.0898	0.0101	0.0417	2.26
	Nitrate (as N) (mg/L)	0.0311	0.0898	0.0101	0.0417	2.25
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0113
	Sulfate (SO4) (mg/L)	9.05	24.8	1.98	59.2	76.5
	Anion Sum (meq/L)	2.63	3.81	1.78	6.23	4.80
	Cation Sum (meq/L)	2.67	3.73	1.87	5.99	4.88
	Cation - Anion Balance (%)	0.7	-1.0	2.7	-1.9	0.8
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	13.5	8.10	15.7	9.76	29.1
Total Metals	Aluminum (Al)-Total (mg/L)	0.0281	0.0209	0.0164	<0.0030	0.0225
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00067	0.00046	0.00046	0.00036	0.00044
	Barium (Ba)-Total (mg/L)	0.0532	0.0619	0.0377	0.0683	0.0560
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	0.020	<0.010
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	31.5	38.2	21.8	67.2	62.4
	Chromium (Cr)-Total (mg/L)	0.00030	0.00014	0.00025	<0.00010	0.00021
	Cobalt (Co)-Total (mg/L)	0.00016	0.00012	<0.00010	<0.00010	0.00014
	Copper (Cu)-Total (mg/L)	0.00139	0.00220	0.00182	0.00716	0.0262
	Iron (Fe)-Total (mg/L)	0.308	0.143	0.079	<0.010	0.145
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	0.0014	<0.0010	0.0014	<0.0010
	Magnesium (Mg)-Total (mg/L)	9.30	16.6	5.79	21.1	16.4
	Manganese (Mn)-Total (mg/L)	0.0590	0.0492	0.00743	0.0222	0.0773

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2295065-6 Water 18-JUN-19 07:45 W2	L2295065-7 Water 18-JUN-19 08:25 MC1	L2295065-8 Water 18-JUN-19 09:50 W3	L2295065-9 Water 15-JUN-19 DUP	L2295065-10 Water 17-JUN-19 DUP
WATER						
Physical Tests	Conductivity (uS/cm)	329	312	519	325	522
	Hardness (as CaCO3) (mg/L)	160	157	266	169	269
	pH (pH)	8.40	8.31	8.39	8.30	8.35
	Total Suspended Solids (mg/L)	6.7	9.7	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	185	181	318	193	319
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	151	155	242	158	231
	Alkalinity, Carbonate (as CaCO3) (mg/L)	8.0	2.0	5.6	1.4	3.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	159	157	248	159	235
	Ammonia, Total (as N) (mg/L)	0.0075	0.0111	0.0066	0.0065	0.0061
	Chloride (Cl) (mg/L)	1.75	1.66	4.82	2.12	7.19
	Nitrate and Nitrite (as N) (mg/L)	0.0987	0.110	0.100	0.0903	0.0420
	Nitrate (as N) (mg/L)	0.0987	0.110	0.100	0.0903	0.0420
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	21.5	20.3	55.5	24.9	59.2
	Anion Sum (meq/L)	3.67	3.61	6.25	3.77	6.12
	Cation Sum (meq/L)	3.64	3.58	6.18	3.90	6.14
	Cation - Anion Balance (%)	-0.4	-0.4	-0.6	1.6	0.1
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	7.97	7.96	6.23	8.31	9.57
Total Metals	Aluminum (Al)-Total (mg/L)	0.0273	0.0422	0.0144	0.0262	0.0032
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00045	0.00050	0.00031	0.00043	0.00037
	Barium (Ba)-Total (mg/L)	0.0606	0.0585	0.0619	0.0608	0.0675
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	0.023	<0.010	0.021
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000053	0.0000055	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	40.4	39.3	58.4	36.8	68.7
	Chromium (Cr)-Total (mg/L)	0.00017	0.00014	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00010	<0.00010	0.00011	<0.00010
	Copper (Cu)-Total (mg/L)	0.00239	0.00198	0.00310	0.00214	0.00716
	Iron (Fe)-Total (mg/L)	0.069	0.158	0.038	0.141	<0.010
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0015	0.0014	0.0032	0.0014	0.0015
	Magnesium (Mg)-Total (mg/L)	13.6	14.7	28.1	15.2	21.1
	Manganese (Mn)-Total (mg/L)	0.0143	0.0334	0.0482	0.0473	0.0237

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2295065-1	L2295065-2	L2295065-3	L2295065-4	L2295065-5
Description	Water	Water	Water	Water	Water
Sampled Date	15-JUN-19	15-JUN-19	15-JUN-19	17-JUN-19	17-JUN-19
Sampled Time	09:20	10:05	10:50	08:10	10:30
Client ID	C4	W46	W6	W17	W15
Grouping / **Analyte**					
WATER					
Total Metals Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.000647	0.00248	0.000449	0.00620	0.00240
Nickel (Ni)-Total (mg/L)	0.00167	0.00102	0.00155	0.00080	0.00100
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.70	1.25	0.31	3.15	1.96
Selenium (Se)-Total (mg/L)	0.000087	0.000211	0.000097	0.000270	0.000988
Silicon (Si)-Total (mg/L)	5.88	5.40	5.80	5.86	3.54
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	5.73	9.85	3.96	13.6	8.40
Strontium (Sr)-Total (mg/L)	0.223	0.496	0.111	0.796	0.589
Sulfur (S)-Total (mg/L)	3.38	8.02	0.69	19.2	25.4
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00133	0.00105	0.00090	<0.00030	0.00102
Uranium (U)-Total (mg/L)	0.000350	0.00189	0.000121	0.00252	0.00111
Vanadium (V)-Total (mg/L)	0.00052	0.00093	0.00068	<0.00050	0.00063
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00033
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0068	0.0054	0.0072	0.0025	0.0182
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00062	0.00046	0.00044	0.00042	0.00045
Barium (Ba)-Dissolved (mg/L)	0.0553	0.0659	0.0383	0.0726	0.0599
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.022	<0.010
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.0000084	<0.0000050	0.0000090	0.0000094
Calcium (Ca)-Dissolved (mg/L)	31.4	39.0	23.6	70.0	63.1
Chromium (Cr)-Dissolved (mg/L)	0.00031	0.00014	0.00023	0.00014	0.00028
Cobalt (Co)-Dissolved (mg/L)	0.00013	<0.00010	<0.00010	<0.00010	0.00013
Copper (Cu)-Dissolved (mg/L)	0.00135	0.00196	0.00157	0.00695	0.0238
Iron (Fe)-Dissolved (mg/L)	0.208	0.088	0.049	<0.010	0.125
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0010	0.0015	<0.0010	0.0016	<0.0010
Magnesium (Mg)-Dissolved (mg/L)	9.80	15.7	6.09	21.5	15.7
Manganese (Mn)-Dissolved (mg/L)	0.0510	0.0442	0.00475	0.0179	0.0758

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2295065-6	L2295065-7	L2295065-8	L2295065-9	L2295065-10
Description	Water	Water	Water	Water	Water
Sampled Date	18-JUN-19	18-JUN-19	18-JUN-19	15-JUN-19	17-JUN-19
Sampled Time	07:45	08:25	09:50		
Client ID	W2	MC1	W3	DUP	DUP
Grouping / **Analyte**					
WATER					
Total Metals Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.00174	0.00196	0.00545	0.00235	0.00640
Nickel (Ni)-Total (mg/L)	0.00097	0.00108	0.00109	0.00096	0.00078
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	1.24	1.18	1.99	1.23	3.15
Selenium (Se)-Total (mg/L)	0.000142	0.000185	0.000255	0.000205	0.000332
Silicon (Si)-Total (mg/L)	5.33	5.56	6.18	5.24	5.71
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	9.17	9.16	17.0	9.67	13.7
Strontium (Sr)-Total (mg/L)	0.428	0.423	0.830	0.467	0.819
Sulfur (S)-Total (mg/L)	7.04	7.03	19.2	7.77	19.2
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00105	<0.0018 DLM	<0.00060 DLM	0.00127	<0.00030
Uranium (U)-Total (mg/L)	0.00181	0.00191	0.00315	0.00189	0.00242
Vanadium (V)-Total (mg/L)	0.00081	0.00105	0.00058	0.00093	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0059	0.0058	0.0026	0.0047	0.0019
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00045	0.00049	0.00029	0.00042	0.00041
Barium (Ba)-Dissolved (mg/L)	0.0633	0.0609	0.0638	0.0629	0.0717
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	0.025	<0.010	0.023
Cadmium (Cd)-Dissolved (mg/L)	0.0000073	0.0000082	0.0000052	<0.0000050	0.0000051
Calcium (Ca)-Dissolved (mg/L)	41.0	39.4	59.7	40.9	70.9
Chromium (Cr)-Dissolved (mg/L)	0.00016	0.00015	0.00011	0.00016	0.00014
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00191	0.00167	0.00274	0.00178	0.00702
Iron (Fe)-Dissolved (mg/L)	0.018	0.052	0.013	0.072	<0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0016	0.0015	0.0032	0.0016	0.0016
Magnesium (Mg)-Dissolved (mg/L)	13.9	14.1	28.5	16.3	22.3
Manganese (Mn)-Dissolved (mg/L)	0.00501	0.0151	0.0478	0.0432	0.0199

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2295065-1	L2295065-2	L2295065-3	L2295065-4	L2295065-5
Description	Water	Water	Water	Water	Water
Sampled Date	15-JUN-19	15-JUN-19	15-JUN-19	17-JUN-19	17-JUN-19
Sampled Time	09:20	10:05	10:50	08:10	10:30
Client ID	C4	W46	W6	W17	W15
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.000648	0.00248	0.000467	0.00653	0.00240
Nickel (Ni)-Dissolved (mg/L)	0.00157	0.00093	0.00145	0.00080	0.00102
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	0.76	1.39	0.33	3.49	2.16
Selenium (Se)-Dissolved (mg/L)	0.000056	0.000160	0.000074	0.000247	0.00126
Silicon (Si)-Dissolved (mg/L)	6.04	5.76	6.16	6.30	3.67
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	6.09	10.4	4.17	14.8	8.63
Strontium (Sr)-Dissolved (mg/L)	0.218	0.468	0.109	0.830	0.576
Sulfur (S)-Dissolved (mg/L)	3.51	8.90	0.89	21.0	27.5
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	0.00048	0.00034	0.00040	<0.00030	0.00081
Uranium (U)-Dissolved (mg/L)	0.000364	0.00197	0.000116	0.00245	0.00108
Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00074	0.00051	<0.00050	0.00054
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0048	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00035

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2295065-6	L2295065-7	L2295065-8	L2295065-9	L2295065-10
Description	Water	Water	Water	Water	Water
Sampled Date	18-JUN-19	18-JUN-19	18-JUN-19	15-JUN-19	17-JUN-19
Sampled Time	07:45	08:25	09:50		
Client ID	W2	MC1	W3	DUP	DUP
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00178	0.00207	0.00543	0.00251	0.00626
Nickel (Ni)-Dissolved (mg/L)	0.00083	0.00088	0.00097	0.00090	0.00084
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	1.35	1.26	2.19	1.39	3.54
Selenium (Se)-Dissolved (mg/L)	0.000137	0.000210	0.000242	0.000246	0.000323
Silicon (Si)-Dissolved (mg/L)	5.59	5.59	6.31	5.82	6.49
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	9.62	9.47	18.3	10.8	15.4
Strontium (Sr)-Dissolved (mg/L)	0.434	0.422	0.806	0.480	0.818
Sulfur (S)-Dissolved (mg/L)	7.91	7.49	20.4	8.96	21.9
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00044	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00181	0.00193	0.00306	0.00194	0.00241
Vanadium (V)-Dissolved (mg/L)	0.00057	0.00071	<0.00050	0.00072	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<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	Sodium (Na)-Dissolved	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2295065-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Total	MS-B	L2295065-1, -10, -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).
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.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

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.

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 CaCO3 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.

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

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2019-06-19 A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2295065-COFC

COC Number: 2019-06-19 A

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / D	
Select Report Format:	☑ PDF ☐ E
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232817 (WUL)
LSD:	
ALS Lab Work Order # (lab use only)	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

I E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM)filtered and preserved	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers
								P	F/P	P	F/P	P	F/P	
	C4	15-Jun-19	9:20	Water	R	R	R	R	R	R	R	R	R	7
	W46	15-Jun-19	10:05	Water	R	R	R	R	R	R	R	R	R	7
	W6	15-Jun-19	10:50	Water	R	R	R	R	R	R	R	R	R	7
	W17	17-Jun-19	8:10	Water	R	R	R	R	R	R	R	R	R	7
	W15	17-Jun-19	10:30	Water	R	R	R	R	R	R	R	R	R	7
	W2	18-Jun-19	7:45	Water	R	R	R	R	R	R	R	R	R	7
	MC1	18-Jun-19	8:25	Water	R	R	R	R	R	R	R	R	R	7
	W3	18-Jun-19	9:50	Water	R	R	R	R	R	R	R	R	R	7
	DUP	15-Jun-19		Water	R	R	R	R	R	R	R	R	R	7
	DUP	17-Jun-19		Water	R	R	R	R	R	R	R	R	R	7

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
5.4			6		

SHIPMENT RELEASE (client use)		
Released by: Chad Bustin	Date: 2019-06-19	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: CL	Date: June 19 2019	Time: 3:34 pm

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: HA	Date: 19/6/19	Time: 15:34

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1] If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 03-JUL-19
Report Date: 12-JUL-19 15:48 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2303254

Project P.O. #: 232817
Job Reference:
C of C Numbers: 2019-07-03 A
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2303254-1	L2303254-2	L2303254-3	L2303254-4	L2303254-5
Description	Water	Water	Water	Water	Water
Sampled Date	30-JUN-19	30-JUN-19	30-JUN-19	30-JUN-19	01-JUL-19
Sampled Time	11:15	13:10	13:50	14:35	13:10
Client ID	MN	W51	W7	AMP-1B	W17
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)	402	1980	287	514	527
Hardness (as CaCO3) (mg/L)	193	981	137	256	261
pH (pH)	8.10	8.27	8.34	8.41	8.45
Total Suspended Solids (mg/L)	<3.0	<3.0	10.4	31.0	4.4
TDS (Calculated) (mg/L)	287	1750	162	317	321
Anions and Nutrients Alkalinity, Bicarbonate (as CaCO3) (mg/L)	76.8	152	147	227	227
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	3.0	6.4	8.8
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3) (mg/L)	76.8	152	150	233	236
Ammonia, Total (as N) (mg/L)	0.0386	3.48	0.0197	0.0060	0.0081
Chloride (Cl) (mg/L)	1.17	17.5	0.53	7.39	7.64
Nitrate and Nitrite (as N) (mg/L)	14.1	10.3	0.186	0.0148	0.0429
Nitrate (as N) (mg/L)	14.0	7.23	0.186	0.0148	0.0429
Nitrite (as N) (mg/L)	0.0674	3.07	<0.0010	<0.0010	<0.0010
Sulfate (SO4) (mg/L)	77.9	1130	14.3	61.9	61.7
Anion Sum (meq/L)	4.20	27.8	3.32	6.15	6.22
Cation Sum (meq/L)	5.01	24.2	3.15	5.85	5.97
Cation - Anion Balance (%)	8.8	-7.0	-2.6	-2.5	-2.1
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)			5.79	8.27	9.74
Total Metals Aluminum (Al)-Total (mg/L)	0.357	<0.030 DLB	0.183	<0.012 DLB	<0.024 DLB
Antimony (Sb)-Total (mg/L)	0.00091	0.00035	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total (mg/L)	0.00055	0.00038	0.00045	0.00031	0.00041
Barium (Ba)-Total (mg/L)	0.0376	0.0480	0.0820	0.0772	0.0781
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	0.081	0.278	0.018	0.026	0.024
Cadmium (Cd)-Total (mg/L)	0.000117	<0.000080 DLM	0.0000067	<0.0000050	<0.000070 DLM
Calcium (Ca)-Total (mg/L)	65.1	298	40.2	69.2	68.8
Chromium (Cr)-Total (mg/L)	0.00031	<0.00010	0.00050	<0.00010	0.00012
Cobalt (Co)-Total (mg/L)	0.00025	0.00044	0.00019	<0.00010	<0.00010
Copper (Cu)-Total (mg/L)	0.0751	0.0297	0.00110	0.00357	0.00892
Iron (Fe)-Total (mg/L)	0.688	0.043	0.290	0.011	0.021
Lead (Pb)-Total (mg/L)	0.00125	<0.000050	0.000094	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	0.0056	0.0127	0.0014	0.0015	0.0017
Magnesium (Mg)-Total (mg/L)	9.61	52.0	12.9	20.5	22.1
Manganese (Mn)-Total (mg/L)	0.0351	0.327	0.0548	0.00306	0.119

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2303254-6	L2303254-7	L2303254-8		
	Description	Water	Water	Water		
	Sampled Date	02-JUL-19	02-JUL-19	02-JUL-19		
	Sampled Time	08:50	09:25			
	Client ID	MC1	W3	DUP		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	361	552	553		
	Hardness (as CaCO3) (mg/L)	174	274	266		
	pH (pH)	8.43	8.49	8.49		
	Total Suspended Solids (mg/L)	4.2	<3.0	<3.0		
	TDS (Calculated) (mg/L)	210	331	333		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	174	242	251		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.4	11.4	11.8		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	180	254	263		
	Ammonia, Total (as N) (mg/L)	0.0081	0.0072	0.0061		
	Chloride (Cl) (mg/L)	2.16	5.22	5.21		
	Nitrate and Nitrite (as N) (mg/L)	0.119	0.105	0.105		
	Nitrate (as N) (mg/L)	0.119	0.105	0.105		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010		
	Sulfate (SO4) (mg/L)	26.8	60.7	60.8		
	Anion Sum (meq/L)	4.22	6.49	6.68		
	Cation Sum (meq/L)	4.02	6.39	6.18		
	Cation - Anion Balance (%)	-2.4	-0.7	-3.9		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.24	6.27	5.96		
Total Metals	Aluminum (Al)-Total (mg/L)	0.139	<0.015 DLB	<0.012 DLB		
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Total (mg/L)	0.00054	0.00027	0.00028		
	Barium (Ba)-Total (mg/L)	0.0706	0.0649	0.0660		
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)	0.021	0.025	0.025		
	Cadmium (Cd)-Total (mg/L)	0.0000054	<0.0000050	<0.0000050		
	Calcium (Ca)-Total (mg/L)	50.4	58.4	60.1		
	Chromium (Cr)-Total (mg/L)	0.00050	0.00012	0.00013		
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Total (mg/L)	0.00174	0.00295	0.00284		
	Iron (Fe)-Total (mg/L)	0.177	0.022	0.017		
	Lead (Pb)-Total (mg/L)	0.000080	<0.000050	<0.000050		
	Lithium (Li)-Total (mg/L)	0.0019	0.0032	0.0032		
	Magnesium (Mg)-Total (mg/L)	16.8	29.0	29.9		
	Manganese (Mn)-Total (mg/L)	0.0146	0.0265	0.0262		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2303254-1	L2303254-2	L2303254-3	L2303254-4	L2303254-5
Description	Water	Water	Water	Water	Water
Sampled Date	30-JUN-19	30-JUN-19	30-JUN-19	30-JUN-19	01-JUL-19
Sampled Time	11:15	13:10	13:50	14:35	13:10
Client ID	MN	W51	W7	AMP-1B	W17
Grouping / **Analyte**					
WATER					
Total Metals Mercury (Hg)-Total (mg/L)	0.0000121	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.0239	0.0398	0.00161	0.00565	0.00671
Nickel (Ni)-Total (mg/L)	<0.00050	0.00319	0.00110	0.00084	0.00079
Phosphorus (P)-Total (mg/L)	0.124	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	4.53	20.3	1.18	2.66	3.80
Selenium (Se)-Total (mg/L)	0.0170	0.00331	0.000208	0.000130	0.000254
Silicon (Si)-Total (mg/L)	3.68	5.05	5.77	6.01	6.52
Silver (Ag)-Total (mg/L)	0.000011	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	23.0	74.6	8.26	15.1	15.0
Strontium (Sr)-Total (mg/L)	1.66	5.18	0.394	0.606	0.777
Sulfur (S)-Total (mg/L)	33.9	378	5.05	21.3	20.9
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	<0.021 DLM	<0.0015 DLM	0.00704	<0.00030	0.00108
Uranium (U)-Total (mg/L)	0.00109	0.00687	0.00197	0.00376	0.00258
Vanadium (V)-Total (mg/L)	0.00182	0.00059	0.00143	0.00054	0.00063
Zinc (Zn)-Total (mg/L)	0.0108	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0046	0.0038	0.0040	0.0021	0.0014
Antimony (Sb)-Dissolved (mg/L)	0.00047	0.00032	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00047	0.00045	0.00041	0.00029	0.00038
Barium (Ba)-Dissolved (mg/L)	0.0343	0.0536	0.0792	0.0793	0.0760
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.073	0.264	<0.010	0.022	0.022
Cadmium (Cd)-Dissolved (mg/L)	0.0000941	<0.000085 DLM	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved (mg/L)	62.0	301	34.1	69.8	69.2
Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00010	0.00015	<0.00010	0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00030	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.0206	0.0247	0.00080	0.00342	0.00718
Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.060	<0.010	<0.010
Lead (Pb)-Dissolved (mg/L)	0.000089	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0047	0.0124	0.0011	0.0013	0.0016
Magnesium (Mg)-Dissolved (mg/L)	9.30	55.8	12.7	19.8	21.4
Manganese (Mn)-Dissolved (mg/L)	0.0214	0.273	0.0490	0.00099	0.0138

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2303254-6	L2303254-7	L2303254-8		
	Description	Water	Water	Water		
	Sampled Date	02-JUL-19	02-JUL-19	02-JUL-19		
	Sampled Time	08:50	09:25			
	Client ID	MC1	W3	DUP		
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.00229	0.00577	0.00562		
	Nickel (Ni)-Total (mg/L)	0.00110	0.00093	0.00096		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	1.53	2.21	2.24		
	Selenium (Se)-Total (mg/L)	0.000146	0.000308	0.000279		
	Silicon (Si)-Total (mg/L)	6.13	6.36	6.29		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	11.1	18.0	18.0		
	Strontium (Sr)-Total (mg/L)	0.492	0.795	0.781		
	Sulfur (S)-Total (mg/L)	9.51	20.7	20.4		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	0.00453	<0.00060 DLM	0.00039		
	Uranium (U)-Total (mg/L)	0.00260	0.00338	0.00335		
	Vanadium (V)-Total (mg/L)	0.00121	0.00055	0.00055		
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0082	0.0022	0.0016		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00048	0.00027	0.00027		
	Barium (Ba)-Dissolved (mg/L)	0.0696	0.0693	0.0680		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	<0.010	0.023	0.023		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)	43.9	59.7	58.2		
	Chromium (Cr)-Dissolved (mg/L)	0.00016	0.00011	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00170	0.00286	0.00279		
	Iron (Fe)-Dissolved (mg/L)	0.037	<0.010	0.011		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0016	0.0031	0.0031		
	Magnesium (Mg)-Dissolved (mg/L)	15.7	30.3	29.2		
	Manganese (Mn)-Dissolved (mg/L)	0.00486	0.0247	0.0323		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2303254-1	L2303254-2	L2303254-3	L2303254-4	L2303254-5
Description	Water	Water	Water	Water	Water
Sampled Date	30-JUN-19	30-JUN-19	30-JUN-19	30-JUN-19	01-JUL-19
Sampled Time	11:15	13:10	13:50	14:35	13:10
Client ID	MN	W51	W7	AMP-1B	W17
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.0219	0.0367	0.00147	0.00489	0.00630
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00332	0.00062	0.00080	0.00063
Phosphorus (P)-Dissolved (mg/L)	0.062	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	4.75	24.7	1.20	2.77	3.88
Selenium (Se)-Dissolved (mg/L)	0.0178	0.00342	0.000240	0.000210	0.000367 DTSE
Silicon (Si)-Dissolved (mg/L)	2.96	4.75	5.42	5.92	6.32
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	23.5	84.6	8.41	15.3	15.0
Strontium (Sr)-Dissolved (mg/L)	1.55	4.71	0.353	0.578	0.766
Sulfur (S)-Dissolved (mg/L)	33.7	362	4.66	20.4	19.9
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.000996	0.00661	0.00186	0.00348	0.00253
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00080	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0067	0.0019	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2303254-6	L2303254-7	L2303254-8		
	Description	Water	Water	Water		
	Sampled Date	02-JUL-19	02-JUL-19	02-JUL-19		
	Sampled Time	08:50	09:25			
	Client ID	MC1	W3	DUP		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	0.0000051	0.0000088		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00212	0.00525	0.00527		
	Nickel (Ni)-Dissolved (mg/L)	0.00070	0.00082	0.00076		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.57	2.41	2.38		
	Selenium (Se)-Dissolved (mg/L)	0.000159	0.000308	0.000248		
	Silicon (Si)-Dissolved (mg/L)	5.88	6.20	6.27		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	11.5	19.7	18.7		
	Strontium (Sr)-Dissolved (mg/L)	0.444	0.757	0.752		
	Sulfur (S)-Dissolved (mg/L)	8.75	20.1	19.2		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	0.00072	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00241	0.00327	0.00314		
	Vanadium (V)-Dissolved (mg/L)	0.00078	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<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)
Method Blank	Calcium (Ca)-Total	B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Method Blank	Magnesium (Mg)-Total	B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Method Blank	Manganese (Mn)-Total	B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Method Blank	Strontium (Sr)-Total	B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Method Blank	Aluminum (Al)-Total	MB-LOR	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2303254-3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Aluminum (Al)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Uranium (U)-Total	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Nitrate (as N)	MS-B	L2303254-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTSE	Dissolved Se concentration exceeds total. Positive bias on D-Se suspected due to signal enhancement from volatile selenium species. Contact ALS if an alternative test to address this interference is needed.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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.

ANIONS-N+N-CALC-WR	Water	Nitrite & Nitrate Nitrogen	EPA 300.1

Nitrate and Nitrite Nitrogen is determined by calculation from the individual Nitrate and Nitrite Nitrogen analyses by Ion Chromatography with UV absorbance.

BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B

Reference Information

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-WR 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.

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 CaCO3 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.

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-WR 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-WR 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-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

Reference Information

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-07-03 A

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2303254-COFC

COC Number: 2019-07-03 A

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax mintoenvironment@mintomine.com
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax ap@mintomine.com
Email 2

Project Information

ALS Account # / Quote #:
Job #:
PO / AFE: 232817 (WUL)
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#
Major/Minor Code: Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only)

ALS Contact: Shane Stack Sampler: CR/IS

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM) (filtered and preserved)	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)					Number of Containers
								P	F/P	P	F/P	P	F/P					
	MN	30-Jun-19	11:15	Water	R	R	R	R	R	R	R	R						6
	W51	30-Jun-19	13:10	Water	R	R	R	R	R	R	R	R						6
	W7	30-Jun-19	13:50	Water	R	R	R	R	R	R	R	R	R					7
	AMP-1B	30-Jun-19	14:35	Water	R	R	R	R	R	R	R	R	R					7
	W17	1-Jul-19	13:10	Water	R	R	R	R	R	R	R	R	R					7
	MC1	2-Jul-19	8:50	Water	R	R	R	R	R	R	R	R	R					7
	W3	2-Jul-19	9:25	Water	R	R	R	R	R	R	R	R	R					7
	DUP	2-Jul-19		Water	R	R	R	R	R	R	R	R	R					7

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
		9.0			8

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-07-03	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: TT	Date: July 3, 2019	Time: 2:40

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: NM	Date: 7/4	Time: 1214 P

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 25-SEP-19
Report Date: 08-OCT-19 17:40 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2354299

Project P.O. #: 232817
Job Reference:
C of C Numbers: 2019-09-25 A 1 of 2, 2019-09-25 A 2 of 2
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2354299-1 Water 19-SEP-19 11:30 MN	L2354299-2 Water 20-SEP-19 14:30 C4	L2354299-3 Water 20-SEP-19 15:00 W46	L2354299-4 Water 20-SEP-19 15:50 W6	L2354299-5 Water 21-SEP-19 09:50 MN-0.2
WATER						
Physical Tests	Conductivity (uS/cm)	500	320	383	238	105
	Hardness (as CaCO3) (mg/L)	192	159	187	120	49.4
	pH (pH)	8.19	8.40	8.46	8.32	7.79
	Total Suspended Solids (mg/L)	4.1	3.5	<3.0	<3.0	4.1
	TDS (Calculated) (mg/L)	324	180	223	132	56.7
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	89.6	166	183	127	43.2
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	7.6	12.4	6.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	89.6	174	195	133	43.2
	Ammonia, Total (as N) (mg/L)	0.0204	0.0057	0.0057	0.0053	0.0061
	Chloride (Cl) (mg/L)	1.34	1.07	2.34	1.19	0.31
	Nitrate and Nitrite (as N) (mg/L)	16.8	<0.0051	0.0311	<0.0051	<0.0051
	Nitrate (as N) (mg/L)	16.8	<0.0050	0.0311	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.0199	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	96.8	10.6	27.2	2.43	8.67
	Anion Sum (meq/L)	5.05	3.72	4.54	2.75	1.05
	Cation Sum (meq/L)	4.92	3.56	4.28	2.66	1.20
	Cation - Anion Balance (%)	-1.3	-2.2	-2.9	-1.6	6.6
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		10.5	6.26	10.2	15.1
Total Metals	Aluminum (Al)-Total (mg/L)	0.0193	0.0275	0.0159	0.0097	0.0497
	Antimony (Sb)-Total (mg/L)	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00049	0.00073	0.00040	0.00054	0.00061
	Barium (Ba)-Total (mg/L)	0.0285	0.0631	0.0674	0.0482	0.0346
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.073	<0.010	0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000433	0.0000145	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	65.8	43.3	45.0	33.1	12.8
	Chromium (Cr)-Total (mg/L)	<0.00040 DLB	0.00041	0.00028	0.00035	0.00056
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00024	<0.00010	<0.00010	0.00034
	Copper (Cu)-Total (mg/L)	0.0183	0.00153	0.00157	0.00129	0.00357
	Iron (Fe)-Total (mg/L)	0.025	0.456	0.157	0.079	0.781
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0046	0.0010	0.0015	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	9.71	14.0	18.3	9.26	4.20
	Manganese (Mn)-Total (mg/L)	0.00981	0.139	0.0391	0.0240	0.0672

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2354299-6 Water 21-SEP-19 11:00 MN-1.5	L2354299-7 Water 21-SEP-19 14:50 MN-0.5	L2354299-8 Water 21-SEP-19 15:30 MN-2.5	L2354299-9 Water 24-SEP-19 09:00 MC1	L2354299-10 Water 24-SEP-19 10:05 W3
WATER						
Physical Tests	Conductivity (uS/cm)	124	260	212	373	575
	Hardness (as CaCO3) (mg/L)	62.0	123	105	184	291
	pH (pH)	7.99	8.35	8.27	8.48	8.54
	Total Suspended Solids (mg/L)	9.3	<3.0	3.1	<3.0	<3.0
	TDS (Calculated) (mg/L)	66.3	145	117	215	346
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	64.2	122	115	178	254
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	6.2	<1.0	13.2	21.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	64.2	129	115	191	275
	Ammonia, Total (as N) (mg/L)	0.0115	<0.0050	<0.0050	<0.0050	0.0061
	Chloride (Cl) (mg/L)	0.28	0.45	0.92	1.73	5.19
	Nitrate and Nitrite (as N) (mg/L)	0.0126	0.0215	0.0081	0.0257	0.0788
	Nitrate (as N) (mg/L)	0.0126	0.0215	0.0081	0.0257	0.0788
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	1.90	15.9	4.20	23.1	56.7
	Anion Sum (meq/L)	1.33	2.91	2.41	4.35	6.83
	Cation Sum (meq/L)	1.41	2.81	2.35	4.21	6.75
	Cation - Anion Balance (%)	3.0	-1.8	-1.3	-1.6	-0.6
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	11.5	5.96 HTP	9.42	6.65	6.08
Total Metals	Aluminum (Al)-Total (mg/L)	0.0396	0.0120	0.0447	0.0355	0.0034
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00011	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00054	0.00032	0.00038	0.00058	0.00028
	Barium (Ba)-Total (mg/L)	0.0379	0.0506	0.0403	0.0557	0.0573
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	0.023
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000063
	Calcium (Ca)-Total (mg/L)	17.4	34.5	29.5	46.5	62.1
	Chromium (Cr)-Total (mg/L)	0.00056	0.00024	0.00030	0.00026	0.00014
	Cobalt (Co)-Total (mg/L)	0.00034	<0.00010	0.00011	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00357	0.00078	0.00127	0.00148	0.00240
	Iron (Fe)-Total (mg/L)	1.10	0.025	0.126	0.117	0.013
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	0.0010	0.0010	0.0017	0.0032
	Magnesium (Mg)-Total (mg/L)	4.87	9.12	8.35	16.6	31.2
	Manganese (Mn)-Total (mg/L)	0.0535	0.00166	0.0304	0.0132	0.0367

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2354299-11 Water 24-SEP-19 10:30 W17	L2354299-12 Water 24-SEP-19 13:50 W7	L2354299-13 Water 20-SEP-19 DUP	L2354299-14 Water 21-SEP-19 DUP	L2354299-15 Water 24-SEP-19 DUP
WATER						
Physical Tests	Conductivity (uS/cm)	538	306	382	105	566
	Hardness (as CaCO3) (mg/L)	267	148	188	49.8	282
	pH (pH)	8.50	8.42	8.46	7.81	8.55
	Total Suspended Solids (mg/L)	3.5	3.1	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	325	172	235	56.8	341
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	235	154	201	43.2	249
	Alkalinity, Carbonate (as CaCO3) (mg/L)	17.4	9.2	12.2	<1.0	22.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	252	163	214	43.2	272
	Ammonia, Total (as N) (mg/L)	0.0201	0.0142	0.0057	0.0078	0.0069
	Chloride (Cl) (mg/L)	7.60	0.43	2.34	0.33	5.19
	Nitrate and Nitrite (as N) (mg/L)	0.0093	0.0867	0.0248	<0.0051	0.0781
	Nitrate (as N) (mg/L)	0.0093	0.0867	0.0248	<0.0050	0.0781
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	53.9	12.5	27.2	8.63	56.7
	Anion Sum (meq/L)	6.37	3.53	4.90	1.05	6.76
	Cation Sum (meq/L)	6.14	3.41	4.34	1.20	6.59
	Cation - Anion Balance (%)	-1.9	-1.8	-6.1	6.6	-1.3
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.51	5.42	6.37	14.9	6.09
Total Metals	Aluminum (Al)-Total (mg/L)	0.0090	0.0139	0.0403	0.0818	0.0087
	Antimony (Sb)-Total (mg/L)	0.00021	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00057	0.00040	0.00049	0.00067	0.00027
	Barium (Ba)-Total (mg/L)	0.0692	0.0684	0.0633	0.0341	0.0583
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.021	<0.010	<0.010	<0.010	0.024
	Cadmium (Cd)-Total (mg/L)	0.0000084	<0.0000050	<0.0000050	0.0000063	0.0000052
	Calcium (Ca)-Total (mg/L)	71.9	37.5	44.3	13.3	64.1
	Chromium (Cr)-Total (mg/L)	0.00019	0.00023	0.00025	0.00058	0.00016
	Cobalt (Co)-Total (mg/L)	0.00017	<0.00010	<0.00010	0.00037	<0.00010
	Copper (Cu)-Total (mg/L)	0.0115	0.00074	0.00160	0.0111	0.00271
	Iron (Fe)-Total (mg/L)	0.212	0.087	0.164	0.868	0.016
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0015	0.0012	0.0016	<0.0010	0.0033
	Magnesium (Mg)-Total (mg/L)	22.3	14.0	17.6	4.19	31.3
	Manganese (Mn)-Total (mg/L)	0.248	0.0306	0.0404	0.0686	0.0377

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2354299-1	L2354299-2	L2354299-3	L2354299-4	L2354299-5
Description	Water	Water	Water	Water	Water
Sampled Date	19-SEP-19	20-SEP-19	20-SEP-19	20-SEP-19	21-SEP-19
Sampled Time	11:30	14:30	15:00	15:50	09:50
Client ID	MN	C4	W46	W6	MN-0.2
Grouping / **Analyte**					
WATER					
Total Metals Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.0229	0.000503	0.00220	0.000568	0.000276
Nickel (Ni)-Total (mg/L)	<0.00050	0.00114	0.00058	0.00109	0.00108
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	4.46	1.35	1.47	0.56	0.26
Selenium (Se)-Total (mg/L)	0.0166	0.000098	0.000185	0.000106	0.000068
Silicon (Si)-Total (mg/L)	2.99	6.03	6.21	7.49	6.33
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	21.9	7.38	11.3	5.25	3.76
Strontium (Sr)-Total (mg/L)	1.65	0.286	0.512	0.157	0.0820
Sulfur (S)-Total (mg/L)	32.9	3.72	9.34	1.07	2.90
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00124	0.00139	0.00080	0.00047	0.00155
Uranium (U)-Total (mg/L)	0.000890	0.000422	0.00158	0.000261	0.000018
Vanadium (V)-Total (mg/L)	0.00072	<0.00050	0.00071	0.00052	0.00069
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	0.00043	<0.00030	<0.00030	0.00049
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0054	0.0042	0.0034	0.0047	0.0404
Antimony (Sb)-Dissolved (mg/L)	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00048	0.00070	0.00039	0.00052	0.00053
Barium (Ba)-Dissolved (mg/L)	0.0286	0.0621	0.0699	0.0520	0.0362
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.071	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	0.0000386	0.0000055	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved (mg/L)	62.2	41.9	45.3	32.8	12.6
Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00023	0.00016	0.00020	0.00040
Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00020	<0.00010	<0.00010	0.00032
Copper (Cu)-Dissolved (mg/L)	0.0132	0.00091	0.00151	0.00115	0.00165
Iron (Fe)-Dissolved (mg/L)	<0.010	0.265	0.103	0.067	0.504
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0047	0.0011	0.0016	<0.0010	<0.0010
Magnesium (Mg)-Dissolved (mg/L)	8.90	13.2	17.8	9.25	4.34
Manganese (Mn)-Dissolved (mg/L)	0.00303	0.125	0.0347	0.0237	0.0674

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2354299-6 Water 21-SEP-19 11:00 MN-1.5	L2354299-7 Water 21-SEP-19 14:50 MN-0.5	L2354299-8 Water 21-SEP-19 15:30 MN-2.5	L2354299-9 Water 24-SEP-19 09:00 MC1	L2354299-10 Water 24-SEP-19 10:05 W3
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.000433	0.00161	0.000706	0.00187	0.00555
	Nickel (Ni)-Total (mg/L)	0.00075	<0.00050	0.00096	0.00079	0.00091
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.22	0.93	0.90	1.42	2.39
	Selenium (Se)-Total (mg/L)	0.000090	0.000222	0.000059	0.000143	0.000274
	Silicon (Si)-Total (mg/L)	6.37	5.55	6.07	6.32	6.50
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	3.50	6.94	4.74	10.8	19.3
	Strontium (Sr)-Total (mg/L)	0.0842	0.288	0.141	0.491	0.817
	Sulfur (S)-Total (mg/L)	0.87	5.62	1.51	7.64	20.1
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00150	0.00061	0.00289	0.00160	<0.00030
	Uranium (U)-Total (mg/L)	0.000032	0.000762	0.000230	0.00206	0.00324
	Vanadium (V)-Total (mg/L)	0.00080	0.00061	<0.00050	0.00074	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.00086	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0253	0.0032	0.0053	0.0036	0.0016
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00040	0.00033	0.00030	0.00054	0.00024
	Barium (Ba)-Dissolved (mg/L)	0.0361	0.0521	0.0441	0.0633	0.0659
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	0.024
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	16.5	34.1	28.4	45.3	64.2
	Chromium (Cr)-Dissolved (mg/L)	0.00038	0.00012	0.00016	<0.00080 DLB	0.00015
	Cobalt (Co)-Dissolved (mg/L)	0.00026	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00308	0.00081	0.00124	0.00132	0.00242
	Iron (Fe)-Dissolved (mg/L)	0.283	0.013	0.043	0.056	0.016
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0010	<0.0010	0.0016	0.0031
	Magnesium (Mg)-Dissolved (mg/L)	5.06	9.25	8.34	17.2	31.8
	Manganese (Mn)-Dissolved (mg/L)	0.0350	0.00087	0.0205	0.0102	0.0383

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2354299-11	L2354299-12	L2354299-13	L2354299-14	L2354299-15
Description	Water	Water	Water	Water	Water
Sampled Date	24-SEP-19	24-SEP-19	20-SEP-19	21-SEP-19	24-SEP-19
Sampled Time	10:30	13:50			
Client ID	W17	W7	DUP	DUP	DUP
Grouping / **Analyte**					
WATER					
Total Metals Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.00577	0.00161	0.00212	0.000247	0.00563
Nickel (Ni)-Total (mg/L)	0.00108	0.00067	0.00079	0.00112	0.00095
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	3.61	1.20	1.46	0.28	2.39
Selenium (Se)-Total (mg/L)	0.000269	0.000141	0.000137	0.000072	0.000280
Silicon (Si)-Total (mg/L)	6.19	5.74	6.16	5.97	6.41
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	15.2	8.51	11.3	3.72	19.2
Strontium (Sr)-Total (mg/L)	0.751	0.428	0.499	0.0771	0.841
Sulfur (S)-Total (mg/L)	18.3	4.49	9.25	2.75	20.9
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	0.00049	<0.00060 DLM	<0.0030 DLM	0.00361	0.00031
Uranium (U)-Total (mg/L)	0.00251	0.00167	0.00178	0.000021	0.00320
Vanadium (V)-Total (mg/L)	0.00050	0.00060	0.00067	0.00067	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	0.0049
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00043	0.00084
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0023	0.0036	0.0044	0.0422	0.0019
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00058	0.00038	0.00043	0.00049	0.00023
Barium (Ba)-Dissolved (mg/L)	0.0796	0.0811	0.0729	0.0352	0.0691
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.021	<0.010	<0.010	<0.010	0.024
Cadmium (Cd)-Dissolved (mg/L)	0.0000075	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved (mg/L)	70.2	35.9	44.6	13.0	61.2
Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00015	0.00011	0.00041	<0.00010
Cobalt (Co)-Dissolved (mg/L)	0.00017	<0.00010	<0.00010	0.00032	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00920	0.00098	0.00165	0.00136	0.00241
Iron (Fe)-Dissolved (mg/L)	0.194	0.073	0.103	0.490	0.014
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0015	0.0011	0.0015	<0.0010	0.0031
Magnesium (Mg)-Dissolved (mg/L)	22.3	14.3	18.6	4.19	31.3
Manganese (Mn)-Dissolved (mg/L)	0.247	0.0330	0.0376	0.0616	0.0389

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2354299-1 Water 19-SEP-19 11:30 MN	L2354299-2 Water 20-SEP-19 14:30 C4	L2354299-3 Water 20-SEP-19 15:00 W46	L2354299-4 Water 20-SEP-19 15:50 W6	L2354299-5 Water 21-SEP-19 09:50 MN-0.2
Sample ID / **Description** / **Sampled Date** / **Sampled Time** / **Client ID**						
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0223	0.000506	0.00209	0.000542	0.000254
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00136	0.00094	0.00150	0.00134
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	4.57	1.35	1.54	0.58	0.25
	Selenium (Se)-Dissolved (mg/L)	0.0170	0.000065	0.000179	0.000076	<0.000050
	Silicon (Si)-Dissolved (mg/L)	2.98	6.15	6.35	7.77	6.15
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	22.0	7.49	11.6	5.69	3.96
	Strontium (Sr)-Dissolved (mg/L)	1.61	0.269	0.488	0.153	0.0748
	Sulfur (S)-Dissolved (mg/L)	32.1	3.78	9.37	0.80	2.74
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00031	<0.00030	<0.00030	0.00113
	Uranium (U)-Dissolved (mg/L)	0.00102	0.000480	0.00174	0.000277	0.000017
	Vanadium (V)-Dissolved (mg/L)	0.00056	<0.00050	0.00054	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0059	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00045

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2354299-6	L2354299-7	L2354299-8	L2354299-9	L2354299-10
	Description	Water	Water	Water	Water	Water
	Sampled Date	21-SEP-19	21-SEP-19	21-SEP-19	24-SEP-19	24-SEP-19
	Sampled Time	11:00	14:50	15:30	09:00	10:05
	Client ID	MN-1.5	MN-0.5	MN-2.5	MC1	W3
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000382	0.00145	0.000711	0.00187	0.00541
	Nickel (Ni)-Dissolved (mg/L)	0.00107	0.00070	0.00114	0.00084	0.00117
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.19	0.98	0.93	1.47	2.52
	Selenium (Se)-Dissolved (mg/L)	0.000075	0.000227	0.000070	0.000119	0.000327
	Silicon (Si)-Dissolved (mg/L)	6.41	5.59	6.24	6.22	6.52
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	3.47	7.29	5.04	11.4	19.9
	Strontium (Sr)-Dissolved (mg/L)	0.0786	0.262	0.137	0.477	0.789
	Sulfur (S)-Dissolved (mg/L)	0.70	5.31	1.36	7.69	19.8
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00068	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)-Dissolved (mg/L)	0.000032	0.000825	0.000215	0.00198	0.00300
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00062	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	0.00040	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2354299-11	L2354299-12	L2354299-13	L2354299-14	L2354299-15
Description	Water	Water	Water	Water	Water
Sampled Date	24-SEP-19	24-SEP-19	20-SEP-19	21-SEP-19	24-SEP-19
Sampled Time	10:30	13:50			
Client ID	W17	W7	DUP	DUP	DUP
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00559	0.00160	0.00213	0.000267	0.00549
Nickel (Ni)-Dissolved (mg/L)	0.00118	0.00085	0.00094	0.00129	0.00120
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	3.79	1.28	1.61	0.25	2.57
Selenium (Se)-Dissolved (mg/L)	0.000302	0.000183	0.000166	0.000064	0.000322
Silicon (Si)-Dissolved (mg/L)	6.46	6.11	6.30	6.39	6.40
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	15.8	9.29	12.3	3.83	20.5
Strontium (Sr)-Dissolved (mg/L)	0.725	0.405	0.496	0.0755	0.805
Sulfur (S)-Dissolved (mg/L)	18.5	4.54	9.45	3.00	19.6
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00119	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00248	0.00166	0.00170	0.000019	0.00304
Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00059	0.00059	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0013
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00068	<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)
Method Blank	Chromium (Cr)-Dissolved	MB-LOR	L2354299-9
Method Blank	Chromium (Cr)-Total	MB-LOR	L2354299-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2354299-10, -11, -12, -15, -2, -3, -4, -5, -6, -8
Matrix Spike	Dissolved Organic Carbon	MS-B	L2354299-7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2354299-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2354299-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2354299-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2354299-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2354299-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2354299-1, -10, -11, -12, -13, -14, -15, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Antimony (Sb)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Arsenic (As)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Arsenic (As)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Total	MS-B	L2354299-10, -11, -12, -13, -14, -15, -8, -9
Matrix Spike	Boron (B)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2354299-10, -11, -12, -13, -14, -15, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Cobalt (Co)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Copper (Cu)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2354299-10, -11, -12, -13, -14, -15, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Total	MS-B	L2354299-10, -11, -12, -13, -14, -15, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Potassium (K)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2354299-10, -11, -12, -13, -14, -15, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2354299-10, -11, -12, -13, -14, -15, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Sulfur (S)-Total	MS-B	L2354299-2, -3, -4, -5, -6, -7
Matrix Spike	Uranium (U)-Total	MS-B	L2354299-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfate (SO4)	MS-B	L2354299-1, -10, -11, -12, -13, -15, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTP	Sample preparation or preservation hold time was exceeded.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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

Reference Information

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.

ANIONS-N+N-CALC-VA Water Nitrite & Nitrate in Water (Calculation) EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BE-D-L-CCMS-VA Water Diss. Be (low) 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.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

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-L-IC-N-WR Water Chloride in Water by IC (Low Level) 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.

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 CaCO3 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.

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-WR 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.

Reference Information

NO3-L-IC-N-WR	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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

2019-09-25 A 1 of 2 2019-09-25 A 2 of 2

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2354299-COFC

COC Number: 2019-09-25 A

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	232817 (WUL)
LSD:	
ALS Lab Work Order # (lab use only)	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Shane Stack	Sampler: CR/CB

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM)(filtered and preserve	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)					Number of Containers
								P	F/P	P	F/P	P	F/P					
	W17	24-Sep-19	10:30	Water	R	R	R	R	R	R	R	R	R					7
	W7	24-Sep-19	13:50	Water	R	R	R	R	R	R	R	R	R					7
	DUP	20-Sep-19		Water	R	R	R	R	R	R	R	R	R					7
	DUP	21-Sep-19		Water	R	R	R	R	R	R	R	R	R					7
	DUP	24-Sep-19		Water	R	R	R	R	R	R	R	R	R					7

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☑ NO

Are samples for human drinking water use?

☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			7°C		

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-09-25	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: JG	Date: 26Sep19	Time: 11:30 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2354299-COFC

COC Number: 2019-09-25 A

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4] ☐		1 Business day [E1] ☐
	3 day [P3] ☐		Same Day, Weekend or Statutory holiday [E0] ☐
	2 day [P2] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:	232817 (WUL)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact: Shane Stack	Sampler: CR/CB

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM)(filtered and preserved	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers
						P	F/P	P	F/P	P	F/P			
	MN	19-Sep-19	11:30	Water	R	R	R	R	R	R	R	R	[redacted]	6
	C4	20-Sep-19	14:30	Water	R	R	R	R	R	R	R	R	R	7
	W46	20-Sep-19	15:00	Water	R	R	R	R	R	R	R	R	R	7
	W6	20-Sep-19	15:50	Water	R	R	R	R	R	R	R	R	R	7
	MN-0.2	21-Sep-19	9:50	Water	R	R	R	R	R	R	R	R	R	7
	MN-1.5	21-Sep-19	11:00	Water	R	R	R	R	R	R	R	R	R	7
	MN-0.5	21-Sep-19	14:50	Water	R	R	R	R	R	R	R	R	R	7
	MN-2.5	21-Sep-19	15:30	Water	R	R	R	R	R	R	R	R	R	7
	MC1	24-Sep-19	9:00	Water	R	R	R	R	R	R	R	R	R	7
	W3	24-Sep-19	10:05	Water	R	R	R	R	R	R	R	R	R	7

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
8.9	7.8		7		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-09-25	Time:	Received by:	Date: Sept 25	Time: 3:20 PM	Received by: JG	Date: 26 Sep 19	Time: 11:30 AM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 06-NOV-19
Report Date: 20-NOV-19 14:46 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2378301

Project P.O. #: 232817 (WUL)
Job Reference:
C of C Numbers: 2109-11-05 A
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2378301-1 Water 04-NOV-19 07:20 W50	L2378301-2 Water 04-NOV-19 07:40 W17	L2378301-3 Water 04-NOV-19 10:45 W46	L2378301-4 Water 05-NOV-19 07:55 W3	L2378301-5 Water 05-NOV-19 08:40 W7
WATER						
Physical Tests	Conductivity (uS/cm)	514	480	418	520	310
	Hardness (as CaCO3) (mg/L)	295	277	228	294	169
	pH (pH)	7.82	8.35	8.14	8.20	8.06
	Total Suspended Solids (mg/L)	4.4	<3.0	<3.0	<3.0	64.2
	TDS (Calculated) (mg/L)	341	323	276	349	207
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	284	235	234	278	203
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	8.6	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	284	244	234	278	203
	Ammonia, Total (as N) (mg/L)	0.282	0.0130	0.0157	0.0111	0.0504
	Chloride (Cl) (mg/L)	7.48	7.84	3.44	5.19	0.55
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0072	0.105	0.101	0.144
	Nitrate (as N) (mg/L)	<0.0050	0.0061	0.102	0.101	0.144
	Nitrite (as N) (mg/L)	0.0024	0.0011	0.0028	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	40.3	54.1	39.0	57.0	15.3
	Anion Sum (meq/L)	6.72	6.22	5.60	6.90	4.41
	Cation Sum (meq/L)	6.85	6.33	5.24	6.84	3.83
	Cation - Anion Balance (%)	0.9	0.9	-3.3	-0.4	-7.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	14.8	10.5	5.44	5.64	5.36
Total Metals	Aluminum (Al)-Total (mg/L)	0.0414	0.0089	0.0165	0.0182	0.776
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00050	0.00039	0.00037	0.00026	0.00113
	Barium (Ba)-Total (mg/L)	0.146	0.0664	0.0878	0.0704	0.113
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	0.000033
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.018	0.021	0.013	0.026	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000500	0.0000145	0.0000290	0.0000244	0.0000405
	Calcium (Ca)-Total (mg/L)	74.7	73.7	57.4	68.1	44.9
	Chromium (Cr)-Total (mg/L)	0.00061	0.00011	0.00018	0.00017	0.00161
	Cobalt (Co)-Total (mg/L)	0.00186	<0.00010	<0.00010	<0.00010	0.00062
	Copper (Cu)-Total (mg/L)	0.0155	0.0132	0.00444	0.00288	0.00707
	Iron (Fe)-Total (mg/L)	0.135	0.056	0.135	0.037	1.69
	Lead (Pb)-Total (mg/L)	0.000249	<0.000050	<0.000050	<0.000050	0.000272
	Lithium (Li)-Total (mg/L)	0.0016	0.0018	0.0021	0.0037	0.0019
	Magnesium (Mg)-Total (mg/L)	27.8	23.2	22.6	33.5	16.0
	Manganese (Mn)-Total (mg/L)	4.07	0.0473	0.0579	0.0438	0.147

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2378301-6	L2378301-7			
Description	Water	Water			
Sampled Date	04-NOV-19	05-NOV-19			
Sampled Time					
Client ID	DUP	DUP			
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)	426	529			
Hardness (as CaCO3) (mg/L)	228	287			
pH (pH)	8.17	8.22			
Total Suspended Solids (mg/L)	<3.0	<3.0			
TDS (Calculated) (mg/L)	265	342			
Anions and Nutrients Alkalinity, Bicarbonate (as CaCO3) (mg/L)	219	272			
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
Alkalinity, Total (as CaCO3) (mg/L)	219	272			
Ammonia, Total (as N) (mg/L)	0.0163	0.0123			
Chloride (Cl) (mg/L)	3.33	5.20			
Nitrate and Nitrite (as N) (mg/L)	0.0975	0.116			
Nitrate (as N) (mg/L)	0.0954	0.116			
Nitrite (as N) (mg/L)	0.0021	<0.0010			
Sulfate (SO4) (mg/L)	37.5	57.5			
Anion Sum (meq/L)	5.26	6.79			
Cation Sum (meq/L)	5.23	6.67			
Cation - Anion Balance (%)	-0.3	-0.9			
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	5.45	5.56			
Total Metals Aluminum (Al)-Total (mg/L)	0.0087	0.0174			
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
Arsenic (As)-Total (mg/L)	0.00035	0.00025			
Barium (Ba)-Total (mg/L)	0.0887	0.0674			
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020			
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			
Boron (B)-Total (mg/L)	0.013	0.026			
Cadmium (Cd)-Total (mg/L)	0.0000322	0.0000078			
Calcium (Ca)-Total (mg/L)	56.6	67.2			
Chromium (Cr)-Total (mg/L)	0.00015	0.00013			
Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010			
Copper (Cu)-Total (mg/L)	0.00349	0.00252			
Iron (Fe)-Total (mg/L)	0.126	0.032			
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050			
Lithium (Li)-Total (mg/L)	0.0021	0.0037			
Magnesium (Mg)-Total (mg/L)	22.9	31.5			
Manganese (Mn)-Total (mg/L)	0.0570	0.0395			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2378301-1	L2378301-2	L2378301-3	L2378301-4	L2378301-5
Description	Water	Water	Water	Water	Water
Sampled Date	04-NOV-19	04-NOV-19	04-NOV-19	05-NOV-19	05-NOV-19
Sampled Time	07:20	07:40	10:45	07:55	08:40
Client ID	W50	W17	W46	W3	W7
Grouping / **Analyte**					
WATER					
Total Metals Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.00598	0.00603	0.00221	0.00542	0.00123
Nickel (Ni)-Total (mg/L)	0.00913	0.00096	0.00080	0.00109	0.00207
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	0.101
Potassium (K)-Total (mg/L)	2.60	3.65	1.79	2.54	1.51
Selenium (Se)-Total (mg/L)	0.000182	0.000301	0.000225	0.000318	0.000227
Silicon (Si)-Total (mg/L)	7.29	6.25	6.32	6.75	7.66
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	16.4	15.7	15.0	21.7	10.1
Strontium (Sr)-Total (mg/L)	0.668	0.799	0.638	0.861	0.472
Sulfur (S)-Total (mg/L)	14.5	18.7	13.2	20.7	5.68
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	<0.0018 DLM	0.00043	0.00114	0.00123	0.0319
Uranium (U)-Total (mg/L)	0.00168	0.00266	0.00217	0.00313	0.00151
Vanadium (V)-Total (mg/L)	0.00095	0.00057	0.00079	0.00061	0.00313
Zinc (Zn)-Total (mg/L)	0.0106	<0.0030	<0.0030	<0.0030	0.0048
Zirconium (Zr)-Total (mg/L)	0.00033	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0127	0.0019	0.0049	0.0015	0.0048
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved (mg/L)	0.00047	0.00038	0.00035	0.00024	0.00057
Barium (Ba)-Dissolved (mg/L)	0.132	0.0654	0.0809	0.0645	0.0879
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	0.017	0.020	0.012	0.025	<0.010
Cadmium (Cd)-Dissolved (mg/L)	0.000239	<0.000010 DLM	0.0000238	0.0000238	0.0000318
Calcium (Ca)-Dissolved (mg/L)	69.6	69.5	51.4	61.8	40.7
Chromium (Cr)-Dissolved (mg/L)	0.00037	0.00012	0.00014	0.00012	0.00017
Cobalt (Co)-Dissolved (mg/L)	0.00182	<0.00010	<0.00010	<0.00010	0.00013
Copper (Cu)-Dissolved (mg/L)	0.00253	0.0109	0.00188	0.00226	0.00154
Iron (Fe)-Dissolved (mg/L)	0.053	0.044	0.117	<0.010	0.210
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0015	0.0016	0.0018	0.0034	0.0013
Magnesium (Mg)-Dissolved (mg/L)	29.5	25.1	24.1	33.9	16.3
Manganese (Mn)-Dissolved (mg/L)	4.14	0.0371	0.0563	0.0359	0.0913

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2378301-6	L2378301-7			
	Description	Water	Water			
	Sampled Date	04-NOV-19	05-NOV-19			
	Sampled Time					
	Client ID	DUP	DUP			
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00215	0.00525			
	Nickel (Ni)-Total (mg/L)	0.00081	0.00103			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	1.81	2.46			
	Selenium (Se)-Total (mg/L)	0.000194	0.000292			
	Silicon (Si)-Total (mg/L)	6.55	6.76			
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Total (mg/L)	15.2	20.8			
	Strontium (Sr)-Total (mg/L)	0.635	0.842			
	Sulfur (S)-Total (mg/L)	13.4	20.6			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00055	0.00082			
	Uranium (U)-Total (mg/L)	0.00219	0.00322			
	Vanadium (V)-Total (mg/L)	0.00068	0.00063			
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030			
	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)	0.0033	0.0017			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00036	0.00025			
	Barium (Ba)-Dissolved (mg/L)	0.0824	0.0660			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.012	0.024			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000216	0.0000155			
	Calcium (Ca)-Dissolved (mg/L)	51.6	59.6			
	Chromium (Cr)-Dissolved (mg/L)	0.00011	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.00171	0.00237			
	Iron (Fe)-Dissolved (mg/L)	0.112	0.013			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.0018	0.0033			
	Magnesium (Mg)-Dissolved (mg/L)	23.9	33.7			
	Manganese (Mn)-Dissolved (mg/L)	0.0556	0.0361			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2378301-1	L2378301-2	L2378301-3	L2378301-4	L2378301-5
Description	Water	Water	Water	Water	Water
Sampled Date	04-NOV-19	04-NOV-19	04-NOV-19	05-NOV-19	05-NOV-19
Sampled Time	07:20	07:40	10:45	07:55	08:40
Client ID	W50	W17	W46	W3	W7
Grouping / **Analyte**					
WATER					
Dissolved Metals Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.00568	0.00570	0.00208	0.00512	0.00121
Nickel (Ni)-Dissolved (mg/L)	0.00858	0.00094	0.00077	0.00095	0.00060
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	2.68	3.96	1.79	2.48	1.39
Selenium (Se)-Dissolved (mg/L)	0.000309 DTSE	0.000294	0.000218	0.000310	0.000202
Silicon (Si)-Dissolved (mg/L)	7.29	6.16	6.44	6.60	6.23
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	16.1	16.1	14.6	20.7	9.35
Strontium (Sr)-Dissolved (mg/L)	0.647	0.807	0.623	0.837	0.457
Sulfur (S)-Dissolved (mg/L)	14.0	16.6	12.6	18.7	5.26
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	0.00057	<0.00030	0.00031	<0.00030	0.00041
Uranium (U)-Dissolved (mg/L)	0.00166	0.00250	0.00200	0.00295	0.00132
Vanadium (V)-Dissolved (mg/L)	0.00050	<0.00050	<0.00050	<0.00050	0.00053
Zinc (Zn)-Dissolved (mg/L)	0.0026	0.0012	0.0012	0.0022	0.0021
Zirconium (Zr)-Dissolved (mg/L)	0.00038	<0.00030	<0.00030	<0.00030	<0.00030

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2378301-6	L2378301-7			
	Description	Water	Water			
	Sampled Date	04-NOV-19	05-NOV-19			
	Sampled Time					
	Client ID	DUP	DUP			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00202	0.00504			
	Nickel (Ni)-Dissolved (mg/L)	0.00065	0.00111			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	1.77	2.46			
	Selenium (Se)-Dissolved (mg/L)	0.000214	0.000319			
	Silicon (Si)-Dissolved (mg/L)	6.48	6.64			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	14.4	19.9			
	Strontium (Sr)-Dissolved (mg/L)	0.609	0.827			
	Sulfur (S)-Dissolved (mg/L)	13.0	19.6			
	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)	0.00202	0.00294			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010			
	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	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Total	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfur (S)-Total	MS-B	L2378301-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTSE	Dissolved Se concentration exceeds total. Positive bias on D-Se suspected due to signal enhancement from volatile selenium species. Contact ALS if an alternative test to address this interference is needed.
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.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BE-D-L-CCMS-VA	Water	Diss. Be (low) 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.			
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
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.			
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 CaCO3 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.			
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.			

Reference Information

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.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

** 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:

2109-11-05 A

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2378301-COFC

COC Number: 2019-11-05 A

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Di...	...all E&P TATs with your AM - surcharges will apply
Company:	Minto Explorations Ltd.	Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Minto Environment - Coordinator	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4] ☐ / 3 day [P3] ☐ / 2 day [P2] ☐ — EMERGENCY: 1 Business day [E1] ☐ / Same Day, Weekend or Statutory holiday [E0] ☐
Phone:	1-604-759-4659	☑ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	2100-510 West Georgia St.	Email 1 or Fax mintoenvironment@mintomine.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Vancouver, British Columbia	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	V6B 0M3	Email 3	
Invoice To	Same as Report To ☐ YES ☑ NO	**Invoice Distribution**	**Analysis Request**
	Copy of Invoice with Report ☐ YES ☑ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	Minto Explorations Ltd.	Email 1 or Fax ap@mintomine.com	
Contact:	Ruth Cayetano	Email 2	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Account # / Quote #:		AFE/Cost Center: / PO#	
Job #:		Major/Minor Code: / Routing Code:	
PO / AFE:	232817 (WUL)	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		**ALS Contact:** Shane Stack / **Sampler:**	

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH / Conductivity / Alkalinity / Anions	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Total Metals (TM), Hardness	Dissolved Metals (DM)(filtered and preserved	Total Mercury, Hardness	Dissolved Mercury [1] (Filtered + preserved)	Total Nutrients (Ammonia)	Dissolved Organic Carbon (DOC)	Number of Containers
								P	F/P	P	F/P	P	F/P	
	W50	4-Nov-19	7:20	Water	R	R	R	R	R	R	R	R	R	7
	W17	4-Nov-19	7:40	Water	R	R	R	R	R	R	R	R	R	7
	W46	4-Nov-19	10:45	Water	R	R	R	R	R	R	R	R	R	7
	W3	5-Nov-19	7:55	Water	R	R	R	R	R	R	R	R	R	7
	W7	5-Nov-19	8:40	Water	R	R	R	R	R	R	R	R	R	7
	DUP	4-Nov-19		Water	R	R	R	R	R	R	R	R	R	7
	DUP	5-Nov-19		Water	R	R	R	R	R	R	R	R	R	7

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
					1

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Ian Smith	Date: 2019-11-05	Time:	Received by:	Date:	Time:	Received by: HA	Date: 11/6	Time: 12:25 pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**

BIOASSAY COA’s

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 20-FEB-19
Report Date: 25-MAR-19 16:51 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2234925

Project P.O. #: 229101
Job Reference:
C of C Numbers: 2019-02-20 C
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID					
Grouping **Analyte**					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

** 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

Chain of Custody Numbers:

2019-02-20 C

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.

Acute Toxicity Test Results

Sample L2234925-1 W3,
collected February 19, 2019

Final Report

March 5, 2019

Submitted to: **ALS Environmental**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates				Receipt temp.
	Collected	Received	Rainbow trout test initiation	*Daphnia magna* test initiation	
L2234925-1 W3	19-Feb-19 at 1510h	21-Feb-19 at 1550h/1613h	22-Feb-19 at 1645h	21-Feb-19 at 1710h	10.5°C/9.2°C

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

Toxicity test results

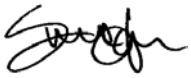
Sample ID	LC50 (% v/v)	
	Rainbow trout	*Daphnia magna*
L2234925-1 W3	>100	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	Rainbow trout	*Daphnia magna*
Reference toxicant LC50 (95% CL)	75.8 (66.4 – 86.4) µg/L Zn[1]	7.3 (6.4 – 8.3) g/L NaCl[2]
Reference toxicant historical mean (2 SD range)	93.8 (37.8 – 232.7) µg/L Zn	5.3 (3.6 – 7.7) g/L NaCl
Reference toxicant CV	48%	19%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

[1]Test date: February 22, 2019; [2]Test date: February 20, 2019; LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist



Reviewed By:
Edmund Canaria, R.P. Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as $ZnSO_4$)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	*Daphnia magna*
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: Feb 22, 2019; 1645h

Work Order No.: 190318

Test Species: *Oncorhynchus mykiss*

Test Validity Criteria:
≥ 90% control survival
WQ Ranges:
T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Sample Information:

Sample ID: L2234925-1 W3
Sample Date: Feb 19, 2019
Date Received: Feb 21, 2019
Sample Volume: 2×20L
Other: -

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 10
Alkalinity (mg/L $CaCO_3$): 8

Test Organism Information:

Batch No.: 020619
Source: Lyndon Fish Hatcheries
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.23
Mean Length ± SD (mm): 34 ± 3 Range: 30 – 37
Mean Weight ± SD (g): 0.28 ± 0.08 Range: 0.19 – 0.40

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn149
Stock Solution ID: 192001
Date Initiated: February 22, 2019
96-h LC50 (95% CL): 75.8 (66.4 – 86.4) µg/L Zn

Reference Toxicant Mean and Historical Range: 93.8 (37.8 – 232.7) µg/L Zn
Reference Toxicant CV (%): 48%

Test Results: The 96 hour LC50 is estimated to be >100 % (v/v).

Reviewed by: [signature]

Date reviewed: March 1, 2019

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
Sample I.D. L2234925-1 IW3
W.O. # 190318
RBT Batch #: ~~012219~~ JD 020619
Date Collected/Time: Feb 19/19 @ JD 1510h
Date Setup/Time: Feb 22/19 @ 1645h
CER #: 2
Sample Setup By: JD

Thermometer: Cer 2
D.O. meter/probe: 2 / D2
Cond./Salinity meter/probe: 2 / C2
pH meter/probe: 2 / P2

Number Fish/Volume: 10/12L
7-d % Mortality: 1/.
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.5		14.0
D.O. (mg/L)	9.4		9.8
pH	7.3		7.4
Cond. (µS/cm)	641		639
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	10	14.0	14.0	14.0	15.5	16.0	10.1	9.6	9.9	9.7	9.2	7.1	7.0	6.9	7.0	7.0	31	35
6.25				10	10	10	10	14.0	14.0	14.0	15.5	16.0	10.2	9.8	9.9	9.7	9.3	7.1	7.1	7.2	7.1	7.0	64	69
12.5				10	10	10	10	14.0	14.0	14.0	15.5	16.0	10.3	9.8	10.0	9.8	9.5	7.1	7.3	7.4	7.4	7.3	95	98
25				10	10	10	10	14.0	14.0	14.0	15.5	16.0	10.3	9.8	9.9	9.7	9.5	7.2	7.7	7.8	7.8	7.7	202	205
50				10	10	10	10	14.0	14.0	14.0	15.5	16.0	10.0	9.9	9.9	9.7	9.2	7.3	8.1	8.1	7.8	7.7	334	336
100				10	10	10	10	14.0	14.0	14.0	15.5	16.0	9.8	9.9	10.0	9.3	9.2	7.4	8.4	8.4	8.5	8.4	639	631
Initials				~	~	JD	JD	JD	~	~	JD	JD	JD	~	~	JD	JD	JD	~	~	JD	JD	JD	JD

Sample Description/Comments: Clear yellow liquid. Brown ~~liquid~~ JD particulates. No odour.

Fish Description at 96 h All fish appear normal. Number of Stressed Fish at 96 h 0

Other Observations:

Reviewed by: [signature] Date Reviewed: March 7, 2019

Daphnia magna Summary Sheet

Client: ALS
Work Order No.: 1903I7

Start Date/Time: Feb 21, 2019 @ 1710h
Test Species: *Daphnia magna*
Set up by: MML

Sample Information:

Sample ID: L2234925-1 W3
Sample Date: Feb 19 2019
Date Received: Feb 21, 2019
Sample Volume: 2 x 20L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤2 daphnids exibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 020G19B
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 20
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC77
Stock Solution ID: 18NA05
Date Initiated: Feb 20, 2019
48-h LC50 (95% CL): 7.3 (6.4-8.3) g/L NaCL

Reference Toxicant Mean and Historical Range: 6.3 (3.6 - 7.7) g/L NaCL
Reference Toxicant CV (%): 19

Test Results: The 48h LC50 is estimated to be >100% (v/v)

Reviewed by: [signature]

Date reviewed: March 1, 2019

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: ALS
Sample ID: L2234925-1 W3
Work Order No.: L90317

Start Date/Time: February 21, 2019 @1704
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by:

Thermometer: Clear5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Rep	Number of Live Organisms 24	Number of Live Organisms 48	No. Immobilized 48	Temperature (°C) 0	Temperature (°C) 24	Temperature (°C) 48	Dissolved oxygen (mg/L) 0	Dissolved oxygen (mg/L) 24	Dissolved oxygen (mg/L) 48	pH 0	pH 24	pH 48	Conductivity (µS/cm) 0	Conductivity (µS/cm) 48
control	A	10	10	0	18.5	19.0	19.0	8.9	8.6	8.6	7.6	7.6	7.7	349	354
	B														
	C														
	D														
6.25	A	10	10	0	18.5	19.0	19.0	8.9	8.6	8.6	7.6	7.6	7.7	371	376
	B														
	C														
	D														
12.5	A	10	10	0	18.5	19.0	19.0	8.8	8.5	8.6	7.5	7.6	7.7	394	395
	B														
	C														
	D														
25	A	10	10	0	18.5	19.0	19.0	8.6	8.6	8.6	7.5	7.6	7.7	421	428
	B														
	C														
	D														
50	A	10	10	0	18.5	19.0	19.0	8.0	8.5	8.6	7.3	7.5	7.9	487	488
	B														
	C														
	D														
100	A	10	10	0	19.0	19.0	19.0	6.3	8.4	8.7	7.2	7.3	8.0	646	647
	B														
	C														
	D														
Technician Initials															

Concentration	Hardness*	Alkalinity*
	*(mg/L as CaCo3)	
Control (MHW)	100	68
Highest conc.	266	282
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	19.0		
DO (mg/L)	6.3		
pH	7.2		
Cond (µS/cm)	646		
Salinity (ppt)	0.3		

Comments:

Mortality: Heartbeat checked under microscope not required

Sample Description: clear, light yellow, no odour, some particulates

Batch#: 02061913 7-d previous # young/brood: 20 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: Date reviewed: March 1, 2019

APPENDIX C – Chain-of-custody form

L2234925

VANCOUVER

ALS Environmental

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# *L2234925*
ALS requires QC data to be provided with your final results.

2

Please see enclosed 1 sample(s) in ~~4~~ Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2234925-1 W3		**2/19/2019**	
	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	2/28/2019 190317	
	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	2/28/2019 190318	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Heather McKenzie
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: Heather.McKenzie@alsglobal.com

Please email confirmation of receipt to: **Heather.McKenzie@alsglobal.com**

Shipped By: mel Date Shipped: Feb 21 2019

Received By: _____ Date Received: Feb 21, 2019 ; 1550h

Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____

2 x 20L
10.5°C

NEW Reporting Contacts:
1.Account Manager Listed Below
2.ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3.ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

Mint

hursday, February 21, 2019 3:01 PM

ALS Environmental

L2234925

VANCOUVER

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# *L2234925*
ALS requires QC data to be provided with your final results.

Please see enclosed 1 **sample(s) in** 4 **Container(s)**

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2234925-1 W3		2/19/2019	
wo# 190317	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	2/28/2019	
wo# 190318	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	2/28/2019	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Heather McKenzie
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: Heather.McKenzie@alsglobal.com

NEW Reporting Contacts:
1.Account Manager Listed Below
2.ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3.ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

Please email confirmation of receipt to: **Heather.McKenzie@alsglobal.com**

Shipped By: MQ | Date Shipped: Feb 21 2019

Received By: TH | Date Received: Feb. 21/19 @ 16:13

Verified By: | Date Verified:

Temperature: 9.2

Sample Integrity Issues: 2x1L

COPY

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2234925-COFC

COC Number: 2019-02-20 C

Page 1 of 1

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	mintoenvironment@mintomine.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap@mintomine.com
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	
PO / AFE:	229101 (MMER)
LSD:	
ALS Lab Work Order # (lab use only)	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	**Sampler:** CR/CB

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	96hr LC50 RainbowTrout	48hr - LC50 Daphnia	7day - RainbowTroutEmbryoToxicity	7day - Ceriodaphnia	7day - Lemma minor	Alga 72-h Growth Inhibition	7day - Flathead Minnow	Number of Containers
	W3	19-Feb-19	15:10	Water	R	R						4

SEND W/ SAMPLES TO NAUTILUS.

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human drinking water use? ☐ YES ☑ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☐ | Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
5°	6°				

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-02-20	Time:	Received by: (2)	Date: Feb 20, 2019	Time: 14:22	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

END OF REPORT

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2234925-COFC

COC Number: 2019-02-20 C

Page 1 of 1

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	229101 (MMER)
LSD:	
ALS Lab Work Order # (lab use only)	

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: mintoenvironment@mintomine.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: ap@mintomine.com

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: | Sampler: CR/CB

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	96hr LC50 RainbowTrout	48hr - LC50 Daphnia	7day - RainbowTroutEmbryoToxicity	7day - Ceriodaphnia	7day - Lemma minor	Alga 72-h Growth Inhibition	7day - Flathead Minnow	Number of Containers
	W3	19-Feb-19	15:10	Water	R	R						4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C			
5°	6°				

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-02-20	Time:	Received by:	Date: Feb 20, 2019	Time: 14:22	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form maydelay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using anAuthorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 15-MAY-19
Report Date: 26-JUN-19 18:41 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2274020

Project P.O. #: 232819 (MMER)
Job Reference:
C of C Numbers: 2019-05-15E
Legal Site Desc:

Comments: Nautilus reports for toxicity testing are included within this report.

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID					
Grouping **Analyte**					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

** 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

Chain of Custody Numbers:

2019-05-15E

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.

Acute Toxicity Test Results

Sample L2274020-1 W3,
collected May 14, 2019

Final Report

May 30, 2019

Submitted to: **ALS Environmental**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates				Receipt temp.
	Collected	Received	Rainbow trout test initiation	*Daphnia magna* test initiation	
L2274020-1 W3	14-May-19 at N/A	16-May-19 at 1511h	17-May-19 at 1810h	17-May-19 at 1440h	10.2°C

N/A = Not Available

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

Toxicity test results

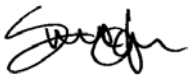
Sample ID	LC50 (% v/v)	
	Rainbow trout	*Daphnia magna*
L2274020-1 W3	>100	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	Rainbow trout	*Daphnia magna*
Reference toxicant LC50 (95% CL)	61.6 (51.7 – 73.4) µg/L Zn[1]	7.3 (6.4 – 8.3) g/L NaCl[2]
Reference toxicant historical mean (2 SD range)	92.2 (42.0 – 202.3) µg/L Zn	5.2 (3.7 – 7.3) g/L NaCl
Reference toxicant CV	41%	18%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

[1]Test date: May 17, 2019; [2]Test date: May 15, 2019; LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist



Reviewed By:
Edmund Canaria, R.P. Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as $ZnSO_4$)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	*Daphnia magna*
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: May 17, 2019; 1810h

Work Order No.: 190996

Test Species: *Oncorhynchus mykiss*

Test Validity Criteria:
≥ 90% control survival
WQ Ranges:
T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Sample Information:

Sample ID: L2274020-1 W3
Sample Date: May 14, 2019
Date Received: May 16, 2019
Sample Volume: 3 x 20L
Other:

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 14
Alkalinity (mg/L $CaCO_3$): 12

Test Organism Information:

Batch No.: 042619a
Source: AquaFarms
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.46
Mean Length ± SD (mm): 40 ± 3 Range: 35 - 46
Mean Weight ± SD (g): 0.55 ± 0.14 Range: 0.36 - 0.88

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn156
Stock Solution ID: 192n03
Date Initiated: 17May19
96-h LC50 (95% CL): 61.6 (51.7 - 73.4) µg/L Zn

Reference Toxicant Mean and Historical Range: 92.2 (42.0 - 202.3) µg/L Zn
Reference Toxicant CV (%): 41%

Test Results: The 96 hour LC50 is estimated to be >100% (v/v).

Reviewed by: [signature]

Date reviewed: May 29, 2019

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
Sample I.D. L2274020-1 W3
W.O. # 190996
RBT Batch #: 042619a
Date Collected/Time: May 14, 2019; Not Avialable
Date Setup/Time: May 17, 2019; 1810h
CER #: 2
Sample Setup By: AL

Number Fish/Volume: 10/12L
7-d % Mortality: 0.3%
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer 2
D.O. meter/probe: 2 / D2
Cond./Salinity meter/probe: 2 / C02
pH meter/probe: 2 / P2

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.0		15.0
D.O. (mg/L)	9.0		9.5
pH	7.7		7.8
Cond. (µS/cm)	559		559
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	10	14.0	15.0	15.0	15.0	15.0	10.3	9.7	9.8	9.4	9.1	7.1	7.0	6.7	7.0	7.0	32	36
6.25				10	10	10	10	14.0	15.0	15.0	15.0	15.0	10.3	9.5	9.9	9.4	9.2	7.2	7.0	6.8	7.0	7.0	66	71
12.5				10	10	10	10	14.0	15.0	15.0	15.0	15.0	10.3	9.6	9.9	9.5	9.1	7.3	7.2	6.9	7.2	7.2	105	111
25				10	10	10	10	14.0	15.0	15.0	15.0	15.0	10.2	9.6	9.7	9.5	9.2	7.5	7.4	7.2	7.5	7.5	173	180
50				10	10	10	10	14.5	15.0	15.0	15.0	15.0	9.9	9.5	9.8	9.6	9.2	7.7	7.9	7.6	7.9	7.9	313	319
100				10	10	10	10	15.0	15.0	15.0	15.0	15.0	9.5	9.6	9.9	9.6	9.3	7.8	8.2	8.0	8.1	8.3	559	560
Initials																								

Sample Description/Comments: Slightly turbid, yellow liquid, no odour, few brown particulates

Fish Description at 96 h: All fish appear Normal
Number of Stressed Fish at 96 h: 0

Other Observations:

Reviewed by:
Date Reviewed: May 29, 2019

Daphnia magna Summary Sheet

Client: AIS/MMTD MIWS
Work Order No.: 190995

Start Date/Time: May 17, 2019 @ 1440h
Test Species: *Daphnia magna*
Set up by: ST

Sample Information:

Sample ID: L2274620-1 WS
Sample Date: May 14, 2019
Date Received: May 16, 2019
Sample Volume: 2 x 1L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤2 daphnids exibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 042419A
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 44
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC32
Stock Solution ID: 15NA06
Date Initiated: May 15, 2019
48-h LC50 (95% CL): 7.3 (6.4 - 8.3) g/LNaCL

Reference Toxicant Mean and Historical Range: 5.2 (3.7-7.3) g/L NaCL
Reference Toxicant CV (%): 18

Test Results: The 48h LC50 is estimated to be >100 %(v/v)

Reviewed by: [signature]

Date reviewed: May 29, 2019

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: Minto Mine / ALS Environmental
Sample ID: ~~MB~~ L2274070-1 WB
Work Order No.: 190995
Start Date/Time: May 17, 2019 @1440h
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: ST

Thermometer: CER#5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration %(v/v)	Rep	Number of Live Organisms 24	Number of Live Organisms 48	No. Immobilized 48	Temperature (°C) 0	Temperature (°C) 24	Temperature (°C) 48	Dissolved oxygen (mg/L) 0	Dissolved oxygen (mg/L) 24	Dissolved oxygen (mg/L) 48	pH 0	pH 24	pH 48	Conductivity (µS/cm) 0	Conductivity (µS/cm) 48
CTRL	A	10	10	0	18.5	19.0	19.0	8.9	8.8	8.7	7.9	7.7	7.6	339	344
	B														
	C														
	D														
6.25	A	10	10	0	18.5	19.0	19.0	8.9	8.6	8.7	7.8	7.7	7.6	352	365
	B														
	C														
	D														
12.5	A	10	10	0	18.5	19.0	19.0	9.0	8.9	8.6	7.7	7.6	7.6	366	370
	B														
	C														
	D														
25	A	10	10	0	18.5	19.0	19.0	8.7	8.9	8.6	7.7	7.6	7.7	393	396
	B														
	C														
	D														
50	A	10	10	0	19.0	19.0	19.0	8.9	8.9	8.8	7.6	7.7	7.8	445	447
	B														
	C														
	D														
100	A	10	10	0	19.5	19.6	19.0	9.0	8.7	8.8	7.5	7.7	7.9	560	563
	B														
	C														
	D														
Technician Initials		ac	ac	ac	SJ	ac	ac	SJ	ac	ac	SJ	ac	ac	SJ	ac

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCo3)	
Control (MHW)	100	70
Highest conc.	1500	218
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	19.5		
DO (mg/L)	~~8.7~~ 9.0		
pH	7.5		
Cond (µS/cm)	560		
Salinity (ppt)	0.3		

Comments: 0/1 daphnid floating on surface
Mortality: Heartbeat checked under microscope not reqd

Sample Description: slightly turbid yellow liquid, no odor, few brown particulates

Batch#: 042419A 7-d previous # young/brood: 44 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: [signature] Date reviewed: May 29, 2019

APPENDIX C – Chain-of-custody form

L2274020

VANCOUVER

ALS Environmental

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NEW Reporting Contacts:
1.Account Manager Listed Below
2.ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3.ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

NOTES: Please reference on final report and invoice: PO# L2274020
ALS requires QC data to be provided with your final results.

COPY

Please see enclosed 2 sample(s) in ~~1~~ 5 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2274020-1 W3		**5/14/2019**	
	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	5/27/2019	2x1L
	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	5/27/2019	3x20L
L2274020-2 W3		**5/15/2019**	1x1L
	Algae 72 hour Growth Inhibition (ALGAE-72HR-NL 1)	5/27/2019	

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Heather McKenzie
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: Heather.McKenzie@alsglobal.com

Please email confirmation of receipt to: Heather.McKenzie@alsglobal.com

Shipped By: _____ Date Shipped: _____

Received By: Tyrone Hamilton Date Received: May 16/19 @ 15:11

Verified By: _____ Date Verified: _____

Temperature: 10.2 °C

Sample Integrity Issues: _____

Slightly turbid yellow liquid.
No odour, few brown particulates.

Daphnia - 190995
Abt - 190996
Algae - 190997

Minto

Thursday, May 16, 2019 3:11 PM

END OF REPORT

Toxicity Testing on L2274020-2 W3

(collected May 15, 2019)

Final Report

June 24, 2019

Submitted to: **ALS Environmental**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

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Table 3. Reference toxicant results. 4

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APPENDIX A – *Pseudokirchneriella subcapitata* Toxicity Test Data

APPENDIX B – Chain-of-Custody Form

SIGNATURE PAGE

Report By:
Jeslin Wijaya, B.Sc.
Laboratory Biologist

Reviewed By:
Armando Tang, R.P.Bio
Senior Reviewer

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

SUMMARY

Sample Information and Test Type

Sample ID	L2274020-2 W3
Sample collection date	May 15, 2019
Sample receipt date	May 16, 2019
Sample receipt temperature	10.2°C
Test types	72-h *Pseudokirchneriella subcapitata* growth inhibition

Summary of Results

Cell Yield	% v/v
P. subcapitata	
growth IC25	>95.2
growth IC50	>95.2

IC = Inhibition Concentration

1.0 INTRODUCTION

Nautilus Environmental Company Inc. conducted a 72-h *Pseudokirchneriella subcapitata* growth inhibition toxicity test for ALS Environmental on a sample identified as L2274020-2 W3. The sample was collected on May 15, 2019 and delivered to the Nautilus Environmental laboratory in Burnaby, BC on May 16, 2019. The sample was transported in one 1-L plastic container and was received at a temperature of 10.2°C. The sample was stored in the dark at 4 ± 2°C prior to testing.

This report describes the results of the toxicity test. Copies of raw laboratory data sheets and statistical analyses are provided in Appendix A. The chain-of-custody form is provided in Appendix B.

2.0 METHODS

Methods for the toxicity tests are summarized in Table 1. Testing was conducted according to procedures described by Environment Canada (2007). Statistical analyses were performed using CETIS (Tidepool Scientific Software, 2013).

Table 1. Summary of test conditions: 72-h *Pseudokirchneriella subcapitata* growth inhibition test.

Test species	*Pseudokirchneriella subcapitata*, strain CPCC #37
Organism source	In-house axenic culture, obtained from Canadian Phycological Culture Center, and originally isolated from Nivelta River, Norway.
Organism age	3-to 7-day old culture in logarithmic growth phase
Test type	Static
Test duration	72 hours
Test vessel	Microplate
Test volume	220 µL
Test concentrations	Seven concentrations, plus laboratory control
Test replicates	4 per treatment; 8 for laboratory control
Number of organisms	10,000 cells/mL
Control/dilution water	Deionized water supplemented with nutrients
Test solution renewal	None
Test temperature	24 ± 2°C
Feeding	None
Light intensity	3600 to 4400 lux
Photoperiod	24 hours light
Aeration	None
Test measurements	Test area temperature measured daily; temperature and pH measured at test initiation; pH of two control wells measured at test termination
Test protocol	Environment Canada (2007), EPS 1/RM/25
Statistical software	CETIS Version 1.9.4
Test endpoint	Algal cell growth inhibition
Test acceptability criteria for controls	>16-fold increase in number of algal cells; CV ≤ 20%; no trend when analyzed using Mann-Kendall test
Reference toxicant	Zinc (added as $ZnSO_4$)

3.0 RESULTS

The results of the toxicity test are summarized in Table 2. There were no adverse effects on cell yield of *P. subcapitata*, resulting in IC25 and IC50 values that were >95.2%. Significant stimulatory effects were observed between test concentrations 3.0 and 95.2% (v/v); percent stimulation ranged between 27.6 and 170.2%.

Table 2. Results: 72-h *Pseudokirchneriella subcapitata* growth inhibition test.

Concentration (% v/v)	Cell Yield (x 10^4 cells/mL) (Mean ± SD)	Stimulation (%)
Laboratory Control	33.1 ± 3.4	--
1.5	32.2 ± 3.4	--
3.0	42.2 ± 3.0*	27.6
6.0	52.8 ± 3.2*	59.2
11.9	73.2 ± 4.2*	121.1
23.8	82.8 ± 2.2*	149.8
47.6	89.5 ± 1.3*	170.2
95.2	81.5 ± 2.1*	146.0
Test Endpoint (% v/v)		
IC25	>95.2	
IC50	>95.2	

SD = Standard Deviation, IC = Inhibition Concentration
* = indicates cell yield that was significantly greater than the lab control

4.0 QA/QC

The health history of the test organisms used in the exposure was acceptable and met the requirements of the Environment Canada protocol. The test met all control acceptability criteria and water quality parameters remained within ranges specified in the protocol throughout the tests. There were no deviations from the test methodology. Uncertainty associated with the test is best described by the standard deviation around the mean and/or the confidence intervals around the point estimates.

Result of the reference toxicant test conducted during the testing program is summarized in Table 3. Result for this test fell within the range for organism performance of the mean and two standard deviations, based on historical results obtained by the laboratory with this test. Thus, the sensitivity of the organisms used in the test was appropriate. The reference toxicant test was performed under the same conditions as those used for the sample.

Table 3. Reference toxicant results.

Test Species	Endpoint	Historical Mean (2 SD Range)	CV (%)	Test Date
P. subcapitata	Growth (IC50): 32.9 µg/L Zn	31.0 (25.2 – 38.1)	10	May 28, 2019

SD = Standard Deviation, CV = Coefficient of Variation, IC = Inhibition Concentration

5.0 REFERENCES

Environment Canada. 2007. Biological test method: growth inhibition test using the freshwater alga. Environmental Protection Series, Report EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON. 53 pp.

Tidepool Scientific Software. 2013. CETIS comprehensive environmental toxicity information system, version 1.9.4.11 Tidepool Scientific Software, McKinleyville, CA. 275 pp.

APPENDIX A – *Pseudokirchneriella subcapitata* Toxicity Test Data

Pseudokirchneriella subcapitata Summary Sheet

Client: ALS
Work Order No.: 190997

Start Date: May 17/19
Set up by: ML

Sample Information:

Sample ID: L2274020-2 W3
Sample Date: May 14/19
Date Received: May 16/19
Sample Volume: 1 x 1L

Test Organism Information:

Culture Date: May 10/19
Age of culture (Day 0): 7d

Zinc Reference Toxicant Results:

Reference Toxicant ID: SC183
Stock Solution ID: 197n08
Date Initiated: May ~~27~~ 28/19

72-h IC50 (95% CL): 32.9 (29.9 - 36.0) mg/L Zn

72-h IC50 Reference Toxicant Mean and Range: 31.0 (25.2 - 38.1) mg/L Zn CV (%): 10.

Test Results:

	Algal Growth
IC25 %(v/v) (95% CL)	>95.2
IC50 %(v/v) (95% CL)	>95.2

Reviewed by: JM

Date reviewed: June 12/19

72-h Algal Growth Inhibition Toxicity Test
Water Quality Measurements

Client: ALS | Setup by: MG

Sample ID: L2274020-2 WS | Test Date/Time: May 17/19 @ 1225h

Work Order No.: 190997 | CER #: 4

Test Species: *Pseudokirchneriella subcapitata*

Culture Date: May 10/19 | Age of Culture: 7d | Culture Health: Good

Culture Count: 1 450 2 420 | Average: ~~425~~ MG 435 | Culture Cell Density (c1): MG ~~425~~ 435 x 10^4 cells/mL

v1 = 220,000 cells/ml x 100 ml / (c1) ~~425~~ 435 ~~425~~ MG x 10^4 cells/ml = ~~5.18~~ MG mL 5.06mL

Time Zero Counts: 1 20 2 22 | Average: 21

No. of Cells/mL: 21 x 10^4 | Initial Density: # cells/mL ÷ 220 µL x 10 µL = 954 cells/mL

Concentration %(v/v)	Water Quality pH 0 h	Water Quality Temp (°C) 0 h	Incubator Temperature (°C) 0 h	24 h	48 h	72 h	Microplates rotated 2X per day? 0 h	24 h	48 h	72 h
Control	7.3	24.0	25.0	25.0	25.0	25.0	✓	✓	✓	✓
1.5	7.4	24.0					✓	✓	✓	✓
3	7.4	24.0					✓	✓	✓	✓
6	7.6	24.0					✓	✓	✓	✓
11.9	7.7	24.0					✓	✓	✓	✓
23.8	8.0	24.0					✓	✓	✓	✓
47.6	8.2	24.0					✓	✓	✓	✓
95.2	8.3	24.0					✓	✓	✓	✓
Initials	MG	MG	MG	MG	↗	MG	MG	MG	↗	MG

Initial control pH: Well 1: 7.3 | Well 2: 7.3

Final control pH: Well 1: 7.2 | Well 2: 7.2

Light intensity (lux): 4100 | Date measured: May 17/19

Thermometer: 4 | Light meter: 1 | pH meter/probe: 1 / 1

Sample Description: slightly turbid, yellow, odourless, few brown particulates

Comments:

Reviewed: JOH | Date reviewed: June 12/19

Pseudokirchneriella subcapitata Toxicity Test Data Sheet
72-h Algal Cell Counts

Client: ALS
Start Date/Time: May 17/19 @ 1225h
Work Order #: ~~L2274020-2 MG W3~~ (1)
Termination Date: May 20/19 @ 1225h
Sample ID: L2274020-2 W3
Test set up by: MG
%(v/v)
(1) 190997

Concentration	Rep	Count 1	Count 2	Count 3	Count 4	Comments	Initials
Control	A	34					MG
	B	30					
	C	36					
	D	31					
	E	36					
	F	30					
	G	39					
	H	37					
1.5	A	30					
	B	32					
	C	38					
	D	33					
3	A	42					
	B	40					
	C	44					
	D	47					
6	A	51					
	B	51					
	C	56					
	D	57					
11.9	A	76					
	B	77					
	C	68					
	D	76					
23.8	A	81					
	B	86					
	C	85					
	D	83					
47.6	A	89					
	B	90					
	C	92					
	D	91					
95.8	A	82					
	B	83					
	C	80					
	D	85					✓

Comments:

Reviewed by: JGh
Date Reviewed: June 12/19

Pseudokirchneriella subcapitata Algal Counts

Client: ALS
WO#: 190997
Sample ID: L2274020-2 W3

Start Date/Time: 17-May-19 @ 1225h
Termination Date/Time: 20-May-19 @ 1225h

Initial Cell Density: 9545 cell/mL

									210000
									0.22
									0.01
Concentration %(v/v)	Rep	Count 1 (x 10^4)	Count 2 (x 10^4)	Count 3 (x 10^4)	Count 4 (x 10^4)	Mean (x 10^4)	Cell Yield (x 10^4) cell/mL		9545.455
Control	A	34				34	33.0	mean	33.2
	B	30				30	29.0	SD	3.440826
	C	36				36	35.0	CV	10.37317
	D	31				31	30.0		
	E	36				36	35.0		
	F	30				30	29.0		
	G	39				39	38.0		
	H	37				37	36.0		
1.5	A	30				30	29.0		
	B	32				32	31.0		
	C	38				38	37.0		
	D	33				33	32.0		
3	A	42				42	41.0		
	B	40				40	39.0		
	C	44				44	43.0		
	D	47				47	46.0		
6	A	51				51	50.0		
	B	51				51	50.0		
	C	56				56	55.0		
	D	57				57	56.0		
11.9	A	76				76	75.0		
	B	77				77	76.0		
	C	68				68	67.0		
	D	76				76	75.0		
23.8	A	81				81	80.0		
	B	86				86	85.0		
	C	85				85	84.0		
	D	83				83	82.0		
47.6	A	89				89	88.0		
	B	90				90	89.0		
	C	92				92	91.0		
	D	91				91	90.0		
95.2	A	82				82	81.0		
	B	83				83	82.0		
	C	80				80	79.0		
	D	85				85	84.0		

Reviewed by: JCh

Date reviewed: June 12/19

CETIS Analytical Report

EC Alga Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	19-6834-5054	**Endpoint:**	Cell Yield	**CETIS Version:**	CETISv1.9.4
Analyzed:	28 May-19 17:44	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1
Batch ID:	01-4501-5941	**Test Type:**	Cell Growth	**Analyst:**	Mimi Tran
Start Date:	17 May-19 12:25	**Protocol:**	EC/EPS 1/RM/25	**Diluent:**	Deionized Water + nutrients
Ending Date:	20 May-19 12:25	**Species:**	Pseudokirchneriella subcapitata	**Brine:**	
Test Length:	72h	**Taxon:**	Chlorophyta	**Source:**	In-House Culture **Age:** 7d
Sample ID:	09-0475-7802	**Code:**	35ED822A	**Project:**	
Sample Date:	14 May-19	**Material:**	Water Sample	**Source:**	ALS
Receipt Date:	16 May-19	**CAS (PC):**		**Station:**	L2274020-2 W3
Sample Age:	84h (10.2 °C)	**Client:**	ALS		

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	1909777	200	Yes	Two-Point Interpolation

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			0.4054	Non-Significant Trend in Controls

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
IC5	>95.2	n/a	n/a	<1.05	n/a	n/a
IC10	>95.2	n/a	n/a	<1.05	n/a	n/a
IC15	>95.2	n/a	n/a	<1.05	n/a	n/a
IC20	>95.2	n/a	n/a	<1.05	n/a	n/a
IC25	>95.2	n/a	n/a	<1.05	n/a	n/a
IC40	>95.2	n/a	n/a	<1.05	n/a	n/a
IC50	>95.2	n/a	n/a	<1.05	n/a	n/a

Cell Yield Summary

			Calculated Variate						Isotonic Variate	
Conc-%	Code	Count	Mean	Min	Max	Std Dev	CV%	%Effect	Mean	%Effect
0	N	8	33.12	29	38	3.441	10.39%	0.0%	60.92	0.0%
1.5		4	32.25	29	37	3.403	10.55%	2.64%	60.92	0.0%
3		4	42.25	39	46	2.986	7.07%	-27.55%	60.92	0.0%
6		4	52.75	50	56	3.202	6.07%	-59.25%	60.92	0.0%
11.9		4	73.25	67	76	4.193	5.73%	-121.1%	60.92	0.0%
23.8		4	82.75	80	85	2.217	2.68%	-149.8%	60.92	0.0%
47.6		4	89.5	88	91	1.291	1.44%	-170.2%	60.92	0.0%
95.2		4	81.5	79	84	2.082	2.55%	-146.0%	60.92	0.0%

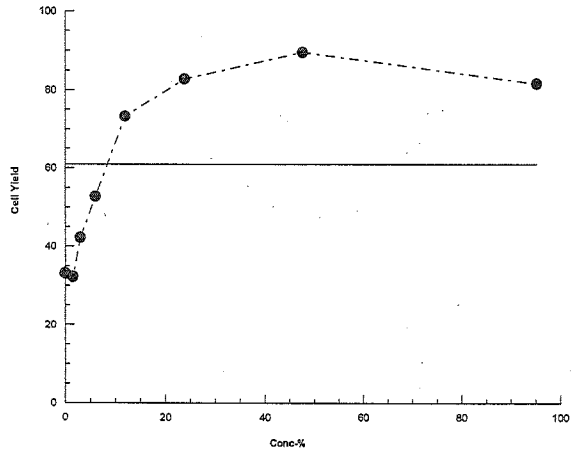
Cell Yield Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	N	33	29	35	30	35	29	38	36
1.5		29	31	37	32				
3		41	39	43	46				
6		50	50	55	56				
11.9		75	76	67	75				
23.8		80	85	84	82				
47.6		88	89	91	90				
95.2		81	82	79	84				

EC Alga Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	19-6834-5054	**Endpoint:**	Cell Yield	**CETIS Version:**	CETISv1.9.4
Analyzed:	28 May-19 17:44	**Analysis:**	Linear Interpolation (ICPIN)	**Status Level:**	1

Graphics



CETIS Analytical Report

EC Alga Growth Inhibition Test — **Nautilus Environmental**

Analysis ID:	12-7507-0045	**Endpoint:**	Cell Yield	**CETIS Version:**	CETISv1.9.4
Analyzed:	28 May-19 17:44	**Analysis:**	Parametric-Control vs Treatments	**Status Level:**	1
Batch ID:	01-4501-5941	**Test Type:**	Cell Growth	**Analyst:**	Mimi Tran
Start Date:	17 May-19 12:25	**Protocol:**	EC/EPS 1/RM/25	**Diluent:**	Deionized Water + nutrients
Ending Date:	20 May-19 12:25	**Species:**	Pseudokirchneriella subcapitata	**Brine:**	
Test Length:	72h	**Taxon:**	Chlorophyta	**Source:**	In-House Culture **Age:** 7d
Sample ID:	09-0475-7802	**Code:**	35ED822A	**Project:**	
Sample Date:	14 May-19	**Material:**	Water Sample	**Source:**	ALS
Receipt Date:	16 May-19	**CAS (PC):**		**Station:**	L2274020-2 W3
Sample Age:	84h (10.2 °C)	**Client:**	ALS		

Data Transform	Alt Hyp	NOEL	LOEL	TOEL	TU	PMSD
Untransformed	C < T	1.5	3	2.121	66.67	14.25%

Dunnett Multiple Comparison Test

Control	vs	Conc-%	Test Stat	Critical	MSD	DF	P-Type	P-Value	Decision(α:5%)
Negative Control		1.5	-0.4683	2.526	4.72	10	CDF	0.9812	Non-Significant Effect
		3*	4.884	2.526	4.72	10	CDF	1.3E-04	Significant Effect
		6*	10.5	2.526	4.72	10	CDF	<1.0E-37	Significant Effect
		11.9*	21.48	2.526	4.72	10	CDF	<1.0E-37	Significant Effect
		23.8*	26.56	2.526	4.72	10	CDF	<1.0E-37	Significant Effect
		47.6*	30.17	2.526	4.72	10	CDF	<1.0E-37	Significant Effect
		95.2*	25.89	2.526	4.72	10	CDF	<1.0E-37	Significant Effect

Auxiliary Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:5%)
Control Trend	Mann-Kendall Trend Test			0.4054	Non-Significant Trend in Controls

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	18262.4	2608.91	7	280.3	<1.0E-37	Significant Effect
Error	260.625	9.30804	28			
Total	18523		35			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance Test	4.444	18.48	0.7275	Equal Variances
Distribution	Shapiro-Wilk W Normality Test	0.9745	0.9166	0.5611	Normal Distribution

Cell Yield Summary

Conc-%	Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	N	8	33.12	30.25	36	34	29	38	1.217	10.39%	0.00%
1.5		4	32.25	26.83	37.67	31.5	29	37	1.702	10.55%	2.64%
3		4	42.25	37.5	47	42	39	46	1.493	7.07%	-27.55%
6		4	52.75	47.66	57.84	52.5	50	56	1.601	6.07%	-59.25%
11.9		4	73.25	66.58	79.92	75	67	76	2.097	5.72%	-121.13%
23.8		4	82.75	79.22	86.28	83	80	85	1.109	2.68%	-149.81%
47.6		4	89.5	87.45	91.55	89.5	88	91	0.6455	1.44%	-170.19%
95.2		4	81.5	78.19	84.81	81.5	79	84	1.041	2.55%	-146.04%

Analyst: MD QA: June 12/19

EC Alga Growth Inhibition Test

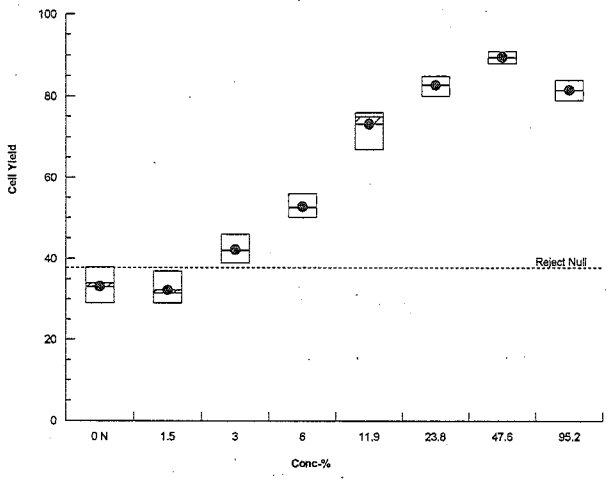
Nautilus Environmental

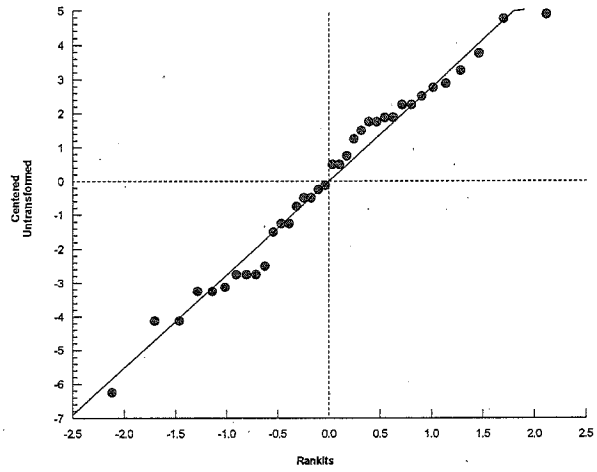
Analysis ID: 12-7507-0045 **Endpoint:** Cell Yield **CETIS Version:** CETISv1.9.4
Analyzed: 28 May-19 17:44 **Analysis:** Parametric-Control vs Treatments **Status Level:** 1

Cell Yield Detail

Conc-%	Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	N	33	29	35	30	35	29	38	36
1.5		29	31	37	32				
3		41	39	43	46				
6		50	50	55	56				
11.9		75	76	67	75				
23.8		80	85	84	82				
47.6		88	89	91	90				
95.2		81	82	79	84				

Graphics





APPENDIX B – Chain-of-Custody Form

ALS Environmental

L2274020

VANCOUVER

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NEW Reporting Contacts:
1.Account Manager Listed Below
2.ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3.ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

NOTES: Please reference on final report and invoice: PO# *L2274020*
ALS requires QC data to be provided with your final results.

Please see enclosed 2 sample(s) in ~~1~~ 5 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2274020-1 W3		**5/14/2019**	
	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	5/27/2019 2x1L	
	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	5/27/2019 3x20L	
L2274020-2 W3		**5/15/2019** 1x1L	
	Algae 72 hour Growth Inhibition (ALGAE-72HR-NL 1)	5/27/2019	

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Heather McKenzie
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: Heather.McKenzie@alsglobal.com

Please email confirmation of receipt to: Heather.McKenzie@alsglobal.com

Shipped By: _____ Date Shipped: _____

Received By: Tyrone Hamilton Date Received: May 16/19 @ 15:11

Verified By: _____ Date Verified: _____

Temperature: 10.2

Sample Integrity Issues: _____

Sample description:
slightly turbid, yellow, odourless, few brown particulates.

Daphnia - 190995
Rbt - 190996
Algae - 190997

Minto

END OF REPORT

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2274020-COFC

COC Number: 2019-05-15 E

Page 1 of 1

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: mintoenvironment@mintomine.com
Email 2:
Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: ap@mintomine.com
Email 2:

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232819 (MMER)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: **Sampler:** DF/CR

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	96hr LC50 Rainbow Trout	48hr - LC50 Daphnia	7day - RainbowTroutEmbryoToxicity	7day - Ceriodaphnia	7day - Lemma minor	Alga 72-h Growth Inhibition	7day - Flathead Minnow	Ra226						Number of Containers
	W3	14-May-19	9:25	Water	R	R												4
	W3	15-May-19	9:30	Water						R								1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
15.0					8

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Corey Roberts	Date: 2019-05-15	Time:	Received by: EF	Date: 15 May 2019	Time: 1530	Received by: HA	Date: 5/16	Time: 12:25p

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 07-AUG-19
Report Date: 30-AUG-19 14:12 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2324367

Project P.O. #: 232819
Job Reference:
C of C Numbers: 2019-08-07 G
Legal Site Desc:

Comments: Please note, this report contains only Nautilus Environmental reports (at the end of the attachment).

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID					
Grouping **Analyte**					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

** 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

Chain of Custody Numbers:

2019-08-07 G

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.

Acute Toxicity Test Results

Sample L2324367-1 W3,
collected August 6, 2019

Final Report

August 21, 2019

Submitted to: **ALS Environmental**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates				Receipt temp.
	Collected	Received	Rainbow trout test initiation	*Daphnia magna* test initiation	
L2324367-1 W3	06-Aug-19 at N/A	09-Aug-19 at 0840h	09-Aug-19 at 1400h	09-Aug-19 at 1400h	6.2 – 7.4°C

N/A = Not Available

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

Toxicity test results

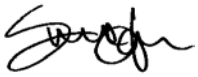
Sample ID	LC50 (% v/v)	
	Rainbow trout	*Daphnia magna*
L2324367-1 W3	>100	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	Rainbow trout	Daphnia magna
Reference toxicant LC50 (95% CL)	87.1 (71.2 – 106.4) µg/L Zn[1]	7.3 (6.4 – 8.3) g/L NaCl[2]
Reference toxicant historical mean (2 SD range)	85.9 (30.2 – 244.1) µg/L Zn	5.4 (3.7 – 7.8) g/L NaCl
Reference toxicant CV	56%	19%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

[1] Test date: July 25, 2019; [2] Test Date: August 7, 2019, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist



Reviewed By:
Edmund Canaria, R.P. Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as $ZnSO_4$)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	*Daphnia magna*
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: August 9 2019; 1400h

Work Order No.: 191529

Test Species: *Oncorhynchus mykiss*

Test Validity Criteria:
≥ 90% control survival
WQ Ranges:
T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Sample Information:

Sample ID: L2324367-1 W3
Sample Date: August 6, 2019
Date Received: August 9, 2019
Sample Volume: 2x 20L
Other: —

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 9
Alkalinity (mg/L $CaCO_3$): 10

Test Organism Information:

Batch No.: 071119b
Source: Lyndon Fish Hatcheries
No. Fish/Volume (L): 10 / 12L
Loading Density (g/L): 0.39
Mean Length ± SD (mm): 40 ± 2 Range: 37 - 44
Mean Weight ± SD (g): 0.46 ± 0.09 Range: 0.29 - 0.64

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZnL025
Stock Solution ID: 19Zn04
Date Initiated: 25Jul19
96-h LC50 (95% CL): 87.1 (71.2 - 106.4) µg/L Zn

Reference Toxicant Mean and Historical Range: 85.9 (30.2 - 244.1) µg/L Zn
Reference Toxicant CV (%): 56%

Test Results: The 96 hour LC50 is estimated to be >100% (v/v).

Reviewed by: [signature]

Date reviewed: Aug 19, 2019

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
Sample I.D. L2324367-1 W3
W.O. # 191529
RBT Batch #: 071119b
Date Collected/Time: August 6, 2019; not available
Date Setup/Time: August 9, 2019; 1400h
CER #: 2
Sample Setup By: RL

Number Fish/Volume: 10/12L
7-d % Mortality: 0.25
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: #2
D.O. meter/probe: DO 2/2
Cond./Salinity meter/probe: C2 / 2
pH meter/probe: pH 2 / 2

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.5		14.5
D.O. (mg/L)	10.3		10.1
pH	8.2		8.2
Cond. (µS/cm)	579		579
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Control				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.1	9.5	9.7	9.7	9.9	7.2	7.0	7.1	7.1	7.2	31	38
6.25				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.1	9.6	9.7	9.7	9.8	7.5	7.3	7.2	7.4	7.4	70	76
12.5				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.1	9.7	9.8	9.8	9.9	7.6	7.4	7.6	7.5	7.5	97	104
25				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.1	9.5	9.7	9.9	9.8	7.8	7.8	7.7	7.8	7.8	181	188
50				10	10	10	10	15.0	15.0	15.0	15.0	15.0	10.1	9.5	9.8	9.8	9.9	8.1	8.2	8.1	8.2	8.2	317	324
100				10	10	10	10	14.5	15.0	15.0	15.0	15.0	10.1	9.5	9.8	9.9	9.9	8.2	8.5	8.4	8.5	8.5	579	580
Initials				RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL	RL

Sample Description/Comments: Clear, light yellow liquid, no odour, brown and black particulates

Fish Description at 96 h: All fish appear normal Number of Stressed Fish at 96 h: 0

Other Observations:

Reviewed by: [signature] Date Reviewed: Aug. 19, 2019

Daphnia magna Summary Sheet

Client: ALS Environmental
Work Order No.: 191528

Start Date/Time: Aug 9, 2019 @ 1400h
Test Species: *Daphnia magna*
Set up by: ST

Sample Information:

Sample ID: L2324367-1 W3
Sample Date: Aug 6, 2019
Date Received: Aug 9, 2019
Sample Volume: 2 x 1L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤2 daphnids exibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 072419C
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 29
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC36
Stock Solution ID: 18NA06
Date Initiated: Aug 7, 2019
48-h LC50 (95% CL): 7.3 (6.4 - 8.3) g/LNaCL

Reference Toxicant Mean and Historical Range: 5.4 (3.7 - 7.8) g/L NaCL
Reference Toxicant CV (%): 19

Test Results: The 48h LC50 is estimated to be >100% (V/V)

Reviewed by: [signature]

Date reviewed: Aug 19, 2019

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: ~~ALS~~ / ~~MINTO MINES~~ MS ENVIRONMENTAL
Sample ID: ~~MW-~~ 123243167-W3
Work Order No.: 191528

Start Date/Time: AUG 9, 2019 @ 1400h
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: ST

Thermometer: ER#5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration 9.1 (V/V)	Rep	Number of Live Organisms 24	48	No. Immobilized 48	Temperature (°C) 0	24	48	Dissolved oxygen (mg/L) 0	24	48	pH 0	24	48	Conductivity (µS/cm) 0	48
CTRL	A	10	10	0	19.5	20.0	20.0	9.2	8.4	8.6	7.3	7.5	7.6	341	348
	B														
	C														
	D														
6.25	A	10	10	0	19.5	20.0	20.0	9.0	8.3	8.5	7.4	7.5	7.5	356	361
	B														
	C														
	D														
12.5	A	10	10	0	19.5	20.0	20.0	9.0	8.3	8.5	7.5	7.6	7.5	369	371
	B														
	C														
	D														
25	A	10	10	0	19.5	20.0	20.0	9.0	8.2	8.6	7.6	7.7	7.7	395	397
	B														
	C														
	D				ST										
50	A	10	10	0	~~19.5~~	20.0	20.0	9.0	8.2	8.5	7.6	7.7	7.8	454	452
	B				19.0										
	C														
	D														
100	A	10	10	0	18.5	20.0	20.0	9.5	8.2	8.5	7.6	~~7.8~~	7.8	577	567
	B														
	C														
	D														
Technician Initials		DL	A	A	ST	DL	A	ST	A	A	ST	A	A	ST	A

Concentration	Hardness*	Alkalinity*
	*(mg/L as CaCo3)	
Control (MHW)	100	70
Highest conc.	~~99~~ 304	~~44~~ 238
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	18.5		19.0
DO (mg/L)	11.8	(aerated for 30 mins)	9.5
pH	7.4		7.6
Cond (µS/cm)	577		577
Salinity (ppt)	0.3		0.3

Comments: _____ Mortality: Heartbeat checked under microscope NO

Sample Description: clear light yellow liquid, no odour, brown and black particulates

Batch#: 0724190 7-d previous # young/brood: 29 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: _____ Date reviewed: Aug 19, 2019

APPENDIX C – Chain-of-custody form

ALS Environmental

L2324367

VANCOUVER

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# L2324367
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 4 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2324367-1 W3		**8/6/2019**	
191528 –	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	8/16/2019	
191529 –	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	8/16/2019	

Subcontract Info Contact: Brittany Puckey (604) 253-4188

Analysis and reporting info contact: Heather McKenzie
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: Heather.McKenzie@alsglobal.com

Please email confirmation of receipt to: **Heather.McKenzie@alsglobal.com**

Shipped By: mel Date Shipped: Aug 09, 2019

Received By: Tyson Hamilton Date Received: Aug. 9/19 @ 8:40

Verified By: Date Verified:

Temperature: 6.2-7.4°C

Sample Integrity Issues: 2x20L + 2x1L

NEW Reporting Contacts:
1.Account Manager Listed Below
2.ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3.ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

Minto

Thursday, August 08, 2019 3:42 PM

END OF REPORT

Nedn

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2324367-COFC

COC Number: 2019-08-07 G

Page 1 of 1

Report To	Contact and companyname below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax mintoenvironment@mintomine.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax ap@mintomine.com

Email 2

Project Information

ALS Account # / Quote #:

Job #:

PO / AFE: 232819 (MMER)

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:** CR/DJ

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	96hr LC50 RainbowTrout	48hr - LC50 Daphnia	7day - RainbowTroutEmbryoToxicity	7day - Ceriodaphnia	7day - Lemma minor	Alga 72-h Growth Inhibition	7day - Flathead Minnow	Ra226	Number of Containers
	W3	6-Aug-19	15:15	Water	R	R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
6.5					

SHIPMENT RELEASE (client use)		
Released by: Corey Roberts	Date: 2019-08-07	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: CC	Date: Aug 7 2019	Time: 3:33pm

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: H.A	Date: 8/8	Time: 12:10 pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the backpage of the white - report copy

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Minto Explorations Ltd.
ATTN: Minto Environment - Coordinator
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 12-NOV-19
Report Date: 27-NOV-19 18:47 (MT)
Version: FINAL

Client Phone: 604-759-4659

Certificate of Analysis

Lab Work Order #: L2380930

Project P.O. #: 232819
Job Reference:
C of C Numbers: 2019-11-12 C
Legal Site Desc:

Heather McKenzie
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID					
Grouping **Analyte**					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

** 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

Chain of Custody Numbers:

2019-11-12 C

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.

Acute Toxicity Test Results

Sample L2380930-1 W3,
collected November 12, 2019

Final Report

November 27, 2019

Submitted to: **ALS Environmental**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates				Receipt temp.
	Collected	Received	Rainbow trout test initiation	*Daphnia magna* test initiation	
L2380930-1 W3	12-Nov-19 at N/A	13-Nov-19 at 1609h	14-Nov-19 at 1330h	14-Nov-19 at 1550h	10.7 – 11.3°C

N/A = Not Available

TESTS

- Rainbow trout 96-h LC50 test
- *Daphnia magna* 48-h LC50 test

RESULTS

Toxicity test results

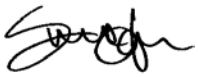
Sample ID	LC50 (% v/v)	
	Rainbow trout	*Daphnia magna*
L2380930-1 W3	>100	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	Rainbow trout	Daphnia magna
Reference toxicant LC50 (95% CL)	91.9 (68.7 – 123.0) µg/L Zn[1]	5.9 (4.8 – 7.3) g/L NaCl[2]
Reference toxicant historical mean (2 SD range)	83.9 (35.4 – 198.7) µg/L Zn	5.7 (3.9 – 8.4) g/L NaCl
Reference toxicant CV	45%	20%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

[1] Test date: October 31, 2019; [2] Test Date: November 20, 2019, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist



Reviewed By:
Edmund Canaria, R.P. Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as $ZnSO_4$)

Table 2. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	*Daphnia magna*
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: 14Nov19 @ 1330h

Work Order No.: 192290

Test Species: *Oncorhynchus mykiss*

Test Validity Criteria:
≥ 90% control survival
WQ Ranges:
T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Sample Information:

Sample ID: L2380930-1 W3
Sample Date: 12Nov19
Date Received: 13Nov19
Sample Volume: 2 x 20L
Other: —

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 9
Alkalinity (mg/L $CaCO_3$): 6

Test Organism Information:

Batch No.: 101719
Source: Lyndon Fish Hatcheries
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.47
Mean Length ± SD (mm): 40 ± 2 Range: 38 - 43
Mean Weight ± SD (g): 0.56 ± 0.05 Range: 0.50 - 0.65

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn L035
Stock Solution ID: 192n05
Date Initiated: Oct 31/19
96-h LC50 (95% CL): 91.9 (68.7 - 123.0) mg/L Zn

Reference Toxicant Mean and Historical Range: 83.9 (35.4 - 198.7) mg/L Zn
Reference Toxicant CV (%): 45.2%

Test Results: The 96h LC50 is estimated to be > 100% (v/v).

Reviewed by: [signature]

Date reviewed: NN·27, 2019

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
Sample I.D. L2380930-1 W3
W.O. # 192290
RBT Batch #: 101719
Date Collected/Time: Nov 12/19 @ not available
Date Setup/Time: Nov 14/19 @ 1330h
CER #: 2
Sample Setup By: JD

Number Fish/Volume: 10/12L
7-d % Mortality: 0.05%
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Thermometer: Cer 2
D.O. meter/probe: YSI / PDS JD
Cond./Salinity meter/probe: YSI / CT CP5 JD
pH meter/probe: SX / PP5 JD

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.0		14.0
D.O. (mg/L)	9.7		9.6
pH	7.6		7.7
Cond. (µS/cm)	593		593
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	10	14.0	14.0	14.5	15.0	15.0	10.2	9.6	9.5	9.6	9.8	7.0	6.9	7.1	7.0	7.2	28	46
6.25				10	10	10	10	14.0	14.0	14.5	15.0	15.0	10.3	9.9	9.5	9.7	9.9	7.4	7.2	7.4	7.1	7.2	61	66
12.5				10	10	10	10	14.0	14.0	14.5	15.0	15.0	10.3	9.6	9.5	9.6	9.7	7.4	7.5	7.6	7.4	7.5	125	132
25				10	10	10	10	14.0	14.0	14.5	15.0	15.0	10.3	9.6	9.6	9.4	9.8	7.5	7.8	7.9	7.8	7.8	190	203
50				10	10	10	10	14.0	14.0	14.5	15.0	14.5	10.3	9.6	9.6	9.5	9.7	7.7	8.0	8.2	8.1	8.2	328	350
100				10	10	10	10	14.0	14.0	14.5	15.0	15.0	9.6	9.7	9.7	9.6	9.8	7.7	8.4	8.4	8.3	8.5	593	612
Initials				SPT	M	A	SPT	JD	SPT	M	A	SPT	JD	SPT	M	M	SPT	JD	SPT	M	A	SPT	JD	SPT

Sample Description/Comments: Clear yellow liquid. No particulates. No odour

Fish Description at 96 h: All fish appear normal — Number of Stressed Fish at 96 h: 0

Other Observations:

Reviewed by: — Date Reviewed: NOV. 27, 2019

Daphnia magna Summary Sheet

Client: ALS Environmental
Work Order No.: 192289

Start Date/Time: Nov 14/19 @ 1550h
Test Species: *Daphnia magna*
Set up by: MF

Sample Information:

Sample ID: C2380980-1 W3
Sample Date: Nov 12/19
Date Received: Nov 13/19
Sample Volume: 2 x 1L.

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤2 daphnids exibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 030196
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 15
Mortality (%) in previous 7 d: 0
Days to first brood: 11

NaCl Reference Toxicant Results:

Reference Toxicant ID: DmNaCl42
Stock Solution ID: 19NaCl
Date Initiated: Nov 20/19
48-h LC50 (95% CL): 5.9 (4.5 - 7.3) g/LNaCL

Reference Toxicant Mean and Historical Range: 5.7 (3.9 - 8.4) g/L NaCL
Reference Toxicant CV (%): 20

Test Results: The 48h LC50 is estimated to be >100 % (v/v)

Reviewed by: [signature]

Date reviewed: Nov 27, 2019

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: ALS Environmental
Sample ID: ~~9 to 3~~ L2386930-1 W3
Work Order No.: 1922289

Start Date/Time: Nov 14/19 @ 15506
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: D.magna
Set up by: MLF

Thermometer: CER#5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration % (v/v)	Rep	Number of Live Organisms 24	Number of Live Organisms 48	No. Immobilized 48	Temperature (°C) 0	Temperature (°C) 24	Temperature (°C) 48	Dissolved oxygen (mg/L) 0	Dissolved oxygen (mg/L) 24	Dissolved oxygen (mg/L) 48	pH 0	pH 24	pH 48	Conductivity (µS/cm) 0	Conductivity (µS/cm) 48
CTRL	A	10	10	0	18.0	19.0	18.5	8.9	9.0	8.2	7.6	7.7	7.7	346	347
	B														
	C														
	D														
6.25	A	10	10	0	18.5	19.0	18.5	8.9	9.0	8.3	7.5	7.7	7.8	359	370
	B														
	C														
	D														
12.5	A	10	10	0	18.5	19.0	18.5	8.9	9.0	8.4	7.4	7.7	7.8	375	379
	B														
	C														
	D											MLF			
25	A	10	10	0	18.5	19.0	18.5	8.8	9.0	8.5	7.4	~~7.8~~ 7.8	7.9	406	408
	B														
	C														
	D														
50	A	10	10	0	18.5	19.0	18.5	8.6	8.9	8.5	7.4	7.8	8.0	467	466
	B														
	C														
	D														
100	A	10	10	0	18.5	19.0	18.5	7.6	8.7	8.6	7.2	7.8	8.1	597	589
	B														
	C														
	D														
Technician Initials		MLF	n	n	MLF	MLF	n	MLF	MLF	n	MLF	MLF	n	MLF	n

Concentration	Hardness*	Alkalinity*
	*(mg/L as CaCo3)	
Control (MHW)	100	66
Highest conc.	300	298
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	18.5		
DO (mg/L)	7.6		
pH	7.2		
Cond (µS/cm)	597		
Salinity (ppt)	0.3		

Comments: _____ Mortality: Heartbeat checked under microscope not req'd

Sample Description: clear yellow liquid, no particulates, no odour

Batch#: 1030/19C 7-d previous # young/brood: 15 Previous 7-d Mortality (%): 0 Day of 1st Brood: 11

Reviewed by: _____ Date reviewed: NOV 27, 2019

APPENDIX C – Chain-of-custody form

ALS Environmental

L2380930

VANCOUVER

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# *L2380930*
ALS requires QC data to be provided with your final results.

Please see enclosed 1 **sample(s) in** 4 **Container(s)**

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag	
L2380930-1 W3		11/12/2019		
192289	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	11/20/2019	2×1L	10.7°
192290	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	11/20/2019	2×20L	11.3°

Subcontract Info Contact: Brittany Puckey (604) 253-4188

Analysis and reporting info contact: Heather McKenzie
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: Heather.McKenzie@alsglobal.com

Please email confirmation of receipt to: **Heather.McKenzie@alsglobal.com**

Shipped By: _____ Date Shipped: _____

Received By: Tyrone Hamilton Date Received: Nov. 13/19 @ 16:09

Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____

Minto

esday, November 12, 2019 4:22 PM

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2380930-COFC

IC Number: 2019-11-12 C

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax mintoenvironment@mintomine.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax ap@mintomine.com

Email 2

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232819 (MMER)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact:

Sampler:

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	96hr LC50 RainbowTrout	48hr - LC50 Daphnia	7day - RainbowTroutEmbryoToxicity	7day - Ceriodaphnia	7day - Lemma minor	Alga 72-h Growth Inhibition	7day - Fathead Minnow	Ra226						Number of Containers
	W3	12-Nov-19		Water	R	R												4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C		
3°	2°			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chad Bustin	Date: 2019-11-12	Time:	Received by:	Date: NOV 12/19	Time: 14:52	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

END OF REPORT

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2380930-COFC

COC Number: 2019-11-12 C

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Minto Explorations Ltd.
Contact:	Minto Environment - Coordinator
Phone:	1-604-759-4659
	Company address below will appear on the final report
Street:	2100-510 West Georgia St.
City/Province:	Vancouver, British Columbia
Postal Code:	V6B 0M3
Invoice To	Same as Report To ☐ YES ☑ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Minto Explorations Ltd.
Contact:	Ruth Cayetano

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax mintoenvironment@mintomine.com
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax ap@mintomine.com
Email 2

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	
Job #:	
PO / AFE:	232819 (MMER)
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: **Sampler:**

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	96hr LC50 RainbowTrout	48hr - LC50 Daphnia	7day - RainbowTroutEmbryoToxicity	7day - Ceriodaphnia	7day - Lemma minor	Alga 72-h Growth Inhibition	7day - Flathead Minnow	Ra226	Number of Containers
	W3	12-Nov-19		Water	R	R							4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human drinking water use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
3°	2°	2°			10°

SHIPMENT RELEASE (client use)		
Released by: Chad Bustin	Date: 2019-11-12	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: RD	Date: NOV 12/19	Time: 14:52

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: RD	Date: Nov 13, 19	Time: 12:00 pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Appendix L – Minto Mine Phase 5 EEM Study Design



Minto Mine
Phase 5 EEM
Study Design

Prepared for:
Capstone Mining Corp. Minto Mine
Whitehorse, Yukon

Prepared by:
Minnow Environmental Inc.
Victoria, British Columbia

January 2019

Minto Mine
Phase 5 EEM
Study Design

Lisa Bowron, M.Sc., R.P. Bio.
Project Manager

Pierre Stecko, M.Sc., R.P. Bio., EP
Senior Project Advisor

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ACRONYMS AND ABBREVIATIONS

ABA – Acid Base Accounting
ANOVA – Analysis of Variance
ANCOVA – Analysis of Covariance
ARD – Acid Rock Drainage
BACI – Before-After-Control-Impact
CALA – Canadian Association for Laboratory Accreditation
CI – Control Impact
CPUE – Catch-per-unit-effort
CWQG – Canadian Water Quality Guidelines
DFO – Fisheries and Oceans Canada
DO – Dissolved Oxygen
DSTSF - Dry Stack Tailing Storage Facility
EEM – Environmental Effects Monitoring
EPT – Ephemeroptera, Plecoptera, and Trichoptera
GIS – Geographic Information System
GPS – Geographic Positioning System
IOC – Investigation of Cause
K-S – Kolmogorov- Smirnov
MACG – Maximum Authorized Concentration in a Grab Sample
MCDS – Minto Creek Detention Structure
MDMER – *Metal and Diamond Mining Effluent Regulation*
MIBC – Methly Isobutyl Carbinol
Minnow – Minnow Environmental Inc.
Minto – Minto Explorations Ltd.
MSE – Mean Square Error
MVFE – Mill Valley Fill Expansion
MVFES2 – Mill Valley Fill Extension Stage 2
PAX – Potassium Amyl Xanthate
PCA – Principal Component Analysis
QA/QC – Quality Assurance/Quality Control
QML – Quartz Mining Licence
RCA – Reference Condition Approach
RO – Reverse Osmosis
TSS – Total Suspended Solid

WRFH – Whitehorse Rapids Fish Hatchery

WSP – Water Storage Pond

WUL – Water Use Licence

WTP – Water Treatment Plant

1 INTRODUCTION

1.1 Site Description

The Minto Mine is a high-grade copper mine located within Selkirk First Nation Category A Settlement Land Parcel R-6A, approximately 240 kilometres (km) northwest of Whitehorse, Yukon Territory (62°37'N latitude and 137°15'W longitude; Figure 1.1). It is owned and operated by Minto Explorations Ltd. (Minto), a wholly owned subsidiary of Capstone Mining Corporation. Development of the mine began in 1997, commercial operations started in October 2007, and the mine entered temporary care and maintenance on October 19, 2018. The facility was permitted to conduct open pit and underground mining, and includes a mill with a capacity of 4,200 tonnes of ore per day. The Minto Mine produced 35.9 million pounds of copper in 2017. Current mineral reserves are approximately 3.4 million tonnes at an average copper grade of 1.6 percent (%).

Mining operations ceased on October 19, 2018 and milling stopped on October 20, 2018. The Minto Mine site currently includes inactive open pit mines and underground mines, the mill, a number of waste rock dumps, a concentrate storage shed, a tailings storage facility, a water retention dam with a Water Storage Pond (WSP), a water treatment plant, administrative offices, an airstrip, and a camp (Figure 1.2). Mill tailings are stored in the Main Pit, Area 2 Pit, and the Dry Stack Tailing Storage Facility (DSTSF; Figure 1.2). Mine-impacted seepage from the DSTSF and from under the Mill Valley Fill Extension (MVFE) is collected at the toe of the MVFE and is pumped to the Main Pit (Figure 1.2). Non-impacted water and treated mine-impacted water are collected in the WSP (Figure 1.2). Effluent from the WSP is periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL) QZ14-031 (August 2015). Minto Creek, in turn, discharges to the Yukon River approximately 7.7 km southeast of the WSP (Figure 1.2).

1.2 Background

Federal effluent regulations for the metal mining industry (*Metal and Diamond Mining Effluent Regulations*; MDMER) were most recently updated in October 2018 (Government of Canada 2018). These regulations, administered under the federal *Fisheries Act*, apply to mining and milling operations that discharge effluent at a rate greater than (>) 50 cubic metres per day (m^3/day). The MDMER outline requirements for routine effluent quality monitoring, acute lethality testing, and Environmental Effects Monitoring (EEM). The objective of EEM is to determine whether effluent discharge is causing an effect on fish, benthic invertebrate communities, and/or the use of fisheries resources. The Minto Mine triggered the MDMER (which were the Metal Mining Effluent Regulations at that time) on July 10, 2006.



Map of Canada



Location of the Minto Mine

0 100 200 400 km

Projection: North American Datum 1983 UTM Zone 8V

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N W E S

Date December 2018
Project 187202.0056

minnow environmental inc.

Figure 1.1

Document Path: S:\Projects\187202\187202.0056 - Minto Phase 5 EEM\4 - GIS\18-56 Fig 1.1 Minto Mine Location.mxd



LEGEND

- Final Effluent Discharge Point
- Mine Footprint
- Water Retention Dam
- Building

0 0.25 0.5 1 km

N W E S

Projection: North American Datum 1983 UTM Zone 8V
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Minto Mine Site Layout and Receiving Environment

Date December 2018
Project 187202.0056

minnow environmental inc.

Figure 1.2

Document Path: S:\Projects\187202\187202.0056 - Minto Phase 5 EEM\4 - GIS\18-56 Fig 1.2 Minto Mine Site Layout and Recieving Env.mxd

In accordance with the MDMER, the following EEM study designs were developed and implemented for the Minto Mine:

- **Phase 1:** developed in 2007 (Minnow and Access 2007) and implemented in 2008 (Minnow and Access 2009);
- **Phase 2:** developed in 2010 (Minnow and Access 2010) and implemented in 2011 (Minnow and Access 2012);
- **Phase 3 (Investigation of Cause):** developed and implemented in 2014 (Minnow 2014a, 2015b); and
- **Phase 4:** developed and implemented in 2016 (Minnow 2016b, 2018b).

Results of the Phase 4 EEM were generally consistent with previous EEMs (Minnow 2018b). In accordance with the MDMER, the biological monitoring requirements of a given Phase of EEM are dependent upon the results of the previous two phases (Government of Canada 2018). For the benthic invertebrate community survey, the Phase 3 and 4 EEMs both indicated no effects on key metrics at magnitudes greater than the Critical Effect Size (CES; see Section 3 for additional detail). For the fish survey, the Phase 2 and 4 EEMs both indicated no effects on key metrics at magnitudes greater than the Critical Effect Size (CES; see Section 3 for additional detail). However, a fish survey was not completed in Phase 3 as that phase focused on an Investigation of Cause (IOC) of effects to the benthic invertebrate community identified in Phases 1 and 2. Environment and Climate Change Canada (ECCC) provided clarification that, as there was not a fish survey in Phase 3, agreement of the Phase 2 and Phase 4 results is not considered confirmation and a fish survey must be completed in Phase 5. Accordingly, the Phase 5 EEM will include a fish survey, and supporting physical, chemical, and biological measures, with an Interpretive Report due to Environment and Climate Change Canada by January 10, 2021. To achieve this deadline, the Phase 5 EEM will be implemented in 2019.

1.3 Objective

The objective of this Phase 5 EEM Study Design is to provide an overview of the characteristics of the mine and its local environment (site characterization) based on information collected to date, a summary of the results of previous EEM studies, and the design of the Phase 5 EEM study. The study design section (Section 4) includes detailed descriptions of the fish survey, along with all supporting physical, chemical, and biological measures, taking into account relevant site characterization information, previous biological monitoring data, and comments and recommendations from previous EEM studies.

1.4 Report Organization

The content of this report reflects the requirements outlined under the EEM portion of the MDMER (Government of Canada 2018) and in the Technical Guidance Document for Metal Mining EEM (Environment Canada 2012). A detailed site characterization is provided in Section 2. A summary of the results from the previous EEM studies is presented in Section 3. Section 4 describes the Minto Mine Phase 5 EEM Study Design, including a benthic invertebrate community survey, a fish survey, supporting environmental measures, sublethal effluent toxicity testing, effluent characterization, and receiving water quality monitoring. Section 5 provides a schedule of project activities. References cited throughout the document are provided in Section 6.

1.5 Contacts

Please contact Ms. Deborah Flemming if there are any questions or comments regarding this report.

Ms. Deborah Flemming, Environmental Manager
Capstone Mining Corp. - Minto Mine
PO Box 11
Whitehorse Central PO
Whitehorse, Yukon Y1A 5X9
Telephone: (604) 759-4634
Email: deborahf@mintomine.com

In the event Minto personnel are unavailable to address technical questions or comments, contact Ms. Lisa Bowron of Minnow Environmental Inc. (Minnow).

Ms. Lisa Bowron, Aquatic Toxicologist
Minnow Environmental Inc.
A Trinity Consultant Company
204 - 1006 Fort Street
Victoria, British Columbia V8V 3K4
Telephone: (250) 595-1627
Email: lbowron@minnow.ca

2 SITE CHARACTERIZATION UPDATE

2.1 Overview

Site characterization information is required with each EEM Study Design. Detailed site characterization information was provided in the Phase 1 to Phase 4 EEM study design reports (Minnow and Access 2007, 2010; Minnow 2014a, 2016b). Therefore, the following sections provide a summary of the previous site characterization information, along with updates, where applicable.

2.2 Mine History

Copper deposits at the Minto Mine were first discovered in 1970 and claims were staked in 1971. Extensive exploration yielded the first significant drill intersection in July 1973. The Minto Mine claims and leases cover an area of approximately 25.9 square kilometres (km^2). Minto Mine entered temporary care and maintenance after mining (October 19, 2018) and milling (October 20, 2018) ceased.

The Minto Mine plan was comprised of seven phases. Phase 1 included construction (April 2006 to October 2007), Phase 2 was from October 2007 to July 2008, Phase 3 was from July 2008 to February 2011, Phase 4 was from February 2011 to 2015, and Phase 5/6 started in 2015 and was halted when the mine was placed in temporary care and maintenance at the end of 2018. These first five phases included incremental increases in processing capacity of the mill (see Section 2.3.1). The mine was in the process of mining the remainder of Phase 6 and licensing Phase 7 when it entered temporary care and maintenance.

2.3 Minto Mine Operations

The Minto operation is currently in temporary care and maintenance and all pits (Minto North, Main, Area 2 Stage 2, Area 2 Stage 3, and Area 118) and underground mines (Minto South, Minto East, and M-Zone) are now mined out and inactive (Figure 1.2). The Minto site also includes waste dumps associated with the different mining areas, ore storage areas, a mill, a crusher pad, a concentrate storage shed, a WSP with a water retention dam, a water treatment plant, administrative offices, an airstrip, and a camp (Figure 1.2). Processing of ore occurred on site in the mill and from Phase 2 until October 20, 2018 (Phase 6). The mill's main unit operations have remained the same as previously reported (Minnow and Access 2007, 2010) except for the process of dealing with tailings (Section 2.3.2).

2.3.1 Mining and Milling

As of October 19, 2018, Minto Mine is under temporary care and maintenance. Previously, open pits were mined using conventional open pit truck and loader operations, and underground mine areas were mined by either room-and-pillar, post-pillar cut-and-fill, or longhole stoping methods (Minto 2014). In its Phase 1 design, the Minto mill was originally authorized to process 1,800 tonnes per day (tpd) of copper ore. In Phase 2, provisions were made to the plant layout and design to accommodate throughput of 2,400 tpd. Equipment initially installed in Phase 1 was sized to accommodate tonnages associated with subsequent phases and only minor modifications to the grinding circuit (i.e., grate sizes inside the semi-autogenous grinding mill and trommel screen size) were required to increase the milling rate to 2,400 tpd in Phase 2, 3,600 tpd in Phase 3, and 4,200 tpd in Phases 4 and 5.

The primary crusher was originally designed to operate six hours per day, 365 days per year at 75% availability, but when mill throughput was increased, the crusher was able to operate 24 hours per day, 365 days per year at an availability of 75%. The mill circuit operated 24 hours per day, 365 days per year at an availability of approximately 93%. Potassium amyl xanthate (PAX), methyl isobutyl carbinol (MIBC), oxide collector alkyl hydroxamates (AM28), mill flocculant, tails flocculant, nitric acid, potassium hydroxide, and hydrated lime were the primary process reagents used in Minto's milling process (Table 2.1). Oxide ore was removed from the mill feed in May 2018 and lead to the elimination of sodium sulfide from the mill process.

2.3.2 Tailings Management and Waste Management

In 2006, planning and development for the Minto Mine included a review of the proposed tailings de-watering technology. Subsequent to this review, and as part of mine construction, Minto installed a filter press system for dewatering tailings to produce dry tailings (approximately 16.5% to 18% moisture by weight) suitable for dry-stacking and compaction. Tailings were thickened and filtered to form filtered cake. From November 2012 to October 2018, thickened tailings were stored as slurry in the Main Pit and the Area 2 Pit. Operation of the tailings facility is in accordance with the amended Quartz Mining Licence (QML)-0001, which expires on December 31, 2030.

Tailings management activities permitted as part of the Phase 5/6 permitting process included expanded use of the Main Pit and Area 2 Pit (Stage 2 and 3) for tailings storage, construction of a dam on the Main Pit, use of the Ridgetop North Pit for tailings storage, and tailings placement in the underground facilities. At present, the tailings are stored in the Main Pit and the Area 2 Pit (Figure 1.2).

Prior to temporary care and maintenance, waste rock was generated from the Minto North Pit and the Minto South Underground. Waste rock was disposed of in the Main Waste Dump Expansion,

Table 2.1: Reagents used in the Minto Mill and Water Treatment Plant, 2015 to 2018

Reagent	Unit	2015	2016	2017	2018
Minto Mill					
Potassium Amyl Xanthate (PAX)	kg	318,900	299,248	312,212	158,700
Methyl Isobutyl Carbinol (MIBC)	L	37,200	45,753	39,528	21,786
Oxide Collector Alkyl Hydroxamates (AM28)	kg	0	0	0	0
Mill Flocculant	kg	4,677	6,000	6,000	2,000
Tails Flocculant	kg	18,000	23,675	25,750	15,750
Nitric Acid	L	56,527	113,384	68,391	44,602
Sodium Sulphide	kg	198,000	8,700	199,670	56,430
Potassium Hydroxide	kg	0	0	0	0
Hydrated Lime	kg	36,400	55,000	73,000	35,000
Minto Water Treatment Plant					
Hydrex/Aluminex	L	24,000	30,750	8,610	0
Flocculant	kg	200	100	0	0
Antiscalant	L	1,248	3,744	1,040	0
1,3,5-triazine-2,4,6-trithione trisodium salt (TMT)	L	0	9,734	6,591	0
Sodium Bicarbonate	kg	1,725	0	0	0
Hydrated Lime	kg	0	0	0	0

MVFE Stage 2 (MVFES2), or Main Pit (Figure 1.2), depending on the results of acid base accounting (ABA) used to characterize its acid rock drainage (ARD) potential. Waste rock that met the criteria (construction grade waste rock that has a Neutralization Potential:Acid Production Potential (NP:AP) ≥ 3, total copper content of < 0.01 , and total Sulphur content of < 0.3%) defined in Minto's WUL and QML could be utilized elsewhere on site for construction material.

The Ridgetop South Backfill Dump and Area 118 Backfill Dump overburden storage areas were designed in Phases 5 and 6. The Ridgetop South Backfill Dump was never constructed and the Area 118 Dump was backfilled with overburden. Instead, overburden material from the Minto North Pit was placed in an overburden pad on top of the Main Waste Dump Expansion for use in future reclamation activities. Overburden material from the Area 2 Pit was placed as a temporary cover for the Dry Stack Tailings Storage Facility (Figure 1.2).

A low-grade ore stockpile is located in the northeast corner of the Main Waste Dump and the oxide ore stockpile is located near the pits (Figure 1.2). A small low-grade ore stockpile remains and will be processed when the mine reopens but alternative plans will be considered if closure occurs. The oxide ore stockpile may be processed if commodity prices are favorable.

Mine-impacted seepage from the Dry Stack Tailings Storage Facility and under the MVFE was originally collected at the Minto Creek Detention Structure (MCDS) at the toe of the MVFE and pumped to the Main Pit (Figure 1.2). In 2016, the MCDS was decommissioned and replaced by the MVFES2 sump. The MVFES2 sump operates on the same concept as the MCDS, collecting mine-impacted seepage from the Dry Stack Tailings Storage Facility, MVFE, and MVFES2 with conveyance to the Main Pit. Precipitation and any surface run-off water meeting end-of-pipe standards were collected in the WSP (Figure 1.2) and additional mine-impacted water was treated and directed to the WSP. Effluent from the WSP was periodically discharged to Minto Creek (see Section 2.4 below).

Minto's Water Treatment Plant (WTP) consists of a filter unit, clarifier unit, and two reverse osmosis (RO) trains constructed in two stages. The first stage consisted of the filter and clarifier units, which were constructed in 2010. The first stage was designed for a maximum capacity of 3,600 m^3/day but proved to operate reliably at flows of approximately 4,000 m^3/day. The ballasted lamella clarifier unit (Actiflo®) system was designed to remove total suspended solids (TSS), total metals, and dissolved copper. In 2012, two RO trains capable of handling 2,500 m^3/day each were added to the treatment process downstream of the existing filtration and clarification units to remove nitrate and selenium. Treatment chemicals used in Minto's WTP include hydrex/aluminex, flocculant, antiscalant, 1,3,5-triazine-2,4,6-trithione trisodium salt (TMT), sodium bicarbonate, and hydrated lime (Table 2.1). Treated effluent, which meets Minto's WUL standards, is typically directed to the WSP, but it can also be directed to Minto Creek. The

by-product of the process is a brine stream that is pumped to the Main Pit or Area 2 Pit, as is any effluent that does not meet the WUL conditions.

2.4 Effluent Quality and Applicable Regulations

From 2015 to 2018 (EEM Phases 4 and 5), the Minto Mine discharged 633,961 cubic metres (m^3) of effluent into Minto Creek. Total annual discharges in the period from 2015 to 2018 were 328,526 m^3 in 2015, 196,689 m^3 in 2016, 81,304 m^3 in 2017, and 27,438 m^3 in 2018 (Table 2.2; Figure 2.1).

2.4.1 Applicable Regulations

Effluent from the Minto Mine is regulated under the federal MDMER and a Type A WUL (QZ14-031) issued by the Yukon Water Board on August 5, 2015. The limits in a Type A WUL are generally more restrictive than those in the MDMER, and require separate monitoring and reporting for effluent discharge and receiving water quality under the WUL's Water Quality Surveillance Program (Table 2.3).

2.4.2 Effluent Quality

Effluent quality monitoring is conducted at Station W3 (Minto Mine final effluent discharge location; Figure 2.2) to meet two MDMER requirements: routine monitoring (once per week) and effluent characterization (four times per year). Effluent quality monitoring has been conducted since pre-construction (i.e., prior to April 1, 2006) and has continued through operations. During mine operations, effluent from the mine was discharged periodically from the WSP into Minto Creek in accordance with the Minto Mine water management plan. Months where effluent was not discharged from the WSP represent flows associated with groundwater inputs and local surface run-off from a small watershed that is located between the WSP and Station W3 and drains into Mine Creek. Since 2006, concentrations of all MDMER parameters have been well below monthly mean limits during routine effluent monitoring (i.e., for both discharge and non-discharge periods). All parameters were below the maximum authorized concentrations in grab samples (MACG) from 2015 to 2018 (i.e., EEM Phases 4 and 5; Table 2.4; Appendix Tables A.1 and A.2). Prior EEMs have shown occasional TSS exceedances of the MACG, but TSS was below MACG from 2015 to 2018.

Acute toxicity testing of rainbow trout (*Oncorhynchus mykiss*, 96-hour pass/fail) and *Daphnia magna* (48-hour pass/fail) returned non-toxic (pass) results over the period from 2015 to 2018 (Table 2.5).

Table 2.2: Volume (m^3) of Effluent Discharged into Upper Minto Creek, 2015 to 2018

Year	Start Time	End Time	Volume of Effluent Discharged
2015	3-Apr-15	31-May-15	328,526
2016	8-Apr-16	6-May-16	443,354
	15-May-16	26-Jun-16	28,723
	7-Jul-16	25-Oct-16	123,612
2017	1-May-17	26-Jun-17	73,493
	11-Jul-17	13-Jul-17	1,904
	26-Jul-17	5-Aug-17	5,907
2018	9-Jun-18	6-Jul-18	21,844
	16-Jul-18	17-Jul-18	610
	10-Aug-18	12-Aug-18	1,888
	27-Aug-18	21-Aug-18	3,096

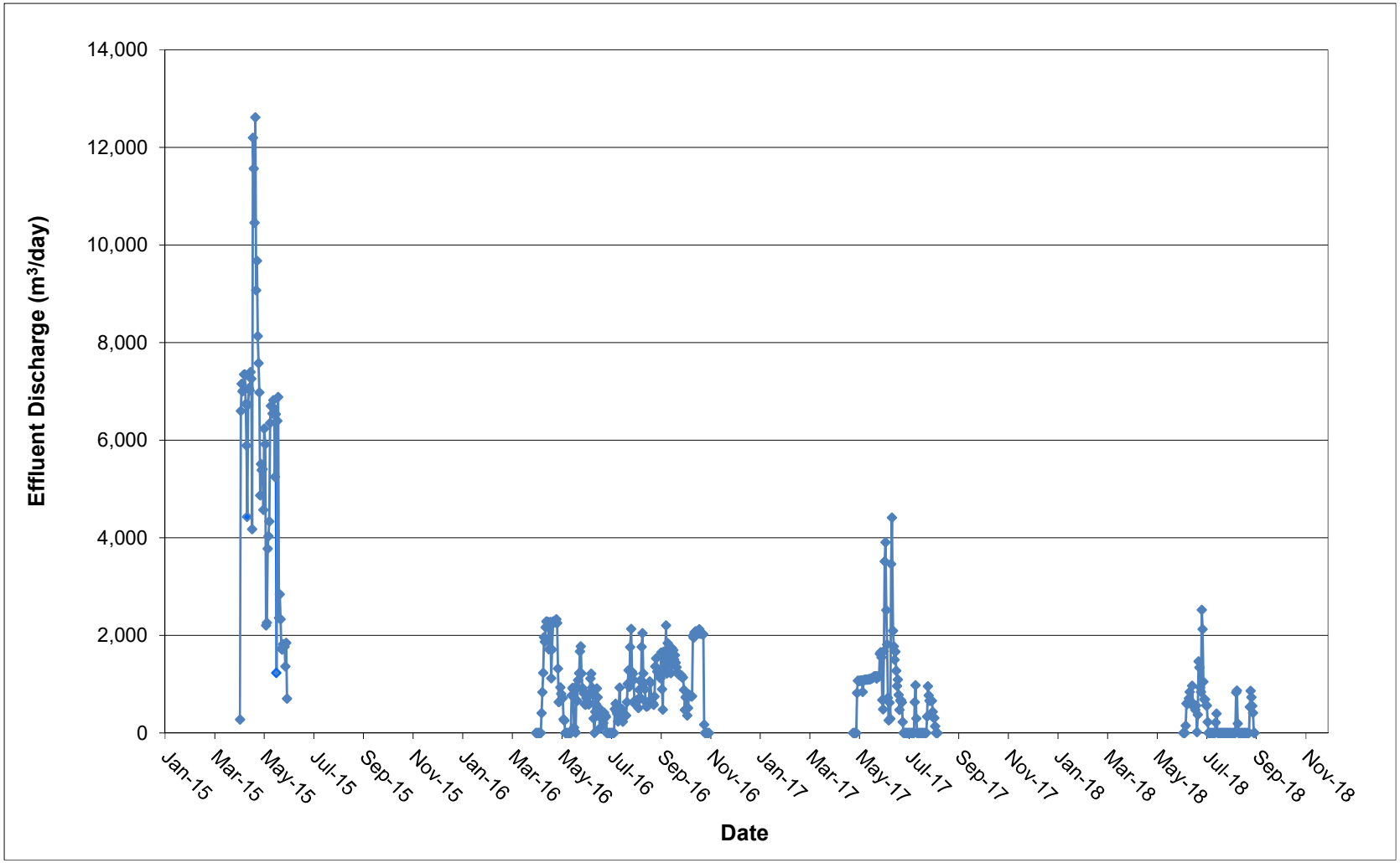


Figure 2.1: Daily Effluent Discharge Volume, 2015 to 2018

Table 2.3: Compliance Monitoring Frequency and Limits Applicable to the Minto Mine Effluent

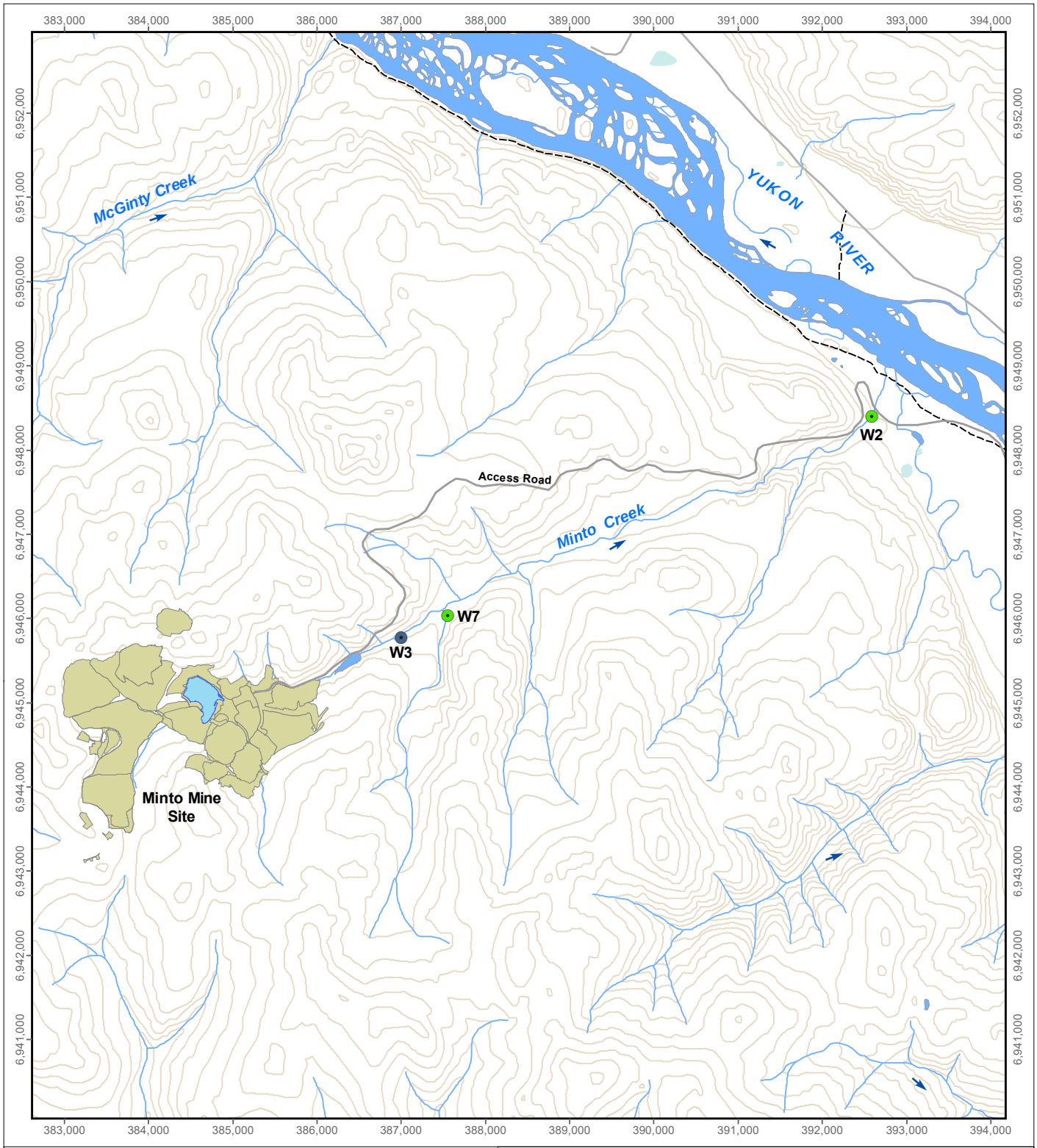
Parameter [a, b]	Units	MDMER Effluent Quality Standards [b]			Water Use License QZ14-031 Effluent Quality Standards [b]	
		Sampling Frequency	Maximum Monthly Mean Concentration	Maximum Authorized Concentration in Grab Samples	Sampling Frequency	Daily Limit
pH	pH units	weekly	-	6.0 - 9.5	weekly	6.5 - 9.0
Suspended Solids	mg/L	weekly	15	30	weekly	15
Aluminum	mg/L	-	-	-	weekly	0.30
Arsenic	mg/L	weekly	0.50	1.0	weekly	0.015
Iron	mg/L	-	-	-	weekly	3.3
Copper	mg/L	weekly	0.30	0.60	weekly	0.060
Lead	mg/L	weekly	0.20	0.40	weekly	0.012
Manganese	mg/L	-	-	-	-	-
Nickel	mg/L	weekly	0.50	1.0	weekly	0.33
Radium-226	Bq/L	quarterly	0.37	1.1	-	-
Zinc	mg/L	weekly	0.50	1.0	weekly	0.090
Total Ammonia	mg/L	-	-	-	weekly	1.0
Oil and Grease	visibility	-	-	-	weekly	no visible oil or grease
Rainbow Trout Acute Lethality	% mortality in 100% effluent	monthly	pass [c]		monthly	pass [c]
Daphnia magna Acute Lethality	% mortality in 100% effluent	monthly	pass [c]		-	-

Notes: MDMER = *Metal and Diamond Mining Effluent Regulations*; - = not applicable.

[a] Analysis of cyanide concentrations is not required under the MDMER because cyanide is not used as a processing agent at the Minto Mine.

[b] MDMER effluent quality standards apply to total metals; Water Use Licence effluent quality standards apply to dissolved metals.

[c] A pass result is < 50% mortality in 100% effluent.



LEGEND

- Final Effluent Discharge Location
- Water Quality Station
- Main Pit Lake
- Mine Footprint

Mine infrastructure data provided by Access Mining Consultants Inc. Mine site contours derived from 2012 aerial imagery otained from Challenger Geomatics.

Minto Mine Effluent and Routine Water Quality Monitoring Stations

0 1 2 4 km

Datum: NAD 83 Map Projection: UTM Zone 8V Data Source: National Topographic Data Base (NTDB) compiled by Department of Natural Resources Canada at a scale of 1:50,000. All rights reserved.

N W E S

Date December 2018
Project 187202.0056

minnow environmental inc.

Figure 2.2

Document Path: S:\Projects\187202\187202.0056 - Minto Phase 5 EEM\4 - GIS\18-56 Fig 2.2 Minto Water Quality.mxd

Table 2.4: Summary of Minto Mine Effluent Quality, Station W3, 2015 to 2018

Parameters	Units	MDMER Monthly Mean Limit	MDMER Grab Limit (MACG)	WUL Daily Limit	2015			2016			2017			2018		
					Sample Size	Mean	% > MACG	Sample Size	Mean	% > MACG	Sample Size	Mean	% > MACG	Sample Size	Mean	% > MACG
Routine Effluent Monitoring																
pH	pH units	6.0-9.5	6.0-9.5	6.5-9.0	48	8.2	0%	54	8.1	0%	54	8.2	0%	39	8.3	0%
Arsenic	mg/L	0.50	1.0	0.015	48	0.00029	0%	54	0.00030	0%	54	0.00030	0%	39	0.00030	0%
Copper	mg/L	0.30	0.60	0.060	48	0.0057	0%	54	0.0074	0%	54	0.0079	0%	39	0.0083	0%
Lead	mg/L	0.20	0.40	0.012	48	0.00021	0%	54	0.000065	0%	54	0.000066	0%	39	0.000057	0%
Nickel	mg/L	0.50	1.0	0.33	48	0.0011	0%	54	0.00097	0%	54	0.0011	0%	39	0.00099	0%
Zinc	mg/L	0.50	1.0	0.090	48	0.010	0%	54	0.0032	0%	54	0.0033	0%	39	0.0045	0%
Total Suspended Solids	mg/L	15	30	15	47	2.6	0%	54	3.3	0%	54	3.9	0%	39	3.5	0%
Radium 226	Bq/L	0.37	1.1	-	4	< 0.010	0%	-	-	-	4	0.024	0%	3	0.010	0%
Effluent Characterization																
Hardness	mg/L	-	-	-	4	257	-	4	225	-	4	222	-	4	254	-
Alkalinity	mg/L	-	-	-	4	212	-	4	183	-	4	196	-	4	223	-
Aluminum	mg/L	-	-	0.30	4	0.15	-	4	0.025	-	4	0.012	-	4	0.071	-
Cadmium	mg/L	-	-	-	4	0.000012	-	4	< 0.0000050	-	4	< 0.0000050	-	4	0.0000092	-
Iron	mg/L	-	-	3.3	4	0.25	-	4	0.065	-	4	0.044	-	4	0.13	-
Mercury	mg/L	-	-	-	4	< 0.000010	-	4	< 0.0000050	-	4	< 0.0000050	-	4	< 0.0000050	-
Molybdenum	mg/L	-	-	-	4	0.0052	-	4	0.0042	-	4	0.0042	-	4	0.0044	-
Ammonia	mg/L	-	-	1.0	4	0.043	-	4	0.034	-	4	0.0067	-	4	0.010	-
Nitrate	mg/L	-	-	-	4	0.89	-	4	2.1	-	4	0.82	-	4	0.38	-
Selenium	mg/L	-	-	-	4	0.00054	-	4	0.00070	-	4	0.00041	-	4	0.00042	-
Conductivity	µS/cm	-	-	-	4	284	-	4	280	-	4	299	-	3	280	-
Temperature	°C	-	-	-	4	2.4	-	4	4.5	-	4	6.0	-	3	4.4	-

Notes: MDMER = *Metal and Diamond Mining Effluent Regulations* ; MACG = maximum authorized concentrations in grab samples; WUL = Water Use Licence.
Shaded values indicate more than 5% of samples had concentrations greater than MDMER Grab limits (MACG).

Table 2.5: Summary of Effluent Acute Toxicity Results, Minto Mine 2015 to 2018

Year	Sample Date	Discharge [a]	Rainbow Trout		*Daphnia magna*	
			Survival at 100% Effluent	Pass/Fail	Survival at 100% Effluent	Pass/Fail
2015	9-Mar-15	ND	100	pass	100	pass
	22-Jun-15	ND	100	pass	100	pass
	31-Aug-15	ND	100	pass	100	pass
	5-Oct-15	ND	100	pass	100	pass
2016	24-Mar-16	ND	100	pass	100	pass
	16-Jul-16	D	100	pass	100	pass
	6-Sep-16	D	100	pass	100	pass
2017	14-Mar-17	ND	100	pass	100	pass
	6-Jun-17	D	100	pass	100	pass
	8-Aug-17	ND	100	pass	100	pass
	24-Oct-17	ND	100	pass	100	pass
2018	20-Feb-18	ND	100	pass	100	pass
	7-Aug-18	ND	100	pass	100	pass
	2-Oct-18	ND	100	pass	100	pass

[a] D = discharge; ND = non-discharge.

2.5 Effluent Mixing

Mixing of Minto Mine effluent in Minto Creek has been reported previously (Minnow 2016b). The groundwater discharge/seepage contribution was initially estimated based on relative flows (at discharge versus in lower Minto Creek), and ranged from 1% in May to 12% in June (Minnow and Access 2007). More recent calculations of mixing confirmed that the percent effluent from groundwater discharge/seepage has been relatively low (i.e., less than [<] 10%) during non-discharge periods. However, during surface water discharge events in 2008 and 2009, effluent concentration at lower Minto Creek ranged from 40% to 100% (Minnow and Access 2010). Flow monitoring in 2016 and 2017, which occasionally included concurrent data for the WSP, final effluent (W3), and lower Minto Creek (W1), suggested an estimated average WSP effluent concentration of 18% and an estimated average final effluent concentration of 23% during discharge (Table 2.6).

2.6 Receiving Water Quality

Receiving water quality has been described in detail in the Phase 1 through Phase 4 EEM reports (Minnow and Access 2007, 2009, 2010, 2012, Minnow 2014a, 2015b, 2016b, 2018b) and in reports prepared under the Minto Mine's WUL (e.g., Minnow 2009a,b, 2010a,b, 2011, 2012, 2013, 2014b, 2015a, 2016a, 2017, 2018a). Under MDMER, receiving water quality is monitored at an effluent-exposed station on lower Minto Creek (Station W2) and at a reference station (Station W7) located on a tributary to Minto Creek (Figure 2.2). Generally, water quality in the Minto Creek drainage is characterized as slightly basic, moderately hard, moderately high in total suspended and dissolved solids, and moderately to highly conductive (Minnow and Access 2009). Background concentrations of total aluminum, total copper, and total iron were associated with elevated TSS concentrations (e.g., Minnow 2009a) and have been identified as naturally greater than Canadian Water Quality Guidelines (CWQG). From 2015 to 2018, concentrations of all parameters in samples from W7 (reference) and W2 (mine-exposed) were below the CWQG; however, individual samples of aluminum, copper, and iron concentrations occasionally exceeded background 95th percentile concentrations (Tables 2.7 and 2.8). At W7, aluminum and iron concentrations exceeded their respective background 95th percentile concentrations in one to two samples per year in 2017 and 2018 (Table 2.7). In 2015, concentrations of aluminum, copper, and iron at W2 exceeded the background 95th percentile concentrations once. Aluminum and iron exceeded the background 95th percentile concentrations at W2 once in 2017 (Table 2.8). These exceedances of background generally occur at frequencies that would be expected (i.e., 95th percentile concentrations are expected to be exceeded at a frequency of 5% by chance alone).

Parameter concentrations at the exposed station (W2) were not elevated compared to the reference station (W7), except with some parameters in 2015, 2016, and 2017

Table 2.6: Relative Effluent and Lower Minto Creek Flow Rates, 2016 and 2017 [a]

Date	Water Flow Rate (m^3/s)			Estimated Effluent Concentration (%)	
	Water Storage Pond	Final Effluent (Station W3)	Lower Minto Creek [b]	Water Storage Pond Water at Lower Minto Creek	Final Effluent at Lower Minto Creek
11-Apr-16	0.014	0.025	0.34	4%	7%
12-Apr-16	0.023	0.026	0.29	8%	9%
13-Apr-16	0.022	0.027	0.47	5%	6%
14-Apr-16	0.025	0.030	0.58	4%	5%
15-Apr-16	0.026	0.027	0.28	10%	10%
16-Apr-16	0.026	0.025	0.34	8%	7%
18-Apr-16	0.020	0.0040	0.13	16%	3%
19-Apr-16	0.026	0.025	0.11	24%	23%
20-Apr-16	0.026	0.025	0.056	47%	45%
21-Apr-16	0.013	0.0085	0.12	11%	7%
29-Apr-16	0.015	0.0090	0.055	28%	16%
17-May-16	0.011	0.013	0.10	10%	13%
25-May-16	0.014	0.017	0.109	13%	16%
3-Jun-16	0.0083	0.010	0.034	24%	30%
7-Jun-16	0.0094	0.013	0.063	15%	21%
9-Jun-16	0.014	0.015	0.046	31%	33%
17-Jun-16	0.0085	0.0085	0.031	27%	27%
25-Jun-16	0.0049	0.0080	0.020	24%	40%
15-Jul-16	0.0046	0.0040	0.028	16%	14%
24-Jul-16	0.012	0.014	0.061	19%	23%
28-Jul-16	0.025	0.022	0.068	36%	32%
2-Aug-16	0.0068	0.010	0.031	22%	32%
5-Aug-16	0.0079	0.010	0.029	27%	34%
18-Aug-16	0.0065	0.0085	0.034	19%	25%
3-Sep-16	0.019	0.025	0.076	25%	33%
6-Sep-16	0.020	0.048	0.087	23%	55%
13-Sep-16	0.019	0.020	0.061	31%	33%
20-Sep-16	0.018	0.042	0.083	22%	51%
23-Sep-16	0.014	0.035	0.070	20%	50%
27-Sep-16	0.014	0.033	0.068	20%	49%
4-Oct-16	0.0086	0.013	0.0360	24%	36%
18-Oct-16	0.024	0.026	0.028	87%	91%
2-May-17	0.0095	0.016	0.079	12%	20%
3-May-17	0.012	0.017	0.17	7%	10%
4-May-17	0.012	0.016	0.11	11%	15%
5-May-17	0.012	0.017	0.30	4%	6%
6-May-17	0.012	0.016	0.20	6%	8%
7-May-17	0.012	0.016	0.11	11%	14%
8-May-17	0.012	0.016	0.11	11%	14%
9-May-17	0.0097	0.015	0.12	8%	12%
10-May-17	0.013	0.015	0.085	15%	18%
11-May-17	0.013	0.015	0.079	16%	19%
12-May-17	0.013	0.016	0.093	14%	17%
13-May-17	0.013	0.016	0.12	10%	13%
14-May-17	0.013	0.017	0.12	10%	14%
15-May-17	0.013	0.017	0.093	14%	18%
16-May-17	0.013	0.016	0.10	12%	16%
17-May-17	0.013	0.018	0.13	10%	13%
18-May-17	0.013	0.018	0.066	19%	27%
19-May-17	0.013	0.018	0.10	13%	18%
20-May-17	0.013	0.018	0.079	16%	22%
24-May-17	0.013	0.017	0.074	18%	23%
31-May-17	0.019	0.018	0.067	29%	27%
6-Jun-17	0.045	0.046	0.14	31%	32%
9-Jun-17	0.0083	0.0046	0.045	18%	10%
13-Jun-17	0.040	0.053	0.23	18%	23%
20-Jun-17	0.011	0.014	0.053	21%	26%
27-Jun-17	0.0026	0.0040	0.019	14%	21%
			Average	**18%**	**23%**

[a] Data are only presented when available for the same date at all three monitoring locations. Flow was not measured at all three monitoring locations on the same day in 2018.

[b] Flow was measured at Station W1 from 11-Apr-16 to 20-Apr-16 and 2-May-17 to 20-May-17 and measured at MC1 from 21-Apr-16 to 18-Oct-16 and 24-May-17 to 27-Jun-17.

Table 2.7: Summary of Receiving Water Quality at Reference Station W7, Minto Mine, 2015 to 2018

Parameter	Unit	Background 95th Percentile [a]	Canadian Water Quality Guideline	2015			2016			2017			2018		
				Number	Mean	% > Applicable Guidelines	Number	Mean	% > Applicable Guidelines	Number	Mean	% > Applicable Guidelines	Number	Mean	% > Applicable Guidelines
EEM Parameters															
pH	pH units	-	6.5-9.0	4	7.64	0%	4	7.71	0%	4	7.70	0%	3	7.86	0%
Temperature	Celsius	-	-	4	1.05	-	4	1.9	-	4	1.8	-	3	2.3	-
Hardness	mg/L	-	-	4	142	-	4	130	-	4	113	-	4	114	-
Alkalinity	mg/L	-	-	4	130	-	4	131	-	4	118	-	4	119	-
Conductivity	µS/cm	-	-	4	147	-	4	147	-	4	132	-	3	121	-
Dissolved Oxygen	mg/L	-	-	3	12	-	4	13	-	4	13	-	3	13	-
Total Suspended Solids	mg/L	-	-	4	60	-	4	9.0	-	4	13	-	4	24	-
Ammonia	mg/L	-	1.5 [b]	4	0.034	0%	4	0.016	0%	4	0.012	0%	4	0.016	0%
Nitrate (as N)	mg/L	-	3.0	4	0.095	0%	4	0.10	0%	4	0.096	0%	4	0.088	0%
Aluminum	mg/L	0.62	0.10	4	0.24	0%	4	0.22	0%	4	0.42	25%	4	0.48	25%
Arsenic	mg/L	-	0.0050	4	0.00054	0%	4	0.00052	0%	4	0.00064	0%	4	0.00080	0%
Cadmium	mg/L	-	0.00012-0.00024 [c]	4	0.000010	0%	4	0.0000062	0%	4	0.000011	0%	3	0.000014	0%
Copper	mg/L	0.013	0.0020-0.0036 [c]	4	0.0026	0%	4	0.0022	0%	4	0.0035	0%	4	0.0039	0%
Iron	mg/L	1.1	0.30	4	0.50	0%	4	0.41	0%	4	0.77	25%	4	0.94	50%
Lead	mg/L	-	0.0022-0.0059 [c]	4	0.00022	0%	4	0.00013	0%	4	0.00021	0%	4	0.00020	0%
Mercury	mg/L	-	0.000026	4	< 0.000010	0%	4	0.0000068	0%	4	< 0.0000050	0%	4	0.0000054	0%
Molybdenum	mg/L	-	0.073	4	0.0015	0%	4	0.0013	0%	4	0.0013	0%	4	0.0012	0%
Nickel	mg/L	-	0.076-0.14 [c]	4	0.0015	0%	4	0.0015	0%	4	0.0022	0%	4	0.0022	0%
Selenium	mg/L	-	0.0010	4	0.00014	0%	4	0.00014	0%	4	0.00014	0%	4	0.00017	0%
Zinc	mg/L	-	0.034-0.051 [d]	4	< 0.0050	0%	4	< 0.0030	0%	4	0.0037	0%	4	0.0036	0%
Additional Parameters with Canadian Water Quality Guidelines															
Thallium	mg/L	-	0.00080	4	< 0.000050	0%	4	< 0.000010	0%	4	< 0.000010	0%	4	0.000010	0%

Mean results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.
Between 5 and 25% of individual results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.
Between 25 and 50% of individual results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.
> 50% of individual results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.

[a] 95th percentile of background identified by Minnow (2009a). If available compare mean concentration to background 95th percentile.
[b] Based on pH 8 and temperature of 5 °Celsius.
[c] Based on the lowest guidelines using lowest hardness.
[d] Based on guideline using 25th percentile of hardness, DOC, and field pH.

Table 2.8: Summary of Receiving Water Quality at Mine-exposed Station W2, Minto Mine, 2015 to 2018

Parameter	Unit	Background 95th Percentile [a]	Canadian Water Quality Guideline	2015			2016			2017			2018		
				Number	Mean	% > Applicable Guidelines	Number	Mean	% > Applicable Guidelines	Number	Mean	% > Applicable Guidelines	Number	Mean	% > Applicable Guidelines
EEM Parameters															
pH	pH units	-	6.5-9.0	4	7.97	0%	4	7.92	0%	4	7.73	0%	4	8.00	0%
Temperature	Celsius	-	-	4	3.9	-	4	3.5	-	4	3.8	-	4	2.9	-
Hardness	mg/L	-	-	4	176	-	4	173	-	4	153	-	4	145	-
Alkalinity	mg/L	-	-	4	157	-	4	151	-	4	148	-	4	142	-
Conductivity	µS/cm	-	-	4	185	-	4	174	-	4	187	-	4	182	-
Dissolved Oxygen	mg/L	-	-	4	12	-	4	13	-	4	13	-	4	13	-
Total Suspended Solids	mg/L	-	-	4	4.2	-	4	4.5	-	4	18	-	4	7.0	-
Ammonia	mg/L	-	1.5 [b]	4	0.018	0%	4	0.0054	0%	4	0.0077	0%	4	0.0070	0%
Nitrate (as N)	mg/L	-	3.0	4	0.12	0%	4	0.63	0%	4	0.15	0%	4	0.074	0%
Aluminum	mg/L	0.62	0.10	4	0.068	25%	4	0.061	0%	4	0.28	25%	4	0.14	0%
Arsenic	mg/L	-	0.0050	4	0.00055	0%	4	0.00050	0%	4	0.00070	0%	4	0.00058	0%
Cadmium	mg/L	-	0.00012-0.00024 [c]	4	0.000012	0%	4	0.0000060	0%	4	0.000011	0%	4	0.0000080	0%
Copper	mg/L	0.013	0.0020-0.0036 [c]	4	0.0065	25%	4	0.0033	0%	4	0.0045	0%	4	0.0036	0%
Iron	mg/L	1.1	0.30	4	0.23	25%	4	0.20	0%	4	0.49	25%	4	0.30	0%
Lead	mg/L	-	0.0022-0.0059 [c]	4	0.00020	0%	4	0.000054	0%	4	0.0014	0%	4	0.000093	0%
Mercury	mg/L	-	0.000026	4	< 0.000010	0%	4	0.0000063	0%	4	< 0.0000050	0%	4	< 0.0000050	0%
Molybdenum	mg/L	-	0.073	4	0.0018	0%	4	0.0016	0%	4	0.0015	0%	4	0.0013	0%
Nickel	mg/L	-	0.076-0.14 [c]	4	0.0012	0%	4	0.0012	0%	4	0.0018	0%	4	0.0014	0%
Selenium	mg/L	-	0.0010	4	0.00015	0%	4	0.00024	0%	4	0.00015	0%	4	0.00014	0%
Zinc	mg/L	-	0.034-0.051 [d]	4	< 0.0050	0%	4	< 0.0030	0%	4	0.0040	0%	4	< 0.0030	0%
Additional Parameters with Canadian Water Quality Guidelines															
Thallium	mg/L	-	0.00080	4	< 0.000050	0%	4	< 0.000010	0%	4	< 0.000010	0%	4	< 0.000010	0%

Mean results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.
Between 5 and 25% of individual results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.
Between 25 and 50% of individual results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.
> 50% of individual results are > applicable guidelines or, for aluminum, copper and iron, 95th percentiles.

[a] 95th percentile of background identified by Minnow (2009a). If available compare mean concentration to background 95th percentile.
[b] Based on pH 8 and temperature of 5 °Celsius.
[c] Based on the lowest guidelines using lowest hardness.
[d] Based on guideline using 25th percentile of hardness, DOC, and field pH.

(Appendix Table A.4). Copper was elevated at W2 compared to W7 in 2015 and 2016, and the elevated concentrations did not coincide with elevated TSS concentrations, suggesting that they were likely mine related (Appendix Table A.4). In 2017, concentrations of arsenic, copper, lead, and zinc were elevated at W2 relative to W7, and these elevated concentrations coincided with higher TSS concentrations. Despite these differences, all values were below applicable CWQG or background 95th percentile concentrations.

2.7 Aquatic Habitats Subject to Biological Monitoring

2.7.1 Receiving Environment

Minto Creek is an ephemeral watercourse, has a main stem length of approximately 17 km, a watershed area of approximately 41 km^2, flows northeast to its confluence with the Yukon River (Figures 1.2 and 2.2), and has been described in detail by Minnow and Access (2007, 2010). The substrate of upper Minto Creek is predominantly sand and gravel, with a very small proportion of cobble that is generally restricted to locations of higher than average gradient and water velocity. Most of upper Minto Creek is confined within an incised channel with steep banks. During the Phase 4 EEM, upper Minto Creek and its watershed (i.e., the watershed upstream of the benthic invertebrate sampling area) were characterized using Geographic Information System (GIS) analysis and *in situ* measurements of habitat variables (September 2017; Table 2.9).

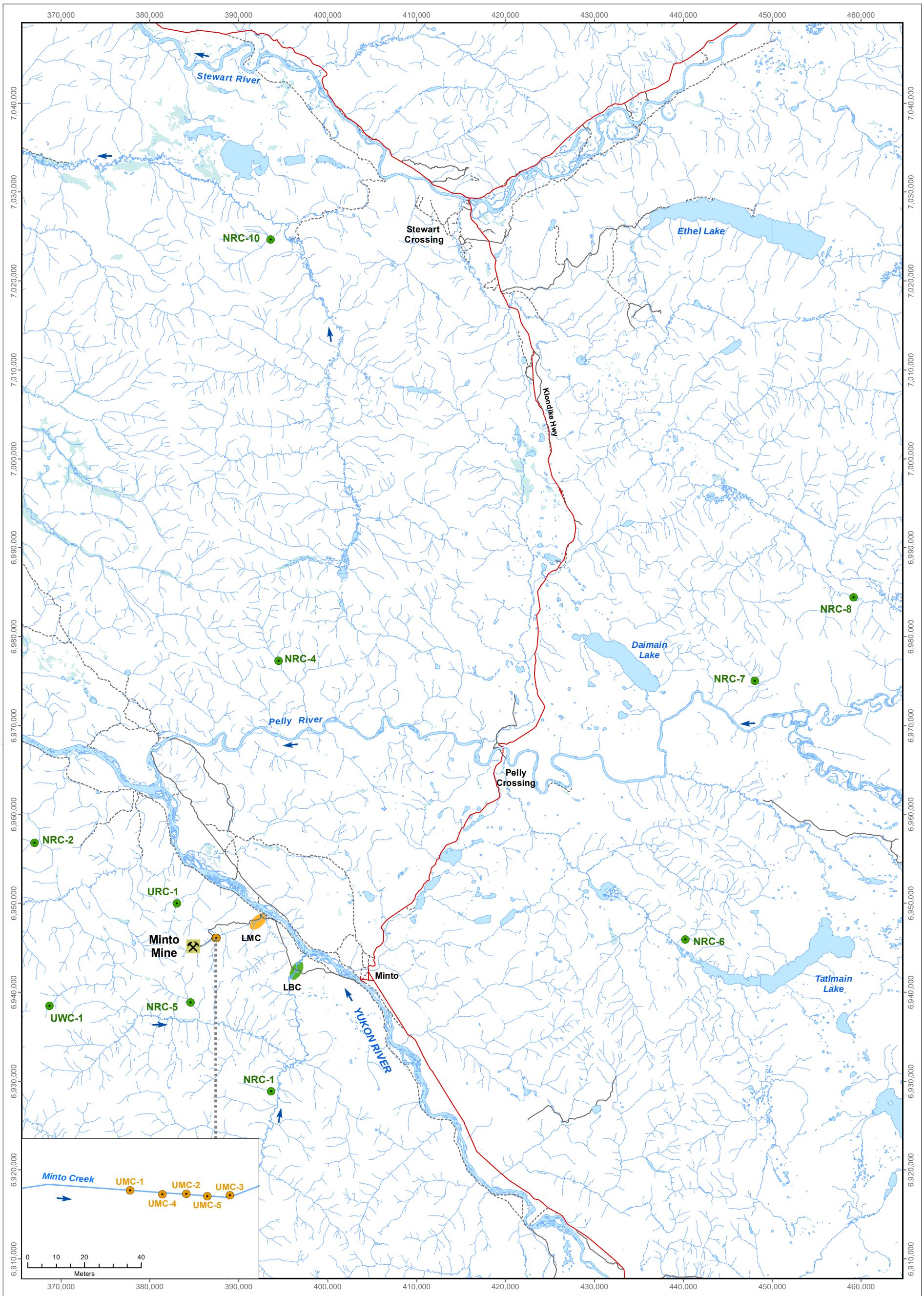
2.7.2 Reference Areas

Reference areas for benthic invertebrate community monitoring include those used in the Phase 1 and Phase 2 EEM studies (upper McGinty Creek and upper Wolverine Creek) and an additional ten benthic invertebrate community reference sites added in Phase 3 to evaluate community conditions using the Reference Condition Approach (RCA; Figure 2.3). Initially, 60 potential sites were selected from a list of 396 potential reference streams and watersheds selected based on common watershed characteristics with upper Minto Creek. These 60 sites were then ranked using Principal Component Analysis (PCA) and the 10 RCA reference sites were selected based on accessibility (i.e., whether or not a helicopter could land nearby) and the similarity of substrate, water depth, stream gradient, and water velocity to upper Minto Creek. All 10 of the RCA reference sites are comparable to upper Minto Creek and require helicopter access. In the Phase 4 EEM, upper McGinty and upper Wolverine creeks plus eight of the new RCA reference sites (from the 10 used in Phase 3) were targeted and will be used in the Phase 5 EEM. If site access is an issue, the 60 ranked potential sites from Phase 4 will be revisited and used to augment the RCA reference group as necessary.

Table 2.9: Summary of Habitat Characteristics of Upper Minto Creek

Characteristics	Value
Watershed Characteristics Measured using GIS	
Stream order [a]	2
Watershed area [b]	11.3 km^2
Watershed perimeter [b]	16 km
Upstream length [b]	8.3 km
Upstream drainage density [b]	0.73 km/km^2
Elevation [a]	660 m asl
Basin slope	9^0
Watershed aspect	southeast
Coverage by low shrubs	39%
Coverage by herbs	48%
Coverage by sparse conifers	6.8%
Plutonic geology	92.6%
Volcanic geology	7.4%
Not burned since 1950	2.0%
Sampling Site Characteristics Measured in September 2014	
Mean gradient	2.30%
Mean water velocity	0.14 m/s
Mean depth	9 cm
Maximum depth	17 cm
Mean wetted width	1.4 m
Mean bankfull width	1.7 m
Mean morphology	23% riffle; 77% run
Mean substrate	43% cobble; 23% gravel; 34% sand
Overhead cover	alder, willow, aspen, spruce

[a] At the benthic invertebrate community sampling sites in upper Minto Creek.
[b] Prior to mine development.



LEGEND

Benthic Invertebrate Community Sampling Locations

- Reference Site
- Exposed Site

Fish Sampling Locations

- Reference Fishing Area
- Exposed Fishing Area

Note - Fish sampling locations for the supporting field-based fish survey (as support for the laboratory-based exposures).

Minto Mine Phase 4 EEM Benthic Invertebrate Community (RCA Design) and Fish Sampling Locations

0 5 10 20
km

Datum: NAD 83 Map Projection: UTM Zone 7V & Zone 8V

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

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Date December 2018
Project 187202.0056

minnow environmental inc.

Figure 2.3

Document Path: S:\Projects\187202\187202.0056 - Minto Phase 5 EEM\4 - GIS\18-56 Fig 2.3 Minto Mine Phase 4 EEM Benthic Invertebrate Community.mxd

2.8 Fish and Aquatic Resources

Previous fishing in Minto Creek (baseline sampling in 1994 [HKP 1994] and annual fish surveys from 2006 to present) has indicated that fish use is restricted to lower Minto Creek and is transient (typically between June and November only). The latter is consistent with other studies indicating utilization of small creeks that flow into large rivers is typically transient and short-lived (Walker 1976, Scrivener et al. 1994). Fishing conducted by the Minto Mine throughout the ice-free season (2006 to 2014; R&D Environmental 2006, 2007, Access 2009, 2010, 2011, 2013, 2014a,b) suggests that use is restricted to the area downstream of a natural barrier located approximately 1.5 km upstream of the creek mouth and highest abundance typically occurs between July and September (Table 2.10). Based on fishing conducted from 1994 and 2018, six fish species have been documented in Minto Creek: Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), juvenile Chinook salmon (*Oncorhynchus tshawytscha*), longnose sucker (*Catostomus catostomus*), round whitefish (*Prosopium cylindraceum*), and slimy sculpin (*Cottus cognatus)*. Juvenile Chinook salmon were consistently the most abundant fish species (Tables 2.10 and 2.11) and were captured while briefly utilizing Minto Creek during migration along the Yukon River to the Pacific Ocean from natal streams upstream of Minto Creek (Access and Minnow 2013).

Substantially more juvenile Chinook salmon were collected in 2009 and 2010 than in other years (Table 2.10), presumably due to emergency discharge of mine water, which resulted in higher than usual flows in Minto Creek; fish were likely attracted to the stable, elevated flow of warmer water with a more consistent temperature regime (Access and Minnow 2013). Studies elsewhere have indicated that juvenile Chinook salmon only enter non-natal tributaries during out-migration when temperatures of those streams reach an equilibrium with the Yukon River, which is usually in June (Walker 1976; Duncan and Bradford 2004). A mark-recapture study completed in 2010 (Access 2010) indicated that up to approximately 1,500 juvenile Chinook salmon were present in lower Minto Creek at any one time (in August, attracted by enhanced water flow). This study also indicated that 90% of the juvenile Chinook salmon spent two weeks or less in Minto Creek and few individuals (approximately 1%) spent 12 weeks in the creek (Access 2010). This is consistent with previous observations of brief occupancy (i.e., nine days on average) of juvenile Chinook salmon in non-natal tributaries (Scrivener et al. 1994).

Since 2012, a reference creek, Big Creek (approximately 7 km southeast of Minto Creek; Figure 2.3), has also been fished for comparison to lower Minto Creek (Access 2013, 2014a,b). This fishing has indicated a similar fish community to Minto Creek, as well as similar juvenile Chinook salmon catchability.

Minto Mine has monitored benthic invertebrate community condition in dominant erosional habitat of lower Minto Creek annually since 2010 as required under their WUL (e.g., Minnow 2009b,

Table 2.10: Summary of Fish Catch in Minto Creek, 1994 to 2018

Year	Month	Method [a]	Effort [b]	Arctic Grayling	Burbot	Chinook Salmon	Longnose Sucker	Round Whitefish	Slimy Sculpin
1994 (Hallam Knight Piesold 1994)	June	EF	8.0	0	0	0	0	1	0
		MT	NR	0	0	0	0	0	2
	August	MT	NR	0	0	0	0	0	4
		EF	16	2	0	0	0	0	2
	September	EF	7.0	2	0	0	0	0	0
		MT	NR	0	0	0	0	0	0
2006 (R&D Environmental 2006)	September	MT	1.0	0	0	0	0	0	0
2007 (R&D Environmental 2007)	May	EF	11	0	0	8	0	0	0
		MT	2.1	0	0	4	0	0	0
	June	EF	3.5	0	0	0	0	0	0
		MT	3.4	0	0	24	0	0	6
2008 (Access Consulting Group)	June	EF	6.6	0	0	0	0	0	0
		MT	11	0	0	0	0	0	0
	September	EF	6.7	0	0	1	0	0	0
		MT	19	0	0	17	0	0	0
2009 (Access Consulting Group 2009)	September	MT	32	1	0	292	0	0	0
	October	MT	98	0	1	695	0	0	0
2010 (Access Consulting Group 2010)	June	MT	16	0	0	0	0	0	3
	July	MT	30	0	0	493	0	0	3
	August	MT	35	3	1	831	0	0	0
	September	MT	29	1	1	433	0	0	1
	October	MT	16	0	1	95	0	0	0
	November	MT	35	0	0	371	0	0	0
2011 (Access Consulting Group 2011)	July	MT	19	0	0	1	0	0	2
	August	MT	19	0	0	3	9	0	0
	September	MT	12	0	0	6	3	0	4
	October	MT	15	0	0	2	0	0	1
2012 (Access Consulting Group 2013)	June	EF	9.2	1	0	0	0	0	3
		MT	10	0	0	0	0	0	4
	July	MT	13	0	0	0	0	0	1
	August	MT	8.8	0	0	0	0	0	0
	September	MT	11	0	0	3	0	0	1
2013 (Access Consulting Group 2014a)	May	EF	27	1	0	0	0	0	0
		MT	5.1	0	0	0	0	0	1
	June	EF	30	0	1	0	0	0	2
		MT	10	0	0	0	0	0	0
	July	MT	10	0	0	0	0	0	0
	August	MT	16	0	0	19	0	0	6
	September	MT	14	0	0	19	0	0	0
	October	MT	17	0	0	83	0	0	0
2014 (Access Consulting Group 2014b)	June	MT	12	0	0	0	0	0	0
	July	MT	14	0	0	0	0	0	0
	August	MT	13	0	1	58	0	0	2
	September	MT	18	0	0	89	0	0	0
	October	MT	13	0	0	4	0	0	0
2015 (Access Consulting Group)	June	MT	11	0	0	0	0	0	0
	July	MT	14	0	0	4	0	0	0
	August	MT	13	0	0	0	0	0	0
	September	MT	14	0	0	2	0	0	0
	October	MT	12	0	0	0	0	0	0
2016 (Access Consulting Group)	June	MT	18	0	0	0	0	0	0
	July	MT	16	0	0	0	0	0	0
	August	MT	18	0	0	0	0	0	0
	September	MT	18	0	0	6	0	0	0
2017 (Minto Mine)	June	MT	4.0	0	0	0	0	0	4
	July	MT	3.0	0	1	6	0	0	0
	August	MT	3.0	0	0	11	0	0	1
	September	MT	4.0	0	1	10	0	0	1
2018 (Minto Mine)	June	MT	13	0	0	0	0	0	0
	July	MT	2.0	0	0	0	0	0	0
	September	MT	14	0	0	0	0	0	0

[a] EF = electrofishing; MT = minnow trapping.

[b] EF effort in minutes of electric current application and MT effort in minnow trap days. NR = effort was not recorded.

Table 2.11: Summary of Fish Catch and CPUE in Minto Creek, 2011 to 2018

Year	Month	Method [a]	Effort [b]	Units	Arctic Grayling	Burbot	Chinook Salmon	Longnose Sucker	Slimy Sculpin
2011 (Access Consulting Group 2011)	July	MT	19	number	-	-	1	-	2
				#/MT day	-	-	0.052	-	0.10
	August	MT	19	number	-	-	3	9	-
				#/MT day	-	-	0.16	0.49	-
	September	MT	12	number	-	-	6	3	4
				#/MT day	-	-	0.49	0.25	0.33
	October	MT	15	number	-	-	2	-	1
				#/MT day	-	-	0.13	-	0.066
2012 (Access Consulting Group 2013)	June	EF	9.2	number	1 [c]	-	-	-	3
				#/min	0.0018	-	-	-	0.0054
		MT	10	number	-	-	-	-	4
				#/MT day	-	-	-	-	0.38
	July	MT	13	number	-	-	-	-	1
				#/MT day	-	-	-	-	0.078
	August	MT	8.8	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	September	MT	11	number	-	-	3	-	1
				#/MT day	-	-	0.28	-	0.092
2013 (Access Consulting Group 2014a)	May	EF	27	number	1 [c]	-	-	-	-
				#/min	0.00062	-	-	-	-
		MT	5.1	number	-	-	-	-	1
				#/MT day	-	-	-	-	0.20
	June	EF	30	number	-	1	-	-	2
				#/min	-	0.034	-	-	0.067
		MT	10	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	July	MT	10	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	August	MT	16	number	-	-	19	-	6
				#/MT day	-	-	1.2	-	0.39
	September	MT	14	number	-	-	19	-	-
				#/MT day	-	-	1.3	-	-
	October	MT	17	number	-	-	83	-	-
				#/MT day	-	-	5.0	-	-
2014 (Access Consulting Group 2014b)	June	MT	12	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	July	MT	14	number	-	-	-	-	-
				#/MT day	-	-	-	-	-

[a] EF = electrofishing; MT = minnow trapping.
[b] EF effort in minutes of electrical current application and MT effort in minnow trap days.
[c] Observed but not captured.

Table 2.11: Summary of Fish Catch and CPUE in Minto Creek, 2011 to 2018

Year	Month	Method [a]	Effort [b]	Units	Arctic Grayling	Burbot	Chinook Salmon	Longnose Sucker	Slimy Sculpin
2014 (Access Consulting Group 2014b)	August	MT	13	number	-	1	58	-	2
				#/MT day	-	0.075	4.3	-	0.15
	September	MT	18	number	-	-	89	-	-
				#/MT day	-	-	5.1	-	-
	October	MT	13	number	-	-	4	-	-
				#/MT day	-	-	0.31	-	-
2015 (Access Consulting Group)	June	MT	11	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	July	MT	14	number	-	-	4	-	-
				#/MT day	-	-	0.29	-	-
	August	MT	13	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	September	MT	14	number	-	-	2	-	-
				#/MT day	-	-	0.15	-	-
	October	MT	12	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
2016 (Access Consulting Group)	June	MT	18	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	July	MT	16	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	August	MT	18	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	September	MT	18	number	-	-	6	-	-
				#/MT day	-	-	0.33	-	-
2017 (Minto Mine)	June	MT	4.0	number	-	-	-	-	4
				#/MT day	-	-	-	-	1.0
	July	MT	3.0	number	-	-	4	-	-
				#/MT day	-	-	1.3	-	-
	August	MT	3.0	number	-	-	-	-	1
				#/MT day	-	-	-	-	0.33
	September	MT	4.0	number	-	-	2	-	1
				#/MT day	-	-	0.50	-	0.25
2018 (Minto Mine)	June	MT	13	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	July	MT	2.0	number	-	-	-	-	-
				#/MT day	-	-	-	-	-
	September	MT	14	number	-	-	-	-	-
				#/MT day	-	-	-	-	-

[a] EF = electrofishing; MT = minnow trapping.
[b] EF effort in minutes of electrical current application and MT effort in minnow trap days.
[c] Observed but not captured.

2010b, 2011, 2012, 2013, 2014b, 2015a, 2016a, 2017, 2018a). From 2012 to present, a Hess sampler with 500-micrometre (µm) mesh has been used to collect samples from erosional habitats in lower Minto Creek. Results of this sampling indicate a mean taxon richness of 12 to 20, good representation of sensitive Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa (mayflies, stoneflies and caddisflies; 22% to 63% of all organisms) and good representation by non-biting midge larvae (Chironomidae; 29% to 61% of all organisms). Inter-annual variability has been high, possibly due to glaciation of the creek over the winter and other inter-annual differences in environmental conditions. Comparisons to a reference Creek (lower Wolverine Creek, located approximately 12 km northwest of Minto Creek; Figure 2.3) has generally indicated that lower Minto Creek has a greater number of taxa and a greater dominance of sensitive EPT taxa than the reference creek.

3 REVIEW OF PREVIOUS EEM STUDIES

3.1 Overview

The Minto Mine Phase 1 to 4 EEM studies were implemented in 2008, 2011, 2014, and 2016. The Phase 1, 2, and 4 studies included a benthic invertebrate community survey and a fish population survey (Table 3.1), as well as supporting effluent sublethal toxicity testing and receiving water quality monitoring (Minnow and Access 2009, 2012). The Phase 3 study was an Investigation of Cause (IOC) into differences in benthic invertebrate community structure in upper Minto Creek, relative to reference creeks as detected using the Bray-Curtis Index of Dissimilarity (Bray and Curtis 1957). A fish study was not required in Phase 3, but as with other phases, the IOC included supporting effluent sublethal toxicity testing and receiving water quality monitoring (Table 3.1; Minnow 2015b). Results of the Minto Mine Phases 1 to 4 EEM biological studies are briefly summarized in the following subsections.

3.2 Benthic Invertebrate Community Surveys

Phase 1 and 2 EEM benthic invertebrate community surveys indicated a number of differences between mine-exposed and reference areas (Table 3.2). The Bray-Curtis Index differed in all comparisons to references creeks, indicating a consistent difference in the benthic invertebrate community composition of upper Minto Creek relative to upper McGinty and upper Wolverine creeks. Such differences in the Bray-Curtis Index are neither unusual, nor necessarily attributable to the Minto Mine. Furthermore, the Bray-Curtis Index does not provide information on the nature of the differences (although supporting analyses can be used to infer reasons for differences) and has been identified as being pre-disposed towards significant differences even in the absence of a real effect (Huebert et al. 2011). The EEM endpoints of number of taxa, density, and Simpson's Evenness returned equivocal results in the first two studies, but in general, indicated higher density, higher number of taxa, and lower Simpson's Evenness in upper Minto Creek relative to the reference creeks (Table 3.2). Higher number of taxa is often associated with good environmental quality and likely contributes to lower Simpson's Evenness as is often observed in communities with greater taxon richness. Supporting analyses suggested that upper Minto Creek had lower proportions of EPT taxa (mayflies, stoneflies, and caddisflies) and higher proportions of chironomids (non-biting midge larvae) compared to reference. This may have caused the differences shown in the Bray-Curtis Index, and correlation analysis of the Phase 1 and 2 data indicated that they could have been attributable to a slight mine-related influence on nutrient concentrations in Minto Creek.

Phase 1 and the Phase 2 Bray-Curtis Index differences triggered an IOC in Phase 3. The Phase 3 (IOC) benthic invertebrate community survey was implemented using the RCA. The RCA

Table 3.1: Summary of Previous Minto Mine Environmental Effects Monitoring (EEM) Study Designs

EEM Phase	Benthic Invertebrate Community Survey	Fish Survey	Fish Usability [a]
1 (2008)	Erosional habitat of upper Minto Creek compared to erosional habitat of upper McGinty Creek. Hess sampling using 250 µm mesh. Results evaluated at > 250 µm.	Non-lethal survey of lower Minto Creek targeting young-of-year chinook salmon.	Not required
2 (2011)	Erosional habitat of upper Minto Creek compared to erosional habitat of upper McGinty Creek and erosional habitat of upper Wolverine Creek. Hess sampling using 250 µm mesh. Results evaluated at > 250 µm and at > 500 µm.	Non-lethal survey of lower Minto Creek targeting young-of-year chinook salmon. Laboratory (fish hatchery) exposure of young-of-year chinook salmon to a mixture of Minto effluent and Minto Creek water (approximately 12% effluent) compared to reference fish (reared in hatchery water)	Not required
3 (2014)	Erosional habitat of upper Minto Creek compared to erosional habitat of twelve reference creeks using the Reference Condition Approach (RCA). Hess sampling using 500 µm mesh. Results evaluated at > 500 µm.	Not required	Not required
4 (2016)	Erosional habitat of upper Minto Creek compared to erosional habitat of ten reference creeks using the Reference Condition Approach (RCA). Hess sampling using 500 µm mesh. Results evaluated at > 500 µm. Conducted a Control-Impact (CI) comparing exposed areas (5 replicate stations) of Minto Creek to 10 reference sites.	Non-lethal survey of lower Minto Creek targeting young-of-year chinook salmon. Laboratory (fish hatchery) exposure of young-of-year chinook salmon to two mixture of Minto effluent and Yukon River water (approximately 14% and 25% effluent) compared to reference fish (reared in Yukon River water)	Not required

[a] Fish usability studies were not required due to low mercury levels.

Table 3.2: Summary of Comparisons of Benthic Invertebrate Community and Fish Population EEM metrics in Upper Minto Creek to Reference, 2008 to 2016

Phase	Significantly Different?							
	Benthic Invertebrate Community [a]				Fish population [b,c]			
	Density	Number of Taxa	Simpson's Evenness	Bray-Curtis Index	Survival	Energy Use		Energy Storage
					Length-Frequency	Body Weight	Fork Length	Condition
Phase 1 (2008)	Yes (+13.9)	No	No	Yes (+12.7)	-	-	-	-
Phase 2 (2011) [d]	Yes (+46.1)/ No	No/ Yes (+3.8)	Yes (-2.4)/ Yes (-2.8)	Yes (+11.5)/ Yes (+10.5)	No	6.0%	No	2.0%
	Yes (+22.6)/ No	Yes (+3.2)/ Yes (+2.3)	Yes (-3.5)/ Yes (-1.5)	Yes (+6.0)/ Yes (+6.4)	-	-	-	-
Phase 3 (2014)	No at ⅔ stations [e,f]	No	No	No at ⅔ stations [e,g]	1.0%	No	No	-2.7%
Phase 4 (2016)	Yes (-1.2)	No	No	No	-8.0%	6.9%	1.6%	2.3%

[a] Effect size expressed as number of reference area standard deviations where a statistically significant difference was found, the value represents the number of standard deviations and direction of change (positive or negative) by which the exposure area differed from the reference areas.

[b] Effect size expressed as increase or decrease percent (%) compared to reference.

[c] Only a fish usage survey was conducted in Phase 1 and fish surveys were not required in Phase 3.

[d] Benthic invertebrate results for 250 µm mesh/500 µm mesh.

[e] In the Phase 3 Environmental Effects Monitoring (EEM), stations UMC-1 and UMC-2 were within reference condition for all EEM primary metrics.

[f] One of three stations (station UMC-3) was out of reference condition for density (higher than reference condition).

[g] One of three stations (station UMC-3) was "possibly" out of reference condition for Bray-Curtis index (per Kilgour et al. 1998).

evaluation indicated that two of three upper Minto Creek replicates (UMC-1 and UMC-2) did not differ from the reference condition based on any of the four primary EEM-effect metrics (Table 3.2). One replicate (UMC-3) was within reference condition for taxon richness and Simpson's evenness, had organism abundance significantly greater than the reference condition, and had a Bray-Curtis Index that could not be conclusively categorized as within the reference condition nor significantly different from the reference condition (Table 3.1). Overall, the RCA evaluation suggested that effluent exposure had minimal influence on benthic invertebrate communities of upper Minto Creek. The evaluation also suggested that previous control-impact (CI) studies might have been confounded by comparison to too few reference areas that were naturally different from Minto Creek. Nonetheless, some supporting benthic invertebrate community metrics continued to suggest subtle differences in community structure of upper Minto Creek relative to reference (including lower percent mayflies and stoneflies, higher percent caddisflies, and higher percent chironomidae) that were similar to those previously observed. Correlation analysis of the Phase 3 data did not identify any clear mine-related influences on the benthic invertebrate community.

Phase 4 EEM benthic invertebrate community survey results were consistent with Phase 3 (Table 3.2). Unlike in Phases 1 and 2, Bray-Curtis Index in Phase 4 was not significantly different at upper Minto Creek when compared to reference areas. Mine-exposed benthic invertebrate communities of upper Minto Creek were within reference range for all four primary EEM metrics. Under a supporting CI evaluation, density was significantly lower at upper Minto Creek compared to reference areas but below the critical effect size of plus or minus (±) 2 standard deviations (Table 3.2). This suggests that the differences may not be ecologically relevant. Both Phase 3 and 4 had significant differences between upper Minto Creek and reference for EPT taxa, Plecoptera (stoneflies), and oligochaetes (worms), but differences were in the opposite direction. Phase 3 had greater proportion of ETP and Plecoptera and lower oligochaetes whereas, Phase 4 had lower EPT and Plecoptera and greater oligochaetes. Taxon proportion results were ambiguous to interpreting effluent-related influences.

In accordance with the MDMER, the biological monitoring requirements of a given Phase of EEM are dependent upon the results of the previous two phases (Government of Canada 2018). For the benthic invertebrate community survey, the Phase 3 and 4 EEMs both indicated no effects on key metrics (density, taxon richness, and Simpson's Evenness) at magnitudes greater than the Critical Effect Size (CES; ± 2 standard deviations), and thus a benthic invertebrate community survey is not required in Phase 5.

3.3 Fish Population Surveys

The Phase 1 EEM fish survey indicated that Minto Creek was unused by fish in June 2008 and was only used by very small numbers of juvenile Chinook salmon in September 2008 (Table 2.10). The Phase 2 EEM fish survey confirmed the limited use of lower Minto Creek by fish in 2011, with capture of low numbers of juvenile Chinook salmon and extremely low numbers of longnose sucker and slimy sculpin (Table 2.10). Hatchery-based exposures in Phase 2 indicated that exposure to mine effluent may result in a very slight increase in fish size (below critical effect size of 25%) and body condition (below the critical effect size of 10%), but that a minimum of five to six weeks of constant exposure would be required to elicit this response (Table 3.2). A fish population survey was not required in Phase 3. Phase 4 EEM fish survey results confirmed Phase 1 and 2 results that lower Minto Creek had limited use by fish (Table 2.10). Only six juvenile Chinook salmon were captured from June to September 2016. A hatchery-based exposure similar to Phase 2 was conducted in Phase 4 but with two different effluent concentrations (14% and 25%). Fish exposed to the higher concentration were slightly larger and had better condition (below the critical effect size of 10%) that reference fish (Table 3.2). At the lower concentration, exposed fish had slightly lower condition than reference fish. Exposed Phase 2 fish and fish exposed to the higher concentration in Phase 4 were similar in that they had slightly greater size and condition.

In accordance with the MDMER, the biological monitoring requirements of a given Phase of EEM are dependent upon the results of the previous two phases (Government of Canada 2018). For the fish survey, the Phase 2 and 4 EEMs both indicated no effects on key metrics at magnitudes greater than the Critical Effect Size (CES; see Section 3 for additional detail). However, a fish survey was not completed in Phase 3 as that phase focused on an Investigation of Cause (IOC) of effects to the benthic invertebrate community identified in Phases 1 and 2. Environment and Climate Change Canada (ECCC) provided clarification that, as there was not a fish survey in Phase 3, agreement of the Phase 2 and Phase 4 results is not considered confirmation and a fish survey must be completed in Phase 5.

3.4 Sublethal Toxicity Testing

Sublethal toxicity testing of final effluent was conducted twice per year from 2007 to 2009 and has been conducted annually since 2010, all in accordance with MDMER. The most recent instance of a response was in 2013 (prior to Phase 5) when testing of the water flea *Ceriodaphnia dubia* indicated reproductive impairment at an effluent concentration of 38.6% (Table 3.3). Impairment to this endpoint was also observed in one of two tests conducted in 2008, but was not corroborated in any other tests since then.

Table 3.3: Minto Mine Effluent Sublethal Toxicity Test Results (% Effluent) at W3, 2007 to 2018

EEM Phase	Date	Rainbow trout embryo	*Ceriodaphnia dubia*		*Pseudokirchneriella subcapitata*	*Lemna minor*	
		EC25 Survival	LC50 Survival	IC25 Reproduction	IC25 Growth [a]	IC25 Dry Weight [a]	IC25 Frond Increase [a]
1	5 & 7-Jun-07	> 100% [b]	> 100%	> 100%	> 90.0%	> 97%	> 97%
	29-Oct-07	> 100%	> 100%	> 100%	> 90.0%	> 97%	> 97%
	3-June-08	88%	> 100%	> 100%	> 90.9%	> 97%	> 97%
	28-Oct-08	> 100%	> 100%	0.33%	> 90.9%	> 97%	> 97%
Geometric Mean		**97%**	**> 100%**	**24%**	**> 90.9%**	**> 97%**	**> 97%**
2	26-May-09	> 100%	> 100%	> 100%	> 90.9%	> 97%	> 97%
	15-Sep-09	-	> 100%	> 100%	-	-	-
	16-Nov-09	> 100%	> 100%	> 100%	> 90.9%	> 97%	> 97%
	11-May-10	> 100%	> 100%	> 100%	> 90.9%	> 97%	> 97%
	22-Nov-11	> 100%	> 100%	> 100%	> 90.9%	> 97%	> 97%
Geometric Mean		**> 100%**	**> 100%**	**> 100%**	**> 90.9%**	**> 97%**	**> 97%**
3	16-Oct-12	> 100%	> 100%	> 100%	> 90.9%	> 97%	> 97%
	5-Nov-13	> 100%	> 100%	38.6%	> 90.9%	> 97%	> 97%
	27-Oct-14	> 100%	> 100%	>100%	> 90.9%	> 97%	> 97%
Geometric Mean		**> 100%**	**> 100%**	**73%**	**> 90.9%**	**> 97%**	**> 97%**
4	13-Oct-15 [c]	> 100% [d]	> 100%	> 100%	> 90.9%	> 97%	> 97%
	23-Oct-16	> 100%	> 100%	> 100%	> 95.2%	> 97%	> 97%
	12-Sep-17 [e]	> 100%	> 100%	> 100%	> 95.2%	> 97%	> 97%
	2-Oct-18	> 100%	> 100%	> 100%	> 95.2%	> 97%	> 97%
Geometric Mean		**> 100%**	**> 100%**	**> 100%**	**> 95.2%**	**> 97%**	**> 97%**

Notes: EEM = Environmental Effects Monitoring; EC = Effects Concentration; IC = Inhabitation Concentration.

[a] Highest concentration tested.

[b] 2007 June test invalid due to non-viable eggs - the quality control criteria for viability in controls were not met.

[c] All tests except rainbow trout test, which was initiated with a sample collected October 5th, 2015.

[d] Minto also completed a rainbow trout embryo-alevin test which returned the same result.

[d] *Ceriodaphnia dubia* and *P. subcapitata* samples were collected on 12-Sep-17, samples for the rainbow trout embryo test were collected on 22-Oct-17 and the *Lemna minor* samples were collected on 26-Sep-17.

4 PHASE 5 EEM STUDY DESIGN

The Minto Mine Phase 5 EEM is a "periodic monitoring" study (Environment Canada 2012), and includes a laboratory-based fish exposure program using juvenile Chinook salmon, and a field-based characterization of the use of Minto Creek by fish (Table 4.1). Other EEM components implemented by the Minto Mine are also presented as part of this study design (sublethal toxicity testing, effluent characterization, and water quality monitoring). A fish usability assessment is not required at the Minto Mine because mercury concentrations in final effluent do not exceed 0.10 micrograms per litre (µg/L; per Environment Canada 2012). Similarly, a selenium fish tissue study (under the updated MDMER; Government of Canada 2018) is not required since selenium concentrations in effluent were lower than the guideline of 5 µg/L (average concentration) and the single grab sample concentration of 10 µg/L.

The benthic invertebrate community survey will be conducted in erosional habitat of upper Minto Creek (the immediate receiver of Minto Mine effluent), and will be evaluated using the RCA consistent with the approach applied in the Minto Mine Phase 4 EEM. The benthic survey will be conducted in the late summer (late August or early September) of 2019.

Requirements for a fish population survey will be addressed in an on-site laboratory study similar to that implemented for the Minto Mine Phase 4 EEM. This alternative approach is proposed due to very low numbers of fish typically encountered in Minto Creek (see Section 2.8) precluding sample sizes sufficient for meaningful data analysis and interpretation. This alternative approach will be supported by non-lethal fish collections and meristic measurement in lower Minto Creek, which is the area closest to the mine previously shown to support fish. The laboratory-based fish exposures will be implemented in the summer (late July to early September) of 2019. The field-based fish occupancy characterization will be implemented at monthly intervals in July, August, and September 2019 to identify periods of maximum use and to potentially provide sufficient sample size for non-lethal data analysis and interpretation.

Additional detail on all components of the Minto Mine Phase 5 EEM is provided in the following sections.

4.1 Fish Survey - Laboratory Exposures

As indicated in Section 2.7, fish studies were initiated in Minto Creek in 1994 (baseline) and have been completed annually since 2006. To date, only one species (juvenile Chinook salmon) has occurred at sufficient abundance to support a conventional EEM fish survey; however, this only occurred in 2009 and 2010, when emergency discharge resulted in significantly enhanced flow in Minto Creek. Furthermore, exposure duration is limited, with 90% of juvenile Chinook salmon spending less than two weeks in Minto Creek during their out-migration along the Yukon River

Table 4.1: Overview of the Minto Mine Phase 5 Environmental Effects Monitoring Study Design for Biological Monitoring

Area	Fish Survey		Supporting Water Quality	
	Overview	Supporting Data	Field-Based Measures [a]	Analytical Samples [b]
Effluent-Exposed Areas				
Lower Minto Creek	Non-lethal survey commencing in July 2019 and repeated monthly through September. Targeting the collection of 100 juvenile Chinook salmon, which will be measured (length and fresh body weight). Any external abnormalities will noted on all fish captured.	Fishing effort, station description, wet and bankfull width, mean depth, field-based water quality, habitat description and GPS coordinates	Collected at all fish survey areas	One water sample collected during each fishing effort. Parameter suite includes all MDMER compliance monitoring analytes
Exposure Vessels in Laboratory	Exposure of 150 juvenile Chinook salmon to each of two effluent concentrations (1 part effluent and 3 parts reference water, and 1 part effluent and 6 parts reference water) for six weeks from late July to early September. Length, weight, growth rate, survival and physical condition will be monitored. Results will be compared to the control fish.	Water flow, dissolved oxygen and temperature monitored daily	-	One sample collected once per week for six weeks during exposure test; Parameter suite includes all MDMER compliance monitoring analytes
Reference Areas				
Lower Big Creek	Non-lethal survey commencing in July 2019 and repeated monthly through September. Targeting the collection of 100 juvenile Chinook salmon, which will be measured (length and fresh body weight). Any external abnormalities will noted on all fish captured.	Fishing effort, station description, wet and bankfull width, mean depth, field-based water quality, habitat description and GPS coordinates	Collected at all fish survey areas	One water sample collected during each fishing effort. Parameter suite includes all MDMER compliance monitoring analytes
Control Vessels in Laboratory	Exposure of 150 juvenile Chinook salmon to reference water for six weeks from late July to early September. Length, weight, growth rate, survival and physical condition will be monitored.	Water flow, dissolved oxygen and temperature monitored daily	-	One sample collected once per week for six weeks during testing. Parameter suite includes all MDMER compliance monitoring analytes

Note: MDMER = *Metal and Diamond Mining Effluent Regulations*.

[a] Field-based water quality parameter suite includes water temperature, dissolved oxygen, pH, and conductivity.

[b] Analytical water quality parameter suite includes hardness, alkalinity, pH, total suspended solids, total dissolved solids, ammonia, nitrate, total Kjeldahl nitrogen, total phosphorus, total organic carbon, and ICP total metal scan (including aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, selenium, nickel, and zinc).

(Access 2010). Thus, fish usage and duration is not sufficiently predictable to ensure that a field-based EEM fish survey will be successful in any given year. Therefore, as in Phase 4, the Phase 5 EEM will include a controlled (field laboratory) fish exposure. As juvenile chinook salmon are typically unavailable for experimental purposes due to population decline, a Yukon hatchery-raised alternate salmonid (either kokanee [*Onchorynchus nerka*] or arctic char [*Salvelinus alpinus*]) will be exposed to mixtures of Minto Mine effluent and reference water in a field laboratory setting for six weeks from late July to early September 2019 (Table 4.1). The objective is to mimic the exposure conditions (timing and duration) that would be experienced in Minto Creek. A conventional fish survey will also be attempted (see Section 4.3), but it is anticipated that the conventional survey will primarily serve to characterize fish use of lower Minto Creek in 2019 and support interpretation of the results of the field laboratory exposures.

4.1.1 Fish Source and Exposure System

The field laboratory exposure study will be implemented using kokanee fry obtained from the Whitehorse Rapids Fish Hatchery (WRFH) or alternatively arctic char obtained from Icy Waters Ltd., a Yukon based commercial aquaculture company. Both species are considered suitable surrogates for Chinook salmon; however, kokanee were the species used during Minto's Phase 4 EEM, and are therefore the first choice of species to be used for the study. Arctic char will be used as a backup if kokanee cannot be obtained. Regardless of the fish species used, test fish will be of an age (young-of-the-year fry) and size (approximately 1.0 to 3.0 grams [g]) that effectively represents the juvenile Chinook salmon that utilize lower Minto Creek.

Approximately 375 salmon fry will be obtained for the field laboratory exposures. These fish will be divided into three groups of 125 fish each:

1. Group 1 will be exposed to a mixture of one part Minto Mine effluent (WSP water) and three parts reference water from a Minto Creek reference station or from the Yukon River.
2. Group 2 will be exposed to a mixture of one part Minto effluent to six parts reference water.
3. Group 3 will be exposed to reference water.

This will result in testing of 25% Minto Mine effluent (Group 1) and 12.5% Minto Mine effluent (Group 2) relative to reference. The former represents the maximum allowable discharge of mine water (from the WSP or WTP) to Minto Creek under the Yukon WUL.

Exposures will be set up at the Minto Mine site using circular fish rearing tanks with a size appropriate for the number of fish being held (approximately 200 liters). Flow-through water will be delivered to the tanks from header tanks at a rate sufficient to maintain dissolved oxygen (DO) concentration at 8 milligrams per litre (mg/L) or higher in the tank discharge water. It is anticipated

that a flow rate of approximately 1.0 litres per kilogram (L/kg) of fish per minute will be required to sustain DO at the desired level. Based on a maximum starting weight of 3.0 g and 150 fish per tank, an initial flow rate of 0.50 liters per minute (L/m) will be required per tank. This flow rate will increase over the course of the study, possibly doubling to 1.0 L/m. Rearing system water will be supplemented with oxygen delivered through ceramic diffusers to ensure DO levels remain above 8 mg/L throughout the study. To maintain consistent temperatures in the exposure and reference tanks, feed water will pass in parallel through a tube and pipe-type heat exchanger. Minto Mine well water with an approximate temperature of 4 degrees Celsius (°C) will be used as cooling water, and will be passed counter-current to the rearing water through the heat exchanger. It is anticipated that the resulting temperature of water delivered to the tanks will be between 8 and 10 °C. The flow rate of the cooling water can be adjusted in order to achieve the target temperature and to keep the rearing environments as consistent as possible.

The salmonid fry will be fed a commercial salmon diet at the 100% feeding rate recommended by the manufacturer. An appropriate pellet size will be selected and no feed beyond its expiration date will be used. If mortality occurs in the tanks, feeding rates will be adjusted so as not to differentially influence growth rates between treatments. Quality assurance/quality control (QA/QC) to ensure valid testing will include minimum survival of reference fish (> 90%), as well as consistency of temperature, flow rate, and DO among treatments and replicates. All groups will be exposed for six weeks (late July to early September 2019). This will allow for an approximate doubling of weight of the reference group. This exposure reflects the brief occupancy of juvenile Chinook salmon in non-natal tributaries (Section 2.7).

4.1.2 Fish Growth and Condition Measures

Physiological measurements recommended for non-lethal fish surveys (Environment Canada 2012) will be collected from each fish upon study initiation (Day 0), at Day 21, and at the end of the exposure period (Day 42). Fish will be sedated using a dilute solution of clove oil in ethanol or MS222 (a certified fish anesthetic). Fish length (both total and fork) will be measured to the nearest hundredth of a millimeter using digital calipers. Fresh body weight will be measured using an analytical balance with an accuracy of 0.001 g. While taking these measurements, all fish will be carefully observed for external abnormalities, which will be recorded on data sheets. Following these measurements, all live fish will be placed in recovery buckets containing aerated water for subsequent re-introduction to their exposure or reference tanks. Exposure systems will be monitored daily for mortalities. All mortalities will be removed and measured as described above. At experiment termination, all test fish will be destroyed.

4.1.3 Supporting Data Collection

Water in the rearing tanks will be measured continuously for temperature, flow, and DO will be monitored at least two times per day. Flows will be adjusted daily, as needed, to adjust temperature and/or DO levels. Water from the Minto WSP and reference water (Yukon River) will be delivered to the header tanks at a minimum frequency of once per week during the study. Since water quality in the system will be subject to change due to environmental influences (e.g., precipitation), water samples from each rearing tank will be collected subsequent to each delivery. Samples will be captured after water passes through the heat exchanger and as it enters the rearing tanks, and will be sent to an accredited Canadian Association for Laboratory Accreditation (CALA) laboratory for analysis of EEM-related parameters. Specifically, samples will be analyzed for hardness, alkalinity, aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, nickel, selenium, zinc, TSS, ammonia, and nitrate (Environment Canada 2012, Government of Canada 2018). Dissolved metals, dissolved organic carbon, total Kjeldahl nitrogen, and total phosphorus concentrations will also be determined.

4.1.4 Data Analysis

Raw fish physiological measurement data will be transcribed from field sheets into an electronic spreadsheet and checked by a separate individual for potential entry errors as part of routine QA/QC procedures. Initial data analysis will include plotting size-frequency distributions as described by Bonar (2002) and Gray et al. (2002) for each treatment. Consistent with EEM technical guidance (Environment Canada 2012), summary statistics including mean, median, minimum, maximum, standard deviation, standard error, and sample size will be calculated by treatment for endpoints related to age, growth, and condition. Length frequency distributions will be compared using a two-sample Kolmogorov-Smirnov (K-S) test. The K-S test is a non-parametric test of potential differences between two distributions (Zar 2010). All length and body weight data will be inspected for normality and homogeneity of variance before applying parametric statistical procedures. Violations of normality and homogeneity of variance will be reduced using $\log_{10}$ transformations, as required. ANOVA with post-hoc testing will be used to evaluate potential differences in treatment means for these metrics. Analysis of Covariance (ANCOVA) will be used to evaluate potential differences in condition (weight at length) among treatments. All ANOVA and ANCOVA comparisons will be evaluated at an alpha level of 0.10, consistent with the recommendations of Environment Canada (2012) respecting statistical power. Prior to conducting the ANCOVA tests, scatter plots of all variable and covariate combinations will be examined to identify outliers, high-leverage values, or other unusual data. The scatter plots will also be examined to ensure adequate overlap between treatment groups and a linear relationship between the variable and the covariate. In order to verify the existence of a linear

relationship, each relationship will be tested using linear regression analysis by treatment and evaluated at an alpha level of 0.05. If no significant linear regression relationship exists between the variable and covariate for the treatments, then ANCOVA will not performed.

If data can be analyzed by ANCOVA, the slopes of the regression lines for the three treatments will be tested to determine if they are equal. A significant interaction in the ANCOVA model for covariate "X" versus treatment (e.g., size*treatment) indicates significantly different slopes. In such cases, the ANCOVA cannot be completed and an effect is determined as a significant difference in slopes between treatments. If the interaction term is not significant (i.e., homogeneous slopes between the treatments), then the ANCOVA model will be run without the interaction term to test for differences in adjusted means between the treatments. The adjusted mean is an estimate of the population mean based on the value of the covariate in the ANCOVA model. If outliers or high-leverage values are observed in a data set upon examination of scatter plots and residuals, then these values will be removed and ANCOVA tests will be repeated for the reduced data set.

Following the ANOVA and ANCOVA testing, the magnitude of the difference between treatments will be calculated for each endpoint where a significant difference is detected. If there is no significant difference detected between treatments, the minimum detectable effect size will be calculated as a percent difference from the reference mean for ANOVA or adjusted reference mean for ANCOVA. Alpha and beta will be set equal to 0.10 using the square root of the mean square error (generated during either the ANOVA or the ANCOVA procedures) as a measure of variability in the sample population:

$\delta = (t_\alpha + t_\beta)(\sqrt{MSE})(\sqrt{2/n'})$, where
δ = minimum detectable effect size,
MSE = mean square error, and
$n' = (2n_1n_2)/(n_1+n_2)$, where n_1 = reference sample size and n_2 = exposure sample size.

The percent difference will then be calculated using the following equations:

for untransformed data: % difference = $((\text{ref.mean} \pm \delta)/\text{ref.mean} - 1) \times 100$
for $\log_{10}$ transformed data: % difference = $(10^{\pm\delta} - 1) \times 100$

A priori power analyses will also be completed to determine appropriate fish sample sizes for future studies as recommended by Environment Canada (2012). These analyses will be completed based on the mean square error values generated during the ANOVA or ANCOVA procedures at alpha and beta equal to 0.10. Results will be reported as the minimum sample size (number of fish/treatment) required to detect a given magnitude of difference (effect size) between

treatment populations for each endpoint. The magnitude of the difference will be presented as a percentage of the reference mean for each endpoint.

In addition to the conventional analysis described above, a Before-After-Control-Impact (BACI) approach will be employed to assess differences in these endpoints among treatment groups. The "Before" denotes measurements taken on Day 0 and the "After" denotes measurements taken on Day 21 and 42. Accordingly, the Control and Impact denote the reference and exposure treatments, respectively. The BACI approach takes into account any possible differences in size of the fish between treatments prior to exposure. BACI analysis will be completed by factorial ANOVA to assess any significant differences (at = 0.10) in fork length, body weight, and condition factor. The measurement of endpoints twice during exposure (Day 21 and Day 42) will help determine the duration of exposure necessary to elicit a significant difference (if any), which in turn, will assist in the overall assessment of risks to juvenile Chinook salmon frequenting Minto Creek in their natural setting.

4.2 Fish Survey - Field Studies

The Phase 5 EEM will include fishing of lower Minto Creek (exposed) and Big Creek (reference) in July, August, and September 2019 (Table 4.1; Figure 2.3). Due to limited fish usage of lower Minto Creek as described previously (Sections 2.7 and 4.2), it is anticipated that the fishing will primarily provide information on fish usage of these creeks in 2019, thereby providing additional perspective for interpretation of the field laboratory exposures. However, physiological measurements will be collected on each Chinook salmon captured, and if sufficient numbers are collected to support a non-lethal fish population survey, the analyses, interpretation, and reporting recommended for such a survey will be completed, as outlined below.

4.2.1 Fish Collection

Fish collection will be completed in lower Minto Creek between the Minto Mine access road and the fish barrier located approximately 1.2 km upstream. Fish collection in Big Creek will be completed in the vicinity of the Minto Mine access road (both upstream and downstream of the bridge). Monthly sampling at all study areas will be completed using minnow traps baited with salmon roe. A minimum of 15 minnow traps will be deployed overnight at each area. Every effort will be made to collect fish; however, it is noted that lower Minto Creek occasionally dries up in summer months due to low water levels. All fishing will be conducted under a "Licence to Collect Fish for Scientific, Educational, or Public Display Purposes" from Fisheries and Oceans Canada (DFO). The location of each minnow trap will be recorded in degrees latitude and longitude as measured using a handheld Geographic Positioning System (GPS) unit. Deployment and retrieval times will also be recorded.

All captured fish will be identified and enumerated according to species and minnow trap. Juvenile Chinook salmon will be retained for measurement (up to a maximum of 100 fish) and all other species will be released to the waters from which they were captured.

4.2.2 Fish Growth and Condition Measures

Length (fork and total) and weight of juvenile Chinook salmon will be measured in the field as described above for the field laboratory exposures (Section 4.2.2). The external health of each fish will be noted and any abnormality recorded.

4.2.3 Supporting Data Collection

Supporting *in situ* measurements of water quality parameters and water chemistry samples will be collected during each fishing effort (monthly). *In situ* measurements, including water temperature, DO, pH, and specific conductance, will be measured at each fish sampling area. Water samples will be sent to a CALA-accredited laboratory for analysis of EEM related parameters including hardness, alkalinity, aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, nickel, selenium, zinc, TSS, ammonia, and nitrate (Environment Canada 2012, Government of Canada 2018). Dissolved metals, dissolved organic carbon, total Kjeldahl nitrogen, and total phosphorus concentrations will also be determined.

4.2.4 Data Analysis

Fish capture data will be summarized by reporting total catch and catch-per-unit-effort (CPUE; catch per minnow trap day) for each sampling event and area. Physiological measurement data will be treated and analyzed as described above for the field laboratory exposures (Section 4.2.2), with the sole exception that no BACI analysis is supported.

4.3 Routine Effluent and Water Quality Monitoring

Monitoring completed by the Minto Mine consists of effluent characterization, sublethal toxicity testing, and routine MDMER receiving environment water quality monitoring. The Minto Mine continues to conduct effluent characterization in accordance with MDMER requirements. Effluent characterization samples will continue to be shipped to a CALA-accredited laboratory for analysis.

Sublethal toxicity testing of final effluent will continue to be conducted annually. The suite of sublethal tests (including rainbow trout or fathead minnow [*Pimephales promelas*; fish], *Ceriodaphnia dubia* [invertebrate], *Lemna minor* [plant], and *Pseudokirchneriella subcapitata* [algae]) will be performed in accordance with standard methods (Environment Canada 1998, 2007a,b,c, 2011). The results of all sublethal toxicity tests completed prior to preparation of the Phase 5 EEM Interpretive Report will be summarized and discussed therein. Any observations of sublethal toxicity will be assessed relative to effluent mixing within the creek

to support conclusions regarding whether or not responses observed in the tests would be expected in the receiving environment.

The Minto Mine will continue to complete routine water quality monitoring four times per year at reference (Station W7) and exposed (Station W2) areas for three years after the mine declares its intention to become a recognized closed mine. Similar to effluent characterization samples, water quality monitoring samples will continue to be shipped to a CALA-accredited laboratory for analysis of EEM-related parameters including pH, hardness, alkalinity, aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, nickel, selenium, zinc, TSS, ammonia, and nitrate. Supporting water quality data will be compared to applicable CWQG for the protection of aquatic life (CCME 2016), and results from the effluent-exposed sites will be compared to reference. All water quality monitoring results collected prior to preparation of the Phase 5 EEM Interpretive Report will be summarized and discussed therein.

5 SCHEDULE

The Minto Mine's Phase 5 EEM biological surveys are scheduled between late July and September 2019, which is consistent with the use of Minto Creek by juvenile chinook salmon. Water samples will be submitted promptly after they are collected and benthic invertebrate samples will be submitted after completion of field work.

The Phase 5 Interpretive Report (i.e., the results of the 2019 field programs) is due to Environment and Climate Change Canada on or before January 6, 2021.

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APPENDIX A
SUMMARY OF MDMER EFFLUENT AND WATER QUALITY, 2015 TO 2018

Table A.1: Routine Effluent Quality Monitoring at W3, 2015 to 2018

Sample Date	pH (pH units)	Arsenic (mg/L)	Copper (mg/L)	Lead (mg/L)	Nickel (mg/L)	Zinc (mg/L)	Total Suspended Solids (mg/L)	Radium-226 (Bq/L)
MACG	6.0-9.5	1.0	0.60	0.40	1.0	1.0	30	1.1
2-Jan-15	8.11	0.00025	0.0031	<0.00020	0.0012	<0.0050	3.6	-
6-Jan-15	8.04	0.00027	0.0024	<0.00020	<0.0010	<0.0050	-	-
13-Jan-15	8.26	0.00024	0.0023	<0.00020	<0.0010	<0.0050	1.5	-
21-Jan-15	8.28	0.00023	0.0019	<0.00020	<0.0010	<0.0050	1.7	-
29-Jan-15	8.29	0.00024	0.0023	<0.00020	<0.0010	<0.0050	1.2	-
3-Feb-15	8.19	0.00042	0.0034	<0.00020	0.0016	<0.0050	2.9	-
11-Feb-15	7.91	0.00023	0.0033	<0.00020	0.0011	<0.0050	<1.0	-
18-Feb-15	7.88	0.00022	0.0021	<0.00020	0.0011	<0.0050	<1.0	-
26-Feb-15	8.08	0.00021	0.0018	<0.00020	0.0012	<0.0050	<1.0	-
3-Mar-15	7.88	0.00021	0.0038	<0.00020	0.0012	0.032	<1.0	-
9-Mar-15	8.06	0.00023	0.0033	<0.00020	<0.0010	<0.0050	<1.0	-
16-Mar-15	8.11	0.00021	0.0034	<0.00020	0.0011	0.021	<1.0	<0.010
25-Mar-15	8.09	0.00022	0.0017	<0.00020	0.0011	<0.0050	<1.0	-
30-Mar-15	8.45	0.00023	0.0046	<0.00020	0.0012	0.16	<1.0	-
6-Apr-15	8.11	0.00048	0.011	<0.00020	<0.0010	0.014	2.8	-
14-Apr-15	8.22	0.00041	0.015	0.00058	<0.0010	<0.0050	4.3	<0.010
21-Apr-15	8.13	0.00049	0.019	0.00021	<0.0010	<0.0050	9.4	-
27-Apr-15	8.14	0.00035	0.023	<0.00020	<0.0010	<0.0050	4.2	-
10-May-15	8.16	0.00033	0.0099	<0.00020	<0.0010	0.016	<1.0	-
14-May-15	8.06	0.00043	0.021	<0.00020	<0.0010	<0.0050	11	-
20-May-15	8.07	0.00049	0.024	<0.00020	0.0012	<0.0050	5.4	-
29-May-15	8.13	0.00035	0.012	<0.00020	<0.0010	<0.0050	1.4	-
31-May-15	8.24	0.00041	0.013	<0.00020	<0.0010	<0.0050	2.0	-
4-Jun-15	8.15	0.00025	0.0030	<0.00020	<0.0010	0.051	<1.0	-
9-Jun-15	8.19	0.00025	0.0029	<0.00020	<0.0010	<0.0050	<1.0	-
15-Jun-15	8.21	0.00053	0.020	0.00028	0.0018	<0.0050	13	-
22-Jun-15	8.32	0.00026	0.0024	<0.00020	<0.0010	<0.0050	<1.0	-
29-Jun-15	8.32	0.00022	0.0030	<0.00020	<0.0010	<0.0050	<1.0	-
7-Jul-15	8.31	0.00027	0.0027	<0.00020	<0.0010	<0.0050	8.3	-
14-Jul-15	8.16	0.00023	0.0026	<0.00020	<0.0010	<0.0050	<1.0	-
20-Jul-15	8.26	0.00028	0.0024	<0.00020	<0.0010	<0.0050	<1.0	-
29-Jul-15	8.22	0.00029	0.0025	<0.00020	<0.0010	<0.0050	<1.0	-
5-Aug-15	8.34	0.00027	0.0021	<0.00020	<0.0010	<0.0050	<1.0	-
14-Aug-15	8.18	0.00028	0.0029	<0.00020	<0.0010	<0.0050	<1.0	-
18-Aug-15	8.32	0.00032	0.0033	<0.00020	<0.0010	<0.0050	<1.0	-
24-Aug-15	8.04	0.00025	0.0022	<0.00020	<0.0010	<0.0050	<1.0	-
31-Aug-15	8.19	0.00033	0.0053	<0.00020	0.0012	<0.0050	4.6	<0.010
8-Sep-15	8.27	0.00029	0.0058	<0.00020	0.0011	<0.0050	17	-
15-Sep-15	8.34	0.00029	0.0030	<0.00020	<0.0010	<0.0050	<1.0	-
23-Sep-15	8.43	0.00026	0.0026	<0.00020	<0.0010	<0.0050	<1.0	-
30-Sep-15	8.42	0.00030	0.0026	<0.00020	<0.0010	<0.0050	<1.0	-
5-Oct-15	8.38	0.00025	0.0021	<0.00020	<0.0010	<0.0050	<1.0	<0.010
13-Oct-15	8.28	0.00021	0.0027	<0.00020	<0.0010	<0.0050	<1.0	-
22-Oct-15	8.16	0.00028	0.0025	<0.00020	<0.0010	<0.0050	<1.0	-
28-Oct-15	8.20	0.00027	0.0025	<0.00020	<0.0010	<0.0050	<1.0	-
28-Oct-15	8.12	0.00026	0.0025	<0.00020	<0.0010	<0.0050	<1.0	-
2-Nov-15	8.15	0.00017	0.0021	<0.00020	<0.0010	<0.0050	<1.0	-
9-Nov-15	8.20	0.00023	0.0025	<0.00020	<0.0010	<0.0050	<1.0	-
16-Nov-15	8.42	0.00030	0.0031	<0.00020	<0.0010	<0.0050	<1.0	-
23-Nov-15	8.23	0.00024	0.0020	<0.00020	<0.0010	<0.0050	<1.0	-
6-Dec-15	8.25	0.00031	0.0020	<0.00020	0.0029	<0.0050	<1.0	-
8-Dec-15	8.46	0.00017	0.0021	<0.00020	0.0015	<0.0050	<1.0	-
19-Dec-15	8.10	0.00023	0.0023	<0.00020	<0.0010	0.0083	5.6	-
26-Dec-15	8.22	0.00022	0.0033	<0.00020	0.0010	0.0094	6.1	-
8-Jan-16	8.22	0.00027	0.0032	<0.00020	0.0011	<0.0050	1.0	-
14-Jan-16	8.16	0.00026	0.0037	<0.00020	<0.0010	0.0068	3.1	-
19-Jan-16	8.23	0.00031	0.0020	<0.00020	0.0011	<0.0050	1.1	-
25-Jan-16	8.10	0.00029	0.0022	<0.00020	<0.0010	<0.0050	1.1	-
1-Feb-16	8.43	0.00031	0.0033	<0.00020	<0.0010	<0.0050	1.1	-
14-Feb-16	8.01	0.00037	0.011	0.00021	<0.0010	<0.0050	4.1	-
20-Feb-16	8.35	0.00024	0.0021	<0.00020	<0.0010	<0.0050	18	-
28-Feb-16	8.21	0.00031	0.0029	<0.00020	<0.0010	<0.0050	4.7	-
1-Mar-16	8.39	0.00037	0.0022	<0.00020	<0.0010	<0.0050	2.6	-
8-Mar-16	8.11	0.00029	0.0040	<0.00020	0.0011	<0.0050	5.1	-
19-Mar-16	8.23	0.00028	0.0019	<0.00020	<0.0010	<0.0050	2.8	-
24-Mar-16	8.12	0.00031	0.0045	<0.00020	<0.0010	0.0095	2.5	-
30-Mar-16	7.84	0.00056	0.014	0.00021	0.0015	0.0034	30	-
4-Apr-16	8.14	0.00036	0.0049	0.000074	0.0011	<0.0030	6.7	-
12-Apr-16	7.99	0.00052	0.020	0.00021	0.0020	0.0035	7.3	-
19-Apr-16	8.28	0.00033	0.012	<0.000050	0.0011	<0.0030	<3.0	-
26-Apr-16	8.08	0.00032	0.012	0.000053	0.0010	<0.0030	<3.0	-
2-May-16	8.32	0.00027	0.0089	<0.000050	0.0010	<0.0030	5.3	-
12-May-16	8.24	0.00029	0.0072	<0.000050	0.0015	<0.0030	<3.0	-
17-May-16	8.15	0.00035	0.015	<0.000050	0.0013	<0.0030	4.0	-
24-May-16	7.99	0.00029	0.014	<0.000050	0.0011	<0.0030	<3.0	-
31-May-16	8.09	0.00030	0.012	<0.000050	0.0011	<0.0030	<3.0	-

Notes: MDMER = Metal and Diamond Mining Effluent Regulations; MACG = maximum authorized concentrations in grab samples.
Highlighted values are greater than MDMER grab limits.

Table A.1: Routine Effluent Quality Monitoring at W3, 2015 to 2018

Sample Date	pH (pH units)	Arsenic (mg/L)	Copper (mg/L)	Lead (mg/L)	Nickel (mg/L)	Zinc (mg/L)	Total Suspended Solids (mg/L)	Radium-226 (Bq/L)
MACG	6.0-9.5	1.0	0.60	0.40	1.0	1.0	30	1.1
7-Jun-16	8.15	0.00029	0.012	<0.000050	0.0012	<0.0030	<3.0	-
14-Jun-16	8.06	0.00030	0.0097	<0.000050	0.0010	<0.0030	<3.0	-
21-Jun-16	8.03	0.00028	0.0071	<0.000050	0.0012	<0.0030	<3.0	-
28-Jun-16	8.13	0.00023	0.0035	<0.000050	0.00096	<0.0030	<3.0	-
5-Jul-16	8.39	0.00026	0.0029	<0.000050	0.0011	<0.0030	<3.0	-
12-Jul-16	8.01	0.00028	0.0039	<0.000050	0.0011	<0.0030	<3.0	-
19-Jul-16	8.20	0.00027	0.0059	<0.000050	0.0011	<0.0030	<3.0	-
26-Jul-16	7.98	0.00040	0.012	<0.000050	0.0014	<0.0030	4.7	-
2-Aug-16	8.05	0.00032	0.0096	<0.000050	0.0010	<0.0030	<3.0	-
9-Aug-16	8.16	0.00035	0.0095	<0.000050	0.0010	<0.0030	<3.0	-
15-Aug-16	8.09	0.00029	0.0086	<0.000050	0.00095	<0.0030	<3.0	-
17-Aug-16	7.93	0.00031	0.0082	<0.000050	0.0010	<0.0030	<3.0	-
23-Aug-16	8.13	0.00035	0.0087	<0.000050	0.00092	<0.0030	<3.0	-
30-Aug-16	8.31	0.00033	0.012	<0.000050	0.00092	<0.0030	<3.0	-
6-Sep-16	8.10	0.00025	0.0083	<0.000050	0.00050	<0.0030	<3.0	-
13-Sep-16	7.86	0.00022	0.0072	0.000081	0.00054	<0.0030	<3.0	-
20-Sep-16	7.87	0.00022	0.0074	<0.000050	0.00056	<0.0030	<3.0	-
27-Sep-16	7.99	0.00020	0.0063	0.000067	0.00056	<0.0030	<3.0	-
3-Oct-16	7.96	0.00016	0.0048	<0.000050	<0.00050	<0.0030	<3.0	-
4-Oct-16	8.15	0.00023	0.0067	<0.000050	0.00070	<0.0030	<3.0	-
11-Oct-16	8.22	0.00029	0.0094	<0.000050	0.0010	<0.0030	<3.0	-
18-Oct-16	8.20	0.00036	0.013	0.000052	0.00088	<0.0030	<3.0	-
23-Oct-16	8.27	0.00034	0.013	0.000050	0.00076	<0.0030	<3.0	-
25-Oct-16	8.23	0.00030	0.013	0.00031	0.00078	0.0031	<3.0	-
1-Nov-16	8.46	0.00024	0.0041	<0.000050	0.00088	<0.0030	<3.0	-
8-Nov-16	8.25	0.00026	0.0033	<0.000050	0.00099	<0.0030	<3.0	-
15-Nov-16	8.13	0.00027	0.0029	<0.000050	0.00095	<0.0030	3.7	-
22-Nov-16	7.88	0.00028	0.0027	<0.000050	0.0010	<0.0030	3.5	-
29-Nov-16	8.14	0.00027	0.0035	<0.000050	0.0011	<0.0030	<3.0	-
6-Dec-16	8.35	0.00026	0.0056	<0.000050	0.00094	<0.0030	<3.0	-
13-Dec-16	8.05	0.00024	0.0022	<0.000050	0.00090	<0.0030	<3.0	-
20-Dec-16	8.00	0.00024	0.0083	0.000052	0.0012	0.0030	6.5	-
3-Jan-17	7.92	0.00027	0.0027	<0.000050	0.00088	<0.0030	3.0	-
10-Jan-17	7.97	0.00024	0.0039	<0.000050	0.00091	<0.0030	3.0	-
17-Jan-17	8.17	0.00027	0.0031	<0.000050	0.0010	<0.0030	3.0	-
24-Jan-17	8.01	0.00057	0.0099	0.00030	0.0023	0.0061	18	-
31-Jan-17	8.12	0.00035	0.0034	<0.000050	0.00086	<0.0030	3.0	-
7-Feb-17	8.16	0.00037	0.0037	0.00011	0.0014	0.0056	9.3	-
14-Feb-17	8.24	0.00033	0.011	<0.000050	0.00091	0.0037	3.0	-
21-Feb-17	8.16	0.00023	0.0039	<0.000050	0.00085	<0.0030	3.0	-
28-Feb-17	8.10	0.00030	0.0036	0.000061	0.0010	<0.0030	3.0	-
7-Mar-17	8.14	0.00024	0.0029	<0.000050	0.00093	<0.0030	3.0	-
14-Mar-17	8.00	0.00029	0.0062	<0.000050	0.0013	0.010	3.0	0.070
21-Mar-17	8.30	0.00029	0.0028	<0.000050	0.0012	<0.0030	3.0	-
28-Mar-17	8.09	0.00024	0.0029	<0.000050	0.0013	<0.0030	3.0	-
4-Apr-17	8.03	0.00027	0.0019	0.000050	0.0018	0.0030	3.0	-
6-Apr-17	8.27	0.00036	0.0067	0.000050	0.0012	0.0030	3.0	-
11-Apr-17	8.25	0.00026	0.0078	0.000050	0.00093	0.0030	3.0	-
18-Apr-17	8.24	0.00024	0.0090	0.000050	0.00092	0.0030	3.0	-
25-Apr-17	8.30	0.00022	0.0043	0.000050	0.00086	0.0030	3.0	-
2-May-17	8.04	0.00039	0.030	0.00018	0.0015	0.0030	10	-
9-May-17	8.08	0.00037	0.013	0.000050	0.00094	0.0030	3.0	-
16-May-17	8.32	0.00030	0.014	0.000050	0.00090	0.0030	3.0	-
23-May-17	8.13	0.00037	0.016	0.00011	0.0013	0.0030	11	-
30-May-17	8.29	0.00049	0.024	0.00023	0.0016	0.0039	3.0	-
6-Jun-17	8.21	0.00039	0.027	0.000078	0.0012	0.0030	5.7	0.0082
13-Jun-17	8.03	0.00043	0.026	0.000074	0.0014	0.0030	3.0	-
20-Jun-17	8.19	0.00040	0.016	0.000050	0.0012	0.0030	3.0	-
27-Jun-17	8.19	0.00027	0.0053	0.000050	0.0011	0.0030	3.4	-
4-Jul-17	8.31	0.00025	0.0035	<0.000050	0.00093	<0.0030	3.0	-
11-Jul-17	8.33	0.00029	0.0036	<0.000050	0.00098	<0.0030	3.0	-
18-Jul-17	8.19	0.00035	0.0090	0.000092	0.0014	0.0037	5.4	-
25-Jul-17	8.11	0.00034	0.0049	<0.000050	0.0012	<0.0030	3.0	-
1-Aug-17	8.05	0.00044	0.014	<0.000050	0.0012	<0.0030	3.0	<0.0096
8-Aug-17	8.09	0.00029	0.0050	<0.000050	0.0011	<0.0030	3.0	-
15-Aug-17	8.34	0.00029	0.0035	<0.000050	0.0010	<0.0030	3.0	-
22-Aug-17	8.38	0.00025	0.0029	<0.000050	0.0011	<0.0030	3.0	-
29-Aug-17	8.25	0.00026	0.0029	<0.000050	0.00093	<0.0030	3.0	-
5-Sep-17	8.35	0.00027	0.0030	<0.000050	0.0010	<0.0030	<3.0	-
12-Sep-17	8.50	0.00025	0.0032	<0.000050	0.0010	<0.0030	<3.0	-
19-Sep-17	8.30	0.00027	0.0029	<0.000050	0.00092	<0.0030	<3.0	-
26-Sep-17	8.32	0.00025	0.0026	<0.000050	0.0010	<0.0030	<3.0	-
3-Oct-17	8.29	0.00022	0.0026	<0.000050	0.00097	0.0030	3.0	-
10-Oct-17	8.42	0.00025	0.0024	<0.000050	0.0011	0.0030	3.0	-
17-Oct-17	8.41	0.00025	0.0027	<0.000050	0.00094	0.0030	3.0	-
22-Oct-17	8.28	0.00017	0.0030	<0.000050	0.0011	0.0030	3.0	-
24-Oct-17	8.20	0.00026	0.0037	<0.000050	0.0010	0.0030	3.0	<0.0085
31-Oct-17	8.30	0.00025	0.0031	<0.000050	0.0010	0.0030	3.0	-

Notes: MDMER = Metal and Diamond Mining Effluent Regulations; MACG = maximum authorized concentrations in grab samples.
Highlighted values are greater than MMER grab limits.

Table A.1: Routine Effluent Quality Monitoring at W3, 2015 to 2018

Sample Date	pH (pH units)	Arsenic (mg/L)	Copper (mg/L)	Lead (mg/L)	Nickel (mg/L)	Zinc (mg/L)	Total Suspended Solids (mg/L)	Radium-226 (Bq/L)
MACG	6.0-9.5	1.0	0.60	0.40	1.0	1.0	30	1.1
7-Nov-17	8.22	0.00028	0.0026	<0.000050	0.0010	0.0030	3.0	-
14-Nov-17	8.21	0.00026	0.0028	<0.000050	0.00095	0.0030	3.0	-
21-Nov-17	8.09	0.00026	0.0027	<0.000050	0.00097	0.0030	4.7	-
28-Nov-17	7.94	0.00032	0.0032	<0.000050	0.0011	0.0030	3.0	-
5-Dec-17	8.12	0.00025	0.0030	<0.000050	0.0011	0.0030	3.3	-
12-Dec-17	8.03	0.00037	0.065	0.00015	0.0011	0.0032	5.6	-
19-Dec-17	8.18	0.00030	0.0026	<0.000050	0.00083	0.0030	3.0	-
26-Dec-17	8.23	0.00029	0.0029	<0.000050	0.00087	0.0033	3.2	-
2-Jan-18	8.30	0.00022	0.0026	0.000084	0.00080	<0.0030	<3.0	-
9-Jan-18	8.05	0.00021	0.0021	<0.000050	0.00083	<0.0030	<3.0	-
16-Jan-18	8.26	0.00023	0.0026	<0.000050	0.00093	<0.0030	4.4	-
23-Jan-18	8.03	0.00028	0.0023	<0.000050	0.00087	<0.0030	4.0	-
30-Jan-18	8.16	0.00025	0.0016	<0.000050	0.00082	<0.0030	<3.0	-
6-Feb-18	8.03	0.00024	0.0013	<0.000050	0.00061	<0.0030	4.3	-
13-Feb-18	7.90	0.00024	0.0078	<0.000050	0.00062	0.016	<3.0	-
20-Feb-18	8.11	0.00025	0.0053	0.00024	0.0011	0.0034	<3.0	0.0096
27-Feb-18	8.05	0.00027	0.0054	<0.000050	0.00054	0.0066	<3.0	-
6-Mar-18	8.08	0.00023	0.0077	<0.000050	0.00060	0.0079	<3.0	-
13-Mar-18	8.17	0.00028	0.0095	0.000061	0.00060	0.022	<3.0	-
20-Mar-18	8.16	0.00023	0.0034	<0.000050	0.00062	0.0042	<3.0	-
27-Mar-18	8.34	0.00021	0.0052	<0.000050	0.00069	0.010	5.6	-
3-Apr-18	8.46	0.00027	<0.0040	<0.000050	0.00074	0.0079	<3.0	-
10-Apr-18	8.15	0.00025	0.0062	<0.000050	0.00073	0.0058	<3.0	-
17-Apr-18	8.50	0.00027	0.0030	<0.000050	0.00066	<0.0030	<3.0	-
24-Apr-18	8.49	0.00027	0.0044	<0.000050	0.00073	<0.0030	<3.0	-
1-May-18	8.28	0.00048	0.032	<0.000050	0.0022	<0.0030	<3.0	-
8-May-18	8.20	0.00049	0.026	<0.000050	0.0022	<0.0030	<3.0	-
15-May-18	8.39	0.00039	0.037	0.000055	0.0016	<0.0030	8.9	-
22-May-18	8.44	0.00029	0.0054	<0.000050	0.0011	<0.0030	<3.0	-
29-May-18	8.53	0.00036	0.0047	<0.000050	0.0010	<0.0030	3.0	-
5-Jun-18	8.49	0.00043	0.017	0.000064	0.0016	<0.0030	<3.0	-
12-Jun-18	8.35	0.00041	0.013	<0.000050	0.0013	<0.0030	4.6	<0.0069
19-Jun-18	8.52	0.00039	0.013	<0.000050	0.0011	<0.0030	<3.0	-
26-Jun-18	8.39	0.00037	0.019	<0.000050	0.00094	<0.0030	<3.0	-
3-Jul-18	8.36	0.00037	0.018	<0.000050	0.0012	<0.0030	4.1	-
10-Jul-18	8.08	0.00028	0.0038	<0.000050	0.00089	<0.0030	<3.0	-
17-Jul-18	8.38	0.00035	0.013	0.000054	0.0013	<0.0030	<3.0	-
24-Jul-18	8.44	0.00026	0.0032	<0.000050	0.00089	<0.0030	3.1	-
31-Jul-18	8.39	0.00026	0.0049	<0.000050	0.00082	<0.0030	<3.0	-
7-Aug-18	8.29	0.00028	0.0033	<0.000050	0.0010	<0.0030	<3.0	0.014
14-Aug-18	8.34	0.00028	0.0053	<0.000050	0.00089	<0.0030	<3.0	-
21-Aug-18	8.18	0.00023	0.0030	<0.000050	0.00094	<0.0030	<3.0	-
28-Aug-18	8.14	0.00041	0.015	<0.000050	0.0012	<0.0030	<3.0	-
4-Sep-18	8.20	0.00025	0.0035	<0.000050	0.0010	<0.0030	<3.0	-
11-Sep-18	8.42	0.00026	0.0031	<0.000050	0.00097	<0.0030	<3.0	-
18-Sep-18	8.41	0.00025	0.0029	<0.000050	0.0010	<0.0030	<3.0	-
25-Sep-18	8.16	0.00028	0.0035	<0.000050	0.00099	<0.0030	7.6	-

Notes: MDMER = Metal and Diamond Mining Effluent Regulations; MACG = maximum authorized concentrations in grab samples.

Highlighted values are greater than MMER grab limits.

Table A.2: Effluent Characterization at W3 for MDMER Samples, 2015 to 2018

Date		Hardness (mg/L)	Alkalinity (mg/L)	Aluminum (mg/L)	Cadmium (mg/L)	Iron (mg/L)	Mercury (mg/L)	Molybdenum (mg/L)	Ammonia (mg/L)	Nitrate-N (mg/L)	Selenium (mg/L)	Conductivity (µS/cm)	Temperature (°C)
2015	10-May-15	223	184	0.020	< 0.000010	0.061	< 0.000010	0.0059	0.10	2.8	0.0011	315	2.6
	15-Jun-15	305	217	0.57	0.000018	0.88	< 0.000010	0.0058	0.025	0.37	0.00037	232	5.4
	5-Aug-15	246	224	0.0099	< 0.000010	0.025	< 0.000010	0.0045	0.018	0.23	0.00031	307	1.1
	13-Oct-15	252	222	0.0076	< 0.000010	0.036	< 0.000010	0.0046	0.028	0.19	0.00037	282	0.50
	Mean	**257**	**212**	**0.15**	**0.000012**	**0.25**	**< 0.000010**	**0.0052**	**0.043**	**0.89**	**0.00054**	**284**	**2.4**
2016	26-Apr-16	223	187	0.055	< 0.0000050	0.12	< 0.0000050	0.0036	0.096	0.77	0.00037	266	1.7
	23-Jun-16	217	180	0.011	< 0.0000050	0.030	< 0.0000050	0.0046	<0.0050	1.3	0.00052	280	5.8
	17-Aug-16	227	183	0.018	< 0.0000050	0.039	< 0.0000050	0.0046	0.0066	2.0	0.00065	310	7.9
	23-Oct-16	231	180	0.014	< 0.0000050	0.072	< 0.0000050	0.0040	0.030	4.5	0.0013	265	2.7
	Mean	**225**	**183**	**0.025**	**< 0.0000050**	**0.065**	**< 0.0000050**	**0.0042**	**0.034**	**2.1**	**0.00070**	**280**	**4.5**
2017	16-May-17	170	143	0.021	< 0.0000050	0.069	< 0.0000050	0.0034	0.0069	1.6	0.00054	252	6.6
	27-Jun-17	234	214	0.011	< 0.0000050	0.026	< 0.0000050	0.0047	0.0078	0.23	0.00028	315	5.2
	1-Aug-17	223	185	0.013	< 0.0000050	0.053	< 0.0000050	0.0041	0.0069	1.3	0.00044	339	11
	3-Oct-17	261	242	0.0051	< 0.0000050	0.026	< 0.0000050	0.0047	0.0053	0.18	0.00037	291	0.80
	Mean	**222**	**196**	**0.012**	**< 0.0000050**	**0.044**	**< 0.0000050**	**0.0042**	**0.0067**	**0.82**	**0.00041**	**299**	**6.0**
2018	15-May-18	252	221	0.16	0.000021	0.28	< 0.0000050	0.0045	0.013	0.16	0.00027	269	0.40
	3-Jul-18	232	183	0.039	0.0000058	0.081	< 0.0000050	0.0035	0.0083	1.1	0.00082	338	10
	4-Sep-18	256	235	0.0057	< 0.0000050	0.022	< 0.0000050	0.0049	< 0.0050	0.13	0.00025	232	2.4
	9-Oct-18	274	253	0.082	0.0000055	0.15	< 0.0000050	0.0048	0.016	0.15	0.00037	-	-
	Mean	**254**	**223**	**0.071**	**0.0000092**	**0.13**	**< 0.0000050**	**0.0044**	**0.010**	**0.38**	**0.00042**	**280**	**4.4**

Notes: MDMER = *Metal and Diamond Mining Effluent Regulations*; - = no data.

Table A.3: MDMER EEM Water Quality at W7 (Reference) and W2 (Exposed), 2015 to 2018

Parameter	Units	Background 95th Percentile [a]	Canadian Water Quality Guideline	W7 (Reference)									
				2015					2016				
				31-May-15	11-Jul-15	21-Aug-15	15-Oct-15	Mean	28-Apr-16	23-Jun-16	17-Aug-16	23-Oct-16	Mean
EEM Parameters													
pH	pH units	-	6.5-9.0	7.51	7.67	7.85	7.53	7.64	7.72	7.62	7.81	7.68	7.71
Temperature	Celsius	-	-	0	1.2	3.0	0	1.1	0.10	3.1	4.5	-0.10	1.9
Hardness	mg/L	-	-	104	145	164	154	142	74	144	147	156	130
Alkalinity	mg/L	-	-	100	143	140	138	130	70	134	157	164	131
Conductivity	µS/cm	-	-	109	167	161	152	147	76	163	178	170	147
Dissolved Oxygen	mg/L	-	-	13	11	12	12	12	15	11	12	12	13
Total Suspended Solids	mg/L	-	-	36	38	161	4.1	60	3.3	20	10	< 3.0	9.0
Ammonia	mg/L	-	1.5 [b]	0.011	0.045	0.043	0.038	0.034	0.0069	0.015	0.016	0.027	0.016
Nitrate (as N)	mg/L	-	3	0.047	0.12	0.11	0.11	0.095	0.0063	0.15	0.088	0.17	0.10
Aluminum	mg/L	0.62	0.10	0.25	0.53	0.074	0.097	0.24	0.073	0.54	0.26	0.014	0.22
Arsenic	mg/L	-	0.0050	0.00051	0.00061	0.00062	0.00041	0.00054	0.00043	0.00059	0.00057	0.00049	0.00052
Cadmium	mg/L	-	0.00012-0.00024 [c]	< 0.000010	0.000011	< 0.000010	< 0.000010	0.000010	0.0000091	0.0000058	< 0.0000050	< 0.0000050	0.0000062
Copper	mg/L	0.013	0.0020-0.0036 [c]	0.0035	0.0034	0.0018	0.0016	0.0026	0.0040	0.0020	0.0018	0.0012	0.0022
Iron	mg/L	1.1	0.30	0.50	0.95	0.29	0.27	0.50	0.31	0.70	0.47	0.15	0.41
Lead	mg/L	-	0.0022-0.0059 [c]	< 0.00020	0.00027	< 0.00020	< 0.00020	0.00022	< 0.000050	0.00026	0.00014	< 0.000050	0.00013
Mercury	mg/L	-	0.000026	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	0.000012	< 0.0000050	< 0.0000050	< 0.0000050	0.0000068
Molybdenum	mg/L	-	0.073	0.0013	0.0015	0.0019	0.0014	0.0015	0.00073	0.0016	0.0016	0.0013	0.0013
Nickel	mg/L	-	0.076-0.14 [c]	0.00	0.0023	0.0014	0.0010	0.0015	0.0015	0.0018	0.0017	0.00088	0.0015
Selenium	mg/L	-	0.0010	0.00010	0.00014	0.00016	0.00014	0.00014	0.000087	0.00018	0.00012	0.00016	0.00014
Zinc	mg/L	-	0.034-0.051 [d]	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030
Additional Parameters with Canadian Water Quality Guidelines													
Thallium	mg/L	-	0.00080	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010

Notes: MDMER = *Metal and Diamond Mining Effluent Regulations* ; EEM = Environmental Effects Monitoring.

[a] 95th percentile of background identified by Minnow (2009a).

[b] Based on pH 8 and temperature of 5 °Celsius.

[c] Cadmium, copper, lead, and nickel guidelines are dependent on water hardness.

[d] Based on guideline using 25th percentile of hardness, DOC, and field pH.

Table A.3: MDMER EEM Water Quality at W7 (Reference) and W2 (Exposed), 2015 to 2018

Parameter	Units	Background 95th Percentile [a]	Canadian Water Quality Guideline	W7 (Reference)									
				2017					2018				
				16-May-17	27-Jun-17	1-Aug-17	3-Oct-17	Mean	15-May-18	3-Jul-18	3-Sep-18	8-Oct-18	Mean
EEM Parameters													
pH	pH units	-	6.5-9.0	7.6	8.13	7.58	7.50	7.70	8.10	7.82	7.67	-	7.86
Temperature	Celsius	-	-	-0.10	2.3	4.0	0.80	1.8	0.10	3.6	3.2	-	2.3
Hardness	mg/L	-	-	78	111	125	139	113	75	97	128	155	114
Alkalinity	mg/L	-	-	76	118	127	150	118	71	105	138	163	119
Conductivity	µS/cm	-	-	80	133	149	164	132	74	121	167	-	121
Dissolved Oxygen	mg/L	-	-	15	12	12	14	13	15	11	12	-	13
Total Suspended Solids	mg/L	-	-	< 3.0	22	21	4.9	13	21	61	7.1	5.2	24
Ammonia	mg/L	-	1.5 [b]	0.0070	0.011	0.014	0.015	0.012	0.012	0.0098	0.014	0.027	0.016
Nitrate (as N)	mg/L	-	3	0.0050	0.14	0.12	0.12	0.096	0.010	0.079	0.089	0.17	0.088
Aluminum	mg/L	0.62	0.10	0.041	0.37	0.54	0.74	0.42	0.54	1.3	0.034	0.10	0.48
Arsenic	mg/L	-	0.0050	0.00049	0.00059	0.00071	0.00075	0.00064	0.00084	0.00097	< 0.00080	0.00058	0.00080
Cadmium	mg/L	-	0.00012-0.00024 [c]	0.0000082	0.000010	0.000011	0.000014	0.000011	0.000016	0.000026	< 0.0000050	0.0000074	0.000014
Copper	mg/L	0.013	0.0020-0.0036 [c]	0.0062	0.0029	0.0028	0.0023	0.0035	0.0072	0.0047	0.0012	0.0024	0.0039
Iron	mg/L	1.1	0.30	0.23	0.66	0.85	1.4	0.77	1.4	1.9	0.19	0.33	0.94
Lead	mg/L	-	0.0022-0.0059 [c]	< 0.000050	0.00019	0.00021	0.00039	0.00021	0.00021	0.00050	< 0.000050	< 0.000050	0.00020
Mercury	mg/L	-	0.000026	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	0.0000067	< 0.0000050	< 0.0000050	< 0.0000050	0.0000054
Molybdenum	mg/L	-	0.073	0.00081	0.0016	0.0014	0.0013	0.0013	0.00073	0.0012	0.0015	0.0012	0.0012
Nickel	mg/L	-	0.076-0.14 [c]	0.0018	0.0020	0.0021	0.0028	0.0022	0.0027	0.0039	0.0011	0.0012	0.0022
Selenium	mg/L	-	0.0010	0.00013	0.00016	0.00015	0.00011	0.00014	0.00015	0.00017	0.00015	0.00021	0.00017
Zinc	mg/L	-	0.034-0.052 [d]	< 0.0030	< 0.0030	0.0032	0.0055	0.0037	0.0031	0.0054	< 0.0030	< 0.0030	0.0036
Additional Parameters with Canadian Water Quality Guidelines													
Thallium	mg/L	-	0.00080	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	0.000011	< 0.000010	< 0.000010	0.000010

Notes: MDMER = *Metal and Diamond Mining Effluent Regulations* ; EEM = Environmental Effects Monitoring.

[a] 95th percentile of background identified by Minnow (2009a).

[b] Based on pH 8 and temperature of 5 °Celsius.

[c] Cadmium, copper, lead, and nickel guidelines are dependent on water hardness.

[d] Based on guideline using 25th percentile of hardness, DOC, and field pH.

Table A.3: MDMER EEM Water Quality at W7 (Reference) and W2 (Exposed), 2015 to 2018

Parameter	Units	Background 95th Percentile [a]	Canadian Water Quality Guideline	W2 (Exposed)									
				2015					2016				
				9-May-15	15-Jun-15	13-Aug-15	5-Oct-15	Mean	27-Apr-16	23-Jun-16	17-Aug-16	23-Oct-16	Mean
EEM Parameters													
pH	pH units	-	6.5-9.0	7.60	7.87	8.09	7.92	7.87	7.95	7.81	8.06	7.87	7.92
Temperature	Celsius	-	-	2.5	6.5	6.7	0	3.9	0.20	6.8	7.0	0	3.5
Hardness	mg/L	-	-	115	172	176	178	160	115	178	196	201	173
Alkalinity	mg/L	-	-	85	154	164	165	142	95	158	176	176	151
Conductivity	µS/cm	-	-	121	224	223	184	188	118	227	235	117	174
Dissolved Oxygen	mg/L	-	-	14	11	12	14	13	14	11	12	13	13
Total Suspended Solids	mg/L	-	-	150	1.3	2.6	< 1.0	39	4.0	8.0	< 3.0	< 3.0	4.5
Ammonia	mg/L	-	1.5 [b]	0.028	0.030	0.039	0.013	0.028	< 0.0050	< 0.0050	0.0061	0.0055	0.0054
Nitrate (as N)	mg/L	-	3	0.45	0.18	0.052	0.086	0.19	0.072	0.099	0.22	2.1	0.63
Aluminum	mg/L	0.62	0.10	2.9	0.020	0.058	0.0067	0.744	0.10	0.071	0.041	0.029	0.061
Arsenic	mg/L	-	0.0050	0.0023	0.00039	0.00055	0.00043	0.00093	0.00053	0.00045	0.00058	0.00045	0.00050
Cadmium	mg/L	-	0.00012-0.00024 [c]	0.000054	< 0.000010	< 0.000010	< 0.000010	0.000021	0.0000091	< 0.0000050	< 0.0000050	< 0.0000050	0.0000060
Copper	mg/L	0.013	0.0020-0.0036 [c]	0.017	0.0022	0.0024	0.0015	0.0057	0.0050	0.0025	0.0023	0.0032	0.0033
Iron	mg/L	1.1	0.30	5.3	0.069	0.21	0.065	1.42	0.35	0.14	0.23	0.081	0.20
Lead	mg/L	-	0.0022-0.0059 [c]	0.0015	< 0.00020	< 0.00020	< 0.00020	0.00054	0.000065	< 0.000050	< 0.000050	< 0.000050	0.000054
Mercury	mg/L	-	0.000026	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	0.000010	< 0.0000050	< 0.0000050	< 0.0000050	0.0000063
Molybdenum	mg/L	-	0.073	0.0015	0.0015	0.0016	0.0014	0.0015	0.0012	0.0014	0.0017	0.0022	0.0016
Nickel	mg/L	-	0.076-0.14 [c]	0.0069	< 0.0010	0.0010	< 0.0010	0.0025	0.0015	0.0012	0.0012	0.00084	0.0012
Selenium	mg/L	-	0.0010	0.00042	< 0.00010	< 0.00010	< 0.00010	0.00018	0.00010	0.00014	0.00017	0.00054	0.00024
Zinc	mg/L	-	0.034-0.052 [d]	0.013	< 0.0050	< 0.0050	< 0.0050	0.0071	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030
Additional Parameters with Canadian Water Quality Guidelines													
Thallium	mg/L	-	0.00080	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010

Notes: MDMER = *Metal and Diamond Mining Effluent Regulations* ; EEM = Environmental Effects Monitoring.

[a] 95th percentile of background identified by Minnow (2009a).

[b] Based on pH 8 and temperature of 5 °Celsius.

[c] Cadmium, copper, lead, and nickel guidelines are dependent on water hardness.

[d] Based on guideline using 25th percentile of hardness, DOC, and field pH.

Table A.3: MDMER EEM Water Quality at W7 (Reference) and W2 (Exposed), 2015 to 2018

Parameter	Units	Background 95th Percentile [a]	Canadian Water Quality Guideline	W2 (Exposed)									
				2017					2018				
				16-May-17	27-Jun-17	1-Aug-17	3-Oct-17	Mean	15-May-18	3-Jul-18	4-Sep-18	25-Sep-18	Mean
EEM Parameters													
pH	pH units	-	6.5-9.0	7.69	7.96	7.81	7.47	7.73	8.10	7.98	7.81	8.12	8.00
Temperature	Celsius	-	-	1.5	6.0	6.7	0.80	3.8	0.50	6.1	3.5	1.5	2.9
Hardness	mg/L	-	-	107	156	173	174	153	100	149	163	167	145
Alkalinity	mg/L	-	-	99	150	168	174	148	91	146	169	163	142
Conductivity	µS/cm	-	-	118	212	224	193	187	104	203	221	202	182
Dissolved Oxygen	mg/L	-	-	15	11	12	14	13	15	8.7	12	14	13
Total Suspended Solids	mg/L	-	-	6.7	7.4	35	24	18	< 3.0	18	< 3.0	4.2	7.0
Ammonia	mg/L	-	1.5 [b]	0.0062	0.013	0.0061	< 0.0050	0.0077	0.010	0.0077	< 0.0050	< 0.0050	0.0070
Nitrate (as N)	mg/L	-	3	0.094	0.31	0.20	0.016	0.15	< 0.0050	0.21	0.079	< 0.0050	0.074
Aluminum	mg/L	0.62	0.10	0.16	0.14	0.82	0.0098	0.28	0.057	0.48	0.017	0.015	0.14
Arsenic	mg/L	-	0.0050	0.00068	0.00061	0.0011	0.00038	0.00070	0.00062	0.00089	0.00043	0.00037	0.00058
Cadmium	mg/L	-	0.00012-0.00024 [c]	0.000016	< 0.0000050	0.000015	0.0000068	0.000011	0.000011	0.000011	< 0.0000050	< 0.0000050	0.0000080
Copper	mg/L	0.013	0.0020-0.0036 [c]	0.0071	0.0032	0.0062	0.0017	0.0045	0.0058	0.0046	0.0021	0.0019	0.0036
Iron	mg/L	1.1	0.30	0.44	0.28	1.2	0.078	0.49	0.24	0.85	0.066	0.045	0.30
Lead	mg/L	-	0.0022-0.0059 [c]	0.000083	0.000077	0.00032	< 0.000050	0.0014	< 0.000050	0.00022	< 0.000050	< 0.000050	0.000093
Mercury	mg/L	-	0.000026	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
Molybdenum	mg/L	-	0.073	0.0011	0.0019	0.0018	0.0014	0.0015	0.00080	0.0019	0.0014	0.0013	0.0013
Nickel	mg/L	-	0.076-0.14 [c]	0.0018	0.0014	0.0028	0.0010	0.0018	0.0018	0.0021	0.00092	0.00093	0.0014
Selenium	mg/L	-	0.0010	0.00018	0.00017	0.00016	0.000085	0.00015	0.00013	0.00018	0.00012	0.00014	0.00014
Zinc	mg/L	-	0.034-0.052 [d]	0.0056	< 0.0030	0.0042	< 0.0030	0.0040	< 0.0030	< 0.0030	< 0.0030	< 0.0030	< 0.0030
Additional Parameters with Canadian Water Quality Guidelines													
Thallium	mg/L	-	0.00080	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010	< 0.000010

Notes: MDMER = *Metal and Diamond Mining Effluent Regulations* ; EEM = Environmental Effects Monitoring.

[a] 95th percentile of background identified by Minnow (2009a).

[b] Based on pH 8 and temperature of 5 °Celsius.

[c] Cadmium, copper, lead, and nickel guidelines are dependent on water hardness.

[d] Based on guideline using 25th percentile of hardness, DOC, and field pH.

Table A.4: Comparison of Mean Concentrations of Key Analytes at Reference (W7) and Mine Exposed (W2) Stations, 2015 to 2018

Parameter	Units	2015			2016			2017			2018		
		W7	W2	Ratio	W7	W2	Ratio	W7	W2	Ratio	W7	W2	Ratio
Total Suspended Solids	mg/L	60	38.7	0.65	9.0	4.5	0.50	13	18	1.4	24	7.0	0.30
Aluminum	mg/L	0.24	0.74	3.1	0.22	0.061	0.28	0.42	0.28	0.67	0.48	0.14	0.30
Arsenic	mg/L	0.00054	0.00093	1.7	0.00052	0.00050	0.97	0.00064	0.00070	1.1	0.00080	0.00058	0.72
Cadmium	mg/L	0.000010	0.000021	2.0	0.0000062	0.0000060	0.97	0.000011	0.000011	0.99	0.000014	0.0000080	0.58
Copper	mg/L	0.0026	0.0057	2.2	0.0022	0.0033	1.5	0.0035	0.0045	1.3	0.0039	0.0036	0.92
Iron	mg/L	0.50	1.4	2.8	0.41	0.20	0.48	0.77	0.49	0.64	0.94	0.30	0.32
Lead	mg/L	0.00022	0.00054	2.5	0.00013	0.000054	0.43	0.00021	0.0014	6.5	0.00020	0.000093	0.46
Zinc	mg/L	< 0.0050	0.0071	1.4	< 0.0030	< 0.0030	1.0	0.0037	0.0040	1.4	0.0036	< 0.0030	0.83

Appendix M – Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment 2019 Update



Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment - 2019

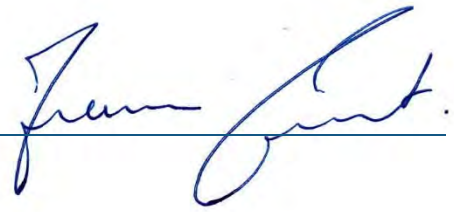
Prepared for:
Minto Explorations, Ltd.
Whitehorse, Yukon

Prepared by:
Minnow Environmental Inc.
Victoria, British Columbia

March 2020

Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment - 2019

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Aquatic Biologist



Pierre Stecko, M.Sc., EP, R.P. Bio.
Senior Project Advisor



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1 INTRODUCTION

1.1 Site Description

The Minto Mine is a high-grade copper mine located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R-6A approximately 240 km northwest of Whitehorse, Yukon Territory (62°37'N latitude and 137°15'W longitude; Figure 1.1). It is owned and operated by Minto Explorations Ltd. (MintoEx), a wholly owned subsidiary of Pembridge Resources (Pembridge). Mine development was initiated in 1997 and commercial operations started in October 2007. The facility was permitted to conduct open pit and underground mining with milling at a rate of 4,200 tonnes per day of copper/gold/silver ore. Minto Mine produced 39.2 million pounds of copper in 2017, its last full year of production. Mill tailings are stored in the Main Pit, Area 2 Pit, and the Dry Stack Tailing Storage Facility (DSTSF; Figure 1.2). Mine-impacted seepage from the DSTSF and under the Mill Valley Fill Extension (MVFE) is collected at the toe of the MVFE and pumped to the Main Pit (Figure 1.2). Non-impacted water and treated mine-impacted water are collected in a Water Storage Pond (WSP; Figure 1.3).

Effluent from the WSP is periodically discharged to Minto Creek under conditions specified in Water Use Licence (WUL; QZ14-031; Yukon Water Board 2015). Minto Creek, in turn, discharges to the Yukon River approximately 7.7 km south-east of the WSP (Figure 1.3).

1.2 Background

Under Minto Mine's WUL, the Minto Mine implements an Environmental Monitoring, Surveillance, and Reporting Plan (EMSRP). The EMSRP is completed by the mine and includes routine water quality monitoring during the ice-free period (typically from April to October or November) in Minto Creek and reference tributaries at sampling frequencies varying from weekly to monthly. In accordance with the WUL, the Minto Mine submits water quality data to the Yukon Water Board as original laboratory reports and monthly summary reports within 30 days of month end. The WUL specifies effluent discharge concentrations and volumes based on the receiving aquatic environment assessment (WUL; QZ14-031; August 2015). Additionally, site specific water quality objectives (SSWQO) have been developed for Minto Creek based on background geological conditions, bioavailability, toxicity considerations, and behavioral impact studies (Minnow 2009; Kennedy et al., 2012). These limits are used to evaluate water quality monitoring data collected from the AEMP and EMSRP and potential exceedances trigger follow up actions in the operational Adaptive Management Plan (AMP).

Minto Mine also implements biological monitoring under the EMSRP, including an Aquatic Environmental Monitoring Program (AEMP) and Environmental Effects Monitoring (EEM) in accordance with federal requirements under the federal *Fisheries Act*.



Map of Canada



Location of the Minto Mine

0 105 210 420
Kilometers

N
W E
S

Projection: North American Datum 1983 UTM Zone 8V

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Figure 1.1

Document Path: S:\Projects\197202\197202.0051 - Minto WUL and Se 2019\4 - GIS\Report\19-51 Fig 1.1 Minto Mine Location.mxd



LEGEND

- Final Effluent Discharge Point
- Mine Footprint
- Water Retention Dam
- Building

0 0.25 0.5 1 km

N W E S

Projection: North American Datum 1983 UTM Zone 8V
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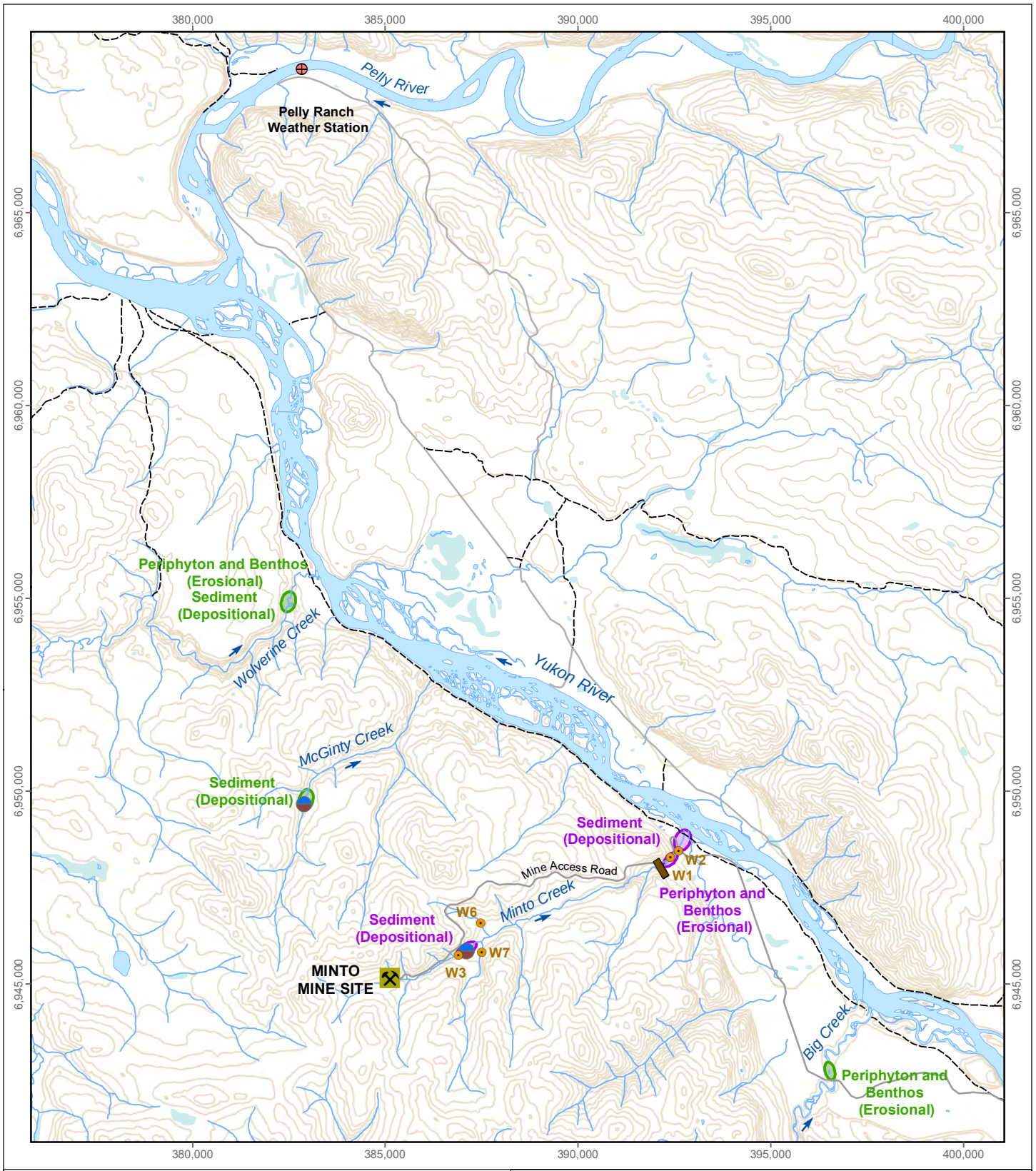
Minto Mine Site Layout and Receiving Environment

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Figure 1.2

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LEGEND

2019 AEMP Samples Collected

- Water
- Sediment
- Pelly Ranch Weather Station
- Fish Barrier
- Routine Water Quality Station

Monitoring Area

- Exposure Area
- Reference Area

AEMP Water, Sediment, Periphyton, and Benthic Invertebrate Monitoring Areas

0 2 4 8
Kilometers

Datum: NAD 83 Map Projection: UTM Zone 8V
Data Source: National Topographic Data Base (NTDB) compiled by Department of Natural Resources Canada at a scale of 1:50,000. All rights reserved.

N W E S

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Figure 1.3

Document Path: S:\Projects\197202\197202.0051 - Minto WUL and Se 2019\4 - GIS\Report\19-51 Fig 3 WUL & Selenium Monitoring.mxd

The AEMP is focused on the evaluation of potential mine-related effects to Minto Creek, with sampling areas located in upper Minto Creek and lower Minto Creek. These Minto Creek areas are evaluated in comparison to matching reference areas – upper McGinty Creek as reference for upper Minto Creek and lower Wolverine Creek and lower Big Creek as references for lower Minto Creek (Table 1.1; Figure 1.3). The annual AEMP includes monitoring of water, sediment, periphyton, benthic invertebrates, fish, and fish habitat. Data from 1994 (baseline) and 2006 to 2018 have been reported previously (e.g., HKP 1994, Minnow 2010, Minnow 2016, Minnow 2019a), with some program modifications over time.

Environmental Effects Monitoring (EEM) is required by the mine under the federal Metal and Diamond Mining Effluent Regulations (MDMER; Environment Canada 2012) and includes additional acute and sublethal toxicity testing (Environment Canada 1997; 2013) and biological monitoring in Minto Creek (e.g., Minnow 2018b). Biological monitoring under EEM is implemented every three years and field work for Phase 5 of the EEM was recently completed in the fall of 2019 and remains to be analyzed and reported.

In Phase 4 of the EEM, some mine influence was observed in routine water quality monitoring and water samples collected in conjunction with benthic invertebrate sampling. Analytes with concentrations higher than reference (or the reference range), include conductivity, hardness, nitrate, total Kjeldahl nitrogen, total phosphorus, and total aluminum, arsenic, copper, iron, molybdenum, and selenium. Concentrations of nitrate were most strongly associated with the release of water from the WSP but remained below the CWQG. Mean concentrations of aluminum and arsenic were above CWQG but at both reference and exposed areas. Copper exceeded CWQG but was lower than the site-specific water quality objective (SSWQO). Primary EEM metrics (density, taxon richness, Simpson's Evenness, and Bray-Curtis index) were within reference condition at upper Minto Creek but density was significantly lower at upper Minto Creek than reference in a control-impact comparison (Minnow 2018b). The difference was not considered ecologically meaningful since the magnitude of difference was below the critical effect size (CES) of ± 2 standard deviations (Minnow 2018b). Fish exposed to the highest concentrations of Minto Mine effluent (25 percent [%]) for 47 days were slightly larger and of better condition than reference fish, but differences were less than the CES of 10%, and considered not to be ecologically meaningful (Minnow 2018b).

The mine entered temporary care and maintenance on October 19, 2018 and has not discharged effluent since August 31, 2018. The Minto Mine has continued to implement the AEMP and retained Minnow Environmental Inc. (Minnow) to complete the 2019 AEMP. The AEMP implemented by Minto Mine on an annual basis is more comprehensive than specified under the WUL. The portion of the AEMP that Minnow conducts includes:



Table 1.1: Minto Mine Water Use Licence Sediment, Periphyton, and Benthic Invertebrate Monitoring Program Overview, September 2019

Area Type	Area	Station	Minto Mine Water Use Licence (QZ14-031, Amendment 10)								
			Water	Sediment by Spoon [a]	Sediment by Hand Corer/Petite Ponar [b]	Sediment Toxicity Testing	Periphyton Chlorophyll-a	Periphyton Community	Periphyton Tissue [c]	Benthic Community by Hess Sampler [d]	Benthic Invertebrate Tissue [c]
Lower Creek Areas	Lower Wolverine Creek (Reference)	LWC-1	✓	-	✓	✓	✓	✓	✓	✓	✓
		LWC-2		-	✓	✓	✓	✓	✓	✓	✓
		LWC-3		-	✓	✓	✓	✓	✓	✓	✓
		LWC-4		-	✓	✓	✓	✓	✓	✓	✓
		LWC-5		-	✓	✓	✓	✓	✓	✓	✓
	Lower Big Creek (Reference)	LBC-1	✓	-	-	-	-	-	✓	✓	✓
		LBC-2		-	-	-	-	-	✓	✓	✓
		LBC-3		-	-	-	-	-	✓	✓	✓
		LBC-4		-	-	-	-	-	✓	✓	✓
		LBC-5		-	-	-	-	-	✓	✓	✓
	Lower Minto Creek (Exposed)	LMC-1	✓	-	✓	✓	✓	✓	✓	✓	✓
		LMC-2		-	✓	✓	✓	✓	✓	✓	✓
		LMC-3		-	✓	✓	✓	✓	✓	✓	✓
		LMC-4		-	✓	✓	✓	✓	✓	✓	✓
		LMC-5		-	✓	✓	✓	✓	✓	✓	✓
Upper Creek Areas	Upper McGinty Creek (Reference)	URC-1	✓	✓	-	-	-	-	-	-	-
		URC-2		✓	-	-	-	-	-	-	-
		URC-3		✓	-	-	-	-	-	-	-
		URC-4		✓	-	-	-	-	-	-	-
		URC-5		✓	-	-	-	-	-	-	-
	Upper Minto Creek (Exposed)	UMC-1	✓	✓	-	-	-	-	-	-	-
		UMC-2		✓	-	-	-	-	-	-	-
		UMC-3		✓	-	-	-	-	-	-	-
		UMC-4		✓	-	-	-	-	-	-	-
		UMC-5		✓	-	-	-	-	-	-	-

Reduced sampling in September of 2019 due to lower dry conditions in lower Minto Creek (See section 3.1 for additional information).

Notes: ✓ = Included in the annual Monitoring Program."-" = Not included in program.

[a] Top 2 centimeters collected; minimum 3-grab composite.

[b] Top 2 centimeters collected; 3-grab composite.

[c] Productivity permitting; in some cases, replication (of 5) may not be achieved with reasonable effort.

[d] 500 µm mesh; 3-grab composite.

1) sediment (chemistry and toxicity testing); 2) periphyton (chlorophyll-a, community, and tissue chemistry); and 3) benthic invertebrate (community and tissue) (Table 1.1; Figure 1.3). Thus, the more comprehensive program is referred to as the Sediment, Periphyton, and Benthic Assessment and it is conducted every year in September. Supporting conditions (e.g., field meter measures, water quality samples, depth, flow, habitat observations) are collected at all sampling areas. Under the WUL, the AEMP program design is reviewed every three years and refined through annual recommendations.

The AEMP field program was completed on September 4 to 8, 2019 with the assistance of Minto Mine staff. AEMP sediment sampling was successfully completed at upper Minto Creek and at the associated reference area (upper McGinty Creek). However, subsequent sampling of the entire lower section of Minto Creek was not possible as it was found to be dry[1]. It was determined that collecting samples from a dry creek bed would not be of value as dry sediment chemistry and toxicity testing would be of little biological relevance, that a dry creek bed does not support periphyton or aquatic benthic invertebrates, and that the Minto Mine is not permitted to discharge effluent under this condition. The corresponding lower reference areas were therefore also determined unnecessary and not sampled. EEM was also conducted by Minnow on upper Minto Creek concurrently with AEMP monitoring and will be reviewed and reported according to federal reporting deadlines (Environment Canada 2012).

1.3 Objectives

Given the above background, the objectives of this study and report are to characterize and interpret current (2019) water and sediment quality of upper Minto Creek relative to the reference, McGinty Creek, and previous years' conditions. Supporting environmental data are also reported.

[1] Minto Creek was dry from June 25, 2019 onwards, refer to Section 3.1 and Appendix B and Minnow 2019b for additional details.

2 METHODS

2.1 Overview

Minnow Environmental Inc. implemented the 2019 Minto Creek sediment, periphyton, and benthic invertebrate assessment with the assistance of Minto Mine staff. Sediment sampling was completed in upper Minto Creek from September 4 to 6 and in the corresponding reference area (upper McGinty Creek) on September 6 (Table 1.1; Figure 1.3). Supporting measures (e.g., field meter measures, water quality samples, depth, flow, habitat observations) were also collected at the upper creek sampling areas (Upper McGinty and Upper Minto Creek). Sampling of lower Minto Creek, however, could not be completed due to dry conditions (refer to Section 3.1 and Appendix B for additional details).

2.1.1 Field Collection

Many environmental variables were measured to support the sediment quality data collected for the Minto Creek assessment. The location of each station was recorded using a handheld Geographic Positioning System (GPS) with coordinates recorded in Universal Transverse Mercator (UTM) units (using the North American Datum of 1983).

Supporting measures collected concurrently with sediment sampling (i.e., at depositional areas) included sample texture, and the presence or absence of organic detritus. *In situ* measurements including temperature, dissolved oxygen, specific conductance, and pH were taken at each station using a YSI field meter (Yellow Springs Instruments, Yellow Springs, OH). Water depth (by meter stick) and water velocity (by HACH FH950 handheld flow meter [HACH Company, Loveland, CO]) were measured at sampling stations.

Water samples for chemical analysis were collected at sediment sampling areas (Table 1.1; Figure 1.3). Samples were collected using a master bottle from which the collected water was poured into pre-labeled sample bottles and preservatives were added, as required. A field duplicate was collected from one area using a split sample method; water from the master bottle was poured into one bottle and then into a duplicate bottle. Water samples for dissolved organic wcarbon (DOC) and for dissolved metals were filtered in the field using 0.45 micrometer (µm) polypropylene filters. Immediately after collection, water samples were placed in a cooler and refrigerated at approximately 4 degrees Celsius (°C) until submission to ALS Environmental in Whitehorse, YT, for analysis (refer to Appendix C for analytical methods).

2.1.2 Data Analysis

A formal data quality review (DQR) was completed to assess data quality and by extension, the confidence with which the data can be used to derive conclusions relative to the program

objectives (Appendix A). The quality of the data was evaluated by: comparing laboratory reporting limits to pre-determined program targets, observing relative percent differences of field duplicates, and reviewing field blanks for potential contamination during sampling or transport. The accredited laboratory conducted their own Quality Assurance/Quality Control (QA/QC) analysis, including method blanks, laboratory duplicates, matrix spikes, spiked blanks, and certified reference materials.

Water quality from Minto Creek was evaluated relative to: WUL objectives, concentrations measured at reference areas, applicable Canadian Water Quality Guidelines (CWQG; CCME 1999), and historical water quality conditions. Sample-specific toxicity modifying factors, such as hardness, alkalinity, pH, DOC and temperature were used to calculate environmental quality guidelines for the protection of aquatic health where required. Seasonal summary statistics for mine related indicators in upper Minto Creek were also reviewed for context (EMSRP Minto Mine 2020; Appendix B).

Supporting field measures (temperature, dissolved oxygen, pH, and specific conductance) were tested for differences between upper Minto Creek and the reference area (upper McGinty Creeks) using two-sample t-tests. The assumption of normality was assessed using the Shapiro Wilks' test (α = 0.05) and homogeneity of variance was assessed using Levene's Test (α = 0.05). Data were $\log_{10}$ transformed when required to meet the assumption of normality. A value of 1 was added before taking the logarithm if values of zero were in the data set. A significance level (α) of 0.05 was used for all statistical tests. Statistical comparisons were conducted in R Studio version 1.2.5001 (2017). A magnitude of difference (MOD) was reported for statistical comparisons that were significant as:

$$MOD = \frac{\left(MCT_{Exp} - MCT_{Ref}\right)}{MCT_{Ref}} \times 100\%$$

where *MCT* is the measure of central tendency (i.e., mean for the t-test after back-transforming to original data units when a transformation was used).

Summary statistics (means and standard deviations) were calculated using R and the Kaplan-Meir (K-M) method to estimate values for analytes with censored data (non-detections). This method was applied to avoid bias introduced by substitution methods (Helsel 2012; Lee 2017). The K-M method involves transforming the left censored (i.e., < value) dataset to a right censored (i.e., > value) dataset, and then using the K-M estimator (used to estimate the mean survival time in survival analysis) to estimate the mean. The calculation was conducted using the survfit function in the survival package (Therneau 2017) in R and involves calculating the area under the K-M survival curve. The K-M method is non-parametric and can accommodate multiple laboratory reporting limits (LRLs). This method of estimating the mean is equivalent to

using the distribution of detectable values below the LRL to represent values that are < LRL. When a standard deviation could not be estimated (e.g., when all data were below the LRL), then it was not reported. When a value was reported below a poor LRL (defined as a LRL that exceeded the maximum detected value) then the value was removed from the dataset.

2.2 Sediment Quality

2.2.1 Sample Collection

Sediment samples were collected for particle size and chemical analysis at depositional areas within upper Minto Creek and McGinty Creek, the reference creek (Table 1.1, Figure 1.3). As found in previous years, sediment deposits were rare and typically very shallow (i.e., deposits were less than one centimeter in depth). Sediment was therefore collected using a stainless-steel spoon instead of a ponar or coring equipment.

At locations of sediment deposition, surficial sediment was carefully collected by slowly spooning the sediment into a pre-labeled glass jar, with care taken to avoid the loss of fine material. Sediment was collected from five sites for chemical analyses and a composite sample was collected for particle size. Immediately after collection, sediment samples were placed in a cooler and later into a refrigerator to maintain temperatures at approximately 4°C. Samples were subsequently submitted to ALS Environmental in Whitehorse, YT (refer to Appendix C for methods, laboratory certificates, and field notes).

2.2.2 Data Analysis

A formal Data Quality Review (DQR) was completed to assess sediment data quality (Appendix A). Laboratory reporting limits were compared to study target limits and were generally defined as ≤ 1/10th guideline values for the analytes of interest. The relative percent difference of field duplicates for various analytes were also collected and compared as a part of the DQR as a measure of field precision. Laboratory QA/QC analysis included method blanks, laboratory duplicates, spiked blanks, and certified reference materials (Appendix C).

Sediment chemistry data were summarized by reporting mean, standard deviation, minimum, and maximum for each area. Sediment quality data were evaluated relative to sediment quality guidelines (SQGs) for the protection of aquatic life (e.g., CCME 1999) and reference concentrations to identify metals with the potential to adversely affect aquatic life and/or that could be elevated due to mine activity. Sediment chemistry data were also generally compared to historical data for analytes of interest (1994, and 2006 to 2019). Interpretation was mostly focused on results using the whole sediment data collection methods (described above in 2.2.1) used in the program from 2010 to 2019 and SQGs for the protection of aquatic life (e.g., CCME 1999) apply to whole sediment. Sediment collection methods prior to 2010 were

either not specified (1994) or only focused on the fraction of sediment that passed through a mesh sieve (< 63 µm; silt and clay). Details of this historical method and rationale for the method change are previously described in earlier annual reports (e.g., Minnow 2019a).

Differences between 2019 sediment samples from Minto Creek and the reference area were tested using a two-sample t-test, with a p-value < 0.05 for statistical tests. The assumption of normality was assessed using the Shapiro Wilks' test (α = 0.05) and homogeneity of variance was assessed using Levene's Test (α = 0.05). If variances were unequal, then the two-sample t-test for unequal variances was conducted (Ruxton 2006). Data that could not be normalized were log transformed. A value of 1 was added before taking the logarithm if values of zero were in the data set. If data could not be normalized after transformation, a non-parametric Mann-Whitney test was applied. Statistical comparisons were conducted using Real Statistics in R Studio version 1.2.5001 (R core team 2019). A magnitude of difference (MOD) was calculated for each metric as:

$$MOD = \frac{\left(\bar{X}_{Exp} - \bar{X}_{Ref}\right)}{SD}$$

where the SD is an estimate of the reference standard deviation. The estimate of the reference standard deviation was the pooled standard deviation in the two-sample t-test for equal variances or the reference standard deviation when the two-sample t-test for unequal variances was applied.

The MOD for the Mann-Whitney test was calculated using medians instead of means and the pooled median absolute deviation (MAD) instead of the SD. The MAD is calculated as the median of the absolute values of the differences between each observation and the median observation for that area (and corrected by a factor of 1.4826 to scale the MAD to a comparable magnitude to the SD).

In cases where there was a value below the reported detection limit, the value was replaced with the detection limit and a non-parametric Mann-Whitney test was conducted. If all values for a parameter were below the detection limit, no statistical analysis was conducted.

2.3 Hydrology and Climate

Given the dry condition of the lower Minto Creek bed, flow conditions of Minto Creek and local climate data were reviewed and summarized for regional context in data interpretation. A summary of flow conditions for lower Minto Creek Stations was provided by Minto Mine staff (Minto Mine 2020; Appendix B). Climate data (i.e. temperature and precipitation) for 2019 were compared to Climate Normals (1981 to 2010) recorded at the Pelly Ranch weather station (Government of Canada 2019) (Minnow 2019b). Key findings of the review are summarized in Section 3.1.



2.4 Periphyton and Benthic Invertebrate Community

As previously mentioned, periphyton and benthic invertebrate community samples were not collected in erosional habitat of lower Minto, lower Wolverine, and lower Big Creeks in 2019 because there was no water in lower Minto Creek to sample (Appendix B). Furthermore, there was no effluent discharged from the mine in 2019.

3 SUPPORTING MEASURES

3.1 Hydrology and Climate

The field crew encountered dry conditions in lower Minto Creek in September 2019. Recorded flow data indicated that conditions were dry from June 25th onwards until freeze up in 2019 (Minto Mine 2019). Flow and stage height decreased rapidly at Station W1 through June 2019, from a maximum of 0.129 m^3/s on June 4th, 2019 to 0.0013 m^3/s on June 22nd, 2019 (Appendix B). Low flows were consistent with local climate data (Pelly Ranch weather station; Government of Canada 2019). Temperatures were higher, and precipitation was lower, in 2019 in the Minto Mine region when compared to the Climate Normals collected from 1981 to 2010 (Appendix B; Government of Canada 2019). From June to November 2019, temperatures were approximately 1 to 2 °C warmer than normal (Minnow 2019b) and there was substantially lower annual average precipitation (160 mm) when compared to the annual average from the Climate Normals (321 mm; Appendix B and C). Drier conditions measured in 2019 were obvious when compared to climate Normals and recent year conditions (Figure 3.1).

3.2 Field Surface Water Measures

In situ surface water conditions were considered good, however, differed between upper Minto Creek and the reference creek. Specific conductance and pH were significantly higher in upper Minto Creek (567 µS/cm; 8.2) than in upper McGinty Creek (242 µS/cm; 7.8; Figure 3.2, Table 3.1) suggesting an influence from the Minto Mine. All pH values were within the range of the WUL objectives for pH for the protection of aquatic health. Mean temperature at the sediment sampling area of upper Minto Creek (2.8°C) was higher than in upper McGinty Creek (1.1°C) and may be attributed to the warmer temperatures later in the sampling day (>17:15) and lower shade cover at Minto Creek (Figure 3.2, Appendix Table B). Both creeks were well oxygenated with values above the CWQG for the protection of aquatic health with the exception of one sample from McGinty Creek that was slightly below (9.3 mg/L) the guideline for the protection of early life stages (9.5 mg/L). Dissolved oxygen (percentage and mg/L) values were higher at upper Minto Creek (89.0% saturation and 12.2 mg/L) than at upper McGinty Creek (75.8% saturation and 10.3 mg/L; Figure 3.2, Appendix B).

3.3 Water Chemistry

The quality of water chemistry data was judged as good (Appendix A). Laboratory reporting limits for all analytes were suitable for project purposes. RPDs for analytes in duplicate demonstrated acceptable percentages (< 40%) of precision for analytes of interest (mine influence indicators or potential toxicity modifying factors). Total copper, a mine influence indicator of interest, had a

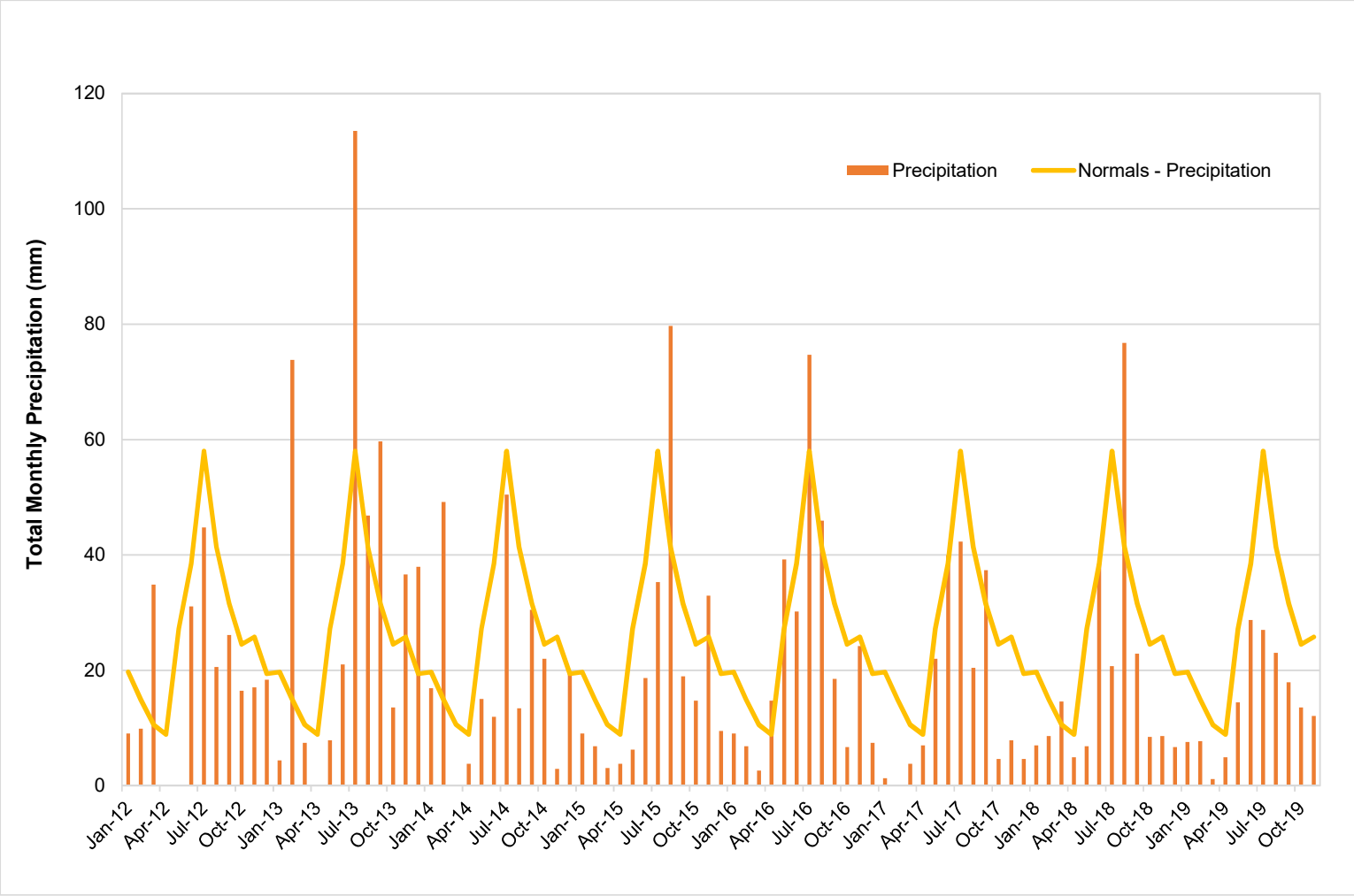


Figure 3.1: Total Monthly Precipitation at Minto Mine Compared to Climate Normals, 2012 to 2019

Notes: Canada Climate Normals from 1981 to 2010 (Government of Canada 2019). Precipitation data from the Pelly Ranch weather station. (modified from Minnow 2019b)

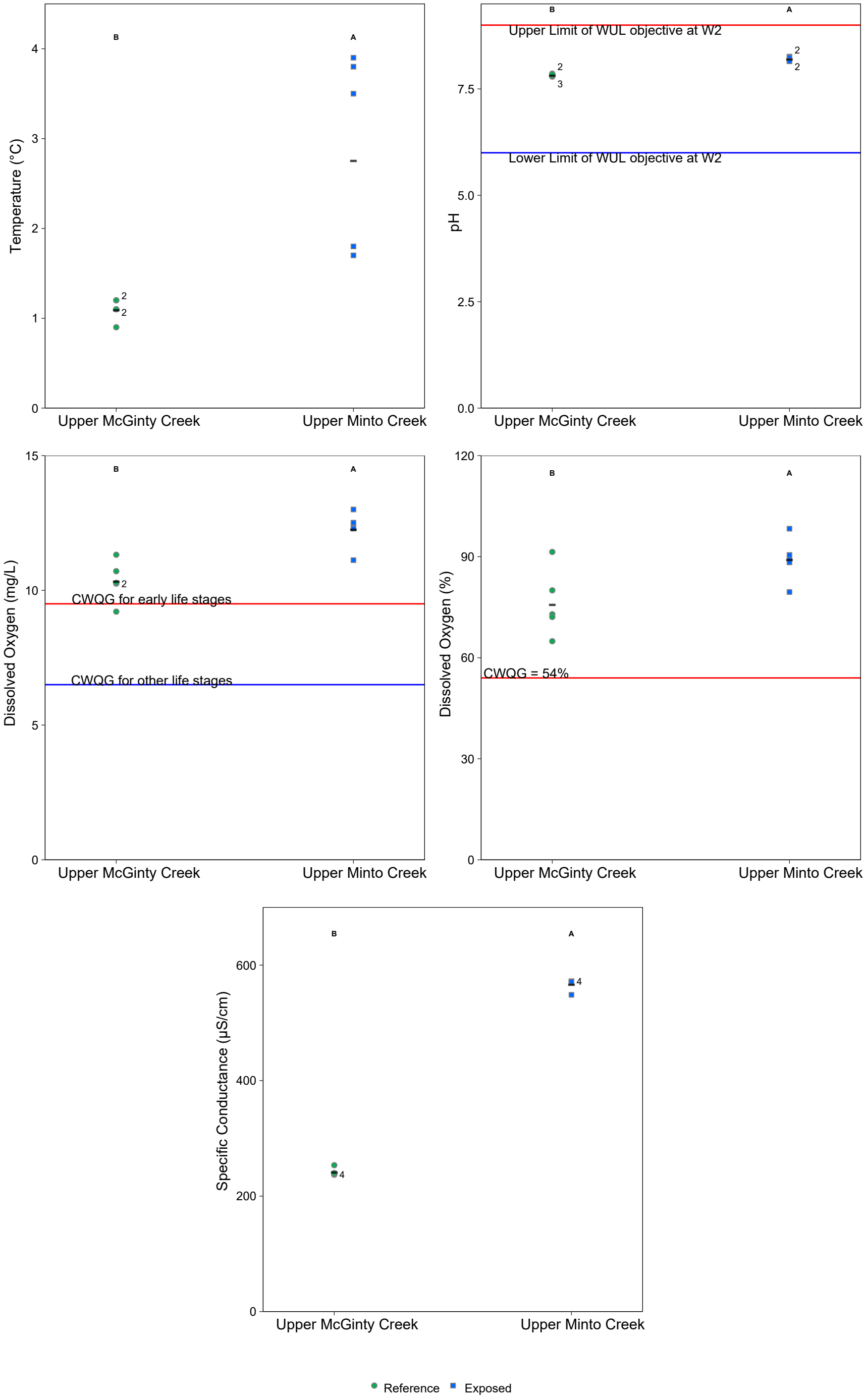


Figure 3.2: Physico-chemical Measurements in Depositional Areas

Table 3.1: Summary of *In Situ* Water Quality Statistical Comparisons Between Upper McGinty Creek (Reference) and Upper Minto Creek (Mine-Exposed), 2019

Endpoint	Data Transformation	Test	Test P-value	MCT[a]		MOD[b] (%)
				Upper McGinty	Upper Minto	
Temperature (°C)	log_{10}	tequal	0.001	1.09	2.76	153
Dissolved Oxygen (mg/L)	log_{10}	tequal	0.004	10.3	12.2	18.4
Dissolved Oxygen (%)	log_{10}	tequal	0.042	75.8	89.0	17.4
pH	none	tequal	<0.001	7.80	8.20	4.86
Specific Conductance (µS/cm)	log_{10}	tequal	<0.001	242	567	134

P-value < 0.05.

[a] MCT Measure of Central Tendency is the mean for parameters where statistics were conducted on the raw scale and the geometric mean when statistics were log_{10} transformed to meet the assumtions of normality.

[b] MOD= magnitude of difference.

RPD value of 41%. This value is considered relatively good in terms of field precision which measures natural and sampling variability. Dissolved metal duplicates all demonstrated low RPDs and therefore high field precision. Other analytes of interest were associated with high precision. Strong agreement (< 20% RPD) was achieved between laboratory duplicate samples for all analytes (Appendix C) indicating high analytical precision.

Nutrient (i.e., total phosphorus (TP), total dissolved phosphorus (TDP) and nitrogen species [nitrate, nitrite, ammonia]) concentrations were relatively low at both the upper exposure and reference areas. Both systems are defined as oligotrophic (based only on total phosphorus, < 0.025 mg/L) in terms of trophic classification (Dodds et al. 1988; Table 3.2). McGinty Creek was slightly more productive than upper Minto Creek based on fall 2019 TP (0.0081 mg/L > 0.0043 mg/L) and nitrate concentrations (0.0950 mg/L > 0.0529 mg/L, respectively). Nitrate is a mine related parameter of interest and has been associated with water from the WSP during discharge years (Minnow 2018b).

Hardness, total dissolved solids, total alkalinity, and total inorganic carbon concentrations in 2019 were generally higher in upper Minto Creek when compared to those in McGinty Creek (Table 3.2). Higher hardness, dissolved organic carbon (DOC), and alkalinity can modify the toxicity of certain metals (e.g., copper). Total and dissolved organic carbon were similar in the two creeks in 2019. Higher boron and lithium concentrations found in upper Minto Creek compared to the reference creek may suggest a higher groundwater contribution to consider for context in future chemical comparisons.

All analytes were below the CWQG in 2019 in both Upper Minto and the reference creek with the exception of fluoride. Fluoride exceeded the interim CWQG in both upper Minto Creek and the reference area, upper McGinty Creek (Table 3.2) suggesting a regional and non-mine related influence. The total copper concentration of 0.0039 mg/L was just below the CWQG of 0.004 mg/L for the protection of aquatic life using the corresponding sample hardness of 277 mg/L as $CaCO_3$ in the guideline equation CCME (1999). Copper is a mine related parameter of interest and can be toxic to aquatic life under certain conditions (CCME 1999). In 2017 and 2018, the total copper concentrations just exceeded the CWQG guideline. However, the fall 2019 (0.0023 mg/L) and historical dissolved copper concentrations were well below the WUL SSWQO (0.013 mg/L; Table 3.2, Appendix B). The WUL objectives, particularly those for metals, such as copper, with hardness and DOC as modifying factors, were developed with consideration of natural background concentrations and the protection of aquatic organisms in Minto Creek in mind (Minnow 2009; Kennedy et al., 2012). Surface water quality data monitored as part of the EMSRP program are discussed elsewhere; however, 2019 data demonstrated dissolved copper concentrations varied seasonally; with higher concentrations measured in the spring



Table 3.2: Water Quality Results at Exposed and Reference Upper Areas, Minto Mine WUL, September 2018 to 2019

Analyte		Units	CCME Water Quality Guidelines[a]		WUL Objectives	2018		2019	
			Long-term	Short-Term		UMC	URC	UMC	URC
Field	Specific Conductance	µS/cm	-	-	-	489	128	567	242
	Conductivity	µS/cm	-	-	-	556	146	570	254
	Dissolved Oxygen	%	-	-	-	75.0	81.2	89.2	76.3
	Dissolved Oxygen	mg/L	6.5 - 9.5	-	-	10.1	11.3	12.3	10.4
	pH	pH units	6.5 - 9.0	-	6.0 - 9.0	7.89	7.21	8.20	7.82
	Temperature	°C	-	-	-	3	1.90	2.94	1.10
Physical Test	Hardness	mg/L as $CaCO_3$	-	-	-	256	68.1	277	120
	pH	pH units	6.5 - 9.0	-	6.0 - 9.0	8.28	7.85	8.50	8.22
	Total Suspended Solids	mg/L	-	-	-	3.30	8.80	<3.0	<3.0
	Total Dissolved Solids	mg/L	-	-	-	344	121	363	155
	Turbidity	NTU	-	-	-	0.130	1.22	0.100	0.370
Anions and Nutrients	Total Alkalinity	mg/L	-	-	-	249	60.5	307	115
	Total Ammonia (as N)	mg/L	0.50 to 4.8 [b]	-	0.25	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br)	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	120	640	-	4.53	<0.50	4.93	<0.50
	Fluoride (F)	mg/L	0.12	-	-	0.529	0.260	0.532	0.479
	Nitrate (as N)	mg/L	3.0	124	9.1	0.107	0.0535	0.0529	0.0950
	Nitrite (as N)	mg/L	0.060	-	0.060	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total dissolved	mg/L	-	-	-	0.00520	0.0114	0.00430	0.00810
	Phosphorus (P)-Total	mg/L	-	-	-	0.0240	0.0120	0.00520	0.0100
	Sulfate (SO_4)	mg/L	-	-	-	58.0	10.1	54.4	20.2
Other	Total Cyanide	mg/L	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050
	Dissolved Organic Carbon	mg/L	-	-	-	6.41	17.2	5.42	5.49
	Total Inorganic Carbon	mg/L	-	-	-	60.3	13.8	62.1	27.0
	Total Organic Carbon	mg/L	-	-	-	6.19	16.1	5.91	5.86
Total Metals	Total Aluminum (Al)	mg/L	0.10 [c]	-	-	0.0100	0.0282	0.0765	0.00980
	Total Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Total Arsenic (As)	mg/L	0.0050	-	-	0.000260	0.000410	0.000290	0.000350
	Total Barium (Ba)	mg/L	-	-	-	0.0635	0.0285	0.0713	0.0393
	Total Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Total Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050
	Total Boron (B)	mg/L	1.5	29	-	0.0230	<0.010	0.0250	<0.010
	Total Cadmium (Cd)	mg/L	0.00012 to 0.00037 [d]	0.001 [d]	-	<0.0000050	<0.0000050	<0.000015	<0.0000050
	Total Calcium (Ca)	mg/L	-	-	-	57.5	18.3	63.6	33.7
	Total Cesium (Cs)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010
	Total Chromium (Cr)	mg/L	0.0010 Cr(VI)	-	-	0.000190	0.000390	0.000240	0.000200
	Total Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	0.000110	<0.00010
	Total Copper (Cu)	mg/L	0.0020 to 0.0040 [e]	-	-	0.00405	0.00143	0.00388	<0.00050
	Total Iron (Fe)	mg/L	0.30	-	-	0.0190	0.226	0.132	0.146
	Total Lead (Pb)	mg/L	0.0020 to 0.0070 [f]	-	-	<0.000050	<0.000050	0.0000540	<0.000050
	Total Lithium (Li)	mg/L	-	-	-	0.00300	<0.0010	0.00350	<0.0010
	Total Magnesium (Mg)	mg/L	-	-	-	30.5	5.85	29.9	9.54
	Total Manganese (Mn)	mg/L	-	-	-	0.0402	0.0130	0.0567	0.0314
	Total Mercury (Hg)	mg/L	0.000026	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Total Molybdenum (Mo)	mg/L	0.073	-	-	0.00459	0.000911	0.00587	0.00250
	Total Nickel (Ni)	mg/L	0.071 to 0.15 [g]	-	-	0.000990	0.000960	0.00100	<0.00050
	Phosphorus (P)-Total	mg/L	-	-	-	0.0240	0.0120	0.00520	0.0100
	Total Potassium (K)	mg/L	-	-	-	2.38	0.413	2.38	0.806
	Total Rubidium (Rb)	mg/L	-	-	-	0.000320	<0.00020	0.000340	<0.00020
	Total Selenium (Se)	mg/L	0.0010	-	-	0.000169	0.000261	0.000308	0.000734
	Total Silicon (Si)	mg/L	-	-	-	3.76	5.80	6.90	6.08
	Total Silver (Ag)	mg/L	0.00025	-	-	<0.000010	<0.000010	<0.000010	<0.000010
	Total Sodium (Na)	mg/L	-	-	-	19.1	3.89	20.6	6.16
	Total Strontium (Sr)	mg/L	-	-	-	0.707	0.128	0.843	0.237
	Total Sulfur (S)	mg/L	-	-	-	11.1	3.04	20.7	7.52
	Total Tellurium (Te)	mg/L	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020
	Total Thallium (Tl)	mg/L	0.00080	-	-	<0.000010	<0.000010	<0.000010	<0.000010
	Total Thorium (Th)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Total Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	0.000120
	Total Titanium (Ti)	mg/L	-	-	-	0.000340	<0.00090	<0.0060	0.000450
	Total Tungsten (W)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Total Uranium (U)	mg/L	0.015	0.033	-	0.00278	0.000354	0.00302	0.00108
	Total Vanadium (V)	mg/L	-	-	-	<0.00050	0.000550	0.000830	0.000690
	Total Zinc (Zn)	mg/L	-	-	-	<0.0030	<0.0030	<0.0030	<0.0030
	Total Zirconium (Zr)	mg/L	-	-	-	0.000113	0.000409	<0.00020	<0.00020

Short term water quality guideline not met.
Long term water quality guideline not met.
Water quality guideline and water use licence objectives not met.

Notes: UMC= upper Minto creek, URC = upper reference creek.

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

[b] Total ammonia is based on sample temperature and pH.

[c] Total aluminum is based on pH. 5 µg/L if pH < 6.5 and 100 µg/L if pH ≥ 6.5.

[d] Total cadmium guidelines, Short-term benchmark (µg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$. Long-term guideline at hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation (µg/L) = $10^{\{0.83(\log[\text{hardness}]) - 2.46\}}$.

[e] Total copper guideline is based on hardness and using the equation= $0.2 \times e^{\{0.8545[\ln(\text{hardness})]-1.465\}} \times 1000$ (mg/L).

[f] Total lead guideline is related to water hardness (as CaCO3): At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation CWQG (µg/L)= e{1.273[ln(hardness)]-4.705}. At hardness >180 mg/L, the CWQG is 7 µg/L.

[g] Total nickel is based on a guideline using water hardness (as CaCO3): At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation CWQG (µg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$. At hardness >180 mg/L, the CWQG is 150 µg/L.

[h] Dissolved Cadmium (µg/L) guidelines based on the following formula: $e^{(0.736(\ln(\text{Hardness}))-4.943)}$.

[i] Dissolved Copper water quality objective depends on whether the concentration of dissolved organic carbon (DOC) is above 10 mg/L and is 0.02 mg/L or below ≤ 10 mg/L DOC and is 0.013 mg/L Cu.

[j] Dissolved Zinc short-term benchmark is calculated as: exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). The long-term guideline is for dissolved zinc is calculated as: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625).

Table 3.2: Water Quality Results at Exposed and Reference Upper Areas, Minto Mine WUL, September 2018 to 2019

Analyte		Units	CCME Water Quality Guidelines[a]		WUL Objectives	2018		2019	
			Long-term	Short-Term		UMC	URC	UMC	URC
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	-	-	0.10	<0.0020	0.0249	0.00110	0.00450
	Dissolved Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Arsenic (As)	mg/L	-	-	0.0050	0.000250	0.000390	0.000210	0.000280
	Dissolved Barium (Ba)	mg/L	-	-	-	0.0675	0.0281	0.0668	0.0378
	Dissolved Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Boron (B)	mg/L	-	-	-	0.0220	<0.010	0.0230	<0.010
	Dissolved Cadmium (Cd)	mg/L	-	-	0.000159 to 0.000447 [h]	0.00000620	<0.0000050	<0.0000050	<0.0000050
	Dissolved Calcium (Ca)	mg/L	-	-	-	55.4	18.2	62.1	32.2
	Dissolved Cesium (Cs)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Chromium (Cr)	mg/L	-	-	0.0010	<0.00010	0.000380	0.000110	0.000200
	Dissolved Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Copper (Cu)	mg/L	-	-	0.020/0.013 [i]	0.00279	0.00136	0.00231	0.000440
	Dissolved Iron (Fe)	mg/L	-	-	1.1	0.0140	0.185	<0.010	0.0930
	Dissolved Lead (Pb)	mg/L	-	-	0.0040	<0.000050	<0.000050	<0.000050	0.0000690
	Dissolved Lithium (Li)	mg/L	-	-	-	0.00290	<0.0010	0.00310	<0.0010
	Dissolved Magnesium (Mg)	mg/L	-	-	-	28.6	5.52	29.5	9.59
	Dissolved Manganese (Mn)	mg/L	-	-	-	0.0372	0.0116	0.0317	0.0287
	Dissolved Mercury (Hg)	mg/L	-	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Dissolved Molybdenum (Mo)	mg/L	-	-	0.073	0.00499	0.000883	0.00562	0.00241
	Dissolved Nickel (Ni)	mg/L	-	-	0.11	0.000920	0.000940	0.000920	<0.00050
	Phosphorus (P)-Total dissolved	mg/L	-	-	-	0.00520	0.0114	0.00430	0.00810
	Dissolved Potassium (K)	mg/L	-	-	-	2.25	0.407	2.42	0.793
	Dissolved Rubidium (Rb)	mg/L	-	-	-	0.000280	<0.00020	0.000250	<0.00020
	Dissolved Selenium (Se)	mg/L	-	-	0.0020	0.000326	0.000281	0.000293	0.000640
	Dissolved Silicon (Si)	mg/L	-	-	-	5.82	5.68	6.05	5.50
	Dissolved Silver (Ag)	mg/L	-	-	0.00010	<0.000010	<0.000010	<0.000020	<0.000010
	Dissolved Sodium (Na)	mg/L	-	-	-	17.5	3.70	18.7	6.24
	Dissolved Strontium (Sr)	mg/L	-	-	-	0.770	0.124	0.858	0.248
	Dissolved Sulfur (S)	mg/L	-	-	-	19.3	3	17.6	6.74
	Dissolved Tellurium (Te)	mg/L	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020
	Dissolved Thallium (Tl)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Thorium (Th)	mg/L				<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Titanium (Ti)	mg/L	-	-	-	<0.00030	0.000610	<0.00030	<0.00030
	Dissolved Tungsten (W)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Uranium (U)	mg/L	-	-	-	0.00270	0.000348	0.00299	0.00111
	Dissolved Vanadium (V)	mg/L	-	-	-	<0.00050	<0.00050	<0.00050	<0.00050
	Dissolved Zinc (Zn)	mg/L	0.032 to 0.066 [j]	0.11 to 0.27 [j]	0.030	<0.0010	<0.0010	<0.0010	<0.0010
	Dissolved Zirconium (Zr)	mg/L	-	-	-	0.0000900	0.000396	<0.00020	<0.00020

Short term water quality guideline not met.

Long term water quality guideline not met.

Water quality guideline and water use licence objectives not met.

Notes: UMC= upper Minto creek, URC = upper reference creek.

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality guidelines.

[b] Total ammonia is based on sample temperature and pH.

[c] Total aluminum is based on pH. 5 µg/L if pH < 6.5 and 100 µg/L if pH ≥ 6.5.

[d] Total cadmium guidelines, Short-term benchmark (µg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$. Long-term guideline at hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation (µg/L) = $10^{\{0.83(\log[\text{hardness}]) - 2.46\}}$.

[e] Total copper guideline is based on hardness and using the equation= $0.2 \times e^{\{0.8545[\ln(\text{hardness})]-1.465\}} \times 1000$ (mg/L).

[f] Total lead guideline is related to water hardness (as CaCO3): At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation CWQG (µg/L)= e{1.273[ln(hardness)]-4.705}. At hardness >180 mg/L, the CWQG is 7 µg/L.

[g] Total nickel is based on a guideline using water hardness (as CaCO3): At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation CWQG (µg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$. At hardness >180 mg/L, the CWQG is 150 µg/L.

[h] Dissolved Cadmium (µg/L) guidelines based on the following formula: $e^{(0.736(\ln(\text{Hardness}))-4.943)}$.

[i] Dissolved Copper water quality objective depends on whether the concentration of dissolved organic carbon (DOC) is above 10 mg/L and is 0.02 mg/L or below ≤ 10 mg/L DOC and is 0.013 mg/L Cu.

[j] Dissolved Zinc short-term benchmark is calculated as: exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). The long-term guideline is for dissolved zinc is calculated as: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625).

(median 0.00301 mg/L) and lower concentrations in the fall (median 0.00228 mg/L) (Appendix B; Minto Mine 2020). Three dissolved copper values exceeded the WUL SSWQO objective on two occasions in 2019 (Feb. 12, 0.0212 mg/L and Apr 30, 0.147 mg/L) which required review as per the adaptive management plan (Minto Mine 2017). Dissolved hardness and pH were slightly lower in the spring (median 271 mg/L, 8.3, respectively) compared to fall conditions (medians 290 mg/L and 8.47). In the upper reference creek, both total and dissolved copper values (< 0.0005 mg/L; 0.00044 mg/L) were well below the acute CWQG guideline and WUL objective despite a relatively lower hardness value (120 mg/L as $CaCO_3$). The relatively higher copper concentrations suggest an influence of the mine on upper Minto Creek.

3.4 Summary

Supporting *in situ* measurements collected in September of 2019 indicated good Minto Creek water quality. Influence of the Minto Mine was evident in higher specific conductance and pH values relative to the reference creek, but water quality generally met guidelines and WUL objectives.

The concentration of total copper, a parameter of concern, at upper Minto Creek was just below the CWQG and was similar to recent historical values. It should be noted that total copper guideline exceedances were observed in background, which led to development of the WUL objective (Minnow 2009). The concentration of dissolved copper, which is considered a better indicator of bioavailability to aquatic organisms, was below the WUL objective. Concentrations of total and dissolved copper in the reference creek were much lower than both the CWQG and WUL objective. Total copper concentrations have historically been lower than CWQGs at lower Minto Creek where higher trophic organisms (fish) are more commonly reported (Minnow 2019a). Given the generally higher copper concentrations in upper Minto Creek, relative to CWQG guideline and the reference creek conditions, continued evaluation of the potential adverse effects to the aquatic community remains a priority for monitoring.

4 SEDIMENT QUALITY

4.1 Sediment Particle Size and Chemistry

Sediment data quality was assessed prior to data analysis and interpretation, and was judged as excellent in terms of agreement between field duplicate results for metals and other analytes (Appendix A). It should be noted that duplicates for particle size were not taken due to low volumes of sediment available for sampling (Appendix C).

Sediments collected in 2019 were largely composed of fine particles of silt/clay (>15%) and sand (>60%) content (Figure 4.1; Appendix B). There were relatively more finer particles (silt /clay category) at the upper Minto Creek depositional area than at the upper reference area, McGinty Creek (28% vs 17%; Figure 4.1, Appendix C). Organic content measured by mean loss on ignition (LOI), total organic carbon (TOC), and total carbon was slightly higher in upper Minto Creek than McGinty Creek sediments, but the difference was not significant (Table 4.1). However, inorganic carbon was significantly higher at upper Minto Creek relative to the reference location (0.15% vs 0.063 %; Table 4.2).

Concentrations of several metal were found to be significantly higher in upper Minto Creek than McGinty Creek sediments (Table 4.1). Sediment concentrations of copper (1,208%), molybdenum (446%), and cadmium (221%) had the highest magnitude of difference between the upper creeks suggesting a mine influence. Mean concentrations of copper also exceeded the Interim Sediment Quality Guidelines (ISQG) for the protection of aquatic life (CCME 1999) in the upper effluent-exposed area (Table 4.2, Appendix B). Copper concentration measured in one sediment sample was above the probable effect level (PEL) at which adverse biological effects are likely to occur[2]. Arsenic concentrations measured in both upper Minto Creek and the reference site, were also above the ISQG indicating arsenic was associated with a more regional influence and not the Minto Mine.

4.2 Temporal Comparisons

Sand is generally the dominant particle size distribution in Upper Minto Creek as observed over the more recent historical data (post 2010; Figure 4.1). Particle size distribution observed from 2010 to 2018 was notably different from data collected prior to 2010, which employed different sampling methodology (described in Minnow 2019a). Upper McGinty particle distribution is noticeably more variable in clay and sand percentages (Appendix B), perhaps reflecting more dynamic hydrology in this system.

[2] Although it is recognized that guideline exceedances, even of probable effect levels, can occur naturally in highly mineralized areas.

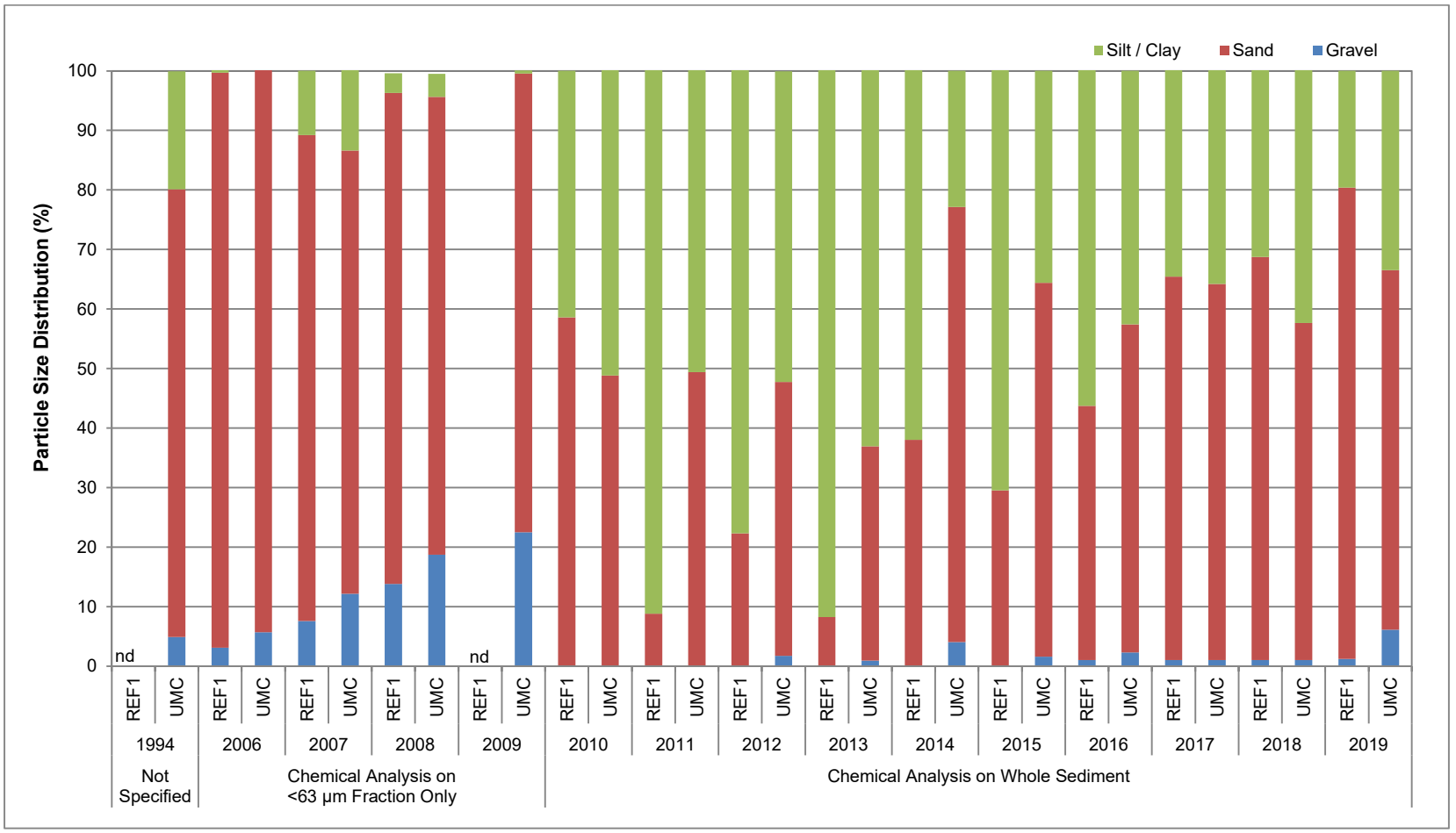


Figure 4.1: Particle Size Distribution of Sediment Collected in Upper Minto Creek and Reference Location, 1994 to 2019 [a]

Notes: Methods used in 1994 were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994), nd = no data.

[a] REF1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2018; UMC = Upper Minto Creek.

Table 4.1: Summary of Sediment Chemistry Data Collected at Upper Reference and Exposed Areas, Minto Mine WUL, 2019

Analytes		Units	CSQG [a]		Upper McGinty Creek (Reference)				Upper Minto Creek (Exposed)			
			ISQG	PEL	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum
TKN, carbon analytes and pH	Loss on Ignition	%	-	-	4	0.707	3	5	5.40	2.30	3	8
	pH (1:2 soil:water)	pH units	-	-	7.09	0.579	6.46	7.63	8.26	0.153	8.07	8.42
	Total Kjeldahl Nitrogen	%	-	-	0.0928	0.0213	0.0670	0.122	0.165	0.0810	0.0820	0.270
	Inorganic Carbon	%	-	-	0.0636	0.0102	0.0520	0.0720	0.181	0.124	0.0740	0.378
	Inorganic Carbon (as $CaCO_3$ Equivalen	%	-	-	0.528	0.0853	0.430	0.600	1.51	1.03	0.620	3.15
	Total Carbon by Combustion	%	-	-	1.77	0.329	1.34	2.18	2.59	1.24	1.12	3.90
	Total Organic Carbon	%	-	-	1.71	0.319	1.29	2.11	2.41	1.14	1.04	3.52
Total Metals	Aluminum (Al)	mg/kg	-	-	6,558	1,279	4,870	8,220	9,982	2,127	7,060	12,900
	Antimony (Sb)	mg/kg	-	-	0.260	0.0616	0.210	0.360	0.450	0.126	0.340	0.610
	Arsenic (As)	mg/kg	5.9	17	7.73	2.78	3.87	11.2	6.25	1.48	4.76	8.34
	Barium (Ba)	mg/kg	-	-	131	20.9	105	152	332	200	137	625
	Beryllium (Be)	mg/kg	-	-	0.212	0.0377	0.170	0.270	0.396	0.0789	0.280	0.480
	Bismuth (Bi)	mg/kg	-	-	< 0.2	-	<0.2	<0.2	< 0.2	-	<0.2	<0.2
	Boron (B)	mg/kg	-	-	< 5.0	-	< 5.0	< 5.0	< 5.0	-	< 5.0	< 5.0
	Cadmium (Cd)	mg/kg	0.60	3.5	0.0758	0.0144	0.0550	0.0900	0.244	0.128	0.111	0.385
	Calcium (Ca)	mg/kg	-	-	4,560	632	3,500	5,070	8,964	1,937	6,870	11,200
	Chromium (Cr)	mg/kg	37	90	13.3	3.49	9.07	16.2	25.2	6.73	13.4	30.2
	Cobalt (Co)	mg/kg	-	-	6.08	0.959	4.57	6.77	11.1	1.73	8.93	12.8
	Copper (Cu)	mg/kg	36	197	10.0	2.08	7.77	13.4	131	61.4	66.4	200
	Iron (Fe)	mg/kg	-	-	19,620	3,304	15,200	24,300	23,060	4,711	15,900	27,900
	Lead (Pb)	mg/kg	35	91	2.78	0.360	2.39	3.33	5.43	1.24	3.66	6.60
	Lithium (Li)	mg/kg	-	-	4.06	0.808	3.10	5.20	6.76	1.35	5	8.70
	Magnesium (Mg)	mg/kg	-	-	2,836	605	2,020	3,540	5,996	1,193	4,210	7,550
	Manganese (Mn)	mg/kg	-	-	587	282	297	979	5,761	5,398	847	13,900
	Mercury (Hg)	mg/kg	0.17	0.49	0.0172	0.00439	0.0124	0.0244	0.0211	0.00861	0.0126	0.0331
	Molybdenum (Mo)	mg/kg	-	-	0.454	0.0945	0.370	0.610	2.48	1.84	0.860	5.03
	Nickel (Ni)	mg/kg	-	-	10.4	2.22	7.46	13.1	26.6	3.98	21.7	30.9
	Phosphorus (P)	mg/kg	-	-	743	127	554	905	897	191	590	1,070
	Potassium (K)	mg/kg	-	-	416	84.4	310	490	1,250	232	1,010	1,580
	Selenium (Se)	mg/kg	-	-	0.334	0.0910	0.220	0.440	0.506	0.254	0.200	0.740
	Silver (Ag)	mg/kg	-	-	< 0.10	-	<0.10	<0.10	< 0.10	-	< 0.10	0.110
	Sodium (Na)	mg/kg	-	-	136	31.7	93.0	170	299	46.6	223	342
	Strontium (Sr)	mg/kg	-	-	42.0	3	37.2	44.8	108	37.1	69.2	153
	Thallium (Tl)	mg/kg	-	-	<0.050	0	< 0.050	0.0500	0.0784	0.0159	0.0600	0.100
	Tin (Sn)	mg/kg	-	-	<2.0	-	<2.0	< 2.0	<2.0	-	<2.0	< 2.0
	Titanium (Ti)	mg/kg	-	-	427	108	307	550	618	142	377	741
	Uranium (U)	mg/kg	-	-	0.608	0.0760	0.492	0.673	0.700	0.143	0.581	0.924
	Vanadium (V)	mg/kg	-	-	33.7	5.46	25.8	38.8	52.3	10.6	35.2	64.0
	Zinc (Zn)	mg/kg	123	315	27.4	5.05	20.6	33.2	59.0	11.4	47.1	72.2

Indicates sediment concentration exceeding CSQG ISQG.
Indicates sediment concentration exceeding CSQG PEL.
Indicates sediment concentration exceeding higher reference mean by more than two times.
Indicates sediment concentration exceeding higher reference mean by more than two times and higher than CSQG ISQG and/or PEL.

Note: "-" = no guideline or not possible to calculate from non detectable data.

[a] Canadian Sediment Quality Guidelines: ISQG = interim sediment quality guideline; PEL = probable effect level (CCME 1999).

Table 4.2: Statistical Comparisons Between Upper McGinty Creek (Reference) and Upper Minto Creek (Mine-Exposed) Sediment Chemistry

Endpoint	Data Transformation	Test	Test P-value	MCT[a]		MOD[b] (%)
				Upper McGinty	Upper Minto	
Loss On Ignition @ 420 ˚C	none	tequal	0.230	4	5.40	-
Total Kjeldahl Nitrogen	none	tequal	0.0910	0.0928	0.165	-
Inorganic Carbon	log_{10}	tequal	0.0250	0.0629	0.150	139
Inorganic Carbon (as $CaCO_3$ Equivalent)	log_{10}	tequal	0.0240	0.522	1.25	140
Total Carbon by Combustion	none	tequal	0.194	1.77	2.59	-
Total Organic Carbon	none	tequal	0.222	1.71	2.41	-
Aluminum (Al)	none	tequal	0.0150	6,558	9,982	52.0
Antimony (Sb)	none	tequal	0.0160	0.260	0.450	73.0
Arsenic (As)	none	tequal	0.323	7.73	6.25	-
Barium (Ba)	none	tunequal	0.0880	131	332	-
Beryllium (Be)	none	tequal	0.00200	0.212	0.396	87.0
Cadmium (Cd)	none	tunequal	0.0420	0.0758	0.244	221
Calcium (Ca)	none	tequal	0.00100	4,560	8,964	97.0
Chromium (Cr)	rank	M-W	0.0560	15.6	27.8	-
Cobalt (Co)	none	tequal	0.00100	6.08	11.1	83.0
Copper (Cu)	none	tunequal	0.0110	10.1	131	1,208
Iron (Fe)	none	tequal	0.218	19,620	23,060	-
Lead (Pb)	none	tequal	0.00200	2.78	5.43	96.0
Lithium (Li)	none	tequal	0.00500	4.06	6.76	66.0
Magnesium (Mg)	none	tequal	0.00100	2,836	5,996	111
Manganese (Mn)	none	tunequal	0.0990	587	5,761	-
Mercury (Hg)	none	tequal	0.393	0.0172	0.0211	-
Molybdenum (Mo)	none	tequal	0.0390	0.454	2.48	446
Nickel (Ni)	none	tequal	0.00100	10.4	26.6	156
Phosphorus (P)	none	tequal	0.172	743	897	-
Potassium (K)	none	tequal	0.00100	416	1,250	200
Selenium (Se)	none	tequal	0.192	0.334	0.506	-
Silver (Ag)	rank	M-W	0.424	0.100	0.100	-
Sodium (Na)	none	tequal	0.00100	136	299	120
Strontium (Sr)	none	tequal	0.00400	42.0	108	157
Thallium (Tl)	rank	M-W	0.00700	0.0500	0.0760	52.0
Titanium (Ti)	none	tequal	0.0430	427	618	45.0
Uranium (U)	none	tequal	0.236	0.608	0.700	-
Vanadium (V)	none	tequal	0.00800	33.7	52.3	55.0
Zinc (Zn)	none	tequal	0.00100	27.4	59.0	116
Zirconium (Zr)	rank	M-W	0.168	1.50	2.40	-

P-value < 0.05.

[a] Measure of Central Tendency is the mean for parameters where statistics were conducted on the raw scale, the geometric mean when statistics were log_{10} transformed to meet the assumtions of normality, and the median when rank tranformed.

[b] MOD = magnitude of difference.

Historically, higher copper concentrations have been measured and reported in both upper and lower Minto Creek sediments (Figure 4.2; Minnow 2019a). Average copper concentrations in upper Minto Creek have historically (2018, 2016) exceeded the probable effect level (Figure 4.2). Mean copper concentrations have also been historically greater than the ISGQ in lower Minto Creek sediment during most years, (Figure 4.2; Table 4.1; Appendix Table C).

Lower sediment volume and a predominantly erosional habitat has been suggested to potentially limit the exposure of aquatic biota to sediment in upper Minto Creek (Minnow 2019a). Environmental Effects Monitoring (EEM) is conducted in this reach of the creek but is reported elsewhere (Minnow 2018b). EEM monitoring was completed in this reach in 2016 (see Section 1.2) and 2019 (data interpretation pending). In lower Minto Creek, fine sediment deposits are more common along with higher trophic organisms (fish). For this reason, the AEMP is focused on biological monitoring and toxicity work in lower Minto Creek to monitor for potential adverse impacts of elevated copper concentrations and other mine parameter influences.

4.3 Sediment Toxicity

Sediment toxicity tests were not conducted in 2019 due to low flows, however, historically, survival and growth were evaluated using the 10-day test of *Chironomus dilutus* (midge) and the 14-day test of *Hyalella azteca* (amphipod). In 2018 sediment toxicity testing of *Chironomus dilutus* suggested adverse effects to survival (but not growth) in lower Minto Creek sediment when compared to the laboratory control and the field reference (lower Wolverine Creek) (Minnow 2019). No effects to *Hyalella azteca* were observed in 2018 as found in 2011, 2015, 2017 (Minnow 2012, 2016, 2017, 2019a).

4.4 Summary

Overall, concentrations of metals in upper Minto Creek sediments were higher than those in McGinty Creek but concentrations remain below sediment quality guidelines with the exception of copper. Concentrations of copper in Minto Creek were greater than the sediment quality guideline and reference creek conditions but were within the range observed since 2011. Sediment toxicity, periphyton and benthic invertebrate community, and tissue chemistry could not be collected this year in lower Minto Creek due to low flows.

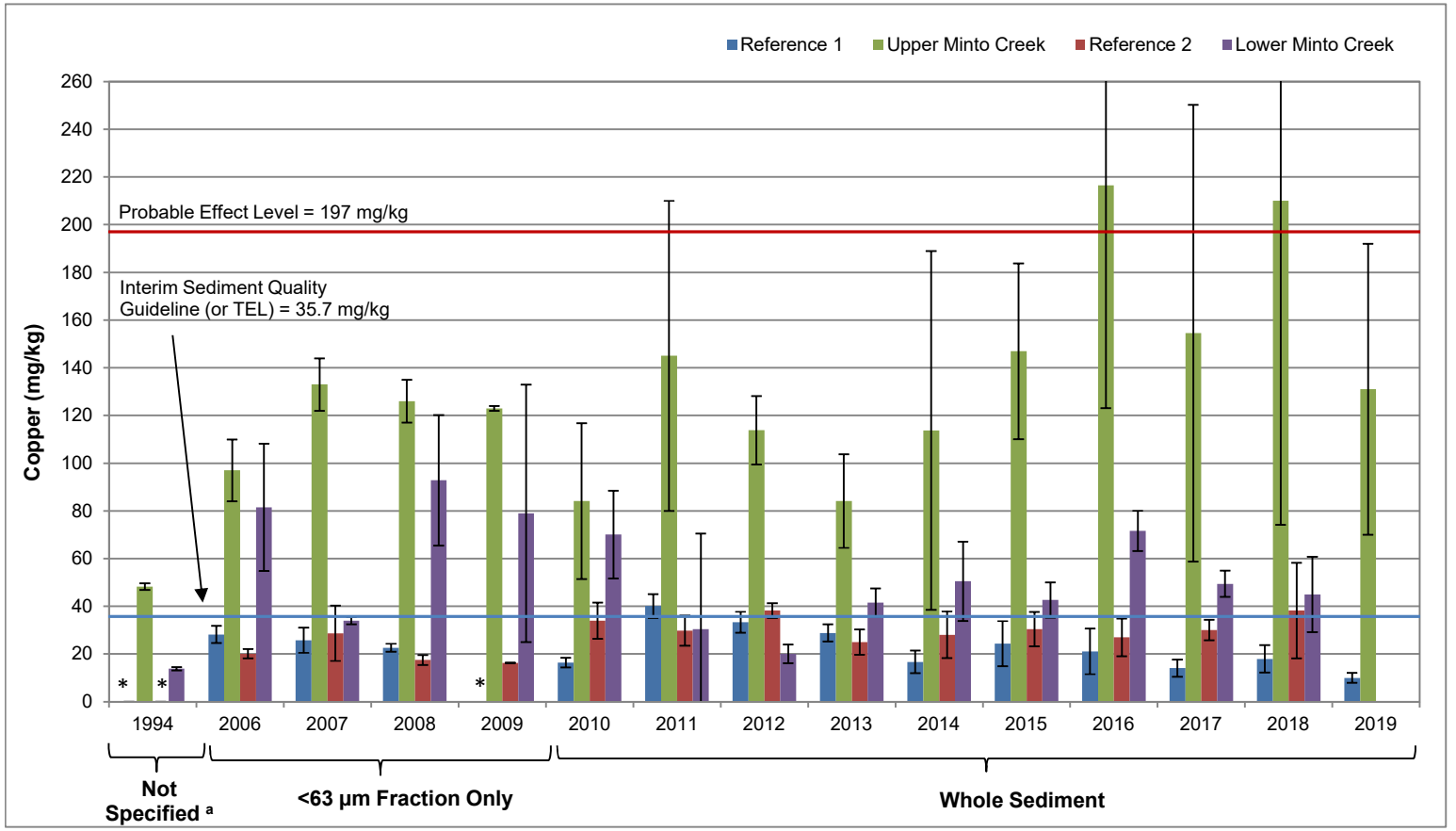


Figure 4.2: Copper Concentrations (Mean ± Standard Deviation) in Sediment Collected in Minto Creek and Reference Locations, 1994 to 2019[b]

Note: TEL = Threshold Effect Level, * = no data.

[a] Methods were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994).

[b] Reference 1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2019; Reference 2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2018.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The Sediment, Periphyton, and Benthic Assessment component of the Minto Mine AEMP evaluates the potential mine related effects to Minto Creek. Water quality (field measures and chemistry), sediment quality, periphyton and benthic invertebrate community, and tissue quality of upper and lower Minto Creek are evaluated in comparison to reference creeks and previous data. This year, the assessment was reduced in scope because there was no flow in lower Minto Creek and no mine effluent discharge. The program therefore served to compare water quality (field measures and chemistry) and sediment quality of upper Minto Creek to the upper reference (McGinty Creek) and previous data.

Supporting in stream field measures collected in September 2019 indicated relatively good Minto Creek water quality. The influence of the Minto Mine was evident with higher specific conductance and pH values than those measured in the reference creek. All measures met WUL objectives and CWQG guidelines for the protection of aquatic life. Concentrations of total copper at upper Minto Creek were just below the CWQG and were higher than concentrations at the reference creek. Fall dissolved copper concentrations, however, were well below the WUL SSWQO, as observed in 2018.

Concentrations of several metals in upper Minto Creek sediments were significantly higher than those in the upper reference site sediments, particularly, copper, molybdenum, and cadmium. Average concentrations of copper in Minto Creek sediment were greater than the ISQG and the reference creek sediment. One sediment sample in Minto Creek was above the probable effect level for the protection of aquatic life. Similar concentrations were observed in previous years and low sediment volume within predominantly erosional habitat limits the exposure of aquatic biota.

5.2 Recommendations

Based on the results and conclusions of the 2019 Minto Mine sediment, periphyton, and benthic assessment, and the reduced program scope this year due to insufficient flows, it is recommended that the program is repeated in 2020. Given the continued high copper concentrations in sediment and surface water in Minto Creek in 2019 (non-discharge year) and historically, the following recommendations are listed for the Adaptive Management Plan:

- Continue to monitor for potential adverse effects on the aquatic ecosystem (through benthic invertebrate community monitoring and sediment toxicity testing).

Environmental Effects Monitoring (EEM) data were collected in 2019 and will provide additional insight on recent aquatic ecosystem health at upper Minto Creek.

- Conduct a trend analysis in 2020 for sediment quality analytes of interest (e.g. copper and other mine processing related metals) in upper and lower Minto Creek to determine if concentrations are increasing and if so, determine the potential magnitude.
- Continue to review SSWQO exceedances and trends of analytes of interest as outlined in the adaptive management plan (AMP) to ensure that limits remain relevant to effluent discharge under climate change conditions.
- Continue to integrate hydrology and seasonal chemistry into the AEMP report to provide context on the range of physical and chemical conditions experienced by biota and supporting indicators over the year. Hydrology characterization would better describe annual sediment dynamics (accumulation or transport) under various flow duration conditions in upper and lower Minto Creek site.
- Continue to communicate flow conditions in the open water season at lower Minto Creek to optimize fall field work. If flow conditions are uncharacteristically dry again in the future, it is recommended that toxicity and benthic invertebrate community conditions be assessed at upper Minto Creek under the AEMP program.
- Continue to sample both lower Wolverine Creek and lower Big Creek as reference areas for the benthic invertebrate community assessment to provide perspective on whether any of the observed differences are due to mine influence or natural differences among creeks.
- Review the periphyton community assemblages at the species level instead of genus level and consider whether to focus future periphyton community assessment on the class of algae, *Bacillariophyceae* (diatoms, and their taxonomically distinct and ubiquitous siliceous algae frustrules). This could facilitate a more effective evaluation of the relative abundance of indicator species associated with water quality conditions of interest such as alkalinity and monitor assemblages over time.

The above information is recommended for consideration within the adaptive management plan to ensure the monitoring continues to meet the goals of the AEMP program.

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APPENDIX A
DATA QUALITY REVIEW

APPENDIX A DATA QUALITY REVIEW

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A1 INTRODUCTION

This Data Quality Review (DQR) provides an evaluation of data collected as part of the 2019 Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment Report. The objective of the DQR is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

A1.1 Background

A variety of factors can influence the chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Inconsistencies in sampling or laboratory methods, use of instruments that are inadequately calibrated or which cannot measure to the desired level of accuracy or precision, and contamination of samples in the field or laboratory are just some of the potential factors that can lead to the reporting of data that do not accurately reflect actual environmental conditions. Depending on the magnitude of the problem, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that monitoring programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. The DQR involves comparison of actual field and laboratory measurement performance to data quality objectives (DQOs) established for a particular study, such as evaluation of laboratory reporting limits (LRL), blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials). Trusted analytical laboratories certified by Canadian Association for Laboratory Accreditation (CALA) with rigorous internal quality assurance programs were selected to ensure the highest possible quality.

DQOs were established either at the outset of the field program or by the laboratories and reflect reasonable and achievable performance expectations. The LRLs were set at the outset of the field program for water, sediment, and tissue quality. Only results that were below the LRL were evaluated against target detection limits. Target detection limits should be at least as low as applicable guidelines, ideally ≤ 1/10th guideline values. Programs involving a large numbert of samples and analytes usually result in some analytes that exceed the DQOs. This is particularly so for multi-element scans (e.g., ICP scans for metals) since the analytical



conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 25% of the parameters fail to meet the DQOs. Overall, the intent of comparing data to DQOs was not to reject any measurement that did not meet the DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

A1.2 Types of Quality Control Samples

Several types of quality control (QC) samples were assessed based on samples collected (or prepared) in the field and laboratory. These samples included the following:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples will reflect any contamination that occurred in the field (in the case of field or travel blanks) or the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable although a DQO of twice the LRL allows for slight "noise" around the LRL.
- **Field Duplicates** are sub-sample pairs collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field duplicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.
- **Laboratory Duplicates** are sub-sample pairs created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.
- **Spike Recovery Samples** are created in the laboratory by adding a known amount/concentration of a given analyte (or mixture of analytes) to a randomly selected test sample previously divided to create two sub-samples. The spiked and regular sub-samples are then analyzed in an identical manner. The spike recovery represents the difference between the measured spike amount (total amount in spiked sample minus amount in original sample) relative to the known spike amount (as a percentage). Two types of spike recovery samples are commonly analyzed. Spiked blanks (or blank spikes) are created using laboratory control materials whereas matrix spikes



are created using field-collected samples. The analysis of spiked samples provides an indication of the accuracy of analytical results.

- **Internal Reference Materials** are samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known amount that was recovered in the analysis.

A2 WATER SAMPLES

A2.1 Laboratory Reporting Limits

All applicable guidelines could be achieved with the 2019 laboratory reporting limits (Table A.1). All target values (≤ 1/10th guideline or water use license objectives) could be achieved with the 2019 laboratory reporting limits, except for total mercury and total zinc. Laboratory reporting limits for both these analytes were still good (i.e. just below the guidelines), and therefore results were considered appropriate for the program evaluation.

A2.2 Blanks and Duplicates

No analytes were detectable in the field blank (Appendix C). This suggests regular samples were not associated with any inadvertent contamination during the field program.

Relative percent differences (RPDs) between field duplicate samples were greater than 25% for eight of the 100 analytes, including turbidity, total aluminum, total chromium, total copper, total iron, total manganese, and total rubidium, and total vanadium (Table A.2). Total aluminum, total iron and total chromium had the highest RPDs of 163, 150, and 59, respectively and reflect lower precision in these analyte values. High RPDs for total aluminum and total iron were not considered a concern as these analytes are strongly associated with suspended sediment and the dissolved form is often considered more appropriate to evaluate because the particulate fraction is largely natural and of limited bioavailability (GOA 2018). Regardless, laboratory and duplicate field sampling is recommended to be reviewed for the future program for these analytes. Total copper, a mine influence indicator of interest, had a RPD value of 41%. This value is considered relatively good in terms of field precision which measures natural and sampling variability. Other analytes of interest, including dissolved metals (i.e. dissolved copper RPD 5.8%) were associated with high precision (<25%).

Agreement (< 20% RPD) was achieved between laboratory duplicate samples for all analytes (Appendix C). This result indicates high analytical precision.

A2.3 Laboratory Data Accuracy

Analyte recoveries for matrix spiked samples met DQOs for most analytes with the exception of the following thirteen including: total inorganic carbon, total and dissolved barium, calcium, magnesium, manganese, sodium, and strontium. Recovery of these analytes could not be accurately calculated due to high analyte background in the samples. The matrix spiked samples indicate good analytical accuracy for most parameters of interest (mine influence



indicators and modifying toxicity factors e.g. pH, hardness) in the water sample analyses (Appendix C).

A3 SEDIMENT SAMPLES

A3.1 Laboratory Reporting Limits

Analytes with guidelines were all detectable at laboratory reporting limits indicating that the data can be reliably interpreted for the program objectives.

A3.2 Duplicates

The RPDs between analyte measurements for field duplicate samples were all below 25% indicating excellent precision in terms of potential variability associated with natural conditions or field sampling (Table A.3). It should be noted that there was no duplicate collected for % gravel, sand, silt, and clay due to limitations associated with very sparse availability of fine sediment in upper Minto creek and upper McGinty creek.

The laboratory RPDs for the duplicate results for barium, calcium, cobalt, copper, manganese, phosphorus, potassium and zinc were reported outside of DQOs due to sample heterogeneity in some reference site samples (Appendix C). However, RPD exceedances (DUP-H) refer to unrelated RPDs 'anonymous' samples as part of the laboratory QC batch (pg 14, L2345947). The laboratory confirmed samples from the Minto program i.e. L2345947 met RPDs and these sample values were associated with good precision (Appendix C).

A3.3 Laboratory Data Accuracy

Recoveries of all analytes met internal reference material DQOs indicating excellent analytical accuracy for the sediment sample analyses (Appendix C).

A4 DATA QUALITY STATEMENT

Water and sediment data were considered of good quality compared to DQOs indicating that they can be reliably interpreted. The overall quality of data for this project can serve to meet the project objectives.

A5 REFERENCES:

Government of Alberta (GOA). 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta.

Table A.1: Laboratory Reporting Limits (LRLs) Relative to Targets and Water Quality Guidelines, Minto Mine, 2019 [a]

Analyte		Units	Laboratory Reporting		Water Use Licence Objectives	CCME Water Quality Guidelines [b]	
			Target	Achieved		Long-term	Short-term
Physical Tests	Total Suspended Solids	mg/L	-	3.0	-	-	-
Anions and Nutrients	Total Ammonia (as N)	mg/L	0.025	0.0050	0.25	0.41 [c]	-
	Bromide (Br)	mg/L	-	0.050	-	-	-
	Chloride (Cl)	mg/L	12	0.50	-	120	640
	Nitrite (as N)	mg/L	0.0060	0.0010	0.060	0.060	-
Cyanides	Total Cyanide	mg/L	-	0.0050	-	-	-
Total Metals	Total Antimony (Sb)	mg/L	-	0.00010	-	-	-
	Total Beryllium (Be)	mg/L	-	0.00010	-	-	-
	Total Bismuth (Bi)	mg/L	-	0.000050	-	-	-
	Total Boron (B)	mg/L	0.15	0.010	-	1.5	29
	Total Cadmium (Cd)	mg/L	0.000012	0.0000050	-	0.00012 to 0.00037 [d]	0.0010 [d]
	Total Cesium (Cs)	mg/L	-	0.000010	-	-	-
	Total Cobalt (Co)	mg/L	-	0.00010	-	-	-
	Total Lead (Pb)	mg/L	0.00020	0.000050	-	0.0020 to 0.0070 [d]	-
	Total Lithium (Li)	mg/L	-	0.0010	-	-	-
	Total Mercury (Hg)	mg/L	0.0000026	0.0000050	-	0.000026	-
	Total Phosphorus (P)	mg/L	-	0.050	-	-	-
	Total Rubidium (Rb)	mg/L	-	0.00020	-	-	-
	Total Silver (Ag)	mg/L	0.000025	0.000010	-	0.00025	-
	Total Tellurium (Te)	mg/L	-	0.00020	-	-	-
	Total Thallium (Tl)	mg/L	0.000080	0.000010	-	0.00080	-
	Total Thorium (Th)	mg/L	-	0.0010	-	-	-
	Total Tin (Sn)	mg/L	-	0.00010	-	-	-
	Total Titanium (Ti)	mg/L	-	0.00030 - 0.0027	-	-	-
	Total Tungsten (W)	mg/L	-	0.0010	-	-	-
	Total Vanadium (V)	mg/L	-	0.00050	-	-	-
	Total Zinc (Zn)	mg/L	0.0024	0.0030	-	0.024 [e]	0.013 [e]
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	0.010	0.00100	0.10	-	-
	Dissolved Antimony (Sb)	mg/L	-	0.00010	-	-	-
	Dissolved Beryllium (Be)	mg/L	-	0.00010	-	-	-
	Dissolved Bismuth (Bi)	mg/L	-	0.000050	-	-	-
	Dissolved Boron (B)	mg/L	-	0.010	-	-	-
	Dissolved Cadmium (Cd)	mg/L	0.000024	0.0000050	0.00024 [f]	-	-
	Dissolved Cesium (Cs)	mg/L	-	0.00010	-	-	-
	Dissolved Chromium (Cr)	mg/L	0.00010	0.00010	0.0010	-	-
	Dissolved Cobalt (Co)	mg/L	-	0.00010	-	-	-
	Dissolved Lead (Pb)	mg/L	0.00040	0.000050	0.0040	-	-
	Dissolved Lithium (Li)	mg/L	-	0.0010	-	-	-
	Dissolved Mercury (Hg)	mg/L	-	0.0000050	-	-	-
	Dissolved Phosphorus (P)	mg/L	-	0.050	-	-	-
	Dissolved Rubidium (Rb)	mg/L	0.00020	0.00020	0.0020	-	-
	Dissolved Silver (Ag)	mg/L	0.000010	0.000010	0.00010	-	-
	Dissolved Tellurium (Te)	mg/L	-	0.00020	-	-	-
	Dissolved Thallium (Tl)	mg/L	-	0.000010	-	-	-
	Dissolved Thorium (Th)	mg/L	-	0.00010	-	-	-
	Dissolved Tin (Sn)	mg/L	-	0.00010	-	-	-
	Dissolved Titanium (Ti)	mg/L	-	0.00030 - 0.00090	-	-	-
	Dissolved Tungsten (W)	mg/L	-	0.00010	-	-	-
	Dissolved Vanadium (V)	mg/L	-	0.00050	-	-	-
	Dissolved Zinc (Zn)	mg/L	0.0030	0.0010	0.030	-	-

Value greater than target.Target values should be at least as low as applicable guidelines and ideally ≤ 1/10th guideline values.

Note: "-" = if value less than detection limits, RPD was not reported

[a] Only analytes with reported values less than LRL were presented.

[b] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg.

[c] Based on guideline using sample temperature and pH.

[d] Based on guideline using hardness.

[e] Based on guideline using sample hardness, DOC, and field pH.

[f] Dissolved cadmium (µg/L) calculations based on the following formula using sample hardness: $e^{(0.736(\ln(\text{Hardness})-4.943)}$.

Table A.2: Field Duplicate Results for Analysis of Water Quality, Minto Mine, 2019

Analytes		Units	Lab Report L2343815		
			UMC	UMCX	RPD (%)
			8-Sep-19	8-Sep-19	
Physical Tests	Conductivity	µS/cm	570	564	1.06
	Hardness (as $CaCO_3$)	mg/L	277	277	-
	pH	pH Units	8.5	8.5	0.12
	Total Suspended Solids	mg/L	<3.0	<3.0	-
	Total Dissolved Solids	mg/L	363	365	0.55
	Turbidity	NTU	0.10	0.13	26.09
Anions and Nutrients	Total Alkalinity (as $CaCO_3$)	mg/L	307	291	5.35
	Total Ammonia (as N)	mg/L	<0.0050	<0.0050	-
	Bromide (Br)	mg/L	<0.050	<0.050	-
	Chloride (Cl)	mg/L	4.9	4.9	0.41
	Fluoride (F)	mg/L	0.53	0.54	1.49
	Nitrate (as N)	mg/L	0.053	0.053	0.57
	Nitrite (as N)	mg/L	<0.0010	<0.0010	-
	Total dissolved Phosphorus (P)	mg/L	0.0043	0.0053	20.83
	Total Phosphorus (P)	mg/L	0.0052	0.0049	5.94
	Sulfate (SO_4)	mg/L	54.4	54.4	0
Other	Total Cyanide	mg/L	<0.0050	<0.0050	-
	Dissolved Organic Carbon	mg/L	5.42	5.47	0.92
	Total Inorganic Carbon	mg/L	62.1	63.5	2.23
	Total Organic Carbon	mg/L	5.91	5.92	0.17
Total Metals	Total Aluminum (Al)	mg/L	0.077	0.008	162.6
	Total Antimony (Sb)	mg/L	<0.00010	<0.00010	-
	Total Arsenic (As)	mg/L	0.00029	0.00027	7.14
	Total Barium (Ba)	mg/L	0.071	0.065	9.71
	Total Beryllium (Be)	mg/L	<0.00010	<0.00010	-
	Total Bismuth (Bi)	mg/L	<0.000050	<0.000050	-
	Total Boron (B)	mg/L	0.025	0.026	3.92
	Total Cadmium (Cd)	mg/L	<0.000015	<0.000010	-
	Total Calcium (Ca)	mg/L	63.6	62.4	1.90
	Total Cesium (Cs)	mg/L	<0.000010	<0.000010	-
	Total Chromium (Cr)	mg/L	0.00024	0.00013	59.46
	Total Cobalt (Co)	mg/L	0.00011	<0.00010	9.52
	Total Copper (Cu)	mg/L	0.0039	0.0026	40.99
	Total Iron (Fe)	mg/L	0.132	0.019	149.67
	Total Lead (Pb)	mg/L	0.000054	<0.000050	7.69
	Total Lithium (Li)	mg/L	0.0035	0.0036	2.82
	Total Magnesium (Mg)	mg/L	30	30	0.33
	Total Manganese (Mn)	mg/L	0.057	0.034	49.50
	Total Mercury (Hg)	mg/L	<0.0000050	<0.0000050	-
	Total Molybdenum (Mo)	mg/L	0.0059	0.0060	2.19
	Total Nickel (Ni)	mg/L	0.001	0.0009	9.42
	Total Phosphorus (P)	mg/L	<0.050	<0.050	-
	Total Potassium (K)	mg/L	2.38	2.39	0.42
	Total Rubidium (Rb)	mg/L	0.00034	0.00025	30.51
	Total Selenium (Se)	mg/L	0.00031	0.00027	12.78
	Total Silicon (Si)	mg/L	6.9	6.7	3.09
	Total Silver (Ag)	mg/L	<0.000010	<0.000010	-
	Total Sodium (Na)	mg/L	21	21	0.49
	Total Strontium (Sr)	mg/L	0.84	0.84	0.12
	Total Sulfur (S)	mg/L	21	21	0
	Total Tellurium (Te)	mg/L	<0.00020	<0.00020	-
	Total Thallium (Tl)	mg/L	<0.000010	<0.000010	-
	Thorium (Th)-Total	mg/L	<0.00010	<0.00010	-
	Total Tin (Sn)	mg/L	<0.00010	<0.00010	-
	Total Titanium (Ti)	mg/L	<0.0060	<0.00030	-
	Tungsten (W)-Total	mg/L	<0.00010	<0.00010	-
	Total Uranium (U)	mg/L	0.00302	0.00305	0.99
	Total Vanadium (V)	mg/L	0.00083	0.00061	30.56
	Total Zinc (Zn)	mg/L	<0.0030	<0.0030	-
	Total Zirconium (Zr)	mg/L	<0.00020	<0.00020	-
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	0.00110	0.00140	24.00
	Dissolved Antimony (Sb)	mg/L	<0.00010	<0.00010	-
	Dissolved Arsenic (As)	mg/L	0.00021	0.00022	4.65
	Dissolved Barium (Ba)	mg/L	0.0668	0.0676	1.19
	Dissolved Beryllium (Be)	mg/L	<0.00010	<0.00010	-
	Dissolved Bismuth (Bi)	mg/L	<0.000050	<0.000050	-
	Dissolved Boron (B)	mg/L	0	0	4.26
	Dissolved Cadmium (Cd)	mg/L	<0.0000050	<0.0000050	-
	Dissolved Calcium (Ca)	mg/L	62.1	62.1	0
	Dissolved Cesium (Cs)	mg/L	<0.000010	<0.000010	-
	Dissolved Chromium (Cr)	mg/L	0.0001	<0.00010	-
	Dissolved Cobalt (Co)	mg/L	<0.00010	<0.00010	-
	Dissolved Copper (Cu)	mg/L	0.00231	0.00218	5.79
	Dissolved Iron (Fe)	mg/L	<0.010	<0.010	-
	Dissolved Lead (Pb)	mg/L	<0.000050	<0.000050	-
	Dissolved Lithium (Li)	mg/L	0.003	0.003	6.25
	Dissolved Magnesium (Mg)	mg/L	29.5	29.6	0.34
	Dissolved Manganese (Mn)	mg/L	0.0317	0.0314	0.95
	Dissolved Mercury (Hg)	mg/L	<0.0000050	<0.0000050	-
	Dissolved Molybdenum (Mo)	mg/L	0.00562	0.00573	1.94
	Dissolved Nickel (Ni)	mg/L	0.0	0.0	3.21
	Dissolved Phosphorus (P)	mg/L	<0.050	<0.050	-
	Dissolved Potassium (K)	mg/L	2.42000	2.39000	1.25
	Sdissolved Rubidium (Rb)	mg/L	0.0	0.0	11.32
	Dissolved Selenium (Se)	mg/L	0.000293	0.000269	8.54
	Dissolved Silicon (Si)	mg/L	6.1	6.0	1.50
	Dissolved Silver (Ag)	mg/L	<0.000020	<0.000010	-
	Dissolved Sodium (Na)	mg/L	19	19	2.12
	Dissolved Strontium (Sr)	mg/L	0.858	0.859	0.12
	Dissolved Sulfur (S)	mg/L	17.6	18	2.25
	Dissolved Tellurium (Te)	mg/L	<0.00020	<0.00020	-
	Dissolved Thallium (Tl)	mg/L	<0.000010	<0.000010	-
	Dissolved Thorium (Th)	mg/L	<0.00010	<0.00010	-
	Dissolved Tin (Sn)	mg/L	<0.00010	<0.00010	-
	Dissolved Titanium (Ti)	mg/L	<0.00030	<0.00030	-
	Dissolved Tungsten (W)	mg/L	<0.00010	<0.00010	-
	Dissolved Uranium (U)	mg/L	0.00299	0.00307	2.64
	Dissolved Vanadium (V)	mg/L	<0.00050	<0.00050	-
	Dissolved Zinc (Zn)	mg/L	<0.0010	<0.0010	-
	Dissolved Zirconium (Zr)	mg/L	<0.00020	<0.00020	-

> 25% Relative Percent Difference (RPD).

Note: "-" if values less than detection limits were measured, RDPs were not reported. UMC = upper Minto creek and URC= upper McGinty creek.

Table A.3: Field Duplicate Results for Analysis of Sediment Quality, Minto Mine, 2019

Analytes		Units	Lab Report L2343814-1		
			UMC-1-M	UMC-X-M	RPD (%)
			5-Sep-2019	5-Sep-2019	
Physical Tests	Loss on Ignition	%	7.0	8	13
	pH (1:2 soil:water)	pH	8.1	8.1	0.1
Other	Total Kjeldahl Nitrogen	%	0.206	0.23	12
	Inorganic Carbon	%	0.211	0.23	9
	Inorganic Carbon (as $CaCO_3$ Equivalent)	%	1.75	1.9	10
	Inorganic Carbon (as $CaCO_3$ Equivalent)	%	3.4	3.9	15
	Total Organic Carbon	%	3.2	3.7	15
Total Metals	Total Aluminum (Al)	mg/kg	12,900	13,500	5
	Total Antimony (Sb)	mg/kg	0.61	0.68	11
	Total Arsenic (As)	mg/kg	8.3	7.4	12
	Total Barium (Ba)	mg/kg	288	302	5
	Total Beryllium (Be)	mg/kg	0.48	0.51	6
	Total Bismuth (Bi)	mg/kg	<0.20	<0.20	-
	Total Boron (B)	mg/kg	<5.0	<5.0	-
	Total Cadmium (Cd)	mg/kg	0.21	0.21	1
	Total Calcium (Ca)	mg/kg	10,400	11,300	8
	Total Chromium (Cr)	mg/kg	30	31	3.9
	Total Cobalt (Co)	mg/kg	13	12	7.3
	Total Copper (Cu)	mg/kg	156	146	7
	Total Iron (Fe)	mg/kg	27,900	26,700	4.4
	Total Lead (Pb)	mg/kg	6.6	7.0	5
	Total Lithium (Li)	mg/kg	8.7	9	8
	Total Magnesium (Mg)	mg/kg	7,550	7,780	3
	Total Manganese (Mn)	mg/kg	4,870	5,320	9
	Total Mercury (Hg)	mg/kg	0.033	0.034	4
	Total Molybdenum (Mo)	mg/kg	1.72	1.78	3
	Total Nickel (Ni)	mg/kg	31	31	0.6
	Total Phosphorus (P)	mg/kg	1,010	987	2.3
	Total Potassium (K)	mg/kg	1,580	1,590	1
	Total Selenium (Se)	mg/kg	0.57	0.55	4
	Total Silver (Ag)	mg/kg	0.11	0.11	0
	Total Sodium (Na)	mg/kg	310	334	7
	Total Strontium (Sr)	mg/kg	124	126	2
	Total Thallium (Tl)	mg/kg	0.100	0.107	7
	Total Tin (Sn)	mg/kg	<2.0	<2.0	-
	Total Titanium (Ti)	mg/kg	618	673	8.5
	Total Uranium (U)	mg/kg	0.9	1.1	13
	Total Vanadium (V)	mg/kg	56	56	0.2
	Total Zinc (Zn)	mg/kg	72	72	0

> 25% Relative Percent Difference (RPD).

Note: "-" if less than detection limits RPD not reported. UMC = upper Minto creek and URC= upper McGinty creek.

APPENDIX B
SUPPORTING INFORMATION
AND DATA

Table B.1. Stage height and total discharge at station W1 on Minto Creek, 2019

Date	Time	Total Discharge (m^3/s)	Staff Gauge/Stage (m)	Initials
04/16/2019	10:00	0.02646	0	CR/CB
04/23/2019	14:00	0.03878	0	CR/PM
04/30/2019	08:00	0.02444	0	PM/IS
05/07/2019	10:00	0.04119	0.2	CR/IS
05/07/2019	10:30	0.03398	0.2	CR/IS
05/14/2019	09:30	0.04721	0.23	CR/CB
05/21/2019	07:30	0.04805	0.25	CB/TS
05/21/2019	08:00	0.04355	0.25	CB
05/28/2019	08:00	0.01709	0.23	IS/TS
06/04/2019	09:30	0.12883	0.33	CR/IS
06/11/2019	08:00	0.00583	0.22	CR/DJ
06/18/2019	07:30	0.00910	0.22	CB/DJ
06/18/2019	07:30	0.00807	0.22	CB/DJ
06/22/2019	17:00	0.00128	0.18	IS/CR
06/25/2019	09:00	0	0	CR/TS
07/02/2019	08:30	0	0	CR/IS
07/16/2019	07:30	0	0	IS/DJ
01/00/1900	00:00	0	-	0
01/00/1900	00:00	0	-	0

Data provided by Minto Mine (Swanson, T., February 20, 2020)

Table B.2a: Monthly Temperature at Minto Mine Compared to Climate Normals

Month	Daily Average Temperature (°C)																
	Canada Climate Normals	2012		2013		2014		2015		2016		2017		2018		2019	
		Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals
January	-24.9	-21.3	3.6	-16.9	8.0	-9.3	15.6	-15.8	9.1	-9.4	15.5	-17.8	7.1	-15.1	9.8	-17.0	7.9
February	-19.5	-7.6	11.9	-10.2	9.3	-17.3	2.2	-13.7	5.8	-8.0	11.5	-11.5	8.0	-17.8	1.7	-17.2	2.3
March	-10.6	-8.8	1.8	-9.6	1.0	-8.1	2.5	-6.3	4.3	-1.8	8.8	-13.5	-2.9	-7.5	3.1	-1.2	9.4
April	0.7	3.2	2.5	-5.2	-5.9	0.9	0.2	2.0	1.3	4.7	4.0	2.2	1.5	-0.6	-1.3	1.8	1.1
May	8.3	6.5	-1.8	7.2	-1.1	9.6	1.3	13.1	4.8	10.1	1.8	8.3	0.0	8.5	0.2	11.0	2.7
June	13.9	12.8	-1.1	15.8	1.9	12.1	-1.8	13.5	-0.4	14.1	0.2	13.0	-0.9	12.9	-1.0	14.8	0.9
July	15.8	13.6	-2.2	15.4	-0.4	14.8	-1.0	14.2	-1.6	14.8	-1.0	15.8	0.0	16.4	0.6	16.9	1.1
August	12.8	12.8	0.0	14.5	1.7	12.5	-0.3	10.8	-2.0	13.5	0.7	13.9	1.1	11.8	-1.0	11.8	-1.0
September	6.5	7.2	0.7	6.7	0.2	5.9	-0.6	5.1	-1.4	7.3	0.8	8.6	2.1	6.2	-0.3	9.0	2.5
October	-2.5	-5.5	-3.0	1.3	3.8	-1.8	0.7	0.1	2.6	-4.9	-2.4	-1.2	1.3	1.1	3.6	-1.4	1.1
November	-16.3	-19.0	-2.7	-14.3	2.0	-13.2	3.1	-11.5	4.8	-10.2	6.1	-18.3	-2.0	-10.5	5.8	-12.5	3.8
December	-21.9	-23.4	-1.5	-21.0	0.9	-12.2	9.7	-14.4	7.5	-18.7	3.2	-11.2	10.7	-12.4	9.5	-	-

Notes: Canada Climate Normals from 1981 to 2010 (Government of Canada 2019). Climate normals are from the Pelly Ranch weather station. (Minnow 2019b)

Table B2.b: Monthly Precipitation at Minto Mine Compared to Canada Climate Normals

Month	Total Precipitation (mm)																
	Canada Climate Normals	2012		2013		2014		2015		2016		2017		2018		2019	
		Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals
January	19.7	9.0	-10.7	4.4	-15.3	16.9	-2.8	9.1	-10.7	9.1	-10.6	1.3	-18.4	7.0	-12.7	7.2	-12.5
February	14.9	9.9	-5.0	73.8	58.9	49.2	34.3	6.9	-8.0	6.9	-8.0	0.0	-14.9	8.6	-6.3	7.7	-7.2
March	10.6	34.9	24.3	7.4	-3.2	0.0	-10.6	3.1	-7.5	2.6	-8.0	3.8	-6.8	14.6	4.0	1.2	-9.4
April	8.9	0.0	-8.9	0.0	-8.9	3.8	-5.1	3.8	-5.1	14.7	5.8	7.0	-1.9	5.0	-3.9	5.0	-3.9
May	27.2	0.1	-27.1	7.9	-19.3	15.0	-12.2	6.3	-20.9	39.3	12.1	22.0	-5.2	6.9	-20.3	17.2	-10.0
June	38.5	31.1	-7.4	21.0	-17.5	12.0	-26.5	18.7	-19.8	30.2	-8.3	40.0	1.5	38.5	0.0	26.0	-12.5
July	58.0	44.8	-13.2	113.5	55.5	50.5	-7.5	35.3	-22.7	74.7	16.7	42.3	-15.7	20.7	-37.3	27.0	-31.0
August	41.4	20.6	-20.8	46.8	5.4	13.4	-28.0	79.7	38.3	46.0	4.6	20.4	-21.0	76.8	35.4	23.1	-18.3
September	31.6	26.1	-5.5	59.7	28.1	30.5	-1.1	19.0	-12.6	18.5	-13.1	37.4	5.8	22.9	-8.7	18.0	-13.7
October	24.5	16.5	-8.0	13.6	-10.9	22.0	-2.5	14.7	-9.8	6.7	-17.8	4.7	-19.8	8.5	-16.0	13.6	-10.9
November	25.8	17.1	-8.7	36.6	10.8	2.9	-22.9	33.0	7.2	24.2	-1.6	7.9	-17.9	8.6	-17.2	12.1	-13.7
December	19.4	18.4	-1.0	37.9	18.5	19.4	0.0	9.5	-9.9	7.4	-12.0	4.7	-14.7	6.7	-12.7	-	-
Annual Total:	320.5	228.5		422.7		235.7		238.9		280.4		191.5		224.7		157.9	

Notes: Canada Climate Normals from 1981 to 2010 (Government of Canada 2019). Climate normals are from the Pelly Ranch weather station. (modified from Minnow 2019b)

Table B.3: In Situ Water Quality Measurements at Sediment Sampling Stations, Minto Mine WUL, September 2019

Parameter	Units	CCME Water Quality Guidelines[a]	WUL Objective	Upper McGinty Creek (Reference)						
				URC-1	URC-2	URC-3	URC-4	URC-5	Mean	Standard Deviation
UTM (NAD 83)				0382963 6949875	0382959 6949896	0382984 6949927	0382992 6949960	0382995 6949970		
Sampling time				11:10	10:45	18:05	17:40	17:15		
Temperature	°C	-	-	1.2	1.2	1.1	1.1	0.9	1.1	0.12
Conductivity	µS/cm	-	-	129	125	130	130	138	130	4.72
Specific Conductivity	µS/cm	-	-	237	238	240	240	254	242	6.75
pH	-	6.5 - 9.5	6.0 -9.0	7.9	7.8	7.8	7.8	7.9	7.8	-
Dissolved Oxygen	mg/L	6.5 - 9.0 [a]	-	11.3	10.7	10.3	10.3	9.2	10.4	0.77
Dissolved Oxygen	%	-	-	91	80	73	72	65	76	10

Table B.3: In Situ Water Quality Measurements at Sediment Sampling Stations, Minto Mine WUL, September 2019

Parameter	Units	CCME Water Quality Guidelines[a]	WUL Objective	Upper Minto Creek (Exposed)						
				UMC-1-M	UMC-2-M	UMC-3-M	UMC-4-M	UMC-5-M	Mean	Standard Deviation
UTM (NAD 83)				0387021 6945794	0387040 6945816	0387057 6945825	0387090 6945851	0387126 6945870		
Sampling time				10:20	10:00	9:50	9:30	9:00		
Temperature	°C	-	-	1.8	1.7	3.8	3.9	3.5	2.94	1.10
Conductivity	µS/cm	-	-	319	317	339	328	336	328	10.0
Specific Conductivity	µS/cm	-	-	572	571	570	549	571	567	10.2
pH	-	6.5 - 9.5	6.0 -9.0	8.2	8.3	8.2	8.2	8.2	8.2	-
Dissolved Oxygen	mg/L	6.5 - 9.0 [a]	-	12.4	12.3	13.0	12.5	11.1	12.3	0.70
Dissolved Oxygen	%	-	-	90	88	98	91	80	89	6.7

Table B.4: Comparison of Water Quality Results at Reference and Exposed Areas in 2017 to 2019, Minto Mine WUL

Analyte		Units	CCME Water Quality Guidelines [a]		WUL Objectives at W2	Upper McGinty Creek (Reference)			Upper Minto Creek (Exposed)		
			Long-term	Short-term		2017	2018	2019	2017	2018	2019
Routine	Hardness	mg/L as $CaCO_3$	-	-	-	113	68	120	260	256	277
	DOC	mg/L	-	-	-	10.0	17.4	5.5	5.8	6.4	5.4
	Total Suspended Solids	mg/L	-	-	-	<3.0	8.8	<3.0	<3.0	3.3	<3.0
Total Metals	Total Aluminum (Al)	mg/L	0.10 [b]	-	-	0.022	0.028	0.00980	0.0055	0.010	0.0765
	Total Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Arsenic (As)	mg/L	0.0050	-	-	0.00042	0.00041	0.000350	0.00025	0.00026	0.000290
	Total Barium (Ba)	mg/L	-	-	-	0.032	0.029	0.0393	0.068	0.064	0.0713
	Total Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Total Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Total Boron (B)	mg/L	1.5	29	-	<0.010	<0.010	<0.010	0.025	0.023	0.0250
	Total Cadmium (Cd)	mg/L	0.00012 to 0.00037 [c]	0.0010 [c]	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000015
	Total Calcium (Ca)	mg/L	-	-	-	23.8	18.3	33.7	59.0	57.5	63.6
	Total Cesium (Cs)	mg/L	-	-	-	-	<0.000010	<0.000010	-	<0.000010	<0.000010
	Total Chromium (Cr)	mg/L	0.0010 Cr(VI)	-	-	0.00034	0.00039	0.000200	<0.00010	0.00019	0.000240
	Total Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.000110
	Total Copper (Cu)	mg/L	0.0020 to 0.0040 [d]	-	-	0.00118	0.00143	<0.00050	0.00251	0.00405	0.00388
	Total Iron (Fe)	mg/L	0.30	-	-	0.26	0.23	0.146	0.025	0.019	0.132
	Total Lead (Pb)	mg/L	0.0020 to 0.0070 [e]	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.0000540
	Total Lithium (Li)	mg/L	-	-	-	<0.0010	<0.0010	<0.0010	0.0032	0.0030	0.00350
	Total Magnesium (Mg)	mg/L	-	-	-	6.6	5.9	9.54	29	31	29.9
	Total Manganese (Mn)	mg/L	-	-	-	0.021	0.013	0.0314	0.047	0.040	0.0567
	Total Mercury (Hg)	mg/L	0.000026	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Total Molybdenum (Mo)	mg/L	0.073	-	-	0.0013	0.00091	0.00250	0.0048	0.0046	0.00587
	Total Nickel (Ni)	mg/L	0.071 to 0.15 [f]	-	-	0.00091	0.00096	<0.00050	0.00092	0.00099	0.00100
	Total Phosphorus (P)	mg/L	-	-	-	<0.30	<0.050	0.0100	<0.30	<0.050	0.00520
	Total Potassium (K)	mg/L	-	-	-	0.59	0.41	0.81	2.35	2.38	2.38
	Total Rubidium (Rb)	mg/L	-	-	-	-	<0.00020	<0.00020	-	0.00032	0.000340
	Total Selenium (Se)	mg/L	0.0010	-	-	0.00036	0.00026	0.000734	0.00031	0.00017	0.000308
	Total Silicon (Si)	mg/L	-	-	-	6.4	5.8	6.08	6.3	3.8	6.90
	Total Silver (Ag)	mg/L	0.00025	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Sodium (Na)	mg/L	-	-	-	4.4	3.9	6.2	18.7	19.1	20.6
	Total Strontium (Sr)	mg/L	-	-	-	0.16	0.13	0.24	0.77	0.71	0.84
	Total Sulfur (S)	mg/L	-	-	-	-	3.0	7.5	-	11.1	20.7
	Total Tellurium (Te)	mg/L	-	-	-	-	<0.00020	<0.00020	-	<0.00020	<0.00020
	Total Thallium (Tl)	mg/L	0.00080	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Total Thorium (Th)	mg/L	-	-	-	-	<0.00010	<0.00010	-	<0.00010	<0.00010
	Total Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	0.000120	<0.00010	<0.00010	<0.00010
	Total Titanium (Ti)	mg/L	-	-	-	<0.010	<0.00090	0.000450	<0.010	0.00034	<0.0060
	Total Tungsten (W)	mg/L	-	-	-	-	<0.00010	<0.00010	-	<0.00010	<0.00010
	Total Uranium (U)	mg/L	0.015	0.033	-	0.00054	0.00035	0.00108	0.0026	0.0028	0.00302
	Total Vanadium (V)	mg/L	-	-	-	0.00056	0.00055	0.000690	<0.00050	<0.00050	0.000830
	Total Zinc (Zn)	mg/L	-	-	-	0.0051	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Total Zirconium (Zr)	mg/L	-	-	-	-	0.00041	<0.00020	-	0.00011	<0.00020

Water quality guideline not met.
Water use license objectives not met.

Notes: "-" indicates no data or guideline.

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality

[b] Total aluminum is based on pH. 5 µg/L if pH < 6.5 and 100 µg/L if pH ≥ 6.5

[c] Total cadmium guidelines, Short-term benchmark (µg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$. Long-term guideline at hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation (µg/L) = $10^{\{0.83(\log[\text{hardness}]) - 2.46\}}$

[d] Total copper guideline is based on hardness and using the equation= 0.2 x $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 1000 (mg/L)

[e] Total lead guideline is related to water hardness (as $CaCO_3$): At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation CWQG (µg/L)= $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$. At hardness >180 mg/L, the CWQG is 7 µg/L.

[f] Total nickel is based on a guideline using water hardness (as $CaCO_3$): At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation CWQG (µg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$. At hardness >180 mg/L, the CWQG is 150 µg/L.

Table B.4: Comparison of Water Quality Results at Reference and Exposed Areas in 2017 to 2019, Minto Mine WUL

Analyte		Units	CCME Water Quality Guidelines [a]		WUL Objectives at W2	Upper McGinty Creek (Reference)			Upper Minto Creek (Exposed)		
			Long-term	Short-term		2017	2018	2019	2017	2018	2019
Dissolved Metals	Dissolved Aluminum (Al)	mg/L	-	-	0.100	0.006	0.025	0.005	0.003	<0.0020	0.001
	Dissolved Antimony (Sb)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Arsenic (As)	mg/L	-	-	0.0050	0.00019	0.00039	0.000280	0.00024	0.00025	0.000210
	Dissolved Barium (Ba)	mg/L	-	-	-	0.0221	0.0281	0.0378	0.0709	0.0675	0.0668
	Dissolved Beryllium (Be)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dissolved Boron (B)	mg/L	-	-	-	<0.010	<0.010	<0.010	0.021	0.022	0.0230
	Dissolved Cadmium (Cd)	mg/L	-	-	0.000159 to 0.000447 [h]	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000062	<0.0000050
	Dissolved Calcium (Ca)	mg/L	-	-	-	33	18	32	56	55	62
	Dissolved Cesium (Cs)	mg/L	-	-	-	-	<0.000010	<0.000010	-	<0.000010	<0.000010
	Dissolved Chromium (Cr)	mg/L	-	-	0.0010	0.00015	0.00038	0.000200	<0.00010	<0.00010	0.000110
	Dissolved Cobalt (Co)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Copper (Cu)	mg/L	-	-	0.020/0.013 [i]	0.00032	0.0014	0.000440	0.0025	0.0028	0.00231
	Dissolved Iron (Fe)	mg/L	-	-	1.1	0.055	0.19	0.0930	0.020	0.014	<0.010
	Dissolved Lead (Pb)	mg/L	-	-	0.0040	<0.000050	<0.000050	0.0000690	<0.000050	<0.000050	<0.000050
	Dissolved Lithium (Li)	mg/L	-	-	-	<0.0010	<0.0010	<0.0010	0.0033	0.0029	0.00310
	Dissolved Magnesium (Mg)	mg/L	-	-	-	9.2	5.5	9.6	29	29	29.5
	Dissolved Manganese (Mn)	mg/L	-	-	-	0.0060	0.012	0.0287	0.047	0.037	0.0317
	Dissolved Mercury (Hg)	mg/L	-	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Dissolved Molybdenum (Mo)	mg/L	-	-	0.073	0.0029	0.00088	0.00241	0.0041	0.0050	0.00562
	Dissolved Nickel (Ni)	mg/L	-	-	0.11	<0.00050	0.00094	<0.00050	0.00081	0.00092	0.000920
	Dissolved Phosphorus (P)	mg/L	-	-	-	<0.30	<0.050	0.00810	<0.30	<0.050	0.00430
	Dissolved Potassium (K)	mg/L	-	-	-	0.7	0.4	0.8	2.5	2.3	2.4
	Dissolved Rubidium (Rb)	mg/L	-	-		-	<0.00020	<0.00020	-	0.00028	0.000250
	Dissolved Selenium (Se)	mg/L	-	-	0.0020	0.00086	0.00028	0.000640	0.00032	0.00033	0.000293
	Dissolved Silicon (Si)	mg/L	-	-	-	5.73	5.68	5.50	6.00	5.82	6.05
	Dissolved Silver (Ag)	mg/L	-	-	0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020
	Dissolved Sodium (Na)	mg/L	-	-	-	6.46	3.70	6.24	18.70	17.50	18.70
	Dissolved Strontium (Sr)	mg/L	-	-	-	0.25	0.12	0.25	0.71	0.77	0.86
	Dissolved Sulfur (S)	mg/L	-	-	-	-	3.0	6.7	-	19.3	17.6
	Dissolved Tellurium (Te)	mg/L	-	-	-	-	<0.00020	<0.00020	-	<0.00020	<0.00020
	Dissolved Thallium (Tl)	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Dissolved Thorium (Th)	mg/L	-	-	-	-	<0.00010	<0.00010	-	<0.00010	<0.00010
	Dissolved Tin (Sn)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Dissolved Titanium (Ti)	mg/L	-	-	-	<0.010	0.00061	<0.00030	<0.010	<0.00030	<0.00030
	Dissolved Tungsten (W)	mg/L	-	-	-	-	<0.00010	<0.00010	-	<0.00010	<0.00010
	Dissolved Uranium (U)	mg/L	-	-	-	0.0012	0.0003	0.0011	0.0023	0.0027	0.0030
	Dissolved Vanadium (V)	mg/L	-	-	-	0.0011	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Dissolved Zinc (Zn)	mg/L	0.032 to 0.066 [j]	0.11 to 0.27 [j]	0.030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dissolved Zirconium (Zr)	mg/L	-	-	-	-	0.00040	<0.00020	-	0.000090	<0.00020

Water quality guideline not met.

Water use license objectives not met.

[a] CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. 1999 (plus updates), Canadian Council of Ministers of the Environment, Winnipeg. See Appendix Table B.6 for explanatory notes on selected water quality

[h] Dissolved Cadmium (µg/L) guidelines based on the following formula: $e^{(0.736(\ln(\text{Hardness}))-4.943)}$.

[i] Dissolved Copper water quality objective depends on whether the concentration of dissolved organic carbon (DOC) is above 10 mg/L and is 0.02 mg/L or below ≤ 10 mg/L DOC and is 0.013 mg/L Cu.

[j] Dissolved Zinc short-term benchmark is calculated as: exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). The long-term guideline is for dissolved zinc is calculated as: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625).

Table B.5: **Surface Water Chemistry Summary Statistics for Upper Minto, Station W3, 2019**

Season	Statistic	Al.D	As.D	Cd.D	C.DOC	Cr.D	Cu.D	Fe.D	Mo.D	Ni.D	NH3-N	NO2-N	NO3-N	pH	Se.D	Zn.D	Temp.	Hard.D
Fall	N	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	perNDet	0	0	77.8	0	88.9	0	44.4	0	0	11.1	77.8	0	0	0	66.7	0	0
	mean	0.00190	0.000229	0.0000129	5.82	0.000106	0.00231	0.0116	0.00531	0.000949	0.00771	0.00104	0.0839	8.44	0.000306	0.00160	0.956	288
	sd	0.000616	0.0000117	0.0000315	0.212	-	0.000239	0.00236	0.000130	0.0000965	0.00336	0.0000889	0.0211	0.116	0.0000402	0.000783	1.21	10.9
	min	0.00120	0.000210	<0.000005	5.63	<0.000100	0.00201	<0.0100	0.00507	0.000830	<0.00500	<0.00100	0.0423	8.21	0.000251	<0.00100	0	269
	max	0.00330	0.000240	0.0000759	6.25	0.000150	0.00273	0.0160	0.00546	0.00117	0.0142	0.00130	0.112	8.56	0.000397	0.00360	3.60	302
	P_50	0.00170	0.000230	<0.000005	5.78	<0.000100	0.00228	0.0100	0.00532	0.000950	0.00610	<0.00100	0.0816	8.47	0.000299	<0.00100	0.600	290
Spring	N	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	perNDet	11.1	0	0	0	88.9	0	11.1	0	11.1	11.1	88.9	11.1	0	0	44.4	0	0
	mean	0.00258	0.000236	0.0000136	5.58	0.000101	0.00438	0.0278	0.00479	0.000761	0.0133	0.00109	0.0733	8.25	0.000308	0.00262	0.756	264
	sd	0.00190	0.0000378	0.0000079	0.648	-	0.00393	0.0103	0.00115	0.000172	0.00599	-	0.0224	0.203	0.0000621	0.00293	1.15	36.4
	min	0.00120	0.000160	0.0000061	4.72	<0.000100	0.00209	<0.0100	0.00185	<0.000500	<0.00500	<0.00100	<0.00500	7.80	0.000164	<0.00100	0	183
	max	0.00660	0.000290	0.0000291	6.50	0.000110	0.0147	0.0480	0.00591	0.00106	0.0216	0.00180	0.110	8.42	0.000364	0.00920	3.30	310
	P_50	0.00170	0.000230	0.0000104	5.59	<0.000100	0.00307	0.0270	0.00498	0.000710	0.0125	<0.00100	0.0793	8.32	0.000314	0.00100	0.200	271
Summer	N	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	perNDet	7.14	0	71.4	0	57.1	0	64.3	0	0	14.3	92.9	0	0	0	78.6	0	0
	mean	0.00389	0.000271	0.0000058	7.49	0.000212	0.00345	0.0169	0.00532	0.00104	0.00730	0.00106	0.0946	8.51	0.000318	0.00114	3.71	275
	sd	0.00556	0.0000467	0.0000020	4.73	0.000434	0.00302	0.0186	0.000428	0.000416	0.00253	-	0.0108	0.0731	0.0000350	0.000390	5.69	17.9
	min	<0.00100	0.000220	<0.000005	5.66	<0.000100	0.00210	<0.0100	0.00402	0.000770	<0.00500	<0.00100	0.0741	8.36	0.000242	<0.00100	0	226
	max	0.0221	0.000410	0.0000110	23.8	0.00164	0.0138	0.0750	0.00592	0.00246	0.0121	0.00190	0.114	8.62	0.000380	0.00230	23.0	305
	P_50	0.00195	0.000260	<0.000005	6.17	<0.000100	0.00266	<0.0100	0.00538	0.000945	0.00665	<0.00100	0.0932	8.52	0.000318	<0.00100	2.60	274
Winter	N	23	23	23	23	21	23	23	23	23	23	23	23	23	23	23	23	23
	perNDet	0	0	8.70	0	76.2	0	26.1	0	0	0	69.6	0	0	0	21.7	0	0
	mean	0.00231	0.000352	0.0000166	5.85	0.000117	0.00404	0.0480	0.00481	0.000929	0.0329	0.00163	0.112	8.08	0.000311	0.0152	0.991	286
	sd	0.00144	0.000301	0.0000112	0.766	0.0000657	0.00430	0.0513	0.000653	0.000197	0.0314	0.00203	0.0429	0.184	0.0000856	0.0486	1.07	18.0
	min	0.00120	0.000200	<0.000005	5.02	<0.000100	0.00163	<0.0100	0.00355	0.000510	0.00710	<0.00100	0.0250	7.77	0.0000740	<0.00100	0	260
	max	0.00710	0.00166	0.0000507	8.71	0.000370	0.0212	0.200	0.00579	0.00131	0.131	<0.0100	0.168	8.47	0.000444	0.234	2.70	337
	P_50	0.00180	0.000250	0.0000130	5.64	<0.000100	0.00243	0.0300	0.00504	0.000950	0.0187	<0.00100	0.119	8.09	0.000326	0.00220	0.300	283

Notes: 2019 water quality data provided by Minto Mine staff (2020), n=sample size, perNDet= percent non-detects, sd=standard deviation, p_50= median, "-" not appropriate to calculate given number of values below detections.

Table B.6: Sediment Quality Results for upper Minto and upper McGinty Creeks, 2019

Analytes	LDL	units	Sample ID				
			UMC-1-M	UMC-2-M	UMC-3-M	UMC-4-M	UMC-5-M
	Date Sampled		5-Sep-2019	5-Sep-2019	4-Sep-2019	4-Sep-2019	4-Sep-2019
Physical Characteristics							
Loss On Ignition @ 420 C	1	%	7	8	6	3	3
pH (1:2 soil:water)	0.10	pH	8.07	8.13	8.28	8.38	8.42
% Gravel (>2mm)	1.0	%	6.1	-	-	-	-
% Sand (2.0mm - 0.063mm)	1.0	%	60.4	-	-	-	-
% Silt (0.063mm - 4um)	1.0	%	28.3	-	-	-	-
% Clay (<4um)	1.0	%	5.2	-	-	-	-
Texture		-	Sandy loam	-	-	-	-
Total Kjeldahl Nitrogen	0.020	%	0.206	0.270	0.180	0.085	0.082
Organic/Inorganic Carbon							
Inorganic Carbon	0.050	%	0.211	0.378	0.164	0.074	0.079
Inorganic Carbon (as $CaCO_3$)	0.40	%	1.75	3.15	1.36	0.62	0.66
Total Carbon by Combustion	0.05	%	3.40	3.90	3.11	1.41	1.12
Total Organic Carbon	0.050	%	3.19	3.52	2.95	1.34	1.04
Metals							
Aluminum (Al)	50	mg/kg	12900	7060	10700	9250	10000
Antimony (Sb)	0.10	mg/kg	0.61	0.34	0.56	0.35	0.39
Arsenic (As)	0.10	mg/kg	8.34	4.76	7.07	5.06	6.01
Barium (Ba)	0.50	mg/kg	288	625	434	137	176
Beryllium (Be)	0.10	mg/kg	0.48	0.28	0.45	0.36	0.41
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	0.020	mg/kg	0.209	0.385	0.371	0.111	0.142
Calcium (Ca)	50	mg/kg	10400	11200	9250	6870	7100
Chromium (Cr)	0.50	mg/kg	30.20	13.40	26.40	27.80	28.20
Cobalt (Co)	0.10	mg/kg	12.80	11.50	12.60	8.93	9.69
Copper (Cu)	0.50	mg/kg	156.0	168.0	200.0	66.7	66.4
Iron (Fe)	50	mg/kg	27900	15900	26500	21600	23400
Lead (Pb)	0.50	mg/kg	6.60	3.66	6.56	4.85	5.49
Lithium (Li)	2.0	mg/kg	8.7	5.0	7.1	6.2	6.8
Magnesium (Mg)	20	mg/kg	7550	4210	6170	5860	6190
Manganese (Mn)	1.0	mg/kg	4870	13900	7960	847	1230
Mercury (Hg)	0.0050	mg/kg	0.0331	0.0194	0.0263	0.0126	0.0140
Molybdenum (Mo)	0.10	mg/kg	1.72	5.03	3.76	0.86	1.02
Nickel (Ni)	0.50	mg/kg	30.9	21.7	30.0	23.6	27.0
Phosphorus (P)	50	mg/kg	1010	590	841	972	1070
Potassium (K)	100	mg/kg	1580	1010	1380	1080	1200
Selenium (Se)	0.20	mg/kg	0.57	0.74	0.74	0.28	0.20
Silver (Ag)	0.10	mg/kg	0.11	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	50	mg/kg	310	223	293	329	342
Strontium (Sr)	0.50	mg/kg	124.0	153.0	124.0	69.2	69.8
Sulfur (S)	1000	mg/kg	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	0.050	mg/kg	0.100	0.060	0.088	0.068	0.076
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	618	377	741	682	672
Tungsten (W)	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	0.050	mg/kg	0.924	0.627	0.760	0.610	0.581
Vanadium (V)	0.20	mg/kg	55.6	35.2	64.0	52.0	54.6
Zinc (Zn)	2.0	mg/kg	72.2	50.7	69.9	47.1	55.1
Zirconium (Zr)	1.0	mg/kg	2.7	<1.0	1.6	2.4	2.8

Notes: LDL Lowest detection limit, UMC- Upper Minto Creek, URC- upper reference creek, McGinty Creek

Table B.6: Sediment Quality Results for upper Minto and upper McGinty Creeks, 2019

Analytes	LDL	units	Sample ID				
			URC-1-M	URC-2-M	URC-3-M	URC-4-M	URC-5-M
	Date Sampled		6-Sep-2019	6-Sep-2019	6-Sep-2019	6-Sep-2019	6-Sep-2019
Physical Characteristics							
Loss On Ignition @ 420 C	1	%	4	4	5	4	3
pH (1:2 soil:water)	0.10	pH	7.39	6.46	6.47	7.51	7.63
% Gravel (>2mm)	1.0	%	1.2	-	-	-	-
% Sand (2.0mm - 0.063mm)	1.0	%	79.2	-	-	-	-
% Silt (0.063mm - 4um)	1.0	%	17.3	-	-	-	-
% Clay (<4um)	1.0	%	2.3	-	-	-	-
Texture		-	Loamy sand	-	-	-	-
Total Kjeldahl Nitrogen	0.020	%	0.096	0.078	0.122	0.101	0.067
Organic/Inorganic Carbon							
Inorganic Carbon	0.050	%	0.071	0.052	0.070	0.072	0.053
Inorganic Carbon (as $CaCO_3$)	0.40	%	0.59	0.43	0.58	0.6	0.44
Total Carbon by Combustion	0.05	%	1.83	1.56	2.18	1.95	1.34
Total Organic Carbon	0.050	%	1.76	1.51	2.11	1.88	1.29
Metals							
Aluminum (Al)	50	mg/kg	5780	4870	8220	6940	6980
Antimony (Sb)	0.10	mg/kg	0.21	0.21	0.36	0.25	0.27
Arsenic (As)	0.10	mg/kg	6.84	11.2	9.45	7.29	3.87
Barium (Ba)	0.50	mg/kg	130	116	152	151	105
Beryllium (Be)	0.10	mg/kg	0.21	0.17	0.27	0.22	0.19
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	0.020	mg/kg	0.085	0.055	0.082	0.090	0.067
Calcium (Ca)	50	mg/kg	4490	3500	4960	5070	4780
Chromium (Cr)	0.50	mg/kg	9.92	9.07	16.20	15.60	15.70
Cobalt (Co)	0.10	mg/kg	6.63	4.57	6.77	6.75	5.67
Copper (Cu)	0.50	mg/kg	9.3	7.8	13.4	10.2	9.5
Iron (Fe)	50	mg/kg	18500	19500	24300	20600	15200
Lead (Pb)	0.50	mg/kg	2.53	2.39	3.33	2.81	2.82
Lithium (Li)	2.0	mg/kg	3.5	3.1	5.2	4.3	4.2
Magnesium (Mg)	20	mg/kg	2430	2020	3540	3120	3070
Manganese (Mn)	1.0	mg/kg	760	297	369	979	529
Mercury (Hg)	0.0050	mg/kg	0.0165	0.0124	0.0244	0.0164	0.0162
Molybdenum (Mo)	0.10	mg/kg	0.46	0.37	0.44	0.61	0.39
Nickel (Ni)	0.50	mg/kg	8.9	7.5	13.1	11.5	11.0
Phosphorus (P)	50	mg/kg	554	785	905	749	721
Potassium (K)	100	mg/kg	340	310	490	460	480
Selenium (Se)	0.20	mg/kg	0.44	0.26	0.38	0.37	0.22
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	50	mg/kg	113	93	152	170	151
Strontium (Sr)	0.50	mg/kg	37.2	43.8	40.7	43.5	44.8
Sulfur (S)	1000	mg/kg	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	0.050	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	1.0	mg/kg	328	307	550	434	514
Tungsten (W)	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)	0.050	mg/kg	0.673	0.492	0.626	0.672	0.576
Vanadium (V)	0.20	mg/kg	30.2	25.8	38.8	36.6	36.9
Zinc (Zn)	2.0	mg/kg	24.0	20.6	33.2	30.4	28.6
Zirconium (Zr)	1.0	mg/kg	<1.0	<1.0	1.6	1.8	1.5

Notes: LDL Lowest detection limit, UMC- Upper Minto Creek, URC- upper reference creek, McGinty Creek

APPENDIX C
LABORATORY REPORTS - CERTIFICATE OF ANALYSIS

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343814-1	L2343814-2	L2343814-3	L2343814-4	L2343814-5
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	05-SEP-19	05-SEP-19	04-SEP-19	04-SEP-19	04-SEP-19
Sampled Time	11:10	10:45	18:05	17:40	17:15
Client ID	UMC-1-M	UMC-2-M	UMC-3-M	UMC-4-M	UMC-5-M
Grouping / **Analyte**					
SOIL					
Physical Tests Loss On Ignition @ 420 C (%)	7	8	6	3	3
pH (1:2 soil:water) (pH)	8.07	8.13	8.28	8.38	8.42
Particle Size % Gravel (>2mm) (%)					
% Sand (2.0mm - 0.063mm) (%)					
% Silt (0.063mm - 4um) (%)					
% Clay (<4um) (%)					
Texture					
Leachable Anions & Nutrients Total Kjeldahl Nitrogen (%)	0.206	0.270	0.180	0.085	0.082
Organic / Inorganic Carbon Inorganic Carbon (%)	0.211	0.378	0.164	0.074	0.079
Inorganic Carbon (as CaCO3 Equivalent) (%)	1.75	3.15	1.36	0.62	0.66
Total Carbon by Combustion (%)	3.40	3.90	3.11	1.41	1.12
Total Organic Carbon (%)	3.19	3.52	2.95	1.34	1.04
Metals Aluminum (Al) (mg/kg)	12900	7060	10700	9250	10000
Antimony (Sb) (mg/kg)	0.61	0.34	0.56	0.35	0.39
Arsenic (As) (mg/kg)	8.34	4.76	7.07	5.06	6.01
Barium (Ba) (mg/kg)	288	625	434	137	176
Beryllium (Be) (mg/kg)	0.48	0.28	0.45	0.36	0.41
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.209	0.385	0.371	0.111	0.142
Calcium (Ca) (mg/kg)	10400	11200	9250	6870	7100
Chromium (Cr) (mg/kg)	30.2	13.4	26.4	27.8	28.2
Cobalt (Co) (mg/kg)	12.8	11.5	12.6	8.93	9.69
Copper (Cu) (mg/kg)	156	168	200	66.7	66.4
Iron (Fe) (mg/kg)	27900	15900	26500	21600	23400
Lead (Pb) (mg/kg)	6.60	3.66	6.56	4.85	5.49
Lithium (Li) (mg/kg)	8.7	5.0	7.1	6.2	6.8
Magnesium (Mg) (mg/kg)	7550	4210	6170	5860	6190
Manganese (Mn) (mg/kg)	4870	13900	7960	847	1230
Mercury (Hg) (mg/kg)	0.0331	0.0194	0.0263	0.0126	0.0140
Molybdenum (Mo) (mg/kg)	1.72	5.03	3.76	0.86	1.02
Nickel (Ni) (mg/kg)	30.9	21.7	30.0	23.6	27.0
Phosphorus (P) (mg/kg)	1010	590	841	972	1070
Potassium (K) (mg/kg)	1580	1010	1380	1080	1200
Selenium (Se) (mg/kg)	0.57	0.74	0.74	0.28	0.20
Silver (Ag) (mg/kg)	0.11	<0.10	<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343814-6	L2343814-7	L2343814-8	L2343814-9	L2343814-10
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	05-SEP-19	05-SEP-19	06-SEP-19	06-SEP-19	06-SEP-19
Sampled Time	11:10	11:10	10:20	10:00	09:50
Client ID	UMC-X-M	UMC-5	URC-1-M	URC-2-M	URC-3-M
Grouping / **Analyte**					
SOIL					
Physical Tests Loss On Ignition @ 420 C (%)	8		4	4	5
pH (1:2 soil:water) (pH)	8.06		7.39	6.46	6.47
Particle Size % Gravel (>2mm) (%)		6.1			
% Sand (2.0mm - 0.063mm) (%)		60.4			
% Silt (0.063mm - 4um) (%)		28.3			
% Clay (<4um) (%)		5.2			
Texture		Sandy loam			
Leachable Anions & Nutrients Total Kjeldahl Nitrogen (%)	0.233		0.096	0.078	0.122
Organic / Inorganic Carbon Inorganic Carbon (%)	0.232		0.071	0.052	0.070
Inorganic Carbon (as CaCO3 Equivalent) (%)	1.93		0.59	0.43	0.58
Total Carbon by Combustion (%)	3.94		1.83	1.56	2.18
Total Organic Carbon (%)	3.71		1.76	1.51	2.11
Metals Aluminum (Al) (mg/kg)	13500		5780	4870	8220
Antimony (Sb) (mg/kg)	0.68		0.21	0.21	0.36
Arsenic (As) (mg/kg)	7.36		6.84	11.2	9.45
Barium (Ba) (mg/kg)	302		130	116	152
Beryllium (Be) (mg/kg)	0.51		0.21	0.17	0.27
Bismuth (Bi) (mg/kg)	<0.20		<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0		<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.207		0.085	0.055	0.082
Calcium (Ca) (mg/kg)	11300		4490	3500	4960
Chromium (Cr) (mg/kg)	31.4		9.92	9.07	16.2
Cobalt (Co) (mg/kg)	11.9		6.63	4.57	6.77
Copper (Cu) (mg/kg)	146		9.34	7.77	13.4
Iron (Fe) (mg/kg)	26700		18500	19500	24300
Lead (Pb) (mg/kg)	6.95		2.53	2.39	3.33
Lithium (Li) (mg/kg)	9.4		3.5	3.1	5.2
Magnesium (Mg) (mg/kg)	7780		2430	2020	3540
Manganese (Mn) (mg/kg)	5320		760	297	369
Mercury (Hg) (mg/kg)	0.0344		0.0165	0.0124	0.0244
Molybdenum (Mo) (mg/kg)	1.78		0.46	0.37	0.44
Nickel (Ni) (mg/kg)	31.1		8.90	7.46	13.1
Phosphorus (P) (mg/kg)	987		554	785	905
Potassium (K) (mg/kg)	1590		340	310	490
Selenium (Se) (mg/kg)	0.55		0.44	0.26	0.38
Silver (Ag) (mg/kg)	0.11		<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2343814-11 Description: Sediment Sampled Date: 06-SEP-19 Sampled Time: 09:30 Client ID: URC-4-M	Sample ID: L2343814-12 Description: Sediment Sampled Date: 06-SEP-19 Sampled Time: 09:00 Client ID: URC-5-M	Sample ID: L2343814-13 Description: Sediment Sampled Date: 06-SEP-19 Sampled Time: 10:20 Client ID: URC-5		
SOIL						
Physical Tests	Loss On Ignition @ 420 C (%)	4	3			
	pH (1:2 soil:water) (pH)	7.51	7.63			
Particle Size	% Gravel (>2mm) (%)			1.2		
	% Sand (2.0mm - 0.063mm) (%)			79.2		
	% Silt (0.063mm - 4um) (%)			17.3		
	% Clay (<4um) (%)			2.3		
	Texture			Loamy sand		
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.101	0.067			
Organic / Inorganic Carbon	Inorganic Carbon (%)	0.072	0.053			
	Inorganic Carbon (as CaCO3 Equivalent) (%)	0.60	0.44			
	Total Carbon by Combustion (%)	1.95	1.34			
	Total Organic Carbon (%)	1.88	1.29			
Metals	Aluminum (Al) (mg/kg)	6940	6980			
	Antimony (Sb) (mg/kg)	0.25	0.27			
	Arsenic (As) (mg/kg)	7.29	3.87			
	Barium (Ba) (mg/kg)	151	105			
	Beryllium (Be) (mg/kg)	0.22	0.19			
	Bismuth (Bi) (mg/kg)	<0.20	<0.20			
	Boron (B) (mg/kg)	<5.0	<5.0			
	Cadmium (Cd) (mg/kg)	0.090	0.067			
	Calcium (Ca) (mg/kg)	5070	4780			
	Chromium (Cr) (mg/kg)	15.6	15.7			
	Cobalt (Co) (mg/kg)	6.75	5.67			
	Copper (Cu) (mg/kg)	10.2	9.52			
	Iron (Fe) (mg/kg)	20600	15200			
	Lead (Pb) (mg/kg)	2.81	2.82			
	Lithium (Li) (mg/kg)	4.3	4.2			
	Magnesium (Mg) (mg/kg)	3120	3070			
	Manganese (Mn) (mg/kg)	979	529			
	Mercury (Hg) (mg/kg)	0.0164	0.0162			
	Molybdenum (Mo) (mg/kg)	0.61	0.39			
	Nickel (Ni) (mg/kg)	11.5	11.0			
	Phosphorus (P) (mg/kg)	749	721			
	Potassium (K) (mg/kg)	460	480			
	Selenium (Se) (mg/kg)	0.37	0.22			
	Silver (Ag) (mg/kg)	<0.10	<0.10			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2343814-1 Sediment 05-SEP-19 11:10 UMC-1-M	L2343814-2 Sediment 05-SEP-19 10:45 UMC-2-M	L2343814-3 Sediment 04-SEP-19 18:05 UMC-3-M	L2343814-4 Sediment 04-SEP-19 17:40 UMC-4-M	L2343814-5 Sediment 04-SEP-19 17:15 UMC-5-M
Sample ID		L2343814-1	L2343814-2	L2343814-3	L2343814-4	L2343814-5
Description		Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date		05-SEP-19	05-SEP-19	04-SEP-19	04-SEP-19	04-SEP-19
Sampled Time		11:10	10:45	18:05	17:40	17:15
Client ID		UMC-1-M	UMC-2-M	UMC-3-M	UMC-4-M	UMC-5-M
SOIL						
Metals	Sodium (Na) (mg/kg)	310	223	293	329	342
	Strontium (Sr) (mg/kg)	124	153	124	69.2	69.8
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.100	0.060	0.088	0.068	0.076
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	618	377	741	682	672
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.924	0.627	0.760	0.610	0.581
	Vanadium (V) (mg/kg)	55.6	35.2	64.0	52.0	54.6
	Zinc (Zn) (mg/kg)	72.2	50.7	69.9	47.1	55.1
	Zirconium (Zr) (mg/kg)	2.7	<1.0	1.6	2.4	2.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2343814-6 Description: Sediment Sampled Date: 05-SEP-19 Sampled Time: 11:10 Client ID: UMC-X-M	L2343814-7 Sediment 05-SEP-19 11:10 UMC-5	L2343814-8 Sediment 06-SEP-19 10:20 URC-1-M	L2343814-9 Sediment 06-SEP-19 10:00 URC-2-M	L2343814-10 Sediment 06-SEP-19 09:50 URC-3-M
SOIL						
Metals	Sodium (Na) (mg/kg)	334		113	93	152
	Strontium (Sr) (mg/kg)	126		37.2	43.8	40.7
	Sulfur (S) (mg/kg)	<1000		<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.107		<0.050	<0.050	<0.050
	Tin (Sn) (mg/kg)	<2.0		<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	673		328	307	550
	Tungsten (W) (mg/kg)	<0.50		<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	1.05		0.673	0.492	0.626
	Vanadium (V) (mg/kg)	55.7		30.2	25.8	38.8
	Zinc (Zn) (mg/kg)	72.1		24.0	20.6	33.2
	Zirconium (Zr) (mg/kg)	2.7		<1.0	<1.0	1.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID Description Sampled Date Sampled Time Client ID	L2343814-11 Sediment 06-SEP-19 09:30 URC-4-M	L2343814-12 Sediment 06-SEP-19 09:00 URC-5-M	L2343814-13 Sediment 06-SEP-19 10:20 URC-5		
SOIL							
Metals	Sodium (Na) (mg/kg)		170	151			
	Strontium (Sr) (mg/kg)		43.5	44.8			
	Sulfur (S) (mg/kg)		<1000	<1000			
	Thallium (Tl) (mg/kg)		<0.050	<0.050			
	Tin (Sn) (mg/kg)		<2.0	<2.0			
	Titanium (Ti) (mg/kg)		434	514			
	Tungsten (W) (mg/kg)		<0.50	<0.50			
	Uranium (U) (mg/kg)		0.672	0.576			
	Vanadium (V) (mg/kg)		36.6	36.9			
	Zinc (Zn) (mg/kg)		30.4	28.6			
	Zirconium (Zr) (mg/kg)		1.8	1.5			

* 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)
Duplicate	Barium (Ba)	DUP-H	L2343814-10, -11, -12, -8, -9
Duplicate	Calcium (Ca)	DUP-H	L2343814-10, -11, -12, -8, -9
Duplicate	Cobalt (Co)	DUP-H	L2343814-10, -11, -12, -8, -9
Duplicate	Copper (Cu)	DUP-H	L2343814-10, -11, -12, -8, -9
Duplicate	Manganese (Mn)	DUP-H	L2343814-10, -11, -12, -8, -9
Duplicate	Phosphorus (P)	DUP-H	L2343814-10, -11, -12, -8, -9
Duplicate	Potassium (K)	DUP-H	L2343814-10, -11, -12, -8, -9
Duplicate	Zinc (Zn)	DUP-H	L2343814-10, -11, -12, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

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.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
LOI-420-SK	Soil	Loss on Ignition @ 420 C	CSSS (1978) METHOD 3.81

The dry-ash method involves the removal of organic matter by combustion at 420OC for 2 hours. Samples are dried prior to combustion.

Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 3.81

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in "pH, Electrometric in Soil and Sediment - Prescriptive Method", Rev. 2005, Section B Physical, Inorganic and Misc. Constituents, BC Environmental Laboratory Manual. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

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.

** 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:

Reference Information

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

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.

Quality Control Report

Workorder: L2343814 Report Date: 11-MAR-20

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4827328								
WG3161976-1 DUP		**L2344692-1**						
Inorganic Carbon		0.509	0.524		%	3.0	20	20-SEP-19
WG3161976-4 IRM		**08-109_SOIL**						
Inorganic Carbon			97.3		%		80-120	20-SEP-19
WG3161976-2 LCS								
Inorganic Carbon			92.6		%		80-120	20-SEP-19
WG3161976-3 MB								
Inorganic Carbon			<0.050		%		0.05	20-SEP-19
C-TOT-LECO-SK	**Soil**							
Batch R4816692								
WG3161228-2 DUP		**L2343814-3**						
Total Carbon by Combustion		3.11	2.95		%	5.5	20	17-SEP-19
WG3161228-3 IRM		**08-109_SOIL**						
Total Carbon by Combustion			105.1		%		80-120	17-SEP-19
WG3161228-6 LCS								
Total Carbon by Combustion			98.4		%		90-110	17-SEP-19
WG3161228-5 MB								
Total Carbon by Combustion			<0.05		%		0.05	17-SEP-19
HG-200.2-CVAF-VA	**Soil**							
Batch R4817229								
WG3163305-2 DUP		**L2343814-1**						
Mercury (Hg)		0.0331	0.0287		mg/kg	14	40	17-SEP-19
WG3163305-3 LCS								
Mercury (Hg)			105.5		%		80-120	17-SEP-19
WG3163305-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	17-SEP-19
Batch R4822029								
WG3164314-2 DUP		**L2345947-26**						
Mercury (Hg)		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	19-SEP-19
WG3164314-3 LCS								
Mercury (Hg)			101.2		%		80-120	19-SEP-19
WG3164314-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	19-SEP-19
LOI-420-SK	**Soil**							

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
LOI-420-SK	**Soil**							
Batch R4816688								
WG3163165-1 DUP		**L2343814-2**						
Loss On Ignition @ 420 C		8	8		%	2.6	20	17-SEP-19
WG3163165-3 IRM		**SAL2001**						
Loss On Ignition @ 420 C			100.6		%		80-120	17-SEP-19
WG3163165-2 MB								
Loss On Ignition @ 420 C			<1		%		1	17-SEP-19
MET-200.2-CCMS-VA	**Soil**							
Batch R4815130								
WG3163305-2 DUP		**L2343814-1**						
Aluminum (Al)		12900	13900		mg/kg	7.4	40	17-SEP-19
Antimony (Sb)		0.61	0.52		mg/kg	15	30	17-SEP-19
Arsenic (As)		8.34	8.24		mg/kg	1.2	30	17-SEP-19
Barium (Ba)		288	292		mg/kg	1.3	40	17-SEP-19
Beryllium (Be)		0.48	0.55		mg/kg	14	30	17-SEP-19
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	17-SEP-19
Boron (B)		<5.0	<5.0	RPD-NA	mg/kg	N/A	30	17-SEP-19
Cadmium (Cd)		0.209	0.182		mg/kg	14	30	17-SEP-19
Calcium (Ca)		10400	10900		mg/kg	4.7	30	17-SEP-19
Chromium (Cr)		30.2	31.6		mg/kg	4.7	30	17-SEP-19
Cobalt (Co)		12.8	12.3		mg/kg	4.1	30	17-SEP-19
Copper (Cu)		156	148		mg/kg	4.9	30	17-SEP-19
Iron (Fe)		27900	28400		mg/kg	1.8	30	17-SEP-19
Lead (Pb)		6.60	6.71		mg/kg	1.7	40	17-SEP-19
Lithium (Li)		8.7	9.4		mg/kg	7.7	30	17-SEP-19
Magnesium (Mg)		7550	7650		mg/kg	1.3	30	17-SEP-19
Manganese (Mn)		4870	4450		mg/kg	9.0	30	17-SEP-19
Molybdenum (Mo)		1.72	1.69		mg/kg	1.8	40	17-SEP-19
Nickel (Ni)		30.9	30.7		mg/kg	0.8	30	17-SEP-19
Phosphorus (P)		1010	1100		mg/kg	8.9	30	17-SEP-19
Potassium (K)		1580	1720		mg/kg	8.4	40	17-SEP-19
Selenium (Se)		0.57	0.55		mg/kg	3.1	30	17-SEP-19
Silver (Ag)		0.11	0.10		mg/kg	7.5	40	17-SEP-19
Sodium (Na)		310	362		mg/kg	16	40	17-SEP-19
Strontium (Sr)		124	126		mg/kg	1.4	40	17-SEP-19

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4815130								
WG3163305-2 DUP		**L2343814-1**						
Sulfur (S)		<1000	<1000	RPD-NA	mg/kg	N/A	30	17-SEP-19
Thallium (Tl)		0.100	0.115		mg/kg	14	30	17-SEP-19
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	17-SEP-19
Titanium (Ti)		618	795		mg/kg	25	40	17-SEP-19
Tungsten (W)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	17-SEP-19
Uranium (U)		0.924	0.987		mg/kg	6.6	30	17-SEP-19
Vanadium (V)		55.6	59.9		mg/kg	7.5	30	17-SEP-19
Zinc (Zn)		72.2	68.7		mg/kg	5.0	30	17-SEP-19
Zirconium (Zr)		2.7	2.5		mg/kg	7.0	30	17-SEP-19
WG3163305-3 LCS								
Aluminum (Al)			94.3		%		80-120	17-SEP-19
Antimony (Sb)			95.2		%		80-120	17-SEP-19
Arsenic (As)			99.2		%		80-120	17-SEP-19
Barium (Ba)			101.7		%		80-120	17-SEP-19
Beryllium (Be)			95.4		%		80-120	17-SEP-19
Bismuth (Bi)			93.7		%		80-120	17-SEP-19
Boron (B)			96.8		%		80-120	17-SEP-19
Cadmium (Cd)			97.6		%		80-120	17-SEP-19
Calcium (Ca)			94.6		%		80-120	17-SEP-19
Chromium (Cr)			100.1		%		80-120	17-SEP-19
Cobalt (Co)			97.9		%		80-120	17-SEP-19
Copper (Cu)			96.2		%		80-120	17-SEP-19
Iron (Fe)			99.9		%		80-120	17-SEP-19
Lead (Pb)			93.7		%		80-120	17-SEP-19
Lithium (Li)			90.2		%		80-120	17-SEP-19
Magnesium (Mg)			98.7		%		80-120	17-SEP-19
Manganese (Mn)			99.9		%		80-120	17-SEP-19
Molybdenum (Mo)			97.1		%		80-120	17-SEP-19
Nickel (Ni)			97.7		%		80-120	17-SEP-19
Phosphorus (P)			109.5		%		80-120	17-SEP-19
Potassium (K)			101.1		%		80-120	17-SEP-19
Selenium (Se)			94.2		%		80-120	17-SEP-19
Silver (Ag)			95.7		%		80-120	17-SEP-19

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2

Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4815130								
WG3163305-3 LCS								
Sodium (Na)			98.6		%		80-120	17-SEP-19
Strontium (Sr)			96.7		%		80-120	17-SEP-19
Sulfur (S)			100.3		%		80-120	17-SEP-19
Thallium (Tl)			94.5		%		80-120	17-SEP-19
Tin (Sn)			97.8		%		80-120	17-SEP-19
Titanium (Ti)			89.9		%		80-120	17-SEP-19
Tungsten (W)			97.6		%		80-120	17-SEP-19
Uranium (U)			95.6		%		80-120	17-SEP-19
Vanadium (V)			100.7		%		80-120	17-SEP-19
Zinc (Zn)			96.1		%		80-120	17-SEP-19
Zirconium (Zr)			91.3		%		70-130	17-SEP-19
WG3163305-1 MB								
Aluminum (Al)			<50		mg/kg		50	17-SEP-19
Antimony (Sb)			<0.10		mg/kg		0.1	17-SEP-19
Arsenic (As)			<0.10		mg/kg		0.1	17-SEP-19
Barium (Ba)			<0.50		mg/kg		0.5	17-SEP-19
Beryllium (Be)			<0.10		mg/kg		0.1	17-SEP-19
Bismuth (Bi)			<0.20		mg/kg		0.2	17-SEP-19
Boron (B)			<5.0		mg/kg		5	17-SEP-19
Cadmium (Cd)			<0.020		mg/kg		0.02	17-SEP-19
Calcium (Ca)			<50		mg/kg		50	17-SEP-19
Chromium (Cr)			<0.50		mg/kg		0.5	17-SEP-19
Cobalt (Co)			<0.10		mg/kg		0.1	17-SEP-19
Copper (Cu)			<0.50		mg/kg		0.5	17-SEP-19
Iron (Fe)			<50		mg/kg		50	17-SEP-19
Lead (Pb)			<0.50		mg/kg		0.5	17-SEP-19
Lithium (Li)			<2.0		mg/kg		2	17-SEP-19
Magnesium (Mg)			<20		mg/kg		20	17-SEP-19
Manganese (Mn)			<1.0		mg/kg		1	17-SEP-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	17-SEP-19
Nickel (Ni)			<0.50		mg/kg		0.5	17-SEP-19
Phosphorus (P)			<50		mg/kg		50	17-SEP-19
Potassium (K)			<100		mg/kg		100	17-SEP-19
Selenium (Se)			<0.20		mg/kg		0.2	17-SEP-19

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4815130								
WG3163305-1 MB								
Silver (Ag)			<0.10		mg/kg		0.1	17-SEP-19
Sodium (Na)			<50		mg/kg		50	17-SEP-19
Strontium (Sr)			<0.50		mg/kg		0.5	17-SEP-19
Sulfur (S)			<1000		mg/kg		1000	17-SEP-19
Thallium (Tl)			<0.050		mg/kg		0.05	17-SEP-19
Tin (Sn)			<2.0		mg/kg		2	17-SEP-19
Titanium (Ti)			<1.0		mg/kg		1	17-SEP-19
Tungsten (W)			<0.50		mg/kg		0.5	17-SEP-19
Uranium (U)			<0.050		mg/kg		0.05	17-SEP-19
Vanadium (V)			<0.20		mg/kg		0.2	17-SEP-19
Zinc (Zn)			<2.0		mg/kg		2	17-SEP-19
Zirconium (Zr)			<1.0		mg/kg		1	17-SEP-19
Batch R4822972								
WG3164314-2 DUP		**L2345947-26**						
Aluminum (Al)		4920	6780		mg/kg	32	40	19-SEP-19
Antimony (Sb)		0.19	0.27	J	mg/kg	0.08	0.2	19-SEP-19
Arsenic (As)		1.24	1.64		mg/kg	28	30	19-SEP-19
Barium (Ba)		79.6	123	DUP-H	mg/kg	43	40	19-SEP-19
Beryllium (Be)		0.16	0.21		mg/kg	28	30	19-SEP-19
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	19-SEP-19
Boron (B)		<5.0	<5.0	RPD-NA	mg/kg	N/A	30	19-SEP-19
Cadmium (Cd)		0.057	0.080	J	mg/kg	0.023	0.04	19-SEP-19
Calcium (Ca)		2980	4290	DUP-H	mg/kg	36	30	19-SEP-19
Chromium (Cr)		7.16	9.35		mg/kg	26	30	19-SEP-19
Cobalt (Co)		3.09	4.18	DUP-H	mg/kg	30	30	19-SEP-19
Copper (Cu)		8.97	13.0	DUP-H	mg/kg	37	30	19-SEP-19
Iron (Fe)		12200	16100		mg/kg	28	30	19-SEP-19
Lead (Pb)		10.6	15.2		mg/kg	36	40	19-SEP-19
Lithium (Li)		6.9	9.4	J	mg/kg	2.5	4	19-SEP-19
Magnesium (Mg)		2950	3980		mg/kg	30	30	19-SEP-19
Manganese (Mn)		242	344	DUP-H	mg/kg	35	30	19-SEP-19
Molybdenum (Mo)		0.30	0.44		mg/kg	38	40	19-SEP-19
Nickel (Ni)		5.20	6.98		mg/kg	29	30	19-SEP-19

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2

Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4822972								
WG3164314-2 DUP		**L2345947-26**						
Phosphorus (P)		699	1020	DUP-H	mg/kg	38	30	19-SEP-19
Potassium (K)		1660	2500	DUP-H	mg/kg	40	40	19-SEP-19
Selenium (Se)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	19-SEP-19
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	19-SEP-19
Sodium (Na)		1600	2320		mg/kg	37	40	19-SEP-19
Strontium (Sr)		35.7	53.1		mg/kg	39	40	19-SEP-19
Sulfur (S)		<1000	<1000	RPD-NA	mg/kg	N/A	30	19-SEP-19
Thallium (Tl)		0.068	0.096	J	mg/kg	0.027	0.1	19-SEP-19
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	19-SEP-19
Titanium (Ti)		561	742		mg/kg	28	40	19-SEP-19
Tungsten (W)		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	19-SEP-19
Uranium (U)		0.616	0.795		mg/kg	25	30	19-SEP-19
Vanadium (V)		25.1	33.7		mg/kg	29	30	19-SEP-19
Zinc (Zn)		48.9	70.4	DUP-H	mg/kg	36	30	19-SEP-19
Zirconium (Zr)		1.6	1.9		mg/kg	20	30	19-SEP-19
WG3164314-3 LCS								
Aluminum (Al)			97.2		%		80-120	19-SEP-19
Antimony (Sb)			105.0		%		80-120	19-SEP-19
Arsenic (As)			99.8		%		80-120	19-SEP-19
Barium (Ba)			102.9		%		80-120	19-SEP-19
Beryllium (Be)			100.6		%		80-120	19-SEP-19
Bismuth (Bi)			100.0		%		80-120	19-SEP-19
Boron (B)			99.8		%		80-120	19-SEP-19
Cadmium (Cd)			99.0		%		80-120	19-SEP-19
Calcium (Ca)			98.0		%		80-120	19-SEP-19
Chromium (Cr)			100.3		%		80-120	19-SEP-19
Cobalt (Co)			99.4		%		80-120	19-SEP-19
Copper (Cu)			98.7		%		80-120	19-SEP-19
Iron (Fe)			100.9		%		80-120	19-SEP-19
Lead (Pb)			102.7		%		80-120	19-SEP-19
Lithium (Li)			99.6		%		80-120	19-SEP-19
Magnesium (Mg)			105.7		%		80-120	19-SEP-19
Manganese (Mn)			99.7		%		80-120	19-SEP-19

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4822972								
WG3164314-3 LCS								
Molybdenum (Mo)			101.7		%		80-120	19-SEP-19
Nickel (Ni)			100.0		%		80-120	19-SEP-19
Phosphorus (P)			100.2		%		80-120	19-SEP-19
Potassium (K)			100.5		%		80-120	19-SEP-19
Selenium (Se)			101.3		%		80-120	19-SEP-19
Silver (Ag)			96.9		%		80-120	19-SEP-19
Sodium (Na)			101.8		%		80-120	19-SEP-19
Strontium (Sr)			101.0		%		80-120	19-SEP-19
Sulfur (S)			102.9		%		80-120	19-SEP-19
Thallium (Tl)			100.2		%		80-120	19-SEP-19
Tin (Sn)			101.1		%		80-120	19-SEP-19
Titanium (Ti)			96.9		%		80-120	19-SEP-19
Tungsten (W)			103.5		%		80-120	19-SEP-19
Uranium (U)			99.4		%		80-120	19-SEP-19
Vanadium (V)			100.9		%		80-120	19-SEP-19
Zinc (Zn)			97.7		%		80-120	19-SEP-19
Zirconium (Zr)			95.9		%		70-130	19-SEP-19
WG3164314-1 MB								
Aluminum (Al)			<50		mg/kg		50	19-SEP-19
Antimony (Sb)			<0.10		mg/kg		0.1	19-SEP-19
Arsenic (As)			<0.10		mg/kg		0.1	19-SEP-19
Barium (Ba)			<0.50		mg/kg		0.5	19-SEP-19
Beryllium (Be)			<0.10		mg/kg		0.1	19-SEP-19
Bismuth (Bi)			<0.20		mg/kg		0.2	19-SEP-19
Boron (B)			<5.0		mg/kg		5	19-SEP-19
Cadmium (Cd)			<0.020		mg/kg		0.02	19-SEP-19
Calcium (Ca)			<50		mg/kg		50	19-SEP-19
Chromium (Cr)			<0.50		mg/kg		0.5	19-SEP-19
Cobalt (Co)			<0.10		mg/kg		0.1	19-SEP-19
Copper (Cu)			<0.50		mg/kg		0.5	19-SEP-19
Iron (Fe)			<50		mg/kg		50	19-SEP-19
Lead (Pb)			<0.50		mg/kg		0.5	19-SEP-19
Lithium (Li)			<2.0		mg/kg		2	19-SEP-19
Magnesium (Mg)			<20		mg/kg		20	19-SEP-19

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R4822972								
WG3164314-1 MB								
Manganese (Mn)			<1.0		mg/kg		1	19-SEP-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	19-SEP-19
Nickel (Ni)			<0.50		mg/kg		0.5	19-SEP-19
Phosphorus (P)			<50		mg/kg		50	19-SEP-19
Potassium (K)			<100		mg/kg		100	19-SEP-19
Selenium (Se)			<0.20		mg/kg		0.2	19-SEP-19
Silver (Ag)			<0.10		mg/kg		0.1	19-SEP-19
Sodium (Na)			<50		mg/kg		50	19-SEP-19
Strontium (Sr)			<0.50		mg/kg		0.5	19-SEP-19
Sulfur (S)			<1000		mg/kg		1000	19-SEP-19
Thallium (Tl)			<0.050		mg/kg		0.05	19-SEP-19
Tin (Sn)			<2.0		mg/kg		2	19-SEP-19
Titanium (Ti)			<1.0		mg/kg		1	19-SEP-19
Tungsten (W)			<0.50		mg/kg		0.5	19-SEP-19
Uranium (U)			<0.050		mg/kg		0.05	19-SEP-19
Vanadium (V)			<0.20		mg/kg		0.2	19-SEP-19
Zinc (Zn)			<2.0		mg/kg		2	19-SEP-19
Zirconium (Zr)			<1.0		mg/kg		1	19-SEP-19
N-TOTKJ-COL-SK	**Soil**							
Batch R4848372								
WG3171264-1 DUP		**L2343814-5**						
Total Kjeldahl Nitrogen		0.082	0.080		%	2.4	20	26-SEP-19
WG3171264-2 IRM		**08-109_SOIL**						
Total Kjeldahl Nitrogen			108.1		%		80-120	26-SEP-19
WG3171264-3 LCS								
Total Kjeldahl Nitrogen			98.6		%		80-120	26-SEP-19
WG3171264-4 MB								
Total Kjeldahl Nitrogen			<0.020		%		0.02	26-SEP-19
Batch R4850189								
WG3171270-1 DUP		**L2338679-22**						
Total Kjeldahl Nitrogen		0.80	0.80		%	0.1	20	28-SEP-19
WG3171270-2 IRM		**08-109_SOIL**						
Total Kjeldahl Nitrogen			96.8		%		80-120	28-SEP-19
WG3171270-3 LCS								
Total Kjeldahl Nitrogen			92.6		%		80-120	28-SEP-19

Quality Control Report

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N-TOTKJ-COL-SK	**Soil**							
Batch R4850189								
WG3171270-4 MB								
Total Kjeldahl Nitrogen			<0.020		%		0.02	28-SEP-19
PH-1:2-VA	**Soil**							
Batch R4815990								
WG3163305-2 DUP		**L2343814-1**						
pH (1:2 soil:water)		8.07	8.11	J	pH	0.04	0.2	17-SEP-19
Batch R4823270								
WG3164314-2 DUP		**L2345947-26**						
pH (1:2 soil:water)		8.26	8.21	J	pH	0.05	0.2	19-SEP-19
PSA-PIPET+GRAVEL-SK	**Soil**							
Batch R4819875								
WG3161969-1 DUP		**L2343814-7**						
% Gravel (>2mm)		6.1	6.1	J	%	0.0	5	18-SEP-19
% Sand (2.0mm - 0.063mm)		60.4	58.7	J	%	1.6	5	18-SEP-19
% Silt (0.063mm - 4um)		28.3	30.0	J	%	1.7	5	18-SEP-19
% Clay (<4um)		5.2	5.1	J	%	0.1	5	18-SEP-19
WG3161969-2 IRM		**2017-PSA**						
% Sand (2.0mm - 0.063mm)			45.3		%		39.1-49.1	18-SEP-19
% Silt (0.063mm - 4um)			37.1		%		32.5-42.5	18-SEP-19
% Clay (<4um)			17.6		%		13.4-23.4	18-SEP-19

Quality Control Report

Workorder: L2343814 Report Date: 11-MAR-20

Client: MINNOW ENVIRONMENTAL INC.
204-1006 Fort Street
Victoria BC V8T 2A2
Contact: Lisa Bowron

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

L2343814-COFC

COC # _____

Page 1 of 2

Sediment

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	☑ Standard ☐ Other		◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	☑ PDF ☑ Excel ☐ Digital ☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	~~101 - 1028 Hillside Ave.~~ 204 - 1006 Fort Street	Email 1: lbowron@minnow.ca		○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2: pstecko@minnow.ca		○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		
Invoice To	Same as Report ? ☐ Yes ☑ No	Client / Project Information		Analysis Request
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Minnow Project 19-51		Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	Minto Explorations Ltd	PO / AFE:		
Contact:	~~Cindy Keeling~~ Bill Woods	LSD:		
Address:	~~Suite 2100-510 West Georgia Street, Vancouver, BC~~ Whitehorse, YT Y1A 5X9			
Phone:	~~604-684-6004~~ 867-929-1874 Fax: ~~604-688-2180~~	Quote #: ~~Q5527~~ ~~Q5510~~ Q75875		

Lab Work Order # (lab use only)		ALS Contact: Jerry Holzbecher	Sampler: Lisa Bowron

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote #~~Q5527~~ Q75875			Number of Containers
	UMC-1-M	05/09/19	11:10	Sediment	X	X	X	X	X	X		X	X	X			1
	UMC-2-M	05/09/19	10:45		X	X	X	X	X	X		X	X	X			1
	UMC-3-M	04/09/19	18:05		X	X	X	X	X	X		X	X	X			1
	UMC-4-M	04/09/19	17:40		X	X	X	X	X	X		X	X	X			1
	UMC-5-M	04/09/19	17:15		X	X	X	X	X	X		X	X	X			1
	UMC-X-M	05/09/19	11:10		X	X	X	X	X	X		X	X	X			1
	UMC-5	05/09/19	11:10		X						X			X			1
	URC-1-M	06/09/19	10:20		X	X	X	X	X	X		X	X	X			1
	URC-2-M	06/09/19	10:00		X	X	X	X	X	X		X	X	X			1
	URC-3-M	06/09/19	9:50		X	X	X	X	X	X		X	X	X			1
	URC-4-M	06/09/19	9:30		X	X	X	X	X	X		X	X	X			1
	URC-5-M	06/09/19	9:00		X	X	X	X	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

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

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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
				Sept 09 2019	3:30 PM	3.8, 7.8°C				

7.1, 4.0

GENF 20.00 Front

ALS Environmental

L2343814-COFC

COC #

Sediment

Page 2 of 2

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	☑ Standard ☐ Other		◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	☑ PDF ☑ Excel ☐ Digital ☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	~~104-1925 Hillside Ave.~~ 204 - 1006 Fort Street	Email 1: lbowron@minnow.ca		○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2: pstecko@minnow.ca		○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		
Invoice To	Same as Report ? ☐ Yes ☑ No	Client / Project Information		Analysis Request
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Minnow Project 19-51		Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	Minto Explorations Ltd PO Box 11	PO / AFE:		
Contact:	~~Cindy Keehn~~ Bill Woods Whitehorse, YT	LSD:		
Address:	~~Suite 2100-510 West Georgia Street, Vancouver, BC V7A~~			
Phone:	~~604-682-8294~~ 780-929-1874 Fax: ~~604-682-8760~~ 5X9	Quote #: ~~Q51827~~ ~~Q59886~~ Q75875		

Lab Work Order # (lab use only)		ALS Contact: Jerry Holzbecher	Sampler: Lisa Bowron

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote # ~~Q51827~~ Q75875			Number of Containers
	URC-5	06/09/19	10:20	Sediment							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

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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: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

GENF 20.00 Front

Sample Receipt Confirmation

Report Distribution:

Company Name: MINNOW ENVIRONMENTAL INC.
Contact: Lisa Bowron
Address: 204-1006 Fort Street,
Victoria, BC, V8T 2A2
Phone: 250-595-1627
Fax: 250-595-1625
Email: lbowron@minnow.ca
pstecko@minnow.ca
EDD Email: --
Distribution: Hard Copy: N Email: Y Fax: N EDD: N

Invoice Distribution:

Acct Name: Minto Explorations Ltd.
Contact: Accounts Payable
Address: MINTO EXPLORATION LTD., PO Box 33174
Whitehorse, YK, Y1A 6S1
Phone: 604-759-0860
Fax: 604-759-0861
Invoice Email: jamess@mintomine.com
ap@mintomine.com
Project #: MEI125-MIN200
Account #: MIN200

Client Information:

Job Reference #: MINNOW PROJECT 19-51
Project PO #:
Legal Site Description: N/A
Quote #: Q75875
Date Sampled: 04-SEP-19
Date Received: 09-SEP-19
Sampled By: Lisa Bowron
Chain Of Custody: --

Workorder Summary:

Lab Work Order #: **L2343814**
Estimated completion date: 19-SEP-19
13 Samples received at ALS in **VANCOUVER**
Client Job #: MINNOW PROJECT 19-51
Account Manager: Can Dang
Estimated sample disposal date: See Sample Disposal Information section below.

Lab Sample ID	Client Sample ID	Date Sampled	Date Received	Sample Due Date	Priority Flag	Sample Type
L2343814-1	UMC-1-M	05-SEP-19 11:10	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-2	UMC-2-M	05-SEP-19 10:45	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-3	UMC-3-M	04-SEP-19 18:05	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-4	UMC-4-M	04-SEP-19 17:40	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-5	UMC-5-M	04-SEP-19 17:15	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-6	UMC-X-M	05-SEP-19 11:10	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-7	UMC-5	05-SEP-19 11:10	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-8	URC-1-M	06-SEP-19 10:20	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-9	URC-2-M	06-SEP-19 10:00	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-10	URC-3-M	06-SEP-19 09:50	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-11	URC-4-M	06-SEP-19 09:30	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-12	URC-5-M	06-SEP-19 09:00	09-SEP-19 16:21	19-SEP-19		Sediment
L2343814-13	URC-5	06-SEP-19 10:20	09-SEP-19 16:21	19-SEP-19		Sediment

Analysis Requested :	Total Carbon, TOC and TIC in soil	Loss on Ignition @ 420 C	Metals in Soil [CCME] with Extra Metals	Total Kjeldahl Nitrogen	pH in Soil [1:2 Soil:Water Extraction]	Dry and Grind	Particle size - Sieve and Pipette	Sample Handling and Disposal Fee
UMC-1-M	✓	✓	✓	✓	✓	✓		✓
UMC-2-M	✓	✓	✓	✓	✓	✓		✓
UMC-3-M	✓	✓	✓	✓	✓	✓		✓
UMC-4-M	✓	✓	✓	✓	✓	✓		✓
UMC-5-M	✓	✓	✓	✓	✓	✓		✓
UMC-X-M	✓	✓	✓	✓	✓	✓		✓
UMC-5						✓	✓	✓
URC-1-M	✓	✓	✓	✓	✓	✓		✓
URC-2-M	✓	✓	✓	✓	✓	✓		✓
URC-3-M	✓	✓	✓	✓	✓	✓		✓
URC-4-M	✓	✓	✓	✓	✓	✓		✓
URC-5-M	✓	✓	✓	✓	✓	✓		✓
URC-5						✓	✓	✓

Sample Integrity Observations: No observations were identified for this work order submission.

Notice of Sub-contract Laboratory Service

Please be advised that the following tests will be subcontracted to the corresponding laboratory:

Total Organic Carbon Calculation subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
Inorganic Carbon as CaCO3 Equivalent subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
Particle size - Sieve and Pipette subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
Total Inorganic Carbon in Soil subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
Total Carbon by combustion method subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
Total Kjeldahl Nitrogen subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
Loss on Ignition @ 420 C subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
Dry and Grind subcontracted to: ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Please contact your Account Manager immediately should you have questions or concerns regarding this arrangement. Approval of this arrangement shall be implied unless otherwise notified by you.

Sample Disposal Information:

Where possible, ALS will store samples for the following durations, measured from date of sample submission: 45 days for Soil and Water samples; 6 months for Tissue/Biota samples; 14 days for air samples collected on re-usable media; and 3 days for water samples submitted for microbiological testing. Longer storage times are available upon request.

For information about ALS accreditations and certifications please contact your Account Manager or visit our webpage at www.alsglobal.com (see Canada downloads).

ALS Group strives to deliver on-time results to our clients at all times. However, there are times when due to capacity issues or other unforeseen circumstances we are unable to meet our expected turnaround times. The information above is related to a recent workorder you have submitted to our laboratory. In the event that you have an inquiry, please refer to the Lab Work Order # when calling your Account Manager.

ALS Group appreciates your business. Thank you for the opportunity to work with you.

ALS Environmental

L2343814-COFC

COC # _____

Page 1 of 2

Sediment

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	☑ Standard ☐ Other		◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	☑ PDF ☑ Excel ☐ Digital ☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	~~101 - 1028 Hillside Ave.~~ 204 - 1006 Fort Street	Email 1: lbowron@minnow.ca		○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2: pstecko@minnow.ca		○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		
Invoice To	Same as Report ? ☐ Yes ☑ No	Client / Project Information		Analysis Request
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Minnow Project 19-51		Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	Minto Explorations Ltd	PO / AFE:		
Contact:	~~Cindy Keeling~~ Bill Woods	LSD:		
Address:	~~Suite 2100-510 West Georgia Street, Vancouver, BC~~ Whitehorse, YT Y1A 5X9			
Phone:	~~604-684-6004~~ 867-929-1874 Fax: ~~604-688-2180~~	Quote #: ~~Q5527~~ ~~Q5510~~ Q75875		

Lab Work Order # (lab use only)		ALS Contact: Jerry Holzbecher	Sampler: Lisa Bowron

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote #~~Q5527~~ Q75875			Number of Containers
	UMC-1-M	05/09/19	11:10	Sediment	X	X	X	X	X	X		X	X	X			1
	UMC-2-M	05/09/19	10:45		X	X	X	X	X	X		X	X	X			1
	UMC-3-M	04/09/19	18:05		X	X	X	X	X	X		X	X	X			1
	UMC-4-M	04/09/19	17:40		X	X	X	X	X	X		X	X	X			1
	UMC-5-M	04/09/19	17:15		X	X	X	X	X	X		X	X	X			1
	UMC-X-M	05/09/19	11:10		X	X	X	X	X	X		X	X	X			1
	UMC-5	05/09/19	11:10		X						X			X			1
	URC-1-M	06/09/19	10:20		X	X	X	X	X	X		X	X	X			1
	URC-2-M	06/09/19	10:00		X	X	X	X	X	X		X	X	X			1
	URC-3-M	06/09/19	9:50		X	X	X	X	X	X		X	X	X			1
	URC-4-M	06/09/19	9:30		X	X	X	X	X	X		X	X	X			1
	URC-5-M	06/09/19	9:00		X	X	X	X	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

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				Sept 09 2019	3:30 PM	3.8, 7.8°C				

7.1, 4.0

GENF 20.00 Front

ALS Environmental

L2343814-COFC

COC #

Sediment

Page 2 of 2

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
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Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		
Invoice To	Same as Report ? ☐ Yes ☑ No	Client / Project Information		Analysis Request
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Minnow Project 19-51		Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	Minto Explorations Ltd PO Box 11	PO / AFE:		
Contact:	~~Cindy Keehn~~ Bill Woods Whitehorse, YT	LSD:		
Address:	~~Suite 2100-510 West Georgia Street, Vancouver, BC V7A~~			
Phone:	~~604-682-8294~~ 780-929-1874 Fax: ~~604-682-8760~~ 5X9	Quote #: ~~Q51827~~ ~~Q59886~~ Q75875		

Lab Work Order # (lab use only)		ALS Contact: Jerry Holzbecher	Sampler: Lisa Bowron

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Rescan Low Level Sediments	Inorganic Carbon	Total Carbon by combustion	Mercury by CVAFS	Loss on Ignition	pH in soil	Particle Size	Total Organic Carbon	Total Kjeldahl Nitrogen	**See Complete Quote # ~~Q51827~~ Q75875			Number of Containers
	URC-5	06/09/19	10:20	Sediment							X			X			1

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Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

GENF 20.00 Front

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343815-1	L2343815-2	L2343815-3	L2343815-4	
Description	Water	Water	Water	Water	
Sampled Date	06-SEP-19	08-SEP-19	08-SEP-19	08-SEP-19	
Sampled Time	10:45	15:00	15:00	15:00	
Client ID	URC	UMC	DUP	FB	
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)	254	570	564	<2.0	
Hardness (as CaCO3) (mg/L)	120	277	277	<0.50	
pH (pH)	8.22	8.50	8.49	5.39	
Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	
Total Dissolved Solids (mg/L)	155	363	365	<10	
Turbidity (NTU)	0.37	0.10	0.13	<0.10	
Anions and Nutrients Alkalinity, Total (as CaCO3) (mg/L)	115	307	291	<1.0	
Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
Chloride (Cl) (mg/L)	<0.50	4.93	4.91	<0.50	
Fluoride (F) (mg/L)	0.479	0.532	0.540	<0.020	
Nitrate (as N) (mg/L)	0.0950	0.0529	0.0526	<0.0050	
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
Phosphorus (P)-Total Dissolved (mg/L)	0.0081	0.0043	0.0053	<0.0020	
Phosphorus (P)-Total (mg/L)	0.0100	0.0052	0.0049	<0.0020	
Sulfate (SO4) (mg/L)	20.2	54.4	54.4	<0.30	
Cyanides Cyanide, Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	5.49	5.42	5.47	<0.50	
Total Inorganic Carbon (mg/L)	27.0	62.1	63.5	<0.50	
Total Organic Carbon (mg/L)	5.86	5.91	5.92	<0.50	
Total Metals Aluminum (Al)-Total (mg/L)	0.0098	0.0765	0.0079	<0.0030	
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Arsenic (As)-Total (mg/L)	0.00035	0.00029	0.00027	<0.00010	
Barium (Ba)-Total (mg/L)	0.0393	0.0713	0.0647	<0.00010	
Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
Boron (B)-Total (mg/L)	<0.010	0.025	0.026	<0.010	
Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.000015 DLM	<0.000010 DLM	<0.0000050	
Calcium (Ca)-Total (mg/L)	33.7	63.6	62.4	<0.050	
Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Chromium (Cr)-Total (mg/L)	0.00020	0.00024	0.00013	<0.00010	
Cobalt (Co)-Total (mg/L)	<0.00010	0.00011	<0.00010	<0.00010	
Copper (Cu)-Total (mg/L)	<0.00050	0.00388	0.00256	<0.00050	
Iron (Fe)-Total (mg/L)	0.146	0.132	0.019	<0.010	
Lead (Pb)-Total (mg/L)	<0.000050	0.000054	<0.000050	<0.000050	
Lithium (Li)-Total (mg/L)	<0.0010	0.0035	0.0036	<0.0010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343815-1	L2343815-2	L2343815-3	L2343815-4	
Description	Water	Water	Water	Water	
Sampled Date	06-SEP-19	08-SEP-19	08-SEP-19	08-SEP-19	
Sampled Time	10:45	15:00	15:00	15:00	
Client ID	URC	UMC	DUP	FB	
Grouping / **Analyte**					
WATER					
Total Metals Magnesium (Mg)-Total (mg/L)	9.54	29.9	30.0	<0.0050	
Manganese (Mn)-Total (mg/L)	0.0314	0.0567	0.0342	<0.00010	
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Total (mg/L)	0.00250	0.00587	0.00600	<0.000050	
Nickel (Ni)-Total (mg/L)	<0.00050	0.00100	0.00091	<0.00050	
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Total (mg/L)	0.806	2.38	2.39	<0.050	
Rubidium (Rb)-Total (mg/L)	<0.00020	0.00034	0.00025	<0.00020	
Selenium (Se)-Total (mg/L)	0.000734	0.000308	0.000271	<0.000050	
Silicon (Si)-Total (mg/L)	6.08	6.90	6.69	<0.10	
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Total (mg/L)	6.16	20.6	20.5	<0.050	
Strontium (Sr)-Total (mg/L)	0.237	0.843	0.844	<0.00020	
Sulfur (S)-Total (mg/L)	7.52	20.7	20.7	<0.50	
Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Tin (Sn)-Total (mg/L)	0.00012	<0.00010	<0.00010	<0.00010	
Titanium (Ti)-Total (mg/L)	0.00045	<0.0060 DLM	<0.00030	<0.00030	
Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Uranium (U)-Total (mg/L)	0.00108	0.00302	0.00305	<0.000010	
Vanadium (V)-Total (mg/L)	0.00069	0.00083	0.00061	<0.00050	
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
Zirconium (Zr)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
Aluminum (Al)-Dissolved (mg/L)	0.0045	0.0011	0.0014	<0.0010	
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Arsenic (As)-Dissolved (mg/L)	0.00028	0.00021	0.00022	<0.00010	
Barium (Ba)-Dissolved (mg/L)	0.0378	0.0668	0.0676	<0.00010	
Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
Boron (B)-Dissolved (mg/L)	<0.010	0.023	0.024	<0.010	
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Calcium (Ca)-Dissolved (mg/L)	32.2	62.1	62.1	<0.050	
Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Chromium (Cr)-Dissolved (mg/L)	0.00020	0.00011	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343815-1	L2343815-2	L2343815-3	L2343815-4	
Description	Water	Water	Water	Water	
Sampled Date	06-SEP-19	08-SEP-19	08-SEP-19	08-SEP-19	
Sampled Time	10:45	15:00	15:00	15:00	
Client ID	URC	UMC	DUP	FB	
Grouping / **Analyte**					
WATER					
Dissolved Metals Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Copper (Cu)-Dissolved (mg/L)	0.00044	0.00231	0.00218	<0.00020	
Iron (Fe)-Dissolved (mg/L)	0.093	<0.010	<0.010	<0.010	
Lead (Pb)-Dissolved (mg/L)	0.000069	<0.000050	<0.000050	<0.000050	
Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0031	0.0033	<0.0010	
Magnesium (Mg)-Dissolved (mg/L)	9.59	29.5	29.6	<0.0050	
Manganese (Mn)-Dissolved (mg/L)	0.0287	0.0317	0.0314	<0.00010	
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved (mg/L)	0.00241	0.00562	0.00573	<0.000050	
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00092	0.00095	<0.00050	
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved (mg/L)	0.793	2.42	2.39	<0.050	
Rubidium (Rb)-Dissolved (mg/L)	<0.00020	0.00025	0.00028	<0.00020	
Selenium (Se)-Dissolved (mg/L)	0.000640	0.000293	0.000269	<0.000050	
Silicon (Si)-Dissolved (mg/L)	5.50	6.05	5.96	<0.050	
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 DLM	<0.000010	<0.000010	
Sodium (Na)-Dissolved (mg/L)	6.24	18.7	19.1	<0.050	
Strontium (Sr)-Dissolved (mg/L)	0.248	0.858	0.859	<0.00020	
Sulfur (S)-Dissolved (mg/L)	6.74	17.6	18.0	<0.50	
Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Uranium (U)-Dissolved (mg/L)	0.00111	0.00299	0.00307	<0.000010	
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
Zirconium (Zr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	

* 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	Total Inorganic Carbon	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2343815-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2343815-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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-WR	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.

CARBONS-TIC-VA	Water	Total inorganic carbon by CO2 purge	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

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-WR	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 CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

Reference Information

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.

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.

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-WR	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-WR	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.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-PRES-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

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-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

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.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

L2343815-COFC

COC # _____

Page ___ of ___

Water

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	☑ Standard ☐ Other		○ Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	☑ PDF ☑ Excel ☐ Digital ☐ Fax		● Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	204-1006 Fort Street	Email 1: lbowron@minnow.ca		○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2: pstecko@minnow.ca		○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		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 #: Minnow Project 19-51		
Company:	Minto Explorations Ltd	PO / AFE:		
Contact:	Bill Woods	LSD:		
Address:	PO Box Whitehose, YT Y1A 5X9			
Phone:	780-929-1874 Fax:	Quote #: Q75875		
Lab Work Order # (lab use only)		ALS Contact: Can Dang	Sampler: Lisa Bowron	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals by CCMS & ICPOES	Mercury by CVAFS (Low)	Alkalinity by Auto Titration	Phosphorus in water by colour	Organic/Inorganic Carbon	Cyanide	Conductivity, Hardness and pH	TDS & TSS by Gravimetric	Turbidity by Meter	Anions by Ion Chromatography	Ammonia by Fluorescence	**See Complete Quote #Q75827	Number of Containers Q75875
	URC	06/09/19	10:45	Water	X	X	X	X	X	X	X	X	X	X	X	X	9
	UMC	06/09/19	15:00	"	X	X	X	X	X	X	X	X	X	X	X	X	9
	Dup	08/09/19	15:00	"	X	X	X	X	X	X	X	X	X	X	X	X	9
	FB	08/09/19	15:00	"	X	X	X	X	X	X	X	X	X	X	X	X	9

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

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
			FT	Sept 9 2019	3:30 PM	6.5 °C	HA	9/10	12pm	

6.7 5

GENF 20.00 Front

Sample Receipt Confirmation

Report Distribution:

Company Name: MINNOW ENVIRONMENTAL INC.
Contact: Lisa Bowron
Address: 101 - 1025 Hillside Ave.,
Victoria, BC, V8T 2A2
Phone: 250-595-1627
Fax: 250-595-1625
Email: lbowron@minnow.ca
pstecko@minnow.ca
EDD Email: --
Distribution: Hard Copy: N Email: Y Fax: N EDD: N

Invoice Distribution:

Acct Name: Minto Explorations Ltd.
Contact: Accounts Payable
Address: MINTO EXPLORATION LTD., PO Box 33174
Whitehorse, YK, Y1A 6S1
Phone: 604-759-0860
Fax: 604-759-0861
Invoice Email: jamess@mintomine.com
ap@mintomine.com
Project #: MEI125-MIN200
Account #: MIN200

Client Information:

Job Reference #: MINNOW PROJECT 19-51
Project PO #:
Legal Site Description: N/A
Quote #: Q75875
Date Sampled: 06-SEP-19
Date Received: 09-SEP-19
Sampled By: Lisa Bowrom
Chain Of Custody: --

Workorder Summary:

Lab Work Order #: **L2343815**
Estimated completion date: 12-SEP-19
4 Samples received at ALS in **VANCOUVER**
Client Job #: MINNOW PROJECT 19-51
Account Manager: Can Dang
Estimated sample disposal date: See Sample Disposal Information section below.

Lab Sample ID	Client Sample ID	Date Sampled	Date Received	Sample Due Date	Priority Flag	Sample Type
L2343815-1	URC	06-SEP-19 10:45	09-SEP-19 15:30	12-SEP-19	P	Water
L2343815-2	UCM	08-SEP-19 15:00	09-SEP-19 15:30	12-SEP-19	P	Water
L2343815-3	DUP	08-SEP-19 15:00	09-SEP-19 15:30	12-SEP-19	P	Water
L2343815-4	FB	08-SEP-19 15:00	09-SEP-19 15:30	12-SEP-19	P	Water

Analysis Requested:

	Total Alkalinity by Titration	Anions by Ion Chromatography	Dissolved organic carbon by combustion	Total inorganic carbon by CO2 purge	Total organic carbon by combustion	Total Cyanide in water by CFA	Conductivity [Automated]	Conductivity Screen [Internal Use Only]	Diss. Metals + Hg - CSR,CCME,BCAWQG,CDW	Total Metals + Hg - CSR,CCME,BCAWQG,CDW	Ammonia in Water by Fluorescence	Total P in Water by Colour	pH by Meter [Automated]	Total Dissolved Solids by Gravimetric	Total Suspended Solids by Gravimetric	Turbidity by Meter	Sample Handling and Disposal Fee
URC	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
UCM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DUP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Analysis Completion Date (if different than sample due date):

Analysis Requested	Matrix	Due Date	Lab Sample ID
Total Alkalinity by Titration	Water	17-SEP-19	L2343815-1, 2, 3, 4

Analysis Completion Date (if different than sample due date):

Analysis Requested	Matrix	Due Date	Lab Sample ID
Alkalinity Species by Titration	Water	17-SEP-19	L2343815-1, 2, 3, 4
Dissolved organic carbon by combu	Water	17-SEP-19	L2343815-1, 2, 3, 4
Total inorganic carbon by CO2 purg	Water	17-SEP-19	L2343815-1, 2, 3, 4
Total organic carbon by combustior	Water	17-SEP-19	L2343815-1, 2, 3, 4
Total Cyanide in water by CFA	Water	17-SEP-19	L2343815-1, 2, 3, 4
Conductivity (Automated)	Water	16-SEP-19	L2343815-1, 2, 3, 4
Conductivity Screen (Internal Use C	Water	16-SEP-19	L2343815-1, 2, 3, 4
Conductivity Screen (Internal Use C	Water	16-SEP-19	L2343815-1, 2, 3, 4
Hardness	Water	17-SEP-19	L2343815-1, 2, 3, 4
Diss. Mercury in Water by CVAAS (	Water	17-SEP-19	L2343815-1, 2, 3, 4
Total Mercury in Water by CVAAS (	Water	17-SEP-19	L2343815-1, 2, 3, 4
Dissolved Metals in Water by CRC	Water	17-SEP-19	L2343815-1, 2, 3, 4
Diss. Metals + Hg - CSR,CCME,BC	Water	17-SEP-19	L2343815-1, 2, 3, 4
Total Metals in Water by CRC ICPM	Water	17-SEP-19	L2343815-1, 2, 3, 4
Total Metals + Hg - CSR,CCME,BC	Water	17-SEP-19	L2343815-1, 2, 3, 4
Ammonia in Water by Fluorescence	Water	16-SEP-19	L2343815-1, 2, 3, 4
Total P in Water by Colour	Water	17-SEP-19	L2343815-1, 2, 3, 4
pH by Meter (Automated)	Water	16-SEP-19	L2343815-1, 2, 3, 4
Total Dissolved Solids by Gravimet	Water	16-SEP-19	L2343815-1, 2, 3, 4
Total Suspended Solids by Gravime	Water	16-SEP-19	L2343815-1, 2, 3, 4
Turbidity by Meter	Water	16-SEP-19	L2343815-1, 2, 3, 4

Hold Time Exceedences: The following samples have exceeded recommended holding times prior to sample receipt.

Analysis Requested	Lab Sample ID	Recommended Hold Time	Date Sampled	Date Received
Nitrate in Water by IC (Low Level)	L2343815-1	3 days	06-SEP-19	09-SEP-19
Nitrite in Water by IC (Low Level)	L2343815-1	3 days	06-SEP-19	09-SEP-19
Turbidity by Meter	L2343815-1	3 days	06-SEP-19	09-SEP-19
pH by Meter (Automated)	L2343815-1, 1	0.25 hours	06-SEP-19	09-SEP-19
pH by Meter (Automated)	L2343815-2, 2, 3, 3, 4, 4	0.25 hours	08-SEP-19	09-SEP-19

Sample Integrity Observations: No observations were identified for this work order submission.

Notice of Sub-contract Laboratory Service

Please be advised that the following tests will be subcontracted to the corresponding laboratory:

Nitrite in Water by IC (Low Level) subcontracted to: ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
Nitrate in Water by IC (Low Level) subcontracted to: ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
Sulfate in Water by IC subcontracted to: ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
Bromide in Water by IC (Low Level) subcontracted to: ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
Fluoride in Water by IC subcontracted to: ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
Chloride in Water by IC subcontracted to: ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA

Please contact your Account Manager immediately should you have questions or concerns regarding this arrangement. Approval of this arrangement shall be implied unless otherwise notified by you.

Sample Disposal Information:

Where possible, ALS will store samples for the following durations, measured from date of sample submission: 45 days for Soil and Water samples; 6 months for Tissue/Biota samples; 14 days for air samples collected on re-usable media; and 3 days for water samples submitted for microbiological testing. Longer storage times are available upon request.

For information about ALS accreditations and certifications please contact your Account Manager or visit our webpage at www.alsglobal.com (see Canada downloads).

ALS Group strives to deliver on-time results to our clients at all times. However, there are times when due to capacity issues or other unforeseen circumstances we are unable to meet our expected turnaround times. The information above is related to a recent workorder you have submitted to our laboratory. In the event that you have an inquiry, please refer to the Lab Work Order # when calling your Account Manager.

ALS Group appreciates your business. Thank you for the opportunity to work with you.

ALS Environmental

L2343815-COFC

COC # _____

Page ___ of ___

Water

Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Minnow Environmental Inc.	☑ Standard ☐ Other		○ Regular (Standard Turnaround Times - Business Days)
Contact:	Lisa Bowron	☑ PDF ☑ Excel ☐ Digital ☐ Fax		● Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	204-1006 Fort Street	Email 1: lbowron@minnow.ca		○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Victoria, BC	Email 2: pstecko@minnow.ca		○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	(250)595-1627 x21 Fax: (250) 595-1625	Email 3:		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 #: Minnow Project 19-51		
Company:	Minto Explorations Ltd	PO / AFE:		
Contact:	Bill Woods	LSD:		
Address:	PO Box Whitehose, YT Y1A 5X9			
Phone:	780-929-1874 Fax:	Quote #: Q75875		
Lab Work Order # (lab use only)		ALS Contact: Can Dang	Sampler: Lisa Bowron	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Metals by CCMS & ICPOES	Mercury by CVAFS (Low)	Alkalinity by Auto Titration	Phosphorus in water by colour	Organic/Inorganic Carbon	Cyanide	Conductivity, Hardness and pH	TDS & TSS by Gravimetric	Turbidity by Meter	Anions by Ion Chromatography	Ammonia by Fluorescence	**See Complete Quote #Q75827	Number of Containers Q75875
	URC	06/09/19	10:45	Water	X	X	X	X	X	X	X	X	X	X	X	X	9
	UMC	06/09/19	15:00	"	X	X	X	X	X	X	X	X	X	X	X	X	9
	Dup	08/09/19	15:00	"	X	X	X	X	X	X	X	X	X	X	X	X	9
	FB	08/09/19	15:00	"	X	X	X	X	X	X	X	X	X	X	X	X	9

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Small samples. The critical analyte of interest is selenium; please ensure best possible MDLs.

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
			FT	Sept 9 2019	3:30 PM	6.5 °C	HA	9/10	12pm	

6.7 5

GENF 20.00 Front

minnow environmental inc. — A Trinity Consultants Company

Stream / River Habitat Characterization

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date/Time: Sept 5/19
Waterbody: 10120
Easting: 08V 0387057
Northing: 6945823

Project Name/Number: Minto WUL - 19-51
Field Crew: ~~EB~~ VM, Dawn
Station Identifier: UMC-3
Map Datum (NAD): 83

GENERAL CHARACTERISTICS (map/diagram below)

Length of Reach Assessed (m): 15

Gradient (%): ~~Mean~~ 3%
Depth (cm): ~~Mean~~ Mean of 5, 6, 4.5, 3, 10 9
Width (m): Wetted 1.3 Bankfull 3.0
General Morphology: % Pool/Pond 20 % Riffle 20 % Run 60

Comments
Maximum 16
Water Appearance (colour/clarity): clear, no colour

Geomorphic Type (Circle One, Legend on Reverse): Aa+ A (B) C D E F G

Bank Condition (Circle One): Unstable - Substantial Bank Erosion — (Moderate) — Stable - no Bank Erosion

Substrate (% coverage) % Bedrock – % Boulder ~~10~~ 10 % Cobble 10 % Gravel 20
% Sand & finer 60 Comments:

Instream Cover (% of total Surface): Undercut Banks 10 Boulder ___ Woody Debris 50
Deep Pool ___ Macrophytes ___ Other ___

Residual (Refuge) Pool Depth (cm): 10 Other in-stream features (e.g., falls, beaver dams): lots of leaf debris

Overhead Canopy (% Surface): Dense 60 Partially Open 20 Open 20

Riparian vegetation types (list in approximate order of descending dominance): alder, moss,

Aquatic Vegetation (% areal coverage and dominant species):

Emergent:	% area –	species	
Submergent:	% area –	species	
Floating:	% area –	species	
Attached Algae:	% area 10	species	

Surrounding Land Use: forest

Evidence of anthropogenic disturbances or any factors that may affect physical or chemical quality (specify)? Mine rds

Weather Notes (rain): partial cloud.

☑ Photographs (upstream, downstream, across, etc.), noted in Photolog:

☑ Field Water Quality (on benthic):

☑ Water Sample Collected Sample ID: UMC

☑ Duplicate Sample Collected Sample ID: DUP

☑ Field Blank Sample Collected Sample ID: FB

Signature: ___

Date 8-Sep-19

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Stream / River Habitat Characterization

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date: Sept 6/19
Time: 10:45
Easting: 08V 038 2999
Northing: 6949963

Project Name/Number: Minto WUL - 19-51
Field Crew: LB KM, Dawn
Waterbody: Upper McGinty
Station Identifier: URC-5
Map Datum (NAD): 15 83

GENERAL CHARACTERISTICS (map/diagram below)

Length of Reach Assessed (m): _____

Gradient (%): ~~Mean~~ 2
Comments: _____

Depth (cm): Mean _____ ~~Mean~~ 5 reps: 9, 5, 5, 21, 20
Maximum 25

Width (m): Wetted 1.1 Bankfull 1.1 Water Appearance (colour/clarity): clear

General Morphology: % Pool/Pond 70 % Riffle 20 % Run 10

Geomorphic Type (Circle One, Legend on Reverse): Aa+ A (B) C D E F G

Bank Condition (Circle One): Unstable - Substantial Bank Erosion (Moderate) Stable - no Bank Erosion

Substrate (% coverage) % Bedrock _____ % Boulder _____ % Cobble _____ % Gravel 10

% Sand & finer 90 Comments: _____

Instream Cover (% of total Surface): Undercut Banks 50 Boulder _____ Woody Debris 30

Deep Pool _____ Macrophytes _____ Other _____

Residual (Refuge) Pool Depth (cm): 20 Other in-stream features (e.g., falls, beaver dams): flocalent in some areas

Overhead Canopy (% Surface): Dense 100 Partially Open _____ Open _____

Riparian vegetation types (list in approximate order of descending dominance): alder, spruce

Aquatic Vegetation (% areal coverage and dominant species):

Emergent: % area – species _____

Submergent: % area – species _____

Floating: % area – species _____

Attached Algae: % area – species _____

Surrounding Land Use: forest

Evidence of anthropogenic disturbances or any factors that may affect physical or chemical quality (specify)? none

Weather Notes (rain): _____

☑ Photographs (upstream, downstream, across, etc.), noted in Photolog:

☑ Field Water Quality (on benthic):

Date

☑ Water Sample Collected Sample ID: URC

☐ Duplicate Sample Collected Sample ID: _____ Signature: _____

☐ Field Blank Sample Collected Sample ID: _____

Sediment Sampling by Spoon Field Sheet

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date: Sept 4, 2019
Time: 17:15
Easting: 08V 0387126
Northing: 6945870
Weather: clear

Project Name/Number: Minto WUL - 19-51
Field Crew: ~~EB~~ KM, Dawn
Waterbody: Upper Minto Cr
Station Identifier: UMC-5-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID:

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate collected? Y (N)

WATER QUALITY MEASURES

Temperature (°C): 3.5
DO (mg/L): 11.12
Conductivity (uS/cm): 336.3

pH (pH units): 8.15
DO (% sat): 79.5
Specific Conductivity (uS/cm): 571.1

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: fine sand
Colour: dark brown
Organics Present (Plants/Algae): algae on surface

Date: Sept 4/2019
Time: 17:40
Easting: 08V 0387090
Northing: 6945851
Weather: clear

Field Crew: ~~EB~~ KM, Dawn
Waterbody: Upper Minto Cr
Station Identifier: UMC-4-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID:

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected: Y (N)

WATER QUALITY MEASURES

Temperature (°C): 3.9
DO (mg/L): 12.51
Conductivity (uS/cm): 327.6

pH (pH units): 8.16
DO (% sat): 90.5
Specific Conductivity (uS/cm): 548.5

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: fine sand
Colour: dark brown
Organics Present (Plants/Algae): lots of leaf debris

Signature:

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Sediment Sampling by Spoon Field Sheet

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date: Sept 4/2019
Time: 18:05
Easting: 08V 0387057
Northing: 6945625
Weather: Clear

Project Name/Number: Minto WUL - 19-51
Field Crew: ~~KB~~ KM, Dawn
Waterbody: Upper Minto Cr
Station Identifier: UMC-3-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID: _____

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected? Y (N)

WATER QUALITY MEASURES

Temperature (°C): 3.98
DO (mg/L): 13.00
Conductivity (uS/cm): 339.2

pH (pH units): 8.24
DO (% sat): 98.3
Specific Conductivity (uS/cm): 570.2

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: fine sand
Colour: dark brown
Organics Present (Plants/Algae): leaf debris

Date: Sept 5/19
Time: 10:45
Easting: 08V 0387040
Northing: 6945816
Weather: cloudy

Field Crew: ~~KB~~ KM, Dawn
Waterbody: Upper Minto Cr
Station Identifier: UMC-2-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID: _____

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected. Y N

WATER QUALITY MEASURES

Temperature (°C): 1.7
DO (mg/L): 12.29
Conductivity (uS/cm): 316.9

pH (pH units): 8.26
DO (% sat): 88.3
Specific Conductivity (uS/cm): 571.3

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: fine sand
Colour: dark brown.
Organics Present (Plants/Algae): leaf debris, algae

Signature: _____

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Sediment Sampling by Spoon Field Sheet

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date: Sept 5/19
Time: 11:10
Easting: 08V 0387021
Northing: 6945794
Weather: cloudy

Project Name/Number: Minto WUL - 19.51
Field Crew: LB KM, Dawn
Waterbody: Upper Minto Cr
Station Identifier: GMC-1-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID? GMC-X-M

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected: (Y) N

WATER QUALITY MEASURES

Temperature (°C): 1.8
DO (mg/L): 12.42
Conductivity (uS/cm): 318.8

pH (pH units): 8.21
DO (% sat): 89.5
Specific Conductivity (uS/cm): 572.1

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: fine sand
Colour: dark brown.
Organics Present (Plants/Algae): leaf debris

Date:
Time:
Easting:
Northing:
Weather:

Field Crew: LB
Waterbody:
Station Identifier:
Map Datum (NAD): 83
Wave Action:

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID?

Portion of Sample for Sediment Texture?: Y N
Sample for Metal Analysis: Y N
Duplicate Collected: Y N

WATER QUALITY MEASURES

Temperature (°C):
DO (mg/L):
Conductivity (uS/cm):

pH (pH units):
DO (% sat):
Specific Conductivity (uS/cm):

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture:
Colour:
Organics Present (Plants/Algae):

Signature:

minnow environmental inc. — A Tetra Tech Company

Sediment Sampling by Spoon Field Sheet

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date: Sept 6/19
Time: 9:00
Easting: 08V ~~0348001~~ 0383017
Northing: ~~6449983~~ 6950006
Weather: clear

Project Name/Number: Minto WUL - 19.51
Field Crew: ~~LB~~ KM, Dawn
Waterbody: Upper McGinty Cr
Station Identifier: URC-5-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID:

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected: Y (N)

WATER QUALITY MEASURES

Temperature (°C): 0.9
DO (mg/L): 9.21
Conductivity (uS/cm): 137.8
pH (pH units): 7.85
DO (% sat): 64.9
Specific Conductivity (uS/cm): 255.5

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: Sand/fine sand
Colour: med brown
Organics Present (Plants/Algae): leaf debris

Date: Sept 6/19
Time: 9:30
Easting: 08V ~~0352958~~ 0382992
Northing: ~~6449951~~ 6449960
Weather: clear

Field Crew: ~~LB~~ KM, Dawn
Waterbody: Upper McGinty
Station Identifier: URC-4-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID:

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected: Y (N)

WATER QUALITY MEASURES

Temperature (°C): 1.1
DO (mg/L): 10.28
Conductivity (uS/cm): 130.2
pH (pH units): 7.81
DO (% sat): 72.6
Specific Conductivity (uS/cm): 259.7

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: Sand/fine sand
Colour: med. brown
Organics Present (Plants/Algae): leaf debris

Signature:

minnow environmental inc. — A Trinity Consultants Company

Sediment Sampling by Spoon Field Sheet

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date: Sept 6/19
Time: 9:50
Easting: 08V ~~0382986~~ 0382984
Northing: ~~6949940~~ 6949927
Weather: clear

Project Name/Number: Minto WUL - 19-51
Field Crew: ~~LB~~ KM, Dawn
Waterbody: Upper McGinty
Station Identifier: UMC-3-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID _____

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected: Y (N)

WATER QUALITY MEASURES

Temperature (°C): 1.1
DO (mg/L): 10.25
Conductivity (uS/cm): 129.7

pH (pH units): 7.80
DO (% sat): 77.9
Specific Conductivity (uS/cm): 239.9

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: Sand/fine sand
Colour: med brown
Organics Present (Plants/Algae): organic debris

Date: Sept 6/19
Time: 10:00
Easting: 08V 0382959
Northing: 6949896
Weather: clear

Field Crew: ~~LB~~ KM, Dawn
Waterbody: Upper McGinty
Station Identifier: UMC-2-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID? _____

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected? Y (N)

WATER QUALITY MEASURES

Temperature (°C): 1.2
DO (mg/L): 10.71
Conductivity (uS/cm): 124.7

pH (pH units): 7.79
DO (% sat): 80.0
Specific Conductivity (uS/cm): ~~236.~~ 238.0

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: Sand/fine sand
Colour: med brown.
Organics Present (Plants/Algae): organic debris

Signature: _____

Sediment Sampling by Spoon Field Sheet

MINNOW ENVIRONMENTAL INCORPORATED

101-1025 Hillside Ave.
Victoria, BC V8T 2A2

Telephone: (250) 595-1627
Facsimilie: (250) 595-1625

Client: Minto Mine
Date: Sept 6/19
Time: 10:20
Easting: 08V 0387963
Northing: 6949875
Weather: clear

Project Name/Number: Minto WUL - 19-51
Field Crew: LB KM, Dawn
Waterbody: Upper McGinty
Station Identifier: UPC-1-M
Map Datum (NAD): 83
Wave Action: none

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID:

Portion of Sample for Sediment Texture?: (Y) N
Sample for Metal Analysis: (Y) N
Duplicate Collected? Y (N)

WATER QUALITY MEASURES

Temperature (°C): 1.2
DO (mg/L): 11.32
Conductivity (uS/cm): 129.3
pH (pH units): 7.86
DO (% sat): 91.4
Specific Conductivity (uS/cm): 237.0

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture: Sand / fine sand
Colour: med brown
Organics Present (Plants/Algae): leaf debris

Date:
Time:
Easting:
Northing:
Weather:

Field Crew: LB
Waterbody:
Station Identifier:
Map Datum (NAD): 83
Wave Action:

Photos collected: Field Sheet/US/DS/Across/Sub
Duplicate ID:

Portion of Sample for Sediment Texture?: Y N
Sample for Metal Analysis: Y N
Duplicate Collected? Y N

WATER QUALITY MEASURES

Temperature (°C):
DO (mg/L):
Conductivity (uS/cm):
pH (pH units):
DO (% sat):
Specific Conductivity (uS/cm):

SEDIMENT OBSERVATION (APPROXIMATE AVERAGE)

Sample Texture:
Colour:
Organics Present (Plants/Algae):

Signature:

APPENDIX D
HYDROLOGY AND CLIMATE CONDITIONS

minnow environmental inc.
A Trinity Consultants Company
204-1006 Fort Street
Victoria, British Columbia
V8V 3K4
Tel: (250) 595-1627
Fax: (250) 595-1625

December 20, 2019

Mr. Todd Swenson
Environmental Manager
Pembridge Resources – Minto Mine
PO Box 11
Whitehorse Central PO
Whitehorse, Yukon
Y1A 2V3

Mr. Todd Swenson,

Re: Notification and Documentation of Conditions that Prevented Sampling under the Minto Mine AEMP in September 2019

Under Minto Mine's Water Use Licence (WUL; QZ14-031; August 2015), the Minto Mine is required to implement an Aquatic Environmental Monitoring Program (AEMP). The AEMP includes federal requirements for Environmental Effects Monitoring (EEM) under the Metal and Diamond Mining Effluent Regulations (MDMER), sediment toxicity monitoring, and benthic invertebrate tissue chemistry monitoring. The AEMP implemented by Minto Mine on an annual basis is more comprehensive than specified under the WUL and also includes: 1) sediment chemistry; 2) periphyton chlorophyll-a, community, and tissue chemistry; and 3) benthic invertebrate community. Thus overall, the AEMP conducted every year in September includes monitoring of water, sediment (chemistry and toxicity testing), periphyton (chlorophyll-a, community, and tissue), and benthic invertebrates (community and tissue; Table 1; Figure 1). The AEMP is focussed on the evaluation of potential mine-related effects to Minto Creek, with sampling areas located in upper Minto Creek and lower Minto Creek. These Minto creek areas are evaluated in comparison to matching reference areas – upper McGinty Creek as reference for upper Minto Creek[1] and lower Wolverine Creek and lower Big Creek as references for lower Minto Creek (Table 1; Figure 1). Supporting measures (e.g., field meter measures, water quality samples, depth, flow, habitat observations) are collected at all sampling areas.

The Minto Mine has been under care and maintenance since October 19th, 2018 and has not discharged effluent since. Nonetheless, the Minto Mine has continued to implement the AEMP and retained Minnow Environmental Inc. (Minnow) to complete the 2019 AEMP. Federal EEM at Minto Mine was completed by Minnow between September 5th to 8th, 2019 with the assistance of Minto Mine staff. Sediment sampling at upper Minto Creek was successfully completed on

[1] Reference for the EEM benthic survey include nine additional reference creeks, all of which were sampled successfully in 2019.

DRAFT

Table 1: Minto Mine Water Use Licence Biological Monitoring Program Overview, September 2019

Area Type	Area	Station	Minto Mine Water Use Licence (QZ14-031, Amendment 10)								
			Water	Sediment by Spoon [a]	Sediment by Hand Corer/Petite Ponar [b]	Sediment Toxicity Testing	Periphyton Chlorophyll-a	Periphyton Community	Periphyton Tissue [c]	Benthic Community by Hess Sampler [d]	Benthic Invertebrate Tissue [c]
Lower Creek Areas	Lower Wolverine Creek (Reference)	LWC-1	✓		✓	✓	✓	✓	✓	✓	✓
		LWC-2			✓	✓	✓	✓	✓	✓	✓
		LWC-3			✓	✓	✓	✓	✓	✓	✓
		LWC-4			✓	✓	✓	✓	✓	✓	✓
		LWC-5			✓	✓	✓	✓	✓	✓	✓
	Lower Big Creek (Reference)	LBC-1	✓						✓	✓	✓
		LBC-2							✓	✓	✓
		LBC-3							✓	✓	✓
		LBC-4							✓	✓	✓
		LBC-5							✓	✓	✓
	Lower Minto Creek (Exposed)	LMC-1	✓		✓	✓	✓	✓	✓	✓	✓
		LMC-2			✓	✓	✓	✓	✓	✓	✓
		LMC-3			✓	✓	✓	✓	✓	✓	✓
		LMC-4			✓	✓	✓	✓	✓	✓	✓
		LMC-5			✓	✓	✓	✓	✓	✓	✓
Upper Creek Areas	Upper McGinty Creek (Reference)	URC-1	✓	✓							
		URC-2		✓							
		URC-3		✓							
		URC-4		✓							
		URC-5		✓							
	Upper Minto Creek (Exposed)	UMC-1	✓	✓							
		UMC-2		✓							
		UMC-3		✓							
		UMC-4		✓							
		UMC-5		✓							

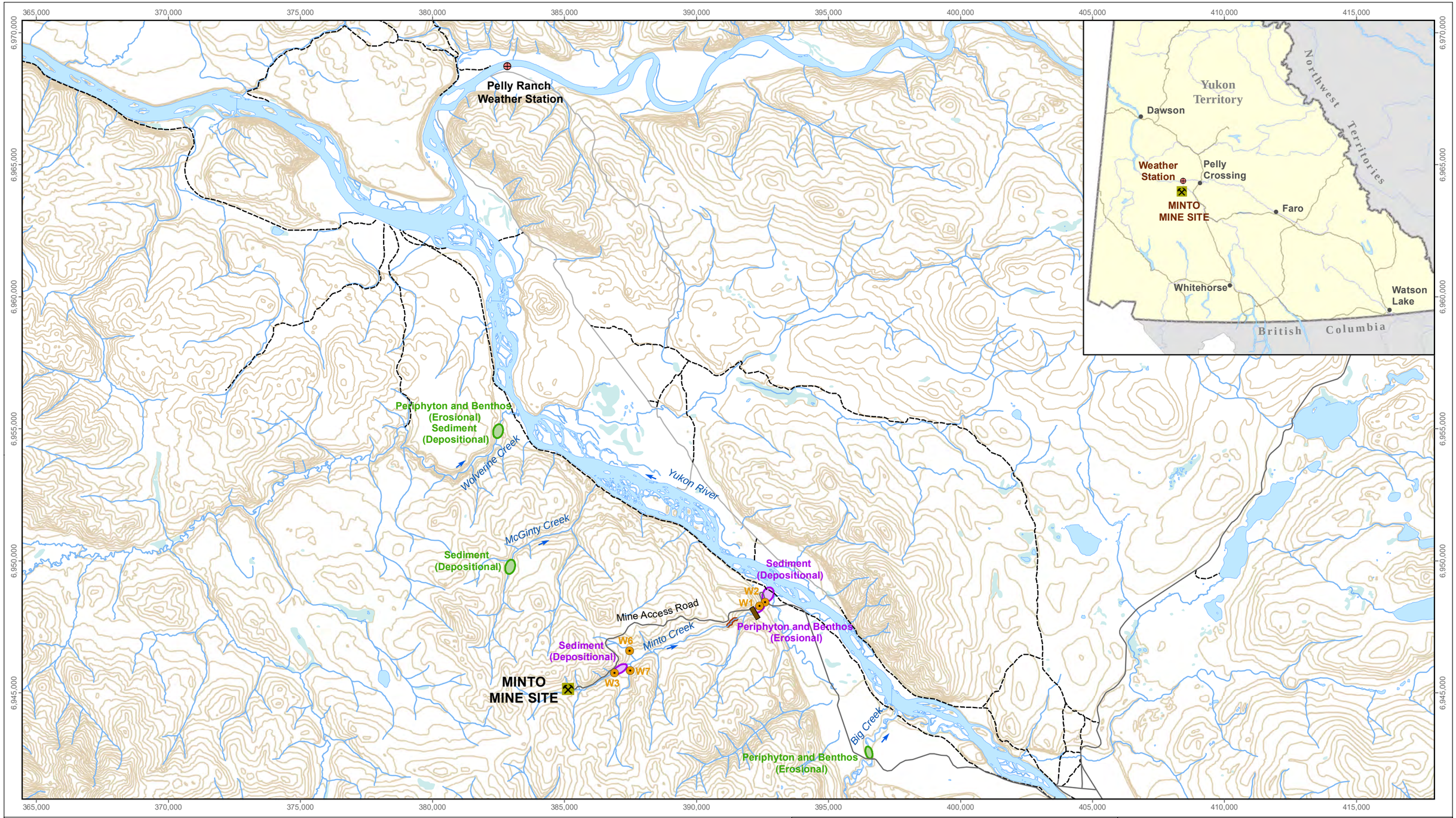
Note: ✓ = Included in the Monitoring Program.

[a] Top 2 centimeters collected; minimum 3-grab composite.

[b] Top 2 centimeters collected; 3-grab composite.

[c] Productivity permitting; in some cases, replication (of 5) may not be achieved with reasonable effort.

[d] 500 µm mesh; 3-grab composite.



LEGEND

- Pelly Ranch Weather Station
- Fish Barrier
- Water Quality Station
- Exposure Area
- Reference Area
- Canyon

0 2.25 4.5 9 km

N W E S

Datum: NAD 83 Map Projection: UTM Zone 8V
Data Source: National Topographic Data Base (NTDB) compiled by Department of Natural Resources Canada at a scale of 1:50,000. All rights reserved.

Sediment, Periphyton, and Benthic Invertebrates Monitoring Areas for the Water Use Licence Program

Date: October 2019
Project 197202.0051

minnow environmental inc.

Figure 1

Document Path: S:\Projects\197202\197202.0051 - Minto WUL and Se 2019\4 - GIS\WUL Memo\December Update\19-51 Figure 1 Minto WUL & Selenium Monitoring.mxd

September 4th and 5th, 2019, with sediment sampling at the associated reference area (upper McGinty Creek) completed on September 6th, 2019. After upper Minto Creek sampling was completed, attempts were made to collect samples from lower Minto Creek. However, lower Minto Creek was found to be dry. After an extensive search of the lower Minto Creek area downstream of the canyon (Figure 1), it was confirmed that the entire lower section of Minto Creek was dry (Photos 1 to 8). Given the dry status of lower Minto Creek, it was determined that collecting samples from a dry creek bed would not be of value (i.e., that dry sediment chemistry and toxicity testing would be of little biological relevance and that a dry creek bed does not support periphyton or aquatic benthic invertebrates). Since lower Minto Creek was the exposed area for the lower creek areas, sampling of the corresponding reference areas was deemed unnecessary.

To provide broader temporal context, the condition of Minto Creek over a longer time frame was examined. Minto Mine staff monitor the condition of lower Minto Creek at Stations W1 and W2 (Figure 1). Both stations were dry from June 25th, 2019 onwards (Swenson 2019, pers. comm.). Prior to completely drying up, water depth and flow decreased rapidly at Station W1 through June 2019, from a maximum of 19 cm and 0.129 m^3/s on June 4th, 2019 to 4 cm and 0.0013 m^3/s on June 22nd, 2019 (Swenson 2019, pers. comm.). Continued observation of lower Minto Creek documented no flow through to freeze up in 2019.

Low water levels were consistent with climate data. Specifically, temperature was higher and precipitation was lower in 2019 at Minto Mine compared to the Canada Climate Normals collected at the weather station, Pelly Ranch (see Figure 1 for location), from 1981 to 2010 (Tables 2 and 3; Figures 2 and 3; Government of Canada 2019). From June to November 2019, temperatures were approximately 1 to 2 °C warmer and there has been 12.5 to 36.6 mm less precipitation compared to normals (Tables 2 and 3; Figures 2 and 3).

In summary, higher temperature and lower rainfall in the vicinity of the Minto Mine in 2019 lead to dry conditions in lower Minto Creek starting in late June and persisting through the fall season until freeze-up. These conditions prevented the complete implementation of Minto Mine in AEMP in 2019. Specifically, although all EEM and monitoring of upper Minto Creek was completed, monitoring of lower Minto Creek could not be completed. In accordance with the WUL, sediment and biological monitoring under the AEMP will be attempted again in September 2020.

Sincerely,

Minnow Environmental Inc.

UNSIGNED FOR DRAFT

Lisa Bowron, M.Sc., R.P.Bio.

Aquatic Toxicologist

cc: Pierre Stecko, M.Sc., R.P.Bio., EP, Senior Aquatic Scientist

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Table 2: Monthly Temperature at Minto Mine Compared to Canada Climate Normals

Month	Daily Average Temperature (°C)																
	Canada Climate Normals	2012		2013		2014		2015		2016		2017		2018		2019	
		Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals
January	-24.9	-21.3	3.6	-16.9	8.0	-9.3	15.6	-15.8	9.1	-9.4	15.5	-17.8	7.1	-15.1	9.8	-17.0	7.9
February	-19.5	-7.6	11.9	-10.2	9.3	-17.3	2.2	-13.7	5.8	-8.0	11.5	-11.5	8.0	-17.8	1.7	-17.2	2.3
March	-10.6	-8.8	1.8	-9.6	1.0	-8.1	2.5	-6.3	4.3	-1.8	8.8	-13.5	-2.9	-7.5	3.1	-1.2	9.4
April	0.7	3.2	2.5	-5.2	-5.9	0.9	0.2	2.0	1.3	4.7	4.0	2.2	1.5	-0.6	-1.3	1.8	1.1
May	8.3	6.5	-1.8	7.2	-1.1	9.6	1.3	13.1	4.8	10.1	1.8	8.3	0.0	8.5	0.2	11.0	2.7
June	13.9	12.8	-1.1	15.8	1.9	12.1	-1.8	13.5	-0.4	14.1	0.2	13.0	-0.9	12.9	-1.0	14.8	0.9
July	15.8	13.6	-2.2	15.4	-0.4	14.8	-1.0	14.2	-1.6	14.8	-1.0	15.8	0.0	16.4	0.6	16.9	1.1
August	12.8	12.8	0.0	14.5	1.7	12.5	-0.3	10.8	-2.0	13.5	0.7	13.9	1.1	11.8	-1.0	11.8	-1.0
September	6.5	7.2	0.7	6.7	0.2	5.9	-0.6	5.1	-1.4	7.3	0.8	8.6	2.1	6.2	-0.3	9.0	2.5
October	-2.5	-5.5	-3.0	1.3	3.8	-1.8	0.7	0.1	2.6	-4.9	-2.4	-1.2	1.3	1.1	3.6	-1.4	1.1
November	-16.3	-19.0	-2.7	-14.3	2.0	-13.2	3.1	-11.5	4.8	-10.2	6.1	-18.3	-2.0	-10.5	5.8	-12.5	3.8
December	-21.9	-23.4	-1.5	-21.0	0.9	-12.2	9.7	-14.4	7.5	-18.7	3.2	-11.2	10.7	-12.4	9.5	-	-

Notes: Canada Climate Normals from 1981 to 2010 (Government of Canada 2019). Climate normals are from the Pelly Ranch weather station.

Table 3: Monthly Precipitation at Minto Mine Compared to Canada Climate Normals

Month	Total Precipitation (mm)																
	Canada Climate Normals	2012		2013		2014		2015		2016		2017		2018		2019	
		Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals	Minto Mine	Difference from Normals
January	19.7	9.0	-10.7	4.4	-15.3	16.9	-2.8	9.1	-10.7	9.1	-10.6	1.3	-18.4	7.0	-12.7	7.2	-12.5
February	14.9	9.9	-5.0	73.8	58.9	49.2	34.3	6.9	-8.0	6.9	-8.0	0.0	-14.9	8.6	-6.3	7.7	-7.2
March	10.6	34.9	24.3	7.4	-3.2	0.0	-10.6	3.1	-7.5	2.6	-8.0	3.8	-6.8	14.6	4.0	1.2	-9.4
April	8.9	0.0	-8.9	0.0	-8.9	3.8	-5.1	3.8	-5.1	14.7	5.8	7.0	-1.9	5.0	-3.9	5.0	-3.9
May	27.2	0.1	-27.1	7.9	-19.3	15.0	-12.2	6.3	-20.9	39.3	12.1	22.0	-5.2	6.9	-20.3	17.2	-10.0
June	38.5	31.1	-7.4	21.0	-17.5	12.0	-26.5	18.7	-19.8	30.2	-8.3	40.0	1.5	38.5	0.0	26.0	-12.5
July	58.0	44.8	-13.2	113.5	55.5	50.5	-7.5	35.3	-22.7	74.7	16.7	42.3	-15.7	20.7	-37.3	27.0	-31.0
August	41.4	20.6	-20.8	46.8	5.4	13.4	-28.0	79.7	38.3	46.0	4.6	20.4	-21.0	76.8	35.4	23.1	-18.3
September	31.6	26.1	-5.5	59.7	28.1	30.5	-1.1	19.0	-12.6	18.5	-13.1	37.4	5.8	22.9	-8.7	18.0	-13.7
October	24.5	16.5	-8.0	13.6	-10.9	22.0	-2.5	14.7	-9.8	6.7	-17.8	4.7	-19.8	8.5	-16.0	13.6	-10.9
November	25.8	17.1	-8.7	36.6	10.8	2.9	-22.9	33.0	7.2	24.2	-1.6	7.9	-17.9	8.6	-17.2	12.1	-13.7
December	19.4	18.4	-1.0	37.9	18.5	19.4	0.0	9.5	-9.9	7.4	-12.0	4.7	-14.7	6.7	-12.7	-	-

Notes: Canada Climate Normals from 1981 to 2010 (Government of Canada 2019). Climate normals are from the Pelly Ranch weather station.

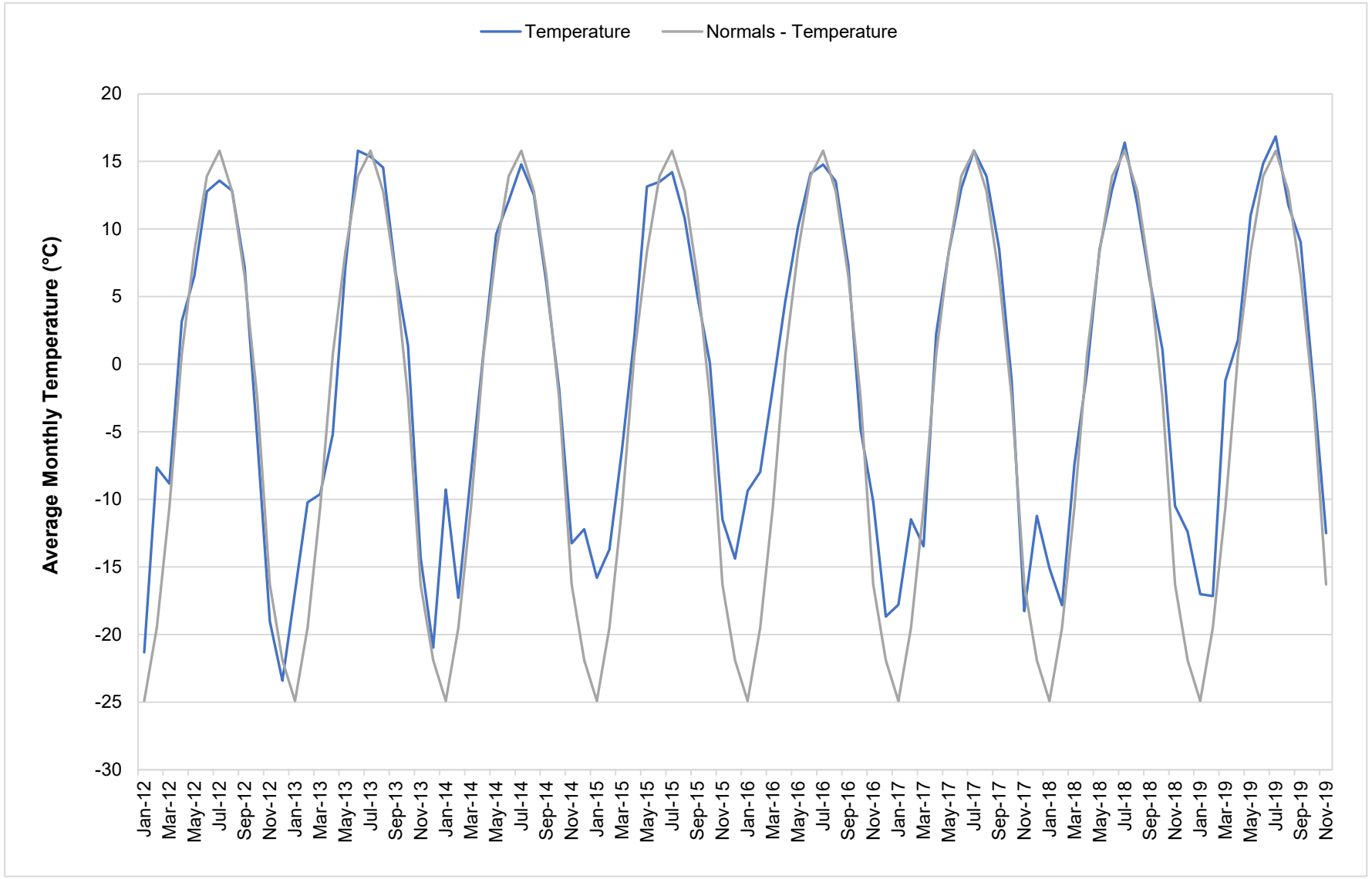


Figure 2: Average Monthly Temperature at Minto Mine Compared to Canada Climate Normals, 2012 to 2019

Notes: Canada Climate Normals from 1981 to 2010 (Government of Canada 2019). Climate normals are from the Pelly Ranch weather station.

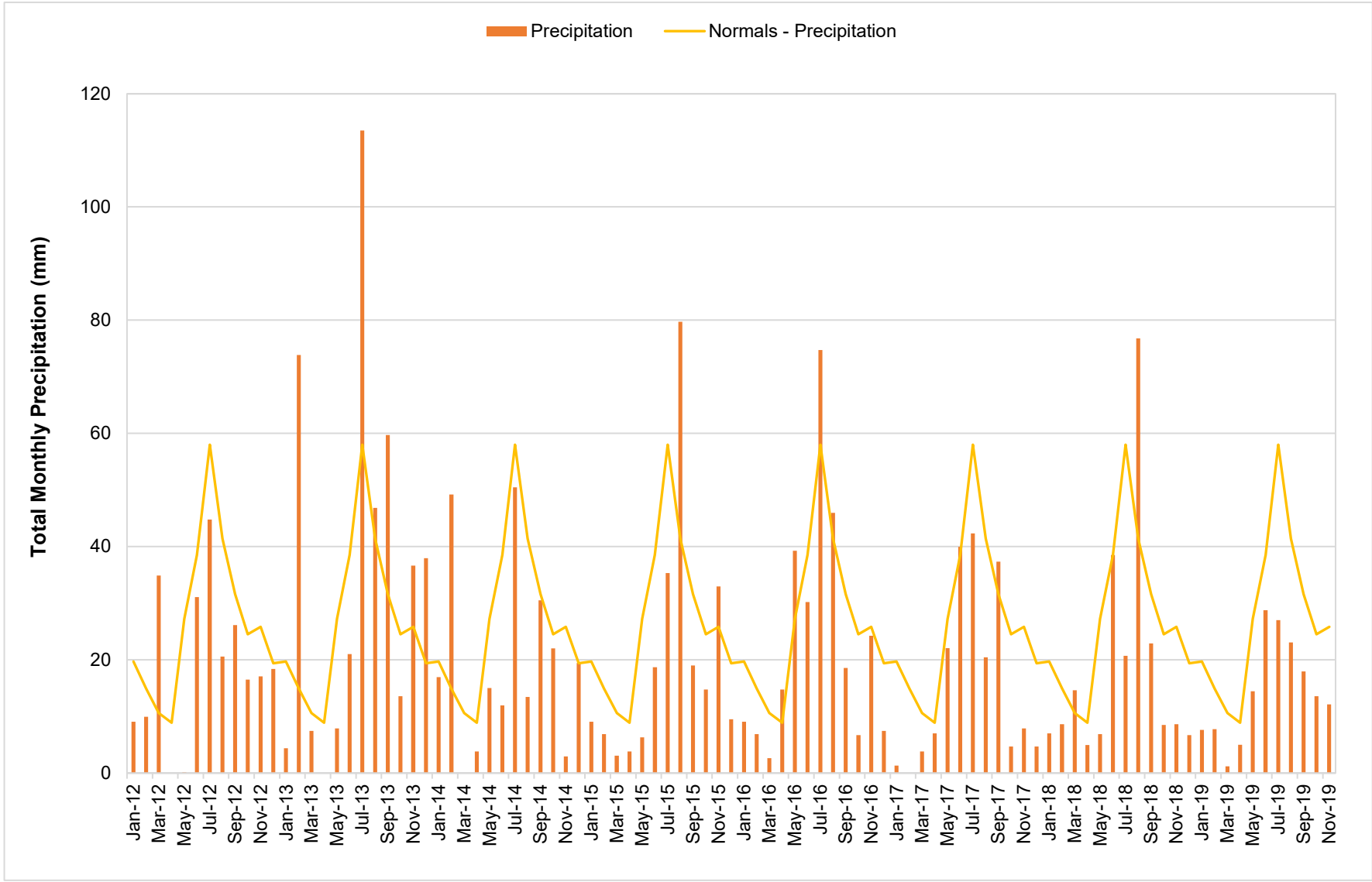


Figure 3: Total Monthly Precipitation at Minto Mine Compared to Canada Climate Normals, 2012 to 2019

Notes: Canada Climate Normals from 1981 to 2010 (Government of Canada 2019). Climate normals are from the Pelly Ranch weather station.

References

Swenson, T. 2019. Environmental Manager, Minto Explorations Ltd. Subsidiary of Pembridge Resources PLC. Email conversation with Lisa Bowron (Minnow). September 6, 2019.

Government of Canada. 2019. Climate Change Normals 1981-2010 Station Data. Available from https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=sstnNam&txtStationName=Pelly+Ranch&searchMethod=contains&txtCentralLatMin=0&txtxtCentralLatS=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=1586&dispBack=1 [accessed 24 September 2019].

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Photo 1: Water Quality Monitoring Station W1, Minto Mine, September 5, 2019



Photo 2: Sediment Quality Monitoring Station LMC-4, Minto Mine, September 5, 2019



Photo 3: **Sediment Quality Monitoring Station LMC-2, Minto Mine, September 5, 2019**

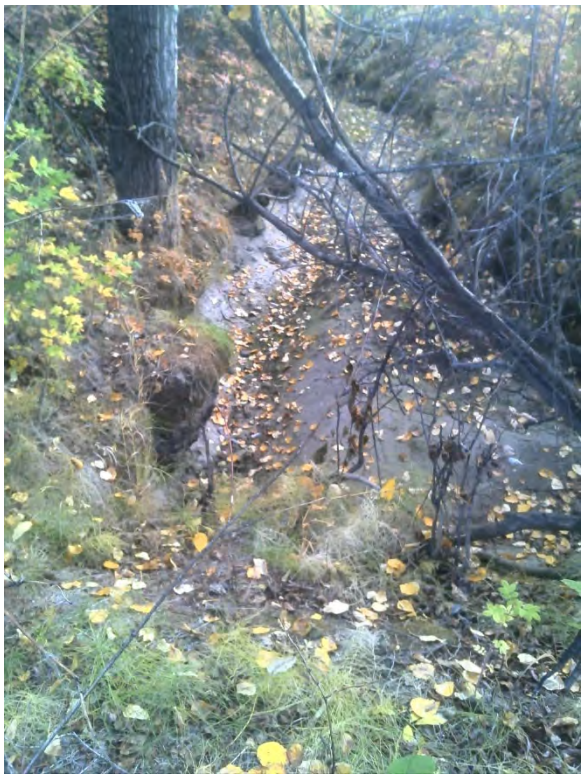


Photo 4: **Sediment Quality Monitoring Station LMC-1, Minto Mine, September 5, 2019**



Photo 5: **Benthic Invertebrate Monitoring Station LMC-5, Minto Mine, September 5, 2019**



Photo 6: **Benthic Invertebrate Monitoring Station LMC-3, Minto Mine, September 5, 2019**



Photo 7: Benthic Invertebrate Monitoring Station LMC-2, Minto Mine, September 5, 2019



Photo 8: Benthic Invertebrate Monitoring Station LMC-1, Minto Mine, September 5, 2019

Appendix N – Minto Creek Fish Monitoring Program Review and Recommendations



Minto Mine
Fisheries Monitoring Program
2019 Summary Report

February 4th, 2020

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1.0 Introduction

Minto Explorations Ltd. (MEL), a wholly owned subsidiary of Pembridge Resources Ltd., owns and operates the Minto Mine, a high-grade copper mine, located approximately 240 km northwest of Whitehorse, Yukon Territory (Figure 1-1). The project is located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R6A, and is centered at approximately 62°37'N latitude and 137°15'W longitude. The Minto Mine commenced commercial operation in October 2007 and is permitted to conduct mining and milling operations at a rate of 4,200 tonnes of ore per day. Some of the Minto ore deposits (copper/gold/silver) currently being mined are located in the upper reaches of the Minto Creek watershed, approximately 12 km to the west of the Minto Creek confluence with the Yukon River (Figure 1-2)

MEL is required, under the terms of its water use license #QZ14-031 (Amendment 1), to conduct an aquatic environmental monitoring program, of which fisheries monitoring program in Minto Creek is a component. This current report provides details of the monitoring conducted during the open water season in 2018 and the results of the work undertaken. This program was carried out under DFO Scientific Collection Licence number XR 156 2019.



Figure 1-1: Project Location

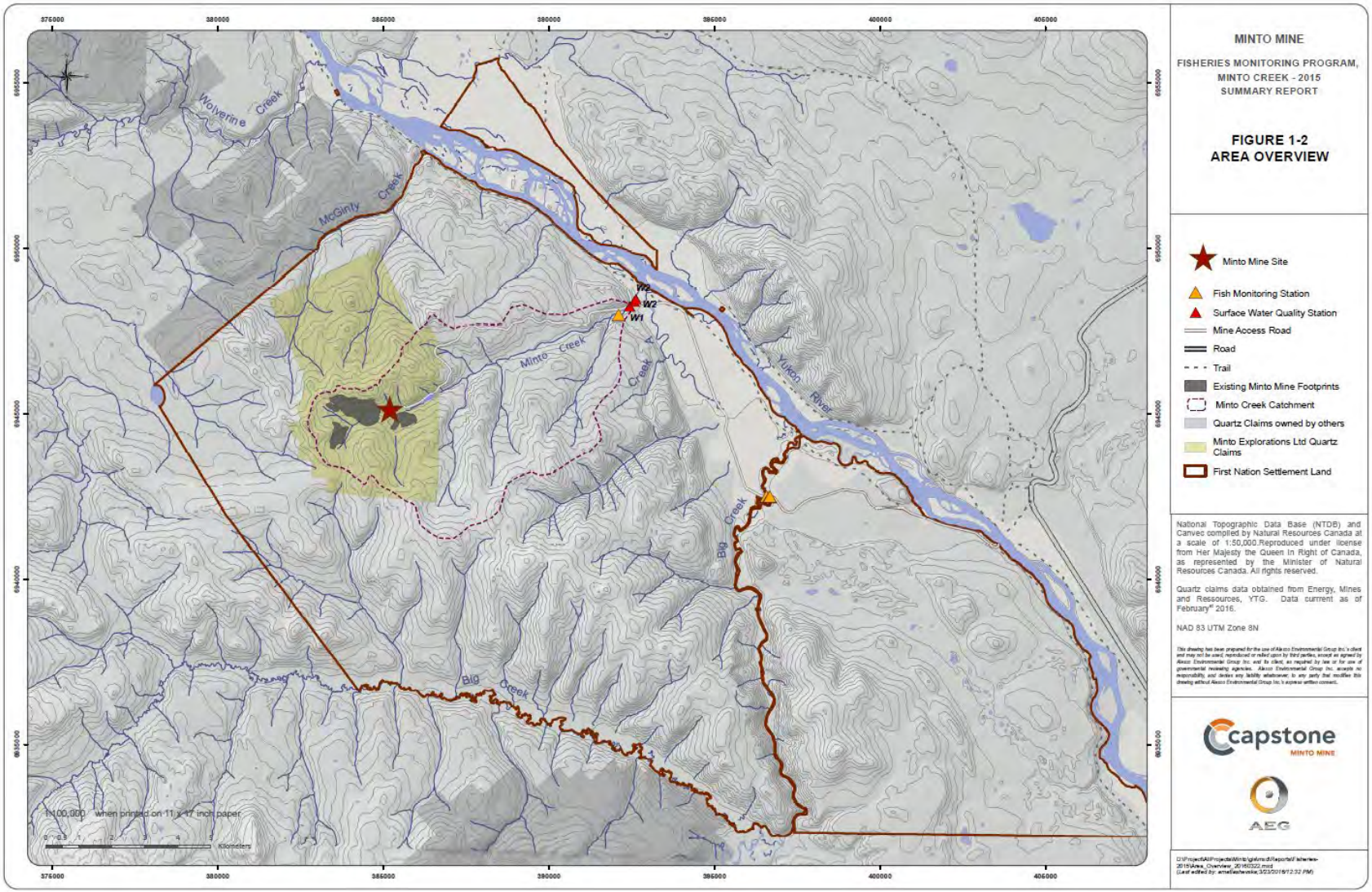


Figure 1-2: Project Overview

2.0 Previous Studies

Numerous studies on fisheries and fish habitat have been conducted over the recent history of the Minto Mine. These studies are summarized chronologically in Table 2-1, below.

Table 2-1: Minto Creek Fish Investigations

Year	***Months***	***Purpose of Study***	***Conducted by***
1994	June, August, September	Baseline Collection	Hallam Knight Piesold (HKP)
2006	September	Baseline Collection	Access Consulting Group (ACG)
2007	May, June, August, September	Environmental Effects Monitoring Study Design Development	ACG / Minnow Environmental (Minnow)
2008	June, September	Environmental Effects Monitoring, Cycle I	ACG / Minnow
2009	June, July	Monitoring	ACG
2009	September, October	Fish Re-location	ACG
2010	June - October	Juvenile Chinook Salmon Mark-recapture program, compliance Monitoring	ACG
2011	July - October	Environmental Effects Monitoring Cycle II, Compliance Monitoring	ACG, Minnow
2011	July, August	EEM Cycle II – Growth Trials	ACG, Minnow
2012	May - September	Compliance Monitoring Se in tissue study	ACG, MEL (Minto Exploration Ltd.)
2013-2015	May - October	Compliance Monitoring	ACG/AEG, MEL
2016	June - September	Compliance Monitoring	MEL, AEG
2017	June - September	Compliance Monitoring	MEL
2018	June - September	Compliance Monitoring	MEL

Attempts to collect fish in lower Minto Creek while conducting the Phase 1 Metal Mining Effluent Regulation (MMER), Environmental Effects Monitoring (EEM) study in 2008 resulted in the capture of no fish during the entire fisheries program (June – September). This is consistent with the findings of previous fish investigations conducted in the creek (HKP 1994; R&D 2006, 2007). Fish use of Minto Creek is transient and likely short-lived, as has been found in other non-natal chinook rearing creeks (Walker 1976; Scrivener et al. 1994).

The majority of fish previously using the creek system were juvenile chinook salmon (*Onchoryhnchus tshawytscha*), as determined by the above investigations. Other species that have been found in the creek in low numbers include round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*),

Slimy sculpin (*Cottus cognatus*) and Burbot (*Lota lota*). Of these, only slimy sculpin have been captured on a regular basis.

Juvenile chinook salmon (JCS) have never been encountered in the creek before July and their numbers tend to peak in late August or early September. Moreover, the mark-recapture investigation conducted in 2010 on JCS indicates that use of the creek is transient. Most JCS using the system stay in the creek for about two to three weeks or less.

A summary of past fish sampling results in Minto Creek is presented in Table 2-2.

Table 2-2: Summary of Fish captures in Minto Creek between 2008 and 2018

Year	Method	Effort	Summary Statistics	Units	Juvenile Chinook Salmon	All Other Species
2008	Backpack Electrofishing	796 secs	Catch	#	1	0
			CPUE	Fish/min	0.075	0
	Baited Gee Minnow Trapping	28.6 days	Catch	#	18	0
			CPUE	Fish/day	0.63	0
2009	Baited Gee Minnow Trapping	28.6 days	Catch	#	136	142
			CPUE	Fish/day	4.76	4.97
2010	Baited Gee Minnow Trapping	145.9 days	Catch	#	2293	2307
			CPUE	Fish/day	15.72	15.81
2011	Baited Gee Minnow Trapping	71 days	Catch	#	12	29
			CPUE	Fish/day	0.17	0.41
2012	Backpack Electrofishing	1051 secs	Catch	#	0	4
			CPUE	Fish/min	0	0.23
	Baited Gee Minnow Trapping	43 days	Catch	#	3	6
			CPUE	Fish/day	0.07	0.14
2013	Backpack Electrofishing	3402 secs	Catch	#	0	4
			CPUE	Fish/min	0	0.07
	Baited Gee Minnow Trapping	62.5 days	Catch	#	121	7
			CPUE	Fish/day	1.94	0.11
2014	Baited Gee Minnow Trapping	70.2 days	Catch	#	151	3
			CPUE	Fish/day	2.15	0.04
2015	Baited Gee Minnow Trapping	67.3 days	Catch	#	6	0
			CPUE	Fish/day	0.089	0
2016	Baited Gee Minnow Trapping	69.3 days	Catch	#	6	0
			CPUE	Fish/day	0.086	0
2017	Baited Gee Minnow Trapping	43.3 days	Catch	#	0	0
			CPUE	Fish/day	0.000	0
2018	Baited Gee Minnow Trapping	41.9 days	Catch	#	0	0
			CPUE	Fish/day	0.000	0

JCS presence in Minto creek was observed to be influenced by mine water discharge. During non-discharge periods, and prior to operations (baseline), numbers of JCS and other species of fish in the system were found to be very low. In contrast, during the two major discharge events (2009 and 2010), numbers of JCS were 20 to 30 times higher in the system (see Table 2-3 below), indicating that they may have been attracted into the system as a likely result of a more consistent temperature and flow regime associated with mine water discharge. Numbers of other species of fish during discharge events did not increase. It is important to note however, that numbers of other species using the system has been consistently very low, prior to mine development and during operations.

Table 2- 3: Maximum Catch per Unit Effort (CPUE) of Juvenile Chinook Salmon in Minto Creek using baited Minnow traps 1994-2018

Year	Month	JCS – CPUE (#fish/trap-day)*	Minto Creek Conditions
1994	September	0	Pre-development – no discharge
2008	September	0.9	Operational – no discharge
2009	September/October	20.0	Discharge
2010	August	30.0	Discharge
2011	September	0.43	No discharge – high TSS contribution from tributary
2012	September	0.19	No discharge – high TSS contribution from tributary
2013	October	5.01	Operational – no discharge
2014	September	5.05	Operational – no discharge
2015	July	0.30	Operational – no discharge
2016	July	0.30	Operational – no discharge
2017	June-September	0.00	Discharge only during June trapping
2018	June-September	0.00	Discharge only during June trapping

**CPUE calculated for actual 24-hr period (rather than nominal 24-hr period)*

Minto Creek does not provide preferred spawning habitat for fish because it completely freezes during winter months with no flow in lower Minto Creek. Accordingly, there is no evidence of spawning in Minto Creek (HKP 1994; R&D 2006, 2007), nor is there traditional knowledge indicating spawning occurred in

the system (HKP 1994). Lower Minto Creek is also subject to low or zero flow conditions during periods in the summer when a portion (or all) of the flow sometimes infiltrates the ground, preventing the establishment of resident fish populations in this section of the stream. A natural barrier to fish passage exists at approximately km 1.2 upstream in Minto Creek from the Yukon River, therefore limiting fish use upstream of the barrier. This barrier is largely comprised of organic debris and can be considered to be temporary as it will likely degrade over time, although it has been consistently observed since it was first characterized in 2010. Sampling effort has been applied upstream of the barrier during every sampling event since 2010 and resulted in no fish capture. New temporary barriers may also be established in any given year and could occur both upstream and further downstream of the current barrier location. The canyon located upstream of the current barrier however, is a permanent barrier to fish passage due to its high gradient, thus limiting fish habitat to the lower 2.0 km of the system.

Water temperatures tend to remain cooler in Minto Creek than in the Yukon River. This likely deters fish, (JCS, in particular) from entering the system until creek temperatures approach or equilibrate with the Yukon River. Minto Creek is subject to large diurnal fluctuations in temperature (up to 5°C or more) throughout the open water season. This daily variation is not ideal for fish and may limit their interest in using the creek for rearing.

Creek bottom substrate is comprised mostly of fines (silt/sand) with limited cobble/gravel sections which are more desirable for fish. In addition, significant input of suspended solids from a tributary in 2011 and 2012 may have further limited the use of the system by JCS during those years.

Bottom substrate at the mouth of Minto Creek and at the Yukon River confluence consists primarily of silt and mud which is not considered suitable substrate for salmonid spawning (grayling, salmon etc.). Aerial surveys for spawning fish were conducted in 2011, 2012, 2013 and 2014, and no adult fish were observed spawning near the Minto Creek/Yukon River confluence. No signs were present during the surveys that this area is used for spawning (such as redds or carcasses).

Starting in 2012, the compliance monitoring program included sampling efforts in Big Creek, which serves as a reference site. The same fish species as in Minto Creek were generally observed in Big Creek, and the CPUE has normally been slightly higher in Big Creek. Table 2-4 summarizes fish captures in Big Creek from 2012 to 2018.

Table 2-4: Summary of Fish captures in Big Creek in 2012 to 2018

Year	Method	Effort	Summary Statistics	Units	Juvenile Chinook Salmon	All Other Species
2012	Backpack Electrofishing	273 secs	Catch	#	1	23
			CPUE	Fish/min	0.22	5.05
	Baited Gee Minnow Trapping	11.8 days	Catch	#	7	2
			CPUE	Fish/day	0.59	0.17
2013	Backpack Electrofishing	911 secs	Catch	#	0	27
			CPUE	Fish/min	0	1.78
	Baited Gee Minnow Trapping	14.8 days	Catch	#	19	2
			CPUE	Fish/day	1.28	0.14
2014	Baited Gee Minnow Trapping	16.4 days	Catch	#	96	3
			CPUE	Fish/day	5.86	0.18
2015	Baited Gee Minnow Trapping	17.1 days	Catch	#	58	5
			CPUE	Fish/day	3.39	0.15
2016	Baited Gee Minnow Trapping	22.2 days	Catch	#	51	11
			CPUE	Fish/day	2.30	0.49
2017	Baited Gee Minnow Trapping	13.4 days	Catch	#	27	8
			CPUE	Fish/day	2.01	0.60
2018	Baited Gee Minnow Trapping	15.4	Catch	#	30	2
			CPUE	Fish/day	1.95	0.13

3.0 Objectives

The objectives of the 2018 Fisheries Monitoring Program were to monitor, assess and characterize fish usage in Minto Creek during the open water season, and to provide data for the interpretation of the potential role and influence of the Minto Mine on the fish community. The 2019 fisheries program was a continuation of the previous year's components and targeted all species that have previously been encountered, as well as any new species. As part of the monitoring program since 2012, assessments at Big Creek were made concurrently with sampling in Minto Creek, to compare fish use in a neighboring system relative to Minto Creek. Fish monitoring studies were conducted in support of the requirements of Water Use License QZ14-031.

4.0 Methodology

4.1 Fish Monitoring

Fish monitoring of Minto Creek and Big Creek was conducted monthly during open water season, from June to September 2019, at trapping sites consistent with the 2010 mark-recapture study and the 2011 to 2017 fish monitoring programs (Figure 4-1). Capture effort included the use of Gee-type Minnow traps with 0.635 cm wire mesh size, baited with Yukon River origin chinook salmon roe. 2 to 15 minnow traps were set during each sampling event in Minto Creek, depending on water levels and availability of pools and backwater areas. Four traps were set during each event in Big Creek, near the Minto access road bridge.

All fish captured were identified, enumerated and measured for fork length or total length (± 1 mm), inspected for abnormalities, and released near their trapping location. JCS were also weighed (± 0.01g) prior to being released.

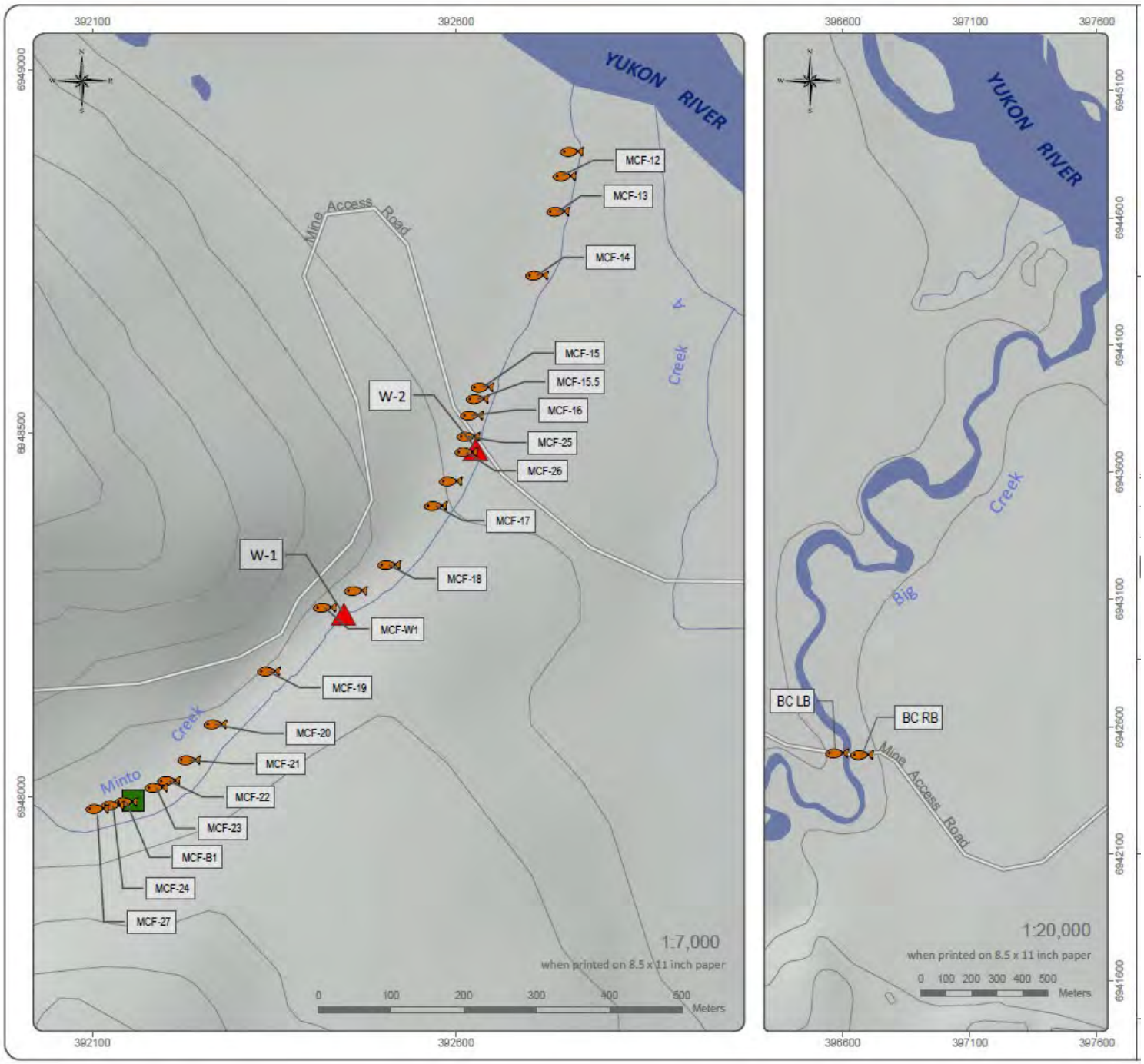
Additional supporting information collected included:

- photo-documentation of the creek,
- water level readings at station W1 staff gauge,
- in situ water parameters in Minto Creek, Big Creek and the Yukon River - temperature, dissolved oxygen, conductivity, pH, ORP,
- flow discharge measured at W1, and at MC1 due to W1 being dry in July, August and September.
- weather conditions at time of sampling.

Continuous temperature loggers (Tidbit) were deployed in the Yukon River and Big Creek for the duration of the project, however the Tidbits were found to be out of the water on some visits due to changes in water level. A Levelogger recorded continuous temperature and stage in Minto Creek. Supporting variables also included monitoring of the previously identified fish barrier (1.2 km upstream of the Yukon River confluence) and/or any new barriers that may have developed.

Selected photographs documenting field activities and site conditions are presented in Appendix A.

Figure 4-1: Minto Creek and Big Creek Fisheries Monitoring Stations



5.0 Results

5.1 Fish Usage and Distribution

5.1.1 Minto Creek

Minto Creek was assessed monthly between June and September 2019. No fish were captured in Minto Creek in 2019. In June, fish trap locations nearest to the Yukon River were dry, which likely prevented fish movement up and down Minto Creek. Traps were set upstream of the dry areas in case any fish had become stranded. From July through September, Minto Creek was found to be mostly dry with no observable flow in isolated pools of water. Other than the June trapping session, only one other trap was set, in July, in a relatively large pool well upstream from the Yukon River. The following table (Table 5-1) presents the effort applied and the summary of fish capture in Minto Creek in 2019.

Table 5-1: Summary Statistics of Minnow Trapping in Minto Creek

Month	Effort (trap-hours)	Effort(trap-days)	Juvenile Chinook Salmon (*Onchoryhnchus tshawytscha*)	
			Results	CPUE*
June	343	15.2	0	0
July	23	0.95	0	0
August	0	0	0	0
September	0	0	0	0
Total	365.4	15.4	0	0

** CPUE = fish/trap-day (for actual 24-hr period)*

5.1.2 Big Creek

Fisheries sampling effort in Big Creek was initiated in June, and conducted monthly until September, concurrent with sampling in Minto Creek, resulting in the capture of 79 fish, 72 of which were JCS. JCS were captured in all sampling events in 2019, with highest number, sixty-one (61), captured in June. In addition, six (2) slimy sculpin and one (1) juvenile burbot were captured during the 2019 sampling season.

The average catch per unit effort for JCS in Big Creek was 4.73 JCS/trap-day and was highest in June (16.05 JCS/trap-day). In comparison, the average JCS CPUE (June to September) in 2018 was lower at 1.956 JCS/trap-day. The following table (Table 5-2) presents the effort undertaken and the resulting fish capture in Big Creek in 2019.

Table 6-2: Summary Statistics of Minnow Trapping in Big Creek in 2019

Month	Effort (trap-hours)	Effort (trap-days)	Juvenile Chinook Salmon (*Onchoryhnchus tsawytscha*)		Slimy Sculpin (*Cottus cognatus*)		Burbot (*Lota lota*)	
			Results	CPUE*	Results	CPUE*	Results	CPUE*
June	91.5	3.8	61	16.05	3	0.792	0	0.000
July	91.2	3.8	2	0.528	1	0.264	0	0.000
August	94.0	3.9	4	1.032	2	0.504	1	0.264
September	93.0	3.9	5	1.296	0	0.000	0	0.000

**CPUE = fish/trap-day (for actual 24-hr period)*

5.2 Fish Metrics

Fork lengths of JCS captured in Big Creek ranged from 38 to 87 mm and their weights ranged from 0.75 to 7.44g. There was a notable difference between the JCS lengths and widths during each sampling event, with the JCS observed in June smaller than the JCS captured in September. The lengths and weights observed throughout the season were consistent with 0+ aged fish (young of year).

Figure 5-2 presents the monthly averages for both creeks. Individual results for all fish captured are presented in Appendix B.

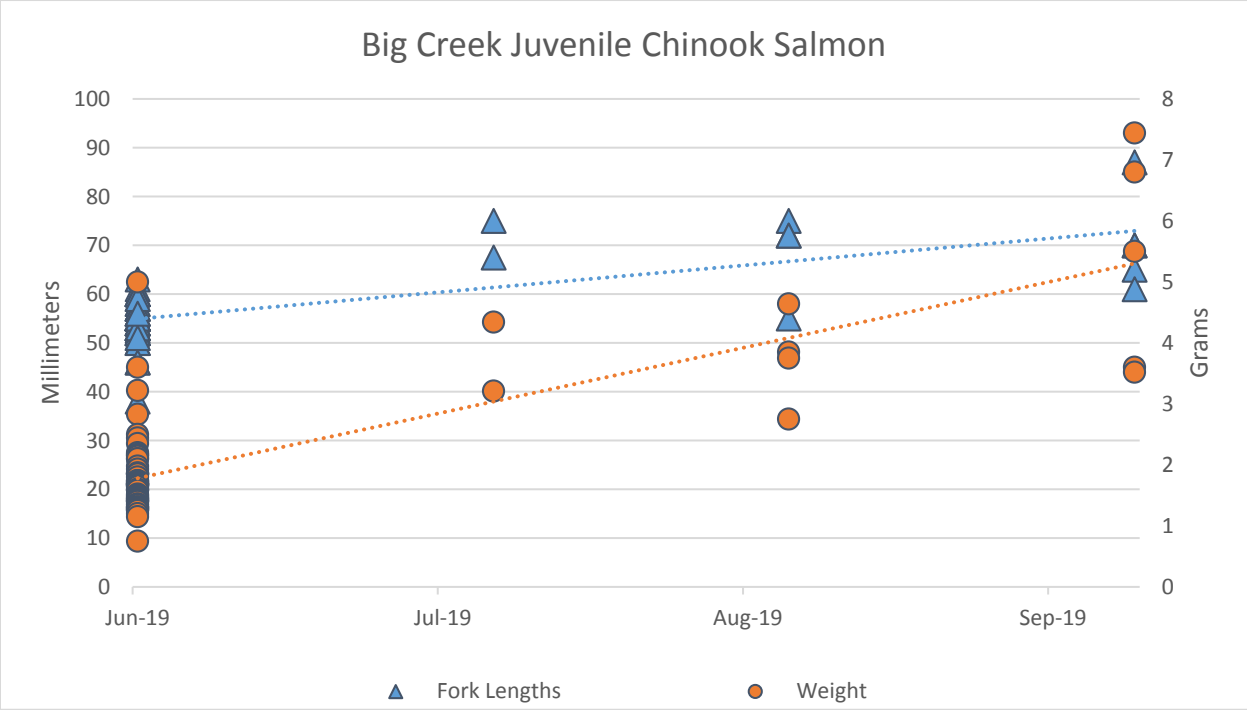


Figure 5-1: JCS fork length and weight, Big Creek, 2019

5.3 Water Quality Parameters

In situ data was collected in Minto Creek at station W2, and Big Creek (bridge) during each site visit and results are summarized in Table 5-3. In situ data was also collected at the Yukon River (W4) during the June, July and September sampling events. In situ parameters were collected with a YSI Professional Plus multimeter, which was calibrated prior to each trip. Since it was completely dry in August and September, no in situ parameters were collected from Minto Creek for these months.

Table 7-3: In situ data from Minto Creek, Big Creek, and Yukon River, 2018

Site	Date	Time	Temperature (˚C)	Dissolved Oxygen (%)	Dissolved Oxygen (m/L)	pH	ORP (mV)
Minto Creek	21-Jun-19	16:30	10.6	90.2	10	7.8	136.4
	26-Jun-19	16:45	4	76.6	10	7.65	163.6
Big Creek	21-Jun-19	15:53	13.3	106.2	11.11	7.85	142.1
	26-Jun-19	16:48	14.7	91.6	9.29	7.84	138.1
	24-Aug-19	13:50	9.4	107	12.24	6.82	136
	27-Sep-19	15:30	4	112.2	14.71	8.21	152.2
Yukon River	21-Jun-19	15:25	14.8	99	10.02	7.22	189.9
	26-Jun-19	15:40	17.5	98.5	9.4	8.08	123.9
	24-Aug-19	13:45	11.4	101.3	11.07	6.79	167
	27-Sep-19	15:15	7.2	105.2	12.71	8.31	152.8

Tidbit water temperature loggers were deployed in the Yukon River at station W4 (between the barge landing and the mouth of Minto Creek) and in Big Creek (near the bridge) during the open water season, while a continuous logger located at W1 records the water temperature and stage of lower Minto Creek.

Figure 5-3 presents the three temperature curves. This figure indicates that the temperature of Minto Creek is generally colder than that of Big Creek, and both are generally colder than the Yukon River. The average difference in water temperature over this period between the Yukon River and Big Creek was 2.31°C, while the difference between Big Creek and Minto Creek was 2.16°C.

As shown in figure 5-3 Minto creek ran dry during the fisheries monitoring season. The Yukon River and Big Creek tidbits were also found out of the water on occasion during the season. Temperatures recorded during these periods have been removed from the dataset.

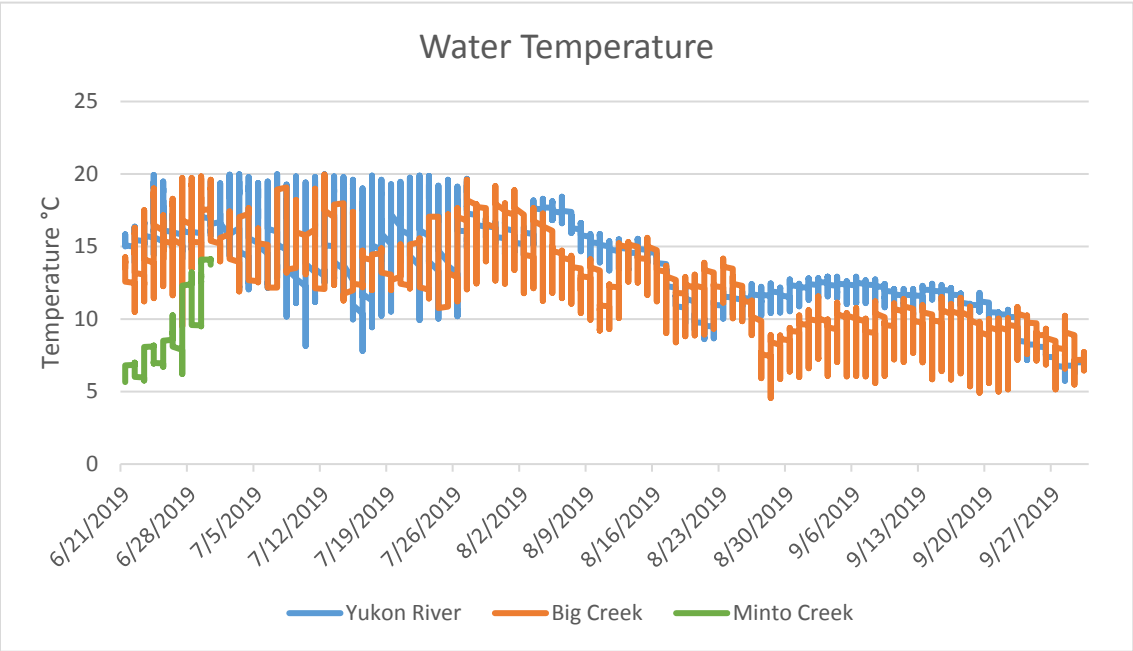


Figure 5-2: *Water Temperature, Minto Creek, Big Creek, and Yukon River, 2019*

5.4 Stage and Discharge

The staff gauge located at W1 in Minto Creek was read during each trip, and discharge was measured at W1 with a Hach FH950 electromagnetic flow meter. A continuously logging water level and temperature recorder is also located at W1.

Water levels and discharge for Minto Creek from May 7th to June 22nd, 2019, are presented in Table 5-4 below. In the past, Big Creek values were obtained through the Water Survey of Canada on-line database. Unfortunately, real-time data was not available through the Water Survey's website at the time of 2019 fisheries surveys and no data has been made available at the time of this report.

Table 8-4: Stage and Discharge in Minto Creek, 2019

Date	Minto Creek	
	Stage (m)	Discharge (m^3/s)
5/7/2019	0.2	0.033976
5/14/2019	0.23	0.04721
5/21/2019	0.25	0.04805
5/21/2019	0.25	0.043548
5/28/2019	0.23	0.017088
6/4/2019	0.33	0.128834
6/11/2019	0.22	0.005827
6/18/2019	0.22	0.0091
6/18/2019	0.22	0.00807
6/22/2019	0.18	0.00128

Figure 5-4 displays the continuous stage and discharge record available from May to June 25th in Minto Creek. As shown in the graph the creek ran dry on June 24th or 25th during the 2019 Fisheries program season.

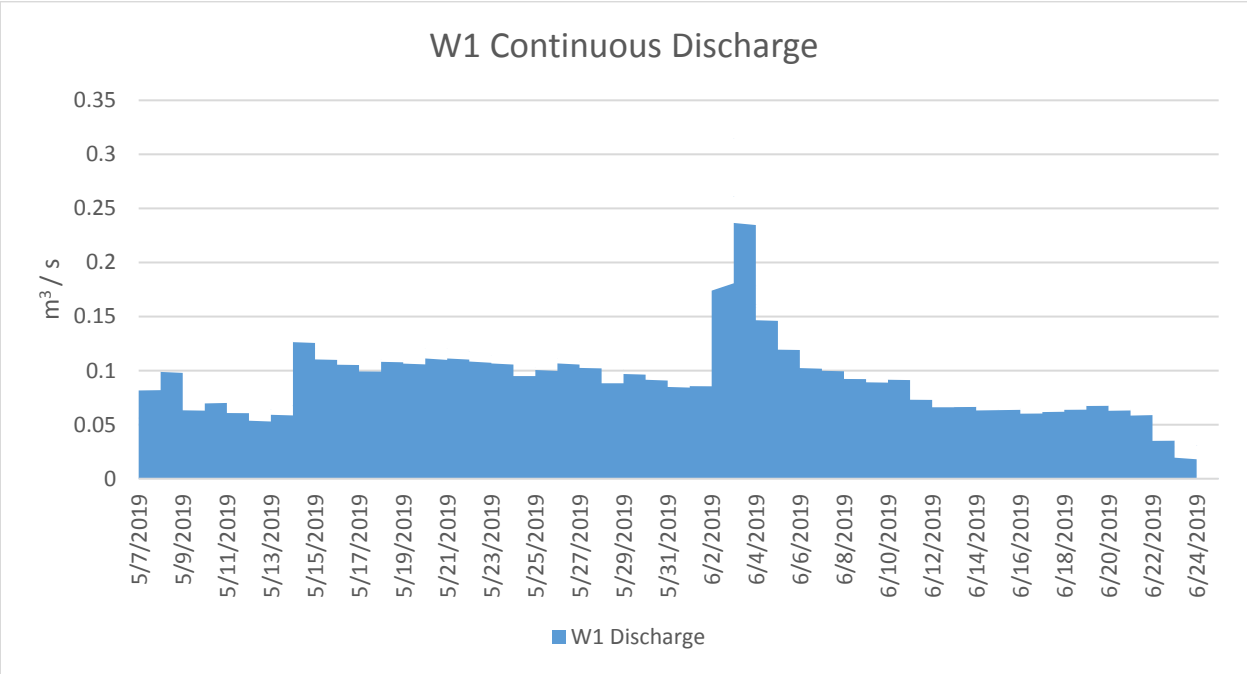


Figure 5-4: Discharge in Minto Creek at monitoring station W1, 2019

5.5 Fish Barrier

The fish barrier located approximately 1.2 km upstream of the Yukon River (MCF-B1 on Figure 5-5), which was documented in previous years, was re-confirmed in 2019. Another fish barrier exists approximately 200m downstream of MCF-B1 at MCF-21. Fish use upstream of the barriers, which consists of a log jam (Figure 5-6), was assessed by setting traps upstream of it during the June sampling event. No fish were captured upstream of the barrier during 2019.



Figure 5-5: *Fish Barrier and Minnow Trap at MCF-B1*



Figure 5-6: *Fish Barrier at MCF-21*

6.0 Discussion

A section of lower Minto Creek was dry during the June sampling event at MFC-12 and MCF-13 trapping locations. These stations are our most downstream trapping sites which indicates fish would have no way of entering Minto creek. Additionally, the creek was dry as far as MCF-21 during the July sampling event, preventing fish movement up the system. Minto Creek was completely dry at all fish capture locations for the August and September sampling events.

In 2019, no JCS were captured in Minto Creek during all sampling events. This may be related in part to the higher water temperatures observed in Big Creek and the lower temperatures observed in Minto Creek during this season. More generally this supports previous findings that JCS do not tend to enter Minto Creek (or Big Creek) until the water temperature has equilibrated with that of the Yukon River or reached a minimum threshold temperature, which was not observed in 2019, since Minto Creek went dry relatively early compared to previous years. Minto Mine has discharged at least some water into Minto Creek in all previous years a fish capture study has been conducted; this, coupled with a light freshet, could explain the low water encountered this season. It should also be noted that the monitoring station at MC1, located roughly 1 km upstream from MCF-27, had continuous flow throughout the sampling season. It is therefore possible that the water is going to ground, or becoming otherwise captured, somewhere between MC1 and MCF-27.

The highest JCS catch per unit effort (CPUE) was observed in June in Big Creek. Figure 6-1: shows the CPUE trends since 2008 for JCS (Minnow trapping only) in Minto Creek and since 2012 in Big Creek. The average CPUE in Minto Creek has shown some variability since 2008 but has generally been relatively low. One exception is the year 2010 where the average CPUE in Minto Creek was 15.7 JCS/trap-day and some trapping events returned over 400 JCS. Those high numbers are thought to be associated with mine water discharge occurring throughout the open water season in Minto Creek that year (ACG, 2010), the more consistent temperature and flow regimes possibly acting as attractants to fish.

No fish were caught in Minto Creek in 2019. This could be explained by a section of the lower creek going dry for periods from June through August, preventing fish movement up or down the creek, combined with a relatively low temperature profile in 2018. In some years, water temperature of Minto Creek and Yukon River reach equilibrium for a short period in June, however this did not happen from 2014 to 2018. In 2018, Minto Creek's maximum water temperature stayed below 9°C, whereas the Yukon River minimum temperature largely stayed above 11°C throughout the summer. The colder temperature profile of Minto Creek in 2018 may have deterred the movement of JCS into the system.

In Big Creek, the average CPUE for 2019 was slightly higher than in 2018, which was the lowest CPUE since 2012. The CPUE was generally higher in Big Creek than in Minto Creek, except in 2013 where it was the opposite. A higher CPUE in Big Creek than in Minto Creek could be explained by the fact that Big Creek is a larger system, with a higher water temperature, generally providing better rearing conditions for JCS. The CPUE has also been noted as following the same trend within both Minto Creek and Big Creek since 2008.

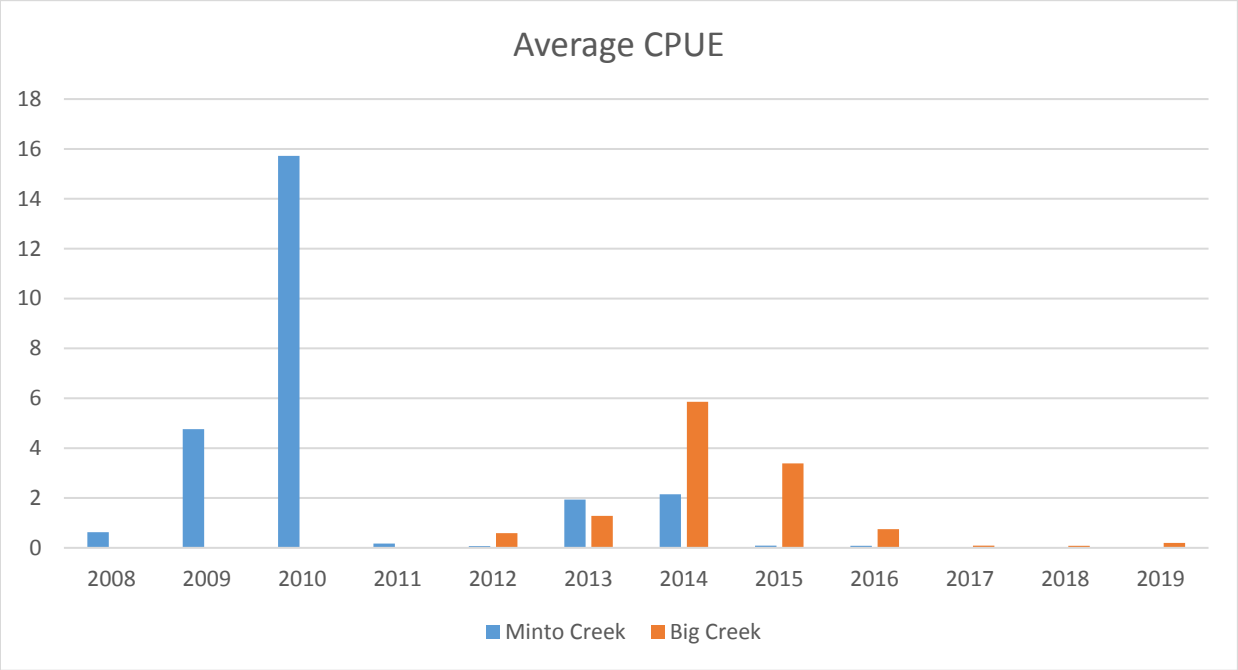


Figure 6-1: *JCS Average CPUE, Minnow Trapping, Minto Creek(2008-2019) and Big Creek(2012-2019)*

In 2009 and 2010, the mine was discharging water throughout the open water season into Minto Creek, causing higher and more consistent flow and temperature regimes in lower Minto Creek, conditions which may have been more attractive to JCS. Mine water discharge only occurred during spring freshet from 2012 to 2015 and no discharge occurred in 2011. In 2016 the new permitted discharge rate (Q_{EFF}), as per the WUL QZ14-031, was calculated as follows:

a) Initial discharge rate: 1/3 (Q_{MC}+Q_{RO})≥Q_{EFF-c}
b) Rate after discharge has commenced: 1/3 (Q_{MC}+Q_{RO} -Q_{EFF-M})≥Q_{EFF-c}

Where:

Q_{MC} = daily flow rate in Lower Minto Creek (represented by either W1 or MC1),
Q_{RO} = daily flow rate of discharged from the RO
Q_{EFF-M} = measured daily rate of discharge from mine site
Q_{EFF-C} = calculated rate of water discharge from mine site

Minto Mine did not discharge into Minto Creek during 2019.

Following a forest fire in 2010, more sediment entered Minto Creek through runoff in 2011 and 2012, thereby increasing turbidity. A small landslide was also documented by Minto personnel in an upstream tributary in May 2012, likely contributing to high TSS levels observed downstream. The elevated turbidity may have deterred fish from entering Minto Creek. Average TSS values at W2 in 2016 were the lowest since 2011, with the highest being observed in 2012 (see Appendix C for details). Average TSS values at W2 in 2017 were the lowest since 2011, with the highest being observed in 2012 (see Figure 8 for details). Turbidity and TSS did not likely influence fish presence or absence in Minto Creek in 2018 as values remained low throughout the season.

The natural fish barrier identified in Minto Creek in previous years was again confirmed in 2019, as well as a second natural fish barrier 200m downstream. Therefore, the area of usable fish habitat in Minto Creek is limited to the lower 1 km of the creek.

Aerial surveys for spawning fish were carried out near the Minto Creek/Yukon River confluence from 2010 to 2014 and no spawning activity was ever observed or suspected. Bottom substrate in the confluence area consists primarily of silt and mud which is not suitable substrate for salmon spawning.

Minto Mine was under Care and Maintenance from November 2018 to June 2019. All mining activities were ceased during this time. The fisheries program was unaffected by this closure and the fisheries study will continue in 2020 as required by the water use license.

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Appendix A - 2019 Photo Log



Figure A-1: Big Creek, July 2019



Figure A-2: Fish Barrier MCF-B1, July 2019



Figure A-3 JCS caught at BC1 (Big Creek), June 2019



Figure A-4 MCF-14, Dry, June 2019



Figure A-5 MCF-25, Dry, July 2019



Figure A-6 Juvenile Burbot, Big Creek, August 2019



Figure A-7 MCF-27, September 2019



Figure A-8 Big Creek, August 2019

Appendix B - Fish Data, Minto Creek and Big Creek, 2018

Table B-1 2018 Fish Collection Data

ID	Date	Location	Location Code	Samplers	Species	Length (mm)	Weight (g)	Fate	Sex	Maturity	Age
XR 157-2019-1	2019/Jun/22	Big Creek	BC1	IS/CR	CH	55	1.74	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC1	IS/CR	CH	57	2.17	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC1	IS/CR	CH	60	3.6	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC1	IS/CR	CH	55	2.35	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC1	IS/CR	CH	50	1.98	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	52	2.83	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	60	3.22	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	50	2.16	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	52.5	2.5	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	50	1.31	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	55	1.71	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	52	1.44	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	59	1.64	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	51	1.5	Released (good)	Unknown	Immature	Juvenile

XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	57	1.8	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	60	1.85	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	63	2.44	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	58	1.85	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	56	1.93	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	55	1.67	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	60	2.2	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	60	5	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	55	1.52	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	54	1.59	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	56	1.7	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	61	2.14	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC2	IS/CR	CH	60	2.1	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CCG	80	5.3	Released (good)	Unknown	Unknown	Unknown
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	54	1.3	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	53	1.74	Released (good)	Unknown	Immature	Juvenile

XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	52	1.48	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	51	1.15	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	53	1.67	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.69	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	57	1.85	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.59	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	52	1.41	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	53	1.34	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	54	1.46	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	52	1.36	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	59	1.87	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	46	0.75	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.68	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.6	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	57	1.73	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	56	1.69	Released (good)	Unknown	Immature	Juvenile

XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.65	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.67	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.58	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	53	1.3	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.26	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.3	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	54	1.43	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	54	1.27	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	60	2.1	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.68	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	58	1.85	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	53	1.45	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	56	1.2	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	53	1.25	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	55	1.4	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jun/22	Big Creek	BC3	IS/CR	CH	53	1.4	Released (good)	Unknown	Immature	Juvenile

XR 157-2019-1	2019/Jun/22	Big Creek	BC4	IS/CR	CCG	83	5.21	Released (good)	Unknown	Unknown	Unknown
XR 157-2019-1	2019/Jun/22	Big Creek	BC4	IS/CR	CCG	68	3.62	Released (good)	Unknown	Unknown	Unknown
XR 157-2019-1	2019/Jul/27	Big Creek	BC2	IS/CR	CCG	80	4.84	Released (good)	Unknown	Unknown	Unknown
XR 157-2019-1	2019/Jul/27	Big Creek	BC2	IS/CR	CH	67.5	3.21	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Jul/27	Big Creek	BC2	IS/CR	CH	75	4.34	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Aug/25	Big Creek	BC2	IS/CR	CH	72	3.75	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Aug/25	Big Creek	BC3	IS/CR	CH	75	4.64	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Aug/25	Big Creek	BC3	IS/CR	CH	55	2.75	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Aug/25	Big Creek	BC3	IS/CR	CH	72	3.85	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Aug/25	Big Creek	BC3	IS/CR	BB	163	26.23	Released (good)	Unknown	Immature	Juvenile
XR 157-2019-1	2019/Aug/25	Big Creek	BC4	IS/CR	CCG	70	5.32	Released (good)	Unknown	Unknown	Unknown
XR 157-2019-1	2019/Aug/25	Big Creek	BC4	IS/CR	CCG	100	9.35	Released (good)	Unknown	Immature	Unknown
XR 157-2019-1	2019/Sep/28	Big Creek	BC2	IS/CR	CH	65	7.44	Released (good)	Unknown	Immature	Unknown
XR 157-2019-1	2019/Sep/28	Big Creek	BC2	IS/CR	CH	70	5.5	Released (good)	Unknown	Immature	Unknown
XR 157-2019-1	2019/Sep/28	Big Creek	BC3	IS/CR	CH	61	3.6	Released (good)	Unknown	Immature	Unknown
XR 157-2019-1	2019/Sep/28	Big Creek	BC4	IS/CR	CH	70	3.52	Released (good)	Unknown	Immature	Unknown

XR 157-2019-1	2019/Sep/28	Big Creek	BC4	IS/CR	CH	87	6.8	Released (good)	Unknown	Immature	Unknown

Table B-2 Fish Collection Summary Data

ID	Licence Or Ref. No.	Corporation	Sampler Or Data Collectors	Collection Date (YYYY-MMM-DD)	Waterbody Name	Watershed Code	Upper Latitude (Decimal Degree eg. 62.82527)	Upper Longitude (Decimal Degree eg. -137.62750)	Species (see look-up tab)	Lifestage	# Captured	# Retained	# Of Incidental Mortalities	Method	Effort	Unit of Measure	Comments
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Jun-22	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	61	0	0	MT	91.5	hr	4 traps set
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Jun-22	Big Creek	80080623801957	62.598706	-137.013264	CCG	unknown	3	0	0	MT	91.5	hr	4 traps set
XR 156 2019-02	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Jun-22	Minto Creek	800803912	62.65442	-137.0929558			0	0	0	MT	342.9	hr	15 traps set
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Jul-27	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	2	0	0	MT	91.2	hr	4 traps set
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Jul-27	Big Creek	80080623801957	62.598706	-137.013264	CCG	unknown	1	0	0	MT	91.2	hr	4 traps set
XR 156 2019-02	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Jul-27	Minto Creek	800803912	62.65442	-137.0929558			0	0	0	MT	22.5	hr	1 trap set
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Aug-25	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	4	0	0	MT	94.0	hr	4 traps set
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Aug-25	Big Creek	80080623801957	62.598706	-137.013264	BB	juvenile	1	0	0	MT	94.0	hr	4 traps set
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Aug-25	Big Creek	80080623801957	62.598706	-137.013264	CCG	unknown	2	0	0	MT	94.0	hr	4 traps set
XR 156 2019-01	XR 156 2019	Minto Explorations Ltd.	Ian Smith, Corey Roberts	2019-Sep-28	Big Creek	80080623801957	62.598706	-137.013264	CH	juvenile	5	0	0	MT	92.9	hr	4 traps set

Table B-3 Net Times

Site	Date in	Set	Date Pulled	Pulled	Net Time
BC1	6/21/2019	16:00	6/22/2019	14:26	22.4
BC2	6/21/2019	16:19	6/22/2019	15:00	22.7
BC3	6/21/2019	16:25	6/22/2019	15:26	23.0
BC4	6/21/2019	16:27	6/22/2019	15:50	23.4
MCF16	6/21/2019	17:20	6/22/2019	16:19	23.0
MCF15	6/21/2019	17:22	6/22/2019	16:21	23.0
MCF15.5	6/21/2019	17:25	6/22/2019	16:20	22.9
MCF25	6/21/2019	17:30	6/22/2019	16:25	22.9
MCF26	6/21/2019	17:33	6/22/2019	16:33	23.0
MCF17	6/21/2019	17:44	6/22/2019	16:36	22.9
MCF18	6/21/2019	17:56	6/22/2019	16:42	22.8
MCF-W1	6/21/2019	18:01	6/22/2019	16:41	22.7
MCF19	6/21/2019	18:05	6/22/2019	16:57	22.9
MCF20	6/21/2019	18:10	6/22/2019	17:02	22.9
MCF21	6/21/2019	18:15	6/22/2019	17:05	22.8
MCF23	6/21/2019	18:23	6/22/2019	17:11	22.8
MCF22	6/21/2019	18:27	6/22/2019	17:11	22.7
MCF24	6/21/2019	18:31	6/22/2019	17:20	22.8
MCF25	6/21/2019	18:33	6/22/2019	17:25	22.9
BC1	7/26/2019	15:10	7/27/2019	14:00	22.8
BC2	7/26/2019	15:20	7/27/2019	14:05	22.7
BC3	7/26/2019	15:22	7/27/2019	14:10	22.8
BC4	7/26/2019	15:25	7/27/2019	14:12	22.8
MCF22	7/26/2019	16:45	7/27/2019	15:15	22.5
BC1	8/24/2019	13:55	8/25/2019	13:20	23.4
BC2	8/24/2019	14:00	8/25/2019	13:26	23.4
BC3	8/24/2019	14:05	8/25/2019	13:35	23.5
BC4	8/24/2019	14:06	8/25/2019	13:50	23.7
	8/24/2019		8/25/2019		24.0
BC1	9/27/2019	15:30	9/28/2019	14:37	23.1
BC2	9/27/2019	15:35	9/28/2019	14:43	23.1
BC3	9/27/2019	15:35	9/28/2019	14:56	23.3
BC4	9/27/2019	15:40	9/28/2019	15:07	23.4

Table B-4-1 June Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	CPUE	Species	Length (mm)	Weight (g)
BC1	1	6/21/2019	16:00	6/22/2019	14:26	22.43333	5	0.222883	CH	55	1.74
									CH	57	2.17
									CH	60	3.6
									CH	55	2.35
									CH	50	1.98
BC2	1	6/21/2019	16:19	6/22/2019	15:00	22.68333	24	1.058046	CH	38	1.27
									CH	46	1.41
									CH	52	2.83
									CH	60	3.22
									CH	50	2.16
									CH	52.5	2.5
									CH	50	1.31
									CH	55	1.71
									CH	52	1.44
									CH	59	1.64
									CH	51	1.5
									CH	57	1.8
									CH	60	1.85
									CH	63	2.44
									CH	58	1.85
									CH	56	1.93
									CH	55	1.67
									CH	60	2.2
									CH	60	5
									CH	55	1.52
									CH	54	1.59

									CH	56	1.7
									CH	61	2.14
									CH	60	2.1
BC3	1	6/21/2019	16:25	6/22/2019	15:26	23.01667	35	0.043447	CCG	80	5.3
								1.47719	CH	54	1.3
									CH	53	1.74
									CH	52	1.48
									CH	51	1.15
									CH	53	1.67
									CH	55	1.69
									CH	57	1.85
									CH	55	1.59
									CH	52	1.41
									CH	53	1.34
									CH	54	1.46
									CH	52	1.36
									CH	59	1.87
									CH	46	0.75
									CH	55	1.68
									CH	55	1.6
									CH	57	1.73
									CH	56	1.69
									CH	55	1.65
									CH	55	1.67
									CH	55	1.58
									CH	53	1.3
									CH	55	1.26
									CH	55	1.3
									CH	54	1.43
									CH	54	1.27

									CH	60	2.1
									CH	55	1.68
									CH	58	1.85
									CH	53	1.45
									CH	56	1.2
									CH	53	1.25
									CH	55	1.4
									CH	53	1.4
BC4	1	6/21/2019	16:27	6/22/2019	15:50	23.38	2	0.085531	CCG	83	5.21
									CCG	68	3.62

Table B-4-2 June Trapping Effort Minto Creek

Site	Date in	Set	Date Pulled	Pulled	Net Time	Results
MCF16	6/21/2019	17:20	6/22/2019	16:19	23.0	0.0
MCF15	6/21/2019	17:22	6/22/2019	16:21	23.0	0.0
MCF15.5	6/21/2019	17:25	6/22/2019	16:20	22.9	0.0
MCF25	6/21/2019	17:30	6/22/2019	16:25	22.9	0.0
MCF26	6/21/2019	17:33	6/22/2019	16:33	23.0	0.0
MCF17	6/21/2019	17:44	6/22/2019	16:36	22.9	0.0
MCF18	6/21/2019	17:56	6/22/2019	16:42	22.8	0.0
MCF-W1	6/21/2019	18:01	6/22/2019	16:41	22.7	0.0
MCF19	6/21/2019	18:05	6/22/2019	16:57	22.9	0.0
MCF20	6/21/2019	18:10	6/22/2019	17:02	22.9	0.0
MCF21	6/21/2019	18:15	6/22/2019	17:05	22.8	0.0
MCF23	6/21/2019	18:23	6/22/2019	17:11	22.8	0.0
MCF22	6/21/2019	18:27	6/22/2019	17:11	22.7	0.0
MCF24	6/21/2019	18:31	6/22/2019	17:20	22.8	0.0
MCF25	6/21/2019	18:33	6/22/2019	17:25	22.9	0.0

Table B-4-3 June Water Quality Details

Site	Date	Time	Water Temp (°C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek (BC1)	6/21/2019	15:53	13.3	106.2	11.11	7.85	142.1
Minto Creek (W2)	6/22/2019	16:30	10.6	90.2	10	7.8	136.4
Yukon River	6/21/2019	15:25	14.8	99	10.02	7.22	189.9

Table B-4-4 June Flow – Minto Creek

Site	Date	Time	Water Level (m)	Discharge (m3/s)
Minto Creek (W1)	6/22/2019	16:45	0.1	0.00128

Table B-5-1 July Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	CPUE	Species	Length (mm)	Weight (g)
BC1	1	7/26/2019	15:10	7/27/2019	14:00	22.8	0	0.00			
BC2	1	7/26/2019	15:20	7/27/2019	14:05	22.7	1	0.04	CCG	80	4.84
BC3	1	7/26/2019	15:22	7/27/2019	14:10	22.8	0	0.00			
BC4	1	7/26/2019	15:25	7/27/2019	14:12	22.8	2	0.09	CH	67.5	3.21
		7/26/2019							CH	75	4.34

Table B-5-2 July Trapping Effort Minto Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time	Results
MCF22	1	7/26/2019	16:45	7/27/2019	15:15	22.5	0

Table B-5-3 July Water Quality Details

Site	Date	Time	Water Temp (^{o}C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek (BC1)	7/26/2019	15:10	14.7	91.6	9.29	7.84	138.1
Minto Creek (MCF22)	7/26/2019	16:45	4	76.6	10	7.65	163.6
Yukon River	7/26/2019	15:40	17.5	98.5	9.4	8.08	123.9

Table B-5-4 July Flow – Minto Creek

Site	Date	Time	Water Level (m)	Discharge (m3/s)
Minto Creek (W1)	7/26/2019	16:00	0	0

Table B-6-1 August Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	CPUE	Species	Length (mm)	Weight (g)

BC1	1	8/24/2019	13:55	8/25/2019	13:20	23.4	0	0.00			
BC2	1	8/24/2019	14:00	8/25/2019	13:26	23.4	1	0.04	CH	72	3.75
BC3	1	8/24/2019	14:05	8/25/2019	13:35	23.5	4	0.17	CH	75	4.64
									CH	55	2.75
									CH	72	3.85
									BB	163	26.23
BC4	1	8/24/2019	14:06	8/25/2019	13:50	23.7	2	0.08	SS	70	5.32
									SS	100	9.35

Table B-6-4 August Water Quality Details

Site	Date	Time	Water Temp (^{o}C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek (BC1)	8/24/2019	13:50	9.4	107	12.24	6.82	136
Yukon River	8/24/2019	13:45	11.4	101.3	11.07	6.79	167

Table B-7-1 September Trapping effort and Catch Details Big Creek

Site	# Traps	Date In	Time In	Date Out	Time Out	Soak Time (hrs)	Results	CPUE	Species	Length (mm)	Weight (g)
BC1	1	9/27/2019	15:30	9/28/2019	14:37	23.1	0	0.00			
BC2	1	9/27/2019	15:35	9/28/2019	14:43	23.1	2	0.09	CH	65	7.44
									CH	70	5.5
BC3	1	9/27/2019	15:35	9/28/2019	14:56	23.3	1	0.04	CH	61	3.6
BC4	1	9/27/2019	15:40	9/28/2019	15:01	23.3	2	0.09	CH	70	3.52
									CH	87	6.8

Table B-7-2 September Water Quality Details

Site	Date	Time	Water Temp (°C)	DO (%)	DO (mg/L)	pH	ORP (mV)
Big Creek (BC1)	9/27/2019	15:30	4	112.2	14.71	8.21	152.2
Yukon River	9/27/2019	15:15	7.2	105.2	12.71	8.31	152.8

Table B-8 CPUE – Full Species List

Month	Total net times MC	Total net times BC	CH Caught BC	CCG caught BC	BB Caught BC	CH CPUE BC	CH CPUE MC	CCG CPUE BC	CCG CPUE MC	BB CPUE BC
June	343	92	61	3	0	0.667	0.667	0.033	0.033	0
July	23	91	2	1	0	0.022	0.022	0.011	0.011	0
August	0	94	4	2	1	0.043	0.043	0.021	0.021	0.01
September	0	93	5	0	0	0.054	0.054	0.000	0.000	0
					Average CPUE	0.196	0.196	0.016	0.016	0.0025

Appendix O – Waste Rock Verification and ABA Program Results

Minto Explorations Ltd.
ATTN: Laura Battison
Suite 2100- 510 West Georgia St
Vancouver BC V6B 0M3

Date Received: 21-JAN-20
Report Date: 02-MAR-20 14:29 (MT)
Version: FINAL

Client Phone: 604-759-0860

Certificate of Analysis

Lab Work Order #: L2407917

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers: 1 of 1
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2407917-1				
	Description	Rock				
	Sampled Date					
	Sampled Time					
	Client ID	MM 170440				
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (Unity)	8.2				
Organic / Inorganic Carbon	Carbon (C) (%)	0.27				
Acid Base Accounting	FIZZ RATING (Unity)	2				
	MPA (tCaCO3/1Kt)	8.4				
	Neutralization Potential (NP) (tCaCO3/1Kt)	34				
	NNP (tCaCO3/1Kt)	26				
	Ratio (NP/MPA) (Unity)	4.03				
	Sulfate Sulfur (carbonate leach) (%)	0.13				
	Sulfate Sulfur (HCl leach) (%)	0.09				
	Sulfide Sulfur (T minus HCl leach) (%)	0.18				
	Total Sulfur (combustion) (%)	0.27				
Total Metals	Aluminum (Al) (%)	1.20				
	Antimony (Sb) (ppm)	0.08				
	Arsenic (As) (ppm)	1.1				
	Barium (Ba) (ppm)	300				
	Beryllium (Be) (ppm)	0.37				
	Bismuth (Bi) (ppm)	0.03				
	Boron (B) (ppm)	10				
	Cadmium (Cd) (ppm)	0.10				
	Calcium (Ca) (%)	1.58				
	Cerium (Ce) (ppm)	27.2				
	Cesium (Cs) (ppm)	0.34				
	Chromium (Cr) (ppm)	6				
	Cobalt (Co) (ppm)	8.7				
	Copper (Cu) (ppm)	391				
	Gallium (Ga) (ppm)	6.16				
	Germanium (Ge) (ppm)	0.09				
	Gold (Au) (ppm)	<0.02				
	Hafnium (Hf) (ppm)	0.08				
	Indium (In) (ppm)	0.028				
	Iron (Fe) (%)	2.59				
	Lanthanum (La) (ppm)	15.0				
	Lead (Pb) (ppm)	5.4				
	Lithium (Li) (ppm)	6.0				
	Magnesium (Mg) (%)	0.71				
	Manganese (Mn) (ppm)	598				

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2407917-1				
	Description	Rock				
	Sampled Date					
	Sampled Time					
	Client ID	MM 170440				
Grouping	**Analyte**					
SOIL						
Total Metals	Mercury (Hg) (ppm)	0.01				
	Molybdenum (Mo) (ppm)	5.19				
	Nickel (Ni) (ppm)	2.3				
	Niobium (Nb) (ppm)	0.31				
	Phosphorus (P) (ppm)	780				
	Potassium (K) (%)	0.45				
	Rhenium (Re) (ppm)	0.011				
	Rubidium (Rb) (ppm)	23.1				
	Scandium (Sc) (ppm)	4.5				
	Selenium (Se) (ppm)	0.2				
	Silver (Ag) (ppm)	0.14				
	Sodium (Na) (%)	0.08				
	Strontium (Sr) (ppm)	138.0				
	Sulfur (S) (%)	0.30				
	Tantalum (Ta) (ppm)	<0.01				
	Tellurium (Te) (ppm)	0.02				
	Thallium (Tl) (ppm)	0.13				
	Thorium (Th) (ppm)	3.6				
	Tin (Sn) (ppm)	0.7				
	Titanium (Ti) (%)	0.126				
	Tungsten (W) (ppm)	0.08				
	Uranium (U) (ppm)	0.50				
	Vanadium (V) (ppm)	58				
	Yttrium (Y) (ppm)	7.40				
	Zinc (Zn) (ppm)	81				
	Zirconium (Zr) (ppm)	1.5				
Permanent Gases	Carbon Dioxide (CO2) (%)	1.0				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ABA-OA-VOL08-AX	Soil	Acid Base Accounting	OA-VOL08
CARBON-C-GAS05-AX	Soil	Carbon, TOC and CO2	C-GAS05
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.

PH-OA-ELE07-AX	Soil	pH	OA-ELE07
SULPHUR-S-CAL06A-AX	Soil	Sulfide Sulfur Calc from HCl Leach	ALS Minerals S-CAL06A

Sulfide Sulfur (as S) is calculated by subtracting the HCl Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.

SULPHUR-S-GRA06-AX	Soil	Sulfate Sulfur in Soil (Carbonate Leach)	ALS Minerals S-GRA06

A prepared sample is boiled with a sodium carbonate solution for 30 minutes. Any insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).

SULPHUR-S-GRA06A-AX	Soil	Sulfate Sulfur in Soil (HCl Leach)	ALS Minerals S-GRA06A

A prepared sample is heated with dilute hydrochloric acid for 30 minutes. Silica and any acid-insoluble materials are removed by filtration and ferric iron is reduced to ferrous iron by the addition of hydroxylamine hydrochloride. The sulfate in the resulting filtrate is then precipitated with barium chloride in a dilute hydrochloric acid medium. The barium sulfate precipitate is filtered, ignited, weighed and the Sulfate Sulfur is calculated (as S).

SULPHUR-S-IR08-AX	Soil	Total Sulfur in Soil by Combustion	ALS Minerals S-IR08

The sample is heated to approximately 1350 °C in an induction furnace while passing a stream of oxygen through the sample. Sulfur dioxide released from the sample is measured by an IR detection system and the Total Sulfur result is provided.

** 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
AX	ALS MINERALS - VANCOUVER, B.C., 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.

ALS Minerals — Sample Submittal Form

Company Name: Minto Exploration Ltd
Submitted by: Peter Pang
Telephone: 250-203-1850
Courier/Waybill:
Containers:
Date Shipped:
PO Number:

Internal Use Only
Date Received: JAN 21, 2020
Client Code:
Workorder No: L2407917
Quote: Q78311
Template:

Standard Project: Minto Mine - WRMP
Commodity: ☐ Ore ☑ Trace ☐ Potentially Hazardous Materials
Special Instructions:
Sample Type: ☑ Rock ☐ Pulp ☑ Percussion ☐ Soil ☐ Sediment ☐ Drill Core Other

Results to
Name: Laura Battsion
Email: LauraB@mintomine.com
Address:
City: Whitehorse State: Yukon
Country: Canada Zip:
☑ Invoice ☑ Certificate ☑ QC Certificate ☑ Data File ☐ Webtrieve Only

Copy to
Name: Peter Pang
Email: PeterP@mintomine.com
☑ Webtrieve Only ☐ Certificate ☑ Data File

Copy to
Name: Danica Pascua
Email: DanicaP@mintomine.com
☑ Webtrieve Only ☐ Certificate ☑ Data File

Sample Return

Pulps	Rejects
☑ Return after analysis	☑ Return after analysis
☐ Return after 90 days	☐ Return after 45 days
☐ Discard	☐ Discard
☐ Paid Storage	☐ Paid Storage

Failure to indicate pulp & reject disposition considered as paid storage.

Return Address:
Minto Mine, c/o Smalls Expediting
25 Pilgram Pl Suite 2
Whitehorse, Yukon,
Attention: Laura Battison

L240791 7-COFC

Authorized By:
Name: Laura Battison (Please Print)
Signature:

*All shipments received are subject to inspection upon layout; all services are rendered in accordance with ALS Minerals Terms & Conditions (see the current Schedule of Services & Fees).

Samples ID's		Quantity	Sample Preparation Required (Prep Code)	Analytical (Elements or Method Code)	Check here for Rush Premium Service
Start No.	Finish No.				
MM 170440		1		ME-MS41-AX	
		1		ACIDBASE-ACC04-AX	
		1		SULPHUR-S-GRA06-AX	☐
	Total Samples	1			

Appendix P – Leach Pad Sampling Program Results



Minto Mine

Leach Pad Sampling Summary Report

2018 - 2019

Prepared by:
Minto Explorations Ltd.
Minto Mine
February 2020

1 Introduction

The following report presents a summary of the construction for the Leach Pads, constructed from August 2017 to March 2018. And the subsequent monitoring of the leachate produced from March 2018 to October 2019.

1.1 Background

The Geochemical Monitoring Program detailed in the Water Use Licence QZ14-031 includes as one of the conditions the requirement for geochemical characterization of waste, including leachate quality (Section 5.1.5, Article 94):

> *The Licensee shall update the Geochemical Monitoring Program to include a monitoring and geochemical characterization program that will produce detailed metals leaching characterization from the low-grade ore and oxide ore.*

Implementation of a monitoring program that satisfies this condition was included in the Environmental Monitoring, Surveillance, and Reporting Plan (EMSRP). The plan included construction of the leach pads in the summer of 2017 and sampling of the leachate for one year, starting in September 2017.

2 Construction Activities

Details of the Construction Activities are included in Appendix LPS-A.

3 Sampling Methodology

Samples were collected from the Leach pads beginning in May 2018, and continued for the following 17 months during unfrozen seasons. It should be noted that this is longer than the 12-month sampling requirement identified in the EMSRP. Water quality parameters chosen for analysis were the same as those used for groundwater monitoring at Minto.

A detailed SOP for Leach Pad sample collection is included in Appendix LPS-B.

4 Sampling results and analysis

The following Table 4.1 outlines the sampling effort and success for the Leach Pads over the 17-month period from May 2018 to October 2019.

Table 4-1: Leach Pad Sampling Effort, 2018-2019

Month	Leach Pad 1 Samples	Leach Pad 2 Samples
2018-May	1	1
2018-Jun	2	2
2018-Jul	2	2
2018-Aug	1	1
2018-Sep	2	2
2018-Oct	1	1
2018-Nov[1]	0	0
2019-Mar	1	1
2019-Apr[2]	0	0
2019-May	1	1
2019-Jun	2	2
2019-Jul	1	1
2019-Aug	1	1
2019-Sep	1	1
2019-Oct	1	1
2019-Nov[1]	0	0

[1] Leach Pad Frozen

[2] Leach Pads Dry - Not enough water for a sample.

Table 4.2 presents the raw data from Leach Pad samples collected from May 2018 – October 2019.

Table 4-2: Leach Pad Sample Results, 2018-2019

Leach Pad Sampling Results, May 2018 - October 2019																		
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH units	mg/L	mg/L
Station	Date	Ag-D	Al-D	As-D	Cd-D	Cr-D	Cu-D	Fe-D	Mo-D	Ni-D	N-NH3	N-NO2	N-NO3	Pb-D	pH-L	Se-D	Zn-D
LP1	26-May-18	<0.000010	0.0129	0.00042	0.000121	<0.00010	0.0118	<0.010	0.006	<0.00050	0.0025	0.0559	1.80	<0.000050	7.91	0.002	0.0142
LP1	26-May-18	<0.000010	0.0119	0.00043	0.000115	<0.00010	0.0116	<0.010	0.0051	<0.00050	0.0025	0.0560	1.80	<0.000050	7.94	0.0017	0.0139
LP1	9-Jun-18	<0.000020	0.0024	0.00044	0.000358	<0.00020	0.0351	<0.020	0.0380	<0.0010	1.31	4.63	127	<0.00010	7.75	0.465	0.0071
LP1	19-Jun-18	<0.000020	0.0024	0.00020	0.000121	<0.00020	0.0239	<0.020	0.0328	<0.0010	0.346	0.977	26.2	0.00015	7.85	0.127	0.0085
LP1	19-Jun-18	<0.000020	0.0020	<0.00020	0.000129	<0.00020	0.0244	<0.020	0.0326	<0.0010	0.347	0.957	25.9	0.00016	7.86	0.127	0.0093
LP1	9-Jul-18	<0.000010	0.0068	0.00013	0.0000441	<0.00010	0.0141	<0.010	0.0176	<0.00050	0.0464	0.116	6.52	0.000221	7.89	0.0340	0.0168
LP1	21-Jul-18	<0.000010	0.0036	0.00019	0.0000499	<0.00010	0.0148	<0.010	0.0180	<0.00050	0.0115	0.0467	11.1	0.000350	7.99	0.0501	0.0260
LP1	21-Jul-18	<0.000010	0.0041	0.00021	0.0000402	<0.00010	0.0148	<0.010	0.0183	<0.00050	0.0121	0.0471	11.0	0.000350	7.97	0.0489	0.0262
LP1	20-Aug-18	<0.000010	0.0017	0.00026	0.000136	<0.00010	0.0451	<0.010	0.0464	<0.00050	0.0025	0.0097	41.4	0.000352	7.94	0.140	0.0184
LP1	6-Sep-18	<0.000010	0.0010	0.00029	0.000154	<0.00010	0.0449	<0.010	0.0453	<0.00050	0.0025	0.0053	46.4	0.000157	7.93	0.152	0.0134
LP1	6-Sep-18	<0.000010	0.0011	0.00032	0.000152	<0.00010	0.0438	<0.010	0.0452	<0.00050	0.0025	0.0025	46.3	0.000148	7.93	0.155	0.0147
LP1	28-Sep-18	<0.000010	<0.0010	0.00028	0.000160	<0.00010	0.0454	<0.010	0.0428	<0.00050	0.0119	0.005	52.2	<0.000050	7.78	0.167	0.0131
LP1	8-Oct-18	<0.000020	0.0051	0.00072	0.000296	<0.00020	0.0899	<0.020	0.109	<0.0010	0.0140	0.022	134	<0.00010	8.04	0.454	0.0185
LP1	31-Mar-19	<0.000010	0.0012	0.00035	<0.00014	0.00013	0.0710	<0.010	0.0465	<0.00050	0.0078	0.005	50.5	<0.000050	7.79	0.186	0.0064
LP1	20-May-19	<0.000010	0.0029	0.00027	<0.000085	<0.00010	0.0254	<0.010	0.0325	<0.00050	0.0025	0.0061	38.3	0.000377	7.88	0.127	0.0292
LP1	4-Jun-19	<0.000010	0.0044	0.00026	<0.00017	<0.00010	0.0364	0.012	0.0312	<0.00050	0.0025	0.010	59.6	<0.000050	7.85	0.225	0.0030
LP1	24-Jun-19	<0.000010	0.0022	0.00020	<0.00011	<0.00010	0.0325	<0.010	0.0288	<0.00050	0.0025	0.005	30.2	0.000199	7.80	0.131	0.0191
LP1	15-Jul-19	<0.000010	0.0039	0.00035	<0.000030	0.00020	0.0353	<0.010	0.0420	<0.00050	0.0130	0.114	45.0	<0.000050	7.66	0.183	0.0115
LP1	8-Aug-19	<0.000020	0.0027	0.00081	0.000402	<0.00020	0.0643	<0.020	0.0391	<0.0010	2.16	0.889	106	0.00021	7.96	0.112	0.0295
LP1	8-Sep-19	<0.000010	0.0014	0.00029	<0.000090	<0.00010	0.0288	<0.010	0.0489	<0.00050	0.0067	0.0237	33.7	0.000061	7.93	0.155	0.0107
LP1	7-Oct-19	<0.000020	<0.0020	0.00033	0.000131	<0.00020	0.0410	<0.020	0.0750	<0.0010	0.0025	0.01	46.5	<0.00010	8.04	0.231	0.0077
LP2	26-May-18	0.000085	0.0051	0.00088	0.000153	<0.00050	0.0959	<0.050	0.0925	<0.0025	0.0025	13.3	959	0.00404	7.89	0.181	0.314
LP2	9-Jun-18	0.000015	0.0041	0.00044	0.0000875	<0.00010	0.0219	<0.010	0.0176	<0.00050	1.25	1.61	118	<0.000050	7.68	0.0283	0.0018
LP2	19-Jun-18	<0.000010	0.0092	0.00032	0.0000507	<0.00010	0.0113	<0.010	0.0122	<0.00050	5.51	1.19	90.2	<0.000050	7.74	0.0198	0.0011
LP2	9-Jul-18	<0.000010	0.0065	0.00029	<0.000055	<0.00010	0.0288	<0.010	0.0674	<0.00050	14.5	1.04	27.9	0.000271	8.07	0.133	0.0260
LP2	9-Jul-18	<0.000010	0.0103	0.00031	<0.000055	<0.00010	0.0300	<0.010	0.0695	<0.00050	11.9	1.03	27.5	0.000311	8.08	0.133	0.0262
LP2	21-Jul-18	<0.000010	0.0056	0.00038	<0.000050	<0.00020	0.0487	<0.010	0.0765	<0.00050	10.8	1.06	30.7	0.00107	8.12	0.159	0.0834
LP2	20-Aug-18	<0.000010	0.0027	0.00037	0.000129	<0.00010	0.0743	<0.010	0.0513	<0.00050	18.3	0.697	52.4	0.000445	7.95	0.179	0.0328
LP2	20-Aug-18	<0.000010	0.0028	0.00040	0.000155	<0.00010	0.0759	<0.010	0.0527	<0.00050	17.3	0.705	53.2	0.000513	7.92	0.181	0.0362
LP2	6-Sep-18	<0.000010	0.0037	0.00049	0.000180	0.00021	0.0839	<0.010	0.0441	<0.00050	15.2	0.172	67.5	0.000191	7.95	0.159	0.0211
LP2	28-Sep-18	<0.000010	0.0021	0.00049	0.000226	<0.00010	0.0969	<0.010	0.0376	<0.00050	12.5	0.114	81.2	0.000376	7.86	0.153	0.0408
LP2	28-Sep-18	<0.000010	0.0012	0.00047	0.000256	0.00012	0.0948	<0.010	0.0381	<0.00050	10.8	0.112	81.8	0.000350	7.82	0.154	0.0437
LP2	8-Oct-18	<0.000020	0.0043	0.00098	0.000418	<0.00020	0.147	<0.020	0.0741	<0.0010	20.7	0.096	182	0.00052	8.01	0.326	0.101
LP2	8-Oct-18	<0.000020	0.0327	0.00104	0.000430	<0.00020	0.148	<0.020	0.0746	<0.0010	19.1	0.088	172	0.00055	8.04	0.319	0.100
LP2	31-Mar-19	<0.000010	0.0022	0.00034	0.000126	0.00019	0.0221	<0.010	0.0193	<0.00050	1.07	0.0120	25.7	<0.000050	7.77	0.0350	0.0460
LP2	20-May-19	<0.000010	0.0018	0.00032	0.000229	<0.00010	0.0736	<0.010	0.0299	<0.00050	5.44	0.797	52.7	0.000172	8.03	0.145	0.0346
LP2	4-Jun-19	<0.000010	0.0024	0.00021	0.000106	<0.00010	0.0181	<0.010	0.01	<0.00050	1.29	0.392	24.7	<0.000050	7.58	0.0643	0.0134
LP2	24-Jun-19	<0.000010	0.0030	0.00040	0.000146	<0.00010	0.0561	<0.010	0.0321	<0.00050	4.90	0.585	33.5	0.000711	7.92	0.0860	0.149
LP2	15-Jul-19	0.000016	0.0042	0.00052	0.0000820	<0.00010	0.0316	<0.010	0.0415	<0.00050	2.91	0.421	49.3	0.000119	8.06	0.104	0.0484
LP2	8-Aug-19	<0.000010	0.0029	0.00054	<0.00010	<0.00010	0.0655	<0.010	0.0551	<0.00050	0.0087	0.023	43.5	<0.000050	8.05	0.204	0.0036
LP2	8-Sep-19	<0.000020	<0.0020	0.00089	0.000361	<0.00020	0.0619	<0.020	0.0367	<0.0010	0.0676	0.177	89.7	0.00035	7.95	0.152	0.0860
LP2	7-Oct-19	<0.000020	0.0027	0.00145	0.000643	<0.00020	0.0848	<0.020	0.0570	<0.0010	0.157	0.105	151	<0.00010	7.98	0.262	0.0180

5 Results Presentation and Discussion

The data presented in Table 4.2 above has been presented in the following figures for ease of interpretation, along with comments regarding apparent trends. Green dotted lines represent Minto's Effluent Release Limits, while blue dotted lines represent the trend line.

5.1 pH

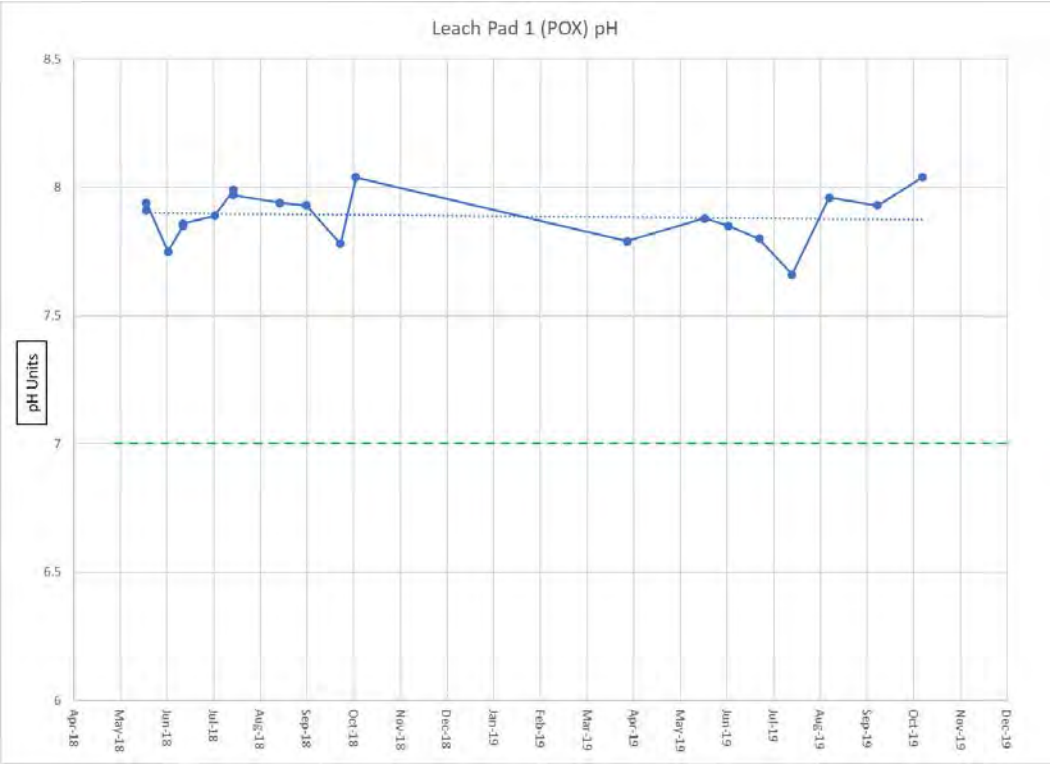


Figure 5-1: Leach Pad 1 pH

(Green dotted line represents neutral pH)

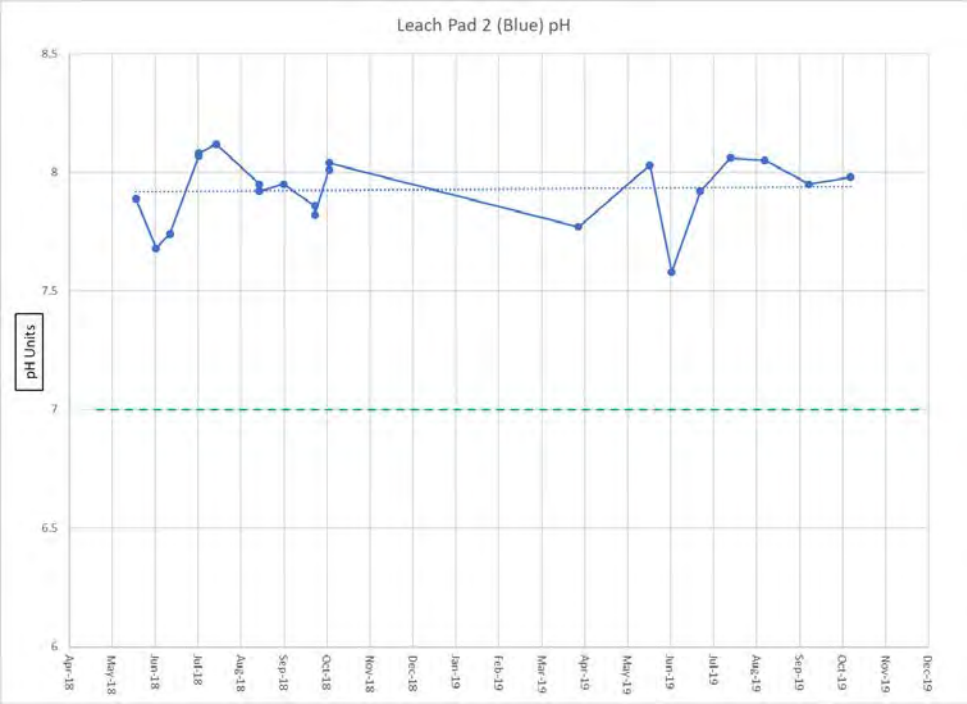


Figure 5-2: Leach Pad 2 pH

(Green dotted line represents neutral pH)

The pH of leachate from both leach pads was well above neutral, indicating they are both currently non-acid-generating, with trends indicating a stable neutralizing potential.

16 Samples of rock were collected from the Leach pads as they were constructed, and analyzed for percent copper, Silver concentration in grams/tonne, percent carbon, percent sulfur, and Neutralizing potential and acid generating potential.

The results of these samples are presented in table 5-1, below.

These results indicate that the POX material, sourced from the Top of the World POX pile, are clearly Non-Acid Generating with and Average NP:AP of well over the cut-off value of 3.0 (Mean of 5.41). The Blue Ore pile, however, while still not currently acid generating, are Potentially Acid Generating with an average NP:AP below the 3.0 cut-off (mean of 1.50).

Table 5-1: Rock Samples from Leach Pad Construction

Sample ID	HOLE ID	Cu %	Ag (g/tonne)		% C(Tot)		% S(Tot)	NP	AP	NP/AP
Leach Pad #1 (POX)										
LP1-1	MM168851	0.124	<1		0.059		0.015	4.91	0.47	10.48
LP1-2	MM168852	1.045			0.077		0.044	6.41	1.38	4.66
LP1-3	MM168853	0.705			0.057		0.017	4.75	0.53	8.94
LP1-4	MM168854	0.417	<1		0.046		0.034	3.83	1.06	3.61
LP1-5	MM168855	0.371	<1		0.044		0.032	3.67	1.00	3.67
LP1-6	MM168856	0.509			0.049		0.022	4.08	0.69	5.94
LP1-7	MM168857	0.62			0.057		0.026	4.75	0.81	5.84
LP1-8	MM168858	0.366	<1		0.03		0.018	2.50	0.56	4.44
LP1-9	MM168859	0.547			0.074		0.058	6.16	1.81	3.40
LP1-10	MM168860	0.291	<1		0.051		0.013	4.25	0.41	10.46
LP1-11	MM168861	0.247	<1		0.099		0.031	8.25	0.97	8.51
LP1-12	MM168862	0.243	<1		0.03		0.018	2.50	0.56	4.44
LP1-13	MM168863	0.364	<1		0.068		0.074	5.66	2.31	**2.45**
LP1-14	MM168864	0.572			0.044		0.032	3.67	1.00	3.67
LP1-15	MM168865	0.469	<1		0.055		0.041	4.58	1.28	3.58
LP1-16	MM168866	0.556			0.066		0.071	5.50	2.22	**2.48**
LEACH PAD 1	**Average Cu %**	**0.465**		**Average % C(tot)**	**0.0566**	**Average %S(Tot)**	**0.0341**	**Average NP:AP**		**5.41**
Leach Pad #2 (Blue Ore)										
LP2-1	MM168867	0.305	<1		0.194		0.349	16.16	10.91	**1.48**
LP2-2	MM168868	0.378	<1		0.164		0.541	13.66	16.91	**0.81**
LP2-3	MM168869	0.358	<1		0.139		0.693	11.58	21.66	**0.53**
LP2-4	MM168870	0.56			0.333		0.778	27.74	24.31	**1.14**
LP2-5	MM168871	0.645			0.214		0.86	17.83	26.88	**0.66**
LP2-6	MM168872	0.581			0.477		0.778	39.73	24.31	**1.63**
LP2-7	MM168873	0.426	<1		0.454		0.643	37.82	20.09	**1.88**
LP2-8	MM168874	0.325	<1		0.215		0.399	17.91	12.47	**1.44**
LP2-9	MM168875	0.517			0.282		0.65	23.49	20.31	**1.16**
LP2-10	MM168876	0.385	<1		0.221		0.525	18.41	16.41	**1.12**
LP2-11	MM168877	0.764			0.862		0.939	71.80	29.34	**2.45**
LP2-12	MM168878	0.442	<1		0.657		0.511	54.73	15.97	3.43
LP2-13	MM168879	0.895			0.667		1.125	55.56	35.16	**1.58**
LP2-14	MM168880	0.401	<1		0.214		0.527	17.83	16.47	**1.08**
LP2-15	MM168881	0.645			0.64		0.711	53.31	22.22	**2.40**
LP2-16	MM168882	0.301	<1		0.159		0.341	13.24	10.66	**1.24**
LEACH PAD 2	**Average Cu %**	**0.496**		**Average % C(tot)**	**0.368**		**0.648**	**Average NP:AP**		**1.50**

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5.2 Dissolved Copper

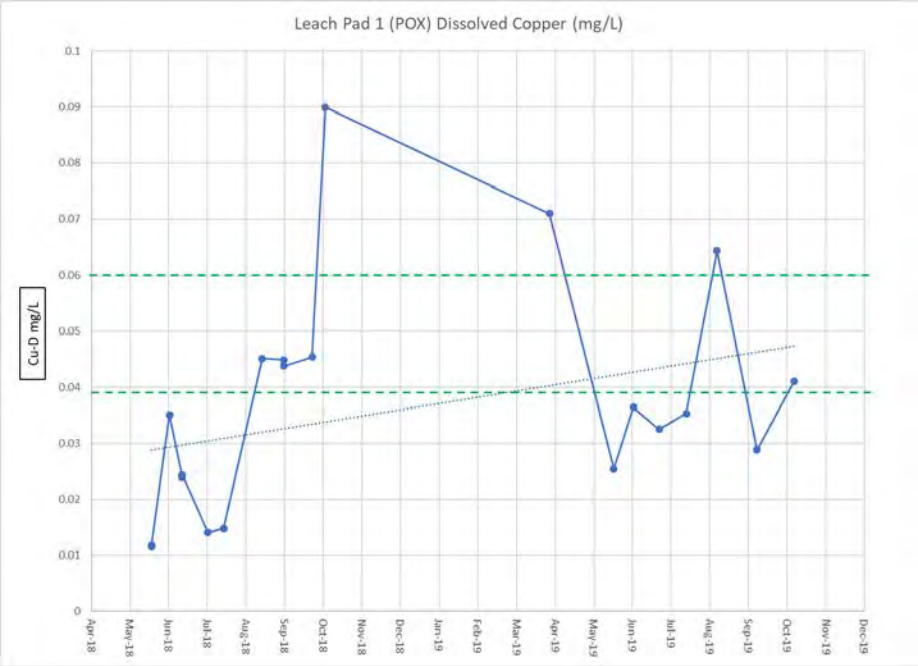


Figure 5-3: Leach Pad 1 Dissolved Copper

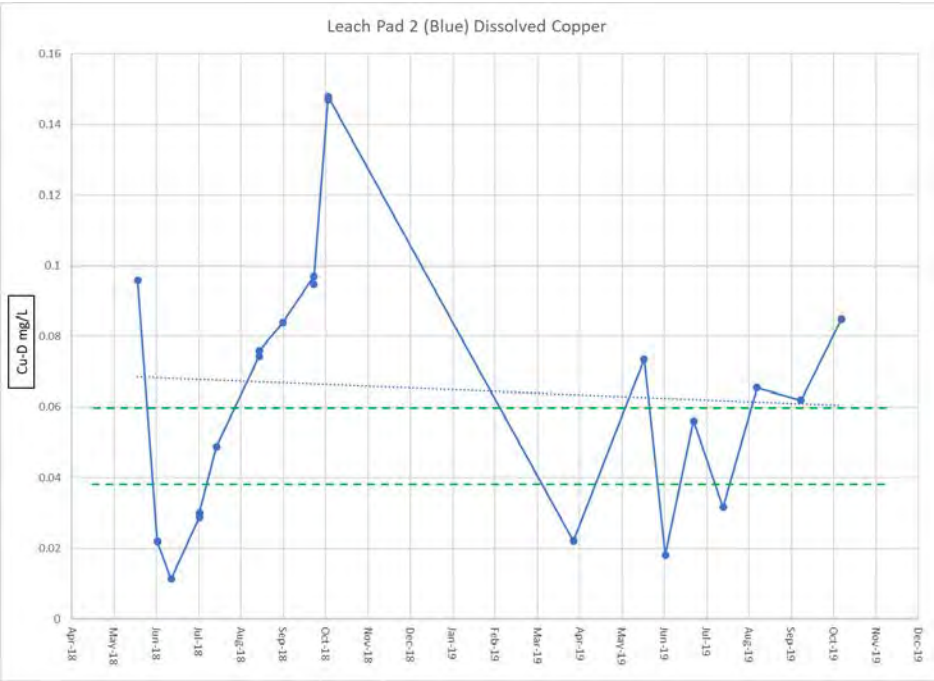


Figure 5-4: Leach Pad 2 Dissolved Copper

5.3 Nitrite

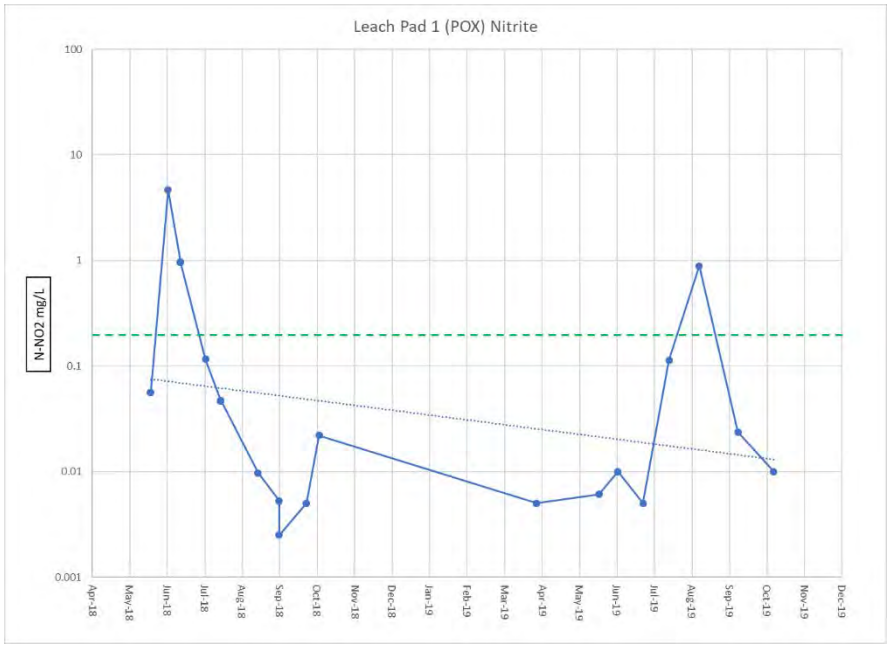


Figure 5-5: Leach Pad 1 Nitrite



Figure 5-6: Leach Pad 2 Nitrite

5.4 Nitrate

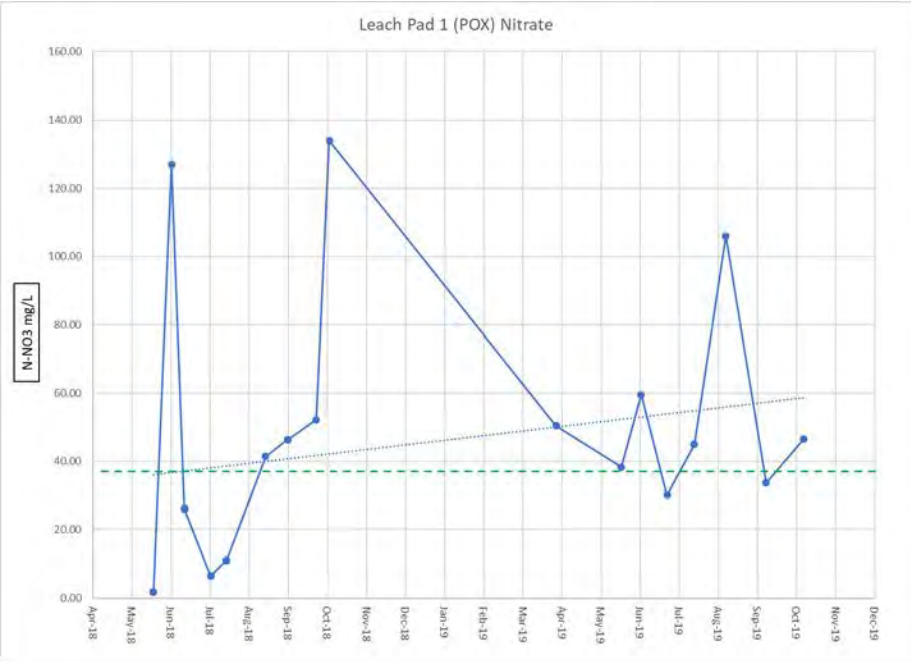


Figure 5-7: Leach Pad 1 Nitrate

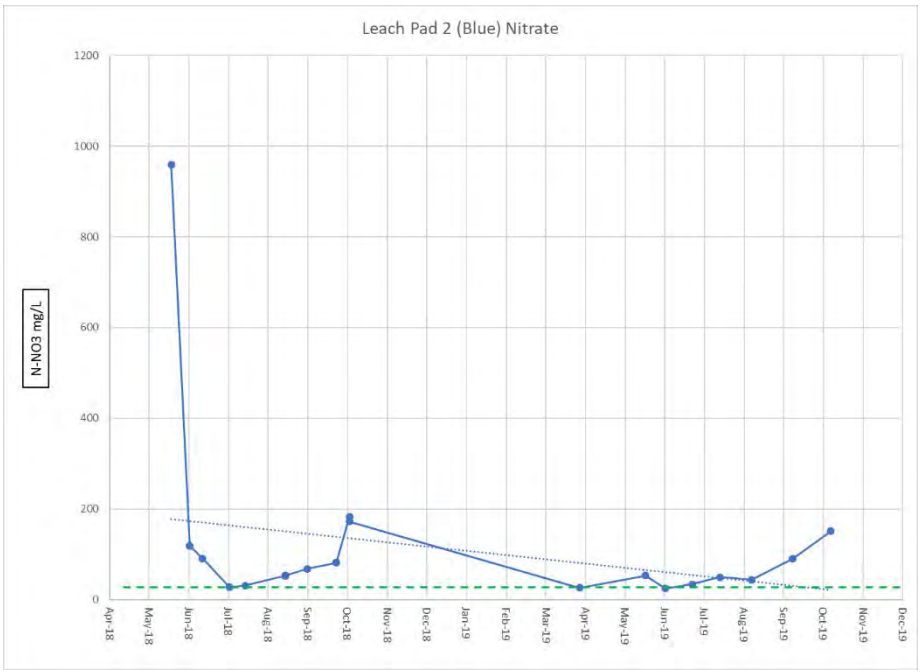


Figure 5-8: Leach Pad 2 Nitrate

5.5 Ammonia

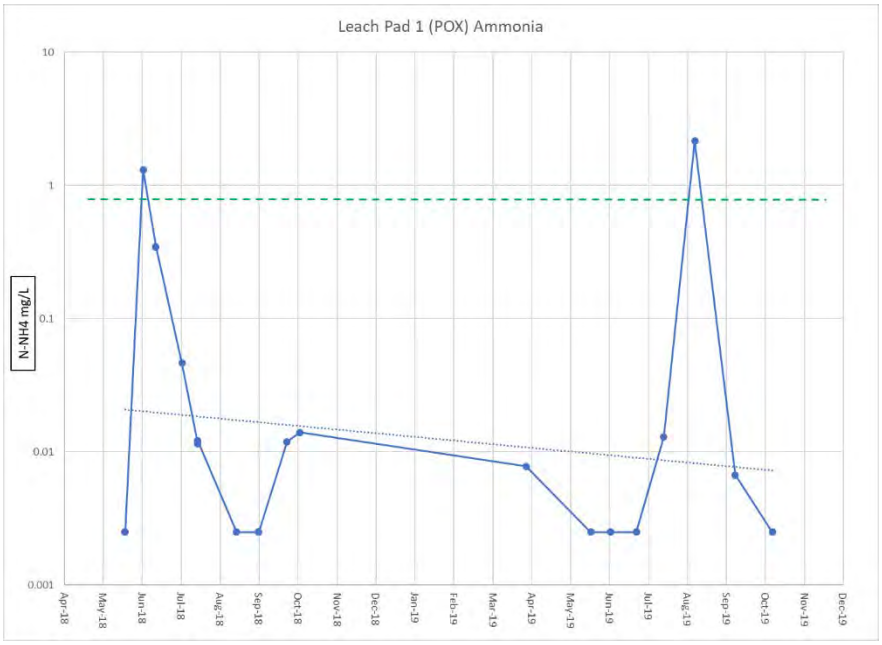


Figure 5-9: Leach Pad 1 Ammonia

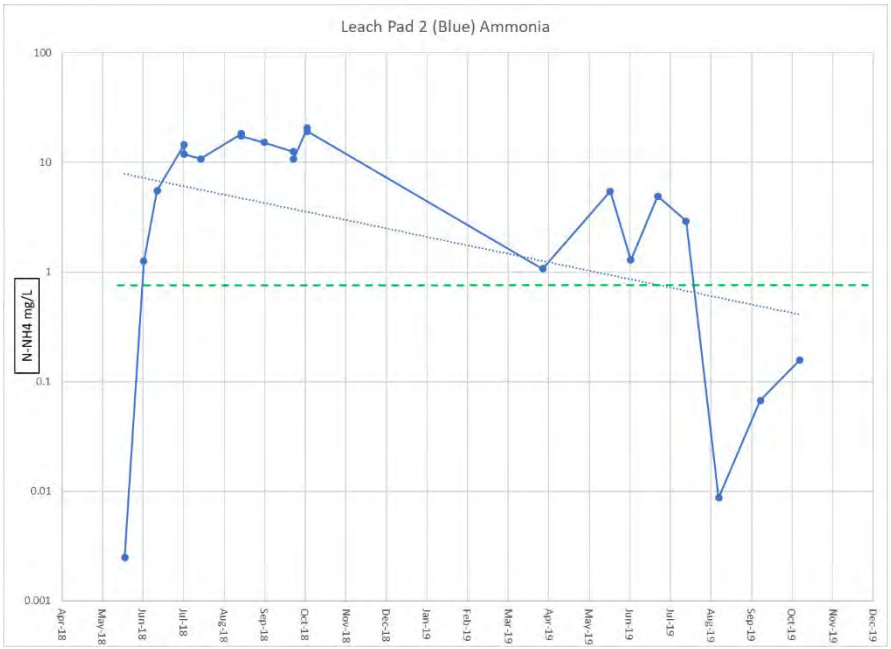


Figure 5-10: Leach Pad 2 Ammonia

5.6 Dissolved Selenium

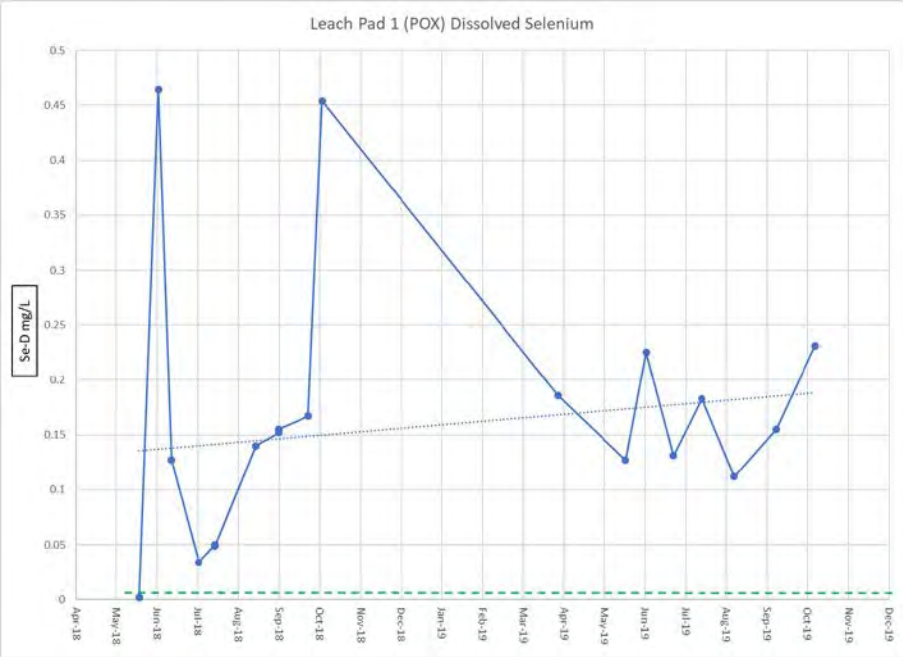


Figure 5-11: Leach Pad 1 Dissolved Selenium

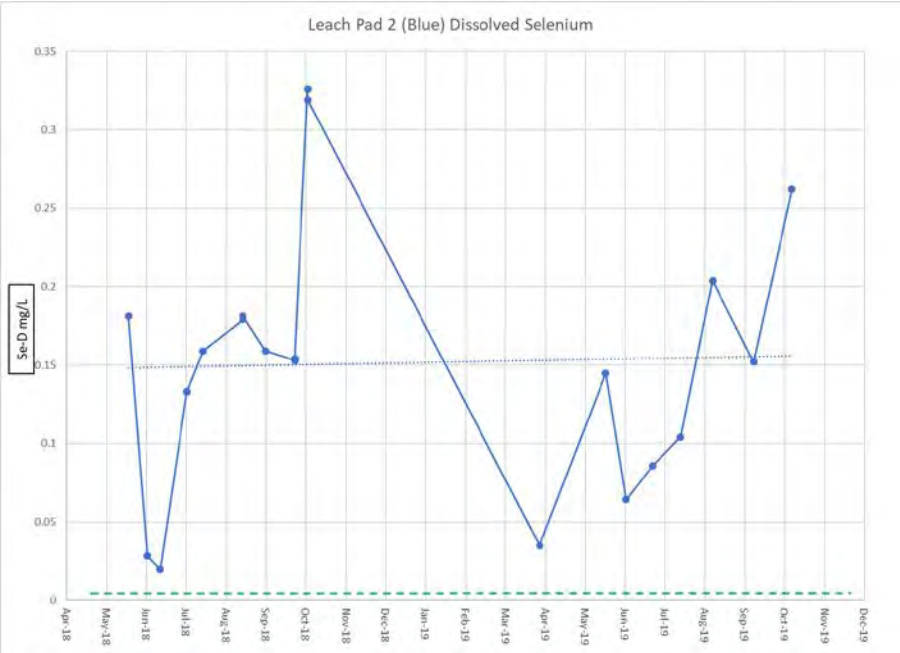


Figure 5-12: Leach Pad 2 Dissolved Selenium

5.7 Dissolved Zinc

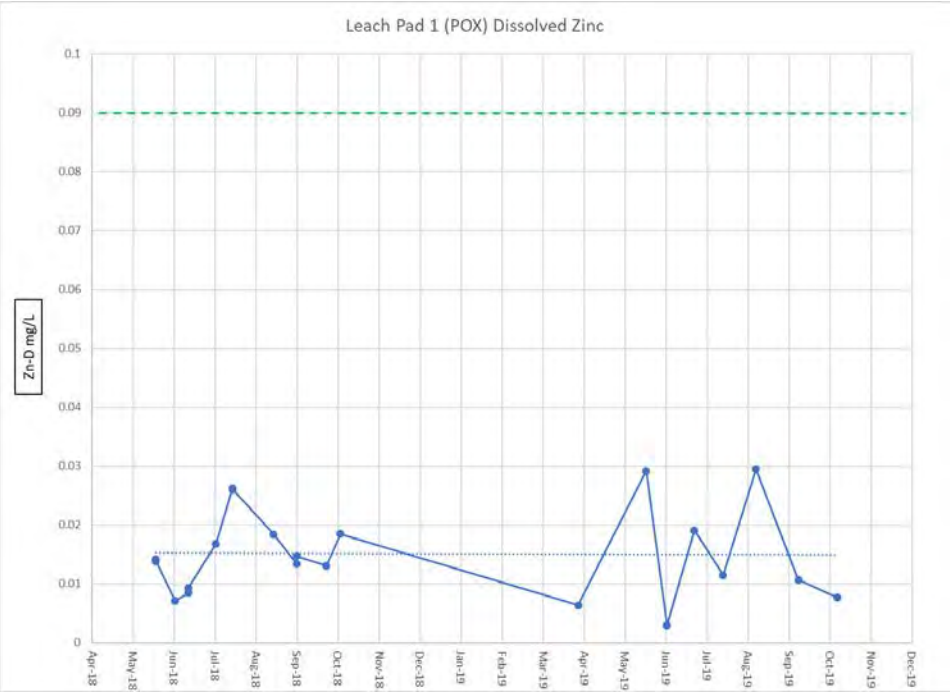


Figure 5-13: Leach Pad 1 Dissolved Zinc

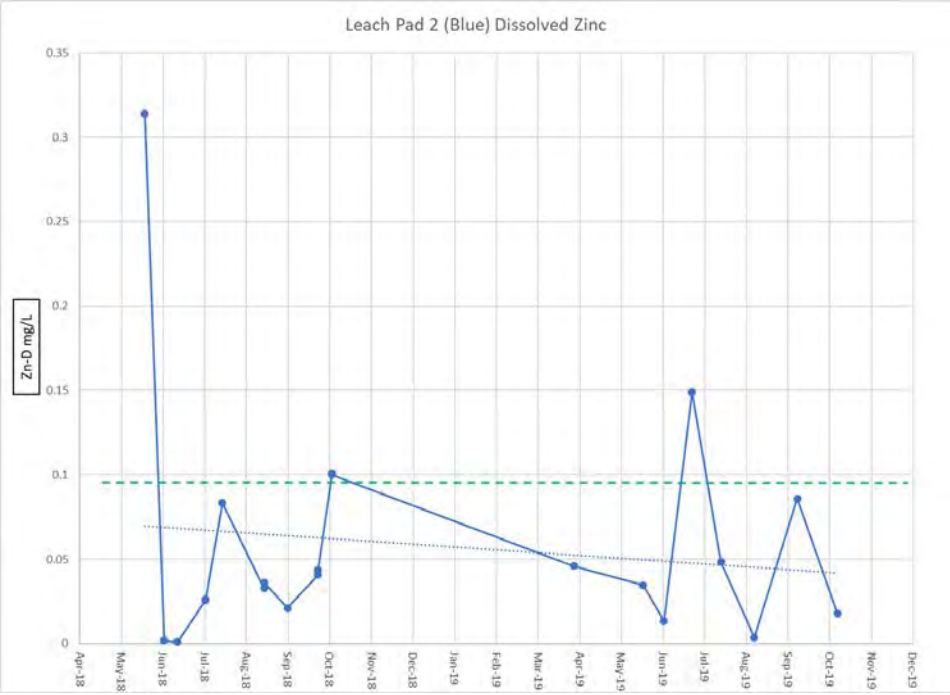


Figure 5-14: Leach Pad 2 Dissolved Zinc

6 Conclusions and Recommendations

Overall, the Contaminants of Potential Concern (COPC's) are at, near, or below the effluent release limits from both leachate sources, with the one exception of Selenium. This seems to indicate at closure, that the leachate from POX material on surface may have a slight increasing influence on other runoff waters reporting to the pits, however based on these findings, elevated selenium may be the only contaminant of concern.

The blue ore pile's NP:AP indicates this material either requires milling or aqueous disposal within the pits.

Further testing and analysis by other Qualified Professionals is recommended over the next few years, to assess differing trends from dry vs. wet years (2018 and 2019 were relatively dry, while the winter leading into 2020 has seen significantly more precipitation and snow pack).

Appendix LPS A – Leach Pad Construction Report

Metals Leaching Characterization
Leach Pads
Record of Construction

Prepared by:
Minto Explorations Ltd.
Minto Mine
May, 2018

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1 Introduction 1
2 Construction Activities 1
2.1 Work Site Preparation 1
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1 Introduction

The following report presents a record of construction for the Leach Pads, constructed from August 2017 to March 2018. The Geochemical Monitoring Program detailed in the Water Use Licence QZ14-031 includes as one of the conditions the requirement for geochemical characterization of waste, including leachate quality (Section 5.1.5, Article 94):

> *The Licensee shall update the Geochemical Monitoring Program to include a monitoring and geochemical characterization program that will produce detailed metals leaching characterization from the low-grade ore and oxide ore.*

Implementation of a monitoring program that satisfies this condition was included in the Environmental Monitoring, Surveillance, and Reporting Plan (EMSRP). The plan included construction of the leach pads in the summer of 2017 and sampling of the leachate for one year, starting in September 2017.

2 Construction Activities

The Design drawings for the construction of the Leach Pads were provided by SRK in late July, and construction began in August and September, proceeding intermittently due to high competitive demand for the necessary equipment during aggressive production mining activity in the Area 2 Phase 4 Pit.

2.1 Work Site Preparation

Work site preparation began with the initial excavation of the ground surface for the placement of residuum for the base construction and shaping, and was undertaken in August of 2017. Construction of outfall channels and the placement of 100 mm HDPE leachate collection pipes in the bottom of the pads was completed prior to the placement and shaping of residuum base material to the design dimensions from the design drawings provided by SRK (See Figure 1).

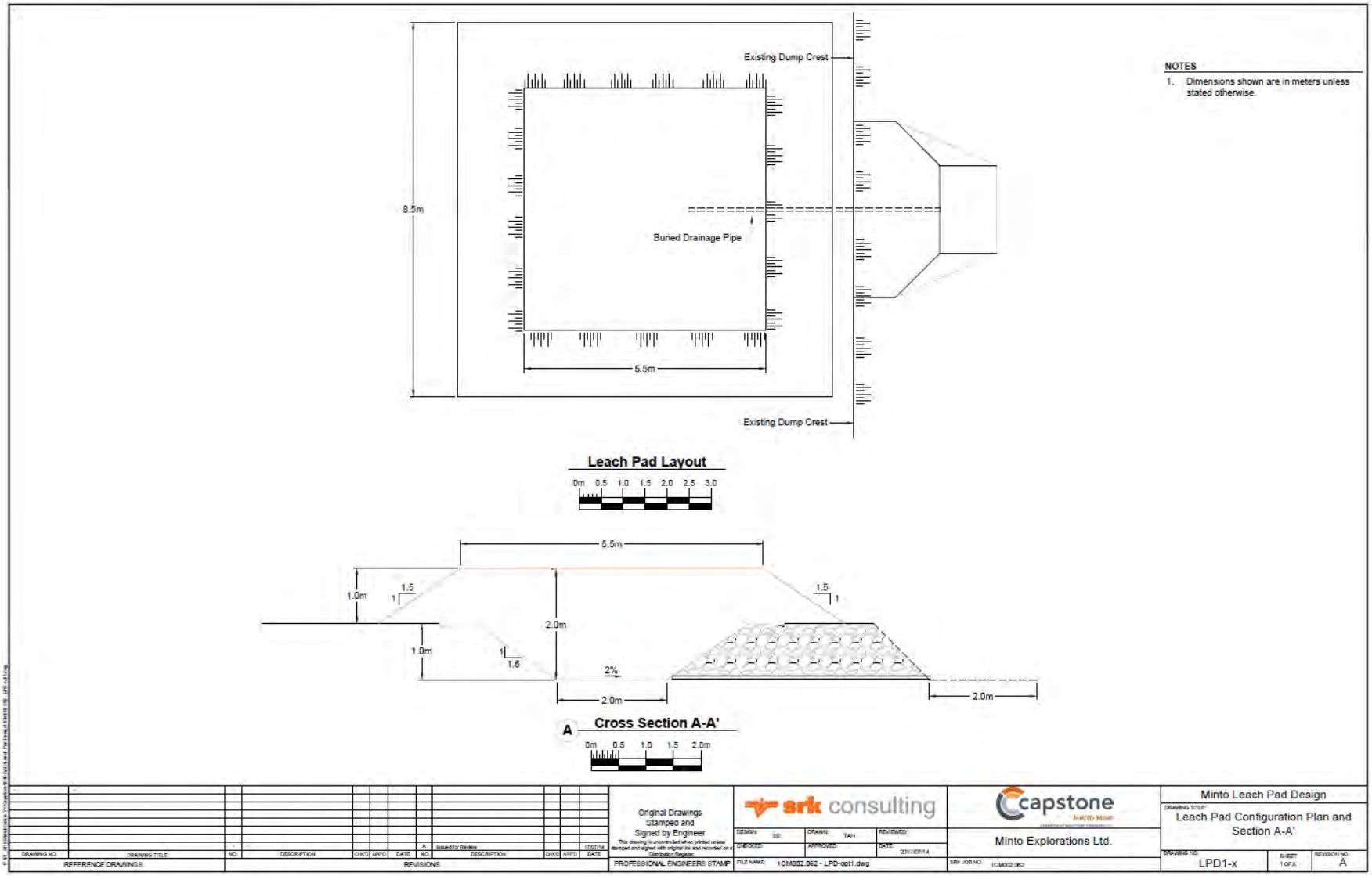


Figure 1: Leach Pad Design Drawing



Photo 1: Pad #2 under construction using Residuum. Pad 1 in Foreground – looking southeast

The initial Shaping of Pad #1 was completed in it's entirety before Pad #2 construction began. Placement of Residuum and shaping of the berms prior to liner installation was completed on October 6th (See Photos 1&2).



Photo 2: Leach Pad #1 residuum placement completed. Pipe in bottom visible



Photo 3: Outfall for leachate collection pipe placement

2.2 Liner Placement

A 4.0 mm Bituminous Geomebrane Liner (BGM Liner) was selected for the Leach Pads due to relative ease of installation, requiring no specialized tools or skills to weld the seams. A liner installation plan was supplied by SRK (See Figure 2), however it was not deemed practical for field installation due to the difficulty in installing the largest piece of liner by hand due to it's weight, as well as the number of seams requiring sealing and the propensity for smaller liner pieces to shift and move while being walked on. Each liner was installed in 5 pieces; one for the bottom, and one for each of the sides. All liner pieces overlapped the next piece by at least 150 mm as per the manufacturers recommendations. The installed liners are shown in Photos 4, 5, and 6.

All seams were welded using a "tiger torch", with pressure applied to the seams ensuring full bonding of both layers. Quality Control was completed during seam welding on at least 10% of each seam and in random locations following completion of each weld. Particular attention was paid to areas where three layers converged, ensuring a strong, water tight bond between all layers.

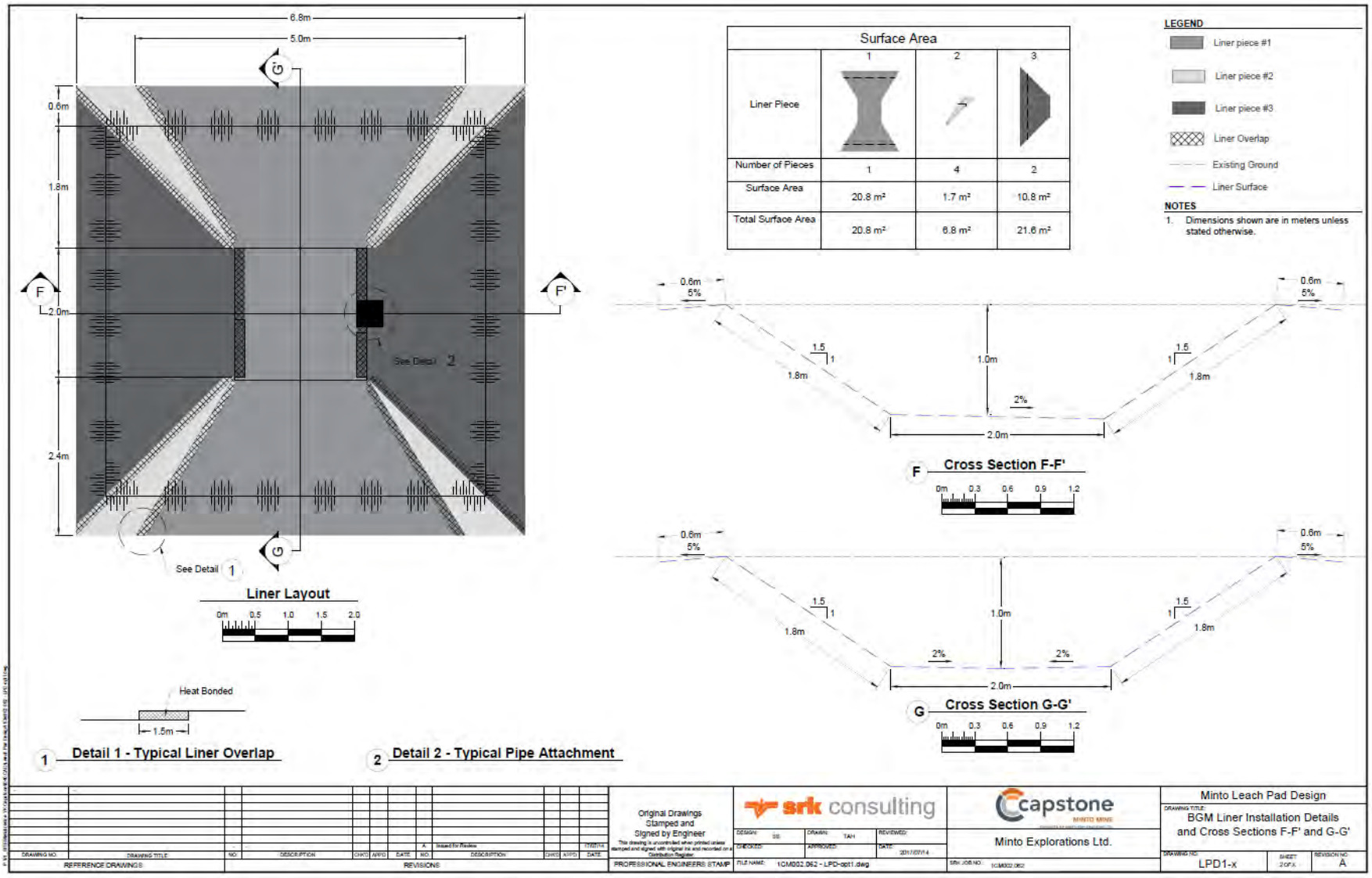


Figure 2: Liner Installation Design Drawings



Photo 4: BGM liner install: bottom not yet sealed



Photo 5: Leachate collection pipe boot seal detail

2.3 Pad Filling

The Leach pads were designed to be filled with a nominal depth of 2.0 meters of ore. Pad #1 was to be filled with Partially Oxidized Ore (POX), and Pad #2 was to be filled with Low Grade Sulphide (Blue) Ore. SRK provided fill design plans (See Figure 3), and these were roughly adhered to in the field resulting in a nominal depth of 2.5 meters of POX on Pad #1, and a nominal depth of 2.1 meters of Blue Ore on Pad #2. The final measured volume of material placed on Pad 1 was 143 m3, and on Pad 2 was 126 m3. Because placement of both materials occurred during the winter, the pads had to be cleared of snow before the ore could be placed. This activity and the completed placement of ore can be seen in Photos 6 -8.

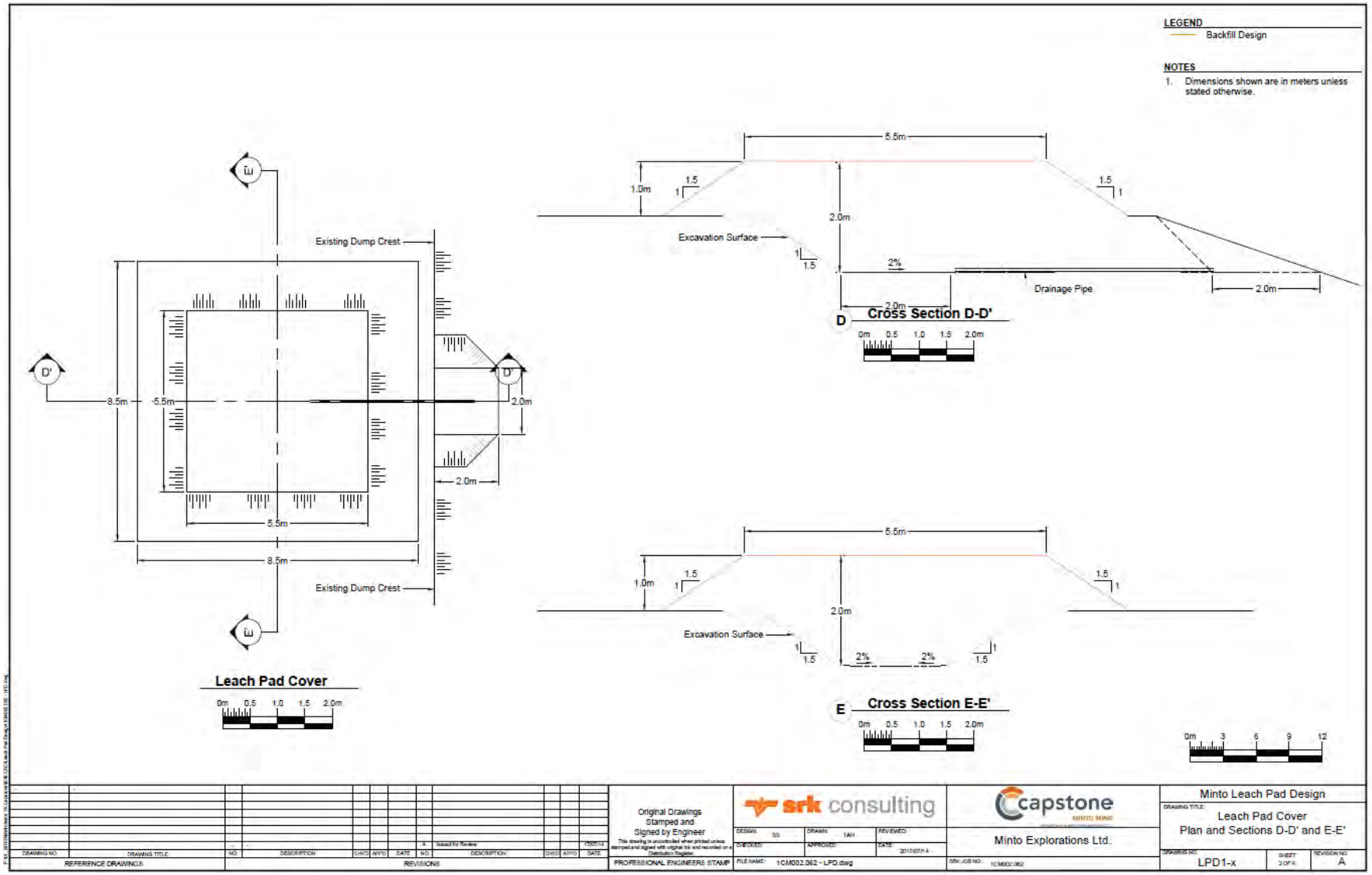


Figure 3: Leachate Pad Cover/Fill Design



Photo 6: Leach Pad #1 snow clearing prior to POX placement



Photo 7: Leach Pad #1 filled with POX



Photo 8: Leach Pads #1 and #2 Completed (Spring 2018 photo)

Figure 4 shows Survey scans of the completed Leach Pads before and after placement of materials in plan view. Figure 5 shows a cross-section of each leach pad as-constructed in the field.

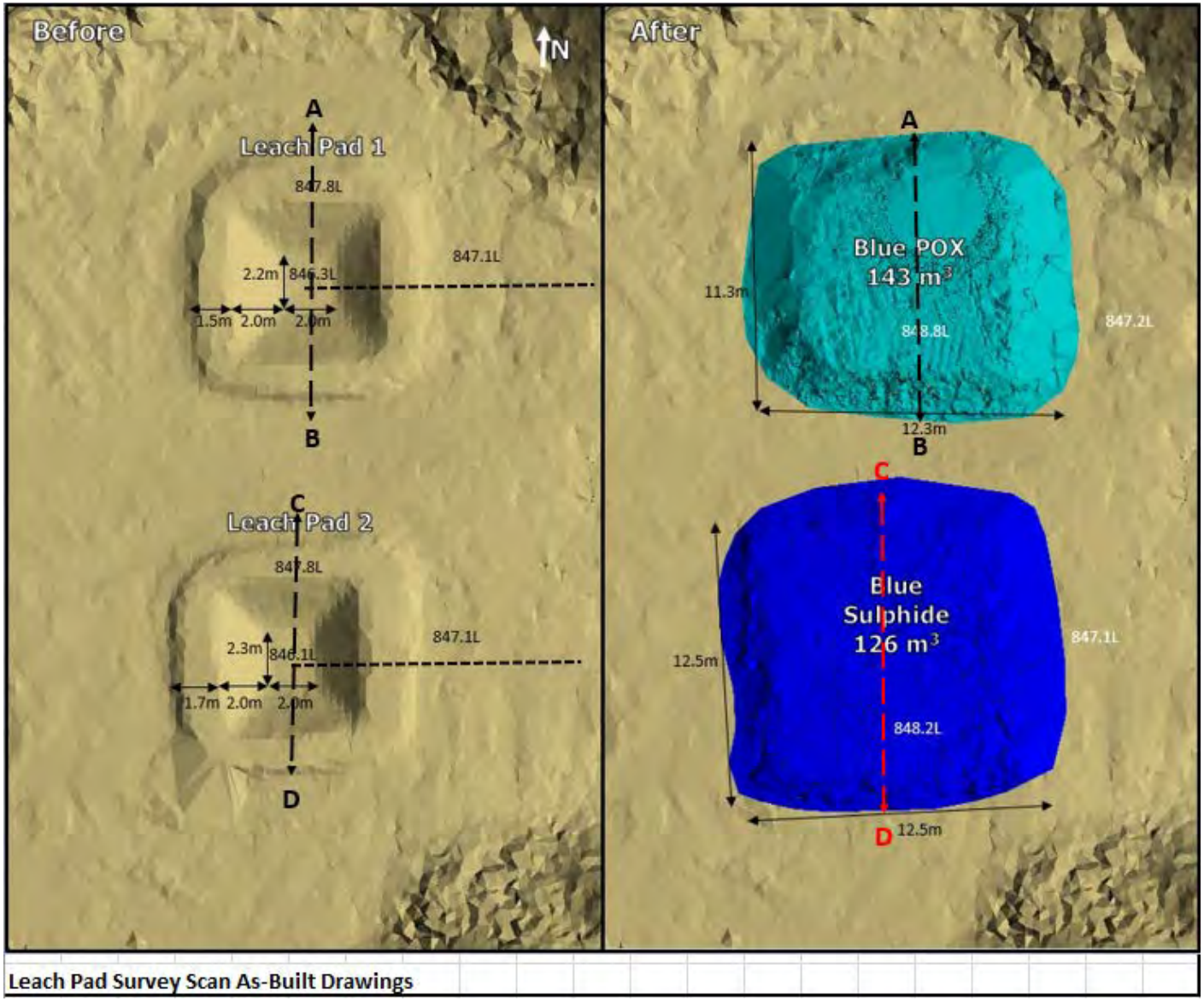


Figure 4 – Plan View of Pads before and after material placement

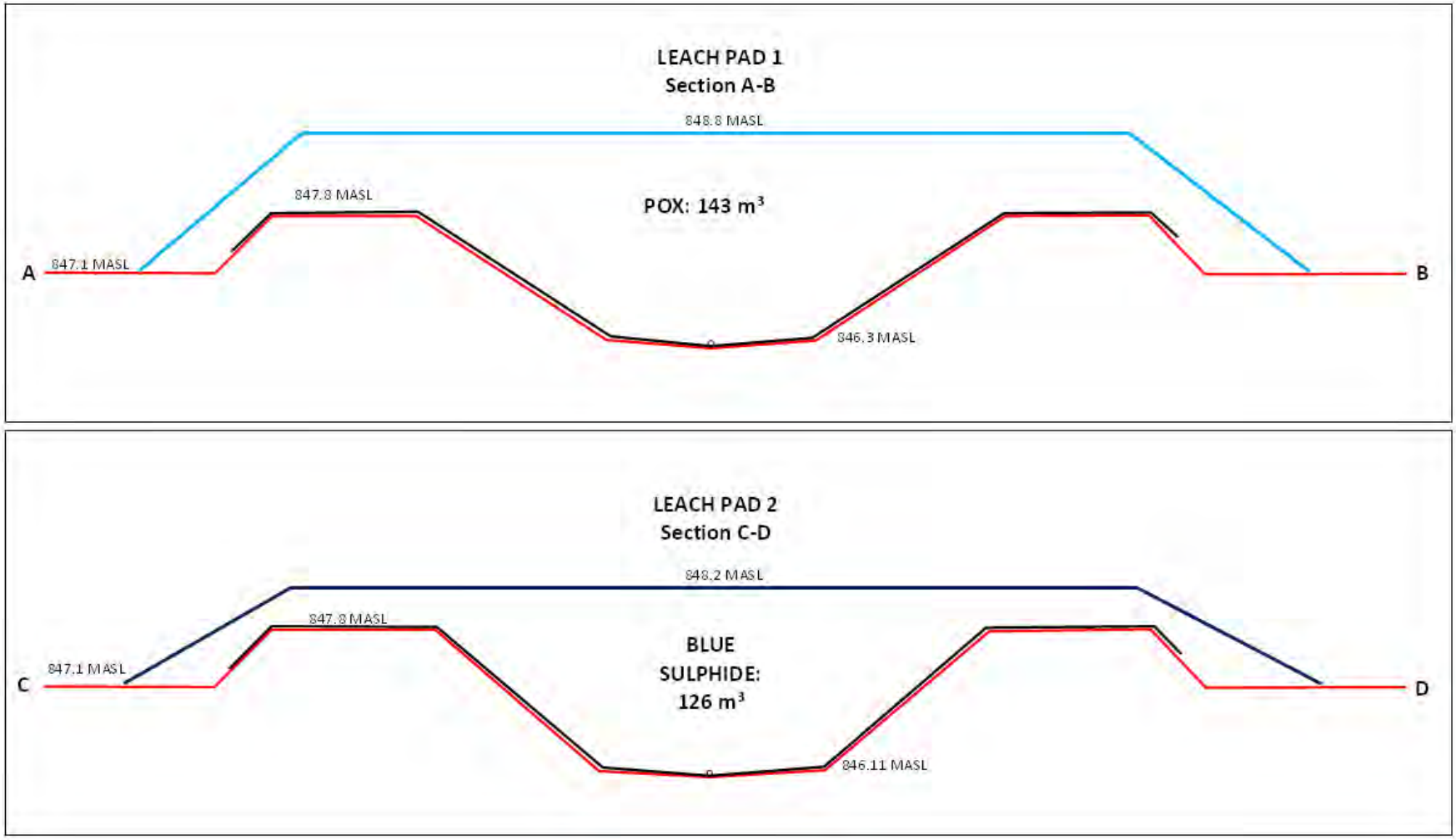


Figure 5: Cross Sections A-B and C-D of Pads 1 and 2.

3 Conclusion

This report has been prepared to satisfy the as-built construction report for the metals leaching characterization test pads as per Article 34 of Water Licence QZ14-031.

Prepared By:

_____
Todd Swenson, EP

Environmental Professional

Date: May 22, 2018

Reviewed by:

_____
Kevin Cymbalisty, P.Eng

Mine Manager

Date: May 28, 2018

4 References

Environmental Moitoring, Sampling, and Reporting Plan (EMSRP). Minto Explorations, July 2016.

SRK Consulting (Canada) Inc. 2017. Proposal for Installation of Lysimeters and Construction of Leach Pads. Proposal prepared for Minto Explorations Ltd., SRK Project Number 1CM002.P13. June 9, 2017.

SRK Consulting (Canada) Inc. 2017. Leach Pad Construction Drawings. Memo prepared for Minto Explorations Ltd., SRK Project Number 1CM002.062. July 14, 2017.

Appendix LPS B – Sampling Methodology

Background

The collection of leachate samples from two Leach Characterization Testing Pads (Leach Pads) at Minto Mine (Minto) was first required by the approved 2017-02 EMSRP. Leach Pad 1 is filled with POX material. Leach Pad 2 is filled with blue ore. Water quality samples are required monthly from both leach pads.

Field staff are responsible for coordinating all sampling events in accordance with the requirements of the current EMSRP, including sampling locations, sampling frequency, and parameter requirements.

All sampling and documentation must be conducted in accordance with the Surface WQ Sampling SOP and the QA/QC protocols.

Preparation for Leach Pad sampling must also include provision for quality control samples. Due to the short term of this sampling project, a duplicate sample will be collected from one of the Leach Pads each month.

Safety Precautions

It is particularly important for employees to be aware they are working in proximity to a sheer rock face. It is important they remain aware of where they are, stay as far away from the cliff face as possible, and remain conscious of their footing when approaching the sampling sites.

Leach Pad water quality sampling and related tasks can be carried out by an employee working alone.

Equipment

- Sample bottles, labels, and seepage WQ field forms
- pH Pen
- Nitrile gloves
- Syringes and filters
- Sample preservatives
- Cooler and sufficient ice packs

Procedure

1. Clearly label all sample bottles with station name (LP1 or LP2), date, time (24-hour clock). See Figure 1 below for the location of the leach pads.
2. Put on clean nitrile gloves prior to collecting the sample.
3. For each leach pad, shown in Figure 1, collect a WQ sample as listed in Table 1 and send to ALS Environmental labs.

Table 1: Leach Pad WQ Sample Requirements

Analysis Name	Parameters (not inclusive)	Bottle	Filter	Preservative
Physical Parameters (General)	pH, Conductivity, TSS, TDS, Alkalinity, Anions	500 mL (Plastic)	Not required	Not required
Dissolved Metals	Metals	125 mL (Plastic)	Required	Required
Ammonia/Phosphorus	P, NH_3	125 mL (Glass)	Not Required	Required

4. All bottles will be triple-rinsed.
    a. Ensure that samples requiring filtering are rinsed with filtered water only.
5. Collect water directly from the sampling bucket using a syringe.
6. Use new syringes and filters for every station
7. Filter and add preservatives to the required samples as soon as possible after sample collection and filtering, at the sampling location.
8. **COLLECT A DUPLICATE sample from one of the Leach Pads every sampling event.**
    a. If sufficient water is available, collect the duplicate from Pad #1 on odd numbered months, and from Pad #2 on even numbered months.
    b. Alternatively collect the duplicate from whichever pad collection sump (bucket) has the most water present.
9. Field measurements can be made either in situ (in the water bucket) or using a sub-sample taken in a separate container which is discarded once the measurements are recorded.

a. Sub-samples are not used for further chemical analyses, and must be taken after the sample collection has been completed.

b. Instrumentation must display stable in-situ parameters before field staff record parameters.

10. Once Sampling is complete, the buckets should be tipped over and drained, allowing for new leachate to enter the bucket for the next sampling session, and ensuring the same leachate water is not being sampled twice.

11. Complete the seepage field form at the station, including

    a. Station Name (LP1 or LP2)

    b. Date and time of sample collection;

    c. Weather at time of sample collection;

    d. Field measurements of pH, conductivity, temperature;

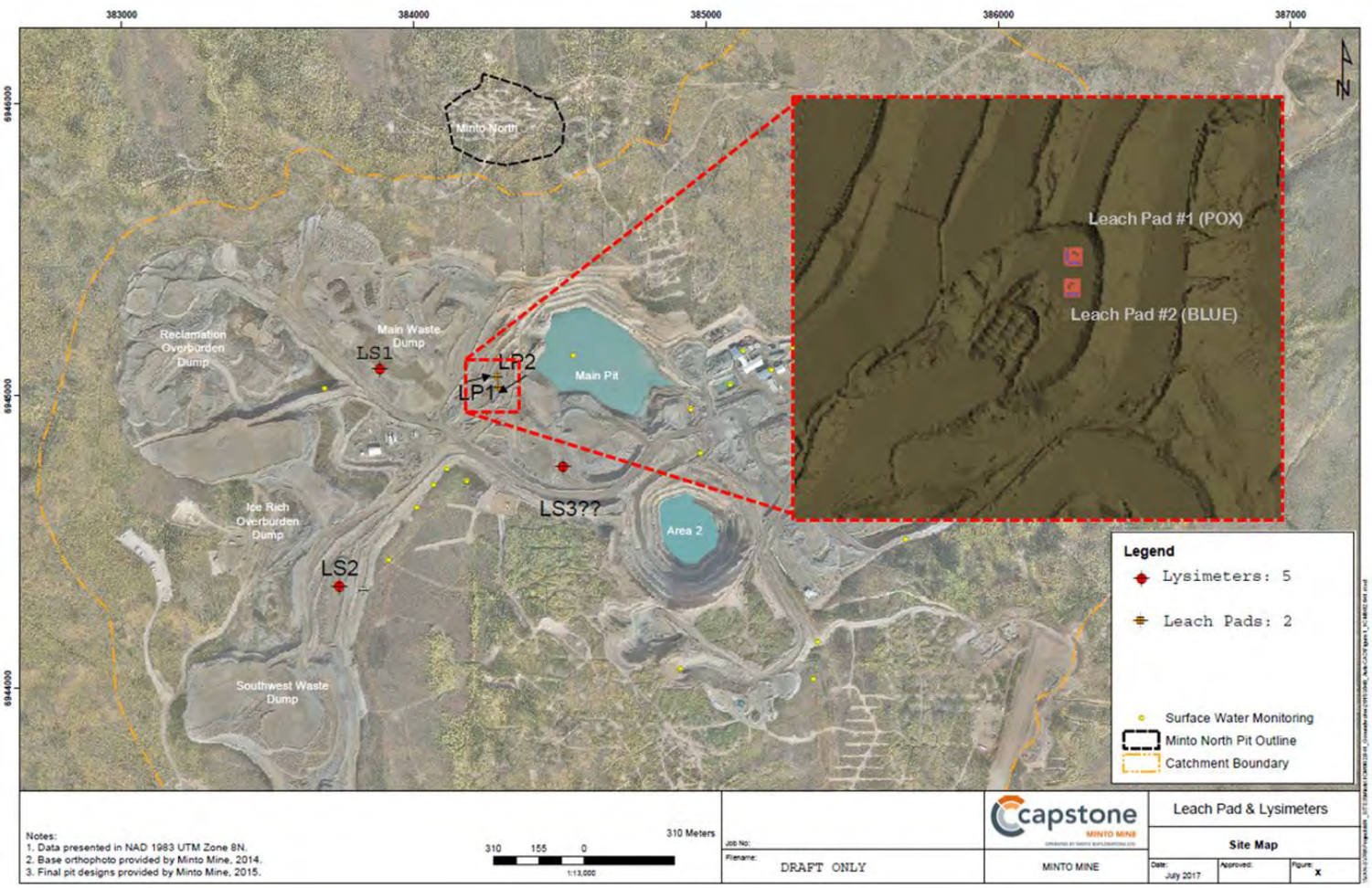
    e. Water colour, turbidity, and presence of any precipitates or mineral staining; and

    f. Record the quantity of filters used and the colour of the sediment contained, photograph the filters.

12. Enter the sample data into the water quality tracking sheet (WQTS) and file the field form.

13. Ship the samples to ALS Environmental at the earliest opportunity, as per the regular shipping process.

Figure 1: Leach Pad Location



Appendix Q – Wildlife and Hazing Tracking Report

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Was the animal hazed?	What hazing technique was used?	What was the animals response?	Who performed the hazing?	Has this animal been hazed in 2019?	Reportable Incident (Yes/No)
7-Jan-19	?	Wolf	1	2KM	Big Black no Additional markings at this time	No	N/A	Ran From Vehicle	No one	Unknown	No
23-Mar-19	14:00	Black bear	3	KM 9	looked scuffled just woke up	No	N/A	WALKING	N/A	N/a	NO
1-Apr-19	9:00	Porcupine	1	Dyno Access	Fat,Black with grey tail tip	Yes	Stomped Feet and yelled	Ran from Person	PM	Unknown	No
12-Apr-19	9:50	Moose	2	KM17	Healthy, dark brown	No	N/A	Ran from truck	N/A	N/a	No
15-Apr-19	21:00	Black Bear	1	Tailings/Km 0.5	Healthy, dark brown	No	N/A	N/A	N/A	No	No
19-Apr-19	18:20	Black Bear	1	Kitcen Patio/Barbeque Area	Healthy, dark brown	Yes	Loud yelling and air horn	Left area and walked away from camp.	CB	No	No
21-Apr-19	21:00	Black Bear	1	Tailings	Healthy, dark brown	Yes	Bear Banger (Pistol)	Continued through tailings, towards the airstrip.	CB	Yes	No
25-Apr-19	10:30	Black Bear	1	Km 1.5 Hillside	Healthy, dark brown	No	N/A	N/A	N/A	No	No
3-May-19	10:00	Bear tracks	1	Dyno Yard	Tracks of a small/medium bear seen in the snow.	No	N/A	N/A	N/A	Unknown	No
4-May-19	9:00	Black Bear	3	W3	Sow and 2 cubs	No	N/A	N/A	N/A	No	No
6-May-19	11:00	Black Bear	3	MW17-12	Sow and 2 cubs	No	N/A	N/A	N/A	No	No
7-May-19	15:15	Black Bear	3	DST	Sow and 2 cubs	No	N/A	N/A	N/A	No	No
8-May-19	14:00	Fox	1	Warehouse Laydown	Healthy	No	N/A	N/A	N/A	No	No
9-May-19	9:00	Fox	2	Mine Tech	Healthy	No	N/A	N/A	N/A	No	No
9-May-19	13:00	Fox	1	KM 0.5	Dark Fur, Healthy	Yes	Honking/Loud Noises	Ran into nearby woods	CB	No	No
9-May-19	14:00	Bears	3	Seepage Pond (WSP)	Sow and 2 cubs	No	N/A	N/A	N/A	No	No
12-May-19	19:30	Fox	1	STP	Red fox with dark colourings, healthy	No	N/A	N/A	N/A	No	No
13-May-19	10:30	Moose	1	KM 19	Healthy	No	N/A	N/A	N/A	No	No
16-May-19	16:30	Black Bear	1	WMA Landfill	Healthy, dark brown	Yes	Rubber Bullets	Left area, at a walk/jog	TS	Yes	No
17-May-19	8:00	Black Bear	2	Dumas Area	Healthy Dark Brown, smaller Black	Yes	Rubber Bullets	Left area	KR	Yes	No
24-May-19	14:45	Black Bear	1	North of W30	Healthy, dark brown	No	N/A	Heard our voices and moved away	N/A	Yes	No
25-May-19	7:45	Northern Flicker (woodpecker)	1	W62 Pumphouse		No	N/A	N/A	N/A	No	No
1-Jun-19	16:45	Mountain bluebird	1	Washbay	Distinctive blue in colour, male.	No	N/A	N/A	N/A	No	No
3-Jun-19	10:00	Fox	1	Enviro Shed/Washbay	Red fox with dark colourings, healthy	Yes	Honking/Loud Noises	Moved away from truck, not very concerned	IS	Unknown	No
5-Jun-19	10:00	Black Bear	1	KM 6.5	Black bear	No	N/A	N/A	N/A	No	No
7-Jun-19	10:00	Porcupine	1	Dyno Road		No	N/A	N/A	N/A	No	No
9-Jun-19	12:00	Moose	1	km 11		No	N/A	Moved away from truck, not very concerned	N/A	No	No
9-Jun-19	21:00	Black Bear	3	WSP dam	Sow and 2 cubs	No	N/A	Moved away from truck, not very concerned	N/A	No	No
12-Jun-19	14:00	coyote	1	L/D Shop area	N/A	NO	N/A	N/A	N/A	N/A	NO
13-Jun-19	19:00	Black Bear	1	Km 10	Healthy, Black Colour	No	N/A	N/A	N/A	No	No
2-Jul-19	6:00	Fox	1	outside ERT bays	Healthy adult Brown in color	Yes	Chased it yelling	Ran away quickly	DF	unknown	no
3-Jul-19	8:30	Black Bear	1	underneath kitchen rear patio	Healthy young brown in color	Yes	chasing it in vehicle honking and banger	innitially would not move off from under deck. Sat on edge of bushes until hazed with banger	DF	no	No
6-Jul-19	11:30	Black Bear	3	Tailings/TDD	Sow and 2 cubs	No	N/A	N/A	N/A	No	No
7-Jul-19	6:30	Fox	1	ERT/Mine Tech Area	Black colouring with a white tail. Healthy	Yes	Yelling/Clapping Hands	Moved into the woods above the ERT building.	CB	Unknown	No
8-Jul-19	10:30	Mule Deer	1	Km 2	Healthy Doe	Yes	Yelling/Clapping Hands/Air Horn	Ran into nearby woods	CB	Unknown	No
9-Jul-19	11:00	Mule Deer	1	Propane Tanks/ Tailings	Healthy Doe	Yes	Yelling/Clapping Hands	Ran onto Tailings	CB	Yes	No

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Was the animal hazed?	What hazing technique was used?	What was the animals response?	Who performed the hazing?	Has this animal been hazed in 2019?	Reportable Incident (Yes/No)
12-Jul-19	10:45	Black Bear	1	Tailings/TDD	Young, brown in colour	Yes	Rubber Bullets and Bear Bangers	Retreated into tailings reclamation area	KR	Potentially	No
12-Jul-19	10:55	Black Bear	1	Minto North Access	Young, Black in Colour	No	N/A	Seen from Helicopter before landing at airstrip	N/A	Unknown	No
20-Jul-19	Unknown	Black Bear	3	Km 3.5	Sow and 2 cubs	No	N/A	Unknwon	N/A	No	No
26-Jul-19	13:30	Black Bear	1	Airstrip/WMA Road	Young, skinny, dull black	Yes	Honking/driving towards with truck	Ran quickly into bush towards TDD	IS	Unknown	No
1-Aug-19	17:00	Porcupine	1	Behind Underground Shop	Healthy	No	N/A	Was eating leaves and quickly moved on	N/A	No	No
3-Aug-19	11:00	Porcupine	1	Flume	Healthy	No	N/A	Ran off Into the brush away from me	N/A	No	No
3-Aug-19	16:00	Lynx	1	Flume	Young/Small - Healthy	No	N/A	Sat there watching me and ran off once I had noted him	N/A	Unknown	No
4-Aug-19	7:00	Fox	1	Behind ERT Building	Healthy, Mottled	No	N/A	N/A	N/A	Unknown	No
5-Aug-19	13:00	Wolf	1	Km 21	Healthy	No	N/A	Ran across road	N/A	No	No
5-Aug-19	14:00	Cougar	1	KM 23	Healthy	No	N/A	Sitting by the side of the road	N/A	No	No
9-Aug-19	17:00	Black Bear	2	Km 7	Sow and 1 cub	Yes	Honking and Yelling	Eating berries by the side of road	CB	No	No
9-Aug-19	6:30	Fox	1	Km 18	running across the road	No	N/A	N/A	N/A	No	No
17-Aug-19	18:20	Black Bear	3	Km 2	Sow and 2 cubs	No	N/A	Came over the bank and walked down the KM 2 Road	N/A	No	No
17-Aug-19	18:45	Black Bear	2	Km 4	Sow and 1 cub	No	N/A	N/A	N/A	Yes	No
19-Aug-19	20:00	Moose	1	KM 11	Healthy Female	No	N/A	N/A	N/A	No	No
19-Aug-19	20:20	Black Bear	2	KM 2	Two Cubs	No	N/A	N/A	N/A	No	No
20-Aug-19	13:00	Black Bear	1	KM 6.5	Healthy Male	No	N/A	N/A	N/A	Unknown	No
22-Aug-19	10:30	Black Bear	3	Behind Selkirk Tower S	Sow and 2 cubs	No	N/A	N/A	N/A	No	No
24-Aug-19	17:00	Black Bear	2	KM 6-7	Sow and cub	Yes	Honking/driving towards with truck	Ran into the bush but not very far. They were still hanging around 45 minutes later.	IS	Yes	No
27-Aug-19	11:30	Black Bear	3	WSP	Sow and 2 cubs	Yes	Honking/driving towards with truck	Ran up the hill on north side of the road.	IS	No	No
27-Aug-19	14:30	Black Bear	3	KM 1.5/WSP	Sow and 2 cubs	Yes	Loud yelling/honking of vehicle horn	Did not haze until three bears had crossed the road. Once on the hill, bears were hazed and moved quicker up the hill face.	CB	Yes	No
28-Sep-19	10:00	Deer	1	Km 3	Running on road	No	N/A	N/A	N/A	No	No
29-Aug-19	13:00	Black Bear	1	Behind ERT Building	Unknown	No	N/A	N/A	N/A	Unknown	No
30-Aug-19	16:00	Mule Deer	1	KM 6	Healthy Doe	No	N/A	N/A	N/A	No	No
3-Sep-19	14:00	Black Bear	3	KM 0.5	Sow and 2 cubs	Yes	Bear Banger (Shotgun)	Ran into the bush. One cub momentarily climbed tree but climbed down and followed other two shortly after.	CB	Yes	No
3-Sep-19	16:00	Moose	1	KM 4	Cow	No	N/A	N/A	N/A	No	No
9-Sep-19	10:00	Scoter (duck)	3	WSP		No	N/A	N/A	N/A	No	No
14-Sep-19	9:00	Black Bear	1	Tailings/TDD Area	Healthy and brown coloured	Yes	Bear Banger (Shotgun)	Nothing of note. Was not particularly close.	CB	Unknown	No
14-Sep-19	13:00	Black Bear	2	Km 3	Sow and a cub	No	N/A	N/A	N/A	Yes	No
14-Sep-19	16:00	Black Bear	1	Dyno	Healthy and brown coloured	No	N/A	N/A	N/A	Yes	No
12-Oct-19	8:30	Moose	1	Km 23	Cow Moose standing by the road	No	N/A	N/A	N/A	Unknown	No
17-Oct-19	11:00	Black Bear	1	Km 12	Unknown	No	N/A	N/A	N/A	Unknown	No
25-Oct-19	17:05	Wolf	1	Landfill	Crossing road						
9-Nov-19	5:45	Fox	1	Portal	Good condition	No	N/A	N/A	N/A	Unknown	No
10-Nov-19	5:50	Fox	1	Portal Trailer		No	N/A	N/A	N/A	No	No
22-Nov-19	17:30	Fox	1	Rom Pad	Black	No	N/A	N/A	N/A	No	No

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Was the animal hazed?	What hazing technique was used?	What was the animals response?	Who performed the hazing?	Has this animal been hazed in 2019?	Reportable Incident (Yes/No)
13-Dec-19	16:30	Fox	1	Ore Pad	Black colouring	Yes	Honking/driving towards with truck	Ran off	CR	Potentially	No
19-Dec-20	20:00	Coyote	1	South Selkirk Tower	Skinny, limping	Yes	Yelling and throwing rocks	Ran off	CR	No	No
20-Dec-19	11:00	Coyote	1	WTP/Wash Bay	Skinny, limping	No		N/A	N/A	Yes	No
21-Dec-19	11:20	Coyote	1	Main Dry Entrance	Laying under stairs, pocupine quills in face	Yes	Bear banger, prodding with pole	Would not move from under stairs	IS/CR	Yes	No
23-Dec-19	11:00	Coyote	1	Main Dry Entrance	Laying under stairs, pocupine quills in face	Yes	Captured with pole snare, put down with shotgun slug		IS/CR	Yes	Yes

Appendix R – Vegetation Metal Uptake Program Report

ALEXCO ENVIRONMENTAL GROUP

VEGETATION METAL UPTAKE MONITORING PROGRAM

FOR MINTO MINE

Final

March 2020

Prepared for:

MINTO EXPLORATIONS LTD.

ALEXCO ENVIROMENTAL GROUP INC SIGNATURES

Report prepared by:



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Senior Biologist, Project Manager

EXECUTIVE SUMMARY

The Minto Mine is a high-grade copper mine located approximately 240 km northwest of Whitehorse, Yukon Territory. The project is located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R6A. The Minto Mine commenced commercial operation in October 2007. Minto initiated a vegetation metal uptake (VMU) monitoring program to meet requirements for Minto mine's permit compliance and the conditions specified in the Yukon Government's December 18, 2014 "Minto Mine Project QML-0001 Plan Requirements" letter. The objective of the program is to establish a network of monitoring sites around the mine site to quantify the effects of airborne transport and metal uptake in vegetation on the mine site and surrounding areas through time.

The VMU program was initiated in 2016, when sixteen exposure and five control sites were established. Samples were collected from key soil horizons and key plant species that could be vectors to humans or wildlife (blueberry, horsetail, Labrador tea, lichen, and willow). These monitoring sites were sampled in 2019 with the following changes: 1) lowbush cranberry was sampled in plae of blueberry, and 2) three samples were collected from the available target vegetation species at each site. Constituents of Potential Concern (COPC) that were examined include: Aluminum (Al), Antimony (Sb), Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Molybdenum (Mo), Nickle (Ni), Selenium (Se), and Zinc (Zn). These COPCs were analyzed and then compared between control and exposure sites and between unrinsed and rinsed samples to try and quantify the effects of mine related activity on vegetation metal concentrations, including the influence of particulates on the measured concentrations.

Paired sample Wilcoxon's statistical tests were performed on rinsed and unrinsed vegetation samples for each species. Concentrations of COPCs in Labrador tea and willow samples were significantly higher in unrinsed samples when evaluated to a significance value (p) of 0.05 (meaning there is a 95% probability that there is a statistically significant difference between unrinsed and rinsed samples for Labrador tea and willow).

Two sample Wilcoxon's statisical tests were performed between control and exposure sites, and between 2016 and 2019 results. Most COPCs were significantly higher at exposure sites compared to control sites in Labrador tea, lichen, and willow samples (Al, As, Cu, Fe, Pb, and Cu and Zn in lichen) and some were also higher in exposure horsetail (Al, Cu, Fe) and cranberry (Al and Cu). COPC concentrations in control sites were significantly higher in 2019 than 2016 only in lichen samples. COPCs were also significanly higher in lichen from exposure sites in 2019 than 2016. Various COPCs were higher in 2019 exposure sites samples in horsetail (Al, Cu, Fe, Pb), Labrador tea (Cu, Zn), and willow (Pb); zinc was significantly lower in willow in 2019 exposure sites. A comparison of the 2016 blueberry and 2019 cranberry samples found aluminum was significantly higher in 2019 cranberry, and cadmium was significantly higher in 2016 blueberry.

Soil samples were compared by horizon between exposure and control sites for the 2019 sampling event. As in 2016, exposure sites typically contained higher concentrions of COPCs than control sites, particularly in the upper horizons. The largest concentration differences were in copper, manganese, and molybdenum, followed by zinc, selenium, and cadmium. Exceedances of CCME industrial guidelines were found in two sites for arsenic (four samples) and six sites for copper (14 samples) out of a total of 21 sites (63 samples). Soil pH was similar between control and exposure sites and was typically lower in the upper soil horizons. No significant differences were recorded between 2016 blueberry and 2019 cranberry control sites, though 2019 cranberry had significantly higher aluminum and lower cadmium than 2016 blueberry.

Overall, results indicate higher concentrations of COPCs in vegetation from exposure sites, and an increase in concentration from 2016 to 2019 in lichen for all COPCs and some COPCs in other vegetation species. The increase in concentration in exposure sites and with time could be due to airborne particulates from the Minto Mine though continued monitoring is needed to determine whether the increases in 2019 are part of a trend. Subsequent studies will help establish a trend and provide ongoing evaluation of the extent and degree that metals from mining activity may be affecting vegetation in the proximity of the project site.

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APPENDIX B: 2019 VEGETATION AND SOIL LAB RESULTS

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LIST OF ACRONYMS AND ABBREVIATIONS

AEG	Alexco Environmental Group Inc.
CCME	Canadian Council of Minister of the Environment
CEQG	Canadian Environmental Quality Guidelines
Contango	Contango Strategies Ltd., an Alexco Environmental Group (AEG) Company
COPC	Constituent of potential concern
DL	Detection limit
DQO	Data Quality Objective
EMR	Government of Yukon, Department of Energy, Mines and Resources
EMSRP	Minto Phase V/VI Environmental, Monitoring, Surveillance and Reporting Plan
ICP-MS	Inductively coupled plasma mass spectrometry
Minto	Minto Explorations Ltd.
PQL	Practical quantitation limit
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
VMU	Vegetation metals uptake

1 INTRODUCTION

Increased metal concentrations on mine sites often occur as a result of extraction of highly mineralized rock, which is transported, milled and stored in these areas, and the exposure of mined materials to environmental influences. Metals can leach from mine waste into the immediate aquatic environment via direct surface water runoff or infiltration of precipitation (aqueous transport). In terrestrial systems, in-situ soils may already have naturally occuring elevated levels of metals due to local mineralization of the surficial parent material. Dust from blasting, ore crushing and waste dumping, can be wind (aeolian) transported to surrounding terrestrial areas, settling on the ground and the surface of plant leaves, stems and fruits. Over time, these receiving environments can accumulate contaminants which can affect the biological function of aquatic and terrestrial ecosystems.

These effects can be influenced by a number of variables, and the accumulation processes can be complex. Generally speaking, plants can accumulate metals which can then be consumed by herbivores, which in turn become prey for carnivores. Harvesting and consuming country foods by humans can also present an exposure pathway. Monitoring metal uptake in plants in areas with mining actvity has been used to assess potential and ongoing risks to these receptors. Understanding this potential can help guide futre mine operations to reduce adverse effects on the environment.

Alexco Environmental Group Inc. (AEG) was retained by Minto Explorations Ltd. (Minto) in 2016 to develop a Vegetation Metals Uptake (VMU) Monitoring Plan (the Plan) that meets requirements for Minto mine's permit compliance. The long term goal of the VMU monitoring is to determine if, and to what extent, metals from the mine are transferred to the surrounding environment and and if the metals deposition is occurring, are the concentrations high enough to pose a risk to wildlife or humans.

The first VMU monitoring was completed in August 2016, during which the 16 exposure sites and five control sites were established. Key soil horizons and vegetation species (blueberry (*Vaccinium* spp.), horsetail (*Equisetum* spp.), Labrador tea (*Rhododendron* spp.), lichen (*Cladonia, Cladina,* and *Stereocaulon* spp.), and willow (*Salix* spp.)) were sampled from each site and analyzed for the Constituents of Potential Concern (COPCs). COPCs include antimony (Sb), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se), and zinc (Zn). Results were compared between control and exposure sites to determine if mine related activity is resulting in increased vegetation metal concentrations. Rinsed and unrinsed plant samples were also compared to determine if metal concentrations were from particulates on the plant or the plant itself. Overall, metal concentrations were higher at exposure sites, compared to control sites.

The result from the 2016 monitoring indicated that the metals that are of potential wildlife and human health concern, including arsenic and lead, were higher at exposure sites than at control sites for lichen and willow. Copper was higher at exposure than control sites for horsetail and Labrador tea. Blueberry showed no response. While this increase could potentially be the result of airborne particulates from the Minto Mine, the results were inconclusive due to the high variability associated with the data and minimal pre-mine data. As this first program provided the basis for initial comparison, subsequent studies will help establish a trend and provide ongoing evaluation of the extent and degree that metals from mining activity may be affecting vegetation in the proximity of the project site.

Minto's Quartz Mining Licence requires that VMU monitoring be conducted every three years, and Minto reqested AEG to conduct the sampling, analysis and reporting in 2019. The following sections provide the details of the second round of VMU monitoring for the Minto Mine and provides a comparison to the results from the first year of monitoring.

1.1 REGIONAL SETTING

The Minto Mine lies within the Boreal Cordillera Ecozone and Yukon Plateau Ecoregion (Smith et al., 2004). The Minto Mine is situated in the far western part of the Yukon Plateau Ecoregion near the Dawson Range and adjacent to the Klondike Plateau Ecoregion in the west. This area was part of the eastern extent of Beringia, which remained ice free approximately twenty to fifteen thousand years ago (Smith et al., 2004).

Forest fires are frequent in this part of the Yukon Territory as it lies in the rain shadow of the St. Elias-Coast Mountains and receives less than 300 mm of precipitation per year (Smith et al., 2004). As a result, the study area around Minto Mine has experienced numerous fires over the last forty years rendering it a complex mosaic of plant communities at varying stages of succession. Young mixed lodgepole pine and trembling aspen forests are the most common forest type, and willow species are ubiquitous in the understory as well as in the main canopy in shrub dominated areas. Black and white spruce with shrub and feathermoss understories can be found on northerly aspects and in moist drainages. The study area is in the eastern part of the Dawson Range foothills with elevation range of 700 metres above sea level (masl) to 950 masl. The landscape has rounded mountains intersected by broad valleys and drainages that are part of the Yukon River watershed. The project is in the sporadic discontinuous permafrost zone where permafrost is encountered on northern slopes and in low lying areas where solar radiation is reduced (Smith et al., 2004).

1.2 SITE DESCIPTION

The Minto Mine is located 240 km northwest of Whitehorse on the west side of the Yukon River (approximately 62°37'N latitude and 137°15'W longitude; Figure 1-1 and Figure 1-2) and is located within Selkirk First Nation (SFN) Category A Settlement Land Parcel R6A. The Minto Mine is a combination open pit and underground copper mine that began operation in October 2007. It consists of multiple open pits and an underground workings. In addition to the mining areas, the mine consists of a number of other facilities and infrastructure, including waste rock storage areas, ore stockpiles, a crusher, a mill for processing the ore, and a dry stack tailings storage facility (Figure 1-3). In October 2018, due to unfavourable equity market conditions, the Minto Mine was placed into temporary care and maintenance (Capstone, 2018). In June 2019 the Minto Mine was purchased by Pembridge Resources and underground mining activities resumed in late 2019.

1.3 REGULATORY REQUIREMENTS

The VMU Monitoring Plan is required by the Government of Yukon, Department of Energy, Mines and Resources (EMR), to form part of the revised Minto Phase V/VI Environmental, Monitoring, Surveillance and Reporting Plan (EMSRP). Specifically, the VMU Monitoring Plan meets requirement (d) of EMR's Plan Requirement Letter (December, 2014) and satisfies conditions (c, d, e, f) of the Environmental Monitoring, Surveillance and Reporting section of EMR's Approval of Operational and Environmental Plans – QML-0001 Letter (March, 2016), which specifies that the following be submitted:

EMR Plan Requirement Letter:

(d) a program for monitoring and measuring metal uptake in vegetation on the mine site, and in areas surrounding the mine site.

Approval of Operational and Environmental Plans – QML-0001:

(c) the selection of vegetation control plots for the monitoring program must take into consideration the proximity of all active mining areas, and those areas located within migration paths of prevailing wind directions (after considering year-round prevailing wind directions);

(d) the selection of vegetation species for the monitoring program must consider species that represent good indicators for evaluating airborne transport and metal uptake;

(e) opportunities must be made available for Selkirk First Nation participation in the vegetation monitoring program, including the identification of key vegetation species for consideration prior to finalizing the selection of plants; and

(f) a comprehensive soil sampling program must include sampling at various soil horizons to provide a more comprehensive soil profile.

1.4 PROGRAM OBJECTIVES

The main objective of the VMU Monitoring Program is to develop and execute a program that monitors and measures the effects of airborne transport and metal uptake in vegetation on the mine site and surrounding areas that:

- Uses previously established or documented conditions, monitoring results or predictive efforts, where appropriate and possible;
- Establishes a network of plots for monitoring both soil and vegetation metal concentrations; and
- Allows for an ongoing evaluation of the extent and degree that metals from mining activity is affecting vegetation in proximity to the project site.





PEMBRIDGE RESOURCES

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MINTO MINE

VEGETATION METAL UPTAKE MONITORING PROGRAM

FIGURE 1-1
PROJECT LOCATION

JANUARY 2020

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MINTO MINE

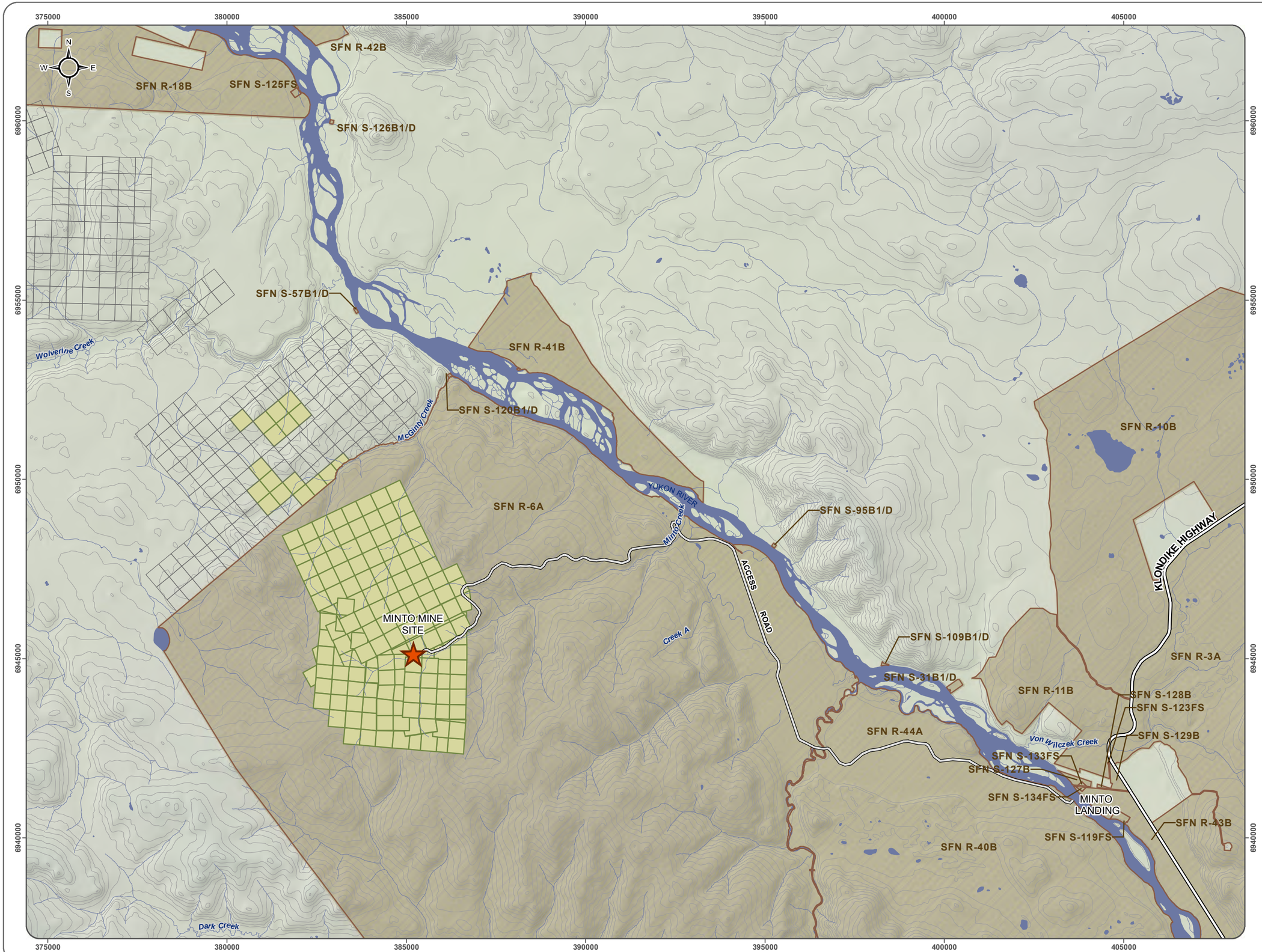
VEGETATION METAL UPTAKE MONITORING PROGRAM

FIGURE 1-2

MINTO MINE SITE PROPERTY OVERVIEW

JANUARY 2020

PEMBRIDGE RESOURCES



- Minto Mine Site
- Mine Access Road
- Selkirk First Nation Settlement Lands
- MInto Exploration Ltd. Claims
- Other Claims

1:100,000 *when printed on 11 x 17 inch paper*

0 1 2 3 4 5

kelometres

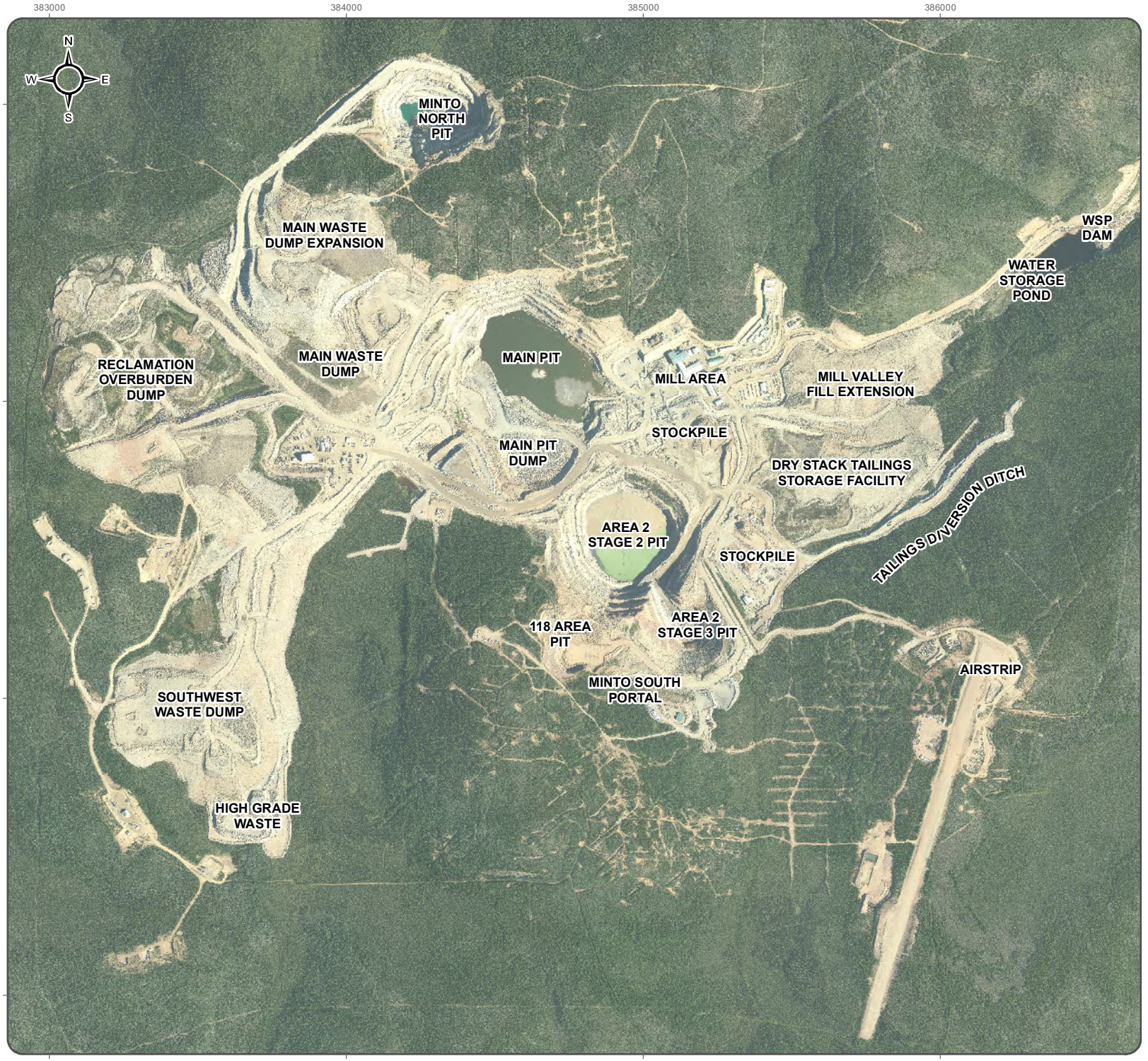
ALEXCO ENVIRONMENTAL GROUP

First Nation Settlement land obtained from Natural Resource Canada. Quartz claim boundaires and ownership are current as of 03 January 2020. Data obtained from Mineral Resources Branch, Energy Mines and Resources Department, Government of Yukon.
Site hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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(*Last edited by: amatlashevska,2020-01-03,4:14 PM*)



MINTO MINE
VEGETATION METAL UPTAKE MONITORING PROGRAM

FIGURE 1-3

SITE CONFIGURATION AND EXISTIG INFRASTRUCTURE

JANUARY 2020

PEMBRIDGE RESOURCES

1:18,000 ***when printed on 8x11 inch paper***

0 100 200 300 400 500 Meters

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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.

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2 METHODS

The following section describes the methods used in 2019 by AEG and Minto staff to meet the objectives as outlined above. The methods include defining the study area and monitoring network (sample sites), selection of target vegetation species, identification of metals of concern, microsite selection and establishment, sampling procedures for vegetation and soils, laboratory analysis, and Quality Assurance/Quality Control.

2.1 STUDY AREA AND MONITORING NETWORK

The study area was selected in 2016 by considering direct disturbance (and reclamation) by mining activities, previous monitoring locations, the prevailing wind direction, the accessibility of the area, and the anticipated dispersal mechanisms and extent of metal contamination. Areas anticipated to receive higher densities of dust fallout, based on meterological data indicating prevailing winds and air dispersion modelling conduted by RWDI Consulting Engineers in 2013 were chosen for the sampling sites, with control sites located outside of the projected zone of influence. When possible, plots established during the 2010 ecosystem mapping were used. Sampling sites are shown in Figure 2-1.

MINTO MINE

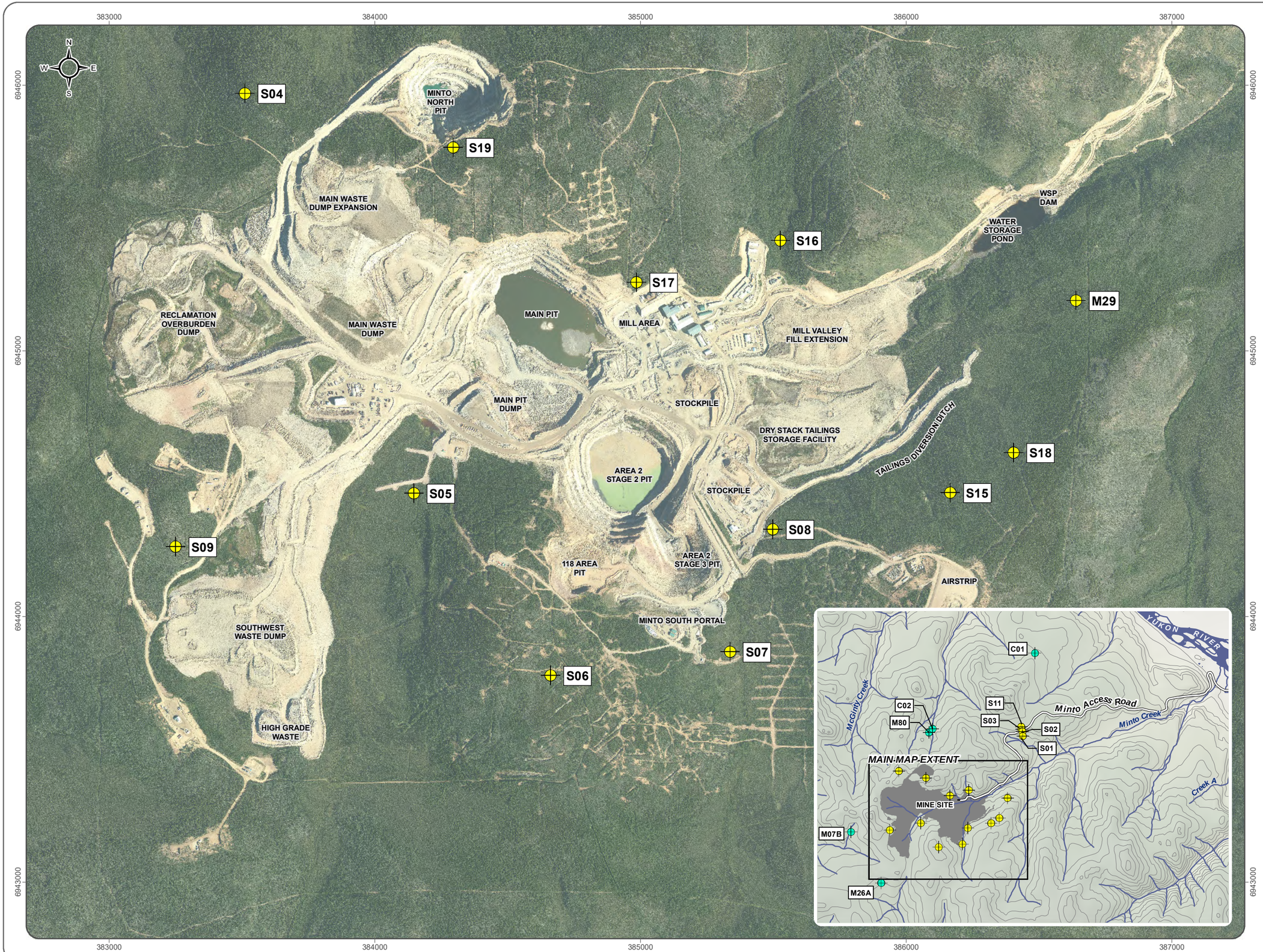
VEGETATION METAL UPTAKE MONITORING PROGRAM

FIGURE 2-1

2016 VEGETATION METAL UPTAKE MONITORING NETWORK

JANUARY 2020

PEMBRIDGE RESOURCES



1:13,500 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

- Control Plot
- Exposure Plot
- Minto Access Road
- Mine Footprint
- Waterbody
- Watercourse

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Aerial imagery obtained from Challenger Geomatics. Imagery acquired August 9rd 2017

Datum: NAD 83 Projection: UTM Zone 8N

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(*Last edited by: amatlashevska;2020-01-03;4:04 PM*)

2.2 CONSTITUENTS (METALS) OF POTENTIAL CONCERN

Based on the Canadian Council of Ministers of the Environment (CCME) and the Yukon *Environment Act*, certain metals are identified as Constituents of Potential Concern (COPC), since exposure and/or bioaccumulation to high concentrations of these elements can result in damage to plants, aquatic organisms, terrestrial wildlife, and human health. Of these COPC's, the metals of interest that were selected for the VMU program in 2016 were those known to have elevated levels specific to the minerals in the Minto deposit and are species consumed by other animals; the same COPCs were monitored in 2019. It should be noted that toxic effects usually require persistent exposure to high concentrations of the metals, and that as naturally mineralized area, elevated metal concentrations in soil (and to some degree in vegetation) are expected in the baseline condition in the vicinity of the mine site.

Laboratory analyses were completed for the full suite of metals by inductively coupled plasma mass spectrometry (ICP-MS) as reported in Appendix B; however, the results discussed in Section 3 focus on the following:

- COPCs include Antimony (Sb), Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Manganese (Mn), Molybdenum (Mo), Nickel (Ni), Selenium (Se), and Zinc (Zn); and,
- Metals related to dust include Aluminum (Al) and Iron (Fe).

2.3 SELECTED TARGET VEGETATION SPECIES

Active mine sites by their nature are often situated in highly mineralized areas. In-situ soils, as well as vegetation growing in the soils, may have naturally elevated concentrations of metals due to local mineralization of the surficial parent material or near surface lithic layers. During the development and operation of a mine site, metals can mobilize from mined material by aqueous transport into immediate aquatic environments, and dust can be transported by wind to terrestrial areas. Metals can accumulate in these receiving environments over time; while accretion processes are highly complex, plants can become intermediaries or vectors in conveying metals to higher trophic levels when consumed by herbivores, which subsequently become prey for carnivores (CCME, 2006).

The potential for bioaccumulation of metals, and the degree to which it can occur, is a function of a number of variables, and the accumulation processes is highly complex. In addition, harvesting and consumption of vegetation and mammals by people can present an exposure pathway for metals to humans. Two predominant pathways are uptake through plant roots from the soil and uptake through the leaves from airborne dust dispersion (Kabata-Pendias et al., 2011). Additionally, there are two effects pathways of concern from metal accumulation in vegetation: effects from plants to wildlife and effects from plants to humans, potentially through wildlife. There are numerous plants species that are either known or expected to be consumed directly by wildlife in the study area. To a lesser degree, there are some plant species in the study area which are known to be consumed by humans as part of traditional gathering.

The target species were selected in 2016 after a review of the vegetation metal uptake programs developed for the Minto Mine and consultations with Selkirk First Nation (AEG, 2016). Five species (willows, horsetail, blueberries. Labrador tea, and lichen) were selected as representative of the two pathways and their effects on wildlife and humans that use the area (Table 2-1). Due to the limited blueberry sample size in 2016, a result of

lower abundance in the region, lowbush cranberry was added as a target species in 2019. It is more commonly present than blueberry, and is also an important harvest species and consumed by wildlife.

Table 2-1: Selected Target Vegetation Species for Metal Uptake

Target Plants	Plant Part Collected	Rationale for Selection
Willows (*Salix* spp.)	Leaves	Willows are common in the project site. Willows hyper- accumulate cadmium (Cd) in leaves. Are important browse species for moose.
Horsetail (*Equisetum* spp.)	Plant	An accumulator of zinc (Zn). Consumed by moose and bear.
Blueberries (*Vaccinium* ssp.) or Soapberries	Fruit	Human gathering/bear and bird forage.
Lowbush cranberry (*Vaccinium vitis-idaea*)	Fruit	Human gathering/bear and bird forage.
Labrador tea (*Rhododendron* ssp.)	Leaves	Medicinal uses. Bog Labrador teas leaves and twigs are browsed by caribou and moose in small quantities.
Lichen (*Cladonia*, *Cladina*, and *Stereocaulon* spp.)	Thallus	Lichen are an evergreen species (i.e they keep their foliage year round), and accumulation of dust can occur throughout the year with the exception of snow cover. They are an important species for caribou browse.

The monitoring of metal uptake in plant tissue around other mines is a typical permit requirement requested to assess potential and ongoing risks to humans and wildlife. However, the interactions between soil, plants, particulate matter and the surrounding environment are very interconnected and complex, making the understanding of metal uptake difficult. Furthermore, concentrations and metal uptake vary from species to species and vary geographically as plants adapt to their environments (Kabata-Pendias et al., 2011).

2.4 FIELD INVESTIGATION

Collection of samples took place from August 26 to 28, 2019 by Charlotte Rentmeister of AEG and Chad Bustin of Minto Mine. The same study area and monitoring network of stations was covered as in 2016, when five control monitoring sites outside the mine effected area and sixteen exposure monitoring sites in close proximity to mine infrastructure and the access road were established (Figure 2-1). At each of the monitoring sites, soil and vegetation samples were collected. A summary of the site locations and associated samples to be collected are presented in Table 2-2.

Key components of the monitoring program at each station included the following:

1. Selection of an appropriate microsite in the vicinity of the proposed station identified on the map;
2. Documenting location, and collecting relevant ecological attributes and photo documenting of the plot (see Appendix A);
3. Soil sampling at multiple horizons; and
4. Vegetation tissue sampling for target species within the plot.

Table 2-2: Summary of Monitoring Sites and Samples

Site ID	Low Bush Cranberries[1]	Horsetail	Labrador Tea	Lichen	Willow	Soil horizons sampled
Control Site						
C-01[2]		X	X		X	X
C-02	X	X	X	X	X	X
M-07B			X		X	X
M-26			X	X	X	X
M-80	X		X		X	X
Exposure Site						
M-29			X			X
S-01			X			X
S-02[3]						X
S-03					X	X
S-04	X		X		X	X
S-05	X	X	X			X
S-06			X			X
S-07		X	X		X	X
S-08[2]			X	X	X	X
S-09					X	X
S-11					X	X
S-15		X	X			X
S-16			X		X	X
S-17					X	X
S-18			X		X	X
S-19	X		X		X	X

[1]*All berry samples collected from* Vaccinium vitis-idaea; *no blueberry samples were collected in 2019.*
[2]*Duplicates collected at these sites.*
[3]*No target species present.*

2.4.1 Site Investigation

The same sites which were selected for the 2016 monitoring were used for the 2019 monitoring (five control and 16 exposure sites). The sites were marked in 2016 by an aluminum pin with flagging tape at the centre of the plot, with two pieces of flagging tape marking exposure plots. GPS coordinates were recorded for each site with the station ID.

Sites were selected in 2016, first being generally located based on maps and air quality modelling then selected in the field. Chosen sites contained at least two of the target plant species, were relatively undisturbed with an intact soil pedon and established vegetation, and were representative of the surrounding ecosystem conditions. The soil pit was established as the centre of the plot and was situated in proximity to the roots of the plants to be sampled. Sites were marked with aluminum pins and flagging tape, as described above.

An ecological attribute form was completed for each station for comparison to the conditions in 2016, which included the following details:

- Mesoslope position, slope and aspect;
- Dominant vegetation and main cover heights;
- Plant species sampled;
- Successional stage;
- Signs of wildlife diggings, browsing and/or grazing;
- Signs of site disturbance;
- Distance from possible dust source (can be determined from map); and
- Photographs of the soil pit and a representative shot of the site.

2.4.2 Soil Characterization and Sampling

Soil sampling was conducted using the same methods as the 2016 monitoring. The soil pit was dug near the original pit at the centre of the plot, but the same pit was not used. The soil pit was dug to a depth of greater then 60 cm or until a restricting layer such as ice or rock was encountered. Once the pit was excavated it was characterized into organic and mineral horizons based on Field Manual for Describing Terrestrial Ecosystems 2nd Edition (BC MFR and BC MOE, 2010).

Soil samples were collected from the top surface layer of mineral soil at a depth of 4–10 cm (within the rooting zone of plants to be sampled) and again at 20–30 cm. Where possible, a third sample was taken deeper than 30 cm to determine migration potential of specific metals through the pedon.

The procedure involved:

1. Characterizing the soil pit, delineating different soil horizons, taking photographs and recording field notes on standardized datasheets.
2. A composite grab sample was taken from each distinguishable horizon wearing nitrile gloves and using clean sampling equipment (spade or knife) rinsed in deionized water.
3. Approximately 300 g of soil was placed in a fresh plastic sample bag and labelled with sample site identifier, date, project number and sampler's initials.
4. Samples were kept cool and out of the light in coolers with ice packs.

2.4.3 Vegetation Sampling

Vegetation sampling was conducted using the same methods as the 2016 monitoring, with the following modifcations. Sampling was increased to three replicates per available species at each site to improve the ability to determine statistically valid spatial and temporal differences. Low bush cranberry samples were collected when available, as it is a harvested species and consumed by animals, and is more commonly available than blueberry. Though blueberry samples were left as a target species, in 2019 no blueberries were present on the sites and therefore none were collected.

The specific vegetation sampling protocol is:

1. Vegetation sampling was conducted adjacent to the site soil pit.

2. Vegetation samples were collected wearing clean nitrile gloves to pick the desired healthy plant parts which were placed in a sterile sealable plastic bag.

3. Sampling of plant tissue focused on a single specimen of a species adjacent to the soil pit; however, where limited supply was encountered tissue samples were composed of the closest communities of the same species.

4. Approximately 100–150 g of tissue was collected in the sample bag, sealed and labeled with sample site identifier, date, project number and sampler's initials.

5. Samples were kept frozen and out of direct light until delivered to the lab.

2.5 LABORATORY ANALYSIS

Each vegetation tissue sample was homogenized by the lab and divided into two subsamples. One sample was rinsed with deionized water and the second sample left unrinsed. The two subsamples were then analyzed independently to try and understand the degree of metal contamination being contributed by dust. The rationale being the unrinsed vegetation analysis would reflect the total amount of metals both external from dust and internal from soil while the rinsed samples reflect the metals being up taken from the soil. Samples were analyzed in wet weight (mg/kg) and dry weight (mg/kg) as a means to determine percent moisture per sample. Results are presented in dry weight consistent with the British Columbia Environmental Laboratory Manual (Austin, 2015).

All soil samples analyses by the lab followed standard protocols for inductively coupled plasma mass spectrometry (ICP-MS) total metals and pH.

The ICP-MS analysis for metal concentrations is sensitive in detecting concentrations in the range of micrograms per kilogram. Due to this level of sensitivity, soil samples were carefully sampled and placed in sealed plastic bags for shipping to avoid compromising the results. The following quality control and quality assurance protocols were carried out to ensure the results were of high quality.

2.6 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

QA/QC measures were established to quantify laboratory or field variability within the data. Laboratory QA/QC were based on ALS Global standards and consisted of comparing samples to certified references material and internal reference material as well as conducting method blanks, duplicates and laboratory control sample tests. Laboratory defined Data Quality Objectives (DQO) were used to determine if laboratory duplicate results met the specific replicate criteria for QA/QC standards. DQO thresholds for vegetation samples is 40% variation in concentration of metals and for soils ranges from 30–40 % depending on the element.

Field variability was quantified with duplicate samples collected at a rate of one per 10 samples and submitted to the lab under a pseudonym sample number. The lab results were compared between duplicates to understand variability that was introduce by the field sampling methodology.

Relative Percent Difference (RPD) was used to determine field variability and is the difference between the sample result and replicate result, divided by the average of the sample result and replicate result and expressed as a percentage.

$$RPD = \frac{(Field\ Sample\ Concetration - Duplicate\ Sample\ Concentration)}{(Field\ Sample\ Concentration + Dulplicate\ Sample\ Concentration)/2} \times 100\%$$

Where analyte results have RPD >25% a subsequent check was done against the laboratory detection limit (DL) to establish if the practical quantitation limit (PQL) was met. The PQL is five times the DL and is defined as the minimum concentration that can be measured within specified limits of precision and accuracy. Both the sample result and the replicate result need to be above the PQL for the analyte to be considered as 'meeting the PQL'. If one result from the sample or duplicate is greater than five times the DL and one result is less than five times the DL, then the 'PQL is not met'. An analyte with results below the PQL indicates that the constituent being analyzed is not present in a sufficient amount to be reliably quantified. Typically, as parameters approach their detection limit, high variability is more likely to occur. The RPD of 25% can be used as a benchmark whereby results with an RPD >25% warrant further comment or consideration.

3 RESULTS

Results from the 2019 VMU sampling program are separated into vegetation and soil, and compared against soil quality guidelines. These are presented in the following subsections.

3.1 GUIDELINES

Guidelines are not currently established for metal concentration in native vegetation tissue, therefore agricultural standards were used as a surrogate for potential effects of plant species that would be consumed by wildlife and fish. The species of concern for Selkirk First Nations are Arctic grayling, bears, beavers, caribou, coyotes, dog salmon (chum salmon), ducks, fox, eagles, frogs, gophers (Arctic ground squirrel), grouse, inconnu (coney), lynx, king salmon (chinook salmon), marten, moose, muskrat, otter, peregrine falcon, porcupine, rabbit, sheep, squirrels, wolves, and wolverine. As proxies for these species, metals in vegetation were compared to the maximum tolerable levels (MTL) for metals in animal feed for rodents, cattle, poultry, and fish (Table 3-1; NRC, 2005). MTLs are defined as the maximum dietary level that will not impair the animal's health or performance over time (NCR, 2005).

Table 3-1: Maximum Tolerable Levels of Minerals in Animal Feed

Metal (mg/kg)	Maximum Tolerable Limit [1]			
	Rodent	Cattle	Poultry	Fish
Aluminum	200	1000	1000	--
Arsenic [2]	30	(30)	(30)	5
Cadmium [2]	10	10	10	10
Chromium (Soluble Cr^{3+}) [2]	100	(100)	500	--
Copper [2]	500	40 [3]	250 [4]	100
Iron [2]	(500)	500	500	--
Manganese	2000	2000	2000	--
Molybdenum	7	5	100	10
Nickel	50	100	250	50
Lead [2]	10	100	10	10
Antimony	70 – 150	--	--	--
Selenium [2]	(5)	5	3	(2)
Zinc	(500)	500	500	250

Levels in parentheses were derived from interspecies extrapolation. Dashes indicate that data were insufficient to set a maximum tolerable level.
[1] NRC, 2005
[2] The MTL provided for this nutrient is based on animal health and not human health. Lower levels are necessary to avoid excessive accumulation in edible tissues.
[3] Assuming normal concentrations of molybdenum (1–2 mg/kg diet) and sulfur (0.15–0.25%). At molybdenum and sulfur concentrations below these, copper may become toxic at lower levels.
[4] For ducks the MTL for copper is 100 mg/kg diet.

The CCME released Canadian Environmental Quality Guidelines (CEQG) to measure parameters in soil and to provide "science based goals for the quality of atmospheric, aquatic, and terrestrial ecosystems" (CCME, 2006).

The recommended Canadian soil quality guidelines are derived specifically for the protection of ecological receptors in the environment or for the protection of human health associated with four land uses: agricultural, residential and parkland, commercial, and industrial (CCME, 1999). The guidelines for metals in soil are presented in Table 3-2, and the industrial land use guidelines were chosen as the most appropriate for assessing metal concentrations reported in the soil results.

Table 3-2: CCME Soil Quality Guidelines for the Protection of Environmental and Human Health

Chemical Name	Chemical Grouping	Agricultural	Residential/Parkland	Commercial	Industrial	Guideline Date
		Concentration (mg/kg dry weight)				
Antimony	Inorganic Metals	20	20	40	40	1991
Arsenic		12	12	12	12	1997
Barium		750	500	2,000	2,000	2013
Beryllium		44	8	8	2015	
Boron		2	No data	No data	No data	1991
Cadmium		1.4	10	22	22	1999
Chromium (total)		64	64	87	87	1997
Chromium (Cr(VI))		0.4	0.4	1.4	1.4	1999
Cobalt		40	50	300	300	1991
Copper		63	63	91	91	1999
Lead		70	140	260	600	1999
Mercury		6.6	6.6	24	50	1999
Molybdenum		5	10	40	40	1991
Nickel		45	45	89	89	2015
Selenium		1	1	2.9	2.9	2009
Silver		20	20	40	40	1991
Thallium		1	1	1	1	1999
Tin		5	50	300	300	1991
Uranium		23	23	33	300	2007
Vanadium		130	130	130	130	1997
Zinc		250	250	410	410	2018

3.2 VEGETATION

Vegetation samples were analyzed for moisture and total metal concentration with results presented as dry weight concentration in milligrams per kilogram (mg/kg). Complete vegetation results including wet and dry weight concentrations can be found in Appendix B. Mean metal concentrations for the metals were compared between the unrinsed and rinsed samples for each vegetation species and are presented in Table 3-3. Note that statistics were calculated using half the method detection limit where results were reported as less than detection.

Table 3-3: Mean Vegetation Metal Concentration Comparison Between Unrinsed and Rinsed Samples

Metal concentration		Cranberry[2]				Horsetail (n = 12)			Labrador Tea (n = 48)			Lichen (n = 9)			Willow (n = 48)		
Dry Weight (mg/kg)		Unrinsed (n = 16)	Unrinsed (n = 5)	Rinsed (n = 5)	Mean Difference[1]	Unrinsed	Rinsed	MEan Difference[1]	Unrinsed	Rinsed	MEan Difference[1]	Unrinsed	Rinsed	Mean Difference[1]	Unrinsed	Rinsed	MEan Difference[1]
Aluminum (Al)	**Mean**	**31.28**	**50.70**	**23.52**	**27.18**	**30.26**	**27.49**	**2.77**	**69.32**	**49.74**	**19.58**	**1802.89**	**1508.44**	**294.44**	**84.30**	**62.57**	**21.73**
	Std Dev	24.85	34.55	5.24		19.96	17.78		70.45	38.74		1862.54	1601.91		87.21	67.25	
Arsenic (As)	**Mean**	**0.01**	**0.01**	**0.01**	**0.00**	**0.02**	**0.02**	**0.00**	**0.03**	**0.02**	**0.00**	**0.42**	**0.37**	**0.00**	**0.03**	**0.02**	**0.00**
	Std Dev	0.00	0.01	0.01		0.02	0.01		0.02	0.01		0.26	0.25		0.02	0.02	
Cadmium (Cd)	**Mean**	**0.01**	**0.02**	**0.00**	**0.00**	**0.18**	**0.17**	**0.01**	**0.01**	**0.00**	**0.01**	**0.12**	**0.13**	**0.05**	**1.33**	**1.30**	**0.01**
	Std Dev	0.02	0.03	0.00		0.14	0.18		0.00	0.00		0.05	0.06		1.07	1.04	
Chromium (Cr)	**Mean**	**0.12**	**0.19**	**0.15**	**0.01**	**0.11**	**0.11**	**0.01**	**0.12**	**0.10**	**0.00**	**1.32**	**1.07**	**-0.01**	**0.14**	**0.11**	**0.03**
	Std Dev	0.07	0.08	0.08		0.07	0.11		0.05	0.04		0.82	0.70		0.07	0.06	
Copper (Cu)	**Mean**	**5.00**	**6.76**	**3.49**	**0.04**	**8.99**	**7.69**	**0.00**	**15.88**	**11.91**	**0.03**	**449.73**	**365.19**	**0.25**	**18.92**	**13.51**	**0.03**
	Std Dev	3.32	5.14	0.80		6.06	5.43		13.84	8.36		598.99	478.69		22.54	15.16	
Iron (Fe)	**Mean**	**36.20**	**65.36**	**21.22**	**3.27**	**50.64**	**43.37**	**1.31**	**135.98**	**98.54**	**3.97**	**3533.56**	**2815.56**	**84.54**	**175.90**	**129.12**	**5.41**
	Std Dev	36.56	54.61	6.33		13.20	15.15		143.82	77.85		4038.60	3224.04		185.85	138.06	
Manganese (Mn)	**Mean**	**290.19**	**346.80**	**321.60**	**44.14**	**265.31**	**243.58**	**7.28**	**743.02**	**706.88**	**37.44**	**187.10**	**189.63**	**718.00**	**282.48**	**277.38**	**46.78**
	Std Dev	68.25	84.11	117.12		237.10	221.59		415.36	417.59		121.99	127.84		288.05	230.68	
Molybdenum (Mo)	**Mean**	**0.46**	**0.68**	**0.70**	**0.02**	**0.42**	**0.37**	**0.00**	**0.30**	**0.28**	**0.02**	**0.96**	**0.71**	**0.06**	**0.39**	**0.38**	**0.02**
	Std Dev	0.32	0.37	0.57		0.20	0.18		0.36	0.30		1.15	0.83		0.23	0.26	
Nickel (Ni)	**Mean**	**0.39**	**0.53**	**0.50**	**25.20**	**2.61**	**2.49**	**21.73**	**0.62**	**0.61**	**36.15**	**1.23**	**1.03**	**-2.53**	**2.81**	**2.71**	**5.10**
	Std Dev	0.21	0.27	0.44		1.26	1.58		0.41	0.53		0.53	0.35		2.37	2.30	
Lead (Pb)	**Mean**	**0.02**	**0.03**	**0.01**	**-0.02**	**0.02**	**0.02**	**0.06**	**0.06**	**0.04**	**0.03**	**0.84**	**0.78**	**0.25**	**0.06**	**0.04**	**0.01**
	Std Dev	0.02	0.02	0.01		0.01	0.01		0.04	0.02		0.73	0.76		0.04	0.03	
Antimony (Sb)	**Mean**	**0.01**	**0.01**	**0.01**	**0.03**	**0.01**	**0.01**	**0.12**	**0.01**	**0.01**	**0.02**	**0.03**	**0.03**	**0.19**	**0.01**	**0.01**	**0.10**
	Std Dev	0.00	0.00	0.00		0.00	0.00		0.00	0.00		0.01	0.01		0.00	0.00	

Metal concentration		Cranberry[2]				Horsetail (n = 12)			Labrador Tea (n = 48)			Lichen (n = 9)			Willow (n = 48)		
Dry Weight (mg/kg)		Unrinsed (n = 16)	Unrinsed (n = 5)	Rinsed (n = 5)	Mean Difference[1]	Unrinsed	Rinsed	MEan Difference[1]	Unrinsed	Rinsed	MEan Difference[1]	Unrinsed	Rinsed	Mean Difference[1]	Unrinsed	Rinsed	MEan Difference[1]
Selenium (Se)	**Mean**	**0.03**	**0.03**	**0.03**	**0.00**	**0.14**	**0.13**	**0.01**	**0.03**	**0.03**	**0.00**	**0.41**	**0.34**	**0.07**	**0.06**	**0.05**	**0.00**
	Std Dev	0.00	0.00	0.00		0.22	0.20		0.01	0.01		0.48	0.40		0.05	0.05	
Zinc (Zn)	**Mean**	**8.44**	**10.69**	**8.19**	**2.50**	**37.47**	**35.18**	**2.28**	**23.69**	**22.79**	**0.90**	**28.38**	**27.98**	**0.40**	**94.82**	**91.17**	**3.65**
	Std Dev	2.77	4.09	1.96		11.21	11.98		4.54	4.06		16.13	16.63		55.46	59.10	

[1]Mean difference calculated by taking the difference between unrinsed and rinsed samples and then calculating the mean

[2]Rinsed data were not available for 11 of the berry samples due to laboratory error. Means were therefore calculated for all unrinsed samples and only the five unrinsed with a corresponding rinsed sample. Mean differences were calculated using the mean of the five samples with a corresponding rinsed sample.

COPC concentrations were consistently lower in the rinsed samples than the unrinsed samples in horsetail, Labrador tea, lichen, and willow samples, with the exception of chromium and lead in horsetail and cadmium and manganese in lichen when rinsed samples had slightly higher concentrations. This is likely a result of variation in homogenization and the lab's DQO of 40% repeatability. These results are consistent with the 2016 results, which also found higher concentrations of metals in unrinsed samples (AEG, 2017).

Of the 16 cranberry samples collected, only five were subsampled prior to homogenization and therefore only five rinsed samples are available. Therefore, means were calculated for both the full set of unrinsed samples and only the five unrinsed samples with a corresponding rinsed sample (Table 3-3). Mean differences then were calculated using the five unrinsed samples. Only molybdenum was slightly higher in rinsed samples than unrinsed. Again, this is likely a result of variation during the homogenization.

The statistical package, R, was used to compare the unrinsed and rinsed samples of key metals were chosen in 2016 based on literature citing them as having the greatest potential effect on wildlife and human health (Roggeman et al., 2012; Csavina, 2012; European Commission, 2006; Australian Government, 2016). Iron and aluminum were also assessed, as they are metals related to dust (Section 2.2). Iron was also included in the 2016 assessment as it appeared to be affected by rinsing. A non-parametric statistical test was chosen since the data did not meet the requirements of normal distribution and equal variances. A paired sample Wilcoxon test was chosen given the small sample size and each sample was both rinsed and unrinsed (i.e. paired and dependent). The tests were conducted using a significance level (p) of 0.05. If p is less than 0.05 there is a 95% chance that the concentrations are statistically different. The results of the analyses are presented in Table 3-4.

Table 3-4: Paired Wilcoxon Results between Rinsed and Unrinsed Vegetation Samples

Metal[1]	Cranberry (n = 5)[2]		Horsetail (n = 12)		Labrador Tea (n = 48)		Lichen (n = 9)		Willow (n = 48)	
	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value
Aluminum (Al)	0.0	0.059	24.0	0.255	192.0	<0.001	6.0	0.058	133.5	<0.001
Arsenic (As)	1.0	1.000	12.5	0.865	72.0	0.001	11.0	0.193	34.0	<0.001
Cadmium (Cd)	0.0	0.371	26.5	0.346	105.0	0.045	25.0	0.813	597.5	0.926
Copper (Cu)	3.0	0.281	23.0	0.224	320.0	0.006	10.0	0.155	287.5	0.002
Iron (Fe)	1.0	0.106	22.0	0.195	237.0	<0.001	6.0	0.058	153.5	<0.001
Lead (Pb)	0.0	0.100	11.0	1.000	199.0	<0.001	11.0	0.193	76.0	<0.001
Zinc (Zn)	3.0	0.281	29.0	0.456	415.0	0.116	24.0	0.906	487.0	0.303

[1]Highlighted cells represent a p < 0.05 which is the significance value for accepting the null hypothesis (i.e., that there is a difference)
[2]Rinsed data were not available for 11 of the berry samples due to laboratory error. Wilcoxon tests were therefore performed using only the five unrinsed cranberry samples with a corresponding rinsed sample.

Results from the paired Wilcoxon test show significantly higher (p<0.05) concentrations of COPCs in unrinsed Labrador tea and willow samples, with the exception of zinc (both) and cadmium (willow only). No significant differences were found between unrinsed and rinsed cranberry, horsetail, or lichen samples. Only five cranberry samples could be compared due to the rinsing error in the laboratory.

Vegetation metal analyses were also compared between the control sites and the exposure sites to determine if there were any statistically significant differences between treatments. Unrinsed samples were selected for comparison between exposure and control sites to avoid any variability that may have been introduced as a result of the rinsing process, as well as to avoid error introduced by the missing cranberry samples. Results of this comparison are presented in Table 3-5.

Table 3-5: Mean Unrinsed Vegetation Metal Concentration Comparison Between Control and Exposure Sites

Metal concentration		Cranberry			Horsetail			Labrador Tea			Lichen			Willow		
Dry Weight (mg/kg)		Control (n = 4)	Exposure (n = 12)	Percent Difference[1]	Control (n = 3)	Exposure (n = 9)	Percent Difference[1]	Control (n = 15)	Exposure (n = 33)	Percent Difference[1]	Control (n = 6)	Exposure (n = 3)	Percent Difference[1]	Control (n = 15)	Exposure (n = 33)	Percent Difference[1]
Aluminum (Al)	**Mean**	**13.60**	**37.17**	**93%**	**11.97**	**36.36**	**101%**	**29.92**	**87.23**	**98%**	**611.00**	**4186.67**	**149%**	**23.41**	**111.98**	**131%**
	Std Dev	10.72	25.68		2.15	19.48		16.38	78.20		407.49	822.03		12.19	92.61	
Arsenic (As)	**Mean**	**0.01**	**0.01**	**21%**	**0.01**	**0.03**	**21%**	**0.01**	**0.03**	**21%**	**0.26**	**0.75**	**21%**	**0.01**	**0.04**	**21%**
	Std Dev	0.00	0.00		0.01	0.02		0.01	0.02		0.10	0.12		0.01	0.02	
Cadmium (Cd)	**Mean**	**0.01**	**0.01**	**63%**	**0.34**	**0.13**	**63%**	**0.00**	**0.01**	**63%**	**0.09**	**0.18**	**63%**	**1.92**	**1.05**	**63%**
	Std Dev	0.01	0.02		0.17	0.08		0.00	0.00		0.03	0.02		1.53	0.65	
Chromium (Cr)	**Mean**	**0.11**	**0.12**	**8%**	**0.12**	**0.10**	**8%**	**0.11**	**0.13**	**8%**	**0.87**	**2.21**	**8%**	**0.10**	**0.16**	**8%**
	Std Dev	0.04	0.08		0.05	0.07		0.04	0.05		0.54	0.37		0.05	0.07	
Copper (Cu)	**Mean**	**3.23**	**5.59**	**167%**	**3.06**	**10.97**	**167%**	**5.19**	**20.74**	**167%**	**63.10**	**1223.00**	**167%**	**4.78**	**25.35**	**167%**
	Std Dev	0.27	3.67		0.33	5.74		0.97	14.24		39.12	293.18		2.02	24.65	
Iron (Fe)	**Mean**	**16.85**	**42.65**	**21%**	**31.47**	**57.03**	**21%**	**48.34**	**175.82**	**21%**	**925.33**	**8750.00**	**21%**	**51.95**	**232.25**	**21%**
	Std Dev	2.01	40.49		3.04	7.30		9.39	158.45		530.27	1820.14		21.58	200.13	
Manganese (Mn)	**Mean**	**266.00**	**298.25**	**113%**	**126.00**	**311.74**	**113%**	**726.00**	**750.76**	**113%**	**126.15**	**309.00**	**113%**	**189.17**	**324.90**	**113%**
	Std Dev	47.55	73.83		8.54	259.95		468.79	396.30		93.74	64.21		117.39	331.51	
Molybdenum (Mo)	**Mean**	**0.39**	**0.49**	**89%**	**0.30**	**0.47**	**89%**	**0.26**	**0.32**	**89%**	**0.24**	**2.40**	**89%**	**0.41**	**0.38**	**89%**
	Std Dev	0.09	0.37		0.02	0.22		0.15	0.43		0.07	0.79		0.29	0.20	
Nickel (Ni)	**Mean**	**0.31**	**0.42**	**29%**	**3.61**	**2.28**	**29%**	**0.58**	**0.64**	**29%**	**1.00**	**1.67**	**29%**	**3.99**	**2.28**	**29%**
	Std Dev	0.18	0.22		0.92	1.22		0.27	0.47		0.48	0.30		3.25	1.65	
Lead (Pb)	**Mean**	**0.01**	**0.02**	**16%**	**0.01**	**0.02**	**16%**	**0.03**	**0.07**	**16%**	**0.36**	**1.79**	**16%**	**0.03**	**0.08**	**16%**
	Std Dev	0.01	0.02		0.01	0.01		0.01	0.04		0.13	0.27		0.01	0.04	
Antimony (Sb)	**Mean**	**0.01**	**0.01**	**18%**	**0.01**	**0.01**	**18%**	**0.01**	**0.01**	**18%**	**0.02**	**0.04**	**18%**	**0.01**	**0.01**	**18%**
	Std Dev	0.00	0.00		0.00	0.00		0.00	0.00		0.01	0.01		0.00	0.00	

Metal concentration		Cranberry			Horsetail			Labrador Tea			Lichen			Willow		
Dry Weight (mg/kg)		Control (n = 4)	Exposure (n = 12)	Percent Difference[1]	Control (n = 3)	Exposure (n = 9)	Percent Difference[1]	Control (n = 15)	Exposure (n = 33)	Percent Difference[1]	Control (n = 6)	Exposure (n = 3)	Percent Difference[1]	Control (n = 15)	Exposure (n = 33)	Percent Difference[1]
Selenium (Se)	**Mean**	**0.03**	**0.03**	**74%**	**0.03**	**0.18**	**74%**	**0.03**	**0.03**	**74%**	**0.10**	**1.03**	**74%**	**0.06**	**0.06**	**74%**
	Std Dev	0.00	0.00		0.00	0.24		0.00	0.01		0.04	0.24		0.05	0.04	
Zinc (Zn)	**Mean**	**7.74**	**8.67**	**48%**	**36.30**	**37.86**	**48%**	**22.73**	**24.12**	**48%**	**18.42**	**48.30**	**48%**	**108.70**	**88.52**	**48%**
	Std Dev	0.39	3.19		1.22	13.10		2.69	5.15		5.61	8.31		71.75	46.19	

[1]*Percent difference is the difference in mean exposure concentration from the mean control concentration divided by the average of both concentrations*

Higher mean concentrations of metals were present in the majority of vegetation species at exposure sites than control sites, with willow having the highest number of COPCs higher in control sites (five of 13 COPCs higher in control sites). Vegetation from exposure sites typically had higher standard deviation than control sites; the larger number of exposure sites likely contributed to the higher variance. These results are consistent with those obtained during the 2016 VMU (AEG, 2017).

Figure 3-1 to Figure 3-13 present the mean difference in concentration and variation for respective metals by species between exposure and control sites for both 2016 and 2019. Error bars are +/- one standard deviation which is an indication of variation in data from the mean value.

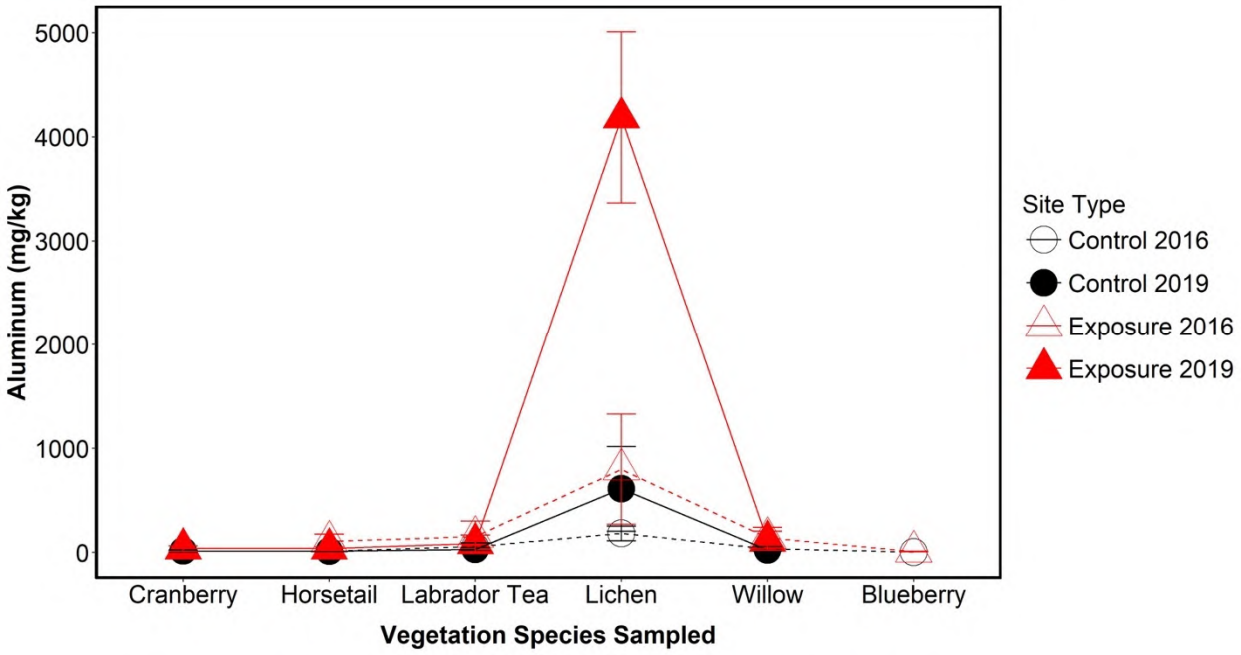


Figure 3-1: Comparison of Mean Aluminum Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

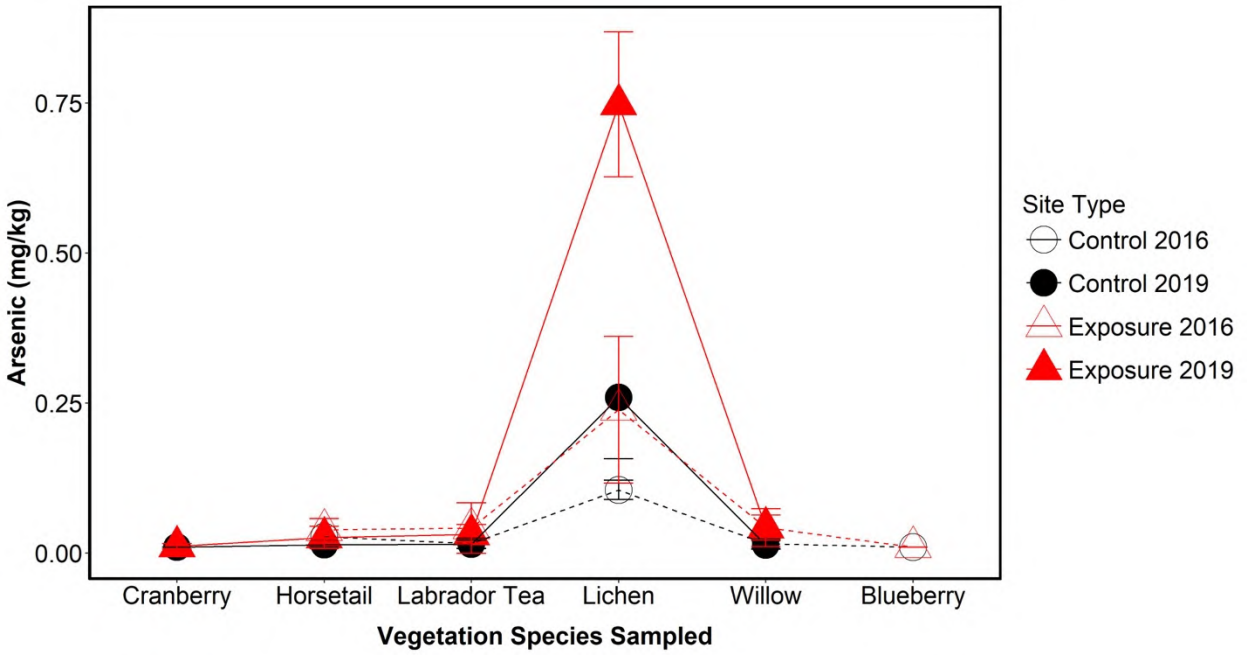


Figure 3-2: Comparison of Mean Arsenic Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

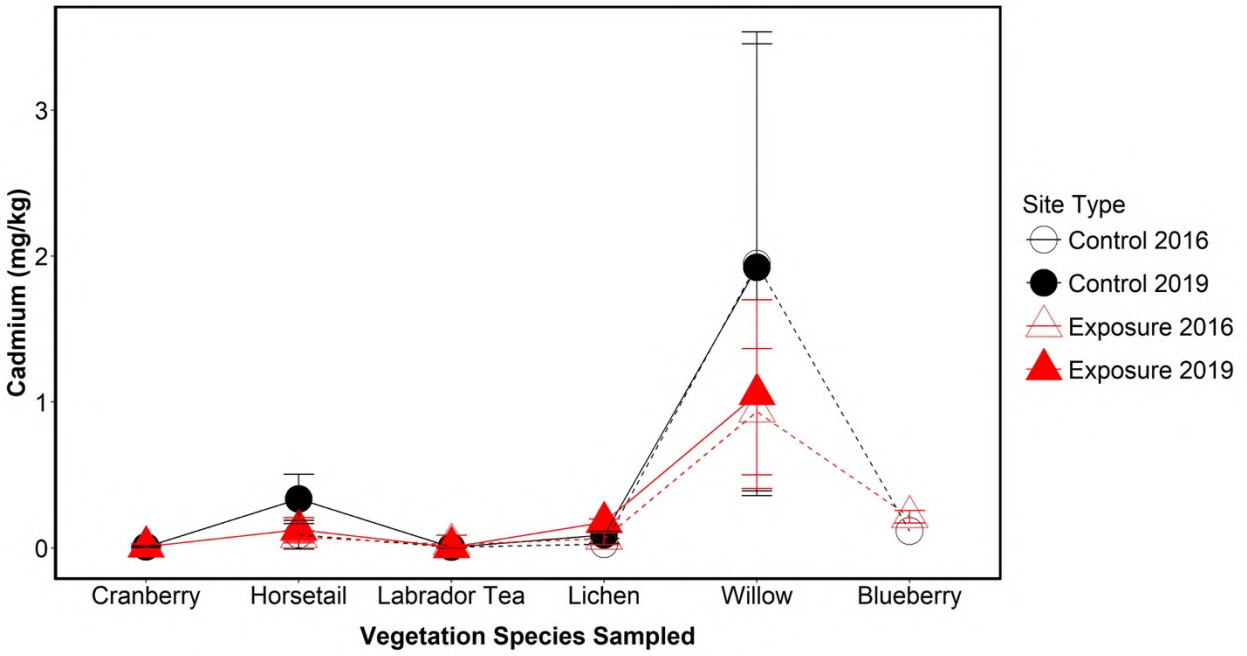


Figure 3-3: Comparison of Mean Cadmium Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

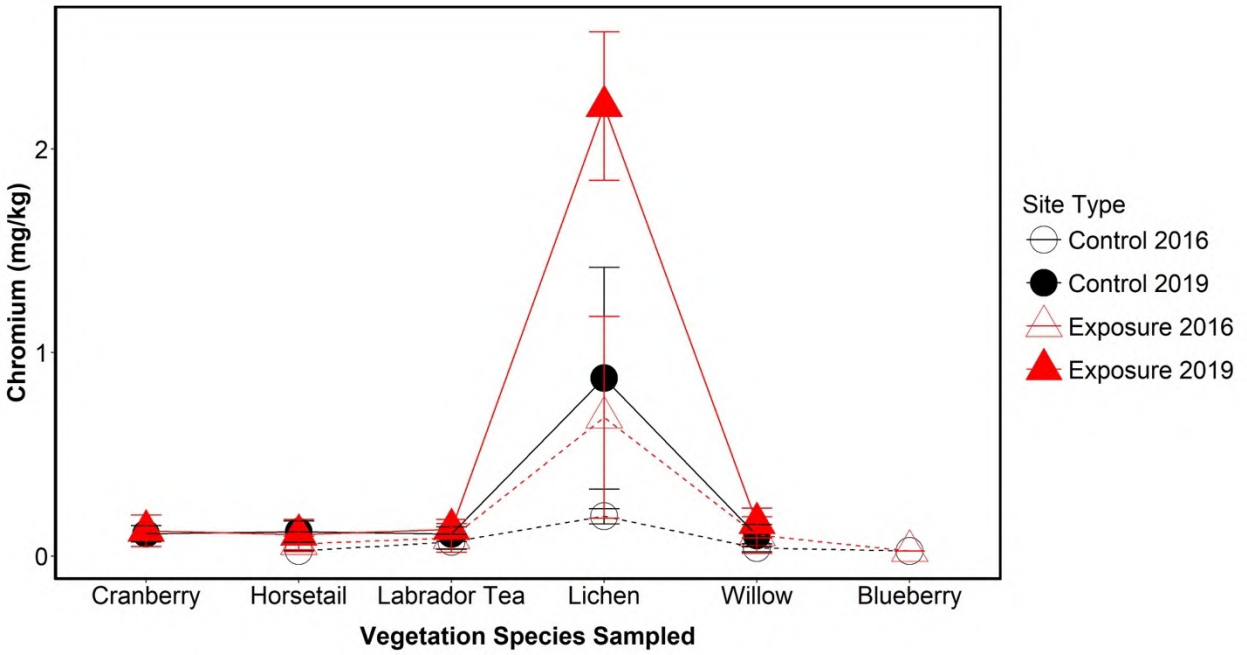


Figure 3-4: Comparison of Mean Chromium Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

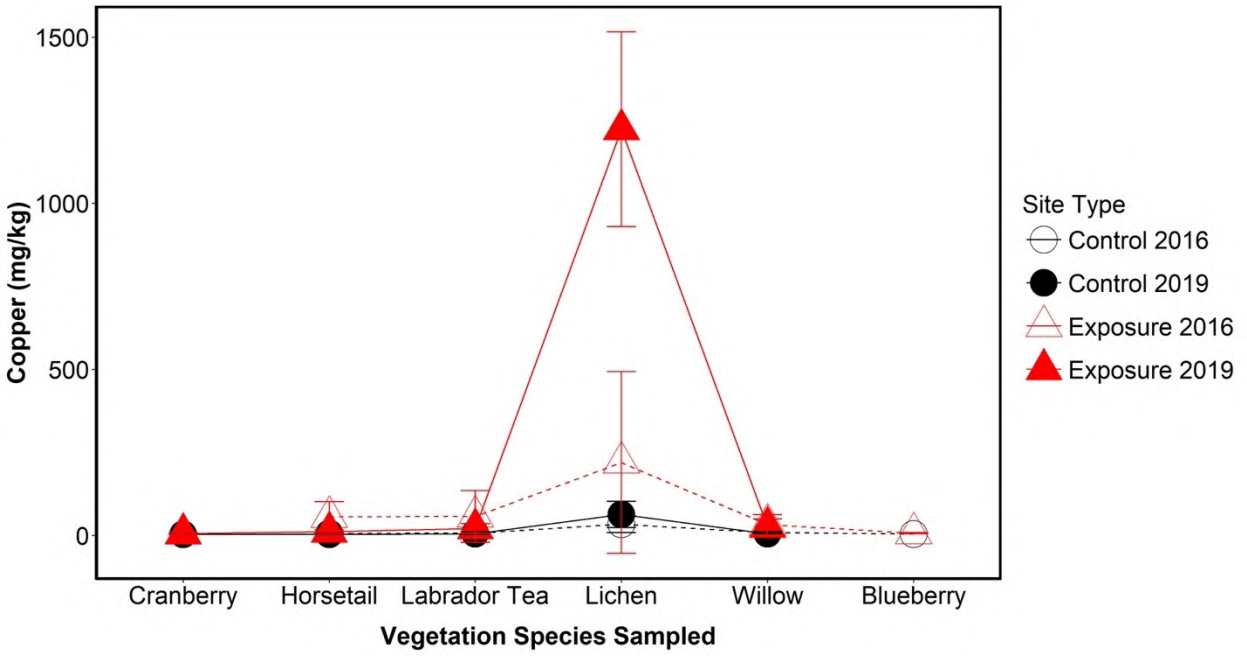


Figure 3-5: Comparison of Mean Copper Concentration (mg/kg) Between Control and Exposure Sites Sites in 2016 and 2019 (Error bar ± 1 SD)

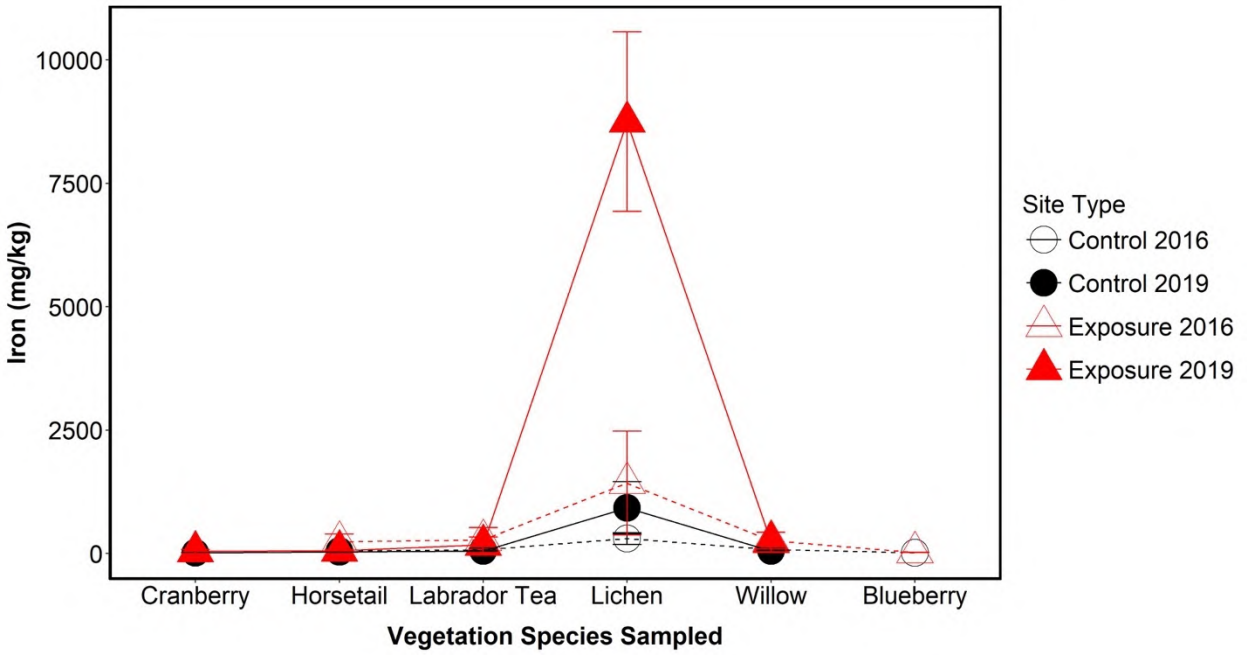


Figure 3-6: Comparison of Mean Iron Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

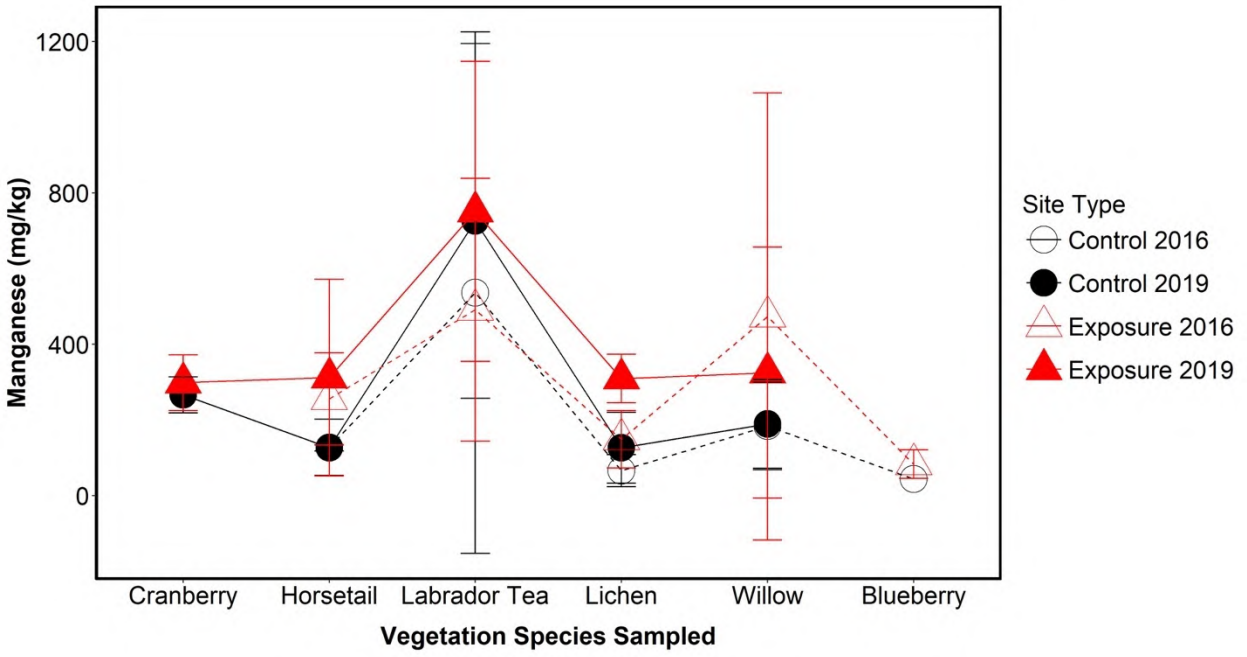


Figure 3-7: Comparison of Mean Manganese Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

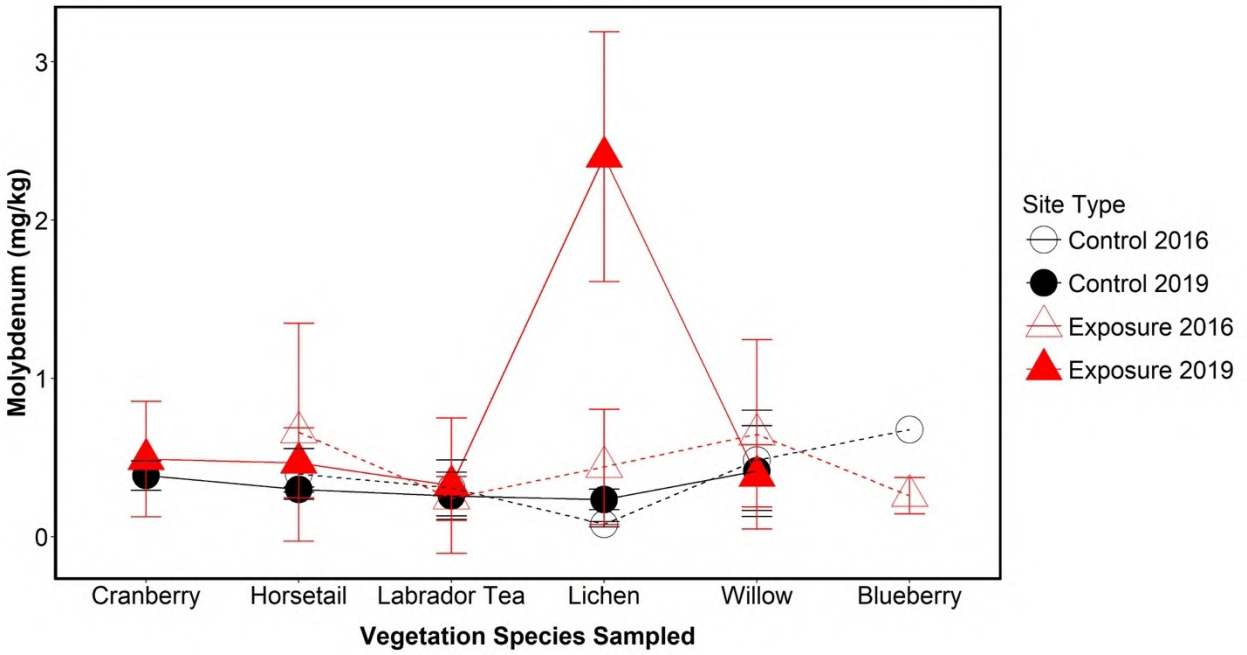


Figure 3-8: Comparison of Mean Molybdenum Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

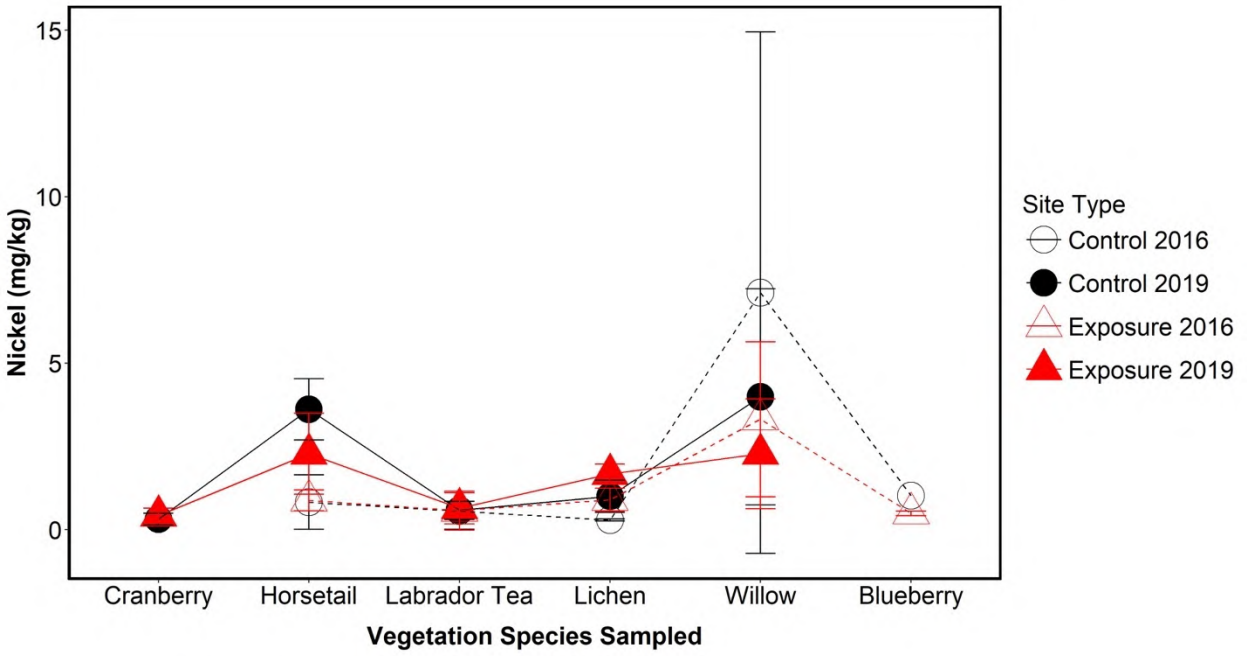


Figure 3-9: Comparison of Mean Nickel Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

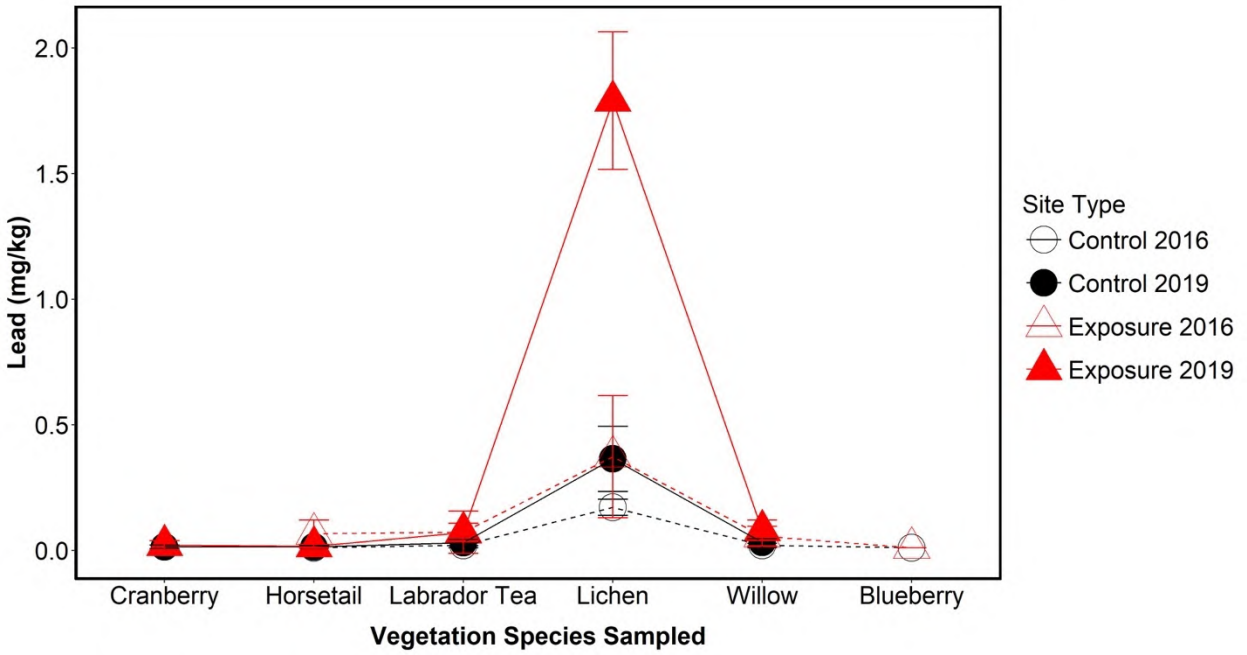


Figure 3-10: Comparison of Mean Lead Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

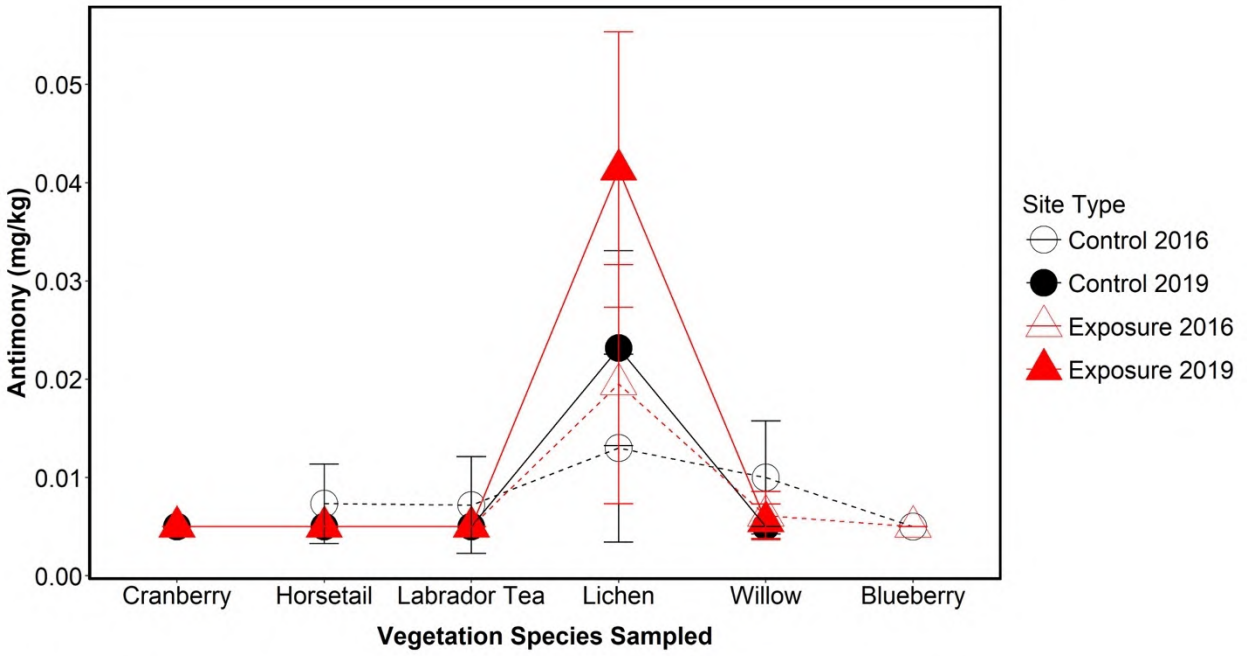


Figure 3-11: Comparison of Mean Antimony Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

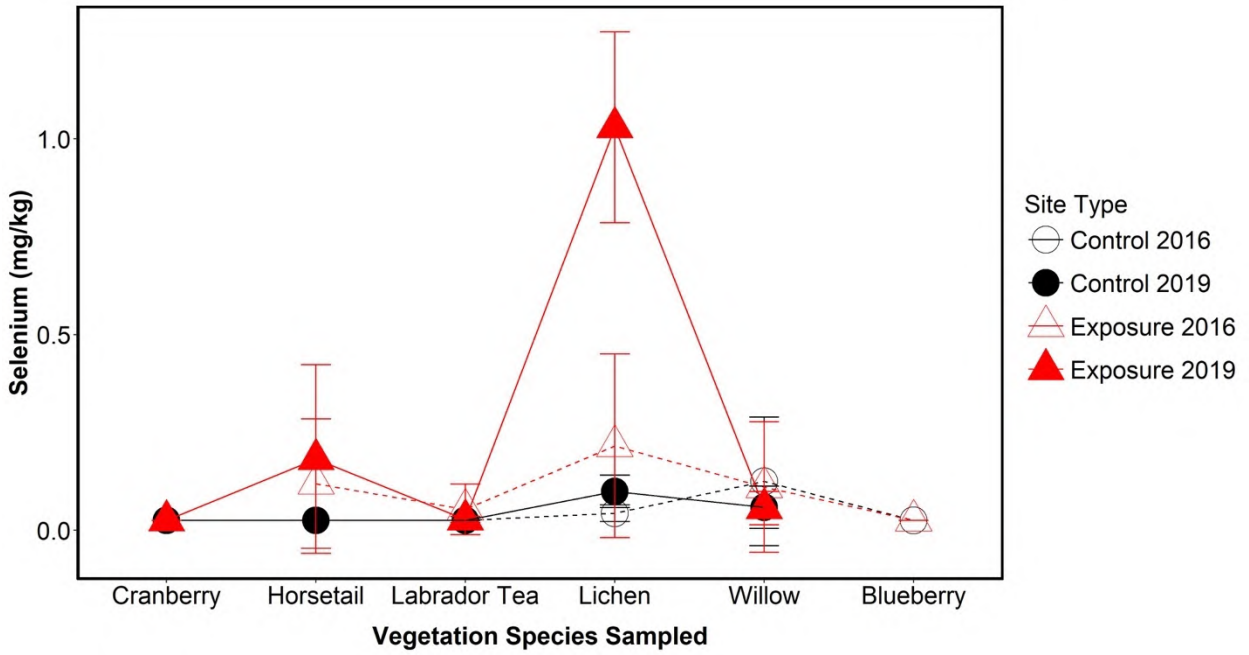


Figure 3-12: Comparison of Mean Selenium Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

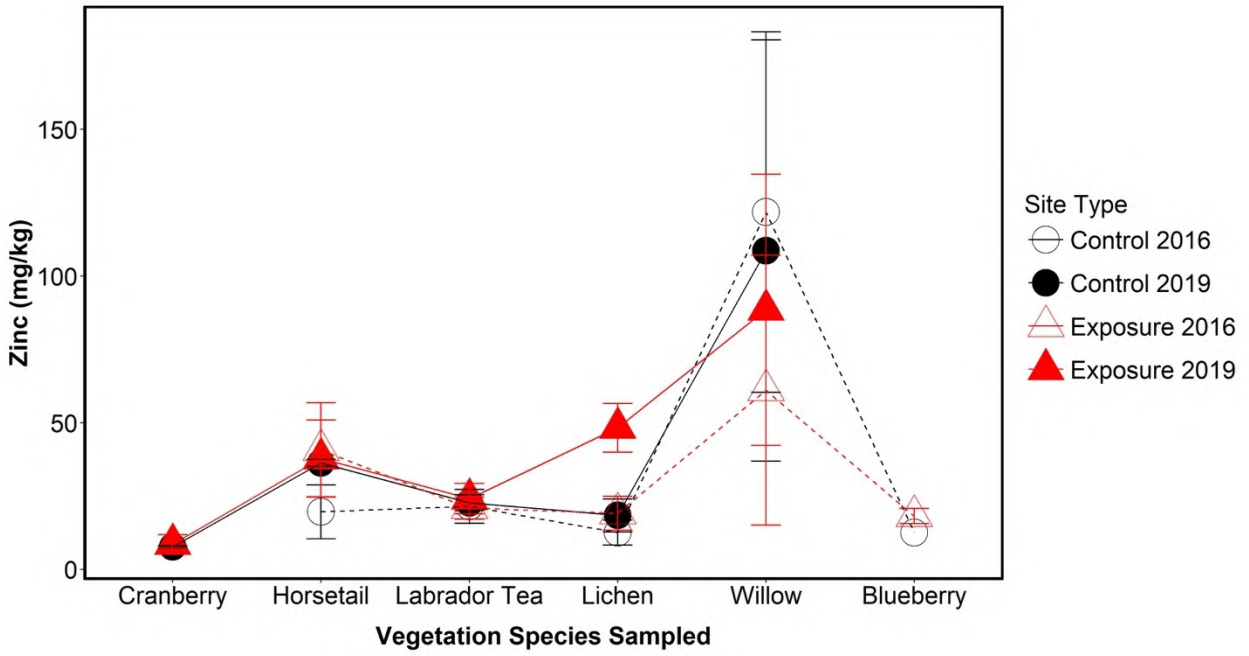


Figure 3-13: Comparison of Mean Zinc Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

Horsetail, Labrador tea, and willow samples contained similar concentrations of most COPCs between both control and exposure sites and years, with the exception of manganese for all three species and nickel and zinc in willow, where larger differences were observed. Blueberry, sampled in 2016, and cranberry, sampled in 2019, also had limited differences between control and exposure sites and contained similar concentrations of all COPCs. Lichen samples taken from exposure sites had much higher concentrations of aluminum, arsenic, chromium, copper, iron, molybdenum, lead, and selenium in 2019 than 2016. Antimony concentrations were also higher in 2019 than in 2016, though there was overlap of the error bars (Figure 3-11). Cadmium, manganese, nickel, and zinc concentrations in lichen were similar between the two years.

A two sample Wilcoxon test was performed between exposure and control sites for each species for selected metals. Two sample Wilcoxon tests were also performed between 2016 and 2019 control and 2016 and 2019 exposure sites. A two sample test was used rather than a paired test because the exposure and control samples are independent samples (i.e., not linked). Results were compared to a significance level of 0.05 and are presented in Table 3-6 to Table 3-8.

Table 3-6: Two Sample Wilcoxon Results Between Exposure and Control Sites

Metal[1]	Cranberry (n =16)		Horsetail (n = 12)		Labrador Tea (n = 48)		Lichen (n = 9)		Willow (n = 48)	
	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value
Aluminum (Al)	5.0	0.025	0.0	0.016	82.0	<0.001	0.0	0.028	25.0	<0.001
Arsenic (As)	22.0	0.665	8.5	0.373	83.5	<0.001	0.0	0.028	39.5	<0.001
Cadmium (Cd)	36.0	0.090	26.0	0.027	198.5	0.244	0.0	0.028	327.0	0.079
Copper (Cu)	6.0	0.034	0.0	0.016	13.0	<0.001	0.0	0.028	32.0	<0.001
Iron (Fe)	8.0	0.060	0.0	0.016	31.5	<0.001	0.0	0.028	13.0	<0.001
Lead (Pb)	19.5	0.577	10.0	0.536	68.5	<0.001	0.0	0.028	33.0	<0.001
Zinc (Zn)	22.0	0.856	9.0	0.460	221.0	0.563	0.0	0.028	276.5	0.526

[1]Highlighted cells represent a p < 0.05 which is the significance value for accepting the null hypothesis (i.e., that there is a difference)
2 n/a indicates all concentrations were below detection
3 Blueberry 2016 samples compared to cranberry 2019 samples

Results from the analysis showed that COPCs were significantly higher at exposure sites compared to control sites in Labrador tea, lichen, and willow samples. In lichen, all COPCs were significantly higher in exposure sites while all but cadmium and zinc were significantly higher in Labrador tea in exposure sites. Willow had significantly higher concentrations of aluminum, arsenic, copper, iron, and lead in exposure sites but lower (though not statistically significant) concentrations of cadmium and zinc, the same as was seen in 2016 (AEG, 2017). Horsetail had significantly higher concentrations of aluminum, copper, and iron in exposure sites, but significantly higher cadmium in control sites.. Copper and aluminum were significantly higher in cranberry exposure samples, unlike the blueberry samples in 2016 which showed no significant differences between site types.

Table 3-7: Two Sample Wilcoxon Results Between 2016 and 2019 Control Sites

Metal[1]	Berry (n = 5)[2, 3]		Horsetail (n = 6)		Labrador Tea (n = 20)		Lichen (n = 10)		Willow (n = 20)	
	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value
Aluminum (Al)	0.0	0.289	5.0	1.000	55.0	0.138	0.5	0.019	57.0	0.097
Arsenic (As)	n/a	n/a	7.0	0.354	40.5	0.797	0.0	0.014	44.0	0.491
Cadmium (Cd)	4.0	0.289	0.0	0.081	33.0	0.682	0.0	0.014	39.0	0.930
Copper (Cu)	4.0	0.289	9.0	0.081	40.5	0.827	6.0	0.241	67.0	0.011
Iron (Fe)	0.0	0.289	7.0	0.383	48.0	0.383	0.0	0.014	63.0	0.029
Lead (Pb)	1.5	1.000	3.0	0.505	21.5	0.175	0.0	0.014	18.0	0.096
Zinc (Zn)	4.0	0.289	0.0	0.081	28.5	0.458	4.0	0.110	44.0	0.600

[1]Highlighted cells represent a p < 0.05 which is the significance value for accepting the null hypothesis (i.e., that there is a difference)
[2]n/a indicates all concentrations were below detection
[3]Blueberry 2016 samples compared to cranberry 2019 samples

Table 3-8: Two Sample Wilcoxon Results Between 2016 and 2019 Exposure Sites

Metal[1]	Berry (n =14)[2, 3]		Horsetail (n = 15)		Labrador Tea (n = 43)		Lichen (n = 11)		Willow (n = 49)	
	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value	Test Statistic	p-value
Aluminum (Al)	0.0	0.036	46.0	0.029	219.0	0.124	0.0	0.019	323.5	0.208
Arsenic (As)	n/a	n/a	39.0	0.167	159.5	0.885	0.0	0.019	223.5	0.393
Cadmium (Cd)	24.0	0.009	20.0	0.444	175.0	0.771	0.0	0.019	271.0	0.890
Copper (Cu)	19.0	0.235	47.0	0.022	239.0	0.035	0.0	0.019	325.0	0.197
Iron (Fe)	9.5	0.715	54.0	0.002	214.0	0.163	0.0	0.019	305.0	0.388
Lead (Pb)	7.0	0.338	46.0	0.024	121.5	0.216	0.0	0.019	159.5	0.027
Zinc (Zn)	23.0	0.055	33.5	0.479	95.0	0.046	0.0	0.019	162.5	0.031

[1]Highlighted cells represent a p < 0.05 which is the significance value for accepting the null hypothesis (i.e., that there is a difference)
[2]n/a indicates all concentrations were below detection
[3]Blueberry 2016 samples compared to cranberry 2019 samples

Control sites contained similar concentrations of COPCs between 2016 and 2019 in all species except lichen, which had significantly higher concentrations of all tested COPCs but copper and zinc. Lichen also contained significantly higher levels of all tested COPCs in exposure sites in 2019. Concentrations of aluminum, copper, iron, and lead were significantly higher in horsetail from exposure sites in 2019. Concentrations of copper and zinc in exposure sites Labrador tea were significantly higher in 2019, as was lead in willow. Zinc was significantly lower in exposure site willow in 2016.

Blueberry (2016) and cranberry (2019) samples were compared to one another as cranberry was collected in place of blueberry in 2019. No cranberry was collected in 2016. For most COPCs, there was no difference

between the 2016 blueberry and 2019 cranberry in exposure sites; however, aluminum was significantly higher and cadmium significantly lower in the 2019 cranberry. No significant differences were recorded in control sites.

Vegetation metal concentrations were compared to MTL for animal feed for rodents, cattle, poultry, and fish (NRC, 2005) as a proxy for wildlife ingestion, with exceedances of guidelines occuring for aluminum, copper, and iron (Table 3-9). Aluminum exceeded the rodent, cattle, and poultry guidelines in S-08 lichen samples; the rodent guideline was also exceeded in C-02 and M-26 lichen samples and S-08 labrador tea and willow samples. All four copper guidelines were exceeded in S-08 lichen samples, while labrador tea from S-08 exceeded all but the fish guideline. C-02 lichen samples exceeded the rodent and cattle guidelines, and additionally the cattle guideline was exceeded in S-07, S-08, and S-17 willow samples. Iron guidelines for rodents, cattle, and poultry were exceeded by C-02 and S-08 lichen samples and S-08 willow samples. S-08 labrador tea samples also exceeded the rodent iron guideline.

Table 3-9: Vegetation Sample Concentrations Compared to Maximum Tolerable Limits for Metals

Metal (mg/kg)	Maximum Tolerable Limit[1]				Sites Exceeding MTL (species) [2, 3]			
	Rodent	Cattle	Poultry	Fish	Rodent	Cattle	Poultry	Fish
Aluminum	200	1000	1000	--	S-08 (Labrador Tea) C-02, M-26, S-08 (Lichen) S-08 (Willow)	S-08 (Lichen)	S-08 (Lichen)	--
Arsenic	30	30	(30)	5	None	None	None	None
Cadmium	10	10	10	10	None	None	None	None
Chromium (Soluble Cr^{3+})	100	100	500	--	None	None	None	--
Copper	500	40	100 – 250	100	S-08 (Labrador Tea) C-02, S-08 (Lichen)	S-08 (Labrador Tea) C-02, S-08 (Lichen) S-07, S-08, S-17 (Willow)	S-08 (Labrador Tea) S-08 (Lichen)	S-08 (Lichen)
Iron	500	500	500	--	S-08 (Labrador Tea) C-02, S-08 (Lichen) S-08 (Willow)	C-02, S-08 (Lichen) S-08 (Willow)	C-02, S-08 (Lichen) S-08 (Willow)	--
Manganese	2000	2000	2000	--	None	None	None	--
Molybdenum	7	5	100	10	None	None	None	None
Nickel	50	100	250	50	None	None	None	None
Lead	10	100	10	10	None	None	None	None
Antimony	70 – 150	--	--	--	None	--	--	--
Selenium	5	5	3	(2)	None	None	None	None
Zinc	500	500	500	250	None	None	None	None

[1] *NRC, 2005*

[2] *Total site samples: Cranberry n = 6, Horsetail n = 4, Labrador Tea n = 16, Lichen n = 3, Willow n = 16*

[3] *Total number of samples: Cranberry n = 16, Horsetail n = 12, Labrador Tea n = 48 , Lichen n = 9, Willow n = 48*

The relationship between COPC concentrations and distance from mine footprint shows no clear correlation. Some sites had higher metals concentraions while others were lower. In general, the highest concentrations of COPCs in vegetation were measured at S-08, located just east of the Area Stage 2 Pit and Stockpile. S-07, which is east of the Minto South Portal and south of S-08, had middling to high concentrations of COPCs such as arsenic, cadmium, copper, chromium, and iron in labrador tea, lichen, and willow samples. S-19, located beside the North Pit, had generally high concentrations of COPCs om cranberry, labrador tea, and willow samples. In exposure sites further from the mine, such as S-18, S-11, and S-01, concentrations of COPCs were in general lower than in the exposure sites in direct proximity to the mine site; however, S-03 arsenic, chromium, and selenium concentrations were middling to high despite its distance from the site and close proximity to S-11 and S-01. Nickel concentrations in S-01, S-03, and S-11 tended to be higher than the nickel concentrations observed closer to the mine site.

During the 2019 monitoring program, field duplicates were collected at two sites from all target vegetation species present to determine field variability between simultaneous soil grab samples. Relative percent difference (RPD) was calculated between the duplicate soil samples and compared against the 25% threshold. The following duplicate samples were collected: C-01 Horsetail, Labrador Tea, and Willow; S-08 Labrador Tea, Lichen, and Willow. Results from the QA/QC analyses of unrinsed vegetation tissue samples are presented in Table 3-10. Variability between simultaneous field duplicates is most likely attributed to field homogenization techniques resulting is different concentrations between samples.

Table 3-10: Summary of QA/QC Results for Vegetation Tissue Analysis

Parameter	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL
	C-01A Horsetail 1		C-01A Horsetail 2		C-01A Horsetail 3		C-01A Labrador Tea 1		C-01A Labrador Tea 2		C-01A Labrador Tea 3	
Aluminum (Al)	46%	No	94%	No	15%		59%	Yes	78%	Yes	30%	Yes
Antimony (Sb)	0%		0%		0%		0%		0%		0%	
Arsenic (As)	71%	No	79%	No	0%		0%		0%		82%	No
Barium (Ba)	21%		3%		8%		19%		41%	Yes	49%	Yes
Beryllium (Be)	67%	No	0%		75%	No	0%		0%		0%	
Bismuth (Bi)	0%		0%		0%		0%		0%		0%	
Boron (B)	39%	Yes	15%		20%		12%		24%		31%	Yes
Cadmium (Cd)	82%	Yes	36%	Yes	49%	Yes	0%		0%		86%	No
Calcium (Ca)	3%		16%		22%		12%		1%		23%	
Cesium (Cs)	54%	Yes	58%	Yes	37%	Yes	143%	No	78%	No	84%	No
Chromium (Cr)	49%	No	65%	No	149%	No	34%	No	89%	No	8%	
Cobalt (Co)	7%		88%	No	71%	No	53%	No	105%	No	95%	No
Copper (Cu)	8%		63%	Yes	14%		4%		32%	Yes	5%	
Iron (Fe)	34%	Yes	72%	Yes	25%		12%		25%	Yes	36%	Yes
Lead (Pb)	67%	No	125%	No	0%		0%		49%	No	54%	No
Lithium (Li)	0%		0%		0%		0%		0%		0%	
Magnesium (Mg)	23%		51%	Yes	28%	Yes	17%		11%		4%	
Manganese (Mn)	20%		37%	Yes	66%	Yes	87%	Yes	94%	Yes	28%	Yes
Mercury (Hg)	8%		47%	No	107%	No	3%		28%	No	73%	No
Molybdenum (Mo)	33%	Yes	20%		10%		56%	Yes	70%	Yes	81%	Yes

Parameter	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL
	C-01A Horsetail 1		C-01A Horsetail 2		C-01A Horsetail 3		C-01A Labrador Tea 1		C-01A Labrador Tea 2		C-01A Labrador Tea 3	
Nickel (Ni)	3%		32%	Yes	37%	Yes	59%	No	5%		4%	
Phosphorus (P)	28%	Yes	2%		11%		10%		8%		14%	
Potassium (K)	30%	Yes	33%	Yes	11%		12%		16%		18%	
Rubidium (Rb)	53%	Yes	51%	Yes	15%		120%	Yes	72%	Yes	96%	Yes
Selenium (Se)	105%	No	111%	No	75%	No	0%		0%		0%	
Sodium (Na)	115%	No	97%	No	92%	No	0%		0%		0%	
Strontium (Sr)	6%		13%		24%		6%		19%		6%	
Tellurium (Te)	0%		0%		0%		0%		0%		0%	
Thallium (Tl)	0%		67%	No	0%		97%	No	44%	No	88%	No
Tin (Sn)	0%		0%		0%		0%		0%		0%	
Uranium (U)	0%		0%		0%		0%		0%		0%	
Vanadium (V)	0%		0%		0%		0%		0%		0%	
Zinc (Zn)	5%		21%		6%		13%		11%		7%	
Zirconium (Zr)	0%		0%		0%		0%		0%		0%	
	C-01A Willow 1		C-01A Willow 2		C-01A Willow 3		S-08A Labrador Tea 1		S-08A Labrador Tea 2		S-08A Labrador Tea 3	
Aluminum (Al)	21%		114%	Yes	33%	Yes	30%	Yes	18%		18%	
Antimony (Sb)	0%		0%		0%		67%	No	0%		0%	
Arsenic (As)	0%		111%	No	82%	No	25%	No	4%		14%	
Barium (Ba)	4%		60%	Yes	40%	Yes	26%	Yes	9%		15%	
Beryllium (Be)	0%		105%	No	0%		75%	No	67%	No	67%	No
Bismuth (Bi)	0%		0%		0%		0%		0%		0%	
Boron (B)	16%		6%		24%		57%	Yes	6%		13%	

Parameter	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL
	C-01A Willow 1		C-01A Willow 2		C-01A Willow 3		S-08A Labrador Tea 1		S-08A Labrador Tea 2		S-08A Labrador Tea 3	
Cadmium (Cd)	19%		22%		36%	Yes	19%		69%	No	3%	
Calcium (Ca)	14%		42%	Yes	35%	Yes	14%		15%		3%	
Cesium (Cs)	0%		89%	No	0%		39%	Yes	1%		21%	
Chromium (Cr)	1%		53%	No	97%	No	17%		6%		13%	
Cobalt (Co)	25%	Yes	40%	Yes	30%	Yes	35%	Yes	30%	Yes	10%	
Copper (Cu)	21%		71%	Yes	18%		58%	Yes	42%	Yes	2%	
Iron (Fe)	17%		84%	Yes	16%		34%	Yes	39%	Yes	18%	
Lead (Pb)	4%		68%	No	33%	No	39%	Yes	12%		14%	
Lithium (Li)	0%		0%		0%		0%		0%		0%	
Magnesium (Mg)	19%		11%		45%	Yes	6%		5%		24%	
Manganese (Mn)	6%		48%	Yes	40%	Yes	61%	Yes	31%	Yes	40%	Yes
Mercury (Hg)	7%		30%	No	18%		17%		19%		17%	
Molybdenum (Mo)	11%		1%		15%		30%	Yes	42%	Yes	11%	
Nickel (Ni)	43%	Yes	30%	Yes	125%	Yes	78%	No	23%		27%	No
Phosphorus (P)	36%	Yes	29%	Yes	38%	Yes	22%		25%	Yes	11%	
Potassium (K)	21%		57%	Yes	4%		45%	Yes	37%	Yes	5%	
Rubidium (Rb)	22%		103%	Yes	49%	Yes	23%		35%	Yes	36%	Yes
Selenium (Se)	0%		0%		0%		73%	No	0%		4%	
Sodium (Na)	0%		0%		0%		0%		0%		0%	
Strontium (Sr)	19%		39%	Yes	39%	Yes	6%		20%		24%	
Tellurium (Te)	0%		0%		0%		0%		0%		0%	
Thallium (Tl)	0%		0%		0%		143%	No	10%		37%	Yes

Parameter	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL
	C-01A Willow 1		C-01A Willow 2		C-01A Willow 3		S-08A Labrador Tea 1		S-08A Labrador Tea 2		S-08A Labrador Tea 3	
Tin (Sn)	0%		178%	No	0%		0%		0%		0%	
Uranium (U)	0%		89%	No	0%		41%	No	28%	No	21%	
Vanadium (V)	0%		109%	No	0%		29%	Yes	27%	Yes	20%	
Zinc (Zn)	18%		18%		43%	Yes	42%	Yes	34%	Yes	12%	
Zirconium (Zr)	0%		0%		0%		0%		0%		0%	
	S-08A Lichen 1		S-08A Lichen 2		S-08A Lichen 3		S-08A Willow 1		S-08A Willow 2		S-08A Willow 3	
Aluminum (Al)	50%	Yes	28%	Yes	16%		55%	Yes	47%	Yes	25%	
Antimony (Sb)	101%	No	51%	No	20%		0%		0%		0%	
Arsenic (As)	62%	Yes	33%	Yes	35%	Yes	49%	No	53%	No	24%	
Barium (Ba)	48%	Yes	56%	Yes	25%	Yes	15%		10%		20%	
Beryllium (Be)	55%	Yes	36%	Yes	17%		67%	No	75%	No	75%	No
Bismuth (Bi)	60%	Yes	40%	Yes	23%		0%		0%		0%	
Boron (B)	29%	No	51%	No	31%	No	13%		57%	Yes	36%	Yes
Cadmium (Cd)	58%	Yes	53%	Yes	33%	Yes	22%		74%	Yes	30%	Yes
Calcium (Ca)	39%	Yes	77%	Yes	24%		4%		12%		31%	Yes
Cesium (Cs)	56%	Yes	41%	Yes	4%		9%		51%	Yes	5%	
Chromium (Cr)	60%	Yes	30%	Yes	23%		81%	No	36%	No	26%	Yes
Cobalt (Co)	58%	Yes	37%	Yes	25%	Yes	17%		5%		20%	
Copper (Cu)	62%	Yes	41%	Yes	13%		66%	Yes	69%	Yes	24%	
Iron (Fe)	57%	Yes	30%	Yes	17%		51%	Yes	53%	Yes	27%	Yes
Lead (Pb)	51%	Yes	40%	Yes	29%	Yes	28%	Yes	46%	No	29%	Yes
Lithium (Li)	64%	No	30%	No	34%	No	0%		0%		0%	

Parameter	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL
	S-08A Lichen 1		S-08A Lichen 2		S-08A Lichen 3		S-08A Willow 1		S-08A Willow 2		S-08A Willow 3	
Magnesium (Mg)	56%	Yes	39%	Yes	25%		3%		2%		33%	Yes
Manganese (Mn)	37%	Yes	69%	Yes	14%		32%	Yes	14%		26%	Yes
Mercury (Hg)	31%	Yes	31%	Yes	23%		4%		27%	No	12%	
Molybdenum (Mo)	44%	Yes	33%	Yes	10%		2%		68%	Yes	29%	Yes
Nickel (Ni)	58%	No	53%	Yes	33%	No	9%		43%	Yes	103%	Yes
Phosphorus (P)	60%	Yes	48%	Yes	10%		34%	Yes	37%	Yes	46%	Yes
Potassium (K)	40%	Yes	49%	Yes	10%		8%		8%		28%	Yes
Rubidium (Rb)	44%	Yes	58%	Yes	1%		6%		67%	Yes	64%	Yes
Selenium (Se)	64%	Yes	38%	Yes	16%		0%		75%	No	80%	No
Sodium (Na)	52%	No	44%	No	8%		131%	No	157%	No	166%	No
Strontium (Sr)	41%	Yes	61%	Yes	24%		3%		7%		22%	
Tellurium (Te)	81%	No	43%	No	34%	No	0%		0%		0%	
Thallium (Tl)	57%	Yes	38%	Yes	11%		22%		52%	No	18%	
Tin (Sn)	58%	No	29%	No	17%		0%		0%		0%	
Uranium (U)	43%	Yes	40%	Yes	15%		50%	No	59%	No	25%	
Vanadium (V)	55%	Yes	28%	Yes	22%		57%	Yes	50%	Yes	27%	Yes
Zinc (Zn)	51%	Yes	50%	Yes	24%		17%		27%	Yes	31%	Yes
Zirconium (Zr)	59%	No	34%	No	44%	No	0%		0%		0%	

RPD = relative percent difference; PQL = practical quantitation limit

3.3 SOIL

Composite soil samples were taken at each site and represented all distinguishable horizons within the soil profile. Samples were analyzed by ALS Laboratories for total metals and pH. A complete list of soil sample results can be found in Appendix B. A summary of mean total metal concentration comparing exposure to control by horizon are is presented in Table 3-11. Note that statistics were calculated using half the method detection limit where results were reported as less than detection.

Table 3-11: Soil Metal Concentration by Horizon Between Control and Exposure Sites

Metal concentration		Horizon 1			Horizon 2			Horizon 3		
Dry Weight (mg/kg)		Control (n = 5)	Exposure (n = 16)	Percent Difference[1]	Control (n = 5)	Exposure (n = 16)	Percent Difference[1]	Control (n = 5)	Exposure (n = 16)	Percent Difference[1]
Aluminum (Al)	Mean	16122	14021	14%	13160	17526	28%	15442	18682	19%
	Std Dev	14589	8142		6059	5318		6771	6022	
Arsenic (As)	Mean	3.95	4.30	8%	5.77	7.15	21%	9.95	7.15	33%
	Std Dev	3.27	2.99		2.01	2.96		7.43	2.26	
Cadmium (Cd)	Mean	0.34	0.41	16%	0.09	0.16	63%	0.11	0.08	24%
	Std Dev	0.35	0.42		0.06	0.14		0.09	0.04	
Chromium (Cr)	Mean	21.65	20.55	5%	23.99	26.06	8%	29.64	28.06	5%
	Std Dev	17.56	10.48		11.94	7.23		12.38	9.53	
Copper (Cu)	Mean	21.18	112.09	136%	15.42	171.11	167%	27.48	139.43	134%
	Std Dev	18.37	157.96		4.34	320.81		9.54	256.96	
Iron (Fe)	Mean	18530	19891	7%	21300	26169	21%	24980	27556	10%
	Std Dev	17519	10404		3686	7407		3998	8092	
Manganese (Mn)	Mean	324	818	86%	1909	529	113%	558	363	42%
	Std Dev	361	994		3669	290		445	159	
Molybdenum (Mo)	Mean	0.69	1.06	42%	0.76	1.98	89%	0.60	1.57	90%
	Std Dev	0.37	0.67		0.50	4.37		0.19	3.56	
Nickel (Ni)	Mean	15.39	17.37	12%	14.16	19.00	29%	18.28	18.95	4%
	Std Dev	14.88	12.11		1.79	4.83		1.13	7.40	
Lead (Pb)	Mean	5.02	4.99	1%	5.11	6.02	16%	5.40	6.10	12%
	Std Dev	4.07	2.54		2.79	1.65		2.55	1.45	
Antimony (Sb)	Mean	0.32	0.36	11%	0.39	0.47	18%	0.51	0.46	10%
	Std Dev	0.17	0.17		0.14	0.16		0.07	0.21	
Selenium (Se)	Mean	0.16	0.21	31%	0.13	0.29	74%	0.24	0.23	5%
	Std Dev	0.08	0.14		0.07	0.22		0.31	0.21	
Zinc (Zn)	Mean	34.04	50.28	39%	34.16	55.64	48%	35.36	59.10	50%
	Std Dev	34.45	26.27		4.36	27.42		11.00	26.20	
Physical properties										
pH (1:2 soil:water)	Mean	5.80	5.51	5%	6.12	5.67	8%	6.10	5.87	4%
	Std Dev	0.61	0.83		0.49	0.64		0.57	0.63	

[1]Percent difference is the difference in mean exposure concentration from the mean control concentration divided by the average of both concentrations.

Metals concentrations were typically higher in exposure sites than control in the upper two soil horizons, while approximately half of the investigated metals were higher in exposure sites than control in the lowest horizon (Table 3-11). The largest concentration differences were in copper, manganese, and molybdenum, followed by zinc, selenium, and cadmium. While copper, molybdenum, zinc, selenium, and cadmium were higher or similar in exposure sites compared to control sites, manganese was higher in the top horizon of exposure sites but lower than control sites in the lower two horizons. Copper, molybdemun, selenium, and zinc were noted as having the highest differences between control and exposure sites in 2016 (AEG, 2017). Generally, concentrations in the top horizon were lower than the concentrations in the lowest horizon.

Of the 21 sites sampled in 2016 and 2019, two were also sampled in 2010: one control (M-29) and one exposure (M-54A, renamed S-04 in 2016/2019) (Horizon Ecosystem Consultants, 2010). Soil samples were collected by horizon or depth in 2016 and 2019, but in bulk in 2010; therefore, for comparison purposes concentrations were averaged when more than one sample collected. Soil COPC concentrations were generally higher in 2016 than 2010 and 2019 at both sites but the differences were typically not large (Table 3-12). In the control site COPC concentrations were lowest in 2019 while concentrations at the exposure site were lowest in 2010.

Table 3-12: Comparison of Soil Metal Concentrations from 2010 to 2019

Metal concentration	M-29 (control)			M-54A/S-04 (exposure)		
Dry Weight (mg/kg)	2010 (n = 1)	2016 (n = 2)	2019 (n = 3)	2010 (M-54A) (n = 1)	2016 (S-04) (n = 1)	2019 (S-04) (n = 3)
Aluminum (Al)	15200	19750	14667	17200	25100	17153
Arsenic (As)	0.80	0.93	0.65	0.20	0.52	0.37
Cadmium (Cd)	8.20	10.0	6.23	4.30	11.4	8.46
Chromium (Cr)	0.31	0.27	0.55	0.03	0.04	0.09
Copper (Cu)	30.0	39.6	27.4	14.0	31.2	23.0
Iron (Fe)	38.1	40.3	33.3	6.70	15.2	20.9
Manganese (Mn)	29900	34000	23467	26700	33300	24333
Molybdenum (Mo)	9.00	9.36	6.39	4.80	7.92	6.75
Nickel (Ni)	581	729	442	278	315	242
Lead (Pb)	0.90	0.94	0.77	0.40	0.80	0.63
Antimony (Sb)	34.8	39.1	27.8	9.00	19.3	16.1
Selenium (Se)	0.25	0.26	0.36	0.25	0.10	0.10
Zinc (Zn)	80.0	81.5	68.6	60.0	60.6	43.5

Soil metal concentrations were compared to CCME Industrial Guidelines with exceedances occurring at two sites for arsenic and six sites for copper, out of 21 total sites (Table 3-13). Arsenic exceedances occurred in the deepest horizon in M-07B and all three horizons in S-06, corresponding to an exceedance rate of 6% (4/63 samples). Neither of these sites exceeded CCME guidelines in 2016, when two exceedances were recorded in S-02 and S-19 respectively (AEG, 2017). Copper exceedances occurred in all horizons at sites S-06, S-07, and S-17, as well as in two horizons in S-05 and S-16 and one in S-15. In 2016 copper exceedances were recorded in all these sites except S-15. In total, 14 of 63 samples exceeded copper CCME (22%).

Soil pH was similar between control and exposure sites, with exposure sites being more acidic on average. Both control and exposure sites had lower pH on average in the top horizon, ranging from 5.13–6.42 versus 5.41–

6.68 in the top and bottom horizons of control sites, and 4.35–6.69 versus 4.96–7.17 in the top and bottom horizons of exposure sites, respectively. These results are consistent with those observed in 2016 (AEG, 2017).

Table 3-13: Soil Sample Concentrations Compared to CCME Industrial Soil Guidelines for Metals

Element	CCME Industrial Guideline	Sites exceeding CCME Guideline (soil horizon)	Total sites samples	Total number of samples (n)
Aluminum (Al)	-	-	21	63
Antimony (Sb)	40	None		
Arsenic (As)	12	M-07B (Horizon 3), S-06 (Horizon 1, 2, 3)		
Cadmium (Cd)	22	None		
Chromium (Cr) (total)	87	None		
Copper (Cu)	91	S-05 (Horizon 2,3), S-06 (Horizon 1, 2, 3), S-07 (Horizon 1, 2, 3), S-15 (Horizon 1), S-16 (Horizon 1, 3), S-17 (Horizon 1, 2, 3)		
Iron (Fe)	-	-		
Lead (Pb)	600	None		
Manganese (Mn)	-	-		
Molybdenum (Mo)	40	None		
Nickel (Ni)	89	None		
Selenium (Se)	2.9	None		
Zinc (Zn)	410	None		

During the 2019 monitoring program, field duplicates were collected at from all horizons at two sampling sites to determine field variability between simultaneous soil grab samples. RPD was calculated between the duplicate soil samples and compared against the 25% threshold. Duplicate samples were collected at the following sites: C-01 Horizon 1 (0–8 cm), Horizon 2 (8–15 cm), Horizon 3 (+15 cm) and S-08 Horizon 1 (2-8 cm), Horizon 2 (8–15 cm), Horizon 3 (+15 cm). Results from the QA/QC analyses are presented inTable 3-14.

Table 3-14: Summary of QA/QC Results for Duplicate Soil Analysis

Analyte	C-01 Horizon 1 (0 - 8 cm)		C-01 Horizon 2 (8 - 15 cm)		C-01 Horizon 3 (+15 cm)		S-08 Horizon 1 (2 - 8 cm)		S-08 Horizon 2 (8 - 15 cm)		S-08 Horizon 3 (+15 cm)	
	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL	RPD	Meets PQL
Physical Parameter												
pH	2%		0%		0%		5%		3%		2%	
Metals												
Aluminum (Al)	10%		5%		6%		32%	Yes	65%	Yes	5%	
Antimony (Sb)	2%		6%		2%		29%	No	61%	No	4%	
Arsenic (As)	3%		36%	Yes	21%		24%		73%	Yes	17%	
Barium (Ba)	8%		5%		1%		36%	Yes	24%		4%	
Beryllium (Be)	5%		20%		0%		0%		10%		9%	
Bismuth (Bi)	14%		0%		0%		0%		0%		0%	
Boron (B)	0%		0%		0%		0%		0%		0%	
Cadmium (Cd)	17%		4%		10%		77%	Yes	65%	Yes	32%	No
Calcium (Ca)	4%		12%		16%		43%	Yes	76%	Yes	29%	Yes
Chromium (Cr)	10%		3%		1%		60%	No	69%	Yes	2%	
Cobalt (Co)	11%		5%		0%		49%	Yes	43%	Yes	11%	
Copper (Cu)	15%		1%		3%		58%	Yes	9%		1%	
Iron (Fe)	4%		2%		6%		31%	Yes	81%	Yes	1%	
Lead (Pb)	10%		6%		1%		80%	No	101%	No	8%	
Lithium (Li)	16%		1%		6%		0%		134%	No	6%	
Magnesium (Mg)	2%		2%		3%		36%	Yes	31%	Yes	1%	
Manganese (Mn)	20%		7%		3%		28%	Yes	18%		17%	
Mercury (Hg)	7%		4%		17%		14%		53%	Yes	3%	
Molybdenum (Mo)	5%		6%		5%		39%	Yes	33%	Yes	2%	
Nickel (Ni)	16%		1%		1%		48%	Yes	9%		4%	
Phosphorus (P)	5%		6%		4%		55%	Yes	27%	Yes	97%	Yes
Potassium (K)	13%		10%		12%		90%	No	32%	No	15%	
Selenium (Se)	4%		0%		0%		0%		16%		0%	
Silver (Ag)	22%		0%		0%		0%		0%		0%	
Sodium (Na)	18%		17%		26%	No	95%	No	20%		7%	
Strontium (Sr)	6%		3%		13%		32%	Yes	71%	Yes	15%	
Sulfur (S)	0%		0%		0%		0%		82%	No	0%	
Thallium (Tl)	21%		16%		16%		0%		0%		21%	
Tin (Sn)	0%		0%		0%		0%		0%		0%	
Titanium (Ti)	20%		19%		28%	Yes	39%	Yes	87%	Yes	6%	
Tungsten (W)	0%		0%		0%		0%		0%		0%	
Uranium (U)	10%		2%		2%		29%	No	80%	Yes	7%	
Vanadium (V)	9%		5%		1%		41%	Yes	79%	Yes	7%	
Zinc (Zn)	5%		2%		22%		66%	No	93%	No	3%	
Zirconium (Zr)	8%		50%	No	29%	Yes	82%	No	11%		12%	

RPD = relative percent difference; PQL = practical quantitation limit

4 DISCUSSION

The main objective of the vegetation metal uptake program was to monitor and measure effects of airborne transport and metal uptake in vegetation on and around the mine site using previously established or documented conditions, monitoring results, or predictive efforts, where appropriate and possible; establish a network of plots for monitoring both soil and vegetation metal concentrations; and, allow for an ongoing evaluation of the extent and degree that metals from mining activity is affecting vegetation in proximity to the project site.

To meet these objectives, all 16 exposure sites and five control sites that were established in 2016 were resampled. At each site three replicate samples were collected from each of the five target vegetation species present, along with samples of each distinguishable soil horizon. The data were described with statistics and compared to results from the 2016 monitoring event.

Results from the 2019 monitoring event present evidence that some metals are elevated in certain plant species near the mine when compared to control sites, particularly in lichen. Some of these metals were also noted as elevated in vegetation in the 2016 monitoring event.

Results from the comparison of unrinsed and rinsed vegetation samples contained large amounts of variability. Mean COPC concentrations were higher in unrinsed samples for the majority of metals and vegetation species (horsetail, Labrador tea, lichen, and willow); the differences in Labrador tea and willow samples were statistically significant for all tested metals except zinc (both species) and cadmium (willow only). Higher concentrations in rinsed samples were found in only two metals each in horsetail and lichen and the small differences between unrinsed and rinsed samples indicates this may be a result of variability introduced through the subsampling, rinsing, and comparison of the paired samples. No significant differences were found in other vegetation species, including cranberry where five metals were identified as higher in rinsed samples (arsenic, chromium, manganese, molybdenum, and lead). The homogenization of the cranberry samples prior to subsampling for rinsing meant that the sample size for the comparison was small (five) and therefore these results may not be an accurate representation of the true differences between unrinsed and rinsed samples. The larger sample sizes of Labrador tea and willow may have contributed to the detection of significant differences in those species despite the large amount of variability in the data.

Rinsing has been shown to significantly decrease concentrations of most metals in moss samples, with only cadmium and zinc being significantly higher in rinsed samples (Fernández et al., 2009). These findings are similar to those described by Kabatta-Pendias et al (2011), where metals were affected differently by rinsing. Specifically, they found rinsing had a large effect on lead concentrations but limited impact on cadmium, copper, and zinc concentrations. These results are consistent with lack of significant decreases in zinc in any vegetation species, and cadmium in only Labrador tea. In 2016, the majority of metals in willow and lichen were significantly different after rinsing, along with copper and iron in horsetail, but no statistically significant differences in Labrador tea were recorded (AEG, 2017). The difference between 2016 and 2019 Labrador tea results may be due to the larger samples size in 2019 (48 vs 15 in 2016) and the rain which occurred at the beginning of the 2016 sampling period, along with variability in samples. The difference in horsetail and lichen results between 2016 and 2019 may be attributable to the small sample sizes in both years (12 and 9 in 2019, respectively) and high variability in the samples.

Concentrations of most COPCs in horsetail, Labrador tea, lichen, and willow were significantly higher in exposure sites than control sites, particularly in lichen. Lichen exposure samples also had higher COPC concentrations than control samples in 2016 (AEG, 2017); however, COPC concentrations in lichen were significantly higher in 2019 than they were in 2016. Lichen species are known to be good indicators of airborne metals, and range from being tolerant to sensitive to airborne metals, depending on the physiological form and species (Garty, 2000; Branquinho et al., 2000; Kabata-Pendias et al., 2011). The significant differences in lichen concentrations between control and exposure sites and the significant increase in concentrations from 2016 to 2019 is likely due to its ability to effectively intercept the airborne metals, and accumulate and retain metals in excess of its nutrient requirements (Bačkor and Loppi, 2009). The concentration increases may represent the amount of deposition which occurred around the mine in the three years between sampling events. Exposure sites will receive more dust from the mine complex due to their proximity, accounting for the much larger increase in concentrations seen in these samples.

Concentrations of aluminum, arsenic, copper, iron, and lead in willow samples were significantly higher in exposure sites than control sites, suggesting deposition of metals from the mine site is impacting concentrations in exposure sites. However, concentrations between 2016 and 2019 were similar which indicates that the effects of deposition occur more slowly in willows than in lichen. Willows species are known to be accumulators of metals (Kosvakinka and Quigley, 2004), uptaking cadmium and zinc in particular from surrounding soils (Tlustos et al., 2007). This may account for the slightly lower concentrations in cadmium and zinc at exposure sites than control sites: as willow may accumulate and store large amounts from the soil, the effects of surface deposition would be less prominent. In further support of this, cadmium and zinc were higher in willow than any other vegetation species.

Labrador tea and horsetail generally had higher concentrations of COPCs in exposure sites, and limited differences between 2016 and 2019 concentrations. This indicates that, similar to willow, the effects of surface deposition are not as large as for lichen, and may take more time to appear as the metals will have to enter further into the soil profile to become available to roots. Higher concentrations in exposure sites are likely due to higher metal content in the soils, both from natural mineralization and deposition.

Cranberry samples generally had similar COPC concentations in control and exposure sites, possibly due to the short period when berries are produced resulting in limited exposure. These results are consistent with blueberry results from 2016, which were not different from 2019 cranberry results for most COPCs.

The guidelines for rodents, cattle, poultry, and fish (NRC, 2005) were exceeded only for aluminum, copper, and iron. This is consistent with dust being the major cause of elevated COPC concentrations, as aluminum and iron were included in the COPC list for being related to dust and elevated copper concentrations in dust are likely considering the Minto Mine is a copper mine. The majority of exceedances occurred in site S-08 (20 out of 28 exceedances), particularly in the lichen samples. S-08 is located close to the mine area, just east of the stockpile (Figure 2-1), and is therefore likely highly exposed to dust. Five of the remaining exceedances occurred in lichen samples from C-02, a control site located to the north of the mine site. The control sites were assumed to be outside of the influence of the mine area, but it is possible that dust deposition may still occur and as lichen is a good indicator of airborne metals (Bačkor and Loppi, 2009) the effects may be more visible on the lichen samples.

Although sites close to the mine infrastructure (S-08, S-07, S-19) generally had higher concentrations of COPCs than sites further away (S-01, S-03, S-11), the effects were not always clear and were not consistent between

COPCs or vegetation species. The limited amount of samples collected from each location makes it difficult to present results with certainty, and as all vegetation species were not collected from all sites, a complete picture of concentrations is not available. Labrador tea and willow provide the most complete data set, but as discussed above they were less affected by surface deposition than lichen and therefore may not fully reflect the effect of distance on COPC concentrations resulting from dust exposure.

Soil metals were generally higher at exposure sites than control sites, particularly in the upper horizons. In the bottom horizon, around half of the COPCs were higher in the control sites. This is consistent with atmospheric deposition of COPCs occurring at the exposure sites, which would primarily influence surface horizons. The bottom horizon is likely largely influenced by bedrock and natural background metals. The comparison of COPC concentrations in 2010, 2016, and 2019 also indicates surface deposition has a larger effect on exposure sites, as the lowest concentrations of COPCs in the exposure sites were in 2010 while lowest concentrations in the control site were in 2019. However, only two sites were sampled in 2010 and differences in sampling methods may also have contributed to the pattern seen in concentrations through the years, particularly the high concentrations in 2016. The 2019 data indicated that the top horizon typically had the lowest COPC concentrations, likely due to reduced influence of bedrock and higher annual inputs of organic material diluting the concentrations. Soil horizons were sampled separately in 2016 and 2019 and the lower horizons (Bm) were the ones analyzed in 2016 (AEG, 2017) while the top horizons were included in the 2019 analyses, and likely in 2010. The exclusion of the top horizon in the 2016 analysis may have contributed to that year having the highest concentrations of COPCs out of the three.

CCME exceedances were recorded only for arsenic (6% of samples) and copper (22% of samples). With the exception of arsenic in horizon 3 of control site M-07B, all exceedances were recorded in exposure sites. This may be a reflection of the six exposure sites' close proximity to the mine footprint; not only will they be exposed to large amount of dust, but they are in the area with the highest concentration of copper in the bedrock. The multiple exceedances of copper through the soil profile in several sites suggests a continuum of copper from the parent material, reflecting the mineralization of the area.

Large amounts of variation (noted by high standard deviations) were present within the data collected in 2016; as a result several changes were made to the sampling procedure in 2019 to reduce variation when possible. Sources of variation identified in 2016 were natural variability in soil and plant tissue, plant species, source types and distance to exposure sites, field sampling conditions, and small sample size. Natural variation within soils and plants cannot be reduced, nor can variation from distance to exposure sites as the establishment of ongoing monitoring plots is an important objective of the VMU. However, the 2019 field sampling conditions and sample sizes differ from the 2016 conditions and sample sizes in the following ways.

Field sampling conditions in 2016 were not ideal due to the rain which occurred at the beginning of the sampling period and the scattered showers in the following days. In 2019, field sampling was conducted over a three day period when the weather was mostly clear. Although ideal weather conditions will not always be possible during future sampling events, the lack of rain during the 2019 sampling period may have reduced variability between exposed and covered vegetation, as well as between samples collecting during and post rain. However, it should be noted that variability will unavoidably exist between plants which grow under different levels of cover, as they will be exposed to differing levels of wind, rain, and snow throughout the year.

Small sample sizes in 2016, particularly for blueberry, resulted in a number of recommendations for the 2019 season to reduce the associated variability. These were the addition of cranberry as an alternative target

vegetation species to blueberry and the collection of three replicate samples from the target vegetation present at each site. As a result of these changes, sample sizes in 2019 ranged from nine to 48, compared with three to 21 in 2016. Overall increases in sample sizes, particularly in Labrador tea and willow (48 each), resulted in a more robust data set for analysis. However, cranberry, horsetail, and lichen sample sizes remained fairly small (n=9 to 16), and cranberry rinsed samples were further reduced by laboratory error from 16 to five.

Laboratory variability was encounted by nature of the selected lab's data quality objective (DQO). The DQO implemented by the lab for tissue analysis was 40% repeatability. This threshold allows for 40% variation in concentrations between any duplicate samples. This threshold was set by the lab and is a factor of the natural variability that is present in vegetation tissue sampling. This variation is compounded when the lab homogonized, subsampled, and rinsed half of the samples for the purpose of quantifying external and internal metal concentrations. Large variation made comparisons between rinsed and unrinsed samples challanging when there were low metal concentations and minimal differences between subsamples. Additionally, many of the results received were below the method detection limits. When this was the case, the value used for graphing and to calculate statistics was half the detection limits. Including these halved detection limits is likely to have increased the variation and standard deviation for each variable.

5 CONCLUSIONS AND RECOMMENDATIONS

Overall, results indicate higher concentrations of COPCs in vegetation from exposure sites, and an increase in concentration from 2016 to 2019 in lichen for all COPCs and some COPCs in other vegetation species. The increase in concentration in exposure sites and with time could be due to airborne particulates from the Minto Mine though continued monitoring is needed to determine whether the increases in 2019 are part of a trend. Subsequent studies will help establish a trend and provide ongoing evaluation of the extent and degree that metals from mining activity may be affecting vegetation in the proximity of the project site.

The following recommendations should be considered for subsequent VMU sampling events based on the 2019 VMU program results:

- Continue sampling both blueberry and cranberry when available as samples are limited for both;
- Continue collecting three replicates per available species at each site to improve the ability to determine statistically valid spatial and temporal differences; and
- When possible, collect samples during a period with little to no rain to reduce variability;
- Conduct continual periodic sampling until a temporal range of data can be analyzed to determine any significant patterns in the data.

In addition to the recommendations for future VMU sampling, the Minto Mine Best Management Practices for Dust Control should also be reviewed by a Qualified Person and updated, based on the results of this report, where required.

6 REFERENCES

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APPENDIX A:

2019 VMU SITE SUMMARY

Project ID: Minto	Site ID: 516
Weather: 10° Cloudy	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR, ChadB	26 Aug 19	15:47	16:20

Type of samples: ☑ Labrador Tea. ☑ **PHOTOS**

- ☐ ~~Horsetail~~
- ☑ **Willow** *S. bebbiana* *S. glauca* *S. myrtillifolia* *S. scouleriana*
- ☐ **Lichen** *C. rangiferina* *C. stellaris*
- ☐ **Berries** *V. vitisidaea* *V. oxycoccos* *uliginosumn*
- ☑ **Soil** (dark) medium light N/A

WP #	516
ASPECT (°)	350°
SLOPE (%)	15°
ELEVATION (m)	768 m

Wildlife signs:
Small trails maybe made by animals

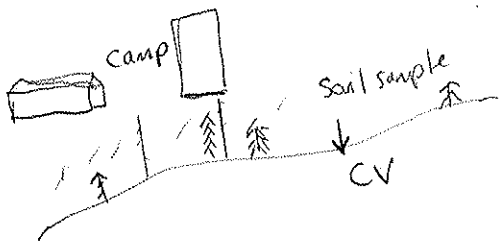
Vegetation Cover	%
Tree layer (A)	30
Shrub layer (B)	20
Herb layer (C)	30
Moss layer (D)	15
Lichen layer (E)	<2%

Other Notes:
Fire - long time ago
No active mining ever here

Disturbed Site: Y / (N)

Blueberry bushes present - no berries

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
(CV)	Concave
CX	Convex
ST	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
(MS)	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
white spruce, pine in distance ~25m 1 birch tree ~15 m away
Shrub Layer (B) Species:
willow sp(?) ~~(unidentified)~~, blueberry bushes.
Herb Layer (C) Species: (lots – some – little bit – none)
some
Moss Layer (D) Species: (lots – some – little bit – none)
little bit
Lichen Layer (E) Species: (lots – some – little bit – none)
none

Project ID:	Site ID:
Minto	S17

Weather:	Duplicate ID:
Clear 5°	

Field Crew:	Date:	Start:	End:
CR CB	Aug 27.2019	6:40	7:05

Type of samples: ☐ horse tail ☐ Lab. Tea ☑ PHOTOS

soft under side

☑	**Willow**	*S. bebbiana* (?)	*S. glauca*	*S. myrtillifolia* *S. scouleriana*
☒	☐ **Lichen**	*C. rangiferina*	*C. stellaris*	
☒	☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*
	☐ **Soil**	dark	medium	light (N/A) no soil - O layer + clay.

photos taken - hard to identify species.

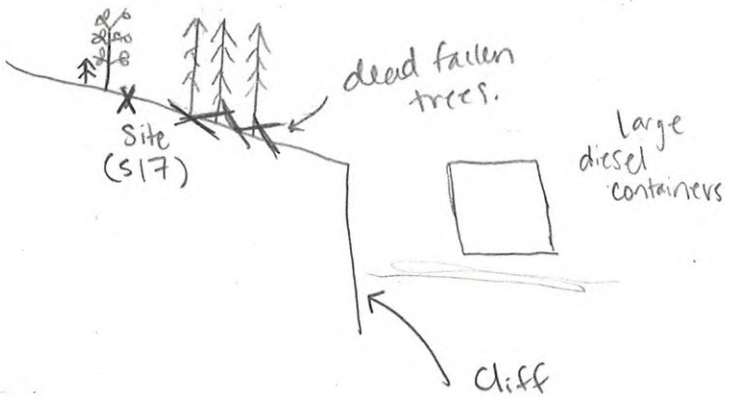
WP #	S17
ASPECT (°)	126° SE
SLOPE (%)	20 %
ELEVATION (m)	828

Wildlife signs: N/A

Vegetation Cover	%
Tree layer (A)	30
Shrub layer (B)	<5
Herb layer (C)	<5
Moss layer (D)	—
Lichen layer (E)	—

Other Notes: lots of fallen dead trees (from fire?)
- not a lot of ground cover
- trees are small (mostly - some large pine) + poplar
Disturbed Site: (Y) / N disturbed from fire

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
(LS)	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
Poplar (trembling aspen), white spruce (small), pine trees (large + small)
Shrub Layer (B) Species:
Soap berries, willow
Herb Layer (C) Species: (lots – some – little bit – none)
(little bit) cranberry bushes - no berries
Moss Layer (D) Species: (lots – some – little bit – none)
none
Lichen Layer (E) Species: (lots – some – little bit – none)
none.

Project ID:	Minto	Site ID:	S19
Weather:	clear 5°	Duplicate ID:	—

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 2019	7:40	8:25

Type of samples: ☑ Lab. Tea ☐ ~~horse~~ tail ☑ PHOTOS

- ☑ **Willow** *S. bebbiana*? *S. glauca* *S. myrtillifolia* *S. scouleriana* — see photos
- ☐ **Lichen** *C. rangiferina* *C. stellaris*
- ☑ **Berries** *V. vitisidaea* *V. oxycoccos* *uliginosumn* — not plentiful.
- ☑ **Soil** dark medium light N/A (clay) — silty

WP #	S19
ASPECT (°)	300 NW
SLOPE (%)	12
ELEVATION (m)	921

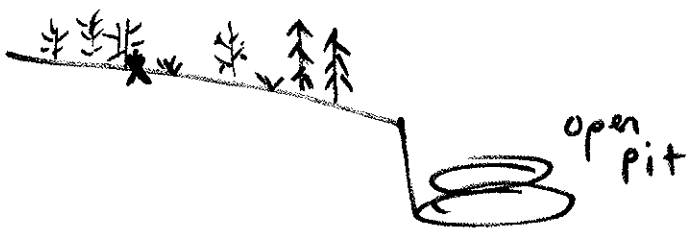
Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	30
Shrub layer (B)	10
Herb layer (C)	20
Moss layer (D)	5
Lichen layer (E)	5

Other Notes:
Five (old) burnt trees
Lichen present but not species of interest. see photos

Disturbed Site: (Y) / N

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
(MS)	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
Pine trees, birch, white spruce
Shrub Layer (B) Species:
willow
Herb Layer (C) Species: (lots – some – little bit – none)
LT, - some
Moss Layer (D) Species: (lots – some – little bit – none)
little bit - cranberry ↳ Sphagnum.
Lichen Layer (E) Species: (lots – some – little bit – none)
little bit

Project ID: Minto	Site ID: S05
Weather: clear 8°C	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 19	9:22	9:58

Type of samples: ☑ horsetail ☑ lab. tea ☑ PHOTOS

- ☐ **Willow** *S. bebbiana* *S. glauca* *S. myrtillifolia* *S. scouleriana*
- ☐ **Lichen** *C. rangiferina* *C. stellaris*
- ☑ **Berries** (*V. vitisidaea*) *V. oxycoccos* *uliginosumn*
- ☑ **Soil** (dark) medium light N/A — first 15cm

clay soil (dark)

WP #	S05
ASPECT (°)	304 NW
SLOPE (%)	8%
ELEVATION (m)	855

Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	20
Shrub layer (B)	5
Herb layer (C)	95
Moss layer (D)	40
Lichen layer (E)	<5

Other Notes:
Near main waste dump. lots more veg than elsewhere
think O layer.
Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



WIS (pond)

Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
(L)	Level

Tree Layer (A) Species:
Birch, white spruce.
Shrub Layer (B) Species:
dwarf birch (tall brush), willow
Herb Layer (C) Species: (lots – some – little bit – none)
LT, cranberry (lots.), cloud berry maybe
Moss Layer (D) Species: (lots – some – little bit – none)
lots
Lichen Layer (E) Species: (lots – some – little bit – none)
none

Project ID: Minto VMU	Site ID: S09
Weather: clear 10°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 19	10:20	10:47

Type of samples: ☐ horsetail ☐ Lab. tea ☑ PHOTOS

☑ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☐ **Lichen**	*C. rangiferina*	*C. stellaris*			
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*		
☑ **Soil**	dark	(medium)	light	N/A	small O layer clayish soil - rock @ ~20 cm

WP #	S09
ASPECT (°)	117 SE
SLOPE (%)	25%
ELEVATION (m)	916

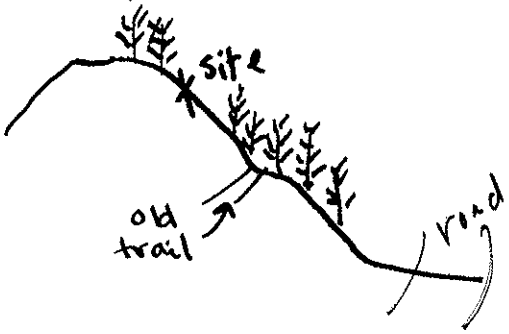
Wildlife signs: scat on road below

Vegetation Cover	%
Tree layer (A)	50
Shrub layer (B)	10
Herb layer (C)	<10
Moss layer (D)	—
Lichen layer (E)	15

Other Notes:
- not a lot of veg.
- ground mostly covered in dead leaves/pine needles/sticks

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
(UP)	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
lots of poplar, large pine trees, small cotton wood(?) + small
Shrub Layer (B) Species:
willow, rose bush
Herb Layer (C) Species: (lots – some – little bit – none)
~~none~~ little bit.
Moss Layer (D) Species: (lots – some – little bit – none)
none
Lichen Layer (E) Species: (lots – some – little bit – none)
little bit.

Project ID: Minto VNU	Site ID: S08
Weather: clear 5	**Duplicate ID:** S08A

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 19	11:00	11:41

Type of samples: ☐ horsetail ☒ LT (lab + tea) ☑ PHOTOS

☑ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☑ **Lichen**	*C. rangiferina*	*C. stellaris*			
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	blueberry bushes present – no berries	
☑ **Soil**	dark	medium	light	N/A	

WP #	S08
ASPECT (°)	298°
SLOPE (%)	3%
ELEVATION (m)	803

Wildlife signs:
small trails (animals)

Vegetation Cover	%
Tree layer (A)	30
Shrub layer (B)	<10
Herb layer (C)	15
Moss layer (D)	30
Lichen layer (E)	20

Other Notes:
lots of diversity - large O layer/A
cloudberry bushes present

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
(D)	Depression
(L)	Level

Tree Layer (A) Species:
white spruce
Shrub Layer (B) Species:
willows
Herb Layer (C) Species: (lots – some – little bit – none)
Labrador tea, blueberry bushes, Cloudberry bushes lots
Moss Layer (D) Species: (lots – some – little bit – none)
sphagnum - lots
Lichen Layer (E) Species: (lots – some – little bit – none)
some

Project ID: Minto VMU	Site ID: S04
Weather: Clear 10°	**Duplicate ID:** —

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 19	13:33	14:00

Type of samples: ☐ horsetail ☑ labrador tea ☑ PHOTOS

☑ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	large leaves
☐ **Lichen**	*C. rangiferina*	*C. stellaris*			
☑ **Berries**	(*V. vitisidaea*)	*V. oxycoccos*	*V. uliginosumn*		
☑ **Soil**	dark	medium	(light)	N/A	hit clay quickly ~4cm

WP #	S04
ASPECT (°)	313 NW
SLOPE (%)	25 %
ELEVATION (m)	918

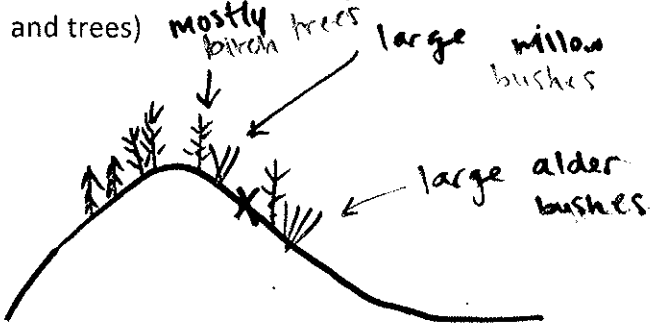
Wildlife signs:
- Moose poop seen while walking here
- heard branches cracking nearby - maybe rodent?

Vegetation Cover	%
Tree layer (A)	15
Shrub layer (B)	20
Herb layer (C)	20
Moss layer (D)	<5
Lichen layer (E)	—

Other Notes:
Black growths on willows leaves

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
(CX)	Convex
ST	Straight
UN	Undulating
Plot position Meso	
C	Crest
(UP)	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
pine (smaller), birch (white + dark bark), some small ~~pepper~~ trembling aspen
Shrub Layer (B) Species:
alder (sitka)
Herb Layer (C) Species: (lots – some – little bit – none)
lots
Moss Layer (D) Species: (lots – some – little bit – none)
littlebit
Lichen Layer (E) Species: (lots – some – little bit – none)
none

Project ID: Minto VMU	Site ID: S-06

Weather: clear 13°	Duplicate ID: —

Field Crew: CR CB	Date: 27 Aug 2019	Start: 14:55	End: 15:09

Type of samples: ☐ horsetail ☑ labrador tea ☑ PHOTOS

☐ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*
☐ **Lichen**	*C. rangiferina*	*C. stellaris*		
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	
☑ **Soil**	dark	medium	light	(N/A)

clay — small O-layer straight into clay

WP #	S06
ASPECT (°)	88E
SLOPE (%)	
ELEVATION (m)	929

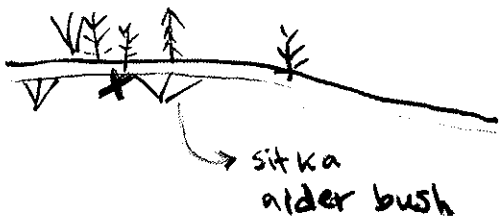
Wildlife signs: moose poop

Vegetation Cover	%
Tree layer (A)	~~20~~ 10
Shrub layer (B)	15
Herb layer (C)	5
Moss layer (D)	10
Lichen layer (E)	—

Other Notes: Old road
Some cranberry present but not enough to sample.

Disturbed Site: (Y) / N

Site Sketch: (dominant plants, shrubs and trees)



Slightly → (CX)

Surface Shape	
CV	Concave
(CX)	Convex
ST	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
(L)	Level

Tree Layer (A) Species:
lots of trembling aspen, birch, some pine
Shrub Layer (B) Species:
sitka alder. - lots especially by the "road"
Herb Layer (C) Species: (lots – some – little bit – none)
little bit,
Moss Layer (D) Species: (lots – some – little bit – none)
~~some~~ little bit
Lichen Layer (E) Species: (lots – some – little bit – none)
none.

Project ID: Minto VMU	Site ID: S-07

Weather: Clear 15°	Duplicate ID: ———

Field Crew:	Date:	Start:	End:
LR CB	27 Aug 19	15:50	16:22

Type of samples: ☒ Labrador tea ☒ Horsetail ☑ PHOTOS

☑ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*
☐ **Lichen**	*C. rangiferina*	*C. stellaris*		
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	
☑ **Soil**	(dark)	medium	light	N/A

- Some cranberry bushes
- blueberry bushes around but no blueberries.

WP #	S07
ASPECT (°)	25 NE
SLOPE (%)	
ELEVATION (m)	847

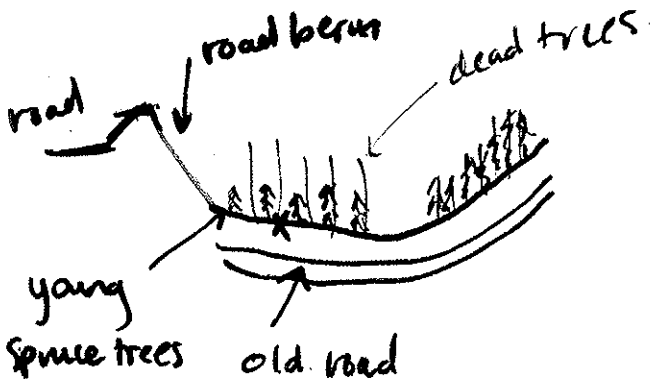
Wildlife signs:

Vegetation Cover	%
Tree layer (A)	25
Shrub layer (B)	20
Herb layer (C)	30
Moss layer (D)	20
Lichen layer (E)	10

Other Notes: LT-dying >HT dead not enough cran to sample lots of dead trees from fire (old) very dry site

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
(D)	Depression
L	Level

Tree Layer (A) Species:
young white spruce, 3 birch (small)
Shrub Layer (B) Species:
willow, some rose bushes,
Herb Layer (C) Species: (lots – some – little bit – none)
labrador tea, blue berry, cloud berry bushes, some cran. lots
Moss Layer (D) Species: (lots – some – little bit – none)
some
Lichen Layer (E) Species: (lots – some – little bit – none)
~~some~~. little bit

Project ID: Minto VMH	Site ID: S-11

Weather: clear 15°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 19	17:15	17

Type of samples: ☐ horsetail ☐ Labrador tea ☑ PHOTOS

☑ **Willow**	*S. bebbiana*	(*S. glauca*)	*S. myrtillifolia*	*S. scouleriana*	
☐ **Lichen**	*C. rangiferina*	*C. stellaris*			
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	- few cran	- not enough to sample
☑ **Soil**	dark	medium	(light) dry	(N/A) Loess	- rocky ~~tourn~~

WP #	S-11
ASPECT (°)	356°N
SLOPE (%)	[redacted]
ELEVATION (m)	765

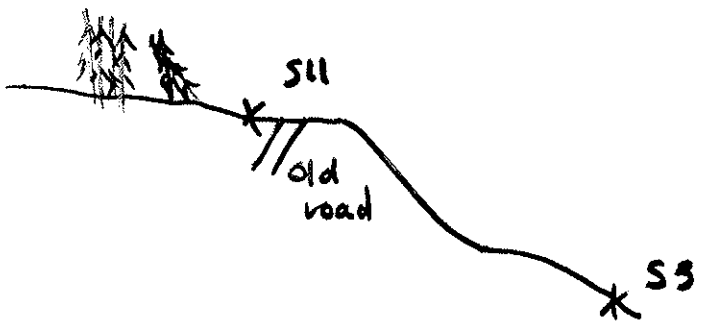
Wildlife signs:
- bear (sow + 2 cubs) 2km away
- fresh bear poop ~25m away

Vegetation Cover	%
Tree layer (A)	15
Shrub layer (B)	15
Herb layer (C)	5
Moss layer (D)	5
Lichen layer (E)	—

Other Notes:
Soil very dry - lots of

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
(L)	Level

Tree Layer (A) Species:
Spruce (large), trembling aspen,
Shrub Layer (B) Species:
Sitka alder., little bit of willow
Herb Layer (C) Species: (lots – some – little bit – none)
little bit, some fire weed
Moss Layer (D) Species: (lots – some – little bit – none)
little
Lichen Layer (E) Species: (lots – some – little bit – none)
none

Project ID: Minto VM1	Site ID: S-03
Weather: clear / partly cloudy	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 19	17:35	~~18:06~~

Type of samples: ☐ horsetail ☐ labrador tea ☑ PHOTOS

☑ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	1 bush only
☐ **Lichen**	*C. rangiferina*	*C. stellaris*			
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*		
☑ **Soil**	dark	medium	light	N/A	• loess – not much O-layer • rocky at ~10 cm

WP #	S03
ASPECT (°)	356 N
SLOPE (%)	28
ELEVATION (m)	764

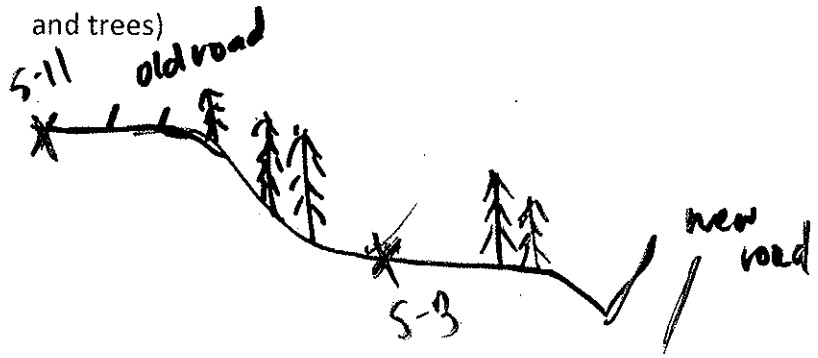
Wildlife signs:
Fresh bear scat (yesterday) up the hill

Vegetation Cover	%
Tree layer (A)	20
Shrub layer (B)	<5
Herb layer (C)	30
Moss layer (D)	~~20~~ 25
Lichen layer (E)	10

Other Notes:
- Opening in the slope
- trees around site

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
ST	Straight
(UN)	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
(LS)	Lower Slope
T	Toe
(D)	Depression
L	Level

Tree Layer (A) Species:
White spruce (large) + small & trembling aspen
Shrub Layer (B) Species:
- soap berry bushes - 1 willow - rose hip / bushes.
Herb Layer (C) Species: (lots – some – little bit – none)
some
Moss Layer (D) Species: (lots – some – little bit – none)
lots
Lichen Layer (E) Species: (lots – some – little bit – none)
little bit.

Project ID: Minto VMH	Site ID: M-26
Weather: Clear 7°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	28	6:50	7:15

Type of samples: ☐ Horsetail ☑ Labrador tea ☐ PHOTOS

☑ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☑ **Lichen**	*C. rangiferina*	*C. stellaris*			
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	blueberry bushes present no berries	
☑ **Soil**	dark	medium	light	N/A	hard clay @ 20cm

WP #	M-26
ASPECT (°)	161S
SLOPE (%)	10
ELEVATION (m)	879M

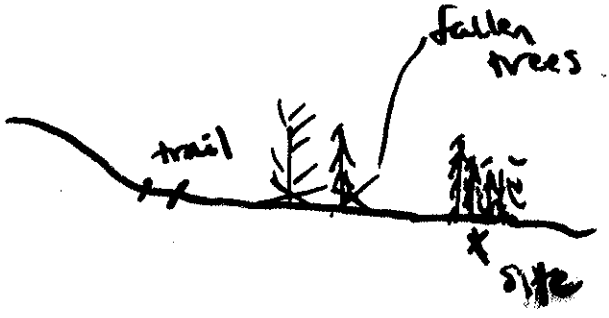
Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	60
Shrub layer (B)	10
Herb layer (C)	15
Moss layer (D)	5
Lichen layer (E)	10

Other Notes:
beside "clearing". in the bush beside cleared area w lots of fallen trees. (old fire)

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
(L)	Level

Tree Layer (A) Species:
white spruce, some birch + trembling aspen around site
Shrub Layer (B) Species:
willow - glauca?
Herb Layer (C) Species: (lots – some – little bit – none)
Labrador tea, blueberry - some.
Moss Layer (D) Species: (lots – some – little bit – none)
little bit
Lichen Layer (E) Species: (lots – some – little bit – none)
little bit

Project ID: Minto VMM	Site ID: M07B
Weather: Clear 5°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	28 Aug 19	8:15	8:40

Type of samples: ☐ horsetail ☑ labrador tea ☑ PHOTOS

☑ Willow	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☐ Lichen	*C. rangiferina*	*C. stellaris*			
☐ Berries	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*		lo. bushes - no blueberries
☑ Soil	dark	medium	light	N/A	thick O layer

WP #	M07B
ASPECT (°)	216 SW
SLOPE (%)	5
ELEVATION (m)	894

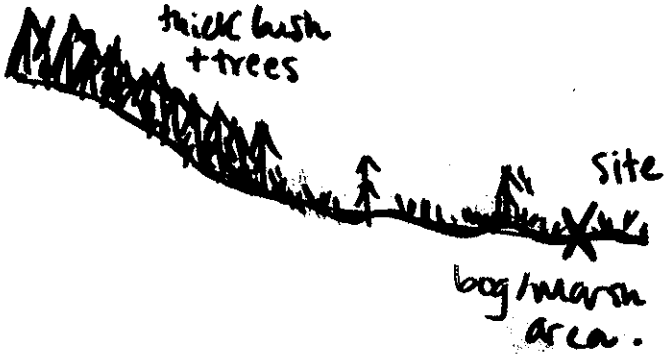
Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	10
Shrub layer (B)	10
Herb layer (C)	50
Moss layer (D)	90
Lichen layer (E)	—

Other Notes:
Site in a valley.
Marshy area - lots of veg & moss

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
(UD)	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
(L)	Level

Tree Layer (A) Species:
White Spruce.
Shrub Layer (B) Species:
Willow
Herb Layer (C) Species: (lots – some – little bit – none)
lots
Moss Layer (D) Species: (lots – some – little bit – none)
lots
Lichen Layer (E) Species: (lots – some – little bit – none)
none

Project ID: MINTO VMU	Site ID: M-29
Weather: clear 10°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
LR CB	28 Aug 19	10:50	10:50

Type of samples: ☐ horsetail ☑ labrador tea ☑ PHOTOS

☐ Willow	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☐ Lichen	*C. rangiferina*	*C. stellaris*			
☐ Berries	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*		
☑ Soil	(dark)	medium	light	N/A	large O-layer 30 to clay

WP #	M29
ASPECT (°)	342 N
SLOPE (%)	23%
ELEVATION (m)	779 m

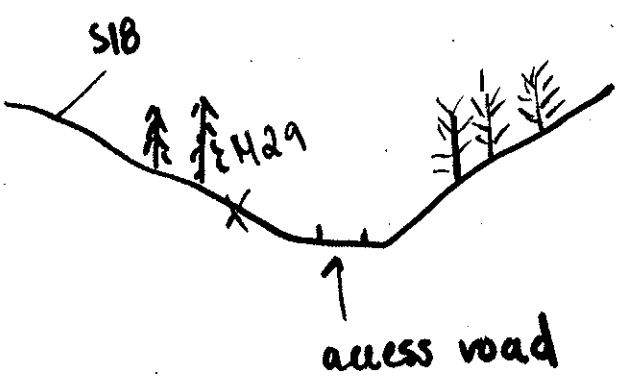
Wildlife signs:
- wolf scat @ site (old)
  - hair + bones in it.
- bird poop + feathers (not grouse/ ptarmigan)

Vegetation Cover	%
Tree layer (A)	10
Shrub layer (B)	10
Herb layer (C)	90
Moss layer (D)	80
Lichen layer (E)	—

Other Notes: site close to old road

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
(MS)	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
white spruce, birch.
Shrub Layer (B) Species:
sitka alder, [illegible]
Herb Layer (C) Species: (lots – some – little bit – none)
lots
Moss Layer (D) Species: (lots – some – little bit – none)
feather moss lots
Lichen Layer (E) Species: (lots – some – little bit – none)
none

Project ID: Minto MU	Site ID: S-18
Weather: Clear 7°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	28 Aug 19	11:14	11:30

Type of samples: ☐ horstail ☑ labrador tea ☑ PHOTOS

☑ Willow	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☐ Lichen	*C. rangiferina*	*C. stellaris*			
☐ Berries	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*		some blueberries bushes - no berries
☑ Soil	(dark)	medium	light	N/A	

WP #	518
ASPECT (°)	306 W
SLOPE (%)	13
ELEVATION (m)	813

Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	10
Shrub layer (B)	30
Herb layer (C)	60
Moss layer (D)	40
Lichen layer (E)	5 <

Other Notes:
signs of disturbance (overgrown) ~25m from site but not at site itself

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
(MS)	Mid Slope
LS	Lower Slope
T	Toe
(D)	Depression
L	Level

Tree Layer (A) Species:
spruce, birch
Shrub Layer (B) Species:
Sitka alder, willow
Herb Layer (C) Species: (lots – some – little bit – none)
Labrador tea, [redacted] blueberries, some cran bushes lots
Moss Layer (D) Species: (lots – some – little bit – none)
lots
Lichen Layer (E) Species: (lots – some – little bit – none)
little bit.

Project ID: Minto VMH	Site ID: S15
Weather: clear ~13°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
LR UB	28 Aug 19	11:40	12:00

Type of samples: ☒ horsetail ☒ labrador tea ☒ PHOTOS

☐ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☐ **Lichen**	*C. rangiferina*	*C. stellaris*			
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*		
☑ **Soil**	(dark)	medium	light	N/A	thick moss rock layer ~ 15-20cm

WP #	S15
ASPECT (°)	300 NW
SLOPE (%)	14
ELEVATION (m)	814

Wildlife signs: small rodent trails around

Vegetation Cover	%
Tree layer (A)	30
Shrub layer (B)	15
Herb layer (C)	25
Moss layer (D)	90
Lichen layer (E)	<10

Other Notes:
~50m from trail

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
(MS)	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
majority spruce, birch
Shrub Layer (B) Species:
sitka alder
Herb Layer (C) Species: (lots – some – little bit – none)
labrador tea, horsetail, rose bushes some
Moss Layer (D) Species: (lots – some – little bit – none)
lots
Lichen Layer (E) Species: (lots – some – little bit – none)
little bit.

Project ID: Minto VMU	Site ID: M80
Weather: partly cloudy 10°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
LR CB	28 Aug 19	14:10	1430

Type of samples: ☐ horsetail ☑ Labrador tea ☑ PHOTOS

- ☑ **Willow** *S. bebbiana* *S. glauca* *S. myrtillifolia* *S. scouleriana*
- ☐ **Lichen** *C. rangiferina* *C. stellaris*
- ☑ **Berries** *V. vitisidaea* *V. oxycoccos* *uliginosumn*
- ☑ **Soil** dark medium light N/A

cranberries present not abor - enough for one sample

no soil - small o+ loess/sand.

WP #	M80
ASPECT (°)	40 NE
SLOPE (%)	24
ELEVATION (m)	829

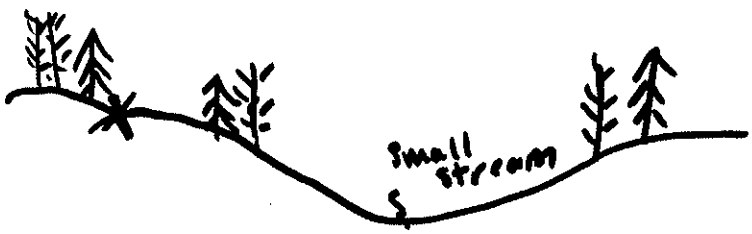
Wildlife signs:
animal paths noticeable

Vegetation Cover	%
Tree layer (A)	10
Shrub layer (B)	10
Herb layer (C)	<10
Moss layer (D)	5
Lichen layer (E)	<5

Other Notes:
area very sparce

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
ST	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
(MS)	Mid Slope
LS	Lower Slope
T	Toe
(D)	Depression
L	Level

Tree Layer (A) Species:
Pine tree (majority), trembling aspen, some small white spruce
Shrub Layer (B) Species:
willow
Herb Layer (C) Species: (lots – some – little bit – none)
little bit - labrador tea - some cran. ↳ more cran not too far (~25 m) from site.
Moss Layer (D) Species: (lots – some – little bit – none)
very little
Lichen Layer (E) Species: (lots – some – little bit – none)
very little

Project ID: Minto VMU	Site ID: C02
Weather: partly cloudy 13°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	28 Aug 19	14:40	15:10

Type of samples: ☑ horsetails ☑ labrador tea ☑ PHOTOS

- ☑ **Willow** — *S. bebbiana* *S. glauca* *S. myrtillifolia* *S. scouleriana*
- ☑ **Lichen** — *C. rangiferina* *C. stellaris*
- ☑ **Berries** — *V. vitisidaea* *V. oxycoccos* *uliginosumn*
- ☑ **Soil** — dark medium light N/A — Olayer + A ~10cm then loess

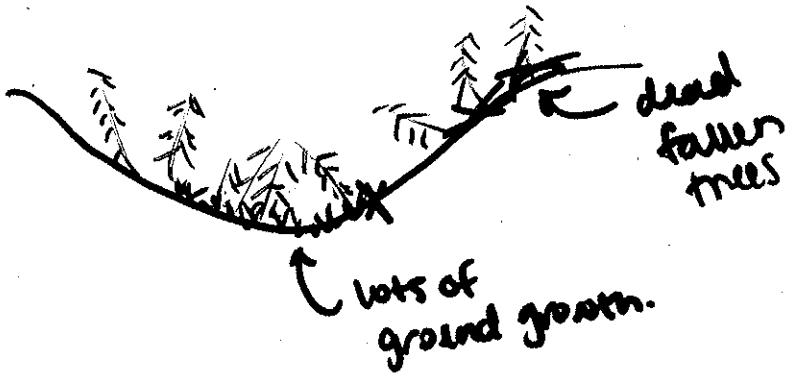
WP #	C02
ASPECT (°)	266 W
SLOPE (%)	24
ELEVATION (m)	802

Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	15
Shrub layer (B)	<10
Herb layer (C)	30
Moss layer (D)	30
Lichen layer (E)	10

Other Notes:
in a "valley"
lots of witches hair on spruce trees.
Disturbed Site: Y / (N) — chainsaw marks ~25m away

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
(CV)	Concave
CX	Convex
ST	Straight
(UN)	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
(LS)	Lower Slope
T	Toe
(D)	Depression
L	Level

Tree Layer (A) Species:
spruce, pine, birch
Shrub Layer (B) Species:
sitka alder, willow
Herb Layer (C) Species: (lots – some – little bit – none)
LT, unknown, (lots) bear berry, cranberry some blueberry bushes
Moss Layer (D) Species (lots – some – little bit – none)
lots
Lichen Layer (E) Species: (lots – some – little bit – none)
some

Project ID: Minto UMM	Site ID: C01

Weather: overcast 10	Duplicate ID: C01A

Field Crew:	Date:	Start:	End:
CR CB	20 Aug 19	15:55	16:40

Type of samples: ☐ Horsetail ☑ Labrador Tea ☑ **PHOTOS**

☑ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*	
☐ **Lichen**	*C. rangiferina*	*C. stellaris*			
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	some cran present (no berries)	
☑ **Soil**	dark	medium	light	N/A	10cm to clay

WP #	C01
ASPECT (°)	2° N
SLOPE (%)	6
ELEVATION (m)	782

Wildlife signs: ———

Vegetation Cover	%
Tree layer (A)	10
Shrub layer (B)	20
Herb layer (C)	50
Moss layer (D)	10
Lichen layer (E)	10

Other Notes:
close to Minto water sampling access trail (~25m)

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
(ST)	Straight
UN	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
(L)	Level

Tree Layer (A) Species:
Spruce, birch, pine
Shrub Layer (B) Species:
Sitka alder, willow (only few)
Herb Layer (C) Species: (lots – some – little bit – none)
Labrador tea, horsetail, fern some
Moss Layer (D) Species: (lots – some – little bit – none)
little bit
Lichen Layer (E) Species: (lots – some – little bit – none)
little bit

Project ID: Minto VMU	Site ID: SØ-1
Weather: mostly cloudy 15	**Duplicate ID:** —

Field Crew:	Date:	Start:	End:
CR CB	28 Aug 2019	17:00	17:15

Type of samples: ☒ labrador tea ☐ horsetail ☑ **PHOTOS**

☐ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*
☐ **Lichen**	*C. rangiferina*	*C. stellaris*		
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	
☑ **Soil**	dark	medium	(light)	N/A

WP #	SØ 1
ASPECT (°)	104 E
SLOPE (%)	22
ELEVATION (m)	752

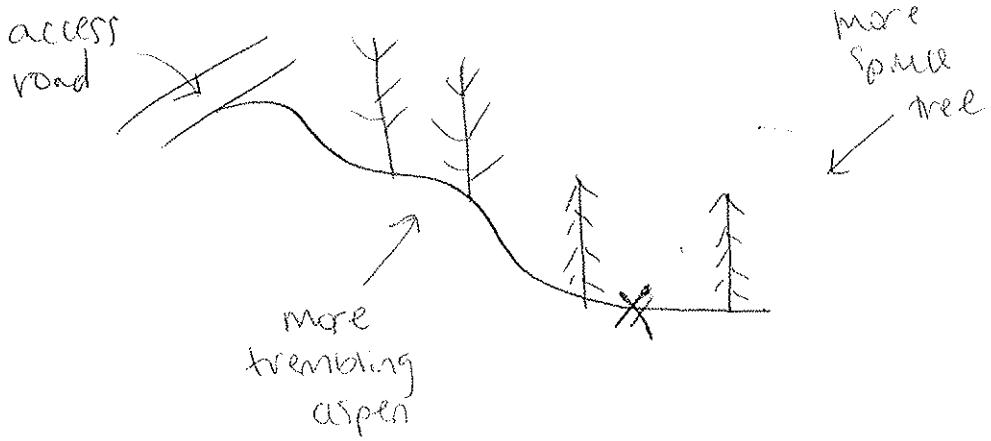
Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	50
Shrub layer (B)	<5
Herb layer (C)	5
Moss layer (D)	90
Lichen layer (E)	<5

Other Notes:
- old growth forest (large trees)
- no sign of fires
- not much other veg except moss

Disturbed Site: Y / (N)

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
ST	Straight
(UN)	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
MS	Mid Slope
LS	Lower Slope
T	Toe
(D)	Depression
L	Level

Tree Layer (A) Species:
Spruce, some large trembling aspen uphill from site
Shrub Layer (B) Species:
little to no willows
Herb Layer (C) Species: (lots – some – little bit – none)
~~some~~ little lab tea – little soap berry, & rose hip bushes
Moss Layer (D) Species: (lots – some – little bit – none)
lots – feather moss
Lichen Layer (E) Species: (lots – some – little bit – none)
little to none.

Project ID: Minto UMU	Site ID: SØ 2
Weather: partly cloudy 10°	**Duplicate ID:** —

Field Crew:	Date:	Start:	End:
CR CB	28 August 19	1725	17:30

Type of samples: no veg collected. ☑ **PHOTOS**

☐ **Willow**	*S. bebbiana*	*S. glauca*	*S. myrtillifolia*	*S. scouleriana*
☐ **Lichen**	*C. rangiferina*	*C. stellaris*		
☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*	
☑ **Soil**	dark	medium	(light)	N/A

WP #	SØ 2
ASPECT (°)	175 S
SLOPE (%)	21
ELEVATION (m)	758

iphone says 780 Dsapprox

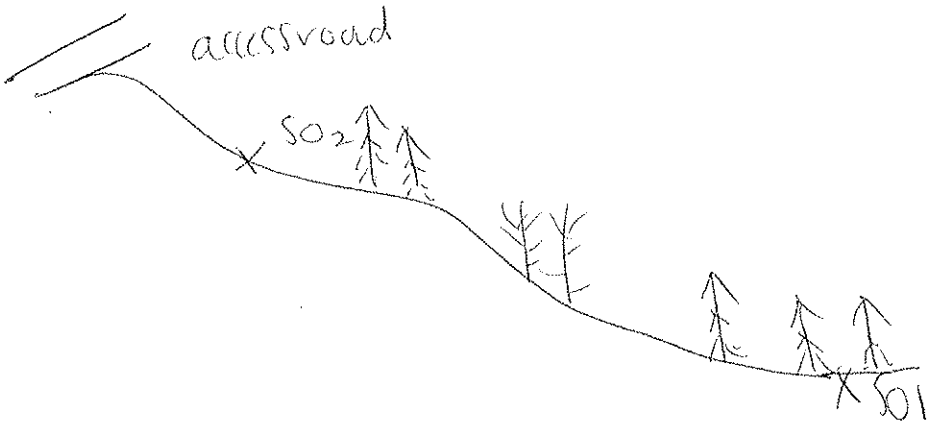
Wildlife signs:
old bear poop
→ uphill from SØ1

Vegetation Cover	%
Tree layer (A)	20
Shrub layer (B)	—
Herb layer (C)	10
Moss layer (D)	35
Lichen layer (E)	<5

Other Notes:
bare site, no trees on site but ~1.5m around

Disturbed Site: Y / N

Site Sketch: (dominant plants, shrubs and trees)



Surface Shape	
CV	Concave
CX	Convex
ST	Straight
(UN)	Undulating
Plot position Meso	
C	Crest
UP	Upper Slope
(MS)	Mid Slope
LS	Lower Slope
T	Toe
D	Depression
L	Level

Tree Layer (A) Species:
Spruce, trembling aspen
Shrub Layer (B) Species:
—
Herb Layer (C) Species: (lots – some – little bit – none)
Soap berry, some cran
Moss Layer (D) Species: (lots – some – little bit – none)
feather moss
Lichen Layer (E) Species: (lots – some – little bit – none)
little to none

APPENDIX B:

2019 VEGETATION AND SOIL LAB Results

Alexco Environmental Group Inc.
ATTN: Charlotte Rentmeister
#3 Calcite Business Centre
151 Industrial Road
Whitehorse YT Y1A 2V3

Date Received: 03-SEP-19
Report Date: 30-NOV-19 10:47 (MT)
Version: FINAL

Client Phone: 867-668-6463

Certificate of Analysis

Lab Work Order #: L2341109

Project P.O. #: MN19-02
Job Reference: MINTO
C of C Numbers: 1 of 23, 2 of 23, 3 of 23, 4 of 23, 5 of 23, 6 of 23, 7 of 23, 8 of 23, 9 of 23, 10 of 23, 11 of 23, 12 of 23, 13 of 23, 14 of 23, 15 of 23, 16 of 23, 17 of 23, 18 of 23, 19 of 23, 20 of 23, 21 of 23, 22 of 23, 23 of 23
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-10	L2341109-11	L2341109-12	L2341109-16	L2341109-17
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	15:56	15:56	15:56	10:30	10:30
Client ID	C-01A (0-8CM)	C-01A (8-15CM)	C-01A (+15CM)	M-29 (0-10CM)	M-29 (10-20CM)
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	5.23	5.66	6.13	6.11	5.79
Metals Aluminum (Al) (mg/kg)	35500	12500	16400	10800	13000
Antimony (Sb) (mg/kg)	0.52	0.32	0.46	0.47	0.64
Arsenic (As) (mg/kg)	9.50	6.20	6.12	3.47	5.32
Barium (Ba) (mg/kg)	423	110	138	333	355
Beryllium (Be) (mg/kg)	1.23	0.50	0.64	0.51	0.55
Bismuth (Bi) (mg/kg)	0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.758	0.056	0.068	1.08	0.367
Calcium (Ca) (mg/kg)	7100	3820	4170	14500	14900
Chromium (Cr) (mg/kg)	44.7	23.3	30.5	19.1	23.5
Cobalt (Co) (mg/kg)	18.1	5.95	10.4	5.49	7.89
Copper (Cu) (mg/kg)	42.3	10.4	19.5	31.9	30.6
Iron (Fe) (mg/kg)	45700	21100	25400	15500	20700
Lead (Pb) (mg/kg)	9.87	5.53	5.93	4.45	5.49
Lithium (Li) (mg/kg)	14.8	10.0	11.2	5.0	7.0
Magnesium (Mg) (mg/kg)	6420	4330	5100	4300	5520
Manganese (Mn) (mg/kg)	1180	245	495	181	381
Mercury (Hg) (mg/kg)	0.0544	0.0154	0.0240	0.0574	0.0528
Molybdenum (Mo) (mg/kg)	1.18	0.33	0.42	0.83	0.55
Nickel (Ni) (mg/kg)	33.9	12.7	18.0	21.7	25.4
Phosphorus (P) (mg/kg)	1080	735	658	537	690
Potassium (K) (mg/kg)	1640	730	700	630	900
Selenium (Se) (mg/kg)	0.26	<0.20	<0.20	0.32	0.36
Silver (Ag) (mg/kg)	0.44	<0.10	<0.10	<0.10	0.12
Sodium (Na) (mg/kg)	139	127	142	225	281
Strontium (Sr) (mg/kg)	70.9	36.3	32.8	84.9	86.8
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.109	0.064	0.074	0.059	0.073
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	526	692	759	259	437
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	1.56	0.961	1.11	0.758	0.949
Vanadium (V) (mg/kg)	93.2	53.6	64.4	31.4	39.4
Zinc (Zn) (mg/kg)	89.5	39.5	63.2	64.9	61.4
Zirconium (Zr) (mg/kg)	1.2	2.7	6.0	1.7	4.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-18	L2341109-28	L2341109-29	L2341109-30	L2341109-37
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	28-AUG-19
Sampled Time	10:30	07:40	07:40	07:40	11:15
Client ID	M-29 (+20CM)	S-19 (2-6CM)	S-19 (6-15CM)	S-19 (+15CM)	S-18 (0-8CM)
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	6.52	4.75	4.96	5.28	6.11
Metals Aluminum (Al) (mg/kg)	20200	16400	20800	23400	7540
Antimony (Sb) (mg/kg)	0.84	0.44	0.35	0.12	0.40
Arsenic (As) (mg/kg)	9.90	8.81	9.24	4.36	2.09
Barium (Ba) (mg/kg)	369	187	140	163	470
Beryllium (Be) (mg/kg)	0.72	0.23	0.31	0.42	0.33
Bismuth (Bi) (mg/kg)	<0.20	0.21	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.214	0.067	0.055	0.036	0.488
Calcium (Ca) (mg/kg)	8290	1980	1810	2460	24000
Chromium (Cr) (mg/kg)	39.7	28.4	25.3	10.4	10.2
Cobalt (Co) (mg/kg)	15.6	5.02	7.91	9.64	6.95
Copper (Cu) (mg/kg)	37.3	18.6	22.8	8.57	58.8
Iron (Fe) (mg/kg)	34200	28800	33800	37700	8640
Lead (Pb) (mg/kg)	9.23	8.79	6.64	3.38	2.26
Lithium (Li) (mg/kg)	11.3	7.7	9.6	9.6	3.1
Magnesium (Mg) (mg/kg)	8100	4710	6870	9130	2110
Manganese (Mn) (mg/kg)	764	224	342	556	595
Mercury (Hg) (mg/kg)	0.0423	0.0208	0.0178	0.0052	0.0937
Molybdenum (Mo) (mg/kg)	0.93	1.00	0.91	0.55	0.39
Nickel (Ni) (mg/kg)	36.3	10.6	11.9	4.82	14.3
Phosphorus (P) (mg/kg)	956	1320	1040	1750	725
Potassium (K) (mg/kg)	1710	1230	2230	6260	470
Selenium (Se) (mg/kg)	0.40	<0.20	<0.20	<0.20	0.49
Silver (Ag) (mg/kg)	0.12	0.11	<0.10	<0.10	0.17
Sodium (Na) (mg/kg)	453	90	101	114	100
Strontium (Sr) (mg/kg)	60.6	22.6	21.2	18.3	119
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.121	0.140	0.123	0.187	<0.050
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	938	1220	1070	1190	125
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	1.23	0.461	0.336	0.240	0.435
Vanadium (V) (mg/kg)	72.0	87.4	82.6	91.7	17.9
Zinc (Zn) (mg/kg)	79.4	49.6	58.7	88.1	20.1
Zirconium (Zr) (mg/kg)	5.9	1.8	2.4	1.3	1.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-38	L2341109-39	L2341109-43	L2341109-44	L2341109-45
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	28-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:15	11:15	06:40	06:40	06:40
Client ID	S-18 (8-16CM)	S-18 (+16CM)	S-17 (3-6CM)	S-17 (6-15CM)	S-17 (+15CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	6.29	7.17	4.85	4.96	5.10
Metals Aluminum (Al) (mg/kg)	14800	11500	17300	20200	22000
Antimony (Sb) (mg/kg)	0.50	0.53	0.25	0.28	0.45
Arsenic (As) (mg/kg)	4.87	5.55	4.68	6.79	8.52
Barium (Ba) (mg/kg)	580	239	199	130	178
Beryllium (Be) (mg/kg)	0.54	0.40	0.29	0.38	0.51
Bismuth (Bi) (mg/kg)	<0.20	<0.20	0.22	<0.20	0.21
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.539	0.082	0.060	0.044	0.051
Calcium (Ca) (mg/kg)	16600	4860	2530	2470	2200
Chromium (Cr) (mg/kg)	22.8	26.9	15.7	19.0	33.4
Cobalt (Co) (mg/kg)	16.7	7.82	8.51	7.77	8.12
Copper (Cu) (mg/kg)	27.0	20.2	472	406	280
Iron (Fe) (mg/kg)	20400	20400	27000	30000	29300
Lead (Pb) (mg/kg)	4.75	5.44	4.41	4.86	6.42
Lithium (Li) (mg/kg)	8.2	8.9	8.0	9.0	10.5
Magnesium (Mg) (mg/kg)	3120	4050	6330	6460	6610
Manganese (Mn) (mg/kg)	1170	223	323	321	319
Mercury (Hg) (mg/kg)	0.0556	0.0227	0.0121	0.0096	0.0132
Molybdenum (Mo) (mg/kg)	0.53	0.41	0.54	0.50	0.76
Nickel (Ni) (mg/kg)	23.8	18.3	12.4	14.5	20.9
Phosphorus (P) (mg/kg)	666	562	837	615	382
Potassium (K) (mg/kg)	460	490	1100	750	1530
Selenium (Se) (mg/kg)	0.48	<0.20	0.28	<0.20	<0.20
Silver (Ag) (mg/kg)	0.21	<0.10	0.19	0.18	0.25
Sodium (Na) (mg/kg)	138	153	67	94	91
Strontium (Sr) (mg/kg)	81.5	28.3	27.7	35.0	37.6
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.061	0.061	0.178	0.187	0.166
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	168	456	1150	1230	1200
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.978	0.570	0.387	0.417	0.639
Vanadium (V) (mg/kg)	38.9	47.2	62.2	70.6	71.0
Zinc (Zn) (mg/kg)	40.0	41.1	67.9	68.5	66.2
Zirconium (Zr) (mg/kg)	1.4	1.8	<1.0	2.5	5.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-52	L2341109-53	L2341109-54	L2341109-61	L2341109-62
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	26-AUG-19	26-AUG-19	26-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	15:50	15:50	15:50	11:40	11:40
Client ID	S-16 (4-10CM)	S-16 (20CM)	S-16 (30CM)	S-15 (0-5CM)	S-15 (5-15CM)
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	6.57	6.43	6.34	6.33	6.54
Metals Aluminum (Al) (mg/kg)	1610	14000	15500	31500	21200
Antimony (Sb) (mg/kg)	0.35	0.68	0.50	0.86	0.64
Arsenic (As) (mg/kg)	1.26	5.94	4.89	6.32	6.98
Barium (Ba) (mg/kg)	211	290	198	1020	555
Beryllium (Be) (mg/kg)	0.20	0.45	0.45	1.33	0.66
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	6.9	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.327	0.184	0.110	1.62	0.302
Calcium (Ca) (mg/kg)	29200	15500	5580	18500	7450
Chromium (Cr) (mg/kg)	3.46	26.4	26.6	39.1	29.5
Cobalt (Co) (mg/kg)	1.46	12.8	8.12	21.1	15.0
Copper (Cu) (mg/kg)	97.9	73.9	102	114	54.8
Iron (Fe) (mg/kg)	2780	24100	23000	31800	26400
Lead (Pb) (mg/kg)	0.84	5.54	5.54	5.60	5.46
Lithium (Li) (mg/kg)	<2.0	8.0	8.9	12.3	9.9
Magnesium (Mg) (mg/kg)	2590	6070	6230	4760	3990
Manganese (Mn) (mg/kg)	213	886	332	1540	853
Mercury (Hg) (mg/kg)	0.0686	0.0432	0.0299	0.101	0.0510
Molybdenum (Mo) (mg/kg)	0.81	0.94	0.48	0.67	0.75
Nickel (Ni) (mg/kg)	11.9	24.7	18.3	55.3	25.1
Phosphorus (P) (mg/kg)	636	681	812	1140	674
Potassium (K) (mg/kg)	520	1740	2470	1120	840
Selenium (Se) (mg/kg)	<0.20	0.29	<0.20	0.55	0.35
Silver (Ag) (mg/kg)	<0.10	0.11	<0.10	0.59	0.20
Sodium (Na) (mg/kg)	89	155	148	386	203
Strontium (Sr) (mg/kg)	131	86.7	32.6	110	52.3
Sulfur (S) (mg/kg)	1100	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	<0.050	0.129	0.145	0.124	0.096
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	49.9	430	797	423	392
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.163	0.829	1.06	1.61	1.14
Vanadium (V) (mg/kg)	8.35	43.8	57.6	53.3	52.1
Zinc (Zn) (mg/kg)	33.8	73.5	69.9	88.0	53.6
Zirconium (Zr) (mg/kg)	1.1	2.3	3.7	3.0	<1.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-63	L2341109-67	L2341109-68	L2341109-69	L2341109-73
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:40	17:15	17:15	17:15	10:20
Client ID	S-15 (+15CM)	S-11 (0-5CM)	S-11 (5-15CM)	S-11 (+15CM)	S-09 (2-6CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	6.59	6.29	6.35	6.04	6.96
Metals Aluminum (Al) (mg/kg)	8680	21400	21500	23000	22500
Antimony (Sb) (mg/kg)	0.39	0.46	0.47	0.91	0.16
Arsenic (As) (mg/kg)	4.31	5.90	9.56	8.77	3.25
Barium (Ba) (mg/kg)	157	768	333	340	481
Beryllium (Be) (mg/kg)	0.22	0.57	0.46	0.56	0.43
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.068	0.574	0.064	0.060	0.125
Calcium (Ca) (mg/kg)	3920	11400	4470	4840	8300
Chromium (Cr) (mg/kg)	18.5	34.9	42.1	42.8	13.5
Cobalt (Co) (mg/kg)	5.67	21.6	8.28	10.5	11.0
Copper (Cu) (mg/kg)	20.4	25.8	16.6	21.9	9.58
Iron (Fe) (mg/kg)	15100	27300	26300	28800	34400
Lead (Pb) (mg/kg)	4.30	8.74	7.57	7.29	5.13
Lithium (Li) (mg/kg)	5.1	9.8	12.6	12.1	8.1
Magnesium (Mg) (mg/kg)	3090	4980	5910	6130	9800
Manganese (Mn) (mg/kg)	181	3010	279	356	743
Mercury (Hg) (mg/kg)	0.0155	0.0346	0.0107	0.0154	0.0067
Molybdenum (Mo) (mg/kg)	0.33	0.90	0.44	0.45	0.24
Nickel (Ni) (mg/kg)	11.3	33.2	23.4	24.9	10.2
Phosphorus (P) (mg/kg)	604	1240	255	387	1950
Potassium (K) (mg/kg)	490	1280	900	1000	2550
Selenium (Se) (mg/kg)	<0.20	0.23	<0.20	<0.20	<0.20
Silver (Ag) (mg/kg)	<0.10	0.33	<0.10	<0.10	<0.10
Sodium (Na) (mg/kg)	173	170	127	146	372
Strontium (Sr) (mg/kg)	26.7	88.5	35.0	37.3	58.4
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	<0.050	0.100	0.096	0.095	0.092
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	540	796	859	1040	1750
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.397	0.640	0.856	1.30	0.212
Vanadium (V) (mg/kg)	39.2	67.0	69.7	75.1	90.1
Zinc (Zn) (mg/kg)	31.8	60.9	44.6	50.7	115
Zirconium (Zr) (mg/kg)	1.5	2.3	6.3	8.0	1.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-74	L2341109-75	L2341109-85	L2341109-86	L2341109-87
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	10:20	10:20	11:00	11:00	11:00
Client ID	S-09 (6-12CM)	S-09 (+12CM)	S-08 (2-8CM)	S-08 (8-15CM)	S-08 (+15CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	6.29	6.27	4.35	6.49	6.02
Metals Aluminum (Al) (mg/kg)	27900	29800	1490	5210	16800
Antimony (Sb) (mg/kg)	0.23	0.15	0.20	0.83	0.53
Arsenic (As) (mg/kg)	5.36	5.56	1.02	2.86	8.34
Barium (Ba) (mg/kg)	405	373	89.2	394	288
Beryllium (Be) (mg/kg)	0.51	0.53	<0.10	0.29	0.48
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.101	0.066	0.652	0.294	0.135
Calcium (Ca) (mg/kg)	7710	10600	10600	33000	7970
Chromium (Cr) (mg/kg)	18.3	12.7	3.40	9.57	31.9
Cobalt (Co) (mg/kg)	13.1	14.2	0.91	6.85	7.76
Copper (Cu) (mg/kg)	11.6	9.18	20.9	29.2	38.7
Iron (Fe) (mg/kg)	40700	45600	1900	7600	23100
Lead (Pb) (mg/kg)	6.38	5.26	0.58	1.33	6.85
Lithium (Li) (mg/kg)	9.5	9.4	<2.0	<2.0	8.9
Magnesium (Mg) (mg/kg)	11300	14500	1020	2560	5180
Manganese (Mn) (mg/kg)	578	610	15.7	861	244
Mercury (Hg) (mg/kg)	0.0080	<0.0050	0.0622	0.0722	0.0360
Molybdenum (Mo) (mg/kg)	0.35	0.20	1.05	0.98	0.41
Nickel (Ni) (mg/kg)	13.6	11.2	4.90	14.1	21.8
Phosphorus (P) (mg/kg)	2230	2440	551	937	1600
Potassium (K) (mg/kg)	1900	2750	740	240	570
Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	0.41	0.34
Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na) (mg/kg)	356	377	70	103	185
Strontium (Sr) (mg/kg)	61.9	57.1	65.4	172	46.6
Sulfur (S) (mg/kg)	<1000	<1000	<1000	1200	<1000
Thallium (Tl) (mg/kg)	0.109	0.085	<0.050	<0.050	0.068
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	1980	2480	45.8	120	688
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.273	0.223	0.113	0.532	2.66
Vanadium (V) (mg/kg)	110	125	6.66	19.1	64.1
Zinc (Zn) (mg/kg)	142	132	9.5	9.2	40.7
Zirconium (Zr) (mg/kg)	2.7	1.9	1.2	1.9	2.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-97	L2341109-98	L2341109-99	L2341109-109	L2341109-110
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:05	11:05	11:05	15:50	15:50
Client ID	S-08A (2-8CM)	S-08A (8-15CM)	S-08A (+15CM)	S-07 (0-5CM)	S-07 (5-15CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	4.56	6.29	5.89	5.32	5.32
Metals Aluminum (Al) (mg/kg)	1080	10200	16000	10700	12800
Antimony (Sb) (mg/kg)	0.15	0.44	0.55	0.30	0.37
Arsenic (As) (mg/kg)	0.80	6.14	7.03	4.69	9.21
Barium (Ba) (mg/kg)	62.3	311	278	304	273
Beryllium (Be) (mg/kg)	<0.10	0.32	0.44	0.25	0.44
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.289	0.150	0.098	0.252	0.078
Calcium (Ca) (mg/kg)	6880	14900	5980	5830	3810
Chromium (Cr) (mg/kg)	1.83	19.7	31.4	18.0	23.2
Cobalt (Co) (mg/kg)	0.55	10.6	8.63	4.80	9.05
Copper (Cu) (mg/kg)	11.5	32.0	38.4	339	535
Iron (Fe) (mg/kg)	1390	18000	22800	16300	24700
Lead (Pb) (mg/kg)	<0.50	4.07	6.33	4.40	7.07
Lithium (Li) (mg/kg)	<2.0	5.1	8.4	4.4	6.4
Magnesium (Mg) (mg/kg)	712	3500	5130	2960	4100
Manganese (Mn) (mg/kg)	11.9	716	288	229	354
Mercury (Hg) (mg/kg)	0.0540	0.0419	0.0348	0.0291	0.0200
Molybdenum (Mo) (mg/kg)	0.71	0.70	0.40	1.97	2.43
Nickel (Ni) (mg/kg)	2.99	15.5	22.6	10.4	14.2
Phosphorus (P) (mg/kg)	313	712	558	455	668
Potassium (K) (mg/kg)	280	330	490	760	660
Selenium (Se) (mg/kg)	<0.20	0.35	0.34	0.24	0.49
Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	0.13	0.12
Sodium (Na) (mg/kg)	<50	126	172	124	117
Strontium (Sr) (mg/kg)	47.5	81.8	40.1	40.9	29.5
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	<0.050	<0.050	0.055	0.062	0.062
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	30.9	306	649	324	543
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.084	1.24	2.47	0.413	0.690
Vanadium (V) (mg/kg)	4.40	43.9	60.0	40.1	56.9
Zinc (Zn) (mg/kg)	4.8	25.1	39.5	36.0	48.1
Zirconium (Zr) (mg/kg)	<1.0	1.7	2.7	<1.0	2.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-111	L2341109-115	L2341109-116	L2341109-117	L2341109-127
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	15:50	14:55	14:55	14:55	09:25
Client ID	S-07 (+15CM)	S-06 (1-8CM)	S-06 (8-16CM)	S-06 (+16CM)	S-05 (2-10CM)
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	5.89	4.76	5.17	5.09	4.59
Metals Aluminum (Al) (mg/kg)	9330	18300	24200	23900	4940
Antimony (Sb) (mg/kg)	0.39	0.48	0.44	0.34	0.17
Arsenic (As) (mg/kg)	6.54	12.2	13.9	12.8	1.60
Barium (Ba) (mg/kg)	218	118	207	206	223
Beryllium (Be) (mg/kg)	0.34	0.23	0.48	0.41	0.10
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.076	0.082	0.127	0.101	0.131
Calcium (Ca) (mg/kg)	3600	930	1160	1200	5640
Chromium (Cr) (mg/kg)	19.4	25.8	29.2	24.0	15.9
Cobalt (Co) (mg/kg)	6.94	5.92	8.99	10.1	7.22
Copper (Cu) (mg/kg)	325	449	1220	1010	73.5
Iron (Fe) (mg/kg)	18600	32300	36400	39200	8040
Lead (Pb) (mg/kg)	5.58	6.88	8.47	7.36	1.96
Lithium (Li) (mg/kg)	5.3	9.3	13.3	12.3	<2.0
Magnesium (Mg) (mg/kg)	2910	4630	6130	7640	1850
Manganese (Mn) (mg/kg)	299	187	276	358	187
Mercury (Hg) (mg/kg)	0.0161	0.0153	0.0155	0.0102	0.0617
Molybdenum (Mo) (mg/kg)	1.30	2.88	18.2	14.8	1.64
Nickel (Ni) (mg/kg)	11.7	14.7	16.4	12.9	12.2
Phosphorus (P) (mg/kg)	736	385	320	433	770
Potassium (K) (mg/kg)	490	850	1290	2450	770
Selenium (Se) (mg/kg)	0.45	0.24	0.67	0.58	0.26
Silver (Ag) (mg/kg)	<0.10	0.23	0.17	0.10	0.21
Sodium (Na) (mg/kg)	109	67	75	82	96
Strontium (Sr) (mg/kg)	26.6	11.4	16.5	15.5	47.5
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.050	0.126	0.135	0.155	<0.050
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	516	868	900	1340	195
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.589	0.389	0.509	0.385	0.318
Vanadium (V) (mg/kg)	42.2	92.7	85.4	98.0	15.9
Zinc (Zn) (mg/kg)	35.6	53.2	66.2	81.4	21.1
Zirconium (Zr) (mg/kg)	4.7	1.4	3.5	3.0	<1.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-128	L2341109-129	L2341109-139	L2341109-140	L2341109-141
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	09:25	09:25	13:35	13:35	13:35
Client ID	S-05 (10-20CM)	S-05 (+20CM)	S-04 (2-7CM)	S-04 (7-16CM)	S-04 (+16CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	5.35	5.77	4.96	5.25	5.22
Metals Aluminum (Al) (mg/kg)	17900	21200	9660	19100	22700
Antimony (Sb) (mg/kg)	0.37	0.41	0.36	0.39	0.37
Arsenic (As) (mg/kg)	6.34	6.91	5.15	11.5	8.73
Barium (Ba) (mg/kg)	386	399	263	204	175
Beryllium (Be) (mg/kg)	0.40	0.46	0.19	0.27	0.37
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.091	0.097	0.142	0.069	0.057
Calcium (Ca) (mg/kg)	5700	6900	3160	2410	2220
Chromium (Cr) (mg/kg)	29.0	33.3	17.2	25.9	25.8
Cobalt (Co) (mg/kg)	11.1	10.4	4.52	7.11	9.49
Copper (Cu) (mg/kg)	244	285	34.1	12.0	16.6
Iron (Fe) (mg/kg)	25800	27700	19500	28500	25000
Lead (Pb) (mg/kg)	6.51	7.24	6.30	7.71	6.25
Lithium (Li) (mg/kg)	8.7	10.6	4.1	12.6	10.4
Magnesium (Mg) (mg/kg)	6010	6930	2620	5200	6400
Manganese (Mn) (mg/kg)	539	458	308	189	229
Mercury (Hg) (mg/kg)	0.0378	0.0405	0.0154	0.0141	0.0131
Molybdenum (Mo) (mg/kg)	2.43	2.15	0.74	0.64	0.50
Nickel (Ni) (mg/kg)	21.1	24.6	10.1	15.7	22.6
Phosphorus (P) (mg/kg)	667	663	799	1140	508
Potassium (K) (mg/kg)	770	950	740	820	670
Selenium (Se) (mg/kg)	0.74	0.76	<0.20	<0.20	<0.20
Silver (Ag) (mg/kg)	0.11	0.12	0.13	<0.10	<0.10
Sodium (Na) (mg/kg)	172	216	93	77	90
Strontium (Sr) (mg/kg)	45.7	54.4	37.3	28.8	29.5
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.104	0.127	0.081	0.094	0.076
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	786	1110	744	815	773
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	1.04	1.12	0.257	0.291	0.311
Vanadium (V) (mg/kg)	65.3	73.4	51.7	69.9	60.6
Zinc (Zn) (mg/kg)	48.4	55.7	38.9	45.3	46.2
Zirconium (Zr) (mg/kg)	2.2	4.2	1.3	2.5	3.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-142	L2341109-143	L2341109-144	L2341109-148	L2341109-149
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	17:25	17:25	17:25	17:35	17:35
Client ID	S-02 (0-6CM)	S-02 (6-15CM)	S-02 (+15CM)	S-03 (0-4CM)	S-03 (4-15CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	5.02	5.61	5.70	5.61	4.87
Metals Aluminum (Al) (mg/kg)	18600	15600	13600	12300	16300
Antimony (Sb) (mg/kg)	0.29	0.30	0.41	0.26	0.46
Arsenic (As) (mg/kg)	2.57	3.70	6.16	1.65	4.57
Barium (Ba) (mg/kg)	510	315	168	562	283
Beryllium (Be) (mg/kg)	0.52	0.40	0.37	0.27	0.33
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.335	0.156	0.067	0.256	0.085
Calcium (Ca) (mg/kg)	3420	3060	2920	5290	4050
Chromium (Cr) (mg/kg)	28.4	29.1	29.6	24.0	30.0
Cobalt (Co) (mg/kg)	17.4	12.2	8.16	8.58	8.59
Copper (Cu) (mg/kg)	17.6	9.35	14.0	11.4	15.2
Iron (Fe) (mg/kg)	22600	22600	22700	18700	25200
Lead (Pb) (mg/kg)	7.36	7.27	5.51	5.55	5.51
Lithium (Li) (mg/kg)	7.4	8.8	8.6	6.2	9.2
Magnesium (Mg) (mg/kg)	3560	4060	5120	3310	5010
Manganese (Mn) (mg/kg)	3250	769	327	1140	297
Mercury (Hg) (mg/kg)	0.0322	0.0112	<0.0050	<0.0050	<0.0050
Molybdenum (Mo) (mg/kg)	1.61	0.93	0.63	0.72	0.58
Nickel (Ni) (mg/kg)	22.4	17.6	19.7	14.3	18.4
Phosphorus (P) (mg/kg)	1480	766	639	869	777
Potassium (K) (mg/kg)	740	860	1100	860	560
Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag) (mg/kg)	0.42	0.13	<0.10	0.27	0.33
Sodium (Na) (mg/kg)	157	91	106	134	122
Strontium (Sr) (mg/kg)	24.9	20.0	20.8	31.4	24.3
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.118	0.086	0.068	0.065	0.083
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	660	569	683	559	740
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.330	0.343	0.365	0.238	0.362
Vanadium (V) (mg/kg)	53.9	57.1	54.1	42.9	65.6
Zinc (Zn) (mg/kg)	43.8	43.5	40.5	54.0	44.0
Zirconium (Zr) (mg/kg)	1.5	2.5	3.2	1.5	2.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-150	L2341109-154	L2341109-155	L2341109-156	L2341109-163
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	17:35	17:00	17:00	17:00	08:15
Client ID	S-03 (+15CM)	S-01 (5-10CM)	S-01 (10-15CM)	S-01 (+15CM)	M-07B (0-10CM)
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	5.95	4.76	5.95	4.96	6.42
Metals Aluminum (Al) (mg/kg)	14300	19300	15900	23000	511
Antimony (Sb) (mg/kg)	0.60	0.32	0.57	0.40	<0.10
Arsenic (As) (mg/kg)	6.06	4.13	8.29	7.03	0.57
Barium (Ba) (mg/kg)	160	343	201	275	52.8
Beryllium (Be) (mg/kg)	0.39	0.33	0.51	0.44	<0.10
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.073	0.304	0.054	0.066	0.040
Calcium (Ca) (mg/kg)	4180	4640	4730	4340	4940
Chromium (Cr) (mg/kg)	32.5	31.8	34.1	41.4	1.14
Cobalt (Co) (mg/kg)	8.68	10.1	9.92	9.23	0.55
Copper (Cu) (mg/kg)	24.8	19.3	29.7	17.3	1.98
Iron (Fe) (mg/kg)	24400	22700	25500	26100	1350
Lead (Pb) (mg/kg)	4.53	6.53	5.73	7.36	<0.50
Lithium (Li) (mg/kg)	7.6	8.8	9.8	10.9	<2.0
Magnesium (Mg) (mg/kg)	5250	4460	5950	5680	610
Manganese (Mn) (mg/kg)	298	942	375	253	171
Mercury (Hg) (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	0.0277
Molybdenum (Mo) (mg/kg)	0.46	0.97	0.54	0.70	0.33
Nickel (Ni) (mg/kg)	22.7	19.3	24.1	21.1	1.20
Phosphorus (P) (mg/kg)	840	424	364	271	138
Potassium (K) (mg/kg)	1200	520	530	470	150
Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag) (mg/kg)	<0.10	0.15	<0.10	<0.10	<0.10
Sodium (Na) (mg/kg)	101	147	171	123	<50
Strontium (Sr) (mg/kg)	27.2	34.2	31.8	30.4	28.4
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.074	0.093	0.060	0.107	<0.050
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	617	697	831	785	25.6
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.524	0.311	0.641	0.393	<0.050
Vanadium (V) (mg/kg)	56.7	62.5	65.7	73.9	2.41
Zinc (Zn) (mg/kg)	44.3	47.7	43.3	42.0	9.7
Zirconium (Zr) (mg/kg)	2.6	<1.0	5.9	2.9	<1.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-164	L2341109-165	L2341109-175	L2341109-176	L2341109-177
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	08:15	08:15	06:50	06:50	06:50
Client ID	M-07B (10-30CM)	M-07B (+30CM)	M-26 (0-5CM)	M-26 (5-10CM)	M-26 (+15CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	6.56	5.66	6.10	6.34	6.63
Metals Aluminum (Al) (mg/kg)	3500	6810	12200	19500	25400
Antimony (Sb) (mg/kg)	0.19	0.48	0.32	0.38	0.45
Arsenic (As) (mg/kg)	3.12	23.1	2.49	7.17	7.97
Barium (Ba) (mg/kg)	756	522	263	202	256
Beryllium (Be) (mg/kg)	0.11	0.75	0.50	0.53	0.82
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	6.1	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.174	0.271	0.223	0.038	0.034
Calcium (Ca) (mg/kg)	28900	22300	18000	5760	5730
Chromium (Cr) (mg/kg)	5.83	13.1	17.2	38.7	47.9
Cobalt (Co) (mg/kg)	25.3	12.2	3.04	10.5	12.0
Copper (Cu) (mg/kg)	11.4	42.0	18.5	18.9	29.4
Iron (Fe) (mg/kg)	17300	27600	10400	25900	30500
Lead (Pb) (mg/kg)	1.26	2.24	2.30	8.80	9.24
Lithium (Li) (mg/kg)	<2.0	<2.0	4.6	9.5	12.1
Magnesium (Mg) (mg/kg)	2680	2260	4070	6390	7270
Manganese (Mn) (mg/kg)	8470	1320	176	431	478
Mercury (Hg) (mg/kg)	0.0558	0.0628	0.0767	0.0149	0.0220
Molybdenum (Mo) (mg/kg)	1.53	0.71	0.37	0.31	0.34
Nickel (Ni) (mg/kg)	12.4	19.0	11.3	14.6	18.5
Phosphorus (P) (mg/kg)	762	1070	695	269	247
Potassium (K) (mg/kg)	280	240	850	1070	1230
Selenium (Se) (mg/kg)	0.26	0.79	0.23	<0.20	<0.20
Silver (Ag) (mg/kg)	<0.10	<0.10	0.13	<0.10	<0.10
Sodium (Na) (mg/kg)	114	131	95	213	238
Strontium (Sr) (mg/kg)	191	145	131	47.0	48.2
Sulfur (S) (mg/kg)	1300	2400	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	<0.050	<0.050	<0.050	0.072	0.094
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	115	188	234	1190	1350
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.236	1.41	0.652	1.03	1.58
Vanadium (V) (mg/kg)	8.54	96.1	29.3	87.8	93.9
Zinc (Zn) (mg/kg)	31.0	20.4	18.3	35.4	39.5
Zirconium (Zr) (mg/kg)	<1.0	2.0	3.3	7.0	12.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-187	L2341109-188	L2341109-189	L2341109-205	L2341109-206
Description	Sediment	Sediment	Sediment	Sediment	Sediment
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	14:10	14:10	14:10	14:40	14:40
Client ID	M-80 (0-6CM)	M-80 (6-16CM)	M-80 (+16CM)	C-02 (0-6CM)	C-02 (6-15CM)
Grouping **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	5.17	5.54	5.41	6.19	6.53
Metals Aluminum (Al) (mg/kg)	9000	12900	14300	19800	16800
Antimony (Sb) (mg/kg)	0.34	0.53	0.63	0.38	0.52
Arsenic (As) (mg/kg)	2.99	6.27	6.75	4.47	7.98
Barium (Ba) (mg/kg)	97.3	79.9	95.7	432	251
Beryllium (Be) (mg/kg)	0.15	0.24	0.31	0.44	0.34
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd) (mg/kg)	0.119	0.103	0.107	0.441	0.058
Calcium (Ca) (mg/kg)	2740	2350	2480	7990	4020
Chromium (Cr) (mg/kg)	16.8	22.8	28.0	23.8	28.7
Cobalt (Co) (mg/kg)	2.57	5.66	6.62	10.7	8.20
Copper (Cu) (mg/kg)	9.01	16.7	18.7	27.1	19.8
Iron (Fe) (mg/kg)	13500	18400	21400	19900	24200
Lead (Pb) (mg/kg)	5.44	4.01	4.83	6.20	6.30
Lithium (Li) (mg/kg)	3.1	5.7	6.6	7.3	12.2
Magnesium (Mg) (mg/kg)	1440	2720	2900	3070	4660
Manganese (Mn) (mg/kg)	108	170	220	200	243
Mercury (Hg) (mg/kg)	0.0103	0.0065	0.0101	0.0800	0.0241
Molybdenum (Mo) (mg/kg)	0.77	0.68	0.76	0.75	0.93
Nickel (Ni) (mg/kg)	6.95	14.4	16.6	17.8	16.8
Phosphorus (P) (mg/kg)	335	721	778	499	271
Potassium (K) (mg/kg)	580	570	600	590	510
Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	0.16	<0.10
Sodium (Na) (mg/kg)	81	65	77	194	103
Strontium (Sr) (mg/kg)	20.8	19.3	17.1	62.6	23.8
Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
Thallium (Tl) (mg/kg)	0.088	<0.050	0.058	0.094	0.090
Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti) (mg/kg)	814	557	668	514	640
Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U) (mg/kg)	0.315	0.287	0.339	0.390	0.436
Vanadium (V) (mg/kg)	46.3	45.1	54.7	47.5	67.9
Zinc (Zn) (mg/kg)	19.1	28.9	32.5	28.6	35.4
Zirconium (Zr) (mg/kg)	<1.0	3.3	2.9	1.4	1.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-207	L2341109-217	L2341109-218	L2341109-219	
Description	Sediment	Sediment	Sediment	Sediment	
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	
Sampled Time	14:40	15:55	15:55	15:55	
Client ID	C-02 (+15CM)	C-01 (0-8CM)	C-01 (8-15CM)	C-01 (+15CM)	
Grouping	**Analyte**				
SOIL					
Physical Tests	pH (1:2 soil:water) (pH)	6.68	5.13	5.65	6.10
Metals	Aluminum (Al) (mg/kg)	13300	39100	13100	17400
	Antimony (Sb) (mg/kg)	0.50	0.53	0.34	0.47
	Arsenic (As) (mg/kg)	6.96	9.24	4.33	4.98
	Barium (Ba) (mg/kg)	180	391	105	139
	Beryllium (Be) (mg/kg)	0.39	1.29	0.41	0.64
	Bismuth (Bi) (mg/kg)	<0.20	0.23	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.055	0.901	0.054	0.075
	Calcium (Ca) (mg/kg)	3660	7420	4290	4890
	Chromium (Cr) (mg/kg)	28.3	49.3	23.9	30.9
	Cobalt (Co) (mg/kg)	9.07	16.2	5.66	10.4
	Copper (Cu) (mg/kg)	28.3	49.3	10.3	19.0
	Iron (Fe) (mg/kg)	21400	47500	20700	24000
	Lead (Pb) (mg/kg)	4.69	10.9	5.19	6.01
	Lithium (Li) (mg/kg)	8.7	17.4	10.1	11.9
	Magnesium (Mg) (mg/kg)	4590	6550	4400	5230
	Manganese (Mn) (mg/kg)	263	967	229	510
	Mercury (Hg) (mg/kg)	0.0204	0.0584	0.0148	0.0203
	Molybdenum (Mo) (mg/kg)	0.73	1.24	0.35	0.44
	Nickel (Ni) (mg/kg)	19.5	39.7	12.6	17.8
	Phosphorus (P) (mg/kg)	323	1030	691	630
	Potassium (K) (mg/kg)	460	1860	810	790
	Selenium (Se) (mg/kg)	<0.20	0.25	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	0.55	<0.10	<0.10
	Sodium (Na) (mg/kg)	96	167	151	185
	Strontium (Sr) (mg/kg)	22.6	66.7	37.3	37.4
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.055	0.135	0.075	0.087
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	689	640	835	1010
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.475	1.73	0.942	1.13
	Vanadium (V) (mg/kg)	58.2	102	56.1	65.2
	Zinc (Zn) (mg/kg)	33.8	94.5	40.1	50.6
	Zirconium (Zr) (mg/kg)	3.2	1.3	4.5	8.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-1	L2341109-2	L2341109-3	L2341109-4	L2341109-5
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	15:56	15:56	15:56	15:56	15:56
Client ID	C-01A (HORSETAIL) 1	C-01A (HORSETAIL) 2	C-01A (HORSETAIL) 3	C-01A (LABRADOR TEA) 1	C-01A (LABRADOR TEA) 2
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	68.6	70.1	64.2	46.6	50.3
Metals Aluminum (Al)-Total (mg/kg)	8.6	26.6	10.8	23.0	14.5
Aluminum (Al)-Total (mg/kg wwt)	2.69	7.96	3.87	12.3	7.18
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0024	0.0037
Arsenic (As)-Total (mg/kg)	<0.020	0.023	<0.020	<0.020	<0.020
Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.0068	<0.0040	0.0096	0.0054
Barium (Ba)-Total (mg/kg)	250	257	312	91.3	67.0
Barium (Ba)-Total (mg/kg wwt)	78.6	76.8	112	48.8	33.3
Beryllium (Be)-Total (mg/kg)	0.010	<0.010	0.011	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	0.0032	0.0029	0.0040	<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	16.6	16.2	15.7	19.5	12.3
Boron (B)-Total (mg/kg wwt)	5.22	4.85	5.64	10.4	6.12
Cadmium (Cd)-Total (mg/kg)	0.223	0.317	0.156	<0.0050	<0.0050
Cadmium (Cd)-Total (mg/kg wwt)	0.0701	0.0949	0.0558	0.0015	<0.0010
Calcium (Ca)-Total (mg/kg)	23600	25800	26400	5050	5170
Calcium (Ca)-Total (mg/kg wwt)	7410	7710	9460	2700	2570
Cesium (Cs)-Total (mg/kg)	0.0788	0.0873	0.0856	0.0150	0.0057
Cesium (Cs)-Total (mg/kg wwt)	0.0248	0.0261	0.0307	0.0080	0.0028
Chromium (Cr)-Total (mg/kg)	0.071	0.138	<0.050	0.089	0.058
Chromium (Cr)-Total (mg/kg wwt)	0.022	0.041	0.011	0.047	0.029
Cobalt (Co)-Total (mg/kg)	0.140	0.181	0.187	0.022	<0.020
Cobalt (Co)-Total (mg/kg wwt)	0.0440	0.0541	0.0669	0.0117	0.0056
Copper (Cu)-Total (mg/kg)	3.16	5.78	3.18	4.01	6.09
Copper (Cu)-Total (mg/kg wwt)	0.993	1.73	1.14	2.14	3.03
Iron (Fe)-Total (mg/kg)	24.0	59.8	25.2	53.6	34.9
Iron (Fe)-Total (mg/kg wwt)	7.55	17.9	9.03	28.7	17.3
Lead (Pb)-Total (mg/kg)	<0.020	0.043	<0.020	0.039	0.020
Lead (Pb)-Total (mg/kg wwt)	0.0041	0.0128	0.0050	0.0207	0.0100
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	4300	5300	4580	1160	1350
Magnesium (Mg)-Total (mg/kg wwt)	1350	1580	1640	619	669
Manganese (Mn)-Total (mg/kg)	156	195	231	494	409
Manganese (Mn)-Total (mg/kg wwt)	48.9	58.2	82.8	264	203

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

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Grouping	Analyte	L2341109-6 Tissue 28-AUG-19 15:56 C-01A (LABRADOR TEA) 3	L2341109-7 Tissue 28-AUG-19 15:56 C-01A (WILLOW) 1	L2341109-8 Tissue 28-AUG-19 15:56 C-01A (WILLOW) 2	L2341109-9 Tissue 28-AUG-19 15:56 C-01A (WILLOW) 3	L2341109-13 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 1
TISSUE						
Physical Tests	% Moisture (%)	42.8	64.2	62.5	55.9	46.7
Metals	Aluminum (Al)-Total (mg/kg)	25.8	13.6	53.8	23.9	34.3
	Aluminum (Al)-Total (mg/kg wwt)	14.7	4.89	20.2	10.6	18.3
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0056	<0.0020	0.0033	0.0021	0.0022
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	0.035	<0.020	0.027
	Arsenic (As)-Total (mg/kg wwt)	0.0085	0.0043	0.0132	0.0079	0.0142
	Barium (Ba)-Total (mg/kg)	110	120	82.1	80.9	121
	Barium (Ba)-Total (mg/kg wwt)	63.0	43.0	30.8	35.7	64.6
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	0.016	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0027	0.0059	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	20.4	17.2	19.3	18.2	20.1
	Boron (B)-Total (mg/kg wwt)	11.7	6.17	7.22	8.03	10.7
	Cadmium (Cd)-Total (mg/kg)	<0.0050	3.83	6.31	2.89	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0014	1.37	2.36	1.27	0.0017
	Calcium (Ca)-Total (mg/kg)	5580	20400	15100	19000	4730
	Calcium (Ca)-Total (mg/kg wwt)	3200	7300	5670	8390	2520
	Cesium (Cs)-Total (mg/kg)	<0.0050	<0.0050	0.0065	<0.0050	0.0144
	Cesium (Cs)-Total (mg/kg wwt)	0.0018	<0.0010	0.0024	0.0020	0.0077
	Chromium (Cr)-Total (mg/kg)	0.130	0.068	0.128	0.096	0.138
	Chromium (Cr)-Total (mg/kg wwt)	0.074	0.024	0.048	0.042	0.073
	Cobalt (Co)-Total (mg/kg)	<0.020	0.820	0.736	0.415	0.025
	Cobalt (Co)-Total (mg/kg wwt)	0.0107	0.294	0.276	0.183	0.0132
	Copper (Cu)-Total (mg/kg)	4.45	2.90	6.46	3.80	14.5
	Copper (Cu)-Total (mg/kg wwt)	2.55	1.04	2.42	1.68	7.74
	Iron (Fe)-Total (mg/kg)	43.4	40.2	111	56.3	75.9
	Iron (Fe)-Total (mg/kg wwt)	24.8	14.4	41.5	24.8	40.5
	Lead (Pb)-Total (mg/kg)	0.034	0.024	0.065	0.035	0.044
	Lead (Pb)-Total (mg/kg wwt)	0.0195	0.0086	0.0245	0.0154	0.0237
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	993	4480	4240	6410	1230
	Magnesium (Mg)-Total (mg/kg wwt)	568	1610	1590	2830	656
	Manganese (Mn)-Total (mg/kg)	1100	250	603	316	731
	Manganese (Mn)-Total (mg/kg wwt)	629	89.6	226	140	390

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-14 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 2	L2341109-15 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 3	L2341109-19 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 1	L2341109-20 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 2	L2341109-21 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 3
TISSUE						
Physical Tests	% Moisture (%)	47.9	47.8	43.4	43.1	47.1
Metals	Aluminum (Al)-Total (mg/kg)	33.6	80.0	181	106	148
	Aluminum (Al)-Total (mg/kg wwt)	17.5	41.7	103	60.5	78.5
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0021	0.0033	0.0035	0.0027	0.0033
	Arsenic (As)-Total (mg/kg)	0.022	0.036	0.052	0.030	0.042
	Arsenic (As)-Total (mg/kg wwt)	0.0113	0.0188	0.0292	0.0169	0.0222
	Barium (Ba)-Total (mg/kg)	101	93.4	133	111	153
	Barium (Ba)-Total (mg/kg wwt)	52.8	48.8	75.2	63.1	81.2
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0031	<0.0020	0.0024
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	20.2	13.9	9.9	8.4	12.9
	Boron (B)-Total (mg/kg wwt)	10.5	7.24	5.61	4.80	6.84
	Cadmium (Cd)-Total (mg/kg)	<0.0050	0.0066	0.0070	0.0060	0.0067
	Cadmium (Cd)-Total (mg/kg wwt)	0.0015	0.0035	0.0040	0.0034	0.0036
	Calcium (Ca)-Total (mg/kg)	5180	5600	6310	5710	7710
	Calcium (Ca)-Total (mg/kg wwt)	2700	2920	3570	3250	4080
	Cesium (Cs)-Total (mg/kg)	0.0208	0.0247	0.0252	0.0128	0.0218
	Cesium (Cs)-Total (mg/kg wwt)	0.0109	0.0129	0.0143	0.0073	0.0116
	Chromium (Cr)-Total (mg/kg)	0.074	0.152	0.150	0.114	0.154
	Chromium (Cr)-Total (mg/kg wwt)	0.038	0.080	0.085	0.065	0.081
	Cobalt (Co)-Total (mg/kg)	0.028	0.051	0.111	0.069	0.094
	Cobalt (Co)-Total (mg/kg wwt)	0.0144	0.0267	0.0630	0.0393	0.0499
	Copper (Cu)-Total (mg/kg)	14.2	12.8	21.2	16.9	16.3
	Copper (Cu)-Total (mg/kg wwt)	7.38	6.69	12.0	9.63	8.62
	Iron (Fe)-Total (mg/kg)	79.7	133	295	173	244
	Iron (Fe)-Total (mg/kg wwt)	41.5	69.3	167	98.6	129
	Lead (Pb)-Total (mg/kg)	0.038	0.061	0.104	0.090	0.092
	Lead (Pb)-Total (mg/kg wwt)	0.0196	0.0317	0.0590	0.0510	0.0488
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1460	1290	1040	1130	1370
	Magnesium (Mg)-Total (mg/kg wwt)	762	675	589	641	728
	Manganese (Mn)-Total (mg/kg)	793	583	948	788	1490
	Manganese (Mn)-Total (mg/kg wwt)	413	304	536	449	789

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-22 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 1	L2341109-23 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 2	L2341109-24 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 3	L2341109-25 Tissue 27-AUG-19 07:40 S-19 (BERRIES) 1	L2341109-26 Tissue 27-AUG-19 07:40 S-19 (BERRIES) 2
TISSUE						
Physical Tests	% Moisture (%)	61.3	63.8	62.9	82.5	81.6
Metals	Aluminum (Al)-Total (mg/kg)	244	137	97.9	104	35.1
	Aluminum (Al)-Total (mg/kg wwt)	94.5	49.4	36.3	18.2	6.47
	Antimony (Sb)-Total (mg/kg)	0.011	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0041	0.0026	0.0029	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.072	0.041	0.026	0.026	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0277	0.0150	0.0097	0.0045	<0.0040
	Barium (Ba)-Total (mg/kg)	309	215	539	46.5	15.4
	Barium (Ba)-Total (mg/kg wwt)	119	77.8	200	8.15	2.84
	Beryllium (Be)-Total (mg/kg)	0.022	0.020	0.022	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0084	0.0073	0.0082	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	14.4	6.5	10.8	8.9	5.4
	Boron (B)-Total (mg/kg wwt)	5.56	2.36	4.01	1.56	1.00
	Cadmium (Cd)-Total (mg/kg)	0.971	0.859	0.705	0.0685	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.375	0.311	0.261	0.0120	<0.0010
	Calcium (Ca)-Total (mg/kg)	26300	20400	32800	3380	1180
	Calcium (Ca)-Total (mg/kg wwt)	10200	7380	12200	592	217
	Cesium (Cs)-Total (mg/kg)	0.0112	0.0189	0.0081	0.0259	0.0146
	Cesium (Cs)-Total (mg/kg wwt)	0.0043	0.0068	0.0030	0.0045	0.0027
	Chromium (Cr)-Total (mg/kg)	0.225	0.142	0.109	0.300	0.109
	Chromium (Cr)-Total (mg/kg wwt)	0.087	0.051	0.040	0.053	0.020
	Cobalt (Co)-Total (mg/kg)	2.21	2.19	0.910	0.117	<0.020
	Cobalt (Co)-Total (mg/kg wwt)	0.855	0.792	0.337	0.0205	<0.0040
	Copper (Cu)-Total (mg/kg)	17.1	10.5	7.76	15.5	3.85
	Copper (Cu)-Total (mg/kg wwt)	6.62	3.80	2.88	2.71	0.710
	Iron (Fe)-Total (mg/kg)	355	193	158	156	32.8
	Iron (Fe)-Total (mg/kg wwt)	137	69.7	58.4	27.4	6.05
	Lead (Pb)-Total (mg/kg)	0.114	0.070	0.056	0.070	0.023
	Lead (Pb)-Total (mg/kg wwt)	0.0439	0.0252	0.0206	0.0123	0.0042
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	2780	3390	4310	696	550
	Magnesium (Mg)-Total (mg/kg wwt)	1070	1230	1600	122	101
	Manganese (Mn)-Total (mg/kg)	804	636	261	371	304
	Manganese (Mn)-Total (mg/kg wwt)	311	230	96.6	65.1	56.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-27	L2341109-31	L2341109-32	L2341109-33	L2341109-34
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	07:40	11:15	11:15	11:15	11:15
Client ID	S-19 (BERRIES) 3	S-18 (LABRADOR TEA) 1	S-18 (LABRADOR TEA) 2	S-18 (LABRADOR TEA) 3	S-18 (WILLOW) 1
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	81.1	45.8	48.6	47.6	61.8
Metals Aluminum (Al)-Total (mg/kg)	65.3	12.6	13.6	11.1	28.5
Aluminum (Al)-Total (mg/kg wwt)	12.3	6.81	6.97	5.81	10.9
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0020	0.0020
Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	0.024
Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.0048	0.0057	0.0048	0.0092
Barium (Ba)-Total (mg/kg)	31.3	96.0	103	83.4	71.1
Barium (Ba)-Total (mg/kg wwt)	5.90	52.1	53.0	43.7	27.2
Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	8.1	9.5	9.1	11.6	8.4
Boron (B)-Total (mg/kg wwt)	1.52	5.16	4.65	6.07	3.21
Cadmium (Cd)-Total (mg/kg)	0.0134	<0.0050	<0.0050	<0.0050	1.95
Cadmium (Cd)-Total (mg/kg wwt)	0.0025	0.0015	<0.0010	<0.0010	0.746
Calcium (Ca)-Total (mg/kg)	1990	4150	4660	4430	21900
Calcium (Ca)-Total (mg/kg wwt)	375	2250	2400	2320	8360
Cesium (Cs)-Total (mg/kg)	0.0095	0.0130	0.0218	0.0211	0.100
Cesium (Cs)-Total (mg/kg wwt)	0.0018	0.0070	0.0112	0.0111	0.0384
Chromium (Cr)-Total (mg/kg)	0.251	0.058	<0.050	0.101	0.107
Chromium (Cr)-Total (mg/kg wwt)	0.047	0.031	0.022	0.053	0.041
Cobalt (Co)-Total (mg/kg)	0.040	<0.020	<0.020	<0.020	0.887
Cobalt (Co)-Total (mg/kg wwt)	0.0075	0.0081	0.0075	0.0100	0.339
Copper (Cu)-Total (mg/kg)	7.22	7.03	8.28	6.98	12.9
Copper (Cu)-Total (mg/kg wwt)	1.36	3.81	4.25	3.66	4.93
Iron (Fe)-Total (mg/kg)	76.0	42.4	48.2	43.2	95.4
Iron (Fe)-Total (mg/kg wwt)	14.3	23.0	24.8	22.6	36.5
Lead (Pb)-Total (mg/kg)	0.030	0.027	0.021	0.023	0.042
Lead (Pb)-Total (mg/kg wwt)	0.0056	0.0147	0.0110	0.0122	0.0162
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	741	1170	1260	1360	6980
Magnesium (Mg)-Total (mg/kg wwt)	140	635	649	714	2670
Manganese (Mn)-Total (mg/kg)	466	368	397	363	356
Manganese (Mn)-Total (mg/kg wwt)	87.9	200	204	190	136

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-35 Tissue 28-AUG-19 11:15 S-18 (WILLOW) 2	L2341109-36 Tissue 28-AUG-19 11:15 S-18 (WILLOW) 3	L2341109-40 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 1	L2341109-41 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 2	L2341109-42 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 3
TISSUE						
Physical Tests	% Moisture (%)	52.7	57.2	56.6	56.8	56.5
Metals	Aluminum (Al)-Total (mg/kg)	55.4	111	145	99.9	83.3
	Aluminum (Al)-Total (mg/kg wwt)	26.2	47.7	63.1	43.1	36.2
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0035	0.0029	0.0034	0.0031	<0.0020
	Arsenic (As)-Total (mg/kg)	0.041	0.055	0.053	0.031	0.028
	Arsenic (As)-Total (mg/kg wwt)	0.0194	0.0235	0.0229	0.0132	0.0122
	Barium (Ba)-Total (mg/kg)	40.7	64.0	174	167	169
	Barium (Ba)-Total (mg/kg wwt)	19.2	27.4	75.6	72.1	73.3
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	0.015	0.014	0.011
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0066	0.0059	0.0046
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0022	0.0041	0.0033	0.0031	<0.0020
	Boron (B)-Total (mg/kg)	13.8	13.0	13.6	10.1	11.2
	Boron (B)-Total (mg/kg wwt)	6.52	5.56	5.90	4.34	4.85
	Cadmium (Cd)-Total (mg/kg)	1.73	1.83	0.959	0.466	0.600
	Cadmium (Cd)-Total (mg/kg wwt)	0.818	0.782	0.416	0.201	0.261
	Calcium (Ca)-Total (mg/kg)	13900	16100	24800	15200	19100
	Calcium (Ca)-Total (mg/kg wwt)	6560	6870	10800	6540	8310
	Cesium (Cs)-Total (mg/kg)	0.151	0.0587	0.0078	0.0051	<0.0050
	Cesium (Cs)-Total (mg/kg wwt)	0.0713	0.0251	0.0034	0.0022	0.0019
	Chromium (Cr)-Total (mg/kg)	0.132	0.129	0.158	0.129	0.106
	Chromium (Cr)-Total (mg/kg wwt)	0.062	0.055	0.068	0.056	0.046
	Cobalt (Co)-Total (mg/kg)	0.527	0.453	1.40	1.03	1.37
	Cobalt (Co)-Total (mg/kg wwt)	0.249	0.194	0.609	0.445	0.596
	Copper (Cu)-Total (mg/kg)	30.9	70.5	67.3	58.9	40.0
	Copper (Cu)-Total (mg/kg wwt)	14.6	30.2	29.2	25.4	17.4
	Iron (Fe)-Total (mg/kg)	169	301	282	219	153
	Iron (Fe)-Total (mg/kg wwt)	79.7	129	123	94.6	66.7
	Lead (Pb)-Total (mg/kg)	0.076	0.119	0.117	0.095	0.070
	Lead (Pb)-Total (mg/kg wwt)	0.0361	0.0511	0.0506	0.0410	0.0303
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	2960	3130	3980	2850	3330
	Magnesium (Mg)-Total (mg/kg wwt)	1400	1340	1730	1230	1450
	Manganese (Mn)-Total (mg/kg)	163	261	129	68.0	113
	Manganese (Mn)-Total (mg/kg wwt)	77.3	112	56.0	29.3	49.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2341109-46 Tissue 26-AUG-19 15:50 S-16 (LABRADOR TEA) 1	L2341109-47 Tissue 26-AUG-19 15:50 S-16 (LABRADOR TEA) 2	L2341109-48 Tissue 26-AUG-19 15:50 S-16 (LABRADOR TEA) 3	L2341109-49 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 1	L2341109-50 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 2
TISSUE						
Physical Tests	% Moisture (%)	45.3	46.2	43.5	54.1	56.9
Metals	Aluminum (Al)-Total (mg/kg)	45.9	69.2	94.4	19.8	48.0
	Aluminum (Al)-Total (mg/kg wwt)	25.1	37.2	53.3	9.09	20.7
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0027	0.0033	0.0044	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.033	0.048	0.051	<0.020	0.031
	Arsenic (As)-Total (mg/kg wwt)	0.0179	0.0257	0.0288	0.0069	0.0133
	Barium (Ba)-Total (mg/kg)	65.9	58.6	75.9	15.8	24.8
	Barium (Ba)-Total (mg/kg wwt)	36.1	31.5	42.9	7.25	10.7
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0025	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	0.0020	0.0032	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	13.1	12.7	11.6	13.4	14.4
	Boron (B)-Total (mg/kg wwt)	7.17	6.85	6.53	6.17	6.21
	Cadmium (Cd)-Total (mg/kg)	<0.0050	0.0080	0.0087	0.763	1.03
	Cadmium (Cd)-Total (mg/kg wwt)	0.0025	0.0043	0.0049	0.350	0.445
	Calcium (Ca)-Total (mg/kg)	6080	6040	5060	11500	12200
	Calcium (Ca)-Total (mg/kg wwt)	3330	3240	2860	5280	5250
	Cesium (Cs)-Total (mg/kg)	0.0055	0.0063	0.0094	0.0116	0.0082
	Cesium (Cs)-Total (mg/kg wwt)	0.0030	0.0034	0.0053	0.0053	0.0035
	Chromium (Cr)-Total (mg/kg)	0.126	0.156	0.198	0.078	0.118
	Chromium (Cr)-Total (mg/kg wwt)	0.069	0.084	0.112	0.036	0.051
	Cobalt (Co)-Total (mg/kg)	0.037	0.054	0.070	0.287	0.299
	Cobalt (Co)-Total (mg/kg wwt)	0.0202	0.0290	0.0395	0.132	0.129
	Copper (Cu)-Total (mg/kg)	15.1	26.1	36.8	7.19	13.6
	Copper (Cu)-Total (mg/kg wwt)	8.24	14.0	20.8	3.30	5.88
	Iron (Fe)-Total (mg/kg)	119	168	234	63.4	117
	Iron (Fe)-Total (mg/kg wwt)	64.8	90.5	132	29.1	50.5
	Lead (Pb)-Total (mg/kg)	0.055	0.066	0.098	0.034	0.047
	Lead (Pb)-Total (mg/kg wwt)	0.0300	0.0353	0.0553	0.0154	0.0204
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	0.11	<0.10
	Magnesium (Mg)-Total (mg/kg)	1050	1360	1220	2920	2960
	Magnesium (Mg)-Total (mg/kg wwt)	574	729	688	1340	1280
	Manganese (Mn)-Total (mg/kg)	171	128	165	246	225
	Manganese (Mn)-Total (mg/kg wwt)	93.7	69.0	93.4	113	96.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-51 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 3	L2341109-55 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 1	L2341109-56 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 2	L2341109-57 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 3	L2341109-58 Tissue 28-AUG-19 11:40 S-15 (LABRADOR TEA) 1
TISSUE						
Physical Tests	% Moisture (%)	53.5	74.3	74.8	74.0	48.4
Metals	Aluminum (Al)-Total (mg/kg)	92.9	35.5	34.0	18.8	76.2
	Aluminum (Al)-Total (mg/kg wwt)	43.2	9.11	8.57	4.89	39.3
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0023	<0.0020	<0.0020	<0.0020	0.0028
	Arsenic (As)-Total (mg/kg)	0.047	<0.020	0.022	<0.020	0.025
	Arsenic (As)-Total (mg/kg wwt)	0.0220	0.0050	0.0056	0.0051	0.0130
	Barium (Ba)-Total (mg/kg)	22.1	197	180	185	98.6
	Barium (Ba)-Total (mg/kg wwt)	10.3	50.5	45.5	48.2	50.9
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0020	<0.0020	<0.0020	<0.0020	0.0021
	Boron (B)-Total (mg/kg)	11.7	16.0	16.3	14.2	12.3
	Boron (B)-Total (mg/kg wwt)	5.46	4.10	4.12	3.70	6.35
	Cadmium (Cd)-Total (mg/kg)	0.878	0.197	0.165	0.184	0.0063
	Cadmium (Cd)-Total (mg/kg wwt)	0.408	0.0505	0.0415	0.0479	0.0033
	Calcium (Ca)-Total (mg/kg)	11200	31500	33100	29200	5190
	Calcium (Ca)-Total (mg/kg wwt)	5210	8090	8340	7590	2680
	Cesium (Cs)-Total (mg/kg)	0.0195	0.102	0.129	0.136	0.0168
	Cesium (Cs)-Total (mg/kg wwt)	0.0091	0.0262	0.0325	0.0353	0.0087
	Chromium (Cr)-Total (mg/kg)	0.170	0.240	0.204	0.116	0.123
	Chromium (Cr)-Total (mg/kg wwt)	0.079	0.062	0.051	0.030	0.063
	Cobalt (Co)-Total (mg/kg)	0.326	0.153	0.092	0.095	0.053
	Cobalt (Co)-Total (mg/kg wwt)	0.151	0.0393	0.0232	0.0247	0.0276
	Copper (Cu)-Total (mg/kg)	28.3	8.21	5.56	7.32	32.9
	Copper (Cu)-Total (mg/kg wwt)	13.2	2.11	1.40	1.90	17.0
	Iron (Fe)-Total (mg/kg)	209	51.2	55.6	46.0	169
	Iron (Fe)-Total (mg/kg wwt)	97.1	13.1	14.0	12.0	87.0
	Lead (Pb)-Total (mg/kg)	0.079	0.027	<0.020	<0.020	0.075
	Lead (Pb)-Total (mg/kg wwt)	0.0369	0.0070	0.0050	0.0046	0.0389
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	3330	3540	3390	2920	1630
	Magnesium (Mg)-Total (mg/kg wwt)	1550	909	854	759	843
	Manganese (Mn)-Total (mg/kg)	147	85.0	43.9	33.8	1070
	Manganese (Mn)-Total (mg/kg wwt)	68.4	21.8	11.1	8.78	553

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-59 Tissue 28-AUG-19 11:40 S-15 (LABRADOR TEA) 2	L2341109-60 Tissue 28-AUG-19 11:40 S-15 (LABRADOR TEA) 3	L2341109-64 Tissue 27-AUG-19 17:15 S-11 (WILLOW) 1	L2341109-65 Tissue 27-AUG-19 17:15 S-11 (WILLOW) 2	L2341109-66 Tissue 27-AUG-19 17:15 S-11 (WILLOW) 3
TISSUE						
Physical Tests	% Moisture (%)	50.4	47.3	62.4	64.1	61.7
Metals	Aluminum (Al)-Total (mg/kg)	65.6	74.4	38.6	44.4	38.2
	Aluminum (Al)-Total (mg/kg wwt)	32.5	39.2	14.5	16.0	14.6
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0021	0.0038	0.0025	0.0028	0.0028
	Arsenic (As)-Total (mg/kg)	0.029	0.028	0.038	0.030	0.039
	Arsenic (As)-Total (mg/kg wwt)	0.0144	0.0150	0.0141	0.0109	0.0148
	Barium (Ba)-Total (mg/kg)	60.3	96.5	163	187	154
	Barium (Ba)-Total (mg/kg wwt)	29.9	50.8	61.5	67.1	59.0
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0023	0.0026
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	6.6	11.3	7.6	9.1	6.3
	Boron (B)-Total (mg/kg wwt)	3.27	5.94	2.86	3.27	2.40
	Cadmium (Cd)-Total (mg/kg)	0.0074	0.0071	2.37	2.44	1.53
	Cadmium (Cd)-Total (mg/kg wwt)	0.0037	0.0037	0.894	0.878	0.586
	Calcium (Ca)-Total (mg/kg)	5400	5410	24500	26200	24200
	Calcium (Ca)-Total (mg/kg wwt)	2670	2850	9210	9410	9300
	Cesium (Cs)-Total (mg/kg)	0.0203	0.0152	0.0103	0.0086	0.0071
	Cesium (Cs)-Total (mg/kg wwt)	0.0101	0.0080	0.0039	0.0031	0.0027
	Chromium (Cr)-Total (mg/kg)	0.105	0.118	0.115	0.147	0.136
	Chromium (Cr)-Total (mg/kg wwt)	0.052	0.062	0.043	0.053	0.052
	Cobalt (Co)-Total (mg/kg)	0.055	0.055	0.608	0.850	0.606
	Cobalt (Co)-Total (mg/kg wwt)	0.0272	0.0288	0.229	0.305	0.232
	Copper (Cu)-Total (mg/kg)	34.5	29.5	5.46	4.74	4.62
	Copper (Cu)-Total (mg/kg wwt)	17.1	15.5	2.06	1.70	1.77
	Iron (Fe)-Total (mg/kg)	156	169	75.0	84.2	76.1
	Iron (Fe)-Total (mg/kg wwt)	77.5	89.2	28.2	30.2	29.2
	Lead (Pb)-Total (mg/kg)	0.071	0.074	0.046	0.040	0.055
	Lead (Pb)-Total (mg/kg wwt)	0.0352	0.0389	0.0172	0.0145	0.0212
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1350	1180	4400	3670	4760
	Magnesium (Mg)-Total (mg/kg wwt)	667	622	1660	1320	1820
	Manganese (Mn)-Total (mg/kg)	668	918	124	204	222
	Manganese (Mn)-Total (mg/kg wwt)	331	483	46.7	73.3	84.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-70 Tissue 27-AUG-19 10:20 S-09 (WILLOW) 1	L2341109-71 Tissue 27-AUG-19 10:20 S-09 (WILLOW) 2	L2341109-72 Tissue 27-AUG-19 10:20 S-09 (WILLOW) 3	L2341109-76 Tissue 27-AUG-19 11:00 S-08 (LABRADOR TEA) 1	L2341109-77 Tissue 27-AUG-19 11:00 S-08 (LABRADOR TEA) 2
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
TISSUE						
Physical Tests	% Moisture (%)	56.0	62.5	62.7	48.6	47.2
Metals	Aluminum (Al)-Total (mg/kg)	29.4	61.7	52.4	259	294
	Aluminum (Al)-Total (mg/kg wwt)	13.0	23.1	19.6	133	155
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0025	0.0024	0.0034	0.0042
	Arsenic (As)-Total (mg/kg)	<0.020	0.031	0.030	0.055	0.069
	Arsenic (As)-Total (mg/kg wwt)	0.0084	0.0115	0.0112	0.0283	0.0362
	Barium (Ba)-Total (mg/kg)	147	239	319	95.8	154
	Barium (Ba)-Total (mg/kg wwt)	64.6	89.6	119	49.2	81.3
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0022	0.0031	0.0028	0.0043	0.0055
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0024	0.0036
	Boron (B)-Total (mg/kg)	8.3	7.9	14.3	20.2	14.5
	Boron (B)-Total (mg/kg wwt)	3.65	2.96	5.33	10.4	7.66
	Cadmium (Cd)-Total (mg/kg)	0.670	1.87	1.22	0.0108	0.0132
	Cadmium (Cd)-Total (mg/kg wwt)	0.295	0.699	0.455	0.0055	0.0070
	Calcium (Ca)-Total (mg/kg)	14600	21800	30100	6200	8080
	Calcium (Ca)-Total (mg/kg wwt)	6420	8160	11200	3190	4270
	Cesium (Cs)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	0.0281	0.0373
	Cesium (Cs)-Total (mg/kg wwt)	0.0013	0.0017	0.0017	0.0144	0.0197
	Chromium (Cr)-Total (mg/kg)	0.064	0.130	0.108	0.233	0.233
	Chromium (Cr)-Total (mg/kg wwt)	0.028	0.049	0.040	0.120	0.123
	Cobalt (Co)-Total (mg/kg)	0.833	0.563	0.385	0.160	0.189
	Cobalt (Co)-Total (mg/kg wwt)	0.367	0.211	0.144	0.0822	0.0999
	Copper (Cu)-Total (mg/kg)	4.90	9.57	6.52	42.2	57.3
	Copper (Cu)-Total (mg/kg wwt)	2.16	3.59	2.43	21.7	30.3
	Iron (Fe)-Total (mg/kg)	71.8	138	99.6	498	615
	Iron (Fe)-Total (mg/kg wwt)	31.6	51.7	37.2	256	324
	Lead (Pb)-Total (mg/kg)	0.035	0.074	0.051	0.133	0.152
	Lead (Pb)-Total (mg/kg wwt)	0.0154	0.0277	0.0190	0.0685	0.0802
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	2280	3630	3690	1540	1420
	Magnesium (Mg)-Total (mg/kg wwt)	1010	1360	1380	790	752
	Manganese (Mn)-Total (mg/kg)	317	404	85.5	787	731
	Manganese (Mn)-Total (mg/kg wwt)	140	151	31.9	405	386

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-78 Tissue 27-AUG-19 11:00 S-08 (LABRADOR TEA) 3	L2341109-79 Tissue 27-AUG-19 11:00 S-08 (WILLOW) 1	L2341109-80 Tissue 27-AUG-19 11:00 S-08 (WILLOW) 2	L2341109-81 Tissue 27-AUG-19 11:00 S-08 (WILLOW) 3	L2341109-82 Tissue 27-AUG-19 11:00 S-08 (LICHEN) 1
TISSUE						
Physical Tests	% Moisture (%)	47.0	59.8	59.3	55.3	40.0
Metals	Aluminum (Al)-Total (mg/kg)	348	211	370	392	4720
	Aluminum (Al)-Total (mg/kg wwt)	184	85.0	151	175	2830
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.055
	Antimony (Sb)-Total (mg/kg wwt)	0.0044	0.0025	0.0034	0.0038	0.0332
	Arsenic (As)-Total (mg/kg)	0.074	0.046	0.084	0.080	0.851
	Arsenic (As)-Total (mg/kg wwt)	0.0394	0.0186	0.0341	0.0359	0.511
	Barium (Ba)-Total (mg/kg)	108	23.5	22.6	22.2	80.5
	Barium (Ba)-Total (mg/kg wwt)	57.1	9.46	9.21	9.94	48.4
	Beryllium (Be)-Total (mg/kg)	0.010	<0.010	0.011	0.011	0.141
	Beryllium (Be)-Total (mg/kg wwt)	0.0055	0.0027	0.0045	0.0047	0.0846
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.189
	Bismuth (Bi)-Total (mg/kg wwt)	0.0039	<0.0020	0.0034	0.0041	0.113
	Boron (B)-Total (mg/kg)	18.4	11.5	5.5	8.6	2.4
	Boron (B)-Total (mg/kg wwt)	9.76	4.63	2.25	3.85	1.43
	Cadmium (Cd)-Total (mg/kg)	0.0113	0.995	0.537	0.518	0.189
	Cadmium (Cd)-Total (mg/kg wwt)	0.0060	0.400	0.219	0.231	0.113
	Calcium (Ca)-Total (mg/kg)	7290	12600	12100	10000	5390
	Calcium (Ca)-Total (mg/kg wwt)	3860	5080	4940	4490	3240
	Cesium (Cs)-Total (mg/kg)	0.0383	0.0913	0.0691	0.0884	0.216
	Cesium (Cs)-Total (mg/kg wwt)	0.0203	0.0367	0.0281	0.0395	0.130
	Chromium (Cr)-Total (mg/kg)	0.261	0.180	0.299	0.336	2.50
	Chromium (Cr)-Total (mg/kg wwt)	0.138	0.072	0.122	0.150	1.50
	Cobalt (Co)-Total (mg/kg)	0.212	0.610	0.455	0.603	2.71
	Cobalt (Co)-Total (mg/kg wwt)	0.112	0.245	0.185	0.269	1.63
	Copper (Cu)-Total (mg/kg)	60.1	37.2	71.4	68.4	1470
	Copper (Cu)-Total (mg/kg wwt)	31.8	15.0	29.1	30.6	883
	Iron (Fe)-Total (mg/kg)	732	457	828	857	10100
	Iron (Fe)-Total (mg/kg wwt)	388	184	337	383	6050
	Lead (Pb)-Total (mg/kg)	0.171	0.121	0.160	0.176	2.00
	Lead (Pb)-Total (mg/kg wwt)	0.0903	0.0488	0.0650	0.0784	1.20
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	2.42
	Lithium (Li)-Total (mg/kg wwt)	0.12	0.17	0.18	0.16	1.45
	Magnesium (Mg)-Total (mg/kg)	1640	3130	5130	4660	2840
	Magnesium (Mg)-Total (mg/kg wwt)	869	1260	2090	2080	1710
	Manganese (Mn)-Total (mg/kg)	795	292	215	139	320
	Manganese (Mn)-Total (mg/kg wwt)	421	118	87.4	62.1	192

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-83 Tissue 27-AUG-19 11:00 S-08 (LICHEN) 2	L2341109-84 Tissue 27-AUG-19 11:00 S-08 (LICHEN) 3	L2341109-88 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 1	L2341109-89 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 2	L2341109-90 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 3
TISSUE						
Physical Tests	% Moisture (%)	19.0	26.4	43.9	48.4	44.6
Metals	Aluminum (Al)-Total (mg/kg)	4600	3240	351	245	292
	Aluminum (Al)-Total (mg/kg wwt)	3730	2380	197	126	162
	Antimony (Sb)-Total (mg/kg)	0.042	0.027	0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0339	0.0200	0.0057	0.0029	0.0040
	Arsenic (As)-Total (mg/kg)	0.777	0.615	0.071	0.072	0.064
	Arsenic (As)-Total (mg/kg wwt)	0.629	0.453	0.0400	0.0371	0.0355
	Barium (Ba)-Total (mg/kg)	90.4	63.5	125	141	125
	Barium (Ba)-Total (mg/kg wwt)	73.2	46.8	70.2	72.8	69.0
	Beryllium (Be)-Total (mg/kg)	0.126	0.096	0.011	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.102	0.0704	0.0060	0.0036	0.0053
	Bismuth (Bi)-Total (mg/kg)	0.167	0.126	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.136	0.0926	0.0049	0.0024	0.0036
	Boron (B)-Total (mg/kg)	2.7	1.1	11.3	15.4	16.2
	Boron (B)-Total (mg/kg wwt)	2.22	0.84	6.36	7.95	8.99
	Cadmium (Cd)-Total (mg/kg)	0.189	0.149	0.0131	0.0064	0.0117
	Cadmium (Cd)-Total (mg/kg wwt)	0.153	0.110	0.0073	0.0033	0.0065
	Calcium (Ca)-Total (mg/kg)	7000	4180	7150	6930	7080
	Calcium (Ca)-Total (mg/kg wwt)	5670	3080	4010	3580	3920
	Cesium (Cs)-Total (mg/kg)	0.225	0.115	0.0416	0.0378	0.0472
	Cesium (Cs)-Total (mg/kg wwt)	0.182	0.0847	0.0234	0.0195	0.0262
	Chromium (Cr)-Total (mg/kg)	2.33	1.80	0.276	0.220	0.228
	Chromium (Cr)-Total (mg/kg wwt)	1.89	1.32	0.155	0.114	0.126
	Cobalt (Co)-Total (mg/kg)	2.56	1.88	0.227	0.140	0.191
	Cobalt (Co)-Total (mg/kg wwt)	2.07	1.38	0.127	0.0723	0.106
	Copper (Cu)-Total (mg/kg)	1300	899	77.0	37.5	61.3
	Copper (Cu)-Total (mg/kg wwt)	1050	661	43.2	19.3	34.0
	Iron (Fe)-Total (mg/kg)	9470	6680	701	413	612
	Iron (Fe)-Total (mg/kg wwt)	7670	4910	393	213	339
	Lead (Pb)-Total (mg/kg)	1.89	1.48	0.198	0.135	0.148
	Lead (Pb)-Total (mg/kg wwt)	1.54	1.09	0.111	0.0697	0.0818
	Lithium (Li)-Total (mg/kg)	2.22	1.74	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	1.80	1.28	0.11	<0.10	0.11
	Magnesium (Mg)-Total (mg/kg)	2820	2010	1640	1500	1290
	Magnesium (Mg)-Total (mg/kg wwt)	2290	1480	921	773	716
	Manganese (Mn)-Total (mg/kg)	367	240	420	533	528
	Manganese (Mn)-Total (mg/kg wwt)	297	176	236	275	292

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2341109-91 Tissue 27-AUG-19 11:05 S-08A (WILLOW) 1	L2341109-92 Tissue 27-AUG-19 11:05 S-08A (WILLOW) 2	L2341109-93 Tissue 27-AUG-19 11:05 S-08A (WILLOW) 3	L2341109-94 Tissue 27-AUG-19 11:05 S-08A (LICHEN) 1	L2341109-95 Tissue 27-AUG-19 11:05 S-08A (LICHEN) 2
TISSUE						
Physical Tests	% Moisture (%)	57.4	62.8	60.1	32.5	26.3
Metals	Aluminum (Al)-Total (mg/kg)	373	229	305	2830	3480
	Aluminum (Al)-Total (mg/kg wwt)	159	85.0	122	1910	2560
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	0.018	0.025
	Antimony (Sb)-Total (mg/kg wwt)	0.0030	0.0021	0.0029	0.0121	0.0187
	Arsenic (As)-Total (mg/kg)	0.076	0.049	0.063	0.448	0.558
	Arsenic (As)-Total (mg/kg wwt)	0.0326	0.0183	0.0250	0.303	0.411
	Barium (Ba)-Total (mg/kg)	27.3	20.5	27.2	49.4	50.8
	Barium (Ba)-Total (mg/kg wwt)	11.6	7.63	10.8	33.4	37.4
	Beryllium (Be)-Total (mg/kg)	0.010	<0.010	<0.010	0.080	0.088
	Beryllium (Be)-Total (mg/kg wwt)	0.0043	0.0021	0.0038	0.0540	0.0648
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	0.102	0.111
	Bismuth (Bi)-Total (mg/kg wwt)	0.0034	<0.0020	0.0028	0.0687	0.0819
	Boron (B)-Total (mg/kg)	13.1	9.9	12.4	1.8	1.6
	Boron (B)-Total (mg/kg wwt)	5.56	3.69	4.96	1.25	1.16
	Cadmium (Cd)-Total (mg/kg)	0.797	1.17	0.699	0.104	0.110
	Cadmium (Cd)-Total (mg/kg wwt)	0.340	0.434	0.279	0.0705	0.0811
	Calcium (Ca)-Total (mg/kg)	12100	13700	13700	3640	3120
	Calcium (Ca)-Total (mg/kg wwt)	5150	5100	5450	2460	2300
	Cesium (Cs)-Total (mg/kg)	0.0833	0.116	0.0845	0.122	0.148
	Cesium (Cs)-Total (mg/kg wwt)	0.0355	0.0431	0.0337	0.0822	0.109
	Chromium (Cr)-Total (mg/kg)	0.426	0.207	0.260	1.35	1.73
	Chromium (Cr)-Total (mg/kg wwt)	0.181	0.077	0.104	0.914	1.28
	Cobalt (Co)-Total (mg/kg)	0.516	0.477	0.494	1.49	1.76
	Cobalt (Co)-Total (mg/kg wwt)	0.220	0.177	0.197	1.01	1.30
	Copper (Cu)-Total (mg/kg)	74.0	34.6	54.0	771	854
	Copper (Cu)-Total (mg/kg wwt)	31.5	12.9	21.5	520	630
	Iron (Fe)-Total (mg/kg)	766	482	651	5620	7000
	Iron (Fe)-Total (mg/kg wwt)	326	179	260	3800	5160
	Lead (Pb)-Total (mg/kg)	0.160	0.100	0.131	1.19	1.26
	Lead (Pb)-Total (mg/kg wwt)	0.0681	0.0373	0.0523	0.802	0.928
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	1.24	1.64
	Lithium (Li)-Total (mg/kg wwt)	0.16	0.17	0.16	0.84	1.21
	Magnesium (Mg)-Total (mg/kg)	3050	5040	3350	1600	1890
	Magnesium (Mg)-Total (mg/kg wwt)	1300	1870	1340	1080	1390
	Manganese (Mn)-Total (mg/kg)	211	187	181	220	178
	Manganese (Mn)-Total (mg/kg wwt)	89.9	69.7	72.2	149	132

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-96 Tissue 27-AUG-19 11:05 S-08A (LICHEN) 3	L2341109-100 Tissue 27-AUG-19 15:50 S-07 (LABRADOR TEA) 1	L2341109-101 Tissue 27-AUG-19 15:50 S-07 (LABRADOR TEA) 2	L2341109-102 Tissue 27-AUG-19 15:50 S-07 (LABRADOR TEA) 3	L2341109-103 Tissue 27-AUG-19 15:50 S-07 (WILLOW) 1
TISSUE						
Physical Tests	% Moisture (%)	26.2	42.7	45.1	45.4	60.1
Metals	Aluminum (Al)-Total (mg/kg)	2750	85.0	115	67.1	161
	Aluminum (Al)-Total (mg/kg wwt)	2030	48.7	63.2	36.7	64.2
	Antimony (Sb)-Total (mg/kg)	0.022	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0163	0.0029	0.0036	<0.0020	0.0032
	Arsenic (As)-Total (mg/kg)	0.431	0.036	0.043	0.023	0.063
	Arsenic (As)-Total (mg/kg wwt)	0.318	0.0205	0.0238	0.0125	0.0253
	Barium (Ba)-Total (mg/kg)	49.3	86.2	71.2	63.3	64.1
	Barium (Ba)-Total (mg/kg wwt)	36.4	49.4	39.1	34.6	25.6
	Beryllium (Be)-Total (mg/kg)	0.081	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0601	<0.0020	0.0021	<0.0020	0.0023
	Bismuth (Bi)-Total (mg/kg)	0.100	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0738	<0.0020	0.0027	<0.0020	0.0026
	Boron (B)-Total (mg/kg)	1.5	17.3	17.9	10.6	17.3
	Boron (B)-Total (mg/kg wwt)	1.12	9.90	9.86	5.80	6.92
	Cadmium (Cd)-Total (mg/kg)	0.107	0.0068	0.0109	0.0063	0.783
	Cadmium (Cd)-Total (mg/kg wwt)	0.0787	0.0039	0.0060	0.0035	0.313
	Calcium (Ca)-Total (mg/kg)	3270	5080	5120	4770	15100
	Calcium (Ca)-Total (mg/kg wwt)	2420	2910	2810	2600	6010
	Cesium (Cs)-Total (mg/kg)	0.120	0.0078	0.0127	0.0088	0.0323
	Cesium (Cs)-Total (mg/kg wwt)	0.0884	0.0045	0.0070	0.0048	0.0129
	Chromium (Cr)-Total (mg/kg)	1.43	0.121	0.144	0.104	0.216
	Chromium (Cr)-Total (mg/kg wwt)	1.05	0.069	0.079	0.057	0.086
	Cobalt (Co)-Total (mg/kg)	1.46	0.062	0.085	0.047	0.318
	Cobalt (Co)-Total (mg/kg wwt)	1.08	0.0357	0.0468	0.0259	0.127
	Copper (Cu)-Total (mg/kg)	793	28.0	40.5	22.8	47.1
	Copper (Cu)-Total (mg/kg wwt)	585	16.0	22.3	12.5	18.8
	Iron (Fe)-Total (mg/kg)	5620	203	282	164	388
	Iron (Fe)-Total (mg/kg wwt)	4150	116	155	89.5	155
	Lead (Pb)-Total (mg/kg)	1.10	0.083	0.119	0.056	0.114
	Lead (Pb)-Total (mg/kg wwt)	0.810	0.0474	0.0652	0.0304	0.0456
	Lithium (Li)-Total (mg/kg)	1.24	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	0.92	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1570	1570	1370	1850	7040
	Magnesium (Mg)-Total (mg/kg wwt)	1160	901	753	1010	2810
	Manganese (Mn)-Total (mg/kg)	208	262	527	224	248
	Manganese (Mn)-Total (mg/kg wwt)	154	150	290	123	98.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-104 Tissue 27-AUG-19 15:50 S-07 (WILLOW) 2	L2341109-105 Tissue 27-AUG-19 15:50 S-07 (WILLOW) 3	L2341109-106 Tissue 27-AUG-19 15:50 S-07 (HORSETAIL) 1	L2341109-107 Tissue 27-AUG-19 15:50 S-07 (HORSETAIL) 2	L2341109-108 Tissue 27-AUG-19 15:50 S-07 (HORSETAIL) 3
TISSUE						
Physical Tests	% Moisture (%)	59.2	56.8	17.4	37.2	19.5
Metals	Aluminum (Al)-Total (mg/kg)	265	70.3	17.4	19.2	20.7
	Aluminum (Al)-Total (mg/kg wwt)	108	30.4	14.4	12.0	16.7
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0040	0.0028	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.078	0.039	0.053	0.046	0.051
	Arsenic (As)-Total (mg/kg wwt)	0.0316	0.0170	0.0439	0.0290	0.0414
	Barium (Ba)-Total (mg/kg)	48.8	69.4	135	155	140
	Barium (Ba)-Total (mg/kg wwt)	19.9	30.0	111	97.6	112
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0040	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	0.012	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0050	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	16.8	24.1	22.8	25.2	29.6
	Boron (B)-Total (mg/kg wwt)	6.84	10.4	18.8	15.8	23.8
	Cadmium (Cd)-Total (mg/kg)	2.50	1.83	0.243	0.124	0.140
	Cadmium (Cd)-Total (mg/kg wwt)	1.02	0.791	0.201	0.0778	0.112
	Calcium (Ca)-Total (mg/kg)	10500	14000	22700	23100	26100
	Calcium (Ca)-Total (mg/kg wwt)	4300	6070	18800	14500	21000
	Cesium (Cs)-Total (mg/kg)	0.0278	0.0212	0.186	0.248	0.222
	Cesium (Cs)-Total (mg/kg wwt)	0.0114	0.0091	0.154	0.156	0.178
	Chromium (Cr)-Total (mg/kg)	0.276	0.138	<0.050	0.081	0.117
	Chromium (Cr)-Total (mg/kg wwt)	0.113	0.060	0.039	0.051	0.094
	Cobalt (Co)-Total (mg/kg)	0.691	0.634	0.391	0.281	0.447
	Cobalt (Co)-Total (mg/kg wwt)	0.282	0.274	0.323	0.176	0.360
	Copper (Cu)-Total (mg/kg)	89.1	17.3	22.0	16.8	15.8
	Copper (Cu)-Total (mg/kg wwt)	36.4	7.47	18.1	10.5	12.7
	Iron (Fe)-Total (mg/kg)	629	181	48.5	61.6	58.7
	Iron (Fe)-Total (mg/kg wwt)	257	78.0	40.1	38.7	47.3
	Lead (Pb)-Total (mg/kg)	0.193	0.057	<0.020	<0.020	<0.020
	Lead (Pb)-Total (mg/kg wwt)	0.0789	0.0248	0.0120	0.0117	0.0153
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	4390	6450	6050	6240	6290
	Magnesium (Mg)-Total (mg/kg wwt)	1790	2790	5000	3920	5060
	Manganese (Mn)-Total (mg/kg)	453	288	262	212	258
	Manganese (Mn)-Total (mg/kg wwt)	185	124	216	133	208

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2341109-112 Tissue 27-AUG-19 14:55 S-06 (LABRADOR TEA) 1	L2341109-113 Tissue 27-AUG-19 14:55 S-06 (LABRADOR TEA) 2	L2341109-114 Tissue 27-AUG-19 14:55 S-06 (LABRADOR TEA) 3	L2341109-118 Tissue 27-AUG-19 09:25 S-05 (LABRADOR TEA) 1	L2341109-119 Tissue 27-AUG-19 09:25 S-05 (LABRADOR TEA) 2
TISSUE						
Physical Tests	% Moisture (%)	46.2	49.4	51.1	48.3	48.0
Metals	Aluminum (Al)-Total (mg/kg)	73.5	64.0	63.8	73.3	58.7
	Aluminum (Al)-Total (mg/kg wwt)	39.6	32.4	31.2	37.9	30.6
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0026	0.0024	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.025	0.020	<0.020	0.037	0.024
	Arsenic (As)-Total (mg/kg wwt)	0.0136	0.0104	0.0087	0.0192	0.0123
	Barium (Ba)-Total (mg/kg)	181	225	195	115	100
	Barium (Ba)-Total (mg/kg wwt)	97.5	114	95.4	59.3	52.1
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	8.6	8.5	8.6	10.2	11.1
	Boron (B)-Total (mg/kg wwt)	4.65	4.31	4.20	5.25	5.78
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0025	0.0021	0.0022	0.0022	0.0026
	Calcium (Ca)-Total (mg/kg)	6160	5960	6110	5440	4420
	Calcium (Ca)-Total (mg/kg wwt)	3310	3020	2980	2810	2300
	Cesium (Cs)-Total (mg/kg)	0.0180	0.0172	0.0053	0.0171	0.0078
	Cesium (Cs)-Total (mg/kg wwt)	0.0097	0.0087	0.0026	0.0088	0.0041
	Chromium (Cr)-Total (mg/kg)	0.128	0.097	0.128	0.092	0.097
	Chromium (Cr)-Total (mg/kg wwt)	0.069	0.049	0.063	0.048	0.050
	Cobalt (Co)-Total (mg/kg)	0.063	0.075	0.085	0.061	0.055
	Cobalt (Co)-Total (mg/kg wwt)	0.0341	0.0380	0.0418	0.0315	0.0287
	Copper (Cu)-Total (mg/kg)	13.3	9.91	9.77	19.4	19.6
	Copper (Cu)-Total (mg/kg wwt)	7.15	5.01	4.77	10.1	10.2
	Iron (Fe)-Total (mg/kg)	104	85.5	72.1	140	131
	Iron (Fe)-Total (mg/kg wwt)	55.7	43.3	35.2	72.7	68.2
	Lead (Pb)-Total (mg/kg)	0.084	0.065	0.037	0.104	0.067
	Lead (Pb)-Total (mg/kg wwt)	0.0455	0.0329	0.0181	0.0540	0.0350
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	936	1000	1160	1080	844
	Magnesium (Mg)-Total (mg/kg wwt)	503	507	566	561	439
	Manganese (Mn)-Total (mg/kg)	894	1360	1040	1390	1600
	Manganese (Mn)-Total (mg/kg wwt)	481	689	508	720	831

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2341109-120 Description: Tissue Sampled Date: 27-AUG-19 Sampled Time: 09:25 Client ID: S-05 (LABRADOR TEA) 3	L2341109-121 Tissue 27-AUG-19 09:25 S-05 (BERRIES) 1	L2341109-122 Tissue 27-AUG-19 09:25 S-05 (BERRIES) 2	L2341109-123 Tissue 27-AUG-19 09:25 S-05 (BERRIES) 3	L2341109-124 Tissue 27-AUG-19 09:25 S-05 (HORSETAIL) 1
TISSUE						
Physical Tests	% Moisture (%)	48.1	84.4	85.3	83.4	58.9
Metals	Aluminum (Al)-Total (mg/kg)	79.5	16.8	18.8	44.2	63.8
	Aluminum (Al)-Total (mg/kg wwt)	41.3	2.62	2.76	7.36	26.2
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0023	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.033	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0171	<0.0040	<0.0040	<0.0040	0.0073
	Barium (Ba)-Total (mg/kg)	120	7.95	9.30	12.7	170
	Barium (Ba)-Total (mg/kg wwt)	62.3	1.24	1.36	2.10	69.8
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.015
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0061
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	8.4	6.1	7.2	6.9	13.9
	Boron (B)-Total (mg/kg wwt)	4.36	0.95	1.06	1.15	5.71
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	0.0268
	Cadmium (Cd)-Total (mg/kg wwt)	0.0023	<0.0010	<0.0010	<0.0010	0.0110
	Calcium (Ca)-Total (mg/kg)	5860	732	856	1080	22100
	Calcium (Ca)-Total (mg/kg wwt)	3040	114	126	179	9060
	Cesium (Cs)-Total (mg/kg)	0.0113	<0.0050	<0.0050	0.0050	0.435
	Cesium (Cs)-Total (mg/kg wwt)	0.0059	<0.0010	<0.0010	<0.0010	0.179
	Chromium (Cr)-Total (mg/kg)	0.121	0.067	0.057	0.089	0.053
	Chromium (Cr)-Total (mg/kg wwt)	0.063	0.010	<0.010	0.015	0.022
	Cobalt (Co)-Total (mg/kg)	0.067	<0.020	<0.020	0.022	2.82
	Cobalt (Co)-Total (mg/kg wwt)	0.0346	<0.0040	<0.0040	<0.0040	1.16
	Copper (Cu)-Total (mg/kg)	17.6	4.11	5.05	9.68	8.72
	Copper (Cu)-Total (mg/kg wwt)	9.15	0.640	0.741	1.61	3.58
	Iron (Fe)-Total (mg/kg)	147	16.4	21.1	62.4	68.2
	Iron (Fe)-Total (mg/kg wwt)	76.4	2.55	3.09	10.4	28.0
	Lead (Pb)-Total (mg/kg)	0.072	<0.020	<0.020	0.033	0.024
	Lead (Pb)-Total (mg/kg wwt)	0.0375	<0.0040	<0.0040	0.0054	0.0099
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1380	429	486	482	5140
	Magnesium (Mg)-Total (mg/kg wwt)	715	66.9	71.4	80.2	2110
	Manganese (Mn)-Total (mg/kg)	1470	223	258	314	706
	Manganese (Mn)-Total (mg/kg wwt)	762	34.8	37.9	52.2	290

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-125	L2341109-126	L2341109-130	L2341109-131	L2341109-132
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	09:25	09:25	13:35	13:35	13:35
Client ID	S-05 (HORSETAIL) 2	S-05 (HORSETAIL) 3	S-04 (LABRADOR TEA) 1	S-04 (LABRADOR TEA) 2	S-04 (LABRADOR TEA) 3
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	65.5	67.4	50.1	51.2	51.4
Metals Aluminum (Al)-Total (mg/kg)	53.7	64.1	63.6	59.5	44.6
Aluminum (Al)-Total (mg/kg wwt)	18.5	20.9	31.7	29.1	21.7
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0036	<0.0020	<0.0020
Arsenic (As)-Total (mg/kg)	<0.020	0.021	0.028	0.027	0.021
Arsenic (As)-Total (mg/kg wwt)	0.0060	0.0068	0.0137	0.0130	0.0103
Barium (Ba)-Total (mg/kg)	195	241	144	130	123
Barium (Ba)-Total (mg/kg wwt)	67.2	78.7	71.8	63.4	60.0
Beryllium (Be)-Total (mg/kg)	0.012	0.013	<0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	0.0041	0.0044	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	16.4	16.2	10.3	7.3	15.2
Boron (B)-Total (mg/kg wwt)	5.64	5.29	5.14	3.56	7.41
Cadmium (Cd)-Total (mg/kg)	0.0250	0.0264	0.0069	<0.0050	0.0085
Cadmium (Cd)-Total (mg/kg wwt)	0.0086	0.0086	0.0034	0.0015	0.0042
Calcium (Ca)-Total (mg/kg)	24000	23100	4870	4100	5080
Calcium (Ca)-Total (mg/kg wwt)	8260	7520	2430	2000	2470
Cesium (Cs)-Total (mg/kg)	0.570	0.367	0.0076	0.0073	0.0068
Cesium (Cs)-Total (mg/kg wwt)	0.197	0.120	0.0038	0.0036	0.0033
Chromium (Cr)-Total (mg/kg)	<0.050	0.080	0.145	0.108	0.116
Chromium (Cr)-Total (mg/kg wwt)	0.017	0.026	0.072	0.053	0.056
Cobalt (Co)-Total (mg/kg)	2.11	2.28	0.077	0.078	0.082
Cobalt (Co)-Total (mg/kg wwt)	0.727	0.744	0.0386	0.0382	0.0400
Copper (Cu)-Total (mg/kg)	7.01	7.33	12.6	11.5	8.75
Copper (Cu)-Total (mg/kg wwt)	2.42	2.39	6.26	5.63	4.26
Iron (Fe)-Total (mg/kg)	60.6	62.9	110	105	87.5
Iron (Fe)-Total (mg/kg wwt)	20.9	20.5	54.8	51.5	42.6
Lead (Pb)-Total (mg/kg)	0.022	0.021	0.085	0.041	0.038
Lead (Pb)-Total (mg/kg wwt)	0.0077	0.0067	0.0425	0.0202	0.0186
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	5630	5130	1070	1050	1290
Magnesium (Mg)-Total (mg/kg wwt)	1940	1670	534	515	626
Manganese (Mn)-Total (mg/kg)	589	616	560	547	687
Manganese (Mn)-Total (mg/kg wwt)	203	201	279	267	334

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-133	L2341109-134	L2341109-135	L2341109-136	L2341109-137
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	13:35	13:35	13:35	13:35	13:35
Client ID	S-04 (WILLOW) 1	S-04 (WILLOW) 2	S-04 (WILLOW) 3	S-04 (BERRIES) 1	S-04 (BERRIES) 2
Grouping **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	62.4	68.0	65.4	81.7	83.7
Metals Aluminum (Al)-Total (mg/kg)	59.4	50.7	63.9	38.6	37.8
Aluminum (Al)-Total (mg/kg wwt)	22.3	16.2	22.1	7.07	6.17
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total (mg/kg)	0.035	0.032	0.029	<0.020	<0.020
Arsenic (As)-Total (mg/kg wwt)	0.0130	0.0103	0.0101	<0.0040	<0.0040
Barium (Ba)-Total (mg/kg)	254	124	130	21.6	22.9
Barium (Ba)-Total (mg/kg wwt)	95.2	39.7	45.1	3.96	3.74
Beryllium (Be)-Total (mg/kg)	<0.010	0.012	0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0038	0.0035	<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	12.5	5.5	8.6	6.3	6.7
Boron (B)-Total (mg/kg wwt)	4.70	1.75	2.97	1.16	1.09
Cadmium (Cd)-Total (mg/kg)	0.613	0.391	0.477	<0.0050	<0.0050
Cadmium (Cd)-Total (mg/kg wwt)	0.230	0.125	0.165	<0.0010	<0.0010
Calcium (Ca)-Total (mg/kg)	22400	17300	14400	1470	1580
Calcium (Ca)-Total (mg/kg wwt)	8420	5540	4990	270	258
Cesium (Cs)-Total (mg/kg)	0.0086	0.0104	0.0065	0.0050	0.0053
Cesium (Cs)-Total (mg/kg wwt)	0.0032	0.0033	0.0022	<0.0010	<0.0010
Chromium (Cr)-Total (mg/kg)	0.169	0.143	0.091	0.069	0.081
Chromium (Cr)-Total (mg/kg wwt)	0.063	0.046	0.032	0.013	0.013
Cobalt (Co)-Total (mg/kg)	0.440	1.82	0.970	<0.020	<0.020
Cobalt (Co)-Total (mg/kg wwt)	0.165	0.584	0.336	<0.0040	<0.0040
Copper (Cu)-Total (mg/kg)	8.60	9.33	10.9	4.13	4.09
Copper (Cu)-Total (mg/kg wwt)	3.23	2.99	3.76	0.757	0.669
Iron (Fe)-Total (mg/kg)	99.0	105	121	29.8	24.5
Iron (Fe)-Total (mg/kg wwt)	37.2	33.7	41.8	5.46	4.00
Lead (Pb)-Total (mg/kg)	0.068	0.047	0.048	<0.020	<0.020
Lead (Pb)-Total (mg/kg wwt)	0.0255	0.0150	0.0167	<0.0040	<0.0040
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	2740	2430	2350	601	654
Magnesium (Mg)-Total (mg/kg wwt)	1030	776	815	110	107
Manganese (Mn)-Total (mg/kg)	97.8	222	222	289	314
Manganese (Mn)-Total (mg/kg wwt)	36.7	71.0	76.9	53.0	51.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-138	L2341109-145	L2341109-146	L2341109-147	L2341109-151
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	13:35	17:35	17:35	17:35	17:00
Client ID	S-04 (BERRIES) 3	S-03 (WILLOW) 1	S-03 (WILLOW) 2	S-03 (WILLOW) 3	S-01 (LABRADOR TEA) 1
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	83.7	64.4	62.0	63.5	45.9
Metals Aluminum (Al)-Total (mg/kg)	22.3	122	168	119	30.7
Aluminum (Al)-Total (mg/kg wwt)	3.64	43.2	63.8	43.5	16.6
Antimony (Sb)-Total (mg/kg)	<0.010	0.011	0.011	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0038	0.0043	0.0035	0.0022
Arsenic (As)-Total (mg/kg)	<0.020	0.060	0.084	0.064	0.021
Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.0213	0.0319	0.0233	0.0115
Barium (Ba)-Total (mg/kg)	17.8	89.9	97.4	91.0	133
Barium (Ba)-Total (mg/kg wwt)	2.89	32.0	37.0	33.2	72.1
Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	6.0	14.6	13.2	12.9	8.9
Boron (B)-Total (mg/kg wwt)	0.97	5.21	5.01	4.72	4.83
Cadmium (Cd)-Total (mg/kg)	<0.0050	0.752	0.554	0.562	<0.0050
Cadmium (Cd)-Total (mg/kg wwt)	<0.0010	0.268	0.210	0.205	0.0017
Calcium (Ca)-Total (mg/kg)	1120	23700	24400	24900	8110
Calcium (Ca)-Total (mg/kg wwt)	183	8420	9270	9080	4390
Cesium (Cs)-Total (mg/kg)	<0.0050	0.0117	0.0182	0.0134	0.0670
Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0042	0.0069	0.0049	0.0363
Chromium (Cr)-Total (mg/kg)	0.059	0.256	0.341	0.251	0.145
Chromium (Cr)-Total (mg/kg wwt)	<0.010	0.091	0.129	0.091	0.078
Cobalt (Co)-Total (mg/kg)	<0.020	0.221	0.191	0.175	0.033
Cobalt (Co)-Total (mg/kg wwt)	<0.0040	0.0786	0.0724	0.0640	0.0178
Copper (Cu)-Total (mg/kg)	3.16	8.62	9.55	8.04	6.07
Copper (Cu)-Total (mg/kg wwt)	0.514	3.07	3.63	2.93	3.29
Iron (Fe)-Total (mg/kg)	14.0	203	267	190	65.6
Iron (Fe)-Total (mg/kg wwt)	2.27	72.3	101	69.3	35.5
Lead (Pb)-Total (mg/kg)	<0.020	0.087	0.088	0.062	0.035
Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.0310	0.0336	0.0225	0.0187
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	528	1950	2240	2280	1560
Magnesium (Mg)-Total (mg/kg wwt)	86.0	694	851	831	846
Manganese (Mn)-Total (mg/kg)	244	55.3	69.2	60.8	832
Manganese (Mn)-Total (mg/kg wwt)	39.8	19.7	26.3	22.2	451

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-152	L2341109-153	L2341109-157	L2341109-158	L2341109-159
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	17:00	17:00	08:15	08:15	08:15
	Client ID	S-01 (LABRADOR TEA) 2	S-01 (LABRADOR TEA) 3	M-07B (LABRADOR TEA) 1	M-07B (LABRADOR TEA) 2	M-07B (LABRADOR TEA) 3
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	50.0	48.5	51.6	49.0	46.6
Metals	Aluminum (Al)-Total (mg/kg)	27.9	25.4	27.3	21.5	19.6
	Aluminum (Al)-Total (mg/kg wwt)	14.0	13.1	13.2	11.0	10.5
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0021	<0.0020	<0.0020	<0.0020	0.0025
	Arsenic (As)-Total (mg/kg)	0.020	<0.020	0.025	0.025	0.025
	Arsenic (As)-Total (mg/kg wwt)	0.0101	0.0099	0.0119	0.0128	0.0134
	Barium (Ba)-Total (mg/kg)	124	129	86.2	77.1	82.1
	Barium (Ba)-Total (mg/kg wwt)	62.2	66.4	41.7	39.4	43.8
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	6.6	8.0	10.6	14.2	15.7
	Boron (B)-Total (mg/kg wwt)	3.30	4.12	5.12	7.22	8.39
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	0.0088
	Cadmium (Cd)-Total (mg/kg wwt)	0.0015	0.0015	0.0023	0.0016	0.0047
	Calcium (Ca)-Total (mg/kg)	5790	7470	6630	8150	7360
	Calcium (Ca)-Total (mg/kg wwt)	2900	3850	3210	4160	3930
	Cesium (Cs)-Total (mg/kg)	0.0500	0.110	0.0119	0.0110	0.0082
	Cesium (Cs)-Total (mg/kg wwt)	0.0250	0.0569	0.0058	0.0056	0.0044
	Chromium (Cr)-Total (mg/kg)	0.142	0.131	0.082	0.088	0.107
	Chromium (Cr)-Total (mg/kg wwt)	0.071	0.068	0.039	0.045	0.057
	Cobalt (Co)-Total (mg/kg)	0.045	0.045	0.025	0.024	0.028
	Cobalt (Co)-Total (mg/kg wwt)	0.0225	0.0232	0.0122	0.0121	0.0152
	Copper (Cu)-Total (mg/kg)	7.00	4.98	8.03	5.62	5.11
	Copper (Cu)-Total (mg/kg wwt)	3.50	2.57	3.88	2.87	2.73
	Iron (Fe)-Total (mg/kg)	57.4	53.6	64.6	56.2	60.1
	Iron (Fe)-Total (mg/kg wwt)	28.7	27.6	31.2	28.7	32.1
	Lead (Pb)-Total (mg/kg)	0.032	0.028	0.050	0.038	0.030
	Lead (Pb)-Total (mg/kg wwt)	0.0161	0.0143	0.0240	0.0192	0.0159
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1560	1490	1160	1340	1370
	Magnesium (Mg)-Total (mg/kg wwt)	782	766	562	686	731
	Manganese (Mn)-Total (mg/kg)	716	772	269	319	439
	Manganese (Mn)-Total (mg/kg wwt)	358	398	130	163	235

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-160	L2341109-161	L2341109-162	L2341109-166	L2341109-167
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	08:15	08:15	08:15	06:50	06:50
	Client ID	M-07B (WILLOW) 1	M-07B (WILLOW) 2	M-07B (WILLOW) 3	M-26 (LABRADOR TEA) 1	M-26 (LABRADOR TEA) 2
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	57.3	58.1	55.0	49.5	48.9
Metals	Aluminum (Al)-Total (mg/kg)	54.4	23.4	16.3	13.8	13.3
	Aluminum (Al)-Total (mg/kg wwt)	23.2	9.80	7.33	6.97	6.82
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0024	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.032	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0137	0.0071	0.0065	0.0075	0.0065
	Barium (Ba)-Total (mg/kg)	59.9	38.1	33.4	133	100
	Barium (Ba)-Total (mg/kg wwt)	25.6	16.0	15.0	67.0	51.4
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	14.4	14.4	16.4	14.1	9.8
	Boron (B)-Total (mg/kg wwt)	6.16	6.03	7.37	7.12	4.99
	Cadmium (Cd)-Total (mg/kg)	0.146	0.184	0.234	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0623	0.0773	0.105	0.0014	0.0017
	Calcium (Ca)-Total (mg/kg)	20600	18500	17200	6460	5340
	Calcium (Ca)-Total (mg/kg wwt)	8790	7770	7740	3260	2730
	Cesium (Cs)-Total (mg/kg)	0.0112	0.0223	0.0206	0.0101	0.0080
	Cesium (Cs)-Total (mg/kg wwt)	0.0048	0.0094	0.0092	0.0051	0.0041
	Chromium (Cr)-Total (mg/kg)	0.132	0.079	0.058	0.182	0.066
	Chromium (Cr)-Total (mg/kg wwt)	0.056	0.033	0.026	0.092	0.034
	Cobalt (Co)-Total (mg/kg)	0.177	0.278	0.212	<0.020	<0.020
	Cobalt (Co)-Total (mg/kg wwt)	0.0756	0.117	0.0955	0.0081	0.0088
	Copper (Cu)-Total (mg/kg)	10.6	5.43	3.91	4.77	4.40
	Copper (Cu)-Total (mg/kg wwt)	4.54	2.28	1.76	2.41	2.25
	Iron (Fe)-Total (mg/kg)	122	60.6	45.6	41.2	44.3
	Iron (Fe)-Total (mg/kg wwt)	52.2	25.4	20.5	20.8	22.7
	Lead (Pb)-Total (mg/kg)	0.074	0.033	0.028	0.026	0.023
	Lead (Pb)-Total (mg/kg wwt)	0.0314	0.0140	0.0125	0.0131	0.0120
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	5060	4660	4680	1310	1410
	Magnesium (Mg)-Total (mg/kg wwt)	2160	1950	2100	663	722
	Manganese (Mn)-Total (mg/kg)	128	255	254	194	186
	Manganese (Mn)-Total (mg/kg wwt)	54.5	107	114	97.9	94.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-168 Tissue 28-AUG-19 06:50 M-26 (LABRADOR TEA) 3	L2341109-169 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 1	L2341109-170 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 2	L2341109-171 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 3	L2341109-172 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 1
TISSUE						
Physical Tests	% Moisture (%)	44.2	60.0	57.2	60.8	36.3
Metals	Aluminum (Al)-Total (mg/kg)	13.1	17.8	13.2	12.0	301
	Aluminum (Al)-Total (mg/kg wwt)	7.30	7.13	5.65	4.71	192
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.018
	Antimony (Sb)-Total (mg/kg wwt)	0.0022	0.0021	0.0029	0.0020	0.0116
	Arsenic (As)-Total (mg/kg)	<0.020	0.025	<0.020	<0.020	0.189
	Arsenic (As)-Total (mg/kg wwt)	0.0077	0.0099	0.0048	0.0050	0.120
	Barium (Ba)-Total (mg/kg)	115	56.2	30.2	41.8	27.7
	Barium (Ba)-Total (mg/kg wwt)	64.1	22.5	12.9	16.4	17.6
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0048
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0048
	Boron (B)-Total (mg/kg)	10.3	11.2	8.6	6.3	1.4
	Boron (B)-Total (mg/kg wwt)	5.76	4.46	3.68	2.46	0.91
	Cadmium (Cd)-Total (mg/kg)	0.0055	1.17	0.823	1.01	0.0593
	Cadmium (Cd)-Total (mg/kg wwt)	0.0031	0.468	0.352	0.396	0.0378
	Calcium (Ca)-Total (mg/kg)	6100	19400	11700	14500	2480
	Calcium (Ca)-Total (mg/kg wwt)	3400	7760	5020	5680	1580
	Cesium (Cs)-Total (mg/kg)	0.0091	0.0083	<0.0050	<0.0050	0.0589
	Cesium (Cs)-Total (mg/kg wwt)	0.0051	0.0033	0.0020	0.0017	0.0375
	Chromium (Cr)-Total (mg/kg)	0.118	0.065	0.069	0.064	0.440
	Chromium (Cr)-Total (mg/kg wwt)	0.066	0.026	0.029	0.025	0.280
	Cobalt (Co)-Total (mg/kg)	<0.020	0.226	0.240	0.182	0.178
	Cobalt (Co)-Total (mg/kg wwt)	0.0072	0.0905	0.103	0.0713	0.113
	Copper (Cu)-Total (mg/kg)	4.63	3.34	3.48	3.36	33.9
	Copper (Cu)-Total (mg/kg wwt)	2.58	1.34	1.49	1.31	21.6
	Iron (Fe)-Total (mg/kg)	41.1	44.4	35.7	31.4	502
	Iron (Fe)-Total (mg/kg wwt)	22.9	17.8	15.3	12.3	320
	Lead (Pb)-Total (mg/kg)	0.027	0.036	0.024	0.023	0.291
	Lead (Pb)-Total (mg/kg wwt)	0.0149	0.0144	0.0104	0.0090	0.185
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1450	5230	2950	3370	475
	Magnesium (Mg)-Total (mg/kg wwt)	810	2090	1260	1320	302
	Manganese (Mn)-Total (mg/kg)	185	161	77.1	71.9	35.6
	Manganese (Mn)-Total (mg/kg wwt)	103	64.2	33.0	28.2	22.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2341109-173 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 06:50 Client ID: M-26 (LICHEN) 2	L2341109-174 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 3	L2341109-178 Tissue 28-AUG-19 14:10 M-80 (LABRADOR TEA) 1	L2341109-179 Tissue 28-AUG-19 14:10 M-80 (LABRADOR TEA) 2	L2341109-180 Tissue 28-AUG-19 14:10 M-80 (LABRADOR TEA) 3
TISSUE						
Physical Tests	% Moisture (%)	17.1	18.3	44.3	44.5	45.5
Metals	Aluminum (Al)-Total (mg/kg)	253	291	65.4	57.9	45.1
	Aluminum (Al)-Total (mg/kg wwt)	209	237	36.4	32.1	24.6
	Antimony (Sb)-Total (mg/kg)	0.014	0.014	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0118	0.0112	0.0026	0.0022	0.0022
	Arsenic (As)-Total (mg/kg)	0.183	0.177	<0.020	0.021	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.151	0.144	0.0095	0.0116	0.0080
	Barium (Ba)-Total (mg/kg)	36.5	20.2	117	155	134
	Barium (Ba)-Total (mg/kg wwt)	30.2	16.5	65.4	85.9	73.2
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0059	0.0067	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0051	0.0053	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	2.1	<1.0	13.5	9.6	10.4
	Boron (B)-Total (mg/kg wwt)	1.76	0.66	7.52	5.33	5.70
	Cadmium (Cd)-Total (mg/kg)	0.105	0.0746	0.0111	<0.0050	0.0060
	Cadmium (Cd)-Total (mg/kg wwt)	0.0870	0.0610	0.0062	0.0019	0.0033
	Calcium (Ca)-Total (mg/kg)	4360	2270	5350	7690	6620
	Calcium (Ca)-Total (mg/kg wwt)	3610	1860	2980	4270	3610
	Cesium (Cs)-Total (mg/kg)	0.0626	0.0610	0.0163	0.0174	0.0274
	Cesium (Cs)-Total (mg/kg wwt)	0.0519	0.0498	0.0091	0.0097	0.0149
	Chromium (Cr)-Total (mg/kg)	0.394	0.462	0.114	0.092	0.143
	Chromium (Cr)-Total (mg/kg wwt)	0.326	0.377	0.063	0.051	0.078
	Cobalt (Co)-Total (mg/kg)	0.183	0.166	0.079	0.078	0.102
	Cobalt (Co)-Total (mg/kg wwt)	0.151	0.136	0.0438	0.0431	0.0557
	Copper (Cu)-Total (mg/kg)	27.4	22.0	5.72	5.58	5.38
	Copper (Cu)-Total (mg/kg wwt)	22.7	18.0	3.19	3.09	2.94
	Iron (Fe)-Total (mg/kg)	431	499	39.0	59.5	40.4
	Iron (Fe)-Total (mg/kg wwt)	357	408	21.7	33.0	22.1
	Lead (Pb)-Total (mg/kg)	0.243	0.255	0.023	0.038	0.024
	Lead (Pb)-Total (mg/kg wwt)	0.202	0.208	0.0127	0.0213	0.0130
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	0.10	0.11	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	616	449	989	1150	1200
	Magnesium (Mg)-Total (mg/kg wwt)	511	367	551	637	653
	Manganese (Mn)-Total (mg/kg)	51.9	36.4	1270	1650	866
	Manganese (Mn)-Total (mg/kg wwt)	43.1	29.7	708	916	472

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-181	L2341109-182	L2341109-183	L2341109-184	L2341109-193
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	14:10	14:10	14:10	14:10	14:40
	Client ID	M-80 (WILLOW) 1	M-80 (WILLOW) 2	M-80 (WILLOW) 3	M-80 (BERRIES) 1	C-02 (LABRADOR TEA) 1
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	59.2	58.2	61.8	80.7	46.0
Metals	Aluminum (Al)-Total (mg/kg)	38.0	21.0	37.5	29.2	25.3
	Aluminum (Al)-Total (mg/kg wwt)	15.5	8.77	14.3	5.62	13.6
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0073	0.0049	0.0068	<0.0040	0.0081
	Barium (Ba)-Total (mg/kg)	353	264	265	15.1	93.8
	Barium (Ba)-Total (mg/kg wwt)	144	110	101	2.92	50.6
	Beryllium (Be)-Total (mg/kg)	0.013	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0054	0.0021	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	18.1	17.2	28.6	9.3	15.6
	Boron (B)-Total (mg/kg wwt)	7.39	7.18	10.9	1.78	8.44
	Cadmium (Cd)-Total (mg/kg)	2.28	3.12	3.39	0.0158	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.927	1.30	1.29	0.0031	0.0012
	Calcium (Ca)-Total (mg/kg)	29800	21500	24300	1570	4300
	Calcium (Ca)-Total (mg/kg wwt)	12200	8990	9270	303	2320
	Cesium (Cs)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	0.0085	0.0237
	Cesium (Cs)-Total (mg/kg wwt)	0.0015	0.0016	0.0013	0.0016	0.0128
	Chromium (Cr)-Total (mg/kg)	0.133	0.110	0.115	0.149	0.067
	Chromium (Cr)-Total (mg/kg wwt)	0.054	0.046	0.044	0.029	0.036
	Cobalt (Co)-Total (mg/kg)	1.57	1.17	1.08	0.050	0.025
	Cobalt (Co)-Total (mg/kg wwt)	0.640	0.489	0.412	0.0096	0.0137
	Copper (Cu)-Total (mg/kg)	6.02	5.97	6.50	3.48	5.36
	Copper (Cu)-Total (mg/kg wwt)	2.45	2.50	2.48	0.670	2.89
	Iron (Fe)-Total (mg/kg)	52.3	41.6	50.7	17.9	43.2
	Iron (Fe)-Total (mg/kg wwt)	21.3	17.4	19.3	3.44	23.3
	Lead (Pb)-Total (mg/kg)	0.030	0.022	0.029	0.024	0.021
	Lead (Pb)-Total (mg/kg wwt)	0.0121	0.0092	0.0112	0.0045	0.0114
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	3900	3350	3930	559	1000
	Magnesium (Mg)-Total (mg/kg wwt)	1590	1400	1500	108	542
	Manganese (Mn)-Total (mg/kg)	162	112	244	223	1060
	Manganese (Mn)-Total (mg/kg wwt)	66.1	46.7	93.0	42.9	571

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2341109-194 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 14:40 Client ID: C-02 (LABRADOR TEA) 2	L2341109-195 Tissue 28-AUG-19 14:40 C-02 (LABRADOR TEA) 3	L2341109-196 Tissue 28-AUG-19 14:40 C-02 (WILLOW) 1	L2341109-197 Tissue 28-AUG-19 14:40 C-02 (WILLOW) 2	L2341109-198 Tissue 28-AUG-19 14:40 C-02 (WILLOW) 3
TISSUE						
Physical Tests	% Moisture (%)	41.5	40.9	60.4	60.3	63.4
Metals	Aluminum (Al)-Total (mg/kg)	18.6	17.8	21.0	21.0	16.4
	Aluminum (Al)-Total (mg/kg wwt)	10.9	10.5	8.31	8.33	5.99
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0060	0.0065	0.0062	0.0079	0.0062
	Barium (Ba)-Total (mg/kg)	73.7	76.7	186	34.8	42.4
	Barium (Ba)-Total (mg/kg wwt)	43.1	45.3	73.6	13.8	15.5
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	14.2	13.2	10.6	16.3	20.9
	Boron (B)-Total (mg/kg wwt)	8.30	7.82	4.18	6.48	7.64
	Cadmium (Cd)-Total (mg/kg)	<0.0050	0.0057	1.42	0.982	1.71
	Cadmium (Cd)-Total (mg/kg wwt)	0.0013	0.0034	0.564	0.390	0.625
	Calcium (Ca)-Total (mg/kg)	4330	4370	23400	13000	14600
	Calcium (Ca)-Total (mg/kg wwt)	2530	2590	9260	5170	5350
	Cesium (Cs)-Total (mg/kg)	0.0070	0.0074	<0.0050	0.0065	0.0107
	Cesium (Cs)-Total (mg/kg wwt)	0.0041	0.0044	0.0019	0.0026	0.0039
	Chromium (Cr)-Total (mg/kg)	0.061	0.075	0.096	0.085	0.074
	Chromium (Cr)-Total (mg/kg wwt)	0.036	0.044	0.038	0.034	0.027
	Cobalt (Co)-Total (mg/kg)	<0.020	0.026	1.45	0.422	0.200
	Cobalt (Co)-Total (mg/kg wwt)	0.0093	0.0152	0.574	0.168	0.0733
	Copper (Cu)-Total (mg/kg)	5.27	5.41	4.52	4.81	3.71
	Copper (Cu)-Total (mg/kg wwt)	3.08	3.20	1.79	1.91	1.36
	Iron (Fe)-Total (mg/kg)	40.6	39.9	48.4	55.9	44.9
	Iron (Fe)-Total (mg/kg wwt)	23.8	23.6	19.2	22.2	16.4
	Lead (Pb)-Total (mg/kg)	<0.020	0.021	0.027	0.023	0.021
	Lead (Pb)-Total (mg/kg wwt)	0.0102	0.0123	0.0107	0.0092	0.0077
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1080	1040	3700	4300	5240
	Magnesium (Mg)-Total (mg/kg wwt)	633	613	1470	1710	1920
	Manganese (Mn)-Total (mg/kg)	611	629	53.5	118	122
	Manganese (Mn)-Total (mg/kg wwt)	357	372	21.2	46.8	44.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-199 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 1	L2341109-200 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 2	L2341109-201 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 3	L2341109-202 Tissue 28-AUG-19 14:40 C-02 (BERRIES) 1	L2341109-203 Tissue 28-AUG-19 14:40 C-02 (BERRIES) 2
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
TISSUE						
Physical Tests	% Moisture (%)	19.4	19.3	14.5	85.1	84.5
Metals	Aluminum (Al)-Total (mg/kg)	643	938	1240	5.1	11.5
	Aluminum (Al)-Total (mg/kg wwt)	519	757	1060	0.76	1.78
	Antimony (Sb)-Total (mg/kg)	0.023	0.032	0.038	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0189	0.0262	0.0321	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.246	0.329	0.431	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.198	0.266	0.369	<0.0040	<0.0040
	Barium (Ba)-Total (mg/kg)	35.3	45.8	75.0	13.6	15.3
	Barium (Ba)-Total (mg/kg wwt)	28.5	37.0	64.1	2.04	2.38
	Beryllium (Be)-Total (mg/kg)	0.018	0.025	0.031	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0141	0.0205	0.0261	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	0.018	0.019	0.021	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0147	0.0153	0.0176	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	1.6	1.9	2.9	9.6	9.0
	Boron (B)-Total (mg/kg wwt)	1.32	1.53	2.48	1.44	1.40
	Cadmium (Cd)-Total (mg/kg)	0.0723	0.0944	0.128	<0.0050	0.0080
	Cadmium (Cd)-Total (mg/kg wwt)	0.0583	0.0761	0.110	<0.0010	0.0012
	Calcium (Ca)-Total (mg/kg)	2930	3570	5530	1160	1260
	Calcium (Ca)-Total (mg/kg wwt)	2360	2880	4730	173	196
	Cesium (Cs)-Total (mg/kg)	0.0529	0.0701	0.0998	0.0054	0.0080
	Cesium (Cs)-Total (mg/kg wwt)	0.0426	0.0566	0.0853	<0.0010	0.0012
	Chromium (Cr)-Total (mg/kg)	0.904	1.35	1.69	0.134	0.064
	Chromium (Cr)-Total (mg/kg wwt)	0.729	1.09	1.45	0.020	<0.010
	Cobalt (Co)-Total (mg/kg)	0.375	0.500	0.792	<0.020	<0.020
	Cobalt (Co)-Total (mg/kg wwt)	0.302	0.404	0.677	<0.0040	<0.0040
	Copper (Cu)-Total (mg/kg)	98.6	91.7	105	3.08	3.43
	Copper (Cu)-Total (mg/kg wwt)	79.5	73.9	89.7	0.460	0.533
	Iron (Fe)-Total (mg/kg)	1060	1370	1690	14.7	19.1
	Iron (Fe)-Total (mg/kg wwt)	855	1100	1440	2.19	2.97
	Lead (Pb)-Total (mg/kg)	0.373	0.446	0.577	<0.020	<0.020
	Lead (Pb)-Total (mg/kg wwt)	0.301	0.360	0.493	<0.0040	<0.0040
	Lithium (Li)-Total (mg/kg)	<0.50	0.51	0.61	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	0.27	0.41	0.52	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	752	848	1160	525	502
	Magnesium (Mg)-Total (mg/kg wwt)	607	684	993	78.4	78.0
	Manganese (Mn)-Total (mg/kg)	192	217	224	227	302
	Manganese (Mn)-Total (mg/kg wwt)	155	175	192	33.8	47.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-204 Tissue 28-AUG-19 14:40 C-02 (BERRIES) 3	L2341109-208 Tissue 28-AUG-19 15:55 C-01 (HORSETAIL) 1	L2341109-209 Tissue 28-AUG-19 15:55 C-01 (HORSETAIL) 2	L2341109-210 Tissue 28-AUG-19 15:55 C-01 (HORSETAIL) 3	L2341109-211 Tissue 28-AUG-19 15:55 C-01 (LABRADOR TEA) 1
TISSUE						
Physical Tests	% Moisture (%)	84.0	63.6	63.5	59.0	45.5
Metals	Aluminum (Al)-Total (mg/kg)	8.6	13.8	9.6	12.5	42.2
	Aluminum (Al)-Total (mg/kg wwt)	1.38	5.03	3.51	5.13	23.0
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0022
	Arsenic (As)-Total (mg/kg)	<0.020	0.021	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.0077	0.0055	0.0071	0.0087
	Barium (Ba)-Total (mg/kg)	14.2	308	250	289	111
	Barium (Ba)-Total (mg/kg wwt)	2.27	112	91.0	119	60.6
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0027	0.0022	0.0029	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	8.8	24.6	18.8	19.1	17.3
	Boron (B)-Total (mg/kg wwt)	1.40	8.95	6.87	7.83	9.40
	Cadmium (Cd)-Total (mg/kg)	0.0063	0.531	0.221	0.257	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0010	0.193	0.0804	0.105	0.0015
	Calcium (Ca)-Total (mg/kg)	1190	22900	22000	21100	5680
	Calcium (Ca)-Total (mg/kg wwt)	190	8340	8010	8650	3090
	Cesium (Cs)-Total (mg/kg)	0.0076	0.0451	0.0480	0.0591	<0.0050
	Cesium (Cs)-Total (mg/kg wwt)	0.0012	0.0164	0.0175	0.0242	0.0026
	Chromium (Cr)-Total (mg/kg)	0.090	0.117	0.070	0.173	0.125
	Chromium (Cr)-Total (mg/kg wwt)	0.014	0.043	0.026	0.071	0.068
	Cobalt (Co)-Total (mg/kg)	<0.020	0.130	0.070	0.089	0.038
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040	0.0474	0.0255	0.0366	0.0209
	Copper (Cu)-Total (mg/kg)	2.92	3.41	3.01	2.76	3.85
	Copper (Cu)-Total (mg/kg wwt)	0.466	1.24	1.10	1.13	2.10
	Iron (Fe)-Total (mg/kg)	15.7	34.0	28.1	32.3	47.4
	Iron (Fe)-Total (mg/kg wwt)	2.50	12.4	10.3	13.3	25.8
	Lead (Pb)-Total (mg/kg)	<0.020	0.020	<0.020	<0.020	0.039
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.0075	0.0068	0.0082	0.0210
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	498	3410	3160	3460	977
	Magnesium (Mg)-Total (mg/kg wwt)	79.5	1240	1150	1420	532
	Manganese (Mn)-Total (mg/kg)	312	127	134	117	1250
	Manganese (Mn)-Total (mg/kg wwt)	49.9	46.1	48.9	47.9	679

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-212 Tissue 28-AUG-19 15:55 C-01 (LABRADOR TEA) 2	L2341109-213 Tissue 28-AUG-19 15:55 C-01 (LABRADOR TEA) 3	L2341109-214 Tissue 28-AUG-19 15:55 C-01 (WILLOW) 1	L2341109-215 Tissue 28-AUG-19 15:55 C-01 (WILLOW) 2	L2341109-216 Tissue 28-AUG-19 15:55 C-01 (WILLOW) 3
TISSUE						
Physical Tests	% Moisture (%)	45.4	46.9	57.5	57.5	61.9
Metals	Aluminum (Al)-Total (mg/kg)	32.9	35.0	11.0	14.8	33.3
	Aluminum (Al)-Total (mg/kg wwt)	18.0	18.6	4.65	6.32	12.7
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0029
	Arsenic (As)-Total (mg/kg)	<0.020	0.024	<0.020	<0.020	0.024
	Arsenic (As)-Total (mg/kg wwt)	0.0087	0.0130	0.0056	0.0085	0.0092
	Barium (Ba)-Total (mg/kg)	102	66.5	115	152	53.9
	Barium (Ba)-Total (mg/kg wwt)	55.5	35.3	48.8	64.5	20.6
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0024	0.0041	0.0035
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	15.7	15.0	14.6	18.1	23.2
	Boron (B)-Total (mg/kg wwt)	8.61	7.95	6.18	7.68	8.86
	Cadmium (Cd)-Total (mg/kg)	<0.0050	0.0063	3.16	5.06	4.15
	Cadmium (Cd)-Total (mg/kg wwt)	0.0022	0.0033	1.34	2.15	1.58
	Calcium (Ca)-Total (mg/kg)	5130	4420	17700	23200	13300
	Calcium (Ca)-Total (mg/kg wwt)	2800	2350	7520	9870	5060
	Cesium (Cs)-Total (mg/kg)	<0.0050	0.0061	<0.0050	<0.0050	<0.0050
	Cesium (Cs)-Total (mg/kg wwt)	0.0019	0.0033	<0.0010	<0.0010	0.0018
	Chromium (Cr)-Total (mg/kg)	0.151	0.141	0.067	0.074	0.276
	Chromium (Cr)-Total (mg/kg wwt)	0.083	0.075	0.029	0.031	0.105
	Cobalt (Co)-Total (mg/kg)	0.032	0.028	0.636	1.10	0.562
	Cobalt (Co)-Total (mg/kg wwt)	0.0173	0.0147	0.270	0.469	0.214
	Copper (Cu)-Total (mg/kg)	4.43	4.23	2.34	3.08	4.56
	Copper (Cu)-Total (mg/kg wwt)	2.42	2.25	0.993	1.31	1.74
	Iron (Fe)-Total (mg/kg)	44.9	62.7	34.0	45.5	66.2
	Iron (Fe)-Total (mg/kg wwt)	24.6	33.3	14.4	19.4	25.2
	Lead (Pb)-Total (mg/kg)	0.033	0.059	0.023	0.032	0.049
	Lead (Pb)-Total (mg/kg wwt)	0.0178	0.0312	0.0097	0.0136	0.0188
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1210	1030	3720	4740	4040
	Magnesium (Mg)-Total (mg/kg wwt)	663	547	1580	2020	1540
	Manganese (Mn)-Total (mg/kg)	1130	832	236	368	475
	Manganese (Mn)-Total (mg/kg wwt)	615	442	100	156	181

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-220	L2341109-221	L2341109-222	L2341109-223	L2341109-224
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date					
Sampled Time					
Client ID	S-03 (CRANBERRY) 1	S-03 (CRANBERRY) 2	S-03 (CRANBERRY) 3	S-05 (WILLOW) 1	S-05 (WILLOW) 2
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	81.1	80.5	80.5	58.7	61.2
Metals Aluminum (Al)-Total (mg/kg)	14.0	32.0	17.1	63.7	117
Aluminum (Al)-Total (mg/kg wwt)	2.65	6.26	3.33	26.3	45.3
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0020	0.0031
Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	0.025	0.041
Arsenic (As)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0105	0.0161
Barium (Ba)-Total (mg/kg)	12.6	25.9	15.6	38.9	42.1
Barium (Ba)-Total (mg/kg wwt)	2.39	5.05	3.04	16.0	16.4
Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0025	0.0021
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	7.0	8.6	7.4	4.5	7.1
Boron (B)-Total (mg/kg wwt)	1.32	1.68	1.44	1.84	2.75
Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	0.635	0.245
Cadmium (Cd)-Total (mg/kg wwt)	<0.0010	<0.0010	<0.0010	0.262	0.0952
Calcium (Ca)-Total (mg/kg)	847	1600	1080	9930	7140
Calcium (Ca)-Total (mg/kg wwt)	160	312	210	4100	2770
Cesium (Cs)-Total (mg/kg)	0.0059	0.0090	0.0077	0.0143	0.0844
Cesium (Cs)-Total (mg/kg wwt)	0.0011	0.0018	0.0015	0.0059	0.0328
Chromium (Cr)-Total (mg/kg)	0.108	0.154	0.143	0.113	0.142
Chromium (Cr)-Total (mg/kg wwt)	0.020	0.030	0.028	0.046	0.055
Cobalt (Co)-Total (mg/kg)	<0.020	<0.020	<0.020	2.12	0.847
Cobalt (Co)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.873	0.329
Copper (Cu)-Total (mg/kg)	3.09	4.11	3.10	14.1	29.3
Copper (Cu)-Total (mg/kg wwt)	0.585	0.803	0.605	5.82	11.4
Iron (Fe)-Total (mg/kg)	16.8	40.5	21.5	149	241
Iron (Fe)-Total (mg/kg wwt)	3.18	7.92	4.20	61.3	93.5
Lead (Pb)-Total (mg/kg)	<0.020	0.021	<0.020	0.065	0.082
Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.0041	<0.0040	0.0270	0.0318
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	440	612	471	2270	2770
Magnesium (Mg)-Total (mg/kg wwt)	83.2	120	91.9	937	1070
Manganese (Mn)-Total (mg/kg)	203	354	239	1500	884
Manganese (Mn)-Total (mg/kg wwt)	38.4	69.1	46.6	620	343

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-225				
	Description	Tissue				
	Sampled Date					
	Sampled Time					
	Client ID	S-05 (WILLOW) 3				
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	58.1				
Metals	Aluminum (Al)-Total (mg/kg)	35.0				
	Aluminum (Al)-Total (mg/kg wwt)	14.7				
	Antimony (Sb)-Total (mg/kg)	<0.010				
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020				
	Arsenic (As)-Total (mg/kg)	<0.020				
	Arsenic (As)-Total (mg/kg wwt)	0.0055				
	Barium (Ba)-Total (mg/kg)	37.2				
	Barium (Ba)-Total (mg/kg wwt)	15.6				
	Beryllium (Be)-Total (mg/kg)	<0.010				
	Beryllium (Be)-Total (mg/kg wwt)	0.0020				
	Bismuth (Bi)-Total (mg/kg)	<0.010				
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020				
	Boron (B)-Total (mg/kg)	4.4				
	Boron (B)-Total (mg/kg wwt)	1.85				
	Cadmium (Cd)-Total (mg/kg)	0.544				
	Cadmium (Cd)-Total (mg/kg wwt)	0.228				
	Calcium (Ca)-Total (mg/kg)	9160				
	Calcium (Ca)-Total (mg/kg wwt)	3840				
	Cesium (Cs)-Total (mg/kg)	0.0077				
	Cesium (Cs)-Total (mg/kg wwt)	0.0032				
	Chromium (Cr)-Total (mg/kg)	0.085				
	Chromium (Cr)-Total (mg/kg wwt)	0.035				
	Cobalt (Co)-Total (mg/kg)	1.77				
	Cobalt (Co)-Total (mg/kg wwt)	0.740				
	Copper (Cu)-Total (mg/kg)	6.88				
	Copper (Cu)-Total (mg/kg wwt)	2.88				
	Iron (Fe)-Total (mg/kg)	89.6				
	Iron (Fe)-Total (mg/kg wwt)	37.6				
	Lead (Pb)-Total (mg/kg)	0.030				
	Lead (Pb)-Total (mg/kg wwt)	0.0124				
	Lithium (Li)-Total (mg/kg)	<0.50				
	Lithium (Li)-Total (mg/kg wwt)	<0.10				
	Magnesium (Mg)-Total (mg/kg)	2280				
	Magnesium (Mg)-Total (mg/kg wwt)	955				
	Manganese (Mn)-Total (mg/kg)	1210				
	Manganese (Mn)-Total (mg/kg wwt)	508				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-1	L2341109-2	L2341109-3	L2341109-4	L2341109-5
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	15:56	15:56	15:56	15:56	15:56
Client ID	C-01A (HORSETAIL) 1	C-01A (HORSETAIL) 2	C-01A (HORSETAIL) 3	C-01A (LABRADOR TEA) 1	C-01A (LABRADOR TEA) 2
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0059	0.0092	0.0083	0.0088	0.0059
Mercury (Hg)-Total (mg/kg wwt)	0.0019	0.0028	0.0030	0.0047	0.0030
Molybdenum (Mo)-Total (mg/kg)	0.205	0.258	0.267	0.307	0.153
Molybdenum (Mo)-Total (mg/kg wwt)	0.0643	0.0770	0.0957	0.164	0.0759
Nickel (Ni)-Total (mg/kg)	4.51	4.48	4.30	0.42	0.78
Nickel (Ni)-Total (mg/kg wwt)	1.42	1.34	1.54	0.223	0.386
Phosphorus (P)-Total (mg/kg)	954	1330	1040	1140	1410
Phosphorus (P)-Total (mg/kg wwt)	300	399	372	606	700
Potassium (K)-Total (mg/kg)	24200	30300	19800	3710	4080
Potassium (K)-Total (mg/kg wwt)	7600	9070	7100	1980	2030
Rubidium (Rb)-Total (mg/kg)	17.5	20.8	18.1	3.50	2.41
Rubidium (Rb)-Total (mg/kg wwt)	5.49	6.21	6.47	1.87	1.20
Selenium (Se)-Total (mg/kg)	0.080	0.087	0.055	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	0.025	0.026	0.020	<0.010	<0.010
Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	5.4	5.7	5.5	<4.0	<4.0
Strontium (Sr)-Total (mg/kg)	126	122	140	11.9	16.1
Strontium (Sr)-Total (mg/kg wwt)	39.6	36.6	50.1	6.35	8.00
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	<0.0020	0.0020	<0.0020	0.0030	0.0050
Thallium (Tl)-Total (mg/kg wwt)	0.00062	0.00061	0.00064	0.00159	0.00249
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00055	<0.00040	0.00068	<0.00040
Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Vanadium (V)-Total (mg/kg wwt)	<0.020	0.023	<0.020	0.041	<0.020
Zinc (Zn)-Total (mg/kg)	37.6	46.5	33.5	21.6	20.5
Zinc (Zn)-Total (mg/kg wwt)	11.8	13.9	12.0	11.5	10.2
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-6 Tissue 28-AUG-19 15:56 C-01A (LABRADOR TEA) 3	L2341109-7 Tissue 28-AUG-19 15:56 C-01A (WILLOW) 1	L2341109-8 Tissue 28-AUG-19 15:56 C-01A (WILLOW) 2	L2341109-9 Tissue 28-AUG-19 15:56 C-01A (WILLOW) 3	L2341109-13 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0055	0.0052	0.0092	0.0083	0.0082
	Mercury (Hg)-Total (mg/kg wwt)	0.0031	0.0019	0.0035	0.0037	0.0044
	Molybdenum (Mo)-Total (mg/kg)	0.443	0.504	0.547	0.495	2.18
	Molybdenum (Mo)-Total (mg/kg wwt)	0.253	0.180	0.205	0.218	1.16
	Nickel (Ni)-Total (mg/kg)	0.70	10.9	8.86	1.92	0.42
	Nickel (Ni)-Total (mg/kg wwt)	0.399	3.89	3.32	0.846	0.226
	Phosphorus (P)-Total (mg/kg)	1140	5200	6730	7230	1200
	Phosphorus (P)-Total (mg/kg wwt)	655	1860	2520	3190	642
	Potassium (K)-Total (mg/kg)	3600	9560	16100	14200	4310
	Potassium (K)-Total (mg/kg wwt)	2060	3430	6040	6260	2300
	Rubidium (Rb)-Total (mg/kg)	0.788	0.812	2.02	2.99	3.56
	Rubidium (Rb)-Total (mg/kg wwt)	0.451	0.291	0.756	1.32	1.90
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.015	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	13.8	127	98.8	123	7.19
	Strontium (Sr)-Total (mg/kg wwt)	7.90	45.5	37.0	54.1	3.83
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0042	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0048	<0.0020	<0.0020	<0.0020	0.0254
	Thallium (Tl)-Total (mg/kg wwt)	0.00277	<0.00040	<0.00040	<0.00040	0.0135
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	0.0026	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00053	<0.00040	0.00099	0.00044	0.00065
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	0.17	<0.10	0.11
	Vanadium (V)-Total (mg/kg wwt)	0.032	<0.020	0.063	0.032	0.060
	Zinc (Zn)-Total (mg/kg)	25.9	153	289	244	25.0
	Zinc (Zn)-Total (mg/kg wwt)	14.8	54.9	108	107	13.3
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-14 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 2	L2341109-15 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 3	L2341109-19 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 1	L2341109-20 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 2	L2341109-21 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0082	0.0072	0.0089	0.0066	<0.0050
	Mercury (Hg)-Total (mg/kg wwt)	0.0043	0.0038	0.0050	0.0037	<0.0020
	Molybdenum (Mo)-Total (mg/kg)	1.16	1.32	0.276	0.238	0.266
	Molybdenum (Mo)-Total (mg/kg wwt)	0.604	0.689	0.156	0.135	0.141
	Nickel (Ni)-Total (mg/kg)	0.34	0.46	0.45	0.64	0.55
	Nickel (Ni)-Total (mg/kg wwt)	0.175	0.239	0.254	0.363	0.290
	Phosphorus (P)-Total (mg/kg)	1250	1140	1270	1510	1640
	Phosphorus (P)-Total (mg/kg wwt)	652	594	718	857	867
	Potassium (K)-Total (mg/kg)	4880	3840	3470	4400	4290
	Potassium (K)-Total (mg/kg wwt)	2540	2010	1970	2500	2270
	Rubidium (Rb)-Total (mg/kg)	4.69	4.13	6.07	5.76	7.02
	Rubidium (Rb)-Total (mg/kg wwt)	2.45	2.16	3.44	3.28	3.72
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	0.015	0.014	0.014
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	4.7	<4.0	<4.0	4.2
	Strontium (Sr)-Total (mg/kg)	7.41	7.52	15.4	14.5	13.5
	Strontium (Sr)-Total (mg/kg wwt)	3.86	3.92	8.73	8.23	7.16
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0595	0.0397	0.165	0.0830	0.142
	Thallium (Tl)-Total (mg/kg wwt)	0.0310	0.0207	0.0933	0.0472	0.0751
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	0.0046	0.0053	0.0032	0.0043
	Uranium (U)-Total (mg/kg wwt)	0.00058	0.00239	0.00301	0.00182	0.00226
	Vanadium (V)-Total (mg/kg)	0.11	0.24	0.63	0.34	0.50
	Vanadium (V)-Total (mg/kg wwt)	0.058	0.126	0.354	0.196	0.266
	Zinc (Zn)-Total (mg/kg)	26.9	25.1	30.8	25.7	37.9
	Zinc (Zn)-Total (mg/kg wwt)	14.0	13.1	17.4	14.6	20.1
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	0.048

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-22	L2341109-23	L2341109-24	L2341109-25	L2341109-26
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	07:40	07:40	07:40	07:40	07:40
Client ID	S-19 (WILLOW) 1	S-19 (WILLOW) 2	S-19 (WILLOW) 3	S-19 (BERRIES) 1	S-19 (BERRIES) 2
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0090	0.0112	0.0113	0.0078	<0.0050
Mercury (Hg)-Total (mg/kg wwt)	0.0035	0.0041	0.0042	0.0014	<0.0010
Molybdenum (Mo)-Total (mg/kg)	0.276	0.179	0.195	0.524	0.324
Molybdenum (Mo)-Total (mg/kg wwt)	0.107	0.0647	0.0722	0.0918	0.0597
Nickel (Ni)-Total (mg/kg)	2.29	2.05	1.09	0.35	0.23
Nickel (Ni)-Total (mg/kg wwt)	0.887	0.740	0.405	0.062	0.042
Phosphorus (P)-Total (mg/kg)	3040	2520	5900	1300	1140
Phosphorus (P)-Total (mg/kg wwt)	1170	912	2190	228	211
Potassium (K)-Total (mg/kg)	10600	10200	10300	6200	5770
Potassium (K)-Total (mg/kg wwt)	4100	3680	3830	1090	1060
Rubidium (Rb)-Total (mg/kg)	6.53	8.67	8.88	6.80	6.50
Rubidium (Rb)-Total (mg/kg wwt)	2.53	3.13	3.29	1.19	1.20
Selenium (Se)-Total (mg/kg)	0.074	0.053	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	0.029	0.019	0.014	<0.010	<0.010
Sodium (Na)-Total (mg/kg)	<20	<20	<20	37	26
Sodium (Na)-Total (mg/kg wwt)	6.2	<4.0	<4.0	6.6	4.7
Strontium (Sr)-Total (mg/kg)	229	218	303	16.8	2.84
Strontium (Sr)-Total (mg/kg wwt)	88.6	79.0	112	2.95	0.524
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	0.0049	0.0050	0.0069	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	0.0022	<0.0020	<0.0020	<0.0020	<0.0020
Thallium (Tl)-Total (mg/kg wwt)	0.00083	0.00064	<0.00040	<0.00040	<0.00040
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	0.0075	0.0037	<0.0020	0.0025	<0.0020
Uranium (U)-Total (mg/kg wwt)	0.00292	0.00133	0.00071	0.00044	<0.00040
Vanadium (V)-Total (mg/kg)	0.77	0.36	0.29	0.28	<0.10
Vanadium (V)-Total (mg/kg wwt)	0.297	0.131	0.109	0.049	<0.020
Zinc (Zn)-Total (mg/kg)	90.3	49.8	114	16.7	8.44
Zinc (Zn)-Total (mg/kg wwt)	34.9	18.0	42.1	2.93	1.56
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	0.30	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.053	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-27	L2341109-31	L2341109-32	L2341109-33	L2341109-34
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	07:40	11:15	11:15	11:15	11:15
Client ID	S-19 (BERRIES) 3	S-18 (LABRADOR TEA) 1	S-18 (LABRADOR TEA) 2	S-18 (LABRADOR TEA) 3	S-18 (WILLOW) 1
Grouping / **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	<0.010	0.0055	<0.0050	0.0056	0.0075
Mercury (Hg)-Total (mg/kg wwt)	<0.0020	0.0030	0.0025	0.0029	0.0029
Molybdenum (Mo)-Total (mg/kg)	0.449	0.262	0.216	0.188	0.639
Molybdenum (Mo)-Total (mg/kg wwt)	0.0846	0.142	0.111	0.0985	0.244
Nickel (Ni)-Total (mg/kg)	0.47	0.30	0.29	0.35	4.56
Nickel (Ni)-Total (mg/kg wwt)	0.088	0.165	0.149	0.185	1.74
Phosphorus (P)-Total (mg/kg)	1500	1170	1230	1540	1640
Phosphorus (P)-Total (mg/kg wwt)	284	633	630	805	629
Potassium (K)-Total (mg/kg)	6480	3870	3580	4300	8930
Potassium (K)-Total (mg/kg wwt)	1220	2100	1840	2250	3420
Rubidium (Rb)-Total (mg/kg)	6.60	4.97	4.90	6.08	8.95
Rubidium (Rb)-Total (mg/kg wwt)	1.24	2.69	2.52	3.19	3.42
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	0.142
Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	0.054
Sodium (Na)-Total (mg/kg)	29	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	5.5	<4.0	<4.0	<4.0	5.0
Strontium (Sr)-Total (mg/kg)	6.79	8.58	10.2	7.55	68.2
Strontium (Sr)-Total (mg/kg wwt)	1.28	4.65	5.24	3.95	26.1
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	<0.0020	0.0073	0.0096	0.0128	0.0069
Thallium (Tl)-Total (mg/kg wwt)	<0.00040	0.00395	0.00495	0.00672	0.00263
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	0.020
Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	0.00050
Vanadium (V)-Total (mg/kg)	0.16	<0.10	<0.10	<0.10	0.11
Vanadium (V)-Total (mg/kg wwt)	0.030	0.023	0.027	<0.020	0.042
Zinc (Zn)-Total (mg/kg)	12.9	20.4	20.7	24.6	59.0
Zinc (Zn)-Total (mg/kg wwt)	2.43	11.0	10.7	12.9	22.6
Zirconium (Zr)-Total (mg/kg)	0.26	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	0.050	<0.040	<0.040	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-35 Tissue 28-AUG-19 11:15 S-18 (WILLOW) 2	L2341109-36 Tissue 28-AUG-19 11:15 S-18 (WILLOW) 3	L2341109-40 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 1	L2341109-41 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 2	L2341109-42 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0070	0.0091	0.0089	0.0060	0.0067
	Mercury (Hg)-Total (mg/kg wwt)	0.0033	0.0039	0.0038	0.0026	0.0029
	Molybdenum (Mo)-Total (mg/kg)	0.411	0.973	0.204	0.137	0.141
	Molybdenum (Mo)-Total (mg/kg wwt)	0.195	0.416	0.0888	0.0591	0.0612
	Nickel (Ni)-Total (mg/kg)	3.89	2.59	2.29	1.84	2.25
	Nickel (Ni)-Total (mg/kg wwt)	1.84	1.11	0.994	0.795	0.979
	Phosphorus (P)-Total (mg/kg)	1170	861	3240	2010	2200
	Phosphorus (P)-Total (mg/kg wwt)	554	369	1400	868	955
	Potassium (K)-Total (mg/kg)	6280	5330	6460	4450	4700
	Potassium (K)-Total (mg/kg wwt)	2970	2280	2800	1920	2040
	Rubidium (Rb)-Total (mg/kg)	7.73	3.83	1.72	0.860	1.04
	Rubidium (Rb)-Total (mg/kg wwt)	3.66	1.64	0.746	0.371	0.450
	Selenium (Se)-Total (mg/kg)	0.104	0.107	0.107	0.084	0.067
	Selenium (Se)-Total (mg/kg wwt)	0.049	0.046	0.047	0.036	0.029
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	4.7	5.4	5.2	4.6	5.8
	Strontium (Sr)-Total (mg/kg)	49.2	58.1	212	153	187
	Strontium (Sr)-Total (mg/kg wwt)	23.3	24.8	92.0	65.9	81.3
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0056	0.0043	0.0041
	Thallium (Tl)-Total (mg/kg)	0.0055	0.0093	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00261	0.00399	0.00078	0.00056	0.00047
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	0.023	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0025	0.0045	0.0049	0.0042	0.0028
	Uranium (U)-Total (mg/kg wwt)	0.00117	0.00194	0.00211	0.00180	0.00121
	Vanadium (V)-Total (mg/kg)	0.23	0.49	0.53	0.38	0.28
	Vanadium (V)-Total (mg/kg wwt)	0.110	0.209	0.231	0.166	0.121
	Zinc (Zn)-Total (mg/kg)	107	120	64.6	46.6	50.7
	Zinc (Zn)-Total (mg/kg wwt)	50.6	51.5	28.0	20.1	22.0
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-46	L2341109-47	L2341109-48	L2341109-49	L2341109-50
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	26-AUG-19	26-AUG-19	26-AUG-19	26-AUG-19	26-AUG-19
Sampled Time	15:50	15:50	15:50	15:50	15:50
Client ID	S-16 (LABRADOR TEA) 1	S-16 (LABRADOR TEA) 2	S-16 (LABRADOR TEA) 3	S-16 (WILLOW) 1	S-16 (WILLOW) 2
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0062	0.0074	0.0068	0.0052	0.0055
Mercury (Hg)-Total (mg/kg wwt)	0.0034	0.0040	0.0038	0.0024	0.0024
Molybdenum (Mo)-Total (mg/kg)	0.052	0.074	0.165	0.397	0.325
Molybdenum (Mo)-Total (mg/kg wwt)	0.0285	0.0396	0.0933	0.182	0.140
Nickel (Ni)-Total (mg/kg)	0.21	0.22	0.27	6.73	1.74
Nickel (Ni)-Total (mg/kg wwt)	0.114	0.120	0.153	3.09	0.749
Phosphorus (P)-Total (mg/kg)	978	934	907	743	815
Phosphorus (P)-Total (mg/kg wwt)	535	502	512	341	352
Potassium (K)-Total (mg/kg)	4140	4330	3020	12000	10400
Potassium (K)-Total (mg/kg wwt)	2270	2330	1710	5520	4480
Rubidium (Rb)-Total (mg/kg)	3.40	2.93	1.67	9.43	8.33
Rubidium (Rb)-Total (mg/kg wwt)	1.86	1.58	0.942	4.33	3.59
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	0.017	0.026	0.022	<0.010	<0.010
Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	<4.0	4.0	4.5	<4.0	<4.0
Strontium (Sr)-Total (mg/kg)	12.3	12.7	14.5	41.8	50.3
Strontium (Sr)-Total (mg/kg wwt)	6.72	6.82	8.21	19.2	21.7
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	0.0041	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	0.0033	<0.0020	0.0025	<0.0020	<0.0020
Thallium (Tl)-Total (mg/kg wwt)	0.00182	0.00066	0.00140	<0.00040	0.00042
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.040	<0.020
Uranium (U)-Total (mg/kg)	0.0026	0.0029	0.0048	<0.0020	0.0020
Uranium (U)-Total (mg/kg wwt)	0.00145	0.00158	0.00270	<0.00040	0.00087
Vanadium (V)-Total (mg/kg)	0.23	0.32	0.47	<0.10	0.20
Vanadium (V)-Total (mg/kg wwt)	0.124	0.172	0.264	0.036	0.085
Zinc (Zn)-Total (mg/kg)	25.4	22.6	21.8	168	182
Zinc (Zn)-Total (mg/kg wwt)	13.9	12.2	12.3	76.9	78.4
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	0.052	<0.040	<0.040

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Grouping	Analyte	L2341109-51 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 3	L2341109-55 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 1	L2341109-56 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 2	L2341109-57 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 3	L2341109-58 Tissue 28-AUG-19 11:40 S-15 (LABRADOR TEA) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0067	0.0066	<0.0050	0.0067	0.0084
	Mercury (Hg)-Total (mg/kg wwt)	0.0031	0.0017	0.0012	0.0017	0.0043
	Molybdenum (Mo)-Total (mg/kg)	0.376	0.102	0.194	0.277	0.144
	Molybdenum (Mo)-Total (mg/kg wwt)	0.175	0.0262	0.0490	0.0720	0.0742
	Nickel (Ni)-Total (mg/kg)	4.34	1.29	0.78	0.71	0.58
	Nickel (Ni)-Total (mg/kg wwt)	2.02	0.330	0.198	0.185	0.302
	Phosphorus (P)-Total (mg/kg)	757	535	457	610	1160
	Phosphorus (P)-Total (mg/kg wwt)	352	137	115	159	597
	Potassium (K)-Total (mg/kg)	11100	8960	7470	11600	3530
	Potassium (K)-Total (mg/kg wwt)	5170	2300	1880	3010	1820
	Rubidium (Rb)-Total (mg/kg)	11.3	10.4	9.07	13.6	4.38
	Rubidium (Rb)-Total (mg/kg wwt)	5.24	2.67	2.29	3.55	2.26
	Selenium (Se)-Total (mg/kg)	<0.050	0.381	0.586	0.520	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.010	0.098	0.148	0.135	0.019
	Sodium (Na)-Total (mg/kg)	<20	49	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	5.0	12.5	<4.0	<4.0	4.3
	Strontium (Sr)-Total (mg/kg)	45.1	121	128	117	10.3
	Strontium (Sr)-Total (mg/kg wwt)	20.9	31.1	32.4	30.5	5.31
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	0.0100
	Thallium (Tl)-Total (mg/kg wwt)	0.00069	<0.00040	<0.00040	<0.00040	0.00514
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0040	<0.0020	0.0020	<0.0020	0.0028
	Uranium (U)-Total (mg/kg wwt)	0.00187	<0.00040	0.00051	<0.00040	0.00146
	Vanadium (V)-Total (mg/kg)	0.38	<0.10	<0.10	<0.10	0.27
	Vanadium (V)-Total (mg/kg wwt)	0.179	0.022	0.021	<0.020	0.140
	Zinc (Zn)-Total (mg/kg)	169	21.4	21.2	20.8	25.8
	Zinc (Zn)-Total (mg/kg wwt)	78.4	5.48	5.34	5.40	13.3
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

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	Sample ID	L2341109-59	L2341109-60	L2341109-64	L2341109-65	L2341109-66
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	11:40	11:40	17:15	17:15	17:15
	Client ID	S-15 (LABRADOR TEA) 2	S-15 (LABRADOR TEA) 3	S-11 (WILLOW) 1	S-11 (WILLOW) 2	S-11 (WILLOW) 3
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0080	0.0113	0.0087	0.0101	0.0114
	Mercury (Hg)-Total (mg/kg wwt)	0.0039	0.0059	0.0033	0.0036	0.0044
	Molybdenum (Mo)-Total (mg/kg)	0.107	0.275	0.614	0.488	0.806
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0530	0.145	0.231	0.175	0.309
	Nickel (Ni)-Total (mg/kg)	0.79	0.67	3.79	4.98	5.88
	Nickel (Ni)-Total (mg/kg wwt)	0.393	0.354	1.43	1.79	2.25
	Phosphorus (P)-Total (mg/kg)	960	1060	3620	2650	3510
	Phosphorus (P)-Total (mg/kg wwt)	476	556	1360	953	1350
	Potassium (K)-Total (mg/kg)	3360	3570	8460	7350	9840
	Potassium (K)-Total (mg/kg wwt)	1660	1880	3180	2640	3770
	Rubidium (Rb)-Total (mg/kg)	4.48	3.83	4.20	2.88	2.57
	Rubidium (Rb)-Total (mg/kg wwt)	2.22	2.02	1.58	1.03	0.984
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.014	0.017	0.011	0.018	0.017
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	11.8	9.02	151	161	153
	Strontium (Sr)-Total (mg/kg wwt)	5.86	4.75	56.8	57.8	58.6
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0065	0.0043
	Thallium (Tl)-Total (mg/kg)	0.0124	0.0199	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00617	0.0105	<0.00040	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0024	0.0041	0.0021	<0.0020	0.0034
	Uranium (U)-Total (mg/kg wwt)	0.00120	0.00217	0.00080	0.00051	0.00132
	Vanadium (V)-Total (mg/kg)	0.25	0.29	0.13	0.14	0.13
	Vanadium (V)-Total (mg/kg wwt)	0.125	0.153	0.048	0.050	0.048
	Zinc (Zn)-Total (mg/kg)	21.7	22.3	68.0	76.7	42.9
	Zinc (Zn)-Total (mg/kg wwt)	10.8	11.8	25.6	27.5	16.4
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-70	L2341109-71	L2341109-72	L2341109-76	L2341109-77
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	10:20	10:20	10:20	11:00	11:00
Client ID	S-09 (WILLOW) 1	S-09 (WILLOW) 2	S-09 (WILLOW) 3	S-08 (LABRADOR TEA) 1	S-08 (LABRADOR TEA) 2
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0094	0.0108	0.0103	0.0112	0.0109
Mercury (Hg)-Total (mg/kg wwt)	0.0041	0.0040	0.0038	0.0058	0.0058
Molybdenum (Mo)-Total (mg/kg)	0.268	0.608	0.467	0.187	0.187
Molybdenum (Mo)-Total (mg/kg wwt)	0.118	0.228	0.174	0.0960	0.0987
Nickel (Ni)-Total (mg/kg)	0.37	0.38	0.68	0.44	0.53
Nickel (Ni)-Total (mg/kg wwt)	0.165	0.141	0.254	0.227	0.278
Phosphorus (P)-Total (mg/kg)	2810	3920	4870	1070	767
Phosphorus (P)-Total (mg/kg wwt)	1240	1470	1820	550	405
Potassium (K)-Total (mg/kg)	8010	9280	8830	4330	2410
Potassium (K)-Total (mg/kg wwt)	3530	3480	3290	2230	1270
Rubidium (Rb)-Total (mg/kg)	0.651	1.12	1.53	6.78	4.48
Rubidium (Rb)-Total (mg/kg wwt)	0.287	0.418	0.571	3.49	2.37
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.024	0.023
Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	6.6	6.1
Strontium (Sr)-Total (mg/kg)	185	224	307	12.2	16.3
Strontium (Sr)-Total (mg/kg wwt)	81.5	84.0	114	6.28	8.63
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	0.0052	0.0060	0.0051	<0.0040
Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0086	0.0286
Thallium (Tl)-Total (mg/kg wwt)	<0.00040	0.00042	<0.00040	0.00441	0.0151
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	<0.0020	0.0024	<0.0020	0.0086	0.0098
Uranium (U)-Total (mg/kg wwt)	0.00052	0.00090	0.00057	0.00442	0.00517
Vanadium (V)-Total (mg/kg)	0.10	0.23	0.17	1.11	1.30
Vanadium (V)-Total (mg/kg wwt)	0.045	0.088	0.063	0.570	0.688
Zinc (Zn)-Total (mg/kg)	53.5	55.3	83.3	36.5	33.2
Zinc (Zn)-Total (mg/kg wwt)	23.6	20.7	31.1	18.7	17.5
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

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	Sample ID	L2341109-78	L2341109-79	L2341109-80	L2341109-81	L2341109-82
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	11:00	11:00	11:00	11:00	11:00
	Client ID	S-08 (LABRADOR TEA) 3	S-08 (WILLOW) 1	S-08 (WILLOW) 2	S-08 (WILLOW) 3	S-08 (LICHEN) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0100	0.0082	0.0088	0.0081	0.0559
	Mercury (Hg)-Total (mg/kg wwt)	0.0053	0.0033	0.0036	0.0036	0.0335
	Molybdenum (Mo)-Total (mg/kg)	0.241	0.458	0.299	0.656	3.01
	Molybdenum (Mo)-Total (mg/kg wwt)	0.128	0.184	0.122	0.293	1.81
	Nickel (Ni)-Total (mg/kg)	0.49	1.77	1.70	4.32	1.77
	Nickel (Ni)-Total (mg/kg wwt)	0.261	0.712	0.691	1.93	1.06
	Phosphorus (P)-Total (mg/kg)	781	494	743	880	818
	Phosphorus (P)-Total (mg/kg wwt)	413	199	302	393	491
	Potassium (K)-Total (mg/kg)	2760	5030	7040	5950	2110
	Potassium (K)-Total (mg/kg wwt)	1460	2030	2870	2660	1260
	Rubidium (Rb)-Total (mg/kg)	3.89	5.38	6.00	9.15	11.9
	Rubidium (Rb)-Total (mg/kg wwt)	2.06	2.16	2.44	4.09	7.13
	Selenium (Se)-Total (mg/kg)	0.053	<0.050	0.055	0.058	1.23
	Selenium (Se)-Total (mg/kg wwt)	0.028	0.015	0.022	0.026	0.736
	Sodium (Na)-Total (mg/kg)	<20	476	<20	109	65
	Sodium (Na)-Total (mg/kg wwt)	8.4	192	7.9	48.6	39.0
	Strontium (Sr)-Total (mg/kg)	13.3	45.6	47.0	39.7	26.8
	Strontium (Sr)-Total (mg/kg wwt)	7.06	18.3	19.1	17.8	16.1
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	0.101
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	0.0607
	Thallium (Tl)-Total (mg/kg)	0.0270	0.0040	0.0061	0.0054	0.0502
	Thallium (Tl)-Total (mg/kg wwt)	0.0143	0.00159	0.00250	0.00239	0.0302
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	0.29
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	0.174
	Uranium (U)-Total (mg/kg)	0.0111	0.0065	0.0131	0.0118	0.131
	Uranium (U)-Total (mg/kg wwt)	0.00590	0.00260	0.00532	0.00527	0.0786
	Vanadium (V)-Total (mg/kg)	1.56	0.93	1.70	1.78	20.3
	Vanadium (V)-Total (mg/kg wwt)	0.828	0.375	0.690	0.793	12.2
	Zinc (Zn)-Total (mg/kg)	28.0	106	136	66.0	51.9
	Zinc (Zn)-Total (mg/kg wwt)	14.9	42.8	55.1	29.5	31.1
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.79
	Zirconium (Zr)-Total (mg/kg wwt)	0.040	<0.040	<0.040	<0.040	0.476

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Sample ID	L2341109-83	L2341109-84	L2341109-88	L2341109-89	L2341109-90
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:00	11:00	11:05	11:05	11:05
Client ID	S-08 (LICHEN) 2	S-08 (LICHEN) 3	S-08A (LABRADOR TEA) 1	S-08A (LABRADOR TEA) 2	S-08A (LABRADOR TEA) 3
Grouping / **Analyte**					
TISSUE					
Metals					
Mercury (Hg)-Total (mg/kg)	0.0575	0.0322	0.0133	0.0090	0.0084
Mercury (Hg)-Total (mg/kg wwt)	0.0466	0.0237	0.0075	0.0046	0.0046
Molybdenum (Mo)-Total (mg/kg)	2.68	1.51	0.254	0.285	0.215
Molybdenum (Mo)-Total (mg/kg wwt)	2.17	1.11	0.143	0.147	0.119
Nickel (Ni)-Total (mg/kg)	1.91	1.33	1.00	0.67	0.64
Nickel (Ni)-Total (mg/kg wwt)	1.55	0.976	0.564	0.344	0.354
Phosphorus (P)-Total (mg/kg)	834	521	856	988	876
Phosphorus (P)-Total (mg/kg wwt)	676	383	481	510	485
Potassium (K)-Total (mg/kg)	2280	1320	2740	3500	2900
Potassium (K)-Total (mg/kg wwt)	1850	975	1540	1810	1610
Rubidium (Rb)-Total (mg/kg)	13.2	7.25	5.37	6.39	5.61
Rubidium (Rb)-Total (mg/kg wwt)	10.7	5.34	3.02	3.30	3.11
Selenium (Se)-Total (mg/kg)	1.10	0.758	0.054	<0.050	0.051
Selenium (Se)-Total (mg/kg wwt)	0.891	0.558	0.030	0.017	0.028
Sodium (Na)-Total (mg/kg)	72	38	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	58.2	27.6	8.2	7.9	6.1
Strontium (Sr)-Total (mg/kg)	32.1	20.9	12.9	13.4	17.0
Strontium (Sr)-Total (mg/kg wwt)	26.0	15.4	7.26	6.93	9.43
Tellurium (Te)-Total (mg/kg)	0.101	0.076	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	0.0815	0.0557	<0.0040	<0.0040	0.0040
Thallium (Tl)-Total (mg/kg)	0.0466	0.0332	0.0522	0.0317	0.0185
Thallium (Tl)-Total (mg/kg wwt)	0.0378	0.0244	0.0293	0.0164	0.0102
Tin (Sn)-Total (mg/kg)	0.28	0.19	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	0.226	0.138	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	0.122	0.0874	0.0130	0.0074	0.0090
Uranium (U)-Total (mg/kg wwt)	0.0990	0.0644	0.00729	0.00384	0.00497
Vanadium (V)-Total (mg/kg)	19.3	14.5	1.49	0.99	1.28
Vanadium (V)-Total (mg/kg wwt)	15.6	10.7	0.838	0.508	0.709
Zinc (Zn)-Total (mg/kg)	54.2	38.8	23.9	23.6	24.8
Zinc (Zn)-Total (mg/kg wwt)	43.9	28.6	13.4	12.2	13.7
Zirconium (Zr)-Total (mg/kg)	0.76	0.66	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	0.619	0.488	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-91	L2341109-92	L2341109-93	L2341109-94	L2341109-95
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	11:05	11:05	11:05	11:05	11:05
	Client ID	S-08A (WILLOW) 1	S-08A (WILLOW) 2	S-08A (WILLOW) 3	S-08A (LICHEN) 1	S-08A (LICHEN) 2
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0085	0.0067	0.0072	0.0411	0.0421
	Mercury (Hg)-Total (mg/kg wwt)	0.0036	0.0025	0.0029	0.0278	0.0310
	Molybdenum (Mo)-Total (mg/kg)	0.447	0.609	0.492	1.92	1.93
	Molybdenum (Mo)-Total (mg/kg wwt)	0.190	0.227	0.196	1.30	1.42
	Nickel (Ni)-Total (mg/kg)	1.62	2.64	1.39	0.97	1.11
	Nickel (Ni)-Total (mg/kg wwt)	0.689	0.983	0.555	0.653	0.816
	Phosphorus (P)-Total (mg/kg)	694	1080	548	442	509
	Phosphorus (P)-Total (mg/kg wwt)	296	403	219	298	375
	Potassium (K)-Total (mg/kg)	5460	6480	4500	1410	1380
	Potassium (K)-Total (mg/kg wwt)	2330	2410	1790	952	1020
	Rubidium (Rb)-Total (mg/kg)	5.69	12.0	4.70	7.58	7.27
	Rubidium (Rb)-Total (mg/kg wwt)	2.42	4.45	1.87	5.12	5.36
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	0.632	0.750
	Selenium (Se)-Total (mg/kg wwt)	0.021	0.011	0.017	0.427	0.553
	Sodium (Na)-Total (mg/kg)	100	82	<20	38	46
	Sodium (Na)-Total (mg/kg wwt)	42.8	30.6	5.6	25.8	33.5
	Strontium (Sr)-Total (mg/kg)	44.4	50.6	49.7	17.7	17.1
	Strontium (Sr)-Total (mg/kg wwt)	18.9	18.8	19.8	12.0	12.6
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	0.043	0.065
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0293	0.0479
	Thallium (Tl)-Total (mg/kg)	0.0050	0.0036	0.0045	0.0279	0.0316
	Thallium (Tl)-Total (mg/kg wwt)	0.00214	0.00135	0.00178	0.0188	0.0233
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	0.16	0.21
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.109	0.158
	Uranium (U)-Total (mg/kg)	0.0108	0.0071	0.0092	0.0849	0.0817
	Uranium (U)-Total (mg/kg wwt)	0.00462	0.00263	0.00367	0.0573	0.0602
	Vanadium (V)-Total (mg/kg)	1.68	1.02	1.35	11.6	14.5
	Vanadium (V)-Total (mg/kg wwt)	0.715	0.379	0.539	7.80	10.7
	Zinc (Zn)-Total (mg/kg)	126	104	90.0	30.7	32.4
	Zinc (Zn)-Total (mg/kg wwt)	53.6	38.8	35.9	20.8	23.9
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	0.43	0.54
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.291	0.395

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-96	L2341109-100	L2341109-101	L2341109-102	L2341109-103
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	11:05	15:50	15:50	15:50	15:50
	Client ID	S-08A (LICHEN) 3	S-07 (LABRADOR TEA) 1	S-07 (LABRADOR TEA) 2	S-07 (LABRADOR TEA) 3	S-07 (WILLOW) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0404	0.0075	0.0088	0.0070	0.0078
	Mercury (Hg)-Total (mg/kg wwt)	0.0298	0.0043	0.0048	0.0038	0.0031
	Molybdenum (Mo)-Total (mg/kg)	1.36	0.126	0.090	0.144	0.318
	Molybdenum (Mo)-Total (mg/kg wwt)	1.00	0.0719	0.0492	0.0787	0.127
	Nickel (Ni)-Total (mg/kg)	0.95	0.31	0.33	0.52	0.86
	Nickel (Ni)-Total (mg/kg wwt)	0.704	0.179	0.180	0.285	0.342
	Phosphorus (P)-Total (mg/kg)	471	1110	1020	1050	873
	Phosphorus (P)-Total (mg/kg wwt)	348	634	561	576	349
	Potassium (K)-Total (mg/kg)	1460	4230	3900	3370	6560
	Potassium (K)-Total (mg/kg wwt)	1080	2420	2140	1840	2620
	Rubidium (Rb)-Total (mg/kg)	7.32	2.90	3.74	2.91	3.32
	Rubidium (Rb)-Total (mg/kg wwt)	5.41	1.66	2.05	1.59	1.33
	Selenium (Se)-Total (mg/kg)	0.643	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.475	0.014	0.020	0.011	0.020
	Sodium (Na)-Total (mg/kg)	35	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	26.0	4.5	4.8	4.5	5.8
	Strontium (Sr)-Total (mg/kg)	16.5	11.0	11.9	12.9	72.1
	Strontium (Sr)-Total (mg/kg wwt)	12.2	6.30	6.55	7.08	28.8
	Tellurium (Te)-Total (mg/kg)	0.054	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	0.0402	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0296	0.0064	0.0116	0.0052	0.0022
	Thallium (Tl)-Total (mg/kg wwt)	0.0219	0.00366	0.00640	0.00285	0.00087
	Tin (Sn)-Total (mg/kg)	0.16	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	0.120	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0749	0.0037	0.0056	0.0028	0.0066
	Uranium (U)-Total (mg/kg wwt)	0.0553	0.00210	0.00306	0.00151	0.00263
	Vanadium (V)-Total (mg/kg)	11.6	0.40	0.56	0.29	0.77
	Vanadium (V)-Total (mg/kg wwt)	8.55	0.229	0.306	0.161	0.309
	Zinc (Zn)-Total (mg/kg)	30.4	22.0	22.4	18.0	75.1
	Zinc (Zn)-Total (mg/kg wwt)	22.5	12.6	12.3	9.86	30.0
	Zirconium (Zr)-Total (mg/kg)	0.42	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	0.313	<0.040	<0.040	<0.040	<0.040

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Sample ID	L2341109-104	L2341109-105	L2341109-106	L2341109-107	L2341109-108
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	15:50	15:50	15:50	15:50	15:50
Client ID	S-07 (WILLOW) 2	S-07 (WILLOW) 3	S-07 (HORSETAIL) 1	S-07 (HORSETAIL) 2	S-07 (HORSETAIL) 3
Grouping / **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0115	0.0074	0.0052	<0.0050	0.0052
Mercury (Hg)-Total (mg/kg wwt)	0.0047	0.0032	0.0043	0.0030	0.0042
Molybdenum (Mo)-Total (mg/kg)	0.360	0.559	0.736	0.643	0.633
Molybdenum (Mo)-Total (mg/kg wwt)	0.147	0.242	0.608	0.404	0.510
Nickel (Ni)-Total (mg/kg)	1.07	1.07	2.30	1.89	2.53
Nickel (Ni)-Total (mg/kg wwt)	0.436	0.460	1.90	1.19	2.04
Phosphorus (P)-Total (mg/kg)	857	1020	1060	1150	997
Phosphorus (P)-Total (mg/kg wwt)	350	442	875	723	803
Potassium (K)-Total (mg/kg)	6010	7500	15300	17600	15400
Potassium (K)-Total (mg/kg wwt)	2450	3240	12700	11100	12400
Rubidium (Rb)-Total (mg/kg)	3.29	4.79	29.1	41.7	33.3
Rubidium (Rb)-Total (mg/kg wwt)	1.34	2.07	24.1	26.2	26.8
Selenium (Se)-Total (mg/kg)	0.070	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	0.029	<0.010	0.017	0.011	0.015
Sodium (Na)-Total (mg/kg)	<20	<20	28	46	56
Sodium (Na)-Total (mg/kg wwt)	6.1	6.6	23.0	28.6	45.2
Strontium (Sr)-Total (mg/kg)	49.9	66.6	109	113	124
Strontium (Sr)-Total (mg/kg wwt)	20.4	28.8	90.2	70.7	99.7
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	0.0048
Thallium (Tl)-Total (mg/kg)	0.0034	<0.0020	0.0038	0.0079	0.0046
Thallium (Tl)-Total (mg/kg wwt)	0.00140	0.00083	0.00313	0.00494	0.00374
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	0.0106	0.0028	0.0163	0.0125	0.0129
Uranium (U)-Total (mg/kg wwt)	0.00432	0.00121	0.0135	0.00784	0.0104
Vanadium (V)-Total (mg/kg)	1.28	0.32	<0.10	<0.10	<0.10
Vanadium (V)-Total (mg/kg wwt)	0.522	0.139	0.052	0.055	0.069
Zinc (Zn)-Total (mg/kg)	208	128	49.8	51.2	48.1
Zinc (Zn)-Total (mg/kg wwt)	84.9	55.2	41.1	32.2	38.8
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2341109-112	L2341109-113	L2341109-114	L2341109-118	L2341109-119
	Description:	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date:	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time:	14:55	14:55	14:55	09:25	09:25
	Client ID:	S-06 (LABRADOR TEA) 1	S-06 (LABRADOR TEA) 2	S-06 (LABRADOR TEA) 3	S-05 (LABRADOR TEA) 1	S-05 (LABRADOR TEA) 2
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0096	0.0071	0.0070	0.0071	0.0065
	Mercury (Hg)-Total (mg/kg wwt)	0.0052	0.0036	0.0034	0.0037	0.0034
	Molybdenum (Mo)-Total (mg/kg)	0.304	0.341	0.226	0.163	0.105
	Molybdenum (Mo)-Total (mg/kg wwt)	0.164	0.173	0.110	0.0846	0.0547
	Nickel (Ni)-Total (mg/kg)	0.80	0.46	0.86	0.51	0.40
	Nickel (Ni)-Total (mg/kg wwt)	0.432	0.235	0.421	0.263	0.210
	Phosphorus (P)-Total (mg/kg)	1220	951	1260	1040	911
	Phosphorus (P)-Total (mg/kg wwt)	657	481	616	539	474
	Potassium (K)-Total (mg/kg)	3470	2960	4130	2920	3020
	Potassium (K)-Total (mg/kg wwt)	1870	1500	2020	1510	1570
	Rubidium (Rb)-Total (mg/kg)	5.89	4.44	4.50	2.94	3.09
	Rubidium (Rb)-Total (mg/kg wwt)	3.17	2.25	2.20	1.52	1.61
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.012	0.011	0.016	<0.010	0.013
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	4.3
	Strontium (Sr)-Total (mg/kg)	14.4	20.5	20.8	9.04	8.83
	Strontium (Sr)-Total (mg/kg wwt)	7.75	10.4	10.2	4.68	4.59
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0491	0.0966	0.0508	0.0329	0.0186
	Thallium (Tl)-Total (mg/kg wwt)	0.0264	0.0489	0.0248	0.0170	0.00969
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0023	<0.0020	<0.0020	0.0022	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00122	0.00079	0.00053	0.00116	0.00100
	Vanadium (V)-Total (mg/kg)	0.18	0.14	0.12	0.25	0.23
	Vanadium (V)-Total (mg/kg wwt)	0.096	0.072	0.058	0.130	0.120
	Zinc (Zn)-Total (mg/kg)	20.6	28.8	27.8	18.7	20.2
	Zinc (Zn)-Total (mg/kg wwt)	11.1	14.6	13.6	9.70	10.5
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-120	L2341109-121	L2341109-122	L2341109-123	L2341109-124
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	09:25	09:25	09:25	09:25	09:25
	Client ID	S-05 (LABRADOR TEA) 3	S-05 (BERRIES) 1	S-05 (BERRIES) 2	S-05 (BERRIES) 3	S-05 (HORSETAIL) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0068	<0.0050	<0.0050	<0.0050	0.0057
	Mercury (Hg)-Total (mg/kg wwt)	0.0035	<0.0010	<0.0010	<0.0010	0.0023
	Molybdenum (Mo)-Total (mg/kg)	0.171	0.076	0.067	0.081	0.508
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0890	0.0118	0.0099	0.0134	0.209
	Nickel (Ni)-Total (mg/kg)	0.57	<0.20	0.24	0.26	3.91
	Nickel (Ni)-Total (mg/kg wwt)	0.296	<0.040	<0.040	0.043	1.61
	Phosphorus (P)-Total (mg/kg)	916	747	856	793	976
	Phosphorus (P)-Total (mg/kg wwt)	476	117	126	132	401
	Potassium (K)-Total (mg/kg)	2930	5680	6040	5350	9860
	Potassium (K)-Total (mg/kg wwt)	1520	885	886	890	4050
	Rubidium (Rb)-Total (mg/kg)	3.96	3.22	3.48	3.34	40.4
	Rubidium (Rb)-Total (mg/kg wwt)	2.06	0.502	0.511	0.556	16.6
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.012	<0.010	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	23	22	22	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	4.3
	Strontium (Sr)-Total (mg/kg)	10.9	1.02	1.29	1.81	141
	Strontium (Sr)-Total (mg/kg wwt)	5.65	0.158	0.189	0.301	58.0
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0161	<0.0020	<0.0020	<0.0020	0.0145
	Thallium (Tl)-Total (mg/kg wwt)	0.00838	<0.00040	<0.00040	<0.00040	0.00597
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0024	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00123	<0.00040	<0.00040	<0.00040	0.00046
	Vanadium (V)-Total (mg/kg)	0.28	<0.10	<0.10	0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.144	<0.020	<0.020	<0.020	0.033
	Zinc (Zn)-Total (mg/kg)	23.8	5.45	6.40	6.83	44.1
	Zinc (Zn)-Total (mg/kg wwt)	12.4	0.85	0.94	1.14	18.1
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-125	L2341109-126	L2341109-130	L2341109-131	L2341109-132
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	09:25	09:25	13:35	13:35	13:35
Client ID	S-05 (HORSETAIL) 2	S-05 (HORSETAIL) 3	S-04 (LABRADOR TEA) 1	S-04 (LABRADOR TEA) 2	S-04 (LABRADOR TEA) 3
Grouping / Analyte					
TISSUE					
Metals					
Mercury (Hg)-Total (mg/kg)	0.0056	<0.0050	0.0064	0.0057	0.0085
Mercury (Hg)-Total (mg/kg wwt)	0.0019	0.0016	0.0032	0.0028	0.0042
Molybdenum (Mo)-Total (mg/kg)	0.574	0.535	0.516	0.213	0.095
Molybdenum (Mo)-Total (mg/kg wwt)	0.198	0.174	0.257	0.104	0.0464
Nickel (Ni)-Total (mg/kg)	3.43	3.68	0.92	1.21	0.54
Nickel (Ni)-Total (mg/kg wwt)	1.18	1.20	0.457	0.589	0.262
Phosphorus (P)-Total (mg/kg)	980	953	1270	1250	1410
Phosphorus (P)-Total (mg/kg wwt)	338	311	635	611	684
Potassium (K)-Total (mg/kg)	8630	10100	4080	4880	4980
Potassium (K)-Total (mg/kg wwt)	2980	3280	2030	2380	2420
Rubidium (Rb)-Total (mg/kg)	41.6	34.2	4.22	6.38	3.39
Rubidium (Rb)-Total (mg/kg wwt)	14.3	11.1	2.10	3.12	1.65
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	4.0	4.1	<4.0	<4.0	<4.0
Strontium (Sr)-Total (mg/kg)	151	145	17.2	15.3	15.3
Strontium (Sr)-Total (mg/kg wwt)	52.2	47.4	8.57	7.46	7.45
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	0.0176	0.0150	0.0170	0.0329	0.0081
Thallium (Tl)-Total (mg/kg wwt)	0.00608	0.00490	0.00848	0.0161	0.00394
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	0.0024	<0.0020	<0.0020
Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00041	0.00119	0.00073	0.00077
Vanadium (V)-Total (mg/kg)	<0.10	<0.10	0.19	0.17	0.14
Vanadium (V)-Total (mg/kg wwt)	0.027	0.029	0.094	0.081	0.068
Zinc (Zn)-Total (mg/kg)	46.2	37.9	22.2	14.6	23.0
Zinc (Zn)-Total (mg/kg wwt)	15.9	12.4	11.1	7.11	11.2
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-133 Tissue 27-AUG-19 13:35 S-04 (WILLOW) 1	L2341109-134 Tissue 27-AUG-19 13:35 S-04 (WILLOW) 2	L2341109-135 Tissue 27-AUG-19 13:35 S-04 (WILLOW) 3	L2341109-136 Tissue 27-AUG-19 13:35 S-04 (BERRIES) 1	L2341109-137 Tissue 27-AUG-19 13:35 S-04 (BERRIES) 2
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0081	0.0106	0.0096	<0.0050	<0.0050
	Mercury (Hg)-Total (mg/kg wwt)	0.0031	0.0034	0.0033	<0.0010	<0.0010
	Molybdenum (Mo)-Total (mg/kg)	0.434	0.315	0.366	0.398	0.423
	Molybdenum (Mo)-Total (mg/kg wwt)	0.163	0.101	0.127	0.0730	0.0691
	Nickel (Ni)-Total (mg/kg)	0.41	1.51	0.81	0.37	0.40
	Nickel (Ni)-Total (mg/kg wwt)	0.155	0.484	0.280	0.068	0.066
	Phosphorus (P)-Total (mg/kg)	4950	4840	4200	940	1010
	Phosphorus (P)-Total (mg/kg wwt)	1860	1550	1450	172	166
	Potassium (K)-Total (mg/kg)	8110	12800	9820	5170	5780
	Potassium (K)-Total (mg/kg wwt)	3040	4090	3400	947	944
	Rubidium (Rb)-Total (mg/kg)	5.24	8.95	4.80	4.90	5.32
	Rubidium (Rb)-Total (mg/kg wwt)	1.97	2.86	1.66	0.897	0.869
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	27	24
	Sodium (Na)-Total (mg/kg wwt)	4.4	4.2	<4.0	4.9	<4.0
	Strontium (Sr)-Total (mg/kg)	197	162	146	4.91	5.13
	Strontium (Sr)-Total (mg/kg wwt)	74.0	52.0	50.4	0.900	0.838
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00068	<0.00040	<0.00040	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00074	0.00048	0.00068	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	0.19	0.14	0.19	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.071	0.044	0.065	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	120	49.4	61.2	8.55	9.18
	Zinc (Zn)-Total (mg/kg wwt)	45.2	15.8	21.2	1.57	1.50
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-138 Tissue 27-AUG-19 13:35 S-04 (BERRIES) 3	L2341109-145 Tissue 28-AUG-19 17:35 S-03 (WILLOW) 1	L2341109-146 Tissue 28-AUG-19 17:35 S-03 (WILLOW) 2	L2341109-147 Tissue 28-AUG-19 17:35 S-03 (WILLOW) 3	L2341109-151 Tissue 28-AUG-19 17:00 S-01 (LABRADOR TEA) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	<0.0050	0.0094	0.0097	0.0115	0.0085
	Mercury (Hg)-Total (mg/kg wwt)	<0.0010	0.0034	0.0037	0.0042	0.0046
	Molybdenum (Mo)-Total (mg/kg)	0.487	0.238	0.225	0.205	0.198
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0793	0.0846	0.0853	0.0746	0.107
	Nickel (Ni)-Total (mg/kg)	0.39	2.80	1.76	1.89	1.91
	Nickel (Ni)-Total (mg/kg wwt)	0.064	0.997	0.668	0.689	1.04
	Phosphorus (P)-Total (mg/kg)	1000	2280	2150	2300	1090
	Phosphorus (P)-Total (mg/kg wwt)	163	809	817	838	589
	Potassium (K)-Total (mg/kg)	5910	6860	7040	6700	3590
	Potassium (K)-Total (mg/kg wwt)	962	2440	2670	2450	1940
	Rubidium (Rb)-Total (mg/kg)	4.98	1.88	2.17	1.84	7.22
	Rubidium (Rb)-Total (mg/kg wwt)	0.810	0.670	0.824	0.670	3.91
	Selenium (Se)-Total (mg/kg)	<0.050	0.152	0.142	0.145	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.054	0.054	0.053	0.020
	Sodium (Na)-Total (mg/kg)	<20	22	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	7.9	6.2	6.4	<4.0
	Strontium (Sr)-Total (mg/kg)	3.91	83.0	84.0	81.1	16.2
	Strontium (Sr)-Total (mg/kg wwt)	0.636	29.5	31.9	29.6	8.76
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	0.0027
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	0.00047	0.00062	0.00042	0.00144
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	0.0045	0.0057	0.0041	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00161	0.00217	0.00150	0.00066
	Vanadium (V)-Total (mg/kg)	<0.10	0.43	0.62	0.41	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.153	0.235	0.150	0.054
	Zinc (Zn)-Total (mg/kg)	7.61	34.7	30.0	30.8	21.8
	Zinc (Zn)-Total (mg/kg wwt)	1.24	12.4	11.4	11.2	11.8
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2341109-152 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 17:00 Client ID: S-01 (LABRADOR TEA) 2	L2341109-153 Tissue 28-AUG-19 17:00 S-01 (LABRADOR TEA) 3	L2341109-157 Tissue 28-AUG-19 08:15 M-07B (LABRADOR TEA) 1	L2341109-158 Tissue 28-AUG-19 08:15 M-07B (LABRADOR TEA) 2	L2341109-159 Tissue 28-AUG-19 08:15 M-07B (LABRADOR TEA) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0059	0.0081	0.0082	0.0086	0.0073
	Mercury (Hg)-Total (mg/kg wwt)	0.0030	0.0042	0.0040	0.0044	0.0039
	Molybdenum (Mo)-Total (mg/kg)	0.262	0.150	0.040	0.075	0.076
	Molybdenum (Mo)-Total (mg/kg wwt)	0.131	0.0772	0.0193	0.0383	0.0404
	Nickel (Ni)-Total (mg/kg)	1.94	1.95	0.26	0.38	0.37
	Nickel (Ni)-Total (mg/kg wwt)	0.969	1.01	0.127	0.195	0.198
	Phosphorus (P)-Total (mg/kg)	1220	1130	847	785	1030
	Phosphorus (P)-Total (mg/kg wwt)	609	584	410	401	550
	Potassium (K)-Total (mg/kg)	3860	3200	3240	2480	3710
	Potassium (K)-Total (mg/kg wwt)	1930	1650	1570	1270	1980
	Rubidium (Rb)-Total (mg/kg)	6.24	7.60	4.02	4.42	4.04
	Rubidium (Rb)-Total (mg/kg wwt)	3.12	3.91	1.94	2.26	2.16
	Selenium (Se)-Total (mg/kg)	0.051	0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.026	0.026	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	12.5	15.5	20.2	25.6	22.5
	Strontium (Sr)-Total (mg/kg wwt)	6.26	7.98	9.77	13.1	12.0
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0084	<0.0020	0.0091	<0.0020	0.0099
	Thallium (Tl)-Total (mg/kg wwt)	0.00418	0.00098	0.00440	0.00043	0.00530
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00054	0.00057	0.00063	0.00051	0.00056
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	0.11	0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.039	0.036	0.054	0.052	0.042
	Zinc (Zn)-Total (mg/kg)	21.2	16.5	23.4	25.3	27.0
	Zinc (Zn)-Total (mg/kg wwt)	10.6	8.52	11.3	12.9	14.4
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-160	L2341109-161	L2341109-162	L2341109-166	L2341109-167
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	08:15	08:15	08:15	06:50	06:50
	Client ID	M-07B (WILLOW) 1	M-07B (WILLOW) 2	M-07B (WILLOW) 3	M-26 (LABRADOR TEA) 1	M-26 (LABRADOR TEA) 2
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0087	0.0067	0.0059	0.0079	0.0080
	Mercury (Hg)-Total (mg/kg wwt)	0.0037	0.0028	0.0027	0.0040	0.0041
	Molybdenum (Mo)-Total (mg/kg)	0.386	0.219	0.167	0.217	0.282
	Molybdenum (Mo)-Total (mg/kg wwt)	0.165	0.0918	0.0751	0.110	0.144
	Nickel (Ni)-Total (mg/kg)	0.86	0.99	1.20	0.30	0.27
	Nickel (Ni)-Total (mg/kg wwt)	0.370	0.417	0.540	0.151	0.138
	Phosphorus (P)-Total (mg/kg)	837	567	724	1210	1340
	Phosphorus (P)-Total (mg/kg wwt)	358	238	326	612	686
	Potassium (K)-Total (mg/kg)	8400	6620	7150	3780	3770
	Potassium (K)-Total (mg/kg wwt)	3590	2780	3210	1910	1930
	Rubidium (Rb)-Total (mg/kg)	4.80	2.54	2.68	2.15	3.18
	Rubidium (Rb)-Total (mg/kg wwt)	2.05	1.06	1.21	1.08	1.63
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	22	22	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	9.5	9.3	4.7	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	115	99.4	90.2	26.2	23.1
	Strontium (Sr)-Total (mg/kg wwt)	49.1	41.7	40.6	13.2	11.8
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0030	0.0032
	Thallium (Tl)-Total (mg/kg wwt)	0.00048	<0.00040	<0.00040	0.00151	0.00163
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0023	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00099	0.00042	<0.00040	<0.00040	0.00049
	Vanadium (V)-Total (mg/kg)	0.19	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.080	0.032	0.023	0.028	0.028
	Zinc (Zn)-Total (mg/kg)	186	197	200	22.5	17.3
	Zinc (Zn)-Total (mg/kg wwt)	79.3	82.6	90.0	11.4	8.87
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2341109-168 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 06:50 Client ID: M-26 (LABRADOR TEA) 3	L2341109-169 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 1	L2341109-170 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 2	L2341109-171 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 3	L2341109-172 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0087	0.0098	0.0051	0.0053	0.0462
	Mercury (Hg)-Total (mg/kg wwt)	0.0049	0.0039	0.0022	0.0021	0.0294
	Molybdenum (Mo)-Total (mg/kg)	0.230	0.782	0.241	0.209	0.236
	Molybdenum (Mo)-Total (mg/kg wwt)	0.128	0.313	0.103	0.0819	0.150
	Nickel (Ni)-Total (mg/kg)	0.36	3.62	4.83	6.96	0.60
	Nickel (Ni)-Total (mg/kg wwt)	0.203	1.45	2.07	2.73	0.384
	Phosphorus (P)-Total (mg/kg)	1310	1680	3680	2790	484
	Phosphorus (P)-Total (mg/kg wwt)	732	670	1580	1100	308
	Potassium (K)-Total (mg/kg)	3650	10500	13600	9980	961
	Potassium (K)-Total (mg/kg wwt)	2040	4210	5810	3910	612
	Rubidium (Rb)-Total (mg/kg)	3.36	4.60	5.67	3.92	1.38
	Rubidium (Rb)-Total (mg/kg wwt)	1.88	1.84	2.43	1.54	0.881
	Selenium (Se)-Total (mg/kg)	<0.050	0.087	0.130	0.211	0.066
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.035	0.055	0.083	0.042
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	4.4	<4.0	<4.0	<4.0	11.7
	Strontium (Sr)-Total (mg/kg)	28.0	131	81.4	94.9	14.2
	Strontium (Sr)-Total (mg/kg wwt)	15.6	52.5	34.9	37.2	9.02
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0025	<0.0020	<0.0020	<0.0020	0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00138	<0.00040	<0.00040	<0.00040	0.00252
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.022	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	0.0180
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	0.0115
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	1.01
	Vanadium (V)-Total (mg/kg wwt)	0.028	0.023	<0.020	<0.020	0.645
	Zinc (Zn)-Total (mg/kg)	20.7	24.3	32.6	34.9	13.0
	Zinc (Zn)-Total (mg/kg wwt)	11.6	9.72	13.9	13.7	8.30
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	0.102

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2341109-173 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 06:50 Client ID: M-26 (LICHEN) 2	L2341109-174 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 3	L2341109-178 Tissue 28-AUG-19 14:10 M-80 (LABRADOR TEA) 1	L2341109-179 Tissue 28-AUG-19 14:10 M-80 (LABRADOR TEA) 2	L2341109-180 Tissue 28-AUG-19 14:10 M-80 (LABRADOR TEA) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0576	0.0372	<0.0050	0.0072	0.0052
	Mercury (Hg)-Total (mg/kg wwt)	0.0477	0.0304	0.0025	0.0040	0.0028
	Molybdenum (Mo)-Total (mg/kg)	0.227	0.208	0.392	0.535	0.172
	Molybdenum (Mo)-Total (mg/kg wwt)	0.188	0.170	0.218	0.297	0.0937
	Nickel (Ni)-Total (mg/kg)	0.79	0.58	1.22	0.77	0.82
	Nickel (Ni)-Total (mg/kg wwt)	0.652	0.477	0.682	0.429	0.446
	Phosphorus (P)-Total (mg/kg)	622	580	1410	1180	1360
	Phosphorus (P)-Total (mg/kg wwt)	516	474	787	657	743
	Potassium (K)-Total (mg/kg)	1170	1220	4170	3250	3620
	Potassium (K)-Total (mg/kg wwt)	971	999	2320	1800	1980
	Rubidium (Rb)-Total (mg/kg)	1.65	1.71	7.53	5.66	6.40
	Rubidium (Rb)-Total (mg/kg wwt)	1.37	1.40	4.19	3.14	3.49
	Selenium (Se)-Total (mg/kg)	0.065	0.058	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.054	0.047	0.025	0.017	0.023
	Sodium (Na)-Total (mg/kg)	<20	30	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	12.4	24.6	<4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	26.8	13.7	14.1	18.5	19.3
	Strontium (Sr)-Total (mg/kg wwt)	22.2	11.2	7.88	10.3	10.5
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0033	0.0028	0.198	0.0713	0.137
	Thallium (Tl)-Total (mg/kg wwt)	0.00270	0.00226	0.110	0.0395	0.0748
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0107	0.0169	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00891	0.0138	<0.00040	0.00063	<0.00040
	Vanadium (V)-Total (mg/kg)	0.90	1.40	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.745	1.14	0.022	0.042	0.022
	Zinc (Zn)-Total (mg/kg)	22.3	11.0	21.0	24.4	26.2
	Zinc (Zn)-Total (mg/kg wwt)	18.5	8.96	11.7	13.5	14.3
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	0.124	0.155	<0.040	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-181	L2341109-182	L2341109-183	L2341109-184	L2341109-193
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	14:10	14:10	14:10	14:10	14:40
	Client ID	M-80 (WILLOW) 1	M-80 (WILLOW) 2	M-80 (WILLOW) 3	M-80 (BERRIES) 1	C-02 (LABRADOR TEA) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0104	0.0106	0.0098	<0.0050	0.0055
	Mercury (Hg)-Total (mg/kg wwt)	0.0042	0.0044	0.0037	<0.0010	0.0030
	Molybdenum (Mo)-Total (mg/kg)	0.326	0.184	0.255	0.348	0.288
	Molybdenum (Mo)-Total (mg/kg wwt)	0.133	0.0768	0.0975	0.0671	0.155
	Nickel (Ni)-Total (mg/kg)	3.43	2.70	2.73	0.53	0.56
	Nickel (Ni)-Total (mg/kg wwt)	1.40	1.13	1.04	0.102	0.305
	Phosphorus (P)-Total (mg/kg)	3590	4180	4800	1240	1130
	Phosphorus (P)-Total (mg/kg wwt)	1460	1750	1830	238	611
	Potassium (K)-Total (mg/kg)	7350	7190	8010	6480	3800
	Potassium (K)-Total (mg/kg wwt)	3000	3010	3050	1250	2050
	Rubidium (Rb)-Total (mg/kg)	1.79	2.16	1.81	4.34	2.30
	Rubidium (Rb)-Total (mg/kg wwt)	0.731	0.904	0.692	0.836	1.24
	Selenium (Se)-Total (mg/kg)	0.090	0.068	0.071	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.037	0.028	0.027	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	58	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	4.8	5.4	11.1	<4.0
	Strontium (Sr)-Total (mg/kg)	234	174	183	5.03	9.08
	Strontium (Sr)-Total (mg/kg wwt)	95.5	72.6	69.8	0.968	4.91
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	0.0051	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	0.0305
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	0.0165
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.025	<0.020	0.024	<0.020	0.029
	Zinc (Zn)-Total (mg/kg)	99.7	60.7	68.7	8.24	19.0
	Zinc (Zn)-Total (mg/kg wwt)	40.6	25.4	26.2	1.59	10.2
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-194	L2341109-195	L2341109-196	L2341109-197	L2341109-198
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	14:40	14:40	14:40	14:40	14:40
	Client ID	C-02 (LABRADOR TEA) 2	C-02 (LABRADOR TEA) 3	C-02 (WILLOW) 1	C-02 (WILLOW) 2	C-02 (WILLOW) 3
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0059	0.0060	0.0087	0.0060	0.0062
	Mercury (Hg)-Total (mg/kg wwt)	0.0034	0.0036	0.0034	0.0024	0.0023
	Molybdenum (Mo)-Total (mg/kg)	0.290	0.224	0.280	0.348	1.24
	Molybdenum (Mo)-Total (mg/kg wwt)	0.170	0.133	0.111	0.138	0.454
	Nickel (Ni)-Total (mg/kg)	0.47	0.79	1.91	1.22	2.06
	Nickel (Ni)-Total (mg/kg wwt)	0.276	0.465	0.758	0.486	0.755
	Phosphorus (P)-Total (mg/kg)	1110	999	2160	1970	1150
	Phosphorus (P)-Total (mg/kg wwt)	651	591	854	784	421
	Potassium (K)-Total (mg/kg)	4050	4090	6580	10600	8580
	Potassium (K)-Total (mg/kg wwt)	2370	2420	2610	4200	3140
	Rubidium (Rb)-Total (mg/kg)	2.85	3.04	2.09	3.03	2.60
	Rubidium (Rb)-Total (mg/kg wwt)	1.67	1.79	0.829	1.20	0.951
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	0.018	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	4.3	6.3	4.1	4.6
	Strontium (Sr)-Total (mg/kg)	8.94	9.50	182	58.2	65.7
	Strontium (Sr)-Total (mg/kg wwt)	5.23	5.62	72.3	23.1	24.0
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0183	0.0186	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.0107	0.0110	<0.00040	0.00041	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00042	0.00045	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.028	0.029	0.025	0.025	<0.020
	Zinc (Zn)-Total (mg/kg)	20.8	21.7	32.1	73.5	94.0
	Zinc (Zn)-Total (mg/kg wwt)	12.2	12.9	12.7	29.2	34.4
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-199 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 1	L2341109-200 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 2	L2341109-201 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 3	L2341109-202 Tissue 28-AUG-19 14:40 C-02 (BERRIES) 1	L2341109-203 Tissue 28-AUG-19 14:40 C-02 (BERRIES) 2
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0418	0.0342	0.0521	<0.0050	<0.0050
	Mercury (Hg)-Total (mg/kg wwt)	0.0337	0.0276	0.0446	<0.0010	<0.0010
	Molybdenum (Mo)-Total (mg/kg)	0.166	0.218	0.359	0.526	0.339
	Molybdenum (Mo)-Total (mg/kg wwt)	0.134	0.176	0.307	0.0786	0.0526
	Nickel (Ni)-Total (mg/kg)	0.92	1.32	1.81	0.26	0.36
	Nickel (Ni)-Total (mg/kg wwt)	0.739	1.07	1.55	<0.040	0.057
	Phosphorus (P)-Total (mg/kg)	694	783	972	1030	946
	Phosphorus (P)-Total (mg/kg wwt)	559	632	831	154	147
	Potassium (K)-Total (mg/kg)	1930	2100	2170	5700	5800
	Potassium (K)-Total (mg/kg wwt)	1550	1700	1850	851	901
	Rubidium (Rb)-Total (mg/kg)	2.02	2.37	3.57	2.61	2.66
	Rubidium (Rb)-Total (mg/kg wwt)	1.63	1.91	3.05	0.390	0.414
	Selenium (Se)-Total (mg/kg)	0.127	0.126	0.154	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.103	0.102	0.132	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	22	24	30	30	23
	Sodium (Na)-Total (mg/kg wwt)	18.0	19.1	25.4	4.4	<4.0
	Strontium (Sr)-Total (mg/kg)	11.1	13.3	27.2	3.09	3.64
	Strontium (Sr)-Total (mg/kg wwt)	8.92	10.7	23.3	0.461	0.566
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	0.0057	0.0067	0.0068	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0070	0.0093	0.0105	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00562	0.00751	0.00900	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	0.025	0.030	0.037	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0248	0.0376	0.0474	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.0200	0.0303	0.0405	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	2.07	2.79	3.73	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	1.67	2.25	3.19	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	18.5	19.8	25.9	7.82	7.57
	Zinc (Zn)-Total (mg/kg wwt)	14.9	15.9	22.2	1.17	1.18
	Zirconium (Zr)-Total (mg/kg)	0.24	0.40	0.43	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	0.191	0.324	0.369	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-204 Tissue 28-AUG-19 14:40 C-02 (BERRIES) 3	L2341109-208 Tissue 28-AUG-19 15:55 C-01 (HORSETAIL) 1	L2341109-209 Tissue 28-AUG-19 15:55 C-01 (HORSETAIL) 2	L2341109-210 Tissue 28-AUG-19 15:55 C-01 (HORSETAIL) 3	L2341109-211 Tissue 28-AUG-19 15:55 C-01 (LABRADOR TEA) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	<0.0050	0.0064	0.0057	<0.0050	0.0091
	Mercury (Hg)-Total (mg/kg wwt)	<0.0010	0.0023	0.0021	0.0020	0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.333	0.285	0.315	0.294	0.545
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0533	0.104	0.115	0.120	0.297
	Nickel (Ni)-Total (mg/kg)	<0.20	4.66	3.23	2.95	0.77
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	1.70	1.18	1.21	0.417
	Phosphorus (P)-Total (mg/kg)	951	1270	1300	1160	1260
	Phosphorus (P)-Total (mg/kg wwt)	152	463	474	476	687
	Potassium (K)-Total (mg/kg)	6010	17900	21800	22200	4170
	Potassium (K)-Total (mg/kg wwt)	961	6500	7950	9120	2270
	Rubidium (Rb)-Total (mg/kg)	2.85	10.2	12.3	15.5	0.873
	Rubidium (Rb)-Total (mg/kg wwt)	0.456	3.72	4.49	6.34	0.475
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.016	0.014	0.015	<0.010
	Sodium (Na)-Total (mg/kg)	29	37	29	27	<20
	Sodium (Na)-Total (mg/kg wwt)	4.7	13.4	10.6	10.9	<4.0
	Strontium (Sr)-Total (mg/kg)	2.91	119	107	110	12.6
	Strontium (Sr)-Total (mg/kg wwt)	0.465	43.2	39.2	45.2	6.84
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	0.0087
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00050	0.00472
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00046	0.00052
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	0.034
	Zinc (Zn)-Total (mg/kg)	7.34	35.7	37.7	35.5	24.7
	Zinc (Zn)-Total (mg/kg wwt)	1.17	13.0	13.7	14.6	13.5
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-212	L2341109-213	L2341109-214	L2341109-215	L2341109-216
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	15:55	15:55	15:55	15:55	15:55
	Client ID	C-01 (LABRADOR TEA) 2	C-01 (LABRADOR TEA) 3	C-01 (WILLOW) 1	C-01 (WILLOW) 2	C-01 (WILLOW) 3
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0078	0.0118	0.0056	0.0068	0.0069
	Mercury (Hg)-Total (mg/kg wwt)	0.0043	0.0062	0.0024	0.0029	0.0026
	Molybdenum (Mo)-Total (mg/kg)	0.317	0.188	0.453	0.554	0.575
	Molybdenum (Mo)-Total (mg/kg wwt)	0.173	0.100	0.192	0.236	0.219
	Nickel (Ni)-Total (mg/kg)	0.74	0.67	7.03	12.0	8.30
	Nickel (Ni)-Total (mg/kg wwt)	0.403	0.357	2.98	5.11	3.17
	Phosphorus (P)-Total (mg/kg)	1530	1310	3600	5040	4940
	Phosphorus (P)-Total (mg/kg wwt)	836	695	1530	2150	1880
	Potassium (K)-Total (mg/kg)	4800	4300	7740	8970	13600
	Potassium (K)-Total (mg/kg wwt)	2620	2280	3290	3820	5180
	Rubidium (Rb)-Total (mg/kg)	1.14	2.24	0.649	0.647	1.82
	Rubidium (Rb)-Total (mg/kg wwt)	0.624	1.19	0.276	0.275	0.694
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	0.018	0.014	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	4.4	5.2
	Strontium (Sr)-Total (mg/kg)	13.3	13.0	105	146	83.2
	Strontium (Sr)-Total (mg/kg wwt)	7.26	6.92	44.6	62.1	31.7
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0044	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0078	0.0124	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00426	0.00656	<0.00040	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	0.88	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.374	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00050	0.00077	<0.00040	<0.00040	0.00063
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.028	0.049	<0.020	<0.020	0.035
	Zinc (Zn)-Total (mg/kg)	22.8	24.2	128	241	158
	Zinc (Zn)-Total (mg/kg wwt)	12.4	12.9	54.3	102	60.4
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2341109-220	L2341109-221	L2341109-222	L2341109-223	L2341109-224
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date					
Sampled Time					
Client ID	S-03 (CRANBERRY) 1	S-03 (CRANBERRY) 2	S-03 (CRANBERRY) 3	S-05 (WILLOW) 1	S-05 (WILLOW) 2
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	0.0080	0.0065
Mercury (Hg)-Total (mg/kg wwt)	<0.0010	<0.0010	<0.0010	0.0033	0.0025
Molybdenum (Mo)-Total (mg/kg)	0.952	1.23	0.871	0.296	0.243
Molybdenum (Mo)-Total (mg/kg wwt)	0.180	0.241	0.170	0.122	0.0944
Nickel (Ni)-Total (mg/kg)	0.63	0.85	0.76	1.25	0.90
Nickel (Ni)-Total (mg/kg wwt)	0.119	0.165	0.147	0.515	0.350
Phosphorus (P)-Total (mg/kg)	1090	1300	1200	1500	1210
Phosphorus (P)-Total (mg/kg wwt)	206	254	234	617	471
Potassium (K)-Total (mg/kg)	5890	6210	5830	7000	9820
Potassium (K)-Total (mg/kg wwt)	1120	1210	1140	2890	3810
Rubidium (Rb)-Total (mg/kg)	2.10	2.02	2.00	3.00	14.8
Rubidium (Rb)-Total (mg/kg wwt)	0.398	0.394	0.390	1.24	5.76
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.011	<0.010
Sodium (Na)-Total (mg/kg)	24	27	25	<20	<20
Sodium (Na)-Total (mg/kg wwt)	4.5	5.2	4.8	<4.0	<4.0
Strontium (Sr)-Total (mg/kg)	2.53	5.06	3.26	57.8	41.6
Strontium (Sr)-Total (mg/kg wwt)	0.478	0.989	0.635	23.9	16.2
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00043	0.00069
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0023	0.0065
Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00094	0.00253
Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	0.22	0.46
Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.090	0.180
Zinc (Zn)-Total (mg/kg)	6.55	8.96	6.45	71.5	124
Zinc (Zn)-Total (mg/kg wwt)	1.24	1.75	1.26	29.5	48.1
Zirconium (Zr)-Total (mg/kg)	<0.20	0.33	0.35	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	0.064	0.067	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-225				
	Description	Tissue				
	Sampled Date					
	Sampled Time					
	Client ID	S-05 (WILLOW) 3				
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0074				
	Mercury (Hg)-Total (mg/kg wwt)	0.0031				
	Molybdenum (Mo)-Total (mg/kg)	0.204				
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0854				
	Nickel (Ni)-Total (mg/kg)	1.34				
	Nickel (Ni)-Total (mg/kg wwt)	0.562				
	Phosphorus (P)-Total (mg/kg)	1340				
	Phosphorus (P)-Total (mg/kg wwt)	564				
	Potassium (K)-Total (mg/kg)	7160				
	Potassium (K)-Total (mg/kg wwt)	3000				
	Rubidium (Rb)-Total (mg/kg)	1.93				
	Rubidium (Rb)-Total (mg/kg wwt)	0.809				
	Selenium (Se)-Total (mg/kg)	<0.050				
	Selenium (Se)-Total (mg/kg wwt)	0.013				
	Sodium (Na)-Total (mg/kg)	<20				
	Sodium (Na)-Total (mg/kg wwt)	<4.0				
	Strontium (Sr)-Total (mg/kg)	55.1				
	Strontium (Sr)-Total (mg/kg wwt)	23.1				
	Tellurium (Te)-Total (mg/kg)	<0.020				
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040				
	Thallium (Tl)-Total (mg/kg)	<0.0020				
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040				
	Tin (Sn)-Total (mg/kg)	<0.10				
	Tin (Sn)-Total (mg/kg wwt)	<0.020				
	Uranium (U)-Total (mg/kg)	<0.0020				
	Uranium (U)-Total (mg/kg wwt)	<0.00040				
	Vanadium (V)-Total (mg/kg)	<0.10				
	Vanadium (V)-Total (mg/kg wwt)	0.036				
	Zinc (Zn)-Total (mg/kg)	79.6				
	Zinc (Zn)-Total (mg/kg wwt)	33.4				
	Zirconium (Zr)-Total (mg/kg)	<0.20				
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040				

* 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)
Method Blank	Manganese (Mn)-Total	B	L2341109-100, -101, -102, -103, -104, -105, -106, -107, -108, -113, -114, -84, -88, -90, -91, -92, -93, -94, -95, -96
Method Blank	Manganese (Mn)-Total	B	L2341109-100, -101, -102, -103, -104, -105, -106, -107, -108, -113, -114, -84, -88, -90, -91, -92, -93, -94, -95, -96
Duplicate	Calcium (Ca)	DUP-H	L2341109-10, -11, -12, -16, -17, -18, -28, -29, -30, -37, -38, -39, -43, -44, -45, -52
Duplicate	Manganese (Mn)	DUP-H	L2341109-111, -115, -116, -117, -127, -128, -129, -139, -140, -141, -142, -143, -144, -148, -149, -150, -154, -155, -156
Duplicate	Strontium (Sr)	DUP-H	L2341109-10, -11, -12, -16, -17, -18, -28, -29, -30, -37, -38, -39, -43, -44, -45, -52
Duplicate	Antimony (Sb)-Total	DUP-H	L2341109-100, -101, -102, -103, -104, -105, -106, -107, -108, -113, -114, -84, -88, -90, -91, -92, -93, -94, -95, -96
Duplicate	Antimony (Sb)-Total	DUP-H	L2341109-13, -169, -3, -42, -89
Duplicate	Calcium (Ca)-Total	DUP-H	L2341109-221, -222, -25, -26, -27
Duplicate	Strontium (Sr)-Total	DUP-H	L2341109-221, -222, -25, -26, -27
Certified Reference Material	Chromium (Cr)-Total	MES	L2341109-13, -169, -3, -42, -89
Certified Reference Material	Chromium (Cr)-Total	MES	L2341109-13, -169, -3, -42, -89
Laboratory Control Sample	Iron (Fe)	MES	L2341109-10, -11, -12, -16, -17, -18, -28, -29, -30, -37, -38, -39, -43, -44, -45, -52
Laboratory Control Sample	Antimony (Sb)-Total	MES	L2341109-35, -36, -40, -41, -49, -60, -64, -65, -66, -70, -71, -72, -76, -77, -78, -79, -80, -81, -82, -83
Laboratory Control Sample	Magnesium (Mg)-Total	MES	L2341109-35, -36, -40, -41, -49, -60, -64, -65, -66, -70, -71, -72, -76, -77, -78, -79, -80, -81, -82, -83
Laboratory Control Sample	Phosphorus (P)-Total	MES	L2341109-35, -36, -40, -41, -49, -60, -64, -65, -66, -70, -71, -72, -76, -77, -78, -79, -80, -81, -82, -83
Laboratory Control Sample	Antimony (Sb)-Total	MES	L2341109-35, -36, -40, -41, -49, -60, -64, -65, -66, -70, -71, -72, -76, -77, -78, -79, -80, -81, -82, -83
Laboratory Control Sample	Magnesium (Mg)-Total	MES	L2341109-35, -36, -40, -41, -49, -60, -64, -65, -66, -70, -71, -72, -76, -77, -78, -79, -80, -81, -82, -83
Laboratory Control Sample	Phosphorus (P)-Total	MES	L2341109-35, -36, -40, -41, -49, -60, -64, -65, -66, -70, -71, -72, -76, -77, -78, -79, -80, -81, -82, -83
Certified Reference Material	Manganese (Mn)-Total	RM-H	L2341109-121, -122, -123, -131, -132, -133, -134, -135, -136, -137, -138, -152, -153, -157, -158, -184, -202, -203, -204
Certified Reference Material	Manganese (Mn)-Total	RM-H	L2341109-121, -122, -123, -131, -132, -133, -134, -135, -136, -137, -138, -152, -153, -157, -158, -184, -202, -203, -204

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
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).
RM-H	Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

HG-DRY-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAAS (DRY)	EPA 200.3, EPA 245.7

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. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

HG-WET-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAAS (WET)	EPA 200.3, EPA 245.7

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

Reference Information

peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-200.2-CCMS-VA Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

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.

MET-WET-CCMS-N-VA Tissue Metals in Tissue by CRC ICPMS (WET) EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-TISS-VA Tissue % Moisture in Tissues Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PH-1:2-VA Soil pH in Soil (1:2 Soil:Water Extraction) BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in "pH, Electrometric in Soil and Sediment - Prescriptive Method", Rev. 2005, Section B Physical, Inorganic and Misc. Constituents, BC Environmental Laboratory Manual. The procedure involves mixing the dried (at <60 C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

** 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 23	10 of 23	11 of 23	12 of 23	13 of 23
14 of 23	15 of 23	16 of 23	17 of 23	18 of 23
19 of 23	2 of 23	20 of 23	21 of 23	22 of 23
23 of 23	3 of 23	4 of 23	5 of 23	6 of 23
7 of 23	8 of 23	9 of 23		

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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 1 of 23

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)	Emergency
4 day [P4-20%] ☐	1 Business day [E1 - 100%] ☐
3 day [P3-25%] ☐	Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
2 day [P2-50%] ☐	

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	TH-1?-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
1	C-01A (horsetail)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (horsetail)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (horsetail)	28-Aug-19	15:56	Tissue	R	R	R	R									
2	C-01A (labrador tea)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (labrador tea)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (labrador tea)	28-Aug-19	15:56	Tissue	R	R	R	R									
3	C-01A (willow)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (willow)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (willow)	28-Aug-19	15:56	Tissue	R	R	R	R									
4	C-01A	28-Aug-19	15:56	Sediment								R	R	R	R		
	C-01A	28-Aug-19	15:56	Sediment								R	R	R	R		
	C-01A	28-Aug-19	15:56	Sediment								R	R	R	R		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
15.0	15.0	15.0			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
CR			EF	3 Sep 2019	15:50	JG	5 Sep 19	11:33 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

L2341109-COFC

COC Number: 17 -

Page 2 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: crentmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

Project Information

ALS Account # / Quote #:

Job #: Minto

PO / AFE: MN19-02

LSD:

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐; 3 day [P3-25%] ☐; 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E1 - 100%] ☐; Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)) ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
5	M-29 (labrador tea)	28-Aug-19	10:30	Tissue	R	R	R	R									1
	M-29 (labrador tea)	28-Aug-19	10:30	Tissue	R	R	R	R									1
	M-29 (labrador tea)	28-Aug-19	10:30	Tissue	R	R	R	R									1
	M-29	28-Aug-19	10:30	Sediment					R	R	R	R	R	R			1
6	M-29	28-Aug-19	10:30	Sediment					R	R	R	R	R	R			1
	M-29	28-Aug-19	10:30	Sediment					R	R	R	R	R	R			1
				Tissue													
				Tissue													
				Tissue													
				Tissue													
				Tissue													
				Tissue													

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.2				16.1	12.3		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SHIPMENT RELEASE (client use)

Released by: CR Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: LF Date: 3 SEP 2019 Time: 15:50

FINAL SHIPMENT RECEPTION (lab use only)

Received by: JL Date: 5 Sep 19 Time: 11:35 AM

WHITE - L 2nd copy

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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 agre

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 3 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report:	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs: ..

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
7	S-19 (labrador tea)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (labrador tea)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (labrador tea)	27-Aug-19	7:40	Tissue	R	R	R	R									1
8	S-19 (willow)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (willow)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (willow)	27-Aug-19	7:40	Tissue	R	R	R	R									1
9	S-19 (berries)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (berries)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (berries)	27-Aug-19	7:40	Tissue	R	R	R	R									1
10	S-19	27-Aug-19	7:40	Sediment					R	R	R	R	R	R			1
	S-19	27-Aug-19	7:40	Sediment					R	R	R	R	R	R			1
	S-19	27-Aug-19	7:40	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.1	12.3	

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
CR		EF	3 Sep 2019	15:50	JG	5 Sep 19	11:40 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2341109-COFC

Page 4 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice To		
	Same as Report To	☑ YES ☐ NO
	Copy of Invoice with Report	☑ YES ☐ NO
Company:		
Contact:		

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W.

Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FIP) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
11	S-18 (labrador tea)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (labrador tea)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (labrador tea)	28-Aug-19	11:15	Tissue	R	R	R	R									1
12	S-18 (willow)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (willow)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (willow)	28-Aug-19	11:15	Tissue	R	R	R	R									1
13	S-18	28-Aug-19	11:15	Sediment					R	R	R	R	R	R			1
	S-18	28-Aug-19	11:15	Sediment					R	R	R	R	R	R			1
	S-18	28-Aug-19	11:15	Sediment					R	R	R	R	R	R			1
																	1
																	1
																	1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
17.0			6.6	7.1	8.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: RF	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 11:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 5 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3

Report Format / Distribution	
Select Report Format:	☐ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Regular [R]	☑ Standard TAT if received by 3 pm - business days - no surcharges apply
PRIORITY (Business Days) 4 day [P4-20%]	☐
PRIORITY (Business Days) 3 day [P3-25%]	☐
PRIORITY (Business Days) 2 day [P2-50%]	☐
EMERGENCY 1 Business day [E1 - 100%]	☐
EMERGENCY Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)]	☐
Date and Time Required for all E&P TATs:	
For tests that can not be performed according to the service level selected, you will be contacted	

Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Invoice Distribution	
Select Invoice Distribution:	☐ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
14	S-17 (willow)	27-Aug-19	6:40	Tissue	R	R	R	R									1
	S-17 (willow)	27-Aug-19	6:40	Tissue	R	R	R	R									1
	S-17 (willow)	27-Aug-19	6:40	Tissue	R	R	R	R									1
15	S-17	27-Aug-19	6:40	Sediment					R	R	R	R	R	R			1
	S-17	27-Aug-19	6:40	Sediment					R	R	R	R	R	R			1
	S-17	27-Aug-19	6:40	Sediment					R	R	R	R	R	R			1

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C
17.0	9.0	15.0	(1-6) 7.7 | 2.1 | 3

SHIPMENT RELEASE (client use)		
Released by: CR		Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: EF	Date: 3Sep2019	Time: 15:50

FINAL SHIPMENT RECEPTION (lab use only)		
Received by: JK	Date: 5 Sep 19	Time: 11:32 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 6 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: crentmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	
ALS Contact:	Selam W.
Sampler:	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BGY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1-2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
16	S-16 (labrador tea)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (labrador tea)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (labrador tea)	26-Aug-19	15:50	Tissue	R	R	R	R									1
17	S-16 (willow)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (willow)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (willow)	26-Aug-19	15:50	Tissue	R	R	R	R									1
18	S-16	26-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-16	26-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-16	26-Aug-19	15:50	Sediment					R	R	R	R	R	R			1

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
16.0				6.6	7.1	12.3	

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SHIPMENT RELEASE (client use)

Released by: | Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: ET | Date: 3 Sep 2019 | Time: 15:50

FINAL SHIPMENT RECEPTION (lab use only)

Received by: | Date: 5 Sep 19 | Time: 11:31 AM

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2341109-COFC

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP.TISS.DIGEST-VA	CEC	particle size	PREP.200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
19	S-15 (horsetail)	28-Aug-19	11:40	Tissue	R	R	R	R									1
	S-15 (horsetail)	28-Aug-19	11:40	Tissue	R	R	R	R									1
	S-15 (horsetail)	28-Aug-19	11:40	Tissue	R	R	R	R									1
20	S-15 (labrador tea)	28-Aug-19	11:40	Tissue	R	R	R	R									1
	S-15 (labrador tea)	28-Aug-19	11:40	Tissue	R	R	R	R									1
	S-15 (labrador tea)	28-Aug-19	11:40	Tissue	R	R	R	R									1
21	S-15	28-Aug-19	11:40	Sediment					R	R	R	R	R	R			1
	S-15	28-Aug-19	11:40	Sediment					R	R	R	R	R	R			1
	S-15	28-Aug-19	11:40	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C			
Nil			6	6	7	7

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
			EF	3 Sep 2019	15:50		5 Sep 19	11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1] If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 3 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1.2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
22	S-11 (willow)	27-Aug-19	17:15	Tissue	R	R	R	R									1
	S-11 (willow)	27-Aug-19	17:15	Tissue	R	R	R	R									1
	S-11 (willow)	27-Aug-19	17:15	Tissue	R	R	R	R									1
23	S-11	27-Aug-19	17:15	Sediment					R	R	R	R	R	R			1
	S-11	27-Aug-19	17:15	Sediment					R	R	R	R	R	R			1
	S-11	27-Aug-19	17:15	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
11.0				6.6	7.1	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: JK	Date: 5 Sep 19	Time: 11:30 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (surcharges may apply): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W.

Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY CVAFS N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	TH-1.2-VA	HG-200.2-CVAF-VA	ME-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
24	S-09 (willow)	27-Aug-19	10:20	Tissue	R	R	R	R									1
	S-09 (willow)	27-Aug-19	10:20	Tissue	R	R	R	R									1
	S-09 (willow)	27-Aug-19	10:20	Tissue	R	R	R	R									1
25	S-09	27-Aug-19	10:20	Sediment					R	R	R	R	R	R			1
	S-09	27-Aug-19	10:20	Sediment					R	R	R	R	R	R			1
	S-09	27-Aug-19	10:20	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
16.0				6.6	7.1	7.3	6.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: JH	Date: 5 Sep 19	Time: 14:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)	EMERGENCY
4 day [P4-20%] ☐	1 Business day [E1 - 100%] ☐
3 day [P3-25%] ☐	Same Day, Weekend or Statutory holiday [E2 -200%] ☐
2 day [P2-50%] ☐	(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
26	S-08 (labrador tea)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (labrador tea)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (labrador tea)	27-Aug-19	11:00	Tissue	R	R	R	R									1
27	S-08 (willow)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (willow)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (willow)	27-Aug-19	11:00	Tissue	R	R	R	R									1
28	S-08 (lichen)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (lichen)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (lichen)	27-Aug-19	11:00	Tissue	R	R	R	R									1
29	S-08	27-Aug-19	11:00	Sediment					R	R	R	R	R	R			1
	S-08	27-Aug-19	11:00	Sediment					R	R	R	R	R	R			1
	S-08	27-Aug-19	11:00	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.7	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:54	Received by: JG	Date: 5 Sep 19	Time: 11:23 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report:	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked:	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	creatmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Selam W.	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days): 4 day [P4-20%] ☐; 3 day [P3-25%] ☐; 2 day [P2-50%] ☐

Emergency: 1 Business day [E1 - 100%] ☐; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-ORY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
30	S-08A (labrador tea)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (labrador tea)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (labrador tea)	27-Aug-19	11:05	Tissue	R	R	R	R									1
31	S-08A (willow)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (willow)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (willow)	27-Aug-19	11:05	Tissue	R	R	R	R									1
32	S-08A (lichen)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (lichen)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (lichen)	27-Aug-19	11:05	Tissue	R	R	R	R									1
33	S-08A	27-Aug-19	11:05	Sediment					R	R	R	R	R	R			1
	S-08A	27-Aug-19	11:05	Sediment					R	R	R	R	R	R			1
	S-08A	27-Aug-19	11:05	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
5.0				6.6	7.1	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
CR			EF	3 Sep 2019	15:50	TG	5 SEP 19	11:35 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

L2341109-COFC

COC Number: 17 -

Page 12 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Reatmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: creitmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	
ALS Contact:	Selam W.
Sampler:	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TIGS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	ME-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
34	S-07 (labrador tea)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (labrador tea)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (labrador tea)	27-Aug-19	15:50	Tissue	R	R	R	R									1
35	S-07 (willow)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (willow)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (willow)	27-Aug-19	15:50	Tissue	R	R	R	R									1
36	S-07 (horsetail)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (horsetail)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (horsetail)	27-Aug-19	15:50	Tissue	R	R	R	R									1
37	S-07	27-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-07	27-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-07	27-Aug-19	15:50	Sediment					R	R	R	R	R	R			1

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☑ | Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0							

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
LR			RF	8 Sep 2019	15:52			

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 1 of 3

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-DRY DIGEST-VA	PREP-HSS-DIGEST-VA			CEC	particle size	PREP-200.2-VA	PH 1:2 VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA				SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
38	S-06 (labrador tea)	27-Aug-19	14:55	Tissue	R	R	R	R														1
	S-06 (labrador tea)	27-Aug-19	14:55	Tissue	R	R	R	R														1
	S-06 (labrador tea)	27-Aug-19	14:55	Tissue	R	R	R	R														1
39	S-06	27-Aug-19	14:55	Sediment							R	R	R	R	R	R						1
	S-06	27-Aug-19	14:55	Sediment							R	R	R	R	R	R						1
	S-06	27-Aug-19	14:55	Sediment							R	R	R	R	R	R						1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☑	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☑				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
15.0			6.6	7.1	12.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
			EF	3 Sep 2019	15:50	TG	5 Sep 19	11:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 14 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax crentmeister@alexcoenv.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax

Email 2

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)

AFE/Cost Center	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: Selam W. Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

Emergency: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200%] ☐ (Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
40	S-05 (labrador tea)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (labrador tea)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (labrador tea)	27-Aug-19	9:25	Tissue	R	R	R	R									1
41	S-05 (berries)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (berries)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (berries)	27-Aug-19	9:25	Tissue	R	R	R	R									1
42	S-05 (horsetail)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (horsetail)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (horsetail)	27-Aug-19	9:25	Tissue	R	R	R	R									1
43	S-05	27-Aug-19	9:25	Sediment					R	R	R	R	R	R			1
	S-05	27-Aug-19	9:25	Sediment					R	R	R	R	R	R			1
	S-05	27-Aug-19	9:25	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
16.0				6.6	7.1	12.3	3.1

SHIPMENT RELEASE (client use)

Released by: Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: Date: 3 Sep 2019 Time: 1515

FINAL SHIPMENT RECEPTION (lab use only)

Received by: Date: 5Sep19 Time:

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 1 of 5

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐; 3 day [P3-25%] ☐; 2 day [P2-50%] ☐ — EMERGENCY: 1 Business day [E1 - 100%] ☐; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	Date and Time Required for all E&P TATs:
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	For tests that can not be performed according to the service level selected, you will be contacted.
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☐ EMAIL ☑ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA			CEC	particle size	PREP 200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA				SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
44	S-04 (labrador tea)	27-Aug-19	13:35	Tissue	R	R	R	R														1
	S-04 (labrador tea)	27-Aug-19	13:35	Tissue	R	R	R	R														1
	S-04 (labrador tea)	27-Aug-19	13:35	Tissue	R	R	R	R														1
45	S-04 (willow)	27-Aug-19	13:35	Tissue	R	R	R	R														1
	S-04 (willow)	27-Aug-19	13:35	Tissue	R	R	R	R														1
	S-04 (willow)	27-Aug-19	13:35	Tissue	R	R	R	R														1
46	S-04 (berries)	27-Aug-19	13:35	Tissue	R	R	R	R														1
	S-04 (berries)	27-Aug-19	13:35	Tissue	R	R	R	R														1
	S-04 (berries)	27-Aug-19	13:35	Tissue	R	R	R	R														1
47	S-04	27-Aug-19	13:35	Sediment							R	R	R	R	R	R						1
	S-04	27-Aug-19	13:35	Sediment							R	R	R	R	R	R						1
	S-04	27-Aug-19	13:35	Sediment							R	R	R	R	R	R						1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C
15.0			6.6; 7.1; 12.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: EF	Date: 30 Aug 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 1 of 2

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐; 3 day [P3-25%] ☐; 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax crentmeister@alexcoenv.com	Date and Time Required for all E&P TATs:
City/Province:	Whitehorse, YT	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
48	S-02	28-Aug-19	17:25	Sediment					R	R	R	R	R	R			1
	S-02	28-Aug-19	17:25	Sediment					R	R	R	R	R	R			1
	S-02	28-Aug-19	17:25	Sediment					R	R	R	R	R	R			1
49	S-03 (willow)	27-Aug-19	17:35	Tissue	R	R	R	R									1
	S-03 (willow)	27-Aug-19	17:35	Tissue	R	R	R	R									1
	S-03 (willow)	27-Aug-19	17:35	Tissue	R	R	R	R									1
50	S-03	27-Aug-19	17:35	Sediment					R	R	R	R	R	R			1
	S-03	27-Aug-19	17:35	Sediment					R	R	R	R	R	R			1
	S-03	27-Aug-19	17:35	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.1	7.3	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:52	Received by: JG	Date: 5 Sep 19	Time: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2341109-COFC

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3

Report Format / Distribution	
Select Report Format	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)			
Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply			
PRIORITY (Business Days)	4 day [P4-20%] ☐	EMERGENCY	1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		
Date and Time Required for all E&P TATs:			
For tests that can not be performed according to the service level selected, you will be contacted.			

Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W.

Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P), or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA			COFC	particle size	PREP-200.2-VA	PH-1-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA			SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
51	S-01 (labrador tea)	28-Aug-19	17:00	Tissue	R	R	R	R													1
	S-01 (labrador tea)	28-Aug-19	17:00	Tissue	R	R	R	R													1
	S-01 (labrador tea)	28-Aug-19	17:00	Tissue	R	R	R	R													1
52	S-01	28-Aug-19	17:00	Sediment							R	R	R	R	R	R					1
	S-01	28-Aug-19	17:00	Sediment							R	R	R	R	R	R					1
	S-01	28-Aug-19	17:00	Sediment							R	R	R	R	R	R					1

Drinking Water (DW) Samples (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☑	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☑				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0							

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
CR			EF	3 Sep 2019	1550			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

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Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax crentmeister@alexcoenv.com	Date and Time Required for all E&P TATs:
City/Province:	Whitehorse, YT	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
53	M-07b (labrador tea)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (labrador tea)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (labrador tea)	28-Aug-19	8:15	Tissue	R	R	R	R									1
54	M-07b (willow)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (willow)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (willow)	28-Aug-19	8:15	Tissue	R	R	R	R									1
55	M-07b	28-Aug-19	8:15	Sediment					R	R	R	R	R	R			1
	M-07b	28-Aug-19	8:15	Sediment					R	R	R	R	R	R			1
	M-07b	28-Aug-19	8:15	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.1	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EP	Date: 3 SEP 2019	Time: 15:15	Received by: JG	Date: 5 Sep 19	Time: 11:35 am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2341109-COFC

COC Number: 17 -

Page 19 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ ; 3 day [P3-25%] ☐ ; 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐ ; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	
	Copy of invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-R5Y DIGEST-VA	PREP-TISS-DIGEST VA	CEC	particle size	PREP-200.2-VA	PH-1:2 VA	HG-200.2-CVAF VA	MET 200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
~~53~~ 56	M-26 (labrador tea)	28-Aug-19	6:50	Tissue	R	R	R	R									1
	M-26 (labrador tea)	28-Aug-19	6:50	Tissue	R	R	R	R									1
	M-26 (labrador tea)	28-Aug-19	6:50	Tissue	R	R	R	R									1
~~54~~ 57	M-26 (willow)	28-Aug-19	6:50	Tissue	R	R	R	R									1
	M-26 (willow)	28-Aug-19	6:50	Tissue	R	R	R	R									1
	M-26 (willow)	28-Aug-19	6:50	Tissue	R	R	R	R									1
58	M-26 (lichen)	28-Aug-19	6:50	Tissue	R	R	R	R									1
	M-26 (lichen)	28-Aug-19	6:50	Tissue	R	R	R	R									1
	M-26 (lichen)	28-Aug-19	6:50	Tissue	R	R	R	R									1
59	M-26	28-Aug-19	6:50	Sediment					R	R	R	R	R	R			1
	M-26	28-Aug-19	6:50	Sediment					R	R	R	R	R	R			1
	M-26	28-Aug-19	6:50	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C			
15.0			6.6	9.7	12.1	6

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
			EF	3 Sep 2019	15:50		5 Sep 19	11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

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Canada Toll Free: 1 800 668 9878

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COC Number: 17 -

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Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐ — EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax crentmeister@alexcoenv.com	Date and Time Required for all E&P TATs:
City/Province:	Whitehorse, YT	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	Y1A 2V3	Email 3	

Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX
Company:		Email 1 or Fax
Contact:		Email 2

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): | ALS Contact: Selam W. | Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TI99-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
60	M-80 (labrador tea)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (labrador tea)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (labrador tea)	28-Aug-19	14:10	Tissue	R	R	R	R									1
61	M-80 (willow)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (willow)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (willow)	28-Aug-19	14:10	Tissue	R	R	R	R									1
62	M-80 (berries)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (berries)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (berries)	28-Aug-19	14:10	Tissue	R	R	R	R									1
63	M-80	28-Aug-19	14:10	Sediment					R	R	R	R	R	R			1
	M-80	28-Aug-19	14:10	Sediment					R	R	R	R	R	R			1
	M-80	28-Aug-19	14:10	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.7	12.5	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: GF	Date: 3 Sep 2019	Time: 15:50	Received by:	Date: 5 Sep 19	Time: 9:35

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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ALS Environmental

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Canada Toll Free: 1 800 668 9878

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COC Number: 17 -

Page 2 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐ — EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax crentmeister@alexcoenv.com	Date and Time Required for all E&P TATs:
City/Province:	Whitehorse, YT	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	Y1A 2V3	Email 3	

Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX
Company:		Email 1 or Fax
Contact:		Email 2

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): **ALS Contact:** Selam W. **Sampler:**

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP TISS DIGEST-VA	CEC	particle size	PREP 200.2 VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
64	C-02 (horsetail)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (horsetail)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (horsetail)	28-Aug-19	14:40	Tissue	R	R	R	R									1
65	C-02 (labrador tea)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (labrador tea)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (labrador tea)	28-Aug-19	14:40	Tissue	R	R	R	R									1
66	C-02 (willow)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (willow)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (willow)	28-Aug-19	14:40	Tissue	R	R	R	R									1
67	C-02 (lichen)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (lichen)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (lichen)	28-Aug-19	14:40	Tissue	R	R	R	R									1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6	6	7	7

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: BF	Date: 3 Sep 2019	Time: 15:50	Received by: TK	Date: 5 Sep 19	Time: 11:25 AM

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2341109-COFC

COC Number: 17 -

Page 22 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
68	C-02 (berries)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (berries)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (berries)	28-Aug-19	14:40	Tissue	R	R	R	R									1
69	C-02	28-Aug-19	14:40	Sediment					R	R	R	R	R	R			1
	C-02	28-Aug-19	14:40	Sediment					R	R	R	R	R	R			1
	C-02	28-Aug-19	14:40	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.3	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
LR			ZP	3 Sep 2019	15:50	JG	5 Sep 19	11:30

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

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Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	Priority (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	Emergency: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP DSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PHEP-200.2-VA	PH-1.2-VA	HG-200.2-CVAF VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
70	C-01 (horsetail)	28-Aug-19	15:55	Tissue	R	R	R	R									1
	C-01 (horsetail)	28-Aug-19	15:55	Tissue	R	R	R	R									1
	C-01 (horsetail)	28-Aug-19	15:55	Tissue	R	R	R	R									1
71	C-01 (labrador tea)	28-Aug-19	15:55	Tissue	R	R	R	R									1
	C-01 (labrador tea)	28-Aug-19	15:55	Tissue	R	R	R	R									1
	C-01 (labrador tea)	28-Aug-19	15:55	Tissue	R	R	R	R									1
72	C-01 (willow)	28-Aug-19	15:55	Tissue	R	R	R	R									1
	C-01 (willow)	28-Aug-19	15:55	Tissue	R	R	R	R									1
	C-01 (willow)	28-Aug-19	15:55	Tissue	R	R	R	R									1
73	C-01	28-Aug-19	15:55	Sediment					R	R	R	R	R	R			1
	C-01	28-Aug-19	15:55	Sediment					R	R	R	R	R	R			1
	C-01	28-Aug-19	15:55	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.2	11.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:55	Received by:	Date: 5 Sep 19	Time: (1:30)

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Alexco Environmental Group Inc.
ATTN: Charlotte Rentmeister
#3 Calcite Business Centre
151 Industrial Road
Whitehorse YT Y1A 2V3

Date Received: 05-SEP-19
Report Date: 30-NOV-19 11:22 (MT)
Version: FINAL

Client Phone: 867-668-6463

Certificate of Analysis

Lab Work Order #: L2355568

Project P.O. #: MN19-02
Job Reference: MINTO - RINSED TISSUE
C of C Numbers:
Legal Site Desc:

Heather McKenzie
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-1 Tissue 28-AUG-19 03:56 C-01A (HORSETAIL) 1	L2355568-2 Tissue 28-AUG-19 03:56 C-01A (HORSETAIL) 2	L2355568-3 Tissue 28-AUG-19 03:56 C-01A (HORSETAIL) 3	L2355568-4 Tissue 28-AUG-19 03:56 C-01A (LABRADOR TEA) 1	L2355568-5 Tissue 28-AUG-19 03:56 C-01A (LABRADOR TEA) 2
TISSUE						
Physical Tests	% Moisture (%)	68.6	70.1	64.2	46.6	50.3
Metals	Aluminum (Al)-Total (mg/kg)	4.6	3.8	4.8	12.3	18.9
	Aluminum (Al)-Total (mg/kg wwt)	1.43	1.15	1.70	6.55	9.37
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0021
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0052	0.0057	0.0066
	Barium (Ba)-Total (mg/kg)	252	188	245	61.7	64.5
	Barium (Ba)-Total (mg/kg wwt)	79.2	56.2	87.8	33.0	32.1
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0024	<0.0020	0.0029	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	14.6	8.9	11.6	12.9	12.7
	Boron (B)-Total (mg/kg wwt)	4.59	2.65	4.14	6.89	6.29
	Cadmium (Cd)-Total (mg/kg)	0.245	0.147	0.204	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0770	0.0441	0.0731	<0.0010	0.0013
	Calcium (Ca)-Total (mg/kg)	20300	15700	19800	3940	4380
	Calcium (Ca)-Total (mg/kg wwt)	6380	4690	7090	2100	2180
	Cesium (Cs)-Total (mg/kg)	0.0625	0.0666	0.0685	0.0237	0.0062
	Cesium (Cs)-Total (mg/kg wwt)	0.0197	0.0199	0.0246	0.0126	0.0031
	Chromium (Cr)-Total (mg/kg)	0.056	0.112	<0.050	<0.050	0.074
	Chromium (Cr)-Total (mg/kg wwt)	0.017	0.033	0.017	0.023	0.037
	Cobalt (Co)-Total (mg/kg)	0.120	0.153	0.159	<0.020	<0.020
	Cobalt (Co)-Total (mg/kg wwt)	0.0376	0.0459	0.0570	0.0059	0.0069
	Copper (Cu)-Total (mg/kg)	2.96	2.64	2.80	3.10	4.14
	Copper (Cu)-Total (mg/kg wwt)	0.929	0.789	1.00	1.66	2.06
	Iron (Fe)-Total (mg/kg)	19.7	17.3	19.7	31.0	38.9
	Iron (Fe)-Total (mg/kg wwt)	6.20	5.16	7.06	16.6	19.3
	Lead (Pb)-Total (mg/kg)	<0.020	<0.020	<0.020	0.020	0.031
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0107	0.0157
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	3570	2800	3340	885	1040
	Magnesium (Mg)-Total (mg/kg wwt)	1120	838	1200	473	514
	Manganese (Mn)-Total (mg/kg)	142	104	142	290	548
	Manganese (Mn)-Total (mg/kg wwt)	44.5	31.2	51.0	155	272

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-6	L2355568-7	L2355568-8	L2355568-9	L2355568-10
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	03:56	03:56	03:56	03:56	10:30
	Client ID	C-01A (LABRADOR TEA) 3	C-01A (WILLOW) 1	C-01A (WILLOW) 2	C-01A (WILLOW) 3	M-29 (LABRADOR TEA) 1
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	42.8	64.2	62.5	55.9	46.7
Metals	Aluminum (Al)-Total (mg/kg)	16.9	7.6	32.0	7.9	14.5
	Aluminum (Al)-Total (mg/kg wwt)	9.65	2.73	12.0	3.48	7.76
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	0.021	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0069	0.0044	0.0079	<0.0040	0.0048
	Barium (Ba)-Total (mg/kg)	96.3	109	59.8	55.2	90.0
	Barium (Ba)-Total (mg/kg wwt)	55.1	39.2	22.4	24.4	48.0
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0021	0.0034	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	18.4	13.4	12.9	13.1	15.4
	Boron (B)-Total (mg/kg wwt)	10.6	4.80	4.84	5.80	8.22
	Cadmium (Cd)-Total (mg/kg)	<0.0050	3.34	5.01	2.13	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0014	1.20	1.88	0.941	0.0017
	Calcium (Ca)-Total (mg/kg)	4550	17700	9640	12900	3960
	Calcium (Ca)-Total (mg/kg wwt)	2600	6350	3620	5710	2110
	Cesium (Cs)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	0.0085
	Cesium (Cs)-Total (mg/kg wwt)	0.0014	<0.0010	0.0017	<0.0010	0.0045
	Chromium (Cr)-Total (mg/kg)	0.066	<0.050	0.077	<0.050	<0.050
	Chromium (Cr)-Total (mg/kg wwt)	0.038	0.017	0.029	0.019	0.020
	Cobalt (Co)-Total (mg/kg)	<0.020	0.672	0.452	0.260	<0.020
	Cobalt (Co)-Total (mg/kg wwt)	0.0074	0.241	0.170	0.114	0.0078
	Copper (Cu)-Total (mg/kg)	3.42	2.35	4.87	2.32	6.85
	Copper (Cu)-Total (mg/kg wwt)	1.96	0.843	1.83	1.02	3.65
	Iron (Fe)-Total (mg/kg)	28.3	29.0	66.6	23.9	36.7
	Iron (Fe)-Total (mg/kg wwt)	16.2	10.4	25.0	10.5	19.6
	Lead (Pb)-Total (mg/kg)	0.022	<0.020	0.053	<0.020	<0.020
	Lead (Pb)-Total (mg/kg wwt)	0.0126	0.0062	0.0200	0.0059	0.0088
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	703	3350	2270	4450	976
	Magnesium (Mg)-Total (mg/kg wwt)	402	1200	852	1960	520
	Manganese (Mn)-Total (mg/kg)	834	183	394	176	584
	Manganese (Mn)-Total (mg/kg wwt)	477	65.7	148	77.6	312

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2355568-11 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 2	L2355568-12 Tissue 28-AUG-19 10:30 M-29 (LABRADOR TEA) 3	L2355568-13 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 1	L2355568-14 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 2	L2355568-15 Tissue 27-AUG-19 07:40 S-19 (LABRADOR TEA) 3
TISSUE						
Physical Tests	% Moisture (%)	47.9	47.8	43.4	43.1	47.1
Metals	Aluminum (Al)-Total (mg/kg)	27.9	28.8	103	91.2	88.6
	Aluminum (Al)-Total (mg/kg wwt)	14.5	15.0	58.4	51.9	46.9
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	0.034	0.030	0.027
	Arsenic (As)-Total (mg/kg wwt)	0.0082	0.0082	0.0193	0.0170	0.0143
	Barium (Ba)-Total (mg/kg)	93.1	69.2	124	107	106
	Barium (Ba)-Total (mg/kg wwt)	48.5	36.1	70.3	60.7	56.2
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	16.3	9.6	9.4	8.0	7.9
	Boron (B)-Total (mg/kg wwt)	8.51	5.03	5.33	4.57	4.19
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0022	0.0021	0.0022	0.0018	0.0017
	Calcium (Ca)-Total (mg/kg)	4120	4110	6220	4730	5290
	Calcium (Ca)-Total (mg/kg wwt)	2150	2140	3520	2690	2800
	Cesium (Cs)-Total (mg/kg)	0.0156	0.0141	0.0120	0.0147	0.0125
	Cesium (Cs)-Total (mg/kg wwt)	0.0081	0.0073	0.0068	0.0084	0.0066
	Chromium (Cr)-Total (mg/kg)	0.057	0.056	0.090	0.088	0.073
	Chromium (Cr)-Total (mg/kg wwt)	0.030	0.029	0.051	0.050	0.039
	Cobalt (Co)-Total (mg/kg)	0.023	<0.020	0.062	0.058	0.055
	Cobalt (Co)-Total (mg/kg wwt)	0.0121	0.0103	0.0352	0.0332	0.0293
	Copper (Cu)-Total (mg/kg)	13.5	7.75	9.16	8.55	7.34
	Copper (Cu)-Total (mg/kg wwt)	7.02	4.05	5.19	4.87	3.89
	Iron (Fe)-Total (mg/kg)	64.9	51.1	144	134	124
	Iron (Fe)-Total (mg/kg wwt)	33.8	26.7	81.2	76.2	65.7
	Lead (Pb)-Total (mg/kg)	0.031	0.021	0.049	0.041	0.049
	Lead (Pb)-Total (mg/kg wwt)	0.0162	0.0109	0.0280	0.0235	0.0258
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1150	981	984	898	818
	Magnesium (Mg)-Total (mg/kg wwt)	598	512	557	511	433
	Manganese (Mn)-Total (mg/kg)	543	346	1230	948	837
	Manganese (Mn)-Total (mg/kg wwt)	283	181	696	540	443

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-16 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 1	L2355568-17 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 2	L2355568-18 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 3	L2355568-19 Tissue 27-AUG-19 07:40 S-19 (BERRIES) 1	L2355568-20 Tissue 27-AUG-19 07:40 S-19 (BERRIES) 2
TISSUE						
Physical Tests	% Moisture (%)	61.3	63.8	62.9	82.5	81.6
Metals	Aluminum (Al)-Total (mg/kg)	153	96.2	57.1	24.9	22.0
	Aluminum (Al)-Total (mg/kg wwt)	59.2	34.8	21.2	4.37	4.05
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.043	0.027	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0168	0.0098	0.0064	<0.0040	<0.0040
	Barium (Ba)-Total (mg/kg)	258	199	450	12.4	8.84
	Barium (Ba)-Total (mg/kg wwt)	99.9	71.9	167	2.17	1.63
	Beryllium (Be)-Total (mg/kg)	0.018	0.018	0.019	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0068	0.0063	0.0071	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	10.1	4.9	9.7	5.0	3.6
	Boron (B)-Total (mg/kg wwt)	3.90	1.78	3.59	0.87	0.67
	Cadmium (Cd)-Total (mg/kg)	0.802	0.951	0.772	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.310	0.344	0.286	<0.0010	<0.0010
	Calcium (Ca)-Total (mg/kg)	21200	17900	30000	1130	803
	Calcium (Ca)-Total (mg/kg wwt)	8220	6480	11100	198	148
	Cesium (Cs)-Total (mg/kg)	0.0074	0.0145	<0.0050	0.0186	0.0204
	Cesium (Cs)-Total (mg/kg wwt)	0.0029	0.0053	0.0017	0.0033	0.0038
	Chromium (Cr)-Total (mg/kg)	0.125	0.095	0.076	0.096	0.080
	Chromium (Cr)-Total (mg/kg wwt)	0.048	0.034	0.028	0.017	0.015
	Cobalt (Co)-Total (mg/kg)	2.08	2.39	1.19	<0.020	<0.020
	Cobalt (Co)-Total (mg/kg wwt)	0.805	0.863	0.440	<0.0040	<0.0040
	Copper (Cu)-Total (mg/kg)	8.88	5.91	5.43	2.91	2.44
	Copper (Cu)-Total (mg/kg wwt)	3.44	2.14	2.01	0.510	0.449
	Iron (Fe)-Total (mg/kg)	215	112	81.0	19.9	11.4
	Iron (Fe)-Total (mg/kg wwt)	83.0	40.6	30.0	3.49	2.10
	Lead (Pb)-Total (mg/kg)	0.075	0.049	0.029	0.023	<0.020
	Lead (Pb)-Total (mg/kg wwt)	0.0292	0.0178	0.0109	0.0041	<0.0040
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	2220	2960	3690	447	377
	Magnesium (Mg)-Total (mg/kg wwt)	859	1070	1370	78.3	69.5
	Manganese (Mn)-Total (mg/kg)	697	623	389	242	205
	Manganese (Mn)-Total (mg/kg wwt)	270	225	144	42.4	37.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-21 Tissue 27-AUG-19 07:40 S-19 (BERRIES) 3	L2355568-22 Tissue 28-AUG-19 11:15 S-18 (LABRADOR TEA) 1	L2355568-23 Tissue 28-AUG-19 11:15 S-18 (LABRADOR TEA) 2	L2355568-24 Tissue 28-AUG-19 11:15 S-18 (LABRADOR TEA) 3	L2355568-25 Tissue 28-AUG-19 11:15 S-18 (WILLOW) 1
TISSUE						
Physical Tests	% Moisture (%)	81.1	45.8	48.6	47.6	61.8
Metals	Aluminum (Al)-Total (mg/kg)	31.1	8.5	6.6	8.3	22.8
	Aluminum (Al)-Total (mg/kg wwt)	5.86	4.60	3.40	4.37	8.71
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.0056	0.0041	0.0047	0.0070
	Barium (Ba)-Total (mg/kg)	23.0	73.3	81.2	68.7	76.1
	Barium (Ba)-Total (mg/kg wwt)	4.35	39.7	41.8	36.0	29.1
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	7.1	7.9	9.0	10.3	6.5
	Boron (B)-Total (mg/kg wwt)	1.33	4.28	4.61	5.41	2.49
	Cadmium (Cd)-Total (mg/kg)	0.0055	<0.0050	<0.0050	<0.0050	2.22
	Cadmium (Cd)-Total (mg/kg wwt)	0.0010	<0.0010	<0.0010	<0.0010	0.847
	Calcium (Ca)-Total (mg/kg)	1720	3320	3560	3800	22800
	Calcium (Ca)-Total (mg/kg wwt)	324	1800	1830	1990	8720
	Cesium (Cs)-Total (mg/kg)	0.0095	0.0108	0.0220	0.0180	0.102
	Cesium (Cs)-Total (mg/kg wwt)	0.0018	0.0058	0.0113	0.0095	0.0391
	Chromium (Cr)-Total (mg/kg)	0.103	<0.050	<0.050	<0.050	0.082
	Chromium (Cr)-Total (mg/kg wwt)	0.019	0.021	0.020	0.019	0.031
	Cobalt (Co)-Total (mg/kg)	0.022	<0.020	<0.020	<0.020	1.01
	Cobalt (Co)-Total (mg/kg wwt)	0.0041	0.0069	0.0051	0.0103	0.387
	Copper (Cu)-Total (mg/kg)	3.67	6.07	5.58	6.93	11.2
	Copper (Cu)-Total (mg/kg wwt)	0.692	3.29	2.87	3.63	4.29
	Iron (Fe)-Total (mg/kg)	24.1	33.4	28.8	33.9	81.3
	Iron (Fe)-Total (mg/kg wwt)	4.55	18.1	14.8	17.8	31.1
	Lead (Pb)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	0.032
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.0079	0.0059	0.0063	0.0121
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	712	1010	1110	1100	7990
	Magnesium (Mg)-Total (mg/kg wwt)	134	547	569	575	3060
	Manganese (Mn)-Total (mg/kg)	495	315	283	329	339
	Manganese (Mn)-Total (mg/kg wwt)	93.4	171	145	172	130

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-26	L2355568-27	L2355568-28	L2355568-29	L2355568-30
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	28-AUG-19	28-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:15	11:15	06:40	06:40	06:40
Client ID	S-18 (WILLOW) 2	S-18 (WILLOW) 3	S-17 (WILLOW) 1	S-17 (WILLOW) 2	S-17 (WILLOW) 3
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	52.7	57.2	56.6	56.8	51.4
Metals Aluminum (Al)-Total (mg/kg)	35.4	27.0	97.1	67.3	67.8
Aluminum (Al)-Total (mg/kg wwt)	16.8	11.5	42.1	29.1	32.9
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0022	<0.0020	<0.0020
Arsenic (As)-Total (mg/kg)	0.022	0.021	0.036	0.020	0.023
Arsenic (As)-Total (mg/kg wwt)	0.0102	0.0088	0.0158	0.0087	0.0112
Barium (Ba)-Total (mg/kg)	41.8	73.5	195	208	199
Barium (Ba)-Total (mg/kg wwt)	19.8	31.4	84.7	89.8	96.7
Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	0.015	0.018	0.015
Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0065	0.0079	0.0074
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	14.6	13.2	14.3	9.4	9.4
Boron (B)-Total (mg/kg wwt)	6.92	5.63	6.23	4.05	4.55
Cadmium (Cd)-Total (mg/kg)	1.82	2.09	1.13	0.740	0.908
Cadmium (Cd)-Total (mg/kg wwt)	0.863	0.895	0.491	0.319	0.441
Calcium (Ca)-Total (mg/kg)	15800	23300	28500	25300	26600
Calcium (Ca)-Total (mg/kg wwt)	7450	9980	12400	10900	12900
Cesium (Cs)-Total (mg/kg)	0.150	0.0574	<0.0050	<0.0050	<0.0050
Cesium (Cs)-Total (mg/kg wwt)	0.0707	0.0246	0.0021	0.0014	0.0015
Chromium (Cr)-Total (mg/kg)	0.058	0.062	0.106	0.091	0.093
Chromium (Cr)-Total (mg/kg wwt)	0.027	0.027	0.046	0.039	0.045
Cobalt (Co)-Total (mg/kg)	0.620	0.612	1.87	2.37	2.63
Cobalt (Co)-Total (mg/kg wwt)	0.293	0.262	0.810	1.02	1.28
Copper (Cu)-Total (mg/kg)	17.6	9.50	27.0	15.6	15.0
Copper (Cu)-Total (mg/kg wwt)	8.32	4.07	11.7	6.71	7.30
Iron (Fe)-Total (mg/kg)	88.2	68.4	146	99.8	93.9
Iron (Fe)-Total (mg/kg wwt)	41.7	29.3	63.4	43.1	45.6
Lead (Pb)-Total (mg/kg)	0.044	0.035	0.077	0.043	0.042
Lead (Pb)-Total (mg/kg wwt)	0.0210	0.0151	0.0332	0.0188	0.0202
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	3560	5290	4500	5410	5480
Magnesium (Mg)-Total (mg/kg wwt)	1680	2260	1960	2330	2660
Manganese (Mn)-Total (mg/kg)	148	188	127	215	317
Manganese (Mn)-Total (mg/kg wwt)	70.2	80.5	55.0	93.0	154

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2355568-31 Tissue 26-AUG-19 15:50 S-16 (LABRADOR TEA) 1	L2355568-32 Tissue 26-AUG-19 15:50 S-16 (LABRADOR TEA) 2	L2355568-33 Tissue 26-AUG-19 15:50 S-16 (LABRADOR TEA) 3	L2355568-34 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 1	L2355568-35 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 2
TISSUE						
Physical Tests	% Moisture (%)	45.3	46.2	43.5	54.1	56.9
Metals	Aluminum (Al)-Total (mg/kg)	58.8	43.3	64.8	44.7	17.8
	Aluminum (Al)-Total (mg/kg wwt)	32.2	23.3	36.6	20.5	7.67
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0031	0.0028	0.0033	0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.040	0.034	0.045	0.029	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0218	0.0183	0.0255	0.0134	0.0061
	Barium (Ba)-Total (mg/kg)	77.8	60.5	83.3	16.3	15.6
	Barium (Ba)-Total (mg/kg wwt)	42.6	32.5	47.1	7.48	6.73
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	14.8	13.1	14.1	11.2	11.9
	Boron (B)-Total (mg/kg wwt)	8.07	7.03	7.94	5.15	5.12
	Cadmium (Cd)-Total (mg/kg)	0.0082	0.0064	<0.0050	1.11	0.934
	Cadmium (Cd)-Total (mg/kg wwt)	0.0045	0.0035	0.0025	0.510	0.403
	Calcium (Ca)-Total (mg/kg)	6940	6160	6940	10300	10000
	Calcium (Ca)-Total (mg/kg wwt)	3800	3310	3920	4740	4320
	Cesium (Cs)-Total (mg/kg)	0.0061	0.0055	0.0068	0.0081	0.0074
	Cesium (Cs)-Total (mg/kg wwt)	0.0033	0.0029	0.0038	0.0037	0.0032
	Chromium (Cr)-Total (mg/kg)	0.173	0.119	0.207	0.088	0.063
	Chromium (Cr)-Total (mg/kg wwt)	0.095	0.064	0.117	0.040	0.027
	Cobalt (Co)-Total (mg/kg)	0.049	0.039	0.053	0.411	0.381
	Cobalt (Co)-Total (mg/kg wwt)	0.0271	0.0207	0.0298	0.188	0.165
	Copper (Cu)-Total (mg/kg)	23.4	14.5	16.2	20.8	7.54
	Copper (Cu)-Total (mg/kg wwt)	12.8	7.78	9.12	9.53	3.25
	Iron (Fe)-Total (mg/kg)	151	118	158	132	62.8
	Iron (Fe)-Total (mg/kg wwt)	82.5	63.5	89.3	60.7	27.1
	Lead (Pb)-Total (mg/kg)	0.069	0.043	0.053	0.042	<0.020
	Lead (Pb)-Total (mg/kg wwt)	0.0379	0.0230	0.0299	0.0194	0.0080
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	0.15	<0.10
	Magnesium (Mg)-Total (mg/kg)	1300	1640	1480	2120	2170
	Magnesium (Mg)-Total (mg/kg wwt)	713	880	835	975	935
	Manganese (Mn)-Total (mg/kg)	148	100	216	464	378
	Manganese (Mn)-Total (mg/kg wwt)	81.0	53.9	122	213	163

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-36 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 3	L2355568-37 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 1	L2355568-38 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 2	L2355568-39 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 3	L2355568-40 Tissue 28-AUG-19 11:15 S-15 (LABRADOR TEA) 1
TISSUE						
Physical Tests	% Moisture (%)	53.5	74.3	74.8	74.0	48.4
Metals	Aluminum (Al)-Total (mg/kg)	147	25.2	13.7	9.4	42.0
	Aluminum (Al)-Total (mg/kg wwt)	68.3	6.46	3.46	2.44	21.7
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0036	<0.0020	<0.0020	<0.0020	0.0023
	Arsenic (As)-Total (mg/kg)	0.057	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0267	<0.0040	<0.0040	<0.0040	0.0079
	Barium (Ba)-Total (mg/kg)	24.6	141	158	170	70.5
	Barium (Ba)-Total (mg/kg wwt)	11.5	36.2	39.9	44.2	36.4
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0021	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0034	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	12.2	12.6	15.6	12.3	10.9
	Boron (B)-Total (mg/kg wwt)	5.65	3.23	3.94	3.19	5.62
	Cadmium (Cd)-Total (mg/kg)	0.701	0.145	0.136	0.0882	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.326	0.0372	0.0344	0.0229	0.0014
	Calcium (Ca)-Total (mg/kg)	12900	28500	32200	30600	5680
	Calcium (Ca)-Total (mg/kg wwt)	5980	7300	8110	7960	2930
	Cesium (Cs)-Total (mg/kg)	0.0165	0.0848	0.106	0.121	0.0153
	Cesium (Cs)-Total (mg/kg wwt)	0.0077	0.0218	0.0268	0.0314	0.0079
	Chromium (Cr)-Total (mg/kg)	0.166	0.105	0.061	0.114	0.078
	Chromium (Cr)-Total (mg/kg wwt)	0.077	0.027	0.015	0.030	0.040
	Cobalt (Co)-Total (mg/kg)	0.243	0.075	0.058	0.087	0.033
	Cobalt (Co)-Total (mg/kg wwt)	0.113	0.0193	0.0146	0.0226	0.0172
	Copper (Cu)-Total (mg/kg)	56.5	5.03	5.33	4.39	16.2
	Copper (Cu)-Total (mg/kg wwt)	26.3	1.29	1.34	1.14	8.37
	Iron (Fe)-Total (mg/kg)	342	31.6	24.8	30.5	96.7
	Iron (Fe)-Total (mg/kg wwt)	159	8.11	6.24	7.92	49.9
	Lead (Pb)-Total (mg/kg)	0.093	<0.020	<0.020	<0.020	0.029
	Lead (Pb)-Total (mg/kg wwt)	0.0431	0.0041	<0.0040	<0.0040	0.0151
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	3100	2620	2860	2680	1440
	Magnesium (Mg)-Total (mg/kg wwt)	1440	672	722	698	741
	Manganese (Mn)-Total (mg/kg)	180	46.6	38.1	34.2	893
	Manganese (Mn)-Total (mg/kg wwt)	83.5	11.9	9.61	8.90	461

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2355568-41 Tissue 28-AUG-19 11:15 S-15 (LABRADOR TEA) 2	L2355568-42 Tissue 28-AUG-19 11:15 S-15 (LABRADOR TEA) 3	L2355568-43 Tissue 27-AUG-19 17:15 S-11 (WILLOW) 1	L2355568-44 Tissue 27-AUG-19 17:15 S-11 (WILLOW) 2	L2355568-45 Tissue 27-AUG-19 17:15 S-11 (WILLOW) 3
TISSUE						
Physical Tests	% Moisture (%)	50.4	47.3	62.4	64.1	61.7
Metals	Aluminum (Al)-Total (mg/kg)	41.0	41.1	28.7	17.5	15.3
	Aluminum (Al)-Total (mg/kg wwt)	20.3	21.6	10.8	6.28	5.86
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0027	0.0040	0.0027	0.0022	0.0025
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	0.025	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0083	0.0069	0.0093	0.0062	0.0065
	Barium (Ba)-Total (mg/kg)	64.6	74.4	143	113	126
	Barium (Ba)-Total (mg/kg wwt)	32.0	39.2	53.6	40.6	48.3
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0025
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	7.4	8.8	6.0	7.6	6.8
	Boron (B)-Total (mg/kg wwt)	3.69	4.65	2.27	2.72	2.60
	Cadmium (Cd)-Total (mg/kg)	<0.0050	0.0052	1.84	1.59	1.04
	Cadmium (Cd)-Total (mg/kg wwt)	0.0017	0.0027	0.691	0.572	0.399
	Calcium (Ca)-Total (mg/kg)	5630	4160	23100	17100	21200
	Calcium (Ca)-Total (mg/kg wwt)	2790	2190	8690	6130	8130
	Cesium (Cs)-Total (mg/kg)	0.0179	0.0132	0.0083	<0.0050	<0.0050
	Cesium (Cs)-Total (mg/kg wwt)	0.0089	0.0069	0.0031	0.0016	0.0012
	Chromium (Cr)-Total (mg/kg)	0.090	0.114	0.094	0.059	0.065
	Chromium (Cr)-Total (mg/kg wwt)	0.045	0.060	0.035	0.021	0.025
	Cobalt (Co)-Total (mg/kg)	0.035	0.040	0.613	0.401	0.287
	Cobalt (Co)-Total (mg/kg wwt)	0.0172	0.0212	0.230	0.144	0.110
	Copper (Cu)-Total (mg/kg)	15.8	16.2	4.49	3.47	4.00
	Copper (Cu)-Total (mg/kg wwt)	7.82	8.52	1.69	1.25	1.53
	Iron (Fe)-Total (mg/kg)	92.9	98.9	52.2	36.9	34.8
	Iron (Fe)-Total (mg/kg wwt)	46.0	52.1	19.6	13.3	13.3
	Lead (Pb)-Total (mg/kg)	0.032	0.035	0.025	<0.020	0.025
	Lead (Pb)-Total (mg/kg wwt)	0.0159	0.0183	0.0094	0.0068	0.0097
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1170	1140	3120	2400	3620
	Magnesium (Mg)-Total (mg/kg wwt)	579	602	1170	860	1390
	Manganese (Mn)-Total (mg/kg)	838	717	109	75.0	102
	Manganese (Mn)-Total (mg/kg wwt)	415	378	41.1	27.0	39.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2355568-46 Tissue 27-AUG-19 10:20 S-09 (WILLOW) 1	L2355568-47 Tissue 27-AUG-19 10:20 S-09 (WILLOW) 2	L2355568-48 Tissue 27-AUG-19 10:20 S-09 (WILLOW) 3	L2355568-49 Tissue 27-AUG-19 11:00 S-08 (LABRADOR TEA) 1	L2355568-50 Tissue 27-AUG-19 11:00 S-08 (LABRADOR TEA) 2
TISSUE						
Physical Tests	% Moisture (%)	56.0	62.5	62.7	48.6	47.2
Metals	Aluminum (Al)-Total (mg/kg)	18.8	40.2	23.6	138	177
	Aluminum (Al)-Total (mg/kg wwt)	8.27	15.0	8.79	71.0	93.3
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0021	0.0024	<0.0020	0.0025	0.0036
	Arsenic (As)-Total (mg/kg)	<0.020	0.021	<0.020	0.030	0.036
	Arsenic (As)-Total (mg/kg wwt)	0.0044	0.0078	0.0067	0.0152	0.0190
	Barium (Ba)-Total (mg/kg)	143	201	268	77.1	145
	Barium (Ba)-Total (mg/kg wwt)	62.9	75.3	99.9	39.6	76.8
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0021	0.0022	<0.0020	0.0021	0.0027
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	8.2	8.0	12.1	17.7	14.4
	Boron (B)-Total (mg/kg wwt)	3.62	2.98	4.53	9.11	7.61
	Cadmium (Cd)-Total (mg/kg)	0.579	1.45	0.870	0.0057	0.0096
	Cadmium (Cd)-Total (mg/kg wwt)	0.255	0.542	0.325	0.0029	0.0051
	Calcium (Ca)-Total (mg/kg)	13900	18300	24700	5710	6880
	Calcium (Ca)-Total (mg/kg wwt)	6110	6870	9210	2940	3630
	Cesium (Cs)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	0.0125	0.0331
	Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0012	0.0010	0.0064	0.0175
	Chromium (Cr)-Total (mg/kg)	0.055	0.097	0.053	0.119	0.130
	Chromium (Cr)-Total (mg/kg wwt)	0.024	0.036	0.020	0.061	0.068
	Cobalt (Co)-Total (mg/kg)	0.749	0.464	0.291	0.092	0.119
	Cobalt (Co)-Total (mg/kg wwt)	0.330	0.174	0.108	0.0472	0.0627
	Copper (Cu)-Total (mg/kg)	4.79	8.49	4.82	25.3	34.6
	Copper (Cu)-Total (mg/kg wwt)	2.11	3.18	1.80	13.0	18.3
	Iron (Fe)-Total (mg/kg)	49.8	86.8	48.7	289	366
	Iron (Fe)-Total (mg/kg wwt)	21.9	32.5	18.2	149	193
	Lead (Pb)-Total (mg/kg)	0.024	0.053	0.027	0.068	0.089
	Lead (Pb)-Total (mg/kg wwt)	0.0106	0.0199	0.0102	0.0350	0.0472
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	2040	2900	2860	1200	1240
	Magnesium (Mg)-Total (mg/kg wwt)	898	1080	1070	618	654
	Manganese (Mn)-Total (mg/kg)	289	317	70.8	610	606
	Manganese (Mn)-Total (mg/kg wwt)	127	119	26.4	314	320

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-51	L2355568-52	L2355568-53	L2355568-54	L2355568-55
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:00	11:00	11:00	11:00	11:00
Client ID	S-08 (LABRADOR TEA) 3	S-08 (WILLOW) 1	S-08 (WILLOW) 2	S-08 (WILLOW) 3	S-08 (LICHEN) 1
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	47.0	59.8	59.3	55.3	40.0
Metals Aluminum (Al)-Total (mg/kg)	171	171	331	243	2900
Aluminum (Al)-Total (mg/kg wwt)	90.4	69.0	135	109	1740
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.035
Antimony (Sb)-Total (mg/kg wwt)	0.0020	0.0031	0.0036	0.0035	0.0211
Arsenic (As)-Total (mg/kg)	0.034	0.036	0.069	0.055	0.558
Arsenic (As)-Total (mg/kg wwt)	0.0182	0.0146	0.0282	0.0246	0.335
Barium (Ba)-Total (mg/kg)	81.5	23.2	23.0	17.9	68.0
Barium (Ba)-Total (mg/kg wwt)	43.2	9.32	9.35	8.01	40.8
Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	0.011	<0.010	0.108
Beryllium (Be)-Total (mg/kg wwt)	0.0027	0.0022	0.0046	0.0032	0.0650
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	0.113
Bismuth (Bi)-Total (mg/kg wwt)	0.0021	<0.0020	0.0035	0.0024	0.0677
Boron (B)-Total (mg/kg)	17.3	11.5	6.9	8.1	2.3
Boron (B)-Total (mg/kg wwt)	9.15	4.63	2.79	3.60	1.39
Cadmium (Cd)-Total (mg/kg)	0.0114	0.878	0.611	0.451	0.154
Cadmium (Cd)-Total (mg/kg wwt)	0.0060	0.353	0.249	0.202	0.0927
Calcium (Ca)-Total (mg/kg)	6240	11500	11800	10100	5320
Calcium (Ca)-Total (mg/kg wwt)	3300	4640	4820	4530	3190
Cesium (Cs)-Total (mg/kg)	0.0240	0.0904	0.0711	0.0884	0.144
Cesium (Cs)-Total (mg/kg wwt)	0.0127	0.0364	0.0289	0.0395	0.0866
Chromium (Cr)-Total (mg/kg)	0.147	0.129	0.250	0.199	1.55
Chromium (Cr)-Total (mg/kg wwt)	0.078	0.052	0.102	0.089	0.930
Cobalt (Co)-Total (mg/kg)	0.105	0.510	0.447	0.508	1.57
Cobalt (Co)-Total (mg/kg wwt)	0.0558	0.205	0.182	0.227	0.942
Copper (Cu)-Total (mg/kg)	31.4	34.9	64.4	50.6	892
Copper (Cu)-Total (mg/kg wwt)	16.6	14.0	26.2	22.6	536
Iron (Fe)-Total (mg/kg)	348	374	696	535	5620
Iron (Fe)-Total (mg/kg wwt)	184	150	283	239	3380
Lead (Pb)-Total (mg/kg)	0.075	0.089	0.153	0.103	1.59
Lead (Pb)-Total (mg/kg wwt)	0.0399	0.0358	0.0623	0.0461	0.957
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	1.23
Lithium (Li)-Total (mg/kg wwt)	<0.10	0.13	0.16	0.14	0.74
Magnesium (Mg)-Total (mg/kg)	1490	2790	4790	4150	1600
Magnesium (Mg)-Total (mg/kg wwt)	790	1120	1950	1850	961
Manganese (Mn)-Total (mg/kg)	674	202	218	118	279
Manganese (Mn)-Total (mg/kg wwt)	357	81.3	88.8	52.6	167

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-56 Description: Tissue Sampled Date: 27-AUG-19 Sampled Time: 11:00 Client ID: S-08 (LICHEN) 2	L2355568-57 Tissue 27-AUG-19 11:00 S-08 (LICHEN) 3	L2355568-58 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 1	L2355568-59 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 2	L2355568-60 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 3
TISSUE						
Physical Tests	% Moisture (%)	19.0	26.4	43.9	48.4	44.6
Metals	Aluminum (Al)-Total (mg/kg)	4270	3550	137	146	221
	Aluminum (Al)-Total (mg/kg wwt)	3460	2620	77.2	75.4	122
	Antimony (Sb)-Total (mg/kg)	0.049	0.042	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0400	0.0311	0.0039	0.0041	0.0043
	Arsenic (As)-Total (mg/kg)	0.788	0.724	0.032	0.028	0.048
	Arsenic (As)-Total (mg/kg wwt)	0.639	0.533	0.0181	0.0143	0.0264
	Barium (Ba)-Total (mg/kg)	90.8	72.5	97.2	108	124
	Barium (Ba)-Total (mg/kg wwt)	73.5	53.4	54.5	55.8	68.9
	Beryllium (Be)-Total (mg/kg)	0.131	0.115	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.107	0.0844	0.0022	0.0023	0.0042
	Bismuth (Bi)-Total (mg/kg)	0.149	0.145	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.121	0.107	<0.0020	<0.0020	0.0029
	Boron (B)-Total (mg/kg)	3.2	2.5	10.0	12.9	17.6
	Boron (B)-Total (mg/kg wwt)	2.63	1.85	5.60	6.65	9.75
	Cadmium (Cd)-Total (mg/kg)	0.216	0.231	0.0067	0.0070	0.0128
	Cadmium (Cd)-Total (mg/kg wwt)	0.175	0.170	0.0037	0.0036	0.0071
	Calcium (Ca)-Total (mg/kg)	8310	5900	6290	6120	6720
	Calcium (Ca)-Total (mg/kg wwt)	6730	4340	3530	3160	3720
	Cesium (Cs)-Total (mg/kg)	0.205	0.173	0.0374	0.0234	0.0369
	Cesium (Cs)-Total (mg/kg wwt)	0.166	0.127	0.0210	0.0121	0.0205
	Chromium (Cr)-Total (mg/kg)	2.20	1.97	0.117	0.127	0.167
	Chromium (Cr)-Total (mg/kg wwt)	1.78	1.45	0.066	0.066	0.093
	Cobalt (Co)-Total (mg/kg)	2.25	1.99	0.107	0.098	0.143
	Cobalt (Co)-Total (mg/kg wwt)	1.82	1.46	0.0601	0.0504	0.0793
	Copper (Cu)-Total (mg/kg)	1120	983	27.6	28.4	48.7
	Copper (Cu)-Total (mg/kg wwt)	910	724	15.5	14.6	27.0
	Iron (Fe)-Total (mg/kg)	8240	7160	258	284	419
	Iron (Fe)-Total (mg/kg wwt)	6670	5270	145	146	232
	Lead (Pb)-Total (mg/kg)	1.92	1.85	0.071	0.071	0.128
	Lead (Pb)-Total (mg/kg wwt)	1.55	1.37	0.0400	0.0368	0.0711
	Lithium (Li)-Total (mg/kg)	2.05	1.71	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	1.66	1.26	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	2280	2070	1500	1390	1220
	Magnesium (Mg)-Total (mg/kg wwt)	1840	1530	841	715	676
	Manganese (Mn)-Total (mg/kg)	414	284	331	435	595
	Manganese (Mn)-Total (mg/kg wwt)	335	209	186	224	330

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-61	L2355568-62	L2355568-63	L2355568-64	L2355568-65
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	11:05	11:05	11:05	11:05	11:05
	Client ID	S-08A (WILLOW) 1	S-08A (WILLOW) 2	S-08A (WILLOW) 3	S-08A(LICHEN) 1	S-08A(LICHEN) 2
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	57.4	62.8	60.1	32.5	26.3
Metals	Aluminum (Al)-Total (mg/kg)	120	214	167	2450	2060
	Aluminum (Al)-Total (mg/kg wwt)	51.3	79.5	66.4	1660	1520
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	0.037	0.030
	Antimony (Sb)-Total (mg/kg wwt)	0.0023	0.0032	0.0026	0.0252	0.0220
	Arsenic (As)-Total (mg/kg)	0.023	0.050	0.042	0.521	0.434
	Arsenic (As)-Total (mg/kg wwt)	0.0100	0.0184	0.0166	0.352	0.320
	Barium (Ba)-Total (mg/kg)	22.7	23.1	27.5	55.7	49.0
	Barium (Ba)-Total (mg/kg wwt)	9.66	8.60	11.0	37.6	36.1
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	0.081	0.069
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0025	0.0021	0.0544	0.0510
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	0.096	0.083
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0647	0.0610
	Boron (B)-Total (mg/kg)	12.2	19.3	12.4	2.3	2.1
	Boron (B)-Total (mg/kg wwt)	5.19	7.17	4.93	1.58	1.58
	Cadmium (Cd)-Total (mg/kg)	0.755	1.51	0.745	0.178	0.144
	Cadmium (Cd)-Total (mg/kg wwt)	0.321	0.561	0.297	0.120	0.106
	Calcium (Ca)-Total (mg/kg)	12000	12800	14000	5260	4840
	Calcium (Ca)-Total (mg/kg wwt)	5100	4750	5580	3550	3570
	Cesium (Cs)-Total (mg/kg)	0.0765	0.0668	0.0788	0.147	0.136
	Cesium (Cs)-Total (mg/kg wwt)	0.0326	0.0248	0.0314	0.0994	0.101
	Chromium (Cr)-Total (mg/kg)	0.113	0.162	0.153	1.33	1.12
	Chromium (Cr)-Total (mg/kg wwt)	0.048	0.060	0.061	0.896	0.827
	Cobalt (Co)-Total (mg/kg)	0.364	0.290	0.384	1.44	1.18
	Cobalt (Co)-Total (mg/kg wwt)	0.155	0.108	0.153	0.971	0.868
	Copper (Cu)-Total (mg/kg)	25.2	40.3	33.2	703	603
	Copper (Cu)-Total (mg/kg wwt)	10.7	15.0	13.2	475	445
	Iron (Fe)-Total (mg/kg)	246	412	342	4940	4230
	Iron (Fe)-Total (mg/kg wwt)	105	153	136	3340	3110
	Lead (Pb)-Total (mg/kg)	0.056	0.096	0.074	1.22	1.08
	Lead (Pb)-Total (mg/kg wwt)	0.0240	0.0358	0.0296	0.821	0.795
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	1.18	1.01
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	0.13	0.80	0.75
	Magnesium (Mg)-Total (mg/kg)	2760	3050	3080	1470	1310
	Magnesium (Mg)-Total (mg/kg wwt)	1180	1130	1230	992	966
	Manganese (Mn)-Total (mg/kg)	174	214	175	270	232
	Manganese (Mn)-Total (mg/kg wwt)	74.2	79.8	69.6	182	171

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-66	L2355568-67	L2355568-68	L2355568-69	L2355568-70
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:05	15:50	15:50	15:50	15:50
Client ID	S-08A(LICHEN) 3	S-07(LABRADOR TEA) 1	S-07(LABRADOR TEA) 2	S-07(LABRADOR TEA) 3	S-07(WILLOW) 1
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	26.2	42.7	45.1	45.4	60.1
Metals Aluminum (Al)-Total (mg/kg)	3190	86.0	95.6	31.3	83.7
Aluminum (Al)-Total (mg/kg wwt)	2350	49.2	52.5	17.1	33.4
Antimony (Sb)-Total (mg/kg)	0.038	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	0.0283	0.0042	0.0043	0.0034	0.0033
Arsenic (As)-Total (mg/kg)	0.622	0.036	0.031	<0.020	0.037
Arsenic (As)-Total (mg/kg wwt)	0.459	0.0205	0.0172	0.0100	0.0146
Barium (Ba)-Total (mg/kg)	73.8	76.0	62.4	68.6	59.1
Barium (Ba)-Total (mg/kg wwt)	54.5	43.5	34.3	37.5	23.6
Beryllium (Be)-Total (mg/kg)	0.107	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	0.0787	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)	0.121	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	0.0896	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	2.2	12.4	14.9	10.8	17.1
Boron (B)-Total (mg/kg wwt)	1.66	7.08	8.20	5.93	6.83
Cadmium (Cd)-Total (mg/kg)	0.174	0.0093	0.0083	0.0066	0.627
Cadmium (Cd)-Total (mg/kg wwt)	0.128	0.0053	0.0046	0.0036	0.250
Calcium (Ca)-Total (mg/kg)	5430	3510	4310	4490	13300
Calcium (Ca)-Total (mg/kg wwt)	4010	2010	2370	2450	5290
Cesium (Cs)-Total (mg/kg)	0.159	0.0060	0.0125	0.0079	0.0241
Cesium (Cs)-Total (mg/kg wwt)	0.118	0.0034	0.0069	0.0043	0.0096
Chromium (Cr)-Total (mg/kg)	1.71	0.123	0.107	0.053	0.116
Chromium (Cr)-Total (mg/kg wwt)	1.26	0.071	0.059	0.029	0.046
Cobalt (Co)-Total (mg/kg)	1.78	0.063	0.071	0.024	0.210
Cobalt (Co)-Total (mg/kg wwt)	1.31	0.0364	0.0392	0.0132	0.0839
Copper (Cu)-Total (mg/kg)	1010	29.9	32.5	14.0	25.5
Copper (Cu)-Total (mg/kg wwt)	745	17.1	17.8	7.63	10.2
Iron (Fe)-Total (mg/kg)	6490	204	217	81.3	202
Iron (Fe)-Total (mg/kg wwt)	4790	117	119	44.4	80.8
Lead (Pb)-Total (mg/kg)	1.60	0.088	0.092	0.026	0.059
Lead (Pb)-Total (mg/kg wwt)	1.18	0.0503	0.0503	0.0143	0.0234
Lithium (Li)-Total (mg/kg)	1.32	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	0.97	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	1820	1010	1050	1580	5500
Magnesium (Mg)-Total (mg/kg wwt)	1350	576	579	862	2200
Manganese (Mn)-Total (mg/kg)	285	226	547	255	215
Manganese (Mn)-Total (mg/kg wwt)	210	130	300	139	85.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-71 Tissue 27-AUG-19 15:50 S-07(WILLOW) 2	L2355568-72 Tissue 27-AUG-19 15:50 S-07(WILLOW) 3	L2355568-73 Tissue 27-AUG-19 15:50 S-07(HORSETAIL) 1	L2355568-74 Tissue 27-AUG-19 15:50 S-07(HORSETAIL) 2	L2355568-75 Tissue 27-AUG-19 15:50 S-07(HORSETAIL) 3
TISSUE						
Physical Tests	% Moisture (%)	59.2	56.8	17.4	37.2	19.5
Metals	Aluminum (Al)-Total (mg/kg)	133	53.9	9.9	15.1	19.9
	Aluminum (Al)-Total (mg/kg wwt)	54.3	23.3	8.13	9.48	16.1
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0022	0.0026	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.055	0.039	0.029	0.042	0.047
	Arsenic (As)-Total (mg/kg wwt)	0.0223	0.0168	0.0236	0.0261	0.0375
	Barium (Ba)-Total (mg/kg)	47.0	47.8	115	170	148
	Barium (Ba)-Total (mg/kg wwt)	19.2	20.6	95.3	107	119
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0024	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	17.1	19.9	15.2	24.5	25.9
	Boron (B)-Total (mg/kg wwt)	6.97	8.59	12.5	15.4	20.8
	Cadmium (Cd)-Total (mg/kg)	1.47	1.45	0.123	0.119	0.137
	Cadmium (Cd)-Total (mg/kg wwt)	0.602	0.626	0.101	0.0750	0.110
	Calcium (Ca)-Total (mg/kg)	9200	9330	13600	21000	23000
	Calcium (Ca)-Total (mg/kg wwt)	3750	4030	11200	13200	18500
	Cesium (Cs)-Total (mg/kg)	0.0146	0.0268	0.128	0.248	0.173
	Cesium (Cs)-Total (mg/kg wwt)	0.0060	0.0116	0.106	0.156	0.139
	Chromium (Cr)-Total (mg/kg)	0.182	0.258	<0.050	<0.050	0.060
	Chromium (Cr)-Total (mg/kg wwt)	0.074	0.112	0.036	0.022	0.049
	Cobalt (Co)-Total (mg/kg)	0.655	0.451	0.213	0.292	0.294
	Cobalt (Co)-Total (mg/kg wwt)	0.267	0.195	0.176	0.183	0.237
	Copper (Cu)-Total (mg/kg)	44.4	14.3	14.1	16.6	18.4
	Copper (Cu)-Total (mg/kg wwt)	18.1	6.18	11.6	10.4	14.8
	Iron (Fe)-Total (mg/kg)	325	139	33.0	45.4	53.4
	Iron (Fe)-Total (mg/kg wwt)	133	60.2	27.2	28.5	43.0
	Lead (Pb)-Total (mg/kg)	0.093	0.042	<0.020	<0.020	<0.020
	Lead (Pb)-Total (mg/kg wwt)	0.0379	0.0183	0.0085	0.0075	0.0122
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	4580	4280	3710	6020	6030
	Magnesium (Mg)-Total (mg/kg wwt)	1870	1850	3060	3780	4860
	Manganese (Mn)-Total (mg/kg)	431	194	143	186	212
	Manganese (Mn)-Total (mg/kg wwt)	176	83.6	118	117	171

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-76 Tissue 27-AUG-19 14:55 S-06(LABRADOR TEA) 1	L2355568-77 Tissue 27-AUG-19 14:55 S-06(LABRADOR TEA) 2	L2355568-78 Tissue 27-AUG-19 14:55 S-06(LABRADOR TEA) 3	L2355568-79 Tissue 27-AUG-19 09:25 S-05(LABRADOR TEA) 1	L2355568-80 Tissue 27-AUG-19 09:25 S-05(LABRADOR TEA) 2
TISSUE						
Physical Tests	% Moisture (%)	46.2	49.4	51.1	48.3	48.0
Metals	Aluminum (Al)-Total (mg/kg)	58.1	43.4	75.3	51.5	46.8
	Aluminum (Al)-Total (mg/kg wwt)	31.2	22.0	36.8	26.6	24.4
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0022	0.0022	<0.0020
	Arsenic (As)-Total (mg/kg)	0.027	<0.020	0.029	0.025	0.025
	Arsenic (As)-Total (mg/kg wwt)	0.0144	0.0078	0.0139	0.0130	0.0129
	Barium (Ba)-Total (mg/kg)	204	209	196	91.4	96.6
	Barium (Ba)-Total (mg/kg wwt)	110	106	95.8	47.3	50.2
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	6.6	10.5	9.1	10.5	10.9
	Boron (B)-Total (mg/kg wwt)	3.53	5.32	4.46	5.44	5.66
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	0.0177	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0017	0.0016	0.0086	0.0023	0.0019
	Calcium (Ca)-Total (mg/kg)	6100	6080	5730	4800	4210
	Calcium (Ca)-Total (mg/kg wwt)	3280	3080	2800	2480	2190
	Cesium (Cs)-Total (mg/kg)	0.0193	0.0195	0.0077	0.0128	0.0062
	Cesium (Cs)-Total (mg/kg wwt)	0.0104	0.0099	0.0038	0.0066	0.0032
	Chromium (Cr)-Total (mg/kg)	0.073	0.058	0.133	0.065	0.092
	Chromium (Cr)-Total (mg/kg wwt)	0.039	0.029	0.065	0.033	0.048
	Cobalt (Co)-Total (mg/kg)	0.056	0.064	0.162	0.063	0.052
	Cobalt (Co)-Total (mg/kg wwt)	0.0301	0.0323	0.0792	0.0324	0.0269
	Copper (Cu)-Total (mg/kg)	11.7	6.54	16.7	16.6	15.5
	Copper (Cu)-Total (mg/kg wwt)	6.27	3.31	8.14	8.57	8.06
	Iron (Fe)-Total (mg/kg)	80.2	51.6	117	117	104
	Iron (Fe)-Total (mg/kg wwt)	43.1	26.1	57.0	60.6	54.2
	Lead (Pb)-Total (mg/kg)	0.048	0.029	0.076	0.059	0.049
	Lead (Pb)-Total (mg/kg wwt)	0.0260	0.0146	0.0370	0.0307	0.0253
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	833	1190	1180	1000	905
	Magnesium (Mg)-Total (mg/kg wwt)	448	602	574	517	471
	Manganese (Mn)-Total (mg/kg)	875	1540	983	1250	1120
	Manganese (Mn)-Total (mg/kg wwt)	471	777	480	647	585

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-81 Description: Tissue Sampled Date: 27-AUG-19 Sampled Time: 09:25 Client ID: S-05(LABRADOR TEA) 3	L2355568-85 Tissue 27-AUG-19 09:25 S-05(HORSETAIL) 1	L2355568-86 Tissue 27-AUG-19 09:25 S-05(HORSETAIL) 2	L2355568-87 Tissue 27-AUG-19 09:25 S-05(HORSETAIL) 3	L2355568-88 Tissue 27-AUG-19 13:35 S-04(LABRADOR TEA) 1
TISSUE						
Physical Tests	% Moisture (%)	48.1	58.9	65.5	67.4	50.1
Metals	Aluminum (Al)-Total (mg/kg)	99.0	46.6	52.3	63.1	57.8
	Aluminum (Al)-Total (mg/kg wwt)	51.4	19.2	18.0	20.6	28.8
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.039	<0.020	<0.020	0.025	0.023
	Arsenic (As)-Total (mg/kg wwt)	0.0201	0.0063	0.0064	0.0081	0.0116
	Barium (Ba)-Total (mg/kg)	110	180	170	240	148
	Barium (Ba)-Total (mg/kg wwt)	57.1	73.9	58.7	78.2	73.7
	Beryllium (Be)-Total (mg/kg)	<0.010	0.014	0.012	0.013	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0056	0.0041	0.0042	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	10.6	18.6	16.3	17.2	13.9
	Boron (B)-Total (mg/kg wwt)	5.49	7.64	5.61	5.61	6.95
	Cadmium (Cd)-Total (mg/kg)	0.0087	0.0325	0.0212	0.0202	0.0066
	Cadmium (Cd)-Total (mg/kg wwt)	0.0045	0.0134	0.0073	0.0066	0.0033
	Calcium (Ca)-Total (mg/kg)	4610	24700	23700	23000	4780
	Calcium (Ca)-Total (mg/kg wwt)	2400	10200	8160	7510	2380
	Cesium (Cs)-Total (mg/kg)	0.0137	0.459	0.646	0.444	0.0066
	Cesium (Cs)-Total (mg/kg wwt)	0.0071	0.189	0.223	0.145	0.0033
	Chromium (Cr)-Total (mg/kg)	0.133	0.062	0.101	0.056	0.077
	Chromium (Cr)-Total (mg/kg wwt)	0.069	0.025	0.035	0.018	0.039
	Cobalt (Co)-Total (mg/kg)	0.083	2.55	2.26	2.27	0.076
	Cobalt (Co)-Total (mg/kg wwt)	0.0432	1.05	0.779	0.739	0.0377
	Copper (Cu)-Total (mg/kg)	28.7	4.34	5.18	7.70	10.2
	Copper (Cu)-Total (mg/kg wwt)	14.9	1.78	1.79	2.51	5.08
	Iron (Fe)-Total (mg/kg)	208	40.0	47.9	63.7	102
	Iron (Fe)-Total (mg/kg wwt)	108	16.4	16.5	20.8	50.7
	Lead (Pb)-Total (mg/kg)	0.101	<0.020	<0.020	0.020	0.056
	Lead (Pb)-Total (mg/kg wwt)	0.0525	0.0051	0.0057	0.0066	0.0278
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1100	5140	5060	4700	1070
	Magnesium (Mg)-Total (mg/kg wwt)	572	2110	1740	1530	532
	Manganese (Mn)-Total (mg/kg)	1230	632	577	584	615
	Manganese (Mn)-Total (mg/kg wwt)	639	260	199	190	307

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-89 Tissue 27-AUG-19 13:35 S-04(LABRADOR TEA) 2	L2355568-90 Tissue 27-AUG-19 13:35 S-04(LABRADOR TEA) 3	L2355568-91 Tissue 27-AUG-19 13:35 S-04 (WILLOW) 1	L2355568-92 Tissue 27-AUG-19 13:35 S-04 (WILLOW) 2	L2355568-93 Tissue 27-AUG-19 13:35 S-04 (WILLOW) 3
TISSUE						
Physical Tests	% Moisture (%)	51.2	51.4	62.4	68.0	65.4
Metals	Aluminum (Al)-Total (mg/kg)	41.1	47.4	40.9	38.0	23.4
	Aluminum (Al)-Total (mg/kg wwt)	20.1	23.0	15.4	12.2	8.08
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.024	0.021	0.025	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0119	0.0104	0.0094	0.0063	0.0042
	Barium (Ba)-Total (mg/kg)	138	130	248	133	132
	Barium (Ba)-Total (mg/kg wwt)	67.5	63.3	93.2	42.5	45.7
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	0.018	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0056	0.0021
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	15.0	11.1	12.5	3.1	8.2
	Boron (B)-Total (mg/kg wwt)	7.31	5.39	4.71	1.01	2.85
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	0.634	0.487	0.679
	Cadmium (Cd)-Total (mg/kg wwt)	0.0020	0.0020	0.238	0.156	0.235
	Calcium (Ca)-Total (mg/kg)	5730	4140	20700	15400	12800
	Calcium (Ca)-Total (mg/kg wwt)	2800	2010	7760	4930	4440
	Cesium (Cs)-Total (mg/kg)	<0.0050	0.0064	0.0075	0.0080	<0.0050
	Cesium (Cs)-Total (mg/kg wwt)	0.0023	0.0031	0.0028	0.0026	0.0014
	Chromium (Cr)-Total (mg/kg)	0.083	0.081	0.083	0.089	<0.050
	Chromium (Cr)-Total (mg/kg wwt)	0.041	0.039	0.031	0.028	0.014
	Cobalt (Co)-Total (mg/kg)	0.050	0.058	0.587	2.75	1.08
	Cobalt (Co)-Total (mg/kg wwt)	0.0244	0.0284	0.220	0.882	0.374
	Copper (Cu)-Total (mg/kg)	7.73	10.6	5.86	6.41	3.89
	Copper (Cu)-Total (mg/kg wwt)	3.78	5.14	2.20	2.05	1.35
	Iron (Fe)-Total (mg/kg)	71.8	87.8	73.8	68.5	40.3
	Iron (Fe)-Total (mg/kg wwt)	35.1	42.7	27.7	21.9	13.9
	Lead (Pb)-Total (mg/kg)	0.031	0.039	0.041	0.029	<0.020
	Lead (Pb)-Total (mg/kg wwt)	0.0149	0.0189	0.0154	0.0094	0.0059
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1360	1140	2820	2710	2740
	Magnesium (Mg)-Total (mg/kg wwt)	664	556	1060	868	947
	Manganese (Mn)-Total (mg/kg)	522	567	131	301	327
	Manganese (Mn)-Total (mg/kg wwt)	255	276	49.3	96.4	113

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-97 Tissue 28-AUG-19 17:35 S-03(WILLOW) 1	L2355568-98 Tissue 28-AUG-19 17:35 S-03(WILLOW) 2	L2355568-99 Tissue 28-AUG-19 17:35 S-03(WILLOW) 3	L2355568-100 Tissue 28-AUG-19 17:00 S-01 (LABRADOR TEA) 1	L2355568-101 Tissue 28-AUG-19 17:00 S-01 (LABRADOR TEA) 2
TISSUE						
Physical Tests	% Moisture (%)	64.4	62.0	63.5	45.9	50.0
Metals	Aluminum (Al)-Total (mg/kg)	120	135	103	29.0	25.9
	Aluminum (Al)-Total (mg/kg wwt)	42.6	51.3	37.6	15.7	13.0
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0034	0.0035	0.0025	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.060	0.067	0.060	0.021	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0214	0.0253	0.0218	0.0112	0.0096
	Barium (Ba)-Total (mg/kg)	112	107	103	128	118
	Barium (Ba)-Total (mg/kg wwt)	40.0	40.5	37.7	69.2	59.3
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	15.6	14.3	13.8	9.0	6.6
	Boron (B)-Total (mg/kg wwt)	5.56	5.43	5.04	4.88	3.30
	Cadmium (Cd)-Total (mg/kg)	0.772	0.518	0.555	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.275	0.197	0.203	0.0014	<0.0010
	Calcium (Ca)-Total (mg/kg)	29700	26200	28300	7490	6510
	Calcium (Ca)-Total (mg/kg wwt)	10600	9960	10300	4050	3260
	Cesium (Cs)-Total (mg/kg)	0.0112	0.0139	0.0137	0.0933	0.0502
	Cesium (Cs)-Total (mg/kg wwt)	0.0040	0.0053	0.0050	0.0505	0.0251
	Chromium (Cr)-Total (mg/kg)	0.250	0.249	0.284	0.138	0.103
	Chromium (Cr)-Total (mg/kg wwt)	0.089	0.095	0.104	0.075	0.051
	Cobalt (Co)-Total (mg/kg)	0.244	0.180	0.180	0.031	0.048
	Cobalt (Co)-Total (mg/kg wwt)	0.0868	0.0683	0.0657	0.0168	0.0240
	Copper (Cu)-Total (mg/kg)	7.09	7.84	6.94	6.74	7.04
	Copper (Cu)-Total (mg/kg wwt)	2.52	2.98	2.53	3.65	3.52
	Iron (Fe)-Total (mg/kg)	208	231	176	61.9	56.5
	Iron (Fe)-Total (mg/kg wwt)	74.1	87.8	64.2	33.5	28.3
	Lead (Pb)-Total (mg/kg)	0.065	0.066	0.052	0.028	0.026
	Lead (Pb)-Total (mg/kg wwt)	0.0232	0.0251	0.0190	0.0151	0.0130
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	2450	2440	2750	1620	1740
	Magnesium (Mg)-Total (mg/kg wwt)	870	925	1010	877	871
	Manganese (Mn)-Total (mg/kg)	55.8	65.9	61.7	757	781
	Manganese (Mn)-Total (mg/kg wwt)	19.9	25.0	22.5	410	391

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-102	L2355568-103	L2355568-104	L2355568-105	L2355568-106
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	17:00	08:15	08:15	08:15	08:15
	Client ID	S-01 (LABRADOR TEA) 3	M-07B (LABRADOR TEA) 1	M-07B (LABRADOR TEA) 2	M-07B (LABRADOR TEA) 3	M-07B (WILLOW) 1
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	48.5	51.6	49.0	46.6	57.3
Metals	Aluminum (Al)-Total (mg/kg)	21.3	33.0	20.8	17.6	26.7
	Aluminum (Al)-Total (mg/kg wwt)	11.0	16.0	10.6	9.40	11.4
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0020	0.0022
	Arsenic (As)-Total (mg/kg)	0.025	0.022	0.028	0.022	0.024
	Arsenic (As)-Total (mg/kg wwt)	0.0130	0.0108	0.0142	0.0118	0.0102
	Barium (Ba)-Total (mg/kg)	101	139	80.9	92.6	63.9
	Barium (Ba)-Total (mg/kg wwt)	52.0	67.3	41.3	49.4	27.3
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	10.7	7.4	12.9	15.1	14.1
	Boron (B)-Total (mg/kg wwt)	5.49	3.59	6.56	8.04	6.01
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	0.0066	0.152
	Cadmium (Cd)-Total (mg/kg wwt)	0.0015	0.0011	0.0020	0.0035	0.0650
	Calcium (Ca)-Total (mg/kg)	7710	7080	7720	7890	24300
	Calcium (Ca)-Total (mg/kg wwt)	3970	3420	3940	4220	10400
	Cesium (Cs)-Total (mg/kg)	0.0135	0.0909	0.0088	0.0093	0.0104
	Cesium (Cs)-Total (mg/kg wwt)	0.0070	0.0439	0.0045	0.0050	0.0045
	Chromium (Cr)-Total (mg/kg)	0.187	0.119	0.071	0.089	0.084
	Chromium (Cr)-Total (mg/kg wwt)	0.096	0.058	0.036	0.047	0.036
	Cobalt (Co)-Total (mg/kg)	0.022	0.058	0.023	0.025	0.203
	Cobalt (Co)-Total (mg/kg wwt)	0.0114	0.0280	0.0119	0.0135	0.0868
	Copper (Cu)-Total (mg/kg)	6.98	7.09	5.42	5.45	6.61
	Copper (Cu)-Total (mg/kg wwt)	3.59	3.43	2.77	2.91	2.83
	Iron (Fe)-Total (mg/kg)	58.0	63.6	60.3	61.9	79.1
	Iron (Fe)-Total (mg/kg wwt)	29.9	30.7	30.8	33.0	33.8
	Lead (Pb)-Total (mg/kg)	0.046	0.027	0.037	0.029	0.045
	Lead (Pb)-Total (mg/kg wwt)	0.0234	0.0131	0.0191	0.0156	0.0190
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	1560	1580	1540	1660	6790
	Magnesium (Mg)-Total (mg/kg wwt)	801	764	787	884	2900
	Manganese (Mn)-Total (mg/kg)	283	942	249	390	126
	Manganese (Mn)-Total (mg/kg wwt)	146	455	127	208	53.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-107	L2355568-108	L2355568-109	L2355568-110	L2355568-111
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	08:15	08:15	06:50	06:50	06:50
	Client ID	M-07B (WILLOW) 2	M-07B (WILLOW) 3	M-26 (LABRADOR TEA) 1	M-26 (LABRADOR TEA) 2	M-26 (LABRADOR TEA) 3
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	58.1	55.0	49.5	48.9	44.2
Metals	Aluminum (Al)-Total (mg/kg)	20.7	13.2	12.9	14.5	16.5
	Aluminum (Al)-Total (mg/kg wwt)	8.67	5.92	6.54	7.41	8.90
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0022	<0.0020	0.0021
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0066	0.0053	0.0071	0.0081	0.0095
	Barium (Ba)-Total (mg/kg)	38.7	34.5	110	116	117
	Barium (Ba)-Total (mg/kg wwt)	16.2	15.5	55.5	59.2	66.4
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	16.5	15.8	11.5	9.6	9.1
	Boron (B)-Total (mg/kg wwt)	6.91	7.08	5.80	4.92	5.76
	Cadmium (Cd)-Total (mg/kg)	0.211	0.258	<0.0050	<0.0050	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0884	0.116	0.0011	0.0018	0.0029
	Calcium (Ca)-Total (mg/kg)	18700	20300	5600	5120	5440
	Calcium (Ca)-Total (mg/kg wwt)	7830	9130	2830	2620	2820
	Cesium (Cs)-Total (mg/kg)	0.0252	0.0232	0.0082	0.0090	0.0081
	Cesium (Cs)-Total (mg/kg wwt)	0.0106	0.0104	0.0041	0.0046	0.0041
	Chromium (Cr)-Total (mg/kg)	0.210	0.081	0.091	0.071	0.096
	Chromium (Cr)-Total (mg/kg wwt)	0.088	0.037	0.046	0.036	0.052
	Cobalt (Co)-Total (mg/kg)	0.294	0.269	<0.020	<0.020	0.020
	Cobalt (Co)-Total (mg/kg wwt)	0.123	0.121	0.0089	0.0095	0.0106
	Copper (Cu)-Total (mg/kg)	4.45	3.40	5.11	5.02	5.57
	Copper (Cu)-Total (mg/kg wwt)	1.87	1.53	2.58	2.57	3.07
	Iron (Fe)-Total (mg/kg)	56.9	41.9	39.5	41.9	46.4
	Iron (Fe)-Total (mg/kg wwt)	23.9	18.9	20.0	21.4	24.9
	Lead (Pb)-Total (mg/kg)	0.037	0.023	0.030	0.032	0.039
	Lead (Pb)-Total (mg/kg wwt)	0.0156	0.0102	0.0153	0.0165	0.0212
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	4790	5860	1250	1120	1310
	Magnesium (Mg)-Total (mg/kg wwt)	2010	2630	632	574	689
	Manganese (Mn)-Total (mg/kg)	293	295	179	198	174
	Manganese (Mn)-Total (mg/kg wwt)	123	133	90.6	101	95.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-112 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 06:50 Client ID: M-26 (WILLOW) 1	L2355568-113 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 2	L2355568-114 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 3	L2355568-115 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 1	L2355568-116 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 2
TISSUE						
Physical Tests	% Moisture (%)	60.0	57.2	60.8	36.3	17.1
Metals	Aluminum (Al)-Total (mg/kg)	15.4	11.1	12.5	197	191
	Aluminum (Al)-Total (mg/kg wwt)	6.04	4.71	4.35	126	159
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	0.012	0.011
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0025	<0.0020	0.0081	0.0096
	Arsenic (As)-Total (mg/kg)	0.023	<0.020	<0.020	0.143	0.150
	Arsenic (As)-Total (mg/kg wwt)	0.0105	0.0058	0.0069	0.0898	0.124
	Barium (Ba)-Total (mg/kg)	56.8	41.8	57.9	26.8	22.3
	Barium (Ba)-Total (mg/kg wwt)	22.2	18.5	21.8	17.4	18.4
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0031	0.0044
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0041	0.0046
	Boron (B)-Total (mg/kg)	10.4	9.6	7.0	1.3	1.2
	Boron (B)-Total (mg/kg wwt)	4.49	4.58	2.95	0.78	1.04
	Cadmium (Cd)-Total (mg/kg)	1.20	1.22	1.39	0.0567	0.138
	Cadmium (Cd)-Total (mg/kg wwt)	0.495	0.491	0.523	0.0356	0.107
	Calcium (Ca)-Total (mg/kg)	18000	16100	18600	2500	2720
	Calcium (Ca)-Total (mg/kg wwt)	6800	6480	6890	1480	2120
	Cesium (Cs)-Total (mg/kg)	0.0072	<0.0050	<0.0050	0.0537	0.0429
	Cesium (Cs)-Total (mg/kg wwt)	0.0026	0.0016	0.0014	0.0333	0.0333
	Chromium (Cr)-Total (mg/kg)	0.081	0.092	0.092	0.319	0.343
	Chromium (Cr)-Total (mg/kg wwt)	0.031	0.041	0.033	0.194	0.281
	Cobalt (Co)-Total (mg/kg)	0.185	0.313	0.241	0.146	0.145
	Cobalt (Co)-Total (mg/kg wwt)	0.0706	0.130	0.0867	0.0917	0.120
	Copper (Cu)-Total (mg/kg)	3.78	3.90	4.16	30.6	23.9
	Copper (Cu)-Total (mg/kg wwt)	1.46	1.66	1.52	18.9	20.2
	Iron (Fe)-Total (mg/kg)	47.3	39.2	36.1	370	341
	Iron (Fe)-Total (mg/kg wwt)	18.7	16.1	14.5	221	284
	Lead (Pb)-Total (mg/kg)	0.035	0.022	0.023	0.179	0.199
	Lead (Pb)-Total (mg/kg wwt)	0.0156	0.0097	0.0108	0.120	0.174
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	4810	3980	4900	512	564
	Magnesium (Mg)-Total (mg/kg wwt)	1750	1580	1630	291	438
	Manganese (Mn)-Total (mg/kg)	169	119	107	47.2	33.2
	Manganese (Mn)-Total (mg/kg wwt)	62.4	47.4	39.3	28.9	27.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-117	L2355568-118	L2355568-119	L2355568-120	L2355568-121
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	06:50	14:10	14:10	14:10	14:10
	Client ID	M-26 (LICHEN) 3	M-80(LABRADOR TEA)1	M-80(LABRADOR TEA)2	M-80(LABRADOR TEA)3	M-80 (WILLOW)1
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	18.3	44.3	44.5	45.5	59.2
Metals	Aluminum (Al)-Total (mg/kg)	285	40.7	46.2	36.1	29.8
	Aluminum (Al)-Total (mg/kg wwt)	233	22.1	25.6	17.9	12.2
	Antimony (Sb)-Total (mg/kg)	0.017	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0143	0.0024	<0.0020	0.0022	<0.0020
	Arsenic (As)-Total (mg/kg)	0.179	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.146	0.0115	0.0074	0.0067	0.0066
	Barium (Ba)-Total (mg/kg)	37.3	127	137	126	311
	Barium (Ba)-Total (mg/kg wwt)	30.8	71.8	76.0	64.6	127
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0069	<0.0020	<0.0020	<0.0020	0.0039
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0060	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	1.3	13.7	9.3	10.4	17.5
	Boron (B)-Total (mg/kg wwt)	1.11	8.89	5.16	6.26	7.12
	Cadmium (Cd)-Total (mg/kg)	0.113	<0.0050	<0.0050	<0.0050	2.22
	Cadmium (Cd)-Total (mg/kg wwt)	0.0915	0.0016	0.0017	0.0014	0.905
	Calcium (Ca)-Total (mg/kg)	3940	5760	7280	5960	24600
	Calcium (Ca)-Total (mg/kg wwt)	3090	2890	4040	3080	10000
	Cesium (Cs)-Total (mg/kg)	0.0650	0.0139	0.0188	0.0252	<0.0050
	Cesium (Cs)-Total (mg/kg wwt)	0.0514	0.0076	0.0105	0.0127	0.0011
	Chromium (Cr)-Total (mg/kg)	0.412	0.089	0.122	0.126	0.117
	Chromium (Cr)-Total (mg/kg wwt)	0.332	0.048	0.068	0.063	0.048
	Cobalt (Co)-Total (mg/kg)	0.195	0.070	0.075	0.084	1.26
	Cobalt (Co)-Total (mg/kg wwt)	0.161	0.0385	0.0415	0.0416	0.515
	Copper (Cu)-Total (mg/kg)	27.1	6.07	4.82	6.26	7.15
	Copper (Cu)-Total (mg/kg wwt)	21.7	3.34	2.67	3.23	2.91
	Iron (Fe)-Total (mg/kg)	483	48.6	51.5	36.5	44.4
	Iron (Fe)-Total (mg/kg wwt)	376	26.0	28.6	18.7	18.1
	Lead (Pb)-Total (mg/kg)	0.292	0.033	0.030	<0.020	0.027
	Lead (Pb)-Total (mg/kg wwt)	0.245	0.0190	0.0169	0.0077	0.0111
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	599	903	1340	1300	2880
	Magnesium (Mg)-Total (mg/kg wwt)	446	463	746	607	1170
	Manganese (Mn)-Total (mg/kg)	56.3	1710	1770	896	136
	Manganese (Mn)-Total (mg/kg wwt)	43.9	884	983	434	55.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-122	L2355568-123	L2355568-125	L2355568-126	L2355568-127
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	14:10	14:10	14:40	14:40	14:40
Client ID	M-80 (WILLOW)2	M-80 (WILLOW)3	C-02 (LABRADOR TEA) 1	C-02 (LABRADOR TEA) 2	C-02 (LABRADOR TEA) 3
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	58.2	61.8	46.0	41.5	40.9
Metals Aluminum (Al)-Total (mg/kg)	18.1	20.7	25.2	38.0	20.1
Aluminum (Al)-Total (mg/kg wwt)	7.55	7.91	13.6	22.2	11.9
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Arsenic (As)-Total (mg/kg wwt)	0.0057	0.0064	0.0066	0.0088	0.0072
Barium (Ba)-Total (mg/kg)	293	307	111	91.1	77.2
Barium (Ba)-Total (mg/kg wwt)	122	117	59.9	53.3	45.7
Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	0.0022	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total (mg/kg)	18.3	27.3	14.2	12.4	10.9
Boron (B)-Total (mg/kg wwt)	7.67	10.4	7.67	7.23	6.44
Cadmium (Cd)-Total (mg/kg)	3.40	3.67	<0.0050	0.0084	<0.0050
Cadmium (Cd)-Total (mg/kg wwt)	1.42	1.40	0.0024	0.0049	0.0021
Calcium (Ca)-Total (mg/kg)	25300	27900	4000	4680	4160
Calcium (Ca)-Total (mg/kg wwt)	10600	10600	2160	2740	2460
Cesium (Cs)-Total (mg/kg)	<0.0050	<0.0050	0.0269	0.0060	0.0067
Cesium (Cs)-Total (mg/kg wwt)	0.0014	0.0015	0.0145	0.0035	0.0039
Chromium (Cr)-Total (mg/kg)	0.084	0.080	0.094	0.092	0.115
Chromium (Cr)-Total (mg/kg wwt)	0.035	0.031	0.051	0.054	0.068
Cobalt (Co)-Total (mg/kg)	1.19	1.06	0.029	0.033	0.027
Cobalt (Co)-Total (mg/kg wwt)	0.496	0.405	0.0158	0.0196	0.0157
Copper (Cu)-Total (mg/kg)	7.31	8.18	6.65	7.53	6.38
Copper (Cu)-Total (mg/kg wwt)	3.06	3.12	3.59	4.41	3.77
Iron (Fe)-Total (mg/kg)	39.4	46.5	45.5	59.5	48.1
Iron (Fe)-Total (mg/kg wwt)	16.5	17.8	24.5	34.8	28.5
Lead (Pb)-Total (mg/kg)	<0.020	0.029	0.021	0.032	0.024
Lead (Pb)-Total (mg/kg wwt)	0.0081	0.0110	0.0114	0.0190	0.0144
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	3450	4030	1010	1080	1020
Magnesium (Mg)-Total (mg/kg wwt)	1440	1540	543	629	601
Manganese (Mn)-Total (mg/kg)	142	250	1150	767	700
Manganese (Mn)-Total (mg/kg wwt)	59.3	95.4	621	449	414

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-128 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 14:40 Client ID: C-02 (WILLOW) 1	L2355568-129 Tissue 28-AUG-19 14:40 C-02 (WILLOW) 2	L2355568-130 Tissue 28-AUG-19 14:40 C-02 (WILLOW) 3	L2355568-131 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 1	L2355568-132 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 2
TISSUE						
Physical Tests	% Moisture (%)	60.4	60.3	63.4	19.4	19.3
Metals	Aluminum (Al)-Total (mg/kg)	24.7	22.5	10.4	634	730
	Aluminum (Al)-Total (mg/kg wwt)	9.79	8.93	3.81	512	589
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	0.022	0.026
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0180	0.0206
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	0.238	0.269
	Arsenic (As)-Total (mg/kg wwt)	0.0059	0.0076	0.0045	0.192	0.217
	Barium (Ba)-Total (mg/kg)	184	44.9	44.0	37.3	34.7
	Barium (Ba)-Total (mg/kg wwt)	72.8	17.8	16.1	30.1	28.0
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	0.017	0.020
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0137	0.0163
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	0.013	0.013
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0107	0.0105
	Boron (B)-Total (mg/kg)	12.0	16.4	21.6	2.1	1.8
	Boron (B)-Total (mg/kg wwt)	4.75	6.52	7.91	1.65	1.47
	Cadmium (Cd)-Total (mg/kg)	1.37	1.13	1.69	0.0675	0.0735
	Cadmium (Cd)-Total (mg/kg wwt)	0.543	0.447	0.619	0.0544	0.0593
	Calcium (Ca)-Total (mg/kg)	24800	16700	14700	3820	3070
	Calcium (Ca)-Total (mg/kg wwt)	9820	6630	5370	3080	2480
	Cesium (Cs)-Total (mg/kg)	0.0053	0.0065	0.0120	0.0500	0.0605
	Cesium (Cs)-Total (mg/kg wwt)	0.0021	0.0026	0.0044	0.0403	0.0488
	Chromium (Cr)-Total (mg/kg)	0.083	0.107	<0.050	0.808	0.972
	Chromium (Cr)-Total (mg/kg wwt)	0.033	0.042	0.017	0.651	0.784
	Cobalt (Co)-Total (mg/kg)	1.26	0.519	0.182	0.359	0.389
	Cobalt (Co)-Total (mg/kg wwt)	0.499	0.206	0.0664	0.289	0.314
	Copper (Cu)-Total (mg/kg)	5.80	5.70	4.60	77.9	68.7
	Copper (Cu)-Total (mg/kg wwt)	2.30	2.26	1.68	62.8	55.4
	Iron (Fe)-Total (mg/kg)	48.7	57.6	35.2	966	1050
	Iron (Fe)-Total (mg/kg wwt)	19.3	22.9	12.9	779	846
	Lead (Pb)-Total (mg/kg)	0.024	0.020	<0.020	0.321	0.335
	Lead (Pb)-Total (mg/kg wwt)	0.0095	0.0080	0.0054	0.258	0.270
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	0.24	0.28
	Magnesium (Mg)-Total (mg/kg)	3490	5510	4640	782	735
	Magnesium (Mg)-Total (mg/kg wwt)	1380	2190	1700	631	593
	Manganese (Mn)-Total (mg/kg)	59.0	172	128	220	182
	Manganese (Mn)-Total (mg/kg wwt)	23.4	68.4	46.6	178	147

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-133 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 3	L2355568-137 Tissue 28-AUG-19 15:55 C-01(HORSETAIL) 1	L2355568-138 Tissue 28-AUG-19 15:55 C-01(HORSETAIL) 2	L2355568-139 Tissue 28-AUG-19 15:55 C-01(HORSETAIL) 3	L2355568-140 Tissue 28-AUG-19 15:55 C-01 (LABRADOR TEA) 1
TISSUE						
Physical Tests	% Moisture (%)	14.5	63.6	63.5	59.0	45.5
Metals	Aluminum (Al)-Total (mg/kg)	819	30.9	14.5	29.3	47.2
	Aluminum (Al)-Total (mg/kg wwt)	700	11.3	5.29	12.0	25.7
	Antimony (Sb)-Total (mg/kg)	0.026	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0227	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	0.278	0.027	<0.020	0.022	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.238	0.0100	0.0052	0.0092	0.0105
	Barium (Ba)-Total (mg/kg)	57.5	308	227	234	117
	Barium (Ba)-Total (mg/kg wwt)	49.1	112	82.6	96.1	63.6
	Beryllium (Be)-Total (mg/kg)	0.022	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	0.0189	0.0032	0.0022	0.0029	<0.0020
	Bismuth (Bi)-Total (mg/kg)	0.012	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	0.0100	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	2.2	29.5	20.6	21.8	21.8
	Boron (B)-Total (mg/kg wwt)	1.92	10.8	7.49	8.95	11.9
	Cadmium (Cd)-Total (mg/kg)	0.0822	0.648	0.219	0.377	<0.0050
	Cadmium (Cd)-Total (mg/kg wwt)	0.0703	0.236	0.0799	0.154	0.0021
	Calcium (Ca)-Total (mg/kg)	5200	24900	22900	22100	6190
	Calcium (Ca)-Total (mg/kg wwt)	4450	9070	8340	9070	3370
	Cesium (Cs)-Total (mg/kg)	0.0637	0.0435	0.0458	0.0572	0.0058
	Cesium (Cs)-Total (mg/kg wwt)	0.0544	0.0158	0.0167	0.0235	0.0032
	Chromium (Cr)-Total (mg/kg)	1.04	0.448	0.094	0.177	0.120
	Chromium (Cr)-Total (mg/kg wwt)	0.893	0.163	0.034	0.073	0.066
	Cobalt (Co)-Total (mg/kg)	0.516	0.150	0.077	0.111	0.042
	Cobalt (Co)-Total (mg/kg wwt)	0.441	0.0547	0.0280	0.0456	0.0230
	Copper (Cu)-Total (mg/kg)	63.5	4.25	2.84	4.06	4.46
	Copper (Cu)-Total (mg/kg wwt)	54.3	1.55	1.04	1.66	2.43
	Iron (Fe)-Total (mg/kg)	1110	72.0	25.6	52.5	60.2
	Iron (Fe)-Total (mg/kg wwt)	952	26.2	9.33	21.5	32.8
	Lead (Pb)-Total (mg/kg)	0.327	0.046	<0.020	0.034	0.041
	Lead (Pb)-Total (mg/kg wwt)	0.279	0.0169	0.0046	0.0141	0.0223
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	0.33	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	997	3600	3350	3260	969
	Magnesium (Mg)-Total (mg/kg wwt)	853	1310	1220	1340	528
	Manganese (Mn)-Total (mg/kg)	191	169	149	152	1220
	Manganese (Mn)-Total (mg/kg wwt)	163	61.4	54.2	62.4	662

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-141	L2355568-142	L2355568-143	L2355568-144	L2355568-145
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	15:55	15:55	15:55	17:35	17:35
	Client ID	C-01 (LABRADOR TEA) 2	C-01 (LABRADOR TEA) 3	C-01 (WILLOW) 1	C-01 (WILLOW) 2	C-01 (WILLOW) 3
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	45.4	46.9	57.5	57.5	61.9
Metals	Aluminum (Al)-Total (mg/kg)	34.7	19.9	9.7	16.1	24.7
	Aluminum (Al)-Total (mg/kg wwt)	18.9	10.6	4.12	6.86	9.41
	Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total (mg/kg wwt)	0.0036	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Arsenic (As)-Total (mg/kg wwt)	0.0076	0.0055	<0.0040	0.0080	0.0060
	Barium (Ba)-Total (mg/kg)	78.2	66.1	99.4	141	54.1
	Barium (Ba)-Total (mg/kg wwt)	42.8	35.1	42.2	60.0	20.6
	Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	0.010	<0.010
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0023	0.0044	0.0023
	Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg)	15.9	17.5	14.0	16.9	18.8
	Boron (B)-Total (mg/kg wwt)	8.70	9.31	5.94	7.21	7.15
	Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	3.02	4.84	4.32
	Cadmium (Cd)-Total (mg/kg wwt)	0.0013	0.0012	1.28	2.06	1.65
	Calcium (Ca)-Total (mg/kg)	4440	4090	17900	23400	10500
	Calcium (Ca)-Total (mg/kg wwt)	2430	2170	7610	9960	3990
	Cesium (Cs)-Total (mg/kg)	<0.0050	0.0052	<0.0050	<0.0050	<0.0050
	Cesium (Cs)-Total (mg/kg wwt)	0.0020	0.0028	<0.0010	<0.0010	0.0015
	Chromium (Cr)-Total (mg/kg)	0.117	0.149	0.065	0.065	0.109
	Chromium (Cr)-Total (mg/kg wwt)	0.064	0.079	0.028	0.028	0.042
	Cobalt (Co)-Total (mg/kg)	0.025	<0.020	0.664	1.12	0.420
	Cobalt (Co)-Total (mg/kg wwt)	0.0138	0.0082	0.282	0.476	0.160
	Copper (Cu)-Total (mg/kg)	4.23	4.78	2.29	3.01	4.63
	Copper (Cu)-Total (mg/kg wwt)	2.31	2.54	0.973	1.28	1.77
	Iron (Fe)-Total (mg/kg)	41.9	37.1	29.0	39.0	55.3
	Iron (Fe)-Total (mg/kg wwt)	22.9	19.7	12.3	16.6	21.1
	Lead (Pb)-Total (mg/kg)	0.022	0.020	<0.020	0.024	0.035
	Lead (Pb)-Total (mg/kg wwt)	0.0118	0.0109	0.0062	0.0104	0.0133
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg)	989	1160	3670	4920	3230
	Magnesium (Mg)-Total (mg/kg wwt)	540	616	1560	2090	1230
	Manganese (Mn)-Total (mg/kg)	1070	747	192	421	497
	Manganese (Mn)-Total (mg/kg wwt)	587	397	81.5	179	190

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-147	L2355568-148	L2355568-149	L2355568-150	L2355568-151
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date					
Sampled Time					
Client ID	S-03 (CRANBERRY) 2	S-03 (CRANBERRY) 3	S-05(WILLOW) 1	S-05(WILLOW) 2	S-05(WILLOW) 3
Grouping / **Analyte**					
TISSUE					
Physical Tests % Moisture (%)	80.5	80.5	58.7	61.2	58.1
Metals Aluminum (Al)-Total (mg/kg)	23.0	16.6	58.8	182	33.2
Aluminum (Al)-Total (mg/kg wwt)	4.69	3.48	24.2	70.6	13.9
Antimony (Sb)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0026	<0.0020
Arsenic (As)-Total (mg/kg)	0.024	<0.020	<0.020	0.050	<0.020
Arsenic (As)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0074	0.0194	0.0051
Barium (Ba)-Total (mg/kg)	22.7	17.8	47.5	41.3	44.9
Barium (Ba)-Total (mg/kg wwt)	4.26	3.30	19.6	16.0	18.8
Beryllium (Be)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0039	0.0022
Bismuth (Bi)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0023	<0.0020
Boron (B)-Total (mg/kg)	12.6	10.0	5.6	6.2	5.1
Boron (B)-Total (mg/kg wwt)	2.31	1.88	2.29	2.43	2.13
Cadmium (Cd)-Total (mg/kg)	<0.0050	<0.0050	0.573	0.239	0.712
Cadmium (Cd)-Total (mg/kg wwt)	<0.0010	<0.0010	0.236	0.0929	0.298
Calcium (Ca)-Total (mg/kg)	1640	1240	8230	9100	9140
Calcium (Ca)-Total (mg/kg wwt)	327	250	3400	3530	3830
Cesium (Cs)-Total (mg/kg)	0.0067	0.0092	0.0094	0.0452	0.0075
Cesium (Cs)-Total (mg/kg wwt)	0.0013	0.0019	0.0039	0.0175	0.0031
Chromium (Cr)-Total (mg/kg)	0.236	0.225	0.072	0.186	0.056
Chromium (Cr)-Total (mg/kg wwt)	0.048	0.044	0.030	0.072	0.023
Cobalt (Co)-Total (mg/kg)	<0.020	<0.020	1.36	1.08	1.55
Cobalt (Co)-Total (mg/kg wwt)	<0.0040	<0.0040	0.560	0.420	0.650
Copper (Cu)-Total (mg/kg)	4.40	4.03	16.3	45.8	8.36
Copper (Cu)-Total (mg/kg wwt)	0.891	0.803	6.73	17.8	3.50
Iron (Fe)-Total (mg/kg)	28.5	22.2	141	371	90.1
Iron (Fe)-Total (mg/kg wwt)	5.36	4.27	58.3	144	37.8
Lead (Pb)-Total (mg/kg)	<0.020	<0.020	0.040	0.127	0.025
Lead (Pb)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0164	0.0494	0.0103
Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	0.10	<0.10
Magnesium (Mg)-Total (mg/kg)	738	610	1720	3500	2140
Magnesium (Mg)-Total (mg/kg wwt)	154	124	710	1360	895
Manganese (Mn)-Total (mg/kg)	381	285	881	849	1130
Manganese (Mn)-Total (mg/kg wwt)	83.4	59.5	364	330	472

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-1	L2355568-2	L2355568-3	L2355568-4	L2355568-5
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	03:56	03:56	03:56	03:56	03:56
	Client ID	C-01A (HORSETAIL) 1	C-01A (HORSETAIL) 2	C-01A (HORSETAIL) 3	C-01A (LABRADOR TEA) 1	C-01A (LABRADOR TEA) 2
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0064	<0.0050	0.0055	0.0059	0.0053
	Mercury (Hg)-Total (mg/kg wwt)	0.0020	0.0014	0.0020	0.0032	0.0026
	Molybdenum (Mo)-Total (mg/kg)	0.207	0.147	0.181	0.159	0.235
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0652	0.0438	0.0649	0.0849	0.117
	Nickel (Ni)-Total (mg/kg)	3.52	2.56	3.09	0.32	0.47
	Nickel (Ni)-Total (mg/kg wwt)	1.11	0.767	1.11	0.173	0.236
	Phosphorus (P)-Total (mg/kg)	854	815	939	1130	1200
	Phosphorus (P)-Total (mg/kg wwt)	268	244	337	602	597
	Potassium (K)-Total (mg/kg)	20800	19000	17800	3320	3470
	Potassium (K)-Total (mg/kg wwt)	6540	5670	6380	1770	1730
	Rubidium (Rb)-Total (mg/kg)	14.5	16.9	14.9	4.08	2.02
	Rubidium (Rb)-Total (mg/kg wwt)	4.55	5.05	5.32	2.18	1.00
	Selenium (Se)-Total (mg/kg)	0.066	0.054	0.060	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.021	0.016	0.021	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	5.4	<4.0	4.7	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	112	84.5	106	8.25	15.5
	Strontium (Sr)-Total (mg/kg wwt)	35.3	25.3	37.9	4.40	7.70
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0035	0.0053
	Thallium (Tl)-Total (mg/kg wwt)	0.00051	<0.00040	0.00049	0.00189	0.00265
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	0.022
	Zinc (Zn)-Total (mg/kg)	30.9	27.3	30.6	19.1	20.4
	Zinc (Zn)-Total (mg/kg wwt)	9.71	8.16	11.0	10.2	10.1
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-6	L2355568-7	L2355568-8	L2355568-9	L2355568-10
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	03:56	03:56	03:56	03:56	10:30
	Client ID	C-01A (LABRADOR TEA) 3	C-01A (WILLOW) 1	C-01A (WILLOW) 2	C-01A (WILLOW) 3	M-29 (LABRADOR TEA) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	<0.0050	<0.0050	0.0078	0.0070	0.0054
	Mercury (Hg)-Total (mg/kg wwt)	0.0027	0.0015	0.0029	0.0031	0.0029
	Molybdenum (Mo)-Total (mg/kg)	0.544	0.377	0.327	0.422	1.56
	Molybdenum (Mo)-Total (mg/kg wwt)	0.311	0.135	0.123	0.186	0.835
	Nickel (Ni)-Total (mg/kg)	0.56	9.95	5.14	1.00	0.30
	Nickel (Ni)-Total (mg/kg wwt)	0.320	3.56	1.93	0.440	0.162
	Phosphorus (P)-Total (mg/kg)	1080	4000	3790	6240	1100
	Phosphorus (P)-Total (mg/kg wwt)	620	1440	1420	2750	588
	Potassium (K)-Total (mg/kg)	3450	6610	9380	10000	2990
	Potassium (K)-Total (mg/kg wwt)	1980	2370	3520	4430	1590
	Rubidium (Rb)-Total (mg/kg)	0.844	0.704	1.32	2.20	2.32
	Rubidium (Rb)-Total (mg/kg wwt)	0.483	0.252	0.496	0.969	1.24
	Selenium (Se)-Total (mg/kg)	<0.050	0.051	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.018	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	11.5	114	69.0	94.5	7.02
	Strontium (Sr)-Total (mg/kg wwt)	6.59	40.8	25.9	41.7	3.74
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0044	<0.0020	<0.0020	<0.0020	0.0229
	Thallium (Tl)-Total (mg/kg wwt)	0.00250	0.00043	0.00052	<0.00040	0.0122
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	0.00063	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	0.036	<0.020	0.024
	Zinc (Zn)-Total (mg/kg)	22.7	130	221	177	22.2
	Zinc (Zn)-Total (mg/kg wwt)	13.0	46.6	83.0	78.3	11.8
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-11	L2355568-12	L2355568-13	L2355568-14	L2355568-15
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	10:30	10:30	07:40	07:40	07:40
	Client ID	M-29 (LABRADOR TEA) 2	M-29 (LABRADOR TEA) 3	S-19 (LABRADOR TEA) 1	S-19 (LABRADOR TEA) 2	S-19 (LABRADOR TEA) 3
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0070	<0.0050	0.0062	0.0063	0.0050
	Mercury (Hg)-Total (mg/kg wwt)	0.0036	0.0023	0.0035	0.0036	0.0027
	Molybdenum (Mo)-Total (mg/kg)	1.56	0.698	0.233	0.183	0.167
	Molybdenum (Mo)-Total (mg/kg wwt)	0.813	0.364	0.132	0.104	0.0884
	Nickel (Ni)-Total (mg/kg)	0.25	0.22	0.39	0.54	0.36
	Nickel (Ni)-Total (mg/kg wwt)	0.132	0.117	0.220	0.309	0.188
	Phosphorus (P)-Total (mg/kg)	1170	952	1300	1250	1060
	Phosphorus (P)-Total (mg/kg wwt)	610	497	735	711	563
	Potassium (K)-Total (mg/kg)	3890	2810	3280	3330	2800
	Potassium (K)-Total (mg/kg wwt)	2030	1470	1860	1890	1490
	Rubidium (Rb)-Total (mg/kg)	3.44	2.86	6.01	5.52	4.43
	Rubidium (Rb)-Total (mg/kg wwt)	1.79	1.50	3.40	3.15	2.34
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.011	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	4.9	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	7.69	5.72	12.0	12.7	12.2
	Strontium (Sr)-Total (mg/kg wwt)	4.01	2.98	6.81	7.23	6.47
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0401	0.0263	0.153	0.0442	0.0995
	Thallium (Tl)-Total (mg/kg wwt)	0.0209	0.0137	0.0865	0.0252	0.0527
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	0.0027	0.0023	0.0024
	Uranium (U)-Total (mg/kg wwt)	0.00055	0.00082	0.00154	0.00128	0.00125
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	0.31	0.28	0.27
	Vanadium (V)-Total (mg/kg wwt)	0.050	0.039	0.177	0.160	0.143
	Zinc (Zn)-Total (mg/kg)	26.9	20.4	31.7	23.7	26.9
	Zinc (Zn)-Total (mg/kg wwt)	14.0	10.7	17.9	13.5	14.3
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-16 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 1	L2355568-17 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 2	L2355568-18 Tissue 27-AUG-19 07:40 S-19 (WILLOW) 3	L2355568-19 Tissue 27-AUG-19 07:40 S-19 (BERRIES) 1	L2355568-20 Tissue 27-AUG-19 07:40 S-19 (BERRIES) 2
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0100	0.0112	0.0113	<0.0050	<0.0050
	Mercury (Hg)-Total (mg/kg wwt)	0.0038	0.0040	0.0042	<0.0010	<0.0010
	Molybdenum (Mo)-Total (mg/kg)	0.252	0.167	0.200	0.268	0.250
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0976	0.0604	0.0740	0.0470	0.0460
	Nickel (Ni)-Total (mg/kg)	1.91	2.06	1.02	<0.20	<0.20
	Nickel (Ni)-Total (mg/kg wwt)	0.740	0.745	0.377	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg)	2170	2610	4970	921	825
	Phosphorus (P)-Total (mg/kg wwt)	838	944	1840	162	152
	Potassium (K)-Total (mg/kg)	8520	9590	10200	4550	4700
	Potassium (K)-Total (mg/kg wwt)	3300	3470	3770	798	866
	Rubidium (Rb)-Total (mg/kg)	5.58	9.10	6.77	4.55	5.65
	Rubidium (Rb)-Total (mg/kg wwt)	2.16	3.29	2.51	0.798	1.04
	Selenium (Se)-Total (mg/kg)	0.053	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.021	0.015	0.017	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	59	56
	Sodium (Na)-Total (mg/kg wwt)	4.1	4.6	4.3	10.3	10.4
	Strontium (Sr)-Total (mg/kg)	205	210	316	3.27	1.89
	Strontium (Sr)-Total (mg/kg wwt)	79.4	75.9	117	0.573	0.349
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0047	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0022	0.0020	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00085	0.00073	<0.00040	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0038	0.0021	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00145	0.00077	0.00042	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	0.48	0.22	0.13	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.186	0.080	0.049	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	56.7	44.8	67.9	6.86	5.71
	Zinc (Zn)-Total (mg/kg wwt)	21.9	16.2	25.2	1.20	1.05
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-21	L2355568-22	L2355568-23	L2355568-24	L2355568-25
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	27-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	07:40	11:15	11:15	11:15	11:15
	Client ID	S-19 (BERRIES) 3	S-18 (LABRADOR TEA) 1	S-18 (LABRADOR TEA) 2	S-18 (LABRADOR TEA) 3	S-18 (WILLOW) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	0.0082
	Mercury (Hg)-Total (mg/kg wwt)	<0.0010	0.0025	0.0021	0.0025	0.0031
	Molybdenum (Mo)-Total (mg/kg)	0.340	0.249	0.283	0.162	0.747
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0642	0.135	0.145	0.0848	0.286
	Nickel (Ni)-Total (mg/kg)	0.40	0.23	0.23	0.36	4.89
	Nickel (Ni)-Total (mg/kg wwt)	0.076	0.125	0.117	0.189	1.87
	Phosphorus (P)-Total (mg/kg)	1270	1220	1290	1460	1400
	Phosphorus (P)-Total (mg/kg wwt)	240	660	662	764	534
	Potassium (K)-Total (mg/kg)	6360	3880	3620	3640	7850
	Potassium (K)-Total (mg/kg wwt)	1200	2100	1860	1910	3000
	Rubidium (Rb)-Total (mg/kg)	6.14	5.00	5.43	5.56	7.84
	Rubidium (Rb)-Total (mg/kg wwt)	1.16	2.71	2.79	2.92	3.00
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	0.108
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	0.041
	Sodium (Na)-Total (mg/kg)	65	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	12.3	<4.0	<4.0	<4.0	4.8
	Strontium (Sr)-Total (mg/kg)	5.17	7.32	7.98	6.52	76.8
	Strontium (Sr)-Total (mg/kg wwt)	0.976	3.97	4.10	3.42	29.4
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	0.0076	0.0050	0.0118	0.0071
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	0.00410	0.00255	0.00621	0.00270
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	0.00094	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	0.036
	Zinc (Zn)-Total (mg/kg)	10.6	18.0	19.6	22.2	45.9
	Zinc (Zn)-Total (mg/kg wwt)	2.00	9.75	10.1	11.6	17.6
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-26 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 11:15 Client ID: S-18 (WILLOW) 2	L2355568-27 Tissue 28-AUG-19 11:15 S-18 (WILLOW) 3	L2355568-28 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 1	L2355568-29 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 2	L2355568-30 Tissue 27-AUG-19 06:40 S-17 (WILLOW) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0066	0.0087	0.0093	0.0088	0.0092
	Mercury (Hg)-Total (mg/kg wwt)	0.0031	0.0037	0.0040	0.0038	0.0045
	Molybdenum (Mo)-Total (mg/kg)	0.514	1.71	0.208	0.195	0.154
	Molybdenum (Mo)-Total (mg/kg wwt)	0.243	0.732	0.0901	0.0841	0.0747
	Nickel (Ni)-Total (mg/kg)	4.31	4.38	2.52	2.83	2.39
	Nickel (Ni)-Total (mg/kg wwt)	2.04	1.88	1.09	1.22	1.16
	Phosphorus (P)-Total (mg/kg)	1470	722	4000	3360	3290
	Phosphorus (P)-Total (mg/kg wwt)	697	309	1730	1450	1600
	Potassium (K)-Total (mg/kg)	6530	6280	6550	5730	5560
	Potassium (K)-Total (mg/kg wwt)	3090	2690	2840	2470	2700
	Rubidium (Rb)-Total (mg/kg)	7.93	4.12	1.55	0.917	0.969
	Rubidium (Rb)-Total (mg/kg wwt)	3.75	1.76	0.671	0.396	0.470
	Selenium (Se)-Total (mg/kg)	0.091	0.056	0.076	0.072	0.070
	Selenium (Se)-Total (mg/kg wwt)	0.043	0.024	0.033	0.031	0.034
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	5.6	<4.0	<4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	56.8	85.6	265	281	292
	Strontium (Sr)-Total (mg/kg wwt)	26.9	36.6	115	121	142
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	0.0056	0.0064	0.0076
	Thallium (Tl)-Total (mg/kg)	0.0048	0.0074	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00225	0.00315	0.00049	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	0.0031	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00063	0.00053	0.00136	0.00085	0.00087
	Vanadium (V)-Total (mg/kg)	0.12	<0.10	0.29	0.17	0.17
	Vanadium (V)-Total (mg/kg wwt)	0.057	0.041	0.127	0.075	0.080
	Zinc (Zn)-Total (mg/kg)	93.5	89.4	58.5	25.0	26.6
	Zinc (Zn)-Total (mg/kg wwt)	44.2	38.2	25.4	10.8	12.9
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

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	Sample ID	L2355568-31	L2355568-32	L2355568-33	L2355568-34	L2355568-35
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-19	26-AUG-19	26-AUG-19	26-AUG-19	26-AUG-19
	Sampled Time	15:50	15:50	15:50	15:50	15:50
	Client ID	S-16 (LABRADOR TEA) 1	S-16 (LABRADOR TEA) 2	S-16 (LABRADOR TEA) 3	S-16 (WILLOW) 1	S-16 (WILLOW) 2
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0080	0.0076	0.0083	0.0068	0.0051
	Mercury (Hg)-Total (mg/kg wwt)	0.0044	0.0041	0.0047	0.0031	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.066	0.066	0.097	0.379	0.318
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0363	0.0356	0.0545	0.174	0.137
	Nickel (Ni)-Total (mg/kg)	0.32	0.21	0.26	3.85	2.96
	Nickel (Ni)-Total (mg/kg wwt)	0.173	0.115	0.146	1.77	1.28
	Phosphorus (P)-Total (mg/kg)	891	937	1050	719	895
	Phosphorus (P)-Total (mg/kg wwt)	488	504	592	330	386
	Potassium (K)-Total (mg/kg)	3650	3980	3910	7680	9410
	Potassium (K)-Total (mg/kg wwt)	2000	2140	2210	3530	4060
	Rubidium (Rb)-Total (mg/kg)	3.30	2.52	2.16	5.20	6.71
	Rubidium (Rb)-Total (mg/kg wwt)	1.80	1.35	1.22	2.39	2.90
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.024	0.015	0.019	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	4.9	<4.0
	Strontium (Sr)-Total (mg/kg)	14.4	14.2	15.7	39.1	41.0
	Strontium (Sr)-Total (mg/kg wwt)	7.88	7.65	8.84	18.0	17.7
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	0.0025	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00107	0.00134	0.00099	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0028	0.0024	0.0033	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00155	0.00131	0.00185	0.00088	<0.00040
	Vanadium (V)-Total (mg/kg)	0.26	0.21	0.31	0.20	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.144	0.112	0.174	0.091	0.030
	Zinc (Zn)-Total (mg/kg)	27.0	23.1	29.3	202	164
	Zinc (Zn)-Total (mg/kg wwt)	14.8	12.4	16.5	92.8	70.7
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

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Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2355568-36 Tissue 26-AUG-19 15:50 S-16 (WILLOW) 3	L2355568-37 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 1	L2355568-38 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 2	L2355568-39 Tissue 28-AUG-19 11:40 S-15 (HORSETAIL) 3	L2355568-40 Tissue 28-AUG-19 11:15 S-15 (LABRADOR TEA) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0082	<0.010	<0.0050	0.0064	0.0072
	Mercury (Hg)-Total (mg/kg wwt)	<0.0040	<0.010	<0.0060	<0.0040	0.0037
	Molybdenum (Mo)-Total (mg/kg)	0.285	0.088	0.145	0.218	0.129
	Molybdenum (Mo)-Total (mg/kg wwt)	0.133	0.0225	0.0366	0.0567	0.0666
	Nickel (Ni)-Total (mg/kg)	2.87	0.73	0.64	0.55	0.54
	Nickel (Ni)-Total (mg/kg wwt)	1.33	0.188	0.160	0.142	0.280
	Phosphorus (P)-Total (mg/kg)	784	413	416	457	1100
	Phosphorus (P)-Total (mg/kg wwt)	365	106	105	119	568
	Potassium (K)-Total (mg/kg)	8180	7440	7750	7550	3450
	Potassium (K)-Total (mg/kg wwt)	3800	1910	1950	1960	1780
	Rubidium (Rb)-Total (mg/kg)	6.72	8.71	8.23	9.70	4.66
	Rubidium (Rb)-Total (mg/kg wwt)	3.12	2.23	2.08	2.52	2.41
	Selenium (Se)-Total (mg/kg)	<0.050	0.289	0.574	0.453	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.021	0.074	0.145	0.118	0.012
	Sodium (Na)-Total (mg/kg)	<20	30	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	7.8	<4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	50.3	109	122	116	10.5
	Strontium (Sr)-Total (mg/kg wwt)	23.4	28.0	30.8	30.3	5.44
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0024	<0.0020	<0.0020	<0.0020	0.0073
	Thallium (Tl)-Total (mg/kg wwt)	0.00112	<0.00040	<0.00040	0.00045	0.00377
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.026	<0.020
	Uranium (U)-Total (mg/kg)	0.0045	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00211	<0.00040	<0.00040	<0.00040	0.00062
	Vanadium (V)-Total (mg/kg)	0.60	<0.10	<0.10	<0.10	0.14
	Vanadium (V)-Total (mg/kg wwt)	0.281	<0.020	<0.020	<0.020	0.072
	Zinc (Zn)-Total (mg/kg)	202	20.5	16.8	15.2	23.3
	Zinc (Zn)-Total (mg/kg wwt)	94.0	5.25	4.24	3.96	12.0
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-41	L2355568-42	L2355568-43	L2355568-44	L2355568-45
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	11:15	11:15	17:15	17:15	17:15
	Client ID	S-15 (LABRADOR TEA) 2	S-15 (LABRADOR TEA) 3	S-11 (WILLOW) 1	S-11 (WILLOW) 2	S-11 (WILLOW) 3
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0076	0.0073	0.0075	0.0061	0.0077
	Mercury (Hg)-Total (mg/kg wwt)	<0.0050	<0.0050	<0.0050	<0.0030	<0.0040
	Molybdenum (Mo)-Total (mg/kg)	0.108	0.255	0.508	0.396	0.690
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0536	0.134	0.191	0.142	0.264
	Nickel (Ni)-Total (mg/kg)	0.58	0.61	3.57	2.68	3.28
	Nickel (Ni)-Total (mg/kg wwt)	0.287	0.322	1.34	0.964	1.26
	Phosphorus (P)-Total (mg/kg)	991	1000	2780	1590	2570
	Phosphorus (P)-Total (mg/kg wwt)	491	529	1050	572	986
	Potassium (K)-Total (mg/kg)	3390	3750	7070	4650	7110
	Potassium (K)-Total (mg/kg wwt)	1680	1980	2660	1670	2730
	Rubidium (Rb)-Total (mg/kg)	4.32	4.04	3.51	2.08	1.94
	Rubidium (Rb)-Total (mg/kg wwt)	2.14	2.13	1.32	0.746	0.743
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.010	0.010	0.012	0.013	0.012
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	4.0
	Strontium (Sr)-Total (mg/kg)	9.73	8.10	136	103	133
	Strontium (Sr)-Total (mg/kg wwt)	4.82	4.26	51.3	37.0	50.9
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0130	0.0121	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00643	0.00636	<0.00040	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	0.0034	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00060	0.00075	0.00129	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg)	0.13	0.16	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.064	0.084	0.030	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg)	20.8	16.8	68.3	50.6	27.0
	Zinc (Zn)-Total (mg/kg wwt)	10.3	8.84	25.7	18.2	10.3
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-46	L2355568-47	L2355568-48	L2355568-49	L2355568-50
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	10:20	10:20	10:20	11:00	11:00
Client ID	S-09 (WILLOW) 1	S-09 (WILLOW) 2	S-09 (WILLOW) 3	S-08 (LABRADOR TEA) 1	S-08 (LABRADOR TEA) 2
Grouping / **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0107	<0.010	0.0082	0.0074	0.0073
Mercury (Hg)-Total (mg/kg wwt)	<0.0060	<0.0080	<0.0040	<0.0060	<0.0050
Molybdenum (Mo)-Total (mg/kg)	0.259	0.523	0.395	0.091	0.206
Molybdenum (Mo)-Total (mg/kg wwt)	0.114	0.196	0.147	0.0466	0.109
Nickel (Ni)-Total (mg/kg)	0.34	0.31	0.47	0.25	0.43
Nickel (Ni)-Total (mg/kg wwt)	0.152	0.118	0.174	0.130	0.226
Phosphorus (P)-Total (mg/kg)	2450	3140	3880	840	907
Phosphorus (P)-Total (mg/kg wwt)	1080	1170	1450	432	479
Potassium (K)-Total (mg/kg)	7200	7180	6820	2860	3080
Potassium (K)-Total (mg/kg wwt)	3170	2690	2550	1470	1630
Rubidium (Rb)-Total (mg/kg)	0.564	0.946	1.24	3.18	5.68
Rubidium (Rb)-Total (mg/kg wwt)	0.248	0.354	0.463	1.63	3.00
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.016	0.017
Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	4.0	<4.0
Strontium (Sr)-Total (mg/kg)	176	190	267	11.4	15.9
Strontium (Sr)-Total (mg/kg wwt)	77.7	71.2	99.6	5.88	8.40
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0076	0.0239
Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00391	0.0126
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0039	0.0049
Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00069	<0.00040	0.00199	0.00259
Vanadium (V)-Total (mg/kg)	<0.10	0.12	<0.10	0.56	0.70
Vanadium (V)-Total (mg/kg wwt)	0.021	0.046	0.025	0.286	0.368
Zinc (Zn)-Total (mg/kg)	49.6	52.4	69.9	25.0	28.8
Zinc (Zn)-Total (mg/kg wwt)	21.8	19.6	26.1	12.9	15.2
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-51	L2355568-52	L2355568-53	L2355568-54	L2355568-55
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:00	11:00	11:00	11:00	11:00
Client ID	S-08 (LABRADOR TEA) 3	S-08 (WILLOW) 1	S-08 (WILLOW) 2	S-08 (WILLOW) 3	S-08 (LICHEN) 1
Grouping / **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0063	0.0074	0.0107	<0.0050	0.0586
Mercury (Hg)-Total (mg/kg wwt)	<0.0050	<0.0040	0.0044	<0.0050	0.0352
Molybdenum (Mo)-Total (mg/kg)	0.168	0.381	0.313	0.471	1.37
Molybdenum (Mo)-Total (mg/kg wwt)	0.0890	0.154	0.127	0.210	0.823
Nickel (Ni)-Total (mg/kg)	0.33	1.51	1.88	3.96	1.19
Nickel (Ni)-Total (mg/kg wwt)	0.176	0.608	0.765	1.77	0.716
Phosphorus (P)-Total (mg/kg)	892	513	583	1060	558
Phosphorus (P)-Total (mg/kg wwt)	472	206	237	475	335
Potassium (K)-Total (mg/kg)	3080	5020	5710	6680	1470
Potassium (K)-Total (mg/kg wwt)	1630	2020	2320	2980	884
Rubidium (Rb)-Total (mg/kg)	3.88	5.58	5.49	11.5	7.47
Rubidium (Rb)-Total (mg/kg wwt)	2.06	2.24	2.23	5.15	4.48
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	0.060	<0.050	0.677
Selenium (Se)-Total (mg/kg wwt)	0.017	0.013	0.025	0.018	0.406
Sodium (Na)-Total (mg/kg)	<20	170	21	100	35
Sodium (Na)-Total (mg/kg wwt)	7.1	68.3	8.4	44.6	21.2
Strontium (Sr)-Total (mg/kg)	11.5	45.5	48.6	39.4	29.4
Strontium (Sr)-Total (mg/kg wwt)	6.07	18.3	19.8	17.6	17.7
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	0.061
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	0.0366
Thallium (Tl)-Total (mg/kg)	0.0144	0.0031	0.0054	0.0031	0.0301
Thallium (Tl)-Total (mg/kg wwt)	0.00763	0.00123	0.00219	0.00139	0.0180
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	0.18
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	0.110
Uranium (U)-Total (mg/kg)	0.0046	0.0053	0.0108	0.0066	0.0976
Uranium (U)-Total (mg/kg wwt)	0.00243	0.00214	0.00440	0.00294	0.0586
Vanadium (V)-Total (mg/kg)	0.71	0.72	1.42	1.02	11.5
Vanadium (V)-Total (mg/kg wwt)	0.378	0.291	0.576	0.457	6.91
Zinc (Zn)-Total (mg/kg)	23.2	117	135	63.7	34.9
Zinc (Zn)-Total (mg/kg wwt)	12.3	47.1	54.9	28.5	20.9
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.58
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	0.348

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-56 Description: Tissue Sampled Date: 27-AUG-19 Sampled Time: 11:00 Client ID: S-08 (LICHEN) 2	L2355568-57 Tissue 27-AUG-19 11:00 S-08 (LICHEN) 3	L2355568-58 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 1	L2355568-59 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 2	L2355568-60 Tissue 27-AUG-19 11:05 S-08A (LABRADOR TEA) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0613	0.0556	0.0062	0.0090	0.0087
	Mercury (Hg)-Total (mg/kg wwt)	0.0496	0.0410	<0.0040	<0.0050	0.0048
	Molybdenum (Mo)-Total (mg/kg)	2.00	2.00	0.125	0.139	0.170
	Molybdenum (Mo)-Total (mg/kg wwt)	1.62	1.47	0.0700	0.0719	0.0945
	Nickel (Ni)-Total (mg/kg)	1.55	1.39	0.72	0.40	0.48
	Nickel (Ni)-Total (mg/kg wwt)	1.26	1.02	0.405	0.206	0.264
	Phosphorus (P)-Total (mg/kg)	818	703	1100	1010	977
	Phosphorus (P)-Total (mg/kg wwt)	663	517	616	522	542
	Potassium (K)-Total (mg/kg)	1930	1520	3790	3220	3220
	Potassium (K)-Total (mg/kg wwt)	1560	1120	2130	1660	1790
	Rubidium (Rb)-Total (mg/kg)	9.75	8.08	7.68	4.66	6.74
	Rubidium (Rb)-Total (mg/kg wwt)	7.90	5.95	4.31	2.40	3.73
	Selenium (Se)-Total (mg/kg)	1.02	0.891	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.827	0.656	0.014	0.013	0.021
	Sodium (Na)-Total (mg/kg)	57	43	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	46.4	31.9	4.2	5.0	4.9
	Strontium (Sr)-Total (mg/kg)	38.1	31.5	9.29	11.0	14.5
	Strontium (Sr)-Total (mg/kg wwt)	30.9	23.2	5.22	5.69	8.06
	Tellurium (Te)-Total (mg/kg)	0.091	0.091	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	0.0734	0.0667	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0426	0.0359	0.0248	0.0197	0.0161
	Thallium (Tl)-Total (mg/kg wwt)	0.0345	0.0264	0.0139	0.0102	0.00890
	Tin (Sn)-Total (mg/kg)	0.27	0.25	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	0.219	0.181	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.120	0.114	0.0038	0.0043	0.0074
	Uranium (U)-Total (mg/kg wwt)	0.0974	0.0841	0.00216	0.00222	0.00411
	Vanadium (V)-Total (mg/kg)	17.7	15.0	0.52	0.57	0.92
	Vanadium (V)-Total (mg/kg wwt)	14.3	11.0	0.293	0.297	0.511
	Zinc (Zn)-Total (mg/kg)	63.7	44.5	23.5	25.3	25.0
	Zinc (Zn)-Total (mg/kg wwt)	51.6	32.7	13.2	13.1	13.9
	Zirconium (Zr)-Total (mg/kg)	0.78	0.72	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	0.629	0.530	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-61	L2355568-62	L2355568-63	L2355568-64	L2355568-65
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	11:05	11:05	11:05	11:05	11:05
Client ID	S-08A (WILLOW) 1	S-08A (WILLOW) 2	S-08A (WILLOW) 3	S-08A(LICHEN) 1	S-08A(LICHEN) 2
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0063	0.0064	0.0066	0.0464	0.0395
Mercury (Hg)-Total (mg/kg wwt)	<0.0030	<0.0030	<0.0030	0.0313	0.0291
Molybdenum (Mo)-Total (mg/kg)	0.381	0.414	0.424	1.22	0.805
Molybdenum (Mo)-Total (mg/kg wwt)	0.162	0.154	0.169	0.826	0.594
Nickel (Ni)-Total (mg/kg)	1.34	1.24	1.31	1.13	0.94
Nickel (Ni)-Total (mg/kg wwt)	0.570	0.462	0.520	0.765	0.689
Phosphorus (P)-Total (mg/kg)	561	871	541	542	487
Phosphorus (P)-Total (mg/kg wwt)	239	324	216	366	359
Potassium (K)-Total (mg/kg)	4950	4760	4510	1300	1230
Potassium (K)-Total (mg/kg wwt)	2110	1770	1800	879	904
Rubidium (Rb)-Total (mg/kg)	4.89	8.57	4.38	6.87	5.73
Rubidium (Rb)-Total (mg/kg wwt)	2.08	3.19	1.74	4.64	4.23
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	0.583	0.518
Selenium (Se)-Total (mg/kg wwt)	<0.010	0.013	<0.010	0.394	0.382
Sodium (Na)-Total (mg/kg)	73	26	<20	33	30
Sodium (Na)-Total (mg/kg wwt)	31.2	9.7	4.3	22.1	21.8
Strontium (Sr)-Total (mg/kg)	46.7	49.7	53.7	26.0	23.4
Strontium (Sr)-Total (mg/kg wwt)	19.9	18.5	21.4	17.5	17.2
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	0.057	0.056
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0388	0.0416
Thallium (Tl)-Total (mg/kg)	0.0023	0.0028	0.0033	0.0249	0.0220
Thallium (Tl)-Total (mg/kg wwt)	0.00097	0.00104	0.00130	0.0168	0.0162
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	0.16	0.13
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.109	0.098
Uranium (U)-Total (mg/kg)	0.0037	0.0065	0.0050	0.0716	0.0676
Uranium (U)-Total (mg/kg wwt)	0.00160	0.00241	0.00200	0.0484	0.0498
Vanadium (V)-Total (mg/kg)	0.50	0.88	0.69	10.2	8.57
Vanadium (V)-Total (mg/kg wwt)	0.215	0.328	0.275	6.91	6.32
Zinc (Zn)-Total (mg/kg)	112	121	102	39.7	34.6
Zinc (Zn)-Total (mg/kg wwt)	47.6	45.0	40.7	26.8	25.5
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	0.47	0.42
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.320	0.311

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-66 Tissue 27-AUG-19 11:05 S-08A(LICHEN) 3	L2355568-67 Tissue 27-AUG-19 15:50 S-07(LABRADOR TEA) 1	L2355568-68 Tissue 27-AUG-19 15:50 S-07(LABRADOR TEA) 2	L2355568-69 Tissue 27-AUG-19 15:50 S-07(LABRADOR TEA) 3	L2355568-70 Tissue 27-AUG-19 15:50 S-07(WILLOW) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0546	0.0082	0.0090	0.0054	0.0061
	Mercury (Hg)-Total (mg/kg wwt)	0.0403	<0.0050	0.0049	<0.0050	<0.0030
	Molybdenum (Mo)-Total (mg/kg)	1.24	0.078	0.068	0.127	0.269
	Molybdenum (Mo)-Total (mg/kg wwt)	0.918	0.0446	0.0371	0.0695	0.107
	Nickel (Ni)-Total (mg/kg)	1.33	0.21	0.25	0.39	0.68
	Nickel (Ni)-Total (mg/kg wwt)	0.984	0.118	0.138	0.212	0.271
	Phosphorus (P)-Total (mg/kg)	639	674	839	1040	824
	Phosphorus (P)-Total (mg/kg wwt)	472	386	461	568	329
	Potassium (K)-Total (mg/kg)	1700	3100	3230	3190	5600
	Potassium (K)-Total (mg/kg wwt)	1250	1770	1770	1740	2240
	Rubidium (Rb)-Total (mg/kg)	7.95	2.06	3.46	3.01	2.78
	Rubidium (Rb)-Total (mg/kg wwt)	5.87	1.18	1.90	1.65	1.11
	Selenium (Se)-Total (mg/kg)	0.802	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.592	0.016	0.015	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	41	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	30.4	4.9	<4.0	<4.0	5.0
	Strontium (Sr)-Total (mg/kg)	28.8	9.51	8.86	12.1	66.6
	Strontium (Sr)-Total (mg/kg wwt)	21.3	5.45	4.87	6.63	26.6
	Tellurium (Te)-Total (mg/kg)	0.079	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	0.0581	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0319	0.0044	0.0094	0.0026	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.0235	0.00251	0.00518	0.00144	0.00064
	Tin (Sn)-Total (mg/kg)	0.20	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	0.148	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0942	0.0035	0.0038	<0.0020	0.0035
	Uranium (U)-Total (mg/kg wwt)	0.0696	0.00201	0.00208	0.00058	0.00139
	Vanadium (V)-Total (mg/kg)	12.8	0.39	0.41	0.14	0.37
	Vanadium (V)-Total (mg/kg wwt)	9.47	0.223	0.227	0.074	0.147
	Zinc (Zn)-Total (mg/kg)	40.1	14.3	17.2	17.2	79.2
	Zinc (Zn)-Total (mg/kg wwt)	29.6	8.17	9.45	9.40	31.6
	Zirconium (Zr)-Total (mg/kg)	0.59	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	0.437	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-71 Tissue 27-AUG-19 15:50 S-07(WILLOW) 2	L2355568-72 Tissue 27-AUG-19 15:50 S-07(WILLOW) 3	L2355568-73 Tissue 27-AUG-19 15:50 S-07(HORSETAIL) 1	L2355568-74 Tissue 27-AUG-19 15:50 S-07(HORSETAIL) 2	L2355568-75 Tissue 27-AUG-19 15:50 S-07(HORSETAIL) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0063	0.0058	<0.0050	0.0057	<0.0050
	Mercury (Hg)-Total (mg/kg wwt)	0.0026	0.0025	0.0030	0.0036	0.0037
	Molybdenum (Mo)-Total (mg/kg)	0.367	0.406	0.424	0.590	0.567
	Molybdenum (Mo)-Total (mg/kg wwt)	0.150	0.176	0.350	0.371	0.457
	Nickel (Ni)-Total (mg/kg)	1.17	1.03	1.18	1.53	1.90
	Nickel (Ni)-Total (mg/kg wwt)	0.477	0.445	0.973	0.963	1.53
	Phosphorus (P)-Total (mg/kg)	865	1090	900	1170	1130
	Phosphorus (P)-Total (mg/kg wwt)	353	473	743	738	906
	Potassium (K)-Total (mg/kg)	6190	10400	12100	16200	15300
	Potassium (K)-Total (mg/kg wwt)	2530	4490	9990	10200	12300
	Rubidium (Rb)-Total (mg/kg)	2.71	11.8	24.2	42.4	27.9
	Rubidium (Rb)-Total (mg/kg wwt)	1.11	5.11	20.0	26.6	22.5
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.017	<0.010	<0.010	0.011	0.018
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	37	48
	Sodium (Na)-Total (mg/kg wwt)	5.6	<4.0	13.7	23.1	38.4
	Strontium (Sr)-Total (mg/kg)	45.6	44.9	72.7	112	113
	Strontium (Sr)-Total (mg/kg wwt)	18.6	19.4	60.0	70.2	91.4
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	0.0022	0.0053	0.0039
	Thallium (Tl)-Total (mg/kg wwt)	0.00065	0.00057	0.00182	0.00330	0.00313
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0053	0.0023	0.0125	0.0148	0.0146
	Uranium (U)-Total (mg/kg wwt)	0.00215	0.00100	0.0103	0.00932	0.0117
	Vanadium (V)-Total (mg/kg)	0.61	0.24	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.250	0.104	0.034	0.037	0.065
	Zinc (Zn)-Total (mg/kg)	147	109	34.7	52.1	48.4
	Zinc (Zn)-Total (mg/kg wwt)	60.2	47.1	28.7	32.7	39.0
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID				
		L2355568-76 Tissue 27-AUG-19 14:55 S-06(LABRADOR TEA) 1	L2355568-77 Tissue 27-AUG-19 14:55 S-06(LABRADOR TEA) 2	L2355568-78 Tissue 27-AUG-19 14:55 S-06(LABRADOR TEA) 3	L2355568-79 Tissue 27-AUG-19 09:25 S-05(LABRADOR TEA) 1	L2355568-80 Tissue 27-AUG-19 09:25 S-05(LABRADOR TEA) 2
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0074	0.0059	0.0095	0.0071	0.0068
	Mercury (Hg)-Total (mg/kg wwt)	0.0040	0.0030	0.0046	0.0037	0.0035
	Molybdenum (Mo)-Total (mg/kg)	0.224	0.260	0.326	0.169	0.111
	Molybdenum (Mo)-Total (mg/kg wwt)	0.120	0.131	0.159	0.0874	0.0578
	Nickel (Ni)-Total (mg/kg)	0.79	0.46	0.89	0.51	0.48
	Nickel (Ni)-Total (mg/kg wwt)	0.424	0.232	0.436	0.265	0.252
	Phosphorus (P)-Total (mg/kg)	1260	1270	1300	1260	1030
	Phosphorus (P)-Total (mg/kg wwt)	680	641	633	652	537
	Potassium (K)-Total (mg/kg)	3870	4020	4230	3870	3770
	Potassium (K)-Total (mg/kg wwt)	2080	2030	2070	2000	1960
	Rubidium (Rb)-Total (mg/kg)	7.76	6.17	4.51	4.75	3.67
	Rubidium (Rb)-Total (mg/kg wwt)	4.18	3.12	2.20	2.46	1.91
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.013	<0.010	0.019	0.011	0.011
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	14.5	20.6	21.9	8.57	9.30
	Strontium (Sr)-Total (mg/kg wwt)	7.78	10.4	10.7	4.44	4.84
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0565	0.114	0.0508	0.0219	0.0272
	Thallium (Tl)-Total (mg/kg wwt)	0.0304	0.0576	0.0248	0.0113	0.0142
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	0.0025	0.0023	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00098	0.00042	0.00120	0.00119	0.00087
	Vanadium (V)-Total (mg/kg)	0.13	<0.10	0.20	0.19	0.18
	Vanadium (V)-Total (mg/kg wwt)	0.072	0.036	0.097	0.099	0.094
	Zinc (Zn)-Total (mg/kg)	20.1	31.2	30.8	22.6	21.9
	Zinc (Zn)-Total (mg/kg wwt)	10.8	15.8	15.0	11.7	11.4
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-81	L2355568-85	L2355568-86	L2355568-87	L2355568-88
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
	Sampled Time	09:25	09:25	09:25	09:25	13:35
	Client ID	S-05(LABRADOR TEA) 3	S-05(HORSETAIL) 1	S-05(HORSETAIL) 2	S-05(HORSETAIL) 3	S-04(LABRADOR TEA) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0078	0.0053	0.0055	0.0057	0.0066
	Mercury (Hg)-Total (mg/kg wwt)	0.0041	0.0022	0.0019	0.0019	0.0033
	Molybdenum (Mo)-Total (mg/kg)	0.123	0.423	0.557	0.569	0.147
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0637	0.174	0.192	0.186	0.0734
	Nickel (Ni)-Total (mg/kg)	0.42	4.14	3.45	3.79	0.82
	Nickel (Ni)-Total (mg/kg wwt)	0.218	1.70	1.19	1.23	0.408
	Phosphorus (P)-Total (mg/kg)	1010	757	856	931	1370
	Phosphorus (P)-Total (mg/kg wwt)	524	311	295	303	682
	Potassium (K)-Total (mg/kg)	3210	6950	6460	7550	4490
	Potassium (K)-Total (mg/kg wwt)	1670	2850	2230	2460	2240
	Rubidium (Rb)-Total (mg/kg)	3.72	34.9	39.2	31.3	4.38
	Rubidium (Rb)-Total (mg/kg wwt)	1.93	14.3	13.5	10.2	2.18
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.017	0.012	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	4.1	<4.0	4.5	4.1	<4.0
	Strontium (Sr)-Total (mg/kg)	10.2	156	151	150	14.9
	Strontium (Sr)-Total (mg/kg wwt)	5.29	64.2	52.0	48.9	7.44
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0110	0.0139	0.0190	0.0130	0.0154
	Thallium (Tl)-Total (mg/kg wwt)	0.00570	0.00569	0.00656	0.00424	0.00768
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0037	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00194	<0.00040	<0.00040	<0.00040	0.00090
	Vanadium (V)-Total (mg/kg)	0.40	<0.10	<0.10	<0.10	0.17
	Vanadium (V)-Total (mg/kg wwt)	0.205	<0.020	<0.020	0.029	0.086
	Zinc (Zn)-Total (mg/kg)	19.0	45.7	35.3	36.3	24.5
	Zinc (Zn)-Total (mg/kg wwt)	9.88	18.8	12.2	11.8	12.2
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.080 DLM	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-89	L2355568-90	L2355568-91	L2355568-92	L2355568-93
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19	27-AUG-19
Sampled Time	13:35	13:35	13:35	13:35	13:35
Client ID	S-04(LABRADOR TEA) 2	S-04(LABRADOR TEA) 3	S-04 (WILLOW) 1	S-04 (WILLOW) 2	S-04 (WILLOW) 3
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0072	0.0055	0.0074	0.0128	0.0087
Mercury (Hg)-Total (mg/kg wwt)	0.0035	0.0027	0.0028	0.0041	0.0030
Molybdenum (Mo)-Total (mg/kg)	0.332	0.114	0.414	0.279	0.303
Molybdenum (Mo)-Total (mg/kg wwt)	0.162	0.0557	0.155	0.0894	0.105
Nickel (Ni)-Total (mg/kg)	0.76	0.72	0.51	1.72	0.76
Nickel (Ni)-Total (mg/kg wwt)	0.372	0.351	0.191	0.551	0.262
Phosphorus (P)-Total (mg/kg)	1370	1370	4890	4800	4890
Phosphorus (P)-Total (mg/kg wwt)	668	669	1840	1530	1690
Potassium (K)-Total (mg/kg)	4470	5260	9440	16400	12500
Potassium (K)-Total (mg/kg wwt)	2180	2560	3550	5240	4340
Rubidium (Rb)-Total (mg/kg)	2.51	3.75	5.45	9.98	5.39
Rubidium (Rb)-Total (mg/kg wwt)	1.23	1.82	2.05	3.19	1.87
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	<0.010	0.011	<0.010	<0.010	<0.010
Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	4.4	5.1	<4.0
Strontium (Sr)-Total (mg/kg)	17.9	13.8	216	175	174
Strontium (Sr)-Total (mg/kg wwt)	8.72	6.71	81.3	56.0	60.1
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	0.0086	0.0075	<0.0020	<0.0020	<0.0020
Thallium (Tl)-Total (mg/kg wwt)	0.00419	0.00367	0.00053	<0.00040	<0.00040
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Uranium (U)-Total (mg/kg wwt)	0.00065	0.00074	0.00072	<0.00040	<0.00040
Vanadium (V)-Total (mg/kg)	0.11	0.14	0.13	<0.10	<0.10
Vanadium (V)-Total (mg/kg wwt)	0.052	0.069	0.048	0.027	<0.020
Zinc (Zn)-Total (mg/kg)	21.2	19.6	108	22.6	41.7
Zinc (Zn)-Total (mg/kg wwt)	10.4	9.54	40.5	7.25	14.4
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.080 DLM	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-97 Tissue 28-AUG-19 17:35 S-03(WILLOW) 1	L2355568-98 Tissue 28-AUG-19 17:35 S-03(WILLOW) 2	L2355568-99 Tissue 28-AUG-19 17:35 S-03(WILLOW) 3	L2355568-100 Tissue 28-AUG-19 17:00 S-01 (LABRADOR TEA) 1	L2355568-101 Tissue 28-AUG-19 17:00 S-01 (LABRADOR TEA) 2
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0125	0.0116	0.0116	0.0066	<0.0050
	Mercury (Hg)-Total (mg/kg wwt)	0.0044	0.0044	0.0042	0.0036	0.0024
	Molybdenum (Mo)-Total (mg/kg)	0.229	0.229	0.222	0.230	0.350
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0816	0.0868	0.0810	0.125	0.175
	Nickel (Ni)-Total (mg/kg)	3.24	1.89	1.88	1.81	2.26
	Nickel (Ni)-Total (mg/kg wwt)	1.15	0.719	0.686	0.980	1.13
	Phosphorus (P)-Total (mg/kg)	2240	2270	2680	1370	1490
	Phosphorus (P)-Total (mg/kg wwt)	797	863	979	742	746
	Potassium (K)-Total (mg/kg)	7770	7510	7370	4080	4630
	Potassium (K)-Total (mg/kg wwt)	2760	2850	2690	2210	2320
	Rubidium (Rb)-Total (mg/kg)	1.98	2.15	1.99	8.87	7.25
	Rubidium (Rb)-Total (mg/kg wwt)	0.704	0.815	0.727	4.80	3.63
	Selenium (Se)-Total (mg/kg)	0.160	0.141	0.154	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.057	0.053	0.056	0.023	0.023
	Sodium (Na)-Total (mg/kg)	34	28	26	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	12.0	10.5	9.3	5.1	<4.0
	Strontium (Sr)-Total (mg/kg)	112	94.1	99.5	16.0	14.4
	Strontium (Sr)-Total (mg/kg wwt)	39.7	35.7	36.3	8.64	7.20
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0028	0.0062
	Thallium (Tl)-Total (mg/kg wwt)	0.00043	0.00049	<0.00040	0.00150	0.00310
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0039	0.0038	0.0032	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00138	0.00144	0.00117	0.00059	0.00048
	Vanadium (V)-Total (mg/kg)	0.41	0.46	0.33	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.147	0.176	0.122	0.047	0.036
	Zinc (Zn)-Total (mg/kg)	23.0	23.5	22.6	19.9	21.0
	Zinc (Zn)-Total (mg/kg wwt)	8.20	8.92	8.24	10.8	10.5
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-102	L2355568-103	L2355568-104	L2355568-105	L2355568-106
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	17:00	08:15	08:15	08:15	08:15
	Client ID	S-01 (LABRADOR TEA) 3	M-07B (LABRADOR TEA) 1	M-07B (LABRADOR TEA) 2	M-07B (LABRADOR TEA) 3	M-07B (WILLOW) 1
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0082	0.0069	0.0086	0.0076	0.0099
	Mercury (Hg)-Total (mg/kg wwt)	0.0042	0.0034	0.0044	0.0041	0.0042
	Molybdenum (Mo)-Total (mg/kg)	0.069	0.154	0.050	0.034	0.474
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0356	0.0746	0.0255	0.0184	0.203
	Nickel (Ni)-Total (mg/kg)	0.35	2.99	0.31	0.33	0.91
	Nickel (Ni)-Total (mg/kg wwt)	0.182	1.44	0.156	0.176	0.388
	Phosphorus (P)-Total (mg/kg)	1030	1170	1000	1080	702
	Phosphorus (P)-Total (mg/kg wwt)	531	565	512	577	300
	Potassium (K)-Total (mg/kg)	4030	3350	3740	4120	10600
	Potassium (K)-Total (mg/kg wwt)	2070	1620	1910	2200	4520
	Rubidium (Rb)-Total (mg/kg)	5.10	6.89	5.87	3.94	5.75
	Rubidium (Rb)-Total (mg/kg wwt)	2.62	3.33	3.00	2.11	2.46
	Selenium (Se)-Total (mg/kg)	<0.050	0.075	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.036	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	29
	Sodium (Na)-Total (mg/kg wwt)	4.2	<4.0	5.2	5.1	12.3
	Strontium (Sr)-Total (mg/kg)	24.6	17.5	28.1	24.4	137
	Strontium (Sr)-Total (mg/kg wwt)	12.7	8.44	14.4	13.0	58.5
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0143	0.0030	<0.0020	0.0082	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00738	0.00143	0.00051	0.00436	<0.00040
	Tin (Sn)-Total (mg/kg)	0.12	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	0.063	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00048	0.00054	0.00046	0.00051	0.00051
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.050	0.048	0.051	0.039	0.040
	Zinc (Zn)-Total (mg/kg)	25.7	17.6	24.7	26.9	166
	Zinc (Zn)-Total (mg/kg wwt)	13.2	8.52	12.6	14.4	71.0
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-107	L2355568-108	L2355568-109	L2355568-110	L2355568-111
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	08:15	08:15	06:50	06:50	06:50
	Client ID	M-07B (WILLOW) 2	M-07B (WILLOW) 3	M-26 (LABRADOR TEA) 1	M-26 (LABRADOR TEA) 2	M-26 (LABRADOR TEA) 3
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0077	0.0072	0.0087	0.0084	0.0102
	Mercury (Hg)-Total (mg/kg wwt)	0.0032	0.0032	0.0044	0.0043	0.0057
	Molybdenum (Mo)-Total (mg/kg)	0.194	0.214	0.351	0.305	0.247
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0813	0.0962	0.177	0.156	0.131
	Nickel (Ni)-Total (mg/kg)	1.00	1.26	0.68	0.27	0.38
	Nickel (Ni)-Total (mg/kg wwt)	0.417	0.568	0.343	0.140	0.208
	Phosphorus (P)-Total (mg/kg)	698	617	1230	1150	1100
	Phosphorus (P)-Total (mg/kg wwt)	293	277	621	588	609
	Potassium (K)-Total (mg/kg)	7650	6970	3730	3380	2950
	Potassium (K)-Total (mg/kg wwt)	3210	3130	1880	1730	1730
	Rubidium (Rb)-Total (mg/kg)	2.88	2.45	2.23	2.96	2.65
	Rubidium (Rb)-Total (mg/kg wwt)	1.21	1.10	1.13	1.51	1.48
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	7.8	7.4	4.6	<4.0	<4.0
	Strontium (Sr)-Total (mg/kg)	98.3	102	22.4	23.9	26.0
	Strontium (Sr)-Total (mg/kg wwt)	41.2	45.7	11.3	12.2	14.4
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0036	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	0.00068	0.00184	0.00105
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.00044	<0.00040	<0.00040	<0.00040	0.00050
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.028	<0.020	0.032	0.028	0.041
	Zinc (Zn)-Total (mg/kg)	219	207	19.3	19.0	19.6
	Zinc (Zn)-Total (mg/kg wwt)	91.8	93.0	9.76	9.74	9.97
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	0.27	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	0.135	<0.040	<0.040

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-112 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 06:50 Client ID: M-26 (WILLOW) 1	L2355568-113 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 2	L2355568-114 Tissue 28-AUG-19 06:50 M-26 (WILLOW) 3	L2355568-115 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 1	L2355568-116 Tissue 28-AUG-19 06:50 M-26 (LICHEN) 2
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0109	0.0086	0.0091	0.0391	0.0431
	Mercury (Hg)-Total (mg/kg wwt)	0.0044	0.0037	0.0036	0.0249	0.0358
	Molybdenum (Mo)-Total (mg/kg)	0.619	0.287	0.226	0.118	0.136
	Molybdenum (Mo)-Total (mg/kg wwt)	0.242	0.122	0.0895	0.0756	0.115
	Nickel (Ni)-Total (mg/kg)	3.31	5.40	9.04	0.48	0.70
	Nickel (Ni)-Total (mg/kg wwt)	1.27	2.28	3.27	0.301	0.589
	Phosphorus (P)-Total (mg/kg)	1650	4150	3170	511	652
	Phosphorus (P)-Total (mg/kg wwt)	637	1790	1180	318	537
	Potassium (K)-Total (mg/kg)	9370	12200	10200	1040	1560
	Potassium (K)-Total (mg/kg wwt)	3860	5460	3700	677	1340
	Rubidium (Rb)-Total (mg/kg)	4.10	4.32	3.27	1.30	2.09
	Rubidium (Rb)-Total (mg/kg wwt)	1.61	1.82	1.16	0.830	1.78
	Selenium (Se)-Total (mg/kg)	0.094	0.160	0.260	0.052	0.062
	Selenium (Se)-Total (mg/kg wwt)	0.038	0.068	0.095	0.031	0.047
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	5.7	<4.0	8.9	13.2
	Strontium (Sr)-Total (mg/kg)	117	105	116	13.5	16.3
	Strontium (Sr)-Total (mg/kg wwt)	46.4	45.0	45.7	8.40	13.3
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0025	0.0022
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00161	0.00182
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0081	0.0077
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00542	0.00676
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	0.74	0.72
	Vanadium (V)-Total (mg/kg wwt)	0.021	<0.020	<0.020	0.460	0.583
	Zinc (Zn)-Total (mg/kg)	41.9	41.4	49.3	15.0	15.9
	Zinc (Zn)-Total (mg/kg wwt)	15.1	16.2	16.6	8.79	12.2
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.074	0.105

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-117	L2355568-118	L2355568-119	L2355568-120	L2355568-121
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
Sampled Time	06:50	14:10	14:10	14:10	14:10
Client ID	M-26 (LICHEN) 3	M-80(LABRADOR TEA)1	M-80(LABRADOR TEA)2	M-80(LABRADOR TEA)3	M-80 (WILLOW)1
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0498	0.0095	0.0107	0.0061	0.0089
Mercury (Hg)-Total (mg/kg wwt)	0.0407	0.0053	0.0059	0.0033	<0.0040
Molybdenum (Mo)-Total (mg/kg)	0.272	0.312	0.622	0.141	0.280
Molybdenum (Mo)-Total (mg/kg wwt)	0.231	0.177	0.345	0.0754	0.114
Nickel (Ni)-Total (mg/kg)	0.78	1.36	0.84	1.10	2.45
Nickel (Ni)-Total (mg/kg wwt)	0.629	0.741	0.464	0.567	0.997
Phosphorus (P)-Total (mg/kg)	700	1300	1480	1660	2670
Phosphorus (P)-Total (mg/kg wwt)	565	718	824	848	1090
Potassium (K)-Total (mg/kg)	1280	3810	3650	4190	6140
Potassium (K)-Total (mg/kg wwt)	1090	2180	2030	2250	2500
Rubidium (Rb)-Total (mg/kg)	1.87	6.34	6.02	6.69	1.51
Rubidium (Rb)-Total (mg/kg wwt)	1.54	3.47	3.34	3.47	0.614
Selenium (Se)-Total (mg/kg)	0.066	<0.050	<0.050	<0.050	0.095
Selenium (Se)-Total (mg/kg wwt)	0.053	0.013	0.014	0.014	0.039
Sodium (Na)-Total (mg/kg)	23	<20	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	18.3	<4.0	<4.0	<4.0	6.3
Strontium (Sr)-Total (mg/kg)	22.9	13.2	16.4	16.4	176
Strontium (Sr)-Total (mg/kg wwt)	18.7	7.24	9.08	8.86	71.6
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	0.0030	0.194	0.0574	0.119	<0.0020
Thallium (Tl)-Total (mg/kg wwt)	0.00241	0.113	0.0318	0.0663	<0.00040
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	0.0143	<0.0020	<0.0020	<0.0020	<0.0020
Uranium (U)-Total (mg/kg wwt)	0.0127	0.00043	<0.00040	<0.00040	<0.00040
Vanadium (V)-Total (mg/kg)	1.04	<0.10	<0.10	<0.10	<0.10
Vanadium (V)-Total (mg/kg wwt)	0.846	0.033	0.028	<0.020	<0.020
Zinc (Zn)-Total (mg/kg)	17.7	20.5	26.7	27.7	117
Zinc (Zn)-Total (mg/kg wwt)	13.5	10.7	14.8	13.4	47.7
Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	0.145	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L2355568-122 Description: Tissue Sampled Date: 28-AUG-19 Sampled Time: 14:10 Client ID: M-80 (WILLOW)2	L2355568-123 Tissue 28-AUG-19 14:10 M-80 (WILLOW)3	L2355568-125 Tissue 28-AUG-19 14:40 C-02 (LABRADOR TEA) 1	L2355568-126 Tissue 28-AUG-19 14:40 C-02 (LABRADOR TEA) 2	L2355568-127 Tissue 28-AUG-19 14:40 C-02 (LABRADOR TEA) 3
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0096	0.0088	0.0061	0.0066	0.0051
	Mercury (Hg)-Total (mg/kg wwt)	0.0040	<0.0040	0.0033	0.0039	0.0030
	Molybdenum (Mo)-Total (mg/kg)	0.200	0.259	0.279	0.400	0.332
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0837	0.0989	0.151	0.234	0.196
	Nickel (Ni)-Total (mg/kg)	2.57	2.55	0.52	0.44	0.34
	Nickel (Ni)-Total (mg/kg wwt)	1.08	0.975	0.281	0.259	0.200
	Phosphorus (P)-Total (mg/kg)	4570	4740	1160	1060	989
	Phosphorus (P)-Total (mg/kg wwt)	1910	1810	627	621	584
	Potassium (K)-Total (mg/kg)	7200	7750	3510	2880	3280
	Potassium (K)-Total (mg/kg wwt)	3010	2960	1900	1680	1940
	Rubidium (Rb)-Total (mg/kg)	2.39	1.99	2.34	1.81	2.53
	Rubidium (Rb)-Total (mg/kg wwt)	1.00	0.761	1.26	1.06	1.50
	Selenium (Se)-Total (mg/kg)	0.079	0.070	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.033	0.027	<0.010	<0.010	<0.010
	Sodium (Na)-Total (mg/kg)	<20	20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	5.2	7.7	<4.0	<4.0	4.3
	Strontium (Sr)-Total (mg/kg)	179	190	8.61	10.1	9.58
	Strontium (Sr)-Total (mg/kg wwt)	74.9	72.5	4.65	5.93	5.67
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	0.0354	0.0142	0.0144
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	0.0191	0.00830	0.00850
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.046	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	0.00054	0.00061	0.00087
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.020	0.033	0.046	0.039
	Zinc (Zn)-Total (mg/kg)	76.2	88.0	19.9	23.4	23.3
	Zinc (Zn)-Total (mg/kg wwt)	31.9	33.6	10.8	13.7	13.8
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-128	L2355568-129	L2355568-130	L2355568-131	L2355568-132
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	14:40	14:40	14:40	14:40	14:40
	Client ID	C-02 (WILLOW) 1	C-02 (WILLOW) 2	C-02 (WILLOW) 3	C-02 (LICHEN) 1	C-02 (LICHEN) 2
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0071	0.0066	0.0054	0.0368	0.0410
	Mercury (Hg)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0030	0.0296	0.0331
	Molybdenum (Mo)-Total (mg/kg)	0.263	0.424	0.952	0.153	0.161
	Molybdenum (Mo)-Total (mg/kg wwt)	0.104	0.168	0.348	0.123	0.130
	Nickel (Ni)-Total (mg/kg)	1.37	1.48	2.25	0.91	1.06
	Nickel (Ni)-Total (mg/kg wwt)	0.543	0.589	0.824	0.731	0.856
	Phosphorus (P)-Total (mg/kg)	2400	2410	1280	725	735
	Phosphorus (P)-Total (mg/kg wwt)	950	958	467	585	593
	Potassium (K)-Total (mg/kg)	6960	12000	8320	2020	1800
	Potassium (K)-Total (mg/kg wwt)	2760	4780	3040	1630	1460
	Rubidium (Rb)-Total (mg/kg)	2.52	3.55	2.77	2.09	2.22
	Rubidium (Rb)-Total (mg/kg wwt)	1.00	1.41	1.01	1.68	1.79
	Selenium (Se)-Total (mg/kg)	0.060	<0.050	<0.050	0.102	0.101
	Selenium (Se)-Total (mg/kg wwt)	0.024	<0.010	<0.010	0.082	0.082
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	24	21
	Sodium (Na)-Total (mg/kg wwt)	7.2	6.3	4.8	19.1	17.0
	Strontium (Sr)-Total (mg/kg)	168	69.1	60.5	13.4	10.9
	Strontium (Sr)-Total (mg/kg wwt)	66.7	27.4	22.1	10.8	8.81
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0048	0.0044
	Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0060	0.0063
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.00485	0.00506
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.022	0.021
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0211	0.0308
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	0.0170	0.0249
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	1.95	2.15
	Vanadium (V)-Total (mg/kg wwt)	0.026	0.026	<0.020	1.57	1.74
	Zinc (Zn)-Total (mg/kg)	44.2	91.9	127	21.8	18.3
	Zinc (Zn)-Total (mg/kg wwt)	17.5	36.5	46.4	17.6	14.8
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.22
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.148	0.176

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-133 Tissue 28-AUG-19 14:40 C-02 (LICHEN) 3	L2355568-137 Tissue 28-AUG-19 15:55 C-01(HORSETAIL) 1	L2355568-138 Tissue 28-AUG-19 15:55 C-01(HORSETAIL) 2	L2355568-139 Tissue 28-AUG-19 15:55 C-01(HORSETAIL) 3	L2355568-140 Tissue 28-AUG-19 15:55 C-01 (LABRADOR TEA) 1
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0393	0.0103	<0.0050	0.0074	0.0093
	Mercury (Hg)-Total (mg/kg wwt)	0.0336	<0.0040	<0.0020	<0.0040	0.0051
	Molybdenum (Mo)-Total (mg/kg)	0.192	0.266	0.284	0.252	0.476
	Molybdenum (Mo)-Total (mg/kg wwt)	0.164	0.0967	0.104	0.103	0.259
	Nickel (Ni)-Total (mg/kg)	1.23	5.20	3.23	3.55	0.65
	Nickel (Ni)-Total (mg/kg wwt)	1.06	1.89	1.18	1.45	0.355
	Phosphorus (P)-Total (mg/kg)	743	1360	1370	1350	1240
	Phosphorus (P)-Total (mg/kg wwt)	636	495	500	554	674
	Potassium (K)-Total (mg/kg)	1660	17700	22400	19200	3960
	Potassium (K)-Total (mg/kg wwt)	1420	6460	8170	7860	2160
	Rubidium (Rb)-Total (mg/kg)	2.62	9.82	12.7	13.3	0.905
	Rubidium (Rb)-Total (mg/kg wwt)	2.24	3.57	4.63	5.46	0.493
	Selenium (Se)-Total (mg/kg)	0.101	0.052	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	0.087	0.019	0.012	0.017	<0.010
	Sodium (Na)-Total (mg/kg)	23	45	28	24	<20
	Sodium (Na)-Total (mg/kg wwt)	19.9	16.3	10.4	9.7	<4.0
	Strontium (Sr)-Total (mg/kg)	23.8	123	103	100	12.3
	Strontium (Sr)-Total (mg/kg wwt)	20.4	44.9	37.4	41.2	6.71
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	0.0057	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0064	<0.0020	<0.0020	<0.0020	0.0098
	Thallium (Tl)-Total (mg/kg wwt)	0.00548	<0.00040	<0.00040	<0.00040	0.00532
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	0.022	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	0.0289	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	0.0247	0.00053	<0.00040	0.00061	0.00064
	Vanadium (V)-Total (mg/kg)	2.38	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	2.04	0.027	<0.020	0.030	0.046
	Zinc (Zn)-Total (mg/kg)	20.0	41.4	37.9	37.9	24.8
	Zinc (Zn)-Total (mg/kg wwt)	17.1	15.1	13.8	15.6	13.5
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	0.120	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-141	L2355568-142	L2355568-143	L2355568-144	L2355568-145
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	15:55	15:55	15:55	17:35	17:35
	Client ID	C-01 (LABRADOR TEA) 2	C-01 (LABRADOR TEA) 3	C-01 (WILLOW) 1	C-01 (WILLOW) 2	C-01 (WILLOW) 3
Grouping	**Analyte**					
TISSUE						
Metals	Mercury (Hg)-Total (mg/kg)	0.0079	0.0054	<0.0050	0.0071	0.0069
	Mercury (Hg)-Total (mg/kg wwt)	0.0043	<0.0030	<0.0020	0.0030	0.0026
	Molybdenum (Mo)-Total (mg/kg)	0.333	0.232	0.424	0.527	0.419
	Molybdenum (Mo)-Total (mg/kg wwt)	0.182	0.123	0.180	0.224	0.160
	Nickel (Ni)-Total (mg/kg)	0.66	0.64	8.68	11.7	5.77
	Nickel (Ni)-Total (mg/kg wwt)	0.363	0.338	3.68	4.96	2.20
	Phosphorus (P)-Total (mg/kg)	1390	1540	3680	5210	3910
	Phosphorus (P)-Total (mg/kg wwt)	762	817	1560	2220	1490
	Potassium (K)-Total (mg/kg)	4600	4780	8000	8860	11500
	Potassium (K)-Total (mg/kg wwt)	2510	2540	3400	3770	4380
	Rubidium (Rb)-Total (mg/kg)	1.45	3.18	0.639	0.662	1.56
	Rubidium (Rb)-Total (mg/kg wwt)	0.791	1.69	0.271	0.282	0.596
	Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	0.020	0.011	<0.010
	Sodium (Na)-Total (mg/kg)	<20	<20	<20	<20	<20
	Sodium (Na)-Total (mg/kg wwt)	<4.0	<4.0	<4.0	<4.0	4.0
	Strontium (Sr)-Total (mg/kg)	11.2	10.6	105	143	70.7
	Strontium (Sr)-Total (mg/kg wwt)	6.12	5.65	44.5	60.7	27.0
	Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg)	0.0074	0.0079	<0.0020	<0.0020	<0.0020
	Thallium (Tl)-Total (mg/kg wwt)	0.00404	0.00420	<0.00040	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	<0.00040	<0.00040	0.00043
	Vanadium (V)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Vanadium (V)-Total (mg/kg wwt)	0.026	0.022	<0.020	<0.020	0.027
	Zinc (Zn)-Total (mg/kg)	20.3	24.9	102	249	185
	Zinc (Zn)-Total (mg/kg wwt)	11.1	13.2	43.3	106	70.5
	Zirconium (Zr)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2355568-147	L2355568-148	L2355568-149	L2355568-150	L2355568-151
Description	Tissue	Tissue	Tissue	Tissue	Tissue
Sampled Date					
Sampled Time					
Client ID	S-03 (CRANBERRY) 2	S-03 (CRANBERRY) 3	S-05(WILLOW) 1	S-05(WILLOW) 2	S-05(WILLOW) 3
Grouping **Analyte**					
TISSUE					
Metals Mercury (Hg)-Total (mg/kg)	0.0057	<0.0050	0.0061	0.0090	0.0068
Mercury (Hg)-Total (mg/kg wwt)	0.0011	<0.0010	0.0025	0.0035	0.0028
Molybdenum (Mo)-Total (mg/kg)	1.40	1.24	0.172	0.331	0.191
Molybdenum (Mo)-Total (mg/kg wwt)	0.273	0.248	0.0709	0.128	0.0802
Nickel (Ni)-Total (mg/kg)	1.06	0.84	0.95	1.17	1.56
Nickel (Ni)-Total (mg/kg wwt)	0.212	0.176	0.392	0.456	0.652
Phosphorus (P)-Total (mg/kg)	1720	1560	1210	1300	1310
Phosphorus (P)-Total (mg/kg wwt)	343	314	501	506	551
Potassium (K)-Total (mg/kg)	9640	8560	5410	13900	6860
Potassium (K)-Total (mg/kg wwt)	1860	1590	2230	5400	2880
Rubidium (Rb)-Total (mg/kg)	3.19	2.69	2.02	11.8	1.96
Rubidium (Rb)-Total (mg/kg wwt)	0.647	0.530	0.833	4.58	0.824
Selenium (Se)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	0.011	0.018	0.013
Sodium (Na)-Total (mg/kg)	34	32	<20	<20	<20
Sodium (Na)-Total (mg/kg wwt)	7.5	6.9	<4.0	4.5	<4.0
Strontium (Sr)-Total (mg/kg)	5.10	3.56	49.3	51.1	56.0
Strontium (Sr)-Total (mg/kg wwt)	0.975	0.698	20.3	19.8	23.5
Tellurium (Te)-Total (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0024	<0.0020
Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	0.00041	0.00094	<0.00040
Tin (Sn)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
Uranium (U)-Total (mg/kg)	<0.0020	<0.0020	<0.0020	0.0061	<0.0020
Uranium (U)-Total (mg/kg wwt)	<0.00040	<0.00040	0.00082	0.00238	<0.00040
Vanadium (V)-Total (mg/kg)	<0.10	<0.10	0.21	0.73	<0.10
Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	0.086	0.285	0.040
Zinc (Zn)-Total (mg/kg)	9.45	8.33	106	88.4	90.5
Zinc (Zn)-Total (mg/kg wwt)	2.02	1.76	43.9	34.3	37.9
Zirconium (Zr)-Total (mg/kg)	0.41	<0.20	<0.20	<0.20	<0.20
Zirconium (Zr)-Total (mg/kg wwt)	0.076	<0.040	<0.040	<0.040	<0.040

* 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)
Duplicate	Chromium (Cr)-Total	DUP-H	L2355568-121, -122, -123, -125, -126, -127, -128, -129, -130, -131, -132, -133, -137, -138, -139, -140, -141, -142, -31
Duplicate	Antimony (Sb)-Total	DUP-H	L2355568-51
Duplicate	Chromium (Cr)-Total	DUP-H	L2355568-121, -122, -123, -125, -126, -127, -128, -129, -130, -131, -132, -133, -137, -138, -139, -140, -141, -142, -31
Duplicate	Iron (Fe)-Total	DUP-H	L2355568-51
Certified Reference Material	Thallium (Tl)-Total	MES	L2355568-111, -112, -113, -114, -115, -116, -117, -118, -119, -120, -147, -148
Certified Reference Material	Thallium (Tl)-Total	MES	L2355568-111, -112, -113, -114, -115, -116, -117, -118, -119, -120, -147, -148
Laboratory Control Sample	Selenium (Se)-Total	MES	L2355568-18, -19, -20, -21, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50
Laboratory Control Sample	Selenium (Se)-Total	MES	L2355568-18, -19, -20, -21, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
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**
HG-DRY-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAAS (DRY)	EPA 200.3, EPA 245.7

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. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

HG-WET-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAAS (WET)	EPA 200.3, EPA 245.7

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. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

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.

MET-WET-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

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.

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

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ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Selam W.	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Surcharges apply)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	TH-1?-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
1	C-01A (horsetail)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (horsetail)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (horsetail)	28-Aug-19	15:56	Tissue	R	R	R	R									
2	C-01A (labrador tea)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (labrador tea)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (labrador tea)	28-Aug-19	15:56	Tissue	R	R	R	R									
3	C-01A (willow)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (willow)	28-Aug-19	15:56	Tissue	R	R	R	R									
	C-01A (willow)	28-Aug-19	15:56	Tissue	R	R	R	R									
4	C-01A	28-Aug-19	15:56	Sediment								R	R	R	R		
	C-01A	28-Aug-19	15:56	Sediment								R	R	R	R		
	C-01A	28-Aug-19	15:56	Sediment								R	R	R	R		

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations: Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact: Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
15.0	15.0	15.0			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
CR			EF	3 Sep 2019	8:50	TG	5 Sep 19	10:31 AM

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

Page 2 of

ALS Environmental — www.alsglobal.com — Canada Toll Free: 1 800 668 9878

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Cebitie Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: crentmeister@alexcoenv.com
Email 2:
Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax:
Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:
Major/Minor Code: Routing Code:
Requisitioner:
Location:

Project Information

ALS Account # / Quote #:
Job #: Minto
PO / AFE: MINTO-02
LSD:
ALS Lab Work Order # (lab use only):
ALS Contact: Selam W. Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:
For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BBY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	M-29 (labrador tea)	28-Aug-19	10:30	Tissue	R	R	R	R									1
5	M-29 (labrador tea)	28-Aug-19	10:30	Tissue	R	R	R	R									1
	M-29 (labrador tea)	28-Aug-19	10:30	Tissue	R	R	R	R									1
	M-29	28-Aug-19	10:30	Sediment					R	R	R	R	R	R			1
6	M-29	28-Aug-19	10:30	Sediment					R	R	R	R	R	R			1
	M-29	28-Aug-19	10:30	Sediment					R	R	R	R	R	R			1
	M-29			Tissue													
				Tissue													
				Tissue													
				Tissue													
				Tissue													
				Tissue													

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
15.2			6.1	12.3	

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☐ NO
Are samples for human consumption/ use?
☑ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SHIPMENT RELEASE (client use)

Released by: CR Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: LF Date: 3 Sep 2019 Time: 15:50

FINAL SHIPMENT RECEPTION (lab use only)

Received by: Date: Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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 agre

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Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

Page 3 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☐ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: crentmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: Selam W. Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-RSY-DIGEST-VA	PREP-TISS-DIGEST-VA	COC	particle size	PREP-200.2-VA	PH-1-P-VA	1:10-200.2-CV/AF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
7	S-19 (labrador tea)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (labrador tea)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (labrador tea)	27-Aug-19	7:40	Tissue	R	R	R	R									1
8	S-19 (willow)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (willow)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (willow)	27-Aug-19	7:40	Tissue	R	R	R	R									1
9	S-19 (berries)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (berries)	27-Aug-19	7:40	Tissue	R	R	R	R									1
	S-19 (berries)	27-Aug-19	7:40	Tissue	R	R	R	R									1
10	S-19	27-Aug-19	7:40	Sediment					R	R	R	R	R	R			1
	S-19	27-Aug-19	7:40	Sediment					R	R	R	R	R	R			1
	S-19	27-Aug-19	7:40	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
15.0			5.0	12.3	

SHIPMENT RELEASE (client use)

Released by:	Time:
CR	

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:
	3 Sep 2019	15:56

FINAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:
	5 Sep 19	11:40

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2355568-COFC

Page 4 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: crentmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Project Information

ALS Account # / Quote #:

Job #: Minto

PO / AFE: MN19-02

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only):

ALS Contact: Selena W. Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-ASY-DIGEST-VA	PREP-T198-DIGEST-VA	CHG	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
11	S-18 (labrador tea)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (labrador tea)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (labrador tea)	28-Aug-19	11:15	Tissue	R	R	R	R									1
12	S-18 (willow)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (willow)	28-Aug-19	11:15	Tissue	R	R	R	R									1
	S-18 (willow)	28-Aug-19	11:15	Tissue	R	R	R	R									1
13	S-18	28-Aug-19	11:15	Sediment					R	R	R	R	R	R			1
	S-18	28-Aug-19	11:15	Sediment					R	R	R	R	R	R			1
	S-18	28-Aug-19	11:15	Sediment					R	R	R	R	R	R			1
																	1
																	1
																	1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
17.0				6.0	7.1	7.2	6.3

SHIPMENT RELEASE (client use)

Released by: CR Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: EF Date: 3 Sep 2019 Time: 15:50

FINAL SHIPMENT RECEPTION (lab use only)

Received by: JG Date: 5 Sep 19 Time: 11:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 5 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☐ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: crentmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Project Information

ALS Account # / Quote #:

Job #: Min'to

PO / AFE: MN19-02

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply) ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PWR-400 2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Samples to hazardous (please provide further details)	NUMBER OF CONTAINERS
14	S-17 (willow)	27-Aug-19	6:40	Tissue	R	R	R	R									1
	S-17 (willow)	27-Aug-19	6:40	Tissue	R	R	R	R									1
	S-17 (willow)	27-Aug-19	6:40	Tissue	R	R	R	R									1
15	S-17	27-Aug-19	6:40	Sediment					R	R	R	R	R	R			1
	S-17	27-Aug-19	6:40	Sediment					R	R	R	R	R	R			1
	S-17	27-Aug-19	6:40	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
17.0	9.0	15.0			

SHIPMENT RELEASE (client use)

Released by: Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: EF Date: 3 Sep 2019 Time: 15:50

FINAL SHIPMENT RECEPTION (lab use only)

Received by: Date: 5 Sep 19 Time: 11:30

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REFER TO BACK PAGES FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Chain of Custody (COC) / Analyt Request Form

L2355568-COFC

COC Number: 17 -

Page 6 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Reatmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeisten@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Mints
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Selena W.	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business days)	Emergency
4 day [P4-20%] ☐	1 Business day [E1 - 100%] ☐
3 day [P3-25%] ☐	Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
2 day [P2-50%] ☐	

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BGY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
16	S-16 (labrador tea)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (labrador tea)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (labrador tea)	26-Aug-19	15:50	Tissue	R	R	R	R									1
17	S-16 (willow)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (willow)	26-Aug-19	15:50	Tissue	R	R	R	R									1
	S-16 (willow)	26-Aug-19	15:50	Tissue	R	R	R	R									1
18	S-16	26-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-16	26-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-16	26-Aug-19	15:50	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations Yes	☐ No ☐
Ice Packs	☒ Ice Cubes ☐	Custody seal intact Yes	☐ No ☐
Cooling Initiated	☒		

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
16.0				6.0	7.1	6.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by:	Date: 5 Sep 19	Time: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1] For samples taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

Page 1 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice To	Same as Report To	☑ YES ☐ NO
	Copy of Invoice with Report	☑ YES ☐ NO
Company:		
Contact:		

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)		
AFE/Cost Center:		PO#
Major/Minor Code:		Routing Code:
Requisitioner:		
Location:		

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W.

Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R]: ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐

Emergency: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	CMET-BSY-DIGEST-VA	PREP-MHG-DIGEST-VA			CEC	particle size	PREP 200.2-VA	PH-1:2-VA	HG 200.2-CVAF-VA	MET-200.2-CCMS-VA			SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
19	S-15 (horsetail)	28-Aug-19	11:40	Tissue	R	R	R	R													1
	S-15 (horsetail)	28-Aug-19	11:40	Tissue	R	R	R	R													1
	S-15 (horsetail)	28-Aug-19	11:40	Tissue	R	R	R	R													1
20	S-15 (labrador tea)	28-Aug-19	11:40	Tissue	R	R	R	R													1
	S-15 (labrador tea)	28-Aug-19	11:40	Tissue	R	R	R	R													1
	S-15 (labrador tea)	28-Aug-19	11:40	Tissue	R	R	R	R													1
21	S-15	28-Aug-19	11:40	Sediment							R	R	R	R	R	R					1
	S-15	28-Aug-19	11:40	Sediment							R	R	R	R	R	R					1
	S-15	28-Aug-19	11:40	Sediment							R	R	R	R	R	R					1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
16.0			6.6	11.2	11.5

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
			SF	3 Sep 2019	15:50	JG	5 Sep 19	11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2355568-COFC

COC Number: 17 -

Page 5 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)		
AFE/Cost Center:		PO#:
Major/Minor Code:		Routing Code:
Requisitioner:		
Location:		
ALS Contact:	Selam W.	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
4 day [P4-20%]	☐	1 Business day [E1 - 100%]	☐
3 day [P3-25%]	☐	Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)	☐
2 day [P2-50%]	☐		

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TIMS-DIGMET-VA	CRC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
22	S-11 (willow)	27-Aug-19	17:15	Tissue	R	R	R	R									1
	S-11 (willow)	27-Aug-19	17:15	Tissue	R	R	R	R									1
	S-11 (willow)	27-Aug-19	17:15	Tissue	R	R	R	R									1
23	S-11	27-Aug-19	17:15	Sediment					R	R	R	R	R	R			1
	S-11	27-Aug-19	17:15	Sediment					R	R	R	R	R	R			1
	S-11	27-Aug-19	17:15	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	N/A ☐
Ice Packs ☒	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐	N/A ☐
Cooling Initiated ☒					

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
11.0			6.6	7.1	7.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: JK	Date: 5 SEP 19	Time: 13:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2355568-COFC

COC Number 17 -

Page 9 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] ☐ (Laboratory opening fees may apply)]
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY CVAFS N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CHC	PREP-200.2-VA	VH-1.2-VA	HG 200.2 CVAFS-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
24	S-09 (willow)	27-Aug-19	10:20	Tissue	R	R	R	R								1
	S-09 (willow)	27-Aug-19	10:20	Tissue	R	R	R	R								1
	S-09 (willow)	27-Aug-19	10:20	Tissue	R	R	R	R								1
25	S-09	27-Aug-19	10:20	Sediment					R	R	R	R	R			1
	S-09	27-Aug-19	10:20	Sediment					R	R	R	R	R			1
	S-09	27-Aug-19	10:20	Sediment					R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☒	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☒				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
16.0			6.6	7.1	7.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: JK	Date: 5 Sep 19	Time: 11:30am

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1. If drinking water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytica Request Form

L2355568-COFC

COC Number: 17 -

Page 1 of 1

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	Priority (Business days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	Emergency: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Salam W.	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-COMS-N-VA	PREP-BBY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
26	S-08 (labrador tea)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (labrador tea)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (labrador tea)	27-Aug-19	11:00	Tissue	R	R	R	R									1
27	S-08 (willow)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (willow)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (willow)	27-Aug-19	11:00	Tissue	R	R	R	R									1
28	S-08 (lichen)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (lichen)	27-Aug-19	11:00	Tissue	R	R	R	R									1
	S-08 (lichen)	27-Aug-19	11:00	Tissue	R	R	R	R									1
29	S-08	27-Aug-19	11:00	Sediment					R	R	R	R	R	R			1
	S-08	27-Aug-19	11:00	Sediment					R	R	R	R	R	R			1
	S-08	27-Aug-19	11:00	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.1	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:52	Received by: JG	Date: 5 Sep 19	Time: 11:23 AM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

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Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2W3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	creentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W.

Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

Emergency: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply) ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
30	S-08A (labrador tea)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (labrador tea)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (labrador tea)	27-Aug-19	11:05	Tissue	R	R	R	R									1
31	S-08A (willow)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (willow)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (willow)	27-Aug-19	11:05	Tissue	R	R	R	R									1
32	S-08A (lichen)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (lichen)	27-Aug-19	11:05	Tissue	R	R	R	R									1
	S-08A (lichen)	27-Aug-19	11:05	Tissue	R	R	R	R									1
33	S-08A	27-Aug-19	11:05	Sediment					R	R	R	R	R	R			1
	S-08A	27-Aug-19	11:05	Sediment					R	R	R	R	R	R			1
	S-08A	27-Aug-19	11:05	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
6.0				6.6	11.2	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: TG	Date: 5 Sep 19	Time: 15:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form

Chain of Custody (COC) / Analyti Request Form

L2355568-COFC

COC Number: 17 -

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ALS Environmental

Canada Toll Free: 1 800 668 9878

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Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Reatmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: crentmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

Project Information

ALS Account # / Quote #:	
Job #:	Meta
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	
ALS Contact:	Selam W.
Sampler:	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
34	S-07 (labrador tea)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (labrador tea)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (labrador tea)	27-Aug-19	15:50	Tissue	R	R	R	R									1
35	S-07 (willow)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (willow)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (willow)	27-Aug-19	15:50	Tissue	R	R	R	R									1
36	S-07 (horsetail)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (horsetail)	27-Aug-19	15:50	Tissue	R	R	R	R									1
	S-07 (horsetail)	27-Aug-19	15:50	Tissue	R	R	R	R									1
37	S-07	27-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-07	27-Aug-19	15:50	Sediment					R	R	R	R	R	R			1
	S-07	27-Aug-19	15:50	Sediment					R	R	R	R	R	R			1

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
15.0	

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SHIPMENT RELEASE (client use)

Released by:	Time:
VR	

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:
BF	8 Sep 2019	15:52

FINAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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[1] If samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2355568-COFC

COC Number: 17 -

Page 1 of 3

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report: ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: crentmeister@alexcoenv.com

Email 2:

Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R]: ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #		AFE/Cost Center:	PO#
Job #:	Minto	Major/Minor Code	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-DRY DIGEST-VA	PREP-DRY-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH 1:2 VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
38	S-06 (labrador tea)	27-Aug-19	14:55	Tissue	R	R	R	R									1
	S-06 (labrador tea)	27-Aug-19	14:55	Tissue	R	R	R	R									1
	S-05 (labrador tea)	27-Aug-19	14:55	Tissue	R	R	R	R									1
39	S-06	27-Aug-19	14:55	Sediment					R	R	R	R	R	R			1
	S-05	27-Aug-19	14:55	Sediment					R	R	R	R	R	R			1
	S-06	27-Aug-19	14:55	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/ use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
15.0			6.6	7.1	12.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 19	Time: 15:50	Received by: RG	Date: 5 Sep 19	Time: 11:20

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

Page 14 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

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Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#5 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax crentmeister@alexcoenv.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX

Email 1 or Fax

Email 2

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	
ALS Contact:	Selam W.
Sampler:	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply) ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TI99-DIGEST-VA	CEC	particle size	PREP-300.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
40	S-05 (labrador tea)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (labrador tea)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (labrador tea)	27-Aug-19	9:25	Tissue	R	R	R	R									1
41	S-05 (berries)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (berries)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (berries)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (berries)	27-Aug-19	9:25	Tissue	R	R	R	R									1
42	S-05 (horsetail)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (horsetail)	27-Aug-19	9:25	Tissue	R	R	R	R									1
	S-05 (horsetail)	27-Aug-19	9:25	Tissue	R	R	R	R									1
43	S-05	27-Aug-19	9:25	Sediment					R	R	R	R	R	R			1
	S-05	27-Aug-19	9:25	Sediment					R	R	R	R	R	R			1
	S-05	27-Aug-19	9:25	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples (client use)

Are samples taken from a Regulated DW System?

☐ YES ☐ NO

Are samples for human consumption/use?

☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
16.0	6.0 7.1 8.3

SHIPMENT RELEASE (client use)

Released by: | Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: | Date: 3 Sep 2019 | Time: 1515

FINAL SHIPMENT RECEPTION (lab use only)

Received by: | Date: 5Sep19 | Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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If any water samples are taken from a Regulated Drinking Water (DW) System please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

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L2355568-COFC

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report: ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	Date and Time Required for all E&P TATs:
City/Province:	Whitehorse, YT	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☐ EMAIL ☑ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-NVA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA			CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA			SAMPLES ON HOLD	Analyte is hazardous (please provide further detail)	NUMBER OF CONTAINERS
44	S-04 (labrador tea)	27-Aug-19	13:35	Tissue	R	R	R	R													1
	S-04 (labrador tea)	27-Aug-19	13:35	Tissue	R	R	R	R													1
	S-04 (labrador tea)	27-Aug-19	13:35	Tissue	R	R	R	R													1
45	S-04 (yellow)	27-Aug-19	13:35	Tissue	R	R	R	R													1
	S-04 (yellow)	27-Aug-19	13:35	Tissue	R	R	R	R													1
	S-04 (yellow)	27-Aug-19	13:35	Tissue	R	R	R	R													1
46	S-04 (berries)	27-Aug-19	13:35	Tissue	R	R	R	R													1
	S-04 (berries)	27-Aug-19	13:35	Tissue	R	R	R	R													1
	S-04 (berries)	27-Aug-19	13:35	Tissue	R	R	R	R													1
47	S-04	27-Aug-19	13:35	Sediment							R	R	R	R	R	R					1
	S-04	27-Aug-19	13:35	Sediment							R	R	R	R	R	R					1
	S-04	27-Aug-19	13:35	Sediment							R	R	R	R	R	R					1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.1	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 13:05

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2355568-COFC

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R]: ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report: ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐; 3 day [P3-25%] ☐; 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐; Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply) ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	
Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO #:
Job #:	Mako	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAF/B-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
48	S-02	28-Aug-19	17:25	Sediment					R	R	R	R	R	R			1
	S-02	28-Aug-19	17:25	Sediment					R	R	R	R	R	R			1
	S-02	28-Aug-19	17:25	Sediment					R	R	R	R	R	R			1
49	S-03 (willow)	27-Aug-19	17:35	Tissue	R	R	R	R									1
	S-03 (willow)	27-Aug-19	17:35	Tissue	R	R	R	R									1
	S-03 (willow)	27-Aug-19	17:35	Tissue	R	R	R	R									1
50	S-03	27-Aug-19	17:35	Sediment					R	R	R	R	R	R			1
	S-03	27-Aug-19	17:35	Sediment					R	R	R	R	R	R			1
	S-03	27-Aug-19	17:35	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice Packs	☒ Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐	
Cooling Initiated	☒				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.0	7.5	6.5	6.5

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 11:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

Page 1 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

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Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Selam W.	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS N-VA	MET-DRY-CCMS-N-VA	TREH-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA		OC/C	particle size	PREP-200.2-VA	WH-1/2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA		SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
51	S-01 (labrador tea)	28-Aug-19	17:00	Tissue	R	R	R	R											1
	S-01 (labrador tea)	28-Aug-19	17:00	Tissue	R	R	R	R											1
	S-01 (labrador tea)	28-Aug-19	17:00	Tissue	R	R	R	R											1
52	S-01	28-Aug-19	17:00	Sediment						R	R	R	R	R	R				1
	S-01	28-Aug-19	17:00	Sediment						R	R	R	R	R	R				1
	S-01	28-Aug-19	17:00	Sediment						R	R	R	R	R	R				1

Drinking Water (DW) Samples (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☑	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☒				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
5.0					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
				3 Sep 2019	15:50			

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

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Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

Canada Toll Free: 1 800 668 9878

COC Number: 17 -

Page 18 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W.

Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	pH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
53	M-07b (labrador tea)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (labrador tea)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (labrador tea)	28-Aug-19	8:15	Tissue	R	R	R	R									1
54	M-07b (willow)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (willow)	28-Aug-19	8:15	Tissue	R	R	R	R									1
	M-07b (willow)	28-Aug-19	8:15	Tissue	R	R	R	R									1
55	M-07b	28-Aug-19	8:15	Sediment					R	R	R	R	R	R			1
	M-07b	28-Aug-19	8:15	Sediment					R	R	R	R	R	R			1
	M-07b	28-Aug-19	8:15	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.1	12.3	

SHIPMENT RELEASE (client use)

Released by: | Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: EP | Date: 3 SEP 2019 | Time: 15:50

FINAL SHIPMENT RECEPTION (lab use only)

Received by: TG | Date: 5 Sep 19 | Time: 11:50

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

Page 19 of

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcocear.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W. Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days)		Emergency	
	4 day [P4-20%] ☐		1 Business day [E1 - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200%] ☐
	2 day [P2-50%] ☐		(Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs: : :

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-ARY DIGEST-VA	PREP-HSS-DIGEST VA			CCC	particle size	PREP-200.2-VA	PH-1-2 VA	HG-200.2-CVAF VA	MET-200.2-CCMS-VA			SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
~~53~~ 56	M-26 (labrador tea)	28-Aug-19	6:50	Tissue	R	R	R	R													1
	M-26 (labrador tea)	28-Aug-19	6:50	Tissue	R	R	R	R													1
	M-26 (labrador tea)	28-Aug-19	6:50	Tissue	R	R	R	R													1
~~54~~ 57	M-26 (willow)	28-Aug-19	6:50	Tissue	R	R	R	R													1
	M-26 (willow)	28-Aug-19	6:50	Tissue	R	R	R	R													1
	M-26 (willow)	28-Aug-19	6:50	Tissue	R	R	R	R													1
58	M-26 (lichen)	28-Aug-19	6:50	Tissue	R	R	R	R													1
	M-26 (lichen)	28-Aug-19	6:50	Tissue	R	R	R	R													1
	M-26 (lichen)	28-Aug-19	6:50	Tissue	R	R	R	R													1
59	M-26	28-Aug-19	6:50	Sediment							R	R	R	R	R	R					1
	M-26	28-Aug-19	6:50	Sediment							R	R	R	R	R	R					1
	M-26	28-Aug-19	6:50	Sediment							R	R	R	R	R	R					1

Drinking Water (DW) Samples (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.1	12.6	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:		Time:	Received by: EF	Date: 3 Sep 2019	Time: 1550	Received by: JK	Date: 5 Sep 19	Time: 1130

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

For Drinking Water (DW) Samples, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

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Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 2 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R]: ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report: ☑ YES ☐ NO	Priority (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	Emergency: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	83 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TI99-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.4-CVAFS-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Samples in hazardous (please provide further details)	NUMBER OF CONTAINERS
60	M-80 (labrador tea)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (labrador tea)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (labrador tea)	28-Aug-19	14:10	Tissue	R	R	R	R									1
61	M-80 (willow)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (willow)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (willow)	28-Aug-19	14:10	Tissue	R	R	R	R									1
62	M-80 (berries)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (berries)	28-Aug-19	14:10	Tissue	R	R	R	R									1
	M-80 (berries)	28-Aug-19	14:10	Tissue	R	R	R	R									1
63	M-80	28-Aug-19	14:10	Sediment					R	R	R	R	R	R			1
	M-80	28-Aug-19	14:10	Sediment					R	R	R	R	R	R			1
	M-80	28-Aug-19	14:10	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☒	Ice Cubes ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☒				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.8	7.1	12.5	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: GP	Date: 3 Sep 2019	Time: 15:50	Received by:	Date: 5 Sep 19	Time: 09:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1]. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytica Request Form

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Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 2 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	Priority (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	Emergency: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	Date and Time Required for all E&P TATs:
City/Province:	Whitehorse, YT	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	Y1A 2V3	Email 3	

Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MN19-02	Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: Selam W.

Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISR DIGEST-VA	CWG	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
64	C-02 (horsetail)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (horsetail)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (horsetail)	28-Aug-19	14:40	Tissue	R	R	R	R									1
65	C-02 (labrador tea)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (labrador tea)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (labrador tea)	28-Aug-19	14:40	Tissue	R	R	R	R									1
66	C-02 (willow)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (willow)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (willow)	28-Aug-19	14:40	Tissue	R	R	R	R									1
67	C-02 (lichen)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (lichen)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (lichen)	28-Aug-19	14:40	Tissue	R	R	R	R									1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.1	7.3	6.3	6.5

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: BF	Date: 3 Sep 2019	Time: 15:50	Received by: JK	Date: 5 SEP 19	Time: 11:20

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2355568-COFC

COC Number: 17 -

Page 22 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report: ☐ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply) ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs:
Street:	#3 Calcite Business Centre, 151 Industrial Rd	Email 1 or Fax: crentmeister@alexcoenv.com	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Whitehorse, YT	Email 2	
Postal Code:	Y1A 2V3	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☑ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	Minto	Major/Minor Code:	Routing Code:
PO / AFE:	MIN19-02	Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Selam W.	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-BSY-DIGEST-VA	PREP-TISS-DIGEST-VA	CEC	particle size	PREP-200.2-VA	PH-1:2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
68	C-02 (berries)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (berries)	28-Aug-19	14:40	Tissue	R	R	R	R									1
	C-02 (berries)	28-Aug-19	14:40	Tissue	R	R	R	R									1
69	C-02	28-Aug-19	14:40	Sediment					R	R	R	R	R	R			1
	C-02	28-Aug-19	14:40	Sediment					R	R	R	R	R	R			1
	C-02	28-Aug-19	14:40	Sediment					R	R	R	R	R	R			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☒ Ice Cubes ☐	Custody seal intact	Yes ☐	No	☐
Cooling Initiated	☒				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.6	7.3	12.3	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR		Time:	Received by: RP	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

COC Number: 17 -

ALS Environmental

Canada Toll Free: 1 800 668 9878

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Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotte Rentmeister
Phone:	
	Company address below will appear on the final report
Street:	#3 Calcite Business Centre, 151 Industrial Rd
City/Province:	Whitehorse, YT
Postal Code:	Y1A 2V3
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	crentmeister@alexcoenv.com
Email 2	
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Selam W.	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

Emergency: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	HG-DRY-CVAFS-N-VA	MET-DRY-CCMS-N-VA	PREP-DRY-DIGEST-VA	PREP-TISS-DIGEST-VA			CEC	particle size	PHEP-200.2-VA	PH-1.2-VA	HG-200.2-CVAF-VA	MET-200.2-CCMS-VA				BAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
70	C-01 (horsetail)	28-Aug-19	15:55	Tissue	R	R	R	R														1
	C-01 (horsetail)	28-Aug-19	15:55	Tissue	R	R	R	R														1
	C-01 (horsetail)	28-Aug-19	15:55	Tissue	R	R	R	R														1
71	C-01 (labrador tea)	28-Aug-19	15:55	Tissue	R	R	R	R														1
	C-01 (labrador tea)	28-Aug-19	15:55	Tissue	R	R	R	R														1
	C-01 (labrador tea)	28-Aug-19	15:55	Tissue	R	R	R	R														1
72	C-01 (willow)	28-Aug-19	15:55	Tissue	R	R	R	R														1
	C-01 (willow)	28-Aug-19	15:55	Tissue	R	R	R	R														1
	C-01 (willow)	28-Aug-19	15:55	Tissue	R	R	R	R														1
73	C-01	28-Aug-19	15:55	Sediment							R	R	R	R	R	R						1
	C-01	28-Aug-19	15:55	Sediment							R	R	R	R	R	R						1
	C-01	28-Aug-19	15:55	Sediment							R	R	R	R	R	R						1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
15.0				6.0	3.2	1.3	

SHIPMENT RELEASE (client use)		
Released by:		Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: EP	Date: 3 Sep 2019	Time: 15:55

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 5 Sep 19	Time: 0830

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX C:

2019 PHOTO LOG



Photo 1: C-01 vegetation (control)



Photo 2: C-01 soil pit



Photo 3: C-02 vegetation (control)



Photo 4: C-02 soil pit



Photo 5: M-07B vegetation (control)



Photo 6: M-07B soil pit



Photo 7: M-26 vegetation (control)



Photo 8: M-26 soil pit



Photo 9: M-80 vegetation (control)



Photo 10: M-80 soil pit



Photo 11: M-29 vegetation (exposure)



Photo 12: M-29 soil pit



Photo 13: S-01 vegetation (exposure)



Photo 14: S-01 soil pit



Photo 15: S-02 vegetation (exposure)



Photo 16: S-02 soil pit



Photo 17: S-03 vegetation (exposure)



Photo 18: S-03 soil pit



Photo 19: S-04 vegetation (exposure)



Photo 20: S-04 soil pit



Photo 21: S-05 vegetation (exposure)



Photo 22: S-05 soil pit



Photo 23: S-06 vegetation (exposure)



Photo 24: S-06 soil pit



Photo 25: S-07 vegetation (exposure)



Photo 26: S-07 soil pit



Photo 27: S-08 vegetation (exposure)



Photo 28: S-08 soil pit



Photo 29: S-09 vegetation (exposure)



Photo 30: S-09 soil pit



Photo 31: S-11 vegetation (exposure)



Photo 32: S-11 soil pit



Photo 33: S-15 vegetation (exposure)



Photo 34: S-15 soil pit



Photo 35: S-16 vegetation (exposure)



Photo 36: S-16 soil pit



Photo 37: S-17 vegetation (exposure)



Photo 38: S-17 soil pit



Photo 39: S-18 vegetation (exposure)



Photo 40: S-18 soil pit



Photo 41: S-19 vegetation (exposure)



Photo 42: S-19 soil pit

Appendix S – 2019 Update Minto Mine Constructed Wetland Treatment Research Program

Contango STRATEGIES LTD.

Forward looking. Lateral thinking.

ALEXCO ENVIRONMENTAL GROUP

Minto Mine Constructed Wetland Treatment Research Program – Demonstration-Scale 2019 Update Report

Document #011_0320_14B

Prepared for:
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MINTO EXPLORATIONS

Prepared by:

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Executive Summary

The Minto Mine is an open pit and underground copper mine located 240 km northwest of Whitehorse in the Yukon Territory. As a result of mining activities, cadmium, copper, molybdenum, selenium, and zinc are slightly elevated in site drainage water beyond background concentrations and have been identified as constituents of concern (COC). As part of the Reclamation and Closure Plan for the Minto Mine, Contango, an AEG Company (Contango) was retained to evaluate the feasibility of a constructed wetland treatment system (CWTS) for passive water treatment at closure.

A phased approach is being followed to guide the site-specific design and implementation of a CWTS at closure for the Minto Mine. The phased approach was initiated with a site assessment in 2013 followed by pilot-scale testing to confirm and provide proof-of-concept before constructing the on-site demonstration-scale wetland.

The demonstration-scale CWTS was constructed at Minto in 2014, commissioned from 2015 through mid-2017 and transitioned into the operational period in August 2017. In 2018 the demonstration-scale CWTS was tested for its ability to recover and perform under the unintentionally imposed stresses of a winter/freshet drought and elevated nitrate concentrations in the inflow water. The CWTS demonstrated successful recovery and in 2019 the operational period had the primary objective of assessing performance under conditions that would be similar to the full-scale CWTS. This primary objective was developed as a response to lines of questioning in preliminary regulatory review of closure planning documents. Additional aspects that were evaluated include the fate and distribution of treated metals, detritus decomposition and accretion rates, carbon demand, and microbial community characterization. This report presents findings from all operational years of the demonstration-scale CWTS, with a focus on 2019 activities.

The flow rates in 2019 were higher than previous years to mimic shorter hydraulic retention times that are currently anticipated for the full-scale CWTS. The results from 2019 have highlighted that the demonstration-scale CWTS can operate under these shorter HRT conditions while successfully treating most COC and notably removing more load of COC than any previous year. Beneficial microbial populations in the CWTS remained stable, and COC have been treated with minimal uptake by plants. Removal rate coefficients have been developed throughout operations of the demonstration-scale CWTS which will be used to advance the design of a full-scale CWTS at the Mine.

The removal rate coefficients for cadmium, copper, and zinc in 2019 are similar or better to previous years, indicating they were unaffected by the shorter HRTs and less reducing conditions experienced in the CWTS. In contrast, molybdenum and selenium (somewhat) treatment was impacted by the decreased nitrate removal and correspondingly less reducing conditions in the CWTS. While nitrate is not a primary COC for CWTS treatment, removal is evaluated as nitrate can impact treatment of the primary COC. The demonstration-scale system was likely carbon limited due to higher nitrate loads going to the CWTS as a result of higher flow rates. As a result, the removal of molybdenum and selenium (somewhat) was impacted, with decreased removal rate coefficients for molybdenum (albeit similar to 2017)

and slightly lower rates for selenium. Outflow concentrations of molybdenum and selenium did not get as low and the percent removal was lower in 2019 than in previous years.

The testing in 2019 has therefore identified that when nitrate loads are high, the carbon demand for the CWTS may be greater than what is available through annual plant growth. The carbon demand for the full-scale CWTS will be evaluated in the context of expected nitrate loads in closure, where concentrations are expected to decrease over time and would be lower if there is any pre-treatment (e.g., pit lake treatment) before the CWTS. *In situ* pit lake treatment is also being evaluated in 2020 and 2021 with bench- and pilot-scale trials. Should higher nitrate loads be expected early in closure to the CWTS, a forebay could be used for periodic carbon supplementation. To further refine the full-scale CWTS design it is therefore recommended that in 2020 a forebay with organics be incorporated into the demonstration-scale CWTS to evaluate the amount and frequency of carbon addition that may be needed to manage high nitrate loads.

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Appendix C – Multi-year Workplan
Appendix D – Microbiology

Abbreviations and Definitions

Accretion – The process of growth or increase of sediments through deposition and accumulation of organic material deposited solids (such as minerals) within a wetland.

Acid volatile sulphide (AVS) – Sulphide complexed with Fe (FeS) where the sulphide can preferentially exchange Fe for heavy metals (Ni, Zn, Cd, Pb, Cu, Hg) which are then more stably bound.

Acidity – A measure of the capacity of water to neutralize base. Influences pH along with alkalinity.

Alkalinity (Alk) – A measure of the capacity of water to neutralize acids. Influences pH along with acidity.

Amendment – A chemical or organic material added to encourage specific conditions (e.g., aerobic/anaerobic, pH, ORP) or as a source of something that is needed for passive treatment (e.g., nutrients, alkalinity, binding sites, etc).

Biofilm(s) – A visible and often slimy-looking film (community) of bacteria (may contain other microbes).

Carbon source – A source of carbon (energy/electrons) for microbes (see electron donors). Examples include ethanol, methanol, acetate, sugar (glucose), molasses, wood chips, detritus (dead plant matter).

Carex aquatilis – A plant (emergent macrophyte) commonly known as water sedge.

CCME – Canadian Council of Minister of the Environment.

Constituent of Concern (COC) – Specific elements that have been identified for evaluation, including cadmium, copper, molybdenum, selenium, and zinc.

Constructed wetland treatment system (CWTS) – Wetlands that are designed and constructed to remove compounds from water, using natural processes to sequester them into the soils rendering them less bioavailable. They are different from wetlands that provide habitat for wildlife.

Denitrification – Where nitrate (NO_3^-) is reduced by microorganisms to form nitrite (NO_2^-), nitric oxide (NO), or nitrous oxide (N_2O), or nitrogen gas (N_2) (see nitrate reduction).

Dissimilatory metal(s) reduction – A process used by microbes to conserve energy through oxidizing organic or inorganic electron donors and reducing a metal or metalloid.

Dissolved organic carbon (DOC) – Organic (carbon based) molecules in water, that have passed through a filter of 0.45 µm.

Dissolved oxygen (DO) – Diatomic oxygen (O_2) dissolved in water; oxygen can dissolve in water by diffusion from surrounding air, as a product of photosynthesis, or through forced aeration.

Electron donor(s) – A chemical compound that donates electrons to another compound (see carbon source). An electron donor is a reducing agent, which that by virtue of it donating electrons, is itself oxidized (see oxidation and reduction).

Explanatory parameters – Quantifiable parameters that describe how water treatment reactions take place.

Evapotranspiration – The process by which water is transferred to the atmosphere by evaporation from the surface of water and by transpiration from plants.

ICP-MS – Inductively coupled plasma mass spectrometry.

Macrophytes – An aquatic plant, large enough to be seen by eye. Can be emergent, submergent, or floating.

Microbes – Microscopic organisms that cab be uni- or multi-cellular. This includes algae, bacteria, fungi, viruses, and yeast.

Molybdenum reduction – Microbially mediated reduction of soluble Mo(VI) to create Mo(IV) which can complex with sulphide compounds.

Nitrate reduction – Where microbes reduce nitrate (NO_3^-) to form nitrite (NO_2^-); the first step in denitrification (see denitrification).

Oxidation – The loss of electrons, or increase in valence state, by a molecule, atom, or ion. Can be driven by microbes. Process is complementary to chemical reduction.

Oxidation-reduction potential (ORP) – A measure of the tendency of a chemical species to acquire or donate electrons, thus becoming reduced or oxidized, respectively, measured in millivolts.

Redox – Oxidation-reduction potential (in sediment), a measure of the tendency of a chemical species acquire or donate electrons, thus becoming reduced or oxidized, measured in millivolts. This measurement is relative to the water ORP.

Reduction (chemical) – The gain of electrons, or a decrease in valence state, by a molecule, atom, or ion. Can be catalyzed by microbes. Process is complementary to chemical oxidation.

Selenium reduction – Microbially mediated reduction of soluble Se(VI) and Se(IV) to insoluble elemental selenium.

Simultaneously extracted metals (SEM) – amounts of heavy metals such as Ni, Zn, Cd, Pb, Cu, Hg in sediment, assessed in the context of AVS for excess sulphide. (also see acid volatile sulphide)

Sorption – The physical and/or chemical process by which one substance becomes attached to another substance.

Specific conductivity (SPC) – A measurement of electrical conductivity in water that is typically expressed in µs/cm, which has been adjusted for temperature (25°C).

Species (sp.) – One of the basic units of biological classification and a taxonomic rank. Rank in the classification of organisms below genus and above strain. Also can be used to refer to the oxidation state of a mineral (e.g., selenate and selenite are species of selenium).

Sulphide – An inorganic anion of sulphur that can form stable complexes with metals and make them insoluble in water (remove them from the water).

Sulphide producing bacteria (SPB) – Microbial reduction of sulphur compounds, such as sulphate, sulphite, thiosulphate, and sulphur, which produces sulphides and alkalinity. (see also SRB).

Sulphate reducing bacteria (SRB) – a form of sulphide producing bacteria that specifically uses sulphate for reduction (see sulphide producing bacteria).

Sulphide production – Microbial reduction of sulphur compounds, such as sulphate, sulphite, thiosulphate, and sulphur, which produces sulphides and alkalinity.

Total dissolved solids (TDS) – A measure of the combined organic and inorganic salts dissolved in water.

Total kjeldahl nitrogen (TKN) – The sum of organic nitrogen, ammonia (NH_3), and ammonium (NH_4^+) in water (or soil). To calculate the total nitrogen, the concentrations of nitrate as N (NO_3^-N) and nitrite (NO_2^-N) are added to TKN.

Total organic carbon (TOC) – A measurement of the total organic carbons present in water.

Total suspended solids (TSS) – A measurement of all particles in water that are larger than 2 µm (anything smaller than 2 µm considered a dissolved solid).

Transfer – Processes that treat water by transferring a constituent to another location without changing its form. For example: absorption, adsorption, dilution, dispersion, filtration, precipitation (aqueous to solid), and volatilization.

Transform – Processes that change the chemical form or state of a constituent. For example: biodegradation, biotransformation, hydrolysis, ionization, oxidation, photolysis, and reduction.

1. Introduction

The Minto Mine (the "Mine"), owned and operated by Minto Explorations (previously Capstone Mining Corp), is a combination open pit/underground copper mine located 240 km northwest of Whitehorse on the west side of the Yukon River. Mining began in October 2007 and the deposits being mined were copper sulphide mineral deposits. In October 2018, the Mine was placed into temporary care and maintenance due to unfavourable equity market conditions (Capstone, 2018). In June 2019 the Mine was purchased by Minto Explorations and underground mining activities resumed in late 2019. Surface and ground water quality is a key consideration in the evaluation of potential effects of mining and mineral development projects. The resultant changes to water quality parameters have the potential to affect aquatic and human use of water resources.

A Reclamation and Closure Plan (RCP) is required for the Minto Mine under both the Water Use License and the Quartz Mining License. The RCP is intended to address the long-term physical and chemical stability of the site and closure of the proposed features and disturbances associated with the Mine. As a part of the RCP, the Mine has retained Contango Strategies, an AEG company (Contango), to complete an evaluation of the feasibility of a Constructed Wetland Treatment System (CWTS) for water treatment at closure. This assessment includes a phased approach approved during the Minto Phase V/VI Expansion Project (Yukon Online Registry Project Number 2013-0100). The CWTS phased approach will design, evaluate, and optimize water treatment of constituents of concern (COC; cadmium, copper, molybdenum, selenium, and zinc) for closure in a site-specific manner. CWTS are desirable for closure water treatment because once established, they can become self-sustaining ecosystems with the plants providing yearly renewal of carbon to fuel microbial activity. As such, they possess the desirable potential to remediate contaminated mine drainage for as long as it is generated.

Through the RCP, a demonstration-scale CWTS (Phase 4) was constructed at the Minto Mine in 2014, based on the design that was evaluated through pilot-scale testing (Contango, 2014b). Two series were constructed in parallel, each with two cells planted with local *Carex aquatilis* and moss. The demonstration-scale CWTS was commissioned from 2015-2017, and then underwent performance testing from 2017-2019. This report focuses on activities and results of the 2019 operational testing period. Background information on previous phases of work is summarized in Section 3. Background information on construction, commissioning, and operations of the demonstration-scale CWTS leading up to and including 2019 can be found in previous annual reports and is summarized in Section 4. Treatment processes are outlined in Section 5, and results from the demonstration-scale CWTS operations (2017-2019) presented in Section 6. Health and establishment of CWTS vegetation and treatment mechanisms are outlined in Section 7 and 8 respectively, and a summary is presented in Section 9 with recommendations and next steps for 2020 outlined in Section 10.

2. Objectives

The overriding objective of the Minto Mine demonstration-scale CWTS program is to advance proof of concept and ultimately site design of a full-scale CWTS for the Minto Mine. The primary objective in 2019 was to assess performance under a wide range of conditions that mimic the full-scale CWTS. Additional sampling occurred at the end of the 2019 season to evaluate the fate and distribution of COC within the CWTS. Other ongoing activities that have been reported on in previous years and continued in 2019 included:

- Evaluating CWTS performance and determining lowest achievable COC concentrations (performance limits) to provide information for full-scale treatment performance;
- Refining site-specific removal rate coefficients (RRCs) to provide information for full-scale CWTS sizing;
- Monitoring metals leaching from the mineralized soils used in construction to inform treatment extent;
- Assessing the mineral forms of COC sequestered into the soils and production of acid volatile sulphides (AVS) to inform on stability of COC in soils;
- Monitoring for the presence of aphids in the CWTS, and implementing a routine insect pest control plan (for aphids) to maintain plant health during the testing season;
- Determining the amount of vegetation growth and the rate and extent of detritus decomposition (*Carex aquatilis* leaves) in the CWTS over time to evaluate organic carbon production in a mature wetland; and
- Assessing treatment mechanisms (including microbes present) to confirm targeted biogeochemical processes and advance proof of concept.

3. Background

The phased approach for CWTS development at the Mine is summarized in Table 1 along with the objective of each phase. Phases that have been completed and reported elsewhere are also summarized.

Table 1 – Five phased approach for CWTS design and implementation.

Phase	Objective	Status	Document Number
Phase 1	Site assessment and information gathering	Complete	Contango, 2014a
Phase 2	Technology selection and conceptual design	Complete	
Phase 3	Off-site pilot-scale testing and optimization (at Contango)	Complete	Contango, 2014b
Phase 4	On-site demonstration-scale testing and optimization (at the Mine)	In progress	011_0315_01A 011_0316_03B 011_0217_05B 011_1117_10C 011_0119_13B This report
Phase 5	Full-scale implementation	Future scope	Future scope

3.1 Site Assessment and Pilot-Scale Testing

The site assessment (Phase 1) was conducted in 2013 to evaluate feasibility of a CWTS, and to identify possible CWTS locations and borrow sources for substrates and plants. During the site assessment, water, soil, plant, and microbiological samples from the natural wetland and a creek area between the W10 to W15 monitoring stations were collected and assessed. The site assessment revealed borrow sources for the CWTS substrate and vegetation, as well as probable locations for a CWTS (Contango, 2014a). Additionally the geochemical data collected indicated that substantial treatment of seepage water was occurring on site within the natural wetland validating the concept that a CWTS with optimized performance could be designed to function in the long-term closure conditions at the Mine. All the sites sampled were host to a wide diversity of microbes with known capability of performing favourable biogeochemical reactions, which will contribute to water treatment in a CWTS.

Findings from the site assessment supported progression to Phase 2 to select the technology and conceptually design the CWTS (Phase 2). An anaerobic CWTS technology was identified and conceptually designed based on the COC requiring treatment (copper and selenium) and site-specific considerations. The conceptual CWTS design was tested off-site at pilot-scale

(Phase 3) to refine the design for passive treatment during closure. The pilot-scale CWTS tested three anaerobic designs: planted with (i) *C. aquatilis,* (ii) *C. aquatilis* and moss, or (iii) *C. aquatilis,* moss, and with biochar amendment (hybrid bioreactor-CWTS). The three designs were tested in duplicate with synthetic water designed to mimic the predicted worst-case post-closure water chemistry during early and long-term closure (i.e., high and low nitrogen, respectively). Through pilot-scale testing the recommended CWTS design for long-term passive treatment of copper and selenium at the Mine was identified as a combination of *C. aquatilis* and moss planted in a sand substrate supplemented with 2-7% by volume as organic material (e.g., woodchips and peat). This recommendation was used to guide the design and implementation of the demonstration-scale CWTS (Phase 4) at the Mine.

4. Demonstration-Scale CWTS Construction, Commissioning, and Operations (2014-2019)

4.1 Overview of Demonstration-Scale History

Construction of the demonstration-scale CWTS and details of CWTS design, vegetation, and substrate borrow sources are reported in Contango, 2015. A potential borrow source was tested and selected prior to construction as soils in a mining area are likely mineralized. However, a different borrow source (organic peat) was used to construct the demonstration-scale CWTS, and analyses received after construction indicated an elevated concentration of leachable copper (described in Appendix A, Contango, 2017b).

The commissioning period is the time period between the construction of the CWTS and establishment of plants and microbial populations which result in achievement of expected treatment performance. The commissioning period of the demonstration-scale CWTS at the Minto Mine had two stages between September 19, 2014 and August 18, 2017 (Table 2). CWTS plant establishment occurred during the first stage (Commissioning-A; Table 2). Organics (straw and wood chips) were added to the CWTS at the start of the second stage (Commissioning-B; Table 2) to further aid in treatment of the leachable copper in the soils used in construction and to transition copper into sulphide mineral forms. The commissioning period was longer than typical for a CWTS based on the high leachable copper in the soils used for construction. Once sufficient reducing conditions were established at the end of the 2017 commissioning-B period, copper leaching subsided and treatment occurred at a faster rate than leaching (Contango, 2017b). Copper leaching has been discussed extensively in previous reports, with details of the two commissioning periods and criteria marking the end of commissioning outlined in Contango 2016a, 2017a, and 2017b.

The demonstration-scale CWTS was operated from mid-August 2017 to September 2019 (Table 2). In spring 2018, the CWTS was unintentionally exposed to a double stress test which included drying out the CWTS and exposing the wetland soils to air, as well as elevated nitrate concentrations in the water. Following the double stress test, the two mitigation strategies tested to return the CWTS to an operational status showed variable recovery periods for treatment of each COC (Table 2; Contango, 2019). Increased monitoring was implemented through the 2018/2019 winter and early spring season to ensure the CWTS remained flooded prior to beginning flow to the CWTS in 2019. This scenario of spring freshet drought is not expected to occur during full-scale operations as water will be flowing into the wetland by gravity as spring melt occurs and will not rely on pumps with seasonal constraints to supply water to the CWTS. The beginning of the 2019 operational period was marked by the start of continuous flow through the CWTS on May 15, 2019 (Table 2).

Table 2 – Summary of demonstration-scale CWTS timeline.

Period	Year	Days of Operation	Date	
			Start	End
Commissioning-A	2014	0 - 23	Aug 27	Sep 19
	2015	24 - 160	May 16	Sep 29
	2016	161 - 248	May 2	Jul 28
Commissioning-B	2016	249 - 311	Jul 29	Sep 30
	2017	312 - 394	May 27	Aug 17
Operational Period	2017	395 - 430[1]	Aug 18	Sep 22
Double Stress Test Period - Series 1	2018	439 - 494	May 15	Jul 8
Double Stress Test Period - Series 2	2018	439 - 533	May 15	Aug 16
Operational Period	2018	534 - 557[2]	Aug 17	Sep 9
Operational Period[3]	2019	577 - 690	May 15	Sep 5

[1] Flow was continued past the operational period until September 30, 2017 (day 438).
[2] Flow was continued past the operational period until September 28, 2018 (day 576).
[3] The operational period of 2019 consisted of multiple targeted HRT periods as shown in Figure 2.

4.2 Operational Adjustments in 2019

Operational adjustments were made to the demonstration-scale CWTS in 2019 to assist with addressing the objective of assessing performance under conditions that mimic the full-scale CWTS. These adjustment are discussed in Sections 4.2.1 and 4.2.2 below.

4.2.1 Increasing Water Depth

The water depth in each CWTS cell was raised in 2019 to mimic the water depths in the full-scale design and to further promote reducing conditions. Sandbags were added to the end and along the perimeter of each CWTS cell between May 5, 2019 and July 17, 2019 to increase the water depth and minimize short circuiting, respectively. Sandbags were added gradually as the stabilized water depth was confirmed. The water depths were increased by 17 to 23 cm in the four cells, to target 30 to 40 cm (Table 3). It is noted that at full-scale, short circuiting would be mitigated using rip rap armouring around the edges of the wetland.

Table 3 – Demonstration-scale CWTS water depths.

CWTS Cell	Average Water Depth 2017 (cm)	Average Water Depth 2018 (cm)	Maximum Water Depth 2019 (cm)[1]
1A	15.2	20.2	37.5
1B	16.0	20.3	40.5
2A	15.9	18.6	36.5
2B	14.4	15.6	38.5

[1] In 2019, the depth was gradually increased from May 5 to July 17, 2019.

4.2.2 Flow Rates and HRT

Preliminary full-scale design specifications have the flow rate to the CWTS ranging from 1000 to 3000 m^3/day (Figure 1; 2018 Water and Load Balance Model Report; Contango, 2016b; SRK, 2016; SRK, 2018). The maximum flow rate through the full-scale CWTS is designed to be capped at 3000 m^3/day, with water from higher flows directed through the high flow bypass channel. The flow rates of 3000, 2000, and 1000 m^3/day would correspond to approximately 0.8, 1.2, and 2.5 day HRTs in the preliminary full-scale CWTS design, respectively. Thus, these HRTs were selected for testing on the demonstration-scale system in 2019 to mimic the full-scale CWTS.

In addition to the targeted 0.8, 1.2, and 2.5 day HRTs tested in 2019, a longer HRT of 5 days was also tested for comparison to previous years (Figure 2). The targeted HRTs in 2019 resulted in a greater amount of water entering the demonstration-scale CWTS daily compared to previous years, therefore resulting in higher loads of COC entering the CWTS compared to any other year (Table 4). The targeted nominal HRT was calculated using the actual water depth in each series prior to starting the HRT scenario (as the depth gradually increased as sandbags were added until target depths were reached), plus the correction factor obtained from the 2017 tracer study. Actual flow rates are represented along with targeted flow rates and corresponding HRTs in Figure 2.

The influence of evapotranspiration on performance was also evaluated to understand the amount of water lost, which in turn concentrates elements measured at the outflow and influences the constituent load to the receiving environment. Total evapotranspiration from the system is the combined effects of open water evaporation and plant transpiration and is further described in previous reports (Beebe et al., 2014; Contango, 2017b). Therefore, the future models for assimilative capacity in the downstream receiving environment should take into account not only the predicted outflow concentrations from the CWTS using removal rate coefficients (as discussed below), but also the load accounting for evapotranspiration.

The evapotranspiration rate of 5.4 L/m^2/day water loss was applied to the 2019 load removal data to determine the influence of evapotranspiration on outflow loads of COC from the demonstration-scale CWTS (Contango, 2017b). There was minimal influence from evapotranspiration on the load of COC removed in 2019 based on the high volumes of water reporting to the CWTS which were much greater than the volume lost through evapotranspiration (for example, only 1-2% of water is lost at the 0.8-1.2 day HRT).

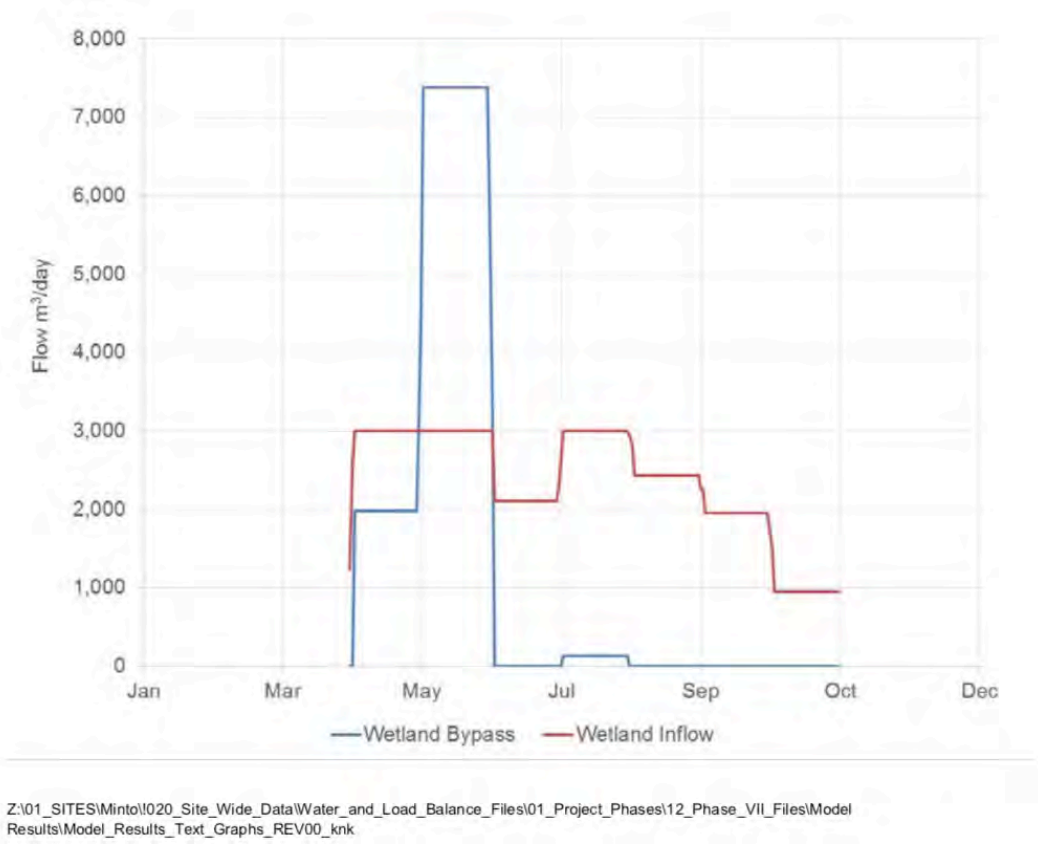


Figure 1 – CWTS and high-flow bypass typical monthly flows (SRK, 2018).

Figure 5-2, as shown on page 36 of the 2018 Water and Load Balance Model Report shows the expected inflow to the full-scale wetland, which is capped to a maximum of 3000 m^3/day as water from higher flows will be directed through the high flow bypass channel.

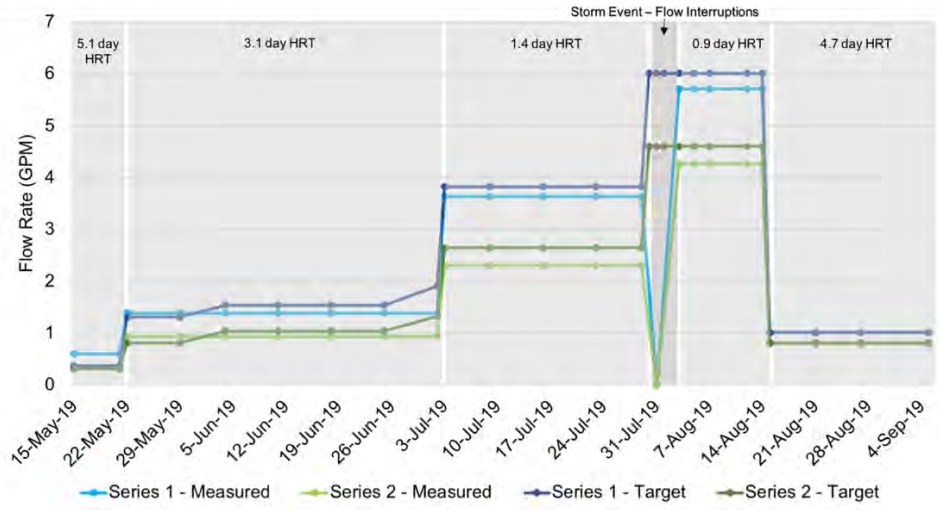


Figure 2 – Flow rates and HRT schedule for Minto demonstration-scale CWTS for Series 1 and 2 over 2019.

Targeted and measured flow rates for Series 1 and 2 are plotted. Grey shading corresponds to different HRT scenarios tested in 2019 with the average HRT of Series 1 and 2 identified.

Table 4 – Volume of water treated per day in the demonstration-scale CWTS.

Year	Actual HRT (days)	m^3/day
2017	6.3	1.8
2018	7.3	1.7
2019	4.8	4.4
	3.1	6.3
	1.4	16.2
	0.9	27.2

5. Treatment Process

The CWTS test work has been designed to treat COCs that are poorly soluble under sulphate reducing conditions, specifically cadmium, copper, molybdenum, selenium, and zinc. Nitrate is also being evaluated as it impacts treatment rates of other COCs (Contango, 2014b). The pilot-scale and demonstration-scale CWTS were designed to stimulate microbes that are naturally in the water, soil, and on the plants in the system. These bacteria oxidize a reduced carbon "food" source (e.g., organics such as decaying *C. aquatilis*) and transfer the electrons released to a terminal electron acceptor (TEA). The TEAs are generally used in the order of which is most energetically favorable by microbes. Therefore, their concentrations can be used to determine the amount of reduced carbon that is necessary to reach sulphate-reducing conditions. Of the major TEAs typically present in mine-impacted surface waters, dissolved oxygen (DO) is used first, followed by nitrate (NO_3), selenium (VI), manganese(IV), iron(III), and then sulphate (SO_4), creating a "redox ladder" as shown in Figure 3. This order of TEA consumption is not absolute, and is used to guide treatment design and performance evaluation. The TEA consumption can be influenced by numerous factors including the overall concentrations of reduced and oxidized TEA species, spatial distribution of organic electron donors and TEAs, presence of constituents that may form complexes with TEAs, and the abundance and diversity of TEA-metabolizing microbial populations present.

In the Minto CWTS, the two TEAs that would have the largest effect on carbon needed to reach sulphate-reducing conditions are oxygen and nitrate. Oxygen concentrations are primarily driven by water temperature and source water conditions. Nitrate concentrations on the other hand are expected to decrease as the nitrogen-bearing residues of explosives used during mining are flushed from waste rock storage areas. Similarly, nitrate loads would be generally lower if there is any pre-treatment (e.g., pit lake treatment) before the CWTS.

While nitrate is not a primary COC for CWTS treatment at the Mine, treatment performance is evaluated in the demonstration-scale CWTS as removal is needed in order to subsequently achieve treatment of other constituents such as selenium and metals through sulphide production. Nitrate can be removed from water through denitrification by different types of microbes, including nitrate reducing bacteria which can reduce nitrate (NO_3) to nitrite (NO_2), and also denitrifying organisms that are capable of fully reducing nitrate to nitric oxide (NO), nitrous oxide (N_2O), and dinitrogen gas (N_2, which is the most abundant gas in air).

The targeted selenium treatment pathways in the CWTS include direct reduction in the water column of selenate (Se(VI)) to selenite (Se(IV)) and sorption to moss, detritus, and substrates, and subsequent microbial reduction of soluble (sorbed) selenite (Se(IV)) to insoluble elemental selenium (Se (0)). This reductive process can also be achieved directly in the water column alone but is more effective when associated with mosses and biofilms due to their sorptive properties that bring the selenium in contact with beneficial selenium-reducing bacteria (SeRB). Selenium reduction biogeochemical processes are achieved within the same range of soil redox conditions that are targeted for sulphate-reduction.

Sulphate-reducing conditions are encountered when the TEAs above sulphate on the redox ladder have either been consumed or their residual products are less energetically favourable to reduce than sulphate. Under sulphate-reducing conditions, sulphate or sulphur-containing compounds are reduced by sulphide-producing bacteria (SPB) to form sulphide, which may then react with chalcophile COC to form insoluble mineral sulphides. Insoluble sulphide minerals then precipitate from the water column and are deposited in the soils. These SPBs thrive in anaerobic conditions with soil redox ranges between -100 and -250 mV (Mitsch and Gosselink, 2007).

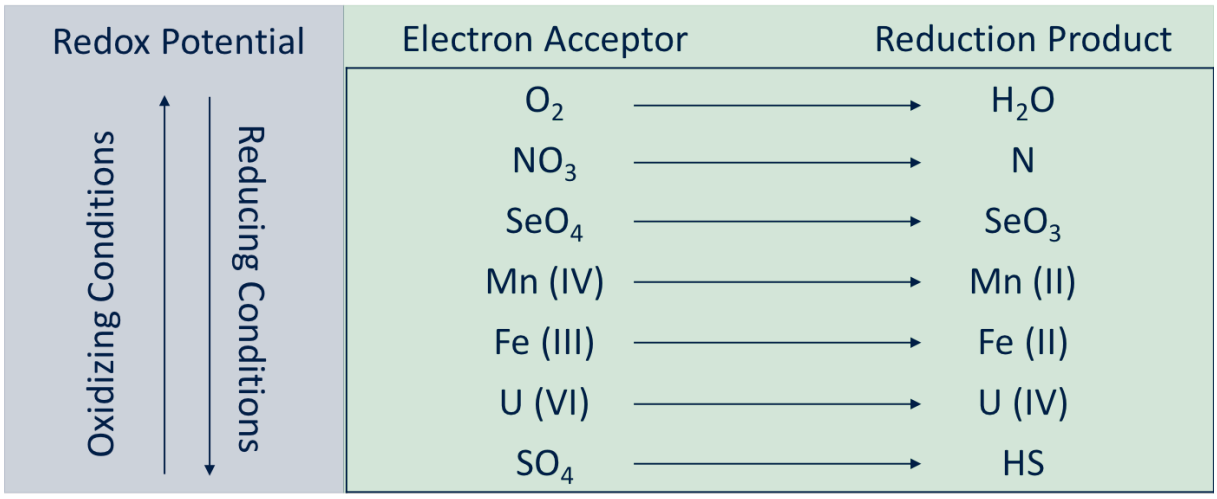


Figure 3 – Redox potential and terminal electron acceptors (TEAs).

6. Operational Period Results (2017-2019)

6.1 Monitoring Explanatory Parameters

In the demonstration-scale CWTS, reducing conditions are targeted to promote the reduction of nitrate, selenium, and sulphate and the subsequent precipitation of COC as metal sulphides. *In situ* measurements for temperature, conductivity, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP) are taken in the CWTS using a YSI ProPlus handheld unit to provide insight into the treatment mechanisms and conditions within the water (Table 5). Reducing conditions are characterised as DO concentrations less than 2 mg/L and ORP less than +50 mV (as measured with the YSI unit).

In 2019, the average ORP and DO was lower than in previous years (Table 5). While ORP and DO measurements decreased through the commissioning period, indicating that reducing conditions were being established, there was a subsequent increase through the operational periods in 2017 and 2018. Based on other explanatory parameters over this time period, it was determined that the increased measurements were likely as a result of the placement of the YSI unit as the CWTS matured and dense mats of vegetation began to interfere with measurements being taken at the base of the CWTS where treatment was occurring. In 2019 YSI measurement procedures were revisited and ensured measurements were recorded in the bottom portion of the CWTS water column. This placement of the YSI unit and the increased water depth in 2019 resulted in decreased ORP and DO measurements to levels commonly associated with reducing systems (Table 5). The average water temperature and conductivity measured in the demonstration-scale CWTS in 2019 was similar to previous years and as expected, pH remained circumneutral (Table 5).

The DO and ORP were also measured at various locations and water depths in 2019 to evaluate conditions through the CWTS. As expected, the DO was lower at the bottom of the wetland water column compared to the surface. Similarly, the outflow measurements were lower than the inflow and midpoint of each CWTS cell. Measurements have historically been taken from the outflow of each cell at the base of the wetland and it is recommended this location be maintained for future measurements of the demonstration-scale CWTS. The ORP measurements throughout the wetland did not present any notable trends or differences.

The soil redox in all demonstration-scale CWTS cells has remained stable within the targeted range (-100 and -250 mV; Contango, 2014b) since the 2017 Commissioning-B period (Figure B5 in Appendix B). In 2018, the average soil redox in Series 1 was unaffected by the CWTS drying out in early spring/freshet, while Series 2 was above -100 mV on May 14, 2018 but rapidly recovered by May 27, 2018 without additional carbon amendments. The average soil redox in Series 1 and 2 remained in the targeted range throughout the double stress test and operational periods in 2018 and shorter HRTs tested in 2019 (Contango, 2019; Table 5, Figure B5 in Appendix B). The stable soil redox indicates a matured CWTS.

In addition to *in situ* measurements, the concentration and trends of redox-active constituents and their relative position in the redox ladder was also evaluated (Figure 3). The low DO in the demonstration-scale CWTS in 2019 (Section 6.1) indicated that the first step on the redox

ladder had been achieved (i.e., consumption of dissolved oxygen). In addition to the persistence of elevated nitrate concentrations, no increases in dissolved manganese or iron were observed in the 2019 dataset (aside from a short-lived peak between June 25 and July 2, 2019), which would be suggestive of more reducing conditions (i.e., manganese- and iron-reducing conditions, respectively). As such, it appears that denitrification was the most reducing stage achieved in the CWTS in 2019 based on the outflow chemistry, with no strong evidence for the development of more reducing manganese-, iron-, or sulphate-reducing conditions.

Table 5 – Average *in situ* measurements from the demonstration-scale CWTS.

Period		Water					Soil
		Temp (°C)	DO (mg/L)	Specific Conductivity (µS/cm)	pH	ORP (mV)	Redox (mV)
2015		12.9	10	817.9	8.11	147.9	-52
2016	Commissioning-A	10.2	15.9	890.9	7.79	143.7	-85
	Commissioning-B		8.4	1020	7.59	157.6	-89
2017	Commissioning-B	15.8	4.3	795.9	7.43	18.7	-162
	Operational period	9.7	5.3	879.7	7.36	124.9	-152
2018	Double stress test period	13.5	6.1	978.8	7.55	143.3	-176
	Operational period	9.8	7.9	990.1	7.45	143.1	-178
2019	5 Day HRT scenario	9.7	4.8	1093.7	7.24	122.7	-180
	2.5 Day HRT scenario	13.1	2.5	1052.0	7.18	87.4	-175
	1.2 Day HRT scenario	12.7	1.8	1083.6	7.34	-32.1	-153
	0.8 Day HRT scenario	10.6	2.7	1068.1	7.18	30.7	-159

DO – dissolved oxygen; ORP – oxidation-reduction potential.

6.2 Carbon Demand and Decomposition

6.2.1 Detritus Study

The detritus study initiated in 2017 was continued through 2019 to assess decomposition rates of *C. aquatilis* in the CWTS over time (Chimney and Pietro, 2006; Hammerly et al., 1989). Carbon cycles through a wetland by accumulation into the plants during photosynthesis, and release through plant decomposition (U.S. EPA, 2008). The rate of decomposition and nutrient release is dependent on many factors, such as plant type, HRT, and environmental conditions (U.S. EPA, 2008), and is therefore assessed through site-specific testing. The rate of decomposition is important in a CWTS to determine the amount of organic matter that will be broken down and become available as organic carbon, and the amount that will contribute to accretion. Accretion is the gradual accumulation of additional layers of organic matter, which aids in building new soils in the CWTS from undecomposed plant tissues. It is an important process in the CWTS as it buries treated minerals making them more stable and maintains low overall concentrations of metals.

The study began on June 21, 2017 when bags filled with oven dried *C. aquatilis* or polyester filter fiber material were submerged into each CWTS cell (Figure 4). Bags with both material were removed from each CWTS cell on specific sampling events up until July 2019 when the study was completed. This resulted in four replicate bags that were dried and weighed for each sampling date. Additional details describing the methods can be found in Appendix A.

In previous reports (Contango, 2017b; Contango, 2019) the amount of *C. aquatilis* decomposition was adjusted for the weighed amount of algae growth on the polyester filter fiber material. However, this adjustment was revisited in 2019 based on measurements of the polyester filter fiber material inferring that all plant material had decomposed, while visible plant material was still present in the bags. As such, results provided in this report for all years were not adjusted based on polyester filter fiber material weights (Figure 4, Figure 5, Appendix A).

The trials show that decomposition occurs quickly after *C. aquatilis* is submerged into the CWTS, with 38% decomposition occurring after 34 days. After 82 days, 48% of *C. aquatilis* had decomposed which represents decomposition that would be expected after one operational season of the CWTS (i.e., from spring to fall). After the first year, decomposition rates begin to plateau around 55% (average of last three time points) indicating that approximately 55% of plant material in the CWTS will decompose over 2 years. The plant material that decomposes provides organic carbon for microbes in the CWTS, while the plant matter that does not readily decompose (~45%) will contribute to accretion.



Figure 4 – Detritus study bags.
Left are mesh bags filled with *C. aquatilis* and polyester fiber fill stuffing in 2017, prior to submersion in the CWTS (June 21, 2017). Middle is a closed mesh bag, and right is an open mesh bag with decomposed *C. aquatilis* (left bag) and polyester fiber fill stuffing (right bag) on July 29, 2019 from cell 1A.

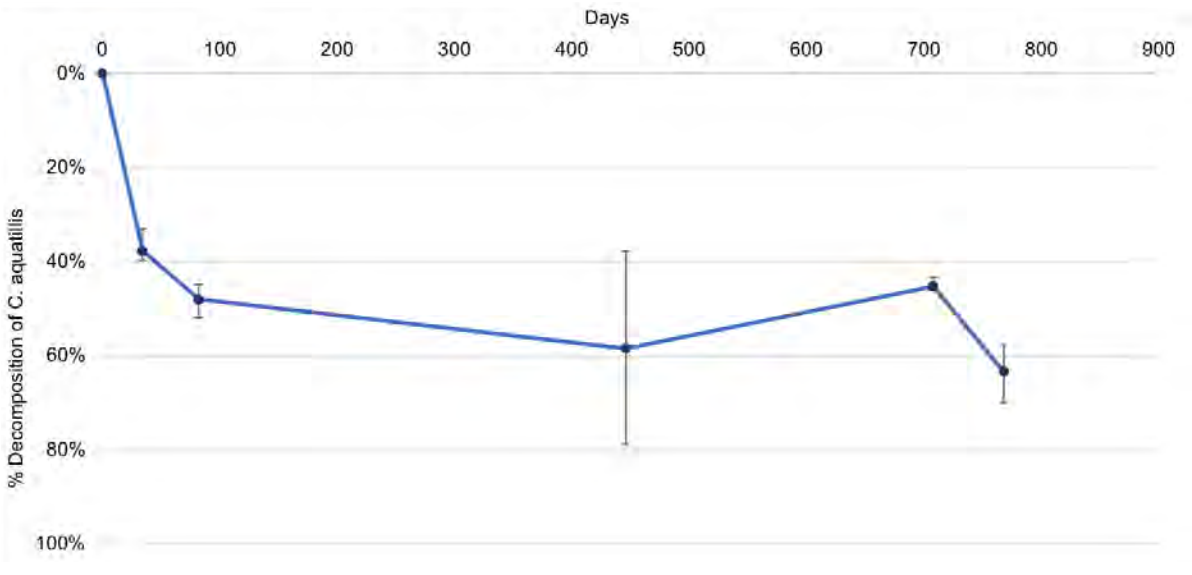


Figure 5 – *C. aquatilis* decomposition over time in the CWTS.
Decomposition was measured by the decrease in dry weight over time of the *C. aquatilis* samples compared to the initial weight. Error bars indicate the variation in results for each time point from multiple cells.

6.2.2 Available organic carbon

A 1 m^2 plot of above water *C. aquatilis* was harvested in 2018 and 2019 (Contango 2019, Appendix A, Section A7.7) to determine the amount of organic matter that is input into the wetland each year. The tests indicated that on average approximately 0.67 kg of dry weight above water *C. aquatilis* biomass is produced per year per square meter in the CWTS (0.80 and 0.54 kg/m^2 in 2018 and 2019, respectively). It is anticipated that annual *C. aquatilis* growth in the demonstration-scale CWTS will be similar to growth in a full-scale CWTS that is exposed to the same site conditions. This information is used in conjunction with the detritus study results to determine the amount of annual *C. aquatilis* biomass that will contribute to accretion and to available organic carbon.

While considering the multiple factors that can impact organic matter decomposition (Section 6.2.1), approximate carbon load into the CWTS was estimated for 2019 based on information available to date. The measured amount of total organic carbon in *C. aquatilis* is approximately 40%, meaning 40% of the dry weight is organic carbon. Additionally, the amount of decomposition in one operational season was approximately 48% (Section 6.2.1). Considering the load of oxygen, nitrate, and COC (cadmium, copper, molybdenum, selenium, and zinc) in the feed water requiring treatment over 2019, the amount of organic carbon needed to fuel treatment in Series 1 and 2 looks to be greater than what was supplied with yearly plant growth. The majority of this carbon demand is based on the nitrate load going to the CWTS at the higher flow rates through 2019.

Other sources of carbon in the wetland include straw that was added at the start of the commissioning period B in July 2016. Elevated dissolved organic carbon (DOC) concentrations were measured in the water after straw was added to the wetland, and have gradually

decreased over time towards baseline DOC concentrations by the end of 2018. Measurements throughout 2019 were also at baseline DOC concentrations, indicating no excess carbon was available in the wetland. This is likely due to a combination of depleted available carbon in the straw from commissioning over time, as well as a higher carbon demand based on nitrate load going to the CWTS in 2019 with higher flow rates. In other words, the testing in 2019 has identified that the carbon demand for the CWTS may be greater than what is available through annual *C. aquatilis* growth when nitrate loads are high.

The carbon demand for the full-scale CWTS will be evaluated based on the expected nitrate load over time in closure, where nitrate concentrations are expected to decrease as the nitrogen-bearing residues of explosives used during mining are flushed from waste rock storage areas. Similarly, nitrate loads would be generally lower if there is any pre-treatment (e.g., pit lake treatment) before the CWTS. If additional carbon is needed in early phases of closure to accommodate higher nitrate loads, the full-scale CWTS could be supplemented with additional carbon through a forebay.

To further refine the full-scale CWTS design, it is recommended that in 2020 a forebay with organics be incorporated into the demonstration-scale CWTS to provide additional carbon for higher nitrate load removal. This testing will refine the amount and frequency of carbon addition that is required to reduce nitrate loads that may be encountered in the full-scale CWTS, and will refine the full-scale CWTS design. It is planned that the flow rate will remain constant in 2020, and a forebay system in the form of a tote with a carbon source will be incorporated upstream of the demonstration-scale CWTS. Bench- and pilot-scale *in situ* pit lake treatment testing is also planned for 2020 and 2021 and the results of these tests will contribute to the full-scale CWTS design.

6.3 Water

6.3.1 Summary of Performance During 2019 Operational Period

As discussed in Section 4.2.2, the flow rates in 2019 were faster than previous years to mimic HRTs expected for the full-scale CWTS. The higher flow rates in 2019 did not result in elevated levels of total concentrations at the outflow or erosion, except for cadmium. While total cadmium concentrations periodically were elevated during the fastest HRT, they remained an order of magnitude below the CCME guideline. Treatment performance was evaluated at different HRT scenarios by the decrease in COC concentration between the inflow and the outflow of each Series, the load of COC removed per day, and the percent removal of COC (Table 6). Treatment performance of nitrate is discussed in Section 6.3.1.1, copper, cadmium, and zinc are discussed in Section 6.3.1.2, and molybdenum and selenium are discussed in Section 6.3.1.3.

Another important factor for CWTS design is the rate of treatment, also known as the removal rate coefficient (RRC; k). The RRC is based on the treatability of a specific compound and the HRT of the CWTS, both of which are site-specific based on water chemistry, CWTS designs, and characteristics of the CWTS. The RRC is developed through site-specific testing and is

used to refine future sizing and performance estimations of a full-scale CWTS. Information regarding calculation of RRCs can be found in previous reports (Contango, 2017b).

A RRC was calculated for all COC during the 2019 operational period (May 15 to September 4, 2019). Although nitrate is not a COC, a RRC was developed to evaluate full-scale CWTS sizing that would be required to remove nitrate before treatment of other COC would occur. There are two orders for a RRC: zero-order and first-order. Treatment with a zero-order removal rate is linear and is independent of concentration, whereas treatment with a first-order removal rate is exponential and proportional to concentration (a half-life type of reaction). Cadmium, copper, selenium, zinc, and nitrate were reported here with first-order RRC based on historical treatment kinetics (Contango, 2019). However, copper, selenium and nitrate did appear to follow a zero-order reaction kinetic at several instances in 2019, possibly due to increased flow rates and/or different treatment mechanisms ongoing in the CWTS (e.g., precipitation as metal (hydr)oxides, sorption, nutrient uptake). During higher flow periods (HRT >1.2 days) cadmium and zinc looked as though it was being removed through a zero-order reaction kinetic, likely due to the increased flow rates, and returned to the expected first-order reaction kinetic at HRTs <1.2 days. The zero-order RRC were therefore also calculated (not presented here) and can be used alongside RRC calculated through various operational testing periods of the demonstration-scale CWTS (Table 7) to evaluate different potential scenarios in the wetland (e.g., high nitrate load with or without carbon supplementation). The RRC for molybdenum has followed a zero-order kinetic throughout the operational period of the demonstration-scale CWTS.

Through subsequent sections, RRCs in the 2019 operational period for each COC and nitrate are discussed alongside other treatment performance metrics. RRCs were also compared to the average RRCs calculated from another pilot-scale copper study completed in the Yukon and were generally similar or better for cadmium, copper, and zinc (Table 7). RRCs developed from the Minto pilot-scale study are also presented in Table 7, however, they were developed using total concentrations of COC in a low nitrate scenario (0.86 mg/L nitrate as N) and are therefore not directly comparable to the RRCs developed from the demonstration-scale studies.

The performance limit (referred to as thermodynamic minimum in previous reports; Contango 2017b) was also evaluated and is the lowest concentration consistently achievable for a given treatment design and water chemistry. Once the performance limit is reached, making the CWTS bigger will not result in further decrease of outflow concentration. In 2019 the performance limit was met for cadmium only. In previous years, the performance limit for cadmium, copper (series 2 only), zinc, and nitrate (series 2 only), had also been achieved at a longer HRT of ~3.5 days. These results indicate that the full-scale CWTS could be larger if there is available space, to increase the HRT and treatment of COC.

Table 6 – Average inflow and outflow concentrations, percent and load removal of COC during the demonstration-scale CWTS operational periods.

COC (µg/L) (Dissolved)		2017	2018		2019							
		6.3 Day HRT	7.3 Day HRT		4.8 Day HRT		3.1 Day HRT		1.4 Day HRT		0.9 Day HRT	
		Avg Series 1 & 2	Series 1	Series 2	Series 1	Series 2	Series 1	Series 2	Series 1	Series 2	Series 1	Series 2
Cd	In	0.0261	0.0264	0.0264	0.0174	0.0174	0.0207	0.0207	0.0157	0.0157	0.0170	0.0170
	Out	0.0092	0.0050	0.0050	0.0050	0.0069	0.0070	0.0058	0.0067	0.0050	0.0099	0.0067
	% removal[1]	66	81	81	71	61	66	72	58	68	42	61
	Load removal (mg/day)	0.0332	0.0410	0.0310	0.0547	0.0337	0.103	0.0742	0.179	0.134	0.222	0.241
Cu	In	49.1	65.8	65.8	48.1	48.1	56.2	56.2	46.1	46.1	39.8	39.8
	Out	17.3	12.5	16.1	15.5	13.3	23.8	20.4	17.6	15.8	19.5	16.3
	% removal[2]	65	81	76	68	72	58	64	62	66	51	59
	Load removal (mg/day)	59.7	102	72	161	129	245	183	566	381	634	547
Mo[3]	In	6.3	10.5	10.5	7.56	7.56	7.16	7.16	6.27	6.27	7.37	7.37
	Out	2.7	2.38	3.48	6.36	7.01	6.71	7.09	5.66	5.94	6.50	6.79
	% removal	57	77	67	21	12	6	5	10	6	12	8
	Load removal (mg/day)	6.73	15.5	10.2	8.35	3.70	3.43	1.71	12.0	4.65	27.2	13.4
Se[4]	In	4.0	3.68	3.68	3.03	3.03	2.56	2.56	2.20	2.20	2.80	2.80
	Out	0.5	0.53	0.47	1.66	1.41	1.81	1.37	1.61	1.45	2.15	2.12
	% removal	87	86	87	45	53	29	46	27	34	24	24
	Load removal (mg/day)	6.36	6.00	4.63	6.91	6.13	5.64	6.07	11.7	9.36	20.8	15.8
Zn	In	49.2	17.3	17.3	11.2	11.2	20.3	20.3	13.0	13.0	7.43	7.43
	Out	1.9	1.23	1.15	2.85	1.75	1.77	1.30	3.30	1.38	2.87	2.40
	% removal[1]	96	93	93	74	84	91	94	75	89	61	68
	Load removal (mg/day)	85.3	30.6	23.3	32.4	27.1	140	96.8	193	146	142	117
NO_3 (mg/L)[5]	In	6.98	8.99	8.99	8.17	8.17	7.26	7.26	6.49	6.49	7.20	7.20
	Out	0.17	0.05	0.01	1.84	1.79	3.48	2.23	3.80	3.15	5.32	5.10
	% removal	98	99	100	77	78	52	69	41	51	26	29
	Load removal (mg/day)	12,549	17,096	12,993	30,961	23,509	28,565	26,021	53,421	41,887	57,870	48,836

% removal – percent load removal

[1] Percent load removal for Cd and Zn are artificially low in 2018 and 2019 due to several outflow concentrations below the detection limit.

[2] Extent of copper removal was influenced by higher copper concentrations in the soils.

[3] Mo concentration at outflow of B cell was typically within 20% method error of inflow in 2019. Percent and load removal have been estimated here, with instances of no treatment included in average as 0.

[4] Total Se concentrations were used in 2019 instead of dissolved Se as described in Appendix A. Instances of no treatment were included as 0 in average for % and load removal.

[5] Nitrate is not a COC, however removal is evaluated as it impacts treatment of other COC as described in Section 5.

Table 7 – Removal rate coefficients (k*day^{-1}) for dissolved COC during the 2017-2019 demonstration-scale CWTS operational periods compared to pilots-scale CWTS.

COC	Minto Pilot[1]	Other Yukon Cu Pilot	2017 Demonstration	2018 Demonstration		2019 Demonstration	
	Total COC		Avg Series 1&2	Series 1	Series 2	Series 1	Series 2
First order removal rate coefficients unless noted otherwise							
Cd	1.14	0.50	>0.52[2]	>0.42[2]	>0.41[2]	0.54	0.66
Cu	1.17	0.50	>0.31[3]	>0.22[3]	>0.35[3]	0.52	0.57
Mo (Zero)	0.101 (First)	N/A	0.0006	0.0011	0.0010	0.0005[6]	0.0003[6]
Se	0.0018 (Zero)	0.46	0.32	-[4]	0.29	0.20[5]	0.23[5]
Zn[7]	1.14	0.48	>0.51[2]	0.57	0.45	1.04	1.08
Nitrate[8]	0.56	N/A	0.59	-[4]	0.57	0.33	0.41

RRC – removal rate coefficient; N/A – RRC is not available.

[1] Values calculated from total concentration data in Contango, 2014b for *C. aquatilis* + moss design with low nitrogen scenario (0.86 mg/L nitrate as N). These RRC are therefore included for reference purposes only and are not directly comparable to other RRC reported here.

[2] Data for Cd or Zn had most sample points at the detection limit in 2017/2018, resulting in insufficient resolution and artificially low RRC for cadmium and zinc in 2017 and cadmium in 2018.

[3] RRCs for copper in demonstration-scale CWTS are artificially low due to copper leaching from soils used in construction of the system.

[4] RRC was not calculated for NO_3 and Se in Series 1 as described in Contango, 2019.

[5] RRC for selenium based on total concentrations instead of dissolved in 2019 as described in Appendix A.

[6] Mo concentration at outflow of B cell was typically within 20% method error of inflow in 2019. RRC have been estimated here, with instances of no treatment included as 0.

[7] Dissolved Zn concentrations used for RRC calculations in 2019 do not include data of low feed concentrations from August 21-September 5, 2019 as treatment is difficult to observe when feed concentrations are so low.

[8] Nitrate is not a COC, however removal is evaluated as it impacts treatment of other COC as described in Section 5.

6.3.1.1 Nitrate

Although nitrate is not a COC, removal is evaluated as it impacts treatment of other COC as described in Section 5. The concentration of nitrate in the feed to the demonstration-scale CWTS has remained relatively stable through the operational periods in 2017-2019 (~6.5-10.0 mg/L as N), other than a short lived spike up to ~20 mg/L as N in early 2018. The extent of treatment, percent removal, and RRC of nitrate in 2019 were lower than previous years (Table 6 andTable 7), likely due to insufficient carbon in the wetland to remove the high nitrate load in 2019 (Section 6.2). The demonstration-scale CWTS removed between 26-78% of nitrate in 2019, compared to 98-100% removal in previous operational years. However, despite insufficient carbon to remove the entire nitrate load in 2019, the demonstration-scale CWTS still removed 2-3 times more nitrate load per day (mg/day) than any previous operational year (Figure 6, Table 6).

The forebay testing with organics in 2020 will provide information on the extent of nitrate load removal that can be achieved with carbon supplementation. This information will be used to refine the design for the full-scale CWTS in closure based on nitrate treatment needs (Section 6.2.2).

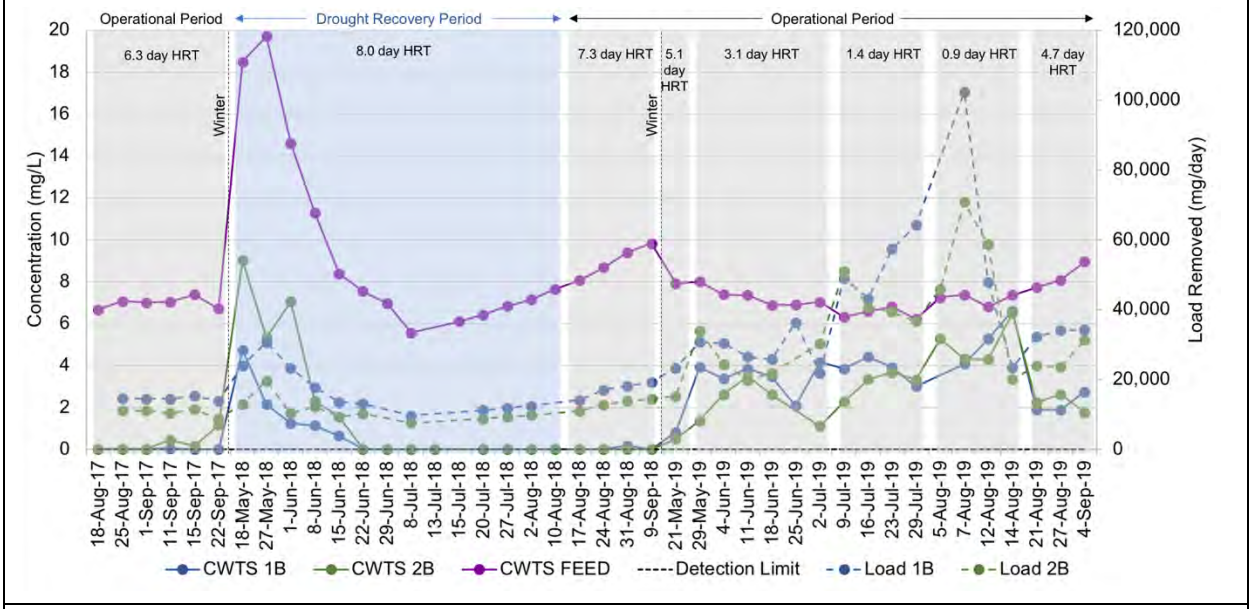


Figure 6 – Nitrate concentrations and load removed per day over the 2017 – 2019 operational periods.

Dissolved water concentrations are on the primary y-axis (solid lines) while load removed are on the secondary y-axis (dotted lines). Concentrations and load removed are based on outflow concentrations from each CWTS series. Operational periods are identified from 2017 through 2018 according to average HRT of Series 1 and 2. Blue shading corresponds to the drought recovery period of 2018. The ALS detection limit (DL; black dotted line on primary y-axis) for dissolved nitrate is 0.005 mg/L.

6.3.1.2 Treatment of copper, cadmium, and zinc

The concentrations of cadmium and copper going to the demonstration-scale CWTS has remained relatively stable through the operational periods in 2017-2019 (0.0157-0.0264 and 39.8-65.8 µg/L, respectively; Table 6). The concentration of zinc has gradually decreased over time from 49.2 µg/L in 2017 to 6.5 µg/L at the end of 2019. The outflow concentrations of cadmium, copper, and zinc have remained similar throughout the 2017-2019 operational periods (0.0050-0.0099, 12.5-23.8, 1.15-3.30 µg/L respectively) despite being operated at a range of HRTs (7.3 days to 0.9 days). The results from 2019 have highlighted that the demonstration-scale CWTS can consistently remove these COC at shorter HRTs (Table 6).

In 2019 the demonstration-scale CWTS removed higher loads per day (mg/day) of cadmium, copper, and zinc compared to any previous operational year (up to 0.241, 634, and 193 mg/day in 2019, respectively; Table 6; Figure 7-Figure 9). The percent removal of cadmium, copper, and zinc at HRTs > 0.9 days were comparable to percent removal in 2017 and 2018 (61-81, 62-81, and 74-96% removal respectively; Table 6). At the fastest HRT of 0.9 days, which represents the maximum flow rate through the currently proposed full-scale CWTS, the average percent removal was slightly lower than other HRT periods, however the overall load removed at this HRT remained higher than any other operational year. As the percent removal does not take into account the HRT of the system, a more holistic approach to characterizing treatment is the removal rate coefficients (RRC) which takes into account not only inflow and outflow concentrations but also HRT.

RRCs for cadmium, copper, and zinc in 2019 are similar or better to previous years, indicating they were unaffected by the shorter HRTs and less reducing conditions in the CWTS (>0.41-0.66, >0.31-0.57, and 0.45-1.08 per day, respectively; Table 7). It is noted, however, that RRCs for copper in the demonstration-scale CWTS in previous years were artificially low due to copper leaching from soils used in construction of the system (Contango, 2016a, 2017a, and 2017b; Section 6.4.1). Therefore, the treatment of copper occurring within the CWTS in commissioning and early operations was far greater than what was being observed by simply measuring the inflow and outflow points of the CWTS cells. Copper leaching from soils was confirmed to have subsided in 2019 based on no increases of copper in the water through the system from the feed to the outflow of the B cells (Figure 10; Section 6.4.1). Leaching of cadmium and zinc has also been monitored from 2015-2019 with no substantial leaching observed (Figures B1 to B4).

Similarly, RRCs for cadmium and zinc in 2017 and 2018 were artificially low as these COC were often treated to levels below the detection limit. At these low concentrations the effects of natural metal attenuation and release processes (i.e., sorption/desorption) are also more noticeable, in addition to decreased analytical precision at these low concentrations. RRCs for cadmium and zinc in the 2019 demonstration-scale CWTS had better resolution as higher flow rates resulted in measurable concentrations in the A cell outflow. There was however, a period of time from August 21 to the end of 2019 where the RRC for zinc could not be evaluated as zinc concentrations in the feed water were low.

The lowest consistently achievable concentrations (performance limit) was achieved only for cadmium in 2019. The performance limit for dissolved cadmium looked to be achieved after

1.5 days. This was determined by the concentration of dissolved cadmium having no statistical difference (as determined by a t-test and described in Appendix A of Contango 2017b) between the outflow of the A cell and the outflow of the B cell at a CWTS HRT of 3 days.

Given the lack of evidence for strongly reducing conditions within the CWTS in 2019 (Section 6.1), the removal of copper, cadmium, and zinc is likely through precipitation of metal (hydr)oxides and/or sorption, instead of the targeted treatment mechanism of sulphate-reduction. Should copper, cadmium, and/or zinc have sorbed on iron and/or manganese (oxyhdr)oxides within the CWTS, the development of more reducing conditions may result in their transient release as the host phases are dissolved under manganese- and iron-reducing conditions. However, they are not expected to be remobilized to a significant degree as the subsequent development of sulphate-reducing conditions would re-precipitate these metals as stable sulphide minerals within the CWTS. Furthermore, leaching of cadmium, copper, or zinc from soils was not promoted in less reducing conditions in 2019 suggesting these COC are stable in the soils. Thus, results in 2019 continued to demonstrate treatment performance when less reducing conditions were present due to insufficient carbon.

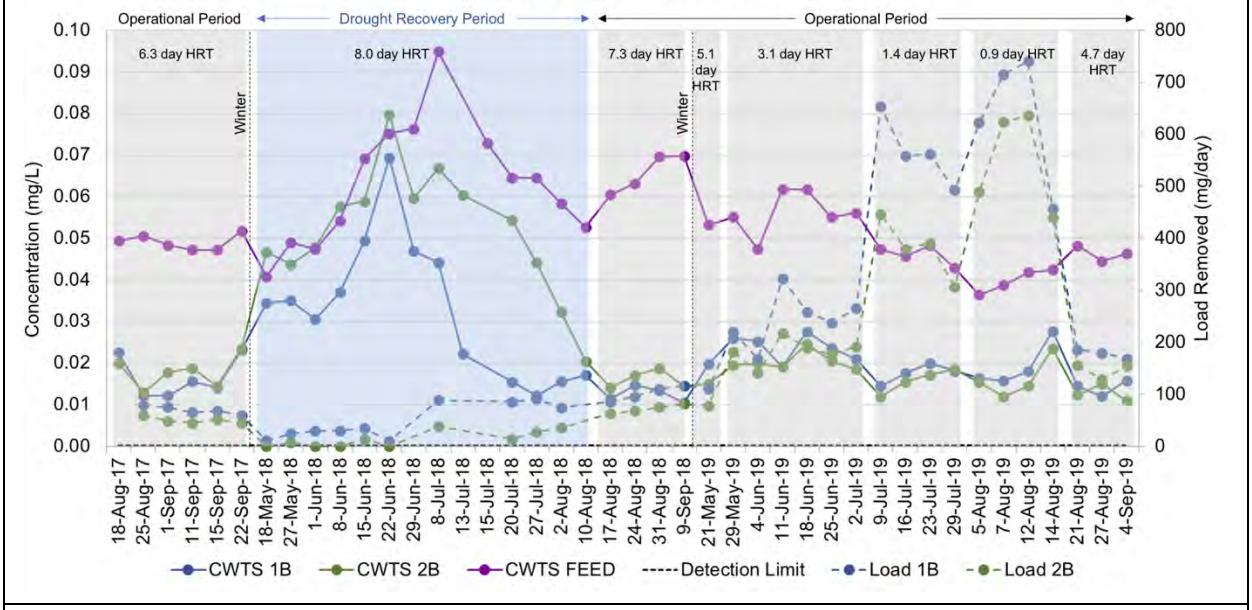


Figure 7 – Dissolved copper concentrations and load removed per day over the 2017 – 2019 operational periods.

Dissolved water concentrations are on the primary y-axis (solid line) while load removed are on the secondary y-axis (dotted lines). Concentrations and load removed are based on outflow concentrations from each CWTS series. Grey shading corresponds to operational periods in 2017, 2018, and 2019, with average of Series 1 and 2 HRT noted. Blue shading corresponds to the drought recovery period of 2018. The ALS detection limit (DL; black dotted line on primary y-axis) for dissolved copper is 0.0002 mg/L.

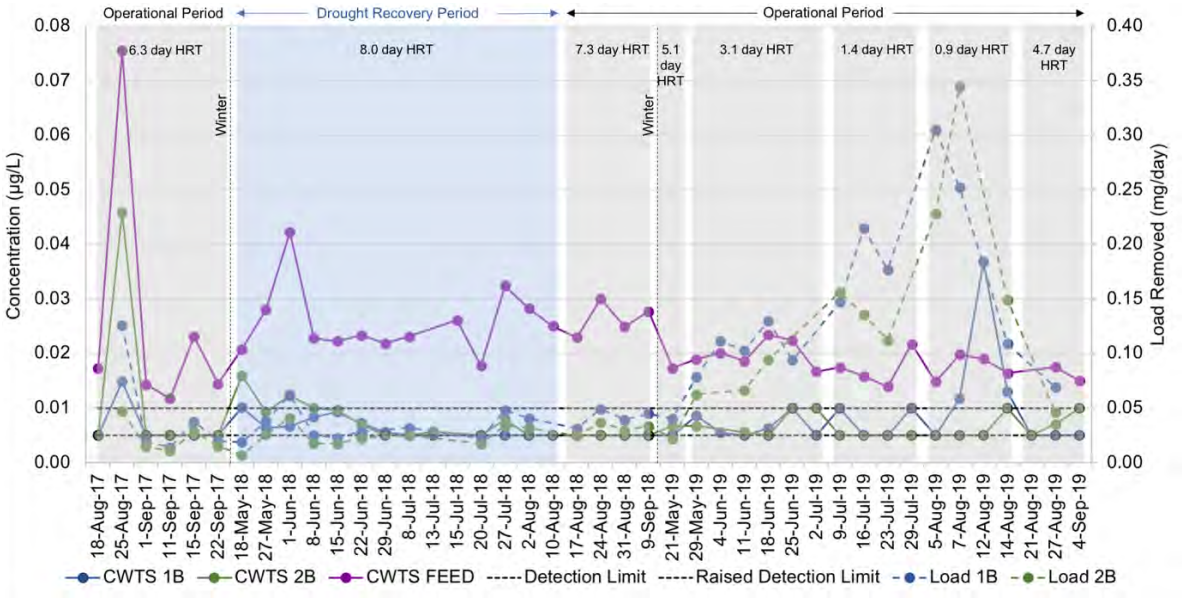


Figure 8 – Dissolved cadmium concentrations and load removed per day over the 2017 – 2019 operational periods.

Dissolved water concentrations are on the primary y-axis (solid lines) while load removed are on the secondary y-axis (dotted lines). Concentrations and load removed are based on outflow concentrations from each CWTS series. Operational periods are identified from 2017 through 2018 according to average HRT of Series 1 and 2. Blue shading corresponds to the drought recovery period of 2018. The ALS detection limit (DL; black dotted line on primary y-axis) for dissolved cadmium is 0.005 µg/L and on occasion was raised up to 0.01 µg/L. Elevated dissolved cadmium concentrations at the 1B location on August 12, 2019 also had elevated total concentrations and may have resulted from sampling.

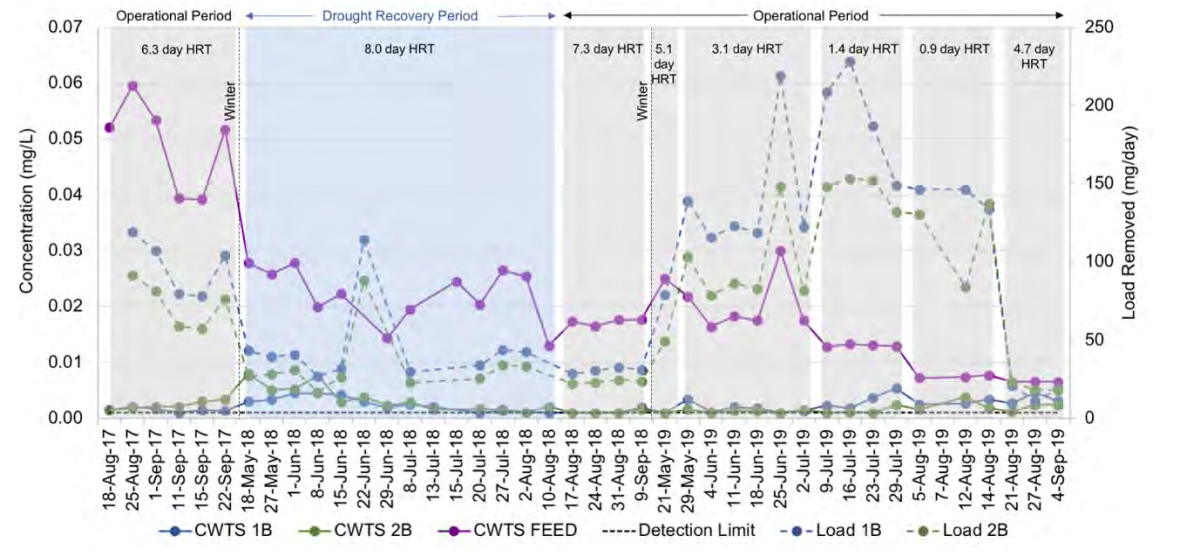


Figure 9 – Dissolved zinc concentrations and load removed per day over the 2017 – 2019 operational periods.

Dissolved water concentrations are on the primary y-axis (solid lines) while load removed are on the secondary y-axis (dotted lines). Concentrations and load removed are based on outflow concentrations from each CWTS series. Operational periods are identified from 2017 through 2018 according to average HRT of Series 1 and 2. Blue shading corresponds to the drought recovery period of 2018. The ALS detection limit (DL; black dotted line on primary y-axis) for dissolved zinc is 0.001 mg/L.

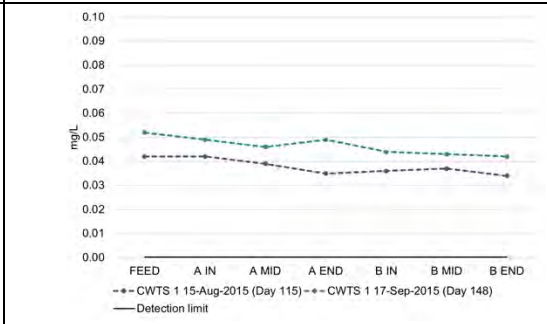
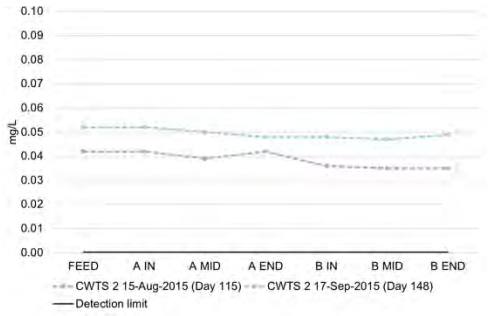
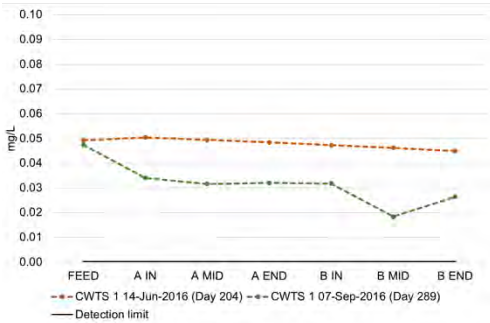
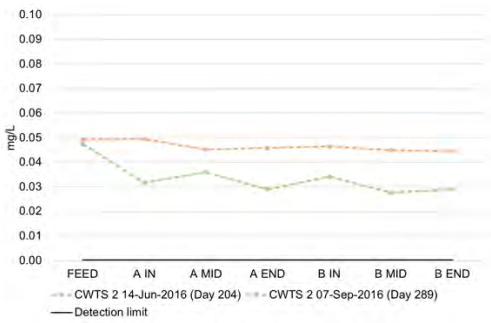
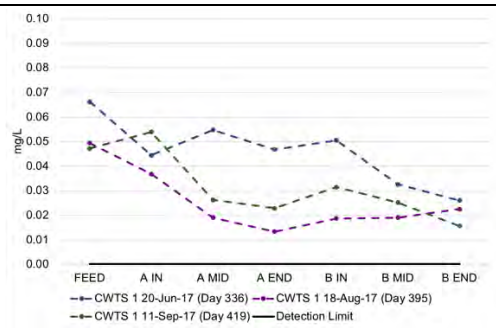
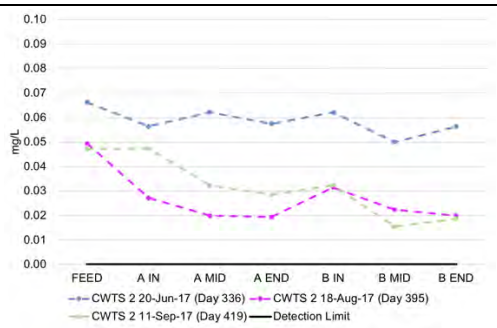
	CWTS Series 1	CWTS Series 2
2015		
2016		
2017		

Figure 10 – Copper concentrations in water through the demonstration-scale CWTS.

Dissolved copper concentrations in water along the length of the CWTS in 2015 through 2019. The Maxxam (2015 results) and ALS (2016–2019 results) detection limit (DL; black line) for copper is 0.0002 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

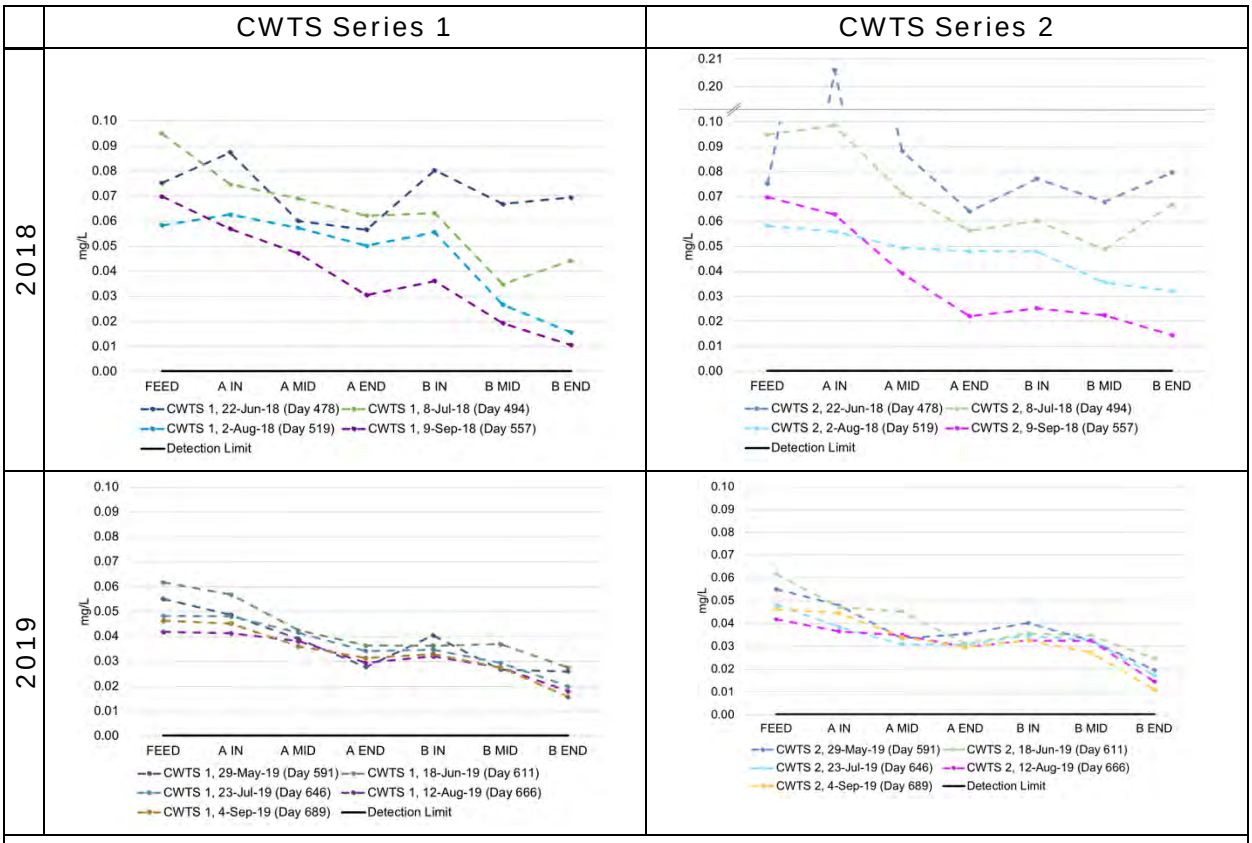


Figure 10 continued – Copper concentrations through the demonstration-scale CWTS.

Dissolved copper concentrations along the length of the CWTS in 2015 through 2019. The Maxxam (2015 results) and ALS (2016–2019 results) detection limit (DL; black line) for copper is 0.0002 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

6.3.1.3 Treatment of molybdenum and selenium

The concentrations of molybdenum and selenium going to the demonstration-scale CWTS have remained relatively stable through the operational periods in 2017-2019 at 6.27-10.5 and 2.2-4.0 µg/L (Table 6). As noted in Section 6.3.1.1, the demonstration-scale system was likely carbon limited due to higher nitrate loads going to the CWTS. As a result, nitrate removal was impacted and since nitrate can interfere with treatment of molybdenum and selenium, the outflow concentrations of these COC did not get as low and the percent removal was lower in 2019 (5-21 and 24-53% removal, respectively) than in previous years (57-77 and 86-87% removal, respectively; Table 6, Figure 11, Figure 12). Despite being carbon limited, however, the overall load removed per day of molybdenum and selenium was higher than previous years (up to 27.2 and 20.8 load removed per day in 2019, respectively).

As discussed in Section 6.1 the most reducing stage likely achieved in 2019 was denitrification. Studies have shown that nitrate and selenate (oxidized selenium) can be co-reduced through a variety of mechanisms (selenate: Madhaiyan et al., 2009; Oremland et al., 1999; selenite: DeMoll-Decker & Macy, 1993). It is therefore possible that selenium treatment in 2019 was through sorption to mosses/detritus and potentially co-reduction with

nitrate. Treatment of selenium is expected to improve with lower nitrate concentrations in the influent and/or sufficient carbon to remove the higher nitrate loads. Treatment of molybdenum is expected to improve in sulphate-reducing conditions as molybdenum is first reduced to Mo(IV) in sulphate-reducing conditions and then treated through dissimilatory sulphate reduction and co-precipitation with iron-sulphides

Treatment performance assessed by the RRC showed a decreased RRC for molybdenum compared to 2018 (0.0004 vs. 0.0010 per day, respectively), but was similar to the RRC developed for molybdenum in 2017 (0.0006 per day). Despite the lower percent removal of selenium in 2019 compared to 2018, the RRC for selenium only had a small decrease in 2019 (0.22 per day) from previous operational years (0.27-0.32 per day; Table 7). Although the RRC was calculated for selenium using a first-order reaction kinetic, a zero-order reaction kinetic could be applied to full-scale sizing calculations to determine the extent of removal (concentration (mg/L) achieved at the outflow of the CWTS) possible under less reducing conditions.

The lowest consistently achievable concentrations (performance limits) were not achieved for molybdenum or selenium in 2019, nor have they been achieved in previous operational years. The addition of carbon in 2020 will provide insight on the influence of carbon limitation on achieving a performance limit for these COC.

A forebay could act as a mitigation strategy during early closure, when nitrate concentrations are expected to increase the carbon demand required to reach sulphate reducing conditions (Section 6.2.2). The RRCs applied here are intended to be conservative estimates for conceptual sizing purposes and will need to be refined through information gathered from the demonstration-scale CWTS in 2020.

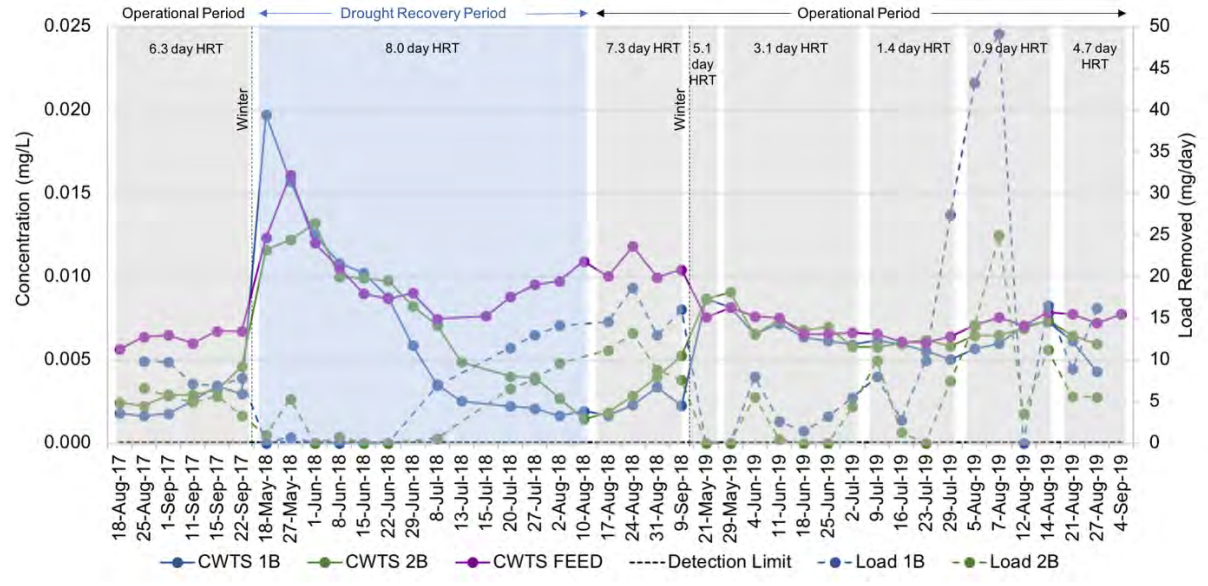


Figure 11 – Dissolved molybdenum concentrations and load removed per day over the 2017 – 2019 operational periods.

Dissolved water concentrations are on the primary y-axis (solid lines) while load removed are on the secondary y-axis (dotted lines). Concentrations and load removed are based on outflow concentrations from each CWTS series. Operational periods are identified from 2017 through 2018 according to average HRT of Series 1 and 2. Blue shading corresponds to the drought recovery period of 2018. The ALS detection limit (DL; black dotted line on primary y-axis) for dissolved molybdenum is 0.00005 mg/L.

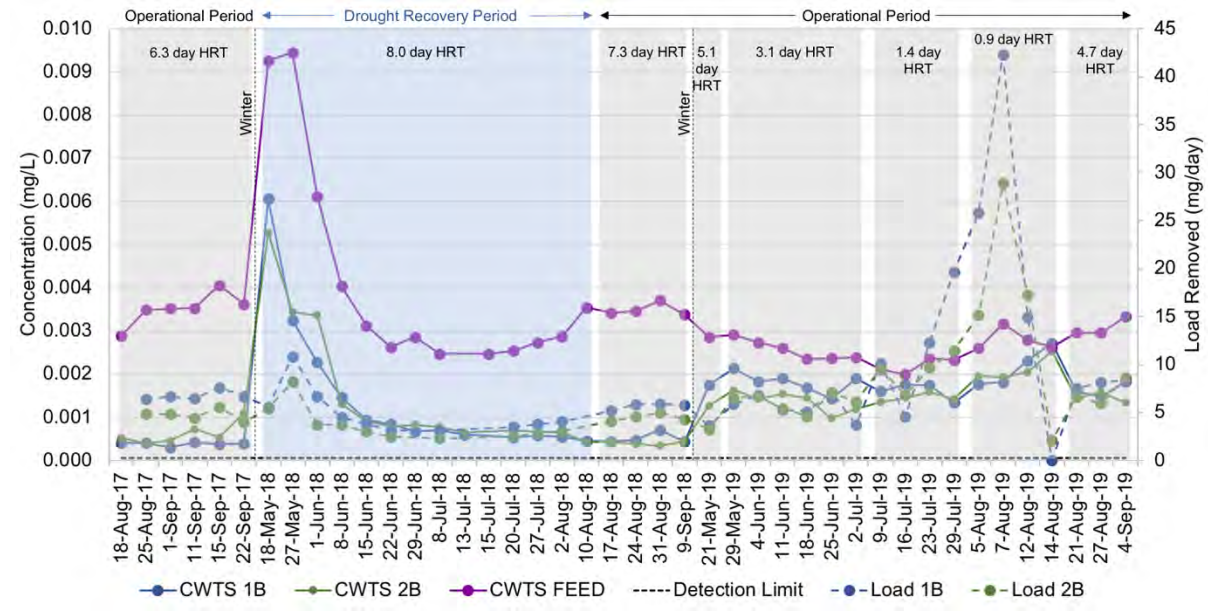


Figure 12 – Total selenium concentrations and load removed per day over the 2017 – 2019 operational periods.

Total water concentrations are on the primary y-axis (solid lines) while load removed are on the secondary y-axis (dotted lines). Concentrations and load removed are based on outflow concentrations from each CWTS series. Operational periods are identified from 2017 through 2018 according to average HRT of Series 1 and 2. Blue shading corresponds to the drought recovery period of 2018. The ALS detection limit (DL; black dotted line on primary y-axis) for total selenium is 0.00005 mg/L.

6.4 Fate and Distribution

6.4.1 Copper leaching from soils

Although unintentional, the high initial leachable copper concentrations in the CWTS soils allowed for additional testing to be carried out on the CWTS (Table B1, and B2, in Appendix B). When compared to 2016 and 2017 results, leachable copper concentrations in the substrate decreased in the CWTS through 2018 and remained low in 2019 (Contango, 2017a, 2017b, 2019), despite slightly less reducing conditions in 2019. Total copper concentrations in the soils remained within ranges previously measured. Additional soil sampling locations were tested in 2019 (near the inflow and mid-way of each cell) to confirm that copper leaching from the soils has stopped. Leachable copper was negligible at the mid-point and outflow of each cell and slightly higher but still low at the inflow of the CWTS. The full-scale system will be built with soil that will have low leachable copper. Additionally, iron could be supplemented in the soils during construction to promote excess acid volatile sulphides (AVS) which provides an additional treatment capacity and redox-buffer during low microbial sulphide production through exchangeable iron sulphide reserve (Section 6.4.3).

6.4.2 Mass balance

Mass balances were calculated for each CWTS series to assess the fate and distribution of COC removed from the water during the commissioning and operation of the demonstration-scale CWTS. Load of a COC retained in the system (difference between concentrations of COC entering and exiting the CWTS) and the concentrations of COC in moss, *C. aquatilis* leaves, and soil at the end of 2019 were evaluated (Appendix A). The percent of each COC load that was removed and retained in the plant and moss was calculated, and the percentage that was not retained in the plants is assumed to be within the soils, plant roots, detritus, and biofilms. The stability of COC in the soils was also assessed through sequential extraction analysis, with definitions of extractable fractions in Appendix B, Table B3 (Tessier et al., 1979). While the concentrations of COC in the top 10 cm of soil were measured in 2019, the load of COC removed by each series is less than the method error of the soils analysis due to the high initial COC concentrations in the soils used for construction. For example, the concentration of zinc in the initial soils for Series 1 is 67.8 mg/kg, which has a greater method error (+/- ~13 mg/kg) than the amount of zinc retained in the series.

The majority of copper entering the demonstration-scale CWTS during the operational period was treated and retained as desired. Sequential extraction analysis shows that despite elevated initial leachable copper concentrations, the soils have become more stable (less leachable) over time in the CWTS as the soils have aged, shifting from oxidized to reduced mineral forms (Contango, 2019; Appendix B, Figures B6, B7, and B8). This beneficial aging of soils to a less soluble mineralized sulphide form is expected for this type of anaerobic CWTS design (Contango, 2017b) and the distribution of copper in mineralized sulphide remained stable in the slightly less reducing conditions in 2019.

The other chalcophile COC (cadmium and zinc) entering the demonstration-scale CWTS were also treated and retained within the CWTS as desired. Cadmium concentrations in the CWTS soils are at or near detection limits for all fractions (Appendix B, Figures B11). Zinc mineral forms have been unchanged over time, with most of the constituent found in the reduced or

mineral form (fraction 4 and 5; Appendix B, Figures B9 and B10). Selenium was at or near the detection limit for all fractions at the end of 2019 (Appendix B, Figures B13 and B14). Molybdenum was in the most stable residual mineral fraction 5, which contained around 40% of the total molybdenum in the samples (Appendix B, Figures B12).

Over time, constituents sorbed to mosses will form reduced minerals, rendering them less bioavailable. Mosses have long been known as metal accumulating organisms useful in remediation. Aquatic mosses are particularly useful to CWTS design as they have a high sorption capacity and contribute to both sulphide-producing conditions and accretion of soils. In contrast to macrophytes (e.g., *C. aquatilis*), mosses tend to trap large amounts of elements, both through sorption and filtration (Aldrich & Feng, 2000; Gstoettner & Fisher, 1997), and are a relatively benign sink for these elements. Subsequent to these transfer processes, the minerals can be transformed to stable insoluble minerals through reductive processes. Mosses also contribute significantly to CWTS substrate accretion and are conducive to the development of reducing conditions by serving as a carbon source. It should be noted that mosses are not generally a food source for invertebrates or higher animals and as such do not contribute greatly to bioaccumulation (Haines & Renwick, 2009; Longton, 1997; Suren & Winterbourn, 1991).

The fate and distribution of treated copper in the CWTS is difficult to assess due to the challenge of quantifying the amount of copper that leached from the soils which has contributed to the load of copper removed by the CWTS. Therefore the concentration of copper in *C. aquatilis* and moss were compared to previous years, and to the load of copper removed in 2019. Copper concentrations in *C. aquatilis* in 2019 were higher than 2018 concentrations, but within the range of concentrations reported in 2017 (Figure 13). The load of copper removed in 2019 by the CWTS was higher than any previous year, and ~2.5% of the load removed was taken up by *C. aquatilis.* Similarly, copper concentrations in moss were lower in 2019 than any previous year in Series 1 (265-396 mg/kg) and Cell 2A (166 mg/kg). Concentrations were higher in moss in Cell 2B (1800 mg/kg) at the end of 2019, however, these concentrations are within the range observed through previous years (Figure 13).

Cadmium concentrations entering and retained within the wetland throughout the demonstration-scale CWTS have been low. As such, the fate and distribution of retained cadmium could not be measured, with concentrations in *C. aquatilis* and moss continuing to be low in 2019 (0.023-0.043 mg/kg and 0.10-0.26 mg/kg, respectively; Figure B15, in Appendix B).

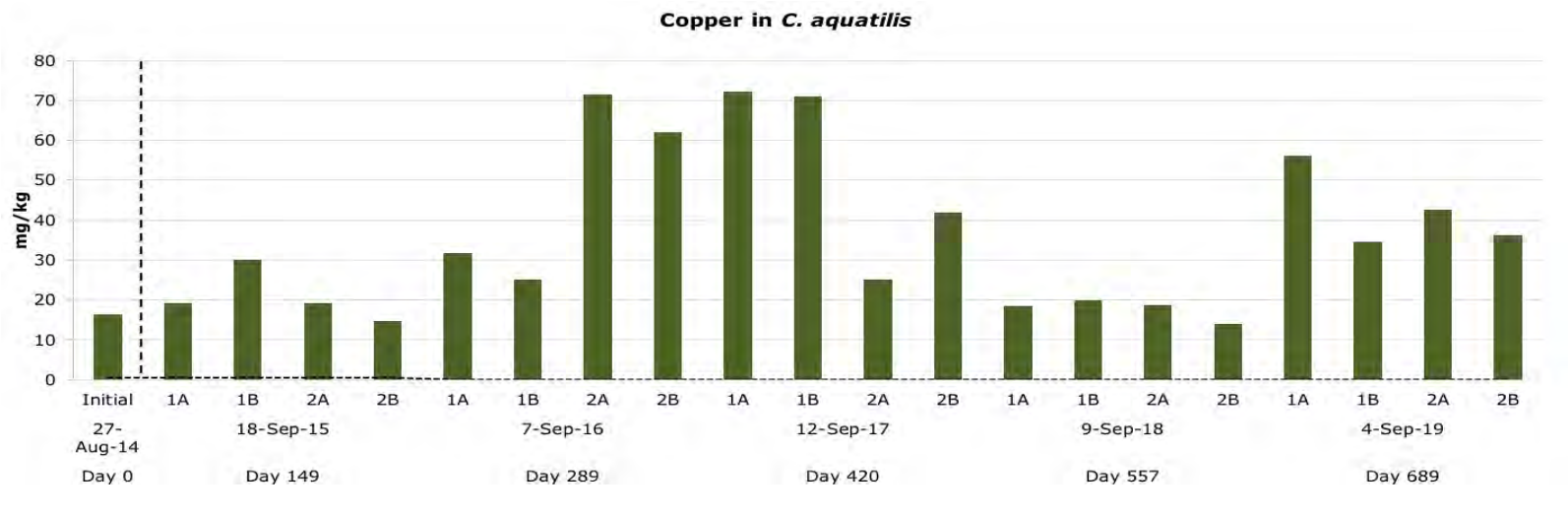
Uptake of molybdenum, selenium, and zinc by *C. aquatilis* and moss over the duration of the demonstration-scale CWTS was evaluated based on the overall load of each COC retained in the wetland over time compared to the concentration that was present in *C. aquatilis* and moss at the end of 2019. The uptake of these COC was low (< 2%) suggesting that these COC retained within the demonstration-scale CWTS are non-bioavailable as intended (Table 8).

In 2019 zinc concentrations in moss were lower than previous operational years (Figure B18, in Appendix B). Zinc concentrations in *C. aquatilis* in Series 1 remained similar to 2018 concentrations, while Series 2 experienced an increase in 2019 although was within trends

from previous years despite the elevated load of COC removed by the CWTS in 2019 (Figure 13, Figure B18, in Appendix B). Selenium concentrations in *C. aquatilis* were generally similar in 2019 compared to 2018 (Figure B16, in Appendix B). In contrast, molybdenum concentrations in *C. aquatilis* decreased in 2019 compared to all previous years (Figure B17 in Appendix B). Lower selenium and molybdenum concentrations in moss were observed in the A cells in 2019 (Figure B16, B17, in Appendix B) and may be due to newly growing moss in cells 1A and 2A, while the concentrations have gradually increased in the B cells since constructing the demonstration scale CWTS in 2014.

Table 8 – Uptake of COC into *C. aquatilis* and moss throughout commissioning and operations.

COC	% Uptake into *C. aquatilis*		% Uptake into moss	
	Series 1	Series 2	Series 1	Series 2
Mo	0.55%	1.25%	0.88%	1.62%
Se	0.23%	0.55%	0.59%	0.90%
Zn	0.74%	0.73%	0.14%	0.37%



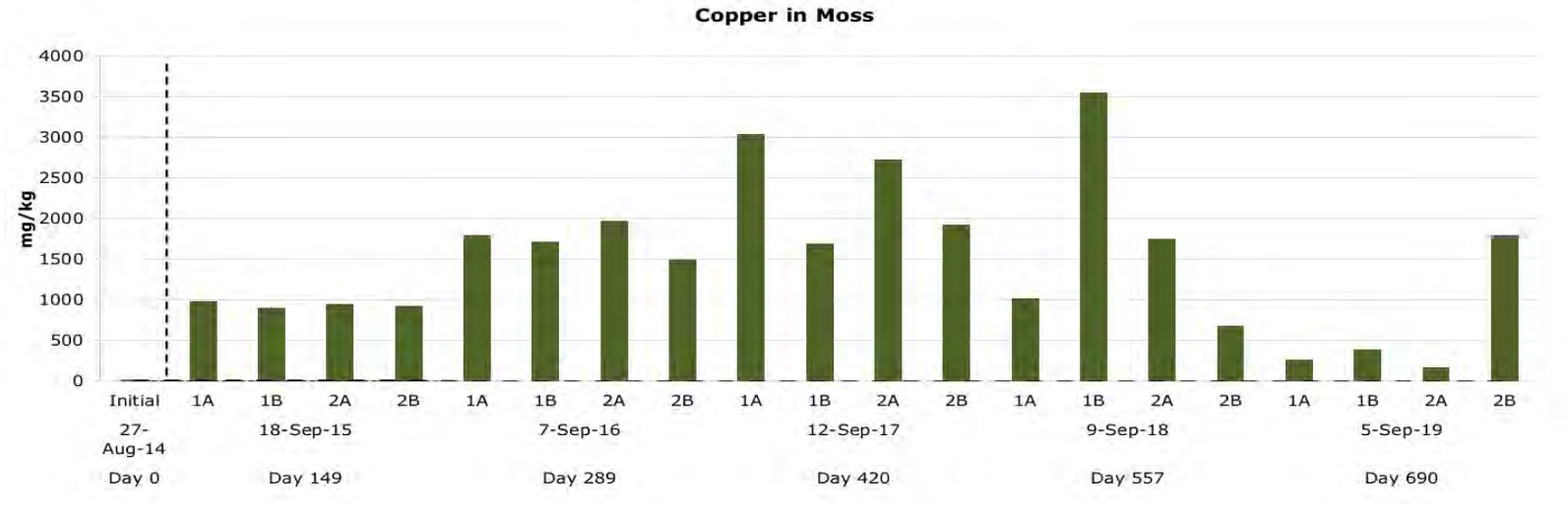


Figure 13 – Copper concentrations in plants.

The 2014 detection limit (DL; horizontal dotted line) for copper is 0.5 mg/kg, the 2015 DL is 0.050 mg/kg, and the 2016-2019 DL is 0.010 mg/kg. The initial timepoint is the average of the three *C. aquatilis* replicates at construction. The vertical dashed line separates the initial timepoint (following CWTS construction) and remaining timepoints that were harvested from the demonstration-scale CWTS.

6.4.3 Acid Volatile Sulphides

Additional treatment capacity can be stored in a CWTS through creation of a reserve of AVS (newly formed amorphous iron sulphides; Contango, 2017b). A strong AVS pool will provide redox buffering and continued metals treatment during periods with insufficient carbon or slower microbial activity (during the shoulder seasons). AVS can also serve as a buffer to oxidation should the soils of a reducing (sulphide producing) CWTS be exposed to oxygen (e.g., briefly drying out), thereby making sequestered metals less likely to re-solubilize. In the case of Minto, where the soils used in construction had excess copper, the appearance of measurable AVS would also indicate that the copper in the soils is nearing an endpoint of transformation to sulphide forms.

AVS has not been measured in desired concentrations in the demonstration-scale CWTS (small amounts measured in 2017 for the first time, as well as in 2018 and 2019; Contango, 2017b, Contango, 2019) as much of it was used to sequester total copper in the copper-rich soils. While small amounts of AVS were measured in 2019, the ratio of simultaneously extractable metals to AVS (ΣSEM:AVS) in all cells were greater than one, indicating there is no excess AVS present in the soil. This is not surprising as there were higher treatment demands in 2019 which resulted in insufficient carbon available to reach sulphide-producing conditions and subsequent formation of AVS. Addition of iron had also been initially planned in 2019 to improve AVS concentrations, however, based on priorities for testing the addition was delayed in order to focus on testing the CWTS at higher HRTs. The addition of iron will therefore be evaluated in 2020.

7. Health and Establishment of CWTS Vegetation

7.1 *Carex aquatilis*

Plants establish and mature over time, with density expected to increase over the commissioning period. From planting in 2014 up to July 2017, *C. aquatilis* thrived in the CWTS creating a dense emergent macrophyte monoculture, alongside aquatic mosses (Figure 14). However, an aphid infestation of the CWTS occurred in 2016 and 2017. Since the demonstration-scale CWTS is constructed of an emergent macrophyte monoculture of *C. aquatilis* in a relatively isolated area on the waste rock dump (i.e., located 50 m away from other vegetation and potential sources of insects), it is more susceptible to infestation by pests such as aphids (Dixon, 1971; Riley et al., 1995; Foottit and Maw, 1997; Contango, 2017b). Additionally, due to its isolated location the CWTS it is unlikely to attract predatory insects such as ladybugs, lacewings, and parasitic wasps to control aphid populations (Flint, 2001; Russel and Diaz, 2015; Finnamore, 1997; Contango, 2017b). While the demonstration-scale CWTS has experienced aphid infestations, this is not expected to occur in the full-scale CWTS and minimal insect control is expected to be needed (Rodgers et al., 2002). The full-scale CWTS will be built in an area with surrounding vegetation, thereby providing habitat for natural predators of aphids.

In July 2017, the aphid infestation affected the above water biomass of *C. aquatilis* (September 2017 and May 2018 photos in Figure 14; Contango, 2017b). While efforts were made in 2017 to control the population through application of pesticide (insecticidal soap), the ongoing spraying regimen was not maintained, and aphids remained. However, the plants continued to send out new shoots therefore suggesting that despite impacted vegetation, the *C. aquatilis* were resilient to the infestation. In 2018, *C. aquatilis* were replanted where vegetation was sparse. Additionally, stronger insecticidal soap (i.e. Trounce, End-All, or Bug-B-Gone) was applied biweekly or weekly to prevent or control aphid populations on *C. aquatilis* in 2018 (Contango, 2019). The CWTS was sprayed with pesticide every two weeks from May 14, 2018 to August 24, 2018 to prevent reoccurrence of the aphid infestation. The application was successful except for a small aphid population that appeared in cell 2A later in 2018, which was targeted with pesticide in August and September 2018. Bug-B-Gone was applied weekly or biweekly in 2019 and was effective at controlling aphid populations. Small isolated areas of aphid populations were observed in 1A and 2A on July 26 and August 27, 2019, respectively. However, these populations were quickly contained and/or eradicated with pesticide application. Routine pesticide application in 2020 is recommended on an as needed basis.

In 2018, the plants re-established in monoculture, and matured to densities visually similar to natural wetlands in the area (Figure 14; Figure 15), with the exception of cell 1A which was still recovering in 2018. The pre-existing mature plants in the CWTS re-established and matured in 2019 to densities similar to early 2017 (pre aphid infestation). However, some areas in the CWTS were still sparse in sections that were replanted in 2018 with plants slowly establishing. Aphid populations were controlled through 2019 with early and routine pesticide application (Table A1 in Appendix A).

Generally, the *C. aquatilis* has been successful in creating the desired conditions for water treatment, and the water chemistry and performance results of the 2019 operations (Section 6) confirm that *C. aquatilis* is a good candidate for use in the full-scale CWTS at Minto.

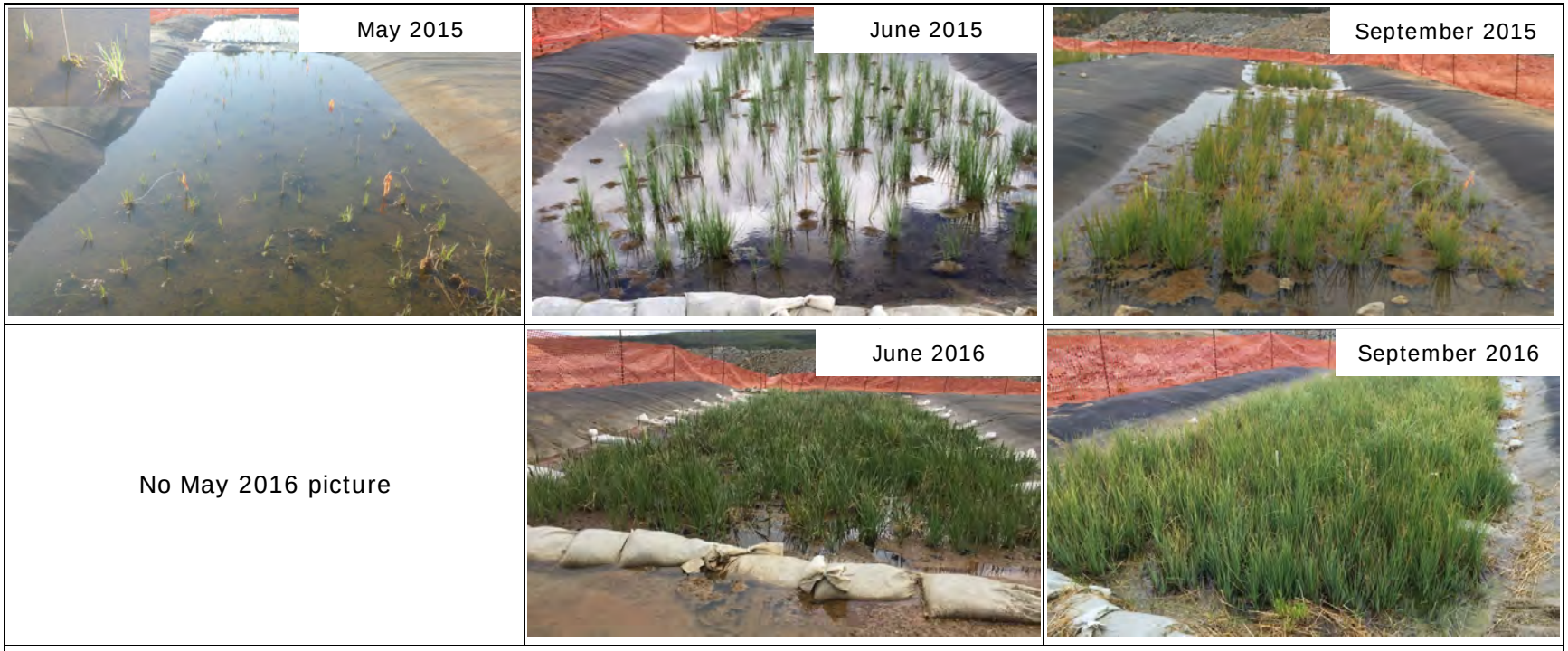


Figure 14 – Maturation of the CWTS from construction in August, 2014 and through operations (2017-2019).
2015 pictures show cell 2A. 2016 pictures show cell 1B.

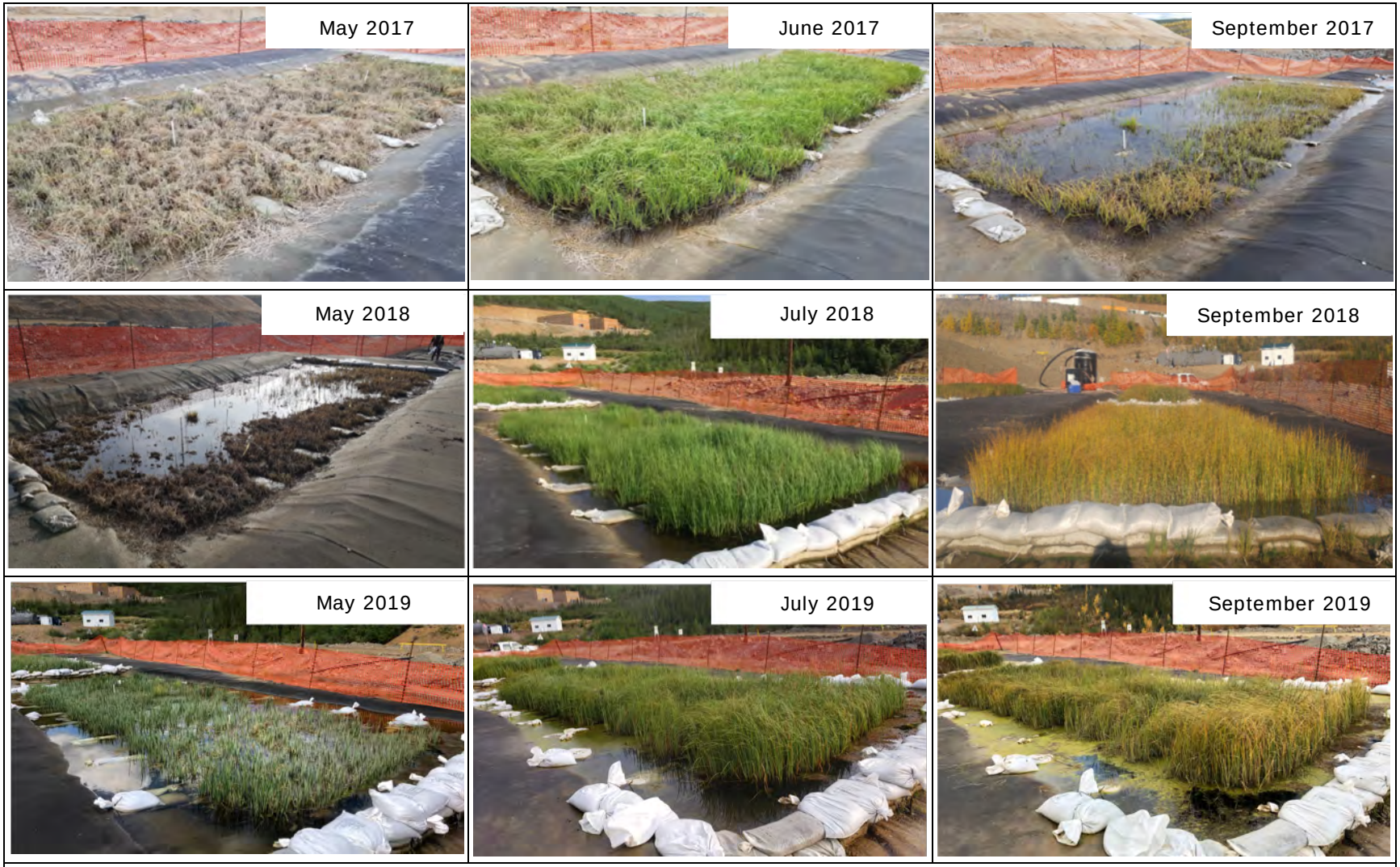


Figure 15 – Maturation of the CWTS from construction through operations.
Pictures show cell 1B. September 12, 2017 shows increased yellowing and die off due to aphid infestation.

7.1 Moss

Aquatic mosses have continued to mature and grow from 2014 through 2019 (Contango, 2019). Lower abundance of moss in cell 1A was noted in 2018, and it was recommended that additional moss be added to the A cells in 2019. The lower amount of moss in the A cells may have been due to the addition of straw to the perimeter of the cells in 2016. The straw addition may have inhibited the growth of some of the moss in the A cells as double the amount of straw was added to the A cells compared to the B cells. Thus, moss was transplanted from W10 to cells 1A and 2A on May 30, 2019 in patches where moss was sparse. It was noted during the large September 2019 sampling event that moss within the A cells was still less abundant compared to the B cells, indicating time is needed for establishment. The mature mosses showed signs of successful transfer (sorption, filtration) and transformation (mineralization, reduction) processes such as new green biomass at the top of the moss and black decomposition at the bottom of the moss. The demonstration-scale testing has therefore continued to refine the process for full-scale implementation (which is the intent of the program), where straw would be added to a forebay rather than to an established CWTS cell, if additional carbon is needed. Thus, it is not expected that moss will need to be re-planted into a full-scale mature wetland, as straw would be added to a forebay.

8. Treatment Mechanisms

Specific types of bacteria have been evaluated in the soil, plant, roots, and detritus in the CWTS to inform treatment mechanisms that are occurring. Background information on the targeted treatment mechanisms and bacteria involved in these biogeochemical reactions is provided in Section 5. DNA testing can be used to identify all bacteria in a sample, along with their relative abundance as a percentage of the community, and diversity. The quantity of bacteria can be determined through growth-based testing. This type of community profiling allows for inferences to be made regarding community structures, functions, relatedness, and biodiversity of organisms in an environment, and helps in the understanding of how they change in response to environmental factors. Diversity in beneficial microbes is favourable and can be regarded as a measure of robustness to conduct a given biogeochemical function, as multiple different bacteria will be able to carry out the beneficial reaction under a wider range of conditions than a small diversity of bacteria could.

8.1.1 Denitrifying Bacteria

Nitrate is not a COC however it is being evaluated as described in Section 5.

As observed in previous years, denitrifying organisms were found associated with all sample types in the demonstration-scale CWTS (Figure B19 in Appendix B). There were slightly higher quantities of denitrifying bacteria associated with moss and detritus in the CWTS compared to the soil. Quantities have remained relatively similar from September 2018 to September 2019 (Figure B19 in Appendix B). The denitrifying bacterial population in the CWTS has demonstrated the capacity to remove higher nitrate loads through 2019. Denitrifying bacteria

will be monitored at the end of 2020 for one of the CWTS series and compared with performance testing.

8.1.2 Selenium-reducing Bacteria

The targeted selenium treatment pathways in the Minto CWTS is described in Section 5.

As observed in previous years, selenium-reducing bacteria (SeRB) were found associated with all sample types in the demonstration-scale CWTS (Figure B20 in Appendix B). There were similar quantities of SeRB associated with soil, moss, and detritus in the CWTS in 2019. Inferred quantities have also remained stable from September 2018 to September 2019 (Appendix B), further supporting that the demonstration-scale CWTS has a beneficial bacterial population that is robust to changes in conditions.

8.1.3 Sulphide-producing Bacteria

Sulphide production is a key biogeochemical mechanism for water treatment as described in Section 5.

The inferred abundance of SPB in soils in 2019 remained stable and were within ranges observed in 2018 for detritus and soil, with an increase observed with moss samples (Figure B21 in Appendix B). The SPB populations therefore demonstrated resilience through the less reducing conditions observed in 2019 when the system was carbon limited. Diversity of SPB in all sample types (soil, roots, moss, and detritus) was also similar to 2018 (Table 9).

Table 9 – Number of different types of sulphide-producing bacteria in the demonstration-scale CWTS over time.

Sample Type	2014 & 2015	2016	2017	2018	2019
Detritus	NT	10	17	16	14
Moss	11	12	15	14	14
Root	11	14	14	15	16
Soil	12	17	18	17	14

NT – not tested. The average number of different types is based on the number of operational taxonomic units (clustered at 97% identity) that are classified as known sulphide-producing bacteria. Organism classifications and data analysis methods were updated based on available information in databases in 2018 (Contango, 2019).

The percentage of SPB in the populations associated with root and detritus were generally similar to 2018 (Figure 16 and Figure 17). The percentage of SPB with the soil and moss samples had some changes in 2019, where the B cells decreased slightly in the soil but increased with moss (Figure 18 and Figure 19). The types of SPB also continue to differ across sample types, with the soil having more *Clostridium* while roots, detritus, and moss have other types of SPB. This diversity across sample types provides robustness to the system as conditions change in the CWTS, as different types of bacteria have environmental preferences that drive their growth. An example of this robustness was observed with the SPB associated with *C. aquatilis* roots. In 2018, the percentage of SPB associated with *C. aquatilis* roots were

initially lower potentially due to the initial drying out of the CWTS in the early spring/freshet; however, populations recovered by September of 2018 and have remained stable, indicating that the drying out of the CWTS did not have a long-term impact on SPB populations associated with *C. aquatilis* roots. However, there was a slight shift in the types of SPB that were associated with *C. aquatilis* roots in 2019. *Sulfurospirillum* has generally been the dominant SPB associated with roots in previous years, and this bacteria can grow in the presence of oxygen (facultative anaerobe or microaerophile). In 2019, *Sulfurospirillum* decreased and the SPB shifted to more anaerobic bacteria. This indicates that while less reducing conditions were experienced in the CWTS in 2019, there were still zones in the wetland that were reducing and could support sulphide-producing conditions should sufficient carbon be available to fuel the reaction.

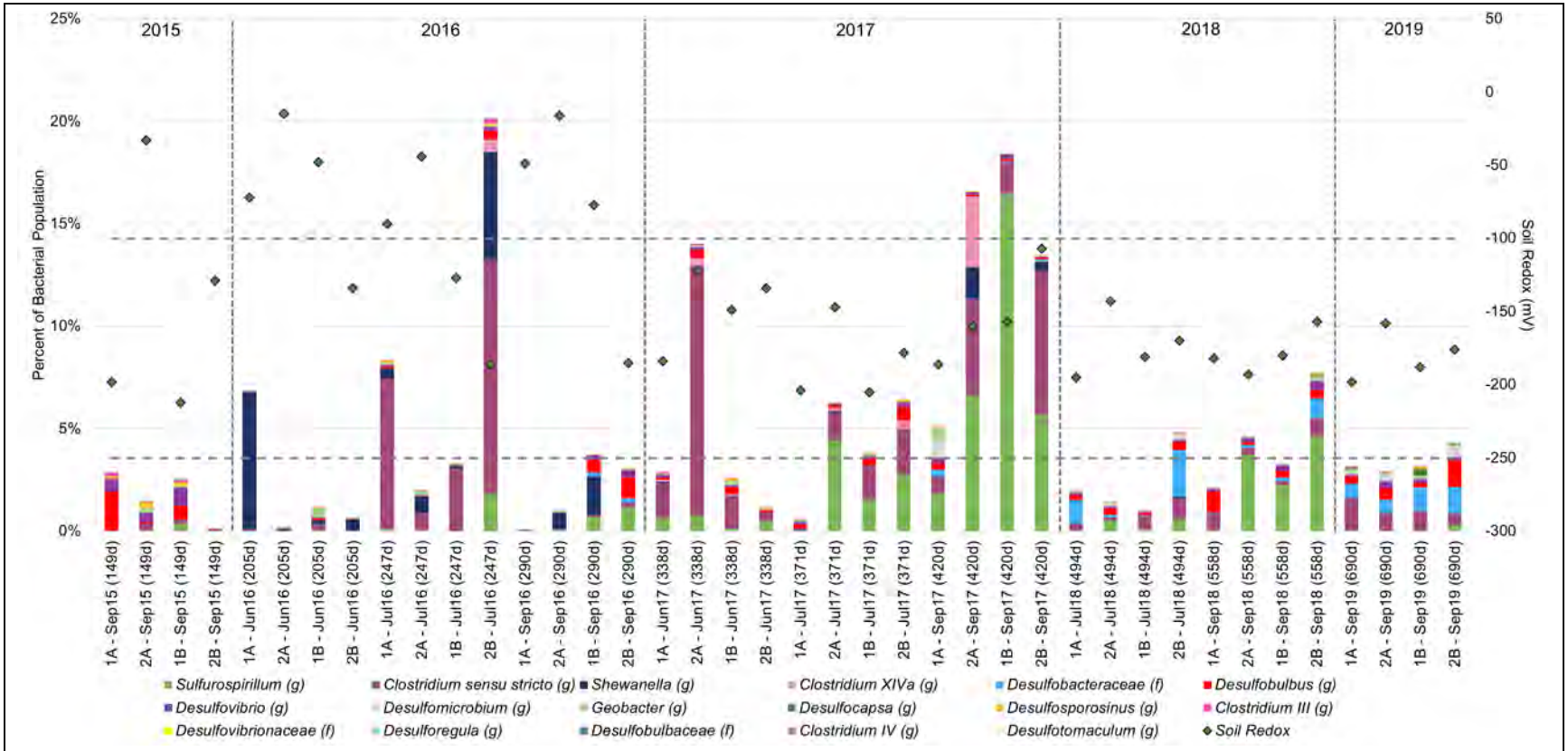


Figure 16 – Sulphide-producing bacteria associated with root alongside CWTS soil redox measurements.

The primary y-axis provides the percentage of the bacterial population (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. The y-axis for root is different from other sample types as the percentage of sulphide-producing bacteria were much higher in many root samples. The secondary y-axis provides the soil redox measurements that were closest to the microbiology sampling date. Horizontal dashed lines indicate the targeted soil redox range. Percentage of bacteria is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f).

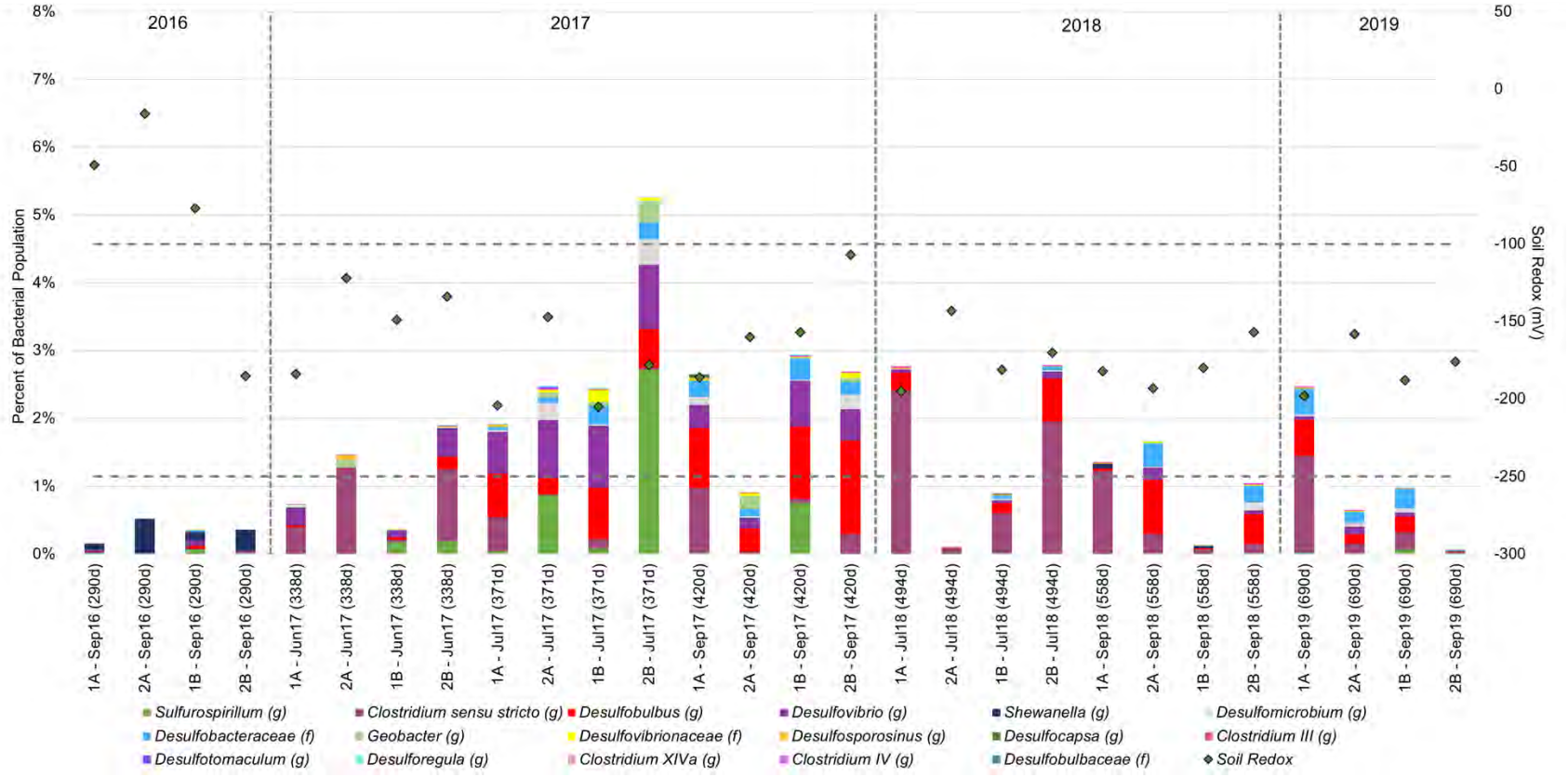


Figure 17 – Sulphide-producing bacteria associated with detritus alongside CWTS soil redox measurements.

The primary y-axis provides the percentage of the bacterial population (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. The secondary y-axis provides the soil redox measurements that were closest to the microbiology sampling date. Horizontal dashed lines indicate the targeted soil redox range. Percentage of bacteria is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f).

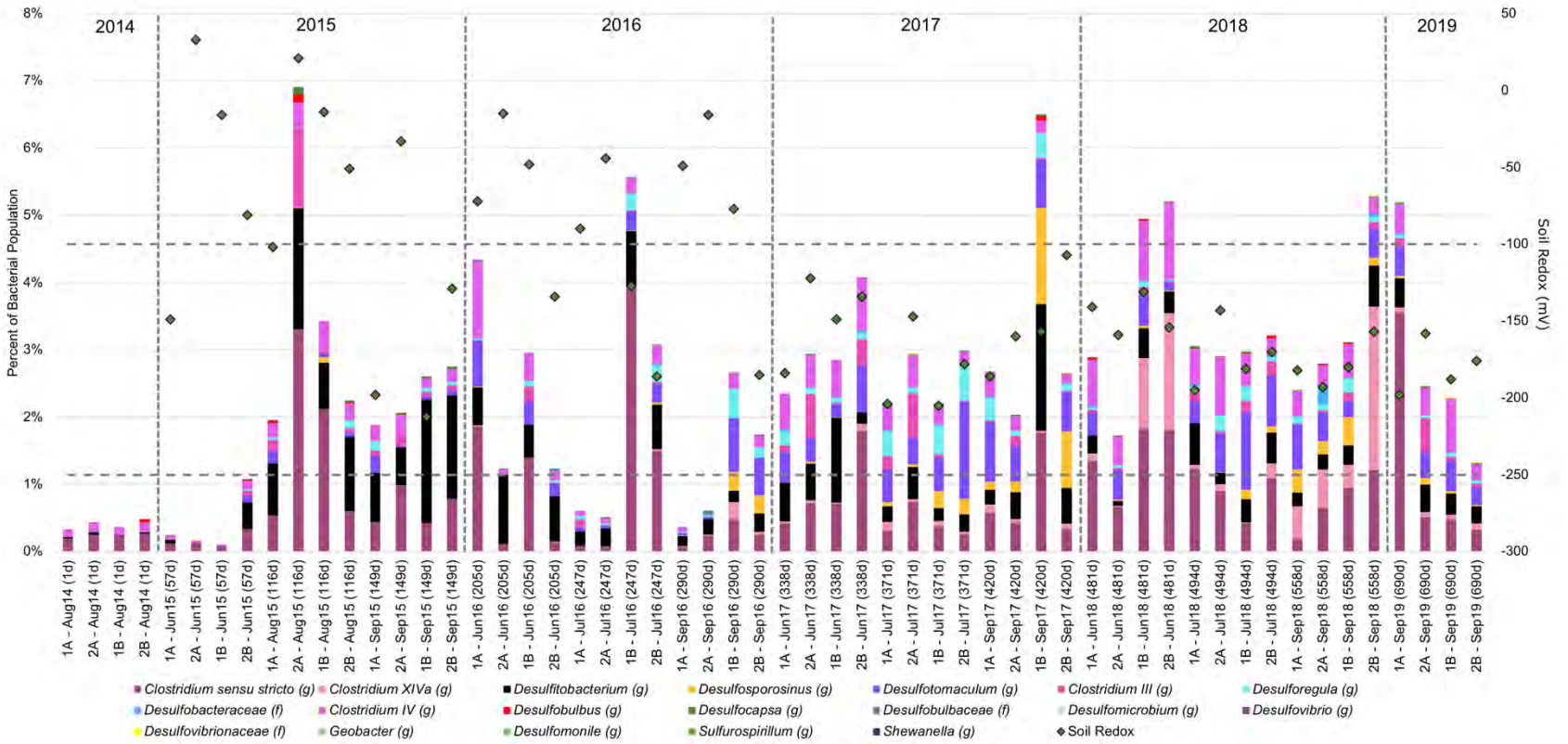


Figure 18 – Sulphide-producing bacteria associated with soil alongside CWTS soil redox measurements.

The primary y-axis provides the percentage of the bacterial population (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. The secondary y-axis provides the soil redox measurements that were closest to the microbiology sampling date. Horizontal dashed lines indicate the targeted soil redox range. Percentage of bacteria is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f).

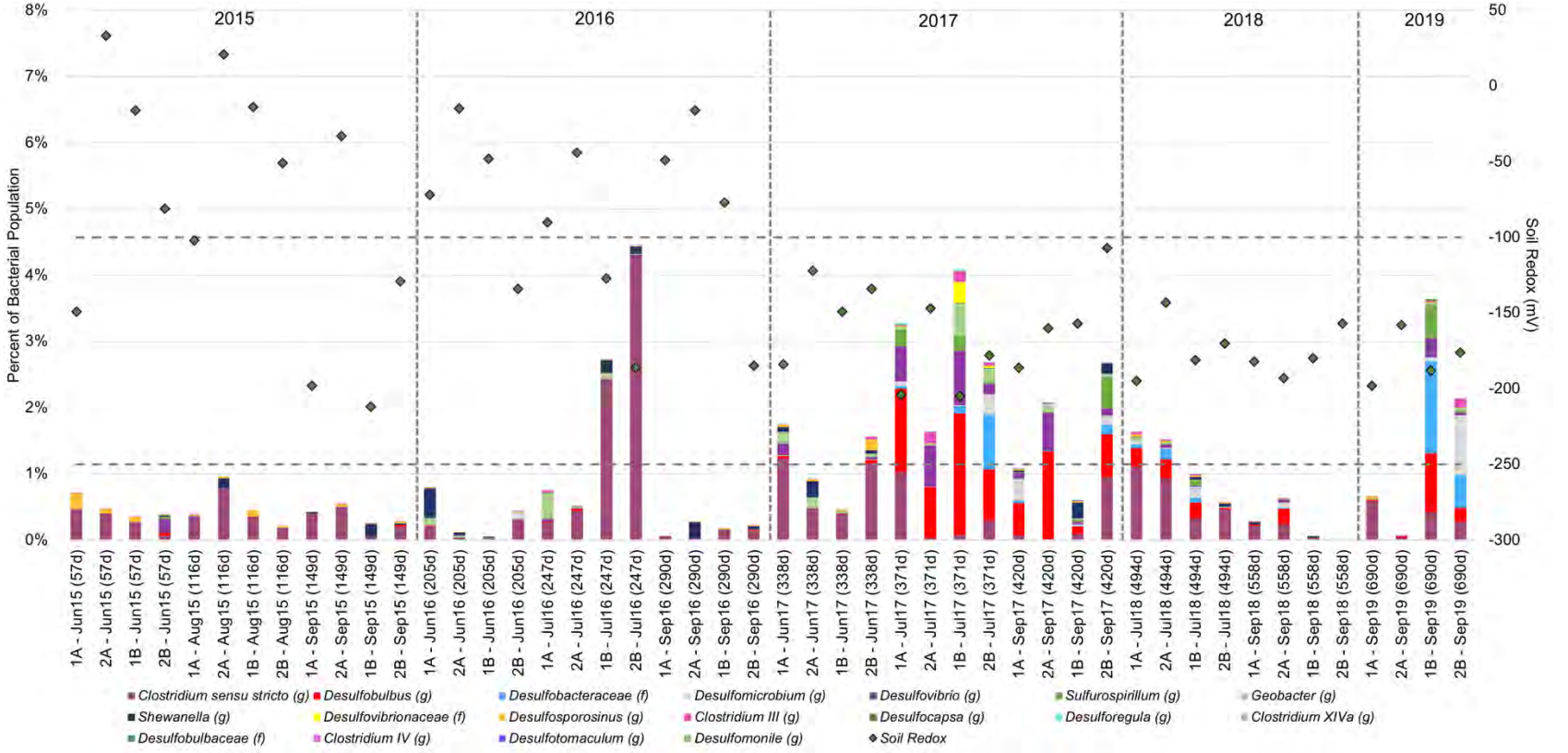


Figure 19 – Sulphide-producing bacteria associated with moss alongside CWTS soil redox measurements.

The primary y-axis provides the percentage of the bacterial population (relative abundance) that corresponds to sulphide-producing bacteria through the reduction of sulphate, sulphite, thiosulphate, and sulphur. The secondary y-axis provides the soil redox measurements that were closest to the microbiology sampling date. Horizontal dashed lines indicate the targeted soil redox range. Percentage of bacteria is based on identification via genetic sequencing. Organisms are either classified to the genus (g) or family level (f).

9. Summary of Results

The overriding objective of the Minto Mine demonstration-scale CWTS program was to advance proof of concept and ultimately site design of a full-scale CWTS for the Minto Mine. The primary objective in 2019 was to assess performance under a wide range of conditions that mimic the full-scale CWTS. The demonstration-scale CWTS was able to operate under these conditions while successfully treating most COC and notably removing more load of COC than any previous year. Removal rate coefficients (RRC) have been developed throughout operations of the demonstration-scale CWTS which will be used to advance the design of a full-scale CWTS at the Mine. Additional sampling occurred at the end of the 2019 season to evaluate the fate and distribution of COC within the CWTS which indicated that COC were being retained within the demonstration-scale CWTS as intended. Key findings are outlined below from each section of the report.

9.1 Monitoring Explanatory Parameters

- Lower DO and ORP measurements were achieved in 2019, likely from improved placement of the YSI unit probe below the dense mats of vegetation that had developed as the CWTS matured, allowing for measurements to be taken at the base of the CWTS where treatment was occurring.
- Soil redox was unaffected by the increased flow rates in 2019, indicating that reducing conditions can be maintained in the substrate while flowing at rates expected for the full-scale CWTS.
- Redox-active metals, such as manganese and iron, showed no increases in dissolved concentrations in the water for most of 2019, indicating that sulphide reduction likely was not maintained likely due to a lack of carbon.

9.2 Carbon Demand and Decomposition

- Decomposition of *C. aquatilis* occurs quickly when initially submerged in the CWTS with 48% decomposition occurring in 82 days (1 operating season). Decomposition remains stable around 55% decomposition after 82 days throughout the 768 day study (including two winter seasons/freezing periods).
- The partial decomposition of *C. aquatilis* biomass from the previous year results in accumulation of organic matter over time (accretion) which is an important process in the CWTS as it buries treated minerals making them more stable.
- Testing in 2019 has identified that the carbon demand for the CWTS may be greater than what is available through annual *C. aquatilis* growth when nitrate loads are high. As high nitrate loads may be experienced during early closure, it is recommended a forebay be evaluated for the full-scale CWTS design for carbon supplementation.

9.3 Water

- Load removed per day of all COC was higher in 2019 compared to other operational years.
- The extent of removal (concentration (mg/L) achieved at the outflow of the CWTS) and removal rate coefficients of cadmium, copper, and zinc were similar to previous years despite less reducing conditions.
- Molybdenum and selenium (somewhat) treatment was impacted by the less reducing conditions and decreased nitrate removal in the CWTS.
- No leachable copper was observed in the water column in 2019.
- The lowest concentration consistently achievable for the treatment design (performance limit) appears to have been reached for dissolved cadmium after 1.5 days. However, the performance limit identification is challenging as cadmium consistently achieved low concentrations in the demonstration-scale CWTS, where greater variability (i.e., fluctuation) is expected with decreased analytical precision. Performance limits have historically been met for cadmium, copper, zinc, and nitrate, indicating the full-scale CWTS could be larger if there is available space.
- Removal rate coefficients developed throughout operations of the demonstration-scale CWTS will be used to advance the full-scale design. Increased flow rates allowed for better resolution of treatment kinetics for cadmium and zinc in 2019.

9.4 Fate and Distribution

- In 2019 leachable copper concentrations in soils remained low in the top 0-10 cm, while total copper concentrations were within ranges previously measured.
- Since commissioning, most constituents (including copper), have shifted primarily into stable reduced and residual minerals fractions in the soil.
- COC loads into the CWTS have been treated with minimal uptake by plant and moss.
- Acid volatile sulphides (AVS) was detected for the first time in 2017 and continued to be detected in 2019; however concentrations have remained low in 2019.

9.5 Health and Establishment of CWTS Vegetation

- An aphid infestation occurred in 2016 and 2017 likely due to the isolated location of the demonstration-scale CWTS. There was impact observed on the above water biomass in July 2017 due to aphids. Aphids were controlled through routine application of insecticidal soap and plants have predominantly recovered.
- Pesticide application is not expected to be needed in the full-scale CWTS as it will not be in an isolated location (Contango, 2017b).

9.6 Treatment Mechanisms

- A robust population of sulphide-producing, denitrifying, and selenium-reducing bacteria have been found associated with all sample types in the demonstration-scale CWTS, and quantities have remained stable despite less reducing conditions in 2019 than previous years.

- The denitrifying bacterial population has demonstrated the capacity to remove higher nitrate loads through 2019.

10. Recommendations and Next Steps for 2020

The 2019 demonstration-scale CWTS testing program showed an increased carbon demand on the wetland due to the high nitrate load. Testing in 2020 is therefore intended to inform design considerations for the full-scale CWTS in early closure, when higher nitrate loads may be experienced. An action plan for operating and testing the demonstration-scale CWTS in 2020 has been developed based on results observed to date. Key activities proposed in the action plan for 2020 include:

- Addition of a forebay (tote) with organics upstream of the demonstration-scale CWTS to provide additional carbon for higher nitrate load removal. This testing will refine the amount and frequency of carbon addition that is required to reduce nitrate loads that may be encountered in the full-scale CWTS, and will refine the full-scale CWTS design.
- Operate the CWTS at a HRT that mimics the full-scale system.
- Develop a sampling plan for monthly monitoring of the CWTS performance through 2020, which will include *in situ* YSI and soil redox, as well as analytical testing with ALS including but not limited to total and dissolved metals, nitrate, nitrite, sulphate, sulphide, and dissolved organic carbon.

Additionally, bench- and pilot-scale *in situ* pit lake treatment testing is also planned for 2020 and 2021 and the results of these tests will help contribute to the full-scale CWTS design for nitrate loads going to the CWTS.

11. Closure

We trust the information herein satisfies your present requirements. Should you have any questions, please contact the persons listed below. We appreciate the opportunity to provide the services detailed in this report, and look forward to discussing any comments you may have.

Regards,

Contango, an AEG company



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Practice Lead - Biological Treatment

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Appendix A – Methods

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Methods from 2019 are described here, along with a brief summary of construction and operational details from previous years. More detail from previous years is available in Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration-scale Update Reports from 2015 to 2018 (Contango 2016a; Contango 2017a; Contango 2017b; Contango 2019).

A1. System Layout and Dimensions

The demonstration-scale constructed wetland treatment system (CWTS) includes two series in parallel with two cells in each series and a final catchment basin that both series flow into. Dimensions and construction details are available in Contango, 2015. In 2019, the two parallel series were operated the same to serve as replicates for data analysis, while in previous years, the two series had different inputs to allow for comparison of different management techniques, such as Fe-EDTA studies on soils leaching copper or iron addition for drought recovery (Contango, 2016a; Contango, 2019).

A2. Vegetation Used in Planting

The demonstration-scale CWTS was planted with *Carex aquatilis* (aquatic sedge) and aquatic mosses from the W10 area of the Minto Site. The plant selection and borrow source was previously determined through the site assessment (Contango, 2014a). During construction, five *C. aquatilis* plants were planted per square meter, with moss tied to stakes that outlined the 1 m x 1 m grid for planting (details provided in Contango, 2015).

A3. Aphid Monitoring and Pesticide Application

Application of pesticide (Bug-B-Gone) on *C. aquatilis* in each cell occurred weekly, starting on May 30, 2019, then bi-weekly, starting July 11, 2019, as a preventative measure tested in 2018 (Contango, 2019).

A4. Water Source

The same water source (W62) was used for the demonstration-scale CWTS in 2019 as was used in 2016 - 2018. The original water source used in 2015 (W36) was changed due to the Mill Valley Fill Extension Stage 2 construction and decommissioning of the W36 collection sump.

A4.1 Water Depth Measurements

Depth sticks installed in the CWTS in June 2016 were used to measure the water depth over time (Contango, 2017a). Sandbags were added to the CWTS gradually from May 5-July 17, 2019 to increase the water level to a target of 30-40 cm depth. After the first sandbags were added, the depth was allowed to stabilize before adding more sandbags. This was done until the targeted depth was measured. The depth stick in cell 1A was corrected to proper depth

during the first seasonal site visit on May 29-30, 2019. The measured depths were used for further calculations regarding cell volume and HRT (Section A11).

A5. Flows Rates

Flow rates were fluctuated over 2019 to target the following hydraulic retention times (HRTs):

- 5 day HRT (May 15-22, 2019; August 16-September 5, 2019)
- 2.5 day HRT (May 23-July 2, 2019)
- 1.2 day HRT (July 3-30, 2019)
- 0.8 day HRT (August 3-15, 2019)

The 5 day HRT was targeted for continuity of HRTs previously tested in the demonstration-scale CWTS (5 and 7.25 day HRT for the 2017 and 2018 operational period, respectively; Contango 2017b; Contango 2019). The 0.8 to 2.5 day HRTs were calculated based on expected flow reporting to the full-scale CWTS. The targeted nominal HRT was calculated using the actual water depth in each series, plus the correction factor obtained from the 2017 tracer study (Contango, 2017b). The actual water depth used to calculate the targeted HRT was measured prior to starting the HRT scenario since the depth increased gradually as sandbags were added slowly until target depths were reached.

A6. Timeline and Sampling Schedule

Major events and operational adjustments or amendments for 2019 are listed in Table A1. Details for events up to 2017 and through 2018 can be found in Contango, 2017b and Contango, 2019, respectively. The actual dates as well as effective days of operation are provided, which adjusts for time that the CWTS was not receiving water when it was frozen or not flowing. The effective days of operation allows for comparison to expected timelines from pilot-scale testing, and for planning and scheduling for the full-scale system. The operational testing plan was conceptually developed prior to beginning construction of the demonstration-scale CWTS and the sampling schedule for each year was refined annually. Actual dates of sampling were adjusted for timing of spring thaw and winter freeze-up, and the associated ability to have the pumps operating at the W62 sump to supply water to the demonstration-scale CWTS.

Table A1 – Events and sampling activities in 2019.

Event	Key Activity	Flow Rate Recorded m^3/day (GPM)		Dates	Effective Days of Operation (start date = August 27, 2014)
		Series 1	Series 2		
CWTS water depth maintained	Prevented CWTS drought at spring thaw	n/a	n/a	April 5-8, 2019	-
	Added WTP water	n/a	n/a	April 16-May 1, 2019	-
	Added W62 water	n/a	n/a	May 2-14, 2019	-
Water depth raised	Added sandbags gradually to target 30 - 40 cm water depth above substrate	n/a	n/a	May 5-July 17, 2019	-
Start flow	Flow started to target a 5 day HRT	3.27 (0.60)	2.02 (0.37)	May 15, 2019	577
Flow rates increased	Adjusted flow to target a 2.5 day HRT	7.14 (1.31)	4.42 (0.81)	May 22, 2019	584
Contango Site Visit #10 & spring seasonal sampling	Tested soils, water, detritus bags, and sampled microbiology[1]	7.25 (1.33)	7.14 (1.31)	May 29-30, 2019	591-592
Moss transplanted from W10	Replenish cells 1A and 2A moss	n/a	n/a	May 30, 2019	592
Aphid spraying started	Applied insecticide once every week	n/a	n/a	May 30, 2019	592
Flow rates increased	Adjusted flow to target a 1.2 day HRT	21.15 (3.88)	13.74 (2.52)	July 3, 2019	627
Insecticide regimen changed	Applied insecticide every two weeks	n/a	n/a	July 11, 2019	634
Aphids observed on 1A	Resolved with spraying regimen	n/a	n/a	July 26, 2019	649
Contango Site Visit #11 & summer seasonal sampling	Tested soils, water, detritus bags, and sampled microbiology[1]	20.71 (3.80)	15.26 (2.80)	July 29-30, 2019	652-653
Storm event	Stopped flow due to source issues	*	*	July 30-31, 2019	653-654
Flow rates increased after flow re-established	Cleared excess TSS in tank, flow blockages and adjusted flow to target a 0.8 day HRT.	31.29 (5.74)	24.31 (4.46)	August 3, 2019	657
Intermittent ice formation on CWTS surface	No action performed	n/a	n/a	August 14-28, 2019	668-682
Target flow rates decreased	Adjusted flow to target a 5 day HRT	6.11 (1.12)	4.80 (0.88)	August 15, 2019	669
Aphids observed on 2A	Resolved with spraying regimen	n/a	n/a	August 27, 2019	681
Contango Site Visit #12 & fall seasonal sampling	Tested microbiology, soils, water, *C. aqualtilis* and moss, mass balance, and vegetation plot	5.45 (1.00)	4.25 (0.78)	September 4-5, 2019	689-690
Winterize CWTS	Flow stopped & wetland closed	0	0	September 12, 2019	697

'*' – indicates that no flow rate was given or that flow rate was unmeasurable or variable; however, cells remained flooded throughout. n/a – flow rate not applicable.
[1] Microbiology samples were collected and bio-banked.

A7. Sampling and Analyses Methods

A7.1 Routine Monitoring of Explanatory Parameters

Explanatory parameters are quantifiable aspects of a CWTS environment that can be used to assess feasibility of treatment for a range of constituents, and therefore 'explain' the performance of a CWTS. These parameters were monitored on a weekly basis from spring thaw in May 2019 to freeze up in September 2019, with an increased monitoring frequency during the fastest HRT scenario. Methods are described in Appendix A of Contango, 2017b.

A7.2 Water Sampling and Analyses

Water sampling occurred on a weekly basis from spring thaw in May 2019 to freeze up in September 2019, with an increased sampling frequency during the fastest HRT scenario. Additional parameters were also tested at least once per HRT scenario. At least one full HRT period was allowed to pass before each sampling event, including after flow rates were adjusted. Frequencies and sampling parameters are outlined in Table A2. Grab samples were collected as described in Appendix A of Contango, 2017b.

After it was observed that copper was leaching from the CWTS substrates into the water, an additional sampling structure was designed to sample at the inflow, mid-point, and outflow of each cell. Details of this sampling method are described in Appendix A of Contango, 2017b. Water was sampled for total and dissolved metals from the inflow, mid-point, and outflow of each cell monthly in 2019 (May 29, June 18, July 23, August 12, and September 4, 2019).

Table A2 – Summary of 2019 water sampling analytical parameters, frequencies, and locations.

Analytical Parameters	Frequency of Sampling	Sample Locations
Dissolved and total metals	Weekly[1]	Outflow of each cell and feed
Ammonia		
Nitrate		
Nitrite		
Hardness ($CaCO_3$)		
Sulphate (SO_4)		
Flow rate	Daily	Feed
pH, DO, ORP, Conductivity (*in situ*), Temperature	Weekly[1]	All cells and feed
Anion Sum	Minimum once per HRT scenario	Outflow of each cell and feed
Cation Sum		
Ion Balance		
Total Dissolved Solids (TDS)		
Chloride (Cl)		
Nitrogen (Total)		
Alkalinity		
pH		
Conductivity		
Chemical Oxygen Demand (COD)		
Total Organic Carbon (TOC)		
Total Kjeldahl Nitrogen (TKN)		
Total Suspended Solids (TSS)		
Dissolved Organic Carbon (DOC)		
Bicarbonate (HCO_3)		
Carbonate (CO_3)		
Hydroxide (OH)		

[1]Sample frequency was increased during the fastest HRT scenario. At least one full HRT period was allowed to pass before each sampling event, including after flow rates were adjusted.

A7.3 Soil Sampling and Analyses

Soil sampling was conducted three times in 2019 (May 30, July 30, and September 5, 2019), while *in situ* relative soil redox was measured at least once per HRT scenario. A sample of the CWTS soil was collected for analyses as outlined in Table A3. Each CWTS cell was a composite of the top 0-10 cm from both sides of the CWTS sampled near the inflow, mid-point (September only), or outflow during each sampling event. An additional soil sample was collected on September 5, 2019 and brought to Contango to determine a wet and dry weight from a known volume of soil for analyses associated with evaluating the fate and distribution of constituents of concern (COCs) within the CWTS (Section A12).

Table A3 – Summary of 2019 soil sampling analytical parameters, frequencies, and locations.

Parameters	Frequency of Sampling	Sample Locations
Relative soil redox (*in situ*)	Minimum once per HRT scenario	All probes (6 per cell)
Analyses completed on soil sample		
SAR[4], pH, EC[4], %sat[4], Ca[4], Mg[4], Na[4], K[4], Cl[4], SO_4[4]	Seasonally (3x per year)	From a depth of 0-10 cm near the inflow, mid-point (September only) and outflow.
Available NPK and sulphur[4]		
Bicarbonate (HCO_3)		
Carbonate (CO_3)		
Total Organic Carbon (TOC)[4]		
Metals Analysis (Total)[1]		
Sulfur by LECO		
Metals Leach[1,3]		
Acid Volatile Sulphides (AVS)[1,2] and Simultaneously Extracted Metals (SEM)[1,2]		
Sequential Leaching (5 Acid Test)[1,4]		
Analyses completed on special leach		
Bromide (Br)	Seasonally (3x per year)	From a depth of 0-10 cm near the inflow, mid-point (September only) and outflow.
Chloride (Cl)		
Sulphate (SO_4)		
Fluoride (F)		
Alkalinity		
Bicarbonate (HCO_3)		
Carbonate (CO_3)		
Hydroxide (OH)		
Dissolved Organic Carbon (DOC)		
Ammonia		
Nitrate		
Nitrite		
Total Dissolved Solids (TDS)		

[1] Only select parameters were possible for the May 30th, 2019 samples, and therefore parameters were prioritized for testing.
[2] Only the May 30th, 2019 outflow sample was tested.
[3] For the May 30th, 2019 samples, parameters were tested using reverse osmosis water instead of the special leach water provided as no additional special leach water was available for re-testing. Results were removed from further analysis.
[4] Parameters were not part of planned testing for the September 5, 2019 mid-point soil sample.

To assess the effect of the elevated copper in the soils used in construction and the high initial copper concentrations on CWTS functionality, four soil analytical test methods have been used as described in Appendix A of Contango, 2017b. Three of these analytical test methods were used in 2019:

1. Total concentration of elements in the soils by CRC ICPMS.
2. The concentration of metals that are being released from the soil into the overlying water column by specialized leach method.
3. Stability and form of elements in soils by a sequential extraction procedure for the speciation of particulate trace metals (Tessier et al., 1979).

A7.4 Plant Sampling and Analyses

Moss and above water *C. aquatilis* samples from each cell were collected for metals analysis at the final sampling event of the demonstration-scale CWTS (September 2019) as described in Appendix A of Contango, 2017b. Analyses of tissue samples are outlined in Table A4 (reported in mg/kg dry weight). The tissue samples were homogenized and sub-sampled prior to digestion. In 2019, moss samples were collected for analysis of metals from a 4 m^2 area. A sub-sample of the 4 m^2 area harvest was brought to Contango and dried to determine the moisture content of moss. This information was used in calculations of fate and distribution of COCs within the CWTS (Section A12). *C. aquatilis* samples were also collected from a known area to evaluate fate and distribution of COC within the CWTS as described in Section A7.7.

Table A4 – Summary of 2019 plant sampling analytical parameters, frequencies, and locations.

Analytical Parameters	Plants Sampled	Location	Frequency of Sampling
Total Metals by ICPMS	*Carex aquatilis*	Composite of four locations in each cell	Year end
	Aquatic moss	Composite sample from 4 m^2 plot in each cell	

A7.5 Microbial Sampling and Analysis

Four microbial sample types (soil, roots, detritus, and moss) were collected from each cell in the CWTS three times in 2019 during the each seasonal sampling event (May, July, and September). Microbial samples from May and July were biobanked (i.e., stored but not processed), while quantification and DNA based analyses (genetic sequencing) were conducted for all sample types collected in September 2019. Methods for sample collection for each sample type is described in Appendix A of Contango, 2017b.

A7.5.1 Quantification Analyses

In 2018, Contango's microbial quantification analyses progressed from growth-based analyses (MPN) to a new technology that enabled improved quantification (quantitative polymerase chain reaction; qPCR). Consequently, the soil samples collected in June 2018, and all samples collected in July 2018 were analyzed using both growth-based and genetic qPCR microbial analyses to compare the two methods. While not directly comparable, the

results of the comparison indicated that qPCR analyses were better suited to move forward with. In 2019, microbial samples were analyzed by qPCR quantification only. Therefore, only results from 2018 and 2019 qPCR analyses are shown in graphs and overall trends for all years are described.

Methods for MPN and qPCR analyses are described in Appendix A of Contango, 2017b and Appendix A of the Minto Constructed Wetland Treatment Research Program – Demonstration-scale 2018 Update (Contango, 2019), respectively.

A7.5.2 Genetic Sequencing Analyses

DNA was extracted and sequenced as described in Appendix A of Contango, 2017b.

A7.6 Detritus Decomposition Trials

A detritus decomposition trial was performed between 2017 and 2019 to assess decomposition rates of *C. aquatilis* and algae growth on organic materials in the demonstration-scale CWTS over time (Chimney and Pietro, 2006; Hammerly et al.,1989). Methods are described in Appendix A of Contango, 2017b.

On May 29 and July 29, 2019 (after 708 and 768 days of submersion in the CWTS, respectively), one bag filled with polyester filter fiber and one bag filled with *C. aquatilis* was removed from each cell, dried, and weighed as described in Appendix A of Contango, 2017b. In 2019, detritus decomposition was measured and assessed from the change in weight of *C. aquatilis* leaves in the mesh bag only and was not adjusted for the increase in dry weight of the polyester fiber. Additional data acquired in 2019 suggested that the increase in weight of the poly filter fiber had a positive bias on *C. aquatilis* decomposition due to excess algae and debris on the poly filter fiber (as described in the main report Section 6.2.1.). This updated method for assessing decomposition was applied to past detritus samples collected since 2017 for comparison across years.

A7.7 Vegetation Study

A vegetation plot harvest was completed in 2018 and 2019 to assess the amount of above water biomass (*C. aquatilis)* that grows per year per m^2 in a mature CWTS. The results from the vegetation plot harvest were applied to the area of each cell in the CWTS to estimate the amount of *C. aquatilis* that would contribute organic matter into the CWTS each year. A 1 m^2 quadrant was delineated in cell 1A of the demonstration-scale CWTS and all the above water *C. aquatilis* was harvested within the quadrant (Figure A1). The *C. aquatilis* was weighed and placed in a drying oven at 50ºC until a constant mass was observed. The dry weight of the *C. aquatilis* was then adjusted for the size of the CWTS to calculate the total biomass of *C. aquatilis* added to the CWTS in a year. Finally, the total biomass addition was compared to the decomposition rate (Section A7.6) to establish organic matter addition to the CWTS. The dry weight from the 1 m^2 plot collected on September 5, 2019 was also used to evaluate fate and distribution of COC within the CWTS (Section A12).



Figure A1 – Vegetation plot harvest 2019.
Photo on the left shows vegetation plot harvest area delineated with wooden stakes. Photo on the right shows the area that was harvested. Photos were taken September 5, 2019.

A8. Data Analysis method

During the operational period of 2019, treatment of cadmium, copper, molybdenum, nitrate, selenium, and zinc was assessed for each HRT scenario. Total metals concentrations were monitored and while there were instances where the total concentration of COC in the feed water was elevated compared to the dissolved concentrations, both total and dissolved concentrations were similar by the outflow indicating that the CWTS is filtering solid forms of COC as intended. Additionally, the higher flow rates in 2019 did not result in elevated levels of total concentrations at the outflow, with a brief exception where cadmium concentrations increased slightly but were still an order of magnitude below CCME guidelines. Therefore dissolved metals concentrations rather than total metals were predominantly used for the discussion in this report as dissolved values are more representative of metals treatment through transformation and transfer from the CWTS water. Selenium was one exception where total concentrations were used, as dissolved selenium concentrations were often (over 40% of measurements) greater than the measured total selenium concentrations when using standard analytical methods (including the feed water source). This can sometimes occur when there is interference with the measurement for dissolved selenium, and digestion of the field filtered sample prior to ICP-MS can provide more accurate results (Wozniak, 2018). A comparison was performed near the end of the 2019 season to compare total selenium concentrations to dissolved concentrations with and without digestion. This analysis confirmed that dissolved concentrations with digestion were within 4-13% of total concentrations (within method error), while without digestion were 27-69% greater than total concentrations. These results will be discussed with Minto and the analytical service provider to evaluate testing methods for 2020.

A9. Performance Limit Calculations

The performance limit (previously referred to as thermodynamic minimum) is the lowest concentration consistently achievable for a given treatment design and water chemistry. These calculations were conducted as described in Appendix A of Contango, 2017b.

A10. Load Removal Calculations

Load removals are calculated both with and without adjustment for evapotranspiration. The evapotranspiration adjustment converts the calculation of load removed during each HRT scenario to the actual amount of load removed, taking into consideration the amount of water lost from the demonstration-scale CWTS through evapotranspiration. Load removal was determined using equations to calculate the initial load removed with and without adjustment for evapotranspiration as described in Appendix A of Contango, 2017b.

A11. Removal Rate Coefficients and HRT Calculations

An important factor for CWTS design is the rate of treatment, also known as the removal rate coefficient (*k*). The removal rate coefficient is based on the treatability of a specific compound and the HRT of the CWTS, both of which are site-specific based on water chemistry, CWTS designs, and characteristics of the CWTS. These calculations were conducted using removal rate coefficient (*k*) equations as described in Appendix A of Contango, 2017b.

A12. Mass Balance Calculations

The fate and distribution of COC were evaluated through mass balance calculations. The load of a constituent entering and exiting the CWTS in a given year as well as over the lifespan of the demonstration-scale CWTS was calculated using total COC concentrations. The load of a COC that was removed by each series through filtration, sorption, and transformation is the difference between the load entering and exiting the CWTS. The concentration of a COC in plant tissues (*C. aquatilis* and moss; Section A7.4) as well as the top 10 cm of soils at the end of the 2019 demonstration-scale season (Section A7.3) were used to evaluate the fate and distribution of COC. For multiple COC, the load removed in the CWTS is within method error of the starting concentration in the substrate.

A13. References

All references provided in main report.

Appendix B – Additional Tables and Figures

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B1. Water Results

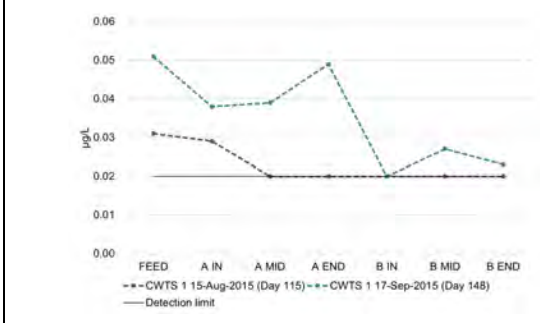
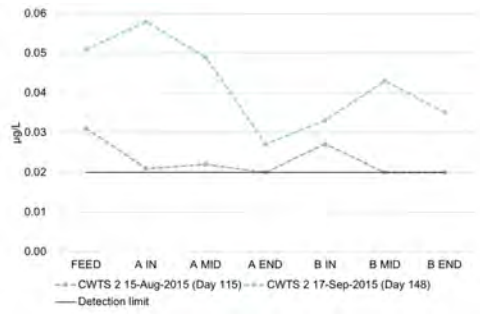
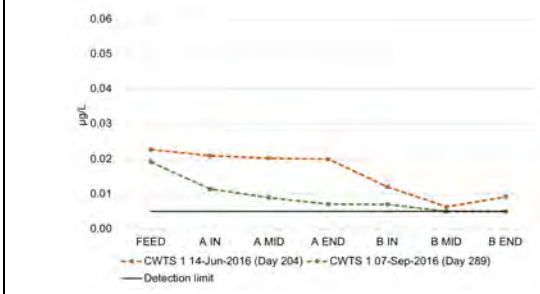
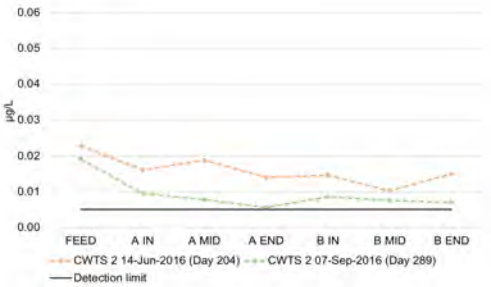
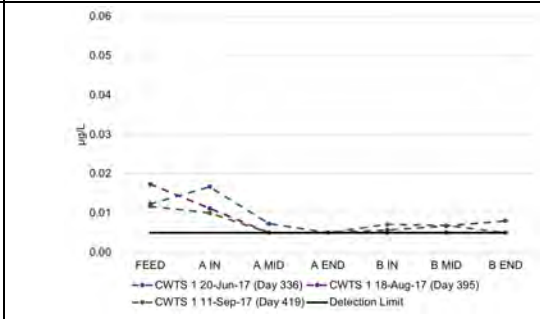
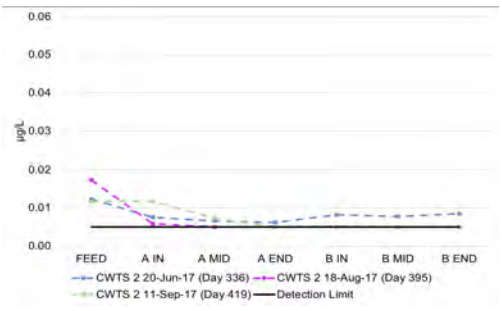
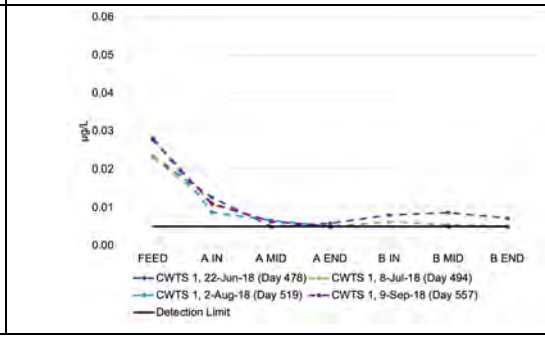
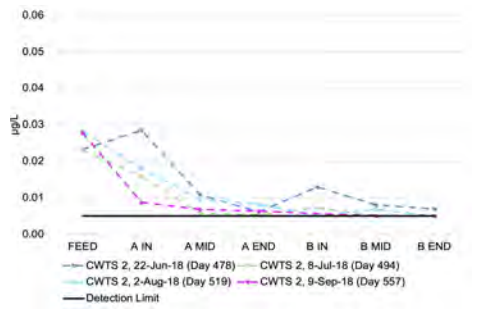
	CWTS Series 1	CWTS Series 2
2015		
2016		
2017		
2018		

Figure B1 – Cadmium concentrations through the demonstration-scale CWTS. Dissolved cadmium concentrations (converted to µg/L) along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. The Maxxam (2015 results) detection limit (DL; black line) for cadmium is 0.020 µg/L. The ALS (2016-2018 results) DL for cadmium is 0.005 µg/L. Detection limits in 2019, however, ranged due to dilution by ALS when analyzing the sampling. DL range in 2019 is indicated by two solid black line, as well as solid black lines around data points that are at DL. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested. Elevated dissolved cadmium concentrations at the 1A midpoint and 1B endpoint location on August 12, 2019 also had elevated total concentrations and may have resulted from sampling.

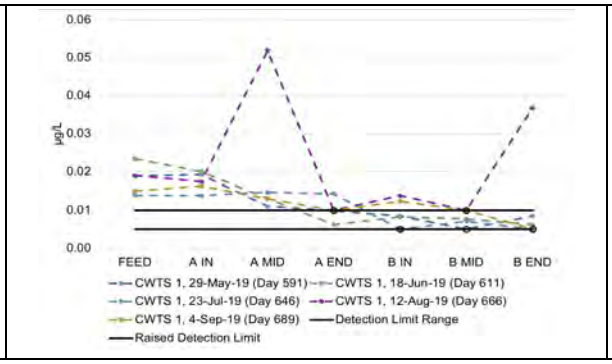
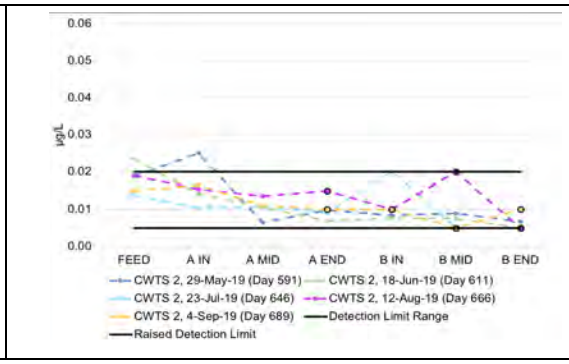
2019		

Figure B1 continued – Cadmium concentrations through the demonstration-scale CWTS.

Dissolved cadmium concentrations (converted to µg/L) along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. The Maxxam (2015 results) detection limit (DL; black line) for cadmium is 0.020 µg/L. The ALS (2016-2018 results) DL for cadmium is 0.005 µg/L. Detection limits in 2019, however, ranged due to dilution by ALS when analyzing the sampling. DL range in 2019 is indicated by two solid black line, as well as solid black lines around data points that are at DL. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested. Elevated dissolved cadmium concentrations at the 1A midpoint and 1B endpoint location on August 12, 2019 also had elevated total concentrations and may have resulted from sampling.

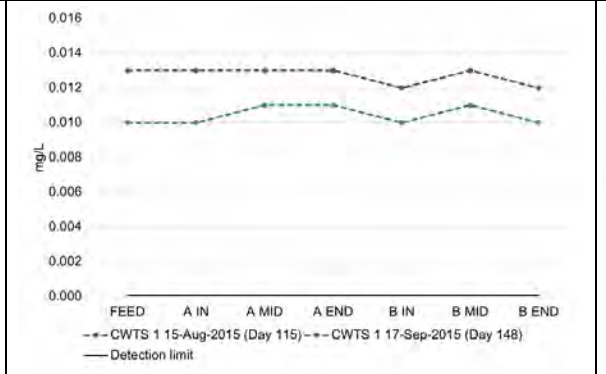
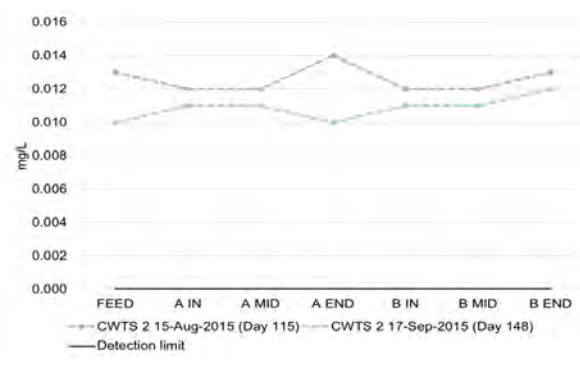
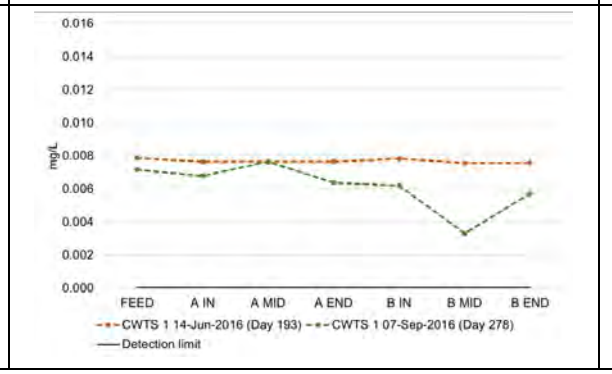
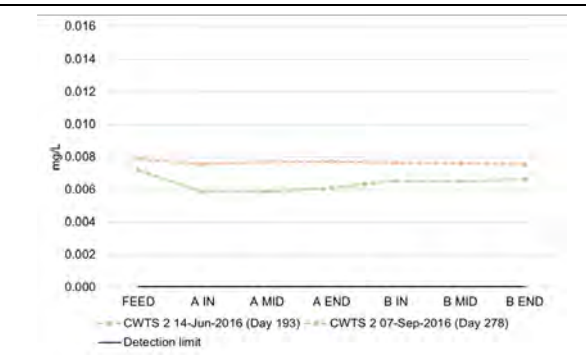
	CWTS 1	CWTS 2
2015		
2016		

Figure B2 – Molybdenum concentrations through the demonstration-scale CWTS.

Dissolved molybdenum concentrations along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. The Maxxam (2015 results) detection limit (DL; black line) for molybdenum is 0.00020 mg/L. The ALS (2016-2019 results) DL for molybdenum is 0.000050 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

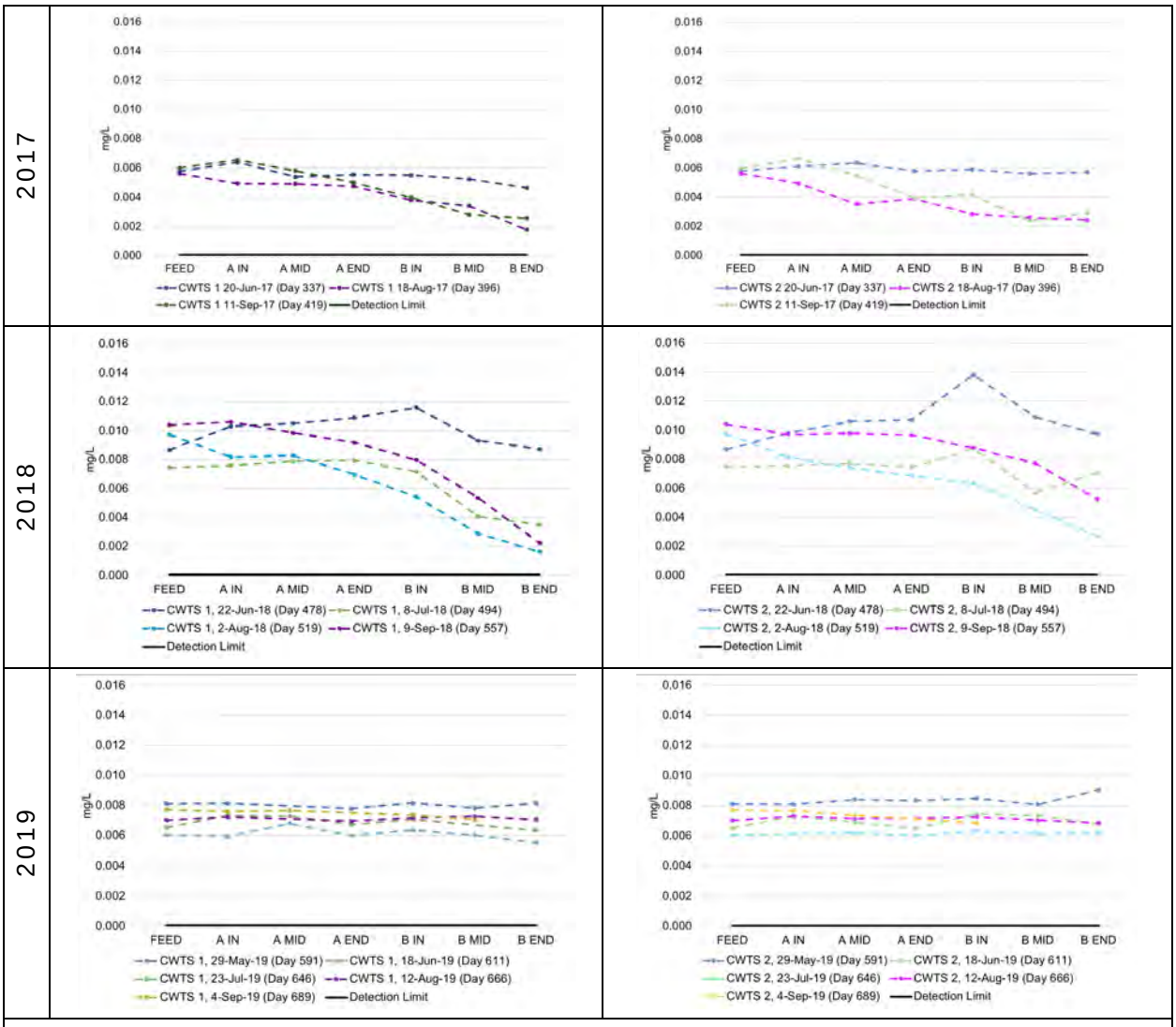


Figure B2 continued – Molybdenum concentrations through the demonstration-scale CWTS

Dissolved molybdenum concentrations along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. The Maxxam (2015 results) detection limit (DL; black line) for molybdenum is 0.00020 mg/L. The ALS (2016-2019 results) DL for molybdenum is 0.000050 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

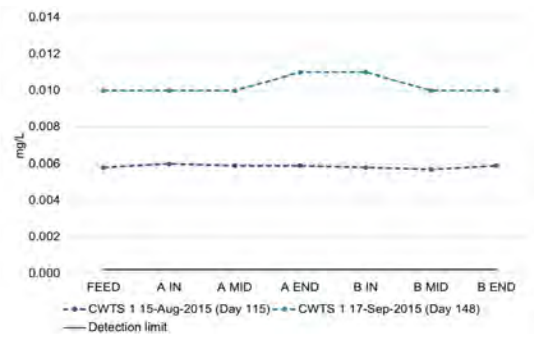
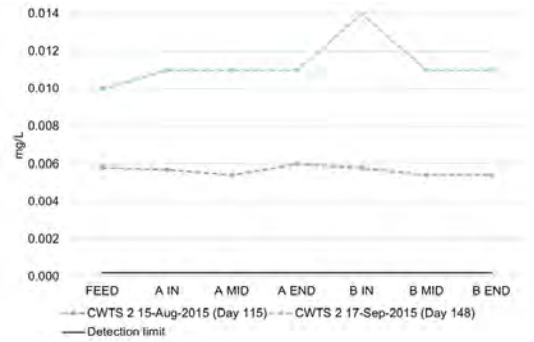
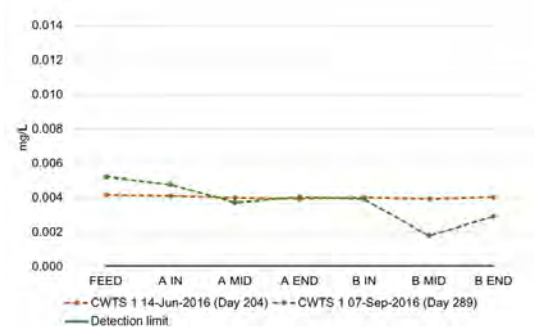
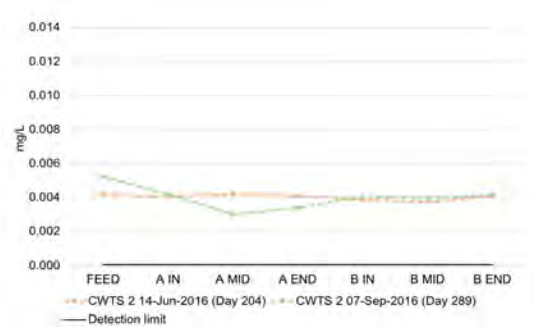
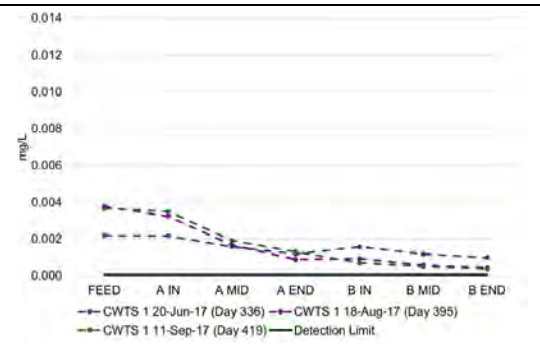
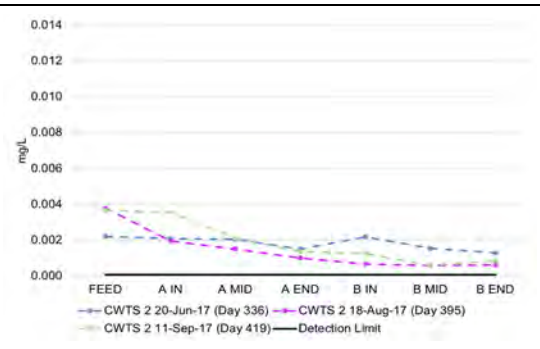
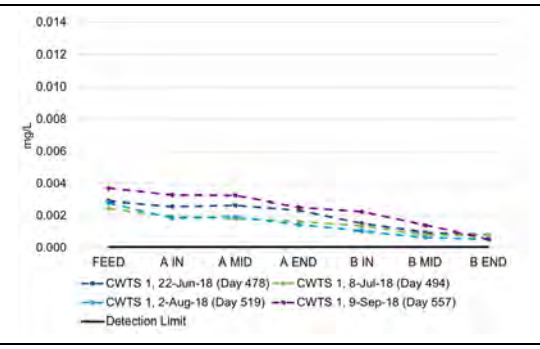
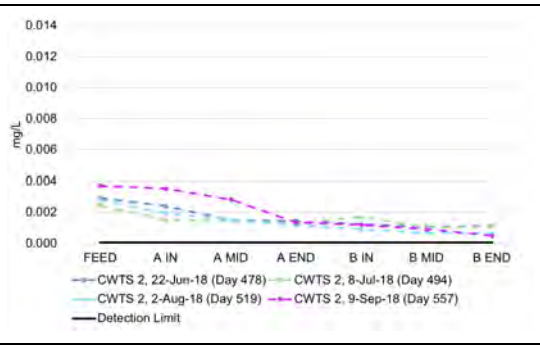
	CWTS Series 1	CWTS Series 2
2015		
2016		
2017		
2018		

Figure B3 – Selenium concentrations through the demonstration-scale CWTS. Dissolved selenium concentrations along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. Total selenium concentrations are plotted for 2019. The Maxxam (2015 results) detection limit (DL; black line) for selenium is 0.00020 mg/L. The ALS (2016-2019 results) DL for selenium is 0.000050 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

2019

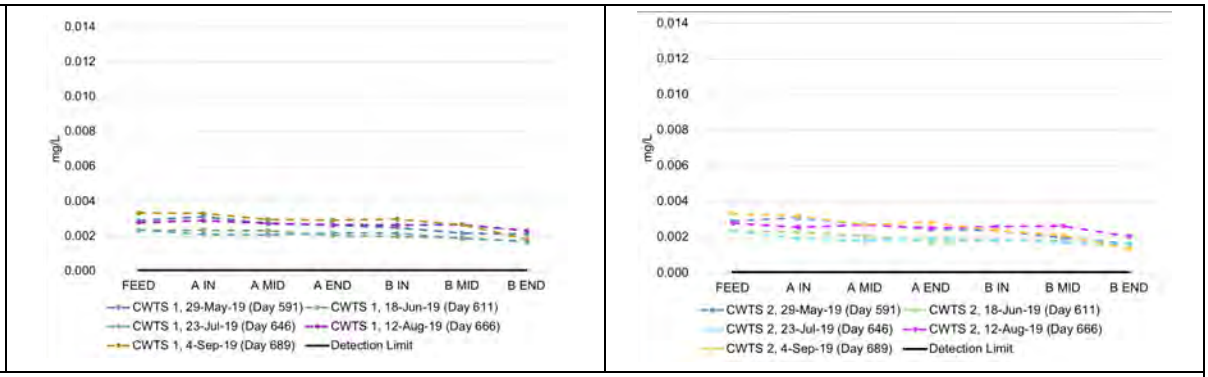


Figure B3 continued – Selenium concentrations through the demonstration-scale CWTS.

Dissolved selenium concentrations along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. Total selenium concentrations are plotted for 2019. The Maxxam (2015 results) detection limit (DL; black line) for selenium is 0.00020 mg/L. The ALS (2016-2019 results) DL for selenium is 0.000050 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

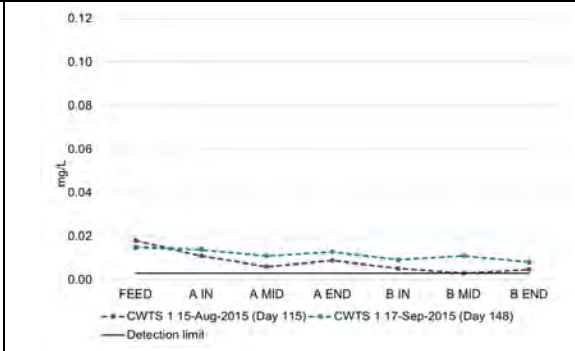
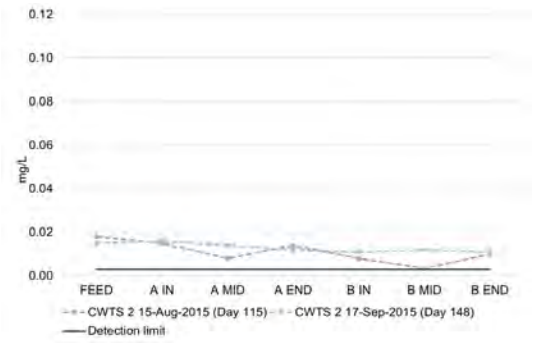
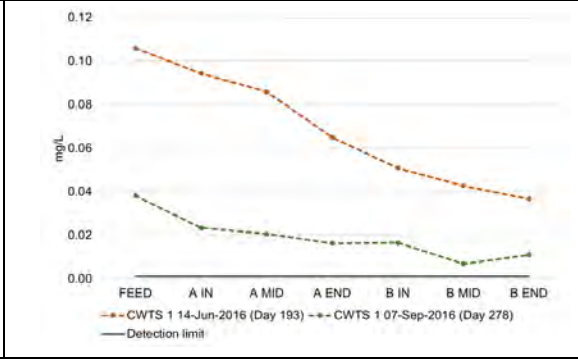
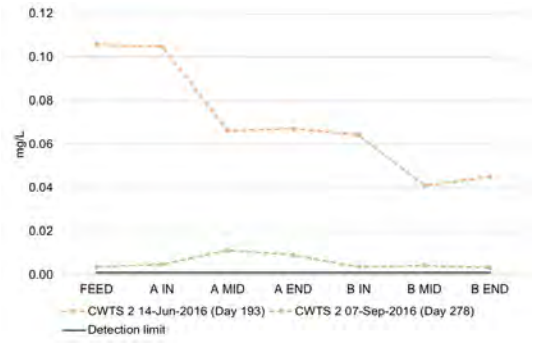
	CWTS Series 1	CWTS Series 2
2015		
2016		

Figure B4 – Zinc concentrations through the demonstration-scale CWTS.

Dissolved zinc concentrations along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. The Maxxam (2015 results) detection limit (DL; black line) for zinc is 0.0030 mg/L. The ALS (2016-2018 results) DL for zinc is 0.0010 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

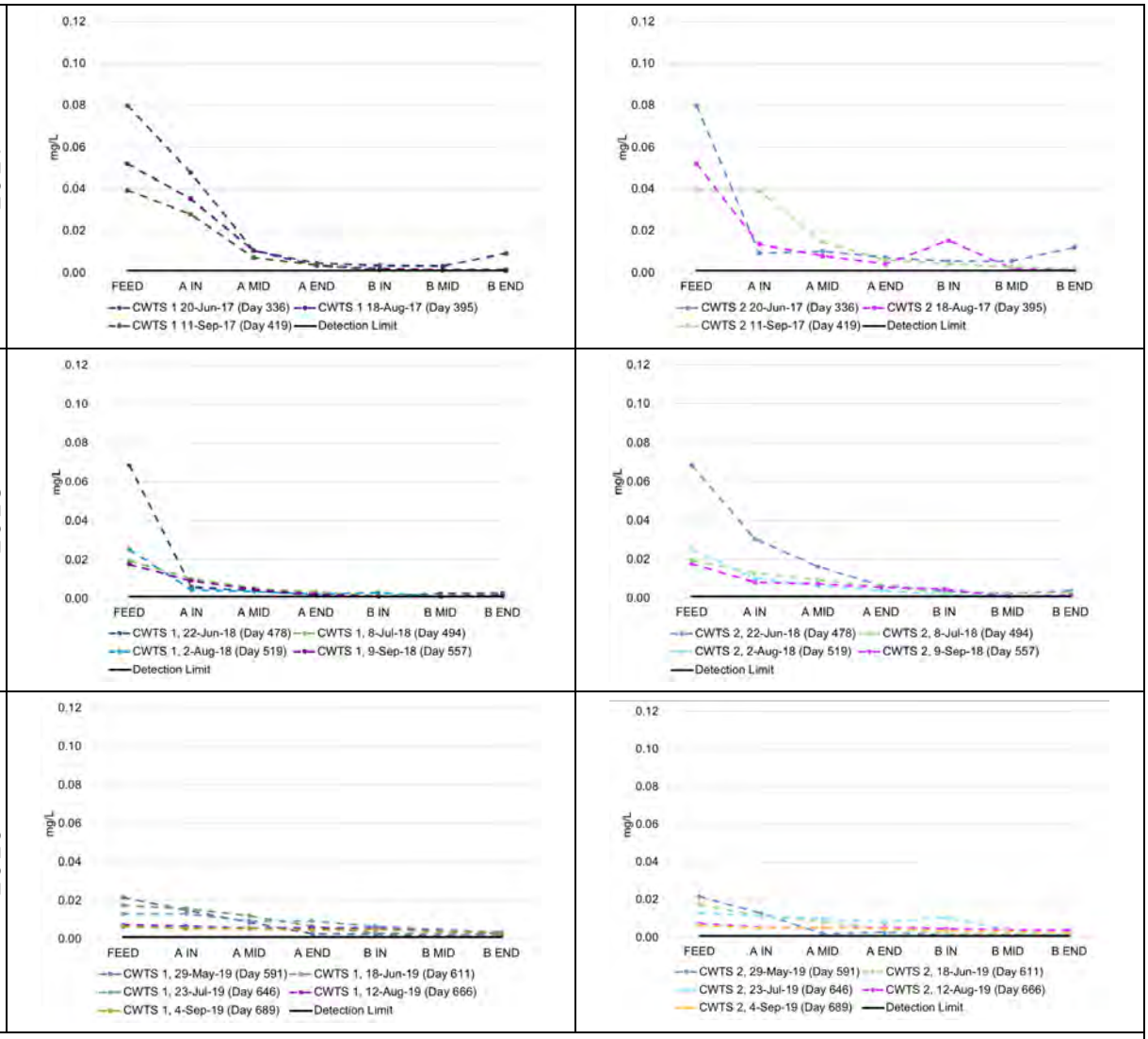


Figure B4 continued – Zinc concentrations through the demonstration-scale CWTS.

Dissolved zinc concentrations along the length of the CWTS in 2015 through 2019 at select time points which included additional sampling locations. The Maxxam (2015 results) detection limit (DL; black line) for zinc is 0.0030 mg/L. The ALS (2016-2018 results) DL for zinc is 0.0010 mg/L. The HRT at end of the B cell varies with date in 2019 based on different HRT scenarios that were tested.

B2. Soil Results

Table B1 – Total and leachable soil copper concentrations in Series 1 since first year of operations.

CWTS Cell	Sampling Date	Days in Operation	Sample Depth (cm)	Total Cu (mg/kg)	SPLP Cu (mg/L)	Leachable Cu (mg/kg)
1A	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	960	0.055[1]	-
	16-Aug-15	116	10-20	950	0.187	-
	18-Sep-15	149	10-20	1300	0.049	-
	29-Sep-15	160	10-20	910	0.069	-
	15-Jun-16	194	0-10	1440	-	0.953
	15-Jun-16	194	10-20	1210	-	0.66
	8-Jul-16	217	0-10	1430	-	0.603
	8-Jul-16	217	10-20	1730	-	0.832
	7-Sep-16	247	0-10	1290	-	0.449
	20-Jun-17	336	0-10	1470	0.315	0.308
	25-Jul-17	371	0-10	1630	0.529	0.463
	12-Sep-17	420	0-10	1490	0.590	0.481
	27-May-18	452	0-10	1510	-	0.616
	8-Jul-18	494	0-10	1420	-	0.628
	9-Sep-18	557	0-10	1160	-	0.038
	30-May-19	592	0-10	1140	-	-[2]
	30-Jul-19	653	0-10	1270	-	0.078
	5-Sep-19	690	0-10	1410	-	0.244
1B	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	1400	0.033[1]	-
	16-Aug-15	116	10-20	1400	0.209	-
	18-Sep-15	149	10-20	830	0.065	-
	29-Sep-15	160	10-20	880	0.059	-
	15-Jun-16	194	0-10	1130	-	1.01
	15-Jun-16	194	10-20	1240	-	0.822
	8-Jul-16	217	0-10	1250	-	1.11
	8-Jul-16	217	10-20	1620	-	1.21
	7-Sep-16	247	0-10	1190	-	0.197
	20-Jun-17	336	0-10	1290	0.450	0.338
	25-Jul-17	371	0-10	1100	0.290	0.165
	12-Sep-17	420	0-10	1100	0.716	0.492
	27-May-18	452	0-10	1930	-	0.784
	8-Jul-18	494	0-10	1430	-	0.232
	9-Sep-18	557	0-10	1580	-	0.238
	30-May-19	592	0-10	1230	-	-[2]
	30-Jul-19	653	0-10	1060	-	0.137
	5-Sep-19	690	0-10	1830	-	0.436

The blue shading indicates samples that were taken from a shallower depth (0-5 cm and 0-10 cm) while white shading indicates a deeper 10-20 cm depth.
[1] Samples collected in June 2015 were at a shallow depth (0-5 cm) and copper content had therefore likely already been removed by washing from the faster flows of the CWTS system.
[2] Not included because reverse osmosis water was used instead of special leach water that was provided.

Table B2– Total and leachable soil copper concentrations in Series 2 since first year of operations.

CWTS Cell	Sampling Date	Days in Operation	Sample Depth (cm)	Total Cu (mg/kg)	SPLP Cu (mg/L)	Leachable Cu (mg/kg)
2A	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	1175	0.037[1]	-
	16-Aug-15	116	10-20	660	0.139	-
	18-Sep-15	149	10-20	880	0.081	-
	29-Sep-15	160	10-20	1000	0.073	-
	15-Jun-16	194	0-10	1100	-	0.823
	15-Jun-16	194	10-20	1280	-	0.900
	8-Jul-16	217	0-10	1450	-	0.963
	8-Jul-16	217	10-20	1150	-	1.68
	7-Sep-16	247	0-10	1290	-	0.838
	20-Jun-17	336	0-10	1820	0.381	1.24
	25-Jul-17	371	0-10	1290	0.419	0.927
	12-Sep-17	420	0-10	1440	0.389	0.381
	27-May-18	452	0-10	1100	-	0.600
	8-Jul-18	494	0-10	1480	-	0.252
	9-Sep-18	557	0-10	1630	-	0.048
	30-May-19	592	0-10	1360	-	-[2]
	30-Jul-19	653	0-10	1150	-	0.063
	5-Sep-19	690	0-10	1340	-	0.258
2B	28-Aug-14	1	Initial Composite	-	0.298 (0.148-0.608)	-
	19-Jun-15	58	0-5	1100	0.039[1]	-
	16-Aug-15	116	10-20	1000	0.201	-
	18-Sep-15	149	10-20	830	0.078	-
	29-Sep-15	160	10-20	540	0.059	-
	15-Jun-16	194	0-10	1040	-	0.771
	15-Jun-16	194	10-20	1310	-	1.16
	8-Jul-16	217	0-10	1070	-	1.38
	8-Jul-16	217	10-20	1180	-	1.25
	7-Sep-16	247	0-10	1520	-	0.123
	20-Jun-17	336	0-10	1110	0.283	0.523
	25-Jul-17	371	0-10	1240	0.477	0.540
	12-Sep-17	420	0-10	1140	0.596	0.809
	27-May-18	452	0-10	1430	-	1.01
	8-Jul-18	494	0-10	1260	-	0.637
	9-Sep-18	557	0-10	1670	-	0.046
	30-May-19	592	0-10	1680	-	-[2]
	30-Jul-19	653	0-10	1030	-	0.119
	5-Sep-19	690	0-10	1420	-	0.141

The blue shading indicates samples that were taken from a shallower depth (0-5 cm and 0-10 cm) while white shading indicates a deeper 10-20 cm depth.
[1] Samples collected in June 2015 were at a shallow depth (0-5 cm) and copper content had therefore likely already been removed by washing from the faster flows of the CWTS system.
[2] Not included because reverse osmosis water was used instead of special leach water that was provided.

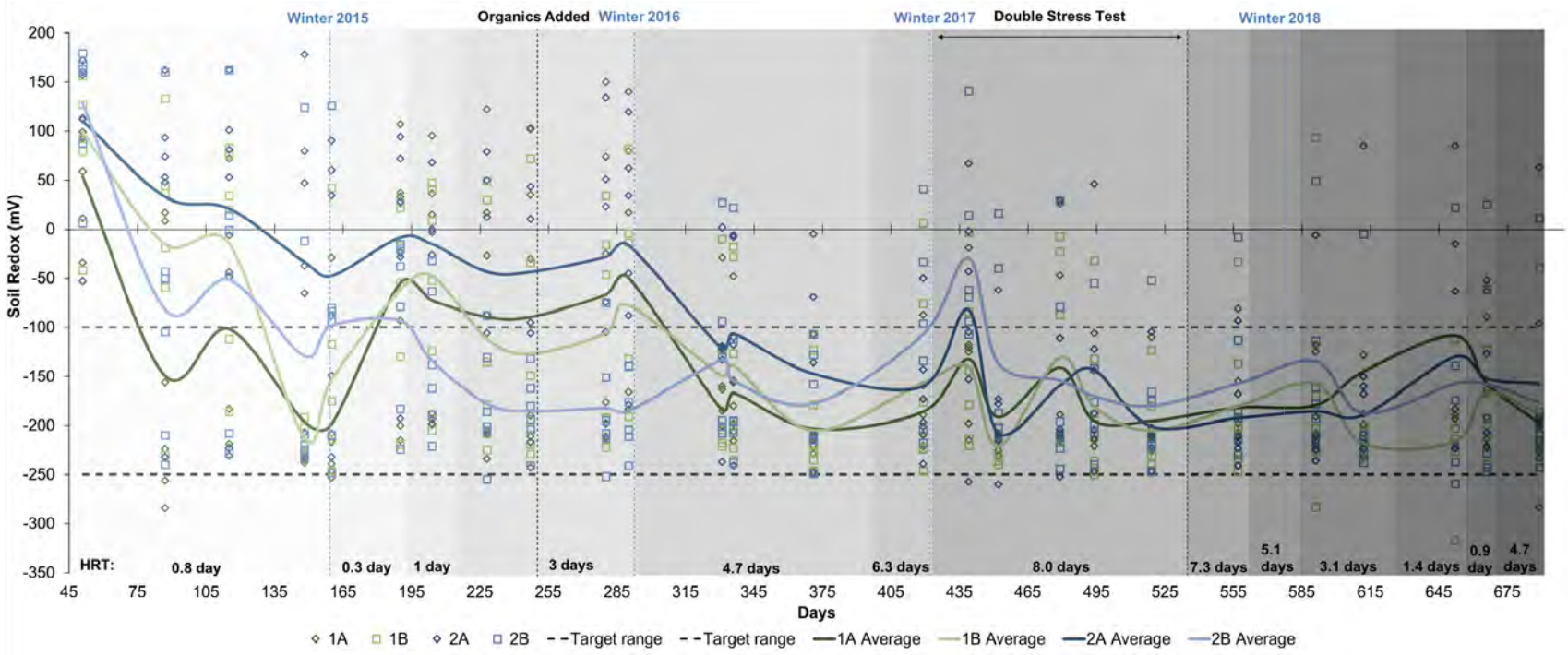
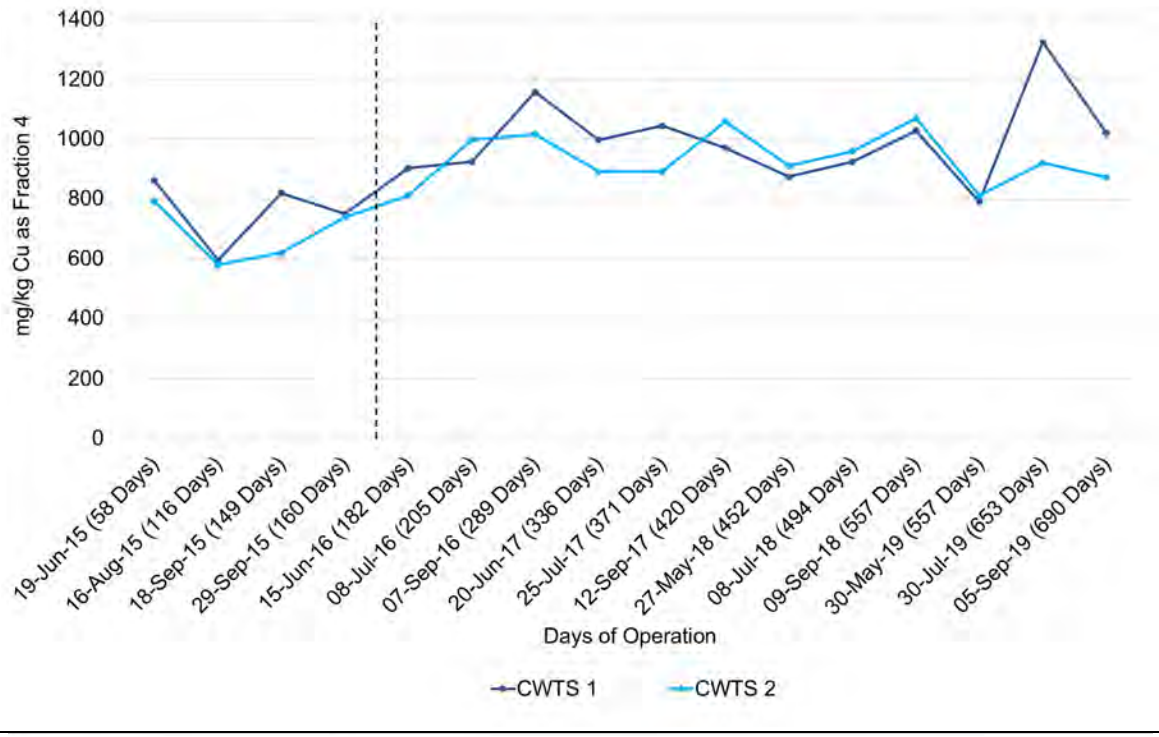


Figure B5 – Soil redox potential of each CWTS cell over time.
All demonstration-scale CWTS soil redox measurements are plotted. Targeted soil redox values based on pilot-scale testing are indicated with dotted lines. The blue dotted lines indicate breaks in measurements for winter. Grey shading corresponds to different HRT scenarios. HRT scenarios in 2015 and 2016 indicate the nominal HRT (days). HRT scenarios in 2017, 2018, and 2019 indicate the actual HRT (average of Series 1 and 2 in days) calculated using measured water depths and flow rates during those time periods.

Table B3 – Summary of fractions from sequential extraction procedure for the speciation of metals[1].

Fraction	Description	COCs unstable when
1	Exchangeable fraction for adsorbed minerals	Readily released (i.e., soluble and exchangeable)
2	Mineral fraction bound to carbonates or solubilized at pH 5	Decreased pH
3	Oxidized mineral fraction bound to Fe-Mn oxides	Reducing conditions
4	Reduced mineral fraction and sulphides	Oxidizing conditions
5	Residual mineral fraction (primary and secondary minerals)	Not expected to be released in solution over time under conditions normally encountered in nature

[1] Method based on Tessier et al., 1979.



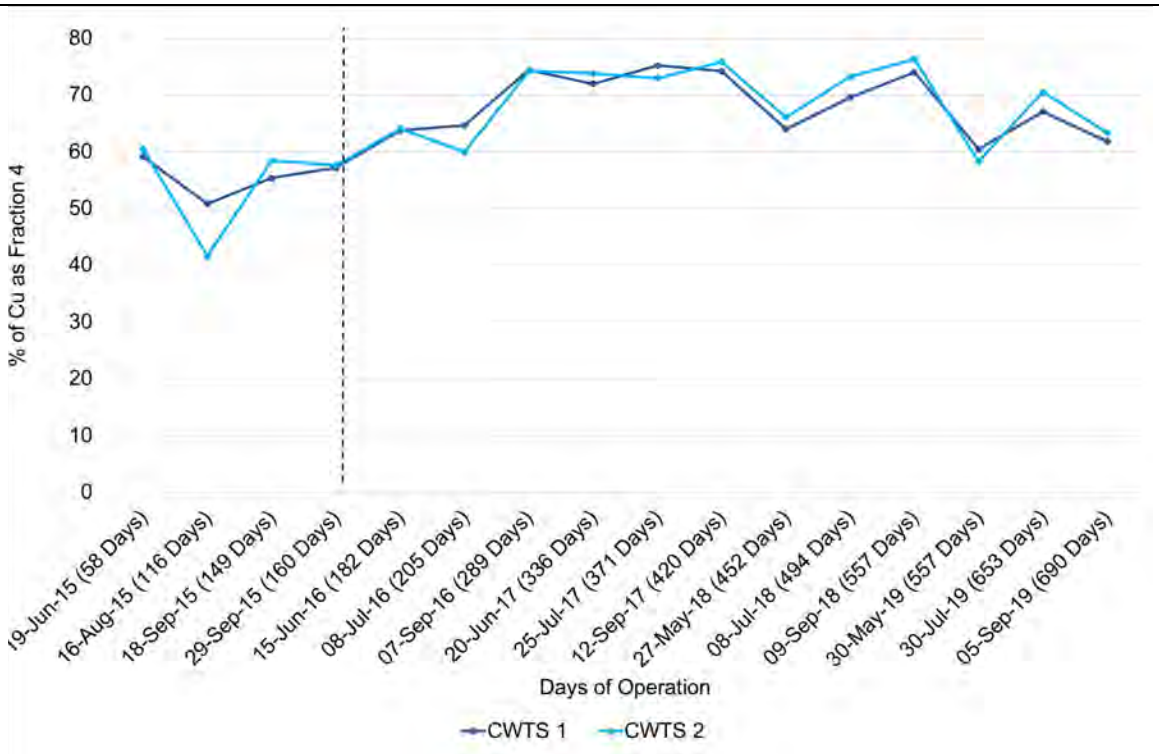


Figure B6 – Copper in CWTS soils as sequential leach fraction 4 over time.
Copper in the form of the targeted fraction 4 (sulphide mineral form and bound to organics) in CWTS substrate (top) or expressed as a percent (bottom) over time. Fraction 4 increased in the CWTS over time as the soils matured. The vertical dashed line separates Maxxam (2015) and ALS (2016-2019) analytical providers.

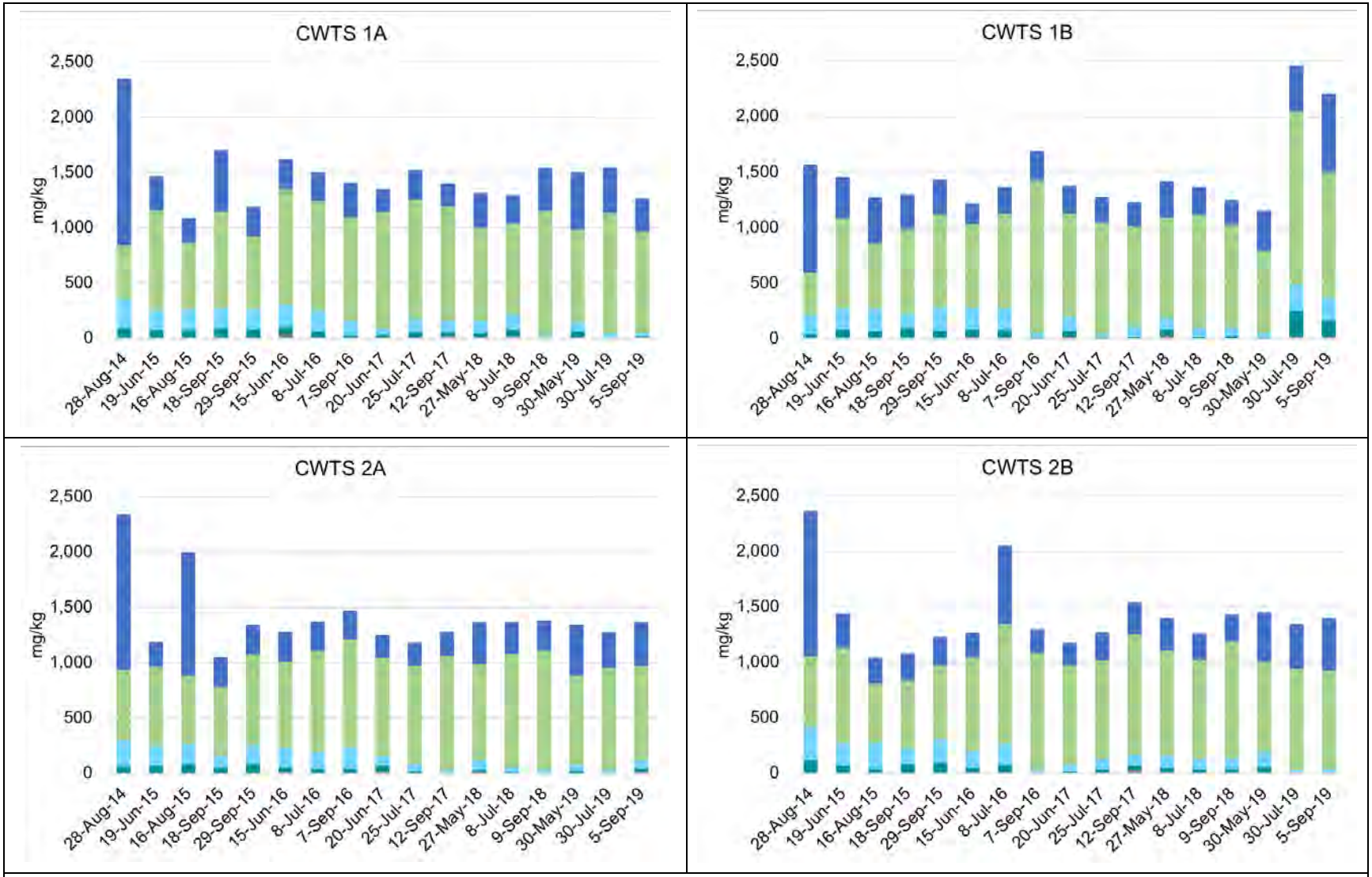


Figure B7 – Sequential leach fraction distribution of copper in CWTS substrate over time (2014-2019).
Fractions are defined in Table B3. The detection limit for copper is 0.50 mg/kg for all fractions.

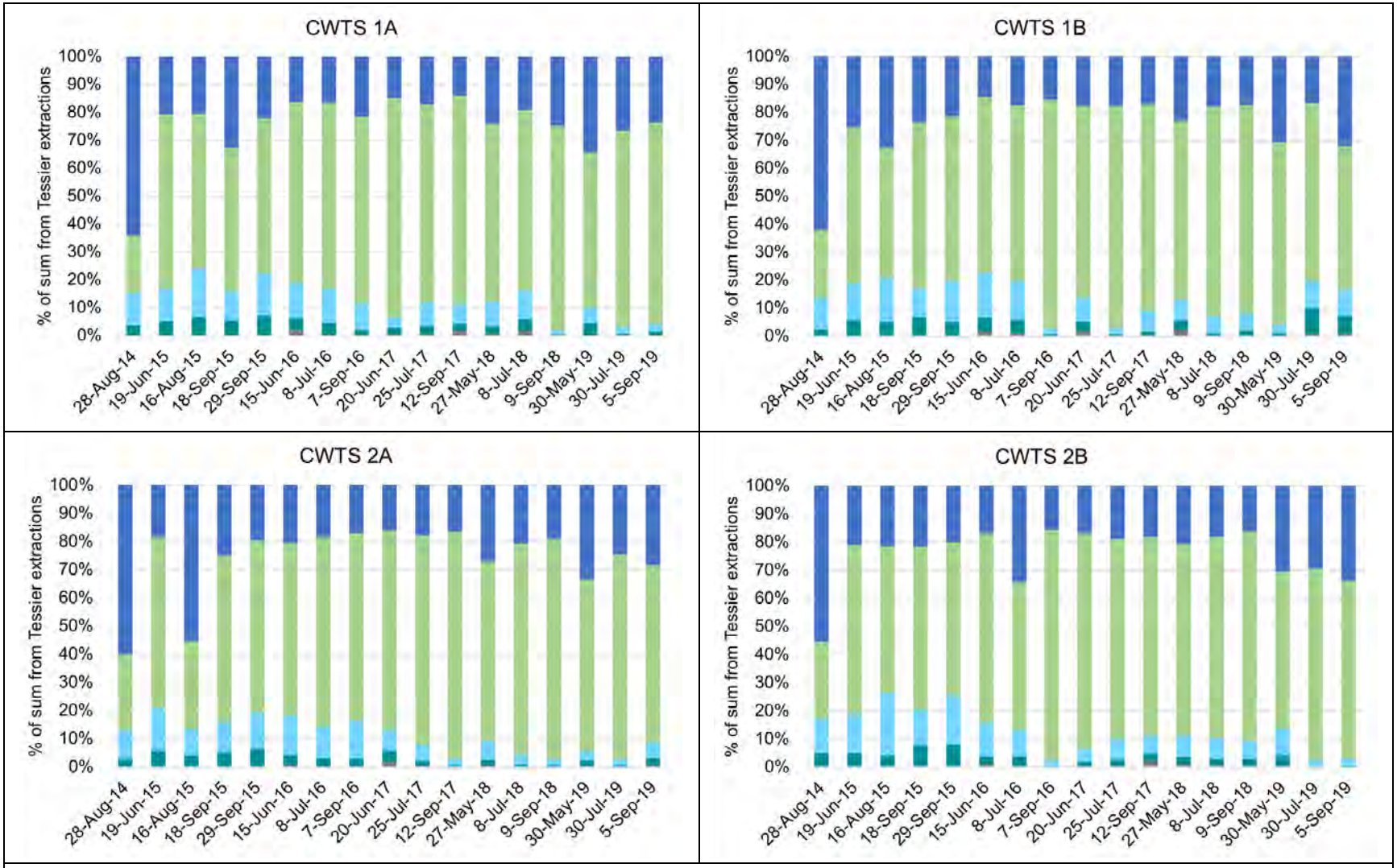


Figure B8 – Sequential leach fraction distribution of copper expressed as percent over time (2014-2019).
Fractions are defined in Table B3.

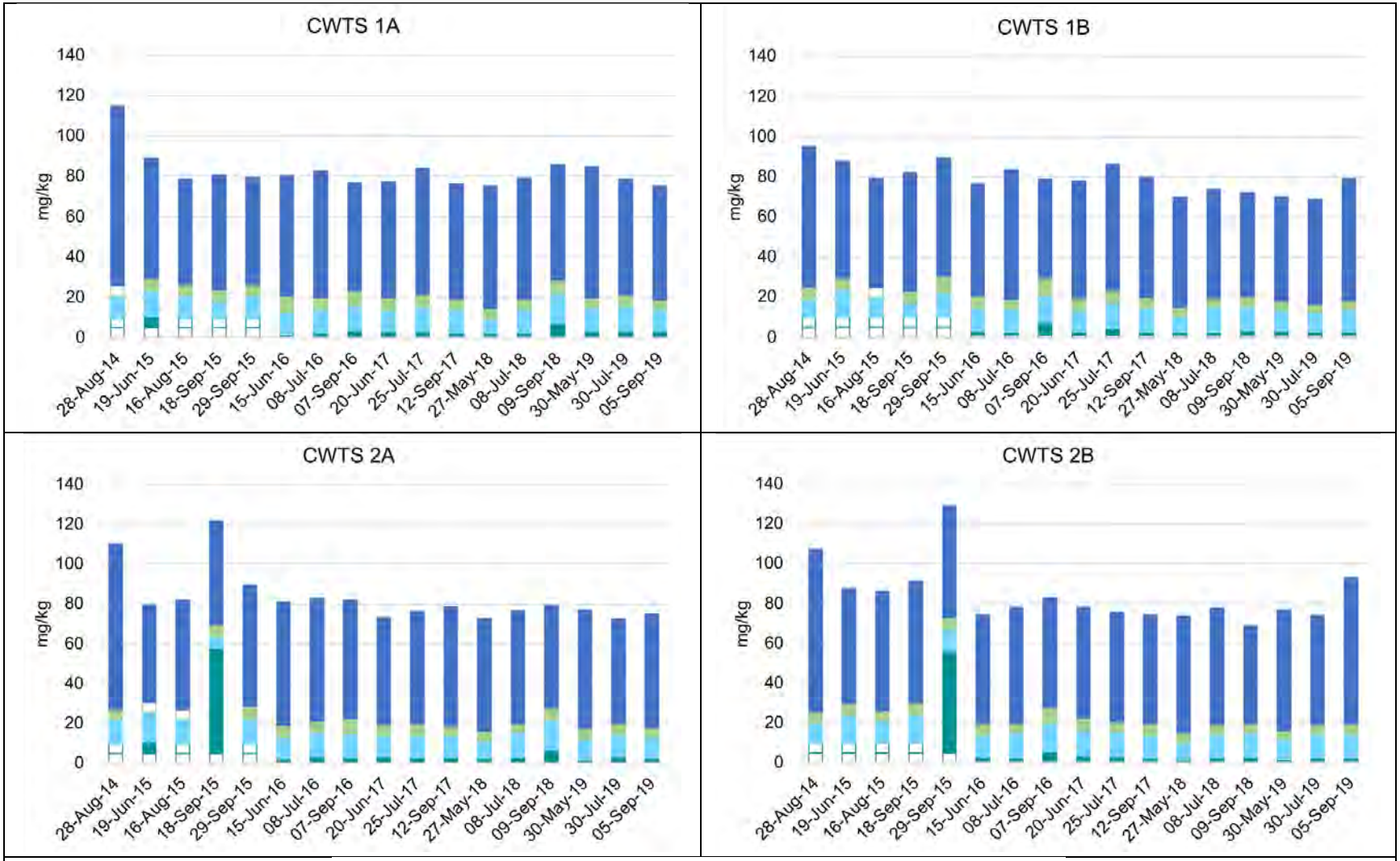


Figure B9 – Sequential leach fraction distribution of zinc in CWTS substrate over time (2014-2019).
Unfilled areas are values at or below detection limit. The detection limit for zinc is 1.0 mg/kg. Fractions are defined in Table B3.

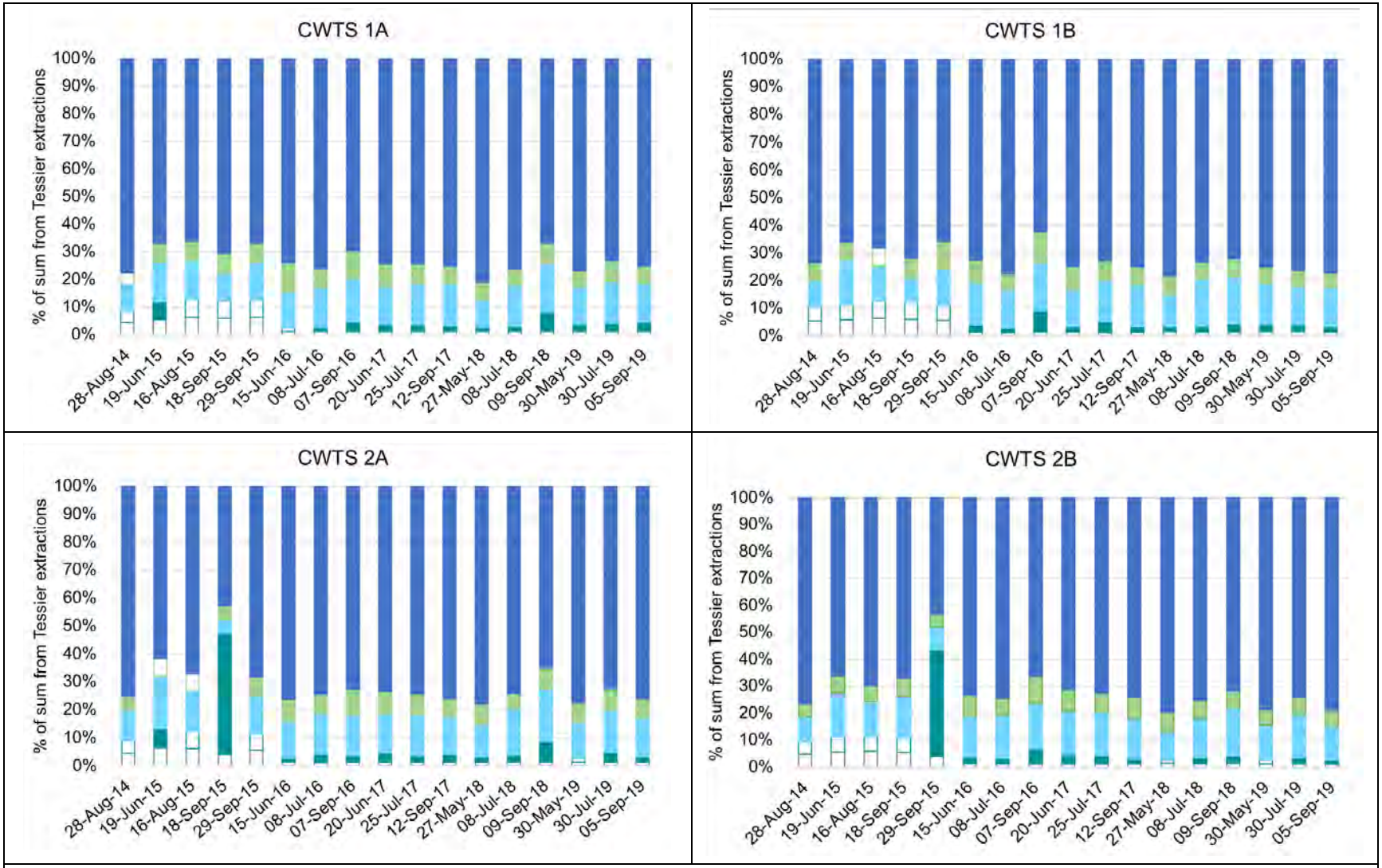


Figure B10 – Sequential leach fraction distribution of zinc expressed as percent over time (2014-2019).
Unfilled areas are values at or below detection limit. Fractions are defined in Table B3.

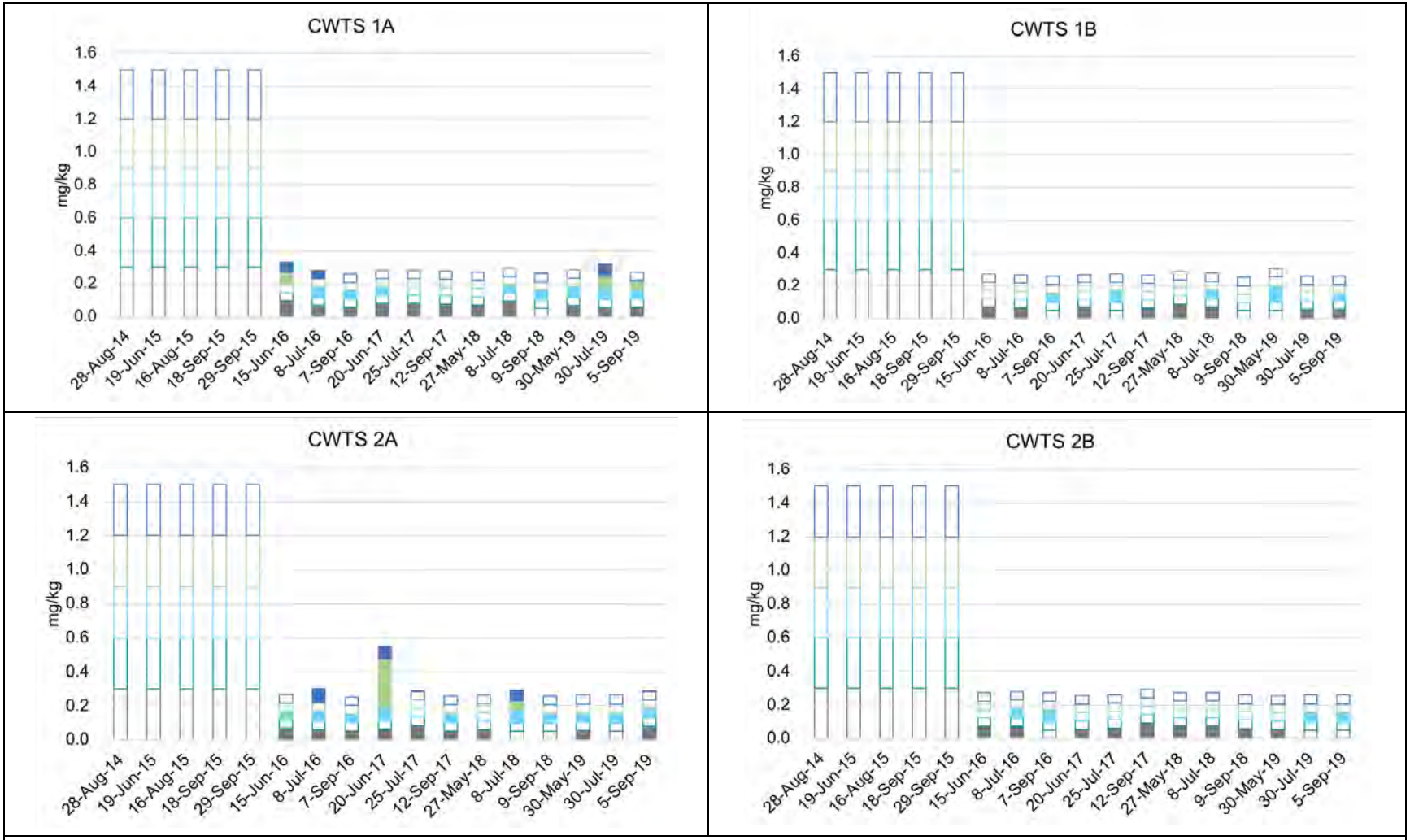


Figure B11 – Sequential leach fraction distribution of cadmium in CWTS substrate over time (2014-2019).
Unfilled areas are values at or below detection limit. Detection limits changed after 2015, which is indicated by the smaller bars after 2015. The detection limit (DL) for cadmium in 2014 and 2015 was 0.30 mg/kg for all fractions. The DL for cadmium in 2016-2019 was 0.050 mg/kg for all fractions. Fractions are defined in Table B3. Graphs for the sequential leach fraction distribution expressed as percent over time was not included based on majority being less than the detection limit.

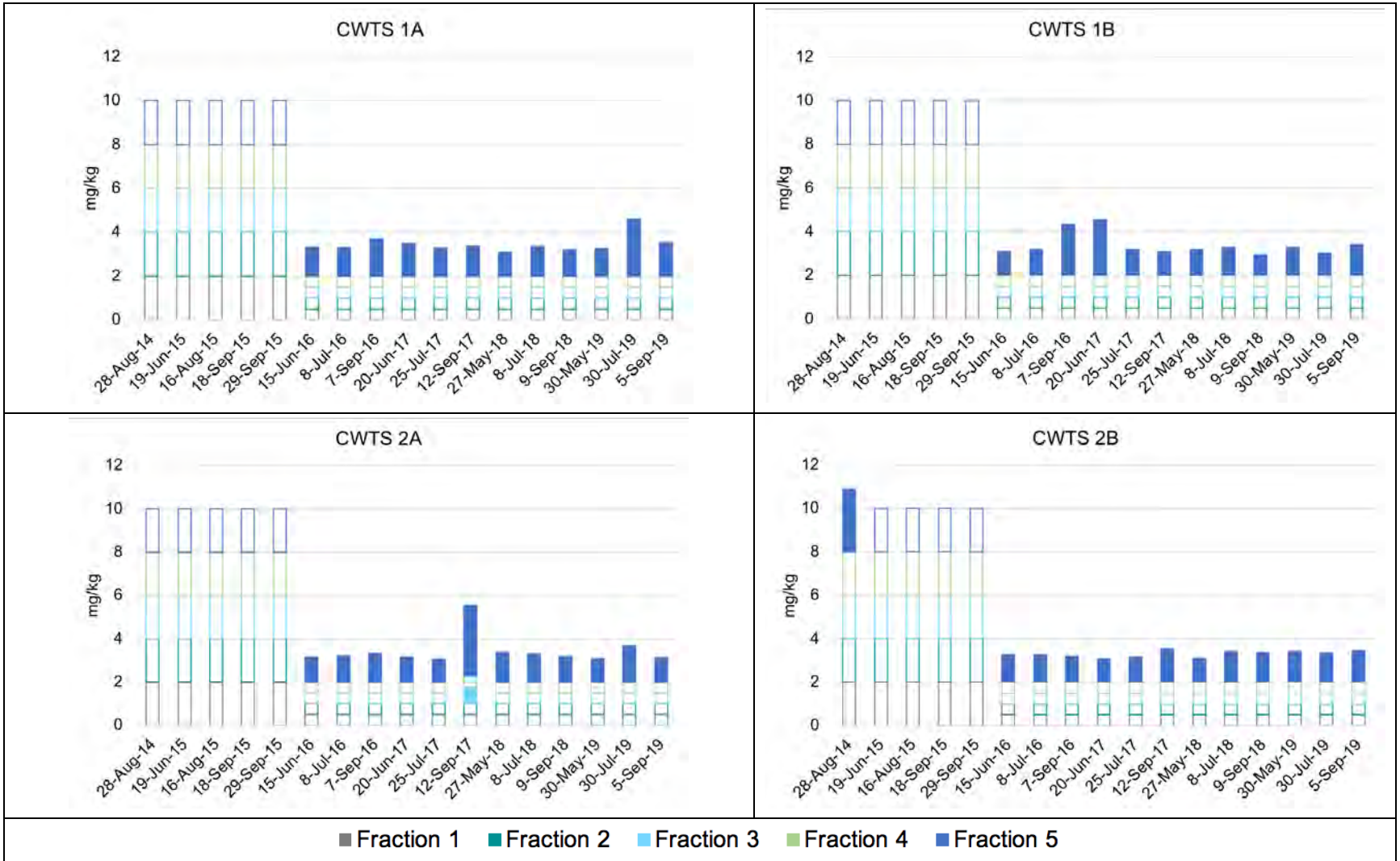


Figure B12 – Sequential leach fraction distribution of molybdenum in CWTS substrate over time (2014-2019).

Unfilled areas are values at or below detection limit. Detection limits changed after 2015, which is indicated by the smaller bars after 2015. The detection limit (DL) for molybdenum in 2014 and 2015 was 2.0 mg/kg for all fractions. The DL for molybdenum in 2016-2019 was 0.50 mg/kg for all fractions. Fractions are defined in Table B3. Graphs for the sequential leach fraction distribution expressed as percent over time was not included based on majority being less than the detection limit.

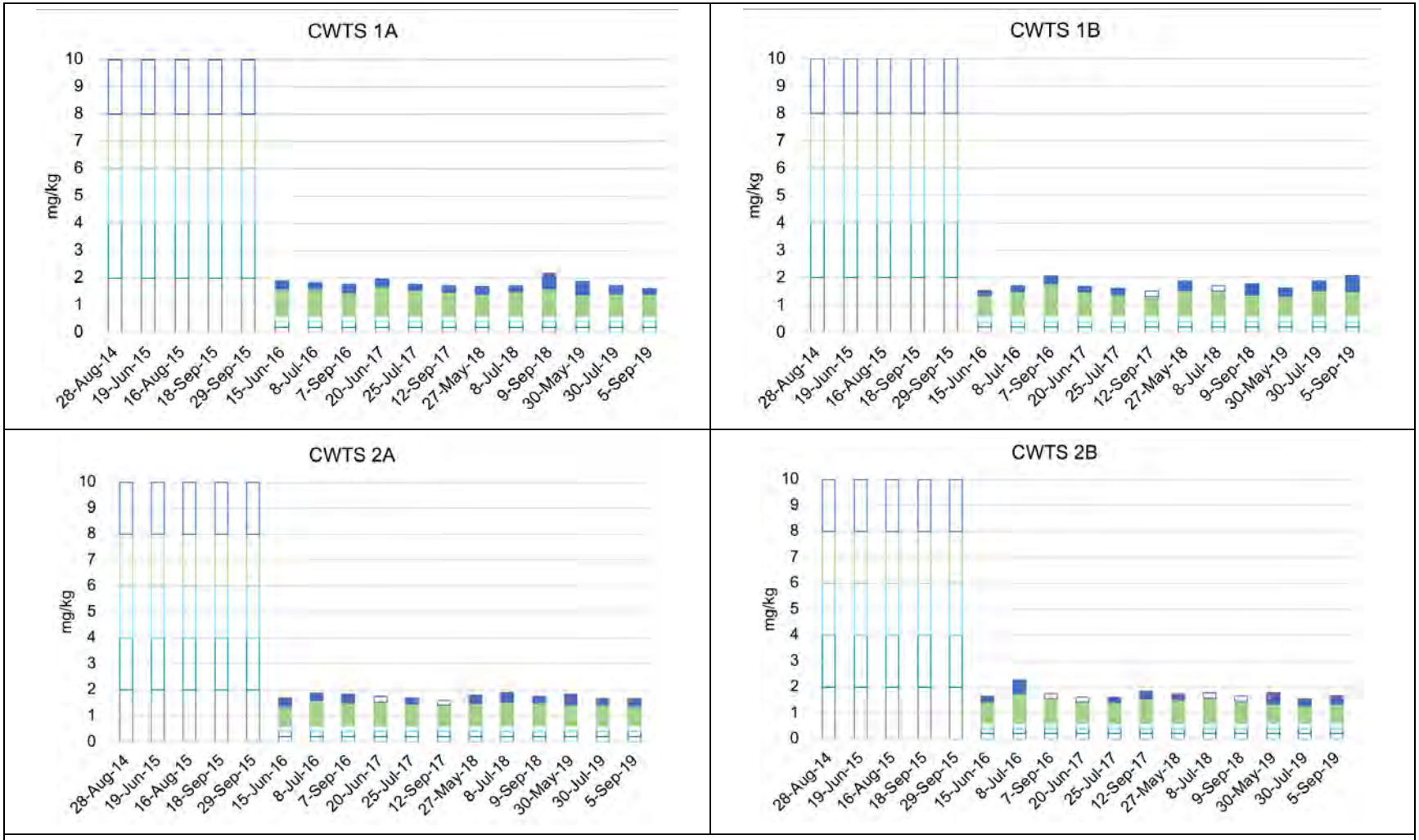


Figure B13 – Sequential leach fraction distribution of selenium in CWTS substrate over time (2014-2019).
Unfilled areas are values at or below detection limit. Detection limits changed after 2015, which is indicated by the smaller bars after 2015. The detection limit (DL) for selenium in 2014 and 2015 was 2.0 mg/kg for all fractions. The DL for selenium in 2016-2019 was 0.20 mg/kg for all fractions. Fractions are defined in Table B3.

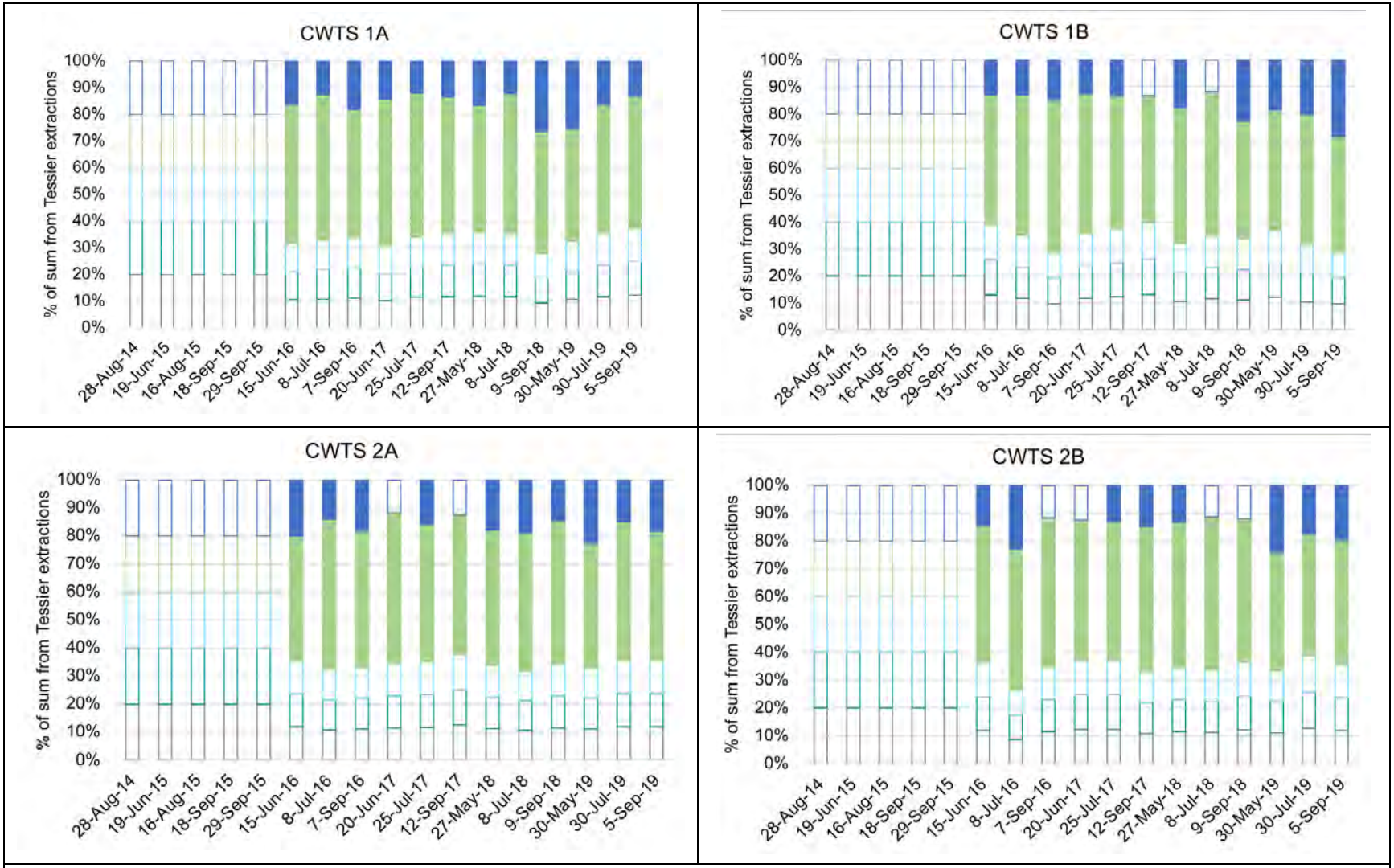
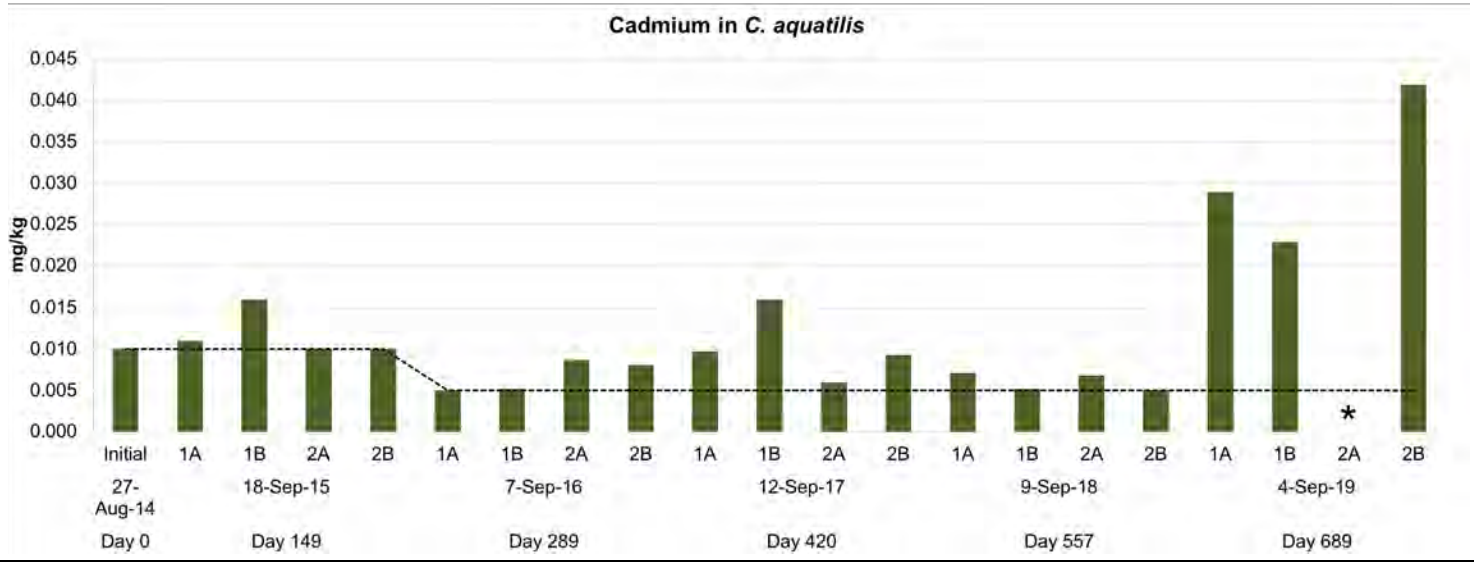


Figure B14 – Sequential leach fraction distribution of selenium expressed as percent over time (2014-2019).
Unfilled areas are values at or below detection limit. Fractions are defined in Table B3.

B3. Plant Results



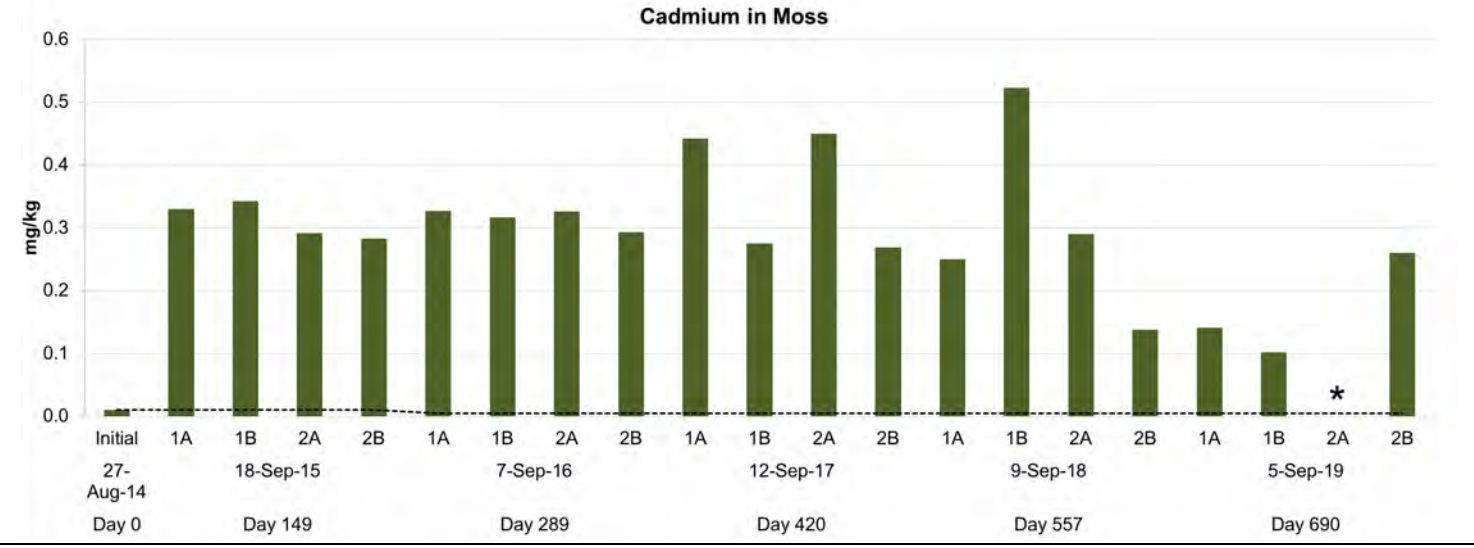
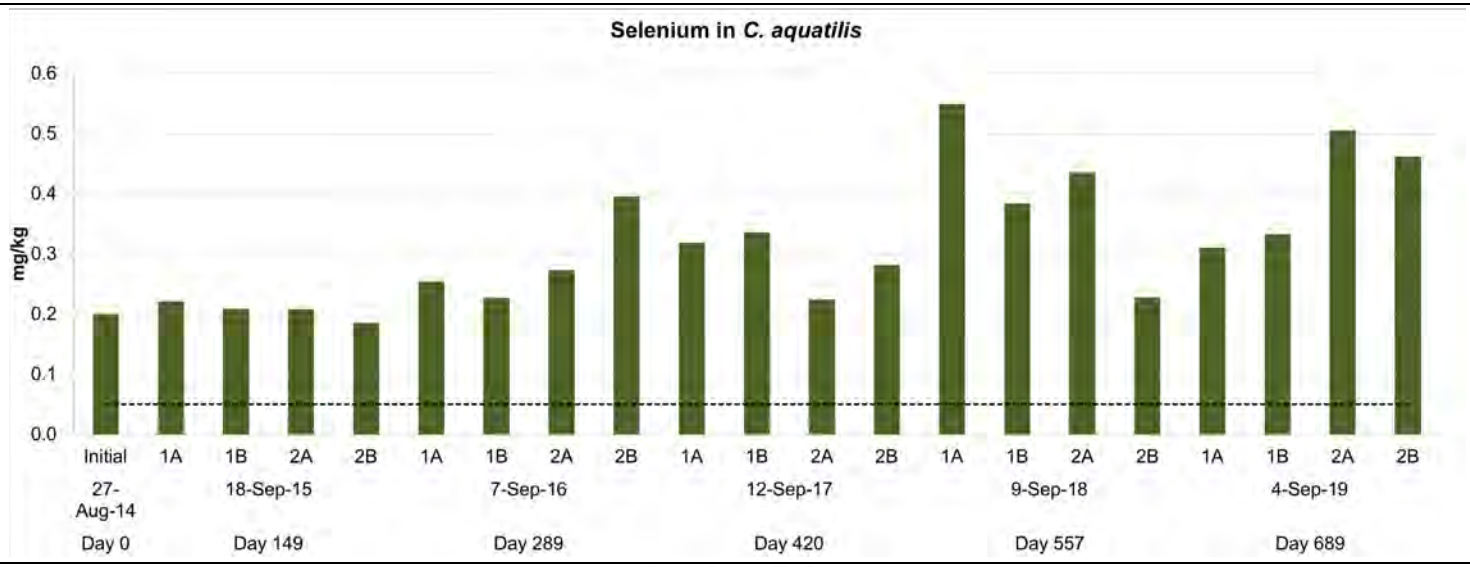


Figure B15 – Cadmium concentrations in plants.
The 2014 detection limit (DL; horizontal dotted line) for cadmium is 0.10 mg/kg, the 2015 DL is 0.010, and the 2016-2019 DL is 0.0050 mg/kg. The initial timepoint is the average of three C. aquatilis or three moss replicates at construction.



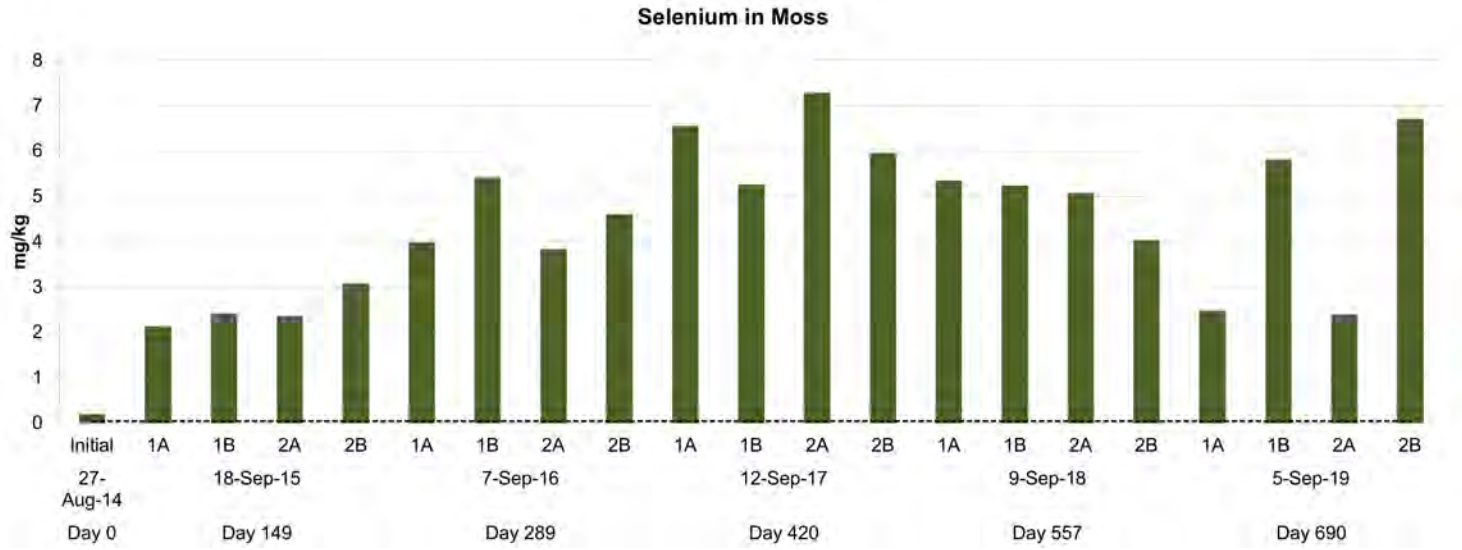
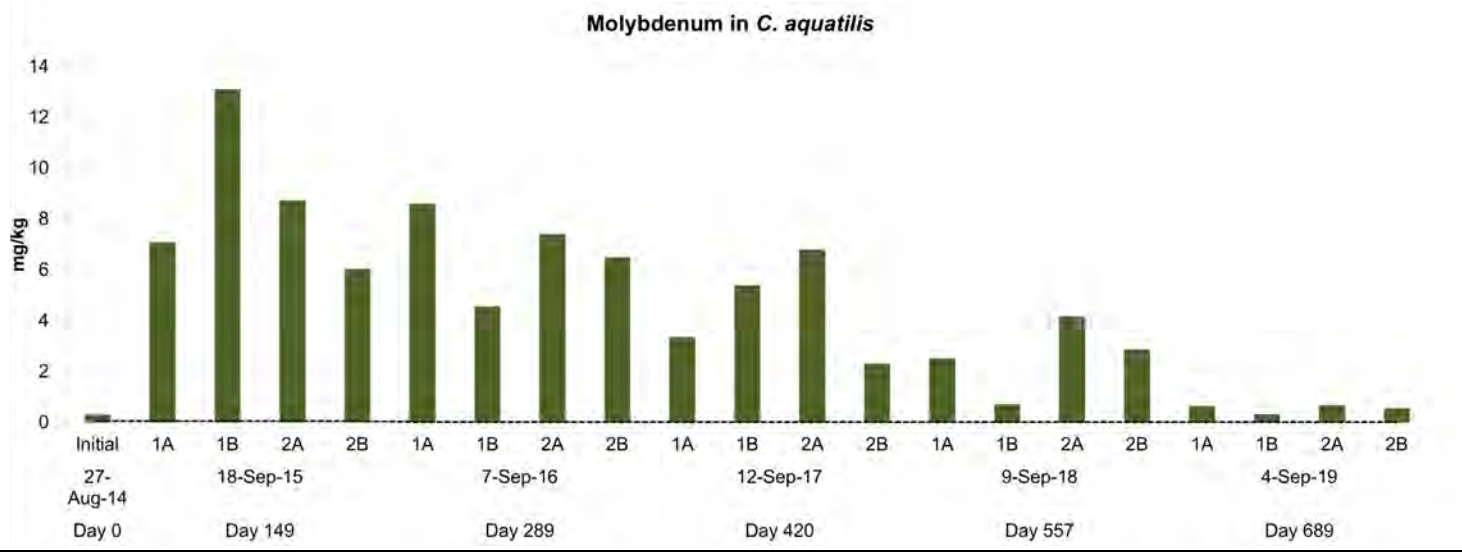


Figure B16 – Selenium concentrations in plants.
The detection limit (DL; horizontal dotted line) for all years for selenium is 0.05 mg/kg. The initial timepoint is the average of the three *C. aquatilis* or three moss replicates at constructions.



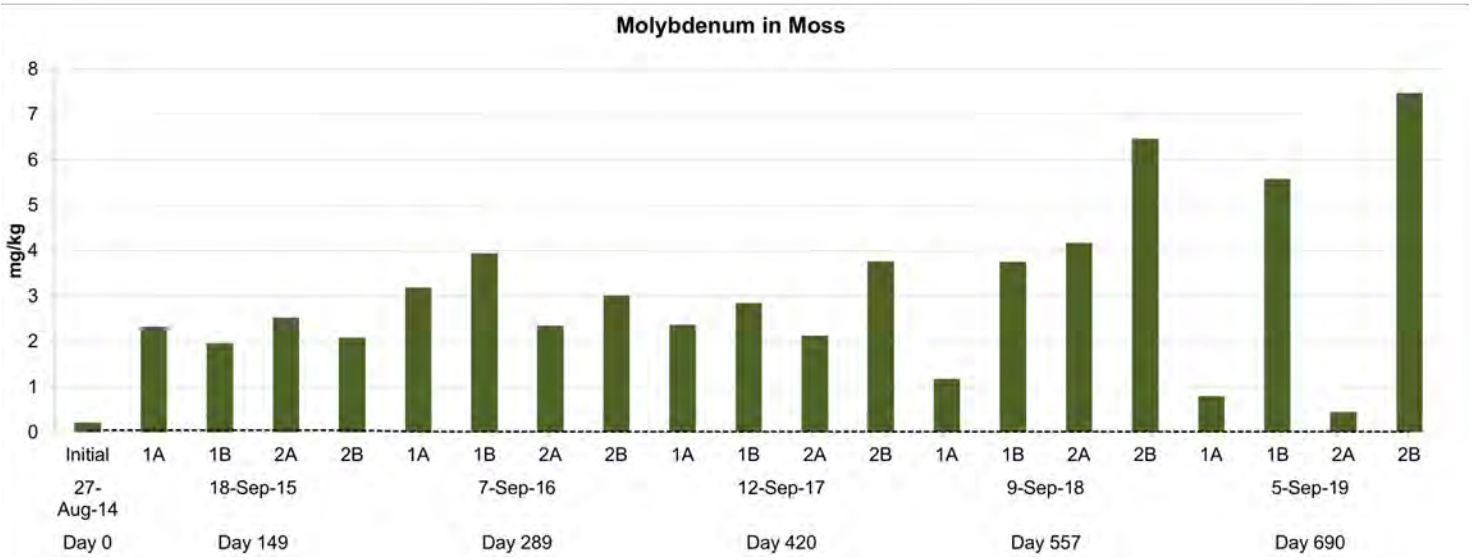
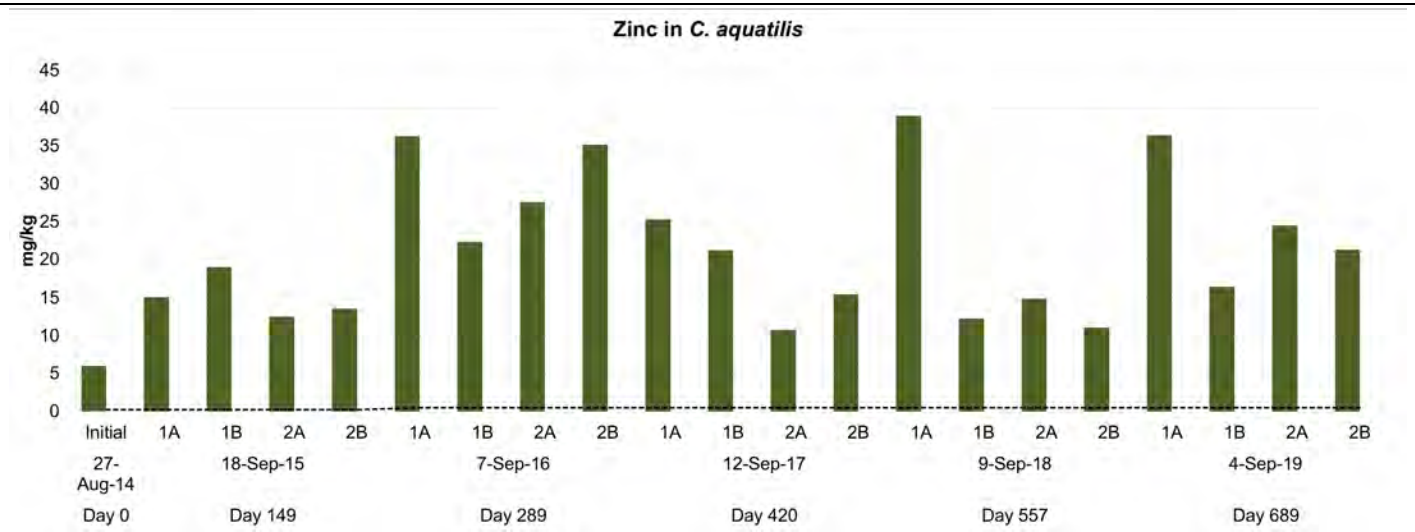


Figure B17 – Molybdenum concentrations in plants.
The 2014 and 2015 detection limit (DL; horizontal dotted line) for molybdenum is 0.05 mg/kg, and the 2016-2019 DL is 0.020 mg/kg. The initial timepoint is the average of the three *C. aquatilis* or three moss replicates at construction.



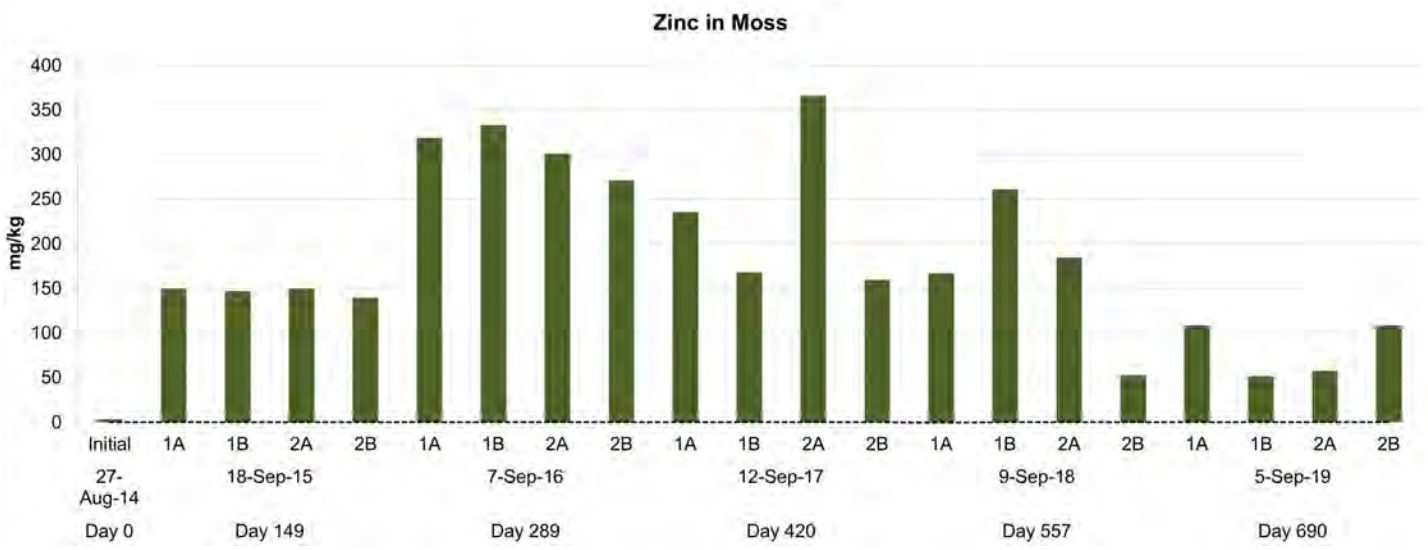


Figure B18 – Zinc concentrations in plants.
The 2014 and 2015 detection limit (DL; horizontal dotted line) for zinc is 0.20 mg/kg, and the 2016-2019 DL is 0.50 mg/kg. The initial timepoint is the average of three *C. aquatilis* or three moss replicates at construction.

B4. Microbiology Results

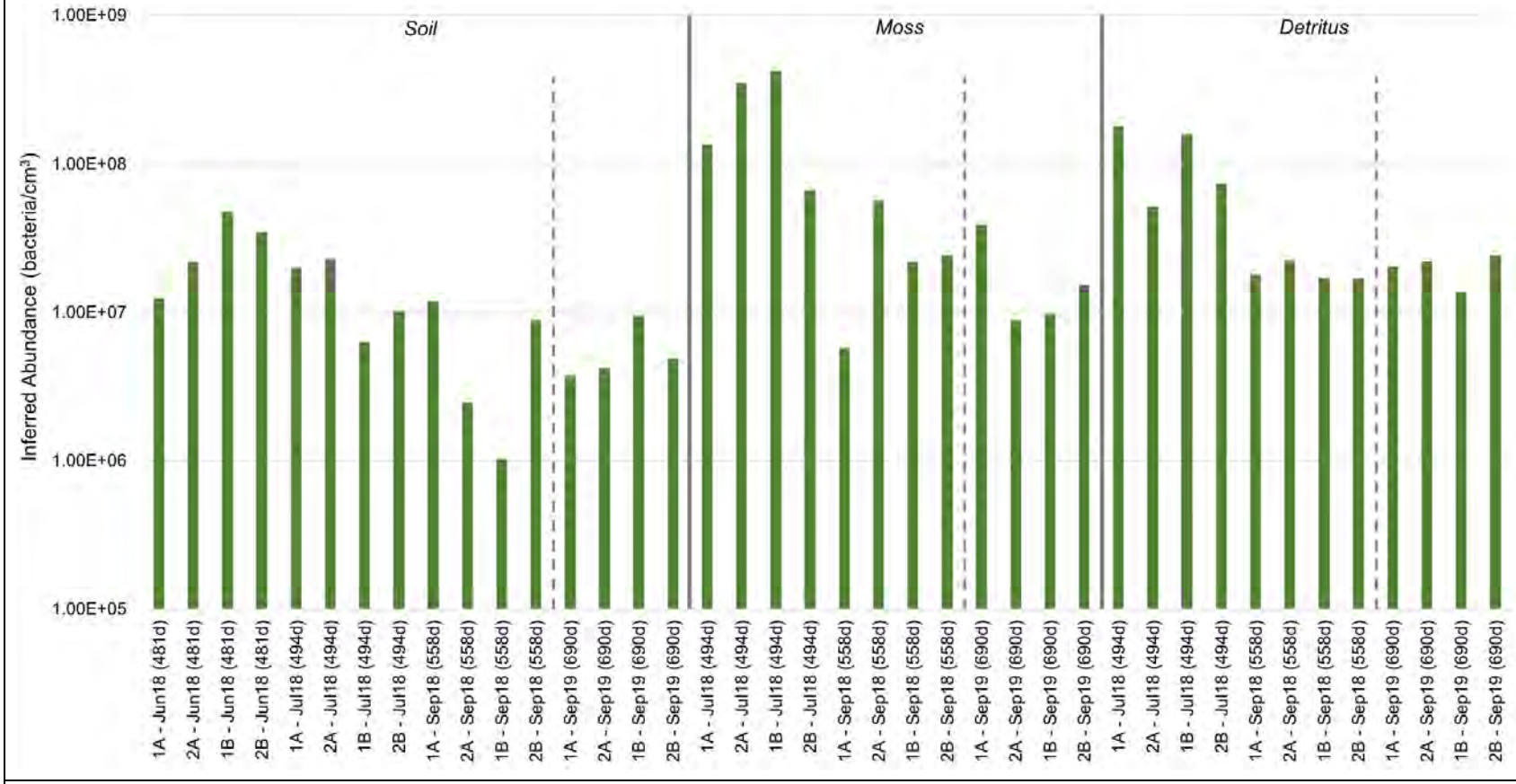


Figure B19 – Inferred abundance of denitrifying bacteria in soil, moss, and detritus in the demonstration-scale CWTS in 2018 and 2019.

Inferred abundance is calculated based on a combination of genetic and quantification data. Methods for quantification changed from growth-based analyses (most probable number) from 2014 to 2017 to quantitative polymerase chain reaction (qPCR) analyses in 2018 and 2019. As methods are not directly comparable (Appendix A, Section A7.5.1.), only results from 2018 and 2019 are shown here. Solid vertical lines separate the different sample types (soil, moss, detritus), while dashed vertical lines separate the year samples were collected (2018, 2019). Inferred abundance is not calculated for root samples.

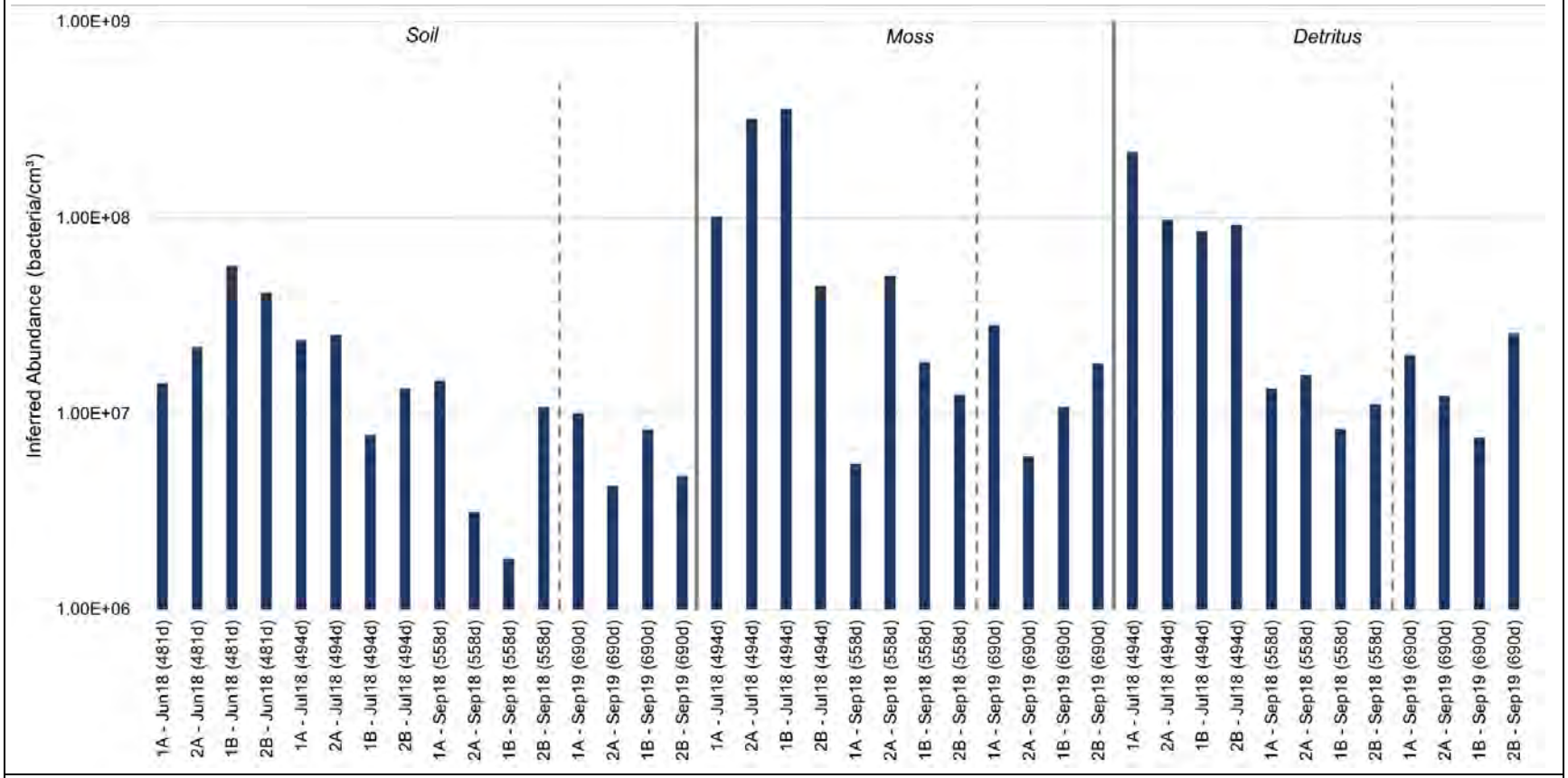


Figure B20 – Inferred abundance of selenium-reducing bacteria in soil, moss, and detritus in the demonstration-scale CWTS in 2018 and 2019.

Inferred abundance is calculated based on a combination of genetic and quantification data. Methods for quantification changed from growth-based analyses (most probable number) from 2014 to 2017 to quantitative polymerase chain reaction (qPCR) analyses in 2018 and 2019. As methods are not directly comparable (Appendix A, Section A7.5.1.), only results from 2018 and 2019 are shown here. Solid vertical lines separate the different sample types (soil, moss, detritus), while dashed vertical lines separate the year samples were collected (2018, 2019). Inferred abundance is not calculated for root samples.

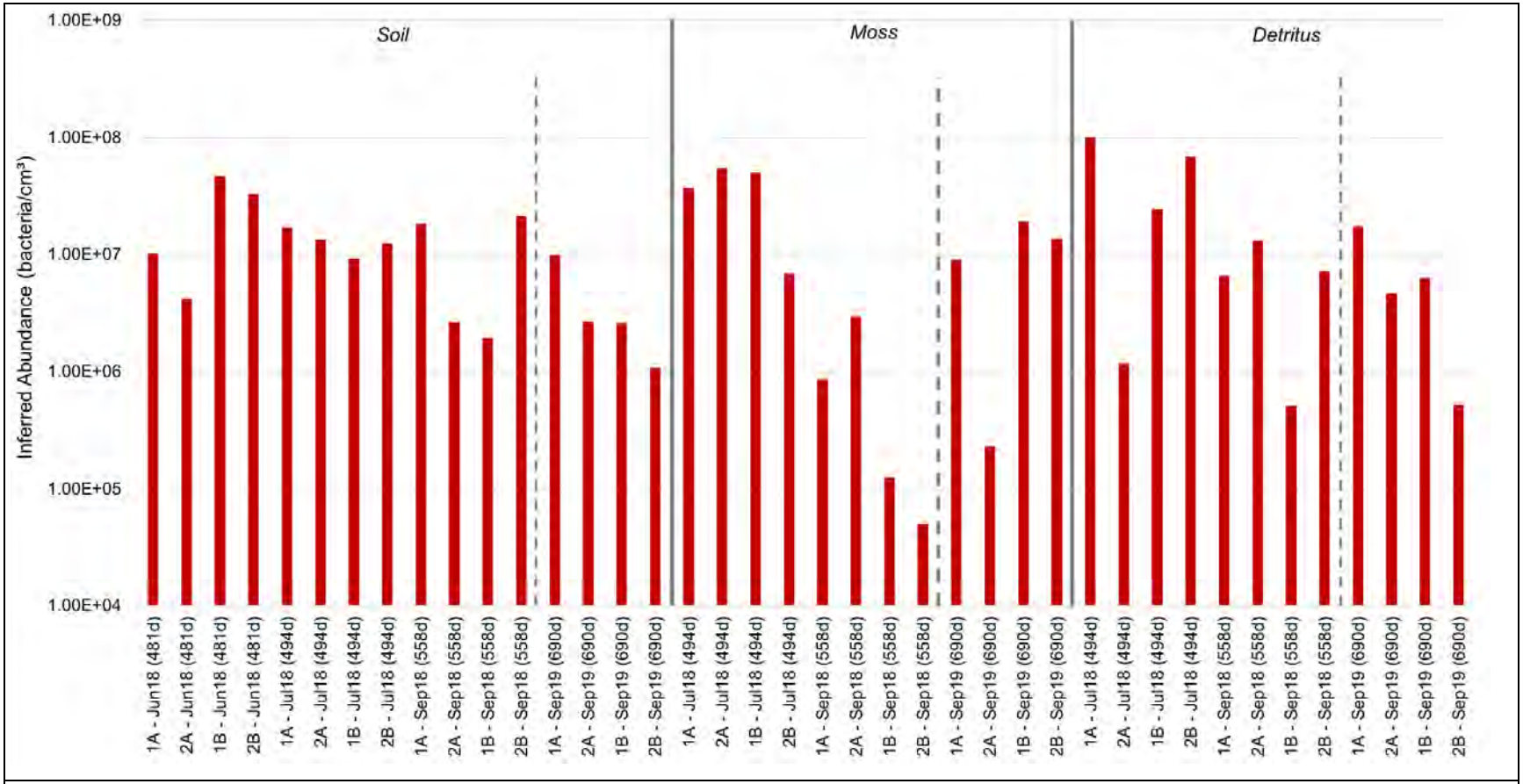


Figure B21 – Inferred abundance of sulphide-producing bacteria in soil, moss, and detritus in the demonstration-scale CWTS in 2018 and 2019.

Inferred abundance is calculated based on a combination of genetic and quantification data. Methods for quantification changed from growth-based analyses (most probable number) from 2014 to 2017 to quantitative polymerase chain reaction (qPCR) analyses in 2018 and 2019. As methods are not directly comparable (Appendix A, Section A7.5.1.), only results from 2018 and 2019 are shown here. Solid vertical lines separate the different sample types (soil, moss, detritus), while dashed vertical lines separate the year samples were collected (2018, 2019). Inferred abundance is not calculated for root samples.

Appendix C – Multi-year Workplan

Table C1 – Schedule of work and activities for demonstration-scale CWTS.

Item	Date	Activities	Actual
Construction	2014	Identify potential location for demonstration scale CWTS (Contango site visit – 1 scientist)	Completed June 2014
		Engineering and geotechnical (Minto)	Completed July 2014
		Construction (Minto)	Completed July 2014
		Planting and bringing system online (Contango site visit – 1 scientist, 1 technologist), coordinate for local students to assist	Completed August 2014 (no students available, brought 2 technologists)
Commissioning	2014	Acclimation and maturation at constant flow rate, ~20 hr HRT	Completed
		September - Contango site visit/checkup (1 technologist, 1 scientist)	Did not occur because construction was last week of August
	2015	Continued commissioning. Operation at constant flow rate, ~20 hr HRT	Completed (at shorter HRT)
		Spring – Contango site visit/checkup (1 technologist, 1 scientist), includes micro sampling	Completed
		Summer - Increase depth from 10 cm to 20 cm (1 technologist), includes micro sampling	Completed (scientist)
		Fall – Contango site visit/checkup (1 technologist), includes micro sampling	Completed (scientist)
	2016	Minto to add sandbags prior to first site visit and begin W15 creek monitoring	Completed May/June 2016
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report. HRT tracer study completed, outlined in section 7 of report.	Completed June 2016
		Summer - Contango site visit/checkup (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Table 5 of report.	Completed July 2016

Item	Date	Activities	Actual
		Evapotranspiration study completed as outlined in Section 9 of report. Organics were added to the CWTS as outlined in Section 5.1 of report.	
		Fall - Contango site visit/checkup (1 technologist), includes microbial sampling and tasks outlined in Table 5 of report	Completed September 2016
	2017	Continued commissioning operations at constant flow rate.	Completed May 2017
		Two evapotranspiration studies were completed	Completed May/June 2017
		Spring – Contango site visit (1 scientist, 1 technologist), includes microbial sampling and tasks outlined in Appendix A of report. Completed HRT tracer study. Sample for AVS to assess if the added organics are having the desired effect.	Completed June 2017
		Summer - Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Appendix A of report.	Completed July 2017. Seasonal water sampling was not completed due to flow interruptions. Seasonal water sampling was completed by Minto in August.
Commissioning		Minto added sandbags to outflows of CWTS cells to increase water depth	Completed August 2017
		Commissioning completed and beginning of operational period	Completed August 2017
Operations		Fall – Contango site visit/checkup (1 scientist), includes microbial sampling and tasks outlined in Table 5 of report.	Completed by Minto, after being taught microbial sampling by Contango. No site visit needed by Contango.
		Monitor soil redox. Determine when it consistently reaches targeted range.	Completed throughout 2017
Performance monitoring	2018	Develop a sampling plan, and aphid control and monitoring plan for 2018	Completed March, 2018
Drought recovery		Start water flow to CWTS; add sandbags to end and along perimeter of each CWTS cell to increase	Completed May 2018

Item	Date	Activities	Actual
		water depth by 1 to 5 cm; aphid control using more powerful insecticide on a routine schedule	
		Assess recovery of CWTS from drought	Completed throughout 2018
		Summer – Contango site visit (1 scientist); conduct a vegetation plot harvest and assessment of biomass produced; collect one bag of *C. aquatilis* and one bag of polyester filter foam from each CWTS cell; replant *C. aquatilis* in areas with sparse vegetation	Completed July 2018
		Iron added to Series 1	Completed July 2018
		Two evapotranspiration studies were attempted (were not informative due to precipitation during trials)	Completed July/August 2018
Performance monitoring	2019	Fluctuate flow rates, based on expected amount of water for full-scale wetland (scaled to size). Evaluate performance of CWTS at different key periods. Fertilize plants (if necessary).	Completed throughout 2019. It was not necessary to fertilize plants.
Operations		Develop a flow rate schedule and sampling plan for 2019	Completed May 2019
		Provision of updated standard operating procedures for new staff responsible for monitoring and sampling CWTS	
		Start water flow to CWTS	Completed May 2019
		Continue aphid control using insecticide on a routine schedule	Completed May-September 2019
		Spring – Contango site visit; training of new staff responsible for monitoring and sampling CWTS, monitor for presence of aphids, add iron to Series 1, collect one bag of *C. aquatilis* and one bag of polyester filter foam from each CWTS cell	Completed May 2019. Iron addition to Series 1 was not completed due to prioritizing testing HRTs relevant to full-scale.

Item	Date	Activities	Actual
		Summer – Contango site visit; conduct a vegetation plot harvest and assessment of biomass produced; conduct evapotranspiration trial for warmer months	Completed July 2019. Vegetation plot harvest was not completed during the summer site visit as it was completed during the fall site visit. Evapotranspiration trial was not completed due to prioritizing testing HRTs relevant to full-scale.
		Fall – Contango site visit (if necessary), replanting if needed, soil harvesting for additional off-site stress tests, final sampling event.	Completed September 2019. Soil harvesting for additional off-site stress tests was not completed due to stress tests such as freezing occurring naturally each season. Replanting was not completed as it was not needed. Moss was added to the A cells during the spring site visit.
Maintenance and Operations	2020	Add tote to the inflow of the CWTS to simulate a forebay where a carbon source (straw) can be added. This will refine the full-scale design for early closure where higher nitrate loads may be present.	May 2020
		Test straw at the beginning and end of the operating season to evaluate depletion rates.	May 2020
		Develop a sampling plan for monthly monitoring of the CWTS performance through 2020.	April/May 2020
		Operate the CWTS at a hydraulic residence time (HRT) that mimics the full-scale system.	Throughout 2020
Reporting	Feb 2021	Memorandum to update on 2020 activities	On Schedule

Appendix T - 2019 Annual Socio-Economic Monitoring Report

(Will be submitted at a later date)