Site Characterization Plan

Prepared for:

Minto Explorations Ltd.
61 Wasson Place
Whitehorse, YT Y1A 0H7

Project No. 106392-01

Prepared by:

Hemmera Envirochem Inc.
18th Floor, 4515 Central Boulevard
Burnaby, BC V5H 0C6
T: 604.669.0424
F: 604.669.0430
hemmera.com

November 1, 2021

TABLE OF CONTENTS

LIST OF TABLES (WITHIN TEXT)

LIST OF FIGURES (WITHIN TEXT)

LIST OF APPENDICES

1.0 INTRODUCTION

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. It is owned and operated by Minto Explorations Ltd.

The Minto Mine has been operated since 2007 by several public companies and since 1977 during the exploration and permitting stages. The Minto mine was in continuous production between 2007 and 2018, when the mine was placed onto temporary care and maintenance. Pembridge Resources PLC acquired Minto from Capstone Mining Corporation in June 2019 and recommenced operations in October 2019. The current mine operations are based on two underground zones Minto East and Copper Keel, a process plant to produce high grade copper, gold and silver concentrate and all supporting infrastructure associated with a remote location in the Yukon.

As a requirement for Minto Explorations Ltd (Minto)'s Quartz Mining Licence, a Site Characterization Plan has been developed. The Plan will outline the existing condition at the Minto Mine. **Table 1.1** shows how sections of this plan correspond to the Plan Requirements Guidance for Quartz Mining Projects.

Table 1.1 Concordance with Plan Requirements

Section in Guidance Document		Corresponding Section(s) in this Plan	
4.1	Introduction	1	Introduction
4.2	Geology	2	Geology
4.3	Climate and Hydrology	3 4	Meteorology Surface Water Hydrology
4.4	Surface Water	5	Surface Water Quality
4.5	Groundwater	6	Groundwater
4.6	Vegetation and Wildlife	7 8 9	Wildlife Aquatic Resources Vegetation
4.7	Soils and Bedrock	2	Geology
4.8	Seismicity	2	Geology
4.9	Geochemistry and Geotechnical Information	10	Geochemistry and Geotechnical Information

The Plan Requirements Guidance for Quartz Mining Projects references a concordance table outlining applicable proponent commitments and decision document conditions. As this plan describes the existing site conditions, none of the commitments made in the YESAB process or the conditions in the decision document are relevant to the understanding of this plan. Minto's commitments and the conditions contained in the decision document are addressed in the appropriate documents that evaluate the potential environmental effects of the project and the issues raised in the evaluation process.

1.1 Site Overview

The Minto Mine is located on the west side of the Yukon River, approximately 240 km northwest of Whitehorse, Yukon (**Figure 1.1**) and is centered at 62°37'N latitude and 137°15'W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). Highway 2 (North Klondike Highway) is located on the east side ofthe Yukon River; the mine can be accessed in the summer by barge crossing or in winter by the ice bridge crossing at Minto Landing.

A summary of environmental and socio-economic conditions are summarized in the table below:

Table 1.2 Summary of Environmental and Socio-economic Conditions in the Minto Mine Area.

Project Area Attribute Description	Project Area Attribute Description
Region:	Yukon
Topographic map sheet:	NTS 115 I/10, 115 I/11
Geographic location name code:	Minto Project
Latitude:	62° 36' N
Longitude:	137° 15' W
Drainage region:	Yukon River
Watersheds:	Yukon River, Big Creek, Wolverine Creek, Dark Creek, McGinty Creek, and Minto Creek.
Ecoregion:	Yukon Plateau (Central) - Pelly River ecoregion.
Study area elevation:	Rolling hills above mine site at 1131 to 600 m at the Yukon River Valley bottom.
Site climate:	Temperature ranges from –43.2°C (November 2006) to 30.3°C (July 2009). Mean annual temperature of –1.8°C. Mean annual rainfall is 174mm.
Vegetation communities:	Riparian, black spruce, white spruce, paper birch, lodgepole pine, buck brush/willow and ericaceous shrubs, feather moss, sedge, sagewort, grassland, mixed forest (aspen, balsam, and sub-alpine). Discontinuous permafrost is present on site. Site has been subject to recent forest fires.
Wildlife species:	Moose, caribou, Dall sheep, mule deer, grizzly and black bear, varying hare, beaver, lynx, marten, ermine, deer mouse, fox, mink, wolverine, least weasel, wolf, squirrel, porcupine coyote, muskrat, otter and wood frog. Bird species include: spruce, blue, ruffed, and sharp-tail grouse, waterfowl, raptors, and a variety of smaller birds.
Fish species:	In the Yukon River, Chinook, Coho, and chum salmon, rainbow trout, lake trout, least cisco, Bering cisco, round whitefish, lake whitefish, inconnu, Arctic grayling, northern pike, burbot, longnose sucker and slimy sculpin; In Big Creek, Chinook and chum salmon, Arctic grayling and whitefish species; In Wolverine Creek, Chinook salmon, Arctic grayling, and slimy sculpin; In Minto Creek (lower reaches only), Chinook salmon, slimy sculpin, round whitefish, Arctic grayling, longnose sucker, burbot; In McGinty Creek (lower reaches only), slimy sculpin, Arctic grayling
Known heritage resources:	East side of Yukon River in the vicinity of Minto Landing four historic sites designated KdVc-2 (Minto Landing), KdVc-3 (MintoEx Resort), KdVc-4 (Old Tom's Cabin), and KdVD-1 (Minto Creek).

Project Area Attribute Description	Project Area Attribute Description
Registered trapline concessions	Several Registered Trapping Concessions (RTCs) are held in the project area. Trapper access to the project area has been identified and will be maintained in accordance with the Cooperation Agreement. Compensation agreements have been negotiated with the RTC #146 & #145 trap line holders of the trapping areas impacted by the mine and access road.
Registered outfitting concessions	Two outfitting concessions fall within the project area. Registered Outfitting Concessions #13 is held by Tim Mervyn (Mervyn Outfitting) and #14 is held by Curt Thompson (Trophystone Safaris).

The Minto Mine property lies in the eastern portion of the Dawson Range, which is part of the Klondike Plateau Physiographic Region, an uplifted surface that has been dissected by erosion. The area was largely unglaciated during the last ice age and topography consists of deep and narrow valleys, rounded rolling hills, and ridges with relief of up to 600 m (2,000 ft.). The highest elevation on the property is 975 m (3,200 ft.) above sea level, compared to lower elevations in the region with elevations of 460 m (1,500 ft.) along the Yukon River.

The Minto Mine is near the height of land with relatively gentle slopes and smooth ridges that often have spines of bedrock outcrops (tors) at their crests left from long periods of weathering. Broad ridges are typically mantled with felsenmeer (fields of angular, frost-heaved, in situ rock fragments). Below the ridge crests, bedrock exposures are limited or negligible. The Project area lies in a zone of extensive discontinuous (50–90%) permafrost and is included in the western portion of the Yukon plateau central ecozone. North- facing slopes in the area are commonly underlain by permafrost. Valley-bottom deposits and upland soils usually contain ice-rich horizons. Well-drained uplands may have permafrost-free soils.

As the ecoregion is largely unglaciated, the dominant parent materials are stony residual materials along ridge tops and summits, coarse colluvium on upper slopes, and silty colluvium and loess, rich in organic matter, on lower slopes and floors of main valleys. Muck is usually capped with peat and underlain by permafrost. In the Minto Mine area, much of the colluvium on ridge slopes is coarse sand derived from decomposition of the largely granitic bedrock in the area. Overburden of relic soils that predate the last glaciation includes lacustrine deposits overlain by colluvium and organic silt in some upper valleys, some of which was exposed during excavation on the south side of the pit.

The mine development area is in the transition from the forested to non-forested (alpine) zone. Below the treeline (elev. ~1,000 m) the vegetation patterns reflect the discontinuous distribution of permafrost with stunted black spruce woodlands on cold, north-facing sites and mixed (aspen, white spruce, minor birch) forests on warm, south-facing slopes. The area has been burned over by several wildfires, the latest of which was in 2010 (Minto Landing to lower Minto Creek area). Many of the burnt trees have blown down and natural regeneration of pine and alder is occurring over much of the property and the Project area.

The climate of the region is continental with short, warm summers and very cold winters. Annual precipitation ranges from 300 to 500 mm. Mean annual temperatures are near –5ºC with mean mid-winter temperatures of –23ºC to –32ºC, in July from +10ºC to +15ºC and extremes in the lower valleys ranging from –60ºC to +35ºC.

The area is drained by tributaries of the Yukon River. The rate of runoff is controlled by almost total vegetation ground cover and moderate slope gradients. Infiltration rate is expected to be high in areas of thicker colluvium. However, permafrost and seasonally frozen soils inhibit vertical percolation.

Topography in the Dawson Range is moderate and the active geomorphological processes in the study area are typically limited to include slow mass movement (solifluction) and some minor gully erosion. Although there are no reports of large-scale active natural landslides in the Minto Project area, smaller scale instabilities have recently been documented in the Minto Creek catchment area, downstream of the mine site. Substantial sediment loading in lower Minto Creek in the absence of effluent discharge from the site was observed throughout the open water months of 2011 (**Appendix 1-3,** *Minto Creek Water Quality Characterization*). This prompted a targeted water quality survey and an aerial investigation of the creek and tributaries in spring of 2012 to identify the source(s) of the sediment. Two areas were identified in tributaries on the southern side of the Minto Creek catchment, below the area of control of the mine, where soil materials had slumped and transported a significant amount of material into the creek channel. Although ground investigations were not conducted, it is suspected that these instances may be related to thawing of frozen ground conditions or may simply be small-scale instability of fine textured (lacustrine) soils.

1.2 Project Description

The Minto Property comprises 164 Yukon quartz mining claims covering 2,760 hectares (6,817 acres), centered at 62°37’05” N Latitude, 137°14’56” W Longitude, within the Whitehorse Mining District.

1.3 Location, Access and Ownership

The Minto Mine is located within a package of Category A settlement land held by the Selkirk First Nation (“SFN”), and within the traditional territory of the SFN. There is a Co-operation Agreement (CA) between MintoEx and the SFN. The property is located west of the Yukon River, about 20 km WNW of Minto Landing, the latter on the east side of the river. The property is accessible by Yukon Highway 2 to Minto Landing. In summer months, MintoEx operates a barge connecting the landing with an all-weather gravel road extending 27 km from the west bank to the mine site. In winter, the crossing is accessed by an ice bridge. There is typically a 6 to 8-week period associated with each of freeze-up and breakup, where access across the river is not possible. During freeze-up and break-up, access is provided by chartered air services from Whitehorse to an airstrip on the property. The property is serviced by a spur of the main Yukon electrical grid. The closest communities are the villages of Pelly Crossing and Carmacks, both along the North Klondike Highway. The property is located approximately 250 road-km north of the City of Whitehorse, the capital city of Yukon, which is a full-service community of about 32,000.

1.4 Property Description and Location

The Minto property is comprised of seven separate claim blocks comprising the Minto Copper - Gold Belt. The blocks are: the Minto/Def block, hosting the mine site, and the Del, Bond, Pepper/Toe/Winter, Hun North, Hun South and WS blocks (**Figure 1.2**). These properties extend northwest from the WS block, centered about 28 km northwest of the village of Carmacks, Yukon Territory, to the Bond block, located 39 km WNW of the mine site and about 117 km northwest of Carmacks. **Figure 1.2** shows the claim blocks comprising the Minto property. The seven claims cover a combined area of 25,000 hectares (61,760 acres).

MINTO

ENSERO solutions

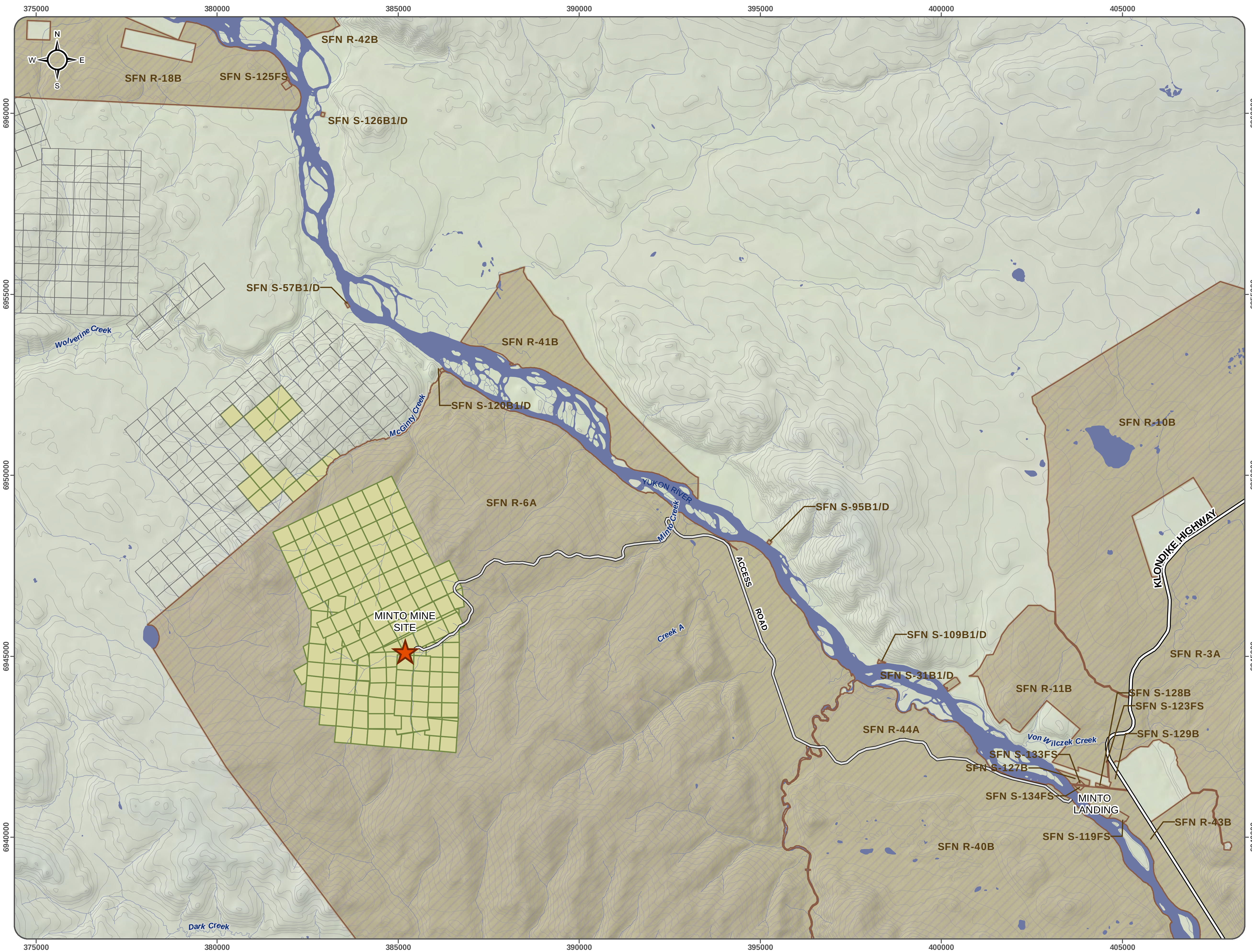
MINTO MINE

SITE CHARACTERIZATION PLAN

FIGURE 1-1
PROJECT LOCATION

OCTOBER 2021

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\01-Project Location\Project_Location_20200914.mxd (*Last edited by: amatlashevska; 2021-10-27/13:17 PM*)



MINTO MINE

SITE CHARACTERIZATION PLAN

FIGURE 1-2
AREA OVERVIEW

OCTOBER 2021

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

First Nation Settlement land obtained from Natural Resource Canada. Quartz claim boundaires and ownership are current as of 12 November 2020.

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\01-Property Overview\Property_Overview_20201103.mxd
(*Last edited by: amatlashevska;2020-11-12/11:43 AM*)

MINTO MINE
SITE CHARACTERIZATION PLAN

FIGURE 1-3
MINTO 2020 SITE LAYOUT

OCTOBER 2021

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.

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\05-Project Size\Year_0_Overview_Letter_20201103.mxd Development\Letter

MINTO MINE

SITE CHARACTERIZATION PLAN

FIGURE 1-4

EXISTING SITE FACILITIES (INFRASTRUCTURE)

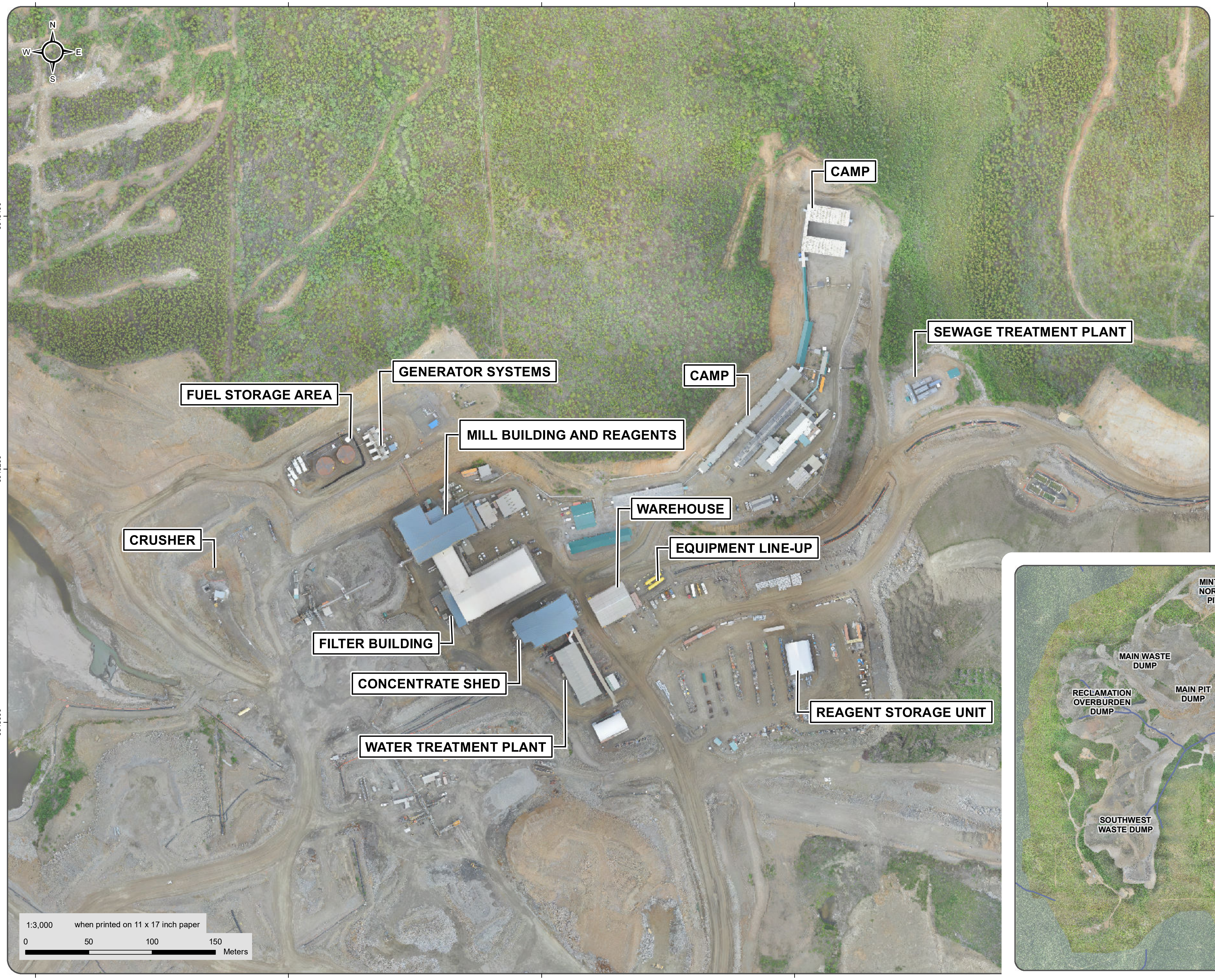
OCTOBER 2021

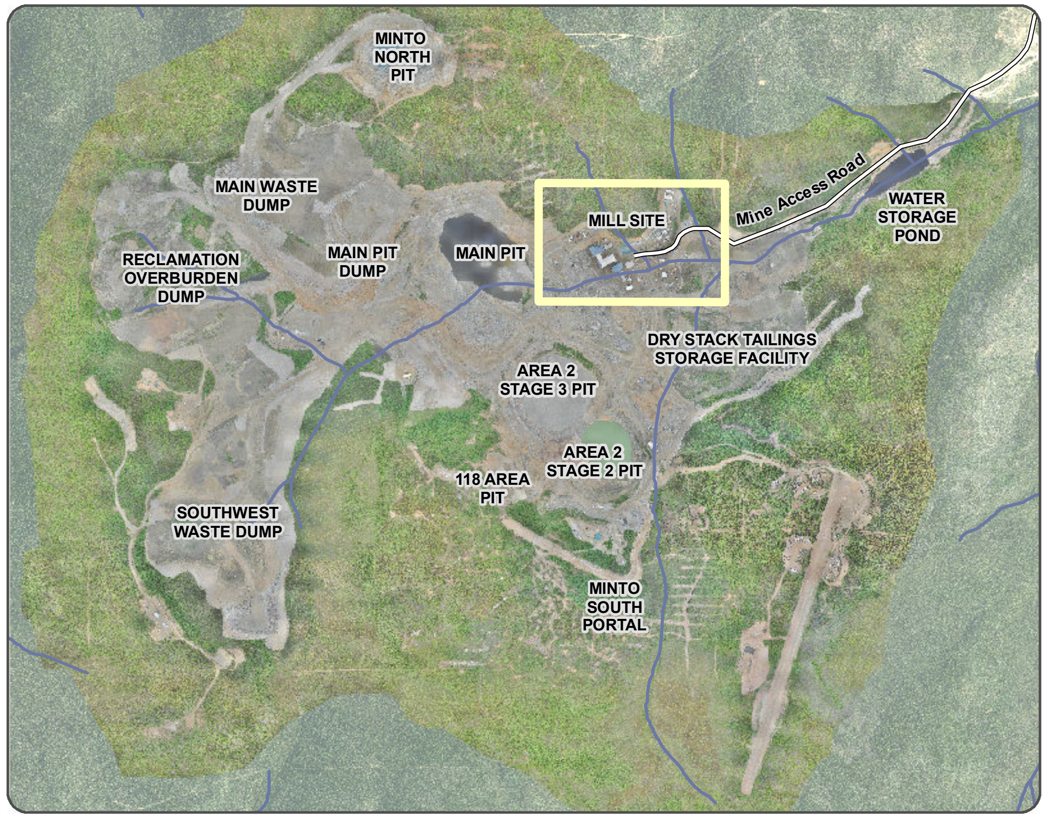
MINTO

ENSERO solutions

NAD 83 UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\03-SpecificTopics\Infrastructure_Buildings\Mill_Existing_Facilities_20210512.mxd





2.0 GEOLOGY AND MINERALIZATION

2.1 Physiography

The property lies towards the eastern limit of the Dawson Range which is typified by rolling hills and gentle to moderate topography, with elevations ranging from 640 m (2,100‘) to 975 m (3,200’) ASL. The fairly gentle slopes do not result in accessibility problems, or avalanche risk. South facing slopes are normally stable and suitable for building and infrastructure construction while north-facing slopes are typically permafrost-bearing. Overburden consists mainly of colluvium, comprised of sand originating from weathering of granitic bedrock underlying the area. Overburden depth is typically fairly thin, although may exceed 50 m locally. Bedrock exposure is fairly abundant along ridgelines and hilltops but is scarce elsewhere. The Minto mine site occurs somewhat east of the western limit of the Reid glacial advance, occurring from 120 to 60 Ka. Vegetation consists of typical northern boreal forest, which has undergone several episodes of burning, the most recent in 2010.

2.2 Geological Setting

The Minto property is located within the Minto Copper Belt (formerly known as the Carmacks Copper Belt) (Kovacs, 2018), a 42 km long, NW-trending series of copper-gold deposits and occurrences in central Yukon. These deposits are hosted within deformed and metamorphosed inliers engulfed by the intrusions of the Late Triassic to Early Jurassic Minto pluton (204-195 Ma) (Colpron et al., 2015).

The MINTO/DEF property area is underlain by the southern margin of the 204 – 195-million-year-old (Ma) Minto pluton. The Minto pluton consists of medium to coarse grained granite, biotitehornblende granite, granodiorite and quartz monzonite. The south boundary lies in east-west trending normal fault contact with mafic to intermediate volcanic rocks of the Late Cretaceous Carmacks Group. The east boundary lies in NNW trending fault contact with Lewes River Group, Povoas Formation augite phyric basalt, volcaniclastic rocks, and hornblende gabbro (Hart and Radloff, 1990). Lewes River Group rocks comprise part of the northern extent of the Whitehorse Trough, representing the northern limit of the Stikine Terrane, or “Stikinia”.

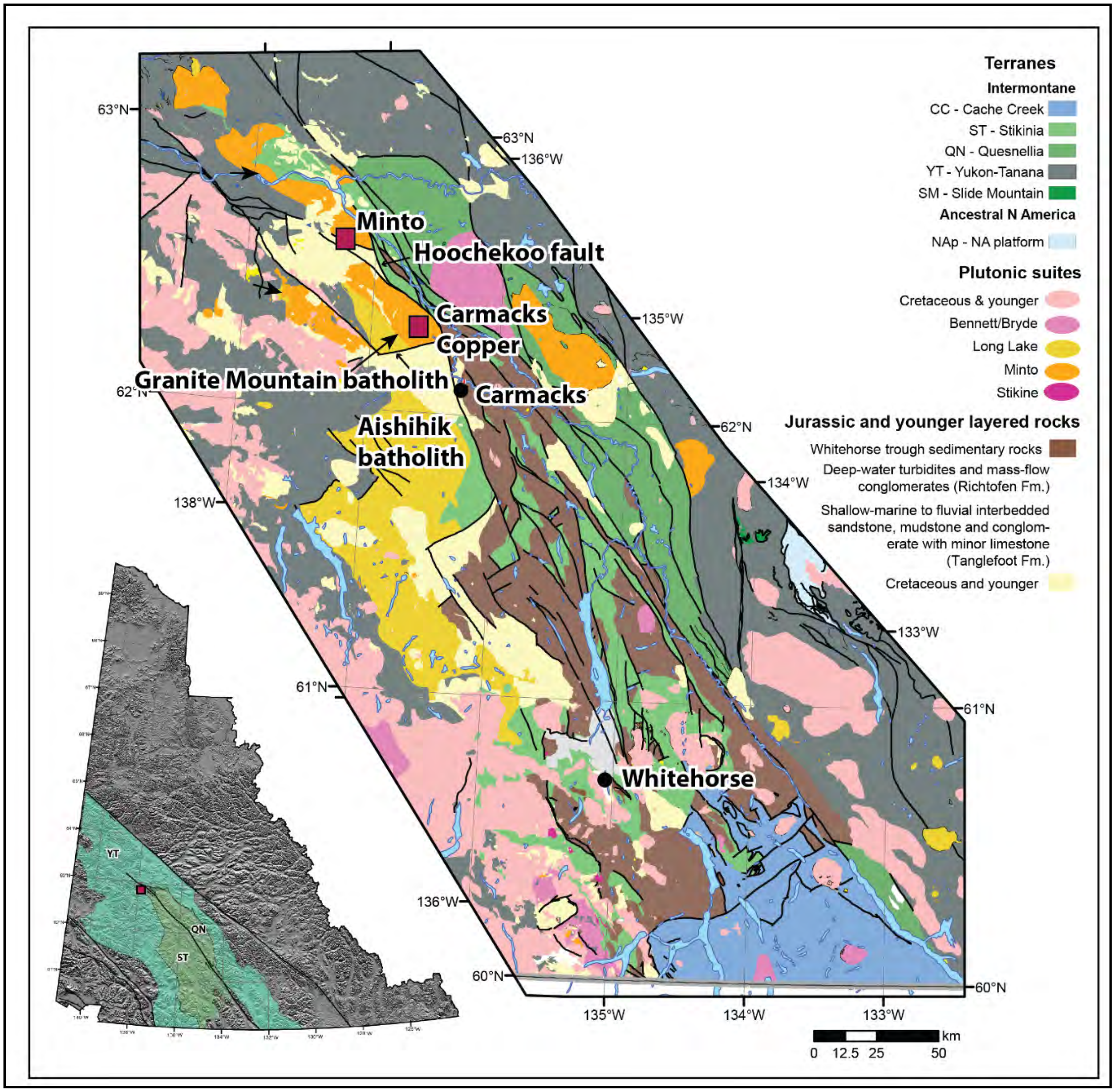
Hypogene copper sulphide mineralization is hosted within variably deformed, metamorphosed, and migmatized Late Triassic rocks that are engulfed by the undeformed and unmineralized felsic intrusive phases of the Minto pluton (Kovacs, 2018). Copper sulphide mineralization is restricted to the metamorphic rocks and occurs in three distinct forms: disseminated chalcopyrite ± pyrite, foliaform chalcopyrite, and net-textured bornite-chalcopyrite ± digenite (Kovacs, 2018). Contacts between foliated and massive phases are typically very sharp and lack chilled margins. Oxidation and alteration of primary mineralization indicates near-surface extensions of mineralized zones. Drill intercepts of copper-mineralized cobbles indicate that, by the Cretaceous period, “Mintostyle” mineralization was exposed, eroded and re-deposited in sedimentary strata.

Both brittle and ductile deformation occur in the Minto Mine vicinity. Amphibolite facies ductile deformation affected the metamorphic rock, evident by the alignment of hornblende and biotite grains forming foliation, and by the segregation of quartz and feldspar grains, forming a gneissic texture in areas of higher strain. Deformation zones occur as sub-horizontal horizons traceable for more than 1,000 m and are commonly stacked in parallel to sub-parallel sequences. The felsic intrusive rocks are generally undeformed, although moderate to strong foliation is locally developed near the contact with the metamorphic inliers (Kovacs, 2018).

Late faulting and brittle fracturing occur throughout the property, significantly affecting the economic potential. The Minto Creek fault (MC Fault), a steeply north-east dipping fault, roughly bisects the Minto Main deposit into north and south blocks. The north block has moved upwards and to the left of the south block, although displacement appears minimal. To the north, the roughly east-west striking, north-northwest dipping DEF fault marks the northern limit of the Minto Main deposit. The sense of movement may be similar to the MC Fault, but with a significant inferred displacement. Elsewhere, the boundary between the Area 2 and Area 118 deposits is a NW-SE striking, northeast-dipping fault, showing significant displacement.

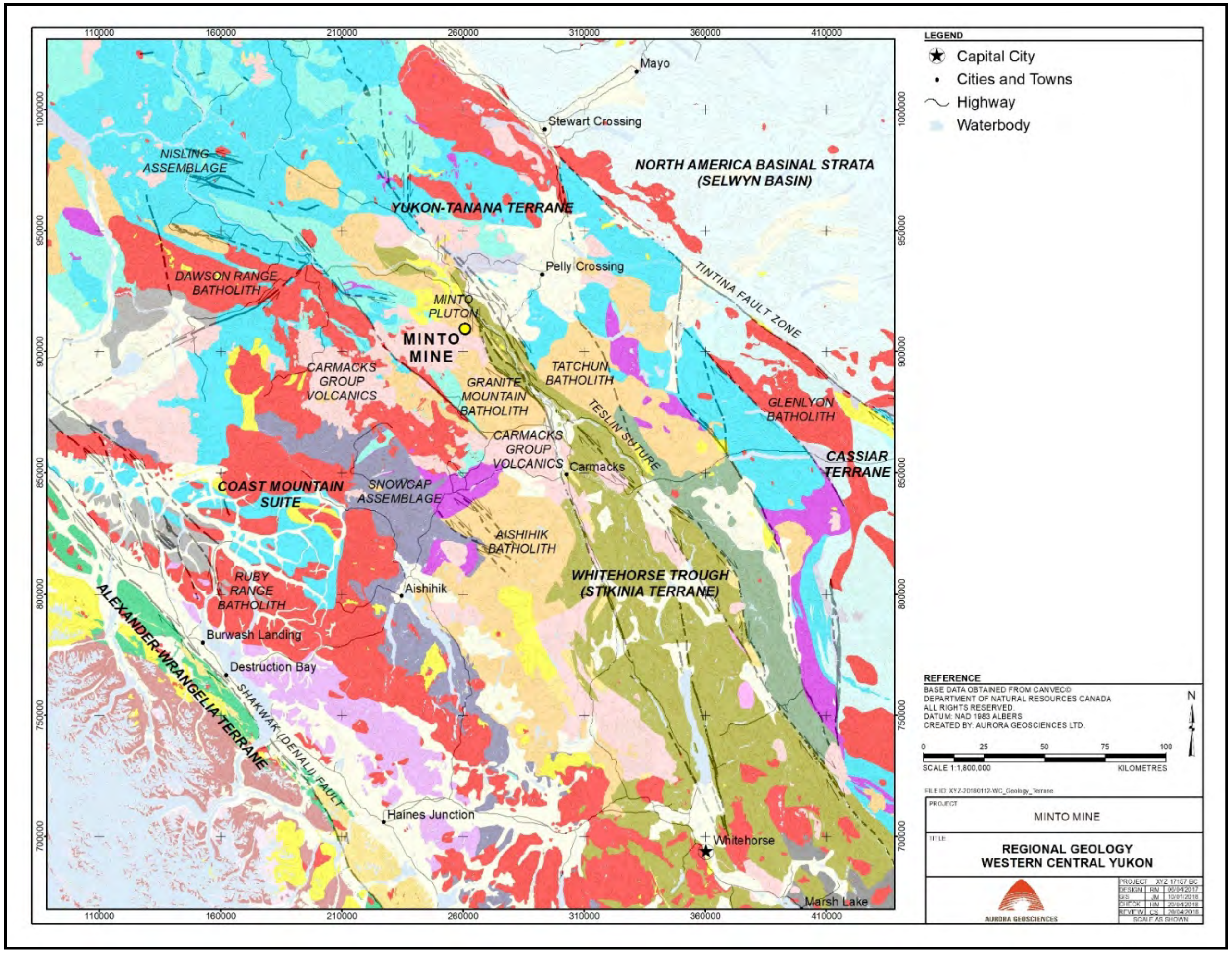
Pervasive potassic (biotite ± magnetite) alteration of the metamorphic host rocks is associated with hypogene copper mineralization (Kovacs, 2018). Chloritic and/or hematitic fracturing in some areas locally host visible gold, suggesting this late structural/hydrothermal event may be economically significant. There are no veins associated with hypogene copper mineralization; however, a few late chlorite-hematite-carbonate veinlets are locally present indicating postmineral hydrothermal alteration.

Figure 2-1: Yukon Geological Terranes



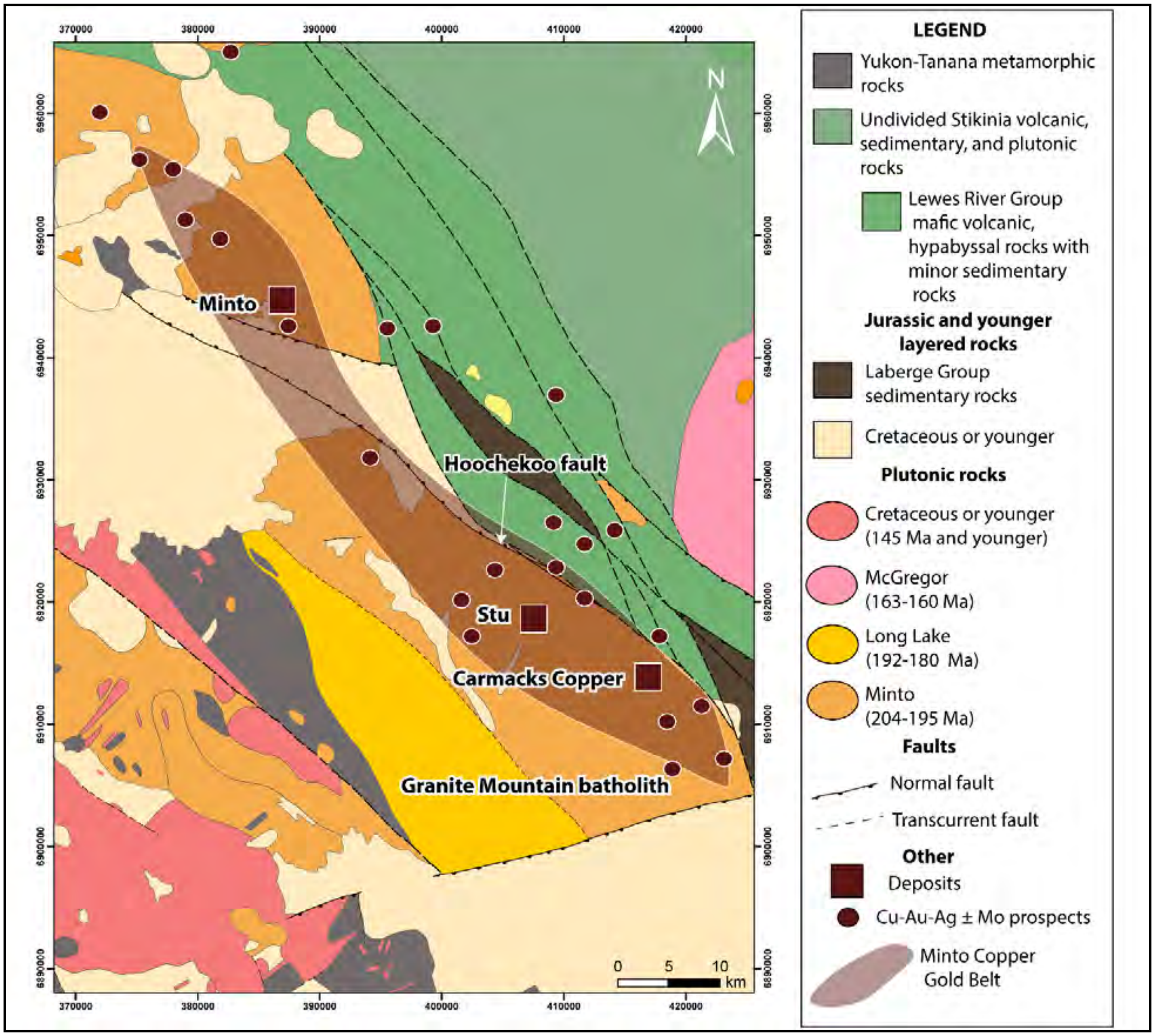
Source: Kovacs (2018)

Figure 2-2: Regional Geology, West-central Yukon



Source: Yukon Mapmaker Online, Yukon Geological Survey

Figure 2-3: Local Geology, Minto Mine Area



Source: Kovacs (2018)

7.2 Property Geology

Hypogene copper sulphide mineralization is hosted within variably deformed, metamorphosed, and migmatized Late Triassic volcanic rocks of Stikinia (Kovacs, 2018) that occur as rafts within the Late Triassic-Early Jurassic age Minto pluton (204-195 Ma).

2.3 Mineralization

Four major deposits have been delineated and/or have undergone mineral extraction: the Minto Main, Minto East, Minto North and Minto South deposits. The Area 2, Area 118, Copper Keel and Wildfire resource sub-domains are now considered to be continuous, comprising the Minto South deposit. Recent delineation and infill drilling programs have divided the Copper Keel into the Copper Keel Main, Copper Keel North, Copper Keel West and Copper Keel South deposits.

A north-northwest trend of copper deposits and prospects is evident from the alignment of the known deposits and also regionally (extending over 42 km). The trend includes the Carmacks Copper Cu-Au-Ag deposit and the Stu prospect. Copper grades increase progressively towards the north within the trend.

The primary hypogene minerals are chalcopyrite, bornite, chalcocite, and minor pyrite. Copper sulphide minerals occur mainly as disseminated grains, foliaform stringers, and net-textured domains. Sulphide mineral content tends to increase with ductile deformation. Native gold, electrum, and gold tellurides mainly occur as inclusions in bornite. Coarse free gold is locally found along late chloritic fractures, likely resulting from secondary enrichment from a hydrothermal event. Hypogene sulphide mineralization is almost always associated with biotite alteration and magnetite.

A crude zonation occurs from west to east at the Minto Main deposit, with bornite predominating in the west, transitioning to a thicker, lower grade chalcopyrite-bearing zone in the east. Both the Minto North and Minto East deposits show a similar zonation.

At the Area 2, Area 118 and Copper Keel resource subdomains of the Minto South deposit, ductile deformation appears to be more developed and mineralization is characterized by disseminated grains and minor foliaform stringers. The assemblage consists mainly of chalcopyrite-bornite-magnetite and minor pyrite. Mineralization is more homogenous and consistent than at the Minto Main and Minto North deposits, where mineralization is dominated by net-textured domains of bornite-chalcopyrite.

The predominant alteration assemblage associated with hypogene copper mineralization in the Minto mine area is a pervasive, potassic alteration, characterized by elevated biotite and magnetite content, within the horizontal mineralized zones, present in all Minto deposits. Pervasive silicification tends to coincide with areas of higher-grade mineralization.

Copper oxide mineralization resulting from supergene alteration processes represents either the erosional remnants of foliated horizons above the deposits, or the vertical remobilization of copper along late brittle faults and fracture zones from underlying copper sulphide zones. The oxide mineral assemblage consists of chalcocite, malachite, minor chrysocolla and azurite and rare native copper. Mineralization occurs as fracture-fill and joint coatings and, to a lesser extent, interstitially to rock-forming silicate minerals. Oxidation is related directly to the depth of the water table, typically less than 30 m, and is a minimal component of the Minto Main zone, due to its depth.

2.4 Property Geology

Hypogene copper sulphide mineralization is hosted within variably deformed, metamorphosed, and migmatized Late Triassic volcanic rocks of Stikinia (Kovacs, 2018) that occur as rafts within the Late Triassic-Early Jurassic age Minto pluton (204-195 Ma).

Inliers of metamorphic rocks within the intrusive phases of the Minto pluton have been characterized as migmatite that is texturally and compositionally variable (Kovacs 2018, Kovacs et al., 2020). Age dating on the migmatite by complex “laser-ablation inductively coupled plasma mass spectrometer” (LA-ICP-MS) and “chemical abrasion isotope dilution-thermal ionization mass spectrometry” (CA- ID TIMS) zircon dating using U-Pb geochronology yielded a CA-TIMS weighted mean date of 217.53 ± 0.16 Ma and 217.07 ± 0.23 Ma respectively. These ages support the protolith age of the migmatite at 217.5 to 217.0 Ma, within the Late Triassic (Kovacs et. Al., 2020), indicating these rocks belong to Late Triassic metavolcanic rocks of the Povoas Formation of the Lewes River Group that outcrop 10km east of the Minto Property.

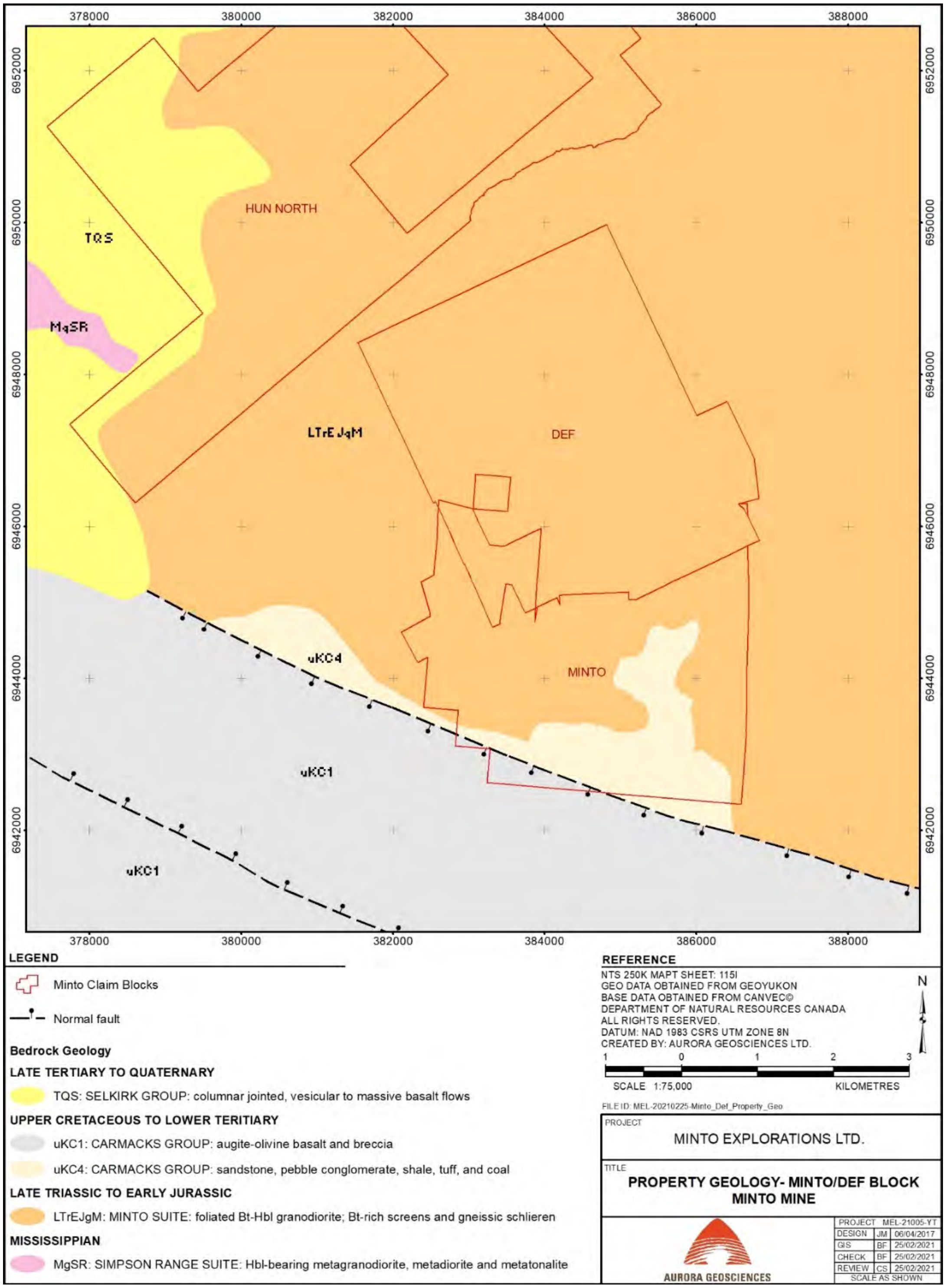
The metavolcanic protolith of the mineralized material hosting migmatite was mineralized in the Late Triassic and subsequently underwent partial melting during the emplacement of the Late Triassic-Early Jurassic Granite Mountain batholith and the Minto pluton at ca. 205-195 Ma. The temperature and pressure regimes were ~800°C at 5.5-6.5 kbar respectively (Kovacs, 2018; Tafti, 2005). During this partial melting event the mineralized metavolcanic xenoliths/rafts were variably migmatized, and the existing copper mineralization was remobilized as an immiscible sulphide melt. This melt crystallized into a migmatite as coarse, net-textured bornite and chalcopyrite, coeval with crystallization of the Minto plutonic suite (ca. 198 Ma from 187Re/187Os molybdenite) (Kovacs, 2018).

Three distinct intrusive phases of the pluton are identified on the Minto property: K-feldspar megacrystic granodiorite to quartz diorite, diorite to monzonite, and quartz granodiorite to granitic pegmatite (Tafti, 2005; Hood, 2008; Kovacs 2018, Kovacs et al., 2020). The most common intrusive phase is dominantly medium to coarse grained, K-feldspar megacrystic granodiorite which is in gradational contact with subordinate quartz diorite. These rocks are mainly undeformed, but locally exhibit weak tectonic foliation near their contacts with the metamorphic inliers. U-Pb geochronology by CA-ID-TIMS analysis on the intrusive rocks yielded 195.14 ± 0.25 - 0.31 Ma ages for the K-feldspar megacrystic granodiorite.

Dykes of quartz monzonite, quartz monzodiorite, granite pegmatite, and aplite crosscut the metamorphic host rocks and other massive intrusive phases (e.g., K-feldspar megacrystic granodiorite) and are variably overprinted in the metamorphic rocks by folding and boudinage. U-Pb geochronology by CA-ID-TIMS age dating revealed 194 Ma ages for these dykes, indicating that they are slightly younger than the massive phases of the pluton. Collectively, the geochemistry of all intrusive phases is consistent with I-type, magmatic arc affinity.

The felsic intrusive rocks are unconformably overlain by the volcanic rocks of the Upper Cretaceous Carmacks Group, which are preserved as an extensive blanket south of the Minto pluton and as isolated erosional remnants within the pluton. The Carmacks Group rocks commonly occur as conglomerate in drill core, and as hornblende-phyric andesite dykes cross-cutting the felsic intrusive rocks. Additional details on Structural Setting, Alteration and other Minto Area Blocks can be found in NI 43-101 Preliminary Economic Assessment Technical Report 2021 for Minto, YT.

Figure 2-4: Property Geology Map, Minto/Def Block



Source: Aurora (2019)

2.5 Seismic Hazard

The tectonics and seismicity of southwestern Yukon are influenced primarily by the Pacific and North American lithospheric plate margins. In Yukon's St. Elias region, northwest British Columbia and southeast Alaska, the boundary of the two lithospheric plates changes from right lateral transform to subductive. Instead of sliding past each other, the Pacific Plate is forced beneath the stable North American plate resulting in the St. Elias region being uplifted. This transfer of force along the fault into uplift or mountain building dissipates tectonic energy, reducing seismic effects on the region northeast of and across the fault (SRK, 2013).

An assessment of peak ground acceleration was performed for the Minto project area using the 2015 National Building Code Seismic Hazard Calculation, and is shown in below. Additional details can be found in **Appendix 1-1** Seismic Hazard Assessment for Minto, YT.

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

July 31, 2016

Site: 62.618 N, 137.241 W User File Reference: Minto Mine

Requested by: , Minto Explorations Ltd.

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.154	0.229	**0.269**	0.246	**0.207**	**0.146**	**0.083**	**0.030**	**0.012**	**0.125**	**0.156**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.025	0.060	0.091
Sa(0.1)	0.034	0.086	0.134
Sa(0.2)	0.052	0.114	0.166
Sa(0.3)	0.060	0.118	0.163
Sa(0.5)	0.058	0.110	0.146
Sa(1.0)	0.047	0.085	0.109
Sa(2.0)	0.028	0.049	0.063
Sa(5.0)	0.0098	0.018	0.023
Sa(10.0)	0.0039	0.0068	0.0089
PGA	0.022	0.050	0.075
PGV	0.046	0.087	0.114

Figure 2.5 2015 National Building Code Seismic Hazard Calculation for the Minto Mine

2.6 Surficial Geology and Permafrost Conditions

Overburden thickness across the site is closely correlated with geomorphological features. Near topographic highs, there is little to no overburden, with increasing overburden thickness down valley slopes and generally the thickest deposits in valley bottoms.

Figure 2.6 provides an isopach map of the overburden thicknesses based on available borehole and test pit logs that were used to interpret the bedrock surface throughout the site. Overburden is very shallow (less than 5 m) close to bedrock outcrop zones near topographic highs and 30 to 50 m in the Minto Creek valley. A paleochannel is present adjacent to the Minto Creek Valley that has an over 100 m thick.

Generally, ridge tops are dominated by sandy, residual soils grading to weathered bedrock. Fine weathered products have been washed downslope, which means within the valleys, finer sandy silts and clays are found. Layers of sandy gravel with cobbles are occasionally found within (with the exception of the paleochannel.

Minto mine is located in a discontinuous permafrost region. In general, the south facing slopes are unfrozen, while north facing slopes contain permafrost. Where permafrost is present it is generally warm, with temperatures slightly below freezing. The active layer is variable ranging from less than 1 m to about 3 m thick. Total depth of permafrost is variable, but, in certain locations is known to extend down to the base of the paleochannel. **Figure 2.7** shows an illustration of pre-mine topography and the location of the warm permafrost in relation to the site structures. The general distribution of permafrost on the site is illustrated on **Figure 2.8**.

The north facing slopes of the Minto Creek Valley are mantled by frozen glacial sediments inter-bedded gravels, sands, silts and clays. These sediments are remnants of glacial deposits formed from advancing and retreating Cordilleran Ice Sheets. Ice contents within the overburden range from non-visible to 30% excess ice, although ice lenses are common and massive ice up to 4 m thick occurs, particularly near the bedrock surface within the paleochannel.

Deep-seated foundation movements have occurred in the open pit and beneath the DSTSF, within plastic lacustrine clay in the Minto Creek Valley and paleochannels, typically situated about five to ten meters above the bedrock contact. Index testing for these high plastic clays shows clay contents ranging from about 28-68% and Plasticity Indices of 23 to 48%. The drill log descriptions that are within the and adjacent to the shear zone identify the presence of slickensides and distorted sedimentary structures. Ice lenses within the clays are oriented horizontally and at shallow angles to the horizontal axis.

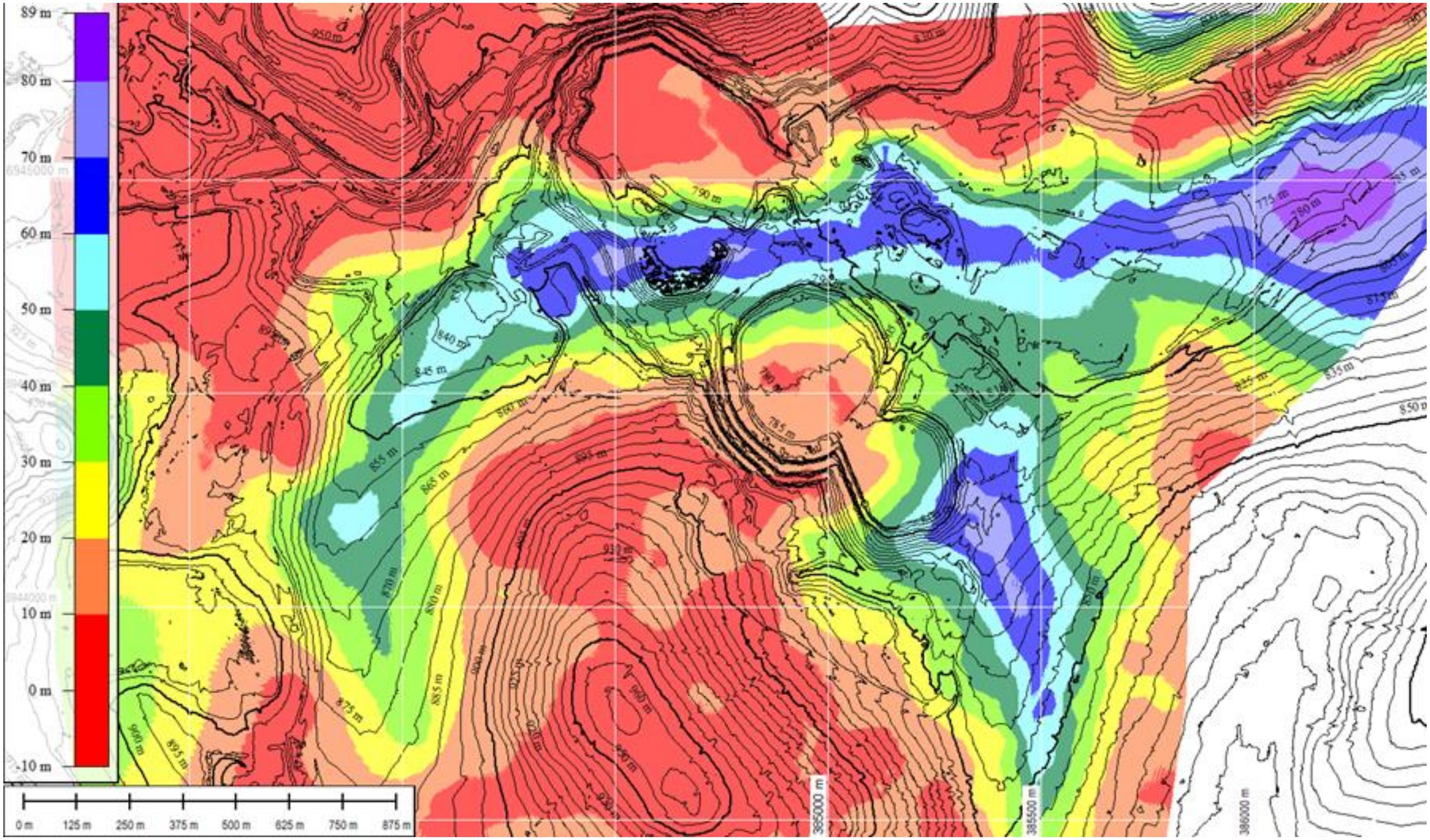


Figure 2.6 Overburden Isopac

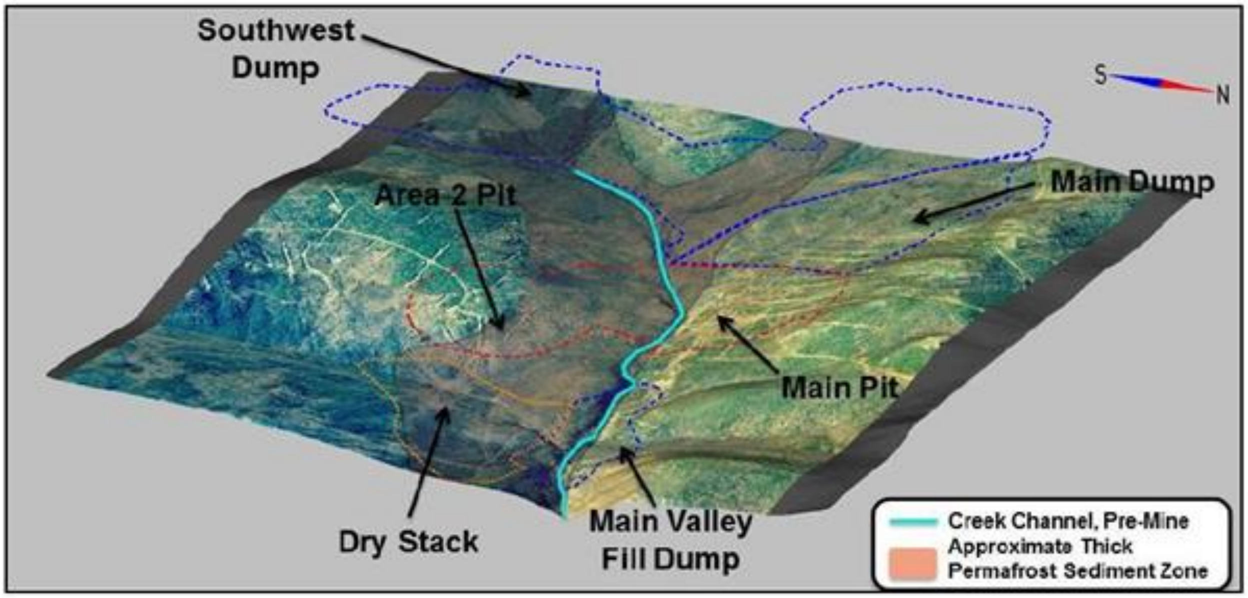
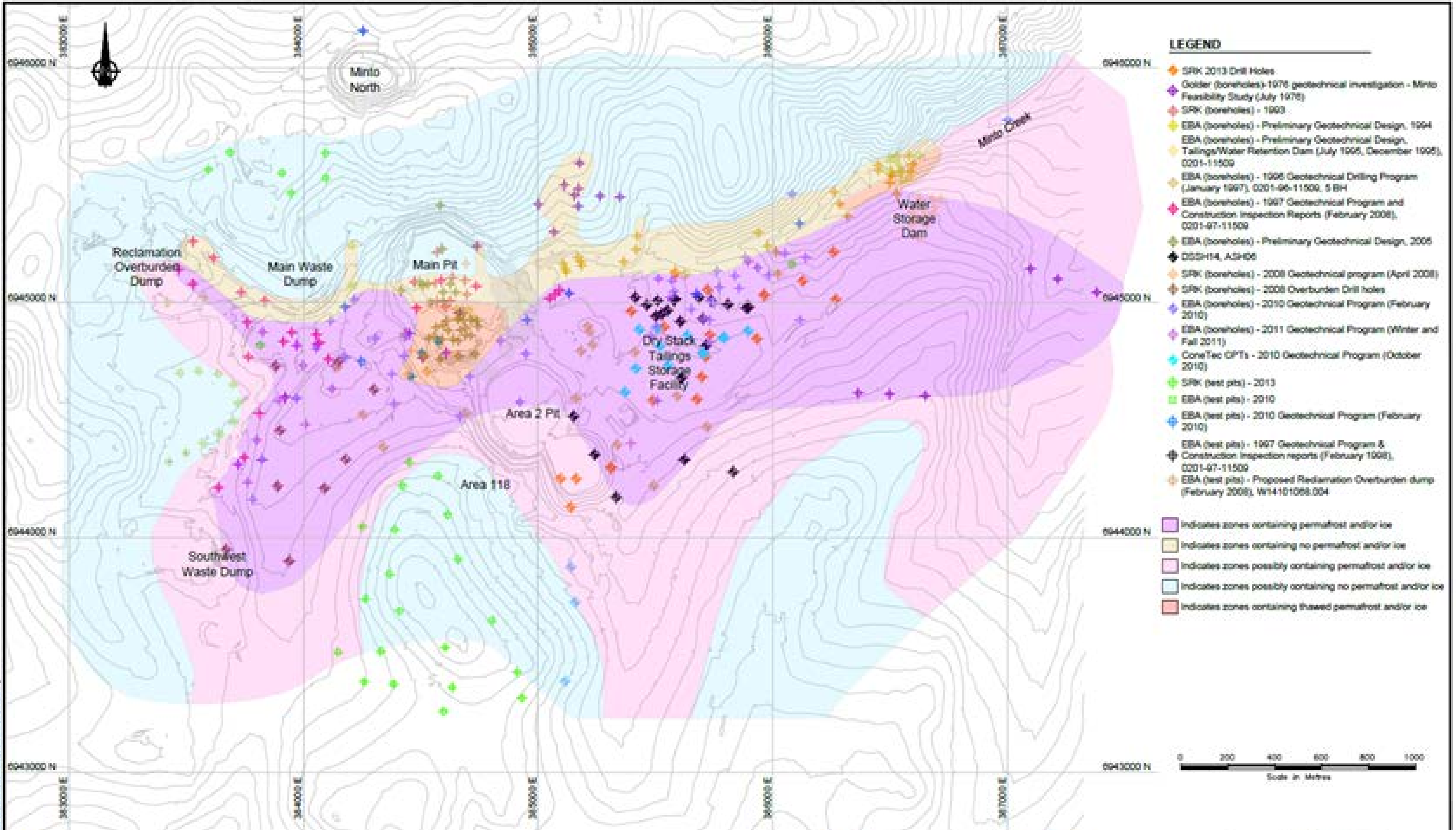


Figure 2.7 Pre-Mine Topography



NOTES

1. Data presented in NAD 1983 UTM Zone 8N.
2. Topographic information provided by Minto Mine, April 2020.
3. Permafrost information adapted from EBA, October 2011.

srk consulting	MINTO	Site Characterization
		Permafrost Distribution
SRK JOB NO.: 1CM002.072	Minto Mine	DATE: Sept. 2021 APPROVED: PHM FIGURE: 3
FILE NAME: 1CM002.072 – Permafrost_Distribution.dwg		

3.0 METEOROLOGY

The existing meteorology of the Project area and the climate trends and projections of the Minto region of Yukon were first described in detail in EBA's report *Minto Mine – 2010 Climate Baseline Report* and subsequently in Access Consulting Group's (ACG) *Minto Climate Baseline Report* (2012) and Alexco Environmental Group's (AEG) *Minto Mine Site Characterization – Hydrometeorology* (2017). The meteorological data contained in the above reports were recorded by two on-site meteorological stations over a period of about fifteen years. Snow depth and water equivalent data were provided from annual on-site snow surveys since 1994. Data used in climate trend analyses were sourced from regional monthly and annual records provided by the Meteorological Service of Canada and applied to the Project area. Future temperature and precipitation scenarios for the Minto Mine areas were obtained from a probabilistic analysis conducted by SRK (2016). Details of the data collection program and the procedures used for analysis are provided in the 2021 Hydrometeorology Site Characterization Report (**Appendix 1-2**).

The climate in the Minto region is subarctic continental characterized by long, cold winters and short, cool summers. The area experiences moderate precipitation in the form of rain and snow and a large range of temperatures on a yearly basis with a mean annual temperature below 0°C.

3.1 Summary of Site Meteorological Conditions (2005-2020)

Two meteorological stations installed at the property have recorded wind speed and direction, air temperature, relative humidity, barometric pressure, solar radiation and rainfall in one-hour intervals since September 7, 2005 for the HOBO and October 15, 2010 for the Campbell Scientific station. The Campbell Scientific weather station has been shown to provide more reliable data and as such, the HOBO station was decommissioned in the summer of 2014.

3.1.1 Wind

The HOBO anemometer was installed at a height of 3 meters and got damaged by strong winds in 2010. Based on data from the Campbell Scientific anemometer, which is installed at a height of 10 meters and is much less prone to icing than the HOBO anemometer, dominant winds at site originate from the South, Southeast and Northwest, with an average speed of 2.72 m/s and gusts up to 26.8 m/s.

3.1.2 Air Temperature

Summer is characterized by temperatures in the range of 10°C to 20°C. Winter is characterized by a much larger day-to-day variation in temperatures, typically between –10°C and –30°C. Diurnal variation in air temperatures tends to be less during the winter period than during the summer period. The transitions between winter and summer are characterized by a quick rise or fall in air temperatures. July has been the warmest month on average (14.7°C) while the coldest has been December (–16.4°C). The mean annual temperature for the period of record is -1.9°C for the HOBO station and -0.6°C for the Campbell Scientific station. Extremes ranged from -43.2°C to 30.3°C.

3.1.3 Relative Humidity

Relative humidity (RH) is highest during the winter months (typically in the range of 75% to 95%) and lowest during the spring and early summer, typically in the range of 40% to 60%. Relative humidity has a much larger day-to-day variability during the summer. The lowest recorded %RH was 10.25%. The highest was 100%. Annually, mean relative humidity is 68%.

3.1.4 Solar Radiation

As would be expected at a latitude of 62.6°N, a strong seasonal pattern is evident in solar radiation, with a maximum being received near the summer solstice in late June (daily maximums on the order of 750 W/m^2), and daily maximums slightly above zero around the winter solstice when the site experiences only about 3 hours of direct sunlight per day. Mean annual solar radiation is 108 W/m^2 (averaged over the two meteorological stations).

On July 20, 2016, a second pyranometer was installed at the Campbell Scientific station to measure outgoing radiation. Mean monthly outgoing solar radiation from August 2016 to December 2020 range from 5 w/m^2 (December) to 78 W/m^2 (March).

3.1.5 Barometric Pressure

Barometric pressure recorded on-site at 885 m elevation is converted into a meteorological standard sea level equivalent. Mean monthly barometric pressure from 2010 to 2020 ranges from 1003 hPa in December to 1029 hPa in February. Mean annual sea-level equivalent barometric pressure is 1017 hPa.

3.1.6 Precipitation

3.1.6.1 Rainfall

The Minto Mine HOBO meteorological station has been recording rainfall on site since its installation in September 2005 until decommissioning in June 2014. Based on a cumulative of average monthly rainfall, 192.8 mm of rain is expected on average at site in a single year (AEG, 2017). August is the rainiest month with an average rainfall of 46.2 mm. The largest monthly rainfall total was 100.6 mm (August 2008). Rainfall has been recorded in every month of the year. Based on regional data, about 64% of total annual precipitation falls as rain (average proportion over the period of record for four regional stations). Applying this ratio to the average annual rainfall of 192.8 mm measured at the Minto Mine HOBO station would result in a total annual precipitation value of 303.2 mm.

3.1.6.2 Total Precipitation

The Campbell Scientific station was recording rainfall only from time of commissioning until October 14, 2011, when a snowfall conversion adaptor was installed on the tipping bucket to allow for measurement of total precipitation. On November 18, 2014, a Geonor T-200B vibrating wire all weather precipitation gauge was installed in addition to the existing tipping bucket and rainfall adaptor to improve accuracy and validate total precipitation measurements. The Geonor precipitation gauge functioned well and was in agreement with the tipping bucket until late 2016, when it began to give erratic readings. Troubleshooting was unsuccessful until recently (September 2021), therefore only results from the tipping bucket are reported here. Average annual total precipitation is 253.3 mm with the tipping bucket, less than the estimated total of 303.2 mm based on the HOBO rainfall measurements and regional data. This could indicate potential undercatch of both the snowfall adaptor and total precipitation gauge, however, other factors such as wind or snow pillow formation can also play a role. More years of total precipitation data will allow a more meaningful comparison.

3.1.7 Snowpack

Annual snow surveys were conducted during the first week of March, April and May in 1994, 1995, 1998, and annually from 2006 to 2021, at three locations in the Minto Creek catchment area; a fourth station was added in 2016. In four of the seven May surveys between 1994 and 2009, the snowpack had melted entirely by May 1. Minto began conducting additional surveys in the first week of February in 2009 in order to obtain a more robust dataset. Based on the fifteen years of snow surveys, the average water-equivalent snow depth remaining on the first day of February, March and April is 89.4, mm, 93.8 mm and 96.6 mm, respectively.

3.1.8 Evaporation

Starting in August 2012, the Campbell Scientific datalogger program incorporated an instruction for the calculation of potential evapotranspiration (PET) using the American Society of Civil Engineers (ASCE) standardized reference evapotranspiration equation (Penman-Monteith). The PET instruction uses temperature, relative humidity, wind speed, solar radiation, latitude, longitude and altitude to calculate an evaporation rate for a short grass crop. This provides an approximation of actual evaporation, which varies locally depending on surface type and micro topography. The average total annual PET is 444 mm which is similar to the estimated mean evaporation value of 400 mm/year based on regional data.

3.2 Regional Climate Trends

Long-term trends were evaluated by reviewing long-term records from stations in the region (regional analysis). Environment Canada meteorological stations used for this regional analysis were selected based on location/proximity and data availability.

3.2.1 Temperature

3.2.1.1 Past Trends

The annual mean temperature has been increasing at Pelly Ranch by 0.07°C per year on average over the 57- year period corresponding to a total average increase of 4.2°C from 1957 to 2014. For Carmacks, the average rate of increase of the annual mean temperature is slightly less at 0.0047°C per year, resulting in an average increase of 2.6°C for the 56-year period from 1964 to 2020. It is also important to note that the average annual minimum temperature has been increasing at a faster rate than the average annual maximum temperature at both stations, thus implying that the average diurnal range has also been decreasing. With respect to seasonality, January (winter) mean temperatures have experienced much higher rates of increase (0.15°C per year at Pelly Ranch and 0.22°C per year at Carmacks) than July (summer) mean temperatures (0.03°C per year at Pelly Ranch and 0.02°C per year at Carmacks). A close correlation between monthly average temperatures recorded at Minto and at Pelly ranch and Carmacks, as well as the proximity of the stations to the property, suggests that the long-term trends would also be applicable to the Minto property. Winter temperatures at Minto however are approximately 3°C to 5°C higher due to a predominant Yukon winter temperature inversion of +8°C/ km up to an elevation of 1200 m (EBA, 2010).

3.2.1.2 Future Trends

Based on a probabilistic analysis conducted by SRK (2016), the mean annual temperature at Minto is expected to increase by about 3.3°C over the next century, with mean annual temperatures of -0.8°C, 0.2°C and 1.1°C in the 2020s, 2050s and 2080s, respectively. The intra-annual range between extreme maximum and extreme minimum temperatures is expected to decrease with time (SRK, 2016).

3.2.2 Precipitation

3.2.2.1 Past Trends

Environment Canada monthly precipitation records at Pelly Ranch and Carmacks show an increasing trend in total annual precipitation over the period of record, however the correlation is weak. The proportion of total precipitation falling as rain also displays an increasing trend over the period of record, but again, the correlation is weak.

3.2.2.2 Future Trends

Based on a probabilistic analysis conducted by SRK (2016), the total precipitation at Minto is forecasted to increase 67.9 mm (15%) during the mine life (2011 to 2040) and 199.3 mm (44%) by 2100 the total precipitation at Minto is forecasted to increase 67.9 mm (15%) during the mine life (2011 to 2040) and 199.3 mm (44%) by 2100. The simple daily precipitation intensity index (mean annual precipitation divided by the total number of wet days) is forecasted to increase by 6.6% during the mine life and by 25% in the next century. Snow accumulation appears to be increasing between December and March mainly by years 2100s.

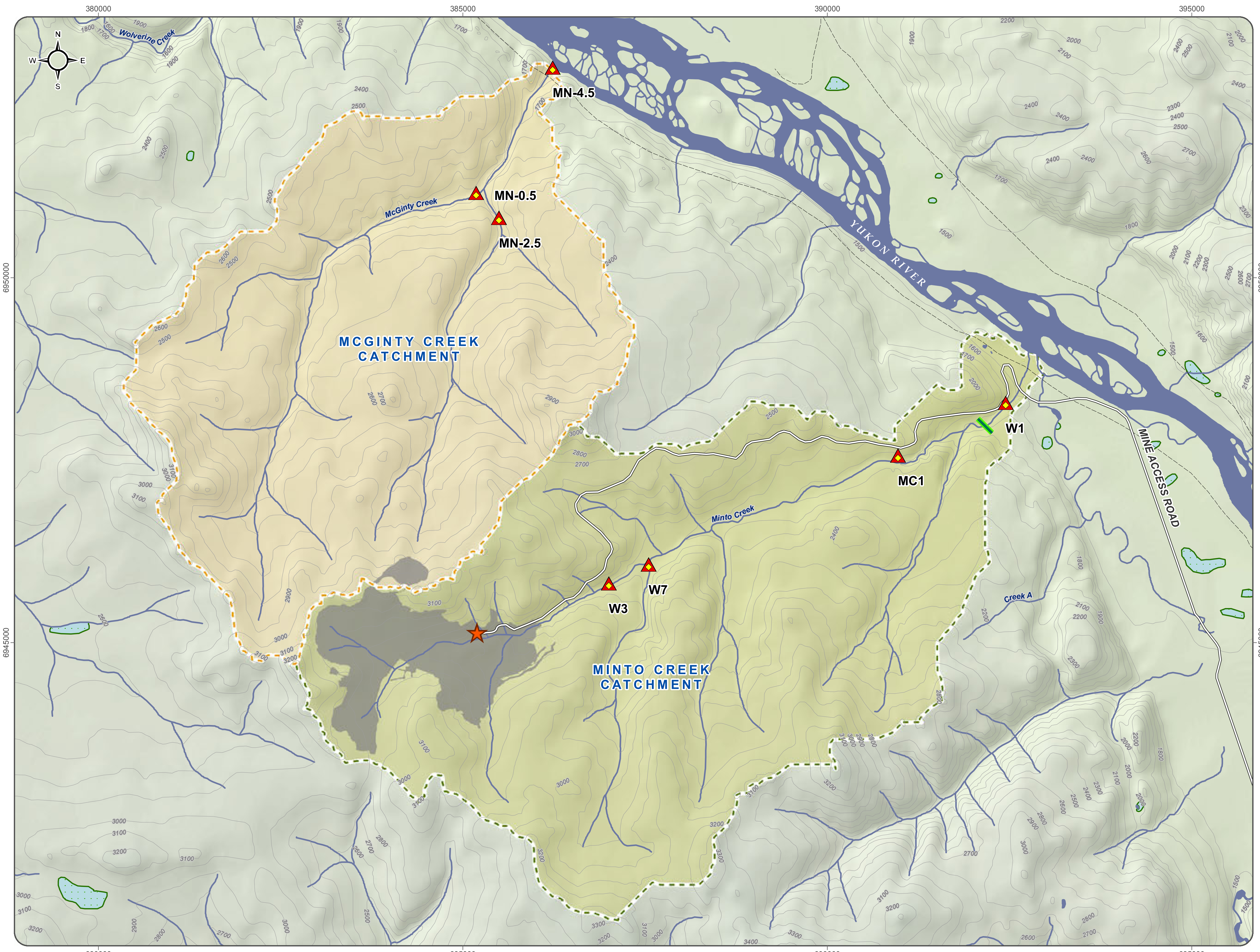
4.0 SURFACE WATER HYDROLOGY

The baseline surface water hydrology of the Minto Creek watershed prior to mining activity was detailed in Clearwater Consultants Ltd. Memorandum CCL-MC6 *Minto Copper Project—Surface Water Hydrology Conditions* (CCL, 2010). CCL-MC6 also covered conditions during Mine Operations until 2009. A subsequent report was prepared by ACG to update CCL-MC6 by presenting those previous data, and data gathered since then until the end of the 2012 open water season (ACG, 2013). Additionally, this report included data since 2009 gathered in McGinty Creek, a catchment of similar size to Minto Creek, also draining into the Yukon River and located directly north of the Minto Creek catchment (**Figure 4.1**). An updated Minto Mine Site Characterization – Hydrometeorology report is presented in **Appendix 1-2**.

Hydrological data have been gathered by either ACG or Minto representatives. Data coverage from year to year varies, depending on when in situ dataloggers were installed and removed, and when instantaneous discharge measurements were taken. Instantaneous discharge is measured using the velocity-area method and a current meter. Solinst Water Leveloggers are used to collect continuous stage readings which are then corrected based on physical staff gauge measurements. The records are processed into continuous discharge based on the stage-discharge relationship. This relationship (stage and discharge) is established each season through rating measurements obtained during regular field visits to the sites.

The locations for which the greatest amount of data have been collected are stations W1, Minto Creek near the mouth (catchment area of 42 km^2); and W3, Minto Creek downstream of water storage pond dam (catchment area of 10.4 km^2 area). In 2010, another continuously monitored hydrometric site called MC1 was added, approximately 2 km upstream of W1. In 2011, data collection did not allow for processing of stage records into continuous discharge; however, improved monitoring allowed for successful processing in 2012.

In addition to Minto Creek, the catchment to the north has been monitored since 2009 to support development of the Minto North deposit and is referred to as McGinty Creek. There are five stations on McGinty Creek at which discharge is measured. In 2009, four stations were established including MN-4.5, MN-2.5, MN-1.5 and MN-0.5; in 2011 a fifth site, MN-0.2, was added (**Figure 4.1**). Continuous hydrometric data has been collected at MN-4.5 since 2009, and additional continuous logging instruments were added to stations MN-2.5 and MN-0.5 in late 2012.



MINTO MINE
SITE CHARACTERIZATION PLAN

FIGURE 4-1
MINTO AND MCGINTY CREEK HYDROMETRIC MONITORING NETWORK AND CATCHMENT AREAS

OCTOBER 2021

MINTO

- Water Quality and Hydrometric Monitoring Station
- Observed Fish Barrier - Minto Creek
- Mine Footprint
- McGinty Creek Catchment
- Minto Creek Catchment
- Wetland
- Minto Access Road
- Contours (100ft)

1:50,000 *when printed on 11 x 17 inch paper*

0 500 1,000 1,500 2,000 Meters

ENSERO solutions

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\04-WaterQuality\04-Minto and McGuinty WQ\McGuinty_MInto_MineSite_Stns_20171016.mxd
(*Last edited by: amatlashevska;12/01/2018/11:24 AM*)

4.1 Minto Creek

Monitoring of hydrological parameters on Minto Creek began in 1993 and has continued intermittently at sites W1 and W3 (**Figure 4.1**). Monitoring has been more intensive since mine commissioning in 2007. W3 is an in-stream trapezoidal flume with a manufacturer-specified stage-discharge relationship. Both discharge and stage are read on an integrated gauge in the throat of the flume. A Solinst Levelogger record is calibrated with these field observations to process a continuous discharge record at this site. Flows at W3 are impacted by storage within, and discharge from the Water Storage Pond. Sites MC-1 and W1 are natural stream channels where manual velocity measurements are taken across the channel and discharge is calculated using the velocity area method. Continuous water levels from Solinst Leveloggers are processed into continuous discharge using these rating measurements. Updated mean monthly flowsfor W1 and W3 are presented in **Table 4.1** and **Table 4.2**, respectively.

Table 4.1 Mean Monthly Discharge (m^3/s) on Minto Creek at Station W1.

	Apr	May	Jun	Jul	Aug	Sep	Oct
1993						0.069	
1994		0.312	0.058	0.095	0.007	0.073	
1995		0.027	0.001	0.091		0.133	
1996		0.031	0.024	0.324		0.146	
1997		1.447			0.265		
1998		0.161			0.003		
1999					0.033		
2000		1.004					
2001		0.467					
2002							
2003					0.129		
2004				0.118			
2005		0.097	0.012	0.127	0.209	0.219	0.134
2006	0.203	0.354	0.15	0.02	0.0068		0.031
2007	0.645	0.175	0.053	0.061	0.025	0.034	0.035
2008		0.117	0.015	0.026	0.184	0.184	0.026
2009		0.868	0.351	0.249	0.139	0.026	
2010	0.560	0.081	0.038	0.106	0.118	0.125	0.092
2011			0.229	0.200	0.200	0.082	
2012		0.269	0.073	0.052	0.051	0.078	0.056 [2]
2013		0.485 [1]	0.064	0.065	0.044	0.085	0.059 [2]
2014		0.138 [1]	0.022	0.020	0.014	0.031	0.025 [2]
2015		0.117	0.010	0.010	0.030	0.024	0.020 [1]
2016	0.252 [1]	0.047	0.020	0.017	0.024	0.043	0.026
2017	0.127	0.085	0.074	0.014	0.011	0.017	0.030

	Apr	May	Jun	Jul	Aug	Sep	Oct
2018		0.132	0.093	0.039	0.009	0.006	
2019		0.078	0.073	-[3]	-[3]	-[3]	0.002
2020		0.076	0.024	0.046	0.047	0.032	0.046
Mean							
Pre-Mine 1993 to 2006	0.203	0.433	0.049	0.129	0.093	0.128	0.083
Mining Period 2007 to 2020	0.388	0.208	0.081	0.070	0.069	0.060	0.039
All Data 1993 to 2020	0.351	0.300	0.073	0.089	0.077	0.079	0.046

Notes: [1] Based on incomplete or derived data
[2] Based on multiple discrete measurements
[3] Creek dry or data unreliable

Table 4.2 Mean Monthly[1] Discharge (m^3/s) on Minto Creek at Station W3.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993									0.028			
1994					0.101	0.028	0.039	0.011	0.028			
1995						0.004	0.017		0.027	0.008		
1996					0.013		0.087		0.021			
1997					0.554							
1998								0.006				
1999								0.006				
2000												
2001					0.160							
2002												
2003								0.037				
2004							0.026					
2005					0.046	0.008	0.014	0.017	0.022	0.020		
2006				0.018	0.128	0.042	0.006	0.015	0.009	0.010		
2007				0.001	0.012	0.009	0.006					
2008								0.064[2]	0.122[2]	0.003		
2009						0.026[2]	0.106[2]	0.092[2]	0.124[2]	0.110		
2010				0.002	0.004	0.005	0.034	0.071	0.086	0.070		
2011						0.005	0.005	0.006	0.005			
2012				0.004	0.020	0.003	0.004	0.004	0.004	0.004		
2013						<0.001	<0.001	0.002	0.003	0.003	0.003	0.006
2014	0.003	0.006	0.006	0.057	0.086	0.003	0.003	0.003	0.004	0.004	0.004	0.006
2015	0.004	0.002	0.001	0.075	0.052	0.003	0.003	0.004	0.004	0.004	0.004	0.003
2016				0.022	0.052	0.003	0.003	0.004	0.004	0.004	0.003	0.004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	0.030	0.020	0.010	0.010	0.016	0.018	0.005	0.008	0.007	0.012	0.010	0.015
2018	0.037	-[4]	-[4]	-[4]	-[4]	0.041	0.022	0.015	0.013	0.012	0.018	-[4]
2019	-[4]	-[4]	-[4]	-[4]	-[4]	0.054	0.012	0.013	0.013	0.014	0.010	-[4]
2020	0.003	0.002	0.002	0.006	0.004	0.003	0.003	0.003	0.003	0.005	0.002	0.002
Mean												
Pre-Mine 1993 to 2006	-[3]	-[3]	-[3]	-[3]	0.167	0.02	0.032	0.015	0.023	0.013	-[3]	-[3]
Mining Period 2007 to 2020	0.015	0.008	0.005	0.022	0.031	0.013	0.009	0.012	0.013	0.020	0.007	0.006
All Data 1993 to 2020	0.015	0.008	0.005	0.022	0.089	0.015	0.017	0.013	0.017	0.019	0.007	0.006

[1]Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

[2]Flows impacted by storage within, and emergency releases from, the Water Storage Pond in August and September 2008 and in June through October 2009.

[3]Insufficient data for calculation.

[4]Unable to obtain accurate readings due to ice build-up in and around flume.

Table 4.3 shows the discharge data gathered to date at station MC-1 and **Table 4.4** shows data available at station W7.

Table 4.3 Mean monthly discharge (m^3/s), Minto Creek at MC-1.

	Month					
Year	May	Jun	Jul	Aug	Sep	Oct
2011					0.118	0.093
2012	0.179	0.065	0.052	0.041	0.108	-
2013	0.358	0.085	0.103	0.044	0.089	0.064 [2]
2014	0.187	0.028	0.031	0.036	0.028	0.033 [2]
2015	0.862 [2]	0.014	0.028	0.042	0.035	0.031 [1]
2016	-	0.029 [1]	0.036	0.048	0.076	-
2017	0.074	0.074	0.018	0.010	0.028	0.029
2018	0.056	0.038	0.015	0.025	0.021	0.009
2019	-	0.045	0.005	0.011	0.030	0.021
2020	0.074	0.040	0.034	0.036	0.050	-
Mean	0.256	0.047	0.036	0.033	0.058	0.040

Notes: [1] Based on incomplete or derived data

[2] Based on multiple discrete measurements

Table 4.4 Mean monthly discharge (m³/s), Minto Creek at W7.

	Month					
Year	May	Jun	Jul	Aug	Sep	Oct
2013			0.013	0.031	0.019	0.006
2014	0.112					
2015		0.006	0.004	0.011	0.011	0.029
2016		0.006	0.010	0.010	0.013	0.010
2017		0.014	0.007	0.012	0.009	0.006
2018		0.005	0.007	0.007	0.007	0.006
2019		0.003	Creek Dry	0.004	0.004	
2020		0.007	0.009	0.020	0.008	0.015
Mean	Insufficient Data	0.007	0.008	0.014	0.010	0.012

Notes: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

4.2 Mcginty Creek

McGinty Creek has two main sub-catchments that each have two water quality monitoring stations, one just above the confluence and one near the headwaters. MN-4.5 is located on the main stem below the confluence of the tributaries near the mouth; just above the Yukon River (**Figure 4.1**). MN-0.5 and MN-0.2 are the lower and upper stations on the west tributary, respectively. MN-2.5 and MN-1.5 are the lower and upper stations on the east tributary, respectively. Stations MN-0.2 and MN-1.5 are not set up with continuous loggers and generally exhibit very low flows. As such they are not included in the discussion below.

Table 4.5 Mean monthly discharge (m³/s), McGinty Creek at MN-4.5.

	Month						
Year	Apr	May	Jun	Jul	Aug	Sep	Oct
2009	-	0.018 [1]	0.033	0.019	0.031	0.016	0.013 [1]
2010	-	0.028 [1]	0.051	0.079	0.047	0.034	-
2011	-	0.444	0.093	0.125	0.134	0.068	0.045 [1]
2012	0.212 [1]	0.230	0.180	0.082	0.053	0.109	-
2013	-	-	0.054 [1]	0.103	0.093	0.116	-
2014	-	0.230 [1]	0.041	0.037	0.026	0.046 [1]	-
2015	-	-	0.013	0.046	0.049	0.029	0.029 [1]
2016	-	0.017 [1]	0.015	0.026	0.028	0.028	0.010 [1]
2017	-		0.021	0.020	0.004	0.011	0.005
2018	-	0.031	0.021	0.005	0.021	0.022	0.006
2019	0.011	0.027	0.079	0.013	0.001	0.002	0.001
2020	-	0.082	0.002	0.051	0.038	0.028	0.031
Mean	-	0.123	0.003	0.077	0.070	0.039	0.058

Notes: [1]Based on incomplete or derived data

Table 4.6 Mean monthly discharge (m³/s), McGinty Creek at MN-2.5.

	Month						
Year	Apr	May	Jun	Jul	Aug	Sep	Oct
2014 [1]	-	0.032	-	-	-	-	-
2015 [1]	-	0.015	0.003	0.011	0.038	0.010	0.010
2016 [1]	0.034	0.08	-	-	0.009	0.014	0.003
2017	-	0.073	0.008	0.004	-	-	-
2018	-	-	0.011	0.011	0.014	0.014	0.019
2019	-	-	0.006	0.006	0.006	0.006	0.007
2020	-	-	0.002	0.019	0.021	0.019	0.022
Mean	[2]	0.032	0.006	0.010	0.018	0.013	0.012

Notes: [1]Based on incomplete or derived data

[2]Insufficient data for calculation

Table 4.7 Mean monthly discharge (m³/s), McGinty Creek at MN-0.5.

	Month						
Year	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
2014 [1]	-	0.045	-	-	-	-	-
2015 [1]	-	0.035	0.013	0.054	0.098	0.029	0.025
2016 [1]	-	0.028	0.016	0.010	0.016	0.035	0.018
2017	-	0.022	0.022	0.009	0.013	-	2017
2018	0.045	0.030	0.016	0.021	0.025	0.041	2018
2019	-	0.018	0.008	0.007	0.008	-	2019
2020	-		0.055	0.055	0.029	0.046	2020
Mean	0.038	0.020	0.028	0.034	0.023	0.032	Mean

Notes: 1 Based on incomplete or derived data

5.0 SURFACE WATER QUALITY

Surface water quality is a key consideration in the evaluation of potential effects of mining and mineral development projects. Effects from mining activities can be observed for significant distances downstream and changes to water quality parameters have the potential to impact aquatic resources and to affect human use of water resources.

Surface water quality in and around the Minto Mine has been the subject of numerous characterization efforts since 1994. Minnow Environmental Inc. (Minnow) first characterized background water quality of Minto Creek to the end of 2008 within the report entitled Evaluation of the Background Water Quality of Minto Creek and Options for the Derivation of Site Specific Water Quality Objectives (Minnow 2009). In 2010, Minnow prepared the Characterization of Baseline and Operational Water Quality of Minto Creek including water quality results to the end of 2009 (Minnow 2010). The Minnow 2009 evaluation report focused on defining background concentrations of key metals to represent Minto Creek as a whole and for potential application as site-specific water quality objectives in lower Minto Creek (Minnow 2009). The Minnow 2010 report characterized water quality for discrete time intervals of relevance to the mine (Minnow 2010). In 2014, Access Consulting Group (ACG) and Minnow worked in conjunction to update the water quality characterization for Minto Creek (including data collected between 2005 and 2012). The 2017 Site Characterization Plan provided an update to the 2014 characterization of Minto Creek water quality and included January 2005 to December 2015 monitoring data. This update also included a dedicated evaluation of background water quality data, which was commissioned to support the development of post-closure water quality objectives, an initiative that was undertaken as a collaboration with Selkirk First Nation representatives in the Bilateral Technical Working Group. The report Background Water Quality of Lower Minto Creek for Application in the Derivation of Post-Closure Water Quality Objectives was issued in 2016 (Minnow, 2016).

For this report, surface water quality at the Minto Mine site and downstream water courses was characterized using data collected from January 2005 to May 2021 (**Appendix 1-3**). The water quality characterization was organized by grouping data into areas including critical water management monitoring locations in the Minto Mine site operational area, the mainstem of Minto Creek, the Minto North Pit, and McGinty Creek. Minto Creek receiving environment data were further divided into periods of active effluent discharge and no discharge from the mine site. Where applicable, comparison of water quality was made to the effluent quality standards (EQS) and water quality objectives (WQO) stipulated within water use licence (WUL) QZ14-031. Summary statistics are presented with graphical plots of concentrations over time at key water quality monitoring stations in **Appendix 1-3**.

5.1 Water Quality Sampling Locations

There are two catchments: Minto Creek and McGinty Creek. Sites were selected upstream and downstream of the mine footprint, where possible.

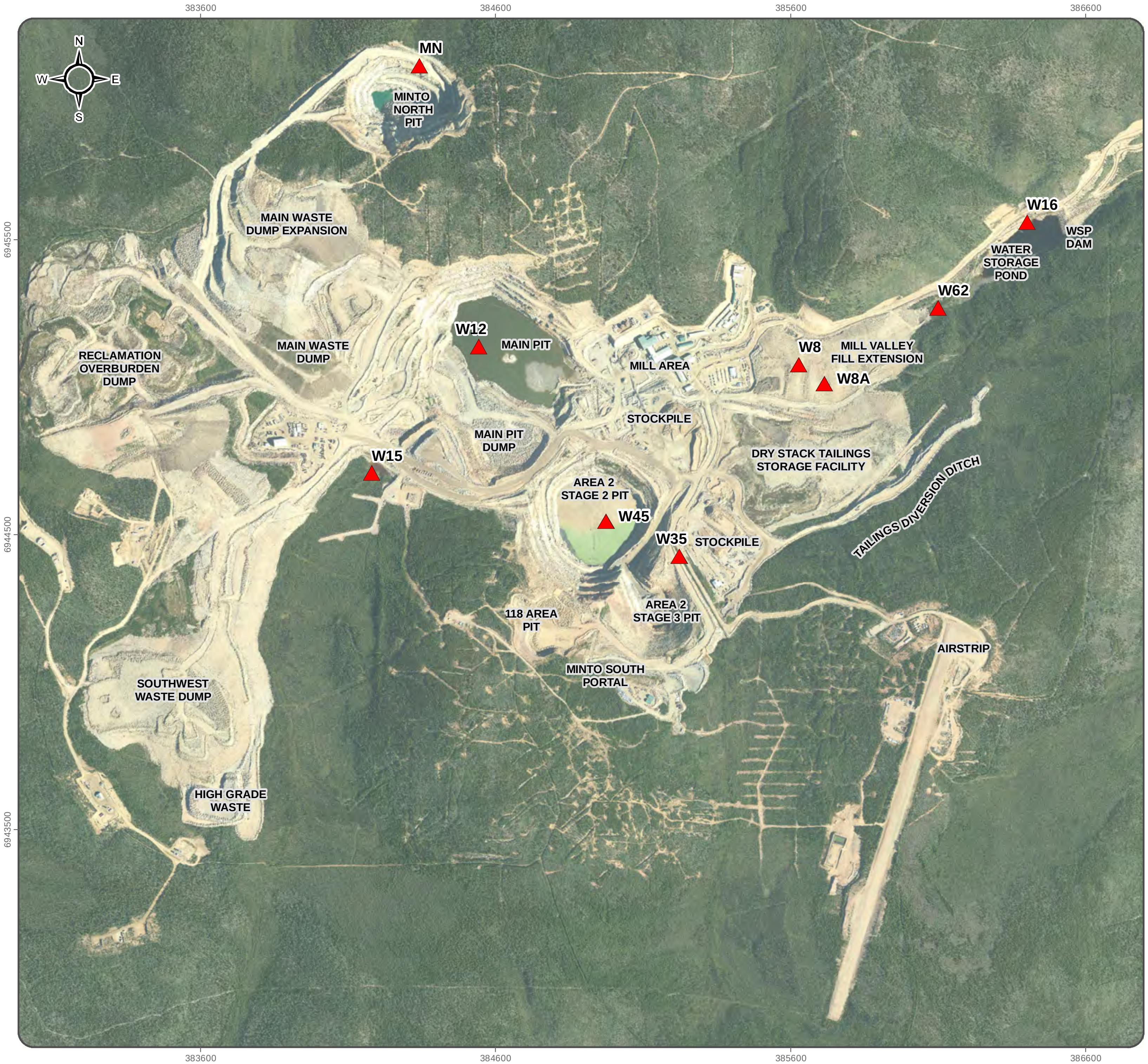
Key monitoring stations were selected for inclusion in this characterization of water quality, and were organized into four distinct groupings:

- Minto Mine Site (**Table 5.1, Figure 5.1**);
- Minto North Pit (**Figure 5.1**);
- Minto Creek (

- Table 5.2, **Figure 5.2**); and
- McGinty Creek (**Table 5.3**, **Figure 5.3**).

Table 5.1 Minto Mine Site Water Quality Monitoring Locations

Station	Description / Location
Upper Mine Site	
W12	Main Pit
W15	Minto Creek, d/s of Southwest Waste Rock Dump
W35	Inflow to Tailings Diversion Ditch
W55	Outflow of Tailings Diversion Ditch
W45	Area 2 Pit Stages 1 & 2
W51	Area 2 Pit Stages 3 & 4(now the primary monitoring station for Area 2 Pit complex)
Lower Mine Site	
W8	Dry Stack Tailings Storage Facility drainage, west
W8A	Dry Stack Tailings Storage Facility drainage, east
W16	Water Storage Pond
W17	Sump at toe of Water Storage Pond Dam
W62	Sump at toe of Mill Valley Fill Extension



MINTO MINE

SITE CHARACTERIZATION PLAN

FIGURE 5-1

MINE SITE MONITORING STATION LOCATIONS

OCTOBER 2021

MINTO

Surface Water Surveillance Program Monitoring Station Locations

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

0 100 200 300 400 500 Meters

ENSERO solutions

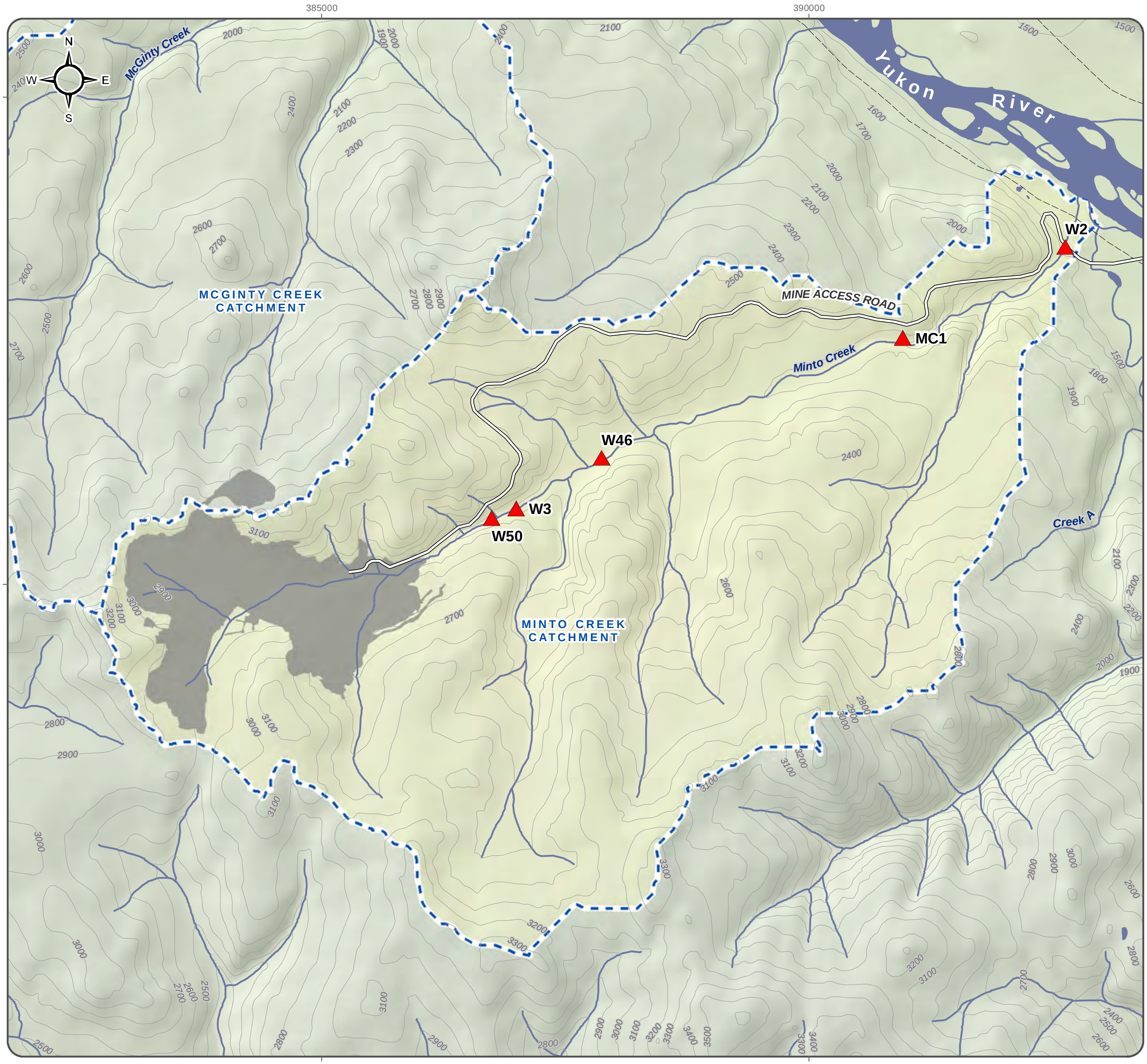
Aerial imagery obtained from Challenger Geomatics. Imagery acquired August 3rd [th] 2017.

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\04-WaterQuality\01-Mine_Site\SWQ_Mine_Site_Letter_20171122.mxd

Table 5.2 Minto Creek Water Quality Monitoring Stations

Station	Description / Location
W50	Minto Creek, approximately 50m downstream of toe of WSP dam
W3	Downstream of Water Storage Pond dam, MMER Final Discharge Point (Flume) – Effluent
MC1	Receiving Environment station upstream of the canyon fish barrier on Minto Creek.
W2	Lower Minto-Creek at Road Crossing – Receiving Environment station in reach with documented fisheries usage.



MINTO MINE
SITE CHARACTERIZATION PLAN

FIGURE 5-2

MINTO CREEK MONITORING STATION LOCATIONS

OCTOBER 2021

MINTO

- Surface Water Surveillance Program Monitoring Station Locations
- Catchment
- Mine Footprint
- Minto Access Road
- Trail

1:55,000 *when printed on 8x11 inch paper*

0 500 1,000 1,500 2,000

Meters

ENSERO solutions

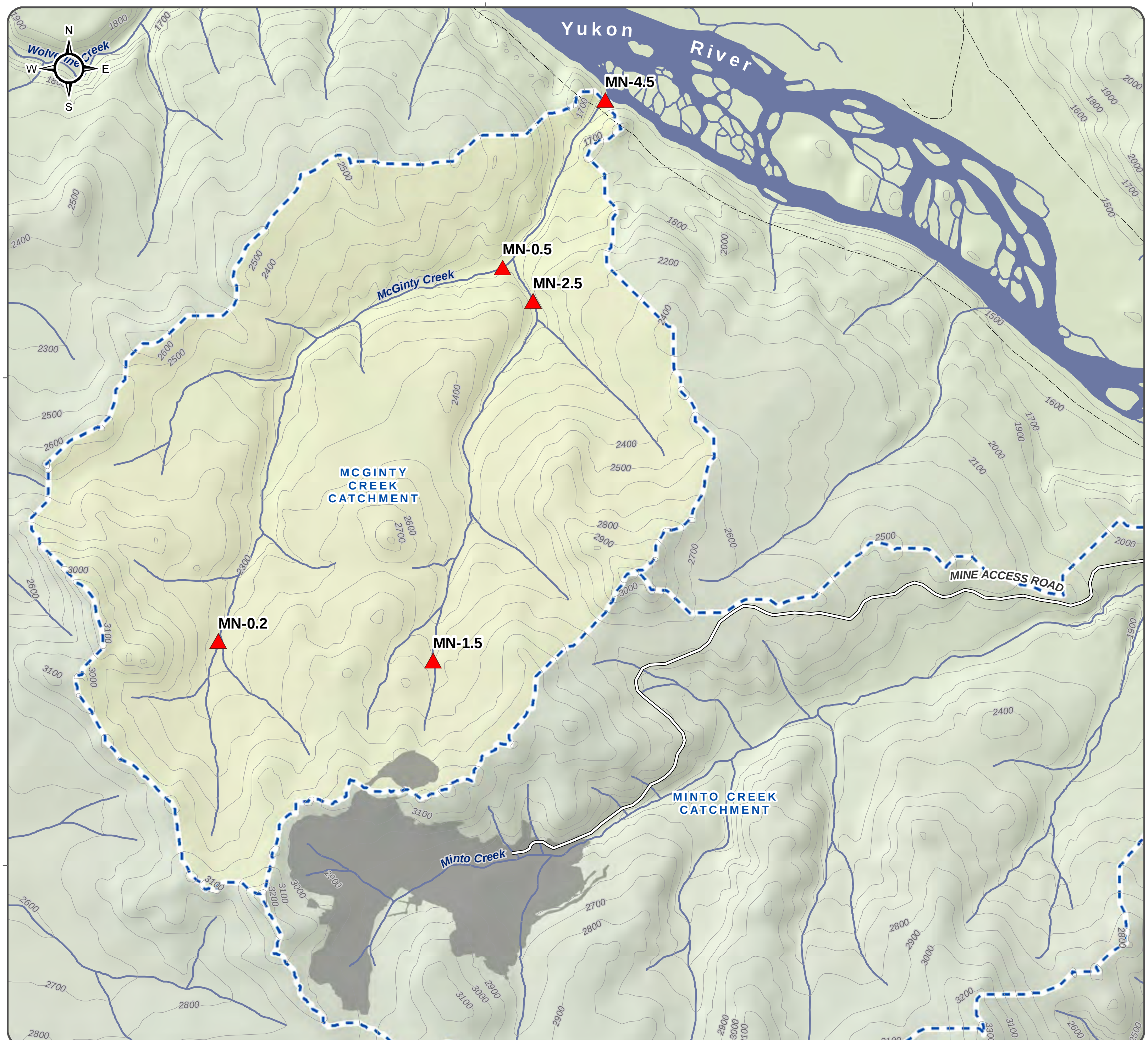
National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\04-WaterQuality\04-Minto and McGuinty WQ\MintoCreek_Stns_Letter_2010112.mxd

Table 5.3 McGinty Creek Water Quality Monitoring Stations

Station	Description / Location
East Arm of McGinty Creek	
MN-1.5	Upper east arm of McGinty Creek downstream of the Minto North deposit
MN-2.5	East arm of McGinty Creek just upstream of confluence with the west arm
MN-4.5	Lower mainstem McGinty Creek near confluence with Yukon River
West Arm of McGinty Creek (Reference Stations)	
MN-0.2	Upper west arm of McGinty Creek
MN-0.5	West arm of McGinty Creek just upstream of the confluence with the east arm



MINTO MINE
SITE CHARACTERIZATION PLAN

FIGURE 5-3

MCGINTY CREEK WATER QUALITY MONITORING STATION LOCATIONS

OCTOBER 2021

MINTO

Surface Water Surveillance Program Monitoring Station Locations

Catchment

Mine Footprint

1:55,000 *when printed on 8x11 inch paper*

0 500 1,000 1,500 2,000

Meters

ENSERO solutions

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\04-WaterQuality\02-McGuinty Creek\McGuintyCreek_Stns_Letter_20180112.mxd

Procedures for collecting data and information on conditions in streams of the study area have used methods consistent with standards under Yukon and federal legislation. Techniques are discussed in the EMSRP, 2016-2.

The pH of the Mine Site, Minto North Pit, Minto Creek, and McGinty Creek waters was predominantly circumneutral to slightly alkaline. Nitrogen species concentrations were generally highest in the pits and DSTSF collection sites reflecting leaching of nitrogen residue from blasting activity. All nitrogen species in the pits showed marked reduction during periods when blasting was not taking place - in the Minto North Pit following cessation of mining activities and in the Main and Area 2 Pits during temporary closure. Nitrate-N levels showed marked seasonality in Minto Creek sites within the site and downstream of the site and in McGinty Creek with higher concentrations in the winter and lower concentrations in the spring and summer, responding to nitrogen uptake demand by primary producers and dilution from spring meltwater. Nitrate-N levels were typically higher in Minto Creek during and following mine discharge periods. Dissolved organic carbon (DOC) concentrations were often highest during spring snowmelt likely due to flushing of labile organic carbon from soils. Higher DOC levels were also observed in late summer in sampling locations farther downstream in Minto Creek and McGinty Creek.

At all flowing sites, dissolved hardness concentrations were typically lowest during spring snowmelt and increased through the year, peaking in winter, suggestive of a marked groundwater component to hardness levels. Dissolved iron, and to a lesser extent aluminum, were often observed at concentrations higher than expected from equilibrium with their oxyhydroxide minerals under the prevalent oxidizing, circumneutral pH conditions. Reasonable correlations between dissolved iron and DOC at several sites on the mine site and in McGinty and Minto Creek suggest complexation with dissolved organic matter likely maintains these elevated dissolved iron and aluminum levels.

On the Mine Site, dissolved copper concentrations were highest in the collection sites and tended to peak with freshet, suggestive of some association with DOC. Dissolved copper concentrations in Minto Creek were higher during and following mine discharge periods, particularly during the emergency site discharge period of June 26 to August 6, 2009. Dissolved copper concentrations in McGinty Creek also tended to be higher during spring snowmelt, correlating reasonably well with DOC concentrations.

Dissolved concentrations of selenium, sulphate and molybdenum increased in the pits from 2013 to 2016. Selenium and molybdenum concentrations returned to pre-2013 levels by 2019, however sulphate levels remain at higher concentrations but appear to have recently stabilized. In Minto Creek and downstream of the mine site and in McGinty Creek, selenium exhibited seasonal cycling with concentrations lowest at freshet, then rising through the year, peaking in winter, suggestive of a strong groundwater contribution. The opposite pattern was observed in the DSTSF collection sites where selenium levels oscillated on an annual basis between summer peaks and winter troughs. Dissolved selenium concentrations in Minto Creek downstream of the mine site were higher during and following mine effluent discharge periods, while in McGinty Creek higher selenium concentrations were observed in the west arm (reference tributary) of McGinty Creek than the east arm.

6.0 GROUNDWATER

Current groundwater conditions for the Minto Mine are presented in multiple reports with a description of each provided in the Groundwater Characterization, Conceptual and Numerical Model Update Report (SRK 2021). Groundwater conditions at the Minto site are monitored as part of the Minto Mine Environmental monitoring, surveillance and reporting plan (EMSRP 2017-2) with monitoring data reviewed as part of the Operational Adaptive Management Plan (OAMP, 2017-02). SRK 2021 provides an update to the 2018 Groundwater Characterization and Conceptual Model Update Report (SRK 2018) and includes physical and chemical groundwater monitoring results, isotopic environmental tracers, hydrogeological conceptual models for Minto and McGinty Creek catchments and an update to the groundwater numerical model (**Appendix 1-4A**). SRK (2021) presents a summary of groundwater quality and exceedances to specific performance thresholds (SPTs), as defined by the OAMP. The sum of this information is the basis for this section.

The Minto Creek and McGinty Creek conceptual models have not changed significantly from that presented in SRK 2018. The groundwater system is believed to be a relatively low flow, low conductivity, fracture-controlled flow system. The majority of flow is expected to occur relatively near to ground surface, where not frozen. Groundwater can flow into and out of the flooded Main Pit or A2 Pits and is also intercepted by underground workings. The large majority of mine contact water is expected to ultimately discharge to ground surface by the area of the Water Storage Pond. Groundwater that does pass the Water Storage Pond has a limited flow rate and is expected to discharge to Minto Creek with contributions from unaffected catchments increasing progressively downstream.

Two different hydrogeochemical facies exist at Minto: a) a lower TDS $Ca\text{-}HCO_3$ to $Mg\text{-}HCO_3$ facies typically associated with shallow, fresh groundwaters or groundwater upgradient of the ore bodies, and b) a higher TDS $Ca\text{-}SO_4$ to $Na\text{-}SO_4$ facies associated with groundwater topographically downgradient of the ore bodies. In terms of groundwater quality, the concentrations measured at the Minto Mine are largely within the range of observed baseline conditions. A low number of consistent SPT exceedances occur for sulphate (MW12-05-01, -02, and 03) and chromium (MW12-06-01) within the Minto Creek catchment, and for arsenic (MW09-03-01) and cadmium, nitrate, and zinc (MW09-03-02) within the McGinty Creek catchment.

Elevated sulphate concentrations in groundwaters near sulphide-containing ore bodies are not uncommon due to interaction with sulphur bearing minerals along the groundwater flow paths. While sulphate concentrations have been increasing and exceeding thresholds in the deeper zones, all available evidence suggest they are not related to mine activities but naturally occurring due to interaction with the sulphur-bearing minerals of the ore body and equilibration following well installation. The exceedances of chromium are thought to be caused by changes in redox conditions related to pressure changes resulting from underground mining activities, and not from mine affected waters infiltrating into groundwater. The elevated nitrate is also interpreted to occur from a change in redox conditions subsequent to the development of the Minto North Pit, as well as a contribution of nitrogen load from the construction of a haul road using blasted rock. Arsenic, cadmium, and zinc may also be attributed to a change in aquifer conditions.

The groundwater numerical model was modified according to the latest site data and upgraded to reproduce the surface and underground mining sequence. The model replicated the full mine progression from 2005 to 2007 and predicted the inflows and infiltration to/from pits and underground between 2007 and 2027, extents that mine affected waters would have travelled by end of mining, and how much load would have discharged to surface. The numerical model estimates that concentrations away from mine sources are low and that plumes had not reached surface receptors, which is generally consistent with the conceptual model and observed data.

6.1 Water Balance Model

The water balance for the Minto Mine and the quality of water at various stations across the site are monitored and tracked on and on-going basis. The water balance is formally updated and documented as part of annual reporting in March of each year (Minto 2021). In addition to monitoring and tracking, Minto uses water balance models to forecast the site water inventory and water management requirement as part of ongoing mine planning. Excel-based spreadsheet models are typically used for short-range planning (up to about 5 years) while a model developed in the software Goldsim typically is used for longer-range planning and forecasts.

The water quality model for Minto Mine is integrated with the long-range Goldsim water balance model. The model represents all sources of constituent loadings that have the potential to meaningfully affect the quality of water stored in the open pits or the quality of the receiving waters downstream of the site (primarily Minto Creek, McGinty Creek and the Yukon River).

In 2021, Minto retained SRK Consulting (SRK) to complete a comprehensive update of the Goldsim water balance and water quality model (referred to as the Water and Load Balance model) for the mine. The last comprehensive model update prior to this was in 2018 when the model was updated as part of the Minto Mine 2018 Reclamation and Closure Plan (RCP) update (SRK 2018). The first revision of the Goldsim water and load balance model was developed in 2010 as part of the planning for Phase IV of the mine development (SRK 2010). A number of major and minor model revisions were developed between 2010 and 2018 to simulate the ongoing development of the site:

- The initial phase of production at Minto began in 2007 and included mining of the Main Pit which was completed in 2011.
- In 2012, the Phase IV expansion was approved and mining advanced into two new open pits (Area 118 and Area 2) and an underground development (Minto South).
- The Phase V/VI application included three new open pits (Minto North, Ridgetop South, and Ridgetop North), an expansion to the previously mined Area 2 Pit and three new underground developments (Minto East, Copper Keel and Wildfire).
- Mining of the Minto North Pit, Area 2 Pit and M Zone underground are now complete with development on-going in the Minto East, and Copper Keel/ Wildfire underground areas (which have since been re-grouped and are referred to only as Copper Keel).
- Mining of Ridgetop via open pit is planned for the future.
- The Phase VII expansion plan consists of additional underground mining targeting the Minto East 2 and Minto North 2 ore zones. Both are a continuation of previously mined deposits in each area and are currently awaiting regulatory approval.

The 2021 model update included a review and update of the source term inputs to the model and an update to the model itself to reflect the Phase VII expansion and changes to the overall mine plan that have been made since the previous water and load balance update completed in 2018.

The objectives of the 2021 water and load balance update were to support the Minto Mine Site Characterization Plan update that is a requirement of Minto's Quartz Mining Licence (QML-0001, Section 13.1) and to reflect current site conditions with available data collected up to the end of 2020. The model covers the end of the operations phase, as well as the active closure and post-closure phases.

The main components of the water balance portion of the model include:

- Inputs: annual net catchment yield (surface and groundwater inflows combined).
- Outputs: water discharged to Minto Creek.
- Water inventory: water stored in the Main Pit Tailings Management Facility (MPTMF), the Area 2 Pit Management Facility (A2PMTF), and Water storage Pond (WSP).

The net catchment yield is based on annual precipitation rates, open water evaporation rates, sub-catchment areas, the site-wide yield coefficient, and the typical hydrograph. Water storage on the mine site is modelled using the measured open water volumes and the tailings and waste rock deposition schedules. The groundwater is modelled using estimated seepage rates to and from the open pits and measured underground dewatering rates. Finally, the water discharged to Minto Creek is based on historical pumping rates and estimated pumping rates required to maintain appropriate operating water levels in the open pits.

The load balance (water quality) model relies on geochemical source terms for estimates of constituent loadings from various mine areas but primarily waste rock and tailings. For this update, all source terms were reviewed, and some were updated. The source term review and updates are described in **Appendix 1-8**. The source terms represent dissolved loadings only as this is consistent with the dissolved nature of both the effluent standards and receiving environment water quality objectives in the current site water use licence (WUL QZ14-031).

The key updates to the water and load balance model include:

- Source term updates (where required).
- Inclusion of mine components associated with the Phase VII expansion.
- Ridgetop Pit configuration update: inclusion of a single pit (Ridgetop Pit) as opposed to a previous plan that included two pits, Ridgetop North and Ridgetop South.
- Adjustments to catchments to reflect current site conditions and future developments, and
- Introduction of the Main Pit Dam (completion planned for 2022) which increases the tailings storage capacity in the Main Pit by approximately 2.7 million m3.

The addition of the Main Pit Dam is a key element of the current operational water and tailings management plan as it adds substantial tailings storage capacity. This model update includes scenarios with and without the additional tailings storage capacity created by the construction of the Main Pit Dam.

Key water and load balance results include:

- The current water inventory in A2PTMF and MPTMF must be reduced to free up storage capacity needed for tailings deposition and to ensure that 1 Mm3 of available storage capacity in available in October of each year.
- Conditions of the current Water Use Licence (WUL QZ14-031) means that treated effluent from the site must meet the lower (more restrictive) Water Quality Objectives (WQOs) for sufficient water to be discharged from site. Only a limited quantity of water meeting the less restrictive Effluent Quality Standards (EQS) can be discharged from site.
- Constituents that currently exceed or are expected to exceed WQOs in A2PTMF and MPTMF water, include ammonia, nitrite, nitrate, dissolved copper, and selenium.

Plans are underway to develop water management measures to address the excess water inventory.

Detailed descriptions of the 2021 water and load balance update, methods and results are included **Appendix 1-4B**.

7.0 WILDLIFE

Wildlife assessments were completed within, or near, the Project area between 1994 and 2017. This section summarizes the results of wildlife surveys conducted in the area to date, identifies species of concern, and lists ongoing and/or near-future surveys to be completed. The last update on the number and types of wildlife studies that have been conducted in the Minto Mine area was in a comprehensive 2010 report produced by EBA Engineering Consultants Ltd (EBA), titled *Minto Mine, Environment BaselineReport – Wildlife*.

7.1 Environmental Setting

The Minto Mine is located within the Boreal Cordillera ecozone and in the western part of Yukon Plateau Central ecoregion (Smith et al., 2004). The Minto Mine is situated in the far western part of the Yukon Plateau-Central ecoregion near the Dawson Range and adjacent to the Klondike Plateau ecoregion in thewest. The area was part of the eastern extent of Beringia, which remained ice-free approximately twenty to fifteen thousand years ago during the last maximum glacial period (Smith et al., 2004).

The Minto Mine is in the eastern part of the Dawson Range the local elevation ranges from 700 m to 950 m; the general landscape is composed of rounded mountains intersected by broad valleys and drainages that flow into the Yukon River. The access road starts on the western side of the Yukon River, at the barge landing site, continues north along the Yukon River and then turns southwest up the Minto Creek valley for 12 km to reach the Minto Mine site.

Forest fires are frequent in this region as less than 300 mm of precipitation falls per year due to the rain shadow formed by the St. Elias-Coast Mountains in the west. As a result, the study area around Minto Mine has experienced numerous fires over the last thirty years, rendering it into a complex mosaic of plant communities at various stages of succession. The oldest pertinent fire burned approximately 7,236ha in 1980, the second and more extensive fire occurred in 1995 and burned approximately 55,521 ha (GYWFM, 2012). The 1995 burn occurred along the access road by the Yukon River barge landing and justwest of the airstrip as shown in. The most recent fires occurred in 2010 and 2011, these small fires only consumed 17 hectares within the Minto claims, southeast of the airstrip.

The fire-disturbed areas are now regenerating and young forest or shrub ecosystems dominate the Minto area (Oswald and Brown, 1990). Willows (*Salix sp*.) and trembling aspen (*Populus tremuloides*) are the most represented species in crown cover at present. Lodge pole pine (*Pinus contorta latifolia*) is a later successional species and will gradually dominate well-drained mid and upper slopes. Shade-tolerant white spruce is the regenerating climax tree species currently found in the understory as seedlings. White spruce will eventually overgrow the pine and trembling aspen communities. Black spruce (*Picea mariana*) is alsoa climax species that is adapted to wetter, cooler sites, and is often the persistent species in white/black spruce-mixed areas along slope toes, valley bottoms and northern aspects. Small grasslands are scattered along dry crests and steep south-facing slopes, these locations do not retain enough moisture to sustain tree growth.

The diversity of vegetative communities and successional stages around the Minto Mine provides a variety of habitat niches that support approximately 46 species of mammal (insectivores, bats, lagomorphs, rodents, carnivores, and ungulates), 60 species of birds, and one species of amphibian, the wood frog (*Rana sylvatica*). The list of mammals and bird species known to exist in the Minto area and/or the Yukon Plateau-Central ecoregion is included in EBA's 2010 baseline report.

7.2 Wildlife Baseline Assessments

lists the wildlife surveys and studies that have been conducted since 1994 in the Minto Mine area.

Table 7.1 Wildlife Surveys and Studies Undertaken in the Minto Project Area.

Dates	Type of Survey	Conducted By
Winter 2013	Late Winter Ungulate Studies (snow tracking surveys and aerial surveys)	EDI, Environment Yukon
Jan-March 2012	Late Winter Ungulate Studies	EDI, Environment Yukon
Fall 2012	Klaza Caribou Herd Study	Environment Yukon
March 2011	Late Winter Ungulate Study	Environment Yukon and EDI (on behalf of Casino Mining Corporation)
July 2010	Baseline Ecosystems and Vegetation Survey	Access Consulting Group
February 2010	Late Winter Moose Survey (Aerial)	Access Consulting Group
December 2010	Post-rut Moose Survey (Aerial)	Access Consulting Group
June 2009	Dall Sheep Survey (Aerial)	Environment Yukon
2007	Moose Survey	Environment Yukon
2003	Klaza Caribou Herd Survey	Environment Yukon
1994	Spring Wildlife Survey Spring Dall Sheep Survey Summer Raptor Survey Summer Wildlife Ground Pellet Survey	Hallam Knight Piesold Ltd.

The most recent wildlife baseline studies were led by the Yukon Government (YG) and were not designed specifically for the Minto Mine project. These studies encompassed the large Carmacks West Moose Management Unit and the Klaza caribou herd range, for a total area of 6,430 km^2 which overlappedthe Minto Mine site. The results from the YG surveys provide more statistically soundestimates of moose and caribou population levels, gender ratios and recruitment success for the overall region.

The 2010 Baseline Ecosystems and Vegetation Study (Access Consulting Group (ACG), 2010) was not primarily focused on wildlife; however, general wildlife observations were made during the vegetation survey, recorded on plot data sheets and wildlife mitigation recommendations were included in the report.

A wildlife log is maintained on site to track the animal sightings, details and behaviour in the site vicinity, and to monitor any human-wildlife interactions.

7.3 Wildlife Species of Conservation Concern in Yukon

The Minto Mine area and surrounding environment provide habitat for several species considered at riskby both the federal and territorial governments. lists species that have been assessed by the Committeeon the Status of Endangered Wildlife in Canada (COSEWIC) and/or the Yukon Government as needing special attention and protective legislation, so that remaining populations are not unduly stressed. The list consists of species whose range overlaps the Minto Mine area.

Table 7.2 Wildlife Species of Conservation Concern in Yukon.

Species	Status*	Source
Little Brown Bat (Myotis lucifugus)	Endangered	COSEWIC (2012)
Common Nighthawk (Chordeiles minor)	Threatened	COSEWIC (2007)
Olive-sided Fly Catcher (Contopus cooperi)	Threatened	COSEWIC (2007)
Barn Swallow (Hirundo rustica)	Threatened	COSEWIC (2011)
Canada Warbler (Wilsonia canadensis)	Threatened	COSEWIC (2008)
Peregrine Falcon (Falco peregrinus anatum - tundrius)	Special concern	COSEWIC (2007), Yukon Wildlife Act (2002)
Short Eared Owl (Asio flammeus)	Special concern	COSEWIC (2008)
Wolverine (Gulo gulo)	Special concern	COSEWIC (2014)
Grizzly Bear (Ursus arctos)	Special concern	COSEWIC (2012)
Northern mountain population of woodlandCaribou (Rangifer tarandus caribou)	Special concern	COSEWIC (2014), SARA (2002)
Collared Pika (Ochotona collaris)	Special concern	COSEWIC (2011)
Rusty Blackbird (Euphagus carolinus)	Special concern	COSEWIC (2017)
Gyrfalcon (Falco rusticolus)	Specially protected	Yukon Wildlife Act (2002)
Trumpeter Swan (Cygnus buccinator)	Specially protected	Yukon Wildlife Act (2002)
Mule Deer (Odocoileus hemionus)	Specially protected	Yukon Wildlife Act (2002)
Cougar (Puma concolor)	Specially protected	Yukon Wildlife Act (2002)
Bank Swallow (Riparia riparia)	Conservation concern	Yukon Environment (2011)
Northern Shrike (Lanius excubitor)	Conservation concern	Yukon Environment (2011)
Mountain Goat (Oreamnos americanus)	Conservation concern	Yukon Environment (2011)

* Status designations by COSEWIC are defined as:

Extinct - A wildlife species that no longer exists.

Extirpated - A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.

Endangered - A wildlife species facing imminent extirpation or extinction.

Threatened - A wildlife species that may become endangered if factors leading to its extirpation or extinction are not reversed.

Special Concern - A wildlife species that may become threatened or endangered because of its biological characteristics combined with environmental impacts.

The Yukon wildlife Act provides more legal protection for those wildlife species recognized as Specially Protected. Yukon Environment wildlife species of Conservation Concern are populations that are decreasing and require more monitoring.

There are currently eleven wildlife species in Yukon rated (in 2017) as threatened or of special concern by COSEWIC, of which ten species have ranges that could possibly encroach upon the area around Minto Mine. These include: grizzly bear (*Ursus arctos*), northern mountain woodland caribou (*Rangifer tarandus caribou*), wolverine (*Gulo gulo*), collared pika (*Ochotona collaris*), bank swallow (*Riparia riparia*), barn swallow (*Hirundo rustica*), rusty blackbird (*Euphagus carolinus*), olive-sided fly catcher (*Contopus cooperi*), common nighthawk (*Chordeiles minor*), short-eared owl (*Asio flammeus*), and peregrine falcon (*Falco peregrines anatum*).

One species, the little brown bat (*Myotis lucifugus*), has been classified by COSEWIC as an endangered species, which means they are in immediate danger of extinction or extirpation. Populations of these mammals have been seriously affected by a fungal infection known as White Nose Syndrome. The Minto Mine is within the northern extent of the summer range of the Little Brown Bat, although their existence within the area has not been verified.

The following sections provide brief descriptions of the most recent wildlife surveys conducted locally for Minto and surveys conducted by the Yukon Government that were larger in scale and included the Minto Mine area.

7.3.1 Moose

Current information regarding moose in the area came from the aerial surveys conducted by Environment Yukon and Environmental Dynamics Inc. (EDI) that covered a survey area that included the Minto Mine site. The average density of moose in the Yukon typically ranges from 100 to 250 moose/1,000km^2 (YukonGovernment, 2017a). Estimates of moose in the Minto Mine area have ranged from 20 to 127 moose/1,000km^2 (EDI, 2013).

7.3.1.1 Aerial Moose Survey – Late Winter 2011/2012, 2013

This late winter aerial survey covered 6,400 km^2 west and northwest of Carmacks. During this survey, a total of 311 moose were observed. The 2011 map shows a cluster of moose observation points around the Minto Mine and in the southeast highlands, indicating that this area has a high density of moose in the late winter as compared to most of the Regional Survey Area (G. Pelchat, pers. comm.). Minto Mine vicinity has been subjected to numerous fires in the last thirty years and the vegetation cover is dominated by tall shrubs, attractive habitat for moose with plenty of browse and cover.

In addition, the Yukon River is approximately 10 km to the east. This large river corridor has ample shoreline and islands for moose calving and post-calving habitat. The Ingersoll Islands, located in the Yukon River downstream of the project site, are known to be used for calving during the spring and as rearing habitat during the summer (Magrum, 1994). The old burn areas in the Minto Creek Valley, the banks of the Yukon River, and the swamp lands below Minto Creek are often used by moose during the spring and summer (EBA, 2010b).

7.3.1.2 Aerial Moose Survey - Winter 2009/2010

Aerial moose surveys were completed on December 15, 2009 (post-rut) and February 23, 2010 (late winter) by ACG (2010). The total area surveyed was 112 km^2, specifically concentrating on the area aroundthe Minto Mine and nearby drainages, see. Moose density for the post-rut survey was estimated to be 125 moose per 1,000 km^2. The average population density for calf-to-cow ratio estimated from this data was 25 calves and no sub adults for every 100 adult cows, and the estimated adult sex ratio was 50 mature bulls for 100 cows, which is considered fair compared to territorial averages.

7.3.1.3 2007 Early Winter Moose Survey

The early winter 2007 moose survey for the Carmacks West Moose Management Unit (MMU) was conducted by Yukon Department of Environment. The densities are comparable, as there are similar habitat types in the MMU and its boundaries overlap the Minto Mine. The calculated moose density was 124 moose per 1,000 km^2 for the survey area.

This survey covered a much larger study area than the surveys conducted by ACG during the winter of 2009/2010, which were specifically focused on the area surrounding the Minto Mine site. However, during this survey in 2007, a total of 208 moose were observed during the survey, with a total population estimate of 520 moose for the study area. Survival rates for calves and yearlings were relatively low. The sex ratio of 75 bulls per 100 cows is considered to be a healthy sex ratio. The average sex ratio for other areas surveyed within Yukon is 68 bulls per 100 cows (O'Donoghue et al., 2008).

7.3.1.4 1994 Late Winter Moose Survey

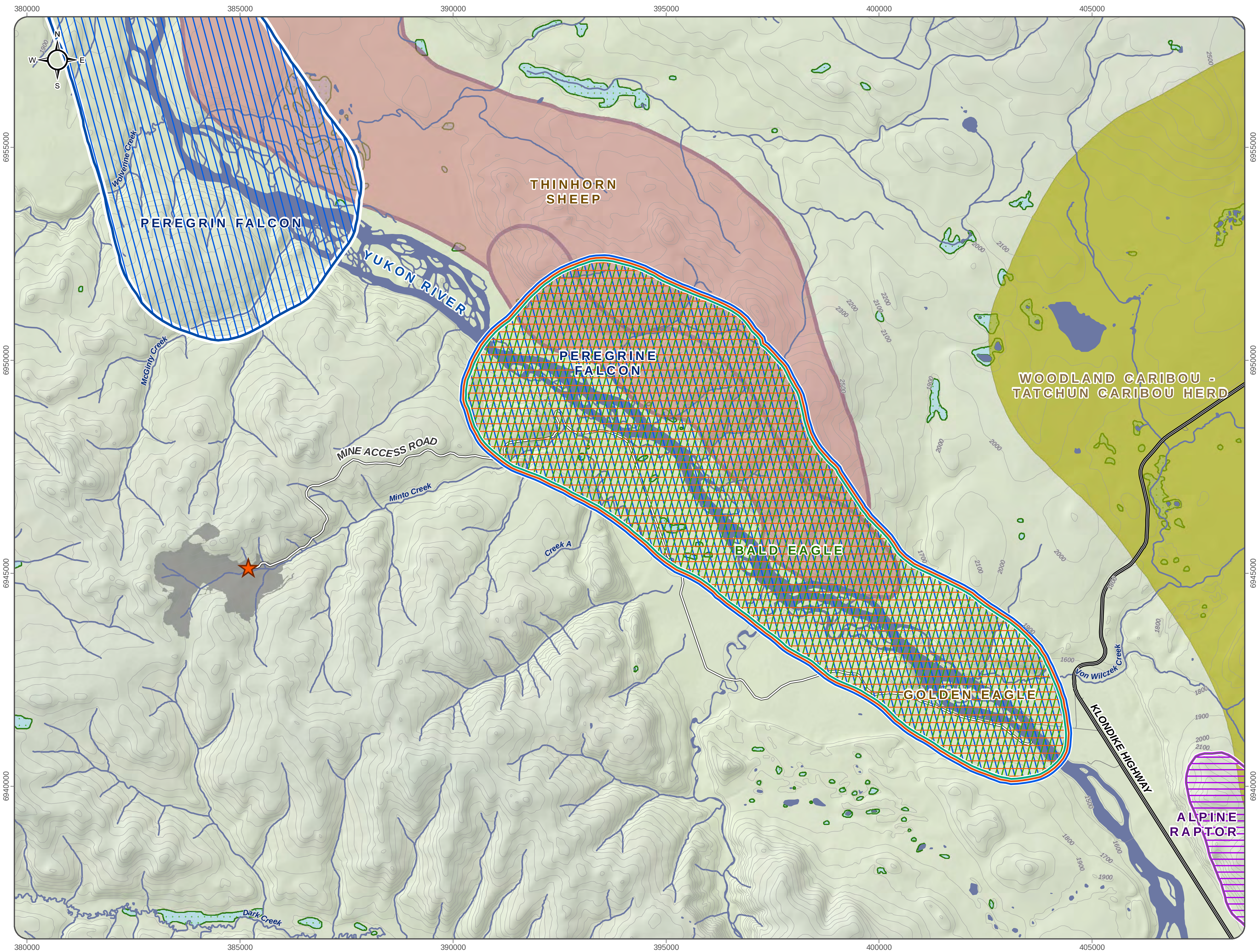
Wildlife Resources surveys conducted in January 1994 by the Yukon Government estimated a moose density of 40 moose per 1,000 km^2 in the Minto area, which was lower then the 100 to 250 per 1,000 km^2 Yukon average (Yukon Government, 2017).

7.3.2 Caribou

The closest Woodland caribou ranges to the Minto Mine belong to the Klaza and the Tatchun herds. The Klaza herd appears to be the more stable of the two, and is the larger herd. Below is a brief summary of the herds' interactions with the Minto Mine area.

In 2005, the Klaza herd population was estimated at 650 and predicted to increase (Yukon Environment, 2005a). There are concerns for this caribou herd, as an increase in exploration projects and road development may cause negative impacts to the health of the Klaza caribou. The Klaza caribou range is west of the Minto Mine. As the area around the Minto Mine has experienced numerous fires recently, the habitat is of minimal value for caribou (Hegel, pers. comm.). Caribou prefer mature open forests where arboreal and ground lichen are plentiful. A Wildlife Key Area (WKA) for woodland caribou winter range was identified approximately 9 km to the east-northeast of the project area (Yukon Environment, 2010a). A fall (rut) count of Klaza caribou herd was conducted by Environment Yukon, EDI and Little Salmon Carmacks First Nation members in 2012. The herd is currently estimated to be approximately 1,180 caribou and is considered stable (Francis et al., 2016).

The Tatchun Caribou herd range is to the east of the Yukon River and does not overlap with the Minto Mine. In 2012, the population estimate for the Tachun herd was 500 animals.



MINTO MINE
SITE CHARACTERIZATION PLAN

FIGURE 7-1
WILDLIFE KEY AREAS

OCTOBER 2021

MINTO

WILDLIFE KEY AREAS

- Golden Eagle
- Peregrine Falcon
- Bald Eagle
- Alpine Raptor
- Thinhorn Sheep
- Woodland Caribou

OTHER MAP FEATURES

- Minto Mine Site
- Mine Footprint
- Wetland
- Minto Access Road
- Contours (100ft)

1:85,000 *when printed on 11 x 17 inch paper*

0 1 2 3 4

Kilometers

ENSERO solutions

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Studies\Wildlife\WLKA_20171005.mxd
(*Last edited by: amatlashevska;28/12/2017/11:10 AM*)

7.3.3 Sheep

The Minto Bluffs along the Yukon River have been identified as an important Dall sheep area, see **Figure 2**, (O'Donoghue, 2009). Although the access road to the Minto Mine passes near sheep habitat, sheep habitat within the project area itself is limited and sheep are not expected to inhabit the project area forany extended length of time.

Between 2000 and 2017, sheep surveys of the Minto Bluffs resulted in observations of between 31 and 153 sheep annually, with the majority of observations being ewes, yearlings and lambs. During the 2016 survey, 153 sheep were observed, of which 59 were observed on the Minto Bluffs (which is located about 8 kilometres downstream and across the river from the Minto Mine site). This is the highest recorded observation for this area. Most sheep observed during these surveys have been located on the Minto Bluffs, Split Mountain, and Mount Hansen (O'Donoghue, 2009).

7.3.4 Carnivores, Fur Bearers and Small Mammals

Fur trapping and big game harvest statistics indicated the following species are expected to occur in the Minto Mine area: grizzly bear, black bear, coyote, gray wolf, red fox, wolverine, marten, least weasel, beaver, and lynx. Cougars may also have the potential to be found in the area as they are known to follow mule deer (Smith et al. 2004). Of the species listed above, the following species (or their sign) have been observed, on site: grizzly bear, black bear, gray wolf, lynx, river otter (HKP 1994, Capstone 2007-2008).

The territorial estimates for bear populations in Yukon are 6,000 to 7,000 grizzly bear and 10,000 black bear (Yukon Environment 2010b). The Yukon Government (2017b) has indicated that key habitat for black bears include seasonally concentrated feeding areas, such as south aspect slopes containing sagewort, bearberry, and grassland habitat. Summer and fall feeding habitats typically consist of those areas where berries grow. Black bears have been observed in the project area on many occasions (Wildlife log – **Appendix 1-5**).

Grizzly bears are known to use the Minto Mine area. Sightings and tracks were documented in the 2010 Baseline Ecosystems and Vegetation Report, and sightings have been reported by mine personnel (**Appendix 1-5**). Key habitat for grizzly bears includes areas where they concentrate seasonally, such as feeding areas, floodplains, and movement corridors. Important feeding habitat includes areas withprofuse berries and areas where salmon spawn (Yukon Environment, 2017b). Although key habitat for grizzly bears has not been identified on site, they have been seen in the project area regularly since the commencement of mine operations. (ACG, 2010).

Wolverines have large territories where they hunt, scavenge and mate. While there is a moderate probability that they inhabit the area, because of their aversion to human activity and low population, they are not likely to be observed.

Small mammals common to the area include red squirrel, varying hare, fox, mink, weasel, vole, and shrew. The Minto Mine site is situated at the apex of five drainages that are part of the Yukon River watershed, so wildlife uses the area to access the valleys offering conduits from lowlands to highlands for seasonal foraging and hunting (ACG, 2010).

7.3.5 Birds

Five species of birds are considered to be of conservation concern: the peregrine falcon, short-eared owl, common nighthawk, olive-sided flycatcher, and rusty blackbird. Three of these species, the peregrine falcon, common nighthawk, and olive-sided flycatcher, have a moderate probability of occurrence at theMinto site. Suitable nesting habitat for the peregrine falcon is located in close proximity to the project site (see **Figure 7.1**), on the bluffs along the Yukon River (O'Donoghue, pers. comm.), and a historical record of nesting for this species was documented at the Pelly–Yukon River confluence (Mossop, pers. comm. as cited in HKP 1994). Common nighthawks are often found near open lodge pole pine forests, old burn areas and open mixed forests, and near wetlands or rivers (Sinclair et al., 2003) and many of these habitat types occur in the project area. The olive-sided flycatcher often occurs in black and white spruce, lodge pole pine, and mixed forests, from lowland areas to tree-line. The short-eared owl and rusty blackbird are considered to have a low probability of occurrence in the project area. The short-eared owl is often associated with open wetland and meadow, alpine, and alpine tundra habitat, which is limited within theproject area. The rusty blackbird is also associated with wetland habitat (Sinclair et al., 2003), which is not abundant within the project area itself, but may occur along the margins of the Yukon River.

The rusty blackbird often nests at the edge of ponds/wetland complexes in boreal forests. They prefer lower elevations, but could feed and nest within the study area. Short-eared owls may travel through thearea, but their typical habitat is in and near large meadows and agricultural fields and they may not be seen often because they are nocturnal. Peregrine falcons do not use the habitats in the Minto area; theynest and hunt near steep canyon walls along the Yukon River, approximately 20 km east.

7.3.6 Raptors

Although numerous raptor species have the potential to inhabit the project area, species that have been observed and documented in the Minto Mine area include the red-tailed hawk (HKP, 1994), peregrine falcon (Mossop, pers. comm. as cited in HKP 1994), and golden eagle (O'Donoghue, pers. comm., as cited in SCP 2017). It shouldbe noted that only one aerial-based raptor survey was conducted as part of the Minto Mine baseline studies (HKP, 1994). High quality riparian cliff habitat for raptors exists along the Yukon River downstreamof the Minto Mine access road. A WKA (wildlife key area) for golden eagle summer nesting habitat has been identified approximately 3 km to the east of the project area (Yukon Environment, 2010a) (**Figure 7.1**). This WKA is primarily associated with the steep bluffs along the Yukon River and includes a buffer area. No cliff-nesting raptor habitat has been identified within the Project area itself. The access road to

the Minto Mine, however, runs adjacent to potential nesting areas for cliff-nesting raptors, such as the golden eagle and peregrine falcon.

7.3.7 Waterfowl

Key habitat for waterfowl includes wetlands that are used as staging areas in the spring and fall, and for breeding and molting in the summer. As suitably-sized wetlands are not found near the Minto Mine, waterfowl are not known to be present in large numbers or for extended periods. A key habitat area, Lhatsaw wetlands, lies approximately 30 km east of the project site and is used for nesting and molting in the summer (Yukon Environment, 2016). Waterfowl that may occasionally use the Minto Creek drainage include Canada goose, mallard, northern pintail, green-winged teal and American widgeon.

7.3.8 Game Species

Game birds that have been observed or that have the potential to occur in the study area include grouse (spruce, ruffed, sharp-tailed) and ptarmigan (willow, white-tailed, and rock). Of the species of grouse that live in Yukon, the sharp-tailed grouse is currently the only species of management concern. Sharp- tailed grouse have a limited distribution in Yukon due to the lack of suitable habitat. Gravel outwashes with fairly stable aspen parkland habitat and wet sedge-hummock meadows after fire are considered suitable habitat for this species. Sharp-tailed grouse have been observed in the Project area.

7.3.9 Amphibians

Of the five amphibian species known to occur in Yukon and northern British Columbia, only the wood frog (*Rana sylvatica*) is known to occur in the project area. This species is restricted to wetland areas and has not been surveyed for at the Minto site, although there have been some anecdotal observations. No reptiles are known to occur in Yukon.

7.4 Summary

The frequent and often large fires that have occurred around the Minto Mine have created high quality habitat for moose. The numerous moose sightings and signs found in the area indicate that it is attractive and well-used by resident moose. Local aerial surveys completed in early (December 2009) and late winter (February 2010) indicated that the moose population in the area was below territorial average and recruitment may be low. However, the population has increased since the initial local survey was done in 1994. Then, the population was estimated at 40 moose per 1,000 km^2 during a government-supported count.

The Klaza woodland caribou herd range is located approximately 10 km west of the Minto Mine, where there is better winter habitat and mature open forests with ample growth of arboreal and ground lichens. The Minto Mine area does not provide good habitat for caribou, but they may travel through occasionally.

Dall sheep habitat is found along the steeper hillsides within the Yukon River corridor; the Minto Mine area does not contain the steep escape topography nor grasslands needed by these animals. The nearest population of Dall sheep is found at the Minto Bluffs approximately 10 km further down the Yukon River. The nearest disturbance is the access road, which is still approximately 10 km from sheep habitat.

Raptor inventories have been concentrated along the Yukon River corridor where steep slopes and cliffs provide nesting and perches for peregrine and golden eagles. Bald eagles commonly use large trees for nesting and are closely associated with riparian systems. Forest-dependent raptors such as northern goshawk and red-tailed hawks are likely nesting around the Minto Mine in mature forest areas.

Black and grizzly bears are known to use the area and may be attracted to food smells emanating from the camp and garbage disposal area. A waste management plan is in place to reduce attracting bears to camp and operation areas.

Large mammals such as moose, mule deer, timber wolves, grizzly bears, and black bears were found to be using riparian corridors, secondary access roads, and exploration transects as migration routes throughout the Minto mine study area (ACG 2010).

There is a dearth of information on other animals existing in the vicinity of Minto such as wolves, lynx, mule deer and bears.

8.0 AQUATIC RESOURCES

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. It is owned and operated by Minto Explorations Ltd. The mine is in the upper reaches of the Minto Creek watershed approximately 10 km west of the Minto Creek confluence with the Yukon River. Commercial production at Minto Mine commenced in October 2007, the mine was placed on temporary care and maintenance in October 2018, and operations recommenced in October 2019. The mine is permitted for open pit and underground mining with a milling rate of 4,200 tonnes per day of copper/gold/silver ore. Minto Mine produced 17.8 million pounds of copper in 2020. Copper reserves are approximately 15 million tonnes (measured and indicated). Mill tailings are stored in the Main Pit, Area 2 Pit, and the Dry Stack Tailing Storage Facility (DSTSF). 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. Non-impacted water and treated mine-impacted water are collected in a Water Storage Pond (WSP). Effluent from the mine area flows into the WSP and into Minto Creek. Minto Creek, in turn, discharges into the Yukon River approximately 7.7 km south-east of the WSP.

As required under condition 13.1 of the QML-001, this Aquatic Resources Characterization Report has been submitted to demonstrate an understanding of site-specific aquatic environmental conditions. This report will also support Phase VII and future licensing applications. The aquatic environment characterized in this report includes Minto Creek (upper and lower reaches), associated reference creeks and tributaries (i.e., McGinty Creek, Big Creek, and Wolverine Creek), and the Yukon River (which receives flows from these creeks). The area of interest within the Yukon River is the 20 kilometer stretch between Big Creek (7 kilometers upstream of the Minto Creek mouth) and Wolverine Creek (13 kilometers downstream of the Minto Creek mouth). Aquatic environmental data considered in this report include those collected from 1994 (baseline) to 2020. Limited data are currently available for the section of interest in the Yukon River and sampling could not be completed in lower Minto Creek in 2019 due to dry conditions.

Sediment sampling was completed using a variety of methods over the years. During baseline (1994), sediment was collected in triplicate in the mainstem of Minto Creek. From 2006 to 2009, sediment collected from slow flowing locations was analyzed on the <63 µm fraction (silt and clay only) and from 2010 to 2020 sediment from quiescent locations was analyzed on whole (bulk) sediment. At upper Minto Creek, concentrations of copper were greater than the Canadian Interim Sediment Quality Guideline (ISQG) during baseline (indicating naturally high concentrations) and have been above guideline for all years since. Copper concentrations in sediment at lower Minto Creek were below all guidelines during baseline but rose above the ISQG for all years except 2011. The upper reach of Minto Creek is primarily erosional and fine sediment would likely wash away each year during freshet. Since there are more depositional locations downstream in lower Minto Creek sediment, sediments are a more relevant route of potential exposure to aquatic organisms in the lower reaches.

Sediment toxicity tests were completed in sediments collected from lower Minto Creek in 2011, 2015 to 2018, and 2020 using the midge *Chironomus dilutus* and the amphipod *Hyalella azteca* as test organisms. Survival of *C. dilutus* was significantly lower in lower Minto Creek sediment compared to reference (lower Wolverine Creek) and control sediment in 2017 and 2018. In 2020, survival of *C. dilutus* in lower Minto Creek sediment was significantly lower than in sediment from lower Wolverine Creek. Growth of *C. dilutus* was significantly lower in lower Minto Creek sediment compared to lower Wolverine Creek sediment in 2017. Lower survival of *H. azteca* in lower Minto Creek sediment was observed in in 2020 when compared to reference (lower Wolverine Creek) and control sediment. Although equivocal, these results suggest a potential for adverse effect, but temporal comparisons show differences in response despite similar sediment chemistry (including baseline elevations in concentrations of several metals as would be expected in association with the ore deposit within the Minto Creek watershed).

Periphyton was collected in 1994 and 2012 to 2020 for chlorophyll-a and community assessment. Chlorophyll-a concentrations observed during baseline and earlier years (2012 to 2015) indicate that lower Minto Creek was oligotrophic (low production/nutrients), but production increased after 2016 as the system moved to the mesotrophic category (increased production/ nutrients compared to oligotrophic). The only exception was in 2020 when lower Minto Creek was again identified as oligotrophic. Increased production over time could be due to increased light penetration and/or increased nutrient inputs to the system. The latter has been observed as higher concentrations of nitrogen species during and after mine discharge events. Even with increased nutrient loads median chlorophyll-a concentrations were all below the British Columbia Water Quality Guideline (BCWQG). The periphyton community was more diverse at lower Minto Creek compared to lower Wolverine Creek regardless of the directional differences of taxon richness between areas. The community composition at both areas was variable, most often diatoms were the most dominant group (including during baseline), but blue-green algae were dominant in some years. This temporal variability was seen at both exposed and reference areas.

Benthic invertebrate community data were collected during baseline (1994), and from 2006 to 2012 (250 µm mesh) and from 2012 to 2020 (500 µm mesh) for Minto's Aquatic Effects Monitoring Program (AEMP). Additional collection under the Environmental Effects Monitoring (EEM) program was completed in 2008 and 2011 (250 µm mesh) and 2011, 2014, 2017, and 2019 (500 µm mesh). Earlier studies showed that the AEMP exposure area had greater taxon richness (compared to reference) using the 250 µm mesh but this was difficult to interpret due to lack of replication. In later years (using 500 µm mesh and a replication level of five), lower Minto Creek compared to reference areas showed no significant differences for taxon richness, except in 2012 (higher number of taxa) and in 2016 (lower number of taxa). Pollution sensitive taxa, EPT (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly]) made up a significantly higher proportion of the community at lower Minto Creek in 2013, 2014, 2017, and 2018 when compared to lower Wolverine Creek. Pollution tolerant Oligochaeta made up a significantly lower proportion of the community at lower Minto Creek compared to the reference areas, lower Wolverine and lower Big creeks. This would indicate that the area sustains sensitive species and suggests limited mine influence.

Benthic invertebrate community monitoring under the Phase 1 EEM in 2008 indicated that upper Minto Creek had significantly higher density when compared to the reference area, upper McGinty Creek. In 2011 (Phase 2 EEM), upper Minto Creek had higher density but only when using the 250 µm mesh (no significant differences were observed with the 500 µm mesh). Taxon richness was significantly higher at upper Minto Creek compared to upper McGinty Creek (250 µm mesh) and upper Wolverine Creek (250 and 500 µm mesh). Phase 3 EEM (2014) showed no significant differences in density and Bray-Curtis Index except for one station at upper Minto Creek. In the previous two EEM programs, Bray-Curtis Index was always significantly higher at upper Minto Creek compared to reference areas suggesting some subtle differences in community composition from reference. Phases 4 (2016) and 5 (2019) introduced a Reference Condition Approach (RCA) to analyze benthic invertebrate community. In both years, upper Minto Creek was within the calculated reference range for density, number of taxa, Simpson's evenness, and Bray-Curtis index. In the Phase 4 control-impact (CI) design (which was embedded within the RCA), upper Minto Creek had significantly lower density compared to the single reference (but was within the RCA reference condition range). Previous EEM phases that used the CI design showed significantly higher density at lower Minto Creek compared to references. In all EEM phases, percent EPT was lower at upper Minto Creek when compared to references/reference ranges. This could indicate a mine influence as EPT are sensitive taxa. Reviewing the four primary EEM metrics over time shows variability among phases. The CI design compares exposed areas to one reference area whereas the RCA compares exposed sites to multiple reference sites (which were used to calculate the reference condition range). In Phases 1 and 2, there were significant differences for density, number of taxa, Simpson's Evenness, and BCI. In Phases 3 through 5 these significant differences occur less often. The additional reference sites included in the RCA capture more natural variability among sites with similar habitat conditions and the RCA is therefore less prone to the potential attribution of a natural differences between areas (e.g., one exposed and one reference) to a mine-related effect. The RCA indicates that the benthic invertebrate community of upper Minto Creek falls within the natural variability of the area.

Benthic invertebrate and periphyton tissue have been collected since 2012 and were analyzed for metal concentrations. Analytes of concern (copper and selenium) were evaluated for both tissue types. Copper concentrations in benthic invertebrate tissue at lower Minto Creek were often significantly higher when compared to the reference area, lower Wolverine Creek. When lower Minto Creek was compared to lower Big Creek, copper concentrations were significantly lower except in 2017 (when concentrations were significantly higher). Selenium concentrations in benthic invertebrate tissue were significantly higher at lower Minto Creek compared to reference areas in 2013, 2015 to 2017, and 2019, except compared to lower Wolverine Creek in 2016. Even though differences were observed, all measures of central tendency (MCT) were below the interim British Columbia Benthic Invertebrate Tissue Guideline (4 mg/kg), except for lower Wolverine Creek in 2016. From 2014 to 2020, concentrations of copper in periphyton tissue were significantly higher at lower Minto Creek compared to lower Wolverine Creek (2014 to 2020) and lower Big Creek (2017, 2018, 2019). In all years, selenium in periphyton was significantly different between lower Minto Creek and reference areas. In 2012 and 2013, periphyton selenium concentrations at lower Minto Creek were significantly lower compared to lower Wolverine Creek but significantly higher in later years (2014 to 2016, 2018, 2020). Lower Minto Creek had significantly higher concentrations of selenium in periphyton compared to lower Big Creek in 2014 to 2020. Tissue concentrations of selenium and copper are higher at the exposed area versus the reference, but the absence of baseline data makes it uncertain whether this represents a mine influence (as concentrations of copper were naturally elevated in the Minto Creek watershed prior to mine activity). For selenium in benthic invertebrate tissue, these differences may not be ecologically relevant as most concentrations are below the guidelines.

The Yukon River (near Minto Creek) supports many resident and migratory fish species, including salmon (chinook, coho, and chum), lake trout, least and Bering cisco, round and lake whitefish, inconnu, arctic grayling, northern pike, burbot, longnose sucker, and slimy sculpin. Chinook salmon, round whitefish, arctic grayling, and slimy sculpin have all been captured in Minto Creek. Spawning shoals for salmon have been identified in the Yukon River downstream of Minto Creek at Ingersoll Islands and upstream of Minto Creek near Big Creek. Juvenile chinook salmon (JCS) can spend about one and a half years in tributaries of the Yukon River before out-migrating to the ocean.

Minnow trapping and electrofishing were used to capture fish during baseline sampling in 1994. Under the AEMP, fisheries monitoring in Minto Creek was completed monthly during the open water season from 2008 to 2019. Fish community monitoring was not conducted in 2020 due to dry conditions and colder water temperatures in Minto Creek. Monitoring in 2007 was conducted to support the development of the EEM Phase 1 Study Design and in 2009 to support the Minto Creek fish relocation project. Fish monitoring and effluent-exposure fish studies have also been completed during all five phases of the EEM, except for Phase 3 as an EEM Investigation of Cause (IOC) study was triggered by benthic invertebrate community results only.

The baseline habitat assessment indicated that Minto Creek is ephemeral with little flow and winter glaciation. These features prevent Minto Creek from being an overwintering fish habitat. It was also determined that fish would only be able to access the lower 2 km of Minto Creek due to a steep canyon with a 21% gradient. Fishing was attempted above the canyon, but no fish were caught. During the fish community sampling no JCS were caught, and the most abundant fish was slimy sculpin (8 fish total over 3 sampling months). Round whitefish (1) and arctic grayling (4) were also caught.

Monthly sampling (June through October) under the AEMP has shown that JCS infrequently use Minto Creek and rarely before July, with peak utilization (if any) occurring in late August and early September. Since Minto Creek is ephemeral and unsuitable for overwintering, JCS only use Minto Creek temporarily during their out-migration from natal stream to the Bering Sea. In 2010, a temporary fish barrier was noted and restricted fish to the lower 1.2 km of the creek. Since 2010, efforts were made to catch fish above the temporary barrier but proved to be unsuccessful, further cementing that fish are unable to move upstream of barriers. Excluding emergency discharge events (which occurred in 2009 and 2010), more JCS have been caught in September compared to other months. Catch-per-unit-effort (CPUE) was highest in 2010 but this occurred during an emergency discharge event (which appears to attract JCS into the creek). Disregarding emergency discharge events, 2007 had the highest CPUE for JCS (mean CPUE = 3.3 fish/trap/day). In 2015 and 2016, fishing efforts produced a combined 12 JCS and no JCS were caught in monitoring completed from 2017 to 2019.

Fish sampling under the AEMP has shown that JCS use Minto Creek in a limited fashion. Water flow and temperature appear to be the key factors determining JCS usage of Minto Creek. The highest abundance of JCS occurred during emergency discharge events when water flows and temperature were higher (temperatures were more comparable to the Yukon River). Also, abundances and CPUE were 10x (or more) higher during emergency discharge events in 2009 and 2010.

Fish monitoring under the Phase 1 EEM consisted of fish community sampling in lower Minto Creek June and September 2008. In June, electrofishing and minnow trapping yielded no fish. Only one fish was observed but not captured when electrofishing in September. Minnow trapping was more successful with 17 JCS caught. Due to a lack of sufficient fish to complete a statistically robust evaluation of the potential influence of the Minto Mine effluent on sentinel fish species, a dual in-situ fish community sampling and a hatchery-based effluent exposure fish study was completed for the Phase 2 EEM in 2011. Fishing efforts occurred in July, August, September, and October. The greatest number of JCS were captured in September (6) which has been shown to be the peak time for JCS usage Minto Creek under normal conditions (i.e., in the absence of emergency discharge). A total of 420 chinook salmon fry were selected for the hatchery-based fish study. Control fish were supplied with water by artesian spring water and exposed fish were supplied with water from the WSP and lower Minto Creek at effluent concentrations similar to those observed in the field. The hatchery-based fish study resulted in fish that had slightly greater size (6% difference) and body condition (2% difference) with five to six weeks of constant effluent exposure. Phase 4 EEM supporting in-situ fish community sampling was completed from June to September 2016. A total of 6 JCS were captured in lower Minto Creek during September monitoring events. Similar to Phase 2, an on-site laboratory exposure was set up to assess fish population health. Kokanee (*Oncorhynchus nerka*; a landlocked strain of sockeye salmon) were used in the Phase 4 exposure as JCS were unavailable. A total of 160 Kokanee fry were used in each treatment tank (control, 14% effluent, and 25% effluent). Exposed Kokanee were slightly larger (1.6% greater length and 6.9% greater weight at 25% effluent) with decreased condition factor at 14% effluent (-2.7%) and increased condition factor at 25% effluent (2.3%) when compared to reference Kokanee. The differences in condition (the EEM-effect endpoint) were small (less than the 10% critical effect size [CES]) so therefore were not considered ecologically relevant. Fishing efforts were unsuccessful during the supporting in-situ fish community sampling for the Phase 5 EEM. Kokanee was used again during the Phase 5 EEM on-site laboratory exposure since JCS were unavailable. A total of 125 Kokanee fry were used in each treatment (control, 14% effluent, and 25% effluent). Results were similar to Phase 4 but of greater magnitude - larger size (60 to 72%) and greater condition factor (12 to 16%) in the exposed groups compared to the reference group. Differences in condition were greater than the CES, so therefore were at a magnitude that would typically be considered ecologically relevant. However, the larger differences between groups appeared to have been due to a myxobacterial infection in the reference group.

Metal concentrations in fish tissue (muscle) were assessed during baseline sampling and in 2012. Very few guidelines for fish tissue quality are available and all mercury concentrations were found to be below the Health and Welfare Canada, Food and Drug Relations Guidelines. Slimy sculpin were collected from lower Minto Creek and lower Big Creek in 2012. Mean selenium concentrations in slimy sculpin collected from lower Minto Creek (5.3 ± 1.1 mg/kg dw) were moderately but significantly higher than lower Big Creek (3.4 ± 0.7 mg/kg dw). Selenium concentrations at lower Minto Creek were just above the BCWQG for fish tissue (4.0 mg/kg dw), whereas lower Big Creek was just below the BCWQG. Metal concentrations in fish tissue have not been monitored since due to very limited use of lower Minto Creek by fish.

9.0 VEGETATION

The Minto Mine lies within the Boreal Cordillera ecozone and is situated in the far western part of the Yukon Plateau ecoregion, adjacent to the Klondike Plateau ecoregion in the west. This area was part of the eastern extent of Beringia, which remained ice-free approximately 15–20 thousand years ago. Endemic and rare plant species are associated with the Beringia area as it was a unique and isolated ecosystem. These remnant species are usually associated with grasslands and wetlands.

The Minto property lies within the eastern part of the Dawson Range, with elevations from 700 to 950 m; the landscape has rounded mountains intersected by broad valleys and drainages that are part of the Yukon River watershed. Discontinuous permafrost occurs on northern slopes and low-lying areas where sunlight is reduced.

Forest fires are frequent in this part of Yukon as it lies in the rain shadow of the St. Elias–Coast Mountains and receives less than 300mm 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 various stages of succession.

Capstone has characterized the baseline vegetation conditions for the project area by commissioning a vegetation survey and mapping project in 2010 and a vegetation metal uptake program in 2016. The following subsections summarize vegetation surveys conducted in the Project area. For further detail, please see the *Minto Mine Site Characterization – Vegetation* (AEG, 2017) in Appendix 1-7 of SCP 2017.

9.1 Vegetation Baseline Survey and Ecosystem Mapping

A previous survey was conducted in 1994 by Hallam Knight Piesold (HKP), before any mine development had begun in the area. The 2010 baseline vegetation survey and mapping project was commissioned by Minto to capture the current biophysical conditions prior to expansion activities. The scope of the survey, mapping, and reporting includes classifying forest and vegetation types, identifying sensitive ecosystems, and compiling vegetation and some surficial soils information. In the intervening years between the 1994 and 2010 studies, the local landscape has been altered by the footprint of the current mine, further exploration and three major fires (See Fire History Map, of the *Minto Mine Site Characterization – Vegetation* (AEG, 2017)).

In the 2010 Vegetation Baseline Survey, different vegetation communities that exist within the study area were identified through aerial photo interpretation and delineated into polygons. Since most of the studyarea is regenerating from past fire disturbances, a mosaic of vegetation communities at different successional stages was delineated and classified. Thirty plots (23 of which are permanent plots) were visited to determine the accuracy of photo interpretation.

Most of the study area is regenerative young forest or shrub-dominated ecosystems where tree and shrub species are at a uniform height, as is common in fire disturbed areas (Oswald and Brown 1990). Willows and trembling aspen are the most represented species in crown cover at the time of the survey. Lodgepole pine is a later successional species and will gradually dominate mid and upper slopes that are well drained. Shade-tolerant white spruce was often found in the understory as seedlings and is a climax species that will eventually overgrow the pine and trembling aspen communities on northern aspects. Black spruce is also a climax species that is adapted to wetter, cooler sites, and is often the persistent species in white/black spruce mixed areas along slope toes and valley bottoms. Small areas of grasslands are scattered along dry crests and steep south facing slopes as these locations do not retain enough moistureto sustain tree growth and are more likely to contain rare or uncommon plants.

Most of the planned expansion is along ridge tops and mid slopes. The main vegetation types in these areas are upland willow species, trembling aspen, lodgepole pine, and associated understory growth. Thepotentially impacted polygons were surveyed for rare and endemic plants; and while none were found atthe time of survey, does not mean that none exist.

The ecosystem map (Appendix 1-7 of SCP 2017) was designed to be used as a land management and planning tool. Asthe mine expands its footprint, the map can be referred to for a quick assessment of which type of vegetation communities will be directly disturbed and how much area is involved. Sensitive areas that should be avoided, if possible, include: riparian corridors, bog/wetlands, mature forests, and grasslands.

9.1.1 Vegetation Types

Vegetation types are based on reoccurring patterns of plant associations dictated by site attributes such as: moisture and nutrient availability, aspect, and elevation. Polygons were delineated based on tree/shrub composition, cover, and structural stage. Plot descriptions are more detailed, but most polygons will fit in one of the following general forest types:

9.1.1.1 Trembling Aspen/Lodgepole Pine

This association is found in early successional forests originating after fire disturbance, on mesic to subxeric sites. Lodgepole pine (*Pinus contorta latifolia*) is more dominant than trembling aspen (*Populus tremuloides)* on well-drained south facing slopes and terraces. Coarse soils are often exposed, and lichensare well represented in the ground cover. Typically, these sites have low growing shrubs such as lingonberry (*Vaccinum vitis idaea*), kinnikinnick (*Arctostaphylos uva-ursi*), and prickly rose (*Rosa acicularis*).

9.1.1.2 Black Spruce/Labrador Tea/Sphagnum

Found in low lying areas and north facing slopes (cool sites), usually sparse to open forests (<50% crown cover), common shrubs in this ecosystem include Labrador tea, scrub birch, willow, and bog blueberry. Herbs present were sweet coltsfoot (*Petasites frigidus*), cloudberry (*Rubus chamaemorus*), and horsetail (*Equisetum sp.)* Sites are poorly drained (hydric to mesic) with peat horizons over mineral soils, often associated with permafrost.

9.1.1.3 White/Black Spruce

This association is typically located on south facing lower slopes with upland willow species and Labrador tea. A thick carpet of feather mosses and sphagnum covers the mineral soil. Ground cover shrubs include lingonberry, bog blueberry, and crowberry.

9.1.1.4 Willow/Trembling Aspen

This was the most common vegetation association in study area, indicative of regenerative growth (>10yrs) after a fire event. Most trees and shrubs are less than 5 m tall; cover can be open to closed as thecanopy layer is of uniform height. Other species that may be present include: Alder (*Alnus crispa*) and Alaskan birch (*Betula neoalaskan*) on north facing slopes. Lodgepole pine and white spruce are also present in the understory and will eventually overtop other competing species to form the dominant canopy as the forest matures. The moisture regime ranges from subhygric to subxeric.

9.1.1.5 Willow/Scrub Birch

Willow (*Salix sp.)* and scrub birch (*Betula glandulosa*) occur in fluvial ecosystems adjacent to streams and fens. Other shrubs present are bog blueberry (*Vaccinium uliginosum*), Labrador tea (*Ledum groenlandicum*), and shrubby cinquefoil (*Potentilla fruticosa*). Associated graminoids include water sedge (*Carex aquatilis*), bluejoint grass (*Calamagrostis canadensis*), and rushes (*Juncus sp*.). Sphagnum, feather, and glow mosses are common.

9.1.1.6 Trembling Aspen/Grassland

This association features sparse to open cover of trembling aspen (*Populus tremuloides*), often with lodgepole pine (*Pinus contorta latifolia*) present as a minor component. Found on steep south and southwest facing slopes, its understory shrubs include prickly rose (*Rosa acicularis*), soapberry (*Shepherdia canadensis*), kinnikinnick (*Arctostaphylos uva-ursi*), purple reedgrass (*Calamagrostis purpurascens*), Glaucous bluegrass (Poa glauca), Threadleaf sedge (Carex filifolia), Death camas (*Zygadenus elegans*), common yarrow (*Acillea millefolium*), pussytoes (*Antennaria sp*.), and prickly saxifrage (*Saxifraga tricuspidata*).

9.2 Vegetation Metal Uptake

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.

10.0 GEOCHEMISTRY AND GEOTECHNICAL INFORMATION

SRK Consulting (SRK) reviewed and updated the assessment of metal leaching and acid rock drainage (ML/ARD) potential of waste rock and tailings at the Minto Mine. This update included a review of operational monitoring data and results from exploration assays and acid base accounting (ABA) testing conducted on Phase VII materials (Minto North 2 and Minto East 2). Since the previous ML/ARD update (SRK 2013), mining advanced into three new deposits including Minto East, Minto North, and Copper Keel. Prior to 2013, mining occurred in the Minto, Minto South, Area 2 and Area 118 ore zones only.

The objectives of this assessment were to evaluate if any differences exist between previously characterized and recently-mined material using operational monitoring data, and to compare characterization results from the planned Phase VII expansion materials to Phase IV and V/VI material.

The initial phase of production at Minto began in 2007 and included mining of the Main Pit which was completed in 2011. In 2012, the Phase IV expansion was approved and mining advanced into two new open pits (Area 118 and Area 2) and an underground development (Minto South). The Phase V/VI application presented three new open pits (Minto North, Ridgetop South, and Ridgetop North), an expansion to the previously mined Area 2 Pit and three new underground developments (Minto East, Copper Keel and Wildfire). Mining of the Minto North Pit, Area 2 Pit and Minto East underground are now complete with development on-going in the Copper Keel and Wildfire underground areas (which have since been re-grouped and are referred to only as Copper Keel). Mining of Ridgetop via open pit is planned for the future. The Phase VII expansion plan consists of additional underground mining targeting the Minto East 2 and Minto North 2 ore zones. Both are a continuation of previously mined deposits in each area and are currently awaiting regulatory approval. Latest geotechnical report is found in Appendix 1-9.

Geochemical characterization of waste materials has been carried out in several phases as the mine has expanded and advanced into new ore zones. Results of pre-production geochemical characterization programs and of operational geochemical monitoring to date are summarized in two main documents:

- SRK 2010 - Minto Mine Expansion – Phase IV ML/ARD Assessment and Post-closure Water Quality Predictions. Prepared by SRK Consulting and submitted to Minto Explorations in August 2010.
- SRK 2013 – Minto Mine Phase V/VI Expansion: ML/ARD Assessment and Inputs to Water Quality Predictions. Prepared by SRK Consulting and submitted to Minto Explorations in July 2013.

While these reports focus on the geochemical characterization of materials related to the Phase IV and V/VI expansions, results of the pre-production testing for waste rock and tailings are also discussed, including a study done by Mills 1997 which presented the results of geochemical analysis on 8 samples undertaken during a review of the initial Minto project proposal.

From 2011 to 2021, a total of 2,102 waste rock and 103 tailings samples were collected during operational monitoring and underwent ABA testing at an off-site laboratory. In general, sulphur exists dominantly as sulphide with a small portion of sulfate present that may be higher in areas mined since 2019. Modified NP is considered to be a representative measure of neutralization potential as a portion of the buffering may be attributed to silicate minerals. Of the 2,102 waste rock samples characterized, 55 samples from open pits and two underground samples were classified as PAG, 261 open pit samples and 38 underground samples were classified as uncertain, and the remaining samples were classified as non-PAG. All tailings samples were classified as non-PAG.

Measured on-site NP and AP values from 2013-2021 were in the range of historical data collected prior to the last ML/ARD assessment (SRK 2013). Open pit and underground samples have a similar visual distribution, with the majority (96 and 63%, respectively) of samples classified as non-PAG. Most samples classified as PAG from both open pits and underground (15 and 12, respectively) originated from MGW or HGW (Cu>0.1%).

Exploration assay results from Phase VII materials were available for 170 samples from the Minto East 2 deposit and 1,582 samples from Minto North 2. From these, a subset of 14 samples from Minto East 2 and 15 samples from Minto North 2 were selected for ABA testing. Samples submitted for ABA testing were representative of zero- to high-grade waste. NPR values were within the range of historic data from Phase IV and V/VI materials with the majority of samples classified as non-PAG based on low sulphur content. Three samples from Phase VII (Minto North) were classified as uncertain, otherwise all samples were non-PAG. Sulphur speciation and a comparison of NP determination methods were also within the range of historic data, with no discernable differences. Additionally, select elements from the exploration assays were compared and found to be in the range of historic data. Assay data included both waste and ore-grade material. As such, the Phase VII materials are expected to have the same ML/ARD potential as previously mined materials.

Four barrel tests intended to evaluate the release rates of weathering products under site temperature and precipitation conditions were initiated in 2010 and are currently on-going (October 2021). Most parameters measured in the leachate have been stable in recent years with all four barrels maintaining a circumneutral pH since their initiation in 2010. Observations in sulphate and calcium trends have confirmed the hypothesis that acid produced during sulphide oxidation is being effectively neutralized by the dissolution of calcium carbonate minerals. As the leachate chemistry from the barrel tests has been stable for many years, and large-scale site-specific monitoring data are available, it is recommended that the barrel tests be terminated.

The collection of operational ABA data has been successful in monitoring the potential for ML/ARD risks and verifying the initial characterization results for waste materials related to different phases of the Minto Mine. No prominent differences have been observed between waste materials produced prior to and since the previous ML/ARD update report (SRK 2013). Operational ABA data remains consistent and there are no observations that indicate a change in waste management methods is required at the Minto Mine. Additionally, Phase VII materials have proven to be fundamentally comparable to Phase IV and V/VI materials and nothing suggests the Phase VII materials will pose greater ML/ARD risks once extracted and processed. Additional details can be found in Appendix 1-8.

11.0 REFERENCES

Access Consulting Group (ACG). 2010. *Sherwood Copper Wildlife Survey*. Prepared for Capstone Mining Corporation.

Access Consulting Group (ACG). 2012. *Minto Climate Baseline Report.* YESAB Project Proposal Phase V/VI. Prepared for Minto Explorations Ltd. October 2012.

Access Consulting Group (ACG). 2013. *Surface Water Hydrology Baseline Conditions.* Minto Phase V/VI Expansion. Prepared for Minto Explorations Ltd. February 2013.

Access Consulting Group (ACG) and Minnow Environmental Inc. (Minnow). 2012. *Aquatic resources Baseline Report. YESAB Project Proposal Phase V/VI.* Prepared for Minto Explorations Ltd. November 2012.

Branquinho, C., F. Catarino, D.H. Brown. 2000. *Improving the Use of Lichens as Biomonitors of Atmospheric Metal Pollution.* In Biomonitoring of atmospheric pollution (with emphasis on trace elements) — BioMAP. Proceedings of an international workshop organized by the International Atomic Energy Agency in co-operation with the Instituto Tecnologico e Nuclear and held in Lisbon,Portugal, 21-24 September 1997.

BCMOE (British Columbia Ministry of Environment). 1985. *Water Quality Criteria for Nutrients and Algae: Technical Appendix.* Prepared by Richard Nordin, Water Quality Unit, Resource QualitySection, Water Management Branch. October 1985.

Capstone Mining Corporation. 2007. *Wildlife Log for the Minto Mine* (spreadsheet).Capstone Mining Corporation. 2008. *Wildlife Log for the Minto Mine* (spreadsheet).

Clearwater Consultants Limited (CCL). 2010. *Memorandum CCL-MC6: Minto Copper Project – Surface Water Hydrology Conditions.* August 2010.

Colpron, M., Crowley, J.L., Gehrels, G., Long, D.G.F., Murphy, D.C., Beranek, L. and Bickerton, L., 2015. Birth of the northern Cordilleran orogen, as recorded by detrital zircons in Jurassic synorogenic strata and regional exhumation in Yukon. Lithosphere, 7(5): 541- 562

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2009. Website accessed November 2012 at: http://www.cosewic.gc.ca/eng/sct1/index_e.cfm

EBA Engineering Consultants Ltd. (EBA). 2010a. *Minto Mine 2010. Climate Baseline Report*. Report prepared for Minto Exploration Inc. 14pp.

EBA Engineering Consultants Ltd.(EBA). 2010b. *Minto Mine Environmental Baseline Studies-Wildlife Report.* Prepared for Capstone Mining Corporation, August 2010.

Environmental Dynamics Inc. (EDI). 2013. *Casino Project: Wildlife Baseline Report.* Prepared for Casino Mining Corporation. October 2013.

Francis. Nishi. 2016. *A Range Assessment for the Klaza Caribou Herd in the Dawson Range of West-Central Yukon.* Prepared for Environment Yukon. Yukon Fish and Wildlife Branch Report MRC-16-01, Whitehorse, Yukon, Canada.

Garty, J. 2000. *Lichens as Environmental Biomonitors in Israel: Two Decades of Research.* In Biomonitoringof atmospheric pollution (with emphasis on trace elements) — BioMAP. Proceedings of an international workshop organized by the International Atomic Energy Agency in co-operation with theInstituto Tecnologico e Nuclear and held in Lisbon, Portugal, 21-24 September 1997.

Government of Canada. 2012. *Species at Risk Public Registry,* Available at http://www.sararegistry.gc.ca Hallam, Knight, Piesold (HKP) Ltd. 1994. *Minto Explorations Limited, Minto Project: Volume II Environmental Settings.* Prepared for Minto Explorations Ltd.

Hart, C.J.R. and Radloff, J.K., 1990b: Geology of Whitehorse, Alligator Lake, Fenwick Creek, Carcross and Part of Robinson Map Areas (105D/11, 6, 3, 2, & 7) Canada Indian Northern Affairs Program Yukon Region Exploration Geological Services Division Yukon Territory, Canada/Yukon Subsidiary Agreement on Mineral Resources, Exploration and Geological Services Division.

Hood, S., Hickey, K., Colpron, M. and Mercer, B., 2008. *High-grade hydrothermal copper-gold mineralization in foliated granitoids at the Minto mine, central Yukon.* Yukon Exploration and Geology.

Kabata-Pendias, A. 2011. *Trace Elements in Soil* (4th ed.). Boca Raton, Florida: CRC Press.

Kellie, K.A. and R.A. DeLong. 2006. *Geospatial survey options manual.* Division of Wildlife Conservation, Alaska Department of Fish and Game, Fairbanks, Alaska, USA.

Kovacs, N., 2018: “Genesis and Post-ore modification of the migmatized Carmacks Copper Cu-Au-Ag porphyry deposit, Yukon, Canada”. MSc Thesis, University of British Columbia, 2018

Kovacs, N., Allan, M. M., Crowley, J. L., Colpron, M., Hart, C. J., Zagorevski, A., & Creaser, R. A. (2020). Carmacks Copper Cu-Au-Ag Deposit: Mineralization and Postore Migmatization of a Stikine Arc Porphyry Copper System in Yukon, Canada. Economic Geology, 115(7), 1413-1442.

Kuzovkina Y.A., Knee M., Quigley M.F. 2004. *Cadmium and copper uptake and translocation offive Salix L. species.* International Journal of Phytoremediation, V.6(3): 269-287.

Little Salmon/Carmacks Fish and Wildlife Planning Team. 2011. Community based-fish and wildlife work plan for the Little Salmon/Carmacks First Nation Traditional Territory (2012 – 2017). Environment Yukon, Whitehorse (36 pages).

Magrum. 1994. An impact assessment of the Minto Project. Memo from the Selkirk First Nations to the Northern Affairs Program.

Minto Explorations Ltd. 1994. Initial Environmental Evaluation for the Minto Project.

Minto Explorations, 2017. Minto Mine Operations Adaptive Management Plan 2017-02. April 2017.

Minto Explorations Ltd. 2021. Minto Mine, Water Licence QZ14-031, Quartz Mining Licence QML-0001, 2020 Annual Report. Report Issued by Minto Explorations Ltd. On 31 March 2021.

O'Donoghue, M, R. Ward, S. Westover, A. Reyner, J. Bellmore. 2008. Carmacks West Moose Management Unit. Summary of Early-Winter 2007 Moose Survey. Yukon Fish and Wildlife Branch,Department of Environment.

O'Donoghue, M. 2009. Survey of Sheep along the Yukon River from Minto to Fort Selkirk and on Mount Hansen (GMS 3-20).

Oswald, E.T. and B.N. Brown. 1990. Vegetation Establishment During 5 Years Following Wildfire in Northern British Columbia and Southern Yukon Territory. Forestry Canada Pacific and Yukon Region Information Report BC-X-320.

Oswald, E.T. and J.P. Senyk. 1977. Ecoregions of Yukon Territory. Canadian Forestry Service and Environment Canada Report BC-X-164.

Sinclair, P.H., W.A. Nixon, C.D. Eckert, and N. L. Hughes (editors). 2003. *Birds of the Yukon Territory.* UBCPress, Vancouver, B.C.

Smith, C.A.S., J.C. Mielkle, and C.F. Roots (editors). 2004. *Ecoregions of the Yukon Territory: Biophysical properties of Yukon Landscapes.* Agriculture and Agri-Food Canada, PARC Technical Bulletin No. 04-01, Summerland, British Columbia.

SRK Consulting. 2010. Minto Mine Expansion- Phase IV ML/ARD Assessment and Post-closure Water Quality Prediction. Report prepared for Minto Explorations Ltd, issued August 2010.

SRK Consulting Inc. 2013. *Freshet Geotechnical Site Inspection*, Minto Mine, YT.

SRK Consulting Inc. (SRK). 2016. *Climate Change Analysis, Minto Mine, Yukon.* Prepared for Minto Explorations Ltd. August 3, 2016.

SRK Consulting Inc. (SRK). 2017. Minto Mine – 2016 *Groundwater Review and Summary of OAMP SPT Exceedances.* Report submitted to Minto Explorations Ltd.

SRK Consulting. 2018. Water and Load Balance Model Report 2018. Report prepared for Minto Explorations Ltd, issued February 2018.

SRK Consulting Inc. (Canada). 2018b. *Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report*. Report submitted to Minto Explorations Ltd. 1CM002.57. January 2018. 148 pages.

SRK Consulting Inc. (Canada). 2020. *Geotechnical Inspection Report*. Report submitted to Minto Explorations Ltd.

SRK Consulting Inc. (SRK). 2021. *Groundwater Characterization, Conceptual and Numerical Model Update Report, Minto Mine, Yukon.* Prepared for MintoExplorations Ltd. October 2021.

Tafti, R. and Mortensen, J.K. 2004. *Early Jurassic porphyry (?) copper (-gold) deposits at Minto and Williams Creek, Carmacks Copper Belt, western Yukon.* Yukon Exploration and Geology 2003, D.S.Emond and L.L. Lewis (eds.), Yukon Geological Survey, 2004.

Tafti, Reza. *Nature and origin of the early Jurassic copper (-gold) deposits at Minto and Williams Creek, Carmacks Copper Belt, Western Yukon*: subtitle examples of deformed porphyry deposits. Diss. University of British Columbia, 2005.

Tlustos, P., Szakova, J., Vyslouzilova, M., Pavlikova, D., Weger, J., Javorska, H. 2007. *Variation in the uptake of Arsenic, Cadmium, Lead and Zinc by different species of willows Salix spp. grown in contaminated soils.* Central European Journal of Biology 2: 254-275.

Yukon Bird Club. 2008. *Checklist of Yukon Birds.* Pamphlet produced with support from Yukon Environment and the Canadian Wildlife Service.

Yukon Environment. 2005a. Department of Environment Map ID ENV.009. *Status of Caribou in the Yukon.*

Yukon Environment. 2005b. *Yukon Amphibians.* Available at www.environmentyukon.gov.yk.ca/viewing Yukon Environment. 2007. *Information for Decisions.* 2007 Fish and Wildlife Inventory Program Project

Summaries.

Yukon Environment. 2010a. *Wildlife Key Areas. Produced by the Wildlife Key Area Inventory Program.* Environment Yukon, Habitat Programs.

Yukon Environment. 2010b. *Yukon Mammals.* Available at http://environmentyukon.gov.yk.ca/wildlifebiodiversity/mammals.php [accessed January 2010].

Yukon Environment, 2012. *Fish and Wildlife Branch 2012-2013 Project Summaries* http://www.env.gov.yk.ca/mapspublications/documents/Fish_Wildlife_Branch_projects_2012- 2013.pdf

Yukon Environment. 2016. *Birds – Monitoring Breeding Waterfowl.* Yukon State of the Environment.

Reporting on Environmental Indicators 2017. Available at: http://www.env.gov.yk.ca/publications-maps/report-fish-wildlife-waterfowl.php

Yukon Environment. 2017a. *Yukon Big Game Species.* Available at: http://www.env.gov.yk.ca/hunting-fishing-trapping/biggame.php

Yukon Environment. 2017b. *Yukon Mammals.* Available at: http://www.env.gov.yk.ca/animals-habitat/mammals.php

Yukon Government, Community Services, Protective Services Branch, Wildland Fire Management (GYWFM). 2012. *Yukon Fire History GIS Coverage and Metadata.* http://www.geomaticsyukon.ca/Yukon%20Coperate%20Spatial%20Data%20%20page%202.html #Land_and_Natural_Resources_-_Fire

Yukon Government. 2009. *Yukon Species at Risk.* Available at http://www.environmentyukon.gov.yk.ca/wildlifebiodiversity/ [accessed on March 29, 2010].

Yukon Water Board (YWB). 2015. *QZ14-031-1 Type A Water Licence for a Quartz Mining Undertaking*, issued to Minto Explorations Ltd. August 5, 2015.

APPENDIX 1-1

Seismic Hazard Assessment

APPENDIX 1-1

MINTO MINE SITE CHARACTERIZATION – SEISMIC HAZARD ASSESSMENT FOR MINTO, YT

Seismic Hazard Assessment for Minto, YT

Final Report:
April 2015

Prepared for:
SRK Consulting Ltd.

Prepared by:
Gail M. Atkinson, Ph.D., P.Geo., FRSC
Engineering Seismologist
And Karen Assatourians, Ph.D.

Seismic Hazard Assessment for Minto, YK

1- Introduction

A limited site-specific seismic hazard analysis has been performed for the site of a tailings facility near Minto, Yukon (62.62N 137.23W), for annual exceedence probabilities in the range from 1/100 to 1/10,000 per annum (p.a.). The rationale and input parameters for the hazard assessment are provided in Sections 2 to 4. Section 5 provides the ground-motion parameters determined in this study for a range of probability levels.

The analysis determines the likelihood of ground motion at the site by considering the magnitudes, rates of occurrence, and locations of earthquakes throughout the region, using the probabilistic Cornell-McGuire method. The method is widely used throughout North America and forms the basis for seismic zoning maps in building codes in Canada (Adams and Halchuk, 2003; Halchuk et al., 2014). This assessment represents an update and refinement of the type of estimate provided in the 2005 and 2010 National Seismic Hazard maps by the Geological Survey of Canada (GSC), both of which were based on the model described by Adams and Halchuk (2003). The results of this study consider the effects of major uncertainties on the hazard at the site, and incorporate up-to-date information on seismicity and ground motion prediction equations (GMPEs), which have evolved considerably over the last 10 years (e.g. see Atkinson and Goda, 2011; Atkinson and Adams, 2013 for discussion). The model employed here makes use of information developed for the new national seismic hazard maps of Canada produced by the GSC, which have been approved for incorporation into the 2015 National Building Code of Canada (NBCC) (Halchuk et al., 2014). Additional factors that are important to the Minto site, but not evaluated in the national-level model, are also considered. We note that this analysis addresses natural seismicity, and does not address the probability of potential induced seismicity sources, if any.

In analyzing the engineering effects of ground motion, both the amplitude and frequency content of the vibrations are important. Therefore the seismic ground motions are expressed using the response spectrum (PSA(f)), which shows the maximum acceleration that a simple structure would experience as a function of its natural frequency. The response spectrum result is a Uniform Hazard Spectrum (UHS), in which the amplitude for each frequency corresponding to a specified exceedence probability is provided. The peak ground acceleration (PGA) for this probability is also estimated, as is the peak ground velocity (PGV). The frequency associated with the PGA varies, but in general the PGA is associated with high-frequency motions (near 10 Hz); the PGV is associated with motions near 2 Hz. The UHS results of this study are presented in the figures and tables provided in Section 5.

We perform hazard calculations at the site for NEHRP B/C conditions (near-surface shear-wave velocity of 760 m/s); this is the reference site condition for the results. These results would apply to facilities at or near the site, provided it is founded on NEHRP B/C or a similar soft-rock condition. The results can be adjusted for site class A to be applicable to very hard rock site conditions (shear-wave velocity >1500 m/s), using conversion factors that represent average site amplifications for such conditions. The conversion factors for correcting results to site class A are given herein.

2 – Seismicity and Tectonic Setting

The Minto site is located in an area of moderate seismicity and complex geology. The active Denali fault system lies >100 km to the south, while the less-active Tintina fault lies to the north. The less-known Teslin fault passes near the site, and could be associated with moderate seismicity. In view of the geological complexity of the site area, a desktop fault study was conducted by SRK (Kramer, 2015). Figure 1 highlights the main findings of that study with regards to faults in the site area that may be associated with seismicity. It is noted that although the Teslin fault is the most prominent, the site area is traversed by a network of faults. The major faults identified by SRK include the northwest-trending Denali, Tintina, Teslin, Coghlan, and Big Creek faults, and the north northwest-trending Braeburn, Towhata, and Big Salmon faults. SRK recommended to treat the Teslin fault as a fault system with distributed seismicity. Specifically, Kramer (2015) recommended the faults be considered as an areal zone, roughly 23 km measured at surface across the Minto mine in a northeast-southwest direction (perpendicular to the strike of the faults), and extending 100 km beyond the Minto mine to the northwest.

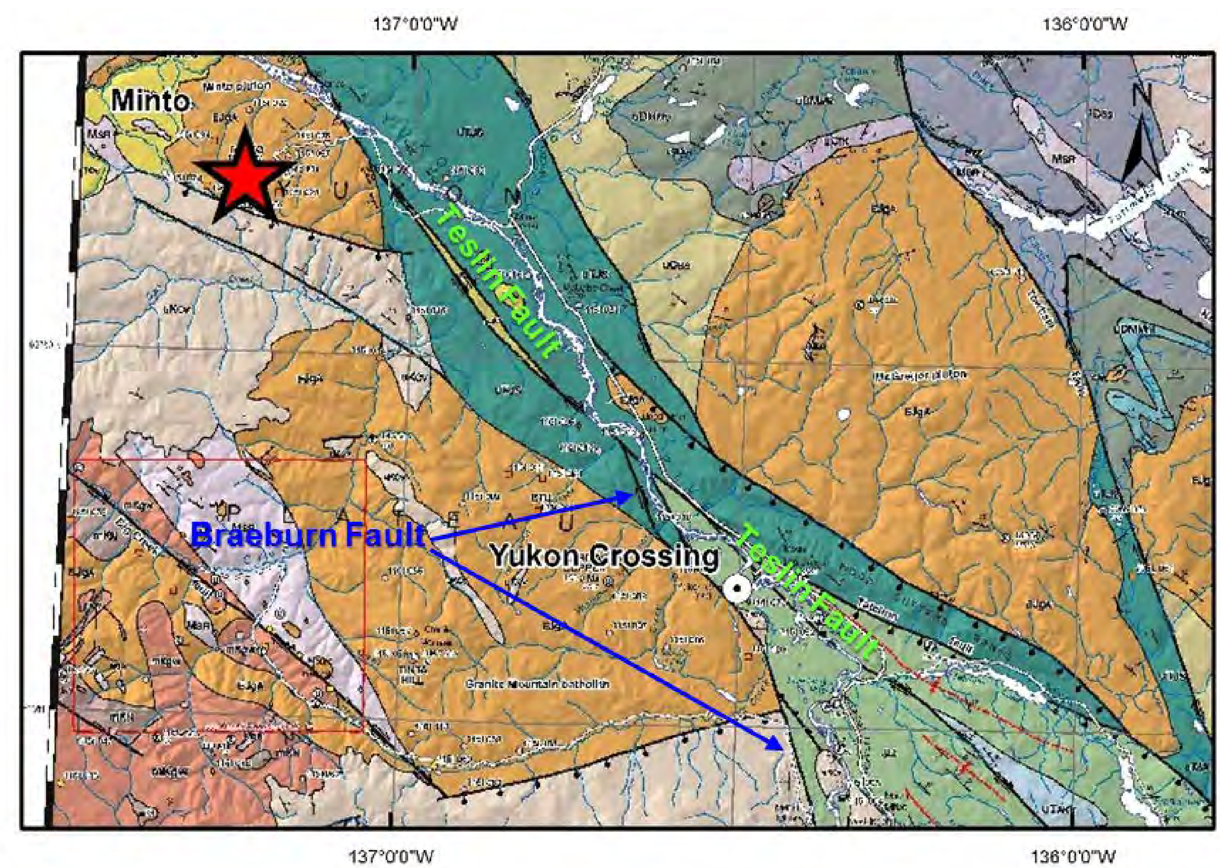


Figure 1 – Faults intersecting near the Minto site, from Kramer (2015) memorandum. Minto site is indicated by the red star.

Figure 2 shows the seismicity in the region around the site in relation to seismotectonic source zones considered in this study. Within the new seismic zoning models developed by the Geological Survey of Canada for the 2015 National Building Code of Canada (Halchuk et al., 2014), the Minto area lies within the YUS areal source zone. This is a very broad areal source zone that apparently contains non-homogeneous seismicity, with events tending to preferentially occur close to the Tintina and Teslin faults, at least in some regions (by inspection of Fig. 2). The GSC model uses fault sources for the active Denali faults to the south, but does not explicitly model the Tintina or Teslin faults, probably because these faults are less active, and there is less available information about them. Site-specific aspects such as the relationship of a site to particular potential seismic sources are not generally considered in the overview-level treatment of seismic sources that is incorporated into the national hazard maps.

We examined the GSC national model to consider the potential impact of defining an areal source zone for the observed seismicity in the region of the Teslin fault and its extension. Because the site lies within this zone, the hazard will be sensitive to how its seismicity is modeled. (By contrast, the Tintina fault is far enough away that hazard is less sensitive to how it is modeled.)

We considered defining a specific source zone to represent the network of faults identified by SRK, as shown by the irregular polygon source on Figure 2 (in which the points of the polygon were provided by Kramer). However, a careful examination of the seismicity at the M>2.7 level reveals that there is no concentration of seismicity in this zone relative to the average rate observed in the YUS zone as a whole. We verified through preliminary hazard calculations that defining this as a separate source, based on the observed rates of M>2.7 events, does not impact the calculated hazard.

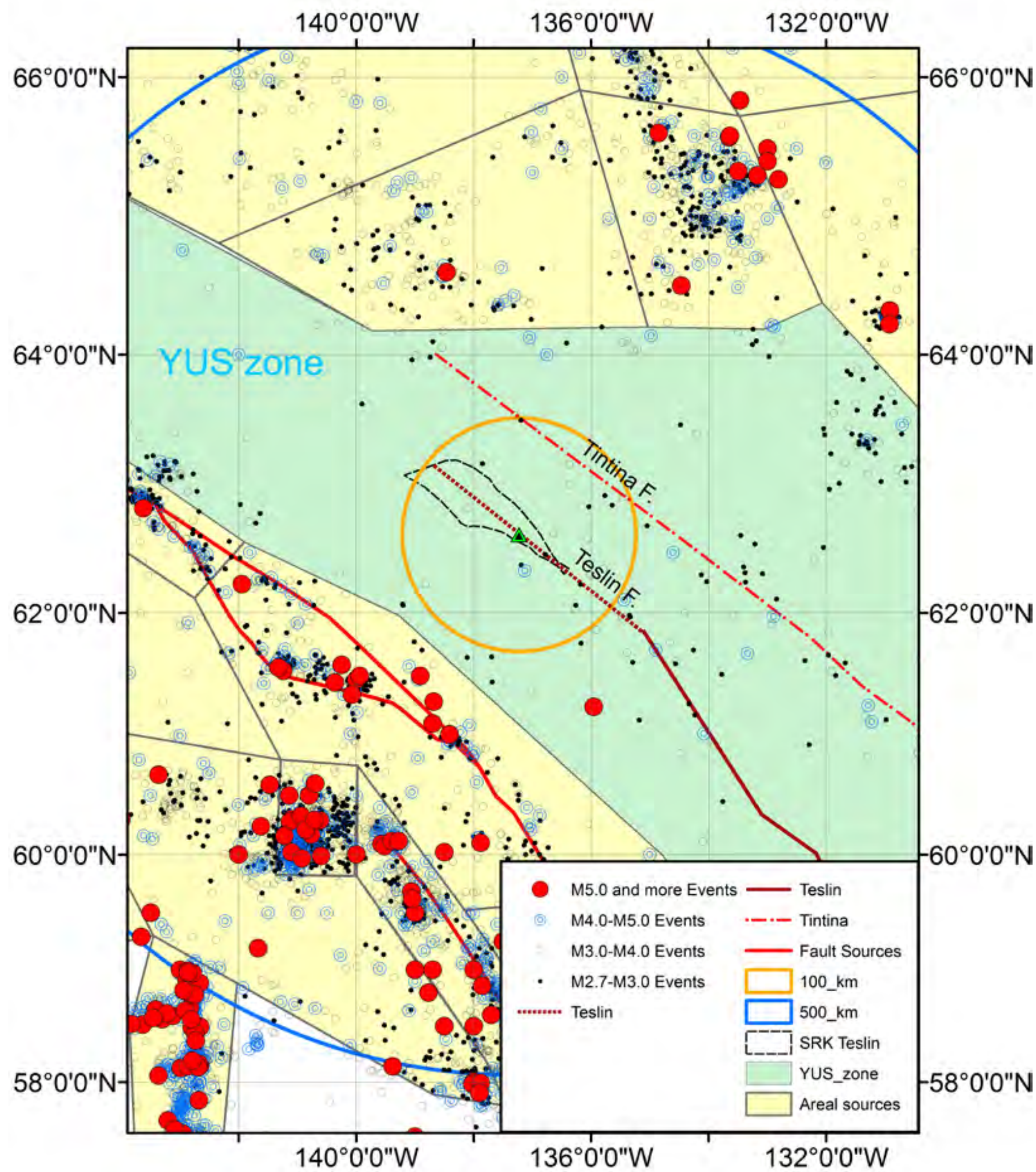


Figure 2 – Historical Seismicity in the Minto area, showing all events of M>2.7 in the catalog within approximately 500 km of the site. Note that the catalog is not complete at lower magnitude levels. We show the regional sources defined in the GSC 2015 model (the solid red lines are the Denali fault sources, the grey lines are areal source zone boundaries, with the YUS zone shown in green). We also show the approximate trace of the Tintina and Teslin Faults as dashed red lines. The dashed black lines outline an alternative source model that contain a group of faults, as suggested by SRK.

While examining the seismicity that might be associated with the network of faults in the site area in detail, we noted that there is an apparent linear trend of low-level (M2 to 2.5) seismicity that passes through the site area, approximately perpendicular to the trace of the Teslin fault. This apparent seismicity trend is shown in Figure 3. Although these events are listed as earthquakes in the Geological Survey of Canada catalogue, a close inspection reveals that they must in fact be blasting events. In addition to the narrow range of magnitudes that they exhibit, we note that if one looks at the time of day of the events, plotted in Figure 4, they occur almost exclusively between 8am and 7pm local time, with most events occurring between 4pm and 6pm – this is characteristic of blasting activity. Therefore we filtered out all events of M<2.7 (thus excluding potential blasts that may have been misidentified as earthquakes) to properly examine the regional seismicity with relation to the faults (Figure 2). Our conclusion is that, in the absence of evidence to suggest geologically-recent activity associated with the faults in the site area, the seismicity environment is best represented by the broad YUS areal source zone. It is recognized that within this broad source zone seismicity occurs at a moderate rate on a diffuse network of faults, which may or may not be recognized in surface expression.

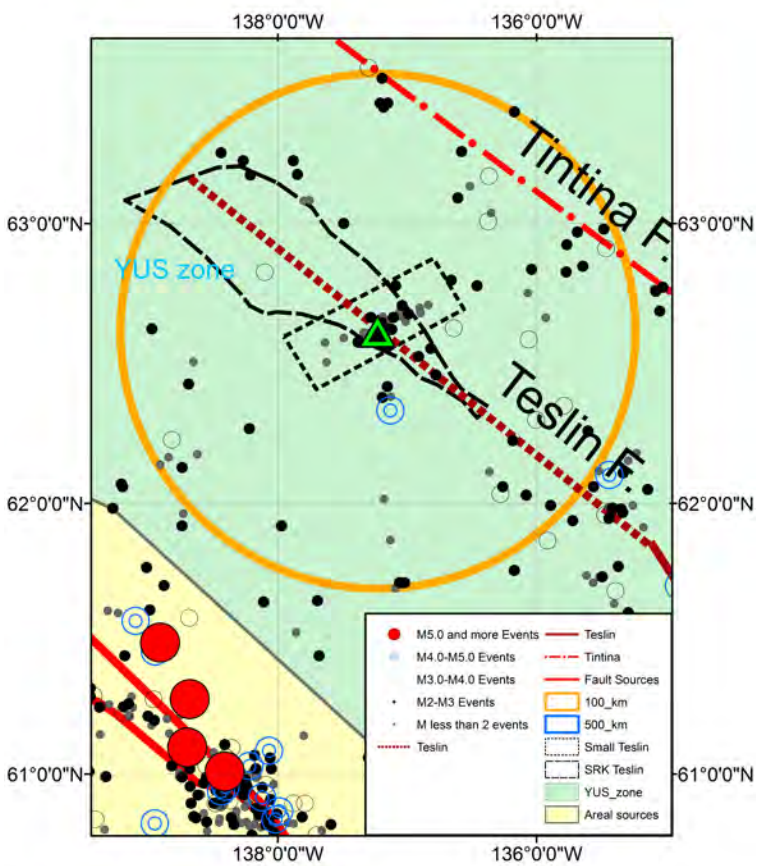


Figure 3 –Enlargement of alternative definitions of the Teslin areal zones. The small dashed black line shows an apparent linear trend of seismicity (see Figure 4). The large dashed black line outlines the fault zone surrounding the Teslin fault as defined by SRK. Dotted red line shows main trend of Teslin fault.

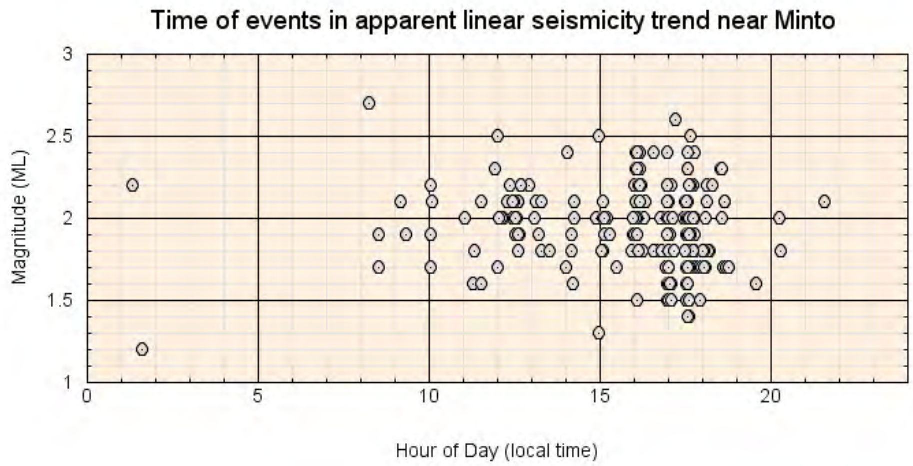


Figure 4 – Plot of time of day in which the events within the apparent linear trend of seismicity noted in Figure 3 occur. Because the events occur almost exclusively between 8am and 7pm, with most being clustered from 4pm to 6pm, we conclude these are actually blasts, not earthquakes.

3 - Seismic Hazard Methodology

We conduct the seismic hazard analysis for Minto using the EqHaz software (Assatourians and Atkinson, 2013). This is an open-source software package that performs probabilistic seismic hazard analysis according to the Cornell-McGuire method, using a Monte Carlo algorithm. It has been validated by checking against the results of FRISK88 as implemented by the Geological Survey of Canada, at selected cities, as described in Assatourians and Atkinson (2013). Furthermore, it was validated for this particular project by checking that the calculated 1/2500 per annum (p.a.) ground motions obtained using EqHaz, for the standard GSC-2015 hazard model, closely match the corresponding results obtained by GSC for the national hazard maps, at a nearby site.

Seismic hazard analyses in Canada are based on probabilistic concepts which allow incorporation of both geologic interpretations of seismic potential and statistical data regarding the locations and sizes of past earthquakes. The Cornell-McGuire method (Cornell, 1968; McGuire, 1976, 1977, 1995; Risk Engineering, 1988) has proven particularly well-suited to calculate expected ground motions for a wide range of seismic hazard environments, offering flexibility in the consideration of spatial and temporal characteristics of regional earthquake occurrence, and the basic physics of the earthquake process.

The spatial distribution of earthquakes is described by defining seismic source zones (areas or faults) on the basis of seismicity and seismotectonic interpretations. The earthquake potential of these zones is often assumed to be spatially uniform; however, an alternative is a "smoothed seismicity" approach, in which the spatial distributions of past event clusters drives the expected seismicity pattern. The GSC uses the uniform seismicity approach exclusively in national seismic hazard mapping, as the software they are currently using does not have the capability to implement the smoothed-seismicity approach. The U.S. Geological Survey uses a smoothed-seismicity approach (Petersen et al., 2008). In this study, we consider both alternatives.

The frequency of earthquake occurrence within each source zone is described by a magnitude recurrence relationship, truncated at an upper magnitude bound, Mx. Earthquake ground motion prediction equations (GMPEs) provide the link between the occurrence of earthquakes of various magnitudes and the resulting ground motion levels at any site of interest. The probability of exceeding a specified level of ground motion at a site can then be calculated by summing up the hazard contributions over all magnitudes and distances, including all source zones. In most cases, including this study, the hazard is generally dominated by contributions from the source zone within which the site is located – although sometimes active distant sources can be important contributors to long-period hazard. The hazard integral sums up the likelihood of earthquakes at all distances within all source zones, assuming that earthquakes are distributed randomly in space across the source zone (or alternatively by using a spatial smoothing algorithm to consider the historical distribution of seismicity patterns more closely). To obtain ground motion levels or earthquake response spectra for a specified probability, calculations are repeated for a number of ground motion values, for all desired ground motion parameters, and interpolation is used to determine the relationship between ground-motion amplitude and annual probability.

The Cornell-McGuire framework has been well-accepted in all parts of North America. In Canada, it forms the basis for the seismic hazard maps in the National Building Code of Canada (NBCC, 1985 and beyond), and is the usual basis for seismic hazard evaluations of all important engineered structures. The results are generally expressed as a Uniform Hazard Spectrum (UHS), in which the amplitude for each frequency corresponding to a specified target probability is provided. The peak ground acceleration (PGA) and velocity (PGV) for the target probability may also be estimated. When time histories of ground-motion are required for use in engineering analyses, these may be derived to be consistent with the expected ground motion characteristics of the UHS for the target probability (e.g. McGuire, 2004).

The calculations are carried out using the EqHaz program set developed by Assatourians and Atkinson (2013) (www.seismotoolbox.ca/EQHAZ.html). This program performs probabilistic seismic-hazard analysis (PSHA) by the Monte Carlo simulation method (Musson, 1998, 1999, 2000, 2012a; Hong and Goda, 2006; Assatourians and Atkinson, 2013). The program can handle areal and fault sources with magnitude-recurrence statistics as described by Gutenberg–Richter (untruncated, truncated, or tapered), or a user-specified discretized cumulative or incremental magnitude-recurrence distribution. Ground-motion amplitudes are modeled as user-specified functions of magnitude and distance (in a table format). Both epistemic and aleatory uncertainty in the key input parameters can be modeled. The user may treat these uncertainty sources as equivalent (in terms of our ability to predict future ground motions), enabling the treatment of ground motions realized over a long simulated catalog as an extreme-value statistical problem. Alternatively, the user may treat epistemic uncertainty separately using confidence fractiles on the input parameters, which has been traditional practice (e.g., McGuire, 2004). The mean-hazard results, which are the focus of this study, are not sensitive to this choice.

To utilize the capabilities of EqHaz, we require a description of seismic hazard parameters and their uncertainties. This includes the delineation of the region into alternative source zone models (which may include both areal sources and fault sources), representing alternative tectonic interpretations of the seismicity, with estimates of the likelihood that each zonation model is the 'true' model. Within each source model, alternative geometric configurations (and associated weights) may be specified for each individual source, if desired. For this study, the main focus is on the regional hazard model defined by the GSC for the 2015 national hazard maps, including its alternative seismicity parameters. However, we also examined the implications of faults not modeled in the GSC model, specifically the Tintina and Teslin faults. We evaluated the sensitivity of the hazard calculations to alternative treatments of seismicity that appears to be associated with these faults.

For each source zone of each model, magnitude recurrence parameters and their uncertainty are modeled by alternative No, beta pairs (eg. rate and slope of the Gutenberg - Richter recurrence relation), with associated weights. Three pairs were used for each source zone. Maximum magnitudes for each source zone were also specified by three alternative values. For each ground motion parameter, three alternative GMPEs were defined; parameters included the 5% damped pseudo-acceleration (average horizontal component), for frequencies of 0.2 to 20 Hz, plus peak ground acceleration and velocity. The alternatives for each input parameter and their weightings follow the GSC 2015 national seismic hazard model, with one exception. The exception is that we also consider a smoothed-seismicity representation of the distribution of epicenters, which better models the spatial distribution of seismicity within the zones. This may help to consider the implications of fault zones that lie within areal sources, which may act to concentrate seismicity over the regional background levels.

4 - Input Parameters for Seismic Hazard Analysis at Minto

To explore the main uncertainties in seismic hazard assessment at Minto, while keeping the scope of the study limited, we have used the GSC national hazard model (as summarized in Halchuk et al., 2014, and Atkinson and Adams, 2013) as a starting point, then added in consideration of the uncertainties that are specific to the Minto site, including information from the geological report on faulting in the site area prepared by SRK (Kramer, 2015). In essence, we use the GSC regional model, but examine the implications of alternative definitions for the seismogenic source zone in which Minto is located, in particular considering the potential sensitivity of hazard to major faults that are near the site (the Tintina and Teslin faults). We also consider uncertainty in the distribution of events within zones, by considering a smoothed-seismicity model that better reproduces concentrations of events that have occurred historically within the source zones. For the smoothed seismicity model, and for consideration of fault activity, we use the Canadian Composite Seismicity Catalogue (CCSC), updated to 2013. The Appendix lists the model parameters employed in the analysis by EqHaz, which follow those used by the GSC in the national hazard maps for 2015.

Source Zones

Known seismicity in the Minto region is mapped in Figure 2, along with the source zones used to characterize seismicity in the Minto region region. The seismicity is taken from the Canadian Composite Seismicity Catalogue (CCSC) (see Fereidoni et al., 2012); information downloaded from the GSC website (www.earthquakescanada.nrcan.gc.ca) is also considered in Figures 3 and 4. All catalogue events for Figure 2 were converted from local magnitude scales to moment magnitude as required, as described in Fereidoni et al. (2012). Most of the events in the catalogue are local magnitude (ML), which was converted to moment magnitude (**M**), using **M**= ML-0.18. This relationship was developed using empirical correlations between **M** and ML for events in the region.

The areal source zones follow those defined by the GSC. In addition to using the GSC approach of assuming uniform seismicity within each zone, we also consider the sensitivity of results to use of the smoothed-seismicity approach, in which epicenters tend to cluster in a manner similar to their historical distribution. The GSC includes fault-source zones for the Denali faults (shown in red in Figure 2; parameters as given in Appendix A).

In the GSC model, a very large geographic region is included within the YUS source zone. Based on examination of the seismicity and major regional faults, it appears that the seismicity within YUS is in places concentrated along the trends of the Tintina and Teslin faults. Moreover, the Teslin fault is part of a complex system of faults in the site area, as documented by SRK (Kramer, 2015). The properties of these faults are not well known, probably due in part to the remoteness of the area. As discussed in Section 2, a careful evaluation of the seismicity in the area led us to the conclusion that it is best modeled using the broad YUS source zone. To consider the implications of clustering of seismicity with the YUS zone, along potential fault sources that it may include, we consider both the uniform and smoothed-seismicity spatial distributions.

Our seismic hazard assessment explicitly considers the influence of all source zones within a 300 km radius of Minto. There are additional active zones at greater distance, but these are too far away to contribute significantly to hazard, relative to the nearby sources. A possible exception is that at long periods (>2 s), there may be a significant contribution to hazard from the subduction zone bordering Alaska. We treat this subduction source deterministically, by considering a M9 scenario event at a distance of 530 km (approximate distance for the nearest approach of the subduction zone). Ground motions from this event will be assessed at the median plus sigma level, and compared to the results from the probabilistic hazard assessment. For this exercise, the medium-level subduction GMPE as given in Atkinson and Adams (2013) (at the +sigma level) is used.

Magnitude Recurrence Relations

Recurrence data, expressing the relative frequency of occurrence of earthquakes within a zone as a function of magnitude, can generally be fit to the Gutenberg-Richter relation:

$$\text{Log } N(M) = a - b\,\mathbf{M}$$

where N(M) is the number of events per annum of magnitude **≥M**, **M** is moment magnitude, and *a* and *b* are the rate and slope of the relation. (Note: various types of truncation to a maximum magnitude can be applied to the above expression; in EQHAZ we use an exponential truncation.) In most parts of the world, *b* values are in the range from 0.8 to 1, while *a* values vary widely depending on the activity level of the region.

For this study, as we have adopted the recently-developed source zone models of the GSC, we likewise adopt their magnitude-recurrence relations for all zones (from Halchuk et al., 2014). These recurrence relations were calculated with a maximum likelihood algorithm, using the seismicity data of the SHEEF2011 moment-magnitude catalog of the GSC (Halchuk et al, 2014). The SHEEF2011 catalog (Geological Survey of Canada) is very similar to the Canadian Composite Catalog of Fereidoni et al. (2011). The magnitude recurrence relations for the most critical zone, the YUS zone, is shown in Figure 5, including the best-estimate rates, and upper and lower alternative curves that express uncertainty in the recurrence rates; the uncertainty in the maximum magnitude is also shown.

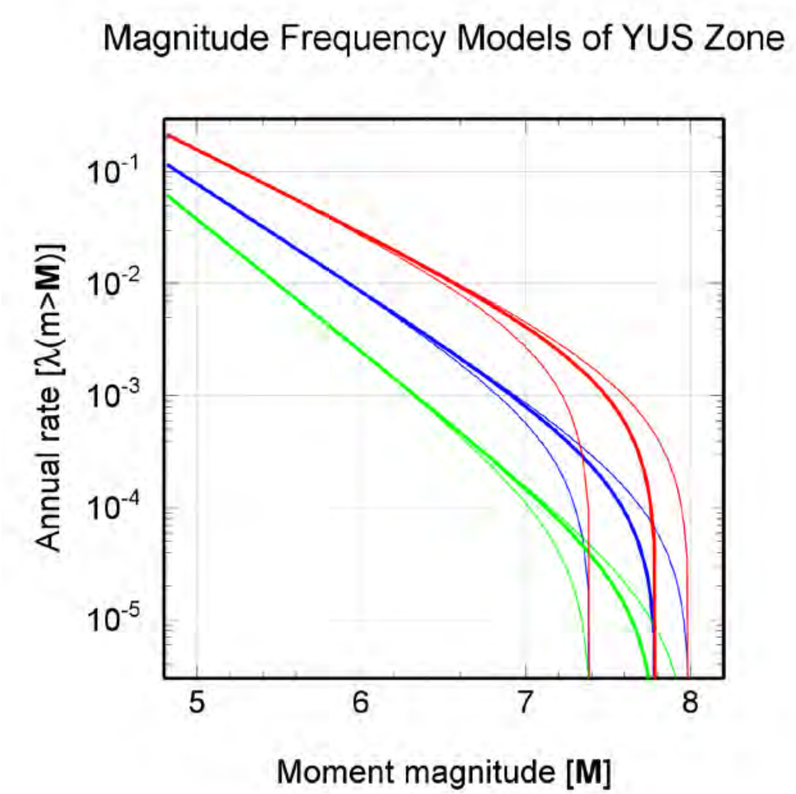


Figure 5 – Recurrence Relations for the YUS (Yukon South) zone. The best-estimate (most-heavily weighted) is the heavy blue line, while red line shows upper-branch recurrence model and green line shows lower-branch recurrence model. Each alternative relation (line) is associated with three alternative Mx (maximum magnitude) values (low, best, high).

The complete set of seismicity parameters for all zones as implemented in this study are given in the Appendix. For all zones outside the YUS the contributions to hazard at Minto will be relatively modest by comparison. For all zones we follow the distributions of the recurrence relations and maximum magnitudes used by the GSC.

The implemented source model incorporates epistemic uncertainty in recurrence parameters and maximum magnitudes. For the minimum magnitude, we used a value of 4.8, consistent with the GSC value. For the maximum magnitude, the range of considered values in the YUS zone is from **M**7.4 to **M**8.0. Larger events, up to **M**8.4, are considered for the Denali fault zone. The relative weights for the alternative models follow those used by GSC, as provided in the Appendix.

An additional modification to the GSC approach that we consider concerns the distribution of seismicity within the zones. In the GSC model, the seismicity within each zone is assumed to be uniformly distributed in space over the entire zone. We consider also an alternative, in which the spatial smoothing algorithm described by Assatourians and Atkinson (2013) is implemented. The spatially-smoothed seismicity more nearly accords with historical clustering of seismicity within each zone (as based on the Canadian Composite Catalog). The spatial smoothing approach is similar to that implemented by the USGS (Petersen et al., 2008). This provides a test of the sensitivity of results to the spatial distribution of events, and its unevenness in some zones.

The completeness intervals used in interpreting the historical seismicity distribution for the spatial-smoothing model are as follows (where it is assumed that the historical catalog is complete for each magnitude level beginning with the years quoted):

Year to begin statistics:

M3.0	**M**3.8	**M**4.3	**M**4.8	**M**5.3	**M**5.8	**M**6.3	**M**7.2
1979	1972	1965	1962	1951	1935	1917	1899

Ground motion prediction equations

Ground motions for the reference ground condition of B/C boundary are given in this analysis by the ground-motion prediction equations (GMPEs) of Atkinson and Adams (2013) for crustal events in western North America (WNA). The equations provide peak ground acceleration (PGA) and velocity (PGV), as well as response spectra (PSA, 5% damped horizontal component) as a function of moment magnitude and distance. The equations were developed considering the alternative GMPEs available from the NGA-West1 project. To consider epistemic uncertainty in the median GMPEs, Atkinson and Adams define a central, lower, and upper suite of GMPEs for input to the hazard analysis. These alternatives were defined by considering alternative proposed GMPEs for WNA, and the data that guided them. The central (preferred) curve follows the Boore and Atkinson (2008) GMPE, as updated by Atkinson and Boore (2011); this is referred to as BA08'. Low and high alternative curves were defined considering uncertainty as indicated by the alternative NGA-West GMPEs (shown in Figure 6), and the constraints on these curves suggested by the data from which they were developed. The epicentral distance version of the

Atkinson and Adams equations is used for areal sources, as the events are treated as point sources in the hazard analysis, with appropriate conversions from finite-source to point-source distance metrics implemented as described by Atkinson and Adams (2013).

We considered these three alternative GMPEs with weights of 0.5 (middle), 0.3 (upper) and 0.2 (lower). The considered suite of ground-motion relations is shown on Figure 6 for NEHRP B/C site conditions (random horizontal component). Conversion of results to other site conditions is discussed in Section 5.

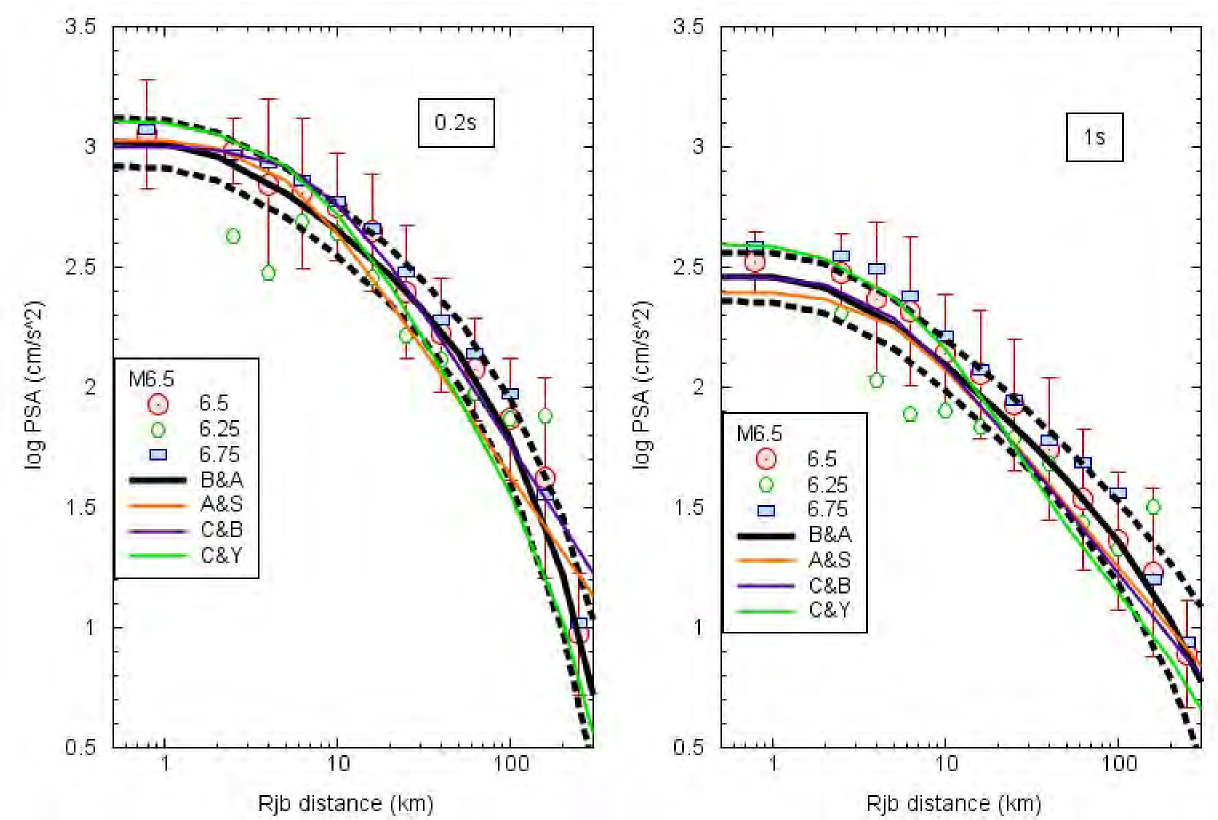


*Figure 6 – Proposed lower, central and upper GMPEs, for **M**6.5 crustal events in WNA. Solid black line is central equation (BA08'); dashed black lines are lower and upper equations, obtained by adding and subtracting delta from the central equation. Solid lines show other PEER-NGA equations. Symbols show means of the log amplitudes for various 0.5 unit magnitude bins; error bars show standard deviation for the M6.5 magnitude bin. (from Atkinson and Adams, 2013)*

Random uncertainty in the GMPEs was modeled by a lognormal distribution of ground motion amplitudes about these median relations, with a standard deviation of 0.23 log (base 10) units for high frequencies, increasing to 0.27 units at low frequencies. This random uncertainty is consistent with recent studies (eg. Atkinson, 2012; Atkinson and Adams, 2013).

Ground-motion prediction equations are also required to consider the deterministic scenario postulated for the subduction zone bordering Alaska. For this event, we use the "weighted-mean" GMPE of Atkinson and Adams (2013) for a **M**9 subduction event at 530 km, multiplied by a factor of two to provide median plus one sigma motions (approximately).

5 - Seismic Hazard Results for Minto

Figure 7 provides the mean-hazard curves for the Minto site for a selection of frequencies, showing how the amplitude of motion increases as the probability of its exceedence decreases. The calculations are performed for a B/C reference site condition (near-surface shear wave velocity of 760 m/s). We show hazard curves for both the uniform and smoothed-seismicity distribution of seismicity. It is noted that the results are very similar. Our preferred model is that from the uniform-seismicity approach as it is slightly more conservative, yet not so different as to suggest that the uniform-seismicity distribution is unreasonable for the site area.

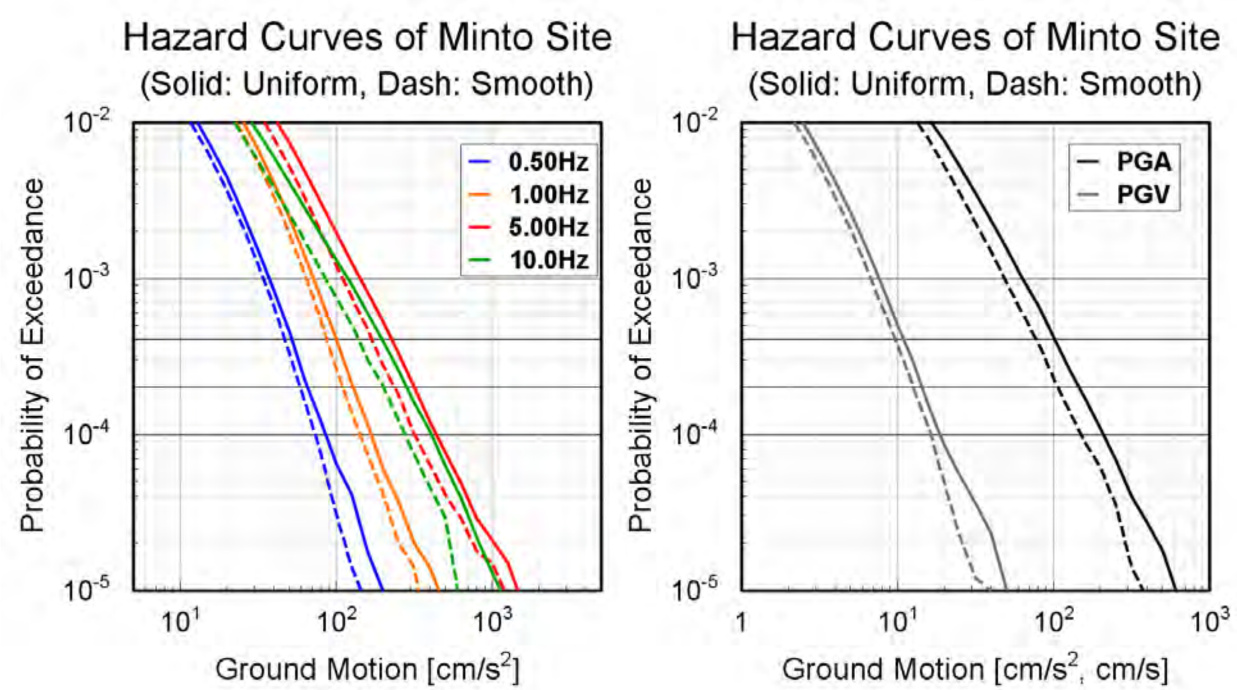


Figure 7 – Mean-hazard curves for Minto for selected frequencies(B/C site conditions). Both the uniform-seismicity and the smoothed-seismicity spatial distribution implementations are shown.

Figure 8 provides an overview of mean-hazard results for a range of probabilities, for B/C conditions (the reference condition, for which all hazard calculations were performed). Probability levels of 0.01 to 0.0001 per annum, corresponding to "return periods" of 100 to 10,000 years, are shown; note that the return period is simply the inverse of the annual probability. The results are given as a Uniform Hazard Spectrum (UHS), in which the mean-hazard motion for each spectral frequency is plotted for a specified probability of exceedence. The peak ground acceleration (PGA) is plotted at 90Hz for reference, even though it does not correspond to a specific frequency.

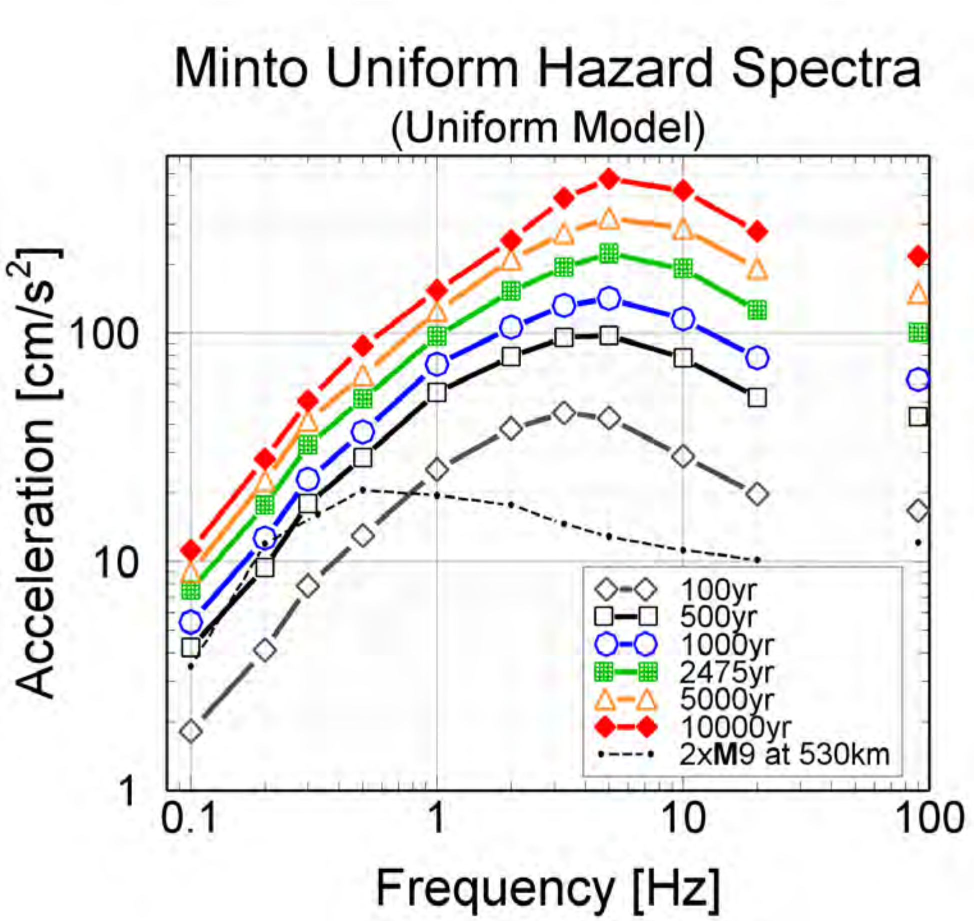


*Figure 8 – Mean-hazard Uniform Hazard Spectrum (UHS) at Minto for a range of return periods (B/C conditions). Deterministic scenario motions for a **M**9 subduction event at 530 km are also shown (the median **M**9 motions are multiplied by a factor of two to represent median + one standard deviation amplitudes). PGA is plotted for reference at a frequency of 90Hz. The uniform seismicity model is assumed.*

Table 1 presents the plotted values in cgs units, while Table 2 presents the equivalent values in units of g (where 1g=980 cm/s^2). (Note: these values use the uniform-seismicity assumption within each source zone.) We also include conversion factors if results are desired for hard-rock site conditions (NEHRP A with near-surface shear wave velocities of >2000 m/s) or NEHRP C (firm ground, with near-surface shear wave velocities of 450 m/s). The conversion to NEHRP A follows that given in Atkinson and Adams (2013), while the conversion to C follows that being recommended for the 2015 NBCC.

Table 1 – Mean-hazard UHS results (average horizontal-component PSA, 5% damped, ***in cm/s²*** *for Minto for B/C conditions.* ***M****9 deterministic scenario motions (B/C), where these should be applied in place of UHS motions where larger. Multiplicative conversion factors to apply to go from B/C to C (450 m/s) are also listed. The uniform-seismicity approach is used.*

Frequency	0.01 p.a.	0.002 p.a.	0.001 p.a.	0.0004 p.a.	0.0002 p.a.	0.0001 p.a.	**M9 scenario (deterministic)**	B/C to C
0.1	1.8	4.2	5.4	7.5	9.0	11.2	**3.5**	1.47
0.2	4.1	9.4	12.6	17.6	22.5	28.1	**12.0**	1.47
0.33	7.8	17.8	22.9	32.4	41.4	50.4	**16.1**	1.47
0.5	13.0	28.5	36.8	51.4	65.4	87.9	**20.6**	1.47
1	25.3	55.1	72.7	96.9	124.8	154.0	**19.4**	1.44
2	38.1	79.0	105.7	152.3	209.9	254.2	**17.8**	1.37
3.33	44.9	95.6	131.4	194.3	275.2	391.7	**14.6**	1.26
5	42.5	97.8	141.6	223.6	319.9	473.0	**12.9**	1.18
10	28.8	77.9	115.6	191.7	287.2	420.3	**11.2**	1.14
20	19.7	52.3	77.8	126.2	190.9	278.0	**10.2**	1.14
PGA	16.7	43.1	62.4	100.8	149.6	218.0	**12.1**	1.21
PGV	2.5	5.6	7.7	10.7	14.4	18.6	**4.2**	1.37

Table 2 – Mean-hazard UHS results (average horizontal-component PSA, 5% damped, in ***units of g****, for Minto for B/C conditions.* ***M****9 deterministic scenario motions (B/C), where these should be applied in place of UHS motions where larger. Multiplicative conversion factors to apply to go from B/C to C (450 m/s) are also listed. The uniform-seismicity approach is used.*

Frequency	0.01 p.a.	0.002 p.a.	0.001 p.a.	0.0004 p.a.	0.0002 p.a.	0.0001 p.a.	**M9 scenario (deterministic)**	B/C to A
0.1	0.002	0.004	0.006	0.008	0.009	0.011	**0.004**	0.92
0.2	0.004	0.010	0.013	0.018	0.023	0.029	**0.012**	0.87
0.33	0.008	0.018	0.023	0.033	0.042	0.051	**0.016**	0.84
0.5	0.013	0.029	0.038	0.052	0.067	0.090	**0.021**	0.81
1	0.026	0.056	0.074	0.099	0.127	0.157	**0.020**	0.78
2	0.039	0.081	0.108	0.155	0.214	0.259	**0.018**	0.72
3.33	0.046	0.097	0.134	0.198	0.281	0.399	**0.015**	0.74
5	0.043	0.100	0.144	0.228	0.326	0.482	**0.013**	0.76
10	0.029	0.079	0.118	0.195	0.293	0.428	**0.011**	0.93
20	0.020	0.053	0.079	0.129	0.195	0.283	**0.010**	1.26
PGA	0.017	0.044	0.064	0.103	0.152	0.222	**0.012**	$10^{(0.3-0.15\times \log R_{epi})}$
PGV(m/s)	0.025	0.056	0.077	0.107	0.144	0.186	**0.004**	0.81

The ground-motion spectrum for the **M**9 deterministic scenario subduction median+sigma event at 530 km is also shown on Figure 8 and in Table 1. The motions from this event are much less than the UHS at all frequencies, for return periods of 1000 years and greater. Therefore the **M**9 scenario can be neglected, except for any facilities that may be sensitive to low amplitudes of shaking with very long duration.

On Figure 9, the UHS is compared to the motions in the current (2010) building code. To make the comparisons applicable to the same site condition, the building code results for Class C were first reduced to the equivalent values for B/C, dividing by the B/C to C factors shown in Table 1. The increase in the UHS relative to the 2010 NBCC values largely reflects additional modeled fault sources in the region, as well as updated representations of ground motions and their uncertainty. Moreover, it may be noted that both this study and the 2015 GSC model provide mean-hazard spectra, whereas the 2010 model is closer to median-hazard.

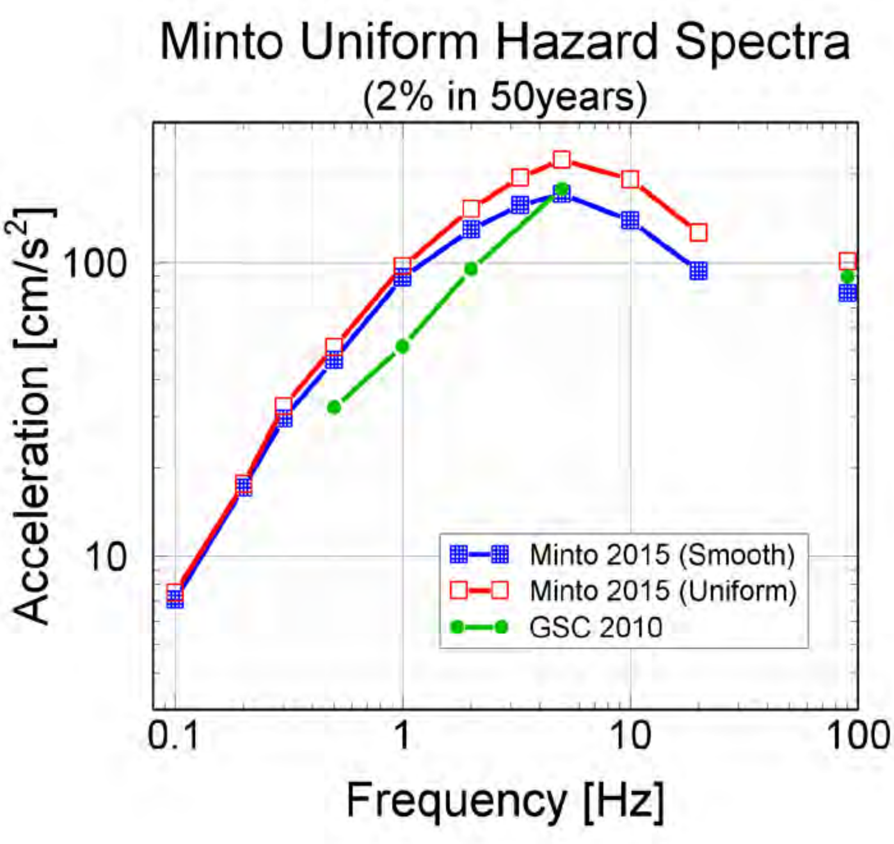


Figure 9 – Comparison of mean-hazard spectrum for Minto at 1/2500 p.a.(2% in 50 years) with results from 2010 building code values, all for B/C site conditions. PGA plotted at 90 Hz for reference. GSC 2010 model is derived from GSC online automatic calculator and converted to B/C site class, while Minto 2015 model is based on implementing 2015 NBCC model in EqHaz.

The seismic hazard can be deaggregated to show the dominant contributions to the hazard at any probability level as a function of magnitude and distance. Figure 10 presents such deaggregations, for selected frequencies, for the 1/10,000 p.a. probability. Note that deaggregations for the 1/2500 p.a. probability are similar, except that the weights of the distributions shift to slightly closer distances, and slightly lower magnitudes.

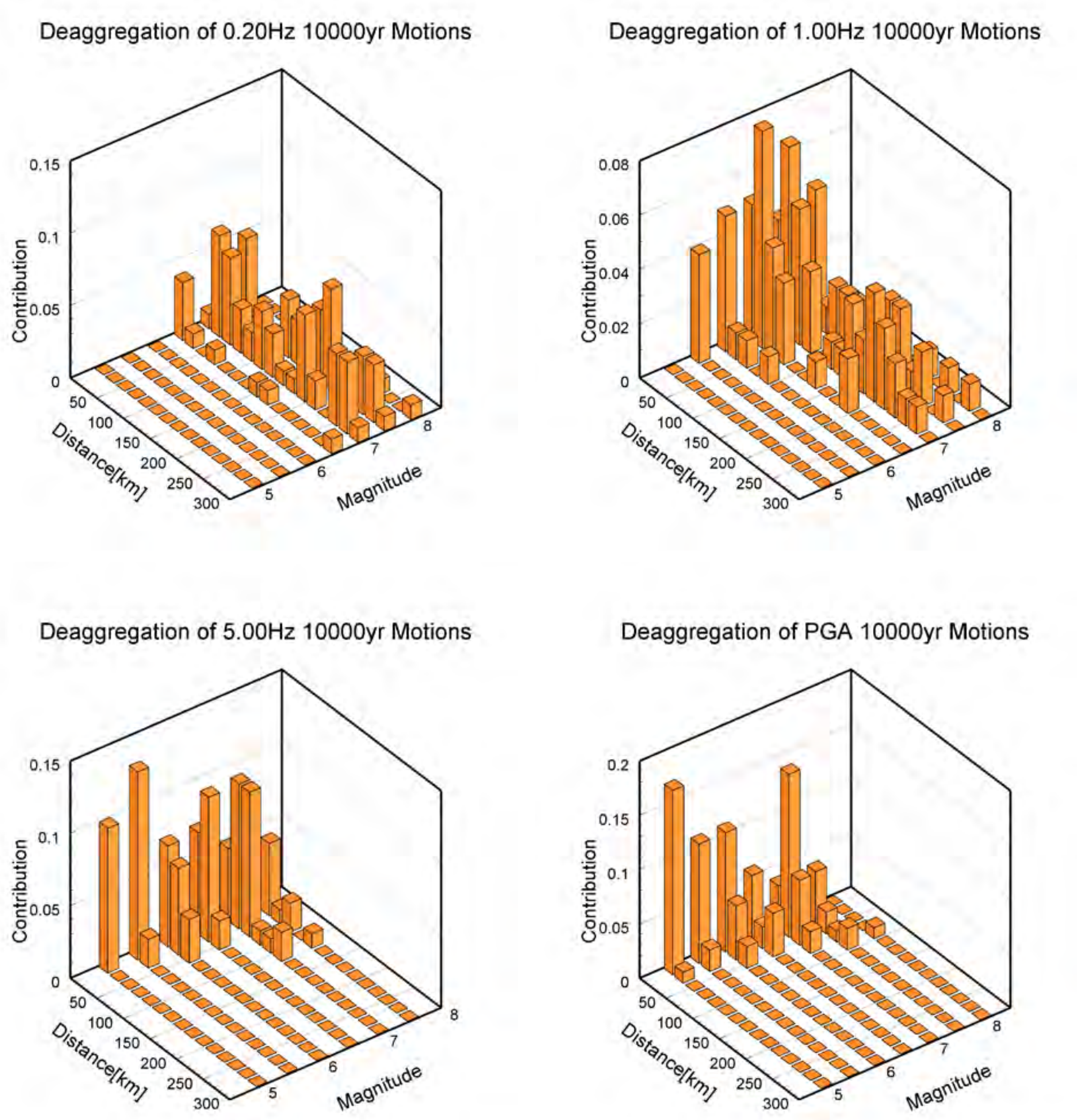


Figure 10 – Deaggregation of Minto hazard for 1/10,000 p.a. motions, for selected frequencies and PGA.

The deaggregation results are useful in the selection of time histories for use in analyses of the dynamic response of structures. Based on the deaggregation results shown, representative time histories for low-probability events would be events in the M 6.5 to 7.5 range, at distances less than 50 km; at high frequencies the contributions shift to somewhat lower magnitudes. On Figure 11, we compare some typical scenario events in the appropriate magnitude-distance range to the Minto mean-hazard UHS at 1/10,000 p.a. probability.

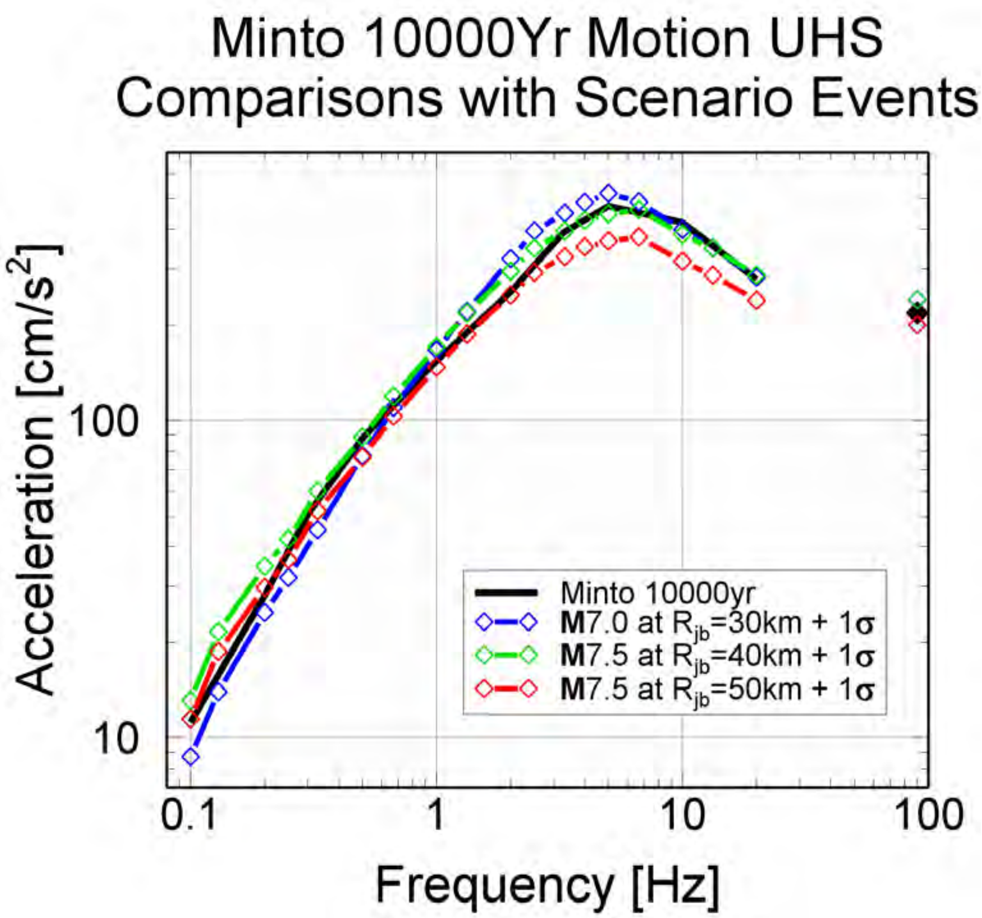


Figure 11 – Comparison of mean-hazard UHS at Minto (B/C site conditions) at 1/10,000 p.a. to selected scenario events.   The central GMPE (BA08'), at approximately the +one sigma level, is used to estimate spectra for the scenario events.

6 – Summary and Conclusions

A seismic hazard analysis has been performed for the Minto, Yukon site. Considering the major regional source zones as defined in the GSC national seismic hazard model, for an annual probability of exceedence of 0.0001, corresponding to a 10,000 year return period ground motion, the mean-hazard value of peak ground acceleration (PGA) at Minto is approximately 22%g (220 cm/s^2) for NEHRP B/C soil conditions (average shear-wave velocity of 760 m/s in upper 30 m).   The mean-hazard ground motions are provided in Table 1. The motions at 1/10,000 p.a. are similar to those that would be expected for events in the M7 range, at distances less than 50 km. Such an event could be considered as a deterministic scenario on a fault in the site area.

We note that the calculated hazard is potentially sensitive to the treatment of activity near the site. Under the source-zone geometry defined by SRK, the site lies within a broad network of area faults having seismicity levels that are consistent with those in the broader YUS area as a whole. Thus the local area faults have minimal impact on the computed seismic hazard in this study. However, if any of the faults near the site has indications of geologically-recent activity, this could impact the hazard significantly. In this study, we have assumed that none of the faults in the site area have enhanced activity, relative to that for the region as a whole. This assumption is consistent with the observed seismicity in the site area.

7 - References

Adams, J. and G. Atkinson (2003). Development of seismic hazard maps for the 2003 National Building Code of Canada. Can. J. Civ. Eng., **30**, 255-271.

Adams, J., and Halchuk, S. 2003. Fourth generation seismic hazard maps of Canada: Values for over 650 Canadian localities intended for the 2005 National Building Code of Canada. Geological Survey of Canada Open File 4459 150 pp.

Assatourians, K., and Atkinson, G., (2013). EqHaz: An Open-Source Probabilistic Seismic-Hazard Code Based on the Monte Carlo Simulation Approach. Seism. Res. Lett., **84**, 516-524.

Atkinson, G., and J. Adams, (2013). Ground motion prediction equations for application to the 2015 Canadian national seismic hazard maps. Can. J. Civ. Eng., **40**, 988-998.

Atkinson, G. M., and Goda, K. (2011). Effects of seismicity models and new ground motion prediction equations on seismic hazard assessment for four Canadian cities, Bull. Seismol. Soc. Am. **101**, 176–189.

Atkinson, G. and D. Boore (2011). Modifications to existing ground-motion prediction equations in light of new data. Bull. Seism. Soc. Am., **101**, 1121-1135.

Atkinson, G. and M. Macias (2009). Predicted ground motions for great interface earthquakes in the Cascadia subduction zone. Bull. Seism. Soc. Am.,**99**, 1552-1578.

Boore, D. and G. Atkinson (2008). Ground-motion prediction equations for the average horizontal component of PGA, PGV, and 5%-damped SA at spectral periods between 0.01s and 10.0 s. Earthquake Spectra, **24**, 99-138.

Boore, D. W. Joyner and T. Fumal (1997). Equations for estimating horizontal response spectra and peak acceleration from western North American earthquakes: A summary of recent work. Seism. Res. L., **68**, 128-153.

Cornell, C. (1968). Engineering seismic risk analysis. Bull Seism. Soc. Am., **58**, 1583-1606.

Fereidoni, A., G. Atkinson, M. Macias and K. Goda (2012). CCSC: Composite seismicity catalog for earthquake hazard studies for major Canadian cities. Seism. Res. L., **83**, 179-189.

Halchuk, S., Allen, T.I., Adams, J., and Rogers, G.C., 2014. Fifth Generation Seismic Hazard Model Input Files as Proposed to Produce Values for the 2015 National Building Code of Canada; Geological Survey of Canada, Open File 7576. doi:10.4095/293907

Hong, H. P., and Goda, K.(2006). A comparison of seismic-hazard and risk deaggregation, Bull. Seismol. Soc. Am. **96**, 2021–2039.

Kramer, J. (2015). Minto mine regional structural geology interpretation. Memo dated Feb. 17, 2015, Project 1CM002.036, SRK Consulting.

McGuire, R. (1976). FORTRAN computer program for seismic risk analysis. U.S. Geol. Surv. Open-file Rpt. 76-67.

McGuire, R. (1977). Seismic design spectra and mapping procedures using hazard analysis based directly on oscillator response. Intl. J. Earthq. Eng. Struct. Dyn., **5**, 211-234.
McGuire, R. (1995). Probabilistic seismic hazard analysis and design earthquakes: Closing the loop. Bull. Seism. Soc. Am., **85**, 1275-1284.
McGuire, R. (2004). Seismic hazard and risk analysis. EERI Monograph MNO-10. Earthq. Eng. Res. Inst., Oakland, Ca.
Musson, R. M. W.(1998). On the use of Monte Carlo simulations for seismic hazard assessment, in Proc. of the sixth US National World Conference on Earthquake Engineering, 12 pp.
Musson, R. M. W. (1999). Determination of design earthquakes in seismic hazard analysis through Monte Carlo simulation, J. Earthq. Eng. **3**, 463–474.
Musson, R. M. W.(2000). The use of Monte Carlo simulations for seismic hazard assessment in the U.K., Ann. Geofisc. **43**, 1–9.
Musson, R. M. W.(2012). PSHA validated by quasi observational means, Seismol. Res. Lett. **83**, 130–134.
Petersen, M., Frankel, A., Harmsen, S., Mueller, C., Haller, K., Wheeler, R., Wesson, R., Zeng, Y., Boyd, O., Perkins, D., Luco, N., Field, E., Wills, C., and Rukstales, K. (2008). Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008–1128, 61 p.
Wells, D. and K. Coppersmith (1994). New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement. Bull. Seism. Soc. Am., **84**, 974-1002.

Appendix – EQHAZ input parameters for calculations

EqHaz1 Input:

```
! EqHaz1 input for SRK project
! GSC 2015 NW model implemented. 12 areal sources within 500 km from site. 12 fault sources are treated after areal sources' block.
! This run will generate 1000000 years of synthetic events to be used in EqHaz2
100 10000.          !Number of subcatalogue simulations and number of years of each subcatalog
12  12              !Number of zones and number of faults
1  1  0             !Seed value of random generation subroutine (Use 0 for random seed, integer for repeatable seed), mixing epistemic/aleatory uncertainties (Yes=1, No=0), do smooth seismicity (Yes=1, No=0)
!ccsc11west.txt  smooth.par   !Name of earthquake catalog file used for smooth seismicity approach, name of parameter file used for smooth seismicity approach
DSR     1  2  4.80
1  10   10.0   2.0   0.0
3
      1.8799     2382.9600      0.6800
      2.3300    13130.1299      0.1600
      1.4299      429.4700      0.1600
3
      7.2000      0.6000
      6.9000      0.3000
      7.5000      0.1000
3
     10.0000      0.5000
     15.0000      0.2500
      5.0000      0.2500
 58.860  -135.446
 59.597  -136.557
 59.521  -138.150
 60.750  -139.982
 60.799  -141.284
 62.116  -142.754
 62.565  -141.900
 61.981  -139.251
 60.005  -134.795
 59.286  -133.669
DCZ     1  2  4.80
1  4   10.0   2.0   0.0
3
      2.2000     3557.8501      0.6800
      2.7190    23664.0195      0.1600
      1.6810      517.3500      0.1600
3
      7.6000      0.6000
      7.4000      0.3000
      7.8000      0.1000
3
     10.0000      0.5000
     15.0000      0.2500
      5.0000      0.2500
 64.175  -139.732
 64.822  -142.342
 65.911  -136.191
 64.203  -135.031
GCB     1  2  4.80
1  4   10.0   2.0   0.0
3
```

```
      2.1791      5157.6499         0.6800
      2.8312     61414.3711         0.1600
      1.5269       403.1200         0.1600
3
      7.2000         0.6000
      7.0000         0.3000
      7.4000         0.1000
3
     10.0000         0.5000
     15.0000         0.2500
      5.0000         0.2500
 59.521  -138.150
 59.597  -136.556
 58.860  -135.447
 58.517  -136.777
RMN      1   2   4.80
1   5   10.0    2.0    0.0
3
      2.0300      2865.2300         0.6800
      2.2030      4410.2300         0.1600
      1.8570      1803.4399         0.1600
3
      7.8000         0.6000
      7.5000         0.3000
      8.0000         0.1000
3
     10.0000         0.5000
     15.0000         0.2500
      5.0000         0.2500
 67.255  -135.166
 66.340  -134.435
 65.729  -133.477
 65.910  -136.189
 67.224  -137.083
RMS      1   2   4.80
1   5   10.0    2.0    0.0
3
      1.8000      1846.3400         0.6800
      1.9730      2889.6799         0.1600
      1.6270      1166.9700         0.1600
3
      7.8000         0.6000
      7.5000         0.3000
      8.0000         0.1000
3
     10.0000         0.5000
     15.0000         0.2500
      5.0000         0.2500
 65.910  -136.191
 65.729  -133.476
 64.382  -132.063
 64.187  -133.047
 64.203  -135.031
WMR      1   2   4.80
1   5   10.0    2.0    0.0
3
      2.0000       818.5100         0.6800
      2.5190      4688.3999         0.1600
      1.4810       138.2200         0.1600
3
      7.6000         0.6000
      7.4000         0.3000
```

```
      7.8000        0.1000
3
     20.0000        0.5000
     30.0000        0.2500
     10.0000        0.2500
 61.131  -145.331
 63.115  -147.674
 63.156  -146.091
 62.116  -142.754
 60.799  -141.284
WSE      1   2   4.80
1   4   10.0    2.0    0.0
3
      2.2726    20668.6309        0.6800
      2.6212    74235.5234        0.1600
      1.9239     5740.2798        0.1600
3
      7.3000        0.6000
      7.1000        0.3000
      7.5000        0.1000
3
     10.0000        0.5000
     15.0000        0.2500
      5.0000        0.2500
 59.831  -141.373
 60.800  -141.285
 60.752  -139.977
 59.817  -140.032
YAK      1   2   4.80
1   8   10.0    2.0    0.0
3
      1.4373      421.7400        0.6800
      1.7047     1060.4700        0.1600
      1.1699      165.3700        0.1600
3
      8.1000        0.6000
      7.9000        0.3000
      8.4000        0.1000
3
     10.0000        0.5000
     15.0000        0.2500
      5.0000        0.2500
 61.131  -145.332
 60.800  -141.285
 59.826  -141.371
 59.813  -139.993
 58.190  -137.790
 57.782  -137.423
 57.885  -138.689
 59.299  -143.454
YAR      1   2   4.80
1   5   10.0    2.0    0.0
3
      2.2000     6720.3101        0.6800
      2.7190    48309.0508        0.1600
      1.6810      923.0400        0.1600
3
      7.8000        0.6000
      7.4000        0.3000
      8.0000        0.1000
3
     10.0000        0.5000
```

```
      15.0000        0.2500
       5.0000        0.2500
 68.222  -137.833
 65.911  -136.190
 64.822  -142.342
 65.551  -145.713
 66.028  -145.592
YUS      1   2   4.80
1  13   10.0    2.0    0.0
3
       2.2000     4442.3630        0.6800
       2.7190    29723.1114        0.1600
       1.6810      620.4459        0.1600
3
       7.8000        0.6000
       7.4000        0.3000
       8.0000        0.1000
3
      10.0000        0.5000
      15.0000        0.2500
       5.0000        0.2500
 63.878  -146.103
 65.550  -145.717
 64.175  -139.730
 64.203  -135.038
 64.187  -133.051
 64.382  -132.065
 62.029  -127.307
 60.785  -127.267
 59.526  -128.270
 59.286  -133.669
 59.999  -134.786
 61.980  -139.267
 62.564  -141.901
FWFA     1   2   4.80
1  10   10.0    2.0    0.0
3
       1.1700       83.7000        0.6800
       1.7063      862.6200        0.1600
       0.6337        7.8700        0.1600
3
       6.7000        0.6000
       6.5000        0.3000
       6.9000        0.1000
3
      10.0000        0.5000
      15.0000        0.2500
       5.0000        0.2500
 55.468  -135.491
 56.556  -136.364
 58.190  -137.790
 59.033  -138.900
 59.813  -139.993
 60.752  -139.977
 59.495  -138.113
 58.398  -136.624
 56.940  -135.350
 55.701  -134.376
CST      1   2   4.80
1  13   10.0    2.0    0.0
3
       2.3991     2728.0200        0.6800
```

```
      3.2540    44174.0391        0.1600
      1.5441      159.6100        0.1600
3
      7.2000        0.6000
      6.9000        0.3000
      7.5000        0.1000
3
     10.0000        0.5000
     15.0000        0.2500
      5.0000        0.2500
 58.517  -136.777
 59.286  -133.669
 57.012  -130.663
 53.269  -126.703
 51.650  -124.430
 50.070  -127.090
 51.620  -130.380
 52.060  -130.930
 52.600  -129.700
 53.650  -130.620
 54.400  -131.500
 54.500  -133.480
 58.402  -136.644
EDF      1   2   6.50
2  13   10.0    2.0    0.0
3
      0.0002        0.0053        0.6800
      0.0002        0.0044        0.1600
      0.0002        0.0064        0.1600
3
      8.0200        0.6000
      7.8700        0.3000
      8.1700        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 14.  90.  1.                !Width, dip angle, and depth of fault (km, deg., km)
 59.147  -135.393
 59.174  -135.446
 59.268  -135.676
 59.457  -135.982
 59.959  -136.833
 60.127  -137.040
 60.355  -137.318
 60.495  -137.623
 60.735  -137.898
 60.877  -138.100
 61.693  -139.851
 61.960  -140.453
 62.232  -141.320
EDF      1   2   6.50
2  13   10.0    2.0    0.0
3
      1.8421      474.5768        0.6800
      1.8421      310.2034        0.1600
      1.8421      730.4868        0.1600
3
      8.0200        0.6000
      7.8700        0.3000
      8.1700        0.1000
0
      1.0000        0.5000
```

```
     15.0000        0.5000
 14.  90.  1.                 !Width, dip angle, and depth of fault (km, deg., km)
 59.147  -135.393
 59.174  -135.446
 59.268  -135.676
 59.457  -135.982
 59.959  -136.833
 60.127  -137.040
 60.355  -137.318
 60.495  -137.623
 60.735  -137.898
 60.877  -138.100
 61.693  -139.851
 61.960  -140.453
 62.232  -141.320
CDT      1   2   6.50
2  19   10.0    2.0    0.0
3
      0.0002        0.0168        0.6800
      0.0002        0.0231        0.1600
      0.0002        0.0118        0.1600
3
      7.9800        0.6000
      7.8300        0.3000
      8.1300        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 14.  90.  1.                 !Width, dip angle, and depth of fault (km, deg., km)
 61.510  -141.300
 61.595  -141.514
 61.678  -141.671
 61.746  -141.759
 61.855  -141.981
 61.976  -142.160
 62.259  -142.508
 62.487  -142.779
 62.731  -143.270
 62.856  -143.422
 63.162  -144.629
 63.228  -144.935
 63.468  -146.154
 63.500  -146.694
 63.527  -147.083
 63.528  -147.204
 63.524  -147.372
 63.510  -147.609
 63.489  -147.998
CDT      1   2   6.50
2  19   10.0    2.0    0.0
3
      1.8421     1400.3054        0.6800
      1.8421     1528.6735        0.1600
      1.8421     1255.3637        0.1600
3
      7.9800        0.6000
      7.8300        0.3000
      8.1300        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 14.  90.  1.                 !Width, dip angle, and depth of fault (km, deg., km)
```

```
 61.510  -141.300
 61.595  -141.514
 61.678  -141.671
 61.746  -141.759
 61.855  -141.981
 61.976  -142.160
 62.259  -142.508
 62.487  -142.779
 62.731  -143.270
 62.856  -143.422
 63.162  -144.629
 63.228  -144.935
 63.468  -146.154
 63.500  -146.694
 63.527  -147.083
 63.528  -147.204
 63.524  -147.372
 63.510  -147.609
 63.489  -147.998
WCD      1   2   6.50
2  14   10.0    2.0    0.0
3
      0.0002        0.0209        0.6800
      0.0002        0.0260        0.1600
      0.0002        0.0158        0.1600
3
      8.0300        0.6000
      7.8800        0.3000
      8.1800        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 14.  90.  1.                 !Width, dip angle, and depth of fault (km, deg., km)
 62.232  -141.320
 62.460  -142.130
 62.848  -143.395
 63.169  -144.661
 63.468  -146.149
 63.500  -146.694
 63.527  -147.082
 63.528  -147.209
 63.522  -147.382
 63.480  -148.172
 63.465  -148.667
 63.414  -149.319
 63.370  -149.694
 63.296  -150.237
WCD      1   2   6.50
2  14   10.0    2.0    0.0
3
      1.8421     1906.9710        0.6800
      1.8421     1868.7288        0.1600
      1.8421     1835.2780        0.1600
3
      8.0300        0.6000
      7.8800        0.3000
      8.1800        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 14.  90.  1.                 !Width, dip angle, and depth of fault (km, deg., km)
 62.232  -141.320
```

```
 62.460  -142.130
 62.848  -143.395
 63.169  -144.661
 63.468  -146.149
 63.500  -146.694
 63.527  -147.082
 63.528  -147.209
 63.522  -147.382
 63.480  -148.172
 63.465  -148.667
 63.414  -149.319
 63.370  -149.694
 63.296  -150.237
DRF      1   2   6.50
2   8   10.0    2.0    0.0
3
      0.0002        0.0209        0.6800
      0.0002        0.0118        0.1600
      0.0002        0.0213        0.1600
3
      7.6900        0.6000
      7.4900        0.3000
      7.8900        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 24.4 35.  1.                 !Width, dip angle, and depth of fault (km, deg., km)
 60.756  -137.941
 60.931  -138.317
 60.968  -138.624
 61.219  -139.235
 61.270  -139.391
 61.332  -139.851
 61.463  -141.009
 61.495  -141.272
DRF      1   2   6.50
2   8   10.0    2.0    0.0
3
      1.8421     1122.5174        0.6800
      1.8421      473.7144        0.1600
      1.8421     1552.7743        0.1600
3
      7.6900        0.6000
      7.4900        0.3000
      7.8900        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 24.4 35.  1.                 !Width, dip angle, and depth of fault (km, deg., km)
 60.756  -137.941
 60.931  -138.317
 60.968  -138.624
 61.219  -139.235
 61.270  -139.391
 61.332  -139.851
 61.463  -141.009
 61.495  -141.272
CSF      1   2   6.50
2  13   10.0    2.0    0.0
3
      0.0002        0.0058        0.6800
      0.0002        0.0048        0.1600
```

```
      0.0002        0.0035        0.1600
3
      7.9500        0.6000
      7.8000        0.3000
      8.1000        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 14.  90.  1.                !Width, dip angle, and depth of fault (km, deg., km)
 55.578  -134.922
 55.923  -134.724
 56.222  -134.607
 56.669  -134.596
 56.820  -134.628
 57.125  -134.720
 57.426  -134.764
 57.930  -134.854
 58.005  -134.876
 58.151  -134.965
 58.522  -135.080
 59.027  -135.291
 59.144  -135.398
CSF      1   2   6.50
2  13   10.0    2.0    0.0
3
      1.8421      461.6482        0.6800
      1.8421      302.8469        0.1600
      1.8421      354.3336        0.1600
3
      7.9500        0.6000
      7.8000        0.3000
      8.1000        0.1000
0
      1.0000        0.5000
     15.0000        0.5000
 14.  90.  1.                !Width, dip angle, and depth of fault (km, deg., km)
 55.578  -134.922
 55.923  -134.724
 56.222  -134.607
 56.669  -134.596
 56.820  -134.628
 57.125  -134.720
 57.426  -134.764
 57.930  -134.854
 58.005  -134.876
 58.151  -134.965
 58.522  -135.080
 59.027  -135.291
 59.144  -135.398
FWF      1   2   6.50
2  11   10.0    2.0    0.0
3
      0.0002        0.0525        0.6800
      0.0002        0.0829        0.1600
      0.0002        0.0332        0.1600
3
      8.2700        0.6000
      8.1200        0.3000
      8.4200        0.1000
0
      0.0000        0.5000
     20.0000        0.5000
```

```
 20.  90.  0.              !Width, dip angle, and depth of fault (km, deg., km)
 55.559  -135.062
 55.863  -135.331
 56.880  -135.958
 57.618  -136.539
 57.938  -136.756
 58.483  -137.170
 58.684  -137.495
 58.922  -137.782
 59.469  -138.486
 59.737  -138.851
 60.088  -139.425
FWF      1   2   6.50
2  11   10.0    2.0    0.0
3
      1.8421     7002.6646       0.6800
      1.8421     8675.9844       0.1600
      1.8421     5663.0855       0.1600
3
      8.2700       0.6000
      8.1200       0.3000
      8.4200       0.1000
0
      0.0000       0.5000
     20.0000       0.5000
 20.  90.  0.              !Width, dip angle, and depth of fault (km, deg., km)
 55.559  -135.062
 55.863  -135.331
 56.880  -135.958
 57.618  -136.539
 57.938  -136.756
 58.483  -137.170
 58.684  -137.495
 58.922  -137.782
 59.469  -138.486
 59.737  -138.851
 60.088  -139.425
```

APPENDIX 1-2

Hydrometeorology

Minto Mine Site Characterization

Hydrometeorology

October 2021

Table of Contents

Tables

Figures

1 INTRODUCTION

The existing meteorology of the project area and the climate trends and projections for the region of Yukon Territory around the Minto Mine were first described in detail in EBA's report "Minto Mine—2010 Climate Baseline Report" (EBA, 2010). This report was subsequently updated by Access Consulting Group (ACG) in 2012 (ACG, 2012) with a data cut off date of July 31, 2012, in support of the Minto Phase V/VI Project Proposal submission to Yukon Environmental and Socio-Economic Assessment Board (YESAB).

The baseline surface water hydrology of the Minto Creek watershed prior to mining activity was detailed in Clearwater Consultants Ltd. Memorandum CCL-MC6 "Minto Copper Project—Surface Water Hydrology Conditions" (CCL, 2010). CCL-MC6 also covered conditions during Mine Operations until 2009. A subsequent report was prepared by ACG to update CCL-MC6 by presenting those previous data, and data gathered since then until the end of the 2012 open water season (ACG, 2013). Additionally, this report included data since 2009 gathered in McGinty Creek, a catchment of similar size to Minto Creek, also draining into the Yukon River and located directly north of the Minto Creek catchment (Figure 2-1).

Because of their interconnected nature, meteorology and surface water hydrology are combined in the present report, which constitutes an update to the latest "Minto Climate Baseline Report" and to the "Surface Water Hydrology Baseline Conditions" and includes additional data collected to the end of 2020. This is a component to the more comprehensive Site Characterization Plan for Minto Mine, provided under a condition of Minto's Quartz Mining Licence QML-0001.

1.1 REGIONAL SETTING

The Minto Mine is in the subarctic continental climate zone (Köppen climate classification), which is characterized by long, cold winters and short, cool summers. The area experiences moderate precipitation in the form of rain and snow and a large range of temperatures on a yearly basis with a mean annual temperature below 0°C.

1.2 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). Development of the mine was initiated in 1997, commercial operations started in October 2007. The Minto Mine is permitted to conduct open pit and underground mining, and to mill the copper/gold/silver ore at a rate of 4,200 tonnes of per day. In 2020 (the most recent year of record), the Minto Mine produced 8,089 tonnes of copper from the milling of 629,077 tonnes of ore.

In addition to open pit mines, underground mines, and the mill, the Minto Mine site includes a number of waste rock dumps, a concentrate storage shed, a dry stack tailings storage facility (DSTSF), 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 DSTSF and in mined-out open pits. Mine-impacted seepage from the DSTSF and under the Mill Valley Fill (MVF) is collected at the toe of the MVF in sump W62 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 south-east of the WSP (Figure 1-2).

Figure 1-1: Project Location

MINTO MINE

FIGURE 2-3
MINTO 2020 SITE LAYOUT

MAY 2021

MINTO

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

0 100 200 300 400 500
Meters

ENSERO solutions

Datum: NAD 83 Projection: UTM Zone 8N

2 CLIMATE AND METEOROLOGICAL DATA

The following section presents regional and site-specific climatic and meteorological data. Regional data are available through Environment Canada (EC) and Environment Yukon. Meteorological data have been collected on site continuously since a first meteorological station was installed in 2005. A second meteorological station was commissioned in late October 2010 while the first was decommissioned in 2014.

2.1 METHODS

2.1.1 REGIONAL DATA

Long-term trends were evaluated by reviewing long-term records from stations in the region (regional analysis). EC meteorological stations used for this regional analysis were selected based on location/proximity and data availability, and are presented in Table 2-1 below. Figure 2-1 shows the location of these stations.

Table 2-1: Regional Environment Canada Meteorological Stations.

Station	Climate ID	Years of data	Latitude	Longitude	Elevation	Distance from Minto
Pelly Ranch	2100880	1956-2015	62°49'00" N	137°22'00" W	454.20 m	26 km
Carmacks	2100300	1963-2007	62°06'00" N	136°18'00" W	524.90 m	107 km
Carmacks CS	2100301	1999-present	62°06'54" N	136°11'31" W	542.90 m	115 km
Stewart Crossing	2101030	1963-2007	63°22'48" N	136°40'48" W	480.1 m	102 km
McQuesten	2100719	1986-2014	63°35'24" N	137°31'12" W	458.2 m	114 km

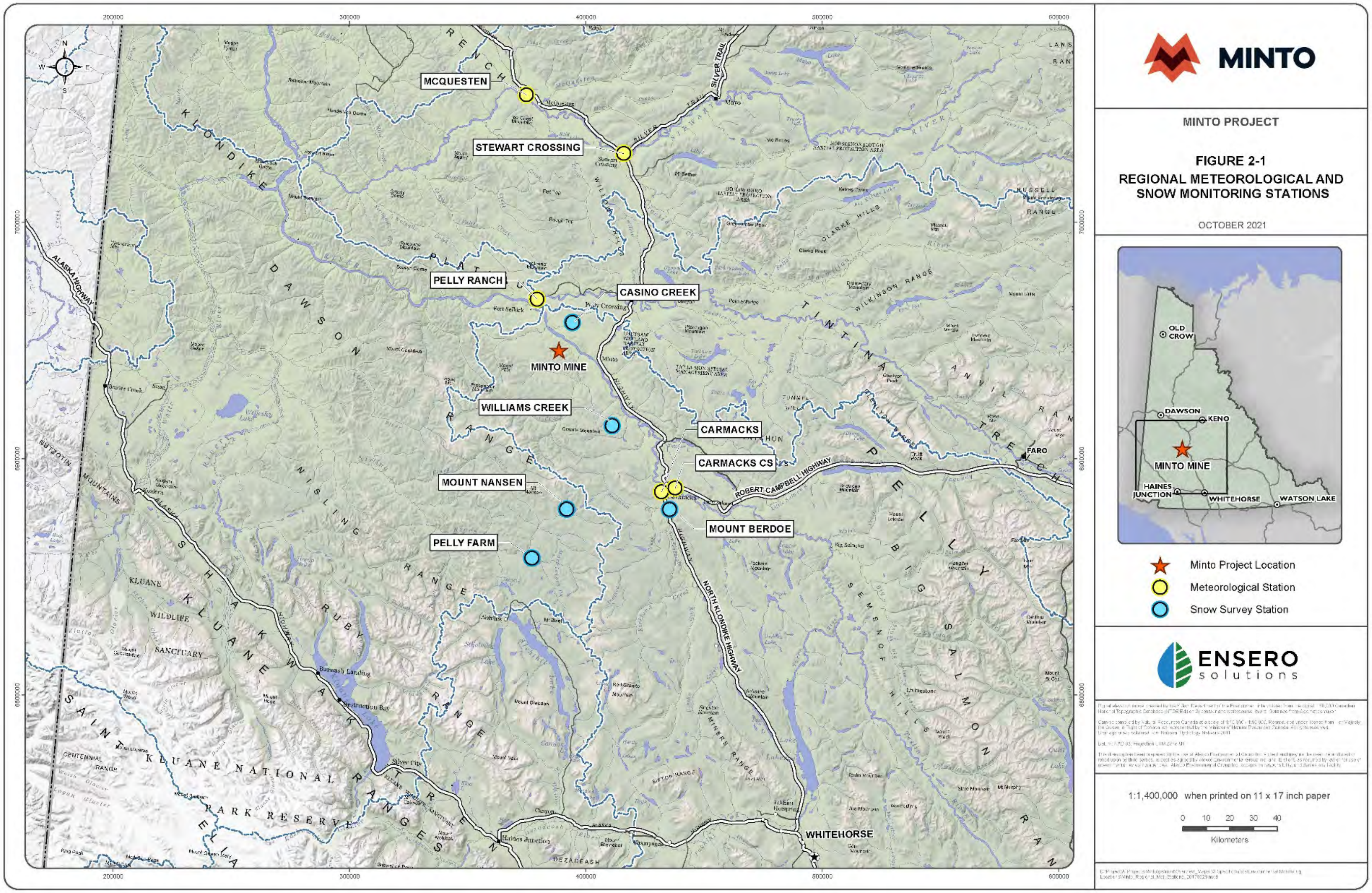


Figure 2-1: Regional Weather station location

2.1.2 SITE DATA

To record meteorological parameters on site, a basic meteorological station was established at the Minto Mine site in late September 1993 at an elevation of 884 meters above sea level (masl) and intermittent temperature and precipitation data were collected in September and October 1993 as well as in June, July and August 1994 (HKP 1994).

On September 7, 2005, a HOBO meteorological station on a three-metre tripod was installed by ACG, with instrumentation to record wind speed and direction, air temperature, relative humidity, barometric pressure, solar radiation and rainfall at a location near camp. On April 11, 2006, the station was relocated to the airstrip (N 62°36'17", W 137°13'19", el. 887 masl). The station has recorded, at hourly sampling intervals, the parameters of: average wind speed and direction; highest three-second wind gust; air temperature; relative humidity; on-site barometric pressure; incident solar radiation and total wet precipitation. This station was decommissioned on June 25, 2014.

On October 15, 2010, a Campbell Scientific (CS) meteorological station was installed adjacent to the existing HOBO meteorological station, whose anemometer was damaged by strong winds in May 2010. The other sensors of the HOBO station remained functional during the summer of 2010; therefore, only wind data are missing for the transition period. The Campbell Scientific meteorological station's anemometer was installed on a 10-meter mast, which is the standard height for collecting wind data used in air dispersion models. The other sensors installed on the Campbell Scientific station include a temperature and relative humidity sensor, a pyranometer, a rain gauge and a barometer. A snowfall conversion adaptor was added in October 2011; a total precipitation gauge was installed in November 2014 and an evaporation pan and outgoing radiation sensor were commissioned in 2016.

2.1.2.1 QA/QC

The site meteorological station is regularly visited and inspected by Minto Mine staff and all maintenance actions are documented. Suspicious data are identified graphically, investigated and invalidated where needed. Third party review of the data is conducted when suspicious data or inconsistent instrument performance are identified.

2.2 RESULTS

2.2.1 TEMPERATURE

2.2.1.1 Regional Data

Extreme and average minimum and maximum, as well as mean monthly and annual temperatures were calculated for each regional station over the entire period of existing records (Table 2-2), except for Carmacks where the two stations were combined to provide a longer record. The mean annual temperatures ranged from -2.4°C at Stewart Crossing to -3.7°C at Pelly Ranch, and extreme annual temperatures ranged from -60.0°C at Pelly Ranch in February to 35.0°C at Pelly Ranch in June and Carmacks in May and June.

Table 2-2: Regional Monthly and Annual Temperatures (°C).

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Extreme Monthly Minimum Temperature (period of record) in °C													
Pelly Ranch	-58.9	-60.0	-50.0	-38.3	-12.2	-5.0	-2.8	-7.0	-20.0	-37.0	-51.0	-56.7	-60.0
Carmacks Combined	-57.8	-57.2	-50.0	-34.0	-12.2	-3.9	-1.1	-5.0	-16.5	-32.5	-46.7	-54.4	-57.8
Stewart Crossing	-55.0	-49.5	-46.0	-34.0	-12.0	-3.5	-0.6	-5.0	-22.0	-35.0	-45.0	-52.8	-55.0
McQuesten	-54.5	-53.0	-47.5	-34.5	-13.5	-6.0	-3.5	-9.5	-21.5	-37.0	-50.0	-52.5	-54.5
Monthly Mean Minimum Temperature (period of record)													
Pelly Ranch	-32.2	-27.4	-20.7	-7.2	0.5	5.9	8.2	5.5	0.2	-7.1	-20.4	-29.4	-10.4
Carmacks Combined	-29.9	-24.8	-18.7	-6.9	0.2	5.9	8.3	5.6	0.4	-6.3	-18.2	-26.5	-9.2
Stewart Crossing	-27.1	-23.6	-20.1	-7.5	0.8	6.7	8.4	5.2	0.0	-6.8	-19.3	-24.3	-9.0
McQuesten	-29.5	-25.0	-19.7	-6.8	0.4	5.6	7.4	4.8	-0.5	-7.8	-21.2	-26.7	-9.9
Mean Monthly Temperature (period of record)													
Pelly Ranch	-26.9	-20.3	-11.6	0.2	8.0	13.5	15.4	12.7	6.7	-2.5	-15.8	-24.3	-3.7
Carmacks Combined	-24.5	-17.9	-10.0	0.7	7.9	13.5	15.3	12.9	6.9	-1.6	-13.9	-21.6	-2.7
Stewart Crossing	-21.9	-16.8	-11.5	0.0	8.3	14.0	15.6	12.6	6.4	-2.5	-14.7	-18.6	-2.4
McQuesten	-24.5	-18.5	-11.4	0.7	8.3	13.7	15.2	12.2	5.9	-3.4	-16.8	-21.6	-3.4
Monthly Mean Maximum Temperature (period of record)													
Pelly Ranch	-21.6	-13.2	-2.5	7.6	15.4	21.2	22.5	19.9	13.1	2.2	-11.4	-19.2	2.8
Carmacks Combined	-19.2	-10.9	-1.1	8.3	15.7	21.0	22.5	20.1	13.5	3.2	-9.6	-16.6	3.9

Stewart Crossing	-16.3	-10.6	-2.9	7.4	15.8	21.5	22.9	19.9	12.8	1.7	-9.9	-13.0	4.1
McQuesten	-19.6	-12.1	-3.0	8.1	16.2	21.8	22.9	19.6	12.3	1.0	-12.3	-16.5	3.2
Extreme Monthly Maximum Temperature (period of record)													
Pelly Ranch	10.0	17.0	20.0	23.5	32.5	35.0	34.0	33.0	25.6	23.0	13.9	10.0	35.0
Carmacks Combined	9.5	13.0	17.3	24.0	35.0	35.0	34.2	33.0	27.0	24.0	12.8	9.5	35.0
Stewart Crossing	7.5	12.0	13.0	23.5	30.0	34.0	33.0	32.0	26.1	22.0	12.0	7.5	34.0
McQuesten	15.0	10.0	12.5	23.5	33.5	33.5	33.3	33.0	25.0	22.5	20.5	15.0	33.5

Long Term Trends

Of the four regional stations presented above, Pelly Ranch and Carmacks have the longest records and were analyzed for historical trends. Figure 2-2 and Figure 2-3 illustrate the annual maximum (plotted in red), mean (green) and minimum (blue) air temperatures along with the respective trendlines and slopes for Pelly Ranch for the available data set between 1957 and 2014 and for Carmacks between 1964 and 2020 respectively. Annual maximums and minimums are calculated as an average of monthly maximum and minimum temperatures for each year.

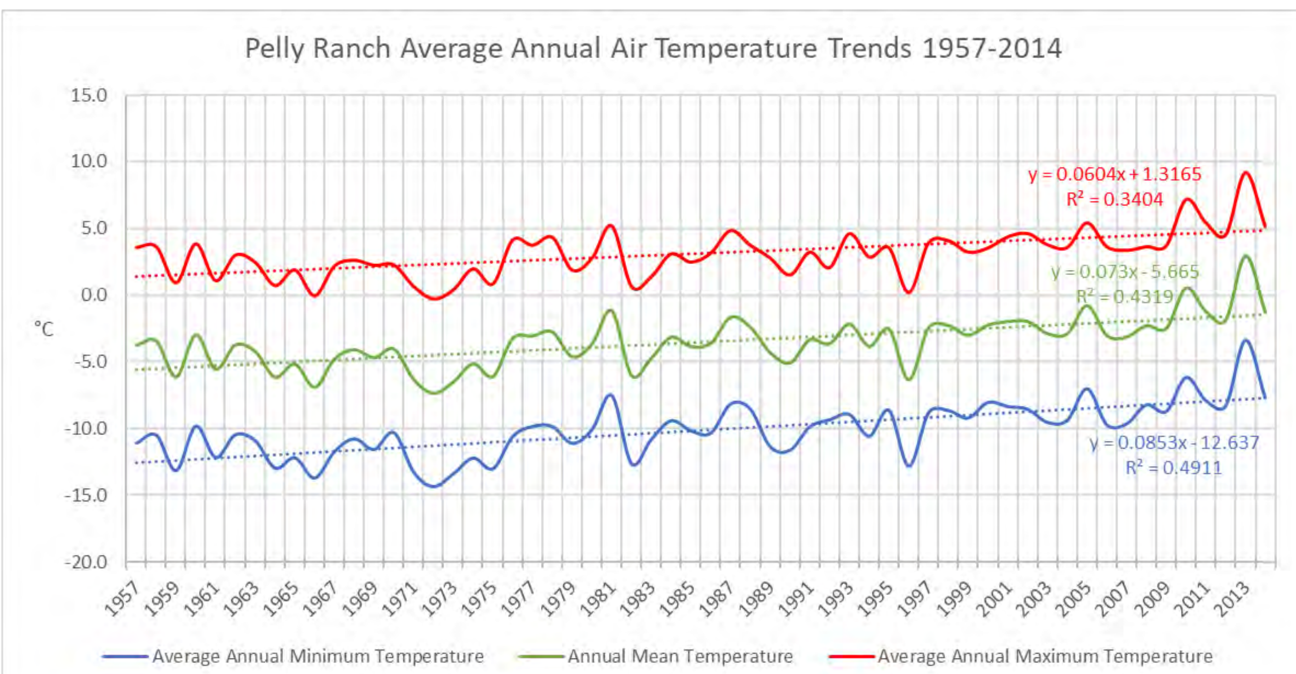


Figure 2-2: Pelly Ranch Average Annual Temperature Trends 1957-2014

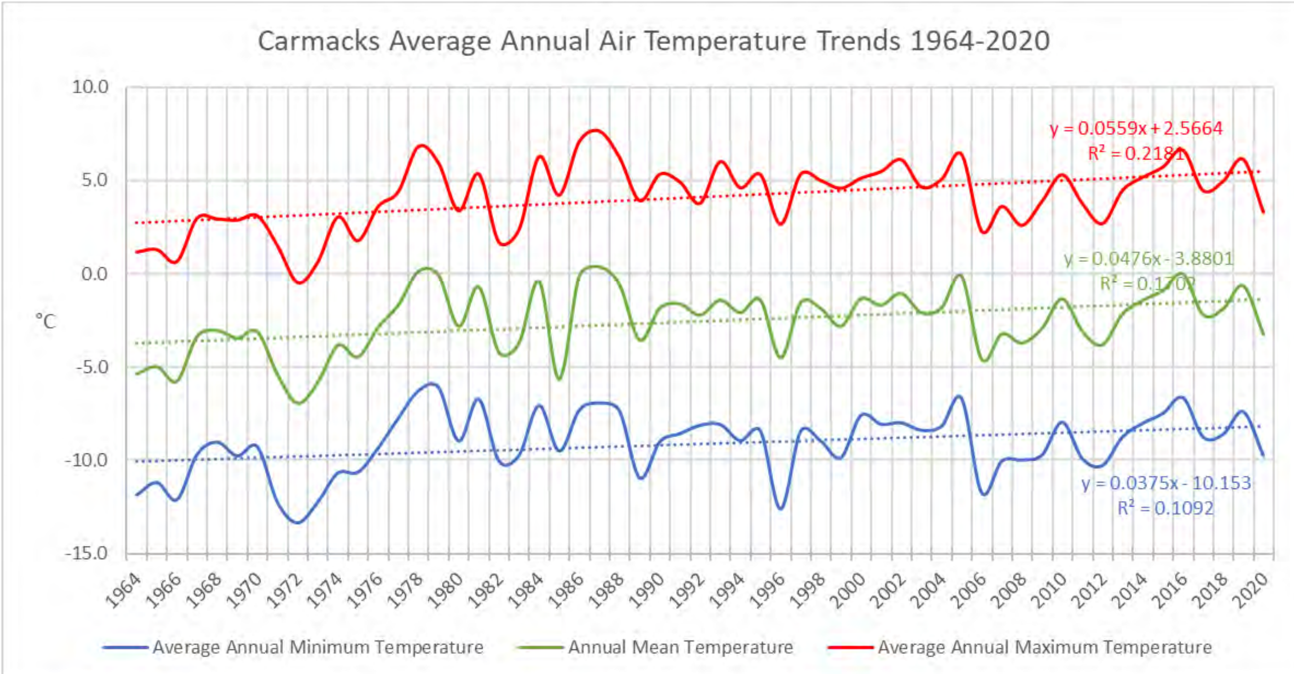


Figure 2-3: Carmacks Average Annual Temperature Trends 1964-2020

The plots show a similar trend for all annual averages. The annual mean temperature has been increasing at Pelly Ranch by 0.07°C per year on average over the 57-year period corresponding to a total average increase of 4.2°C from 1957 to 2014. For Carmacks, the average rate of increase of the annual mean temperature is slightly less at 0.047°C per year, resulting in an average increase of 2.6°C for the 56-year period. It is also important to note that the average annual minimum temperature has been increasing at a faster rate than the average annual maximum temperature at both stations, thus implying that the average diurnal range has also been decreasing.

Figure 2-4 and Figure 2-5 illustrate the mean temperatures for January (blue) and July (orange) at the two regional stations over the same periods as above, in order to better illustrate the trend with respect to seasonality. The graphs show that January (winter) mean temperatures have experienced much higher rates of increase (0.15°C per year at Pelly Ranch and 0.22°C per year at Carmacks) than July (summer) mean temperatures (0.03°C per year at Pelly Ranch and 0.02°C per year at Carmacks).

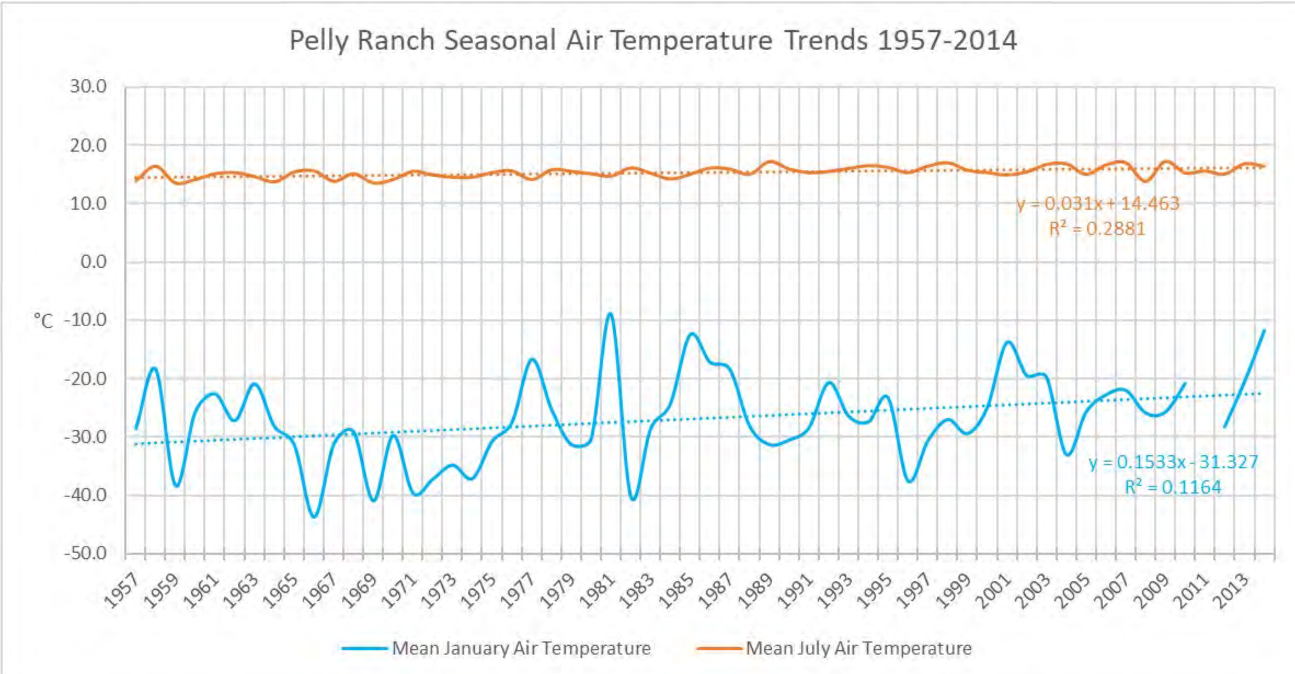


Figure 2-4: Pelly Ranch Seasonal Air Temperature Trends 1957-2014.

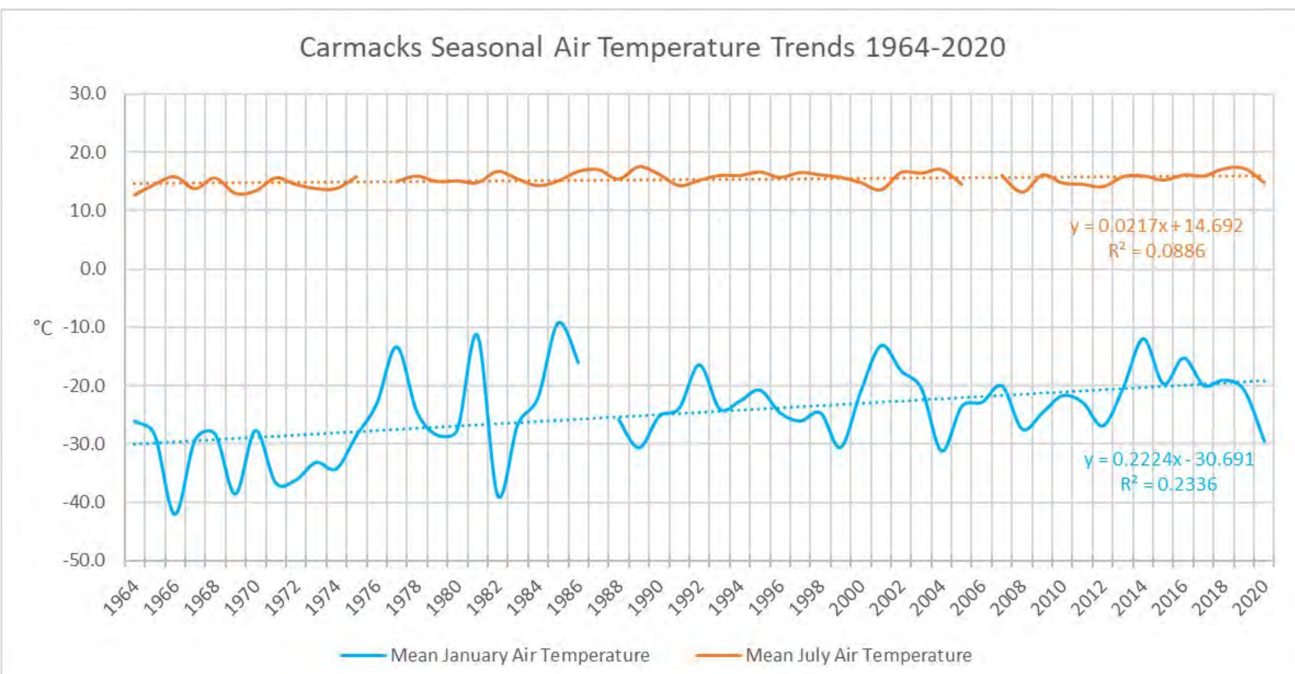


Figure 2-5: Carmacks Seasonal Air Temperature Trends 1964-2020.

2.2.1.2 Site Data

Hourly air temperatures have been plotted for the entire period of record for both stations in Figure 2-6. The plot shows a strong sinusoidal seasonal pattern. The summer period, between late-May and early-September, is characterized by average temperatures in the range of 10 to 20°C. The winter period, between October and March, is characterized by a much larger day-to-day variation in air temperatures, typically between –10 and –30°C, although winter temperatures in the range of 0 and –40°C are not uncommon. The transitions between these seasons are characterized by a quick rise or fall in air temperatures during March/April and mid-September/early-October, respectively.

Monthly average minimum, maximum, mean and extreme temperatures were compiled from the hourly data collected at the Project's two meteorological stations for the period of record and are shown in Table 2-3. The mean annual temperature for the period of record is -1.9°C for the HOBO station and -0.6°C for the Campbell Scientific station. Extremes ranged from -43.2°C to 30.3°C.

Based on the data record, air temperatures would be expected to remain above zero throughout the day between June and September, while between October and March, air temperatures would typically remain below zero. The maximum air temperature ever recorded was 30.3°C on July 29, 2009. The minimum air temperature ever recorded was -43.2°C on November 27, 2006 and again on January 8, 2009. Air temperatures higher than 5°C have been observed in every winter month. Sub-zero temperatures have been recorded every month except in July.

Table 2-3: Minto Mine Monthly Extreme and Average Air Temperature (°C).

Parameter	Air Temperature (°C) HOBO 2005-2014					Air Temperature (°C) Campbell Scientific 2010-2020				
	Extreme Hourly Maximum	Average Daily Maximum	Average Daily Mean	Average Daily Minimum	Extreme Hourly Minimum	Extreme Hourly Maximum	Average Daily Maximum	Average Daily Mean	Average Daily Minimum	Extreme Hourly Minimum
January	9.4	-15.0	-17.8	-20.6	-43.2	9.0	5.5	-14.9	-34.0	-40.1
February	5.8	-11.8	-14.5	-17.3	-41.3	6.3	3.0	-13.5	-32.3	-35.8
March	5.4	-6.5	-9.9	-13.2	-32.5	5.6	9.4	-7.7	-24.5	-25.9
April	17.5	3.6	0.0	-3.7	-18.1	14.7	9.9	1.0	-12.8	-17.8
May	23.6	11.9	7.9	3.8	-5.8	25.8	21.4	9.3	-3.6	-5.5
June	29.5	17.1	13.0	8.9	-0.6	29.5	24.9	13.4	6.7	1.9
July	30.3	18.6	14.6	10.9	4.2	27.5	24.9	14.8	0.0	0.0
August	27.5	15.9	12.2	8.7	2.5	27.4	24.1	12.5	1.4	-0.4

September	21.7	9.9	6.6	3.5	-7.3	21.7	16.3	7.1	-1.9	-3.6
October	15.2	-0.1	-2.4	-4.5	-21.8	14.8	8.8	-1.6	-17.2	-20.8
November	7.4	-12.2	-14.5	-16.8	-43.2	4.6	3.2	-12.7	-33.2	-35.1
December	6.2	-15.4	-18.0	-20.7	-38.0	5.4	3.6	-14.9	-35.3	-36.9
ANNUAL	**30.3**	**1.3**	**-1.9**	**-5.1**	**-43.2**	**29.5**	**12.9**	**-0.6**	**-15.6**	**-40.1**

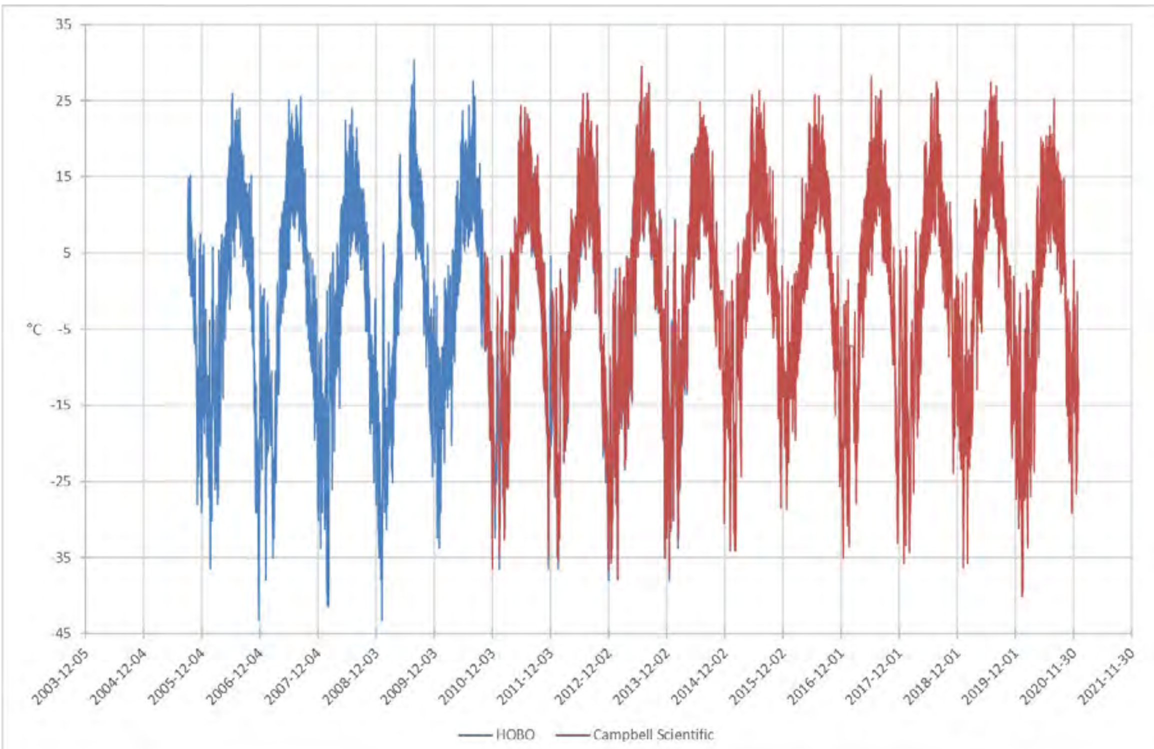


Figure 2-6: Minto Mine Hourly Air Temperatures 2005-2020

2.2.2 PRECIPITATION

2.2.2.1 Regional Data

Mean monthly rain, snow and total precipitations were calculated for the entire period of record for each station listed in Table 2-1 (with the two Carmacks stations combined). Mean annual precipitation ranges from 279 mm at Carmacks to 345 mm at McQuesten. The proportion of total annual precipitation falling as rain ranges from 61% at McQuesten to 68% at Carmacks (Table 2-4). Figure 2-7 presents the average monthly distribution of rain and snow across all regional stations. The greatest amount of precipitation generally falls between June and September for all stations.

Table 2-4: Regional Monthly and Annual Rainfall, Snowfall and Total Precipitation, for period of record.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual*
Mean Monthly Rainfall (mm)													
Pelly Ranch	0.2	0.1	0.2	3.6	22.1	36.5	54.8	39.7	26.7	7.8	0.3	0.1	192.0
Carmacks Combined	0.0	0.0	0.2	1.7	21.2	34.7	53.7	40.4	29.6	6.5	0.3	0.0	188.3
Stewart Crossing	0.0	0.0	0.1	2.0	25.7	39.9	52.7	45.8	32.4	10.4	0.4	0.0	209.5
McQuesten	0.0	0.0	0.2	4.4	24.3	38.8	58.4	43.1	32.6	8.4	0.4	0.0	210.6
Mean Monthly Snowfall (cm)													
Pelly Ranch	20.6	14.2	11.2	6.6	0.5	0.0	0.0	0.0	2.0	15.4	25.0	21.4	116.8
Carmacks Combined	17.5	11.6	7.9	4.6	1.1	0.0	0.0	0.0	1.2	14.0	18.8	16.5	93.2
Stewart Crossing	21.8	13.2	10.2	8.0	0.2	0.0	0.0	0.3	1.0	14.3	27.8	24.0	120.7
McQuesten	24.7	13.9	13.1	4.6	0.8	0.0	0.0	0.0	3.9	16.8	30.5	26.8	135.0
Mean Monthly Precipitation (mm)													
Pelly Ranch	20.7	14.3	11.4	10.2	22.4	36.5	54.8	39.7	28.6	23.2	25.3	21.5	308.6
Carmacks Combined	17.2	11.4	8.1	6.6	22.2	33.3	52.8	41.0	30.2	20.5	19.0	16.5	278.8
Stewart Crossing	21.9	13.2	10.3	9.7	25.9	39.9	52.7	46.1	33.6	24.7	28.2	24.0	330.1
McQuesten	24.7	13.9	13.3	9.1	25.1	38.8	58.4	43.1	36.5	24.9	30.9	26.8	345.3
% of Total Precipitation Falling as Rain													
Pelly Ranch	0.7	0.7	1.3	35.5	98.6	100.0	100.0	100.0	93.1	33.5	1.3	0.4	62.2
Carmacks Combined	0.0	0.4	1.9	25.7	95.7	104.3	101.7	98.6	98.1	31.8	1.3	0.0	67.6
Stewart Crossing	0.2	0.0	1.2	20.6	99.3	100.0	100.0	99.3	96.5	42.1	1.3	0.0	63.5
McQuesten	0.0	0.3	1.2	48.8	96.9	100.0	100.0	100.0	89.3	33.9	1.2	0.0	61.0

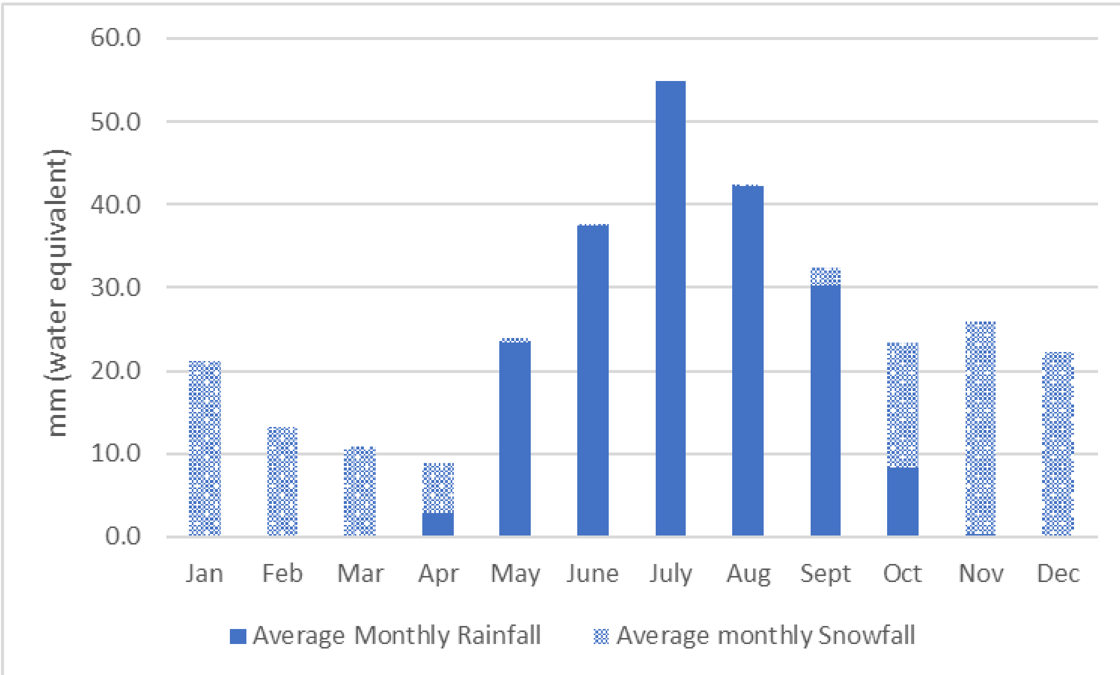


Figure 2-7: Monthly Distribution of Rain and Snow across Four Regional Stations for the Period of Record.

Long-Term Trends

Of the four regional stations presented above, Pelly Ranch and Carmacks have the longest records and were analyzed for historical trends. Figure 2-8 illustrates total annual precipitation along with the respective trendlines and slopes for Pelly Ranch between 1957 and 2014 and for Carmacks between 1964 and 2016 respectively. Although an increasing trend is observed at both stations, the correlation is weak (R2 of 0.04 and 0.03 for Pelly Ranch and Carmacks respectively). Figure 2-9 shows that the proportion of total precipitation falling as rain also displays an increasing trend of the period of record, but again, the correlation is weak (R2 of 0.13 and 0.02 for Pelly Ranch and Carmacks respectively).

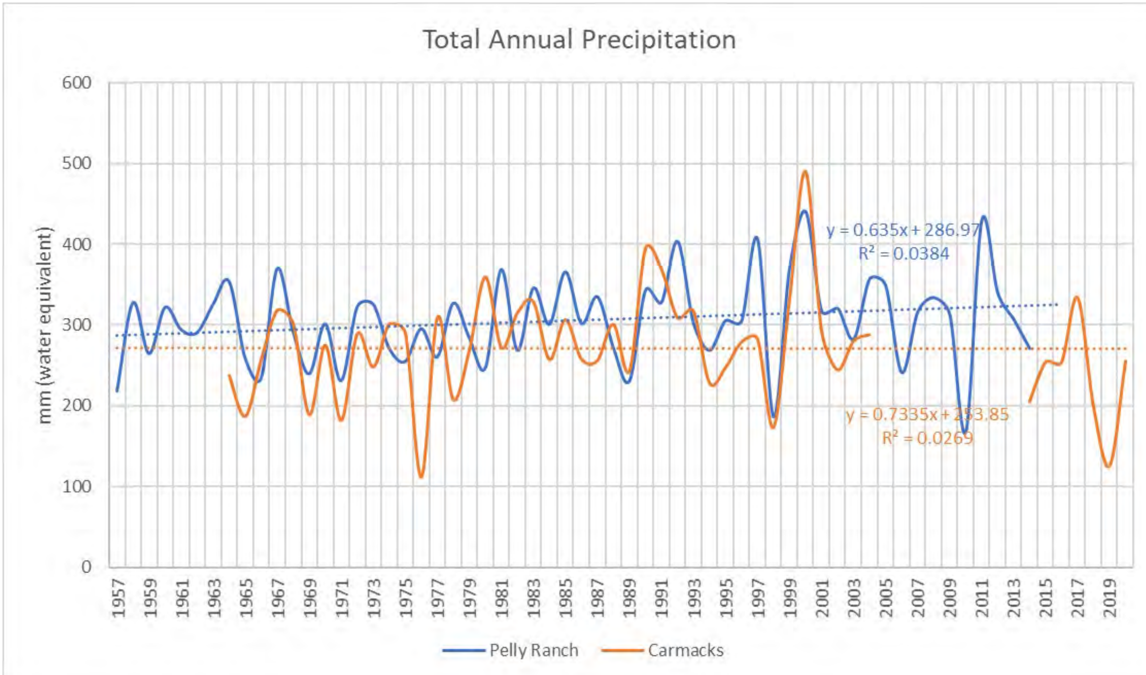


Figure 2-8: Long-Term Trends in Total Annual Precipitation at Regional Stations.

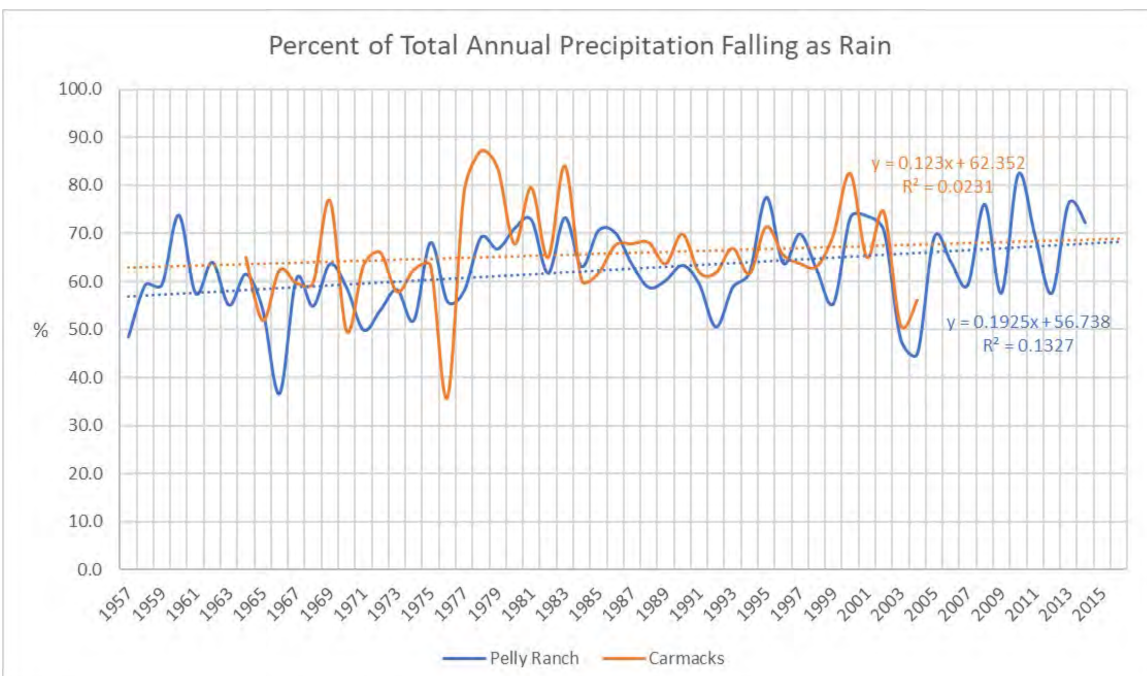


Figure 2-9: Long-Term Trends in Percent of Total Annual Precipitation Falling as Rain at Regional Stations.

2.2.2.2 Site Data

Rainfall

The Minto Mine HOBO meteorological station has been recording rainfall on site since its installation in September 2005 until decommissioning in June 2014. Table 2-5 below presents monthly and annual total for the period of record. Note that only complete months/years were used for computing average values.

Table 2-5: Monthly and Annual Rainfall (mm) - Minto HOBO Station.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005									*21.6*	23	11.6	4.6	
2006	0	*0.4*	*2.8*	0	22.8	35.8	28.6	29.2	12.2	12.2	0	0	144
2007	0.2	0	0.4	5.8	4.6	36	47.8	21	33.8	11.8	0	0	161.4
2008	1.2	2	0.8	1.8	9.6	26.2	*25.8*	100.6	21.8	6.4	0	0	196.2
2009	5.2	0	0.8	3.2	*9.2*		*6.1*	*50.8*	7.2	16.6	0	0	*99.1*
2010	0	0	0	0	7.6	48.8	75.6	46.4	18	10.2	0	0	206.6
2011	0	6	0	0.2	8.9	*43.8*	95.2	58	15	6.4	0	4.6	238.1
2012	0	0.6	0.6	0.4	8.8	33.4	44	36.6	36	13.8	0	0.6	174.8
2013	0.2	0.2	1.4	3.6	18.4	36.2	77.6	31.4	36.8	15.4	0	7.2	228.4
2014	3.4	0	0	2.4	14	*7.6*							
Avg	**1.1**	**1.1**	**0.5**	**1.9**	**11.8**	**36.1**	**61.5**	**46.2**	**22.6**	**12.9**	**1.3**	**1.9**	**192.8**

Note: Values in grey italics indicate a partial total

Based on regional data presented above, about 64% of total annual precipitation falls as rain (average proportion over the period of record for four regional stations). Applying this ratio to the average annual rainfall of 192.8 mm measured at the Minto Mine HOBO station would result in a total annual precipitation value of 303.2 mm.

Total Precipitation

The Campbell Scientific station was recording rainfall only from time of commissioning until October 14, 2011, when a snowfall conversion adaptor was installed on the tipping bucket to allow for measurement of total precipitation. It consists of an antifreeze reservoir, over-flow tube, and catch tube. Snow captured in the catch tube dissolves into the antifreeze and the melted snow raises the level of the antifreeze and water solution. The mixture then flows through the over-flow tube into the tipping bucket where it is measured by the tipping bucket mechanism. On November 18, 2014, a Geonor T-200B vibrating wire all weather precipitation gauge was installed in addition to the existing tipping bucket and rainfall adaptor to improve accuracy and validate total precipitation measurements. The Geonor precipitation gauge functioned well until 2016 when it began giving erratic readings. Table 2-6 presents monthly and annual snow-water equivalent (SWE) totals with the tipping bucket and snowfall adaptor and total precipitation gauge respectively, while Figure 2-10 shows a graphical comparison of results with the two different instruments.

Table 2-6: Monthly and Annual Total Precipitation (mm SWE) - Minto Mine Campbell Scientific Tipping Bucket and Snowfall Adaptor.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010											1.2	0	
2011	0	6.4	0.4	0.6	15.4	56	101.8	64.8	15.6	10.8	0.1	3.9	275.9
2012	9	9.9	34.9	0	0.1	31.1	44.8	20.7	26	16.5	17.1	18.4	228.5
2013	4.4	73.8	7.4	0	7.9	21	113.5	47	59.5	13.6	36.6	37.9	422.7
2014	16.9	49.2	0	3.8	15	12	50.5	13.4	30.5	22	2.9	19.4	235.7
2015	9.1	6.9	3.1	3.8	6.3	18.7	35.3	79.7	19	14.7	14.6	9.5	220.5
2016	9.1	6.9	2.6	14.7	39.3	30.2	74.7	46	18.5	6.7	24.2	7.4	280.4
2017	3.1	0.0	3.8	6.6	22.5	39.5	40.7	20.1	37.3	4.2	8.0	5.0	190.8
2018	7.0	8.6	14.6	5.0	4.8	21.9	21.2	76.3	22.6	8.5	8.6	5.3	204.3
2019	8.9	7.7	1.2	5.1	14.2	29.0	26.8	23.2	33.1	14.2	21.0	20.6	205.0
2020	7.9	15.2	7.3	14.2	10.2	29.0	86.1	50.3	19.1	20.3	11.8	20.3	291.6
Avg	**8.4**	**19.8**	**8.3**	**5.9**	**13.4**	**25.8**	**54.8**	**41.9**	**29.5**	**13.4**	**14.5**	**14.8**	**253.3**

Note: Shaded cells indicate rainfall only (prior to installation of snowfall adaptor) and were not used in calculating averages

Average annual total precipitation is 253.3 mm with the tipping bucket and snowfall adaptor. This is less than the estimated total of 303.2 mm based on the HOBO rainfall measurements and regional data. This could indicate potential undercatch of the snowfall adaptor, however, other factors such as wind or snow pillow formation can also play a role. More years of total precipitation data will allow a more meaningful comparison.

Figure 2-10 shows relatively good agreement in total precipitation measured with the tipping bucket/snowfall adaptor and Geonor precipitation gauge until July of 2016. The difference in annual totals measured with the two instruments for the years 2015 and 2016 is less than 10%. Following that, the Geonor Precipitation Gauge began to malfunction. Troubleshooting began immediately, however the issue was not resolved until the fall of 2021. As such, Geonor results are not presented in this report past 2016.

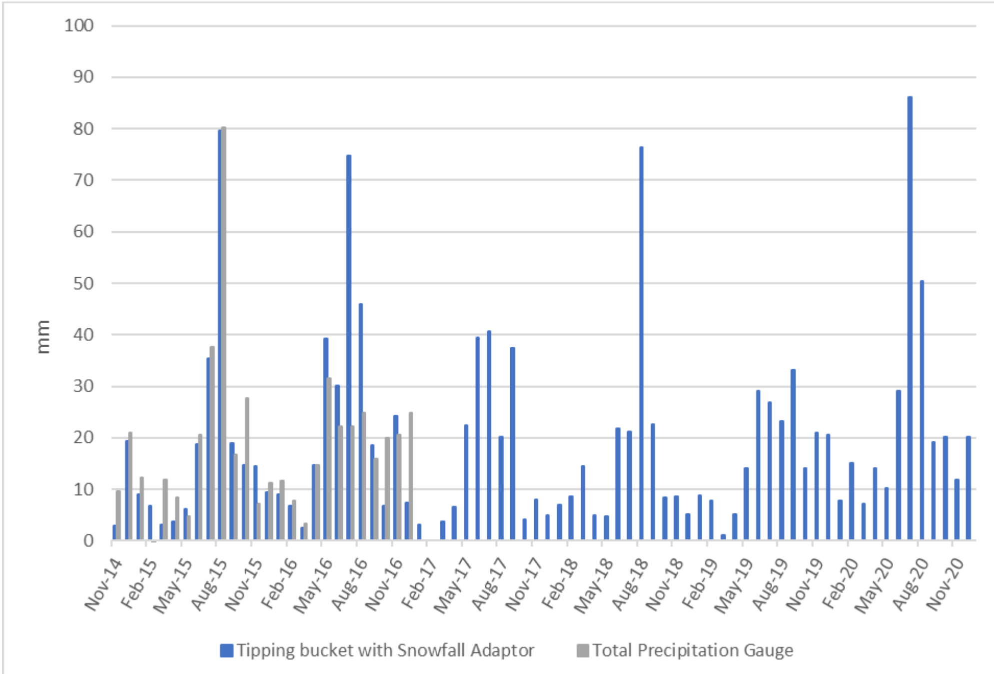


Figure 2-10: Monthly Total Precipitation (SWE) - Minto Mine Campbell Scientific Meteorological Station.

2.2.3 SNOWPACK

2.2.3.1 Regional Data

Environment Yukon conducts regular snow surveys across the territory, on or around March 1, April 1, and May 1 of each year. Average SWE values for the stations located in the Project region are summarized in Table 2-7 (see Figure 2-1 for station locations). Peak snowpack is generally observed in April at all stations.

Table 2-7: Regional Average Snow Water Equivalent (mm).

Station Name	Pelly Farm	Williams Creek	Mount Nansen	Casino Creek	Mount Berdoe
Station ID	09CD-SC03	09AH-SC04	09CA-SC01	09CD-SC01	09AH-SC01
Latitude	61°50'	62°20'48"	62°01'29"	62°44'	60°02'
Longitude	-137°20'	-136°42'50"	-137°03'59"	-138°48'	-136°14'
Elevation (masl)	472	914	1,021	1,164	1,035
Distance from Minto Mine (km)	26	40	66	82	82

Years of data	1986-present	1995-present	1976-present	1977-present	1975-present
March Average SWE (mm)	75	86	68	108	86
April Average SWE (mm)	77	98	79	128	98
May Average SWE (mm)	14	41	14	109	98
March 2019 SWE (mm)	31	49	39	3	56
April 2019 SWE (mm)	6	29	25	4	23
May 2019 SWE (mm)	0	0	0	5	0

Source: Environment Yukon, 2021

2.2.3.2 Site Data

Annual snow surveys have been conducted by J. Gibson & Associates in 1994, 1995, 1998, and annually from 2006 to 2013, at three locations in the Minto Creek catchment area. Minto#1 is located south of the airstrip with a north-facing aspect. Minto#2 is located near the explosives storage area with an east-facing aspect. Minto#3 is located north of the mill with a south-facing aspect. From 2013 to date, Minto environmental staff have conducted the annual snow surveys at the same stations described above. Due to site operations, the snow survey sites were relocated to their present positions in 2007 at the approximate aspects and elevations of the previous sites. A fourth station located at the dry stack storage facility was added in 2016. Snow sampling locations are shown on Figure 2-11.

Snow surveys have been conducted on the first day of March, April and May, or within 2 days before or after these dates, as conditions allowed. Due to the lack of snow remaining on site by May 1, February snow surveys were initiated in 2009 to ensure a consistent annual 3-month record. May snow surveys have subsequently been discontinued for the same reason. Snow collection procedures are in accordance with the Snow Survey Sampling Guide (SS13-81) published by the British Columbia Ministry of Environment (Water Management Branch, Surface Water Section).

Table 2-8 shows, as an average of data recorded at all snow survey stations, the mean snowpack depth (cm), snow density (%) and water-equivalency (mm) on the first day of each month of the survey. Possible errors in the record identified in quality checking of the field data (where the recorded water-equivalency does not equal the product of the recorded snow density and snow depth) have been shaded grey, and retained in the analysis.

Figure 2-11: Minto Snow Sampling Locations

Table 2-8: Summary of Minto Mine Snow Survey Data.

Year	01-Feb			01-Mar			01-Apr			01-May		
	Snow Depth (cm)	**Snow Density (%)**	**Water-equivalent (mm)**	**Snow Depth (cm)**	**Snow Density (%)**	**Water-equivalent (mm)**	**Snow Depth (cm)**	**Snow Density (%)**	**Water-equivalent (mm)**	**Snow Depth (cm)**	**Snow Density (%)**	**Water-equivalent (mm)**
1994				52.2	17.1	89.7	50.3	18.8	94.3	0	n/a	0
1995				41.7	13.8	57.3	38.9	14.9	58.0	4.1	30.7*	18
1998				37.3	18.1****	65.0	39.3	18.2	70.7	0	n/a	0
2006				44.7	16.2	72.7	57.4	17.1	97.7	15.4	34.5**	52.7
2007				40.5	16.9	79.3	49.0	20.2	98.7	0	n/a	0
2008				50.9	17.1	87.0	48.9	20***	97.5	10.3	25.1**	34
2009	55.6	16.6	92.7	70.2	15.7	110.0	67.4	22.3	150.7	0	n/a	0
2010	60.5	17.8	107.7	58.1	20.7	120.7	40.4	13.9**	56.0			
2011	57.2	18.7	106.0	70.3	20.1	141.7	52.3	22.8	111.7			
2012	54.7	20.3	111.0	64.6	19.6	127.0	61.3	21.5	132.7			
2013	58.7	15.7	91.3	45.8	23.2	101.0	33.5	15.4	62.6			
2014	44.3	19.0	95.3	49.7	22.3	111.0	41.0	25.7	98.0			
2015	44.4	220.7	90.3	25.3	29.0	76.7	45.0	23.0	101.7			
2016	40.5	19.3	77.8	38.6	19.4	78.5	15.5	33.6	52.0			
2017	36.7	21.7	79.0	37.3	19.5	69.0	38.5	16.0	59.4			
2018	37.0	15.3	68.0	40.7	18.4	88.3	50.0	20.3	106.7			
2019	32.0	13.5	51.7	32.4	15.9	51.3	No Survey	No Survey	No Survey			
2020	57.3	19.6	112.0	70.3	19.7	138.5	65.9	18.6	130.0			
2021	48.0	16.7	79.5	60.7	19.6	117.8	73.0	21.8	161.2			
Mean	48.2	33.5	89.4	49.0	19.1	93.8	48.2	20.2	96.6	4.3	30.1	15.0

All snow surveys from 1994 - 2013 performed by J. Gibson & Associates

= possible measurement error

* *zero snow recorded at #2 and #3 - density is based on #1 only, average depth and water-equivalent is average of all sites*

** *zero snow at #3, density is an average of snowpack at #1 and #2, average depth and water-equivalent is average of all sites*

*** *omitted snow survey site #3 - error in snow depth reading*

**** *includes potential measurement error from site 3*

Based on the nineteen years of snow surveys, the average water-equivalent snow depth remaining on the first day of March and April is 93.8 mm and 96.6 mm, respectively. In four of the seven May surveys, the snowpack had melted entirely by May 1. In the three years where snow remained on the ground on May 1 (1995, 2006, & 2008), the mean snowpack had reduced 10%, 27%, and 20%, respectively, of the peak measured snowpack in that year. The data indicate that the majority of runoff due to snowmelt occurs in April. Figure 2-12 below shows the average snow water equivalent trend over the period of record.

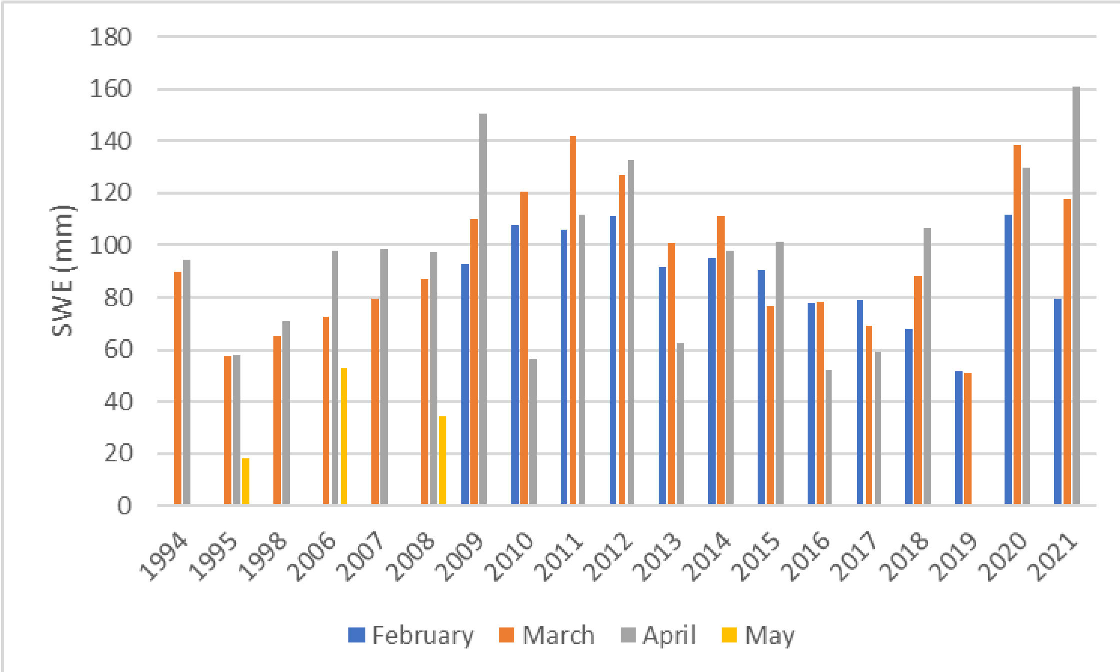


Figure 2-12: Snow Water Equivalent (SWE) Data from Minto Mine Snow Surveys, 1994 – 2021.

2.2.4 WIND SPEED AND DIRECTION

The average wind speed and direction and the maximum wind gust averaged over a three second period for each hour were recorded by the Minto Mine HOBO meteorological station, at a height of 3 meters above the ground. The anemometer was damaged by strong winds in May 2010, so that month marks the extent of the HOBO wind record. Since the HOBO wind sensor was strongly affected by rime icing (see Figure 2-13), much of the record is ice-affected at temperatures below zero.

Figure 2-13: Rime Icing Affecting the Minto Mine HOBO Anemometer (Source: EBA 2010).

Periods when the anemometer cups are not rotating due to ice build-up are recorded as 0 m/s and are easily identified in the record and flagged (for both the HOBO and the Campbell Scientific anemometers). However, ice build-up on the anemometer can result in extended periods of non-zero but diminished wind speeds of varying degree and duration which are difficult to arbitrarily omit from the record. In EBA's 2010 Climate Baseline Report, all wind speeds and directions recorded below 0°C were flagged and omitted from analysis to reduce uncertainty in the data. For consistency, that same approach was kept in the present report for the HOBO wind data. Note that this introduces a bias in the winter wind data, as almost exclusively strong southerly winds (associated with warmer temperatures) end up being kept in the winter wind record.

The new Campbell Scientific anemometer is at a height of 10 meters above the ground and was programmed to record wind speed and direction. This anemometer seems to have been much less affected by ice so far, so most of the winter wind data were retained in the record, to provide a general idea of winter wind patterns. It is however important to keep in mind that if some icing occurred on the Campbell Scientific anemometer, winter wind speeds may be underestimated in the record. Summary statistics for both weather stations are presented in Table 2-9.

Table 2-9: Wind Data Summary Table.

	HOBO	Campbell Scientific
Dates	September 2005 – April 2010	October 2010 – December 2020
Number of hours of data	39,531	89,520

Average wind speed	2.65 m/s	2.72 m/s
Calm winds count	3,227	33,252
Calm winds frequency	8.16%	37.43%
Data Available	42.17%	94.6%
Incomplete or missing data count	22,862	5,032
Total data used	16669	83,786

The wind roses in Figure 2-14 and Figure 2-15 are graphical representations of wind observations recorded by the two Minto Mine meteorological stations over the period of record. Because the anemometer height is different on the two stations (3 meters for the HOBO stations and 10 meters for the CS station), the wind data collected by each station were treated separately. Table 2-11 contains information on the data used for each wind rose, and Figure 2-16 shows statistics on the wind data used to produce the HOBO wind rose with regards to seasonal availability as discussed above.

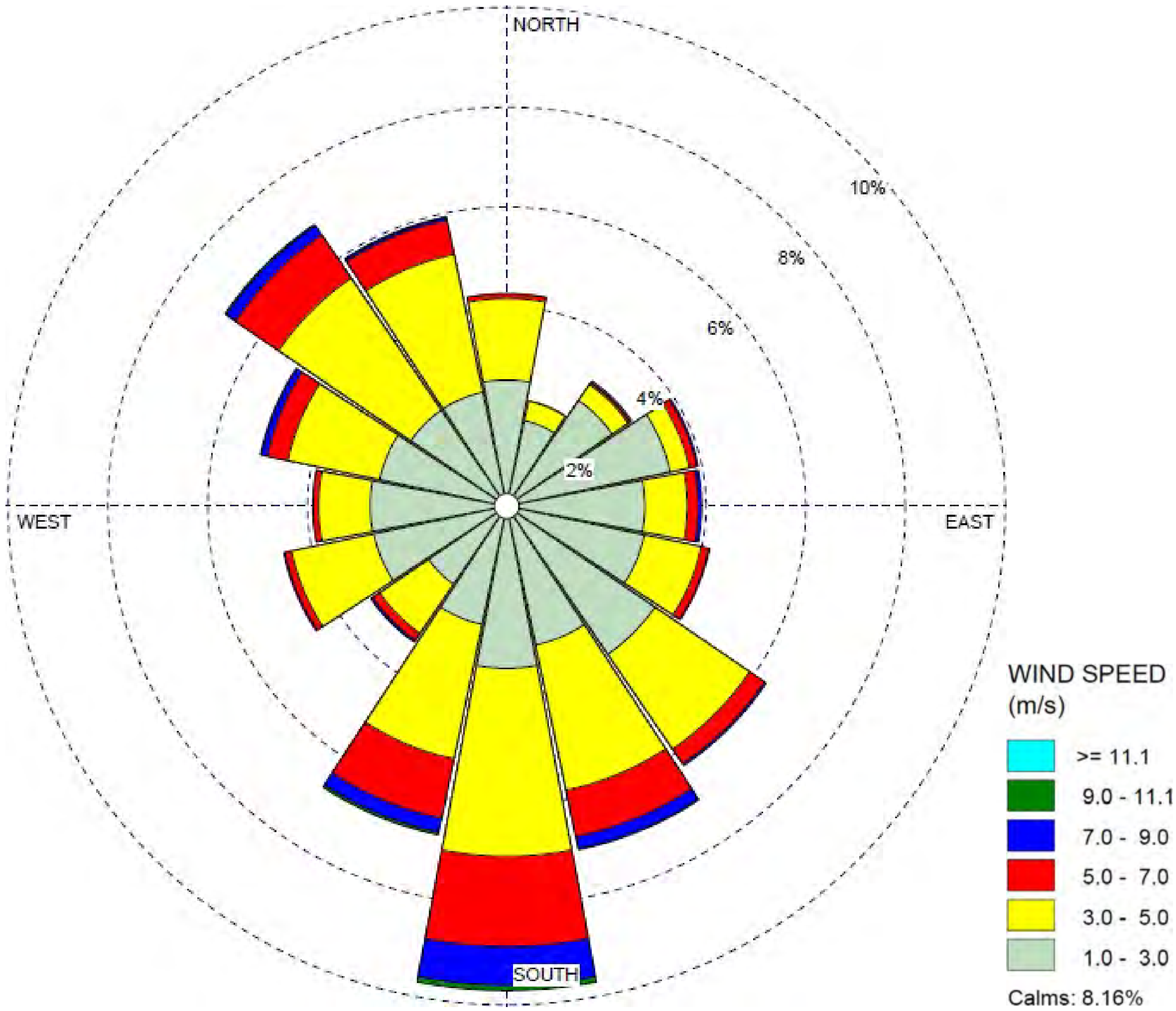


Figure 2-14: Minto Mine HOBO Meteorological Station Wind Plot, September 2005 – April 2010.

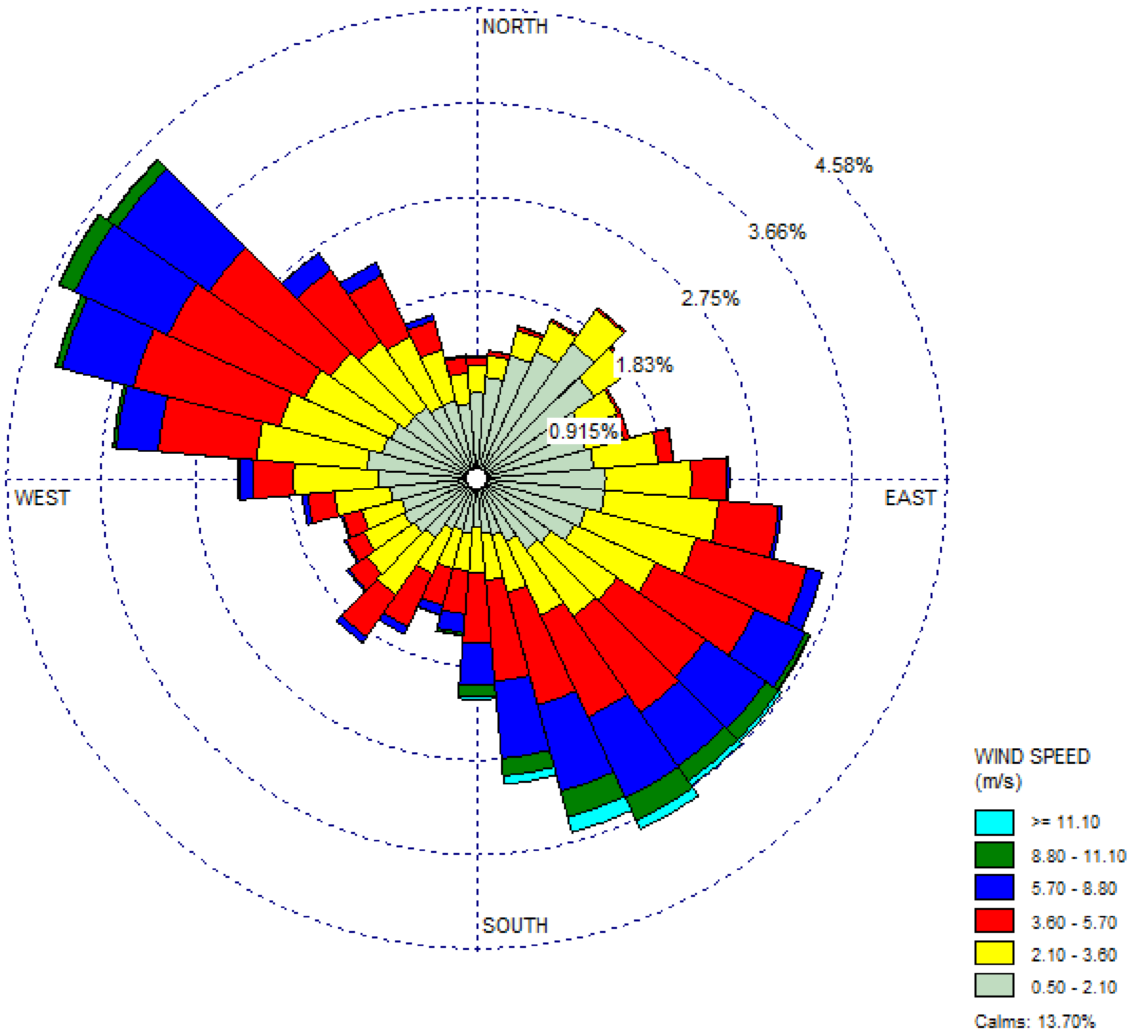


Figure 2-15: Minto Mine Campbell Scientific Meteorological Station Wind Plot, October 2010 – December 2020.

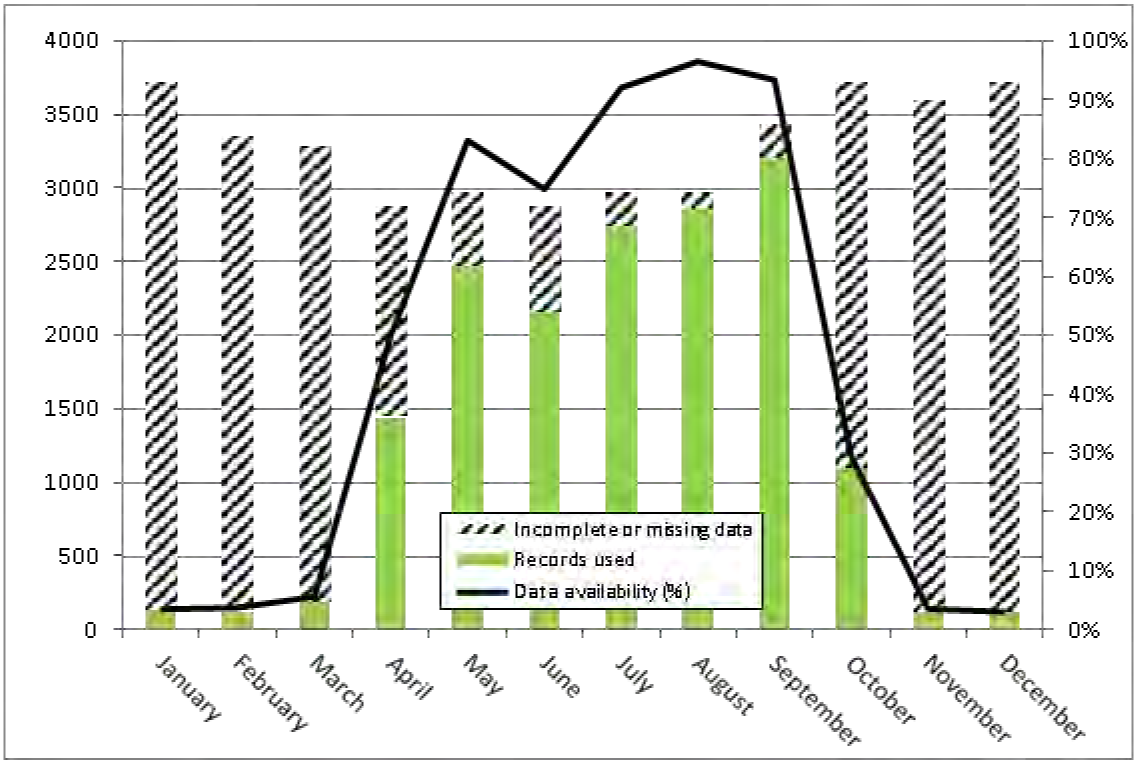


Figure 2-16: HOBO Wind Data Availability Statistics 2005–2010.

It is interesting to note that the record from the two stations is relatively consistent in terms of wind speed and direction, although the Campbell Scientific station generally recorded higher wind speeds and a more southeasterly direction while the HOBO displays a more southerly direction. This can be explained by the fact that the CS anemometer is higher above the ground (where there is less friction and less turbulence) and that the CS record is missing less data (94.6% data available for CS anemometer versus 42.2% for the HOBO).

2.2.5 RELATIVE HUMIDITY

Hourly relative humidity (RH) recorded at the site is plotted for the entire period of record in Figure 2-17 and illustrates a seasonal pattern. RH is highest during the winter months (typically in the range of 75% to 95%) and lowest during the spring and early summer, typically in the range of 40% to 60%; although levels exceeding 90% in summer are not uncommon.

RH has a much larger day-to-day variability during the summer months. The lowest recorded hourly RH was 10.25% (June 20, 2007). The highest was 100%, on several occasions. Table 2-10 shows the average monthly mean %RH.

Table 2-10: Monthly and Annual Average Relative Humidity (%), Minto Mine.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
HOBO (2005-2014)	83	79	68	57	52	57	61	69	71	84	85	83	71
Campbell Scientific (2010-2020)	73	69	59	53	48	55	60	65	66	74	77	75	64

RH is typically greater than 80% between October and February. During the summer months, the daily mean is typically in the range of 50% to 60%, although part of the reason for the lower average is a higher variance. Annually, mean RH is 70% (average over the two meteorological stations).

Figure 2-17 shows the hourly RH record for both stations.

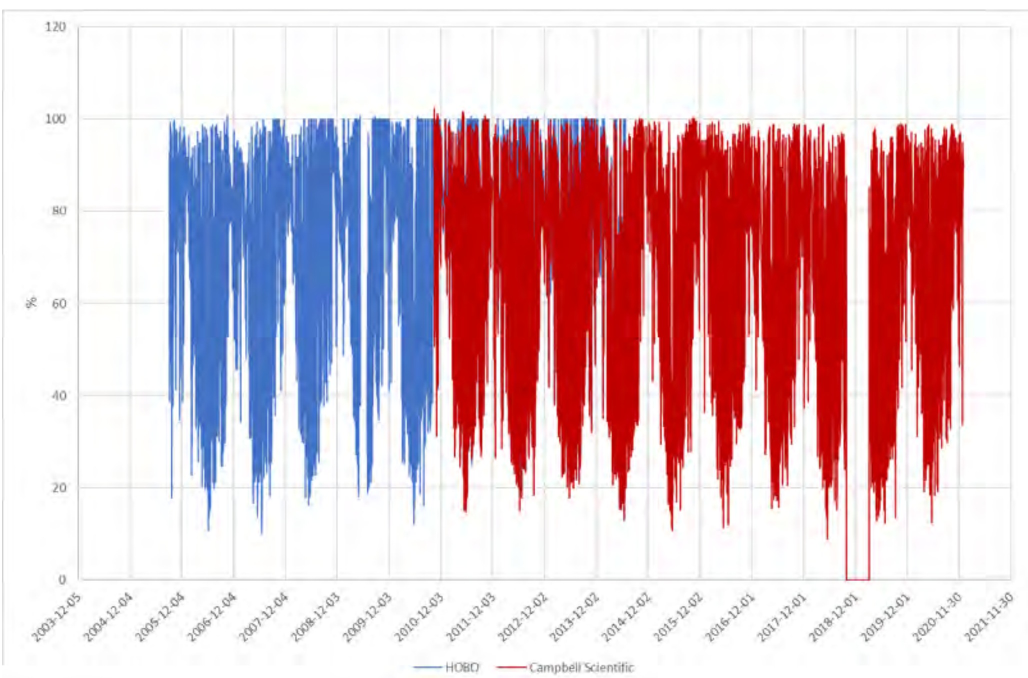


Figure 2-17: Minto Mine Hourly Relative Humidity (%), 2005–2016.

2.2.6 SOLAR RADIATION

Table 2-11 shows the average amount of solar radiation received each day at the site by month. The highest amount is received on average in June and the lowest is in December. Mean annual solar radiation is 108 W/m2 (averaged over the two meteorological stations).

Table 2-11: Monthly and Annual Average Incoming Solar Radiation (W/m2), Minto Mine.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
HOBO (2005-2014)	10	41	109	175	221	237	215	168	104	47	14	5	112
Campbell Scientific (2010-2020)	7	29	83	121	172	181	154	130	87	34	9	4	104

Hourly solar radiation is plotted for the entire period of record in Figure 2-18. As would be expected at a latitude of 62.6 °N, a strong seasonal pattern is evident, with maximum solar radiation observed near the summer solstice in late June, and values just slightly above zero around the winter solstice when the site experiences only about 3 hours of direct sunlight per day. Large fluctuations from the general trend during the summer are due to cloud cover.

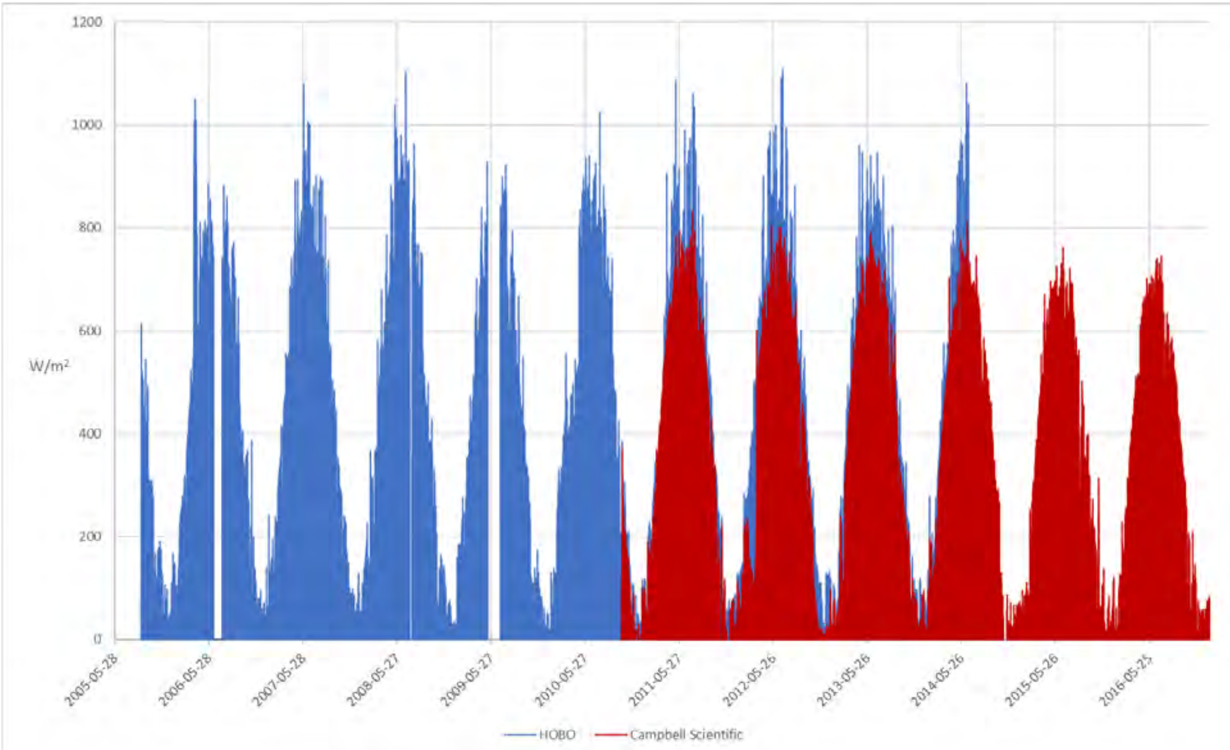


Figure 2-18: Minto Mine Hourly Incoming Solar Radiation (W/m2), 2005–2020.

On July 20, 2016, a second pyranometer was installed at the Campbell Scientific station to measure outgoing radiation. Monthly averages are shown in Table 2-12. Hourly outgoing solar radiation is plotted for the entire period of record in Figure 2-19.

Table 2-12: Monthly Average Outgoing Solar Radiation (W/m2), Minto Mine.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Campbell Scientific	9.442	37	78	70	44	43	41	32	22	21	13	5	35

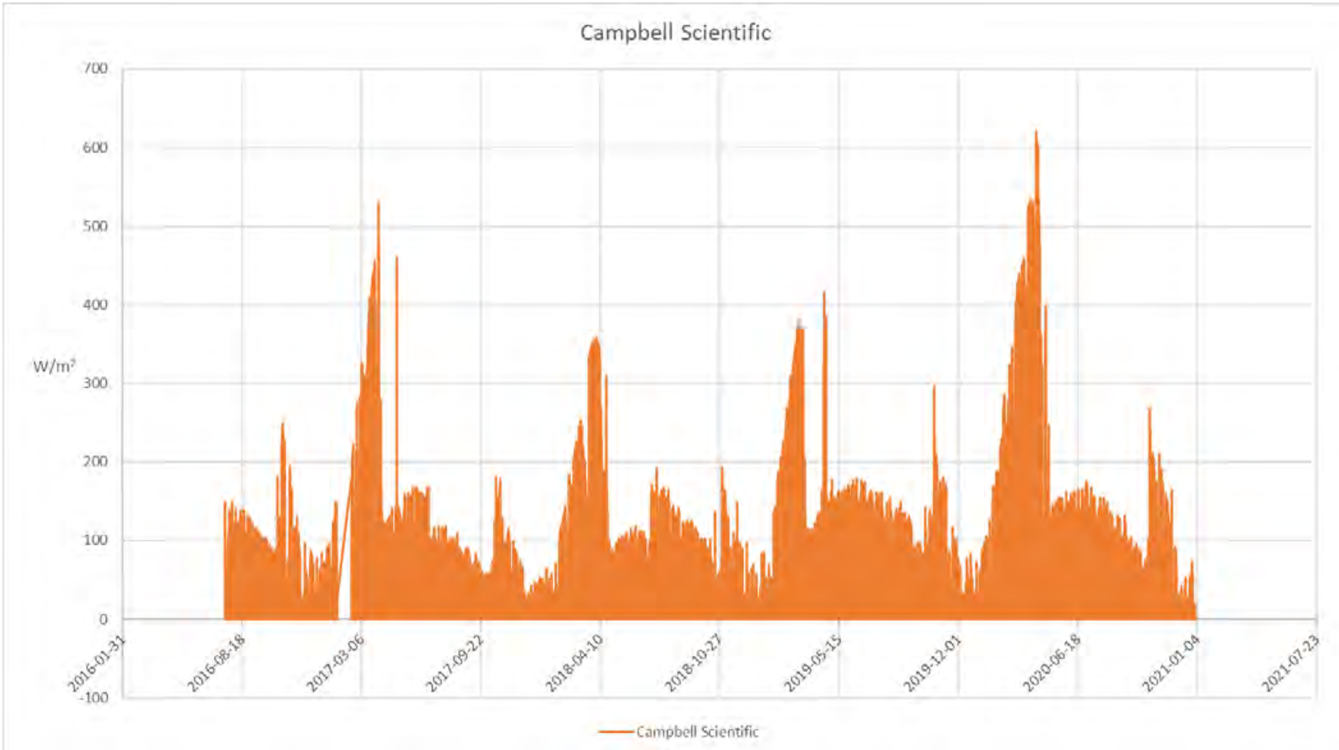


Figure 2-19: Minto Mine Hourly Outgoing Solar Radiation (W/m2), 2016–2020.

2.2.7 BAROMETRIC PRESSURE

Barometric pressure recorded on-site at 885 m elevation has been converted into a meteorological standard sea-level equivalent using the formula:

$$BP_{sl} = BP_{el} + 1013.25\left[1 - \left(\frac{h}{44307.69231}\right)^{5.253283}\right]$$

where: BP_{sl} = sea-level equicalent barometric pressure

BP_{el} = barometric pressure recorded at elevation

h = height above sea level (in m)

Table 2-13 shows average sea-level equivalent barometric pressure by month at the site. Mean annual sea-level equivalent barometric pressure is 1017 hPa.

Table 2-13: Monthly and Annual Average Sea-Level Equivalent Barometric Pressure (hPa), Minto Mine.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Campbell Scientific (2010-2020)	1017	1029	1022	1017	1017	1016	1018	1017	1016	1020	1016	1003	1017

Hourly sea-level equivalent barometric pressure recorded at the site is plotted for the entire period of record in Figure 2-19. A slight seasonal pattern can be observed with higher values during summer than during fall and early winter. Winter is also characterized by a much higher day-to-day variability. Note that the barometric pressure sensor on the Campbell Scientific weather station malfunctioned (possibly as a consequence of low battery voltage) and had to be sent back for repair; hence the data gap between November 12, 2010 and March 4, 2012.

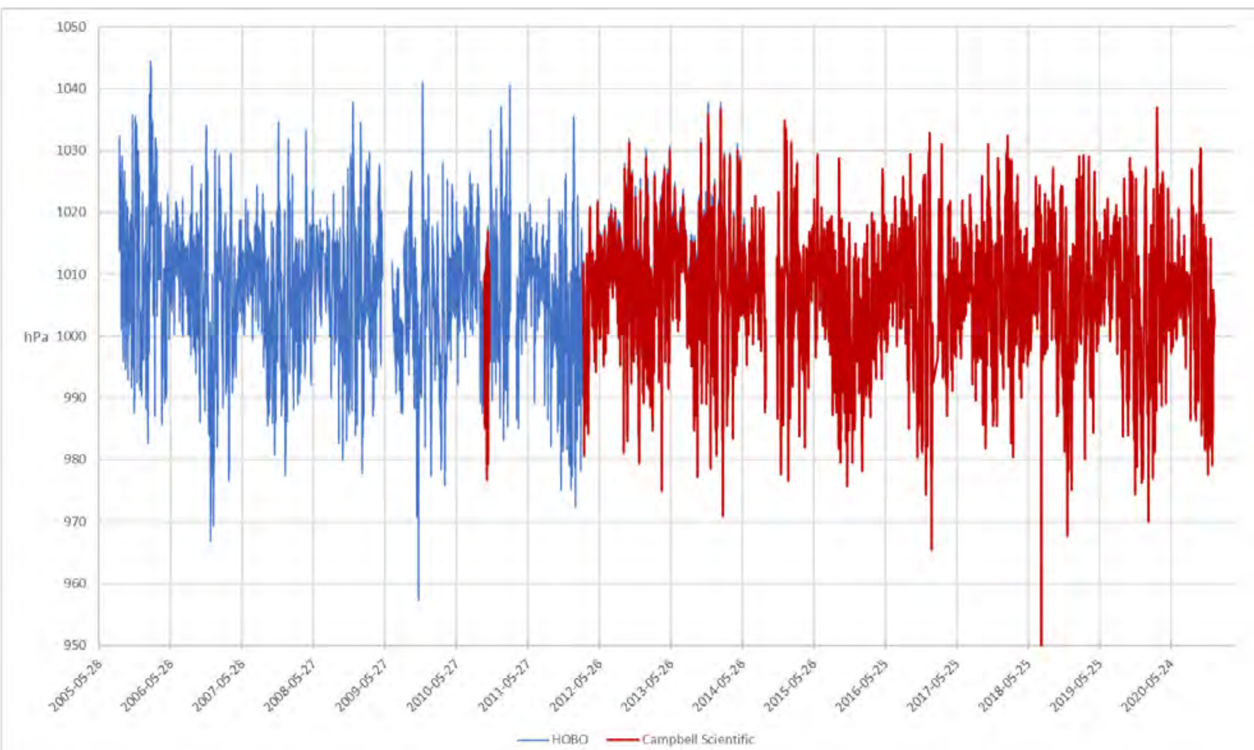


Figure 2-20: Minto Mine Hourly Sea-Level Equivalent Barometric Pressure (hPa), 2005–2020.

2.2.8 EVAPORATION AND EVAPOTRANSPIRATION

2.2.8.1 Regional Data

Monthly lake evaporation was reported by Environment Canada for Pelly Ranch over the period of 1971–1999 as a mean daily evaporation. Data show measurable evaporation occurring only between May and September. An estimate of mean annual lake evaporation is determined to be 460 mm for Pelly Ranch by multiplying each month's daily mean by the number of days in the month. The Ministry of Environment's Manual of Operational Hydrology in B.C. suggests a reduction in evaporation with elevation equal to 10% per 350 m elevation rise (HPK 1994). With an elevation difference of slightly over 400 m, the extrapolation would suggest an annual evaporation at site on the order of 400 mm/year.

2.2.8.2 Site Data

Starting in August 2012, the Campbell Scientific datalogger program incorporated an instruction for the calculation of potential evapotranspiration (PET) using the American Society of Civil Engineers (ASCE) standardized reference evapotranspiration equation (Penman-Monteith). The PET instruction uses temperature, relative humidity, wind speed, solar radiation, latitude, longitude and altitude to calculate an evaporation rate for a short grass crop. This provides an approximation of actual evaporation, which varies locally depending on surface type and micro topography. Table 2-14 presents the average monthly calculated PET.

Table 2-14: Monthly and Annual Average Potential Evapotranspiration (mm), Minto Mine.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
-3.3	0.9	20.7	48.8	96.0	97.7	88.4	57.1	32.7	5.9	-3.4	-3.2	444.0

The average total annual PET is 444 mm which is similar to the estimated mean evaporation value of 400 mm/year based on regional data. Figure 2-20 shows the hourly calculated PET, which displays a strong seasonal pattern. Maximum PET occurs in June while winter months (November to February) often display negative values, which can be interpreted as an increase in soil moisture.

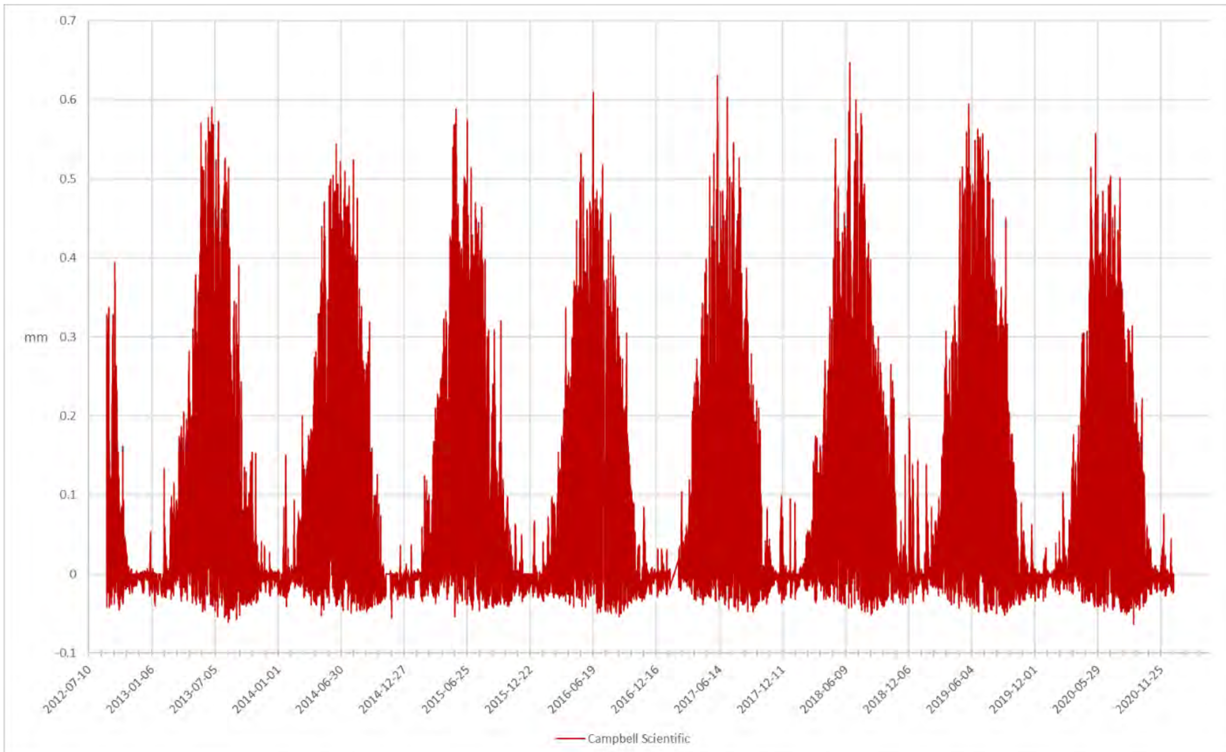


Figure 2-21: Minto Mine Hourly Potential Evapotranspiration (mm), 2012–2020.

3 SURFACE WATER HYDROLOGY

3.1 METHODS

3.1.1 REGIONAL DATA

Regional hydrometric stations operated by Water Survey of Canada (WSC) can provide insight on long-term trends. Big Creek near the Mouth station (09AH003) is located in the vicinity of the Project area (see Figure 3-1) and has been monitored since 1975. Although the drainage area of Big Creek is much larger than that of Minto Creek or McGinty Creek (1800 km2 compared to 42.2 km2 and 33.8 km2 for Minto creek and McGinty creek catchments respectively), the long-term record at Big Creek can be used as a proxy for the site.

3.1.2 SITE DATA

Minto Explorations Ltd. (Minto) maintains a network of hydrometric stations as part of its regular monitoring of surface water hydrological conditions at the Minto Mine in Minto and McGinty Creeks (Figure 3-1). Minto Mine personnel conduct regular discrete discharge measurements and maintenance at the stations where Solinst Levelogger and Barometric Loggers are utilized to capture continuous stage records.

Data coverage from year to year varies, depending on when in situ dataloggers were installed and removed, and when instantaneous discharge measurements were taken. Instantaneous discharge is measured using the velocity-area method using a current meter. Solinst Water Leveloggers are used to collect continuous stage readings which are then corrected based on physical staff gauge measurements. The records are processed into a continuous discharge record based on the stage-discharge relationship. This relationship (stage and discharge) is established each season through rating measurements obtained during regular field visits to the sites.

Paired Solinst Leveloggers and Barologgers are utilized to collect the continuous stage record. All measurements are entered into a master spreadsheet and .CSV files are created which include date, time, staff gauge height and discharge measured. These rating measurements are then imported into a data management software package (Aquatic Informatics' Aquarius Time-Series was used from 2012 to 2015) and a rating curve is built. Rating curve development considers which measurements should be included and when and where shifts to the rating are appropriate.

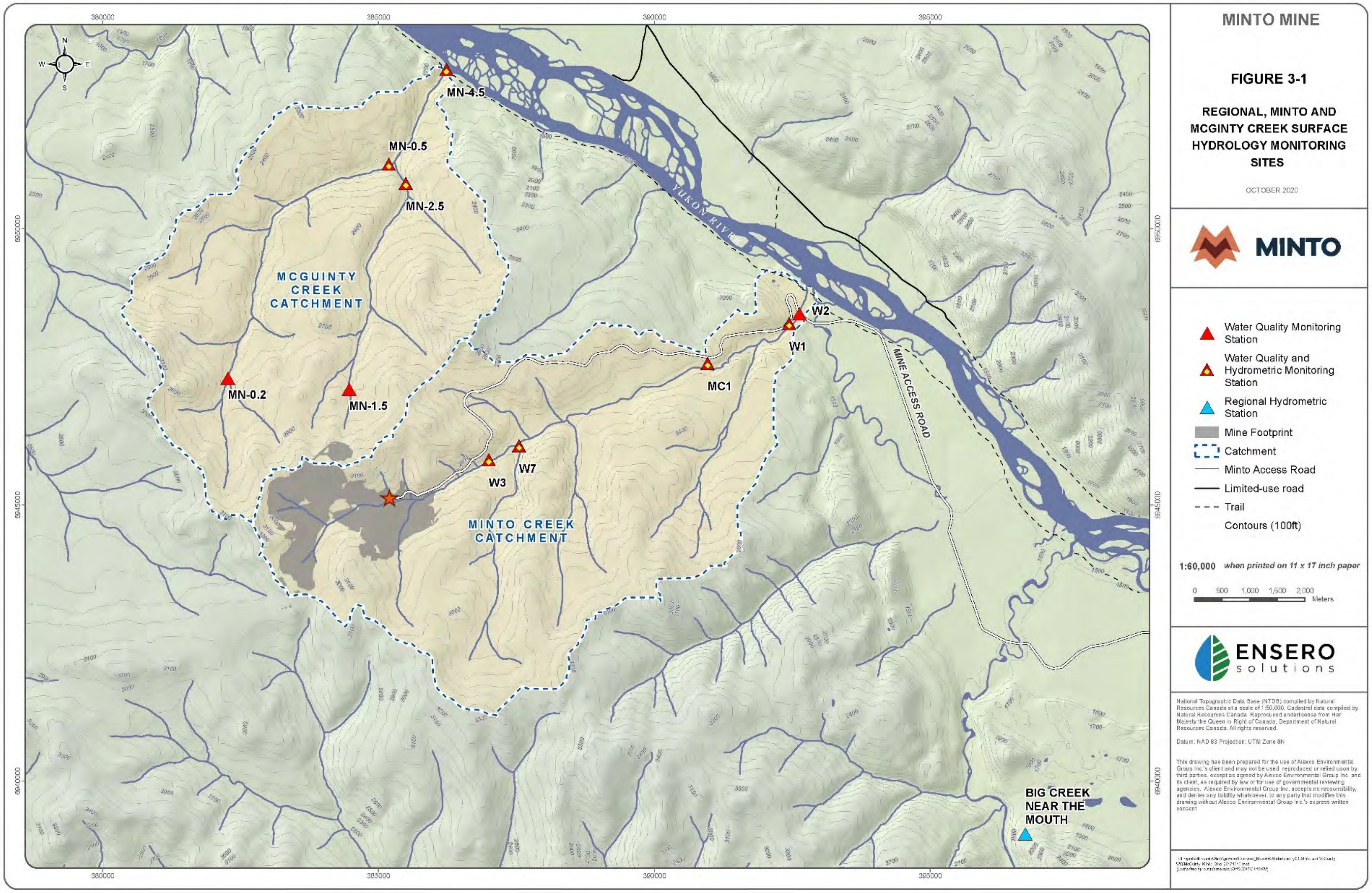


Figure 3-1: Regional Minto and McGinty Creek Surface Hydrology Monitoring Sites

3.1.2.1 QA/QC

Hydrometric data are collected and managed throughout the open water season by Minto staff on both Minto and McGinty Creeks. Minto utilizes the Velocity-Area method of discharge calculation and measures velocity using a Hach FH950 handheld electromagnetic flow meter. Measurements are conducted manually and paired with staff gauge observations and site photographs. In general, multiple visits per month occur on Minto Creek and monthly visits occur on McGinty Creek during the open water season.

These data are checked for entry and calculation errors and suspect measurements by Minto after field personnel have entered measurements into a calculation spreadsheet. Suspect measurements are verified against photos and field notes (e.g. if they differ greatly from the stage-discharge relationship). This can be due to ice effects or other changing control conditions such as scour, aggradation and vegetation control.

Barometrically compensated Solinst water level data are imported into Aquarius software from .CSV files which are exported from Solinst software following compensation. Aquarius allows for adjustment of the Solinst record to match the staff gauge observations, for development of rating curves with the field data, and for automatic processing of continuous discharge records. This preserves the raw data in an easy to reference format and changes can be made to the data at any time which then cascade through the various time series. For example, at new sites, rating curves may improve after several seasons and alter a previous year’s continuous record as the high or low end of the rating curve becomes better defined. Stage time series are adjusted for drift, offset and erroneous data are deleted or omitted from discharge computation if they are deemed ice affected. The rating curve is automatically applied to the continuous stage record for a specified time period to create the continuous discharge time series.

3.2 RESULTS

3.2.1 REGIONAL DATA

Table 3-1 presents the mean monthly discharge for the period of record at WSC station Big Creek near the Mouth, and Figure 3-2 displays the annual mean discharge. No clear long-term trend in mean monthly or annual discharge emerges from Big Creek data. Peak flows typically occur in May.

Table 3-1: Mean monthly discharge (m3/s), Big Creek near the Mouth (WSC station).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1974								19.6	4.53	2.16	0.608	0.118	
1975	0.058	0.083	0.149	0.443	37.3	14.6	23.9	23.1	13.8	4.06	0.423	0.199	**9.96**
1976	0.121	0.081	0.062	0.4	23.4	25.7	42.5	5.94	2.92	1.69	0.758	0.256	**8.72**
1977	0.224	0.201	0.152	0.512	17.6	17.9	15.8	3.92	4.28	2.79	0.696	0.087	**5.39**
1978	0.048	0.028	0.023	0.023	7.04	20.8	40.1	23.4	7.72	4.81	1.77	0.635	**8.95**
1979	0.342	0.125	0.123	0.178	18	18.4	19.6	12	10.3	3.46	1.07	0.355	**7.05**
1980	0.152	0.157	0.184	0.304	7.8	4.7	16.6	11	22.1	7.68	0.781	0.189	**5.99**
1981	0.175	0.169	0.173	0.225	12.8	4.72	18.4	14	5.89	4.8	1.61	0.432	**5.35**
1982	0.153	0.135	0.14	0.218	24	20.1	4.88	16	2.73	1.91	0.85	0.298	**6**
1983	0.125	0.068	0.05	0.054	8.49	21.3	17.9	27.3	8.89	3.27	0.426	0.026	**7.38**
1984	0.005	0.006	0.012	0.124			19.6	4.29	13.8	2.56	0.375	0.073	
1985	0.03	0.02	0.045	0.089	25.9	23.4	20.1	11.7	10.8	3.46	1.34	0.759	**8.21**
1986	0.496	0.298	0.111	0.052	21.6	18.4	17.2	10.9	9.28	3.51	0.668	0.595	**6.98**
1987	0.412	0.207	0.081	0.684	26.8	18.6	7.01	12	7.78	3.28	1.04	0.433	**6.58**
1988	0.192	0.167	0.211	0.499	26.7	11	23	15.7	6.14	3.2	1.66	0.786	**7.5**
1989	0.404	0.181	0.081	0.18	10.6	7.88	6.13	4.74	3.96	2.47	1.13	0.515	**3.22**
1990	0.262	0.113	0.065	21.8	76.8	17	8.48	3.65	19	5.88	0.96	0.317	**12.9**
1991	0.21	0.257	0.368	2.77	49.6	23	18.1	18	20.5	5.75	3.59	2.15	**12.1**
1992	1.1	0.447	0.488	1.37	52.2	33.7	36.2	12.4	16.5	4.92	2.02	1.1	**13.6**
1993	0.481	0.242	0.189	5.33	36	10	12.6	13.5	7.22	2.04	1.89	1.33	**7.64**
1994	0.675	0.294	0.162	7.91	19.1	9.01			3.03	2.27	0.529	0.286	
1996	0.207	0.035	0.006	0.003	6.34	6.03	22.5	21.2	12.1	2.91	0.717	0.147	**6.05**
1997	0.045	0.028	0.022	0.049	28.7	38.8	26.5	24.4	11	3.85	1.78	0.661	**11.4**
1998	0.179	0.128	0.105	0.224	8.61	8.29	2.67	1.87	2.37	1.19	0.221	0.035	**2.17**
1999	0.022	0.018	0.019	0.173	9.6	22	6.31	4.18	8.94	3.12	0.356	0.074	**4.57**
2000	0.033	0.024	0.032	0.682	53.2	26.6	27.8	30.6	34.2	11.8	4.09	2.42	**16**
2001	1.28	0.708	0.571	1.76	15.3	35.4	33.9	19.5	14.8	5.42	2.54	1.09	**11.1**
2002	0.519	0.288	0.227	0.732	19.4	9.12	9.15	14.8	16.4	4.62	1.9	1	**6.56**
2003	0.543	0.264	0.132	3.98	12.3	18.5	20.1	11.7	7.09	4.67	1.63	0.655	**6.84**
2004	0.369	0.378	0.423	2.38	40.2	6.27	4.79	7.13	6.14	4.82	1.25	0.621	**6.29**
2005	0.434	0.352	0.336	7	14.8	8.64	11.8	12.8	16.4	6.1	2.13	0.446	**6.8**
2006	0.207	0.168	0.176	0.625	20.2	10.6	9.55	5.9	4.92	2.86	1.15	0.277	**4.77**

2007	0	0	0.04	2.83	23.3	8.93	11	6.8	7.61	3.66	0.852	0.276	**5.49**
2008	0.146	0.117	0.136	1.28	42.4	11.6	6.74	31.8	16.6	5.92	2.44	1.33	**10.1**
2009	0.864	0.652	0.587	1.7	45.1	19	3.59	4.33	4.78	2.75	1.64	0.755	**7.2**
2010	0.398	0.258	0.242	8.71	17.7	7.69	38	23	16.7	4.74	2.44	1.35	**10.2**
2011	1.21	1.27	0.888	3.7	44.2	31.8	37.2	36.8	12	5.37	3.02	1.69	**15.1**
2012	1.09	0.872	0.98	8.67	28.2	24.9	19.2	20.2	16	6.08	2.64	1.51	**10.9**
2013	1.36	1.27	1.21	1.18	46.3	18.3	17.7	10.6	15	9.08	3.17	1.69	**10.7**
2014	1.35	0.988	0.692	2.82	23.9	4.84	8.79	6.98	12.3	6.18	2.54	1.34	**6.11**
2015	0.593	0.297	0.387	1.47	11.3	5.28	8.13	24.9	16.4	5.16	2.39	1.42	**6.53**
2016	1.01	0.85	1.19	7.5	13.4	8.43	20.6	13.3	11.8	4.33	2.5	1.27	**7.22**
2017	0.703	0.458	0.264	4.85	25.6	25.8	18.7	13.2	7.28	5.06	2.15	0.968	**8.8**
2018	0.708	0.553	0.446	7.16	22.6	15.8	8.63	12.7	12.2	2.56	1.95	0.944	**7.22**
Mean	**0.440**	**0.308**	**0.279**	**2.620**	**25.580**	**16.496**	**17.654**	**14.461**	**11.00**	**4.28**	**1.58**	**0.748**	**8.09**

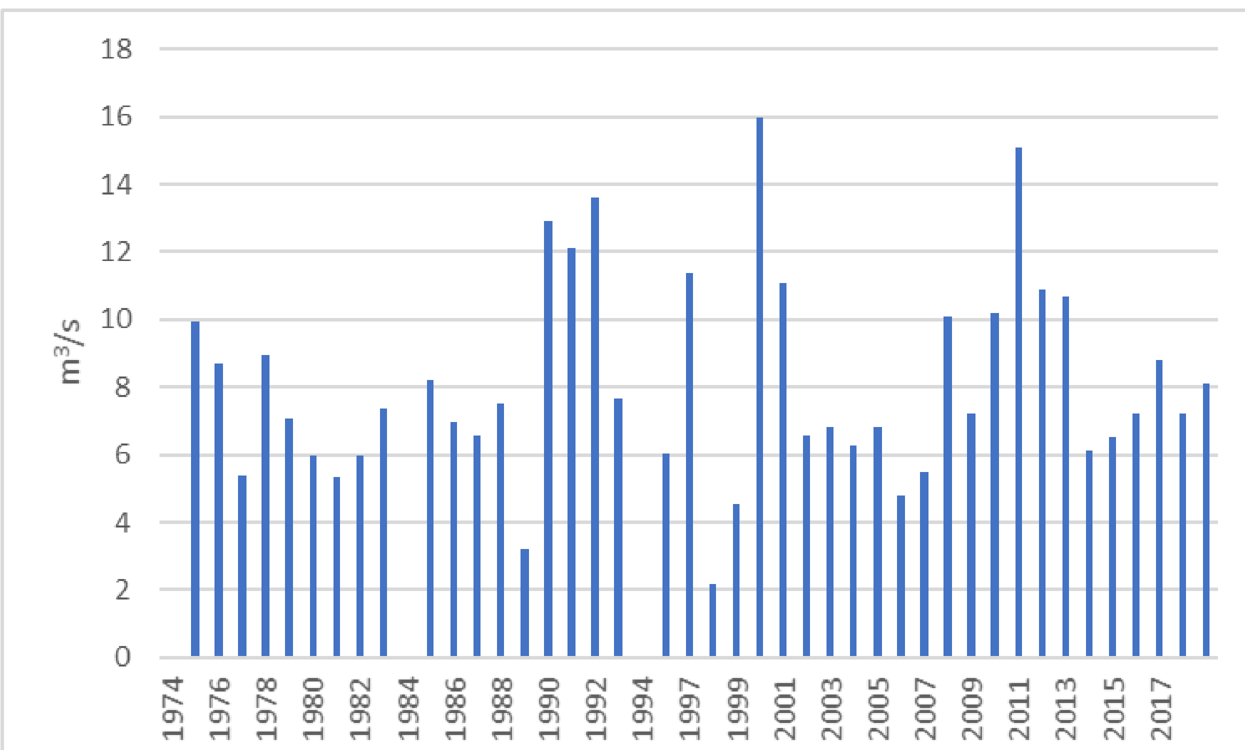


Figure 3-2: Mean annual discharge (m3/s), Big Creek near the Mouth (WSC station).

3.2.2 MINTO CREEK

Monitoring of hydrological parameters on Minto Creek began in 1993 and has continued intermittently to date at sites W1 and W3 (Figure 3-1). Monitoring has been more intensive since mine commissioning in 2007. The locations for which the greatest amount of data have been collected are stations W1, "Minto Creek near the mouth" (catchment area of 42 km2); and W3, "Minto Creek downstream of water storage pond dam" (catchment area of 10.4 km2 area). In 2010, another continuously monitored hydrometric site called MC-1 was added, approximately 2 km upstream of W1. W3 is now an in-stream trapezoidal flume with a manufacturer-specified stage-discharge relationship. Both discharge and stage are read on an integrated gauge in the throat of the flume. A Solinst Levelogger record is calibrated with these field observations to process a continuous discharge record at this site. Sites MC-1 and W1 are natural stream channels where manual velocity measurements are taken across the channel and discharge is calculated using the velocity area method. Continuous water levels from Solinst Leveloggers are processed into continuous discharge using these rating measurements.

3.2.2.1 Station W3 – Flume below Water Storage Pond Dam

Water level is continuously monitored in the flume which is approximately 500m from the toe of the Minto Water Storage Pond dam via a Solinst Levelogger in combination with a barometric logger. Frequent observations by Minto staff (minimum weekly) allow for correction of the level logger to the actual height of water in the flume and confirmation of the manufacturer's specified stage-discharge relationship. This provides a record with a high degree of accuracy. Table 3-2 summarizes the continuous data as mean monthly flows.

B. The winter stage record was interpolated using the discrete stage observations. In general, the flume typically flows at 3-4 L/s, but it should be noted that flows at W3 are impacted by storage within, and discharge from the Water Storage Pond.

Table 3-2: Mean monthly discharge (m3/s), Minto Creek at W3.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993									0.028			
1994					0.101	0.028	0.039	0.011	0.028			
1995						0.004	0.017		0.027	0.008		
1996					0.013		0.087		0.021			
1997					0.554							
1998								0.006				
1999								0.006				
2000												
2001					0.160							
2002												
2003								0.037				
2004							0.026					
2005					0.046	0.008	0.014	0.017	0.022	0.020		
2006				0.018	0.128	0.042	0.006	0.015	0.009	0.010		
2007				0.001	0.012	0.009	0.006					
2008								0.064*	0.122*	0.003		
2009						0.026*	0.106*	0.092*	0.124*	0.110		
2010				0.002	0.004	0.005	0.034	0.071	0.086	0.070		
2011						0.005	0.005	0.006	0.005			
2012				0.004	0.020	0.003	0.004	0.004	0.004	0.004		
2013						<0.001	<0.001	0.002	0.003	0.003	0.003	0.006
2014	0.003	0.006	0.006	0.057	0.086	0.003	0.003	0.003	0.004	0.004	0.004	0.006
2015	0.004	0.002	0.001	0.075	0.052	0.003	0.003	0.004	0.004	0.004	0.004	0.003
2016				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	0.005	0.008	0.007	0.012	0.010	0.015
2018	0.037	***	***	***	***	0.041	0.022	0.015	0.013	0.012	0.018	***
2019	***	***	***	***	***	0.054	0.012	0.013	0.013	0.014	0.010	***
2020	0.003	0.002	0.002	0.006	0.004	0.003	0.003	0.003	0.003	0.005	0.002	0.002
Mean												
Pre-Mine 1993 to 2006	**	**	**	**	0.167	0.02	0.032	0.015	0.023	0.013	**	**
Mining Period 2007 to 2016	0.015	0.008	0.005	0.022	0.031	0.013	0.009	0.012	0.013	0.020	0.007	0.006
All Data 1993 to 2016	0.015	0.008	0.005	0.022	0.089	0.015	0.017	0.013	0.017	0.019	0.007	0.006

Note: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

*Flows impacted by storage within, and emergency releases from, the Water Storage Pond in August and September 2008 and in June through October2009.

**Insufficient data for calculation.

***Unable to obtain accurate readings due to ice build-up in and around flume.

3.2.2.2 Station MC-1 – Minto Creek Mid-Catchment

Hydrometric station MC-1 is located between the flume at W3 and is just upstream of the canyon on lower Minto Creek. This site is characterized by shallow channel slope and slower moving water above the control of the canyon. Table 3-3 summarizes these data as mean monthly flows.

MC-1 experiences a later summer shift which is likely due to aggradation in the channel. This seasonal shift from the base rating curve appears consistently, but is not exactly the same from year to year. Minto staff report that MC-1 freezes to the stream bed in winter. Discharge is again observed to be greater at this site than at W1 which supports the theory that Minto creek loses significant water to groundwater networks as it flows towards the Yukon River.

Table 3-3: Mean monthly discharge (m3/s), Minto Creek at MC-1.

	Month					
Year	May	Jun	Jul	Aug	Sep	Oct
2011					0.118	0.093
2012	0.179	0.065	0.052	0.041	0.108	-
2013	0.358	0.085	0.103	0.044	0.089	0.064 **
2014	0.187	0.028	0.031	0.036	0.028	0.033 **
2015	0.862 **	0.014	0.028	0.042	0.035	0.031 *
2016	-	0.029 *	0.036	0.048	0.076	-
2017	0.074	0.074	0.018	0.010	0.028	0.029
2018	0.056	0.038	0.015	0.025	0.021	0.009
2019	-	0.045	0.005	0.011	0.030	0.021
2020	0.074	0.040	0.034	0.036	0.050	-
Mean	0.256	0.047	0.036	0.033	0.058	0.040

Note: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

**Based on incomplete or derived data*

***Based on multiple discrete measurements*

3.2.2.3 Station W7 – Tributary of Minto Creek

This site is located on the first tributary of Minto Creek below W3 (Figure 3-1). A staff gauge was installed at this station during the summer of 2013. Historically, this station was a regularly monitored surface water station prior to the installation of the staff gauge. In 2014, the staff gauge was damaged by ice and repaired for the hydrometric program in 2015. In 2016, several discrete discharge measurements were recorded without a corresponding stage. Table 3-4 provides a summary of historically measured flows at W7. These flows are based on discrete measurements only. The low discharge combined with the dynamic nature of channel morphology at this site do not contribute to the consistent development of a continuous record, and instead contribute low confidence in the existing continuous record. To obtain good quality data with a pressure transducer, an artificial control such as a v-notch weir is recommended.

Table 3-4: Mean monthly discharge (m3/s), Minto Creek at W7.

	Month					
Year	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
2013			0.013	0.031	0.019	0.006
2014	0.112					
2015		0.006	0.004	0.011	0.011	0.029
2016		0.006	0.01	0.01	0.013	0.01
2017		0.014	0.007	0.012	0.009	0.006
2018		0.005	0.007	0.007	0.007	0.006
2019		0.003	*	0.004	0.004	
2020		0.007	0.009	0.020	0.008	0.015
Mean	**	0.007	0.008	0.014	0.010	0.012

Note: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

* *Creek dry*

** *Insufficient data for calculation*

3.2.2.4 Station W1 – Lower Minto Creek above Road Crossing

W1 station is located on the lower reach of Minto Creek before flowing into the Yukon River. W1 is located downstream of MC-1 and it is expected that flows would be larger because it has a much larger catchment area than MC-1. W1 flows are typically lower than MC-1 from mid-spring through fall suggesting that the section of stream from the bottom of the Minto Creek canyon (upstream of W1) to near the mouth is a 'losing' reach. A portion of the surface water downstream of MC-1 and the canyon recharges the groundwater system and by-passes the surface water hydrometric measurements at station W1. Table 3-5 summarizes these W1 data as mean monthly flows.

Table 3-5: Mean monthly discharge (m3/s), Minto Creek at W1.

Year	Apr	May	Jun	Jul	Aug	Sep	Oct
1993						0.069	
1994		0.312	0.058	0.095	0.007	0.073	
1995		0.027	0.001	0.091		0.133	
1996		0.031	0.024	0.324		0.146	
1997		1.447			0.265		
1998		0.161			0.003		
1999					0.033		
2000		1.004					
2001		0.467					
2002							
2003					0.129		
2004				0.118			
2005		0.097	0.012	0.127	0.209	0.219	0.134
2006	0.203	0.354	0.15	0.02	0.0068		0.031
2007	0.645	0.175	0.053	0.061	0.025	0.034	0.035
2008		0.117	0.015	0.026	0.184	0.184	0.026
2009		0.868	0.351	0.249	0.139	0.026	
2010	0.560	0.081	0.038	0.106	0.118	0.125	0.092
2011			0.229	0.200	0.200	0.082	
2012		0.269	0.073	0.052	0.051	0.078	0.056**
2013		0.485*	0.064	0.065	0.044	0.085	0.059**
2014		0.138*	0.022	0.020	0.014	0.031	0.025**
2015		0.117	0.010	0.010	0.030	0.024	0.02*
2016	0.220	0.079	0.022	0.026	0.020	0.059	
2017	0.127	0.085	0.074	0.014	0.011	0.017	0.030
2018		0.132	0.093	0.039	0.009	0.006	
2019		0.078	0.073	***	***	***	0.002
2020		0.076	0.024	0.046	0.047	0.032	0.046
Mean							
Pre-Mine 1993 to 2006	0.203	0.433	0.049	0.129	0.093	0.128	0.083
Mining Period 2007 to 2015	0.388	0.208	0.081	0.070	0.069	0.060	0.039
All Data 1993 to 2015	0.351	0.300	0.073	0.089	0.077	0.079	0.046

Note: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

* *Based on incomplete or derived data*

** *Based on multiple discrete measurements*

*** *Creek dry or data unreliable*

3.2.3 MCGINTY CREEK

McGinty Creek has two main sub-catchments that each have two water quality monitoring stations, one just above the confluence and one near the headwaters. MN-4.5 is located on the main stem below the confluence of the tributaries near the mouth; just above the Yukon River (Figure 3-1). MN-0.5 and MN-0.2 are the lower and upper stations on the west tributary, respectively. MN-2.5 and MN-1.5 are the lower and upper stations on the east tributary, respectively. Stations MN-0.2 and MN-1.5 are not set up with continuous loggers and generally exhibit very low flows. As such they are not included in the discussion below.

3.2.3.1 Station MN-4.5 – McGinty Creek near the Mouth

Station MN-4.5, situated near the mouth of McGinty Creek, is similar in catchment area to Minto Creek, but exhibits consistently higher flows than W1 (located at a similar location Minto Creek). Table 3-6 summarizes the monthly mean values from the continuous record with earlier years' values included for comparison.

Table 3-6: Mean monthly discharge (m3/s), McGinty Creek at MN-4.5.

	Month						
Year	Apr	May	Jun	Jul	Aug	Sep	Oct
2009	-	0.018	0.033	0.019	0.031	0.016	0.013
2010	-	0.028	0.051	0.079	0.047	0.034	-
2011	-	0.444	0.093	0.125	0.134	0.068	0.045
2012	0.212	0.23	0.18	0.082	0.053	0.109	-
2013	-	-	0.054	0.103	0.093	0.116	-
2014	-	0.23	0.041	0.037	0.026	0.046	-
2015	-	-	0.013	0.046	0.049	0.029	0.029
2016	-	0.017	0.015	0.026	0.028	0.028	0.01
2017	-		0.021	0.020	0.004	0.011	0.005
2018	-	0.031	0.021	0.005	0.021	0.022	0.006
2019	0.011	0.027	0.079	0.013	0.001	0.002	0.001
2020	-	0.082	0.002	0.051	0.038	0.028	0.031
Mean	-	0.123	0.003	0.077	0.070	0.039	0.058

Note: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

3.2.3.2 Station MN-2.5 – East Tributary of McGinty Creek

MN-2.5 station is located on the lower stem of McGinty Creek. Table 3-7 summarizes the monthly mean values from the continuous record.

Table 3-7: Mean monthly discharge (m3/s), McGinty Creek at MN-2.5.

Year	Apr	May	Jun	Jul	Aug	Sep	Oct
2014*	-	0.032	-	-	-	-	-
2015*	-	0.015	0.003	0.011	0.038	0.01	0.01
2016*	0.034	0.008	-	-	0.009	0.014	0.003
2017	-	0.073	0.008	0.004	-	-	-
2018	-	-	0.011	0.011	0.014	0.014	0.019
2019	-	-	0.006	0.006	0.006	0.006	0.007
2020	-	-	0.002	0.019	0.021	0.019	0.022
Mean							

Note: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

* *Based on incomplete or derived data*

3.2.3.3 Station MN-0.5 – West Tributary of McGinty Creek

MN-0.5 station is located on the upper west stem of McGinty Creek. Table 3-8 summarizes the monthly mean values from the continuous record.

Table 3-8: Mean monthly discharge (m3/s), McGinty Creek at MN-0.5.

	Month					
Year	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
2014*	0.045	-	-	-	-	-
2015*	0.035	0.013	0.054	0.098	0.029	0.025
2016*	0.028	0.016	0.01	0.016	0.035	0.018
2017	-	0.022	0.022	0.009	0.013	-
2018	0.045	0.030	0.016	0.021	0.025	0.041
2019	-	0.018	0.008	0.007	0.008	-
2020	-		0.055	0.055	0.029	0.046
Mean	0.038	0.020	0.028	0.034	0.023	0.032

Note: Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

**Based on incomplete or derived data*

4 CONCLUSIONS

Regional and local hydrometeorological data are used to characterize existing conditions at the Project site, which are being refined and updated as more years of data become available. Fifteen years of meteorological data collected at site allow a reasonably good characterization of year to year variability, but may not capture extremes. No clear trend emerges from site meteorological data over the period of record. The hydrological data record is relatively short at most sites and does not allows for the detection of meaningful trends. Sites W1 and W3 have a longer record for the open water season and capture more year to year variability, but no long-term trend in flow rates or timing emerges at this point.

5 REFERENCES

Access Consulting Group (2012). Climate Baseline Conditions, Minto Mine Phase V/VI Expansion. Whitehorse, YT. October 2012.

Access Consulting Group (2013). Surface Water Hydrology Baseline Conditions. Minto Phase V/VI Expansion.

Prepared for Minto Explorations Ltd., June 2013.

Clearwater Consultants Limited (2006). Memorandum CCL-MC-1: Minto Copper Project – Site Hydrology Update.

Clearwater Consultants Limited, Vancouver, BC. October 2006.

Clearwater Consultants Limited (2010). Memorandum CCL-MC6: Minto Copper Project – Surface Water Hydrology Conditions. Clearwater Consultants Limited, Vancouver, BC. August 2010.

EBA. 2010. Minto Mine 2010 Climate Baseline Report. Report prepared for Minto Exploration Inc. 14pp. Environment Canada. 2017. Historical Climate Data. http://climate.weather.gc.ca/index_e.html#access

Environment Yukon. 2017. Yukon Snow Survey & Water Supply Forecast. http://www.env.gov.yk.ca/air-water- waste/snow_survey.php

(HKP) Hallam Knight Piesold Limited. 1994. Minto Project: Environmental Setting (Vol. 2). Report prepared for Minto Explorations Limited, Vancouver, B.C.

SRK Consulting. 2017. Minto and McGinty Creek 2016 Surface Hydrology Memo. Prepared for Minto Explorations Ltd. March 23, 2017.

APPENDIX 1-3

Surface Water Quality

Minto and McGinty Creeks Water Quality Characterization

January 2005 – May 2021

October 2021

Table of Contents

Tables

Figures

EXECUTIVE SUMMARY

Surface water quality in and around the Minto Mine has been the subject of numerous characterization efforts since 1994. In this report, surface water quality at the Minto Mine site and downstream water courses was characterized using data collected from January 2005 to May 2021. The water quality characterization was organized by grouping data into areas including critical water management monitoring locations in the Minto Mine site operational area, the mainstem of Minto Creek during the operational phase of the Minto Mine, the Minto North Pit, and McGinty Creek. Minto Creek receiving environment data were further divided into periods of active effluent discharge and no discharge from the mine site. Where applicable, comparison of water quality was made to the effluent quality standards (EQS) and water quality objectives (WQO) stipulated within water use licence (WUL) QZ14-031. Summary statistics are presented with graphical plots of concentrations over time at key water quality monitoring stations.

The pH of the Mine Site, Minto North Pit, Minto Creek, and McGinty Creek waters was predominantly circumneutral to slightly alkaline. Nitrogen species concentrations were generally highest in the pit lake and DSTSF drainage sites reflecting leaching of nitrogen residue from blasting activity. All pit lake nitrogen species showed marked reduction during periods when blasting was not taking place; in the Minto North Pit following cessation of mining activities and in the Main and Area 2 Pits during temporary closure. Nitrate-N levels showed marked seasonality in Minto Creek sites within the site and downstream of the site and in McGinty Creek with higher concentrations in the winter and lower concentrations in the spring and summer, responding to nitrogen uptake demand by primary producers and dilution from spring meltwater. Nitrate-N levels were typically higher in Minto Creek during and following mine discharge periods. Dissolved organic carbon (DOC) concentrations were often highest during spring snowmelt likely due to flushing of labile organic carbon from soils. Higher DOC levels were also observed in late summer in sampling locations farther downstream in Minto Creek and McGinty Creek.

At all flowing sites, dissolved hardness concentrations were typically lowest during spring snowmelt and increased through the year, peaking in winter, suggestive of a marked groundwater component to hardness levels. Dissolved iron, and to a lesser extent aluminum, were often observed at concentrations higher than expected from equilibrium with their oxyhydroxide minerals under the prevalent oxidizing, circumneutral pH conditions. Reasonable correlations between dissolved iron and DOC at several sites on the mine site and in McGinty and Minto Creek suggest complexation with dissolved organic matter likely maintains these elevated dissolved iron (and often arsenic) and aluminum levels.

On the Mine Site, dissolved copper concentrations were highest in the DSTSF drainage and tended to peak with freshet, suggestive of some association with DOC. Dissolved copper concentrations in Minto Creek were higher during and following mine discharge periods, particularly during the emergency site discharge period of June 26 to August 6, 2009. Dissolved copper concentrations in McGinty Creek also tended to be higher during spring snowmelt, correlating reasonably well with DOC concentrations.

Dissolved concentrations of both selenium and molybdenum increased approximately four-fold in the pit lake sites from 2013 to 2016, alongside sulphate. Selenium and molybdenum concentrations returned to pre-2013 levels by 2019, however sulphate levels remain at higher concentrations but appear to have stabilized in recent years. In Minto Creek and downstream of the mine site and in McGinty Creek, selenium exhibited seasonal cycling with concentrations lowest at freshet, then rising through the year, peaking in winter, suggestive of a strong groundwater contribution. The opposite pattern was observed in the drainage from the DSTSF where selenium levels oscillated on an annual basis between summer peaks and winter troughs. Dissolved selenium concentrations in Minto Creek downstream of the mine site were higher during and following mine effluent discharge periods, while in McGinty Creek higher selenium concentrations were observed in the west arm (reference tributary) of McGinty Creek than the east arm.

1 INTRODUCTION

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 the Capstone Mining Corporation. Development of the mine was initiated in 1997, and commercial operations started in October 2007. The mine entered a period of temporary closure in the fall of 2018 and began producing again in October 2019. The Minto Mine is permitted to conduct open pit and underground mining, and to mill the copper/gold/silver ore at a rate of 4,200 tonnes of per day. In 2020 (the most recent year of record), the Minto Mine produced 8,089 tonnes of copper from the milling of 629,077 tonnes of ore. Mill tailings are deposited into both the Main Pit Tailings Management Facility and the Area 2 Pit Tailings Management Facility (Figure 1-2). Mine-impacted seepage from the Dry Stack Tailings Storage Facility (DSTSF) and under the Mill Valley Fill Expansion (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 1-2). 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 south-east of the WSP (Figure 1-2).

Minto Creek and McGinty Creek are receiving environments for Minto Mine and both have been previously characterized in numerous reports. These previous reporting initiatives are summarized in Section 1.2. This report provides updates to the water quality characterizations of both Minto and McGinty Creek stations and for key mine site water management and monitoring stations, and includes monitoring results to May 2021. Methods used in the evaluation of water quality data are summarized in Section 2 and results which form the basis of the characterization of water quality for Minto Creek and McGinty Creek are provided in Section 3.

1.1 WATER MANAGEMENT HISTORY

Minto constructed, commissioned and operated the Minto Mine under the water management plan and restrictions in the initial project Water Use Licence, QZ96-006. Extremely low effluent quality standards (EQS) – for copper in particular – and low precipitation in 2006 and 2007 led to no effluent discharge from the site. Minto had begun test work and planning to support a licence amendment application to revise the water management strategy – including discharge standards – in 2008, when exceptional summer precipitation led to an inevitable discharge of inventory water that did not meet current EQS. Minto applied for and received an Emergency WUL amendment to release water in August and September of 2008. Minto did so, releasing 350,000m3 of water from the Pit and Water Storage Pond over 35 days.

The Yukon Territory's unusually high precipitation of the 2008 summer continued throughout the 2008/2009 winter and snow pack measurements taken in February 2009 at the Minto Mine were at least 50% above average (70% in some locations). As a result of this and unusually high spring temperatures, the Minto Mine experienced a more voluminous freshet than normal in early May 2009 and diverted all run-off into the WSP and Pit in order to avoid non-compliant discharge. Following 2009 freshet the WSP contained 300,000 m3 of water and the Pit contained 700,000 m3. On application from Minto, the Water Board determined the existence of an emergency and granted an amendment to the WUL on June 26, 2009 authorizing Minto to discharge up to 300,000 m3 of water from the WSP and the Pit, provided such water met, at a minimum, MMER standards. Minto discharged this water between June 26 and August 6, 2009. In August 2009, Minto received an Inspector's direction from Yukon

Government to reduce the inventory of water in the Main Pit for geotechnical reasons. Again, Minto applied for and received an emergency amendment to the WUL and discharged water to Minto Creek between August 13 and October 30, 2009.

Following this event, Minto commissioned a study to evaluate options for implementing a permanent water treatment plant at the mine. Shortly after the completion of the water treatment evaluation, Minto commissioned detailed design, procurement, and construction of a water treatment plant. The water treatment plant installed at Minto in 2010 was designed to remove suspended solids and dissolved metals; in particular, copper and cadmium. The design was based on meeting effluent quality limits in effect at the time (Water Use Licence QZ96- 006 Amendment 6). The total copper concentration limit of 0.01 mg/L was the primary water treatment challenge.

In June 2010, Minto applied for amended effluent quality standards. When Amendment 7 of the Water Use Licence came into effect in March 2011, Minto completed an evaluation of water treatment technologies that would be suitable for producing effluent that would meet the new effluent quality limits. The water treatment evaluation concluded that the main water treatment challenges would be to meet the selenium, nitrate and (to a lesser extent) nitrite limits specified in Amendment 7 (0.003 mg/L, 7.65 mg/L and 0.15 mg/L, respectively). Minto's existing plant would not be effective at removing these parameters.

In 2012, two reverse osmosis (RO) trains capable of handling 2,500 m3/day per train were added to the treatment process downstream of the existing clarification and filtration units, for treating nitrate and selenium, based on water quality limits received in the Water Use Licence Amendment 7. Treated effluent from the RO units may also be amended, when necessary, with sodium bicarbonate to adjust the pH and add salinity and alkalinity. The RO process removes 95–99% of all constituents in the feed water. The feed water for the RO unit is the effluent from clarification and filtration unit, which is operated as a pre-treatment step.

In 2014, Minto submitted an amendment application for the Phase V/VI Expansion Project, which included operational downstream water quality objectives (WQO) and revised EQS. These WQO and EQS were included in Amendment 8 (August 2015) and are the regulatory benchmarks currently in place for the project.

These water management and effluent discharge milestones are important in understanding the Minto site and receiving environment water quality, as presented and interpreted in this report.

1.2 PREVIOUS WATER QUALITY CHARACTERIZATION REPORTING

1.2.1 Minto Creek

Minnow Environmental Inc. (Minnow) first characterized background water quality of Minto Creek to the end of 2008 within the report entitled Evaluation of the Background Water Quality of Minto Creek and Options for the Derivation of Site Specific Water Quality Objectives (Minnow 2009). In 2010, Minnow prepared the Characterization of Baseline and Operational Water Quality of Minto Creek including water quality results to the end of 2009 (Minnow 2010). The Minnow 2009 evaluation report focused on defining background concentrations of key metals to represent Minto Creek as a whole and for potential application as site-specific water quality objectives in lower Minto Creek (Minnow 2009). The Minnow 2010 report characterized water quality for discrete time intervals of relevance to the mine (Minnow 2010). In 2014, Access Consulting Group (ACG) and Minnow worked in conjunction to update the water quality characterization for Minto Creek (including data collected between 2005 and 2012). The most recent report provided an update to the 2014 characterization of Minto Creek water quality and included January 2005 to December 2015 monitoring data. This update also included a dedicated evaluation of background water quality data, which was commissioned to support the development of post-closure water quality objectives, an initiative that was undertaken as a collaboration with Selkirk First Nation representatives in the Bilateral Technical Working Group. The report Background Water Quality of Lower Minto Creek for Application in the Derivation of Post-Closure Water Quality Objectives was issued in 2016 (Minnow, 2016). The pre-operational water quality characterization for Minto Creek has not been updated from that which was provided in Minnow's 2016 report. This characterization report focuses on updates to the operational period (with and without mine discharge).

1.2.2 McGinty Creek

Access Consulting Group (ACG) and Minnow Environmental Inc. prepared an initial baseline water quality characterization report for McGinty Creek in 2013, which included water quality data collected between May 2009 and July 2012 (ACG, 2013). In 2016, ACG prepared an update to the initial characterization report with the inclusion of additional water quality data collected between July 2012 and December 2015.

Activity within the upper McGinty watershed consisted of surface exploration between 2008 and 2009. Road construction and pit stripping started on August 5th, 2015, when water use license QZ14-031 was issued, allowing mining of the Minto North open pit, which was completed on October 1, 2016. During this pit development period, Minto North pit water was collected and trucked to the Main Pit Tailings Management Facility (MPTMF) within the Minto

Creek catchment area and managed with the mine water management systems. Following completion of open pit mining at Minto North in 2016, water has been allowed to accumulate in the pit lake. Water quality monitoring in the McGinty Creek catchment is ongoing as required under WUL QZ14-031. Where relevant, McGinty Creek data are analyzed for the pre-operations period (May 2009 to July 2015), operations period (August 2015 to December 2016) and post-operations period (January 2017 to May 2021).

Figure 1: Project Location

Figure 2: Mine Site Facilities

2 METHODS

Section 2 presents water quality sampling locations, steps followed for water quality data collection and handling, and methodology for data interpretation.

2.1 MONITORING STATION ORGANIZATION

Minto monitors water quality at several locations on the mine site and in the receiving environment downstream of mining operations. Key monitoring stations were selected for inclusion in this characterization of water quality, and were organized into four distinct groupings:

- Minto Mine Site (Section 2.1.1);
- Minto North Pit (Section 2.1.2);
- Minto Creek (Section 2.1.3); and
- McGinty Creek (Section 2.1.4).

2.1.1 Minto Mine Site

This report summarizes the water quality for eleven monitoring stations around the Minto Mine Site including W8, W8A, W12, W15, W16, W17, W35, W45, W51, W55 and W62. For ease of discussion and presentation of results, these stations are further divided into two groupings: the “upper mine site” and “lower mine site”. The Minto Mine Site stations and groupings are described in Table 2-1 and shown in Figure 2-1. Water quality is monitored at many more locations on the Minto site, but these ten stations are the most critical with respect to decisions regarding the conveyance, storage, and treatment of site water.

Table 2-1: Minto Mine Monitoring Station Locations

Station	Description / Location
Upper Mine Site	
W12	Main Pit
W15	Minto Creek, d/s of Southwest Waste Rock Dump
W35	Inflow to Tailings Diversion Ditch
W55	Outflow of Tailings Diversion Ditch
W45	Area 2 Pit Stages 1 & 2
W51	Area 2 Pit Stages 3 & 4
Lower Mine Site	
W8	Dry Stack Tailings Storage Facility drainage, west
W8A	Dry Stack Tailings Storage Facility drainage, east
W16	Water Storage Pond
W17	Sump at toe of Water Storage Pond Dam
W62	Sump at toe of Mill Valley Fill Extension

2.1.1.1 2.1.1.1 Upper Mine Site

The upper mine site grouping consists of the W12, W15, W35, W45, W51 and W55 stations described in detail below.

The Main Pit (W12) has been used as the reservoir for any site water that could not be directly discharged. Given the water management constraints at the site (effluent and water quality standards), the Main Pit has received a significant influx of site water each year and has carried an inventory of runoff and impacted water each year since 2007. The W12 monitoring water quality data determine ongoing site water treatment.

Station W15 is a key water collection point downstream of the Southwest Waste Dump (SWD). Runoff and seepage water currently collects at W15 in a sump and then is conveyed to the Main Pit for treatment (if required) or off site for discharge if appropriate. Monitoring of the water quality at this location determines the fate of this runoff and provides an indication of altered seepage quality from the SWD.

W35 is the current monitoring station at the south end of the Tailings Diversion Ditch (TDD). It receives runoff from the Ridgetop exploration areas, the exploration camp and the airstrip, but the majority of the W35 catchment is undisturbed. The quality of this water determines its ultimate storage facility, and as such monitoring at this location is of importance to site water managers. W55 is at the north end/outlet of the diversion ditch.

W45 is historic monitoring station for Stages 1 & 2 of the Area 2 Pit. W51 was originally the monitoring station for Stages 3 and 4 of the pit complex but is now the primary monitoring station for the Area 2 Pit since water levels rose to a point where both sections of the pit lake merged in September 2020. Water in this pit is a collection of local surface runoff, underground mine water, groundwater, Main Pit water, and tailings supernatant.

2.1.1.2 Lower Mine Site

The lower mine site grouping consists of the W8, W8A, W62, W16 and W17 stations described in detail below.

Stations W8 and W8A are historic monitoring locations for seepage from the Dry Stack Tailings Storage Facility (DSTSF). These two sites were monitored weekly until W8 was destroyed in 2014 due to the construction of the MVFE and W8A went dry in 2019.

W62 is a collection sump at the toe of the MFVE and replaced W37 which was buried by the expansion of the MVFE. Contributors to this collection point include subsurface drainage from the DSTSF, the Mill Valley Fill and extension, and other local groundwater contributions.

Station W16 is the Water Storage Pond (WSP). This important site water management feature accepts water from all site diversions and drainage, except for Water Treatment Plant effluent or other directly discharged runoff (although each of these is often combined with WSP water prior to discharge.) Results from monitoring at Station W16 determine the WSP's fitness for discharge, or alternatively any requirements to withhold or further treat the WSP water. W17 is sump at the toe of the WSP dam which collects and returns any seepage from the WSP.

Figure 2-1: Mine Site Monitoring Station Locations

2.1.2 Minto North Pit

The Minto North Pit is located at the northernmost tip of the mine site (Figure 2-1). Station MN was established with the initiation of the mining activities in the Minto North Pit (August 2015). Water quality data from the Minto North Pit are considered in isolation since the pit does not discharge at present and is not anticipated to discharge during the operational period.

2.1.3 Minto Creek

Several water quality stations are monitored on Minto Creek during the operational period. Data from four of these monitoring stations are provided in this report: W50, W3, MC1, and W2. These stations are described in Table 2-2 and their location shown in Figure 2-2. These stations are all on the ‘mainstem’ of Minto Creek.

Table 2-2: Minto Creek Monitoring Station Locations

Station	Description / Location
W50	Minto Creek, approximately 50m downstream of toe of WSP dam
W3	Downstream of Water Storage Pond dam, MMER Final Discharge Point (Flume) – Effluent
MC1	Receiving Environment station upstream of the canyon fish barrier on Minto Creek.
W2	Lower Minto-Creek at Road Crossing – Receiving Environment station in reach with documented fisheries usage.

W50 is located downstream of the inflow of the treated water and is a point of compliance for EQS as outlined in WUL QZ14-031 (August 5th, 2015). EQS are presented and discussed in further detail in Section 2.3.

Station W3– located downstream of the Water Storage Pond dam – is the mine effluent monitoring and compliance point per the Metal Mining Effluent Regulations (MMER).

Station W2 is the lowermost Minto Creek receiving environment monitoring location before the confluence with the Yukon River, and is the “WQO Station” designated in the Water Use Licence QZ94-031 during the period when flow is encountered at stations W15 and W35 (see Section 2.3). Both W2 and W3 have been monitored regularly since 2005.

Station MC1 in Minto Canyon serves as a comparison monitoring point between W3 and W2 and began regular monitoring in 2010.

Four additional stations (W6, W7, C4 and C10) situated on tributaries to Minto Creek are monitored regularly or semi-regularly. The data for these stations are not included in this reporting update as they were a component of the Minto Creek background water quality evaluation in 2016 and are included in Minnow Environmental Inc. (2016).

For the most part, sampling occurs during the open water season between April and October. Minto Creek, like most small creek systems in the region, freezes entirely during the winter months with only periodic and localized flow persisting in some locations due to groundwater discharge (e.g. station W3). Minto Creek can also be dry at W2 in summer months during prolonged periods without precipitation.

The Minto Creek water quality characterization is divided into pre-mining (January 2005 to March 31, 2006) and operational (April 1, 2006 to December 31, 2016) periods. Monitoring results from the pre-mining period were compiled and included in the Minto Creek background water quality evaluation in 2016 and are reported in Background Water Quality of Lower Minto Creek for Application in the Derivation of Post-Closure Water Quality Objectives report by Minnow Environmental Inc. (2016). This data evaluation was developed in collaboration with technical representatives from Selkirk First Nation through Minto and SFN's Bilateral Technical Working Group as the basis for representing background (non-degraded) water quality, so this data set, including the pre-mining results, has not been updated or re-evaluated.

The Minto Creek operational phase data are further differentiated by grouping data from periods when the mine was discharging effluent, and periods when there was no mine discharge. Operational phase periods with mine discharge to Minto Creek included:

- August 26 to September 30, 2008;*
- June 26 to August 6, 2009;*
- August 13 to October 30, 2009;*
- July 14 to October 27, 2010;
- April 16 to May 11, 2012;
- April 20 to May 22, 2013;
- April 3 to May 26, 2014;
- December 8 to December 16, 2014;
- April 3 to June 1, 2015;
- April 8 to May 6, 2016;
- May 15 to Jun 11, 2016;
- June 13 to June 26, 2016;
- July 7 to Oct 25, 2016;
- May 1 to June 26, 2017;
- July 11 to July 13, 2017;
- July 26 to August 5, 2017;
- May 1, 2018;

- June 8 to July 6, 2018;
- July 11, 2018;
- July 16 to July 18, 2018;
- August 10 to August 12, 2018;
- August 27 to August 31, 2018; and
- October 8 to October 14, 2020.

*Note that discharge during the first three effluent discharge periods was through emergency amendments to the WUL, as described in Section 1.1.

These periods are illustrated for reference on the data plots in Section 3.3.

Figure 2-2: Minto Creek Monitoring Station Locations

2.1.4 McGinty Creek

McGinty Creek water quality was monitored monthly by ACG from May 2009 until July 2012 and has since been monitored monthly by Minto Mine Environment Department staff.

Water quality is monitored at five stations in the McGinty Creek watershed, described in Table 2-3 and shown in Figure 2-3. Water quality results for McGinty Creek stations are presented and discussed in two groups:

1. East arm of McGinty Creek (MN-1.5 and MN-2.5) and MN-4.5; and
2. West arm of McGinty Creek (MN-0.2 and MN-0.5).

The east arm of McGinty Creek is considered the 'exposure tributary' as it originates downgradient of the Minto North deposit where the Minto North pit is located, while the west arm of McGinty Creek is considered the 'reference tributary'. It is important to note that no discharge from the Minto North Pit to McGinty Creek (or elsewhere) has occurred as of the time of writing (January 2018) and no future discharge is anticipated during the operational period.

Table 2-3: McGinty Creek Monitoring Station Locations

Station	Description / Location
East Arm of McGinty Creek	
MN-1.5	Upper east arm of McGinty Creek downstream of the Minto North deposit
MN-2.5	East arm of McGinty Creek just upstream of confluence with the west arm
MN-4.5	Lower mainstem McGinty Creek near confluence with Yukon River
West Arm of McGinty Creek (Reference Stations)	

MN-0.2	Upper west arm of McGinty Creek
MN-0.5	West arm of McGinty Creek just upstream of the confluence with the east arm

Monitoring at the upper reference station MN-0.2 was suspended between June 2009 and April 2011, which explains in part the lower total number of samples collected at this station. Similar to Minto Creek, McGinty Creek typically freezes in the winter months with little to no flow observed at all monitoring stations during this time.

2.2 DATA COLLECTION, HANDLING AND QUALITY ASSESSMENT

Water quality data were obtained from Minto Mine with the understanding that results have been subject to appropriate quality assurance and quality control procedures so that they may be used in the characterization of Minto and McGinty Creeks.

All water quality data are imported and managed in an EQWin database. This continually growing database allows for the assessment of temporal water quality trends for specific parameters of interest, although it is noted that higher detection limits for some parameters limit the value of some of the older data.

An assessment of data outliers has been carried out for water quality data from monitoring stations from May 2005 to May 2021. The purpose of the outlier assessment was to identify potentially erroneous results (e.g., incorrectly transcribed from field notes or laboratory certificates of analysis [COA]) or results that were not representative of the water quality present at a particular site at a particular time (e.g., substrate disturbed in sample collection). The methodology for identifying outliers was adopted from Minnow (2016), as those methods were developed in collaboration with SFN through the Bilateral Technical Working Group. The methodology is summarized below.

The following parameters were examined in the outlier screening process. These are the parameters which have either an associated EQS and/or WQO or are important for the interpretation of other water quality conditions (e.g., toxicity modification):

- pH, conductivity, temperature, turbidity;
- Total suspended solids (TSS), TDS, hardness, alkalinity, chloride, fluoride, sulphate, dissolved organic carbon (DOC);
- Nitrate, nitrite, and ammonia;
- Total and dissolved aluminum, arsenic, cadmium, chromium, copper, iron, lead, molybdenum, nickel, selenium, silver and zinc;
- Radium-226; and
- Total and weak acid dissociable (WAD) cyanide.

First any sample entries in the database that were a replicate of another entry (i.e., erroneously entered twice or duplicated) were identified and removed to avoid biasing any entries. The data were then screened for results that returned very high detection limits. For some analytes, older analyses would have detection limits that were elevated relative to detection limits from more recent analyses, such that the detection limit of older analyses were higher than more recent measured results. These high detection limit results would then bias the dataset containing lower concentration measured data. Therefore, detection limits that exceeded the upper quartile of measured data (i.e., >75%) were removed. The remaining detection limit data were converted to half the detection limit. The lower and upper quartile and the interquartile range (IQR; the difference between the upper and lower quartile of the dataset) were then calculated for each analyte. Outliers for an analyte dataset were considered to be results that were either less than the lower outlier boundary or above the high outlier boundary such that:

Low Outlier Boundary = Lower Quartile – 3*IQR;

and High Outlier Boundary = Upper Quartile + 3*IQR;

As the water quality data exhibit a log-normal distribution, the outlier screening was performed on the regular dataset and a log10-transformed dataset (note that since pH is a log function, the pH data were anti-log transformed). A result was only deemed an outlier if both the untransformed and log10-transformed value met the outlier criteria.

Outliers were identified and reviewed for comparison of outlier result with original Certificates of Analysis (COA) and/or field notes. Where obvious errors were identified (i.e., transcription, incorrect units reported, etc.), erroneous results were replaced with the correct values. Where review of field notes indicated problematic sampling conditions or instruments, or professional judgement indicated an erroneous result (e.g., dissolved element concentration significantly greater than the corresponding total, unfiltered concentration), the outlier result was removed from the dataset. Most “outliers” were kept in the datasets as either the result was confirmed as “real”, a typo correction was made, or there was insufficient evidence to justify their removal. The removed outliers for parameters focussed on this report are summarized in Table 2-4.

Table 2-4: Summary of removed outlier water quality data

Station	Date	Parameter	Concentration (mg/L)	Rationale for Removal
MC1	17-Jul-18	Dissolved Cadmium	0.0000301	Significantly higher than total concentration.
MN	25-Sep-18	Dissolved Zinc	0.0170	Significantly higher than total concentration.
MN-0.2	26-May-18	Total Suspended Solids	395	Significantly higher than duplicate concentration.
MN-0.2	11-Oct-20	Dissolved Cadmium	0.0000142	Significantly higher than total concentration.

MN-0.2	11-Oct-20	Dissolved Copper	0.0106	Significantly higher than total concentration.
MN-0.5	7-Jul-17	Dissolved Arsenic	0.00089	Poor sampling conditions
MN-0.5	29-Apr-19	Dissolved Selenium	0.000372	Significantly higher than total concentration.
MN-1.5	19-May-19	Dissolved Cadmium	0.0000144	Significantly higher than total concentration.
MN-1.5	16-May-21	Field pH	5.21	Typo Assumed
MN-2.5	12-Oct-19	Dissolved Cadmium	0.000109	Significantly higher than total concentration.
MN-2.5	12-Oct-19	Dissolved Copper	0.0122	Significantly higher than total concentration.
MN-2.5	12-Oct-19	Dissolved Zinc	0.0088	Significantly higher than total concentration.
MN-4.5	19-May-21	Dissolved Selenium	0.000426	Significantly higher than total concentration.
W12	30-Jul-17	Field pH	5.73	Typo Assumed
W12	24-Jun-20	Dissolved Organic Carbon	160	Poor sampling conditions
W12	24-Jun-20	Dissolved Lead	0.000338	Poor sampling conditions
W15	9-Apr-18	Dissolved Selenium	0.0157	Poor sampling conditions
W17	24-Apr-18	Total Suspended Solids	37.3	Poor sampling conditions
W17	9-Apr-19	Dissolved Cadmium	0.0000745	Significantly higher than total concentration.
W17	23-Dec-19	Dissolved Iron	0.309	Pump seal was leaking throughout this period.
W17	30-Dec-19	Dissolved Zinc	0.0187	Pump seal was leaking throughout this period.
W17	6-Jan-20	Dissolved Zinc	0.0236	Pump seal was leaking throughout this period.
W17	13-Jan-20	Dissolved Zinc	0.0176	Pump seal was leaking throughout this period.
W17	26-Jan-20	Dissolved Iron	1.47	Pump seal was leaking throughout this period.
W17	3-Feb-20	Dissolved Iron	1.04	Pump seal was leaking throughout this period.
W17	10-Feb-20	Dissolved Cadmium	0.0000516	Pump seal was leaking throughout this period.
W17	17-Feb-20	Dissolved Iron	1.20	Pump seal was leaking throughout this period.
W17	24-Feb-20	Dissolved Iron	1.58	Pump seal was leaking throughout this period.
W17	2-Mar-20	Dissolved Iron	1.48	Pump seal was leaking throughout this period.
W17	16-Mar-20	Dissolved Iron	1.73	Pump seal was leaking throughout this period.
W17	23-Mar-20	Dissolved Iron	0.171	Pump seal was leaking throughout this period.
W17	30-Mar-20	Dissolved Iron	0.104	Pump seal was leaking throughout this period.
W17	6-Apr-20	Dissolved Iron	0.19	Pump seal was leaking throughout this period.
W17	13-Apr-20	Dissolved Iron	0.111	Pump seal was leaking throughout this period.
W17	20-Apr-20	Dissolved Cadmium	0.000038	Pump seal was leaking throughout this period.
W17	1-Jun-20	Dissolved Cadmium	0.0000325	Significantly higher than total concentration.
W17	21-Dec-20	Dissolved Zinc	0.0534	Significantly higher than total concentration.
W3	12-Mar-19	Dissolved Zinc	0.0184	Poor sampling conditions
W3	15-Oct-19	Dissolved Cadmium	0.0000759	Significantly higher than total concentration.
W3	12-Nov-19	Dissolved Cadmium	0.0000507	Significantly higher than total concentration.
W3	22-Dec-20	Dissolved Zinc	0.0478	Significantly higher than total concentration.
W35	20-Jun-18	Dissolved Zinc	0.0280	Significantly higher than total concentration.
W35	13-Apr-20	Dissolved Molybdenum	0.0231	Poor sampling conditions
W35	13-Apr-20	Dissolved Selenium	0.00278	Poor sampling conditions
W35	20-Apr-20	Total Suspended Solids	3770	Poor sampling conditions
W45	9-Mar-20	Total Suspended Solids	66300	Poor sampling conditions
W45	13-Apr-20	Total Suspended Solids	190000	Poor sampling conditions
W51	9-Mar-18	Nitrate (N)	34.8	Poor sampling conditions
W55	6-Jun-19	Dissolved Lead	0.00247	Significantly higher than total concentration.
W62	4-Jan-17	Dissolved Lead	0.000092	Significantly higher than total concentration.
W8A	18-Apr-17	Dissolved Lead	0.00102	Significantly higher than total concentration.
W8A	3-Jul-17	Dissolved Silver	0.00251	Significantly higher than total concentration.
Station	Date	Parameter	Concentration (mg/L)	Rationale for Removal

2.3 WATER QUALITY STANDARDS AND OBJECTIVES

Water quality performance (effluent and receiving environment) for Minto Mine is governed by both the Type A Water Use Licence QZ14-031 and the federal Metal Mining Effluent Regulations (MMER). The Water Use Licence is typically more restrictive in terms of effluent parameter concentrations and sets EQS for compliance comparison at “Effluent Points”. Effluent points include: W16a, W17, W50 and WTP. The focus of comparison for effluent water quality and compliance standards in this report is Station W50 vs. the current WUL QZ14-031 EQS (Table 2-5) and Station W3 vs. the MMER guidelines (Table 2-6).

Table 2-5: Effluent Quality Standards for Site W50

Parameter	Effluent Standards
Total Suspended Solids, excluding March, April and May, mg/L	15
Total Suspended Solids, March, April and May Only, mg/L	30
pH, pH Units	6.0 – 9.0
Ammonia - N, mg/L	0.75
Nitrite - N, mg/L	0.18
Nitrate - N, mg/L	27.3
Aluminum (dissolved), mg/L	0.3
Arsenic (dissolved), mg/L	0.015
Cadmium[1] (dissolved), µg/L	$3*e^{(0.736(\ln(hardness)-4.943)}$
Chromium (dissolved), mg/L	0.003
Copper (dissolved), mg/L (when [DOC] @ W2 >10 mg/L)	0.06
Copper (dissolved), mg/L (when [DOC] @ W2 ≤10 mg/L)	0.039
Iron (dissolved), mg/L	3.3
Lead (dissolved), mg/L	0.012
Molybdenum (dissolved), mg/L	0.219
Nickel (dissolved), mg/L	0.33
Silver (dissolved), mg/L	0.0003
Selenium (dissolved), mg/L	0.006
Zinc (dissolved), mg/L	0.09

Table 2-6:MMER Authorized Limits of Deleterious Substances for Site W3

Parameter	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Total Suspended Solids, mg/L	15	22.5	30
Arsenic (total), mg/L	0.5	0.75	1.0
Copper (total), mg/L	0.3	0.45	0.6
Cyanide, (total), mg/L	1.0	1.5	2.0
Lead (total), mg/L	0.2	0.3	0.4
Nickel (total), mg/L	0.5	0.75	1.0
Zinc (total), mg/L	0.5	0.75	1.0
Radium 226 (total), Bq/L	0.37	0.74	1.11

The Operations Adaptive Management Plan (AMP; Minto 2017) includes performance thresholds for surface water quality in both Minto Creek and McGinty Creek based on the parameters that comprise the EQS and WQO lists in WUL QZ14-031. The AMP thresholds – based primarily on WQO – are evaluated at WQO Stations upstream of the confluence with the Yukon River. For Minto Creek, the WQO Station is defined as:

- Station W2 during the period when flow is encountered at stations W15 and W35; or
- Station W50 during the period when flow is not encountered at stations W35 and W15.

The Minto Creek WQO are presented in Table 2-7 below. Since the issuance of QZ14-031 in August of 2015, there has predominantly been no discharge of effluent when flow is not encountered at stations W35 and W15 (winter). Between October 11th and 26th 2016, W50 was used as the WQO station as there was no flow at W15/W35 due to frozen conditions and discharge occurred. Aside from this date range, there was no discharge of effluent when flow was not encountered at W35 and W15. As such, this report uses Station W2 as the WQO Station for evaluation purposes.

Table 2-7: Water Quality Objectives for Minto Creek Site W2

Parameter	Water Quality Objectives
pH, pH Units	6.0 - 9.0
Ammonia - N, mg/L	0.25
Nitrite - N, mg/L	0.06

Nitrate - N, mg/L	9.1
Aluminum (dissolved), mg/L	0.1
Arsenic (dissolved), mg/L	0.005
Cadmium[1] (dissolved), µg/L	$e^{(0.736(\ln(\text{hardness})-4.943)}$
Chromium (dissolved), mg/L	0.001
Copper (dissolved), mg/L (when [DOC] @ W2 >10 mg/L)	0.02
Copper (dissolved), mg/L (when [DOC] @ W2 ≤10 mg/L)	0.013
Iron (dissolved), mg/L	1.1
Lead (dissolved), mg/L	0.004
Molybdenum (dissolved), mg/L	0.073
Nickel (dissolved), mg/L	0.11
Silver (dissolved), mg/L	0.0001
Selenium (dissolved), mg/L	0.002
Zinc (dissolved), mg/L	0.03

Site MN-4.5 is the WQO station on McGinty Creek as part of the AMP (Minto, 2017). The WQO for individual data points at MN-4.5 are presented in Table 2-8 and used for discussion of water quality data in McGinty Creek at MN-4.5.

Table 2-8: Water Quality Objectives for McGinty Creek Site MN-4.5, AMP Individual Data Point Evaluator

Parameter	AMP IDPE Threshold
TSS, mg/L	269
Ammonia - N, mg/L	0.12
Nitrite - N, mg/L	0.05
Nitrate - N, mg/L	0.232
Aluminum (dissolved), mg/L	0.135
Arsenic (dissolved), mg/L	0.00061
Cadmium (dissolved), mg/L	0.000041
Chromium (dissolved), mg/L	0.001
Copper (dissolved), mg/L	0.0035
Iron (dissolved), mg/L	0.403
Lead (dissolved), mg/L	0.00020

Molybdenum (dissolved), mg/L	0.001
Nickel (dissolved), mg/L	0.0018
Silver (dissolved), mg/L	0.000020
Selenium (dissolved), mg/L	0.00020
Zinc (dissolved), mg/L	0.0052

2.4 INTERPRETATION OF WATER QUALITY DATA

Interpretation of water quality data incorporated summary statistics generated from complete water quality data sets and a discussion of parameters over time (i.e., identification of trends, seasonality, etc.) at each station. The parameters discussed included those stipulated in the EQS and WQO lists as well as additional physical parameters that aid in interpretation of results or derivation of an EQS/WQO (i.e., hardness, DOC). The statistical summaries for each parameter at each station include the following:

- Maximum detection limit (DL);
- Average;
- Count (total number of entries for a parameter);
- Minimum;
- Maximum;
- Percent below DL;
- Standard deviation;
- First quartile;
- Median; and
- Third quartile.

For stations W50, W2, and MN-4.5 for which EQS or WQO apply, the following statistics are also provided when applicable:

- Count above EQS/WQO; and
- Percent above EQS/WQO.

Plots were generated for each parameter for temporal discussions. Concentrations that were reported as less than DL were plotted as half the DL. For each group of locations, physical parameters, anions and nutrients are first discussed, followed by dissolved metal concentrations.

3 RESULTS AND DISCUSSION

For the discussion of water quality data, results are presented from monitoring locations in four groupings:

1. Minto Mine Site (Section 3.1);
2. Minto North Pit (Section 3.2);
3. Minto Creek (Section3.3); and
4. McGinty Creek (Section 3.4).

For the sites in each grouping, in situ and EQS/WQO-regulated anion (nitrate, nitrite) and nutrient (ammonia) parameters are discussed. Hardness and DOC that act as modifiers of metal toxicity are also discussed, along with metals that are regulated within Water License QZ14-031 (dissolved aluminum, arsenic, cadmium, chromium, copper, iron, lead, molybdenum, nickel, silver, selenium, and zinc). The full water quality dataset (excluding outliers) is presented in Appendix A.

3.1 MINTO MINE SITE

Discussion of water quality data on the Minto Mine property comprises results for sample stations in the upper mine site group (W12, W15, W35, W45, W51, W55) and lower mine site group (W8, W8A, W16, W17, W62) as described in Section 2.1.1. Examined parameters included those with designated EQS in Water License QZ14-031.

3.1.1 Upper Minto Mine Site

Upper Minto Mine Site station water quality is presented in discussed with respect to physical parameters and anion and nutrient concentrations in Section 3.1.1.1 and dissolved metals concentrations in Section 3.1.1.2.

3.1.1.1 Physical Parameters, Anions and Nutrients

Statistical summaries of physical parameters and anion and nutrient concentrations at sites W12, W15, W35, W45, W51 and W55 are presented in Table 3-1 through Table 3-6. TSS, field pH, nitrate, nitrite, ammonia, and sulphate data at each of the lower Minto Mine Site stations are presented in Figure 3-1 through Figure 3-6.

The pH of the upper mine site sampling locations has largely remained circumneutral to mildly alkaline over the period of record (Figure 3-2), with median pH ranging between 7.45 (site W51) to 7.78 (site W12 & W45). Temperature varied seasonally from -2.5 to 23 °C. Aside from the Main Pit (W12) and the Area 2 Pit (W45 & W51), the surface waters in the upper mine site were typically well oxygenated, with median oxygen content of 80% to 85% saturation. The flooded pits exhibited lower dissolved oxygen levels (median 41% and 61% respectively), which tended to vary seasonally such that dissolved oxygen was lowest over winter as ice cover restricted replenishment of oxygen to the underlying lake water that was consumed by indigenous microorganisms, whereas higher dissolved oxygen measurements were recorded during the ice-free months. Field conductivity was highest at the flooded pit sites (median 1050 and 1859 µS/cm for sites W12 and W51, respectively), with the highest measurements typically occurring during winter. The TDD sites (W35 and W55) had the lowest median conductivity (141 to 156 µS/cm).

Flowing water sites on Minto Creek (W15) and the TDD (W35 and W55) typically returned higher TSS values in April or May (Figure 3-1), likely caused by erosional mobilization of particulate material with higher flow rates caused by snowmelt; much lower TSS values were often observed throughout the rest of the year (median range of 4.2 to 5.75 mg/L). TSS concentrations in the pit lake sites did not show this same seasonality and had higher median concentrations than flowing water sites (7.5 to 22 mg/L).

The pit lake sites (W12, W45 and W51) had the highest median nitrogen species concentrations for the Upper Mine Site area, with median ammonia-N, nitrite-N, and nitrate-N, for W12 of 1.75, 0.4, and 9.28 mg/L, respectively; 2.7, 1.75, and 17.8 mg/L for W45, respectively; and 3.47, 1.6, and 6.12 mg/L for W51 (Table 3-1, Table 3-4, and Table 3-5; Figure 3-3 to Figure 3-5). These elevated nitrogen species concentrations likely reflect nitrogen residues from blasting activity. Nitrite-N and nitrate-N showed marked seasonality in Minto Creek at site W15 (Figure 3-3 and Figure 3-4), with concentrations highest in winter and lowest over summer/fall due to uptake by primary producers that are most active over summer/fall.

Median DOC concentrations ranged from 3.86 mg/L in the Area 2 Pit (W51; Table 3-5) to 27.1 mg/L at W55 in the TDD. Concentrations were generally highest in April/May when runoff from spring snowmelt likely flushed surface soils, leaching labile organic carbon that had accumulated over the previous summer/fall.

Sulphate concentrations were highest in the pit lakes (median 1170 mg/L and 312 mg/L at W51 and W12, respectively), with an increasing trend noted at all sites (Figure 3-6). Sulphate levels in Minto Creek (W15) displayed distinct seasonality, with the lowest concentrations observed during freshet in April/May followed by an increase over the year peaking in winter before declining again during spring due to snowmelt dilution.

Table 3-1: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W12

W12															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	182	196	192	197	164	168	160	184	82	177	172	175	181	37	177
Average	14.44	7.78	1123.745	7.89	10.09	59.19	139.9	17.961	1.098	503	2.41882	1.42508	17.373	12.97	0.0529
Minimum	<1.0	6.01	0.336	-0.2	0.38	3	-412.4	<0.50	0.012	0.88	<0.0050	<0.0050	<0.01	3.9	<0.01
Maximum	251	9	2632	20.5	531	134.5	276.9	40	3.20	1540	24	8.78	141	28.2	0.44
Percent of results below DL	14.8	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	2.9	1.7	1.1	0.0	49.2
Standard deviation	25.04	0.39	607.798	5.84	41.02	24.14	92.90	12.333	0.549	441.19	2.79221	1.98663	17.4626	6.31	0.0658
First quartile	3.42	7.57	616	2.7	4.99	43.82	105.7	4.6	0.658	141	0.52725	0.1335	9.28	9.23	<0.050
Median	7.5	7.82	1049.5	7	6.84	60.2	158.1	19	1.3	312	1.75	0.4	13.2	11.9	0.03
Third quartile	15.08	8.01	1565	13.3	8.63	75.6	189.8	29.425	1.4	834	3.505	1.885	19.3	16.1	<0.10

Table 3-2: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W15

W15															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	338	690	684	691	610	646	605	323	201	321	316	319	327	186	303
Average	14.96	7.72	425.1	6.69	9.66	78.56	143.75	4.644	0.1824	95.078	0.10798	0.09605	11.6745	20.99	0.0549
Minimum	<1.0	6.06	33.9	-2.5	0.09	0.7	-168.4	0.24	<0.010	<0.50	<0.0050	<0.0050	<0.01	3.2	<0.01
Maximum	370	9.95	1873	20.2	21.31	217.8	2133	100	1.60	1220	5.3	3.78	265	60.9	2.5
Percent of results below DL	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	2.2	7.0	6.3	1.2	0.0	28.1
Standard deviation	31.63	0.37	207.5	5.67	2.55	18.83	106.84	7.121	0.1696	106.999	0.31702	0.23257	19.4436	9.31	0.1471
First quartile	2.3	7.54	271.4	0.84	8.13	72.03	117.6	2.175	0.13	34.5	0.028	0.01925	3.525	15.02	0.025
Median	5.75	7.73	415.4	6.3	9.59	80	143.1	3	0.16	70.8	0.0597	0.0366	6.09	18.9	0.029
Third quartile	12.7	7.91	559	11.3	11.45	87.9	168.5	4.3	0.18	125	0.11	0.111	12.9	24.9	0.056

Table 3-3: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W35

W35															
	TSS	**Field pH**	**Field Conductivity**	**Temperature**	**Dissolved Oxygen**		**ORP**	**Chloride**	**Fluoride**	**Dissolved Sulphate**	**Ammonia-N**	**Nitrite-N**	**Nitrate-N**	**DOC**	**Total Phosphorus**
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	85	489	483	488	462	467	467	83	30	83	84	84	84	55	92
Average	22.18	7.736	200.2	5.4	14.51	83.3	143.8	2.242	0.106	28.913	0.0371	0.0259	8.933	24.53	0.0483
Minimum	<1.0	6.44	19.8	-0.1	0.08	0.6	-337.9	<0.50	0.062	<0.50	0.0059	0.0012	<0.020	2.78	<0.01
Maximum	465	9.9	1169	22.9	958	146.6	1320	12.3	0.17	297	0.303	0.335	90.8	52.2	0.534
Percent of results below DL	32.9	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	14.5	0.0	10.7	1.2	0.0	43.5
Standard deviation	67.47	0.383	166.4	4.8	58.08	14.31	75.80	2.617	0.022	51.859	0.0486	0.04478	16.6564	9.64	0.064
First quartile	<3.0	7.52	90.4	0.5	8.98	76	121.6	0.89	0.092	5.225	0.0137	0.0036	1.1075	19.9	0.025
Median	4.2	7.74	146.3	5	11.1	85.6	142.1	1.47	0.1	11.2	0.0207	0.01165	2.465	22.8	0.025
Third quartile	10.2	7.92	258.4	9.2	12.63	92	168.6	1.96	0.118	26.1	0.0323	0.02515	10.45	29.1	0.0488

Table 3-4: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W45

W45															
	TSS	**Field pH**	**Field Conductivity**	**Temperature**	**Dissolved Oxygen**		**ORP**	**Chloride**	**Fluoride**	**Dissolved Sulphate**	**Ammonia-N**	**Nitrite-N**	**Nitrate-N**	**DOC**	**Total Phosphorus**
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	71	65	65	65	63	63	65	71	34	71	71	71	71	13	71
Average	43.6	7.78	1331	7.4	7.1	58	74.4	22.56	1.73	950.6	5.71	2.4711	20.827	45.24	0.0491
Minimum	<1.0	6.78	0.6	-1.9	0.53	4	-424.3	0.96	0.19	78.2	0.072	<0.020	0.39	1.06	<0.01
Maximum	291	8.39	3303	22.2	19.32	137.6	267.8	44	2.20	2040	37	11.4	77.2	112	0.26
Percent of results below DL	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	1.4	0.0	0.0	62.0
Standard deviation	56.73	0.31	715.6	5.9	3.93	28.6	130.60	15.91	0.44	630.3	6.201	2.3703	15.8	40.75	0.0436
First quartile	9.45	7.63	842	2.8	4.03	35.8	8.5	4.3	1.65	411	2.7	0.466	9.11	15.2	0.025
Median	22.6	7.8	1041	4.7	6.1	55.3	85.8	28.5	1.8	593	4.24	1.75	17.8	25.9	<0.10
Third quartile	47.2	7.99	1785	12	10.36	78.9	173.6	37.85	1.98	1655	6.12	4.465	28.95	80.9	0.05

[a] Not applicable

Table 3-5: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W51

	W51													
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	26	21	22	22	22	22	22	26	2	26	25	26	26	4	26
Average	17.47	7.45	1705	10.9	5.57	50.3	157.5	17.55	1.21	1150	4.374	2.851	7.96	3.87	0.0755
Minimum	<3.0	6.47	509	1.3	0.62	4.7	-55.4	0.87	1.02	218	0.627	0.126	2.82	0.94	<0.050
Maximum	132	8.26	2191	22.1	15.89	127.2	263.2	27.4	1.40	1660	7.47	6.69	19	6.81	0.649
Percent of results below DL	19.2	0.0	0.0	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	88.5
Standard deviation	28.49	0.43	468	7.2	3.54	31.3	75.10	7.77	0.27	458	1.656	1.643	3.74	2.91	0.1206
First quartile	3.2	7.18	1565	5.8	3.14	25.8	160	16.6	1.12	1090	3.47	1.6	6.12	1.62	0.05
Median	7.9	7.55	1859	9.8	5.58	41.8	173.3	18.25	1.21	1170	4.75	3	7.3	3.86	0.05
Third quartile	14.48	7.67	2082	17.1	6.44	73.8	203.8	23	1.3	1537	5.6	3.84	8.6	6.11	0.05

[a] Not applicable

Table 3-6: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W55

	W55													
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	33	38	38	38	37	37	37	33	2	33	33	33	33	7	33
Average	7.82	7.58	166.3	5.6	9.77	77.01	156.4	1.277	0.149	23.519	0.021	0.00876	3.24332	34.3	0.0592
Minimum	1.3	6.11	41.3	0	4.67	37.2	96.3	<0.50	0.132	<0.30	0.0067	<0.0010	<0.0050	21.7	<0.050
Maximum	43.3	9	365.4	15.6	18.67	129.8	230.6	5.87	0.17	103	0.0819	0.144	20.9	59.6	0.169
Percent of results below DL	27.3	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.0	3.0	0.0	45.5	12.1	0.0	57.6
Standard deviation	9.63	0.47	90.8	3.5	3.02	20.3	29.20	1.059	0.023	26.415	0.0175	0.02482	6.30764	16.9	0.0489
First quartile	<3.0	7.3	97.5	2.9	7.07	58	140.2	0.55	0.14	5.16	0.0124	<0.0010	0.0349	23.2	<0.050
Median	4.5	7.56	151.1	5.8	10.23	83.5	153.6	1.15	0.149	14.9	0.0152	<0.0050	0.165	27.1	<0.050
Third quartile	8.2	7.81	191	7.5	11.84	91.3	177.1	1.75	0.157	27.1	0.0212	0.0066	2.61	42.8	0.077

[a] Not applicable

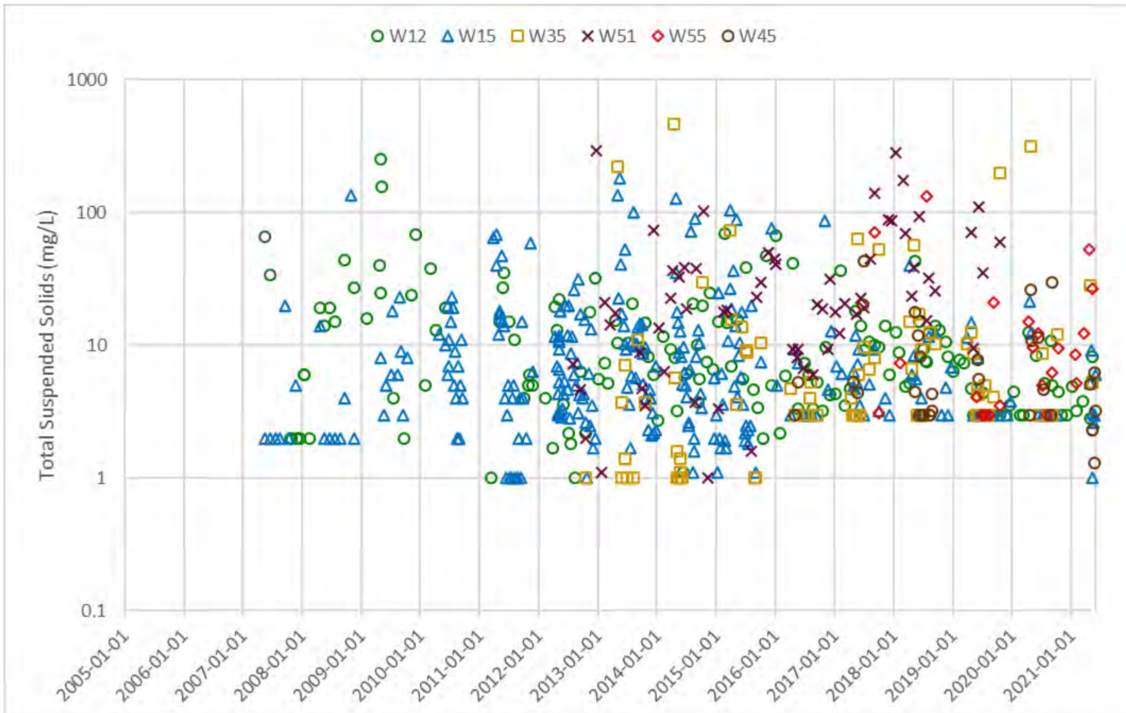


Figure 3-1: Concentrations of Total Suspended Solids at Upper Minto Mine Facility Monitoring Locations. Note Log Scale.

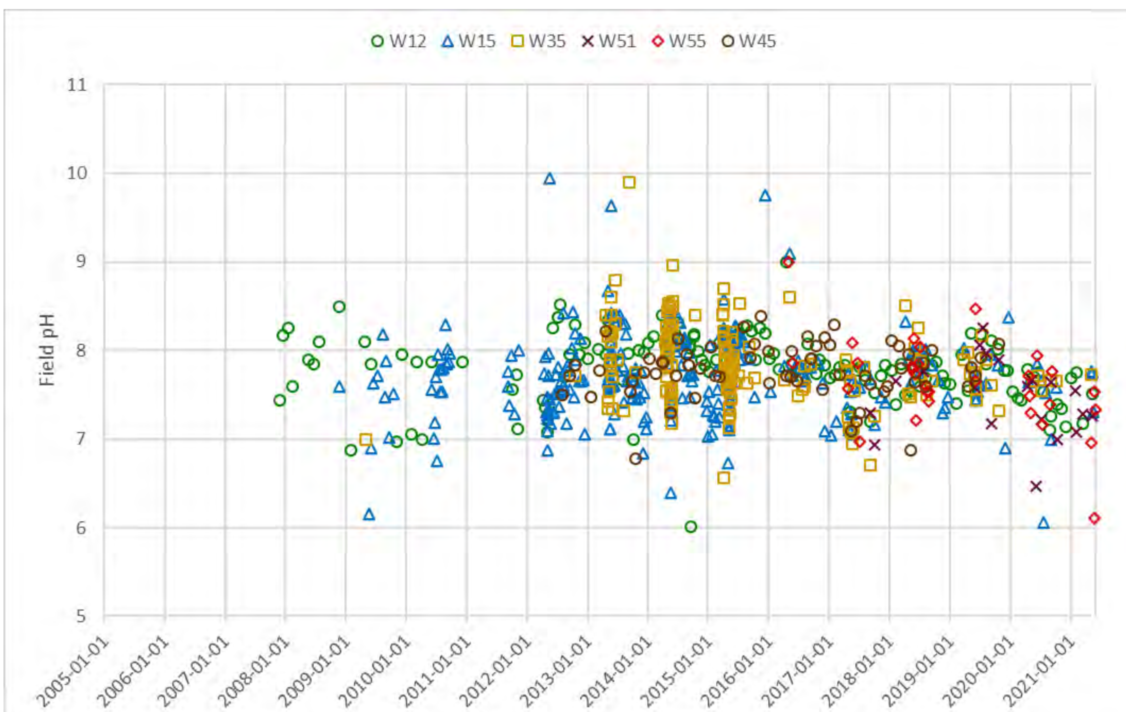


Figure 3-2: Field pH at Upper Minto Mine Facility Monitoring Locations.

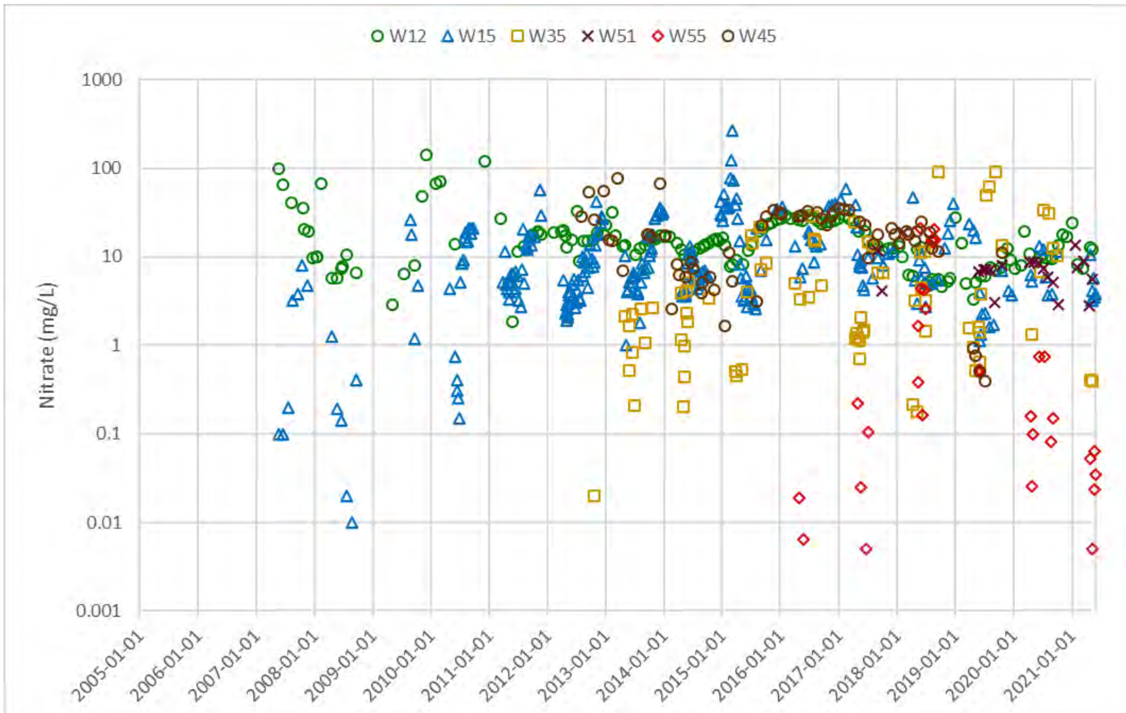


Figure 3-3: Concentrations of Nitrate (N) at Upper Minto Mine Facility Monitoring Locations. Note Log Scale.

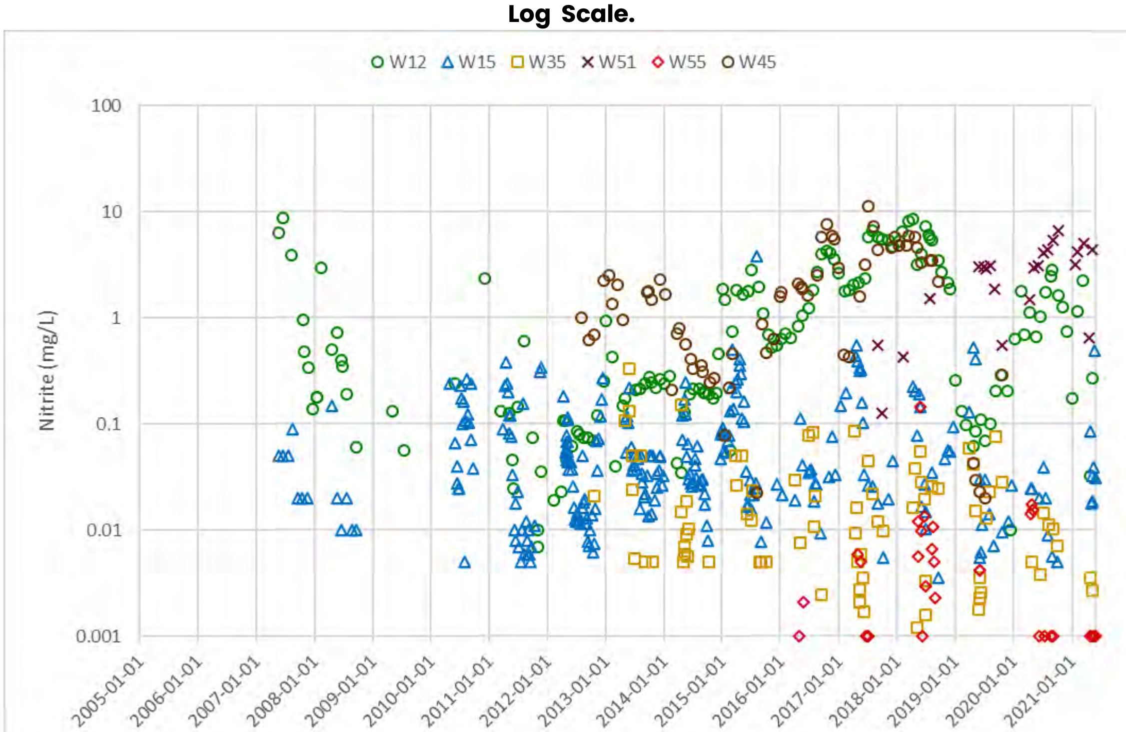


Figure 3-4: Concentrations of Nitrite (N) at Upper Minto Mine Facility Monitoring Locations. Note Log Scale.

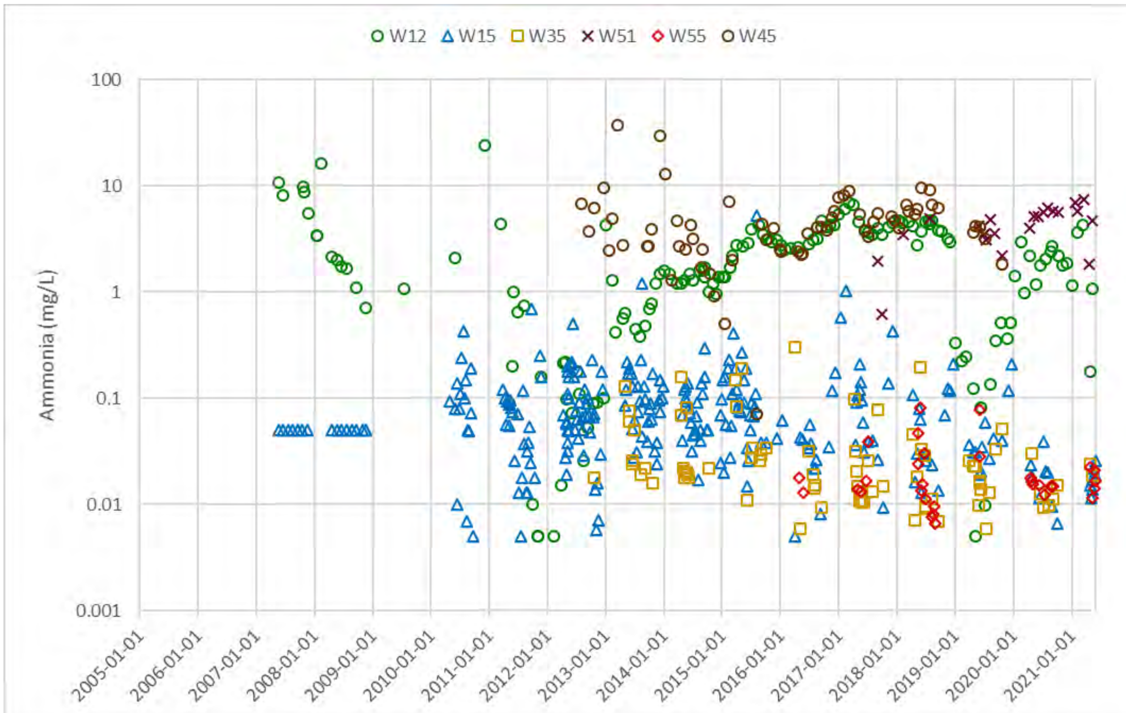


Figure 3-5: Concentrations of Ammonia (N) at Upper Minto Mine Facility Monitoring Locations. Note Log Scale.

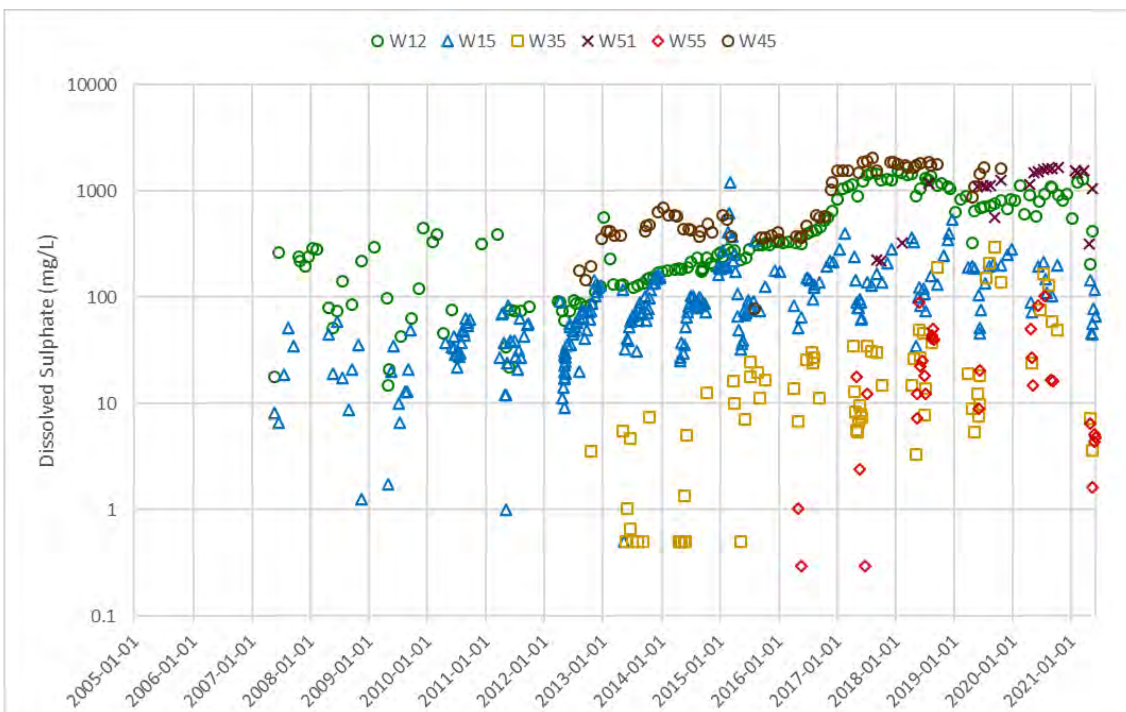


Figure 3-6: Concentrations of Dissolved Sulphate at Upper Minto Mine Facility Monitoring Locations. Note Log Scale.

3.1.1.2 Metals

Statistical summaries of dissolved metals concentrations at sites W12, W15, W35, W45, W51, and W55 are presented in Table 3-7 through Table 3-12. Dissolved metal concentrations at each of the upper Minto Mine Site stations are plotted in Figure 3-7 through Figure 3-18.

Dissolved hardness concentrations, which has a toxicity modifying effect on a number of metals (e.g., copper, cadmium, lead, nickel, zinc), were highest in the pit waterbodies (median 358 mg/L and 1170 mg/L at W12 and W51, respectively; Table 3-7 and Table 3-11). Although no seasonal variation was noted in the pit lakes, hardness levels displayed strong seasonal changes in Minto Creek (W15) and the TDD sites (W35, W55), where hardness concentrations were lowest in April/May due to dilution from snow meltwater, and increased over the remainder of the year, peaking in winter. This is consistent with the ephemeral nature of the South Diversion Ditch with groundwater from various up-gradient spring sources providing flow to the ditch outside of precipitation events and freshet-related flows.

Dissolved chromium, lead, and silver concentrations showed little variation since they were typically close to or below their respective detection limits (Table 3-7 to Table 3-12). Dissolved aluminum and iron concentrations were lowest in the pit lake sites (median 0.009 mg/L aluminum and 0.01 mg/L iron at W12; median 0.004 mg/L aluminum and 0.01 mg/L iron at W51), reflecting the low solubility of these elements at circumneutral pH and residence time for iron oxidation and precipitation. Median dissolved aluminum and iron concentrations were highest at W55 (0.046 mg/L) and W15 (0.217 mg/L), respectively. Indeed, elevated dissolved aluminum and iron concentrations were observed in both the Minto Creek (W15) and TDD (W35, W55) sites, perhaps maintained as soluble species via complexation with dissolved organic matter given the high DOC concentrations recorded at these sites.

Dissolved arsenic, cadmium, and zinc concentrations exhibited sporadic spikes in concentrations at most sites, but generally showed no seasonality and were often close to or below detection (Figure 3-8, Figure 3-9, and Figure 3-18). Between April 2013 and March 2015, dissolved cadmium (0.0001 to 0.0005 mg/L) and zinc (0.006 to 0.07 mg/L) concentrations were elevated relative to their baselines at site W45 (Figure 3-8 and Figure 3-18). Molybdenum and copper concentrations were also relatively elevated at W45 during this period (Figure 3-11 and Figure 3-14), as was sulphate. Indeed, molybdenum concentrations increased markedly in the Area 2 Pit (W45), from a range of 0.01 to 0.05 mg/L between April 2013 and March 2015 to 0.09 to 0.12 mg/L between September 2015 and October 2016. Dissolved molybdenum levels also showed an increasing trend in the Main Pit (W12), rising from 0.02 mg/L in November 2012 to 0.1 in August 2015, before stabilizing around 0.03 mg/L (Figure 3-14).

Selenium exhibited similar behaviour to molybdenum in the pit lakes, rising from 0.004 mg/L in early 2013 in the Main Pit (W12) to 0.021 mg/L in August 2015, before stabilizing at approximately 0.01 mg/L (Figure 3-17). Dissolved selenium concentrations in the Area 2 Pit (W45) also rose sharply in September 2015 to 0.024 mg/L, then stabilized close to 0.02 mg/L (Figure 3-17). Minto Creek (W15) selenium levels ranged between 0.00015 and 0.05 mg/L (median 0.0014 mg/L). Here, dissolved selenium displayed some seasonality, with concentrations lowest during spring freshet and highest over winter, suggestive of a significant groundwater component to Minto Creek selenium levels. The TDD sites typically had the lowest selenium concentrations (generally <0.001 mg/L).

Dissolved copper showed sporadic peaks of between 0.28 and 0.48 mg/L for sites W12, W15, W35B, and W45, typically during the winter (Figure 3-11). Otherwise, dissolved copper concentrations were generally below 0.15 mg/L. One exception was the Area 2 Pit (W45), which varied markedly between 2012 and 2015 (0.01 to 0.28 mg/L) before declining to lower concentrations between 0.001 and 0.02 mg/L in 2016 (Figure 3-11).

Table 3-7: Summary Statistics for Dissolved Metals of Interest at W12

	W12												
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	167	172	172	157	174	172	172	167	172	170	168	172	171
Average	596.403	0.01573	0.000599	0.00006284	0.000349	0.05837	0.03023	0.0000907	0.04611	0.00186	0.0000113	0.007423	0.00412
Minimum	<0.50	<0.0020	<0.00010	<0.0000050	<0.00010	0.00046	<0.0050	<0.000050	<0.0010	<0.00050	<0.000010	<0.00010	<0.0010
Maximum	1420	0.124	0.003	0.00049	0.0025	0.476	0.386	0.0005	0.10	0.0065	0.0002	0.0207	0.031
Percent of results below DL	0.6	5.2	1.7	15.3	89.7	0.0	40.1	86.2	0.6	22.9	94.0	1.2	45.6
Standard deviation	409.444	0.0189	0.000379	0.00006559	0.000298	0.06623	0.05	0.0000743	0.02714	0.001283	0.0000174	0.004146	0.0035
First quartile	260.5	0.00428	0.000408	0.00002	0.0001	0.01967	0.00515	0.00005	0.02147	0.000725	0.000005	0.004795	0.0025
Median	358	0.00945	0.00047	0.00004	0.0005	0.0412	0.0111	<0.00020	0.03685	0.001585	0.00001	0.00642	<0.0050
Third quartile	976.5	0.01902	0.000622	0.000089	0.0005	0.07258	0.02812	0.0001	0.07358	0.002582	0.00001	0.009505	0.005

Table 3-8: Summary Statistics for Dissolved Metals of Interest at W15

	W15												
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	306	314	313	298	292	314	314	314	313	312	293	313	293
Average	315.616	0.04793	0.000506	0.00003221	0.000444	0.02413	0.33764	0.0000972	0.00382	0.001088	0.00000909	0.00288	0.00332
Minimum	<0.50	<0.0030	<0.00010	<0.0000050	<0.00010	<0.00020	<0.0050	<0.000050	0.0001	<0.00050	<0.0000050	<0.00010	<0.0010
Maximum	3120	2.65	0.0022	0.00234	0.0053	0.415	6.48	0.0027	0.11	0.008	0.00018	0.0504	0.041
Percent of results below DL	0.7	1.0	1.3	32.2	74.3	0.6	1.9	94.9	2.9	25.6	98.3	7.0	71.0
Standard deviation	262.085	0.15552	0.000252	0.00014217	0.000377	0.026083	0.51	0.0001672	0.00841	0.000766	0.00001046	0.004154	0.00398
First quartile	178	0.0111	0.00039	0.000005	0.00028	0.01325	0.09192	0.000025	0.002	0.0005	<0.000010	0.00086	<0.0050
Median	260	0.02	0.00045	0.000012	0.0005	0.0198	0.2175	0.0001	0.0027	0.001	<0.000020	0.00152	<0.0050
Third quartile	360.5	0.045	0.00055	0.00003	0.0005	0.02985	0.42075	0.0001	0.0033	0.0012	<0.00002	0.00339	<0.0050

Table 3-9: Summary Statistics for Dissolved Metals of Interest at W35

W35													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	80	81	81	81	80	81	81	81	81	81	81	81	80
Average	155.9	0.0266	0.00036	0.00001374	0.000362	0.0436	0.0759	0.0000545	0.001643	0.00107	0.0000078	0.000371	0.00183
Minimum	42	0.0034	0.00023	<0.0000050	<0.00010	0.0157	<0.010	<0.000050	0.000378	<0.00050	<0.000010	<0.00010	<0.0010
Maximum	764	0.104	0.00066	0.0000789	0.00061	0.127	0.323	0.000123	0.01	0.00178	0.000019	0.00255	0.0068
Percent of results below DL	0.0	0.0	0.0	32.1	41.3	0.0	3.7	95.1	14.8	16.0	86.4	3.7	60.0
Standard deviation	132.2	0.0194	0.00007	0.00001317	0.000139	0.0225	0.06	0.0000366	0.001701	0.000382	0.0000032	0.000461	0.00103
First quartile	83.7	0.0134	0.00031	<0.000010	0.00025	0.029	0.0302	<0.000050	0.000728	0.0007	<0.000010	0.000154	0.0011
Median	111	0.0216	0.00034	0.0000087	0.000375	0.037	0.062	<0.000050	0.0011	0.00118	<0.000010	0.00021	0.002
Third quartile	196.8	0.0326	0.00039	0.0000182	0.0005	0.0487	0.101	<0.00020	0.0015	0.00139	<0.000020	0.000398	0.0025

Table 3-10: Summary Statistics for Dissolved Metals of Interest at W45

W45													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	71	71	71	71	71	71	71	71	71	71	71	71	71
Average	922	0.0166	0.000761	0.00008899	0.00028	0.04106	0.05271	0.000085	0.0665	0.0033	0.0000134	0.00954	0.00805
Minimum	253	0.0032	<0.00010	<0.0000050	<0.00010	0.00025	<0.0050	<0.000050	0.0033	<0.0010	<0.000010	0.00048	<0.0010
Maximum	1720	0.337	0.00234	0.000517	<0.0010	0.276	0.726	0.00066	0.13	0.0095	0.000099	0.0298	0.0851
Percent of results below DL	0.0	0.0	4.2	35.2	100.0	0.0	35.2	93.0	0.0	21.1	87.3	0.0	47.9
Standard deviation	490	0.0395	0.000549	0.00010608	0.000207	0.06665	0.10	0.000084	0.0384	0.0026	0.0000141	0.00779	0.01455
First quartile	529	0.0074	0.00038	0.00002	0.0001	0.00293	0.01	0.00005	0.0259	0.0011	0.00001	0.00188	0.001
Median	746	0.0106	0.00045	0.0000477	<0.00020	0.0116	0.0176	<0.00020	0.086	0.00269	<0.000020	0.00766	<0.0050
Third quartile	1455	0.0142	0.001225	0.0001095	0.0005	0.0504	0.045	0.0001	0.0985	0.00476	0.00001	0.0173	0.00825

Table 3-11: Summary Statistics for Dissolved Metals of Interest at W51

W51													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	26	26	26	26	25	26	26	26	26	26	26	26	26
Average	1204	0.0051	0.00043	0.00006146	0.000104	0.02391	0.0381	0.0000488	0.0397	0.003368	0.0000102	0.00417	0.00351
Minimum	427	0.0012	0.00028	<0.0000200	<0.00010	0.00122	<0.010	<0.000050	0.0257	<0.00050	<0.000010	0.00273	<0.0010
Maximum	1700	0.0153	0.00091	0.00024	0.00042	0.139	0.279	0.00022	0.05	0.00822	0.000033	0.00656	0.0222
Percent of results below DL	0.0	0.0	0.0	61.5	88.0	0.0	53.8	96.2	0.0	7.7	92.3	0.0	26.9
Standard deviation	378	0.0031	0.00017	0.00006673	0.000069	0.03368	0.06	0.0000368	0.0072	0.00185	0.0000057	0.00078	0.00423
First quartile	1052	0.0032	0.00036	0.000015	<0.00020	0.00222	0.01	0.000025	0.0369	0.00273	0.00001	0.00364	0.00105
Median	1170	0.0044	0.00038	0.0000325	<0.00020	0.01297	0.01	0.00005	0.0406	0.00331	0.00001	0.00404	0.00245
Third quartile	1510	0.0061	0.00044	0.00008575	<0.00020	0.0239	0.047	0.00005	0.046	0.003898	0.00001	0.00457	0.00405

Table 3-12: Summary Statistics for Dissolved Metals of Interest at W55

W55													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	33	33	33	33	31	33	33	32	33	33	33	33	33
Average	124.1	0.058	0.00059	0.0000241	0.00039	0.0784	0.121	0.0000389	0.00193	0.00152	0.000008	0.00069	0.00204
Minimum	49.2	0.0116	0.00037	0.0000056	0.0002	0.0149	0.023	<0.000050	0.000424	0.0008	<0.000010	0.000158	<0.0010
Maximum	248	0.152	0.00114	0.0000712	0.00064	0.16	0.338	0.000104	0.01	0.00228	0.000023	0.00435	0.0052
Percent of results below DL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.8	0.0	0.0	66.7	0.0	18.2
Standard deviation	59.1	0.0428	0.00019	0.0000186	0.00012	0.0424	0.07	0.0000227	0.00208	0.00039	0.0000048	0.000948	0.00137
First quartile	76.3	0.0239	0.00045	0.0000101	0.00029	0.0378	0.054	0.000025	0.000802	0.00129	<0.000010	0.000292	0.0011
Median	109	0.0465	0.00051	0.0000164	0.00038	0.0659	0.112	0.000025	0.00128	0.00148	<0.000010	0.000378	0.0016
Third quartile	157	0.0773	0.0007	0.0000398	0.00047	0.111	0.173	0.0000535	0.0022	0.0018	0.000011	0.000607	0.0027

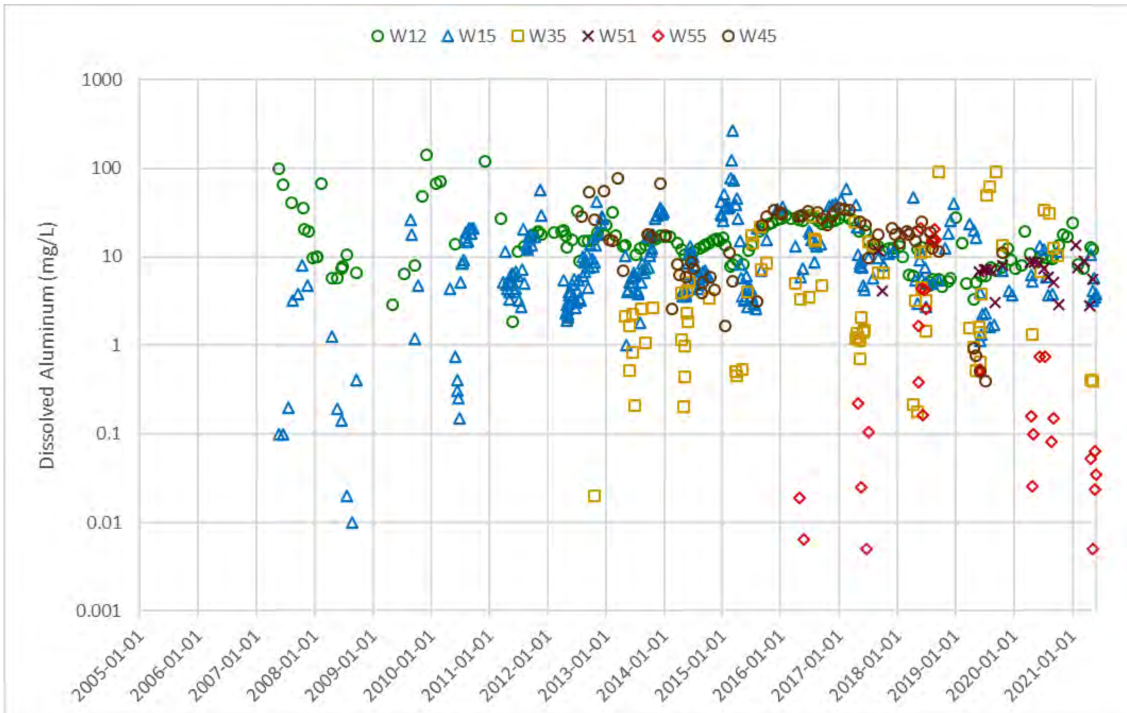


Figure 3-7: Concentrations of Dissolved Aluminum at Upper Minto Mine Facility Monitoring Locations. Note Log Scale.

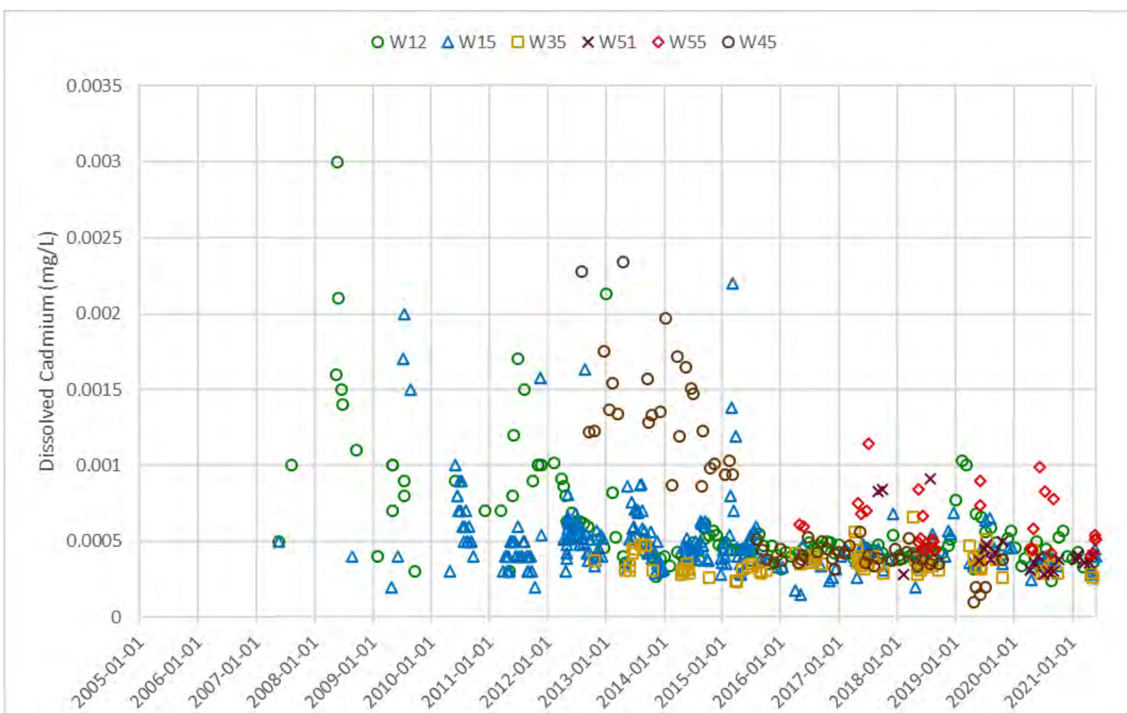


Figure 3-8: Concentrations of Dissolved Cadmium at Upper Minto Mine Facility Monitoring. Note Log Scale.

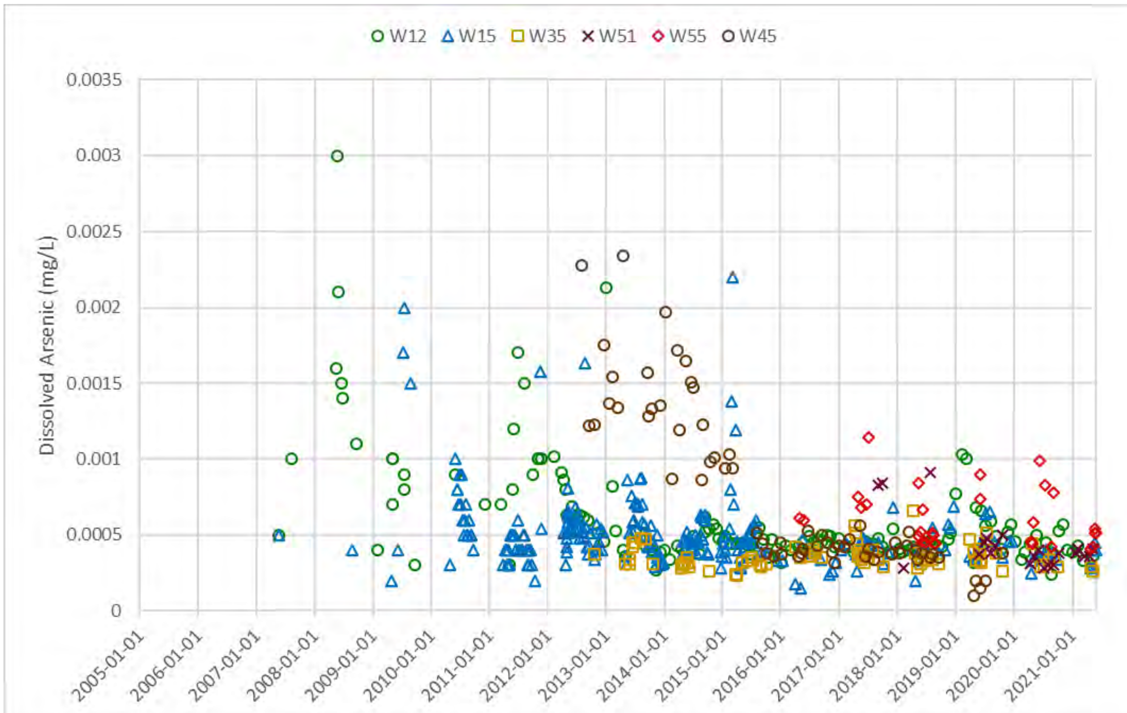


Figure 3-9: Concentrations of Dissolved Arsenic at Upper Minto Mine Facility Monitoring. Note Log Scale.

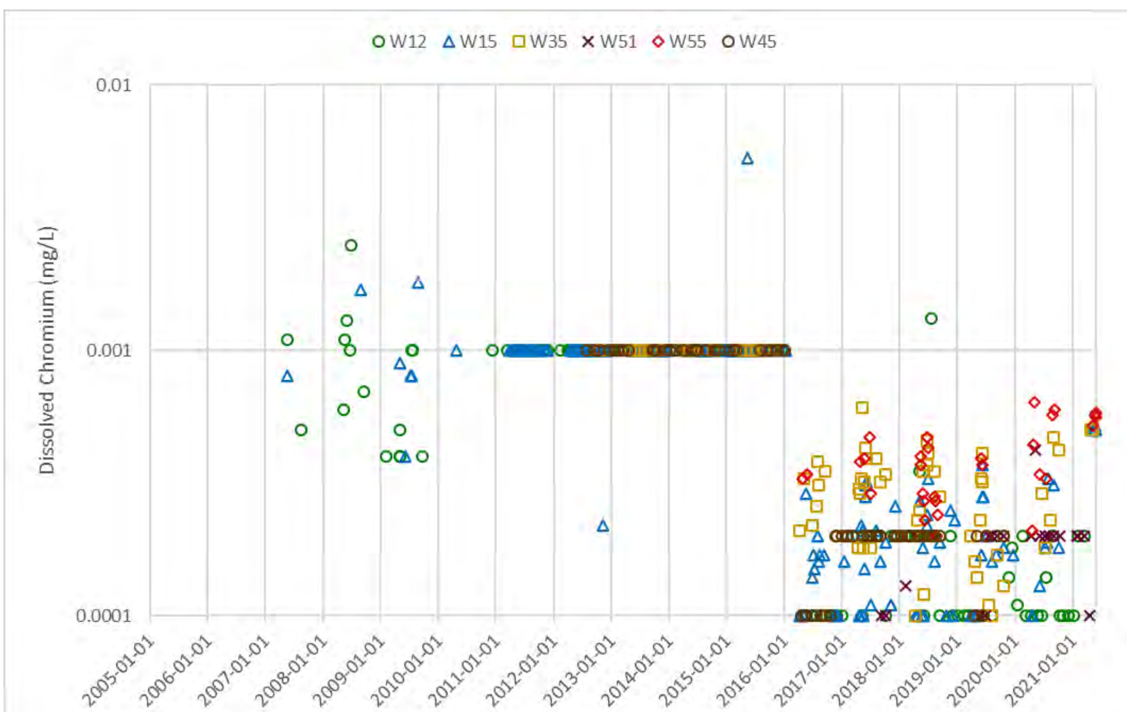


Figure 3-10: Concentrations of Dissolved Chromium at Upper Minto Mine Facility Monitoring. Note Log Scale.

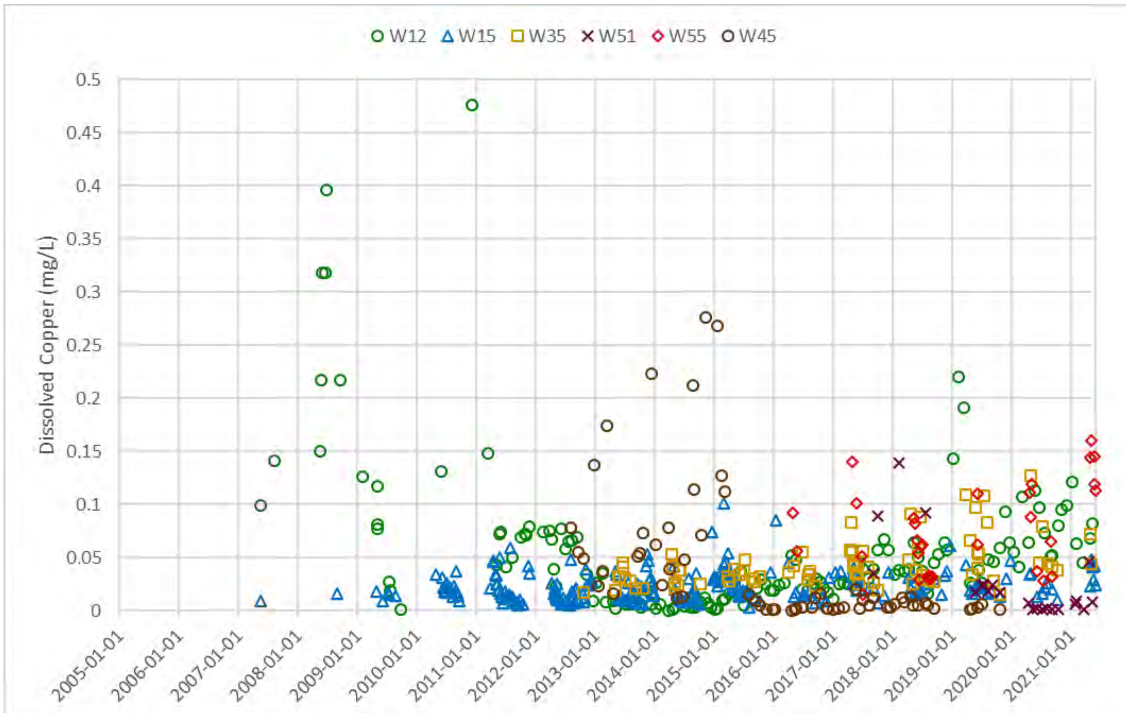


Figure 3-11: Concentrations of Dissolved Copper at Upper Minto Mine Facility Monitoring.

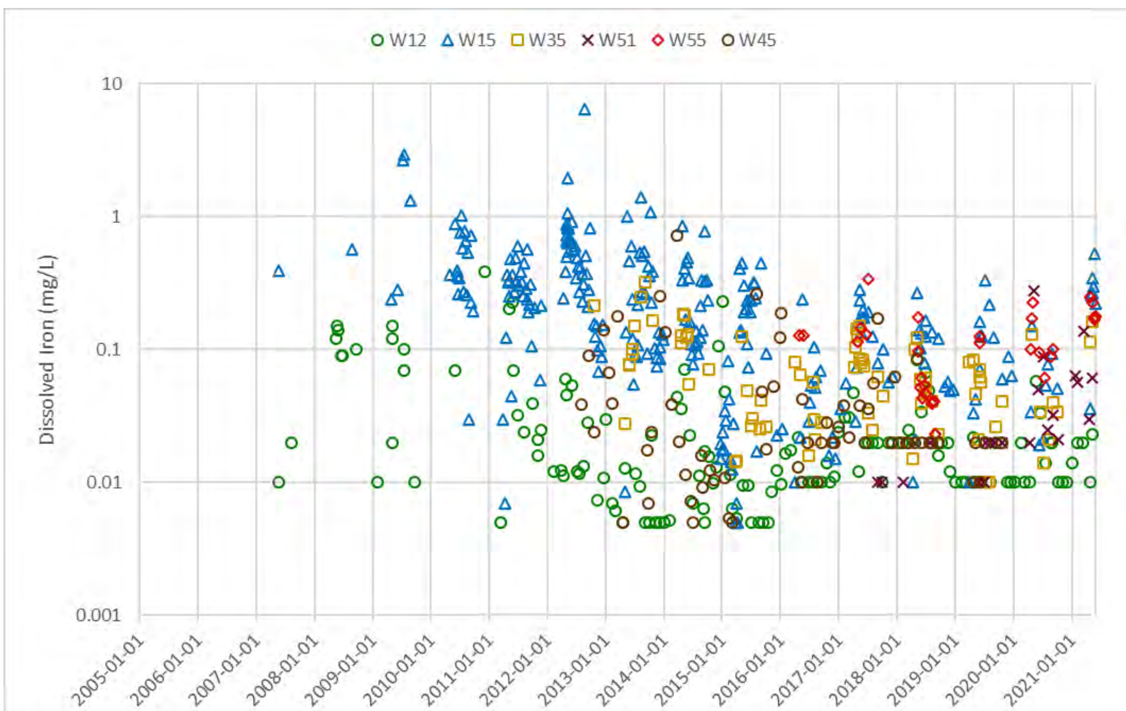


Figure 3-12: Concentrations of Dissolved Iron at Upper Minto Mine Facility Monitoring. Note Log Scale.

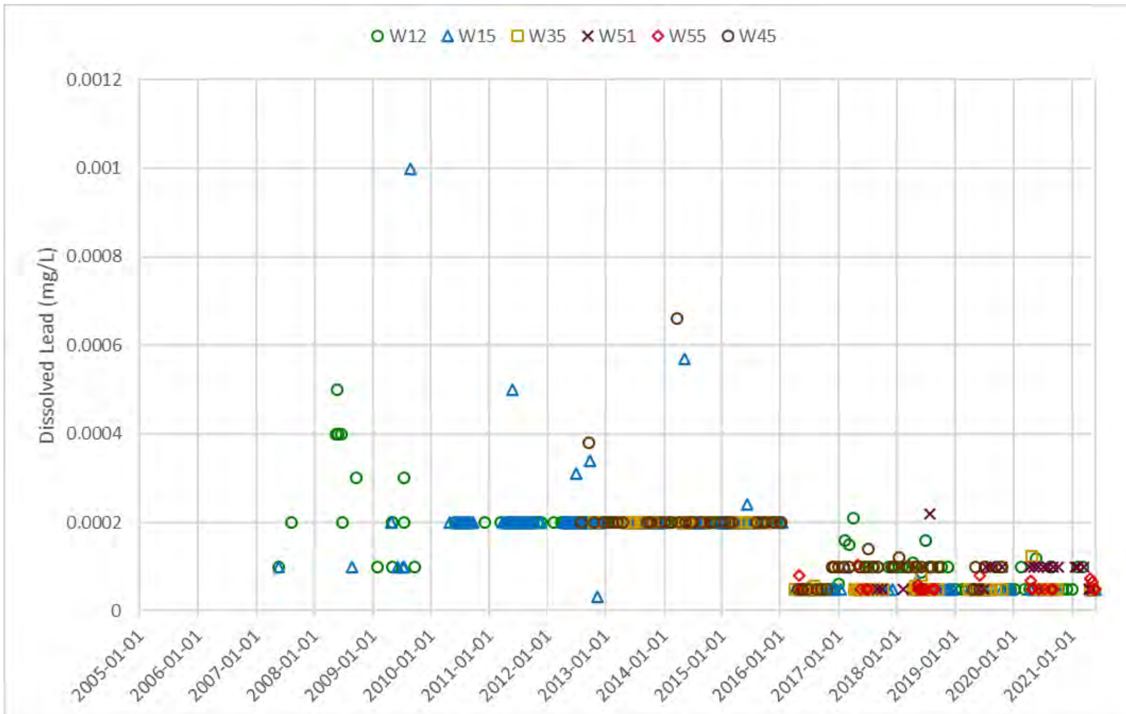


Figure 3-13: Concentrations of Dissolved Lead at Upper Minto Mine Facility Monitoring.

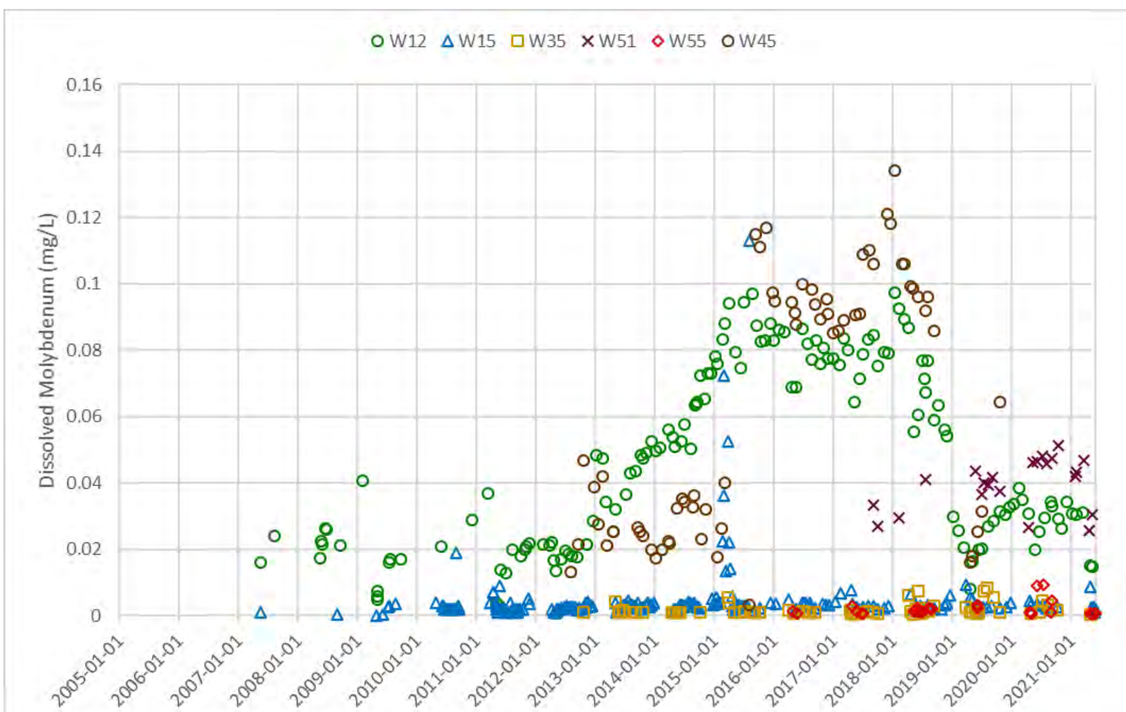


Figure 3-14: Concentrations of Dissolved Molybdenum at Upper Minto Mine Facility Monitoring.

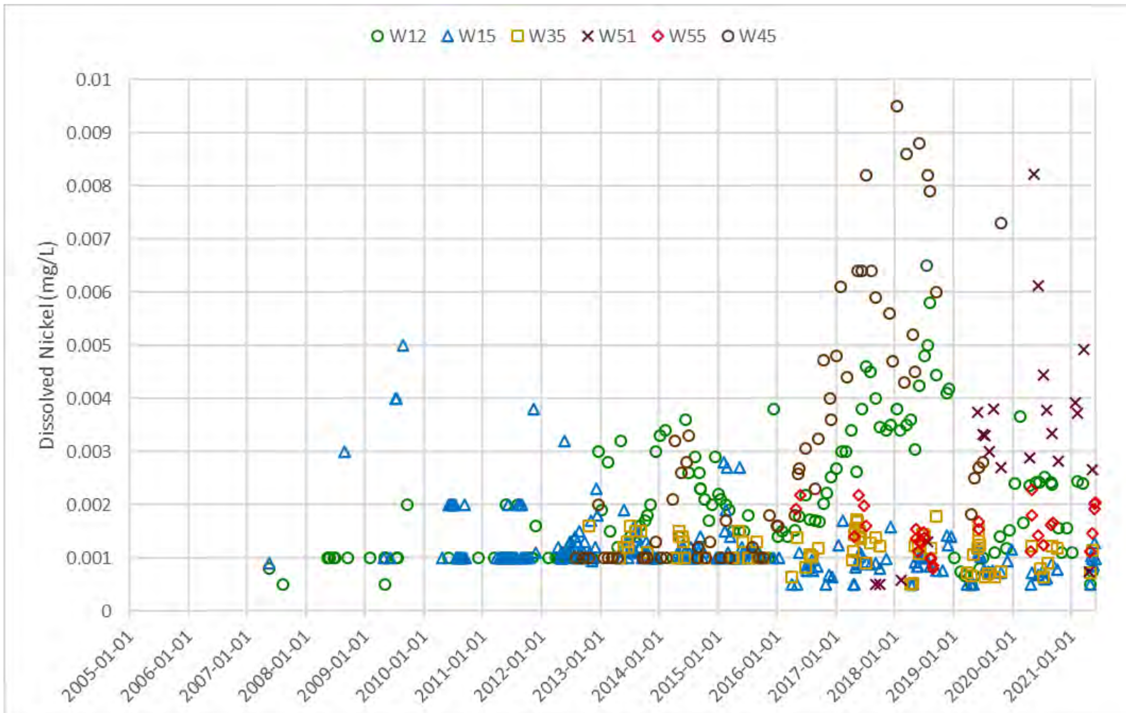


Figure 3-15: Concentrations of Dissolved Nickel at Upper Minto Mine Facility Monitoring.

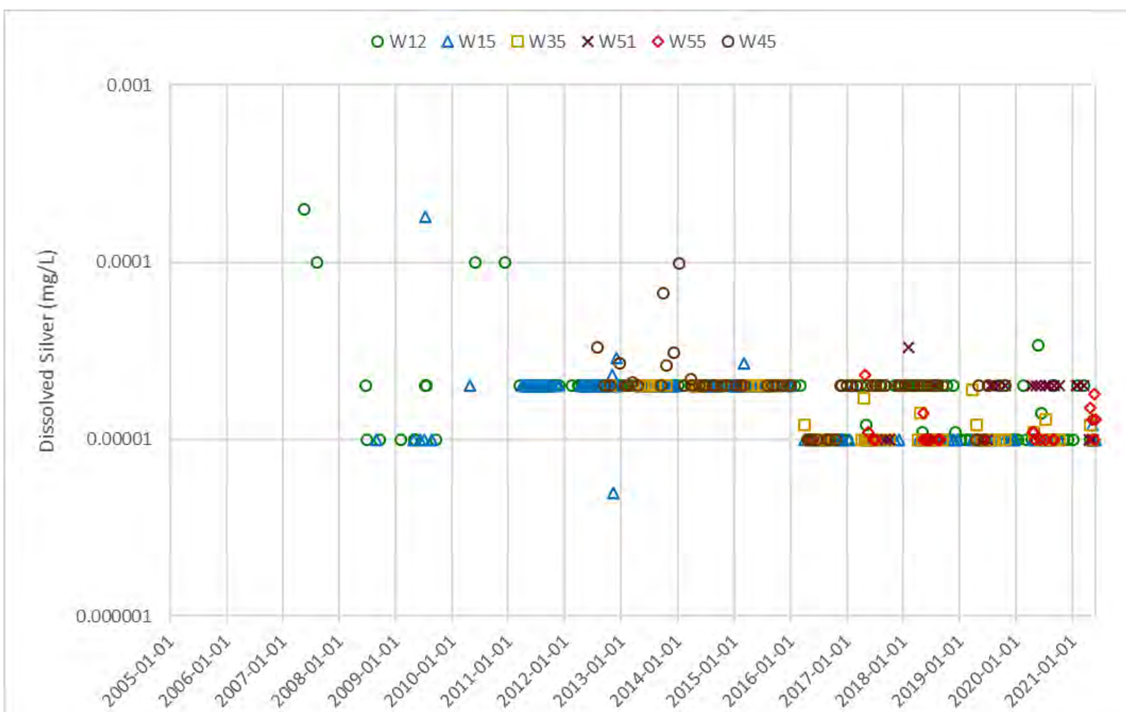


Figure 3-16: Concentrations of Dissolved Silver at Upper Minto Mine Facility Monitoring. Note Log Scale.

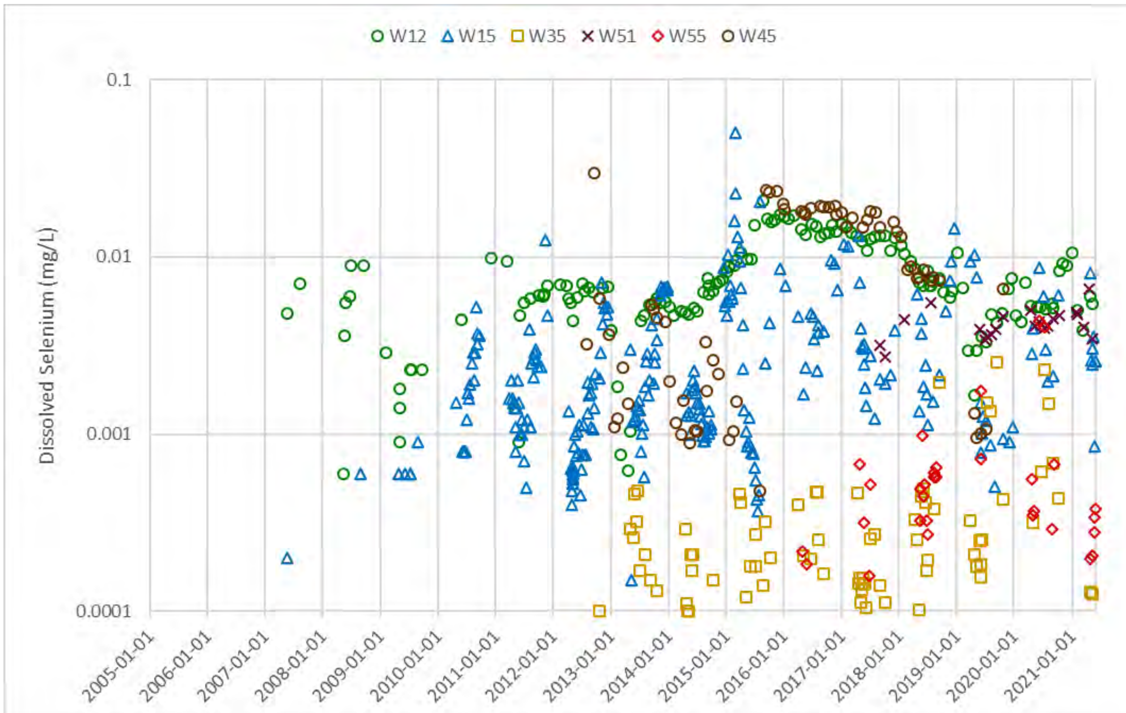


Figure 3-17: Concentrations of Dissolved Selenium at Upper Minto Mine Facility Monitoring. Note Log Scale.

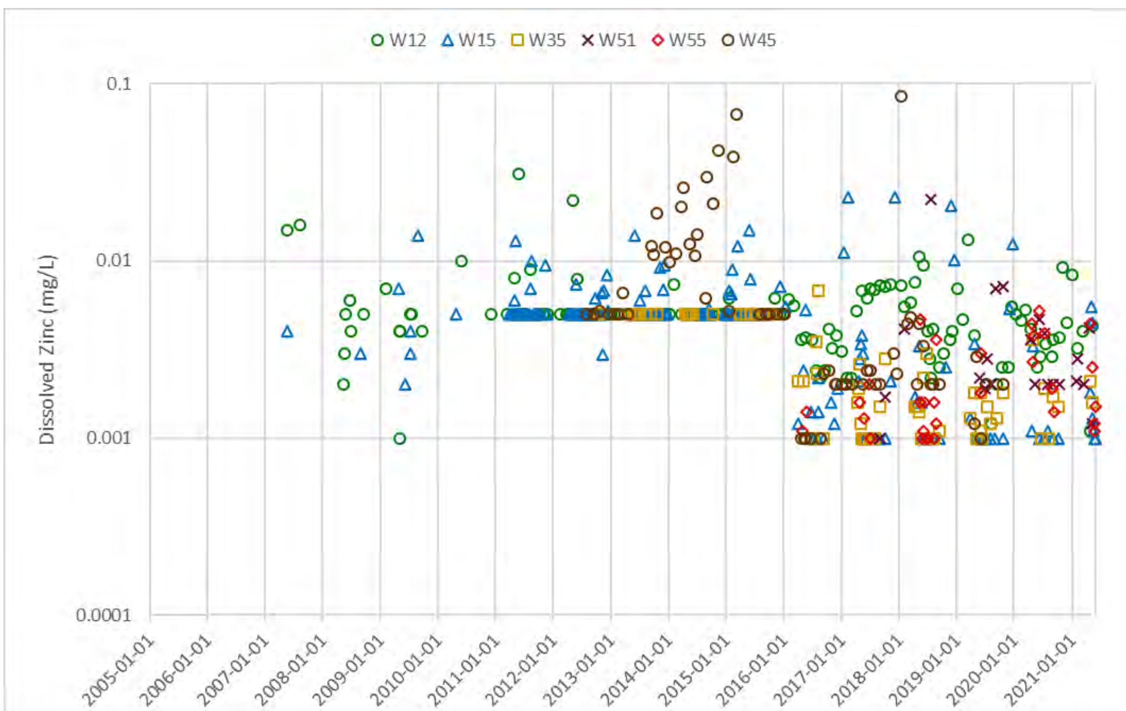


Figure 3-18: Concentrations of Dissolved Zinc at Upper Minto Mine Facility Monitoring. Note Log Scale.

3.1.2 Lower Minto Mine Site

Lower Minto Mine Site station water quality is presented and discussed with respect to physical parameters and anion and nutrient concentrations in Section 3.1.2.1 and dissolved metals concentrations in Section 3.1.2.2.

3.1.2.1 Physical Parameters, Anions and Nutrients

Statistical summaries of physical parameters and anion and nutrient concentrations at sites W8, W8A, W16, W17 and W62 are presented in Table 3-13 through Table 3-17. TSS, field pH, sulphate, nitrate, nitrite, and ammonia data at each of the lower Minto Mine Site stations are presented in Figure 3-19 through Figure 3-24.

The pH at all of the Lower Mine Sites was typically circumneutral to mildly alkaline, with the median pH ranging from 7.3 (W8A) to 7.84 (W16). Temperature varied seasonally from -2 to 24 °C. Median dissolved oxygen levels ranged from 46% (W8A) to 87% (W17) saturation, with lower levels typically recorded during the winter months, likely due to ice cover and associated limitations on oxygen replenishment of the under-ice waters. The highest field conductivity was typically measured in drainage from the DSTSF (median 1194 and 686 μS/cm at W8 and W8A, respectively).

In 2009 through 2011 at W8, TSS was typically highest in spring months – likely due to erosional inputs from spring meltwater – and lower throughout the rest of the year (median 13 mg/L), whereas higher TSS concentrations at W8A were observed later in the summer (median 12 mg/L; Figure 3-19). Relatively higher spring TSS concentrations were also observed at W62 in certain years (e.g. 2020). TSS was more variable and showed less seasonality at all lower mine site since 2013, likely related to day-to-day activities at the mine site.

Nitrate-N concentrations were highest in drainage from the DSTSF (median 22.1 mg/L and 8.41 mg/L for W8 and W62, respectively) and demonstrated some seasonality, typically recorded low concentrations during freshet with its associated dilution, followed by a rise over spring and summer, then declining in winter (Figure 3-24). Nitrite-N and ammonia-N concentrations also displayed some seasonal changes. The east drainage from the DSTSF (W8) generally returned the highest concentrations (median 0.17 mg/L nitrite-N and 0.14 mg/L ammonia-N). Similar nitrite-N levels were observed for sites W16 (median 0.019 mg/L), and W62 (median 0.017 mg/L). Ammonia-N concentrations at sites W8A and W16 were also comparable (median 0.06 mg/L; Figure 3-22), with the lowest concentrations typically observed in the W17 sump (<0.005 to 0.26 mg/L).

DOC concentrations generally ranged between 1 and 30 mg/L for all sites. DOC concentrations were typically highest during spring freshet as organic matter was flushed from surrounding soils by snowmelt.

The highest median sulphate concentrations in the Lower Mine Site were observed at the MVF sump (W62; median 233 mg/L) and DSTSF drainages (median 120 and 165 mg/L for W8 and W8A, respectively). The longer period of record for the east DSTSF drainage (W8A) exhibits an increasing trend, with annual maximum increasing from approximately 180 mg/L in 2012 to 416 mg/L in 2018 (Figure 3-25). This increasing trend shows a seasonal wave-like overprint, with concentrations peaks and troughs typically observed in November/December and April/May, respectively (Figure 3-25). Sulphate concentrations displayed a similar trend in the Water Storage Pond (W16), but the pattern was more subdued than that of W8A (Figure 3-25).

Table 3-13: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W8

W8															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	128	58	59	60	7	31	3	95	62	107	94	92	115	73	89
Average	37.83	7.61	1125.07	2.34	9.38	77.5	142.7	19.732	0.49	112.25	0.4299	0.71337	34.33343	14.24	0.099
Minimum	<2	6.62	189	-0.13	2.02	3.8	108.4	<0.02	0.049	<0.5	0.003	<0.001	<0.002	<0.5	0.017
Maximum	660	8.2	1857	11	17.37	144.6	164	210	1.85	310	4.2	4.5	116	30.4	0.84
Percent of results below DL	18.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7	0.0	1.9	4.3	15.2	19.1	2.7	19.1
Standard deviation	86.98	0.34	417.78	2.53	5.75	32.6	30.00	41.23	0.45	76.45	0.6663	1.07561	31.73298	6.4	0.115
First quartile	5	7.41	833.5	0.88	4.56	69.8	132	3.675	0.272	52.55	0.0425	0.068	5.165	10.4	0.034
Median	12.9	7.62	1194	1.4	11.74	82.9	155.7	7.8	0.32	120	0.1375	0.165	22.1	12	0.058
Third quartile	36.75	7.89	1453.5	3.32	12.71	94.6	159.8	20	0.395	160	0.5275	0.7075	63.5	16.3	0.126

Table 3-14: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W8A

W8A															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	410	338	337	339	269	295	266	389	227	390	378	383	398	105	378
Average	44.89	7.43	690.96	1.99	6.38	49.46	142.89	13.859	0.4797	175.298	0.1587	0.13406	8.48256	13.56	0.0955
Minimum	<1.0	6.2	8.06	-2.2	1.51	2.3	-426.7	<0.50	<0.010	<0.30	0.007	<0.0010	<0.0050	0.6	<0.01
Maximum	6540	21.6	2460	15.2	18.2	125.8	320.6	1300	1.60	416	1.6	1.18	72	30.8	3.55
Percent of results below DL	2.2	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.9	1.0	0.0	9.9	1.0	0.0	5.3
Standard deviation	324.55	0.86	225.07	2.36	2.55	21.45	108.96	66.17	0.1589	92.557	0.1669	0.19784	6.9806	6.26	0.1956
First quartile	7	7.13	566	0.2	4.43	33.5	115.42	5.8	0.39	94.1	0.04	0.015	3.8125	9.45	0.046
Median	16	7.3	686	1.5	6.13	46.7	160	9.4	0.45	165	0.0875	0.0417	7.025	12.9	0.067
Third quartile	34.68	7.6	832	3.22	7.94	61.75	199.48	14.9	0.56	248.75	0.25	0.175	11.7	17	0.1

Table 3-15: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W16

W16															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	579	543	535	540	474	498	454	538	309	515	541	543	550	468	490
Average	7.69	7.88	289.6	8.61	8.74	70.4	117.1	5.326	0.283	47.479	0.12111	0.08392	3.08365	12.66	0.0377
Minimum	<1.0	5.65	23	-1.3	0.18	1.2	-423.4	<0.50	<0.01	<0.50	<0.0050	<0.0010	<0.0050	0.97	<0.01
Maximum	181	10.05	1347	24.3	137.5	144.6	335.3	23.9	0.81	286	2	8.62	35	49.7	0.86
Percent of results below DL	19.5	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.3	1.2	2.6	10.3	1.5	0.0	34.9
Standard deviation	13.29	0.51	130.2	6.98	7.82	22.17	127.50	3.359	0.14	26.011	0.1997	0.41335	3.31429	7.04	0.0457
First quartile	2	7.56	218.9	1.3	6.64	59.62	100	3	0.18	30	0.022	0.0083	0.871	8.97	0.025
Median	4	7.84	275.6	8.5	8.17	72.05	140.9	5.105	0.26	45	0.048	0.0192	1.99	12.2	0.025
Third quartile	8	8.14	351.9	15.02	9.5	84.78	174	7	0.34	64.7	0.11	0.05435	3.9775	15.3	0.042

Table 3-16: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W17

W17															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	1083	948	943	948	705	867	652	1005	565	960	928	909	996	883	767
Average	2.01	7.76	356.16	3.83	14.81	86.53	132.74	7.481	0.4428	60.654	0.02325	0.03122	3.02173	9.216	0.0196
Minimum	<1.0	5.52	2.17	-1.3	2.87	6.2	-384.2	0.05	<0.010	<0.30	-0.01	<0.0010	<0.0050	<0.50	<0.01
Maximum	38.1	9.46	775	16.15	1723	201	1270	62	0.85	120	0.85	7.85	12.4	34.6	0.12
Percent of results below DL	74.2	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.4	25.3	55.6	0.8	0.3	69.8
Standard deviation	3.29	0.3	144.06	2.28	66.61	14.75	91.58	3.845	0.08	20.681	0.04763	0.44959	3.54995	2.547	0.0134
First quartile	0.5	7.64	255.6	2.1	10.53	80.25	104.75	5.6	0.39	45.675	0.0055	<0.0010	0.1875	8.1	0.01
Median	<3.0	7.8	296.4	3.4	11.58	87.2	134.5	7	0.44	59.5	0.011	<0.0050	1.9	9.15	<0.050
Third quartile	1.55	7.92	494.75	5.4	12.32	92.4	173	8.3	0.5	74.55	0.024	0.008	4.6	10.1	0.025

Table 3-17: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W62

W62															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	72	64	64	63	63	63	63	73	6	73	73	73	73	18	72
Average	8.52	7.63	666.4	3	11.61	87.12	160	26.25	0.394	219.72	0.02294	0.02602	9.7833	13.8	0.029
Minimum	<3.0	6.06	174.5	-0.1	5.24	32.2	21.5	0.53	0.344	1.71	<0.0050	<0.0010	0.0084	10.6	0.02
Maximum	58	8.23	1200	12.7	18.71	137	263.2	43.2	0.49	352	0.263	0.119	26.5	17.5	0.075
Percent of results below DL	26.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	21.9	0.0	0.0	87.5
Standard deviation	9.74	0.37	148.8	2.5	2.6	19.07	56.30	5.61	0.052	55.55	0.04798	0.02423	5.2088	2.1	NA [a]
First quartile	1.5	7.42	589	1.4	9.98	76.7	132.7	23.8	0.365	183	0.0086	0.0062	6.34	12.5	0.025
Median	5.9	7.72	650	2.4	11.76	86.7	163.4	27.6	0.38	233	0.0108	0.0174	8.41	13.2	0.025
Third quartile	10	7.91	742	3.8	13.08	96.85	193.4	30	0.402	260	0.0144	0.0427	10.7	15.3	0.025

[a] Not applicable due to too few measurements above the detection limit

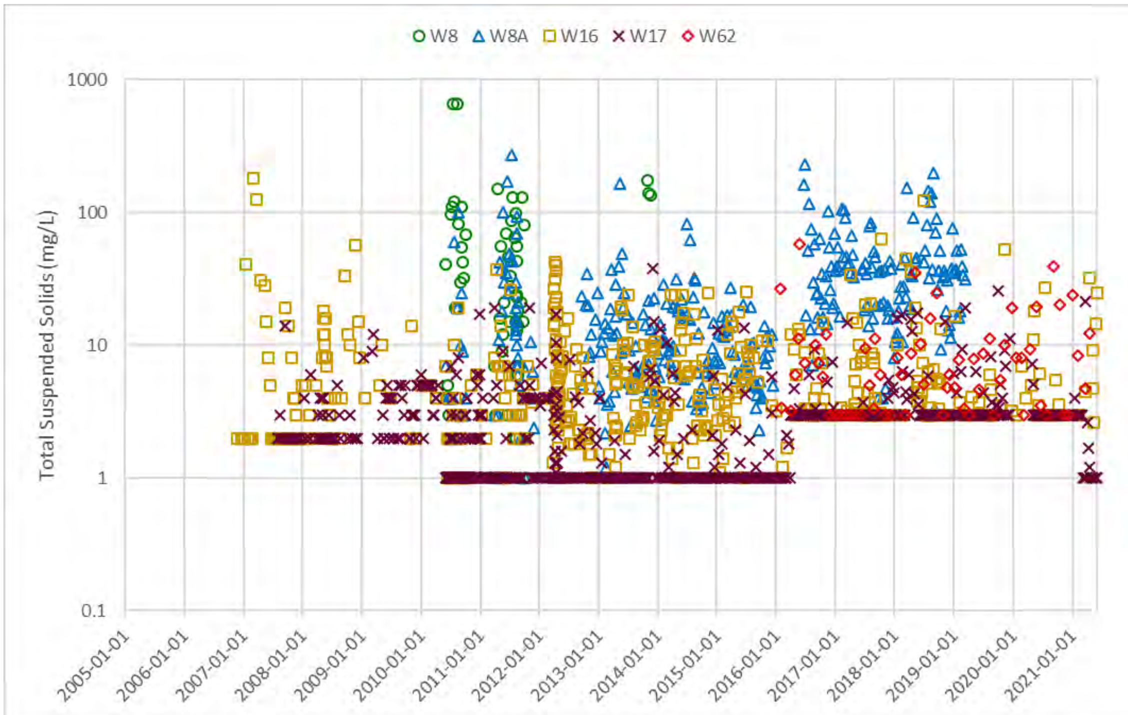


Figure 3-19: TSS at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

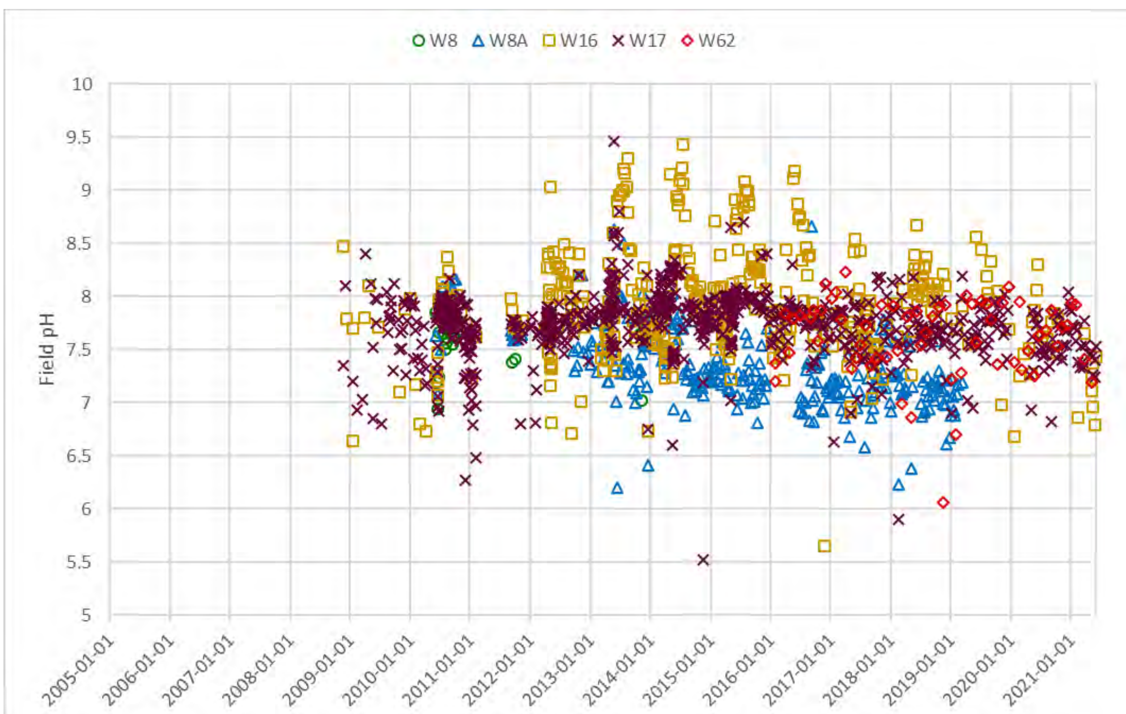


Figure 3-20: Field pH at Lower Minto Mine Facility Monitoring Locations.

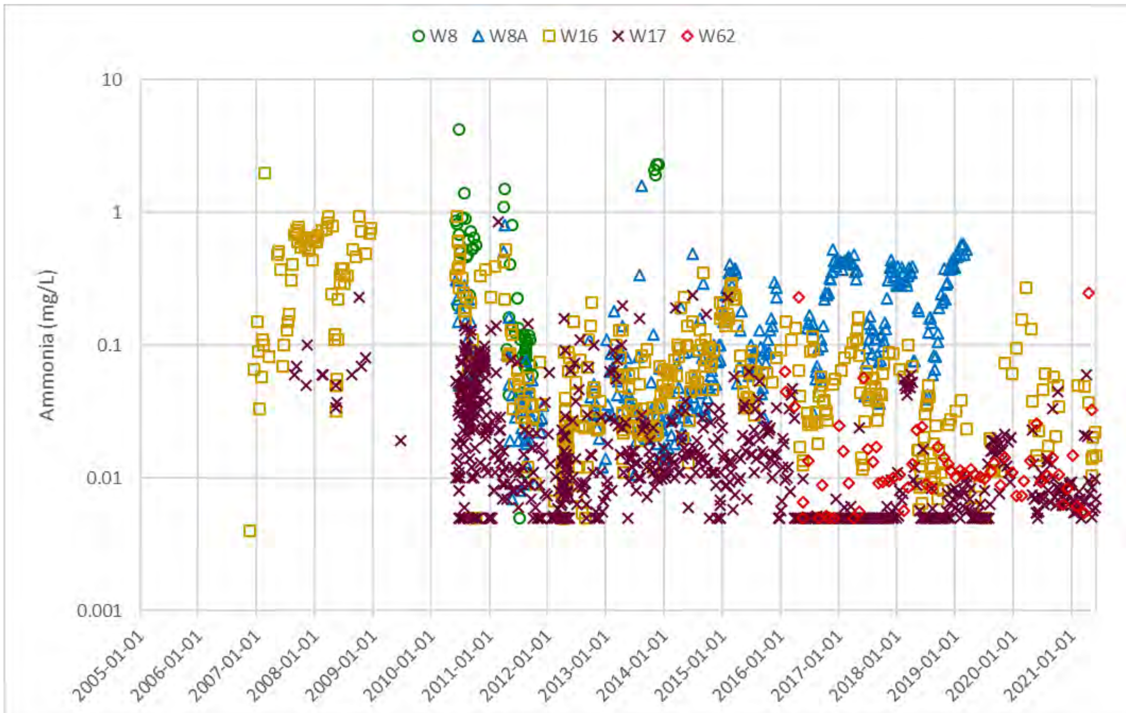


Figure 3-21: Ammonia (N) at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

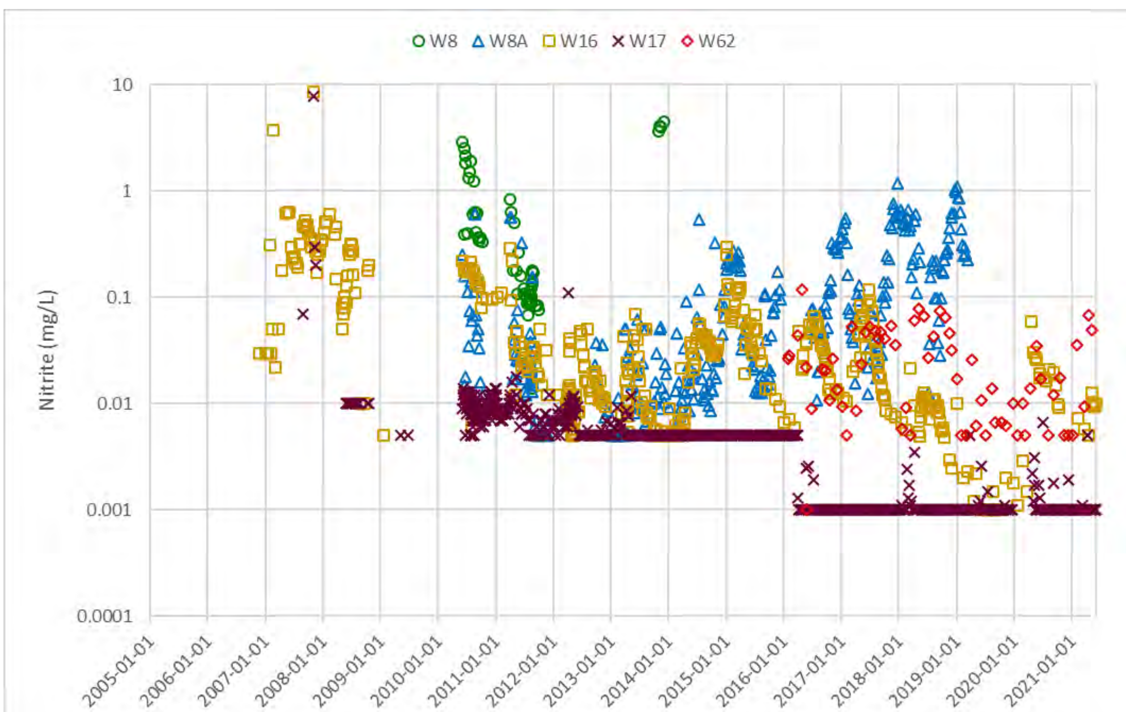


Figure 3-22: Nitrite (N) at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

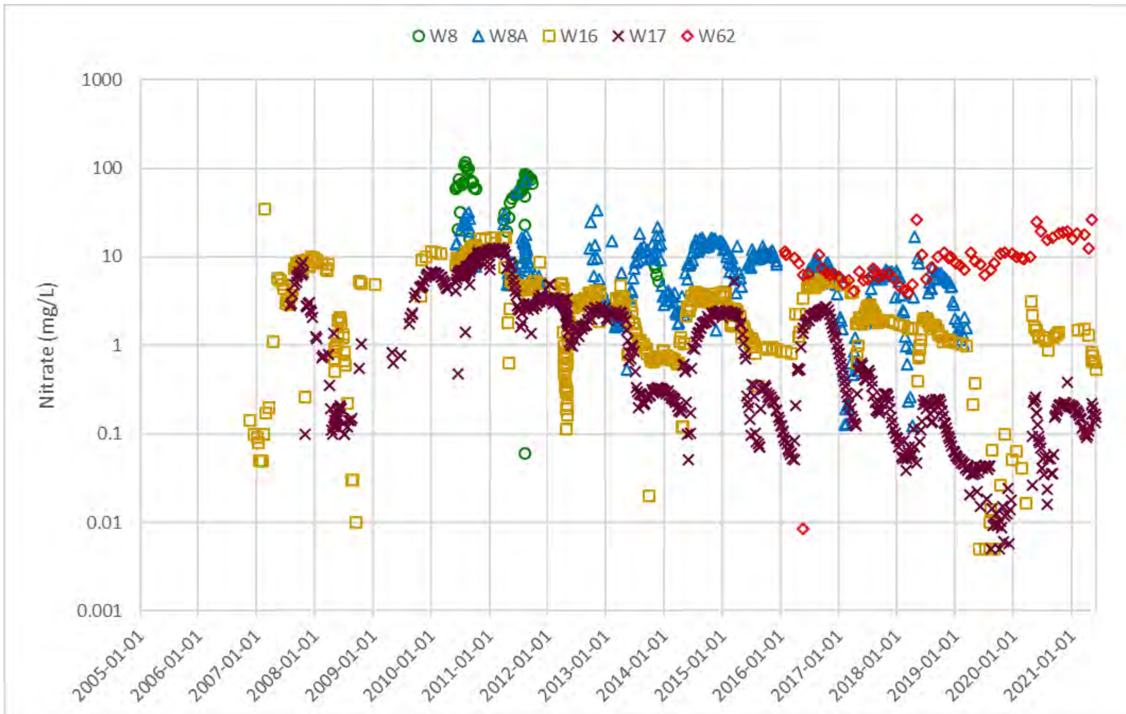


Figure 3-23: Nitrate (N) at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

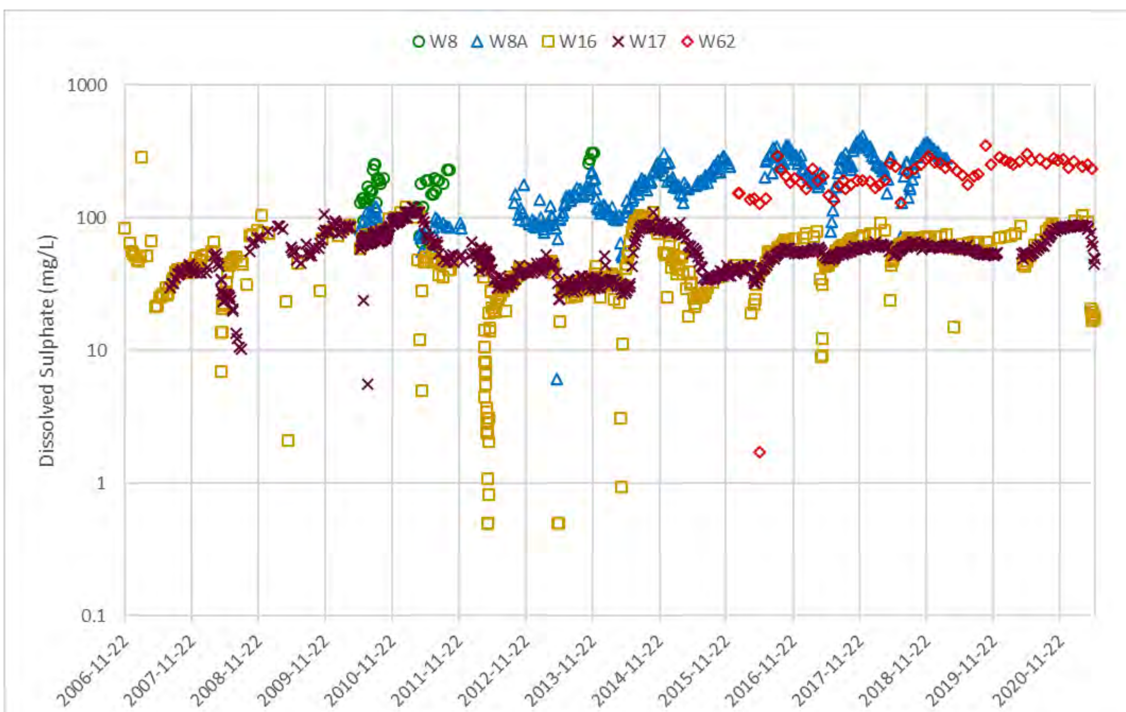


Figure 3-24: Dissolved Sulphate at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

3.1.2.2 Metals

Statistical summaries of dissolved metals concentrations at sites W8, W8A, W16, W17 and W62 are presented in Table 3-18 through Table 3-22. Dissolved metal concentrations at each of the lower Minto Mine Site stations are plotted in Figure 3-25 through Figure 3-36.

It should be noted that the final few samples collected in October and November 2013 at site W8 are likely influenced by the installation of galvanized vertical culverts, as evidenced by the elevated hardness, iron, and particularly zinc concentrations present in these samples (Figure 3-30 and Figure 3-36). As such, the discussion of the dissolved metals data does not consider these final few samples from W8, although they are included in the figures and summary statistics.

For the Lower Mine Sites, dissolved hardness was highest in drainage from the DSTSF (median 551 mg/L at W8 and 565 at W62). Site W62, hardness levels displayed marked seasonal patterns: dilution from snowmelt results in the lowest hardness levels in April/May, followed by a steady increase over the year peaking in winter immediately before the next snowmelt cycle. This is suggestive of a prominent groundwater component to the hardness content of the DSTSF drainage (W8 and W8A) and water storage pond (W16) since the groundwater contribution will be highest during the low flow winter period and lowest during the high surface flows of freshet.

Dissolved concentrations of chromium, lead, and silver were generally close to or below detection (Figure 3-28, Figure 3-31, and Figure 3-34). Dissolved nickel concentrations were also generally close to or below detection, with sporadic spikes throughout the period of record (Figure 3-33). At W8A, dissolved cadmium showed an increasing trend from approximately 0.00011 mg/L in early 2013 rising to 0.00067 in February 2015, before declining and stabilizing at around 0.0003 mg/L in fall 2016 (Figure 3-27). Dissolved zinc concentrations at W8A showed more striking changes, increasing by approximately two orders of magnitude from ≤0.025 mg/L prior to May 2011 to 0.07 to 5.7 mg/L in 2018 (Figure 3-36). This change is an artefact of the installation of galvanized vertical culverts at this site which leach zinc.

Dissolved aluminium and arsenic concentrations were comparable across all four Lower Mine Sites with medians ranging between 0.0028 and 0.009 mg/L for aluminium and 0.00037 and 0.00053 for arsenic (Table 3-18 to Table 3-22). Little seasonal variation was evident for either constituent, with the exception of aluminum in W16. Iron concentrations were slightly higher in the DSTSF drainage (median 0.087 and 0.147 mg/L for W8 and W8A, respectively) than the Water Storage Pond (W16; median 0.054 mg/L) or the MVF Sump (W62; median 0.03 mg/L). That dissolved iron concentrations were often higher than may be expected for well oxygenated, circumneutral pH waters, where equilibrium with ferric oxyhydroxides would be expected to maintain dissolved iron levels at <0.01 mg/L, may be due to complexation by dissolved organic matter given the relatively high DOC concentrations in these waters.

Copper concentrations were highest in the DSTSF drainage (median 0.095 and 0.97 mg/L for W8 and W8A, respectively) and lowest in the WSP dam sump (W17; median 0.006 mg/L). Dissolved copper levels tended to peak during spring freshet (Figure 3-29), consistent with peaks in DOC concentrations. Dissolved molybdenum levels were also highest in the DSTSF drainages (median 0.0078 and 0.01 mg/L at W8 and W8A, respectively), with sporadic spikes in concentration observed for W8 (Figure 3-32). No seasonal trend was discernible in the molybdenum dataset.

Finally, dissolved selenium concentrations were also highest in the DSTSF drainages (median 0.004 and 0.005 mg/L for W8 and W8A, respectively), with the lowest concentrations generally observed in the Water Storage Pond (W16; median 0.004 mg/L). Selenium levels in the DSTSF east drainage (W8) displayed distinct seasonality (Figure 3-35). Here, the lowest selenium concentrations were observed over winter, followed by a sharp rise over spring and summer, peaking in late summer/fall before declining sharply in early winter. Such behaviour mirrored the seasonality observed for sulphate concentrations.

Table 3-18: Summary Statistics for Dissolved Metals of Interest at W8

W8													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	113	127	126	128	107	128	128	125	128	128	93	128	128
Average	501	0.01628	0.000496	0.000122	0.000629	0.10225	0.141	0.0001304	0.011495	0.00207	0.0000282	0.00578	0.24992
Minimum	64	<0.0030	<0.0004	<0.00001	<0.0004	<0.001	<0.01	<0.00005	0.000179	<0.0005	<0.00001	<0.0001	<0.001
Maximum	1280	0.15	0.00148	0.00211	0.0053	0.352	0.826	0.0023	0.06	0.009	0.00076	0.0193	9.49
Percent of results below DL	0.0	21.3	7.9	18.0	72.0	0.8	5.5	86.4	8.6	12.5	77.4	22.7	60.9
Standard deviation	260	0.02347	0.000198	0.000195	0.000553	0.09093	0.15	NA [a]	0.012576	0.00166	NA [a]	0.00521	1.38683
First quartile	243	0.005	0.0004	0.00003	0.0005	0.02215	0.04	<0.0002	0.005	0.001	<0.00002	0.00162	0.0025
Median	552	0.009	0.0005	0.0001	<0.001	0.095	0.087	<0.00020	0.007845	0.00182	<0.00002	0.0039	0.0025
Third quartile	675	0.017	0.0006	0.00017	0.00052	0.13325	0.188	<0.0002	0.013	0.00201	<0.00002	0.0117	0.005

[a] Not applicable due to too few measurements above the detection limit

Table 3-19: Summary Statistics for Dissolved Metals of Interest at W8A

W8A													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	404	410	409	410	389	410	410	409	410	410	386	410	410
Average	550.227	0.01193	0.000544	0.0001876	0.000549	0.099626	0.28412	0.0000863	0.01054	0.001394	0.0000133	0.006015	0.55534
Minimum	<0.50	<0.0030	<0.00010	<0.000010	0.0001	<0.00020	<0.0050	0.000013	0.00033	<0.0010	<0.000010	<0.00010	<0.001
Maximum	1190	0.157	0.00145	0.0013	0.002	0.272	7	0.0005	0.05	0.006	0.00025	0.018	5.17
Percent of results below DL	0.7	8.0	1.7	3.4	61.2	0.2	0.5	92.7	0.7	22.4	65.0	1.5	20.2
Standard deviation	207.111	0.01551	0.00018	0.0001291	0.000235	0.040656	0.61	NA [a]	0.00495	0.000818	0.0000156	0.003952	0.79491
First quartile	410.25	0.0059	0.00045	0.0001022	<0.0010	0.069925	0.069	<0.000050	0.007	0.001	0.00001	0.002602	0.0052
Median	519	0.008	0.00053	0.0001565	<0.001	0.097	0.1475	<0.00020	0.01065	0.00123	0.00001	0.004995	0.259
Third quartile	675.25	0.012	0.0006	0.0002502	<0.0010	0.126	0.3315	<0.00020	0.01327	0.001828	0.000013	0.008645	0.74725

[a] Not applicable due to too few measurements above the detection limit

Table 3-20: Summary Statistics for Dissolved Metals of Interest at W16

W16													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	474	511	512	473	490	513	513	513	513	512	472	513	487
Average	167.3	0.01728	0.000393	0.00003095	0.000458	0.02643	0.1104	0.0000909	0.005066	0.00098	0.00000917	0.001057	0.00384
Minimum	13.3	<0.0010	<0.00010	<0.0000050	<0.00010	0.00158	<0.010	0.00002	<0.0010	<0.00050	<0.0000050	<0.00010	<0.0010
Maximum	355	0.234	0.0015	0.00557	0.0172	0.123	1.36	0.0008	0.03	0.009	0.0003	0.0064	0.0302
Percent of results below DL	0.0	6.5	11.1	35.3	75.3	0.0	4.9	92.6	6.0	40.2	96.0	7.6	70.0
Standard deviation	65.7	0.02345	0.00017	0.00025694	NA [a]	0.01818	0.22	NA [a]	0.004129	0.001052	NA [a]	0.000978	0.00491
First quartile	122.2	0.005	0.000318	<0.000010	0.0002	0.0151	0.025	<0.000050	0.00272	0.0005	0.000005	0.0005	0.0025
Median	180.5	0.0092	0.0004	0.00001	0.0005	0.0213	0.0543	<0.00020	0.00393	0.00075	0.00001	0.0008	<0.0050
Third quartile	210	0.0193	0.00047	0.00002	0.0005	0.0303	0.0934	<0.00020	0.0057	0.001057	0.00001	0.00129	0.0025

[a] Not applicable due to too few measurements above the detection limit

Table 3-21: Summary Statistics for Dissolved Metals of Interest at W17

W17													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	912	842	955	794	848	956	956	934	956	953	836	956	847
Average	235.73	0.00503	0.000377	0.00002049	0.000411	0.00692	0.01743	0.0000852	0.0063355	0.000906	0.00000888	0.0009122	0.00286
Minimum	<0.50	<0.0010	<0.00010	<0.0000050	<0.00010	<0.00020	<0.0050	0.000009	<0.000050	<0.00050	<0.0000050	<0.000050	<0.0010
Maximum	387	0.255	0.0037	0.00278	0.008	0.0371	0.45	0.0008	0.02	0.011	0.00053	0.005	0.043
Percent of results below DL	0.3	22.4	12.8	60.7	76.1	0.1	61.0	95.0	0.4	47.0	98.8	6.5	77.9
Standard deviation	35.511	0.01111	0.000207	0.00014145	NA [a]	0.003234	0.04	NA [a]	0.0015333	0.001113	NA [a]	0.0007756	NA [a]
First quartile	215	0.0016	0.00031	0.000005	0.00012	0.0051	0.0025	0.000025	0.00545	<0.0010	0.000005	0.000398	0.0011
Median	233	0.0028	0.00037	0.000005	0.0005	0.00609	0.00595	0.0001	0.006	0.00058	0.00001	0.00054	<0.005
Third quartile	260	0.005	0.0004	0.00001	0.0005	0.0074	0.014	0.0001	0.007	0.001	0.00001	0.0010525	0.0025

[a] Not applicable due to too few measurements above the detection limit

Table 3-22: Summary Statistics for Dissolved Metals of Interest at W62

W62													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	73	73	73	73	70	73	73	70	73	73	71	73	73
Average	575.5	0.0046	0.00045	0.00002837	0.000191	0.04992	0.0328	0.0000256	0.007986	0.001046	0.0000055	0.004128	0.0982
Minimum	84	0.0017	0.00011	<0.0000050	<0.00010	0.00195	<0.010	<0.000050	0.00042	<0.00050	<0.000010	0.000095	0.0018
Maximum	808	0.0308	0.00072	0.000115	0.00037	0.0724	0.074	0.000064	0.01	0.00161	0.000017	0.0115	0.799
Percent of results below DL	0.0	0.0	0.0	1.4	7.1	0.0	2.7	98.6	0.0	5.5	94.4	0.0	0.0
Standard deviation	115.3	0.0045	0.0001	0.00001803	0.000064	0.01214	0.01	NA [a]	0.002315	0.000244	NA [a]	0.001919	0.1326
First quartile	516	0.0024	0.00039	0.0000175	0.00016	0.0449	0.023	0.000025	0.00629	0.00096	0.000005	0.00307	0.0303
Median	565	0.0032	0.00044	0.0000232	0.00019	0.051	0.03	0.000025	0.00784	0.0011	<0.000010	0.00371	0.0562
Third quartile	655	0.0048	0.00052	0.0000312	0.00023	0.057	0.039	0.000025	0.00918	0.00116	0.000005	0.00472	0.113

[a] Not applicable due to too few measurements above the detection limit

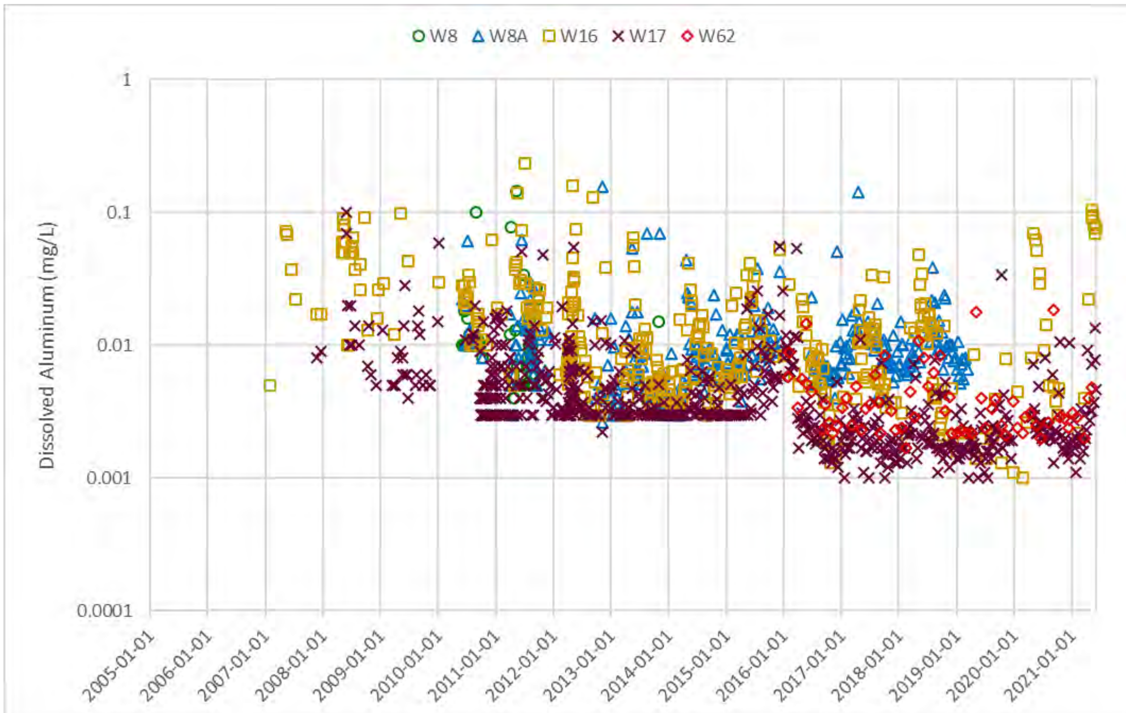


Figure 3-25: Dissolved Aluminum at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

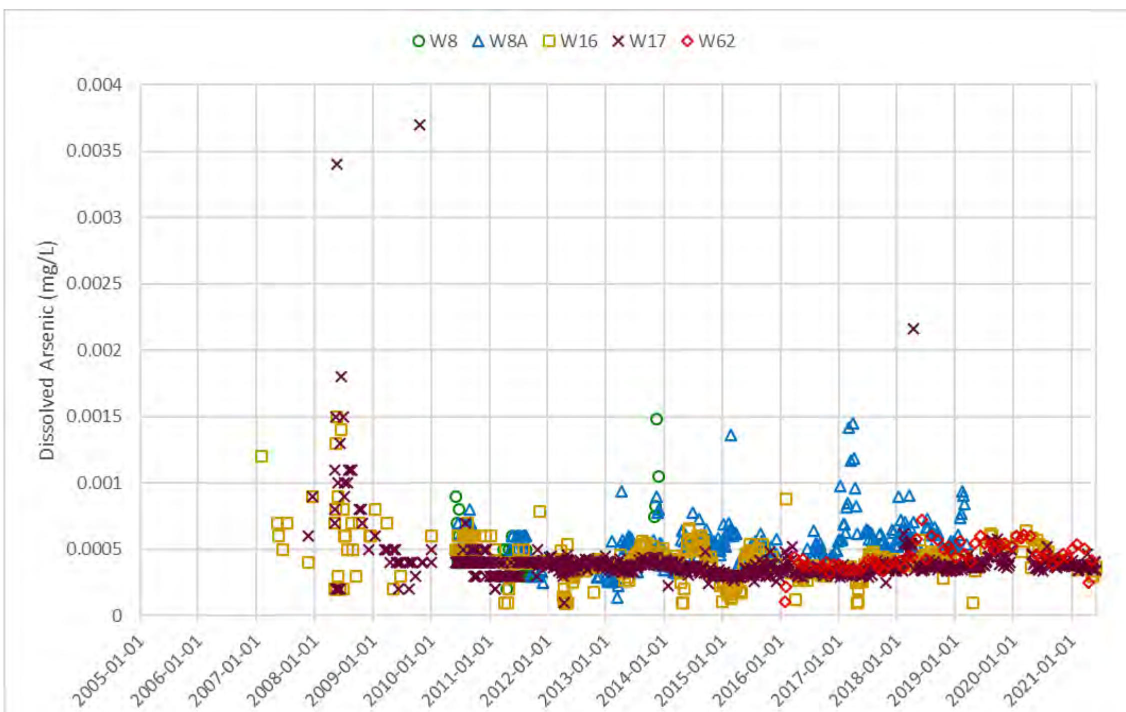


Figure 3-26: Dissolved Arsenic at Lower Minto Mine Facility Monitoring Locations.

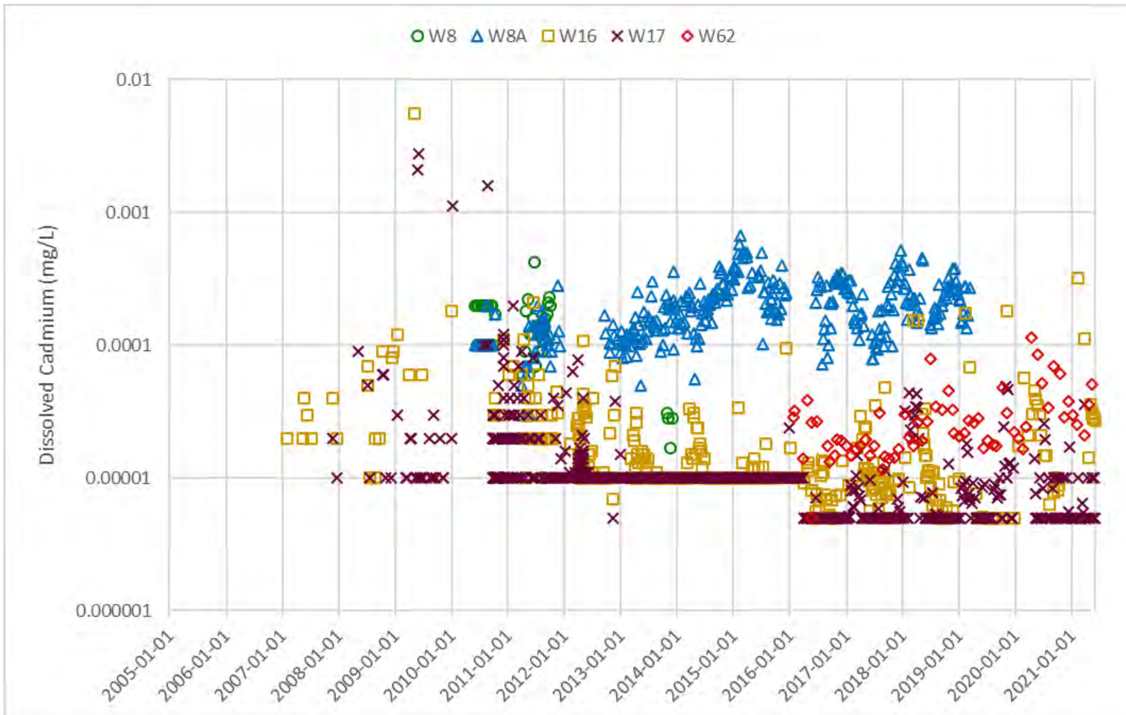


Figure 3-27: Dissolved Cadmium at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

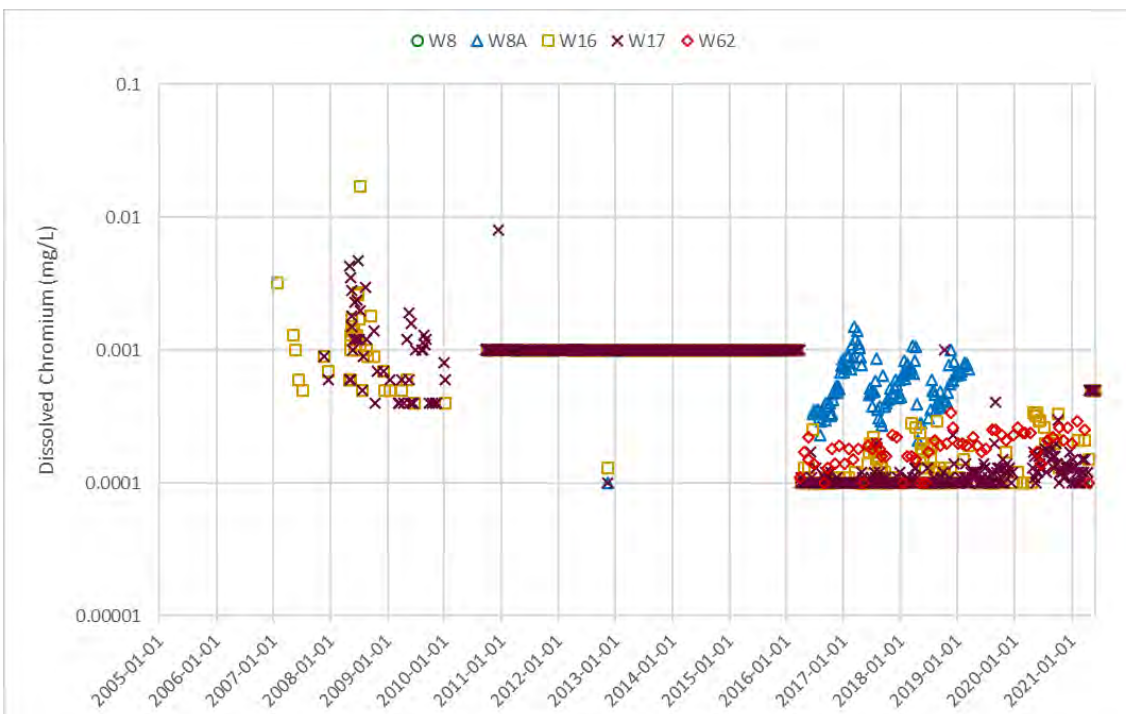


Figure 3-28: Dissolved Chromium at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

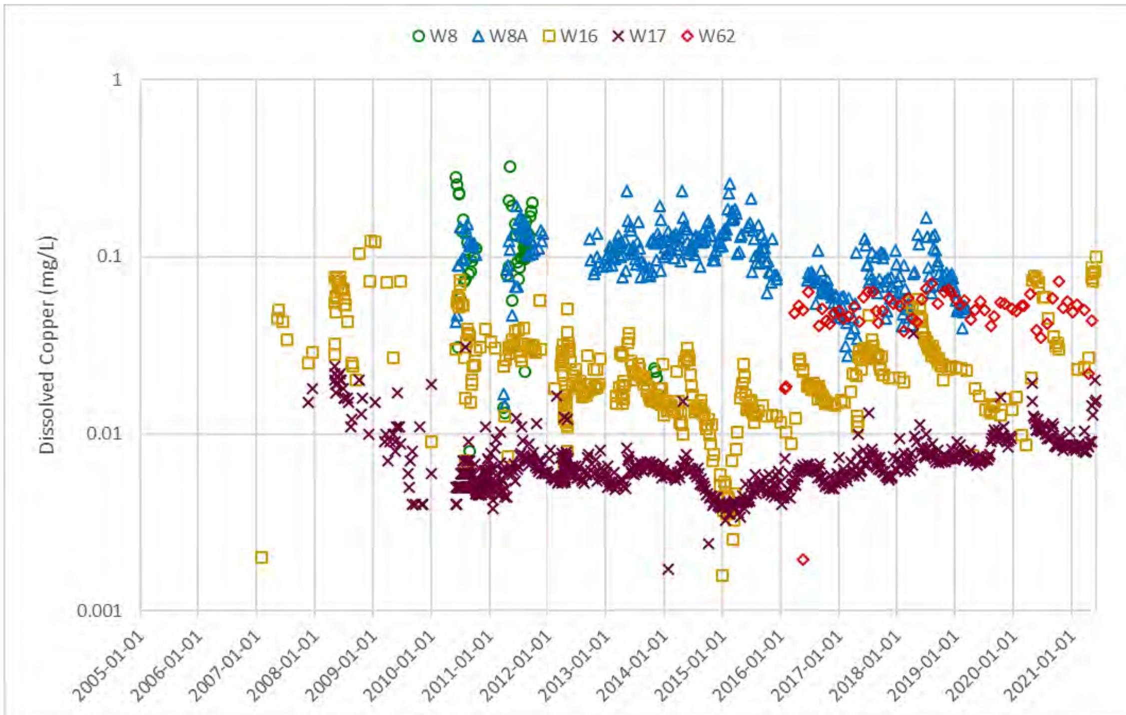


Figure 3-29: Dissolved Copper at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

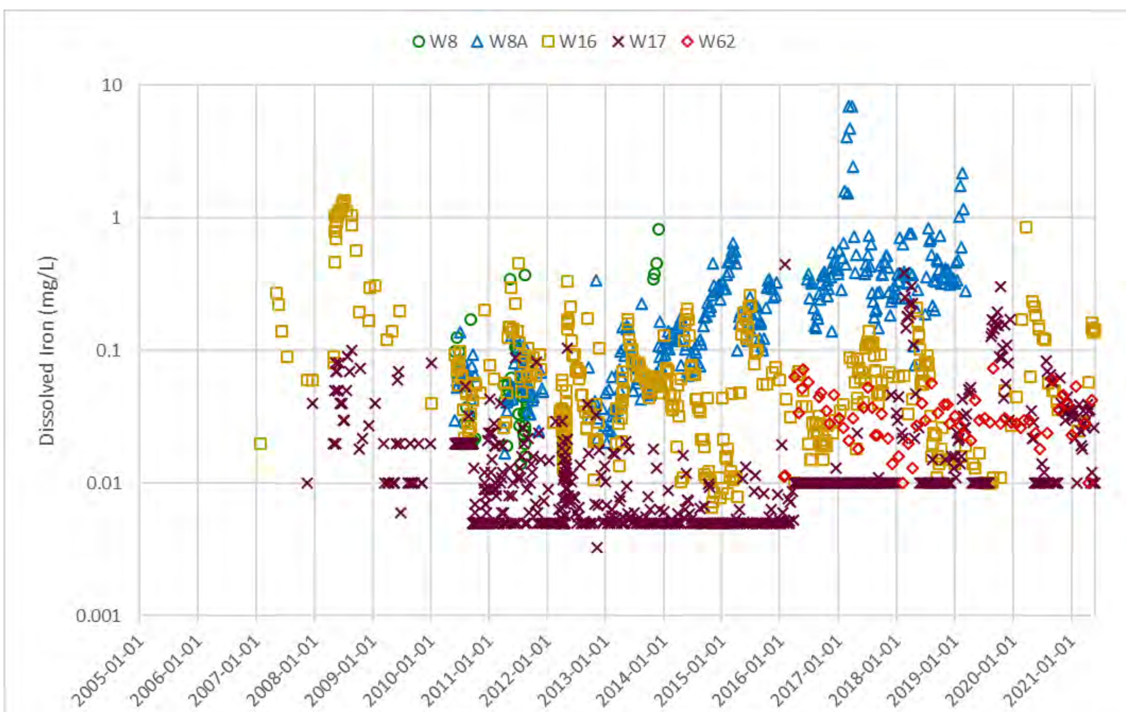


Figure 3-30: Dissolved Iron at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

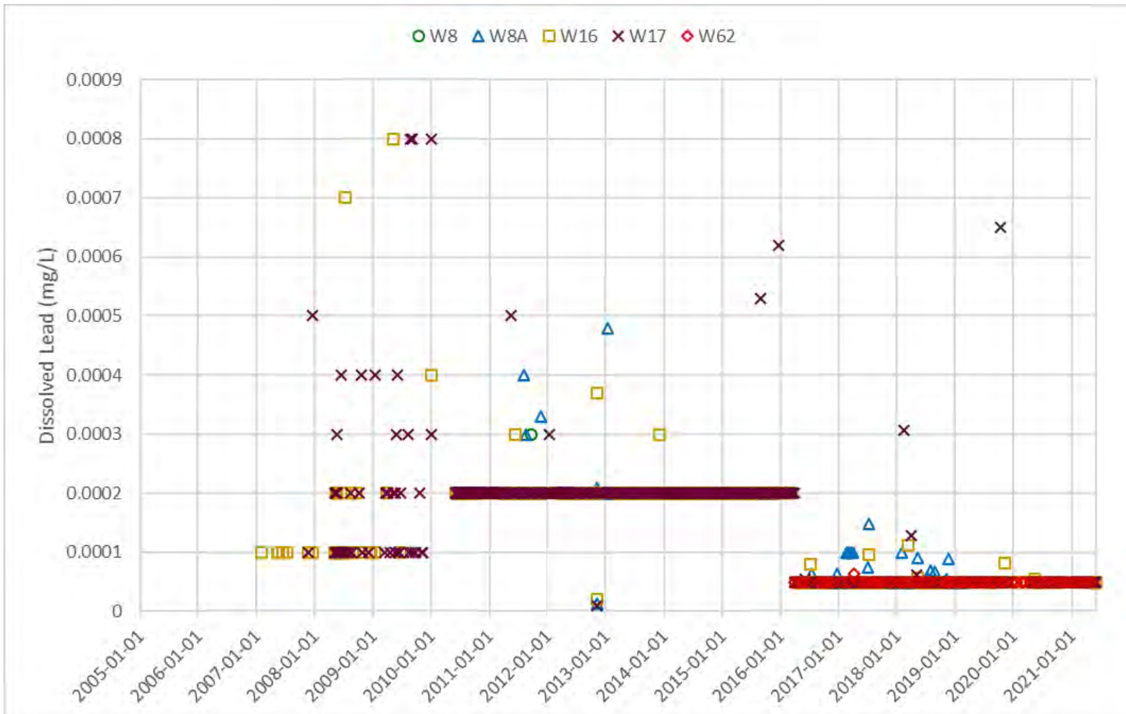


Figure 3-31: Dissolved Lead at Lower Minto Mine Facility Monitoring Locations.

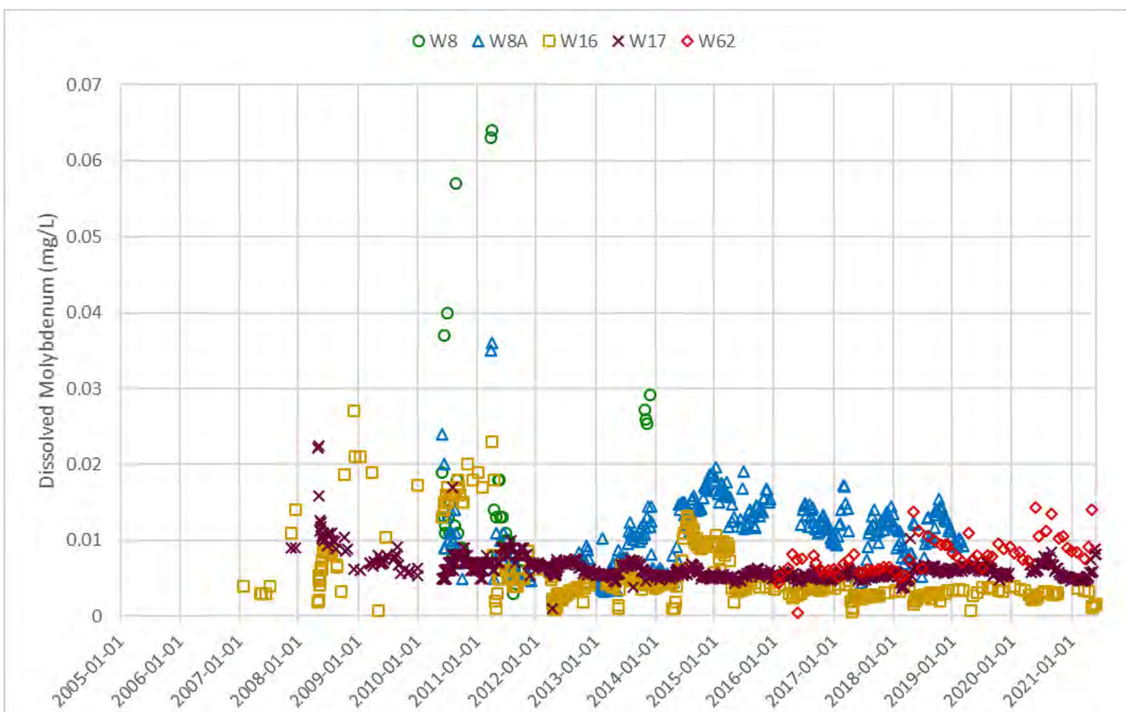


Figure 3-32: Dissolved Molybdenum at Lower Minto Mine Facility Monitoring Locations.

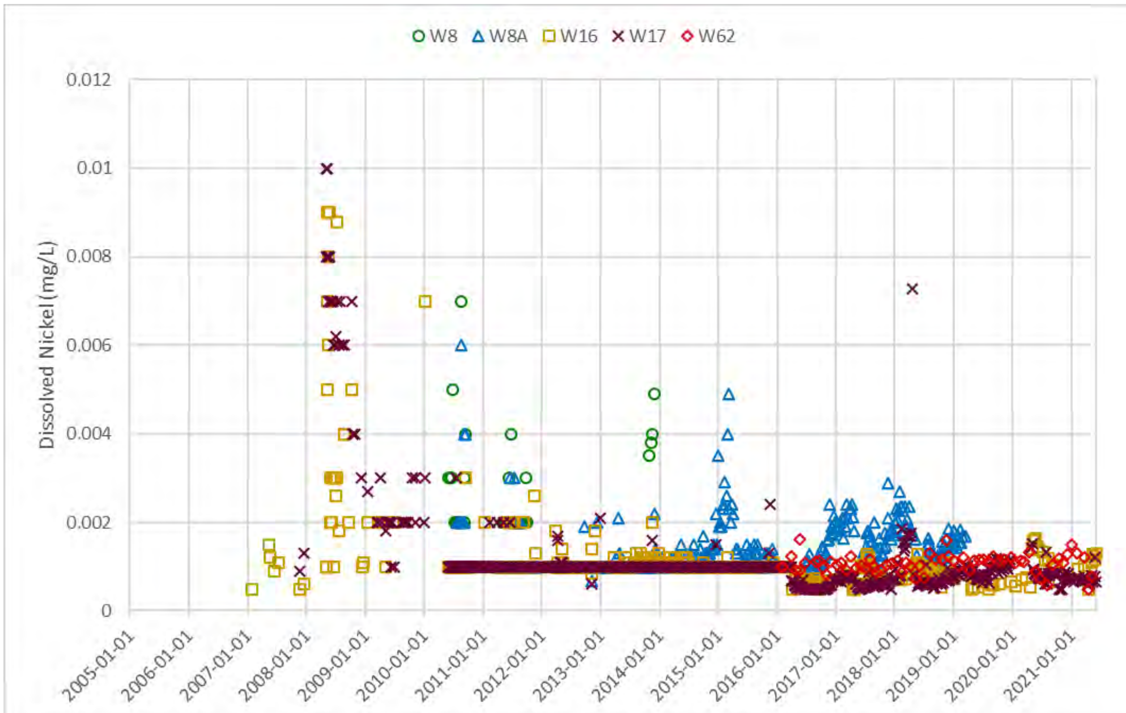


Figure 3-33: Dissolved Nickel at Lower Minto Mine Facility Monitoring Locations.

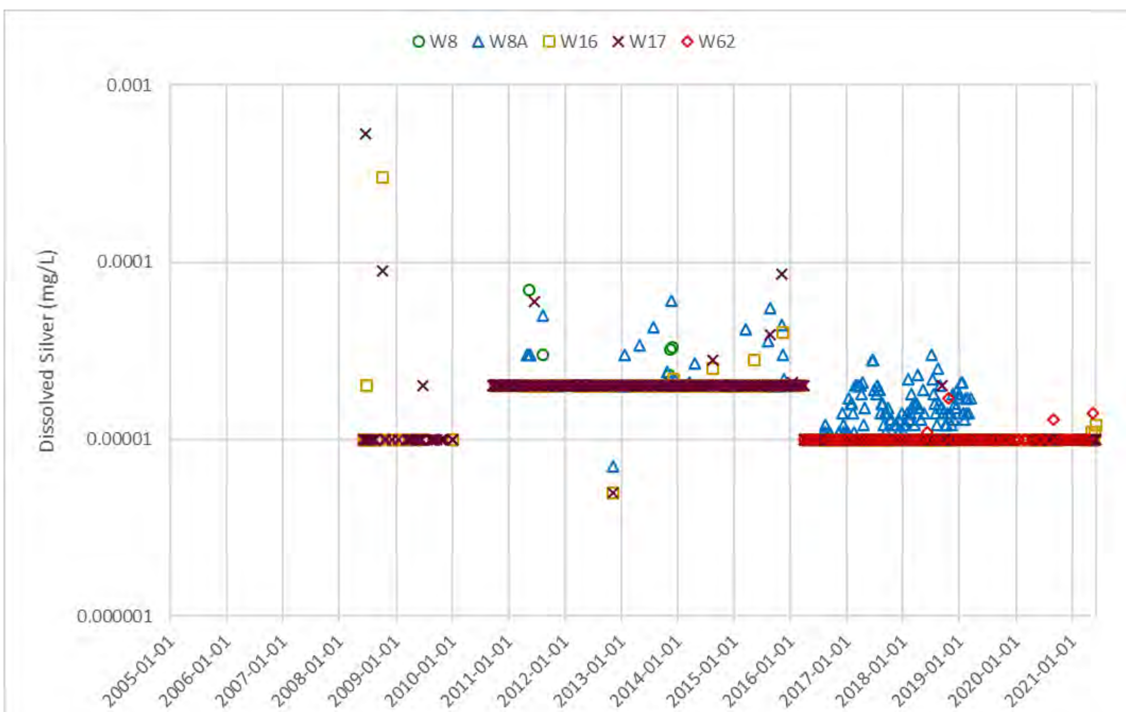


Figure 3-34: Dissolved Silver at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

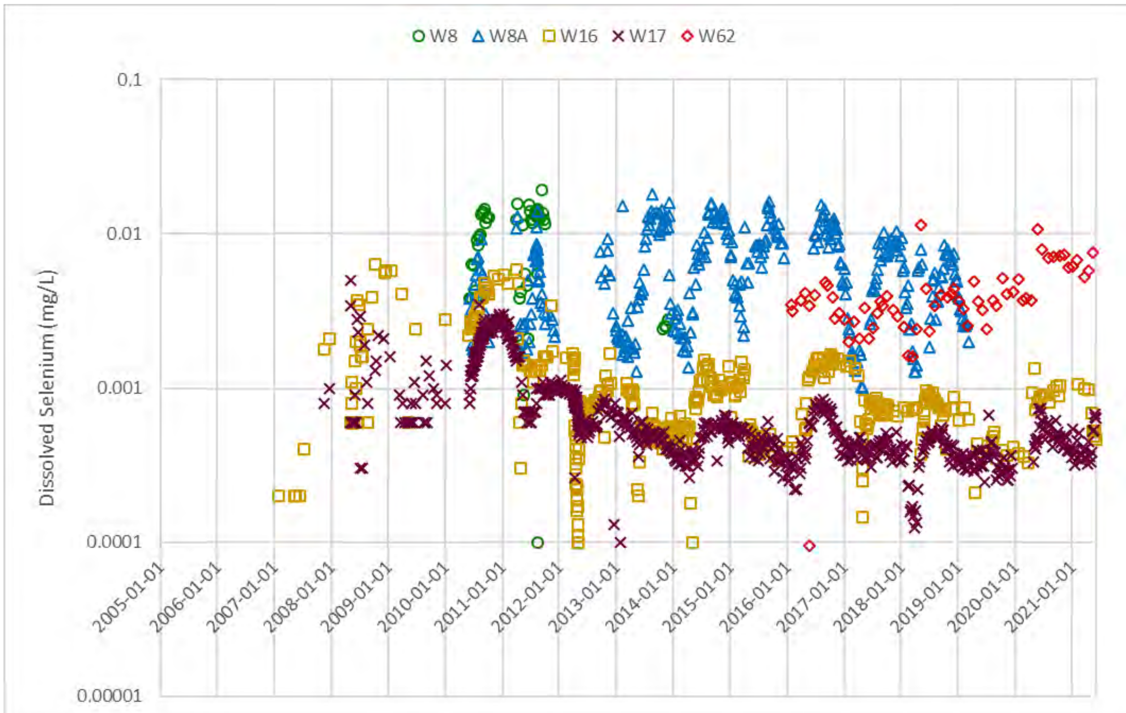


Figure 3-35: Dissolved Selenium at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

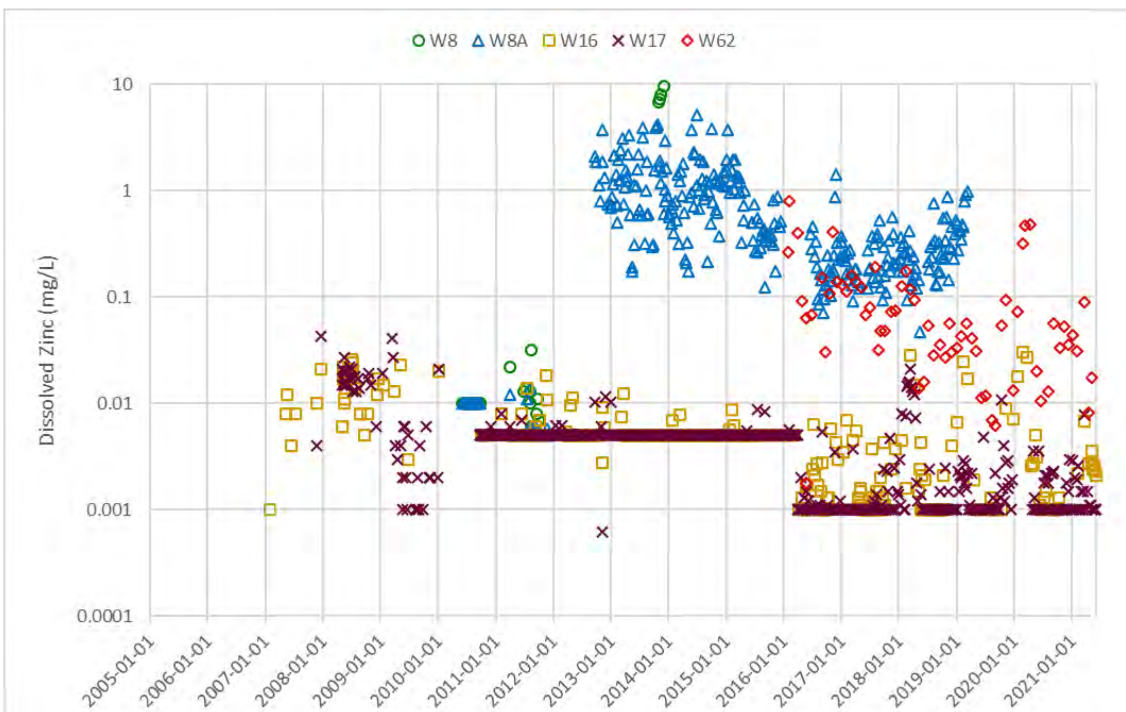


Figure 3-36: Dissolved Zinc at Lower Minto Mine Facility Monitoring Locations. Note Log Scale.

3.2 MINTO NORTH PIT

The Minto North Pit (sampling site MN) has not discharged any water and is not expected to discharge water during the operational period. As such, its water quality is considered separately here.

3.2.1 Physical Parameters, Anions and Nutrients

Statistical summaries of physical parameters and anion and nutrient concentrations at site MN are presented in Table 3-23. TSS, field pH, nitrate, nitrite, ammonia, and sulphate data are presented in Figure 3-37 through Figure 3-42.

The waters in the Mino North pit were circumneutral to mildly alkaline, ranging from pH 7.0 to 8.6 (median 7.8). Temperature varied seasonally from 0.2 to 18°C. Unlike the other flooded pits at the mine site, the Minto North Pit water appeared relatively well oxygenated (median 80% oxygen saturation). Field measured conductivity was lower than that observed at the other flooded pits (median 382 µS/cm) and showed no clear seasonal trends. TSS ranged from <3 mg/L to 779 mg/L (median 8.3 mg/L) and also showed no seasonal trends.

Sulphate concentrations ranged from 27 to 193 mg/L (median 85 mg/L) with the highest concentrations observed over summer/fall 2016. Elevated concentrations of nitrogen species were observed in the Minto North Pit in 2016 but have decreased markedly since that time with median concentrations of nitrite-N, nitrate-N and ammonia-N of 0.07, 16.9, and 0.248 mg/L, respectively. The elevated nitrogen species concentrations were likely related to nitrogen residues from blasting activity in the pit that have since dissipated.

3.2.2 Metals

Statistical summaries of dissolved metals concentrations at site MN are presented in Table 3-24. Dissolved metal concentrations are plotted in Figure 3-43 through Figure 3-54.

Minto North Pit water has a median hardness of 200 mg/L and did not display any seasonal variation during the monitored period. Indeed, no obvious seasonal trends were observed in the Minto North Pit trace element data, perhaps due to its relatively limited dataset.

Dissolved chromium and lead concentrations were near or below detection for all the MN samples collected to date. The majority of nickel (79%), silver (73%), and zinc (55%) measurements were also below detection, with the measurable data indicating generally low concentrations of these elements in the Minto North Pit.

Concentrations of dissolved aluminum, arsenic, cadmium, molybdenum, and nickel were also unremarkable, with median values of 0.0049, 0.00046, 0.00003, 0.02, and 0.00025 mg/L, respectively. Dissolved selenium concentrations were also relatively stable throughout the period of record (median 0.013 mg/L). MN waters generally contained elevated dissolved copper concentrations (0.072 to 0.56 mg/L; median 0.019 mg/L).

Table 3-23: Summary Statistics for Physical Parameters, Anions and Nutrients at MN (Minto North Pit)

	MN														
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	29	28	28	28	25	25	25	29	4	29	29	29	29	4	27
Average	55.45	7.84	666.1	9.5	9.05	78.1	202.3	2.7	1.32	84.5	5.5868	2.0917	65.67	2.97	0.061
Minimum	<3.0	7.03	164.8	0.2	4.24	42.4	-54	0.51	0.27	26.7	0.0141	0.0126	5.43	0.79	<0.050
Maximum	779	8.6	1975	18.9	13.66	102.3	1521	16	2.48	193	51	14.7	342	8.36	0.533
Percent of results below DL	31.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	77.8
Standard deviation	146.1	0.38	553.9	5.8	2.43	14.3	282.40	3.2	0.97	35	10.9068	3.9082	90.04	3.62	NA [a]
First quartile	<3.0	7.6	314.7	3.9	7.57	68.7	131.4	1.17	0.68	70.2	0.0383	0.0494	14	0.89	0.025
Median	8.3	7.79	382.3	9.1	8.2	79.5	166.7	1.37	1.26	85.3	0.248	0.0712	16.9	1.36	<0.050
Third quartile	29.7	8.05	812.5	15.3	10.1	87.9	191.3	<5.0	1.9	92.2	6.4	1.52	97.1	3.44	0.025

[a] Not applicable due to too few measurements above the detection limit

Table 3-24: Summary Statistics for Dissolved Metals of Interest at MN (Minto North Pit)

	MN												
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	27	29	29	29	23	29	29	24	29	28	26	29	28
Average	364	0.0076	0.00051	0.00005617	0.000073	0.0717	0.0447	0.0000687	0.0201	0.000622	0.0001955	0.01462	0.00286
Minimum	119	0.0018	0.0002	<0.000010	<0.00010	0.00772	<0.010	<0.000050	0.0077	<0.00050	<0.000010	0.00385	<0.0010
Maximum	1260	0.0266	0.00142	0.000283	0.00047	0.562	0.449	0.00101	0.04	0.0041	0.00483	0.0627	0.0159
Percent of results below DL	0.0	0.0	0.0	10.3	91.3	0.0	55.2	91.7	0.0	78.6	88.5	0.0	57.1
Standard deviation	316	0.0064	0.00023	0.0000565	NA [a]	0.12496	0.10	NA [a]	0.0066	NA [a]	NA [a]	0.01042	0.00376
First quartile	174	0.0035	0.00041	0.0000271	0.00005	0.0115	<0.010	0.000025	0.0164	0.00025	0.000005	0.00961	0.0005
Median	200	0.0049	0.00046	0.0000369	<0.00010	0.0196	<0.010	0.000025	0.0207	0.00025	0.000005	0.0134	0.0011
Third quartile	460	0.009	0.00051	0.000071	0.00005	0.0508	0.019	0.000025	0.0225	0.00025	0.000005	0.017	0.0029

[a] Not applicable due to too few measurements above the detection limit.

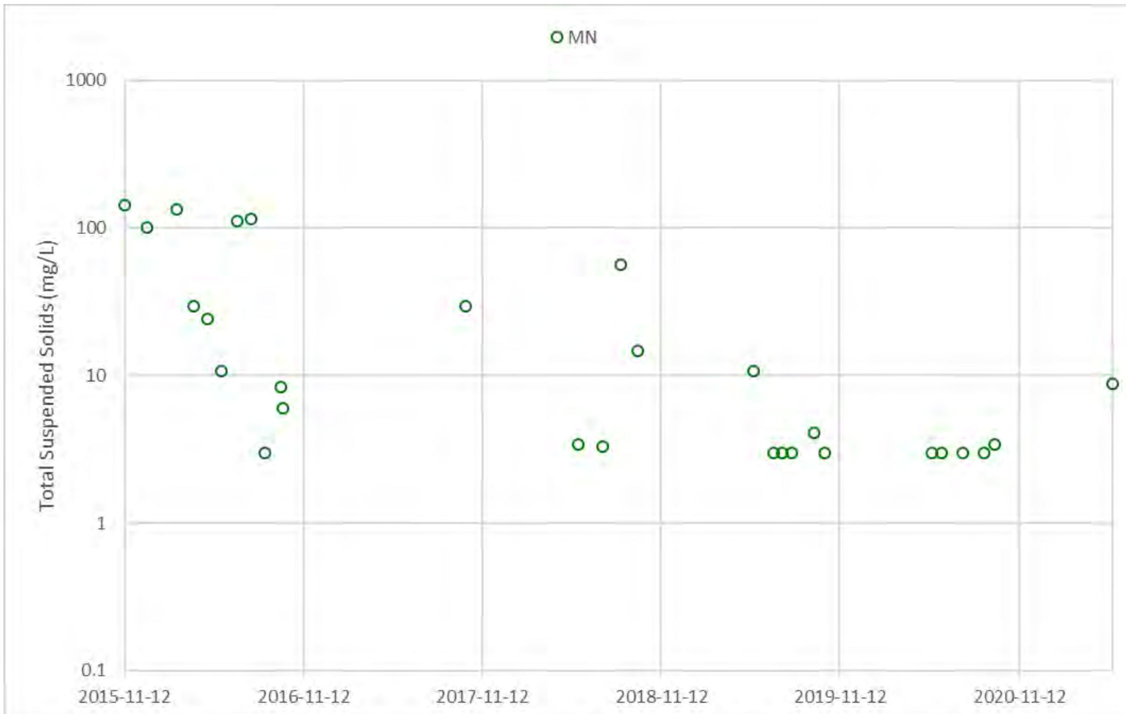


Figure 3-37: Total Suspended Solids at MN (Minto North Pit). Note Log Scale.

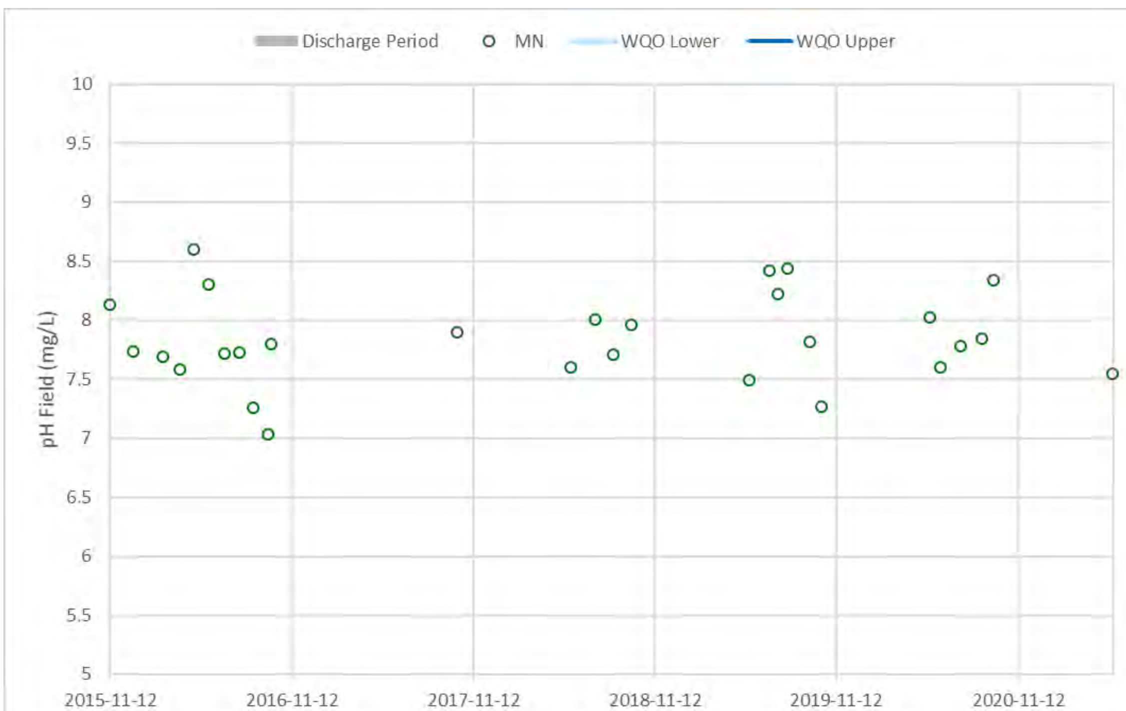


Figure 3-38: Field pH at MN (Minto North Pit)

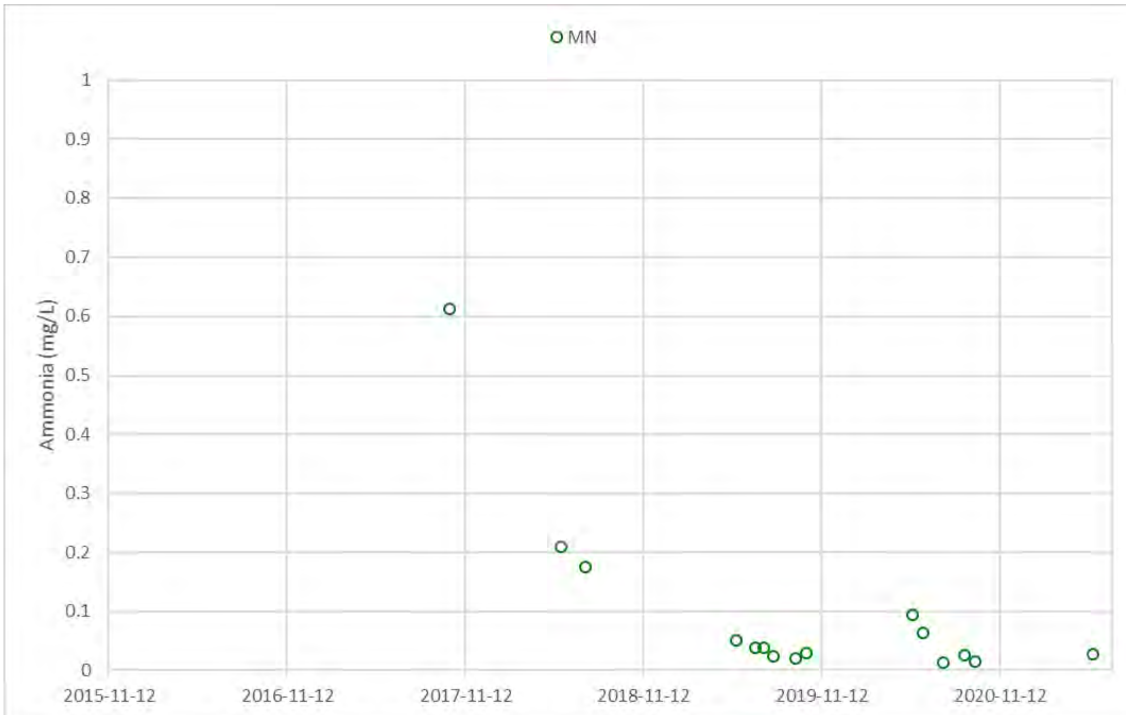


Figure 3-39: Ammonia (N) at MN (Minto North Pit)

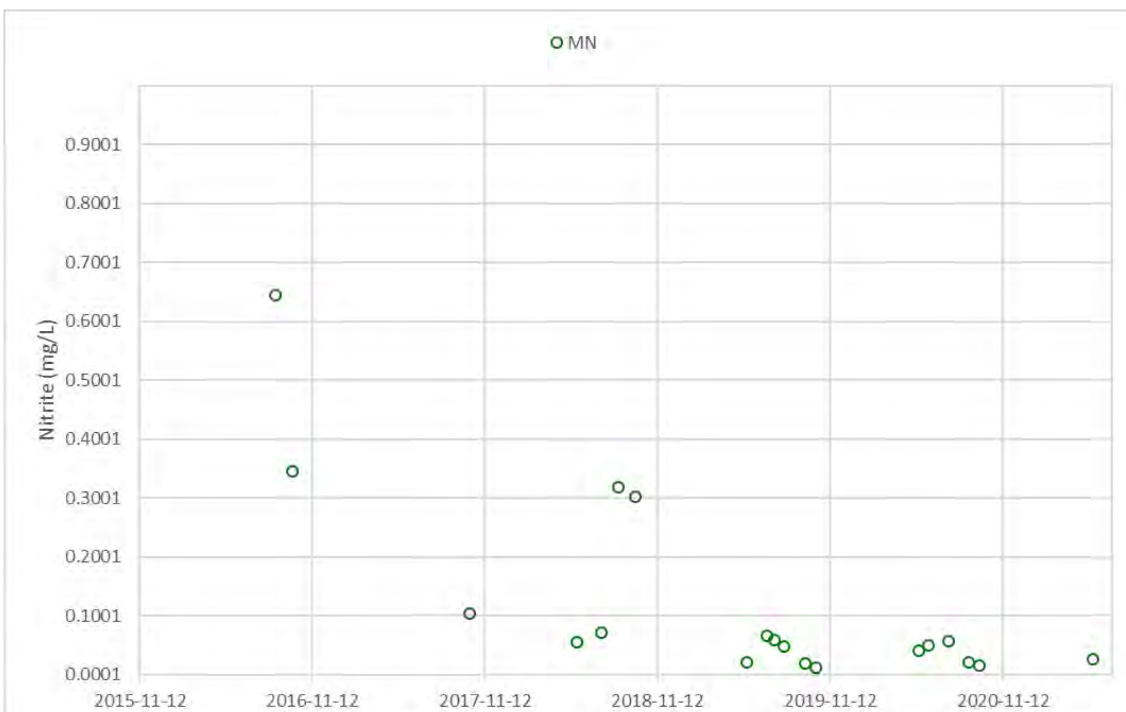


Figure 3-40: Nitrite (N) at MN (Minto North Pit)

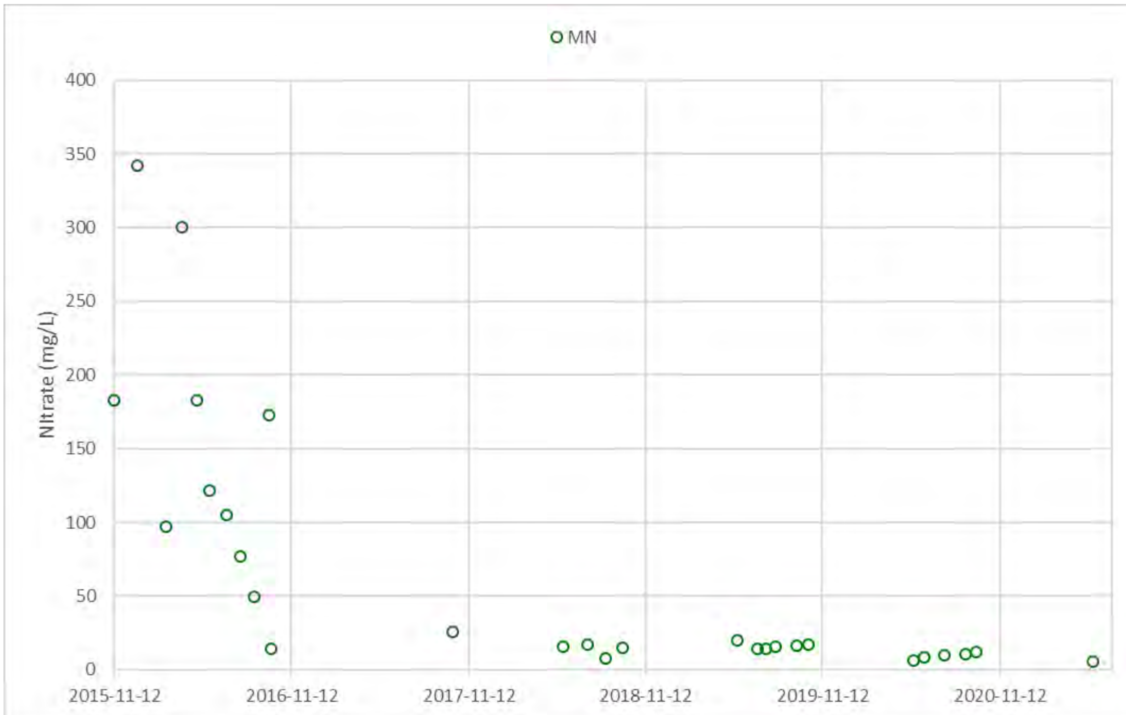


Figure 3-41: Nitrate (N) at MN (Minto North Pit)

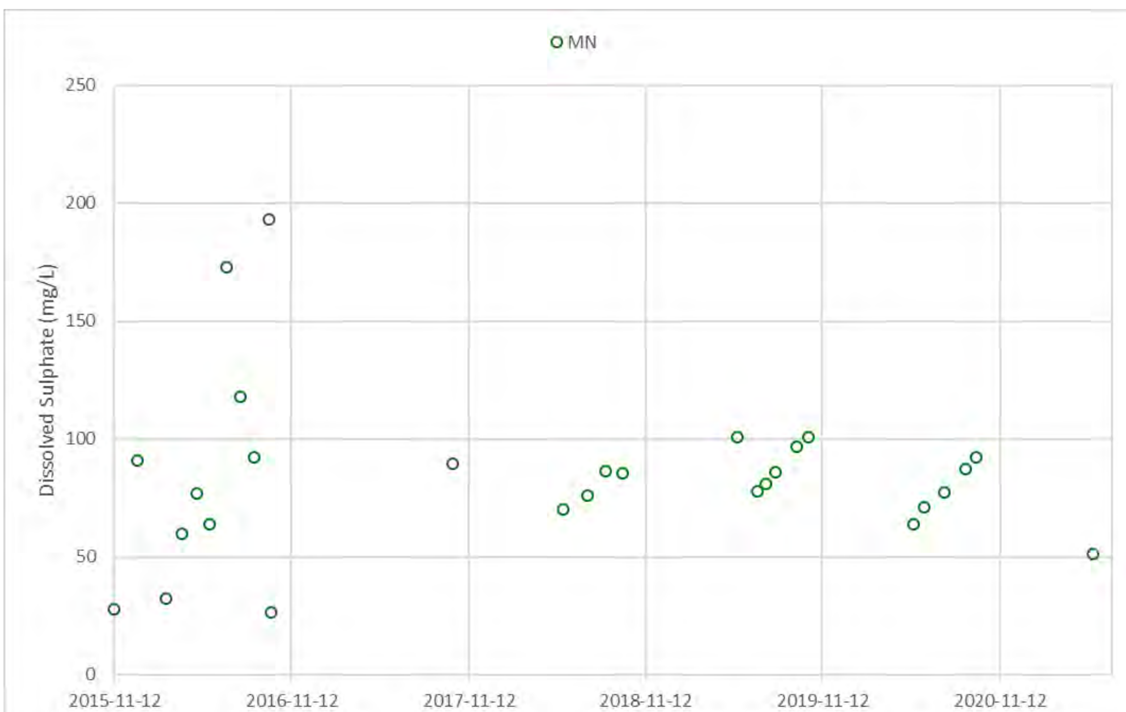


Figure 3-42: Dissolved Sulphate at MN (Minto North Pit)

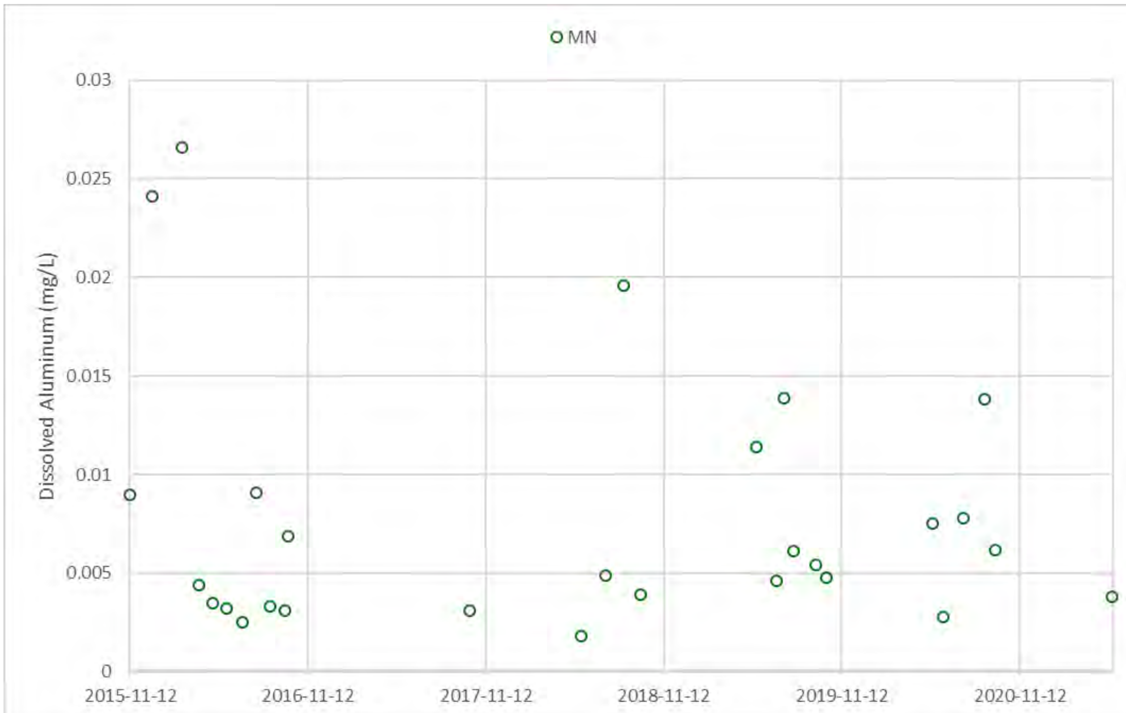


Figure 3-43: Dissolved Aluminum at MN (Minto North Pit)

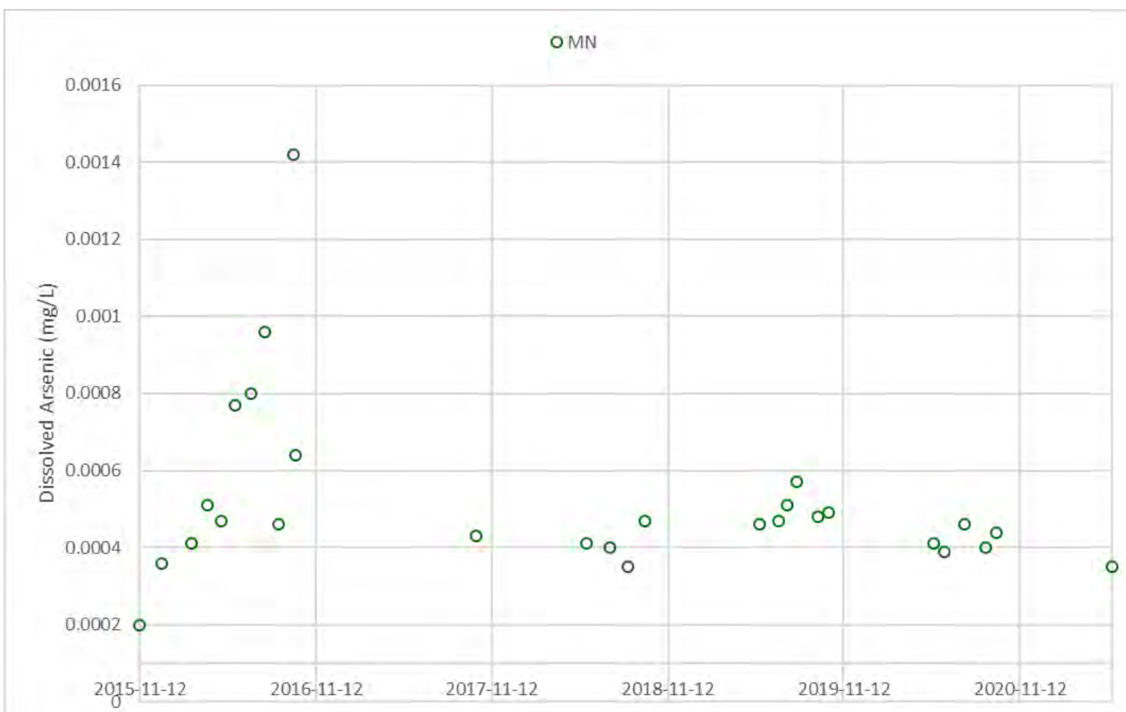


Figure 3-44: Dissolved Arsenic at MN (Minto North Pit)

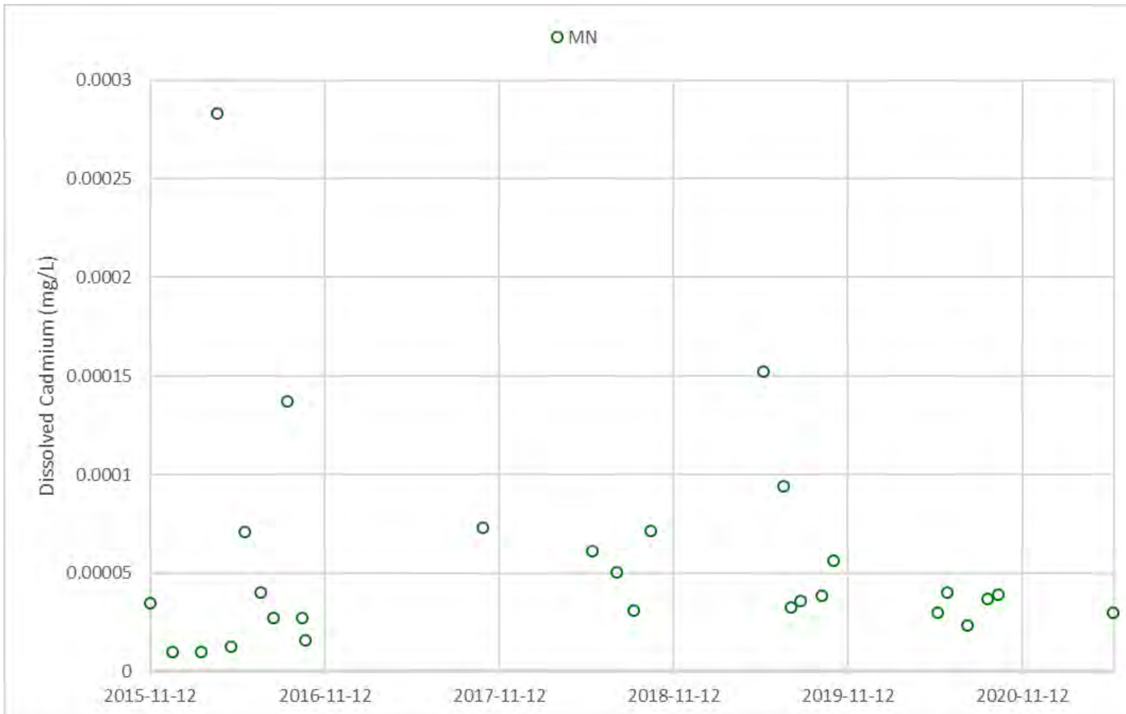


Figure 3-45: Dissolved Cadmium at MN (Minto North Pit)

Figure 3-46: Dissolved Chromium at MN (Minto North Pit)

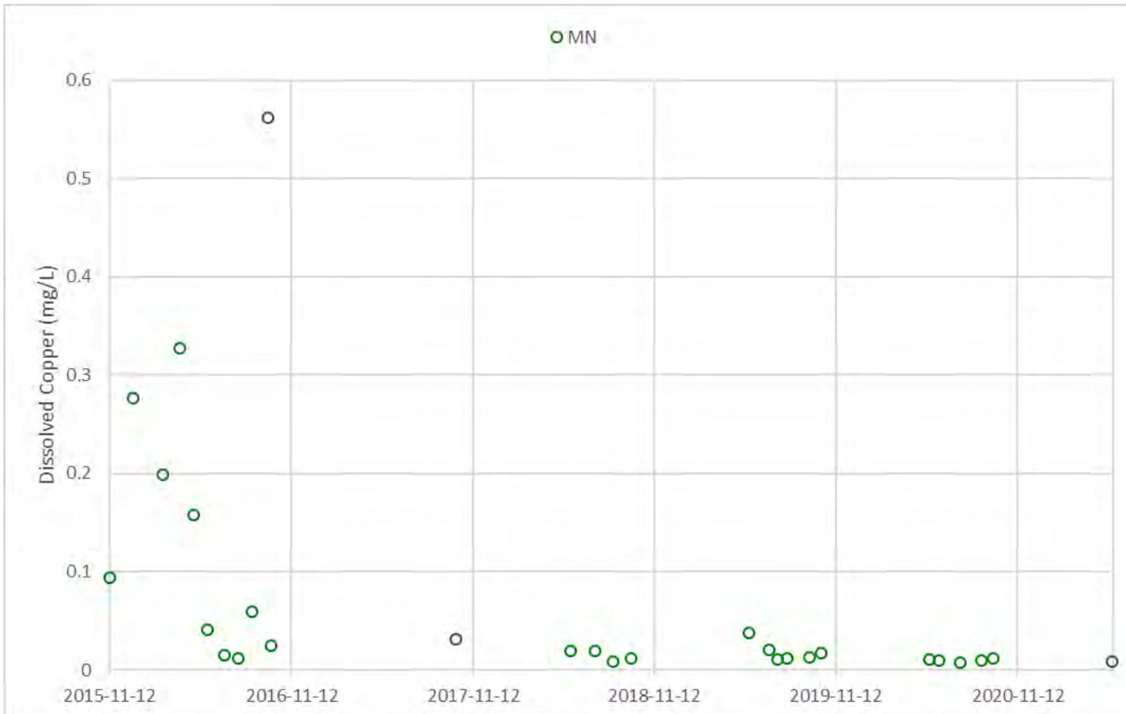


Figure 3-47: Dissolved Copper at MN (Minto North Pit)

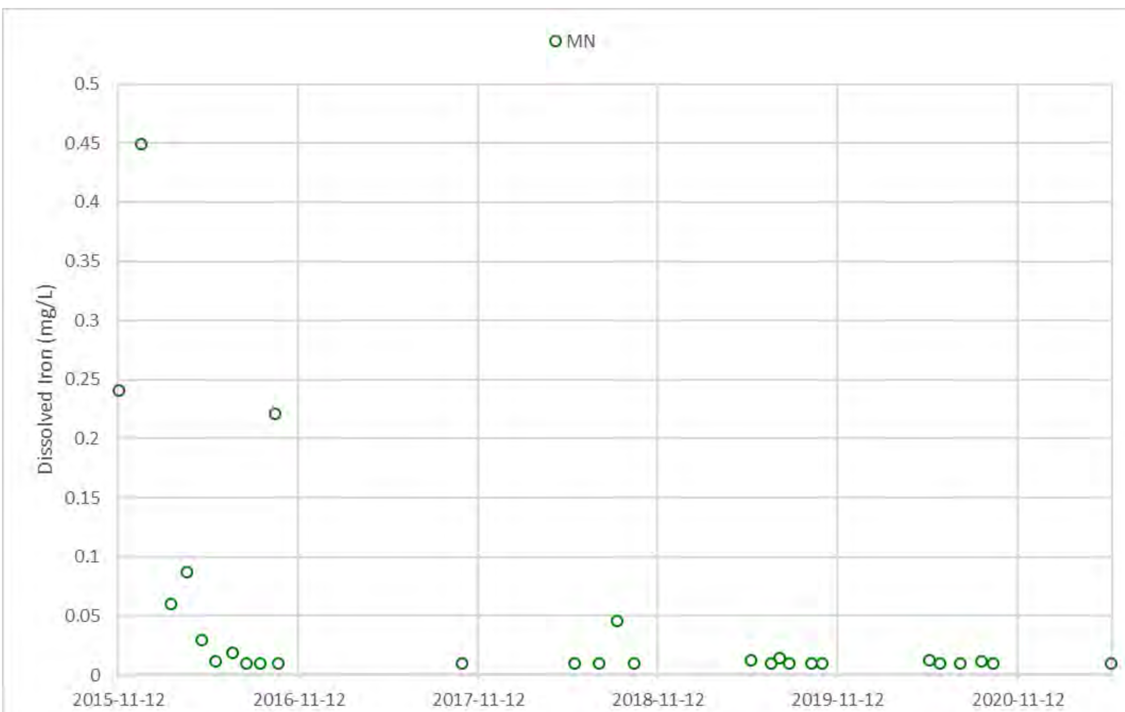


Figure 3-48: Dissolved Iron at MN (Minto North Pit)

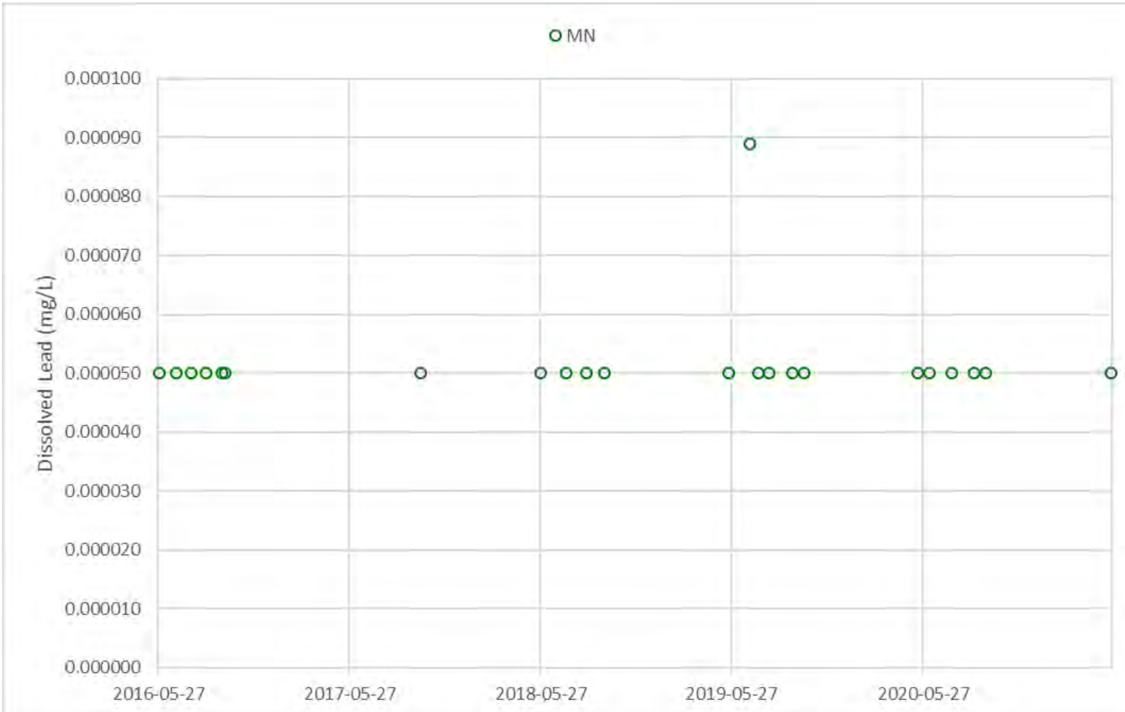


Figure 3-49: Dissolved Lead at MN (Minto North Pit)

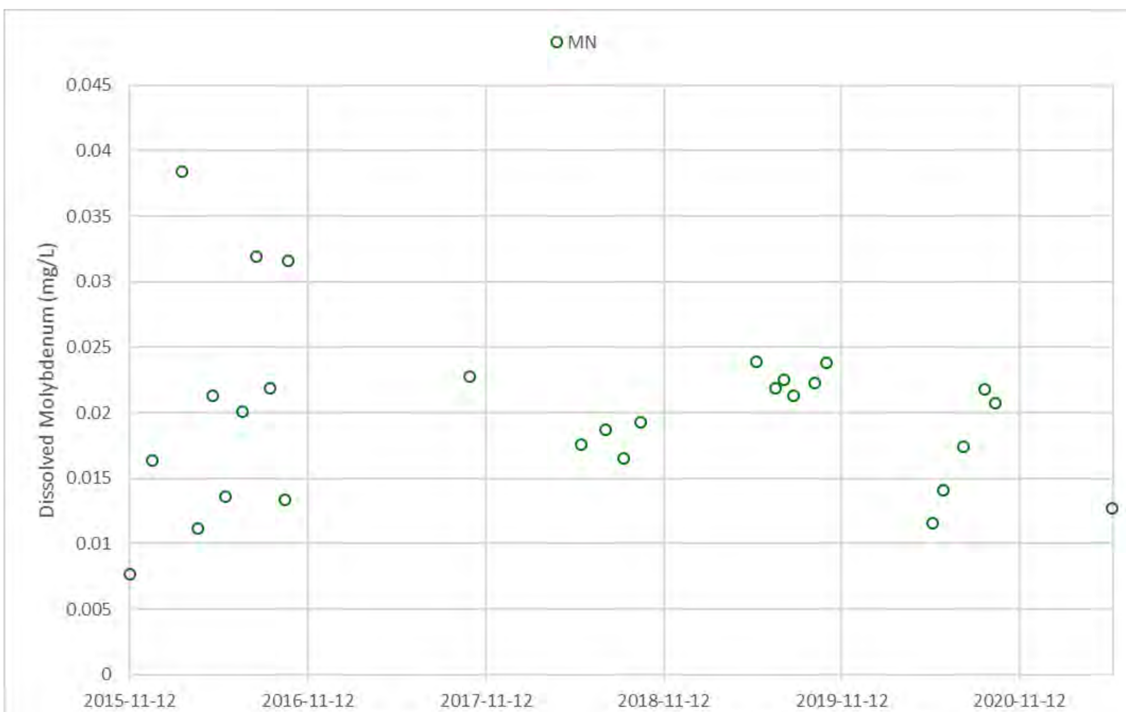


Figure 3-50: Dissolved Molybdenum at MN (Minto North Pit)

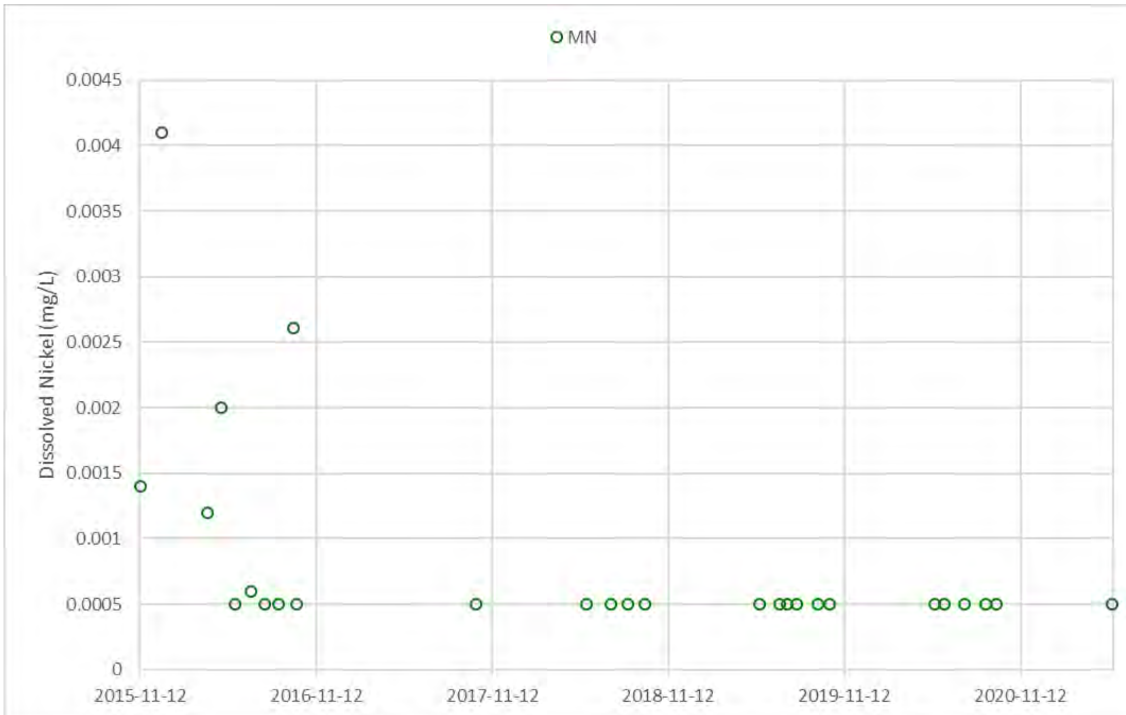


Figure 3-51: Dissolved Nickel at MN (Minto North Pit)

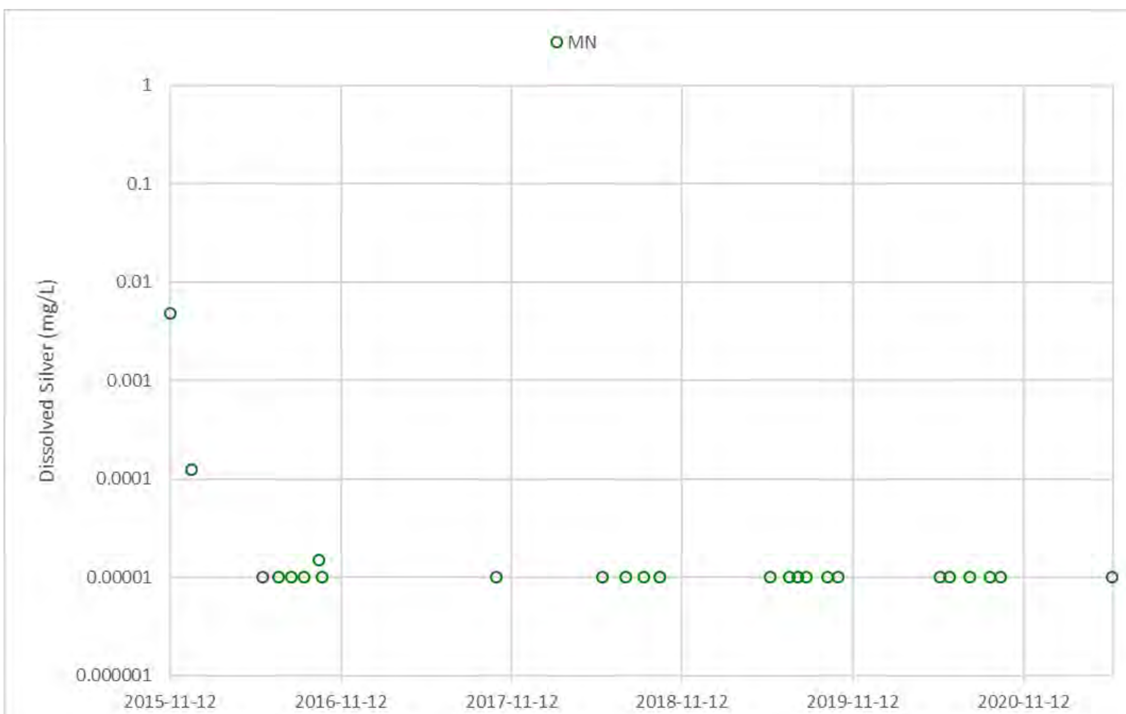


Figure 3-52: Dissolved Silver at MN (Minto North Pit). Note Log Scale.

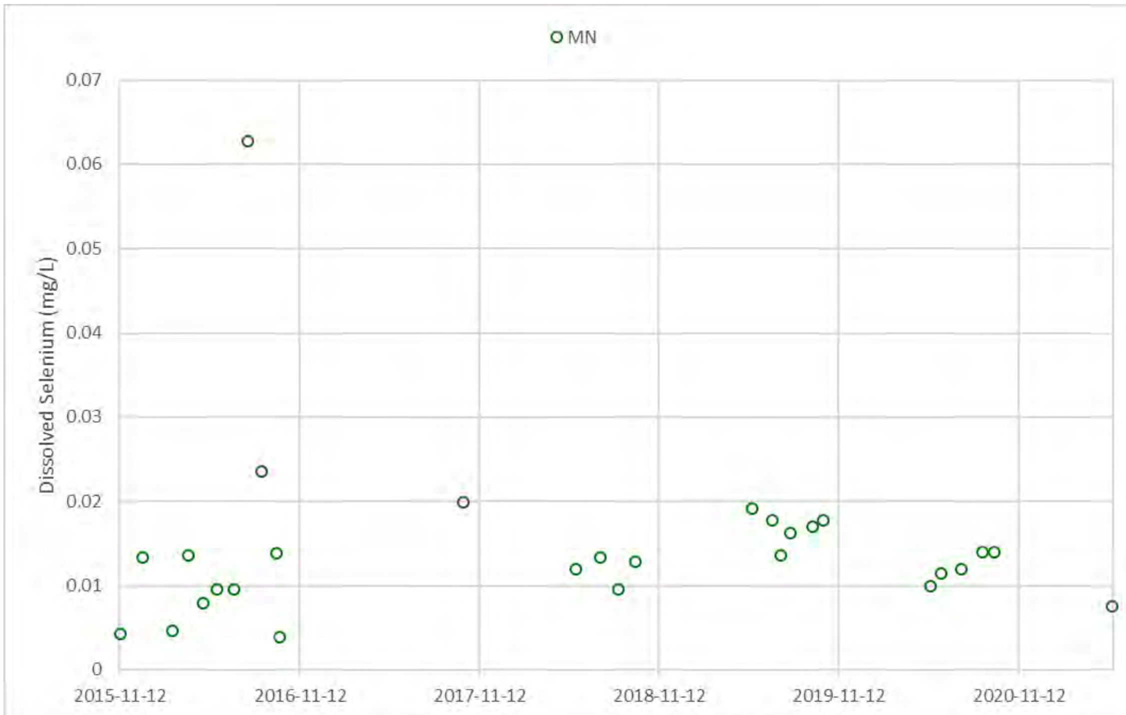


Figure 3-53: Dissolved Selenium at MN (Minto North Pit)

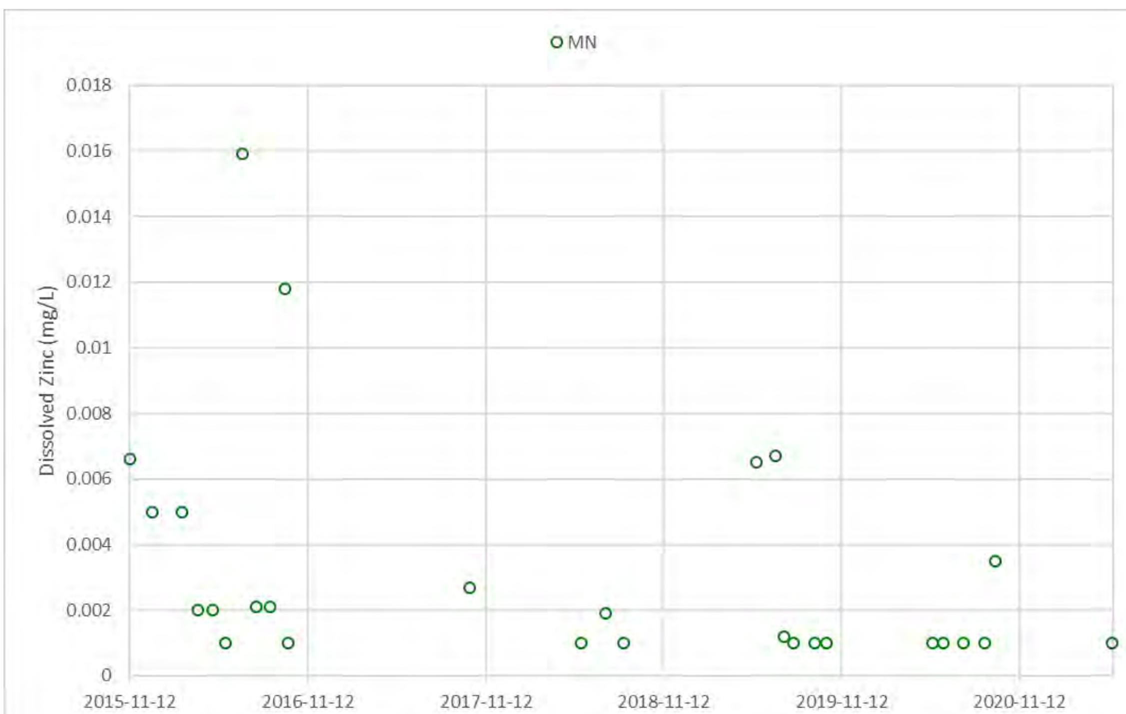


Figure 3-54: Dissolved Zinc at MN (Minto North Pit)

3.3 MINTO CREEK

Discussion of water quality data in Minto Creek comprises results for sample stations W50, W3, MC1 and W2 as outlined in Section 2.1.3. Examined parameters included those included in the list of EQS and WQO in Water License QZ14-031. Interpretation of water quality results was performed in terms of operations without mine discharge (Section 3.3.1) and operations with mine discharge (Section 3.3.2). Water quality in the pre-operations phase was presented and discussed previously in Minnow, 2016. Plots depicting examined parameters (physical parameters, anions, nutrients and dissolved metals concentrations) temporally at Minto Creek stations are shown in Figure 3-55 through Figure 3-108.

EQS, WQO, and MMER standards are shown on plots for W50, W2, and W3, respectively, for reference. In the case of the hardness-dependent cadmium EQS/WQO, the line depicting the EQS/WQO was calculated based on lower quartile hardness at W2 without mine discharge (126 mg/L). In the case of the DOC-dependent EQS/WQO for copper, the lower EQS/WQO is depicted on the plots for reference. Actual exceedances of these varying EQS/WQO were determined on a sample to sample basis and are reflected in the count of exceedances listed in the summary statistics tables.

To delineate the effects of mine site discharge on downstream water quality in Minto Creek, Sections 3.3.1 and 3.3.2 review the chemistry of Minto Creek for periods with and without mine site discharge, respectively. In general, higher concentrations of constituents related to the mine site (e.g., nitrogen species, copper, molybdenum, and selenium) were observed in downstream Minto Creek waters during periods of mine discharge.

3.3.1 Operational Phase without Mine Discharge

Water quality data collected at Minto Creek stations during the operational phase without mine discharge are presented and discussed for physical parameters and anion and nutrient concentrations in Section 3.3.1.1 and for dissolved metals in Section 3.1.1.2.

3.3.1.1 Physical Parameters, Anions and Nutrients

Statistical summaries for physical parameters and anion and nutrient concentrations at Minto Creek stations during periods without mine discharge are presented in Table 3-25 through Table 3-28.

The pH in Minto Creek without mine discharge has been circumneutral with medians ranging from pH 7.6 at W3 to pH 7.9 at MC1 and W2. Temperature varied seasonally from -2.5 to 15.3 °C. The waters of Minto Creek were well oxygenated with occasional lower oxygen content measurements (<40% saturation) generally made in winter months when ice cover could inhibit oxygen ingress to the creek. Median field conductivity decreased going downstream from W50 (304 µS/cm) and W3 (300 µS/cm) to MC1 (200 µS/cm) and W2 (202 µS/cm). Lower conductivity values at W2 were typically measured during high flow periods where dilution would have been provided by spring meltwater while higher measurements were typically made in late summer, fall and winter. This seasonal trend was less apparent at W3 closer to the site where higher conductivity measurements appeared to follow periods of mine discharge.

At all sites, TSS concentrations typically peak in April/May during freshet when the resulting higher flow regime washes particulates into Minto Creek and promotes erosive mobilization of particulates within the wetted width of the creek. TSS levels were generally lower at the upstream sites W3 and W50 (median 1.5 mg/L) than further downstream (median 4 and 8 mg/L at sites W2 and MC1, respectively). TSS concentrations exceed the EQS at W50 in eleven samples (8% of dataset). Exceedances of the MMER grab sample TSS guideline (30 mg/L) occurred in 12 samples (4% of dataset) at site W3 when there was no discharge from the mine site.

Nitrate-N concentrations at W3 and W50 appeared to be influenced by site discharge with higher concentrations often following periods of site discharge. Concentrations decreased following the end of a discharge period and typically reached minima in late summer/early fall due to uptake by primary producers that are most active during those times. Aside from mine discharge – and more apparent farther downstream at MC1 and W2 – nitrate-N concentrations typically increased during winter when uptake by primary producers was likely lowest. During periods without discharge from the mine site, ammonia-N concentrations were highest at W50 with a median concentration of 0.1235 mg/L. Throughout the rest of the Minto Creek stations median concentrations were <0.03 mg/L. No seasonal trends are apparent and higher concentrations often followed periods of mine discharge. Nitrite-N concentrations were often close to or below detection level at W3 and were higher downstream at W2 after periods of mine discharge. No exceedances of the nitrogen species EQS were observed at W50 during periods when the mine was not discharging. Four exceedances of the ammonia-N WQO were observed at W2; however, these occurred prior to August 2015 when this WQO was established with water licence QZ14-031.

DOC concentrations were higher in downstream stations MC1 (median 10.2 mg/L) and W2 (median 10.7 mg/L) than upstream station W3 (median 5.8 mg/L); however, DOC concentrations at W50 were highest at (median 12.5 mg/L), albeit in relatively fewer samples. At W3, higher DOC concentrations typically were recorded after a period of discharge or in

April/May when high flows from snowmelt likely mobilized organic carbon that had accumulated in soils from the previous year. At MC1 and W2, DOC concentrations were generally higher in later summer (August/September) and were lowest in the winter.

Dissolved sulphate concentrations were highest in the upstream stations W50 (median 45.9 mg/L) and W3 (median 56.15 mg/L). The median sulphate concentration for both W2 and MC1 was 18 mg/L. This could be due to a higher influence of groundwater on lower flow upstream stations.

Table 3-25: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W50, Minto Creek without Mine Discharge.

W50															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
EQS	15 - 30 [b]	6.0 - 9.0	-	-	-	-	-	-	-	-	0.75	0.18	27.3	-	-
Count	82	92	96	93	81	85	79	82	18	80	72	73	73	70	76
Average	3.8	7.54	311.04	5.3	6.66	55.2	117.19	6.08	0.35	48.46	0.1362	0.0194	1.92665	12.74	0.0273
Minimum	<1.0	6.86	0.57	0.41	0.3	1.9	-29.3	0.85	0.06	<0.5	<0.005	<0.0010	<0.0050	2.81	<0.01
Maximum	29.9	8.56	625	15.34	16.91	128.8	288.5	29	0.53	95.7	0.33	0.158	10.8	43	0.156
Percent of results below DL	53.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	4.2	31.5	5.5	0.0	85.5
Standard deviation	5.34	0.38	105.41	4.24	4.93	39.2	48.59	3.27	0.12	18	0.1022	0.03083	2.63058	5.74	NA [a]
First quartile	1.5	7.22	258.5	2.5	1.44	10.6	106.55	4.91	0.32	40.52	0.0302	0.0012	0.016	9.49	0.025
Median	1.5	7.58	304.4	3.7	7.79	73	122.1	5.93	0.35	45.9	0.1235	<0.0050	0.225	12.45	0.025
Third quartile	4.15	7.82	329.9	6.3	11.47	88.1	138.45	6.53	0.44	60.22	0.2322	0.0209	2.95	14.78	0.025
Count of results exceeding standard	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percent of results exceeding standard	4.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Not applicable due to too few measurements above the detection limit.

Table 3-26: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W3, Minto Creek without Mine Discharge.

W3															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MDMER [a]	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5	NA	NA	NA	NA
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	1070	849	828	825	638	724	595	1005	473	992	957	867	994	824	846
Average	3.88	7.66	344.76	2.59	11.17	81.83	110.59	5.498	0.462	55.78	0.02578	0.00678	1.2613	7.5345	0.0304
Minimum	<1.0	6.45	2.1	-2.4	1.34	6.9	-409	0.13	0.063	2.4	-0.01	<0.0010	<0.0050	<0.5	<0.01
Maximum	283	8.89	1880	23	85.1	301	307.9	30	0.87	231	0.631	0.19	12.3	63.2	0.25
Percent of results below DL	62.2	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	19.2	78.8	4.2	0.1	74.7
Standard deviation	11.8	0.34	146.88	3.5	3.61	18.9	70.62	4.137	0.114	17.4	0.04341	NA [b]	2.27867	6.1983	0.0356
First quartile	1	7.46	264.98	0.1	10.31	76.88	81.4	3.77	0.4	46.58	0.0096	0.0005	0.131	5.0175	0.012
Median	1.5	7.7	298.9	1.2	11.3	83.4	111.4	4.8	0.49	56.15	0.016	<0.0050	0.279	5.865	0.025
Third quartile	3	7.84	396.1	3.6	12.11	89.6	150.3	5.41	0.55	64	<0.05	0.0025	1.17	7.805	0.025
Count of results exceeding standard	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percent of results exceeding standard	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] MDMER maximum authorized concentration in a grab sample

[b] Not applicable due to too few measurements above the detection limit.

Table 3-27: Summary Statistics for Physical Parameters, Anions and Nutrients at Site MC1, Minto Creek without Mine Discharge.

MC1															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	317	262	261	264	230	236	219	306	163	307	305	305	312	310	281
Average	39.2	7.9	209	2.58	13.36	96.76	131.34	2.193	0.357	19.676	0.02436	0.0024	0.19459	11.986	0.0633
Minimum	<1.0	6.59	35.8	-1.8	0.67	2.3	-505.6	<0.50	0.11	<0.30	<0.0050	<0.0010	<0.0050	<0.50	0.011
Maximum	660	8.8	557	9.14	98.1	699.4	273.4	61.8	1.10	104	0.36	0.026	6.4	62.7	0.769
Percent of results below DL	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.6	15.1	81.3	17.3	0.6	40.6
Standard deviation	91.46	0.29	75.5	2.62	6.02	41.93	94.35	3.727	0.122	11.935	0.03437	NA [a]	0.54219	6.907	0.1001
First quartile	2	7.74	169.1	0.04	11.9	91.5	105.85	1.47	0.295	13.8	0.0072	<0.0010	0.035	8.245	<0.050
Median	8	7.94	199.1	2.05	12.88	95.4	145.2	1.78	0.36	18	0.0126	<0.005	0.102	10.2	<0.050
Third quartile	32.6	8.09	235.7	5.03	14.04	99.48	179.85	2.01	0.4	22.7	0.03	<0.0050	0.162	13.35	0.062

[a] Not applicable due to too few measurements above the detection limit.

Table 3-28: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W2, Minto Creek without Mine Discharge.

W2															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
WQO	-	6.0 - 9.0	-	-	-	-	-	-	-	-	0.25	0.06	9.1	-	-
Count	551	455	422	424	301	372	286	488	297	483	447	465	500	445	394
Average	51.11	7.89	219.3	3.89	13.1	96.02	142.52	2.414	0.312	20.43	0.03036	0.00492	0.37422	12.172	0.0932
Minimum	<1.0	6.3	36.9	-1.9	8.05	11.5	-235.6	<0.5	0.1	<0.5	<.001	<0.0010	<0.0050	<0.50	<0.01
Maximum	2600	8.8	745	13.7	103.2	295	336.4	39.2	0.80	90.2	0.55	0.36	6.7	58.6	1.65
Percent of results below DL	35.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	2.7	22.8	74.0	20.8	0.9	43.1
Standard deviation	192.23	0.35	92.3	3.29	5.5	18.03	61.27	2.899	0.107	13.03	0.05378	0.01794	0.99021	5.936	0.1647
First quartile	1.5	7.75	168.9	0.4	11.57	90.7	118.32	1.32	0.26	12.7	0.0059	<0.0010	0.0194	8.7	0.025
Median	4	7.92	202.7	3.8	12.67	96	148.5	1.72	0.3	18.7	<0.03	<0.0050	0.0874	10.7	0.0295
Third quartile	23.5	8.1	251	6.8	14	100.43	181.55	2.172	0.35	23.95	0.03	<0.0050	0.1735	13.5	0.1298
Count of results exceeding standard	0	0	0	0	0	0	0	0	0	0	6	1	0	0	0
Percent of results exceeding standard	0	0	0	0	0	0	0	0	0	0	1.3	0.2	0	0	0

3.3.1.2 Metals

Statistical summaries for dissolved metal concentrations of interest at Minto Creek stations during periods without mine discharge are presented in Table 3-29 through Table 3-32.

Dissolved hardness was consistently highest at station W3 in Minto Creek without mine discharge with a median hardness of 254 mg/L and decreased going downstream to stations MC1 (median 157 mg/L) and W2 (median 149 mg/L). Seasonal variations in hardness were apparent, particularly in W50 and downstream stations MC1 and W2, as the lowest concentrations were observed in April/May when dilution was likely provided by snowmelt and concentrations increased through the summer, fall and winter as baseflow – the portion of flow that seeps from the ground and is not from runoff or direct precipitation – likely comprised an increasing proportion of Minto Creek flow. The seasonal trend is less obvious in W3 perhaps due to a more consistent, year- round contribution of groundwater to Minto Creek between W50 and W3.

Dissolved aluminium concentrations were similar at stations W50, MC1 and W2 (median 0.0089 mg/L, 0.0092 mg/L and 0.0010 mg/L, respectively) whereas the median concentration at W3 was 0.0048 mg/L. Concentrations were typically higher in April/May when higher flows caused by snowmelt likely mobilized more aluminium and decreased through the remainder of the year. Dissolved arsenic and iron were also higher in stations MC1 (median 0.00054 mg/L arsenic and 0.11 mg/L iron), W2 (0.00048 mg/L arsenic and 0.73 mg/L iron), and W50 (median 0.0004 mg/L arsenic and 0.0475 mg/L iron than W3 (median 0.00025 mg/L arsenic and 0.022 mg/L iron). Concentrations of arsenic and iron followed a seasonal trend with higher concentrations typically observed in August/September and lower concentrations in winter and early spring. A moderate correlation between dissolved iron and DOC concentrations at W2 suggests that DOC may be responsible for higher concentrations of iron in solution in Minto Creek throughout the summer months. The difference between W3 and the rest of the Minto Creek sites is likely because W3 is contained in a heated structure and is sampled year-round, whereas stations W2, W50 and MC1 freeze during winter months.

Concentrations of dissolved cadmium and nickel were often below detection in Minto Creek at all four monitoring stations. Aside from some scatter in pre-2011, dissolved chromium, lead, and zinc concentrations were also predominantly below or close to detection limits.

During periods without discharge from the mine site, dissolved copper concentrations were generally higher at W50 and W3 with medians of 0.006 mg/L and 0.003 mg/L, respectively, than at downstream sites MC1 and W2 (median of 0.002 mg/L at both). Higher concentrations typically occurred following a mine discharge period or during April/May when higher DOC concentrations (associated with higher freshet flows) could likely mobilize more copper. Dissolved molybdenum was also higher at upstream stations W50 and W3 with median concentrations of 0.0058 and 0.0045 mg/L, respectively. While dissolved molybdenum concentrations were fairly stable, more of a seasonal trend was apparent at MC1 and W2 where higher concentrations were typically observed in May and lower concentrations in the winter, suggesting that the higher spring flows caused by meltwater could be responsible for mobilizing more molybdenum.

During periods without discharge from the mine site, dissolved selenium was consistently higher at W50 (median 0.00034 mg/L) and W3 (median 0.00034 mg/L) than at downstream stations MC1 and W2 with median concentrations of 0.00014 and 0.00015 mg/L, respectively. Higher concentrations appeared to follow mine discharge periods – particularly the discharge period ending October 27, 2010. Aside from discharge periods, a marked seasonality was evident with higher concentrations observed in the winter and lower concentrations observed in the summer, suggesting that baseflow likely contributes a significant portion of selenium to Minto Creek.

During periods when the mine site was not discharging, one exceedance of the dissolved copper EQS at site W50 and five exceedances of the dissolved copper WQO at site W2 were recorded; however, the W50 exceedance and three of W2 exceedances occurred before these EQS and WQO came into effect with the issuance of WUL QZ14-031 (August 2015). Similarly, one dissolved silver, one dissolved selenium, and thirteen dissolved chromium concentrations exceeded their respective WQO at W2; however, this occurred before the WQO at this site came into effect with the issuance of WUL QZ14-031 (August 2015). No MMER grab sample exceedances were observed for dissolved metals at site W3.

Table 3-29: Summary Statistics for Dissolved Metals of Interest at Site W50, Minto Creek without Mine Discharge.

W50													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
EQS	-	0.3	0.015	0.00075 [a]	0.003	0.039 - 0.06 [b]	3.3	0.012	0.219	0.33	0.0003	0.006	0.09
Count	81	82	82	78	78	82	82	82	82	82	78	82	78
Average	209.6	0.01174	0.00038	0.00003135	0.000394	0.00905	0.07514	0.0000785	0.00541	0.003871	0.0000061	0.000668	0.00242
Minimum	28.5	0.0013	0.00012	<0.0000050	<0.00010	0.00126	<0.0050	<0.000050	<0.001	<0.00050	<0.000010	<0.0001	<0.0010
Maximum	313	0.079	0.00064	0.000239	0.0017	0.075 [c]	0.405	0.0004	0.01	0.0106	0.00001	0.0026	0.018
Percent of results below DL	0.0	7.3	3.7	34.6	42.3	0.0	14.6	72.0	1.2	23.2	98.7	3.7	55.1
Standard deviation	63.8	0.01277	0.00011	0.0000382	0.000347	0.0096	0.08	0.0000711	0.0023	0.00401	NA [c]	0.000603	0.00284
First quartile	189	0.00502	0.00033	0.000005	0.00014	0.00306	0.015	0.000025	0.00357	0.000585	0.000005	0.000212	0.0005
Median	216	0.0089	0.0004	0.00002	0.00036	0.00606	0.0475	0.0000585	0.00578	0.0016	0.000005	0.000341	0.0017
Third quartile	257	0.01292	0.00046	0.00004945	0.0005	0.012	0.101	0.0001	0.0067	0.008915	0.000005	0.001015	0.0025
Count of results exceeding standard	0	0	0	0	0	1	0	0	0	0	0	0	0
Percent of results exceeding standard	0	0	0	0	0	1.2	0	0	0	0	0	0	0

[a] Based on lower quartile hardness for reference purposes only; hardness-dependent EQS are calculated on a sample-specific basis.

[b] When DOC concentration at W2 ≤ 10 mg/L, dissolved copper EQS is 0.039 mg/L; when DOC concentration at W2 >10 mg/L, dissolved copper EQS is 0.06 mg/L.

[c] Not applicable due to too few measurements above the detection limit

Table 3-30: Summary Statistics for Dissolved Metals of Interest at Site W3, Minto Creek without Mine Discharge.

W3													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
MDMER [a]	NA	NA	1	NA	NA	0.6	NA	1	NA	1	NA	NA	1
Count	905	972	971	853	877	983	983	963	983	979	796	965	890
Average	249.6	0.01179	0.000289	0.0006969	0.000389	0.00413	0.0388	0.0001441	0.004387	0.000908	0.00000739	0.0004989	0.0032
Minimum	70.8	<0.0010	<0.00020	<0.0000050	<0.00010	<0.001	<0.005	0.000009	0.00032	<0.00050	<0.0000050	<0.000050	<0.0010
Maximum	795	0.373	0.00166	0.565	0.0039	0.067	0.75	0.0603	0.02	0.006	0.0001	0.0051	0.143
Percent of results below DL	0.0	18.2	7.5	55.1	73.3	0.5	12.6	91.7	0.2	36.8	98.7	17.4	60.9
Standard deviation	40.8	0.02513	0.000128	0.0193498	0.000392	0.0049	0.05	NA [b]	0.002072	0.00056	NA [b]	0.0005763	0.00731
First quartile	232	0.0023	0.00022	<0.000010	<0.00010	0.0021	0.0135	0.000025	0.003125	0.0005	0.000005	0.000295	0.001
Median	254	0.0048	0.00025	<0.000010	<0.0010	0.00276	0.022	<0.00020	0.00456	0.00087	0.000005	0.00034	0.0025
Third quartile	272	0.00892	0.0003	0.00001	<0.0010	0.004	0.04	0.0001	0.005	0.00102	0.00001	0.00043	0.0025

[a] MDMER maximum authorized concentration in a grab sample

[b] Not applicable due to too few measurements above the detection limit

Table 3-31: Summary Statistics for Dissolved Metals of Interest at Site MC1, Minto Creek without Mine Discharge.

MC1													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	311	313	312	288	137	312	313	313	313	312	287	290	286
Average	157.744	0.01512	0.000576	0.00000783	0.000227	0.002626	0.1951	0.000069	0.0015228	0.001138	0.0000076	0.0001723	0.00202
Minimum	<0.50	<0.0010	<0.00010	<0.0000050	<0.00010	<0.00020	<0.010	<0.000050	<0.000050	<0.00050	<0.000010	<0.000050	<0.0010
Maximum	529	0.121	0.00125	0.0002	0.0021	0.019	1.11	0.00048	0.01	0.004	0.000024	0.0021	0.0334
Count of results below DL	1	16	5	205	8	1	1	305	18	37	286	25	240
Percent of results below DL	0.3	5.1	1.6	71.2	5.8	0.3	0.3	97.4	5.8	11.9	99.7	8.6	83.9
Standard deviation	52.393	0.01714	0.000171	0.00001391	0.000192	0.002199	0.20	NA [a]	0.0007394	0.000477	NA [a]	0.0001823	NA [a]
First quartile	135.5	0.006	0.00048	0.0000025	0.00015	0.00158	0.067	<0.000050	0.0012	0.000862	0.000005	0.00011	0.0005
Median	157	0.0092	0.00054	0.000005	0.00019	0.002	0.111	<0.0002	0.00152	0.00104	<0.000020	0.00014	0.0025
Third quartile	180	0.0182	0.00065	0.00000642	0.00026	0.002592	0.219	<0.00020	0.0018	0.0014	0.00001	0.00017	0.0025

[a] Not applicable due to too few measurements above the detection limit

Table 3-32: Summary Statistics for Dissolved Metals of Interest at Site W2, Minto Creek without Mine Discharge.

W2													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
WQO	-	0.1	0.005	0.00025 [a]	0.001	0.013 - 0.02 [b]	1.1	0.004	0.073	0.11	0.0001	0.002	0.03
Count	442	470	465	370	194	469	469	465	469	465	361	469	393
Average	145.9	0.0169	0.000506	0.00001066	0.000389	0.00299	0.1611	0.0000796	0.001488	0.001118	0.0000088	0.00025	0.00227
Minimum	10	<0.0030	<0.0002	<0.0000050	<0.00010	<0.001	<0.02	<0.000050	0.00018	<0.00050	<0.000010	<0.00010	<0.0010
Maximum	386	0.109	0.00122	0.00026	0.0069	0.0184	0.905	0.0004	0.01	0.004	0.00032	0.0022	0.02
Percent of results below DL	0.0	12.6	9.2	66.5	19.6	0.4	4.1	94.4	9.4	16.8	99.4	34.5	74.6
Standard deviation	40.5	0.01741	0.000195	0.00002308	0.000607	0.00238	0.18	NA [d]	0.001123	0.000501	NA [d]	0.000285	0.00214
First quartile	126	0.00612	0.0004	0.000005	0.00018	0.0019	0.0414	<0.000050	0.001	0.00081	<0.000010	0.00011	<0.0010
Median	149	0.01045	0.00048	0.000005	0.00024	0.00202	0.073	<0.00020	0.0013	0.001	<0.000020	0.000147	<0.0050
Third quartile	167	0.01967	0.0006	0.00001	0.00032	0.003	0.213	<0.0002	0.0016	0.0014	<0.00002	<0.0006	<0.0050
Count of results exceeding standard	0	4	0	0	13	5	0	0	0	0	1	1	0
Percent of results exceeding standard	0	0.9	0	0	6.7	1.1	0	0	0	0	0.3	0.2	0

[a] Based on lower quartile hardness for reference purposes only; hardness-dependent WQO are calculated on a sample-specific basis

[b] When DOC concentration at W2 ≤ 10 mg/L, dissolved copper EQS is 0.013 mg/L; when DOC concentration at W2 >10 mg/L, dissolved copper EQS is 0.02 mg/L.

[c] Not applicable due to too few measurements above the detection limit

3.3.2 Operational Phase with Mine Discharge

3.3.2.1 Physical Parameters, Anions and Nutrients

Statistical summaries for physical parameters and anion and nutrient concentrations at Minto Creek stations during mine discharge periods are presented in Table 3-33 and Table 3-36.

During mine discharge, the pH of the waters of Minto Creek was circumneutral to slightly alkaline with medians ranging from pH 7.8 at W50 to pH 8 at W2. Temperatures varied seasonally with the highest minimum and maximum temperatures recorded at -2ºC and 18ºC. The waters of Minto Creek were generally well oxygenated with median oxygen content increasing moving downstream from 87.3% at W50 to 99.8% at W2. Increasing trends in field conductivity were visible, particularly during longer duration discharge periods (e.g. August 13, 2009 to October 30, 2009 and July 14, 2010 to Oct 27, 2010). However, many of the discharge periods that displayed these trends were in the months following early spring when meltwater would likely have diluted the waters of Minto Creek and therefore the increase in conductivity could also be partially due to less dilution from meltwater in summer and fall.

The highest TSS concentrations throughout Minto Creek were typically encountered during April/May due to mobilization of particulates under the high flow freshet conditions typical of this time of year. TSS concentrations were typically lower in upper Minto Creek (median 2 and 3.8 mg/L at W3 and W50, respectively) than farther downstream (median 7 and 13 mg/L at W2 and MC1, respectively). Eleven TSS measurements exceeded the EQS at site W50; however, these events occurred before the current TSS EQS came into effect with the issuance of WUL QZ14-031 (August 2015). Exceedances of the MMER grab sample TSS guideline (30 mg/L) occurred in 11 samples (8.1% of dataset) at site W3 when there was discharge from the mine site.

Nitrogen species were higher at W50 and W3 during mine discharge phases than at MC1 and W2. At W3, the median concentrations of ammonia-N and nitrite-N during mine discharge were 0.076 and 0.041 mg/L, respectively, and 0.015 and 0.0071 mg/L at W2, respectively. While median nitrate-N concentrations were similar at W50 and W2, visual inspection shows a marked decrease in nitrate-N from upstream to downstream stations on Minto Creek. Generally, nitrogen species were higher during discharge periods than non-discharge periods.

DOC concentrations were fairly similar at all sites in Minto Creek during mine discharge with medians ranging from 9.6 mg/L at W3 to 12.5 mg/L at MC1. While it appears higher DOC concentrations were observed during mine discharge, discharge periods commonly occurred during April/May when higher flows caused by snowmelt would likely mobilize organic carbon from soils and these increased flows likely played an important role in these elevated DOC concentrations.

Table 3-33: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W50, Minto Creek during Mine Discharge.

W50															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
EQS	15 - 30 [b]	6.0 - 9.0	-	-	-	-	-	-	-	-	0.75	0.18	27.3	-	-
Count	136	117	117	118	95	99	88	135	87	118	128	124	134	118	115
Average	5.6	7.77	288.77	6.35	10.96	86.57	121.9	8.44	0.339	53.479	0.08108	0.02248	3.807	11.93	0.028
Minimum	<1.0	6.87	70.2	-0.6	6.07	8.39	-418.2	1.6	0.08	<0.50	<0.0050	<0.0050	0.16	1.17	<0.01
Maximum	42	9.5	641	18	15.47	114	397.4	40.5	0.52	110	1	0.102	16.2	20.3	0.17
Percent of results below DL	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	4.7	6.5	0.0	0.0	41.7
Standard deviation	6.76	0.33	95.75	4.99	1.89	14.54	85.40	7.29	0.092	21.008	0.13502	0.02379	3.315	3.88	0.0201
First quartile	1.5	7.6	239.1	2.4	9.54	82.6	94.6	4.92	0.29	41.1	0.0176	0.0074	1.908	8.91	0.019
Median	3.8	7.79	282.3	4.04	11.21	87.3	138.6	5.4	0.37	49.9	0.0305	0.0098	2.745	11.9	<0.050
Third quartile	6.12	7.88	310.1	10.85	12.37	93.7	165	7.45	0.384	61.8	0.089	0.03002	4.535	13.5	0.029
Count of results exceeding standard	11	1	0	0	0	0	0	0	0	0	2	0	0	0	0
Percent of results exceeding standard	8.1	0.9	0	0	0	0	0	0	0	0	1.6	0	0	0	0

[a] Total Suspended Solids (TSS) of 15 mg/L except during March, April and May when the TSS limit is a maximum grab concentration of 30 mg/L

Table 3-34: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W3, Minto Creek during Mine Discharge.

W3															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
MDMER [a]	30.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5	NA	NA	NA	NA
Count	284	510	510	514	324	494	327	183	130	177	201	194	195	153	111
Average	13.55	7.83	325.75	5.66	11.67	92.69	114.57	12.17	0.377	62.255	0.10488	0.06261	5.4226	10.97	0.0434
Minimum	<1.0	6.46	7.76	-1.9	0.09	0.7	-420.1	0.6	0.12	<0.50	<0.0050	<0.0010	0.04	3	<0.01
Maximum	985	9.06	677	15.02	16.67	150.3	251.9	31	0.61	252	0.62	0.347	18.7	39.2	0.71
Percent of results below DL	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	8.5	10.8	0.0	0.0	36.0
Standard deviation	82.58	0.32	126.68	4.16	1.65	13.79	70.47	9.27	0.094	29.489	0.10229	0.06416	5.2079	4.87	0.0687
First quartile	1.5	7.7	242.5	2.12	10.62	84.85	92.15	4.75	0.312	42.3	<0.03	0.0073	1.245	8.17	0.025
Median	2	7.85	280.05	4.63	11.93	91.45	117.2	6.5	0.39	52.2	0.076	0.0414	2.76	9.6	<0.050
Third quartile	6	8	431.75	9.68	12.75	99.48	150.9	22	0.44	85	0.16	0.111	10.55	12.2	0.0435
Count of results exceeding standard	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percent of results exceeding standard	4.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] MDMER maximum authorized concentration in a grab sample

Table 3-35: Summary Statistics for Physical Parameters, Anions and Nutrients at Site MC1, Minto Creek during Mine Discharge.

MC1															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA [a]	10	NA [a]	0.1	1	NA [a]	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	82	84	83	84	75	84	66	81	47	75	82	81	82	82	68
Average	79.75	7.87	165.4	1.43	13.5	94	124.6	3.44	0.306	24.075	0.02574	0.00561	0.81466	14.45	0.1262
Minimum	<1.0	6.14	55.9	-1.9	4.35	28.5	-189.5	0.98	0.13	<0.50	<0.0050	<0.0010	<0.0050	5.76	0.01
Maximum	793	9.67	454	11	21.44	139.9	243.2	14	0.54	87.7	0.11	0.0342	7.3	39.7	0.788
Percent of results below DL	17.1	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	5.3	7.3	50.6	13.4	0.0	22.1
Standard deviation	161.83	0.39	90.9	2.65	1.93	11.5	65.80	2.93	0.11	16.16	0.02544	0.00738	1.51584	6.76	0.1814
First quartile	3.4	7.65	97.2	0	12.87	91.1	99.1	1.7	0.205	15.45	0.0089	<0.0010	0.09848	10.42	0.025
Median	12.95	7.9	145.1	0.1	13.53	94.5	126	2.13	0.32	20.7	0.016	<0.0050	0.3015	12.5	0.058
Third quartile	57.68	8.08	202	2.45	14.32	98.6	162.5	3.8	0.385	28.7	0.033	0.0066	0.65625	17.45	0.1042

Table 3-36: Summary Statistics for Physical Parameters, Anions and Nutrients at Site W2, Minto Creek during Mine Discharge.

W2															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
WQO	-	6.0 - 9.0	-	-	-	-	-	-	-	-	0.25	0.06	9.1	-	-
Count	293	300	298	298	101	286	94	193	149	186	218	198	205	177	88
Average	37.51	8.04	315.4	4.25	13.61	100	125.2	7.06	0.313	35.001	0.03112	0.01065	3.11355	13.92	0.1188
Minimum	<1.0	7.1	32.2	-2	8.6	40.3	-95	0.78	0.025	<0.50	<0.0050	<0.0010	<0.0050	0.61	0.013
Maximum	597	9.42	549	13.65	19.09	152.1	252.4	27	0.55	92.5	0.83	0.125	9.4	41.8	0.679
Percent of results below DL	11.6	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	4.8	27.1	31.8	6.3	0.0	28.4
Standard deviation	96.22	0.3	133.4	3.82	1.58	14.7	67.80	5.22	0.096	19.922	0.06152	0.01318	2.96683	5.95	0.1389
First quartile	3.4	7.89	196.8	0.62	12.87	93.4	96.8	2.07	0.27	19.425	0.007	0.0025	0.205	10.8	0.025
Median	7	8.09	379	3.46	13.99	99.8	135.9	5.65	0.33	37	0.015	0.0071	2.1	12.3	0.057
Third quartile	20	8.22	412.8	7.63	14.45	108.2	164.2	11	0.37	50	0.0385	0.014	6	14.6	0.1693
Count of results exceeding standard	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0
Percent of results exceeding standard	0	0.3	0	0	0	0	0	0	0	0	0.5	0.5	0.5	0	0

3.3.2.2 Metals

Statistical summaries for dissolved metal concentrations of interest at Minto Creek stations during mine discharge periods are presented in Table 3-37 through Table 3-40.

Dissolved hardness was generally higher in the upstream Minto Creek stations W50 and W3 than downstream stations MC1 and W2 during mine discharge. As was the case with field conductivity, dissolved hardness appeared to increase through several of the longer duration discharge periods. It is likely that high flows related to April/May snowmelt that commonly coincide with the beginning portion of discharge periods and dilute the hardness to decreasing extent moving into the summer and fall months.

Dissolved aluminum concentrations ranged from medians 0.0081 mg/L at W50 to 0.0297 mg/L at W3; however, the relatively high median aluminum concentration for W3 is buoyed by numerous, high concentrations observed during the July 14 to October 27, 2010 discharge period. Aside from this discharge period, dissolved aluminum concentrations were often similar in all Minto Creek stations and appear elevated relative to during non- discharge periods likely due to mine discharge often occurring in April/May when high flows caused by meltwater could mobilize aluminum.

Dissolved arsenic concentrations were generally lower in upstream sites W50 and W3 with median concentrations of 0.00036 and 0.00038 mg/L, respectively compared to downstream sites MC1 and W2, which both had a median concentration of 0.00050 mg/L. Dissolved arsenic concentrations at W50 and W3 were generally slightly higher or similar with or without mine discharge, whereas arsenic concentrations at MC1 and W2 were generally dependent on the seasonality discussed in Section 3.3.1.2 than on mine discharge.

Dissolved cadmium was often elevated in Minto Creek stations during periods when the mine site was discharging water relative to without mine discharge, with slightly higher concentrations observed at upstream stations W50 and W3 than downstream stations. Nevertheless, many dissolved cadmium concentrations were close to or below detection limits, particularly in older samples (pre-2012) when detection levels were higher than in more recent years. Generally, above detection level concentrations appear to have decreased in since 2009.

Aside from some above detection level concentrations observed in the discharge period between August 13, 2009 to October 30, 2009, dissolved chromium, lead and zinc were predominantly below detection levels during mine discharge periods from 2010 to 2015. In 2016 with lower detection levels, above detection level concentrations were observed but concentrations were fairly similar to previous detection limits. In the case of dissolved lead, concentrations were higher at W50 during 2016 discharge periods, but were below detection at downstream stations. Dissolved silver was consistently below detection levels during mine discharge periods.

Dissolved nickel concentrations were often below detection levels during mine discharge and were generally higher in downstream stations MC1 and W2 than upstream stations W50 and W3.

Dissolved copper, molybdenum and selenium were higher in upstream stations W50 and W3 than downstream stations MC1 and W2 during mine discharge periods. Median dissolved copper concentrations were highest at W50 (0.021 mg/L) and decreased moving downstream with medians of 0.0070, 0.0036, and 0.0028 mg/L at sites W3, MC1, and W2, respectively. The dissolved copper concentrations were higher during the August 13 to October 30, 2009 discharge period - an emergency discharge period, as discussed in Section 1.1. Similarly, dissolved selenium and molybdenum concentrations were highest at W50 and W3 and decreased moving downstream to MC1 and W2. This downstream decrease in dissolved selenium concentrations was evident graphically on discharge period to discharge period bases, but was not as well represented in statistical summaries. Higher concentrations of dissolved selenium were observed in all Minto Creek stations during the mine discharge phase of July 14, 2010 to October 27, 2010 and to a lesser extent August 13, 2009 to October 30, 2009 – an emergency discharge period – which skewed the statistics for the discharge periods.

Dissolved iron concentrations were often higher in downstream stations MC1 and W2 with medians of 0.11 and 0.082 mg/L, respectively, than upstream stations W50 (median 0.044 mg/L) and W3 (median 0.019 mg/L). Higher concentrations downstream were likely related to seasonal factors and correlated with DOC concentrations as opposed to influences from mine discharge, as discussed in Section 3.3.1.2.

During periods when the mine site was discharging, one exceedance of the dissolved copper EQS at site W50 was recorded; however, this occurred before this EQS came into effect with the issuance of WUL QZ14-031 (August 2015). Similarly, one dissolved aluminium, two dissolved chromium, nine dissolved copper, and 49 dissolved selenium concentrations exceeded their respective WQO at W2; however, this occurred before the WQO at this site came into effect with the issuance of WUL QZ14-031 (August 2015). No MMER grab sample exceedances were observed for dissolved metals at site W3.

Table 3-37: Summary Statistics for Dissolved Metals of Interest at Site W50, Minto Creek during Mine Discharge.

W50													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
EQS	NA	0.3	0.015	0.00075 [a]	0.003	0.039 - 0.06 [b]	3.3	0.012	0.219	0.33	0.0003	0.006	0.09
Count	117	134	132	134	134	134	134	117	134	134	132	134	134
Average	193	0.01648	0.000358	0.00001429	0.000407	0.01845	0.05605	0.0001198	0.00599	0.00084	0.0000083	0.001244	0.00234
Minimum	57	<0.0030	0.00023	<0.0000050	<0.00010	<0.001	<0.0050	<0.000050	<0.0010	<0.0010	<0.000010	0.00011	<0.0010
Maximum	272	0.12	0.0008	0.00028	0.0012	0.073	0.3	0.0008	0.02	0.003	0.00002	0.0049	0.011
Percent of results below DL	0.0	3.0	12.9	41.0	78.4	0.7	10.4	77.8	0.7	38.8	99.2	3.7	80.6
Standard deviation	46.4	0.02072	0.00009	0.00002666	NA [c]	0.01008	0.06	NA [c]	0.00419	0.00043	NA [c]	0.000963	NA [c]
First quartile	164	0.00552	0.00028	0.000005	0.00018	0.00964	0.01755	<0.00020	0.00311	0.0005	0.000005	0.00062	0.00185
Median	201	0.0081	0.00036	0.0000085	0.0005	0.02105	0.04355	<0.00020	0.00535	0.0007	0.00001	0.00093	0.0025
Third quartile	229	0.01648	0.0004	0.00001875	0.0005	0.0256	0.064	<0.00020	0.00588	0.001	0.00001	0.0017	0.0025
Count of results exceeding standard	0	0	0	0	0	1	0	0	0	0	0	0	0
Percent of results exceeding standard	0	0	0	0	0	0.7	0	0	0	0	0	0	0

[a] Based on lower quartile hardness for reference purposes only; hardness-dependent EQS are calculated on a sample-specific basis

[b] When DOC concentration at W2 ≤ 10 mg/L, dissolved copper EQS is 0.039 mg/L; when DOC concentration at W2 >10 mg/L, dissolved copper EQS is 0.06 mg/L.

[c] Not applicable due to too few measurements above the detection limit

Table 3-38: Summary Statistics for Dissolved Metals of Interest at Site W3, Minto Creek during Mine Discharge.

W3													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
MDMER [a]	NA	NA	1	NA	NA	0.6	NA	0.4	NA	1	NA	NA	1
Count	166	178	172	134	141	178	178	177	178	177	140	178	141
Average	205	0.03882	0.000394	1.486E-05	0.000446	0.01118	0.0556	0.0000964	0.00995	0.00092	0.0000085	0.00219	0.00268
Minimum	56.5	<0.0030	<0.00040	<0.0000050	<0.00010	0.0012	<0.005	<0.000050	0.0015	<0.0010	<0.000010	<0.00040	<0.0010
Maximum	275	0.121	0.0011	0.00021	0.0024	0.0622	0.64	0.0005	0.10	0.006	0.00002	0.0348	0.024
Percent of results below DL	0.0	2.2	5.8	46.3	74.5	0.0	25.3	93.8	0.6	47.5	99.3	2.8	76.6
Standard deviation	40.8	0.03304	0.000146	0.0000233	0.000295	0.01094	0.10	NA [b]	0.00901	0.00072	NA [b]	0.002962	NA [b]
First quartile	187	0.00732	0.0003	0.000005	0.00028	0.004	0.01	<0.00020	0.00426	<0.0010	0.000005	0.000602	<0.0050
Median	214.5	0.0297	0.00038	0.0000056	<0.0010	0.00702	0.019	<0.0002	0.00654	0.00085	0.00001	0.0013	<0.005
Third quartile	229	0.06775	0.0005	1.975E-05	<0.0010	0.01508	0.048	<0.0002	0.015	0.001	0.00001	0.00385	<0.0050

[a] MDMER maximum authorized concentration in a grab sample

[b] Not applicable due to too few measurements above the detection limit

Table 3-39: Summary Statistics for Dissolved Metals of Interest at Site MC1, Minto Creek during Mine Discharge.

MC1													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	76	82	82	75	33	82	82	82	82	82	76	82	76
Average	138.1	0.01774	0.0005	0.00000878	0.00026	0.00449	0.1534	0.0000813	0.002106	0.00101	0.0000078	0.000381	0.00206
Minimum	53.3	<0.0050	<0.00050	<0.0000050	0.00012	0.00175	0.0275	<0.000050	0.000365	<0.0010	<0.000010	0.000082	<0.0010
Maximum	274	0.0678	0.00077	0.000029	0.00039	0.0138	0.559	<0.00050	0.01	0.00173	<0.00002	0.0022	<0.015
Percent of results below DL	0.0	1.2	6.1	57.3	0.0	0.0	1.2	98.8	15.9	30.5	100.0	7.3	78.9
Standard deviation	47.3	0.01295	0.000122	0.000007	0.00007	0.00255	0.11	NA [a]	0.001914	0.00038	NA [a]	0.000463	NA [a]
First quartile	102.5	0.00782	0.00042	0.0000025	0.00021	0.00245	0.0762	0.000025	0.001	0.0005	0.000005	0.000157	0.0011
Median	139	0.01405	0.0005	<0.000010	0.00026	0.00364	0.1105	0.0001	0.00167	0.00109	0.00001	0.000208	0.0025
Third quartile	166.2	0.025	0.00057	0.00001345	0.00031	0.00611	0.2062	0.0001	0.002075	0.00132	0.00001	0.000378	0.0025

[a] Not applicable due to too few measurements above the detection limit

Table 3-40: Summary Statistics for Dissolved Metals of Interest at Site W2, Minto Creek during Mine Discharge.

W2													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
WQO	-	0.1	0.005	0.00025 [a]	0.001	0.013 - 0.02 [b]	1.1	0.004	0.073	0.11	0.0001	0.002	0.03
Count	187	195	195	152	42	195	195	195	195	195	150	195	152
Average	157.9	0.0214	0.000477	0.00001175	0.00034	0.00422	0.1293	0.0000935	0.004598	0.00097	0.0000086	0.001051	0.00222
Minimum	40	<0.0030	<0.0004	<0.0000050	0.0001	0.0013	0.0211	<0.000050	0.000374	<0.0010	<0.000010	<0.00010	<0.0010
Maximum	254	0.201	0.0009	0.0002	0.0021	0.0227	0.761	0.0003	0.02	0.002	<0.00002	0.0026	0.01
Percent of results below DL	0.0	0.5	4.1	46.7	2.4	0.0	0.0	96.9	10.3	31.8	100.0	7.2	88.2
Standard deviation	46.3	0.01815	0.00011	0.00001842	0.00033	0.00376	0.14	NA [c]	0.003314	0.0004	NA [c]	0.000878	NA [c]
First quartile	132.5	0.0123	0.0004	0.000005	0.00022	0.002	0.0503	0.0001	0.00153	0.0005	0.000005	0.00019	0.0025
Median	170	0.018	0.0005	0.0000085	0.00024	0.00278	0.082	<0.0002	0.005	0.001	0.00001	0.0009	0.0025
Third quartile	184.5	0.02325	0.00052	0.0000137	0.00034	0.0051	0.1405	0.0001	0.008	0.00119	0.00001	0.00205	0.0025
Count of results exceeding standard	0	1	0	0	2	9	0	0	0	0	0	49	0
Percent of results exceeding standard	0	0.5	0	0	4.8	4.6	0	0	0	0	0	25.1	0

[a] Based on lower quartile hardness for reference purposes only; hardness-dependent EQS are calculated on a sample-specific basis

[b] When DOC concentration at W2 ≤ 10 mg/L, dissolved copper EQS is 0.013 mg/L; when DOC concentration at W2 >10 mg/L, dissolved copper EQS is 0.02 mg/L.

[c] Not applicable due to too few measurements above the detection limit

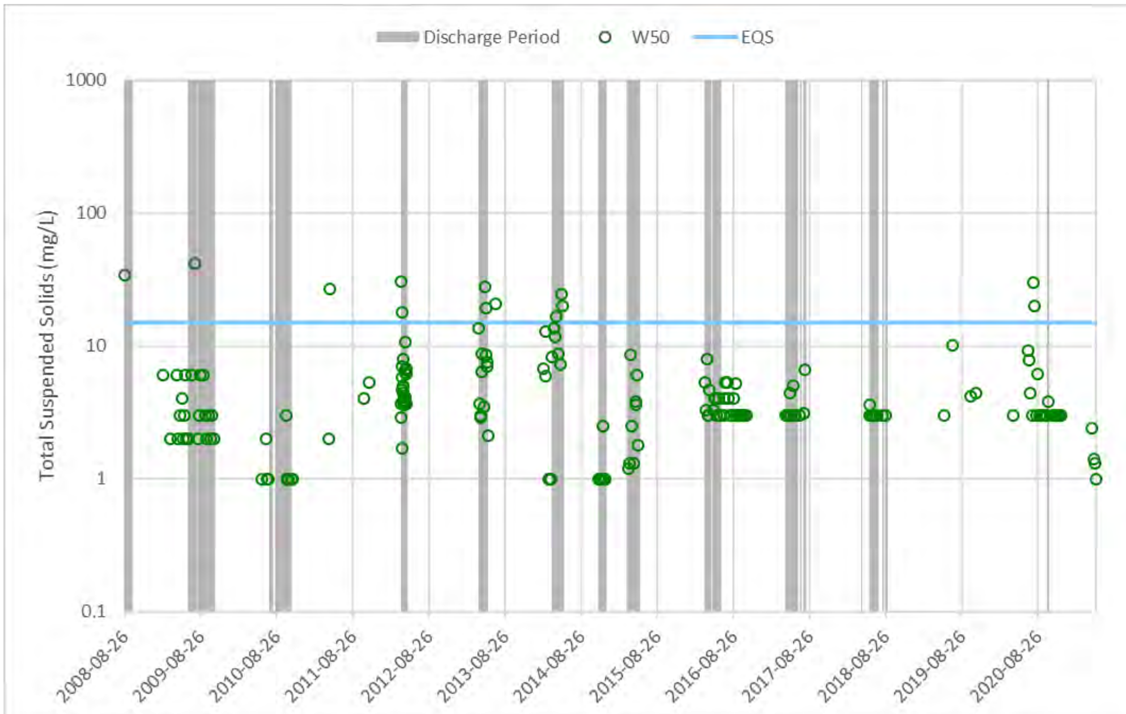


Figure 3-55: TSS in Minto Creek at W50. Note Log Scale.

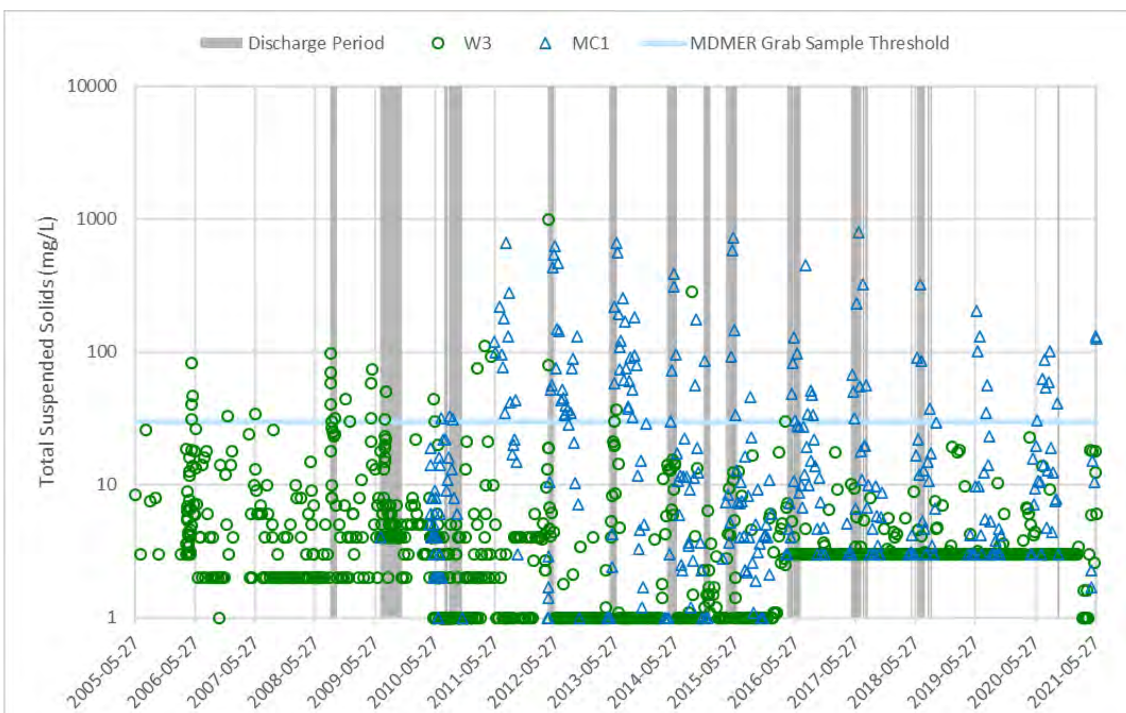


Figure 3-56: TSS in Minto Creek at W3 and MC1. Note Log Scale.

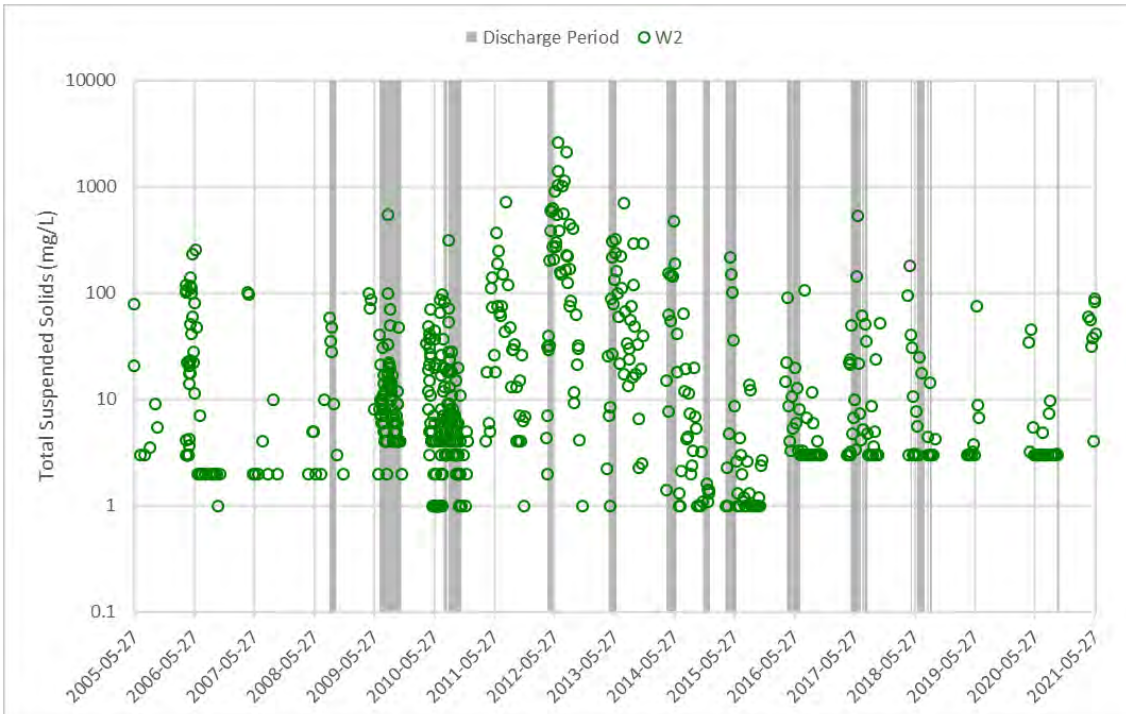


Figure 3-57: TSS in Minto Creek at W2. Note Log Scale.

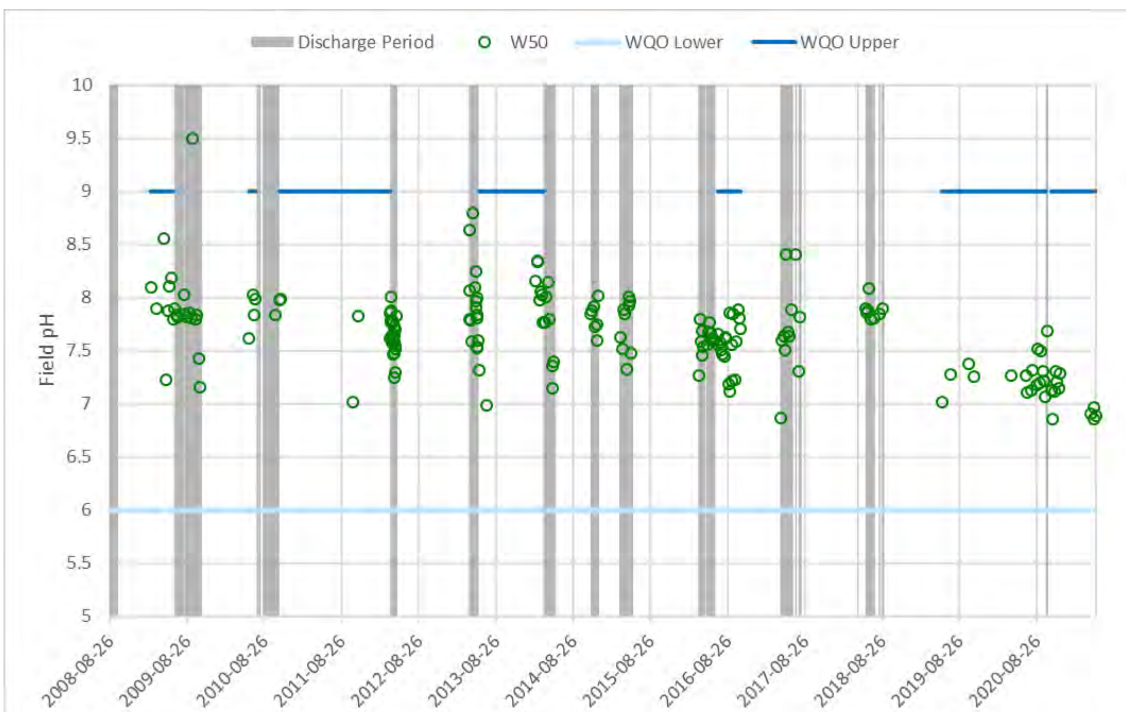


Figure 3-58: Field pH in Minto Creek at W50.

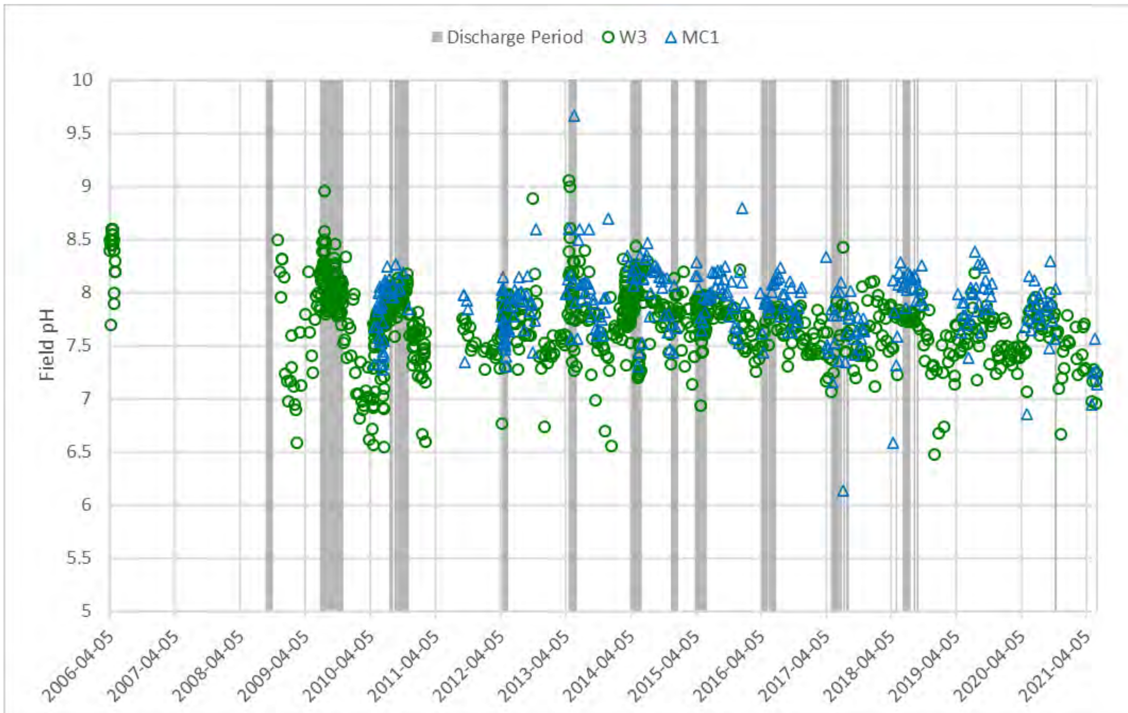


Figure 3-59: Field pH in Minto Creek at W3 and MC1.

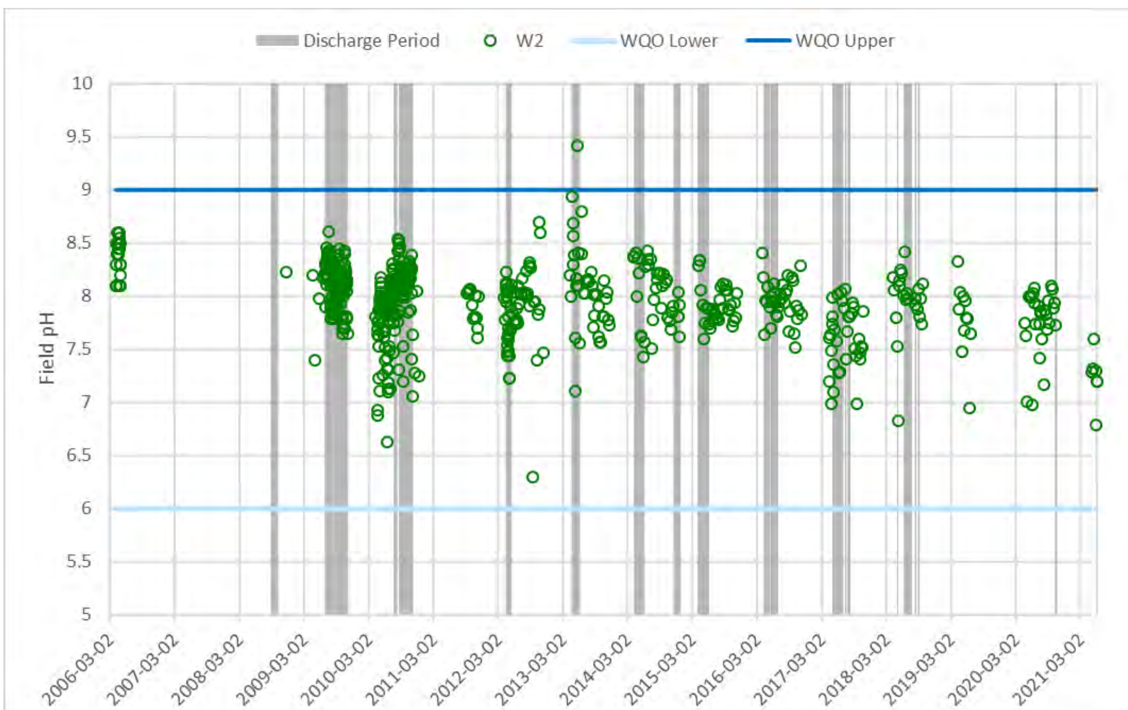


Figure 3-60: Field pH in Minto Creek at W2.

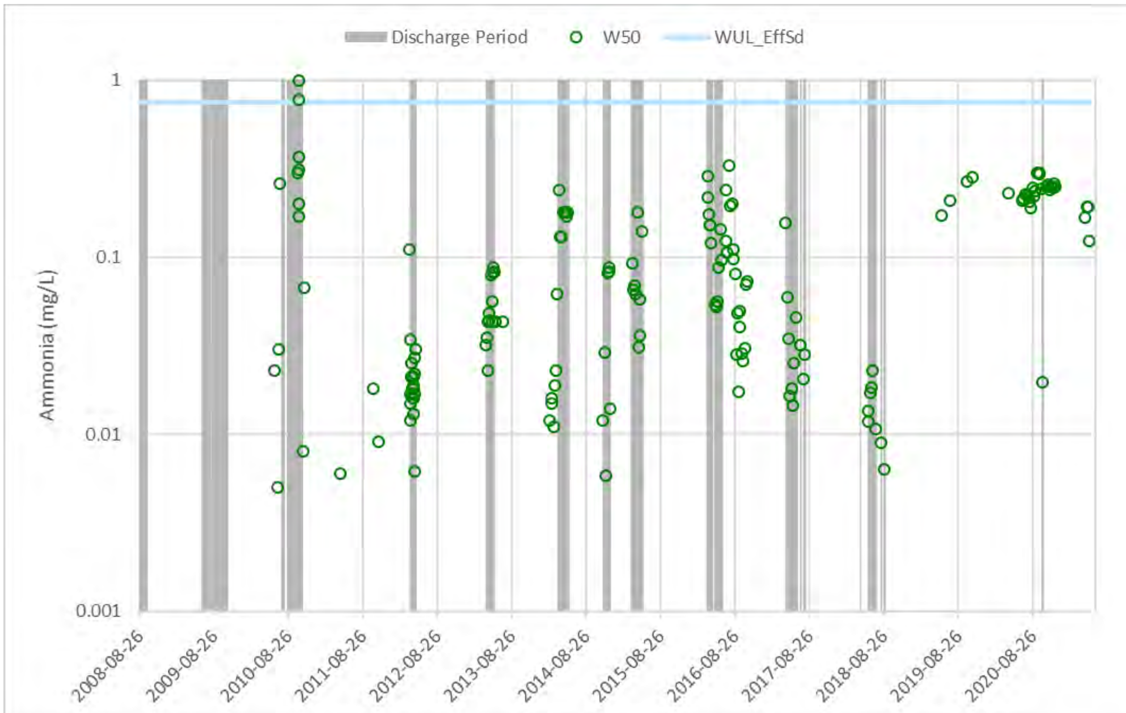


Figure 3-61: Concentrations of Ammonia (N) in Minto Creek at W50. Note Log Scale.

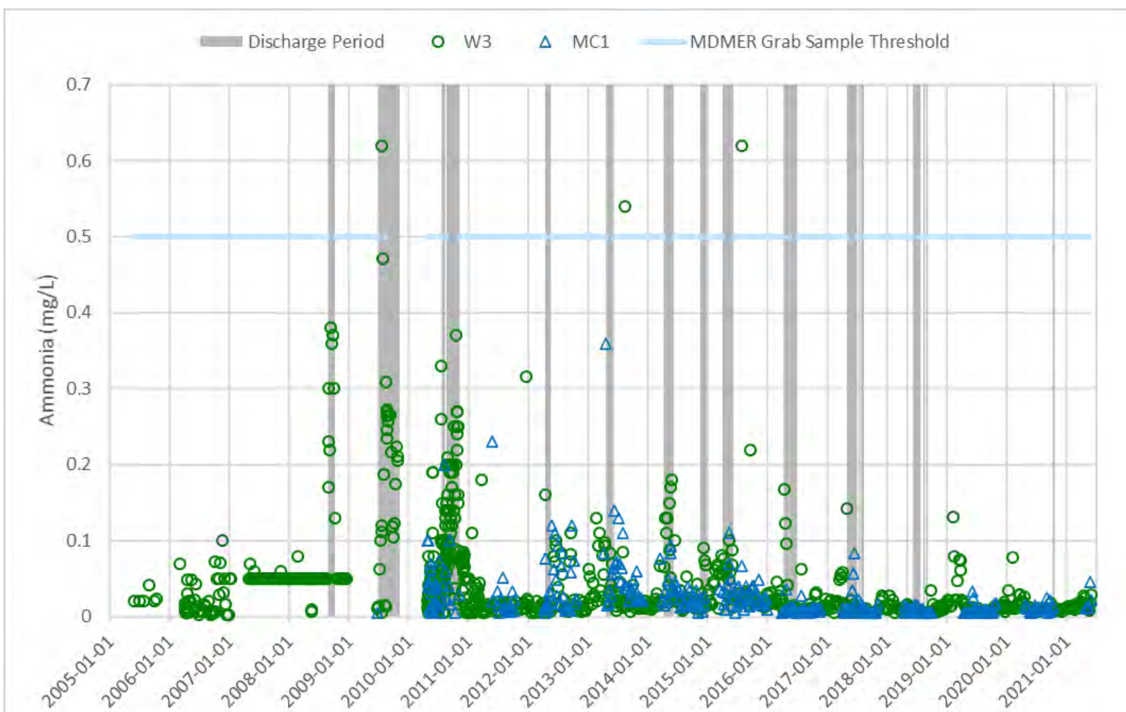


Figure 3-62: Concentrations of Ammonia (N) in Minto Creek at W3 and MC1.

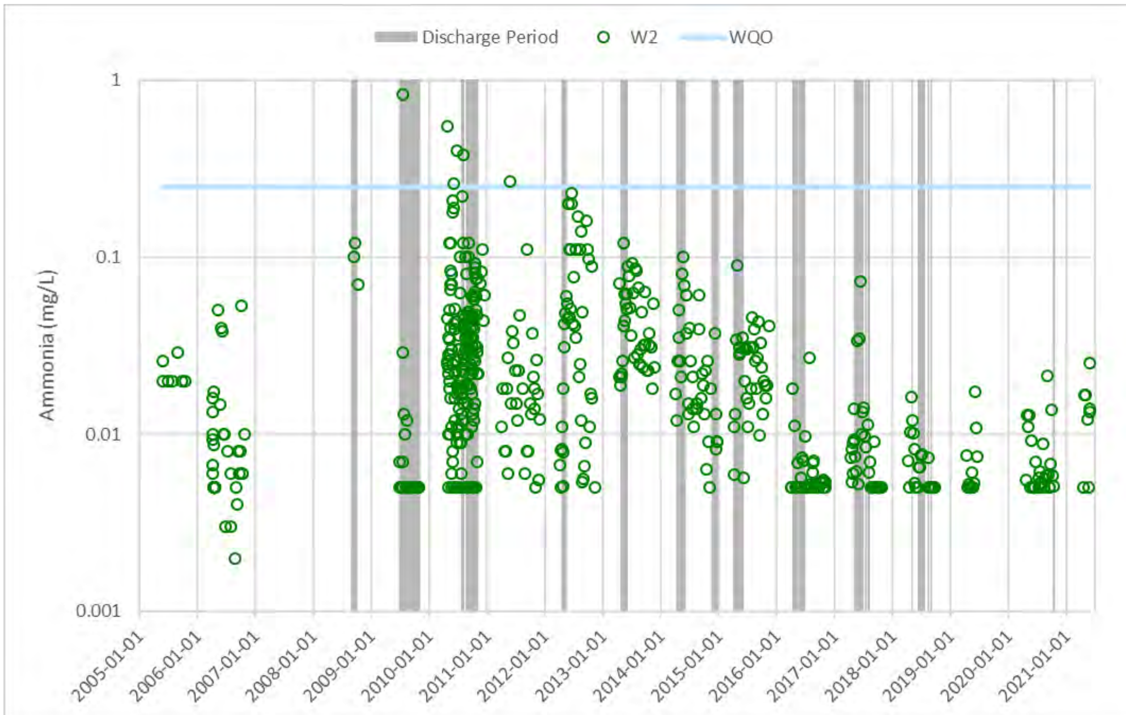


Figure 3-63: Concentrations of Ammonia (N) in Minto Creek at W2. Note Log Scale.

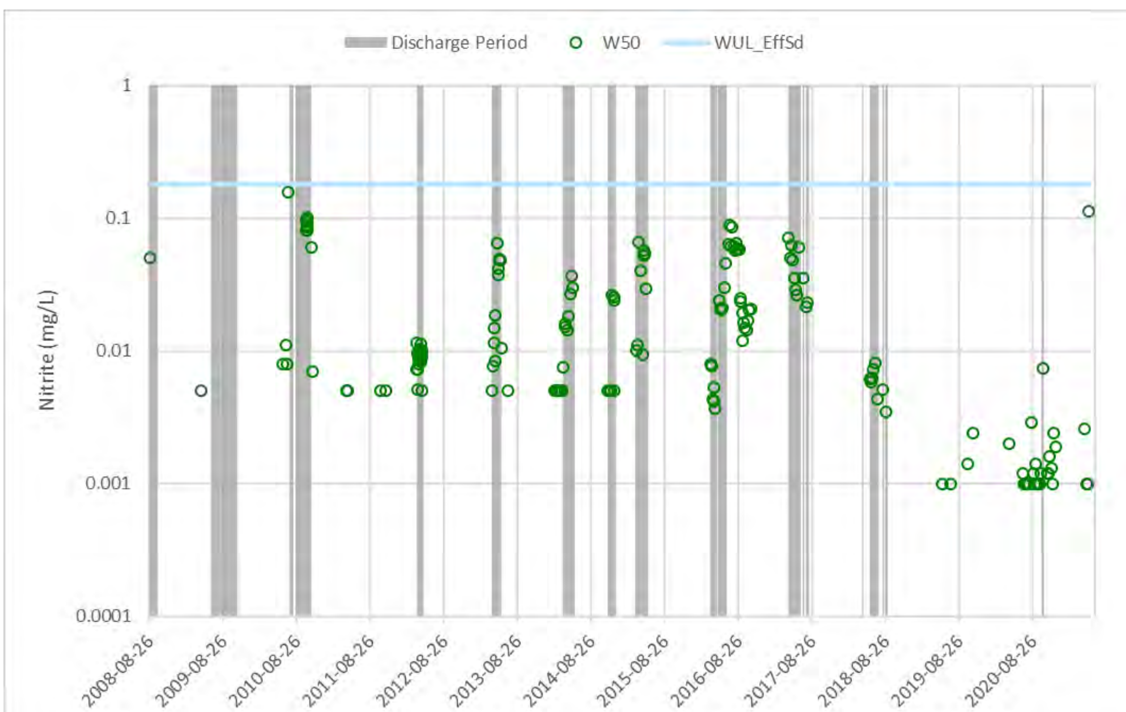


Figure 3-64: Concentrations of Nitrite (N) in Minto Creek at W50. Note Log Scale.

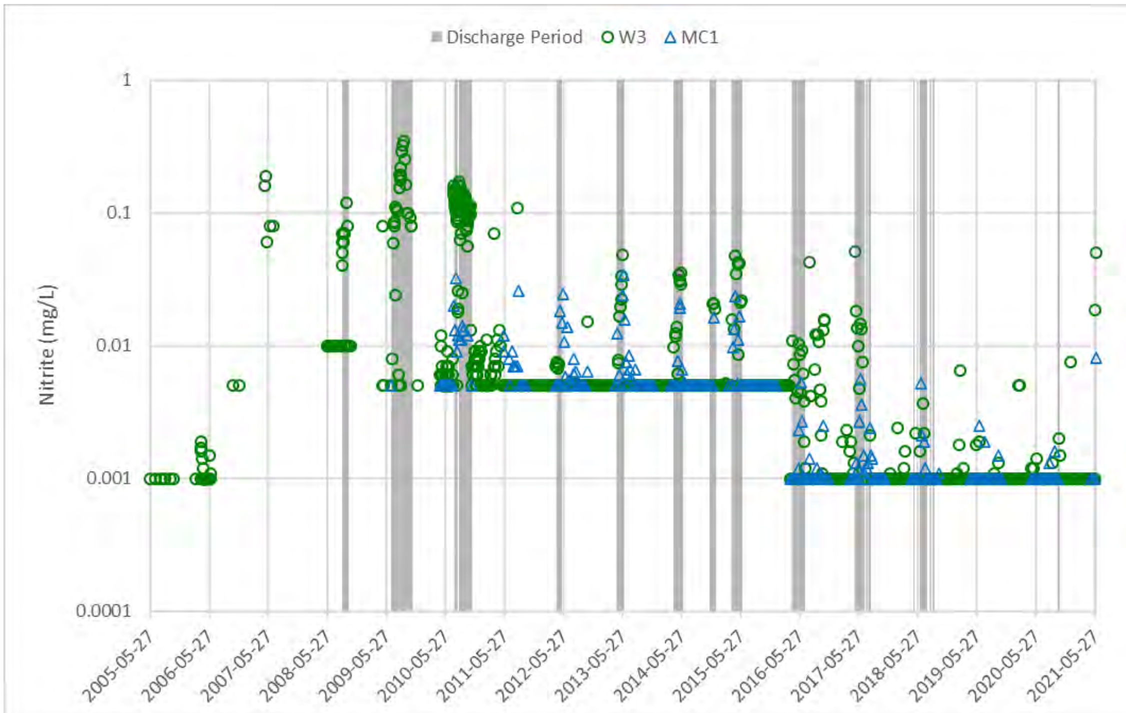


Figure 3-65: Concentrations of Nitrite (N) in Minto Creek at W3 and MC1. Note Log Scale.

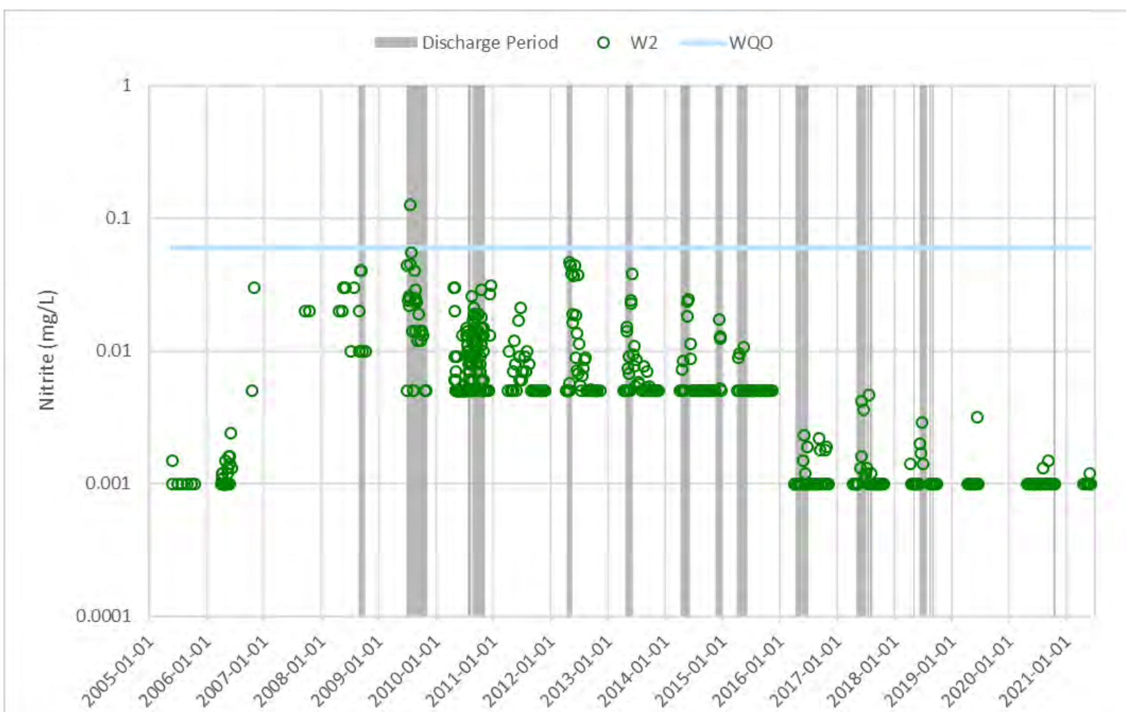


Figure 3-66: Concentrations of Nitrite (N) in Minto Creek at W2. Note Log Scale.

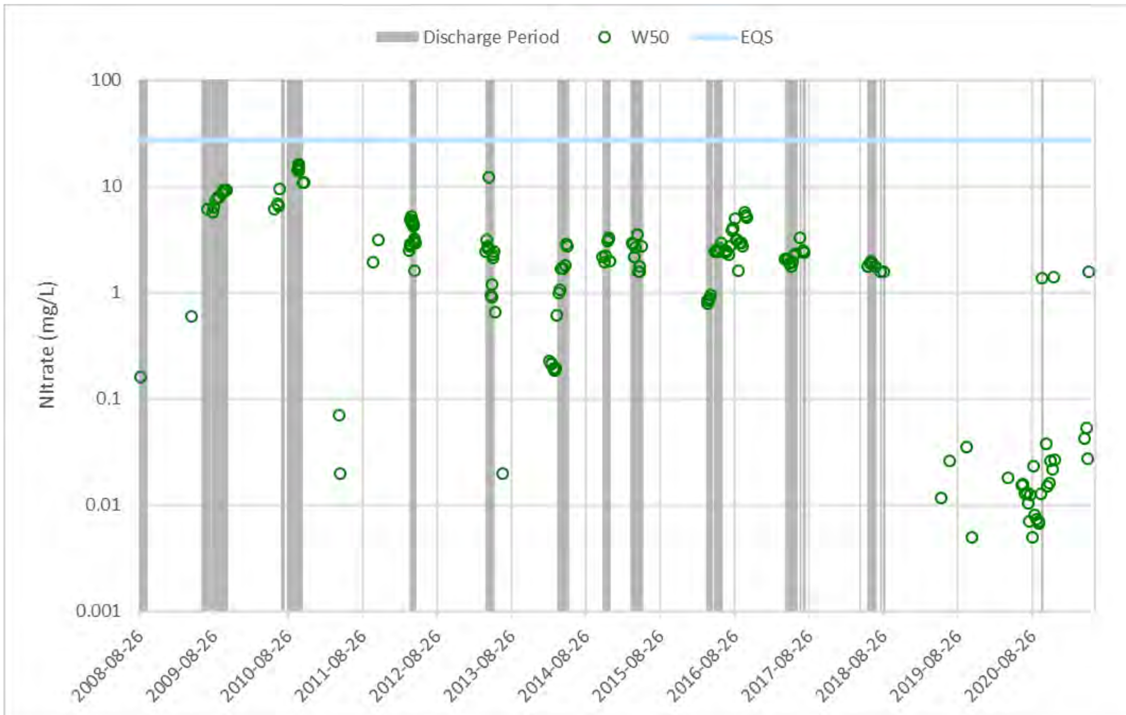


Figure 3-67: Concentrations of Nitrate (N) in Minto Creek at W50. Note Log Scale.

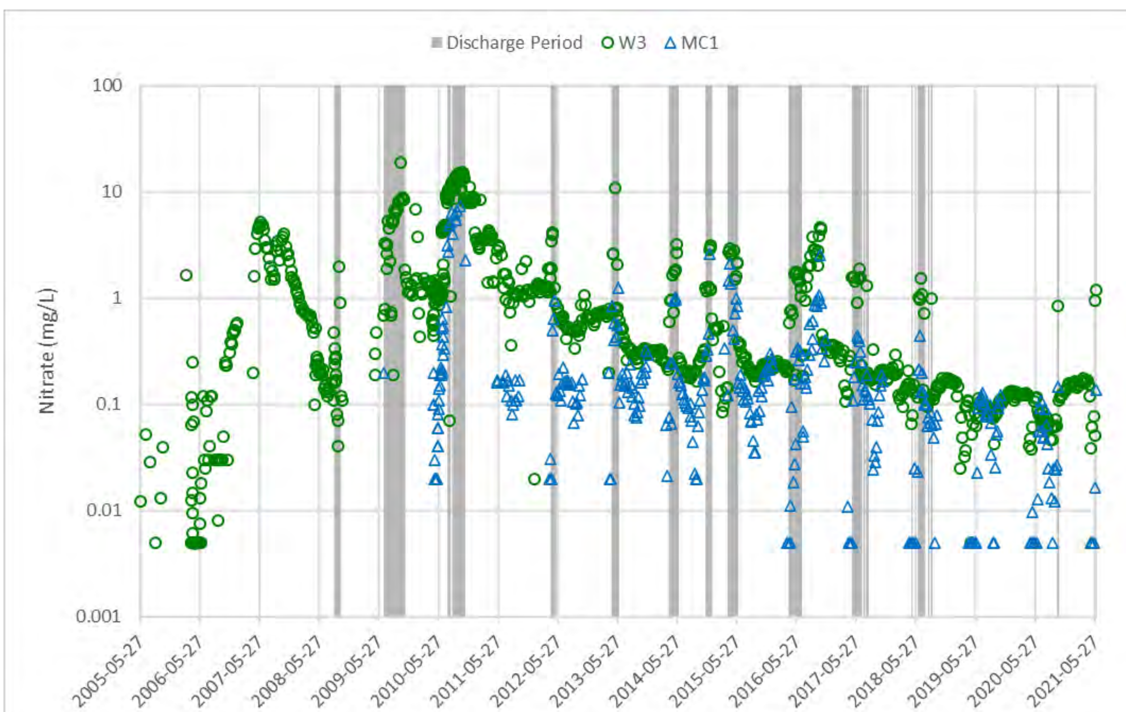


Figure 3-68: Concentrations of Nitrate (N) in Minto Creek at W3 and MC1. Note Log Scale.

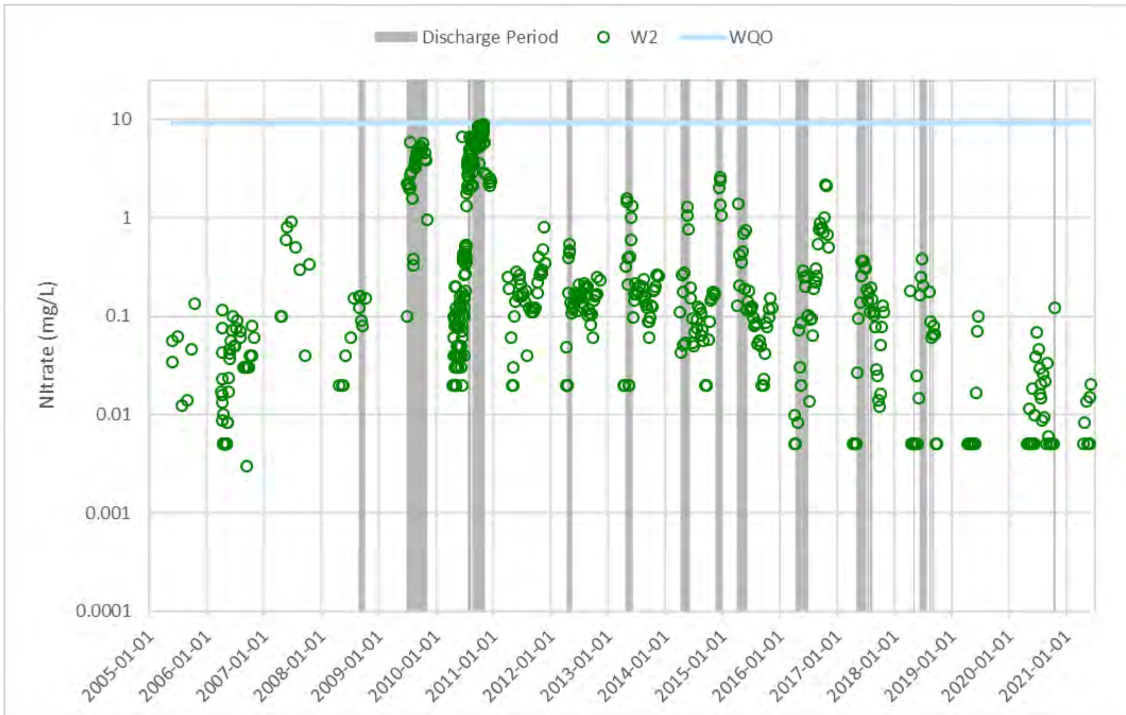


Figure 3-69: Concentrations of Nitrate (N) in Minto Creek at W2. Note Log Scale.

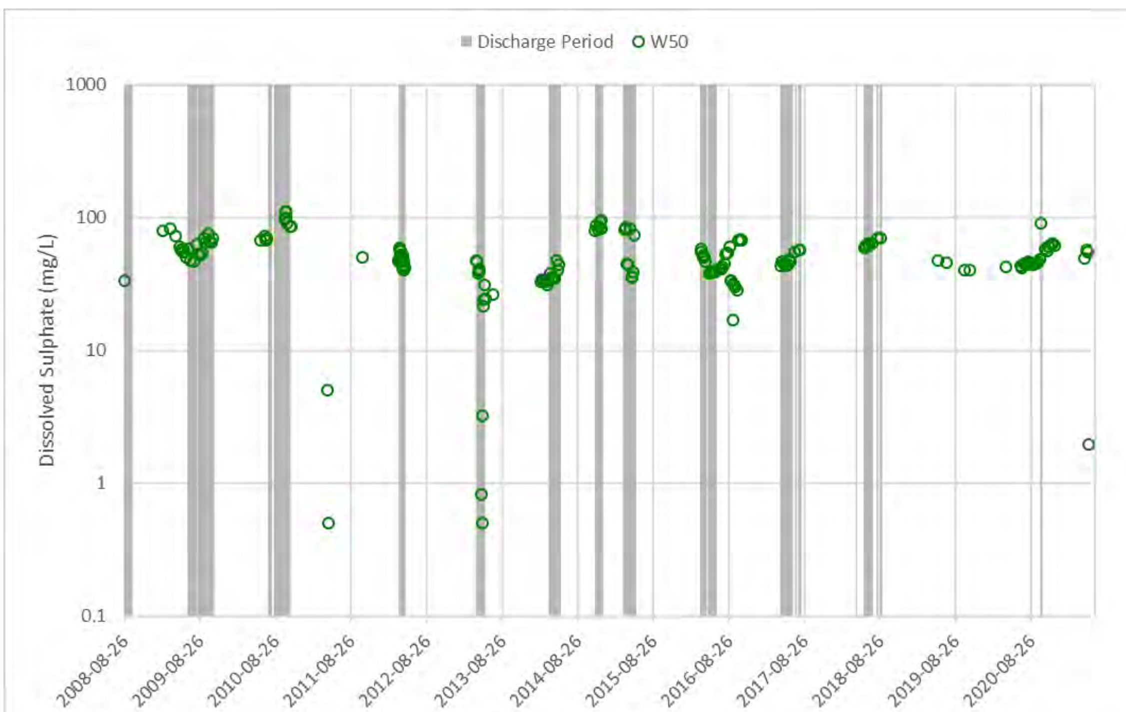


Figure 3-70: Concentrations of Dissolved Sulphate in Minto Creek at W50. Note Log Scale.

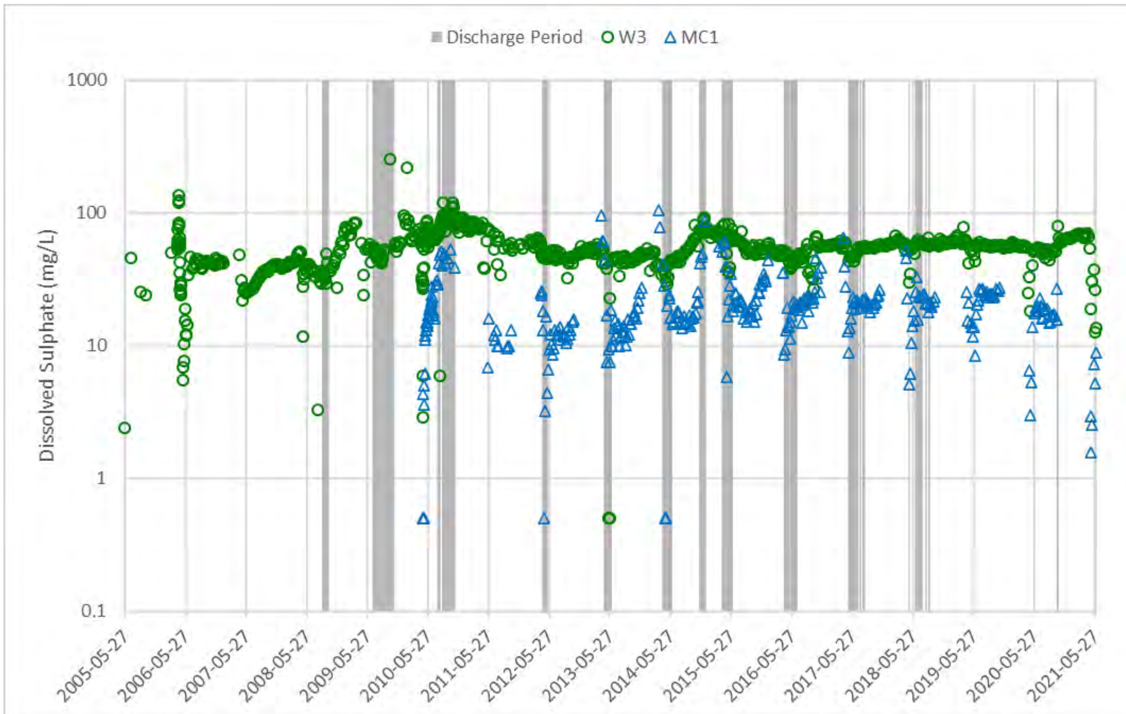


Figure 3-71: Concentrations of Dissolved Sulphate in Minto Creek at W3 and MC1. Note Log Scale.

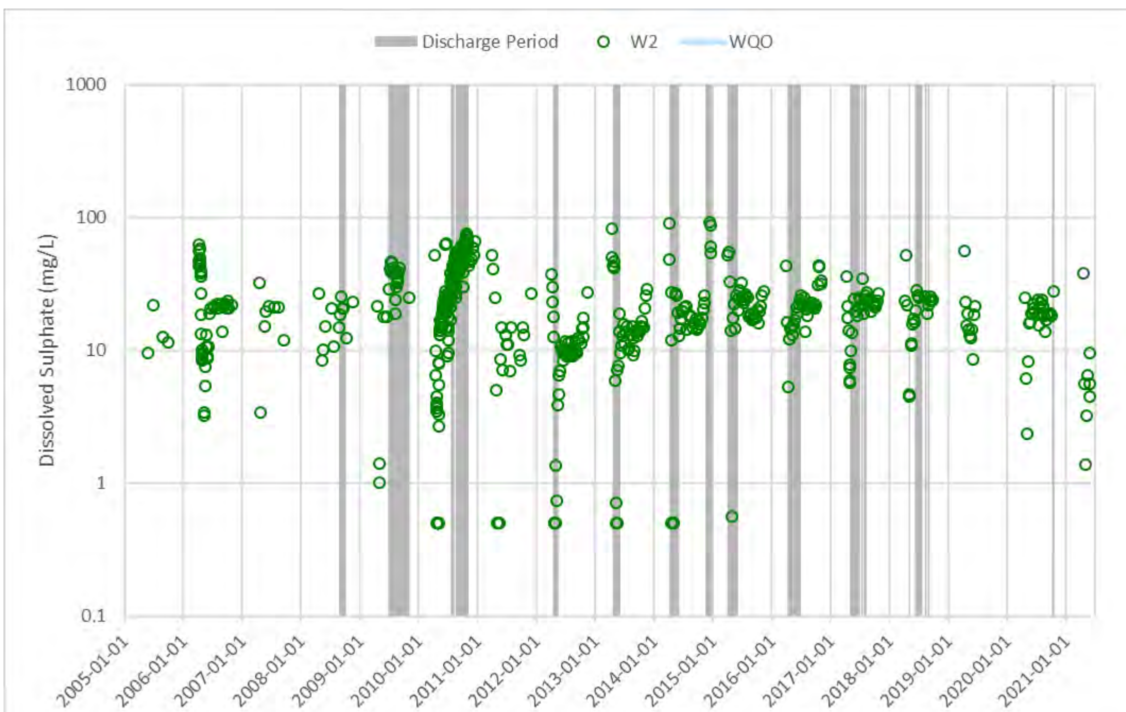


Figure 3-72: Concentrations of Dissolved Sulphate in Minto Creek at W2. Note Log Scale.

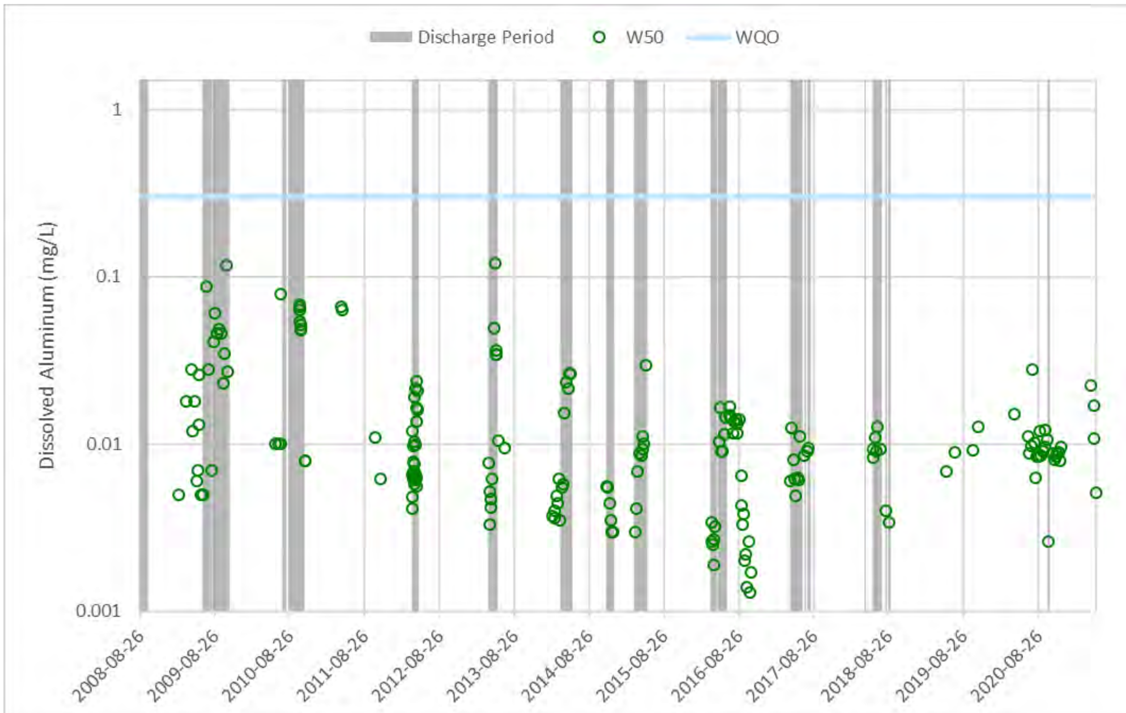


Figure 3-73: Concentrations of Dissolved Aluminum in Minto Creek at W50. Note Log Scale.

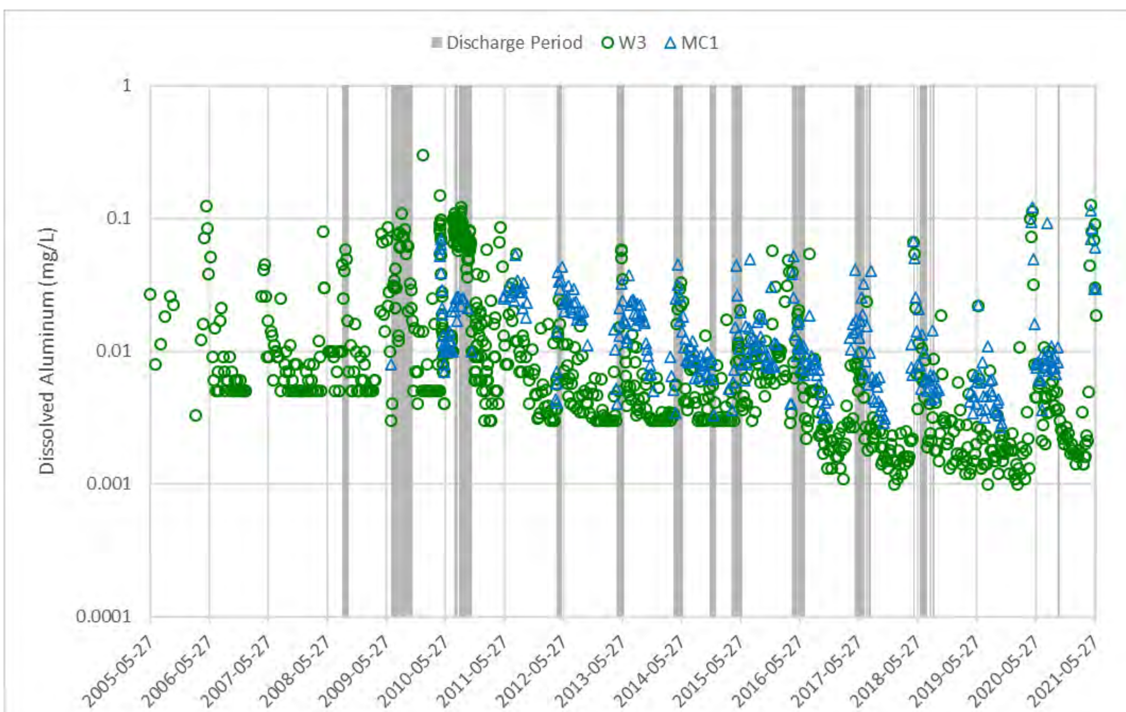


Figure 3-74: Concentrations of Dissolved Aluminum in Minto Creek at W3 and MC1. Note Log Scale.

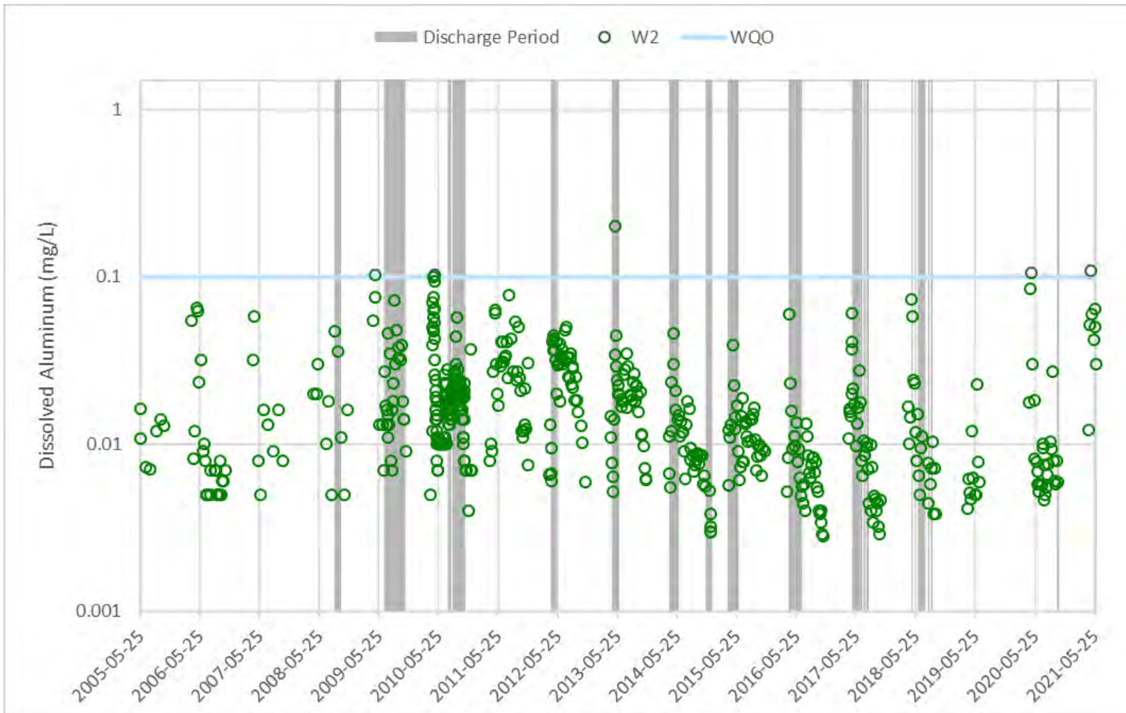


Figure 3-75: Concentrations of Dissolved Aluminum in Minto Creek at W2. Note Log Scale.

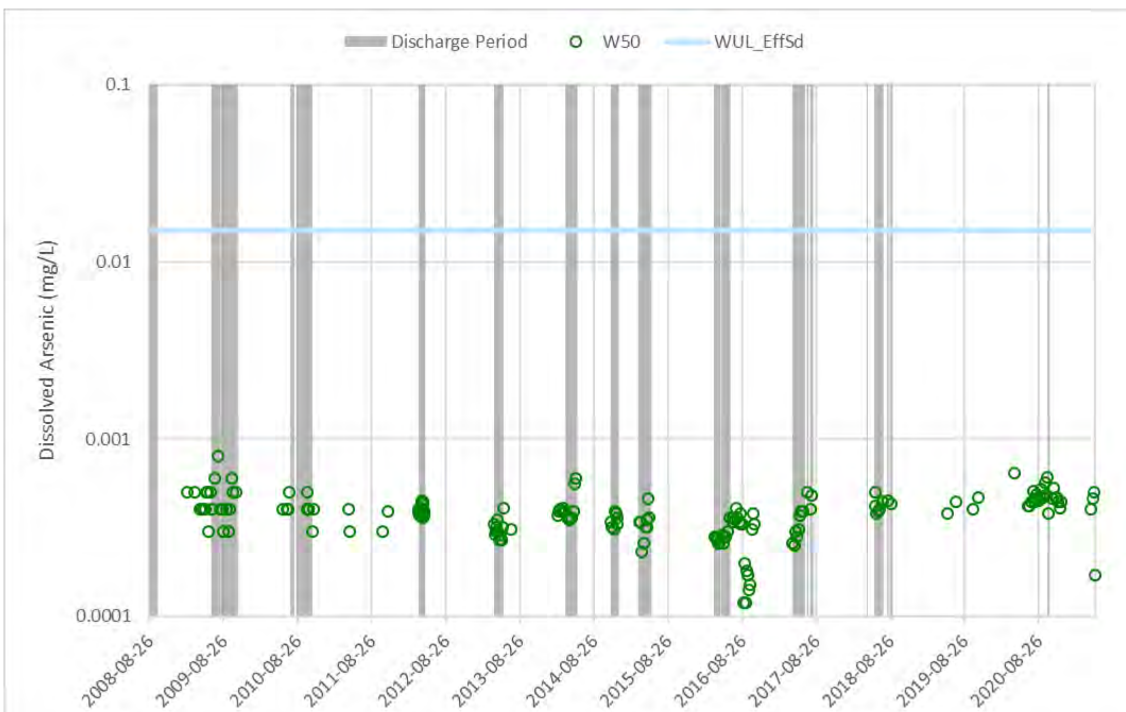


Figure 3-76: Concentrations of Dissolved Arsenic in Minto Creek at W50. Note Log Scale.

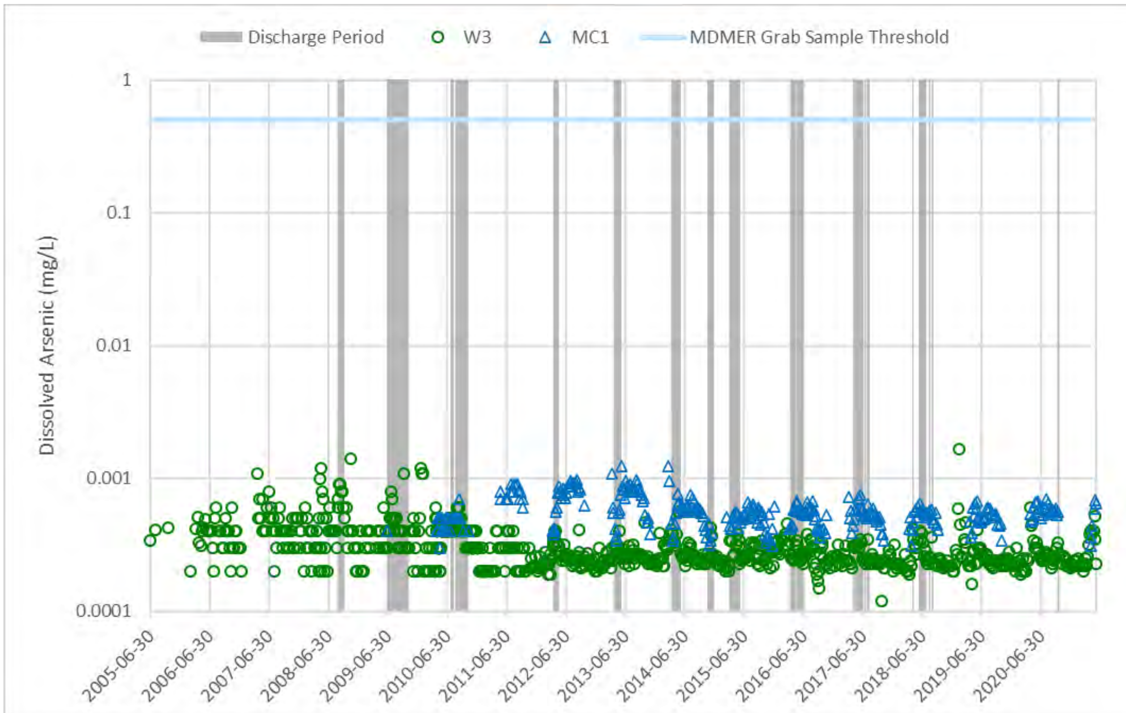


Figure 3-77: Concentrations of Dissolved Arsenic in Minto Creek at W3 and MC1. Note Log Scale.

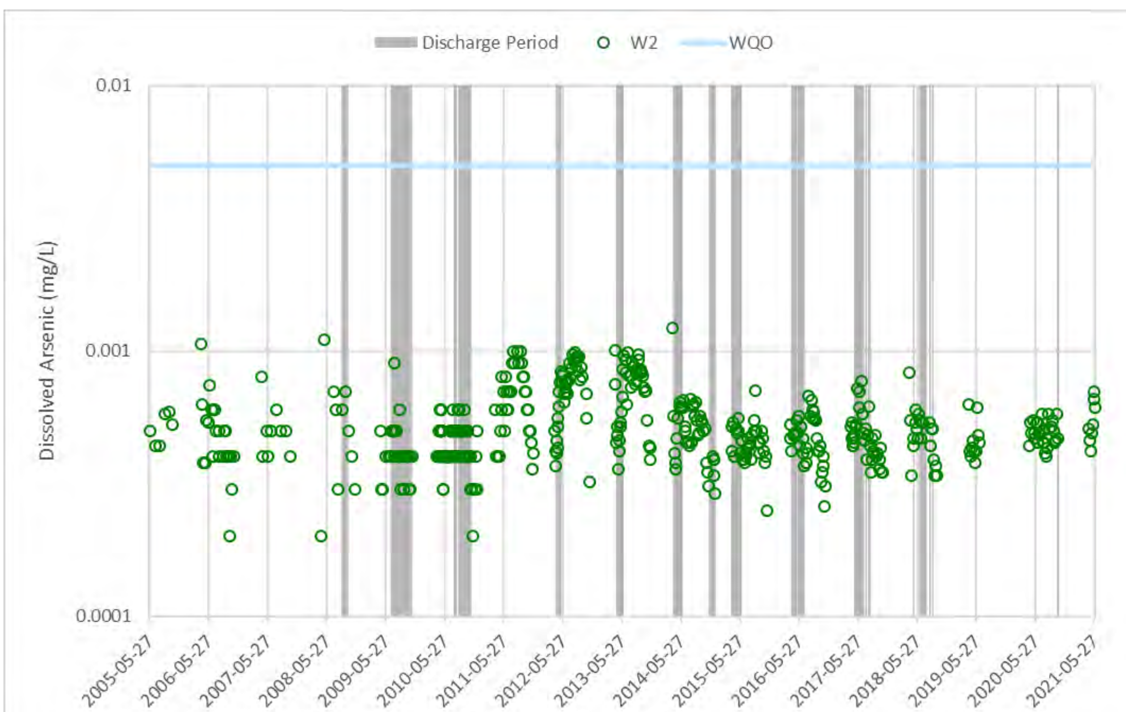


Figure 3-78: Concentrations of Dissolved Arsenic in Minto Creek at W2. Note Log Scale.

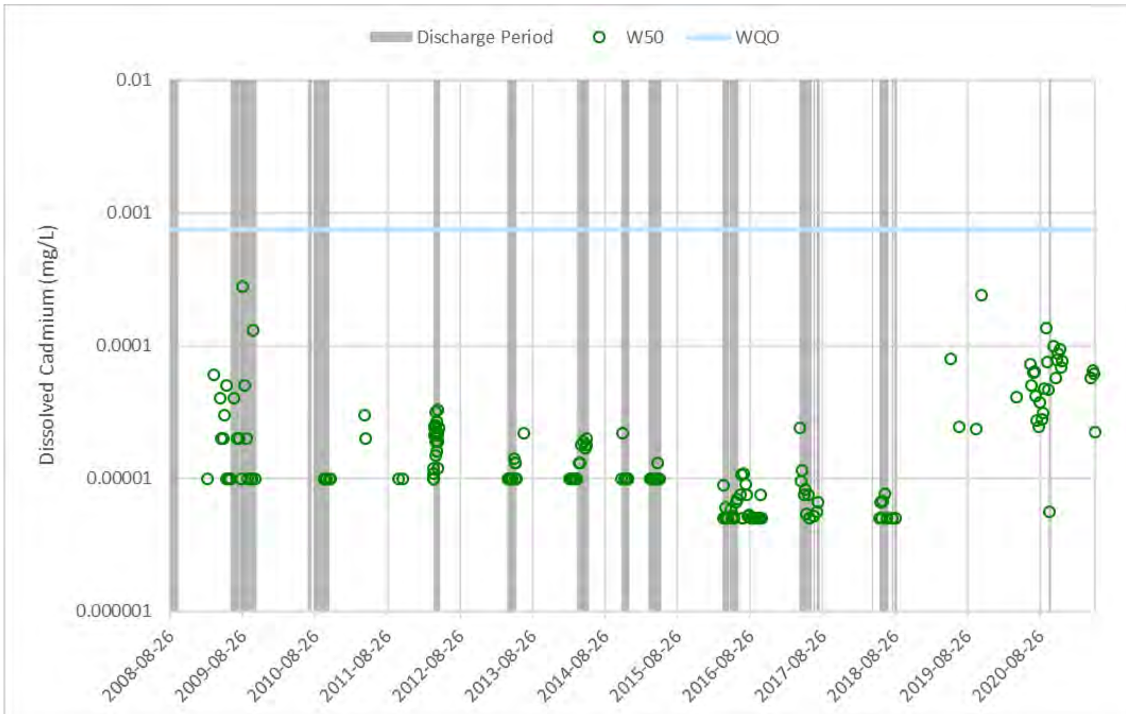


Figure 3-79: Concentrations of Dissolved Cadmium in Minto Creek at W50. Note Log Scale.

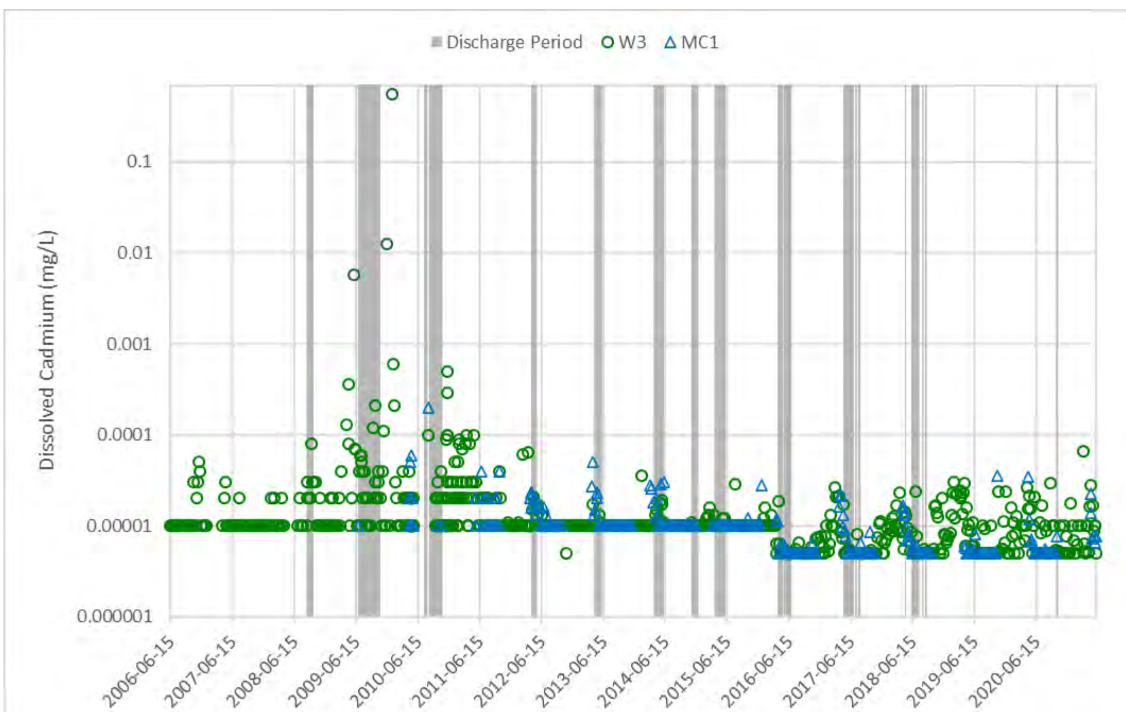


Figure 3-80: Concentrations of Dissolved Cadmium in Minto Creek at W3 and MC1. Note Log Scale.

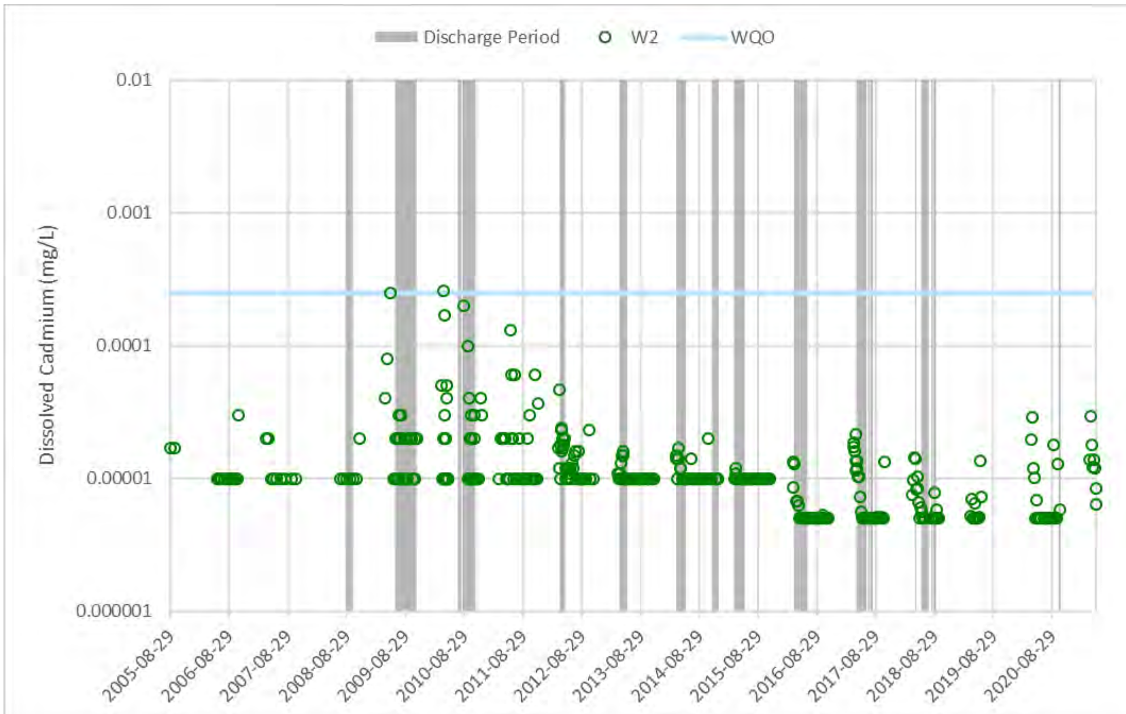


Figure 3-81: Concentrations of Dissolved Cadmium in Minto Creek at W2. Note Log Scale.

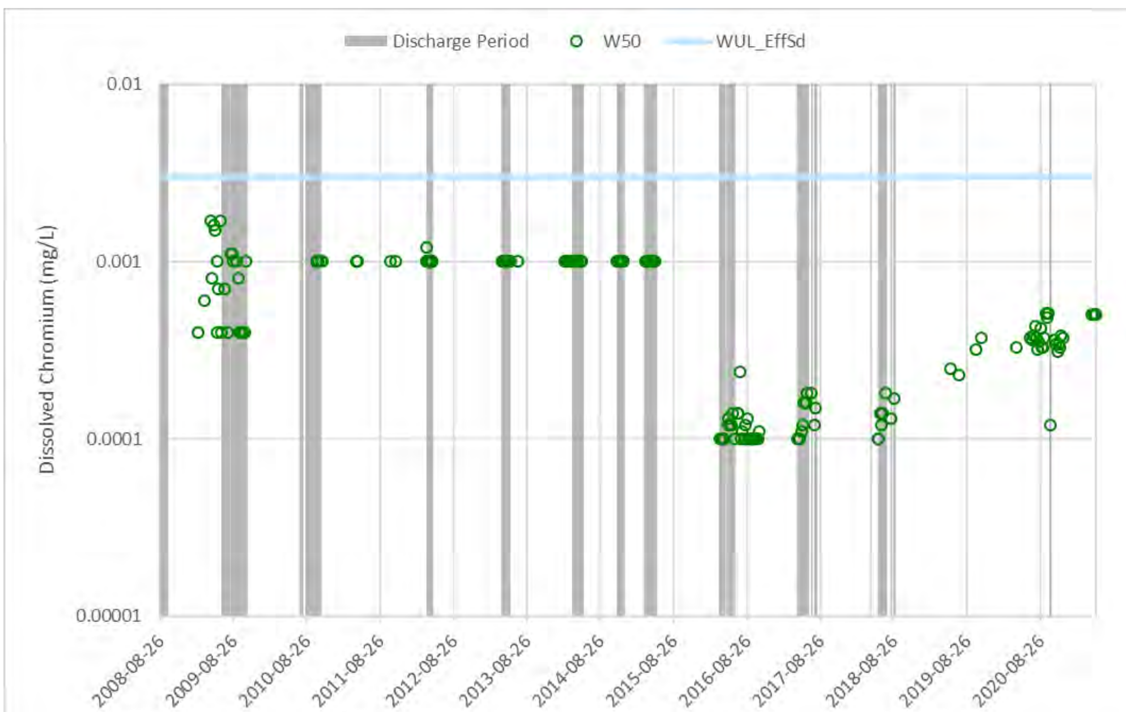


Figure 3-82: Concentrations of Dissolved Chromium in Minto Creek at W50. Note Log Scale.

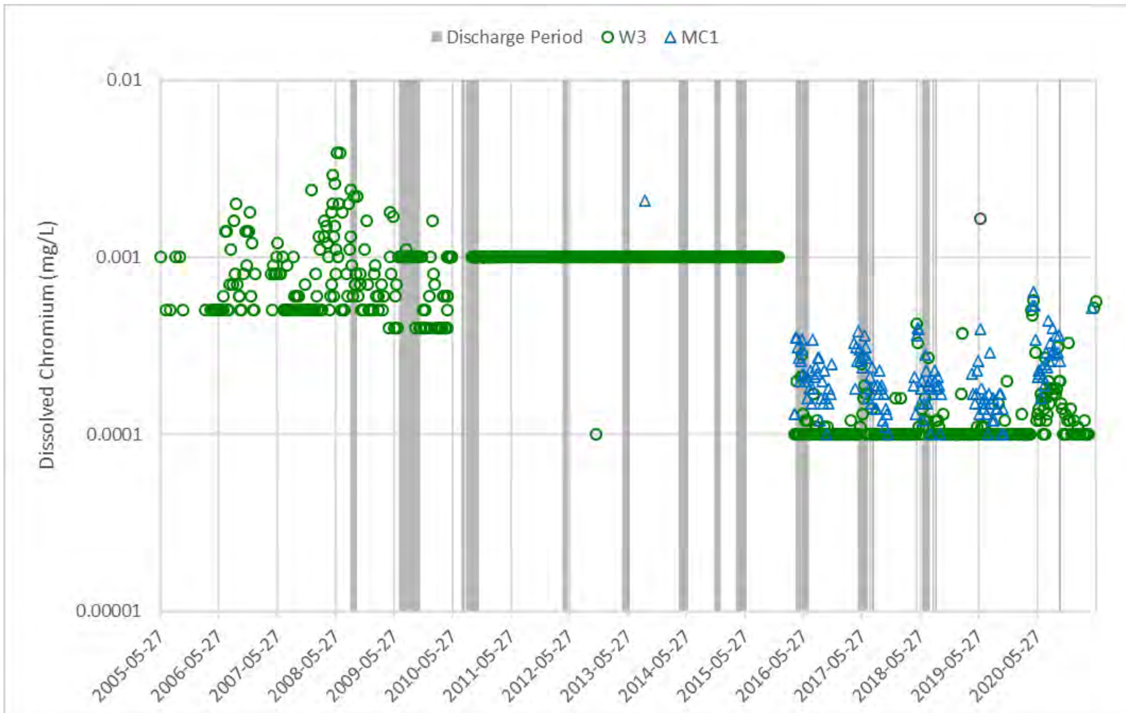


Figure 3-83: Concentrations of Dissolved Chromium in Minto Creek at W3 and MC1. Note Log Scale.

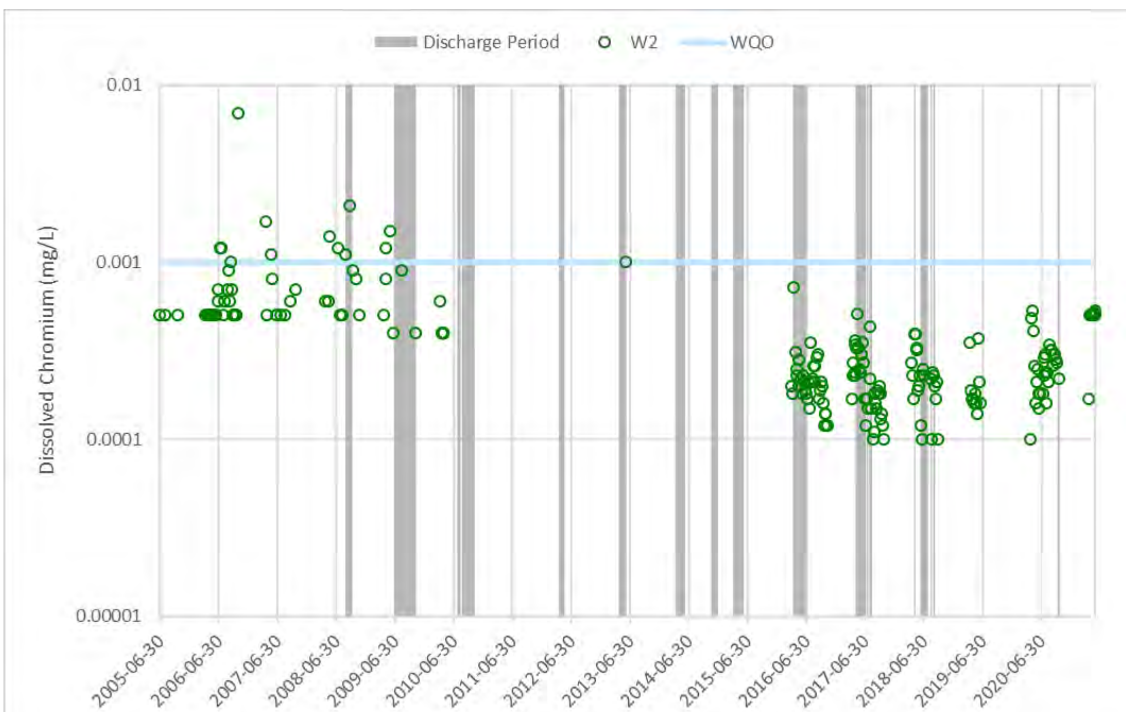


Figure 3-84: Concentrations of Dissolved Chromium in Minto Creek at W2. Note Log Scale.

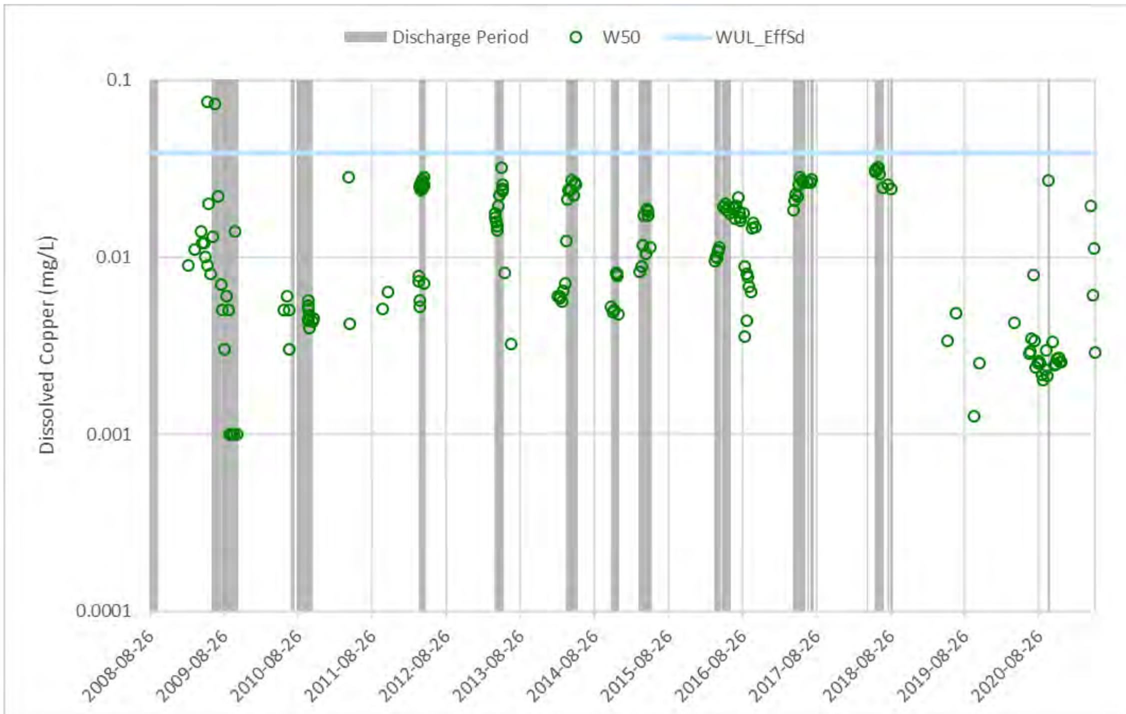


Figure 3-85: Concentrations of Dissolved Copper in Minto Creek at W50. Note Log Scale.

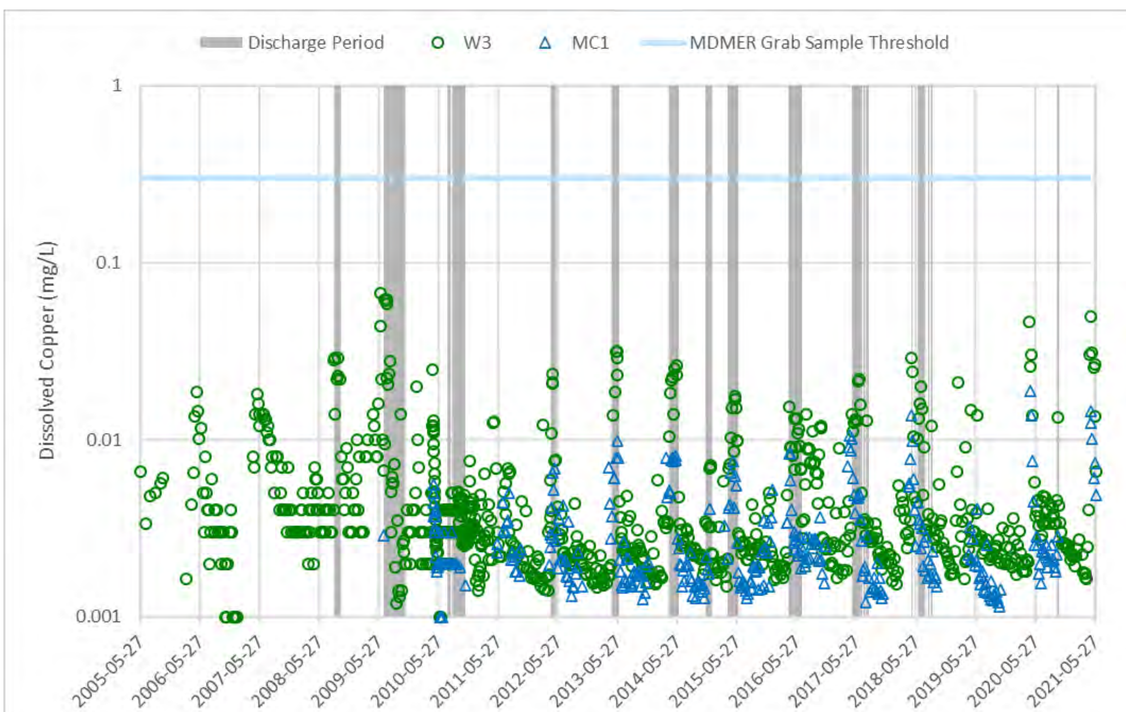


Figure 3-86: Concentrations of Dissolved Copper in Minto Creek at W3 and MC1. Note Log Scale.

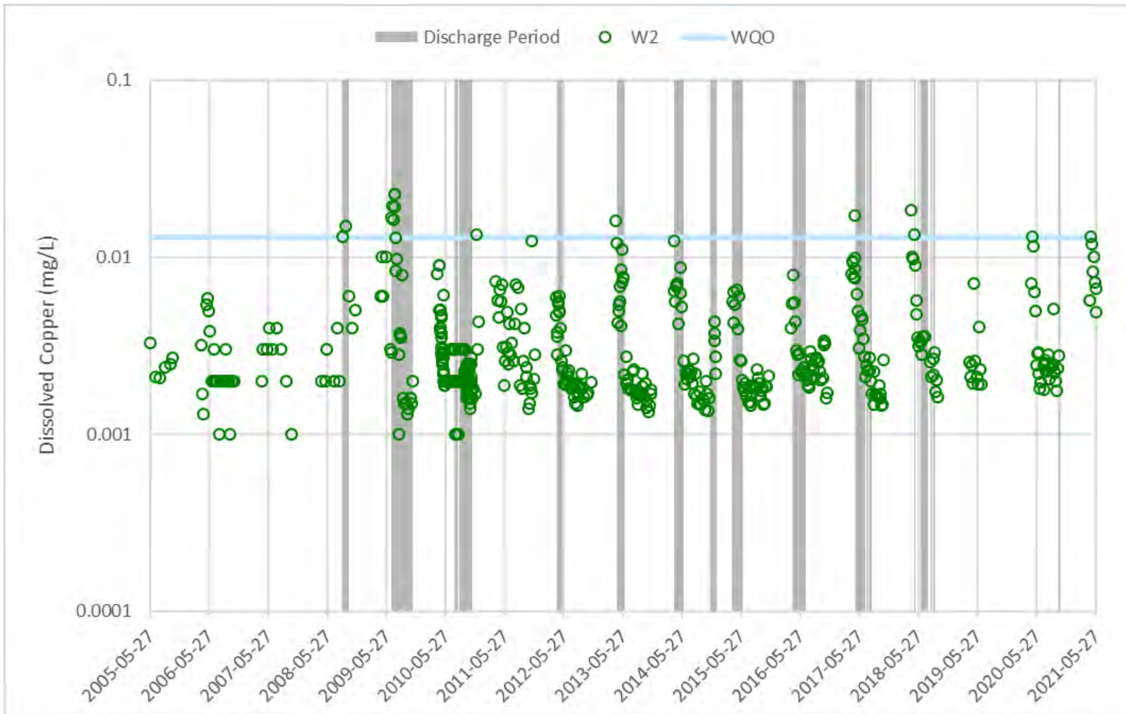


Figure 3-87: Concentrations of Dissolved Copper in Minto Creek at W2. Note Log Scale.

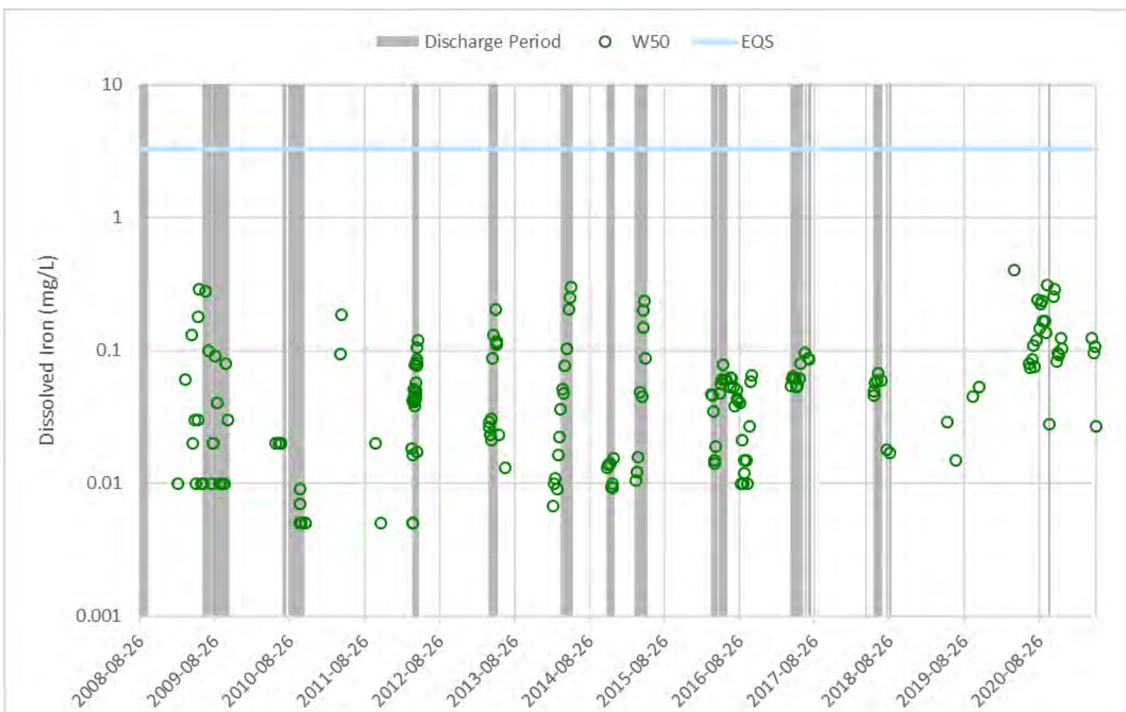


Figure 3-88: Concentrations of Dissolved Iron in Minto Creek at W50. Note Log Scale.

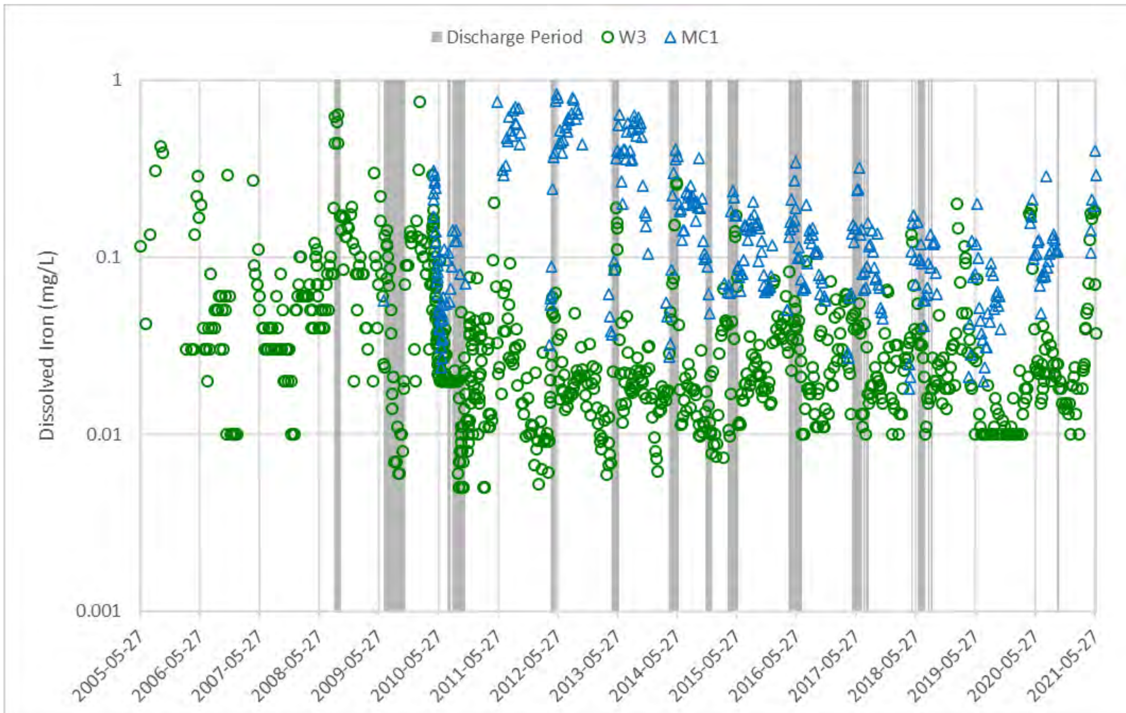


Figure 3-89: Concentrations of Dissolved Iron in Minto Creek at W3 and MC1. Note Log Scale.

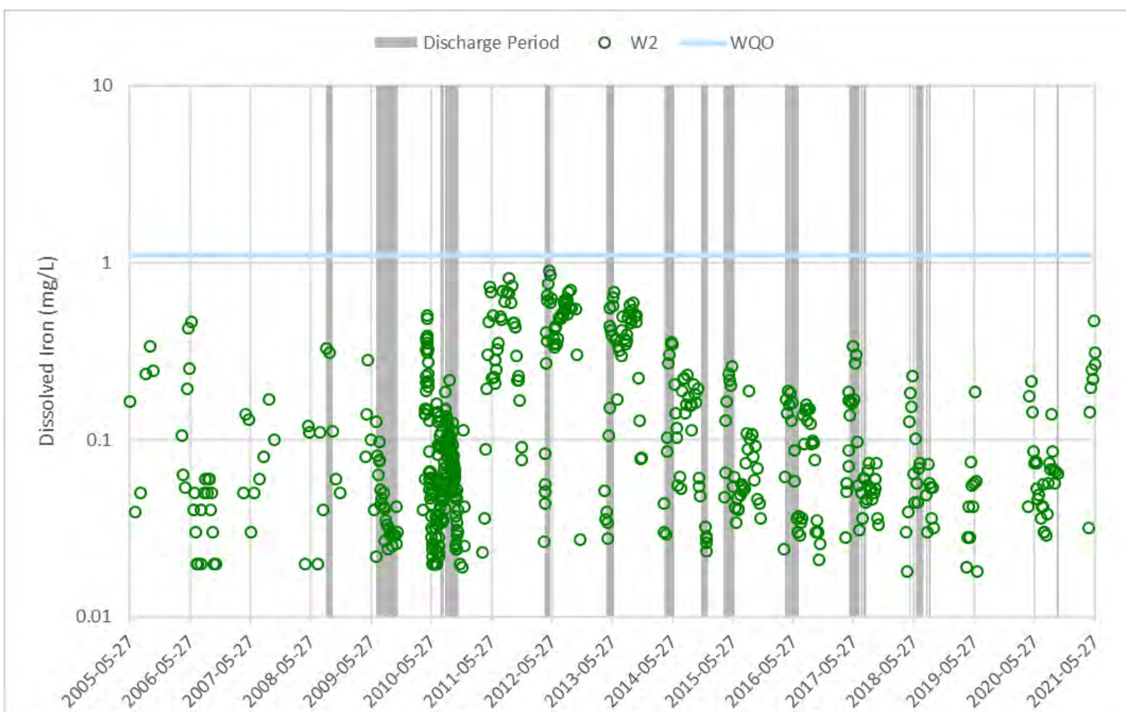


Figure 3-90: Concentrations of Dissolved Iron in Minto Creek at W2. Note Log Scale.

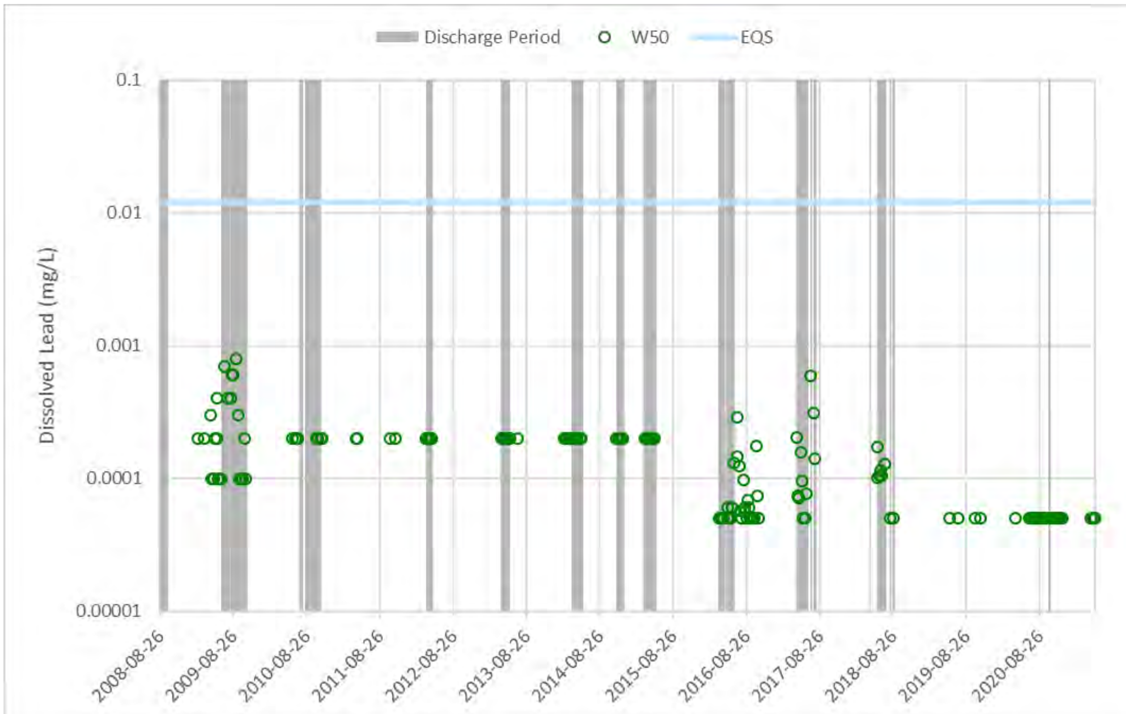


Figure 3-91: Concentrations of Dissolved Lead in Minto Creek at W50. Note Log Scale.

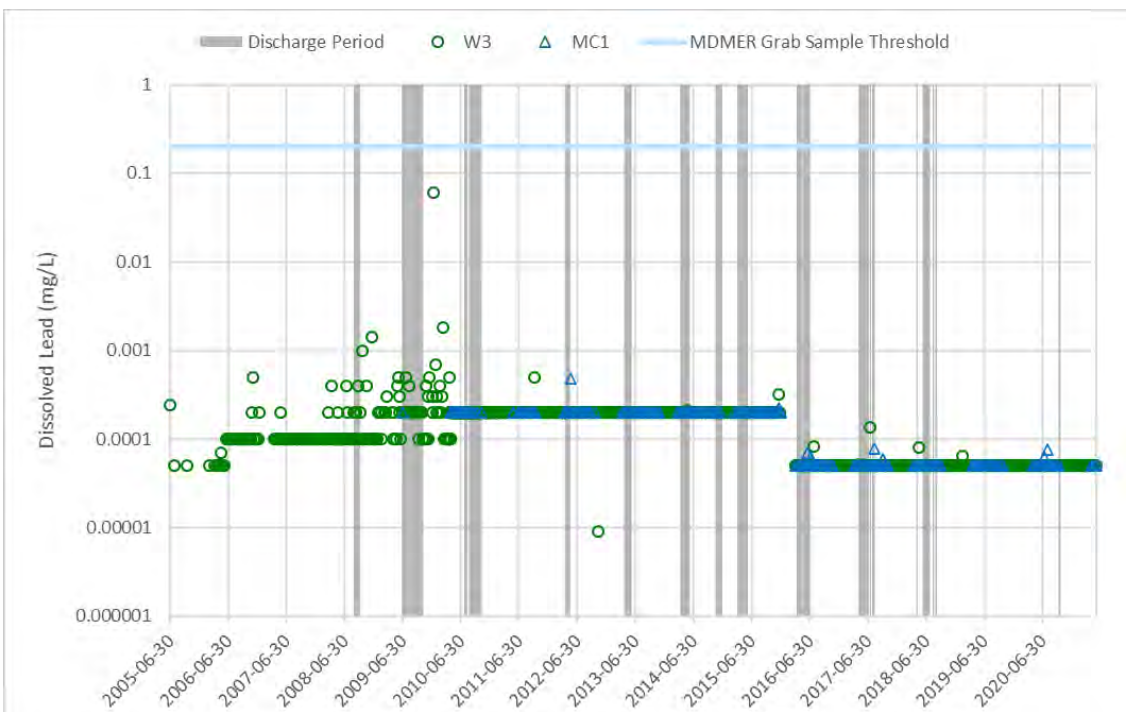


Figure 3-92: Concentrations of Dissolved Lead in Minto Creek at W3 and MC1. Note Log Scale.

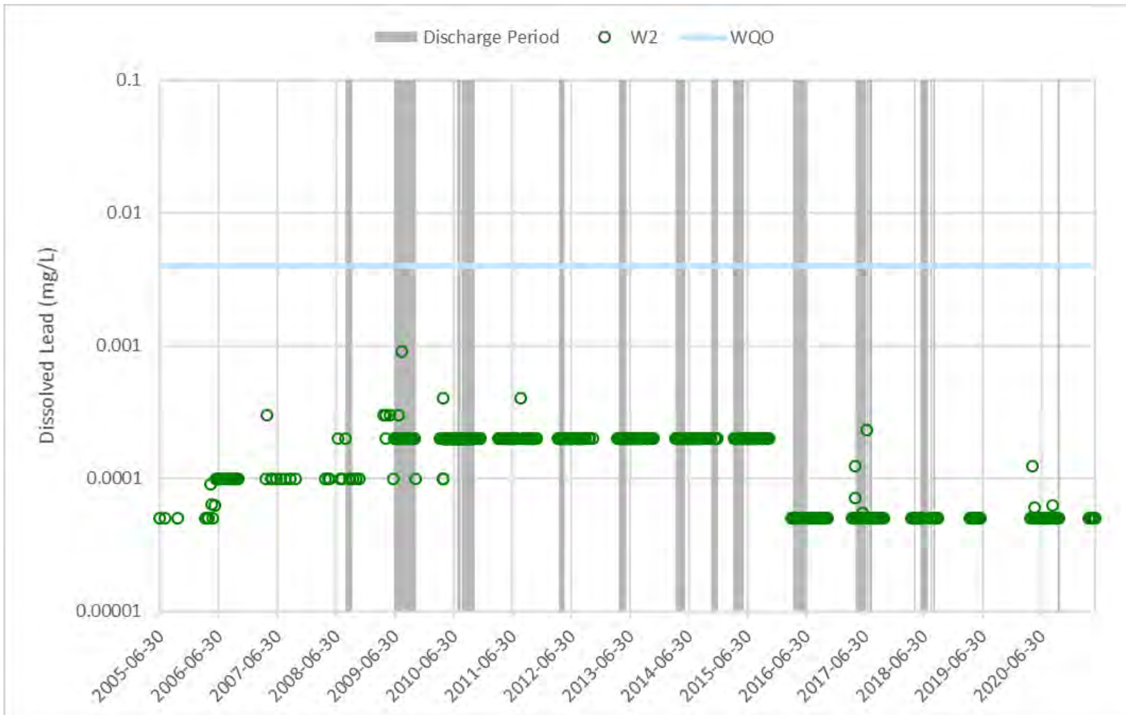


Figure 3-93: Concentrations of Dissolved Lead in Minto Creek at W2. Note Log Scale.

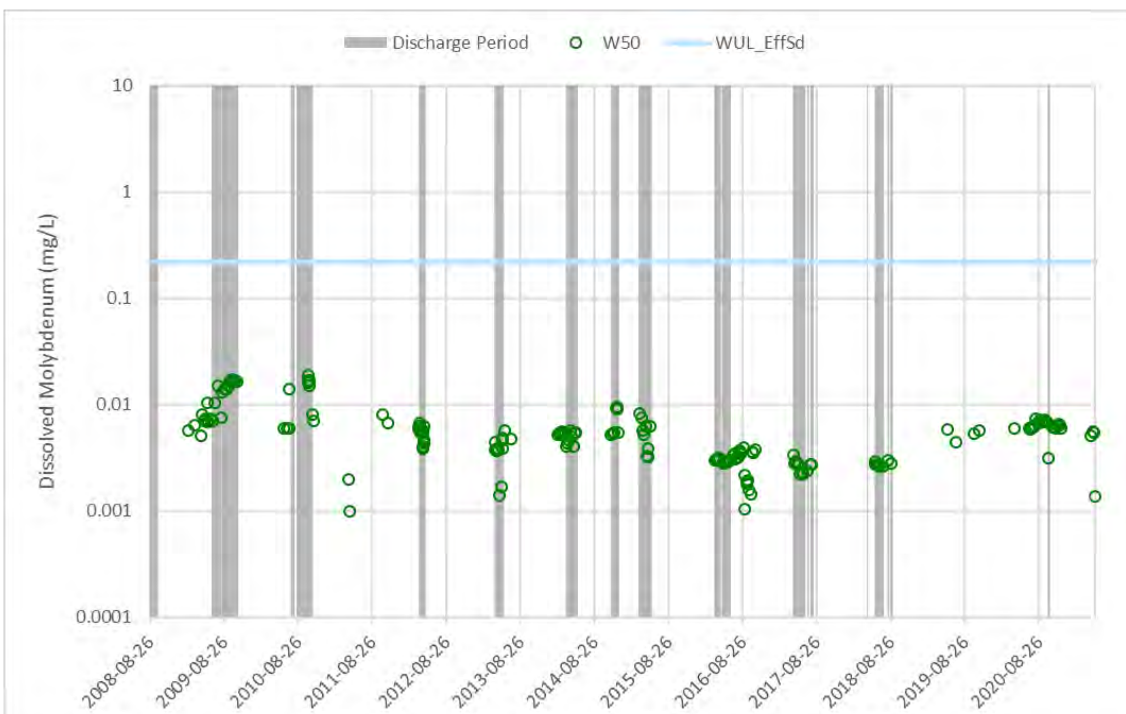


Figure 3-94: Concentrations of Dissolved Molybdenum in Minto Creek at W50. Note Log Scale.

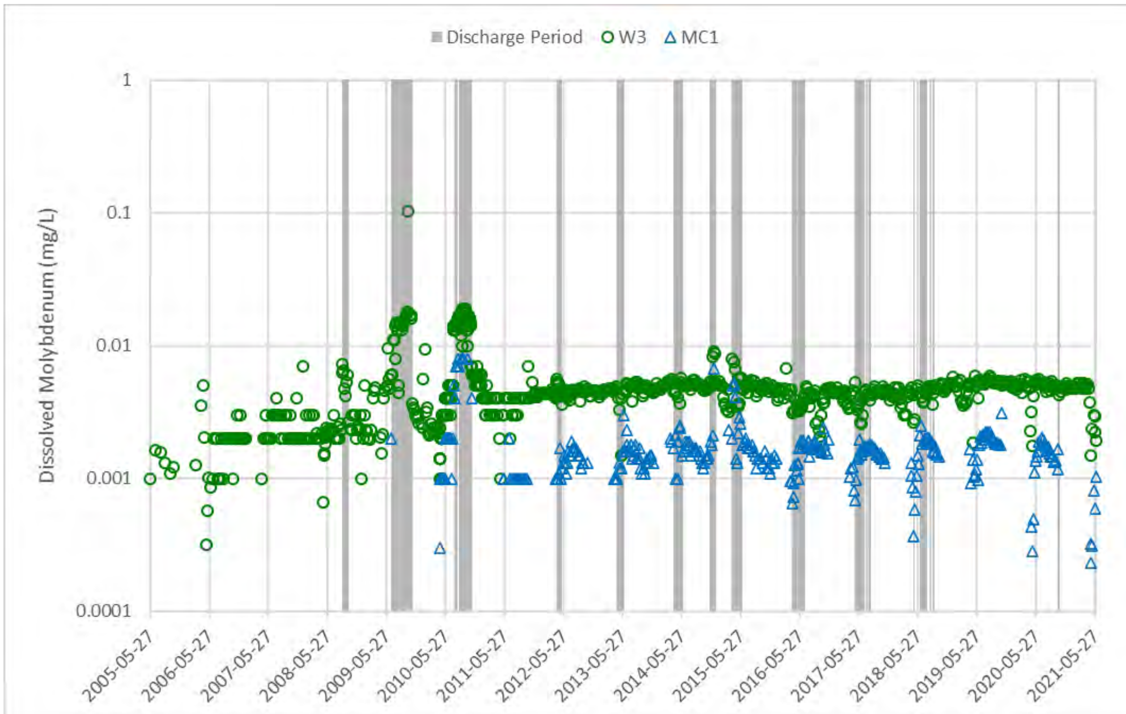


Figure 3-95: Concentrations of Dissolved Molybdenum in Minto Creek at W3 and MC1. Note Log Scale.

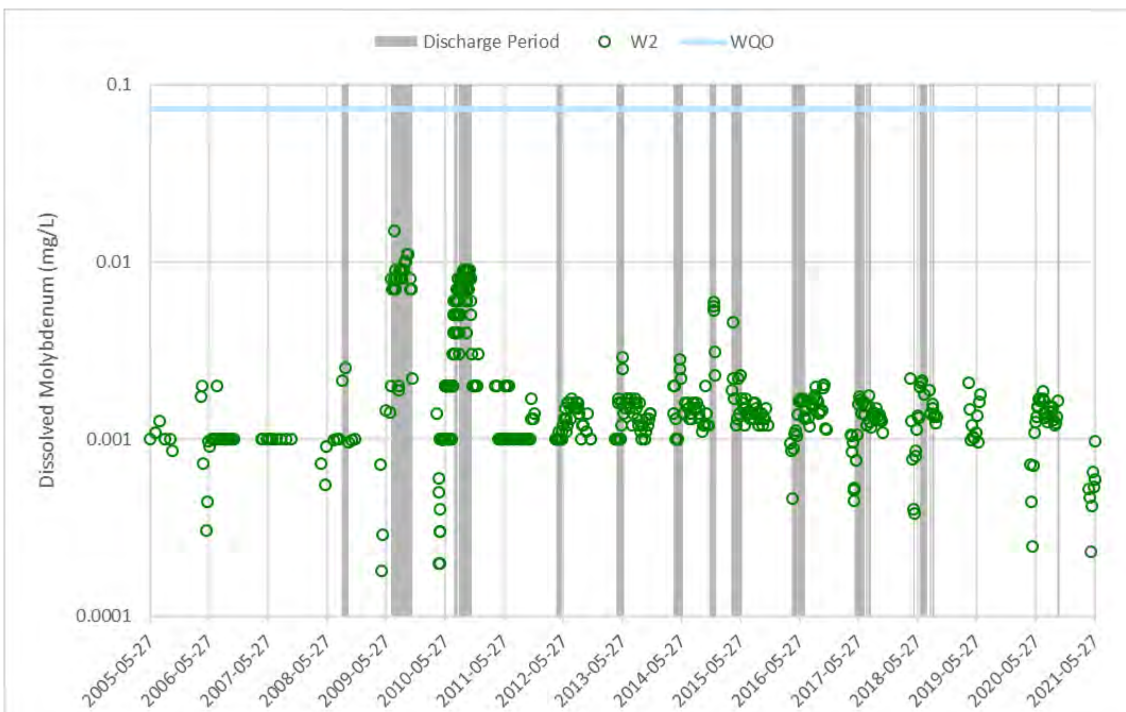


Figure 3-96: Concentrations of Dissolved Molybdenum in Minto Creek at W2. Note Log Scale.

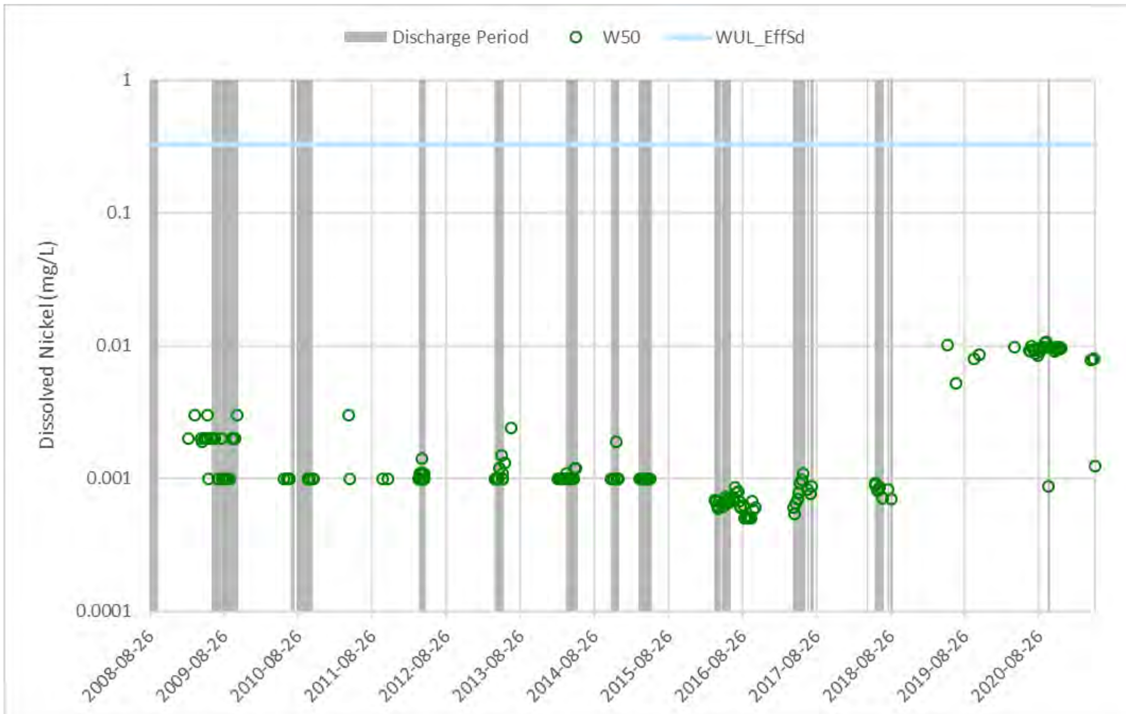


Figure 3-97: Concentrations of Dissolved Nickel in Minto Creek at W50. Note Log Scale.

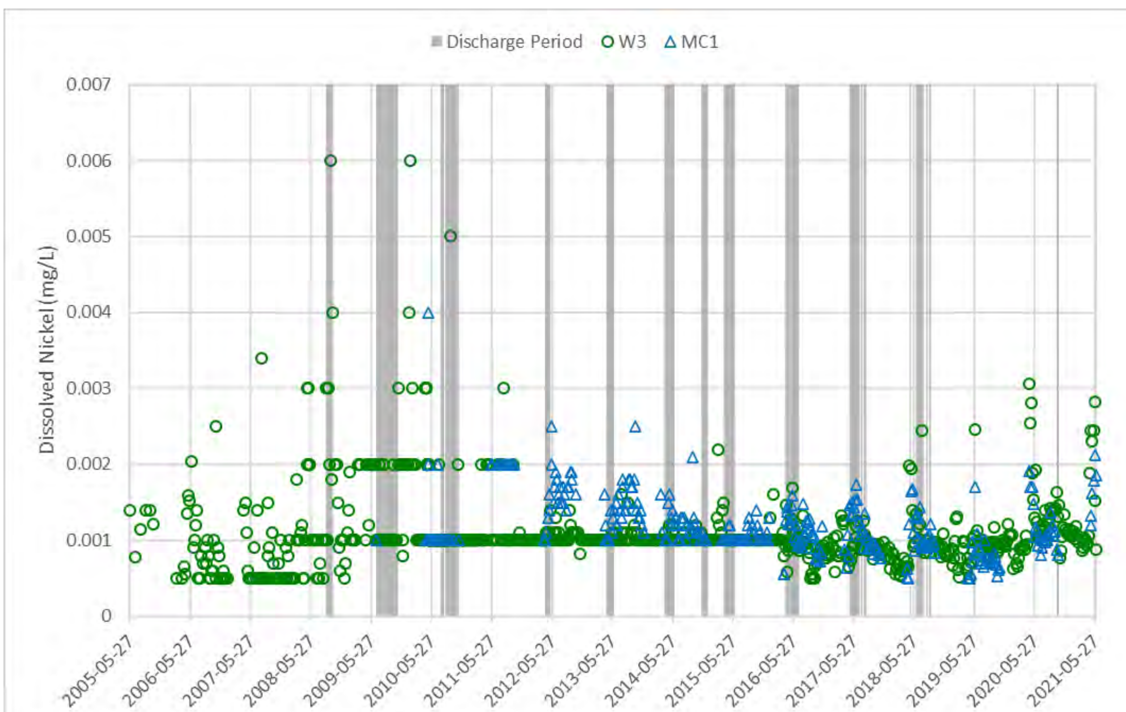


Figure 3-98: Concentrations of Dissolved Nickel in Minto Creek at W3 and MC1. Note Log Scale.

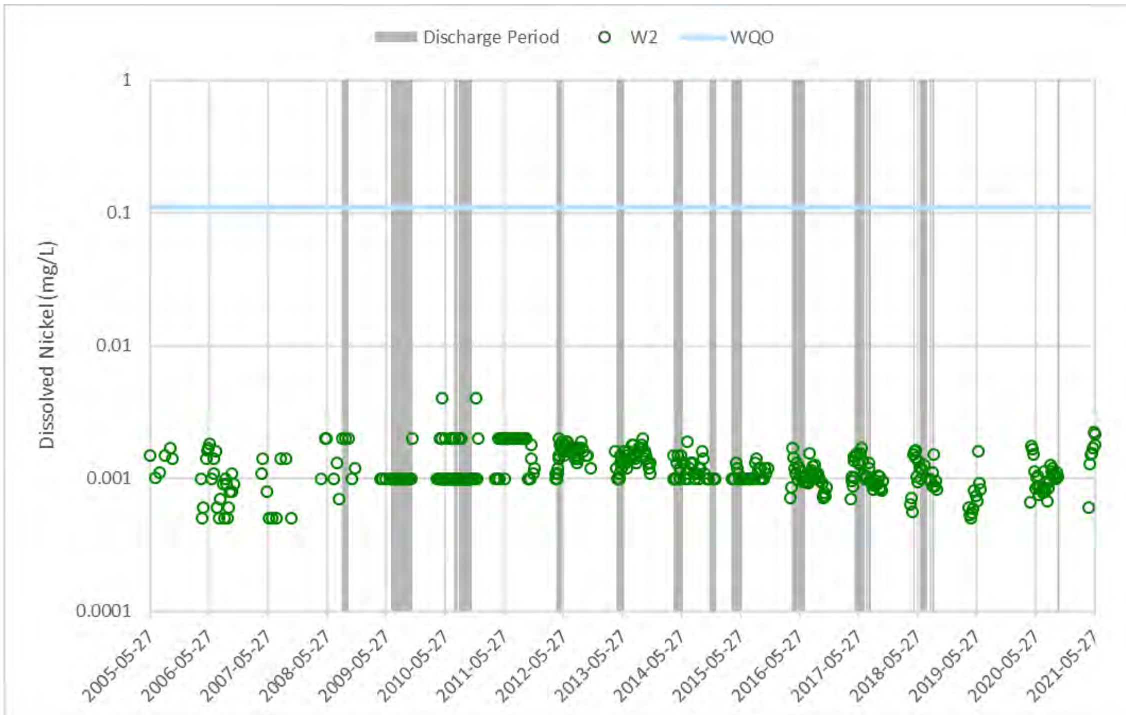


Figure 3-99: Concentrations of Dissolved Nickel in Minto Creek at W2. Note Log Scale.

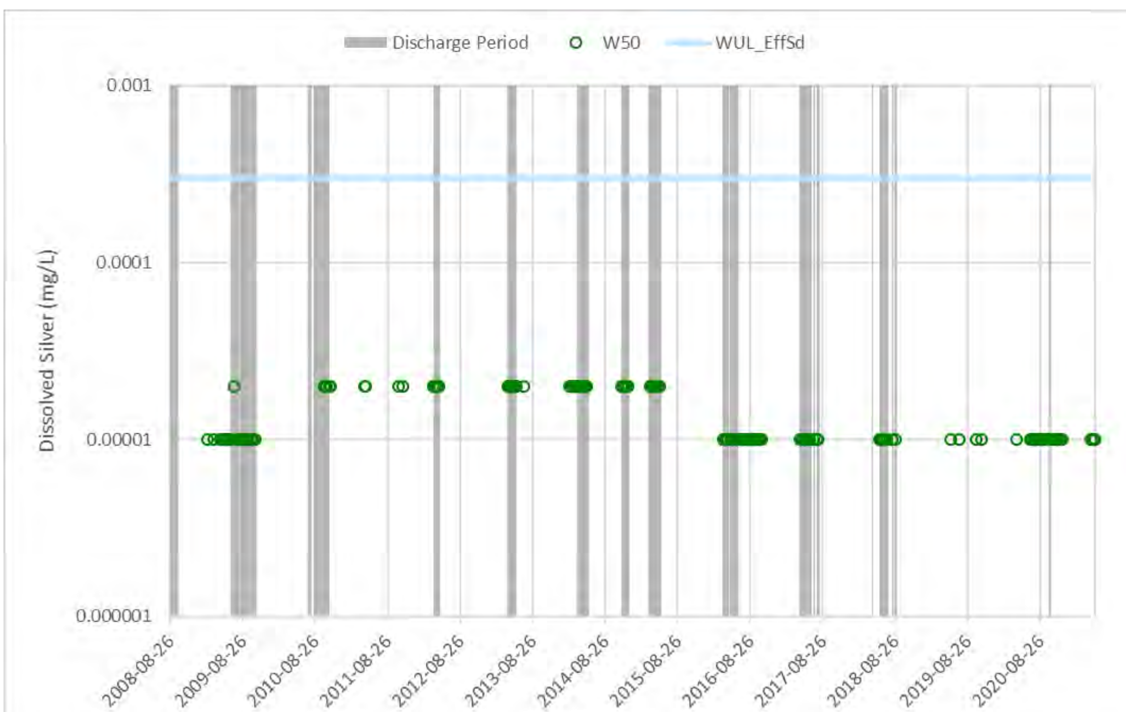


Figure 3-100: Concentrations of Dissolved Silver in Minto Creek at W50. Note Log Scale.

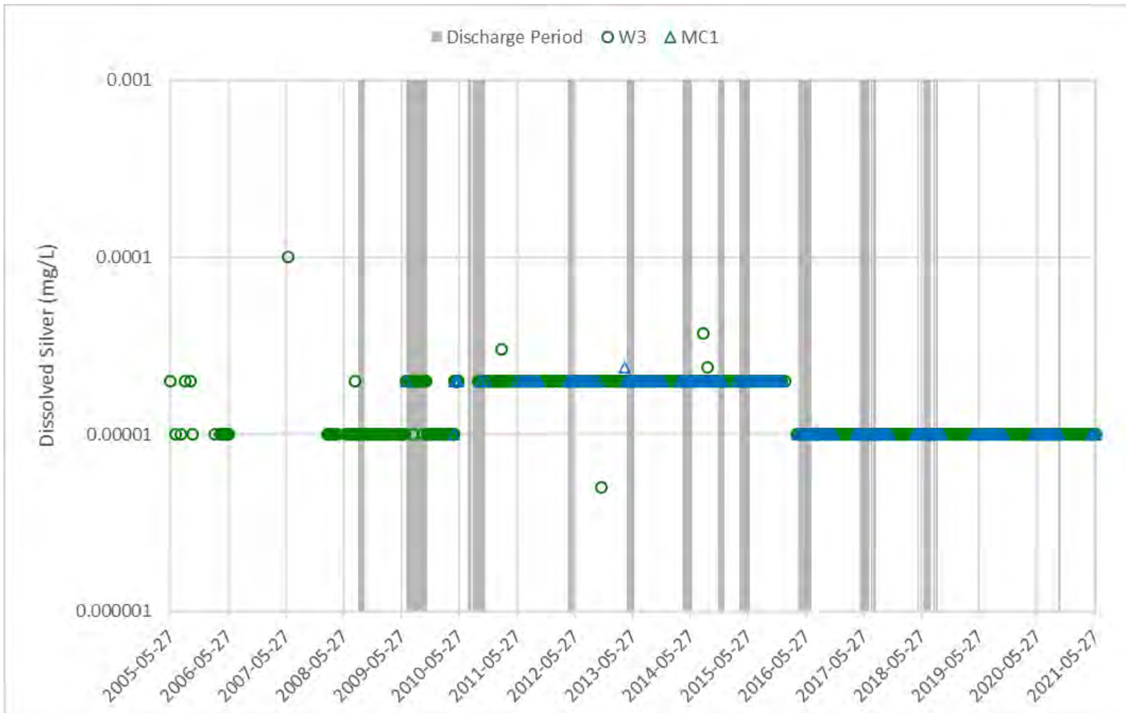


Figure 3-101: Concentrations of Dissolved Silver in Minto Creek at W3 and MC1. Note Log Scale.

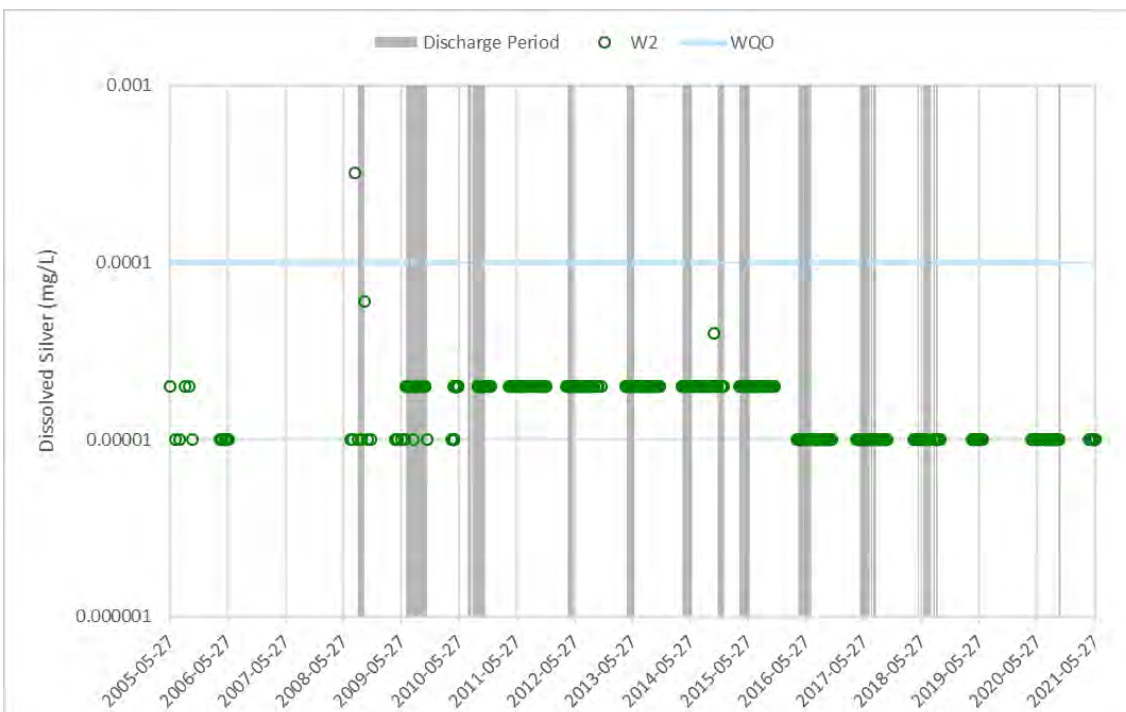


Figure 3-102: Concentrations of Dissolved Silver in Minto Creek at W2. Note Log Scale.

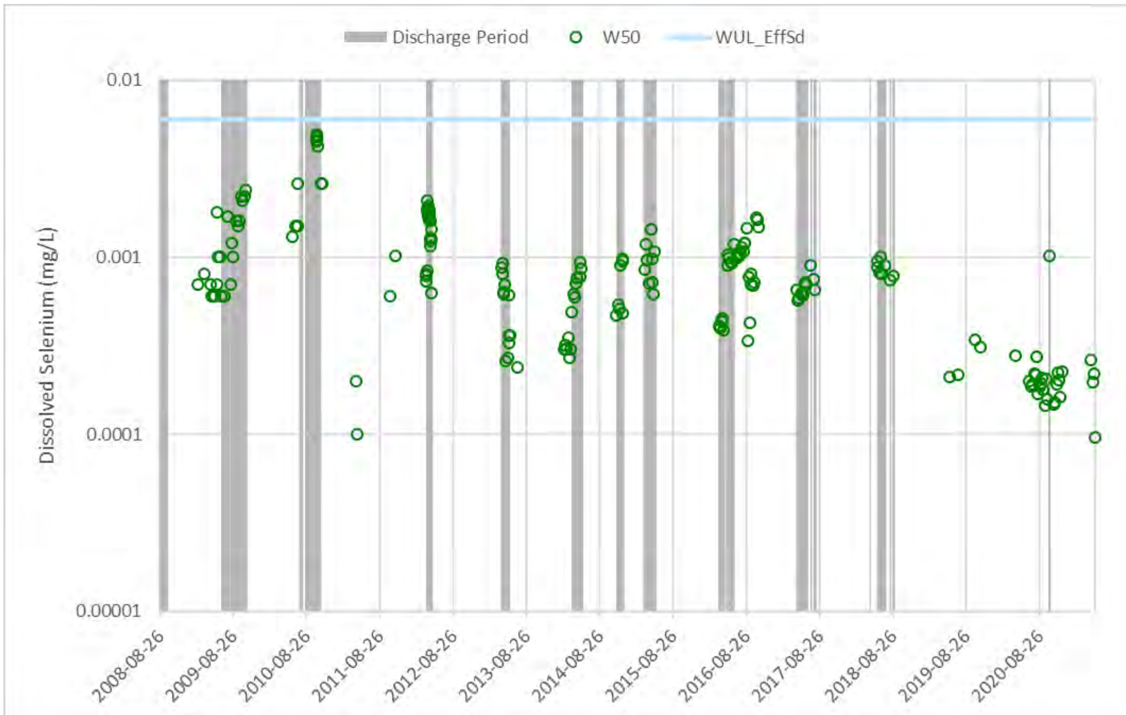


Figure 3-103: Concentrations of Dissolved Selenium in Minto Creek at W50. Note Log Scale.

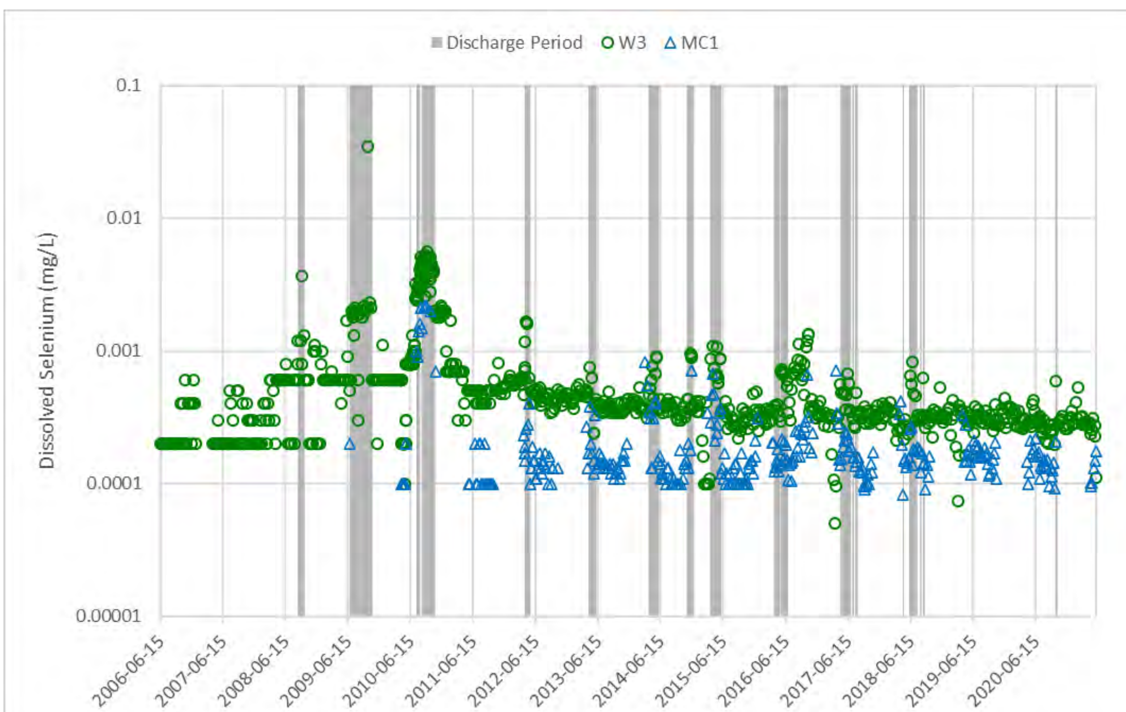


Figure 3-104: Concentrations of Dissolved Selenium in Minto Creek at W3 and MC1. Note Log Scale.

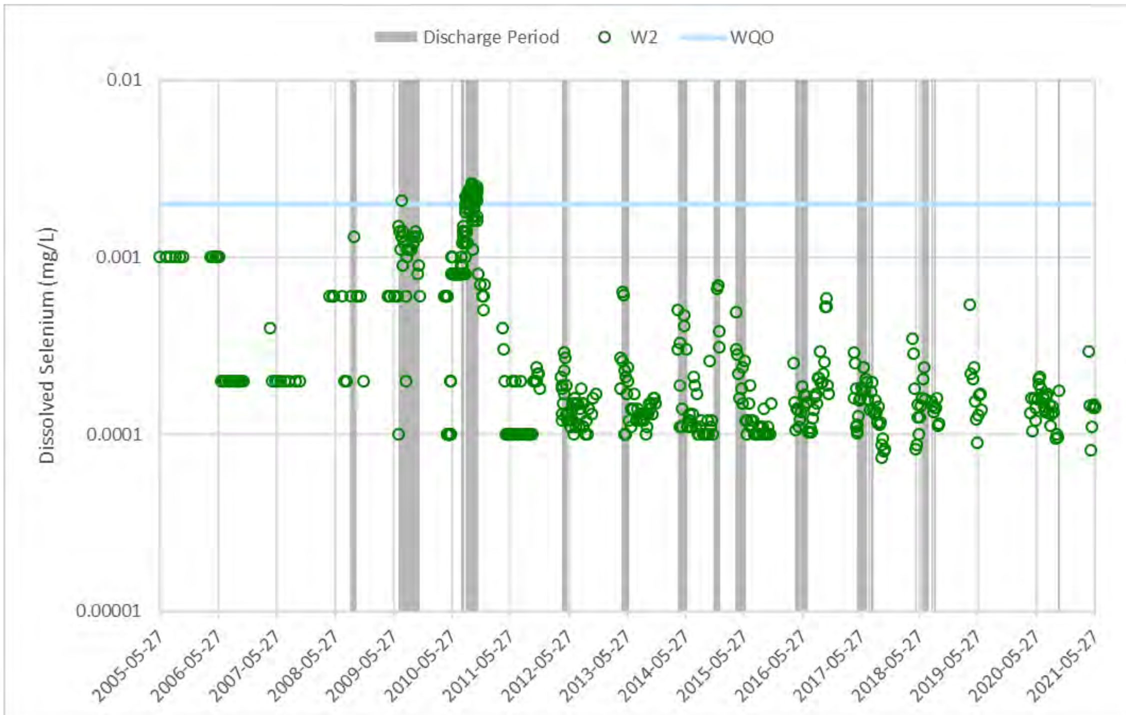


Figure 3-105: Concentrations of Dissolved Selenium in Minto Creek at W2. Note Log Scale.

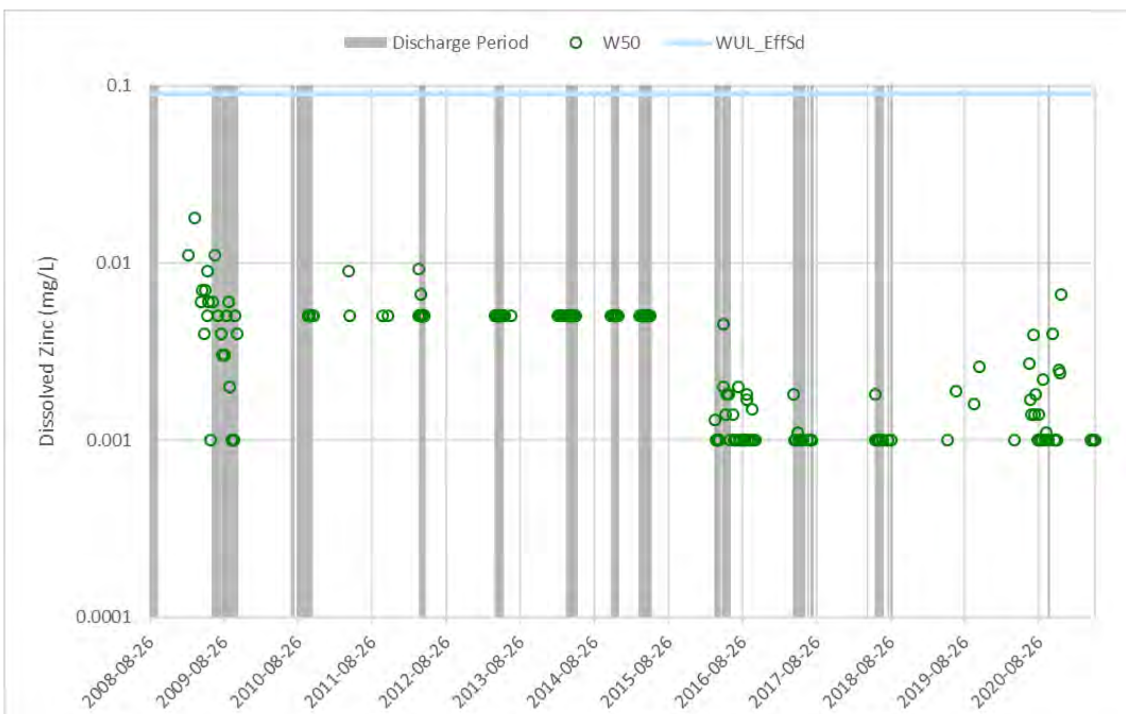


Figure 3-106: Concentrations of Dissolved Zinc in Minto Creek at W50. Note Log Scale.

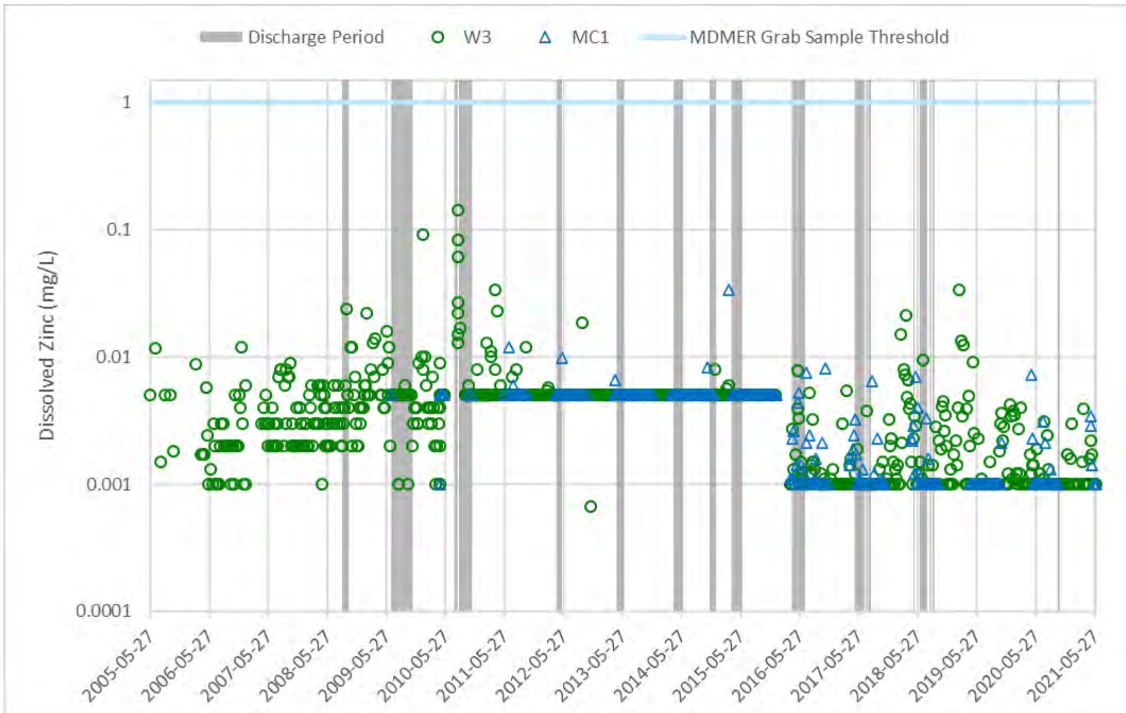


Figure 3-107: Concentrations of Dissolved Zinc in Minto Creek at W3 and MC1. Note Log Scale.

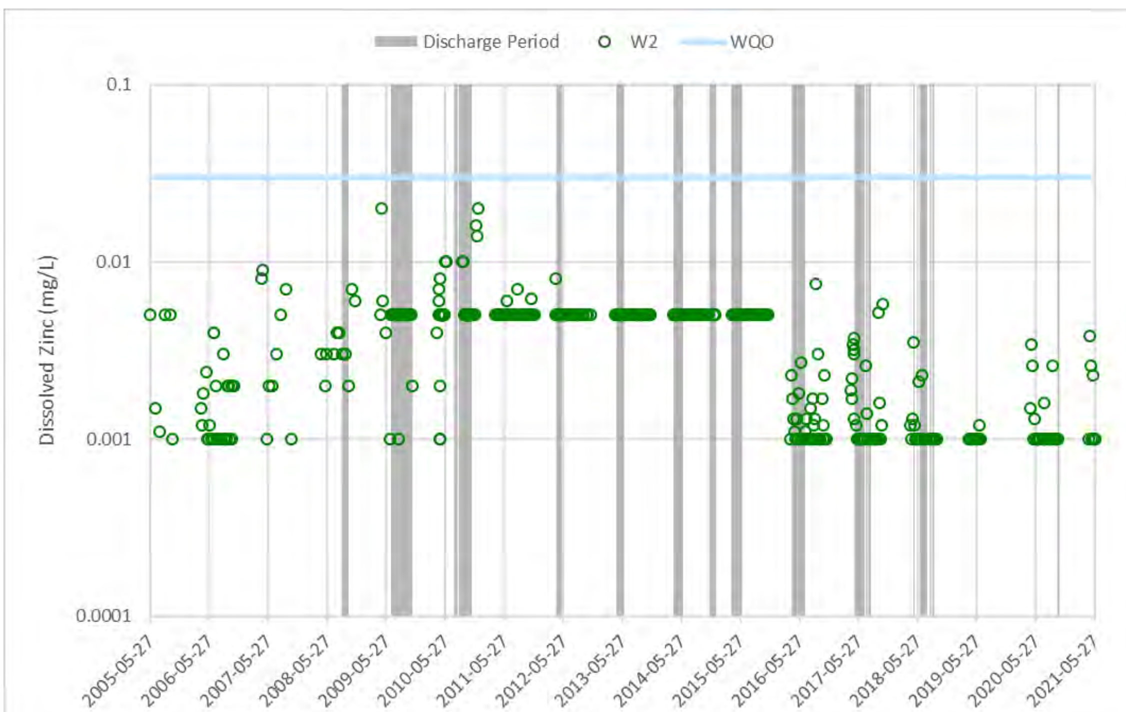


Figure 3-108: Concentrations of Dissolved Zinc in Minto Creek at W2. Note Log Scale.

3.4 MCGINTY CREEK

Discussion of water quality data in Minto Creek comprises results for sample stations MN-1.5, MN-2.5, MN-0.2, MN-0.5 and MN-4.5 as outlined in Section 2.1.4. Examined parameters included those in the list of EQS and WQO in Water License QZ14-031.

3.4.1 McGinty Creek East Arm

The water quality results for the McGinty Creek east arm (MN-1.5, MN-2.5 and MN-4.5) are presented for physical parameters and anion and nutrient concentrations in Section 3.4.1.1 and for dissolved metals in Section 3.4.1.2.

3.4.1.1 Physical Parameters, Anions and Nutrients

Statistical summaries of physical parameters, anions and nutrients in the east arm of McGinty Creek stations are presented in Table 3-32 through Table 3-43. Plots that depict TSS, field pH and nitrogen species temporally at the McGinty Creek east arm stations are presented in Figure 3-109 through Figure 3-114.

The pH in the east arm of McGinty Creek has generally been circumneutral and increases moving downstream from MN-1.5 (median pH 7.3) to MN-4.5 (median pH 7.8) (Figure 3-110). Temperature varied seasonally in McGinty Creek (median -1.9 to 11.9°C) and its waters were often well oxygenated; however, relatively lower dissolved oxygen measurements were recorded at MN-1.5 and MN-2.5 during winter months when ice cover likely restricted oxygen ingress to the creek. McGinty Creek typically demonstrated seasonal variability in field conductivity as the lowest annual measurements were predominantly observed in April due to dilution from snowmelt.

Unlike the mine site and Minto Creek locations, the highest TSS concentrations were typically observed during the summer. TSS concentrations were highest at the most upstream station (median 12 mg/L at MN-1.5), where concentrations as high as 8,200 mg/L were recorded (Table 3-41). Much lower TSS concentrations were observed downstream with sites MC-2.5 and MC-4.5 with median TSS levels of 8.7 and 4 mg/L, respectively. Three sampling events at site MN-4.5 exceeded the AMP IDPE (269 mg/L); however, these sampling events occurred before this WQO came into effect (March 2016).

Nitrite-N concentrations were typically below detection levels in McGinty Creek with occasional greater than detection data in later summer measurements. Nitrate-N concentrations in McGinty Creek showed some seasonality with low or below detection level values in April/May due to dilution meltwater, and higher concentrations generally later in the year. Median ammonia-N was highest in the upstream station MN-1.5 (0.017 mg/L), with lower concentrations observed moving downstream to MN-2.5 (median 0.013 mg/L) and MN-4.5 (median 0.008 mg/L). Two ammonia-N results exceeded AMP WQO at MN-4.5, but both these samples were collected before this WQO came into effect (March 2016).

DOC concentrations were highest at the upstream station MN-1.5 (median 17.2 mg/L) compared to MN-2.5 (median 12.1 mg/L) and MN-4.5 (median 12.6 mg/L). In general, DOC levels were highest in April/May when high flows and runoff likely flushed organic carbon that had accumulated in soils during the past year.

Table 3-41: Summary Statistics for Physical Parameters, Anions and Nutrients at MN-1.5, East Arm of McGinty Creek

MN-1.5															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	87	66	64	68	63	63	61	88	56	85	90	82	82	85	63
Average	204.06	7.15	56.69	2.5	11.59	86.5	96.8	0.843	0.105	1.225	0.04361	0.00349	0.02405	18.48	0.1056
Minimum	<1	4.41	16.3	-1.9	5.36	46.5	-7.1	<0.10	0.05	<0.50	<0.0050	<0.0010	<0.0050	<0.5	<0.050
Maximum	8200	8.3	220.6	11.9	17.52	120.1	325.6	3.5	0.19	5.6	0.66	0.053	0.2	40.8	1.04
Percent of results below DL	10.3	0.0	0.0	0.0	0.0	0.0	0.0	34.1	0.0	48.2	17.8	90.2	47.6	1.2	46.0
Standard deviation	902.63	0.69	28.11	2.8	2.05	15	73.30	0.743	0.022	1.354	0.08334	NA [a]	0.03357	6.92	0.1936
First quartile	3.9	6.98	40.9	0.1	10.46	83.1	36	0.25	0.1	<0.50	0.0068	0.0005	0.01	13.8	0.025
Median	12	7.26	49.4	2.2	11.98	89.3	88.2	0.635	0.11	0.8	0.01685	0.0025	0.01	17.2	0.041
Third quartile	69.95	7.46	69.58	4.5	12.84	95.9	133.9	1.2	0.11	1.66	0.051	0.0025	0.03325	20	0.082

[a] Not applicable due to too few measurements above the detection limit

Table 3-42: Summary Statistics for Physical Parameters, Anions and Nutrients at MN-2.5, East Arm of McGinty Creek

MN-2.5															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	99	75	71	75	69	69	67	100	60	101	101	100	100	95	72
Average	35.8	7.53	97.27	1.79	12.35	90.27	121.28	0.999	0.178	2.289	0.02393	0.00277	0.02761	15.03	0.0561
Minimum	<1.0	4.1	33.6	-1.9	0.72	4.9	-0.2	0.22	0.06	<0.50	<0.0050	<0.0010	<0.0050	6.58	<0.01
Maximum	350	8.6	445.1	6.5	17.13	124	339.2	4.7	1.13	30	0.3	<0.050	0.19	45	0.396
Percent of results below DL	21.2	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	37.6	21.8	98.0	45.0	0.0	44.4
Standard deviation	70.31	0.57	50.21	2.16	2.66	19.22	77.29	0.654	0.134	3.466	0.03969	NA [a]	0.03012	7.71	0.0699
First quartile	2	7.44	74.55	0	11.97	88.7	58.85	0.595	0.15	<0.5	0.0068	0.0005	0.01	10.05	0.025
Median	8.7	7.62	94.8	1.2	12.73	92.7	116.5	0.9	0.17	1.7	0.013	0.0025	0.0173	12.1	0.025
Third quartile	37.65	7.74	112.3	3.75	13.68	96.2	167.9	1.3	0.18	3.27	0.0248	0.0025	0.036	17.05	0.0618

[a] Not applicable due to too few measurements above the detection limit

Table 3-43: Summary Statistics for Physical Parameters, Anions and Nutrients at MN-4.5, McGinty Creek

MN-4.5													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
AMP Individual Data Point Evaluator	-	0.135	0.00061	0.000041	0.001	0.0035	0.403	0.0002	0.001	0.0018	0.00002	0.0002	0.0052
Count	94	94	94	94	75	94	94	74	77	94	74	93	74
Average	85.4	0.0251	0.00039	0.00000911	0.000279	0.00215	0.1172	0.0000457	0.000805	0.001064	0.00000405	0.000161	0.00157
Minimum	25.8	0.0041	0.00019	<0.0000050	<0.00010	0.00101	<0.010	<0.000005	0.00017	<0.00050	<0.0000050	<0.00010	0.0002
Maximum	159	0.174	0.00065	0.000135	0.0009	0.00531	0.562	0.000467	0.00	0.00213	0.000011	0.000444	0.0144
Percent of results below DL	0.0	0.0	0.0	60.6	6.7	0.0	2.1	58.1	0.0	10.6	97.3	1.1	36.5
Standard deviation	22.9	0.0294	0.000094	0.00001565	0.000146	0.00086	0.12	0.0000623	0.000229	0.000402	NA [a]	0.000051	0.00196
First quartile	72	0.0095	0.00034	0.0000025	0.000165	0.00165	0.0302	0.000025	0.000667	0.00076	0.0000025	0.00013	0.0005
Median	86.4	0.0168	0.00037	0.000005	0.00028	0.00191	0.0715	0.000025	0.00086	0.00105	0.000005	0.000156	0.0009
Third quartile	99.2	0.0244	0.00042	0.00000898	0.00037	0.0024	0.1612	0.0000425	0.000965	0.001295	0.000005	0.000176	0.0018
Count of results exceeding standard	0	3	2	2	0	6	4	2	10	6	0	8	2
Percent of results exceeding standard	0	3.2	2.1	2.1	0	6.4	4.3	2.7	13	6.4	0	8.6	2.7

[a] Not applicable due to too few measurements above the detection limit

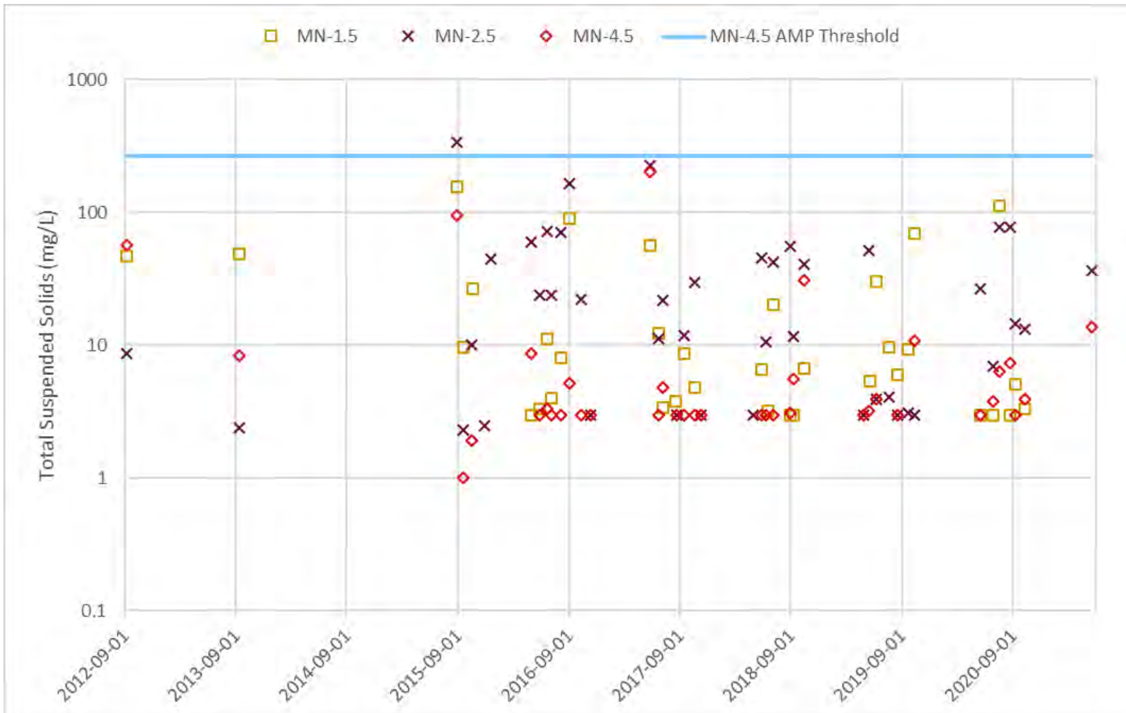


Figure 3-109: TSS at East Arm of McGinty Creek Monitoring Stations

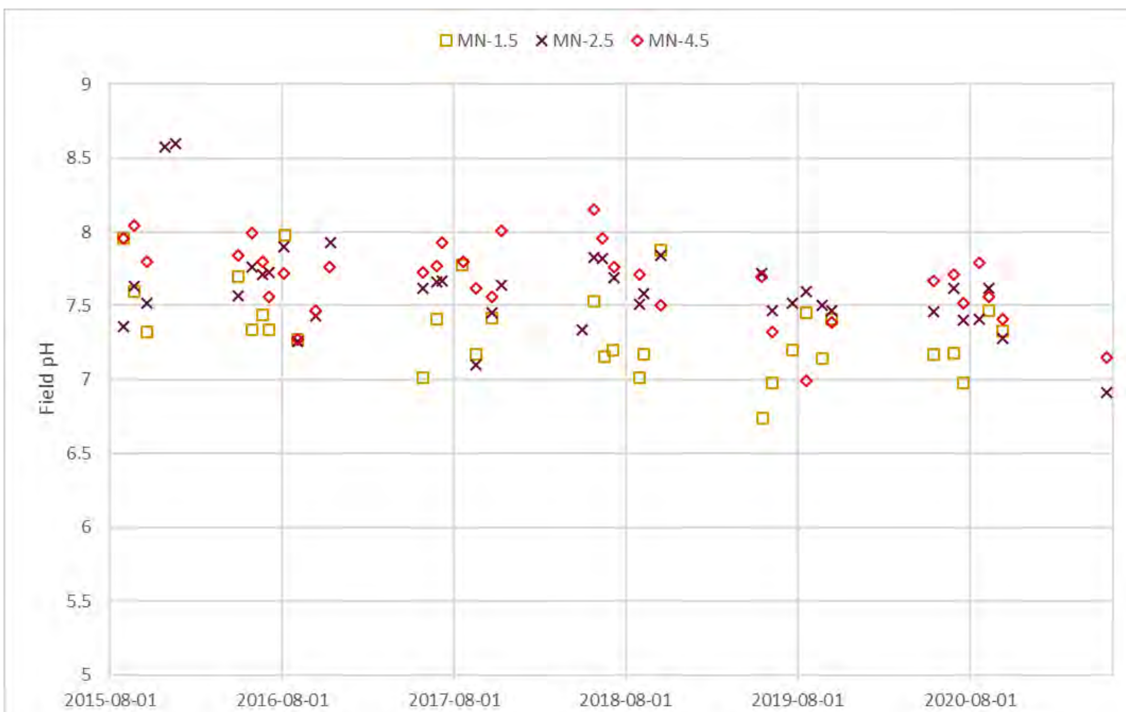


Figure 3-110: pH at East Arm of McGinty Creek Monitoring Stations

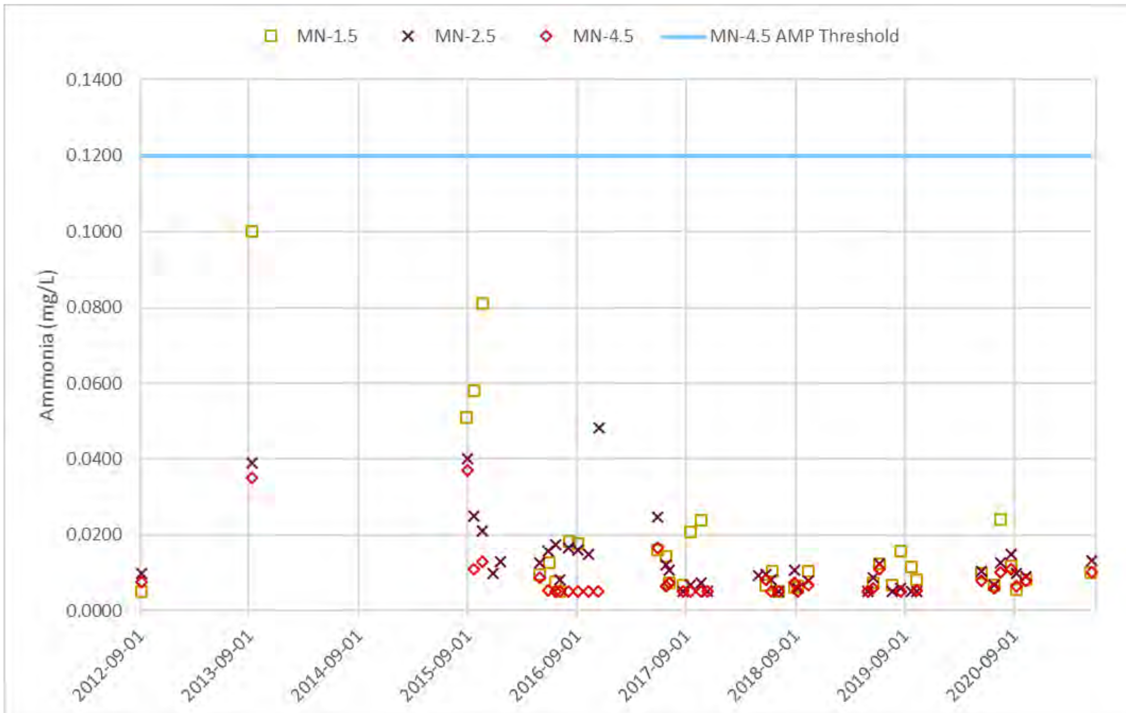


Figure 3-111: Ammonia (N) at East Arm of McGinty Creek Monitoring Stations

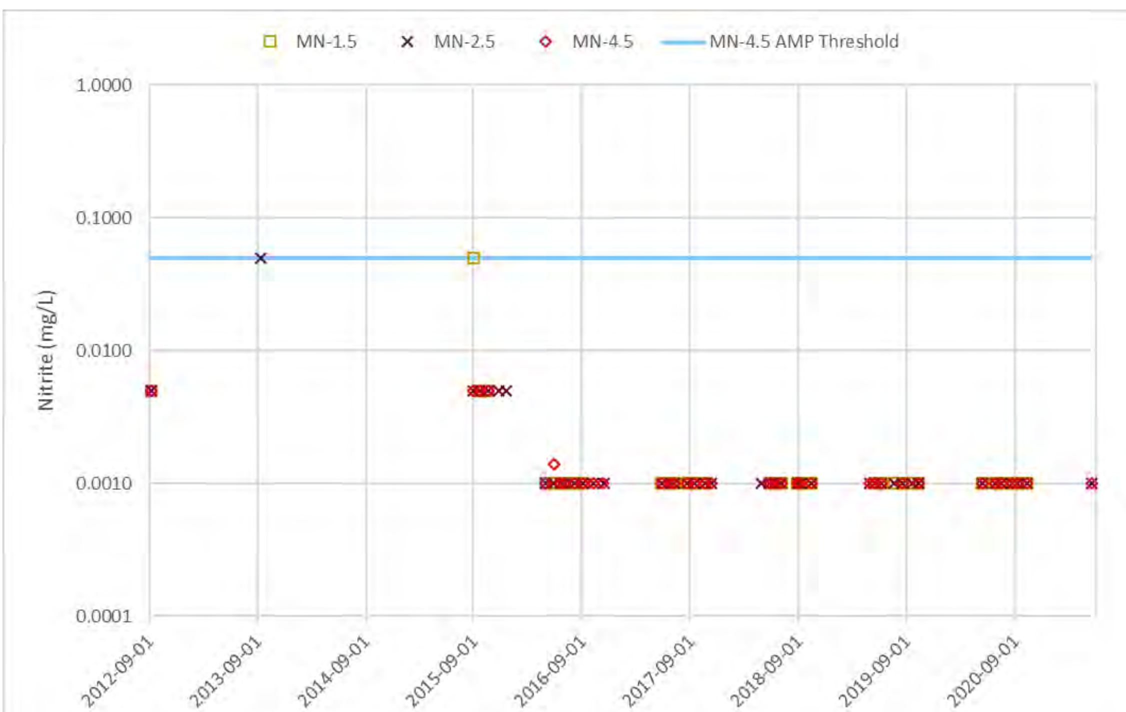


Figure 3-112: Nitrite (N) at East Arm of McGinty Creek Monitoring Stations

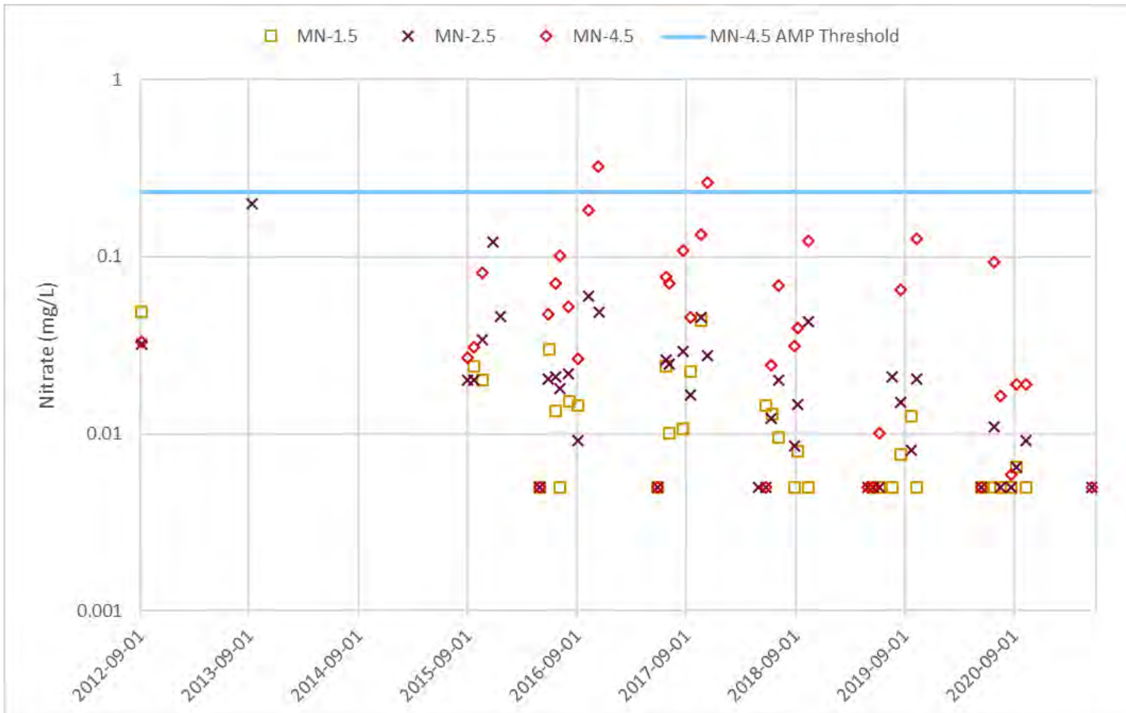


Figure 3-113: Nitrate (N) at East Arm of McGinty Creek Monitoring Stations

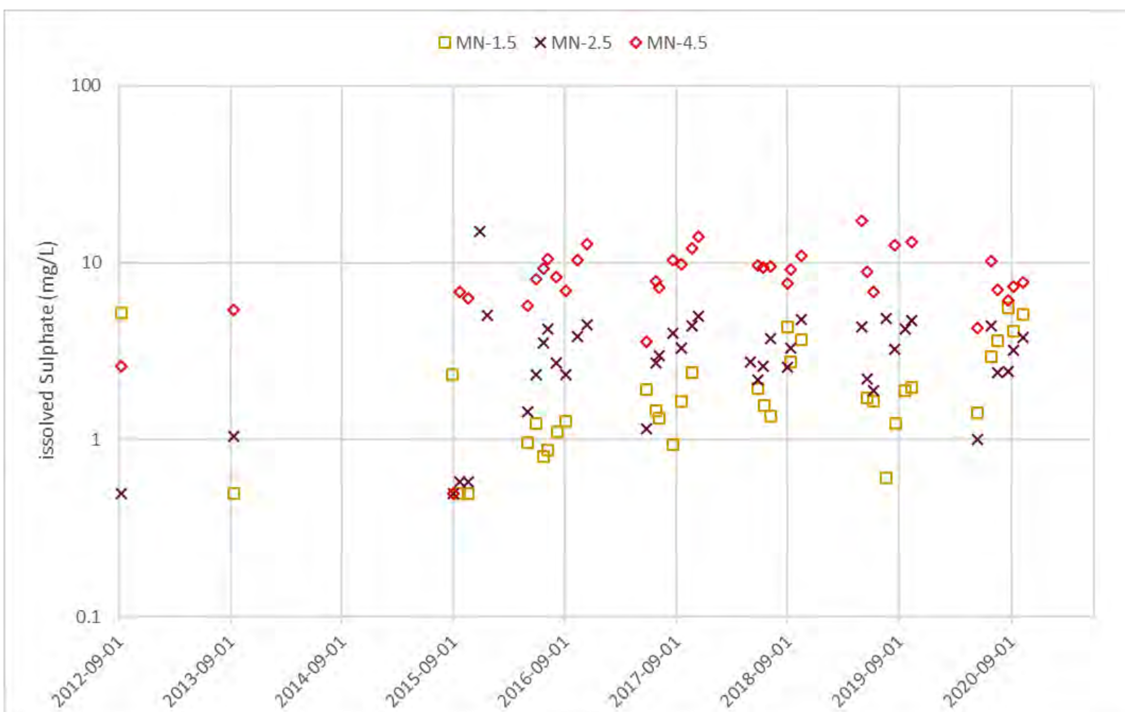


Figure 3-114: Dissolved Sulphate at East Arm of McGinty Creek Monitoring Stations

3.4.1.2 Metals

Statistical summaries of metal concentrations from the McGinty Creek east arm stations are presented in Table 3-44 through Table 3-46. Plots that depict metal concentrations temporally at the McGinty Creek east arm stations are presented in Figure 3-115 through Figure 3-126.

Dissolved hardness typically increased moving downstream in McGinty Creek from MN-1.5 (median 41.5 mg/L) to MN-2.5 (median 82.3 mg/L) and MN-4.5 (median 86.4 mg/L). Hardness levels generally varied seasonally with lower concentrations in April/May due to dilution from meltwater, followed by increasing concentrations through the rest of the year.

In the east arm of McGinty Creek, dissolved aluminum, arsenic, chromium, copper and iron concentrations were generally higher at the most upstream station MN-1.5 and decreased downstream to MN-2.5 and MN-4.5. Concentrations of dissolved aluminum and copper in McGinty Creek at MN-1.5 were typically higher in late spring, likely due mobilization by the higher DOC concentrations observed at this time of year, and decreased throughout the summer although several spikes in dissolved aluminum were observed in August and September. Dissolved aluminum and copper decreased going downstream from MN-1.5 (median 0.09 mg/L aluminum and 0.0058 mg/L copper) to MN-2.5 (median 0.014 mg/L aluminum and 0.0018 mg/L copper) and MN-4.5 (median 0.016 mg/L and 0.0019 mg/L copper).

Dissolved arsenic and iron concentrations were typically highest in July through September at MN-1.5 and lowest in the spring and winter months. A negative correlation between dissolved iron and oxidation reduction potential (ORP) suggests the presence of reducing waters (e.g., groundwater seep) perhaps contributing elevated concentrations of dissolved iron to McGinty Creek upstream of MN-1.5. It is possible that the contribution of dissolved arsenic and iron from a reducing groundwater source was muted in spring due to dilution from meltwater, and in fall and winter due to very low flow rates or ice blockage. Dissolved arsenic and iron concentrations decrease moving downstream from MN-1.5 (median 0.00042 mg/L arsenic and 0.448 mg/L iron) to MN-2.5 (median 0.00035 mg/L arsenic and 0.106 mg/L iron) and MN-4.5 (median 0.00037 mg/L and 0.07 mg/L iron), likely due to precipitation of iron minerals and/or dilution.

Dissolved cadmium, lead and zinc have generally decreased in the east arm of McGinty Creek stations from 2009 to 2012 and have often been close to or below their respective detection limits from 2013 through 2021.

Dissolved molybdenum and selenium concentrations were higher at the downstream McGinty Creek station of MN-4.5 (median 0.00086 mg/L molybdenum and 0.00016 mg/L selenium) relative to the east arm of McGinty Creek stations MN-1.5 (median 0.00030 mg/L molybdenum and 0.000075 mg/L selenium) and MN-2.5 (0.00058 mg/L molybdenum and 0.000076 mg/L selenium). MN-4.5 is downstream of the confluence with the west arm of McGinty Creek and relatively elevated concentrations of molybdenum and selenium in the west arm of McGinty Creek likely contributed to the higher concentrations in MN-4.5 compared to MN-1.5 and MN- 2.5.

Dissolved nickel concentrations were similar throughout the McGinty Creek east arm stations with median concentrations at MN-1.5, MN-2.5 and MN-4.5 of 0.0011, 0.0011 and 0.0010 mg/L, respectively. Dissolved nickel levels were generally lower in April/May and increased throughout the remainder of the year suggesting dilution by meltwater in the spring and an increasing proportion of dissolved nickel from baseflow in the summer through to the winter.

Exceedances of the AMP WQO for individual indicators evaluated at MN-4.5 were generally limited to samples collected before the WQO came into effect at this station (March 2016); however, three dissolved copper, four dissolved molybdenum, three dissolved nickel, and five dissolved selenium exceedances have occurred since March 2016. Since no discharge from the mine site has occurred during this period, such exceedances are part of the natural variability observed in the water quality of McGinty Creek and are addressed as part of the AMP (Minto, 2017).

Table 3-44: Summary Statistics for Dissolved Metals of Interest at MN-1.5, East Arm of McGinty Creek

MN-1.5													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	88	88	88	87	67	88	88	67	67	88	60	69	88
Average	42.8	0.0965	0.00047	0.00001327	0.000504	0.00602	0.527	0.0000458	0.000333	0.0012	0.00000492	0.0000767	0.00226
Minimum	12.5	0.0232	0.00015	<0.0000050	0.0002	0.00278	0.074	0.000008	0.00008	<0.0010	<0.0000050	<0.00004	0.0003
Maximum	206	0.259	0.00113	0.000106	0.0009	0.016	1.62	0.000527	0.00	0.00233	0.000018	0.00015	0.012
Percent of results below DL	0.0	0.0	0.0	54.0	1.5	0.0	0.0	50.7	1.5	1.1	80.0	2.9	51.1
Standard deviation	22.6	0.0525	0.000196	0.00001796	0.000147	0.00223	0.34	0.0000748	0.000158	0.00028	NA [a]	0.0000229	0.00227
First quartile	30	0.0602	0.000328	0.0000025	0.0004	0.00472	0.266	0.000025	0.000222	0.00105	0.0000025	0.000064	0.0005
Median	41.5	0.0904	0.00042	<0.000010	0.0005	0.00582	0.448	<0.000050	0.000295	0.00114	0.000005	0.000075	0.0018
Third quartile	50.8	0.1212	0.000576	0.000017	0.00061	0.0069	0.726	0.000026	0.000421	0.00136	0.000005	0.00009	0.0025

[a] Not applicable due to too few measurements above the detection limit

Table 3-45: Summary Statistics for Dissolved Metals of Interest at MN-2.5, East Arm of McGinty Creek

MN-2.5													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	101	101	101	100	101	100	101	101	101	101	101	101	100
Average	82.3	0.0225	0.000395	0.00000951	0.000323	0.00218	0.1726	0.0000595	0.000593	0.0012	0.00000575	0.0000797	0.00174
Minimum	23.2	0.005	0.00016	<0.0000050	<0.00010	0.00071	0.019	<0.000005	0.00011	<0.00050	<0.0000050	<0.000050	0.0004
Maximum	479	0.112	0.00149	0.000075	0.0007	0.00598	0.867	0.000822	0.00	0.00376	0.000013	0.00038	0.0061
Percent of results below DL	0.0	0.0	0.0	54.0	27.7	0.0	0.0	64.4	19.8	7.9	91.1	23.8	53.0
Standard deviation	45.9	0.0232	0.000161	0.00001239	0.000148	0.00102	0.18	0.0000904	0.000215	0.000454	NA [a]	0.0000404	0.00128
First quartile	63	0.0086	0.00031	0.0000025	0.0002	0.00153	0.0511	<0.000050	<0.0010	0.00098	<0.000005	0.000056	0.0005
Median	82.3	0.0147	0.00035	0.000005	0.0003	0.00184	0.106	<0.000050	0.00058	0.00114	<0.000010	0.000076	0.00155
Third quartile	94.1	0.0251	0.00043	0.00001	<0.0010	0.00263	0.218	<0.00020	0.000738	0.00143	<0.000020	0.00009	0.0025

[a] Not applicable due to too few measurements above the detection limit

Table 3-46: Summary Statistics for Dissolved Metals of Interest at MN-4.5, McGinty Creek

	MN-4.5												
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	94	94	94	94	75	94	94	74	77	94	74	93	74
Average	85.4	0.0251	0.00039	0.00000911	0.000279	0.00215	0.1172	0.0000457	0.000805	0.001064	0.00000405	0.000161	0.00157
Minimum	25.8	0.0041	0.00019	<0.0000050	<0.00010	0.00101	<0.010	<0.000005	0.00017	<0.00050	<0.0000050	<0.00010	0.0002
Maximum	159	0.174	0.00065	0.000135	0.0009	0.00531	0.562	0.000467	0.00	0.00213	0.000011	0.000444	0.0144
Percent of results below DL	0.0	0.0	0.0	60.6	6.7	0.0	2.1	58.1	0.0	10.6	97.3	1.1	36.5
Standard deviation	22.9	0.0294	0.000094	0.00001565	0.000146	0.00086	0.12	0.0000623	0.000229	0.000402	NA [a]	0.000051	0.00196
First quartile	72	0.0095	0.00034	0.0000025	0.000165	0.00165	0.0302	0.000025	0.000667	0.00076	0.0000025	0.00013	0.0005
Median	86.4	0.0168	0.00037	0.000005	0.00028	0.00191	0.0715	0.000025	0.00086	0.00105	0.000005	0.000156	0.0009
Third quartile	99.2	0.0244	0.00042	0.00000898	0.00037	0.0024	0.1612	0.0000425	0.000965	0.001295	0.000005	0.000176	0.0018

[a] Not applicable due to too few measurements above the detection limit

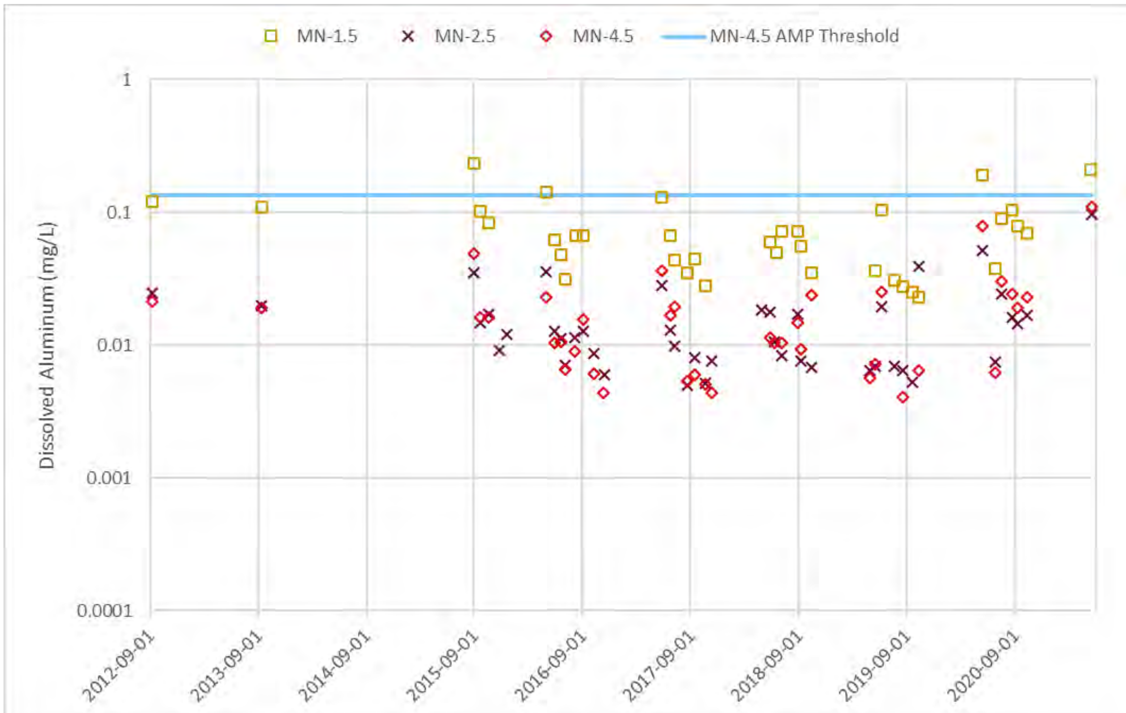


Figure 3-115: Dissolved Aluminum at East Arm of McGinty Creek Monitoring Stations. Note Log Scale.

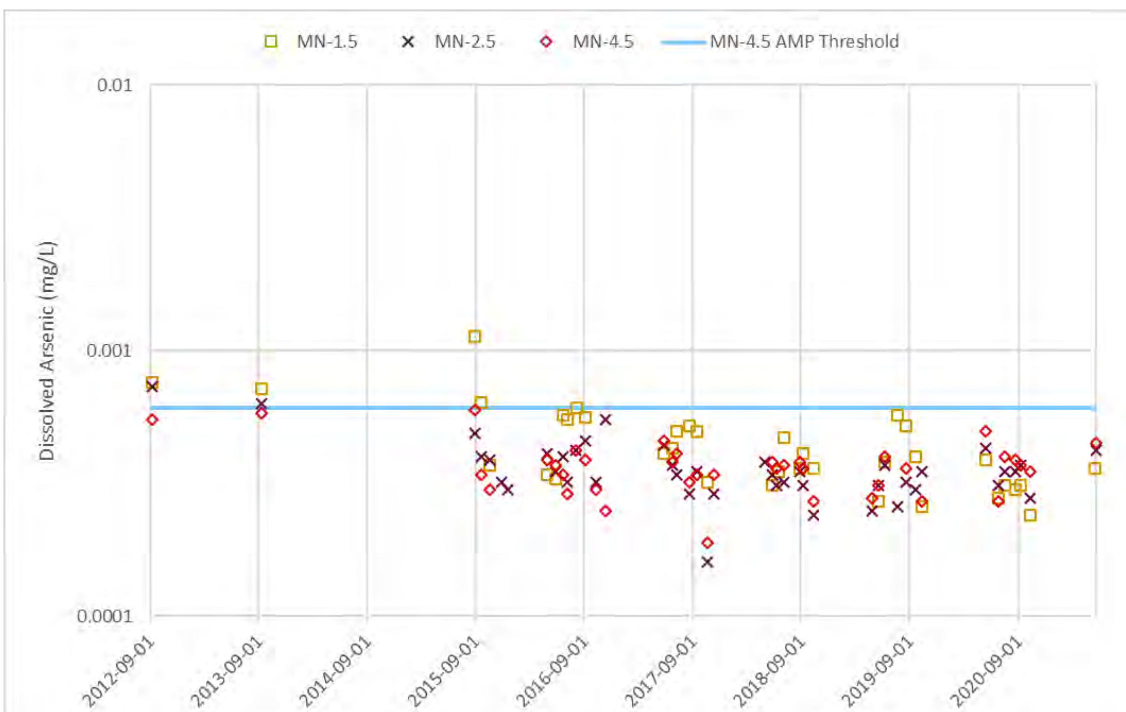


Figure 3-116: Dissolved Arsenic at East Arm of McGinty Creek Monitoring Stations. Note Log Scale.

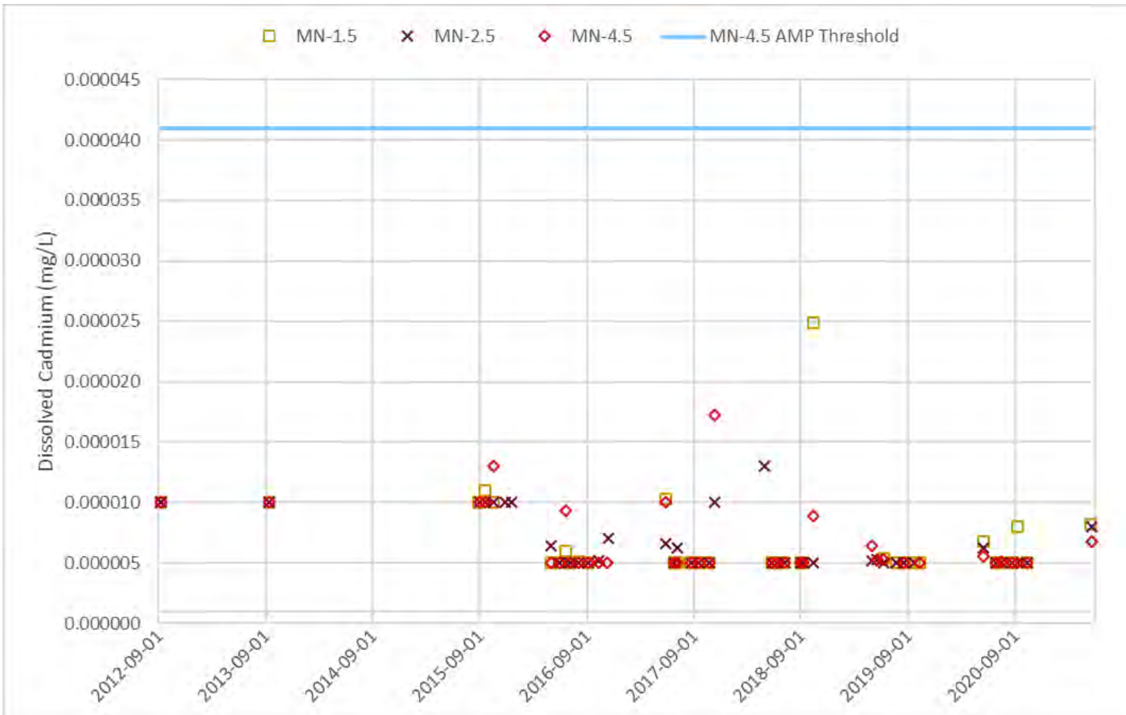


Figure 3-117: Dissolved Cadmium East Arm of at McGinty Creek Monitoring Stations.

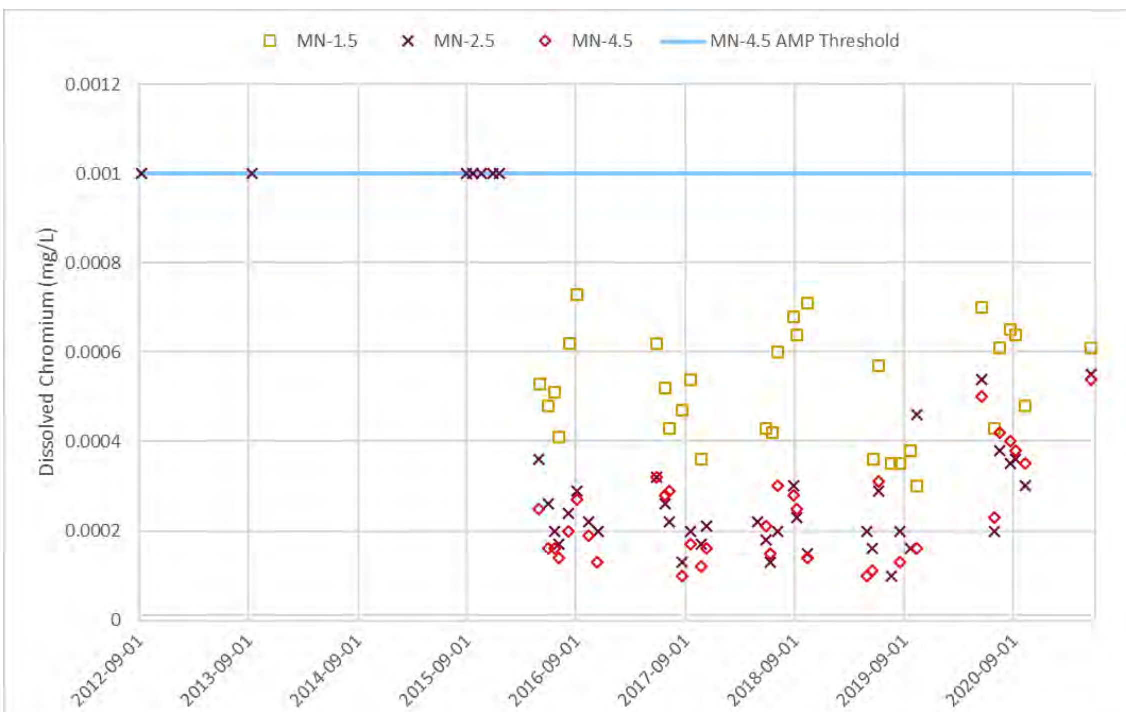


Figure 3-118: Dissolved Chromium at East Arm of McGinty Creek Monitoring Stations.

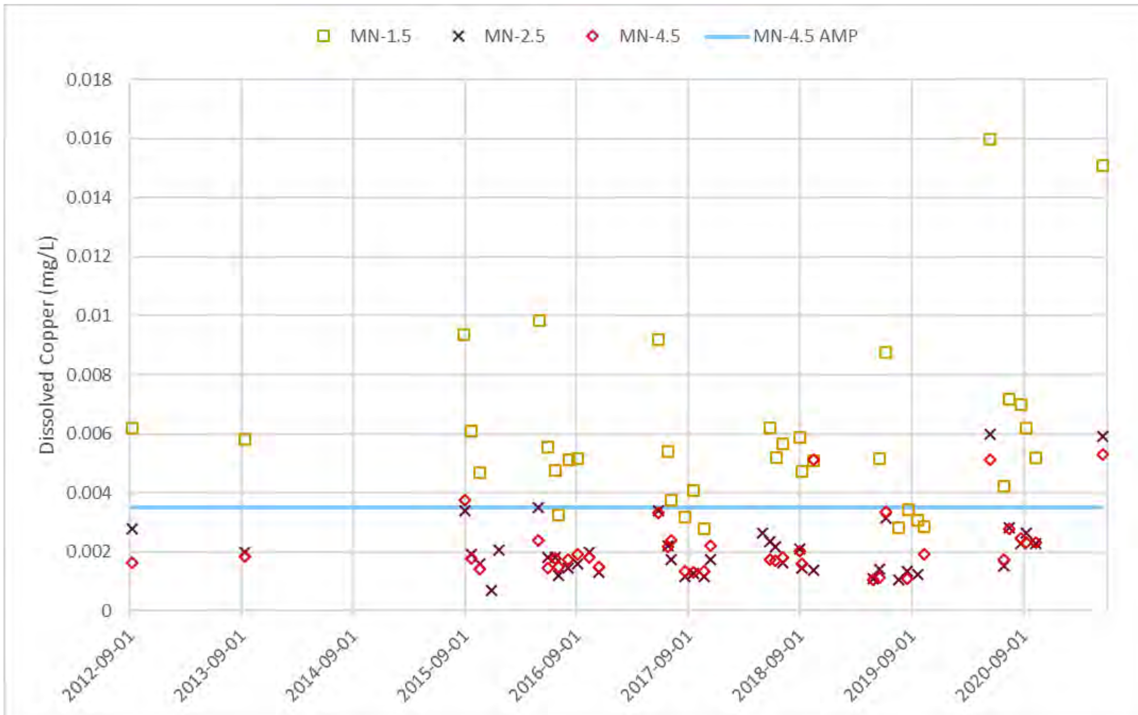


Figure 3-119: Dissolved Copper at East Arm of McGinty Creek Monitoring Stations.

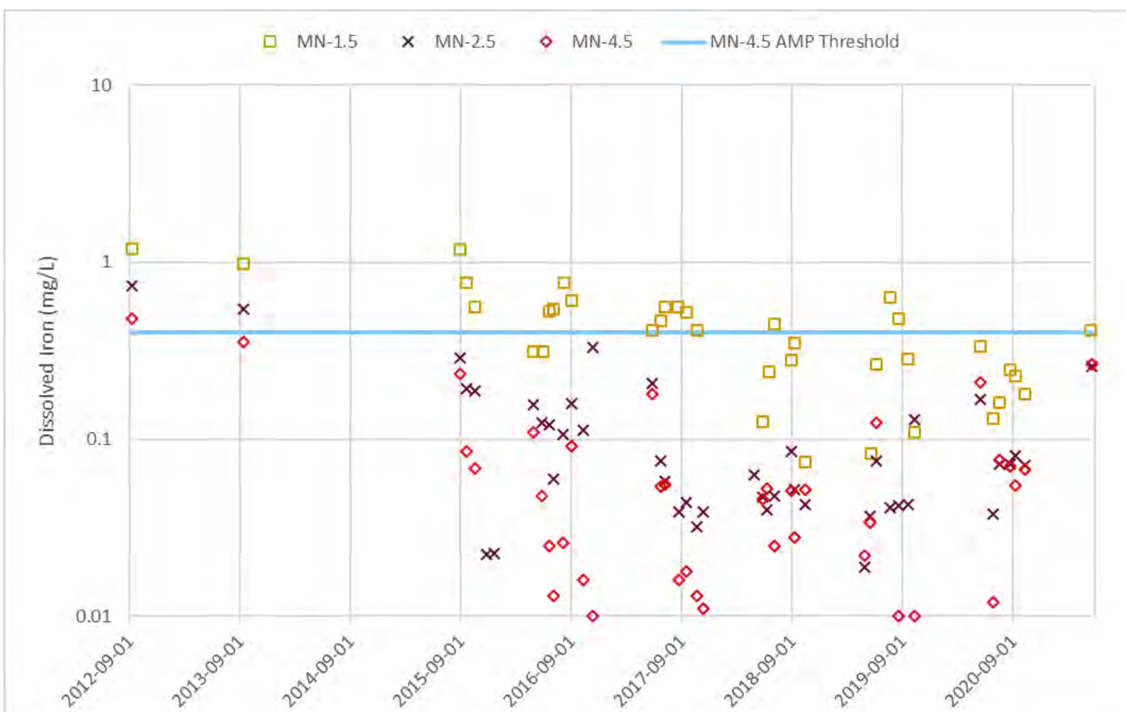


Figure 3-120: Dissolved Iron at East Arm of McGinty Creek Monitoring Stations. Note Log Scale.

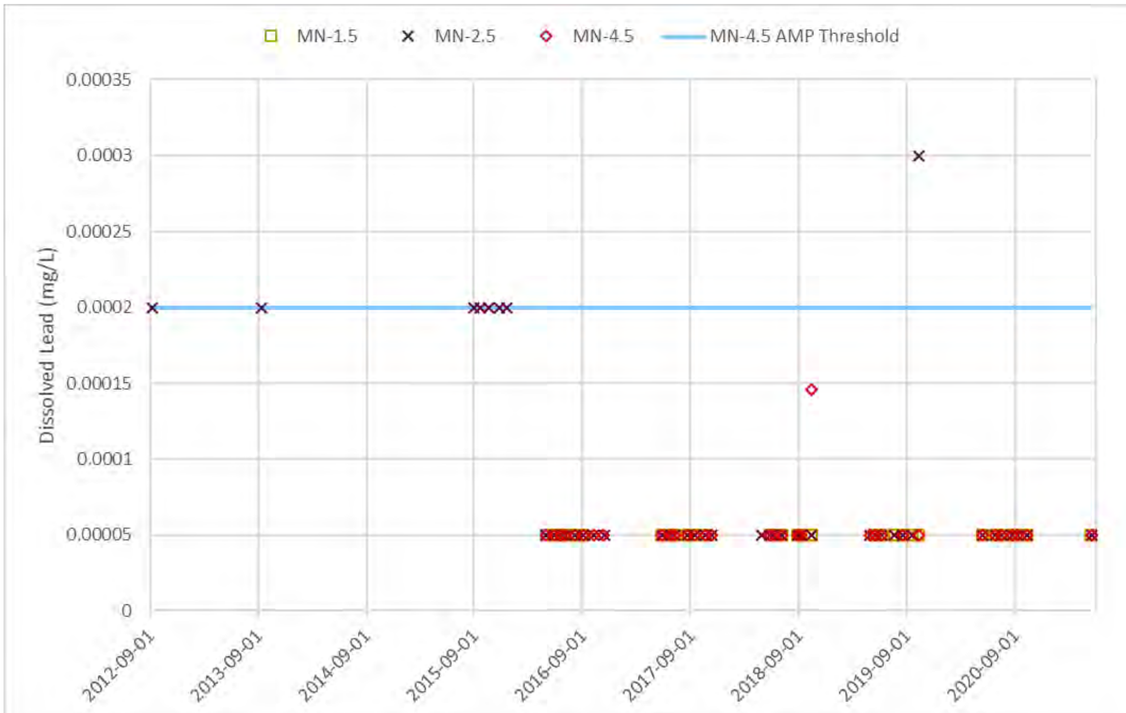


Figure 3-121: Dissolved Lead at East Arm of McGinty Creek Monitoring Stations.

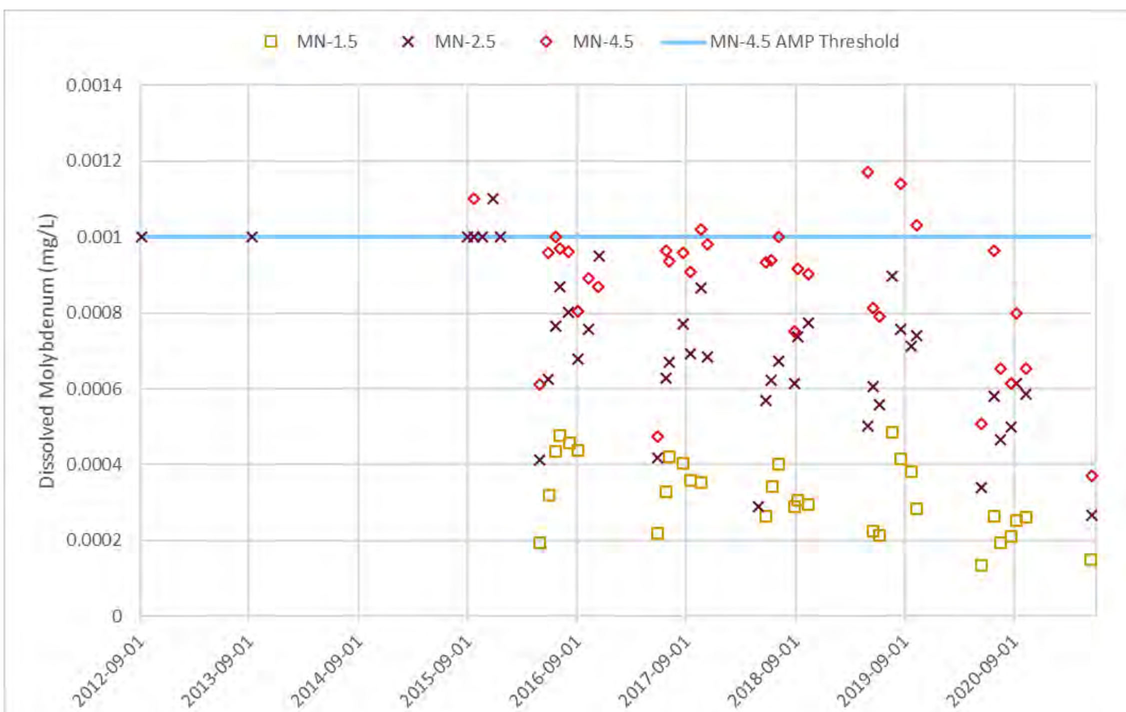


Figure 3-122: Dissolved Molybdenum at East Arm of McGinty Creek Monitoring Stations.

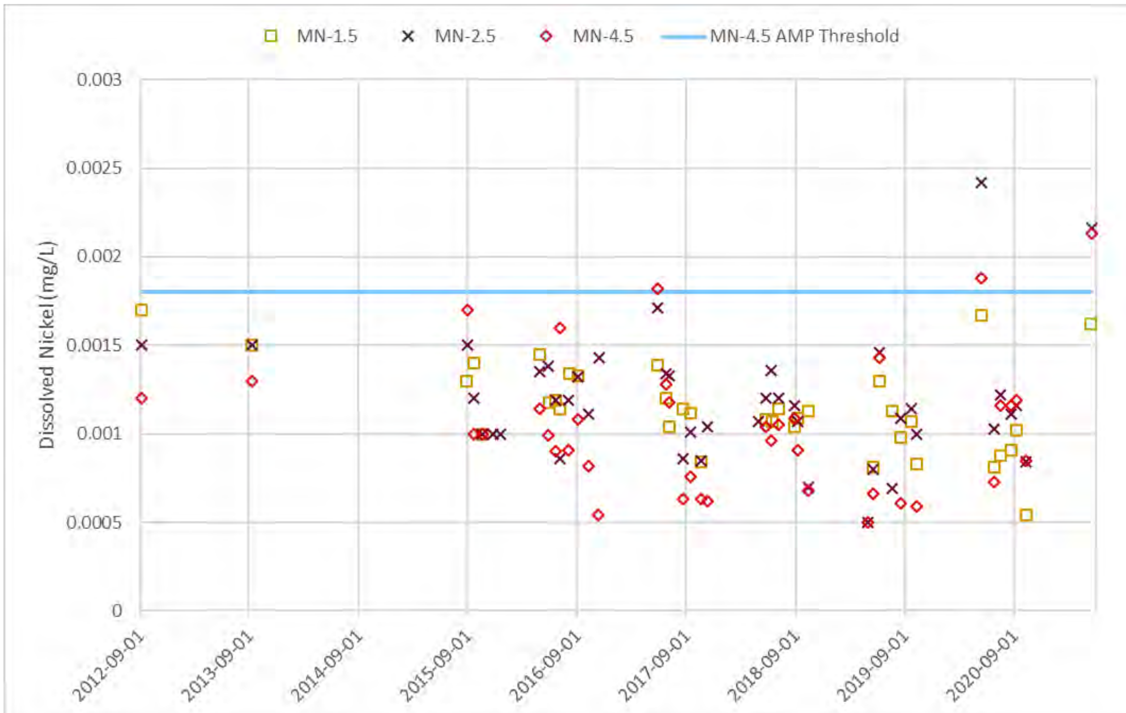


Figure 3-123: Dissolved Nickel at East Arm of McGinty Creek Monitoring Stations.

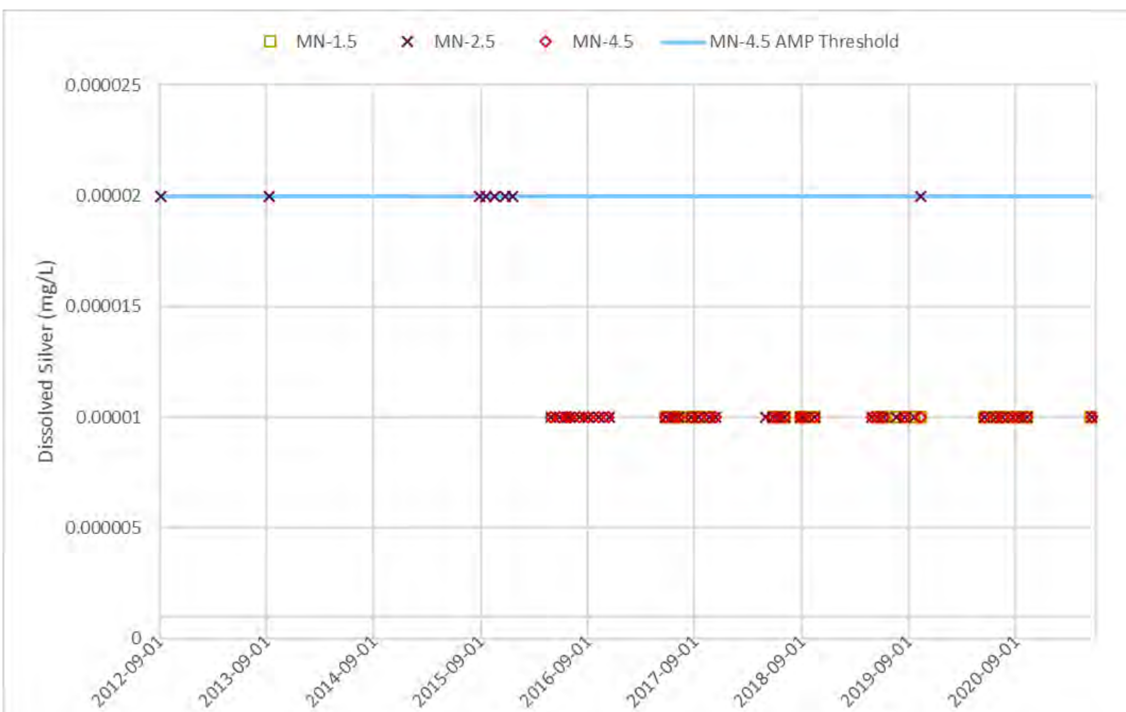


Figure 3-124: Dissolved Silver at East Arm of McGinty Creek Monitoring Stations.

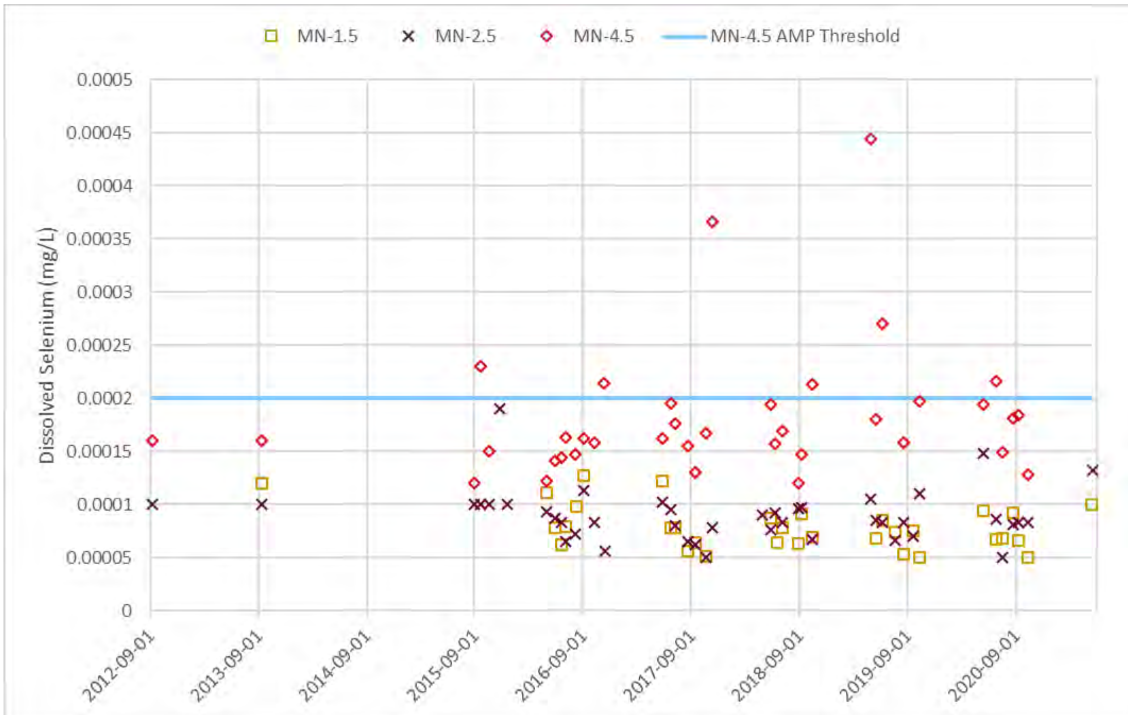


Figure 3-125: Dissolved Selenium at East Arm of McGinty Creek Monitoring Stations.

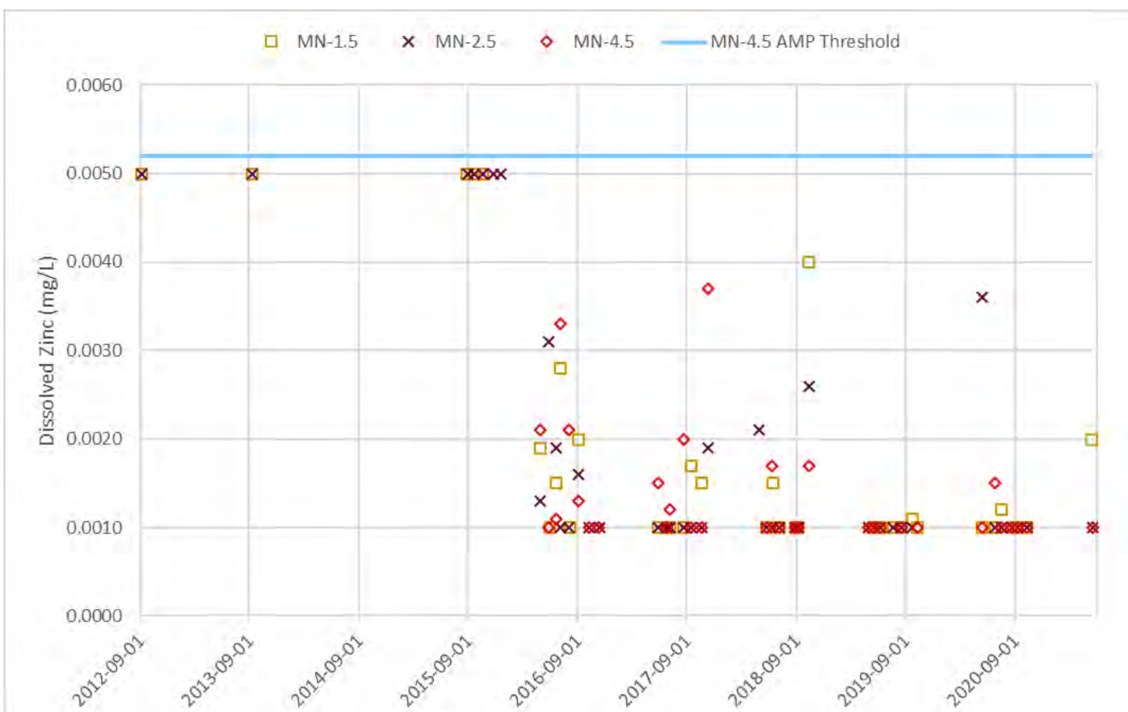


Figure 3-126: Dissolved Zinc at East Arm of McGinty Creek Monitoring Stations.

3.4.2 McGinty Creek West Arm Reference

Water quality results for the McGinty Creek west arm stations (MN-0.2 and MN-0.5) are presented and discussed for physical parameters, anions and nutrients in Section 3.4.2.1 and for dissolved metals of interest in Section 3.4.2.2.

3.4.2.1 Physical Parameters, Anions and Nutrients

Statistical summaries of physical parameters and anion and nutrient concentrations in MN-0.2 and MN-0.5 are presented in Table 3-47 and Table 3-48, respectively. TSS, field pH and nitrogen species in the McGinty Creek west arm stations over time are presented graphically in Figure 3-127 to Figure 3-132.

The pH in the west arm of McGinty Creek has generally been circumneutral and increases moving downstream from MN-0.2 (median pH 7.3) to MN-0.5 (median pH 7.8). Temperature varied seasonally from -1.9 to 7.9°C. Field conductivity was consistently higher in the downstream station of MN-0.5 (median 108.2 µS/cm) than MN-0.2 (median 46.6 µS/cm) with no obvious seasonal trend. TSS concentrations were generally higher at site MN-0.5 (median 7.1 mg/L) than farther upstream at site MN-0.2 (median 1.9 mg/L), and typically peaked during summer sampling events for both sites.

Nitrate-N concentrations were higher at the downstream MN-0.5 station than at MN-0.2 where nitrate-N was most often below detection levels. Nitrite-N concentrations were typically below detection at both MN-0.2 and MN-0.5. Ammonia-N concentrations were similar at MN-0.2 and MN-0.5 with median concentrations of 0.0108 and 0.0095 mg/L, respectively.

DOC concentrations decreased slightly moving downstream from MN-0.2 (18.5 mg/L) to MN-0.5 (11.9 mg/L). Concentrations typically varied seasonally with the highest concentrations observed in April/May when spring runoff likely flushed surface soils and leached organic carbon that had accumulated over the previous year.

Table 3-47: Summary Statistics for Physical Parameters, Anions and Nutrients at MN-0.2, West Arm of McGinty Creek

MN-0.2															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	75	52	49	52	50	49	48	76	37	76	76	71	72	74	67
Average	13.66	7.27	49.7	2.9	11.22	84.5	93.9	0.611	0.107	4.303	0.01733	0.00136	0.00931	20.7	0.0266
Minimum	<1.0	6.08	25	-1.9	4.68	34.7	-66.3	<0.10	0.057	<0.50	<0.0050	<0.0010	<0.0020	9.36	<0.01
Maximum	300	8.57	91.8	7.9	17.37	123.7	288.7	<5.0	0.15	20	0.11	0.007	0.23	42.1	0.119
Percent of results below DL	41.3	0.0	0.0	0.0	0.0	0.0	0.0	42.1	0.0	42.1	10.5	98.6	87.5	0.0	61.2
Standard deviation	40.77	0.49	15.4	2.5	2.46	17	68.30	0.533	0.02	4.286	0.01787	NA [a]	NA [a]	8.04	0.0167
First quartile	1.5	7	40	0.4	9.15	73	61.5	0.25	0.098	0.25	0.00685	0.0005	0.0025	14.45	0.025
Median	1.9	7.29	46.6	3	11.6	87.4	93.7	0.25	0.11	3.63	0.01085	<0.0010	0.0056	18.45	<0.050
Third quartile	4.85	7.58	58.7	4.6	12.64	93.7	139.2	0.885	0.12	7.268	0.0205	0.0025	0.01	25	0.025

[a] Not applicable due to too few measurements above the detection limit

Table 3-48: Summary Statistics for Physical Parameters, Anions and Nutrients at MN-0.2, West Arm of McGinty Creek

MN-0.5															
	TSS	Field pH	Field Conductivity	Temperature	Dissolved Oxygen		ORP	Chloride	Fluoride	Dissolved Sulphate	Ammonia-N	Nitrite-N	Nitrate-N	DOC	Total Phosphorus
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	NA	10	NA	0.1	1	NA	0.5	0.01	0.5	0.002	0.001	0.005	0.5	0.01
Count	106	73	68	73	66	66	66	106	64	107	106	105	99	103	81
Average	55.08	7.64	110.6	1.7	12.79	93.3	151.8	0.78	0.306	9.102	0.02184	0.00315	0.06484	14.321	0.0624
Minimum	<1.0	5.36	37.3	-1.8	1.61	11.6	-16.6	<0.10	0.06	<0.30	<0.0050	<0.0010	<0.0050	<0.50	<0.01
Maximum	737	8.67	220	6.9	18.07	126.7	338.2	2.2	0.89	31.5	0.33	<0.050	1.69	48.7	0.815
Percent of results below DL	20.8	0.0	0.0	0.0	0.0	0.0	0.0	31.1	0.0	16.8	34.9	93.3	29.3	1.0	51.9
Standard deviation	141.19	0.52	39.2	2.3	2.55	17.6	63.70	0.554	0.145	6.473	0.04248	NA [a]	0.16969	8.541	0.1205
First quartile	2.42	7.49	85.6	0	11.96	92	117.9	0.25	0.218	5.14	0.0025	<0.0010	0.01	8.885	<0.050
Median	7.1	7.75	108.2	0.3	13.15	95	151.2	0.715	0.3	8.64	0.00955	<0.0050	0.0473	11.9	<0.050
Third quartile	35.95	7.9	138.4	3.8	14.13	98.2	179.1	1.2	0.35	11.9	0.02325	<0.0050	0.0755	17.3	0.051

[a] Not applicable due to too few measurements above the detection limit

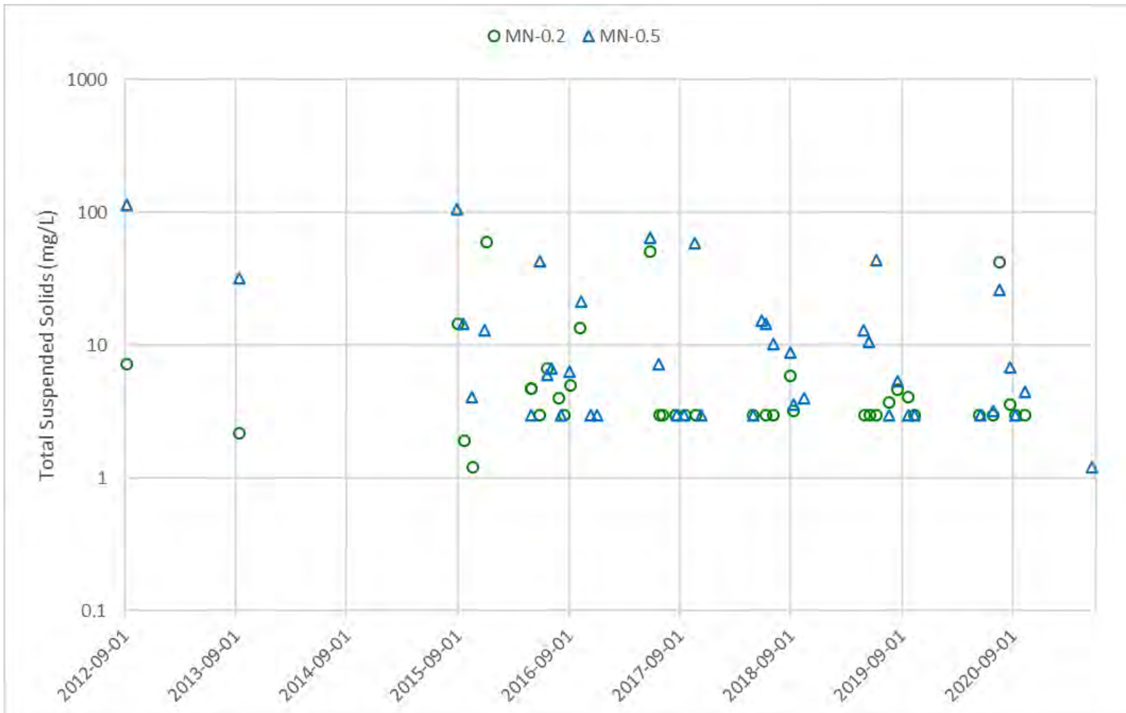


Figure 3-127: TSS at West Arm of McGinty Creek Monitoring Stations

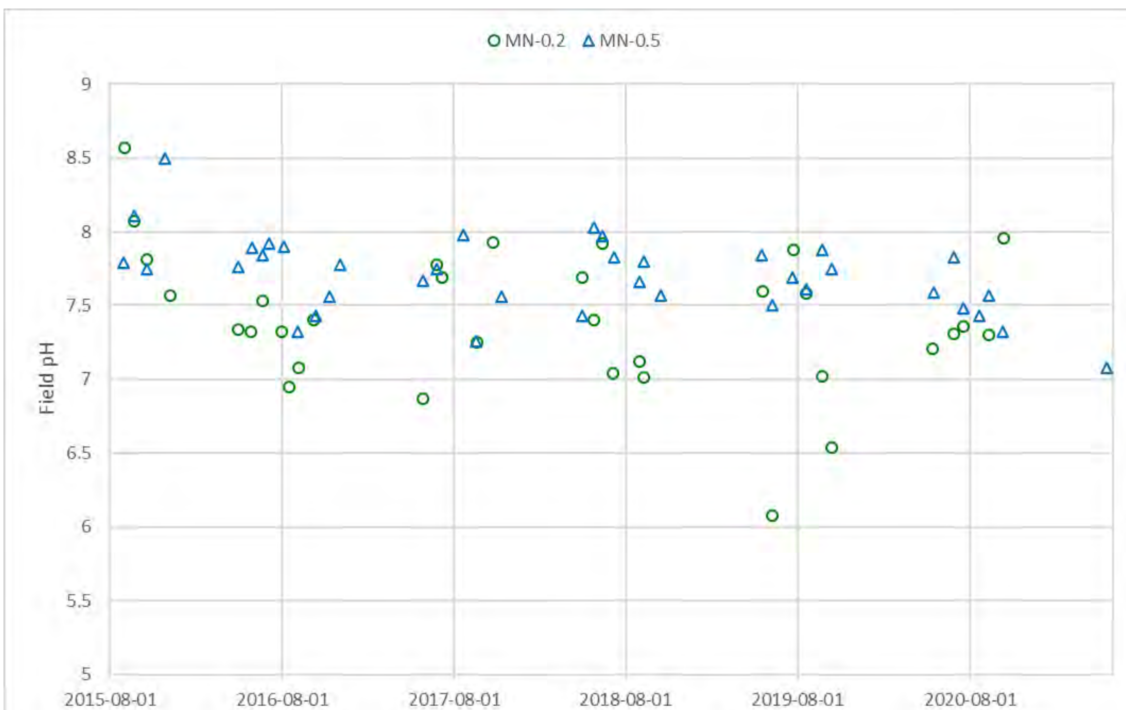


Figure 3-128: pH at West Arm of McGinty Creek Monitoring Stations

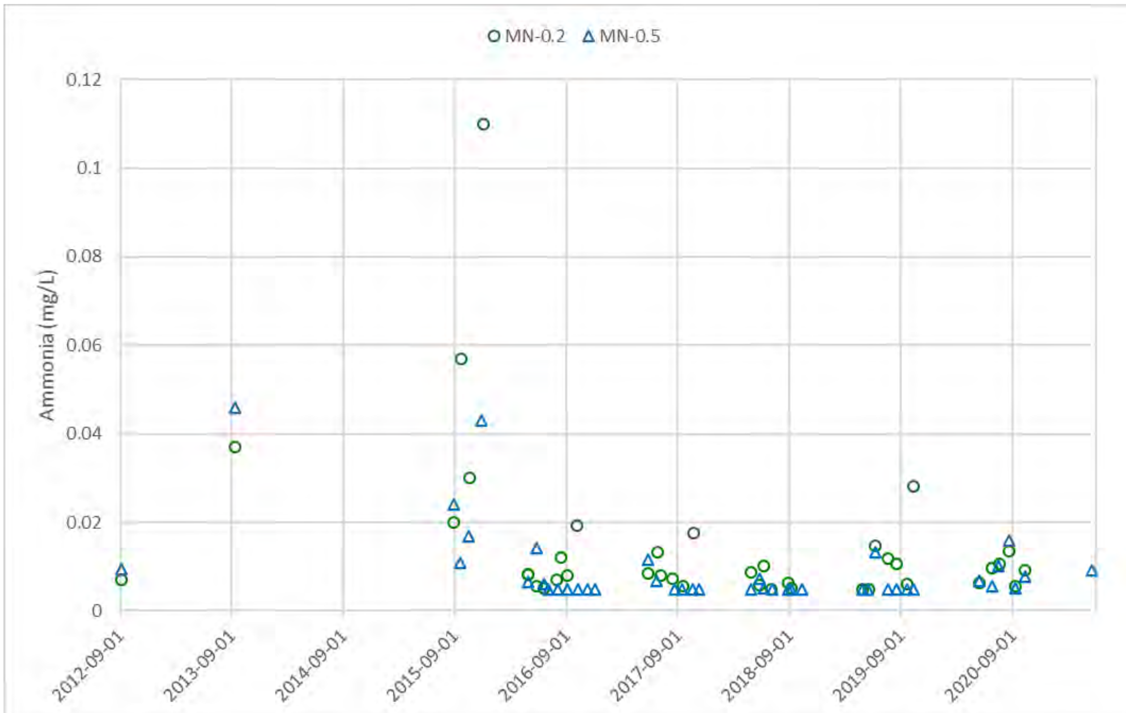


Figure 3-129: Ammonia (N) at West Arm of McGinty Creek Monitoring Stations

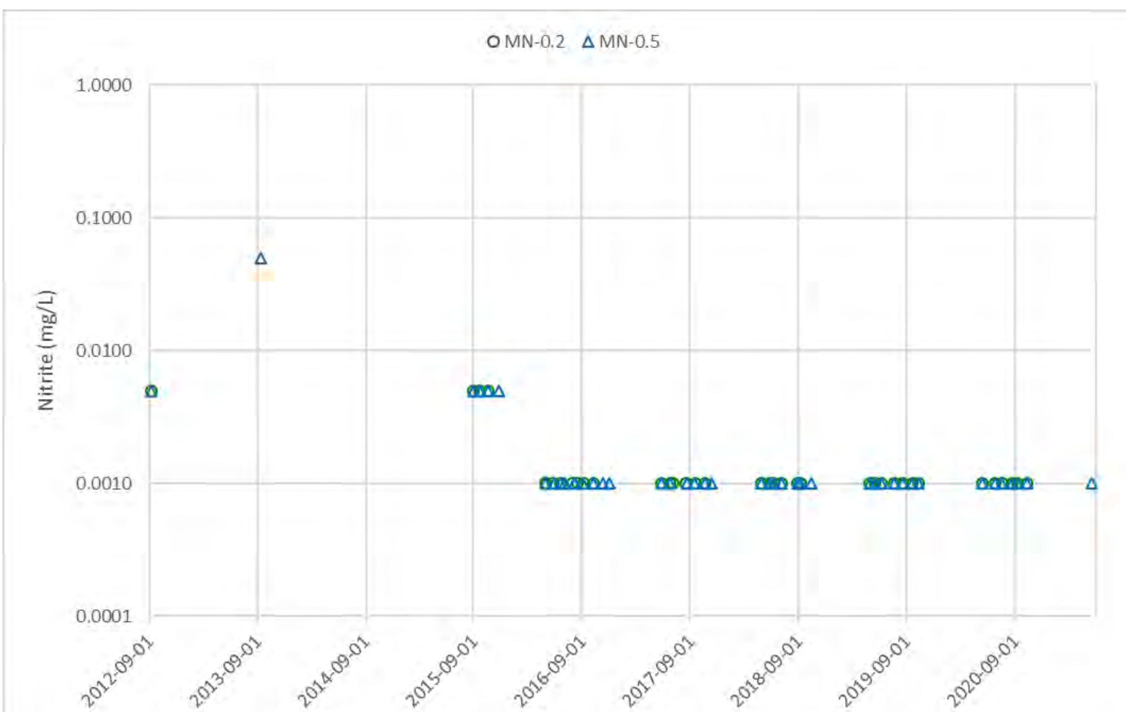


Figure 3-130: Nitrite (N) at West Arm of McGinty Creek Monitoring Stations

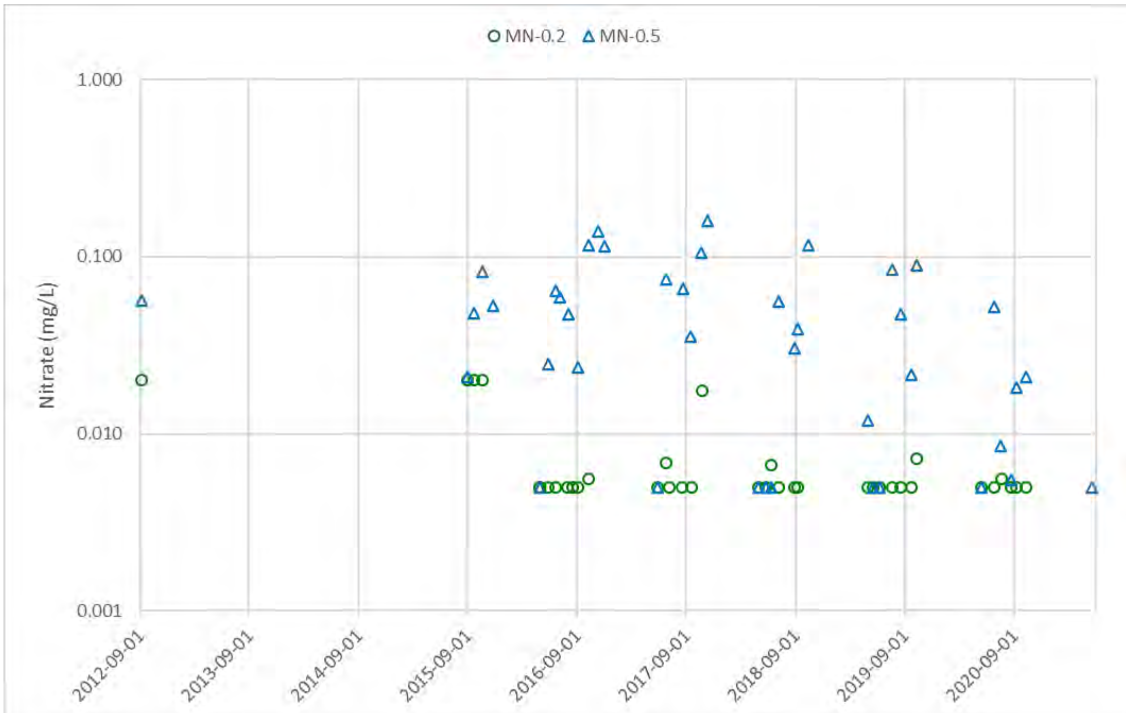


Figure 3-131: Nitrate (N) at West Arm of McGinty Creek Monitoring Stations

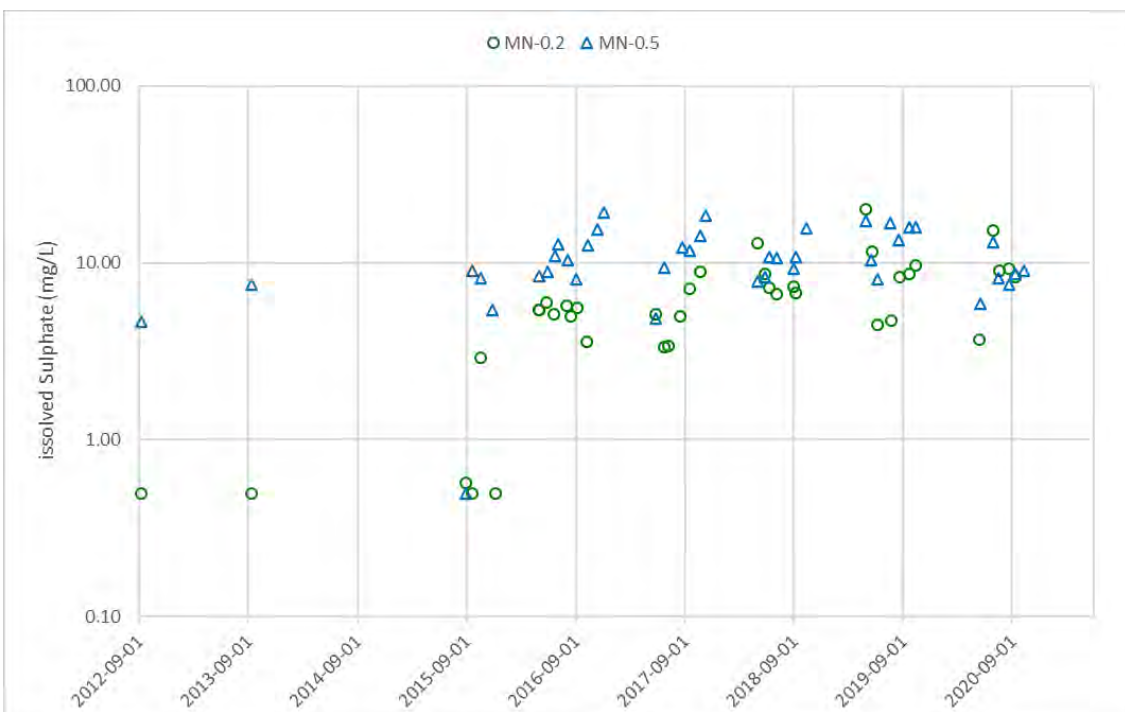


Figure 3-132: Dissolved Sulphate at West Arm of McGinty Creek Monitoring Stations

3.4.2.2 Metals

Statistical summaries of dissolved metals concentrations in MN-0.2 and MN-0.5 are presented in Table 3-49 and Table 3-50, respectively. Dissolved metals of interest in the McGinty Creek west arm stations over time are presented graphically in Figure 3-133 through Figure 3-144.

Dissolved hardness in the west arm of McGinty Creek typically followed a seasonal trend with lower concentrations in April/May due to dilution from meltwater and increasing concentrations through the rest of the year, likely related to an increasing proportion of baseflow in the creek. Hardness levels increased moving downstream from MN-0.2 to MN-0.5 with median concentrations of 35 and 90 mg/L, respectively.

Dissolved aluminium, copper and nickel concentrations were generally higher upstream at MN-0.2 (median 0.071 mg/L aluminium, 0.0025 mg/L copper and 0.0015 mg/L nickel) than downstream at MN-0.5 (0.017 mg/L aluminium, 0.0016 mg/L copper and 0.0096 mg/L nickel). No trends were apparent for aluminium and nickel concentrations, but copper appeared to vary seasonally with higher concentrations in April/May, likely due to mobilization by the elevated DOC levels observed at this time of year, followed by decreasing concentrations through the remainder of the year.

Dissolved arsenic concentrations were similar at MN-0.2 and MN-0.5 except for in 2016 when concentrations were greater at MN-0.2. Similarly, dissolved iron concentrations were greater at MN-0.2 than MN-0.5 following 2015 after being fairly similar to the downstream station from 2009 to 2014. Concentrations of dissolved arsenic and iron were fairly erratic, but higher concentrations were often found in late summer (August) and lower concentrations in April, although this was not observed in every year.

A wide range of dissolved cadmium, lead and zinc concentrations were observed at MN-0.2 and MN-0.5 with no apparent seasonal trends from 2009 through 2013. Since 2013, concentrations appear to have decreased and were often close to or below their respective detection levels. Similarly, dissolved chromium concentrations varied pre-2013 and were close to or below a relatively higher detection level through 2015. In 2016, dissolved chromium concentrations at MN-0.2 appeared to be greater than earlier data however concentrations were still fairly close to previous detection levels. Dissolved silver was often below detection level at both stations on the west arm of McGinty Creek.

Dissolved molybdenum and selenium were higher at the downstream station MN-0.5 (median 0.00092 mg/L molybdenum and 0.00019 mg/L selenium) than upstream at MN-0.2 (median 0.00023 mg/L molybdenum and 0.000068 mg/L selenium). Generally, concentrations varied seasonally with lower concentrations in April with dilution from spring meltwater and increasing concentrations throughout the year as baseflow contributes a greater proportion of flow in McGinty Creek.

Table 3-49: Summary Statistics for Dissolved Metals of Interest at MN-0.2, East Arm of McGinty Creek

MN-0.2													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	77	77	77	76	77	76	77	77	77	77	77	77	77
Average	35.8	0.0824	0.000525	0.00000783	0.000501	0.00276	0.561	0.0000504	0.00027	0.0015	0.00000606	0.0000701	0.00193
Minimum	19.6	0.0178	0.00018	<0.0000050	0.0002	0.00112	0.084	0.000009	<0.00005	0.00052	<0.0000050	<0.000040	0.0001
Maximum	56.1	0.199	0.00388	0.000053	0.0011	0.00842	10.3	0.000271	0.00	0.00272	0.000011	0.000123	0.0131
Percent of results below DL	0.0	0.0	0.0	67.1	24.7	0.0	0.0	75.3	27.3	0.0	93.5	28.6	59.7
Standard deviation	9.4	0.0434	0.000416	0.0000097	0.000148	0.00128	1.16	NA [a]	0.000158	0.00034	NA [a]	0.0000243	0.00206
First quartile	28.4	0.0445	0.00037	0.0000025	0.00043	0.00202	0.225	<0.000050	0.00015	0.0013	<0.000010	<0.00010	<0.0010
Median	35.1	0.0714	0.00046	0.000005	<0.0010	0.00253	0.367	<0.000050	0.000227	0.00147	<0.000010	0.000068	0.0015
Third quartile	42.3	0.117	0.00058	0.00000618	0.00055	0.00293	0.601	<0.00020	<0.0010	0.00169	<0.000020	0.00009	<0.0050

[a] Not applicable due to too few measurements above the detection limit

Table 3-50: Summary Statistics for Dissolved Metals of Interest at MN-0.5, East Arm of McGinty Creek

MN-0.5													
	Hardness (dissolved)	Aluminum (dissolved)	Arsenic (dissolved)	Cadmium (dissolved)	Chromium Dissolved	Copper (dissolved)	Iron (dissolved)	Lead (dissolved)	Molybdenum (dissolved)	Nickel (dissolved)	Silver (dissolved)	Selenium (dissolved)	Zinc (dissolved)
Units	mg/L	pH units	µS/cm	°C	mg/L	%	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit	1.0	0.003	0.0002	0.000005	0.0001	0.001	0.02	0.00005	0.0001	0.0005	0.00001	0.0001	0.001
Count	106	106	106	106	106	106	106	106	106	106	106	106	106
Average	90.432	0.02862	0.000417	0.0000086	0.000344	0.001858	0.1393	0.0000552	0.0008598	0.001002	0.00000589	0.000191	0.00186
Minimum	<0.60	<0.0010	<0.00010	<0.0000050	<0.00010	<0.00020	<0.010	0.000006	<0.000050	<0.00050	<0.0000050	<0.000050	0.00016
Maximum	190	0.191	0.000713	0.000076	0.0016	0.00476	0.716	0.000198	0.00	0.00205	<0.000020	0.00063	0.0121
Count of results below DL	1	2	1	66	39	1	3	74	17	22	101	3	57
Percent of results below DL	0.9	1.9	0.9	62.3	36.8	0.9	2.8	69.8	16.0	20.8	95.3	2.8	53.8
Standard deviation	32.69	0.03624	0.000109	0.00001124	0.000206	0.000936	0.14	0.0000406	0.0003586	0.00046	NA [a]	0.0000833	0.00163
First quartile	73.625	0.00842	0.00036	0.0000025	0.00018	0.001172	0.0312	0.000025	0.0005	0.00063	0.00000312	0.00016	0.0005
Median	90.05	0.01695	0.00039	0.000005	0.00033	0.001635	0.1005	0.000025	0.000918	0.000965	0.000005	0.000185	0.0019
Third quartile	103.75	0.03075	0.000453	0.00000815	0.0005	0.002248	0.1895	0.0001	0.0011075	0.001258	0.00001	0.00021	0.0025

[a] Not applicable due to too few measurements above the detection limit

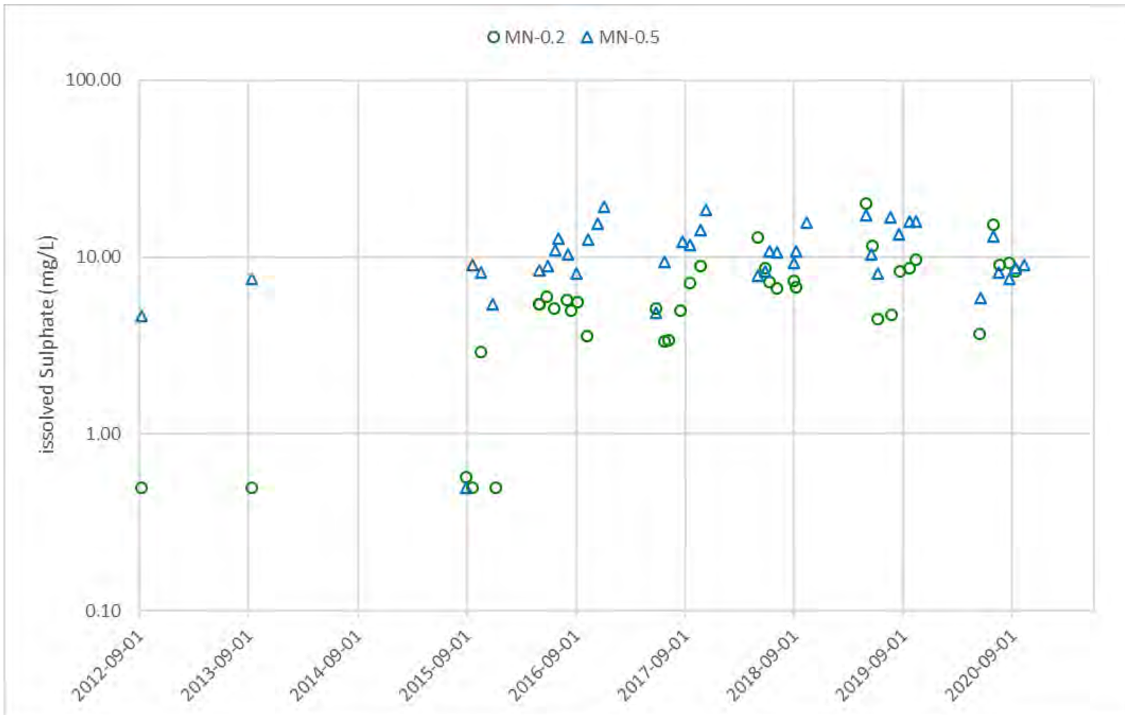


Figure 3-133: Dissolved Aluminum at West Arm of McGinty Creek Monitoring Stations. Note Log Scale.

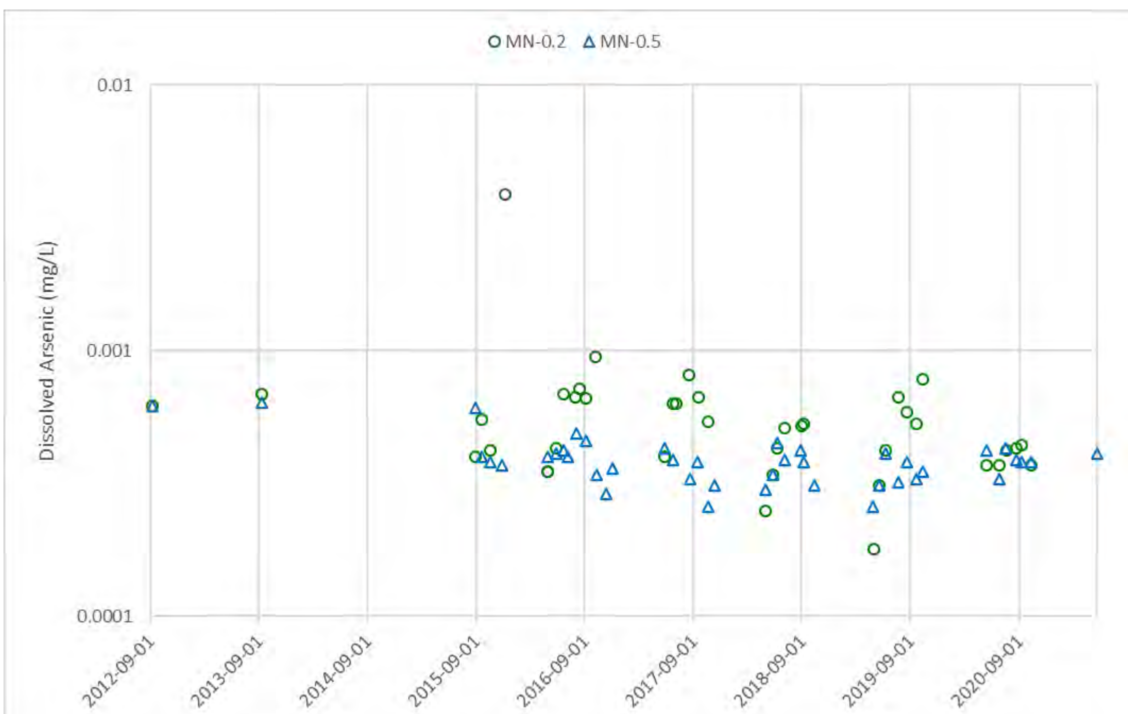


Figure 3-134: Dissolved Arsenic at West Arm of McGinty Creek Monitoring Stations. Note Log Scale.

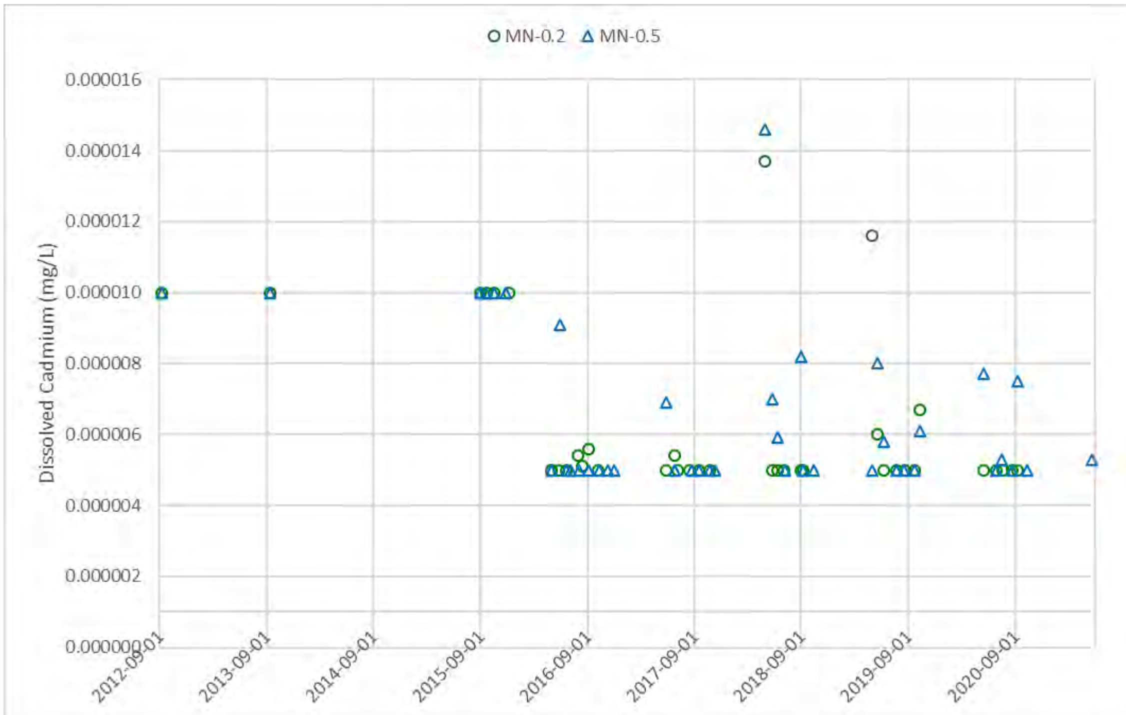


Figure 3-135: Dissolved Cadmium West Arm of at McGinty Creek Monitoring Stations.

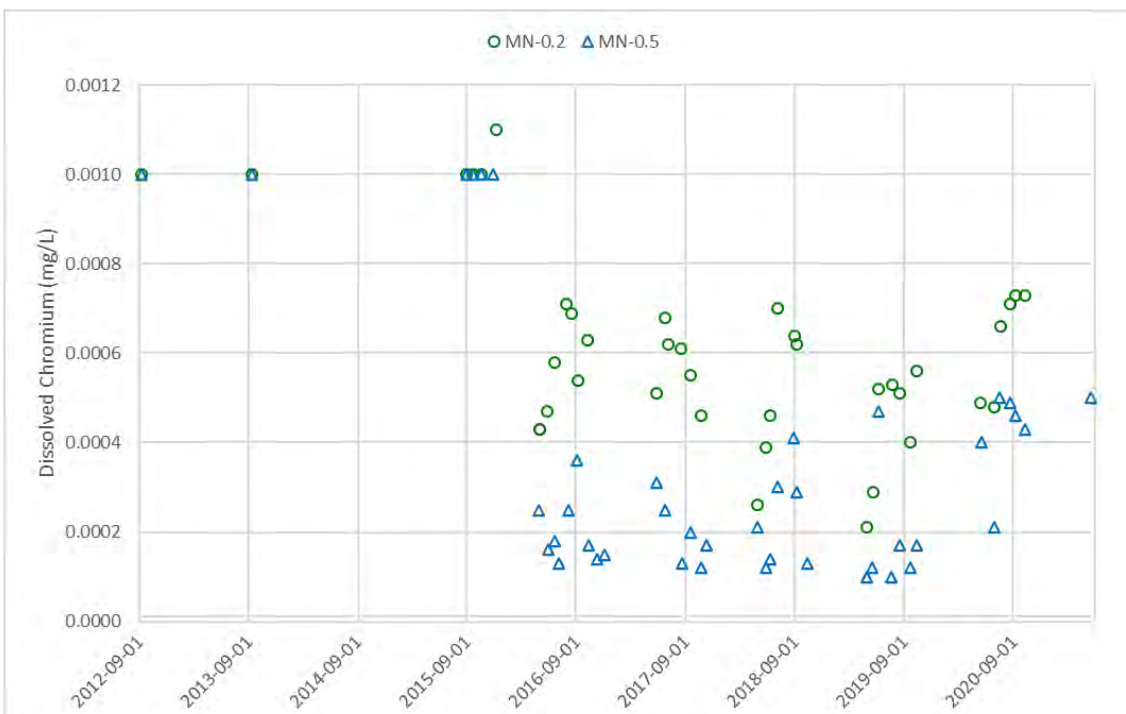


Figure 3-136: Dissolved Chromium at West Arm of McGinty Creek Monitoring Stations.

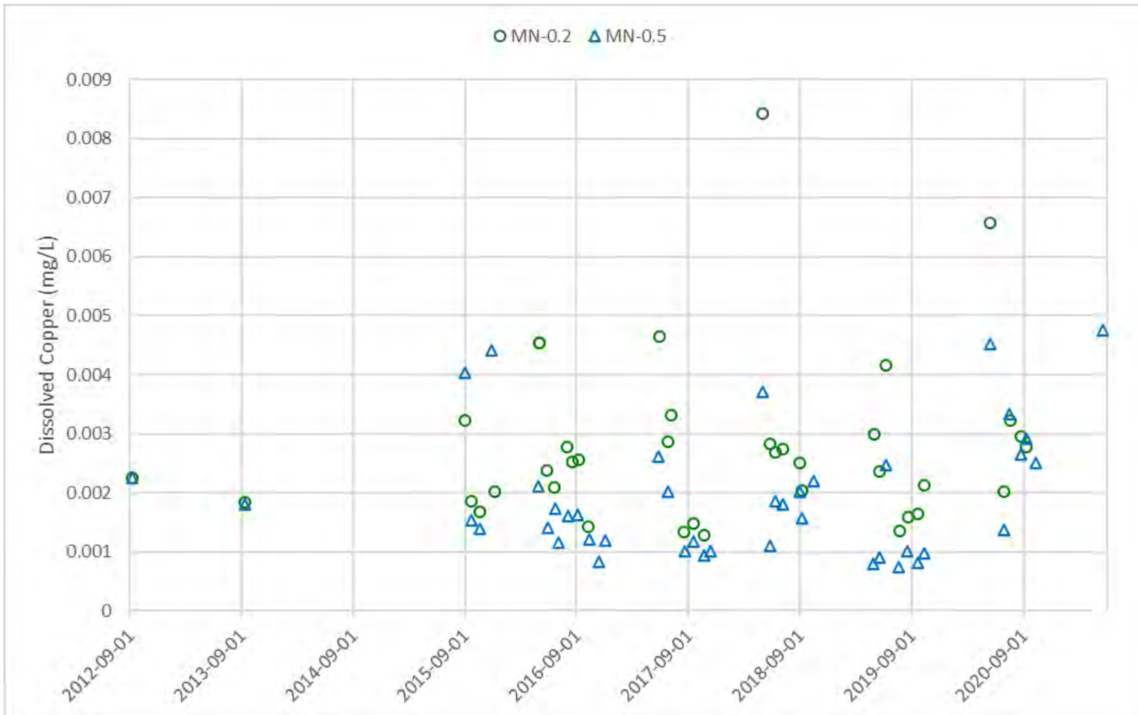


Figure 3-137: Dissolved Copper at West Arm of McGinty Creek Monitoring Stations.

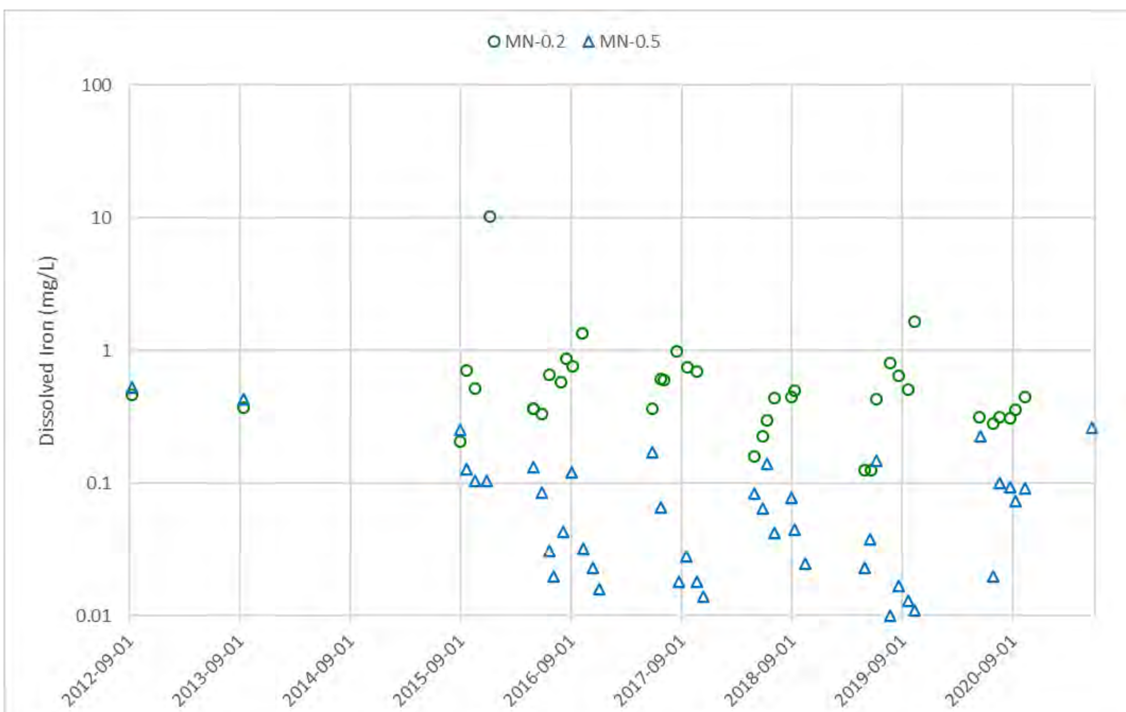


Figure 3-138: Dissolved Iron at West Arm of McGinty Creek Monitoring Stations. Note Log Scale.

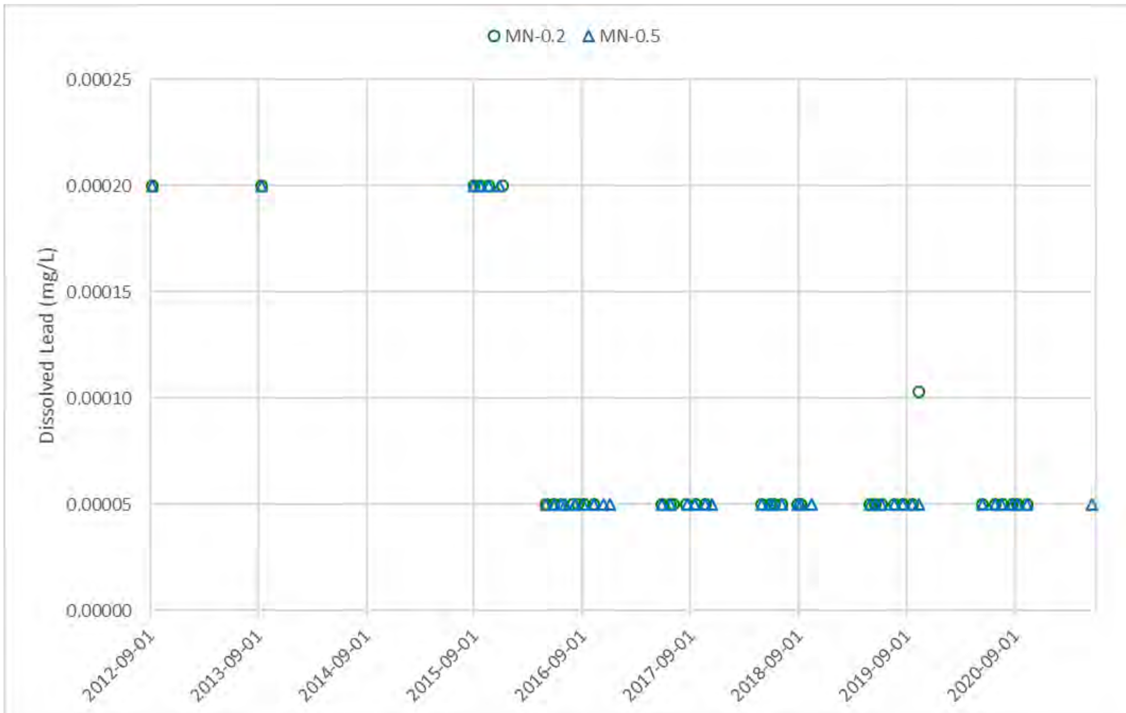


Figure 3-139: Dissolved Lead at West Arm of McGinty Creek Monitoring Stations.

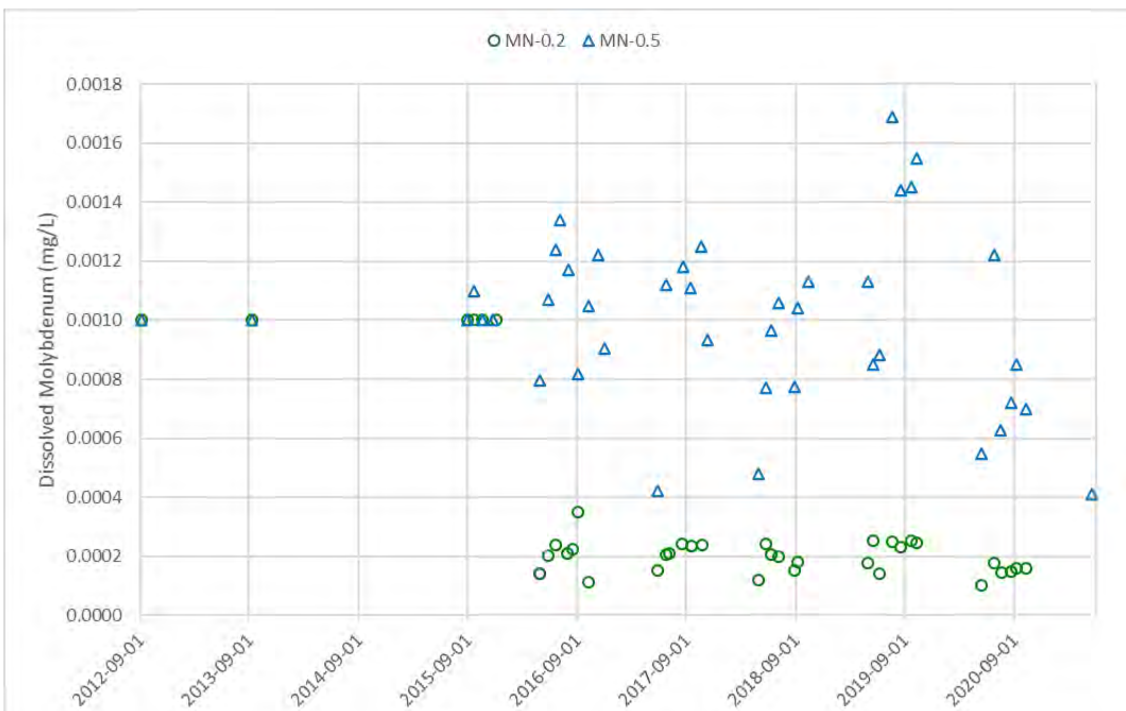


Figure 3-140: Dissolved Molybdenum at West Arm of McGinty Creek Monitoring Stations.

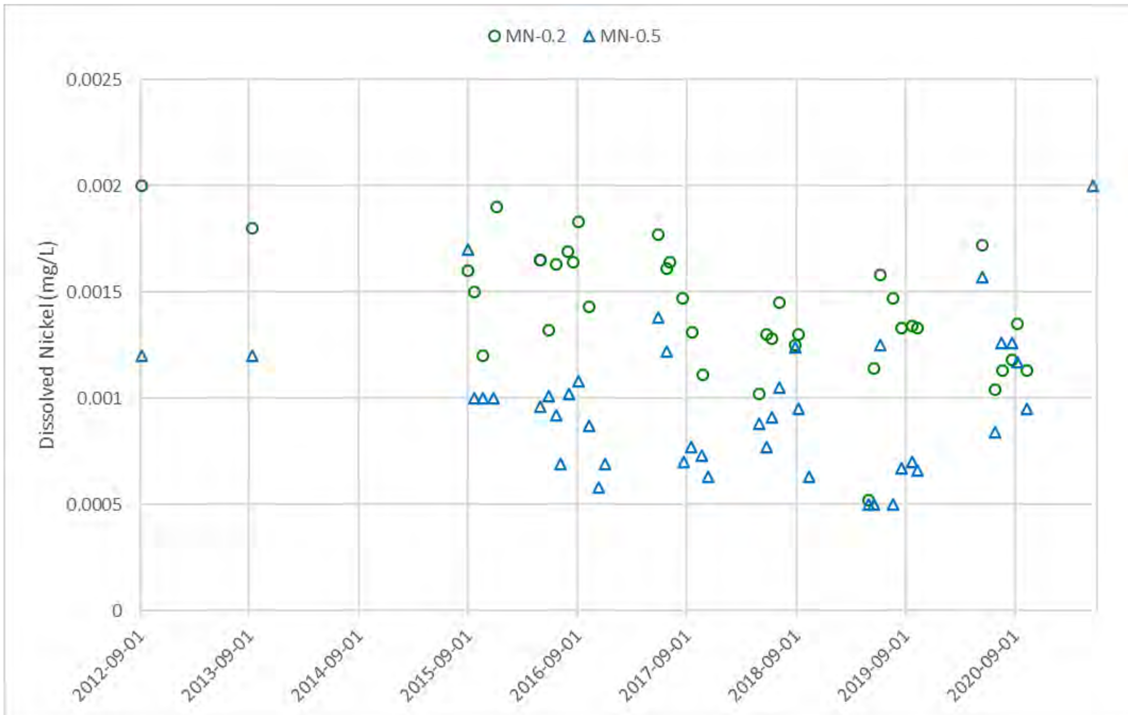


Figure 3-141: Dissolved Nickel at West Arm of McGinty Creek Monitoring Stations.

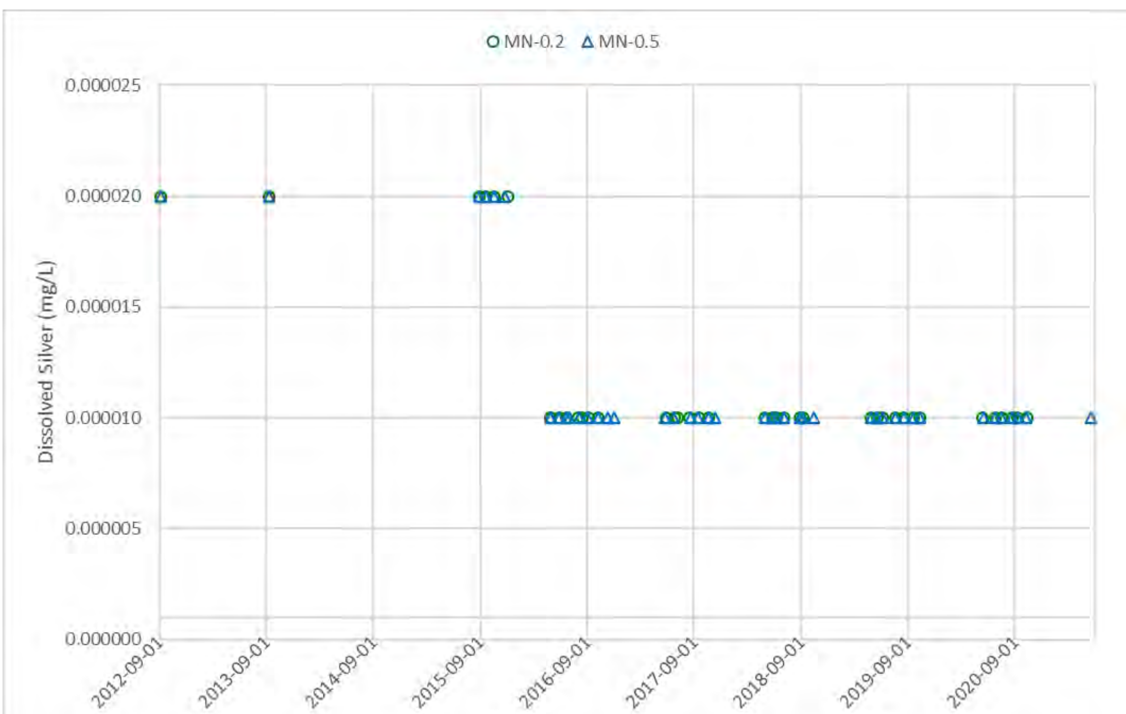


Figure 3-142: Dissolved Silver at West Arm of McGinty Creek Monitoring Stations.

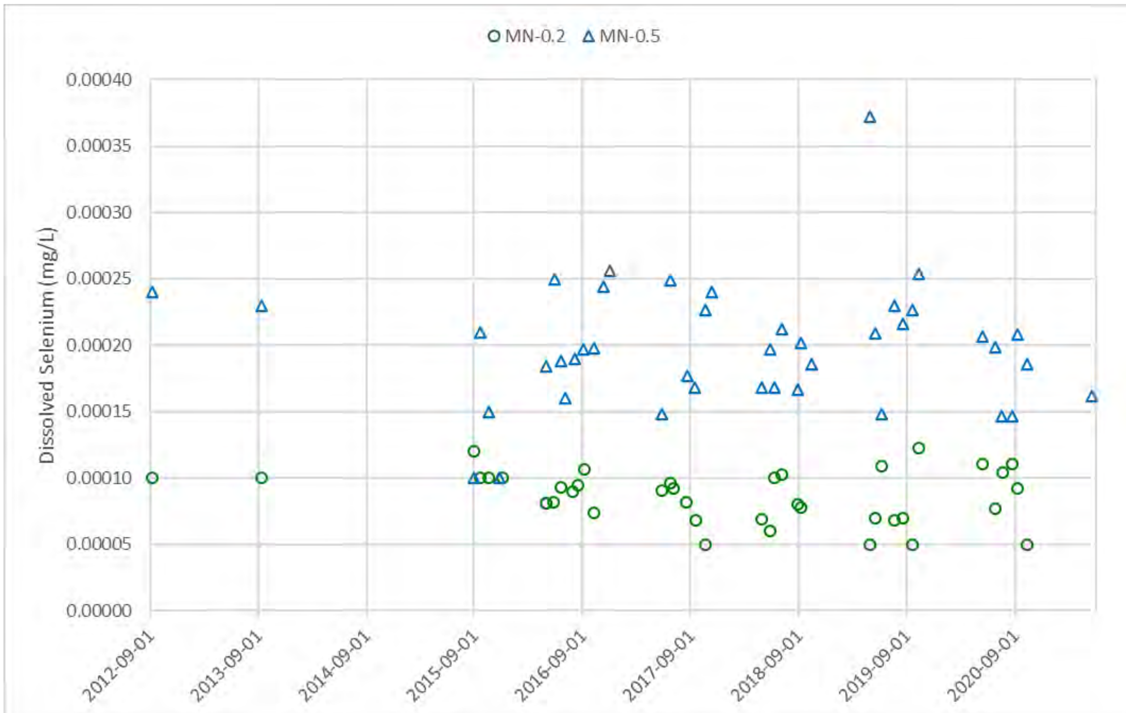


Figure 3-143: Dissolved Selenium at West Arm of McGinty Creek Monitoring Stations.

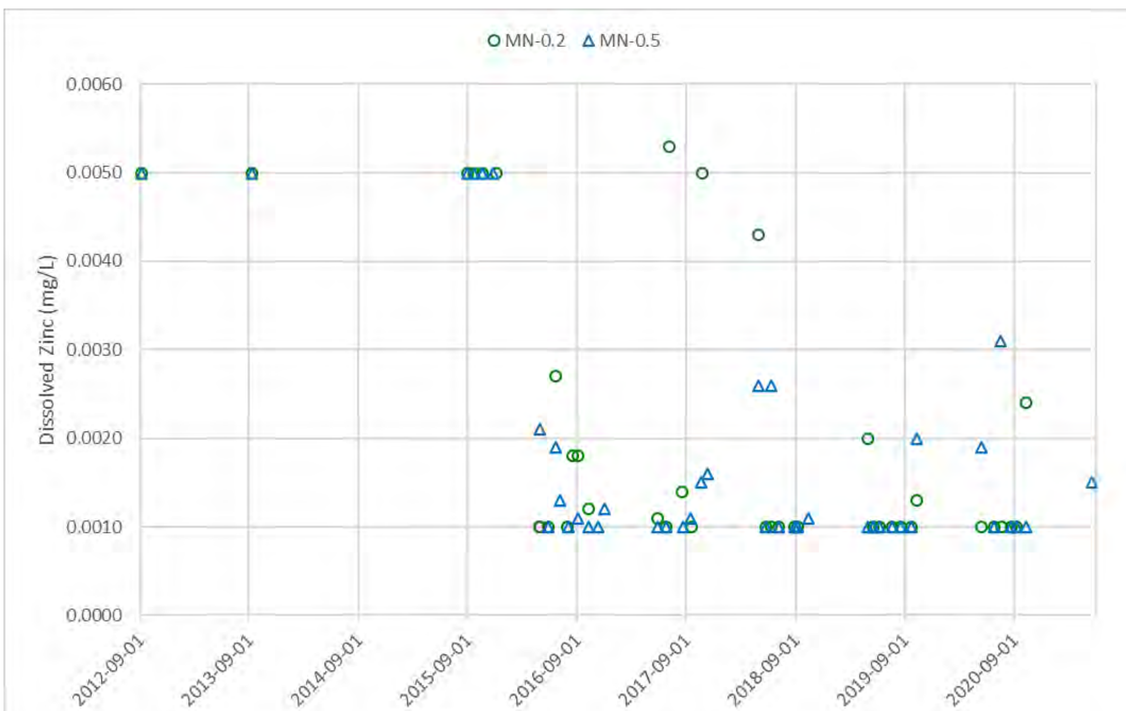


Figure 3-144: Dissolved Zinc at West Arm of McGinty Creek Monitoring Stations.

4 SUMMARY

The characteristics, trends and patterns associated with the geochemistry of surface waters at the Minto Mine Site, Minto North Pit, Minto Creek, and McGinty Creek is summarized in this section.

4.1 MINTO MINE SITE

- The pH of the waters was predominantly circumneutral to slightly alkaline;
- Although typically well oxygenated, lower levels of dissolved oxygen were often observed during winter, particularly for the pit lake locations, where ice cover limited the oxygenation of underlying waters;
- Nitrogen species concentrations were generally highest in the pit lake and DSTSF drainage sites, reflecting leaching of nitrogen residue from blasting activity. Nitrate-N levels showed marked seasonality at both the Minto Creek mine site location (W15) and the DSTSF drainage (W8 and W8A), but with different patterns. In Minto Creek, nitrate-N levels were highest in winter and lowest over summer, responding to nitrogen uptake demand by primary producers, whereas the opposite trend was noted in the DSTSF drainage;
- DOC concentrations were highest during spring snowmelt, likely due to snowmelt flushing the surrounding soils of labile organic matter that had accumulated through the previous summer and fall;
- Dissolved hardness concentrations were typically lowest in spring at the flowing water sites due to snowmelt dilution, and increased through the year, peaking in winter, suggestive of a marked groundwater component to hardness levels;
- Concentrations of dissolved iron, and to a lesser extent dissolved aluminum, often appeared higher than may be expected from equilibrium with their oxyhydroxide minerals under the prevalent oxidizing, circumneutral pH conditions. Complexation with dissolved organic matter likely maintains these elevated dissolved iron and aluminum levels;
- Dissolved copper concentrations were highest in the DSTSF drainage and tended to peak with freshet, suggestive of some association with DOC; and
- Dissolved concentrations of both selenium and molybdenum increased approximately four-fold in the pit lake sites between 2013 and 2016 but returned to 2013 levels by the start of 2019. Dissolved selenium exhibited strong seasonal cycling in both Minto Creek (W15) and the DSTSF drainage (W8A), but with offset patterns. In Minto Creek, selenium concentrations were lowest at freshet, then rose through the year, peaking in winter, suggestive of a strong groundwater contribution. The opposite pattern was observed at site W8A, where selenium levels oscillated on an annual

basis between summer peaks and winter troughs.
- Dissolved sulphate concentrations followed a similar trend at all mine site stations during this time. Concentrations in the pit lakes remain above pre-2013 levels but appear to have stabilized or are decreasing slightly.

4.2 MINTO NORTH PIT

- Minto North Pit waters were circumneutral to mildly alkaline and well oxygenated.
- Field-measured conductivity and hardness were high during active mining at the pit but decreased rapidly following cessation of mining activities; this pattern was observed in most of the analytes.
- Nitrogen species, particularly Nitrates, were very high during the active mining period, likely due to nitrogen residue from blasting activities, but reduced dramatically following 2016.
- Some analytes, such as dissolved molybdenum, selenium, and sulphate, show signs of seasonal fluctuation, increasing over the course of spring/summer but returning to similar concentrations each spring.
- The majority of dissolved chromium, lead, nickel, and silver measurements were below detection; and
- Dissolved zinc has shown the greatest degree of variability since mining ceased in the Minto North Pit.

4.3 MINTO CREEK

- The Minto Creek waters were typically circumneutral to slightly alkaline pH and well-oxygenated.
- Nitrogen species concentrations were generally higher during and following periods of mine discharge, likely due to blasting activity within the mine site. Aside from discharge periods, seasonal trends were observed, particularly for nitrate-N, with lower nitrate-N concentrations typically observed in summer months when primary producers that uptake nitrogen species would be most active.
- Concentrations of DOC at W3 were typically higher during April/May likely due to high flows caused by spring meltwater mobilizing organic carbon that had accumulated over the previous year. DOC concentrations also appeared to be higher during mine discharge periods, but as many of these periods occurred in early spring it is difficult to discern the effects of mine discharge on DOC. At downstream stations MC1 and W2, DOC concentrations were higher in mid to late summer and were generally lower in spring and winter.
- Hardness was often lowest in April and May and increased through the summer and

fall suggesting dilution in spring, followed by a higher proportional contribution of groundwater to Minto Creek flow through summer, fall, and winter. This trend was more marked at W50 and downstream stations MC1 and W2, whereas W3 returned higher hardness concentrations with less seasonality.

- Dissolved aluminum concentrations were higher in the spring and decreased through the year, likely due to mobilization by high flows from spring meltwater and possibly complexation by DOC, which also peaked in spring.
- Dissolved arsenic and iron concentrations were typically higher at downstream stations MC1 and W2 than upstream stations and were highest in mid to late summer. A reasonable correlation with DOC concentrations suggests DOC likely enhances iron solubility at MC1 and W2.
- Since 2010, dissolved lead and silver have generally been closer to or below detection levels with and without mine discharge;
- Dissolved copper, molybdenum and selenium concentrations were higher during and following periods of mine discharge. Dissolved copper concentrations also appeared to vary seasonally with higher concentrations observed in the spring with higher flows from meltwater and were correlated with DOC concentrations. Dissolved molybdenum concentrations were consistently higher at W3 than W2 in pre-operations and during non-discharge periods.

4.4 MCGINTY CREEK

- Field pH was generally circumneutral to slightly alkaline.
- The waters were fairly well-oxygenated with occasional troughs of dissolved oxygen measured in winter months when ice cover likely inhibited ingress of oxygen to McGinty Creek.
- Nitrate-N concentrations were typically lower in April/May due likely to dilution from meltwater and higher values were typically observed in the winter when uptake by primary producers would have been lowest. Nitrate-N and Ammonia-N concentrations have decreased since cessation of mining in the Minto North Pit. Nitrite-N was predominantly below detection level in McGinty Creek.
- Concentrations of DOC were typically higher during April/May likely due to mobilization by high flows caused by spring meltwater. Higher concentrations were also commonly observed in mid to late summer.
- Dissolved aluminum concentrations were higher in the upstream stations of the east and west arms of McGinty Creek and were typically higher in April and May when higher flows caused by spring meltwater could mobilize aluminum. Complexation by DOC, which was highest during spring, may also have maintained elevated dissolved aluminum concentrations at this time.
- Dissolved arsenic and iron concentrations were higher in upstream stations of the east and west arm of McGinty Creek and often peaked in August or September. A

negative correlation between iron and ORP suggests the presence of a groundwater seep with reducing conditions that could have provided elevated concentrations of iron to McGinty Creek. DOC could also be a factor in maintaining higher iron concentrations in solution.

- Dissolved cadmium and zinc concentrations were highest in upstream stations and were at or near detection levels at the furthest downstream station, MN-4.5.
- Dissolved chromium concentrations were higher in upstream stations of the east and west arms of McGinty Creek.
- The upstream-most stations – MN-1.5 (east arm) and MN-0.2 (west arm reference tributary) – consistently returned higher dissolved copper concentrations in McGinty Creek. Generally, concentrations were higher in April/May likely due to mobilization by the elevated DOC levels observed at this time of the year.
- Dissolved molybdenum concentrations typically increased moving downstream in McGinty Creek and varied seasonally such that lower concentrations were observed in the spring and higher concentrations were observed in the winter.
- Dissolved lead and silver concentrations have generally been close to or below their respective detection levels in McGinty Creek.
- Dissolved selenium concentrations in McGinty Creek were generally highest in the west arm (reference tributary) at MN-0.5, suggesting a significant proportion of loading occurs from the west arm to McGinty Creek downstream of MN-2.5 and upstream of MN-4.5.

5 LIMITATIONS OF REPORT

Alexco Environmental Group (AEG) of Whitehorse, Yukon has prepared this Water Quality Characterization for Minto Creek for the Minto Project for the exclusive use of Minto Explorations Ltd., and is based on data and information managed by Minto Mine. AEG has followed standard professional procedures in conducting the investigations and in preparing the contents of this report. The material in this report reflects AEG's best judgment in light of the information available at the time of the preparation of this report. Any use that a third party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of the third parties. AEG accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. AEG believes that the contents of this report are substantively correct.

The information and data contained in this report, including without limitation, the results of any sampling and analyses conducted by AEG, are based solely on the conditions observed at the time of the field assessment and have been developed or obtained through the exercise of AEG's professional judgment and are set to the best of AEG's knowledge, information, and belief. Although every effort has been made to confirm that all such information and data is factual, complete and accurate, AEG offers no guarantees or warranties, either expressed or implied, with respect to such information or data.

AEG shall not by the act of issuing this report be deemed to have represented that any sampling and analyses conducted by it have been exhaustive or will identify all pertinent conditions at the site, and persons relying on the results thereof do so at their own risk.

6 REFERENCES

Access Consulting Group and Minnow Environmental Inc. 2013. McGinty Creek Water Quality Characterization May 2009 – July 2012. YESAB Project Proposal Phase V/VI. Prepared for Minto Explorations Ltd. March 2013.

Minnow Environmental Inc. 2009. Evaluation of the Background Water Quality of Minto Creek and Options for the Derivation of Site Specific Water Quality Objectives. Report prepared for Minto Explorations Ltd.

Minnow Environmental Inc. 2010. Characterization of Baseline and Operational Water Quality of Minto Creek. Report prepared for Minto Explorations Ltd.

Minnow Environmental Inc. 2016. Background Water Quality of Lower Minto Creek for Application in the Derivation of Post-Closure Water Quality Objectives. Prepared for Minto Explorations Ltd. July 2016.

Minnow Environmental Inc. 2017. Methods for Computing Summary Statistics for Censored Data. Technical Memorandum Prepared for Alexco Environmental Group. December 22. 2017

Minto Explorations Ltd. 2017. Minto Mine Operational Adaptive Management Plan. Revision 2017-02.

APPENDIX 1-4A
Groundwater Characterization, Conceptual Model

Minto Groundwater Characterization, Conceptual and Numerical Model Update Report - FINAL

Prepared for

Minto Explorations Ltd

Prepared by

SRK Consulting (Canada) Inc.
1CM002.072
October 2021

Minto Groundwater Characterization, Conceptual and Numerical Model Update Report - FINAL

October 2021

Prepared for

Minto Explorations Ltd
PO Box 11, Whitehorse Central PO,
Whitehorse, Yukon Y1A 5X9

Tel: +1 604 684 8894
Web: www.capstonemining.com

Prepared by

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2
Canada

Tel: +1 604 681 4196
Web: www.srk.com

Project No: 1CM002.072

File Name: Minto_2021 Conceptual and Numerical GW Mdl Upd_1CM002.072_FINAL_20211029_lv_dcm.docx

srk consulting

Table of Contents

List of Figures

List of Tables

Appendices

List of Abbreviations

118UG	Area 118 Underground
A118	Area 118
A2	Area 2
A2S2	Area 2 Stage 2
A2S3S4	Area 2 Stage 3/Stage4
CKUG	Copper Keel Underground
CoCs	Specific Constituents of Concern
DSTSF	Dry Stack Tailings Storage Facility
ha	hectare
K	Hydraulic Conductivity
km	Kilometre
LMWL	Local meteoric water line
L/s	Litre per second
m	Metre
m^3/d	Meter cube per day
masl	Meters above sea level
mbgs	Meters below ground surface
MEL	Minto Explorations Ltd
MEUG	Minto East Underground
ME2UG	Minto East 2 Underground
mg/L	Milligram per litre
MMER	Metal Mining Effluent Regulations
MN	Minto North
m/s	Meter per second
MSUG	Minto South Underground
MVFE	Mill Valley Fill Extension
MW	Monitoring Well
MWD	Main Waste Dump
MWDE	Main Waste Dump Expansion
MZUG	M-Zone Underground
OAMP	Operational Adaptive Management Plan
ORP	Oxidation-reduction potential
ROD	Reclamation Overburden Dump
RTUG	Ridge Top Underground

TDS	Total Dissolved Solids
SPT	Specific performance threshold
SWD	Southwest Dump
TU	tritium units
U/S	Upstream
VCDT	Vienna Cañon Diablo troilite
WLBM	Water and load balance model
WSP	Water Storage Pond

1 Introduction

Minto Explorations Ltd (Minto) retained SRK Consulting Inc. (SRK) to review and update the hydrogeological characterization, conceptual and numerical models for the Minto Mine, a high-grade copper mine located in the Yukon, approximately 240 kilometers (km) north of Whitehorse. An update to the hydrogeological conceptual and numerical models are required to be included in the updated Site Characterization Plan every three years, as required by Minto's Quartz Mining License QML-0001.

This report is organized with general background information related to the mine presented in Section 2, hydrogeological and hydrogeochemical data in Section 3, the hydrogeological conceptual model in Section 4 and the updated groundwater numerical model in Section 5. Data presented in Section 3 are current as of August 2021. If there were no changes to previous data or interpretations, results will be consistent with previous hydrogeological reports.

2 Background

2.1 Minto Mine Description

The Minto Mine is a high-grade copper and gold mine that processes both open-pit and underground ore using conventional crushing, grinding, and flotation to produce copper concentrates with significant gold and silver credits (Minto 2012).

The Project is found in the north-northwest trending Carmacks Copper Belt along the eastern margin of the Yukon-Tanana Composite Terrain. The belt is host to several intrusion related Cu-Au mineralized hydrothermal systems. The Minto Property and surrounding areas are underlain by plutonic rocks of the Granite Mountain Batholith of Early Mesozoic Age.
The batholith represented on the property is the Minto pluton and is predominantly of granodiorite composition. Hypogene copper sulphide mineralization is hosted wholly within this pluton in sub-horizontal horizons of structurally affected rock (Minto, 2012).

2.2 Minto Mine Catchment Descriptions

The Minto Mine is situated in the headwaters of Minto Creek and McGinty Creek (Figure 1), both of which drain northeast to the Yukon River.

- The Minto Creek catchment is characterized by moderate to steep slopes to the north, south, and west. The portion of the catchment occupied by the mine is known as Upper Minto Creek; it is defined as the catchment area topographically upgradient of the Water Storage Dam (SRK 2012). The portion below the Water Storage Dam contains no mine components and is known as Lower Minto Creek. The Upper Minto Creek catchment covers 10.4 km^2 of the 4,100 km^2 Minto Creek catchment.
- The McGinty Creek catchment is characterized by moderate to steep slopes to the south, east, and west. It has a total area of 34 km^2 where the creek intercepts the Yukon River.

The Minto North Pit is in the upper portion of the east tributary of McGinty Creek (11.4 km^2). The catchment area defined by the pit is about 0.12 km^2, including the pit.

2.3 Mine Layout

Figure 2 presents key components of the mine, as well as monitoring stations described in Section 2.7. The key features of the Minto Mine operations include:

- Four (4) open pits including Main, Area 2 (A2), Area 118 (A118) and Minto North (MN); the A2 pit is sub-divided into three stages, Stage 2, 3, and 4, abbreviated S2, S3, and S4.

  As of August 2021 the majoirty of space in the Main Pit and A2 Pit are filled with tailings, and the 118 Pit has been backfilled. The Minto North Pit has not been backfilled and is not used for waste deposition.

- An underground mine subdivided into six (6) zones: Area 118 (118UG), MZone (MZUG), Minto South (MSUG), Area 2 (A2UG), Minto East (MEUG), and Copper Keel (CKUG).

  As of August 2021, 118UG, MZUG, MSUG and MEUG have been mined, CKUG is under development and MEII and MNUG are in the process of being approved.

- Four (4) waste/overburden dumps including the Southwest Dump (SWD), the Reclamation Overburden Dump (ROD), the Main Waste Dump (MWD), and the Mill Valley Fill Extension (MVFE), the latter of which was designed as a buttress to mitigate the down-slope movement of the dry stack tailings storage facility.

- A dry stack tailings storage facility (DSTSF).

  Minto halted deposition of tailings to the DTSTF in November 2012 and transitioned to deposition of tailings in the Main Pit and A2 Pit. It is constructed on a reasonably continuous and thick permafrost layer (see Section 3.2.3)

- A water storage pond (WSP) with a maximum water storage volume of 320,000 m^3.

  The WSP was constructed in 2007 to be used initially as a source of process water for the mill. When the Main Pit was converted to a tailings management facility, it transitioned to function as a storage reservoir for clean runoff and treated water destined to be released into Minto Creek.

2.4 Water Management

Water is collected from the active mine areas, at surface and underground and conveyed to the tailings management facilities located in the Main Pit or the A2 Pit where it is stored and treated prior to release into the WSP. The treated water is either pumped to the WSP or released to lower Minto Creek when license conditions are met and water inventories warranted. For complete details on the site water management routings, the reader is referred to SRK (2021c).

2.5 Mining Sequence

Figure 3 represents the mining sequence and key water management actions on a time scale, and shows elevation time series of the pit bottoms, maximum underground depths, and levels of pits and WSP. The important dates of the mining sequence are listed below:

- The Main Pit was mined from early 2006 to mid 2011 to a final depth of 145 mbgs (715 masl). It was dewatered during this period and acted as a hydraulic sink. From mid 2011 to late 2012, water accumulated progressively to an elevation of 770 masl, and then from late 2012 to early 2015, tailings were also deposited. By the end of 2014 the tailings and water had reached approximately 785 masl and has since fluctuated by approximately 5 m. Since late 2019, water from the Main Pit is pumped to the Mill, and tailings transported to the A2 Pit.
- The A2S2 Pit was mined from early 2011 to mid 2015 to a final depth of 180 mbgs (685 masl). The A2S3 and A2S4 pits were mined from early 2017 to mid 2018 to a final depth of 110 mbgs (716 masl). Both the A2S2 Pit and A2S3/A2S4 pits were actively dewatered during mining and acted as hydraulic sinks; the pit water was pumped to the Main Pit. After the pits were excavated, tailings and water were intermittently deposited and water pumped from the Main Pit to the A2 Pits or vice versa. As of April 2021, the combined tailings and water level in the A2 Pits was approximately 785 masl. The A2S2 Pit began overflowing late 2019 to A2S3/A2S4. Water is recovered from the A2S4 Pit and pumped back to the Main Pit.
- The Area 118 Pit was mined between 2013 and 2014 to a final depth of 40 mbgs (868 masl); it was not actively dewatered as it produced little to no water.
- The Minto North Pit was mined from mid 2015 to late 2016 to a final depth of 105 mbgs (835 masl) and produced little water. Since 2016, it has accumulated precipitation, runoff, windblown snow, and groundwater. The current pit water level is at 855 masl, below the groundwater levels observed around the pit and therefore continues to act as a hydraulic sink.
- The underground developments have been active since Mid 2012, except between early 2014 and early 2015 (i.e., suspended until authorization for Phase V/VI obtained), and between November 2018 and August 2019 (i.e., temporary closure period). The mine water is actively collected in a sump and pumped to the A2 Pit (i.e., A2S2 or A2S3/A2S4) and therefore the underground mine acts as a hydraulic sink.

In terms of future development, Figure 4 shows the 2021 PEA mine plan, and Table 2.1 summarizes the expected schedule.

Table 2.1: Project Schedule

Period	Project Activities
2021 - 2022	Underground mining in Copper Keel, Area 2, and Minto North (pending permitting).
2022 - 2023	Underground mining in Minto East 2 (ME2UG).
2024 - 2025	Underground mining in Copper Keel and Ridgetop (RTUG).

2.6 Hydrogeological Studies

Various hydrogeologic studies have been conducted to characterize both the physical and chemical aspects of groundwater at the Minto Mine and contribute to the overall conceptual model of groundwater flow and transport. The main studies are summarized below:

Minto Mine Phase V/VI Expansion: Hydrogeologic Characterization Report (SRK 2013)

This study presented an early stage hydrogeologic conceptual model that characterized the groundwater flow regime of the Minto Mine site, addressed how groundwater likely moves through the site and how it is potentially impacted by mining activities.

Minto Mine Numerical Groundwater Model (SRK 2014d)

This study presented the initial numerical groundwater model of the Minto Mine site. The objectives were to evaluate the possible extent of a solute plume originating from the mine facilities, identify where groundwater is discharging into Minto Creek and evaluate the effect of the Minto North Pit development on mass loading to McGinty Creek. As a conservative measure, the model neglected permafrost due to uncertainty in exact distribution. It also included the assessment of a hypothetic high-conductivity fault zone along Minto Creek that would connect the identified sources of sulphate upstream and the property boundary. The plume of sulfate was further accentuated by considering sources had double the expected concentration (i.e., worst case evaluation).

The model predicted for base case conditions at post-closure that the concentrations and mass loads into the Yukon River would remain low (or negligible). The scenario simulating a high source concentration combined with a high-conductivity fault showed that: a) the concentrations observed downstream of the WSP in MW12-05 were anomalous and could not result from impacted water migrating off the mine site; and b) a solute plume would ultimately reach as far as the Yukon River, but at only about 30% of the source term concentrations.

Minto 2015 Groundwater Model Update (SRK 2015a)

This study presented an update to the original numerical groundwater model. It included a review of monitoring data, an update to the hydrogeologic conceptual model (i.e., permafrost, and bedrock surface elevations), and an update to groundwater numerical model (i.e., revised overburden and bedrock parameters, calibration to water levels and baseflow estimates as of September 2015 and modelling of permafrost and no-permafrost scenarios).

The model predicted the percentages of loads from each potential source reporting to Minto Creek or McGinty Creek. The study concluded seepages from the Southwest and Main waste dumps would mostly report to the open pits and underground mine; that the Main Pit acted as both a sink and a source, capturing water from upgradient areas, and yielding constituents moving towards and ultimately discharging into Minto Creek upstream of WSP; and that the seepages from the DSTSF moving via groundwater would discharge into the Minto Creek valley upstream of WSP.

Minto Mine Groundwater Monitoring Program – Environmental Tracer Study Results (SRK 2017)

This study presented the results of an environmental tracer study completed as a requirement of the Groundwater Monitoring Program under the water license QZ14-031. It included the analyses of stable isotopes of water (δ^2H and $\delta^{18}O$), sulphur isotopes $\delta^{34}S_{SO4}$, and tritium from a range of groundwater, surface water and seep monitoring stations across the site. The purpose of the δ^2H and $\delta^{18}O$ analyses was to identify groundwater recharge and/or surface water interactions, $\delta^{34}S_{SO4}$ to investigate if different sulphur sources could be identified, and tritium to establish groundwater age.

The report presented the study methods and results and the interpretations of the results were provided in the *Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report* (SRK 2018b).

Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report (SRK 2018b)

This study presented the data collected from the groundwater monitoring network until 2018 and an update to the conceptual groundwater flow conditions, transport conditions, and changes in groundwater quality since the mine has been in operation.

The additional monitoring data did not significantly change the hydrogeologic conceptual model. The system is characterized as a relatively low flow, low conductivity, fracture-controlled environment. The majority of flow is expected to occur relatively near ground surface, where not frozen. Two groundwater facies exist: a Ca-Mg-HCO_3 type associated with low TDS shallow groundwater, and a Ca-SO_4 type associated with high TDS mine sources or deep groundwater topographically downgradient of the ore bodies. Trends in conservative sulphate and chloride concentrations indicate the high sulphate pit waters have not migrated downgradient.

Analysis of the isotopic data suggested that modern, meteoric shallow groundwater is mixing with old, deeper groundwater. Due to the wide range of $\delta^{34}S_{SO4}$ values, no clear conclusion could be made, however it was noted that many of the deep groundwater monitoring zones identified with high sulphate concentrations in MW12-05 were generally outside the range determined for the Minto ore (i.e., -4 to +2‰, Tafti 2005).

Sulphate Exceedances in Groundwater at the Property Boundary - Response to the Yukon Water Board Request IR5-48 (SRK 2021a)

This memo addressed a request from the Yukon Water Board to describe and explain with supporting evidence the SO_4 exceedances in deep groundwater at the property boundary (i.e., elevated sulphate concentrations observed in MW12-05, near Minto Creek).

It presented a summary of the points supporting the hypothesis that the elevated sulphate concentrations are naturally occurring due to influence from the nearby sulfide-rich ore bodies, and not a result of mine activities. The points are provided below:

- Immediately after installation, the sulfate concentration in MW12-05-01 was higher than any potential mine-related sources. The isotopic signature in zones with elevated sulfate were not indicative of recent mixing with surface/mine site sources.
- There is no evidence of mapped structures in the deep groundwater system that would act as a flow conduit connected to the mine facilities, and no known conduits for the deep, high sulfate groundwaters to discharge to Minto Creek.
- The initial increase of sulfate concentration in MW12-05 was observed while the Main Pit was acting as a local sink for groundwater flow (i.e., until at least the summer of 2013, when the water levels in Main Pit rose above the groundwater levels downgradient of the pit).
- Both chloride and sulfate, which are assumed to be conservative tracers, can originate from the mine activities (i.e., chloride is present in the pit water and DSTSF seepages). If the high sulfate concentrations in MW12-05-01 originated from the pits or the DSTSF, the chloride concentrations would have also increased in groundwater; however, they have remained between 10 and 16 mg/L since installation, compared to concentrations as high as 30 to 40 mg/L in the pits.
- Sulfate concentrations in Minto Creek, roughly 4 km and 6 km downstream of MW12-05 show no indication of impact or significant changes.
- The solute transport numerical simulations could not reproduce the high sulfate concentration even when source term concentrations were hypothetically doubled and combined with a preferential conduit connected to the pits.

Minto Mine 2020 Groundwater Review and Summary of OAMP SPT Exceedances (SRK 2021b)

This report is the latest of a series of annual reports that summarizes the quarterly groundwater chemistry monitoring against the specific performance threshold (SPT) exceedances defined in the Minto Mine Operational Adaptive Management Plan (OAMP; Minto, 2017). In addition, SRK completed a review of groundwater chemistry across the whole site to evaluate the potential impacts of mining activities on groundwater and the associated risks for the McGinty Creek, Minto Creek, and the Yukon River.

In 2020, the groundwater exceedances of the OAMP SPTs were limited to a few parameters and consistent SPT exceedance were not widespread; most monitoring zones (~69%) had not exceeded more than one OAMP SPT.

In the Minto Creek catchment, ongoing exceedances included sulphate in MW12-05 (i.e., restricted to zones greater than 85 mbgs) and chromium in MW12-06 (i.e., restricted to the deepest zone at 142 mbgs). The source of deep elevated sulfate was interpreted to reflect natural deep conditions; no effects were observed in Minto Creek. The elevated chromium concentrations occurred concurrently to the stoppage of the Minto South Underground, and while contact water is not suspected to be the source of chromium, equilibrium conditions in the deep groundwater might have been affected, resulting in the observed changes in chemistry. As chromium exceedances were restricted to the deepest zone, and no effects were observed in Minto Creek, mitigation actions were not considered necessary.

In the McGinty Creek catchment, ongoing exceedances include arsenic in MW09-03-01 and cadmium, nitrate, and zinc in MW09-03-02. The elevated groundwater concentrations in MW09-03 cannot originate from the migration of Minto North Pit water because the pit continues to act as a hydraulic sink. The increase in nitrate concentrations, and maybe indirectly arsenic, cadmium and zinc, appear to be caused by a shift in redox conditions as equilibrium conditions were disrupted following mining of the Minto North Pit. Flushing of nitrogen-containing blast residuals from waste rock used to construct the Minto North haul road is another possible source. Concentrations in McGinty Creek remained in the range of observed baseline conditions with no observed changes that reflect an influence from mine-affected groundwater.

2.7 Groundwater Monitoring Network

Eight (8) active Westbay multilevel monitoring wells (i.e., 38 discrete monitoring zones) are periodically monitored across the site. Groundwater levels are measured, and groundwater samples collected for groundwater quality analyses as indicated in the groundwater monitoring plan presented in the Water Licence QZ14-031. The monitoring well zones target bedrock, or the overburden-bedrock contact, except the shallowest zone of MW12-06 (MW12-06-06) which targets solely overburden.

Table 2.2 provides a brief description of the active groundwater monitoring stations listed from upgradient areas to downgradient areas of the mine and Appendix A compiles detailed information on both historical and active monitoring wells. Figure 2 shows the monitoring well locations.

The well ID nomenclature is:

- The first two digits proceeding MW are the year of installation.
  Example: MW09-01 and MW12-06 were installed in 2009 and 2012 respectively.
- The two digits after the install year are a sequential well ID.
  Example: MW17-09 and MW17-10.
- If a monitoring well includes multiple zones (i.e., ports), two digits are added corresponding to the monitoring zones numbered sequentially from deepest to shallowest.
  For example: the individual zones of MW17-08 are (from greatest to shallowest depths): MW17-08-01, MW17-08-02, MW17-08-03, MW17-08-04.

Table 2.2: Groundwater Monitoring Well Descriptions

Station ID	Description	Category
MW17-08	Upper Minto Creek catchment, near the western limit of the Minto Creek catchment.	Active MW, Background
MW11-04a	Upper Minto Creek catchment, ridge top area.	Historical MW (2) Background
MW09-03, MW17-11	McGinty Creek catchment, downgradient of the Minto North Pit.	Active MW (3), Downgradient of Mine
MW17-10	Upper Minto Creek catchment, between the Main Waste Dump and the Main Pit, downgradient of the Main Waste Dump.	Active MW, Downgradient of Mine
P39E	Upper Minto Creek catchment, within the footprint of the Main Pit.	Historical MW (1) Background
MW12-07	Upper Minto Creek catchment, between of the Main Pit and the mill, immediately downhill from Main Pit, near the mill.	Active MW, Downgradient of Mine
MW12-06	Upper Minto Creek catchment, Minto Creek valley, between the DSTSF and the WSP, down gradient of pits, underground, waste dumps, Mill area, DSTSF, and MVFE.	Active MW, Downgradient of Mine
P94-20	Upper Minto Creek catchment, within the footprint of the Water Storage Pond.	Historical MW (1) Background
MW12-05, MW17-12	Lower Minto Creek catchment, Minto Creek valley, downgradient of WSP, and all mine operations.	Active MW, Downgradient of Mine

Note:

1 P39E and P94-20 were conventional standpipe piezometers installed in the 1990s. Both wells no longer exist because they were within the footprint of developed mine components. Minimal well construction data exists for these wells.

2 MW11-04a is a conventional standpipe piezometer. Groundwater levels were collected between June 2012 and October 2015; and groundwater quality between May 2012 and 2017.

3 MW09-03 provides five years of baseline data before the mining of Minto North occurred.

During installation of the 2017 monitoring wells, bromide was used as a tracer to evaluate development. In 2017, MW17-08-01, MW17-10-01, MW17-11-01 and -02 were considered not fully developed based on their bromide concentrations. As bromide is not part of the regular analysis package, it has not been evaluated since. Development status will be updated in the next round of groundwater sampling with new analyses of bromide concentrations.

2.8 Surface Water Monitoring Network

A subset of the actively monitored surface water stations are used throughout this report for the analysis of the mine water flows and/or comparisons to the groundwater hydrogeochemistry. These were selected because they are considered as potential sources of water constituents (i.e., open pits) or locations affected by groundwater discharges (Minto Creek and McGinty Creek) and include sufficient data to assess trends over time.

Table 2.3 provides a description of the selected stations; Figure 2 shows their locations.

Table 2.3: Surface Station Descriptions

Station ID	Description	Category
UG1	Minto South [(1)] Underground Mine dewatering sump	Underground mine infrastructure
UG4	Minto East Underground Mine dewatering sump	Underground mine infrastructure
W14	Tailings Thickener Overflow	Surface mine infrastructure
W12	Main Pit	Surface mine Infrastructure
W45	A2 Pit	Surface mine infrastructure
W8A [(2)]	Dry Stack Tailings Storage Facility drainage	Surface mine infrastructure
W16	Water Storage Pond	Surface mine infrastructure
W3	MMER [(3)] final discharge point (Minto Creek)	Minto Creek
W7	North flowing tributary to Minto Creek	Minto Creek
W6	South flowing tributary into Minto Creek	Minto Creek
W46	Minto Creek downstream of W7 and W6	Minto Creek
MC1	Minto Creek, at Minto Canyon	Minto Creek
MN-1.5	Upper East Arm of McGinty Creek downstream of Minto North Pit	McGinty Creek
MN-2.5	East Arm of McGinty Creek just U/S confluence with West Arm	McGinty Creek
MN-4.5	Main Stem of McGinty Creek near confluence with Yukon River	McGinty Creek

Note:

1. Area 118 and Copper Keel.
2. W8A has been dry since 2019. It was considered representative of the seepages originating from the DSTSF underdrains because permafrost stops vertical drainage to deeper groundwater.
3. MDMER: Metal and Diamond Mining Effluent Regulations

2.9 Temperature Monitoring Network

Ground temperature measurements have been collected from a network of 55 stations in the Upper Minto Creek catchment. The stations are located within the footprints or proximity of the dumps, A2 Pit, the DSTSF, or the MVFE. Out of the 55 stations 12 are actively monitored and 33 were decommissioned because of the mining activities at surface. A map of the ground temperature monitoring stations (Figure 10) is provided in Section 3.2.3 with the interpreted distribution of frozen ground.

3 Hydrogeology and Hydrochemistry Data

3.1 Summary of the Groundwater Monitoring Data

Table 3.1 summarizes the available monitoring data collected by SRK as of August 2021, listed from upgradient areas to downgradient areas of the mine.

Table 3.1: Summary of the Monitoring Data

Location	Groundwater Levels or Flow	Groundwater Quality
Upper Minto Creek catchment, near the western limit of the Minto Creek catchment.	**MW17-08** 4 monitored ports. Time range: Aug 2017 to Oct 2020. Downward vertical gradient. • Levels in all ports are higher than the mine components and higher than the water levels in Main Pit and A2 Pit. The time series show no visible effects from mine activities. Levels seem fluctuate seasonally although this remains uncertain as monitoring in this well started recently. Lows were recorded in May 2018 and Mar 2020; Highs in Oct 2018. There was no low-level period observed in 2019.	**MW17-08** 4 monitored ports. Time range: Aug. 2017 to October 2020. • Groundwater chemistry in this well is considered background with no impacts from mining activity. No increasing trends have been noted.
Upper Minto Creek catchment, ridge top area.	**MW11-04A** Standpipe. Time range: Jun 2012 to Oct 2015. • Limited dataset. Provide an indication of the water level in this area.	**MW11-04A** Standpipe. Time range: May 2012 to May 2017. • Groundwater chemistry in this well is considered background with no impacts from mining activity. No increasing trends were noted while active. pH values were considerably higher than elsewhere on site with values that exceeded 11 during every monitoring event. The source of elevated pH was never resolved.
McGinty Creek catchment, downgradient of the Minto North Pit.	**MW09-03** 2 monitored ports. Time range: Jun 2014 to Dec 2020. Downward vertical gradient. • From Jun 2014 to Mar 2016 water levels declining from 905 to 897 masl, at the estimated time the MN Pit reached under the pre mining groundwater table, which suggests the Minto North pit had a local influence on the groundwater flows. After Mar 2016, levels in all ports relatively stable, similar levels, and seasonal variations. Lows between Mar and May; Highs between Sep and Oct. **MW17-11** 5 monitored ports. Time range: Aug 2017 to Oct 2020. Downward vertical gradient. • Levels relatively stable. Only shallowest port (#5) shows imprints of seasonal variations. Large differences between ports: average level 883.7 masl at Port #1, 858.8 masl at Port #2, 883.8 masl at Port #3, 882.6 masl at Port #4, and 896.3 masl at Port #5. Upward vertical gradient from Port #1 to #2, and downward from Port #5 to #2. It is hypothesized that the bedrock in the MN area is relatively tight with fractures having variable interconnections, and that the monitoring Port #2 is better connected to open fractures intersecting the MN pit walls.	**MW09-03** 3 monitored ports. Time range: Dec 2009 to Mar 2021. • Cd, Zn, and nitrate consistently exceed SPTs in MW09-03-02. Trends are consistent with changes in water levels which occurred during the mining of the Minto North Pit, which may have upset redox equilibrium in the system. Nitrate may also be sourced from blast residuals in rock used to construct the haul road. • Arsenic consistently exceeds SPTs in MW09-03-01. **MW17-11** 5 monitored ports Time range: Aug 2017 to Oct 2020. • As is increasing in the deepest monitoring zones. The Minto North Pit currently acts as a hydraulic sink and groundwater trends are not thought to be caused by pit water seepage. MW17-11-01 and MW17-11-02 were not fully developed after installation, due to low hydraulic conductivity of the rock. Increasing As values may be stabilizing as the wells reach equilibrium.
Upper Minto Creek catchment, between the Waste Dump and the pits, downgradient of the dumps.	**MW17-10** 3 monitored ports. Time range: Aug. 2017 to Oct 2020. Downward vertical gradient. • From Mar 2018, levels in all ports relatively stable, with similar levels, and no visible seasonal variations or trends. It is not possible to evaluate how groundwater levels changed compared to pre-mining conditions since this well was installed after the Main Pit had been completed.	**MW17-10** 4 monitored ports. Time range: Aug 2017 to Mar 2021. • Se and nitrate are increasing in the two deepest monitoring zones and due to its proximity to the Main Waste Dump may be affected by mining activities.
Upper Minto Creek catchment, within the footprint of the Main Pit.	**P39E** Standpipe. No level data.	**P39E** Standpipe. Time range: Sep 1994 to Mar 2006. • Groundwater chemistry in this well is considered baseline. As it was decommissioned before mining began, it has no impacts from mining activity.
Upper Minto Creek catchment, between of the Main Pit and the mill, immediately downhill from Main Pit, near the mill.	**MW12-07** 3 monitored ports. Time range: Oct 2012 to Oct 2020. Downward vertical gradient. • Groundwater levels shows the influence of the pits and, more recently, the underground developments. When this well was installed in 2012, groundwater was at about the same elevation as the water in the Main Pit. After 2012 the Main Pit level rose higher, potentially shifting from a sink to a source, and during the same period, the A2S2 pit was excavated hence replacing the Main Pit as hydraulic sink. Both activities affected the levels, which first started declining and then returned approximately to their initial levels. Between Sep 2017 and May 2018, while underground development access was being advanced from A2UG to MEUG, the levels dropped significantly (approx.10m in Port #2 and #3, and 70m in Port #1) and have been stable since. These observations show the	**MW12-07** 2 monitored ports. Time range: Nov 2012 to Mar 2021. • As, Zn and nitrate are increasing in MW12-07-01 and Cd, Cu, Se, Zn and nitrate in MW12-07-02. Major changes in the observed chemistry coincide with the changes in water levels observed when the underground developments were being advanced. While the underground workings are considered a sink, the changes in flow dynamics and subsequent equilibrium conditions may have influenced chemistry in MW12-07-01 and MW12-07-02.

Location	Groundwater Levels or Flow	Groundwater Quality
	large water bodies in Main Pit and A2 Pit have a limited but visible effect on groundwater levels within relatively proximity and confirm that the underground mine acts as a local hydraulic sink for the groundwater system.	
Upper Minto Creek catchment, underground mine developments.	**UG1 (or W44), UG4** 2 monitored stations. Time range: Feb 2015 to Dec 2020 with a gap between Nov 2017 and Nov 2019. • From 2012 to 2015, the underground mine had intercepted little inflows. Between 2015 and 2017, the inflows ramped up to about 260 m^3/d. In 2020, it had increased to an average of approximately 1,700 m^3/d early in 2020, and 2,600 m^3/d at the end of 2020. At this time, underground had progressed in all areas, and at surface, tailings and water had been deposited in the Main Pit, A2S3 Pit, and A2S3S4 Pit. Analyses of isotopic and general chemistry of selected inflows show the pit infiltration is the primary contributor of inflow to the Minto East underground, and deep old groundwater to the Copper Keel underground.	**UG1** Minto South/Copper Keel Discharge. Time range: Aug 2015 to Mar 2021. • Chemistry has a mixed signature of various groundwater sources and is somewhat variable over time depending on the area of the mine that is receiving inflow. SO_4 concentrations are in the range of deep groundwaters downgradient of the ore bodies and elevated chloride at times suggests some influence of pit infiltration. **UG4** Minto East UG Discharge. Time range: Jun 2018 to Mar 2021. • Chemistry is a mixture of groundwater and pit water infiltration from the overlying open pits. SO_4 concentrations are in a similar range to UG1 but with consistently higher chloride concentrations, suggesting a higher component of pit infiltration than UG1.
Upper Minto Creek catchment, along Minto Creek, between the DSTSF and the WSP, down gradient of pits, underground, waste dumps, Mill, DSTSF, and MVFE.	**MW12-06** 6 monitored ports. Time range: May 2014 to Oct 2020. Upward vertical gradient. • Levels do not show seasonal trends however the variations in some of the ports (i.e., Port #1 and #6) correlates with the fluctuations of water levels in the WSP. This suggests some ports have a better hydraulic connection via fractures with the WSP compared to others. vertical upward gradient towards Minto Creek. The levels have also declined by about 2 to 3 m in all ports since it was installed and is interpreted as an effect of the depressurization cone spreading around the underground developments of CKUG and MEUG, possibly via preferential fractures. Overall, the vertical gradient is upward towards Minto Creek.	**MW12-06** 6 monitored ports. Time range: Nov 2012 to Mar 2021. • Al, As, Se, NH_3 and SO_4 are increasing in the deepest monitoring zone. Sulphate concentrations are generally <500 mg/L, lower than half the concentrations detected in MW12-05 and MW17-12, further downgradient. • Cr consistently exceeds SPTs but is not increasing. • Chemistry in the deepest monitoring zone is unique to the shallower zones and shows evidence of localized effects of underground mining. While the underground workings are considered a sink, the changes in flow dynamics and subsequent equilibrium conditions may have had an effect on chemistry in MW12-06-01.
Upper Minto Creek catchment, within the footprint of the Water Storage Pond.	**P94-20** Standpipe. No level data.	**P94-20** Standpipe. Time range: Sep 1994 to Jun 2006. • Groundwater chemistry in this well is considered baseline. As it was decommissioned before mining began, it has no impacts from mining activity.
Lower Minto Creek catchment, Minto Creek valley, downgradient of WSP, and all mine operations.	**MW17-12** 7 monitored ports. Time range: Aug 2017 to Oct 2020. Upward vertical gradient. • Levels are relatively stable, showing no seasonal variations. Alike MW12-06, the levels declined by about 1 to 3 m but only in the lower ports #3, #2, and #1. This is interpreted as an effect of the depressurization cone spreading around the underground developments of CKUG and MEUG, possibly via preferential fractures. Overall, the vertical gradient is upward towards Minto Creek. **MW12-05:** 6 monitored ports. Time range: May 2014 to Oct 2020. Upward vertical gradient. • All ports are generally stable, showing seasonal fluctuations in all its ports, with, lows generally occurring around Oct, and highs around Apr. This is interpreted by a stronger influence from the recharge cycle in the deep groundwater system, and a possible disconnection with surface and the Minto Creek. There is no significant trend in MW12-05. The levels may have risen a bit (about 0.5 m) between 2014 and 2017, then fluctuations have been relatively stable.	**MW12-05**: 7 monitored ports. Time range: Nov 2012 to Mar 2021. • SO_4 has been increasing in most monitoring ports since installation in 2012 but at a slower rate since 2017 and is characteristic of recovery following installation. SO_4 consistently exceeds SPTs in the two deepest monitoring ports but is believed to be naturally occurring in the deep groundwater downgradient of the ore bodies. **MW17-12**: 8 monitored ports. Time range: Aug 2017 to Mar 2021. • Chemistry is similar to MW12-05 with elevated SO_4 concentrations in the deepest monitoring zones. Some trace elements (As, Se, Zn) are increasing in the deepest monitoring zones but may still be reaching equilibrium following installation and development.

Notes:

Time range refers to data available for this assessment. All wells with data up to March 2021 are active.

MW09-03, MW12-05 and MW12-06 are the only wells monitored for SPT exceedances as per the OAMP. SPTs do not apply to the remaining monitoring wells.

3.2 Hydrostratigraphy

Hydraulic conductivity (K) has been measured at different locations across the site through a combination of packer tests, slug tests and recovery tests following airlift well development. The K database includes 62 data points. Figure 5 presents distribution histograms of the K data and a plot of the K value with depth. Appendix B compiles the monitoring well logs.

The hydrostratigraphy of the project comprises two units: (1) overburden, which is spatially discontinuous but thick along the valley bottoms, and (2) bedrock, where hydraulic conductivity is relatively low, and groundwater occurs in secondary permeability along joints and fractures. Permafrost is observed and expected to occur within the overburden unit, on north-facing slopes and valley bottoms, but the spatial distribution is not well constrained. The majority of the groundwater flow is expected near the ground surface in the absence of permafrost, which acts as an aquiclude.

3.2.1 Overburden

The characteristics and spatial distribution of the overburden were determined from drilling information (MEL drillhole data received on Sep 2020), hydrogeological studies (SRK 2013, 2014b, 2015), interpreted bedrock surface at the Minto Mine Site (SRK 2014a), and aerial photo interpretation (Figure 6, SRK 2014c).

The overburden has been subjected to multiple processes across the site, with fluvial and glacial processes controlling much of the deposition and erosion. It consists predominately of weathered bedrock, colluvial veneer, and morainal till veneer. Colluvial and morainal units are commonly discontinuous and inferred to be <1 m thick, with less extensive areas of exposed bedrock. Local drainage valleys are characterized by alluvial sediments modified or deposited by fluvial processes. At some valley locations, lacustrine units consisting of fine-grained sediments are present. Lacustrine sediment deposits are observed to be locally eroded by more recent fluvial action. Fill has also been placed in the mine's central area near the Main Pit, the mill, the administration, and the camp buildings and extends up to approximately 10 m below current ground surface. The estimated overburden thicknesses are mapped in Figure 7 for the pre-mining conditions. In general, overburden thickness is least along topographic highs or ridgelines, and increases towards valley bottoms.

The ridge tops are typically dominated by sandy, residual soils grading to weathered bedrock. It is generally observed that fine weathering products have been washed down slope, so sandy silts and clays are found in valley bottoms (SRK 2014b). At MW11-04, overburden is only about 1.5 m thick. At MW09-03 and MW17-11, topographically downgradient of the Minto North Pit, overburden is about 3 m and less than 7 m thick, respectively, based on casing depths and logging for these wells (no details are available for overburden material characteristics due to drilling method).

In valley bottoms, the overburden thickness ranges between 20 m to over 90 m. A key feature is a paleochannel that diverges from the topographic valley bottom on the west side of the DSTSF and trends in a northeast-southwest direction parallel to but southeast of, the topographic Minto

Creek valley. Topographically upgradient of this channel, below the Southwest Waste Dump, overburden is characterized by interbedded silty sand, silt and sand, most of which is frozen (refer to Section 3.2.3 and lithologic logs included with thermal data in Appendix C). In the paleochannel itself, overburden is nearly 100 m thick and characterized by interbedded sand, silt, gravel, and clays. An ice-rich clay layer exists at depths between 26 to 64 mbgs, in which local shearing occurred leading to previous instability of the DSTSF. Drill logs indicate that this clay layer typically overlies weathered bedrock or thin sandy units over bedrock. Thermal data indicates most overburden in this area is frozen (refer to Section 3.2.3).

Based on literature (Beale 2013, Gupta 2010), the hydraulic conductivity is expected to range as listed below:

- Minto Creek and McGinty Creek channel: $1x10^{-5}$ to $1x10^{-2}$ m/s (i.e., clean sand and gravel).
- Alluvium, colluvium: $1x10^{-7}$ to $1x10^{-4}$ m/s (i.e., fine sand and silty sand).
- Lacustrine, morainal till: <$1x10^{-9}$ to $1x10^{-5}$ m/s (i.e., slit/clay).

Hydraulic field testing of the overburden is limited to one test in frozen overburden. The test measured a low K value of $6x10^{-9}$ m/s, which is indicative of the low permeability effect permafrost has on overburden.

3.2.2 Bedrock

The Minto Mine site is underlain predominantly by igneous rocks of granodiorite composition. The granodiorite is generally categorized based on textures which are associated with foliation and crystal size. Rock texture ranges from massive granodiorite to foliated granodiorite, with foliated granodiorite typically characterized by increased biotite content. The biotite-rich foliated granodiorite hosts mineralized zones of copper sulphide. Crystal textures range from equigranular to porphyritic.

The other observed minor lithologies consists of small dykes of simple quartz-feldspar pegmatite, aplite, and an aphanitic textured intermediate composition rock. Bodies of these units are relatively thin and rarely exceed one-meter core intersections. The dykes are relatively late, generally postdating the peak ductile deformation event; however, some pegmatite and aplite bodies observed in a rock cut located north of the mill complex are openly folded. There has been evidence of conglomerate and volcanic flows in drill core by past operators, and that a conglomerate unit is bearing local granodiorite pebbles across much of the southern part of the project area.

There is evidence of regional and local geological structures, but these have not been mapped across the entire site. Their position is best delineated in the vicinity of the open pits and the underground mine. MEL provided a lineament analysis (Figure 8) completed in 2008 and 3D surface of the geological structures identified across the site (Figure 9).

The majority of groundwater flow through the granitic bedrock is via fractures and joints within the rock mass. The granodiorite hosting the mineralization is foliated, with biotite-rich shear zones, which could influence the water movements. Observations of drill core indicate bedrock generally has tight fractures or fractures filled with weathered material including clay and hematite (SRK 2013). Geological structures can impact the groundwater flows if they have a higher or lower hydraulic conductivity than that of the surrounding rock, and/or contribute to the underground inflows. The behaviours of the individual structures identified on site are uncertain. The Minto East Fault is the only one which is known to be water bearing and was the main source of inflow while Minto East was being actively mined. Figure 9 show the geological structures identified by MEL and located within proximity of underground point sources of high, consistent inflows (See Section 3.4.1 and Figure 17).

Estimates of hydraulic conductivity in bedrock range between $4x10^{-9}$ and $8x10^{-6}$ m/s, with a geometric mean of $9x10^{-8}$ m/s (n=59). While scattered, a general trend of decreasing hydraulic conductivity with depth is noted (SRK 2015). Test zones of fresh jointed rock does not exhibit increased hydraulic conductivity when compared to weathered and infilled joints, suggesting that jointing is not well connected through the rock mass (SRK 2013). Hydraulic testing at MW12-06 was conducted across a fault zone, characterized with over 1 m of completely altered clay material. It yielded a hydraulic conductivity of $4x10^{-7}$ m/s.

3.2.3 Permafrost

Discontinuous permafrost is present across the site. Distribution is not known precisely for the entire site, but permafrost is more likely to occur on north aspects and in valley bottoms, while not present on south aspects or on ridge tops. Figure 10 shows the interpreted distribution of discontinuous permafrost based on studies by EBA (2011), site thermal data (Appendix C), ground observations, and air photo interpretation.

The west to east trend of the upper Minto Creek valley bottom[1] generally coincides with the permafrost region. The north facing slopes (at the southern edge of the property) have geomorphic features and vegetation suggesting the presence of permafrost or discontinuous permafrost, except along the crests of the ridges which are expected to be free of permafrost. The south facing slopes and ridges are permafrost -free, although there are localized occurrences that typically coincide with local valley bottoms where thicker organic-rich soils have accumulated.

Where ground is permanently frozen, it is rarely colder than -2º C and often warmer than -1º C. The frozen ground is expected to act as a barrier to the vertical infiltration of water, or for upwelling of any deeper water; flow within the active zone (shallow zone affected by seasonal temperature fluctuations) will not move vertically downwards through the permafrost. Likewise, permafrost act as a confining unit for any flow below the permafrost.

The thermistor DST-13, 200m northeast of the DSTSF and within the paleochannel, indicates sub-zero temperatures to a depth of about 67 mbgs (i.e., weathered bedrock is at approximately 90 mbgs). The monitoring wells MW11-02 and -03, in the ridgetop area, south of the A2 Pit, are frozen.

[1] from topographically downgradient of the Southwest Waste Dump, past the mill and administration buildings, the DSTSF, and along the north facing slopes of the Minto Creek drainage, upstream of the Water Storage Dam.

Ground temperature data shows permafrost is warm (0° to -1°C) at the eastern toe of the Southwest Waste Dump (to depths greater than 50 m in overburden and into the underlying bedrock, and in the paleochannel below the DSTSF (to depths greater than 60 m, typically to the depth of, or slightly deeper than, the clay layer reported between 26 to 64 mbgs; see Section 3.2.1).

North of the paleochannel, in the Minto Creek valley, permafrost appears to terminate. At MW12-06 (in the Minto Creek valley topographically upgradient of the Water Storage Pond) ground temperatures are positive; permafrost is not present.

3.3 Groundwater Levels

Water level observations are collected at the monitoring wells, pits, and the water storage pond. General statistics of the groundwater level data are presented for each monitoring wells and individual ports in Appendix D.

The site groundwater levels in the Minto Creek Catchment range from 924 masl (i.e., MW17-08, west of the mining activities) to 661 masl (i.e., MW12-05, downgradient of the WSP). Levels are between 0.5 and 9 mbgs in monitoring wells topographically upgradient of the mine footprint (MW17-08) and close to Minto Creek (MW12-06, MW12-05, and MW17-12), while greater than 10 mbgs in wells closer to the pits (MW09-03, MW12-07, MW17-10, and MW17-11; MW17-10 is the deepest at 70 mbgs). Figure 11 to Figure 14 show the groundwater level time series for each monitoring well, overlaid with bottom elevations of pits/underground developments, and/or water levels of pits/WSP to identify the potential influences from mining activities.

Figure 15 presents a spatial interpolation of the groundwater levels. Groundwater flow follows topographic gradients overprinted by the effects of the pits. Overall, groundwater flows towards the Minto Creek valley and ultimately the Yukon River. The pits act as both a hydraulic sink and source for groundwater. The Main Pit and A2 Pit receives groundwater from the north and west uphill directions and discharges on the east and south towards Minto Creek. The MN Pit receives groundwater from the north and may be discharging south towards the Main Pit.

3.3.1 Upgradient background monitoring wells

(MW17-08, MW11-04a, Figure 11)

Groundwater levels in MW17-08 (avg. 919.8 masl, standard deviation 1.3 m) and MW11-04a (avg. 860.4 masl, standard deviation 4.1 m) are higher than the mine components, and higher than the water levels in Main Pit and A2 Pit.

The MW17-07 time series show no visible effects from mine activities. Levels seem fluctuate seasonally but monitoring in this well started only recently. Lows were recorded in May 2018 and March 2020; Highs in October 2018. There was no low-level period observed in 2019.

The MW11-04a time series is limited. It informs on the groundwater elevation in this area but cannot be used to interpret seasonal patterns or potential changes caused by mining activities.

3.3.2 Monitoring wells downgradient of the Minto North Pit

(MW09-03, MW17-11, Figure 12)

The Minto North Pit was completed in late 2016 and has since accumulated water from runoff, trapping and subsequent melting of wind-blown snow, and minor groundwater inflows. The pit water has remained at a low level, approximately 20 m (855 masl) above the pit bottom elevation (835 masl), while groundwater in MW09-03 and MW17-11 located downgradient of the MN Pit, persisted at elevations (859 to 901 masl) above the water in the pit. The fact that groundwater levels north of (and downhill from) the pit remain higher than the pit suggests the pit is acting as a local hydraulic sink.

Groundwater levels in the two ports of MW09-03 are almost identical. The average level and standard deviation in Port #2 ('mid' monitoring zone 24.4 mbgs) are respectively 891.8 masl and 3.7m, and in Port #1 (38.1 mbgs) 892.1 masl and 3.6 m. Around January 2016, at the estimated time the MN Pit reached under the pre-mining groundwater table, a drop of about 8 m suggests the Minto North pit had a local influence on the groundwater flows. It should be noted however that there were only six measurements in each port before February 2016, therefore a data bias is possible. After this initial period, seasonal variations and levels were relatively stable, with lows generally occurring before the spring freshet, and highs between August and October.

MW17-11 is only about 15 m apart from MW09-03 but groundwater levels measured in its five ports are different. Levels are relatively stable and shows no drop or decreasing trend. Only the shallowest port (#5) shows imprints of seasonal variations, with lows before the spring freshet, and highs in October. The average level and standard deviation in Port #5 (15.5 mbgs) are 896.3 masl and 1.5 m; in Port #4 (58.8 mbgs), #3 (75.6 mbgs), and #1 (96.9 mbgs) average is between 882.6 and 883.8 masl and standard deviation 2 to 2.8 m, and in Port #2 (40.5 mbgs) 858.8 masl and 2.1 m. This suggests a vertical gradient towards Port #2. It is hypothesized that the bedrock in the MN area is relatively tight with fractures having variable interconnections, and that the monitoring Port #2 is better connected to open fractures intersecting the MN pit walls.

3.3.3 Monitoring wells within the active mine footprint, downgradient of dumps, pits and/or underground mine

(MW17-10, MW12-07, Figure 13)

MW17-10 is within the footprint of the Main Pit, to the west. MW12-07 is topographically downgradient of the Main Pit and Area 2 pits (i.e., approximately 250m east of the Main Pit and 400m northeast of the A2 Pit), and also close to the Minto East underground (i.e., at depth, MW12-07 is approximately 225 m from the MEUG developments). Between 2011 and 2015, water and tailings were deposited into the Main Pit and accumulated progressively to an elevation of approximately 785 masl. The developments of underground access from A2UG to MEUG started in 2018.

Groundwater levels in MW17-10 are relatively stable, above Main Pit water elevations, and show no seasonal variations or significant trends. It is not possible to evaluate how groundwater levels changed compared to pre-mining conditions since this well was installed after the Main Pit had been completed. The average level and standard deviation in Port #3 (61,2 mbgs) are 806.3 masl and 0.2 m, in Port #2 (74.8 mbgs), 805.6 masl and 5.3 m, and in Port #1 (85.5 mbgs), 805.3 masl and 5.8 m.

Groundwater levels in MW12-07 (3 ports) have been affected by the pits and, more recently, by the underground developments. When this well was installed in 2012, groundwater levels in all ports (i.e., between 762.1 and 763.7 masl) were at about the same elevation as the water in the Main Pit (762.9 masl). After 2012, the Main Pit level rose higher than the groundwater levels in the MW12-07 area, shifting the influence of the Main Pit to the groundwater system from a hydraulic sink (i.e., flow towards the pit) to a source (i.e., flow from the pit towards the Minto Creek valley downhills). During the same period, the A2S2 pit was excavated and replaced the Main Pit as hydraulic sink. As a result, effects from higher water elevations in Main Pit were attenuated and rather than increasing, the groundwater levels in MW12-07 declined slowly by for about a year (i.e., approximately 3m in the deepest port). In 2015, the declining trend reversed. The A2S2 pit had been fully excavated in 2014 and started being filled with tailings and water in early 2015. The combined influences from the Main Pit and A2S2 Pit caused a slow increase to the levels in MW12-07; in 2016/2017 they had approximately returned to their initial levels. These observations show the large water bodies in Main Pit and A2 Pit have a limited but visible effect on groundwater levels within relatively close proximity. In mid-2017, the levels in all ports dropped significantly while underground development access was being advanced from A2UG to MEUG. Two events are distinguished. A first event in Sep/Oct 2017 where Port #3 (76.6 mbgs), Port #2 (101 mbgs), and Port #1 (133 mbgs) dropped respectively by 7 m, 8m, and 30 m; and a second event in March 2018 where they dropped by 4 m, 2m, and 46 m. These events confirm that the underground mine acts as a local hydraulic sink for the groundwater system.

3.3.4 Monitoring wells along Minto Creek, downgradient of dumps, Pits and/or underground mine, Mill area, DSTSF, and MVFE

(MW12-06, MW17-12, MW12-05, Figure 14)

MW12-06, MW17-12, MW12-05 are located along the Minto Creek valley. MW12-06 is topographically upgradient, 200 m west of the Water Storage Pond. MW 17-12 and MW12-05 are topographically downgradient, 400 and 500 m east respectively of the WSP. Each well has multiple ports ranging in depth from a minimum of 14.9 to a maximum of 142.8 mbgs.

The WSP was filled mid-2017 and has fluctuated since between 705.9 and 716.3 masl; average level is 712.1 masl with a standard deviation of 2.3 m. Currently, the level is at approximately 710 masl.

The average groundwater levels range in MW12-06 from 714.3 to 717 masl with standard deviations between 0.7 and 1.9 m; in MW17-12 from 669.4 to 673.8 masl with standard deviations between 0.2 and 0.8 m; and in MW12-05 ranges from 662.2 to 662.9 masl with standard deviations between 0.6 and 0.9 m. In all three wells, the levels in the shallowest ports are lower than in the deepest ports, which indicates a vertical upward gradient towards Minto Creek.

In terms of annual variations, MW12-06 and MW17-12 do not show seasonal trends however the variations in some of the ports of MW12-06 (i.e., Port #1 and #6) correlates with the fluctuations of water levels in the WSP. This suggests some ports have a better hydraulic connection via fractures with the WSP compared to others. Only MW12-05 shows seasonal trends in all its ports, with, lows generally occurring around October, and highs around April. This is interpreted by a stronger influence from the recharge cycle in the deep groundwater system, and a possible disconnection with surface and the Minto Creek.

Finally, an overall declining trend is noted in MW12-06 and MW17-12. Groundwater levels declined by about 2 to 3 m in all ports of MW12-06 since it was installed, and by about 1 to 3 m in MW17-12, but only in its lower ports #3, #2, and #1. It is hypothesized that this is the result of the depressurization cone spreading around the underground developments of CKUG and MEUG, possibly via preferential fractures.

There is no significant trend in MW12-05. The levels may have risen a bit (about 0.5 m) between 2014 and 2017, then fluctuations have been relatively stable.

3.3.5 Vertical Groundwater Gradients

Water pressure data from the different zones in the monitoring wells provide information on vertical hydraulic head gradients in each area. The observed vertical hydraulic gradients across the site are summarized in Table 3.2.

Table 3.2: Vertical hydraulic head gradient direction

Well ID	Location	Vertical Hydraulic Head Gradient
MW17-08	Topographically upgradient background well	Downward vertical gradient between Ports #3, #2 and Port#1. (approx. $-6x10^{-3}$ to $-1x10^{-2}$ between Port #3 and #2, and Port #1).
MW09-03	Topographically downgradient of Minto North Pit	Downward vertical gradient (approx. $-7x10^{-3}$ to $-5x10^{-2}$ between Port #2 and Port #1).
MW17-11	Topographically downgradient of Minto North Pit	Downward vertical gradient between Ports #5, #4, #3 and Port #2 (approx. -0.7 to -1.7), and upward vertical gradient between Port #1 to Port #2 (approx. 0.9).
MW17-10	Between Main Waste Dump and Main Pit	Downward vertical gradient (approx. $-3x10^{-3}$ between Ports #1, #2, and Port #3).
MW12-07	Between Main Pit and Mill	Downward vertical gradient (up to -0.1 between 2012 and mid-2017, and up to -1.9 since mid-2017 between Ports #3, #2 and Port #1).
MW12-06	Topographically downgradient of pits; upgradient of WSP	Upward vertical gradient (from $7x10^{-3}$ up to 0.2 between Ports #5 to #1 and Port #6).
MW17-12	Topographically downgradient of WSP	Overall, upward vertical gradient (between $1x10^{-2}$ and $4x10^{-2}$), and locally downward between Port #3 and Ports #1, #2 (approx. $-9x10^{-3}$ and $-5x10^{-2}$ respectively), and between Port #1, and Port #2 (approx. $-4x10^{-2}$).
MW12-05	Topographically downgradient of WSP	Downward vertical gradient (approx. $-5x10^{-3}$ between Port #7 and Port #1).

Note:

Downward vertical gradient < 0, and upward > 0

3.4 Groundwater Discharges

3.4.1 Groundwater Inflows to Underground

Underground inflow rates are monitored at two sumps; the station UG1 (previously labelled W44) located about 100 m west from the portal entrance, and the station UG4 at the south end of MEUG, about 80 m west of the Mill in horizontal plan view. Figure 16 plots a time series of the available flow measurements between 2015 and 2020.

From 2012 to 2015, the underground mine had intercepted little inflows. Developments had progressed in MSUG, 118UG, and A2UG, reaching a bottom elevation of 650 masl; tailings and water had been deposited into the Main Pit; and the A2S2 Pit had just been fully excavated. Between 2015 and 2018, inflows remained relatively low, progressively reaching up to 260 m^3/d. During this period, underground had progressed in all areas except MEUG, reaching a bottom elevation of about 500 masl. At surface, tailings and water had been deposited into the A2S2 Pit, and A2S3S4 was being excavated. In 2018, following the temporary closure period, total inflows had increased, ranging between an average of 667 m^3/day in mid 2018 to up to 2,600 m^3/d at the end of 2020. At this time, underground had progressed in all areas, reaching a bottom elevation of about 470 masl and at surface, tailings and water had also been deposited into the A2S3S4 Pit.

The linkages between the inflow rates and the water bodies at surface and/or specific geological structures remain uncertain on the sole basis of underground flow measurements. The inflows from individual structures intercepted by developments are not monitored, hence it is not possible to determine if inflows at individual fractures have been decreasing gradually over time. This would be expected if groundwater was actually released by natural underground storage rather than recharge from the pits.

As part of an internal scope of work to identify sources of inflow to the underground workings, a conceptual model was developed based on isotopic and general chemistry of selected inflows, hydrogeology of the system and mechanisms of water-rock interaction. Discharges to the underground workings were hypothesized as a mixture of several sources with potential end members including pit water, fresh surface water, shallow groundwater, and deep groundwater. Each of these sources has chemical markers that are a product of mine activity, meteoric precipitation and/or water-rock interactions along groundwater flow pathways. Point sources (Figure 17) of high, consistent inflow were identified by Minto geologists and sampled for general chemistry, stable isotopes of water (^2H,^{18}O) and tritium. The results indicated the majority of inflow to the Minto East workings (as monitored at UG4) was pit water that had infiltrated from surface. Pit infiltration was identified along the ramp before Minto East, under the footprint of the A2S3S4 Pit. Point sources of inflow in the Copper Keel area were not identified as pit infiltration but mostly deep, old groundwater or mixed groundwater. A freshwater signature, characteristic of shallow groundwater or unimpacted surface water, was only found in two locations: the underground portal near surface and the vent raise in Minto East.

3.4.2 Groundwater Inflows to and from the Pits

Groundwater flows into and from the pits cannot be not estimated from direct observations. The flow rates were estimated previously for the Main Pit and A2 Pit using groundwater numerical model prediction (SRK 2015a, 2018b).

In the 2015 version (i.e., water elevation 785 masl in Main Pit, and 720 masl in A2 Pit), the model predicted that the Main Pit was receiving a groundwater inflow of 110 m^3/d from uphill and discharging 120 m^3/d towards the Minto Creek valley. The A2 Pit was receiving a groundwater inflow of 90 m^3/d, and discharge was effectively zero because it was acting at the time as a hydraulic sink.

In the 2018 version (i.e., water elevation 786.3 masl in Main Pit, and 765 masl in A2 Pit), the model predicted that the Main Pit was receiving a groundwater inflow of 110 m^3/d from uphill and discharging 70 m^3/d towards the Minto Creek valley. The A2 Pit was receiving a groundwater inflow of 10 m^3/d, and discharge was effectively zero as it continued acting as a hydraulic sink.

These magnitudes are generally corroborated by the results of a sulphate load balance (SRK 2018b). This work had been completed to understand the potential cause of increased sulphate concentrations in the pits. It showed the sulphate load balance is not sensitive to the estimated groundwater discharge rates. While this does not confirm the groundwater discharge estimates, it does support a conclusion that groundwater discharges from the pits are relatively small compared to water transfers between the pits and the mill (i.e., discrepancies in the load balance were within the uncertainty of the flow rates measured at surface).

3.4.3 Groundwater Inflows to the WSP

The cumulative groundwater input to the entire WSP were estimated to be on the order of 350 m^3/day and the groundwater input to the upstream end of the WSP on the order of 170 m^3/day (i.e., in 2017, the WSP held between 55,000 and 84,000 m^3 of water (average of about 70,000 m^3).

3.4.4 Groundwater-Surface Water Interactions

Groundwater discharges into the Minto and McGinty creeks as baseflow. While local variations exist, overall, Minto Creek is a gaining stream down to station MC1, and a losing stream (i.e., surface water leaves the channel and enters the shallow groundwater system) from MC1 to W1 (just upstream of the Yukon River). McGinty Creek is also assumed be a gaining stream over its entire length. SRK determined the September/October period, when climatic conditions are relatively dry, but winter has not set in, represented best the creeks' baseflow (i.e., when groundwater is assumed to be the dominant contributor). During the winter months, Minto Creek in particular is often frozen to its base (except at W3, which has flow year-round), therefore measurements are not possible, with little to no flow during this period; furthermore, the managed discharge from the WSP can overprint the natural hydraulic regime (freshet dominated).

The Appendix E provides statistical summaries and time series of the stream flow observations collected at surface water stations located in creeks. Table 3.3 compiles the estimated baseflows for the September/October periods.

Table 3.3: Estimated Creek Baseflows

Catchment	Station	Avg. Baseflow for the Sep/Oct Period (m^3/d)	St.Dev. (m^3/d)
Minto Creek	W3	340	125
	W7	1135	1230
	W6	160	125
	W46	1880	790
	MC1	2210	1480
McGinty Creek	MN1.5	260	290
	MN2.5	1230	590
	MN4.5	1067	944

Note:

Avg. Baseflow = Median of the flow measurements for the months Sep and Oct between 2017 and 2021.

St.Dev. = Standard deviation of the flow measurements for the months Sep and Oct between 2017 and 2021.

na, not available.

3.5 Groundwater Recharge from Precipitation

Groundwater recharge occurs from direct infiltration of precipitation and via losses from surface water features such as ponds, creeks or flooded open pits, to the groundwater system. The estimated average annual precipitation is 329 mm/year; the average annual runoff 98.7 mm/yr; and the recharge to the groundwater system 29.7 mm/yr (i.e., 9 % of the annual average precipitation). The estimated percentages of recharge to groundwater are based on the stream flow collected in Minto Creek between September and October and the calibration of the groundwater numerical model update presented in this report.

3.6 Hydrogeochemistry

3.6.1 pH and Total Dissolved Solids

pH and total dissolved solids (TDS) of groundwater, surface water, and mine infrastructure stations are summarized in Table 3.4. The pH is relatively consistent between site water types. In contrast, the TDS varies the greatest in the current groundwater wells and mine infrastructure, while the creek water and background wells display a low variability. In general, TDS increases with depth in groundwater wells with the maximum values measured in MW12-05-01 and MW12-05-02, which monitor the deepest points on site. TDS is greatest among mine infrastructure monitoring points in the pits and lowest in the water storage pond.

Table 3.4: Physical Parameters of Site Waters

	pH			TDS (mg/L)		
	Mean	**Min**	**Max**	**Mean**	**Min**	**Max**
Groundwater (n=37)	7.7	6.1	8.8	655	145	3950
Creek Water (n=10)	7.9	6.0	8.4	294	38	788
Mine Infrastructure (n=7)	7.7	6.2	8.7	1426	76	5550
Background Wells (n=3)	8.3	6.9	8.7	211	81	524

Note:

Number of samples refers to the number of stations

Source: Data provided by Minto Mine

Statistics presented include data from 2018 to 2020. Outliers were removed.

Background monitoring stations include MW17-08-01, MW17-08-02, MW17-08-03 and MW17-08-04

A water quality profile of open water in the Main Pit was conducted in October 2017. The physical parameters and major ion lab results did not vary significantly with depth, indicating that there is little variation in water quality with depth in the pit (open lake water is fully mixed). Sulphate concentration ranged between 1,200 mg/L and 1,330 mg/L. This is consistent with what one would expect under fully mixed conditions, which could be the result of mixing due to mine water management actions, or a consequence of monitoring subsequent to a fall turn-over (if seasonal stratification does occur).

3.6.2 Major Ion Chemistry

Piper Diagrams were used to assess the different spatial and depth-related major ion signatures of waters across the Minto Creek and McGinty Creek catchments.

Figure 18 presents a Piper Diagram (proportional major ion concentration) of the 2020 averaged water quality data from monitoring well zones, the background well (MW17-08), select mine component, drainage, or effluent stations (W12, W16, W45, W62, UG1 and UG4), and downstream surface water stations (Minto Creek and McGinty Creek water). Note, MW09-03 is not considered to be background in 2020, thus falls in the 'Groundwater Wells' category. The Piper Diagram values presented are the mean values from 2020. A second Piper Diagram (for ease of interpretation) with scaled circles representing TDS is presented in Figure 19. Data indicates two distinct water facies:

1. A lower TDS Ca-HCO_3 to Mg-HCO_3 facies.
2. A higher TDS Ca-SO_4 to Na-SO_4 facies.

Lists on Figure 18 and Figure 19 tabulate which monitoring stations/well zone fall within which water facies. The majority of the stations belong to the Ca- or Mg-HCO_3 facies. In all types of samples, higher TDS correlates with a higher proportion of sulphate.

An evaluation of the Piper diagrams suggests the major ion chemistry of the groundwater system varies across the site, and with depth. All of the shallow monitoring zones display a Ca-HCO_3 or Mg-HCO_3 type water, typical of shallow, fresh groundwaters (Figure 18). In the past, MW12-06-05 showed a similar signature to seepage from the DSTSF with a higher sulphate content. W8A, which monitors seepage from the DSTSF and is located immediately upgradient of MW12-06, has been dry since 2019 and is therefore no longer contributing load to the groundwater system in that specific area, resulting in a shift to the HCO_3 dominant waters observed in 2020.

High TDS and SO_4 dominant waters occur in groundwater in deep monitoring zones only. Figure 20 presents sulphate concentration compared to elevation of each groundwater monitoring zone. In general, deep monitoring zones vary from their respective shallow zones and largely show a transition from fresher waters to more chemically evolved waters with depth. Strong correlations exist between sulphate concentrations and elevation, with the deepest monitoring zones on site having the highest values. The deepest monitoring zones (MW12-05 and MW17-12) are located downgradient and at similar elevations to the ore bodies being mined at Minto. A more detailed discussion on the origins of sulphate in deep groundwater on site is provided in Section 3.7.1.

As detailed above, there are general depth-related trends observed in the data suggesting that:

- Shallower zones are fresher Ca-HCO_3 or Mg-HCO_3 waters.
- Deeper zones in these wells have a more diverse distribution of groundwater, from fresher (Ca-HCO_3 or Mg-HCO_3;) groundwater upgradient of the ore bodies to more complex, SO_4-bearing (Na-SO_4 or Ca-SO_4) groundwater topographically downgradient of the ore bodies (Figure 18 and Figure 19).

3.7 SPT Exceedances and Visual Trends

Groundwater monitoring is conducted as required by the Minto Mine Groundwater Monitoring Plan (Minto, 2016). Review of groundwater monitoring results is carried out as part of the Operational Adaptive Management Plan (OAMP). In the OAMP, specific performance thresholds (SPTs) have been defined to establish changes in concentration and concentration values for specific constituents of concern (CoCs) at which actions may need to be taken by Minto to avoid potential impacts to the environment. For a complete background on SPTs and detailed report on the results please see SRK 2021, Minto Mine – 2020 Groundwater Review and Summary of OAMP SPT Exceedances.

Groundwater quality at the Minto Mine is largely within the range of observed baseline conditions, with a low number of consistent SPT exceedances. While SPTs are not exceeded or applied to specific wells, visual trends (increasing or decreasing) are observed for various parameters. Table 3.5 summarizes qualitative trends observed in groundwater chemistry at each well with parameters identified that consistently exceed thresholds. While it is important to monitor these trends, they are not unexpected in the vicinity of active mining where the development of pits and underground workings depressurize the system and upset equilibrium conditions, and do not currently pose a risk to Minto Creek water quality.

Table 3.5: Summary of Qualitative Trends in CoCs and Consistent SPT Exceedances in Active Monitoring Wells (2020)

Catchment	Well ID	Monitoring Zone	Visual Trends		Consistent Threshold Exceedances		
			Increasing	Decreasing	SPT 1	SPT 2	SPT 3
Minto Creek	MW12-05	1	SO_4	NH_3	-	SO_4	-
		2	SO_4		-	SO_4	-
		3	-	Zn, NH_3	-	-	-
		4	SO_4, Se		-	-	-
		5	SO_4	Zn, NO_3	-	-	-
		6	SO_4	Zn, NO_3	-	-	-
		7	NH_3, SO_4	-	-	-	-
	MW12-06	1	Al, As, Se, NH_3, SO_4	-	-	-	Cr
		2		-	-	-	-
		3	NH_3	Cr, Zn	-	-	-
		4	-	Zn	-	-	-
		5	-	Zn	-	-	-
		6		Zn	-	-	-
	MW12-07	1	As, Zn, NO_3	Cr	---	---	---
		2	Cd, Cu, Se, Zn, NO_3	NH_3	---	---	---
		3	--	--	---	---	---
		4	--	--	---	---	---
	MW17-08	1		-	---	---	---
		2		-	---	---	---
		3	-	Se	---	---	---
		4	--	--	---	---	---
	MW17-10	1	Se, Zn, NO_3		---	---	---
		2	Se, NO_3	Cu, Ni	---	---	---
		3	Se, NO_3	Cu, Ni	---	---	---
		4	--	--	---	---	---
		5	--	--	---	---	---
	MW17-12	1	Se	-	---	---	---
		2	Se, Zn	-	---	---	---
		3	As, Zn	-	---	---	---
		4			---	---	---
		5		Ni, Se	---	---	---
		6	NO_3	Ni, Se	---	---	---
		7	Zn	Se, NO_3	---	---	---
		8		Se, NO_3	---	---	---
McGinty Creek	MW09-03	1	Cd	Al, Ni, Mo, SO_4	-	As	---
		2	Cd, Zn, NO_3	Al, As, Mo, NH_3, SO_4	Cd	Zn, NO_3	---
		3	--	--	-	-	---
	MW17-11	1	As	Mo	---	---	---

		2	As		---	---	---
		3			---	---	---
		4		Ni	---	---	---
		5	--	--	---	---	---

Notes:

‘-’ No trends or exceedances were identified

‘--’ Insufficient data to evaluate trends

‘---’ SPT does not apply to monitoring well or catchment

3.7.1 Groundwater Quality in Minto Creek Catchment

Trends in certain parameters within the groundwater monitoring network are present, as listed in Table 3.5; however, only sulphate and chromium have consistently exceeded SPTs. Changes in groundwater quality within the mine site are consistent with what is expected during active operations and concentrations in Minto Creek generally remain in the range of baseline conditions.

Sulphate

Sulphate SPT exceedances only occur in MW12-05 and have been restricted to the deeper zones (MW12-05-01, MW12-05-02 and MW12-05-03) which monitor depths greater than 85 meters below ground surface (mbgs) (Figure 21, Figure 22 and Figure 23). Concentrations have been increasing in these three zones, but at a slower rate than previously (Figure 23). Monitoring zones shallower than Zone 3 have also been increasing since installation, but at far lower sulphate concentrations (<100 mg/L) and show signs of stabilization in recent monitoring events. This trend is characteristic of groundwaters reaching equilibrium following installation, which can take several years in aquifers with low hydraulic conductivity.

Figure 21 presents a cross sectional representation of sulphate concentrations in the Minto Creek catchment and Figure 22 presents the distribution of sulphate concentrations in plan view, with nested diamonds representing multi-level wells and the smallest diamonds as the deepest zones. The highest concentrations are localized to the deepest groundwater furthest downgradient in the catchment, within the Main and A2 Pit and the underground workings. While many of the wells show increasing sulphate concentrations with depth, MW17-12 is the only other location with concentrations above 1000 mg/L and is the only well to monitor water as deep as MW12-05.

Elevated sulphate concentrations in groundwaters near sulphide-containing ore bodies are not uncommon due to interaction with sulphur bearing minerals along the groundwater flow paths. Sulphate concentrations have been examined in multiple investigations, all of which suggest elevated concentrations at MW12-05 are not related to mining activities. Details of these investigations can be found in SRK 2021b, and a summary of the observations that contribute to this conclusion are provided below.

- Sulphate concentrations at MW12-05 immediately following installation were higher than any mine source (i.e., Main Pit, DSTSF seepage, etc.).
- The Main Pit acted as a hydraulic sink for groundwater until 2013, one year after the installation of MW12-05 and after the initial increase was observed in MW12-05.
- Chloride, which is only present in high concentrations in mine affected waters, did not increase in MW12-05 concurrent with sulphate. If MW12-05 was receiving mine affected waters, the chloride would also have been expected to increase, which it did not.
- The isotopic signatures of deep groundwater at MW12-05 are not indicative of recent mixing with surface/mine site sources.
- Measured hydraulic conductivities in the bedrock are very low and there are no mapped structures that would act as a conduit for groundwater flow. Additionally, all solute transport simulations conducted during modelling concluded the observed concentrations are unrelated to mine activities.

While sulphate concentrations have been increasing and exceeding thresholds in the deeper zones, all available evidence suggest they are not related to mine activities but naturally occurring due to interaction with the sulphur-bearing minerals of the ore body.

Chromium

Chromium concentrations have consistently exceeded thresholds in the deepest zone of MW12-06 (150 mbgs) since installation. Concentrations in MW12-06-01 increased until mid-2019 but have since stabilized at concentrations greater than SPT 3 (Figure 24). Chromium is the only parameter to consistently exceed thresholds in MW12-06 and is not thought to be caused by mine affected waters infiltrating into groundwater.

As chromium is sensitive to changes in redox conditions, the analysis of other redox-sensitive elements is useful to understand possible mechanisms for observed concentrations in MW12-06-01. Manganese and iron, which exist in an aqueous phase under reducing conditions at neutral pH, were stable until late 2018, at which point they suddenly increased (Figure 25). This event coincides with stoppage of active mining in the Minto South Underground. At that time, water levels (pressure) in MW12-06-01 dropped significantly while no other monitoring zones were affected (Figure 14).

The drop in pressure in MW12-06-01 suggests deep groundwaters in the vicinity of the well are affected by underground mining activities which may disrupt the system’s equilibrium. The changes in redox sensitive elements are likely a response to this disruption, as hydraulic gradients shift due to pressure changes.

While mine activities may influence the groundwater system equilibrium in the vicinity of MW12--06-01, elevated concentrations are not a direct result of mine water infiltration. These trends are not unexpected near active mining, where the development of pits and underground workings abruptly depressurizes the groundwater system.

3.7.2 Groundwater Quality in McGinty Creek Catchment

Trends in certain parameters within the groundwater monitoring network in the McGinty Creek catchment are present, as listed in Table 3.5; however, only arsenic in MW09-03-01 and cadmium, nitrate, and zinc in MW09-03-02 have consistently exceeded SPTs. While the other parameters provide useful insight for interpretation of overall conditions at site and comparison with previously provided water quality predictions, they are not considered problematic at this time as concentrations remain below OAMP thresholds.

For context, in 2019, zinc, molybdenum and selenium consistently exceeded thresholds in MW09-03-01. In 2020, concentrations decreased with only two exceedances for zinc, one for selenium and none for molybdenum.

Nitrate

Nitrate at MW09-03-02 has been increasing since the beginning of 2017 and has consistently exceeded SPT 2. The nitrate concentration of the deeper zone, MW09-03-01, remains stable and below both SPT 1 and SPT 2. Concentrations of the same magnitude observed at MW09-03-02 are consistently observed in MW17-11-05, which is at a similar elevation and adjacent to MW09-03-02 (Figure 26). Presently, the Minto North Pit acts as a hydraulic sink, with a hydraulic divide possible in the vicinity of MW09-03 and MW-17-11 and gradient towards the pit from both wells. As the pit water level is much lower than water levels in the wells, migration of pit water is not the cause of the nitrate increase observed at MW09-03-02.

The increase in nitrate concentrations do coincide with development of the Minto North Pit, which resulted in a water level decrease in MW09-03 and subsequent changes in redox conditions which can cause an increase in nitrate (discussed below). The development of Minto North involved the construction of a haul road using blasted rock and may also contribute nitrogen load to the groundwater. Observed concentrations in MW09-03-02 may be the result of these two different mechanisms.

Nitrate is sensitive to changes in redox conditions. Other redox-sensitive elements were assessed to understand the observed concentrations in MW09-03. Concentrations of ammonia, iron and manganese decreased significantly and concurrently with an increase in oxidation-reduction potential (ORP) at the same time as the observed water level decrease (Figure 27). These observations suggest conditions in the aquifer changed from reducing to oxidizing, resulting in the formation of iron and manganese oxides/oxyhydroxides and a shift in nitrogen speciation from an ammonia dominated system to nitrate (Figure 27).

Blasted rock was used to construct the Minto North haul road which contains nitrogen compounds as residue from the process. These nitrogen compounds can be mobilized as nitrate by precipitation infiltrating through the blasted material. Seepage from nitrogen-containing blast residuals in the haul road material may also contribute an additional load of nitrate to the groundwater.

Arsenic

Arsenic concentrations in MW09-03-01 increased concurrent with the development of the Minto North Pit but appear to have reached equilibrium quickly, as concentrations have since stabilized. Concentrations are consistently above SPT 2 but, as Minto North Pit acts as a hydraulic sink, are not due to pit water infiltration. An inverse trend was observed in MW09-03-02, with an initial decrease followed by stabilization (Figure 28).

Similar to nitrate, arsenic is redox sensitive, and these trends may be attributed to a change in aquifer conditions as water levels dropped in 2015 following the onset of mining at Minto North.

Cadmium and Zinc

Zinc increased in concentration and variability in MW09-03-01 and MW09-03-02, beginning in 2015 when mining of the Minto North Pit started (Figure 29). Cadmium showed similar behavior, particularly in MW09-03-02 (Figure 30). The dominant attenuation process for these ions is adsorption, and it is possible with a change in conditions, competition for adsorption sites caused the increased mobility of zinc and cadmium which have not yet reached equilibrium.

3.8 Isotopic Environmental Tracers

In 2016 data collection for an environmental tracer study was undertaken to fulfill Condition 90.g of the Water License QZ14-031. The study included stable isotopes of water (δ^2H and $\delta^{18}O$), $\delta^{34}S_{SO4}$ and tritium from samples collected from a range of groundwater, surface water and seep monitoring stations across the site. Preliminary findings were presented in October 2017 (SRK 2017c). At the time of the 2017 report, additional work was being planned to use isotopes of sulphur and oxygen in sulphate to distinguish differences in the source of high sulphate waters across the site. Use of the sulphur-containing mill reagent was discontinued, with no material available at site; the work did not proceed. Further analysis of tritium was also planned but upon further review was considered to likely yield inconclusive results. The ‘preliminary’ findings presented in SRK (2017c) can therefore be considered final at this time. The following summarizes observations and interpretations of the isotope and tritium data.

3.8.1 Stable Isotopes of Water

Observations:

Stable isotopes of water (δ^2H and $\delta^{18}O$) were sampled in surface waters, mine seeps and groundwaters across the site. Figure 3-26 presents results. δ^2H and $\delta^{18}O$ generally plot along the linear best fit line for precipitation data from Mayo, YT (IAEA 2017), and parallel to, but below the local meteoric water line (LMWL) for Whitehorse, YT (Lacelle 2011). Some of the surface water samples, as well as one seep (near the Ice Rich Overburden Dump) collected in June 2016 plot to the right of the meteoric water line.

For groundwaters, variation in $\delta^{18}O$ values with depth was observed in MW12-05, and to a lesser extent MW09-03 (Figure 33). Depth-related isotopic variations are not evident within MW-12-06 and MW12-07. In MW12-05, shallower ports (15, 26, and 52 mbgs) have enriched $\delta^{18}O$ and δ^2H

values, while the lower ports (94, 110, and 132 mbgs) have isotopically depleted values (Figure 33). The sampling port at 69 mbgs plots as an intermediate between these two trends.

Interpretations

Stable isotopes of water from the Minto Mine are similar to precipitation measured at Mayo, YT and largely suggest that all have been derived from infiltration of local meteoric water. Seasonal shifts along the Mayo best fit line are also expected due to changes in temperature, which effects the degree of fractionation, and thus the isotopic value (more depleted in heavy isotopes in colder temperatures, less depleted in warmer temperatures). As well, several of the surface waters along with one seep (SS49) trend to the right of the meteoric water line and are consistent with trends in oxygen and hydrogen isotopic values on surficial waters modified by evaporation.

Generally seasonal variation is lost during infiltration through the unsaturated zone, so groundwater is expected to have an isotopic value near the weighted average of annual precipitation (Clark and Fritz 1997). As indicated in Figure 33, observed depth-related trends in the isotopic values are either 1) invariant and may be attributable to relatively unimpeded flow in fracture rock (MW 12-06; MW12-07; Clark and Fritz, 1997), or 2) variable and trend from enriched isotopic values near surface to more depleted isotopic values at depth which are comparable with spatially equivalent groundwaters in the area (MW12-05). This variation is likely the result of groundwater mixing between shallower and somewhat evaporation-affected surface water, and deep groundwater.

3.8.2 Sulphur Isotopes

Observations

The $\delta^{34}S_{SO4}$ values range between -2.7 to +16‰ VCDT. When compared with dissolved sulfate values (Figure 34), some distinctions can be made amongst the $\delta^{34}S_{SO4}$ values. Waters having lower sulphate concentrations of approximately <500 mg/l generally have a fairly wide range of $\delta^{34}S_{SO4}$ values of approximately 20 per mil (‰). In contrast, at sulphate concentrations of greater than approximately 500 mg/L, $\delta^{34}S_{SO4}$ values are far more constrained with a total variation of only 5 per mil.

Interpretations

The observed $\delta^{34}S_{SO4}$ values in these waters may originate from two sources: 1) oxidation of sulfides in the surrounding host-rocks and 2) dissolution of dissolved sulfates within the host-rocks from either ancient seawater sulfate or oxidized sulfides. Both 1) and 2) are geogenic and associated with the geologic and metallogenic history of the area. For instance, Tafti (2005) analyzed $\delta^{34}S$ values on sulfides within ore specimens from the Minto deposit and found that all samples fell within the range of -4 to +2‰, comparable with the lower end of the range observed in this work. In addition, there is another potential source of sulfate, the reagent sodium sulphide which is added in the mill process circuit for certain ore types. At this time, no sulfur isotopic data has been collected on this reagent sulfate source.

As a result, due to the wide range of $\delta^{34}S_{SO4}$ values, and intermediate $\delta^{34}S_{SO4}$ values for samples with elevated sulphate concentrations, no clear conclusion can currently be made, although it is observed that many of the deep groundwater monitoring zones previously identified with high sulphate (i.e., MW12-05-01, MW12-05-02, MW12-05-03) have $\delta^{34}S_{SO4}$ values that are generally outside the range determined by Tafti (2005) for Minto ore.

3.8.3 Tritium

Observations

Tritium values range from less than detection (0.8) to 8.7 tritium units (TU) (Figure 35). Samples from surface water and seeps had values in the range of 4.4 to 8.7 TU. Groundwater samples, on the other hand, had values ranging from 6.8 TU to below detection (<0.7 TU). All samples at depths greater than 60 mbgs have tritium values below 2.0 TU.

Figure 36 compares tritium values with $\delta^{18}O$. Samples with low tritium values tend to have similar, relatively depleted $\delta^{18}O$ values, whereas samples with higher tritium values generally have higher (less depleted) $\delta^{18}O$ values. Samples from well MW12-05 plot in two distinct groups; the shallow zones (-05 and -07) have higher tritium values and $\delta^{18}O$ values between -21.5 and -22.0‰. The deeper zones in MW12-05 have low tritium values and $\delta^{18}O$ values of roughly -22.6‰.

Figure 37 presents tritium vs. $\delta^{34}S_{SO4}$. With the exception of the deeper sample from the monitoring well at Minto North (MW09-03-01), sampling locations with low tritium values have $\delta^{34}S_{SO4}$ values that are generally greater than 5.0‰ VCDT.

Figure 38 presents tritium vs. sulphate concentration. Low levels of tritium were measured over the entire range of sulphate concentration, indicating that samples with high sulphate concentrations may have tritium values that indicate relatively older waters.

Interpretations

Tritium (^{3}H) is a commonly employed radioisotope used to identify the presence of modern recharge. Tritium has a half-life of 12.3 years and its incorporation directly into a water molecule (i.e., HTO) results in actual dating of infiltrating groundwaters over the past 100 years. Tritium is produced at low concentrations (≤10 TU) in the upper atmosphere and accumulates within precipitation, however testing of thermonuclear weapons between 1950 and 1980 introduced a large spike of tritium (~5000 to 8000 TU) into the North America atmosphere and attendant hydrosphere through infiltration of meteoric water (Clark and Fritz 1997).

Long-term records (since approximately 1945) exist for tritium in precipitation (IAEA/WMO 2017). In Canada, this has mainly been developed for Ottawa, however for Yellowknife and Whitehorse partial records exist between 1984 and 1995. Since approximately 1990, tritium levels have been at pre-thermonuclear testing levels, or about 6 TU for the northerly latitudes of this work.

Using the average value for surface waters in this study of 6.2 TU as the input tritium value, it would take roughly 20 to 36 years for tritium decay to the tritium values of ≤2.0 TU observed in groundwaters deeper than 60 m. However, tritium in precipitation values in 1980 were still influenced by thermonuclear ^3H at approximately 40 TU which is much greater than the decay corrected value of 6 TU used here. This clearly indicates that groundwater in this study occurring at depths of 60 m and greater are a two-component mixture including 1) modern meteoric precipitation and 2) a large component of an older, tritium depleted groundwater. This mixing phenomenon is also evident from the distinct groups identified in the tritium vs $\delta^{18}O$ observations above (Figure 36).

3.9 Mine Water Conservative Tracers

Chloride and sulphate distributions across the site were assessed as an indicator of potential transport of mine contact water in the groundwater system. Chloride and sulphate are commonly accepted to be conservative, meaning it generally should not be chemically reactive within the groundwater system, and can therefore act as a tracer of sources with elevated concentrations. Considering chloride and sulphate as tracers is potentially useful at Minto, where concentrations are relatively high within the pits (the largest reservoirs of mine contact water on the property). Thus, the tracer concentration distribution across the site provides insight into contact water movement via groundwater. As sulphate is considered to be naturally occurring at high concentrations in the deep groundwater system downgradient of ore bodies, evaluating it alongside chloride gives the appropriate context to assess mine water transport.

A range of baseline groundwater concentrations are indicated by 1) historic monitoring wells P94-20 and P39E (which no longer exist), 2) MW11-04a, MW17-08 (located topographically upgradient of mine activity in the Minto Creek catchment and 3) MW09-03 prior to mining of Minto North, (topographically downgradient of the pit itself). Well depths and maximum sulphate and chloride concentrations are tabulated in Table 3.6.

Table 3.6: Background well maximum chloride and sulphate concentrations

Well	Depths (mbgs)	Max Chloride Concentration (mg/L)	Max Sulphate Concentration (mg/L)
P94-20	35.9	1.2	31.8
P39E	82.6	1.7	199
MW11-04A	30.3	3.1	10
MW17-08	12, 23, 36, and 46	1.1 [1]	92.7
MW09-03	5, 19, 40	13[1]	117

[1] Note: these are an average of the maximum concentrations of all zones of the respective wells

Table 3.7 tabulates key water quality monitoring stations with the control on seepage from these potential sources and maximum observed chloride concentrations.

Table 3.7: Maximum sulphate concentration across site and control on flow

Well/Station	Max observed [Cl] (mg/L)	Max observed [SO_4] mg/L	Control on Seepage
Main Pit (W12)	73	2950	K (fracture) distribution pit water elevation
A2 Pit (W45)	73	3490	K (fracture) distribution pit water elevation
Minto South Underground (UG1)	19	1640	K (fracture) distribution Dewatering (reduces seepage outflow potential)
Minto East Underground (UG4)	52	1775	K (fracture) distribution Dewatering (reduces seepage outflow potential)
Tailings thickener (W14)	140	3650	No seepage (process water monitoring)
MW12-07	19	1510	K (fracture) distribution Hydraulic Head
DSTSF (W8A)	180	441	K distribution of active-layer
WSP (W16)	32	428	K (fracture) distribution Pond level elevation
MW12-06	13	830	K (fracture) distribution Hydraulic Head
MW12-05	29	2590	K (fracture) distribution Hydraulic Head
MW17-12	13	2470	K (fracture) distribution Hydraulic Head
Minto North Pit (MN)	16	193	K (fracture) distribution Pit water elevation
MW09-03	5.1	117	K (fracture) distribution Hydraulic Head
MW17-11	4.0	89	K (fracture) distribution Hydraulic Head

Note: outliers were removed when considering maximum concentrations.

Figure 31 presents the time series of sulphate for the Main Pit, A2 Pit and the underground workings compared to MW12-07, MW12-06 and MW12-05. These data provide a comparison of the highest sulphate concentrations on site to a transect of monitoring wells down the Minto Creek catchment.

Observations from the sulphate trends are as follows:

- Sulphate concentrations at MW12-07 have differed between the deeper and shallower monitoring zones (MW12-07-01 and MW12-07-02), respectively. The shallower zone showed a continued slow increase in sulphate until February 2018 when it drastically decreased by approximately half, reaching a current concentration of approximately 300 mg/L. Sulphate concentrations in the deepest zone have been more variable with an increase between the time of well installation to mid-2015, followed by August 2017 when concentrations rapidly increased near 600 mg/L and have remained relatively stable since.

- Sulphate concentrations at MW12-06 have remained relatively stable at concentrations less than 200 mg/L in all but the deepest monitoring zone. Sulphate in MW12-06-01 started increasing in October 2019 with a maximum concentration of 829 reached in July 2020.
- Sulphate concentrations in the deeper zones at MW12-05 have increased over time since installation of the well. At the beginning of 2015, concentrations in both of the deepest monitoring zones (Zone 1 and Zone 2) were approximately 800 mg/L. At the same time, concentrations in the Main Pit, A2 Pit and underground ranged from about 200 mg/L to 400 mg/L, respectively. Concentrations in both the monitoring wells and the pits have increased since 2015 but at different rates, with concentrations in MW12-05 showing signs of stabilization since 2017 concurrent with the highest pit concentrations.

The trends observed in sulphate (increases or decreases) of the mine pits and underground are either not observed or out of equilibrium with all three monitoring wells. For example, the increase in concentrations observed at MW12-05-01 and MW12-05-02 began before concentrations at the pits or underground had reached similar concentrations.

Figure 21 presents the recent average groundwater SO_4 concentration with depth from monitoring wells across the site in a cross section. The majority of groundwater has SO_4 concentrations <500 mg/L and remains invariant with depth in most wells. In MW17-12 and MW12-05, SO_4 concentrations increase with increasing depth with the highest concentrations across site detected in the deepest monitoring zones.

For comparison, Figure 32 presents temporal chloride trends compared to sulphate for the deepest monitoring zones in the wells presented on Figure 31. If SO_4 concentrations observed at MW12-05 were a result of seepage from the pits (the only known sources of sufficient concentration) it would be expected that chloride concentrations would show similar trends. The chloride concentration at MW12-05 and MW12-06 has been relatively stable with approximately 15 mg/L and 5 mg/L since installation, respectively. In MW12-07-01, chloride started increasing in August 2018 at the same time sulphate concentrations in that well started decreasing. The inverse was observed in MW12-07-01 where sulphate increased at that time, although chloride concentrations have been relatively stable.

Chloride and sulphate concentrations suggest MW12-05 and MW12-06 are not affected by pit water, as sulphate increases but chloride does not. MW12-07, however, is likely being affected by mining activity. While MW12-07 may not be in direct contact with pit seepage, it experiences drastic changes in chemistry that are likely related to pressure changes as new areas of the mine are developed.

4 Hydrogeological Conceptual Model

The BC MOE Groundwater Modelling Guidelines (BC MOE 2012) provide the following definition of a conceptual model:

> *A conceptual model is a simplified representation of the essential features of the physical hydrogeological system, and its hydraulic behavior.*
>
> *In scientific terms, a conceptual model is a hypothesis which is formulated on the basis of the available data, experience and the professional judgment of the modeller.*

The following sections describe components of the updated conceptual models for the Minto and McGinty catchments. It is expected that conceptual models will be updated over time as additional data becomes available or a specific need is defined.

4.1 Minto Creek Catchment

4.1.1 Hydrostratigraphic Units

Hydrostratigraphic units were discussed in Section 3.2. There is no change in hydrostratigraphic units based on recent data. The three hydrostratigraphic units are:

1. Overburden: The distribution of overburden across the site can influence groundwater flow by providing pathways for groundwater flow, where it is permeable and not frozen. Overburden deposits are not spatially continuous and are thickest along the alignment of the pre-mining Minto Creek valley bottom, until the area around the DSTSF, where the paleochannel exists. In the paleochannel, overburden can be greater than 90 m thick. Typically, the ridge tops are dominated by sandy, residual soils grading to weathered bedrock and overburden in the valley bottoms consists of fine materials dominated by sandy silts and clays. Permafrost can occur within the overburden unit and act as an aquiclude. The spatial distribution of permafrost is known with variable confidence across site, but in general, it is more likely to occur on north aspects and in valley bottoms. In the area around the DSTSF, overburden appears to be mostly frozen. Hydraulic testing data is limited in this unit, with only one test conducted on frozen overburden.

2. Bedrock: Bedrock is of granodiorite composition with low primary permeability. Groundwater occurs in secondary permeability along joints and fractures. Observations indicate the presence of a weathered zone, and hydraulic testing generally supports relatively higher hydraulic conductivity at shallow depths below ground, but not always. Hydraulic testing at greater depths indicate permeable features can exist, though are no more permeable than weathered zones (on average). Fault zone distribution is not well constrained away from the mines. Estimates of hydraulic conductivity range between $4x10^{-9}$ and $8x10^{-6}$ m/s, with a geometric mean of $9x10^{-8}$ m/s and display a general trend of decreasing hydraulic conductivity with depth. Bedrock can be frozen locally.

4.1.2 Hydraulic Gradients

The overall flow direction is from the mine area towards the Minto Creek valley and Yukon River. Groundwater flow generally follows topographic gradients overprinted by the effects of open pits or underground areas. Topographically upgradient of the pits, vertical hydraulic gradients are downwards, indicating recharge zones. Downgradient of the pits, vertical gradients seem to be generally upwards (MW12-06, MW17-12), indicating zones of discharges into the Minto Creek valley; although this may be shifting locally as MW12-05 shows the opposite; a downwards hydraulic gradient in bedrock, from shallow groundwater to deeper groundwater. Permafrost is also present on the south side of the valley, as discussed in Section 3.2.3, creating an aquitard in overburden over deeper bedrock.

Open pits can act as groundwater sinks, sources of recharge, or both depending how water levels in the pits compare to groundwater levels around the pits. When the pit is dewatered or water levels in the pit still lower than groundwater levels around the pit, it acts as a hydraulic sink. If the water levels in the pit rose and are sustained above groundwater levels around the pit, it acts a source of recharge; and when the water levels in the pit are the same as, or close to, the natural groundwater levels, it can act as a hydraulic sink for areas hydraulically upgradient of the pits, and as a source of recharge for areas hydraulically downgradient of the pits. Underground areas are groundwater sinks when dewatering (and to a lesser extent filling) is occurring.

While the exact locations where groundwater discharge to Minto Creek could occur are not known, baseflow in Minto Creek during the winter period must be very low as Minto Creek can freeze to bottom during the late winter period.

4.1.3 Contact Water Transport

Water seeping from waste rock dumps, the flooded pits and the DSTSF can be assumed to flow down valley but will be inhibited in overburden due to permafrost and in bedrock by the overall low hydraulic conductivity of the fractured bedrock. Permafrost underlying the DSTSF is believed to keep water from infiltrating to any deeper groundwater system. Seepage from the Southwest Waste Dump enters the Minto Creek pre-mining alignment topographically upgradient of the pits and is pumped to the Main Pit or the Water Storage Pond. Most water seeping from the Main Pit will daylight as discharge by the WSP, with a small percentage possibly bypassing the pond.

The high concentrations of sulphate specifically observed in the deep monitoring zones of MW12-05 and, and more recently, MW17-12, had previously been inferred to indicate a potential effects of mine contact water reaching these locations. However, while sulphate concentrations have been increasing and exceeding thresholds in the deeper zones, all available evidence suggests they are not related to mine activities but naturally occurring due to interaction with the sulphur-bearing minerals of the ore body (Section 3.7).

4.1.4 Conceptual Model Summary

Figure 39 presents an overview schematic of the conceptual model for the Minto Creek catchment. The conceptual model has not changed from the SRK 2018, Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report.

The groundwater system is believed to be a relatively low flow, low conductivity, fracture-controlled flow system. A majority of flow is expected to occur relatively near to ground surface, where not frozen. Groundwater can flow into and out of the flooded Main Pit or A2 Pits and is also intercepted by underground workings. The large majority of mine contact water is expected to ultimately discharge to ground surface by the area of the Water Storage Pond. Groundwater that does pass the Water Storage Pond has a limited flow rate and is expected to discharge to Minto Creek with contributions from unaffected catchments increasing progressively downstream.

The conceptual section shows schematically the observed distribution of sulphate in the groundwater system. High concentrations can occur across the length of the site but are not directly correlated to any known mine (or non-mine) source.

4.2 McGinty Creek Catchment

4.2.1 Hydrostratigraphic Units

Hydrostratigraphic units are generally the same as for Minto Creek. Hydraulic conductivity had to be lowered for the 2015 groundwater model a calibration and is inferred to indicate a less significant zone of weathered bedrock at shallow depths and aligned with the ridges. Permafrost is not as evident as in the Minto Creek valley, at least not around the Minto North Pit.

4.2.2 Hydraulic Gradients

The overall flow direction is from the Minto North area towards the McGinty Creek and Yukon River. Groundwater flow generally follows topography, overprinted with effects of the MN Pit at its proximity; vertical hydraulic gradients are observed downward. The water levels declined when mining of the MN Pit reached under the groundwater table but remained stable since and always stayed well above the pit water levels. This indicates there is presently a hydraulic barrier on the topographically down-hill side of the MN Pit, which acts as a hydraulic sink.

4.2.3 Contact Water Transport

Water quality data at MW09-03 have shown increases in certain parameters (i.e., nitrate) since the mining of the MN Pit. The pit is not expected to be the source since MN Pit is a hydraulic sink. The nitrate observations are interpreted to be from changes in redox conditions as water levels dropped after mining of the MN Pit, or may also represent leaching of residual nitrogen species present in blasting residues as precipitation and snow melt flush through the rock and interpreted to be infiltrating into the groundwater system. This effect is expected to be relatively short-lived, as the groundwater will continue to equilibrate and blasting residuals represent a modest overall load source. Monitoring data in the nearest McGinty Creek surface water station (MN 2.5) indicate nitrate concentrations have remained within baseline.

4.2.4 Conceptual Model Summary

Figure 40 presents an overview schematic of the conceptual model for the McGinty Creek catchment. The conceptual model has not changed from the SRK 2018, Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report.

The groundwater system is believed to be a relatively low flow, low conductivity, fracture-controlled flow system. Weathered bedrock does not appear to be as significant as in the Minto Creek catchment. Groundwater recharged at higher elevations is assumed to discharge to McGinty Creek.

The MN Pit currently acts as a hydraulic sink. No loading to the groundwater system currently occurs. Changes in water quality observed at MW09-03 are interpreted to be from changes in redox conditions as water levels dropped after the mining of the MN Pit and may also represent flushing of the haul road construction materials and are expected to improve over time.

5 Groundwater Numerical Model

5.1 Lessons from Past Models

Iterations of conceptual models and numerical models provided valuable information about the sensitivities of the model predictions to model parameters. Table 5.1 compiles this knowledge.

5.2 2021 Model Construction

The groundwater numerical model was constructed using FEFLOW v.7.4 (Update2, May 2021). Table 5.2 compiles the settings of the 2021 groundwater numerical model. Figure 41 to Figure 44 show the overall model layout, the hydraulic conductivity distribution, the boundary conditions, and the modeled mining schedule.

Table 5.1: Model Sensitivities

Parameter	Flow Predictions	Mass Predictions
Hydraulic Conductivities	The calibration to heads and baseflows is sensitive to K. They influence the heads, the gradients and where groundwater discharges into creeks, however flow directions remain the same.	The concentrations of groundwater discharges into creeks remained low compared to the sources in scenarios where the K of the conceptual hydrostratigraphic units were increased.
Recharge	The calibration to heads and baseflows is sensitive to recharge. As with K, it influences the heads, the gradients and where groundwater discharges into creeks, however flow directions remain the same.	Recharge influences how much water with background concentration enters the system; the smaller the porosity, the faster particles travel.
Specific Yield and Specific Storage	Flow directions are not sensitive to specific yield. It influences how depressurization spreads and how much groundwater is released by storage but overall, the gradients generated by the pits, lakes and/or underground largely dominates the flow predictions.	Modeled travel times are sensitive to specific yield.
Permafrost	The presence of permafrost influences the flow system but does not fundamentally change any model conclusions. When the permafrost was removed from the model (SRK 2015), the changes to groundwater flow were relatively minor	The permafrost distribution can influence where sources infiltrate and how loads travels in the ground. The tested scenarios showed concentrations in the area of the DSTSF were more distributed without permafrost compared to when permafrost was present, however the loads still reported to the same places at post-closure.
High K structures along Minto Creek (SRK 2014)	Extreme transport scenarios were tested to assess if it could reproduce the high concentrations of sulfate observed at depth in MW12-05 and MW12-07. A high K zone (1) was placed along the Minto Creek valley and extended to the Main Pit. Such structure was never proven to exist but projected from a fault inferred along the valley (SRK 2014b, 2014d). The assumed K of the hypothetical structure influenced where groundwater discharges to Minto Creek but overall, the flow directions remained the same.	The tested scenarios showed sulfate concentrations in MW12-05 represented an anomaly unrelated to mining activities. The concentrations of groundwater discharges into creeks remained low compared to sources. The solute plume could travel as far as the Yukon River, but concentrations in that plume remained at about 30% of the source term concentrations.
High source concentrations (SRK 2014)	Not applicable.	Potential mines sources were tested with a higher concentration (i.e., double of the expected source terms at the time of the modeling analysis, SRK 2014d), but the plumes that had interacted with the mine did not travel far along the Minto Creek valley.
Dispersivity	Not applicable.	The conclusions from the mass transport predictions were not sensitive to dispersivity values.

Note:

1 a 0.5 m thick open fracture with $K=6x10^{-4}$ m/s was placed within a several meters thick high K band between $5x10^{-5}$ and $9x10^{-7}$ m/s; porosity of 0.1%, and longitudinal and transversal dispersivity of 20 m and 3 m respectively.

Table 5.2: Summary of the 2021 Groundwater Numerical Model Settings

Component	Settings Description
Topography	Pre-mining topography, 2010-2020 ground and Mined Out (MOUT) surfaces.
Model Extent	The model includes the entire Minto Creek watershed and a portion of the McGinty Creek watershed. Total model area 46 km^2; Minto Creek watershed 42 km^2; portion of McGinty Creek watershed 4 km^2 (35% of the Upper Minto Creek catchment).
Mine Plans	The 2021 As-built, and the 2021 PEA design, plus interim pit shells and underground developments between 2013 and 2020.
Model mesh and layers	22 layers extending from ground surface to a depth of 480 mbgs. 136,960 elements per layer and 68,881 nodes per slice. Element sizes ranging in length from about 10 to 90 m
Overburden Distribution	The overburden distribution was updated based on the 2021 drillhole database and the historical overburden mapping (Figure 7).
Permafrost	The model includes a 30 m thick permafrost (Figure 10) represented by inactivated model elements. A 2 m thick active layer (i.e., unfrozen ground) covers the whole model surface
Material Properties	Overburden: K = 1x10^{-6} m/s (homogeneous/isotropic); 6x10^{-5} m/s in the beds of Minto Creek and McGinty Creek, porosity = 20%, longitudinal dispersivity = 10 m, transverse dispersivity = 4 m. Bedrock: K at surface is 2.6x10^{-7} m/s then decreases progressively to 3x10^{-9} m/s at the model base (Figure 5). Uphill ridges of the Minto Creek watershed were lowered during calibration to 1x10^{-8} m/s at surface and down to 1x10^{-10} m/s at the model base. Porosity = 1%, longitudinal dispersivity = 60 m, transverse dispersivity = 20 m. The ranges of bedrock K values applicable to mine intercepts are as follows: Main, A2, and A118 pits and lakes: 3x10^{-7} to 3x10^{-8} m/s. - Minto North pit and lake: 1x10^{-8} to 1x10^{-9} m/s; - 2021 As-built underground: 3x10^{-7} to 1x10^{-9} m/s; - 2021 PEA underground: 3x10^{-7} to 3x10^{-9} m/s.
Boundary Conditions	<u>FLOW:</u> Constant recharge at surface of 20.7 mm/yr (9% of the annual precipitation). Minto Creek, McGinty Creek, their tributaries, and the Yukon River are represented by constant head or seepage nodes (1). Head values are set to ground elevation. The Yukon River is at 445 masl. The open pits and underground developments are represented by seepage nodes, and the pits by constant head nodes. Each mine component (i.e., open pits, underground, pits and WSP) is activated progressively to reproduce the mining progression between 2005 and 2028. Mining is incremented on a one-year time step. Figure 44 plots the modeled mine schedule and head values. <u>MASS:</u> Background concentration is set to 20 mg/L for the recharge and the pre-mining groundwater. Plumes from potential sources (i.e., MWD, ROD, SWD, DSTSF. Main Pit, A2 Pit, MN Pit, and underground developments) are evaluated individually using an arbitrary conservative tracer set to a constant concentration of 1,000 mg/L. Figure 44 plots the modeled time tracers were activated.

Note:

Seepage node: a seepage condition is a constant head (Dirichlet) boundary condition with a maximum flow constraint that can only behave as an exit point (drain) for water, i.e., the boundary condition is only active when the water table exceeds the level of the surface water elevations and flow direction is towards surface. Seepage nodes were applied to Minto Creek, and McGinty Creek in the upper area of their watersheds, and to their tributaries.

5.3 Calibration

The model was calibrated to pseudo steady-state conditions. The recharge and hydraulic conductivities (K) were adjusted to match the average groundwater levels (Appendix D) and baseflows (Table 3.3) for the 2017-2021 Sept/Oct periods.

The calibrated recharge value is 29.7 mm/year, which corresponds to about 9% of the total average precipitation. The calibrated K distribution consists of a vertical profile (Figure 5) of decreasing K with increasing depths, based on the Minto site data (Section 3.2.2) and a model proposed by Jiang et al. (2010) that estimates K at given depths based on an empirical relationship between the hydraulic conductivity of a fractured system near surface and the lithostatic stress. The Jiang model matched reasonably well the Minto geometric mean K profile. A local adjustment was incorporated during the calibration to match the water levels observed down gradient of the MN Pit in MW09-03. MW17-11. The adjustment consisted of lowering the bedrock K (i.e., local Jiang model with lower K values from $1.1x10^{-8}$ m/s to $1.2x10^{-10}$ m/s) along the uphill ridges of the Minto Creek and McGinty Creek watersheds. This adjustment was considered plausible considering that a K value of $3x10^{-8}$ m/s was measured in MW17-11 in a shallow weathered bedrock interval (i.e., 7.5 m below bedrock), that the MN Pit is located at higher elevation, where thickness of weathered bedrock is reduced, and that this pit is characterized by relatively competent bedrock with minor groundwater inflows.

The calibration of the model (Figure 45) is considered reasonable, with a Normalized Root Mean Square Error (NRMSE) of 6.7% for hydraulic heads and 20.9% for baseflows. The model fits well the hydraulic heads and simulates baseflows within one standard deviation of the estimated baseflows at surface water stations. The Sept/Oct stream flows were assumed to represent the periods when groundwater is the dominant contributor but can still vary widely, so baseflows were determined using the median of the 2017-2021 Sept/Oct flow observations, which likely overestimate the actual winter baseflows.

In terms of comparisons to observed groundwater levels over time, the modelled head changes follow the observed trends and are within the same order of magnitudes. Figure 46 shows the predicted head changes at monitoring wells relative to pre-mining conditions. Between 2013 and 2021, when actual observations are available, four monitoring wells are influenced by mining activities:

- Within the active mine footprint, the modeled levels at MW12-07 decreased by up to 11 m between 2009 and 2014, rose back by 1.5 m in 2015 and 2016, and then declined again slowly by 4.5 m between 2017 and 2021; a 62 m level drop occurred in 2022 when the PEA design was incorporated. If constrained to the period of available observations, 3 phases are identified. In the first phase, the modeled levels declined by 3 m in 2013-2014; in the second phase, they rose back by 1.5 m in 2015-2016; and in the 3rd phase they declined again by 4 m in 2017-2021. In comparisons, actual monitoring started in 2013. Levels in Port#1 declined by 5 m in 2013-2014, rose back by 5 m in 2015-2016, then dropped by 76 m between mid 2017 and early 2018 while underground development access was being advanced from A2UG to MEUG. The model seems to capture reasonably the changes observed in phase 1 and 2. It misses the significant level drop in phase 3 but still shows a large level drop later with the mining of the PEA 2021 design. The difference could be linked to how the MEUG and ME2UG are modeled or actual discrete connections between MW12-07 and MEUG.

- In the Minto North area, the modeled levels at MW09-03 and MW17-11 decrease by up to 5 m and 14 m respectively between 2016 and 2021. The predictions at MW09-03 compares relatively well in their amplitude and timing to the drop of about 8 m observed around January 2016, at the estimated time the MN Pit reached under the pre-mining groundwater table. For MW17-11, observations are limited to the 2018-2020 period after mining of the Minto North was completed, therefore cannot be compare to pre-mining conditions.
- Along Minto Creek, upgradient of the WSP, the modeled levels in MW12-06 drop by less than a meter between 2013 and 2021. A declining trend was also noted in MW12-06, with levels declining by about 2 to 3 m, and interpreted as an effect of the depressurization cone spreading around the underground developments of CKUG and MEUG, possibly via preferential fractures.

5.4 Groundwater Flow Directions

Figure 47, 48, and 49 show the simulated groundwater heads for the pre-mining, 2021 As-built, and 2021 PEA conditions. Results are in agreement with the groundwater table interpolated from observations and with the conceptual flow directions presented in Section 4. The groundwater flows from high elevations to lower elevations, with flow directions modified locally by the presence of the Main Pit and A2S2 Pits or the underground mine dewatering. Overall, the flows converge towards the Minto Creek Valley.

5.5 Inflows and Infiltrations to/from Pits and Underground

Figure 50 compiles the predictions of inflows and infiltrations (outflows, or water entering groundwater) to/from pits and underground. The results are discussed below.

Main Pit

There are no historical records available of the Main pit inflow rates during excavation. The model predicts a peak of 1,700 m^3/d within the first two years while mining quickly progresses towards the final pit bottom elevation, then inflow decreases down to 1,300 m^3/d until the pit is used to store water and tailings in 2012. The rising of the water in the pit accentuates the inflow reduction, which stabilizes at about 200 m^3/d by the year 2014. The following years, it increases again as a result of mining activities in the A2 pits and plateaus to about 400 m^3/d between 2016 and 2020. Finally, the inflow declines slowly to 300 m^3/d by 2027.

Infiltration from the pits starts between 2013 and 2014. In 2015, it reaches 600 m^3/d, which is greater than the modeled inflows, meaning the pit shifted from a hydraulic sink to a source. In 2017 a peak of 1,200 m^3/d is correlated to effects from the A2S2 mining, then infiltration varies from 500 m^3/d in 2019-2020, to 200 m^3/d in 2021-2022, and finally increases to 900 m^3/d by 2027. The variations from 2020 onward are attributed to the underground mining activities.

A2 Pits

There are no historical records of the A2 pits inflow rates. For the A2S2 Pit, the model predicts an initial inflow of 700 m^3/d, a peak of 1,200 m^3/d early 2017 correlated to an increase of infiltration in the Main Pit, a rapid decline in 2017-2018 down to 300 m^3/d, 200 m^3/d in 2020, and a final decline to small rates of 20 m^3/d. For the A2S3S4 Pit, the model predicts an initial peak inflow of 500 m^3/d, a rapid decline and small inflow rates of 30m3/d between 2021-2027

Infiltrations from the A2S2 and A2S3S4 pits start respectively in 2017 and 2018. They both increase within two years to a plateau of about 900 m^3/d and start increasing again in 2022 when the 2021 PEA design is being mined. By 2027, infiltration reaches 1,800 m3/d in both pits. The A2S2 pit shifts from a hydraulic sink to a source in 2018, and the A2S3S4 in 2019.

A118 Pit

The model does not predict inflows to nor infiltrations from the A118 Pit, as observed.

Minto North Pit

The model predicts a minor inflow and infiltration at the Minto North Pit. Inflow is about 10 to 30 m^3/d, and infiltration about 5 m^3/d.

Underground

The model predicts an inflow ranging between 500 and 800 m^3/d between 2015 and 2017, followed by an increase to about 1,900 m^3/d in 2018 when the ramp accessed the deepest part of the 2021 As-Built mine in the MEUG area, and then a plateau. These trends are in agreement with the observed total inflow rates observed underground between 2015 and 2020 (Figure 16, Section 3.4.1). The observed rates are generally lower than modeled (i.e., 200 m^3/d and 1,700 m^3/d in the first and second phase respectively) but still considered a reasonable fit. The discrepancies between observed and modeled could be related to artefacts caused by the yearly incrementation of the mining progression, a slightly overestimated bulk bedrock K, and/or actual heterogeneity in the fractured bedrock. The fact that model simulates the same magnitudes of inflows as observed indicates model properties are in the correct range and shows that the underground flows as observed can be replicated by the general behaviour of the fractured rock mass rather than specific geological structures.

In the future, as mining of the 2021 PEA design progresses, the model predicts underground inflows will rise to 7,400 m^3/d in 2023 then increase to 9,000 m^3/d in 2027, with a peak of 9,500 m^3/d in 2026 after the mine has reached its maximum depth.

5.6 Changes to Baseflows

Figure 51 plots the predicted changes to baseflows over time at surface water stations. The changes are expressed as relative percentage differences with pre-mining baseflow rates. The model predicts baseflows will be reduced at the end of the mining operations, in 2027, by 70% at

W3, 37% at W46, 20% at MC1, and 6% at MN1.5. These numbers do not consider any waters added to streams by changes in surface water management or managed discharge.

5.7 Transport Simulations

Conservative (i.e., not attenuated) solute transport simulations were completed to assess how load could be moving in groundwater, assuming that sources are the waste dumps, DSTSF, pits, and underground. The objective was to evaluate comparatively the distance of travel from mine sources and relative concentrations when the full mining progression is incorporated to the numerical simulations.

Source terms and transport properties of the model were summarized in Table 5.2. Source terms for all mine sources were fixed at 1,000 mg/L. Figure 52 shows the predicted extent of transport for the 50 mg/L contour (5% of source) on January 1st 2022 (2021 As-built conditions) and January 1st, 2027 (2021 PEA conditions).

The simulation shows concentrations near source term values only exist in relatively close proximity to sources themselves:

- At the waste dumps, the permafrost restricts the movement of the loads to generally remain near surface. Where permafrost is absent, the plume travels towards and discharges to the Main Pit or moves slowly to lower depths. The 50 mg/L plume front has already reached the Main Pit in the January 2022 scenario.
- At the DSTSF, the permafrost also restricts the movement of the loads to near surface. Where permafrost is absent, the plume travels south west towards the Minto Creek valley or else is pulled north east to lower depths by the underground depressurization. For either the January 2002 or January 2027 scenario, the 50 mg/L plume front has remained within or at close proximity to the DSTF footprint.
- At the pits, the plumes for the January 2022 scenario have travelled outside the pit footprints. The plumes from the Main Pit and A2 pits generally migrated further west towards the Minto Creek valley, and the plume from the Minto North Pit towards the East McGinty Creek valley. The 50 mg/L plume fronts have remained within 250 m of the pit footprints and did not reach surface discharge locations. The concentration reported at the monitoring well MW12-07 is 110 mg/L.
- For the January 2027 scenario, the plume extended to the full extent of the mine as a result of the additional underground load, which was assumed to start at the end of the 2021 PEA mining plan (i.e., January 2028). The 50 mg/L plume fronts have remained within 350 m of the pit footprints and 200 m of the underground footprint. The plumes did not reach surface discharge locations. The concentration reported at the monitoring well MW12-07 is 400 mg/L.

Table 5.3 presents the predicted percentage of load from each source to various sub-catchments via the groundwater pathway.

Table 5.3: Percentage of source seepage discharges to surface water baseflows

Receptors		Percentage of source seepage discharges to surface water baseflows (Jan. 1st, 2027)			
		Dumps	DSTSF	Pits	Underground
Minto Creek	Upstream of W3 (1)	15%	0%	0%	0%
	Downstream of W3	0%	0%	0%	0%
McGinty Creek	Downstream of MN1.5	0%	0%	0%	0%

Note:

1 Includes discharges to the mine (i.e., pits and/or underground)

6 Conclusions

This report provides an update on the conceptual model presented in the *Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report* (SRK 2018) and the *Minto 2015 Groundwater Model Update* (SRK 2015). It provides a summary of the current groundwater conditions (quantity and quality) incorporating the monitoring data gathered since submission of the aforementioned reports.

Overall, the Minto Creek and McGinty Creek conceptual models have not changed significantly from that presented in the SRK 2018 report. The groundwater system is believed to be a relatively low flow, low conductivity, fracture-controlled flow system. A majority of flow is expected to occur relatively near to ground surface, where not frozen. Groundwater can flow into and out of the flooded Main Pit or A2 Pits and is also intercepted by underground workings. The large majority of mine contact water is expected to ultimately discharge to ground surface by the area of the Water Storage Pond. Groundwater that does pass the Water Storage Pond has a limited flow rate and is expected to discharge to Minto Creek with contributions from unaffected catchments increasing progressively downstream.

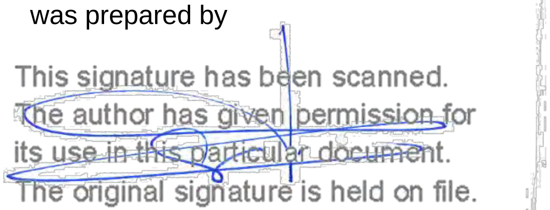
Two differing groundwater geochemical facies exist on at Minto: a) a lower TDS $Ca\text{-}HCO_3$ to $Mg\text{-}HCO_3$ facies, typically associated with shallow, fresh groundwaters or groundwater upgradient of the ore bodies, and b) a higher TDS $Ca\text{-}SO_4$ to $Na\text{-}SO_4$ facies associated with groundwater topographically downgradient of the ore bodies. In terms of groundwater quality, the concentrations measured at the Minto Mine are largely within the range of observed baseline conditions. A low number of consistent SPT exceedances occur for sulphate (MW12-05-01, -02, and 03) and chromium (MW12-06-01) within the Minto Creek catchment, and for arsenic (MW09-03-01) and cadmium, nitrate, and zinc (MW09-03-02) within the McGinty Creek catchment.

Elevated sulphate concentrations in groundwaters near sulphide-containing ore bodies are not uncommon due to interaction with sulphur bearing minerals along the groundwater flow paths. While sulphate concentrations have been increasing and exceeding thresholds in the deeper zones, all available evidence suggest they are not related to mine activities but naturally occurring due to interaction with the sulphur-bearing minerals of the ore body. The exceedances of chromium are thought to be caused by changes in redox conditions related to the underground mining activities, and not from mine affected waters infiltrating into groundwater. The elevated nitrate is also interpreted to occur from a change in redox conditions subsequent to the development of the Minto North Pit, as well as a contribution of nitrogen load from the construction of a haul road using blasted rock. Arsenic, cadmium, and zinc may also be attributed to a change in aquifer conditions.

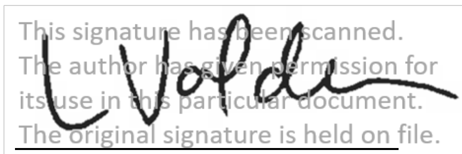
The groundwater numerical model was modified according to the latest site data and upgraded to reproduce the surface and underground mining sequence. The calibration of the model was considered reasonable and fitted well the hydraulic heads and simulated baseflows within one standard deviation of the estimated baseflows at surface water stations. The model reproduced reasonably well the observed groundwater level trends in monitoring wells, and the observed underground inflow rates. It cannot currently reproduce some of the observed sulphate concentrations but does provide a robust picture of how the overall groundwater system is likely working.

The model replicated the full mine progression from 2005 to 2007 and predicted the inflows and infiltration to/from pits and underground between 2007 and 2027, extents that mine affected waters would have travelled by end of mining, and how much load would have discharged to surface. The numerical model estimates that concentrations away from mine sources are low and that plumes had not reached surface receptors, which is generally consistent with the conceptual model and observed data.

This report, *Minto Groundwater Characterization, Conceptual and Numerical Model Update Report*, was prepared by



Gregory Fagerlund, MSc. PGeo
Senior Consultant (Hydrogeologist)



Laura Volden, MSc. PGeo
Consultant (Hydrogeochemistry)

and reviewed by

Dan Mackie, MSc. PGeo
Principle Consultant (Hydrogeology)

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

7 References

[BC MOE] British Columbia Ministry of Environment, 2012. Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities. Report number 194001. Prepared by Robertson GeoConsultants Inc. & SRK Consulting (Canada) Inc for BC Ministry of Environment. http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/groundwater_modelling_guidelines_final-2012.pdf

Beale G, and J Reed. 2013. Guidelines for evaluating water in pit slope stability. CSIRO Publishing, Collingwood, Australia. 600 p.

Clark, Ian D., and Peter Fritz. *Environmental isotopes in hydrogeology*. CRC press, 1997.

[EBA] EBA Engineering, 2011. Site plan showing boreholes with identified permafrost and ice. Drawing. October 2011.

B. B. S. Singhal, R. P. Gupta, Applied Hydrogeology of Fractured Rocks, DOI 10.1007/978-90-481-8799-7, Springer Science Business Media B.V. 2010

IAEA/WMO, 2017. Global Network of Isotopes in Precipitation. The GNIP Database. Accessible at http://www.iaea.org/water

Jiang, Xiao-Wei, Xu-Sheng Wang, Li Wan, 2010. Semi-empirical equations for the systematic decrease in permeability with depth in porous and fractured media. Hydrogeology Journal. 18:839-850.

Lacelle, Denis. "On the δ18O, δD and D-excess relations in meteoric precipitation and during equilibrium freezing: theoretical approach and field examples." *Permafrost and Periglacial Processes* 22.1 (2011): 13-25.

Minto Explorations, 2012. Phase VI Preliminary Feasibility Report, Minto Mine. July 2012.

Minto Explorations Ltd., 2016. Minto Mine Groundwater Monitoring Plan, Version 2016-01. Report prepared by Minto Explorations Limited, with contributions from SRK Consulting. July 2016.

Minto Explorations, 2017. Minto Mine Operations Adaptive Management Plan 2017-02. April 2017.

SRK Consulting (Canada) Inc., 2012. SRK Consulting (Canada) Inc. Minto Mine Phase IV Water and Load Balance Model Report. May.

SRK Consulting (Canada) Inc., 2013. Minto Mine Phase V/VI Expansion: Hydrogeological Characterization Report. Report submitted to Minto Explorations Ltd. 1CM002.008. May 2013. 246 pages.

SRK Consulting (Canada) Inc., 2014a, Memo: Interpreted Bedrock Surface at the Minto Mine Site. Memo. 1CM002.027. July 2014. 10 pages.

SRK Consulting (Canada) Inc., 2014b. Main Dam Preliminary Design Report. Report submitted to Minto Explorations Ltd. 1CM002.018. July 2014. 385 pages.

SRK Consulting Canada) Inc., 2014c, Memo: Surficial Geology Map - Minto Creek Watershed. Memo. 1CM002.032. Nov. 2014. 10 pages.

SRK Consulting (Canada) Inc., 2014d. Minto Mine Groundwater Numerical Model. Report submitted to Minto Explorations Ltd. 1CM002.032. November 2014. 78 pages.

SRK Consulting (Canada) Inc., 2015a. Minto 2015 Groundwater Model Update. Report submitted to Minto Explorations Ltd. 1CM002.041. November 2015. 25 pages.

SRK Consulting (Canada) Inc., 2015b. 2014 Water Balance and Water Quality Model Summary for the Minto Mine Site. Memo submitted to Minto Explorations Ltd. 1CM002.024. March 2015. 16 pages.

SRK Consulting (Canada) Inc., 2017b. 2017 Monitoring Well Installation Report. Report submitted to Minto Explorations Ltd. 1CM002.58. in prep.

SRK Consulting (Canada) Inc., 2017c. Minto Mine Groundwater Monitoring Program - Environmental Tracer Study Results. Report submitted to Minto Explorations Ltd. 1CM002.57. July 2017. 14 pages.

SRK Consulting (Canada) Inc., 2018a. Water and Load Balance Model Report 2018. Prepared for Minto Explorations Ltd. January 2018.

SRK Consulting (Canada) Inc., 2018b. Minto Groundwater Characterization and Hydrogeologic Conceptual Model Update Report. Report submitted to Minto Explorations Ltd. 1CM002.57. January 2018. 148 pages.

SRK Consulting (Canada) Inc., 2020a. Minto Mine –2019 Groundwater Review and Summary of OAMP SPT Exceedances. Report submitted to Minto Explorations Ltd. 1CM002.057. June 2020. 170 pages.

SRK Consulting (Canada) Inc., 2021a. Response to the Yukon Water Board Request for Information (IR5-48) – Sulphate Exceedances in Groundwater. Technical memo submitted to Minto Explorations Ltd. 1CM002.044. February 2021. 10 pages.

SRK Consulting (Canada) Inc., 2021b. Minto Mine –2020 Groundwater Review and Summary of OAMP SPT Exceedances. Report submitted to Minto Explorations Ltd. 1CM002.055. March 2021. 197 pages.

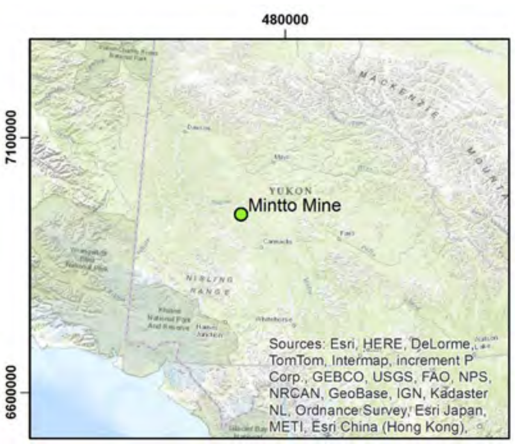
SRK Consulting (Canada) Inc., 2021c. Water and Load Balance model Update Report 2021.

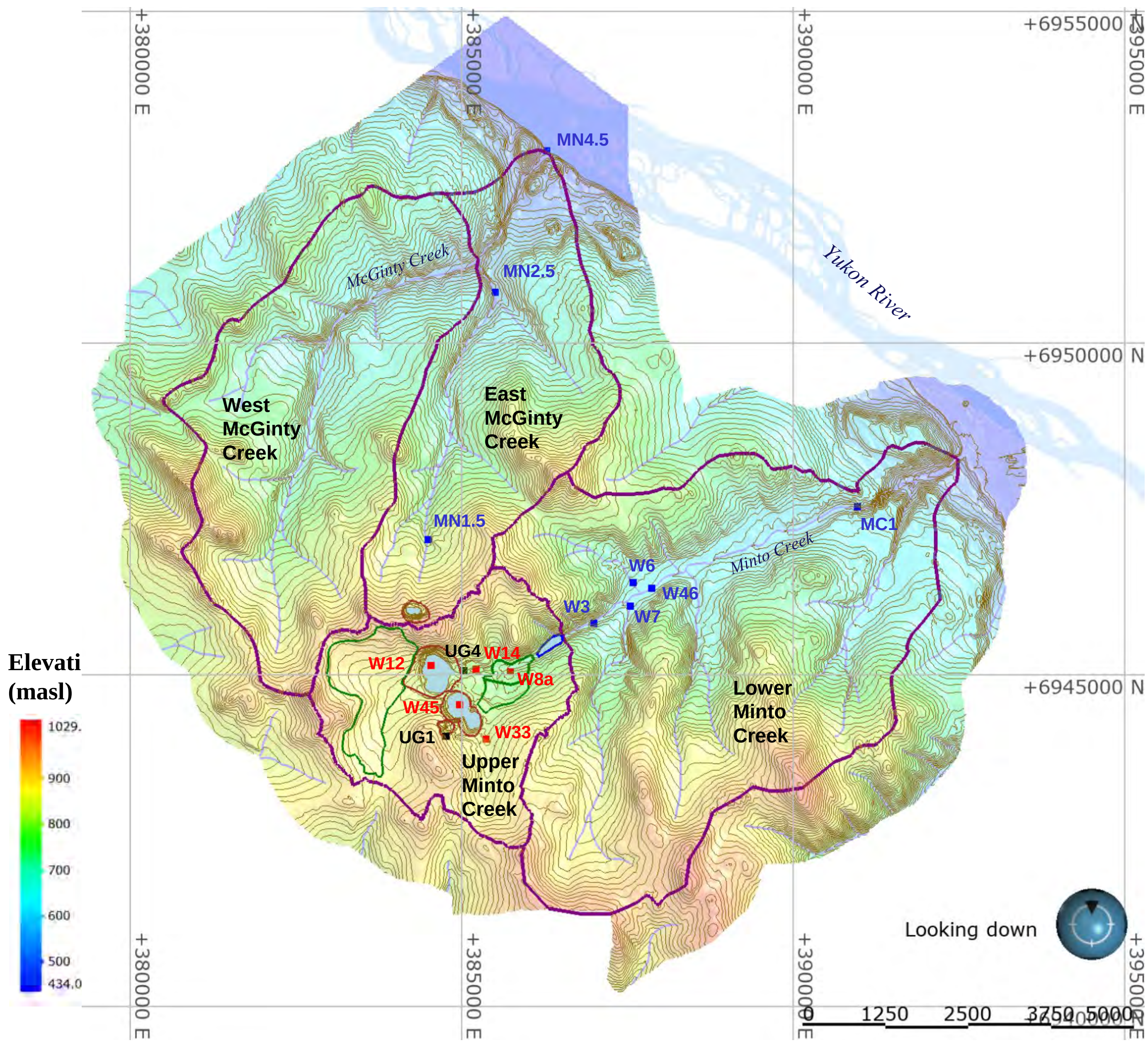
Tafti, Reza. *Nature and origin of the early Jurassic copper (-gold) deposits at Minto and Williams Creek, Carmacks Copper Belt, Western Yukon: subtitle examples of deformed porphyry deposits*. Diss. University of British Columbia, 2005.

Figures

Surface water station

- Creek/tributary
- Surface mine infrastructure
- Underground mine infrastructure
- Water storage pond
- Open pits
- Waste rock dumps
- Catchment divides
- Mined-out topographical contours (10m interval)

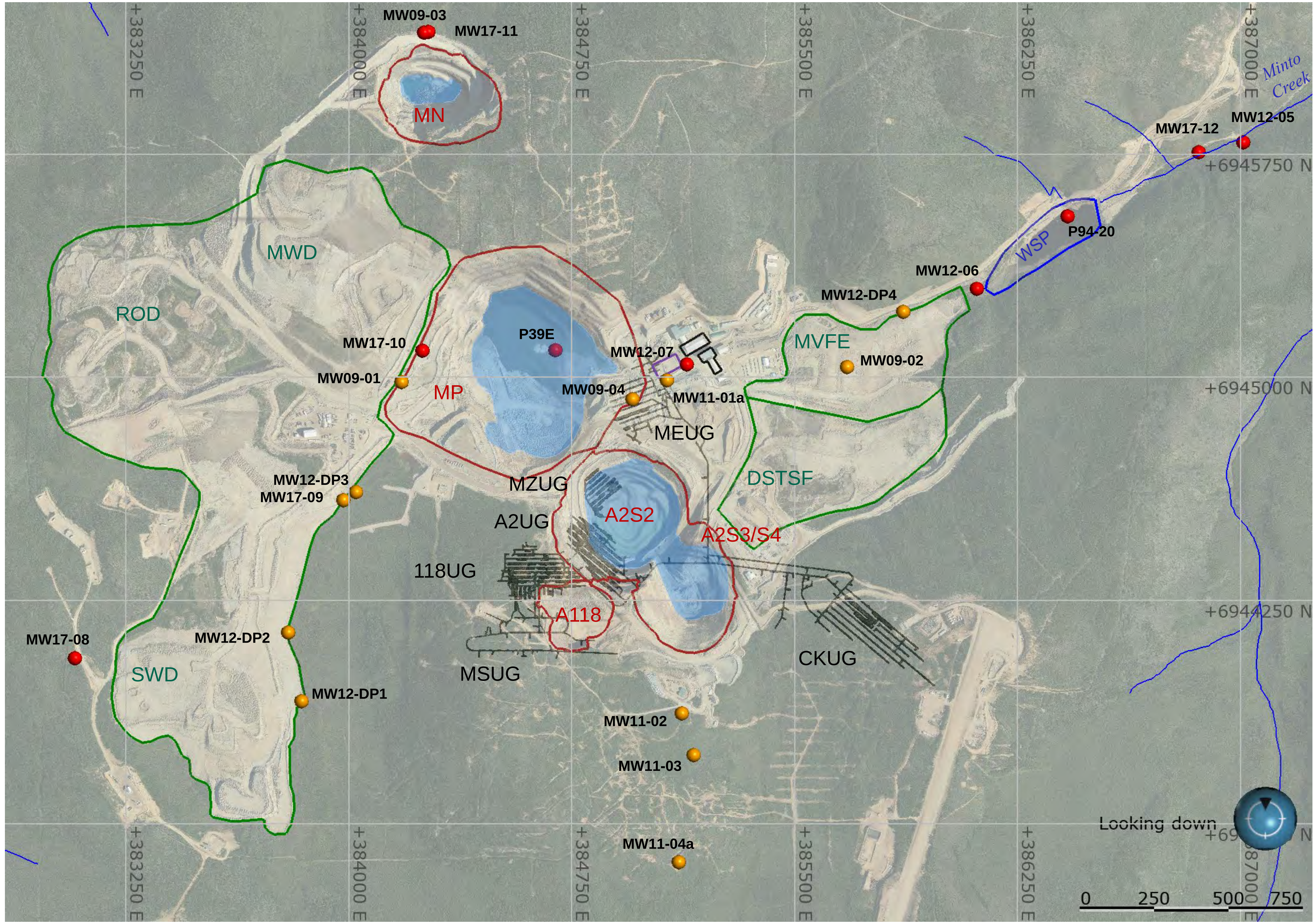




srk consulting	MINTO	Minto Groundwater Model Update
		Regional catchment topography
Job No: 1CM002.072 Filename: 1CM002.072_Fig01_RgnlCatchmtTopo.pptx	MINTO MINE	Date: Oct. 2021 | Approved: GF | Figure: 1

Groundwater Monitoring Wells:

- Active
- Inactive (dry, frozen, or damaged)
- Water storage pond
- Open pits
- Underground
- Waste rock dumps
- Pit lake



MineAreaOrthoMosaic-20170803-24CM

NAD 1983 UTM Zone 8N

srk consulting

MINTO

Job No: 1CM002.072

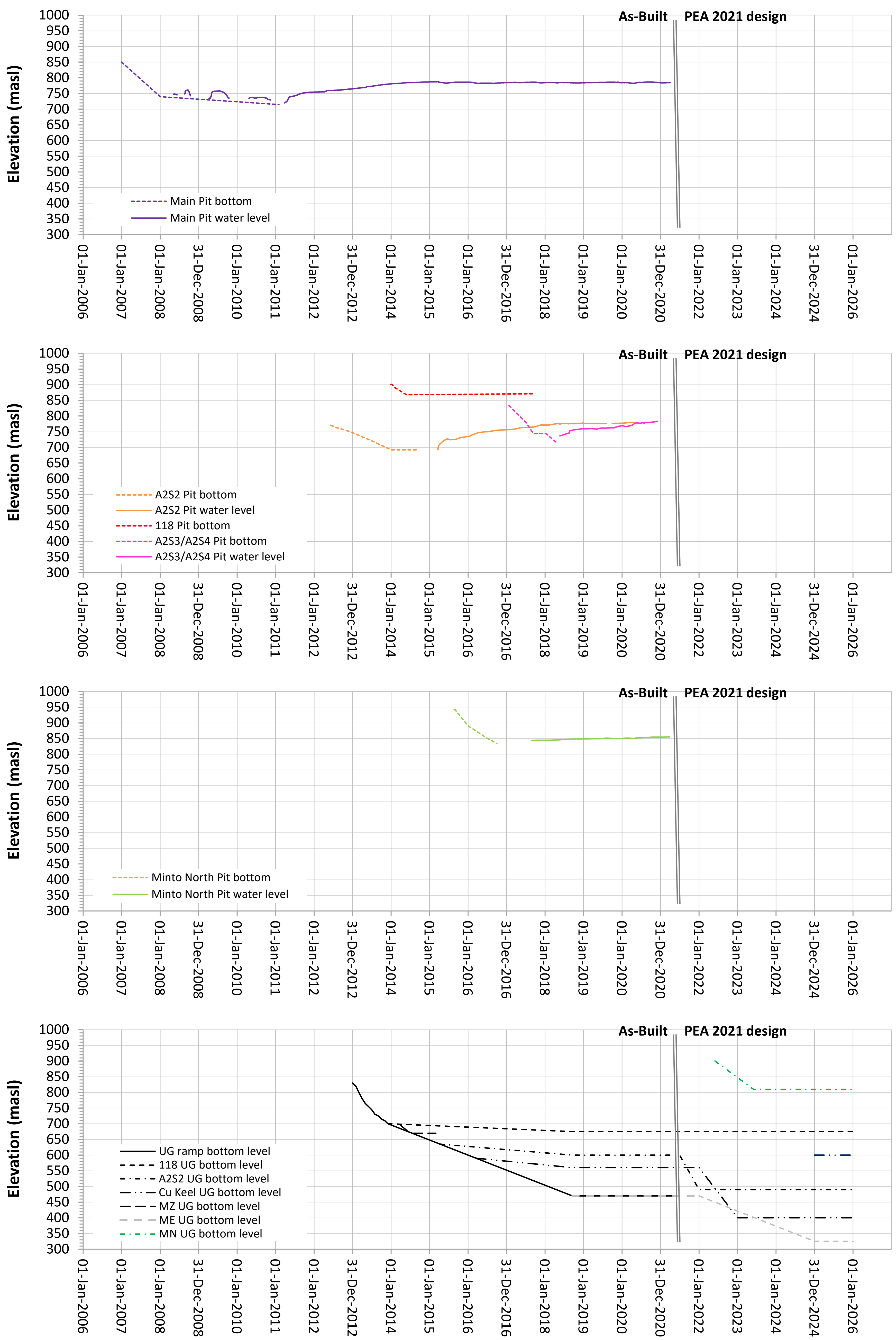
Filename: 1CM002.072_Fig02_MineLayout&MW.pptx

MINTO MINE

Minto Groundwater Model Update

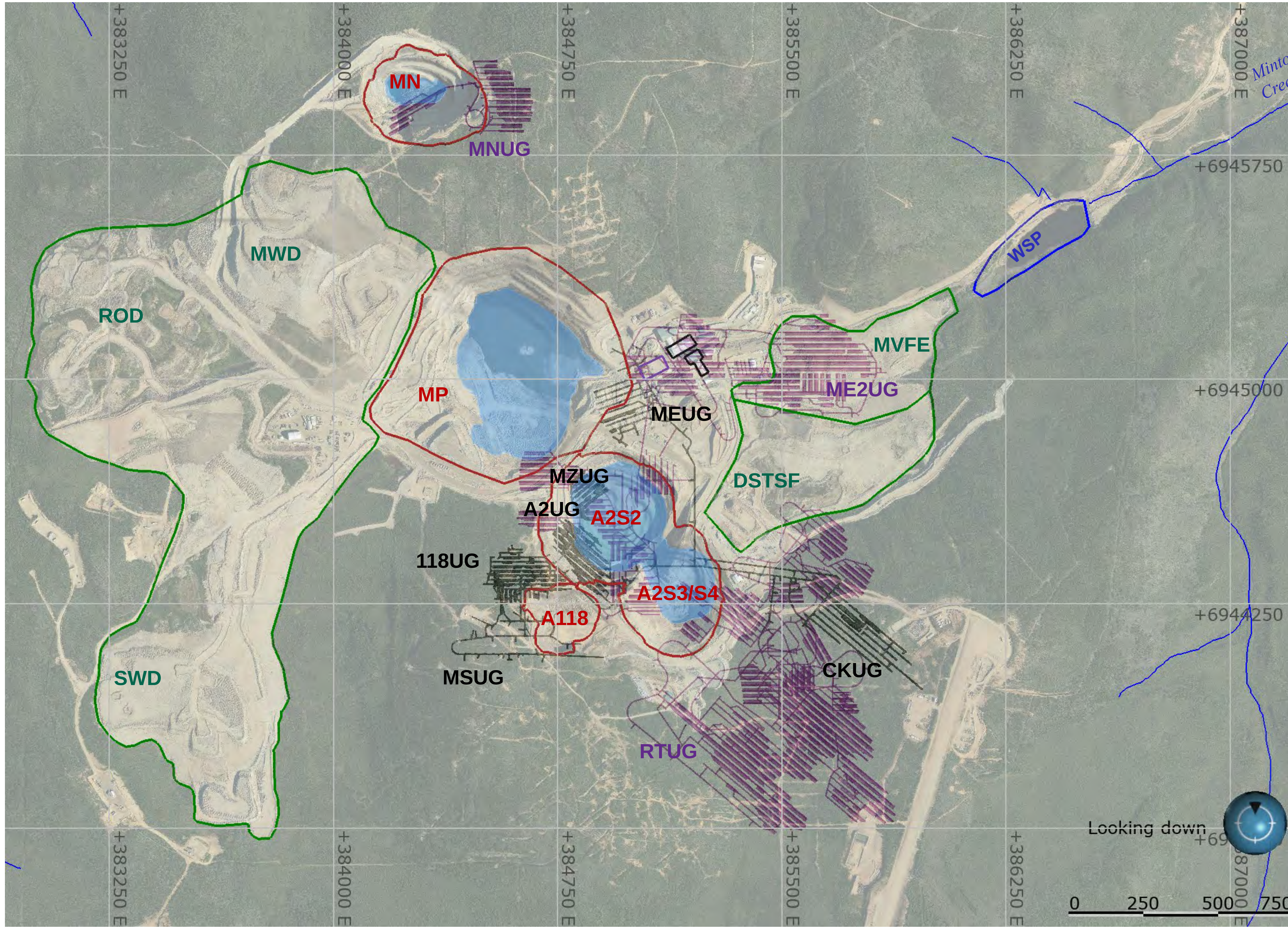
Mine layout and groundwater well monitoring network

Date:	Approved:	Figure:
Oct. 2021	GF	2



srk consulting	MINTO	Minto Groundwater Model Update
		Mining sequence: bottom elevations in pits and underground, and water levels in pit lakes and WSP
Job No: 1CM002.072 Filename: Fig03_Mining Sequence.pptx	MINTO MINE	Date: Oct.2021 · Approved: GF · Figure: 3

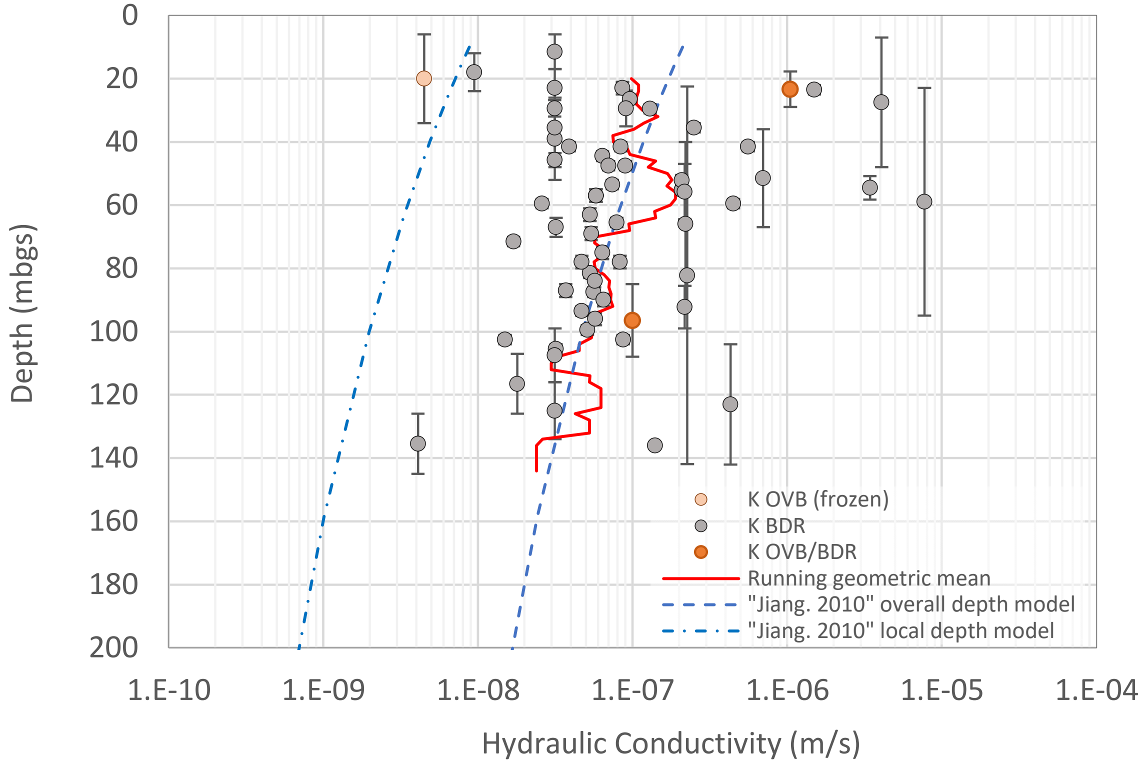
- Water storage pond (As-built 2021)
- Open pits (As-built 2021)
- Underground developments (As-built 2021)
- Future underground developments (PEA 2021)
- Waste rock dumps (As-built 2021)
- Pit lake

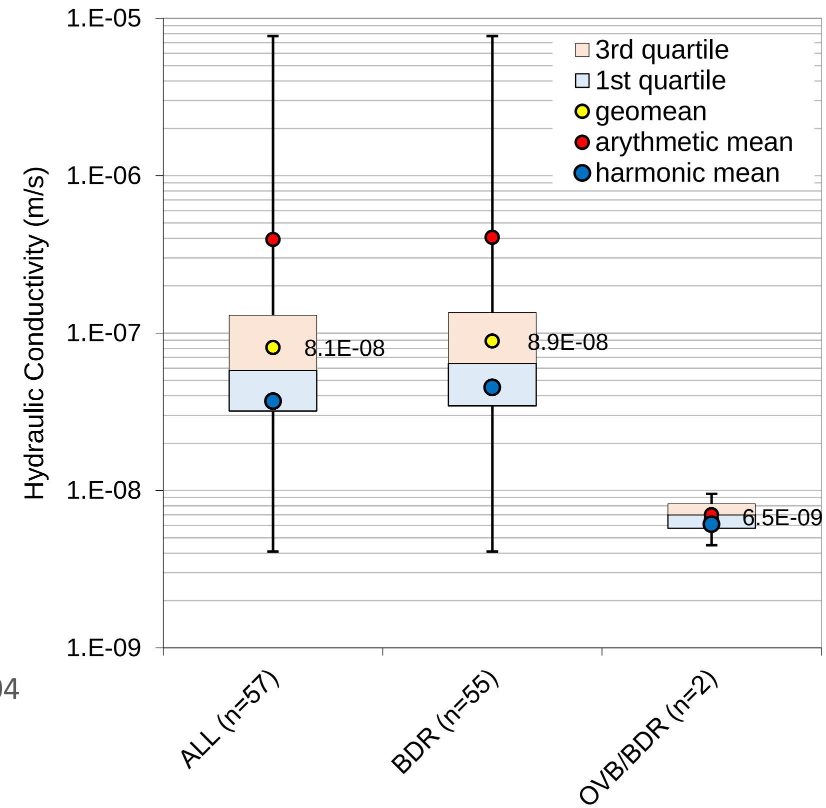


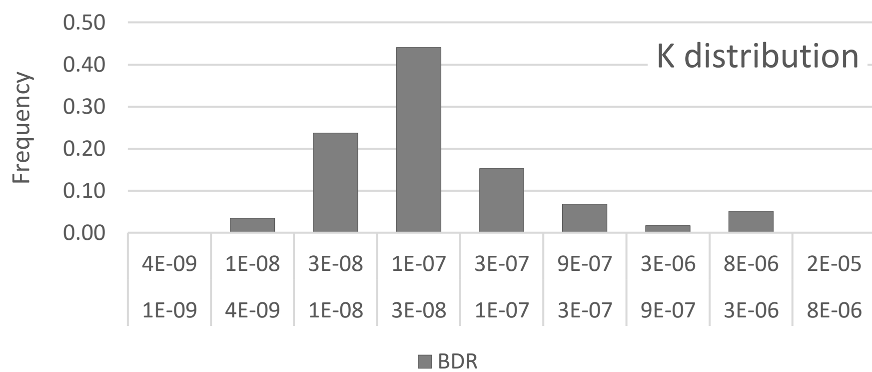
MineAreaOrthoMosaic-20170803-24CM

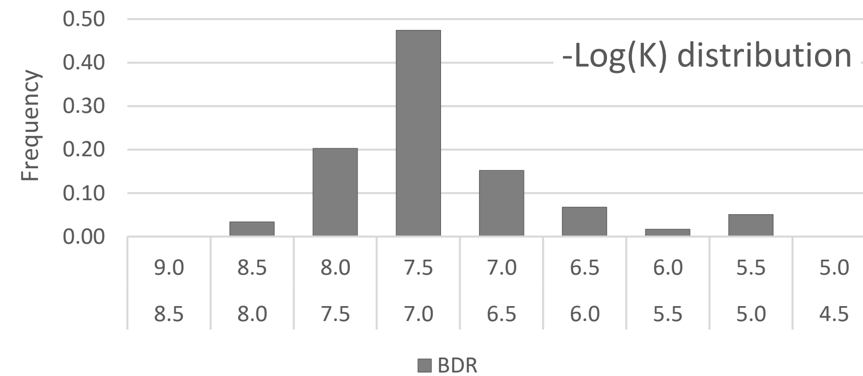
NAD 1983 UTM Zone 8N

srk consulting	MINTO	Minto Groundwater Model Update
		2021 PEA Mine layout
Job No: 1CM002.072 Filename: 1CM002.072_Fig04_2021_PEA_Mine.pptx	MINTO MINE	Date: Oct. 2021 / Approved: GF / Figure: 4









srk consulting

MINTO

Minto Groundwater Model Update

Hydraulic Conductivity Data

Job No: 1CM002.072

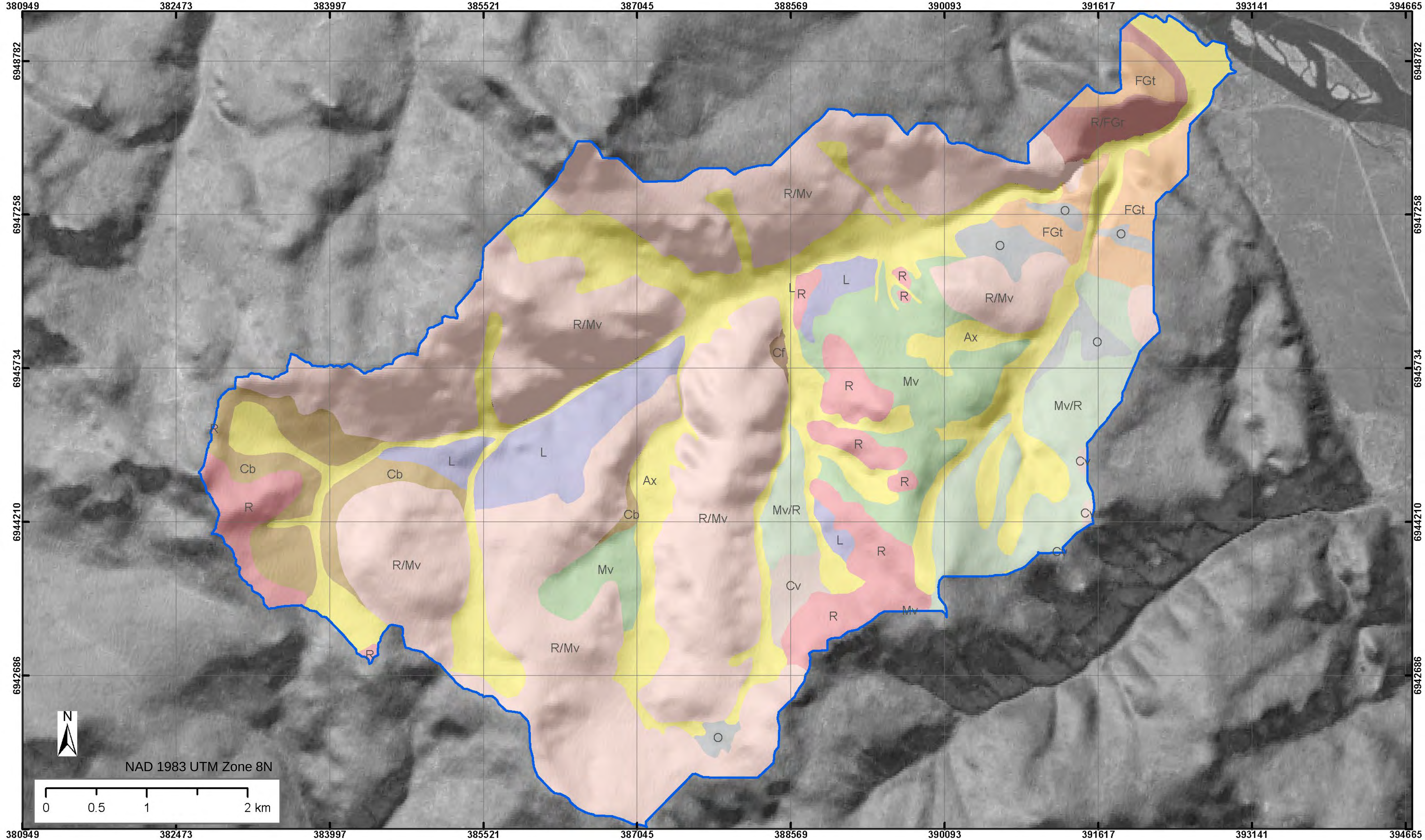
Filename: 1CM002.072_Fig05_K_Data.pptx

MINTO MINE

Date: Oct. 2021

Approved: GF

Figure: 5



Legend

Surficial Geology Unit				
Ax - Alluvial	Cb - Colluvial blanket	FGt - Glaciofluvial terrace	Mv/R - Morainal till / rock	R/Mv - Weathered bedrock / morainal till veneer
	Cf - Colluvial fan	L - Lacustrine	O - Organic	R/FGr - Weathered bedrock / glaciofluvial
	Cv - Colluvial veneer	Mv - Morainal till veneer	R - Bedrock	

PATH: E:\Projects\Minto\Surficial Geology Mapping\Memo\Attachments\Attachment1_MintoCreekSurficialGeology.mxd

srk consulting

MINTO

Minto Groundwater Model Update

Minto Creek Watershed Surficial Geology Map

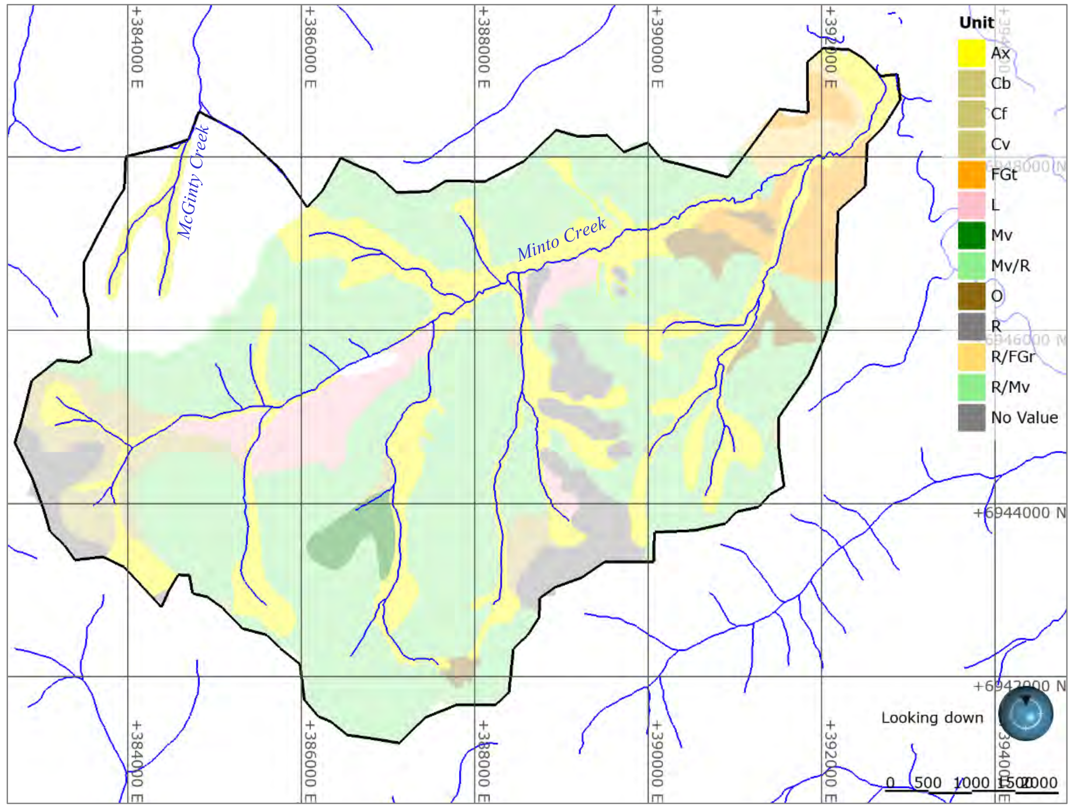
Job No: 1CM002.072

Filename: 1CM002.072_Fig06_SurficialGeol.pptx

MINTO MINE

Date:	Approved:	Figure:
Oct 21	GF	6

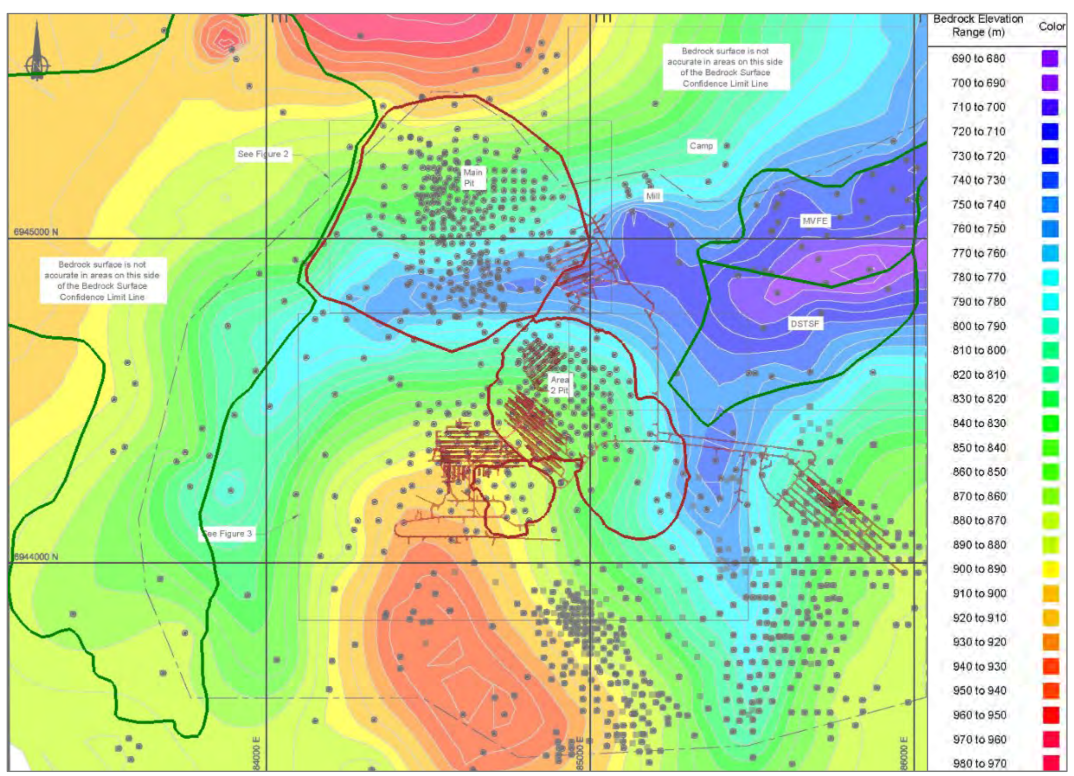
NAD 1983 UTM Zone 8N



Dataset #2: Surficial geology map interpreted from aerial photos.

Source: *SRK Consulting *Canada) Inc., 2014c, Memo: Surficial Geology Map - Minto Creek Watershed. Memo. 1CM002.032. Nov. 2014. 10 pages.*

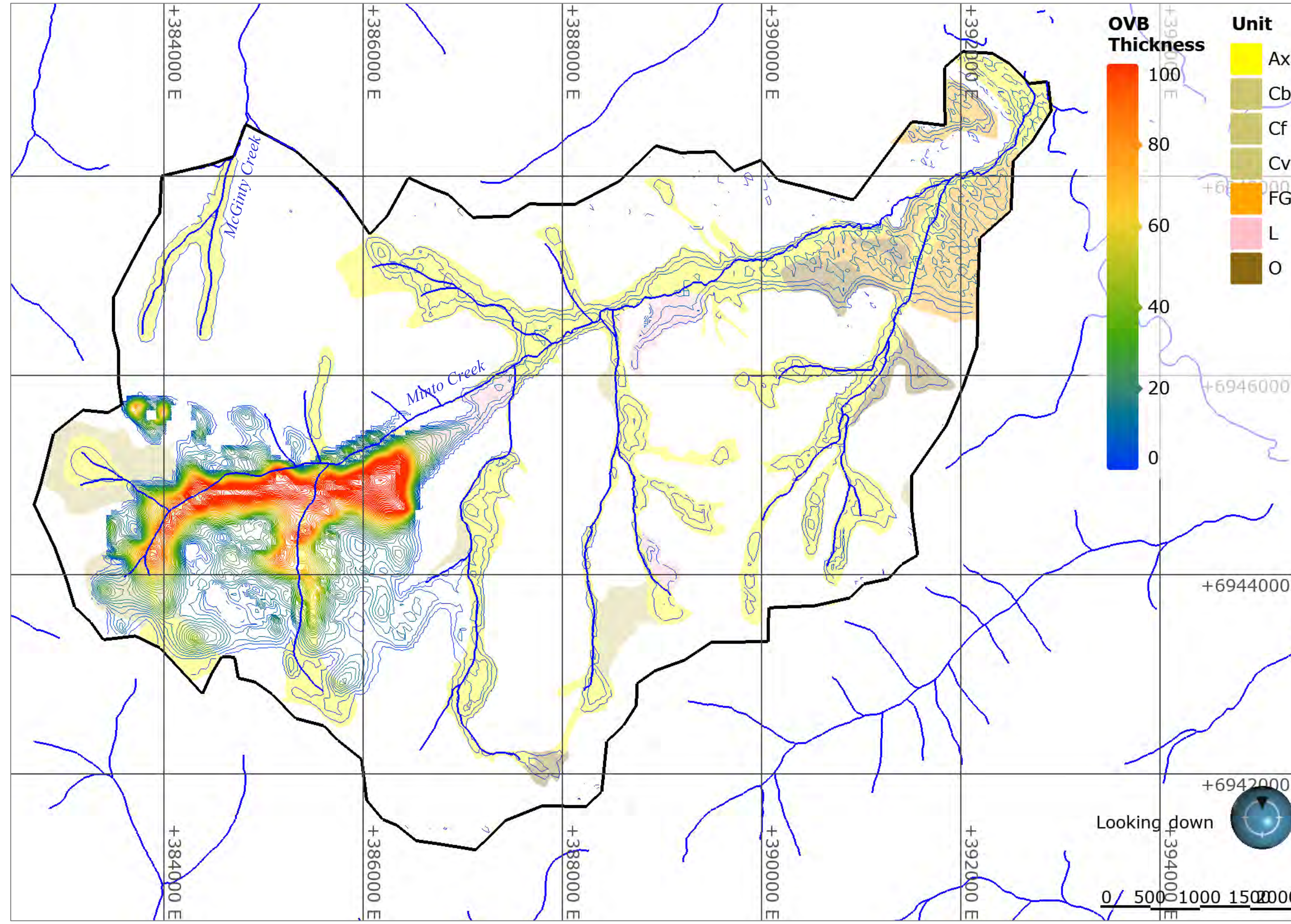
Note: *Fluvial alluvium assumed present in the McGinty Creek valley.*



Dataset #1: Drillhole logs

Sources: *Isopach map: SRK Consulting (Canada) Inc., 2014b. Main Dam Preliminary Design Report. Report submitted to Minto Explorations Ltd. 1CM002.018. July 2014. 385 pages;*

Note: *Drillhole logs from MEL database provided on Sep. 2020 were added to the 2014 map.*



Pre-mining overburden thickness model based on dataset #1 and #2.

Note: *Outside the mine area, where drillhole logs are not available, the overburden is inferred to be 5 to 10m in the valleys where alluvial, colluvial, lacustrine or organic units are mapped, <1 m thick for colluvial and morainal units, and null at bedrock outcrops,*

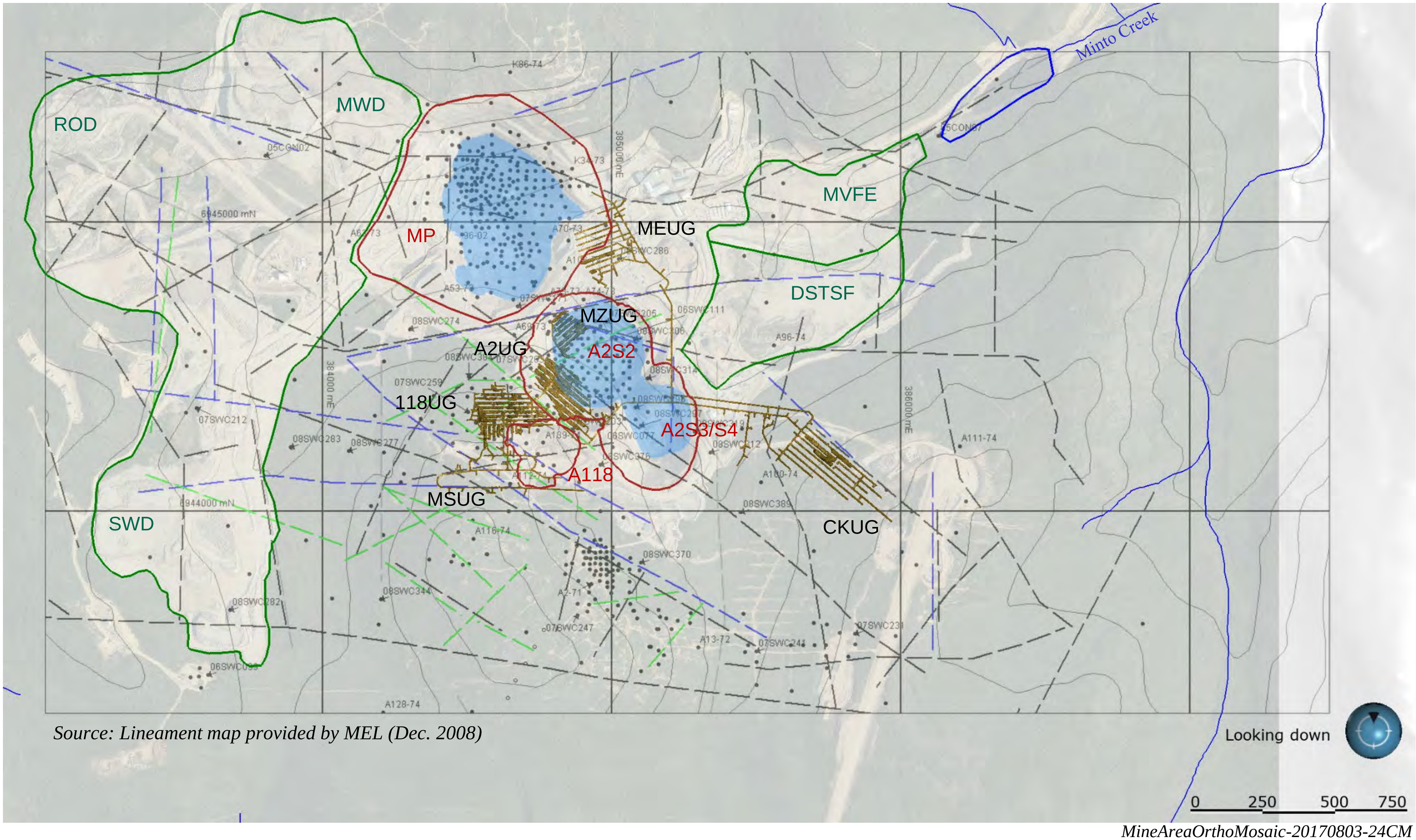
Ax, alluvium
Cb, colluvial blanket
Cf, colluvial fan
Cv, colluvial veneer
FGt, glaciofluvial terrace
L, lacustrine
O, organic,

Mv, morainal till veneer
Mv/R, morainal till / rock
R, bedrock
R/Mv, weathered bedrock / morainal till veneer
R/FGr, weathered bedrock / glaciofluvial

- Drillhole (2014b)
- Drillhole (2020)

Water storage pond
Open pits / underground
Waste rock dumps
Model domain

srk consulting	MINTO	Minto Groundwater Model Update
		Overburden thickness model
Job No: 1CM002.072 Filename: Fig07_Ovb_Thcknss_Mdl.pptx	MINTO MINE	Date: Oct. 2021 / Approved: GF / Figure: 7



Lineaments

Water storage pond

Open pits

Underground

Waste rock dumps

Drillholes (2008)

Pit lake

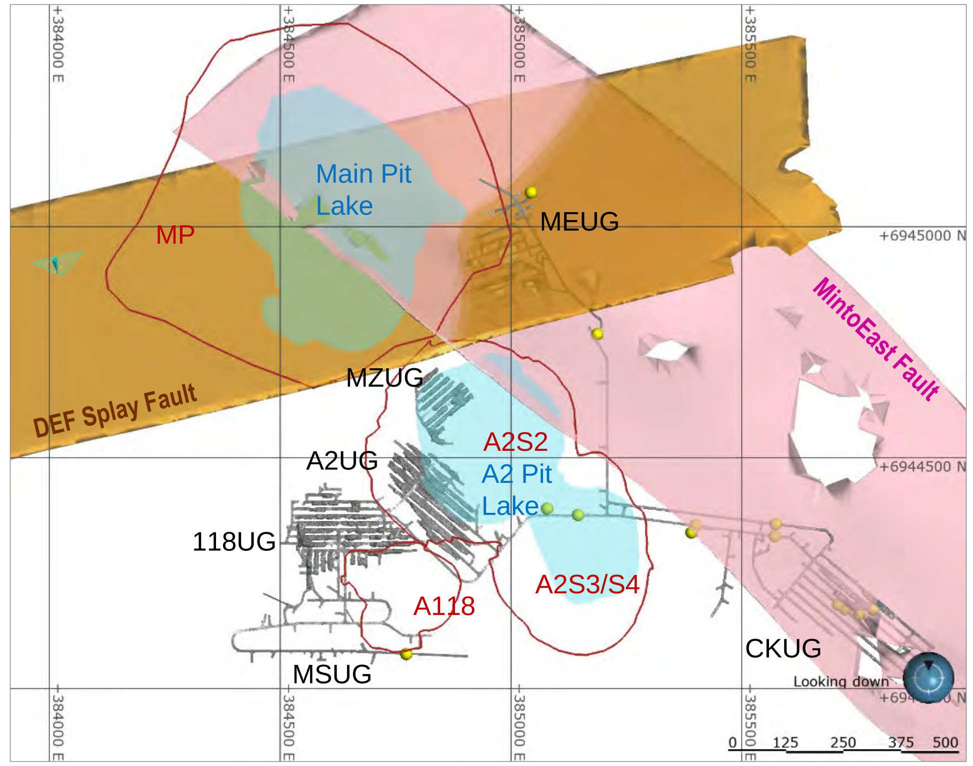
srk consulting	MINTO	Minto Groundwater Model Update
		Lineament Mapping (MEL, 2008)
Job No: 1CM002.072 Filename: 1CM002.072_Fig08_Lineaments.pptx	MINTO MINE	Date: Oct. 2021 / Approved: GF / Figure: 8

The four figures show the geological structures identified by MEL and located at proximity of underground point sources of high, consistent inflows.

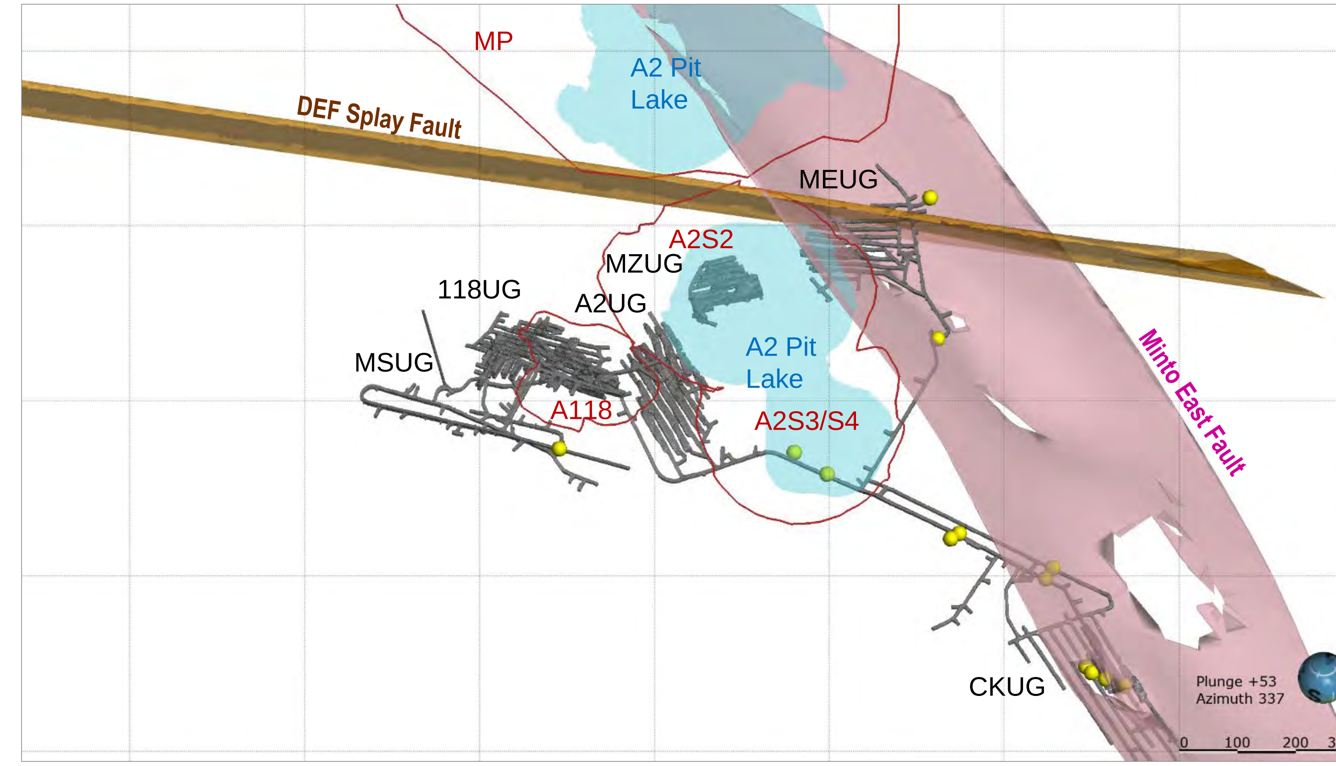
View #1 focuses on structures potentially intercepting MEUG point sources of inflow, and View #2 the ramp under the A2S3S4 pit lake and CKUG.

Point sources of inflow
(See section 3.4.1 of the report, and Figure 17 for additional details)

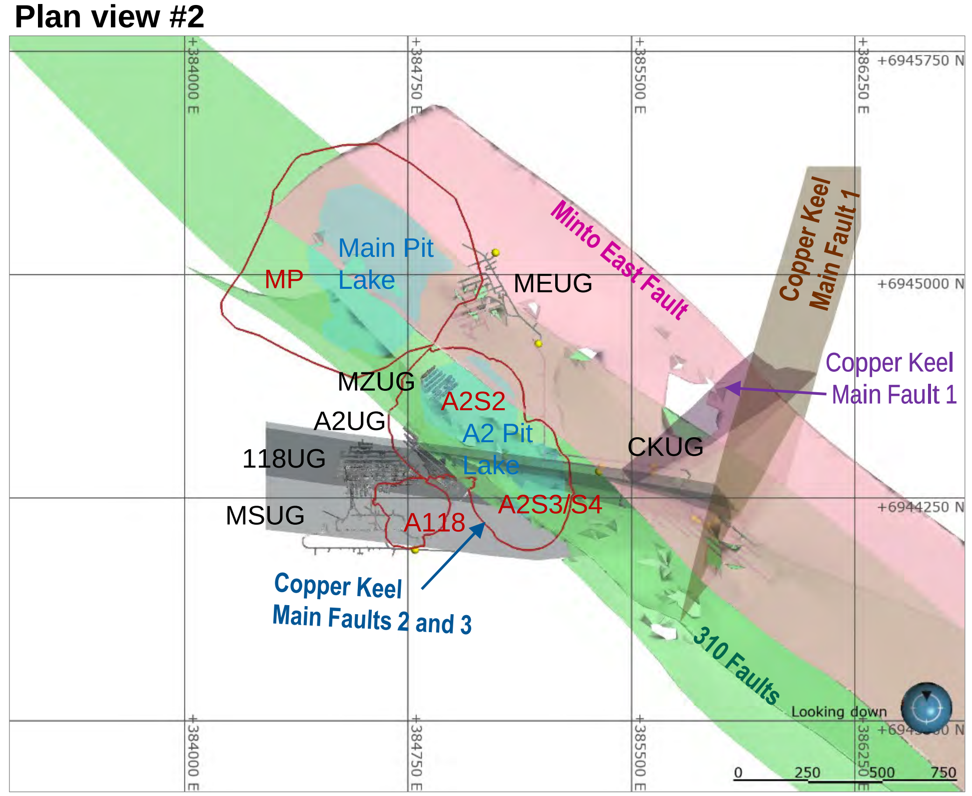
Plan view #1



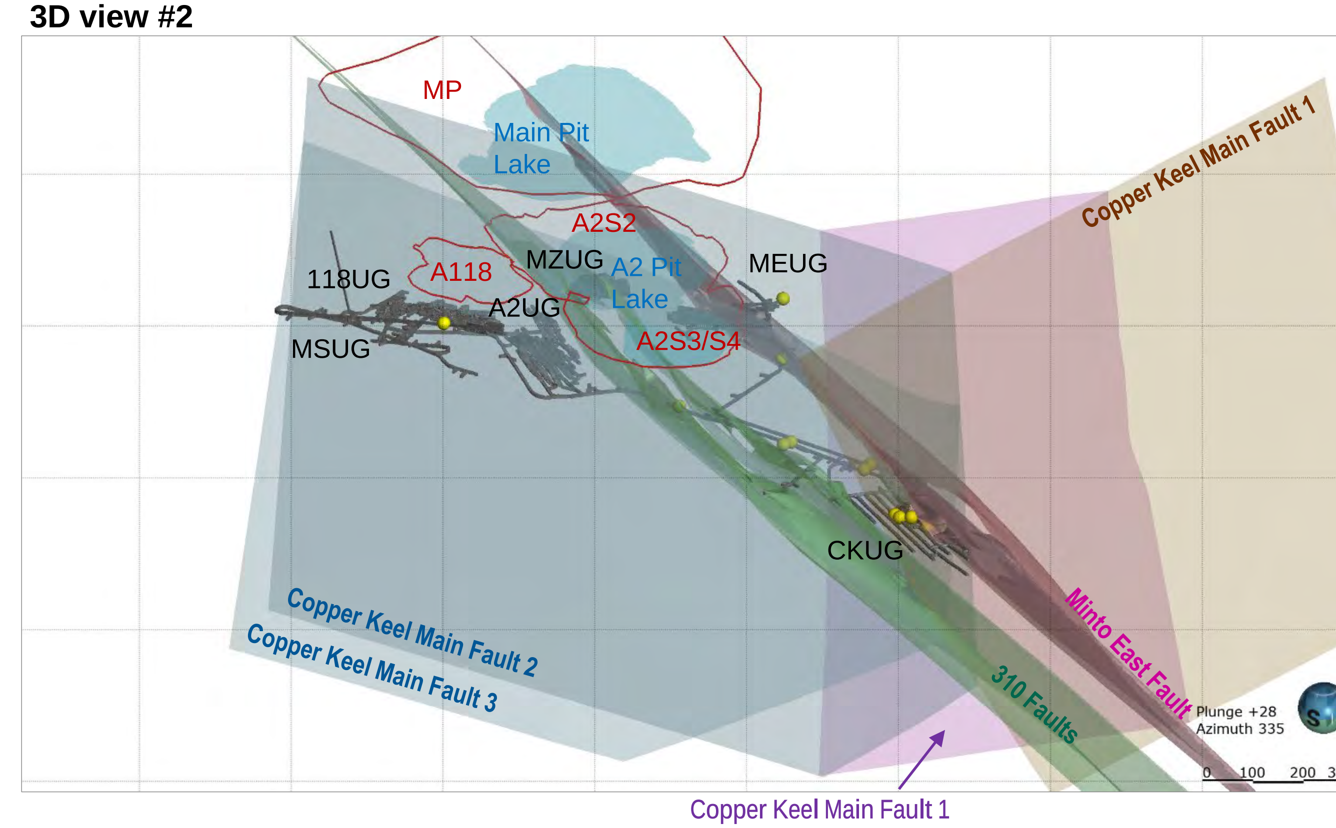
3D view #1



Plan view #2



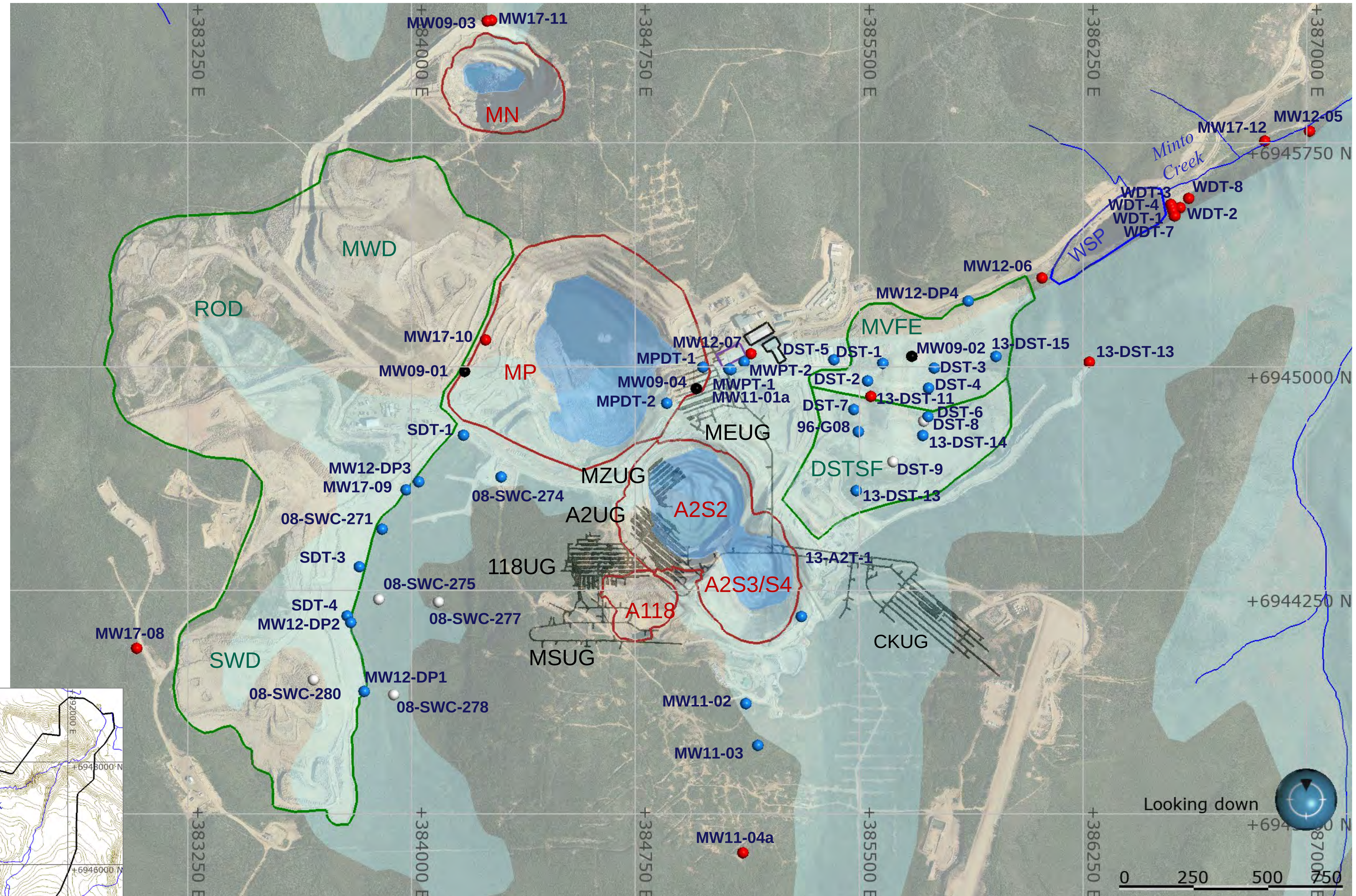
3D view #2

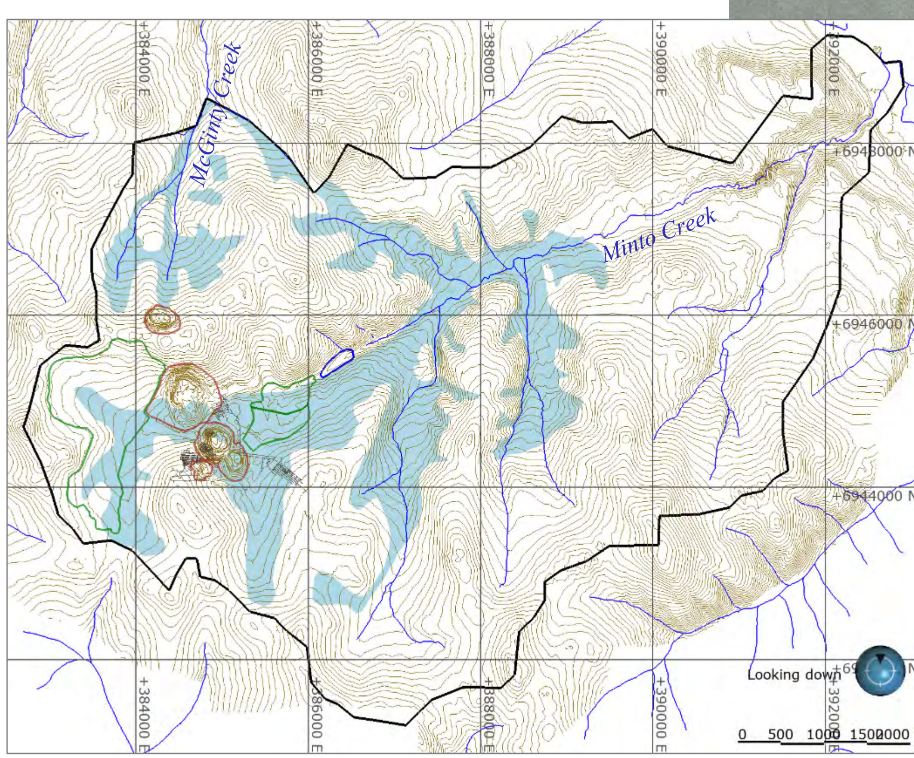


srk consulting

MINTO

Job No: 1CM002.072	MINTO MINE	Minto Groundwater Model Update	
Filename: Potential_water_bearing_strct.pptx		**Potential water bearing geologic structures**	
		Date: Oct. 2021	Approved: GF
		Figure: 9	





srk consulting

MINTO

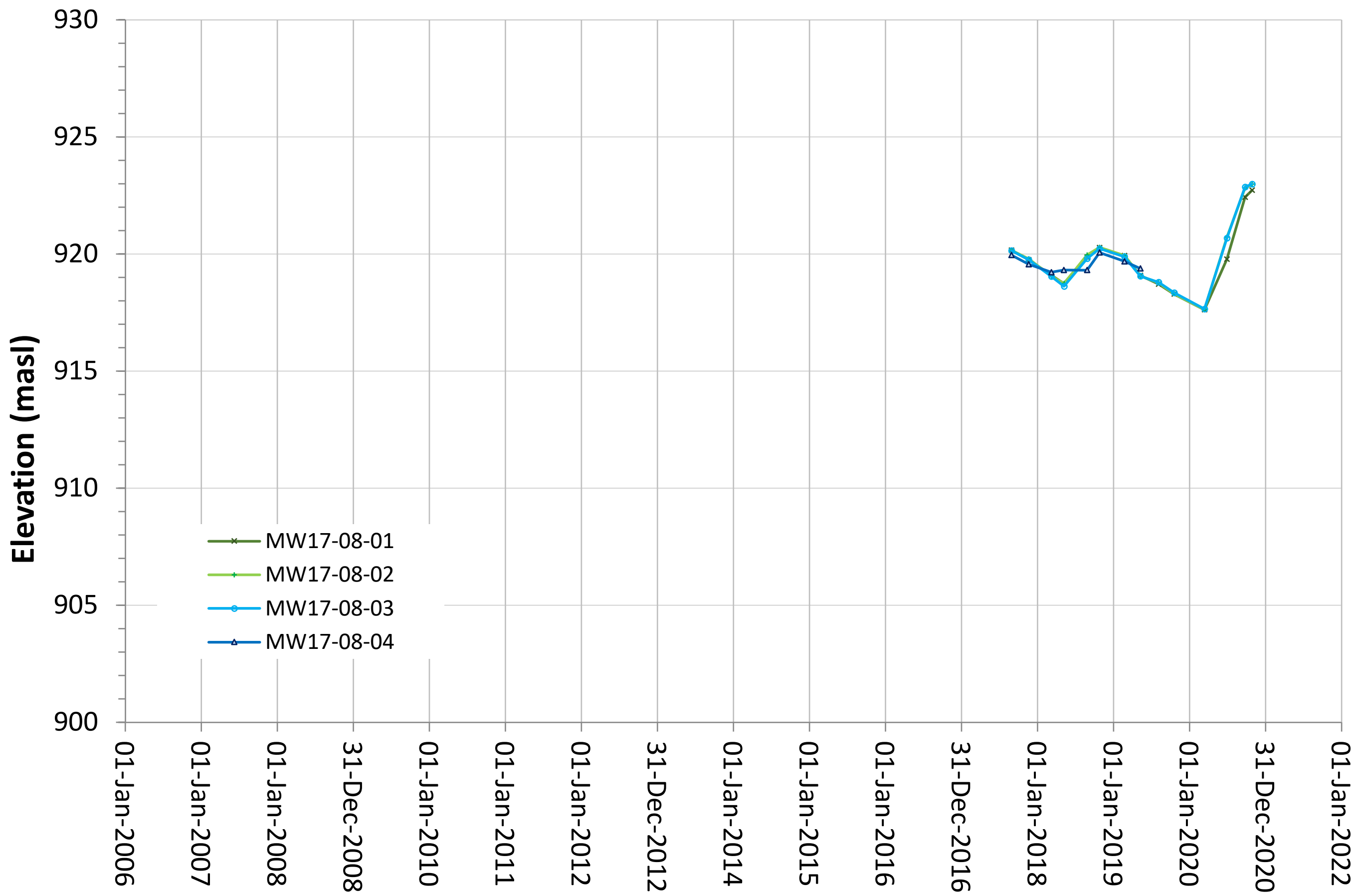
Job No: 1CM002.072
Filename: Fig10_Prmf_distrib.pptx

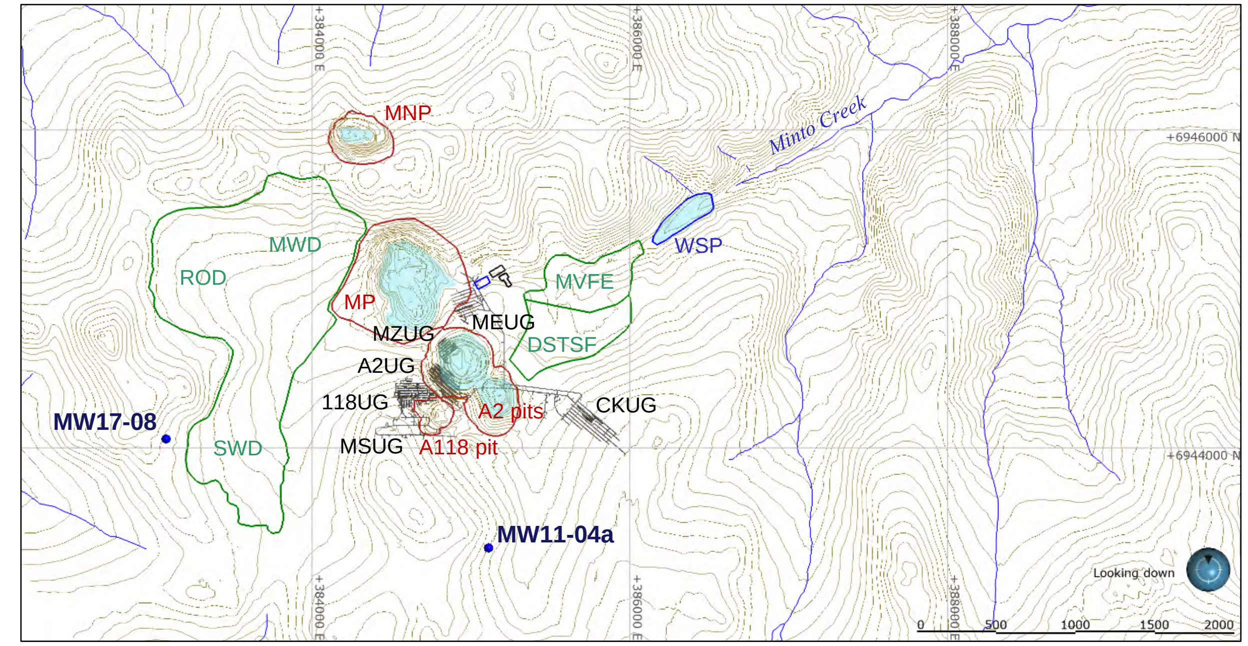
MINTO MINE

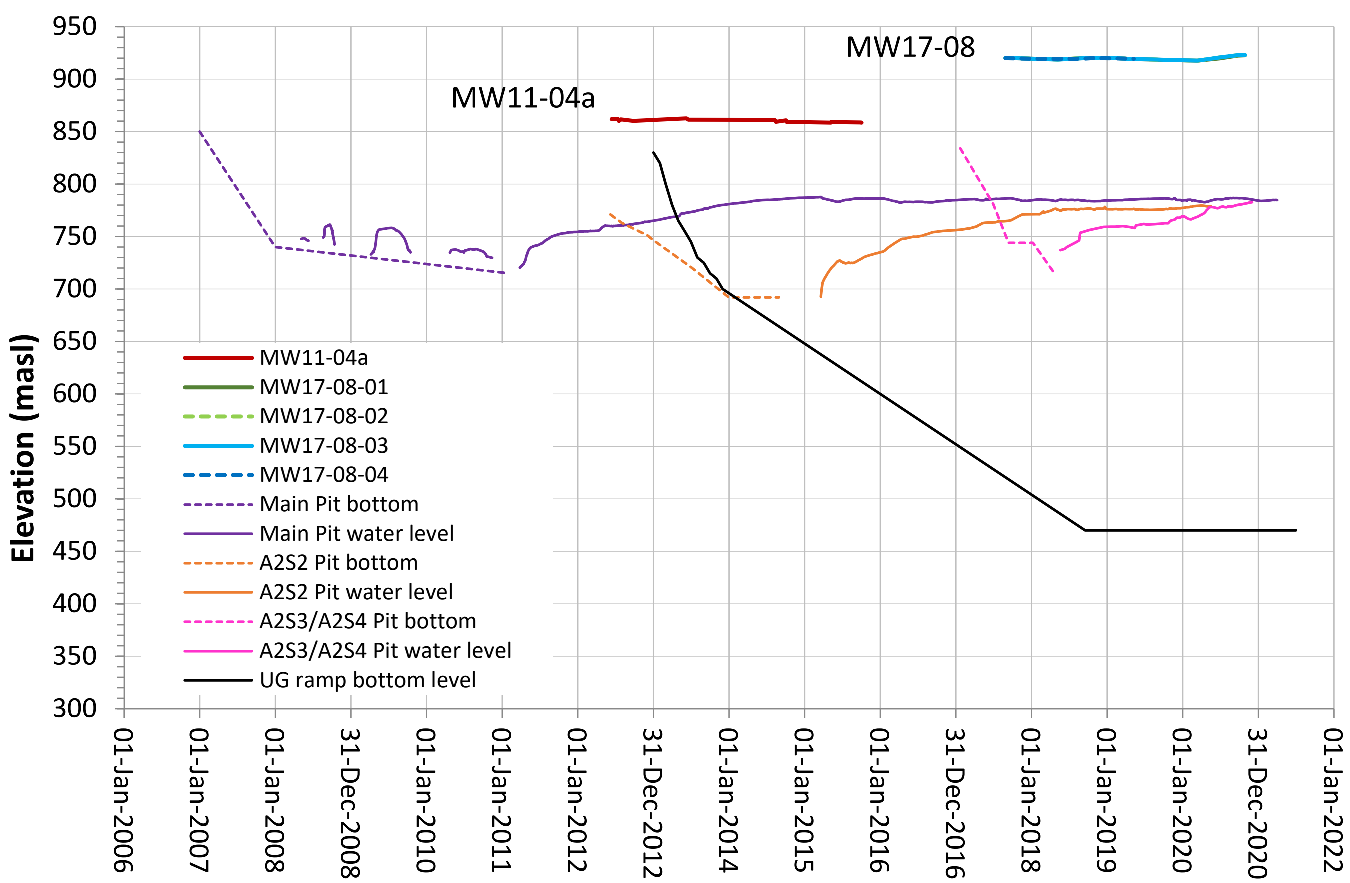
Minto Groundwater Model Update

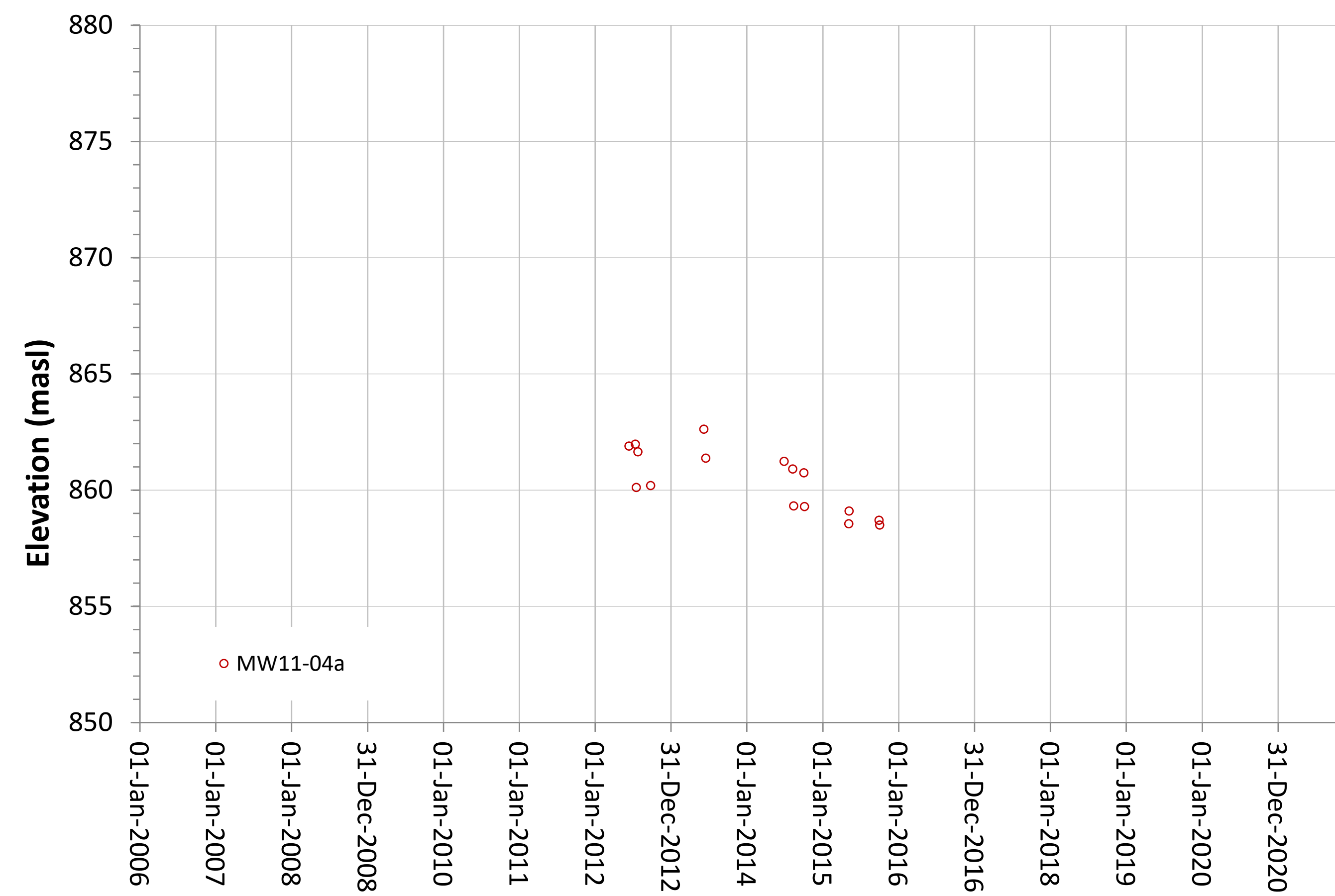
Discontinuous permafrost distribution

Date:	Approved:	Figure:
Oct. 2021	GF	10

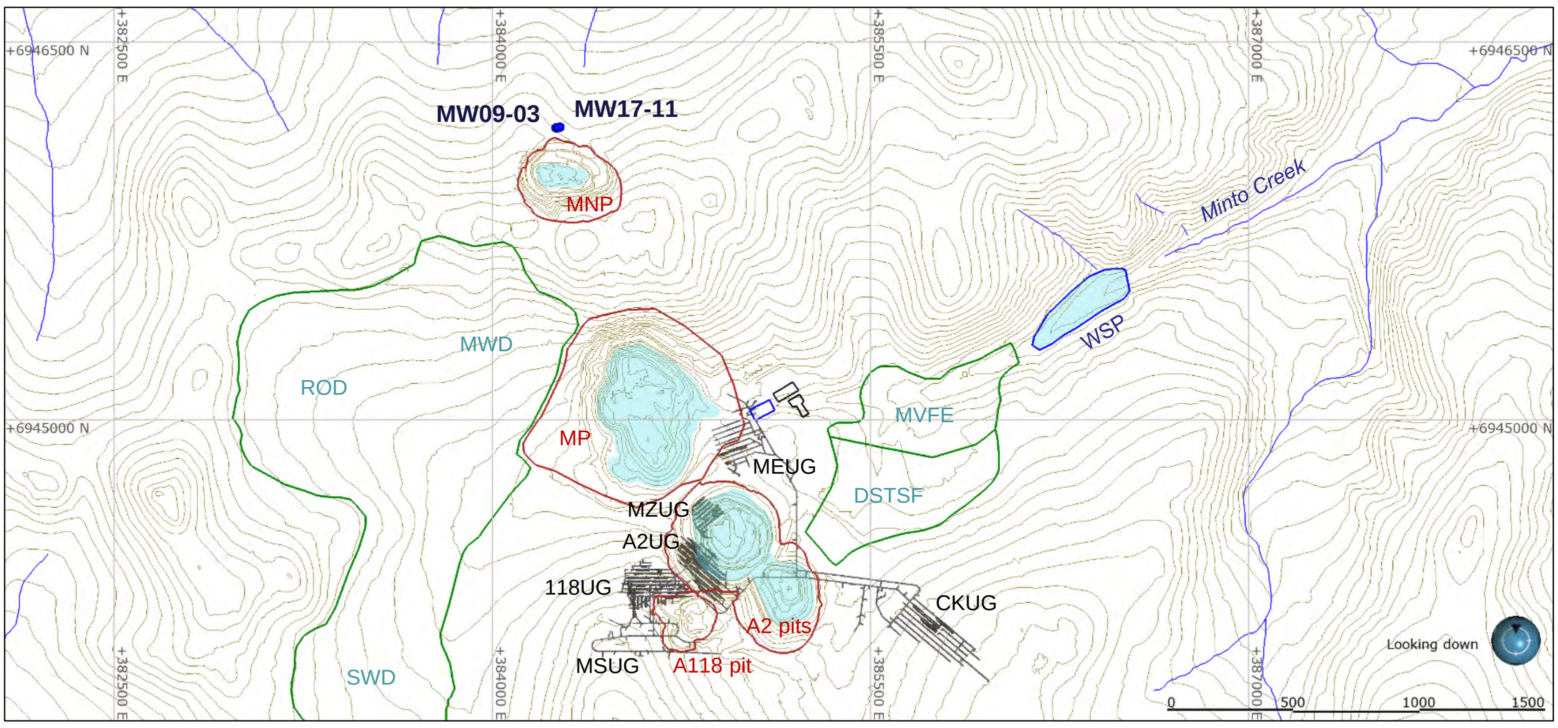


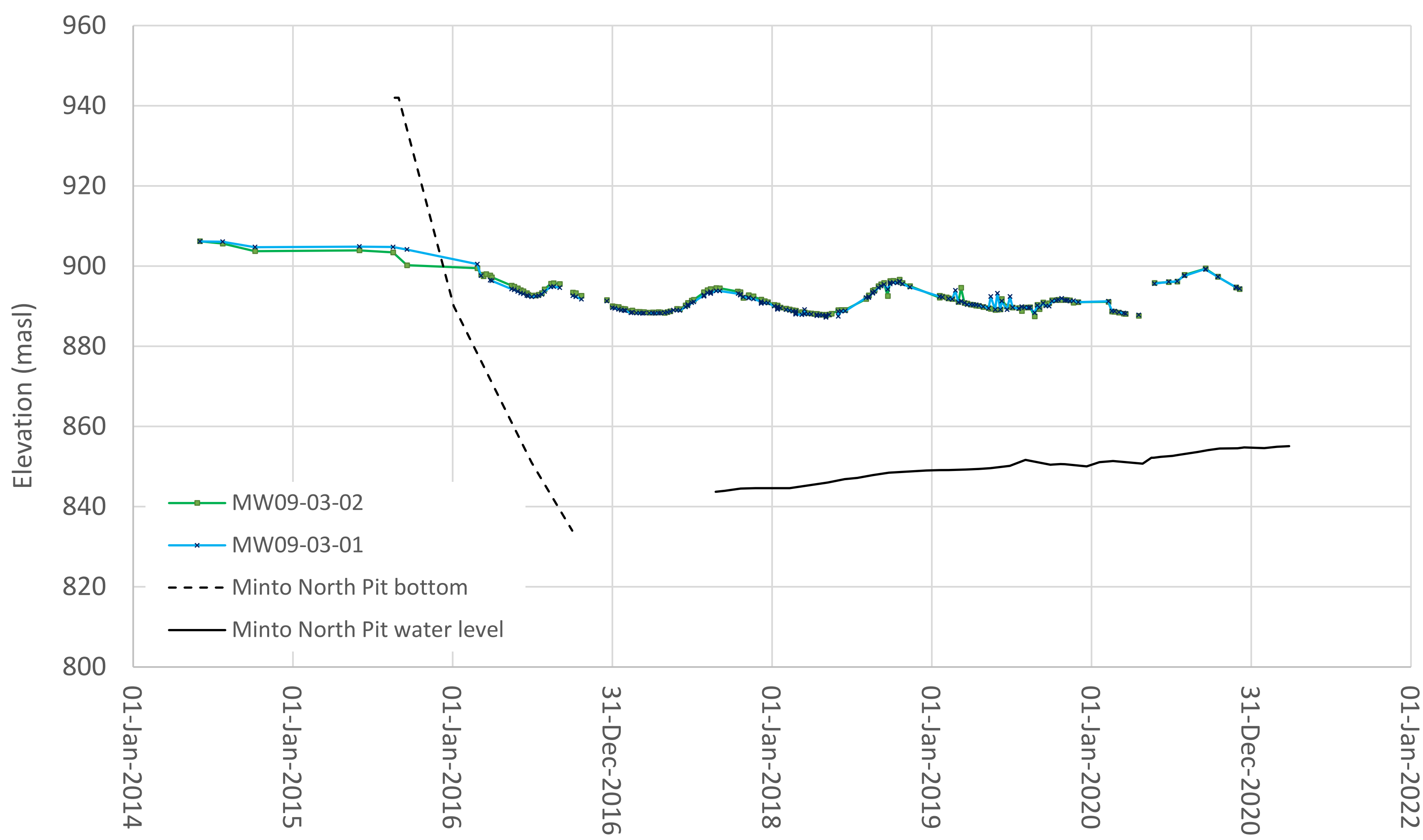


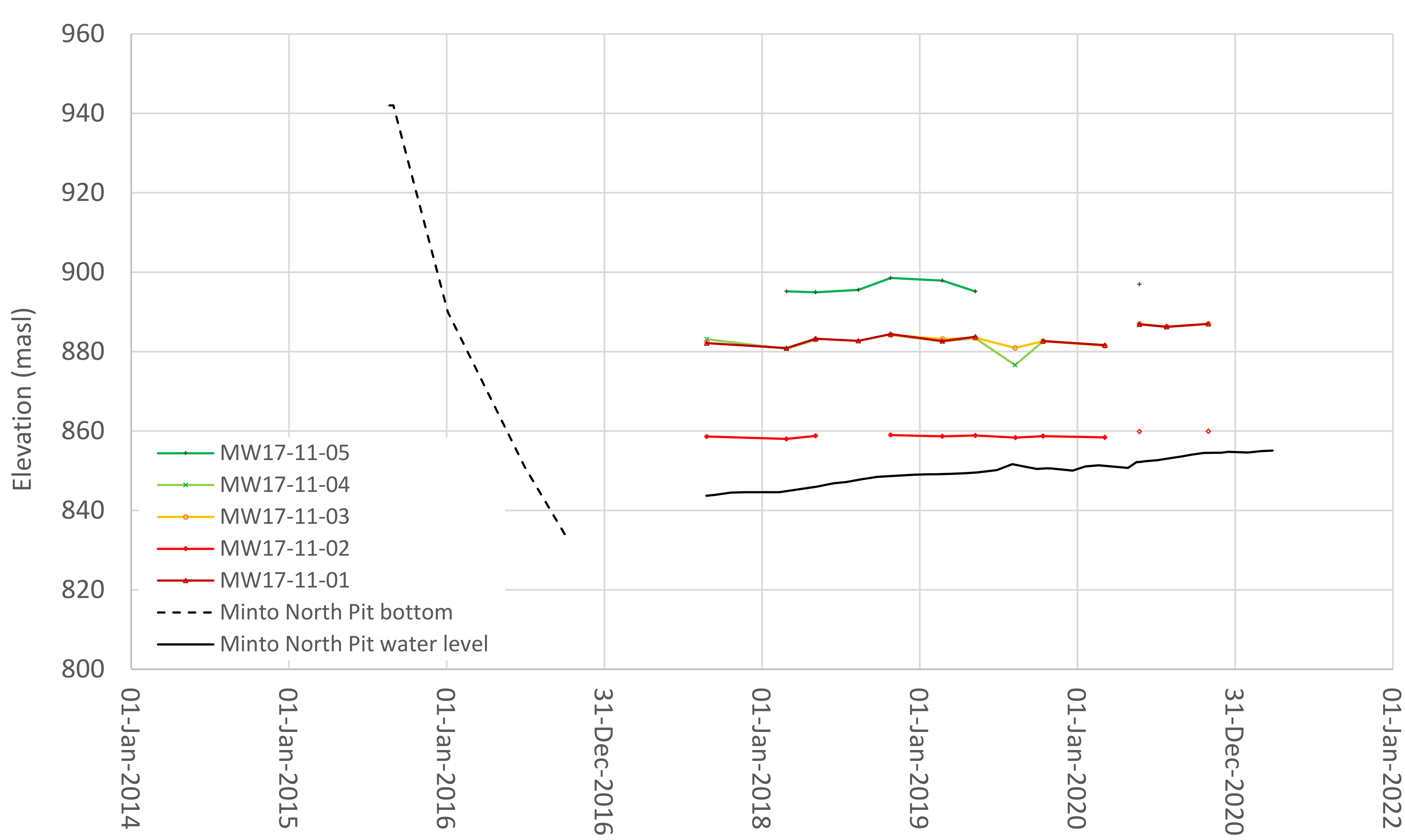




srk consulting	MINTO	Minto Groundwater Model Update
		MW17-08 and MW11-04a groundwater levels
Job No: 1CM002.072 Filename: Fig09_MW17-08_MW11-04a_GWL.pptx	MINTO MINE	Date: Oct. 2021 | Approved: GF | Figure: **11**







srk consulting

MINTO

Minto Groundwater Model Update

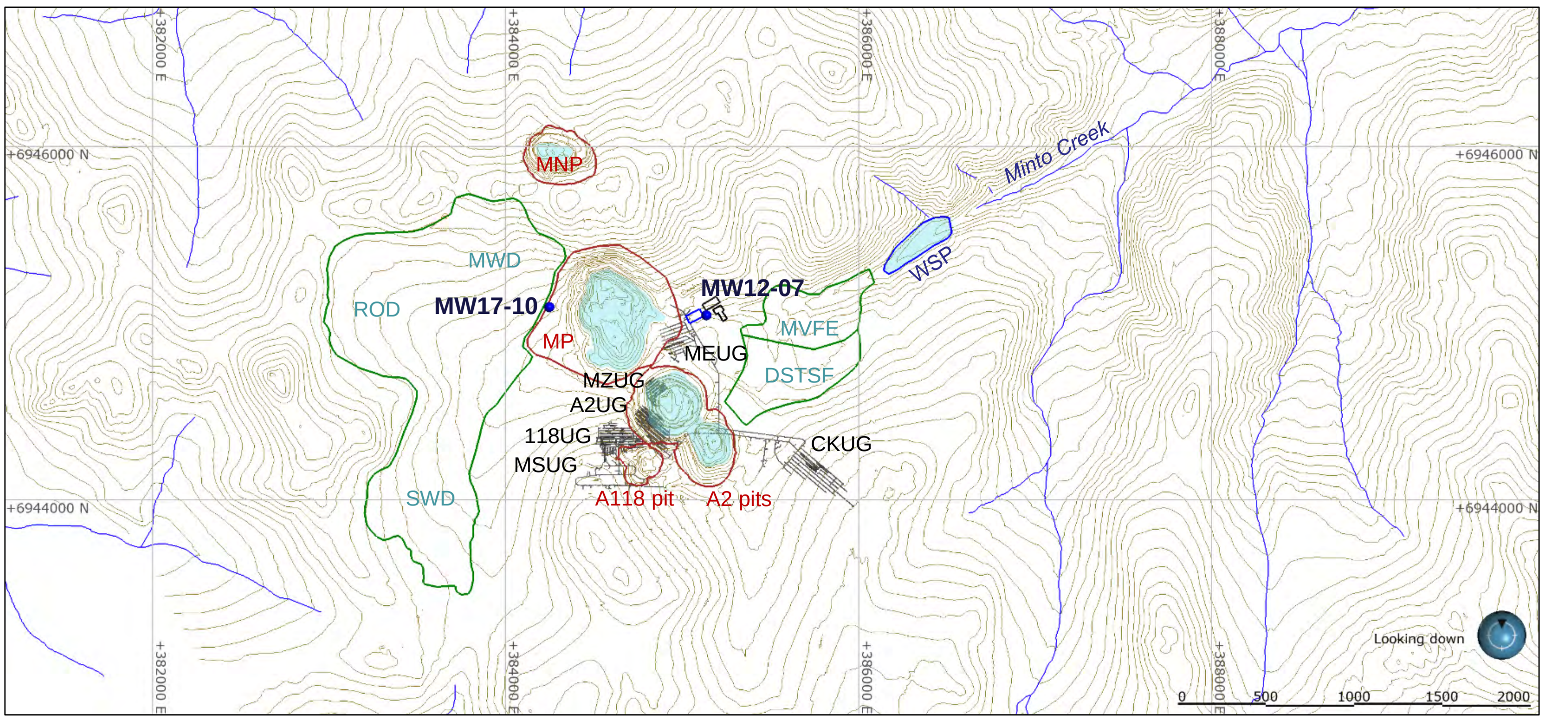
MW09-03 and MW17-11 groundwater levels

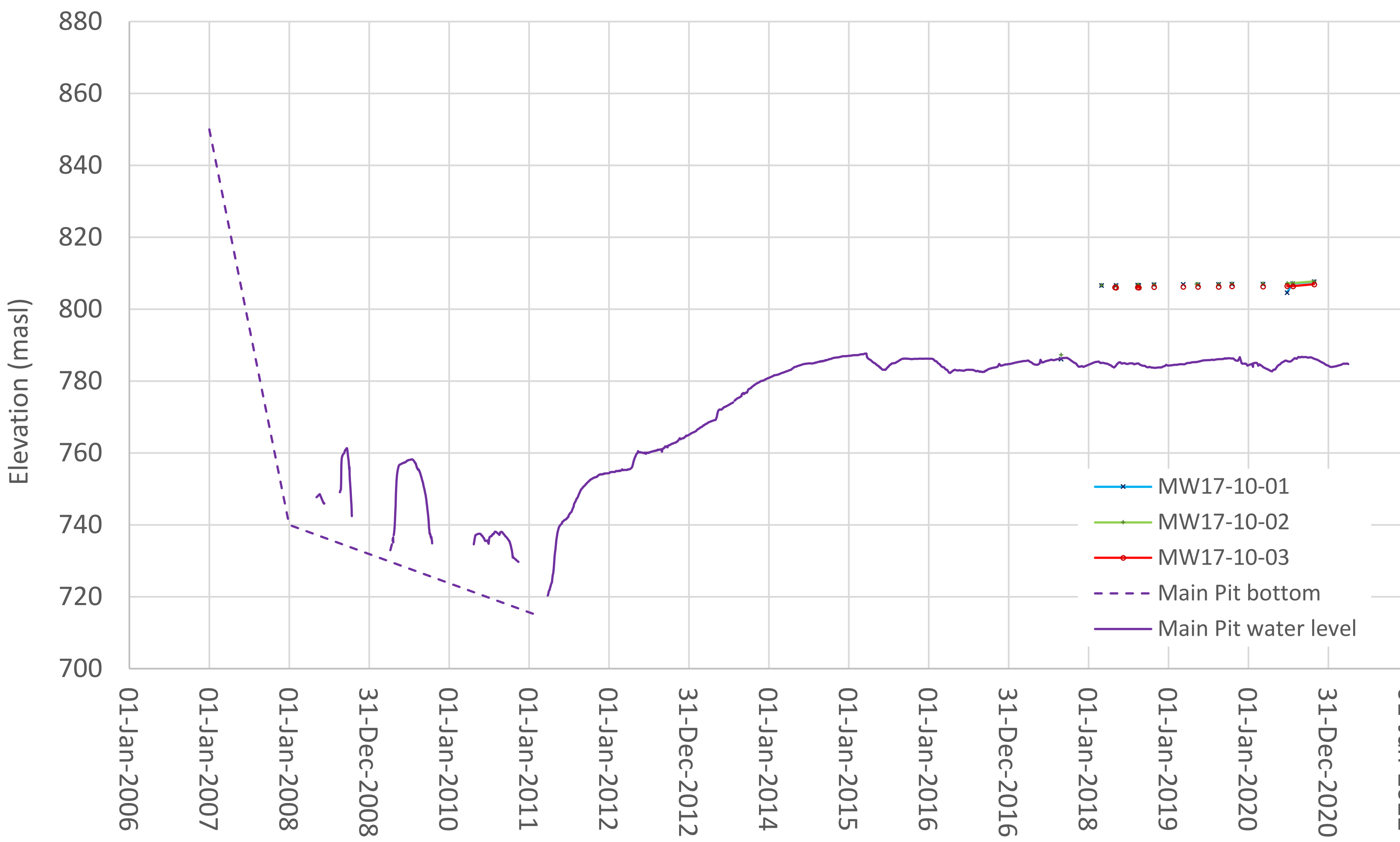
Job No: 1CM002.072

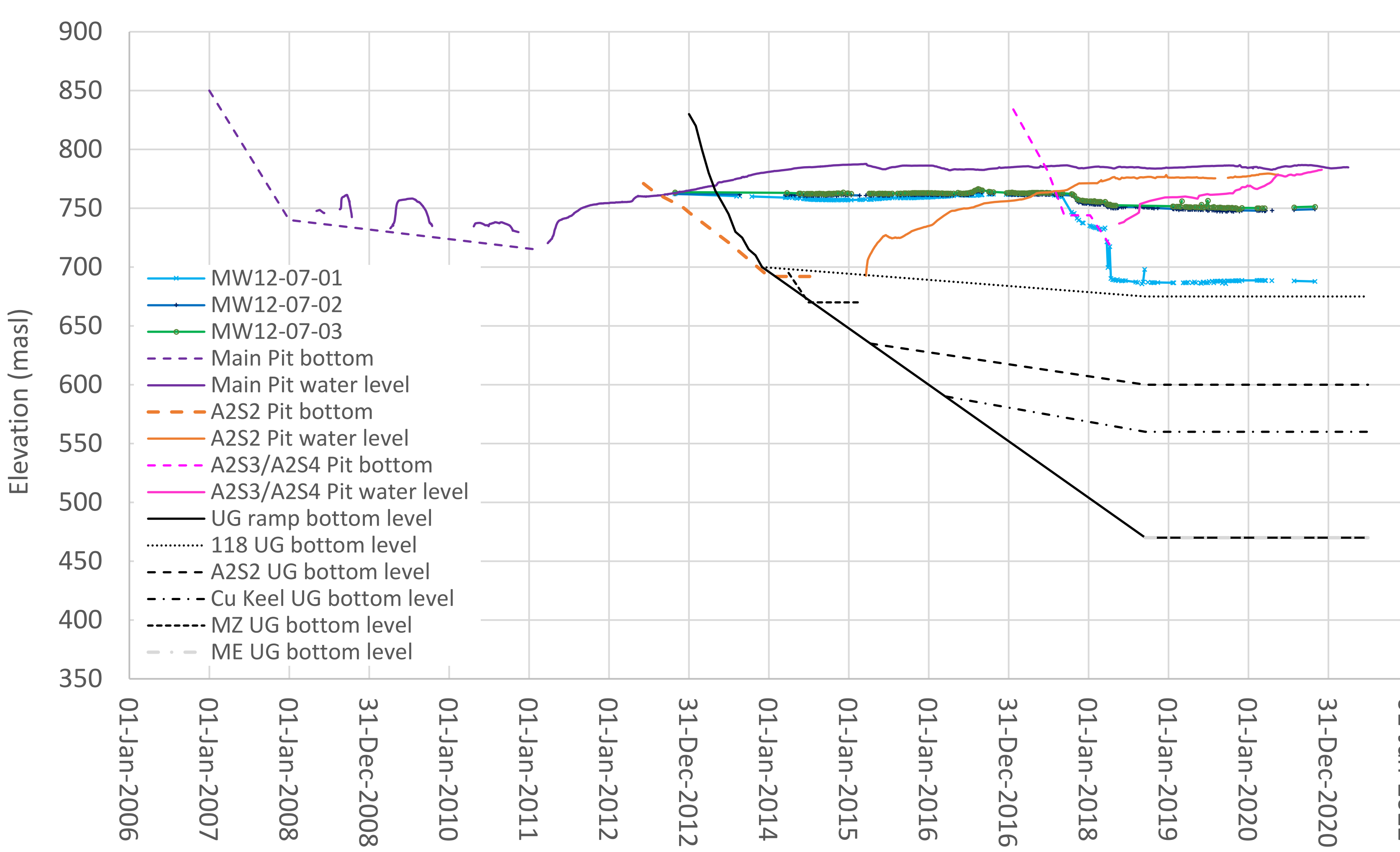
Filename: Fig12_MW09-03_MW17-11_GWL.pptx

MINTO MINE

Date:	Approved:	Figure:
Oct. 2021	GF	12







srk consulting

MINTO

Minto Groundwater Model Update

MW17-10 and MW12-07 groundwater levels

Job No: 1CM002.072

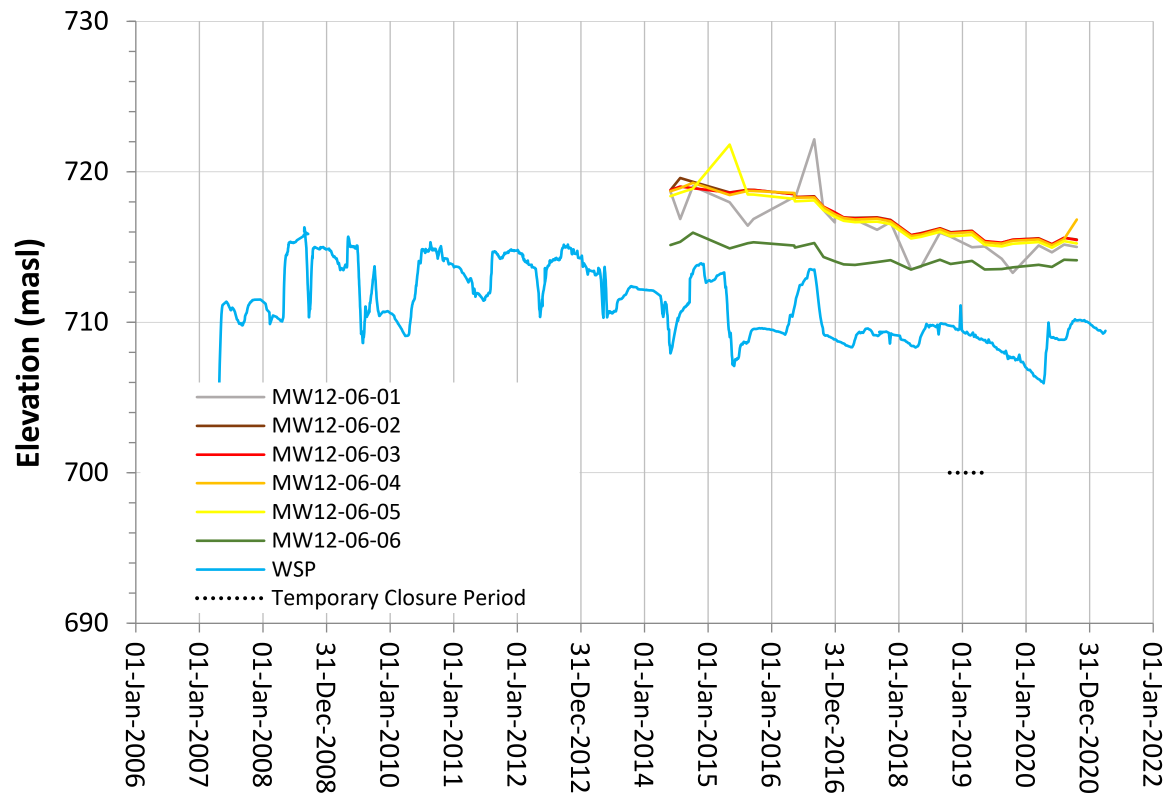
Filename: Fig13_MW17-10_MW12-07_GWL.pptx

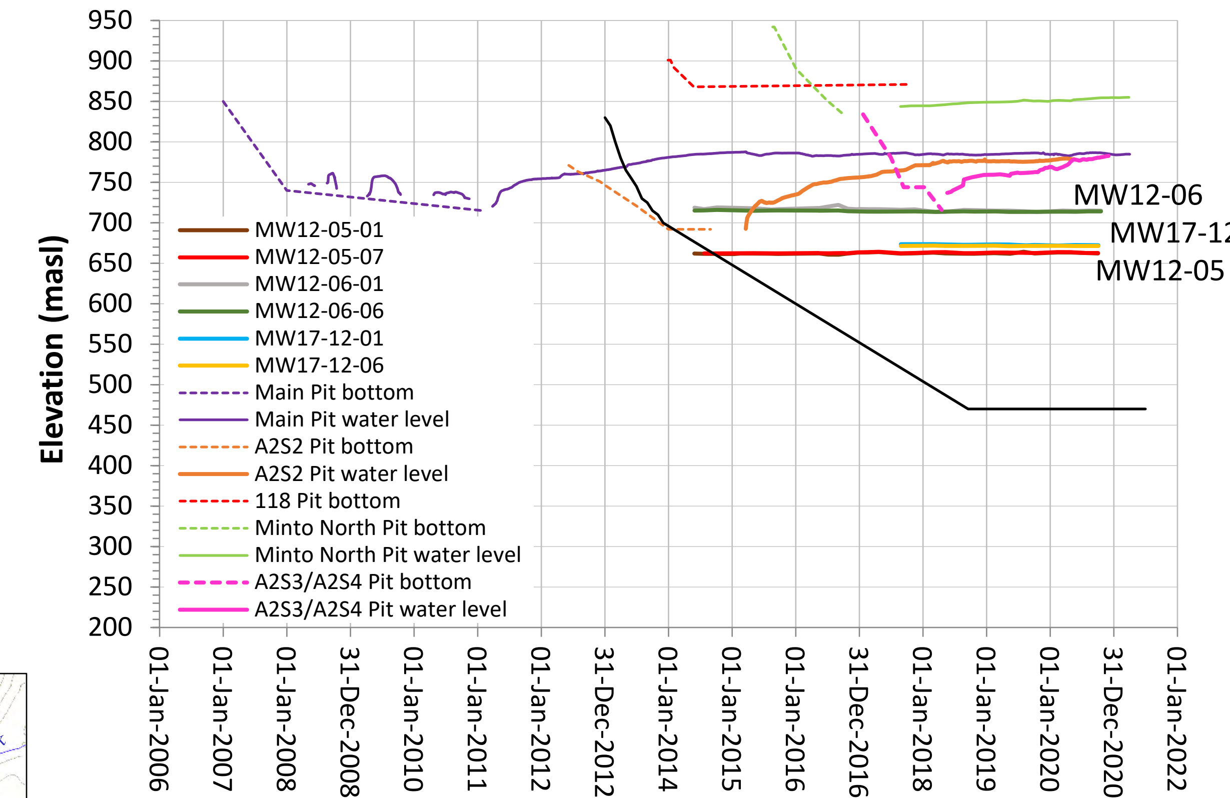
MINTO MINE

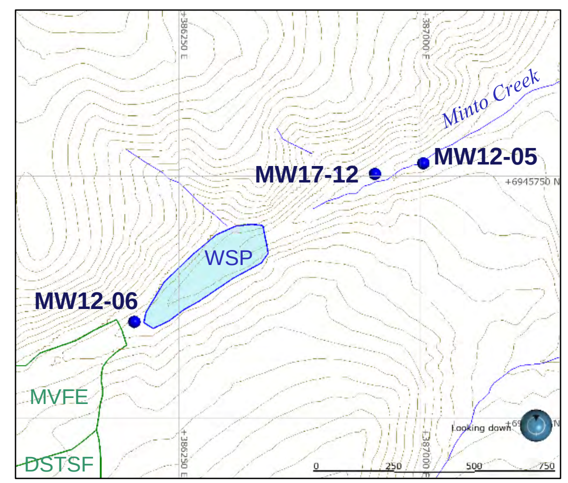
Date: Oct. 2021

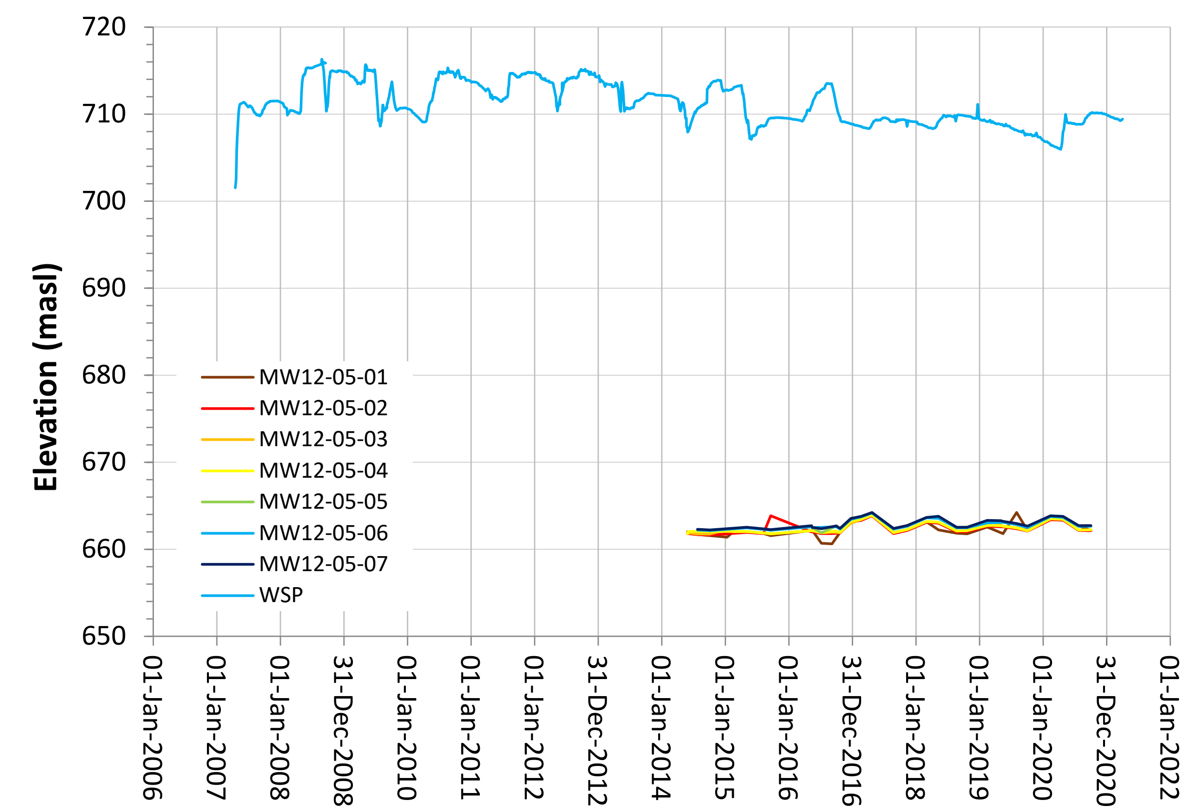
Approved: GF

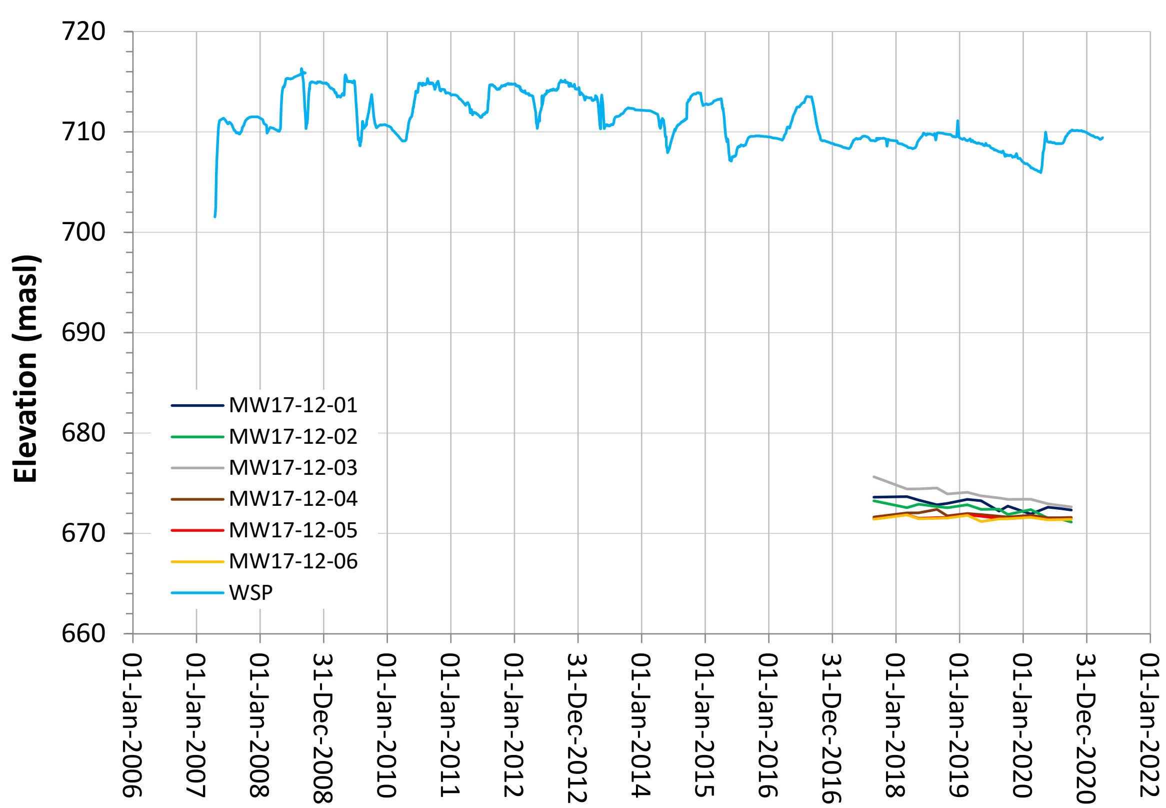
Figure: 13











srk consulting | MINTO

Minto Groundwater Model Update

MW12-06, MW12-05, and MW17-12 groundwater levels

Job No: 1CM002.072	MINTO MINE	Date: Oct. 2021	Approved: GF	Figure: 14
Filename: Fig14_MW12-06_MW12-05_MW17-12_GWL.pptx				

Water Storage Pond

Open pits

Undergrounds

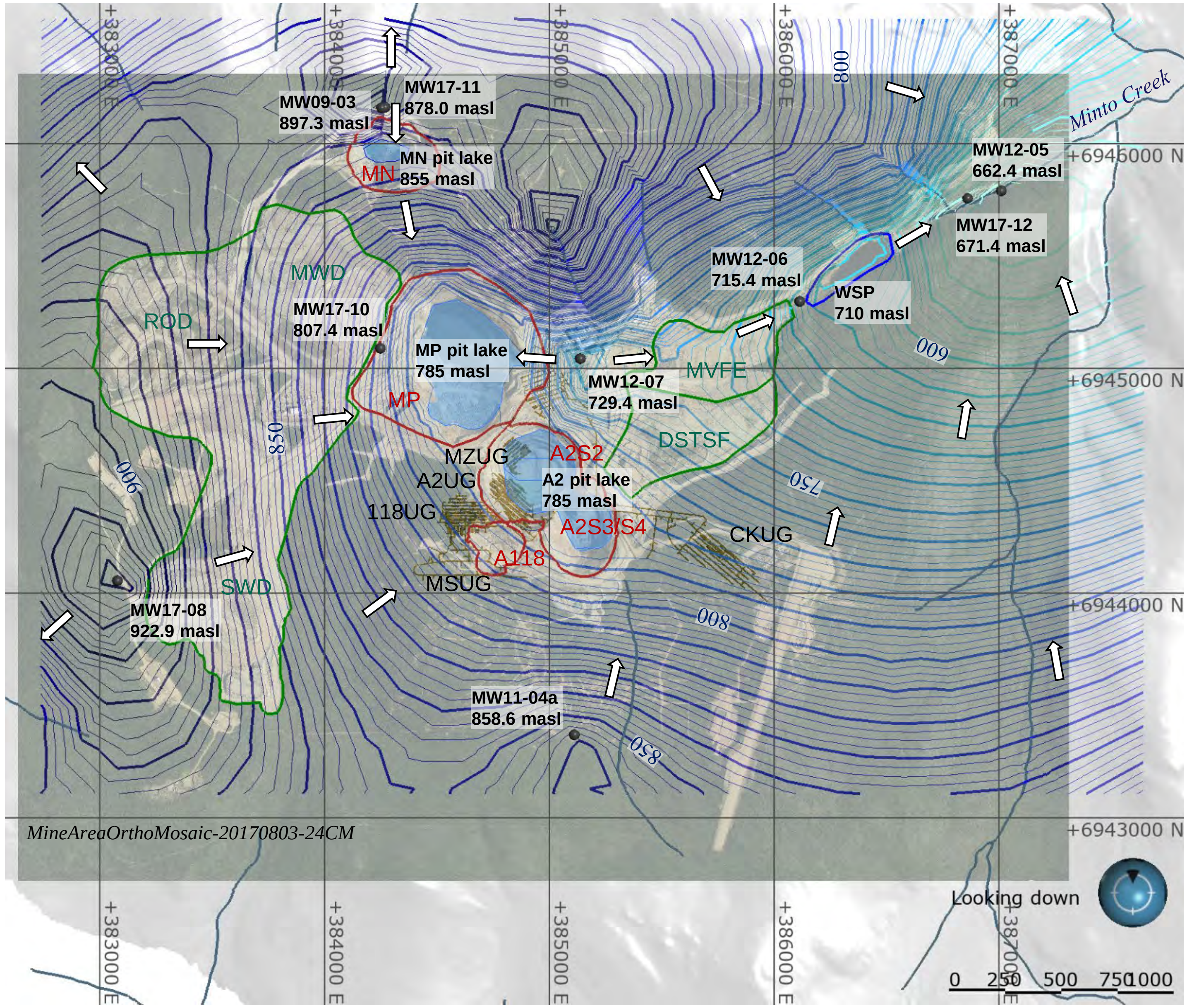
Waste rock dumps

Pit lake

Average groundwater level measured in Oct. 2020

Groundwater head contours (10m and 2.5m intervals)

Groundwater flow direction



NAD 1983 UTM Zone 8N

Note:

1. *Head contours were interpolated based on average water levels measured in October 2020 at groundwater monitoring wells, pit lakes, and the WSP. The creek channels located outside mapped discontinuous permafrost were assumed to be connected to the groundwater system.*

2. *Interpolation of groundwater contours around underground developments is not well constrained by the monitoring network.*

srk consulting

MINTO

Minto Groundwater Model Update

Oct. 2020 groundwater head contours

Job No: 1CM002.072

Filename: 1CM002.072_Fig15_2020_GW_head_ctr.pptx

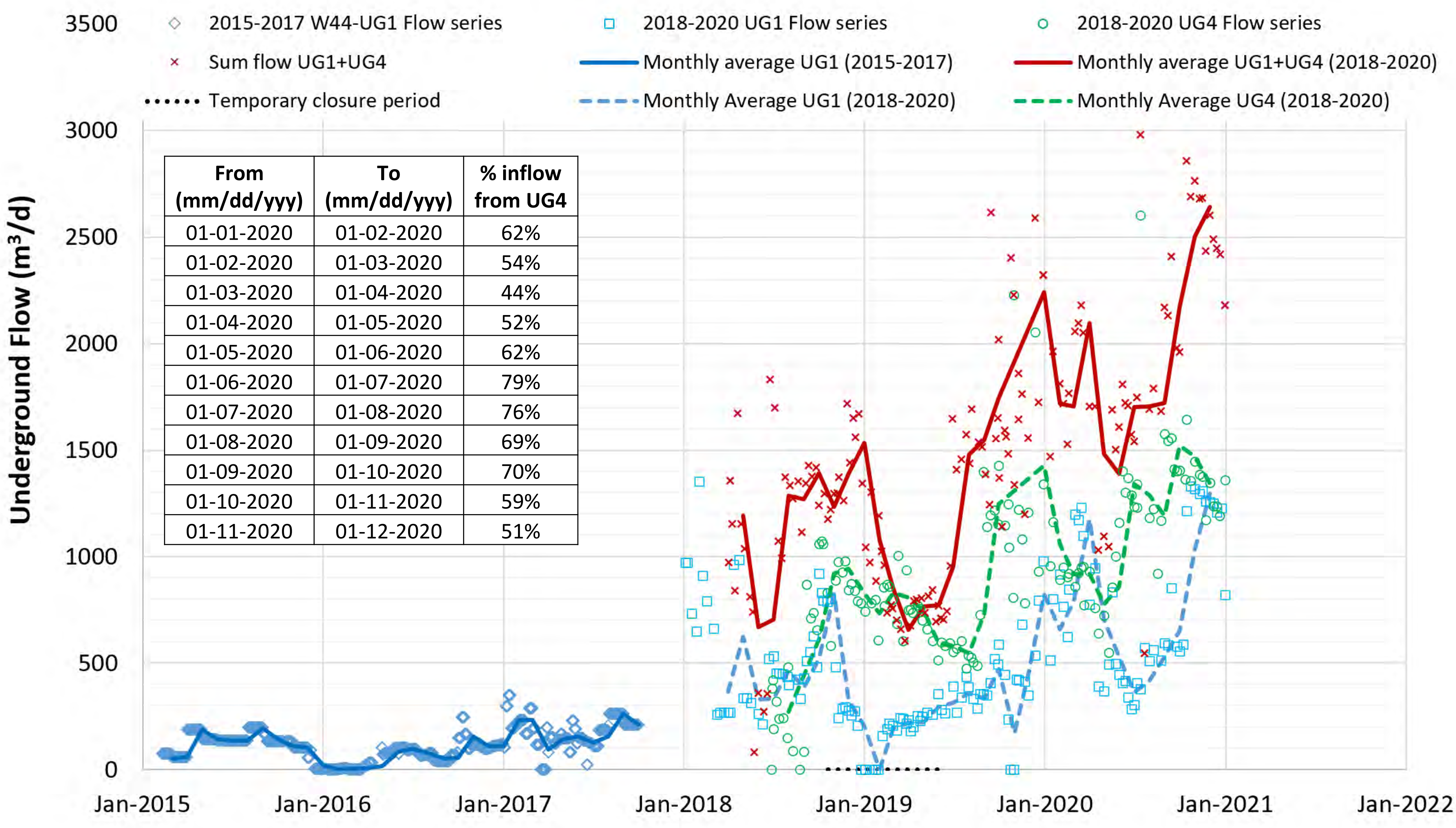
MINTO MINE

Date: Oct. 2021

Approved: GF

Figure: 15

Underground Flow Measurements at Stations UG1 and UG4



From (mm/dd/yyy)	To (mm/dd/yyy)	% inflow from UG4
01-01-2020	01-02-2020	62%
01-02-2020	01-03-2020	54%
01-03-2020	01-04-2020	44%
01-04-2020	01-05-2020	52%
01-05-2020	01-06-2020	62%
01-06-2020	01-07-2020	79%
01-07-2020	01-08-2020	76%
01-08-2020	01-09-2020	69%
01-09-2020	01-10-2020	70%
01-10-2020	01-11-2020	59%
01-11-2020	01-12-2020	51%

srk consulting

MINTO

Minto Groundwater Model Update

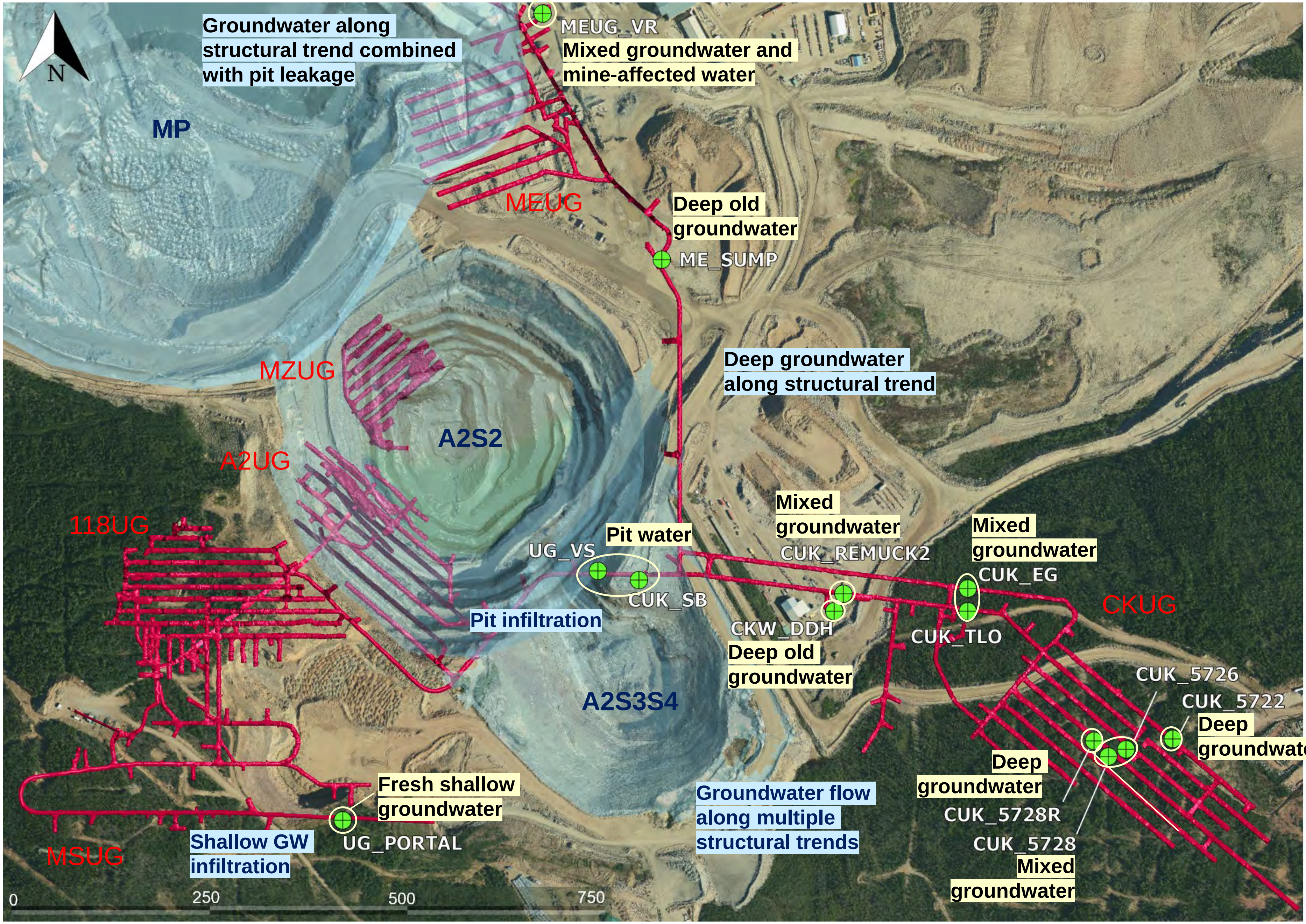
Groundwater inflows to underground

Job No: 1CM002.072
Filename: 1CM002.072_Fig16_UG_inflows.pptx

MINTO MINE

Date: Oct. 2021 | Approved: GF | Figure: 16

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\020_Project_Data\010_SRK\Groundwater\Data compilations\[Minto_GW_Mine_Water_Flows_(GW analysis)_20210910_gf.xlsm]README



Comments
Samples were taken between September 11th and 14th, 2020

srk consulting

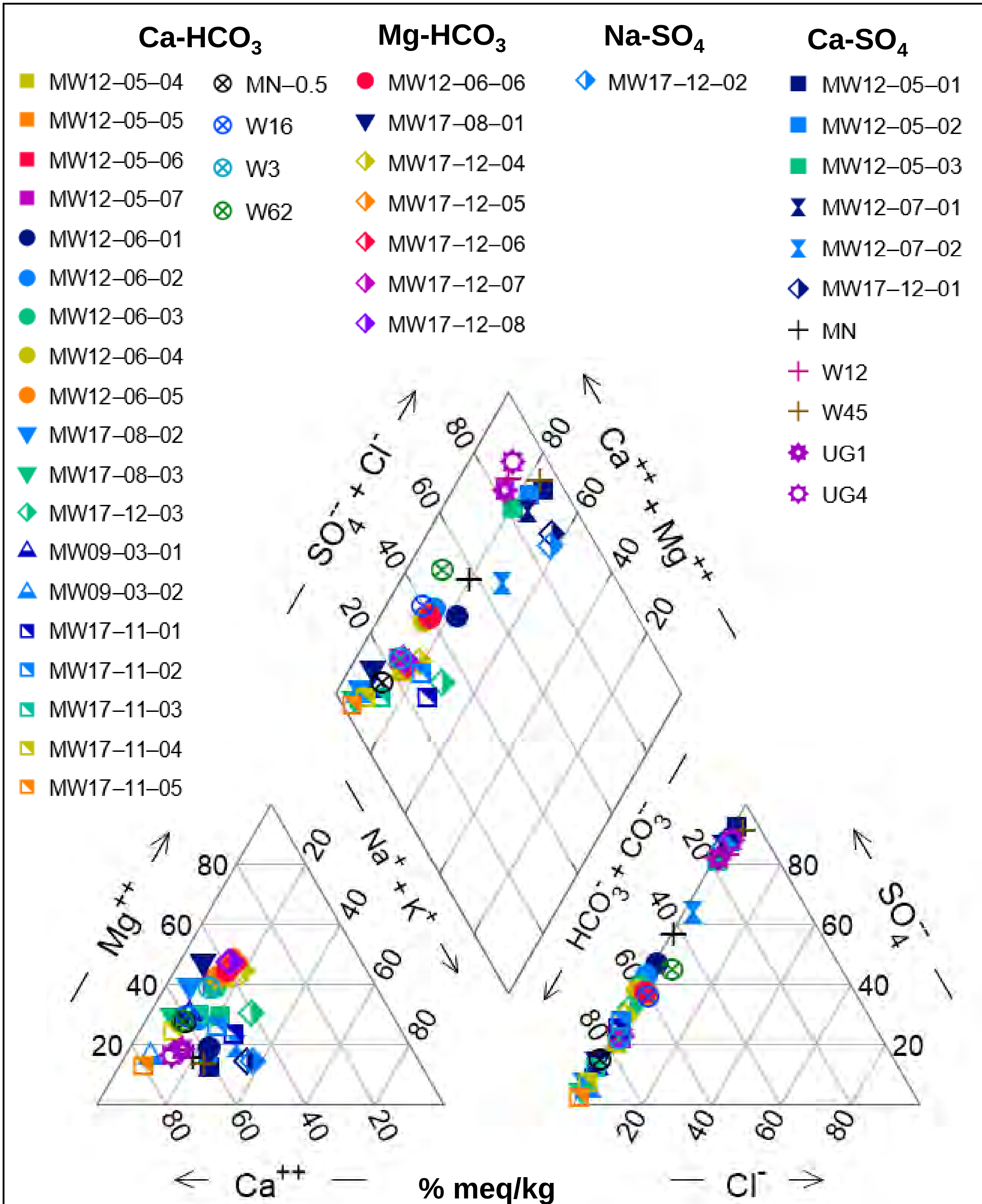
MINTO

Underground Seep Sampling Locations

Job No: 1CM002.072
Filename: 1CM002.072_Fig17_UG_Seep_Charcact.pptx

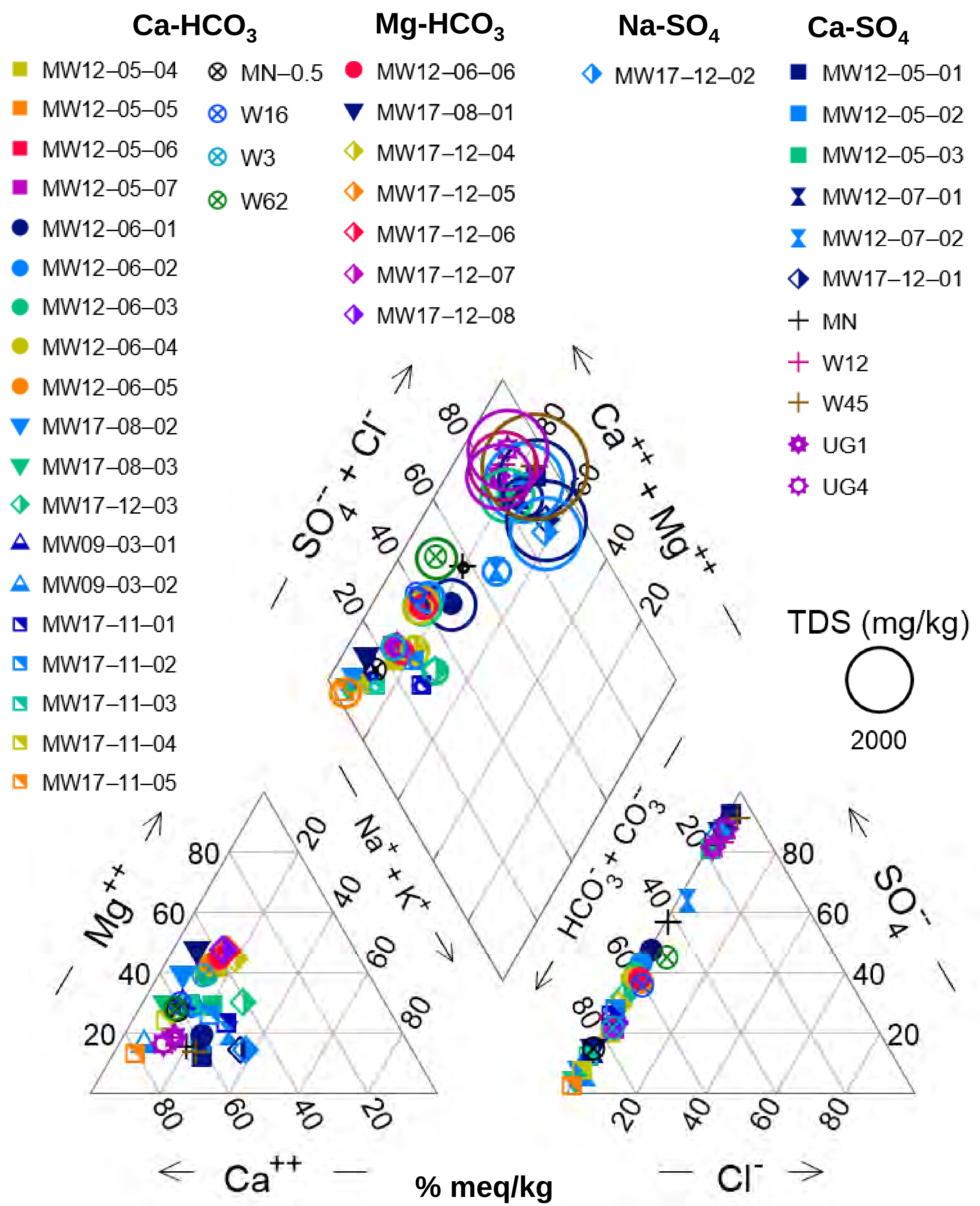
Minto Underground Seep Characterization

Date:	Approved:	Figure:
Oct. 2021	GF	17



% meq/kg

srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update
		Piper Diagram
Job No: 1CM002.072 Filename: Figure18_19_PiperPlots_1CM002.072.pptx	Minto	Date: Oct 2021 / Approved: LV / Figure: 18



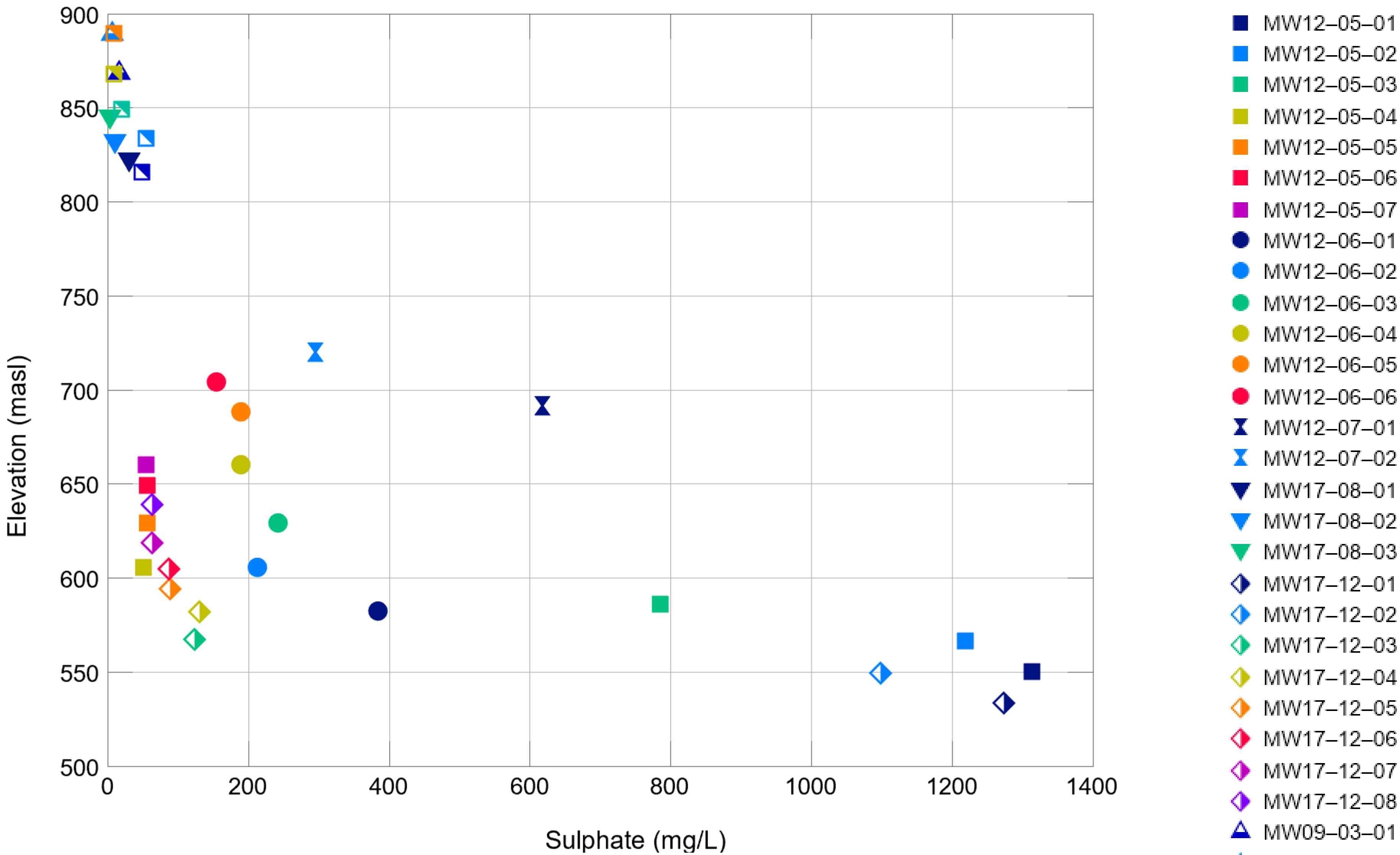
srk consulting

MINTO

2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update

Piper Diagram with Total Dissolved Solids

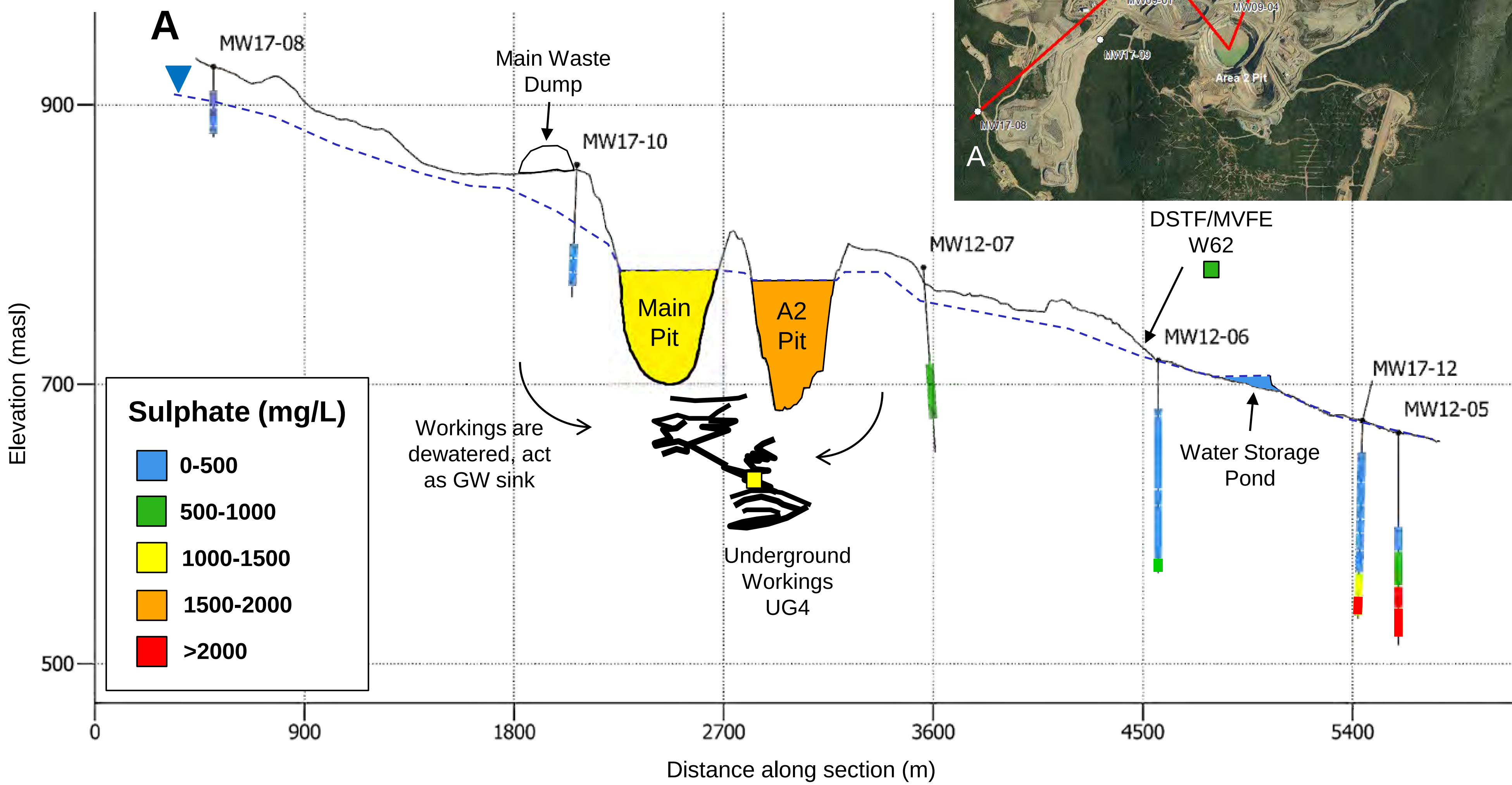
Job No: 1CM002.072	Minto	Date: Oct 2021	Approved: LV	Figure: 19
Filename: Figure18_19_PiperPlots_1CM002.072.pptx				



Notes:
Sulphate concentrations are average values in each monitoring location from 2020
Elevations are the mid-point of each monitoring location

srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update **Sulphate versus Depth**
Job No: 1CM002.072 Filename: Figure20_SulphatevsDepth_1CM002.072.pptx	Minto	Date: Oct 2021 · Approved: LV · Figure: **20**

Notes:
1. Base orthophoto provided by Minto Mine, 2017
2. Water table based on Dec 2020 measurements, combined with 2015 groundwater model results
3. Sulphate concentrations are maximum observed value at a given location in 2020.
4. For most ports, maximum sulphate concentration fell in the same category as the mean concentration throughout 2020. Exceptions to this are MW12-05-01 (mean of 1557 mg/L), MW12-05-02 (mean of 1840 mg/L), MW12-07-02 (mean of 357 mg/L) and MW17-12-01 (mean of 1592 mg/L). All outliers except for MW12-05-02 occurred in February.
5. Main Pit bottom elevation estimated to be 700m.
6. Underground workings location is roughly accurate, but not to scale due to nature of diagram. Workings could not be projected onto section.



Scale: 1:25,000

Vertical exaggeration: 6x

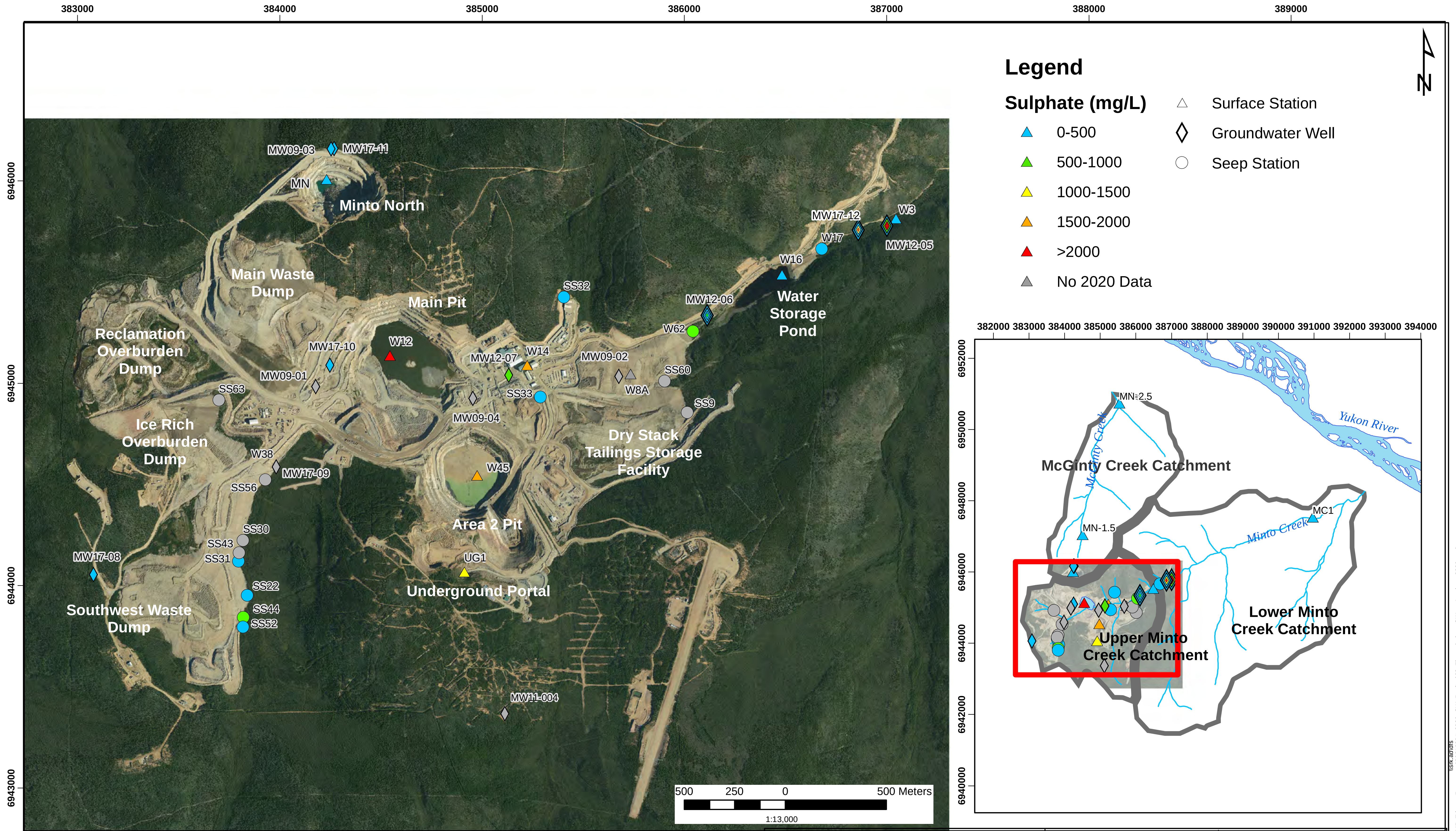
0m 1000m

srk consulting

MINTO

Job No: 1CM002.072	Minto Mine	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update
Filename: Fig21_Xsection_Sulphate_rev00.pdf		**2020 Monitoring Well Sulphate Concentration Fence Diagram**
		Date: Oct 2021 / Approved: LV / Figure: 21

\\VAN-SVR0\Projects\01_SITES\Minto\1CM002.057_Enviro_Tracer_Study\!040_AutoCAD\Minto_SO4_fence_section_inset.mxd



Notes:
1. Data presented in NAD 1983 UTM Zone 8N.
2. Base orthophoto provided by Minto Mine, 2017.
3. Posted sulphate concentrations are maximum observed at a given location in 2020.
4. Multi-level monitoring wells are presented as nested diamonds only if concentrations are variable between depths.
5. The inside marker in a nested diamond represents the deepest port, with diamond size increasing towards the ground surface.
6. Ports shallower than Zone 4 in MW12-05 have sulphate concentrations <500 mg/L and are not presented on the figure.
7. Maximum 2020 sulphate concentration in MW12-05-02 and MW12-05-01 were 2540 mg/L, all other concentrations were <1500 mg/L.

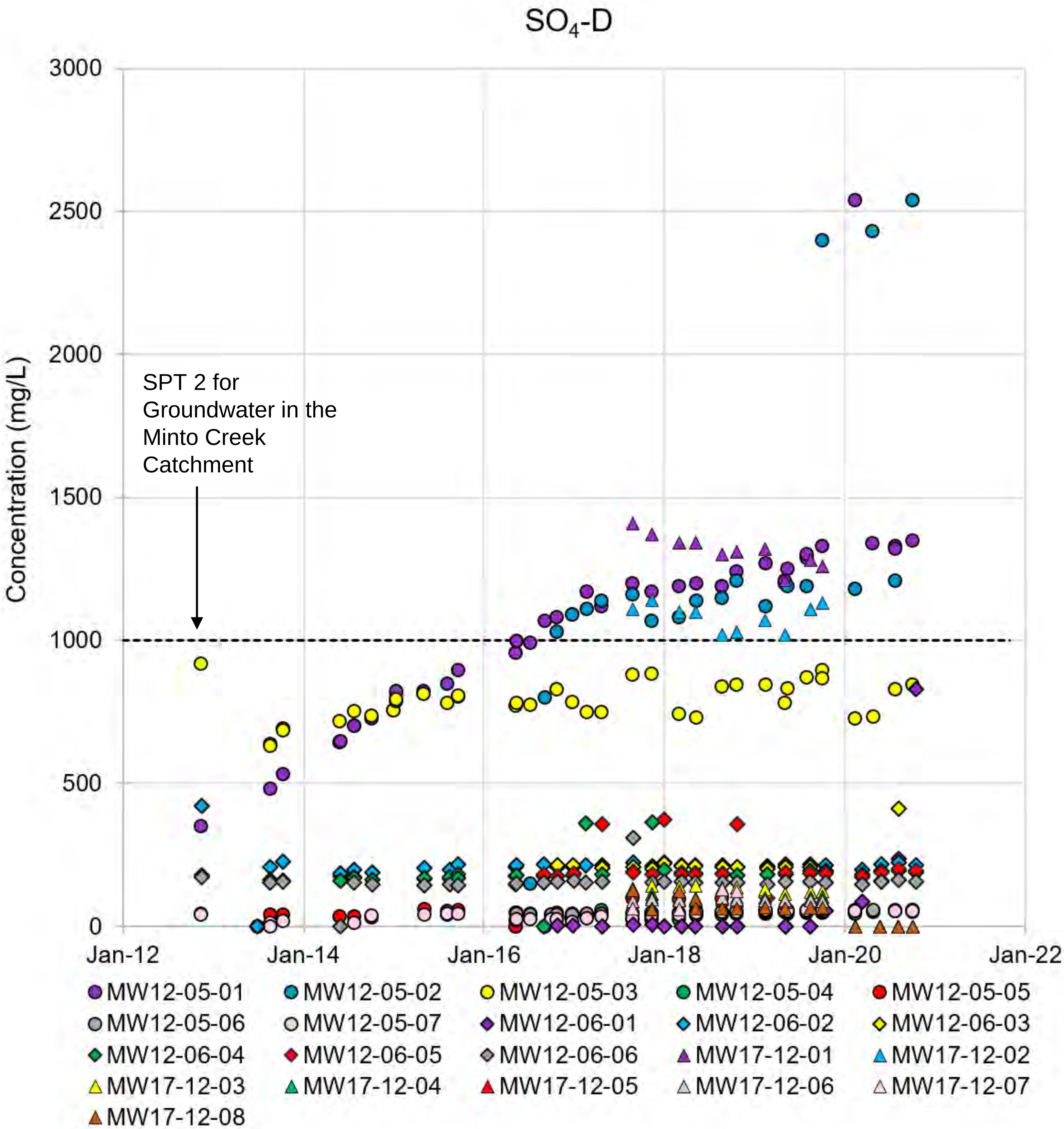
srk consulting

MINTO EXPLORATIONS
A PEMBRIDGE RESOURCES COMPANY

2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update

Maximum Sulphate Concentration in 2020

Job No: 1CM002.072	MINTO MINE	Date: Oct 2021	Approved: MSi	Figure: 22
Filename: minto_GW_so4_colour_2020.mxd				



X:\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20200304_2019_GW_Review\Working Files\[1CM002.055_ChemistryDataFigures_WorkingFile_Rev01_lv.xlsx]MW17-10_Charts

srk consulting | MINTO | 2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update Report

Sulphate at MW12-05, MW12-06 and MW17-12

Job No: 1CM002.072

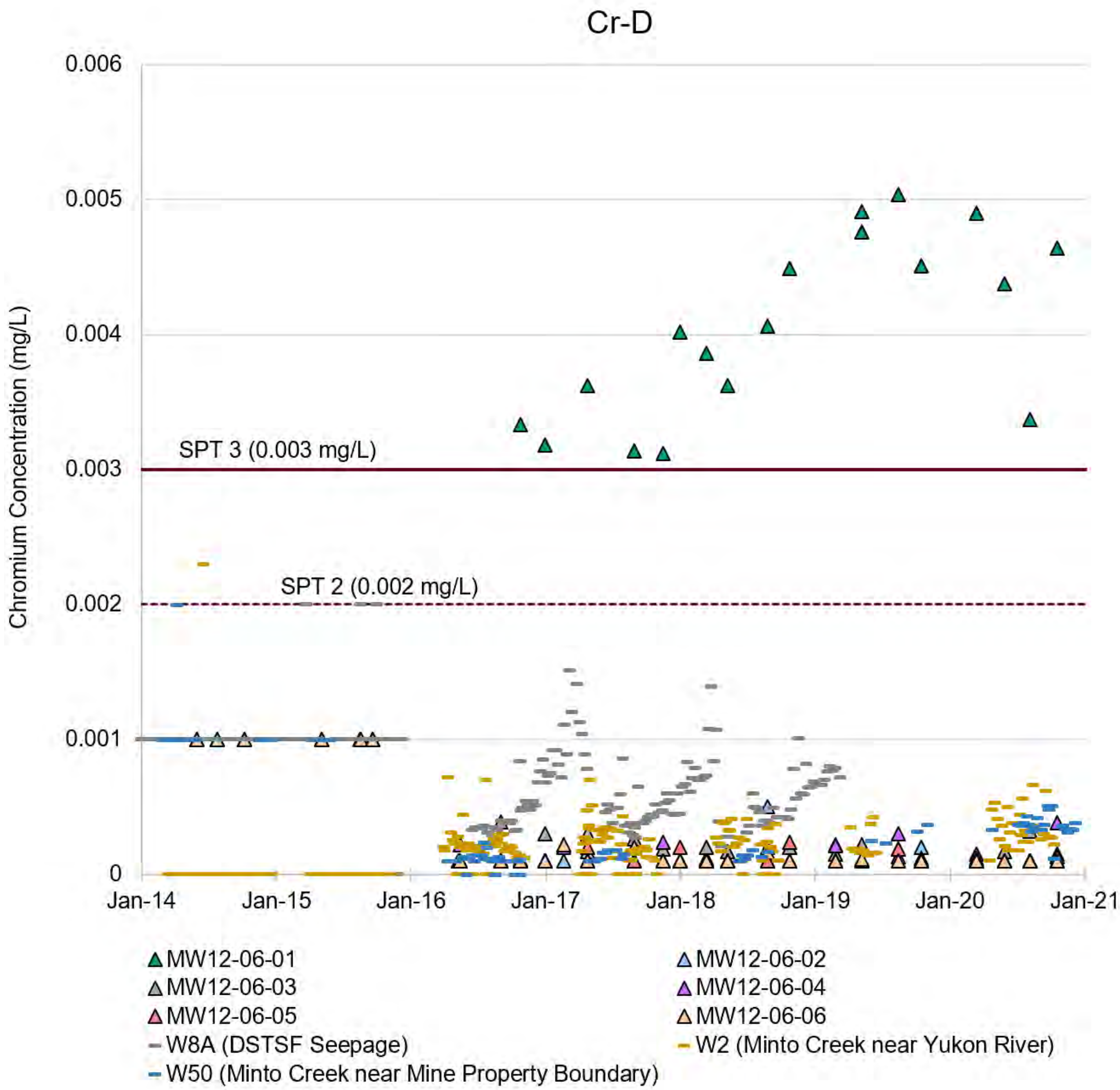
Filename: Fig23-30_ChemistryPlots_1CM002.072

Minto Mine

Date: Oct 2021

Approved: LV

Figure: 23



X:\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20200304_2019_GW_Review\Working Files\[1CM002.055_ChemistryDataFigures_WorkingFile_Rev01_lv.xlsx]MW17-10_Charts

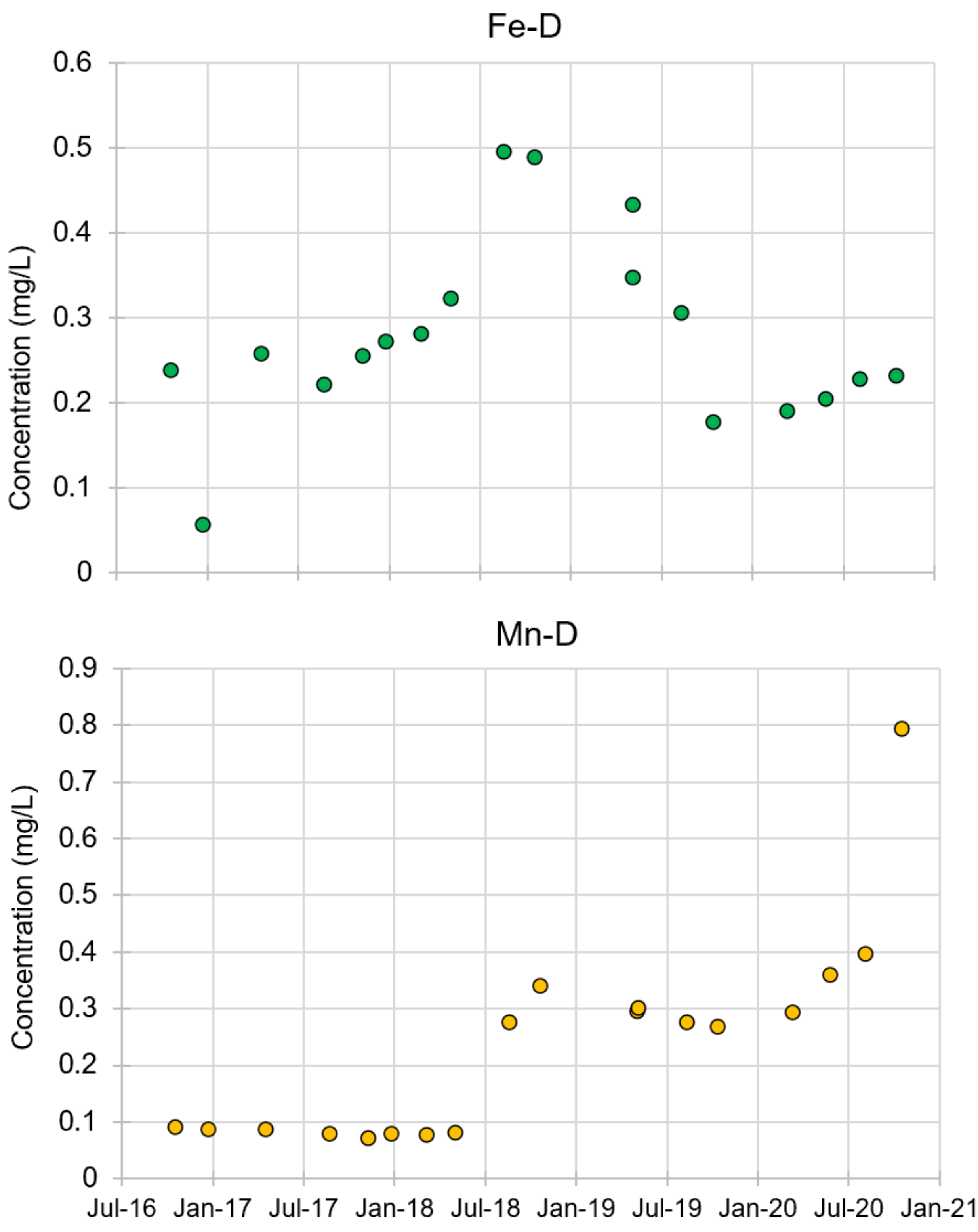
srk consulting

MINTO

2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update Report

Chromium in MW12-06

Job No: 1CM002.072	Minto Mine	Date: Oct 2021	Approved: LV	Figure: 24
Filename: Fig23-30_ChemistryPlots_1CM002.072				



X:\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20200304_2019_GW_Review\Working Files\[1CM002.055_ChemistryDataFigures_WorkingFile_Rev01_lv.xlsx]MW17-10_Charts

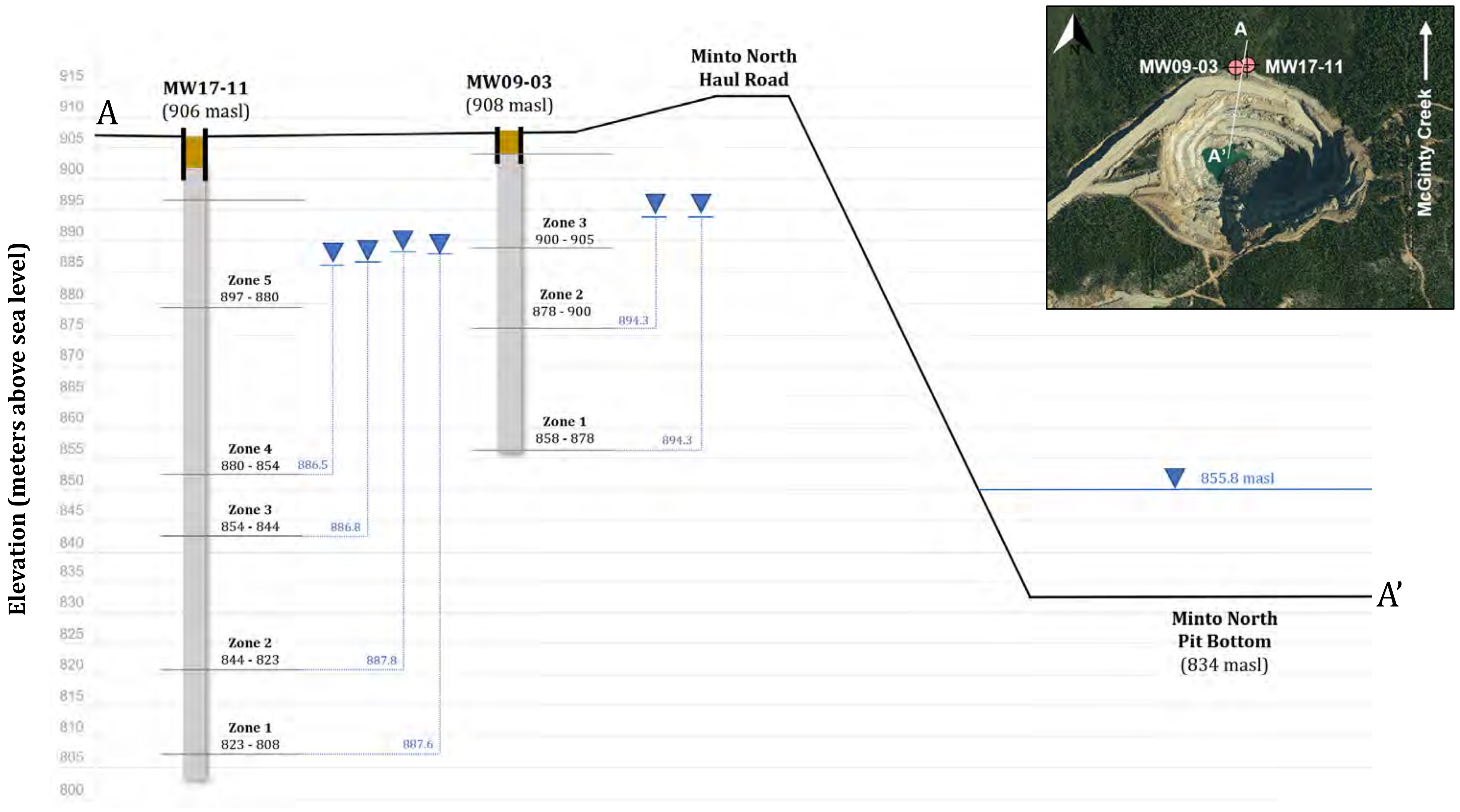
srk consulting

MINTO

2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update Report

Iron and Manganese MW12-06-01

Job No: 1CM002.072	Minto Mine	Date: Oct 2021	Approved: LV	Figure: 25
Filename: Fig23-30_ChemistryPlots_1CM002.072				



Notes:
Drawing is not to scale
Groundwater levels in MW17-11 recorded in Oct 2020
Pit water level and MW09-03 recorded in Dec 2020

LEGEND

- Overburden
- Granodiorite
- Water Level
- Monitoring Well

srk consulting

Job No: 1CM002.072
Filename: MintoNorthCrossSection_Figure_rev01.pptx

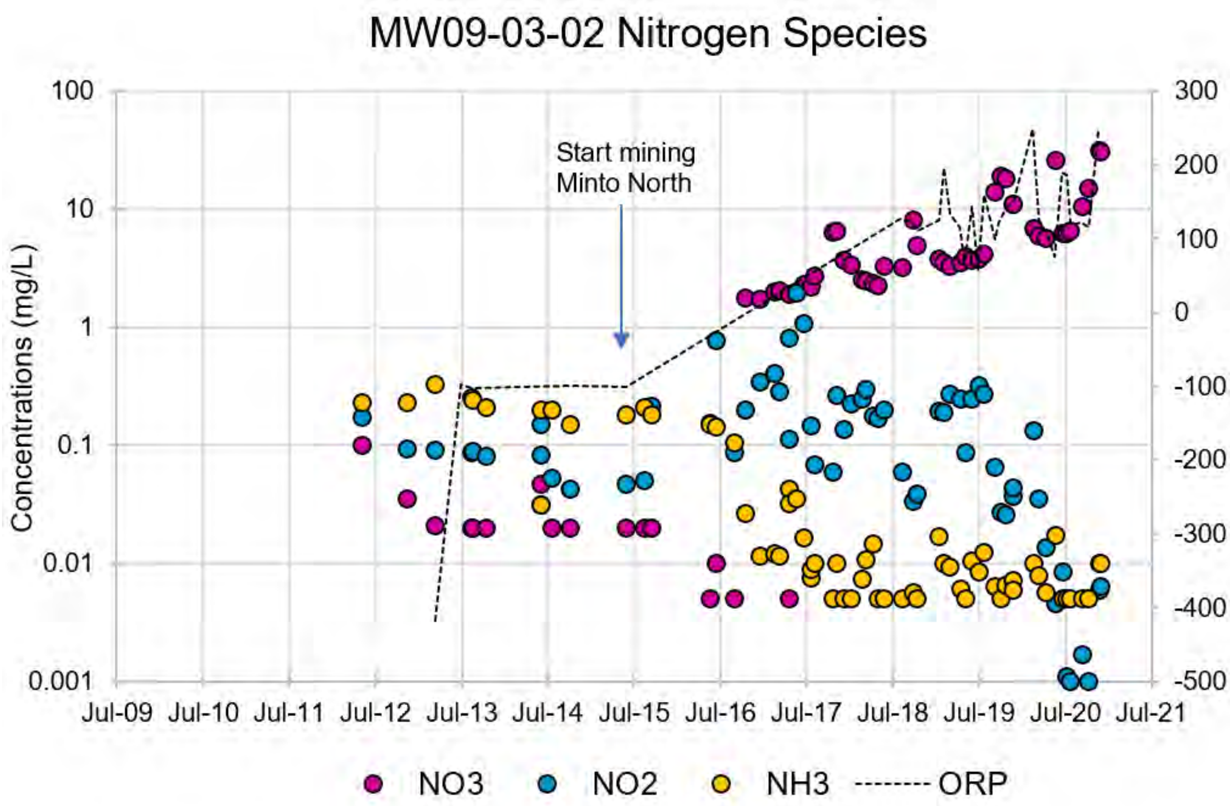
MINTO

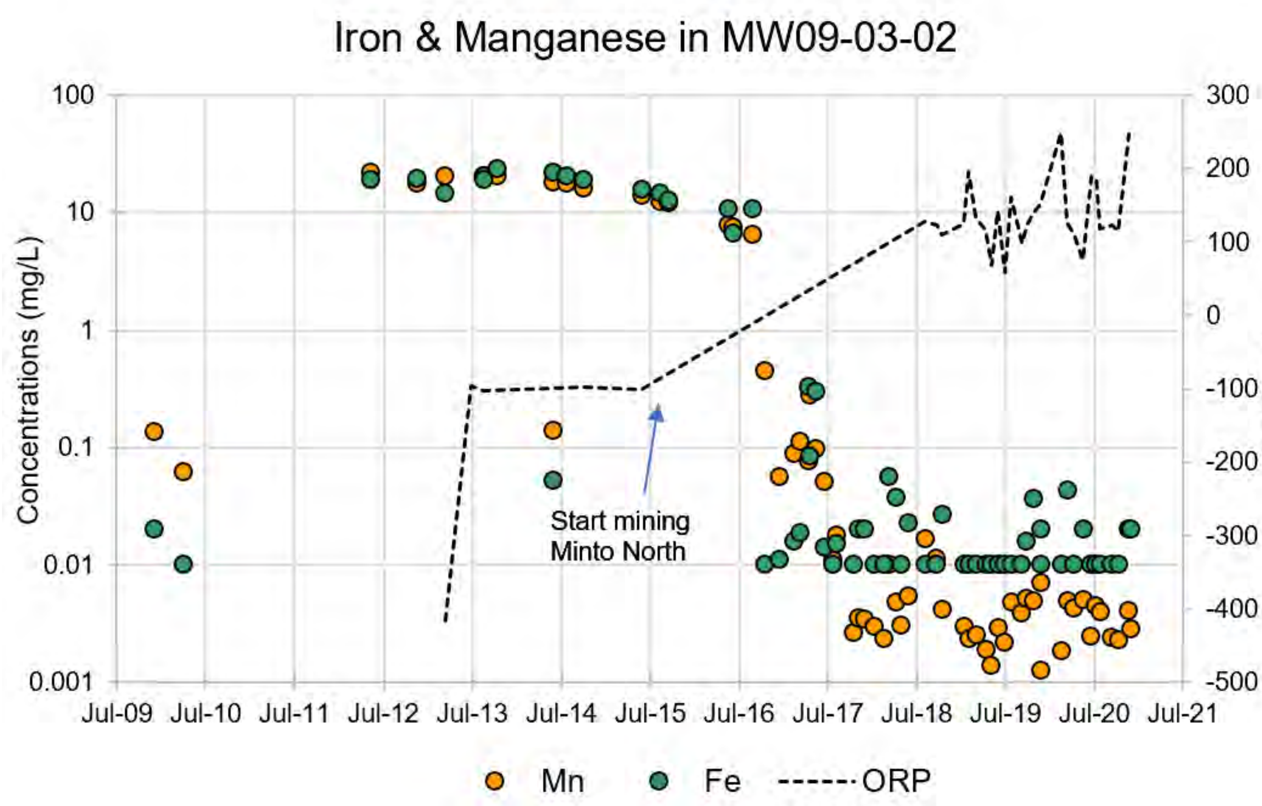
Minto Mine

2021 Characterization, Conceptual and Numerical Model Update

Cross Section of Minto North Pit, MW09-03 and MW17-11

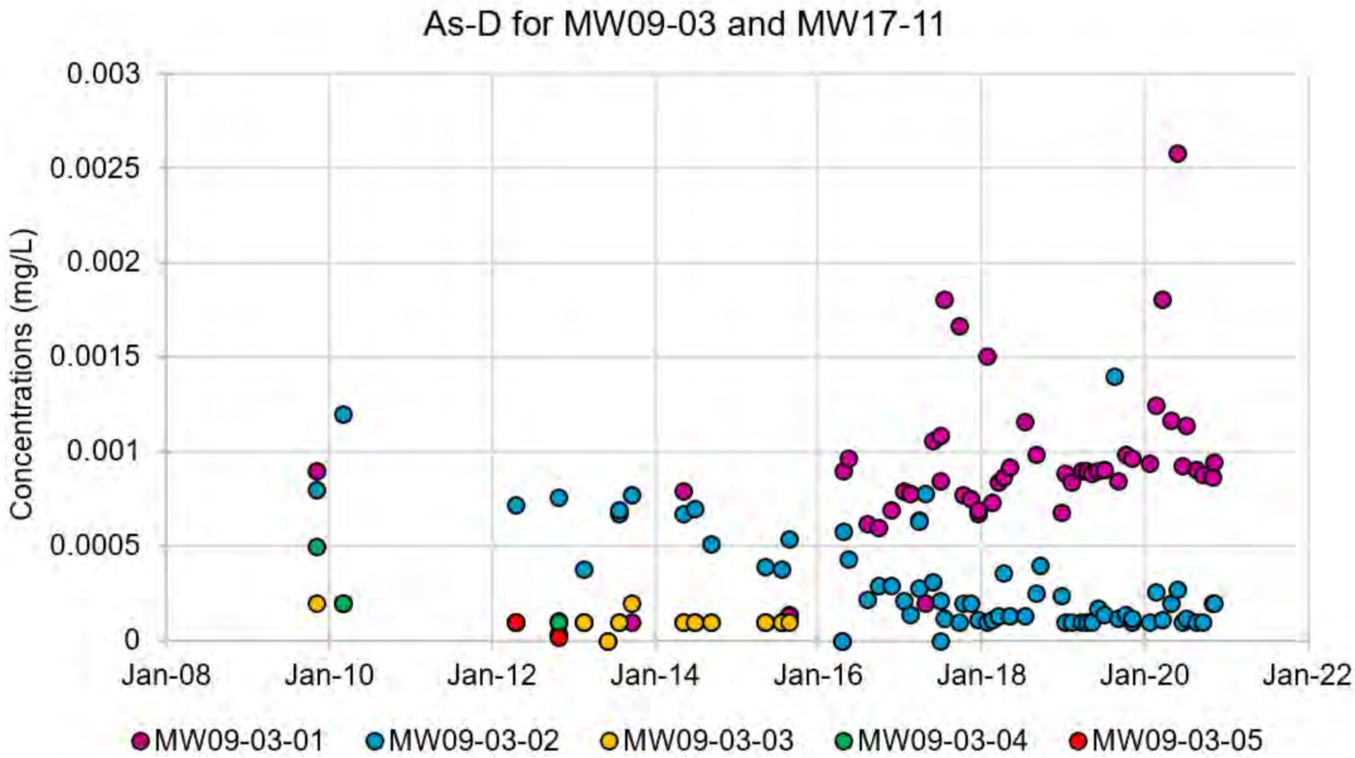
Date: Oct 2021
Approved: LV
Figure: 26

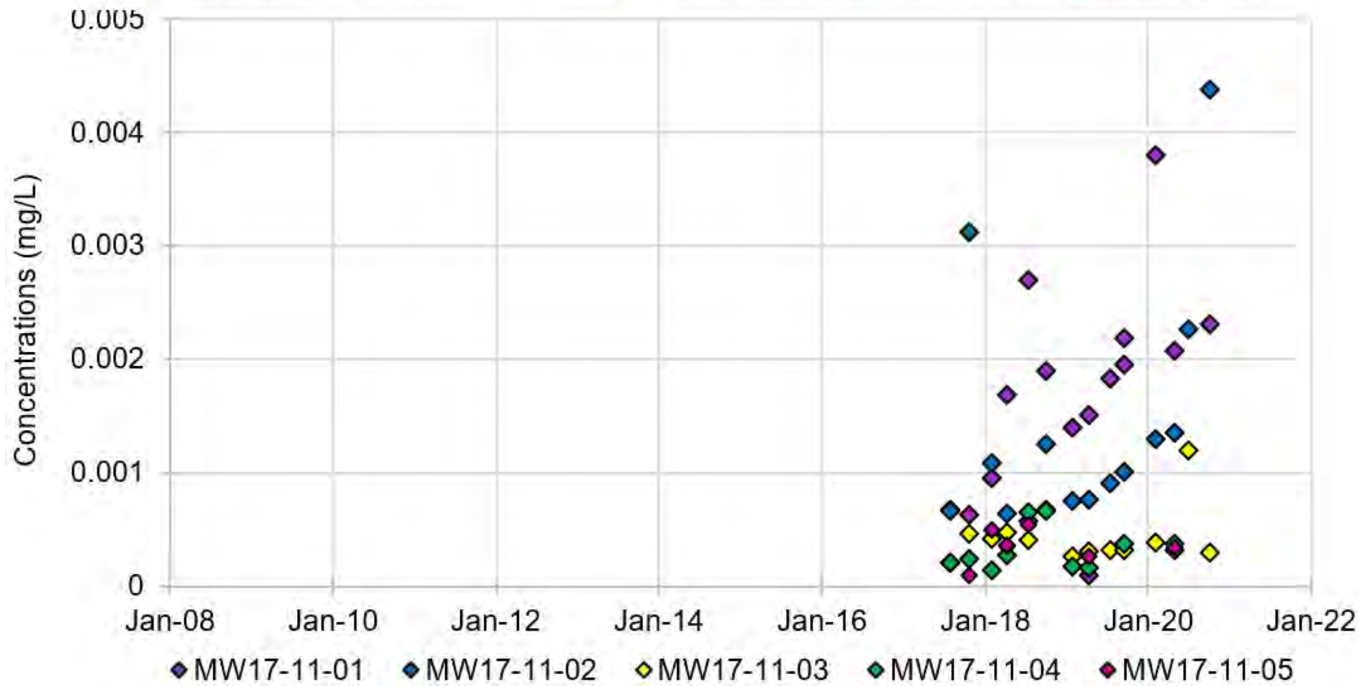




X:\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20200304_2019_GW_Review\Working Files\[1CM002.055_ChemistryDataFigures_WorkingFile_Rev01_lv.xlsx]MW17-10_Charts

srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update Report
		Iron, Manganese and Nitrogen Species Compared to ORP in MW09-03-02
Job No: 1CM002.072 Filename: Fig23-30_ChemistryPlots_1CM002.072	Minto Mine	Date: Oct 2021 · Approved: LV · Figure: 27

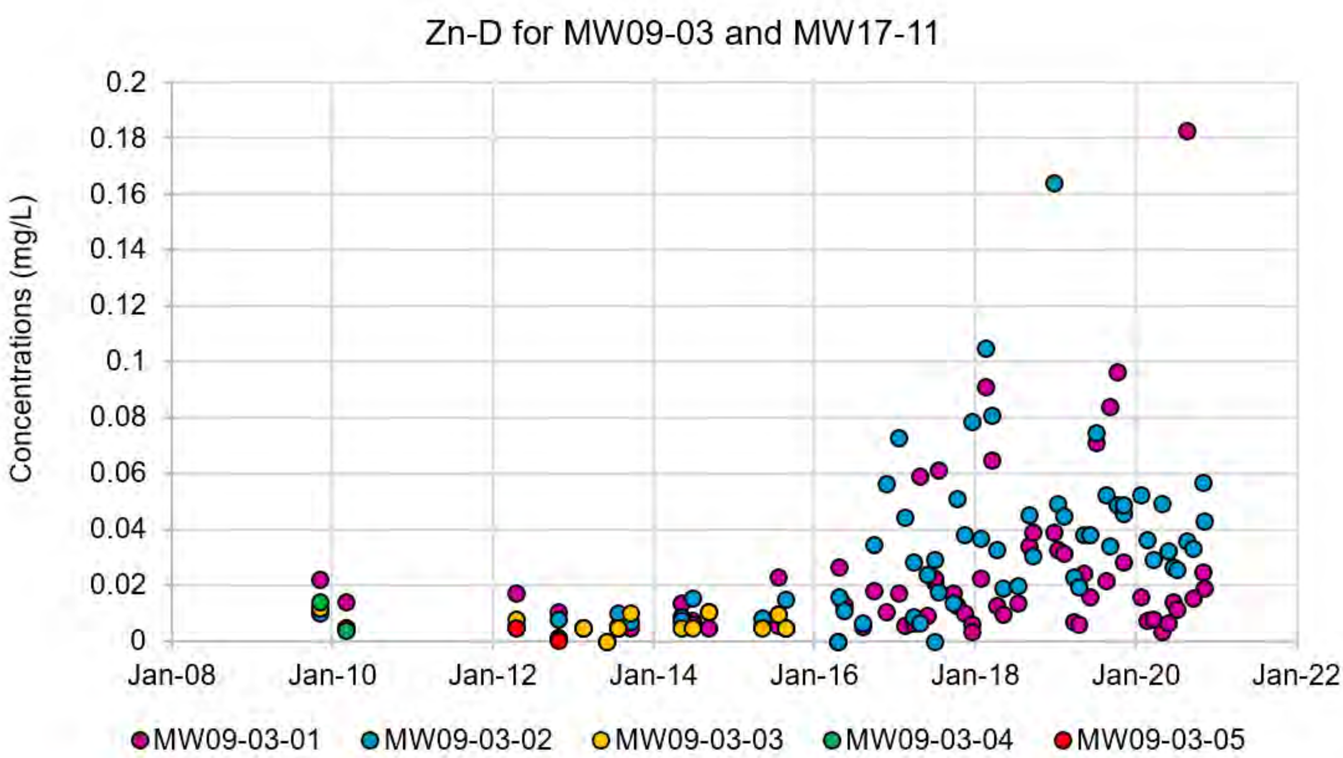


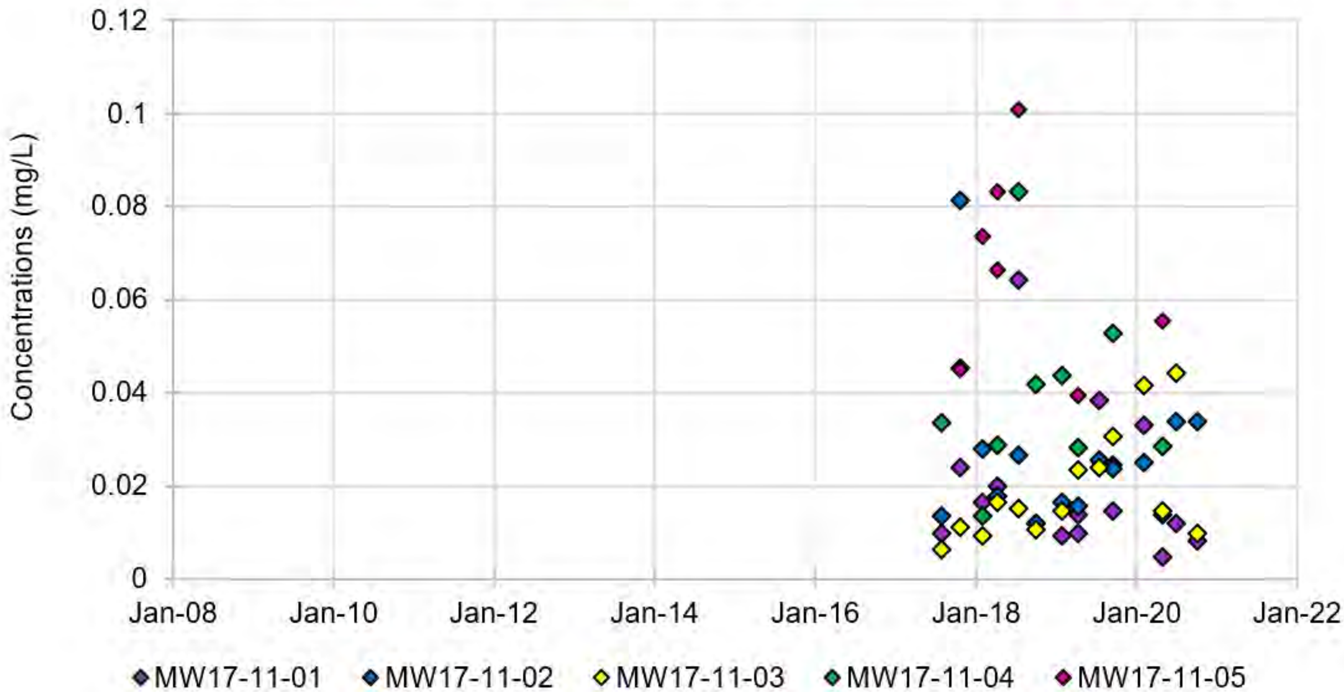


Outliers were removed for interpretation:
MW09-03-01: 0.0093 (Oct 19, 2018), 0.0041 (Sept 13, 2019), 0.0026 (Jun 26, 2020)
MW17-11-01: 0.030 (Jul 26, 2020)

X:\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20200304_2019_GW_Review\Working Files\[1CM002.055_ChemistryDataFigures_WorkingFile_Rev01_lv.xlsx]MW17-10_Charts

srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update Report
		Arsenic in MW09-03 and MW17-11
Job No: 1CM002.072	Minto Mine	Date: Oct 2021
Filename: Fig23-30_ChemistryPlots_1CM002.072		Approved: LV
		Figure: 28





X:\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20200304_2019_GW_Review\Working Files\[1CM002.055_ChemistryDataFigures_WorkingFile_Rev01_lv.xlsx]MW17-10_Charts

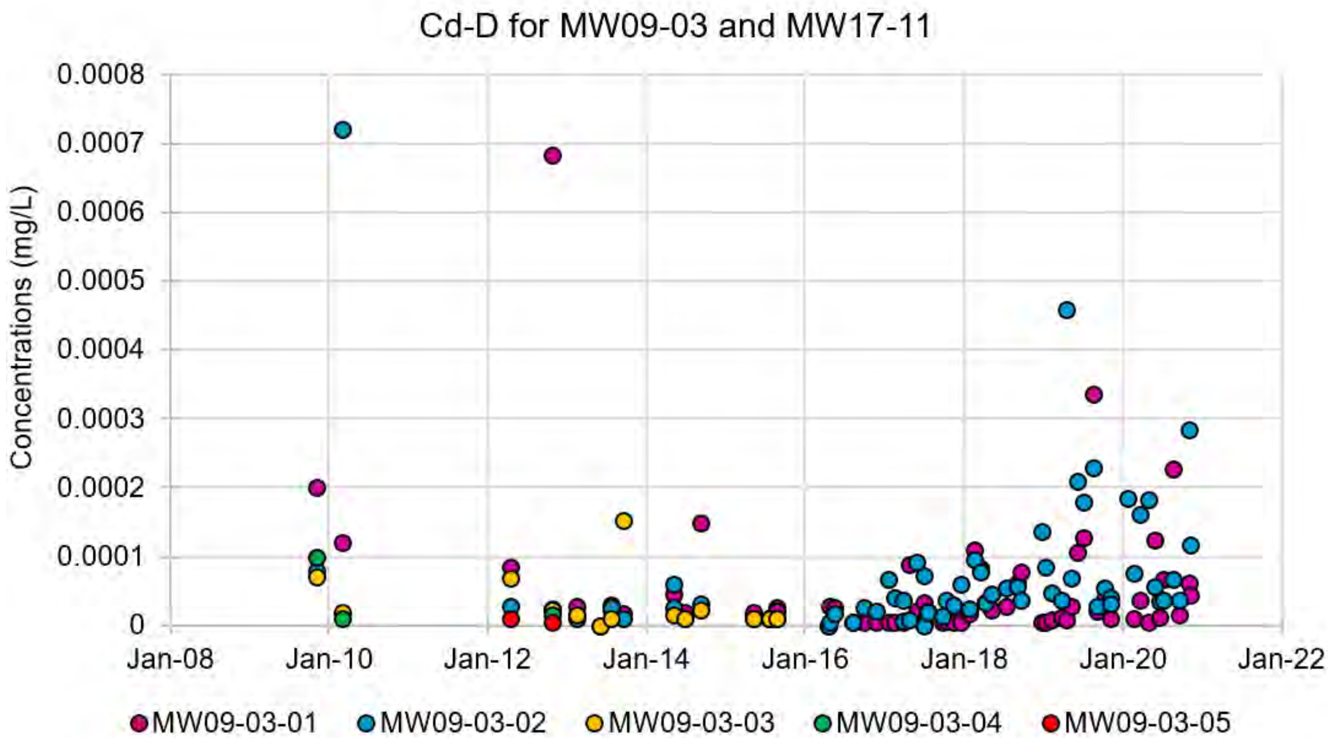
srk consulting

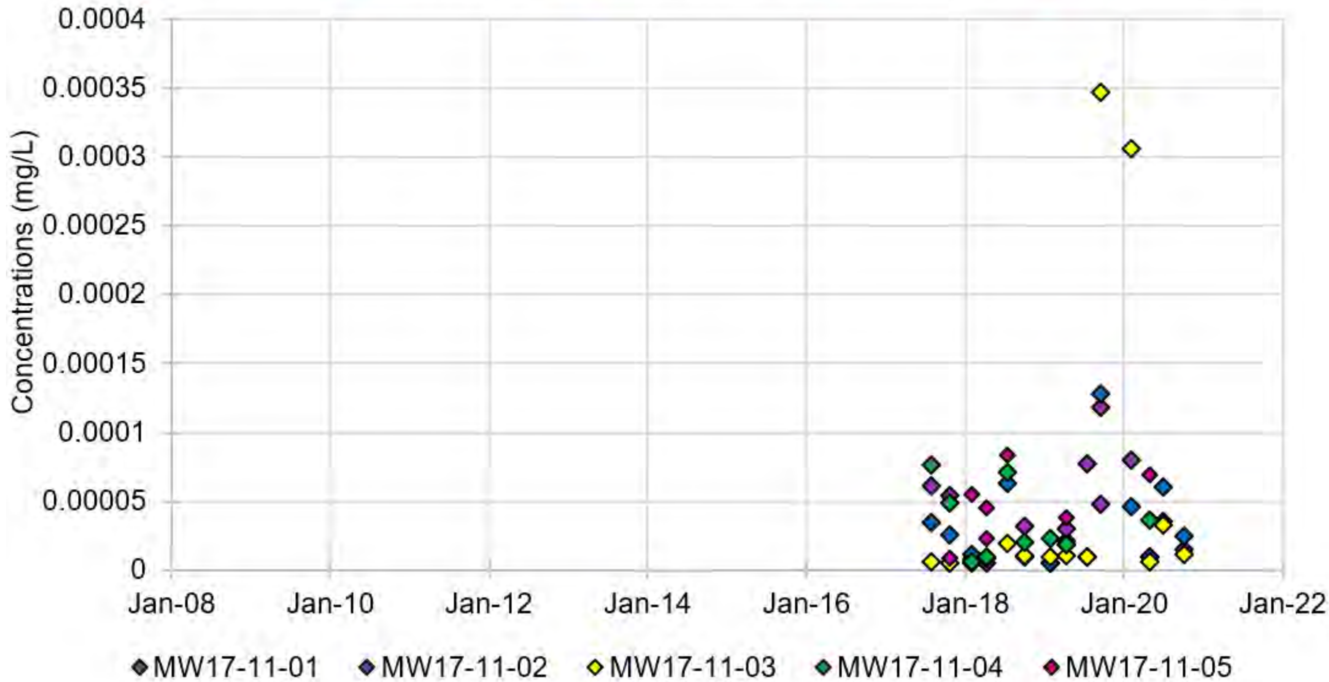
MINTO

2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update Report

Zinc in MW09-03 and MW17-11

Job No: 1CM002.072 Filename: Fig23-30_ChemistryPlots_1CM002.072	Minto Mine	Date: Oct 2021	Approved: LV	Figure: 29

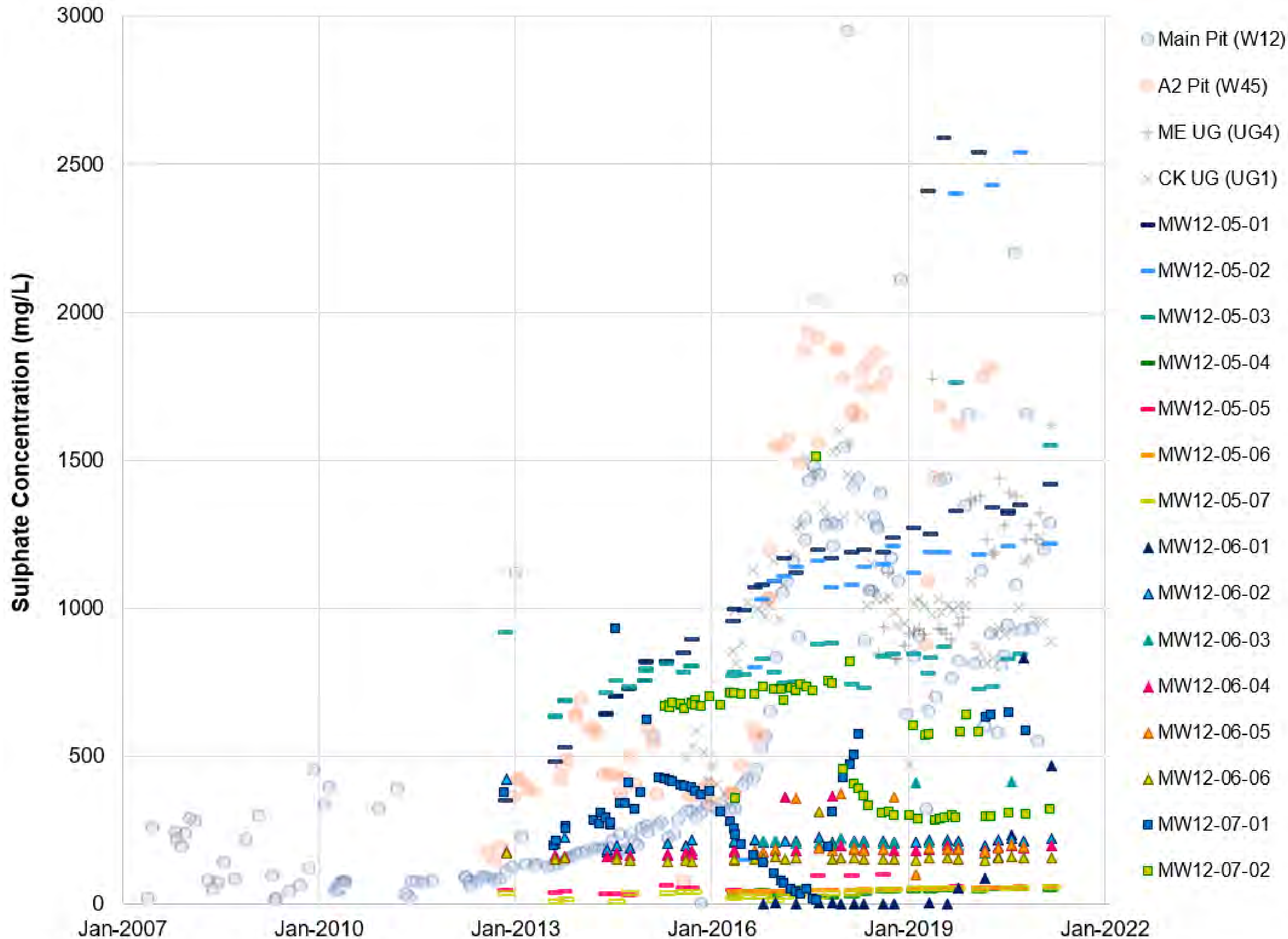




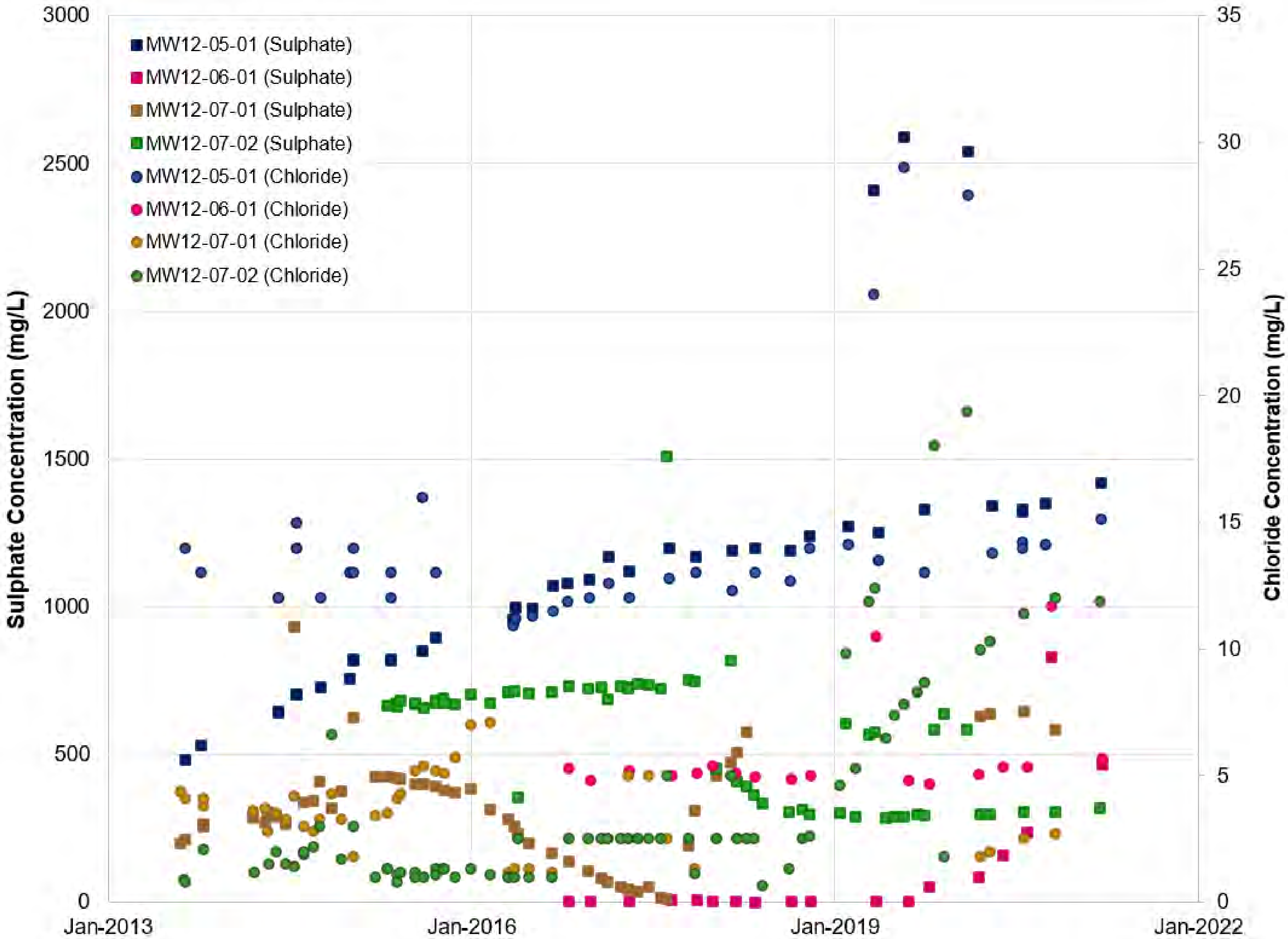
Outliers were removed for interpretation:
MW09-03-01: 0.001 (Feb 23, 2020)
MW17-11-01: 0.007 (Aug 12, 2018)
MW17-11-03: 0.0004 (Oct 14, 2019)
MW17-11-04: 0.0005 (Oct 14, 2019)

X:\01_SITES\Minto\1CM002.055_AMP_Trigger_Responses\20200304_2019_GW_Review\Working Files\[1CM002.055_ChemistryDataFigures_WorkingFile_Rev01_lv.xlsx]MW17-10_Charts

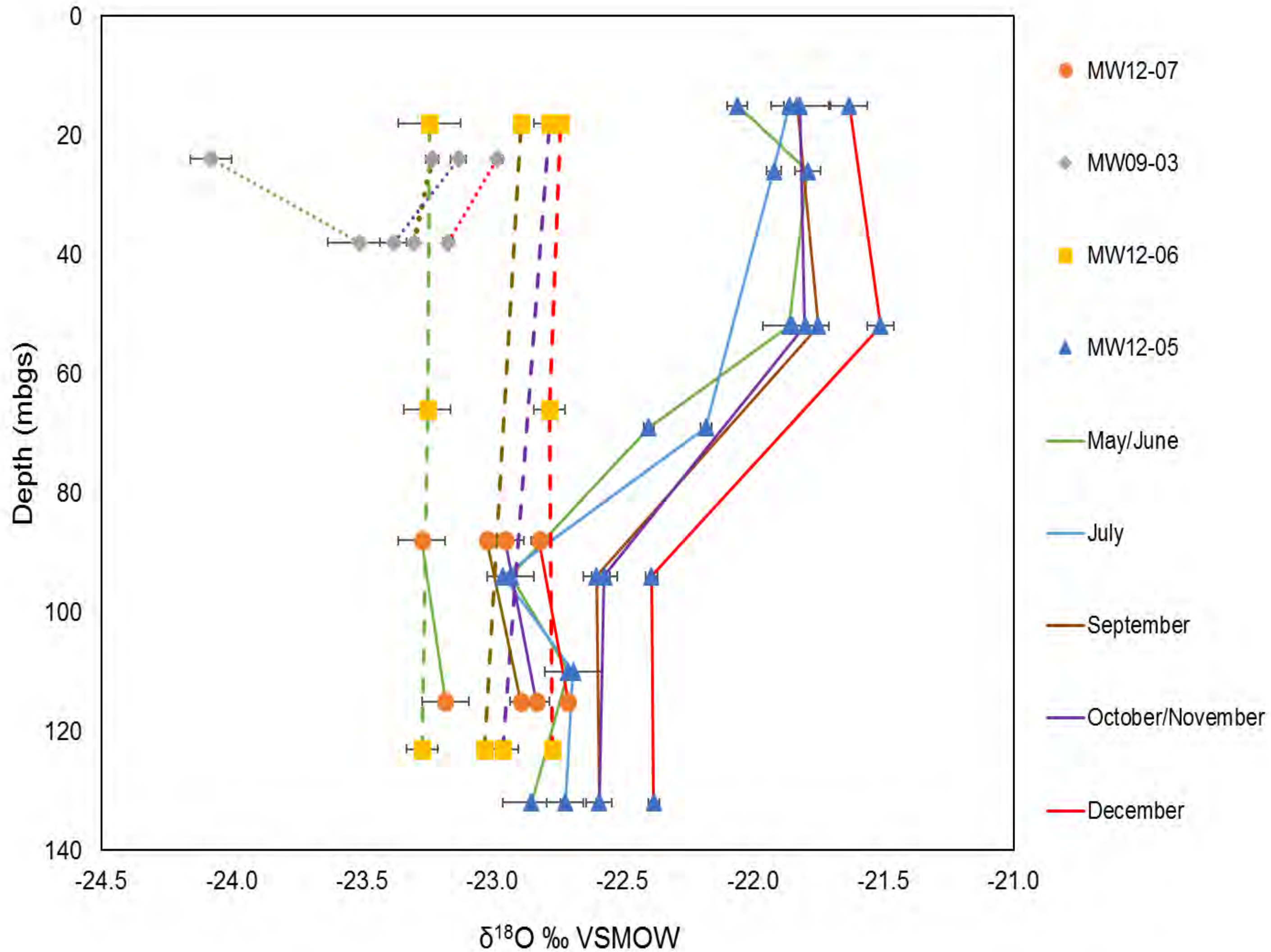
srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update Report
		Cadmium in MW09-03 and MW17-11
Job No: 1CM002.072 Filename: Fig23-30_ChemistryPlots_1CM002.072	Minto Mine	Date: Oct 2021 / Approved: LV / Figure: 30



srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update **Temporal Sulphate Trends in Pits, Underground Discharge and Downgradient Wells**
Job No: 1CM002.072 Filename: TracerFigures_1CM002.072.pptx	Minto	Date: Oct 2021 / Approved: LV / Figure: **31**



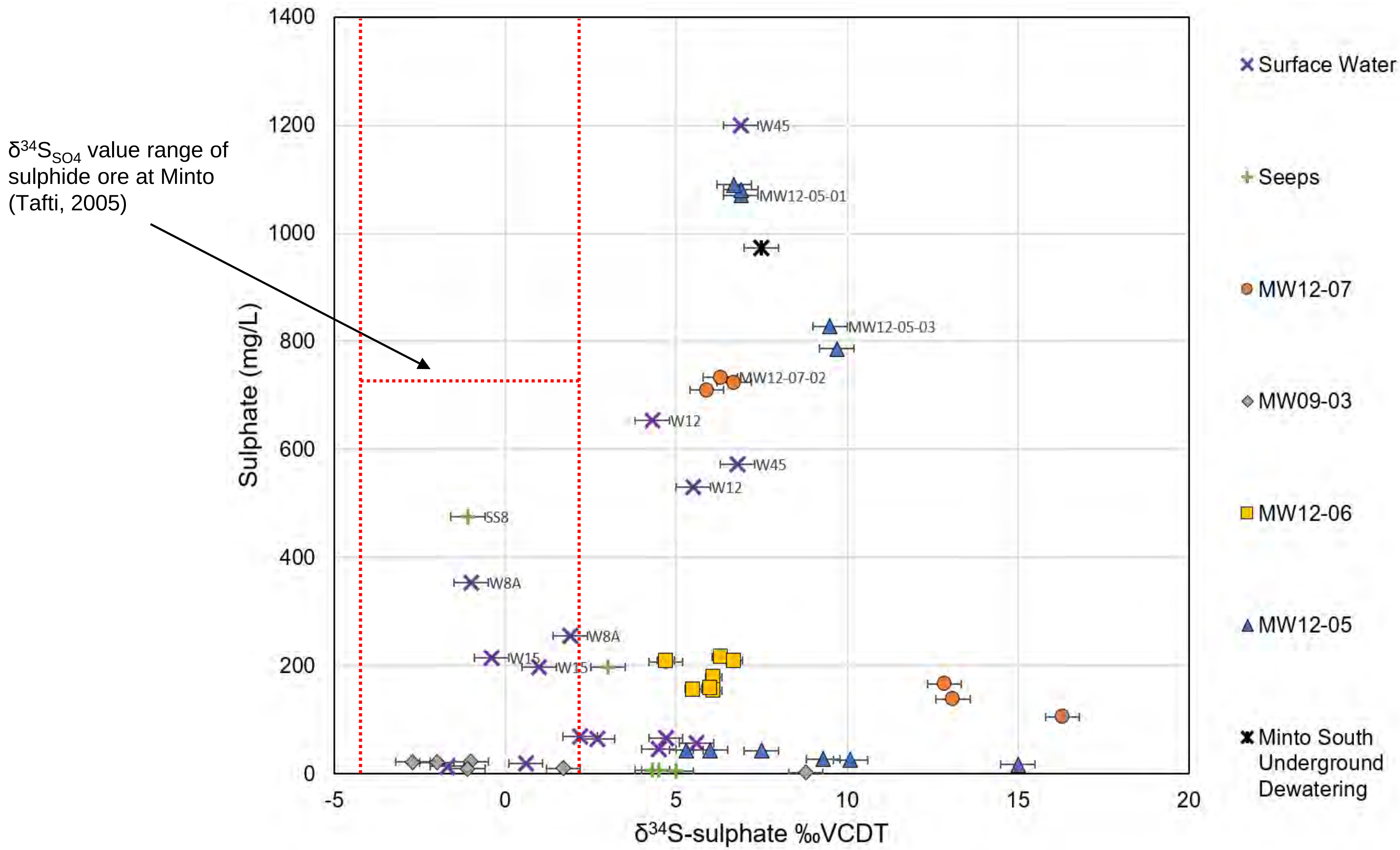
srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update
		Temporal Trends in Sulphate vs Chloride in Downgradient Wells
Job No: 1CM002.072 Filename: TracerFigures_1CM002.072.pptx		Date: Oct 2021 / Approved: LV / Figure: 32



\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\1CM002.051_Minto_2016GroundwaterSupport\[MintoIsotopes_1CM002.051_REV04_MSS.xlsx]

NOTE: Note: Error bars are plotted as the standard deviation based on three to six analyses per sample.

srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update
		δ^{18}O versus Depth
Job No: 1CM002.072 Filename: TracerFigures_1CM002.072.pptx	Minto Mine	Date: Oct 2021 · Approved: LV · Figure: **33**



\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\1CM002.051_Minto_2016GroundwaterSupport\[EnvironmentalTracerStudy_1CM002.057_rev03_mss_rob.xlsx]

NOTE: Error bars are plotted as expected error for this type of analysis as provided by the laboratory (±0.5‰).

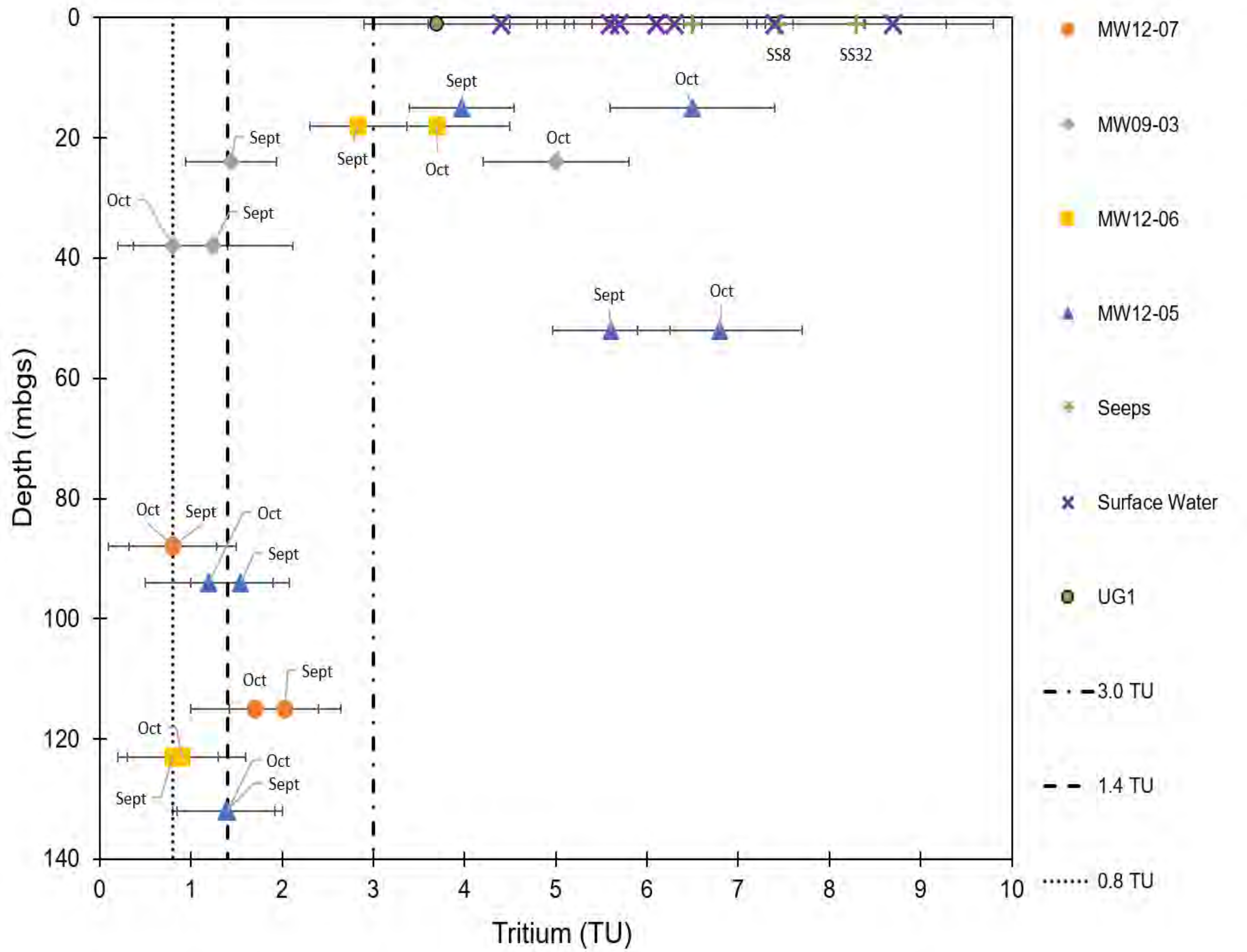
srk consulting | MINTO | 2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update

$\delta^{34}S_{SO4}$ versus Sulphate

Job No: 1CM002.072
Filename: TracerFigures_1CM002.072.pptx

Minto Mine

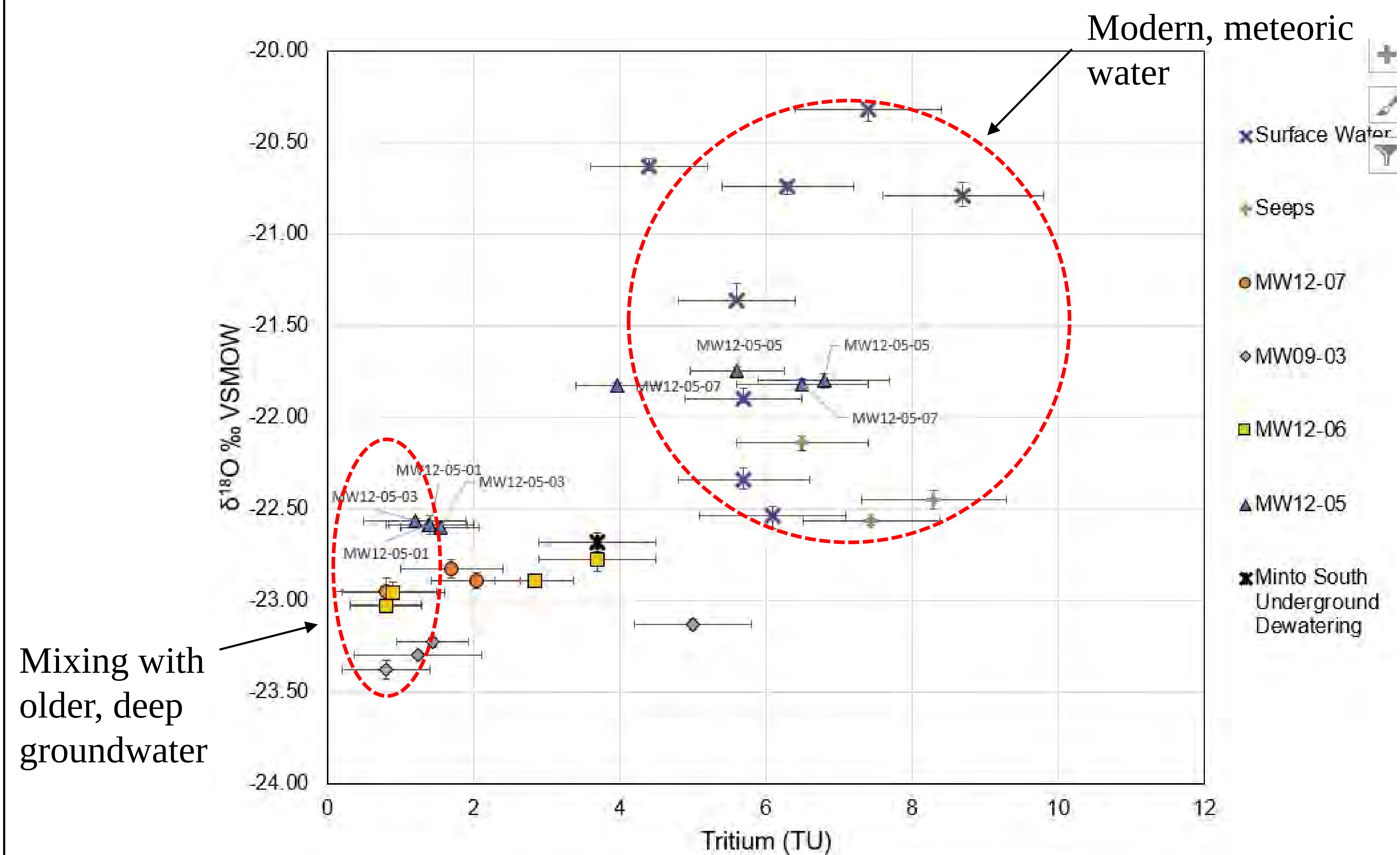
Date: Oct 2021 | Approved: LV | Figure: 34



\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\1CM002.051_Minto_2016GroundwaterSupport\[MintoIsotopes_1CM002.051_REV04_MSS.xlsx]

NOTE: Note all seep, surface water, and precipitation is plotted at zero
Error bars are plotted as the standard deviation based on ten analysis per sample.
Values less than the detection limit (0.8 TU) are plotted at the detection limit.
All surface water samples were collected in October and all seep samples were collected in September

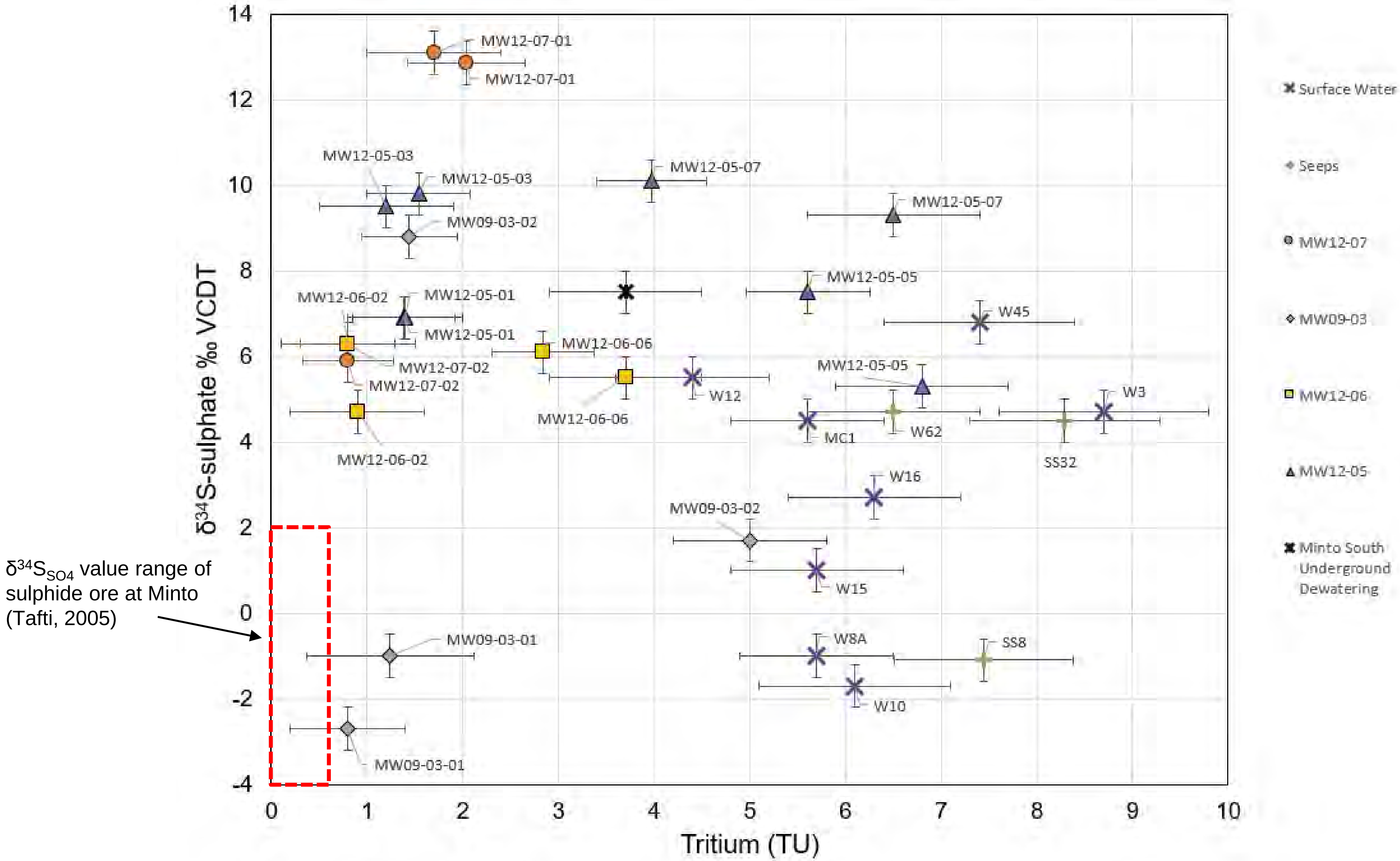
srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update
		Tritium versus Depth
Job No: 1CM002.072 Filename: TracerFigures_1CM002.072.pptx	Minto Mine	Date: Oct 2021 · Approved: LV · Figure: **35**



\\van-svr0\Projects\01_SITES\Minto\1CM002.051_Minto_2016GroundwaterSupport\[EnvironmentalTracerStudy_1CM002.057_rev03_mss_rob.xlsx]

NOTE:
Error bars are plotted as the standard deviation based on ten analysis per sample.
Values less than the detection limit (0.8 TU) are plotted at the detection limit.
All surface water samples were collected in October and all seep samples were collected in September

srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update
		Tritium versus $\delta^{18}O$
Job No: 1CM002.072 Filename: TracerFigures_1CM002.072.pptx	Minto Mine	Date: Oct 2021 / Approved: LV / Figure: 36



NOTE:
Error bars are plotted as the standard deviation based on ten analysis per sample.
Values less than the detection limit (0.8 TU) are plotted at the detection limit.
All surface water samples were collected in October and all seep samples were collected in September

\\van-svr0\Projects\01_SITES\Minto\1CM002.051_Minto_2016GroundwaterSupport\[EnvironmentalTracerStudy_1CM002.057_rev03_mss_rob.xlsx]

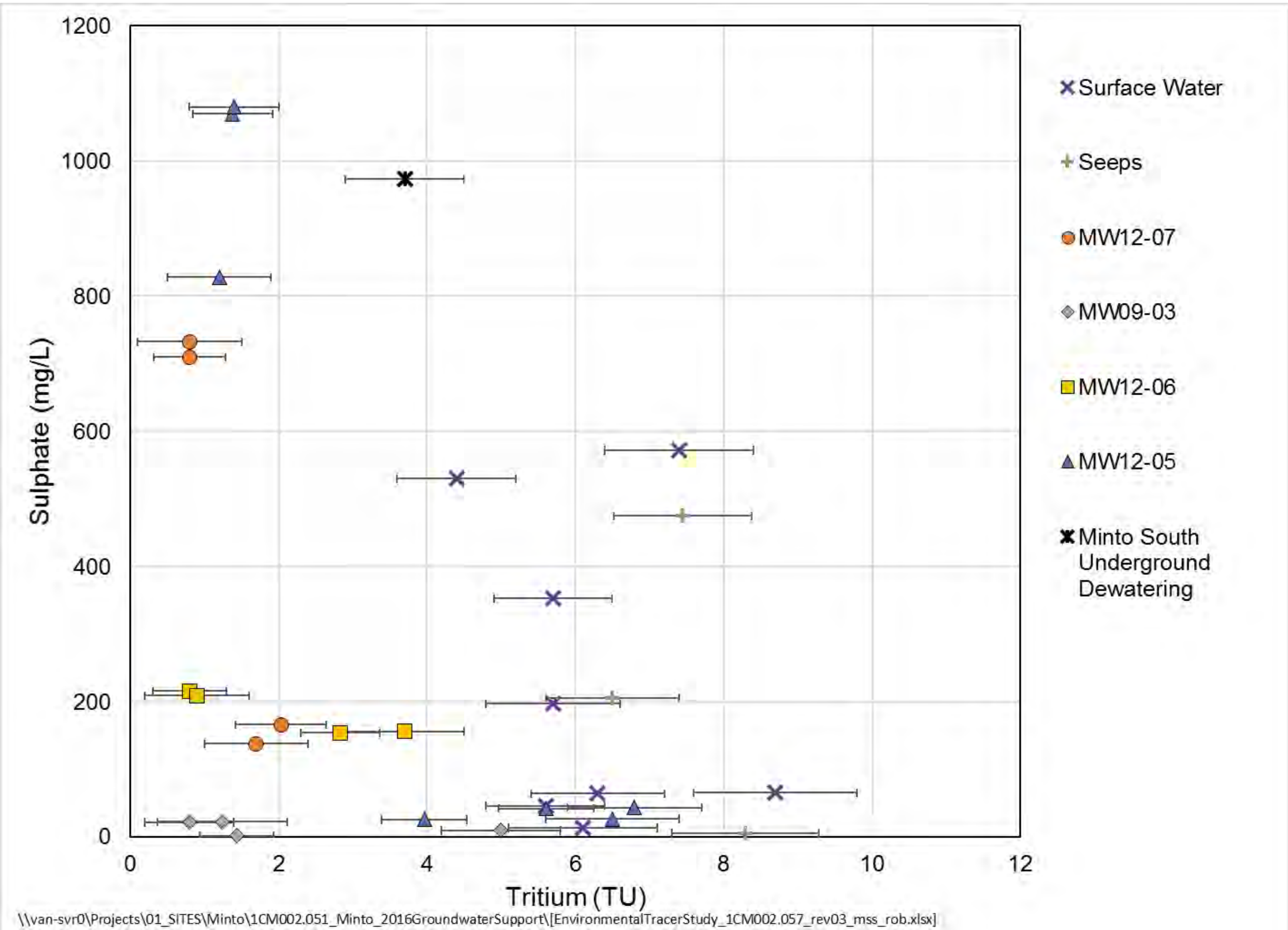
srk consulting

MINTO

2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update

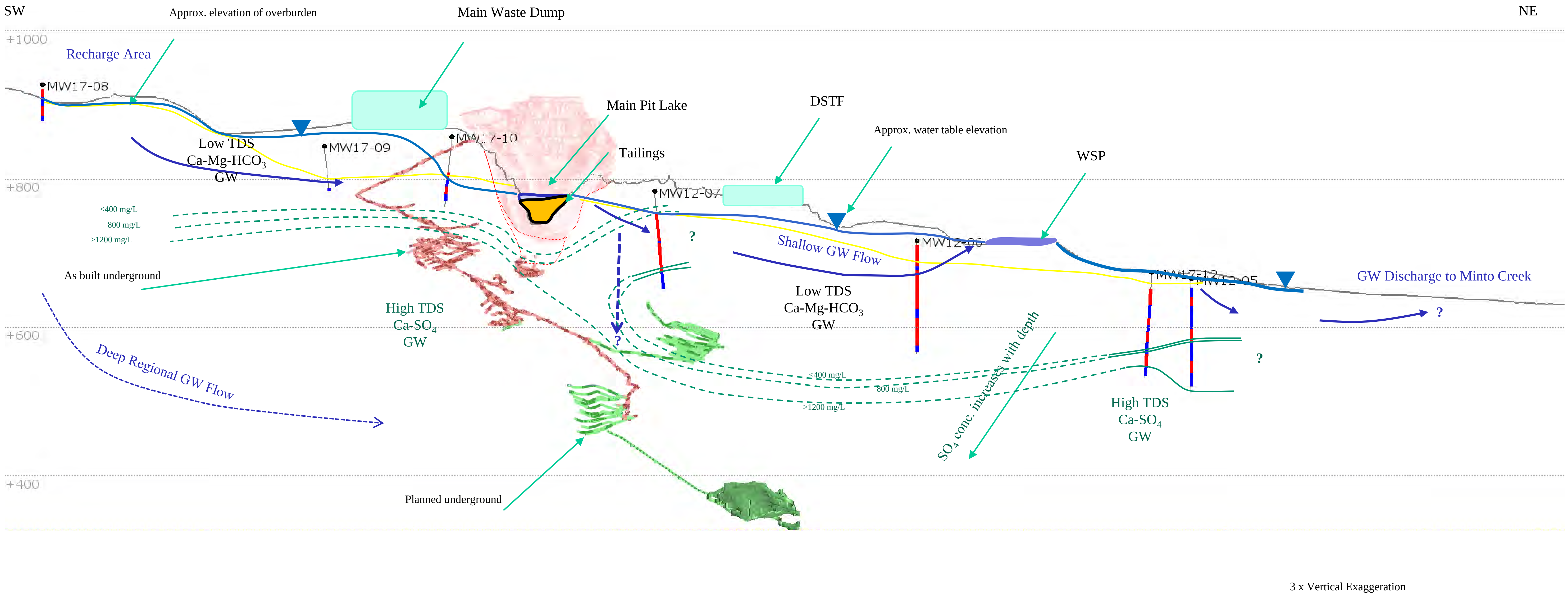
Tritium vs $\delta^{34}S_{SO4}$

Job No: 1CM002.072 Filename: TracerFigures_1CM002.072.pptx	Minto Mine	Date: Oct 2021	Approved: LV	Figure: 37



NOTE:
Error bars are plotted as the standard deviation based on ten analysis per sample.
Values less than the detection limit (0.8 TU) are plotted at the detection limit.
All surface water samples were collected in October and all seep samples were collected in September

srk consulting	MINTO	2021 Minto Groundwater Characterization, Conceptual and Numerical Model Update
		Tritium vs Sulphate
Job No: 1CM002.072 Filename: TracerFigures_1CM002.072.pptx	Minto Mine	Date: Oct 2021 · Approved: LV · Figure: 38



Note:
- Shallow GW refers to relatively shallow GW flow through bedrock, not via active layer
- Concentration contours are of SO$_4$

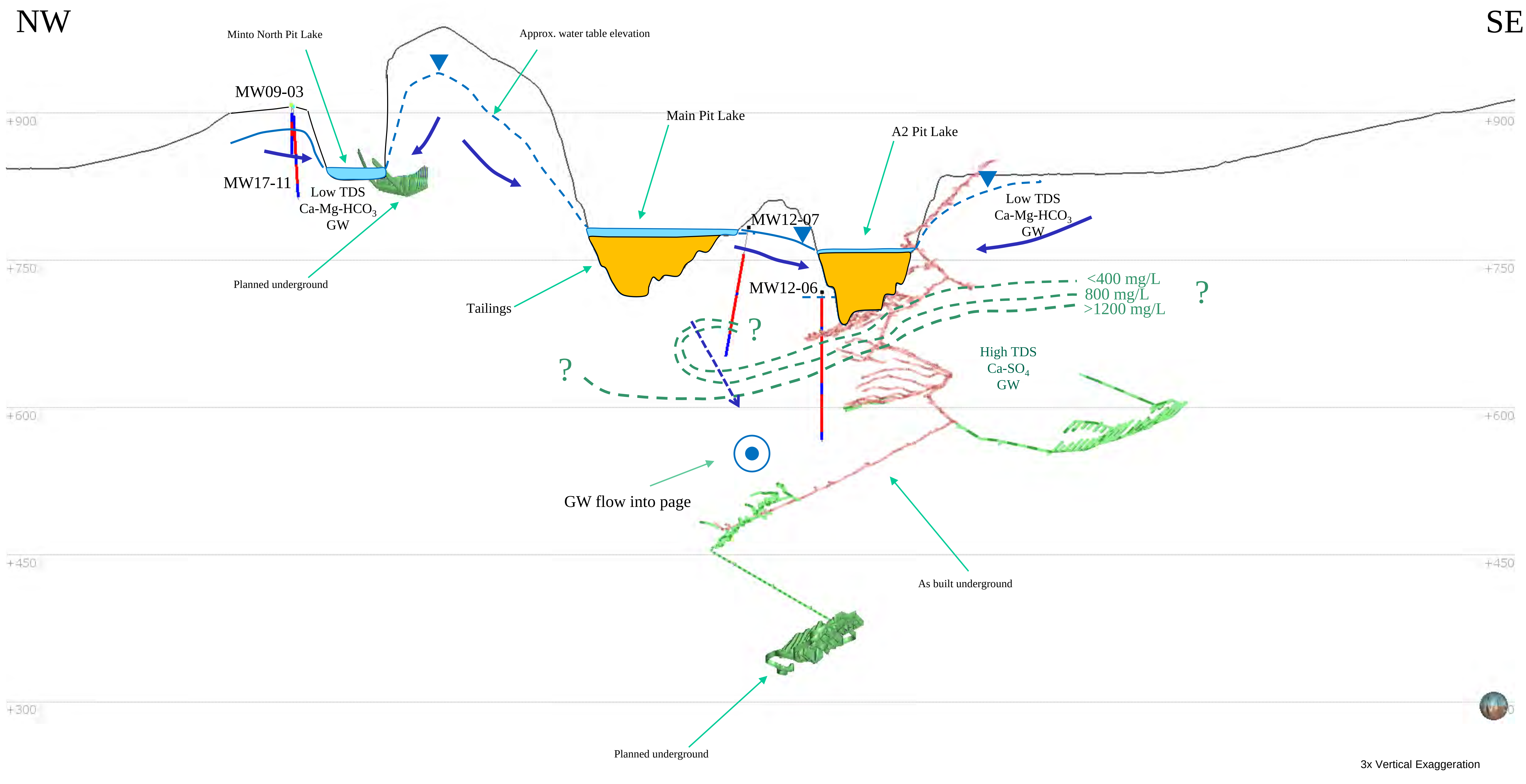
srk consulting | MINTO | Minto Groundwater Model Update

Minto Creek Conceptual Model

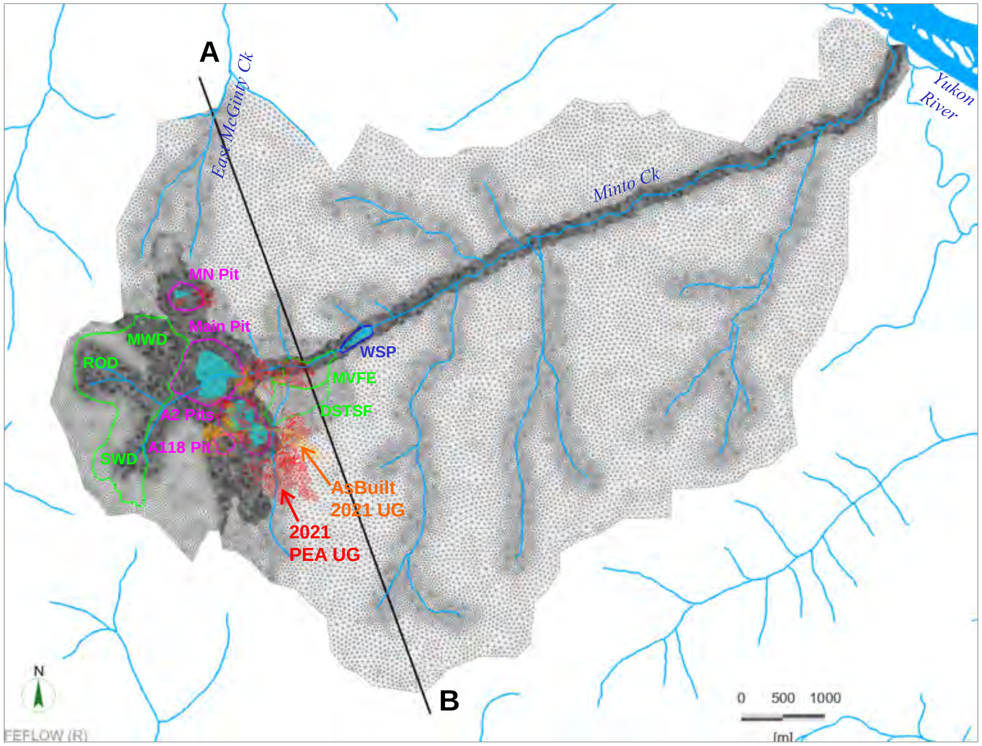
Job No: 1CM002.072
Filename: 1CM002.072_Fig39_MC-Concpt_Mdl.pptx

Minto Mine

Date: Oct. 21 | Approved: GF | Figure: 39

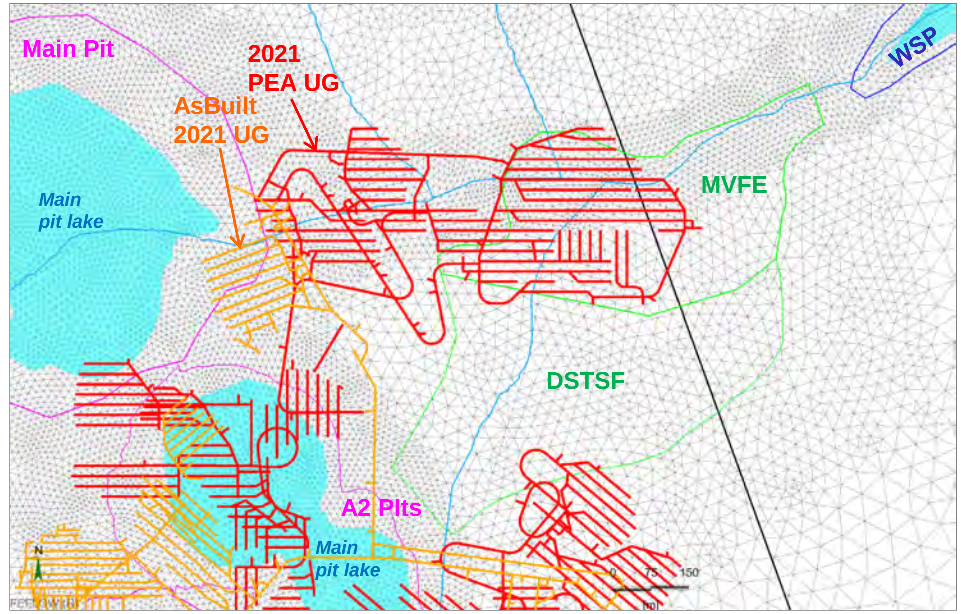


srk consulting	MINTO	Minto Groundwater Model Update
		Minto North Schematic Conceptual Model
Job No: 1CM002.072 Filename: 1CM002.072_Fig40_MN-Concpt_Mdl.pptx	Minto Mine	Date: Oct. 21 · Approved: GF · Figure: 40

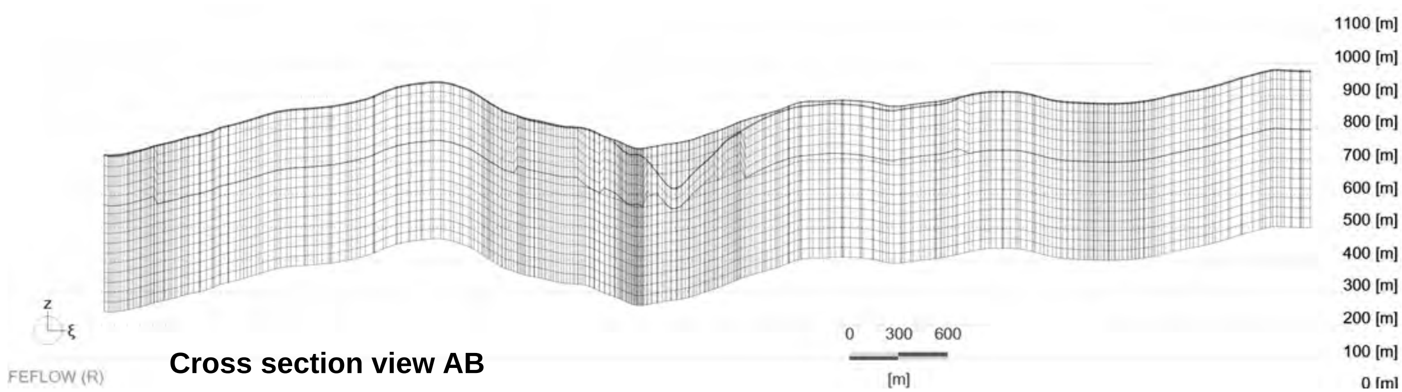


Plan view of model domain

Cross section line denoted as AB (below); zoomed view highlighted by white box.



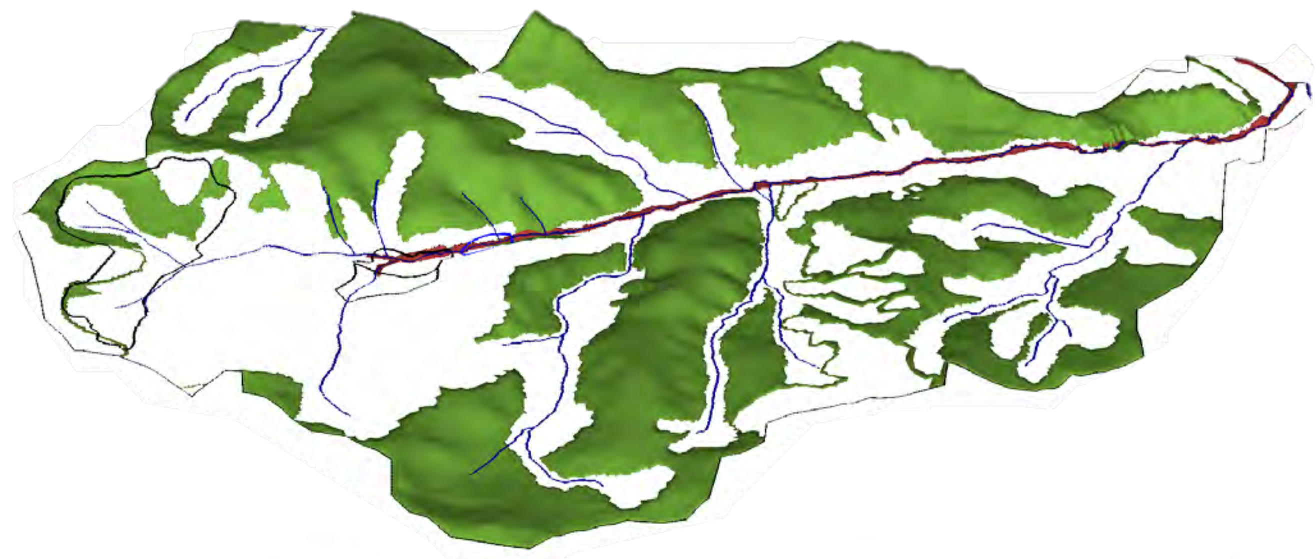
Zoomed view



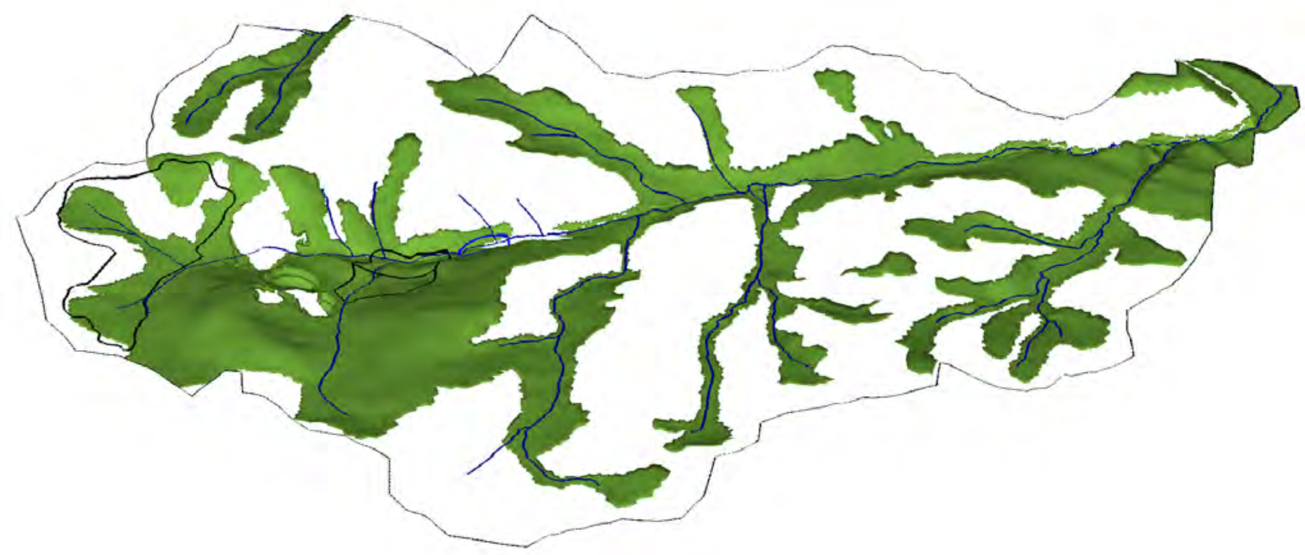
Cross section view AB

srk consulting	MINTO	Minto Groundwater Model Update
		Model Mesh
Job No: 1CM002.072 Filename: 1CM002.072_Fig41_MdlMesh.pptx	MINTO MINE	Date: Oct. 2021 | Approved: GF | Figure: 41

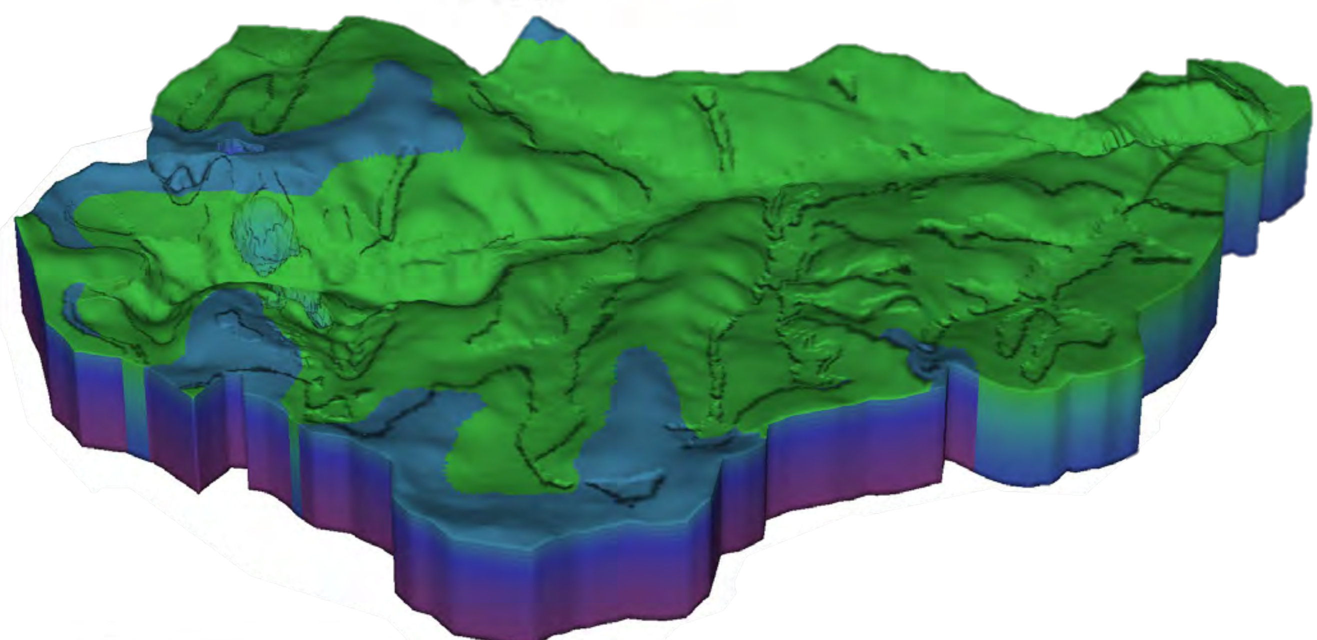
Minto Creek bed and Overburden modelled with a 1 m thickness



Overburden greater than 1 m thick



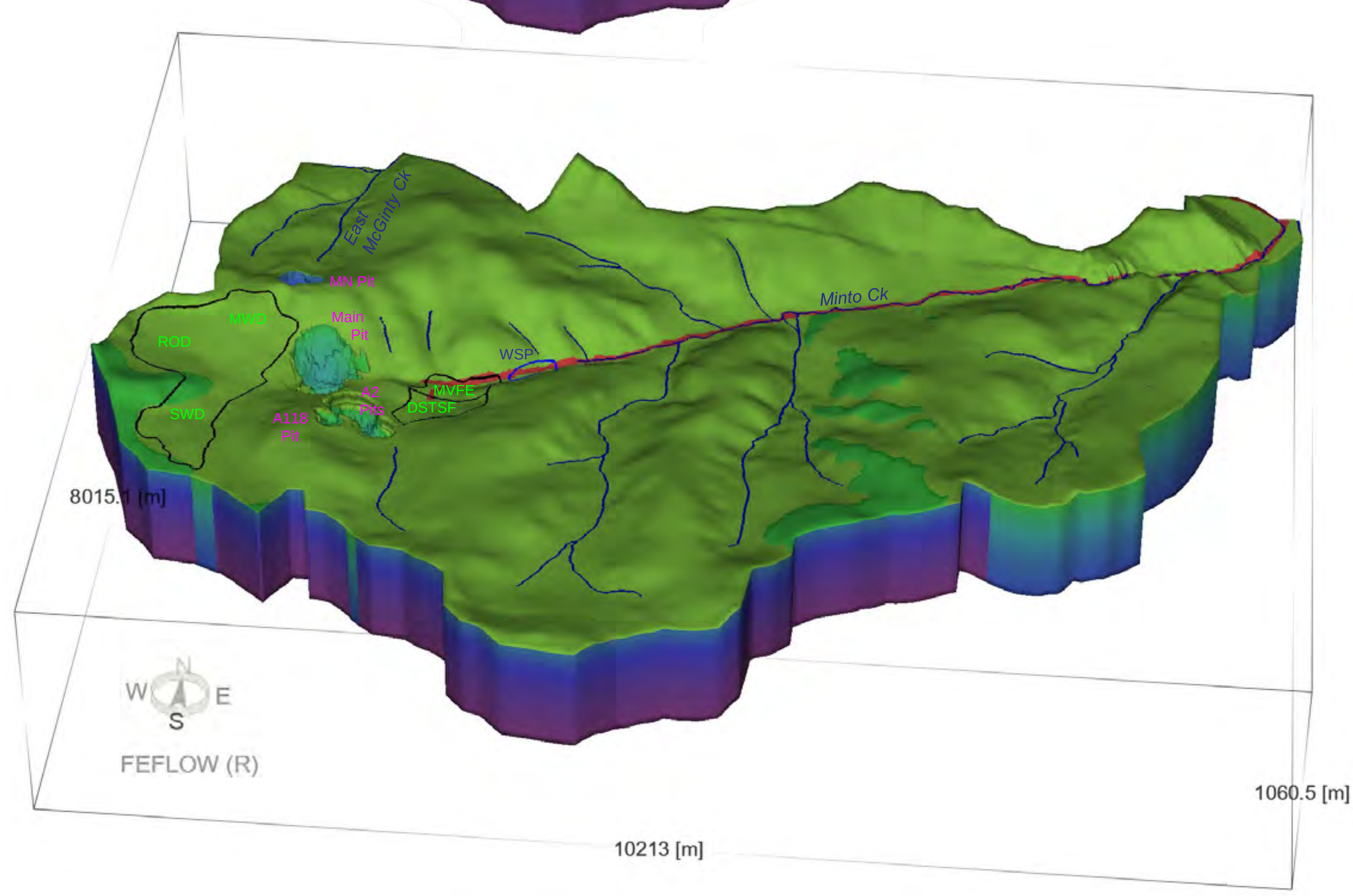
Bedrock



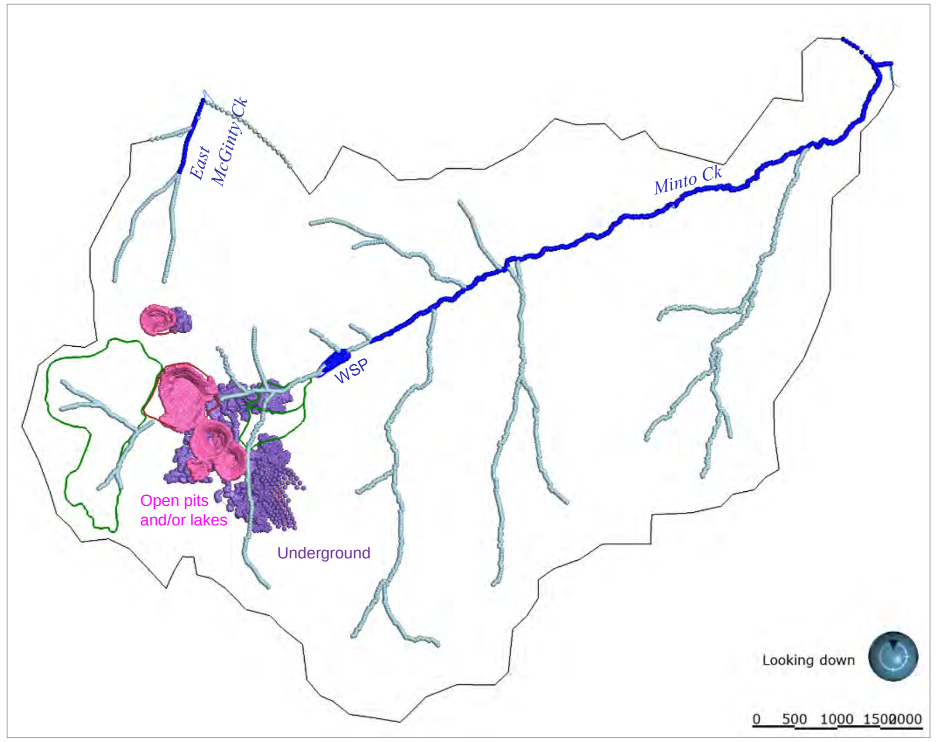
Full model domain
(2021 mined-out topo)

Hydraulic
Conductivity
K (m/s)

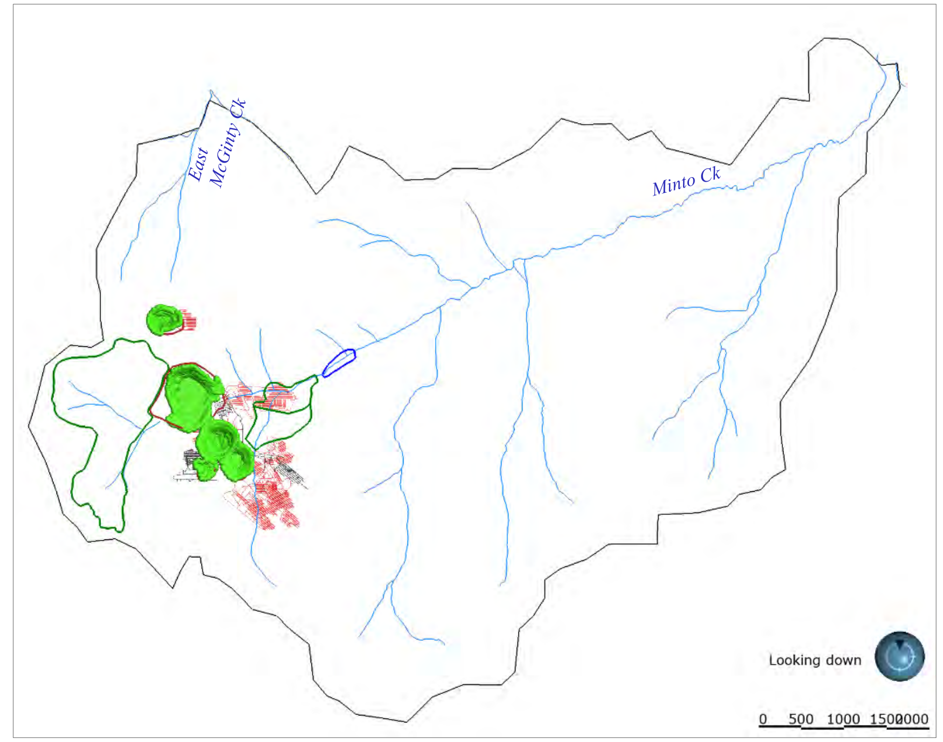
- 5.5E-05
- 1.5E-05
- 4.1E-06
- 1.1E-06
- 3.0E-07
- 8.2E-08
- 2.2E-08
- 6.1E-09
- 1.7E-09
- 4.5E-10
- 1.2E-10



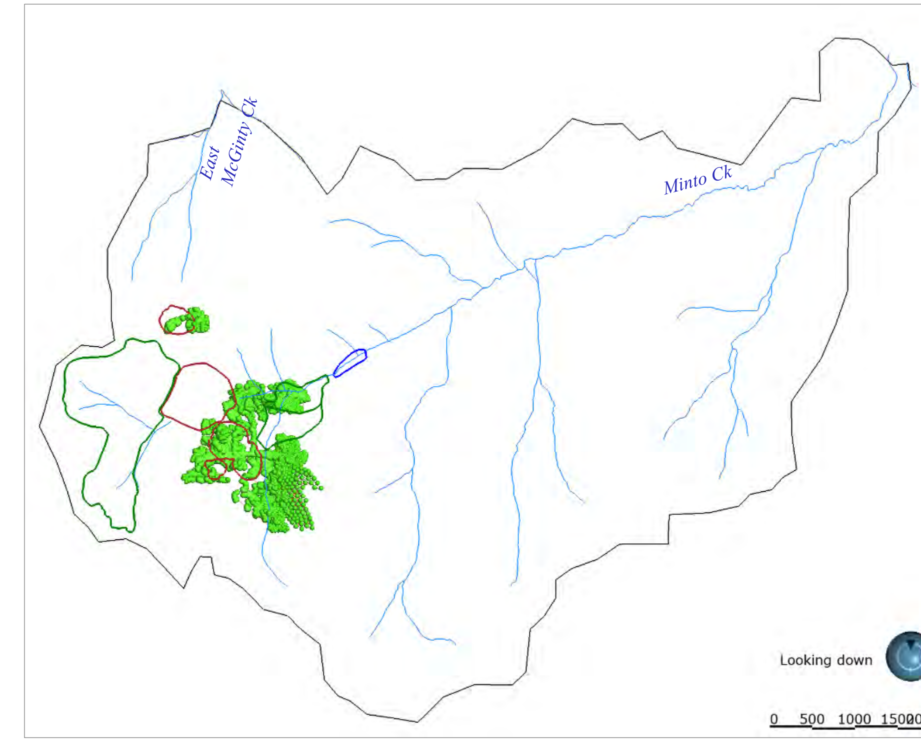
srk consulting	MINTO	Minto Groundwater Model Update
		Modelled hydraulic conductivity distribution in 3D
Job No: 1CM002.072 Filename: Fig42_3D_K_Distrib.pptx	MINTO MINE	Date: Oct.2021 | Approved: GF | Figure: **42**



Flow BC



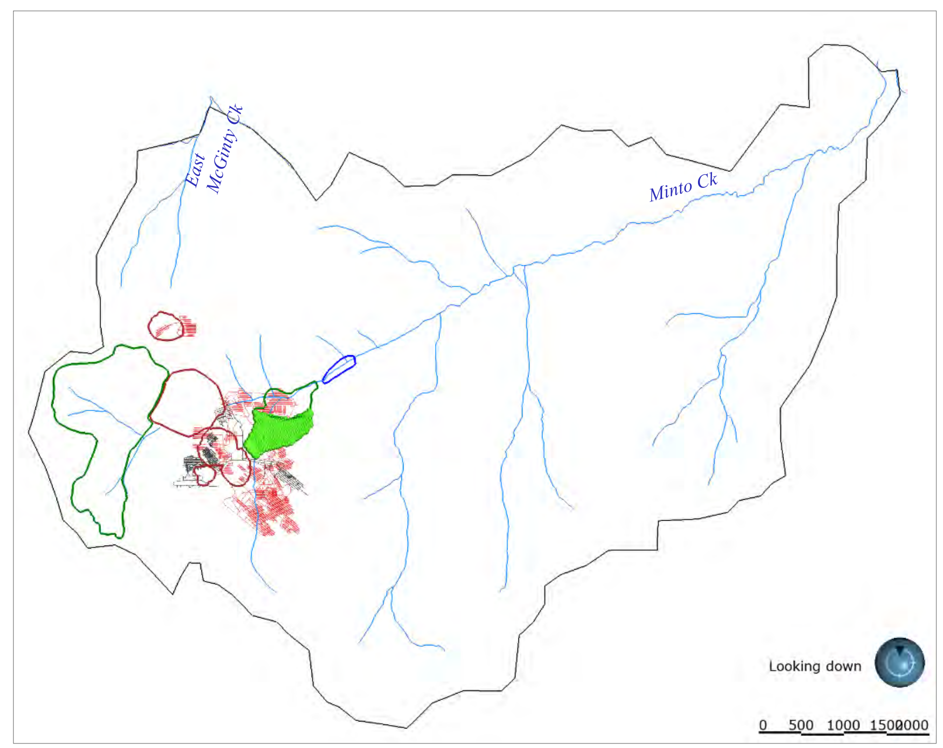
Mass BC: Tracer #1a Pit Lakes



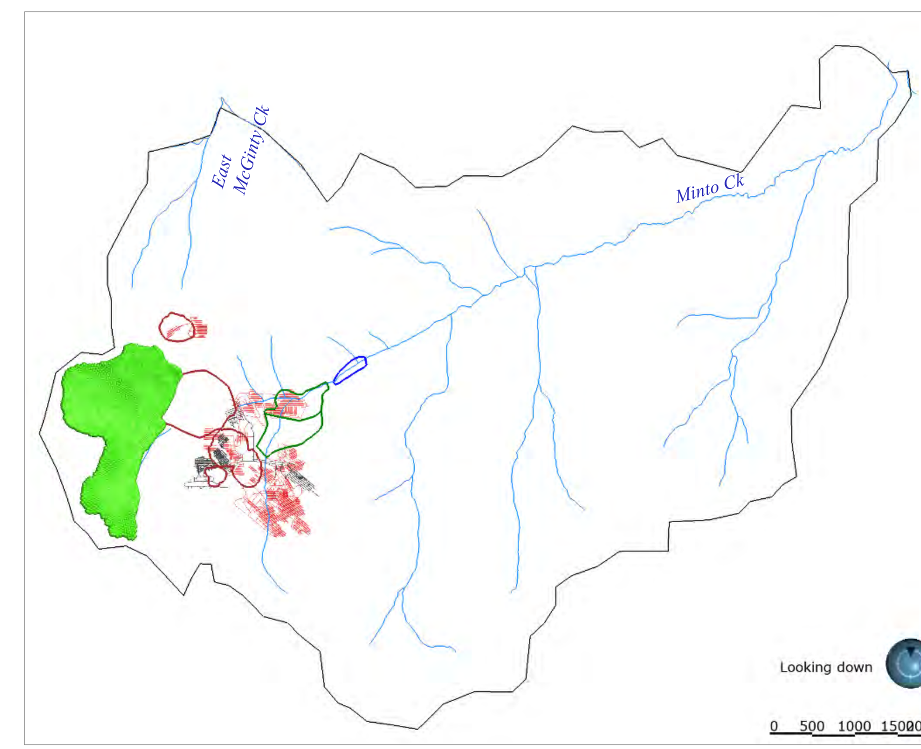
Mass BC: Tracer #1b Underground mine

- Flow BC: Constant head (Dirichlet) applied to surface water network
- Flow BC: Seepage (Dirichlet with flow constraint) applied to surface water network
- Flow BC: Seepage (Dirichlet with flow constraint) applied to the open pits then constant head (Dirichlet) for pit lakes
- Flow BC: Seepage (Dirichlet with flow constraint) applied to the underground
- Mass BC: Constant concentration of 1000 mg/L (Dirichlet) applied to potential sources. (background and recharge concentration set to 20 mg)

- Water Storage Pond outline
- Open pit outline (Main, A2S2, A2S3S4, A118, MN)
- Underground outline (2021 As Built and 2021 PEA)
- Waste rock dump outline (MWD, ROD, SWD, DSTSF, MVFE)
- Model domain outline

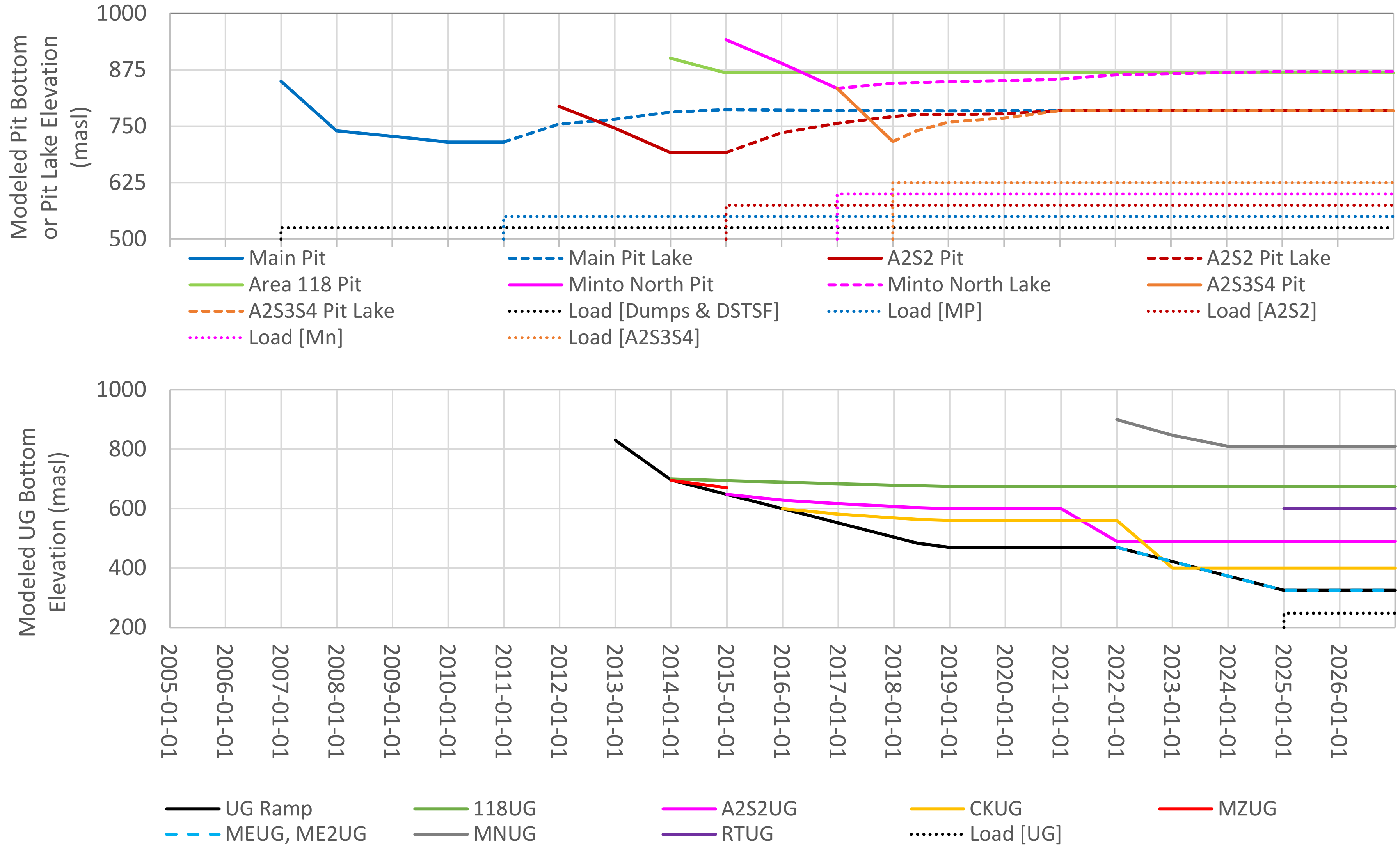


Mass BC: Tracer #2 DSTSF



Mass BC: Tracer #3 MWD, ROD, SWD Dumps

srk consulting	MINTO	Minto Groundwater Model Update
		Modeled boundary conditions
Job No: 1CM002.072 Filename: 1CM002.072_Fig43_ModelBCs.pptx	MINTO MINE	Date: Oct. 2021 / Approved: GF / Figure: 43



srk consulting

MINTO

Minto Groundwater Model Update

Modeled mining schedule

Job No: 1CM002.072

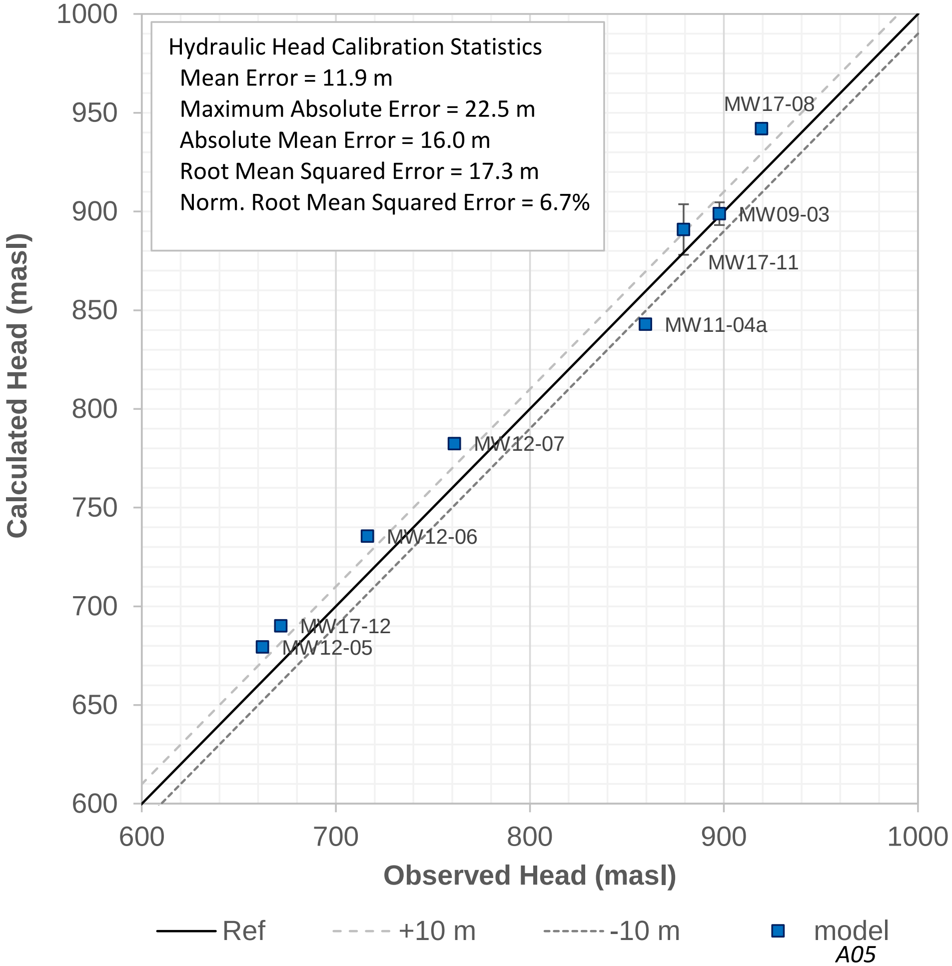
Filename: 1CM002.072_Fig44_Mdl_mining_Schedule.pptx

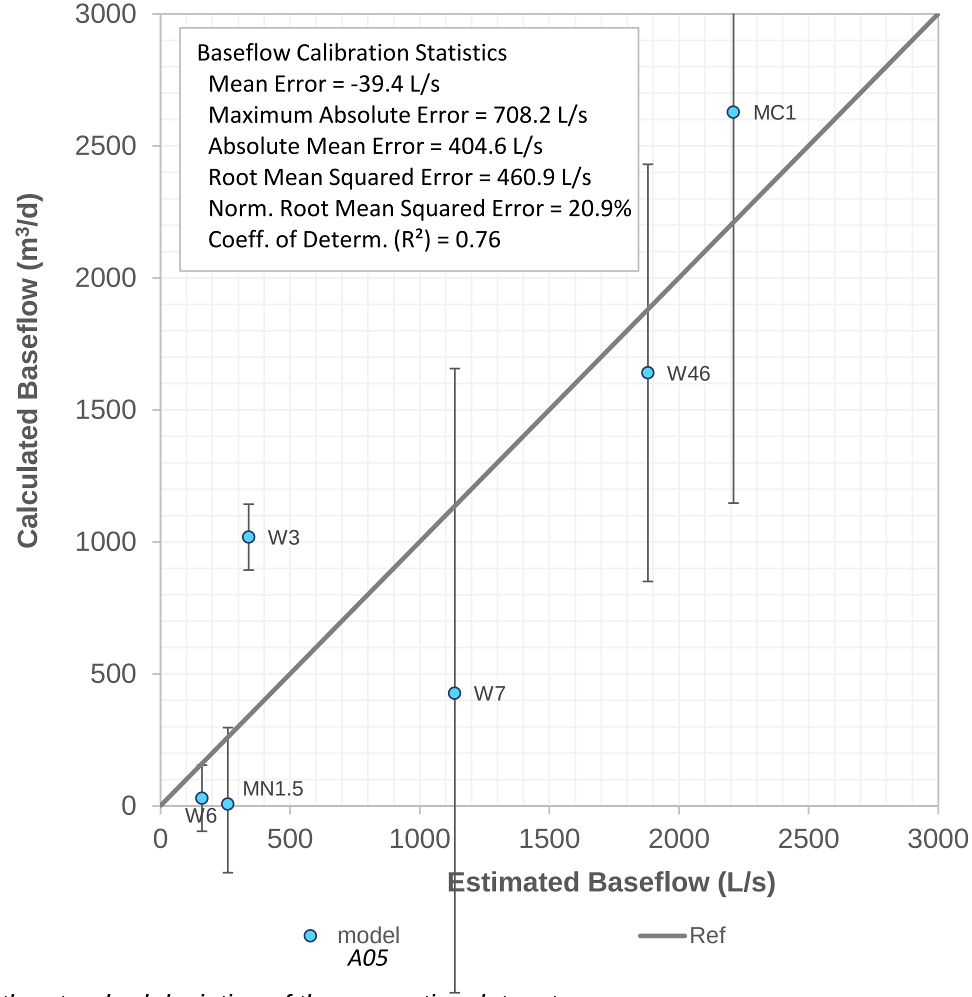
MINTO MINE

Date: Oct. 2021

Approved: GF

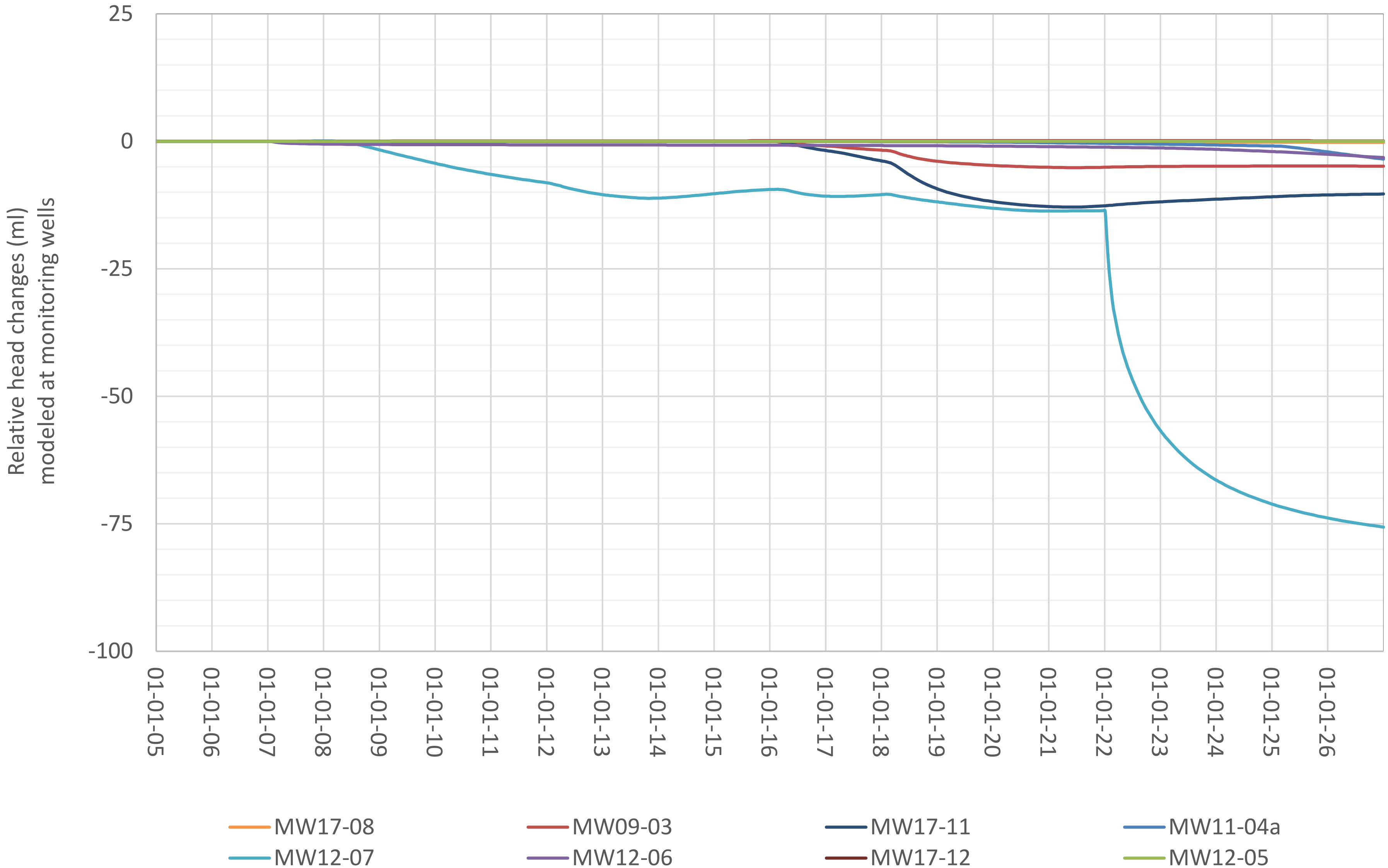
Figure: 44



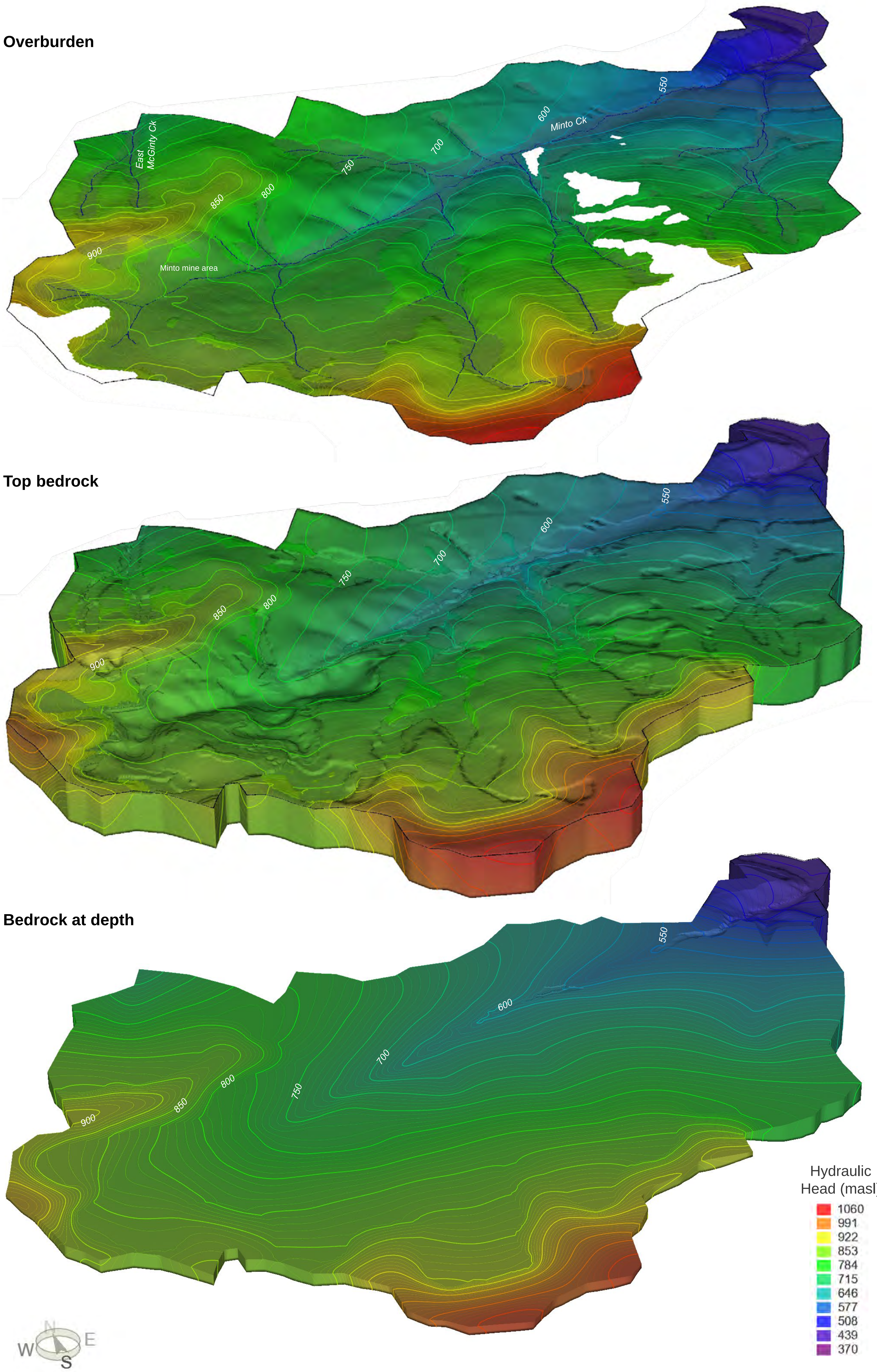


Vertical error bars correspond to the standard deviation of the respective dataset

srk consulting	MINTO	Minto Groundwater Model Update
		Model calibration
Job No: 1CM002.072 Filename: 1CM002.072_Fig45_Mdl_calib.pptx	MINTO MINE	Date: Oct. 2021 · Approved: GF · Figure: 45

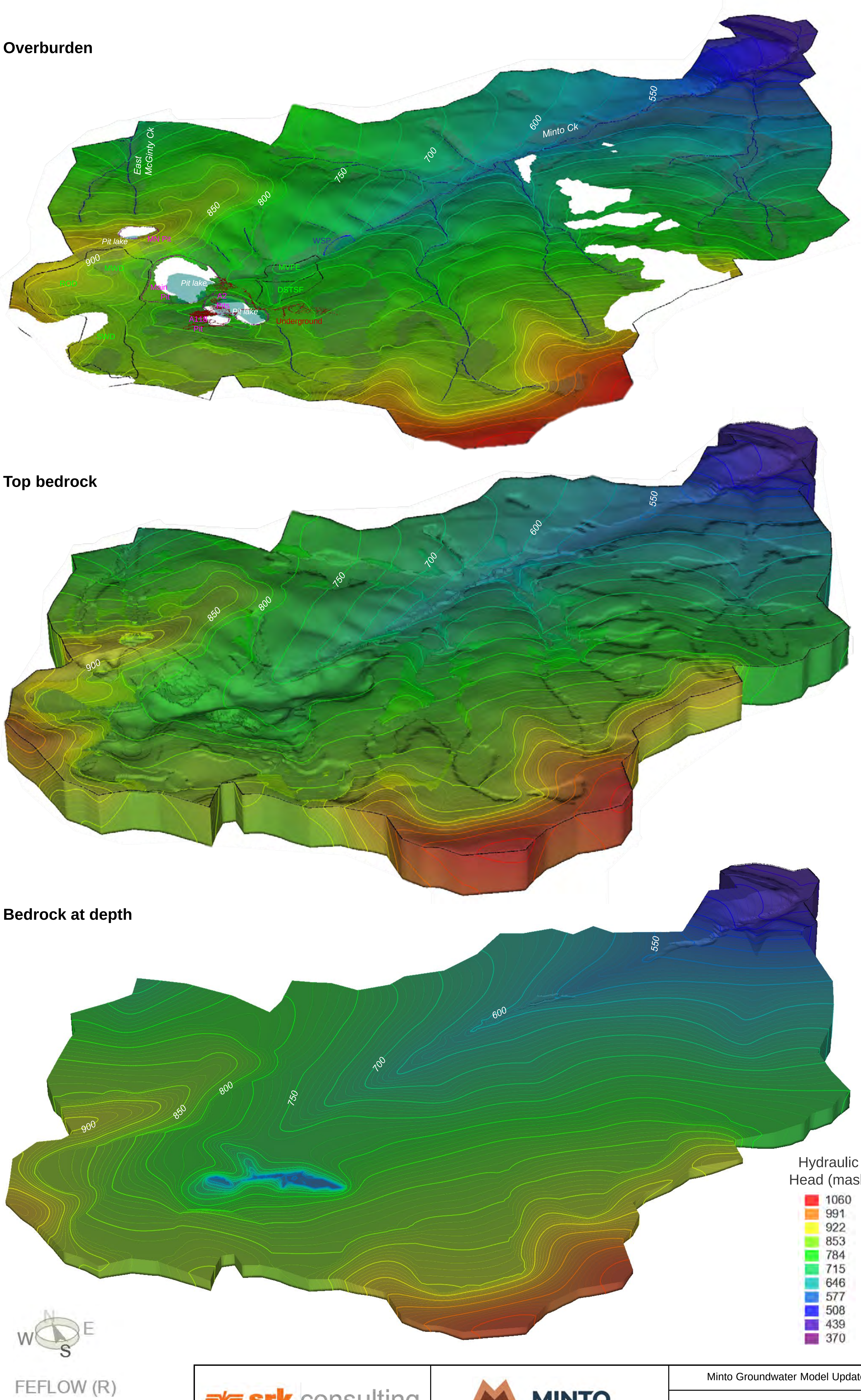


srk consulting	MINTO	Minto Groundwater Model Update
		Relative head changes modeled at monitoring wells
Job No: 1CM002.072 Filename: 1CM002.072_Fig46_Mdl_Heads_ObsWells.pptx	MINTO MINE	Date: Oct. 2021 · Approved: GF · Figure: **46**



FEFLOW (R)

srk consulting	MINTO	Minto Groundwater Model Update
		Modeled hydraulic heads: Premining (Jan. 1st 2027)
Job No: 1CM002.072 Filename: Fig47_Mdl_Heads_Premining.pptx	MINTO MINE	Date: Oct.2021 / Approved: GF / Figure: 47

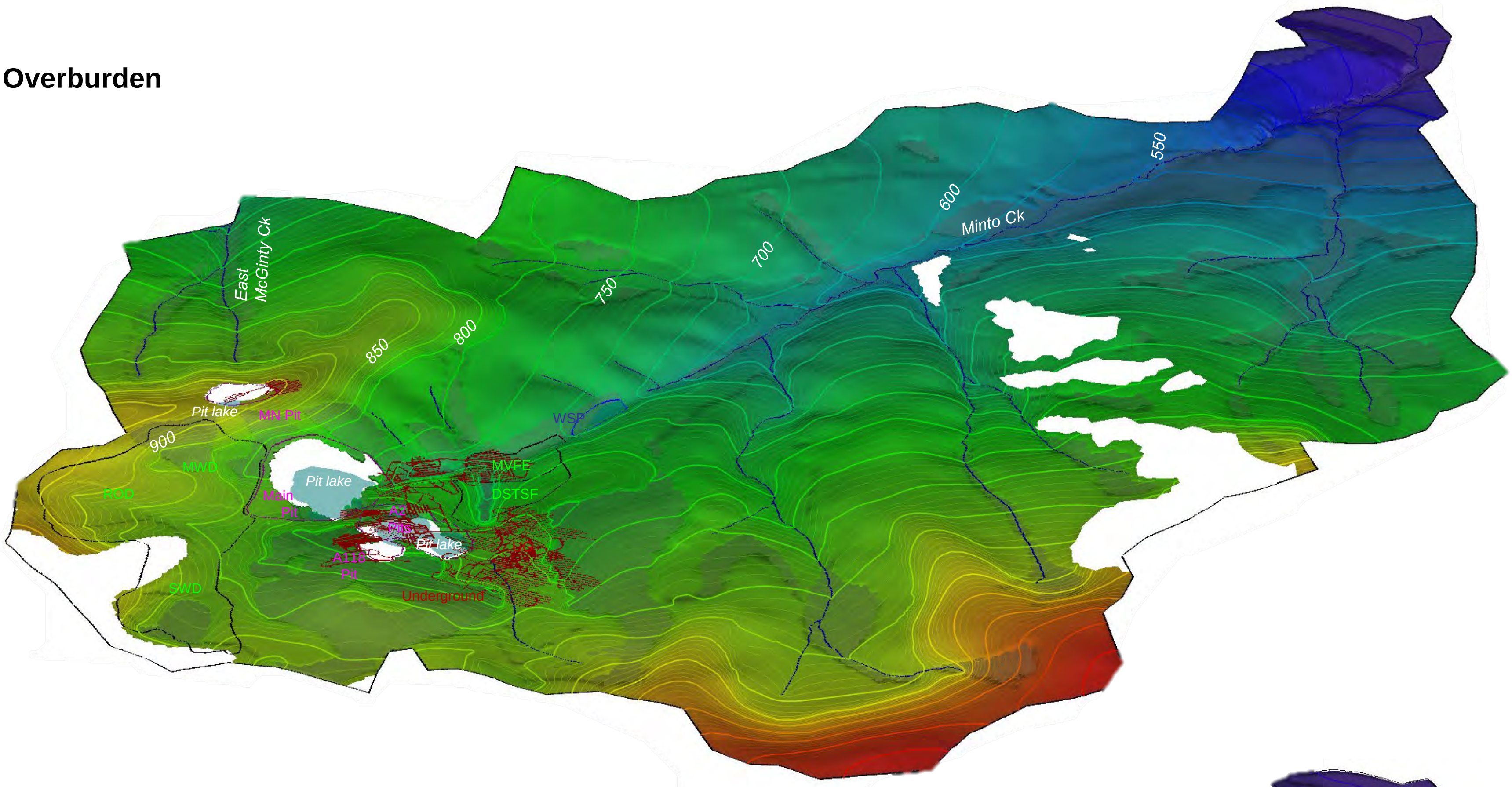


srk consulting

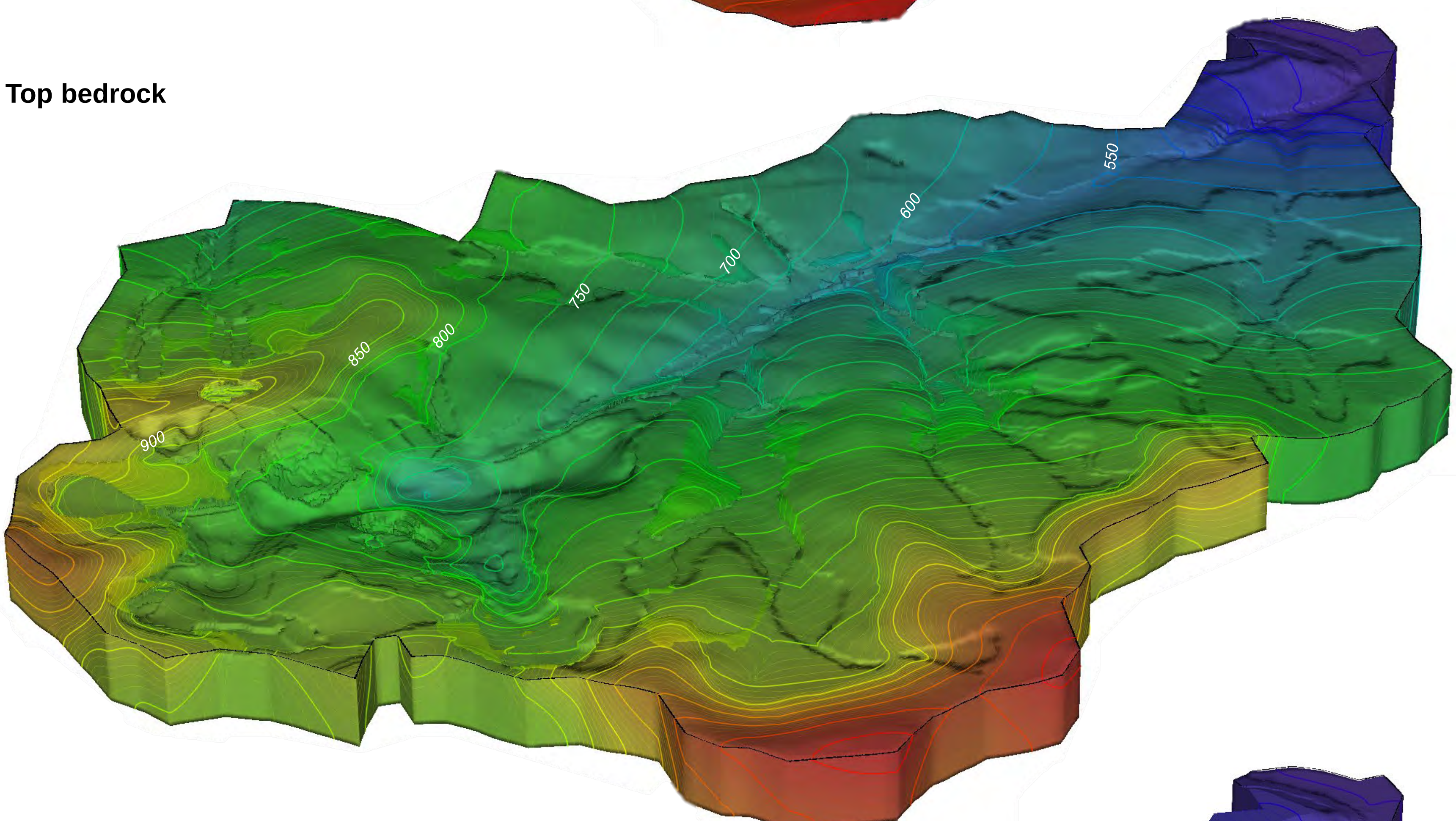
MINTO

Job No: 1CM002.072	MINTO MINE	Minto Groundwater Model Update
Filename: Fig48_Mdl_Heads_2021AsBuilt.pptx		**Modeled hydraulic heads 2021 As-built (Jan. 1st 2022)**
		Date: Oct.2021 · Approved: GF · Figure: 48

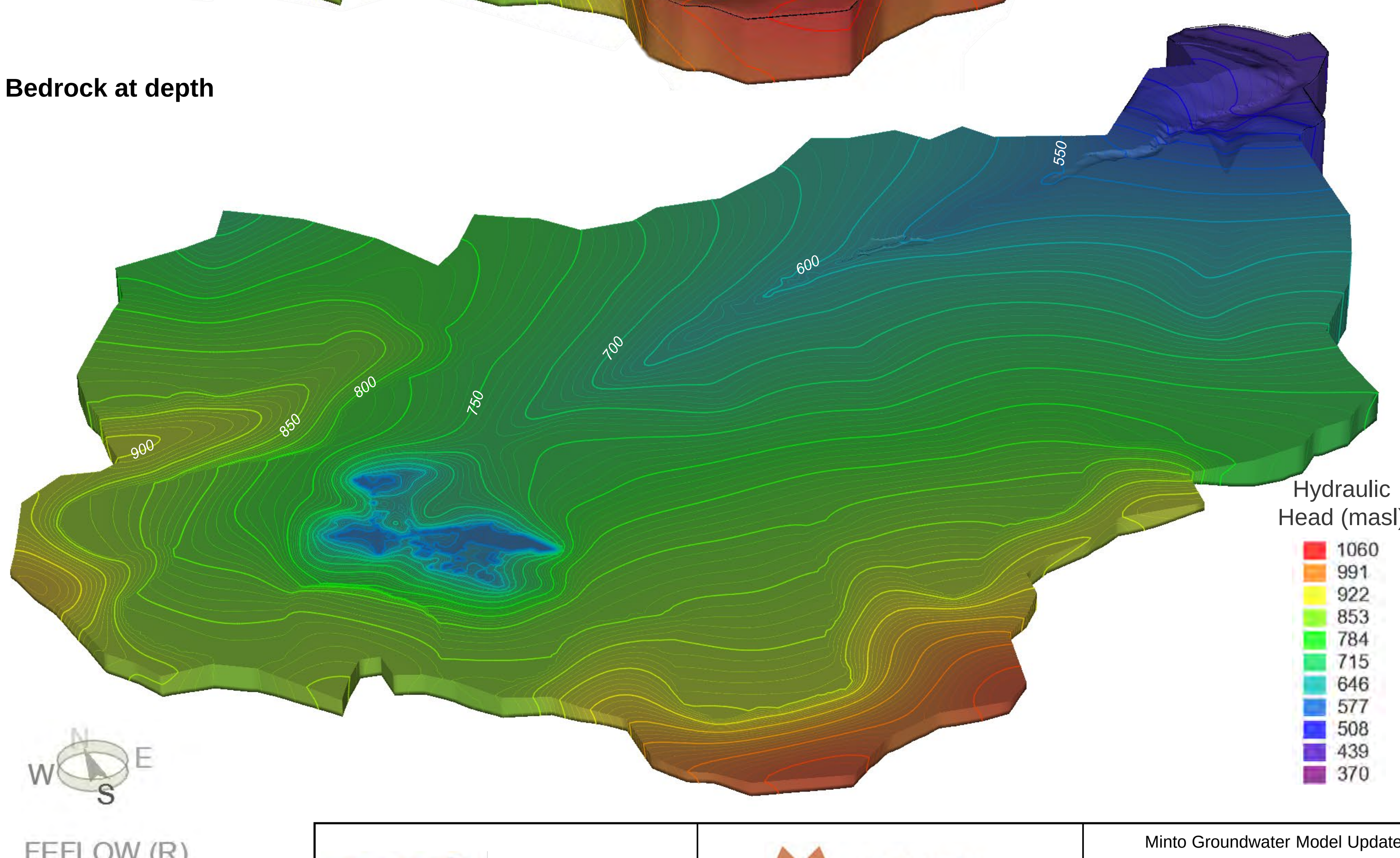
Overburden



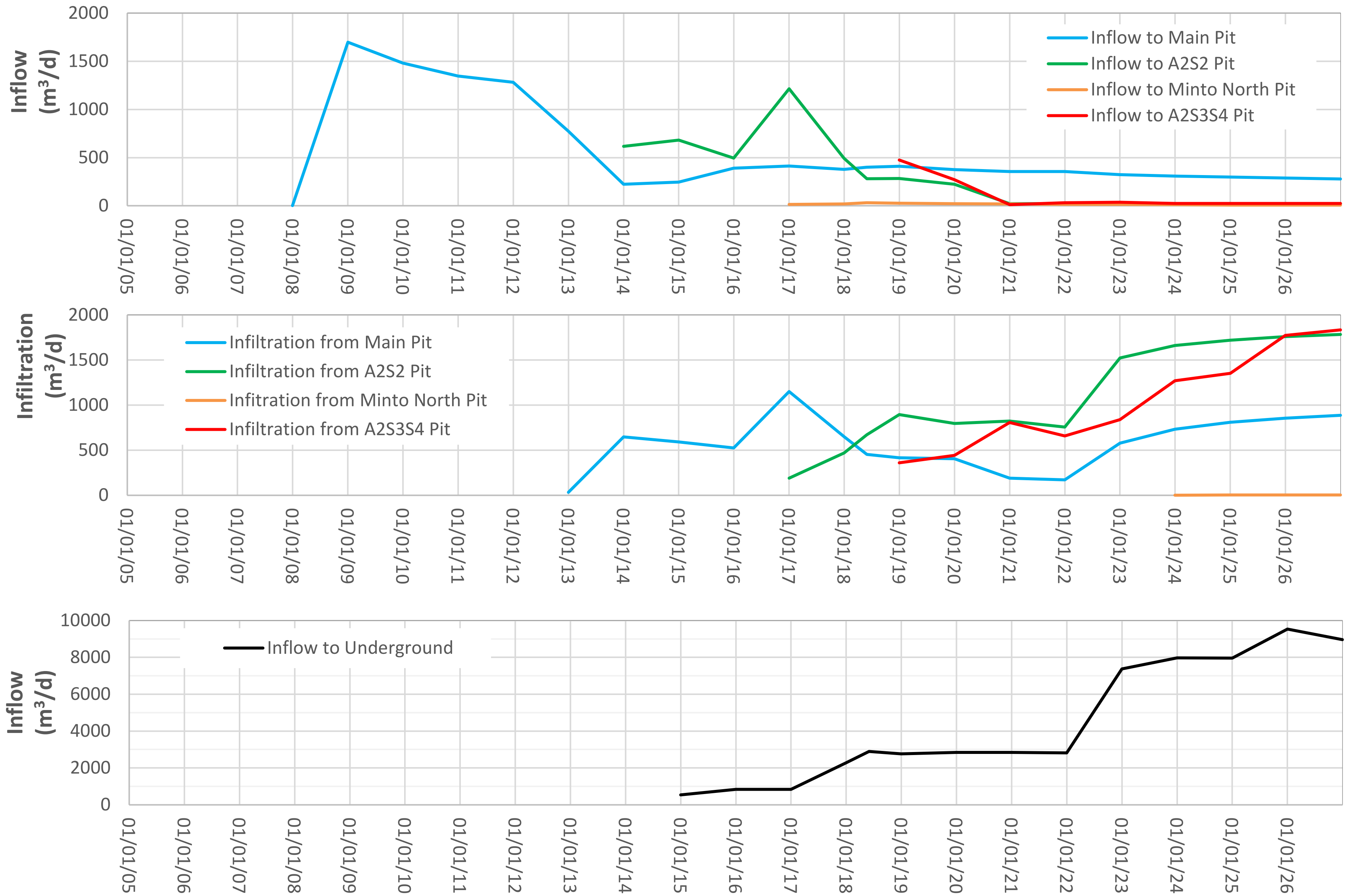
Top bedrock



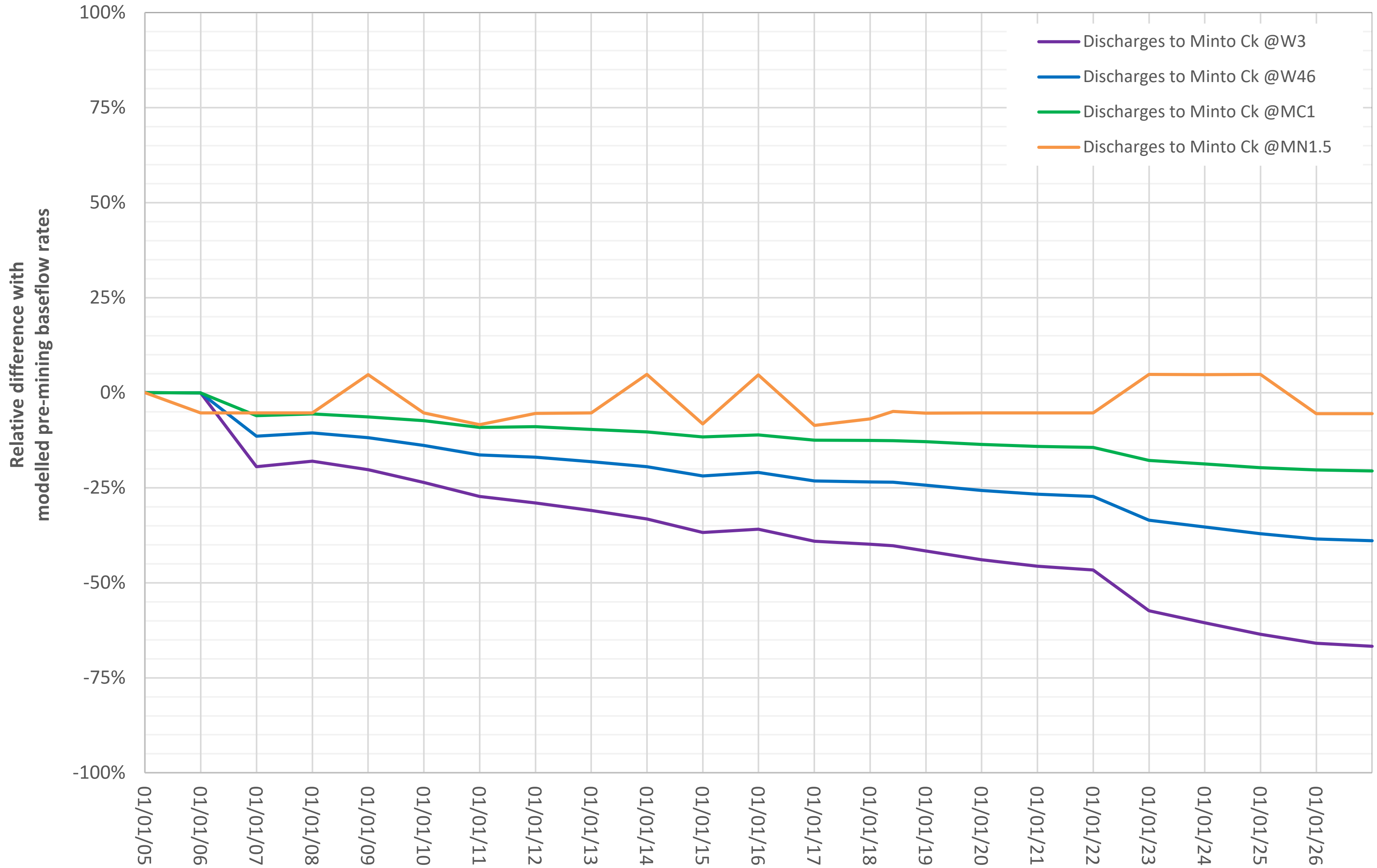
Bedrock at depth



srk consulting	MINTO	Minto Groundwater Model Update
		Modeled hydraulic heads: 2021 PEA (Jan. 1st 2027)
Job No: 1CM002.072 Filename: Fig49_Mdl_Heads_2021PEA.pptx	MINTO MINE	Date: Oct.2021 | Approved: GF | Figure: 49



srk consulting	MINTO	Minto Groundwater Model Update
		Modeled Infiltrations from and inflows to pits and underground
Job No: 1CM002.072 Filename: 1CM002.072_Fig50_Mdl_Q_Pits_UG.pptx	MINTO MINE	Date: Oct. 2021 | Approved: GF | Figure: 50



srk consulting | MINTO | Minto Groundwater Model Update

Modelled changes to baseflows

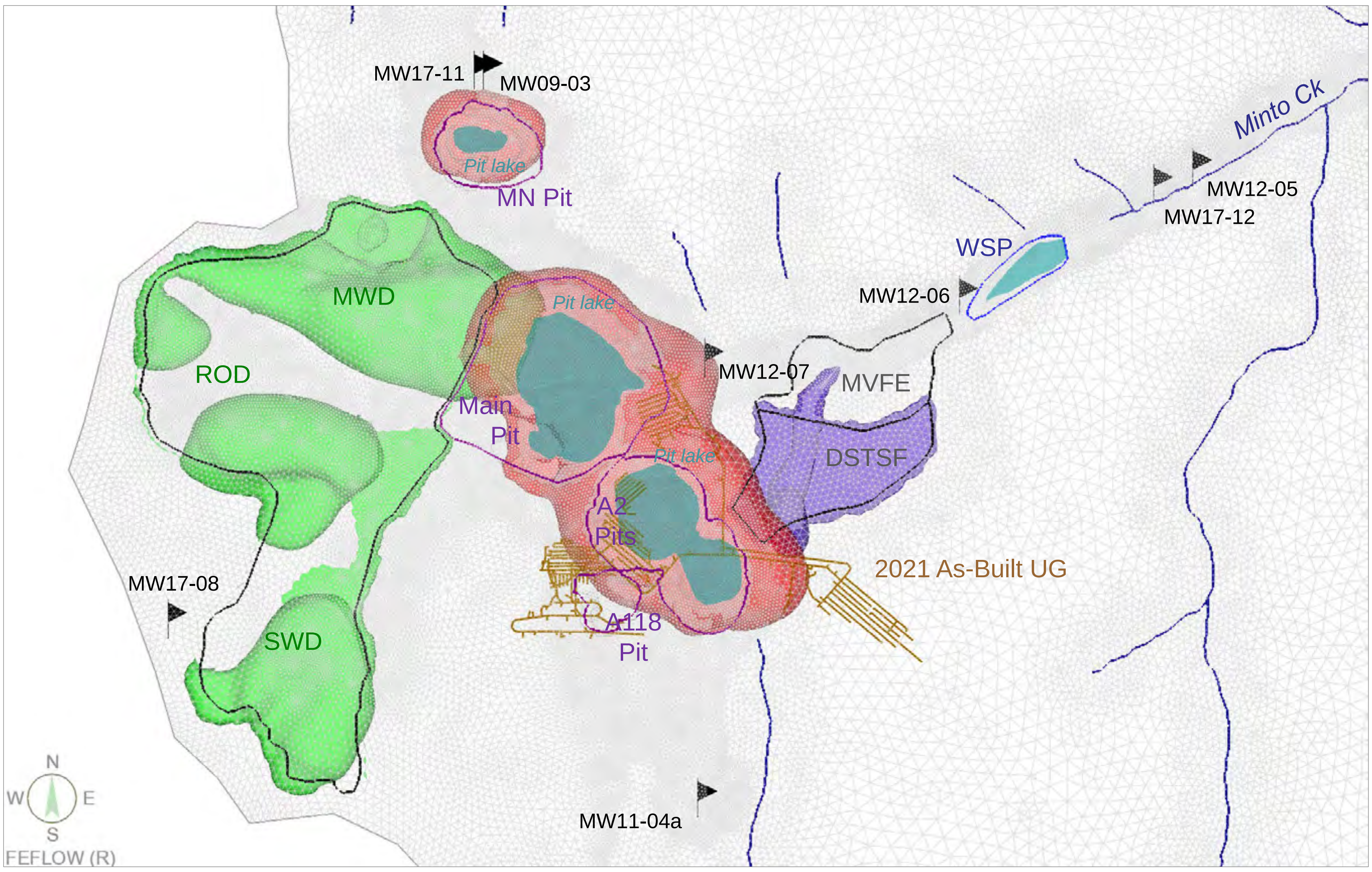
Job No: 1CM002.072

Filename: 1CM002.072_Fig51_Mdl_Changes_SW-Q.pptx

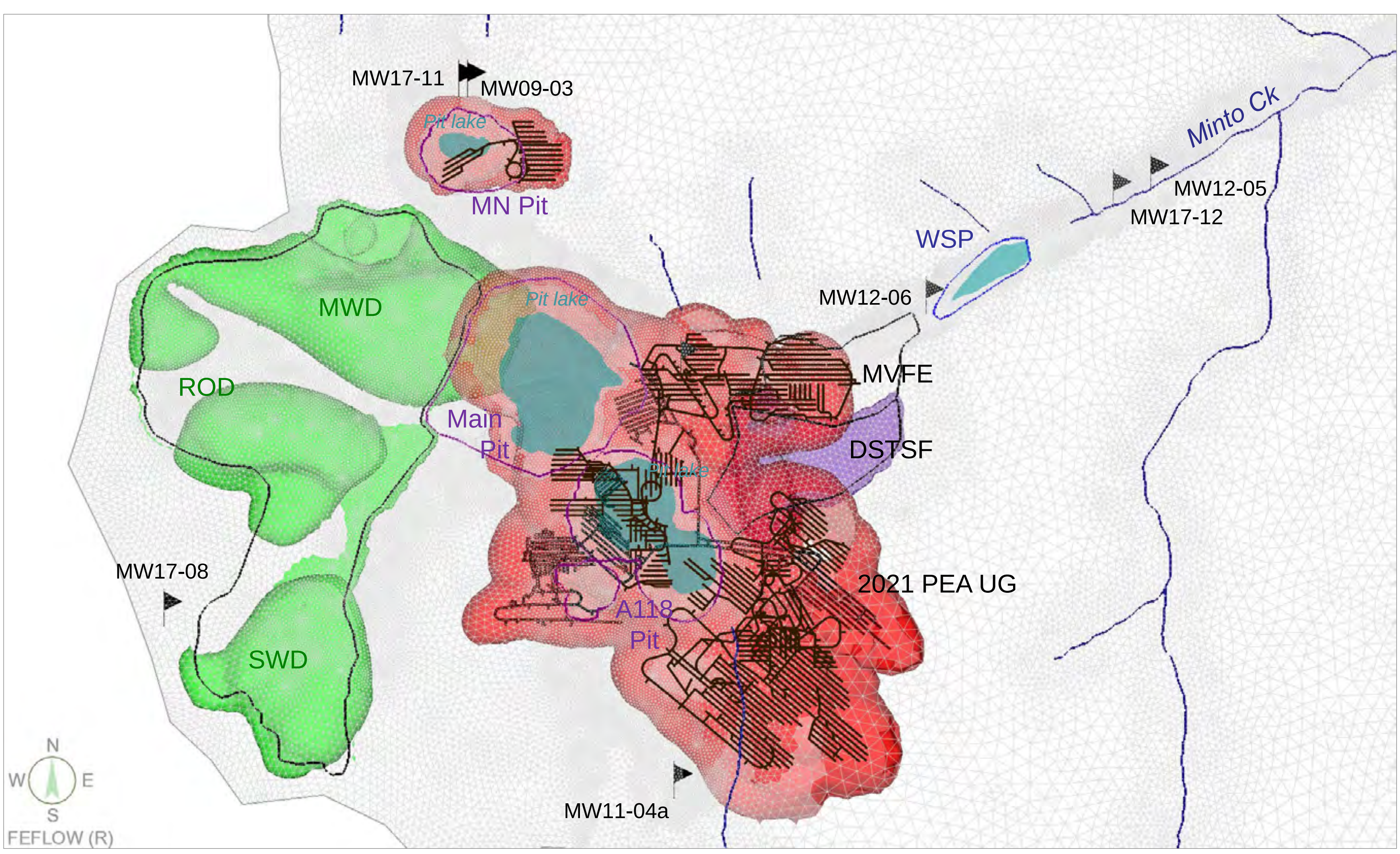
MINTO MINE

Date: Oct. 2021 | Approved: GF | Figure: 51

Modeled time: Jan. 1st 2022 (2021 As-built conditions)



Modeled time: Jan. 1st 2027 (2021 PEA conditions)



- Isosurfaces - [mg/l]	- Isosurfaces - [mg/l]	- Isosurfaces - [mg/l]
50	50	50

Tracer #1:
1000mg/L applied to
pit lakes and underground

Tracer #2:
1000mg/L applied to
DSTSF

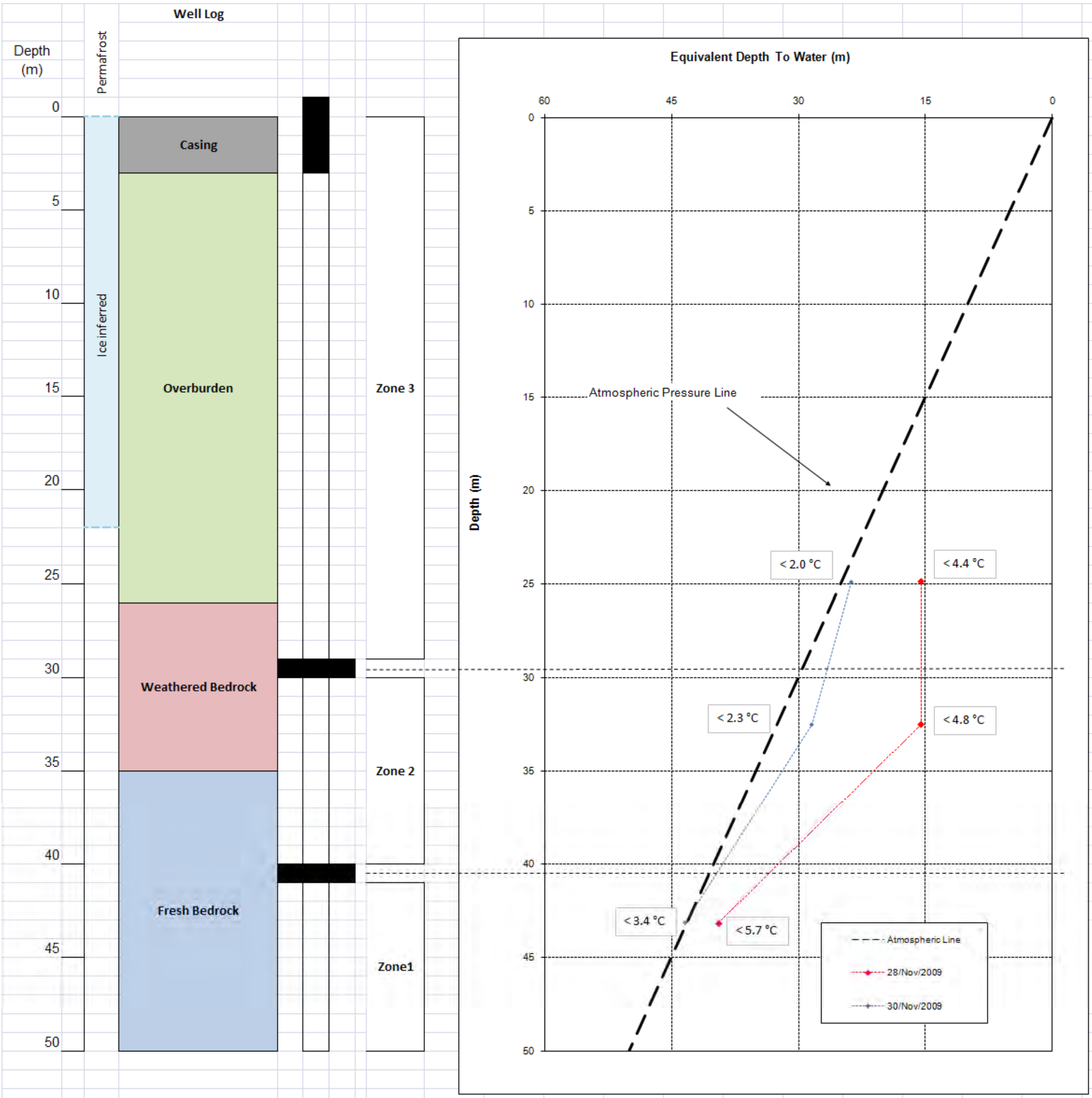
Tracer #3:
1000mg/L applied to
MWD, ROD, and SWD Dumps

srk consulting	MINTO	Minto Groundwater Model Update
		Modeled plumes of tracers
Job No: 1CM002.072 Filename: 1CM002.072_Fig52_PlumesTracers.pptx	MINTO MINE	Date: Oct.2021 / Approved: GF / Figure: 52

Appendix A – Monitoring Well Details

Well ID	Type	Total Depth	Collar			Az (deg)	Dip (deg)	Installation Year	Port	Port ID	Monitoring Zone						Level Measurement Port		Lithology	Well Status	GW Level	# GWL obs	GWL Obs Date min	GWL Obs Date max	Valid GW Quality	# GWQ Sample	GWQ Collected Date min	GWQ Collected Date max	Development Statuts
			Easting (m)	Northing (m)	Elev. (masl)						Top (mbgs along borehole)	Bottom (mbgs along borehole)	Mid (mbgs along borehole)	mid-X (masl) Leapfrog prjct	mid-Y (masl) Leapfrog prjct	mid-Z (masl) Leapfrog prjct	Port Depth (mbgs along borehole)	Port Elev. (masl) Leapfrog prjct											
P93E	Standpipe	83	384695.0	6945091.0	735.80	#N/A	#N/A	#N/A	#N/A	P93E	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Uncertain - assumed bedrock	Destroyed	No	0	#N/A	#N/A	Yes	23	Sep-94	Mar-06	#N/A
P94-20	Standpipe	36	386418.0	6945541.0	704.00	#N/A	#N/A	#N/A	#N/A	P94-20	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Uncertain - assumed bedrock	Destroyed	No	0	#N/A	#N/A	Yes	21	Sep-94	Jun-06	#N/A
MW09-01	MP well	50	384177.0	6944984.0	858.00	-	90	2009	3	MW09-01-03	3.05	29.57	16.31	384177.31	6944983.87	841.27	25.90	831.68	Overburden/Weathered Bedrock	Dry	No	0	#N/A	#N/A	Yes	5	Nov-09	Oct-16	#N/A
MW09-01	MP well	50	384177.0	6944984.0	858.00	-	90	2009	2	MW09-01-02	29.57	41.15	35.36	384177.31	6944983.87	822.22	33.50	824.08	Weathered Bedrock/Fresh Bedrock	Dry	No	0	#N/A	#N/A	Yes	1	Nov-09	Nov-09	#N/A
MW09-01	MP well	50	384177.0	6944984.0	858.00	-	90	2009	1	MW09-01-01	41.15	50.29	45.72	384177.31	6944983.87	811.86	44.20	813.38	Fresh Bedrock	Dry	No	0	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW09-02	MP well	59	385676.1	6945034.5	757.46	-	90	2009	2	MW09-02-02	45.72	50.29	48.01	385676.12	6945034.50	709.45	47.20	710.26	Weathered Bedrock	Destroyed	No	0	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW09-02	MP well	59	385676.1	6945034.5	757.46	-	90	2009	1	MW09-02-01	50.29	59.44	54.87	385676.12	6945034.50	702.59	51.80	705.66	Weathered Bedrock	Destroyed	No	0	#N/A	#N/A	Yes	1	Dec-09	Dec-09	#N/A
MW09-03	MP well	50	384253.2	6946158.5	908.33	-	90	2009	3	MW09-03-03	3.05	7.62	5.34	384253.25	6946158.50	902.99	10.70	897.63	Weathered Bedrock/Fresh Bedrock	Dry	No	0	#N/A	#N/A	Yes	14	Dec-09	Sep-15	#N/A
MW09-03	MP well	50	384253.2	6946158.5	908.33	-	90	2009	2	MW09-03-02	7.62	30.48	19.05	384253.25	6946158.50	889.28	24.40	883.93	Fresh Bedrock	Active	Yes	213	Jun-14	Dec-20	Yes	68	Dec-09	Mar-21	Fully developed
MW09-03	MP well	50	384253.2	6946158.5	908.33	-	90	2009	1	MW09-03-01	30.48	50.29	40.39	384253.25	6946158.50	867.94	38.10	870.23	Fresh Bedrock	Active	Yes	193	Jun-14	Dec-20	Yes	69	Dec-09	Feb-21	Fully developed
MW09-04	MP well	76	384954.0	6944926.0	794.00	-	90	2009	3	MW09-04-03	44.20	54.86	49.53	384954.25	6944925.98	744.28	47.20	746.61	Weathered Bedrock	Destroyed	No	0	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW09-04	MP well	76	384954.0	6944926.0	794.00	-	90	2009	2	MW09-04-02	54.86	62.48	58.67	384954.25	6944925.98	735.14	54.90	738.91	Weathered Bedrock/Fresh Bedrock	Destroyed	No	0	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW09-04	MP well	76	384954.0	6944926.0	794.00	-	90	2009	1	MW09-04-01	62.48	76.20	69.34	384954.25	6944925.98	724.47	68.60	725.21	Fresh Bedrock	Destroyed	No	0	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW11-01A	Standpipe	102	385070.0	6944990.0	786.00	-	90	2011	#N/A	MW11-01A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Inactive	No	#N/A	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW11-02	Standpipe	31	385120.0	6943870.0	861.70	-	90	2011	#N/A	MW11-02	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Inactive	No	#N/A	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW11-03	Standpipe	31	385160.0	6943730.0	867.20	-	90	2011	#N/A	MW11-03	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Inactive	No	#N/A	#N/A	#N/A	No	0	#N/A	#N/A	#N/A
MW11-04a	Standpipe	30	385110.0	6943370.0	887.70	#N/A	#N/A	#N/A	#N/A	MW11-04a	27.30	30.30	28.80	385110.00	6943370.00	858.90	#N/A	#N/A	Bedrock	Destroyed	Yes	16	Jun-12	Oct-15	Yes	16	May-12	May-17	#N/A
MW12-05	MP well	145	387008.9	6945789.6	665.50	-	90	2012	7	MW12-05-07	12.00	24.00	18.00	387008.90	6945789.60	647.50	14.90	650.60	Overburden/Weathered Bedrock	Active	Yes	28	May-14	Oct-20	Yes	33	Nov-12	Mar-21	Fully developed
MW12-05	MP well	145	387008.9	6945789.6	665.50	-	90	2012	6	MW12-05-06	25.00	35.00	30.00	387008.90	6945789.60	635.50	25.60	639.90	Weathered Bedrock	Active	Yes	26	Jul-14	Oct-20	Yes	23	May-16	Mar-21	Fully developed
MW12-05	MP well	145	387008.9	6945789.6	665.50	-	90	2012	5	MW12-05-05	36.00	67.00	51.50	387008.90	6945789.60	614.00	48.70	616.80	Weathered Bedrock	Active	Yes	28	May-14	Oct-20	Yes	33	Nov-12	Mar-21	Fully developed
MW12-05	MP well	145	387008.9	6945789.6	665.50	-	90	2012	4	MW12-05-04	68.00	84.00	76.00	387008.90	6945789.60	589.50	68.50	597.00	Weathered Bedrock	Active	Yes	29	May-14	Oct-20	Yes	23	May-16	Mar-21	Fully developed
MW12-05	MP well	145	387008.9	6945789.6	665.50	-	90	2012	3	MW12-05-03	85.00	108.00	96.50	387008.90	6945789.60	569.00	94.40	571.10	Weathered Bedrock	Active	Yes	31	May-14	Oct-20	Yes	40	Nov-12	Mar-21	Fully developed
MW12-05	MP well	145	387008.9	6945789.6	665.50	-	90	2012	2	MW12-05-02	110.00	125.00	117.50	387008.90	6945789.60	548.00	109.70	555.80	Bedrock	Active	Yes	28	May-14	Oct-20	Yes	22	May-16	Mar-21	Fully developed
MW12-05	MP well	145	387008.9	6945789.6	665.50	-	90	2012	1	MW12-05-01	126.00	145.00	135.50	387008.90	6945789.60	530.00	132.50	533.00	Bedrock	Active	Yes	29	May-14	Oct-20	Yes	41	Nov-12	Mar-21	Fully developed
MW12-06	MP well	150	386112.5	6945297.5	717.30	-	90	2012	6	MW12-06-06	6.00	34.00	20.00	386112.50	6945297.50	697.30	18.20	699.10	Overburden/Weathered Bedrock	Active	Yes	27	May-14	Oct-20	Yes	32	Nov-12	Mar-21	Fully developed
MW12-06	MP well	150	386112.5	6945297.5	717.30	-	90	2012	5	MW12-06-05	34.90	39.00	36.95	386112.50	6945297.50	680.35	35.00	682.30	Weathered Bedrock	Active	Yes	27	May-14	Oct-20	Yes	20	Sep-16	Oct-20	Partially Developed
MW12-06	MP well	150	386112.5	6945297.5	717.30	-	90	2012	4	MW12-06-04	40.00	92.00	66.00	386112.50	6945297.50	651.30	66.10	651.20	Weathered Bedrock/Bedrock	Active	Yes	27	May-14	Oct-20	Yes	37	Nov-12	Mar-21	Fully developed
MW12-06	MP well	150	386112.5	6945297.5	717.30	-	90	2012	3	MW12-06-03	92.50	102.00	97.25	386112.50	6945297.50	620.05	92.60	624.70	Bedrock	Active	Yes	26	May-14	Oct-20	Yes	19	Sep-16	Oct-20	Partially Developed
MW12-06	MP well	150	386112.5	6945297.5	717.30	-	90	2012	2	MW12-06-02	104.00	142.00	123.00	386112.50	6945297.50	594.30	122.50	594.80	Bedrock/Fault Zone	Active	Yes	29	May-14	Oct-20	Yes	34	Nov-12	Mar-21	Fully developed
MW12-06	MP well	150	386112.5	6945297.5	717.30	-	90	2012	1	MW12-06-01	142.00	150.20	146.10	386112.50	6945297.50	571.20	142.30	575.00	Bedrock	Active	Yes	28	May-14	Oct-20	Yes	18	Oct-16	Mar-21	Partially Developed
MW12-07	MP well	126	385136.9	6945043.3	783.70	352	60	2012	4	MW12-07-04	32.00	76.00	54.00	385136.55	6945048.28	730.01	53.20	730.80	Overburden	Active	No	0	#N/A	#N/A	Yes	1	Aug-13	Aug-13	Partially Developed
MW12-07	MP well	126	385136.9	6945043.3	783.70	352	60	2012	3	MW12-07-03	66.20	68.40	67.30	385136.36	6945051.03	717.00	76.60	707.98	Overburden/Weathered Bedrock	Active	Yes	204	Oct-12	Oct-20	Yes	1	Dec-16	Dec-16	Partially Developed
MW12-07	MP well	126	385136.9	6945043.3	783.70	352	60	2012	2	MW12-07-02	69.00	106.00	87.50	385135.99	6945056.32	697.51	101.00	684.71	Weathered Bedrock	Active	Yes	237	Oct-12	Oct-20	Yes	81	Nov-12	Mar-21	Fully developed
MW12-07	MP well	126	385136.9	6945043.3	783.70	352	60	2012	1	MW12-07-01	107.00	126.00	116.50	385135.30	6945066.25	670.29	133.00	655.28	Bedrock	Active	Yes	228	Oct-12	Oct-20	Yes	58	Nov-12	Oct-20	Fully developed
MW12-DP1	Drivepoint	3	383841.0	6943911.0	880.00	-	90	2012	#N/A	MW12-DP1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Inactive	Yes	1	Jun-14	Oct-15	Yes	1	Oct-13	Oct-13	#N/A
MW12-DP2	Drivepoint	3	383796.0	6944142.0	878.30	-	90	2012	#N/A	MW12-DP2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Inactive	No	0	Jun-14	Oct-15	No	0	#N/A	#N/A	#N/A
MW12-DP3	Drivepoint	3	384024.0	6944614.0	860.00	-	90	2012	#N/A	MW12-DP3	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Inactive	Yes	1	Jun-14	Oct-15	Yes	2	Oct-13	Jun-14	#N/A
MW12-DP4	Drivepoint	3	385865.0	6945220.0	760.00	-	90	2012	#N/A	MW12-DP4	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Inactive	Yes	3	Jun-14	Oct-15	Yes	4	Jul-13	Oct-15	#N/A
MW13-DP5	Drivepoint	#N/A	385940.0	6945215.0	724.90	-	90	2013	#N/A	MW13-DP5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Inactive	Yes	3	Sep-14	Oct-15	Yes	3	Sep-14	Oct-15	#N/A
MW17-08	MP well	51	383079.0	6944055.0	927.50	-	90	2017	4	MW17-08-04	6.00	17.00	11.50	383078.61	6944055.43	915.98	8.20	919.28	Bedrock	Active	Yes	8	Aug-17	Oct-20	Yes	4	Aug-17	Oct-18	Fully developed
MW17-08	MP well	51	383079.0	6944055.0	927.50	-	90	2017	3	MW17-08-03	17.00	29.00	23.00	383078.61	6944055.43	904.48	23.40	904.08	Bedrock	Active	Yes	14	Aug-17	Oct-20	Yes	14	Aug-17	Oct-20	Fully developed
MW17-08	MP well	51	383079.0	6944055.0	927.50	-	90	2017	2	MW17-08-02	29.00	43.50	36.25	383078.61	6944055.43	891.23	34.10	893.38	Bedrock/Fault Zone	Active	Yes	14	Aug-17	Oct-20	Yes	15	Aug-17	Oct-20	Fully developed
MW17-08	MP well	51	383079.0	6944055.0	927.50	-	90	2017	1	MW17-08-01	43.50	48.00	45.75	383078.61	6944055.43	881.73	44.70	882.78	Bedrock	Active	Yes	14	Aug-17	Oct-20	Yes	15	Aug-17	Oct-20	Fully developed
MW17-09	MP well	64	383982.0	6944587.0	844.60	90	70	2017	1	MW17-09-01	54.00	60.00	57.00	384001.23	6944586.83	791.06	56.60	791.44	Bedrock	Frozen, Destroyed	Yes	3	Aug-17	Oct-18	Yes	1	Aug-17	Aug-17	#N/A
MW17-10	MP well	101	384248.0	6945089.0	857.20	200	70	2017	4	MW17-10-04	51.00	60.50	55.75	384241.15	6945071.47	804.84	53.50	806.95	Bedrock	Active	No	0	#N/A	#N/A	Yes	1	Mar-21	Mar-21	Fully developed
MW17-10	MP well	101	384248.0	6945089.0	857.20	200	70	2017	3	MW17-10-03	60.50	71.00	65.75	384239.98	6945068.25	795.44	61.20	799.71	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	16	Aug-17	Mar-21	Fully developed
MW17-10	MP well	101	384248.0	6945089.0	857.20	200	70	2017	2	MW17-10-02	71.00	82.00	76.50	384238.73	6945064.80	785.34	74.80	786.93	Bedrock	Active	Yes	14	Aug-17	Oct-20	Yes	18	Aug-17	Mar-21	Fully developed
MW17-10	MP well	101	384248.0	6945089.0	857.20	200	70	2017	1	MW17-10-01	82.00	92.00	87.00	384237.50	6945061.42	775.47	85.50	776.88	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	16	Aug-17	Mar-21	Fully developed
MW17-11	MP well	101	384268.0	6946161.0	906.40	90	70	2017	5	MW17-11-05	9.00	26.00	17.50	384273.78	6946161.09	889.95	15.50	891.83	Bedrock	Active	Yes	7	Aug-17	Oct-20	Yes	7	Nov-17	May-20	Fully developed
MW17-11	MP well	101	384268.0	6946161.0	906.40	90	70	2017	4	MW17-11-04	26.00	52.00	39.00	384281.13	6946161.09	869.75	40.50	868.34	Bedrock/Diorite Dyke	Active	Yes	9	Aug-17	Oct-20	Yes	10	Aug-17	May-20	Fully developed
MW17-11	MP well	101	384268.0	6946161.0	906.40	90	70	2017	3	MW17-11-03	52.00	62.50	57.25	384287.37	6946161.09	852.60	58.80	851.15	Bedrock	Active	Yes	11	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-11	MP well	101	384268.0	6946161.0	906.40	90	70	2017	2	MW17-11-02	62.50	83.50	73.00	384292.76	6946161.09	837.80	75.50	835.45	Bedrock/Fault Zone	Active	Yes	11	Aug-17	Oct-20	Yes	16	Aug-17	Mar-21	Fully developed
MW17-11	MP well	101	384268.0	6946161.0	906.40	90	70	2017	1	MW17-11-01	83.50	98.00	90.75	384298.83	6946161.09	821.12	96.90	815.34	Bedrock	Active	Yes	12	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	8	MW17-12-08	24.00	47.00	35.50	386858.91	6945744.42	640.66	34.60	641.51	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	16	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	7	MW17-12-07	47.00	64.50	55.75	386858.91	6945737.49	621.63	49.80	627.22	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	6	MW17-12-06	64.50	75.00	69.75	386858.91	6945732.70	608.48	69.60	608.62	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	5	MW17-12-05	75.00	85.50	80.25	386858.91	6945729.11	598.61	80.30	598.56	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	4	MW17-12-04	85.50	99.00	92.25	386858.91	6945725.01	587.33	90.90	588.60	Bedrock	Active	Yes	12	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	3	MW17-12-03	99.00	116.00	107.50	386858.91	6945719.79	573.00	110.80	569.90	Bedrock/Diorite Dyke	Active	Yes	13	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	2	MW17-12-02	116.00	134.00	125.00	386858.91	6945713.81	556.56	129.00	552.80	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-12	MP well	151	386859.0	6945757.0	674.00	180	70	2017	1	MW17-12-01	134.00	148.00	141.00	386858.91	6945708.33	541.52	142.80	539.83	Bedrock	Active	Yes	13	Aug-17	Oct-20	Yes	15	Aug-17	Mar-21	Fully developed
MW17-DP01	Drivepoint	3	na	na	na	-	90	2017	#N/A	MW17-DP01	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Active	No	#N/A	#N/A	#N/A	Yes	9	Oct-17	Aug-20	#N/A
MW17-DP02	Drivepoint	3	na	na	na	-	90	2017	#N/A	MW17-DP02	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Active	No	#N/A	#N/A	#N/A	Yes	8	Oct-17	Aug-20	#N/A
MW17-DP03	Drivepoint	3	na	na	na	-	90	2017	#N/A	MW17-DP03	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	Overburden and/or Weathered Bedrock	Active	No	#N/A	#N/A	#N/A	Yes	10	Oct-17	Aug-20	#N/A

Appendix B – Compilation of Monitoring Well Logs



SRK Consulting
Engineers and Scientists
VANCOUVER

Minto Explorations Ltd.

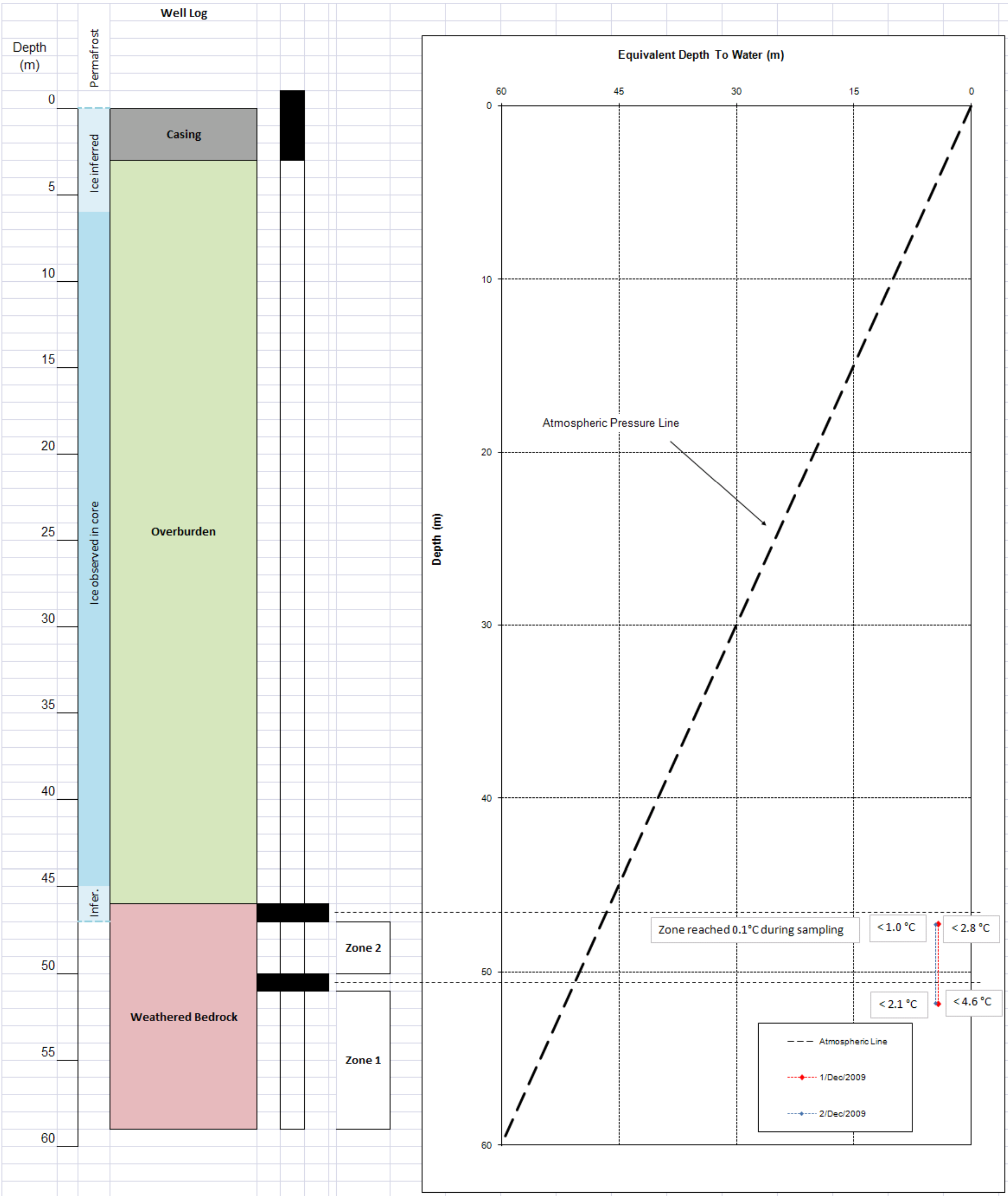
MW09-01 Well Log

Job No: 2CM022.001

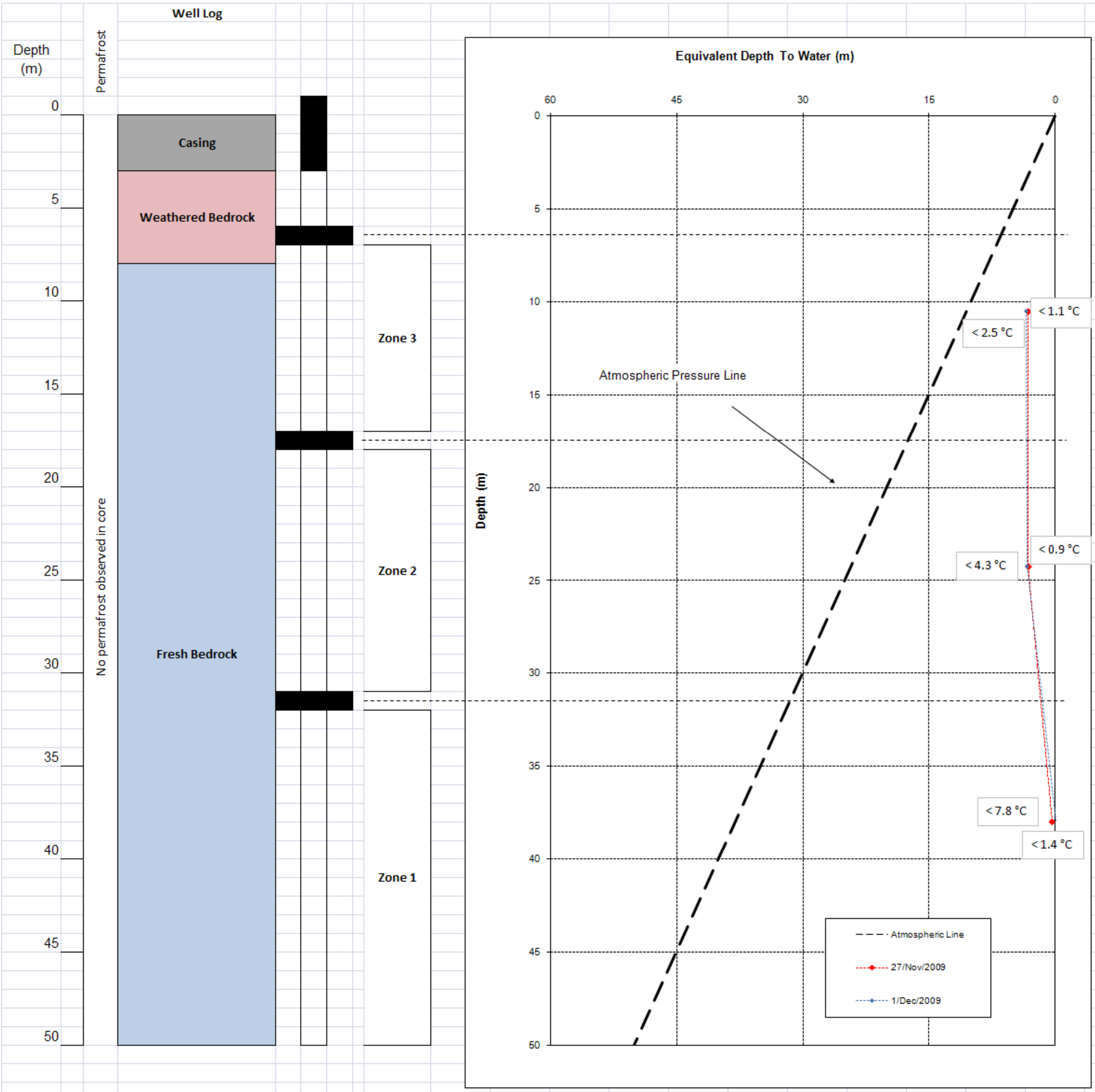
Filename: Fig 2_SRK-09-01_MP Casing Log and Pressure Data

Minto Groundwater Monitoring Plan

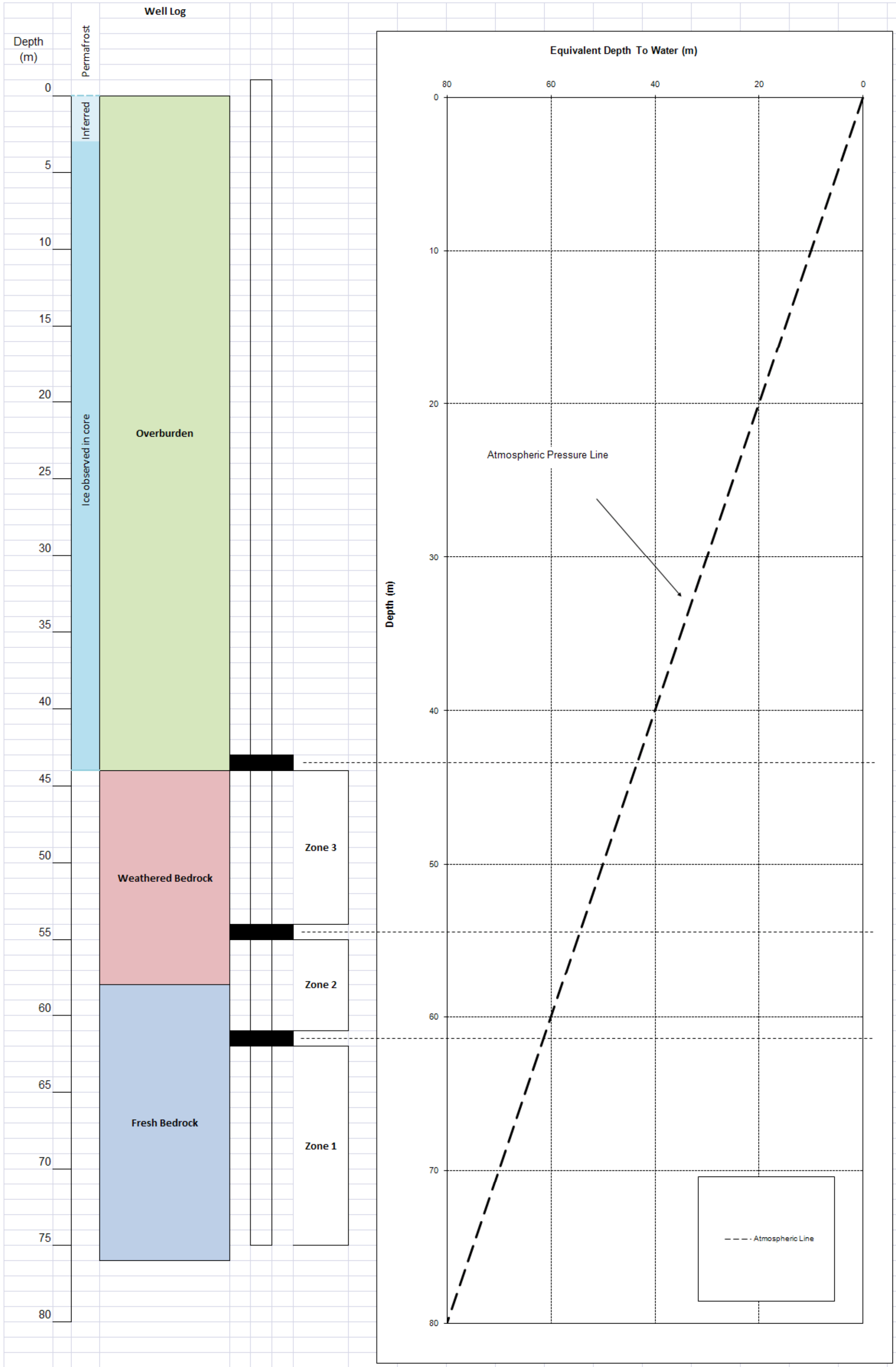
Date:	Approved:	Figure:
February 9, 2010	MDR	2



SRK Consulting Engineers and Scientists VANCOUVER	Minto Explorations Ltd.	MW09-02 Well Log		
Job No: 2CM022.001 Filename: Fig 3_SRK-09-02_MP Casing Log and Pressure Data	Minto Groundwater Monitoring Plan	Date: February 9, 2010	Approved: MDR	Figure: 3



SRK Consulting Engineers and Scientists VANCOUVER	Minto Explorations Ltd.	MW09-03 Well Log		
Job No: 2CM022.001 Filename: Fig 4_SRK-09-03_MP Casing Log and Pressure Data	Minto Groundwater Monitoring Plan	Date: February 9, 2010	Approved: MDR	Figure: 4



SRK Consulting
Engineers and Scientists
VANCOUVER

Minto Explorations Ltd

MW09-04 Well Log

Job No: 2CM022.001

Filename: Fig 5_SRK-09-04_MP Casing Log.ppt

Minto Groundwater Monitoring Plan

Date:	Approved:	Figure:
February 9, 2010	MDR	5

srk consulting

CAPSTONE MINING CORP. MINTO MINE

PROJECT: Minto Mine
CLIENT: Capstone Mining

HOLE ID: MW12-05
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 17-Oct-2012 **DATE COMPLETE:** 21-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 387001 6945779 **DATUM:** NAD83

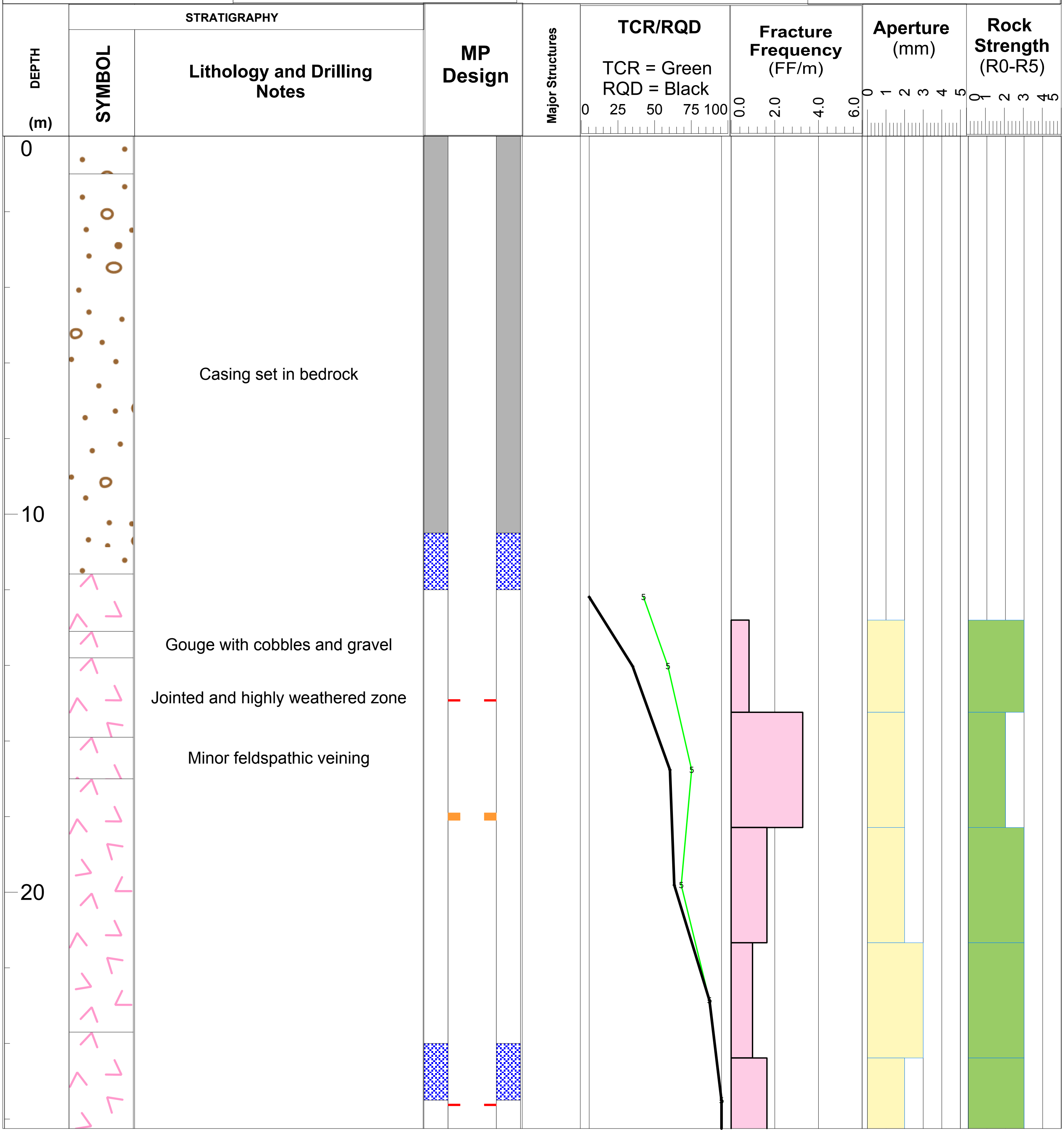
TOTAL DEPTH (m): 152.2
PAGE: 1 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-05
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 17-Oct-2012 **DATE COMPLETE:** 21-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 387001 6945779 **DATUM:** NAD83

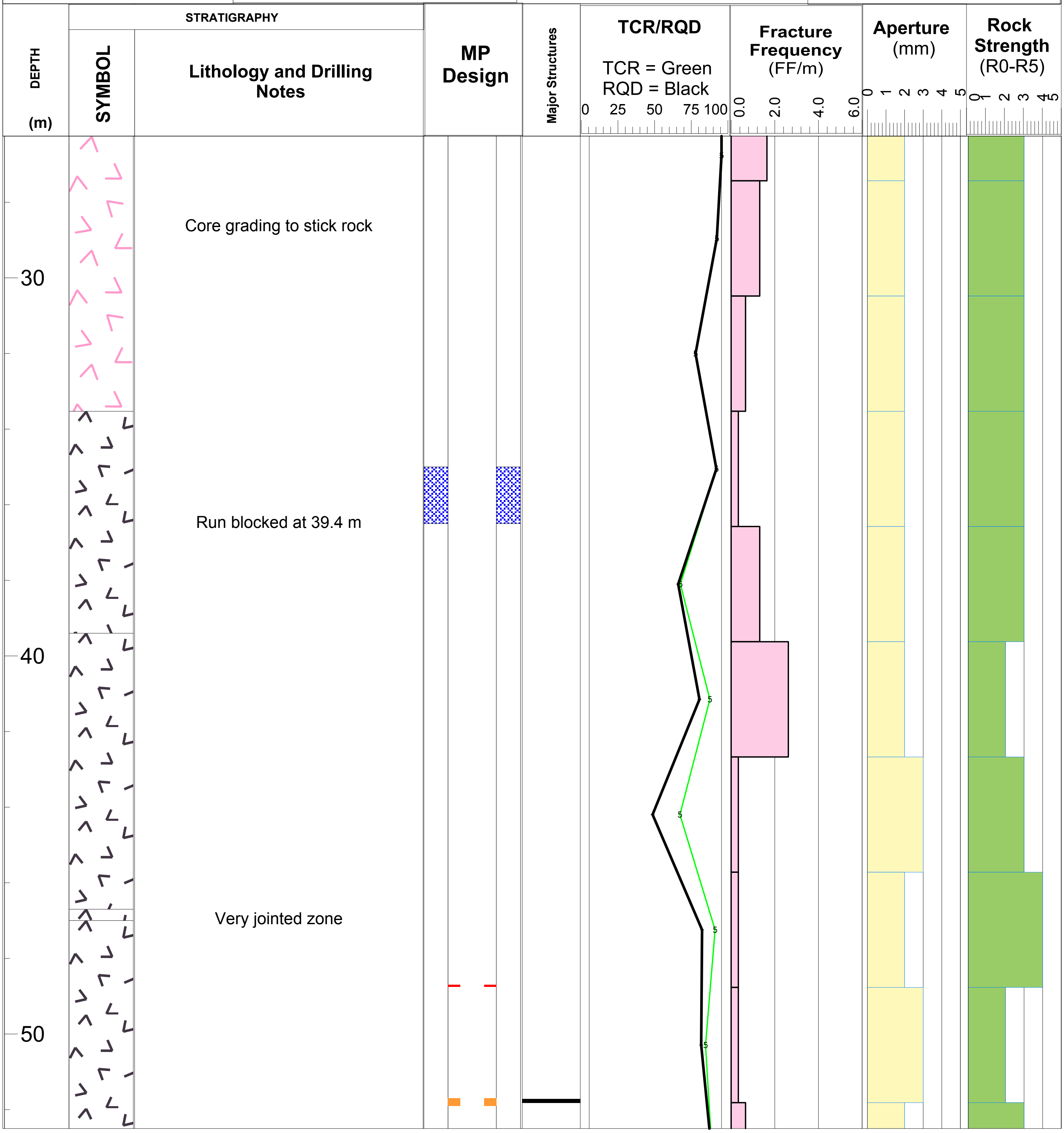
TOTAL DEPTH (m): 152.2
PAGE: 2 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed



srk consulting

PROJECT: Minto Mine

CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-05

LOCATION: Minto, Yukon, Canada

PROJECT No: 1CM002.008

DATE START: 17-Oct-2012 **DATE COMPLETE:** 21-Oct-2012

DIP: -90 **AZIMUTH:** 0

COORDINATES: 387001 6945779 **DATUM:** NAD83

TOTAL DEPTH (m): 152.2

PAGE: 3 **OF** 6

DRILL TYPE: HQ

CORE DIA. (mm): 61.1

DEFINITIONS

FF/m: Fracture Frequency per metre

TCR: Total Core Recovery

RQD: Rock Quality Designation

IRS: Intact Rock Strength (field est.)

Lithology

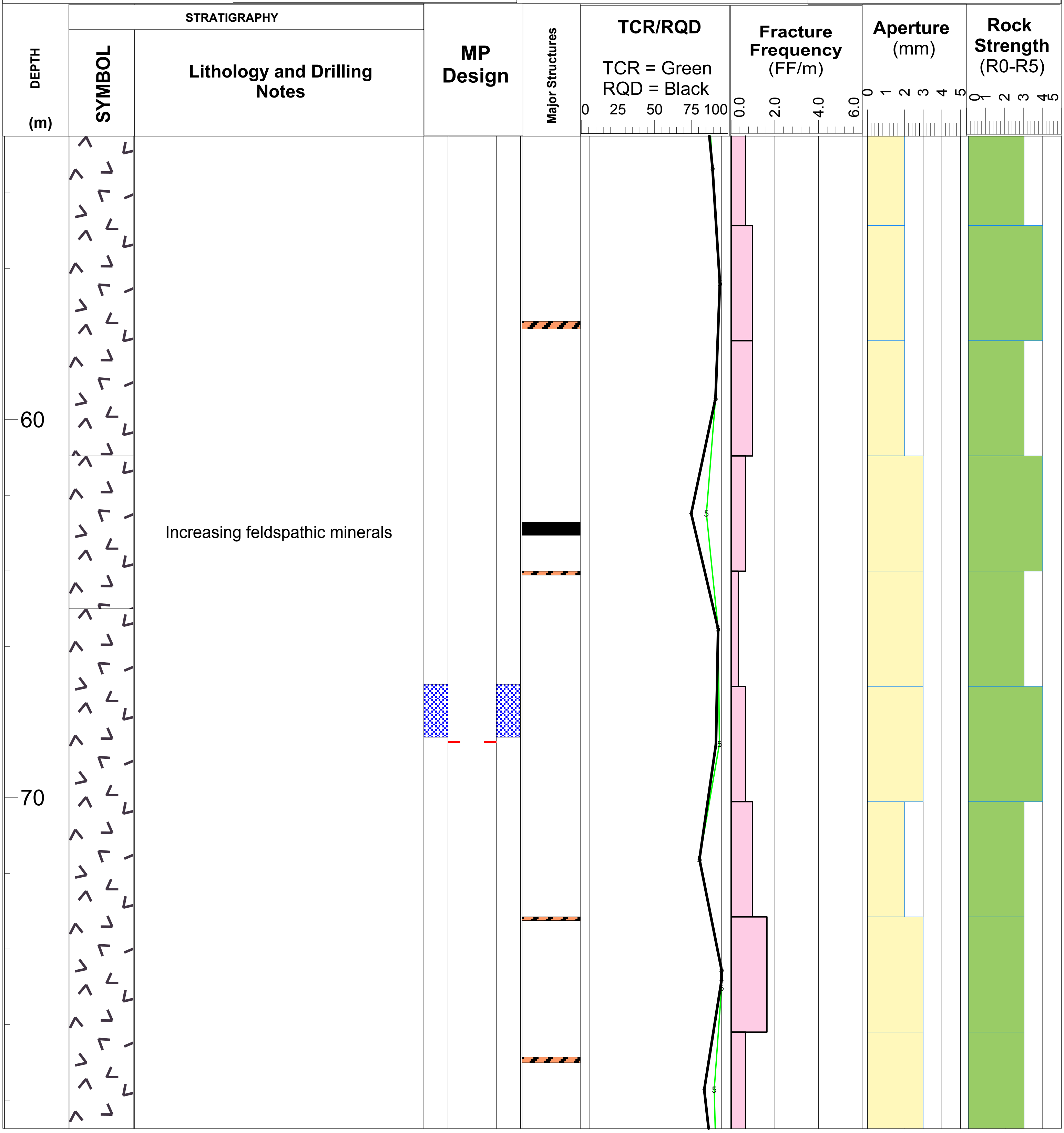
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components

Casing, PVC, PPort, Packer, MPort

Major Structures Legend

gouge, broken gouge, broken, contact, jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP.
MINTO MINE

HOLE ID: MW12-05
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 17-Oct-2012 **DATE COMPLETE:** 21-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 387001 6945779 **DATUM:** NAD83

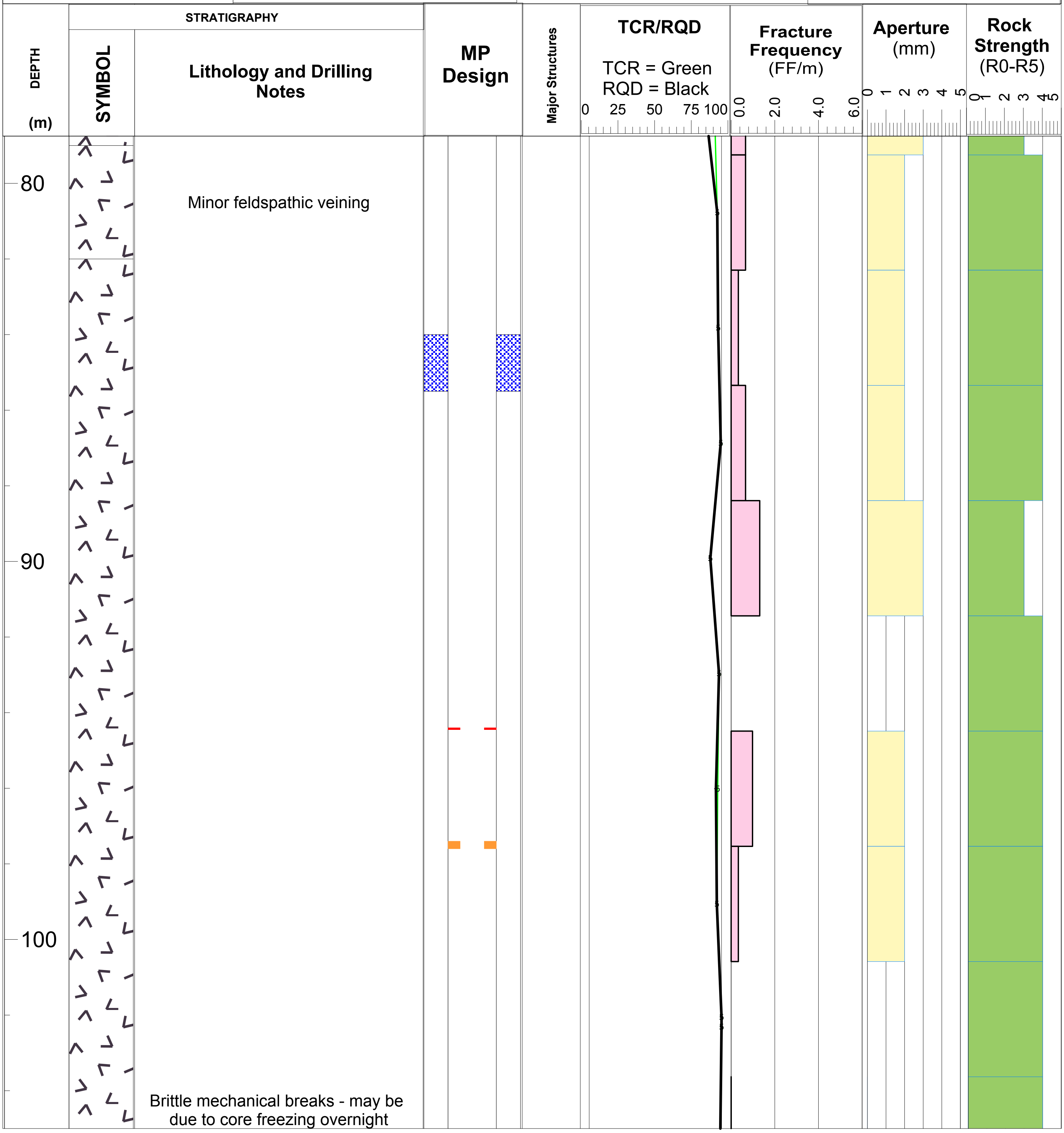
TOTAL DEPTH (m): 152.2
PAGE: 4 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden
Weathered Granodiorite
Mafic Intrusive
Granodiorite

MP components
Casing
PVC
PPort
Packer
MPort

Major Structures Legend
gouge
broken gouge
broken
contact
jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-05
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 17-Oct-2012 **DATE COMPLETE:** 21-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 387001 6945779 **DATUM:** NAD83

TOTAL DEPTH (m): 152.2

DRILL TYPE: HQ
CORE DIA. (mm): 61.1

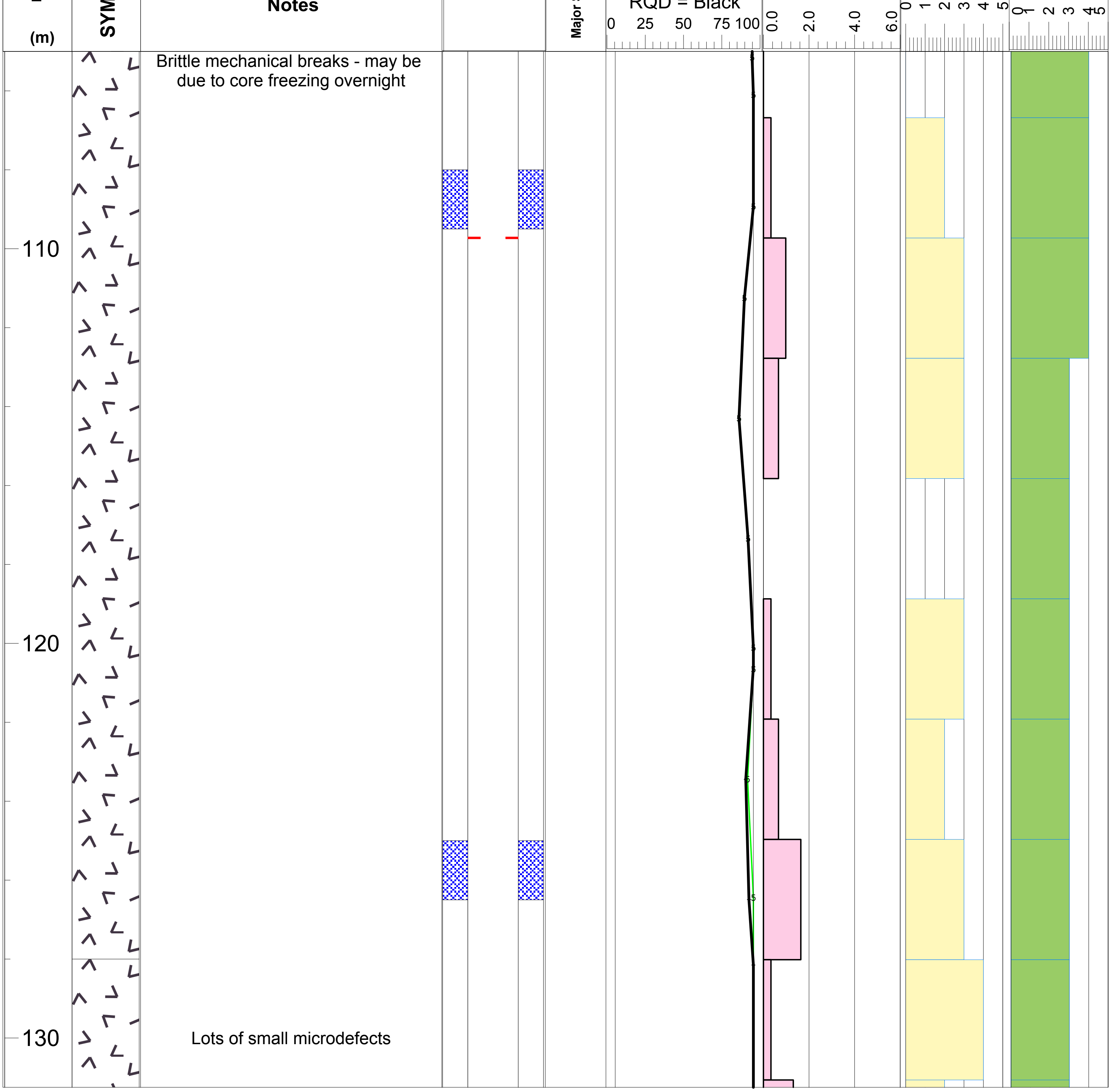
DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed

DEPTH (m)	STRATIGRAPHY: SYMBOL	STRATIGRAPHY: Lithology and Drilling Notes	MP Design	Major Structures	TCR/RQD (TCR = Green, RQD = Black)	Fracture Frequency (FF/m)	Aperture (mm)	Rock Strength (R0-R5)



Brittle mechanical breaks - may be due to core freezing overnight

Lots of small microdefects

PROJECT: Minto Mine
CLIENT: Capstone Mining

HOLE ID: MW12-05
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 17-Oct-2012 **DATE COMPLETE:** 21-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 387001 6945779 **DATUM:** NAD83

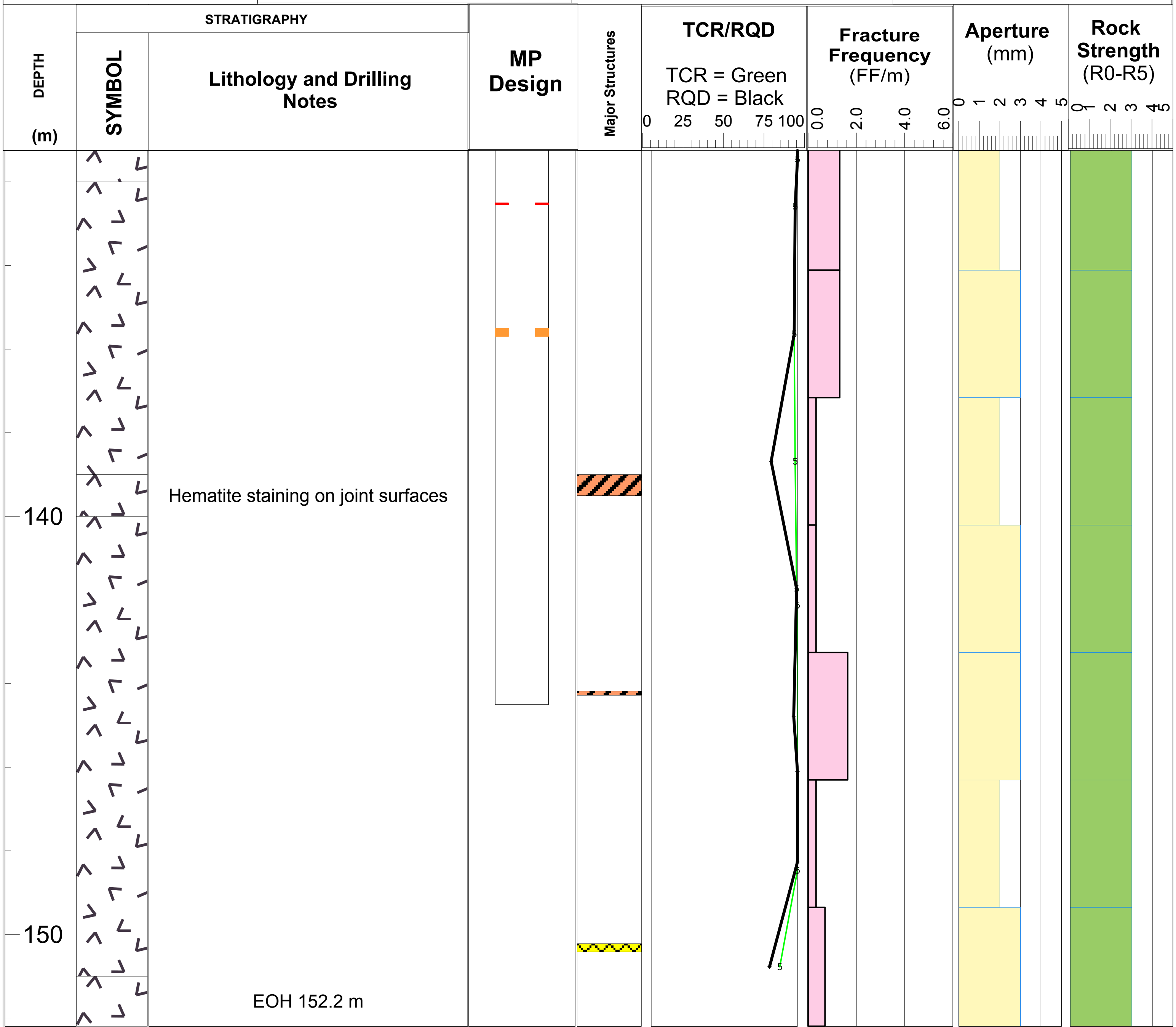
TOTAL DEPTH (m): 152.2
PAGE: 6 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP.
MINTO MINE

HOLE ID: MW12-06
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 21-Oct-2012 **DATE COMPLETE:** 24-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 386113 6945336 **DATUM:** NAD83

TOTAL DEPTH (m): 152.4
PAGE: 1 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden; Weathered Granodiorite; Mafic Intrusive; Granodiorite

MP components
Casing; PVC; PPort; Packer; MPort

Major Structures Legend
gouge; broken gouge; broken; contact; jointed

DEPTH (m)	STRATIGRAPHY: SYMBOL	STRATIGRAPHY: Lithology and Drilling Notes	MP Design	Major Structures	TCR/RQD (TCR = Green, RQD = Black) 0 25 50 75 100	Fracture Frequency (FF/m) 0.0 2.0 4.0 6.0	Aperture (mm) 0 1 2 3 4 5	Rock Strength (R0-R5) 0 1 2 3 4 5
0								
10								
		Casing removed from bedrock, one piece anchored in ground for well completion.			5			
20								

HOLE ID: MW12-06
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 21-Oct-2012 DATE COMPLETE: 24-Oct-2012
DIP: -90 AZIMUTH: 0
COORDINATES: 386113 6945336 DATUM: NAD83

TOTAL DEPTH (m): 152.4
PAGE: 2 OF 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

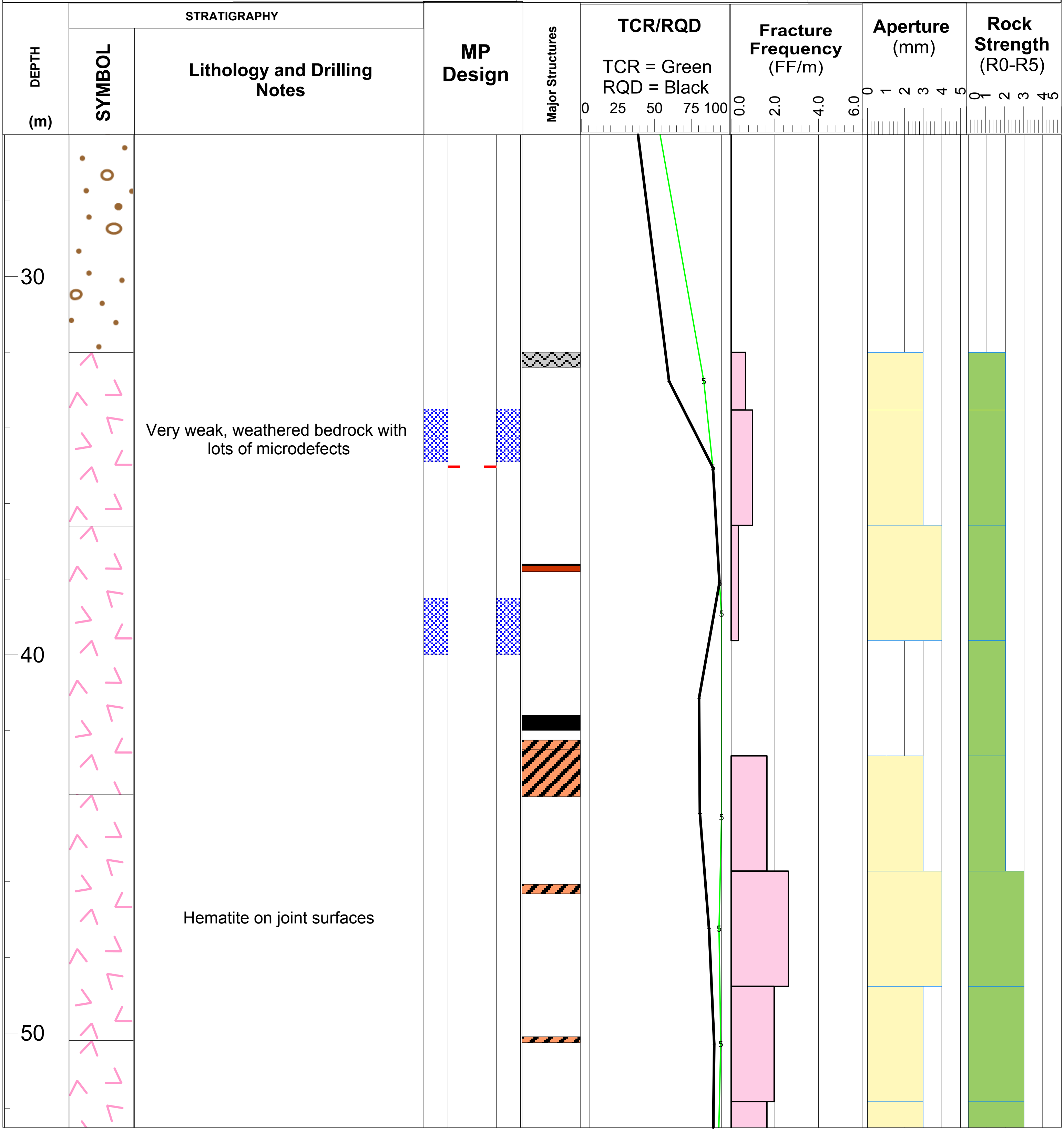
PROJECT: Minto Mine
CLIENT: Capstone Mining

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology: Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components: Casing, PVC, PPort, Packer, MPort

Major Structures Legend: gouge, broken gouge, broken, contact, jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-06
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 21-Oct-2012 **DATE COMPLETE:** 24-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 386113 6945336 **DATUM:** NAD83

TOTAL DEPTH (m): 152.4

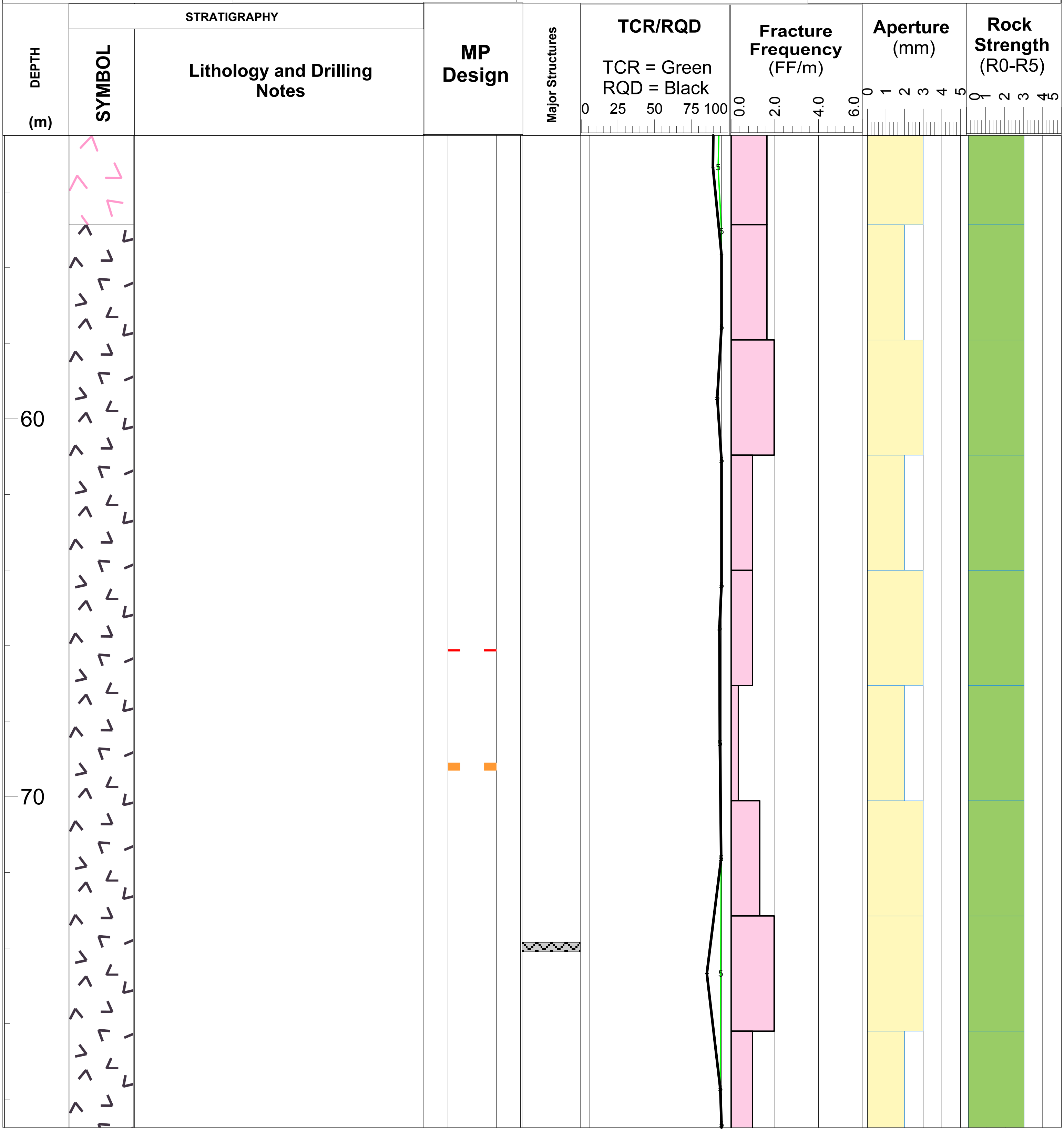
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology: Overburden; Weathered Granodiorite; Mafic Intrusive; Granodiorite

MP components: Casing; PVC; PPort; Packer; MPort

Major Structures Legend: gouge; broken gouge; broken; contact; jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-06
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 21-Oct-2012 **DATE COMPLETE:** 24-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 386113 6945336 **DATUM:** NAD83

TOTAL DEPTH (m): 152.4

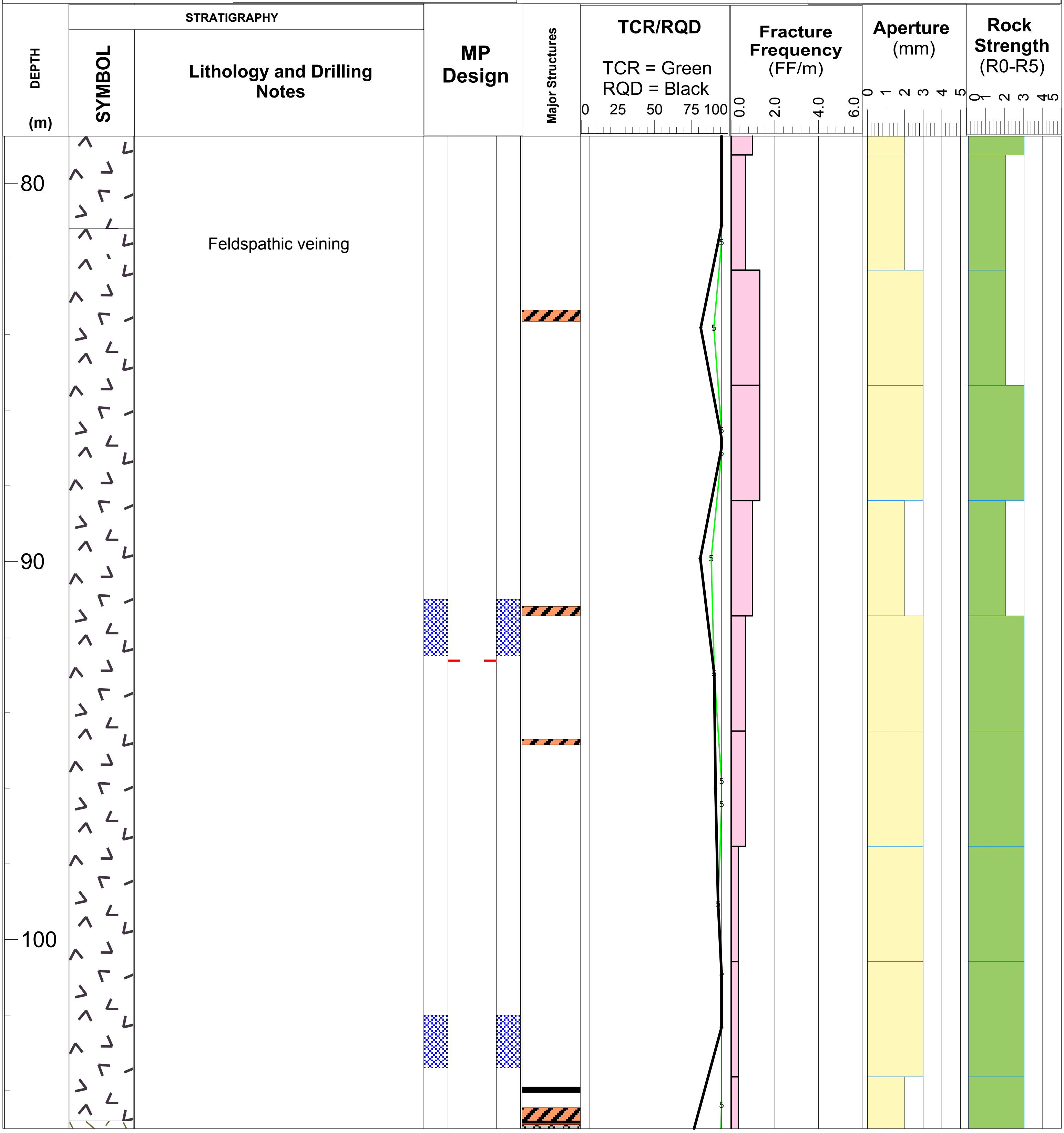
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden; Weathered Granodiorite; Mafic Intrusive; Granodiorite

MP components
Casing; PVC; PPort; Packer; MPort

Major Structures Legend
gouge; broken gouge; broken; contact; jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-06
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 21-Oct-2012 **DATE COMPLETE:** 24-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 386113 6945336 **DATUM:** NAD83

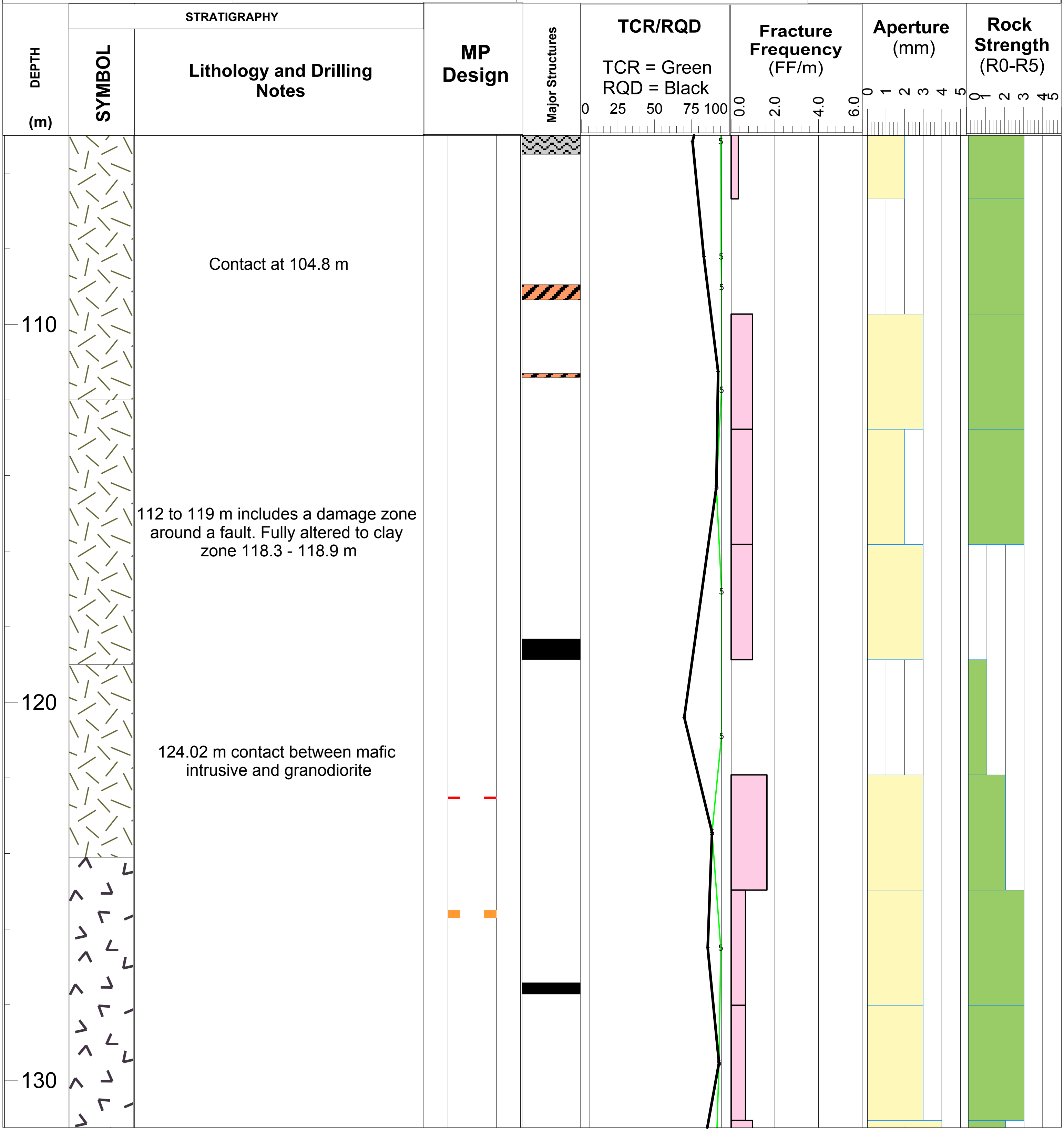
TOTAL DEPTH (m): 152.4
PAGE: 5 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology: Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components: Casing, PVC, PPort, Packer, MPort

Major Structures Legend: gouge, broken gouge, broken, contact, jointed



srk consulting

CAPSTONE MINING CORP. MINTO MINE

PROJECT: Minto Mine
CLIENT: Capstone Mining

HOLE ID: MW12-06
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 21-Oct-2012 **DATE COMPLETE:** 24-Oct-2012
DIP: -90 **AZIMUTH:** 0
COORDINATES: 386113 6945336 **DATUM:** NAD83

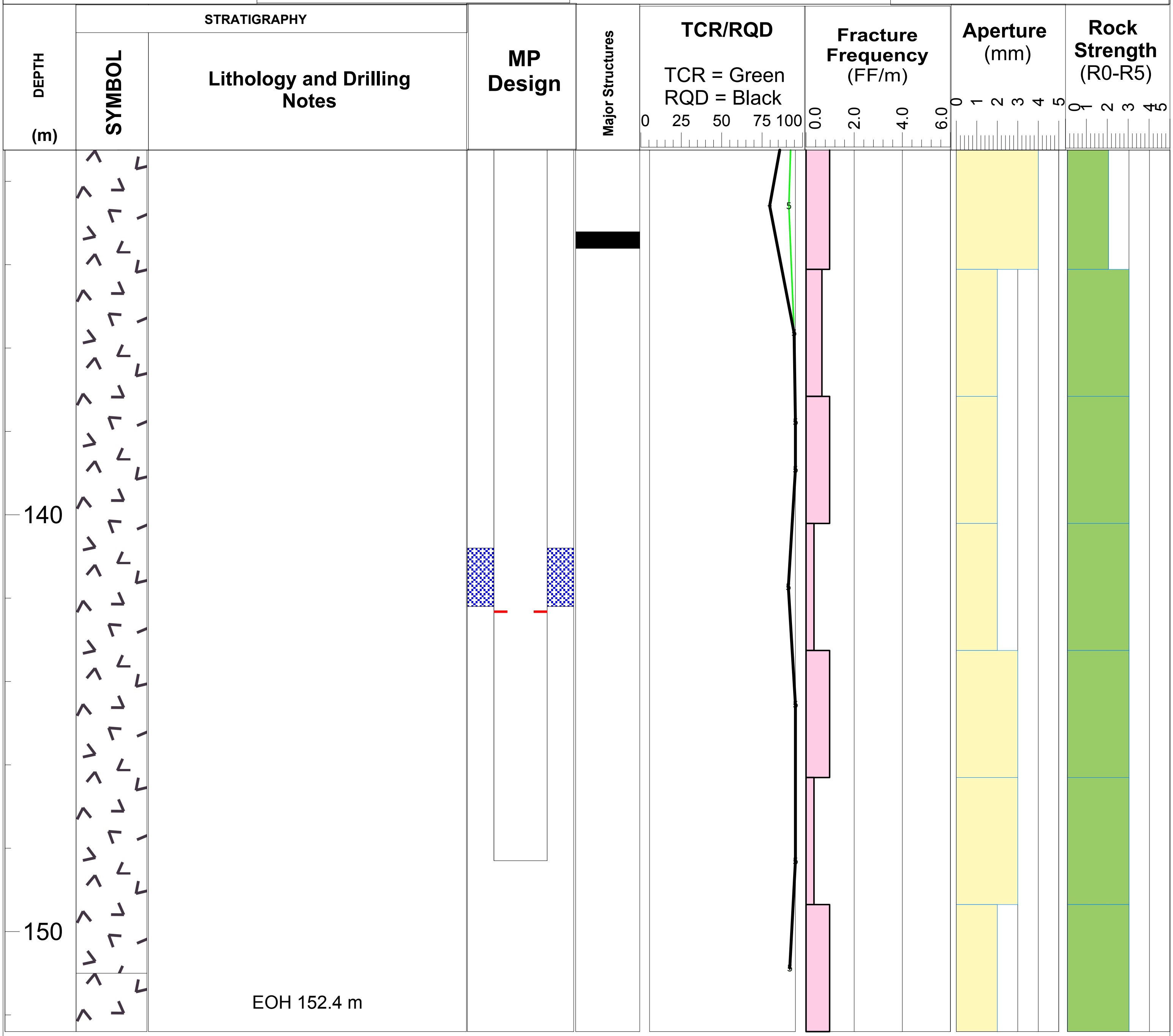
TOTAL DEPTH (m): 152.4
PAGE: 6 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology: Overburden; Weathered Granodiorite; Mafic Intrusive; Granodiorite

MP components: Casing; PVC; PPort; Packer; MPort

Major Structures Legend: gouge; broken gouge; broken; contact; jointed



PROJECT: Minto Mine
CLIENT: Capstone Mining

HOLE ID: MW12-07
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 25-Oct-2012 **DATE COMPLETE:** 27-Oct-2012
DIP: -60 **AZIMUTH:** 352
COORDINATES: 385132 6945040 **DATUM:** NAD83

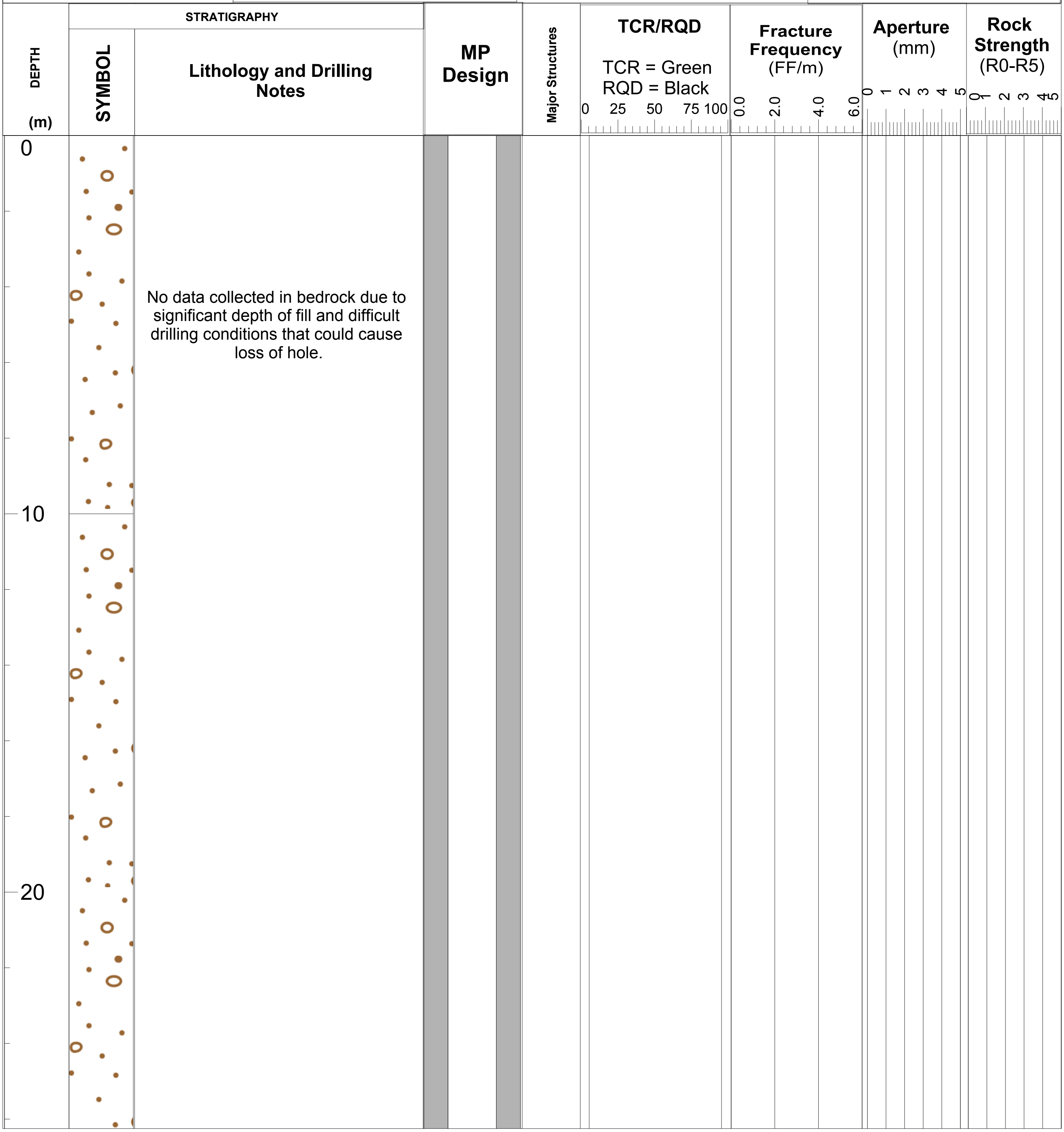
TOTAL DEPTH (m): 152.4
PAGE: 1 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed



srk consulting

CAPSTONE MINING CORP. MINTO MINE

PROJECT: Minto Mine
CLIENT: Capstone Mining

HOLE ID: MW12-07
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 25-Oct-2012 **DATE COMPLETE:** 27-Oct-2012
DIP: -60 **AZIMUTH:** 352
COORDINATES: 385132 6945040 **DATUM:** NAD83

TOTAL DEPTH (m): 152.4
PAGE: 2 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed

DEPTH (m)	STRATIGRAPHY: SYMBOL	STRATIGRAPHY: Lithology and Drilling Notes	MP Design	Major Structures	TCR/RQD (TCR = Green, RQD = Black) 0 25 50 75 100	Fracture Frequency (FF/m) 0.0 2.0 4.0 6.0	Aperture (mm) 0 1 2 3 4 5	Rock Strength (R0-R5) 0 1 2 3 4 5
30								
40								
		Casing into bedrock. Could not remove casing after MP installation, so it was left in the ground.						
50								

srk consulting

CAPSTONE MINING CORP. MINTO MINE

PROJECT: Minto Mine
CLIENT: Capstone Mining

HOLE ID: MW12-07
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 25-Oct-2012 **DATE COMPLETE:** 27-Oct-2012
DIP: -60 **AZIMUTH:** 352
COORDINATES: 385132 6945040 **DATUM:** NAD83

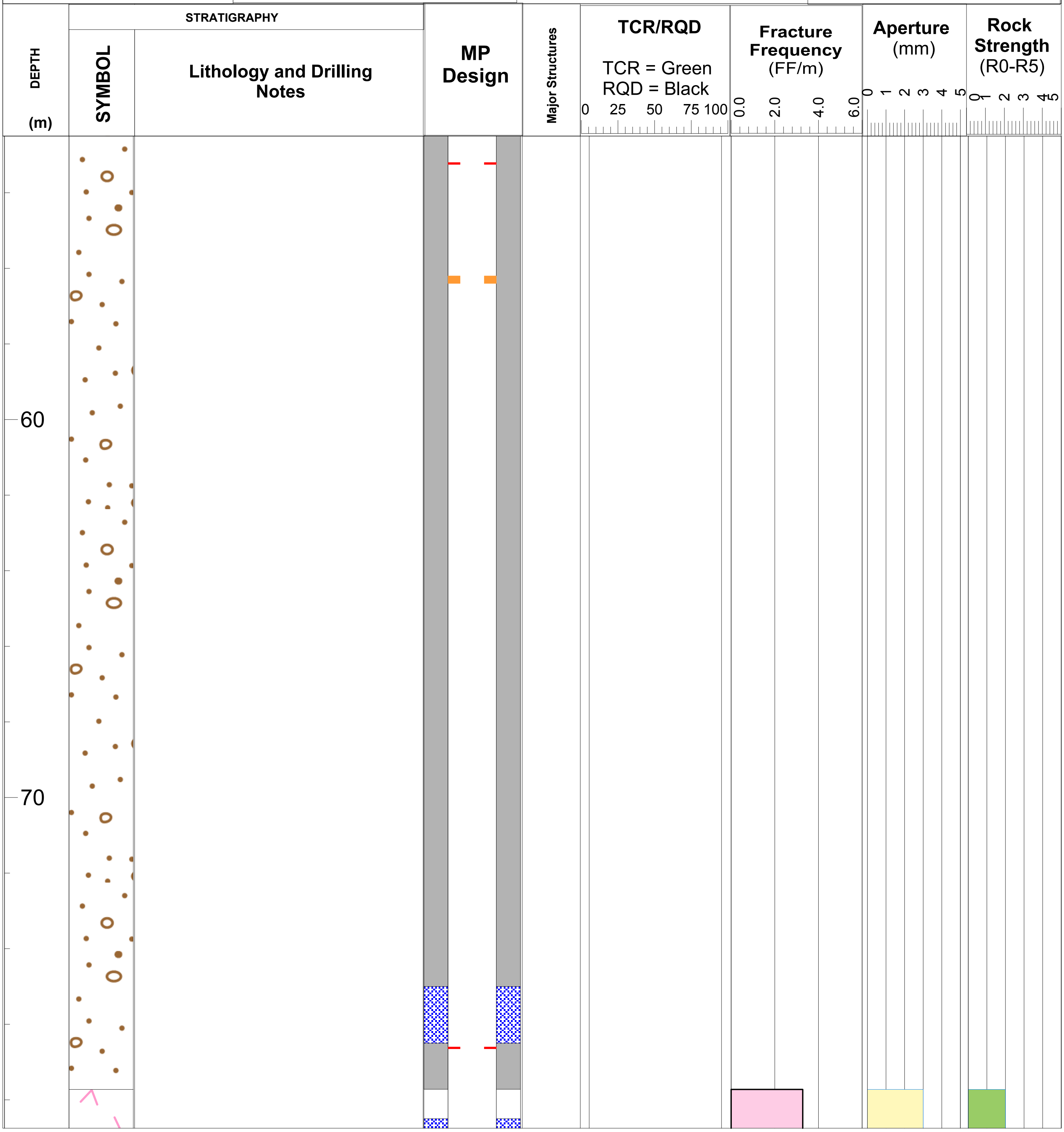
TOTAL DEPTH (m): 152.4
PAGE: 3 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-07
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 25-Oct-2012 **DATE COMPLETE:** 27-Oct-2012
DIP: -60 **AZIMUTH:** 352
COORDINATES: 385132 6945040 **DATUM:** NAD83

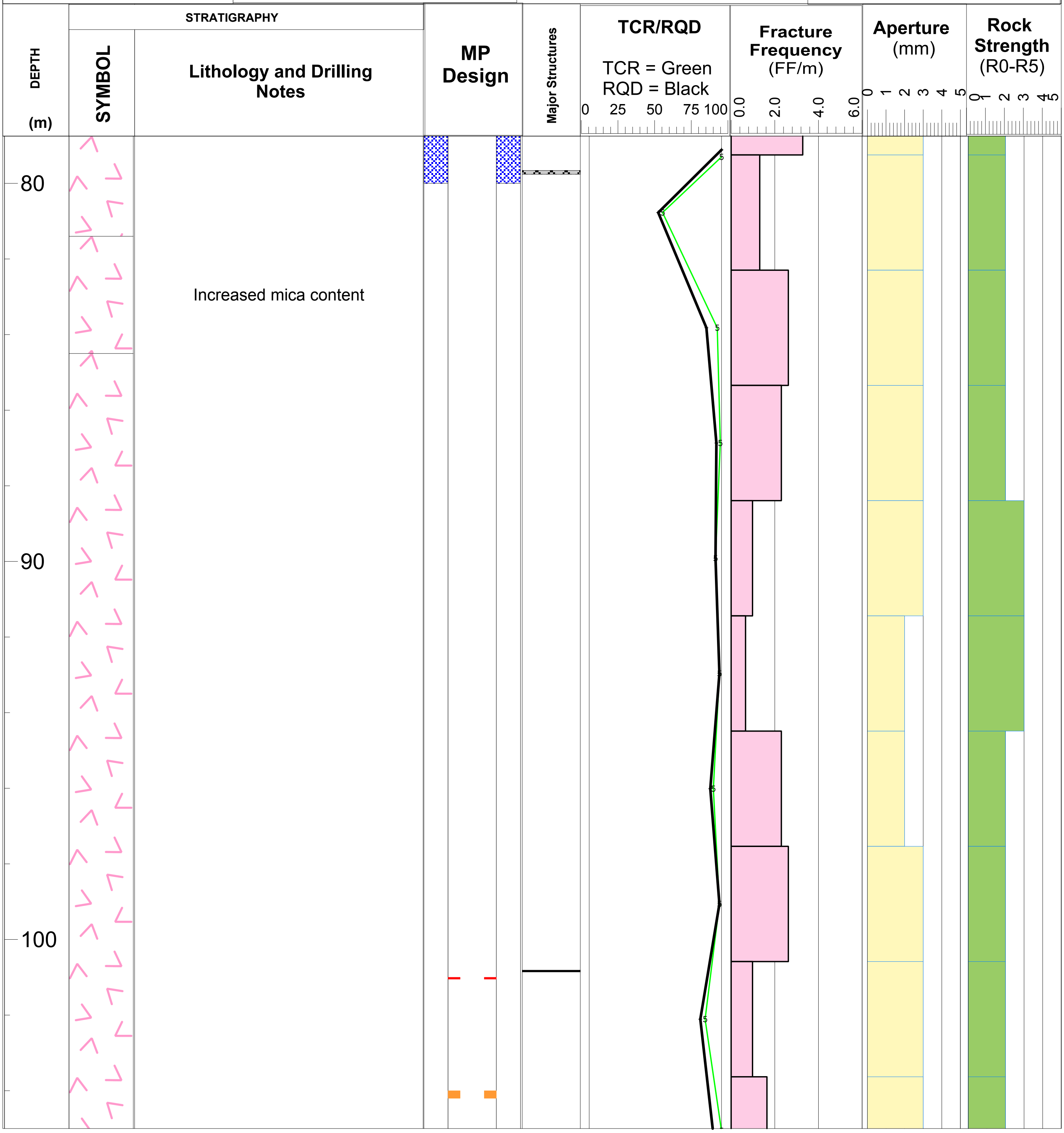
TOTAL DEPTH (m): 152.4
PAGE: 4 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed

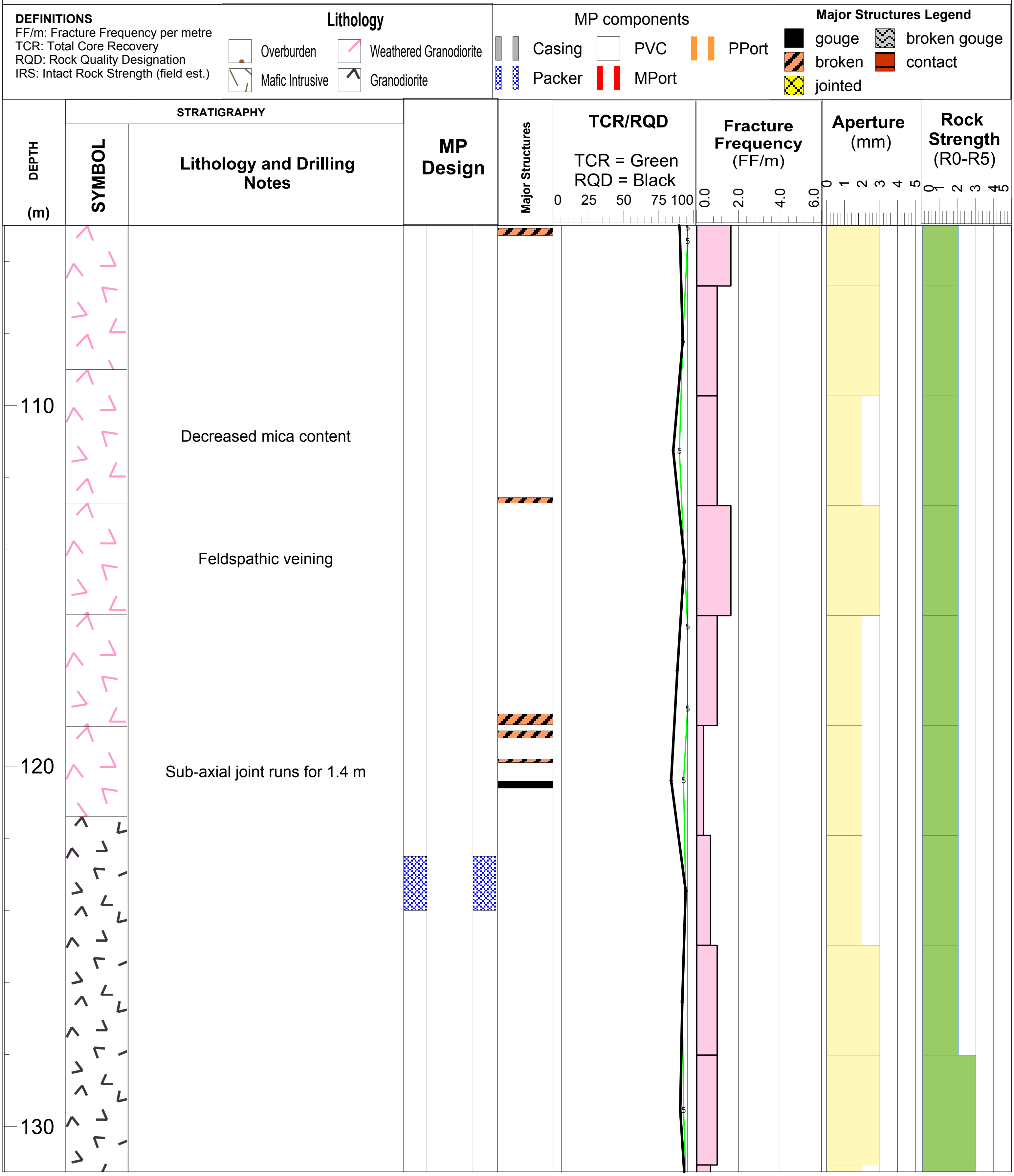


PROJECT: Minto Mine
CLIENT: Capstone Mining

HOLE ID: MW12-07
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 25-Oct-2012 **DATE COMPLETE:** 27-Oct-2012
DIP: -60 **AZIMUTH:** 352
COORDINATES: 385132 6945040 **DATUM:** NAD83

TOTAL DEPTH (m): 152.4
PAGE: 5 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)



srk consulting

PROJECT: Minto Mine
CLIENT: Capstone Mining

CAPSTONE MINING CORP. MINTO MINE

HOLE ID: MW12-07
LOCATION: Minto, Yukon, Canada
PROJECT No: 1CM002.008
DATE START: 25-Oct-2012 **DATE COMPLETE:** 27-Oct-2012
DIP: -60 **AZIMUTH:** 352
COORDINATES: 385132 6945040 **DATUM:** NAD83

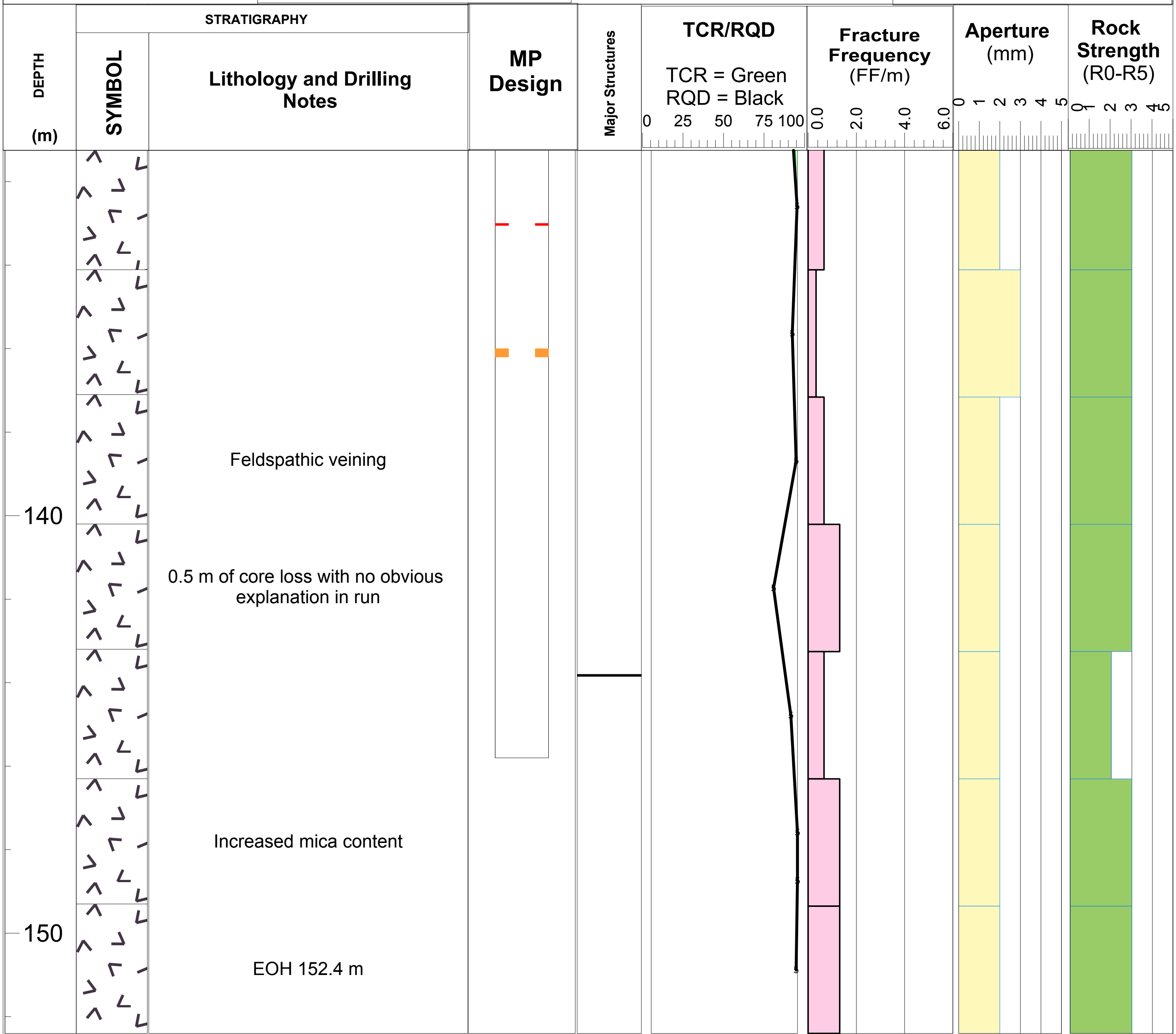
TOTAL DEPTH (m): 152.4
PAGE: 6 **OF** 6
DRILL TYPE: HQ
CORE DIA. (mm): 61.1

DEFINITIONS
FF/m: Fracture Frequency per metre
TCR: Total Core Recovery
RQD: Rock Quality Designation
IRS: Intact Rock Strength (field est.)

Lithology
Overburden, Weathered Granodiorite, Mafic Intrusive, Granodiorite

MP components
Casing, PVC, PPort, Packer, MPort

Major Structures Legend
gouge, broken gouge, broken, contact, jointed



DRAFT

Borehole Number: **MW17-08**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/5/2017**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **3 m**	End Date: **7/9/2017**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **50.5 m**	

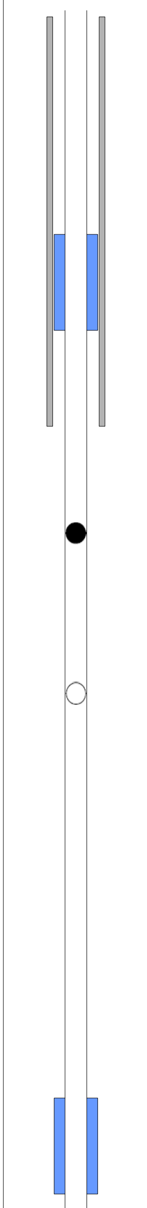
Borehole Coordinates: **E: 383,982 (m)** **N: 6,944,587 (m)** Top of Casing Elevation (mamsl): **844.6**

Collar Dip (deg): **90** Azimuth (deg): **-** Number of Zones: **4** Casing Stickup (m): **0.41**

LITHOLOGY — Andesite, Granodiorite, Overburden, Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
0–3			No Core			Zone 4	
3–20		Granodiorite	Granodiorite: Felsic dominant light white grey color, slightly high fracture frequency, multiple fracture zones, filling course grained sand, rusty red surface weathering iron stained				

Depth scale: 0, 4, 8, 12, 16, 20



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

DRAFT

Borehole Number: **MW17-08**
Location: **Minto Mine**

srk consulting — capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/5/2017**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **3 m**	End Date: **7/9/2017**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **50.5 m**	

Borehole Coordinates: **E: 383,982 (m)** **N: 6,944,587 (m)**   Top of Casing Elevation (mamsl): **844.6**

Collar Dip (deg): **90**   Azimuth (deg): **-**   Number of Zones: **4**   Casing Stickup (m): **0.41**

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
20–29.5		Granodiorite				Zone 3	
29.5–41		Granodiorite	Granodiorite: Broken Zones, low RQD, high FF, low TCR, K-feldspar macro crystals, iron stain and weathering on the joints			Zone 2	

LITHOLOGY: Andesite, Granodiorite, Overburden, Clay

Depth scale: 20, 24, 28, 32, 36, 40

Installation Legend

Measurement Port · Pumping Port · Packer · PVC Casing · Sufrace Casing

Project No.: **1CM002.058** Client: **Capstone Mining Inc** Project: **2017 MP Install**	Drilling Contractor: **Driftwood Drilling** Drilling Equipment: **Diamond** Logged By: **JJ**	Depth to Water: **mbtoc** Depth to Rock: **3 m** Final Depth: **50.5 m**	Start Date: **7/5/2017** End Date: **7/9/2017**

Borehole Coordinates: **E: 383,982 (m)** **N: 6,944,587 (m)** Top of Casing Elevation (mamsl): **844.6**

Collar Dip (deg): **90** Azimuth (deg): **-** Number of Zones: **4** Casing Stickup (m): **0.41**

LITHOLOGY

Andesite, Granodiorite, Overburden, Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
		Granodiorite					
44		Granodiorite	Granodiorite: Light pink stained, granite rock, altered, jointed, cemented joints filled with fine grain dark rusty brown infill				
		Granodiorite	Granodiorite: Light yellow, rusty,zero RQD, completely weathered			Zone 1	
48		Granodiorite	Granodiorite: Light pink stained, granite rock, altered, jointed, cemented joints filled with fine grain dark rusty brown infill				

Installation Legend

Measurement Port, Pumping Port, Packer, PVC Casing, Sufrace Casing

DRAFT

Borehole Number: **MW17-09**
Location: **Minto Mine**

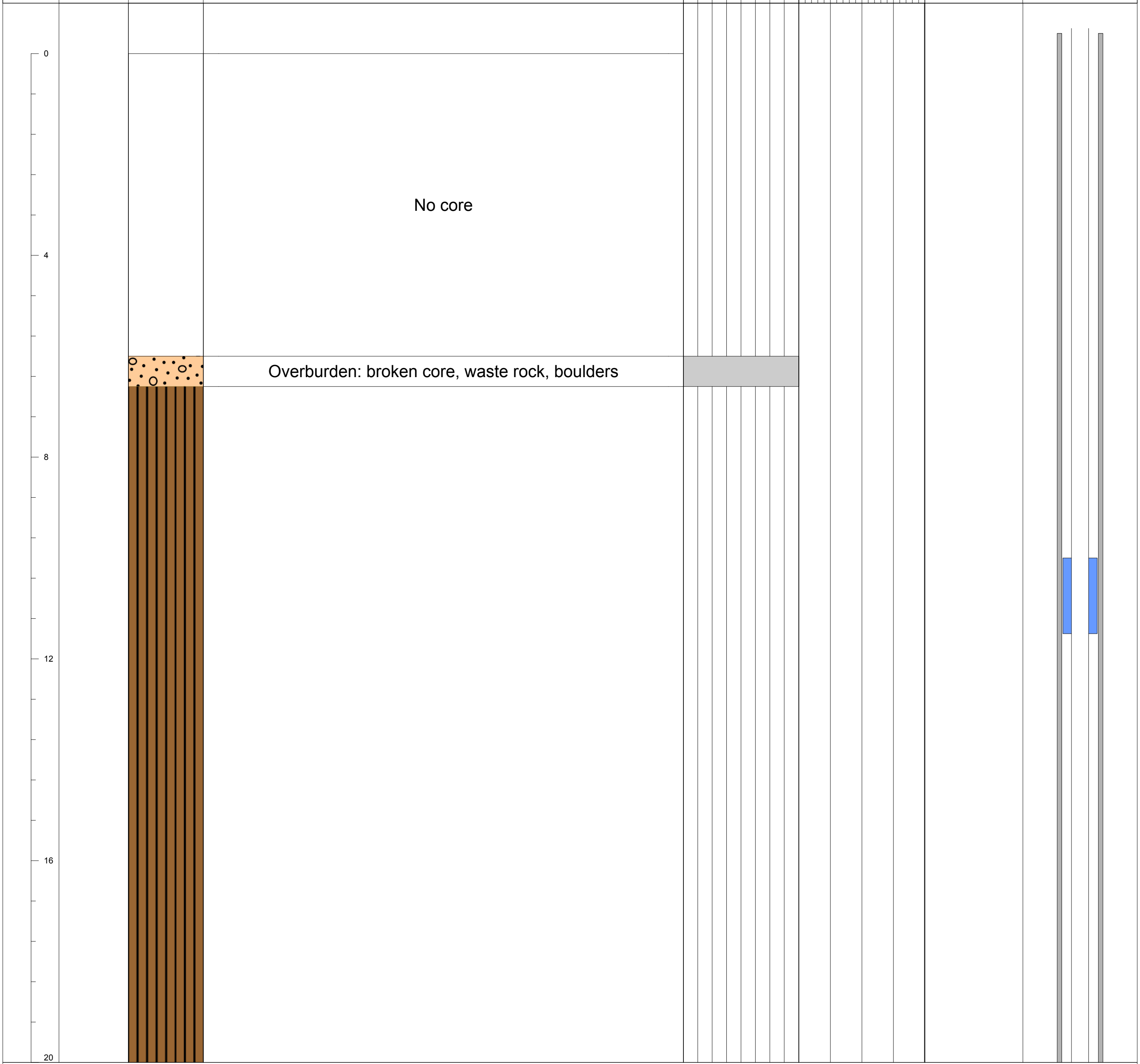
Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/9/2017**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **51.6 m**	End Date: **7/16/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **63.6 m**	

Borehole Coordinates: **E: 383,079 (m)** **N: 6,944,055 (m)** Top of Casing Elevation (mamsl): **927.5**

Collar Dip (deg): **70** Azimuth (deg): **90** Number of Zones: **1** Casing Stickup (m): **0.38**

LITHOLOGY: Andesite, Granodiorite, Overburden, Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%)	Fracture Frequency (per m)	Zone	Installation
0 – ~7.5			No core				
~7.5 – ~8.1		Overburden	Overburden: broken core, waste rock, boulders				
~8.1 – 20		Clay					



Installation Legend

Measurement Port, Pumping Port, Packer, PVC Casing, Sufrace Casing

DRAFT

srk consulting | capstone MINTO MINE

Borehole Number: **MW17-09**	Location: **Minto Mine**
Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**
Project: **2017 MP Install**	Logged By: **JJ**
Depth to Water: **mbtoc**	Start Date: **7/9/2017**
Depth to Rock: **51.6 m**	End Date: **7/16/201**
Final Depth: **63.6 m**	

Borehole Coordinates: **E: 383,079 (m)** **N: 6,944,055 (m)** Top of Casing Elevation (mamsl): **927.5**

Collar Dip (deg): **70** Azimuth (deg): **90** Number of Zones: **1** Casing Stickup (m): **0.38**

Depth (m)	TCLP Sample	LITHOLOGY (Andesite, Granodiorite, Overburden, Clay) Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
20–40		Clay	Clay: Dark grey brown stiff clay, included well rounded to rounded cobbles to boulders size rocks, indications of permafrost -obseved ice chunks during the drilling				

Depth scale: 20, 24, 28, 32, 36, 40

Installation Legend

Measurement Port, Pumping Port, Packer, PVC Casing, Sufrace Casing

Borehole Number: **MW17-09**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

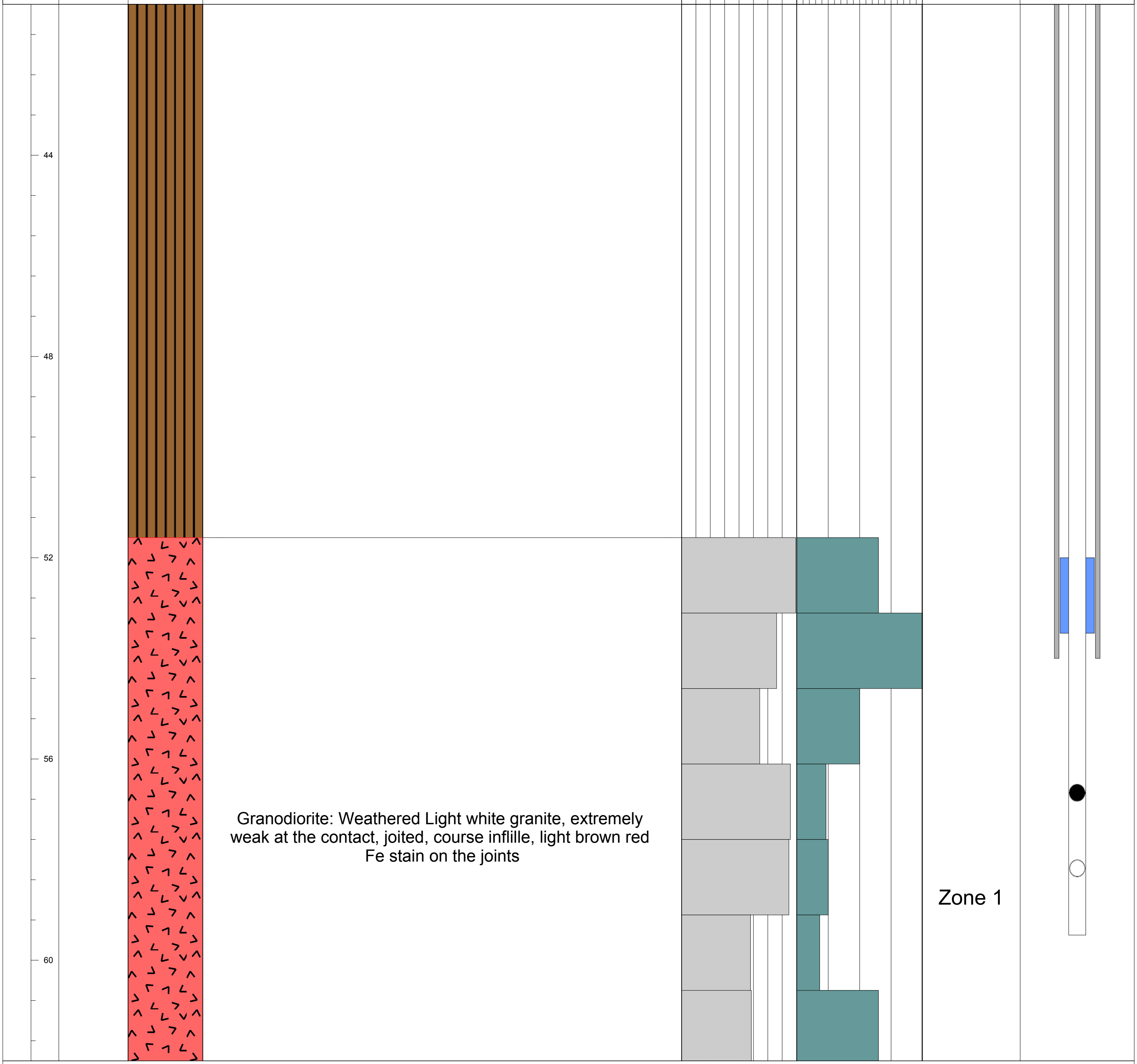
DRAFT

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/9/2017**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **51.6 m**	End Date: **7/16/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **63.6 m**	

Borehole Coordinates: **E: 383,079 (m)** **N: 6,944,055 (m)** Top of Casing Elevation (mamsl): **927.5**

Collar Dip (deg): **70** Azimuth (deg): **90** Number of Zones: **1** Casing Stickup (m): **0.38**

Depth (m)	TCLP Sample	LITHOLOGY: Andesite, Granodiorite, Overburden, Clay — Legend / Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

DRAFT

Borehole Number: **MW17-09**
Location: **Minto Mine**

Project No.: **1CM002.058** Client: **Capstone Mining Inc** Project: **2017 MP Install**	Drilling Contractor: **Driftwood Drilling** Drilling Equipment: **Diamond** Logged By: **JJ**	Depth to Water: **mbtoc** Depth to Rock: **51.6 m** Final Depth: **63.6 m**	Start Date: **7/9/2017** End Date: **7/16/201**

Borehole Coordinates: **E: 383,079 (m)** **N: 6,944,055 (m)** Top of Casing Elevation (mamsl): **927.5**

Collar Dip (deg): **70** Azimuth (deg): **90** Number of Zones: **1** Casing Stickup (m): **0.38**

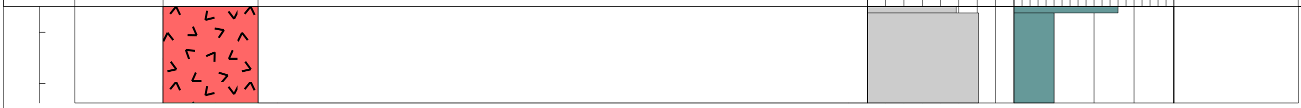
Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%)	Fracture Frequency (per m)	Zone	Installation

LITHOLOGY

Andesite Granodiorite Overburden Clay

Recovery (%): 0 25 50 75 100

Fracture Frequency (per m): 0 10 20 30 40



Installation Legend

Measurement Port Pumping Port Packer PVC Casing Sufrace Casing

DRAFT

srk consulting | capstone MINTO MINE

Borehole Number: **MW17-10**			
Location: **Minto Mine**			
Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/13/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **54.3 m**	End Date: **7/19/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **100.8 m**	

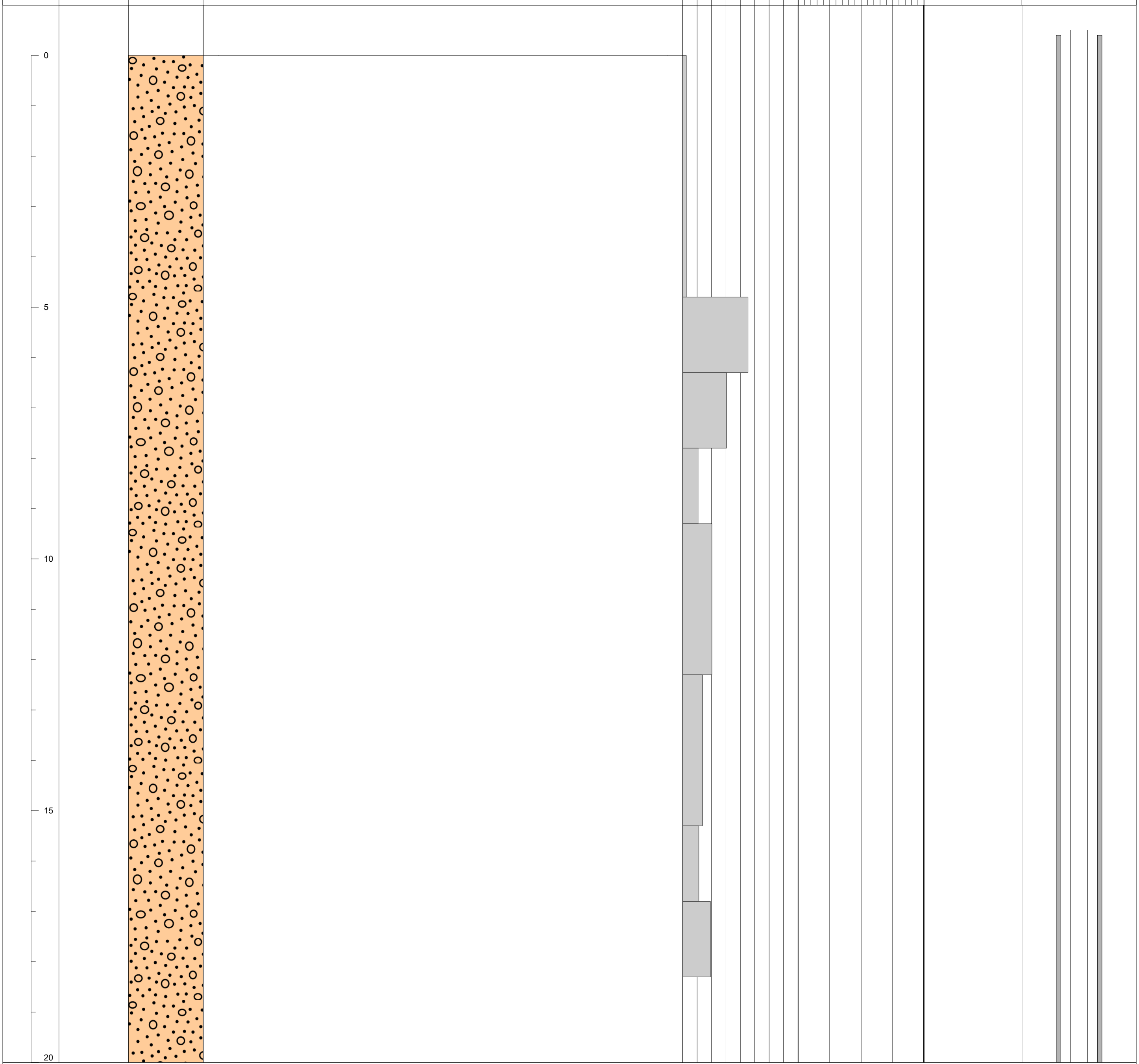
Borehole Coordinates: **E: 384,248 (m)** **N: 6,945,089 (m)** Top of Casing Elevation (mamsl): **857.2**

Collar Dip (deg): **70** Azimuth (deg): **200** Number of Zones: **4** Casing Stickup (m): **0.41**

Depth (m)	TCLP Sample	LITHOLOGY — Legend	Lithology Description	Recovery (%)	Fracture Frequency (per m)	Zone	Installation

LITHOLOGY: Andesite, Granodiorite, Overburden, Clay

Recovery (%): 0, 25, 50, 75, 100
Fracture Frequency (per m): 0, 10, 20, 30, 40



Installation Legend

Measurement Port, Pumping Port, Packer, PVC Casing, Sufrace Casing

Borehole Number: **MW17-10**
Location: **Minto Mine**

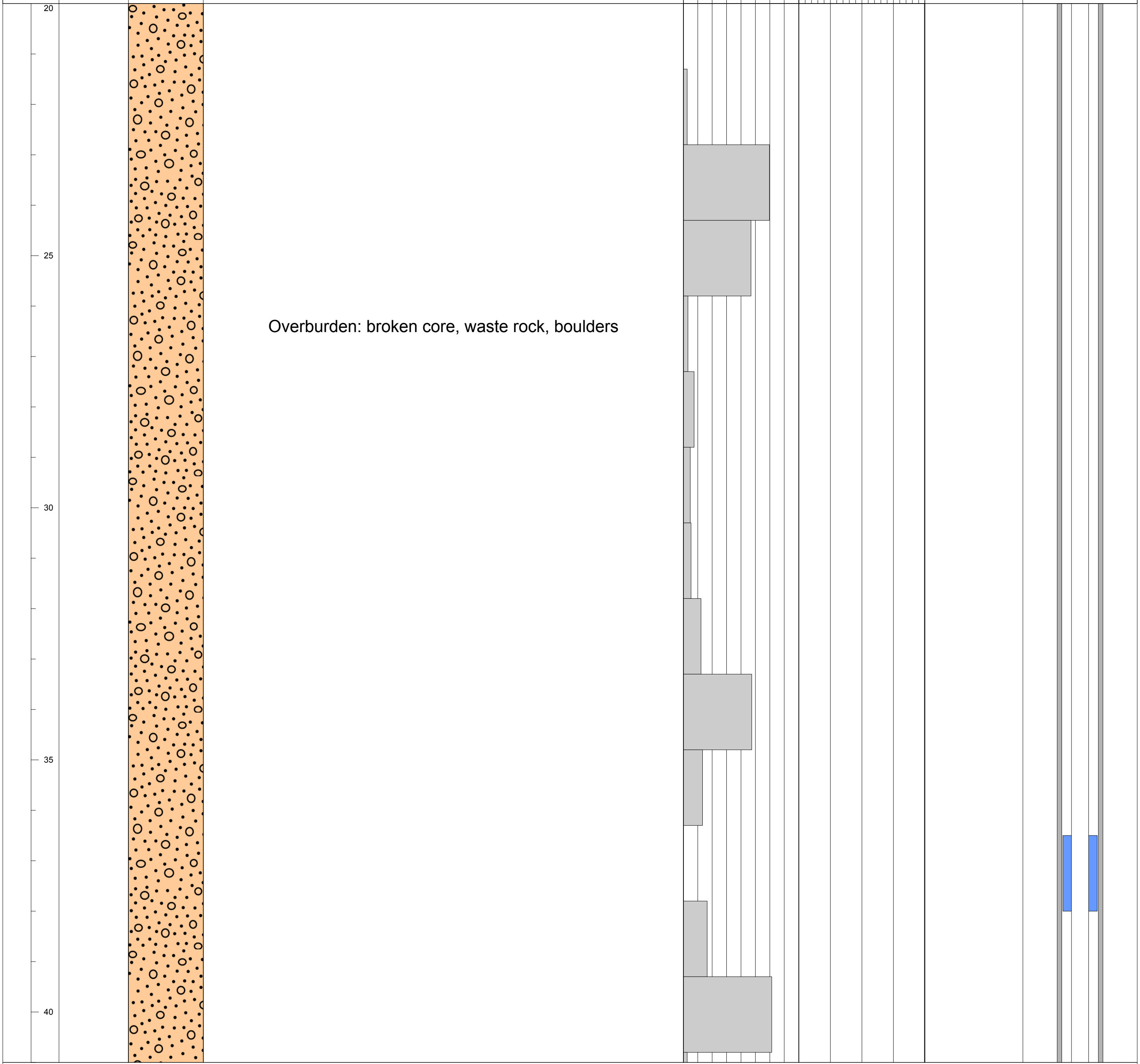
srk consulting | capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/13/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **54.3 m**	End Date: **7/19/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **100.8 m**	

Borehole Coordinates: **E: 384,248 (m)** **N: 6,945,089 (m)** Top of Casing Elevation (mamsl): **857.2**

Collar Dip (deg): **70** Azimuth (deg): **200** Number of Zones: **4** Casing Stickup (m): **0.41**

Depth (m)	TCLP Sample	LITHOLOGY: Andesite, Granodiorite, Overburden, Clay — Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

DRAFT

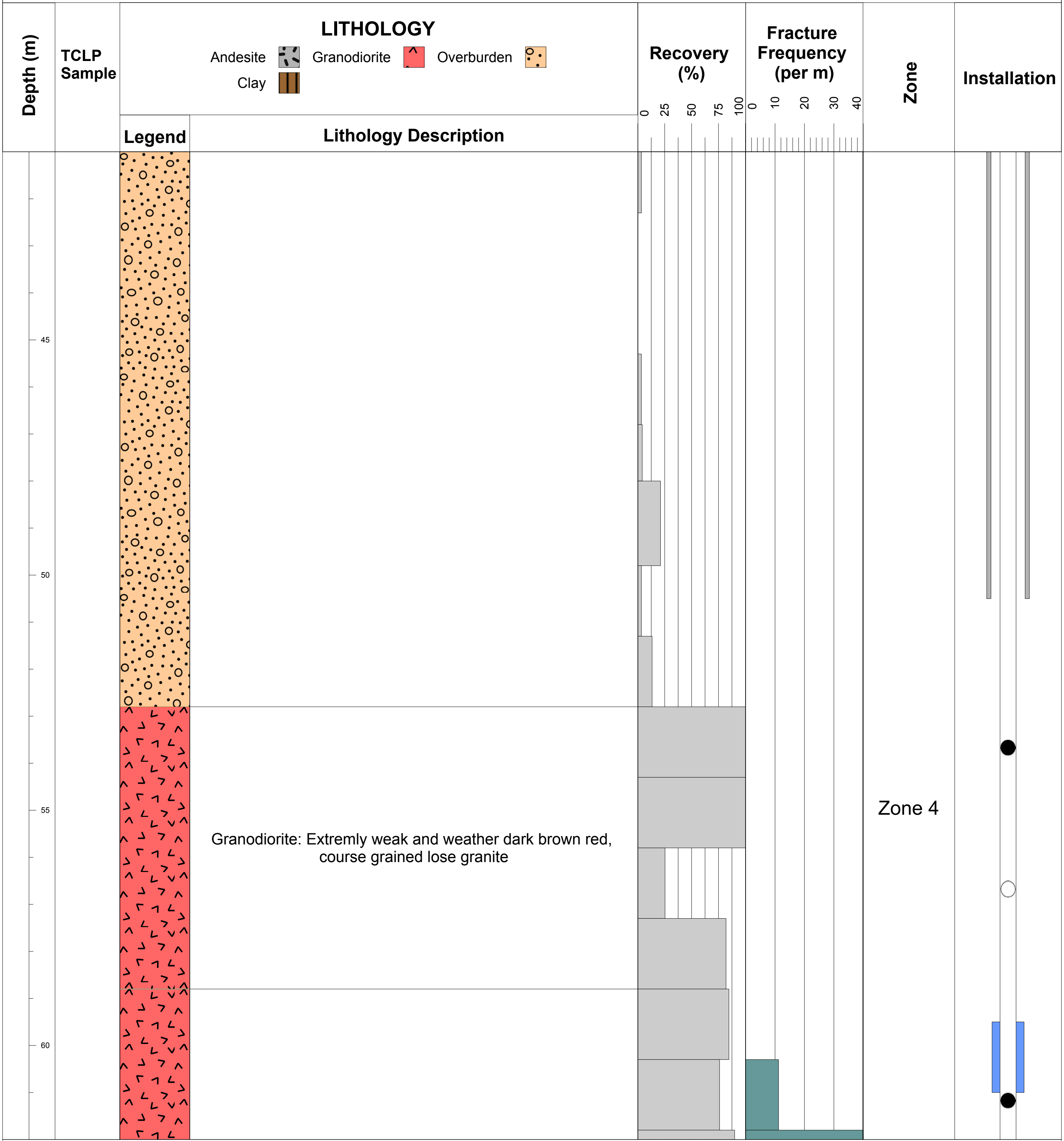
Borehole Number: **MW17-10**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/13/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **54.3 m**	End Date: **7/19/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **100.8 m**	

Borehole Coordinates: **E: 384,248 (m)** **N: 6,945,089 (m)** Top of Casing Elevation (mamsl): **857.2**

Collar Dip (deg): **70** Azimuth (deg): **200** Number of Zones: **4** Casing Stickup (m): **0.41**



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

DRAFT

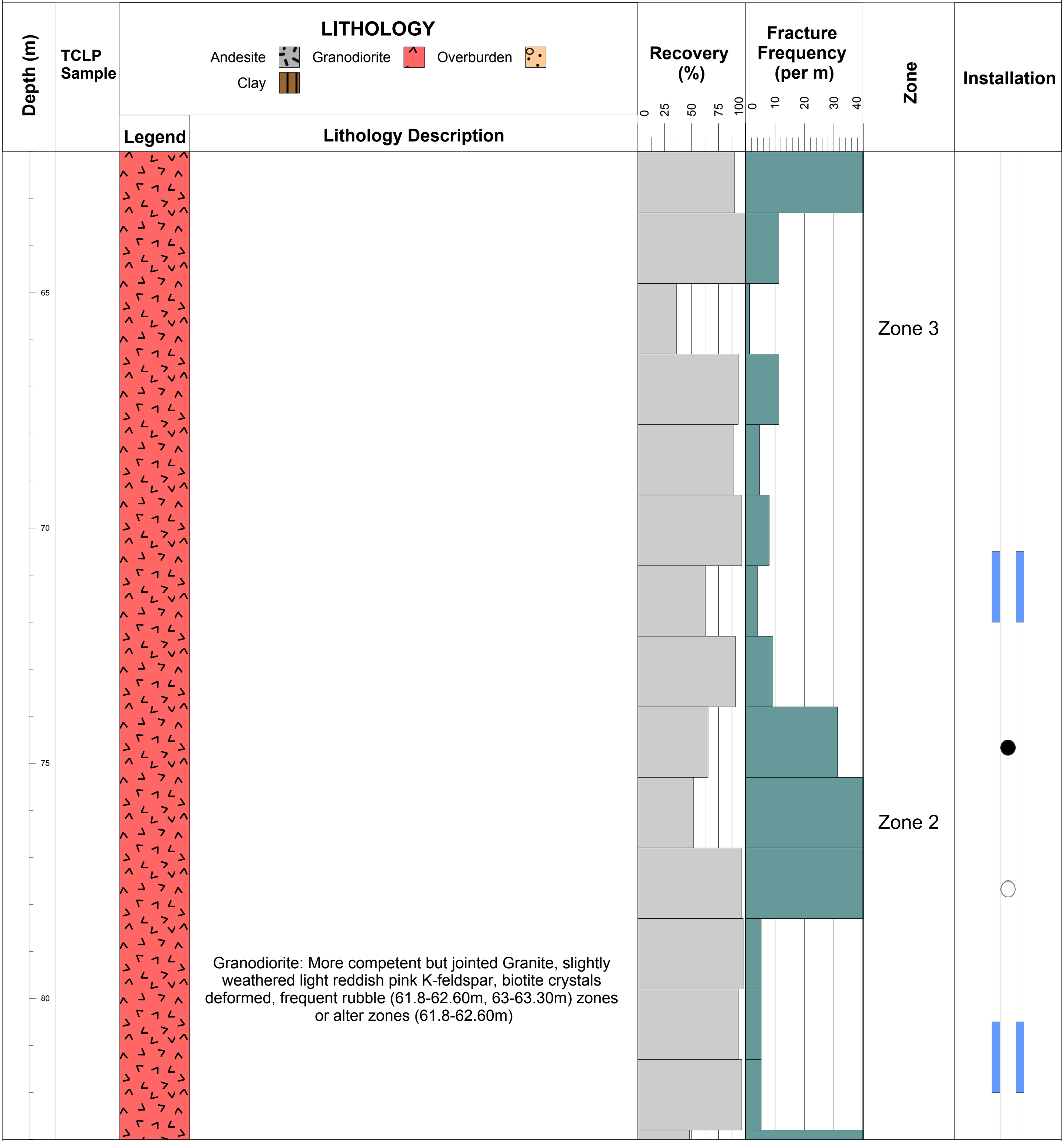
srk consulting | capstone MINTO MINE

Borehole Number: **MW17-10**
Location: **Minto Mine**

Project No.: **1CM002.058** Client: **Capstone Mining Inc** Project: **2017 MP Install**	Drilling Contractor: **Driftwood Drilling** Drilling Equipment: **Diamond** Logged By: **JJ**	Depth to Water: **mbtoc** Depth to Rock: **54.3 m** Final Depth: **100.8 m**	Start Date: **7/13/201** End Date: **7/19/201**

Borehole Coordinates: **E: 384,248 (m)** **N: 6,945,089 (m)** Top of Casing Elevation (mamsl): **857.2**

Collar Dip (deg): **70** Azimuth (deg): **200** Number of Zones: **4** Casing Stickup (m): **0.41**



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

DRAFT

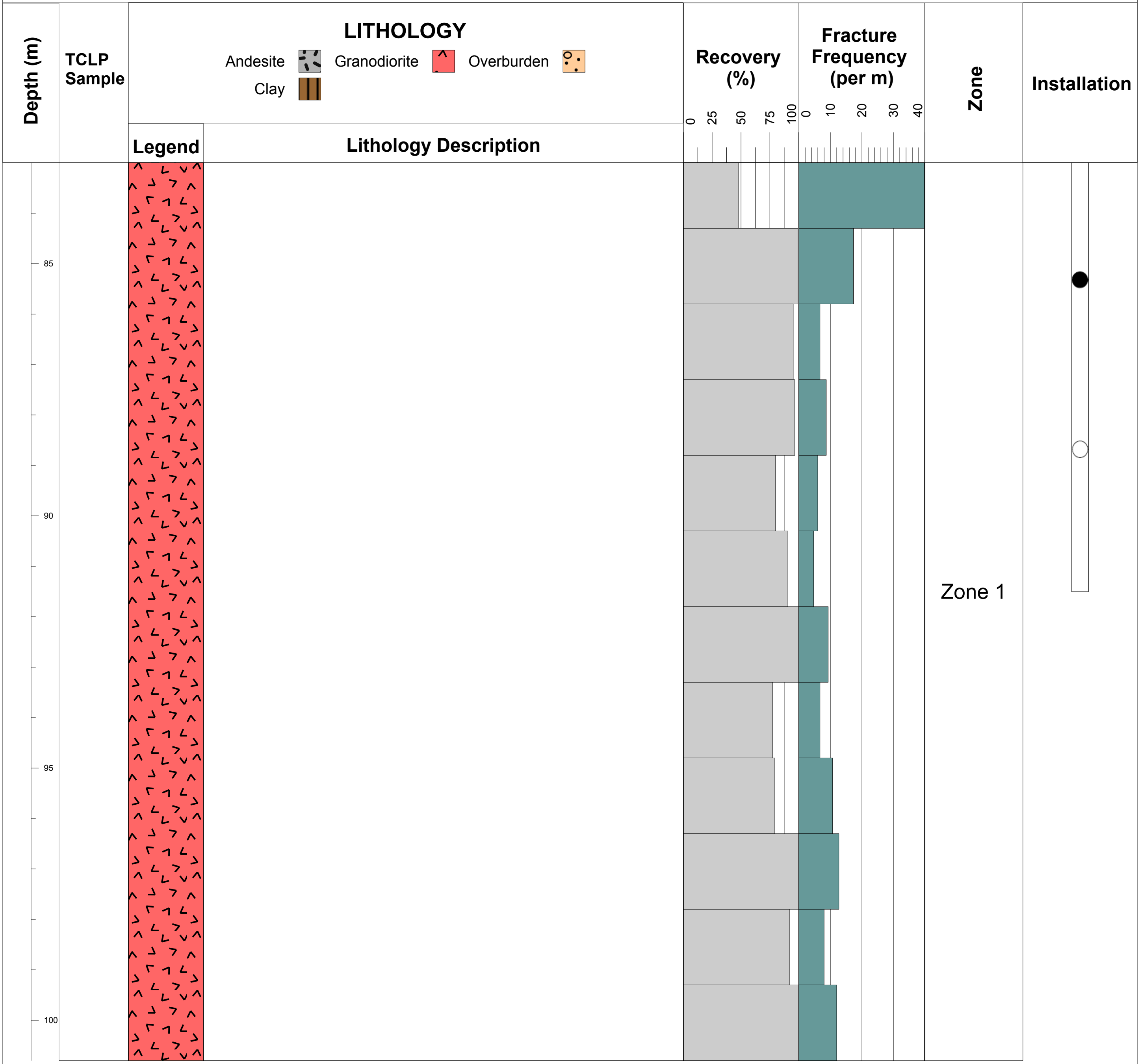
srk consulting | capstone MINTO MINE

Borehole Number: **MW17-10**
Location: **Minto Mine**

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/13/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **54.3 m**	End Date: **7/19/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **100.8 m**	

Borehole Coordinates: **E: 384,248 (m)** **N: 6,945,089 (m)** Top of Casing Elevation (mamsl): **857.2**

Collar Dip (deg): **70** Azimuth (deg): **200** Number of Zones: **4** Casing Stickup (m): **0.41**



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

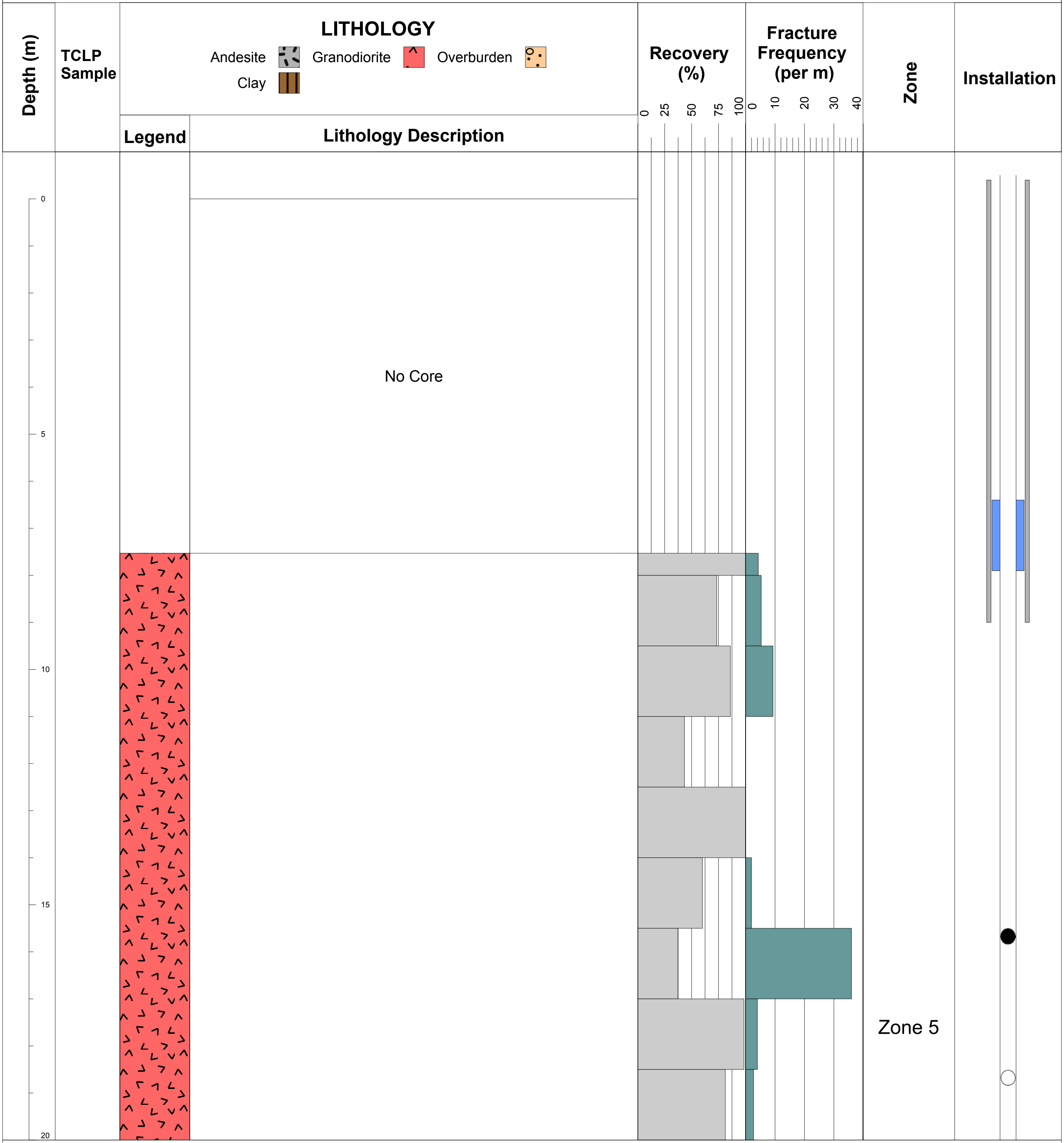
Borehole Number: **MW17-11**
Location: **Minto Mine**

DRAFT

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/16/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **7.5 m**	End Date: **7/20/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **101 m**	

Borehole Coordinates: **E: 384,268 (m)** **N: 6,946,161 (m)** Top of Casing Elevation (mamsl): **906.4**

Collar Dip (deg): **70** Azimuth (deg): **90** Number of Zones: **5** Casing Stickup (m): **0.45**



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

Borehole Number: **MW17-11**
Location: **Minto Mine**

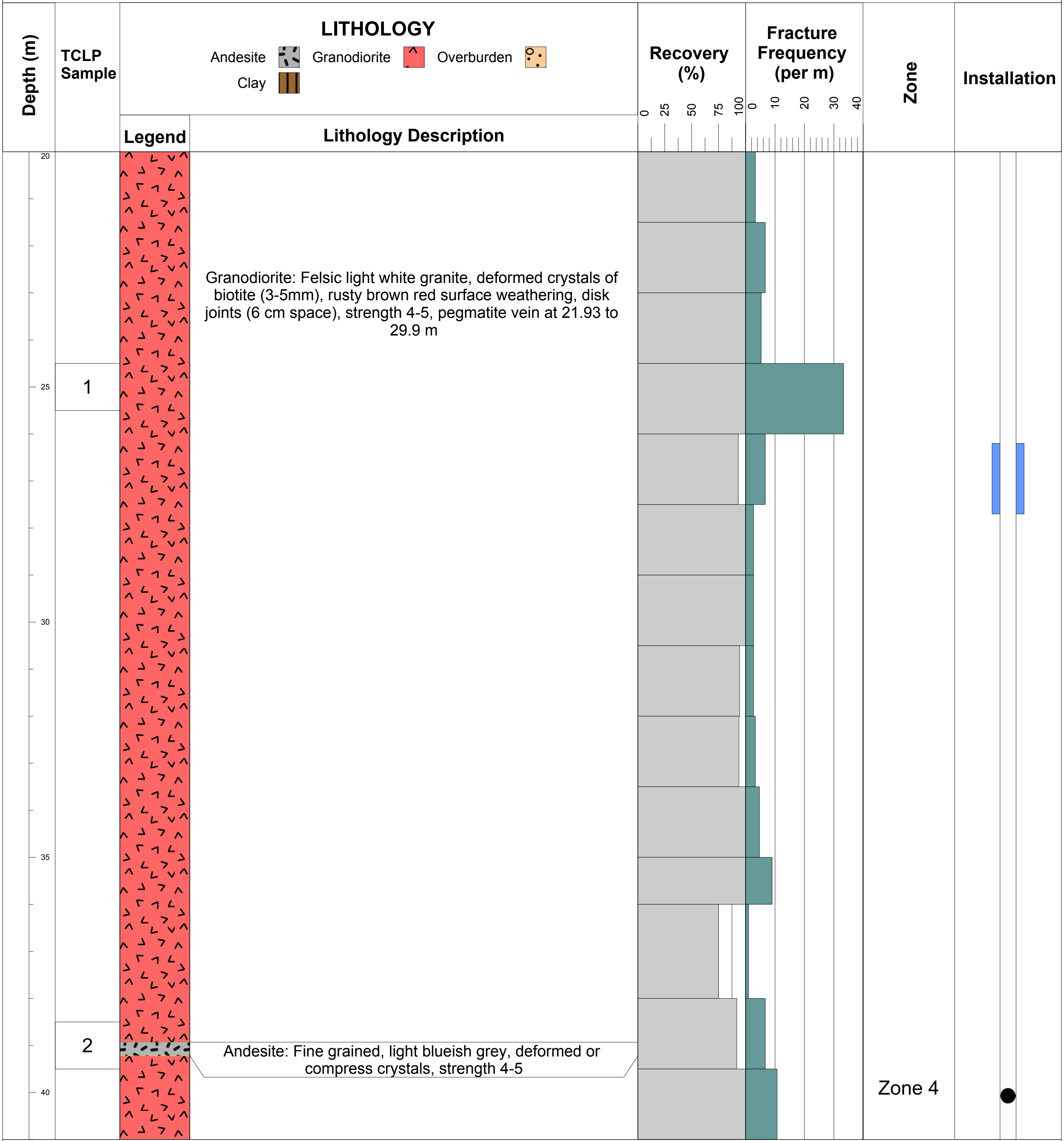
srk consulting | capstone MINTO MINE

DRAFT

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/16/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **7.5 m**	End Date: **7/20/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **101 m**	

Borehole Coordinates: **E: 384,268 (m)** **N: 6,946,161 (m)**
Top of Casing Elevation (mamsl): **906.4**

Collar Dip (deg): **70** Azimuth (deg): **90** Number of Zones: **5** Casing Stickup (m): **0.45**



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

DRAFT

Borehole Number: **MW17-11**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/16/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **7.5 m**	End Date: **7/20/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **101 m**	

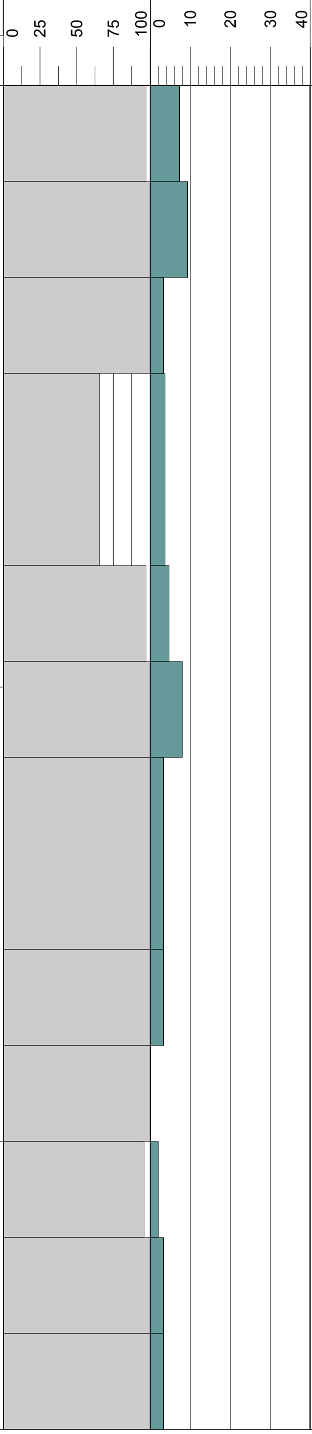
Borehole Coordinates: **E: 384,268 (m)** **N: 6,946,161 (m)**   Top of Casing Elevation (mamsl): **906.4**

Collar Dip (deg): **70**   Azimuth (deg): **90**   Number of Zones: **5**   Casing Stickup (m): **0.45**

LITHOLOGY

Andesite   Granodiorite   Overburden   Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%)	Fracture Frequency (per m)	Zone	Installation
45		Granodiorite	Granodiorite: Felsic light white granite, deformed crystals of biotite (3-5mm), rusty brown red surface weathering, disk joints (6 cm space), strength 4-5, broken zone (40.6-40.9m), pegmatite vein at 50.2 to 50.4 m				
50, 55		Granodiorite	Granodiorite: Felsic light white granite, deformed crystals of biotite (3-5mm), pegmatite vein at 56.4 to 57.5 m				
60	3	Granodiorite				Zone 3	



Installation Legend

Measurement Port   Pumping Port   Packer   PVC Casing   Sufrace Casing

Borehole Number: **MW17-11**
Location: **Minto Mine**

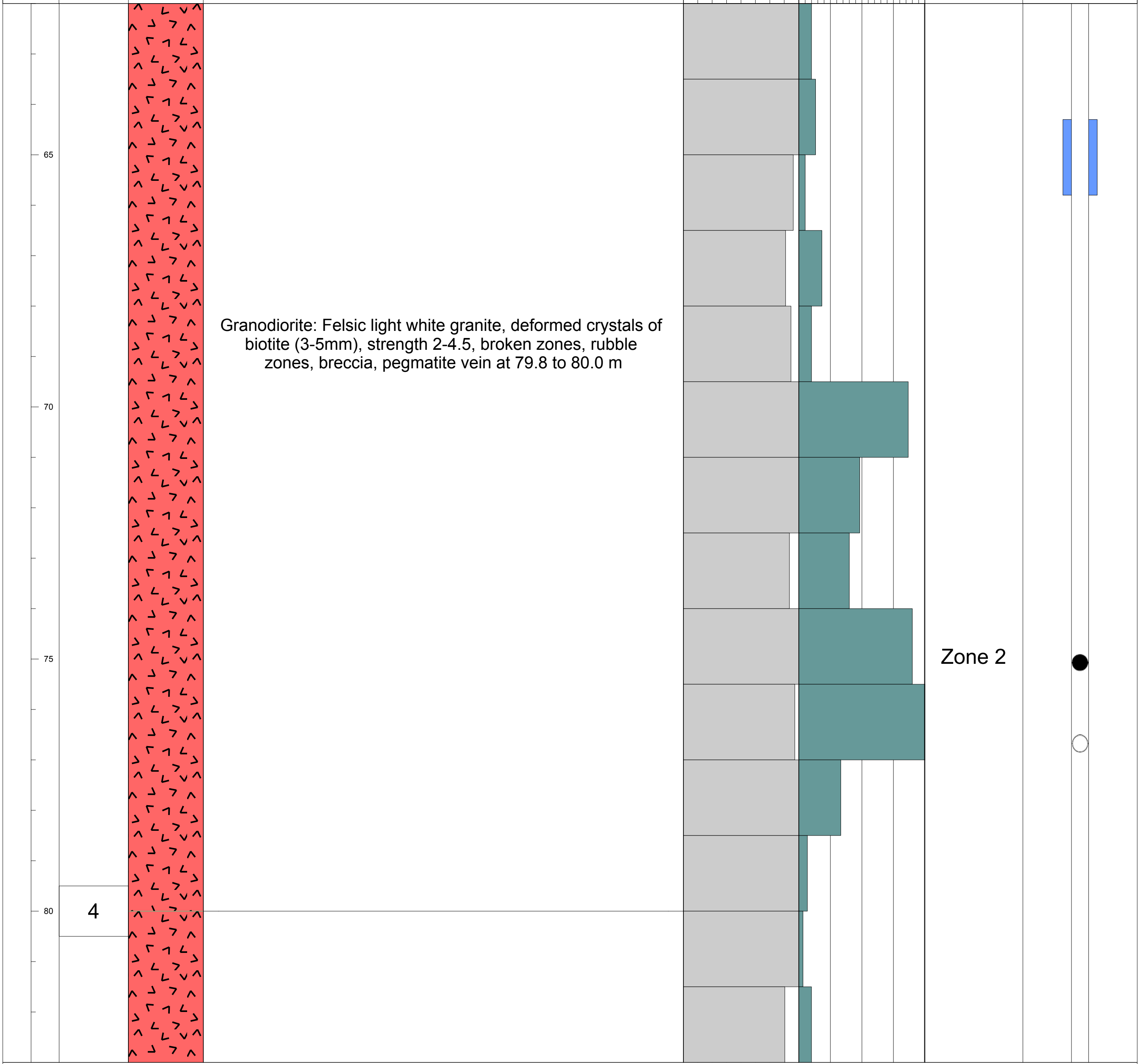
srk consulting | capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/16/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **7.5 m**	End Date: **7/20/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **101 m**	

Borehole Coordinates: **E: 384,268 (m)** **N: 6,946,161 (m)**   Top of Casing Elevation (mamsl): **906.4**

Collar Dip (deg): **70**   Azimuth (deg): **90**   Number of Zones: **5**   Casing Stickup (m): **0.45**

Depth (m)	TCLP Sample	LITHOLOGY (Andesite, Granodiorite, Overburden, Clay) — Legend / Lithology Description	Recovery (%)	Fracture Frequency (per m)	Zone	Installation



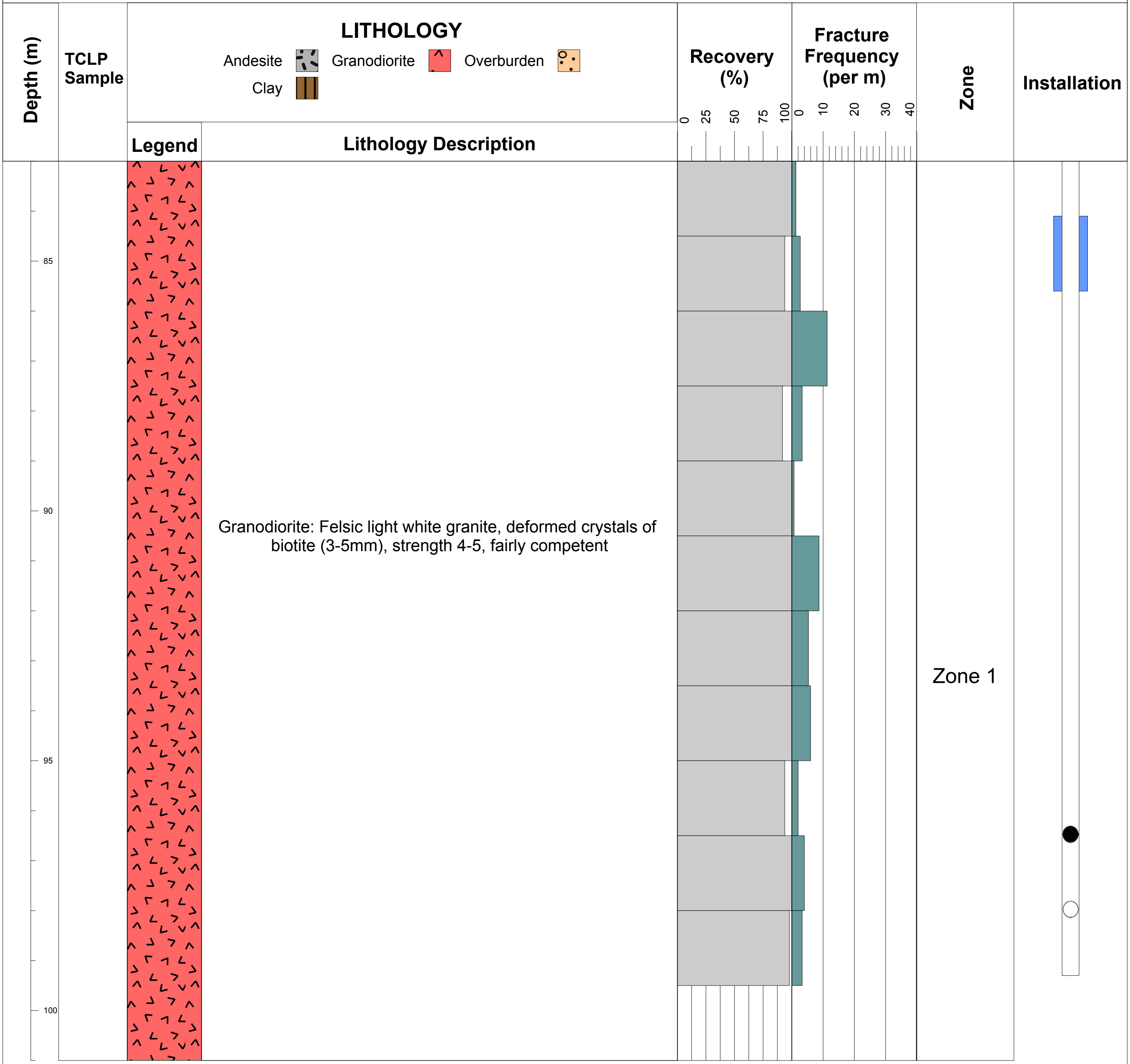
Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/16/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **7.5 m**	End Date: **7/20/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **101 m**	

Borehole Coordinates: **E: 384,268 (m)** **N: 6,946,161 (m)** Top of Casing Elevation (mamsl): **906.4**

Collar Dip (deg): **70** Azimuth (deg): **90** Number of Zones: **5** Casing Stickup (m): **0.45**



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

Borehole Number: **MW17-12**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

DRAFT

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **19 m**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **151 m**

Start Date: **7/18/201**
End Date: **7/22/201**

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)**
Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

LITHOLOGY

Andesite, Granodiorite, Overburden, Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
0							
10			No core				
20		Granodiorite					

Installation Legend

Measurement Port, Pumping Port, Packer, PVC Casing, Sufrace Casing

Borehole Number: **MW17-12**
Location: **Minto Mine**

srk consulting

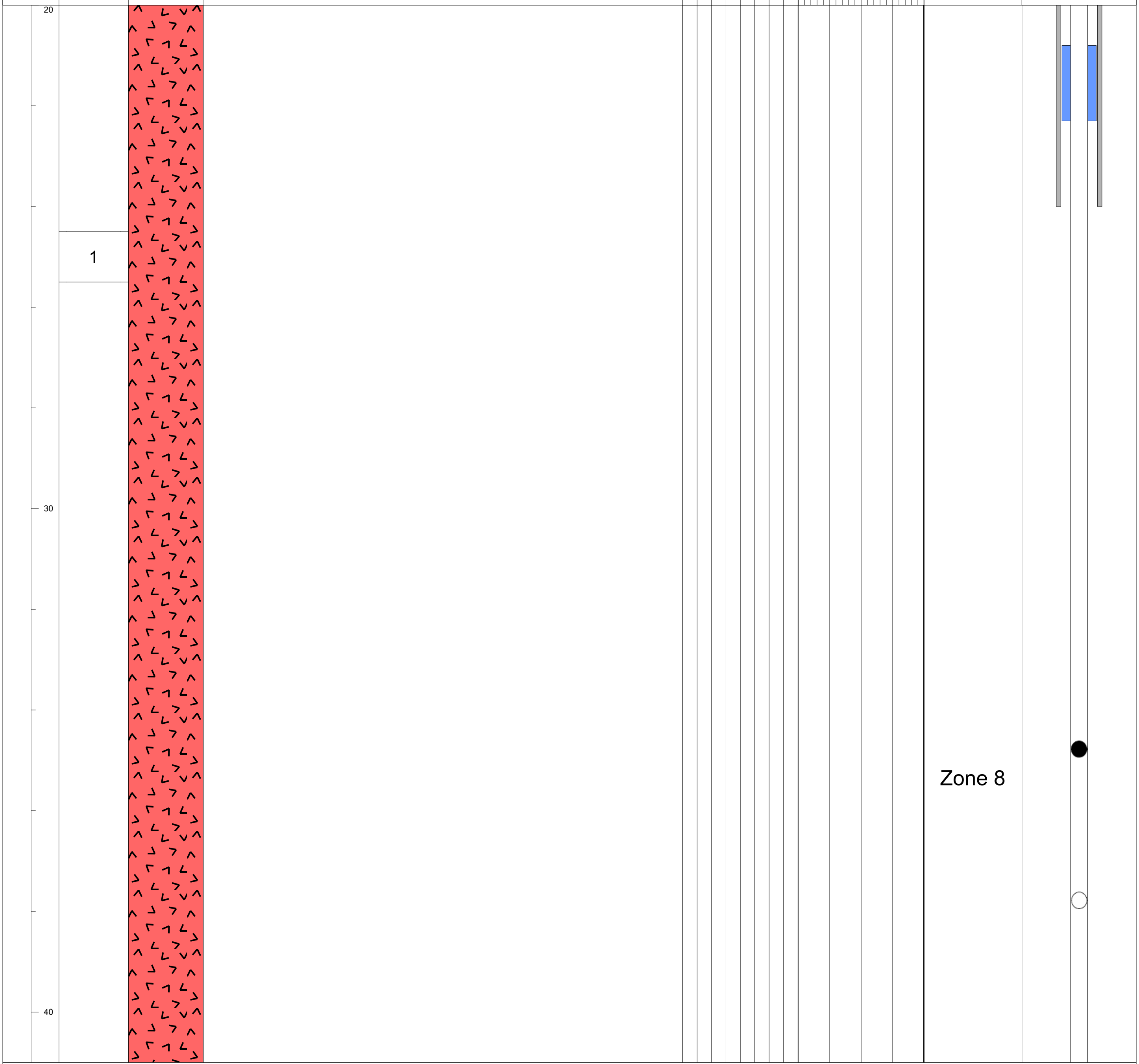
capstone MINTO MINE

Project No.: **1CM002.058** Client: **Capstone Mining Inc** Project: **2017 MP Install**	Drilling Contractor: **Driftwood Drilling** Drilling Equipment: **Diamond** Logged By: **JJ**	Depth to Water: **mbtoc** Depth to Rock: **19 m** Final Depth: **151 m**	Start Date: **7/18/201** End Date: **7/22/201**

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)** Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

Depth (m)	TCLP Sample	LITHOLOGY Andesite, Granodiorite, Overburden, Clay Legend / Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

DRAFT

Borehole Number: **MW17-12**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/18/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **19 m**	End Date: **7/22/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **151 m**	

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)** Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

LITHOLOGY

Andesite Granodiorite Overburden Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
50	2		Granodiorite: Felsic light white granite, rusty brown red surface weathering, shear zone (52 to 52.2 m), pegmatite vein at 71.66 to 72.4 m			Zone 7	
60							

Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

Borehole Number: **MW17-12**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

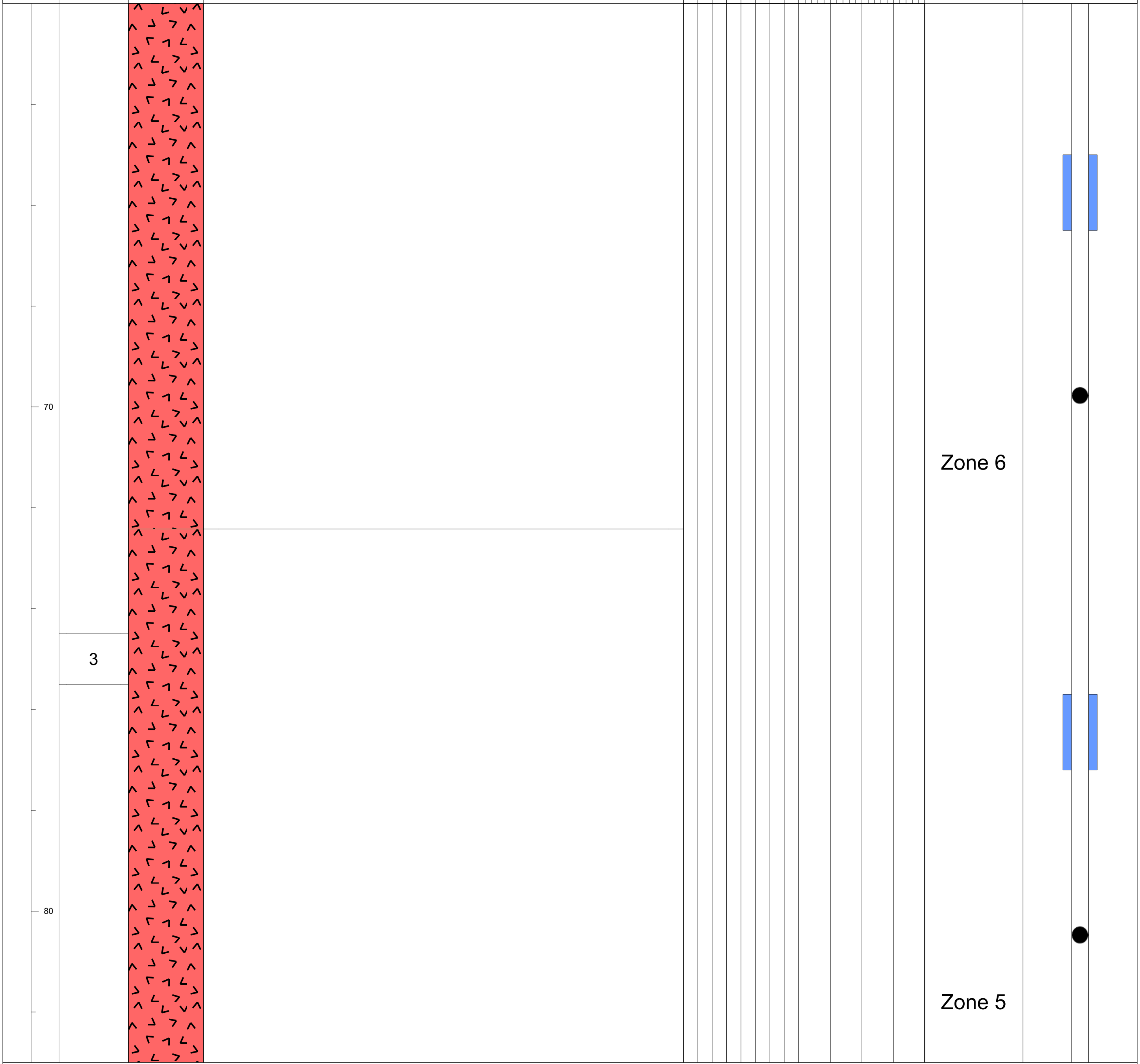
DRAFT

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/18/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **19 m**	End Date: **7/22/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **151 m**	

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)** Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

Depth (m)	TCLP Sample	LITHOLOGY (Andesite, Granodiorite, Overburden, Clay) — Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation



Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

Borehole Number: **MW17-12**	Location: **Minto Mine**

srk consulting — capstone MINTO MINE

Project No.: **1CM002.058** Client: **Capstone Mining Inc** Project: **2017 MP Install**	Drilling Contractor: **Driftwood Drilling** Drilling Equipment: **Diamond** Logged By: **JJ**	Depth to Water: **mbtoc** Depth to Rock: **19 m** Final Depth: **151 m**	Start Date: **7/18/201** End Date: **7/22/201**

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)** Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

LITHOLOGY: Andesite, Granodiorite, Overburden, Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
		Granodiorite	Granodiorite: Felsic light white granite, rusty brown red surface weathering, shear zone (89.5 to 90.0 m), pegmatite vein at 94.14 to 94.66 m				
90						Zone 4	
100	4	Granodiorite	Granodiorite: Felsic light white granite, rusty brown red surface weathering				

Installation Legend

Measurement Port · Pumping Port · Packer · PVC Casing · Suface Casing

Project No.: **1CM002.058** Client: **Capstone Mining Inc** Project: **2017 MP Install**	Drilling Contractor: **Driftwood Drilling** Drilling Equipment: **Diamond** Logged By: **JJ**	Depth to Water: **mbtoc** Depth to Rock: **19 m** Final Depth: **151 m**	Start Date: **7/18/201** End Date: **7/22/201**

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)** Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

LITHOLOGY

Andesite | Granodiorite | Overburden | Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
		Granodiorite					
		Andesite	Andesite: Fine grained, light blueish grey			Zone 3	
110		Granodiorite					Measurement Port; Pumping Port; Packer
120							

Installation Legend

Measurement Port | Pumping Port | Packer | PVC Casing | Sufrace Casing

Borehole Number: **MW17-12**
Location: **Minto Mine**

srk consulting | capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/18/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **19 m**	End Date: **7/22/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **151 m**	

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)** Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

LITHOLOGY

Andesite, Granodiorite, Overburden, Clay

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
	5	Granodiorite	Granodiorite: Felsic light white granite, rusty brown red surface weathering, pegmatite vein at 140.5 to 140.9 m			Zone 2	
130							
140	6						
		Granodiorite	Granodiorite: Felsic light white granite, rusty brown red			Zone 1	

Installation Legend

Measurement Port, Pumping Port, Packer, PVC Casing, Sufrace Casing

Borehole Number: **MW17-12**
Location: **Minto Mine**

srk consulting

capstone MINTO MINE

Project No.: **1CM002.058**	Drilling Contractor: **Driftwood Drilling**	Depth to Water: **mbtoc**	Start Date: **7/18/201**
Client: **Capstone Mining Inc**	Drilling Equipment: **Diamond**	Depth to Rock: **19 m**	End Date: **7/22/201**
Project: **2017 MP Install**	Logged By: **JJ**	Final Depth: **151 m**	

Borehole Coordinates: **E: 386,859 (m)** **N: 6,945,757 (m)** Top of Casing Elevation (mamsl): **674.0**

Collar Dip (deg): **70** Azimuth (deg): **180** Number of Zones: **8** Casing Stickup (m): **0.38**

Depth (m)	TCLP Sample	Legend	Lithology Description	Recovery (%) 0 25 50 75 100	Fracture Frequency (per m) 0 10 20 30 40	Zone	Installation
150		Granodiorite	surface weathering, shear zones (141.6 to 141.9 m and 148.7 to 148.9 m)				

LITHOLOGY
Andesite, Granodiorite, Overburden, Clay

Installation Legend
Measurement Port, Pumping Port, Packer, PVC Casing, Sufrace Casing

Appendix C – Ground Thermal Data

ID	X	Y	Z	Status	Permafrost Present?	Start Obs. Date	End Obs. Date	Max Temp Below Active Layer (°C)	Min Temp Below Active Layer (°C)	Comment
13-A2T-1	385306	6944162	822.4	Active	Yes	1-Apr-13	11-Jun-21	0.4	-0.9	
MW-11-01A	385070	6944990	789.7	Active	Yes	26-Nov-11	27-Mar-12	3.1	-0.6	
MW11-02	385118	6943887	861.3	Active	Yes	26-Nov-11	25-Apr-18	0.0	-1.1	
MW11-03	385159	6943730	868.4	Active	Yes	26-Nov-11	28-Jul-18	0.2	-0.8	
MWPT-1	385063	6944992	791.9	Active	Yes	1-Jun-08	1-Feb-16	-0.1	-0.6	Excel file doesn' t exist in Minto folder
MWPT-2	385114	6945016	787.3	Active	Yes	1-Mar-08	1-Feb-16	-0.3	-0.7	Excel file doesn' t exist in Minto folder
MPDT-1	384976	6944998	791.5	Active	Yes	17-Dec-14	17-Nov-15	0.2	-0.4	
MPDT-2	384855	6944877	811.4	Active	Yes	17-Dec-14	24-May-16	-0.1	-0.5	
SDT-1	384174	6944770	836.4	Active	Yes	1-Nov-13	1-Jun-21	-0.1	-0.8	Coordinates corrected
SDT-2	383971	6977595	847.1	Active	Yes	1-Jun-13	1-Jun-21	-0.2	-0.8	
SDT-3	383825	6944329	860.2	Active	Yes	1-Jun-13	1-Jun-21	-0.1	-1.0	
SDT-4	383784	6944164	861.0	Active	Yes	1-Jun-13	1-Jun-21	0.0	-0.7	
WDT-3	386544	6945544	719.8	Active	No	28-Feb-08	2-Aug-21	5.7	3.8	
WDT-4	386548	6945535	719.9	Active	No	28-Feb-08	2-Aug-21	5.8	0.8	
WDT-1	386551	6945523	720.0	Active	No	7-Feb-08	2-Aug-21	6.0	1.0	
WDT-5	386558	6945505	721.0	Active	No	7-Feb-08	2-Aug-21	7.7	2.9	
WDT-6	386556	6945506	721.0	Active	No	7-Feb-08	2-Aug-21	8.3	2.4	
WDT-7	386556	6945505	721.1	Active	No	16-Feb-09	2-Aug-21	6.8	2.0	
WDT-2	386575	6945533	713.7	Active	No	28-Feb-08	2-Aug-21	5.3	2.3	
WDT-8	386604	6945564	701.8	Active	No	7-Feb-08	2-Aug-21	4.3	2.2	
13-DST-10	385490	6944584	797.1	Active	Yes	1-Oct-13	23-Mar-21	-0.4	-0.7	
13-DST-11	385539	6944900	787.7	Active	No	1-Apr-13	11-Jun-21	0.6	-0.9	
13-DST-13	386271	6945015	777.0	Active	No	1-Sep-13	11-Jun-21	1.7	-0.8	
13-DST-14	385713	6944769	791.5	Active	Yes	1-Aug-13	11-Jun-21	-0.2	-0.8	
13-DST-15	385958	6945034	764.5	Active	Yes	1-Aug-13	11-Jun-21	-0.3	-1.1	
08-SWC-271	383901	6944455	849.2	Decommissioned	Yes	11-Mar-08	20-Oct-09	0.2	-1.0	
08-SWC-274	384300	6944630	838.2	Decommissioned	Yes	24-Mar-08	20-Oct-09	0.0	-0.4	
08-SWC-275	383890	6944220	856.6	Decommissioned	Insufficient Data	22-Mar-08	23-Aug-08	-0.1	-0.6	
08-SWC-277	384090	6944211	869.0	Decommissioned	Insufficient Data	27-Mar-08	23-Aug-08	0.0	0.0	
08-SWC-278	383940	6943900	871.1	Decommissioned	Insufficient Data	30-Mar-08	23-Aug-08	0.0	-0.1	
08-SWC-280	383671	6943950	873.3	Decommissioned	Insufficient Data	17-Apr-08	17-Apr-08	0.0	-0.1	Only one data set
DST-1	385579	6945011	764.5	Decommissioned	Yes	18-Jul-10	10-Jul-11	-0.4	-1.0	
DST-2	385528	6944952	767.5	Decommissioned	Yes	4-Nov-07	9-Feb-11	-0.1	-0.7	
DST-3	385751	6944995	770.0	Decommissioned	Yes	22-Jan-10	12-Apr-12	0.0	-0.6	
DST-4	385732	6944928	773.1	Decommissioned	Yes	27-Jan-10	12-Apr-12	2.0	-0.8	
DST-5	385415	6945023	770.5	Decommissioned	Yes	31-Oct-07	21-Apr-11	0.4	-0.6	
DST-6	385730	6944832	775.0	Decommissioned	Yes	27-Jan-10	7-Aug-11	1.6	-0.6	
DST-7	385482	6944856	777.6	Decommissioned	Yes	28-Jan-10	18-Sep-10	0.1	-0.7	
DST-8	385716	6944817	764.5	Decommissioned	Insufficient Data	22-Mar-09	10-Feb-11	0.7	-0.2	
DST-9	385613	6944681	775.5	Decommissioned	Insufficient Data	22-Mar-09	7-Jun-11	0.0	-0.6	
96-G08	385497	6944782	771.9	Decommissioned	Yes	17-Jul-96	17-May-09	-0.3	-1.0	

File Name
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC + Piezometer Instrumentation - Area 2 Pit_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\1CM002.073_2021 Geotechnical Operational Support\!020_Project_Data\020_Client\Minto Master Ridgetop Thermistor Spreadsheet.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\1CM002.073_2021 Geotechnical Operational Support\!020_Project_Data\020_Client\Minto Master Ridgetop Thermistor Spreadsheet.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\1CM002.073_2021 Geotechnical Operational Support\!020_Project_Data\020_Client\Minto Master Ridgetop Thermistor Spreadsheet.xls
P:\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Annual Inspections\2016
P:\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Annual Inspections\2016
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterMPDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterMPDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoWSPDInstrumentation_SRKrev01.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\MintoMasterSWDInstrumentation_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls
\\van-svr0.van.na.srk.ad\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\GTC_PiezometerInstrumentation_DSTSF_SRK.xls

Appendix D – Groundwater Level Observations

SUMMARY OF GROUNDWATER LEVEL OBSERVATIONS BY WELLS *(Calculated from TAB 'WL_Measurements')*

HoleID	# of Ports used for monitoring GWL	X	Y	Summary of the groundwater level measurements by well									
				# gwl-obs	# obs dry or frz	min Date	max Date	min GW elev (masl)	max GW elev (masl)	Amplitude GW elev (masl)	median GW elev (masl)	average GW elev (masl)	stdev GW elev (masl)
P93E	Standpipe	384695.0	6945091.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
P94-20	Standpipe	386418.0	6945541.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-01	MP well	384177.0	6944984.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-02	MP well	385676.1	6945034.5	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-03	MP well	384253.2	6946158.5	406	0	2-Jun-14	5-Dec-20	887.16	906.18	19.02	891.35	891.96	3.63
MW09-04	MP well	384954.0	6944926.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW11-04a	Standpipe	385110.0	6943370.0	16	1	13-Jun-12	3-Oct-15	858.50	862.62	4.12	860.48	860.39	1.35
MW12-05	MP well	387008.9	6945789.6	199	1	29-May-14	2-Oct-20	660.62	664.23	3.61	662.45	662.58	0.70
MW12-06	MP well	386112.5	6945297.5	164	0	30-May-14	19-Oct-20	713.28	722.16	8.87	716.00	716.40	1.72
MW12-07	MP well	385136.9	6945043.3	669	1	28-Oct-12	31-Oct-20	685.73	766.47	80.74	760.23	751.09	21.44
MW12-DP1	Drivepoint	383841.0	6943911.0	1	5	1-Jun-14	3-Oct-15	878.77	878.77	0.00	878.77	878.77	#DIV/0!
MW12-DP2	Drivepoint	383796.0	6944142.0	0	5	1-Jun-14	3-Oct-15	0.00	0.00	0.00	#NUM!	#DIV/0!	#DIV/0!
MW12-DP3	Drivepoint	384024.0	6944614.0	1	4	1-Jun-14	3-Oct-15	859.23	859.23	0.00	859.23	859.23	#DIV/0!
MW12-DP4	Drivepoint	385865.0	6945220.0	3	2	1-Jun-14	1-Oct-15	758.87	759.10	0.23	759.08	759.02	0.13
MW13-DP5	Drivepoint	385940.0	6945215.0	3	1	1-Sep-14	1-Oct-15	722.49	724.40	1.91	722.70	723.20	1.05
MW17-08	MP well	383079.0	6944055.0	50	5	28-Aug-17	28-Oct-20	917.62	922.99	5.37	919.76	919.78	1.35
MW17-09	MP well	383982.0	6944587.0	3	0	28-Aug-17	26-Oct-18	787.35	834.15	46.80	787.35	802.95	27.02
MW17-10	MP well	384248.0	6945089.0	40	0	28-Aug-17	27-Oct-20	786.12	807.74	21.62	806.72	805.73	4.44
MW17-11	MP well	384268.0	6946161.0	50	8	26-Aug-17	31-Oct-20	858.02	898.55	40.53	882.84	879.81	12.24
MW17-12	MP well	386859.0	6945757.0	103	0	27-Aug-17	4-Oct-20	668.89	675.64	6.75	671.62	671.82	1.30

SUMMARY OF GROUNDWATER LEVEL OBSERVATIONS BY WELLS *(Calculated from TAB 'WL_Measurements')*

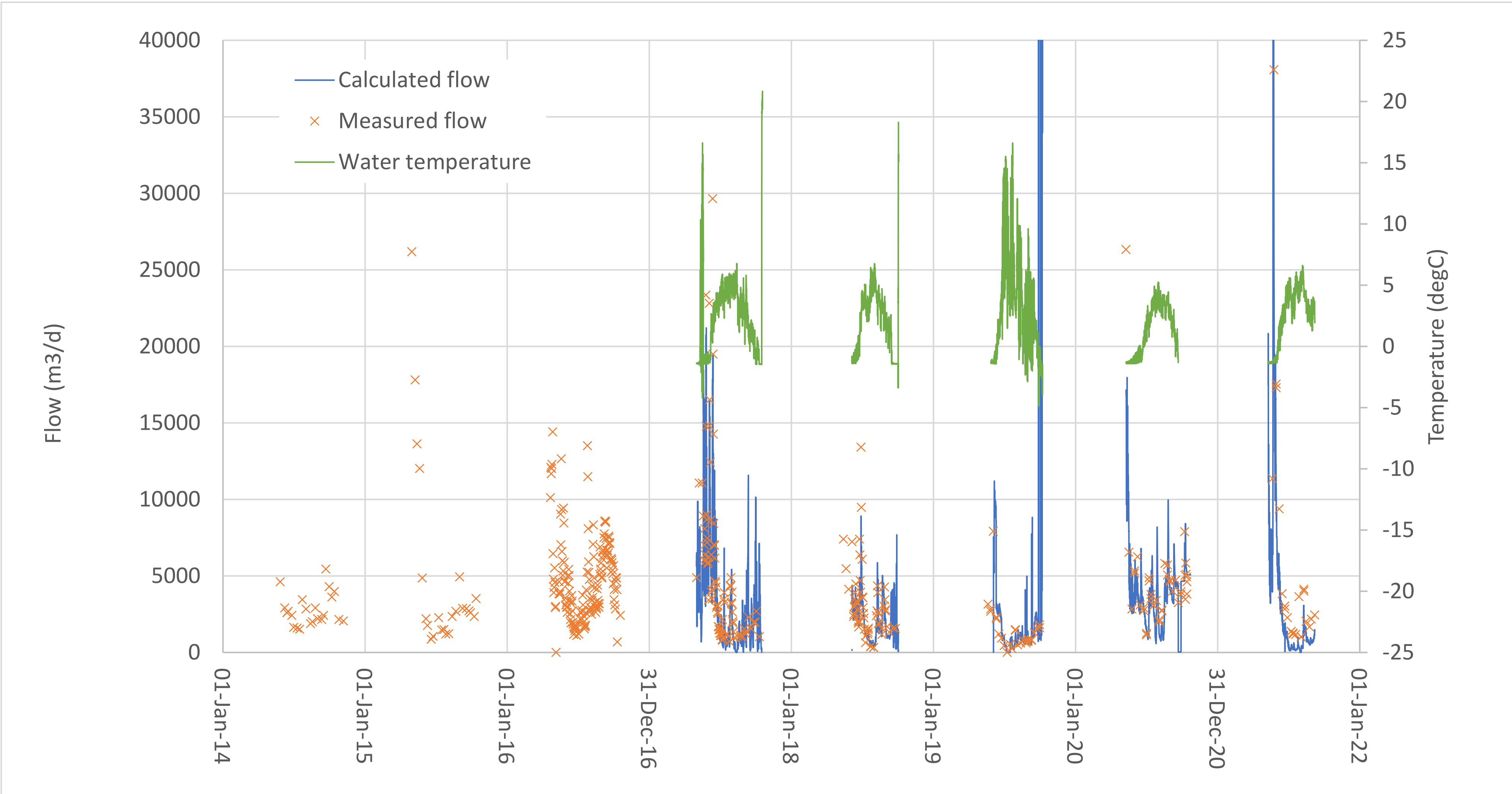
29-May-14 5-Dec-20

				Summary of the groundwater level measurements by well									
HoleID	Well ID	X	Y	# gwl-obs	# obs dry or frz	min Date	max Date	min GW elev (masl)	max GW elev (masl)	Amplitude GW elev (masl)	median GW elev (masl)	average GW elev (masl)	stdev GW elev (masl)
P93E	P93E	384695.0	6945091.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
P94-20	P94-20	386418.0	6945541.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW11-04a	MW11-04a	385110.0	6943370.0	16	1	13-Jun-12	3-Oct-15	858.50	862.62	4.12	860.48	860.39	1.35
MW09-01	MW09-01-03	384177.0	6944984.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-01	MW09-01-02	384177.0	6944984.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-01	MW09-01-01	384177.0	6944984.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-02	MW09-02-02	385676.1	6945034.5	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-02	MW09-02-01	385676.1	6945034.5	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-03	MW09-03-03	384253.2	6946158.5	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-03	MW09-03-02	384253.2	6946158.5	213	0	2-Jun-14	5-Dec-20	887.49	906.18	18.69	891.59	892.13	3.58
MW09-03	MW09-03-01	384253.2	6946158.5	193	0	2-Jun-14	5-Dec-20	887.16	906.14	18.98	891.16	891.76	3.68
MW09-04	MW09-04-03	384954.0	6944926.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-04	MW09-04-02	384954.0	6944926.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW09-04	MW09-04-01	384954.0	6944926.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW12-05	MW12-05-07	387008.9	6945789.6	28	1	29-May-14	2-Oct-20	662.22	664.23	2.00	662.71	662.93	0.59
MW12-05	MW12-05-06	387008.9	6945789.6	26	0	25-Jul-14	2-Oct-20	662.14	664.16	2.02	662.61	662.84	0.59
MW12-05	MW12-05-05	387008.9	6945789.6	28	0	29-May-14	2-Oct-20	661.90	664.18	2.28	662.67	662.86	0.62
MW12-05	MW12-05-04	387008.9	6945789.6	29	0	29-May-14	2-Oct-20	661.78	663.93	2.14	662.14	662.43	0.63
MW12-05	MW12-05-03	387008.9	6945789.6	31	0	29-May-14	2-Oct-20	661.75	663.91	2.16	662.16	662.40	0.60
MW12-05	MW12-05-02	387008.9	6945789.6	28	0	29-May-14	2-Oct-20	661.64	663.85	2.22	662.11	662.40	0.68
MW12-05	MW12-05-01	387008.9	6945789.6	29	0	29-May-14	2-Oct-20	660.62	664.23	3.61	662.04	662.25	0.86
MW12-06	MW12-06-06	386112.5	6945297.5	27	0	30-May-14	19-Oct-20	713.50	715.96	2.45	714.12	714.34	0.71
MW12-06	MW12-06-05	386112.5	6945297.5	27	0	30-May-14	19-Oct-20	714.96	721.81	6.85	716.65	716.86	1.65
MW12-06	MW12-06-04	386112.5	6945297.5	27	0	30-May-14	19-Oct-20	715.12	719.27	4.15	716.83	716.99	1.37
MW12-06	MW12-06-03	386112.5	6945297.5	26	0	30-May-14	19-Oct-20	715.19	719.02	3.83	716.84	716.91	1.34
MW12-06	MW12-06-02	386112.5	6945297.5	29	0	30-May-14	19-Oct-20	715.19	719.59	4.40	716.80	716.91	1.45
MW12-06	MW12-06-01	386112.5	6945297.5	28	0	30-May-14	19-Oct-20	713.28	722.16	8.87	716.53	716.37	1.93
MW12-07	MW12-07-04	385136.9	6945043.3	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW12-07	MW12-07-03	385136.9	6945043.3	204	0	28-Oct-12	31-Oct-20	749.20	766.47	17.26	762.64	759.45	5.26
MW12-07	MW12-07-02	385136.9	6945043.3	237	1	28-Oct-12	31-Oct-20	747.14	764.59	17.45	760.91	756.95	5.75
MW12-07	MW12-07-01	385136.9	6945043.3	228	0	28-Oct-12	31-Oct-20	685.73	762.92	77.19	757.68	737.51	31.77
MW12-DP1	MW12-DP1	383841.0	6943911.0	1	5	1-Jun-14	3-Oct-15	878.77	878.77	0.00	878.77	878.77	#DIV/0!
MW12-DP2	MW12-DP2	383796.0	6944142.0	0	5	1-Jun-14	3-Oct-15	0.00	0.00	0.00	#NUM!	#DIV/0!	#DIV/0!
MW12-DP3	MW12-DP3	384024.0	6944614.0	1	4	1-Jun-14	3-Oct-15	859.23	859.23	0.00	859.23	859.23	#DIV/0!
MW12-DP4	MW12-DP4	385865.0	6945220.0	3	2	1-Jun-14	1-Oct-15	758.87	759.10	0.23	759.08	759.02	0.13
MW13-DP5	MW13-DP5	385940.0	6945215.0	3	1	1-Sep-14	1-Oct-15	722.49	724.40	1.91	722.70	723.20	1.05
MW17-08	MW17-08-04	383079.0	6944055.0	8	5	28-Aug-17	28-Oct-20	919.22	920.06	0.84	919.47	919.56	0.31
MW17-08	MW17-08-03	383079.0	6944055.0	14	0	28-Aug-17	28-Oct-20	917.65	922.99	5.34	919.78	919.85	1.54
MW17-08	MW17-08-02	383079.0	6944055.0	14	0	28-Aug-17	28-Oct-20	917.63	922.98	5.35	919.86	919.87	1.54
MW17-08	MW17-08-01	383079.0	6944055.0	14	0	28-Aug-17	28-Oct-20	917.62	922.72	5.11	919.77	919.75	1.42
MW17-09	MW17-09-01	383982.0	6944587.0	3	0	28-Aug-17	26-Oct-18	787.35	834.15	46.80	787.35	802.95	27.02
MW17-10	MW17-10-04	384248.0	6945089.0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
MW17-10	MW17-10-03	384248.0	6945089.0	13	0	28-Aug-17	27-Oct-20	806.04	806.95	0.91	806.25	806.29	0.24
MW17-10	MW17-10-02	384248.0	6945089.0	14	0	28-Aug-17	27-Oct-20	787.29	807.74	20.45	806.98	805.61	5.28
MW17-10	MW17-10-01	384248.0	6945089.0	13	0	28-Aug-17	27-Oct-20	786.12	807.63	21.51	806.86	805.30	5.77
MW17-11	MW17-11-05	384268.0	6946161.0	7	4	26-Aug-17	31-Oct-20	894.94	898.55	3.61	895.54	896.32	1.47
MW17-11	MW17-11-04	384268.0	6946161.0	9	3	26-Aug-17	31-Oct-20	876.60	886.85	10.25	882.97	882.56	2.77
MW17-11	MW17-11-03	384268.0	6946161.0	11	0	26-Aug-17	31-Oct-20	880.95	887.00	6.05	883.18	883.80	2.10
MW17-11	MW17-11-02	384268.0	6946161.0	11	1	26-Aug-17	31-Oct-20	858.02	859.92	1.90	858.71	858.83	0.58
MW17-11	MW17-11-01	384268.0	6946161.0	12	0	26-Aug-17	31-Oct-20	880.89	886.99	6.10	882.98	883.68	2.04
MW17-12	MW17-12-08	386859.0	6945757.0	13	0	27-Aug-17	4-Oct-20	668.89	670.08	1.20	669.21	669.39	0.36
MW17-12	MW17-12-07	386859.0	6945757.0	13	0	27-Aug-17	4-Oct-20	671.10	671.62	0.51	671.24	671.29	0.16
MW17-12	MW17-12-06	386859.0	6945757.0	13	0	27-Aug-17	4-Oct-20	671.18	671.84	0.66	671.45	671.49	0.18
MW17-12	MW17-12-05	386859.0	6945757.0	13	0	27-Aug-17	4-Oct-20	671.39	671.87	0.47	671.50	671.56	0.16
MW17-12	MW17-12-04	386859.0	6945757.0	12	0	27-Aug-17	4-Oct-20	671.56	672.39	0.83	671.78	671.82	0.26
MW17-12	MW17-12-03	386859.0	6945757.0	13	0	27-Aug-17	4-Oct-20	672.64	675.64	3.00	673.74	673.80	0.83
MW17-12	MW17-12-02	386859.0	6945757.0	13	0	27-Aug-17	4-Oct-20	671.13	673.24	2.12	672.41	672.30	0.63
MW17-12	MW17-12-01	386859.0	6945757.0	13	0	27-Aug-17	4-Oct-20	671.93	673.66	1.74	672.85	672.87	0.55

ANALYSIS SEP/OCT GROUNDWATER LEVEL OBSERVATIONS BY WELLS *(Calculated from TAB 'WL_Measurements')*

HoleID	Well ID	# gwl-obs	# obs dry or frz	2012		2013		2014		2015		2016		2017		2018		2019		2020		Calib dataset	
				Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct	Avg sep/oct	StDev sep/oct
MW11-04a	MW11-04a	16	1	860.2	-	-	-	860.0	1.0	858.6	0.1	-	-	-	-	-	-	-	-	-	-	859.6	0.9
MW09-03	MW09-03-02	213	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	897.7	5.8
MW09-03	MW09-03-01	193	0	-	-	-	-	904.7	-	904.1	-	-	-	893.0	0.6	895.5	0.6	890.8	0.8	898.3	1.1		
MW12-05	MW12-05-07	28	1	-	-	-	-	662.2	-	662.3	-	-	-	-	-	662.5	-	662.7	-	662.7	-	662.2	0.4
MW12-05	MW12-05-06	26	0	-	-	-	-	662.1	-	662.2	-	-	-	-	-	662.5	-	662.5	-	662.6	-		
MW12-05	MW12-05-05	28	0	-	-	-	-	662.2	-	662.2	-	-	-	-	-	662.5	-	662.6	-	662.7	-		
MW12-05	MW12-05-04	29	0	-	-	-	-	-	-	661.8	-	-	-	-	-	662.1	-	662.1	-	662.2	-		
MW12-05	MW12-05-03	31	0	-	-	-	-	661.7	-	661.8	-	-	-	-	-	662.2	-	662.2	-	662.2	-		
MW12-05	MW12-05-02	28	0	-	-	-	-	661.6	-	663.9	-	-	-	-	-	662.0	-	662.1	-	662.1	-		
MW12-05	MW12-05-01	29	0	-	-	-	-	661.6	-	661.6	-	-	-	-	-	661.8	-	662.2	-	662.2	-		
MW12-06	MW12-06-06	27	0	-	-	-	-	716.0	-	715.3	-	-	-	-	-	713.9	-	713.6	-	714.1	-	716.3	1.8
MW12-06	MW12-06-05	27	0	-	-	-	-	718.9	-	718.5	-	-	-	-	-	715.7	-	715.2	-	715.2	-		
MW12-06	MW12-06-04	27	0	-	-	-	-	719.3	-	718.7	-	-	-	-	-	715.9	-	715.4	-	716.8	-		
MW12-06	MW12-06-03	26	0	-	-	-	-	-	-	718.8	-	-	-	-	-	716.0	-	715.5	-	715.5	-		
MW12-06	MW12-06-02	29	0	-	-	-	-	719.3	-	718.8	-	-	-	-	-	716.0	-	715.5	-	715.5	-		
MW12-06	MW12-06-01	28	0	-	-	-	-	719.0	-	716.9	-	-	-	-	-	715.7	-	713.3	-	715.0	-		
MW12-07	MW12-07-03	204	0	763.7	-	-	-	762.5	0.3	763.0	0.1	764.4	0.6	762.0	0.8	-	-	750.5	0.2	751.4	-	761.2	2.0
MW12-07	MW12-07-02	237	1	762.1	-	-	-	760.8	0.1	761.3	0.1	-	-	-	-	-	-	-	-	749.2	-		
MW12-07	MW12-07-01	228	0	762.2	-	760.0	-	757.1	0.1	758.9	0.0	-	-	-	-	-	-	687.7	1.0	687.8	-		
MW17-08	MW17-08-04	8	5	-	-	-	-	-	-	-	-	-	-	-	-	920.1	-	-	-	-	-	919.4	1.0
MW17-08	MW17-08-03	14	0	-	-	-	-	-	-	-	-	-	-	-	-	920.2	-	918.3	-	-	-		
MW17-08	MW17-08-02	14	0	-	-	-	-	-	-	-	-	-	-	-	-	920.3	-	918.3	-	-	-		
MW17-08	MW17-08-01	14	0	-	-	-	-	-	-	-	-	-	-	-	-	920.3	-	918.3	-	-	-		
MW17-09	MW17-09-01	3	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	#DIV/0!	#DIV/0!
MW17-10	MW17-10-03	14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	#DIV/0!	#DIV/0!
MW17-10	MW17-10-02	14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
MW17-10	MW17-10-01	14	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
MW17-11	MW17-11-05	7	4	-	-	-	-	-	-	-	-	-	-	-	-	898.5	-	-	-	-	-	879.2	12.8
MW17-11	MW17-11-04	9	3	-	-	-	-	-	-	-	-	-	-	-	-	884.2	-	882.6	-	-	-		
MW17-11	MW17-11-03	11	0	-	-	-	-	-	-	-	-	-	-	-	-	884.2	-	882.6	-	887.0	-		
MW17-11	MW17-11-02	11	1	-	-	-	-	-	-	-	-	-	-	-	-	859.0	-	858.7	-	859.9	-		
MW17-11	MW17-11-01	12	0	-	-	-	-	-	-	-	-	-	-	-	-	884.4	-	882.7	-	887.0	-		
MW17-12	MW17-12-08	13	0	-	-	-	-	-	-	-	-	-	-	-	-	669.2	-	669.2	-	669.2	-	671.6	1.2
MW17-12	MW17-12-07	13	0	-	-	-	-	-	-	-	-	-	-	-	-	671.3	-	671.2	-	671.2	-		
MW17-12	MW17-12-06	13	0	-	-	-	-	-	-	-	-	-	-	-	-	671.5	-	671.5	-	671.4	-		
MW17-12	MW17-12-05	13	0	-	-	-	-	-	-	-	-	-	-	-	-	671.6	-	671.5	-	671.4	-		
MW17-12	MW17-12-04	12	0	-	-	-	-	-	-	-	-	-	-	-	-	671.7	-	671.6	-	671.6	-		
MW17-12	MW17-12-03	13	0	-	-	-	-	-	-	-	-	-	-	-	-	673.9	-	673.4	-	672.6	-		
MW17-12	MW17-12-02	13	0	-	-	-	-	-	-	-	-	-	-	-	-	672.6	-	671.9	-	671.1	-		
MW17-12	MW17-12-01	13	0	-	-	-	-	-	-	-	-	-	-	-	-	673.0	-	672.7	-	672.3	-		

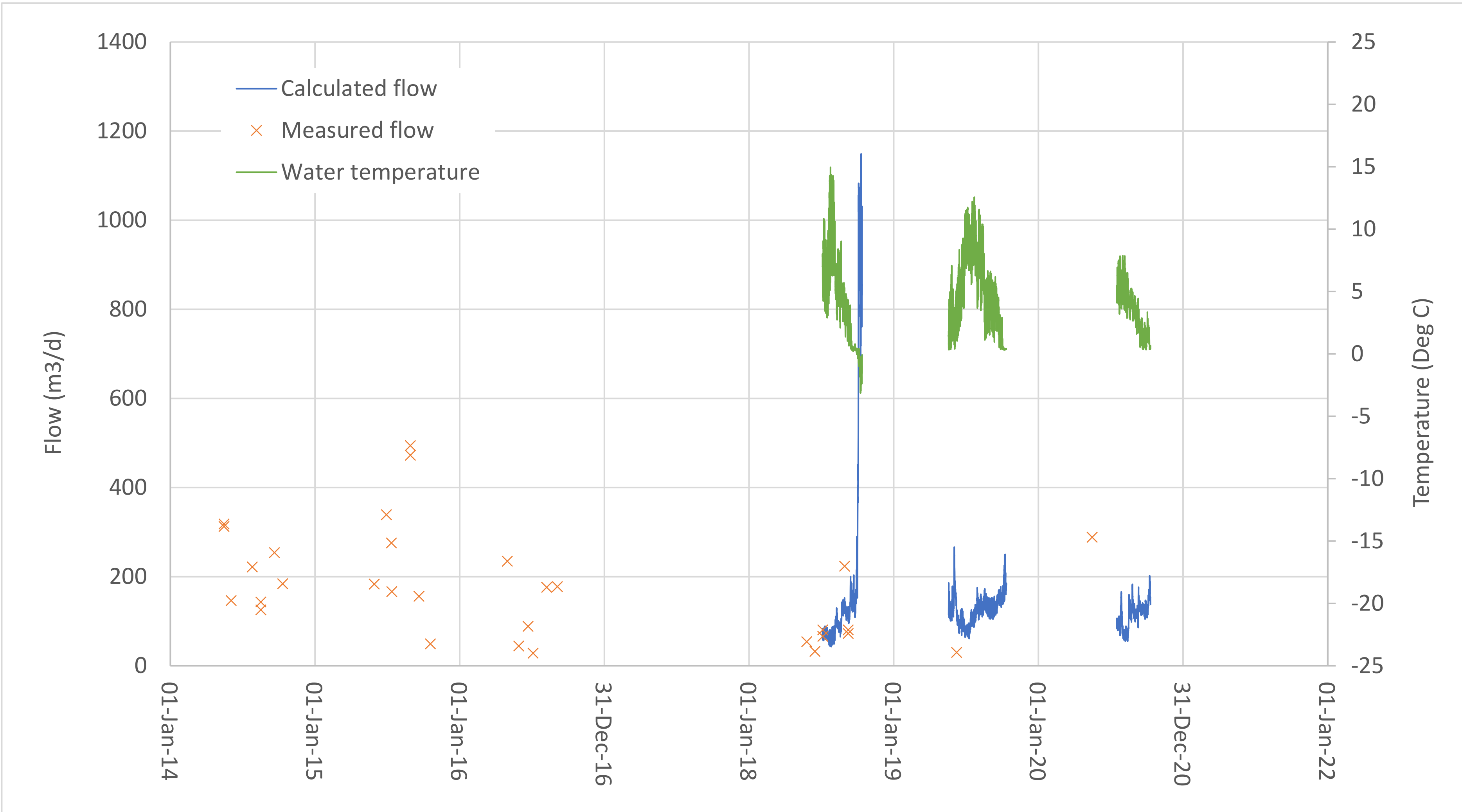
Appendix E – Stream Flow Observation



Sep-Oct flow (i.e., baseflow period)

		Calculated flow (m3/d)						Measured flow (m3/d)					
Year	Month	n obs	min	avg	median	max	stdev	n obs	min	avg	median	max	stdev
2014	Sep	0	na	na	na	na	na	5	2160.2	3304.5	2425.8	5436.7	1486.1
2014	Oct	0	na	na	na	na	na	3	2142.6	3245.5	3615.8	3978.1	972.1
2014	Sep-Oct	0	na	na	na	na	na	8	2142.6	3282.4	3020.8	5436.7	1238.1
2015	Sep	0	na	na	na	na	na	5	2579.9	3196.1	2862.6	4926.5	975.4
2015	Oct	0	na	na	na	na	na	2	2348.6	2930.4	2930.4	3512.2	822.8
2015	Sep-Oct	0	na	na	na	na	na	7	2348.6	3120.2	2862.6	4926.5	874.0
2016	Sep	0	na	na	na	na	na	30	4488.7	6586.9	6533.9	8580.7	1063.8
2016	Oct	0	na	na	na	na	na	11	696.6	3705.2	4091.6	5667.8	1403.7
2016	Sep-Oct	0	na	na	na	na	na	41	696.6	5813.8	6073.9	8580.7	1727.4
2017	Sep	2880	112.4	2449.8	1975.6	11575.9	2117.6	7	1230.5	1700.9	1536.8	2284.4	377.9
2017	Oct	1505	11.8	2532.6	1974.0	10145.4	2173.3	2	1037.2	1864.4	1864.4	2691.5	1169.8
2017	Sep-Oct	4385	11.8	2478.2	1974.7	11575.9	2137.0	9	1037.2	1737.2	1536.8	2691.5	532.3
2018	Sep	2880	229.2	1852.5	1332.4	7687.5	1126.1	4	1327.6	1545.0	1580.6	1691.0	154.0
2018	Oct	221	58.9	737.1	961.7	1495.5	465.7	0	na	na	na	na	na
2018	Sep-Oct	3101	58.9	1773.0	1231.8	7687.5	1129.3	4	1327.6	1545.0	1580.6	1691.0	154.0
2019	Sep	1440	496.9	2551.9	1124.8	139866.1	10731.6	6	715.2	995.9	835.9	1544.0	332.9
2019	Oct	318	792.4	23281.8	2477.4	308629.4	47165.4	2	1605.3	1703.8	1703.8	1802.3	139.3
2019	Sep-Oct	1758	496.9	6301.7	1197.8	308629.4	23651.5	8	715.2	1172.9	1058.0	1802.3	435.1
2020	Sep	1442	32.5	3344.2	4137.0	7096.1	1973.0	5	3239.1	3940.5	3964.0	4721.8	531.9
2020	Oct	1060	4658.0	5280.7	5078.0	8415.2	844.4	8	3462.0	5085.4	4974.9	7880.5	1356.3
2020	Sep-Oct	2502	32.5	4164.6	4658.0	8415.2	1860.3	13	3239.1	4645.1	4613.8	7880.5	1226.1
2021	Sep	306	648.2	911.8	835.5	1485.5	211.0	1	2442.5	2442.5	2442.5	2442.5	#DIV/0!
2021	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2021	Sep-Oct	306	648.2	911.8	835.5	1485.5	211.0	1	2442.5	2442.5	2442.5	2442.5	#DIV/0!

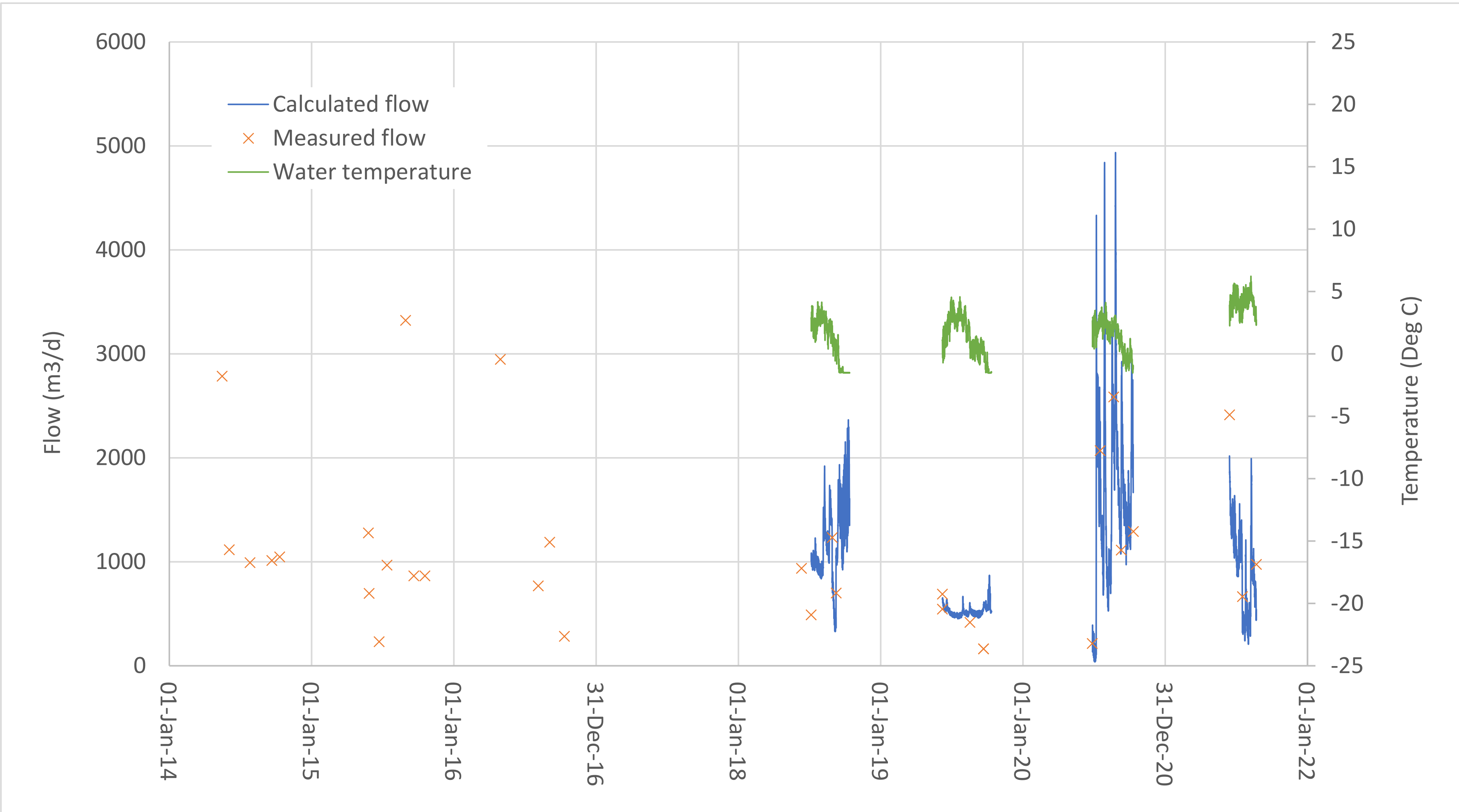
2211	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
1480	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration



Sep-Oct flow (i.e., baseflow period)

		Calculated flow (m3/d)						Measured flow (m3/d)					
Year	Month	n obs	min	avg	median	max	stdev	n obs	min	avg	median	max	stdev
2014	Sep	0	na	na	na	na	na	1	253.8	253.8	253.8	253.8	#DIV/0!
2014	Oct	0	na	na	na	na	na	1	184.2	184.2	184.2	184.2	#DIV/0!
2014	Sep-Oct	0	na	na	na	na	na	2	184.2	219.0	219.0	253.8	49.3
2015	Sep	0	na	na	na	na	na	1	155.5	155.5	155.5	155.5	#DIV/0!
2015	Oct	0	na	na	na	na	na	1	48.8	48.8	48.8	48.8	#DIV/0!
2015	Sep-Oct	0	na	na	na	na	na	2	48.8	102.2	102.2	155.5	75.5
2016	Sep	0	na	na	na	na	na	1	177.6	177.6	177.6	177.6	#DIV/0!
2016	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2016	Sep-Oct	0	na	na	na	na	na	1	177.6	177.6	177.6	177.6	#DIV/0!
2017	Sep	0	na	na	na	na	na	0	na	na	na	na	na
2017	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2017	Sep-Oct	0	na	na	na	na	na	0	na	na	na	na	na
2018	Sep	1440	95.1	142.9	135.6	290.4	32.7	2	72.6	76.6	76.6	80.6	5.7
2018	Oct	605	152.4	785.2	856.5	1148.8	279.2	0	na	na	na	na	na
2018	Sep-Oct	2045	95.1	332.9	152.1	1148.8	331.3	2	72.6	76.6	76.6	80.6	5.7
2019	Sep	1440	104.6	139.5	141.5	177.6	15.0	0	na	na	na	na	na
2019	Oct	558	137.9	172.1	166.2	250.2	25.2	0	na	na	na	na	na
2019	Sep-Oct	1998	104.6	148.6	147.0	250.2	23.5	0	na	na	na	na	na
2020	Sep	1440	85.8	125.6	124.6	176.4	12.2	0	na	na	na	na	na
2020	Oct	465	107.7	145.5	148.2	202.2	21.9	0	na	na	na	na	na
2020	Sep-Oct	1905	85.8	130.5	126.4	202.2	17.4	0	na	na	na	na	na
2021	Sep	0	na	na	na	na	na	0	na	na	na	na	na
2021	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2021	Sep-Oct	0	na	na	na	na	na	0	na	na	na	na	na

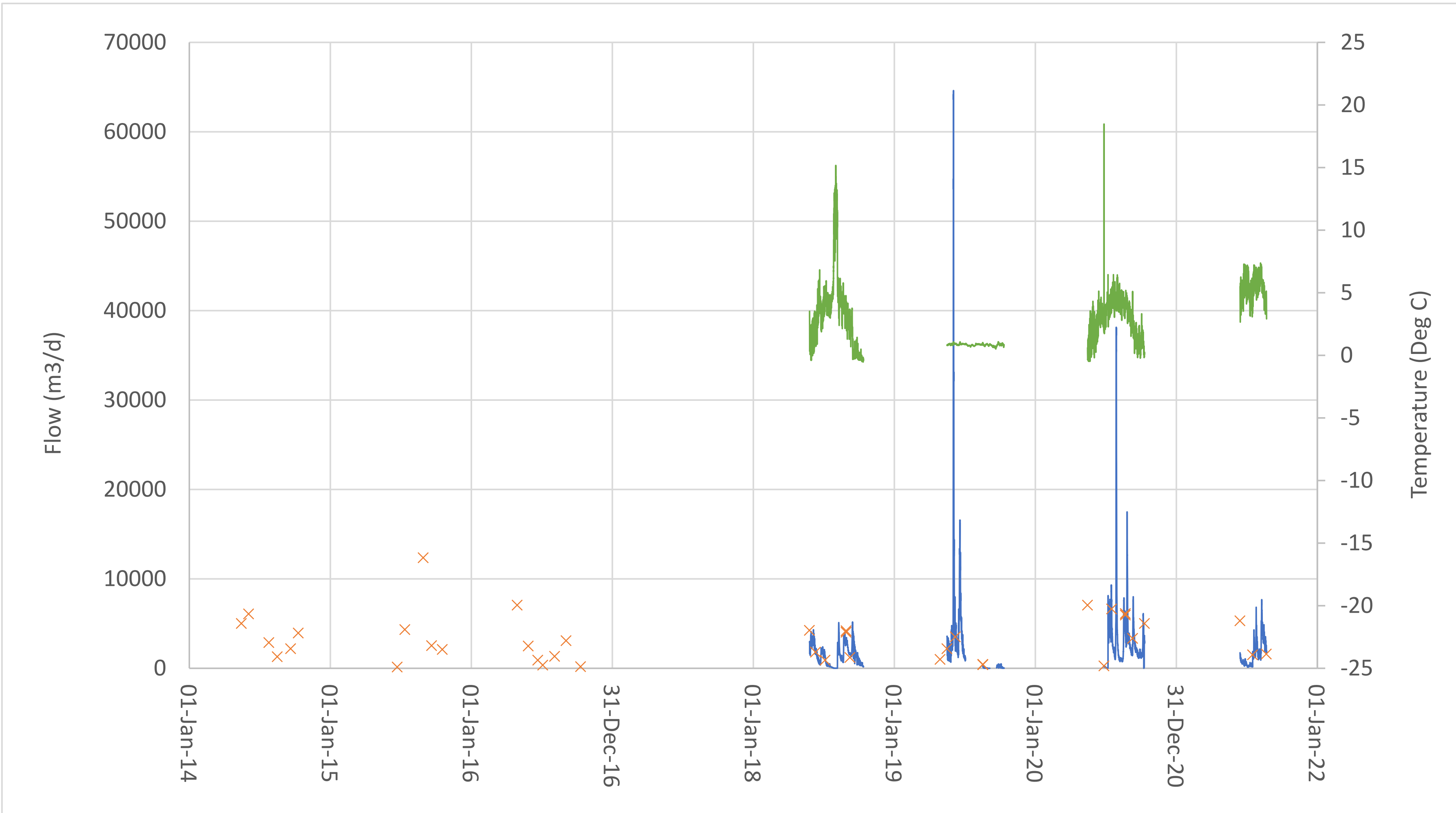
262	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
292	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration



Sep-Oct flow (i.e., baseflow period)

		Calculated flow (m3/d)						Measured flow (m3/d)					
Year	Month	n obs	min	avg	median	max	stdev	n obs	min	avg	median	max	stdev
2014	Sep	0	na	na	na	na	na	1	1011.7	1011.7	1011.7	1011.7	#DIV/0!
2014	Oct	0	na	na	na	na	na	1	1047.2	1047.2	1047.2	1047.2	#DIV/0!
2014	Sep-Oct	0	na	na	na	na	na	2	1011.7	1029.5	1029.5	1047.2	25.0
2015	Sep	0	na	na	na	na	na	1	863.1	863.1	863.1	863.1	#DIV/0!
2015	Oct	0	na	na	na	na	na	1	864.0	864.0	864.0	864.0	#DIV/0!
2015	Sep-Oct	0	na	na	na	na	na	2	863.1	863.6	863.6	864.0	0.6
2016	Sep	0	na	na	na	na	na	1	1189.3	1189.3	1189.3	1189.3	#DIV/0!
2016	Oct	0	na	na	na	na	na	1	283.0	283.0	283.0	283.0	#DIV/0!
2016	Sep-Oct	0	na	na	na	na	na	2	283.0	736.1	736.1	1189.3	640.9
2017	Sep	0	na	na	na	na	na	0	na	na	na	na	na
2017	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2017	Sep-Oct	0	na	na	na	na	na	0	na	na	na	na	na
2018	Sep	1440	329.5	1173.8	1184.0	2027.8	458.1	1	698.3	698.3	698.3	698.3	#DIV/0!
2018	Oct	602	1096.2	1672.2	1635.5	2365.5	341.4	0	na	na	na	na	na
2018	Sep-Oct	2042	329.5	1320.8	1376.3	2365.5	483.7	1	698.3	698.3	698.3	698.3	#DIV/0!
2019	Sep	1440	459.8	525.1	521.4	625.9	37.1	2	161.1	161.1	161.1	161.1	0.0
2019	Oct	558	507.1	593.6	552.2	870.3	84.3	0	na	na	na	na	na
2019	Sep-Oct	1998	459.8	544.2	528.7	870.3	62.6	2	161.1	161.1	161.1	161.1	0.0
2020	Sep	1440	972.3	1629.6	1547.6	2926.1	391.8	1	1113.4	1113.4	1113.4	1113.4	#DIV/0!
2020	Oct	463	1119.1	1914.9	1927.3	2919.6	556.7	1	1292.1	1292.1	1292.1	1292.1	#DIV/0!
2020	Sep-Oct	1903	972.3	1699.0	1560.9	2926.1	454.4	2	1113.4	1202.7	1202.7	1292.1	126.4
2021	Sep	0	na	na	na	na	na	0	na	na	na	na	na
2021	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2021	Sep-Oct	0	na	na	na	na	na	0	na	na	na	na	na

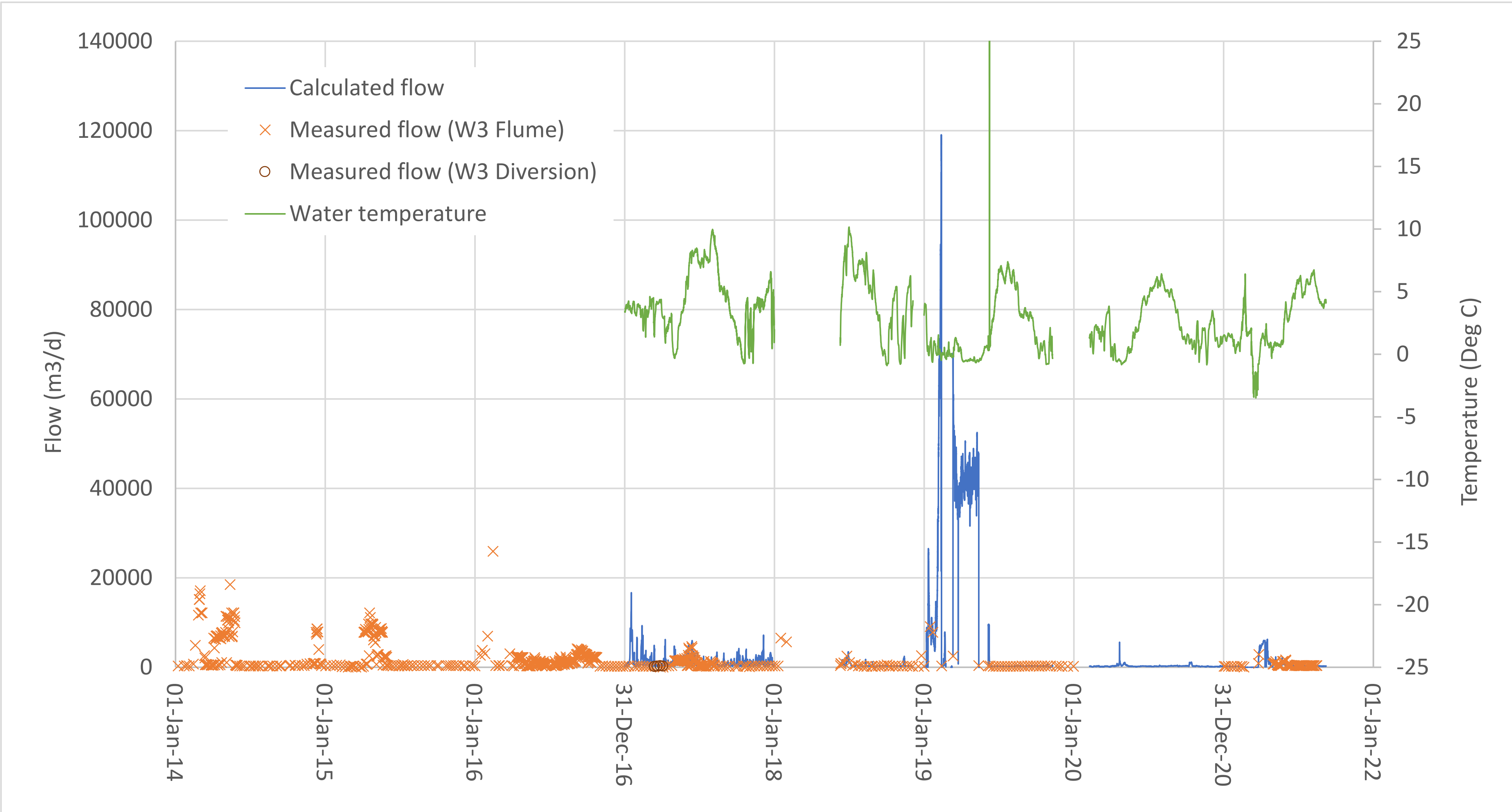
1228	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
586	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration



Sep-Oct flow (i.e., baseflow period)

		Calculated flow (m3/d)						Measured flow (m3/d)					
Year	**Month**	**n obs**	**min**	**avg**	**median**	**max**	**stdev**	**n obs**	**min**	**avg**	**median**	**max**	**stdev**
2014	Sep	0	na	na	na	na	na	1	2191.9	2191.9	2191.9	2191.9	#DIV/0!
2014	Oct	0	na	na	na	na	na	1	3933.9	3933.9	3933.9	3933.9	#DIV/0!
2014	Sep-Oct	0	na	na	na	na	na	2	2191.9	3062.9	3062.9	3933.9	1231.8
2015	Sep	0	na	na	na	na	na	1	2533.2	2533.2	2533.2	2533.2	#DIV/0!
2015	Oct	0	na	na	na	na	na	1	2098.2	2098.2	2098.2	2098.2	#DIV/0!
2015	Sep-Oct	0	na	na	na	na	na	2	2098.2	2315.7	2315.7	2533.2	307.5
2016	Sep	0	na	na	na	na	na	1	3081.9	3081.9	3081.9	3081.9	#DIV/0!
2016	Oct	0	na	na	na	na	na	1	190.1	190.1	190.1	190.1	#DIV/0!
2016	Sep-Oct	0	na	na	na	na	na	2	190.1	1636.0	1636.0	3081.9	2044.8
2017	Sep	0	na	na	na	na	na	0	na	na	na	na	na
2017	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2017	Sep-Oct	0	na	na	na	na	na	0	na	na	na	na	na
2018	Sep	1439	385.0	1920.8	1655.1	5178.8	966.6	1	1202.3	1202.3	1202.3	1202.3	#DIV/0!
2018	Oct	597	166.5	515.1	485.4	1141.0	252.8	0	na	na	na	na	na
2018	Sep-Oct	2036	166.5	1508.6	1433.3	5178.8	1043.4	1	1202.3	1202.3	1202.3	1202.3	#DIV/0!
2019	Sep	548	0.0	140.2	115.5	475.9	129.1	0	na	na	na	na	na
2019	Oct	556	4.7	111.8	71.6	497.6	104.7	0	na	na	na	na	na
2019	Sep-Oct	1104	0.0	125.9	102.9	497.6	118.3	0	na	na	na	na	na
2020	Sep	1440	1124.0	2418.5	2034.3	8001.0	1302.4	1	3326.8	3326.8	3326.8	3326.8	#DIV/0!
2020	Oct	422	0.0	2660.3	2038.7	6118.6	1458.0	1	4983.6	4983.6	4983.6	4983.6	#DIV/0!
2020	Sep-Oct	1862	0.0	2473.3	2036.0	8001.0	1342.7	2	3326.8	4155.2	4155.2	4983.6	1171.5
2021	Sep	0	na	na	na	na	na	0	na	na	na	na	na
2021	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2021	Sep-Oct	0	na	na	na	na	na	0	na	na	na	na	na

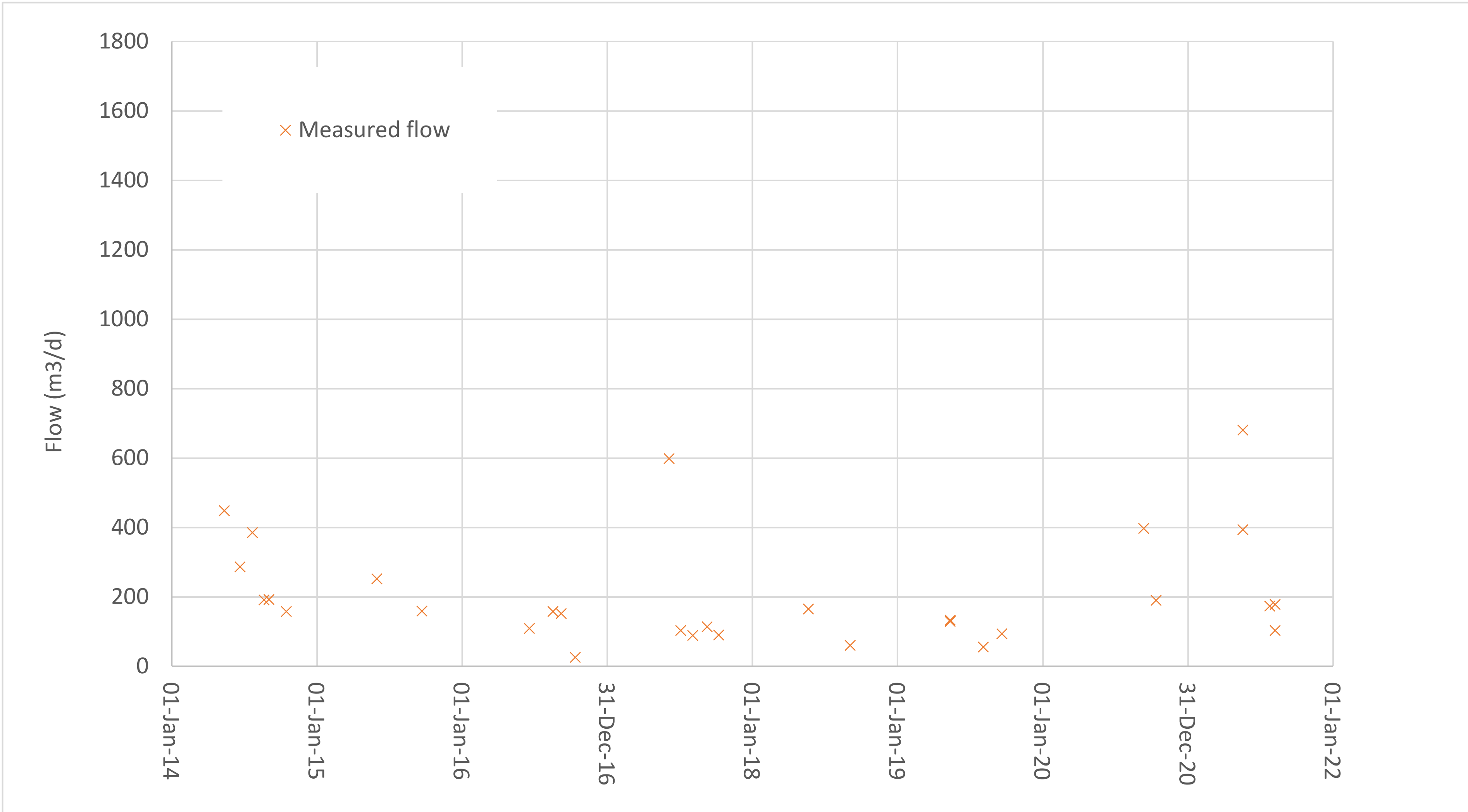
1067	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
944	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration



Sep-Oct flow (i.e., baseflow period)

		Calculated flow (m3/d)						Measured flow (m3/d)					
Year	Month	n obs	min	avg	median	max	stdev	n obs	min	avg	median	max	stdev
2014	Sep	0	na	na	na	na	na	3	259.2	267.8	267.8	276.5	8.6
2014	Oct	0	na	na	na	na	na	5	345.6	362.9	345.6	388.8	23.7
2014	Sep-Oct	0	na	na	na	na	na	8	259.2	327.2	345.6	388.8	52.5
2015	Sep	0	na	na	na	na	na	3	337.0	337.0	337.0	337.0	0.0
2015	Oct	0	na	na	na	na	na	3	337.0	337.0	337.0	337.0	0.0
2015	Sep-Oct	0	na	na	na	na	na	6	337.0	337.0	337.0	337.0	0.0
2016	Sep	0	na	na	na	na	na	29	1287.4	3055.3	3024.0	4104.0	725.7
2016	Oct	0	na	na	na	na	na	25	864.0	1990.8	2203.2	2419.2	478.0
2016	Sep-Oct	0	na	na	na	na	na	54	864.0	2562.5	2332.8	4104.0	817.7
2017	Sep	1440	256.1	648.9	522.1	1968.3	416.9	3	172.8	175.7	172.8	181.4	5.0
2017	Oct	1488	256.1	1024.4	592.9	4201.1	931.1	5	86.4	191.8	181.4	259.2	71.9
2017	Sep-Oct	2928	256.1	839.7	551.2	4201.1	749.1	8	86.4	185.8	177.1	259.2	55.0
2018	Sep	1440	6.5	266.1	292.8	336.6	89.5	4	216.0	263.5	259.2	319.7	42.6
2018	Oct	1488	123.0	254.6	259.7	602.4	45.5	6	172.8	288.0	259.2	518.4	118.0
2018	Sep-Oct	2928	6.5	260.3	278.1	602.4	70.9	10	172.8	278.2	259.2	518.4	92.2
2019	Sep	1440	235.3	277.8	276.2	339.2	23.8	4	216.0	222.5	224.6	224.6	4.3
2019	Oct	1488	80.2	295.5	277.7	727.2	94.8	5	216.0	228.1	233.3	233.3	7.7
2019	Sep-Oct	2928	80.2	286.8	276.7	727.2	70.1	9	216.0	225.6	224.6	233.3	6.8
2020	Sep	1440	200.7	299.5	294.6	446.0	43.4	0	0.0	#DIV/0!	#NUM!	0.0	#DIV/0!
2020	Oct	1488	181.5	425.9	293.2	1108.2	286.6	0	0.0	#DIV/0!	#NUM!	0.0	#DIV/0!
2020	Sep-Oct	2928	181.5	363.8	293.7	1108.2	216.0	0	0.0	#DIV/0!	#NUM!	0.0	#DIV/0!
2021	Sep	319	224.0	258.0	256.3	295.1	15.8	0	na	na	na	na	na
2021	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2021	Sep-Oct	319	224.0	258.0	256.3	295.1	15.8	0	na	na	na	na	na

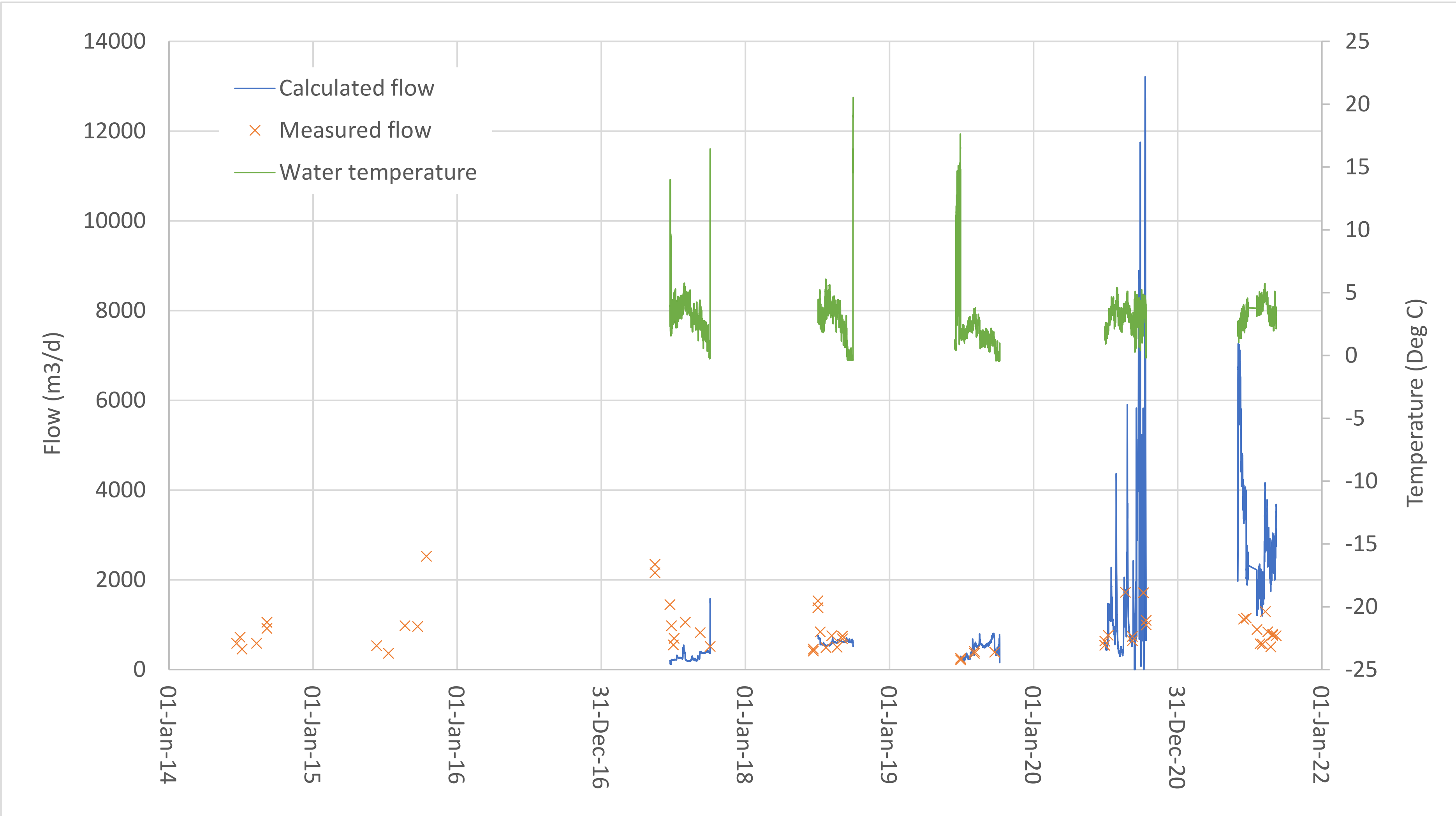
341	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
125	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration



Sep-Oct flow (i.e., baseflow period)

		Measured flow (m3/d)					
Year	**Month**	**n obs**	**min**	**avg**	**median**	**max**	**stdev**
2014	Sep	1	191.3	191.3	191.3	191.3	#DIV/0!
2014	Oct	1	157.6	157.6	157.6	157.6	#DIV/0!
2014	Sep-Oct	2	157.6	174.4	174.4	191.3	23.8
2015	Sep	1	159.0	159.0	159.0	159.0	#DIV/0!
2015	Oct	0	na	na	na	na	na
2015	Sep-Oct	1	159.0	159.0	159.0	159.0	#DIV/0!
2016	Sep	1	150.8	150.8	150.8	150.8	#DIV/0!
2016	Oct	1	25.1	25.1	25.1	25.1	#DIV/0!
2016	Sep-Oct	2	25.1	88.0	88.0	150.8	88.8
2017	Sep	1	112.9	112.9	112.9	112.9	#DIV/0!
2017	Oct	1	89.1	89.1	89.1	89.1	#DIV/0!
2017	Sep-Oct	2	89.1	101.0	101.0	112.9	16.9
2018	Sep	1	59.9	59.9	59.9	59.9	#DIV/0!
2018	Oct	0	na	na	na	na	na
2018	Sep-Oct	1	59.9	59.9	59.9	59.9	#DIV/0!
2019	Sep	1	93.1	93.1	93.1	93.1	#DIV/0!
2019	Oct	0	na	na	na	na	na
2019	Sep-Oct	1	93.1	93.1	93.1	93.1	#DIV/0!
2020	Sep	1	396.6	396.6	396.6	396.6	#DIV/0!
2020	Oct	1	189.2	189.2	189.2	189.2	#DIV/0!
2020	Sep-Oct	2	189.2	292.9	292.9	396.6	146.6
2021	Sep	0	na	na	na	na	na
2021	Oct	0	na	na	na	na	na
2021	Sep-Oct	0	na	na	na	na	na

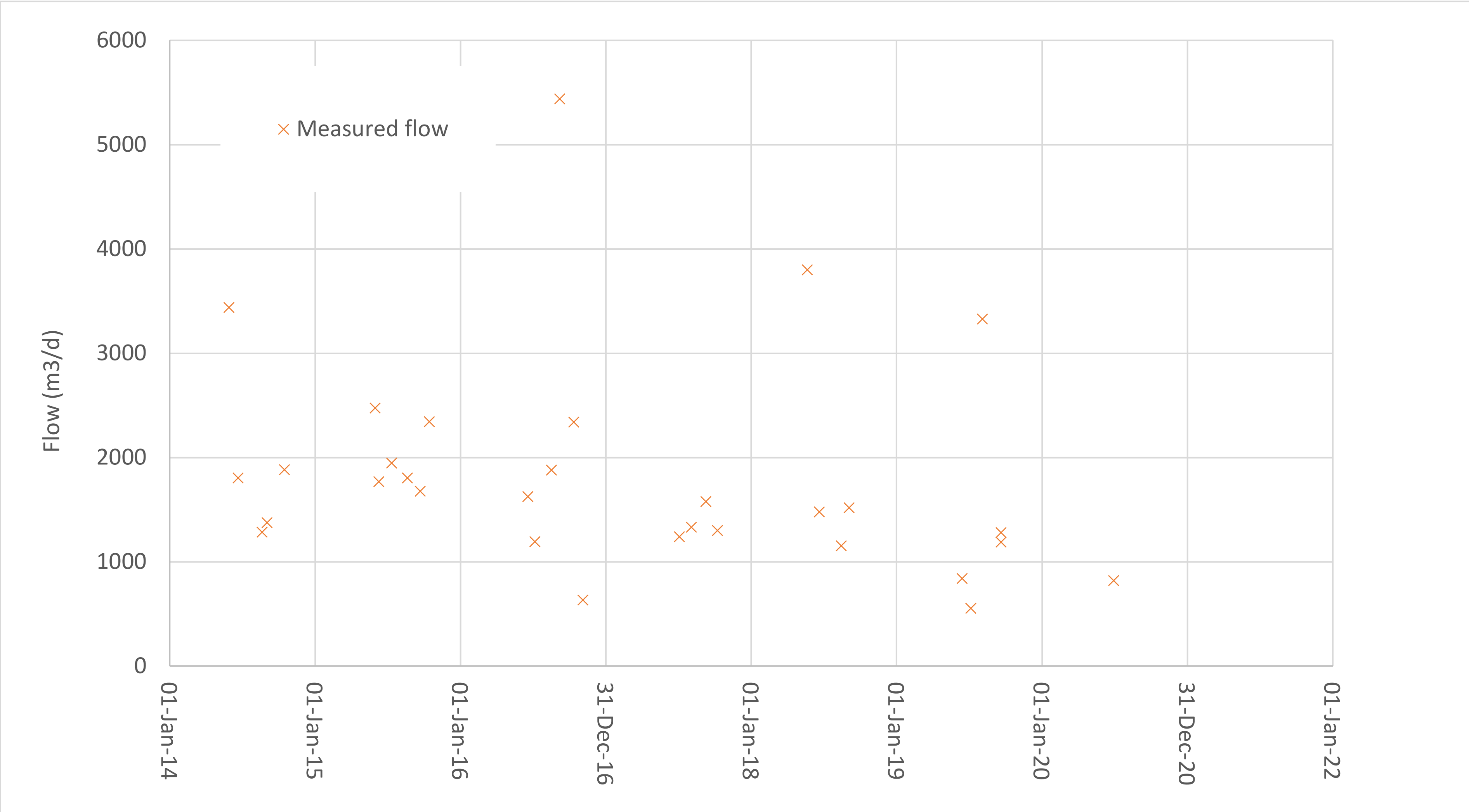
157	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
125	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration



Sep-Oct flow (i.e., baseflow period)

		Calculated flow (m3/d)						Measured flow (m3/d)					
Year	**Month**	**n obs**	**min**	**avg**	**median**	**max**	**stdev**	**n obs**	**min**	**avg**	**median**	**max**	**stdev**
2014	Sep	0	na	na	na	na	na	2	914.1	983.3	983.3	1052.6	98.0
2014	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2014	Sep-Oct	0	na	na	na	na	na	2	914.1	983.3	983.3	1052.6	98.0
2015	Sep	0	na	na	na	na	na	1	957.3	957.3	957.3	957.3	#DIV/0!
2015	Oct	0	na	na	na	na	na	1	2525.0	2525.0	2525.0	2525.0	#DIV/0!
2015	Sep-Oct	0	na	na	na	na	na	2	957.3	1741.2	1741.2	2525.0	1108.6
2016	Sep	0	na	na	na	na	na	0	na	na	na	na	na
2016	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2016	Sep-Oct	0	na	na	na	na	na	0	na	na	na	na	na
2017	Sep	1440	na	na	na	na	na	1	na	na	na	na	na
2017	Oct	131	na	na	na	na	na	1	na	na	na	na	na
2017	Sep-Oct	1571	na	na	na	na	na	2	na	na	na	na	na
2018	Sep	1440	521.3	631.9	624.3	713.3	24.7	2	680.7	713.8	713.8	746.8	46.7
2018	Oct	17	519.8	521.0	521.1	521.5	0.4	0	na	na	na	na	na
2018	Sep-Oct	1457	519.8	630.6	624.1	713.3	27.3	2	680.7	713.8	713.8	746.8	46.7
2019	Sep	1440	318.5	582.6	572.4	805.8	121.6	1	382.1	382.1	382.1	382.1	#DIV/0!
2019	Oct	318	154.8	441.9	414.3	784.2	100.7	0	na	na	na	na	na
2019	Sep-Oct	1758	154.8	557.2	557.6	805.8	129.9	1	382.1	382.1	382.1	382.1	#DIV/0!
2020	Sep	1440	0.0	2507.6	1087.1	11750.7	2626.0	2	643.7	690.6	690.6	737.4	66.3
2020	Oct	521	0.2	4641.4	3595.3	13211.1	3689.6	3	994.0	1266.6	1096.8	1709.0	386.5
2020	Sep-Oct	1961	0.0	3074.5	1860.2	13211.1	3092.4	5	643.7	1036.2	994.0	1709.0	418.8
2021	Sep	0	na	na	na	na	na	1	750.0	750.0	750.0	750.0	#DIV/0!
2021	Oct	0	na	na	na	na	na	0	na	na	na	na	na
2021	Sep-Oct	0	na	na	na	na	na	1	750.0	750.0	750.0	750.0	#DIV/0!

1136	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
1227	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration



Sep-Oct flow (i.e., baseflow period)

		Measured flow (m3/d)					
Year	Month	n obs	min	avg	median	max	stdev
2014	Sep	1	1371.6	1371.6	1371.6	1371.6	#DIV/0!
2014	Oct	1	1881.7	1881.7	1881.7	1881.7	#DIV/0!
2014	Sep-Oct	2	1371.6	1626.7	1626.7	1881.7	360.7
2015	Sep	1	1674.4	1674.4	1674.4	1674.4	#DIV/0!
2015	Oct	1	2339.6	2339.6	2339.6	2339.6	#DIV/0!
2015	Sep-Oct	2	1674.4	2007.0	2007.0	2339.6	470.4
2016	Sep	1	5438.0	5438.0	5438.0	5438.0	#DIV/0!
2016	Oct	1	2338.4	2338.4	2338.4	2338.4	#DIV/0!
2016	Sep-Oct	2	2338.4	3888.2	3888.2	5438.0	2191.7
2017	Sep	1	1573.9	1573.9	1573.9	1573.9	#DIV/0!
2017	Oct	1	1297.9	1297.9	1297.9	1297.9	#DIV/0!
2017	Sep-Oct	2	1297.9	1435.9	1435.9	1573.9	195.1
2018	Sep	1	1516.7	1516.7	1516.7	1516.7	#DIV/0!
2018	Oct	0	na	na	na	na	na
2018	Sep-Oct	1	1516.7	1516.7	1516.7	1516.7	#DIV/0!
2019	Sep	2	1188.0	1233.4	1233.4	1278.7	64.1
2019	Oct	0	na	na	na	na	na
2019	Sep-Oct	2	1188.0	1233.4	1233.4	1278.7	64.1
2020	Sep	1	3485.8	3485.8	3485.8	3485.8	#DIV/0!
2020	Oct	1	2292.2	2292.2	2292.2	2292.2	#DIV/0!
2020	Sep-Oct	2	2292.2	2889.0	2889.0	3485.8	844.0
2021	Sep	1	1761.3	1761.3	1761.3	1761.3	#DIV/0!
2021	Oct	0	na	na	na	na	na
2021	Sep-Oct	1	1761.3	1761.3	1761.3	1761.3	#DIV/0!

1880	Average time series [Median calculated flow for months Sep and Oct] used as baseflow targets for model calibration
790	Stdev.S time series [Median calculated flow for months Sep and Oct] used as error bars for model calibration

APPENDIX 1-4B

2021 Water and Load Balance Update Methods, and Result

APPENDIX 1-5
Wildlife Log

APPENDIX 1-5

MINTO MINE SITE CHARACTERIZATION – WILDLIFE LOG

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reportable Incident Yes
27/02/2012	10:45	Moose	2	In slough close to km 10.5 of access road.	Cow and calf, feeding on bushes in slough. Had gone an hour later.	
16/05/2012	8:00	Wolf	1	On hill above Pelly laydown.	Running away on hill.	
18/06/2012	morning	Moose	2	Big creek.	Moose and calf.	
26/03/2013	5:15	Fox	1	Dumas	Red, average size with some grey on it's leg.	
27/03/2013	5:15	Wolf	1	Km 3 powerline access road.	Black.	
27/03/2013	5:48	Porcupine	1	Exploration yard.	Normal.	
31/03/2013	12:00	Grizzly	3	Km 17 access road.	Cubs- Chocolate (Small) Sow-Dark brown/Tan.	
01/04/2013	4:30	Black bear	1	W37	200 lbs	
03/04/2013	7:10	Fox	2	Laydown on airport road.	1 black and 1 orange fox kits, small.	
05/04/2013	5:40	Moose	2	Portal	Moose and calf, healthy.	
10/04/2013	3:00	Wolf	1	At km 5.	Lone wolf, skinny, eating plants.	
10/04/2013	19:30	Fox	1	Fuel farm.	Dark.	
11/04/2013	16:00	Grouse	2	River crossing highway side.	Spruce grouse, adult, good shape.	
11/04/2013	15:10	Ducks	7	Km 25 (River)	Golden eye, black/white, weather cool.	
15/04/2013	8:50	Bear	1	Km 10 side hill.	Dark brown, scruffy.	
27/04/2013	23:30	Fox	1	At portal near compressor	Adult, not afraid.	
28/04/2013	20:00	Geese	50	Dyno powder MAG	Flock of geese, flying north.	
29/04/2013	1:15	Bear	1	Behind Dumas shop	Black.	
02/05/2013	17:00	Bear	1	Near burn pit	Black bear, ran into the bush.	
03/05/2013	15:30	Fox	1	Front of Dumas shop	Unconcerned with people.	
06/05/2013	20:30	Bear	1	Road leading to tent	Brown bear, 200 lbs. Darted out onto road, then ran back down hill.	
07/05/2013	16:45	Bear	1	Km 6 on access road	Young black bear, running down road.	
07/05/2013	7:45	Moose	1	Km 10.5 at hair pin	Cow moose covered in ticks.	
07/05/2013	16:00	Bear	1	Behind camp	Small brown bear, moving up the drainage towards Minto north.	
07/05/2013	15:40	Yellow warbler	1	Km 10 access road	Foraging	
09/05/2013	15:40	Dark eyed Junco	1	Km 10 access road	Foraging	
10/05/2013	18:00	Lynx	1	Km 9 access road		
11/05/2013	17:15	Bear	1	Km 7		
11/05/2013	22:00	Eagle	1	Landing	Bald eagle, flying around looking for food.	
12/05/2013	15:10	Bear	1	Km 7-8	Black, in great shape.	
12/05/2013	13:10	Grizzly	1	Km 9 access road	Great shape.	
12/05/2013	18:45	Bear	1	Km 2, heading towards km 1	Black, great shape and off the trail.	
13/05/2013	8:30	Fox	1	W 37	Not scared, ran right up to truck.	
13/05/2013	9:48	Fox	1	Crusher pad	Adult.	
16/05/2013	9:00	Squirrel	1	Minto dry room steps	Ground squirrel, running away.	
16/05/2013	9:00	Grouse	2			
17/05/2013	16:07	Porcupine	1	Km 16.5	Big healthy new quills, sunny day.	
17/05/2013	16:31	Bear	1	Km 9	2 year old brown/black bear, healthy coat. Sunny day.	
17/05/2013	13:00	Fox	1	Km 8-12 access road	Foraging, healthy looking.	
19/05/2013	14:00	Chipmunk	1	Km 8-12 access road	Foraging, healthy looking.	
19/05/2013	15:30	Wilson's warbler	1	Km 8-12 access road	Foraging, healthy looking.	
21/05/2013	16:30	Sandpiper	1	Km 8-12 access road	Foraging, healthy looking.	
21/05/2013	18:45	Wolf	1	Km 3.5	Black and grey, good looking, trotting away looking over it's shoulder.	
21/05/2013	7:30	Rabbit	1	Km 12	Running across road, sunny.	

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reportable Incident Yes
22/05/2013	8:00	Grouse	1	Km 18	Running across road, sunny.	
22/05/2013	5:00	Porcupine	1	Km 3.5	Big, calm, slow moving.	
22/05/2013	9:00	Moose	3	Km 10.5	In marsh.	
22/05/2013	9:30	Fox	1	Km 23	Crossing road, sunny, adult, healthy, red.	
24/05/2013	6:20	Fox	1	W 37 Mill valley fill pond	Good condtionion, adult, cloudy.	
24/05/2013	5:30	Fox	1	Airport laydown	Healthy.	
28/05/2013	8:00	Fox	1	Barge landing	Healhy, blondish.	
28/05/2013	3:00	Bear	1	Dyno	Black medium sized, walking towards hill behind dyno. Called enviroment	
28/05/2013	3:00	Fox	1	Front of mill	Healthy, adult, jumped into ert waste bin.	
28/05/2013	2:00	Fox	1	Yukon river Km 14	Healthy and curious.	
30/05/2013	1:50	Fox	1	Front of mill	Snooping around wasted bins.	
04/06/2013	11:00	Bear	1	W3	In creek bed by W3 shack.	
04/06/2013	9:00	Deer	1	Km 20	Running into the bush, looked healthy, young buck.	
05/06/2013	3:30	Fox	1	Assay Lab	skinny, skittish.	
06/06/2013	17:00	Bear	1	Behind camp	Adult black bear.	
06/06/2013	8:33	Moose	1	Km 11.5	Looked healthy, behaviour normal, beautiful day.	
08/06/2013	6:00	Bear	1	Km 5.5	Confident adult beside/on road, brown/black.	
09/06/2013	11:30	Grizzly	1	Km 14	Mature male adult bear, 7' , chocolate brown/black.	
10/06/2013	7:00	Bear feces	1	4.20 Access road (summit)	Located on shoulder of access road, tracks leading west along shoulder of road.	
10/06/2013	14:00	Deer	1	By Pelly manor	Adult, calm, healthy.	
15/06/2013	8:15	Owl	1	Up by Dyno	Sitting in tree watching.	
16/06/2013	7:15	Moose	3	Km 19	Cow moose and 2 calfs standing in big creek.	
17/06/2013	7:00	Beaver	1	Barge landing	Crusing around barge landing.	
19/06/2013	13:00	Bear	1	Core shack	Small brown bear, took one look at the truck and trailor, turned around and gum booted.	
21/06/2013	10:15	Bear	1	Burn pit	Same brown bear that was at the core shack, he knew the person was there and still walked out in the open.	
23/06/2013	5:20	Deer	1	Km 19	Mature buck, crossed road.	
25/06/2013	8:25	Bear	1	Incinerator gate	Wouldn't move away from electrical fence until approached using the horn.	
28/06/2013	10:14	Cyote	1	Km 11.5		
03/07/2013	6:20	Fox	1	Km 7.5	Brown, small w/prey.	
06/07/2013	Various	Fox	1	Pelly yard	Had prey.	
10/07/2013	Various	Fox	1	W15 w/prey	Had prey.	
11/07/2013	Various	Fox	1	WMA		
12/07/2013	3:30	Bear	1	W15	Med, foraging.	
14/07/2013	22:00	Fox	2	On dump road next to laydown in pipe	Baby foxes, cute and cuddly.	
15/07/2013	7:20	Porcupine	1	Airport road	Just waddling along.	
15/07/2013	1:30	Fox	1	Core shack	Sniffing around garbage can, chased him out - was not scared.	
16/07/2013	10:00	Fox	1	Access road km 6	Black fox spotted.	
17/07/2013	9:30	Deer	1	Camp	Behind Pelly lodge.	
17/07/2013	9:00	Fox	3	Airport Laydown	Fox with 2 kits	
19/07/2013	13:00	Moose	2	SWD	Moose with calf	
19/07/2013	6:30	Fox	1	Pelly office	Not afraid of humans	
19/07/2013	6:00	Swallow	A Lot	Tailings chute	Not afraid of pickup. They were flying	
20/07/2013	9:30	Black Bear	1	Km 15 of Access Rd	Black head & brown body	
22/07/2013	11:00	Fox	2	SWD	2 kits: one black & orange, one orange	

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reportable Incident Yes
22/07/2013	14:30	Grizzly bear	1	SWD	Ran as soon as I yelled	
25/07/2013	9:30	Red Fox	1	W15	Walking. Young adult.	
25/07/2013	8:25	Red Fox	1	Airstrip	Exploring, foraging	
25/07/2013	9:30	Deer	2	Barge landing	2 adult bucks, in good shape. Large 4 pt antlers. Drining water	
26/07/2013	15:50	Bear	1	Lower airport Rd	Young (2yr old) cub. Brownish blond. Skinny	
26/07/2013	16:00	Fox	1	Dumas yard	Got scared when I yelled at it. Ran away	
27/07/2013	5:30	Fox	1	Mill Parking Lot	Young	
28/07/2013	4:00	Red Fox	1	Sherwood bunkhouse	Looked good. Skittish	
29/07/2013	10:30	Grey Jay	2	Dyno	Landed on truck & then flew away	
01/08/2013	7:45	Bear	1	Km 11 of Access Rd	Young. Brownish/blond	
07/08/2013	6:00	Red Fox	1	Mill Parking Lot	Looked scared & was looking for a way out	
09/08/2013	1:55	Red Fox	1	Mill Parking Lot	Looking for food/healthy	
10/08/2013	6:00	Fox	1	Pelly office	Running around, inspecting people	
11/08/2013	2:00	Fox	2	Minto office	On & around garbage can. Then followed me to office door	
12/08/2013	6:30	Fox	1	South Stockpile	skinny	
13/08/2013	7:00	Red Fox	1	Mill parking lot	Underneath a parked truck	
13/08/2013	6:00	Wolf	1	Km 15 of Access Rd		
15/08/2013	11:45	Merlin	1	Km 5.5 of Access Rd	Hunting	
16/08/2013	16:15	Red fox	1	Mill parking lot	Looked good. Just checking things out.	
17/08/2013	5:55	Red fox	1	Right outside main mill door	Looked healthy. It approached me and I yelled at it.	
18/08/2013	16:00	Deer	1	Km 11 of Access Rd	Ran away: just saw its back	
19/08/2013	8:00	Fox	1	Airstrip	Black & Brown with white tip on tail	
20/08/2013	6:00	Fox	1	Between Mine Tech and ERT buildings	Red/white. Kept its distance but stopped to look as we passed	
27/08/2013	19:00	Black bear	3	Km 2 of Access Rd	Sow & 2 cubs	
28/08/2013	evening	Deer	1	Access road	Eating grass	
31/08/2013	5:55	Fox	1	Front of Pelly camp	Young, easily spooked	
31/08/2013	evening	Fox	1	Access road	Observing	
01/09/2013	11:45	Fox	1	Inside 16" pipe at Valley Fill laydown	Hiding out. Watching us work	
01/09/2013	15:30	Porcupine	1	airport road	BIG	
02/09/2013	10:45	Bald Eagle	1	Km 10 of Access Rd	Flying high, riding thermals	
03/09/2013	16:00	Northern Goshawk	1	Km 9 of Access Rd	Perched on tree top	
03/09/2013	12:30	Red fox	1	Camp-Minto bunkhouse	Healthy-looking. Young. Almost tame.	
03/09/2013	10:30	Red fox	1	Land fill bin	Digging old lunches out of garbage. Not scared at all	
05/09/2013	13:00	Sandhill cranes	approx 100	Flying over mine site	Migrating south	
07/09/2013	8:30	Red fox	1	Mill parking area	Looking for scraps, sniffing, on the move	
07/09/2013	9:40	Fox	1	North road to crusher	looking	
07/09/2013	6:00	Red fox	1	Pedestrian walk way down from camp	Young, small, watching us pass	
07/09/2013	7:00	Red fox	1	In front of ERT	Staying away. Went behind assay lab	
07/09/2013	7:15	Red fox	1	clarke building	looks young, fluffy	
07/09/2013	7:15	Black Bear	3	Km2.5 of Access Road	Sow & 2 cubs	
08/09/2013	7:15	Red fox	1	Minto smoke shack	good shape, young, hunting	
08/09/2013	23:59	Red fox	1	Crusher pad	We shouted at it	
08/09/2013	16:00	Brown-headed cow bird	1	Mill parking lot	Flying from vehicle to vehicle	

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reportable Incident Yes
08/09/2013	18:30	Fox	1	Across from Gym		
09/09/2013	9:30	Black bear	1	Km 10 of Access Rd	Walking on road	
09/09/2013	5:55	Fox	1	Camp - next to Capstone bunkhouse	Walking toward propane tanks at Km 0	
10/09/2013	15:45	Black bear	1	Between Area 2 Pit and W15	Walking. Ran into bush when truck approached. Large.	
11/09/2013	16:00	Black bear	1	TDD	In ditch. Small bear, 1-2 yr old. Ran when honked horn.	
12/09/2013	22:30	Black bear	1	Camp - behind kitchen	Wandering around trailers. Ran away when shouted at. Midsize, no distinguishing marks.	
12/09/2013	9:30	Black bear	1	Airport Rd	Ran down TDD	
13/09/2013	11:00	Black bear	1	Dyno	Running	
14/09/2013	10:30	Wolf	1	Mag-Dyno junction	Adult , limping back legs, cloudy	
14/09/2013	10:00	Kingfisher	1	W5		
15/09/2013	13:50	Fox	1	ERT	Fox snuck under the bay doors and then stole some garbage and hid under the Ambulance. Brazen and very tame.	
15/09/2013	7:50	Fox	1	Mill Building	Fox snuck around and in to the Mill and defacted on the floor. Not afraid had to shoo the fox out.	
16/09/2013	2:50	Fox	1	Portal	A fox was struck by a Mine Cat Light Vehicle coming out of the portal. The animal was killed on impact. Dean Mclean was called at 9:30AM and again at 2Pm (On Oct 4) with no response. It was decided to incinerate the animal as there was no way to store the animal safely over the weekend to have it shipped out to the Conservation Officer.	Yes
17/09/2013	18:30	Fox	1	Area 2 Pit	Fox seen hiding among rocks before blast. Would not come out. Found dead two days later among rocks.	Yes
17/09/2013	6:00	Red fox	1	clarke building	looks young. Fluffy	
17/09/2013	all day	Fox	1	in between site services and kitchen		
18/09/2013	8:00	Black Bear	1	Km 9 of Access Rd	Big	
19/09/2013	12:00	Wolf tracks	many	Km 19 - Beach at Big Creek	Lot of wolf tracks in sand on east shoreline	
20/09/2013	10:00	Cranes	2500+	Sky	heading south	
20/09/2013	13:30	Bear black/brown	1	dump above Pelly	heading to eskay	
20/09/2013	11:30	Black Bear	1	Km 9 of Access Rd	Small. Ran away	
20/09/2013	9:45	Wolf tracks	many	W5	Large	
20/09/2013	8:00	Black Bear	1	corner going up to airport		Yes
21/09/2013	12:00	Trumpeter Swan	1	Airstrip	Airstrip just above dense fog layer. Swan looking to land. Landed on airstrip, walked back to apron & sat down.	
22/09/2013	7:30	Black bear	1	9.5 haul road	crossing road	
24/09/2013	10:30	Grey Jay	1	Anfo Silos	Adult. On ground. Sunny	
26/09/2013	16:00	Redpolls	2	Road to Anfo silos	Looking for something to eat	
26/09/2013	7:30	Red Fox	1	Dyno Access Rd	Sitting on road. Leg up. Cleaning ass. Sunny. Purrrfect.	
27/09/2013	11:00	Bear tracks	1	Around Dumas office	Took photos. Front feet the size of a spread hand	
27/09/2013	6:30	Bear	2	Underground mag	Ran away	
27/09/2013	9:00	Bear	1	Dyno access D51 rd	Foraging. Stood upright when vehicle approached. Cinamon	
27/09/2013	18:10	Fox	1	In camp		
27/09/2013	9:45	Fox	1	STP heading for camp site		
30/09/2013	9:00	Bear	1	Km7	Running	
30/09/2013	12:30	Bear	1	D51 dump	Heading east	
02/10/2013	8:00	Red Fox	1	Mill parking lot in front of assay lab	Looked healty	
03/10/2013	14:30	Red Fox	1	Microwave tower.	Looked healthy	
07/10/2013	12:15	Red Fox	1	Under jaw crusher	Healthy, furry, not so afraid	
10/10/2013	8:30	Black bear	1	Km 9.5	Going up N side of Minto road	

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reportable Incident Yes
10/10/2013	13:00	Ptarmigan	1	Between Km 5 & 6 on access rd	Plumage beginning to change	
11/10/2013	12:35	Black bear	1	Km12.5 gravel pit	in pit	
11/10/2013	12:00	Whiskey Jack	1	Minto Landing	Looks good and plump	
11/10/2013	5:55	Fox	1	Camp	Ran away when I approached	
16/10/2013	13:00	Red fox	1	Dyno shop	in shop	
16/10/2013	9:45	Black bear	1	Km 9	side of the road	
16/10/2013	10:30	Fox	1	Mill parking lot	scrounging garbage	
16/10/2013	7:15	Fox	3	Pelly office	1 adult, 2 kits	
16/10/2013	16:00	Black Bear	1	D51		
17/10/2013	19:30	Geese	flock	D 51		
19/10/2013	9:20	Fox	1	Road at crusher	running between mill pond and crusher, heading towards mill. Looked in good condition	
22/10/2013	19:15	Black Bear	3	km 2.5 access road	1 sow and 3cubs . Cubs on road	
22/10/2013	18:10	Fox	1	in campbetween minto wing and dry	adorable	
24/10/2013	16:30	Mule deer	3	9.75km haul road	eating on side hill	
24/10/2013	16:30	Fox	1	in camp, smoke pit	looked healthy, lying down and walking around smoke shack, not afraid.	
24/10/2013	5:55	Fox	1	front of Pelly construction camp	young/ easily spooked	
26/10/2013	9:30	Moose	3	old mag site	crossing road	
26/10/2013	9:00	Bear	1	km 7	running	
27/10/2013	8:30	**B**lack bear	1	km 9.5	going up the north side of minto road	
31/10/2013	12:15	Black Bear	1	km 12.5 pit	in gravel pit	
01/11/2013	9:45	Black Bear	1	km 9	side of road	
04/11/2013	6:30	Fox	1	Mill parking lot	Passing by	
08/11/2013	22:00	Red Fox	1	Mill Parking lot	Looked good. Just snooping around	
08/11/2013	17:00	Red fox	1	SS buliding parking	Chewing on extension cords	
10/11/2013	5:30	Red fox	1	ERT bldng	Overly friendy. Came close	
13/11/2013	15:00	Red fox	1	camp parking nr smoke shack	looking healthy, unafraid	
14/11/2013	20:00	Red fox	1	Mill garbage cans	healthy looking. Looking for garbage	
14/11/2013	16:30	Moose calf	1	Side of access road at Km6		
17/11/2013	6:30	Fox	1	Pelly office	Sitting outside office, unafraid	
18/11/2013	20:30	Red fox	1	smoke shack near Pelly bus parking	Curled up sleeping on picnic table. Looked at us. Yawned. Went back to sleep.	
19/11/2013	13:00	Black fox	1	Burn Pit	Friendly. Taking a poop by the pole barn	
20/11/2013	14:00	Red fox	1	W1	Healthy, unaffraid	
22/11/2013	9:00	Fox	1	Electrical shop	Pooped on back step	
23/11/2013	9:00	Fox	1	Beside HD shop	scavenging	
23/11/2013	16:00	Red fox	1	By Pelly manor	Adult, curious, cautious but came up close	
27/11/2013	10:15	Moose	2	Runway	On runway. Plane trying to land. Not skittish	
30/11/2013	1:00	Fox	2	Main pit	Nipped glacier driver	
02/12/2013	18:10	Fox	1	Area 2 Pit	Nipping at coveralls 3 nights in a row, permission to deter the animal without intention to harm, ensure no food is present.	
09/12/2013	5:00	Fox	1	Mill parking lot	sitting on dumpster	
12/12/2013	7:30	Fox	1	North hillside	running up hill	
14/12/2013	11:30	Moose	2	KM7	Ciw and calf on side of road	
14/12/2013	4:30	Moose	2	KM6	Mother and calf standing on side of road	
15/12/2013	10:00	Fox	2	Airport Rd.	2 young reds frolicking	
19/12/2013	9:40	Fox	2	Dumas door steps	Sitting witing to be fed	

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reportable Incident Yes
20/12/2013	0:30	Lynx tracks	1	MVF laydown	Fresh tracks around equipment	
20/12/2013	9:00	Fox	1	ERT building	Trapped in live trap. CO Dean McLean came and picked him up and released it 1/2 way to Pelly.	
20/12/2013	6:30	Fox	1	on hay pile at airport laydown		
21/12/2013	1:00	Fox	1	Airport Laydown - straw bales	Trapped in live trap. CO Dean McLean came and picked him up and released it. See photo in next tabl of excel sheet.	
22/12/2013	11:30	Fox	1	A2 Pit	full hair, not scared	
23/12/2013	5:30	Fox	1	Land fill box in mill parking lot	Jumped in landfill box. V tame and unafraid	
23/12/2013	12:15	Snowshoe hare	1	Road from Airport laydown to mill	Running fast	
24/12/2013	8:00	Fox	1	Outside tech office	Red/white tail, running away toward propane tanks	
28/12/2013	6:20	Fox	1	Pelly office	runnign around office , not scared	
30/12/2013	8:00	Fox	1	Outside Dumas shop	Red/white tail.	

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Reportable Incident (Yes/No)
04/01/2014	6:00	Fox	1	Capstone and Pelly lodge	Med. Size I yelled and it darted away	Victoria C	No
12/01/2014	7:55	Fox	1	Main dry stair case		Shayne Gerald	No
13/01/2014	19:00	Fox	1	Climbing on Neway Pile	Moving quickly up hill	Jim D	No
18/01/2014	16:00	Fox	1	Area 118 pit	Middle of pit	Dave Avar	No
24/01/2014	5:30	Fox	1	Roadway by Capstone Lodge	Running away	R.Proc	No
29/01/2014	15:30	Wolf tracks		W3/W17/W50	Tracks near W3 and along W3 access W17, W50	CH	No
07/02/2014	17:30	Wolf tracks		Mill Valley Laydown	Near the Copco parts trailer. Wandering by all the garbage bins	Kevin Fletcher	No
10/02/2014	morning	Owl with rabbit	1	KM1	Brown owl flying with rabbit	Sebastian T	No
12/02/2014	11:00	Fox	1	Landfill	Checking out the garbage	Las.M	No
13/02/2014	4:30	Rabbit	1	SK	Sitting.	Garry Brown	No
14/02/2014	22:00	Fox	1	In front of waste in front of mill	Looking for food in garbage	Ross	No
25/02/2014	morning	Hawk Owl	1	w17	Dead. Marks in snow show it had fallen down bank	Phill E	No
02/03/2014	17:30	Red fox	1	D51 Ramp	Sitting there	Rene M	No
02/03/2014	10:30	Red fox	1	Pelly Laydown	Crossing road	Rene M	No
08/03/2014	17:30	Red fox	1	Pelly Laydown	Crossing road into pelly yard	Rene M	No
14/03/2014	7:00	Fox	1	Smoke shack	Not scared looking for food	Jim Pillronra	No
19/03/2014	5:20	Fox	1	Bottom of M zone 708 Sump	Sat there staring at me	Rick Jager	No
20/03/2014	5:00	Fox	1	At camp by main entrance	Healthy not afraid of me	Kattleen	No
30/03/2014	17:00	Bear	1	On road	Brown, not afraid	Cody Goebel	No
05/04/2014	23:00	Fox	1	Pit1	Looks to have a broken leg	Rick S	No
11/04/2014	7:00	Fox	1	118	Same fox as above	Rick S	No
14/04/2014	evening	Bear	3	New warehouse building	Sow and two cubs		No
14/04/2014	10PM	Black bear	2	Parking lot behide new warehouse	looked healthy adult.	Rick S	No
15/04/2014	19:00	Bear	1	Big Creek	Black/ Brown bear. Male size. No shoulder hump		No
17/04/2014	20:00	Black Bear	1	Above camp cut bank	Black bear and brown muzzle - sniffing at camp odours deterred with pistol		No
17/04/2014	20:30	Black Bear	1	lower warehouse pad	Dark cinnamon bear med-size - deterred with truck and pistol, good response to deterrent		No
18/04/2014	evening	Bear	1	DST Tailings	Safety got call of bear on tailings but did not see it		No
18/04/2014	evening	Bear tracks	1	TDD	Dear tracks		No
19/04/2014	22:00	Black Bear	1	Behind Sherwood near cutbank	Too dark to telll. Bear responded well to the air horn and took off into bush....did not return to camp.		No
19/04/2014		Black bear	1	KM.5	same as above	Rock s	No

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Reportable Incident (Yes/No)
21/04/2014	4:03	Black bear	1	Portal Road	Walking down road from water shack	Rick S	No
22/04/2014	15:00	Bear	1	WMA	Big russet coloured. Investigating landfill and WMA area	Martin C	No
23/04/2014	19:00	Black bear	1	Camp new construction	Ran at sight of truck. Brown	Ryan H	No
27/04/2014	20:00	Black bear	1	Camp new construction	same as previous bear. Hazed.	Ryan H	No
28/04/2014	15:00	Black bear	1	WMA	Large, good condition, chocolate brown. Walked away as soon as I arrived.		No
28/04/2014	8PM	Black bear	1	W3	Tracks. med/sm size	Chirs H	No
30/04/2014	7:45	Black bear	1	.5 KM Cut back	Hazed with bangers bear did not respond. Slowly walked away	Ryan H	No
01/05/2014	11:00	Black bear	1	Landfill	Calm, scared easy when yelled at	Phil E	No
01/05/2014	19:30	Black bear	1	Fuel farm	Calm scared easy when yelled at		No.
01/05/2014	11:00	Black Bear	1	Landfill	He was along the tree line of the landfill	Phill E	No
01/05/2014	19:30	Black bear	1	Fuel farm	walking aorund fuel farm	Mill operator	No
07/05/2014	19:00	Bear	1	W2	Right at water quality station. Observed by Seb as he drove down the road.	Seb	No
08/05/2014	20:00	Bear	1	Above Pelly laydown	When enviro got there the bear could not be located	Pelly - Justin	no
09/05/2014	14:00	Black bear	1	Was spotted at D-51 bench above Pelly (by Pelly) and then just before the magazine road	Large bear, dark chocolate brown colour. Ran when truck approached it and then calmy walked away when screamers were used	Pelly - Greg	no
09/05/2014	10:00	Swallows	1	Pipe sticking out of tailings building facing tailings chute.	Nesting in pipe.	Ryan Faulds	no
10/05/2014	14:00	Black bear	1	MWD on the grass. Was chased across the top of the dump and into the forest	Looks like the same bear from the day before. Large bear, dark chocolate brown colour. Ran when truck approached and calmy left when screamers/ air horn and yelling were used.	Pelly - Greg	no
10/05/2014	4PM	Fox	1	Dry stack	Sleeping	RickS	no
11/05/2014	10:00	Black Bear	2	D-51 and then up at Sewage lagoon	Same chocolately brown coloured bear that has been seen the last few days.	Pelly - Greg	no
11/05/2014	15:00	Black bear	1	W3	Looked like and behaved like the bear that has been seen around the Pelly yard. Walked away slowly when hazed.	Jasmin and Shaun	no
12/05/2014	13:00	Swallows	0	New warehouse building	We realized the new warehouse building would be prime habitat for swallows due to the open space and open doors. Talked to Bob in warehouse to cover up the entrances to prevent nesting.	Shaun and Jasmin	no
13/05/2014	9:00	Bear	1	On Dyno access road	Enviro did not go check out. Asked Greg to call again if Bear started to approach Pelly laydown.	Pelly - Greg	no
13/05/2014	17:20	Hare	1	on side of raod KM2	White grey changing colour	Ross	no

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Reportable Incident (Yes/No)
14/05/2014	11:30	Fox	1	MCDS	Hopping on 3 legs, back left leg injured. Adult redfox looked healthy.	Enviro-Shaun	no
14/05/2014	14:30	Black Bear	1	Pad 2 then behind Dumas	Black bear spotted at Pad 2. Moved down to corner of airport rd behind laydown. Could not be located after that. Jasmin went in to Dumas to let them know to use the air horn when working behind the shop and to haze with air horn if they see the bear again.	Numerous individuals called this in.	no
14/05/2014	16:00	Black Bear	1	Corner of airport access rd.			no
14/05/2014	15:00	Black Bear	1	beside airstrip	Grazing its way along valley above TDD	MC	
14/05/2014	12:30	Black Bear	1	d-51	walking to pelly laydown unconcerned about truck	Dale W	
15/05/2014	9:00	Black Bear	1	Mill Valley Laydown	Dave Crottey went to haze with rubber bullets. Got to the bear and yelled at it and it ran away; did not get the rubber.	Ryan Faulds	no
15/05/2014	18:00	Black Bear	1	KM 3	Ran off when yelled at. One smaller sized bear, assumed it was a yearling. Did not see mother around.	Eamon Mauer	no
16/05/2014	8:30	Swallows	0	Potential nesting site on missing soffit on Dumas shop, west side of the building	Potential nesting area pointed out by Ryan Faulds. Potential work going to happen in that area late summer. No birds nesting but if Ryan notices them nesting in that area he will let us know in case work does get planned.	Ryan Faulds	no
16/05/2014	12:30	Swallows	1	Pipe in behind of mill	Birds seen nesting in a pipe behind the mill. Jasmin went to look at it with Darrly, Bill and Eric and the valves leading to this pipe are shut off. The pipe is used to purge air from the mill but has not been used in 6 years. Going to leave the birds for the spring and once they have left Jasmin will manage getting the pipe capped so they don't nest in that spot next year.	Ryan Faulds	no
17/05/2014	10:00	Black Bear	1	Corner of airport rd, by Dumas	Very black bear, medium size, good condition. Eating greenery. Reluctant to move off when yelled at. Hazed with screamers, air horn. Ran small way and resumed eating. Gary van B (on May 19th) says that he saw he had a rip on his back, like he had been in a fight. Maybe this one has been edged out of territory.	SS-Gary	no
17/05/2014	17:00	Black Bear	1	Corner of airport rd, by Dumas	Same black bear as this earlier on the same day. Very black bear, medium size, good condition. Eating greenery and stretching on the powerline pole. Alert to horn honking, picked head up. Hazed with screamers, air horn. Ran off into the bush and was not observed thereafter.	Unkown caller on radio	no

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Reportable Incident (Yes/No)
17/05/2014	20:00	Black Bear	1	Corner of airport rd, by Dumas	Same black bear as this earlier on the same day. Very black bear, medium size, good condition. Eating greenery and stretching on the powerline pole. Alert to horn honking, picked head up.	Ryan Faulds	no
17/05/2014	10:00	Swallows	1	Behide mill	building nest in pipe on mill building	R.Faulds.	no
17/05/2014	19:50	Black bear	1	Road up to airstrip	Eating still there ten minutes later	David A	no
18/05/2014	15:00	Black Bear	1	Corner of airport rd, by Dumas	Black bear with a bit of brown. Different bear on the grass than yesterday, could be the one that was seen up near the Pelly yard last week. Shaun hazed and it ran for a short bit and then started to walk. Headed up old exploration road.	Collin Moonen	no
19/05/2014	10:30	Black Bear	1	WMA	Large, brown. Same one from April 28th. Dave Crottey came up and fired a cracker shell, but he had just gone down bank by where barrels are stacked.	SS-Gary	no
20/05/2014	22:00	Black bear tacks	1	Portal Road	bear tracks around wooden shack up at portal where we hook up water truck	Rick S	no
21/05/2014	20:00	Black Bear	1	In camp: near Pelly Manor	Brown, medium size. Took off down bank toward access road. Reported after half hour delay by Sodexo house keeping staff - they didn't know who to call. Followed up with John. He met with staff and explained call-in procedure. Bear was thought by observer to be grizzly cub, but more likely a black bear.	Rona -Sodexo housekeeper	no
21/05/2014	14:00	Black Bear	1	Beside airstrip		CH	no
22/05/2014	7:30	Black Bear	1	Near new camp	Unknown size & colour. Investigated by PE & CH but not seen again.	M&L Contracting	no
22/05/2014	8:00	Black Bear	1	On bank between Dunas shop and airport road.	MC & Mark Goebel went and found medium sized brown bear grazing amonst willows between pole barn and Dumas shop. Hit with a rubber bullet and crackers. Ran but we couldn't find tracks so don't know where he went.	Dumas	no
22/05/2014	8:15	Black Bear	1	At 118 Pit, above chain link fence	MC went to investigate but did not find. Unsure if it was the same one that had just been hazed at airport laydown. Dave C arrived but didn't see it either.	Pelly (Declan)	no
22/05/2014	9:30	Black Bear	1	300m North of Dyno yard call point	Medium sized brown bear with caramel coloured snout. Eating grass and roots around pond. Danny vanB had seen him at same spot 5 days before. Dale at Dyno informed.	Pelly dewatering crew	no

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Reportable Incident (Yes/No)
23/05/2014	7:30	Black bear		Corner of airport rd, by Dumas	Good sized jet black bear grazing on veg by the power pole. Did not respond to shouts. Hit with a rubber bullet and crackers. Ran but stooped after a few yards, acting dopey. Climbed up onto road. We chased him down off road with truck and hit him again with rubber bullet and crackers and he disappeared into bushes. This is not our regular visitor to this corner.	Unidentified (Dumas)	no
23/05/2014	17:00	Black bear	2	KM 2/ KM 5	Large and healthy looking	Javad A.	no
24/05/2014	8:50	Otter	1	Big Creek	Adult heading up stream	K Tutin	no
25/05/2014	13:00	Mule Deer	1	AN laydown	looking at me	Ron Galagas	no
27/05/2014	6:30	Black Bear	1	Corner of airport rd, by Dumas	Small to medium sized, light brown bear, grazing by power pole. Air horn and screamers chased him onto road and along the old road to the grounding grid. After a couple of screamers, he ignored them, but grazed his way away from the road.	Unidentified (Site Services)	no
27/05/2014	7:00	Brown Bear	1	pond below Eskay site	Eating plants- unconcered	Dale W	no
30/05/2014	13:00	Brown Bear	1	pond below Eskay site	Eating plants- unconcered	Rene M	no
31/05/2014	11:00	Black bear	1	Airport laydown	walking foragraing	Ron Galagas	no
09/06/2014	5:30	Fox	1	Dumas Shop	Not afraid, Just wary	Jean Lagarde	no
09/06/2014	14:50	Brown bear	1	KM1 Access Road	Minding his own business	David Grennan	no
09/06/2014	11:25	Fox	1	Camp ,new construction	Yelping on outer grounds	Sabrina	no
10/06/2014	15:45	Black Bear	1	Portal Road	Ran when appraoched with truck. Fair size(med) shot banger and screamer at it and ran down hill side	CH / RM	no
13/06/2014	17:15	Black Bear	1	300m North of Dyno yard call point	Good sized light brown bear foraging and relaxing, not going anywhere. Let him be and called Dyno to let them know it was there.	Unidentified radio caller	no
15/06/2014		Black Bear	1	Near incinerator at WMA	Small black coloured bear. New visitor. Went to haze, but did not find. Was in trees beteen airstrip road and incinerator. Unresponsive to shouts and people working on	Danny van B	no
15/06/2014	7:00	Black Bear	1	Underground shop	eating grass/ not scared	Cody	no
15/06/2014	8:10	Mule deer doe	1	KM .5	On road moving along towards WSP	Ross	no
15/06/2014	9:00	Fox	1	KM9	Skittish/ mottled coat, running off road and up hill	Ross	no
17/06/2014	7:00	Moose	3	Airsprip	cow and 2 calves, ran down the airstrip	Rob T	no
18/06/2014	9:00	Rabbit	1	KM3	Ran as soon as it noticed us	Victoria	no
20/06/2014	19:00	Deer	1	KM2	Ran across access road	Victoria	no
26/06/2014	13:00	Brown bear	1	DSI road	Ran into bush. Good size	CH/ RM	no
27/06/2014	9:35	Moose	2	Airport road	Cow and calf, beside core shack	CH/Rm	no
27/06/2014	8:30	Black bear	1	DSI road	same bear	CH/RM	no
28/06/2014	15:30	Black bear	1	Dumas SHop	Took off after we yelled and clapped up exploration Rd.	CH /RM	no

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Reportable Incident (Yes/No)
01/07/2014	6:30	Fox	1	KM6	Standing mid road, ran to the side when vehicle approached	Karoline	no
03/07/2014	20:30	Grey wolf	1	Powerline Road	Beautiful	RobinW	no
09/07/2014	13:30	Eagle	1	KM21	Big and hungry looking	Robin W	no
12/07/2014		Black bear	1	Near incinerator at WMA	Called in by Site Services. Went to look but was gone.	Unidentified radio caller	no
12/07/2014	13:00	Fox	1	At tug	Skinny	Robin W	no
13/07/2014	10:00	Young grizzly	1	KM12	Running across road	Robin W	no
13/07/2014	14:30	Ptarmigan	1	KM 21	good	Robin W	no
14/07/2014	11:00	Mule deer	4	KM10	3 fawn, 1 doe hopping along to road	James Spencer	no
16/07/2014		Black Bear	1	In front of Dumas shop	Medium sized brown coloured bear. Called in an hour after the fact. Dumas staff scared it off. It went round to the back of the shop. Scared again and took off toward airstrip. Gone by the thime I went to look (MC).	Veronica at Dumas	no
16/07/2014	7:00	Black bear	1	KM6.5	Did not run away until we were beside it	CH	no
16/07/2014	16:15	Grizzly Bear	1	KM5	looked curious, didn't move when vehicle passed by	Karoline Monkvik	no
16/07/2014	7:00	Brown bear	1	Dumas Shop	Bear scared off to rear of shop	Hector,Veronica,Joe	no
17/07/2014	6:00	Black bear	1	KM16	Ran into bushes as soon as it noticed vehicles approaching	Karoline Monkvik	no
18/07/2014	13:00	Black bear	1	KM6.5	Relaxing by the roadside laying in the sun	PE	no
18/07/2014	11:30	black bear	1	West landing	Bear was swimming across the yukon river got out of the water just down stream of the barge.	PE	no
18/07/2014	5:55	Black bear	1	KM13	Stood still while driving by	Karoline monkvik	no
23/07/2014	4:30	Brown bear	1	KM5	Brown bear up at 5KM sitting in pong , must have been hot	Garry brown	no
01/08/2014	10:00	Bald eagle	1	Airport Lay Down	Fighting with ravens over food waste from overflowing bin	Ryan faulds	no
01/08/2014	14:45	Deer, Fawns	4	Fuel Farm	Good healthy, 3 Fawns 2.5ft.,Doe 5ft. tall,	Collin Moonen	no
01/08/2014	11:00	Brown Bear	1	Dyno	Walking around	Collin Moonen	no
02/08/2014	7:00	Grouse	4	Above Camp cut bank	Healthy looking	Javad Azanchi	no
07/08/2014	19:00	Rabbit	3	KM3.5	Hares hanging out on the road		no
08/08/2014	19:40	Brown Bear	1	Airstrip	Coming from core shack area	Danny Vanbibber	no
09/08/2014	15:40	Black bear	1	Near #2 pad at 118 portal	Brown coloured bear eating grass by road. Had gone by the time I got there (MC). Pic from Matt S.	Matt Skanes	no
11/08/2014	20:00	Bald eagle	1	KM2		Rob Proc	no
12/08/2014	20:00	Deer	1	New warehouse building	Healthy, curious	Ian Henry	no
16/08/2014	19:00	Grouse	13	KM25-KM15		Rob Proc	no
16/08/2014	20:00	Porcupine	1	KM5		Rob Proc	no
20/08/2014	7:30	Moose	3	KM21	2 Cows, 1Bull	Stephen	no
20/08/2014	9:00	Black Bear	1	Km 5	Big bear	Stephen	no

Date	Time	Type of Animal	# of individuals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Reportable Incident (Yes/No)
23/08/2014	7:00	Sandhill Cranes	150	Over Camp	3 big V formations, looking for thermals or somwhere to land	Martin Crill	no
27/08/2014	5:30	Moose	1	Km 11	Cow moose jogging down road	Collin Moonen	no
01/09/2014	10:30	Black Bear	1	Km10	Small, on road by disabled machine(looking for lunch)	Ron Light, Ron Bertrand	no
02/09/2014	16:30	Black Bear	1	Km25	Large Black Bear limping on left foot	Kevin Tutin	no
03/09/2014	3:00	Fox	1	Behind kitchen ,smoke area	Running, medium size	Jennifer	no
05/09/2014	?	Wolf	5	North Dyno yard	2 Adults, 3 pups, seen crossing yard ,black+tan marks, reported by Dyno Dale	Martin Crill	no
06/09/2014	15:20	Fox	1	Barge	Skinny looking for food, young ,muddy	Helaina M.	no
10/09/2014	9:45	Moose	3	KM7	Cow and two calfs	Sean Darcy	no
12/09/2014	19:00	Fox	1	Km3	Black/Ginger	Victoria C.	no
13/09/2014	8:30	Hawk	1	Km6	Brown/White	RProc	no
17/09/2014	9:00	Moose	1	KM 5	Lg cow	Collin Moonen	no
22/09/2014	8:30	Moose	1	KM 8	Young adult	Sean Darcy	no
28/09/2014	10:00	Wolf	1	km11	Headed to KM 10	Corey Vaudine	no
01/10/2014	9:00	Unknown Bird	3	New warehouse building	3 birds in building	Ryan Faulds	no
03/10/2014	13:30	Bear Tracks		KM 24	Bear tracks on Access rd.	Ian Young	no
12/10/2014	4:30	Mule Deer (does)	7	9Km	2 lg, 5 small	KTOTIN	no
13/10/2014	7:30	Fox	1	Arctic Corridor	ran underneath corridor heading south	Molly Harrison	no
17/10/2014	3:20	Moose	2	KM 12.5	2 young bulls	Barry Hager Sr.	no
20/10/2014	12:30	Squirrel	1	smoke shack at camp	Heading towards luggage stoage	wendy willis	no
23/10/2014	15:00	Ptarmigan	5	Airport rd. Corner of W35	Saw them when they flew away	Jasmin Dobson	no
23/10/2014	6:45	Fox	1	on slope behide new camp	Walked up slope ; didn't approch	D.Avar	no
27/10/2014	10:00	Loon	1	Main pit	Swimming/diving around near tails line	S.Dunfield	no
27/10/2014	17:00	Duck	1	ERT shack	Landed on ERT shack, fell off. Walking around looking injured, flew away!	S.Dunfield	no
27/10/2014	13:00	Fox	1	outside mine tech office	Adult red fox, not too concerned with people	D.Mckeen	no
01/11/2014	5:45	Fox	1	Assay lab		RPROC	no
01/11/2014	10:00	Fox	1	Barge Km 27	Red, yellowish, orange, black paws	Victoria	no
01/11/2014	9:00	Coyote Tracks	1	chemical tent laydown area	1 set of tracks	Sean Darcy	no
02/11/2014	8:00	Red fox	1	Out back of kitchen smoke area	walked right by me when sitting out back "good condition"	Chef Reid	no
04/11/2014	9:00	Red fox	1	out back of kitchen smoke area	Good behaviour	Chef Reid	no
13/11/2014	14:00	Wolf	1	Dyno	Scared running away from vehicle	HM	no
03/12/2014	7:30	Fox	1	Km2	followed me while I was jogging for approx 1/4 KM	Gary Parrup	no
2014-09	13:00	Gray Jays	2	Dumas Shop	Very curious birds	Ryan Faulds	no
09/11/2014	10:00	Wolf	3	KM 22	2 black wolfs and 1 grey one	Shaun Roberts	no
26/12/2014		Moose	1	Km3	Big brown		

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
06-Jan-15	14:30	Fox	1	Dyno Rd	Orange/ black	Helaina Moses	no	N/a	N/a
18-Jan-15	14:00	Fox	1	KM 1.5	Not too scared hazed down road	Ron B	no	N/a	N/a
23-Jan-15	16:00	Moose	2	Vent raise road	One cow and one calf	Dave Peters	No	N/a	N/a
09-Mar-15	5:00	Moose	1	In camp	Looking at me	Don Hannus	No	N/a	N/a
28-Mar-15	19:30	Hare	1	Km 3.5 Access Road	Dead hare on Access Road. Observed by a runner on road. Reported to Conservation Officer.	Rob Proc	No	N/a	N/a
28-Mar-15	19:00	Rabbit/Hare	1	3.5 Km	Dead hare on Access Road. Observed by a runner on road. Reported to Conservation Officer.	Rob. Proc	No	N/a	N/a
28-Mar-15	19:15	Whiskey Jack	3	3.5 Km	Eating rabbit	Rob. Proc	No	N/a	N/a
02-Apr-15	9:00	Squirrel	1	Mine tech	Running around looking for food	Helaina Moses	No	N/a	N/a
15-Apr-15	19:00	Wolf tracks	1	4 Km	walking towards 4.5	Rob. Proc	No	N/a	N/a
23-Apr-15	15:00	Grouse	1	Km 13 Access Road	Vehicle hit and killed Grouse. Grouse was moved off the road after it had been killed.	Helaina Moses	No	N/a	N/a
25-Apr-15	13:00	Moose	1	Bench on the Main Pit	Calf moose carcass	Jonathon Silverfox	No	N/a	N/a
25-Apr-15	21:30	Black bear	1	Pelly Yard	Black bear (brown) Medium size	Shane Pilsworth	Yes	Yelling, Honking, Air Horn	Ran a little ways and then stopped
26-Apr-15	17:30	Black bear	1	Landfill	Large, Brown	Danny Van Bibber	Yes	Yelling, Honking, Air Horn, Bear Banger, Bear Screamer	Reluctantly walked away
27-Apr-15	15:00	Black bear	1	Camp	Medium, Brown	Unknown	Yes	Yelling, Honking, Air Horn, Bear Banger	Reluctantly walked away
27-Apr-15	16:00	Black bear	1	Camp	Medium, Brown	Unknown	Yes	Yelling, Honking, Air Horn, Bear Banger	Reluctantly walked away
28-Apr-15	13:00	Black bear	1	Camp	Medium, Brown	Unknown	Yes	Yelling, Honking, Air Horn, Bear Banger	Ran away and not seen again
29-Apr-15	17:30	Black bear	1	IROD Dump	Medium, Brown	Dale (Dyno)	Yes	Other	Ran away and not seen again
04-May-15	17:30	Black bear	1	Landfill area	Large brown	Site services	Yes	Yelling, Honking	Ran away and not seen again
05-May-15	8:00	Black bear	1	MWD	Large brown	Flo	Yes	Yelling, Honking, Air Horn, Bear Banger, Bear Screamer	Other (detail in notes)

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
07-May-15	10:30	Black bear	1	In ditch behind Dumas shop	Large, Cinnamon	Unknown	No	N/a	N/a
07-May-15	11:15	Black bear	1	Pelly Yard	Large brown	Niles	Yes	Yelling, Honking, Air Horn, Bear Banger, Bear Screamer	Reluctantly walked away
12-May-15	20:00	Black bear	1	Main Waste Dump	Brown	Dave Heemskerk	No		
14-May-15	11:00	Marten	1	W50	Light brown fur with white fur on chest	Shaun and Helaina	No		
14-May-15	16:00	Black bear	1	Corner of airport road by Dumas	Didn't see it	Unknown	Yes	Bear Banger	Reluctantly walked away
14-May-15	18:00	Black bear	1	Corner of airport road by Dumas	Medium, black fur	Dave crottey	Yes	Rubber Bullet	Other (detail in notes)
15-May-15	8:15	Black bear	1	Corner of airport road by Dumas	Medium, black fur	No one	Yes	Yelling, Honking, Air Horn, Bear Banger, Bear Screamer	Reluctantly walked away
15-May-15	10:40	Black Bear	1	Beside Dumas Shop	Medium Brown fur, very heathly and young adult	Terry Rickard	yes	Yelling, Honking, Air Horn, Bear Banger, Bear Screamer	Other (detail in notes)
16-May-15	5:58	Black bear	1	Corner of airport road by Dumas	Medium to large. Brown	Control Room	Yes	Yelling, Honking, Air Horn, Bear Banger, Bear Screamer	Reluctantly walked away
16-May-15	10:00	Black bear	1	Corner of airport road by Dumas	Medium to large. Brown	Terry Rickard	Yes	Yelling, Honking, Air Horn	Reluctantly walked away
16-May-15	11:00	Black bear	1	On portal road	Medium to large. Brown	Ben from Dewatering	Yes	Yelling, Honking, Air Horn	Ran away and not seen again
16-May-15	17:00	Black bear	1	Vent raise road	Medium to large. Brown	Shawn Regina	No		
17-May-15	20:00	Black bear	1	Corner of airport road by Dumas	Medium black bear with tan face.	Dumas	Yes	Yelling, Honking, Air Horn, Bear Banger, Bear Screamer	Ran a little ways and then stopped
22-May-15	9:00	Black bear	1	Southwest Dump	medium, black	Ralph Harper	Yes	yelling	Other (detail in notes)

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
22-May-15	14:00	Black bear	1	Aiport road	Medium, Brown	Zoom boom Gary	Yes	Yelling, Honking	Reluctantly walked away
23-May-15	17:00	Black bear	1	Corner of airport road by Dumas	Medium, black	Garry Paarup	Yes	Rubber Bullet	Other (detail in notes)
24-May-15	8:00	Black bear	1	Corner of airport road by Dumas	Medium, black	Dumas?	Yes	Rubber Bullet	Ran away and not seen again
02-Jun-15	7:00	Black bear	1	Km 1.5 Access Road	Black bear	Smalls	No	N/a	N/a
02-Jun-15	12:15	Moose	2	Camp	Cow moose and calf	Warehouse	Yes	Bear Banger	Other (detail in notes)
02-Jun-15	16:00	Black bear	1	km 11	350 lb black bear				
02-Jun-15	16:00	Moose	1	km 9	had pretty heavy tick load w big patches of fue rubbed off its flanks				
23-Mar-15		Snow bunting	>20	hillside west of STP	flocks gathering	Rob Proc			
20-Apr-15	7:30	Wolf	1	km 2	black wolf	Martin Crill			
21-Apr-15	9:30	Trumpeter swans and brandt geese	<150	LTF	flying north high 1/4 had black wings immature brant geese	Martin Crill			
07-May-15	10:45	Mountain blue bird	1	km 27	flew across the road to nest	Norma Alfred/Shaun Roberts			
08-May-15	5:45	Black bear	1	east end of MVF	small black walking away from camp down exploration road	Martin Crill			
09-May-15	10:30	Porcupine	1	km 3	black w/ gold trim	Martin Crill			
10-May-15	8:00	Water shrew	1	W3	swimming on bottom of creek	Shaun Roberts			
09-Jun-15	15:20	Black bear	1	km3	Large, cinnamon coloured	SR/NA	No		
11-Jun-15	14:30	Swallows	>20	Tailings Chute	Flying in and out of mud nests on Tailings Chute	Dan Avar	No	N/a	N/a
10-Apr-15	2:00	Black Bear		KM 19	Heathly good size	Sean, Rocky, Damien	No	n/a	n/a
14-Apr-15	14:30	Brown Bear	1	KM 3	Ran into bush	K Tutin	No	n/a	n/a
16-May-15	16:00	Brown Bear	1	Vent raise road	Ran into Bush	Shawn Regina	No	n/a	n/a
16-May-15	12:30	Black Bear	1	Corner of airport road	He was Relaxing	Barry Hager Sr.	No	n/a	n/a
09-Jun-15	11:50	Black Bear	1	KM 0.5	Walked down the road	Todd, Curt	No	n/a	n/a
06-May-15		Black Bear	1	KM 8.5		Seb T	No	n/a	n/a
08-May-15	9:00	Bank Swallow	1	MVF	1st of the season	Martin Crill	No	n/a	n/a
15-May-15	19:30	Bear& Moose tracks	Lots	7Km-8KM	Fresh tracks on Access rd	R Proc	No	n/a	n/a
24-May-15	11:00	Black bear	1	3KM	Black	J.Reading	No	n/a	n/a
29-May-15	6:00	Black Bear	1	Km11	On road	R.Legh	No	n/a	n/a

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
08-Jun-15	10:30	Bear	1	Airport	Light carmel black bear, walking down air strip	Martin Crill	No	n/a	n/a
12-Jun-15	14:00	Duck and 3 duckling	3	KM0.5	walking across road, Healthy maybe a mallard?	Jasmin Dobson	No	N/a	N/a
29-Jun-15	8:30	Fox	1	Km 13		James Cummings	No	n/a	n/a
30-Jun-15	8:30	Ravens	2	Camp	Two ravens found dead in camp below powerlines.		No	n/a	n/a
30-Jun-15	15:30	Grizzly Bear	1	Km 7	Dissapeared into bush	Seb T	No	n/a	n/a
05-Jul-15	10:30	Mule deer	1	On hill behind ERT	Adult	Dave Heemskerk	No	n/a	n/a
06-Jul-15	20:15	Black bear	1	KM 9	Yearling	Ryan Herbert	No	N/a	N/a
06-Jul-15	20:20	Rabbit/Hare	4	KM 3.5	Medium size	Ryan Herbert	No	N/a	N/a
07-Jul-15	13:00	Deer	1	CWTS	Adult	Daryl Johnston	No	N/a	N/a
07-Jul-15	15:15	Black bear	1	11.5KM	Adult	Truck Driver	No	N/a	N/a
09-Jul-15	19:30	Hare	2	KM 3.5	Medium size. On the road.	Jasmin Dobson	No	N/a	N/a
10-Jul-15	19:00	Hare	1	KM 3.5	Medium size. On the road.	Jasmin Dobson	No	N/a	N/a
11-Jul-15	19:30	Hare	3	KM 3.5	Medium size. On the road.	Jasmin Dobson	No	N/a	N/a
12-Jul-15	12:30	Swallow	2	Fuel farm, generator building	Two nestlings inside a hole in building.	Ryan Silverfox	No	N/a	N/a
14-Jul-15	12:15	Black bear	1	KM 10.5	Small black running into bush	Helaina Moses	No	N/a	N/a
14-Jul-15	13:20	Brown Bear	1	KM 19 on the bridge	Big brown bear heathly.	Helaina Moses	No	N/a	N/a
16-Jul-15	6:00	Grizzly Bear	1	KM 21	Heathly good size	Phillyis	No	N/a	N/a
16-Jul-15	13:30	Black bear	1	KM 12.5	Small black bear running into the bush on the side of the road	Ryan Herbert	No	N/a	N/a
17-Jul-15	13:20	Deer	1	W3 Flume	By flume ran into bushes when spotted me and Phyllis	Helaina Moses	no	N/a	N/a
18-Jul-15	17:45	Black bear	1	Airport road	medium cinnamon. Ran into bush upon seeing vehicle	Chris Harry	yes	Yelling, Honking, Air Horn, Bear Banger	Ran away and not seen again
19-Jan-15	7:45	Red Fox	1	Km 18	on road	Correy Vandine	no	N/A	N/A
19-Jan-15	9:00	Ptarmigan	2	Dyno Rd	Eating willow buds	Correy Vandine	No	N/A	N/A
25-Jan-15	9:03	Ptarmigan	2	Dyno Rd	On Road	Correy Vandine	No	N/A	N/a
09-Mar-15	4:45	Moose	1	Main Camp	In Parking lot	A.Rice	No	N/a	N/a
19-May-15	1:20	Bear	1	Access Road	on the road	A.Rice	No	N/a	N/a
25-Jun-15	1:30	Rabbit/Hare	4	Access Road	on road	Correy Vandine	No	N/a	N/a
23-Jun-15	11:30	Cougar	1	Km 17	walking across road	Barry Hager Sr.	No	N/a	N/a
23-Jun-15	3:30	Brown Bear	1	Km 20	side of road	Wade Howe	No	N/a	N/a
24-Jun-15	10:45	Deer with two fawn	3	Km 4	running down the road	Garry Brown	No	N/a	N/a
17-Jun-15	9:00	Deer	1	Km 9.5	young, healthy, male deer with white tail.	Javad A	No	N/a	N/a
10-Jul-15	5:40	Black Bear	1	Km 22	Adult, Healthy	Ron L	No	N/a	N/a
10-Jul-15	5:55	Moose	1	Km 6	Cow moose and calf	Ron L	No	N/a	N/a
09-Jul-15	19:40	Fox	1	Km 11	Black/Silver	R.Proc	No	N/a	N/a
11-Jul-15	0:10	Porcupine	1	Sherwood	Black/Grey	Devin	No	N/a	N/a
14-Jul-15	12:15	Black bear	1	KM 10.5	Small, ran into bush	Helaina Moses	No	N/a	N/a
14-Jul-15	13:20	Brown Bear	1	Km 19	Big & Healthy	Helaina Moses	No	N/a	N/a
15-Jul-15	12:30	Fox	1	Barge	Skinny, looking for food. Hopped into box off truck. Black/ Orange	Helaina Moses	No	N/a	N/a
17-Jul-15	18:00	Deer	1	Km 1.5			No	N/a	N/a
09-May-15	10:30	Porcupine	1	KM 3	Black wit gold trim	Martin Crill	No	N/a	N/a
10/May/2015	8:00	Water Shrew	1	W3	swimming on bottom of creek	Shawn Roberts	No	N/a	N/a

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
24/Jun/2015	9:00	Blacks Bears	2	KM 13/12	Side of road	Norma Alfred	No	N/a	N/a
14/Jun/2015	9:00	Fox	1	Barge landing		norma Alfred	No	N/a	N/a
4/Jul/2015	9:00	Fawn	1	KM 9	Running on Access road without mom	Ryan Herbert/ Norma Alfred	No	N/a	N/a
7/Jul/2015	11:00	Bear	1		Creeping behide willow bush	ShawnR, NormaA	No	N/a	N/a
20/Apr/2015	7:30	Wolf	1	Km2		Martin crill			
18/Jul/2015	1:00	Bear	2	Dyno Rd	2 bear heading twd duck pond.	Flo Foster	No		
26/Jul/2015	13:00	bear	1	Dumas yard	Cinnamon(black bear) Medium	Dumas	YES	yelling, honking, air horn, bear banger	Ran away and not seen again
27/Jul/2015	6:00	Bear	1	Dumas yard	Cinnamon(black bear) Medium	Dumas	Yes	Bear Banger	Other (detail in notes)
2/Aug/2015	9:00	Mule Deer	1	Infront of ERT	Large beige deer	Colin M	Yes	Other	Ran a little ways and then stopped
2/Aug/2015	14:35	Wolf	1	WMA airstrip corner	med. Grey and white colored wolf. Standing there staring not displaying any type of intimidation	Norma /Jasmin	Yes	Yelling, Honking, Air Horn, Bear Banger	Ran away and not seen again
2/Aug/2015	15:20	Swallows	0	Tailings Chute	All of the swallows have left around the 25th of July	Jasmin Dobson	No	N/a	N/a
4/Aug/2015	8:00	Fox	1	km 5	small, black	Ron Light	No	N/a	N/a
4/Aug/2015	8:05	Rabbit/Hare	2	km 3		Ron Light	No	N/a	N/a
6/Aug/2015	8:00	Ducks	4	A2 Pit		Shaun	No	N/a	N/a
6/Aug/2015	10:00	Swallow	1	Mill Valley Fill	Dead in an empty tote	Jasmin Dobson	No	N/a	N/a
15/Aug/2015	6:00	Deer	1	Safety and Mine Office	Deer tracks only	James Cummings	No	n/a	n/a
20/Aug/2015	14:00	Black bear	1	side of the hill km 9.5	huge size black bear walking up on the hill side into the trees	Chris, Norma, Philly	No	n/a	n/a
22/Aug/2015	10:30	Fox	1	km 6 side of the rd	black and orange, walking into the bushes	Chris, Norma, Philly, Shelby, colin	No	n/a	n/a
24/Aug/2015	10:30	Brown Bears	3	In the bush near 13.5 KM	Sow with two yearlign cubs	Ryan Herbert	No	n/a	n/a
10/Apr/2015	2:00	Black bear	1	crossing single lane bridge	young bear, good condition	rocky, Jean damian	No	N/a	N/a
16/May/2015	7:00	Black bear	1	trail at 4.5 km			No	N/a	N/a
16/May/2015	7:00	Rabbits	4	trail at 4.5 km			No	N/a	N/a
16/May/2015	7:00	Grouse	8	trail at 4.5 km			No	N/a	N/a
21/Jul/2015	7:00	Rabbit	1	road @ 1.5km	good condition	Jim Davis	No	N/a	N/a
6/Jul/2015	11:00	Deer	2	Between ERT and Capstone lodge, heading up to fuel farm	Mother and fawn	Daniel Avar	No	N/a	N/a
8/Jul/2015	19:45:00 AM	Bear	1	water storage pond	grazing in grass close to where 2 blue 45 gallon drums are located	D. Macveen	No	N/a	N/a
9/Jul/2015	8:20	Rabbit	1	km 3	bouncing by across the road		No	N/a	N/a
19/Jul/2015	11:10	Deer	1	south of mill valley	young doe	Benjamin Anderson	No	N/a	N/a
3/Aug/2015	9:30	Deer	1	Mill Valley	ok I guess ran away when I drove by	s. dunfield	No	N/a	N/a
10/Aug/2015	4:30	Fox	1	south wall buttress	walking across buttress, too far away to see any detail	D. Avar	No	N/a	N/a
28/Jul/2015	4:15	Bear	2	km 14	Grizzlies, playing	Jean	No	N/a	N/a
24/May/2015	20:15	Brown bear	1	3.5 km	side of the road, up into trees	James Cummings	No	N/a	N/a
7/May/2015	20:20	Black bear	1	km 1	came up bank to cross road	kelly friensen	No	N/a	N/a

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
27/Jul/2015	20:30	Fox	1	12.5 km	cloudy, rough looking	Pam Blanden	No	N/a	N/a
22/Jul/2015	10:00	Deer	1	21 km	buck on the road	Jennie	No	N/a	N/a
8/Aug/2015	15:00	Fox	1	buttress	walking	heather	No	N/a	N/a
16/Aug/2015	15:30	Bald eagles	2	km 24.5	sitting in tree	R Proc	No	N/a	N/a
16/Aug/2015	16:30	Sandhill cranes	12	D-51	resting/chilling	c.harry	No	N/a	N/a
29/Aug/2015	19:00	Sandhill cranes	Flock	MWD	Flew in and landed on MWD	Jasmin Dobson	No	N/a	N/a
30/Aug/2015	19:00	Fox	1	km16	seemed satisfied with himself, rabbit in mouth	D.Avar	no	N/a	N/a
30/Aug/2015	19:00	Rabbit	1	km16	dead in fox mouth (above)	D.Avar	No	N/a	N/a
6/Sep/2015	19:00	Red fox	1	Km2	Healthy looking, lots of fur. Approached and was not scared	Jennifer Johannsen	Yes	Other	Stayed put and didn't move
6/Sep/2015	19:30	Red fox	1	Km2	Healthy looking, lots of fur. Approached and was not scared	Jasmin Dobson	Yes	Other	Reluctantly walked away
14/Sep/2015	10:30	Black bear	1	Km 9	Healthy looking, big	Ryan Herbert	Yes	Other	Ran a little ways and then stopped
19/Sep/2015	17:30	Red Fox	1	WMA airstrip corner	Healthy looking, ran into bush.	S.Charlie	Yes	Other	Ran a little ways and then stopped
27/Sep/2015	8:00	Deer	3	Behind Mine Tech building	Healthy looking mom and 2 fawns.	Temes Teshale	No	N/a	N/a
27/Sep/2015	9:30	Deer	3	Ramp from ERT to fuel farm	mother and two babies	R. Kerr	No	N/a	N/a
2/Oct/2015	14:00	Deer	3	KM 17	Doe with 2 fawns	Shaun Roberts	No	N/a	n/a
9/Oct/2015	9:30	Moose	3	KM19	Looked like Cow and 2 two older calves	Chris Harry	No	n/a	n/a
10/Oct/2015	0:00	Red Fox	1	East of Warehouse	Pelt approaching prime.	Rob Thompson	Yes	Other	Ran away and not seen again
11/Oct/2015	14:00	Grizzly Bear	1	KM 18	Adult	Truck Driver	No	n/a	Ran away and not seen again
13/Oct/2015	11:00	Wolf	1	KM8	Large black white	Truck Driver	No	n/a	Ran away and not seen again
22/Oct/2015	13:15	Deer	6	KM16	2 does with 2 fawns each	Shaun	No	n/a	Stayed put and didn't move
30/Oct/2015	15:00	Fox	1	Minto North Pit	looked like a fox	Roger	No	n/a	n/a
30/Oct/2015	16:00	Fox	1	Minto North Pit Crest	seemed fine, ran away quickly	Roger H	No	N/a	N/a
30/Aug/2015	11:30	Porcupine	1	beside rec room	large adult	Patrick L	No	N/a	N/a
13/Sep/2015	10:30	Deer	3	Minto North Pit		G. Jackson	No	N/a	N/a
5/Oct/2015	15:40	Fox	1	behind arctic corridor		Kelly Friesen	No	N/a	N/a
8/Oct/2015	19:30	Owl	1	KM3 access road	Big creepy looking, yellow eyes. Brown	Darin Kennedy	No	N/a	N/a
16/Sep/2015	8:00	Fox	1	KM 14.5		James Cummings	No	N/a	N/a
23/Sep/2015	15:00	Sandhill cranes	500+	over the mine		Jasmin Dobson	No	N/a	N/a
4/Oct/2015	13:30	Deer	2	km 16.5	grey brown	Ron Light	No	N/a	N/a
7/Nov/2015	16:00	Cross fox	1	km 10	medium sized	Chris Harry	No	N/a	N/a
8/Nov/2015	13:30	Red fox	1	landfill area	medium sized	Chris Harry	No	N/a	N/a
8/Nov/2015	13:40	Peregrine falcon	1	landfill road	large adult	Chris Harry	No	N/a	N/a
23/Sep/2015	21:00	Fox	1	ore pad		Mark St. Germain	No	N/a	N/a
2/Nov/2015	23:00	Fox	1	garbage cans by portal	adult	Mark St. Germain	No	N/a	N/a
18/Nov/2015	12:00	Fox	1	Area 2 Pit and Nuway intersection	adult	Rick Baker	No	N/a	N/a

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
19/Nov/2015	11:00	Fox	1	Intersection at Area2, Nuway, Main Pit	sniffing around	Kaylie R	No	n/a	n/a
20/Nov/2015	13:00	Fox	1	Airport Road	healthy and fuzzy	Ron L	no	N/a	N/a
21/Nov/2015	9:00	Fox	1	Near Pelly	Healthy, orange, walking toward Nuway	DMc?	No	N/a	N/a
21/Nov/2015	13:00	Fox	1	Selkirk Towers	adult	Todd Epps	No	N/a	N/a
22/Nov/2015	7:45	Fox	1	118 Portal bins	Greyish in colour	Rick baker	No	N/a	N/a
7/Dec/2015	15:00	Fox	1	Bench of Mine Pit	healthy	James Cummings			
9/Dec/2015	15:45	Fox	1	KM 14	red fox	Shelby Charlie	No	N/a	N/a
9/Dec/2015	16:00	Lynx	1	KM9	adult. Healthy looking. Grey/white colour	Shelby Charlie	No	N/a	N/a
14/Dec/2015	9:00	Fox	1	Portal Road/Portal Ore Pad	Walking over freshly dumpled ore piles	R Kerr, D Avar	No	N/a	N/a
22/Dec/2015	15:15	Fox	1	Portal Muster Station		D Avar	No		
27/Dec/2015	13:00	Fox	1	Outside Capstone Parking lot		Qing, Sophie	No		
5/Oct/2016	10:45	Fox	1	between capstone and Mine tech	silver/ black	Sean Darcy	No		
5/Dec/2016	18:15	Fox	1	coming down to mine tech	Red adult, good condition	Serge Pitre	No		
30/Dec/2016	15:00	Fox	1	portal ore pad	Red adult, good condition	T. Monteith	No		

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2015?	Reportable Incident (Yes/No)	Notes
06-Jan-15	14:30	Fox	N/a	n/a	No	Running away with rabbits foot in mouth
18-Jan-15	14:00	Fox	N/a	n/a	No	Not too scared, hazed down road
23-Jan-15	16:00	Moose	N/a	N/a	No	
09-Mar-15	5:00	Moose	N/a	n/a	No	Looking at me
28-Mar-15	19:30	Hare	N/a	N/a	Yes	
28-Mar-15	19:00	Rabbit/Hare	N/a	n/a	No	
28-Mar-15	19:15	Whiskey Jack	N/a	n/a	No	
02-Apr-15	9:00	Squirrel	N/a	n/a	No	
15-Apr-15	19:00	Wolf tracks	N/a	n/a	No	
23-Apr-15	15:00	Grouse	N/a	N/a	No	
25-Apr-15	13:00	Moose	N/a	N/a	Yes	Deceased calf moose carcass visible on a bench on the Main Pit. About a month ago ravens were observed in the same area and individuals saw that they were eating a carcass. Information was just recently passed on to Environment. The bench is not accessible and the carcass is just barely visible.
25-Apr-15	21:30	Black bear	CH	No	No	
26-Apr-15	17:30	Black bear	CH	Potentially	No	Bear was not very scared upon initial hazing, but upon seeing truck the second time around (same hazing event), bear ran immediately
27-Apr-15	15:00	Black bear	JD	Potentially	No	Bear first observed behind camp and walked up on hill behind ERT building. After being hazed it popped up on top of small cliffs above Selkirk Towers. After it saw JD again it walked away and could not be spotted.
27-Apr-15	16:00	Black bear	Safety	Yes	No	Mark Goebel came to haze bear with rubber bullet but was not able to get the shot in
28-Apr-15	13:00	Black bear	Safety	Yes	No	Ryan Silverfox chased into bush with truck. Mark arrived and shot bangers towrds wodded area where bear entered.
29-Apr-15	17:30	Black bear	RH	Potentially	No	Honked horn on truck and chased bear into bush.
04-May-15	17:30	Black bear	CH	Yes	No	honked and yelled bear ran into bush
05-May-15	8:00	Black bear	CH	Yes	No	bear ran away out of site, followed and hazed into bush away from mine site. Stopped hazing when bear went into bush.

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2015?	Reportable Incident (Yes/No)	Notes
07-May-15	10:30	Black bear	N/a	Unknown	No	MC was called out. Went with Dave C, but couldn't find bear. Confirmed that it had been in the TDD, at the Dumas shop end, but had likely moved away when equipment was moved in area.
07-May-15	11:15	Black bear	SR	Yes	No	Bear didn't seemed to worried of noise deterrents, but ran away when chased by the truck. Ran down the SW dump and continued along the base of the dump past the W32 sampling site.
12-May-15	20:00	Black bear		No	No	Bear was on Main Waste Dump in the evening
14-May-15	11:00	Marten		No	No	Ran by us while we were taking a flow at W50
14-May-15	16:00	Black bear	MC	No	No	Sean Darcy got there first and fired off a couple of crackers. Said on radio it wasn't moving, but it soon disappeared.
14-May-15	18:00	Black bear	Safety	Unknown	No	Dave Hazed bear with rubber bullets, and it took off into the trees.
15-May-15	8:15	Black bear	SR	Yes	No	Used bear bangers and screamers, bear ran onto the road and then was chased off the road with the truck. Walked up through the trees towards WMA
15-May-15	10:40	Black Bear	HM	No	No	Bear was sitting in the bushes eating willows didn't budge to loud noises so Dave C deployed a Rubber Bullet. Bear than starting making his way back to the bushes and away from camp
16-May-15	5:58	Black bear	MC	Yes	No	Bear backed off into the bushes but didn't want to leave. I went to Dumas shop & Dave Crottey was there. We discussed and DC said he didn't want to haze bears from the corner - only if they came down the bank towards Dumas shop. He had communicated that to Dumas staff.
16-May-15	10:00	Black bear	JD	Yes	No	Bear only moved over a few feet. The bear was eating grass and keeping to itself. Jasmin went to Dumas shop and gave them an airhorn and asked them to use it and their voices if they are working at the back of the shop. Reminded Jeff and Terry about garbage/food waste with a bear being so close. Left the bear up on the corner and if it got closer asked Dumas to call.
16-May-15	11:00	Black bear	JD	Yes	No	Chased bear with truck off the road and into the woods.
16-May-15	17:00	Black bear		Yes	No	Bear eating grass peacefully near vent raise road.
17-May-15	20:00	Black bear	JD	No	No	Hazed the bear until it left the area near the Dumas shop
22-May-15	9:00	Black bear	Other	Unknown	No	Ralph saw bear by his truck, he yelled and it walked away

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2015?	Reportable Incident (Yes/No)	Notes
22-May-15	14:00	Black bear	Other	Unknown	No	Gary saw bear on road, drove ahead and honked bear walked into bush
23-May-15	17:00	Black bear	Safety	Yes	No	Bear ran into bush after getting rubber bullet, came out down the TDD and got another bullet, ran into bush and was not seen after
24-May-15	8:00	Black bear	Safety	Yes	No	Mark got rubber on the bear and bear ran across road into bush on airport road
02-Jun-15	7:00	Black bear	N/a	Unknown	No	
02-Jun-15	12:15	Moose	JD	No	No	Moose was reported by the propane tanks at the warehouse. Safety/Enviro went to investigate and found the moose at the STP/Selkirk Tower rd intersection turning in towards camp. Safety/Enviro then travelled through camp and by this time the animals had turned back around and went over the bank and into the bush by Selkirk Towers. Shot off one bear banger just in case.
02-Jun-15	16:00	Black bear				
02-Jun-15	16:00	Moose				
23-Mar-15		Snow bunting				
20-Apr-15	7:30	Wolf				
21-Apr-15	9:30	Trumpeter swans and brandt geese				
07-May-15	10:45	Mountain blue bird				
08-May-15	5:45	Black bear				
09-May-15	10:30	Porcupine				
10-May-15	8:00	Water shrew				
09-Jun-15	15:20	Black bear		Unknown	No	Bear was eating grass on the side of the road at km 3. When it saw us it turned around and walked slowly down the power line cut.
11-Jun-15	14:30	Swallows	N/a	No	No	
10-Apr-15	2:00	Black Bear	n/a	No	No	
14-Apr-15	14:30	Brown Bear	n/a	No	No	
16-May-15	16:00	Brown Bear	n/a	No	No	
16-May-15	12:30	Black Bear	n/a	No	No	
09-Jun-15	11:50	Black Bear	n/a	No	No	
06-May-15		Black Bear	n/a	No	No	
08-May-15	9:00	Bank Swallow	n/a	No	No	
15-May-15	19:30	Bear& Moose tracks	n/a	No	No	
24-May-15	11:00	Black bear	n/a	No	No	
29-May-15	6:00	Black Bear	n/a	No	No	

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2015?	Reportable Incident (Yes/No)	Notes
08-Jun-15	10:30	Bear	n/a	No	No	
12-Jun-15	14:00	Duck and 3 duckling	N/a	No	No	
29-Jun-15	8:30	Fox	n/a	No	No	
30-Jun-15	8:30	Ravens	n/a	No	No	Reported to CO, who advised to dispose of carcasses by incineration
30-Jun-15	15:30	Grizzly Bear	n/a	No	No	
05-Jul-15	10:30	Mule deer	n/a	No	No	
06-Jul-15	20:15	Black bear	N/a	No	No	
06-Jul-15	20:20	Rabbit/Hare	N/a	No	No	Hanging out on the side of the road.
07-Jul-15	13:00	Deer	N/a	No	No	
07-Jul-15	15:15	Black bear	N/a	No	No	Reported on radio at 11.5 KM
09-Jul-15	19:30	Hare	N/a	No	No	
10-Jul-15	19:00	Hare	N/a	No	No	
11-Jul-15	19:30	Hare	N/a	No	No	
12-Jul-15	12:30	Swallow	N/a	No	No	
14-Jul-15	12:15	Black bear	N/a	No	No	
14-Jul-15	13:20	Brown Bear	N/a	No	No	
16-Jul-15	6:00	Grizzly Bear	N/a	No	No	
16-Jul-15	13:30	Black bear	N/a	No	No	
17-Jul-15	13:20	Deer	N/a	No	No	Deer has been hanging around in that area, by STP few days ago.
18-Jul-15	17:45	Black bear	HM	No	No	
19-Jan-15	7:45	Red Fox	N/A	No	No	
19-Jan-15	9:00	Ptarmigan	N/A	No	No	
25-Jan-15	9:03	Ptarmigan	N/a	No	No	
09-Mar-15	4:45	Moose	N/a	No	No	
19-May-15	1:20	Bear	N/a	No	No	
25-Jun-15	1:30	Rabbit/Hare	N/a	No	No	
23-Jun-15	11:30	Cougar	N/a	No	No	Second party Beleives it was a grizzly Bear. SS Wade
23-Jun-15	3:30	Brown Bear	N/a	No	No	
24-Jun-15	10:45	Deer with two fawn	N/a	No	No	
17-Jun-15	9:00	Deer	N/a	No	No	
10-Jul-15	5:40	Black Bear	N/a	No	No	
10-Jul-15	5:55	Moose	N/a	No	No	
09-Jul-15	19:40	Fox	N/a	No	No	
11-Jul-15	0:10	Porcupine	N/a	No	No	
14-Jul-15	12:15	Black bear	N/a	No	No	
14-Jul-15	13:20	Brown Bear	N/a	No	No	
15-Jul-15	12:30	Fox	N/a	No	No	
17-Jul-15	18:00	Deer	N/a	No	No	
09-May-15	10:30	Porcupine	N/a	No	No	
10/May/2015	8:00	Water Shrew	N/a	No	No	

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2015?	Reportable Incident (Yes/No)	Notes
24/Jun/2015	9:00	Blacks Bears	N/a	No	No	
14/Jun/2015	9:00	Fox	N/a	No	No	
4/Jul/2015	9:00	Fawn	N/a	No	No	
7/Jul/2015	11:00	Bear	N/a	No	No	
20/Apr/2015	7:30	Wolf				
18/Jul/2015	1:00	Bear			No	
26/Jul/2015	13:00	bear	CP	No		
27/Jul/2015	6:00	Bear	CH	Yes		bear was hiding in bush uopon arrival. Fired banger and screamer in general area
2/Aug/2015	9:00	Mule Deer	SR	Potentially	No	
2/Aug/2015	14:35	Wolf	JD	Yes	No	Might have been same wolf Helaina seen last winter.
2/Aug/2015	15:20	Swallows	N/a	No	No	Note that birds have left site before the end of July
4/Aug/2015	8:00	Fox	N/a	No	No	
4/Aug/2015	8:05	Rabbit/Hare	N/a	No	No	
6/Aug/2015	8:00	Ducks	N/a	No	No	Floating around on the water.
6/Aug/2015	10:00	Swallow	N/a	No	No	Dead. Looked like it had been there for some time.
15/Aug/2015	6:00	Deer	n/a	No	No	
20/Aug/2015	14:00	Black bear	n/a	N/a	No	
22/Aug/2015	10:30	Fox	n/a	N/a	No	
24/Aug/2015	10:30	Brown Bears	n/a	N/a	No	They all ran when they saw truck
10/Apr/2015	2:00	Black bear	N/a	N/a	No	
16/May/2015	7:00	Black bear	N/a	N/a	No	
16/May/2015	7:00	Rabbits	N/a	N/a	No	
16/May/2015	7:00	Grouse	N/a	N/a	No	
21/Jul/2015	7:00	Rabbit	N/a	N/a	No	
6/Jul/2015	11:00	Deer	N/a	N/a	No	
8/Jul/2015	19:45:00 AM	Bear	N/a	N/a	No	
9/Jul/2015	8:20	Rabbit	N/a	N/a	No	
19/Jul/2015	11:10	Deer	N/a	N/a	No	
3/Aug/2015	9:30	Deer	N/a	N/a	No	
10/Aug/2015	4:30	Fox	N/a	N/a	No	
28/Jul/2015	4:15	Bear	N/a	N/a	No	
24/May/2015	20:15	Brown bear	N/a	N/a	No	
7/May/2015	20:20	Black bear	N/a	N/a	No	

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2015?	Reportable Incident (Yes/No)	Notes
27/Jul/2015	20:30	Fox	N/a	N/a	No	
22/Jul/2015	10:00	Deer	N/a	N/a	No	
8/Aug/2015	15:00	Fox	N/a	N/a	No	
16/Aug/2015	15:30	Bald eagles	N/a	N/a	No	
16/Aug/2015	16:30	Sandhill cranes	N/a	N/a	No	
29/Aug/2015	19:00	Sandhill cranes	N/a	N/a	No	
30/Aug/2015	19:00	Fox	N/a	N/a	No	
30/Aug/2015	19:00	Rabbit	N/a	N/a	No	
6/Sep/2015	19:00	Red fox	Other	Unknown	No	Fox had just caught a rabbit and then approached Jen as she was biking by. Did not get fazed by her yelling at it.
6/Sep/2015	19:30	Red fox	JD	Yes		Same fox reported by Jen. Ran across the road in front of us and then stared at us as we went by then started trotting up the road.
14/Sep/2015	10:30	Black bear	RH	Unknown	No	honked at bear and chased it into bush.
19/Sep/2015	17:30	Red Fox	SC	Unknown	No	
27/Sep/2015	8:00	Deer	N/a	N/a	No	Deer ran off site before Environment arrived
27/Sep/2015	9:30	Deer	N/a	N/a	No	
2/Oct/2015	14:00	Deer	n/a	Unknown	No	Ran into the trees and just stood there and watched me
9/Oct/2015	9:30	Moose	n/a	n/a	No	Went into bush when vehicle approached
10/Oct/2015	0:00	Red Fox	Other	Unknown	No	
11/Oct/2015	14:00	Grizzly Bear	n/a	Unknown	No	
13/Oct/2015	11:00	Wolf	n/a	Unknown	No	Biggest wolf ever seen by truck driver.
22/Oct/2015	13:15	Deer	n/a	Unknown	No	
30/Oct/2015	15:00	Fox	n/a	Unknown	No	
30/Oct/2015	16:00	Fox	N/a	Unknown	No	
30/Aug/2015	11:30	Porcupine	N/a	N/a	No	
13/Sep/2015	10:30	Deer	N/a	n/a	No	Doe and 2 fawns
5/Oct/2015	15:40	Fox	N/a	n/a	No	running into woods
8/Oct/2015	19:30	Owl	N/a	n/a	No	
16/Sep/2015	8:00	Fox	N/a	n/a	No	healthy silver fox
23/Sep/2015	15:00	Sandhill cranes	N/a	n/a	No	2 flocks
4/Oct/2015	13:30	Deer	N/a	n/a	No	
7/Nov/2015	16:00	Cross fox	N/a	n/a	No	hunting
8/Nov/2015	13:30	Red fox	N/a	n/a	No	walking around. Ran when I approached with truck
8/Nov/2015	13:40	Peregrine falcon	N/a	n/a	No	flying/ hunting. Landed in tree, took off when truck approached
23/Sep/2015	21:00	Fox	N/a	n/a	No	
2/Nov/2015	23:00	Fox	N/a	n/a	No	seeemed to be an adult. Snowing lightly
18/Nov/2015	12:00	Fox	N/a	n/a	No	

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2015?	Reportable Incident (Yes/No)	Notes
19/Nov/2015	11:00	Fox	n/a	N/a	No	
20/Nov/2015	13:00	Fox	N/a	N/a	No	
21/Nov/2015	9:00	Fox	N/a	N/a	No	
21/Nov/2015	13:00	Fox	N/a	n/a	No	
22/Nov/2015	7:45	Fox	N/a	n/a	No	Hanging around the waste bins at the portal
7/Dec/2015	15:00	Fox				
9/Dec/2015	15:45	Fox	N/a	N/a	No	Ran across to the road to the river.
9/Dec/2015	16:00	Lynx	N/a	N/a	No	Hanging out on the side of the road.
14/Dec/2015	9:00	Fox	N/a	N/a	No	
22/Dec/2015	15:15	Fox			No	
27/Dec/2015	13:00	Fox			No	
5/Oct/2016	10:45	Fox			No	adult in good condition
5/Dec/2016	18:15	Fox			No	
30/Dec/2016	15:00	Fox			No	

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?	Who performed the hazing?	Has this animal been hazed in 2016?	Reportable Incident (Yes/No)	Notes
1-Jan-16	16:00	Fox	2	Road to MCDS	Two healthy looking red fox	SC	Yes	Yelling, Honking, Air Horn	Reluctantly walked away	CH	Unknown	No	One fox ran up the hill and watched but the second did not seem nervous of the vehicle or people.
12-Jan-16	13:00	Wolf tracks	4+	LTF	tracks throughout site	GB	no					no	Garry Brown reported tracks at LTF area ,he suspects a pack came through. Track evidence confirms.
12-Jan-16	late night	Wolves	8	Landfill	Looking around for moose or rabbits	Unknown	no						
19-Jan-16	11:30	Wolf tracks	unkown	MN repeater shack	tracks throughout site	Shawn Regina	no					No	no animal seen, only multiple sets of tracks
21-Jan-16	11:15	Wolf	1	Big creek bridge	Black	Shaun	no					No	Trotted along road in front of me till it got to the other side of the bridge and then ran down into the ditch.
17-Feb-16	11:30	Squirrel	1	Camp	Good condition-nice coat. Adult.	Molly	No						
9-Mar-16	19:00	Fox	1	Behind Selkirk Towers	Looked healthy, dark coat. Adult.	Javad	No						
21-Mar-16	9:00	Dunlin	40	Portal	Flock of sandpiper/dunlin	Jasmin	No						
21-Mar-16	14:00	Mule Deer	3	km 24	Doe. Good Shape.	K. Tutin	No					No	
25-Mar-16	11:30	Squirrel	1	ERT Building	Ran past building	DK	No						
18-Apr-16	17:50	Bear	1	km 3	Nice and healthy black bear	Barry Hager	No						
18-Apr-16	11:00	Bear	1	New LTF	Big brown bear (black bear)	Danny Toews	Yes	Bear Banger	Ran away and not seen again	Safety	No	No	First haze of the season. Bear headed into forest below LTF.
18-Apr-16	19:00	Bear	1	km 6.5 Access Rd	Black Bear	James Cummings	No				Unknown	No	
18-Apr-16	19:00	bear	1	6.5km	black	James C							
22-Apr-16	17:00	Bear	1	km 25	Black Bear. Fat. Ran across road.	K. Tutin	No					No	
22-Apr-16	22:00	Bear	1	Pelly Laydown/ MWD	black bear (cinnamon)	Lucas Macleod	no				Unknown	No	Lucas reported bear jumped berm and went into Pelly laydown, by the time Chris got there Pelly shifter Greg Copp said that the bear had gone back to the MWD area, took a drive around and did not spot the bear. Apparently this bear is seen eating grass on the MWD almost nightly.
23-Apr-16	11:00	Bear	1	Dumas/ Airport corner	black bear (cinnamon)	Zoom boom Garry	no				No	No	bear spotted by operator, enviro responded and observed bear in bush eating willows. Informed all personnel working in area of bear in area.
23-Apr-16	13:00	Grouse	1	dyno access road	ruffed grouse hen	Corey Van D							sitting in middle of road
24-Apr-16	16:00	Bear	1	Dumas/ Airport corner	black bear (cinnamon)	Enviro	Yes	Bear Banger	Other (detail in notes)	CH	No	No	Bear ran across road towards portal. Followed it and shot another bear banger scaring it into thick bush. Was not seen again after.
25-Apr-16	7:30	Moose	2	km 10.5	Scruffy. Thin.	K Tutin	No					No	
25-Apr-16	20:00	Bear	1	WSP	Black bear. Seen from a distance.	Javad	No						
26-Apr-16	14:00	Geese	7	Yukon River	Heading up river	K. Tutin	No					No	
27-Apr-16	8:45	Black Bear	1	Dumas	Side of Dumas shop	Daniel Alfred	No						
27-Apr-16	8:45	Grizzly Bear	1	Km 23.5	Blonde feeding on hillside	K. Tutin	No						
29-Apr-16	11:30	Black Bear	1	Dumas/ Airport corner	black bear (cinnamon)	Dumas	Yes	Rubber Bullet	Other (detail in notes)	Safety	Yes	No	Bear was hazed out of area but returned the next day.
29-Apr-16	14:30	Bear	1	magazine access	brown	Dale W						No	walking up access road to magazines
2-May-16	10:00	Bear	1	Pelly Laydown/ MWD	black bear (cinnamon)	Fountain Tire / Pellu	Yes	Yelling, Honking, Air Horn, Bear Banger	Other (detail in notes)	CH	Yes	NO	Bear had moved from the Pelly laydown by the time we arricved and was spotted on the IROD area heading west. It was hazed and took off toward the sewage lagoon running.
5-May-16	0:30	Bear	1	Dumas/Airport Corner	Big brown bear (black bear)	Dumas	Yes	Bear Banger		CB	Yes	No	Bear got into food garbage. Hazed with bangers to move away from area.
5-May-16	9:25	Bear	1	Dumas/Airport Corner	Big brown bear (black bear)	Dumas	Yes	Bear Banger		DF	Yes	No	Bear was seen behind the shop. Responded with Safety, did not see the bear but used banger to ensure bear had moved from the area.
6-May-16	18:00	Bear	1	around km1	black bear		Yes	Bear Banger	Reluctantly walked away	SC	Unknown	No	the bear reacted with little more than a slight startle response before slowly ambling away.
7-May-16	11:00	Bear	1	lagoon area north of SWD	silver-brown black bear (colouration looks like grizzly, no notable grizzly morphology though)	Unknown	Yes	Bear Banger	Ran a little ways and then stopped	CP	Unknown	No	bear's response was sufficient given the area and distance from hazer.
9-May-16	11:00	Black Bear	1	Southwest dump near Pelly Laydown		Mine Tech	No					No	
11-May-16	18:00	Black Bear	1	Road to airstrip near Dumas shop	medium black bear with lighter fur right around the nose	site services	yes	Rubber Bullet	Reluctantly walked away, but immediately began trying to make its way towards Dumas shop once pursuit ceased. This behaviour continued after the bear was shot with 4-5 rubber bullets	CP	Yes	No	This is likely the same bear SC and SR saw at km 1, and the same bear that has been getting into garbage at Dumas shop last year and this year.
12-May-16	18:00	Rabbits	3	road down from radio repeater	All looked healhty and plump.	Chris	No						
12-May-16	18:00	Squirrel	2	road down from radio repeater	All looked healhty and plump.								
12-May-16	11:30	Bear	3	Airstip	Sow and 2 cubs	Pilots	no	N/a	N/a	N/a	No	No	Bears had move off before responders arrived.
14-May-16	6:30	Bear	1	dyno access road	Brown	Cris						no	big, brown in good shape
17-May-16	20:00	Dall Sheep	26	Yukon River	Healthy looking heard. 3 new lambs.	DK	No						
20-May-16	6:40	Moose	1	km 20	Skinny. 2" spike antler - bull	K. Tutin	No						
20-May-16	19:30	Rabbit	1	Km 3.5	Appeared healthy.		No						
21-May-16	20:00	Rabbit	2	Trail	Healthy	R	No						
26-May-16	12:45	Bear	2	Dyno road	2 young bears	Dewatering Tim	Yes	Yelling, Honking, Air Horn	Reluctantly walked away	CH	Unknown	No	Black bears. One brown one black. Approx. 1.5 yrs old
26-May-16	13:30	Bear	2	Dyno gate	one brown , one black	Dale, Corey, Tim, Brendan, Chris H						No	
27-May-16	9:00	Fox	1	KM 1			Yes				Unknown	No	packing dead rabbit, Sunny, chased it away by driiving towards it and honking
28-May-16	17:30	Bear	1	dyno road	brown	Corey, Dale						No	brown bear on road
29-May-16	10:00	Fox	1	Minto North haul road		Roger / Brendan	No					NO	just normal fox
31-May-16	13:00	Bear	1	dyno road	black	Corey						No	black bear on road
2-Jun-16	14:38	Moose	3	km 9.5	cow and two calves	CP	no	N/a	Ran away and not seen again	N/a	No	No	The cow was quite wary of any approach
5-Jun-16	19:30	Bear	1	Km 12	Young adult black bear. In ditch.	Molly	no						
5-Jun-16	20:00	Deer	1	Km 16	Female - adult	Molly	no						
6-Jun-16	18:30	Wolf	1	Near Minto North	Adult at the Yield sign at top of Minto north haul road	Emma/Steve/Jason	No					No	walked across haul road
11-Jun-16	6:30	Deer	2	Confluence		Steve/Roger/Emma/Curtis	No					No	
14-Jun-16	6:30	Deer	2	MWDE		Steve/Roger/Emma/Curtis	Yes	yelling	Reluctantly walked away	Steve/Roger/Emma/Curtis	Unknown	No	Yekled at them to get out of here!
20-Jun-16	12:30	Bear	1	km 8	brown	Javad A						No	young looking , black bear but in brown
20-Jun-16	6:15	Deer	1	UG ore stockpile		Ryan/Dave/Emma/Matt						No	Running through stockpile, startled by pickup
21-Jun-16	8:45	Bear	1	near portal	small/ med. Black (brown) bear	Brandon M	Yes	Yelling, Honking, Air Horn, Bear Banger	Ran away and not seen again	CH	Yes	No	
24-Jun-16	10:30	Fox	1	KM 5		Molly	No					No	eating a rabbit (road kill)
27-Jun-16	11:45	Deer	1	above electrical dept. on cliff		Georgie-Ann S						No	eating plants
30-Jun-16	10:15	Black Bear	1	km 6.5 Access Rd		Kelly							
30-Jun-16	10:18	Rabbit	1	km 5		Kelly	No					No	crossed the road
1-Jul-16	10:00	Deer	1	warehouse laydown	medium sized doe	Shaun	no						Ran through warehouse laydown onto drystack tailings
2-Jul-16	9:00	Mouse	1	office		Rob/Roisin/Brandon	No					No	scared little guy, caught and set free outside, he is now happy

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?	Who performed the hazing?	Has this animal been hazed in 2016?	Reportable Incident (Yes/No)	Notes
4-Jul-16	6:00	Deer	2	mine tech building	small	Shaun	no						Ran up towards fuel farm when I drove by
7-Jul-16	19:45	Moose	2	By pelly office		Melanie Jim							Cow and Calf
8-Jul-16	12:40	Moose	2	960 bench headed toward pit		Melanie Jim							Cow and Calf
9-Jul-16	10:00	Black Bear	1	Barge landing		Kevin Tutin	no						Swam across river (east) at 10am and back across (west) at 4pm
10-Jul-16	20:00	Deer	3	Beside sewage treatment plant	A doe and 2 fawns	Anthony Grennan	No	n/a					
13-Jul-16	10:30	Deer	1	Between capstone and ERT	brown and white	Manny	No					No	
15-Jul-16	7:00	Grizzly Bear	2	Vent raise (portal area)	Sow and 1 cub	site services	No	n/a	Ran away and not seen again	n/a	Unknown	No	
16-Jul-16	8:20	Deer	1	warehouse laydown	Female - adult	Chris Harry	Yes	Yelling, Honking		CH		No	ran on to drystack
16-Jul-16	10:00	Black Bear	1	Landfill	small/med. (2-3 yr) black bear (golden on top).	Chris Blurton	Yes	Yelling, Honking	Other (detail in notes)	CB	Potentially	No	Ran away and not seen in landfill area again. Ran up hill into trees on airstrip side of landfill
16-Jul-16	13:30	Black Bear	1	Exploration laydown	small/med. (2-3 yr) black bear (golden on top).	Chris Blurton	Yes	Yelling, Honking	Ran away and not seen again	CB	Yes	No	Assay lab technician working in area cutting cores. Was told by others prior that bear had been seen in area.
16-Jul-16	2:30	Rabbit	1	821 bench		Melanie Jim							
17-Jul-16	15:30	Bear	1	Dyno AN storage		Cris							brown colored black bear
18-Jul-16	3:35	Mouse	1	above office		Melanie Jim							
19-Jul-16	22:50	Deer	1	948 bench, went off on ATV trail		Melanie Jim							
19-Jul-16	23:55	Bear	1	948	brown	Melanie Jim							brown bear cub
19-Jul-16	13:00	Bear	1	Portal ore pad			No				Unknown	No	smallish black bear with brown coat, kept wandering past
20-Jul-16	6:30	Mouse	1	Mine tech office corridor	very large mouse		no					No	Roger/Matt
29-Jul-16	12:51	Wolf	1	behind DSTF on TDD	large, grey,	Dal e hefferan	No					No	looked healthy, took off right away
7-Aug-16	19:00	Fox	1	Ramp to nuway stockpiles	sooty black coat	Emma trusz	No					No	Not enjoying the hot weather.
11-Aug-16	10:00	Chipmunk	1	rec room		Kelly	No					No	Ended up in camp. Got it out by directing it to an exit.
22-Aug-16	9:45	Black Bear	1	6.75km		James C	No					No	Big and healthy
30-Aug-16	19:00	Wolverine	1	between W3-W7	Tracks along the road	Shelby B	No						
5-Sep-16	13:00	Black bear	1	Dyno	good, walking, adult	Yogi	No	n/a	n/a	n/a	N/A	No	
20-Sep-16	10:00	Bear	1	WSP		Tim piironen	no					No	swimming from one side to the other side.
24-Sep-16	10:00	Wolf	1	waste dump	bull moose waste dump	Casey & Dave	No	n/a	n/a	n/a	N/A	No	
17-Oct-16	20:30	Fox	1	Kitchen smoke shack		Harley	No					no	Standing there looking around
20-Oct-16	15:00	Fox	1	capstone bunk	Young, healthy	Javad A	No					No	
20-Oct-16	17:00	Fox	1	capstone bunk	Healthy	JM Glynn	No					No	not afraid
24-Oct-16	14:00	Fox	1	SWD	Healthy, good size	Dale heffernan	No					No	
31-Oct-16	15:00	Fox	1	Km 15 on access rd	Young, healthy	Shelby B	Yes	Yelling	Ran a little ways and then stopped	SC	Unknown	No	
31-Oct-16	16:30	Fox	1	ERT Building		Melissa Cook	No						
2-Nov-16	10:00	Fox	1	S. Selkirk tower	Small, red, good condition	Sean D	No					No	Ran away
7-Nov-16	13:00	Fox	1	KM 4 on access road	Found dead (ran over)	Steve Maunder	No	n/a		n/a	Unknown	Yes	Reported to Environment Yukon (Conservation Office)
7-Nov-16	13:00	Fox	1	Dumas	reddy brown and white	Chris Blurton	No	n/a	Ran away and not seen again	n/a	Unknown	No	Was crossing Dumas yard. Ran away when I passed in the vehicle.
7-Nov-16	14:30	Grizzly Bear	1	KM 12.5 on access rd	Large	Michael Janssens (General Waste Mgmt)	No	n/a	Ran away and not seen again	n/a	Unknown	No	Crossed the road
18-Nov-16	17:00	Fox	1	Camp	red medium sized. Darker(brown) patch on top of lower back.	The Todd	Yes	Yelling, Honking, Air Horn	Reluctantly walked away	SC	Unknown	No	Eventually went down the access road. Possibly will come back.
22-Nov-16	14:30	Fox	1	Kitchen smoke shack		Harley	no					No	Walking by
28-Nov-16	17:00	Fox	1	Mine road by Dumas	Red Medium. Darker spot on lower back.	Shelby B	Yes	Yelling, Honking	Other (detail in notes)	SC	Yes	No	Charged at us when hazing. Does not seem to have fear of humans.
5-Dec-16	14:00	Lynx	1	Fresh air / vent raise	Large, healthy looking, grey	David Crottey	No	n/a	Ran away and not seen again		Unknown	No	It bound across the road and into the bushes.
9-Dec-16	11:30	Red fox	1	main pit	healthy looking, oung	Javad A	No	n/a	n/a	n/a	N/A	No	
10-Dec-16	10:30	Wolf	2	DYNO	one mostly grey and medium/large. One larger and grey with brown fur	Austin	Yes	Yelling	Reluctantly walked away	CH	Unknown	No	jumped up bank from behind shop when I entered the yard with truck. Stood at top of bank in willows and looked at us for a bit then walked into the willows and out of sight when I yelled.
10-Dec-16	10:00	Wolves	2	dyno yard	dark brown, black/grey	Dustin, Chris Harry	No	n/a	n/a	n/a	N/A	No	
12-Dec-16	14:30	Red fox	1	camp (between gym and smoke pit)	healthy	Georgie-Ann S	No	n/a	n/a	n/a	N/A	No	
13-Dec-16	12:00	Fox	1	Underground fuel tank pad		David Avar	No					No	
13-Dec-16	14:30	Ptarmigan	1	Met station	White	Chris Blurton	No	n/a		n/a	Unknown	No	Was eating / searching for food
17-Dec-16	11:15	Lynx	1	KM 16	Large, Grey, healthy	Shaun	No	n/a		n/a		No	sat on the side of the road and watched me drive by
17-Dec-16	13:40	Lynx	5	W3	Small, grey	Shaun	No	n/a		n/a		No	4 young ones and the mother
23-Dec-16	14:00	Fox	1	Behind Portal Road, around area 2	Healthy, good size	D. Hefferman	No						
31-Dec-16	15:00	Caribou	unk	km21	Tracks from small herd	Larry Smith / Dan Toewes	No	n/a		n/a	N/A	No	The tracks were reported to have been seen near km 21 on the Minto Mine Access Road. Approx coordinates: 62 35' 57.23N 136 58' 55.82W Reported to Environment Yukon

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
1-Jan-17	7:50	Fox	1	Capstone East entrance	Red	Jean Lagarde	No	N/A	Other (detail in notes)
5-Jan-17	11:30	Fox	1	Airport Road near the core shack	Red	Roger H.	No	N/A	Other (detail in notes)
5-Jan-17	13:30	Fox	1	Minto North	Red/Orange	Chris Blurton	Yes	Yelling, Honking	Ran away and not seen again
8-Jan-17	10:30	Fox	1	Surface Magazine		Ryan S.	No		
15-Jan-17	12:40	Fox	1	Burn Pit	Red	Deborah Flemming	Yes	Yelling	Ran away and not seen again
19-Jan-17	16:00	Fox	1	Portal		Roger H.	No		
20-Jan-17	13:00	Fox	1	Surface Magazine		Emma T.	No		
10-Feb-17	17:30	Fox	1	A2S3 Pit		Kathy Alfred	No		
11-Feb-17	9:40	Moose	2	Jump ramp A2S3	Large moose	Doug McIlveen	No		
24-Feb-17	9:00	Fox	1	Access Rd. Km 0.8		Dale H.	No		
24-Feb-17	17:35	Fox	2	KM 0.75	Red	Ryan/ Chris	No		
24-Feb-17	21:30	Fox	1	Pit, 823 Bench		Kevin F. (Kerri F.)	No		
25-Feb-17	14:25	Lynx	5	W3 area	momma and four kittens	Chris Harry	No		
11-Mar-17	13:45	Fox	1	Dry Stack	Healthy, red	Shelby Black	Yes	Yelling, Honking	Ran a little ways and then stopped
22-Mar-17	10:00	Lynx	1	km 16		Ryan H	No		
25-Mar-17	16:15	Bald Eagle	1	km 22	Healthy adult in tree	Chris Harry	No		
25-Mar-17	15:30	Otter	1	Big Creek Bridge	Tracks in snow on river	Todd Swenson	No		

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
31-Mar-17	15:45	Deer	8+	KM 24	on side of road	CH/EB	No		
1-Apr-17	10:00	Rabbit	1	Airstrip SS course	white	CH/EB	No		
1-Apr-17	11:00	Rabbit	1	Dyno SS course	white	CH	No		
17-Apr-17	17:30	Bear	1	0.5 km	Cinnamon Black Bear	Maintenance	Yes	Bear Banger	Ran from banger a little ways and then slowly walked off
19-Apr-17	14:38	Bear	1	3.5Km	Cinnamon Black Bear	Chris Harry	No		
19-Apr-17	16:45	Lynx	1	Landfill/LTF entrance	Adult	Chris Harry	No		
1-May-17	19:00	Bear	2	near km2	Sow and Cub (black bear)	Chad Bustin	No		
5-May-17	11:00	Bear	1	Airport Road (top of Dumas)	Light brown, healthy (Black Bear)	Garry Brown	Yes	Bear Banger	No reaction to first BB, walked off after others into bush towards landfill.
5-May-17	11:30	Bear	3	KM 9 hill	Sow and 2 cubs	Shaun	No		
6-May-17	12:20	Lynx	1	W2	Light grey	Shaun	No		
6-May-17	11:50	Bear	1	Airport Road behind Dumas	Light brown, healthy (Black Bear)	Dumas	Yes	Rubber Bullet	We tried bear bangers first, it didn't affect him too much. When he got hit by the bullet fired by Sean Darcy he ran.
7-May-17	18:30	Bear	1	Behind Selkirk Tower	Dark Brown (Black Bear)	Electrical Larry	Yes	Bear Banger	Bear went into bushes behind Dry
8-May-17	19:00	Bear	1	Sewage Lagoon Road	Light brown, healthy (Black Bear)	Greg from Pelly	Yes	Bear Banger	Ran into bishes behind Mags
9-May-17	13:00	Moose (Cow and Calf)	2	Km 2.5	Healthy Cow moose and year old calf. Both healthy and grazing	Shelby Black	Yes		Honked to try and get them to move off the road
19-May-17	13:30	Bear	1	Dyno road	Large Cinnamon Black bear	Austin	No		
19-May-17	9:00	Black Bear	1	airport road	small black bear w/ tan on nose	unknown	Yes	Other	ran immediately
20-May-17	10:15	Black Bear	2	Dyno	one was larger cinnamon, the other was slightly smaller and all black with tan on the muzzle.	Brett (mechanic)	Yes	Rubber Bullet	the cinnamon bear ran immediately, the black one moved away slowly at first, but began responding much better after being hit with a rubber

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
24-May-17	16:30	Black Bear	1	Willows behind Dumas Shop	Small Black Bear ~250 lbs	unknown	Yes	Other	Animal responded hesitantly to being chased by vehicle. Showed respect for humans and wandered away. Chased beyond open areas into bush.
24-May-17	22:15	Black Bear	1	Willows behind Dumas Shop	black bear - approx 300-350 lb, light brown with silver/grey	Dumas	Yes	rubber bullet, bangers	bear quickly moved away after being shot with rubber. Continued to show warieness and moved away when confronted.
28-May-17	23:00	Black Bear	1	Willows behind Dumas Shop	small black bear w/ tan on nose	Dumas	Yes	rubber bullet, bangers	bear began running before hazing began, was hit by rubber bullets.
1-Jun-17	14:00	Black Bear	1	Km 0.75	Dark Brown (Black Bear)	Deborah Flemming	Yes	Other	bear wondered up the bank towards
1-Jun-17	14:15	Fox	1	WSP	cross-fox, dark colouring with white-ended tail	Deborah Flemming	No		seen going around the WSP
3-Jun-17	15:00	Ermine	1	top of WSP dam	small weasal, approx. 15 cm.long, brown back and head, white belly, dark tipped tail	Deborah Flemming	No		
24-Jun-17	7:45	Bear	1	Dumas shop (behind)	Light brown, healthy (Black Bear)	Driver	Yes	rubber bullet, bangers	ran into bush and then across clear cut into woods
25-Jun-17	19:30	Black Bear	1	Km 1.7	Young, tall/lanky very aggressive and predatory male.	Darrin Kennedy	Yes	Other	Approached and charged worker
27-Jun-17	8:00	Fox	1	Km 10	Dark grey fox, with a rabbit in its mouth	Emilie Bouchard / Chris Harry	Yes	Other	Hid and ran away with its breakfast
23-Mar-17	9:00	Red fox	1	Selkirk Towers		Rob Proc	No	N/A	n/a
8-Apr-17	5:30	Rabbit	1	warehouse		Marcus Lenz	No	N/A	n/a
3-May-17	10:00	Bear	1	airport road	passing through going north	Garry Brown	No	N/A	n/a
14-May-17	12:30	Black Bear	1	access road between 0.5 and 1.0	just chilling	Thomas Gammel	No	N/A	n/a
25-Jun-17	11:00	Deer	1	crusher pad	walking around	stan gostel	No	N/A	n/a
23-Jun-17	13:00	Seagull	1	barge	seagull ate 5 ducklings	Garry Brown	No	N/A	n/a
3-Jun-17	11:30	Bear	1	km 0.8			No	N/A	n/a
8-Jan-17	10:00	Fox	1	bicycle shack	ran away	Wendy Bade	No	N/A	n/a

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
16-May-17	19:30	Black Bear	1	km 3.5	headed south	Ryan Herbert	No	N/A	n/a
18-May-17	20:30	Black Bear	1	km 3		Troy Loren	No	N/A	n/a
13-Jun-17	2:30	Fox	1	haul road by buttress	ran down towards buttress	Robin Ellis	No	N/A	n/a
25-Jun-17	7:58	Bear	1	km 1.7		PK	No	N/A	n/a
26-Jun-17	21:15	Deer	1	in camp	skittish	Troy Loren	No	N/A	n/a
18-Jan-17	10:45	Bull moose	1	Airstrip	walking around	Ryan S.	No	N/A	n/a
17-Feb-17	5:00	Lynx	1	km 6	good shape, running for hills	K Tutin	No	N/A	n/a
15-Apr-17	6:30	Porcupine	1	walking along berm by W15	great big sucker	Ryan S.	No	N/A	n/a
17-Apr-17	17:20	Bear	1	km 0.5	walking around	Todd Epps	No	N/A	n/a
22-Apr-17	17:05	Bear	1	WMA	checking out pallet of buckets	Danny VB	No	N/A	n/a
3-May-17	10:15	Black Bear	1	below air strip		Robin R	No	N/A	n/a
26-May-17	14:00	Wolf	1	km 18	white, scruffy	Robin R	No	N/A	n/a
27-May-17	8:10	Mule deer	1	0.5	healthy looking doe	Robin R	No	N/A	n/a
5-May-17	2:00	Grey wolf	1	Pelly	ran away	Janet	No	N/A	n/a
3-Jun-17	14:00	Black Bear	2	airport road	left towards the bush opposite side of dumas	Janet	No	N/A	n/a
20-May-17	11:00	Black bears	2	black, cinnamon		Foster, Chris H	Yes	Rubber Bullet	both bears showed significant wariness and ran from hazer
25-Jun-17	8:00	Porcupine	1	Dyno gate		gerard	No	N/A	n/a
30-Jun-17	8:30	Black Bear	1	Portal Road	Beautiful cinnamon coloured, big black bear	Emilie Bouchard	Yes	Other	Noise making with the truck honk, was sufficient to get him moving,
30-Jun-17	8:35	Fox	1	Dumas shop (behind)	Dark grey fos with a mouse/rodent in its mouth	Emilie Bouchard	Yes	Yelling, Honking	Ran away
4-Jul-17	13:20	Ravens	3	Warehouse Yard	3 Ravens were picking in the calcium chloride bag	Ryan Faulds	Yes	Yelling	They flew away, not very far but nonetheless away. Hopefully they
12-Jul-17	21:30	Black bear	1	In front of camp, DSTF and Dumas	Large brown bear	Sodexo	yes	Yelling, Honking	Walked into bush
27-Jul-17	8:15	Black Bear	1	Access Road 18.75km	black bear	Ron Light	No	N/a	n/a
9-Jul-17	9:15	Black Bear	2	Access Road 7km	Sow & Cub	Site Services	No	N/a	n/a
9-Jul-17	8:30	Black Bear	1	Access Road 15km	black bear	Site Services	No	N/a	n/a
20-Jul-17	8:45	Black bear	1	Behind Selkirk Tower	black bear	Colin Prentice	Yes	bear banger	n/a
24-Jul-17	20:30	Black Bear	1	Trails above camp	Tall thin Black bear (young)	David Grennan	Yes	Yelling, Throwing Rocks, Charging	At first was non-responsive and aggressive. After David and Dan elevated their own aggression, the
27-Jul-17	15:00	Frog	1	Tailings Pond	Body ~7cm long	Jen Johannson	No	N/a	n/a
28-Jul-17	6:30	Black Bear	1	Dumas shop (behind)		Tim	No		wondered off into bush
29-Jul-17	10:35	Black Bear	3	Landfill	Sow and 2 cubs	Site Services	Yes	Bear Banger	All 3 wandered off as soon as the vehicle pull in

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
29-Jul-17	11:00	Black Bear	1	Dumas shop (behind)	Black bear	Emilie Bouchard	No	N/A	He took off by the time I got to him. I just saw him from the corner of my
1-Aug-17	10:30	Black Bear	1	Corner between Driftwood and Airstrip	Smaller bear, possibly young, sandy coloured body with darker legs	Ryan Faulds	Yes	Bear Banger	The bear moved slowly away towards the WMA, we lost sight of the bear but used a bear banger at 11am in the direction to encourage continued movement from the area.
1-Aug-17	16:30	Black Bear	1	Main Waste Dump Expansion	black	Pelly	No	N/A	n/a
2-Aug-17	14:05	Black Bear	1	W33	Light body with dark legs	Emilie Bouchard	Yes	Bear Banger	The bear wandered off into the brush when the banger went off
4-Aug-17	8:00	Black Bear	1	Core Shack	Light body with dark legs	Danny VB	Yes	Bear Screamer	The bear moved slowly towards the airstrip following the 1st screamer. Hazing continued with a banger - moving the bear the to the east of the strip where it sat and started to eat berries. Hazing continued with a blank banger and then a banger that moved the bear off in a down valley
4-Aug-17	16:00	Black Bear	1	Portal	no description provided	Frank Z	No	N/a	n/a
6-Aug-17	5:50	Fox	2	OB dump behind Pelly	red foxes	Deborah Flemming	No	N/a	n/a
6-Aug-17	13:30	Deer	1	WMA	Small adult deer	Danny VB	No	N/A	n
19-Aug-17	10:30	Fox	1	Main Waste Dump east of Pelly	Friendly Red Fox	Todd Swenson	Yes	Yelling	Ran off a short distance. Animal was looking expectantly and curious about rocks tossed near it. Showing potential signs of improper conditioning.
21-Aug-17	8:00	Bear	1	Dumas Corner	unknown	Tim (Dewatering)	Yes	bear banger	unknown
22-Aug-17	8:00	Black Bear	1	WMA	black throughout, 250-300lbs	David Grennan	Yes	rubber bullets	The bear did not want to leave the WMA. After being shot once, it seemed to retreat into the bush. However, after a few minutes it
22-Aug-17	17:00	Black Bear	1	WMA	black throughout, 250-300lbs	Jean Lagarde	Yes	rubber bullets	The bear appeared to be warier than this morning. Ran a few feet when hit the first time, continued running when we approached. Still didn't go far, as it was spotted on the airport
23-Aug-17	15:00	Black Bear	1	STP	Black throughout	Gary Brown	Yes	Bear Bangers	the bear ddint stick around when the banger went off
23-Aug-17	17:25	Black Bear	1	STP/Camp	Dark brown with a light chest patch	David Grennan	Yes	Bear Bangers	The bear mosied off up the hill in no great hurry. He was spotted by the smoke shack close to the ice rink, but when someone opened the door he hurried down the hill towards the STP. That's where Safety and

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
23-Aug-17	19:00	Black Bear	2	STP/Camp	Dark brown with a light chest patch	Chris Harry	Yes	Bear Bangers	Dark brown with a light patch on his chest, went down the bank, close to camp. In the thick bushes by the
24-Aug-17	18:45	Black bear	1	behind camp (sherwood)	Large healthy black	Kelly Friesen	Yes	rubber bullets, bear banger	ran away
24-Aug-17	23:00	Black bear	1	behind camp (sherwood), in camp by main parking (gym)	Large healthy black	Mill ops	Yes	screamer	went into bush
25-Aug-17	18:45	Black bears	2	Behind camp	2 black bears: 1 black in colour and one brown in colour	Sean Darcy	Yes	Bear bangers	Around 6h45 pm Sean spotted the black one walking up on the ridge, we went out and saw the brown one too. They kept walking on the ridge and moving back towards the
25-Aug-17	19:45	Black bears	2	Behind camp	2 black bears: 1 black in colour and one brown in colour	Sodexo	Yes	Rubber bullets	Around 7h45 pm Safety was called again to answer a bear call. Both Sean and Kevin were armed. The black one was shot in the ribs with a
25-Aug-17	20:30	Black Bear	1	In camp, by the ice rink	The brown coloured bear in the dynamic duo	Tim Biernan (Dewatering Tim)	Yes	Rubber bullets	Tim called safety/enviro, the bear took off behind the electrical (orange) container. Sean and Kevin were armed. They got 2 rubbers on it. The bear took off down the hill
25-Aug-17	22:20	Black Bear	1	In camp by the bicycle shack	The brown coloured bear in the dynamic duo	Sodexo Serge	No	N/A	Serge called environment because the bear was in camp again. As soon as Serge had opened the door the bear took off down the hill to the
26-Aug-17	0:00	Black Bear	1	In camp , by the STP road	Not clear which one as it was dark, but most likely one of our pair	Benoit Gervais	Yes	Yelling, car noises	It got spooked by the truck and ran back down the hill in the bushes
26-Aug-17	0:25	Black Bear	1	By the Dumas shop	Black throughout	Greg from Pelly	Yes	Honking	It moved up the hill towards the
26-Aug-17	6:45	Black Bear	1	STP/Selkirk towers	Large healthy black	Sodexo	Yes	rubber bullets, bear banger	ran into bush and east up hillside
26-Aug-17	7:30	Fox	1	Nuway corner where we store the drill	Red in colour, pretty srawny	Tim Biernan (Dewatering Tim)	Yes	Air horns and rocks	Wasn't impressed with the airhorn, it did budge at all. When we threw the 1st rock it checked if it was food, and finally took off after the 3rd
26-Aug-17	9:30	Black Bears	2	At the underground fuel farm	Black sow, with a brown young cub	Geotech Dale	Yes	Bear banger	I took off up the hill behind the underground fuel farm
28-Aug-17	10:30	Black Bear	1	Up the hill at KM1.5	All black	Emilie Bouchard	No	N/A	I honked a little bit, he walked up
29-Aug-17	10:00	Black Bear	1	At the emergency pullout at KM9.5	All black	Emilie Bouchard	Yes	Honking	We honked at it from the ramp, he walked up the hill a little farther
29-Aug-17	15:00	Black Bear	1	Up on the ridge behind camp	All Black	Sodexo Probably	Yes	Bear bangers	By the time safety got there the bear had moved up the hill, they fired 2
29-Aug-17	19:45	Black Bear	1	At the fuel farm	All black	Mill Control	Yes	Bear Bangers	We fired 2 bear bangers and he disappeared into the woods.
30-Aug-17	8:30	Black Bear	1	Up on the ridge behind camp-behind the Selkirk Tower Corridor	Small brown bear	Sodexo Probably	Yes	Rubber bullet	Safety shot it on the butt with a rubber bullet, he ran up the hill away from camp.

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?
1-Sep-17	17:00	Black Bear	1	Km 1.5 on the hill	Black	Morris Morrison	No	N/A	Morris called it in. We deemed it not to be a emergency.
20-Sep-17	12:15	Deers	2	On the walkway behind Mine Tech	Light brown, one doe and her offspring	Craig	Yes	Yelling	They moved around through the warehouse laydown and up to the
21-Sep-17	12:40	Wolf	1	between 4 & 5km	Grey with some black, medium size	Truck Driver	No	N/A	went into bush
21-Sep-17	14:00	Black Bear	1	Km 3 access road	Black	Larry	No	N/A	
13-Aug-17	12:00	Black Bear	1	between 11 & 12 km	Black	Jenny P	No	N/A	
22-Sep-17	8:00	Black Bear	1	between 11 & 12 km	Black	Truck Driver	No	N/A	
23-Sep-17	8:00	Black Bear	1	Km 1	Large black	Todd Epps	No	N/A	
25-Sep-17	18:10	Deer	5	A2 ramp	mule	Dale H.	Yes	honking, directing with truck	ran away towards confluence and could not be found
26-Sep-17	9:20	Deer	1	Nuway	small, possibly female	Nuway / Dewatering	Yes	honking, directing with truck	ran away over DST and MVF
28-Sep-17	4:45	Porcupine	1	In front of 840 dump	Porcupine colour	Pelly	No	N/A	The animal was hit by a rock truck, and incinerated the following day
28-Sep-17	22:00	Wolf	1	Between Nuway and the Mill	Small, black	Kevin Suits	Yes	Honking, directing with the truck	He trotted across to the southwest duversion ditch and went up in the
12-Jul-17	21:30	Bear	1	In big field in back of camp		Jean Lagarde	No		
22-Jul-17	10:00	Black Bear	1	smoking area beside the rink		Joanne Felix	Yes	bear bangers and air horns	ran over towards the STP tanks
23-Sep-17	16:00	Fox	1	minto north road		M.Martin	No		
25-Aug-17	6:45	Porcupine	1	Portal pad	"large for a porcupine"	Roge H	No		
25-Aug-17	13:00	Black Bear	1	Km 1.5 on the hill	large	Dale H.	No		
26-Aug-17	9:00	Black Bear	2	UG fuel tanks	one sow and one cub healthy and brown in colour	Dale H.	No		
27-Aug-17	7:00	Fox	1			Roger H.	No		
25-Sep-17	5:00	Wolves	2	haul raod behind dumas	one grey, one black	Kevin Fletcher	No		ran up raod towards airport
1-Jul-17	5:45	Deer	1	Offices		Kevin Fletcher	No		walked up behind ERT and off into
27-Jun-17	16:00	Porcupine	1	SWD		Dale H.	No		
1-Jul-17	9:00	Black Bear	1	km 1	Skinny	Dale H.	No		
2-Jul-17	6:30	fox	1	near A2 radar		Dale H.	No		
3-Jul-17	17:00	Deer	1	between mine tech office and warehouse		jeremy vincent	No		
6-Jul-17	15:00	Deer	1	between mine tech office and bunk house	Adult in healthy condition	Dan P.	No		
19-Jul-17	9:15	Wolf	1	km 12	adult	Dale H.	No		
21-Jul-17	2:00	Porcupine	1	by green tents		Kevin Fletcher	No		
21-Aug-17	6:30	Fox	1	A253 Access road		Roger H.	No		
21-Jul-17	2:30	Black Bear	1	km 7		Marcus Lenz	No		
22-Jul-17	13:30	Black Bear	2	river lannding	healthy and young	Javad	No		
4-Aug-17	16:15	Black Bear	1	km 17	healthy and young	Justin M.	No		
3-Sep-17	7:10	Fox	1	airport	healthy	L. Linnick	No		
26-Sep-17	10:30	Deer	1	nuway	young and skinny	stan gostel	No		
6-Oct-17	14:30	Wolf	1	KM 9 hill	Healthy	SR	No		
22-Oct-17	12:15	Black Bear	1	Camp	Adult in healthy condition	CR	Yes	Yelling	Ran away toward STP tanks

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2017?	Reportable Incident (Yes/No)	Notes
1-Jan-17	7:50	Fox		Unknown	No	Report called in by Jean Lagarde. This fox has been seen hanging around camp near the Sherwood dry and Capstone barracks. Tracks from this morning were present in the new blown snow underneath the Sherwood dry. Inspection discovered a small fox sized hole in the hot water tank insulation that was used to prevent cold exterior air from entering beneath the Sherwood barracks. There is a high likelyhood that the fox is using the crawlspace as a den or for hunting. If the case, I suggest we have site services more effectively close off the hole to the crawlspace to prevent access after the crawl space has been cleared of the fox. Trapping the fox is an option however, engineering a control more humane. DP
5-Jan-17	11:30	Fox		Unknown	No	Just sniffing around like a fox
5-Jan-17	13:30	Fox	CB	Unknown	No	Fox was eating a rabbit's foot at access turn-off down to MW09-03. Drove towards fox honking horn, encouragin it to run away. It looked healthy.
8-Jan-17	10:30	Fox		Unknown	No	"Watched me walk back to my truck. Was not startled by loud noise."
15-Jan-17	12:40	Fox	DF	Unknown	No	Noticed the fox sniffing around the burn pit, yelled at it to encourage it to move away from the area. The fox looked healthy and moved away immediately.
19-Jan-17	16:00	Fox		Unknown	No	Not shy around vehicle
20-Jan-17	13:00	Fox		Unknown	No	"Just passing through."
10-Feb-17	17:30	Fox		Unknown	No	Fox reported by truck driver. May be becoming habituated. Did not seem scared.
11-Feb-17	9:40	Moose		N/a	No	Responded to ensure they did not get on the pit haul roads but did not see them again.
24-Feb-17	9:00	Fox				Walking towards MVFE 2 sump, spooked by truck and took off.
24-Feb-17	17:35	Fox			No	Tied togetrher due to mating
24-Feb-17	21:30	Fox		Unknown	No	Just walking through
25-Feb-17	14:25	Lynx			No	Sitting on the road, slowly scattered when I approached.
11-Mar-17	13:45	Fox	SB	Unknown	No	Fox ran away in the end.
22-Mar-17	10:00	Lynx			No	Spotted from bus
25-Mar-17	16:15	Bald Eagle			No	Spotted in tree near Bear Rock
25-Mar-17	15:30	Otter				Spotted tracks of running and belly sliding along river

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2017?	Reportable Incident (Yes/No)	Notes
31-Mar-17	15:45	Deer			No	on side of road, ran away when we approached
1-Apr-17	10:00	Rabbit				hopping
1-Apr-17	11:00	Rabbit			No	hopping
17-Apr-17	17:30	Bear	Safety	No	No	Appears to be the same cinnamon bear that goes through every year. He continued on his way after hazing.
19-Apr-17	14:38	Bear		Potentially	No	spotted bear and stopped vehicle, bear looked at vehicle for a bit then ran a little ways and turned around and looked again, then wandered into bush.
19-Apr-17	16:45	Lynx			No	Lynx saw vehicle and took off into bush
1-May-17	19:00	Bear			No	Chad was running and saw the bewars cross the road on this side of the KM2 sign, the bears went up the slope and in the direction of camp. CH went to investigate and only saw tracks.
5-May-17	11:00	Bear	SB	Unknown	No	Was was seen by Site Services. Was on road munching on bushes. When Enviro showed up it went down to Dumas. Enviro chased back up from Dumas and then used Bear bangers until it went off into bush towards landfill.
5-May-17	11:30	Bear				Grazing on grass up on the hillside
6-May-17	12:20	Lynx				
6-May-17	11:50	Bear	Safety	Unknown	No	Same bear as yesterday.
7-May-17	18:30	Bear	SR	No	No	
8-May-17	19:00	Bear	SR	Yes	No	Same bear from Dumas
9-May-17	13:00	Moose (Cow and Calf)	SR	No	No	
19-May-17	13:30	Bear		Unknown	No	Bear feeding just off dyno road. Went into bush when truck approached. Enviro responded and did not see the bear.
19-May-17	9:00	Black Bear	CP	Unknown	No	bear initially approached truck but quickly ran as soon as hazing commenced. Hazed using only voice and body language.
20-May-17	10:15	Black Bear	CH/CP/Safety	Unknown	No	the two bears seem to be staying together, as though they are siblings or something.

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2017?	Reportable Incident (Yes/No)	Notes
24-May-17	16:30	Black Bear	TS	Yes	No	This animal is thought to have been previously hazed and needs to be hit with Rubber bullets for proper conditioning (TS)
24-May-17	22:15	Black Bear	CP/safety	Yes	No	
28-May-17	23:00	Black Bear	CP/Safety	Yes	No	
1-Jun-17	14:00	Black Bear	DF	Unknown	No	Healthy looking bear, not overly concerned by the vehicle
1-Jun-17	14:15	Fox		Unknown	No	Seen before in the same area.
3-Jun-17	15:00	Ermine		no	no	
24-Jun-17	7:45	Bear	CH/Safety	Yes	No	after hazing, bear responded to me yelling (ran away)
25-Jun-17	19:30	Black Bear	Worker	Unknown	No	Reported to YG CO's and stopped recreational activity at mine for 1 week.
27-Jun-17	8:00	Fox	CH	Unknown	No	We also saw bear tracks at W2 and moose tracks on the W1 trail
23-Mar-17	9:00	Red fox	n/a	Unknown	No	
8-Apr-17	5:30	Rabbit	n/a	Unknown	No	
3-May-17	10:00	Bear	n/a	Unknown	No	
14-May-17	12:30	Black Bear	n/a	Unknown	No	
25-Jun-17	11:00	Deer	n/a	Unknown	No	
23-Jun-17	13:00	Seagull	n/a	Unknown	No	
3-Jun-17	11:30	Bear	n/a	Unknown	No	
8-Jan-17	10:00	Fox	n/a	Unknown	No	

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2017?	Reportable Incident (Yes/No)	Notes
16-May-17	19:30	Black Bear	n/a	Unknown	No	
18-May-17	20:30	Black Bear	n/a	Unknown	No	
13-Jun-17	2:30	Fox	n/a	Unknown	No	
25-Jun-17	7:58	Bear	n/a	Unknown	No	
26-Jun-17	21:15	Deer	n/a	Unknown	No	
18-Jan-17	10:45	Bull moose	n/a	Unknown	No	
17-Feb-17	5:00	Lynx	n/a	Unknown	No	
15-Apr-17	6:30	Porcupine	n/a	Unknown	No	
17-Apr-17	17:20	Bear	n/a	Unknown	No	
22-Apr-17	17:05	Bear	n/a	Unknown	No	
3-May-17	10:15	Black Bear	n/a	Unknown	No	
26-May-17	14:00	Wolf	n/a	Unknown	No	
27-May-17	8:10	Mule deer	n/a	Unknown	No	
5-May-17	2:00	Grey wolf	n/a	Unknown	No	
3-Jun-17	14:00	Black Bear	n/a	Unknown	No	
20-May-17	11:00	Black bears	CP	Yes	No	
25-Jun-17	8:00	Porcupine	n/a	Unknown	No	
30-Jun-17	8:30	Black Bear	EB	Unknown	No	
30-Jun-17	8:35	Fox	EB	Unknown	No	
4-Jul-17	13:20	Ravens	EB	Unknown	No	
12-Jul-17	21:30	Black bear	CH	Potentially	No	bear reported in front of camp, when CH responded it had made its way to DSTF and towards Dumas, CH drove to Dumas yard and spotted the bear walking on TDD road near Dumas. Cut it off and honked and yelled, then it walked over the bank and disappeared into thick bush.
27-Jul-17	8:15	Black Bear	n/a	N/a	No	
9-Jul-17	9:15	Black Bear	n/a	N/a	No	
9-Jul-17	8:30	Black Bear	n/a	N/a	No	
20-Jul-17	8:45	Black bear	CH	n/a	No	After receiving word of black bear behind towers CH visited the site but the bear was gone, fired a screamer in direction bear went into bush.
24-Jul-17	20:30	Black Bear	David and Dan	Yes	No	This is potentially the same bear as stalked Darin Kennedy on June 25th.
27-Jul-17	15:00	Frog	n/a	N/a	No	Released to W3 area
28-Jul-17	6:30	Black Bear		Yes	No	Due to frequency this bear has been seen, a proactive approach will be used in the morning to deter the bear from the area
29-Jul-17	10:35	Black Bear	Safety and EB	N/A	No	I don't know where they ran to, we patrolled the area but couldn't find them. All three were had black fur.

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2017?	Reportable Incident (Yes/No)	Notes
29-Jul-17	11:00	Black Bear	n/a	n/a	No	I'm pretty sure it's the same one as this morning spotted by Tim.
1-Aug-17	10:30	Black Bear	Safety and DF	no	No	This appears to be a new bear to the area this year as it does not meet the description of the other that have been seen in the past week.
1-Aug-17	16:30	Black Bear	n/a	N/a	No	Enviro response did not see bear as it had moved out of the area.
2-Aug-17	14:05	Black Bear	EB	Potentially	No	
4-Aug-17	8:00	Black Bear	DF	Yes	No	There are lots of berries and natural foods in the area that will caus the bears to want to stay. Due to the slow response to the bangers it is recommended that the next hazing be with rubber bullets if possible.
4-Aug-17	16:00	Black Bear		Potentially	No	Report said the bear was near the portal with no other available information. There is a lot of natural food in the area and it is away from active work areas so no hazing was conducted.
6-Aug-17	5:50	Fox		No	No	They ran off as the truck turned towards them and when I got out of the truck to continued to move away.
6-Aug-17	13:30	Deer		No	No	Was in the area for over an hour.
19-Aug-17	10:30	Fox	TS	No	no	Email reminder sent out to site to NOT feed any animals and to haze (condition) any animals we see around our living/working areas.
21-Aug-17	8:00	Bear	CH	Unknown	no	Bear was spotted but
22-Aug-17	8:00	Black Bear	SD/CP/CH	Unknown	No	The bear was originally spotted in the recycling seacan. The doors currently do not securely close, creating an attractant. A WO (#051938) has been submitted to correct this. This may signal the beginning of hyperphagy for the year.
22-Aug-17	17:00	Black Bear	SD/CP/CH	Yes	No	reports suggested that the bear was accompanied by a smaller lighter coloured bear (possibly a cub).
23-Aug-17	15:00	Black Bear	EB/CR	Unknown	No	
23-Aug-17	17:25	Black Bear	EB/CR/CH and Saftey	Unknown	No	This bear was way too close to camp. Rubber bullets will be used on him next time he is spotted.

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2017?	Reportable Incident (Yes/No)	Notes
23-Aug-17	19:00	Black Bear	CH and Safety	Yes	No	Was not visible enough to use rubber bullets but multiple bangers were shot at him.
24-Aug-17	18:45	Black bear	CH and Safety	Yes	No	bear did not seem to care when I was at bottom of hill, made moves like he was going to climb down anyway. SD hit with rubber and I fired bear banger with yelling right after.
24-Aug-17	23:00	Black bear	CH	Yes	No	bear ran up hillside behind sherwood, spotted it peeking out and fired a sdcreamer at it. Was not seen again by me.
25-Aug-17	18:45	Black bears	SD/EB	Yes	No	
25-Aug-17	19:45	Black bears	KR/SD/EB	Yes	No	
25-Aug-17	20:30	Black Bear	KR/SD/EB	Yes	No	
25-Aug-17	22:20	Black Bear	SD/EB	Yes	No	It was dark so it could have potentially been the black one as well.
26-Aug-17	0:00	Black Bear	BG	Potentially	No	It was dark so we're not 100% sure which one it is… but its one of the 2 we're pretty sure.
26-Aug-17	0:25	Black Bear	Pelly	Yes	No	It's the Green Tent problem bear
26-Aug-17	6:45	Black Bear	Safety	Potentially	No	bear was on hillside below selkirk towers, then on road by the rink, safety was able to hit with rubber, then again when in bush.
26-Aug-17	7:30	Fox	EB/CR	Potentially	No	I documented with pictures, this fox is habituated. We found wrappers of food and he peed on it, whatever that means. It is not scared of humans and has been hanging around that corner.
26-Aug-17	9:30	Black Bears	CH/CR	Potentially	No	
28-Aug-17	10:30	Black Bear	EB	Potentially	No	
29-Aug-17	10:00	Black Bear	EB/RH	Potentially	No	
29-Aug-17	15:00	Black Bear	Safety	Potentially	No	
29-Aug-17	19:45	Black Bear	EB/Safety	Potentially	No	
30-Aug-17	8:30	Black Bear	Safety	No	No	Enviro couldn't be there, we were busy at the LTF spill response.

Date	Time	Type of Animal	Who performed the hazing?	Has this animal been hazed in 2017?	Reportable Incident (Yes/No)	Notes
1-Sep-17	17:00	Black Bear		Potentially	No	
20-Sep-17	12:15	Deers	enviro	No	No	
21-Sep-17	12:40	Wolf		No	No	
21-Sep-17	14:00	Black Bear		Unknown	No	
13-Aug-17	12:00	Black Bear		No	No	
22-Sep-17	8:00	Black Bear		No	No	
23-Sep-17	8:00	Black Bear		Unknown	No	CH responded 10 mins later, bear was on hillside @km 1.5 eating plants. When I pulled up the bear ran a little way up the hill upon seeing me.
25-Sep-17	18:10	Deer	enviro	Unknown	No	when enviro responded only one small deeer was seen. Directed deer towards the fuel farm treeline. It ran to confluence and was not seen afterwards
26-Sep-17	9:20	Deer	DF	Potentially	No	
28-Sep-17	4:45	Porcupine	n/a	n/a	Yes	CO was informed shortly after Environment found out. The CO supported our method of disposal.
28-Sep-17	22:00	Wolf	Kevin Suits	No	No	
12-Jul-17	21:30	Bear		Potentially	No	
22-Jul-17	10:00	Black Bear		Potentially	No	
23-Sep-17	16:00	Fox		Unknown	No	
25-Aug-17	6:45	Porcupine		Unknown	No	
25-Aug-17	13:00	Black Bear		Unknown	No	
26-Aug-17	9:00	Black Bear		Unknown	No	
27-Aug-17	7:00	Fox		Unknown	No	
25-Sep-17	5:00	Wolves		Unknown	No	
1-Jul-17	5:45	Deer		Unknown	No	
27-Jun-17	16:00	Porcupine		Unknown	No	
1-Jul-17	9:00	Black Bear		Unknown	No	
2-Jul-17	6:30	fox		Unknown	No	
3-Jul-17	17:00	Deer		Unknown	No	
6-Jul-17	15:00	Deer		Unknown	No	
19-Jul-17	9:15	Wolf		Unknown	No	
21-Jul-17	2:00	Porcupine		Unknown	No	
21-Aug-17	6:30	Fox		Unknown	No	
21-Jul-17	2:30	Black Bear		Unknown	No	
22-Jul-17	13:30	Black Bear		Unknown	No	
4-Aug-17	16:15	Black Bear		Unknown	No	
3-Sep-17	7:10	Fox		Unknown	No	
26-Sep-17	10:30	Deer		Unknown	No	
6-Oct-17	14:30	Wolf				
22-Oct-17	12:15	Black Bear	Corey Roberts	Unknown	No	

Date	Time	Type of Animal	Number of Animals	Location	Description: Size/Color/Markings and Additional Notes	Reported By (Name)	Was the animal hazed?	What hazing technique was used?	What was the animals response?	Who performed the hazing?	Has this animal been hazed in 2018?	Reportable Incident (Yes/No)	Notes
4-Jan-18	12:00	Fox	1	Portal road Main ahul road intersection	Scrambled up bank and watched as the truck drove past	D. Avar	No				No		
9-Mar-18	13:30	Lynx	1	TDD	Adult, Calm	Nathan	No						
19-Mar-18	18:30	Black Bear	1	TDD	Black bear	Ryan Silverfox	No				No	No	Early sighting on a warm afternoon (above freezing), heavy snow later
5-Apr-18	5:30	Lynx	1	Haul Road-W15	Healthy	Dale/Gerard	No						
19-Apr-18	9:30	Black Bear	1	Landfill	Dark black, see photos - they're good	Danny	yes	Enviro fired 3 bangers and safety fired 2 bangers and 2 rubber bullets	Bangers had no effect on it, The first rubber bullet made contact with its back, and the second made contact with its butt. He took off, rather slowly above the berm he was headed west (towards Dyno)	Enviro and Safety	No	No	First official bear encounter at Minto!
19-Apr-18	17:30	Black Bear	1	WMA	Dark brown	Site Services	Yes	Enviro fired 3 bangers	The bear got into a tote that had been cut out and filled with garbage (including plenty of food waste) But he did mosy on when the bangers were fired	Enviro	Yes	No	Totes were sorted through the following day - 2 totes were found with garbage waste and enviro has brought up the issue to management
20-Apr-18	15:00	Black Bear	1	WMA	Dark brown	Site Services	Yes	Safety got him with bangers	Same bear came back for the totes that were gone, he went around the incinerator - and through the back toward the core shack. We intercepted him there, fired 2 bangers, he took off down the hill behind the propane tanks there.	Safety	Yes	No	
20-Apr-18	17:40	Black Bear	1	Dumas Shop	Dark Brown	Dumas Mechanic	Yes	Fired off 2 bangers	Same bear, he was close to Dumas shop in the lay down area. We pushed him off towards the Dry Stack Tailings and he was walking along toward the hill	Enviro	Yes	No	
20-Apr-18	20:30	Black Bear	1	Sewage Treatment Plant	Dark Brown	Ryan Herbert	Yes	Fired 4 bangers	Same bear, he was playing with hoses at the STP. When Ryan H. and Rob P. were walking back to camp spotted him and scared him off. He was walking up the hill towards camp when environment arrived at the scene. Fired off 2 bangers, he walked up the valley, safety showed up but no good shots could be taken. Safety fired off 2 more bangers	Enviro and Safety	Yes	No	
22-Apr-18	20:00	Black Bear (named him Stew)	1	Camp	Dark Brown	Jeff Hewko	yes	Fired only 1 banger	Same bear, came up to the back door (North side) of the Selkirk Towers. He seemed confused , Safety Dave did some yelling. He mosied on up the hill, northly.	Enviro	Yes	No	
22-Apr-18	21:00	Black Bear (named him Stew)	1	Camp	Dark Brown	Gene	yes	Air horn, rubber bullets and bangers	Same bear, came into the Selkirk parking lot. Walked along the Arctic Corridor. And onto the ice rink, tried to come up to the door (smoke shack door) Enviro Emilie fired the air horn to get him away from the building. Safety got a bullet on him, he took off down the hill (towards the STP). Fired off bangers to scare him off further.	Enviro and Safety	Yes	No	
24-Apr-18	18:30	Black Bear	1	Camp	Dark Brown	Travis	yes	Fired 2 Bangers	Animal moved away from the banger, but couldn't escape due to steep hill, upon seeing ENV person, he retreated up a shallower slope, fire second banger as he went out of site.	Enviro	Yes	No	
24-Apr-18	20:30	Black Bear	1	Camp - Selkirk	Dark Brown	Todd	Yes	Safety fired a banger	Was seen again in the North site of the arctic cooridor, near the blue garbage seacan. Walked around towards the front parking lot, but went over the berm and down the hil upon seeing Enviro. Waited until Safety arrived in case rubber bullets would act a s better deterrent.	Safety	Yes	No	
24-Apr-18	21:30	Bear	1	Smoke shelter by capstone			Yes	Banger, Yelling	Went towards the hill and up and out of the camp area		Unknown	No	
25-Apr-18	13:30	Black Bear	1	Landfill	Dark Brown	Danny	Yes	Safety hit him with rubber bullets (x2)	Bear had found a small amount of food waste (from	Safety	Yes	No	Had Pelly push, compact, and cover the landfill on April 26 to remove
2-May-18	6:30	Fox	1	Portal entrance	grey fox, healthy looking, hanging around the waste bins and portal. No	Doug. M	No						
5-May-18	0:00	Black Bear	1	Core Shack	Dark Brown	Benoit Gervais	yes	Honking and chasing with a vehicle	Bear was just wandering around the core shack	Ben	Unknown	No	
6-May-18	10:15	Black Bear	1	Dyno Access	Black	Austin /Dyno	No	N/A			No	No	Austin Called to notify of a bear on dyno access area, not moving
7-May-18	9:45	Black bear	1	Road up to coreshack /	Brown, lean	Tim	Yes	Multiple bangers by Envrio. X1 rubber	Bear travelled >400m from point of hazing, following	Env / Safety KR	No	No	bear
7-May-18	17:00	Black bear	1	Far side of WSP	Black	Dale H.	No	N/A			No	No	Far side of the WSP not near people
7-May-18	18:45	Black bear	1	1km	Black	Tony M.	No	N/A					Same bear that was at WSP earlier.
11-May-18	11:00	Black bear	1	7 km	dark ruddy brown	Colin P, Corey R	No	N/A	Bear began running from the truck before any action was	N/A	Unknown	No	bear looked very healthy, appeared to be afraid of humans without any
13-May-18	19:00	moose and calf	2	dumas corner	no discernable identifyable markings		No	N/A		N/A	No	No	

13-May-18	13:00	Bear	1	Silos in dyno area	Large, brown coloured black bear	Gerard B							
15-May-18	15:00	Moose and calf	2	4 km	no discernable identifyable markings	Ryan Silverfox	No	N/A		N/A	No	No	
16-May-18	12:15	Bear	2	Dyno yard	Black sow and a brown cub	Lewis Mcleod							
17-May-18	16:15	black bear	1	dry stack near dumas	dark red/brown	Doug Harris	yes	yelling, bangers	ran from bangers. Appeared to be wary of humans.	SR/CP	Yes	No	appeared to be eating vegetation. Was not moving deliberately
18-May-18	11:30	Black Bear	1	Hillside near WSP	Black	Doug Harris	No	N/A		N/A	Unknown	No	Bear looked very healthy, grazing and far enough from site to not be a
18-May-18	17:15	Black Bear	1	West end of WSP	Black with grey face small but fat	Todd Swenson	Yes	Honking horn, yelling	Cocked it's head and looked curious. No fear	TS	Unknown	No	Might possibly be the bear described as "aggressive" in 2017, due to
20-May-18	16:00	Black Bear	1	13KM	Black	Doug Harris	No	N/A	N/A	N/A	Unknown	No	Bear looked healthy in the bush on the hill side.
22-May-18	8:00	moose and calf	2	air strip	no discernable identifyable markings	Jean Lagarde	No	N/A	N/A	N/A	No	No	
22-May-18	7:00	Bear	2	8 km	brown	Bob Alexander	No	N/A	N/A	N/A	Yes	No	reported as "brown bear", currently uncertain if it was grizzly or brown black bear
22-May-18	9:15	Black Bear	1	KM 1.5	Black	Shaun	No	N/A	N/A	N/A	Unknown	No	Eating vegetation up on the hill across the road from the WSP
22-May-18	8:40	moose and calf	2	Driftwood laydown	wandering towards airstrip	Curt (S.S)	No						
23-May-18	9:50	Black Bear	1	KM 1.5	Black	Shaun	No	N/A	N/A	N/A	Unknown	No	Eating vegetation up on the hill across the road from the WSP
23-May-18	10:05	Deer	3	KM 0.8		Shaun	No	N/A	N/A	N/A	No	No	Walking down access road towards WSP and ran up the hill as I drove by
26-May-18	0:00	Black Bear	1	Dumas	Black large	Shawn (mechanic)	yes	Honking horn, truck, yelling and bear banger	Ran away at sight and sound of truck.	CH	Yes	No	Bear reported going to Dumas shop, responded and bear ran up the hill towards portal. Chased bear off with truck and shot banger and yelled. The bear then ran into the bush/ Exploration roads.
27-May-18	14:00	Moose	1	Km 19	adult, healthy, bull moose	Trever Harris	No						
29-May-18	15:00	Black Bear	1	Behind Selkirk towers	large, fat, black	Colin P	yes	voice	ran away when people charged and yelled at it	CP	Yes	No	This bear has been hazed several times this year, and seems to be very responsive to hazing.
29-May-18	14:00	Black Bear	1	W2	Small, young, brown	Chris H, Shaun R	yes	Voice, bear banger	did not respond to voice, shot banger twice, ran away after second shot	SR/CH	No	No	Bear must have followed us out of W1 trail, was behind us when we got to the truck and didn't run when we yelled. Shot bear banger twice and it ran away after second shot.
29-May-18	14:45	Black Bear	1	KM7	Large, black	Chris H, Shaun R	No				No	No	Walking on road, ran into bush when truck approached.
29-May-18	19:20	Black Bear	1	Pumphouse near camp		Stanley	No						
30-May-18	13:40	Bear	1	Dyno	Medium ,brown, dark legs	Dale	Yes	Airhorn	ran away but came back to dynos laydown later	CH/CR	No	No	after we hazed the bear it came back to its spot 30 mins later but ran
31-May-18	11:15	Bear	1	Dyno yard	Large Black Bear / Bold walked up to loader an operator in it	Lewis Mcleod	Yes	Bangers	Ran off but came back later	CR/CH	Potentially	No	Once it ran off it came back later. Dyno called again but it wondered off before enviro got to the scene.
3-Jun-18	14:00	Bear	1	WMA	Medium black	Corey	yes	Bear banger, yelling	Did not come out of bush	CH	n/a	No	saw bear by where nitirc barrels are stored, when I walked over it was in the bush. I yelled and fired a bear banger and the bear did not come back while we were there
3-Jun-18	15:50	Bear	2	Exploration roads behind	MED. One brown, one black	Chris	No				Yes	No	Went for ride on roads for bear check as one was seen earlier and saw
4-Jun-18	15:00	Hawk - Sharp-shinned	1	Warehouse	Approx. 8" long, light coloured underbelly with stipes on wings and tail, back, head and wings are dark in colour	Devon	No				No		Door was left open for the bird to leave, fans and lights were turned off. Bird remained in the Warhouse rafters (overnight). Bird left Warehouse June 5th about 1pm. See photos.
5-Jun-18	10:00	Fox	1	Portal	Black in colour / healthy	Lewis Mcleod							
9-Jun-18	7:30	Deer	1	Airport road by W35	Meduim white-tail	Emilie	Yes	yelling	Took off when I yelled at it	EB	No	No	
9-Jun-18	8:40	moose and calf	2	5.5 km	Very young calf, lean cow	Emilie / Deborah	No				No	No	
10-Jun-18	18:00	Hawk - Sharp-shinned	1	Washbay	Found deceased. Preserved in freezer for CO if needed.	Driftwood	No						
11-Jun-18	12:30	Deer	1	near propane farm	curious walked up close to pick-up	Mark (Driftwood)	No						
13-Jun-18	7:00	Deer	1	up on hill behind	Chilling on the hill behind camp	Stan G	No						
27-Jun-18	16:25	Deer	1										
27-Jun-18	15:50	Bear	1	N.Communication Tower	Big Black Bear; not aggressive, sniffing	Shawn - IT	No				Unknown	No	
27-Jun-18	16:25	Deer	1	Just above capstone	eating minding his own buisness	Stan G	No						
28-Jun-18	13:00	Deer	1	Beside ERT building	calm, walking through camp area	Roger H	No						
1-Jul-18	5:15	Deer	1	Portal	Walking up the road		No						
3-Jul-18	9:15	Deer	2	Km 15	Doe and fawn on road. Very young fawn	Shelby/Emilie	No				N/a	No	

4-Jul-18	10:00	Black Bear	1	KM 11	Large Black Bear	Robert Proc	No					No	
4-Jul-18	11:30	Black Bear	1	km 6	Small black bear, still shedding his winter coat	Emilie	Yes	Yelling, throwing rocks, and honking.	He had no reaction, moved very slowly until I got a rock on his head. He didn't like it. His ears went back and he seemed confused. He walked off slowly. - I wanted to ensure he associated humans with not a good thing.	EB	No	No	
5-Jul-18	9:30	Black Bear	2	Pelly Yard	One small black bear, and one small light brown black bear	Gene - Pelly	Yes	Honking.	They both moved on quickly.	EB	No	No	It was noticed afterwards that the bears (not sure which one) had gotten into a garbage bag full of old food in their outdoor plywood bin.
5-Jul-18	13:30	Black Bear	1	Pelly office	Small light brown black bear	Gene - Pelly	Yes	Yelling and air horn	He moved on very slowly at first and with the airhorn he	Gene	Yes	No	He was scratching and pulling on the plywood holding the office
6-Jul-18	7:00	Black Bear	1	Pelly office		Gene - Pelly							A bear (I am assuming the same light brown that has been hanging
7-Jul-18	2:15	Black Bear	1	Dumas Shop	Small light brown black bear	Dumas Mechanic	No		He wandered inside the shop and checked it out, took off	EB	Yes	No	Core shack also seems to have been entered by the bear at some point
7-Jul-18	5:40	Black Bear	1	Camp	Small light brown black bear	Nona	Yes	Bear banger, yelling	He took off in the woods behind the ERT building. First	EB	Yes	No	He'll be back for sure. Sodexo employees were warned to be on the
7-Jul-18	10:00	Grizzly bear	1	22km		Adam Vlastimil	No						
7-Jul-18	10:00	Bear	1	KM 22			No						
8-Jul-18		Black bear	1	Camp	medium (>5') chocolate brown black bear	Kevin Rookes	Yes	Rubber bullet, banger, yelling	He took off in the woods behind the ERT building.	KR	Yes	No	KR seems to think it wasn't the same bear, it seemed larger than the pictures enviro had provided.
8-Jul-18	10:00	Mule deer	1	22km		David Petkovich	No						
8-Jul-18	10:00	Mule deer	1	KM 22.5	healthy standing at side of road		No						
8-Jul-18	9:30	Deer	3	Km 10.5	Doe and two fawns		No						
9-Jul-18	7:00	Deer	1	Warehouse		Kevin Rookes	No						She moved off the the MVFE
10-Jul-18	9:30	Black Bear	1	km 10	Medium size black	EB	No						
10-Jul-18	10:00	Mule Deer	4	Dry stack tailings facility	Mule deer with doe and two fawns		No						
12-Jul-18	8:00	Black Bear	1	Pelly Yard	Light body and dark legs. Bear was spotted multiple times through out the day.	SB	Yes	bangers, yelling, honking	Went into woods by W15	DC	Yes	Yes	Bear broke into Pelly office, core shack, and Dumas. Caused property damage and attempted to re-enter when workers were cleaning up the office.
13-Jul-18	1:00	Black Bear	1	Multiple Locations	Same light body bear	SB	Yes	Bangers, honking	Went to other buildings	SB/DC	Yes	Yes	Same bear. 4 bear calls at night. Dumas, Core Shack, Mill Building, and Camp. CO called.
15-Jul-18	11:00	Lynx	1	North side of the Selkirk	Looked healthy - Adult	Curt (S.S)	Yes						
20-Jul-18	15:30	Deer	2	Mill Pond	Running around not caring about	Brandon Brown	No						
27-Jul-18	10:10	Bear	1	Driftwood laydown	Black bear - Looked healthy - Adult	S.S	No						
29-Jul-18	14:00	Deer	2	Portal road	Doe and fawn on road. Very young fawn	CH	no					No	doe and fawn running on portal road. Went up towrds tent on bank
2-Aug-18	10:00	Black Bear	1	Ridgetop Road	Black bear	Mike Ethelston	Yes	honking	took off behind the UG fuel farm	EB/SMB	Unknown	No	Small black
2-Aug-18	10:30	Deer	1	STP	Light brown deer	EB	No			EB/SMB			
2-Aug-18	12:30	Black Bear	1	Old Pelly Laydown	Light brown	SS	Yes	Bear bangers	Took off towards MN	EB/SMB	Unknown	No	Looks like our problematic bear, but I am not sure
3-Aug-18	8:00	Black Bear	1	Airstrip and WMA corner	unknown	Brandon Brown	No			EB/SMB			We couldn't find it by the time we got up there.
5-Aug-18	9:40	Black Bear	1	WMA area	Small black bear.	Brandon Brown	No						
8-Aug-18	14:00	Black Bear	1	WMA area / Airstrip	small black bear	Curt (S.S)	No					No	Not found once enviro got up there
8-Aug-18	13:58	Deer	1	Between mine tech and	Adult doe	Everett P	No						
8-Aug-18	10:30	Deer	3	Selkirk Towers	Doe and 2X fawn drinking water	Ryan Herbert	No						
19-Aug-18	5:45	Fox	1	Between dry and saftey		Ian L	No						
26-Aug-18	17:40	Bear	1	KM 9	Black bear with blonde hair	Dave G	No						
27-Aug-18	16:00	Black bear	1	8km	Black bear with white patch on head	David Grennen	No				No	No	
29-Aug-18	13:30	Black bear	1	Dyno Road	Black bear	Brandon Brown	No				No	No	
6-Sep-18	5:30	Fox	1	By the rink	Red body black tail - large in size -	Peter M	No						
7-Sep-18	5:50	Fox	1	Behind ERT		Don Patterson	No						
11-Sep-18	14:20	Brown bear	1	km 19	Medium size dark brown bear	Shaheen Baker	No						
12-Sep-18	11:00	Eagle	1	km 23	Sitting on a tree near road	Shaheen Baker	No						
14-Sep-18	16:00	Fox	1	Main pit dump		Ian L	No						
20-Sep-18	10:15	Deer	5	Warehouse laydown	1 Adult deer and 4 samller fawns	Tim C	Yes	Honking, Truck engine	Took off toward mill valley	CR	No	No	
24-Sep-18	13:10	Fox	1	Area 2 pit bench	Red in colour - unintrested in humans	Cobalt	No						
26-Sep-18	8:20	Lynx	1	11.5km	Found dead on the road; likely hit by a	Ryan Silverfox	No					Yes	Found on the road dead by Site Services this morning. Pull at the side
3-Oct-18	10:30	Deer	3	Mine Tech	1 doe with 2 fawns	Ryan F.	No						
5-Oct-18	11:00	Deer	3	Mine Tech	1 doe with 2 fawns	Bob G.	No						
5-Oct-18	17:20	Bear	1	W62 Road	Light brown, large black bear	Bob G.	Yes	Honking	Mosied off into the wooden area (diagonally away from	Bob G.	Probably	No	
6-Oct-18	11:45	Bear	1	Burn pile	Light brown, large black bear	Ryan S.	Yes	Yelling	Mosied on	Ryan S.	Probably	No	
6-Oct-18	13:45	Fox	1	ERT Building	Healthy, red fox	Lesley S.	No				No	No	
20-Oct-18	3:35	Fox/Coyote	1	Behind kitchen	Healthy/Non Aggressive	Randy R	No						
2-Nov-18	8:15	Fox	1	Mobile Maint Shop (Mill)	Healthy red fox	Brett Austin	Yes	Yelling, Clapping	Took a lot to make it move on. Aggressively curious	Brett A. Todd S.	Unknown	No	Tried to follow Brett inside the shop. Looks very people friendly, possibly has been fed, or just more brave and curious now that activities/noise has slowed down.
2-Nov-18	15:30	Black bear	1	Km 10	Tracks in fresh snow	Doug Harris	No						Bear not seen, only tracks observed in 2 day old snow.
2-Nov-18	15:35	Wolves	2	Km 9	Tracks in fresh snow	Doug Harris	No						Wolves were tracking/following Moose. Not seen, only tracks observed in 2 day old snow.
2-Nov-18	15:35	Moose	1	Km 9	Tracks in fresh snow	Doug Harris	No						"
18-Nov-18	11:00	Lynx	1	Km 20	healthy	Greg S	No						
19-Nov-18	14:00	Wolf	1	Barge Landing	healthy	Greg S	No						
24-Nov-18	12:00	Doe and 2 fawns	3	Km 0.5	Healthy	Emilie	Yes	Honking	Mosied on up the hill	Emilie B	No	No	
Nov 16 2018	11:00	fox	1	Dumas shop	Healthy full coat	Dan Fries	Yes	threw my hard hat at it	ran away	Dan Fries	Unknown	No	Fox ran towards me when I opened vehicle door. It appears it may have
Nov 18 2018	8:15	Fox	1	outside mill/ ERT	healthy	Dan Fries	Yes	3 shots with bangers	ran away initially but returned in short order.	Dan Fries	Yes	No	Noticed same fox as Nov 16 scrounging outside mill entrance, I

Dec 21 2018	8:00	Fox	1	Dumas Shop	healthy fox	Dan Fries	Yes	yelling , chasing and eventually banger	Would aggressively follow person. Initially ran away when deterred with banger but returned in 5 minutes displaying the same aggressive behaviour	Dan Fries	Potentially	No	Fox was exhibiting signs of being fed, will run to truck when door opened, will follow behind person when walking away and will come toward a person when they bend over. Sits by the back door of Dumas shop within 5 feet. When questioned the Dumas employees indicate that the building is mouse infested and the fox hunts them.

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	initially 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

Date	Time	Type of animal	Number of animals	Location	Description: Size/Color/Markings and Additional Notes	Was the animal hazed?
29-Jan-20	13:00	Porcupine	1	Fresh Air Raise	Adult, Healthy	No
15-Mar-20	13:00	Wolf	1	Access Road KM 24-25	Black	No
20-Apr-20	15:45	Black Bear	1	Dyno Yard, near office	Young, light brown	Yes
4-May-20	15:30	Black Bear	1	Access Road above WSP	Young, light brown	No
5-May-20	14:00	Black Bear	1	MWD into the bush	Dark fur, Healthy	No
5-May-20	19:30	Black Bear	1	Ridge above Camp	Dark fur, Healthy	Yes
6-May-20	12:45	Black Bear	1	UG shop laydown	Young, dark fur	No
7-May-20	16:00	Black Bear	1	Fuel Farm to ERT	Light brown	No
8-May-20	12:30	Black Bear	1	Mine tech past ERT to bush	Light brown	Yes
9-May-20	21:30	Black Bear	1	Camp parking lot to DSTF	Dark fur, Healthy	No
11-May-20	7:50	Black Bear	1	Airport road	Dark fur, Healthy	No
11-May-20		Black Bear	1	Warehouse yard up through camp past ERT	Dark fur, Healthy	Yes
13-May-20	6:50	Black Bear	1	Below Airstrip Propane Farm	Light brown, Healthy	Yes
14-May-20	6:30	Black Bear	1	Road/Field East of Cobalt Parking.	Dark fur, Healthy	Yes
14-May-20	8:30	Black Bear	1	W35 Sump Area	Dark fur, Healthy	Yes
18-May-20	23:00	Black Bear	1	Near Dyno Yard	Thin	No
20-May-20	9:45	Black Bear	1	Near Main Pit	Dark fur, Healthy	Yes
20-May-20	10:30	Black Bear	1	Behind Underground Shop	Light brown, Healthy	Yes
20-May-20	11:30	Black Bear	1	On Dry Stack	Dark fur, Healthy	No
21-May-20	9:50	Black Bear	1	By W35	Light brown, Healthy	No
21-May-20	11:30	Lynx	1	Drill road behind core shack	Small, young	No
21-May-20	1:55	Black Bear	1	Haul Road between Main Pit and A2P	Dark fur, Healthy	No
24-May-20	12:55	Black Bear	1	Near Yellow Stockpile	Dark fur, Healthy	No
25-May-20	9:30	Black Bear	2	Near Airport road	Light Brown, healthy/Dark Fur, healthy	No
25-May-20	12:30	Black Bear	1	Near Kode Crusher	Light fur	Yes
26-May-20	8:30	Black Bear	1	Behind U/G Shop	Dark fur, healthy	No
26-May-20	2:00	Black bear	1	Fuel Farm to ERT	Light fur	No
19-May-20	5:00	Black Bear	1	Haul Road at airpot interection	medium sized black healthy	Yes
8-Jun-20	9:00	fox	1	Mill	skinny, it came close, tame	No
12-Jun-20	8:30	Porcupine	1	Propane farm	large, light blond/grayish	Yes
12-Jun-20	9:00	fox	1	Hall road	Black and orange, skinny	No
1-Jun-20	2:00	Fox	1	Kode		No
7-Jun-20	10:00	Fox		Mine Rescue/ERT building North side	Light brown	No
8-Jun-20	18:00	Black Bear	3	WSP	Mother very black, cubs dark brown	No
20-Jun-20	1:40	Black Bear	1	Road to Dump	Black with a dark dirty brown face	no
22-Jun-20	9:00	Grizzly bear	1	Trail to W1 from KM11		No
24-Jun-20	16:30	Black Bear	1	CWTS	Light brown	Yes
10-Jul-20	2:00	Grizzlies	2	fighting over territory KM10	both medium sized very healthy looking	No
11-Jul-20	3:30	deer	1	U/G Fuel Farm	large healthy looking	Yes
13-Jul-20	11:00	bear	2	Access Road, KM 4	mother and cub, both very black. Cub very small, born this year.	No

17-Jul-20	15:00	deer	2	MWD, off Minto North Road	doe and fawn	No
20-Jul-20	8:30	bear	2	Acces Road, KM 3	mother and cub, same from June 8th but only saw one cub	Yes
21-Jul-20		Grizzly bear	1	W6 access trail	Younger male	No
23-Jul-20	15:00	bear	2	DSTF	mother and cub	No
24-Jul-20	16:00	bear	?	W3	Bear vocalized while remaining in bush, When DA shouted to alert the bear to his position the vocalization/ barking continued	Yes
27-Jul-20	18:10	Black Bear	2	ERT building	mother and cub	No
9-Jul-20	9:30	Deer	1	Selkirk		No
17-Jul-20	9:00	Fox	1	Back Of Kitchen	Mangy Looking	No
24-Aug-20	8:15	Black Bear	1	Hill Behind Selkirk Tower		No
21-Sep-20	14:50	Black Bear	1	W17	Dark fur- healthy	No
1-Oct-20	7:30	Porcupine	1	In WTP discharge pipe @ W17	Just small enough to fit in an 18-20" pipe	No
2-Oct-20	18:30	Black Bear	2	CWTS area	Mother and cub	No
4-Oct-20	14:45	Black Bear	1	Warehouse yard up through camp past ERT	Dark fur, Healthy	Yes
1-Nov-20	8:30	Fox	1	SWA in WMA	Red coat, healthy	Yes
6-Dec-20	5:15	Lynx	1	Selkirk, near east emergency exits		No

APPENDIX 1-6
Aquatic Resources Characterization Report

minnow environmental inc.

A Trinity Consultants Company

Minto Mine Aquatic Resources Characterization Report

Prepared for:
Minto Explorations Ltd.
Whitehorse, Yukon

Prepared by:
Minnow Environmental Inc.
Georgetown, Ontario

October 2021

Minto Mine Aquatic Resources Characterization

Lisa Bowron, M.Sc., R.P. Bio.
Project Manager

Pierre Stecko, M.Sc., R.P. Bio, EP
Senior Project Advisor

EXECUTIVE SUMMARY

As required under condition 13.1 of the QML-001, this Aquatic Resources Characterization Report has been submitted to demonstrate an understanding of site-specific aquatic environmental conditions in the vicinity of the Minto Mine. This report will also support Phase VII and future licensing applications. The aquatic environment characterized in this report includes Minto Creek (upper and lower reaches), associated reference creeks and tributaries (i.e., McGinty Creek, Big Creek, and Wolverine Creek), and the Yukon River (which receives flows from these creeks). The area of interest within the Yukon River is the 20 kilometer stretch between Big Creek (7 kilometers upstream of the Minto Creek mouth) and Wolverine Creek (13 kilometers downstream of the Minto Creek mouth). Aquatic environmental data considered in this report include sediment, periphyton, benthic invertebrate, and fish data collected from 1994 (baseline) to 2020. Limited data are currently available for the section of interest in the Yukon River and sampling could not be completed in lower Minto Creek in 2019 due to dry conditions.

Sediment sampling was completed using a variety of methods over the years. During baseline (1994), sediment was collected in triplicate in the mainstem of Minto Creek. From 2006 to 2009, sediment collected from slow flowing locations was analyzed on the <63 µm fraction (silt and clay only) and from 2010 to 2020 sediment from quiescent locations was analyzed on whole (bulk) sediment. At upper Minto Creek, concentrations of copper were greater than the Canadian Interim Sediment Quality Guideline (ISQG) during baseline (indicating naturally high concentrations) and have been above guideline for all years since. Copper concentrations in sediment at lower Minto Creek were below all guidelines during baseline but rose above the ISQG for all years except 2011. The upper reach of Minto Creek is primarily erosional and fine sediment would likely wash away each year during freshet. Since there are more depositional locations downstream in lower Minto Creek sediment, sediments are a more relevant route of potential exposure to aquatic organisms in the lower reaches.

Sediment toxicity tests were completed in sediments collected from lower Minto Creek in 2011, 2015 to 2018, and 2020 using the midge *Chironomus dilutus* and the amphipod *Hyalella azteca* as test organisms. Survival of *C. dilutus* was significantly lower in lower Minto Creek sediment compared to reference (lower Wolverine Creek) and control sediment in 2017 and 2018. In 2020, survival of *C. dilutus* in lower Minto Creek sediment was significantly lower than in sediment from lower Wolverine Creek (reference). Growth of *C. dilutus* was significantly lower in lower Minto Creek sediment compared to lower Wolverine Creek sediment in 2017. Lower survival of *H. azteca* in lower Minto Creek sediment was observed in in 2020 when compared to reference (lower Wolverine Creek) and control sediment. Although equivocal, these results suggest a potential for adverse effect, but temporal comparisons show differences in response despite similar sediment chemistry (including baseline elevations in concentrations of several metals as would be expected in association with the ore deposit within the Minto Creek watershed).

Periphyton was collected in 1994 and 2012 to 2020 for chlorophyll-a and community assessment. Chlorophyll-a concentrations observed during baseline and earlier years (2012 to 2015) indicate that lower Minto Creek was oligotrophic (low production/nutrients), but production increased after 2016 as the system moved to the mesotrophic category (increased production/ nutrients compared to oligotrophic). The only exception was in 2020 when lower Minto Creek was again identified as oligotrophic. Increased production over time could be due to increased light penetration and/or increased nutrient inputs to the system. The latter has been observed as higher concentrations of nitrogen species during and after mine discharge events. Even with increased nutrient loads, median chlorophyll-a concentrations were all below the British Columbia Water Quality Guideline (BCWQG). The periphyton community was more diverse at lower Minto Creek compared to lower Wolverine Creek (reference area). The community composition at both areas was variable, most often diatoms were the most dominant group (including during baseline), but blue-green algae were dominant in some years. This temporal variability was seen at both exposed and reference areas.

Benthic invertebrate community data were collected during baseline (1994), and from 2006 to 2012 (250 µm mesh) and from 2012 to 2020 (500 µm mesh) for Minto's Aquatic Effects Monitoring Program (AEMP). Additional collection under the Environmental Effects Monitoring (EEM) program was completed in 2008 and 2011 (250 µm mesh) and 2011, 2014, 2017, and 2019 (500 µm mesh). Earlier studies showed that the AEMP exposure area had greater taxon richness (compared to reference) using the 250 µm mesh but this was difficult to interpret due to lack of replication. In later years (using 500 µm mesh and a replication level of five), lower Minto Creek compared to reference areas showed no significant differences for taxon richness, except in 2012 (higher number of taxa) and in 2016 (lower number of taxa). Pollution sensitive taxa, EPT (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly]) made up a significantly higher proportion of the community at lower Minto Creek in 2013, 2014, 2017, and 2018 when compared to lower Wolverine Creek (reference). Pollution tolerant Oligochaeta made up a significantly lower proportion of the community at lower Minto Creek compared to the reference areas, lower Wolverine and lower Big creeks. This would indicate that the area sustains sensitive species and suggests limited mine influence.

Benthic invertebrate community monitoring under the Phase 1 EEM in 2008 indicated that upper Minto Creek had significantly higher density when compared to the reference area, upper McGinty Creek. In 2011 (Phase 2 EEM), upper Minto Creek had higher density but only when using the 250 µm mesh (no significant differences were observed with the 500 µm mesh).

Taxon richness was significantly higher at upper Minto Creek compared to upper McGinty Creek (250 µm mesh) and upper Wolverine Creek (250 and 500 µm mesh). Phase 3 EEM (2014) showed no significant differences in density and Bray-Curtis Index except for one station at upper Minto Creek. In the previous two EEM programs, Bray-Curtis Index was always significantly higher at upper Minto Creek compared to reference areas suggesting some subtle differences in community composition from reference. Phases 4 (2016) and 5 (2019) introduced a Reference Condition Approach (RCA) to analyze benthic invertebrate community. In both years, upper Minto Creek was within the calculated reference range for density, number of taxa, Simpson's evenness, and Bray-Curtis index. In the Phase 4 control-impact (CI) design (which was embedded within the RCA), upper Minto Creek had significantly lower density compared to the single reference (but was within the RCA reference condition range). Previous EEM phases that used the CI design showed significantly higher density at lower Minto Creek compared to references. In all EEM phases, percent EPT was lower at upper Minto Creek when compared to references/reference ranges. This could indicate a mine influence as EPT are sensitive taxa. Reviewing the four primary EEM metrics over time shows variability among phases. The CI design compares exposed areas to one reference area whereas the RCA compares exposed sites to multiple reference sites (which were used to calculate the reference condition range). In Phases 1 and 2, there were significant differences for density, number of taxa, Simpson's Evenness, and Bray-Curtis Index (BCI). In Phases 3 through 5 these significant differences occur less often. The additional reference sites included in the RCA capture more natural variability among sites with similar habitat conditions and the RCA is therefore less prone to the potential attribution of a natural differences between areas (e.g., one exposed and one reference) to a mine-related effect. The RCA indicates that the benthic invertebrate community of upper Minto Creek falls within the natural variability of the area.

Benthic invertebrate and periphyton tissue have been collected since 2012 and were analyzed for metal concentrations. Analytes of concern (copper and selenium) were evaluated for both tissue types. Copper concentrations in benthic invertebrate tissue at lower Minto Creek were often significantly higher when compared to the reference area, lower Wolverine Creek. When lower Minto Creek was compared to lower Big Creek, copper concentrations were significantly lower except in 2017 (when concentrations were significantly higher). Selenium concentrations in benthic invertebrate tissue were significantly higher at lower Minto Creek compared to reference areas in 2013, 2015 to 2017, and 2019, except compared to lower Wolverine Creek in 2016. Even though differences were observed, all measures of central tendency (MCT) at lower Minto Creek and reference areas, lower Wolverine and Big creeks were below the interim British Columbia Benthic Invertebrate Tissue Guideline (4 mg/kg), except for lower Wolverine Creek in 2016. From 2014 to 2020, concentrations of copper in periphyton tissue were significantly higher at lower Minto Creek compared to lower Wolverine Creek (2014 to 2020) and lower Big Creek (2017, 2018, 2020). In all years, selenium in periphyton was significantly different between lower Minto Creek and reference areas. In 2012 and 2013, periphyton selenium concentrations at lower Minto Creek were significantly lower compared to lower Wolverine Creek but significantly higher in later years (2014 to 2016, 2018, 2020). Lower Minto Creek had significantly higher concentrations of selenium in periphyton compared to lower Big Creek in 2014 to 2020. Tissue concentrations of selenium and copper are higher at the exposed area versus the reference, but the absence of baseline data makes it uncertain whether this represents a mine influence (as concentrations of copper were naturally elevated in the Minto Creek watershed prior to mine activity). For selenium in benthic invertebrate tissue, these differences may not be ecologically relevant as most concentrations are below the guidelines. Overall, the selenium monitoring results indicate no risk of adverse effects to aquatic life, particularly in consideration of lower sensitivity of lotic environments and limited exposure to fish.

The Yukon River (near Minto Creek) supports many resident and migratory fish species, including salmon (chinook, coho, and chum), lake trout, least and Bering cisco, round and lake whitefish, inconnu, arctic grayling, northern pike, burbot, longnose sucker, and slimy sculpin. Chinook salmon, round whitefish, arctic grayling, and slimy sculpin have all been captured in Minto Creek. Spawning shoals for salmon have been identified in the Yukon River downstream of Minto Creek at Ingersoll Islands and upstream of Minto Creek near Big Creek. Juvenile chinook salmon (JCS) can spend about one and a half years in tributaries of the Yukon River before out-migrating to the ocean.

Minnow trapping and electrofishing were used to capture fish during baseline sampling in 1994. Under the AEMP, fisheries monitoring in Minto Creek was completed monthly during the open water season from 2008 to 2019. Fish community monitoring was not conducted in 2020 due to dry conditions and colder water temperatures in Minto Creek. Monitoring in 2007 was conducted to support the development of the EEM Phase 1 Study Design and in 2009 to support the Minto Creek fish relocation project. Fish monitoring and effluent-exposure fish studies have also been completed during all five phases of the EEM, except for Phase 3 as an EEM Investigation of Cause (IOC) study was triggered by benthic invertebrate community results only.

The baseline habitat assessment indicated that Minto Creek is ephemeral with little flow and winter glaciation. These features prevent Minto Creek from being an overwintering fish habitat. It was also determined that fish would only be able to access the lower 2 km of Minto Creek due to a steep canyon with a 21% gradient. Fishing was attempted above the canyon, but no fish were caught. During the fish community sampling no JCS were caught, and the most abundant fish was slimy sculpin (8 fish total over 3 sampling months). Round whitefish (1) and arctic grayling (4) were also caught.

Monthly sampling (June through October) under the AEMP has shown that JCS infrequently use Minto Creek and rarely before July, with peak utilization (if any) occurring in late August and early September. Since Minto Creek is ephemeral and unsuitable for overwintering, JCS only use Minto Creek temporarily during their out-migration from natal stream to the Bering Sea. In 2010, a fish barrier was noted and restricted fish to the lower 1.2 km of the creek. Since 2010, efforts were made to catch fish above the fish barrier but proved to be unsuccessful, further cementing that fish are unable to move upstream of barriers. Excluding emergency discharge events (which occurred in 2009 and 2010), more JCS have been caught in September compared to other months. Mean annual catch-per-unit-effort (CPUE) was highest in 2010 but this occurred during a year with an emergency discharge event (which appears to attract JCS into the creek). Disregarding emergency discharge events, 2007 had the highest mean annual CPUE for JCS (mean CPUE = 6.2 fish/trap day). In 2015 and 2016, fishing efforts produced a combined 12 JCS and no JCS were caught in monitoring completed from 2017 to 2019.

Fish sampling under the AEMP has shown that JCS use Minto Creek in a limited fashion. In addition to providing poor spawning and overwintering habitat (Minto Creek experiences winter glaciation), Minto Creek is a “losing stream” system which has likely limited the opportunity for resident fish populations to become established in the creek. During summer dry periods, surface flows in lower Minto Creek can be very low to zero while flow is still observed in upper sections of the creek, likely due to infiltration of Minto Creek flows into the alluvial materials of the Yukon River floodplain. Water temperatures also tend to remain cooler in Minto Creek than in the Yukon River and fluctuate more widely throughout the day (up to 5°C or more) which likely deters fish from entering the system. The highest abundance of JCS occurred during emergency discharge events when water flows and temperature were higher (temperatures were more comparable to the Yukon River). Also, maximum monthly mean CPUE were about 6x (or more) higher during emergency discharge events in 2009 and 2010. No JCS have been caught in Minto Creek since 2016 coinciding with tighter restrictions on discharge under the WUL and no additional emergency discharge; this provides further evidence that use of the creek by JCS may be influenced by flow and temperature difference between the Yukon River and Minto Creek.

Fish monitoring under the Phase 1 EEM consisted of fish community sampling in lower Minto Creek June and September 2008. In June, electrofishing and minnow trapping yielded no fish. Only one fish was observed but not captured when electrofishing in September. Minnow trapping was more successful with 17 JCS caught. Due to a lack of sufficient fish to complete a statistically robust evaluation of the potential influence of the Minto Mine effluent on sentinel fish species, a dual *in-situ* fish community sampling and a hatchery-based effluent exposure fish study was completed for the Phase 2 EEM in 2011. Fishing efforts occurred in July, August, September, and October. The greatest number of JCS were captured in September (6) which has been shown to be the peak time for JCS usage Minto Creek under normal conditions (i.e., in the absence of emergency discharge). A total of 420 chinook salmon fry were selected for the hatchery-based fish study. Control fish were supplied with water by artesian spring water and exposed fish were supplied with water from the WSP and lower Minto Creek at effluent concentrations similar to those observed in the field. The hatchery-based fish study resulted in fish that had slightly greater size (6% difference) and body condition (2% difference) with five to six weeks of constant effluent exposure. Phase 4 EEM supporting *in-situ* fish community sampling was completed from June to September 2016. A total of 6 JCS were captured in lower Minto Creek during September monitoring events. Similar to Phase 2, an on-site laboratory exposure was set up to assess fish population health. Kokanee (*Oncorhynchus nerka*; a landlocked strain of sockeye salmon) were used in the Phase 4 exposure as JCS were unavailable. A total of 160 Kokanee fry were used in each treatment tank (control, 14% effluent, and 25% effluent). Exposed Kokanee were slightly larger (1.6% greater length and 6.9% greater weight at 25% effluent) with decreased condition at 14% effluent (-2.7%) and increased condition at 25% effluent (2.3%) when compared to reference Kokanee. The differences in condition (the EEM-effect endpoint) were small (less than the 10% critical effect size [CES]) so therefore were not considered ecologically relevant. Fishing efforts were unsuccessful during the supporting *in-situ* fish community sampling for the Phase 5 EEM. Kokanee was used again during the Phase 5 EEM on-site laboratory exposure since JCS were unavailable. A total of 125 Kokanee fry were used in each treatment (control, 14% effluent, and 25% effluent). Results were similar to Phase 4 but of greater magnitude - larger size (60 to 72%) and greater condition (12 to 16%) in the exposed groups compared to the reference group. Differences in condition were greater than the CES, so therefore were at a magnitude that would typically be considered ecologically relevant. However, the larger differences between groups appeared to have been due to a myxobacterial infection in the reference group.

Metal concentrations in fish tissue (muscle) were assessed during baseline sampling and in 2012. Very few guidelines for fish tissue quality are available and all mercury concentrations were found to be below the Health and Welfare Canada, Food and Drug Relations Guidelines. Slimy sculpin were collected from lower Minto Creek and lower Big Creek in 2012. Mean selenium concentrations in slimy sculpin collected from lower Minto Creek (5.3 ± 1.1 mg/kg dw [dry weight]) were moderately but significantly higher than lower Big Creek (3.4 ± 0.7 mg/kg dw). Selenium concentrations at lower Minto Creek were just above the BCWQG for fish tissue

(4.0 mg/kg dw), whereas lower Big Creek was just below the BCWQG. Metal concentrations in fish tissue have not been monitored since due to very limited use of lower Minto Creek by fish.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AEMP - Aquatic Effects Monitoring Program

BCI - Bray-Curtis Index

BCWQG - British Columbia Water Quality Guideline

CES – Critical Effect Size

CI – Control Impact

CPUE - Catch-per-Unit-Effort

DSTSF – Dry Stack Tailing Storage Facility

dw – Dry Weight

EEM - Environmental Effects Monitoring

EMSRP - Environmental Monitoring, Surveillance, and Reporting Plan

EPT - Ephemeroptera, Plecoptera, Trichoptera

IOC – Investigation of Cause

ISQG –Interim Sediment Quality Guideline

JCS - Juvenile Chinook Salmon

MCT - Measure of Central Tendency

MDMER - Metal and Diamond Mining Effluent Regulations

MVFE – Mill Valley Fill Extension

RCA - Reference Condition Approach

SFN – Selkirk First Nation

WSP – Water Storage Pond

WUL - Water Use Licence

1 INTRODUCTION

1.1 Background

The Minto Mine is a high-grade copper mine owned and operated by Minto Explorations Ltd. and 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). Copper deposits were first discovered in the area in 1970 and claims were staked in 1971. Development of the Minto Mine was initiated in 1997 and commercial operations started in October 2007. The mine was in continuous production from October 2007 to October 2018 when it was placed on temporary care and maintenance. Operations recommenced in October 2019. 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. 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 1.2).

Effluent was first discharged from the WSP to upper Minto Creek on July 10th, 2006, triggering monitoring requirements under the Yukon *Waters Act* and the federal *Fisheries Act*. Under the Minto Mine's current Water Use Licence (WUL; QZ14-031; Yukon Water Board 2015), Minto Mine is permitted to discharge effluent to Minto Creek at maximum rate that is roughly equivalent to one part effluent in three parts creek water[1]. Minto Creek discharges to the Yukon River approximately 7.7 km south-east of the WSP (Figure 1.2).

1.2 Overview of Aquatic Environmental Monitoring

Minto Mine completes aquatic environmental monitoring as required under the WUL and guidance of the *Yukon Waters Act* and *Yukon Waters Regulation* as well as under the Metal and Diamond Mining Effluent Regulations (MDMER) of the federal *Fisheries Act*. 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 effluent quality monitoring and 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 effluent and water quality data to the Yukon

[1] Specific equations for determining allowable effluent discharge rates are provided within the WUL.

Map of Canada

Location of the Minto Mine

0 100 200 400 km

N W E S

Projection: North American Datum 1983 UTM Zone 8V

Date October 2021
Project 217202.0096

minnow environmental inc.

Figure 1.1

Document Path: C:\Users\chada\Trinity Consultants, Inc\Pembridge Resources - D - GIS\21-96 Figure 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
Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Minto Mine Site Layout and Receiving Environment

Date October 2021
Project 217202.0096

minnow environmental inc.

Figure 1.2

Document Path: C:\Users\chada\Trinity Consultants, Inc\Pembridge Resources - D - GIS\21-96 Figure 1.2 Minto Mine Site Layout and Recieving Env.mxd

Water Board as original laboratory reports and monthly summary reports within 30 days of month end. Sediment and aquatic biological monitoring is completed under an Aquatic Environmental Monitoring Program (AEMP) that is part of the EMSRP. The AEMP has been completed annually since 2006, with occasional design adjustments, and evaluates 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 and baseline data collected in 1994 (HKP 1994). The annual AEMP includes monitoring of water, sediment, periphyton, benthic invertebrates, fish, and fish habitat.

The MDMER requirements include additional effluent quality monitoring, as well as water and biological monitoring under the Environmental Effect Monitoring (EEM) provisions of the MDMER (Schedule 5 of the MDMER). EEM includes additional effluent characterization, sublethal toxicity testing as well as a benthic invertebrate community survey and a fish survey completed on a three-year cycle.

1.3 Report Objective

As required under condition 13.1 of the QML-001, this Aquatic Resources Characterization Report has been prepared to demonstrate an understanding of site-specific aquatic environmental conditions. This report will also support Phase VII and future licensing applications. The objective of this report is to summarize all sediment and aquatic biological sampling that has been conducted from baseline to 2020. This report builds on the 2018 Minto Site Characterization Report that was produced by the Alexco Environmental Group and Minnow Environmental Inc. (Alexco and Minnow 2018). Additional data collected from 2017 to 2020 has been added and cumulative data interpretation provided.

2 SEDIMENT QUALITY

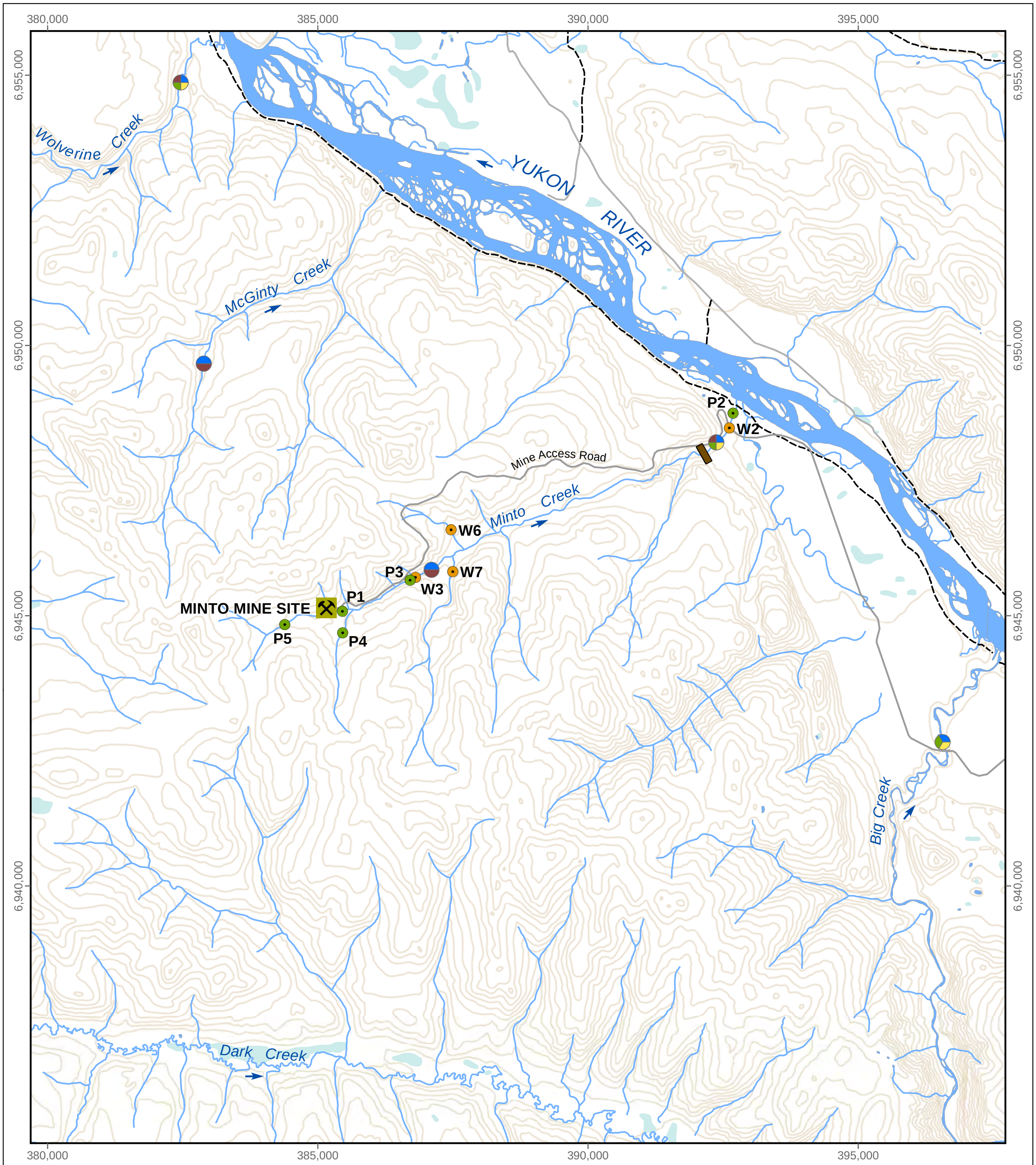
2.1 Baseline Data

During baseline sampling in 1994, sediments were collected in triplicate in the mainstem of Minto Creek (HKP 1994). Sampling was completed in the upper and lower reaches of Minto Creek (Figure 2.1). Sediment collected during baseline consisted of gravel and sand with minimal silt/clay. Copper exceeded the interim sediment quality guideline (ISQG) for the protection of aquatic life (CCME 1999) at upper Minto Creek during baseline sampling (Figure 2.2). This indicates that the area has naturally high levels of copper, consistent with the presence of an economic ore bodies within the watershed.

2.2 Operational Data – Aquatic Effects Monitoring Program

From 2006 to 2009, sediment was collected using an aluminum scoop or a hand corer in slow flowing locations and analyzed on the < 63 µm fraction (the silt and clay fraction; Minnow 2011). Samples were collected from exposed areas in upper and lower Minto Creek and from two tributaries of Minto Creek (reference areas; Figure 2.1). A particle size analyses were completed on bulk sediment, this collection method produced gravel and sand with minimal silt and clay fractions (Figure 2.3). The sediment collection method was revised in 2010 to yield more biologically relevant data. From 2010 onwards, sediment has been collected by petite ponar or hand corer in quiescent locations and analyzed on the whole fraction. This method change produced more silt and clay fractions (the most chemically relevant fraction [Horowitz 1991] and the fraction typically considered of greatest relevance for aquatic life exposure) with very minimal gravel (Figure 2.3). New reference areas were identified for each of the upper and lower areas of Minto Creek. Upper McGinty Creek was used as the reference for upper Minto Creek and lower Wolverine Creek represents the reference area for lower Minto Creek (Figure 2.1).

Arsenic concentrations at upper Minto Creek were higher than baseline and above the ISQGs for the protection of aquatic life (CCME 1999) in 2010, 2011, 2013, 2019, and 2020 (Figure 2.4; Minnow 2011, 2012, 2014, 2020a, 2021a). It was only in 2010 that concentration of arsenic in sediment at upper Minto Creek was higher than guidelines and significantly greater than at the reference area, upper McGinty Creek (Figure 2.4; Table 2.1). Arsenic in sediments of Upper McGinty Creek on the other hand was often above guidelines, suggesting that arsenic concentrations are naturally high in the McGinty Creek watershed. Moving downstream to lower Minto Creek, concentrations of arsenic were higher than guidelines and significantly greater than the reference area (lower Wolverine Creek) in 2013, 2014, 2016, and 2017 (Figure 2.5; Table 2.2; Minnow 2014, 2015a, 2017, 2018a). Sediment arsenic concentrations in lower Wolverine Creek (reference area) were higher than guidelines in all years except 2014, 2017, and 2020



LEGEND
Samples Collected

- Water
- Sediment
- Periphyton
- Benthos
- Routine Water Station
- Periphyton Sampling Station
- Fish Barrier

Water, Sediment, Periphyton, and Benthic Invertebrate Monitoring Areas

0 1.25 2.5 5
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.

Date: October 2021
Project 217202.0096

minnow environmental inc.

Figure 2.1

Document Path: C:\Users\chada\Trinity Consultants, Inc\Pembridge Resources - D - GIS\21-96 Figure 2.1.mxd

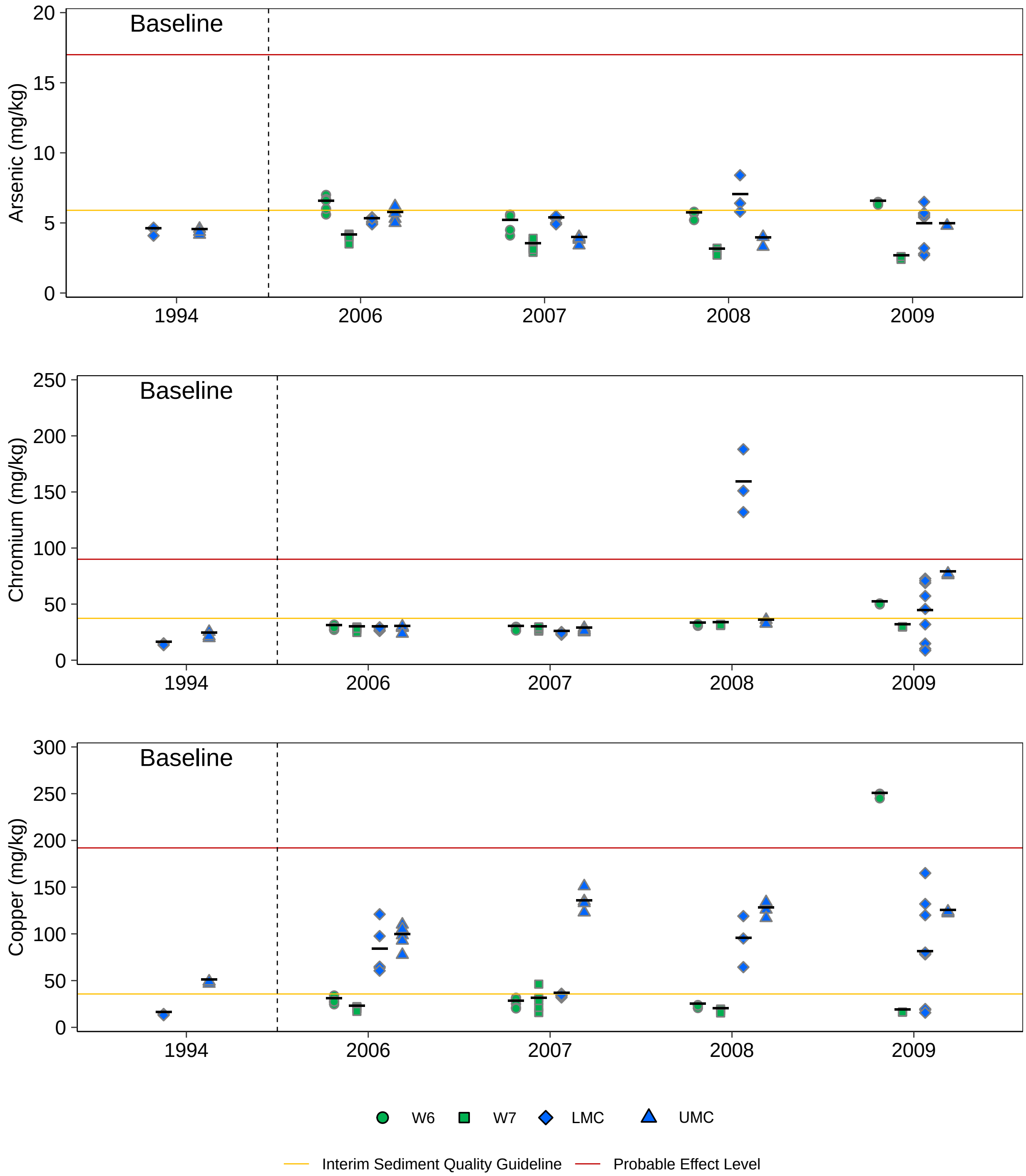


Figure 2.2: Sediment Metal Concentration at Lower and Upper Minto Creek and Reference Areas, W6 and W7, 2006 to 2009

Notes: Arsenic ISQG (Interim Sediment Quality Guideline) = 5.9 mg/kg and the PEL (Probable Effect Level) = 17 mg/kg. Chromium ISQG = 37.3 mg/kg and PEL = 90 mg/kg. Copper ISQG = 35.7 mg/kg and PEL = 192 mg/kg. Black horizontal bars indicate annual means for each station. Green represents reference stations and blue represents exposed stations. W6 = South-flowing tributary of Minto Creek; W7 = North-flowing tributary of Minto Creek; LMC = lower Minto Creek; UMC = upper Minto Creek.

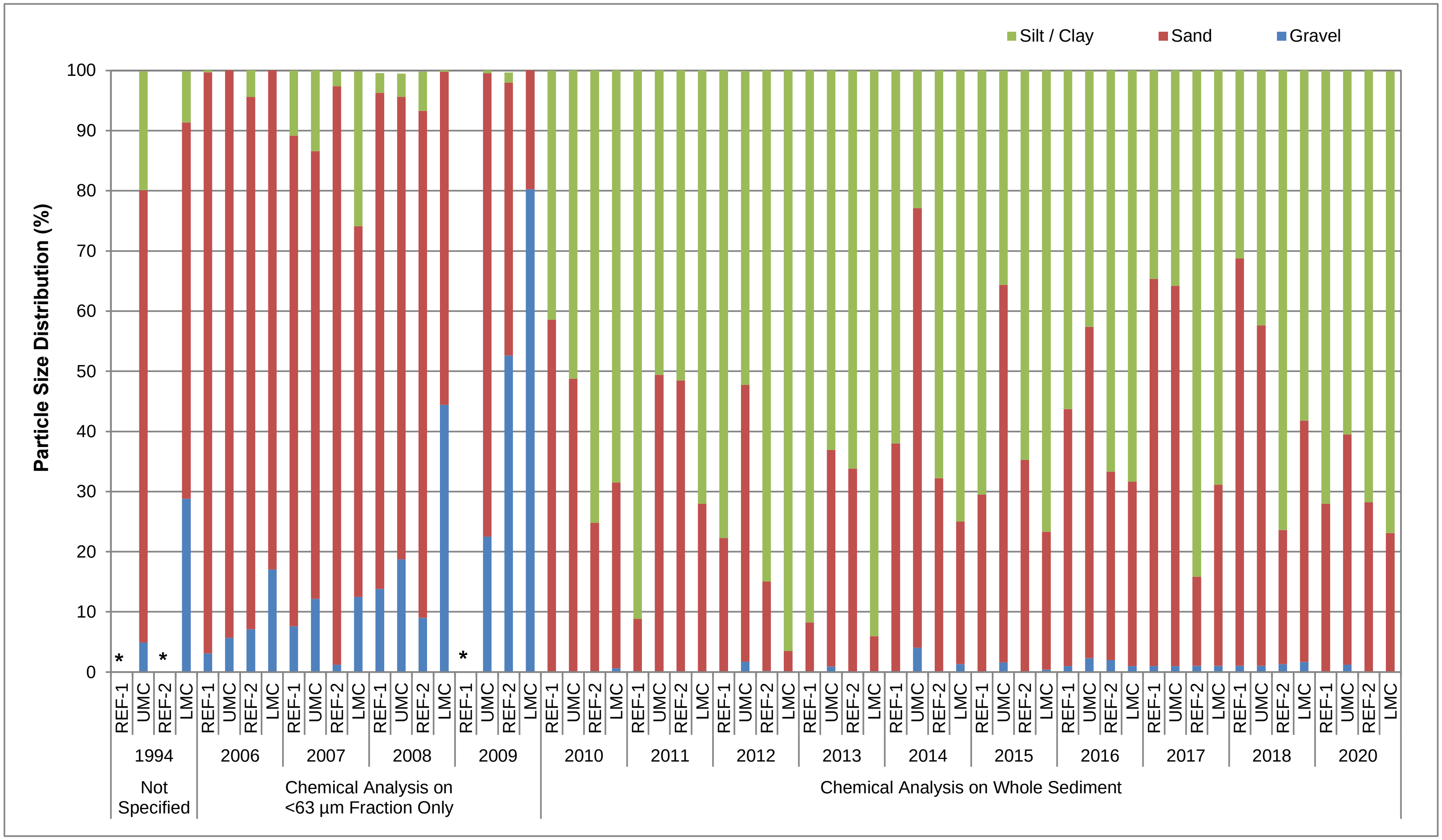


Figure 2.3: Particle Size Distribution of Sediment Collected in Minto Creek and Reference Locations, 1994 to 2020 [a]

Notes: Methods used in 1994 were not specified, fine sediment was collected in triplicate in the mainstem of Minto Creek (HKP 1994). * = no data.

[a] REF-1 = Station W6 (south-flowing tributary) in 2006 to 2008 and McGinty Creek in 2010 to 2018; UMC = Upper Minto Creek; REF-2 = Station W7 (north-flowing tributary) in 2006 to 2009 and Wolverine Creek in 2010 to 2018; LMC = Lower Minto Creek.

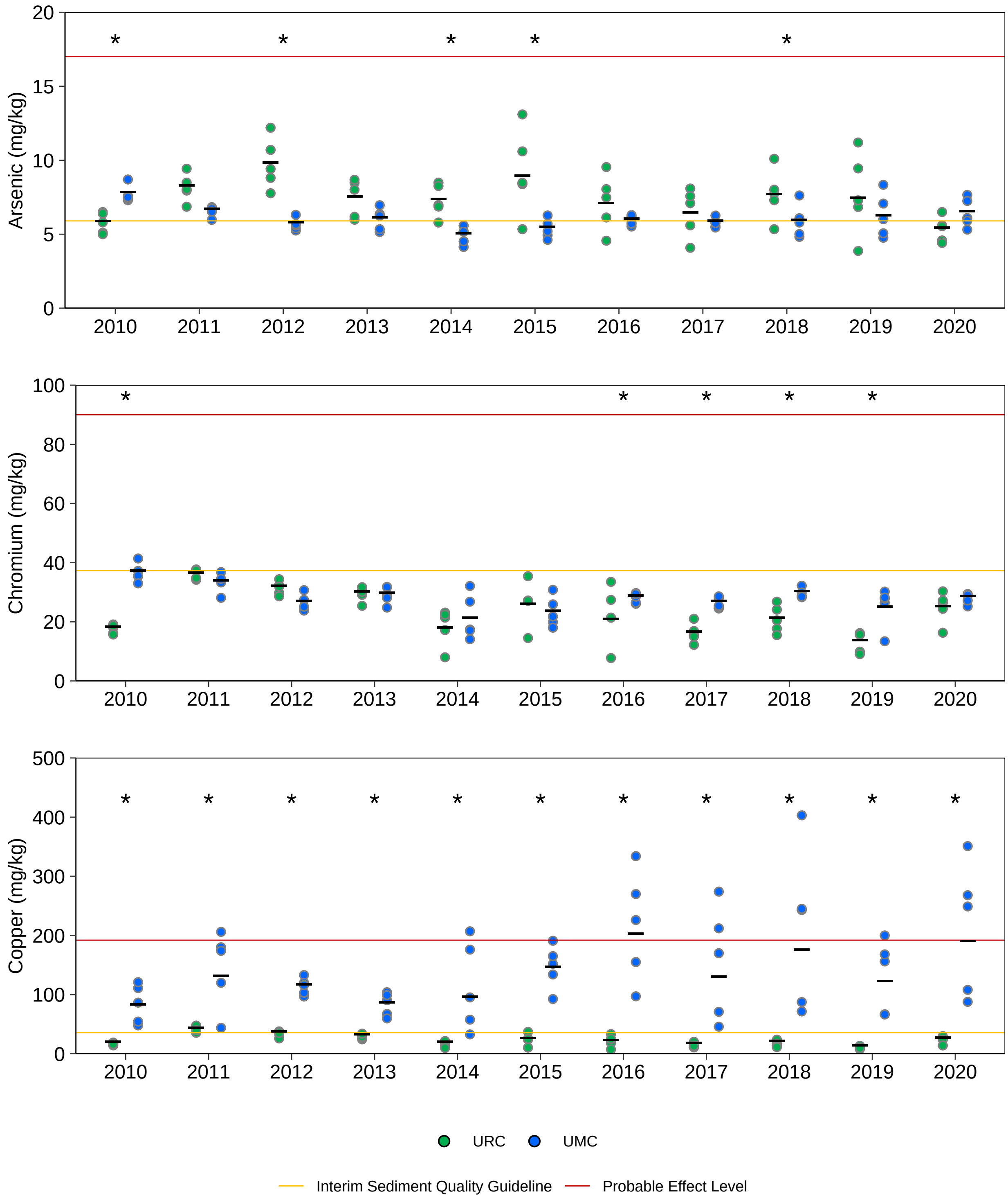


Figure 2.4: Sediment Metal Concentration at Upper Minto Creek (UMC) and Reference Area Upper McGinty Creek (URC), 2010 to 2020

Notes: Arsenic ISQG (Interim Sediment Quality Guideline) = 5.9 mg/kg and the PEL (Probable Effect Level) = 17 mg/kg. Chromium ISQG = 37.3 mg/kg and PEL = 90 mg/kg. Copper ISQG = 35.7 mg/kg and PEL = 192 mg/kg. Black horizontal bars indicate the back−transformed estimated marginal means from a two−way analysis of variance describing the differences among the stations over time. An * indicates stations were significantly different for that year.

Table 2.1: Statistical Comparison of Sediment Metal Concentrations, Upper Creek Areas, Minto, 2010 to 2020

Endpoint	ANOVA Model				Year	Do concentrations differ among years for each area?[a]		Do concentrations differ between areas?
	Transformation	Area	Year	Area x Year		URC	UMC	MOD (%)[b]
Arsenic (mg/kg)	log10	<0.001	0.106	<0.001	2010	CD	A	34
					2011	ABC	AB	-19
					2012	A	AB	-42
					2013	ABCD	AB	-19
					2014	ABCD	B	-32
					2015	AB	AB	-40
					2016	ABCD	AB	ns
					2017	BCD	AB	ns
					2018	ABCD	AB	-23
					2019	ABCD	AB	ns
					2020	D	AB	ns
Chromium (mg/kg)	log10	<0.001	<0.001	<0.001	2010	CD	A	108
					2011	A	AB	ns
					2012	AB	AB	ns
					2013	AB	AB	ns
					2014	CD	B	ns
					2015	ABC	AB	ns
					2016	BCD	AB	40
					2017	CD	AB	65
					2018	BCD	AB	44
					2019	D	AB	88
					2020	ABC	AB	ns
Copper (mg/kg)	log10	<0.001	<0.001	0.001	2010	ABC	A	384
					2011	A	A	220
					2012	AB	A	242
					2013	AB	A	187
					2014	ABC	A	472
					2015	ABC	A	533
					2016	ABC	A	953
					2017	BC	A	819
					2018	ABC	A	899
					2019	C	A	1,097
					2020	ABC	A	708

P-value < 0.05.

Magnitude of Difference (MOD) > 0.

Magnitude of Difference (MOD) < 0.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant post-hoc contrast.

[a] Years that do not share a letter were significantly different in a Tukey's Honestly Significant Difference post-hoc test (α = 0.05).

[b] MOD = $(MCT_{UMC}-MCT_{URC})/MCT_{URC}$ *100; where the measures of central tendency (MCT) were geometric means because the data was $\log_{10}$ transformed prior to the analyses.

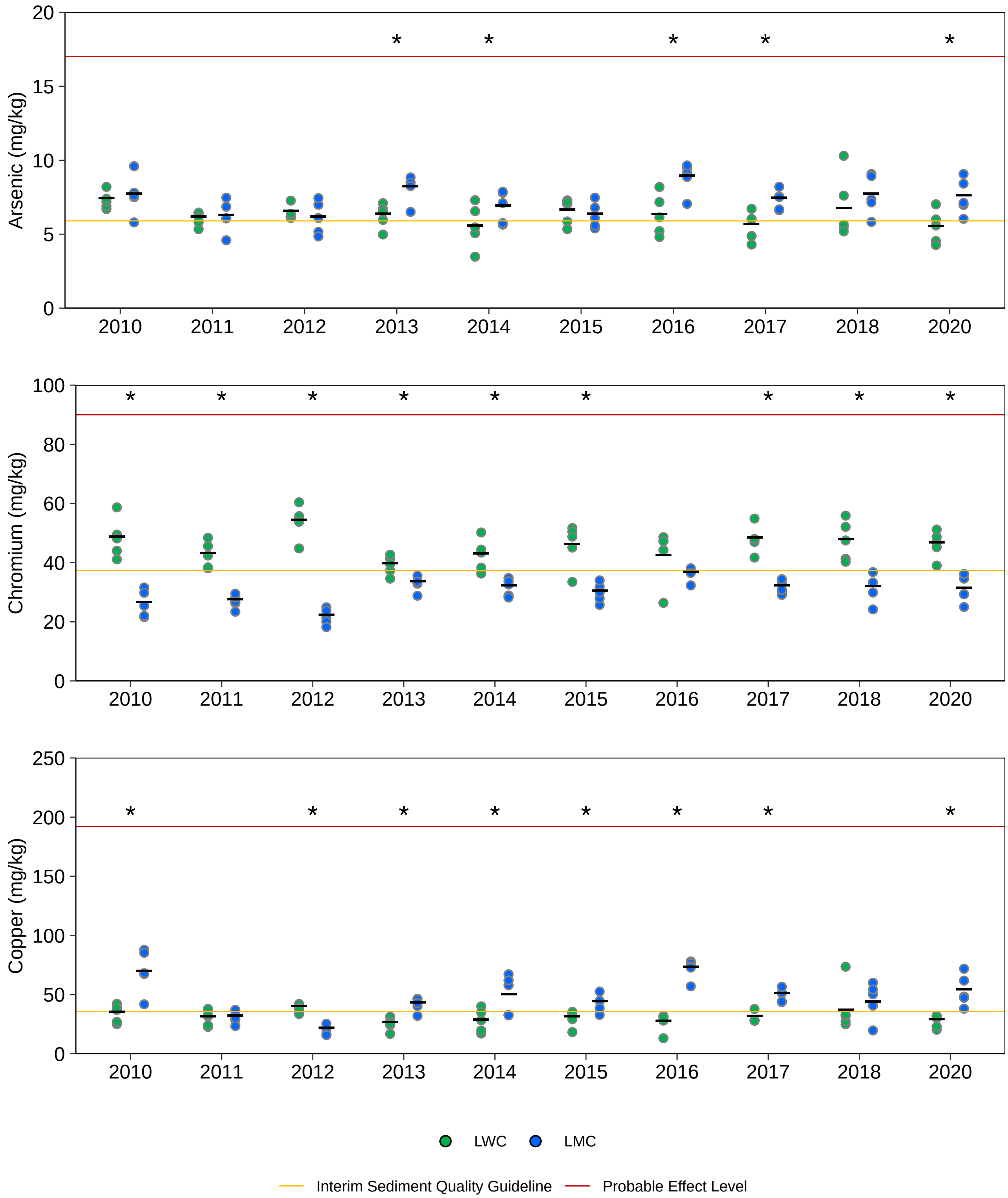


Figure 2.5: Sediment Metal Concentrations at Lower Minto Creek (LMC) and Reference Area Lower Wolverine Creek (LWC), 2010 to 2020

Notes: Arsenic ISQG (Interim Sediment Quality Guideline) = 5.9 mg/kg and the PEL (Probable Effect Level) = 17 mg/kg. Chromium ISQG = 37.3 mg/kg and PEL = 90 mg/kg. Copper ISQG = 35.7 mg/kg and PEL = 192 mg/kg. Black horizontal bars indicate the back−transformed estimated marginal means from a two−way analysis of variance describing the differences among the stations over time. An * indicates stations were significantly different for that year.

Table 2.2: Statistical Comparison of Sediment Metal Concentrations, Lower Creek Areas, Minto, 2011 to 2020

Endpoint	ANOVA Model				Year	Do concentrations differ among years for each area?[a]		Do concentrations differ between areas?
	Transformation	Area	Year	Area x Year		LWC	LMC	MOD (%)[b]
Arsenic (mg/kg)	log10	<0.001	0.031	0.044	2010	A	AB	ns
					2011	A	B	ns
					2012	A	B	ns
					2013	A	AB	30
					2014	A	AB	25
					2015	A	AB	ns
					2016	A	A	42
					2017	A	AB	32
					2018	A	AB	ns
					2020	A	AB	38
Chromium (mg/kg)	log10	<0.001	0.145	<0.001	2010	AB	BC	-46
					2011	AB	BC	-37
					2012	A	C	-60
					2013	B	AB	-16
					2014	AB	AB	-25
					2015	AB	AB	-35
					2016	AB	A	-14
					2017	AB	AB	-34
					2018	AB	AB	-34
					2020	AB	AB	-33
Copper (mg/kg)	log10	<0.001	<0.001	<0.001	2010	A	AB	104
					2011	A	CD	ns
					2012	A	D	-48
					2013	A	BC	68
					2014	A	ABC	81
					2015	A	ABC	42
					2016	A	A	177
					2017	A	ABC	65
					2018	A	ABC	ns
					2020	A	0	93

P-value < 0.05.

Magnitude of Difference (MOD) > 0.

Magnitude of Difference (MOD) < 0.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant post-hoc contrast.

[a] Years that do not share a letter were significantly different for that station in a Tukey's Honestly Significant Difference post-hoc test (α = 0.05).

[b] MOD = $(MCT_{LMC}-MCT_{LWC})/MCT_{LWC}$ *100; where the measures of central tendency (MCT) were geometric means because the data was log_{10} transformed prior to the analyses.

(Minnow 2015, 2018a, 2021a). Mean arsenic concentrations at lower Minto Creek in 2010 onwards were higher than baseline and earlier studies, but this was expected due to the change in sampling methodology to focus on fines (silt and clay) as metal binds more readily to finer sediment than gravel (Figures 2.3 and 2.5). Both reference areas (upper McGinty Creek and lower Wolverine Creek) had sediment arsenic concentrations above guidelines, indicating that arsenic concentrations might be naturally high in the general area.

Sediment chromium concentrations at upper Minto Creek (exposure) were significantly higher than the reference area Upper McGinty Creek in 2010 and from 2016 to 2019 but below guidelines (Figure 2.4; Table 2.1; Minnow 2011, 2017, 2018a, 2020a). Concentrations at lower Minto Creek were significantly lower than the reference area (lower Wolverine Creek), which was ISQG in all years (Figure 2.5; Table 2.2). Sediment chromium concentrations at the upper areas were higher than reference but below guidelines and lower areas were also lower than reference, so concentrations of chromium at the exposed areas may be ecologically irrelevant.

Sediment copper concentrations at upper Minto Creek have been above guidelines in every year including during baseline (Figures 2.3 and 2.4; Minnow 2018a, 2019, 2020a, 2021a). In more recent years, sediment copper concentrations in sediment at upper Minto Creek were significantly higher than reference as well (Figure 2.4; Table 2.1), suggesting a mine-related influence. Moving downstream to lower Minto Creek, concentrations of copper were still higher than reference and guidelines but lower than at upper Minto Creek (Figures 2.4 and 2.5; Tables 2.1 and 2.2). Since concentrations were above guidelines during baseline it was reasonable that concentrations would still be above guidelines.

2.3 Operational Data – Sediment Toxicity Testing

Two sediment toxicity tests, a 10-day test of *Chironomus dilutus* survival and growth, and a 14-day test of *Hyalella azteca* survival and growth, were performed in 2011, 2015 to 2018, and 2020 (Minnow 2012, 2016, 2017, 2019, 2021a). There were no statistically significant differences in survival of C. *dilutus* in the first three years (2011, 2015, and 2016). However, in 2017, 2018, and 2020, survival was significantly lower at lower Minto Creek (exposed) compared to reference sediment (2020) or compared to both reference and control sediment (2017, 2018; Table 2.3). This suggests a possible adverse effect, but temporal comparisons show differences in response despite similar sediment chemistry. Growth in C. *dilutus* in 2017 was significantly smaller at lower Minto Creek than lower Wolverine Creek (reference; Table 2.3). There were no adverse effects on *H. azteca* at lower Minto Creek compared to reference (lower Wolverine Creek) and control sediment for both survival and growth except in 2020 (Table 2.3). In 2020, survival of *H. azteca* was significantly lower in sediment collected from lower Minto creek compared to both the reference and control sediment (Table 2.3). Although equivocal, these results suggest

Table 2.3: Minto Mine Effluent Sediment Toxicity Test Results for Lower Wolverine Creek and Lower Minto Creek, September 2011, 2015 to 2018, and 2020

Endpoint	Year	*Chironomus dilutus*			*Hyalella azteca*		
		Control Sediment	Lower Wolverine Creek	Lower Minto Creek	Control Sediment	Lower Wolverine Creek	Lower Minto Creek
Survival (%)	2011	76 ± 8.9	80 ± 8.2	80 ± 7.1	90 ± 7.1	66 ± 22	98 ± 4.5
	2015	100 ± 0	96 ± 8.9	96 ± 5.5	98 ± 4.5	100 ± 0	100 ± 0
	2016	94 ± 8.9	90 ± 7.1	82 ± 16	100 ± 0	100 ± 0	100 ± 0
	2017	86 ± 8.9	90 ± 17	48 ± 38	96 ± 5.5	94 ± 5.5	92 ± 13
	2018	92 ± 4.5	88 ± 8.4	70 ± 12	96 ± 5.5	100 ± 0	94 ± 5.5
	2020	90 ± 10	94 ± 13	76 ± 21	100 ± 0	100 ± 0	74 ± 36
Dry Weight (mg)	2011	2.4 ± 0.58	2.2 ± 0.53	2.6 ± 0.59	0.11 ± 0.020	0.090 ± 0.040	0.12 ± 0.030
	2015	1.7 ± 0.17	2.3 ± 0.13	2.7 ± 0.26	0.26 ± 0.050	0.20 ± 0.050	0.25 ± 0.080
	2016	2.4 ± 0.20	2.7 ± 0.30	3.4 ± 0.47	0.24 ± 0.060	0.30 ± 0.020	0.31 ± 0.070
	2017	1.2 ± 0.25	2.0 ± 0.24	1.6 ± 0.32	0.11 ± 0.020	0.13 ± 0.030	0.11 ± 0.020
	2018	2.2 ± 0.090	2.6 ± 0.51	3.0 ± 0.31	0.21 ± 0.020	0.26 ± 0.060	0.27 ± 0.020
	2020	1.7 ± 0.18	2.4 ± 0.31	2.7 ± 0.27	0.14 ± 0.020	0.14 ± 0.010	0.13 ± 0.010

Significantly different than control sediment.

Significantly different than reference sediment.

Significantly different than control and reference sediment.

Note: Data presented as mean ± standard deviation.

a potential for adverse effect, but temporal comparisons show differences in response despite similar sediment chemistry (including baseline elevations in concentrations of several metals as would be expected in association with the ore deposit within the Minto Creek watershed).

3 PERIPHYTON

3.1 Baseline Data

Periphyton was collected at five stations (with six replicates per station) during baseline sampling (Figure 2.1; HKP 1994). During baseline sampling, light penetration was identified as a confounding factor in periphyton coverage and subsequently chlorophyll-a concentrations. Areas impacted by a forest fire had more light penetration, therefore more periphyton coverage and a higher chlorophyll-a concentration. Site P3 had a dense coverage of alders and willows, therefore had lower light penetration and the lowest concentration of chlorophyll-a (Figure 2.1; Table 3.1). Regardless of light penetration or periphyton coverage, all stations had chlorophyll-a concentrations below the British Columbia Water Quality Guideline (BCWQG) of 100 mg/m^2 for the protection of aquatic life (BCMOE 1985). Under Dodds' (1998) classification system, all stations would also be categorized as oligotrophic (low production/low nutrients).

Table 3.1: Chlorophyll-a Content of Periphyton (µg/cm2)

Replicate	Site P1	Site P2	Site P3	Site P4	Site P5
1	1.87	0.59	0.94	3.52	3.75
2	2.08	1.12	1.41	<0.1	1.81
3	1.32	6.37	0.98	1.53	11.04
4	0.59	0.77	0.73	0.92	1.89
5	9.41	4.73	0.22	0.81	1.67
6	0.61	3.12	0.47	0.77	3.34
Mean	2.65	2.78	0.792	1.28	3.92

Minto Creek had little periphyton coverage indicating an unproductive stream or scouring events during freshet. Red and blue green algae were abundant in some stations, but Diatoms were found to be the most dominant species at all locations. The diatom, *Nitzschia sp.* was often the most dominant species. This species is associated with organic or nutrient enrichment and can indicate that the area might be sensitive to enrichment.

3.2 Operational Data – Aquatic Effects Monitoring Program

Periphyton sampling for chlorophyll-a has been included in the AEMP since 2012 (e.g., Minnow 2019, 2021a) and lower Minto Creek was significantly different from lower Wolverine Creek (reference) in all years except 2013 and 2016 (Figure 3.1; Table 3.2). When differences in chlorophyll-a concentrations were observed between lower Minto Creek (exposed area) and lower Wolverine Creek (reference area), lower Minto Creek concentrations were significantly higher in 2014, 2015, 2017, and 2018, but were significantly lower in 2012 and 2020 (Figure 3.1; Table 3.2). Despite these differences, the median concentration of

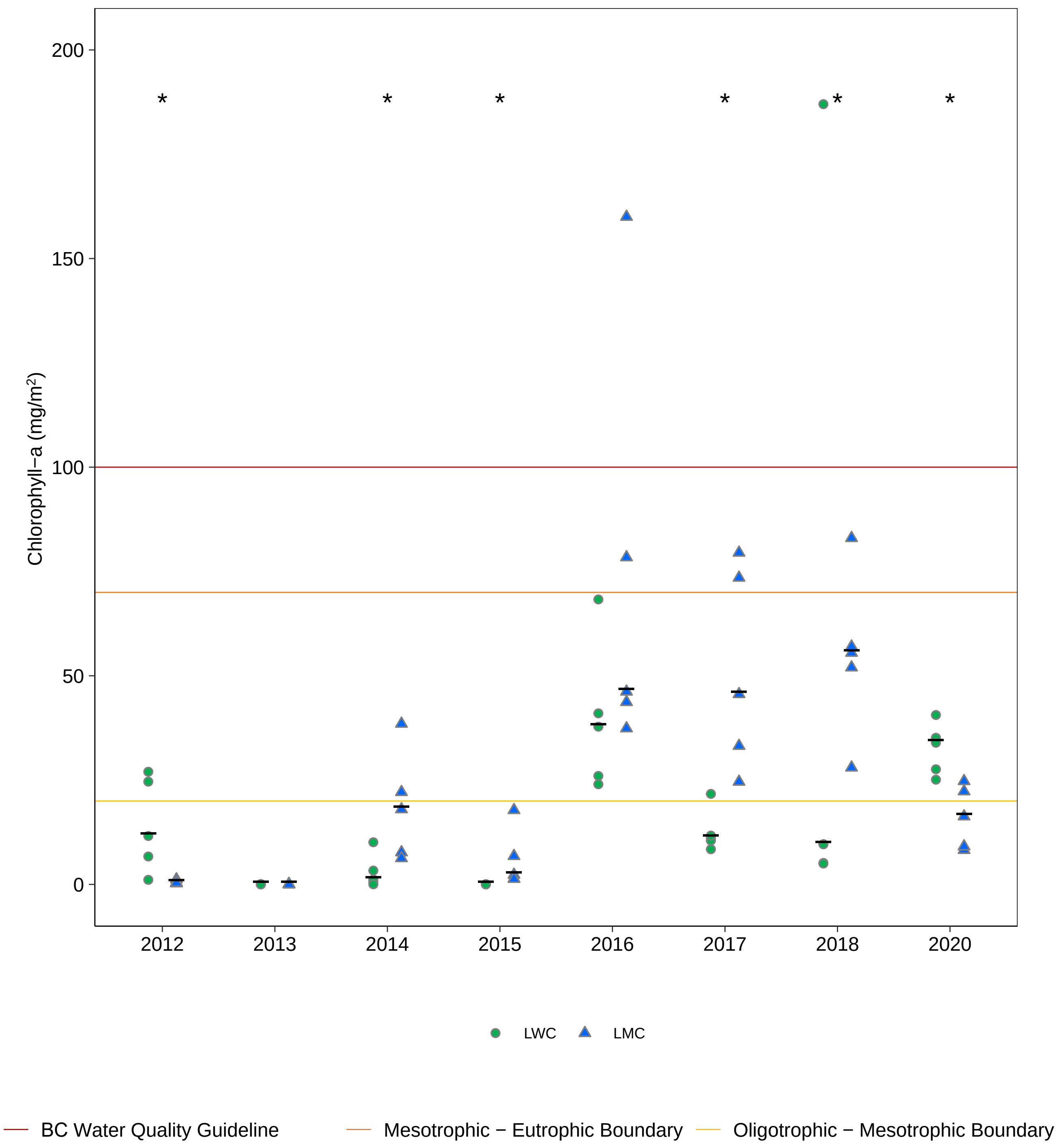


Figure 3.1: Chlorophyll-a at Lower Minto Creek (LMC) and Reference Area, Lower Wolverine Creek (LWC), 2012 to 2020

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The median was selected for the MCT for rank transformed data. An * indicates stations were significantly different for that year.

Table 3.2: Statistical Comparison on Chlorophyll-a, Minto, 2012 to 2020

Endpoint	ANOVA Model				Year	Do endpoints differ between years for each area?[a]		Do endpoints differ between areas?
	Transformation	Area	Year	Area x Year		LWC	LMC	MOD (%)[b]
Chlorophyll-a	rank	<0.001	<0.001	<0.001	2012	CD	CD	-97
					2013	E	D	ns
					2014	DE	B	1,473
					2015	E	BC	8,352
					2016	A	A	ns
					2017	C	A	311
					2018	BC	A	478
					2020	AB	B	-52

P-value < 0.1.

Magnitude of Difference (MOD) < 0.

Magnitude of Difference (MOD) > 0.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant contrast.

[a] Years that do not share a letter were significantly different in a Tukey's Honestly Significant Difference post-hoc test (α = 0.1).

[b] MOD = $(MCT_{LMC}-MCT_{LWC})/MCT_{LWC}$ *100; where the measures of central tendency (MCT) were medians because data were rank-transformed.

chlorophyll-a has always been below the BCWQG. There were two incidences where an individual replicate sample was above the BCWQG, one replicate from lower Minto Creek in 2016 and one replicate from lower Wolverine Creek in 2018 (Figure 3.1; Table 3.2). From 2012 to 2015, both lower Minto and Wolverine creeks were classified as oligotrophic under Dodds' (1998) classification system (Figure 3.1). In 2016, both exposed and reference areas were mesotrophic (Figure 3.1). This trophic status continued for lower Minto Creek until 2020 when it was classified as oligotrophic again (Figure 3.1). Lower Wolverine Creek was again identified as oligotrophic in 2017 and 2018 but was mesotrophic in 2020 (Figure 3.1). The slight enrichment at lower Minto Creek from 2016 to 2018 could indicate some mine influence associated with effluent discharge, but temporal variability in trophic status was observed at both lower Minto Creek and the reference, lower Wolverine Creek. The variability in chlorophyll-a concentrations could be due to factors other than mine influence that play a role in periphyton coverage, such as, light availability, canopy cover, and temperature.

From 2011 to 2013, periphyton taxon richness at lower Minto Creek was significantly lower than at lower Wolverine Creek (reference) but in 2014 to 2016, taxon richness was significantly higher at lower Minto Creek compared to lower Wolverine Creek (Figure 3.2; Table 3.3). Taxon richness might have been higher from 2014 to 2016 but the measure of central tendency (MCT) was lower than in 2011 to 2013 (both reference and exposure; Figure 3.2; Table 3.3). This corresponds with a change in laboratory that was used from 2014 to 2020. This apparent change was only present when interpreting taxon richness data. Simpson's diversity was significantly higher at lower Minto Creek compared to reference area, lower Wolverine Creek in 2011, 2013, 2014, 2016, and 2017.

The Minto Creek periphyton community consisted primarily of diatoms during the operational period (1994, 2013, 2014, 2016, and 2018), as well as during baseline sampling (1994; Figure 3.2). There were significantly fewer diatoms at lower Minto Creek when compared to lower Wolverine Creek (reference), except in 2013 (Figure 3.2). Blue-green algae were also a dominant group at lower Minto Creek in 2011, 2015, 2017, and 2020 (Figure 3.2). Comparisons to lower Wolverine Creek in these years (2011, 2015, 2017, and 2020) indicated that lower Minto Creek had a significantly higher percentage of blue-green algae except in 2011 (Figure 3.2). Diatoms were most often dominant at lower Wolverine Creek except in 2011 and 2013 when blue-green algae were the most dominant.

Overall, periphyton productivity and community monitoring under the AEMP has shown substantial inter-annual variation in Minto Creek and the reference creek (Wolverine Creek). However, consideration of temporal patterns relative to reference suggest limited mine-influence. Importantly, both Minto Creek and Wolverine Creek have been classified as oligotrophic or mesotrophic depending on year of sampling and an apparent trophic change in Minto Creek from oligotrophic to mesotrophic in 2016 to 2018 was temporary (Minto Creek was oligotrophic in 2020).

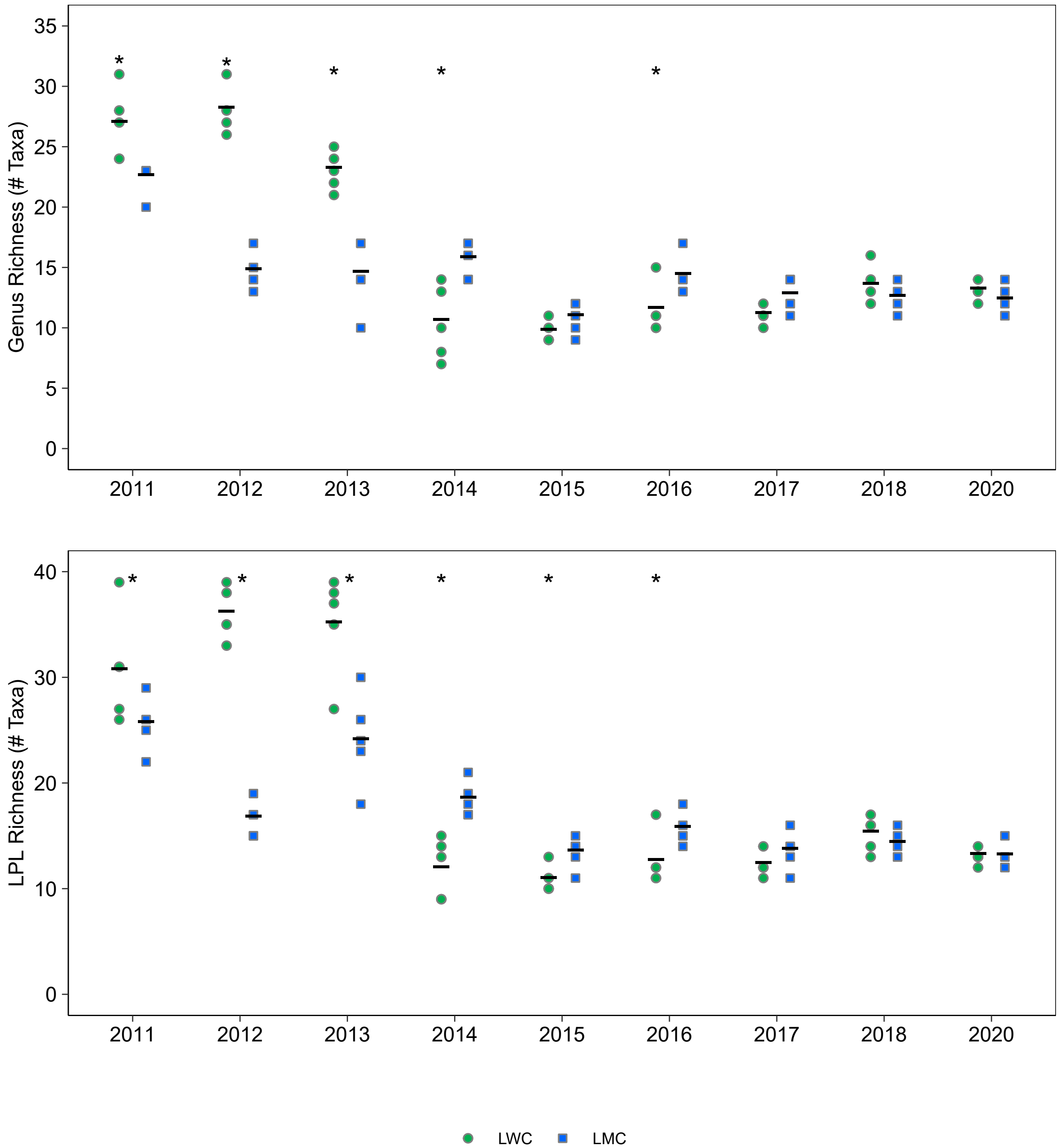


Figure 3.2: Periphyton Community Endpoints at Lower Minto Creek (LMC) and Reference Area, Lower Wolverine Creek, 2011 to 2020

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 or log−10(x+1) transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue.

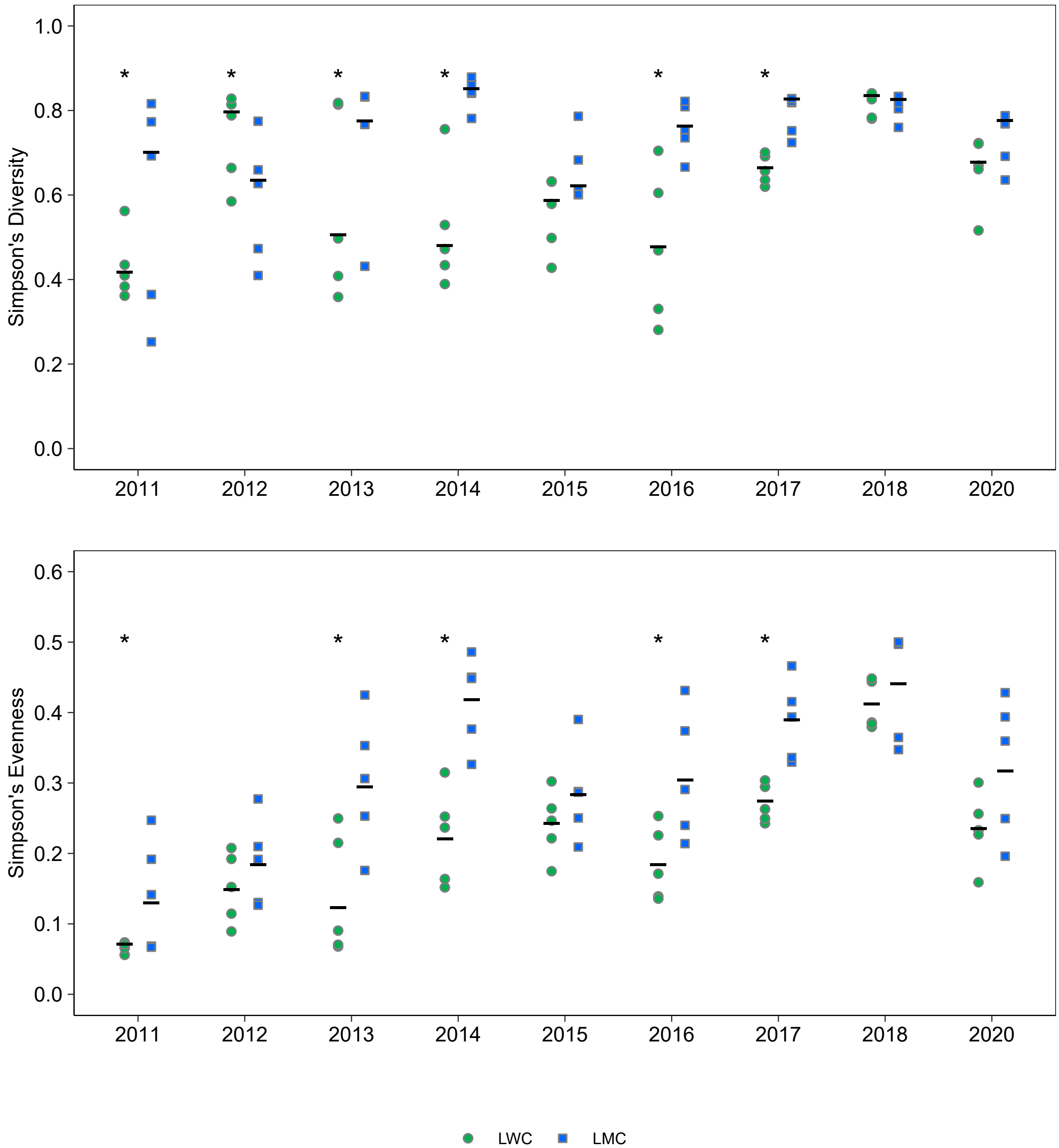


Figure 3.2: Periphyton Community Endpoints at Lower Minto Creek (LMC) and Reference Area, Lower Wolverine Creek, 2011 to 2020

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 or log−10(x+1) transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue.

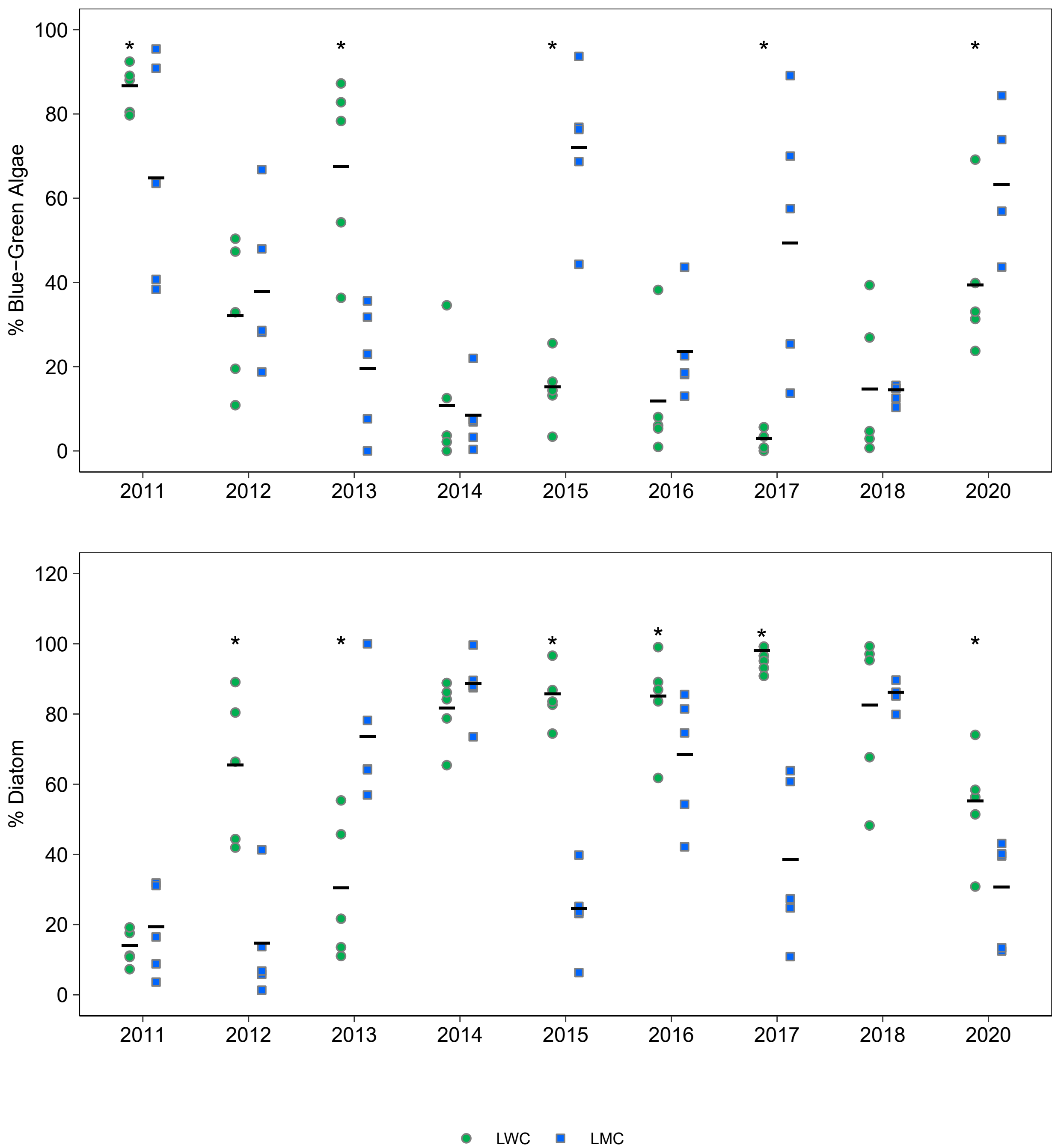


Figure 3.2: Periphyton Community Endpoints at Lower Minto Creek (LMC) and Reference Area, Lower Wolverine Creek, 2011 to 2020

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 or log−10(x+1) transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue.

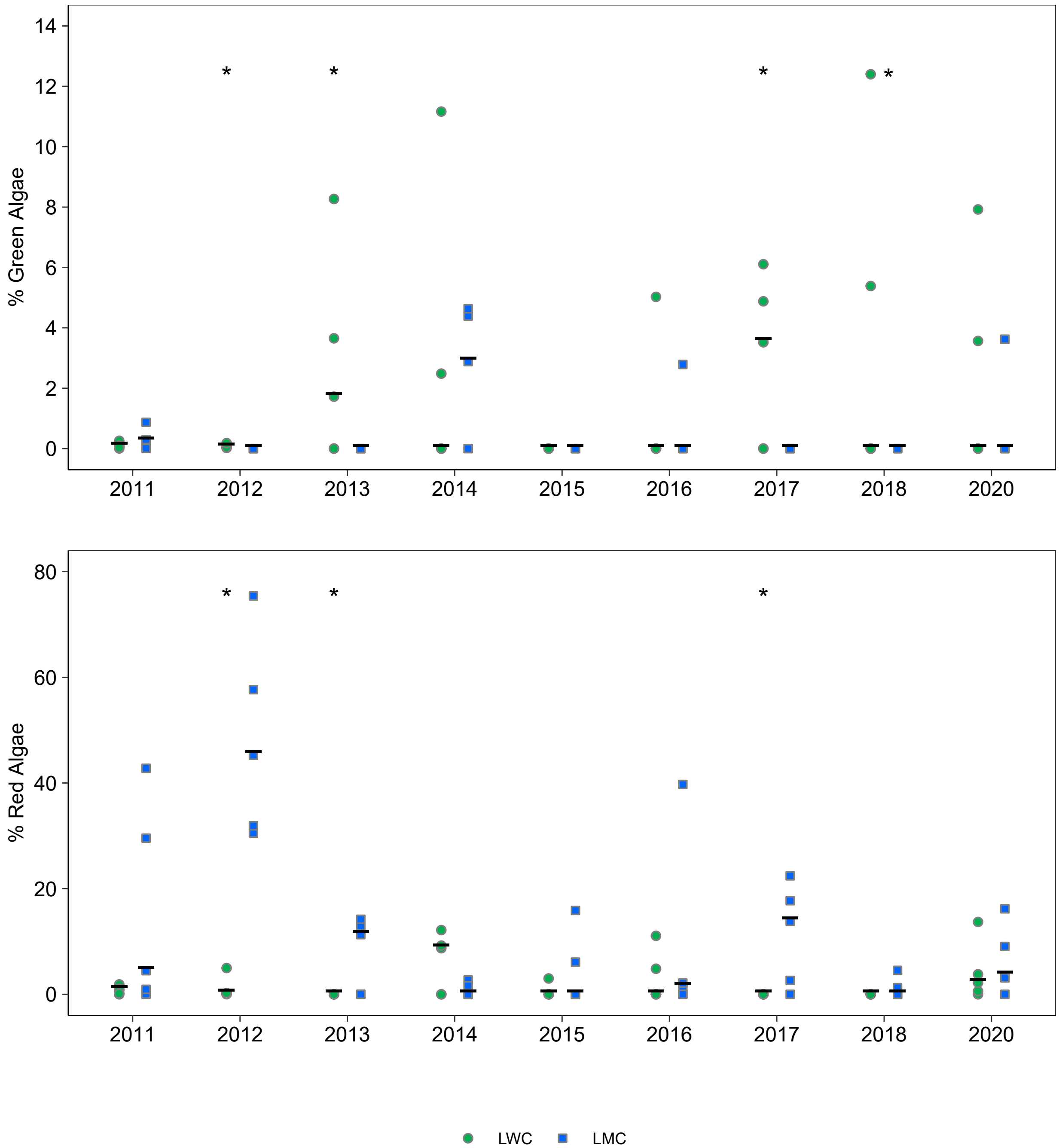


Figure 3.2: Periphyton Community Endpoints at Lower Minto Creek (LMC) and Reference Area, Lower Wolverine Creek, 2011 to 2020

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 or log−10(x+1) transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue.

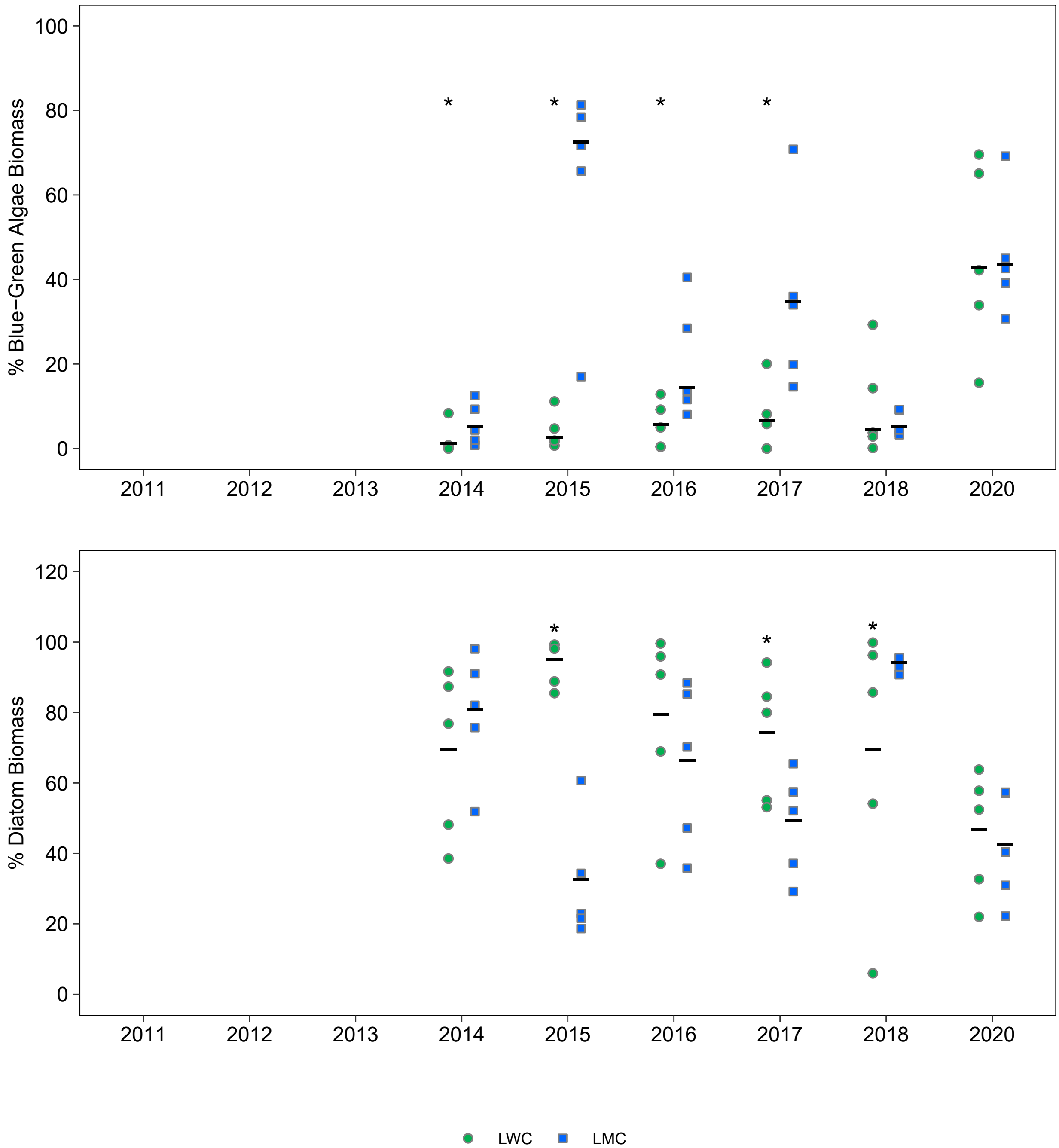


Figure 3.2: Periphyton Community Endpoints at Lower Minto Creek (LMC) and Reference Area, Lower Wolverine Creek, 2011 to 2020

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 or log−10(x+1) transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue.

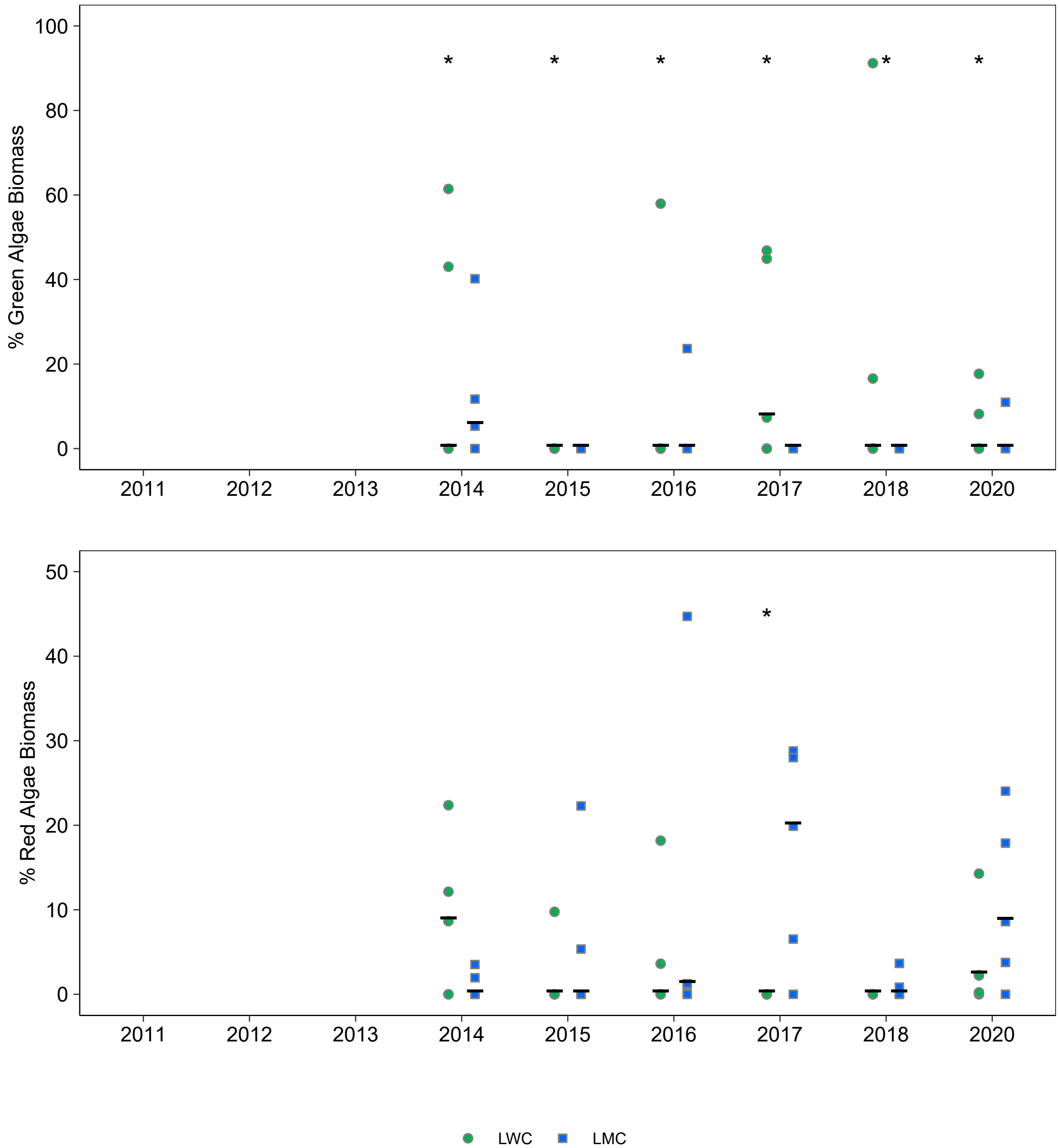


Figure 3.2: Periphyton Community Endpoints at Lower Minto Creek (LMC) and Reference Area, Lower Wolverine Creek, 2011 to 2020

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 or log−10(x+1) transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue.

Table 3.3: Statistical Comparison of Periphyton Community Endpoints, Minto, 2011 to 2020

Endpoint	ANOVA Model				Year	Do values differ among years for each area?[a]		Do values differ between reference and exposed areas?
	Transformation	Area	Year	Area x Year		LWC	LMC	MOD (%)[b] LWC
Genus Richness (# Taxa)	none	<0.001	<0.001	<0.001	2011	A	A	-1.5
					2012	A	BC	-7.2
					2013	B	BC	-5.4
					2014	CD	B	1.7
					2015	D	D	ns
					2016	CD	BC	1.4
					2017	CD	BCD	ns
					2018	C	BCD	ns
					2020	C	CD	ns
LPL Richness (# Taxa)	log10	0.098	<0.001	<0.001	2011	A	A	-1.1
					2012	A	BC	-11
					2013	A	A	-2.5
					2014	C	B	1.8
					2015	C	CD	1.9
					2016	BC	BCD	1.2
					2017	BC	CD	ns
					2018	B	CD	ns
					2020	BC	D	ns
Simpson's Diversity	rank	<0.001	<0.001	<0.001	2011	C	BC	7.4
					2012	AB	C	-2.7
					2013	BC	ABC	1.3
					2014	BC	A	4.4
					2015	BC	BC	ns
					2016	C	ABC	1.4
					2017	BC	AB	3.1
					2018	A	A	ns
					2020	BC	ABC	ns
Simpson's Evenness	log10	<0.001	<0.001	0.072	2011	E	C	6.0
					2012	CD	BC	ns
					2013	D	AB	1.4
					2014	BC	A	2.1
					2015	ABC	AB	ns
					2016	BCD	AB	1.8
					2017	AB	A	3.6
					2018	A	A	ns
					2020	ABC	AB	ns
% Blue-Green Algae	log10(x+1)	0.01	<0.001	<0.001	2011	A	AB	-4.1
					2012	CD	BCD	ns
					2013	AB	DE	-2.5
					2014	DE	E	ns
					2015	CDE	A	5.8
					2016	DE	CDE	ns
					2017	E	ABC	16
					2018	CDE	DE	ns
					2020	BC	AB	1.3
% Diatom	none	<0.001	<0.001	<0.001	2011	E	B	ns
					2012	BC	B	-2.4
					2013	DE	A	2.2
					2014	ABC	A	ns
					2015	AB	B	-7.6
					2016	AB	A	-1.2
					2017	A	B	-18
					2018	ABC	A	ns
					2020	CD	B	-1.6

P-value < 0.1.

Magnitude of Difference (MOD) <-2.

Magnitude of Difference (MOD) >2.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant post-hoc contrast. In cases where an MOD could not be calculated, only directionality is shown.

[a] Years that do not share a letter were significantly different in a Tukey's Honestly Significant Difference post-hoc test (α = 0.1).

[b] Magnitude of Difference (MOD) = (MCT_{EXP}-MCT_{REF})/SD_{REF}; where the measures of central tendency (MCT) were geometric means for log-10 or log-10(x+1) transformed data, medians for rank transformed data, and means for untransformed data.

[c] Although the rank values are significantly higher at the reference area compared to the mine-exposed area, both medians were 0, resulting in an MOD = 0.

Table 3.3: **Statistical Comparison of Periphyton Community Endpoints, Minto, 2011 to 2020**

Endpoint	ANOVA Model				Year	Do values differ among years for each area?[a]		Do values differ between reference and exposed areas?
	Transformation	Area	Year	Area x Year		LWC	LMC	MOD (%)[b] LWC
% Green Algae	rank	0.001	0.011	0.075	2011	A	A	ns
					2012	A	B	-2.8
					2013	A	B	-0.67
					2014	A	AB	ns
					2015	A	B	ns
					2016	A	AB	ns
					2017	A	B	-0.92
					2018	A	B	0[c]
					2020	A	AB	ns
% Red Algae	rank	<0.001	<0.001	0.048	2011	A	AB	ns
					2012	A	A	286
					2013	A	AB	positive
					2014	A	B	ns
					2015	A	B	ns
					2016	A	B	ns
					2017	A	AB	positive
					2018	A	B	ns
					2020	A	AB	ns
% Blue-Green Algae Biomass	rank	<0.001	<0.001	<0.001	2011	-	-	-
					2012	-	-	-
					2013	-	-	-
					2014	B	C	7.3
					2015	B	A	40
					2016	B	BC	1.3
					2017	B	AB	3.3
					2018	B	C	ns
					2020	A	AB	ns
% Diatom Biomass	none	0.037	0.004	<0.001	2011	-	-	-
					2012	-	-	-
					2013	-	-	-
					2014	AB	AB	ns
					2015	A	C	-9.8
					2016	AB	ABC	ns
					2017	AB	BC	-1.4
					2018	AB	A	0.63
					2020	B	C	ns
% Green Algae Biomass	rank	0.083	0.238	0.421	2011	-	-	-
					2012	-	-	-
					2013	-	-	-
					2014	A	A	0[c]
					2015	A	A	
					2016	A	A	
					2017	A	A	
					2018	A	A	
					2020	A	A	
% Red Algae Biomass	rank	0.05	0.135	0.084	2011	-	-	-
					2012	-	-	-
					2013	-	-	-
					2014	A	A	ns
					2015	A	A	ns
					2016	A	A	ns
					2017	A	A	positive
					2018	A	A	ns
					2020	A	A	ns

P-value < 0.1.

Magnitude of Difference (MOD) <-2.

Magnitude of Difference (MOD) >2.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant post-hoc contrast. In cases where an MOD could not be calculated, only directionality is shown.

[a] Years that do not share a letter were significantly different in a Tukey's Honestly Significant Difference post-hoc test (α = 0.1).

[b] Magnitude of Difference (MOD) = (MCT_{EXP}-MCT_{REF})/SD_{REF}; where the measures of central tendency (MCT) were geometric means for log-10 or log-10(x+1) transformed data, medians for rank transformed data, and means for untransformed data.

[c] Although the rank values are significantly higher at the reference area compared to the mine-exposed area, both medians were 0, resulting in an MOD = 0.

4 BENTHIC INVERTEBRATE COMMUNITY

4.1 Baseline Data

Benthic invertebrate community data was collected during baseline sampling as three single grab samples near the mouth of Minto Creek (HKP 1994). During baseline, there were fewer organisms (lower density), but more taxa represented (higher taxon richness) at lower Minto Creek compared to the baseline reference area (W7, a north-flowing tributary of Minto Creek; Figure 4.1).

4.2 Operational Data – Aquatic Effects Monitoring Program

Benthic invertebrate collection methods have changed over time. In 2006, benthic invertebrates were collected the same way as baseline (see Section 4.1) and from 2008 to 2010 samples were collected at W2 as three-grab composites (Figure 2.1; Minnow 2011). The most recent method (used from 2011 to present) collected five replicate three-grab composites from a large area upstream of W2 (Figure 2.1). It was only in later years (2011 to present) that data represent an area (i.e., lower Minto Creek) rather than a station (e.g., Minnow 2021a). In addition, data collected since 2012 were sieved using a 500 µm mesh as recommended for federal EEM (Environment Canada 2012). All other years used a 250 µm mesh (2012 used both methods to assist in transition).

As expected, based on the mesh size change, benthic invertebrate community densities were found to be lower from 2012 (500 µm mesh) to 2020 when compared to samples collected in 1994 and 2006 to 2012 (250 µm mesh; Figures 4.1 and 4.2). Densities at lower Minto Creek were generally higher than at reference areas in earlier studies but lack of replication prohibits definitive (statistical) interpretation (Figure 4.1). Significantly higher densities were observed at lower Minto Creek compared to reference creeks in 2014 (lower Wolverine Creek), 2015 (lower Wolverine and Big creeks), and 2018 and 2020 (lower Big Creeks; Figure 4.2; Table 4.1). The number of taxa present at lower Minto Creek was higher when compared to reference areas from 2006 to 2012, except in 2011 but due to lack of replication it is unclear if these differences are significant (Figure 4.1). From 2012 to 2020, taxon richness only differed significantly from reference in 2012 (higher taxon richness) and 2016 (lower taxon richness) when comparing lower Minto Creek to reference areas, lower Wolverine Creek (2012) and lower Big Creek (2016; Figure 4.2; Table 4.1). Percent EPT (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly]) was significantly higher at lower Minto Creek compared to lower Wolverine Creek (reference area) in 2013, 2014, 2017, and 2018 (Figure 4.2). In 2019, scheduled sampling could not be completed due to dry conditions through early summer and into early fall. In 2020, flows remained low but were sufficient to allow sampling. In 2020, lower Minto Creek had lower percent EPT compared

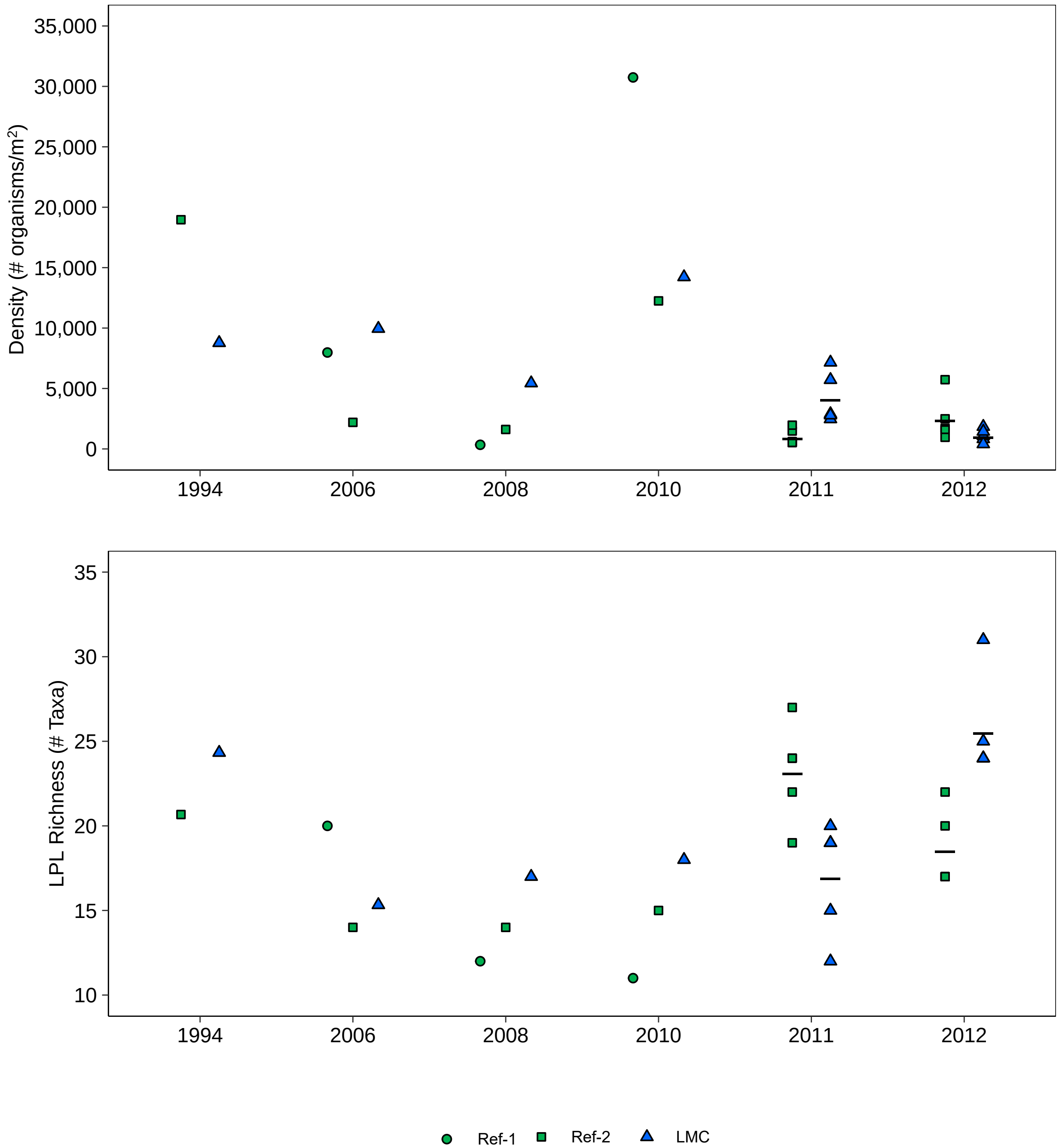


Figure 4.1: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 1994 to 2012 AEMP Program (250 µm)

Notes: Black horizontal bars indicate means. A taxonomic decision key was used only on data from 2008 to 2012. Reference areas are shown in green and mine exposed areas are shown in blue. Ref-1 = W6 (South-flowing tributary) from 1994 to 2008. Ref-2 = W7 (North-flowing tributary) from 1994 to 2010 and lower Wolverine Creek from 2011 to 2012.

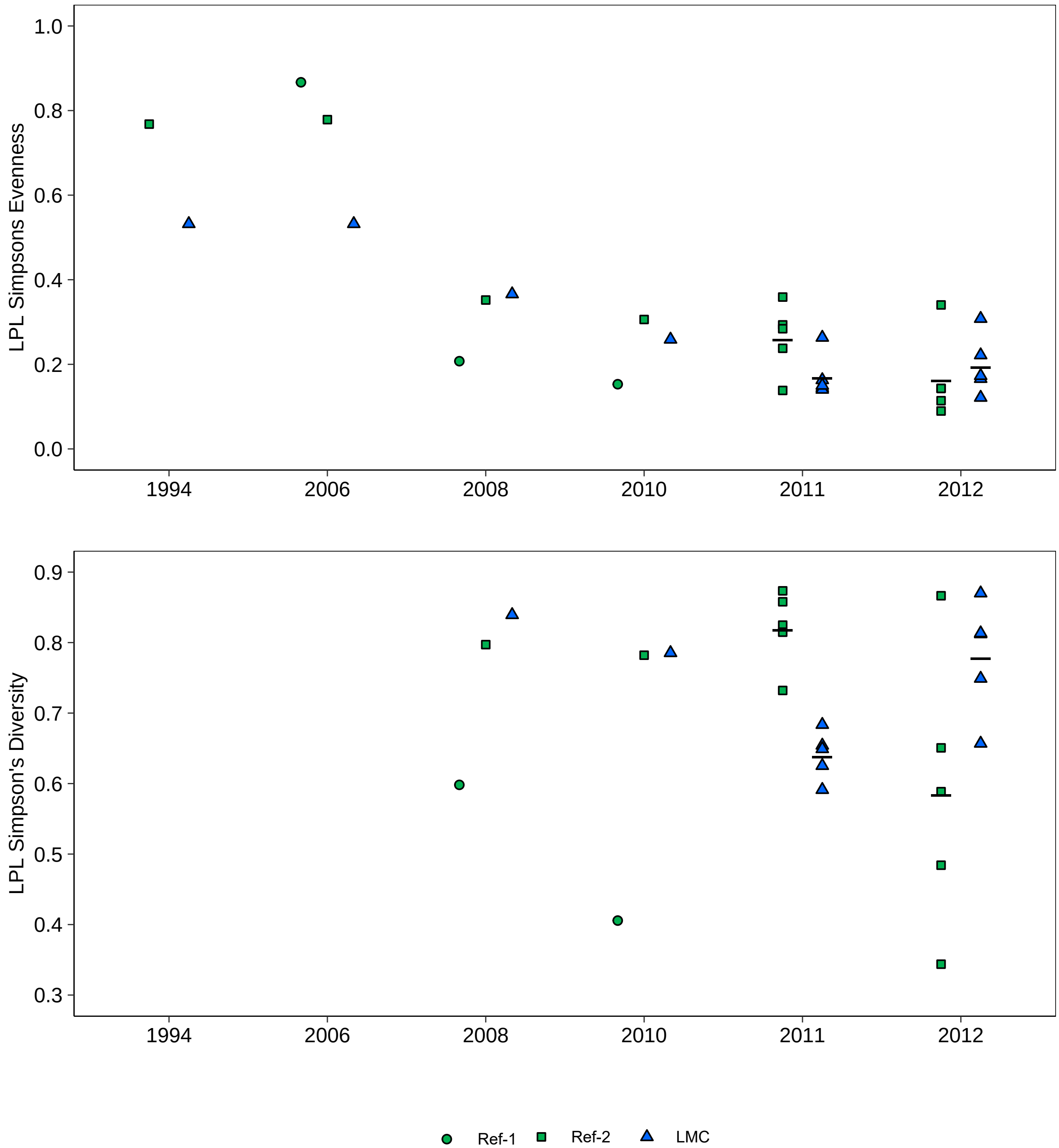


Figure 4.1: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 1994 to 2012 AEMP Program (250 µm)

Notes: Black horizontal bars indicate means. A taxonomic decision key was used only on data from 2008 to 2012. Reference areas are shown in green and mine exposed areas are shown in blue. Ref-1 = W6 (South-flowing tributary) from 1994 to 2008. Ref-2 = W7 (North-flowing tributary) from 1994 to 2010 and lower Wolverine Creek from 2011 to 2012.

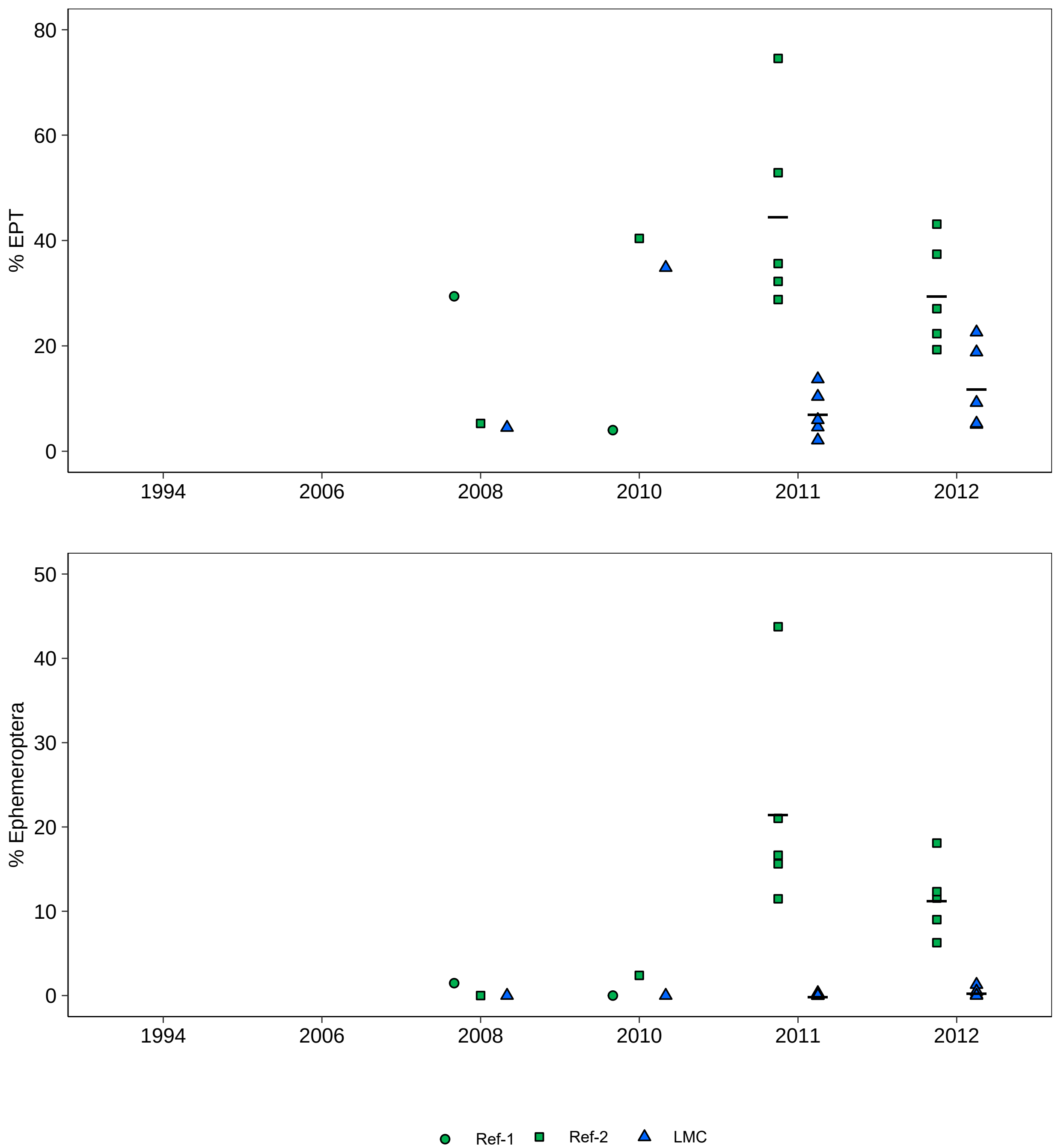


Figure 4.1: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 1994 to 2012 AEMP Program (250 µm)

Notes: Black horizontal bars indicate means. A taxonomic decision key was used only on data from 2008 to 2012. Reference areas are shown in green and mine exposed areas are shown in blue. Ref-1 = W6 (South-flowing tributary) from 1994 to 2008. Ref-2 = W7 (North-flowing tributary) from 1994 to 2010 and lower Wolverine Creek from 2011 to 2012.

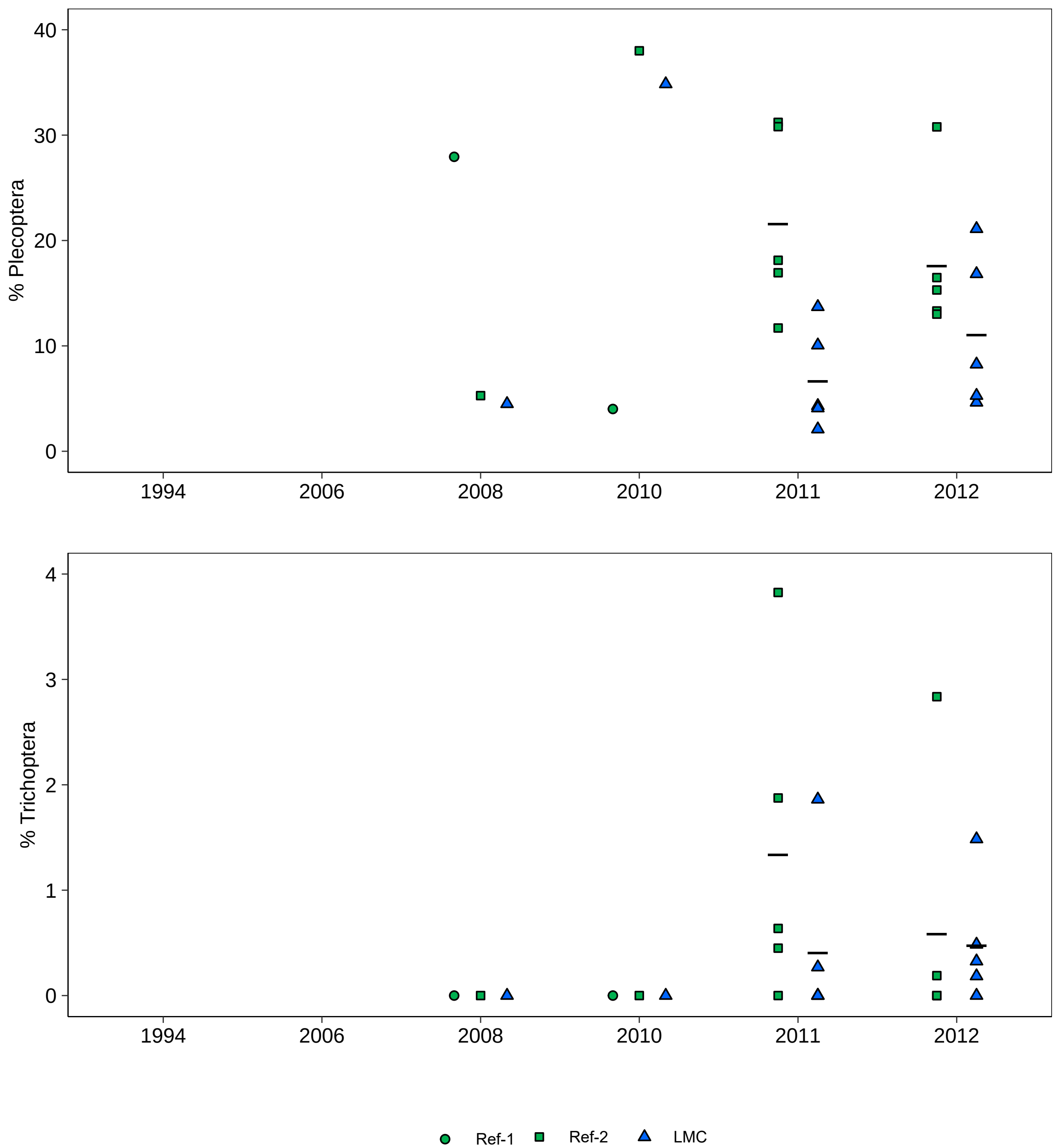


Figure 4.1: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 1994 to 2012 AEMP Program (250 µm)

Notes: Black horizontal bars indicate means. A taxonomic decision key was used only on data from 2008 to 2012. Reference areas are shown in green and mine exposed areas are shown in blue. Ref-1 = W6 (South-flowing tributary) from 1994 to 2008. Ref-2 = W7 (North-flowing tributary) from 1994 to 2010 and lower Wolverine Creek from 2011 to 2012.

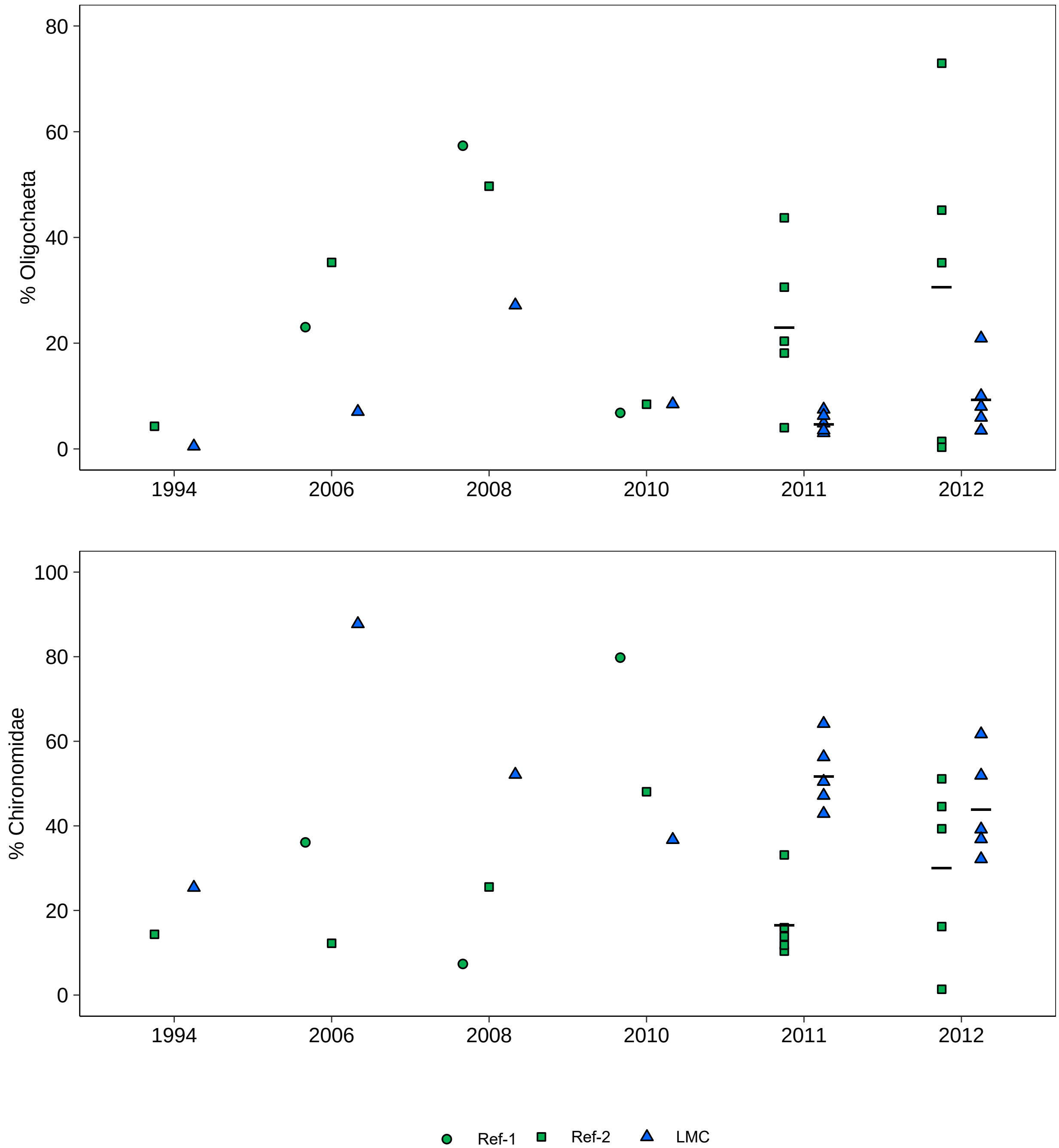


Figure 4.1: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 1994 to 2012 AEMP Program (250 µm)

Notes: Black horizontal bars indicate means. A taxonomic decision key was used only on data from 2008 to 2012. Reference areas are shown in green and mine exposed areas are shown in blue. Ref-1 = W6 (South-flowing tributary) from 1994 to 2008. Ref-2 = W7 (North-flowing tributary) from 1994 to 2010 and lower Wolverine Creek from 2011 to 2012.

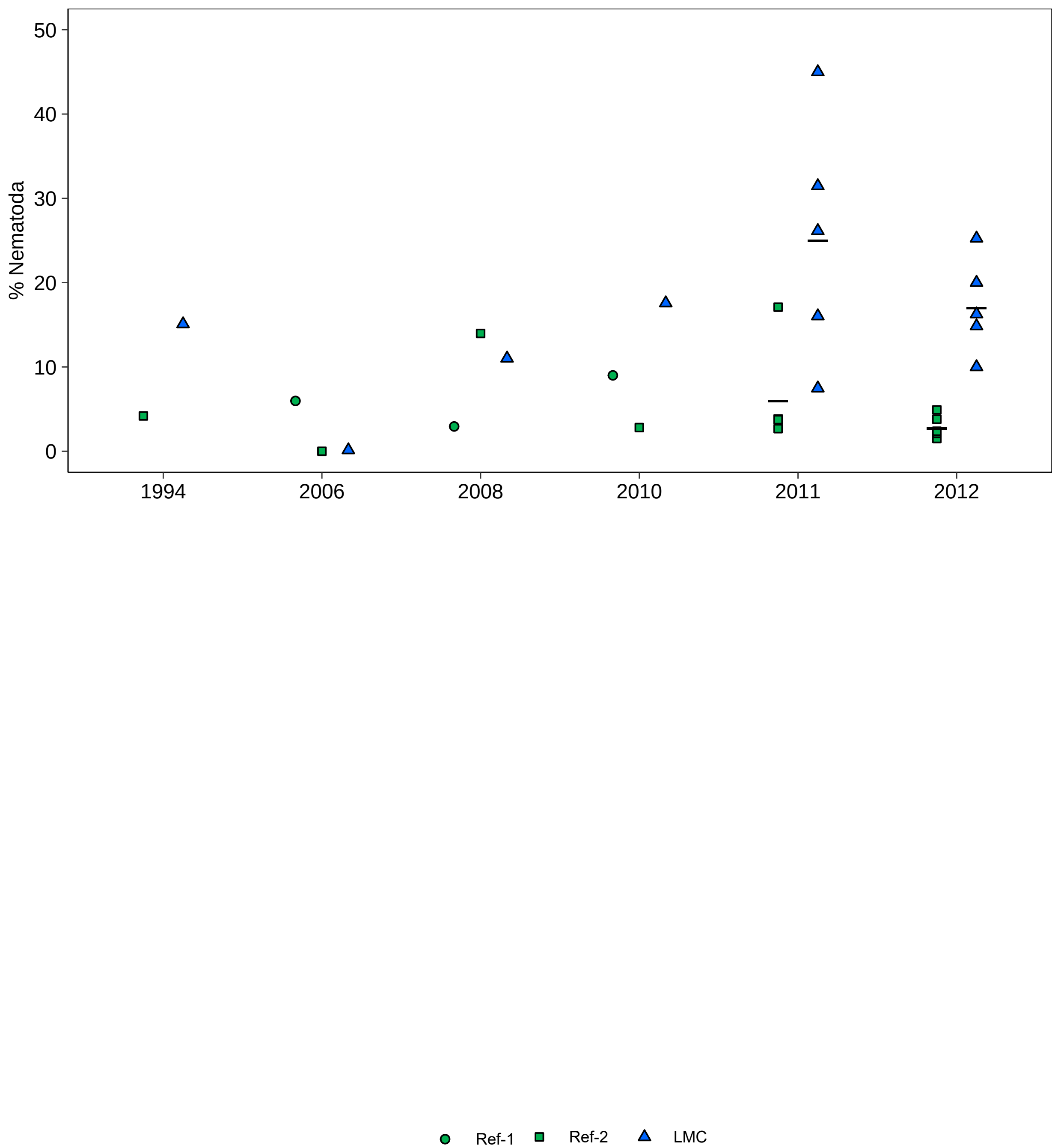


Figure 4.1: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 1994 to 2012 AEMP Program (250 µm)

Notes: Black horizontal bars indicate means. A taxonomic decision key was used only on data from 2008 to 2012. Reference areas are shown in green and mine exposed areas are shown in blue. Ref-1 = W6 (South-flowing tributary) from 1994 to 2008. Ref-2 = W7 (North-flowing tributary) from 1994 to 2010 and lower Wolverine Creek from 2011 to 2012.

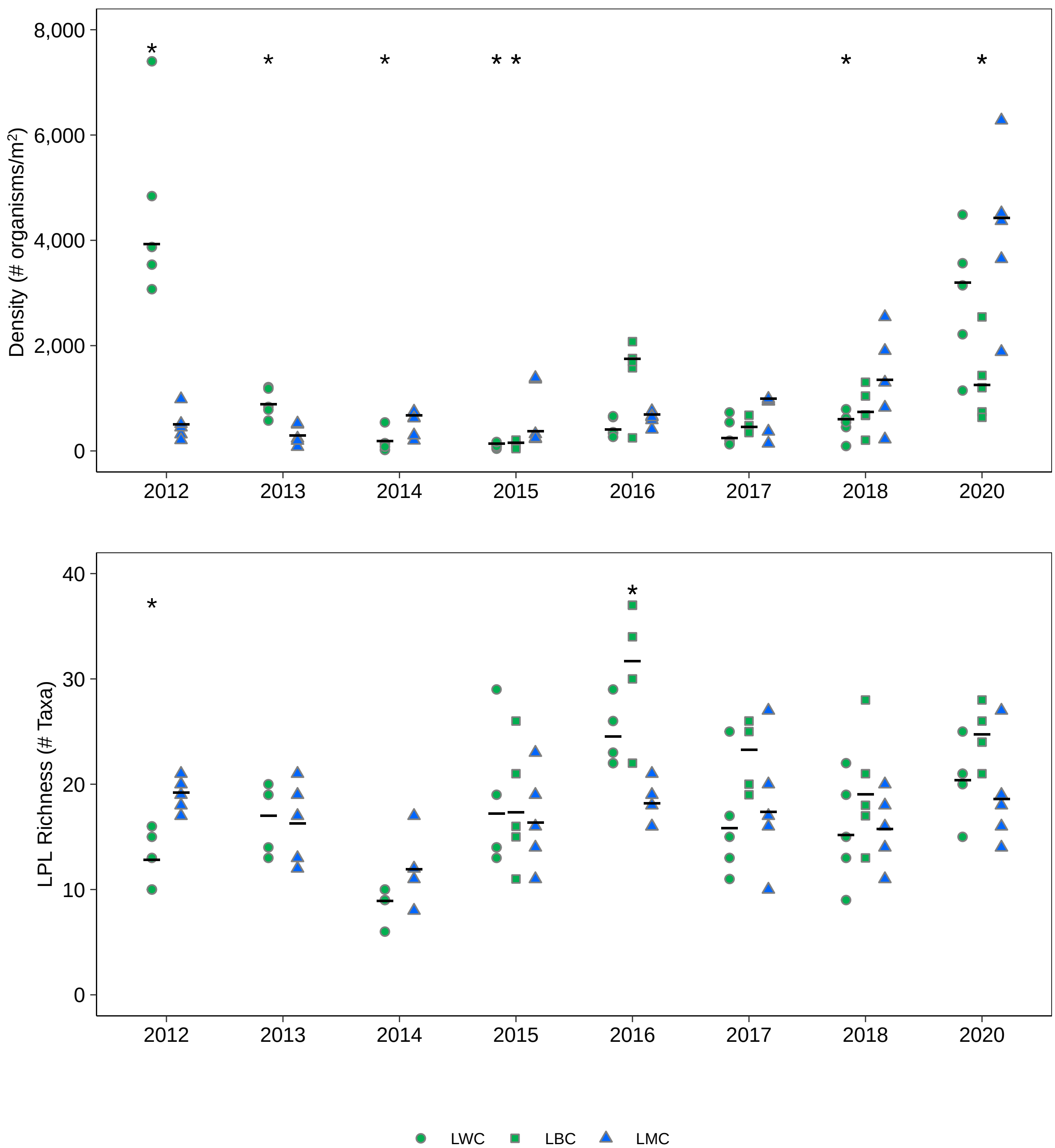


Figure 4.2: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 2012 to 2020 AEMP Program (500 µm)

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT is the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include LWC = lower Wolverine Creek and LBC = lower Big Creek.

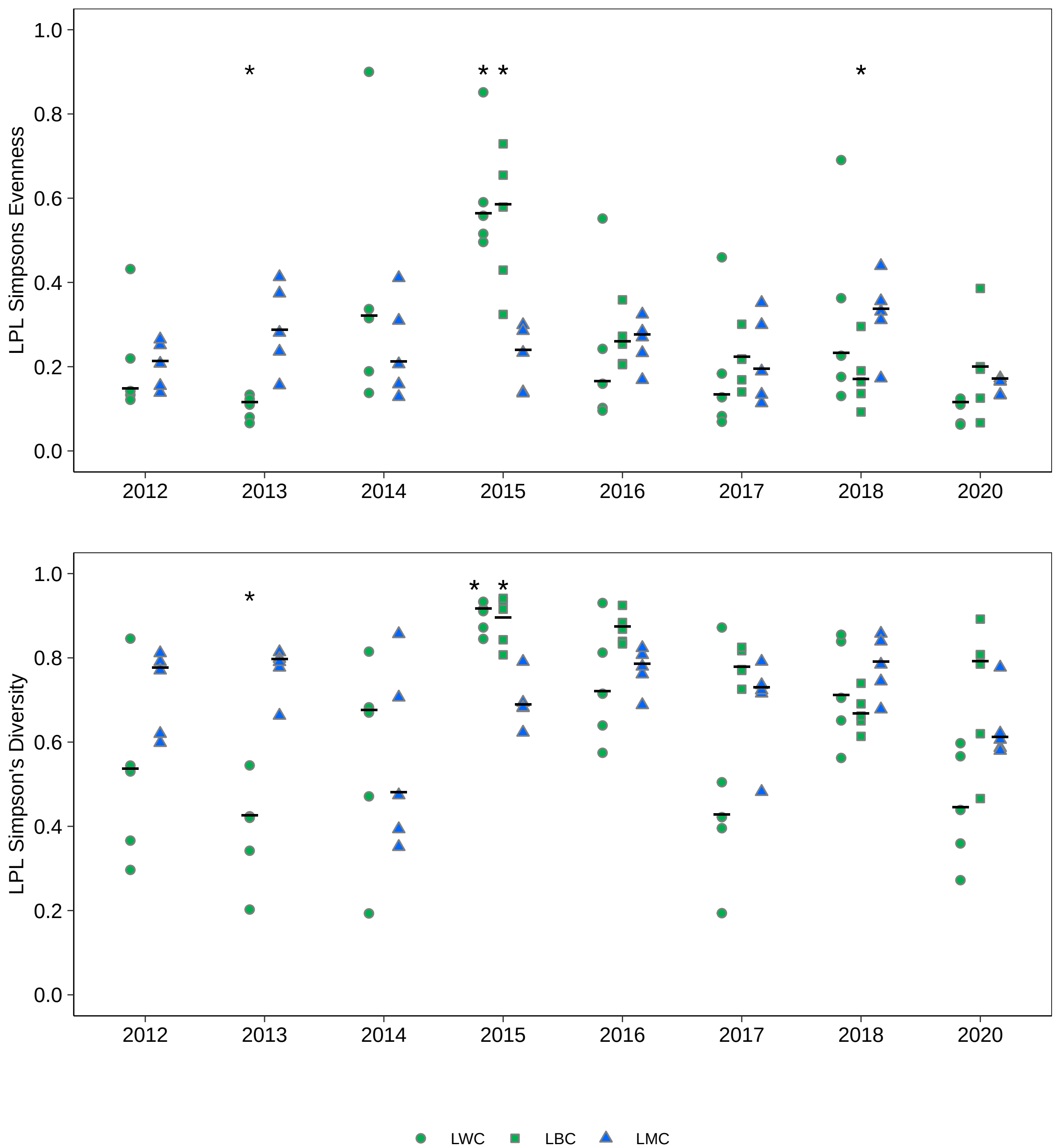


Figure 4.2: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 2012 to 2020 AEMP Program (500 µm)

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT is the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include LWC = lower Wolverine Creek and LBC = lower Big Creek.

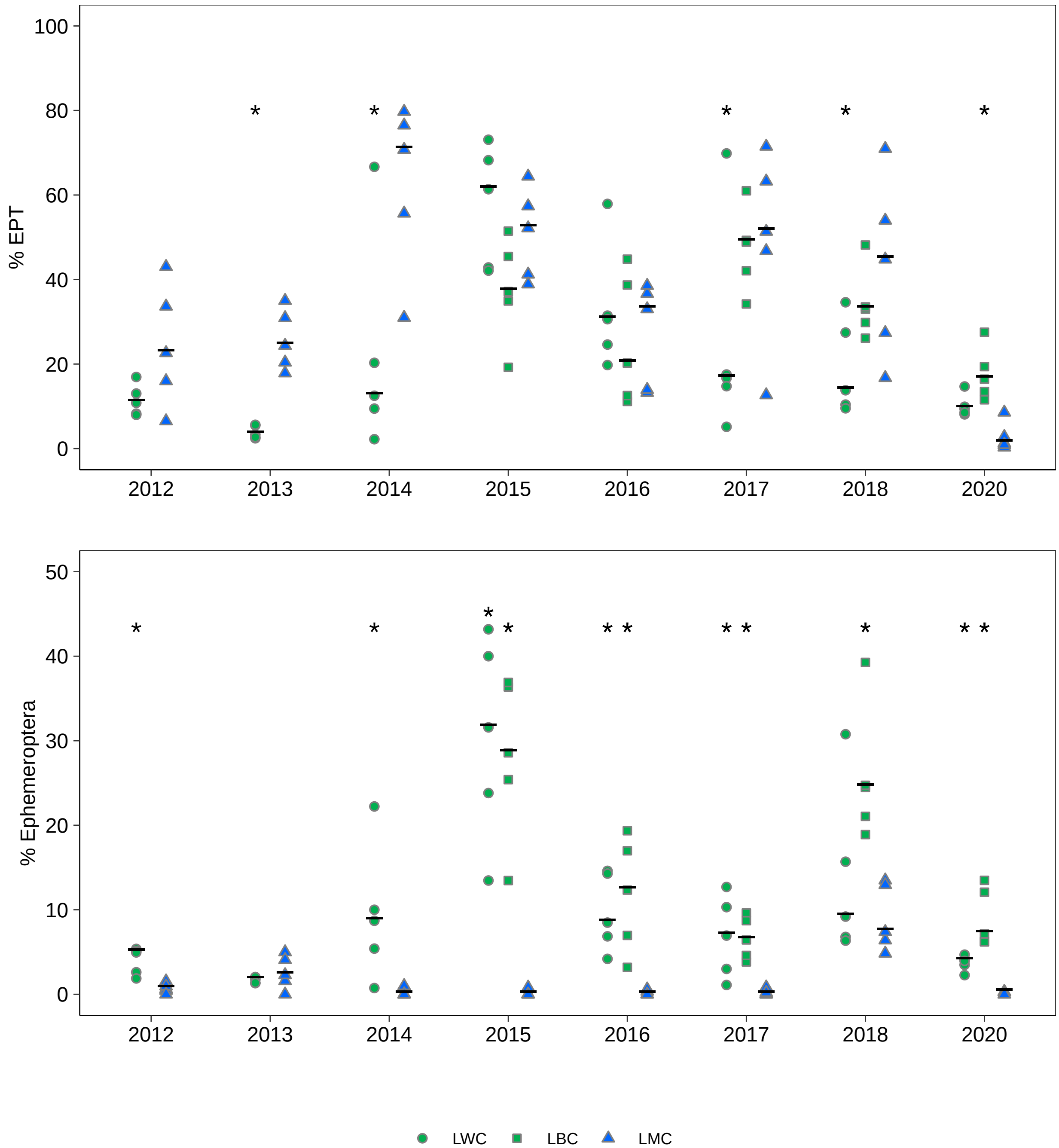


Figure 4.2: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 2012 to 2020 AEMP Program (500 μm)

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT is the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include LWC = lower Wolverine Creek and LBC = lower Big Creek.

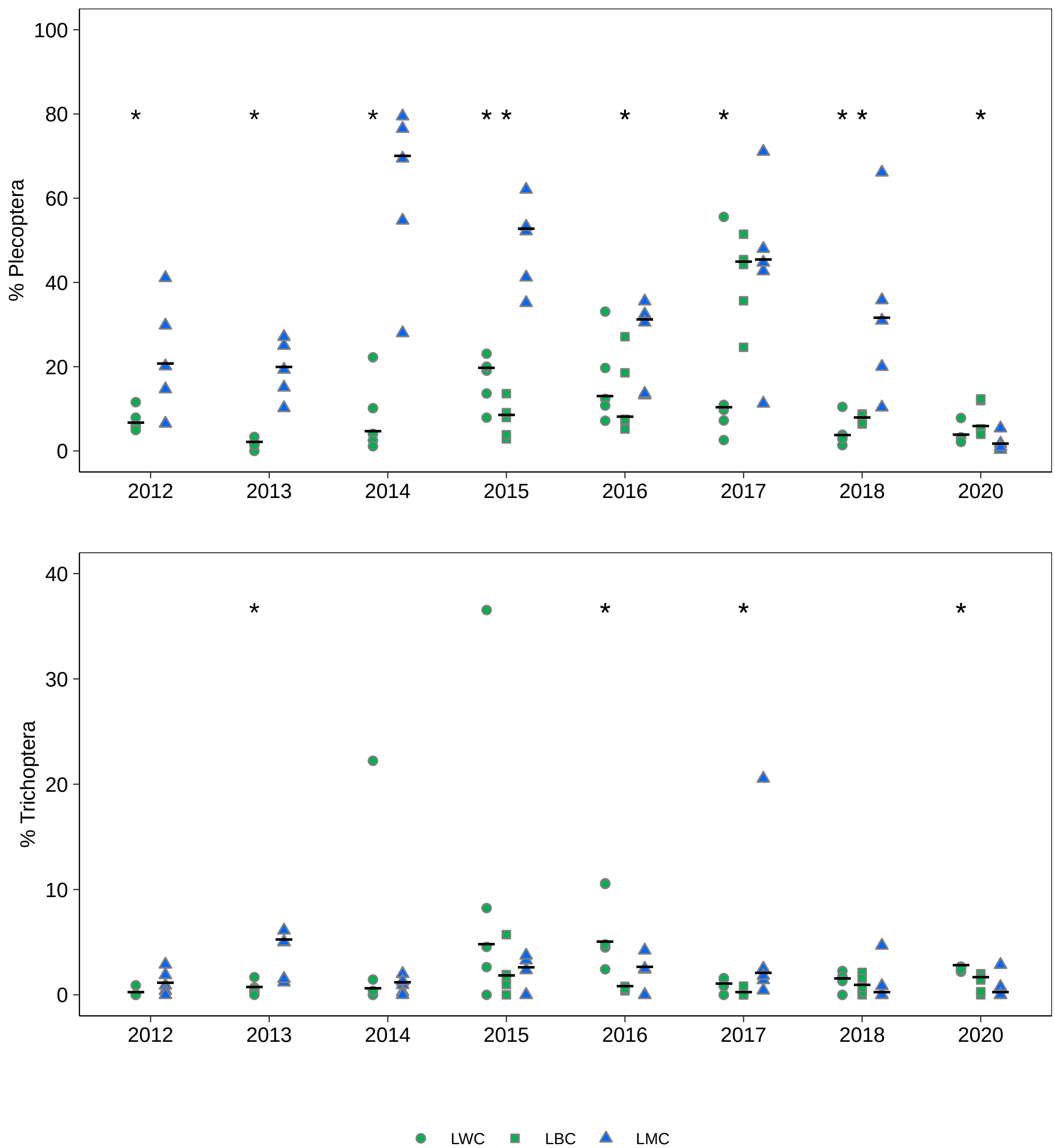


Figure 4.2: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 2012 to 2020 AEMP Program (500 µm)

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT is the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include LWC = lower Wolverine Creek and LBC = lower Big Creek.

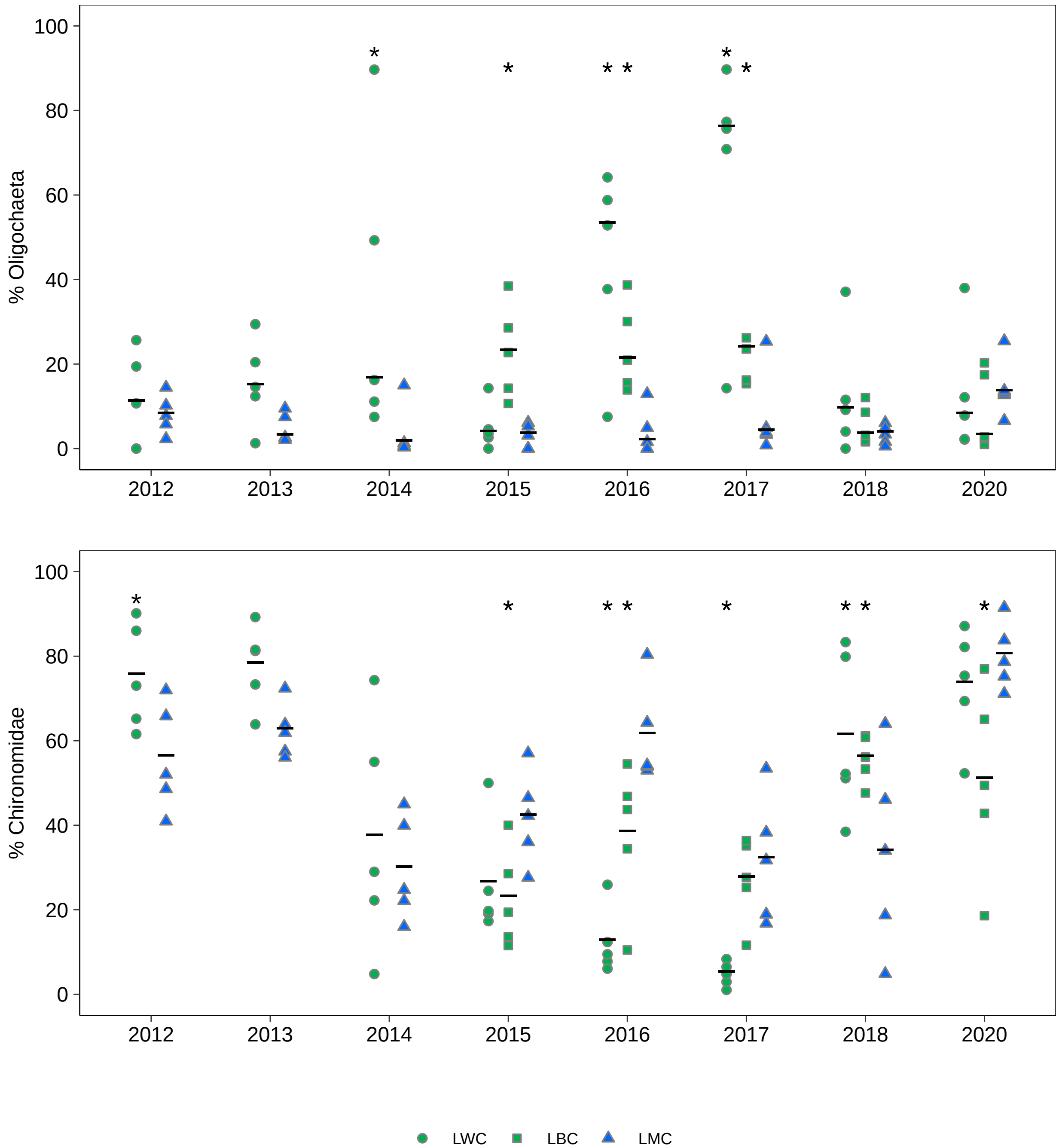


Figure 4.2: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 2012 to 2020 AEMP Program (500 µm)

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT is the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include LWC = lower Wolverine Creek and LBC = lower Big Creek.

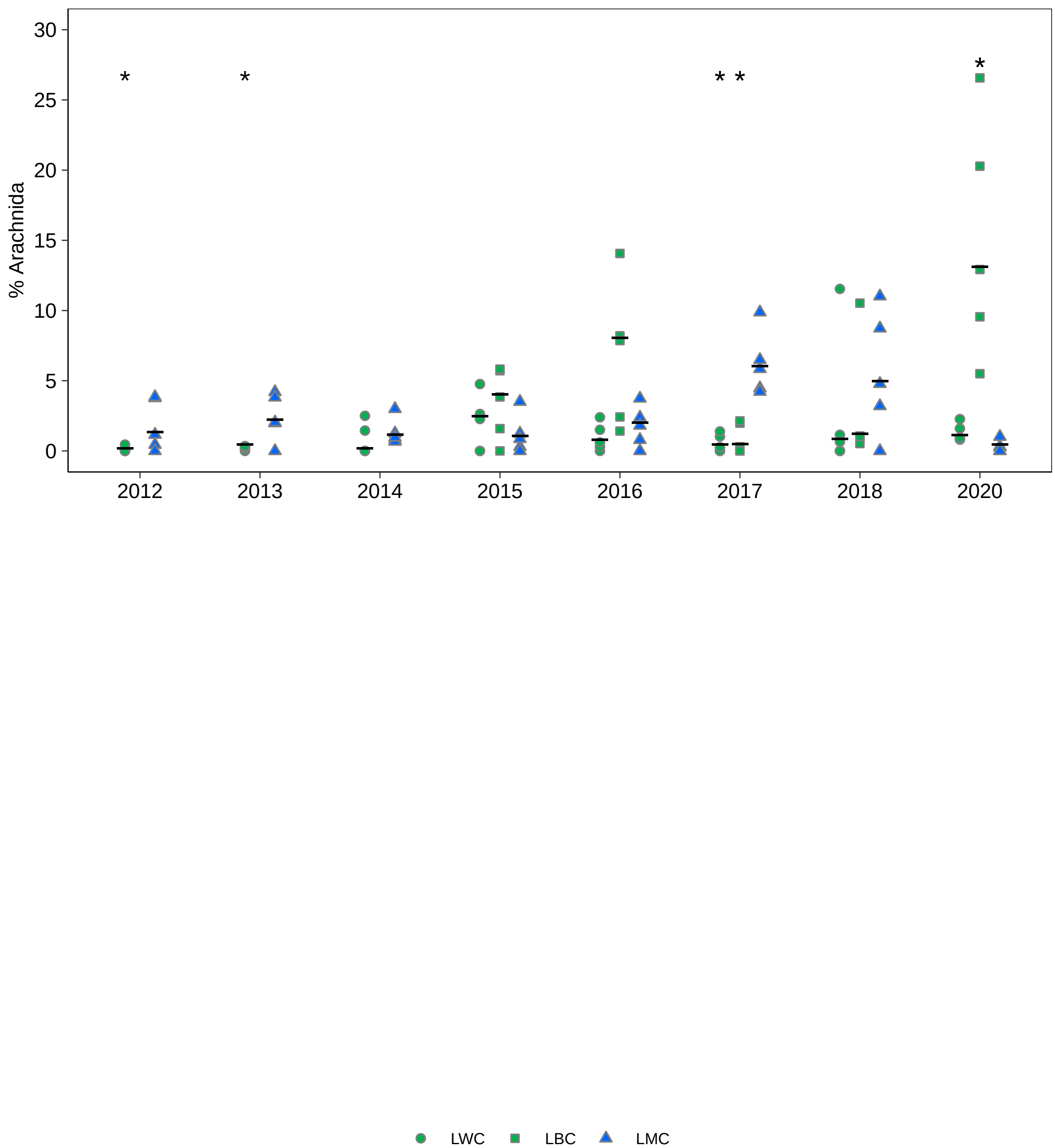


Figure 4.2: Benthic Invertebrate Community Endpoints at Lower Minto Creek (LMC) and Reference Areas from 2012 to 2020 AEMP Program (500 µm)

Notes: Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT is the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include LWC = lower Wolverine Creek and LBC = lower Big Creek.

Table 4.1: Statistical Comparison of Benthic Invertebrate Community Endpoints, AEMP (500 µm) Minto Mine, 2012 to 2020

Endpoint	ANOVA Model				Year	Do values differ among years for each area?[a]			Do values differ between reference and exposed areas? MOD (%)[b]	
	Transformation	Area	Year	Area x Year		LWC	LBC	LMC	LWC	LBC
Density (# organisms/m²)	rank	0.421	<0.001	<0.001	2012	A	-	BC	-2.9	-
					2013	AB	-	C	-1.6	-
					2014	CD	-	BC	5.6	-
					2015	D	C	BC	9.9	4.3
					2016	BC	A	BC	ns	ns
					2017	CD	B	BC	ns	ns
					2018	BC	AB	AB	5.2	ns
					2020	A	AB	A	ns	4.7
LPL Richness (# Taxa)	log10	<0.001	<0.001	0.069	2012	CD	-	A	1.9	-
					2013	ABC	-	AB	ns	-
					2014	D	-	B	ns	-
					2015	ABC	B	AB	ns	ns
					2016	A	A	AB	ns	-2.6
					2017	BC	AB	AB	ns	ns
					2018	BC	B	AB	ns	ns
					2020	AB	AB	A	ns	ns
LPL Simpson's Evenness	rank	0.115	<0.001	<0.001	2012	BC	-	A	ns	-
					2013	C	-	A	4.9	-
					2014	AB	-	A	ns	-
					2015	A	A	A	-5.1	-1.6
					2016	BC	AB	A	ns	ns
					2017	BC	AB	A	ns	ns
					2018	AB	B	A	ns	4.0
					2020	C	B	A	ns	ns
LPL Simpson's Diversity	rank	<0.001	<0.001	<0.001	2012	BC	-	A	ns	-
					2013	C	-	A	3.2	-
					2014	BC	-	A	ns	-
					2015	A	A	A	-6.9	-3.0
					2016	AB	A	A	ns	ns
					2017	BC	AB	A	ns	ns
					2018	B	B	A	ns	ns
					2020	C	AB	A	ns	ns
% EPT	rank	<0.001	<0.001	<0.001	2012	CD	-	C	ns	-
					2013	D	-	BC	16	-
					2014	BCD	-	A	5.0	-
					2015	A	AB	AB	ns	ns
					2016	AB	AB	BC	ns	ns
					2017	BC	A	ABC	12	ns
					2018	BCD	AB	ABC	4.9	ns
					2020	CD	B	D	ns	-3.4
% Ephemeroptera	rank	<0.001	<0.001	<0.001	2012	CDE	-	BC	-7.0	-
					2013	E	-	B	ns	-
					2014	BCD	-	C	-1.8	-
					2015	A	A	C	-2.5	-2.5
					2016	BC	AB	C	-1.3	-1.6
					2017	BCD	B	C	-1.2	-1.9
					2018	AB	A	A	ns	-3.4
					2020	DE	B	BC	-5.4	-4.8

P-value < 0.1.

Magnitude of Difference (MOD) <-2.

Magnitude of Difference (MOD) >2.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant post-hoc contrast. In cases where an MOD could not be calculated, only directionality is shown.

[a] Years that do not share a letter were significantly different in a Tukey's Honestly Significant Difference post-hoc test (α = 0.1).

[b] MOD = (MCT_{EXP}-MCT_{REF})/SD_{REF}; where the measures of central tendency (MCT) were geometric means for log-10 transformed data, medians for rank transformed data, and means for untransformed data.

Table 4.1: Statistical Comparison of Benthic Invertebrate Community Endpoints, AEMP (500 µm) Minto Mine, 2012 to 2020

Endpoint	ANOVA Model				Year	Do values differ among years for each area?[a]			Do values differ between reference and exposed areas?	
	Transformation	Area	Year	Area x Year		LWC	LBC	LMC	MOD (%)[b] LWC	MOD (%)[b] LBC
% Plecoptera	rank	<0.001	<0.001	<0.001	2012	ABCD	-	B	8.2	-
					2013	D	-	B	28	-
					2014	BCD	-	A	15	-
					2015	A	B	AB	5.5	7.3
					2016	AB	B	AB	ns	6.7
					2017	ABC	A	AB	9.4	ns
					2018	CD	B	AB	28	17
					2020	CD	B	C	ns	-2.2
% Trichoptera	rank	0.048	0.022	0.002	2012	C	-	A	ns	-
					2013	BC	-	A	13	-
					2014	BC	-	A	ns	-
					2015	AB	A	A	ns	ns
					2016	A	A	A	-0.68	ns
					2017	BC	A	A	ns	positive
					2018	BC	A	A	ns	ns
					2020	AB	A	A	-14	ns
% Oligochaeta	rank	<0.001	0.005	<0.001	2012	CD	-	A	ns	-
					2013	ABCD	-	A	ns	-
					2014	ABC	-	A	-1.2	-
					2015	D	A	A	ns	-1.6
					2016	AB	A	A	-3.0	-1.9
					2017	A	A	A	-10	-5.1
					2018	BCD	B	A	ns	ns
					2020	BCD	AB	A	ns	ns
% Chironomidae	none	0.308	<0.001	<0.001	2012	A	-	ABC	-1.5	-
					2013	A	-	AB	ns	-
					2014	BC	-	D	ns	-
					2015	CD	C	BCD	ns	1.6
					2016	CD	ABC	AB	6.1	1.4
					2017	D	BC	CD	9.5	ns
					2018	AB	A	CD	-1.4	-4.0
					2020	A	AB	A	ns	1.3
% Arachnida	rank	<0.001	0.616	<0.001	2012	A	-	ABC	positive	-
					2013	A	-	ABC	13	-
					2014	A	-	ABC	ns	-
					2015	A	AB	BC	ns	ns
					2016	A	A	ABC	ns	ns
					2017	A	B	A	14	13
					2018	A	AB	AB	ns	ns
					2020	A	A	C	ns	-1.2

P-value < 0.1.

Magnitude of Difference (MOD) <-2.

Magnitude of Difference (MOD) >2.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant post-hoc contrast. In cases where an MOD could not be calculated, only directionality is shown.

[a] Years that do not share a letter were significantly different in a Tukey's Honestly Significant Difference post-hoc test (α = 0.1).

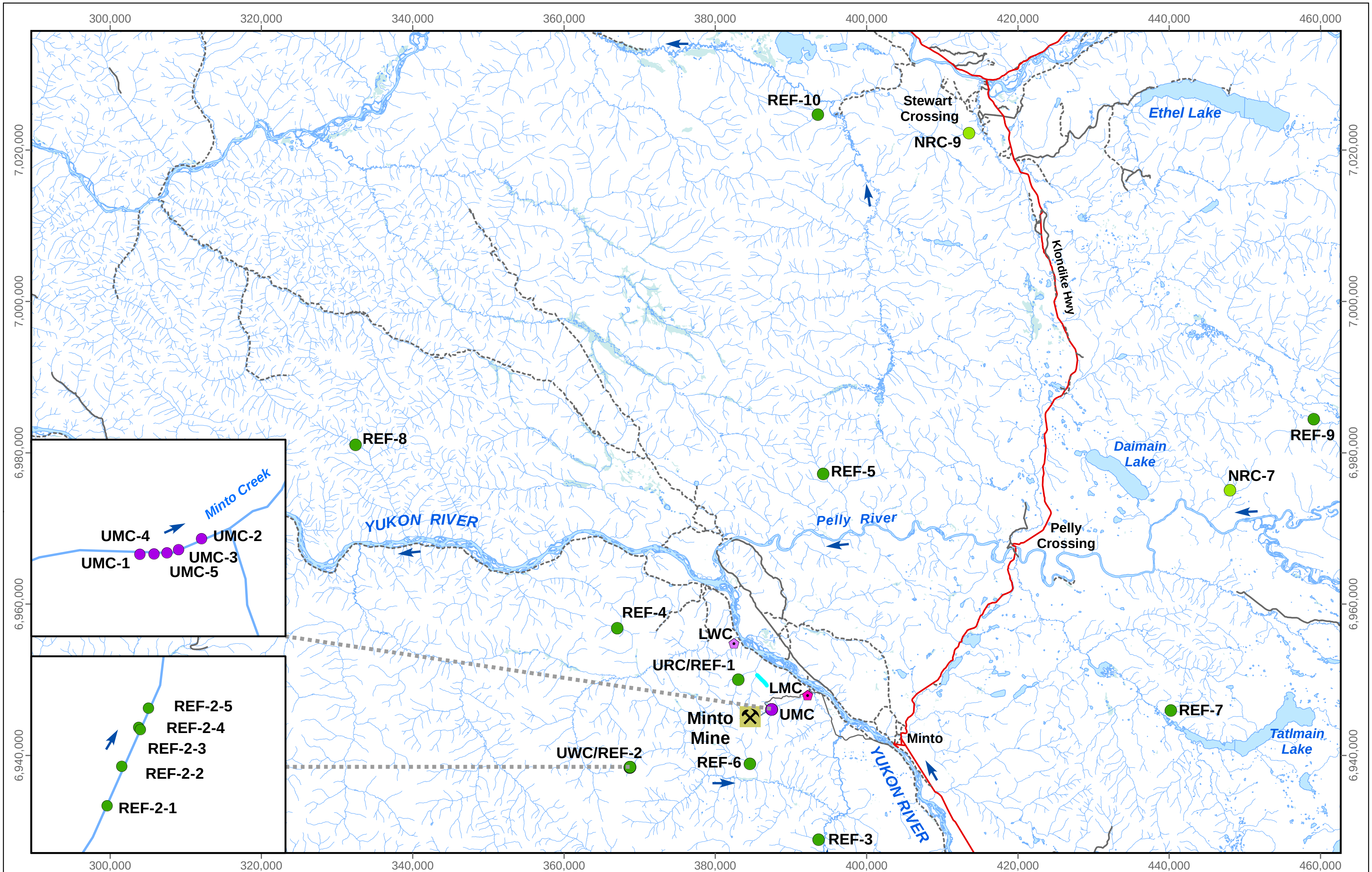
[b] MOD = (MCT_{EXP}-MCT_{REF})/SD_{REF}; where the measures of central tendency (MCT) were geometric means for log-10 transformed data, medians for rank transformed data, and means for untransformed data.

to both reference areas and significantly so when compared to lower Big Creek (Figure 4.2; Table 4.1). Lower density and percent Plecoptera were also observed in 2020 (Figure 4.2; Table 4.1). Density in 2020 at lower Minto Creek was still significantly higher than reference as was seen in other years but when areas were compared among years, the median value was significantly higher than all other years except for 2018 (Figure 4.2; Table 4.1). The change in percent EPT was predominantly driven by the change in percent Plecoptera in 2020 at lower Minto Creek (Figure 4.2: Table 4.1). In 2020, percent EPT and Plecoptera were significantly lower at lower Minto Creek compared to previous years (Figure 4.2: Table 4.1). Changes in density and percent EPT and Plecoptera appear to be associated with the dry conditions that occurred in Minto Creek in 2019. Relative loss of EPT is consistent with their sensitivity to environmental stressors. Chironomids are more tolerant organisms and would be expected to withstand these conditions better. In 2020, percent chironomids were significantly higher at lower Minto Creek compared to percent chironomids in 2017 and 2018 (Figure 4.2; Table 4.1). The decrease in percent EPT (particularly Plecoptera) and the associated increase in percent chironomids in 2020 relative to previous years is considered to be predominantly due to the dry conditions in 2019 which also prohibited the discharge of Minto Mine effluent into Minto Creek.

4.3 Operational Data – Environmental Effects Monitoring

A control-impact (CI) study was designed for the Phase 1 EEM (2008; Minnow/Access 2009), and sampling was completed at upper Minto Creek (exposed) and upper McGinty Creek (reference; Figure 4.3). Density and Bray-Curtis Index (BCI) were significantly higher at upper Minto Creek compared to upper McGinty Creek (Figure 4.4; Table 4.2). Percent EPT was significantly lower at upper Minto Creek compared to upper McGinty Creek (Figure 4.4; Table 4.2; Minnow/Access 2009). As EPT taxa are sensitive to environmental stressors, lower EPT taxa at the exposed area relative to the reference area was considered potentially indicative of a mine-related influence, although absence of baseline data and comparison to only one reference cannot rule out a natural habitat-related difference.

Phase 2 EEM (2011; Minnow/Access 2012) introduced a new reference area, upper Wolverine Creek (Figure 4.3). A similar CI study design was employed for Phase 2, but samples were collected using a 250 µm mesh (as was done for Phase 1) and a 500 µm mesh sieve. Density was significantly higher at upper Minto Creek when compared to both reference areas (upper Wolverine and McGinty creeks) when the 250 µm mesh was used but was not significantly different when the 500 µm mesh was used (Table 4.2). Percent EPT was significantly lower and percent chironomids were significantly higher at upper Minto Creek (500 µm mesh) when compared to both reference areas (Figures 4.4 and 4.5; Minnow/Access 2012). As noted following the Phase 1 EEM, this was considered potentially indicative of a mine-related influence



LEGEND

Benthic Invertebrate Community Sampling Location

- Exposed
- Reference
- Additional Phase 3 Reference
- WUL Exposure Area
- WUL Reference Area

0 5 10 20 30
km

N S E W

Datum: NAD 83 Map Projection: UTM Zone 7V & 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

Minto Mine EEM Benthic Invertebrate Community Sampling Locations

Date October 2021
Project 217202.0096

minnow environmental inc.

Figure 4.3

Document Path: C:\Users\chada\Trinity Consultants, Inc\Pembridge Resources - D - GIS\21-96 Figure 4.3.mxd

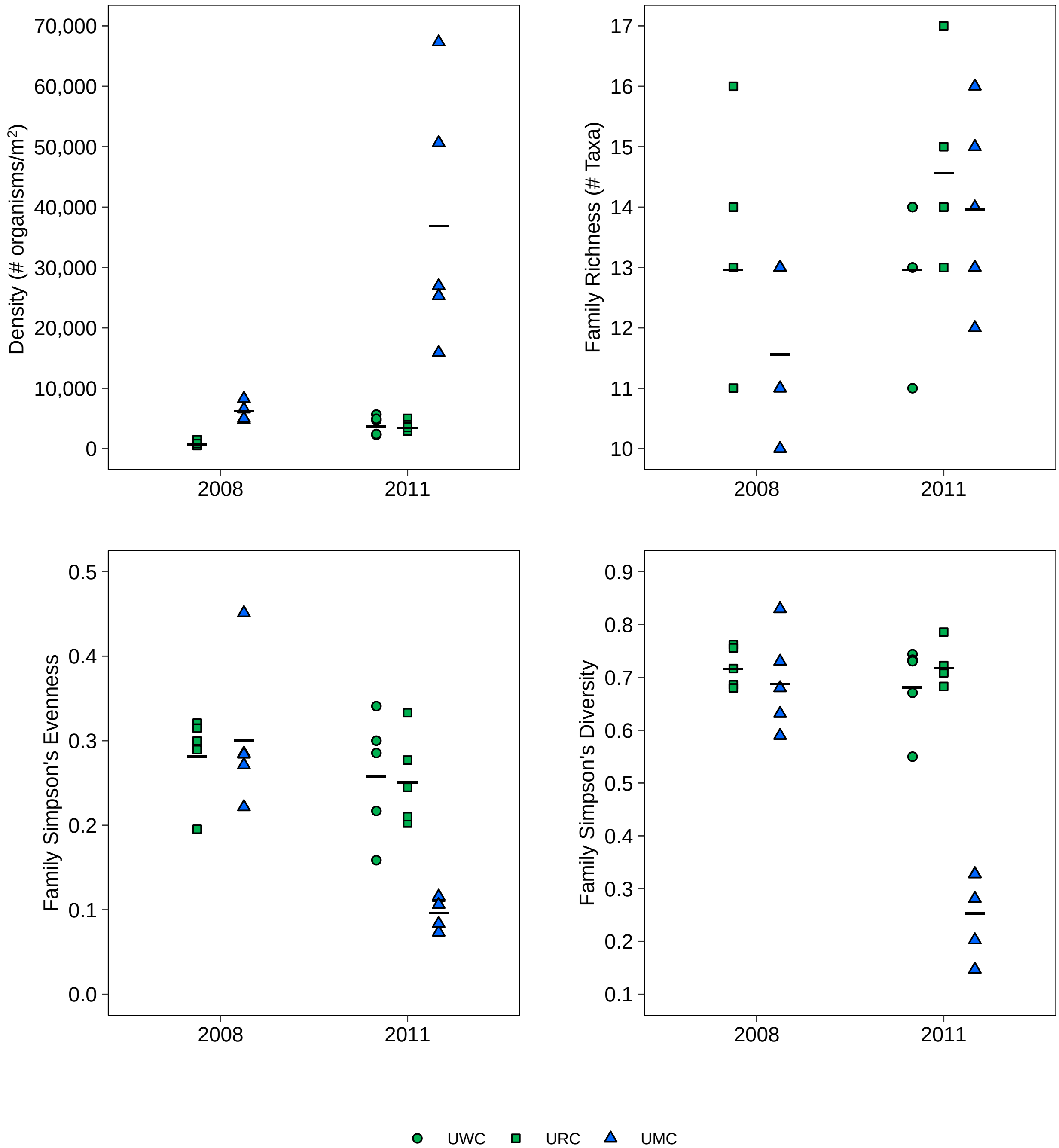


Figure 4.4: Benthic Invertebrate Community Endpoints at Upper Minto Creek (UMC) and Reference Areas in 2008 and 2011 EEM Program (250 µm)

Notes: Black horizontal bars indicate means. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include UWC = upper Wolverine Creek and URC = upper McGinty Creek.

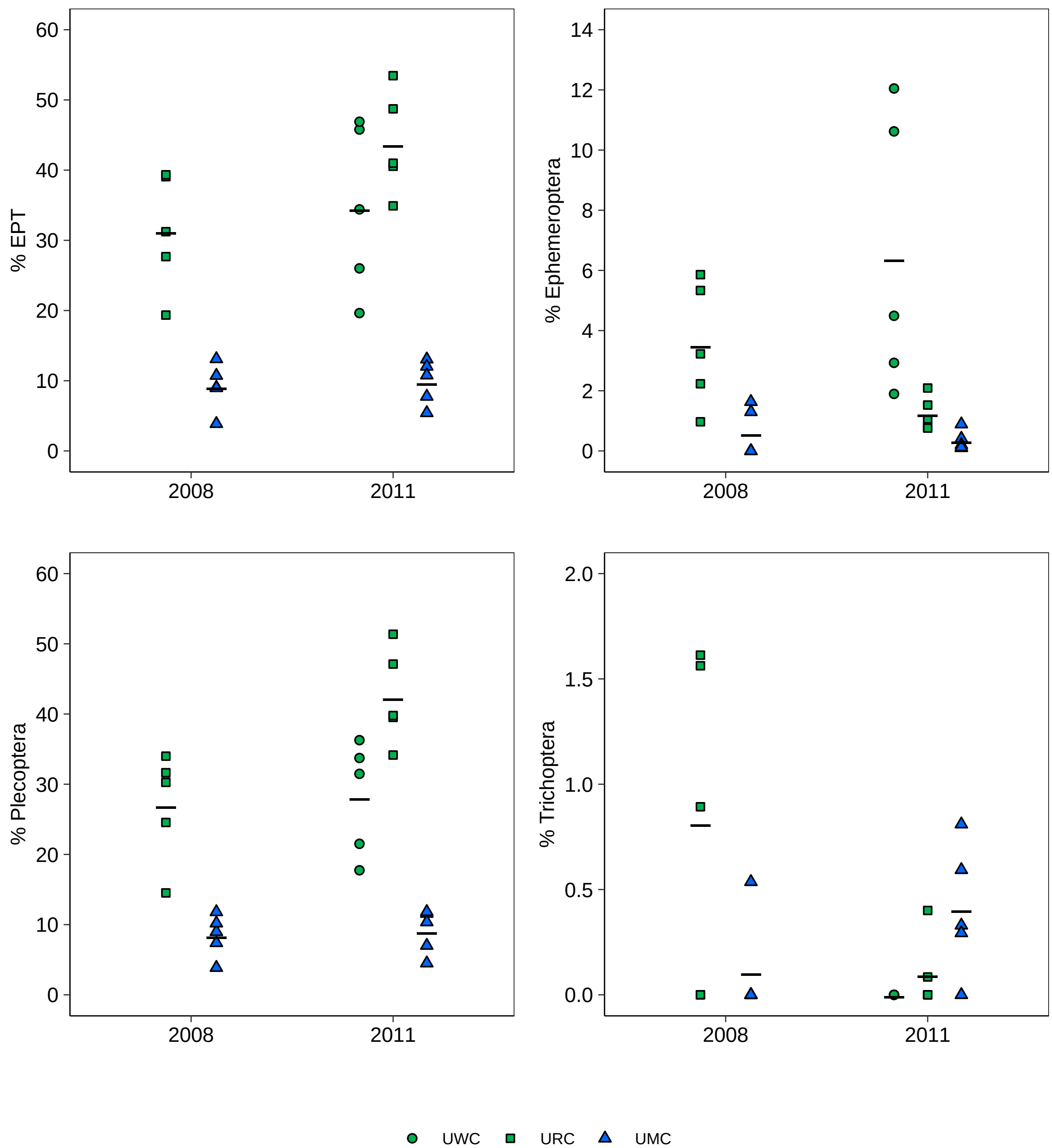


Figure 4.4: Benthic Invertebrate Community Endpoints at Upper Minto Creek (UMC) and Reference Areas in 2008 and 2011 EEM Program (250 µm)

Notes: Black horizontal bars indicate means. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include UWC = upper Wolverine Creek and URC = upper McGinty Creek.

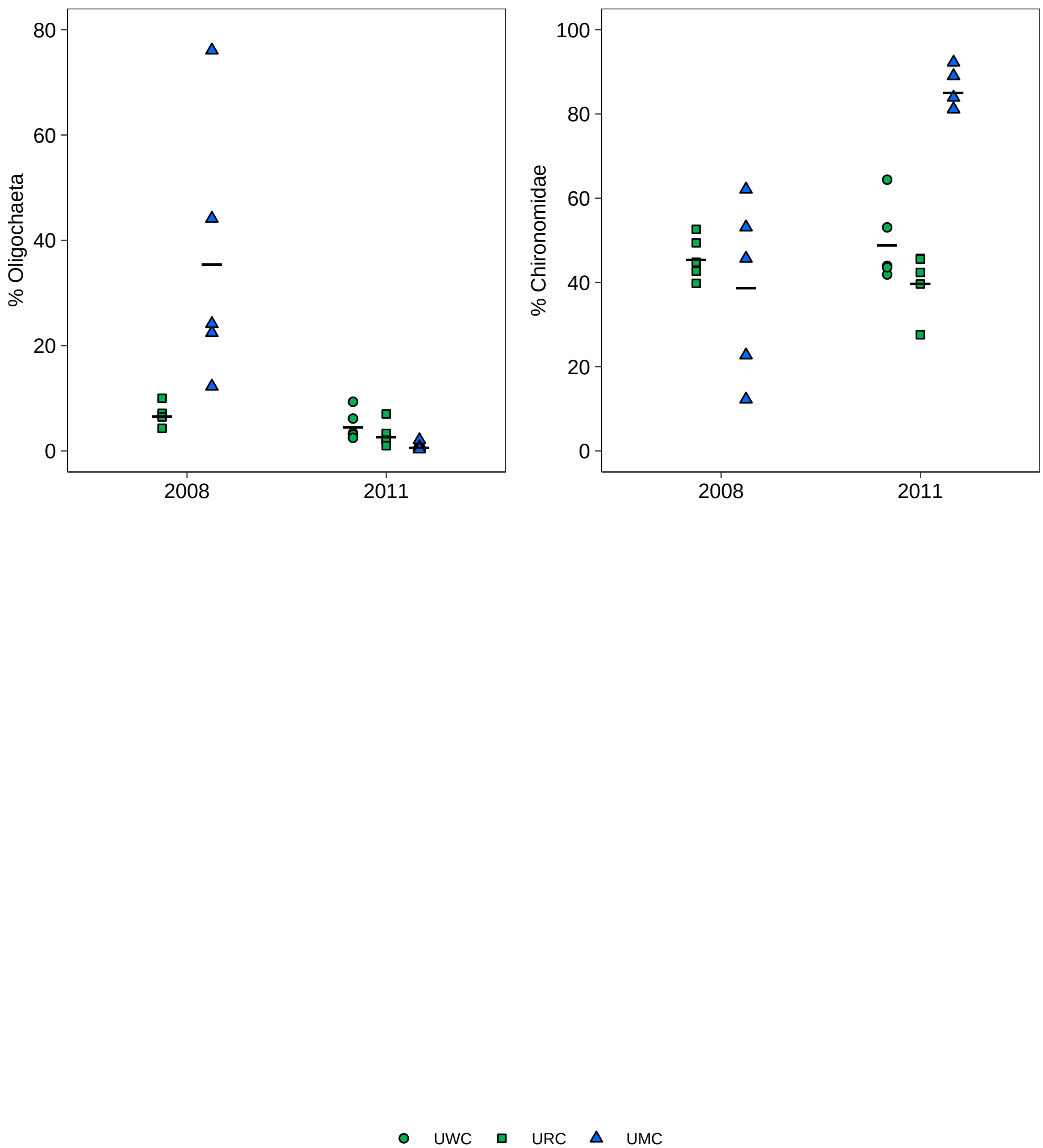


Figure 4.4: Benthic Invertebrate Community Endpoints at Upper Minto Creek (UMC) and Reference Areas in 2008 and 2011 EEM Program (250 µm)

Notes: Black horizontal bars indicate means. Reference areas are shown in green and mine−exposed areas are shown in blue. Reference areas include UWC = upper Wolverine Creek and URC = upper McGinty Creek.

Table 4.2: Summary of Comparisons of Benthic Invertebrate Community EEM metrics in Upper Minto Creek to Reference, Minto Mine Phase 1 to Phase 5 EEM

Phase	Design Type [a] (Mesh Size)	Significantly Different?[b]			
		Density	Number of Taxa	Simpson's Evenness	Bray-Curtis Index
Phase 1 (2008)	CI (250 µm)	Yes (+13.9)	No	No	Yes (+12.7)
Phase 2 (2011)	CI (250 µm) vs. Reference 1	Yes (+46.1)	No	Yes (-2.4)	Yes (+11.5)
	CI (250 µm) vs. Reference 2	Yes (+22.6)	Yes (+3.2)	Yes (-3.5)	Yes (+6.0)
	CI (500 µm) vs. Reference 1	No	Yes (+3.8)	Yes (-2.8)	Yes (+10.5)
	CI (500 µm) vs. Reference 2	No	Yes (+2.3)	Yes (-1.5)	Yes (+6.4)
Phase 3 (2014)[c]	RCA (500 µm)	No at ⅔ stations [c,d]	No	No	No at ⅔ stations [c,e]
Phase 4 (2016)	RCA (500 µm)	No	No	No	No
	CI (500 µm)	Yes (-1.2)	No	No	No
Phase 5 (2019)	RCA (500 µm)	No	No	No	- [f]
	CI (500 µm)	No	No	Yes (-1.3)	Yes [g]

[a] CI = Control-Impact study design; RCA = Reference Condition Approach study design.

[b] 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.

[c] In the Phase 3 Environmental Effects Monitoring (EEM), two of three stations (UMC-1 and UMC-2) were within reference condition for all EEM primary metrics.

[d] One of three stations (station UMC-3) was out of reference condition for density (higher than reference condition).

[e] One of three stations (station UMC-3) was "possibly" out of reference condition for Bray-Curtis index (per Kilgour et al. 1998).

[f] Bray-Curtis Index not calculable under the RCA design using revised guidance.

[g] Magnitude of difference not calculable under revised guidance.

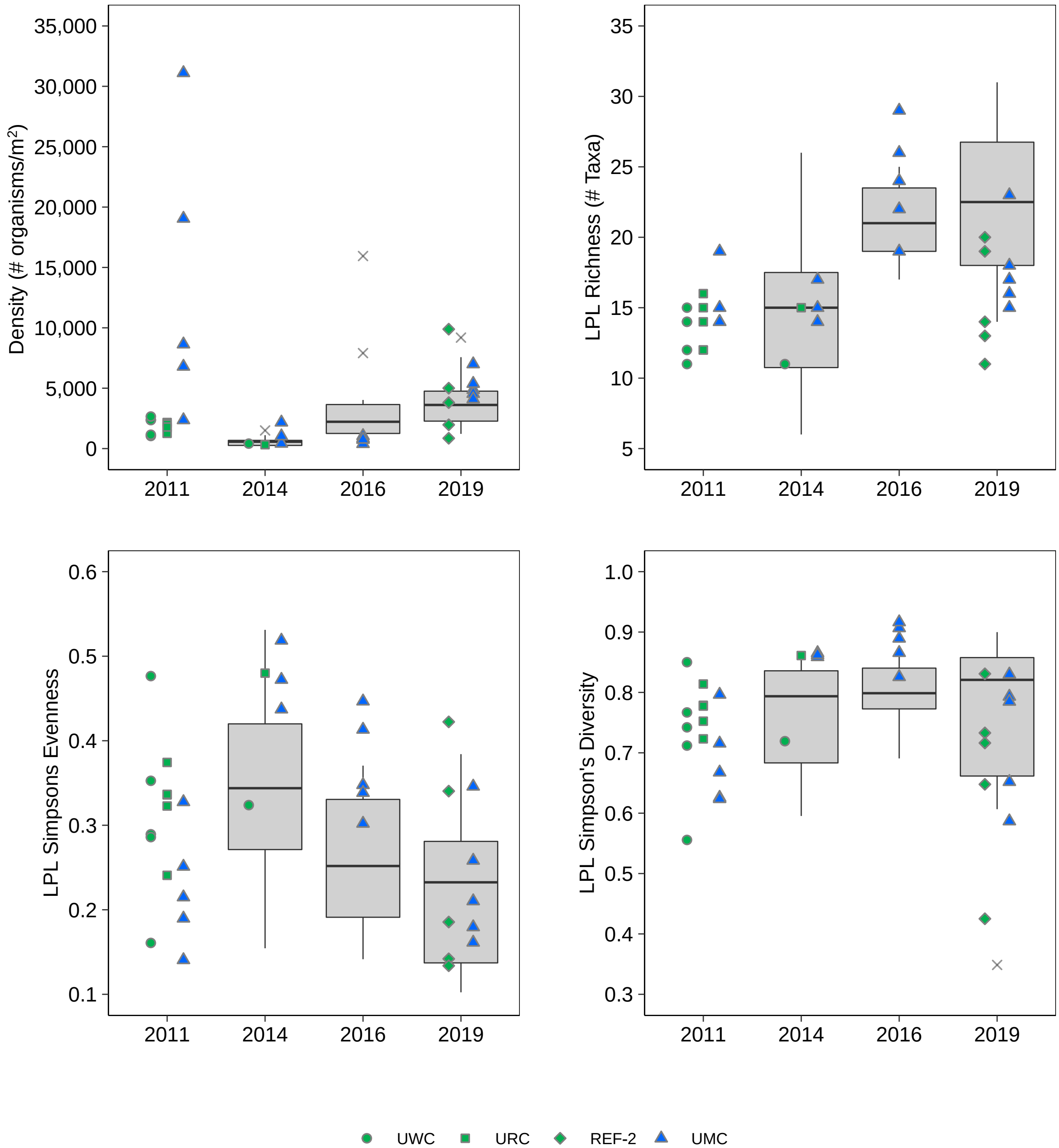


Figure 4.5: Benthic Invertebrate Community Endpoints at Upper Minto Creek (UMC) and Reference Areas in 2011, 2014, 2016, and 2019 EEM Program (500 µm)

Notes: Black horizontal bars indicate means. Reference areas used in a control−impact design are shown in green and mine−exposed areas are shown in blue. Boxplots represent reference areas used for a reference condition approach. Reference areas include UWC = upper Wolverine Creek and URC = upper McGinty Creek. The median of Ref-2 was used in the calculation for the reference condition approach.

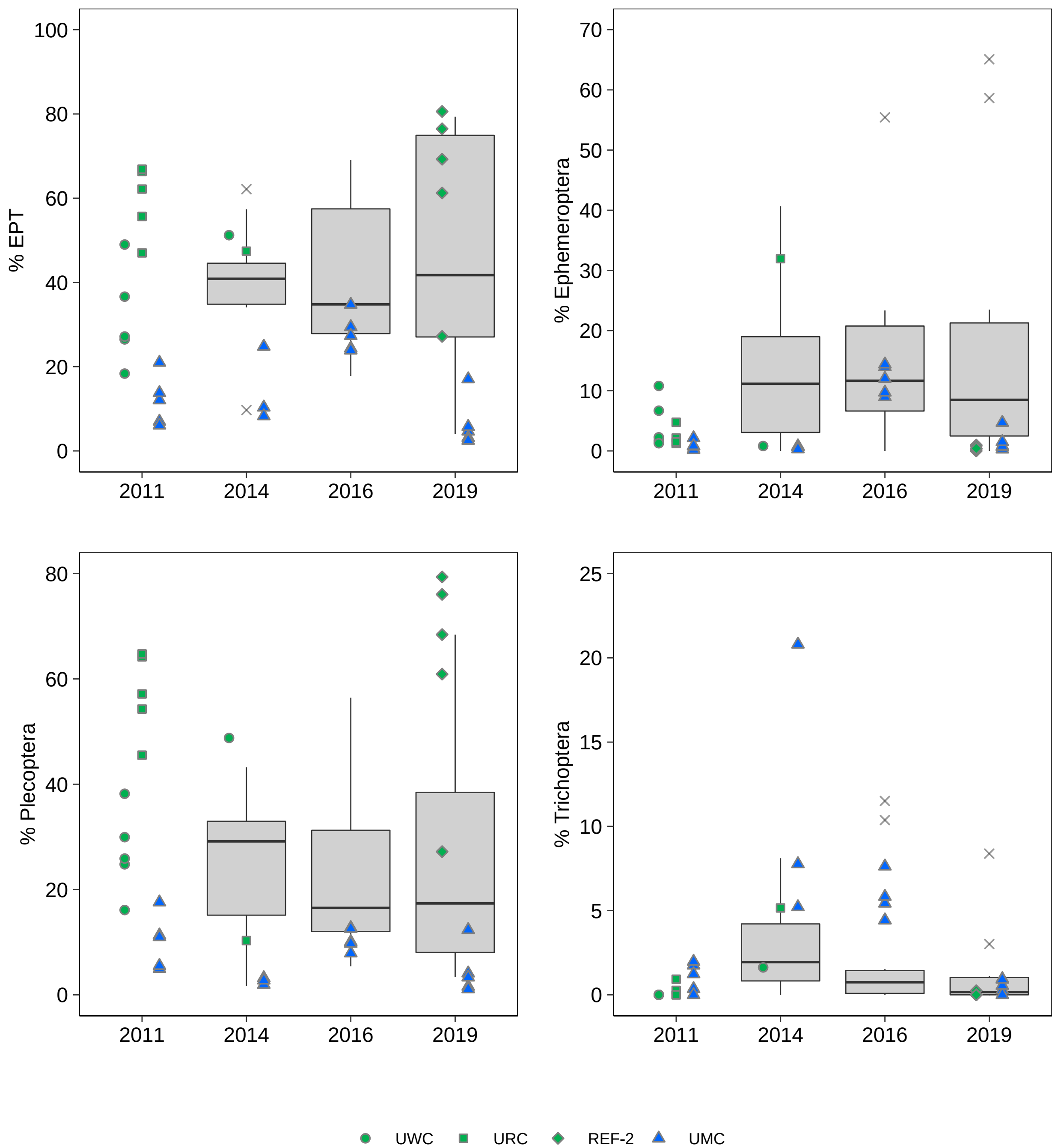


Figure 4.5: Benthic Invertebrate Community Endpoints at Upper Minto Creek (UMC) and Reference Areas in 2011, 2014, 2016, and 2019 EEM Program (250 µm)

Notes: Black horizontal bars indicate means. Reference areas used in a control−impact design are shown in green and mine−exposed areas are shown in blue. Boxplots represent reference areas used for a reference condition approach. Reference areas include UWC = upper Wolverine Creek and URC = upper McGinty Creek. The median of Ref-2 was used in the calculation for the reference condition approach.

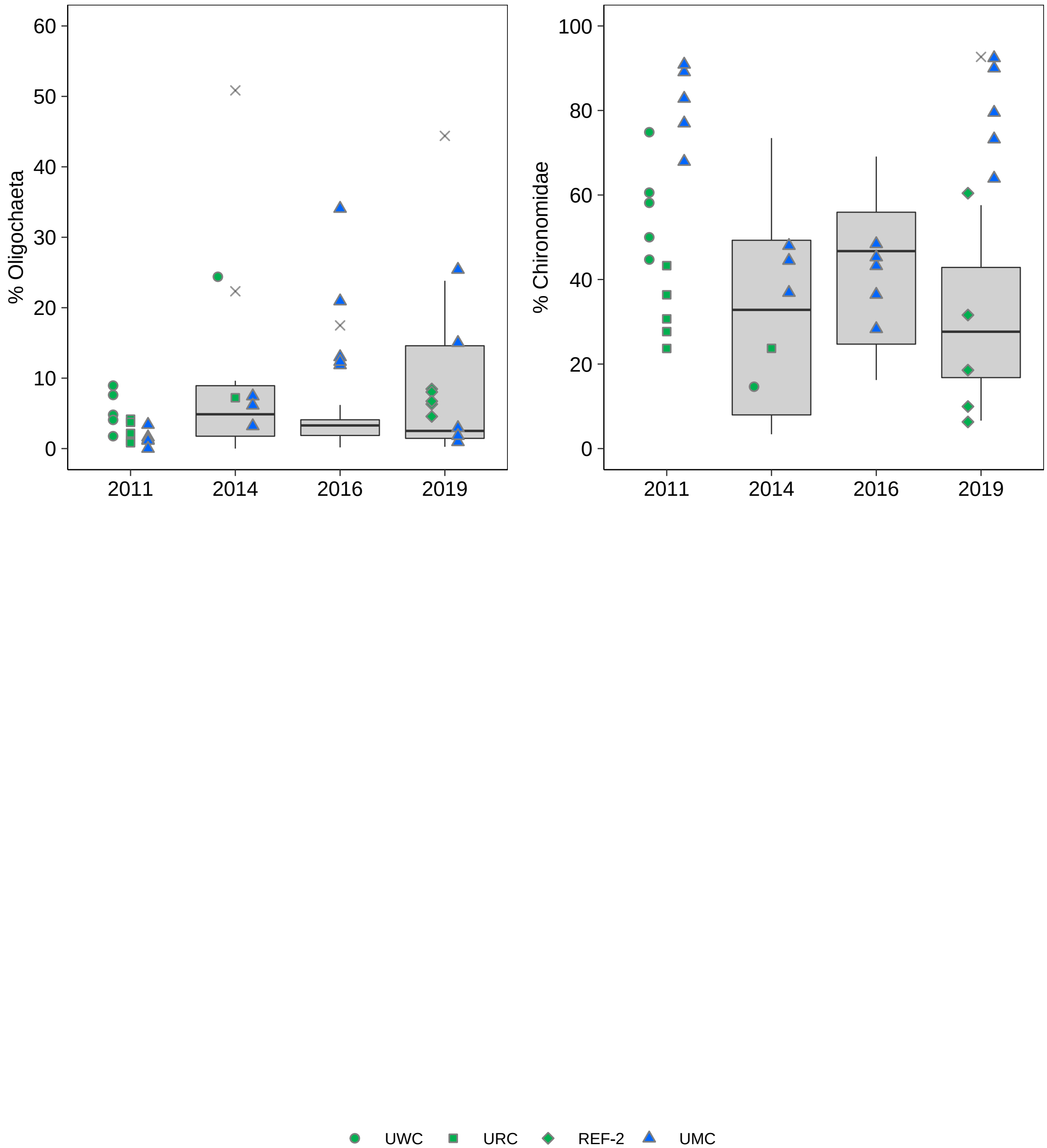


Figure 4.5: Benthic Invertebrate Community Endpoints at Upper Minto Creek (UMC) and Reference Areas in 2011, 2014, 2016, and 2019 EEM Program (250 µm)

Notes: Black horizontal bars indicate means. Reference areas used in a control−impact design are shown in green and mine−exposed areas are shown in blue. Boxplots represent reference areas used for a reference condition approach. Reference areas include UWC = upper Wolverine Creek and URC = upper McGinty Creek. The median of Ref-2 was used in the calculation for the reference condition approach.

as EPT taxa are sensitive and chironomids are a more tolerant species. This result through two consecutive phases of EEM, triggered an Investigation of Cause (IOC) study for Phase 3.

Accordingly, the Phase 3 EEM (2014; Minnow 2015b) employed the Reference Condition Approach (RCA) and a CI study design for IOC. Upper Minto Creek (three replicate stations) was compared to a calculated reference condition which included upper Wolverine and McGinty creeks as well as 10 new reference sites[2] (Figure 4.3). Density at upper Minto Creek was within reference condition except for one replicate (UMC-3) which was out of reference condition (Figure 4.5; Table 4.2). Percent EPT was possibly out of reference condition for two replicates and within reference condition for the third replicate (Figure 4.5; Table 4.3). Percent chironomids were within the reference condition (Figure 4.5; Table 4.3). Previous phases of the EEM showed chironomids were significantly higher at upper Minto Creek compared to reference areas. This difference as well as the possibly out of reference condition status for EPT taxa at the exposed area could indicate a mine influence but also indicates that that upper Minto Creek falls within the natural variability of the area.

Due to the benefit of comparison to a larger group of reference creeks, the RCA was used again in the Phase 4 EEM (2016) to evaluate the benthic invertebrate community (Minnow 2018b). A control-impact study design was also conducted during this phase. Two references areas were dropped and a total of 10 reference areas (including upper Wolverine and McGinty creeks) were used for the reference condition approach (Figure 4.3). Primary EEM endpoints, density, number of taxa, Simpson's Evenness, and BCI were all within reference range (Figure 4.5; Table 4.2). The control-impact design showed lower density when upper Minto Creek was compared to only two reference areas (Figure 4.5; Table 4.2).

Phase 5 EEM (2019; Minnow 2021b) methodology and site locations (Figure 4.3) were similar to the Phase 4 EEM. As was seen in Phase 4, upper Minto Creek was within the reference range for density, number of taxa, Simpson's Evenness, and BCI (Figure 4.5; Table 4.2). As with all EEM phases EPT was lower at upper Minto Creek when compared to references/reference ranges (Minnow 2021b). As previously indicated, lower EPT at the exposed area was considered to be indicative of a mine-related influence but cannot be definitively attributed as such due to a lack of baseline data and the very dry conditions observed in Minto Creek is recent years.

[2] As per CABIN guidance (CABIN 2012) the RCA refers to each sampling location as a site whereas the Control-Impact study design refers to them as a replicate station within a larger area. All reference sites satisfied the criteria for selection (i.e., habitat, access) and changed among EEM Phases as the specific location was less important than selecting acceptable sites (change in access, etc.).

Table 4.3: Statistical Comparisons of Benthic Community Metrics for Mine-Exposed Stations UMC-1, UMC-2, and UMC-3, Relative to the Reference Condition, Minto Mine September 2014

Type	Endpoint	Reference Mean (n = 12) (URC-1, UWC-1, NRC-1, NRC-2, NRC-3, NRC-4, NRC-5, NRC-6, NRC-7, NRC-8, NRC-9, NRC-10)	Upper Minto Creek		
			UMC-1	UMC-2	UMC-3
Primary Metrics	Density/Abundance	177	136	309	652
	Richness	11	11	11	10
	Evenness (Simpson's)	0.40	0.32	0.39	0.33
	B-C Distance	0.58	0.71	0.84	0.90
Supporting Metrics	Diversity (Simpson's)	0.73	0.71	0.77	0.70
	% EPT	40.7	22.8	10.4	8.3
	% Ephemeroptera	13.1	0.7	0.6	0.3
	% Plecoptera	24.8	2.9	1.9	2.8
	% Trichoptera	2.8	19.1	7.8	5.2
	% Diptera (excluding Chironomidae)	14.2	21.3	40.1	39.3
	% Chironomidae	29.9	47.1	36.9	44.5
	% Arachnida	3.5	0.0	5.2	1.8
	% Oligochaeta	11.3	8.1	7.4	6.1
	CA1	4.37 / 5.84 / 5.32 [a]	-69.68	-78.69	-74.37
	CA2	-3.88 / -5.92 / -3.76 [a]	49.87	60.16	41.37

Within reference range (ncP>0.9).

Possibly outside of reference range (0.1<ncP<0.9).

Outside of reference range (ncP<0.1).

Notes: Family level taxonomic resolution was used to calculate richness, diversity, evenness, and CA values. ncP - probability that metric value at exposure area is inside the range of reference values.

[a] CA is conducted separately for each exposure site, therefore reference CA values are calculated for each exposure analysis. Reference means are presented for UMC-1, UMC-,2 and UMC-3, respectively.

5 TISSUE CHEMISTRY

5.1 Baseline Data

Metal concentrations in fish tissue (muscle) were assessed during baseline sampling (HKP 1994). Very few guidelines for fish quality are available and all mercury concentrations in round whitefish, slimy sculpin, and arctic grayling were found to be below the Health and Welfare Canada, Food and Drug Relations Guidelines.

5.2 Operational Data – Aquatic Effects Monitoring Program

Periphyton and benthic invertebrate tissue has been collected and measured for metal concentrations since 2012 from lower Minto Creek and two reference areas, lower Wolverine and Big creeks (Figure 2.1). Copper and selenium (analytes of concern) have been evaluated for both tissue types. In addition, slimy sculpin were collected near the mouth of Minto Creek in 2012 (Minnow 2013).

Concentrations of copper in periphyton tissue were significantly higher at lower Minto Creek compared to lower Wolverine Creek (2014 to 2020) and lower Big Creek (2017 to 2019; Figure 5.1; Table 5.1). The absence of baseline data makes it uncertain whether this represents a natural elevation in association with the presence of a copper-enriched ore body in the Minto Creek watershed or some level of mine influence. Selenium in periphyton collected from lower Minto Creek was significantly lower than in periphyton collected from lower Wolverine Creek in 2012 and 2013 but significantly higher in later years (2014 to 2016, 2018, 2020; Figure 5.1; Table 5.1; e.g., Minnow 2014, 2019, 2021a). Selenium concentrations in periphyton collected from lower Minto Creek was significantly higher than in periphyton tissue collected from lower Big Creek in 2014 to 2020. Selenium concentrations in Minto Creek periphyton were higher than reference areas but, as with copper, the absence of baseline data makes it uncertain whether this represents a mine influence. Overall, the selenium monitoring results indicate no risk of adverse effects to aquatic life, particularly in consideration of lower sensitivity of lotic environments and limited exposure to fish.

Copper concentrations in benthic invertebrate tissue at lower Minto Creek were significantly higher than at the reference area, lower Wolverine Creek in 2013, 2015, 2016, and 2017 (Figure 5.1; Table 5.1). In all other years, copper concentrations in invertebrates collected from lower Minto Creek were not significantly different from those collected from lower Wolverine Creek (Figure 5.1; Table 5.1). Concentrations of copper in benthic invertebrates at lower Minto Creek were significantly lower than those in lower Big Creek (reference) in 2014, 2015, and 2020 but in 2017 were significantly higher in lower Minto Creek compared to lower Big Creek

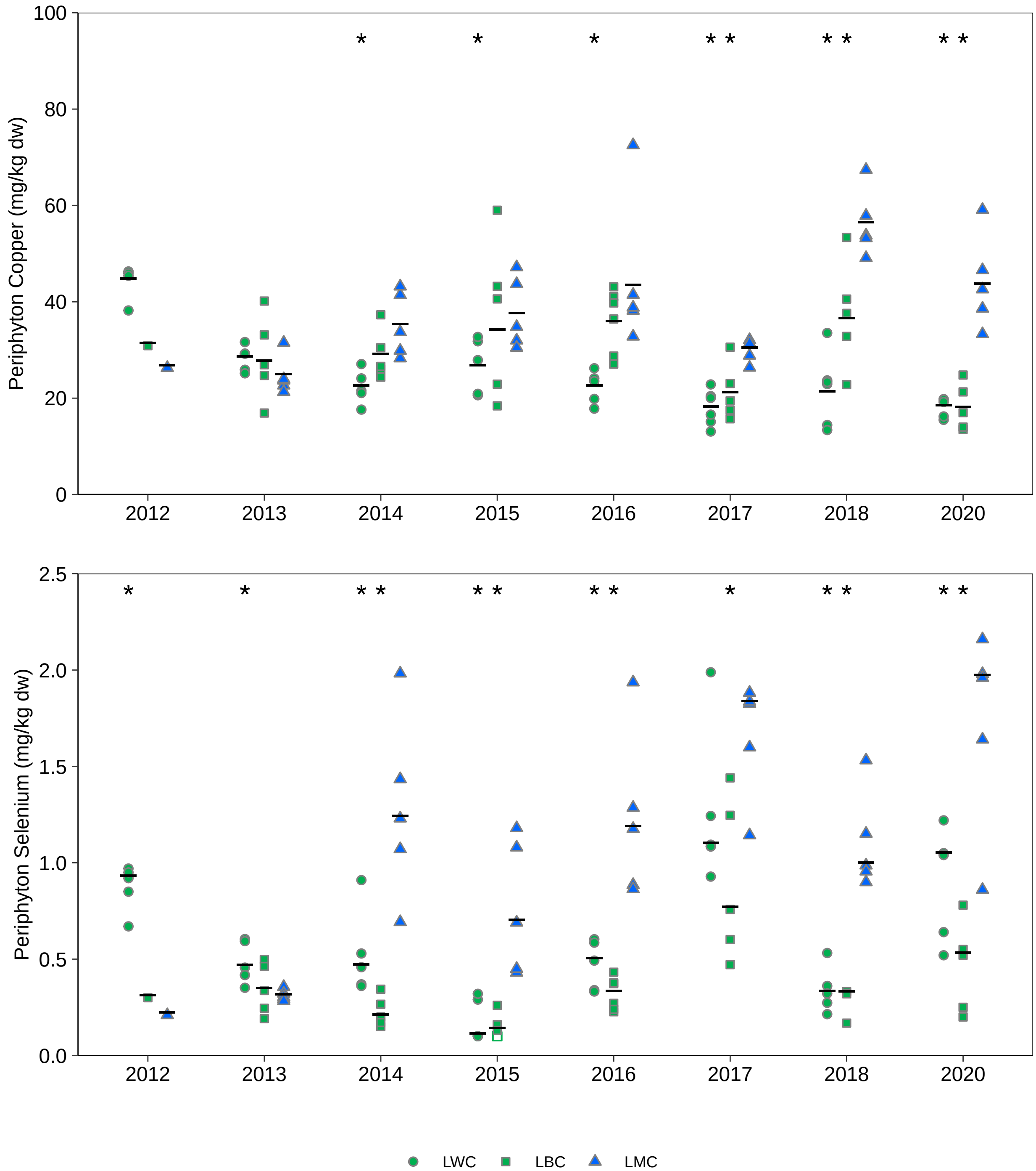


Figure 5.1: Periphyton and Benthic Invertebrate Tissue Metal Concentration at Lower Minto Creek (LMC) and reference areas, Lower Wolverine Creek (LWC) and Lower Big Creek (LBC), 2012 to 2020

Notes: Concentrations below the laboratory reporting limit (LRL) were plotted as open symbols at the LRL. British Columbia Benthic Invertebrate Tissue Guideline for Selenium was shown with a red line. Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year.

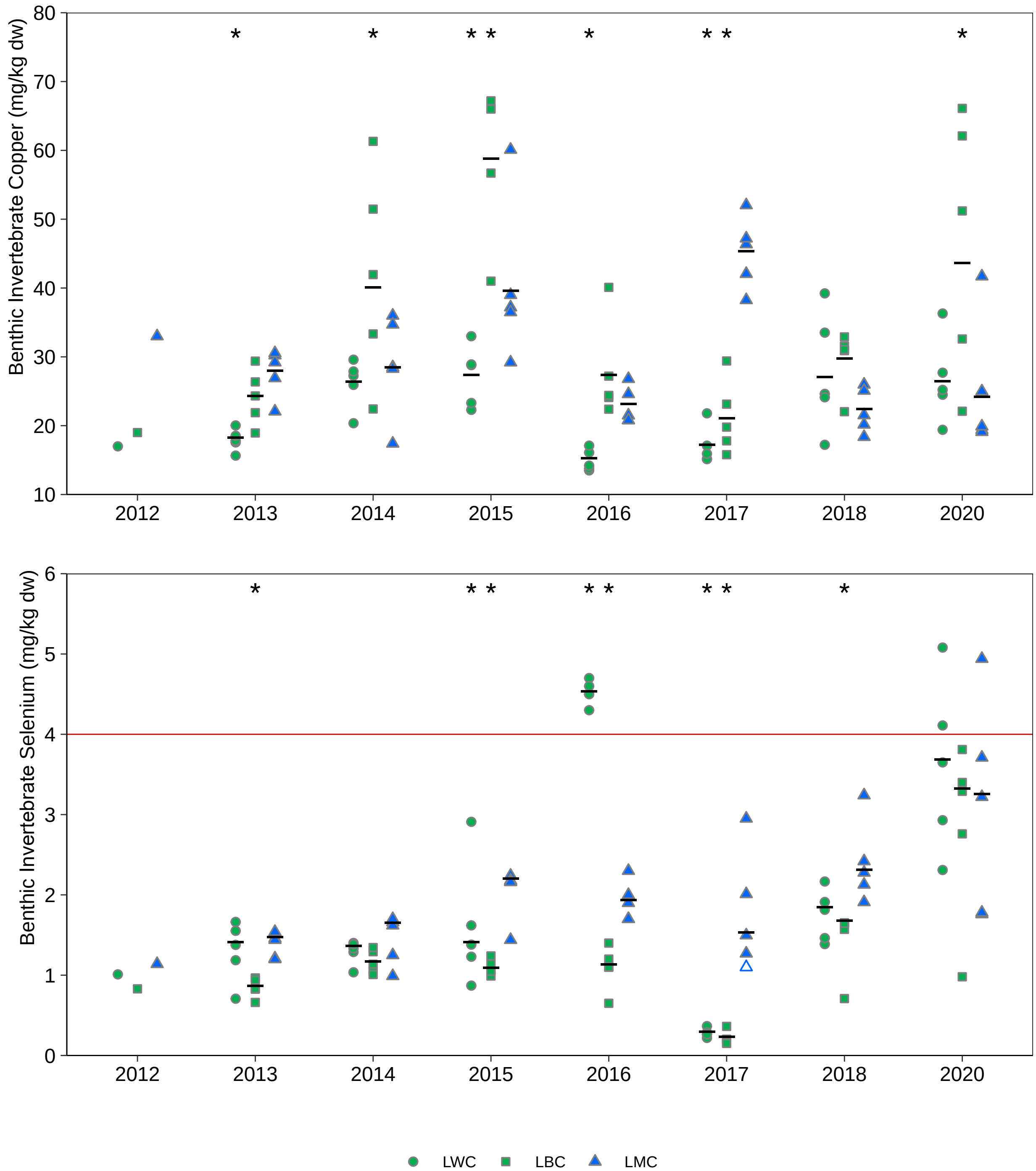


Figure 5.1: Periphyton and Benthic Invertebrate Tissue Metal Concentration at Lower Minto Creek (LMC) and reference areas, Lower Wolverine Creek (LWC) and Lower Big Creek (LBC), 2012 to 2020

Notes: Concentrations below the laboratory reporting limit (LRL) were plotted as open symbols at the LRL. British Columbia Benthic Invertebrate Tissue Guideline for Selenium was shown with a red line. Black horizontal bars indicate the Measure of Central Tendency (MCT). The MCT was the mean for non−transformed data, geometric mean for log−10 transformed data, and median for rank transformed data. An * indicates the reference station was significantly different from the exposed station for that year.

Table 5.1: Statistical Comparison on Benthic Invertebrate and Periphyton Tissue Metal Concentrations, Minto, 2012 to 2020

Endpoint	ANOVA Model				Year	Do endpoints differ between years for each area?[a]			Do endpoints differ between areas?	
	Transformation	Area	Year	Area x Year		LWC	LBC	LMC	MOD (%)[b] LWC vs. LMC	MOD (%)[b] LBC vs. LMC
Periphyton Copper (mg/kg dw)	log10	<0.001	<0.001	<0.001	2012	A	ABC	ABC	ns	ns
					2013	AB	ABC	C	ns	ns
					2014	BC	AB	BC	58	ns
					2015	BC	A	ABC	41	ns
					2016	BC	A	AB	94	ns
					2017	C	BC	BC	69	45
					2018	BC	A	A	168	55
					2020	BC	C	AB	140	145
Periphyton Selenium (mg/kg dw)	rank	<0.001	<0.001	<0.001	2012	AB	ABC	C	-77	ns
					2013	BC	BC	C	-33	ns
					2014	BC	BC	AB	169	516
					2015	D	C	B	590	431
					2016	BC	BC	AB	139	266
					2017	A	A	A	ns	141
					2018	CD	BC	AB	206	208
					2020	AB	B	A	88	277
Benthic Invertebrate Copper (mg/kg dw)	log10	<0.001	<0.001	<0.001	2012	ABC	CD	ABC	ns	ns
					2013	ABC	D	BC	55	ns
					2014	AB	ABC	BC	ns	-29
					2015	A	A	AB	45	-33
					2016	C	CD	C	53	ns
					2017	BC	D	A	167	117
					2018	AB	BCD	C	ns	ns
					2020	AB	AB	C	ns	-45
Benthic Invertebrate Selenium (mg/kg dw)	rank	<0.001	<0.001	<0.001	2012	CD	BCD	BC	ns	ns
					2013	C	CD	C	ns	73
					2014	C	BC	C	ns	ns
					2015	C	BCD	ABC	57	105
					2016	A	BCD	ABC	-58	73
					2017	D	D	ABC	469	651
					2018	BC	AB	AB	ns	38
					2020	AB	A	A	ns	ns

P-value < 0.05.

Magnitude of Difference (MOD) > 0.

Magnitude of Difference (MOD) < 0.

Notes: "-" indicates no data for comparison, "ns" indicates a non-significant contrast.

[a] Years that do not share a letter were significantly different in a Tukey's Honestly Significant Difference post-hoc test (α = 0.05).

[b] MOD = $(MCT_{LMC}-MCT_{ref})/MCT_{ref}$ *100; where the measures of central tendency (MCT) were medians for rank-transformed and geometric means for log10 transformed data.

(Figure 5.1; Table 5.1). Overall, copper concentrations in benthic invertebrates collected from lower Minto Creek are similar to those in benthic invertebrate collected from lower Big Creek, indicating limited mine influence (despite some challenges with interpretation due to an absence of baseline data).

Selenium concentrations in benthic invertebrate tissue were significantly higher at lower Minto Creek compared to both reference areas (lower Wolverine and Big creeks) in 2013, 2015 to 2017, and 2019, but not in in 2016 when concentrations in benthic invertebrates collected from lower Minto Creek were significantly lower compared to those collected from lower Wolverine Creek (Figure 5.1; Table 5.1). Even though differences were observed, all MCT were below the interim British Columbia Benthic Invertebrate Tissue Guideline (4 mg/kg), except in lower Wolverine Creek in 2016.

A study was conducted in 2012 comparing slimy sculpin selenium fish tissue concentrations in lower Minto Creek compared to lower Big Creek (Minnow 2013). Mean selenium concentrations in slimy sculpin collected from lower Minto Creek (5.3 ± 1.1 mg/kg dw [dry weight]) were moderately but significantly higher than lower Big Creek (3.4 ± 0.7 mg/kg dw). At lower Minto Creek the selenium concentrations were just above the BCWQG for fish tissue (4.0 mg/kg) whereas concentrations are just below the BCWQG at lower Big Creek. Metal concentrations in fish tissue have not been monitored since due to very limited use of lower Minto Creek by fish.

6 FISH MONITORING

6.1 Yukon River

The Yukon River supports many resident and migratory fish species, including chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), chum salmon (*Oncorhynchus keta*), lake trout (*Salvelinus namaycush*), least cisco (*Coregonus sardinella*), Bering cisco (*Coregonus laurettae*), round whitefish (*Prosopium clyindraceum*), lake whitefish (*Coregonus clupeaformis*), inconnu (*Stenodus leucichthys*), arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), and slimy sculpin (*Cottus cognatus*). Chinook salmon, round whitefish, arctic grayling, and slimy sculpin have all been captured in Minto Creek.

Spawning shoals for salmon have been identified in the Yukon River in the general vicinity of the Minto Creek mouth (the 20 km area between Big Creek [usptream] and Wolverine Creek [downstream]) at Ingersoll Islands and islands near the mouth of Big Creek. Juvenile chinook salmon (JCS) spend about one and a half years in tributaries of the Yukon River before out-migrating to the ocean (Yukon River Panel 2008).

6.2 Baseline

Habitat assessment, minnow trapping, and backpack electrofishing were completed during baseline (HKP 1994). Minto Creek was identified as being ephemeral with little flow and winter glaciation, preventing Minto Creek as being an overwintering fish habitat. A canyon was observed and was considered too steep (21% gradient) for fish to traverse.

The canyon restricted fish to the lower 2 km of Minto Creek. In June, August, and September, fishing was completed above and below the canyon. Fishing above the canyon was unsuccessful. Below the canyon, no JCS were caught, but slimy sculpin (8), round whitefish (1), and arctic grayling (4) were caught (Table 6.1).

Table 6.1: Summary of Capture Data for Minto Creek During Baseline, 1994

Month	Species			
	Round Whitefish	Slimy Sculpin	Arctic Grayling	Chinook Salmon
June	1	2	0	0
August	0	6	2	0
September	0	0	2	0

6.3 Operational Data – Aquatic Effects Monitoring Program

Under the AEMP, monthly fish monitoring (June through October) was conducted using minnow traps and a backpack electrofisher from 2008 to 2019. Fish monitoring was not conducted in 2020 due to dry conditions in Minto Creek (Smith 2021, pers. comm.). Some additional fish monitoring has been completed in response to specific events or information needs, including fishing to support Minto Creek's fish relocation project (2009) and a mark and recapture study (2010). Fishing in Minto Creek has focused on JCS, but slimy sculpin, round whitefish, Arctic grayling, and burbot have also been caught in low numbers. Juvenile chinook salmon were shown to use Minto Creek infrequently and rarely before July. Peak utilization (if any) occurs in late August and early September. Since Minto Creek is ephemeral and lacks overwintering habitat, it is believed that JCS use the creek sporadically during their out-migration from natal streams to the Bering Sea. In 2010, a fish barrier was noted to restrict fish to the lower 1.2 km of the creek. Efforts to catch fish above the fish barrier have proven to be unsuccessful, further cementing that fish are unable to move upstream of barriers at the foot of the canyon.

In July 2019 during an emergency release of water from the Minto WSP, minnow traps were deployed for 10 trap days. A total of 136 JCS and 6 slimy sculpin were caught (ACG 2009). The utilization of Minto Creek by JCS was observed to increase with increased flows. A relocation plan was initiated in late September/early October 2009 to move fish from Minto Creek to the Yukon River and Big Creek since it was identified that fish could become stranded once the emergency discharge stopped (October 2009). A total of 986 JCS were relocated as well as one slimy sculpin and one burbot (ACG 2009). In 2010, a mark and recapture study was conducted to determine JCS activity in Minto Creek. It was determined from this study that JCS spend little time in Minto Creek, with most of the individuals spending about two weeks and very few individuals spending more than 12 weeks in the system (ACG 2010).

Excluding emergency discharge events (which occurred in 2009 and 2010), JCS were more often caught in September compared to other months. The highest yearly catch-per-unit-effort (CPUE) were recorded in 2009 (12.1 fish/trap day) and 2010 (14.5 fish/trap day) during an emergency discharge event (higher flows attract JCS into the creek; Table 6.2; Minnow 2020b). Disregarding all emergency discharge events, the highest CPUE for JCS was observed in 2007 (mean CPUE = 6.2 fish/trap day). Catch-per-unit-effort has decreased over time, in 2015 and 2016 a combined 12 JCS were caught and from 2017 to 2019 there were no JCS caught (Table 6.2).

Fish monitoring under the AEMP has shown that JCS use Minto Creek in a limited fashion. In addition to providing poor spawning and overwintering habitat, Minto Creek is a "losing stream" system which has likely limited the opportunity for resident fish populations to become established

Table 6.2: Maximum Monthly Mean Catch-per-Unit-Effort of Juvenile Chinook Salmon in Relation to Conditions in Minto Creek, 1994 to 2019

Year	Month	CPUE [a]	Minto Creek Conditions
1994	September	0.00	Pre-development – no discharge
2008	September	0.90	Operational – no discharge
2009	September/October	20.0	Emergency Discharge
2010	August	30.0	Emergency 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
2019	June-September	0.00	Operational – no discharge

[a] CPUE = no. fish /trap day.

in the creek. During summer dry periods, surface flows in lower Minto Creek can be very low to zero while flow is still observed in upper sections of the creek, likely due to infiltration of Minto Creek flows into the alluvial materials of the Yukon River floodplain (CCL 2206). Water temperatures also tend to remain cooler in Minto Creek than in the Yukon River and fluctuate more widely throughout the day (up to 5°C or more) which likely deters fish from entering the system. The highest abundance of JCS occurred during emergency discharge events when water flows and temperature were higher (temperatures were more comparable to the Yukon River). Also, maximum monthly mean CPUE were about 6x (or more) higher during emergency discharge events in 2009 and 2010 (Table 6.2). No JCS have been caught in Minto Creek since 2016 coinciding with tighter restrictions on discharge under the WUL and no additional emergency discharge; this provides further evidence that use of the creek by JCS maybe influenced by flow and the subsequent temperature difference between the Yukon River and Minto Creek.

6.4 Operational Data – Environmental Effects Monitoring

Fish monitoring and effluent-exposure fish studies have been completed during all five phases of the EEM, except for Phase 3 (when an EEM Investigation of Cause [IOC] study was triggered by benthic invertebrate community results only). Fishing was completed in 2007 to support development of the EEM Phase 1 Study Design.

The Phase 1 EEM fish monitoring was completed in June and September 2008 in lower Minto Creek. Minnow trapping and backpack electrofishing yielded no fish in June and only one JCS was observed but not caught when electrofishing in September. A total of 17 JCS were caught by minnow trapping in September 2008.

Due to a lack of sufficient fish to complete a statistically robust evaluation of the potential influence of the Minto Mine effluent on sentinel fish species, a dual *in-situ* fish community sampling and hatchery-based effluent exposure fish study was completed for the Phase 2 EEM in 2011. Fishing occurred from July to October 2011. The greatest number of fish were caught in September (6) which was expected as September is the peak time for JCS usage of Minto-Creek under normal conditions (i.e., in the absence of emergency discharge). The hatchery-based fish study used 210 chinook salmon fry for each treatment, control and exposed. Control fish were supplied with artesian spring water and the exposed treatment consisted of water mixed from the WSP and lower Minto Creek at effluent concentrations that were observed in the field. Fish from the exposed treatment had slightly greater size (6% difference) and body condition (2% difference; Table 6.3). These results were obtained after five to six weeks of constant effluent exposure.

Fish monitoring during the Phase 4 EEM (2016) was completed from June to September 2016 and a total of 6 JCS were caught in lower Minto Creek in September. An on-site laboratory-based fish study (similar to Phase 2 hatchery-based fish study) was conducted during the Phase 4 EEM. Kokanee (*Oncorhynchus nerka*; a landlocked strain of sockeye salmon) were used as JCS were unavailable. In each treatment group (control, 14% effluent, and 25% effluent), 160 Kokanee fry were used. The 14% effluent treatment group had lower condition (-2.7%) when compared to the control treatment group (Table 6.3). Kokanee exposed to 25% effluent were slightly longer (1.6%), heavier (6.9%), and had increased condition (2.3%) compared to reference Kokanee (Table 6.3). Differences seen in condition (EEM-effect endpoint) were less than the 10% critical effect size (CES) so therefore were not considered ecologically relevant.

During the Phase 5 EEM (2019), fishing efforts were unsuccessful in catching JCS. Kokanee fry were used again in the on-site laboratory based fish study as JCS were unavailable. A total of 125 Kokanee fry were used in each treatment group (control, 14% effluent, and 25% effluent). Fish from the 14% effluent exposure treatment were longer (13%), heavier (60%), and had greater condition (12%) when compared to the control treatment (Table 6.3). The 25% effluent exposure treatment were also longer (13%), heavier (72%), and had greater condition (16%) compared to the control treatment (Table 6.3). Differences seen between each effluent exposed group compared to the control group were greater than the CES at magnitudes that would be considered ecologically relevant. However, these differences appear to have been due to a myxobacterial infection in the reference group.

Table 6.3: Summary of Comparisons of Fish Population EEM metrics in Upper Minto Creek to Reference, Minto Mine Phase 1 to Phase 5 EEM

Phase	Exposure Conditions (% Effluent)	Significantly Different?[a,b]			
		Survival	Energy Use		Energy Storage
		Length-Frequency	Fork Length	Body Weight	Condition
Phase 1 (2008)	-	-	-	-	-
Phase 2 (2011)	12% Effluent	No	No	6.0%	2.0%
Phase 3 (2014)	-	-	-	-	-
Phase 4 (2016)	14% Effluent	1.0%	No	No	-2.7%
	25% Effluent	8.0%	1.6%	6.9%	2.3%
Phase 5 (2019)	14% Effluent	61%	13%	60%	12%
	25% Effluent	58%	13%	72%	16%

[a] Effect size expressed as increase or decrease percent (%) compared to reference.

[b] Only a fish usage survey was conducted in Phase 1 and fish surveys were not required in Phase 3.

7 SUMMARY

Minto Mine has characterized aquatic environmental conditions (sediment quality, periphyton, benthic invertebrates, and fish) in Minto Creek in comparison to local and regional reference creeks and environmental quality guidelines as part of baseline studies, under the AEMP, and under federal EEM. Sediment collected in Minto Creek during baseline consisted of gravel and sand with minimal silt and clay. In early years of monitoring (2006 to 2009) under the AEMP, sediment collected also consisted of gravel and sand with very little silt and clay. It was not until 2010, that a method change produced more chemically relevant silt and clay fractions. Copper concentrations in upper Minto Creek sediment exceeded the ISQG indicating that the area has naturally high level of copper (consistent with the presence of an economic ore bodies within the watershed). Arsenic concentrations in sediment at upper and lower Minto Creek were often higher than ISQG but this was also the case at both reference areas, upper McGinty Creek and lower Wolverine Creek, indicating that arsenic concentrations might be naturally high in this general area. Concentrations of chromium in sediment at upper Minto Creek were higher than reference (upper McGinty Creek) but may be of limited ecological consequence as concentrations at the exposed area were below the ISQG.

Survival of *C. dilutus* during the sediment toxicity tests was significantly lower at lower Minto Creek compared to both reference and control sediment in 2017 and 2018 and significantly lower compared to only reference sediment in 2020. Growth of *C. dilutus* was significantly lower in lower Minto Creek compared to reference sediment in 2017. There were no adverse effects of growth on *H. azteca* but survival was significantly lower in exposed sediment (lower Minto Creek) compared to reference (lower Wolverine Creek) and control sediment in 2020. The results of the *C. dilutus* and *H. azteca* sediment toxicity tests suggest potential for adverse effects, but temporal comparisons show differences in response despite stable sediment chemistry.

Sampling areas with open canopies had higher chlorophyll-a concentration compared to those with dense canopy cover which had the lowest concentration of chlorophyll-a. Chlorophyll-a concentrations at all areas were below the BCWQG of 100 mg/m^2. Baseline sampling showed that Minto Creek would be classified as oligotrophic (low production/nutrients) under Dodds (1998) classification system. Periphyton community samples indicated that diatoms were the most dominant taxa with red and blue-green algae being abundant prior to operations in 1994. During operations, chlorophyll-a concentrations at lower Minto Creek were significantly higher compared to lower Wolverine Creek in 2014, 2015, 2017, and 2018 but significantly lower in 2012 and 2020. All median concentrations of chlorophyll-a were below the BCWQG indicating that concentrations might be of limited ecological relevance. While the mine can influence chlorophyll-a concentrations through some release of nitrogen compounds, the temporal variability observed suggests that natural conditions, like temperature, light availability, and canopy may be a dominant factor. From 2012 to 2015, lower Minto Creek was classified as oligotrophic, but moved to mesotrophic in 2016 to 2018. In 2020, the creek was again classified as oligotrophic. The increased production (mesotrophic conditions) could be due to increased light penetration and/or increased nutrient inputs. Regardless of the cause of increased production from 2016 to 2018, all samples of chlorophyll-a were below the BCWQG. Community composition at both areas was variable, usually diatoms were the most dominant group at lower Minto Creek, but blue-green algae have been dominant in some years. Temporal variability has been seen at the reference area as well. Periphyton production and community monitoring have shown variation in lower Minto Creek and reference area, lower Wolverine Creek. The temporal patterns relative to reference suggest limited mine-influence as trophic changes were present at the reference area and the apparent trophic change in lower Minto Creek to mesotrophic (2016 to 2018) was temporary as lower Minto Creek was oligotrophic in 2020.

During baseline, benthic invertebrate communities of lower Minto Creek had lower density, but higher taxon richness compared to reference (W7, a north-flowing tributary of Minto Creek). Earlier studies completed under the AEMP showed that benthic invertebrate communities of lower Minto Creek had greater taxon richness compared to reference using the 250 µm mesh but lack of replication made interpretation difficult. In later years with replication (500 µm mesh), lower Minto Creek showed no significant differences in taxon richness compared to lower Wolverine Creek except in 2012 (higher) and in 2016 (lower) . A significantly higher proportion of pollution sensitive EPT taxa was present at lower Minto Creek when compared to lower Wolverine Creek (reference) in 2013, 2014, 2017, and 2018. Pollution tolerant Oligochaeta were significantly lower at lower Minto Creek compared to lower Wolverine and Big creeks. This would suggest limited mine influence as the area sustains sensitive taxa. In 2020, there was a significant decrease in percent EPT taxa (particularly Plecoptera) and an increase in percent chironomids when compared to previous years. However, the loss of EPT taxa and the increase of chironomids was an expected response to dry conditions in 2019.

Benthic invertebrate community sampling under the Phase 1 and 2 EEMs (2008 and 2011), showed significantly higher density and BCI at upper Minto Creek compared to reference. Phase 2 EEM also showed significant differences in number of taxa (higher) and Simpson's Evenness (lower) at upper Minto Creek compared to reference. In Phase 3 through 5 EEM (2014, 2016, and 2019) when the RCA was applied, there were no significant differences in the four primary EEM endpoints (density, number of taxa, Simpson's Evenness, BCI), except in Phase 3 when one exposed site was out of reference condition for density and BCI. The RCA includes more reference sites (at least 10) than the CI design (one reference area) and captures more natural variability. In all EEM phases, percent EPT was lower at upper Minto Creek when compared to references/reference condition. Since EPT taxa are sensitive to environmental stressors this could indicate a mine influence, but the influence appears to be of limited spatial extent as higher percent EPT has been observed at lower Minto Creek (during the AEMP) compared to reference (lower Wolverine Creek).

Concentrations of copper in periphyton tissue were significantly higher at lower Minto Creek compared to lower Wolverine Creek (2014 to 2020) and lower Big Creek (2017, 2018, 2020). This could represent a natural elevation associated with the presence of a copper-enriched ore body in the watershed or some level of mine influence. However, the absence of any baseline data for periphyton or benthic invertebrate tissue quality limits interpretation. Selenium in periphyton tissue was significantly lower at lower Minto Creek compared to lower Wolverine Creek in 2012 and 2013 but significantly higher in later years (2014 to 2016, 2018, 2020). Copper concentrations in benthic invertebrate tissue at lower Minto Creek were significantly higher when compared to lower Wolverine Creek but were significantly lower when compared to lower Big Creek (except in 2017). Selenium concentrations in benthic invertebrate tissue were significantly higher at lower Minto Creek compared to both references in 2013, 2015 to 2017, and 2019 (except for lower Wolverine Creek in 2016). Higher concentrations of selenium in benthic invertebrate tissue were observed but might be of limited ecological relevance as all MCT were below the interim British Columbia Benthic Invertebrate Tissue Guideline (4 mg/kg), except for at the reference area (lower Wolverine Creek) in 2016. Selenium monitoring results indicate no risk of adverse effects to aquatic life, particularly in consideration of lower sensitivity of lotic environments and limited exposure to fish. Overall, the selenium monitoring results indicate no risk of adverse effects to aquatic life, particularly in consideration of lower sensitivity of lotic environments and limited exposure to fish.

The Yukon River (near Minto Creek) supports many resident and migratory fish species, including salmon (chinook, coho, and chum), lake trout, least and Bering cisco, round and lake whitefish, inconnu, arctic grayling, northern pike, burbot, longnose sucker, and slimy sculpin. Chinook salmon, round whitefish, arctic grayling, and slimy sculpin have all been captured in Minto Creek. Spawning shoals for salmon have been identified in the Yukon River downstream of Minto Creek at Ingersoll Island and upstream at islands near the mouth of Big Creek.

During baseline sampling, all mercury concentrations in round whitefish, slimy sculpin, and arctic grayling were below the Health and Welfare Canada, Food and Drug Relations Guidelines (the only guideline available for the analytes measured). Selenium concentrations measured in slimy sculpin fish tissue in 2012 was moderately but significantly higher at lower Minto Creek compared to lower Big Creek. Concentrations at lower Minto Creek were just above the BCWQG for fish tissue (4.0 mg/kg), whereas concentrations at lower Big Creek were just below. Analysis of metals in fish tissue have not been repeated since 2012 due to limited use of lower Minto Creek by fish.

A steep canyon (21% gradient) was observed during baseline studies and was considered impassible to fish. This canyon restricted fish to the lower 2 km of Minto Creek. Baseline fishing yielded slimy sculpin (8), round whitefish (1), arctic grayling (4), but no JCS. Fishing was attempted upstream of the canyon but was unsuccessful. A fish barrier was observed in 2010 further restricting fish to the lower 1.2 km of the creek (fishing upstream of the fish barrier was unsuccessful). Fishing in Minto Creek has produced few JCS. In addition to providing poor spawning and overwintering habitat, Minto Creek is a “losing stream” system which has likely limited the opportunity for resident fish populations to become established in the creek. During summer dry periods, surface flows in lower Minto Creek can be very low to zero while flow is still observed in upper sections of the creek, likely due to infiltration of Minto Creek flows into the alluvial materials of the Yukon River floodplain (CCL 2006). Water temperatures also tend to remain cooler in Minto Creek than in the Yukon River and fluctuate more widely throughout the day (up to 5°C or more) which likely deters fish from entering the system. The highest yearly CPUEs were recorded in 2009 (12.1 fish/trap days) and 2010 (14.5 fish/trap days), years which included emergency discharge events (Minnow 2020b). The highest yearly CPUE recorded (disregarding years with emergency discharge events) was in 2007 (6.2 fish/trap days). Fishing success has declined over time as there has been little discharge from the mine and no emergency discharge. In 2015 and 2016, a combined total of 12 JCS were caught and from 2017 to 2019 no JCS were caught. No JCS have been caught in Minto Creek since 2016 coinciding with tighter restrictions on discharge under the WUL and no additional emergency discharge; this provides further evidence that use of the creek by JCS maybe influenced by flow and the subsequent temperature difference between the Yukon River and Minto Creek.

During EEM years (every third year), fish monitoring was incorporated into the EEM. Due to low catch numbers, hatchery or laboratory-based fish studies were conducted in Phase 2, Phase 4, and Phase 5 (2011, 2016, and 2019). There was no fish survey during the Phase 3 EEM since it was an IOC that was triggered by benthic invertebrate responses only. All fish studies showed fish (chinook salmon in Phase 2 and kokanee in Phases 4 and 5) with greater body weight and condition in the exposed treatment(s) compared to reference, except for the 14% effluent treatment during Phase 4 (there was no difference for body weight and condition was significantly lower in exposed treatment compared to reference treatment). Phase 2 and 4 differences were all small and below the 10% CES for condition so were not considered ecologically relevant. Differences observed in Phase 5 were well above the CES but this was due to a myxobacterial infection in the reference treatment.

8 REFERENCES

ACG (Access Consulting Group). 2009. Minto Creek Fish Relocation Project. September 29 – October 2, 2009; October 12 – 14, 2009. Letter Report.

ACG. 2010. Juvenile Chinook salmon Mark/Recapture Study, Minto Creek, 2010. November 2010. Draft Report.

Alexco and Minnow (Alexco Environmental Group and Minnow Environmental Inc.). 2018. Minto Mine – Site Characterization Aquatic Resources. Prepared for Minto Explorations Ltd.

BCMOE (British Columbia Ministry of Environment). 1985. Water Quality Criteria for Nutrients and Algae: Technical Appendix. Prepared by Richard Nordin, Water Quality Unit, Resource Quality Section, Water Management Branch. October 1985.

CABIN (Canadian Aquatic Biomonitoring Network). 2012. Field Manual: Wadeable Streams. Environment Canada. March 2012.

CCME (Canadian Council of Ministers of the Environment). 1999 (plus updates). Canadian Environmental Quality Guidelines. CCME, Winnipeg.

Dodds, W.K., J.R. Jones and E.B. Welch. 1998. Suggested Classification of stream trophic state: Distribution of temperate stream types by chlorophyll, total nitrogen, and phosphorus, Water Research, 32(5):1455-1462.

Environment Canada. 2012. 2012 Metal Mining Environmental Effects Monitoring (EEM) Technical Guidance Document. Environment Canada Report.

HKP (Hallam Knight Piesold). 1994. Minto Explorations Limited Minto Project: Volume II Environmental Setting. Prepared for Minto Explorations Limited. December 1994.

Horowitz, A.J. 1991. A Primer on Sediment-Trace Element Chemistry. Second Edition. Lewis Publishers.

Minnow (Minnow Environmental Inc.). 2011. Minto Creek Sediment and Benthic Invertebrate Community Assessment – 2010. Prepared for Minto Explorations Ltd., June 2011.

Minnow. 2012. Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment - 2011. Prepared for Minto Explorations Ltd, March 2012.

Minnow. 2013. Results of Selenium Monitoring in Minto Creek – 2012. Prepared for Capstone Mining Corp – Minto Mine. January 2013.

Minnow. 2014. Capstone Mining Corp. Minto Mine Phase 3 EEM Study Design – Investigation of Cause. Prepared for Capstone Mining Corp – Minto Mine. March 2014.

Minnow. 2015a. Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment - 2014. Prepared for Minto Explorations Ltd, March 2015.

Minnow. 2015b. Minto Mine Phase 3 EEM - Investigation of Cause Interpretive Report. Prepared for Capstone Mining Corp. – Minto Mine. January 2015.

Minnow. 2016. Minto Mine Phase 4 EEM Study Design Report. Prepared for Minto Exploration Ltd. February 2016.

Minnow. 2017. Minto Creek Sediment, Periphyton and Benthic Invertebrate Community Assessment – 2016. Prepared for Minto Explorations Ltd, March 2017.

Minnow. 2018a. Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment – 2017. Prepared for Minto Explorations Ltd, March 2018.

Minnow. 2018b. Minto Mine Phase 4 Environmental Effects Monitoring Interpretive Report. Prepared for Minto Explorations Ltd, January 2018.

Minnow. 2019. Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment – 2018. Prepared for Minto Explorations Ltd, March 2019.

Minnow. 2020a. Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment – 2019. Prepared for Minto Explorations Ltd, March 2020.

Minnow. 2020b. Minto Mine AEMP Fisheries Monitoring Program Evaluation. Prepared for Minto Explorations Ltd., November 2020.

Minnow. 2021a. Minto Creek Sediment, Periphyton, and Benthic Invertebrate Community Assessment – 2020. Prepared for Minto Explorations Ltd., March 2021.

Minnow.2021b. Minto Mine Phase 5 Environmental Effects Monitoring Interpretive Report. Prepared for Minto Explorations Ltd, January 2021.

Minnow/Access. (Minnow Environmental Inc./Access Consulting Group). 2009. Environmental Effects Monitoring First Interpretive Report, Minto Project, Yukon Territory. Prepared for Minto Explorations Ltd. January 2009.

Minnow/Access. 2012. Minto Mine Cycle 2 Environmental Effects Monitoring (EEM). Prepared for Minto Explorations Ltd. January 2012.

Smith, I. 2021. Permit Analyst, Minto Exploration Ltd. Email correspondence with Lisa Bowron (Minnow). October 22, 2021.

Yukon River Panel. 2008. Chinook salmon (Oncorhynchus tshawytscha).http://yukonriverpanel.com/salmon/about/yukon-river-salmon/chinook/

APPENDIX 1-7

Vegetation Metal Uptake 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:

R Vanderhorst

Renate Vanderhorst, MSc.
Junior Scientist

Report reviewed by:

LPigage

Lea Pigage, R.P.Bio, PMP, EPCC
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.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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

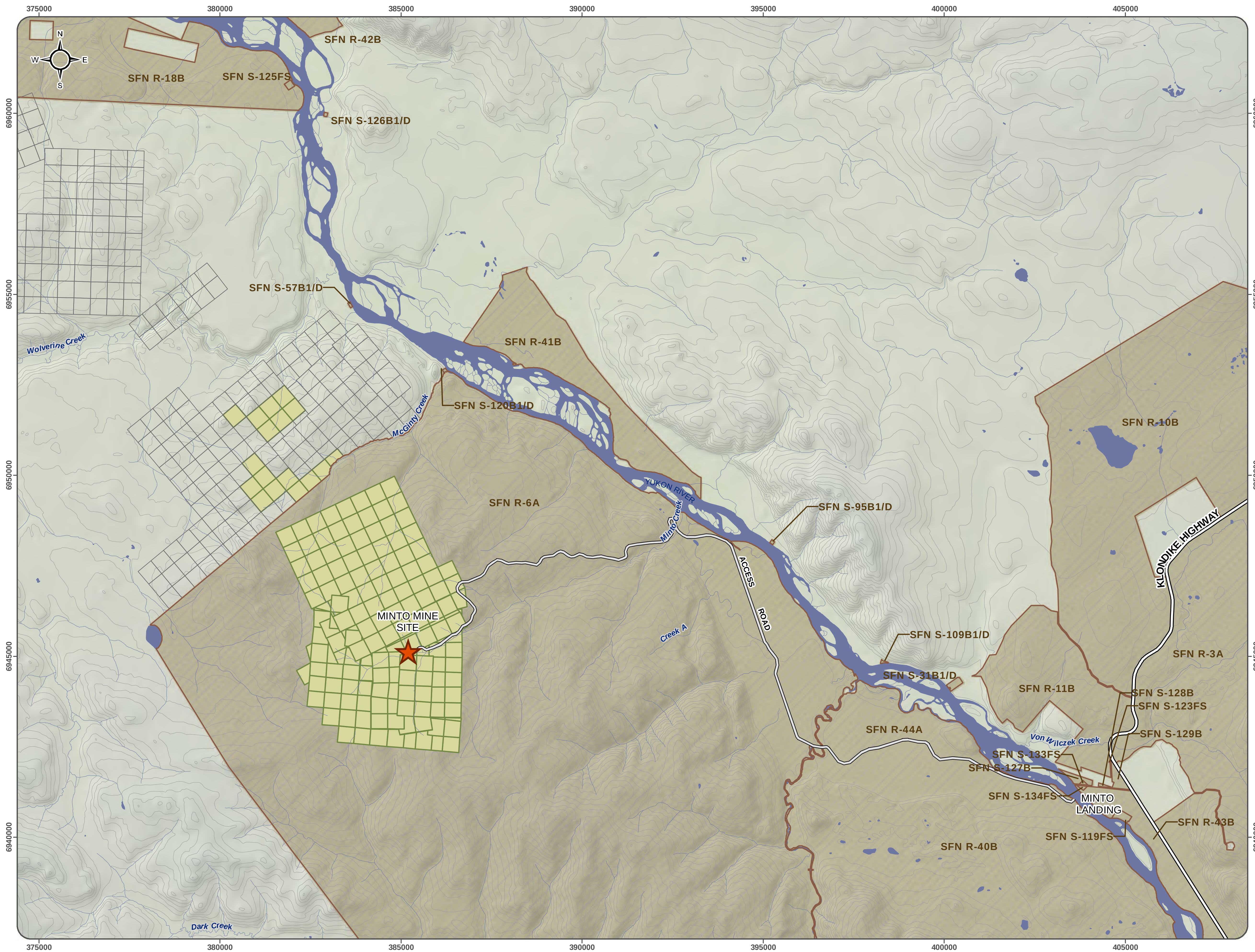
ALEXCO ENVIRONMENTAL GROUP

MINTO MINE
VEGETATION METAL UPTAKE MONITORING PROGRAM

FIGURE 1-1
PROJECT LOCATION

JANUARY 2020

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\01-Project Location\Project_Location_MASTER_ESRI_Layers_20170802.mxd (Last edited by: amatlashevska; 2020-01-03/14:22 PM)



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

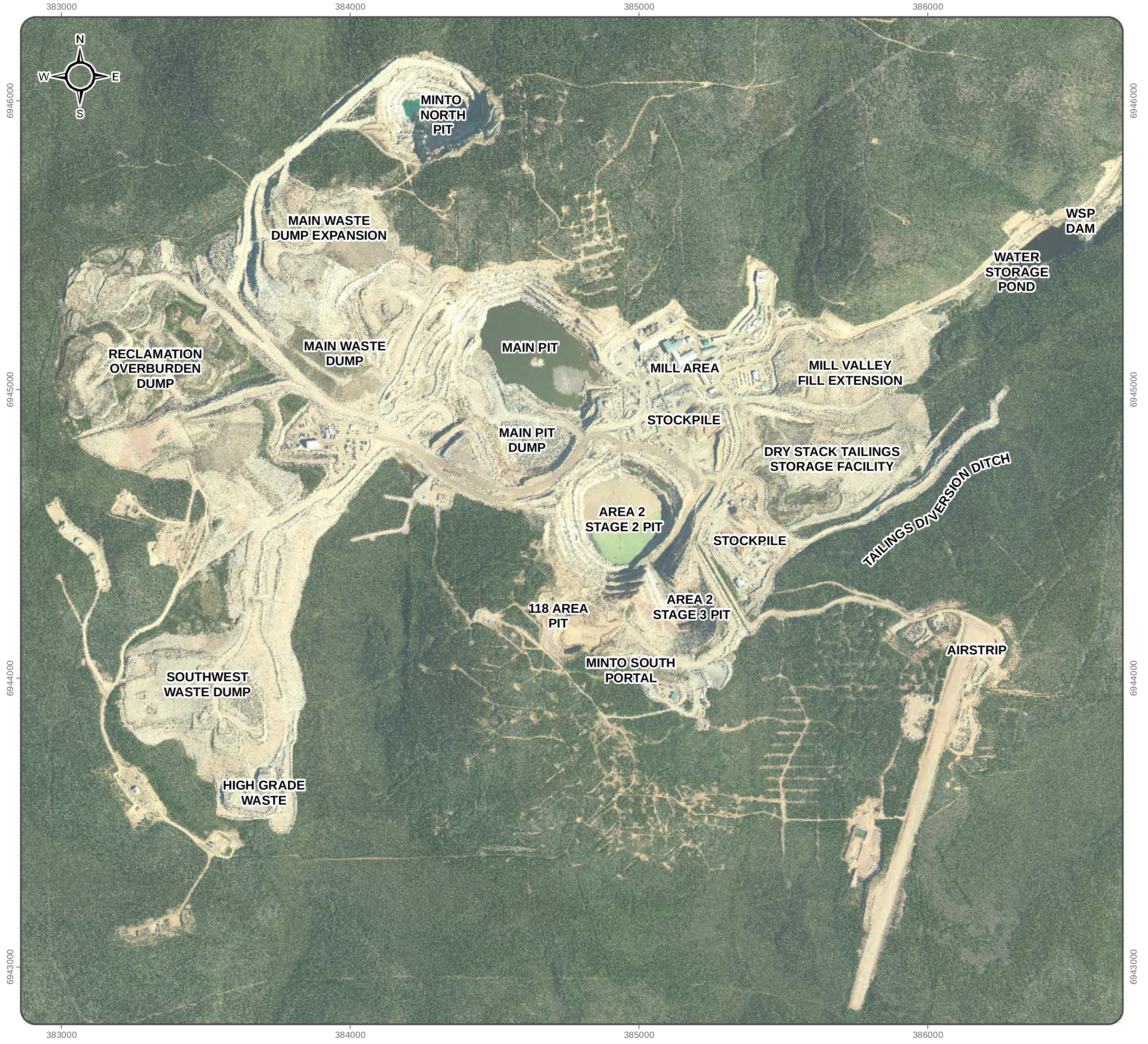
kelometres

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

D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\01-Property Overview\Property_Overview_20200103.mxd
(*Last edited by: amatlashevska;2020-01-03/14:14 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

ALEXCO ENVIRONMENTAL GROUP

Datum: NAD 83 Projection: UTM Zone 8N

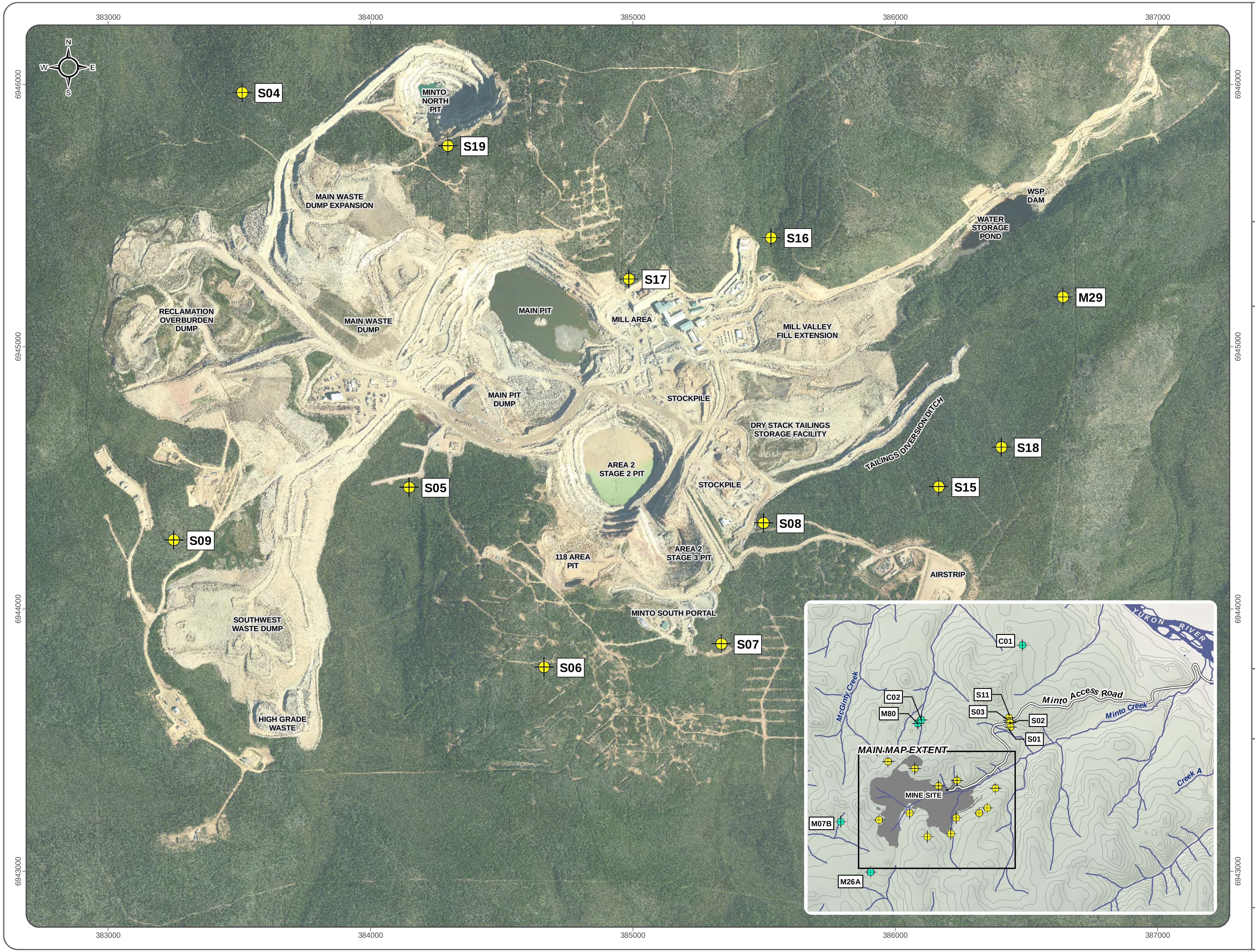
D:\Project\AllProjects\Minto\gis\mxd\Overview_Maps\05-Project Size\Year_0_Overview_Letter_20171115.mxd Development\Letter

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

- Control Plot
- Exposure Plot
- Minto Access Road
- Mine Footprint
- Waterbody
- Watercourse

1:13,500 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

ALEXCO ENVIRONMENTAL GROUP

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

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Studies\Metal_Uptake_Soil_2015\VMU_Monitoring_2020103.mxd
(*Last edited by: amatlashevska;2020-01-03/14:04 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.

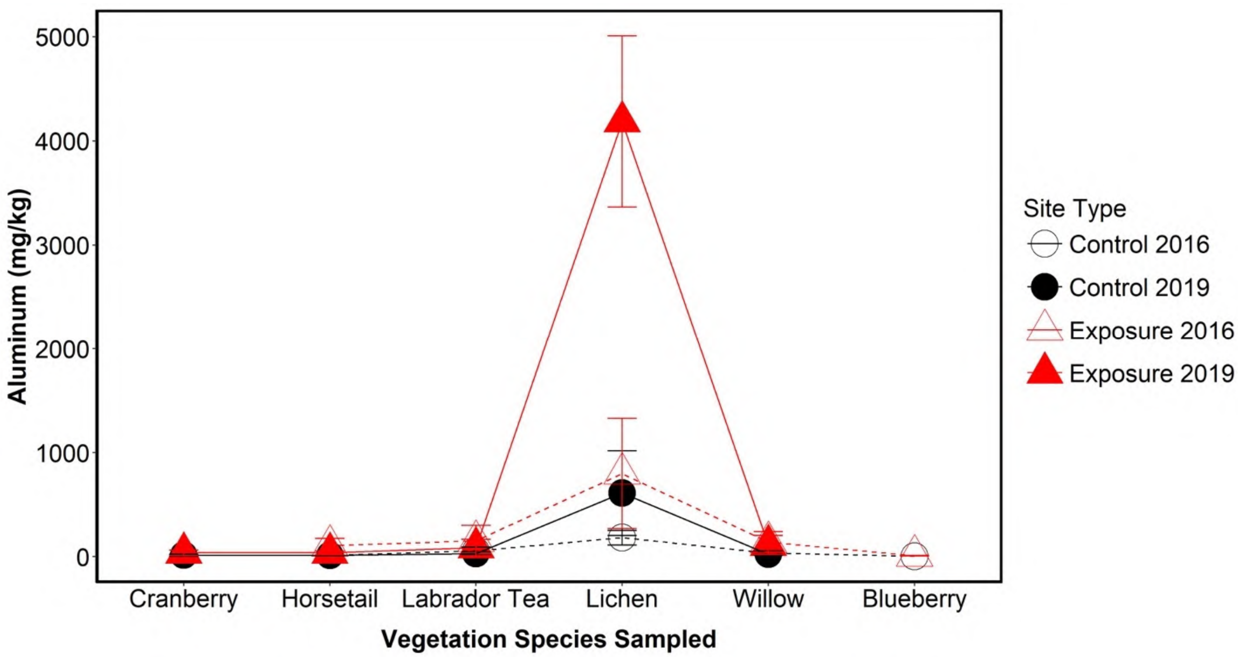


Figure 3-1: Comparison of Mean Aluminum Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

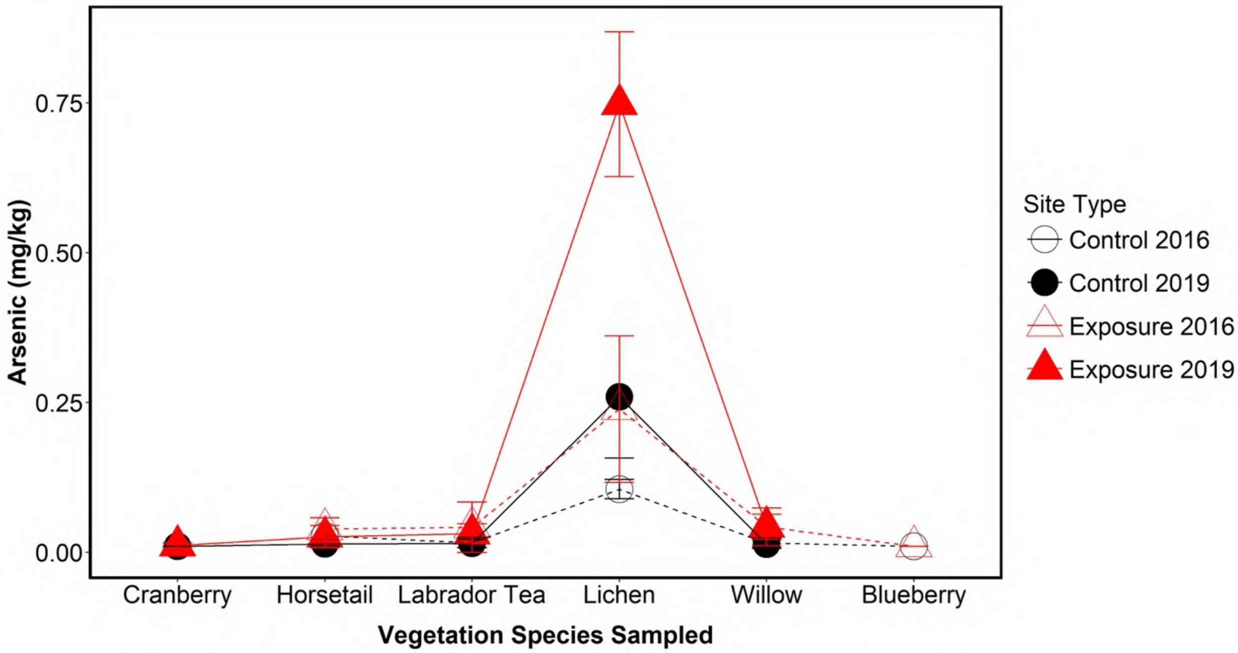


Figure 3-2: Comparison of Mean Arsenic Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

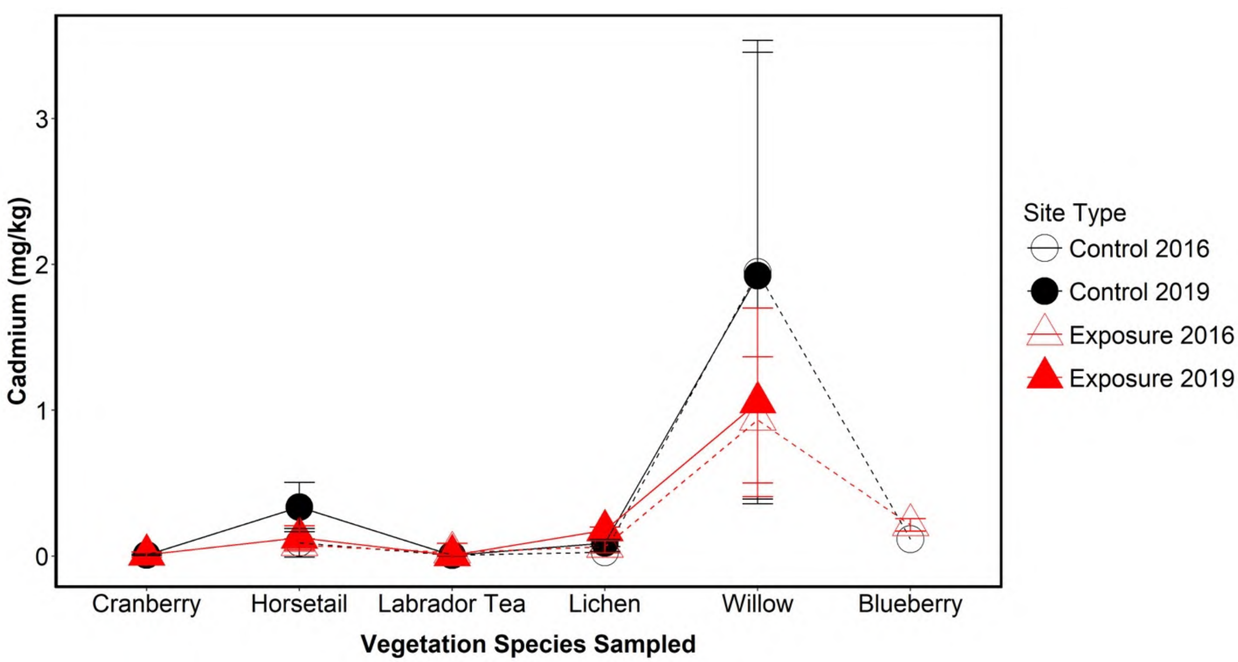


Figure 3-3: Comparison of Mean Cadmium Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

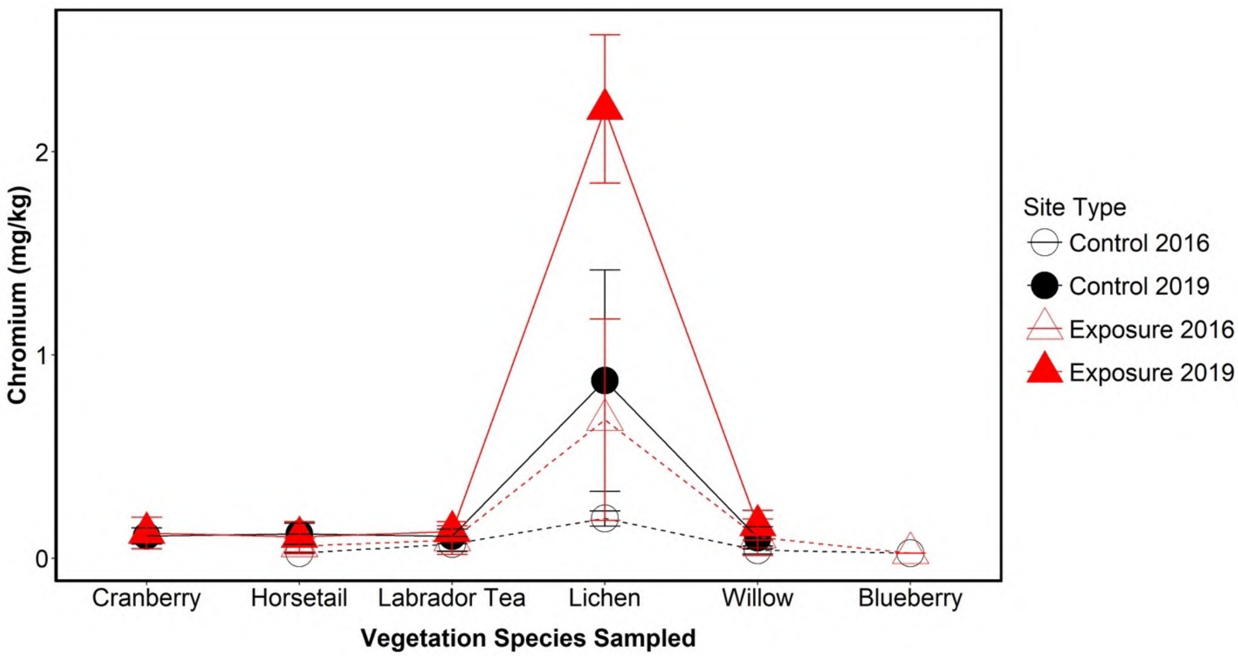


Figure 3-4: Comparison of Mean Chromium Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

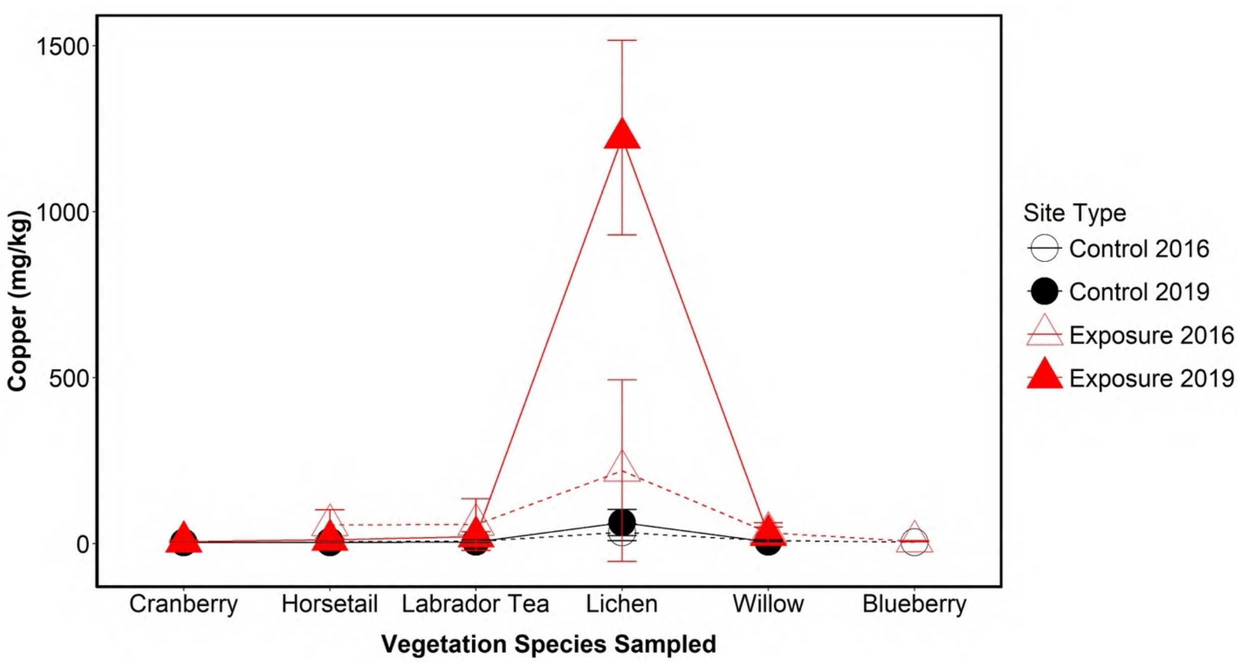


Figure 3-5: Comparison of Mean Copper Concentration (mg/kg) Between Control and Exposure Sites Sites in 2016 and 2019 (Error bar ± 1 SD)

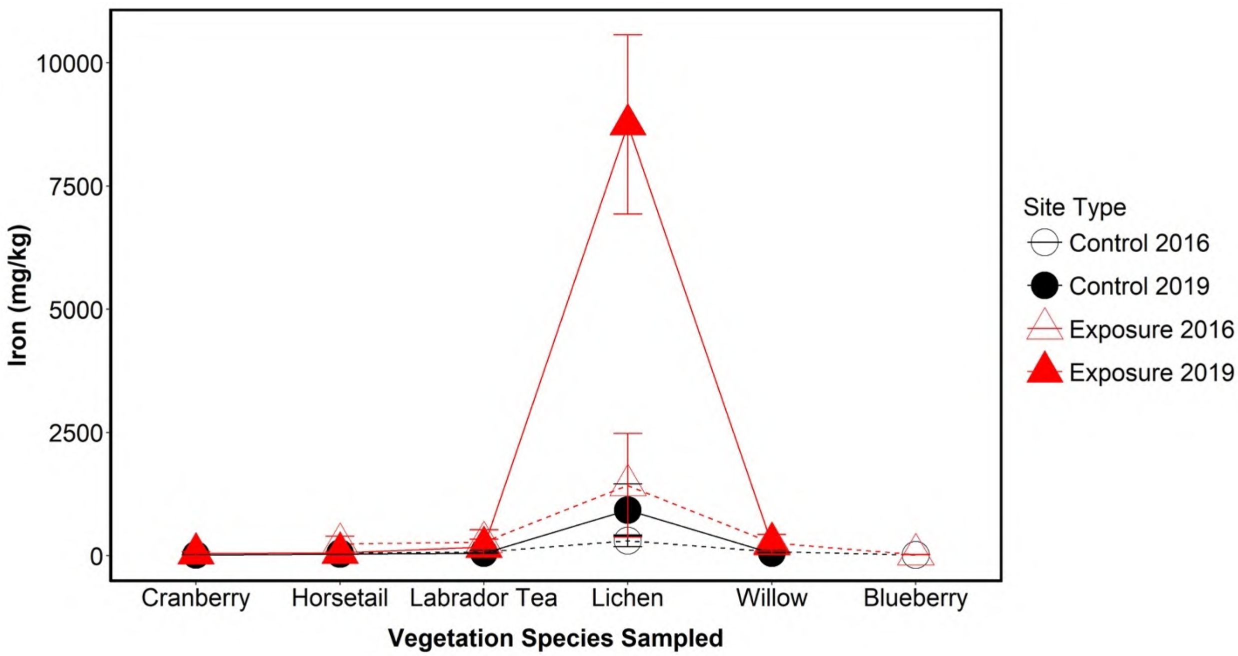


Figure 3-6: Comparison of Mean Iron Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

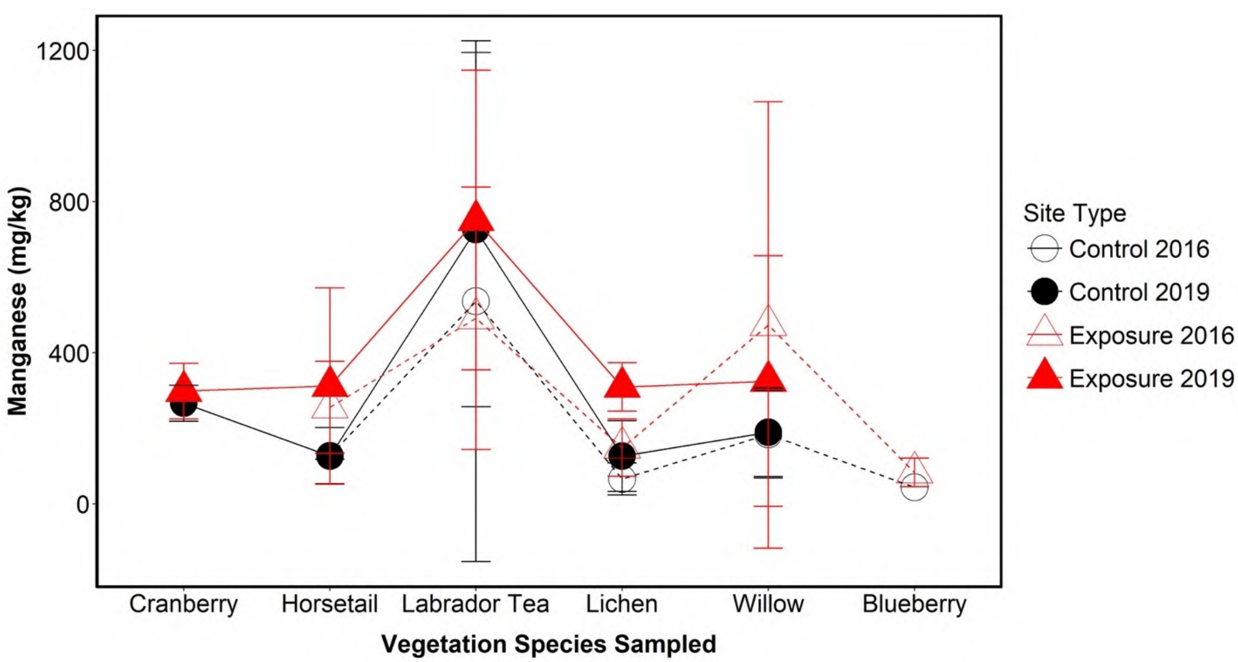


Figure 3-7: Comparison of Mean Manganese Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

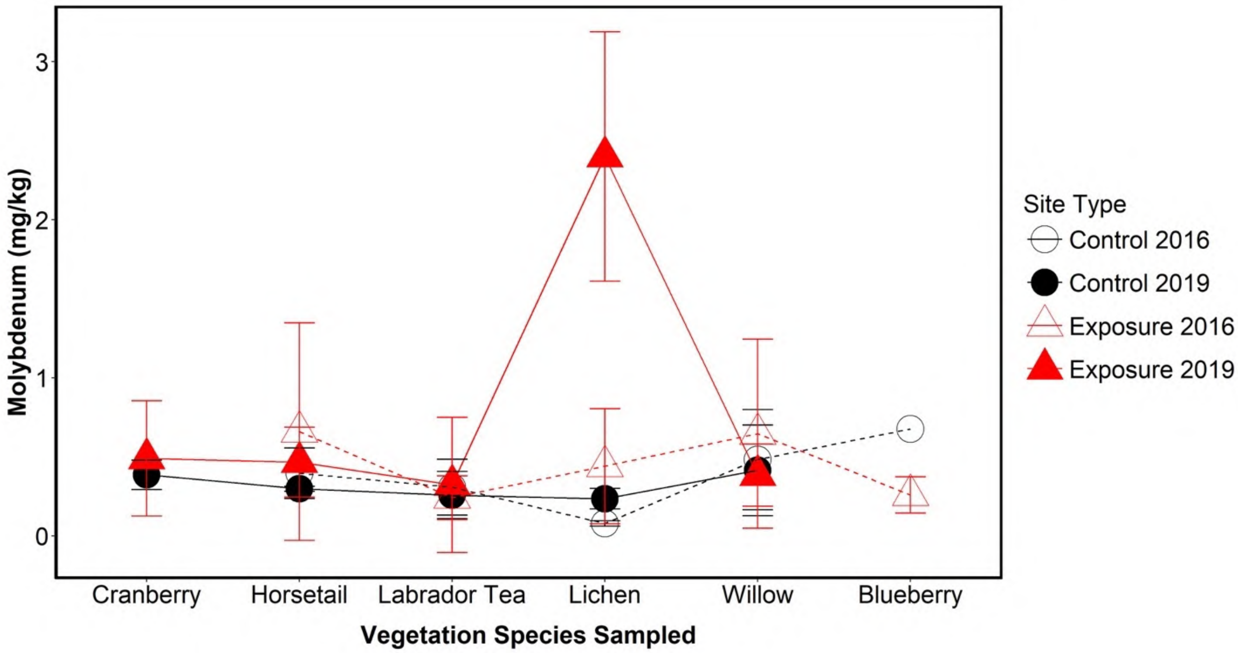


Figure 3-8: Comparison of Mean Molybdenum Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

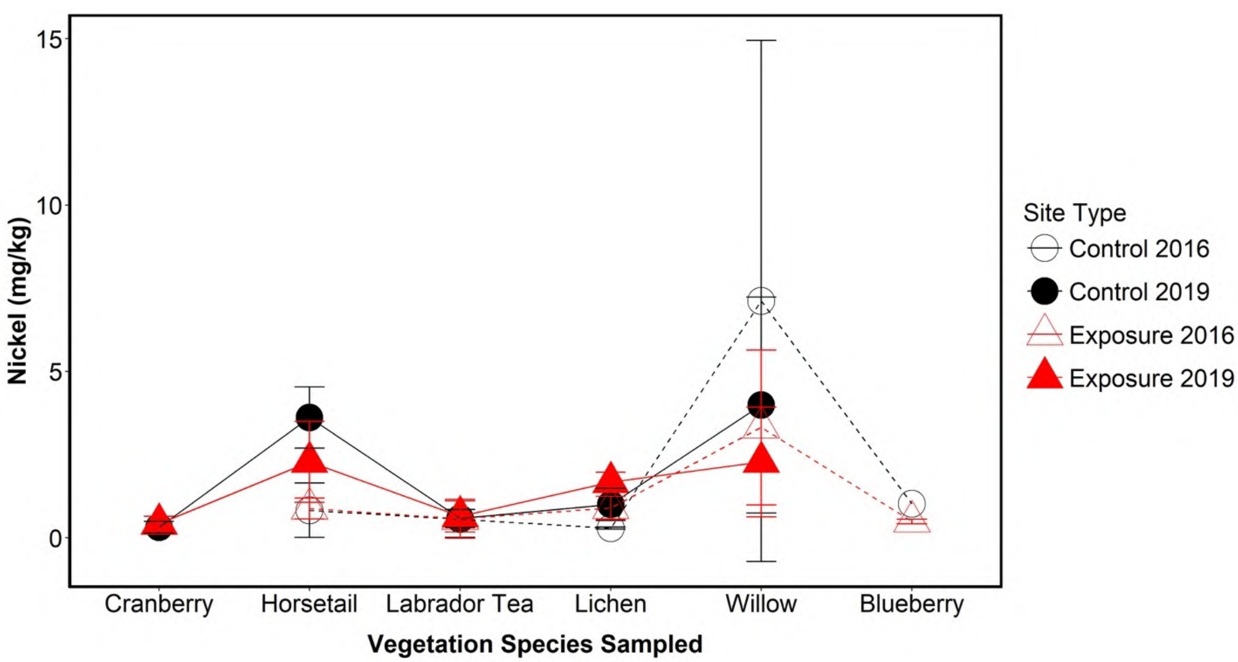


Figure 3-9: Comparison of Mean Nickel Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

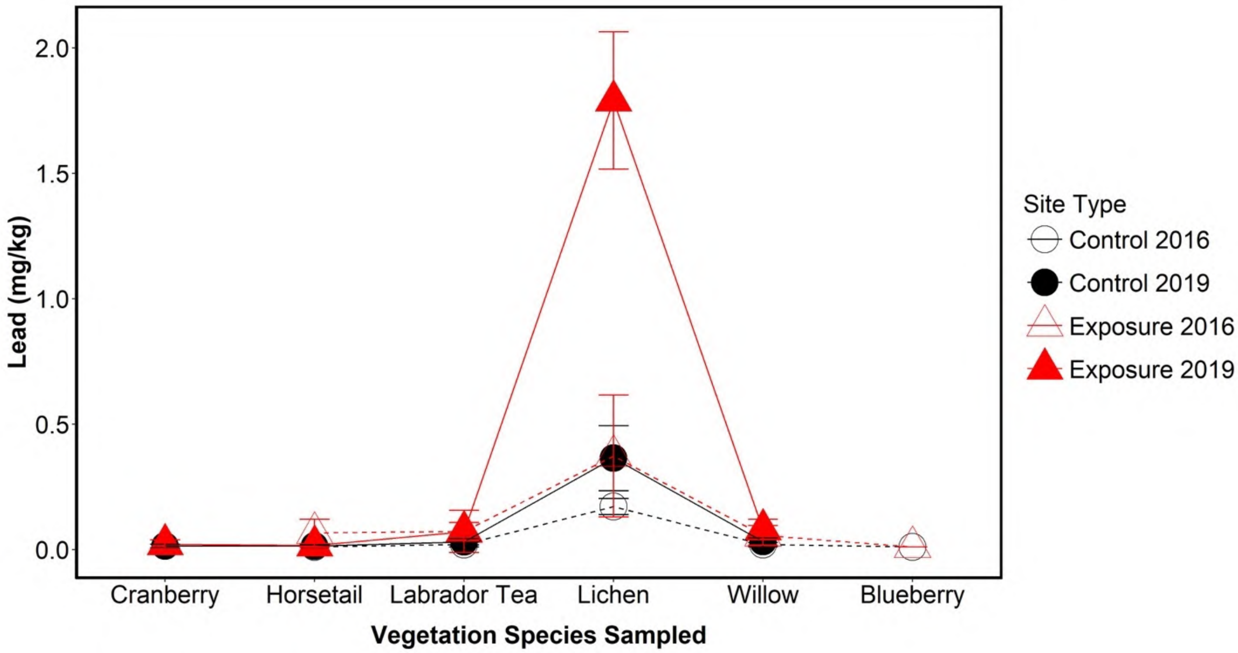


Figure 3-10: Comparison of Mean Lead Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

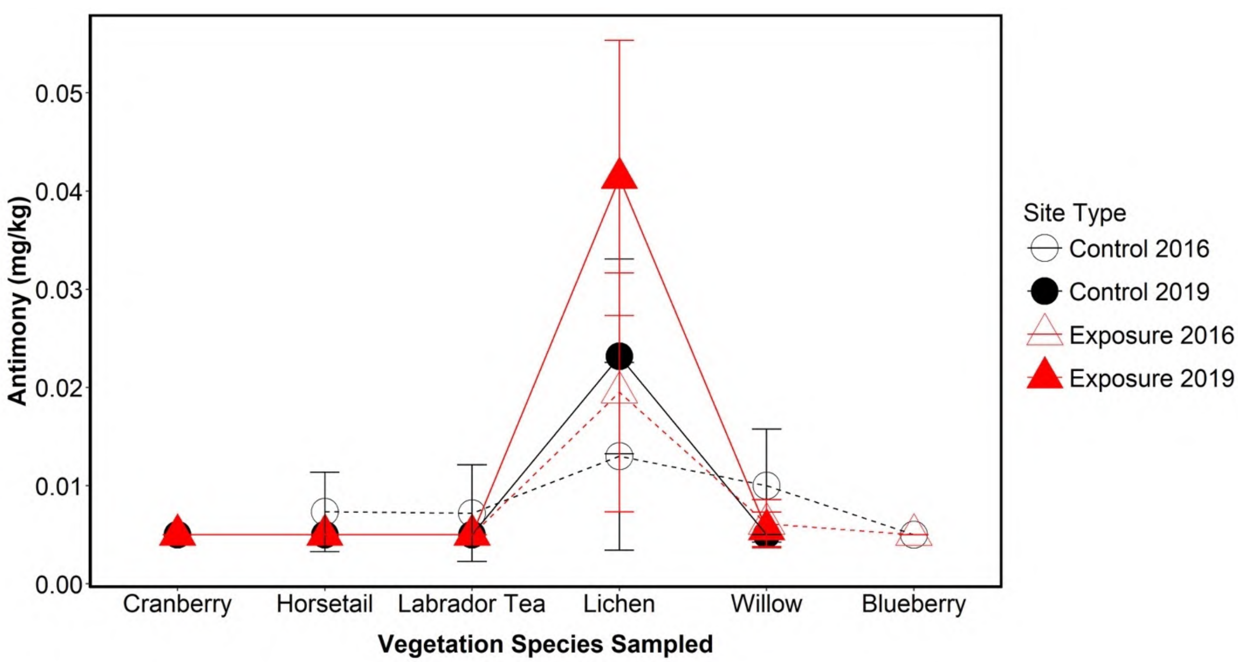


Figure 3-11: Comparison of Mean Antimony Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

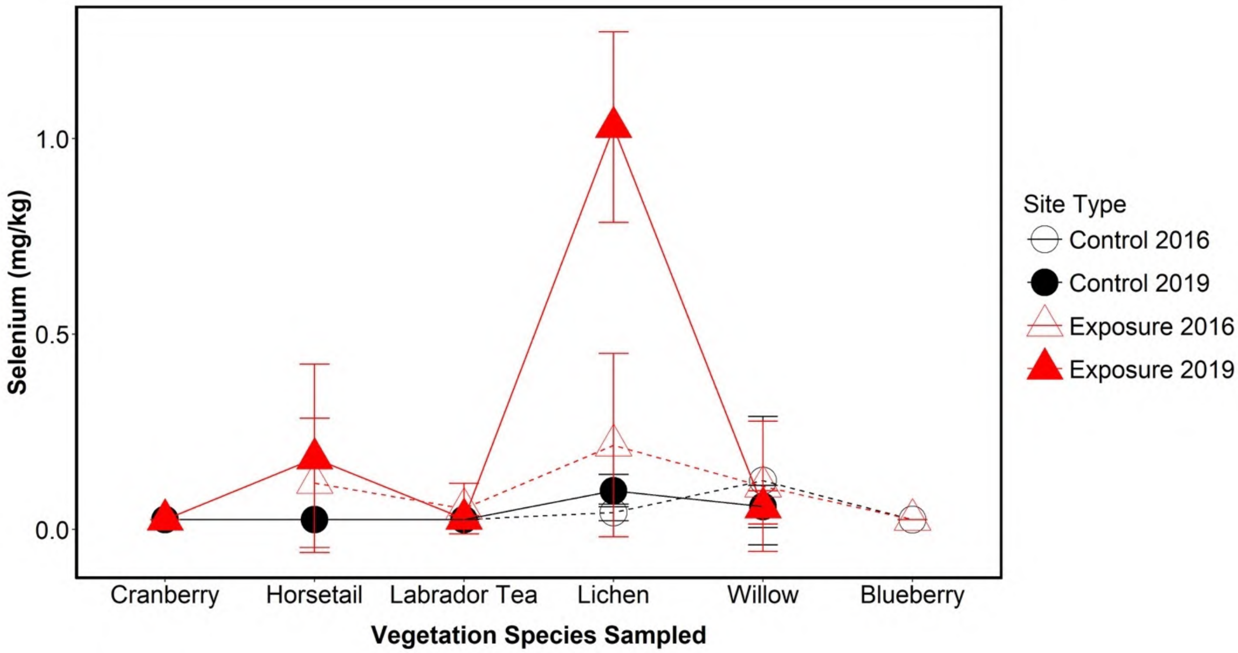


Figure 3-12: Comparison of Mean Selenium Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

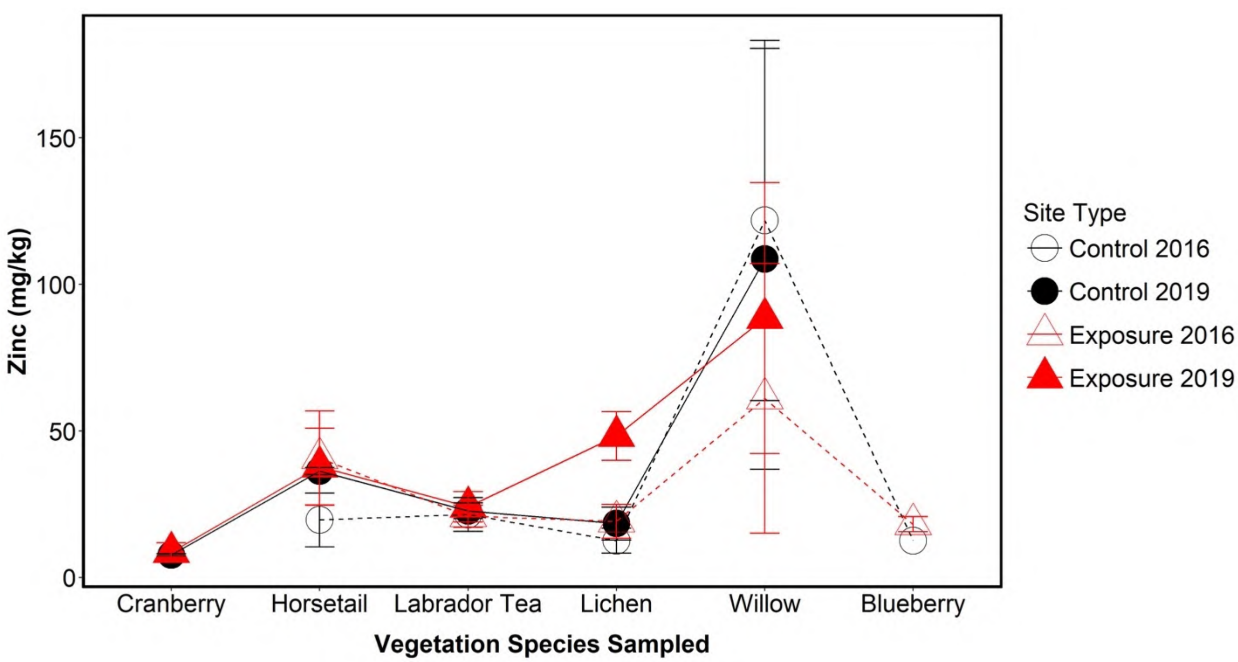


Figure 3-13: Comparison of Mean Zinc Concentration (mg/kg) Between Control and Exposure Sites in 2016 and 2019 (Error bar ± 1 SD)

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

Alexco Environmental Group (AEG). 2017. Vegetation Metal Uptake Monitoring Program for Minto Mine Version 2. February 2017. Prepared for Minto Explorations Ltd.

Australian Government. 2016. Australia New Zealand Food Standards Code – Standard 1.4.1 – Contaminants and natural toxicants. Accessed December 15, 2016 at https://www.legislation.gov.au/Details/F2016C00167.

Branquinho, C., F. Catarino, D.H. Brown. 2000. Improving the Use of Lichens as Biomonitors of Atmospheric Metal Pollution. In Biomonitoring of atmospheric pollution (with emphasis on trace elements) — BioMAP. Proceedings of an international workshop organized by the International Atomic Energy Agency in co-operation with the Instituto Tecnologico e Nuclear and held in Lisbon, Portugal, 21-24 September 1997.

Csavina, J. 2012. Metal and Metalloid Contaminants in Atmospheric Aerosols from Mining Operations. Dissertation in partial fulfillment of the Requirements for the Degree of Doctor of Philosophy with a Major in Environmental Engineering, Department of Chemical and Environmental Engineering, University of Arizona. Accessed November 23, 2016 at arizona.openrepository.com/arizona/bitstream/10150/.../azu_etd_12381_sip1_m.pdf.

European Commission. 2006. Commission Regulation (EC) No. 1881/2006, setting maximum levels for certain contaminants in foodstuffs. In Official Journal of the European Union, 20.12.2006. Accessed December 15, 2016 at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R1881&from=EN.

Fernández, J. A., J. R. Aboal, A. Carballeira. 2010. Testing differences in methods of preparing moss samples. Effect of washing on *Pseudoscleropodium purum*. Environ Monit Assess 163: 669-684.

Garty, J. 2000. Lichens as Environmental Biomonitors in Israel: Two Decades of Research. In Biomonitoring of atmospheric pollution (with emphasis on trace elements) — BioMAP. Proceedings of an international workshop organized by the International Atomic Energy Agency in co-operation with the Instituto Tecnologico e Nuclear and held in Lisbon, Portugal, 21-24 September 1997.

Horizon Ecosystem Consultants. 2010. Minto Mine Environmental Baseline Ecosystems and Vegetation Report. July 2010. Prepared for Minto Explorations Ltd.

Kabata-Pendias, A. 2011. Trace Elements in Soil (4th ed.). Boca Raton, Florida: CRC Press.

National Research Council (NRC). 2005. Mineral Tolerance of Animals: 2nd Revised Edition. Committee on Minerals and Toxic Substances in Diets and Water for Animals, Board on Agriculture and Natural Resources, Division on Earth and Life Studies, National Academy of Sciences.

Roggeman, S., N. van den Brink, R. Blust, L. Bervoets. 2013. Metal exposure and accumulation patterns in free-range cows (*Bos taurus*) in a contaminated natural area: Influence of spatial and social behavior. Environmental Pollution 172: 186-199.

Smith, C.A.S., Miekle, J.C. and Roots, C.F. (eds.), 2004. Ecoregions of the Yukon Territory: Biophysical Properties of Yukon Landscapes. Agriculture and Agri-Food Canada, PARC Technical Bulletin No. 04-01, Summerland, British Columbia.

APPENDIX A:

2019 VMU SITE SUMMARY

Project ID: Minto	**Site ID:** S16

Weather: 10° cloudy	**Duplicate ID:** —

Field Crew:	**Date:**	**Start:**	**End:**
CR, Chad B	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 #	S16
ASPECT (°)	350°
SLOPE (%)	15°
ELEVATION (m)	768 m

Wildlife signs: Small trails maybe made by animals

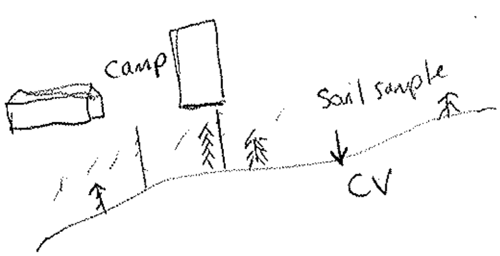
Vegetation Cover	**%**
Tree layer (A)	30
Shrub layer (B)	20
Herb layer (C)	30
Moss layer (D)	15
Lichen layer (E)	<2%

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(?) ~~[illegible]~~ , 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: ~~S[illegible]~~ Minto	**Site ID:** S17
Weather: Clear 5°	**Duplicate ID:** ______

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*	Photos taken - hard to identify species.
X ☐ **Lichen**	*C. rangiferina*	*C. stellaris*			
X ☐ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*uliginosumn*		
☐ **Soil**	dark	medium	light	N/A	no soil - O layer + clay.

WP #	S17
ASPECT (°)	126° SE
SLOPE (%)	20 %
ELEVATION (m)	828

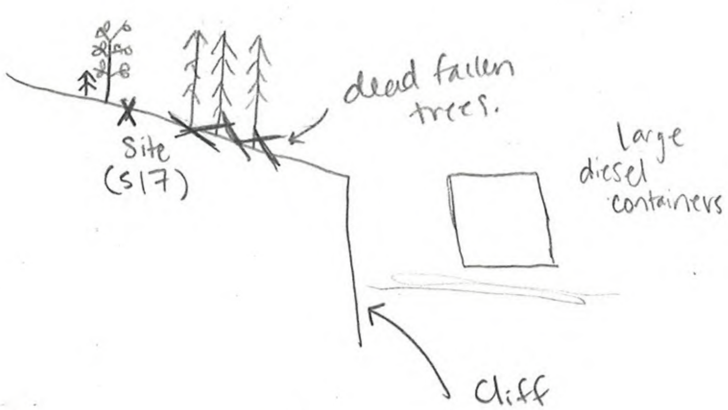
Wildlife signs: N/A

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 ☐ ~~Fox~~ 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

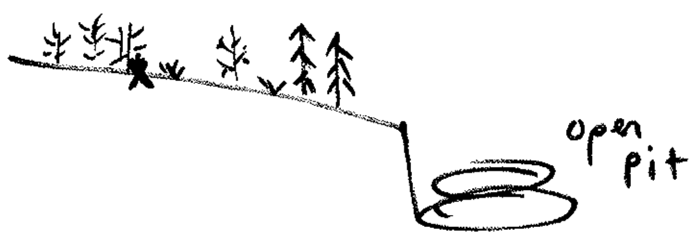
Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	30
Shrub layer (B)	10
Herb layer (C)	20
Moss layer (D)	5
Lichen layer (E)	5

Other Notes: Fire (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: 505
Weather: clear 8°C	Duplicate ID: —

Field Crew:	Date:	Start:	End:
CR CB	27 Aug 17	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 first 15cm	N/A

Clay soil (dark)

WP #	505
ASPECT (°)	304NW.
SLOPE (%)	8%.
ELEVATION (m)	855

Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	20
Shrub layer (B)	5
Herb layer (C)	~~[illegible]~~ 95
Moss layer (D)	~~60~~ 40
Lichen layer (E)	<5

Other Notes:
Near main waste dumb.
lots more veg than elsewhere
thick O layer
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:
Birch, white spruce.
Shrub Layer (B) Species:
dwarf birch (buck brush), willow
Herb Layer (C) Species: (lots – some – little bit – none)
LT, cranberry (lots.), cloudberry 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: SØ9
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

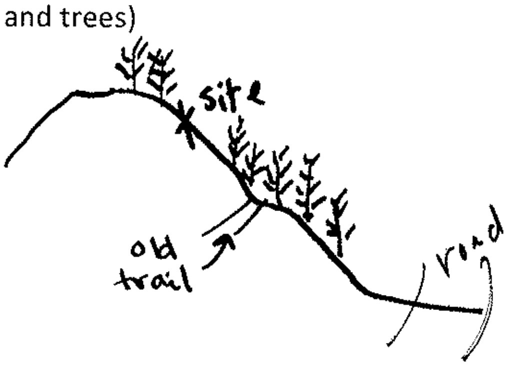
Wildlife signs: scat on road below

Vegetation Cover	%
Tree layer (A)	50
Shrub layer (B)	10
Herb layer (C)	~~[illegible]~~ <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 puplar, 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 VMU	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:
willow,
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*
☐ **Lichen**	*C. rangiferina*	*C. stellaris*		
☑ **Berries**	*V. vitisidaea*	*V. oxycoccos*	*V. uliginosumn*	
☑ **Soil**	dark	medium	light	N/A

large leaves

hit clay quickly ~4cm

WP #	S04
ASPECT (°)	313 NW
SLOPE (%)	25 %
ELEVATION (m)	918

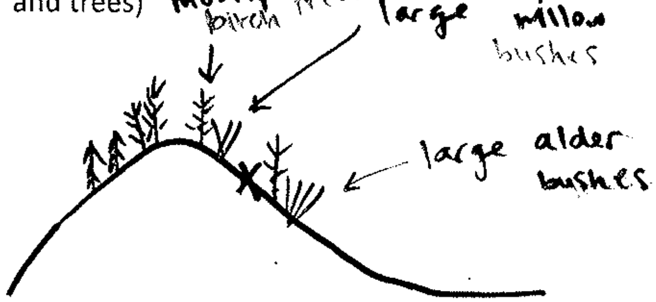
Wildlife signs:
- Moose poop seen while walking here
- heard branches cracking nearby - maybe rodent?

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 ~~poplar~~ 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:	Date:	Start:	End:
CR CB	27 Aug 2019	14:55	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

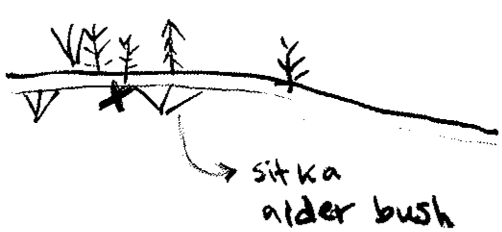
Wildlife signs: moose poop

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)



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

Slightly → CX

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)

· litte 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

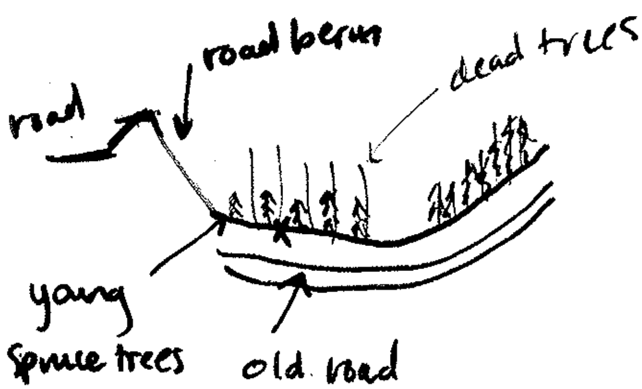
Wildlife signs:

Vegetation Cover	%
Tree layer (A)	~~20~~ 25
Shrub layer (B)	20
Herb layer (C)	30
Moss layer (D)	~~20~~ ~~80~~ 20
Lichen layer (E)	~~15~~ 10

Other Notes: LT-dying → HT dead
not enough cran to sample
lots of ~~dead~~ 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 VMN	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* ~~[illegible]~~ ~~[illegible]~~

☐ **Lichen** *C. rangiferina* *C. stellaris*

☐ **Berries** *V. vitisidaea* *V. oxycoccos* *uliginosumn* - few cran - not enough to sample ~~- rocky - loam~~

☑ **Soil** dark medium light dry N/A Loess

WP #	S-11
ASPECT (°)	356°N
SLOPE (%)	[illegible]
ELEVATION (m)	765

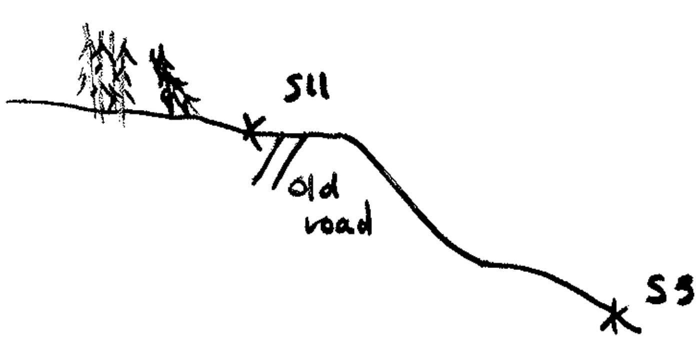
Wildlife signs:
- bear (sow + 2 cubs) 2km away
- fresh bear poop ~25m away

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	~~16~~ 18:06

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

1 bush only

• loess – not much O-layer
• rocky at ~10 cm

WP #	S03
ASPECT (°)	356 N
SLOPE (%)	28
ELEVATION (m)	764

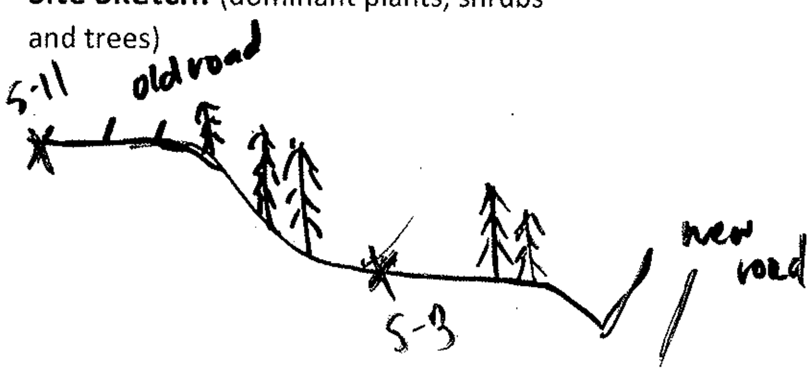
Wildlife signs:
Fresh bear scat (yesterday) up the hill

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 VMU	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 (°)	165
SLOPE (%)	10
ELEVATION (m)	879m

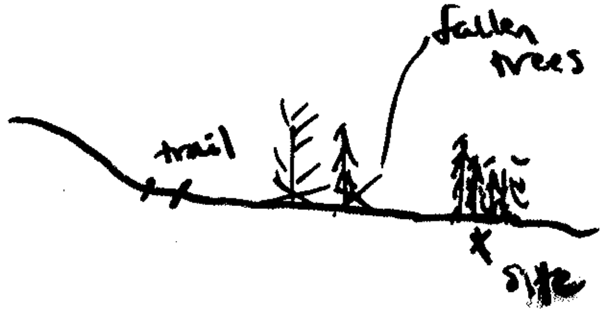
Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	60
Shrub layer (B)	~~20~~ 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 VMU	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*	b. bushes - no blueberries	
☑ Soil	dark	medium	light	N/A	thick O layer

WP #	M07B
ASPECT (°)	216SW
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
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 [illegible] 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	10:30	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)	179 m

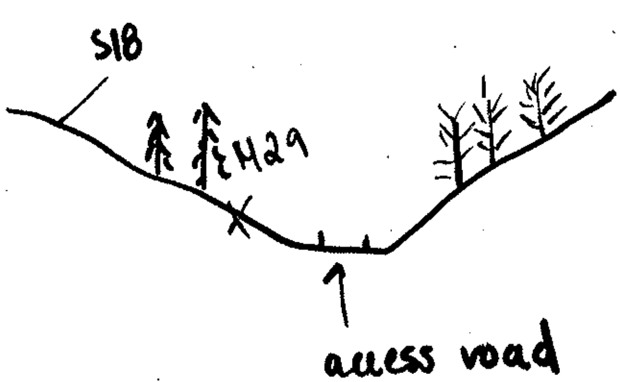
Wildlife signs:
- wolf scat @ site (old)
- hair + bones in it.
- bird poop + feathers (not grouse/ptarmigan)

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 VMU	Site ID: S-18

Weather: Clear 7°	Duplicate ID: —

Field Crew:	Date:	Start:	End:
GR 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 #	98
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, ~~[illegible]~~ 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: MintoVMU	**Site ID:** S15
Weather: clear ~~?~~ 13°	**Duplicate ID:** —

Field Crew:	**Date:**	**Start:**	**End:**
CR CB	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 alot - enough for one sample

no soil - small 0+ loess/sand.

WP #	M80
ASPECT (°)	40 NE
SLOPE (%)	24
ELEVATION (m)	829

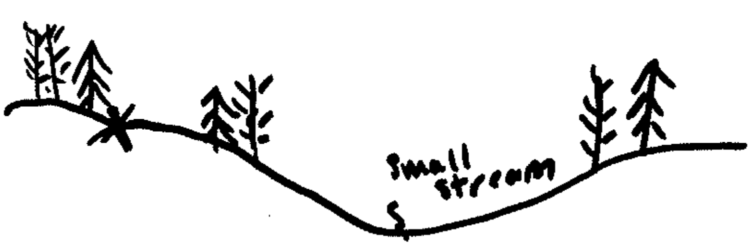
Wildlife signs: animal paths noticeable

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 — O layer + A ~10cm then loess

WP #	C02
ASPECT (°)	266 W
SLOPE (%)	24
ELEVATION (m)	802

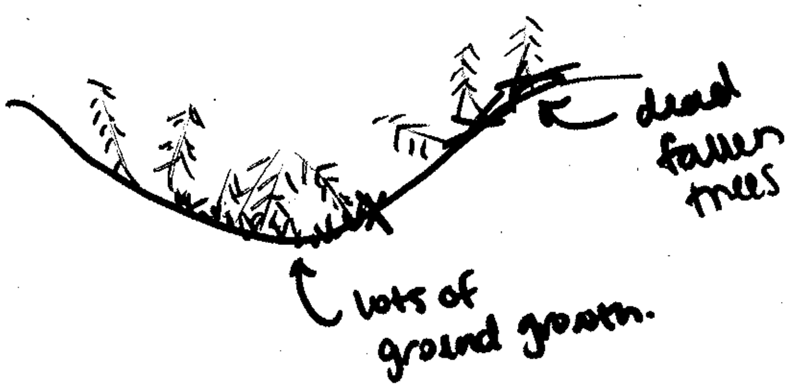
Wildlife signs: —

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 VMU	**Site ID:** CØ1
Weather: overcast 10	**Duplicate ID:** CØ 1A

Field Crew:	**Date:**	**Start:**	**End:**
CR CB	28 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, cran 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

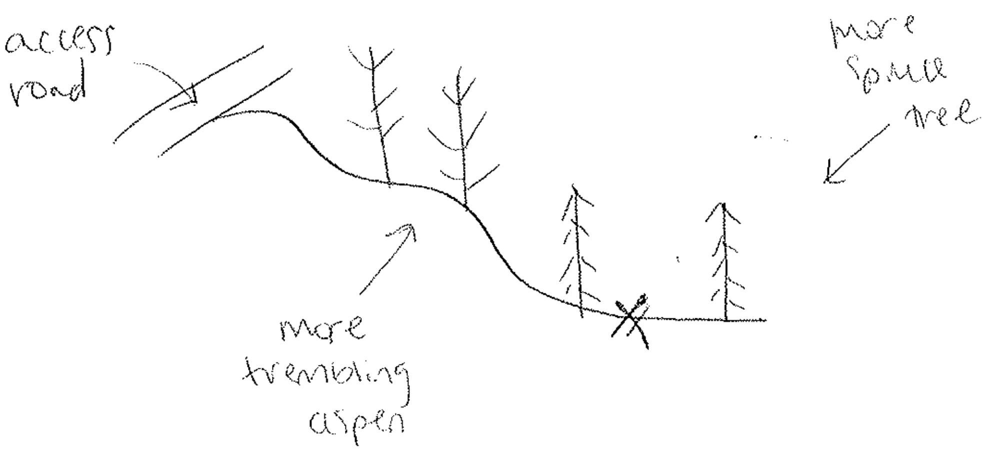
Wildlife signs: —

Vegetation Cover	%
Tree layer (A)	50
Shrub layer (B)	<5
Herb layer (C)	5
Moss layer (D)	90
Lichen layer (E)	<5

Other Notes: (large trees)
- old growth forest
- 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 #	SØ2
ASPECT (°)	175 S
SLOPE (%)	21
ELEVATION (m)	758

Iphone says 780 ↳ suspect → uphill from S01

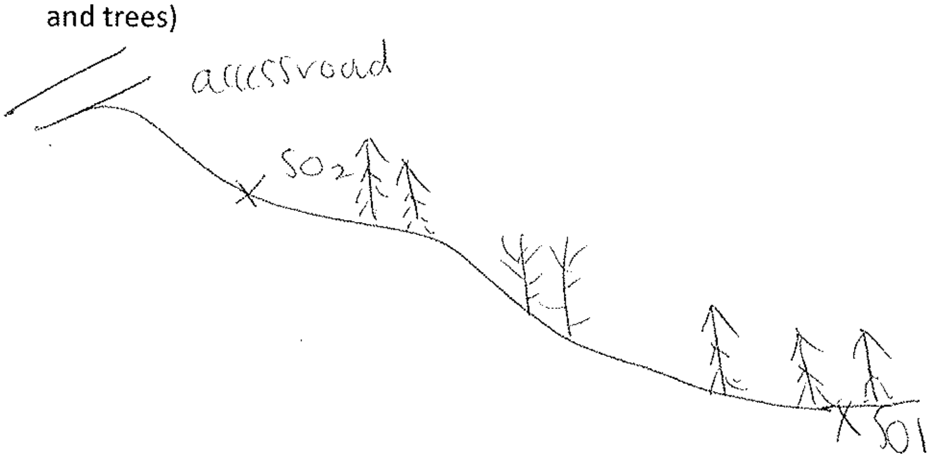
Wildlife signs: old bear poop

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-10	L2341109-11	L2341109-12	L2341109-16	L2341109-17
	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)
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 Description Sampled Date Sampled Time Client ID	L2341109-38 Sediment 28-AUG-19 11:15 S-18 (8-16CM)	L2341109-39 Sediment 28-AUG-19 11:15 S-18 (+16CM)	L2341109-43 Sediment 27-AUG-19 06:40 S-17 (3-6CM)	L2341109-44 Sediment 27-AUG-19 06:40 S-17 (6-15CM)	L2341109-45 Sediment 27-AUG-19 06:40 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 Description Sampled Date Sampled Time Client ID	L2341109-63 Sediment 28-AUG-19 11:40 S-15 (+15CM)	L2341109-67 Sediment 27-AUG-19 17:15 S-11 (0-5CM)	L2341109-68 Sediment 27-AUG-19 17:15 S-11 (5-15CM)	L2341109-69 Sediment 27-AUG-19 17:15 S-11 (+15CM)	L2341109-73 Sediment 27-AUG-19 10:20 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

Grouping	Analyte	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)
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

Grouping	Analyte	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)
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

		L2341109-187	L2341109-188	L2341109-189	L2341109-205	L2341109-206
	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

		L2341109-1	L2341109-2	L2341109-3	L2341109-4	L2341109-5
	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.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2341109-6	L2341109-7	L2341109-8	L2341109-9	L2341109-13
	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	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
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

	Sample ID	L2341109-14	L2341109-15	L2341109-19	L2341109-20	L2341109-21
	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						
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

	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						
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

	Sample ID	L2341109-35	L2341109-36	L2341109-40	L2341109-41	L2341109-42
	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	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

	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						
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

	Sample ID	L2341109-51	L2341109-55	L2341109-56	L2341109-57	L2341109-58
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	15:50	11:40	11:40	11:40	11:40
	Client ID	S-16 (WILLOW) 3	S-15 (HORSETAIL) 1	S-15 (HORSETAIL) 2	S-15 (HORSETAIL) 3	S-15 (LABRADOR TEA) 1
Grouping	**Analyte**					
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

	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						
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

	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						
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

	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						
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

	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						
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

	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						
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

	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						
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

	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						
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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	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
Grouping	**Analyte**					
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

	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						
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

	Sample ID	L2341109-168	L2341109-169	L2341109-170	L2341109-171	L2341109-172
	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	06:50	06:50	06:50	06:50
	Client ID	M-26 (LABRADOR TEA) 3	M-26 (WILLOW) 1	M-26 (WILLOW) 2	M-26 (WILLOW) 3	M-26 (LICHEN) 1
Grouping	**Analyte**					
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

	Sample ID	L2341109-173	L2341109-174	L2341109-178	L2341109-179	L2341109-180
	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	06:50	14:10	14:10	14:10
	Client ID	M-26 (LICHEN) 2	M-26 (LICHEN) 3	M-80 (LABRADOR TEA) 1	M-80 (LABRADOR TEA) 2	M-80 (LABRADOR TEA) 3
Grouping	**Analyte**					
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

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						
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

	Sample ID	L2341109-199	L2341109-200	L2341109-201	L2341109-202	L2341109-203
	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 (LICHEN) 1	C-02 (LICHEN) 2	C-02 (LICHEN) 3	C-02 (BERRIES) 1	C-02 (BERRIES) 2
Grouping	**Analyte**					
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

	Sample ID	L2341109-204	L2341109-208	L2341109-209	L2341109-210	L2341109-211
	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	15:55	15:55	15:55	15:55
	Client ID	C-02 (BERRIES) 3	C-01 (HORSETAIL) 1	C-01 (HORSETAIL) 2	C-01 (HORSETAIL) 3	C-01 (LABRADOR TEA) 1
Grouping	**Analyte**					
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

	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						
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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-6	L2341109-7	L2341109-8	L2341109-9	L2341109-13
	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	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)	0.0055	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	L2341109-15	L2341109-19	L2341109-20	L2341109-21
	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
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

		L2341109-22	L2341109-23	L2341109-24	L2341109-25	L2341109-26
	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

* 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						
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

	Sample ID	L2341109-35	L2341109-36	L2341109-40	L2341109-41	L2341109-42
	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						
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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-51	L2341109-55	L2341109-56	L2341109-57	L2341109-58
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	15:50	11:40	11:40	11:40	11:40
	Client ID	S-16 (WILLOW) 3	S-15 (HORSETAIL) 1	S-15 (HORSETAIL) 2	S-15 (HORSETAIL) 3	S-15 (LABRADOR TEA) 1
Grouping	**Analyte**					
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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	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

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	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

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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	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

	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
Grouping	**Analyte**					
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

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

Sample ID Description Sampled Date Sampled Time Client ID		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
Grouping	**Analyte**					
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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2341109-138	L2341109-145	L2341109-146	L2341109-147	L2341109-151
	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						
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

	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						
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

	Sample ID	L2341109-168	L2341109-169	L2341109-170	L2341109-171	L2341109-172
	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	06:50	06:50	06:50	06:50
	Client ID	M-26 (LABRADOR TEA) 3	M-26 (WILLOW) 1	M-26 (WILLOW) 2	M-26 (WILLOW) 3	M-26 (LICHEN) 1
Grouping	**Analyte**					
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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-173	L2341109-174	L2341109-178	L2341109-179	L2341109-180
	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	06:50	14:10	14:10	14:10
	Client ID	M-26 (LICHEN) 2	M-26 (LICHEN) 3	M-80 (LABRADOR TEA) 1	M-80 (LABRADOR TEA) 2	M-80 (LABRADOR TEA) 3
Grouping	**Analyte**					
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

* 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						
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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-199	L2341109-200	L2341109-201	L2341109-202	L2341109-203
	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 (LICHEN) 1	C-02 (LICHEN) 2	C-02 (LICHEN) 3	C-02 (BERRIES) 1	C-02 (BERRIES) 2
Grouping	**Analyte**					
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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2341109-204	L2341109-208	L2341109-209	L2341109-210	L2341109-211
	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	15:55	15:55	15:55	15:55
	Client ID	C-02 (BERRIES) 3	C-01 (HORSETAIL) 1	C-01 (HORSETAIL) 2	C-01 (HORSETAIL) 3	C-01 (LABRADOR TEA) 1
Grouping	**Analyte**					
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

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

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

* 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							
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					

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.

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.

ALS Test Code	Matrix	Test Description	Method Reference**
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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

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

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.

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-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
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: 15.0 | 15.0 | 15.0

FINAL COOLER TEMPERATURES °C: 6.1 | 4.1 | 2.3

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: JG	Date: 5 Sep 19	Time: 11:31 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 -

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): 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.

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-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
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	28-Aug-19	10:30	Sediment							R	R	R	R	R	R						1
				Tissue																		
				Tissue																		
				Tissue																		
				Tissue																		
				Tissue																		
				Tissue																		

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6 | 7.7 | 2.3

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: LF	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 11:35 PM

WHITE - [illegible] ... [illegible] 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[illegible]

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

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

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.

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		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
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: 15.0

FINAL COOLER TEMPERATURES °C: 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: ZF	Date: 3 Sep 2019	Time: 15:50	Received by: JK	Date: 5 Sep 19	Time: 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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Af L2341109-COFC

COC Number: 17 -

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

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.

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			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: 17.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 7.2, 13

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: JN	Date: 5 Sep 19	Time: 11:35

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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

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
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): 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.

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 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
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: 17.0 | 9.0 | 15.0

FINAL COOLER TEMPERATURES °C: 6.6 | 7.7 | 2.1 | 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: JG	Date: 5 Sep 19	Time: 11:30 PM

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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

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

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.

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-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
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
	S-16																					

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: 16.0

FINAL COOLER TEMPERATURES °C: 6, 6, 7, 7, 12, 13

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Q UR	Time:	Received by: EP	Date: 8 Sep 2019	Time: 15:50	Received by: Th	Date: 5 Sep 19	Time: 11:31 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

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 7 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

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.

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			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)

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: 14.0

FINAL COOLER TEMPERATURES °C: 6, 6, 7, 7, 12, 13

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: Jur	Date: 5 Sep 19	Time: 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 9 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): 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.

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-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: 11.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 2.3

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 PM

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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 9 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

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.

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-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
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)

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: 16.0

FINAL COOLER TEMPERATURES °C: 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: 15:50	Received by: JK	Date: 5 Sep 19	Time: 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

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 10 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

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.

Project Information

ALS Account # / Quote #:

Job #: Mintc

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: 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-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 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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 12, 3

SHIPMENT RELEASE (client use)

Released by: CR | Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: EF | Date: 3 Sep 2019 | Time: 15:54

FINAL SHIPMENT RECEPTION (lab use only)

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

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

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

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 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): 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.

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			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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6 7.7 12.13

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: TK	Date: 5 Sep 19	Time: 11:35 PM

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

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 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): 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.

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-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

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: 15.0

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: UR	Time:	Received by: EF	Date: 8 Sep 2019	Time: 15:50	Received by:	Date:	Time:

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.

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

L2341109-COFC

COC Number: 17 -

Page 12 of 13

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): 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.

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-DRY 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
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: 15.0

FINAL COOLER TEMPERATURES °C: 6, 6, 7, 7, 12, 13

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: 18 CR	Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: TG	Date: 5 Sep 19	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 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

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

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

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.

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	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: 16.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.1, 12.3

SHIPMENT RELEASE (client use)

Released by: CR Date: Time:

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: RF Date: 3 Sep 2019 Time: 1555

FINAL SHIPMENT RECEPTION (lab use only)

Received by: JK Date: 5 Sep 19 Time: 11:30 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

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 15 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	crentmeisten@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): 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.

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-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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6, 6, 7, 7, 12, 13

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: UR	Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 12:35

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
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 16 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

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.

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			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)

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: 15.0
FINAL COOLER TEMPERATURES °C: 6.6 | 7.7 | 12.1 | 13

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: 11:35

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.

ALS Environmental

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2341109-COFC

COC Number: 17 -

Page 17 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

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.

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-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
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) Samples¹ (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: 15.0

FINAL COOLER TEMPERATURES °C:

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:	Date:	Time:

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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

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
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): 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.

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 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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 12.13

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: BP	Date: 3 Sep 2019	Time: 15:50	Received by: TG	Date: 5 Sep 19	Time: 11:25 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

COC Number: 17 -

Page 19 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

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.

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-RSY 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[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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 9.7, 12.13

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: 1550	Received by: JK	Date: 5 Sep 19	Time: 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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 20 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	
Company:	Alexco Environmental Group	Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)	
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☒ YES ☐ NO	
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	
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:

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
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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6, 6, 7, 7, 12, 13

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: tlr	Date: 5 Sep 19	Time: 9:30 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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 21 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)		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.

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:

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
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)

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 13

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: 11:25

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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2341109-COFC

COC Number: 17 -

Page 22 of

Report To	Contact and company name below will appear on the final report
Company:	Alexco Environmental Group
Contact:	Charlotta 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): 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.

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-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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 12.13

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: EP	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 sep 19	Time: 11:31 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.

SEPT 2017 FRONT

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 23 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	

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	
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-DSY-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
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				6.6, 7.4, 12, 13

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: 11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form 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.

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

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						
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

		L2355568-6	L2355568-7	L2355568-8	L2355568-9	L2355568-10
	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

	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						
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

	Sample ID	L2355568-16	L2355568-17	L2355568-18	L2355568-19	L2355568-20
	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						
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

	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						
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

	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						
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

	Sample ID	L2355568-36	L2355568-37	L2355568-38	L2355568-39	L2355568-40
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	15:50	11:40	11:40	11:40	11:15
	Client ID	S-16 (WILLOW) 3	S-15 (HORSETAIL) 1	S-15 (HORSETAIL) 2	S-15 (HORSETAIL) 3	S-15 (LABRADOR TEA) 1
Grouping	**Analyte**					
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

	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						
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

	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						
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

	Sample ID	L2355568-56	L2355568-57	L2355568-58	L2355568-59	L2355568-60
	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						
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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	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
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

		L2355568-66	L2355568-67	L2355568-68	L2355568-69	L2355568-70
	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

	Sample ID	L2355568-71	L2355568-72	L2355568-73	L2355568-74	L2355568-75
	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						
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

		L2355568-76	L2355568-77	L2355568-78	L2355568-79	L2355568-80
	Sample ID	L2355568-76	L2355568-77	L2355568-78	L2355568-79	L2355568-80
	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
Grouping	**Analyte**					
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

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						
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

	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						
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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-97	L2355568-98	L2355568-99	L2355568-100	L2355568-101
	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	17:35	17:35	17:35	17:00	17:00
	Client ID	S-03(WILLOW) 1	S-03(WILLOW) 2	S-03(WILLOW) 3	S-01 (LABRADOR TEA) 1	S-01 (LABRADOR TEA) 2
Grouping	**Analyte**					
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

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

	Sample ID	L2355568-112	L2355568-113	L2355568-114	L2355568-115	L2355568-116
	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	06:50	06:50	06:50	06:50
	Client ID	M-26 (WILLOW) 1	M-26 (WILLOW) 2	M-26 (WILLOW) 3	M-26 (LICHEN) 1	M-26 (LICHEN) 2
Grouping	**Analyte**					
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

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

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						
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

	Sample ID	L2355568-133	L2355568-137	L2355568-138	L2355568-139	L2355568-140
	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	15:55	15:55	15:55	15:55
	Client ID	C-02 (LICHEN) 3	C-01(HORSETAIL) 1	C-01(HORSETAIL) 2	C-01(HORSETAIL) 3	C-01 (LABRADOR TEA) 1
Grouping	**Analyte**					
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

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

	Sample ID	L2355568-16	L2355568-17	L2355568-18	L2355568-19	L2355568-20
	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)	0.0100	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

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2355568-21	L2355568-22	L2355568-23	L2355568-24	L2355568-25
	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

	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						
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.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2355568-36	L2355568-37	L2355568-38	L2355568-39	L2355568-40
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	26-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19	28-AUG-19
	Sampled Time	15:50	11:40	11:40	11:40	11:15
	Client ID	S-16 (WILLOW) 3	S-15 (HORSETAIL) 1	S-15 (HORSETAIL) 2	S-15 (HORSETAIL) 3	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

		L2355568-46	L2355568-47	L2355568-48	L2355568-49	L2355568-50
	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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-56	L2355568-57	L2355568-58	L2355568-59	L2355568-60
	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)	0.0613	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

		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						
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

Sample ID		L2355568-71	L2355568-72	L2355568-73	L2355568-74	L2355568-75
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)	0.0063	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

	Sample ID	L2355568-76	L2355568-77	L2355568-78	L2355568-79	L2355568-80
	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
Grouping	**Analyte**					
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	DLM <0.080	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-97	L2355568-98	L2355568-99	L2355568-100	L2355568-101
	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	17:35	17:35	17:35	17:00	17:00
	Client ID	S-03(WILLOW) 1	S-03(WILLOW) 2	S-03(WILLOW) 3	S-01 (LABRADOR TEA) 1	S-01 (LABRADOR TEA) 2
Grouping	**Analyte**					
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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2355568-112	L2355568-113	L2355568-114	L2355568-115	L2355568-116
	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	06:50	06:50	06:50	06:50
	Client ID	M-26 (WILLOW) 1	M-26 (WILLOW) 2	M-26 (WILLOW) 3	M-26 (LICHEN) 1	M-26 (LICHEN) 2
Grouping	**Analyte**					
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

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L2355568-122	L2355568-123	L2355568-125	L2355568-126	L2355568-127
	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						
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

		L2355568-133	L2355568-137	L2355568-138	L2355568-139	L2355568-140
	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	15:55	15:55	15:55	15:55
	Client ID	C-02 (LICHEN) 3	C-01(HORSETAIL) 1	C-01(HORSETAIL) 2	C-01(HORSETAIL) 3	C-01 (LABRADOR TEA) 1
Grouping	**Analyte**					
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

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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-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:	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
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 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:	
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-T188-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
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			
	C-01A																			

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	6.1/7.6/2.3

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: 8:50	Received by: JG	Date: 5 Sep 19	Time: 11:31 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.

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 2 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:	

Project Information

ALS Account # / Quote #:	
Job #:	Mento
PO / AFE:	MN19-02
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 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:	
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-CVAF8-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 detail)	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
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	28-Aug-19	10:30	Sediment					R	R	R	R	R	R			1
	M-29			Tissue													
				Tissue													
				Tissue													
				Tissue													
				Tissue													
				Tissue													

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6 / 11.1 / 2.3

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: LF	Date: 3 Sep 2019	Time: 15:50	Received by: JU	Date: 5 Sep 19	Time: 11:35 PM

WHITE - LABORATORY 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 ... 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 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

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.

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	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
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: 15.0
FINAL COOLER TEMPERATURES °C: 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: KF	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

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

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.

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-DRY-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: 17.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 7.2, 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: JG	Date: 5 Sep 19	Time: 11:35

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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

Canada Toll Free: 1 800 668 9878

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:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
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: 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:	
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
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: 17.0 | 9.0 | 15.0

FINAL COOLER TEMPERATURES °C: 6.6 7.7 12.1 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: Jia	Date: 5 Sep 19	Time: 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.

(ALS) Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

Canada Toll Free: 1 800 668 9878

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:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
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: 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:	
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
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)

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: 16.0
FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 12.3

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: Th	Date: 5 Sep 19	Time: 11:30 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.

(ALS) Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 7 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

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.

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-TIRA-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)

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: 16.0

FINAL COOLER TEMPERATURES °C: 6.6, 1.1, 1.3, 1.3

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: Tom	Date: 5 Sep 19	Time: 11:30 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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 9 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	

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.

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-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
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: 16.0

FINAL COOLER TEMPERATURES °C: 6.1, 6.7, 7.1, 2.3

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

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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number 17 -

Page 9 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

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.

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
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)

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: 16.0

FINAL COOLER TEMPERATURES °C: 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

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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 10 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:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	AN19-02
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 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:	
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-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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 3.7, 1.2, 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: 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

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

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page [illegible] 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

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.

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	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)

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: 6.0

FINAL COOLER TEMPERATURES °C: 6.6 1.1 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: TG	Date: 5 Sep 19	Time: 11:35 DM

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

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

Canada Toll Free: 1 800 668 9878

COC Number: 17 -

Page 12 of

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

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.

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-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
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

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: 15D

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: BF	Date: 8 Sep 2019	Time: 15:52	Received by:	Date:	Time:

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.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 4 of 13

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	
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-DRY DIGEST-VA	PREP-1189-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
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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.1, 2.3

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: 18 CR	Time:	Received by: EF	Date: 3 Sep 2019	Time: 15:50	Received by: TG	Date: 5 Sep 19	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 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

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

L2355568-COFC

Canada Toll Free: 1 800 668 9878

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:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
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: 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:	

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-RSY-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: 16.0

FINAL COOLER TEMPERATURES °C: 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: RF	Date: 3 Sep 2019	Time: 1515	Received by: JK	Date: 5 Sep 19	Time: 11:20 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.

(ALS) Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 15 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	
Company:	Alexco Environmental Group	Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)	
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☒ YES ☐ NO	
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
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:

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
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)

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: 15D

FINAL COOLER TEMPERATURES °C: 6, 6, 7, 7, 12, 13

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: 10:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form 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

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 16 of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	
Company:	Alexco Environmental Group	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	
Contact:	Charlotte Rentmeister	Quality Control (QC) Report with Report ☑ YES ☐ NO	
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	
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:

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
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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6 7.7 1.2 13

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: 17:37M

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
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 17 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:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
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: 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:	

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	[illegible]	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) Samples¹ (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: 15.0
FINAL COOLER TEMPERATURES °C:

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: 1550	Received by:	Date:	Time:

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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytica Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

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

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.

Project Information

ALS Account # / Quota #:

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-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
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: 15 D

FINAL COOLER TEMPERATURES °C: 6.6, 3.7, 2.1, 3

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: BP	Date: 3 Sep 2019	Time: 15:50	Received by: JG	Date: 5 Sep 19	Time: 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.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 19 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:	

Project Information

ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
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: 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:	

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-AQY 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
~~34~~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[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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 9.9, 12.1

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: 1550	Received by: JK	Date: 5 SEP 19	Time: 1830

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

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 20 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:	53 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		Analysis Request
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
	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:	MN18-02	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-CVAA-VA	MET-200.2-CCMS-VA	SAMPLES ON HOLD	Sample is 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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6 | 7.7 | 12.4 | 3

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: HS	Date: 5 Sep 19	Time: 9:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION   WHITE - LABORATORY COPY   YELLOW - CLIENT COPY

Failure to complete all portions of this form 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
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 21 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:	53 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)		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.

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:

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			OBC	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)

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 8 8

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: 11:25

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT 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

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%] ☐ / EMERGENCY: 1 Business day [E1 - 100%] ☐
Phone:		☐ Compare Results to Criteria on Report - provide details below if box checked	3 day [P3-25%] ☐ / 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	2 day [P2-50%] ☐
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	Analysis Request
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
	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:

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)

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: 15.0

FINAL COOLER TEMPERATURES °C: 6.6, 7.7, 12.13

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: ZF	Date: 3 Sep 2019	Time: 15:50	Received by: Tk	Date: 5 Sep 19	Time: 11:31

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.

(ALS) Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2355568-COFC

COC Number: 17 -

Page 23 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:	

Project Information	
ALS Account # / Quote #:	
Job #:	Minto
PO / AFE:	MN19-02
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	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:	
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-DSY-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
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	6.6, 7.8, 12.3

SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: CR	Time:	Received by: EP	Date: 3 Sep 2019	Time: 15:50	Received by: JW	Date: 5 Sep 19	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 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

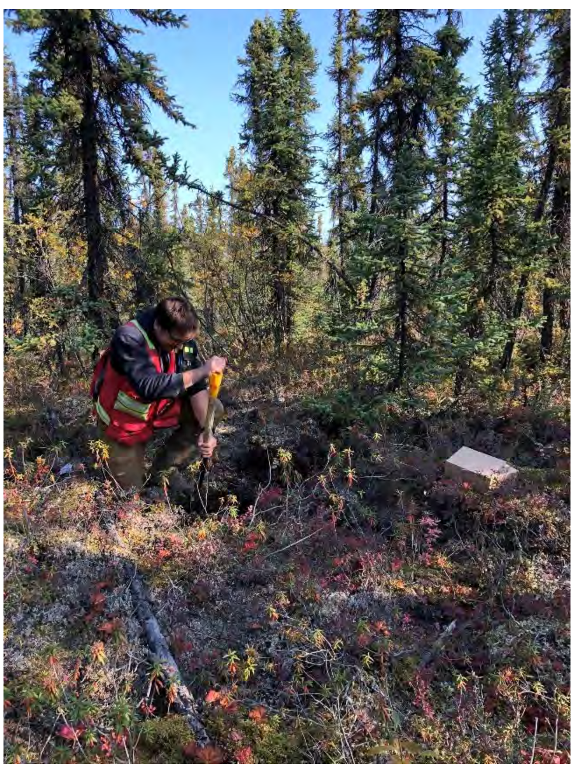


Photo 27: S-08 vegetation (exposure)

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

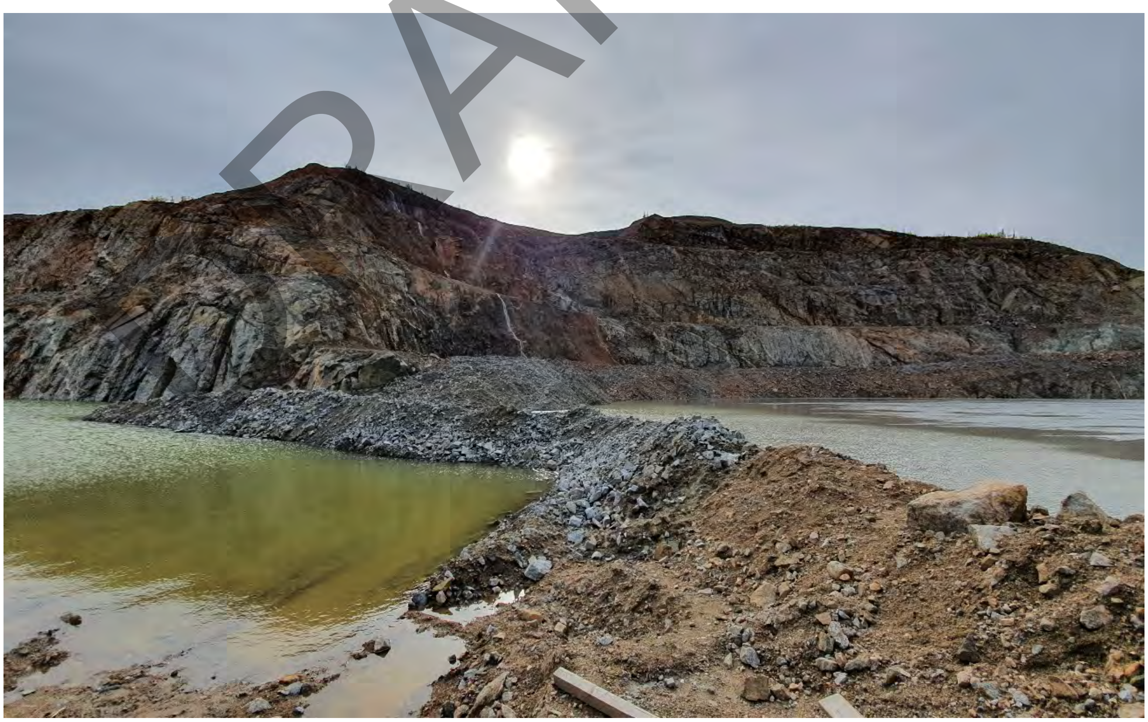
APPENDIX 1-8

MLARD Assessment Update

DRAFT

Minto Mine Phase VII Expansion: ML/ARD Assessment Update

Minto Mine, Yukon, Canada



SRK Consulting (Canada) Inc. ▪ 1CM002.072 ▪ October 2021

srk consulting

DRAFT

Minto Mine Phase VII Expansion: ML/ARD Assessment Update

Minto Mine, Yukon, Canada

Prepared for:
Minto Explorations Ltd.
61 Wasson Place
Whitehorse, Yukon, Y1A 0H7
Canada

604-759-4640
mintomine.com

Prepared by:
SRK Consulting (Canada) Inc.
1066 West Hastings Street, Suite 2200
Vancouver, BC V6E 3X2
Canada

+1 604 681 4196
www.srk.com

Lead Author: Amanda Schevers, MSc, GIT **Initials:** AS
Reviewer: Laura Volden, MSc, PGeo **Initials:** LV

File Name:
MintoMine_MLARD_2021Update_1CM002.072_Draft_20211015_lv.docx

Suggested Citation:
SRK Consulting (Canada) Inc. 2021. Minto Mine Phase VII Expansion: ML/ARD Assessment Update. DRAFT. Prepared for Minto: Whitehorse, Yukon. Project number: 1CM002.072. Issued October 2021.

Cover Image(s):
Area 2 Stage 2 and 3 Pits

Contents

Tables

Figures

Appendices

Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

ABA	Acid Base Accounting
ARD	Acid Rock Drainage
AP	Acid Potential
DSTSF	Dry Stack Tailings Storage Facility
HCT	Humidity Cell Test
MWD	Main Waste Dump
MPD	Main Pit Waste Dump
MVFE	Mill Valley Fill Extension
NP	Neutralization Potential
NP_{TIC}	Neutralization Potential derived from Total Inorganic Carbon content
PAG	Potentially Acid Generating
POX	Partially Oxidized Material
ROD	Reclamation Overburden Dump
S(T)	Total Sulphur
$S(S^{2-})$	Sulphide Sulphur
SFN	Selkirk First Nation
SWB	South Wall Buttress
SWD	Southwest Waste Dump
WLB	Water Load Balance
WRVP	Waste Rock Verification Program
WSP	Water Storage Pond

Executive Summary

SRK Consulting (SRK) reviewed and updated the assessment of metal leaching and acid rock drainage (ML/ARD) potential of waste rock and tailings at the Minto Mine. This update included a review of operational monitoring data and results from exploration assays and acid base accounting (ABA) testing conducted on Phase VII materials (Minto North 2 and Minto East 2). Since the previous ML/ARD update (SRK 2013), mining advanced into three new deposits including Minto East, Minto North, and Copper Keel. Prior to 2013, mining occurred in the Minto, Minto South, Area 2 and Area 118 ore zones only.

The objectives of this assessment were to evaluate if any differences exist between previously characterized and recently-mined material using operational monitoring data, and to compare characterization results from the planned Phase VII expansion materials to Phase IV and V/VI material.

The initial phase of production at Minto began in 2007 and included mining of the Main Pit which was completed in 2011. In 2012, the Phase IV expansion was approved and mining advanced into two new open pits (Area 118 and Area 2) and an underground development (Minto South). The Phase V/VI application presented three new open pits (Minto North, Ridgetop South, and Ridgetop North), an expansion to the previously mined Area 2 Pit and three new underground developments (Minto East, Copper Keel and Wildfire). Mining of the Minto North Pit, Area 2 Pit and Minto East underground are now complete with development on-going in the Copper Keel and Wildfire underground areas (which have since been re-grouped and are referred to only as Copper Keel). Mining of Ridgetop via open pit is planned for the future. The Phase VII expansion plan consists of additional underground mining targeting the Minto East 2 and Minto North 2 ore zones. Both are a continuation of previously mined deposits in each area and are currently awaiting regulatory approval.

Geochemical characterization of waste materials has been carried out in several phases as the mine has expanded and advanced into new ore zones. Results of pre-production geochemical characterization programs and of operational geochemical monitoring to date are summarized in two main documents:

- SRK 2010 - Minto Mine Expansion – Phase IV ML/ARD Assessment and Post-closure Water Quality Predictions. Prepared by SRK Consulting and submitted to Minto Explorations in August 2010.
- SRK 2013 – Minto Mine Phase V/VI Expansion: ML/ARD Assessment and Inputs to Water Quality Predictions. Prepared by SRK Consulting and submitted to Minto Explorations in July 2013.

While these reports focus on the geochemical characterization of materials related to the Phase IV and V/VI expansions, results of the pre-production testing for waste rock and tailings are also discussed, including a study done by Mills 1997 which presented the results of geochemical analysis on 8 samples undertaken during a review of the initial Minto project proposal.

From 2011 to 2021, a total of 2,102 waste rock and 103 tailings samples were collected during operational monitoring and underwent ABA testing at an off-site laboratory. In general, sulphur exists dominantly as sulphide with a small portion of sulfate present that may be higher in areas mined since

2019. Modified NP is considered to be a representative measure of neutralization potential as a portion of the buffering may be attributed to silicate minerals. Of the 2,102 waste rock samples characterized, 55 samples from open pits and two underground samples were classified as PAG, 261 open pit samples and 38 underground samples were classified as uncertain, and the remaining samples were classified as non-PAG. All tailings samples were classified as non-PAG.

Measured on-site NP and AP values from 2013-2021 were in the range of historical data collected prior to the last ML/ARD assessment (SRK 2013). Open pit and underground samples have a similar visual distribution, with the majority (96 and 63%, respectively) of samples classified as non-PAG. Most samples classified as PAG from both open pits and underground (15 and 12, respectively) originated from MGW or HGW (Cu>0.1%).

Exploration assay results from Phase VII materials were available for 170 samples from the Minto East 2 deposit and 1,582 samples from Minto North 2. From these, a subset of 14 samples from Minto East 2 and 15 samples from Minto North 2 were selected for ABA testing. Samples submitted for ABA testing were representative of zero- to high-grade waste. NPR values were within the range of historic data from Phase IV and V/VI materials with the majority of samples classified as non-PAG based on low sulphur content. Three samples from Phase VII (Minto North) were classified as uncertain, otherwise all samples were non-PAG. Sulphur speciation and a comparison of NP determination methods were also within the range of historic data, with no discernable differences. Additionally, select elements from the exploration assays were compared and found to be in the range of historic data. Assay data included both waste and ore-grade material. As such, the Phase VII materials are expected to have the same ML/ARD potential as previously mined materials.

Four barrel tests intended to evaluate the release rates of weathering products under site temperature and precipitation conditions were initiated in 2010 and are currently on-going (October 2021). Most parameters measured in the leachate have been stable in recent years with all four barrels maintaining a circumneutral pH since their initiation in 2010. Observations in sulphate and calcium trends have confirmed the hypothesis that acid produced during sulphide oxidation is being effectively neutralized by the dissolution of calcium carbonate minerals. As the leachate chemistry from the barrel tests has been stable for many years, and large-scale site-specific monitoring data are available, it is recommended that the barrel tests be terminated.

The collection of operational ABA data has been successful in monitoring the potential for ML/ARD risks and verifying the initial characterization results for waste materials related to different phases of the Minto Mine. No prominent differences have been observed between waste materials produced prior to and since the previous ML/ARD update report (SRK 2013). Operational ABA data remains consistent and there are no observations that indicate a change in waste management methods is required at the Minto Mine. Additionally, Phase VII materials have proven to be fundamentally comparable to Phase IV and V/VI materials and nothing suggests the Phase VII materials will pose greater ML/ARD risks once extracted and processed.

1 Introduction

Minto Explorations Ltd (Minto) retained SRK Consulting Inc. (SRK) to review and update the assessment of metal leaching and acid rock drainage (ML/ARD) potential of waste rock and tailings at the Minto Mine. Since the previous ML/ARD Assessment submitted in July 2013 (SRK 2013), mining has advanced into three new deposits including Minto East, Minto North, and Copper Keel. Prior to 2013, mining occurred in the Minto South, Area 2, and Area 118 ore zones only. In addition to the evaluation of recently-mined materials, an assessment of available data from the planned Phase VII expansion was completed, which includes the Minto East 2 and Minto North 2 developments. As a companion scope of work, a review of past water quality modelling results was carried out to support an update to the Water and Load Balance Model. A memo containing the updated water quality modelling results is appended to this document for reference (Appendix A).

1.1 Objective and Scope of Work

The overall objective of this study was to provide an updated assessment of ML/ARD potential for the Minto Mine. The detailed scope of work carried out as part of this assessment is provided below:

- Update relevant background information since the previous ML/ARD update including geologic setting, exploration history, mining history and waste management facilities.
- Provide a summary of previous ML/ARD assessment work conducted for the Minto Mine.
- Incorporate operational monitoring results from waste rock and tailings from Phase IV and V/VI into previously reported data. Evaluate if any differences exist between previously characterized and recently mined materials.
- Update monitoring results of on-site kinetic testing (barrel tests) and evaluate the original objectives of the testing.
- Review available exploration assays and acid base accounting (ABA) data from Phase VII materials. Compare to Phase IV and V/VI materials to inform waste management strategies and support permitting.

2 Background

2.1 Site Location

Minto Mine (the Property) is located west of the Yukon River, approximately 20 kilometers (km) north west of Minto Landing and 250 km north of Whitehorse, Yukon (Figure 1). The Minto Mine is located within Selkirk First Nation (SFN) traditional territory and within SFN Category A Settlement Land Parcel R-6A. The Property is accessible by Yukon Highway 2 to Minto Landing where a barge is in operation during the summer months to cross the Yukon River. From the river, the Property is another 27 km along a gravel access road. During the winter months, the river can be crossed by an ice bridge, but is inaccessible by vehicle for a 6-8 week period during freeze and break-up. During this time, the Property is accessed via chartered flights from Whitehorse.

2.2 Geologic Setting

This section was modified from Section 7 of the Minto 2021 Preliminary Economic Assessment Technical Report (JDS 2021). Section 7 has been appended to this document and contains a complete description of the regional and local geology, deposit type, alteration, and mineralization at Minto (Appendix B). A summary of the details relevant to the ML/ARD assessment is provided below.

2.2.1 Local and Regional Geology

The Minto property is located within the northwest-trending Minto Copper Belt in central Yukon, within the northernmost apical junction of the Stikine and Yukon Tanana terranes (Kovacs et al., 2020). The Minto Copper Belt hosts the Minto mine, the Carmacks Copper deposit, the Stu prospect, and several other Cu-Au-Ag occurrences. Mineralization is hosted within Late Triassic, variably deformed, and metamorphosed rafts of volcanic rocks that are engulfed by intrusions of Late Triassic to Early Jurassic Minto plutonic suite (Kovacs 2018, Kovacs et al., 2020). The Minto suite occurs as a series of large plutons intruded along the contact between mid-Paleozoic rocks of the Yukon-Tanana terrane and Late Triassic rocks of the Lewes River Group of the Stikine terrane (Stikinia).

Three distinct intrusive phases of the pluton are identified on the Minto Property: K-feldspar megacrystic granodiorite to quartz diorite, diorite to monzonite and quartz granodiorite to granitic pegmatite (Tafti, 2005; Hood, 2008; Kovacs, 2018; Kovacs et al., 2020). The most common intrusive phase is dominantly medium to coarse grained, K-feldspar megacrystic granodiorite. These rocks are mainly undeformed, but locally exhibit weak tectonic foliation near their contacts with the metamorphic inliers. Dykes of quartz monzonite, quartz monzodiorite, granite pegmatite and aplite crosscut the metamorphic host rocks and other massive intrusive phases.

The felsic intrusive rocks are unconformably overlain by the volcanic rocks of the Upper Cretaceous Carmacks Group, which are preserved as an extensive blanket south of the Minto pluton and as isolated erosional remnants within the pluton. The Carmacks Group rocks commonly occur as conglomerate in drill core, and as hornblende-phyric andesite dykes cross-cutting the felsic intrusive rocks.

2.2.2 Mineralization

Copper is primarily contained within chalcopyrite, bornite, and chalcocite at Minto which occur mainly as disseminations, foliaform stringers and as net-textured copper sulphides. The intensity of copper sulphide minerals increases with ductile deformation and the highest-grade mineralization occurs as semi-massive, net-textured intergrowths of bornite and chalcopyrite. Typical bornite-chalcopyrite ratios are 3:1, and net-textured bornite is especially abundant in mafic sections where it forms higher grade domains. Covellite may also occur locally as rimming bornite. Hessite (a gold telluride), native gold and electrum occur as inclusions in bornite, accounting for high gold recoveries in copper concentrate.

The mineralogy of the Minto North deposit differs from the rest of the Property with bornite dominating over chalcopyrite and occurring as net-textured domains to massive lenses up to 2 m thick. Precious metal grades are elevated and rare visible gold can occur. In Minto North 2, chalcocite commonly occurs as disseminated or local intergrowths with magnetite. Minto North differs from the Area 2, Area 118, Copper Keel and Minto East deposits which have a mainly disseminated mineral assemblage of chalcopyrite-bornite-magnetite with minor pyrite and the absence of net-textured grains.

The Ridgetop and Copper Keel South deposits are subdivided into a near-surface horizon of supergene oxide and a lower zone of more typical sulphide mineralization. The copper oxide is characterized by malachite, chrysocolla, and azurite. Oxidized magnetite and pyrite are also common. This mixture of oxide material with sulphides is commonly referred to as POX (partially oxidized material). The lower zone is marked by an assemblage of disseminated chalcopyrite, magnetite, minor pyrite, and only minor amounts of bornite. Chalcopyrite and magnetite may also occur in the form of stringers.

In general, copper grades increase progressively northwards from the lower grade material found at Ridgetop towards the highest grades at Minto North (Mercer and Sagman, 2012). This trend is also observed at a regional scale indicated by lower grade mineralization of the Carmacks Copper deposit and progressively increasing northwestward in grade towards the bornite dominant Minto deposits. This change in grade may be due to the increasing northward metamorphic gradient responsible for increased copper content.

2.3 Exploration and Mining History

2.3.1 Exploration

The Minto deposit was first identified during the 1970s through exploration that followed up on a stream sediment anomaly in Minto Creek. Drilling by several operators was carried out during the 1970s, '80s, and '90s, and resulted in the definition of the Minto deposit as a mineable resource.

Exploration by Minto in the time since construction recommenced in 2005 has identified a number of mineable deposits within the Minto claim block, as well as several prospects that remain the subject of further evaluation. Deposits that have been demonstrated to contain economic reserves to date include Area 2, Area 118, M-Zone, Copper Keel, Wildfire, Ridgetop, Minto East, and Minto North. All of these deposits have been developed either by surface or underground mining, with the exception of

Ridgetop, which is authorized for development under the Phase V/VI expansion permit and planned for 2022.

The most recent summary of exploration results and identified deposits is provided in the Minto 2021 Preliminary Economic Assessment Technical Report (JDS 2021). This report presents an update to the mineralized zones and groups the potential deposits as Area 118, Ridgetop, Minto North 2, Copper Keel, and Minto East 2.

2.3.2 Initial Phase of Production

The permit to mine the Minto deposit was granted in 1995, and construction began in 1997 only to be halted by an extended period of low copper prices. Minto re-started mine construction in 2005 and commenced production in 2007.

Mining in the Main Pit was carried out by conventional truck and shovel methods between 2007 and April 2011. Waste rock was placed initially in the Main Waste Dump (MWD), and later in the Southwest Waste Dump (SWD). Overburden was placed in the Overburden Stockpile. Stockpiles of low-grade ore and mixed oxide/sulphide ore were stored in the Blue Stockpile and the Oxide Stockpile, respectively, adjacent to and east of the MWD and west of the Main Pit. All stockpiles and dumps noted above are located upgradient of the Main Pit. Ore processing consisted of crushing, grinding, and froth flotation. Tailings were dewatered through filtration, hauled, placed, and roller-compacted in the Dry Stack Tailings Storage Facility (DSTSF) located southeast (and downgradient) of the Main Pit. All historic and current mine workings and facilities are presented in Figure 2.

2.3.3 Phase IV & V/VI

The Phase IV expansion received final regulatory authorizations in 2012 and the mine plan was used as a key input to the process of planning the Phase V/VI expansion. While the two expansions were approved under different applications, the mine plan was fluid and the distinction between the two is somewhat artificial. The ore zones included in each expansion plan are as follows:

- **Phase IV**: Area 118, Area 2, Minto South
- **Phase V/VI**: Minto North, Minto East, Copper Keel, Wildfire, Ridgetop, Area 2 Expansion

The Phase IV application presented two new open pits (Area 118 and Area 2) and an underground development (Minto South) which extended mining operations to early 2015 and milling to 2016. Pre-stripping of the Area 2 Pit commenced in April 2011, with ore processing following in May 2012. Processing of stockpiled ore from the Main Pit continued during this time. Mining of the Area 2 pit was completed in January 2014, with the underground development of Minto South on-going. Underground mining of Minto South included the M-Zone, which was completed in Q1 2015 and areas under the Area 2 and Area 118 pits, which were completed by Q4 2018. Mining of the Area 118 pit commenced in Q1 2014 and was completed by the end of the year.

The Phase V/VI application presented three new open pits (Minto North, Ridgetop South, and Ridgetop North), an expansion to the previously mined Area 2 Pit (referred to as Area 2 Stage 3) and three new underground developments (Minto East, Copper Keel, and Wildfire). Mining of the Minto North Pit commenced in 2015 and was completed in October 2016. Open pit mining at Ridgetop has not yet commenced but is being planned for the coming years. Surface mining ceased in April 2018 with the completion of the A2S3 Pit, in the same month underground development of the Minto East deposit began. Mining of Minto East continued until October 2018, at which point the mine went into a temporary closure period (TCP). The TCP lasted until July 2019 when mining of the Copper Keel underground commenced. The Wildfire deposit has been reclassified as Copper Keel since the original permit application and is part of the current underground development. Mining of Copper Keel is currently on-going.

2.3.4 Phase VII Expansion Plan

The Phase VII expansion plan consists of an expansion to underground mining at Minto and is currently awaiting regulatory approval. The ore zones included in the expansion plan are as follows:

- Underground mining of Minto East 2, a continuation of the ore lenses that comprise the Minto East deposit previously mined as part of Phase V/VI and accessed from the existing Minto South portal.
- Underground mining of Minto North, a continuation of the ore lenses mined in the Minto North Pit as part of Phase V/VI and accessed via a new portal to be collared within the existing Minto North open pit.

The Minto East 2 ore zone is located underneath the Mill Valley Fill Extension and approximately 450 meters (m) east of the existing Minto East ore zone. It is believed to be a continuation of the same foliated structures that define the Minto East ore zone. It will share infrastructure with the existing Minto South workings, including the portal, main ramp, fresh air raise, and ore stockpiles.

The Minto North underground (Minto North UG) is located approximately 50 m east of the Minto North Pit, approximately 135 m below the ground surface. It is believed to be related to the units of foliated granodiorite that host the copper-bearing mineralization previously mined at Minto North. It will be accessed by a portal and decline to be constructed in the Minto North Pit wall. Ore will be stockpiled temporarily within the existing pit and hauled daily to the existing coarse ore stockpiles adjacent to the mill. Locations of planned developments in relation to existing workings and facilities are presented in Figure 3.

2.4 Existing Mine Workings & Waste Management Plan

The following is a brief description of existing mine workings and waste emplacements at Minto, including open pit and underground developments, waste management structures, and ancillary workings. A complete description of activities can be found in the Minto Mine Waste Management Plan (Minto 2017). Locations of the mine workings and ancillary facilities are provided in Figure 2.

Existing mine workings include four open pits and three areas of underground development. There is no current surface mining on-going at Minto, with ore extraction from the last open pit occurring from Area 2 in late 2018. The four historic pits include:

- Main Pit (active 2007-2011)
- Area 2 Pit (active 2012-2018, including stage 2 and 3)
- Area 118 Pit (active 2014)
- Minto North Pit (active 2015-2016)

Underground development began in 2014 and is currently on-going. Existing developments include the following:

- Minto South: M-Zone, Area 2, Area 118 (active 2014-2018)
- Minto East (active 2018)
- Copper Keel (active 2018 – current)

Each open pit is currently used for waste management apart from Minto North. The Main Pit and Area 2 Pit are currently used as tailings management facilities, with the deposition of slurry tailings beginning in November 2012 and March 2015, respectively. Area 118 Pit was used for waste rock and off-spec overburden deposition between 2014 and 2018. Minto North Pit is not used for waste deposition but captures surface runoff and precipitation.

Inactive areas of the underground development are used for waste management with material placement occurring in both the Minto East and Copper Keel areas.

In addition to the mine workings, several ancillary waste management facilities have been constructed and utilized at Minto. Additional waste facilities are listed below noting their activity status as waste repositories:

- Main Waste Dump (MWD) – inactive
- Southwest Waste Dump (SWD) - inactive
- South Wall Buttress (SWB) - inactive
- Main Pit Dump (MPD) – active
- Dry Stack Tailings Storage Facility (DSTSF) - inactive
- Mill Valley Fill Extension (MVFE) - inactive
- Reclamation Overburden Dump (ROD) – inactive

The Main Waste Dump is located west of the Main Pit and was the first waste rock storage facility constructed at Minto. The MWD contains waste rock from the initial phases of mining the Main Pit, from mining of Minto North Pit, and from later-stage mining of the Area 2 pit and stopped receiving material in 2020. Construction on the Southwest Waste Dump began in March 2009 and continued to receive waste rock until 2014. Major portions of both the MWD and SWD have been re-sloped and closed with no current plans to add additional material.

The South Wall Buttress is a rock fill structure that is designed to buttress the south wall of the Main Pit and preserve the remaining volume for tailings and water storage. Construction of the SWB began in May of 2011, was completed in 2013 and received rock from the Area 2 and 118 Pits.

The Main Pit Dump is the most recently constructed facility and is the only surface facility currently accepting waste rock. It is located on top of the South Wall Buttress and began accepting material in 2017.

The Dry Stack Tailings Storage Facility was used for tailings disposal until the Main Pit was approved for use in the Phase IV authorization. The DSTSF contains all tailings from milling of the Main Pit ore as well as tailings from approximately seven months of milling the Area 2 ore. The DSTSF stopped receiving material in November 2012 and has since been covered with overburden.

The Mill Valley Fill Extension is located at the toe of the DSTSF in the Minto Creek valley, immediately east of the original Mill Valley Fill that was constructed early in the mine life. The MVFE is composed of waste rock and was constructed as a buttress to mitigate movement in the DSTSF. The MVFE stopped receiving waste rock in 2016 and subsequently received overburden as cover material until 2018.

The Reclamation Overburden Dump is located west of the Main Dump and contains overburden materials stripped during surface mining of the Area 118, Area 2, and Main Pits. Material from the ROD is being preserved for use in future closure and remediation activities.

2.5 Summary of Previous ML/ARD Assessments

2.5.1 Geochemical Characterization

Geochemical characterization of waste materials has been carried out in several phases as the mine expands and advances into new ore zones. Results of the geochemical characterization programs to date are summarized in two main documents:

- SRK 2010 - Minto Mine Expansion – Phase IV ML/ARD Assessment and Post-closure Water Quality Predictions. Prepared by SRK Consulting and submitted to Minto Explorations in August 2010
- SRK 2013 – Minto Mine Phase V/VI Expansion: ML/ARD Assessment and Inputs to Water Quality Predictions. Prepared by SRK Consulting and submitted to Minto Explorations in July 2013

While these reports focus on the geochemical characterization of materials related to the Phase IV and V/VI expansions, results of the pre-production testing for waste rock and tailings are also discussed, including a study done by Mills 1997 which presented the results of geochemical analysis on 8 samples during an initial review of the Minto project proposal.

Although results of water quality predictions were included as part of the ML/ARD assessment in the past, the update was conducted as a separate scope of work and is included in this document as Appendix A– Minto Water and Load Balance Model Update Report 2021.

Four humidity cell tests (HCTs) were initiated in July 2009, followed by an additional eight in March 2011. The objective of these tests was to evaluate the release rate of weathering products including major and trace elements. The initial four HCTs represented material from Area 2, while the subsequent eight included materials from the Minto North and Ridgetop deposits. All 14 HCTs were terminated in May 2014 as the original objectives of the testing were considered complete. Details on sample selection, testing objectives, methodology and results are provided in both SRK 2010 and SRK 2013.

Two subaqueous tailings columns were initiated in September 2009 with the objective of evaluating the porewater chemistry that would develop over a long period of contact with tailings solids under water cover. The columns included material produced during metallurgical testing of Area 118 and Ridgetop ore samples. Both columns were terminated in May 2014 as the original objectives of the testing were considered complete. Details on sample selection, testing objectives, methodology and results are provided in both SRK 2010 and SRK 2013.

Four field scale barrel tests were initiated in June 2010 to evaluate site-based weathering mechanisms and the release rates of weathering products under site temperature and precipitation conditions. These barrel tests are currently on-going, and an update of monitoring results is provided in this document. Barrel tests are the only kinetic tests currently on-going at Minto.

2.5.2 Operational Monitoring

Minto includes operational monitoring results in their annual reports as required by Quartz Mining Licence QML-0001 and Water Licence QZ14-031. The Acid Base Accounting (ABA) Program is one component of Minto's Geochemical Monitoring Program which provides monitoring of overburden and waste rock derived from the mine workings and tailings from milling. Details of the program can be found in the Minto Mine Phase VII Expansion Waste Rock and Overburden Management Plan (WROMP) (Minto 2018). The ABA Program is what is referred to as operational monitoring and will be discussed in this report.

To supplement operational monitoring, the Waste Rock Verification Program (WRVP) was initiated in 2014 to support and monitor waste rock handling procedures at the Minto Mine and satisfy Clause 95 of the WUL. The program consists of detailed record keeping on the type and quantity of waste rock placed at each location, and monitoring and verification of the characteristics of the rock as per the WROMP.

3 Methodology

3.1.1 Phase IV & V/VI Operational Monitoring

Waste Rock

On-Site Laboratory Testing

As reported in SRK (2013), Minto commissioned an Eltra CS-800 induction furnace for on-site measurements of total carbon and total sulphur content. Previous work demonstrated a strong correlation between total carbon and total inorganic carbon as well as total sulphur and total sulphide sulphur, indicating the relatively simple total carbon and total sulphur analyses were appropriate for operational ABA characterization.

Operational neutralization potential (NP) and acid potential (AP) values (NP-C(T) and AP-S(T)) are calculated from the total carbon and total sulphur results, respectively, and then used to calculate NP-C(T):AP-S(T). This approach assumes that all sulphur is hosted in the mineral pyrite (FeS_2). At Minto, pyrite is generally less abundant than copper sulphides, which produce less acidity than the oxidation of pyrite in most cases. Sulphate minerals may also be present in the measured total sulphur, which would not contribute to acid generation. Therefore, this method can be considered conservative. Samples for on-site ABA testing are split from blast-hole samples collected for grade control purposes. Cuttings from every blasthole are collected and analyzed, and both assay and ABA results are then imported into the mine's grade control software. Using the results, mine geologists define ore and waste polygons for each blast (including delineating NP-C(T):AP-S(T)<3 waste polygons) and the results are provided to the pit operations staff for staking of ore and waste boundaries and subsequent dispatching of ore and waste to appropriate stockpiles and waste storage facilities.

Offsite Laboratory Testing

Over a period of 10 years, from 2011 to 2021, a total of 2,102 samples (1,980 from open pits and 122 from underground areas) of operational core samples have undergone acid base accounting (ABA) testing at an offsite laboratory. Results to date include samples from the Area 118 Pit, Area 2 Pit (including Stage 3 and 4 areas), Minto North Pit, and underground samples from the Area 118 portal, Area 2, Copper Keel, and Minto East areas. Table 3-1 classifies these samples by mine area and year of analysis.

The Phase IV and V/VI operational data is compared to the historic data as presented in SRK (2013) and included data from Area 2 Stage 3, Minto North, Ridgetop, and Wildfire areas.

Samples were collected by mine geologists and shipped to SGS or ALS laboratory for ABA testing and multi-element determination by aqua regia leach with ICP-MS finish. ABA testing included paste pH (Sobek et al. 1978), total sulphur by Leco, sulphate sulphur by HCl leach, total inorganic carbon (TIC) by coulmetric analysis of evolved CO_2, and Modified NP (MEND 1991).

Table 3-1: Summary of Waste Rock ABA and Trace Element Analyses

Mine Area	Number of Samples	Year of Analysis
Open Pits		
Area 118 Pit	171	2014
Area 2 Pit	1,101	2011 - 2015
Area 2 Stage 3	199	2017
Area 2 Stage 4	187	2017 - 2018
Minto North Pit	322	2015 - 2016
Underground		
Area 118 Portal	58	2013, 2015, 2016
Area 2 Underground	6	2017
Copper Keel Underground	40	2018, 2020 - 2021
ME Underground	18	2017 - 2018

Source: Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV01_AJS.xlsx]

Tailings

A total of 103 tailing samples were collected between 2010 and 2021. Samples for testing consisted of 1 to 2 kg monthly composite samples, prepared from 200 to 500 g tailings samples which were collected daily and stored in sealed plastic bags prior to preparation of the monthly composite sample.

The monthly composites were submitted to SGS or ALS laboratory for ABA and trace element analysis by ICP-MS following an aqua regia digestion. ABA testing included paste pH (Sobek et al. 1978), total sulphur by Leco, sulphate sulphur by HCl leach, total inorganic carbon (TIC) by coulmetric analysis of evolved CO_2, and Modified neutralization potential (NP) (MEND 1991).

The Phase IV and V/VI tailings data is compared to the historic data as presented in SRK (2013) and included data from 2007, 2009, and 2010.

Barrel Tests

Barrel tests are intended to be site-based weathering tests that permit evaluation of rates of release of weathering products under site temperature and precipitation conditions. These tests also provide a larger scale of testing than is typically carried out in a laboratory setting and at the same time provide more certainty regarding the sample characteristics and the related drainage chemistry (unlike a full-scale waste rock dump, for which integrated geochemical characteristics and degree of drainage capture are not readily determined to the same degree).

As discussed in SRK (2013) two broad categories of Area 2 waste rock were initially identified. The first category, containing by far the largest tonnage, was referred to as ‘Bulk Waste’ and was defined as all rock with less than 0.1% sulphur content (as determined by ICP). The second, and much smaller, category was referred to as ‘Mineralized Waste’ and consisted of all rock with sulphur greater than 0.1% and copper less than 0.5% (as an approximation of mine cut-off grade). The Mineralised Waste material was identified as having a higher risk for ML/ARD, and barrel tests were proposed to evaluate samples of Mineralized Waste.

Exploration diamond drill core intervals within the Area 2 Phase 3 pit shell that had sulphur content corresponding to four statistical categories were identified. Table 3-2 lists these categories, the target sulphur content, and the number of drill core intervals that met the criteria for that selection.

Table 3-2: Barrel Test Sample Selection Characteristics

Barrel ID	Target S (%)	Selection Characteristics	Cu Range (%)	S Range (%)	No. of Intervals in S Range
BAR-10	0.15	10th percentile S amongst Mineralized Waste population with S >0.1%	0.005 - 0.45	0.14 - 0.16	292
BAR-50	0.37	50th percentile S amongst Mineralized Waste population with S >0.1%	0.005 - 0.49	0.36 - 0.40	170
BAR-75	379	75th percentile S amongst Mineralized Waste population with S >0.1%	0.005 - 0.49	0.74 - 0.84	167
BAR-90	1.41	90th percentile S amongst Mineralized Waste population with S >0.1%	0.05 - 0.49	1.28 - 1.54	159
BAR-B	n/a	blank for quality control	n/a	n/a	n/a

Source: Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Barrel_Test_Data_1CM002.072_REV00_AJS.xlsx]

The barrels are open to the atmosphere and incident precipitation falls on them. Rainfall and snowmelt percolate through the rock and accumulate in the drain tube and in the bottom of the barrel between sampling events. Sampling of the leachate from the barrels began in June 2010 and has been carried out several times each open-water season since then (Table 3-3). Samples are collected directly from the tubing by opening the ball valve. The remaining accumulated volume of water is drained during each sampling event. Leachate samples are collected for determination of laboratory pH and conductivity, acidity, alkalinity, anions (chloride, fluoride, and sulphate) and trace-level dissolved metal by ICP-MS/OES.

Table 3-3: 2010 - 2020 Barrel Sample Summary

Year	BAR-10	BAR-50	BAR-75	BAR-90	BAR-B
2010	10	12	8	9	8
2011	8	7	7	8	
2012	4	3	3	3	
2013	8	11	10	8	
2014	5	8	7	5	
2015	6	6	6	5	
2016	4	4	4	3	
2017	4	4	3	3	
2018	3	2	3	2	
2019	3	2	2	2	
2020	4	5	5	4	
TOTAL	59	64	58	52	8

Source: Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Barrel_Test_Data_1CM002.072_REV00_AJS.xlsx]

ARD Classification

When interpreting the ABA results for mine rock and tailings samples the ratio of NP to AP was used as the principal measure of ARD potential, where AP is calculated from sulphide sulphur and NP refers to the Modified NP method. Sulphide sulphur was calculated as the difference between total sulphur and sulphate sulphur.

The current permit for the Minto Mine classifies rock with a NP/AP ratio greater than 3 as non-potentially acid generating (non-PAG). It is common practice to categorize rock with a ratio between 1 and 3 as having an uncertain potential for the generation of ARD, and a NP/AP ratio of less than 1 as potentially acid generating (PAG).

Day and Kennedy (2015) demonstrated in many carbonate-deficient systems, the rate of acid generation from low sulphide geological material is sufficiently buffered by bicarbonate produced through meteoric weathering of silicate minerals. They also demonstrated that the Modified NP method underestimates the silicate mineral reservoir potentially available to neutralize acidity generated by low sulphide materials. This conceptual model of buffering by meteoric weathering of silicate minerals provides the basis for classifying material with AP less than 5 kg $CaCO_3$/t as non-PAG.

3.1.2 Phase VII Testing

Exploration Assays

During exploration programs, drill core from the Minto property was split and half of the core was sent for elemental analysis. Assay results were available for Minto East 2 and Minto North deposit areas. A total of 170 samples were collected from Minto East 2 in 2018 and 1,582 samples were collected from Minto North in 2020. Multi-element scans were conducted using ICP-MS following an aqua regia digestion.

Acid Base Accounting

From the exploration drill core for the Phase VII deposits, SRK selected 15 samples from Minto North and 14 samples from Minto East 2. All 29 samples were submitted to ALS North Vancouver, BC, for ABA testing which included paste pH (Sobek et al. 1978), total sulphur by Leco, sulphate sulphur by HCl leach, TIC by coulmetric analysis of evolved CO_2, and Modified NP (MEND 1991).

Data interpretation followed that outlined in Section 3.1.1.

4 Results

4.1.1 Phase IV & V/VI Operational Monitoring

Waste Rock

On-Site Laboratory Testing

The on-site waste rock ABA results for January 2013 through May 2012 are shown in Figure 4. The results are shown separately for the four copper grade categories (Zero-, Low-, Medium- and High-Grade Waste) defined in the Phase IV waste management plan and separated based on open pit and underground samples. Over the period of record, 1,559 samples were collected from open pit waste rock and 168 samples were collected from underground waste rock. In total, 1.0% of the open pit samples and 7.1% of the underground samples were classified as PAG with a NP-C(T):AP-S(T)<1. Overall, 39% and 33% of samples from the open pits and underground areas, respectively, were classified as Zero Grade Waste (Cu<0.03%), and almost all of those samples were classified as non-PAG.

Offsite Acid Base Accounting

Summary statistics of the off-site operational waste rock ABA testing are provided in Appendix C.

Total sulphur and sulphide sulphur are presented in Figure 5. Sulphur in the waste rock from the open pit and underground deposits is largely dominated by sulphide as illustrated by the strong 1:1 correlation for many of the samples. All areas, except the Area 2 Underground, had a portion of samples with total sulphur values greater than sulphide sulphur for samples with total sulphur between 0.02 to 0.63%. The increased sulphate content suggests these samples may have contained gypsum or other sulphate minerals. The Area 2 pit samples had the highest sulphur content, ranging from below the detection limit (<0.005%) to 6.6%.

Chalcopyrite, as well as bornite and chalcocite, are widely observed in Minto rocks and are likely important sulphur hosts. A comparison of sulphide sulphur and copper content shows that the copper mineral chalcopyrite ($CeFeS_2$) may account for a significant amount of the sulphide sulphur in the samples (Figure 6). Samples with sulphide sulphur: copper ratio greater than that of the chalcopyrite S:Cu ratio suggest pyrite may be a source of the sulphide sulphur.

To evaluate the proportion of NP measured by titration that is likely to be derived from carbonate minerals, the NP values were compared with total inorganic carbon content (NP_{TIC}) converted to common units of kg $CaCO_3$/t. Figure 7 presents the results of this comparison. In general, all underground samples have Modified NP values greater than NP_{TIC}. For open pit samples, NP and NP_{TIC} are generally well correlated at high concentrations; however, below approximately 20 kg $CaCO_3$/t, Modified NP systematically exceeds NP_{TIC} with relative differences increasing as Modified NP decreases. The typical conclusion when Modified NP systematically exceeds NP_{TIC} is that silicate minerals (such as clays) are contributing a component of the neutralization that is measured in the NP titration. Several of the Area 2 Stage 4 samples (n=16) have NP_{TIC} values significantly higher than Modified NP values indicating the presence siderite ($FeCO_3$), which does not contribute to net neutralization (SRK 2010).

Figure 8 illustrates the NP_{TIC}:AP ratio for the operational waste rock samples. Of the 2,102 samples characterized, 55 samples from open pits and two underground samples were classified as PAG, 261 open pit samples and 38 underground samples were classified as uncertain, and the remaining samples were classified as non-PAG.

Similarly, Figure 9 presents the NP:AP (based on Modified NP) for the operational waste rock samples. Of the 2,102 samples characterized, 46 open pit and three underground samples were classified as PAG, 197 open pit and 24 underground samples were classified as uncertain, and the remaining samples were classified as non-PAG.

Offsite Trace Element Content

A statistical summary of the solid phase trace element data for waste rock by mine area for selected parameters of interest are presented in Appendix C. Elements that exceeded the screening criteria of ten times the average crustal abundance (crust as a whole) were considered enriched (Price 1997).

All open pit and underground areas had enrichments of selenium with values ranging from the detection limit (0.2 ppm) to 26 times the screening criteria (Area 2 Stage 4 open pit). In general, underground areas had a higher proportion of samples enriched in silver and copper compared to the open pit areas. Maximum values for all open pit areas were enriched in molybdenum, except for Area 2 where P90 values exceeded the screening criteria. Two samples (one historic and one from the Minto North open pit) were enriched in arsenic.

All other samples were below ten times the screening criteria suggesting no appreciable enrichment.

Tailings

Acid Base Accounting

Complete results of the tailings operational static testing are presented in Appendix D.

Total sulphur and sulphide sulphur content are presented in Figure 10. For samples collected prior to 2016, most of the sulphur is in the sulphide form. Most samples collected between 2016 and 2021 have total sulphur greater than sulphide sulphur due to measurable sulphate content, suggesting the samples may have contained gypsum or other sulphate mineral (Figure 11).

Figure 12 shows a plot of NP calculated from inorganic carbon content (NP_{TIC}) compared to Modified NP for the operational tailings samples. Approximately half (54%) of the samples had NP_{TIC} values less than Modified NP, while the rest (46%) had NP_{TIC} values greater than Modified NP. These results suggest that both silicate minerals and iron or manganese carbonates contribute to the various NP measurements for the tailings.

Figure 13 and Figure 14 present results of NP_{TIC} and Modified NP versus AP, respectively. Regardless of the measure used, the low sulphide sulphur content and the moderate neutralization potential in the tailings indicate that acidic conditions are unlikely to develop in these materials (under either saturated or unsaturated storage conditions).

Trace Element Content

A statistical summary of the solid phase trace element data for tailings by year for selected parameters of interest are presented in Appendix D. Elements that exceeded the screening criteria of ten times the average crustal abundance (crust as a whole) were considered enriched (Price 1997).

All tailings samples from 2007 to 2021 (apart from single samples from 2018 and 2020) were enriched in selenium with values up to 6 times greater than the criteria. Samples from all years were enriched in copper with exceedances up to 7 times greater than the criteria. Enrichment of silver in the tailings samples had decreased from 2011 where all samples were enriched, with no silver enrichment since 2017.

All other samples were below ten times the screening criteria suggesting no appreciable enrichment.

Barrel Tests

The four waste rock barrel tests have been sampled during the non-frozen months since 2010. The blank barrel was not sampled again after 2020. As discussed in Section 3.1.1, the samples selected for the barrel tests represent mineralized waste rock with sulphur contents greater than 0.1%. The BAR-10 barrel targeted the 10^{th} percentile sulphur content of the more mineralized rock (i.e. 0.15% S), BAR-50 targeted the 50^{th} percentile (0.37% S), BAR-75 targeted the 75^{th} percentile (0.79% S), and BAR-90 targeted the 90^{th} percentile (1.4% S). The full set of barrel tests results are presented in Appendix E. Selected results are shown graphically in Figure 15.

- The leachate pH levels from all barrels have been consistently circumneutral for the duration of sampling. BAR-10 generally had the highest pH with values fluctuating between 7.5 and 8.3 while BAR-90 had the lowest values between 7.1 and 7.8. The blank barrel had more acidic leachate with levels dropping from 6.7 to 5.6 over the 2020 season which may reflect the flushing of the apparatus by incident precipitation (rainwater in equilibrium with atmospheric carbon dioxide has a pH of approximately 5.5).
- Sulphate concentrations have been stable for BAR-75 and BAR-90 with concentrations generally ranging from 990 to 1,900 mg/L (except for one 2015 sample of BAR-75 with a concentration of 290 mg/L). Concentrations in BAR-50 have been generally decreasing since 2011 with values ranging from 49 to 1,500 mg/L. BAR-10 had the lowest concentrations (8.9 to 110 mg/L) with values decreasing since 2019. The blank barrel had negligible sulphate concentrations, around 1 mg/L.

  Sulphate comprises a very small portion of the solid sulphur content, so most of the sulphate in the leachate is likely derived from sulphide oxidation. Acid production from this sulphide oxidation is being neutralized (as evidenced by the stable circumneutral leachate pH) by calcium and magnesium carbonates. Although BAR-90 has significantly higher sulphur content, its leachate sulphate concentrations were almost identical to BAR-75 and may be attributed to the formation of gypsum [$CaSO_4(2H_2O)_5$], which can precipitate if concentrations of calcium and sulphate reach saturation levels. Although no evaluation of equilibrium conditions has been carried out, the calcium and sulphate concentrations in BAR-75 and BAR-90 leachate are consistent with gypsum control.

- The calcium concentrations reflect the same pattern as the sulphate concentrations and supports the hypothesis that sulphide oxidation products are being neutralized by calcium-bearing carbonate minerals. BAR-75 and BAR-90 have had stable calcium concentrations throughout sampling with concentrations ranging from 360 to 640 and 380 to 620 mg/L for BAR-75 and BAR-90, respectively. Concentrations from BAR-50 have been gradually decreasing since 2014 with concentrations ranging from 17 to 210 mg/L. BAR-10 had the lowest concentrations of all with values ranging from 3 to 56 mg/L.
- Magnesium concentrations from all four barrels have had relatively stable values throughout sampling. With the exception of the initial sample points, magnesium concentrations from BAR-10 and BAR-50 have ranged from 3.8 to 19 and 4.9 to 29 mg/L, respectively. BAR-75 (17 to 69 mg/L) had magnesium concentrations approximately 10 to 20 mg/L higher than BAR-90 (11 to 56 mg/L) which may indicate the sulphide oxidation and carbonate dissolution rates are highest in BAR-75.
- Copper concentrations in the barrels have remained relatively stable and with values generally fluctuating between 0.01 and 0.1 mg/L. BAR-10 had higher concentrations than might have been expected with values between 0.023 and 0.16 mg/L. No clear trend in copper leaching is apparent over the ten sampling years.
- Relative cadmium concentrations in the barrel leachates were correlated to the sulphur percentile of each sample. BAR-75 and BAR-90 had similar concentrations ranging from 0.00001 to 0.00035 mg/L and 0.00011 to 0.00042 mg/L for BAR-75 and BAR-90, respectively.
- Selenium concentrations in all four barrels have ranged from 0.0015 to 0.050 mg/L (except for one BAR-50 sample from the initial testing) with decreasing trends since 2014. The decreasing concentrations suggest selenium release was fastest from the freshest rock and that release rates are declining over time, which is consistent with the established theory that weathering rates decline over time under stable pH conditions.

4.1.2 Phase VII Materials

Exploration Assays

Summary statistics of exploration assay results for waste rock within the Minto North and Minto East 2 areas are provided in Appendix F and select parameters are presented in Table 4-1. Box and whisker plots comparing the Phase VII materials to previous assay data for select parameters are presented in Figure 16 and Figure 17. Waste rock includes significant higher-than-cutoff-grade material where isolated higher copper intercepts could not be laterally modelled to define mineable ore horizons.

Copper values range from 0.00008 to 10% and 0.0004 to 5.5% for Minto North and Minto East 2 areas, respectively. The difference in copper values between the 50th percentile and average indicates a skewed distribution for both Minto North and Minto East 2 samples. Similarly, sulphur content of all samples and cadmium content of Minto East 2 samples showed a similar skewed distribution with values ranging from 0.005 to 9.2% and 0.005 to 3.3% for Minto North and Minto East 2 areas, respectively. Other trace element values were less skewed to high values.

Table 4-1: Summary of Selected Elemental Content from Exploration Assays

Mine Area	Statistic	Total S	Total Cu	Cd	Cr	Mn	Se	Zn
		%	%	ppm	ppm	ppm	ppm	ppm
Minto North	Min	0.005	0.00008	***0.25***	0.5	84	0.5	7.0
	10th percentile	0.005	0.0006	***0.25***	4.0	430	0.5	54
	50th percentile	0.15	0.16	1.0	6.0	590	5.0	90
	Average	0.51	0.53	1.2	7.1	630	4.8	120
	90th percentile	1.5	1.6	3.0	12	930	10	180
	Max	9.2	10	14	19	2,000	70	2,300
	Count	1,582	1,582	1,582	1,582	1,582	1582	1,582
Minto East 2	Min	0.005	0.0004	***0.25***	2.0	250	-	32
	10th percentile	0.005	0.0059	***0.25***	4.0	390	-	63
	50th percentile	0.19	0.32	***0.25***	5.0	660	-	100
	Average	0.46	0.59	0.64	5.6	730	-	120
	90th percentile	1.2	1.2	1.3	8.0	1,200	-	190
	Max	3.3	5.5	5.3	12	2,200	-	600
	Count	170	170	170	170	170	0	170

Source: Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Assay_Data_1CM002.072_REV00_AJS.xlsx]

Notes:

Values in bold italics present at less than the detection limit.

Acid Base Accounting

A statistical summary of ABA data for the Phase VII exploration data are presented in Table 4-2 and Appendix G.

Paste pH values ranged from 7.6 to 9.6 for all samples.

Total sulphur values ranged from less than detection (0.01%) to 0.40%. Sulphate sulphur was less than or near the detection limit (0.01%) for Minto North samples and was higher for samples from Minto East 2 with values ranging from less than detection to 0.21%. The increased sulphate content suggests the Minto East 2 samples may contain gypsum or other sulphate minerals (Figure 18). The low HCl-soluble sulphate values of Minto North samples indicate that the sulphur in the samples was present as sulphide.

To evaluate the proportion of neutralization potential (NP) measure by titration that is likely to be derived from carbonate minerals, the NP values were compared with total inorganic carbon content (NP_{TIC}) converted to common units of kg $CaCO_3$/t. Figure 19 presents the results of this comparison. NP_{TIC} values ranged from less than detection (4.2 kg $CaCO_3$/t) to 29 kg $CaCO_3$/t for Minto North samples and from less than detection to 43 kg $CaCO_3$/t for Minto East 2 samples. Modified NP values ranged from 6.0 to 30 kg $CaCO_3$/t and 10 to 40 kg $CaCO_3$/t for Minto North and Minto East 2 areas, respectively. In general, Modified NP exceeded NP_{TIC} (except for two samples, one from each of the mine areas) indicating the samples contain silicate minerals (such as clays) that contribute a component of neutralization that is measured in the NP titration.

Figure 20 presents the NP_{TIC}:AP ratio for the Phase VII exploration samples. Of the 29 samples characterized, 2 samples from Minto North were classified as PAG and 2 samples, one from each mine area, were classified as uncertain with the remaining samples classified as non-PAG.

Similarly, Figure 21 presents the NP:AP ratio (based on Modified NP) for the Phase VII exploration samples. Of the 30 samples characterized, 3 Minto North samples were classified as uncertain, and all other samples were classified as non-PAG.

Table 4-2: Statistical Summary of ABA Data, Phase VII Exploration Samples

Mine Area	Statistic	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
		pH Units	wt %	wt %	wt %	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t		
Detection Limit		0.01	0.01	0.01	0.01		4.2	1		
Minto North	Min	7.6	***0.01***	***0.01***	***0.01***	0.31	***4.2***	6.0	0.70	1.2
	P10	7.8	***0.01***	***0.01***	***0.01***	0.31	***4.2***	7.4	1.2	1.7
	P50	8.7	0.020	***0.01***	0.020	0.63	11	18	16	27
	Average	8.7	0.067	0.011	0.063	2	12	17	23	33
	P90	9.2	0.20	0.01	0.19	5.8	22	28	52	70
	Max	9.4	0.40	0.02	0.39	12	29	30	59	83
	Count	15	15	15	15	15	15	15	14	14
Minto East 2	Min	7.9	***0.01***	***0.01***	***0.01***	0.31	***4.2***	10	1.9	3.2
	P10	8.1	0.013	***0.01***	***0.01***	0.31	5.4	12	2.1	3.3
	P50	8.4	0.13	***0.01***	0.040	1.3	13	20	9.0	12
	Average	8.7	0.12	0.051	0.074	2.3	16	22	14	20
	P90	9.3	0.23	0.15	0.14	4.3	27	35	31	45
	Max	9.6	0.38	0.21	0.37	12	43	40	35	58
	Count	14	14	14	14	14	14	14	13	13

Source: Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[PhaseVII_Exploration_Data_1CM002.072_REV00_AJS.xlsx]

Notes:

Values in bold italics are present at less than the detection limit.

5 Discussion

5.1 Operational Data

Measured on-site NP and AP values from 2013 to 2021 were in the range of historical data collected prior to the last ML/ARD assessment (SRK 2013). Open pit and underground samples have a similar visual distribution with the majority (96 and 63%, respectively) of samples classified as non-PAG (Figure 4). While a larger percentage of underground samples were classified as PAG or Uncertain, this is likely due to the smaller sample size overall ($n_{underground}$ =168; $n_{openpit}$ =1559). Most samples classified as PAG from both open pits and underground (15 and 12, respectively) originated from MGW or HGW (Cu>0.1%).

While NP_{TIC} versus Modified NP ratios were generally in the range of historic data and consistently plot along a 1:1 line, observations from Area 2 Stage 4 Pit were anomalous, with higher values of NP_{TIC} in several of the samples (Figure 7). This is likely due to the presence of carbonate minerals that do not contribute to buffering, such as siderite ($FeCO_3$). As Modified NP is used as an effective measure of neutralization potential, this does not affect the waste classification as determined by off-site laboratory testing but does suggest a mineralogical anomaly in that area.

A large portion of samples from the Area 118, Minto East and Copper Keel underground workings had higher total sulphur than sulphide values, suggesting the presence of sulphate minerals (Figure 5). Sulphate values in tailings solids from 2020 and 2021 were also considerably higher than previous years (Figure 11). As the underground areas noted above are some of the most recently mined deposits, it is intuitive that the sulphate values persist through processing and are observed in recent tailings samples. This may suggest that sulphate minerals are in greater abundance in deeper deposits, or the development is moving towards an area enriched in sulphate minerals. While the sulphur speciation may be dynamic, all tailings samples measured to date have been classified as non-PAG.

5.2 Phase VII Material

Testing of Phase VII materials included samples that ranged in designation from zero- to high-grade waste. NPR values were within the range of historic data from Phase IV and Phase V/VI materials with the majority of samples classified as non-PAG based on low sulphur content. Three samples from Phase VII (Minto North) were classified as Uncertain, otherwise all samples were non-PAG. Sulphur speciation and a comparison of NP determination methods were also within the range of historic data, with no discernable differences. As such, the Phase VII waste materials are expected to have the same ARD potential as previously mined materials.

Phase VII assay results of select parameters were compared to samples from Phase V/VI materials and are presented on box and whisker plots in Figure 16 and Figure 17. Assay results include all exploration samples, including ore-grade material. Sulphur, chromium, manganese, and zinc had no discernable differences between Phase VII and Phase V/VI materials. Phase VII materials had similar copper concentrations to Minto East, Copper Keel, and Minto Main (comprised of samples from Area 2 and Copper Keel) but were slightly higher than Ridgetop, Area 2, Wildfire, and Area 118. This could be due to the lower number of samples available from the latter deposits. Cadmium values measured in Minto North materials had a broader range than Phase V/VI materials but are overall within the range of concentrations previously measured. As such, the Phase VII materials are expected to have the same metal leaching potential as previously mined materials.

5.3 Barrel Tests

The four waste rock barrel tests were initiated in 2010 to evaluate site-based weathering mechanisms and the release rates of weathering products under site temperature and precipitation conditions. Most parameters measured in the leachate have been stable in recent years with all four barrels retaining a circumneutral pH since their initiation in 2010 (Figure 15). Observations in sulphate and calcium trends have confirmed the hypothesis that acid produced during sulphide oxidation is being effectively neutralized by the dissolution of calcium carbonate minerals. Certain trace elements are showing a decreasing trend which is consistent with the established theory that weathering rates decline over time under stable pH conditions.

In the absence of large-scale site-specific data, barrel tests provide supporting information for use in water quality modelling. In recent years, however, the availability of monitoring data from aging full-scale waste facilities on site has been the preferred source of information for use in developing source terms for use in modelling of future water quality at Minto. As the leachate chemistry from the barrel tests has been stable for many years, and large-scale site-specific monitoring data are available, it is recommended that the barrel tests be terminated.

6 Conclusions

The collection of operational ABA data has been successful in monitoring the potential for ML/ARD risks and verifying the initial characterization results for waste materials related to different phases of the Minto Mine. No prominent differences have been observed between waste materials produced prior to and since the previous ML/ARD update report (SRK 2013). Operational ABA data remains consistent and there are no observations that indicate a change in waste management methods is required at the Minto Mine. Additionally, Phase VII materials have proven to be fundamentally comparable to Phase IV, V/VI materials and there are no data to suggest they will pose additional ML/ARD risks once extracted and processed.

Closure

This report, Minto Mine Phase VII Expansion: ML/ARD Assessment Update, was prepared by

DRAFT

Amanda Schevers, MSc, GIT
Staff Consultant – Geochemistry

DRAFT

Laura Volden, MSc, PGeo
Consultant – Hydrogeochemistry

and reviewed by

DRAFT

Dylan MacGregor, MASc, PGeo
Principle Consultant – Geoenvironmental

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

References

Day, S. D. and Kennedy, C. B. 2015. Setting ARD Management Criteria for Mine Wastes with Low Sulphide and Negligible Carbonate Content. Presented at the 10th International Conference on Acid Rock Drainage, April 22, 2015.

Hood, S.B. 2008. "Mid-crustal Cu-Au Mineralization during Episodic Pluton Emplacement, Hydrothermal Fluid Flow, and Ductile Deformation at the Minto Deposit, YT, Canada", MSC Thesis, Faculty of Graduate Studies, University of British Columbia.

JDS Energy and Mining 2021. Preliminary Economic Assessment Technical Report Minto, Yukon, Canada. Prepared for Minto Explorations Ltd. Whitehorse, Yukon, Canada.

Kovacs, N. 2018. "Genesis and Post-ore modification of the migmatized Carmacks Copper Cu-Au-Ag porphyry deposit, Yukon, Canada", MSc Thesis, University of British Columbia.

Kovacs, N., Allan, M.M., Crowley, J.L., Colpron, M., Hard, C.J., Zagorevski, A. and Creaser, R.A. 2020. Carmacks Copper Cu-Au-Ag Deposit: Mineralization and Postore Migmatization of a Stikine Arc Porphyry Copper System in Yukon, Canada. Economic Geology, 115(7), 1413-1442.

MEND. 1991. Acid Rock Drainage Prediction Manual. MEND Project 1.16.1b.

Mercer, B. and Sagman, J. 2012. Preliminary Feasibility Study Technical Report, Minto Explorations Ltd., In-house report, Minto Explorations Ltd.

Minto Explorations Ltd. 2018. Minto Mine Phase VII Expansion Waste Rock and Overburden Management Plan (WROMP). Prepared by Minto Explorations Ltd. Minto Mine. January 2018

Minto Explorations Ltd. 2017. Minto Mine Waste Management Plan, Attachment 2 of the Water Licence Amendment: Phase VII Expansion of Mining, Minto Mine. Prepared by Minto Explorations Ltd., August 2017.

Price, W. (1997). *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia.* British Columbia Ministry of Employment and Investment, Energy and Minerals Division.

Price, W. (1997). Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. British Columbia Ministry of Employment and Investment, Energy and Minerals Division.

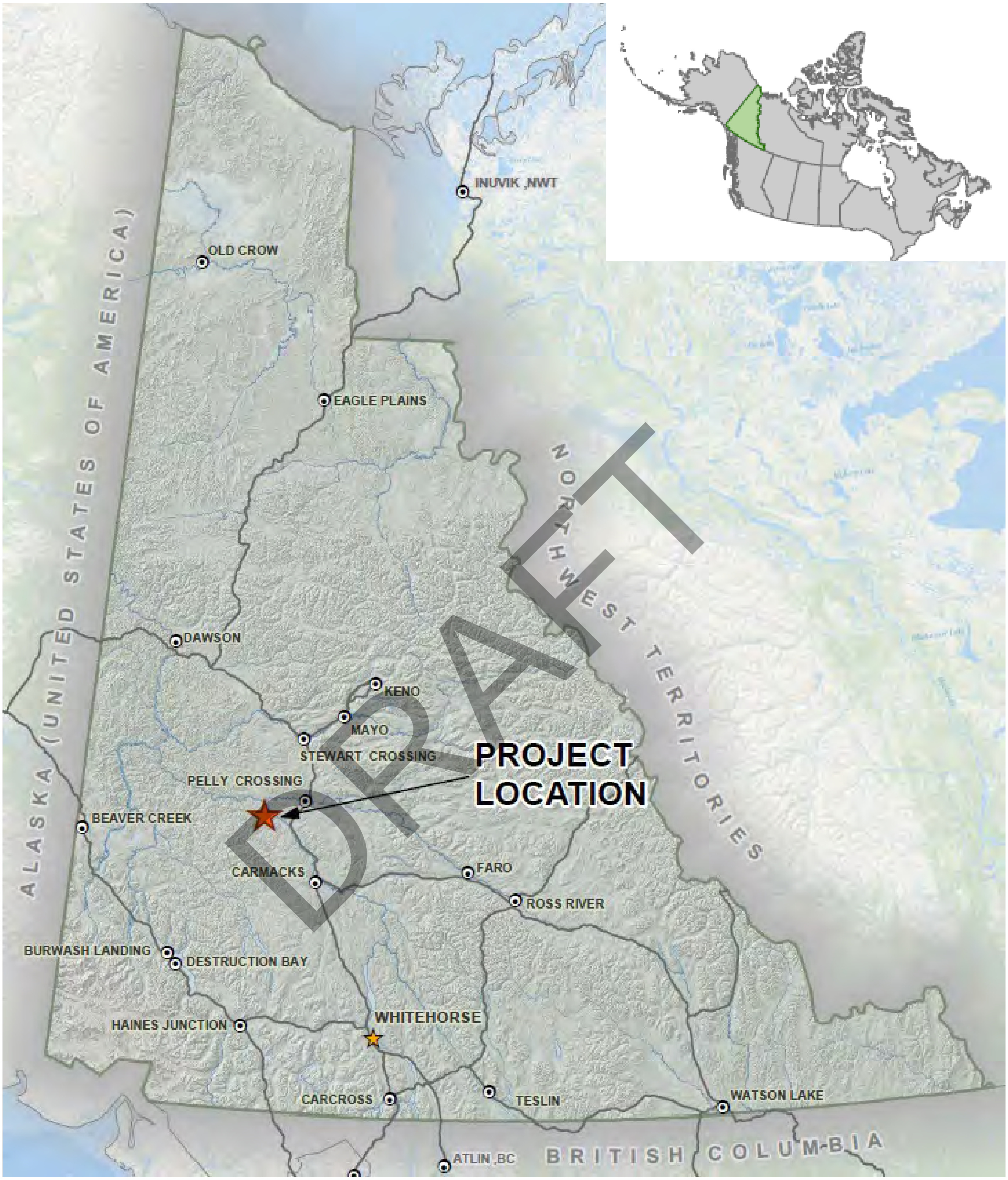
Sobek, A. A, Schuller, W. A., Freeman, J. R., and Smith, R. M. 1978. Field and laboratory methods applicable to overburden and minesoils. USEPA Report No. 600/2-78-054, 203 pp.

SRK Consulting (Canada) Inc. 2010. Minto Mine Expansion – Phase IV ML/ARD Assessment and Post-Closure Water Quality Prediction. Technical report prepared for Minto Explorations Ltd., August 2010.

SRK Consulting (Canada) Inc. 2013. Minto Mine Phase V/VI Expansion: ML/ARD Assessment and Inputs to Water Quality Predictions. Technical report prepared for Minto Explorations Ltd. by SRK Consulting (Canada) Inc., July 2013, Project 1CM002.003.

Tafti, R. and Mortensen, J.K. 2003. Early Jurassic Porphyry Copper (Gold) Deposits at Minto and Williams Creek, Carmacks Copper Belt, Western Yukon. Yukon Exploration and Geology. 289-303.

Figures



Source: Modified from Minto 2018, Minto Mine Water License Amendment: Phase VII Expansion of Mining

srk consulting	MINTO	Minto Mine Phase VII Expansion: ML/ARD Assessment Update **Minto Mine Project Location**
Job No: 1CM002.072 Filename: Figure_1_1CM002.072_rev01_lv.pptx	Minto Mine	Date: October 2021 / Approved: LV / Figure: 1

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Aerial imagery from August 2017

srk consulting

MINTO

Job No: 1CM002.072

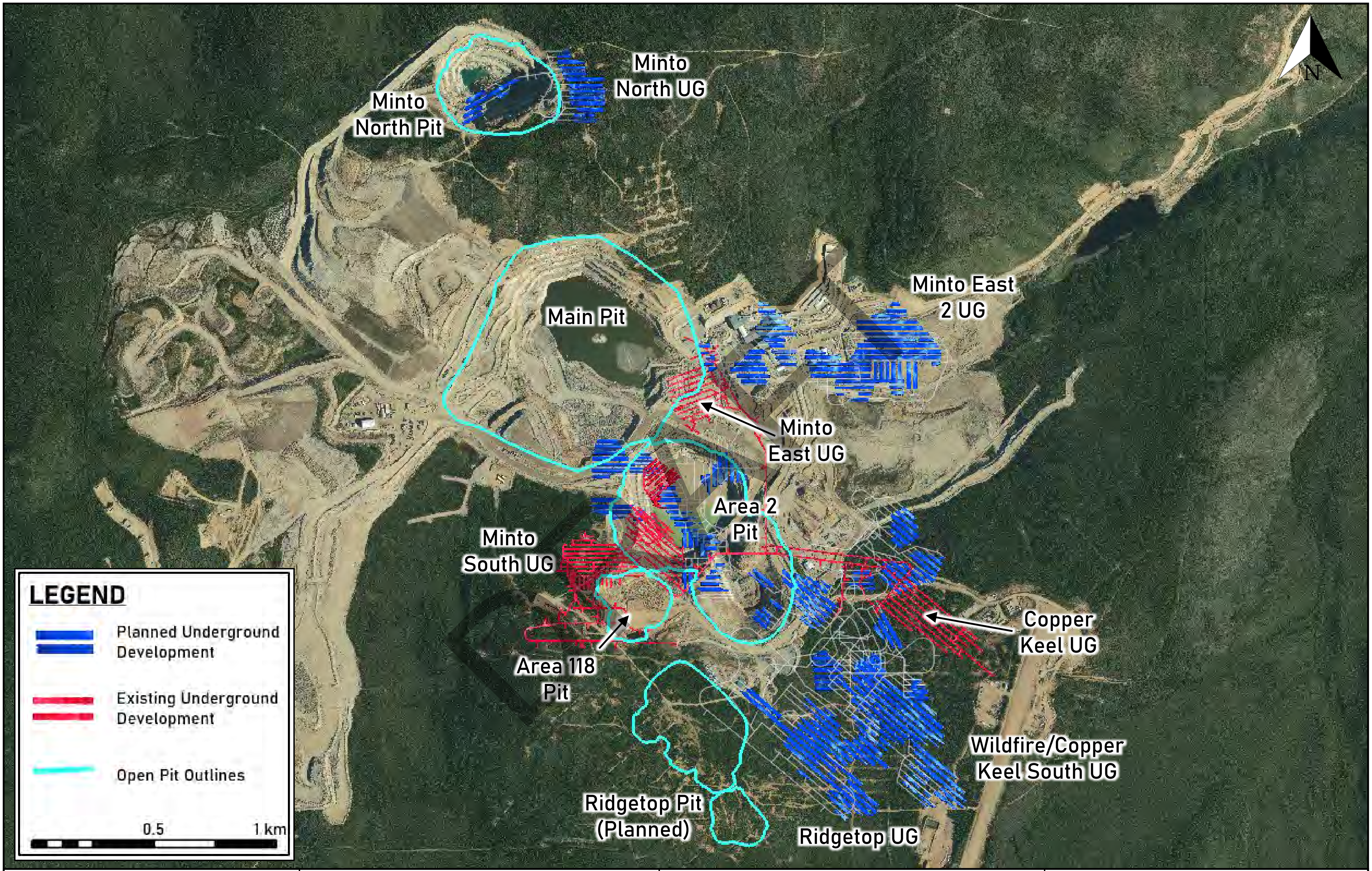
Filename: FrontEndFigures_Landscape_1CM0072_rev01_lv.pptx

Minto Mine

Minto Mine Phase VII Expansion: ML/ARD Assessment Update

Site Layout and Waste Management Facilities

Date:	Approved:	Figure:
October 2021	LV	2



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

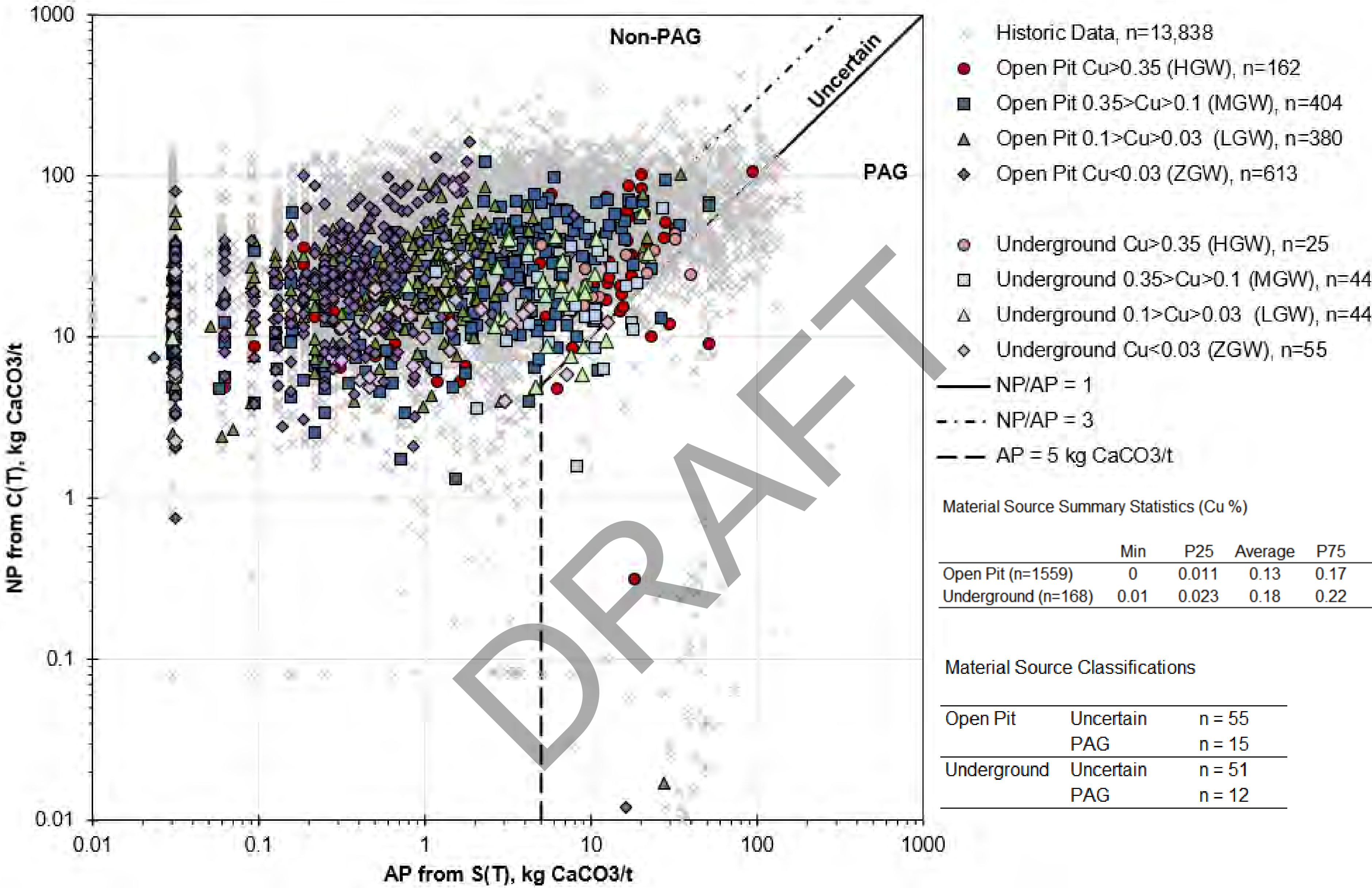
- Aerial imagery from August 2017
- Planned underground development sourced from the 2021 PEA (JDS 2021) and may not be currently permitted.

srk consulting

MINTO

Job No:	1CM002.072	Minto Mine	Minto Mine Phase VII Expansion: ML/ARD Assessment Update		
Filename:	FrontEndFigures_Landscape_1CM0072_rev01_lv.pptx		**Existing and Planned Underground Developments**		
			Date: October 2021	Approved: LV	Figure: 3

Operational Monitoring Data:
On-Site
Waste Rock



Material Source Summary Statistics (Cu %)

	Min	P25	Average	P75	Max
Open Pit (n=1559)	0	0.011	0.13	0.17	3.5
Underground (n=168)	0.01	0.023	0.18	0.22	1.7

Material Source Classifications

Open Pit	Uncertain	n = 55
	PAG	n = 15
Underground	Uncertain	n = 51
	PAG	n = 12

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[OnSite_Operational_Data_1CM002.072_REV01_AJS.xlsx]

Notes:

- Historical data were collected previous to 2013
- HGW – High Grade Waste
- MGW – Medium Grade Waste
- LGW – Low Grade Waste
- ZGW – Zero Grade Waste

srk consulting

Job No: 1CM002.072
Filename: Figures_1CM002.072_REV0_AJS.pptx

MINTO

Minto Mine

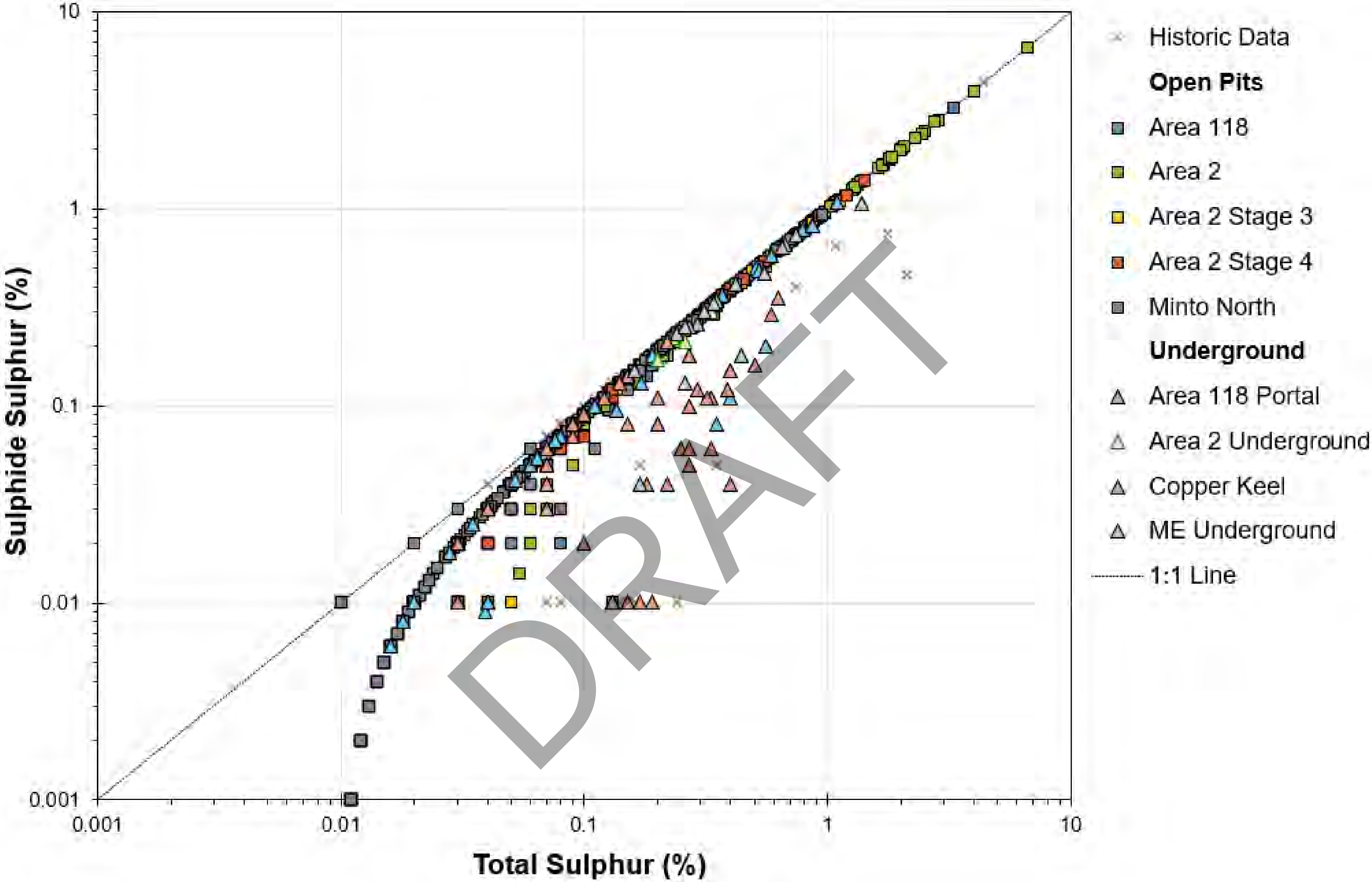
Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Operational Monitoring - Onsite Waste Rock: NP versus AP

Date:	Approved:	Figure:
September 2021	LV	4

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Operational Monitoring Data:
Off-Site
Waste Rock



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2013

srk consulting

MINTO

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Waste Rock: Sulphide Sulphur vs. Total Sulphur

Job No: 1CM002.072

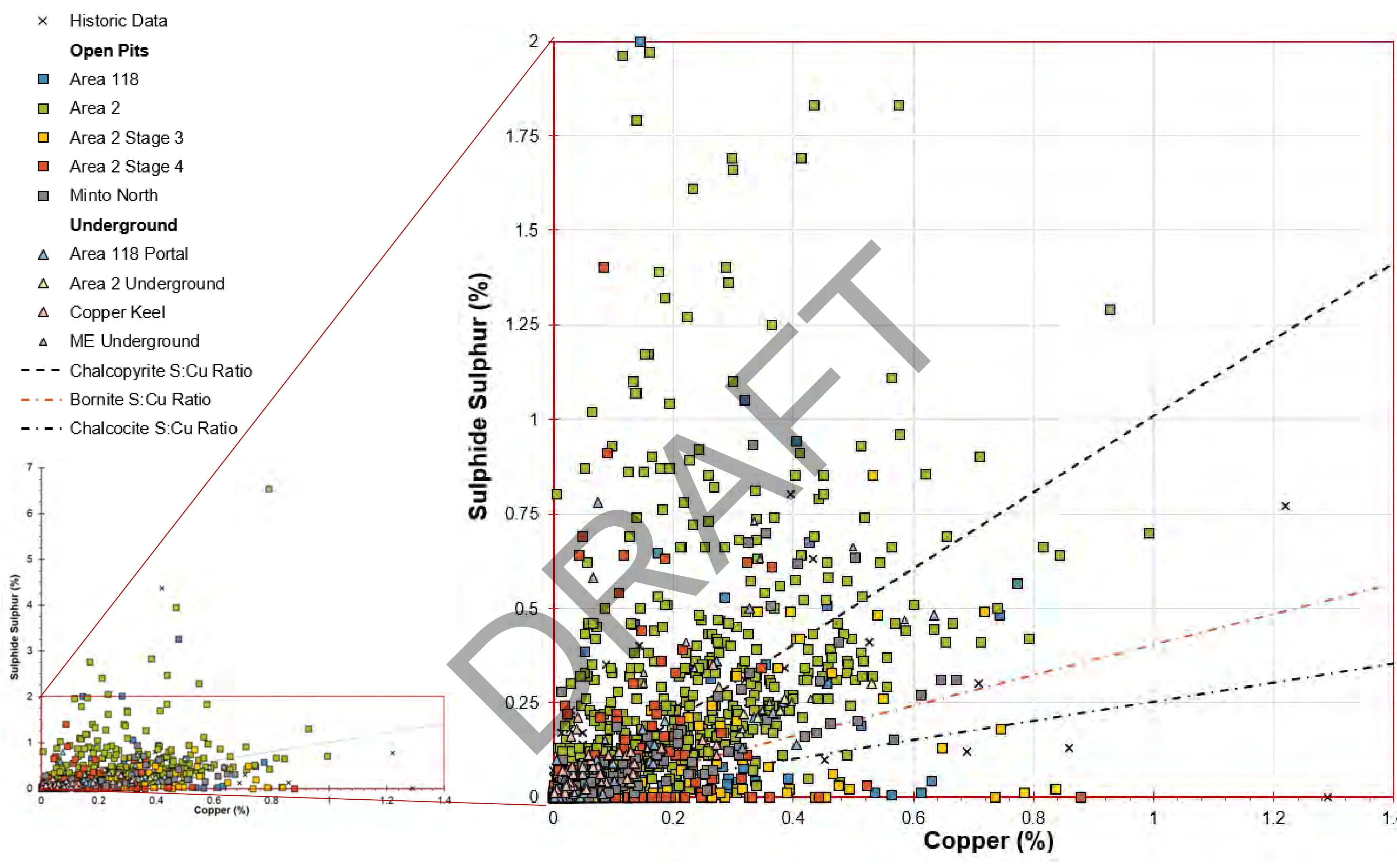
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Date: October 2021

Approved: LV

Figure: 5



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2013.

srk consulting

MINTO

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Waste Rock: Sulphide Sulphur vs. Copper

Job No: 1CM002.072

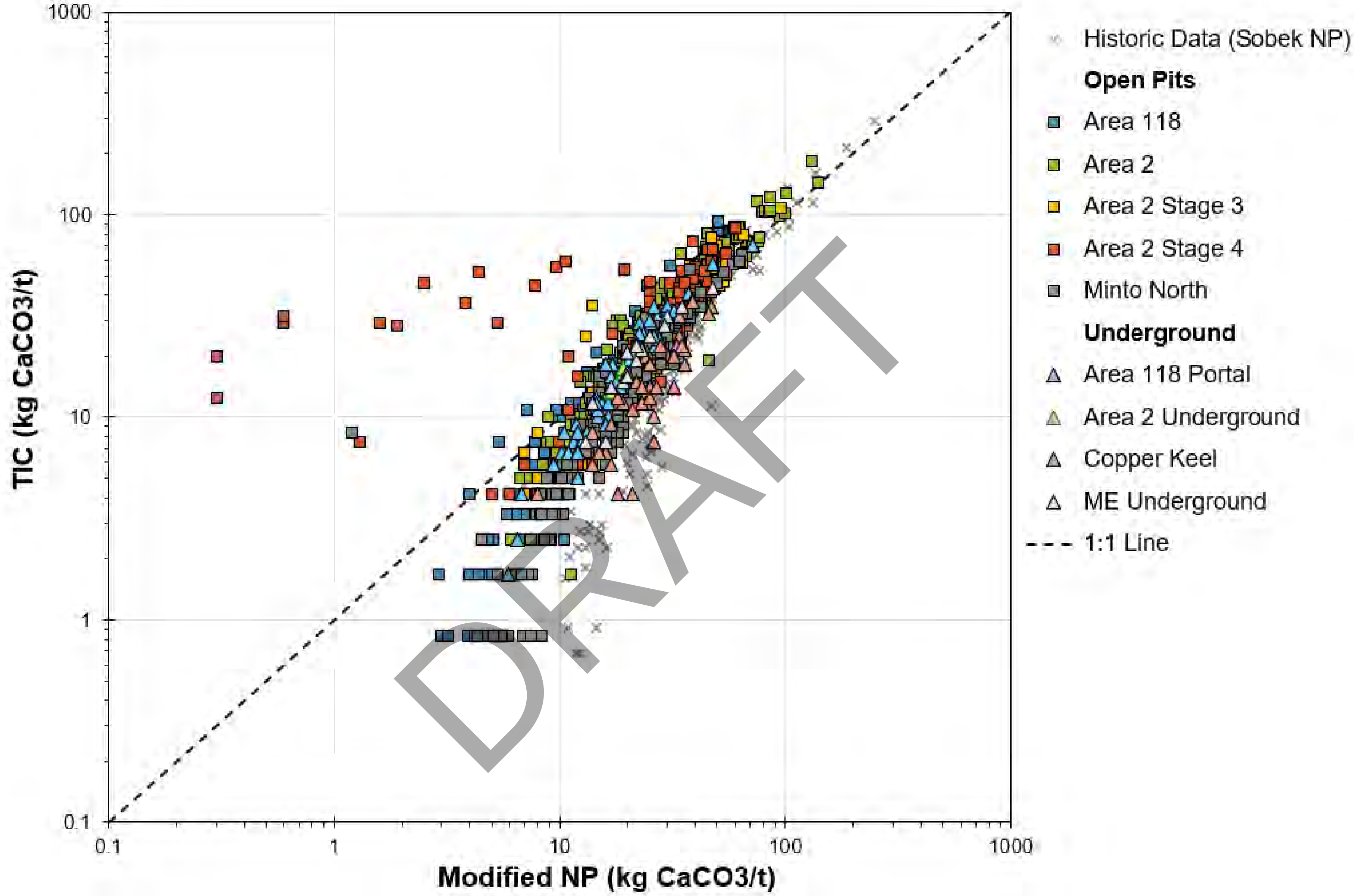
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Date: October 2021

Approved: LV

Figure: 6



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2013.

srk consulting

MINTO

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

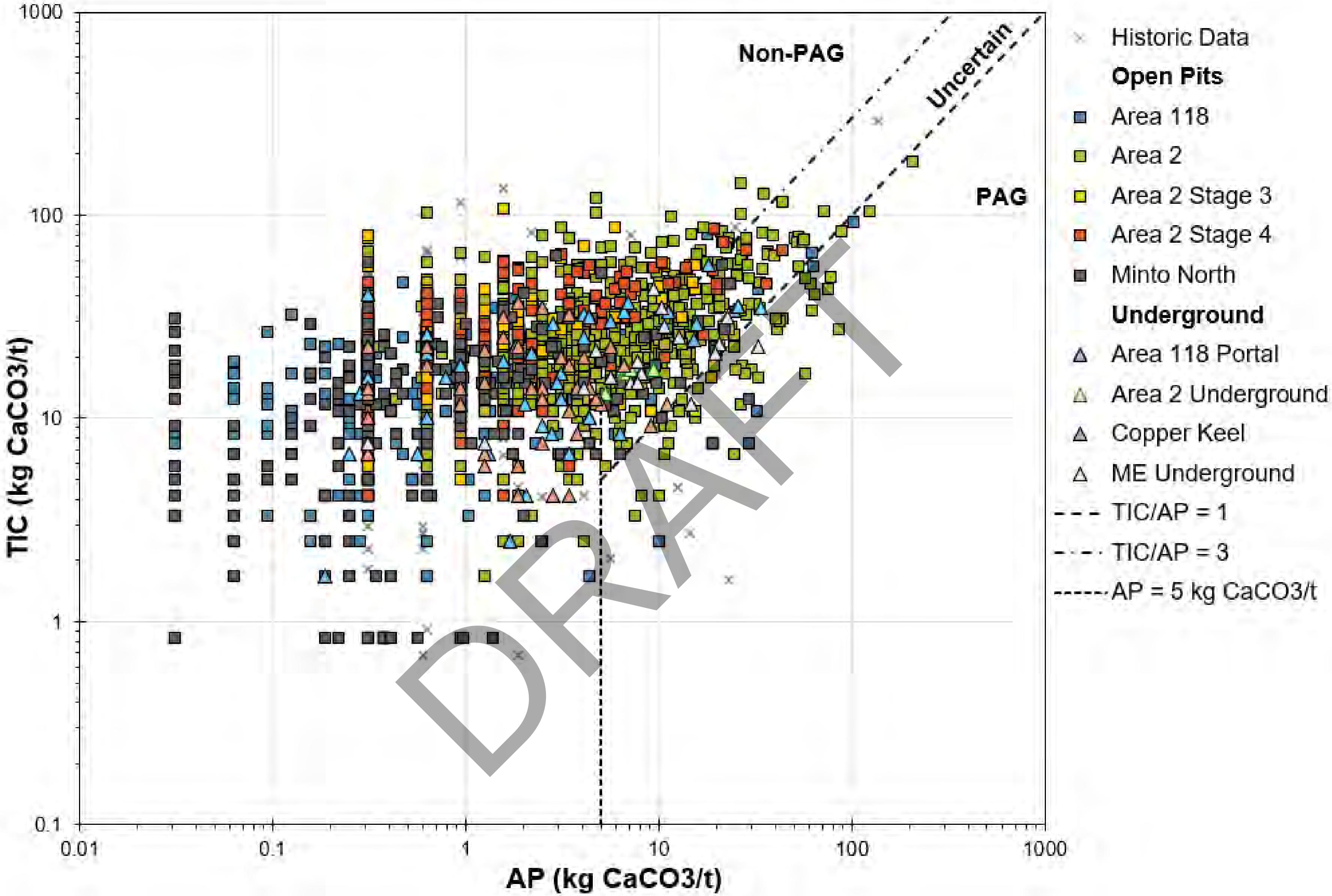
Waste Rock: NP_{TIC} vs. Modified NP

Job No: 1CM002.072

Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Date:	Approved:	Figure:
October 2021	LV	7



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2013.

srk consulting

MINTO

Job No: 1CM002.072

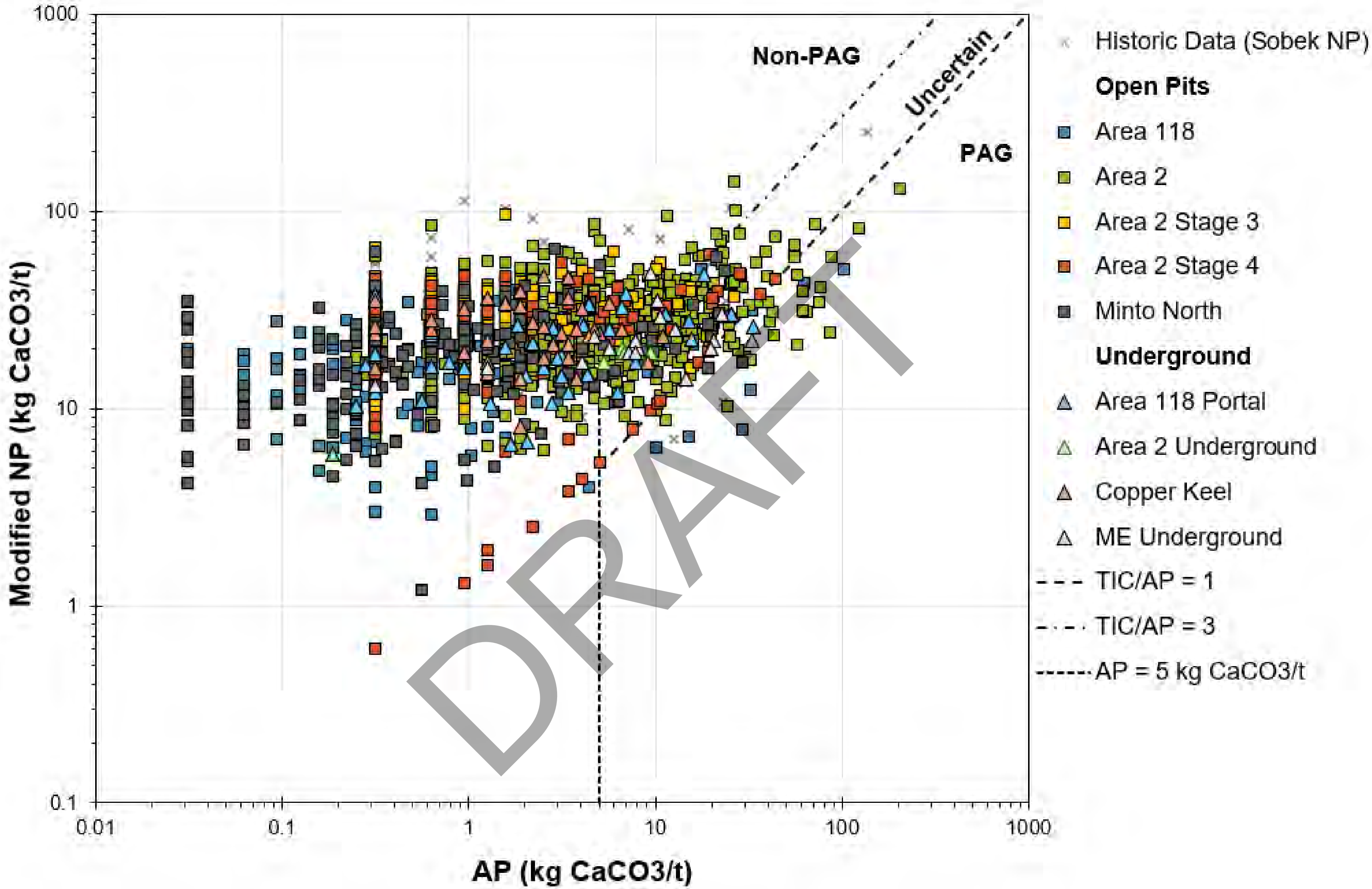
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Waste Rock: NP_{TIC} vs. AP

Date:	Approved:	Figure:
October 2021	LV	8



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2013 and analyzed using the Sobek method, as opposed to the Modified-Sobek method.

srk consulting

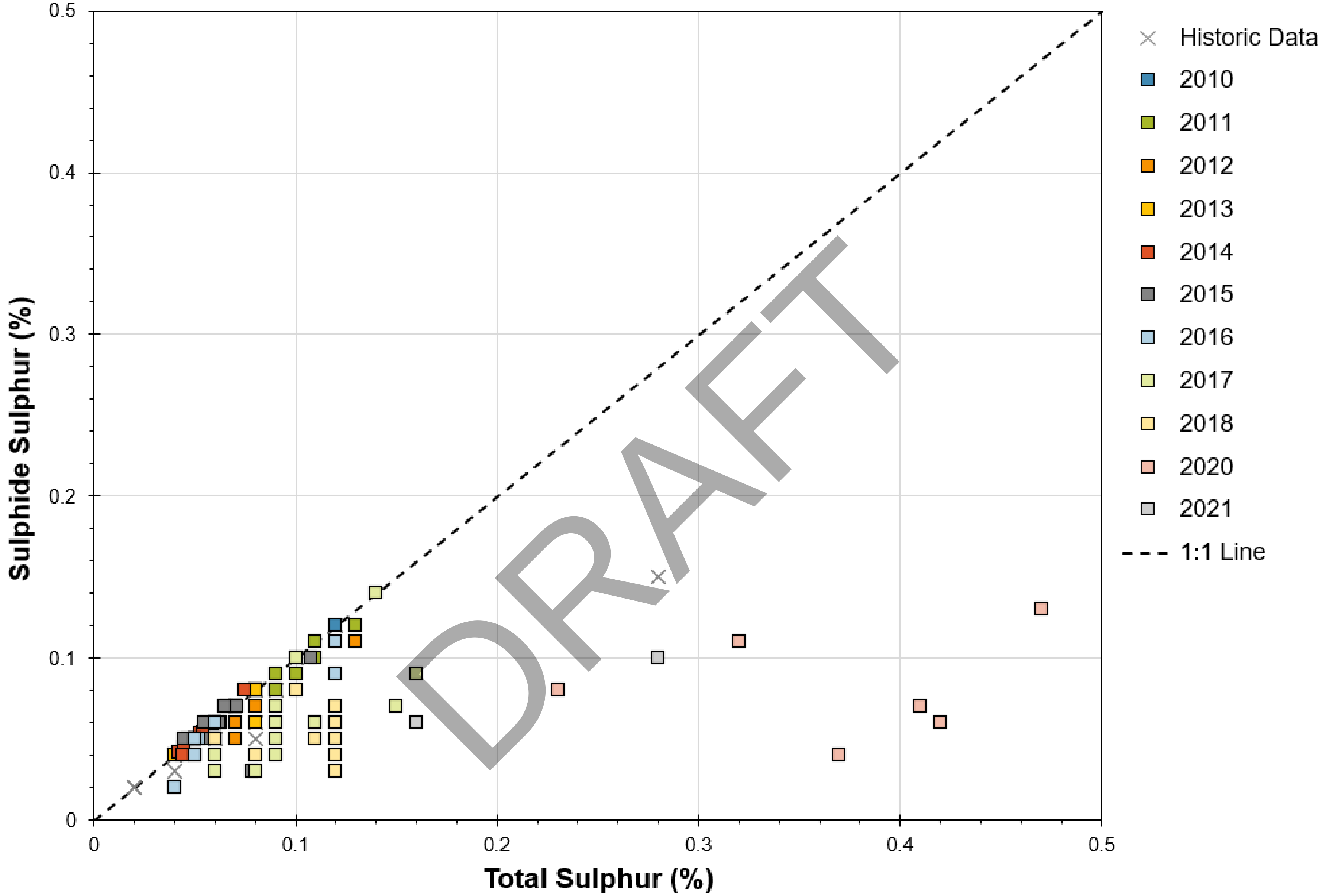
MINTO

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Waste Rock: Modified NP vs. AP

Job No: 1CM002.072	Minto Mine	Date: October 2021	Approved: LV	Figure: 9
Filename: Figures_1CM002.072_REV0_AJS.pptx				

Operational Monitoring Data:
Off-Site
Tailings



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2010.

srk consulting

MINTO

Job No: 1CM002.072

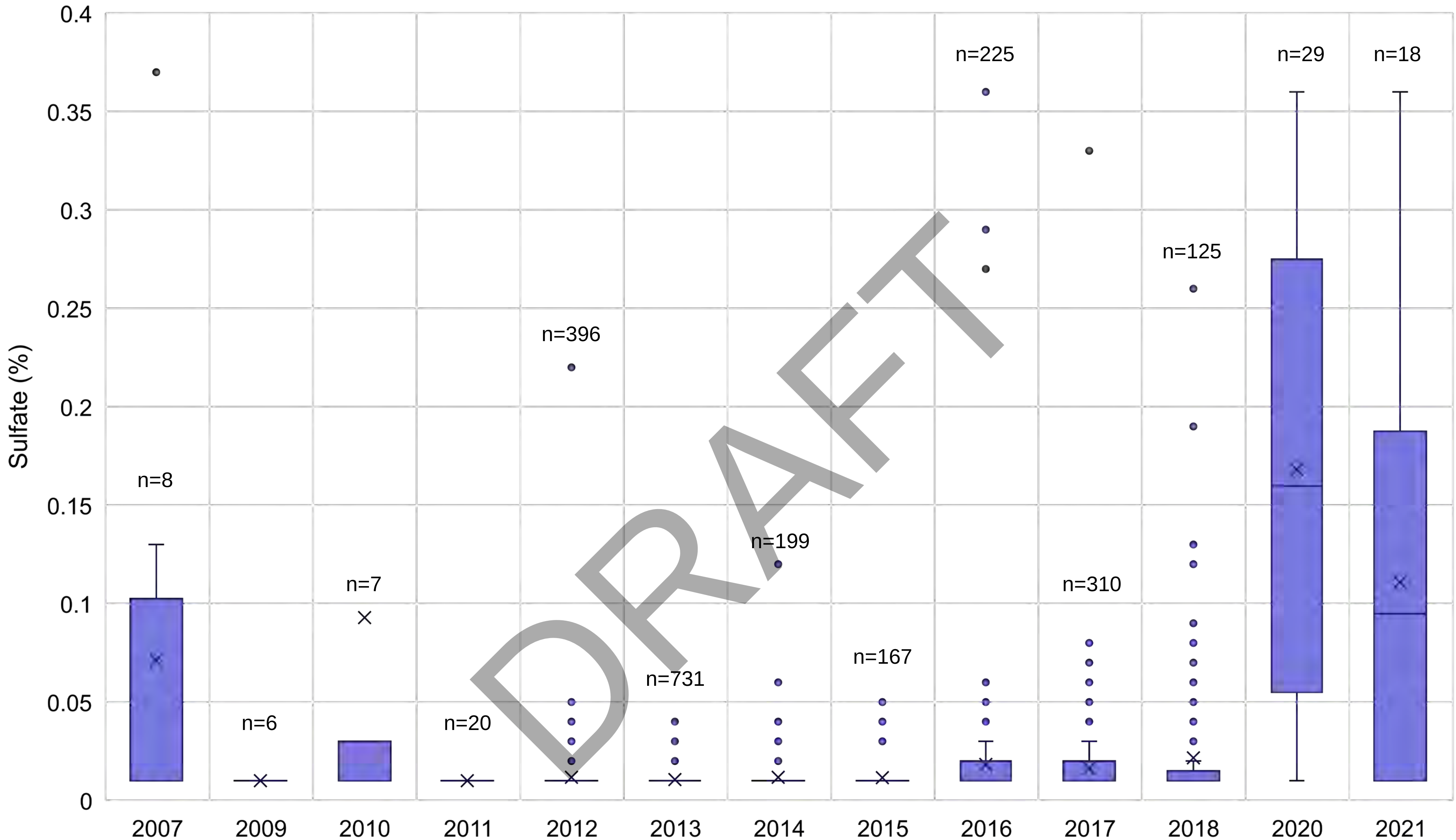
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Tailings: Sulphide Sulphur vs. Total Sulphur

Date:	Approved:	Figure:
October 2021	LV	10



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- No data were collected during 2019 due to the Temporary Closure Period.

.

srk consulting

MINTO

Job No: 1CM002.072

Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

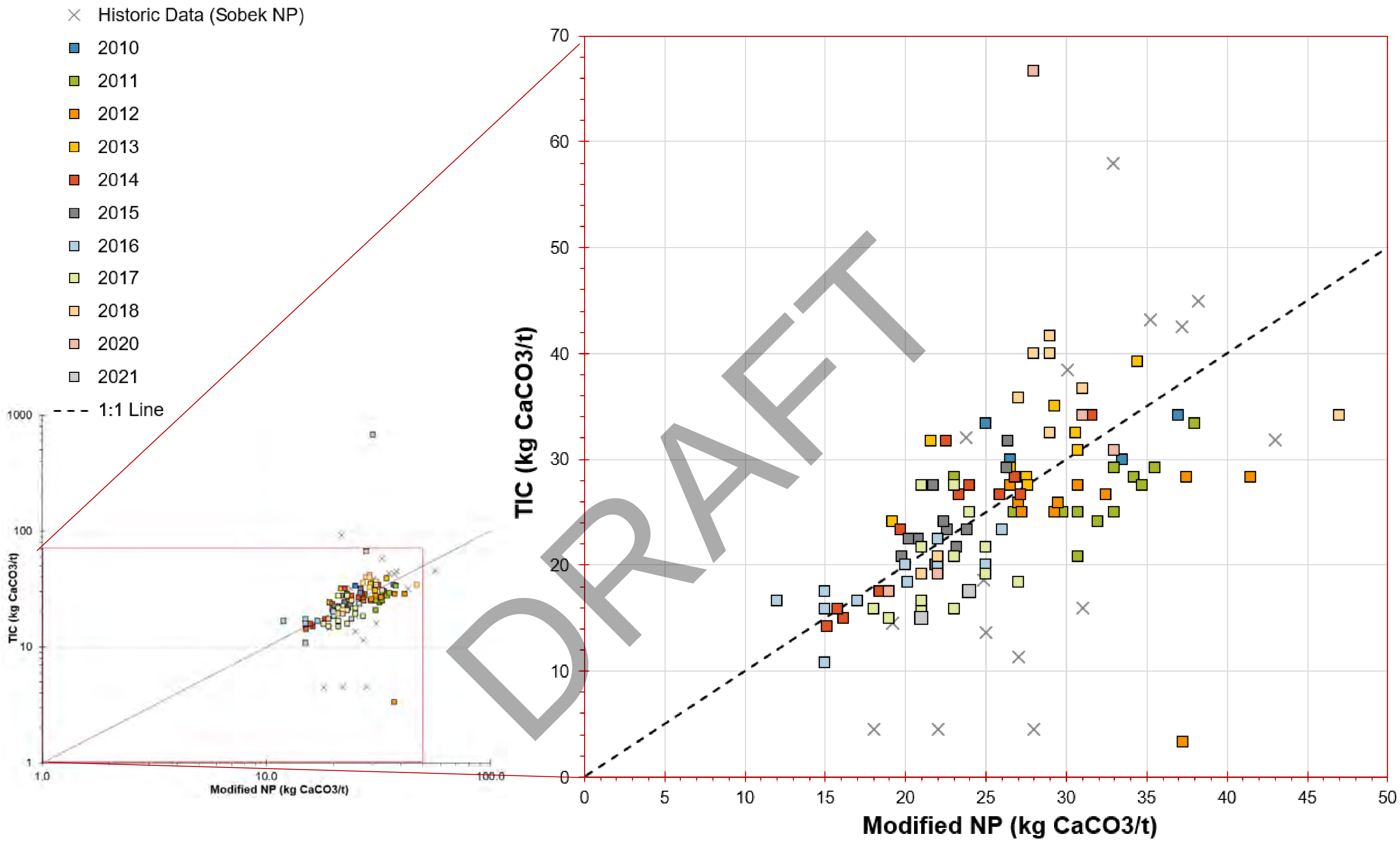
Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Box and Whisker Plot of Sulfate in Tailings by Year

Date: October 2021

Approved: LV

Figure: 11



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2010.

srk consulting

Job No: 1CM002.072

Filename: Figures_1CM002.072_REV0_AJS.pptx

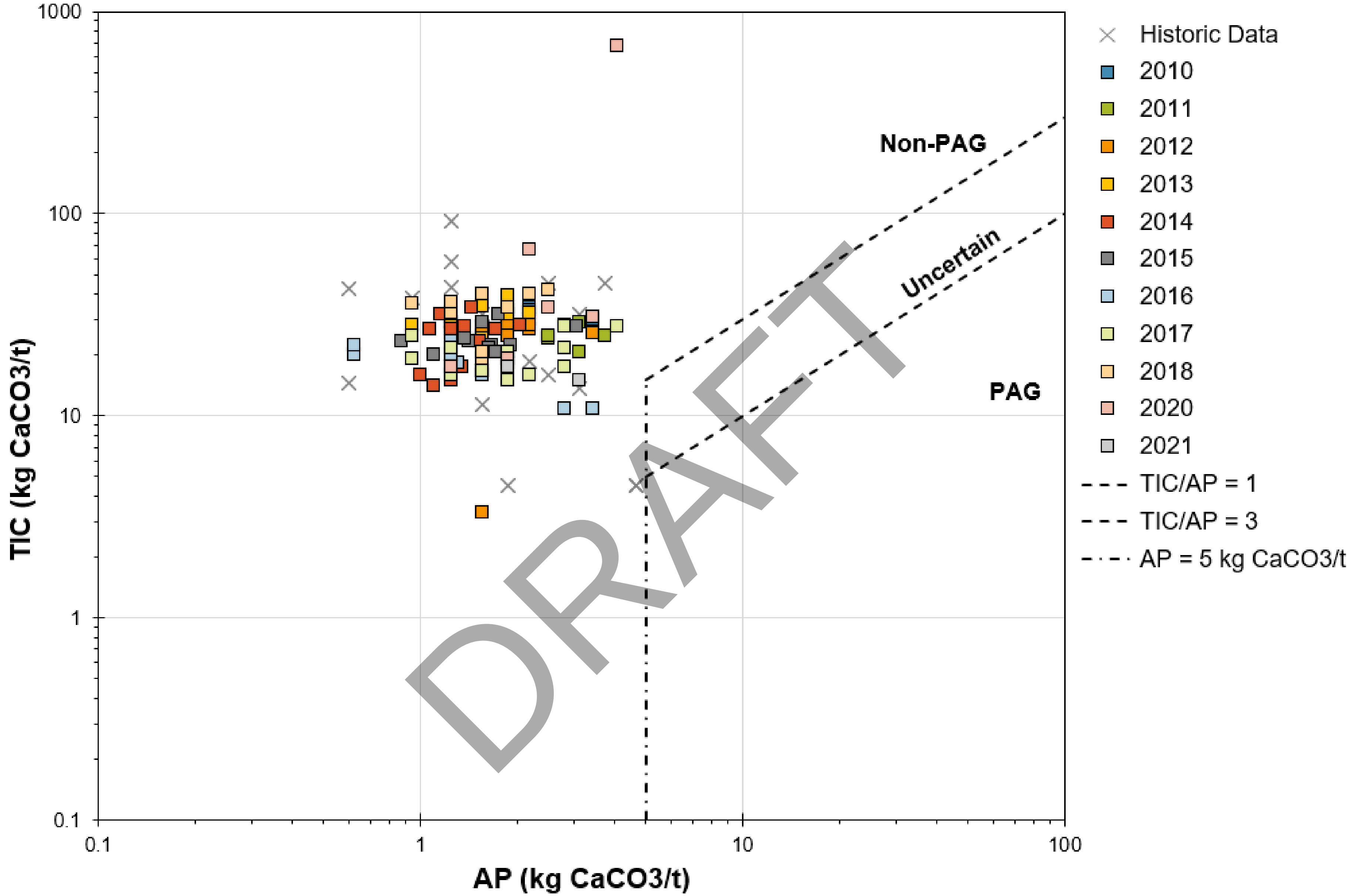
MINTO

Minto Mine

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Tailings: NP_{TIC} vs. Modified NP

Date:	Approved:	Figure:
October 2021	LV	12



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

- Historical data were collected prior to 2010.

srk consulting

MINTO

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Tailings: NP_{TIC} vs. AP

Job No: 1CM002.072

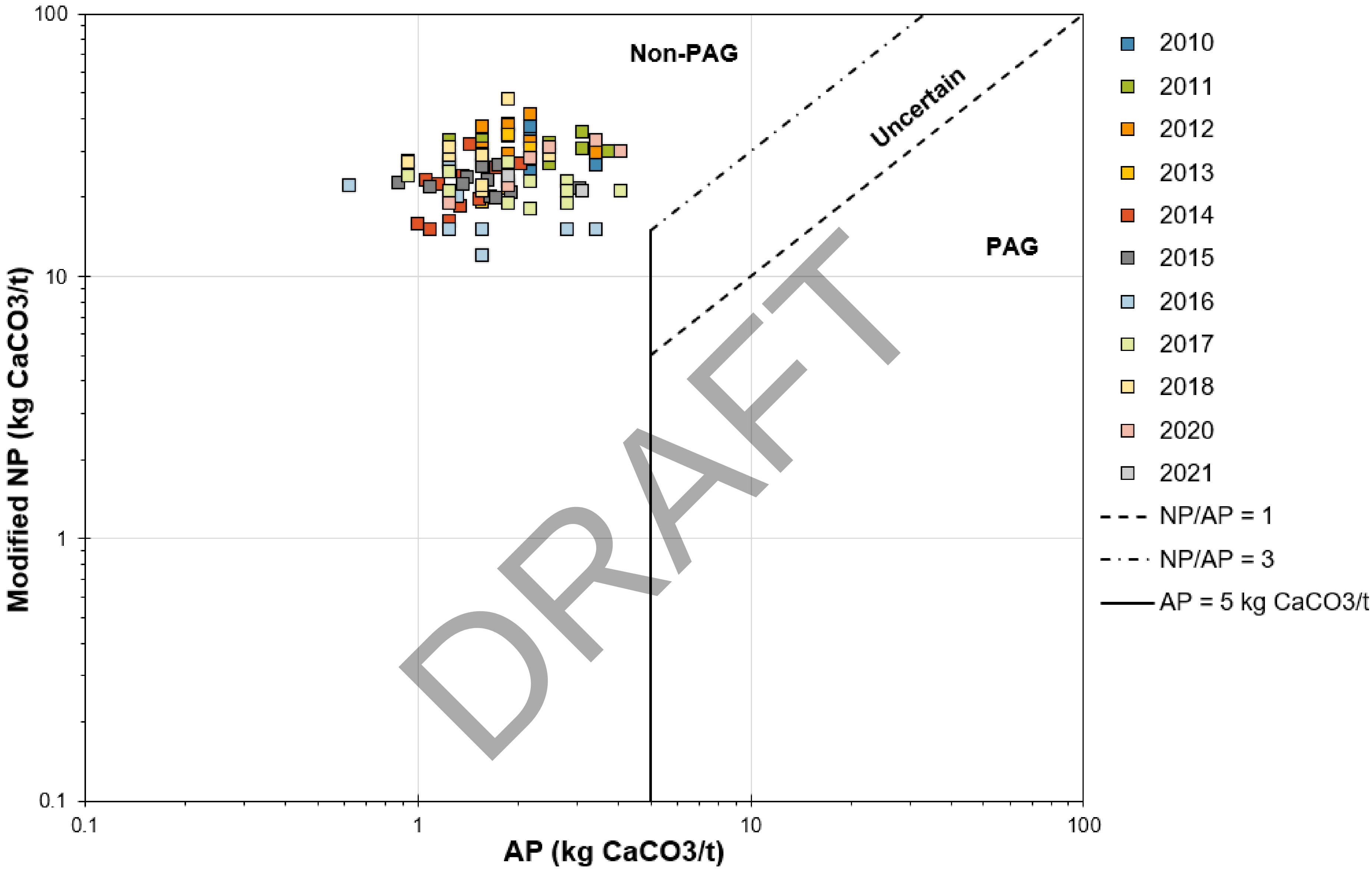
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Date: October 2021

Approved: LV

Figure: 13



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Operational_Data_1CM002.072_REV02_AJS.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

Modified NP was not analyzed prior to 2010 so no historic data are available.

srk consulting

MINTO

Job No: 1CM002.072

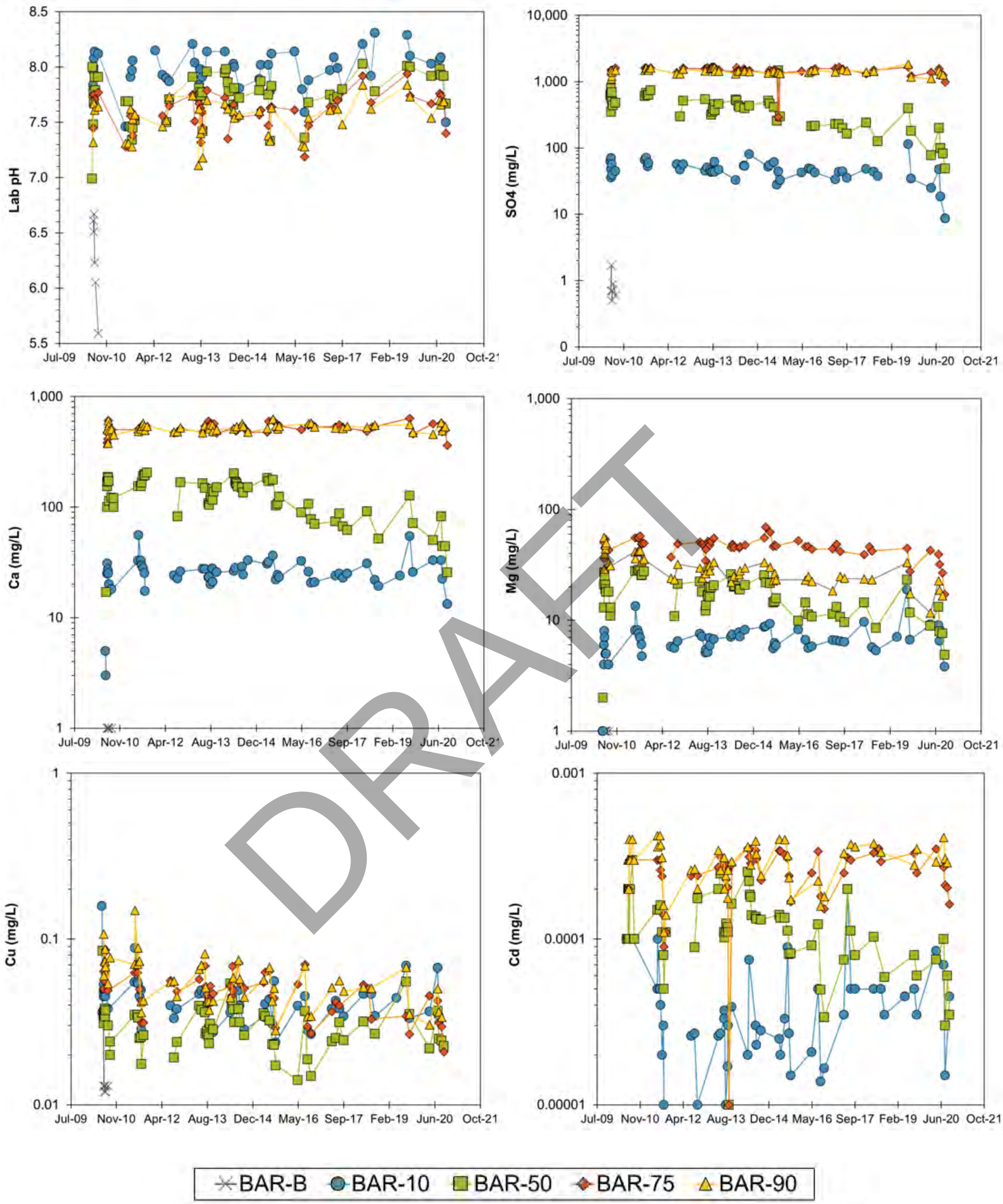
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Tailings: Modified NP vs. AP

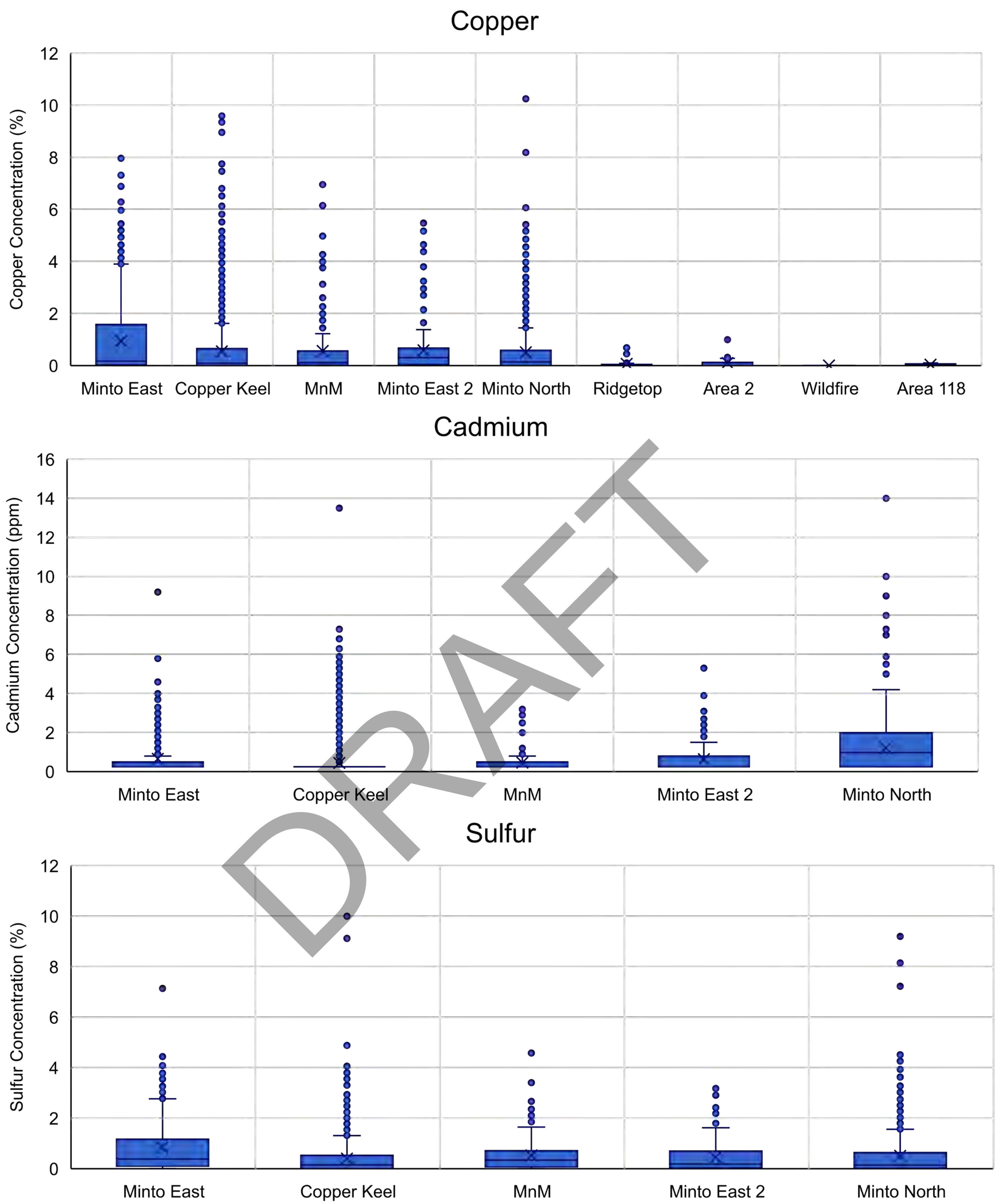
Date:	Approved:	Figure:
October 2021	LV	14



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source

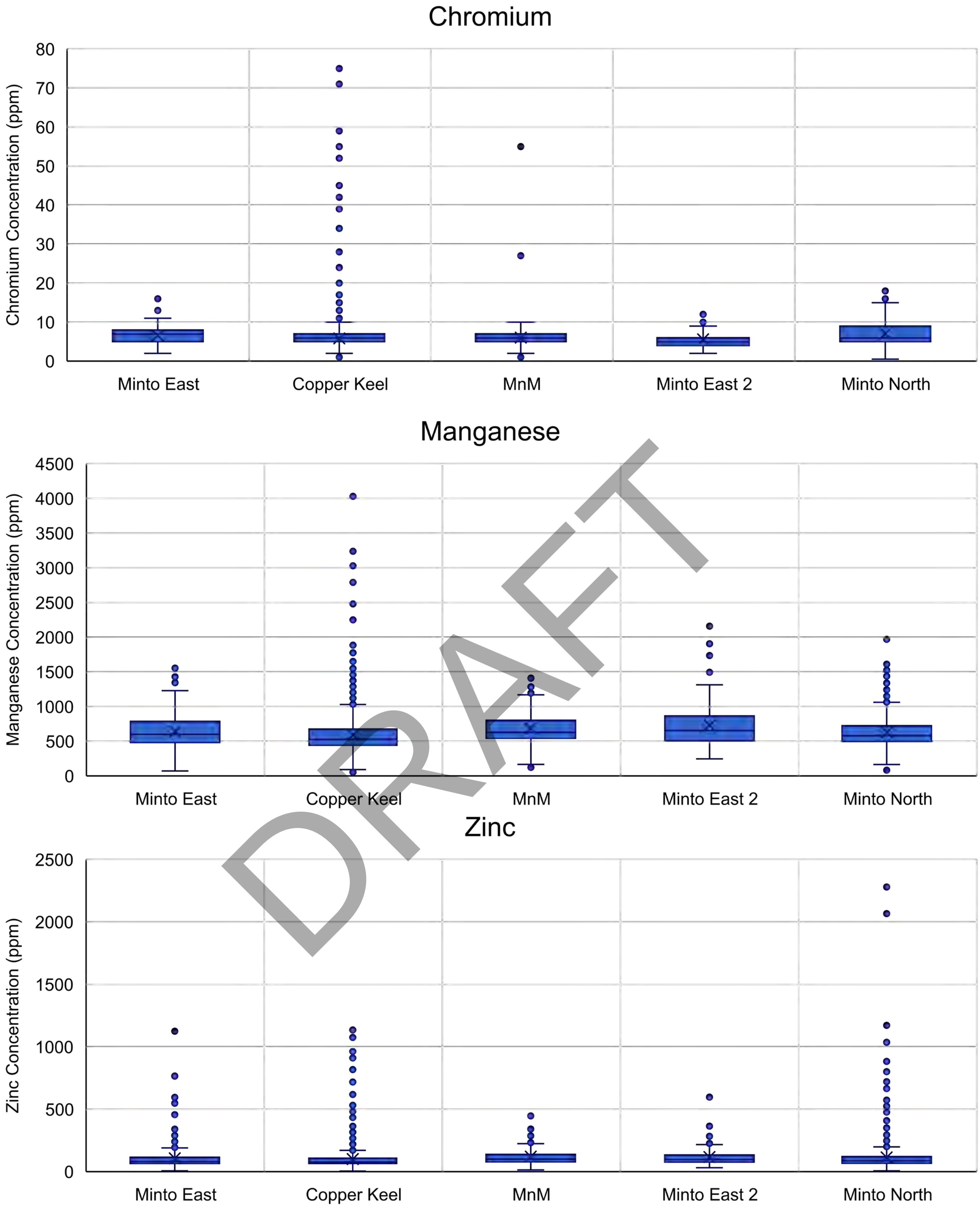
srk consulting	Minto Explorations Ltd.	Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report
		Field Barrel Tests: Selected Results
Job No: 1CM001.072 Filename: Barrel_Figures_1CM002.072_AJS.pptx	Minto Mine	Date: October 2021 · Approved: LV · Figure: **15**

Phase VII Materials Exploration Assays



Source: Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Copy of PhaseVII_Exploration_Data_1CM002.072_REV01_AJS_LV.xlsx]

srk consulting	MINTO	Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report
		Box and Whisker Plots for Cu, Cd and S - Phase V, VI, VII Materials
Job No: 1XX0xx.0xx Filename: Figure xxxx.pptx	Minto Mine	Date: October 2021 / Approved: LV / Figure: **16**



Source: Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Copy of PhaseVII_Exploration_Data_1CM002.072_REV01_AJS_LV.xlsx]

srk consulting

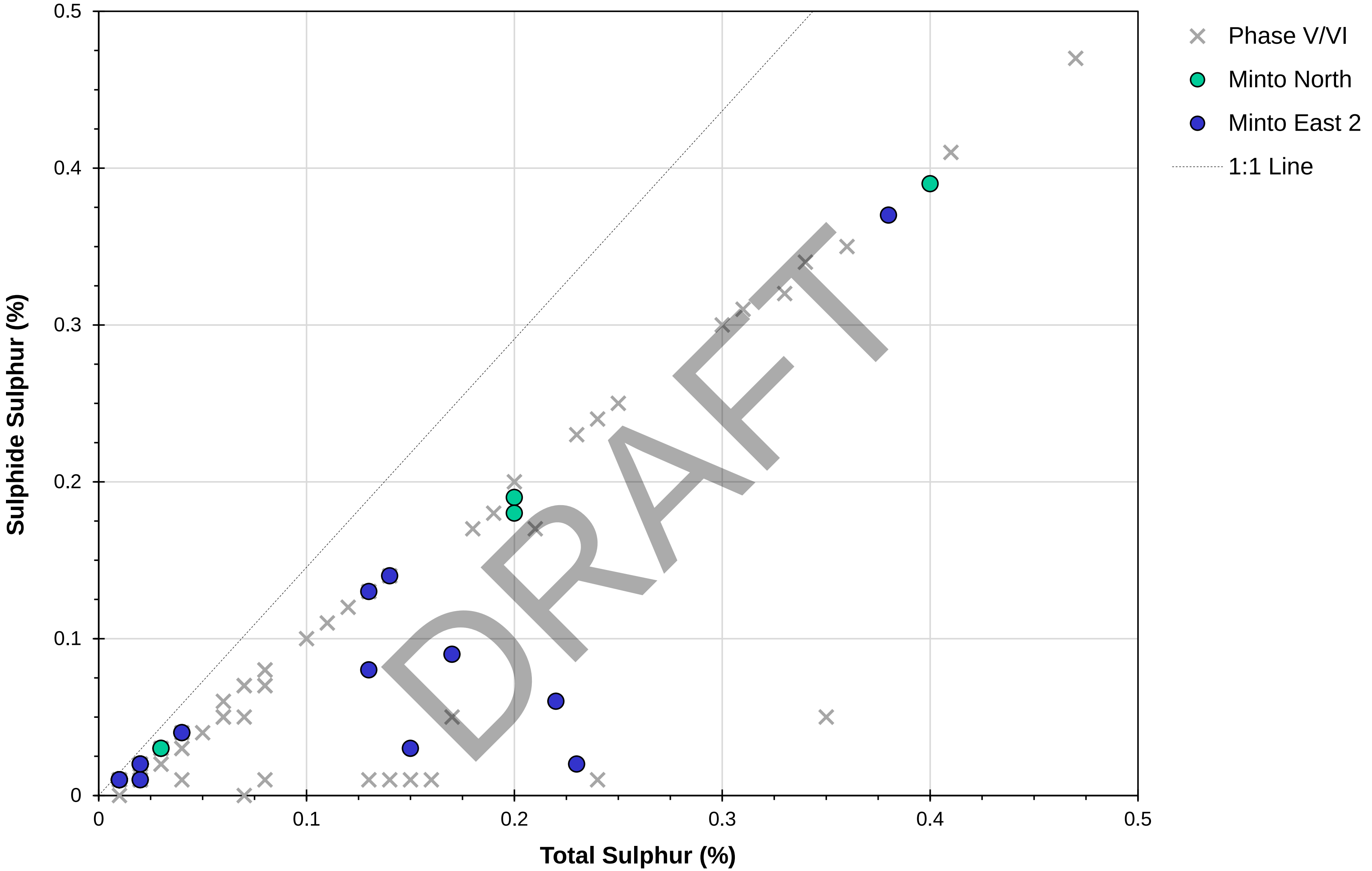
MINTO

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Box and Whisker Plots for Cr, Mn and Zn - Phase V, VI, VII Materials

Job No: 1XX0xx.0xx Filename: Figure xxxx.pptx	Minto Mine	Date: October 2021	Approved: LV	Figure: 17

Phase VII Materials
ABA



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Copy of PhaseVII_Exploration_Data_1CM002.072_REV01_AJS_LV.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

srk consulting

MINTO

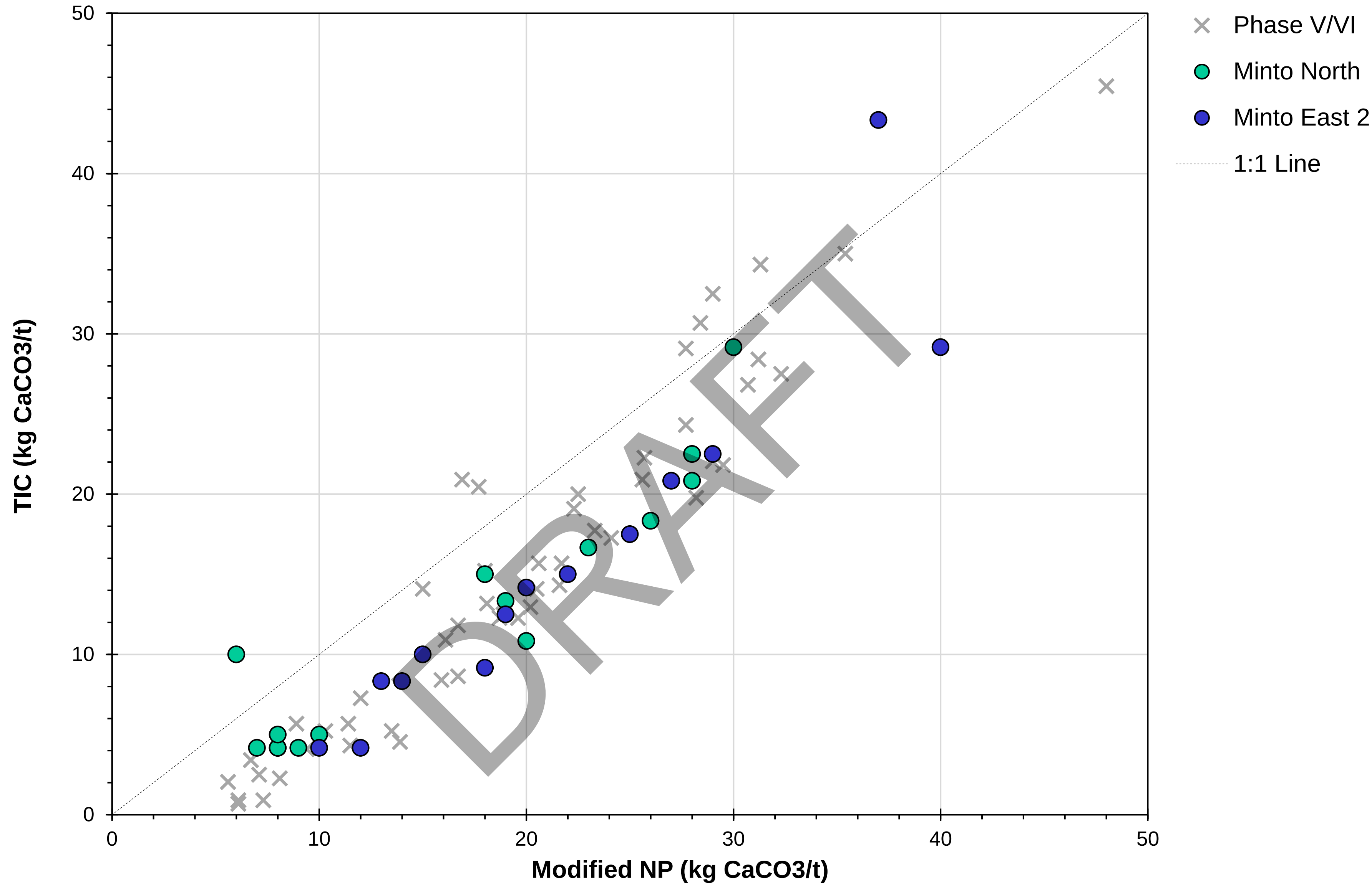
Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Phase VII: Sulphide Sulphur vs Total Sulphur

Job No: 1CM002.072
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

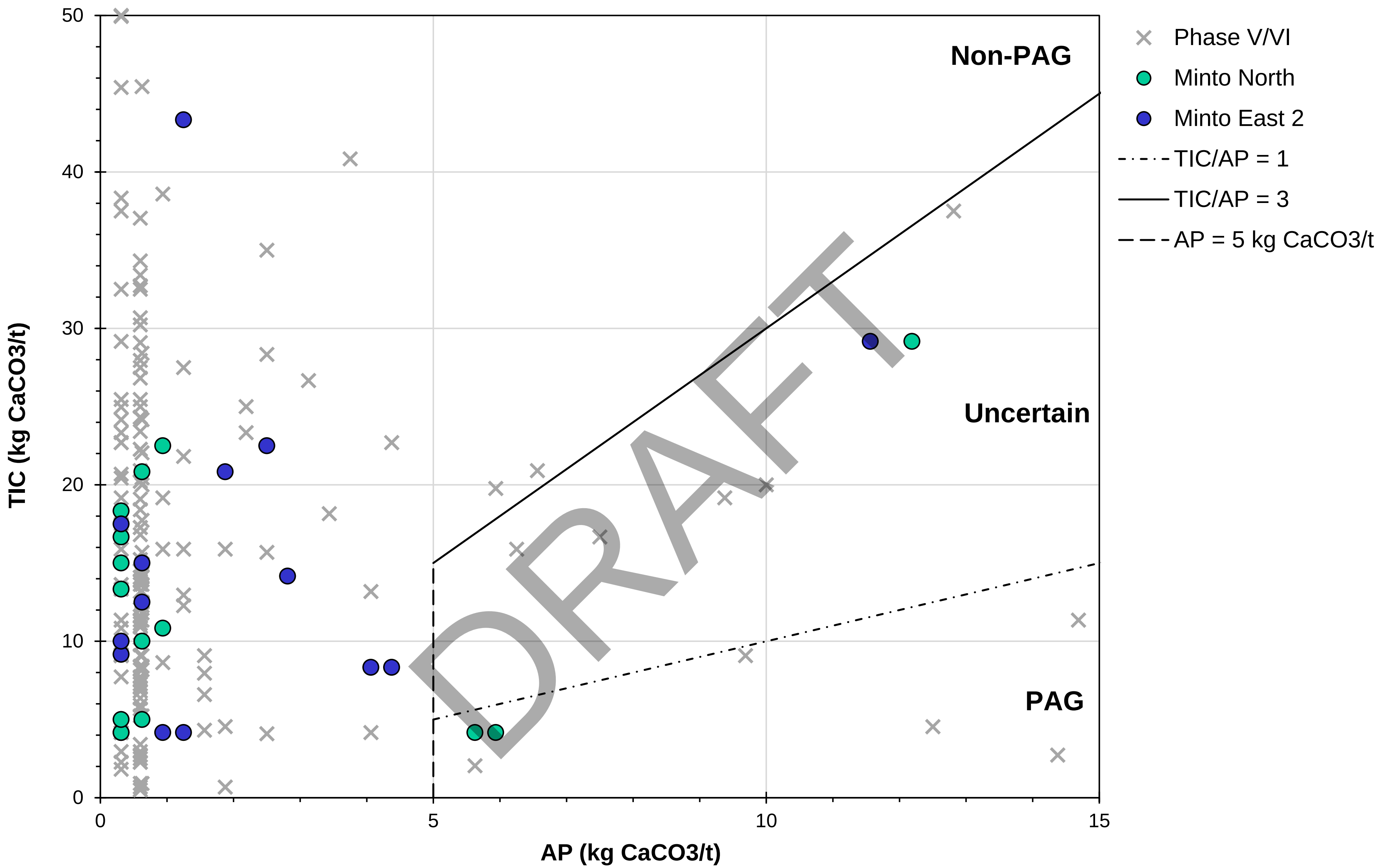
Date:	Approved:	Figure:
October 2021	LV	18



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Copy of PhaseVII_Exploration_Data_1CM002.072_REV01_AJS_LV.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:	srk consulting	MINTO	Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report
			Phase VII: NP_{TIC} vs. Modified NP
	Job No: 1CM002.072 Filename: Figures_1CM002.072_REV0_AJS.pptx	Minto Mine	Date: October 2021 | Approved: LV | Figure: **19**



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Copy of PhaseVII_Exploration_Data_1CM002.072_REV01_AJS_LV.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:

srk consulting

MINTO

Job No: 1CM002.072

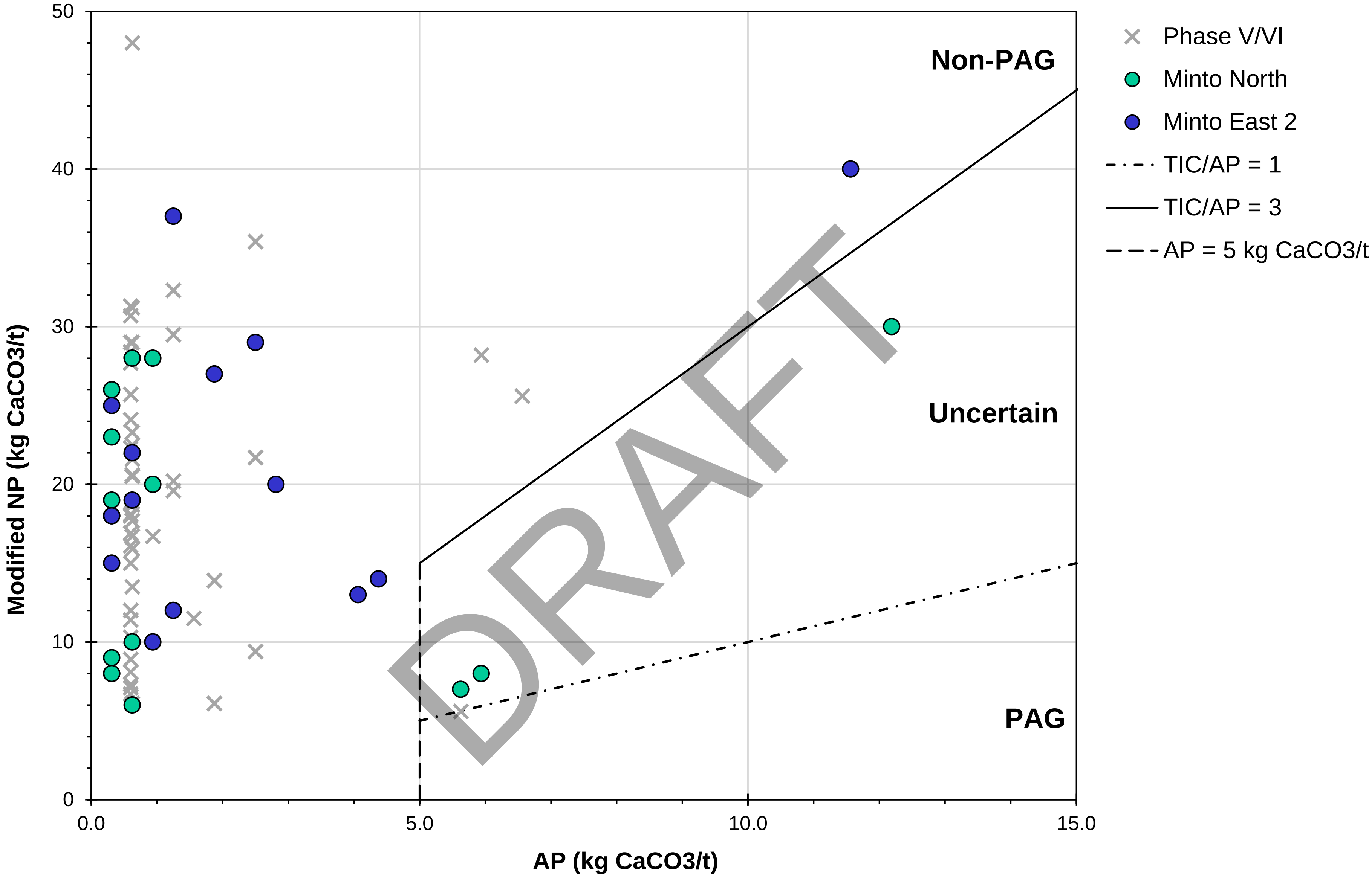
Filename: Figures_1CM002.072_REV0_AJS.pptx

Minto Mine

Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report

Phase VII: NP_{TIC} vs. AP

Date:	Approved:	Figure:
October 2021	LV	20



Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!090_Working_Files\004 MLARD Assessment and Source Terms\[Copy of PhaseVII_Exploration_Data_1CM002.072_REV01_AJS_LV.xlsx]

Z:\01_SITES\Minto\1CM002.072_Site Characterization Plan\!080_Deliverables\004 MLARD Assessment & Source Terms\040_Figures

Notes:	srk consulting	MINTO	Minto Mine ML/ARD Assessment and Water Quality Predictions – 2021 Update Report
			Phase VII: Modified NP vs. AP
	Job No: 1CM002.072 Filename: Figures_1CM002.072_REV0_AJS.pptx	Minto Mine	Date: October 2021 | Approved: LV | Figure: **21**

Appendix A SRK 2021 - Water and Load Balance Model Update Report

Will be available for the final version

Appendix B Geologic Setting

1.1 Geological Setting

Section 1.1 is adapted from Section 7 of Minto (2012).

1.1.1 Regional Geology

The Minto Project is found in the north-northwest trending Carmacks Copper Belt along the eastern margin of the Yukon-Tanana Composite Terrain, which is comprised of several metamorphic assemblages and batholiths (Figure 1). The Belt is host to several intrusion-related Cu-Au mineralized hydrothermal systems. The Yukon-Tanana Composite Terrain is the easternmost and largest of the pericratonic terranes accreted to the Paleozoic northwestern margin of North America (e.g., Colpron et al., 2005). It is regarded to be the product of a continental arc and back-arc system, preserving meta-igneous and metasedimentary rocks of Permian age on top of a pre-Late Devonian metasedimentary basement (e.g., Piercey et al. 2002).

The Minto Property and surrounding area are underlain by plutonic rocks of the Granite Mountain Batholith (Early Mesozoic Age) (Figure 2) that have intruded into the Yukon-Tanana Composite Terrain. They vary in composition from quartz diorite and granodiorite to quartz monzonite. The batholith is unconformably overlain by clastic sedimentary rocks thought to be the Tantalus Formation and andesitic to basaltic volcanic rocks of the Carmacks Group. Both are assigned a Late Cretaceous age. Immediately flanking the Granite Mountain Batholith to the east is a package of undated mafic volcanic rocks which outcrop in the banks of the Yukon River. The structural relationship between the batholith and the undated mafic volcanics is poorly understood because the contact zone is not exposed.

1.1.2 Property Geology and Lithological Description

Much of the geological understanding of the rock around the Minto deposits is based on observations from diamond drill core and extrapolation from regional observations. The reason for this is poor outcrop exposure (less than 5% coverage), as well as the deep weathering and oxidation of the exposed outcrop. The terrain was not glaciated during the last ice age event.

The hypogene copper sulphide mineralization at Minto is hosted wholly within the Minto pluton, which intrudes near the boundary between the Stikinia and Yukon-Tanana terrains, however since the contact is not exposed it is unclear if the pluton stitches the two terrains. The Minto pluton is predominantly of granodiorite composition. Hood et al. (2008) distinguish three varieties of the intrusive rocks in the pluton. The first variety is a megacrystic K-feldspar granodiorite. It gradually ranges in mineralogy to quartz diorite and rarely to quartz monzonite or granite, typically maintaining a massive igneous texture. An exception occurs locally where weakly to strongly foliated granodiorite is seen in distinct sub-parallel zones several metres to tens of metres thick.

A second variety of igneous rock is a folded quartzofeldspathic gneiss with centimeter-thick compositional layering and folded by centimetre to decimetre-scale disharmonic, gentle to isoclinal folds (Hood et al., 2008). The third variety of intrusive is a biotite-rich gneiss. Minto geologists consider all units to be similar in origin and are variously deformed equivalents of the same intrusion.

Copper sulphide mineralization is found in the rocks that have a structurally imposed fabric, ranging from a weak foliation to strongly developed gneissic banding. For this reason all core logging by the past and present operators separates the foliated to gneissic textured granodiorite as a distinctly discernable unit. It is generally believed by Minto geologists that this foliated granodiorite is the variably strained equivalent of the two primary granodiorite textures and not a separate lithology.

The contact relationship between the foliated deformation zones and the massive phases of granodiorite is generally very sharp. These contacts do not exhibit chilled margins and are considered by Minto geologists to be structural in nature, separating the variably strained equivalents of the same rock type. Tafti and Mortensen (2004) had interpreted the sharp contacts to be zones of deformed rock within the unfoliated rock (i.e rafts or roof pendants). Supergene mineralization occurs proximal to near-surface extensions of primary mineralization.

Conglomerate and volcanic flows have been logged in drill core by past operators. New drilling has confirmed the presence of conglomerate, but not the volcanic flows. The latter cannot be confirmed by the authors as the drill core from historic campaigns was largely destroyed in forest fires and no new drilling has intersected such rocks. However, undated volcanic rocks are mapped by Hood, near the southwest margin of the property, south of a fault that is inferred from geophysics to separate them from the Jurassic Age intrusive rocks. The conglomerate has been dated (unpublished date pers. com. Dr. Maurice Colpron- Yukon Geological Survey) as Cretaceous Age. It is now recognized as an outcrop within a borrow pit exposure located west of the airstrip as well as in numerous recent drill holes. Observations of foliated and even copper mineralized cobbles in drilling indicate that “Minto-type” mineralization was exposed, eroded and reincorporated in sedimentary deposits by the Cretaceous Age.

Other rock types, albeit volumetrically insignificant, include dykes of simple quartz-feldspar pegmatite, aplite; and an aphanitic textured intermediate composition rock. Bodies of all of these units are relatively thin and rarely exceed the one meter core intersections. These dykes are relatively late, and observed contact relationships suggest they generally postdate the peak ductile deformation event; however some pegmatite and aplite bodies observed in a rock cut located north of the mill complex are openly folded.

It is unclear if this folding is contemporaneous with foliation development in the deformed rocks or post-dates the foliation development. Observations from drill core and open cut benches in the mine show examples where the foliation and the pegmatitic/aplitic intrusions are both folded, as well as examples where the intrusions are not folded, suggesting two populations of minor dykes.

1.1.3 Veining

Veins in the Minto Deposit appear to have been emplaced after the copper sulphide mineralization and are therefore not economically significant. The most common veins are very narrow (less than 30 cm) steeply dipping, simple quartz-feldspar pegmatite veins that often contain cavities that are indicative of shallow emplacement. The veins crosscut foliation in the deformation zones and the sulphide mineralization, and this cross-cutting is interpreted to be evidence of their post-sulphide mineral emplacement. Other types of late veins found in the deposit include thin (less than 2 mm) calcite, epidote, hematite and gypsum stringers, and fracture coatings. Quartz veining is extremely rare and economically insignificant.

1.2 Deposit Types

Section 2.2 is adapted from Section 8 of Minto (2012).

The host rocks to the Minto deposit were emplaced in a deep batholitic setting (exceeding 9 km deep to perhaps as much as 18-20 km deep), which is not considered to be the typical porphyry environment. The host is a moderately oxidized magma (Tafti and Mortensen, 2004) with widespread iron oxide (magnetite and hematite) mineralization. At least some of the hematite is supergene in origin but it is unclear if some hematite is also primary. There are very strong structural controls on ore mineral emplacement and there is no apparent genetic link to a specific phase of intrusion. Typical porphyry-type alteration zoning such as widespread propylitization, argillization, barren silicic core, or large barren pyritic halo are not recognized. Stockwork style, fracture or vein mineralization is also not present.

Minto geologists have been advised (in personal communications) that some examples of IOCG mineralization exhibit some similar characteristics and setting to Minto including Copperstone in Arizona, Candelaria in Chile, and Ernest Henry in Australia (Williams et al., 2005). From a genetic and structural prospective, albeit not size wise, the Sossego Deposit in Brazil may be a reasonable analog. While an IOCG origin for the Minto Deposit cannot be unequivocally demonstrated, Minto geologists are of the opinion that this style of deposit provides the most consistent model for their current level of understanding. However, the unique nature of this mineralization style and apparent lack of close analogs elsewhere suggests the Minto Copper-Gold deposits may represent an unrecognized mineral deposit type.

1.3 Mineralization

Section 0 is adapted from Section 7 of Minto (2012).

1.3.1 Mineralization

The Minto deposits have essentially no surface exposure with the exception of minimal exposure in historical trenches of the shallow partially oxidized zones associated with the Ridgetop deposit. Observations for the deposits are therefore based almost entirely on hand-specimen and petrographic studies of drill core. The primary hypogene sulphide mineralization consists of chalcopyrite, bornite, euhedral chalcocite, and minor pyrite. Metallurgical testing also indicates the presence of covellite, although this sulphide species has never been positively logged macroscopically. Texturally, sulphide minerals predominantly occur as disseminations and foliaform stringers along foliation planes in the deformed granodiorite (i.e. sulphide stringers tend to follow the foliation planes). However, sulphide mineral content tends to increase where this foliation is disrupted by intense folding. In addition, semi-massive to massive mineralization is also observed; this style of mineralization tends to obliterate the foliation altogether. Silver telluride (hessite) is observed in polished samples but has not been logged macroscopically. Native gold and electrum have both been reported as inclusions within bornite and accounts for the high gold recoveries in test copper concentrates. Occasionally, coarse free gold is observed associated with chloritic or epidote lined fractures that cross-cut the sulphide mineralization. The free gold may be due to secondary enrichment during a later hydrothermal process overprinting the main copper sulphide-gold event. Sulphide mineralization is almost always accompanied by variable amounts of magnetite mineralization and biotite alteration. While these minerals occur in the non-deformed rocks they are present in the mineralized horizons in a much greater abundance in the range of an order of magnitude greater than background.

The Minto Main deposit exhibits crude zoning from west to east. The bornite zone is dominant in the west while a thicker, lower grade chalcopyrite zone is dominant on the east side of the deposit. The bornite zone is defined by the metallic mineral assemblage magnetite-chalcopyrite-bornite. Bornite mineralization is conspicuous, but chalcopyrite is the dominant sulphide species. Stringers and massive lenses of chalcopyrite with various quantities of bornite are typical. Massive mineralization occurs locally over intervals exceeding 0.5 m in thickness and semi-massive mineralization over several metres in thickness may occur. In these sulphide rich areas, textures often resemble those seen in magmatic sulphide zones with sulphide mineralization interstitial to the rock forming silicate minerals. The higher grade portion of the Minto Main deposits roughly corresponds to the bornite zone. Local concentrations of bornite of up to 8% are seen. The precious metal grades are elevated in the bornite zone (very fine gold and electrum occur as inclusions in bornite) and occurrences of coarse grained native gold are noted almost exclusively in bornite-rich material. The chalcopyrite zone is characterized by the metallic mineral assemblage of chalcopyrite-pyrite ± very minor bornite and magnetite.

Empirical observations indicate the highest concentrations of bornite are associated with coarse grained, disseminated and stringer-style magnetite mineralization, up to 20% by volume locally. The stringers of magnetite are often folded or boudinaged, suggesting that at least some of the magnetite mineralization predates peak ductile deformation.

Sulphide mineralization on the other hand, shows both evidence and absence of ductile deformation locally and is interpreted to have formed contemporaneous with, or late in the ductile deformation history.

The Minto North and Minto East Deposits also exhibit a zoning from west to east. High-grade bornite-dominant mineralization is observed in the west with lower grade chalcopyrite-dominant mineralization in the east. The bornite zone is defined by the metallic mineral assemblage bornite-magnetite-chalcopyrite. Bornite mineralization occurs as strong disseminations and foliaform stringers locally >10% to occasional semi-massive to massive lenses up to 2 m in thickness. Chalcopyrite concentrations are typically within the 1 to 2% range, but locally can reach concentrations of 10%. Precious metal grades are elevated in the bornite zone, and visible gold has been observed on occasion.

Mineralization at the Area 2/118/Copper Keel resource sub-domains is distinct in that mineralization is predominantly disseminated (plus occasional foliaform stringers) and that semimassive to massive sulphide mineralization is absent; as a whole, the mineralization is more homogenous and consistent as compared to Minto Main and Minto North. The primary mineral assemblage in the Area 2/118/Copper Keel resource sub-domains includes chalcopyrite-bornite-magnetite with minor amounts of pyrite; and a crude zoning is present in that the higher grade northern half of the Minto South Deposit shows increased bornite concentrations up to 8% locally.

Mineralization at both the Ridgetop deposit and the Wildfire resource sub-domain are subdivided into the near surface horizons that have been affected by supergene oxidation and the more typical primary sulphide mineralization of the deeper zones. The lower zones are defined by a mineral assemblage of chalcopyrite-magnetite with minor amounts of pyrite. Chalcopyrite is the dominant sulphide in the lower zones, and bornite is only observed in minor amounts. Texturally, chalcopyrite occurs as disseminations and foliaform stringers, and is rarely observed as semimassive to massive bands. Magnetite is coarse grained, disseminated, stringer-style, and can occur in bands up to 0.3 m in thickness, up to 20% volume locally.

These empirical observations of bornite/chalcopyrite relative abundances are supported by a copper and gold grade trend in mineral resources discovered to date where the Ridgetop deposit and the southern extent of the Minto South Deposit sit at the lower grade southern end and Minto North sits at the much higher grade northern end of the currently defined trend.

1.3.2 Alteration, Weathering and Oxidation

Pervasive, strong potassic alteration occurs within the flat lying zones of mineralization, and is the predominant alteration assemblage observed in all of the Minto deposits. The potassic alteration assemblage is characterized by elevated biotite content and minor secondary k-feldspar overgrowth on plagioclase relative to the more massive textured country rock. Biotite concentrations range up to 30 to 70% by volume locally, compared to about 5 to 8% in waste rock. Additional alteration includes the replacement of mafic minerals by secondary chlorite, epidote, or sericite observed both in mineralized and waste rock interstitially or fracture/vein proximal, as well as variable degrees of hematization of feldspars. Uncommon but locally pervasive sericite-muscovite alteration is observed associated with post-mineral brittle faults; this type of alteration is most common within the Area 2/118 resource sub-domains.

Hematization is the most pervasive at the Minto Main deposit proximal to the DEF fault, whereas in the other deposits it is predominantly fracture controlled within narrow alteration selvages. It is interpreted to be supergene in origin. Minor carbonate overprint is occasionally observed associated with secondary biotite. The contacts between the altered and unaltered rocks are sharp, as are the contacts between mineralized rocks and waste rocks.

Silicification is present but not pervasive nor uniform in distribution in the Minto deposits. At Minto Main, Minto East, and Minto North it is sporadic within the bornite zone (west) and lacking in the chalcopyrite zone (east). Within the Area 2/118/Copper Keel resource sub-domains, silicification intensity is variable in all ore zones. On rare occasions, silicification is pervasive enough to almost entirely overprint both primary and deformation textures (Area 2) while it is essentially absent at Ridgetop and Wildfire. The relationship between silicification and the mineralization is unclear due to inconsistent core logging over three decades, although in most cases higher grade sulphide mineralization is coincident with silicification.

Copper oxide mineralization, like the hematization seen at surface in float, trenches, and in the upper mineralized zones at Ridgetop and Wildfire is the result of supergene oxidation processes. This near surface mineralization represents either the erosion remnants of foliated horizons that are located above the deposits or is vertical remobilization of copper up late brittle faults and fracture zones that intersect primary sulphide mineralization at depth. Chalcocite is the prime mineral in these horizons along with secondary malachite, minor azurite, and rare native copper. The mineralization is found as fracture fill and joint coatings and more rarely interstitial to rock forming silicate minerals.

At the Ridgetop deposit and the Wildfire resource sub-domain, the upper near surface mineralized zones are unique in that the dominant oxide facies mineral is the sulphide chalcocite rather than chalcopyrite or bornite, and it is believed to be a secondary supergene enrichment associated with a paleo water table, or fault proximal oxidation via circulating groundwater. Minor malachite, azurite, remnant chalcopyrite-bornite, and native copper are also present within these near-surface mineralized zones.

Cobbles and pebbles of this supergene chalcocite mineralization in Cretaceous age (unpublished data) conglomerate that unconformably overlies the plutonic rocks of the Granite Mountain Batholith indicate that the upper parts of the Minto System were on surface and being partially oxidized and eroded in the Late Cretaceous.

In addition to the obvious copper oxide minerals, oxidation is also evident by pervasive iron staining (limonite), earthy hematite, clay alteration of feldspars, and a significant loss in bulk density. The degree and distribution of copper oxide minerals appears to be directly related to the depth of the water table. For the most part this is confined to about -30 m (but up to -90 m) beneath the surface and is generally sub parallel with the present topographic surface. The Minto Main zone has experienced relatively little oxidation since it is generally more than 60 m below the surface except at its southern end where it crops out directly beneath unconsolidated overburden in the Minto Creek Valley. Very locally this oxidation may be drawn deeper along late brittle faults cutting primary sulphide mineralization.

Appendix C Waste Rock: Off-Site Operational Monitoring Statistics

Mine Area	Station Name	Statistic	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
			pH Units	wt %	wt %	wt %	kg CaCO3/t	kg CaCO3/t	kg CaCO3/t		
		Detection Limit	0.01	0.005 or 0.01	0.01			1.7	0.5		
Open Pits	Area 118	Min	6.4	0.005	0.01	-	-	***1.7***	2.9	0.25	0.27
		P10	8	0.006	0.01	-	-	2.5	5.3	1.8	1.7
		P50	8.7	0.019	0.01	0.008	0.25	12	15	18	22
		Average	8.6	0.13	0.012	0.12	3.6	16	16	54	63
		P90	9	0.33	0.01	0.32	10	33	26	150	190
		Max	9.4	3.3	0.12	3.3	100	93	57	590	640
		Count	171	171	171	172	172	172	171	122	122
	Area 2	Min	7.4	0.005	0.01	-	-	1.7	6.1	0.27	0.28
		P10	8.3	0.01	0.01	-	-	11	14	1.7	1.9
		P50	8.7	0.06	0.01	0.05	1.6	21	23	9.2	11
		Average	8.7	0.19	0.011	0.18	5.6	26	26	20	22
		P90	9.1	0.47	0.01	0.46	14	46	42	56	62
		Max	9.7	6.6	0.22	6.5	200	180	140	250	190
		Count	1101	1101	1101	1105	1105	1101	965	922	814
	Area 2 Stage 3	Min	7.5	0.01	0.01	-	-	4.2	6	0.71	1
		P10	8.1	0.01	0.01	-	-	5	10	4.5	4.5
		P50	8.6	0.02	0.01	0.01	0.31	21	26	20	29
		Average	8.5	0.063	0.014	0.05	1.6	23	26	35	39
		P90	9	0.14	0.02	0.13	4.1	43	39	71	86
		Max	9.2	0.87	0.04	0.85	27	110	96	260	210
		Count	199	199	199	199	199	199	199	114	114
	Area 2 Stage 4	Min	7.5	0.01	0.01	-	-	4.2	-	1.1	1
		P10	8.3	0.01	0.01	-	-	4.7	6	3.3	1.2
		P50	8.8	0.02	0.01	0.01	0.31	24	25	14	13
		Average	8.7	0.1	0.013	0.089	2.8	27	24	25	27
		P90	9.1	0.23	0.02	0.22	7	51	41	61	67
		Max	9.5	1.4	0.05	1.4	44	86	60	150	140
		Count	187	187	187	187	187	187	187	113	113
	Minto North	Min	5.2	0.005	0.01	-	-	***1.7***	-	0.39	-
		P10	8.4	0.009	0.01	-	-	2.5	7.6	1.9	2.8
		P50	8.8	0.018	0.01	0.008	0.25	13	18	19	27
		Average	8.7	0.058	0.013	0.047	1.5	14	19	54	74
		P90	9.1	0.12	0.02	0.11	3.4	27	29	100	140
		Max	9.4	0.94	0.06	0.93	29	63	65	990	1100
		Count	322	322	312	322	322	322	322	216	216
	Area 118 Portal	Min	8.1	0.005	0.01	-	-	1.7	5.9	1	0.77
		P10	8.3	0.009	0.01	-	-	6.7	11	1.5	1.9
		P50	8.6	0.056	0.01	0.014	0.44	14	17	5.4	6.4
		Average	8.7	0.16	0.029	0.1	3.2	18	20	13	16
		P90	9.3	0.51	0.04	0.25	7.8	34	31	33	39
		Max	9.5	1.1	0.36	1.1	34	70	72	130	120

Mine Area	Station Name	Statistic	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
			pH Units	wt %	wt %	wt %	kg CaCO3/t	kg CaCO3/t	kg CaCO3/t		
		Detection Limit	0.01	0.005 or 0.01	0.01			1.7	0.5		
Underground		Count	58	58	58	72	72	58	58	42	42
	Area 2 Underground	Min	8.7	0.2	0.01	0.17	5.3	13	17	1.9	2
		P10	8.8	0.22	0.01	0.19	5.9	15	18	2	2.2
		P50	9.1	0.25	0.03	0.23	7	17	19	2.4	2.7
		Average	9	0.26	0.027	0.23	7.2	16	19	2.3	2.7
		P90	9.1	0.31	0.04	0.28	8.8	18	20	2.5	3.1
		Max	9.1	0.33	0.05	0.3	9.4	18	20	2.5	3.2
		Count	6	6	6	6	6	6	6	6	6
	Copper Keel	Min	7.7	0.03	0.01	0.01	0.31	4.2	8	1	1.9
		P10	8	0.07	0.01	0.01	0.31	5.8	16	2.1	4.2
		P50	8.2	0.19	0.12	0.075	2.3	14	25	5.5	11
		Average	8.2	0.21	0.13	0.088	2.8	16	26	13	22
		P90	8.5	0.4	0.27	0.16	5.1	26	36	32	54
		Max	8.9	0.63	0.36	0.35	11	38	47	72	110
		Count	40	40	40	40	40	40	40	40	40
	ME Underground	Min	8	0.13	0.01	0.01	0.31	7.5	13	0.69	0.67
		P10	8.2	0.17	0.01	0.1	3.2	10	15	0.98	1
		P50	8.6	0.33	0.015	0.28	8.8	20	21	2.3	2.7
		Average	8.6	0.42	0.067	0.36	11	21	23	3.7	5.3
		P90	9	0.69	0.17	0.68	21	33	32	5	7.4
		Max	9.1	1.4	0.33	1.1	33	43	48	24	42
		Count	18	18	18	18	18	18	18	18	18
Historic		Min	6.2	0.01	0.01	-	0.31	0.68	7	0.069	0.68
		P10	8.3	0.01	0.01	0.01	0.31	4.2	14	2.4	4.2
		P50	8.8	0.04	0.01	0.02	0.63	16	28	21	16
		Average	8.8	0.19	0.079	0.14	3.4	26	35	38	26
		P90	9.4	0.36	0.14	0.35	8.4	57	60	100	57
		Max	9.8	4.4	1.7	4.4	140	290	250	360	290
		Count	199	113	72	114	157	199	199	200	199

Mine Area	Station Name	Statistic	Ag	Al	As	Cd	Cr	Cu	Fe	Mo	Ni	Pb	Se	Zn
			ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
	10x Average Crustal Abundance[1]		**0.8**	**$8.36x10^{5}$**	**18**	**1.6**	**1,220**	**680**	**62.2**	**12**	**990**	**130**	**0.5**	**760**
Open Pits	Area 118	Min	0.02	0.35	***1***	0.03	57	27	0.75	3.5	2.2	1.1	1	45
		P10	0.04	0.87	***1***	0.04	92	72	2.2	4.7	3.4	1.4	1	61
		P50	0.15	1.1	***1***	0.08	130	540	2.6	5.7	5	2	1	73
		Average	0.26	1.1	1.8	0.11	130	1200	2.8	7.3	5.3	2.3	1.2	77
		P90	0.62	1.4	4	0.19	170	3200	3.6	9.9	7.4	3.5	2	97
		Max	4.4	1.8	11	0.98	210	7700	6.8	38	11	7.5	10	180
		Count	171	171	171	171	171	168	171	171	171	171	171	171
	Area 2	Min	***0.01***	0.28	***1***	***0.01***	3	4	1.5	***0.05***	***0.5***	***0.2***	1	31
		P10	***0.01***	0.95	***1***	0.03	9	51	2.1	1	2	2	1	55
		P50	0.14	1.2	***1***	0.08	98	510	2.5	4.3	3.7	3.1	1	67
		Average	0.31	1.2	1.4	0.13	95	1200	2.7	9.7	4.8	3.7	1.4	71
		P90	0.86	1.4	2	0.29	140	3400	3.5	19	6.2	5.6	2	89
		Max	3.7	2.5	12	1.4	230	9900	11	310	83	26	11	320
		Count	1101	1101	1101	1101	1101	1097	1101	1050	1101	1050	1050	1101
	Area 2 Stage 3	Min	***0.01***	0.48	***1***	0.02	3	16	1.9	0.26	1.6	1.5	***0.2***	40
		P10	0.06	0.72	***1***	0.05	4	110	2.2	0.57	2.1	2.4	0.4	57
		P50	0.22	1.1	1.5	0.14	5	730	2.5	1.2	2.8	3.4	0.8	70
		Average	0.49	1.1	3	0.17	10	1500	2.5	2.1	7	3.9	1.2	71
		P90	0.85	1.3	6.7	0.32	23	3900	3	3.4	20	6.2	2.3	85
		Max	14	1.8	11	0.81	290	8800	4.4	43	82	12	11	130
		Count	199	199	199	199	199	196	199	199	199	199	199	199
	Area 2 Stage 4	Min	***0.01***	0.38	***1***	0.02	2	9.6	1.6	0.23	1.4	1.3	***0.2***	40
		P10	0.02	0.8	***1***	0.03	3	44	2	0.53	2.1	2.3	***0.2***	55
		P50	0.13	1	***1***	0.11	4	400	2.4	1.4	2.6	3.5	0.4	68
		Average	0.25	1	2.2	0.13	7.4	910	2.5	3.8	5.6	3.9	0.7	70
		P90	0.52	1.3	6.1	0.27	20	2300	3	9.8	16	6.1	1.4	85
		Max	5.5	1.8	12	0.69	40	8800	7.1	38	39	15	13	140
		Count	187	187	187	187	187	186	187	187	187	187	187	187
	Minto North	Min	***0.01***	0.77	***1***	***0.01***	3	5.6	1.5	0.17	1.6	1	***0.2***	45
		P10	0.02	1.1	***1***	0.02	5	17	2	0.38	2.1	1.6	0.3	52
		P50	0.07	1.2	***1***	0.05	88	150	2.3	2.3	3.1	2.7	1	61
		Average	0.27	1.2	3.2	0.079	64	620	2.3	2.5	3.4	3.8	1.1	64
		P90	0.78	1.5	3	0.16	110	1800	2.7	5	5.9	6.5	2	78
		Max	6.2	2	430	0.72	210	6700	4.5	34	14	40	11	170
		Count	322	322	322	322	322	320	322	322	322	322	322	322
	Area 118 Portal	Min	***0.01***	0.76	***1***	***0.01***	7	3.7	1.8	0.1	1.7	1.2	***0.2***	50
		P10	0.02	0.99	***1***	0.03	9	19	2.2	1.2	2.1	1.5	0.57	62
		P50	0.16	1.2	***1***	0.07	130	410	2.5	4.7	5.6	2.4	1	83
		Average	0.54	1.2	***1***	0.13	120	970	2.6	5	5.3	2.7	1.5	85
		P90	1.6	1.4	***1***	0.27	170	3200	3.2	7.6	7.2	4	3.3	110
		Max	4.6	1.7	***1***	1	200	6300	5.3	14	19	5.8	11	150

Mine Area	Station Name	Statistic	Ag	Al	As	Cd	Cr	Cu	Fe	Mo	Ni	Pb	Se	Zn
			ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
	10x Average Crustal Abundance[1]		**0.8**	**$8.36x10^5$**	**18**	**1.6**	**1,220**	**680**	**62.2**	**12**	**990**	**130**	**0.5**	**760**
Underground		Count	58	58	58	58	58	56	58	58	58	58	58	58
	Area 2 Underground	Min	1	1.1	***1***	0.17	6	3100	2.9	0.56	1.7	2.1	2.8	70
		P10	1	1.1	***1***	0.18	6	3100	2.9	0.62	1.7	2.1	3	70
		P50	1.1	1.1	***1***	0.21	7	3600	3	0.9	1.8	2.2	3.3	75
		Average	1.3	1.1	***1***	0.25	6.7	3800	3	0.91	1.8	2.2	3.5	75
		P90	1.7	1.2	***1***	0.35	7	4600	3.2	1.2	1.9	2.4	4.2	81
		Max	2	1.2	***1***	0.46	7	5300	3.3	1.4	1.9	2.5	4.8	83
		Count	6	6	6	6	6	6	6	6	6	6	6	6
	Copper Keel	Min	0.02	0.98	***1***	0.03	4	9.9	1.9	0.17	1.4	2.4	***0.2***	57
		P10	0.069	1	***1***	0.04	5	78	2.1	0.24	1.6	3	***0.2***	63
		P50	0.29	1.1	***1***	0.1	6	610	2.4	0.97	1.8	5	0.6	70
		Average	0.43	1.1	1.2	0.11	6.8	870	2.4	1.9	2	5.2	0.84	74
		P90	0.86	1.2	1.6	0.21	9	2500	2.7	5.3	2.4	7.1	2.1	83
		Max	1.4	1.4	3.1	0.31	14	2800	3.3	9.8	4.7	13	2.3	150
		Count	40	40	40	40	40	40	40	40	40	40	40	40
	ME Underground	Min	0.14	0.98	***1***	0.08	5	360	2.2	0.19	1.6	2.2	0.3	59
		P10	0.35	1.1	***1***	0.097	6	840	2.4	0.44	1.7	2.3	1	64
		P50	1.1	1.1	***1***	0.2	7	3200	2.9	2.1	2	3	2.8	76
		Average	1.6	1.1	***1***	0.23	6.7	2800	2.8	6.7	2	3.3	2.7	79
		P90	2.2	1.2	***1***	0.34	7	4600	3.3	19	2.3	4.5	3.7	94
		Max	11	1.3	1.1	0.88	9	5900	3.4	30	3.1	6.5	7.8	100
		Count	18	18	18	18	18	17	18	18	18	18	18	18
Historic		Min	***0.1***	0.3	0.021	***0.1***	1.7	0.5	1.6	0.1	***0.5***	0.8	-	36
		P10	***0.1***	0.63	0.6	***0.1***	4.6	4.5	2	0.2	1.1	1.5	-	47
		P50	***0.1***	1.1	1.4	0.25	54	92	2.4	0.7	3	3	-	66
		Average	0.34	1.2	2.9	0.26	40	720	2.5	8.6	3.2	4.3	-	74
		P90	0.8	1.6	5.4	0.31	72	1900	3.1	5.2	5	7.5	-	87
		Max	3.7	3.2	50	0.71	200	13000	8.8	850	28	35	-	520
		Count	112	173	163	95	173	173	173	173	173	173	0	173

Appendix D Tailings: Operational Monitoring Statistics

Year	Statistic	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
		pH Units	wt %	wt %	wt %	kg CaCO3/t	kg CaCO3/t	kg CaCO3/t		
	Detection Limit	0.01	0.005 or 0.01	0.01			1.7	0.5		
Historic (Sobek NP)	Min	7.7	0.02	***0.01***	0.02	0.6	4.5	18	0.96	3.8
	P10	7.9	0.032	***0.01***	0.026	0.8	4.5	21	1.8	7.2
	P50	8.3	0.08	***0.01***	0.06	1.9	32	28	12	15
	Average	8.3	0.14	0.073	0.071	2.2	30	30	22	19
	P90	8.8	0.38	0.23	0.13	4.1	50	40	56	32
	Max	9.3	0.64	0.57	0.15	4.7	92	57	74	62
	Count	17	17	17	17	17	17	17	17	17
2010	Min	8.4	0.08	***0.01***	0.07	2.2	*1.7*	25	8.7	7.7
	P10	8.4	0.08	***0.01***	0.07	2.2	30	25	10	8.8
	P50	8.5	0.08	***0.01***	0.07	2.2	32	30	14	13
	Average	8.5	0.09	***0.01***	0.08	2.5	32	31	13	13
	P90	8.5	0.11	***0.01***	0.098	3.1	34	36	16	16
	Max	8.5	0.12	***0.01***	0.11	3.4	34	37	16	17
	Count	4	4	4	4	4	4	4	4	4
2011	Min	8.2	0.05	***0.01***	0.04	1.3	21	23	6.7	7.9
	P10	8.2	0.061	***0.01***	0.051	1.6	24	27	6.9	8.3
	P50	8.3	0.09	***0.01***	0.08	2.5	26	33	10	13
	Average	8.4	0.087	***0.01***	0.077	2.4	27	32	12	15
	P90	8.6	0.11	***0.01***	0.1	3.1	29	35	18	21
	Max	8.8	0.13	***0.01***	0.12	3.8	33	38	23	26
	Count	12	12	12	12	12	12	12	12	12
2012	Min	7.9	0.05	***0.01***	0.04	1.3	3.3	27	2.1	8.6
	P10	8.2	0.059	***0.01***	0.049	1.5	23	27	7	14
	P50	8.3	0.07	***0.01***	0.055	1.7	26	30	14	18
	Average	8.4	0.073	0.012	0.061	1.9	24	32	14	18
	P90	8.6	0.085	0.02	0.074	2.3	28	38	18	22
	Max	8.7	0.13	0.02	0.11	3.4	28	42	21	24
	Count	10	10	10	10	10	10	10	10	10
2013	Min	7.7	0.04	***0.01***	0.03	0.94	24	19	15	12
	P10	7.9	0.048	***0.01***	0.038	1.2	27	21	15	12
	P50	8.3	0.06	***0.01***	0.05	1.6	31	28	22	19
	Average	8.2	0.061	0.012	0.049	1.5	31	27	21	19
	P90	8.5	0.08	0.02	0.062	1.9	36	31	26	26
	Max	8.6	0.08	0.02	0.07	2.2	39	34	30	29
	Count	9	9	9	9	9	9	9	9	9
2014	Min	7.8	0.042	***0.01***	0.032	1	*1.7*	15	12	13
	P10	7.9	0.044	***0.01***	0.034	1.1	15	16	13	13
	P50	8.3	0.052	***0.01***	0.042	1.3	27	23	16	15
	Average	8.3	0.053	***0.01***	0.043	1.4	24	22	18	17
	P90	8.6	0.064	***0.01***	0.054	1.7	31	27	25	22
	Max	8.6	0.075	***0.01***	0.065	2	34	32	27	22
	Count	12	12	12	12	12	12	12	12	12

Year	Statistic	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
		pH Units	**wt %**	**wt %**	**wt %**	**kg CaCO3/t**	**kg CaCO3/t**	**kg CaCO3/t**		
	Detection Limit	**0.01**	**0.005 or 0.01**	**0.01**			**1.7**	**0.5**		
	Min	8.3	0.045	***0.01***	0.028	0.88	20	20	9	7.1
	P10	8.3	0.054	***0.01***	0.036	1.1	21	20	12	11
	P50	8.6	0.063	***0.01***	0.051	1.6	23	22	16	15
2015	Average	8.5	0.065	0.013	0.052	1.6	24	23	16	15
	P90	8.7	0.077	0.01	0.061	1.9	29	26	19	20
	Max	8.7	0.11	0.05	0.098	3.1	32	26	27	26
	Count	12	12	12	12	12	12	12	12	12
	Min	8	0.03	***0.01***	-	-	11	12	3.2	4.4
	P10	8	0.04	***0.01***	0.02	0.63	11	15	3.9	5.3
	P50	8.5	0.05	***0.01***	0.04	1.3	18	19	14	15
2016	Average	8.4	0.06	0.016	0.045	1.4	18	19	16	16
	P90	8.8	0.11	0.029	0.086	2.7	22	25	32	35
	Max	8.8	0.12	0.04	0.11	3.4	23	26	36	35
	Count	12	12	12	12	12	12	12	11	11
	Min	7.8	0.06	***0.01***	0.03	0.94	15	18	6.2	5.2
	P10	7.8	0.068	***0.01***	0.034	1.1	16	19	7	7
	P50	8	0.1	0.04	0.06	1.9	19	23	9.8	12
2017	Average	8	0.1	0.039	0.065	2	20	22	12	13
	P90	8.2	0.15	0.066	0.09	2.8	27	25	19	23
	Max	8.2	0.16	0.08	0.13	4.1	28	27	27	27
	Count	15	15	15	15	15	15	15	15	15
	Min	7.9	0.06	***0.01***	0.03	0.94	19	21	12	12
	P10	7.9	0.076	0.018	0.038	1.2	21	22	13	13
	P50	8.1	0.12	0.06	0.05	1.6	36	29	18	19
2018	Average	8.1	0.11	0.053	0.052	1.6	33	29	22	19
	P90	8.3	0.12	0.082	0.072	2.3	40	34	31	26
	Max	8.5	0.12	0.09	0.08	2.5	42	47	38	29
	Count	9	9	9	9	9	9	9	9	9
	Min	7.9	0.23	0.15	0.04	1.3	18	19	9	7.4
	P10	7.9	0.28	0.18	0.05	1.6	18	21	9.6	8.5
	P50	8	0.39	0.34	0.075	2.3	33	29	14	12
2020	Average	8	0.37	0.29	0.082	2.6	140	27	41	12
	P90	8	0.45	0.35	0.12	3.8	370	32	98	14
	Max	8	0.47	0.36	0.13	4.1	680	33	170	15
	Count	5	6	6	6	6	6	6	6	6
	Min	7.9	0.16	0.1	0.06	1.9	15	21	4.8	6.7
	P10	7.9	0.17	0.11	0.064	2	15	21	5.3	7.3
	P50	8	0.22	0.14	0.08	2.5	16	23	7.1	9.8
2021	Average	8	0.22	0.14	0.08	2.5	16	23	7.1	9.8
	P90	8.1	0.27	0.17	0.096	3	17	24	8.9	12
	Max	8.1	0.28	0.18	0.1	3.1	18	24	9.3	13
	Count	2	2	2	2	2	2	2	2	2

Year	Statistic	Ag	Al	As	Cd	Cr	Cu	Fe	Mo	Ni	Pb	Se	Zn
		ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
10x Average Crustal Abundance[1]		**0.8**	**$8.36x10^5$**	**18**	**1.6**	**1,220**	**680**	**62.2**	**12**	**990**	**130**	**0.5**	**760**
Historic	Min	0.19	0.42	0.6	0.16	5	250	2.3	0.4	2.7	2	0.6	68
	P10	0.2	0.72	0.66	0.2	6	420	2.8	0.7	4	2.6	0.6	70
	P50	0.94	0.96	1.3	0.5	9	1,300	4.5	1.1	5.3	5.2	1.2	140
	Average	0.9	1	1.6	0.48	19	1,100	4.8	1.8	6.2	11	1.3	140
	P90	1.6	1.5	3	0.76	49	1,800	7.5	2.7	9.3	32	2.2	190
	Max	2.4	1.6	4	1.1	63	2,000	8.3	7	11	43	2.4	250
	Count	17	17	14	17	17	17	17	17	17	17	17	17
2010	Min	-	-	-	-	-	-	-	-	-	-	-	-
	P10	-	-	-	-	-	-	-	-	-	-	-	-
	P50	-	-	-	-	-	-	-	-	-	-	-	-
	Average	-	-	-	-	-	-	-	-	-	-	-	-
	P90	-	-	-	-	-	-	-	-	-	-	-	-
	Max	-	-	-	-	-	-	-	-	-	-	-	-
	Count	0	0	0	0	0	0	0	0	0	0	0	0
2011	Min	0.96	1.2	***1***	0.32	48	1,800	3.3	1.3	3.4	2.5	***1***	140
	P10	0.96	1.2	***1***	0.38	49	1,900	3.4	1.3	3.5	2.5	1.4	140
	P50	1.1	1.3	***1***	0.47	52	2,200	3.7	1.5	3.6	3	2	150
	Average	1.1	1.3	1.2	0.45	55	2,100	3.7	1.6	3.7	3	1.8	150
	P90	1.1	1.4	1.6	0.51	63	2,200	4	2	3.9	3.4	2	170
	Max	1.1	1.5	2	0.53	67	2,200	4.1	2.1	4	3.7	2	170
	Count	5	5	5	5	5	5	5	5	5	5	5	5
2012	Min	0.66	1.2	***1***	0.26	30	1,200	3.1	1.3	1.5	2.4	***1***	110
	P10	0.66	1.2	***1***	0.32	34	1,300	3.4	1.6	1.5	2.4	***1***	120
	P50	0.7	1.3	***1***	0.37	69	1,400	4.3	2.4	3	3.3	***1***	130
	Average	0.74	1.3	1.4	0.38	69	1,500	4.1	3.1	3	3	1.2	130
	P90	0.89	1.5	1.8	0.45	95	1,900	4.7	5.5	4.4	3.5	1.6	140
	Max	0.97	1.6	5	0.55	110	2,400	4.8	7.6	5	3.5	2	150
	Count	9	9	9	9	9	9	9	5	9	5	5	9
2013	Min	***0.01***	1	***1***	0.21	38	540	3.3	3.4	1.7	1.8	***1***	98
	P10	0.058	1.1	***1***	0.22	63	570	3.3	3.5	3.9	1.9	***1***	99
	P50	0.46	1.3	***1***	0.28	100	840	4.1	4	4.7	2.2	***1***	120
	Average	0.44	1.2	***1***	0.29	95	910	4.5	4.5	4.8	2.3	***1***	120
	P90	0.72	1.3	***1***	0.39	120	1,400	7.2	5.8	5.9	2.7	***1***	140
	Max	0.85	1.3	***1***	0.41	120	1,400	7.3	6	6.9	2.8	***1***	140
	Count	9	9	9	9	9	9	9	9	9	9	9	9
2014	Min	0.39	0.21	***1***	0.22	68	240	1.1	3.5	2.3	1.7	***1***	82
	P10	0.39	1.1	***1***	0.23	73	640	3.8	4	2.4	2.1	***1***	100
	P50	0.47	1.2	***1***	0.26	97	800	4.9	5.2	3.2	2.4	***1***	120
	Average	0.5	1.1	***1***	0.28	100	780	4.6	5.5	4.1	2.3	***1***	120
	P90	0.63	1.3	***1***	0.35	130	990	5.9	7.3	6.9	2.7	***1***	130
	Max	0.66	1.3	***1***	0.36	190	1,000	5.9	7.5	7.6	2.8	***1***	140
	Count	12	12	12	12	12	12	12	12	12	12	12	12

Year	Statistic	Ag	Al	As	Cd	Cr	Cu	Fe	Mo	Ni	Pb	Se	Zn
		ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
10x Average Crustal Abundance[1]		**0.8**	**8.36×10^5**	**18**	**1.6**	**1,220**	**680**	**62.2**	**12**	**990**	**130**	**0.5**	**760**
2015	Min	0.41	1.1	*1*	0.2	83	640	3.3	2.7	4.1	2	*1*	100
	P10	0.46	1.2	*1*	0.27	89	860	3.7	3.7	4.2	2.3	*1*	100
	P50	0.69	1.3	*1*	0.36	95	1,900	4.2	6.5	7.1	2.8	2	110
	Average	0.68	1.3	*1*	0.37	96	1,800	4.1	6.1	6.4	2.7	1.7	110
	P90	0.86	1.3	*1*	0.49	100	2,400	4.5	7.9	7.4	3.1	2	120
	Max	0.89	1.4	*1*	0.53	120	2,800	4.6	8.8	7.9	3.1	2	130
	Count	12	12	12	12	12	12	12	12	12	12	12	12
2016	Min	0.46	0.9	*1*	0.19	6	630	3.2	0.51	2.7	1.7	0.7	100
	P10	0.47	0.94	*1*	0.21	6	690	3.5	0.55	2.8	2	0.7	100
	P50	0.6	1.3	1.1	0.28	6.5	900	4.2	0.69	3	3.3	0.95	120
	Average	0.66	1.2	1.2	0.27	12	1,000	4.3	0.91	3.1	3	1	120
	P90	0.86	1.5	1.6	0.33	7.9	1,600	5.5	1.4	3.2	4	1.5	140
	Max	1.1	1.5	2.1	0.34	76	1,800	5.8	2.5	4.1	4.5	1.6	150
	Count	12	12	12	12	12	12	12	12	12	12	12	12
2017	Min	0.5	0.96	*1*	0.22	5	1,400	3.2	0.94	2.2	2.2	1.1	90
	P10	0.56	1	*1*	0.22	5.4	1,900	3.5	1	2.3	2.4	1.2	95
	P50	0.74	1.1	1.3	0.28	6	2,300	4	2.1	3	3.3	2	100
	Average	0.8	1.2	1.3	0.32	6.3	2,500	4	2.4	3	3.5	1.9	100
	P90	1	1.4	1.7	0.4	7	3,100	4.3	3.6	3.6	3.8	2.4	110
	Max	1.4	1.5	1.7	0.57	8	4,700	4.5	6.7	3.8	9.3	3.1	120
	Count	15	15	15	15	15	15	15	15	15	15	15	15
2018	Min	0.38	0.95	*1*	0.24	6	470	3.6	1.1	2.6	2.2	0.4	100
	P10	0.39	0.97	*1*	0.28	6	690	3.6	1.1	3	2.8	0.64	100
	P50	0.52	1	*1*	0.32	6	1,200	4	1.8	3.4	3.2	1.1	110
	Average	0.54	1	1.1	0.32	6.8	1,300	4	2.1	3.5	3.2	1.1	110
	P90	0.7	1.1	1.3	0.38	7.6	2,100	4.4	3.3	4.2	3.4	1.7	110
	Max	0.73	1.1	1.8	0.41	10	2,300	4.5	4.4	4.5	3.6	2.2	110
	Count	9	9	9	9	9	9	9	9	9	9	9	9
2020	Min	0.39	0.98	*1*	0.21	6	620	3.5	0.83	2.7	1.9	0.5	110
	P10	0.4	1	*1*	0.23	6	770	3.5	0.98	2.8	2.1	0.58	110
	P50	0.54	1.1	*1*	0.41	6.5	990	4.2	1.2	3	2.8	0.7	120
	Average	0.51	1.1	1.2	0.38	6.8	1,000	4.4	1.3	3.1	3.5	0.72	120
	P90	0.61	1.2	1.6	0.5	8	1,300	5.5	1.8	3.6	5.7	0.86	130
	Max	0.61	1.2	2	0.5	8	1,300	6	2	4	8	0.9	130
	Count	6	6	6	6	6	6	6	6	6	6	5	6
2021	Min	0.48	1.1	*1*	0.26	8	810	2.7	1.5	2.6	3.2	0.7	99
	P10	0.49	1.1	*1*	0.26	8.1	830	2.8	1.6	2.6	3.3	0.71	100
	P50	0.51	1.2	1.2	0.26	8.5	910	3.2	1.6	2.7	3.6	0.75	110
	Average	0.51	1.2	1.2	0.26	8.5	910	3.2	1.6	2.7	3.6	0.75	110
	P90	0.53	1.3	1.3	0.26	8.9	980	3.7	1.7	2.7	3.8	0.79	110
	Max	0.53	1.3	1.3	0.26	9	1,000	3.8	1.7	2.7	3.9	0.8	120
	Count	2	2	2	2	2	2	2	2	2	2	2	2

Year	Statistic	Ag mg/L	Al mg/L	As mg/L	Cd mg/L	Cr mg/L	Cu mg/L	Fe mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Se mg/L	Zn mg/L
2014	Min	0.08	57	***0.01***	0.008	0.41	11	240	***0.01***	0.1	0.008	***0.01***	0.88
	P10	0.08	58	***0.01***	0.01	0.41	11	240	***0.01***	0.1	0.01	***0.01***	0.88
	P50	0.08	62	***0.01***	0.019	0.43	12	260	***0.01***	0.11	0.019	***0.01***	0.92
	Average	0.08	61	***0.01***	0.016	0.45	15	250	***0.01***	0.11	0.019	***0.01***	0.94
	P90	0.08	62	***0.01***	0.02	0.5	19	260	***0.01***	0.11	0.027	***0.01***	1
	Max	0.08	62	***0.01***	0.02	0.52	21	260	***0.01***	0.11	0.029	***0.01***	1
	Count	3	3	3	3	3	3	3	3	3	3	3	3

Appendix E Barrel Test Monitoring Statistics

StnCode	CollectDateTime	Year	Ag-D	Ag-T	Al-D	Alk-OH	Alk-T	Alk-B	Al-T	As-D	As-T	Ba-D	Ba-T	B-D	Be-D	Be-T	Bi-D	Bi-T	B-T
BAR-10	2010-06-14 0:00	2010	0.0001		0.035					0.0004		0.011		0.1	0.0002		0.001		
BAR-10	2010-06-17 0:00	2010	0.0001		0.023					0.0004		0.014		0.1	0.0002		0.001		
BAR-10	2010-06-22 0:00	2010		0.0001					0.14		0.0009		0.071			0.0002		0.001	0.1
BAR-10	2010-07-01 0:00	2010	0.0001	0.0002	0.055	0.5	74	90	0.99	0.001	0.0011	0.016	0.029	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-10	2010-07-02 0:00	2010	0.0001		0.02	0.5	110	130		0.0013		0.023		0.1	0.0002		0.001		
BAR-10	2010-07-03 0:00	2010	0.0001		0.074	0.5	120	150		0.0012		0.032		0.1	0.0002		0.001		
BAR-10	2010-07-08 0:00	2010	0.0001	0.0001	0.017	0.5	110	140	0.09	0.0013	0.0014	0.03	0.031	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-10	2010-07-15 0:00	2010	0.0001	0.0001	0.03	0.5	100	130	0.225	0.0011	0.0009	0.018	0.021	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-10	2010-07-23 0:00	2010	0.0001		0.017					0.001		0.018		0.1	0.0002		0.001		
BAR-10	2010-08-20 0:00	2010	0.0001	0.0001	0.016	0.5	81	99	0.204	0.0011	0.0011	0.018	0.021	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-10	2011-06-06 0:00	2011	0.00003		0.007	0.5	74	91		0.0015		0.041		0.05	0.0001		0.001		
BAR-10	2011-06-10 0:00	2011	0.00002		0.012					0.0016		0.092		0.05	0.0001		0.001		
BAR-10	2011-07-06 0:00	2011	0.00003		0.007	0.5	74	91		0.0015		0.041		0.05	0.0001		0.001		
BAR-10	2011-07-15 0:00	2011	0.00005		0.012					0.002		0.034		0.052	0.0001		0.001		
BAR-10	2011-07-31 0:00	2011	0.00004	0.00007	0.02	0.5	65	79	0.09	0.0021	0.002	0.032	0.031	0.05	0.0001	0.0001	0.001	0.001	0.05
BAR-10	2011-08-15 0:00	2011	0.00002		0.012	0.5	52	64		0.0019		0.028		0.05	0.0001		0.001		
BAR-10	2011-08-21 0:00	2011	0.00003		0.025	0.5	52	63		0.0021		0.021		0.05	0.0001		0.001		
BAR-10	2011-09-14 0:00	2011		0.05		0.5	51	62	0.0001		0.001		0.00001			0.0005		0.001	0.0304
BAR-10	2012-04-15 15:00	2012		0.000461		0.5	111	136	2.47		0.00286		0.0993			0.0001		0.001	0.05
BAR-10	2012-07-03 14:25	2012	0.000038	0.000146	0.0117	0.5	62.7	76.5	0.267	0.00191	0.00182	0.0301	0.0331	0.05	0.0001	0.0001	0.001	0.001	0.05
BAR-10	2012-08-11 14:45	2012	0.000028		0.016	0.5	67.5	82.4		0.00124		0.0364		0.05	0.0001		0.001		
BAR-10	2012-09-14 16:25	2012	0.000031		0.0083	0.5	70.8	86.3		0.00153		0.0319		0.05	0.0001		0.001		
BAR-10	2013-05-17 14:50	2013	0.000045		0.0057	0.5	98.9	121		0.00146		0.0331		0.05	0.0001		0.001		
BAR-10	2013-06-09 15:00	2013	0.00002		0.0052	0.5	81.6	99.6		0.00094		0.0408		0.05	0.0001		0.001		
BAR-10	2013-07-19 13:15	2013	0.00002		0.0119	0.5	52.6	64.1		0.00079		0.0351		0.05	0.0001		0.001		
BAR-10	2013-07-24 15:45	2013	0.00002		0.0146	0.5	58.7	71.6		0.00082		0.0349		0.05	0.0001		0.001		
BAR-10	2013-08-11 10:00	2013	0.00003		0.0162	0.5	54.9	66.9		0.00099		0.0288		0.05	0.0001		0.001		
BAR-10	2013-08-30 8:45	2013	0.00002		0.0075	0.5	70.9	86.5		0.00077		0.0391		0.05	0.0001		0.001		
BAR-10	2013-09-03 11:00	2013	0.00002		0.0098	0.5	69.5	84.8		0.00068		0.033		0.05	0.0001		0.001		
BAR-10	2013-10-17 14:30	2013	0.00002		0.0048	0.5	84.2	103		0.00054		0.0338		0.05	0.0001		0.001		
BAR-10	2014-04-24 14:00	2014	0.000024		0.019	0.5	95.9	117		0.00088		0.0334		0.05	0.0001		0.001		
BAR-10	2014-05-08 16:30	2014	0.00002		0.0059					0.00062		0.0415		0.05	0.0001		0.001		
BAR-10	2014-07-24 16:25	2014	0.000024		0.007	0.5	80.2	97.9		0.00088		0.0484		0.05	0.0001		0.001		
BAR-10	2014-08-02 9:30	2014	0.00002		0.0097	0.5	67.2	82		0.00104		0.041		0.05	0.0001		0.001		
BAR-10	2014-09-25 15:50	2014	0.00002		0.004	0.5	63.8	77.9		0.00078		0.0447		0.05	0.0001		0.001		
BAR-10	2015-04-24 15:40	2015	0.00002		0.0056	0.5	83.8	102		0.00072		0.0387		0.05	0.0001		0.001		
BAR-10	2015-05-09 11:00	2015	0.00004		0.0146	0.5	84.1	103		0.00068		0.0438		0.1	0.0002		0.002		
BAR-10	2015-06-28 15:30	2015	0.00002		0.0231					0.00123		0.0527		0.05	0.0001		0.001		
BAR-10	2015-07-30 13:55	2015	0.00002		0.0296	0.5	63.3	77.2		0.00078		0.0282		0.05	0.0001		0.001		
BAR-10	2015-08-16 16:25	2015	0.00002		0.021	0.5	62.5	76.2		0.00094		0.0363		0.05	0.0001		0.001		
BAR-10	2015-09-03 13:40	2015	0.00002		0.0176	0.5	65.9	80.4		0.00084		0.0264		0.05	0.0001		0.001		
BAR-10	2016-05-03 16:00	2016	0.000014		0.0052	1	87.7	87.7		0.00074		0.042		0.01	0.00002		0.00005		
BAR-10	2016-07-20 14:30	2016	0.0001		0.014	1	57.6	57.6		0.0011		0.0468		0.1	0.0002		0.0005		
BAR-10	2016-08-18 13:50	2016	0.000023		0.0094	1	48.1	48.1		0.00121		0.0322		0.012	0.00002		0.00005		
BAR-10	2016-09-28 14:25	2016	0.000012		0.0048	1	54.4	54.4		0.00088		0.0289		0.01	0.00002		0.00005		
BAR-10	2017-05-14 16:15	2017	0.000022		0.0033	1	80.1	80.1		0.00074		0.0374		0.01	0.00002		0.00005		
BAR-10	2017-06-24 14:30	2017	0.000027		0.0096	1	50.2	50.2		0.00101		0.0357		0.01	0.00002		0.00005		
BAR-10	2017-08-03 9:35	2017	0.000028		0.009	1	46.5	46.5		0.00097		0.0371		0.01	0.00002		0.00005		
BAR-10	2017-09-20 16:15	2017	0.000018		0.0051	1	67.5	67.5		0.00068		0.038		0.01	0.00002		0.00005		
BAR-10	2018-04-26 15:25	2018	0.000032		0.0041	1	96	96		0.00084		0.0407		0.01	0.00002		0.00005		
BAR-10	2018-07-20 11:00	2018	0.000027		0.0346	1	51.9	51.9		0.00106		0.033		0.01	0.00002		0.00005		
BAR-10	2018-08-31 14:40	2018	0.000037		0.0065	1	45.8	43.6		0.00107		0.0246		0.01	0.00002		0.00005		
BAR-10	2019-04-22 8:05	2019	0.000024		0.0027					0.00058		0.04		0.01	0.00002		0.00005		
BAR-10	2019-08-09 16:10	2019	0.000016		0.006		128			0.00233		0.126		0.013	0.00002		0.00005		

StnCode	CollectDateTime	Year	Ag-D	Ag-T	Al-D	Alk-OH	Alk-T	Alk-B	Al-T	As-D	As-T	Ba-D	Ba-T	B-D	Be-D	Be-T	Bi-D	Bi-T	B-T
BAR-10	2019-09-10 14:05	2019	0.000011		0.0091	1	68.8	68.8		0.00069		0.0487		0.01	0.00002		0.00005		
BAR-10	2020-04-20 16:05	2020	0.000014		0.0068	1	75.1	75.1		0.00067		0.0458		0.01	0.00002		0.00005		
BAR-10	2020-07-19 15:40	2020	0.000078		0.0068	1	75.5	75.5		0.00104		0.0449		0.01	0.00002		0.00005		
BAR-10	2020-08-02 10:55	2020	0.000018		0.0057	1	73.2	73.2		0.00064		0.0402		0.01	0.00002		0.00005		
BAR-10	2020-09-24 10:30	2020	0.000015		0.0081	1	42.7	42.7		0.00035		0.033		0.01	0.00002		0.00005		
BAR-50	2010-06-18 0:00	2010	0.0001	0.0001	0.148	0.5	21	25	0.254	0.0006	0.0006	0.044	0.047	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-50	2010-06-22 0:00	2010		0.0001					0.04		0.0007		0.13			0.0002		0.001	0.377
BAR-50	2010-07-01 0:00	2010	0.0001	0.0001	0.018	0.5	47	57	0.739	0.0004	0.0006	0.044	0.052	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-50	2010-07-02 0:00	2010	0.0001		0.03	0.5	79	97		0.0006		0.065		0.1	0.0002		0.001		
BAR-50	2010-07-03 0:00	2010	0.0001		0.014	0.5	80	97		0.0006		0.093		0.1	0.0002		0.001		
BAR-50	2010-07-08 0:00	2010	0.0001	0.0001	0.01	0.5	79	96	0.098	0.0006	0.0007	0.074	0.072	0.1	0.0002	0.0002	0.001	0.001	0.108
BAR-50	2010-07-15 0:00	2010	0.0001	0.0001	0.01	0.5	80	98	0.259	0.0006	0.0005	0.047	0.052	0.109	0.0002	0.0002	0.001	0.001	0.1
BAR-50	2010-07-16 0:00	2010	0.0001		0.01					0.0004		0.062		0.102	0.0002		0.001		
BAR-50	2010-07-23 0:00	2010	0.0001		0.01	0.5	73	89		0.0005		0.039		0.103	0.0002		0.001		
BAR-50	2010-08-20 0:00	2010	0.0001	0.0001	0.01	0.5	58	71	0.122	0.0004	0.0004	0.042	0.048	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-50	2010-09-10 0:00	2010	0.0001		0.011					0.0004		0.045		0.1	0.0002		0.001		
BAR-50	2010-09-12 0:00	2010	0.0001		0.01					0.0005		0.052		0.1	0.0002		0.001		
BAR-50	2011-06-06 0:00	2011	0.00003		0.007	0.5	52	63		0.0007		0.057		0.088	0.0001		0.001		
BAR-50	2011-07-06 0:00	2011	0.00003		0.007	0.5	52	63		0.0007		0.057		0.088	0.0001		0.001		
BAR-50	2011-07-15 0:00	2011	0.00002		0.007					0.0008		0.053		0.1	0.0001		0.001		
BAR-50	2011-07-31 0:00	2011	0.00002	0.00004	0.014	0.5	27	33	0.089	0.0011	0.001	0.05	0.048	0.097	0.0001	0.0001	0.001	0.001	0.088
BAR-50	2011-08-15 0:00	2011	0.00002		0.016	0.5	16	20		0.0011		0.042		0.09	0.0001		0.001		
BAR-50	2011-08-21 0:00	2011	0.00002		0.017	0.5	20	25		0.0014		0.041		0.079	0.0001		0.001		
BAR-50	2011-09-14 0:00	2011	0.00002	0.074	0.015	1	48	60	0.0001	0.0017	0.001	0.045	0.00011	0.074	0.0001	0.0005	0.001	0.001	0.0263
BAR-50	2012-04-15 15:00	2012		0.0015					4.07		0.00193		0.0978			0.00018		0.001	0.05
BAR-50	2012-08-11 14:45	2012	0.00002		0.0285	0.5	43.8	53.4		0.00121		0.03		0.075	0.0001		0.001		
BAR-50	2012-09-14 16:25	2012	0.00002		0.0054	0.5	44.8	54.7		0.00118		0.0439		0.05	0.0001		0.001		
BAR-50	2013-05-17 15:05	2013	0.00002		0.003	0.5	73.2	89.3		0.00127		0.0349		0.05	0.0001		0.001		
BAR-50	2013-06-09 15:05	2013	0.00002		0.0136					0.0012		0.0409		0.054	0.0001		0.001		
BAR-50	2013-06-15 14:00	2013																	
BAR-50	2013-07-19 13:20	2013	0.00002		0.0071					0.00086		0.0441		0.053	0.0001		0.001		
BAR-50	2013-07-24 15:55	2013	0.00002		0.0092	0.5	50	61		0.00086		0.0399		0.05	0.0001		0.001		
BAR-50	2013-08-11 10:15	2013	0.000024		0.0111	0.5	41.9	51.1		0.0008		0.0418		0.079	0.0001		0.001		
BAR-50	2013-08-15 11:35	2013	0.000028		0.0085	0.5	50.9	62.1		0.00057		0.0427		0.075	0.0001		0.001		
BAR-50	2013-08-30 8:55	2013	0.00002		0.0052	0.5	49.5	60.3		0.00076		0.0419		0.05	0.0001		0.001		
BAR-50	2013-09-03 11:10	2013	0.00002		0.0049	0.5	50	61		0.00071		0.0343		0.05	0.0001		0.001		
BAR-50	2013-09-15 16:10	2013	0.00002		0.0112					0.00066		0.0375		0.051	0.0001		0.001		
BAR-50	2013-10-17 14:40	2013	0.00002		0.0039	0.5	66.8	81.5		0.00074		0.0362		0.05	0.0001		0.001		
BAR-50	2014-04-24 14:10	2014	0.000021		0.0034	0.5	91.7	112		0.00088		0.029		0.054	0.0001		0.001		
BAR-50	2014-05-08 16:30	2014	0.00002		0.0051	0.5	83.6	102		0.0006		0.0442		0.058	0.0001		0.001		
BAR-50	2014-05-18 13:30	2014	0.00002		0.0042					0.00068		0.0408		0.071	0.0001		0.001		
BAR-50	2014-05-25 10:30	2014	0.00002		0.0061	0.5	58.1	70.9		0.00081		0.0348		0.052	0.0001		0.001		
BAR-50	2014-06-07 9:50	2014	0.00002		0.0066	0.5	54.1	66.1		0.0008		0.0339		0.061	0.0001		0.001		
BAR-50	2014-07-24 16:30	2014	0.00002		0.0042	0.5	56.9	69.5		0.00096		0.05		0.054	0.0001		0.001		
BAR-50	2014-08-02 9:30	2014	0.00002		0.0076	0.5	49	59.8		0.00105		0.0428		0.059	0.0001		0.001		
BAR-50	2014-09-25 15:55	2014	0.00002		0.0069	0.5	48.7	59.4		0.00089		0.0343		0.05	0.0001		0.001		
BAR-50	2015-04-24 15:50	2015	0.00002		0.0058	0.5	70.8	86.4		0.00109		0.0231		0.05	0.0001		0.001		
BAR-50	2015-05-09 11:05	2015	0.00002		0.0077	0.5	67.7	82.6		0.00083		0.0373		0.055	0.0001		0.001		
BAR-50	2015-06-28 15:35	2015	0.00002		0.0262					0.00136		0.0587		0.059	0.0001		0.001		
BAR-50	2015-07-30 13:50	2015	0.00002		0.0144	0.5	40.4	49.3		0.0008		0.0273		0.05	0.0001		0.001		
BAR-50	2015-08-16 16:30	2015	0.00002		0.0138	0.5	30.2	36.8		0.00085		0.0309		0.05	0.0001		0.001		
BAR-50	2015-09-03 13:45	2015	0.00002		0.0179	0.5	42	51.3		0.00073		0.0275		0.05	0.0001		0.001		
BAR-50	2016-05-03 16:05	2016	0.00001		0.0016					0.00046		0.0216		0.025	0.00002		0.00005		
BAR-50	2016-07-20 14:35	2016	0.0001		0.01					0.001		0.0584		0.1	0.0002		0.0005		

StnCode	CollectDateTime	Year	Ag-D	Ag-T	Al-D	Alk-OH	Alk-T	Alk-B	Al-T	As-D	As-T	Ba-D	Ba-T	B-D	Be-D	Be-T	Bi-D	Bi-T	B-T
BAR-50	2016-08-18 13:55	2016	0.000011		0.0048	1	34.8	34.8		0.00079		0.0314		0.036	0.00002		0.00005		
BAR-50	2016-09-28 14:30	2016	0.00001		0.0031	1	31.3	31.3		0.00065		0.0279		0.02	0.00002		0.00005		
BAR-50	2017-05-14 16:20	2017	0.000013		0.0033	1	47.5	47.5		0.00078		0.0263		0.024	0.00002		0.00005		
BAR-50	2017-06-24 14:35	2017	0.000011		0.0086	1	31.6	31.6		0.00087		0.0324		0.034	0.00002		0.00005		
BAR-50	2017-08-03 9:55	2017	0.000011		0.0099	1	46.8	46.8		0.00084		0.0315		0.03	0.00002		0.00005		
BAR-50	2017-09-20 16:25	2017	0.00001		0.0047	1	45.7	45.7		0.00058		0.0258		0.021	0.00002		0.00005		
BAR-50	2018-04-26 15:30	2018	0.000015		0.0021	1	69.7	69.7		0.00077		0.028		0.021	0.00002		0.00005		
BAR-50	2018-08-31 15:05	2018	0.000021		0.004	1	56.9	56.9		0.00052		0.0246		0.018	0.00002		0.00005		
BAR-50	2019-08-09 16:15	2019	0.000052		0.0031		73.6			0.00164		0.0664		0.035	0.00002		0.00005		
BAR-50	2019-09-10 14:05	2019	0.000022		0.0043	1	59.7	59.7		0.00087		0.0331		0.018	0.00002		0.00005		
BAR-50	2020-04-20 16:10	2020	0.00001		0.0062	1	59.6	59.6		0.00037		0.0223		0.014	0.00002		0.00005		
BAR-50	2020-07-19 15:50	2020	0.000037		0.0046	1	57.1	57.1		0.00078		0.0346		0.021	0.00002		0.00005		
BAR-50	2020-08-02 11:15	2020	0.000022		0.0086	1	60.7	60.7		0.00048		0.0207		0.017	0.00002		0.00005		
BAR-50	2020-08-30 14:00	2020	0.000024		0.004	1	64.5	64.5		0.00038		0.0233		0.016	0.00002		0.00005		
BAR-50	2020-09-24 10:45	2020	0.000022		0.0073	1	38.7	38.7		0.00025		0.0167		0.01	0.00002		0.00005		
BAR-75	2010-07-01 0:00	2010	0.0001	0.0002	0.018	0.5	54	66	0.689	0.0012	0.0014	0.042	0.054	0.203	0.0002	0.0002	0.001	0.001	0.218
BAR-75	2010-07-02 0:00	2010	0.0001		0.015	0.5	96	120		0.0017		0.07		0.32	0.0002		0.001		
BAR-75	2010-07-03 0:00	2010																	
BAR-75	2010-07-08 0:00	2010	0.0001	0.0001	0.011	0.5	78	95	0.042	0.0014	0.0014	0.059	0.063	0.332	0.0002	0.0002	0.001	0.001	0.326
BAR-75	2010-07-15 0:00	2010	0.0001	0.0001	0.01	0.5	68	83	0.52	0.0016	0.0012	0.052	0.057	0.363	0.0002	0.0002	0.001	0.001	0.259
BAR-75	2010-07-16 0:00	2010	0.0001		0.01					0.0014		0.057		0.345	0.0002		0.001		
BAR-75	2010-07-23 0:00	2010	0.0001		0.013	0.5	67	82		0.001		0.046		0.238	0.0002		0.001		
BAR-75	2010-08-20 0:00	2010	0.0001	0.0001	0.01	0.5	52	63	0.239	0.0008	0.001	0.045	0.051	0.254	0.0002	0.0002	0.001	0.001	0.273
BAR-75	2011-06-06 0:00	2011	0.00002		0.007	0.5	46	56		0.0013		0.045		0.324	0.0001		0.001		
BAR-75	2011-07-06 0:00	2011	0.00002		0.007	0.5	46	56		0.0013		0.045		0.324	0.0001		0.001		
BAR-75	2011-07-15 0:00	2011	0.00002		0.009					0.0012		0.047		0.355	0.0001		0.001		
BAR-75	2011-07-31 0:00	2011	0.00002	0.00003	0.012	0.5	39	48	0.026	0.0013	0.0011	0.042	0.037	0.367	0.0001	0.0001	0.001	0.001	0.31
BAR-75	2011-08-15 0:00	2011	0.00002		0.008	0.5	29	35		0.0011		0.035		0.296	0.0001		0.001		
BAR-75	2011-08-21 0:00	2011	0.00002		0.021	0.5	24	29		0.0013		0.032		0.276	0.0001		0.001		
BAR-75	2011-09-14 0:00	2011	0.00002	0.252	0.016	1	46	56	0.0001	0.0012	0.001	0.034	0.00011	0.252	0.0001	0.0005	0.001	0.001	0.0313
BAR-75	2012-04-15 15:00	2012		0.000136					0.324		0.00115		0.0207			0.0001		0.001	0.07
BAR-75	2012-07-03 14:25	2012	0.000025	0.000103	0.0113	0.5	39.9	48.7	0.234	0.00198	0.00188	0.0448	0.0441	0.223	0.0001	0.0001	0.001	0.001	0.217
BAR-75	2012-09-14 16:25	2012	0.00004		0.0085	0.5	42.9	52.3		0.00187		0.0395		0.176	0.0002		0.002		
BAR-75	2013-05-17 15:15	2013	0.00002		0.003	0.5	44.6	54.4		0.00215		0.0332		0.168	0.0001		0.001		
BAR-75	2013-06-09 15:07	2013	0.00002		0.0169	0.5	29.5	36		0.00277		0.0397		0.195	0.0001		0.001		
BAR-75	2013-07-19 13:30	2013	0.00002		0.0089					0.00182		0.0429		0.166	0.0001		0.001		
BAR-75	2013-07-24 16:05	2013	0.000024		0.0109	0.5	40.6	49.6		0.00245		0.0454		0.214	0.0001		0.001		
BAR-75	2013-08-11 10:40	2013	0.00002		0.0117	0.5	30.1	36.7		0.00191		0.0438		0.222	0.0001		0.001		
BAR-75	2013-08-15 11:40	2013	0.000024		0.0104	0.5	32.4	39.6		0.00131		0.0434		0.235	0.0001		0.001		
BAR-75	2013-08-30 9:05	2013	0.00002		0.0075	0.5	38.8	47.3		0.00171		0.0336		0.211	0.0001		0.001		
BAR-75	2013-09-03 11:20	2013	0.00002		0.007	0.5	42.1	51.4		0.0014		0.0327		0.224	0.0001		0.001		
BAR-75	2013-09-15 16:15	2013	0.00002		0.0178					0.00121		0.0346		0.203	0.0001		0.001		
BAR-75	2013-10-17 14:50	2013	0.00002		0.0045	0.5	53.2	64.9		0.0013		0.0273		0.196	0.0001		0.001		
BAR-75	2014-04-24 14:20	2014	0.00002		0.0152	0.5	57.5	70.2		0.00134		0.0284		0.143	0.0001		0.001		
BAR-75	2014-05-08 16:30	2014	0.00002		0.0061	0.5	46.6	56.8		0.00122		0.0329		0.162	0.0001		0.001		
BAR-75	2014-05-18 13:30	2014	0.00002		0.005					0.00112		0.0327		0.189	0.0001		0.001		
BAR-75	2014-05-25 10:40	2014	0.00002		0.0044	0.5	31.7	38.7		0.00129		0.0276		0.126	0.0001		0.001		
BAR-75	2014-07-24 16:35	2014	0.000026		0.0061	0.5	49.7	60.6		0.00184		0.0403		0.188	0.0001		0.001		
BAR-75	2014-08-02 9:30	2014	0.00002		0.007	0.5	36.9	45		0.00179		0.0377		0.207	0.0001		0.001		
BAR-75	2014-09-25 16:00	2014	0.00002		0.0067	0.5	46.5	56.7		0.00177		0.0258		0.17	0.0001		0.001		
BAR-75	2015-04-24 16:00	2015	0.00002		0.0065	0.5	55.2	67.3		0.00163		0.0258		0.172	0.0001		0.001		
BAR-75	2015-05-09 11:10	2015	0.00002		0.0088	0.5	39.6	48.3		0.00165		0.0344		0.193	0.0001		0.001		
BAR-75	2015-06-28 15:40	2015	0.00002		0.019					0.00233		0.0408		0.233	0.0001		0.001		
BAR-75	2015-07-30 13:45	2015	0.00002		0.0141	0.5	31.8	38.8		0.00145		0.029		0.151	0.0001		0.001		

StnCode	CollectDateTime	Year	Ag-D	Ag-T	Al-D	Alk-OH	Alk-T	Alk-B	Al-T	As-D	As-T	Ba-D	Ba-T	B-D	Be-D	Be-T	Bi-D	Bi-T	B-T
BAR-75	2015-08-16 16:35	2015	0.00002		0.0172	0.5	37.6	45.8		0.0015		0.0304		0.153	0.0001		0.001		
BAR-75	2015-09-03 13:50	2015	0.00002		0.0234	0.5	32.8	40		0.00112		0.0244		0.129	0.0001		0.001		
BAR-75	2016-05-03 16:10	2016	0.00002		0.0033	1	37	37		0.00139		0.0244		0.136	0.00004		0.0001		
BAR-75	2016-07-20 14:40	2016	0.0001		0.01					0.0014		0.036		0.17	0.0002		0.0005		
BAR-75	2016-08-18 14:00	2016	0.00002		0.0055	1	28	28		0.00145		0.0308		0.106	0.00004		0.0001		
BAR-75	2016-09-28 14:35	2016	0.00002		0.0037	1	28.9	28.9		0.00116		0.024		0.098	0.00004		0.0001		
BAR-75	2017-05-14 16:25	2017	0.00002		0.0033	1	44.9	44.9		0.00138		0.0257		0.119	0.00004		0.0001		
BAR-75	2017-06-24 14:40	2017	0.00002		0.0054	1	36	36		0.00131		0.0298		0.149	0.00004		0.0001		
BAR-75	2017-08-03 10:15	2017	0.00002		0.0051	1	40.9	40.9		0.00137		0.0293		0.134	0.00004		0.0001		
BAR-75	2018-04-26 15:35	2018	0.00002		0.0022	1	64.8	64.8		0.00114		0.0248		0.097	0.00004		0.0001		
BAR-75	2018-06-23 10:05	2018	0.00005		0.0062					0.00119		0.0277		0.112	0.0001		0.00025		
BAR-75	2018-07-20 10:40	2018	0.00002		0.0035	1	37.6	37.6		0.00124		0.0263		0.116	0.00004		0.0001		
BAR-75	2019-08-09 16:30	2019	0.00002		0.0093		62.6			0.00226		0.0398		0.087	0.00004		0.0001		
BAR-75	2019-09-10 14:20	2019	0.000012		0.0053	1	46.1	46.1		0.00147		0.0288		0.062	0.00002		0.00005		
BAR-75	2020-04-20 16:20	2020	0.00002		0.0028	1	45.9	45.9		0.00152		0.025		0.081	0.00004		0.0001		
BAR-75	2020-07-19 16:00	2020	0.00002		0.0044	1	44.7	44.7		0.00136		0.0297		0.082	0.00004		0.0001		
BAR-75	2020-08-02 11:25	2020	0.00002		0.0304	1	44.1	44.1		0.00071		0.0243		0.065	0.00004		0.0001		
BAR-75	2020-08-30 14:15	2020	0.00001		0.0069	1	46	46		0.0006		0.0228		0.058	0.00002		0.00005		
BAR-75	2020-09-24 10:50	2020	0.00002		0.0066	1	31.6	31.6		0.00033		0.0198		0.036	0.00004		0.0001		
BAR-90	2010-07-01 0:00	2010	0.0001	0.0001	0.02	0.5	44	54	0.506	0.0008	0.0009	0.037	0.044	0.101	0.0002	0.0002	0.001	0.001	0.115
BAR-90	2010-07-02 0:00	2010	0.0001		0.02	0.5	93	110		0.0011		0.057		0.224	0.0002		0.001		
BAR-90	2010-07-03 0:00	2010																	
BAR-90	2010-07-08 0:00	2010	0.0001	0.0001	0.016	0.5	69	85	0.197	0.0009	0.0012	0.048	0.068	0.189	0.0002	0.0002	0.001	0.001	0.269
BAR-90	2010-07-15 0:00	2010	0.0001	0.0001	0.012	0.5	58	71	0.109	0.0013	0.0011	0.053	0.044	0.249	0.0002	0.0002	0.001	0.001	0.168
BAR-90	2010-07-16 0:00	2010	0.0001		0.014					0.0013		0.056		0.249	0.0002		0.001		
BAR-90	2010-07-23 0:00	2010	0.0001		0.01					0.001		0.048		0.347	0.0002		0.001		
BAR-90	2010-08-20 0:00	2010	0.0001	0.0001	0.01	0.5	41	50	0.049	0.0008	0.0009	0.04	0.042	0.178	0.0002	0.0002	0.001	0.001	0.19
BAR-90	2010-09-10 0:00	2010	0.0001		0.01					0.0014		0.046		0.187	0.0002		0.001		
BAR-90	2011-06-06 0:00	2011	0.00002		0.01	0.5	38	46		0.0011		0.043		0.223	0.0001		0.001		
BAR-90	2011-06-10 0:00	2011	0.00004		0.01					0.0017		0.052		0.23	0.0001		0.001		
BAR-90	2011-07-06 0:00	2011	0.00002		0.01	0.5	38	46		0.0011		0.043		0.223	0.0001		0.001		
BAR-90	2011-07-15 0:00	2011	0.00002		0.016					0.0011		0.048		0.259	0.0001		0.001		
BAR-90	2011-07-31 0:00	2011	0.00002	0.00003	0.016	0.5	34	41	0.058	0.0014	0.0014	0.047	0.044	0.279	0.0001	0.0001	0.001	0.001	0.245
BAR-90	2011-08-15 0:00	2011	0.00002		0.015	0.5	26	32		0.0016		0.039		0.228	0.0001		0.001		
BAR-90	2011-08-21 0:00	2011	0.00002		0.022	0.5	24	29		0.0019		0.037		0.209	0.0001		0.001		
BAR-90	2011-09-14 0:00	2011	0.00002	0.208	0.031	1	46	56	0.0001	0.0026	0.001	0.041	0.00014	0.208	0.0001	0.0005	0.001	0.001	0.0426
BAR-90	2012-07-03 14:25	2012	0.000021	0.000076	0.0112	0.5	32.5	39.7	0.179	0.00181	0.00155	0.0409	0.038	0.141	0.0001	0.0001	0.001	0.001	0.149
BAR-90	2012-08-11 14:45	2012	0.000025		0.0391	0.5	39.1	47.8		0.002		0.0627		0.166	0.00013		0.0013		
BAR-90	2012-09-14 16:25	2012	0.00004		0.0105	0.5	35	42.7		0.00193		0.0352		0.134	0.0002		0.002		
BAR-90	2013-05-17 15:30	2013	0.00002		0.003	0.5	42.4	51.7		0.00226		0.0353		0.129	0.0001		0.001		
BAR-90	2013-06-09 15:10	2013	0.00002		0.0211					0.00227		0.0432		0.143	0.0001		0.001		
BAR-90	2013-07-19 13:35	2013	0.000026		0.0217	0.5	24.1	29.4		0.00185		0.0461		0.176	0.0001		0.001		
BAR-90	2013-07-24 16:15	2013	0.00002		0.031	0.5	33.2	40.6		0.00221		0.0483		0.16	0.0001		0.001		
BAR-90	2013-08-11 10:25	2013	0.000022		0.0175	0.5	26.4	32.2		0.00182		0.0436		0.176	0.0001		0.001		
BAR-90	2013-08-30 9:15	2013	0.000025		0.01	0.5	36.9	45		0.00172		0.0405		0.176	0.0001		0.001		
BAR-90	2013-09-03 11:30	2013	0.00002		0.0093	0.5	36.4	44.4		0.0012		0.0363		0.164	0.0001		0.001		
BAR-90	2013-10-17 15:00	2013	0.00002		0.0048	0.5	46.1	56.3		0.00129		0.028		0.134	0.0001		0.001		
BAR-90	2014-04-24 14:30	2014	0.00002		0.0066	0.5	46.8	57.1		0.00139		0.0305		0.087	0.0001		0.001		
BAR-90	2014-05-25 10:50	2014	0.00002		0.0069	0.5	41.2	50.3		0.00199		0.0337		0.109	0.0001		0.001		
BAR-90	2014-07-24 16:40	2014	0.00002		0.0068	0.5	41.2	50.3		0.00167		0.0449		0.143	0.0001		0.001		
BAR-90	2014-08-02 9:30	2014	0.00002		0.009	0.5	35.3	43.1		0.00162		0.0417		0.165	0.0001		0.001		
BAR-90	2014-09-25 16:05	2014	0.00002		0.0059	0.5	39.2	47.9		0.00164		0.0274		0.134	0.0001		0.001		
BAR-90	2015-04-24 16:10	2015	0.00002		0.0067	0.5	49.5	60.4		0.00174		0.0289		0.112	0.0001		0.001		
BAR-90	2015-06-28 15:45	2015	0.00002		0.0198					0.00202		0.0429		0.187	0.0001		0.001		

StnCode	CollectDateTime	Year	Ag-D	Ag-T	Al-D	Alk-OH	Alk-T	Alk-B	Al-T	As-D	As-T	Ba-D	Ba-T	B-D	Be-D	Be-T	Bi-D	Bi-T	B-T
BAR-90	2015-07-30 13:40	2015	0.00002		0.0161	0.5	26.8	32.7		0.0012		0.0293		0.103	0.0001		0.001		
BAR-90	2015-08-16 16:40	2015	0.00002		0.0164	0.5	30.2	36.9		0.00135		0.0336		0.134	0.0001		0.001		
BAR-90	2015-09-03 13:55	2015	0.00002		0.0159	0.5	31.3	38.2		0.0008		0.0243		0.095	0.0001		0.001		
BAR-90	2016-07-20 14:45	2016	0.0001		0.011	1	28.6	28.6		0.0014		0.0392		0.11	0.0002		0.0005		
BAR-90	2016-08-18 14:05	2016	0.00002		0.009	1	29.9	29.9		0.00142		0.0345		0.109	0.00004		0.0001		
BAR-90	2016-09-28 14:40	2016	0.00002		0.0047	1	30.3	30.3		0.00109		0.0276		0.065	0.00004		0.0001		
BAR-90	2017-05-14 16:30	2017	0.00002		0.0039	1	36.7	36.7		0.00101		0.0302		0.065	0.00004		0.0001		
BAR-90	2017-08-03 10:00	2017	0.00002		0.0087	1	30.4	30.4		0.00143		0.0361		0.087	0.00004		0.0001		
BAR-90	2017-09-20 16:35	2017	0.00001		0.0152	1	36.6	36.6		0.00125		0.0317		0.067	0.00002		0.00005		
BAR-90	2018-04-26 15:40	2018	0.00002		0.002	1	52.1	52.1		0.00143		0.0286		0.06	0.00004		0.0001		
BAR-90	2018-07-20 10:45	2018	0.00002		0.0067	1	33	33		0.00145		0.033		0.083	0.00004		0.0001		
BAR-90	2019-08-09 16:50	2019	0.00002		0.0067		48.8			0.00264		0.0478		0.101	0.00004		0.0001		
BAR-90	2019-09-10 14:15	2019	0.00001		0.0051	1	39.8	39.8		0.00126		0.0302		0.057	0.00002		0.00005		
BAR-90	2020-04-20 16:25	2020	0.00002		0.0057	1	30.6	30.6		0.00046		0.0231		0.033	0.00004		0.0001		
BAR-90	2020-07-19 16:10	2020	0.000021		0.0055	1	40.3	40.3		0.00142		0.0286		0.075	0.00004		0.0001		
BAR-90	2020-08-02 11:40	2020	0.00002		0.0071	1	37.8	37.8		0.00062		0.0271		0.062	0.00004		0.0001		
BAR-90	2020-08-30 14:25	2020	0.00001		0.0048	1	39.3	39.3		0.00057		0.0271		0.052	0.00002		0.00005		
BAR-B	2010-07-01 0:00	2010	0.0001	0.0001	0.01	0.5	4.7	5.8	0.057	0.0004	0.0004	0.005	0.006	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-B	2010-07-02 0:00	2010	0.0001		0.01	0.5	3.4	4.2		0.0004		0.003		0.1	0.0002		0.001		
BAR-B	2010-07-03 0:00	2010																	
BAR-B	2010-07-08 0:00	2010	0.0001	0.0001	0.01	0.5	4.4	5.3	0.069	0.0004	0.0004	0.003	0.004	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-B	2010-07-15 0:00	2010	0.0001	0.0001	0.01	0.5	2.7	3.3	0.014	0.0004	0.0004	0.002	0.002	0.1	0.0002	0.0002	0.001	0.001	0.1
BAR-B	2010-07-16 0:00	2010	0.0001		0.01					0.0004		0.002		0.1	0.0002		0.001		
BAR-B	2010-07-23 0:00	2010	0.0001		0.01	0.5	1.6	1.9		0.0004		0.001		0.1	0.0002		0.001		
BAR-B	2010-08-20 0:00	2010	0.0001	0.0001	0.01	0.5	0.5	0.5	0.01	0.0004	0.0004	0.001	0.002	0.1	0.0002	0.0002	0.001	0.001	0.1

Ca-D	Ca-T	Cd-D	Cd-T	Co-D	Cond-F	Cond-L	Co-T	Cr-D	Cr-T	Cu-D	Cu-T	Fe-D	Fe-T	Hard-D	Hard-T	Hg-D	Hg-T	Column1	K-D	K-T
5		0.0001		0.0005				0.002		0.158		0.039		13.5		0.0002			3	
3		0.0001		0.0005				0.002		0.036		0.02		7.8		0.0002			1	
	49		0.0001			578	0.0005		0.002		0.098		0.219		170		0.0002			7
17	29	0.0001	0.0001	0.0005		278	0.0005	0.002	0.002	0.045	0.106	0.039	1.79	57.7	91.1	0.0002	0.0002		3	4
25		0.0001		0.0005		384		0.002		0.049		0.02		88.1		0.0002			4	
31		0.0001		0.0005		454		0.002		0.053		0.02		110		0.0002			5	
27	26	0.0001	0.0001	0.0005		423	0.0005	0.002	0.002	0.048	0.054	0.02	0.105	97.1	93.3	0.0002	0.0002		5	5
25	31	0.0001	0.0001	0.0005		332	0.0005	0.002	0.002	0.049	0.073	0.021	0.333	83.6	70.3	0.0002	0.0002		4	4
20		0.0001		0.0005				0.002		0.045		0.02		70.5		0.0002			4	
18	19	0.0001	0.0001	0.0005		282	0.0005	0.002	0.002	0.038	0.062	0.02	0.301	63.3	66.4	0.00002	0.0002		3	3
32.8		0.00005		0.0005		415		0.001		0.055		0.007		115		0.00002			7.66	
55.7		0.0001		0.0005				0.001		0.0882		0.009		194		0.00002			10.3	
32.8		0.00005		0.0005		415		0.001		0.055		0.007		115		0.00002			7.66	
29.8		0.00004		0.0005				0.001		0.0538		0.006		106		0.00002			6.72	
28	24.2	0.00002	0.00003	0.0005		358	0.0005	0.001	0.001	0.0452	0.0536	0.009	0.149	98.6	86.4	0.00002	0.00002		5.44	4.98
25.2		0.00003		0.0005		289		0.001		0.0493		0.005		87.8		0.00002			4.9	
17.4		0.00001		0.0005		292		0.001		0.0286		0.005		62.9		0.00002			3.16	
	22		0.005				0.005		0.001		0.125		0.001		290	0.0692	0.00002			0.02
	45.4		0.000103			369	0.00171		0.0012		0.417		4.67		159		0.00001			5.49
24.2	23.1	0.000026	0.000066	0.0005	205.4	267	0.0005	0.001	0.001	0.0398	0.0687	0.0075	0.348	84.2	80.8	0.00001	0.00001		4.35	3.99
22.6		0.000027		0.0005		248		0.001		0.0332		0.005		79.5		0.00001			4.24	
26.2		0.00001		0.0005		278		0.001		0.0378		0.005		92		0.00001			3.99	
27.6		0.000026		0.0005	182.6	292		0.001		0.0467		0.005		99.9		0.00001			4.06	
27.6		0.000027		0.0005	290	286		0.001		0.0491		0.005		98.2		0.00001			4.96	
23.1		0.000033		0.0005	178.9	214		0.001		0.0468		0.005		78.6		0.00001			3.94	
23.2		0.000037		0.0005	187.2	225		0.001		0.0365		0.005		80.2		0.00001			4.03	
20.1		0.00001		0.0005	224	221		0.001		0.0373		0.005		71.4		0.00001			4.29	
27.8		0.000017		0.0005	273	278		0.001		0.0297		0.005		97.8		0.00001			4.09	
21.1		0.00003		0.0005	237	240		0.001		0.0261		0.005		77.1		0.00001			4.26	
25.8		0.000039		0.0005	146.1	269		0.001		0.0273		0.005		92.3		0.00001			3.15	
26.4		0.00002		0.0005	261	249		0.001		0.0359		0.005		95.1		0.00001			3.38	
28.3		0.000075		0.0005				0.001		0.0431		0.008		101		0.00001			4.1	
28.9		0.00003		0.0005	318	288		0.001		0.049		0.005		104		0.00001			4.39	
24.6		0.000023		0.0005		260		0.001		0.0398		0.005		90.8		0.00001			4.39	
33.1		0.000028		0.0005	199.9	300		0.001		0.0284		0.005		117		0.00001			3.34	
30.7		0.000025		0.0005	177.1	277		0.001		0.0339		0.005		113		0.00001			3.7	
32		0.00002		0.001		290		0.002		0.0405		0.01		116		0.00001			4.71	
36.5		0.000033		0.0005	314			0.001		0.0433		0.005		130		0.00001			5.41	
22.1		0.000089		0.0005	213	201		0.001		0.0309		0.0211		78.2		0.00001			3.16	
24.3		0.000027		0.0005	241	232		0.001		0.0557		0.0356		86.5		0.00001			3.52	
23.2		0.000015		0.0005	236	211		0.001		0.0238		0.0191		82.4		0.00001			2.95	
32.5		0.0000208		0.0001	285	259		0.0001		0.0395		0.01		115		0.000005			4.01	
26		0.00005		0.001	246	229		0.001		0.0452		0.01		92.3					4.11	
20.6		0.0000138		0.0001	213	201		0.00018		0.0282		0.01		74.6					3.91	
21		0.0000166		0.0001	152.9	193		0.00017		0.0267		0.01		76.4		0.000005			3.02	
23.9		0.000035		0.0001	305	227		0.0001		0.038		0.01		87		0.000005			3.45	
25.1		0.0002		0.0001	218	199		0.00012		0.0425		0.01		89.7		0.000005			3.93	
23		0.00005		0.0001		204		0.00019		0.038		0.01		84.1		0.000005			3.67	
25		0.00005		0.0001	249	212		0.00017		0.0343		0.01		88.6		0.000005			3.41	
30.9		0.00005		0.0001	304	279		0.0001		0.0466		0.01		117		0.000005			3.81	
21.9		0.00005		0.0001	210.5	205		0.0002		0.0467		0.049		78.2					3.55	
19.3		0.000035		0.0001	124.7	183		0.00013		0.0344		0.01		70		0.000005			3.11	
23.9		0.000045		0.0001				0.0001		0.0442		0.01		88.7		0.000005			3.03	
54.7		0.00005		0.00014	395.1	493		0.00037		0.069		0.01		214		0.000005			8.43	

Ca-D	Ca-T	Cd-D	Cd-T	Co-D	Cond-F	Cond-L	Co-T	Cr-D	Cr-T	Cu-D	Cu-T	Fe-D	Fe-T	Hard-D	Hard-T	Hg-D	Hg-T	Column1	K-D	K-T
25.9		0.000035		0.0001	173.1	204		0.00021		0.0333		0.01		92		0.000005			3.2	
33.1		0.000085		0.0001	132.6	206				0.0366		0.01				0.000005			3.8	
33.1		0.00007		0.00013	213	253		0.00011		0.067		0.01		120		0.000005			5.07	
22.5		0.000015		0.0001	166.7	185		0.00017		0.0344		0.01		83.1		0.000005			3.6	
13.3		0.000045		0.0001		109		0.00014		0.0227		0.01		48.8		0.000005			2.32	
17	20	0.0001	0.0001	0.0008		155	0.001	0.002	0.002	0.085	0.087	0.158	0.35	52.9	59.2	0.0002	0.0002		4	4
	169		0.0004			1320	0.0006		2.28		0.061		0.058		521		0.0002			18
100	100	0.0001	0.0002	0.0005		880	0.0005	0.002	0.002	0.031	0.083	0.02	1.06	304	309	0.0002	0.0002		6	6
155		0.0002		0.0005		1320		0.002		0.035		0.02		473		0.0002			7	
170		0.0001		0.0005		1580		0.002		0.036		0.02		535		0.0002			8	
187	193	0.0002	0.0002	0.0005		1530	0.0005	0.002	0.002	0.035	0.043	0.02	0.161	571	585	0.0002	0.0002		9	9
183	160	0.0002	0.0002	0.0005		1190	0.0005	0.002	0.002	0.038	0.071	0.02	0.455	545	378	0.0002	0.0002		8	7
172		0.0001		0.0005				0.002		0.034		0.02		508		0.0002			7	
114		0.0002		0.0005		1080		0.002		0.037		0.02		359		0.0022			7	
122	132	0.0003	0.0003	0.0005		1050	0.0005	0.002	0.002	0.03	0.044	0.02	0.177	378	413	0.00002	0.0002		6	7
100		0.0001		0.0005				0.002		0.02		0.02		294		0.0002			4	
121		0.0001		0.0005				0.002		0.024		0.02		355		0.0002			5	
155		0.00015		0.0005		1220		0.001		0.0349		0.005		501		0.00002			16.2	
155		0.00015		0.0005		1220		0.001		0.0349		0.005		501		0.00002			16.2	
167		0.00016		0.0005				0.001		0.0336		0.005		534		0.00002			15.3	
192	188	0.00011	0.00009	0.0005		1320	0.0005	0.001	0.001	0.0253	0.0326	0.007	0.148	594	579	0.00002	0.00002		12.5	12.1
200		0.00008		0.0005		1310		0.001		0.0256		0.005		605		0.00002			10.4	
193		0.00005		0.0005		1350		0.001		0.0176		0.005		587		0.00002			8.43	
206	252	0.00011	0.009	0.0005		1380	0.005	0.001	0.002	0.0263	0.154	0.009	0.001	628	1380	0.62802	0.00002		10.5	0.02
	161		0.000221				0.00337		0.0017		0.59		7.92		474		0.00001			7.07
82.6		0.000089		0.0005		758		0.001		0.0193		0.005		251		0.00001			5.44	
168		0.000176		0.0005		1060		0.001		0.0239		0.005		506		0.00001			7.36	
164		0.0002		0.0005		1070		0.001		0.0395		0.005		503		0.00001			7.77	
149		0.000248		0.0005	947			0.001		0.0374		0.005		446		0.00001			7.63	
					836															
109		0.00011		0.0005				0.001		0.0362		0.0055		323		0.00001			6.35	
105		0.000102		0.0005	616	750		0.001		0.0269		0.005		319		0.00001			6.54	
119		0.00011		0.0005	805	813		0.001		0.0277		0.0087		367		0.00001			8.04	
123		0.000124		0.0005	822	852		0.001		0.0265		0.0055		377		0.00001			7.92	
146		0.000118		0.0005	915	951		0.001		0.0259		0.005		448		0.00001			6.99	
116		0.00011		0.0005	809	830		0.001		0.0234		0.005		356		0.00001			6.47	
138		0.00001		0.0005	892			0.001		0.0308		0.0071		427		0.00001			6.96	
151		0.000163		0.0005	515	1010		0.001		0.0284		0.005		462		0.00001			5.81	
202		0.000254		0.0005	1249	1170		0.001		0.0538		0.005		610		0.00001			6.8	
170		0.000223		0.0005		1070		0.001		0.0402		0.0565		517		0.00001			7.65	
167		0.000185		0.0005				0.001		0.0424		0.005		510		0.00001			7.02	
163		0.000179		0.0005	1006	982		0.001		0.0377		0.0332		489		0.00001			6.41	
153		0.000139		0.0005		959		0.001		0.0314		0.0112		466		0.00001			6.36	
150		0.000136		0.0005	1025	978		0.001		0.0379		0.005		454		0.00001			7.5	
135		0.000132		0.0005		935		0.001		0.0315		0.005		414		0.00001			7.85	
151		0.000131		0.0005	486.1	964		0.001		0.0263		0.005		462		0.00001			5.21	
184		0.00014		0.0005	601	1120		0.001		0.0356		0.005		566		0.00001			6.67	
171		0.000134		0.0005		1040		0.001		0.0342		0.005		517		0.00001			7.73	
177		0.000134		0.0005				0.001		0.0323		0.0127		530		0.00001			7.77	
103		0.000112		0.0005	711	711		0.001		0.0232		0.0176		315		0.00001			4.87	
107		0.000081		0.0005	737	2430		0.001		0.023		0.0095		329		0.00001			5.73	
124		0.000082		0.0005	759	762		0.001		0.0173		0.0174		375		0.00001			4.94	
89.4		0.0000915		0.0001				0.0001		0.0141		0.01		264					3.44	
107		0.000123		0.001	654			0.001		0.0367		0.01		326					5.84	

Ca-D	Ca-T	Cd-D	Cd-T	Co-D	Cond-F	Cond-L	Co-T	Cr-D	Cr-T	Cu-D	Cu-T	Fe-D	Fe-T	Hard-D	Hard-T	Hg-D	Hg-T	Column1	K-D	K-T
77.4		0.0000495		0.0001	517	508		0.0001		0.0188		0.01		240					5.55	
70.7		0.0000338		0.0001	332.8	489		0.0001		0.0149		0.01		221		0.000005			3.92	
74.1		0.000075		0.0001	620	551		0.0001		0.0241		0.01		232		0.000005			4.4	
87.7		0.0002		0.0001	557	535		0.0001		0.0252		0.01		273		0.000005			5.37	
67		0.000112		0.0001		494		0.0001		0.0314		0.01		211		0.000005			4.37	
61.9		0.00008		0.0001	458	430		0.0001		0.0245		0.01		194		0.000005			3.74	
91.3		0.000103		0.0001	637	615		0.0001		0.0317		0.01		287		0.000005			4.64	
51.8		0.000059		0.0001	342	380		0.0001		0.0268		0.01		164					3.55	
127		0.00008		0.00011	72	900		0.00015		0.0553		0.01		413		0.000005			8.73	
71.3		0.00006		0.0001	391.9	486		0.0001		0.0353		0.01		226		0.000005			4.51	
50.3		0.0000753		0.0001	179.2	285				0.0219		0.01				0.000005			3.27	
82.2		0.0001		0.0001	437	522		0.0001		0.0369		0.01		260		0.000005			6.06	
44.2		0.00003		0.0001	251	329		0.0001		0.025		0.01		143		0.000005			3.79	
44.4		0.00006		0.0001	200.5	304		0.00011		0.0244		0.01		142		0.000005			3.66	
25.6		0.000035		0.0001	118.4	195		0.0001		0.0226		0.01		84.1		0.000005			2.47	
382	414	0.0002	0.0003	0.0008		2270	0.0011	0.002	0.002	0.064	0.109	0.02	0.913	1100	1190	0.0002	0.0002		12	13
476		0.0002		0.0009		2840		0.002		0.05		0.02		1390		0.0002			14	
415	418	0.0002	0.0002	0.0006		2550	0.0007	0.002	0.002	0.056	0.06	0.02	0.055	1220	1220	0.0002	0.0002		13	14
608	539	0.0003	0.0003	0.0009		2660	0.0011	0.002	0.002	0.07	0.098	0.02	0.854	1740	1360	0.0002	0.0002		14	13
498		0.0003		0.0008				0.002		0.062		0.02		1430		0.0002			15	
528		0.0003		0.0022		2650		0.002		0.086		0.02		1490		0.0002			10	
502	553	0.0003	0.0004	0.0006		2560	0.0009	0.002	0.002	0.049	0.068	0.02	0.408	1430	1570	0.00002	0.0002		11	12
502		0.0003		0.0005		2660		0.001		0.0627		0.005		1480		0.00002			14.3	
502		0.0003		0.0005		2660		0.001		0.0627		0.005		1480		0.00002			14.3	
542		0.00026		0.0005				0.001		0.0724		0.008		1580		0.00002			15.3	
548	520	0.00024	0.0002	0.0005		2680	0.0005	0.001	0.001	0.0498	0.0458	0.006	0.031	1610	1510	0.00002	0.00002		14.7	13.4
493		0.00014		0.0005		2590		0.001		0.0427		0.005		1430		0.00002			11.9	
495		0.00009		0.0005		2650		0.002		0.0312		0.061		1440		0.00002			9.81	
533	585	0.00011	0.01	0.0005		2610	0.01	0.001	0.002	0.0313	0.19	0.01	0.001	1530	2610	1.53002	0.00002		11.8	0.02
	238		0.000119				0.0005		0.001		0.106		0.605		650		0.00001			4.33
471	434	0.000241	0.000247	0.0005		2290	0.0005	0.001	0.001	0.0562	0.0724	0.0213	0.359	1330	1230	0.00001	0.00001		11.3	10.1
510		0.000242		0.001		2490		0.002		0.0482		0.01		1480		0.00001			11.2	
478		0.000271		0.0005	1529	2570		0.001		0.0572		0.005		1400		0.00001			11.4	
538		0.000314		0.0005	2490	2570		0.001		0.0671		0.0118		1550		0.00001			13	
599		0.000285		0.0005				0.001		0.0687		0.0076		1640		0.00001			12.3	
544		0.000269		0.0005	2057	2550		0.001		0.0518		0.005		1540		0.00001			13	
562		0.000228		0.0005	2500	2540		0.001		0.0412		0.0102		1610		0.00001			15.3	
573		0.000278		0.0005	251	2580		0.001		0.0461		0.0062		1630		0.00001			14.2	
545		0.000205		0.0005	234	2540		0.001		0.0435		0.005		1570		0.00001			12.9	
479		0.000259		0.0005	229	2420		0.001		0.0403		0.005		1390		0.00001			11.9	
569		0.00001		0.0005				0.001		0.052		0.0082		1630		0.00001			12.6	
468		0.000281		0.0005	1244	2440		0.001		0.0468		0.0066		1400		0.00001			11.1	
513		0.000352		0.0005	2480	2330		0.001		0.052		0.0172		1470		0.00001			11.3	
509		0.000313		0.0005		2410		0.001		0.0454		0.0623		1470		0.00001			13	
489		0.00035		0.0005				0.001		0.0685		0.006		1420		0.00001			12.6	
517		0.000287		0.0005	2390	2400		0.001		0.049		0.006		1480		0.00001			11.1	
551		0.000343		0.0005	2570	2500		0.001		0.072		0.0058		1560		0.00001			14.4	
530		0.000304		0.0005		2510		0.001		0.0542		0.005		1510		0.00001			14.7	
477		0.000227		0.0005		2380		0.001		0.0505		0.005		1390		0.00001			10.6	
477		0.000341		0.0005	1413	2310		0.001		0.0548		0.005		1420		0.00001			13.7	
599		0.000339		0.0005		2470		0.001		0.0629		0.0053		1780		0.00001			19.8	
613		0.000323		0.0005				0.001		0.0642		0.005		1790		0.00001			19.1	
506		0.000307		0.0005	2390	2370		0.001		0.0451		0.0112		1450		0.00001			12.5	

Ca-D	Ca-T	Cd-D	Cd-T	Co-D	Cond-F	Cond-L	Co-T	Cr-D	Cr-T	Cu-D	Cu-T	Fe-D	Fe-T	Hard-D	Hard-T	Hg-D	Hg-T	Column1	K-D	K-T
555		0.000241		0.0005	2420	734		0.001		0.0439		0.0102		1580		0.00001			13.7	
547		0.000168		0.0005	228	2330		0.001		0.029		0.0348		1560		0.00001			11.7	
503		0.00025		0.0002		2410		0.0002		0.0534		0.01		1470		0.000005			13.8	
550		0.000338		0.001	2270			0.001		0.0703		0.01		1560					15.6	
566		0.000181		0.0002	2340	2340		0.0002		0.0296		0.01		1600					16.5	
534		0.000152		0.0002	1520	2180		0.0002		0.027		0.02		1510		0.000005			12.6	
531		0.000251		0.0002	2230	2210		0.0002		0.0366		0.02		1510		0.000005			13.1	
554		0.00031		0.0002	2430	2320		0.0002		0.0416		0.02		1580		0.000005			14.7	
526		0.000299		0.0002		2290		0.0002		0.0397		0.02		1490		0.000005			13	
487		0.000331		0.0002	2140	2110		0.0002		0.0532		0.02		1380		0.000005			11.1	
531		0.000352		0.0005	2019			0.0005		0.05		0.05		1520		0.000005			13.1	
537		0.000294		0.0002		2320		0.0002		0.0329		0.02		1510					12.6	
637		0.00033		0.0002	2211	2740		0.00033		0.0343		0.02		1780		0.000005			15.8	
460		0.00025		0.00023	1526	1950		0.00047		0.0267		0.01		1260		0.000005			12.5	
568		0.00035		0.0002	1352	2170				0.0455		0.02				0.000005			13.8	
573		0.000271		0.0002	1970	2350		0.0002		0.0425		0.02		1590		0.000005			15.2	
480		0.000211		0.0002	1551	2020		0.0002		0.0313		0.081		1330		0.000005			11.7	
499		0.000204		0.00014	1339	2030		0.00013		0.0296		0.01		1360		0.000005			11.1	
363		0.000162		0.0002	998	1640		0.00158		0.0209		0.02		978		0.000005			7.26	
378	392	0.0003	0.0003	0.0013		1970	0.0019	0.002	0.002	0.06	0.099	0.02	0.768	1060	1100	0.0002	0.0002		7	8
503		0.0003		0.0031		2770		0.002		0.107		0.02		1490		0.0002			12	
379	388	0.0002	0.0003	0.0015		2190	0.0019	0.002	0.002	0.074	0.081	0.02	0.244	1110	1130	0.0002	0.0002		9	10
607	537	0.0003	0.0003	0.0021		2510	0.0018	0.002	0.002	0.073	0.076	0.02	0.188	1690	1340	0.0002	0.0002		10	10
546		0.0004		0.0029				0.002		0.087		0.02		1560		0.0002			12	
494		0.0003		0.0008				0.002		0.068		0.02		1440		0.0002			13	
506	572	0.0004	0.0004	0.0014		2440	0.0015	0.002	0.002	0.054	0.06	0.02	0.083	1400	1560	0.00002	0.0002		8	8
450		0.0003		0.0013				0.002		0.077		0.02		1250		0.0002			9	
511		0.00042		0.0009		2500		0.001		0.0704		0.007		1450		0.00002			10.6	
485		0.00036		0.0017				0.001		0.149		0.026		1360		0.00002			12.6	
511		0.00042		0.0009		2500		0.001		0.0704		0.007		1450		0.00002			10.6	
541		0.00037		0.001				0.001		0.0883		0.008		1520		0.00002			11.2	
572	519	0.00031	0.00021	0.0006		2540	0.0005	0.001	0.001	0.0733	0.0542	0.009	0.075	1600	1450	0.00002	0.00002		10.7	9.92
543		0.00016		0.0005		2480		0.001		0.0418		0.005		1490		0.00002			8.84	
496		0.00011		0.0005		2530		0.001		0.036		0.005		1380		0.00002			7.38	
540	549	0.00014	0.023	0.0005		2500	0.009	0.001	0.011	0.0426	0.265	0.023	0.001	1490	2500	1.49002	0.00002		8.91	0.02
477	394	0.000261	0.000219	0.0005	1540	2170	0.0005	0.001	0.001	0.0551	0.0605	0.0235	0.285	1290	1070	0.00001	0.00001		8.26	6.67
480		0.000264		0.00063		2250		0.0013		0.0559		0.0063		1290		0.00001			9.14	
522		0.000201		0.001		2350		0.002		0.0451		0.014		1440		0.00001			8.48	
471		0.000342		0.0005	1482	2430		0.001		0.0659		0.005		1300		0.00001			8.75	
545		0.000261		0.0005	2300			0.001		0.0695		0.0201		1460		0.00001			9.31	
535		0.000311		0.0005		2420		0.001		0.0815		0.0051		1450		0.00001			9.92	
512		0.000201		0.0005	1978	2460		0.001		0.0511		0.0497		1400		0.00001			10.4	
555		0.000242		0.0005	2340	2410		0.001		0.0417		0.0125		1510		0.00001			10.3	
553		0.000177		0.0005	221	2390		0.001		0.0421		0.005		1510		0.00001			9.19	
487		0.00026		0.0005	214	2270		0.001		0.0372		0.005		1330		0.00001			8.08	
501		0.000294		0.0005	1164	2310		0.001		0.0422		0.005		1390		0.00001			7.71	
511		0.00036		0.0005	2370	2160		0.001		0.0443		0.0206		1370		0.00001			7.24	
534		0.000281		0.0005	2300	2350		0.001		0.0583		0.0058		1440		0.00001			9.27	
566		0.000391		0.0005	2480	2420		0.001		0.0746		0.0051		1520		0.00001			11.2	
539		0.000326		0.0005		2420		0.001		0.0576		0.005		1460		0.00001			11	
477		0.000242		0.0005		2220		0.001		0.0445		0.005		1310		0.00001			7.91	
515		0.0004		0.0005	1351	2270		0.001		0.0566		0.005		1420		0.00001			9.66	
624		0.000399		0.0005				0.001		0.0675		0.005		1680		0.00001			13.8	

Ca-D	Ca-T	Cd-D	Cd-T	Co-D	Cond-F	Cond-L	Co-T	Cr-D	Cr-T	Cu-D	Cu-T	Fe-D	Fe-T	Hard-D	Hard-T	Hg-D	Hg-T	Column1	K-D	K-T
544		0.00032		0.0005	2330	2270		0.001		0.0422		0.0083		1450		0.00001			7.4	
511		0.000235		0.0005	2290	2340		0.0054		0.0505		0.0304		1380		0.00001			8.38	
539		0.000173		0.0005	217	2240		0.001		0.0281		0.0084		1440		0.00001			7.38	
566		0.000224		0.001	2160	2340		0.001		0.0688		0.01		1510					10	
575		0.000158		0.0002	2170	2260		0.0002		0.034		0.01		1540					9.49	
532		0.00018		0.0002	1481	2090		0.0002		0.0342		0.02		1420		0.000005			7.13	
519		0.000329		0.0002	2110	2130		0.0002		0.0509		0.02		1370		0.000005			7.2	
517		0.000373		0.0002		2230		0.0002		0.0561		0.02		1390		0.000005			9.03	
538		0.00036		0.00021	2240	2170		0.0001		0.0485		0.015		1440		0.000005			9.1	
526		0.000377		0.0002	2230	2160		0.0002		0.0509		0.02		1410		0.000005			7.9	
551		0.000334		0.00022	1845	2290		0.0002		0.0506		0.02		1470					8.72	
560		0.00028		0.00028	2087	2550		0.0002		0.0675		0.02		1530		0.000005			15.6	
475		0.00035		0.00028	1469	1910		0.0001		0.0352		0.01		1260		0.000005			9.19	
458		0.000293		0.00025	1154	1810				0.0304		0.02				0.000005			5.77	
581		0.00041		0.00031	1811	2210		0.0002		0.0503		0.02		1540		0.000005			10.1	
493		0.000305		0.0002	1547	2010		0.0002		0.0364		0.02		1310		0.000005			8.43	
535		0.00029		0.00016	1350	2010		0.0001		0.0337		0.01		1400		0.000005			9.03	
1	1	0.0001	0.0001	0.0005		23	0.0005	0.002	0.002	0.031	0.038	0.02	0.086	3.1	3.3	0.0002	0.0002		3	3
1		0.0001		0.0005		11		0.002		0.013		0.02		0.5		0.0002			1	
1	1	0.0001	0.0001	0.0005		14	0.0005	0.002	0.002	0.012	0.02	0.02	0.118	0.5	0.5	0.0002	0.0002		1	1
1	1	0.0001	0.0001	0.0005		7	0.0005	0.002	0.002	0.013	0.014	0.02	0.02	0.5	0.5	0.0002	0.0002		1	1
1		0.0001		0.0005				0.002		0.013		0.02		0.5		0.0002			1	
1		0.0001		0.0005		5		0.002		0.012		0.02		0.5		0.0002			1	
1	1	0.0001	0.0001	0.0005		6	0.0005	0.002	0.002	0.013	0.014	0.02	0.02	0.5	0.5	0.00002	0.0002		1	1

Li-D	Li-T	Mg-D	Mg-T	Mn-D	Mn-T	Mo-D	Mo-T	Na-D	Na-T	Ni-D	Ni-T	N-NO2	N-NO3	ORP	Pb-D	Pb-T	Column2	pH-F	pH-L	P-T	Sb-D
0.01		1		0.062		0.001		2		0.001					0.0002						0.0005
0.01		1		0.047		0.001		1		0.001					0.0002						0.0005
	0.01		12		0.047		0.057		52		0.001					0.0002			8		
0.01	0.01	4	4	0.005	0.027	0.04	0.041	30	32	0.001	0.001	0.024	0.66		0.0003	0.0032			7.84		0.0005
0.01		6		0.005		0.053		41		0.001					0.0002				7.96		0.0005
0.01		8		0.007		0.068		48		0.001					0.0002				8		0.0011
0.01	0.01	7	7	0.004	0.008	0.074	0.069	46	47	0.001	0.001				0.0002	0.0003			8.08		0.0005
0.01	0.01	5	5	0.002	0.012	0.06	0.055	37	38	0.001	0.001	0.035	0.53		0.0003	0.0016			8.14		0.0005
0.01		5		0.002		0.067		39		0.001					0.0004						0.0005
0.01	0.01	4	5	0.004	0.011	0.048	0.048	30	31	0.001	0.001	0.58	0.18		0.0005	0.0013			8.12		0.0005
0.005		8.13		0.015		0.117		37.7		0.001					0.0002				7.46		0.0005
0.005		13.4		0.037		0.125		37.7		0.001					0.0012						0.0005
0.005		8.13		0.015		0.117		37.7		0.001					0.0002				7.46		0.0005
0.005		7.59		0.011		0.117		37.3		0.001					0.0002						0.0005
0.005	0.005	6.98	6.3	0.008	0.011	0.124	0.107	33.7	30.5	0.001	0.001				0.0004	0.0012			7.91	0.02	0.0005
0.005		6.03		0.004		0.115		29.9		0.001					0.0014				7.97		0.0005
0.005		4.74		0.001		0.112		23.8		0.001					0.0002				8.06		0.0005
	0.0002		23		0.01		0.0005		2.4		0.0082	0.02	0.005			2.94				0.005	
	0.005		11.1		0.0996		0.095		30		0.001					0.0659			8.15	0.306	
0.005	0.005	5.79	5.61	0.0116	0.0163	0.0917	0.0886	18.5	19	0.001	0.001	0.005	0.193		0.00035	0.0013		8.04	7.93	0.022	0.0005
0.005		5.6		0.0033		0.0774		14.2		0.001					0.00033				7.9		0.0005
0.005		6.47		0.0015		0.0861		20		0.001					0.0002				7.87		0.0005
0.005		7.53		0.0018		0.0968		19.5		0.001				65.5	0.0002			8.5	8.21		0.0005
0.005		7.12		0.0021		0.106		18.5		0.001					0.00059			8.3	8.04		0.0005
0.005		5.1		0.0045		0.106		12.8		0.001		0.005	0.02	103	0.00041			7.73	7.72		0.0005
0.005		5.42		0.0039		0.109		13		0.001		0.05	0.2	96.7	0.00054			8.15	7.84		0.0005
0.005		5.12		0.0013		0.127		16.6		0.001					0.0002			8.4	7.98		0.0005
0.005		6.91		0.001		0.102		16.1		0.001					0.0002			9.2	7.91		0.0005
0.005		5.92		0.001		0.0956		13.6		0.001					0.0002			5.6	7.78		0.0005
0.005		6.76		0.001		0.0928		13.8		0.001				118.6	0.0002			7.93	8.14		0.0005
0.005		7.05		0.0026		0.0631		12.9		0.001					0.0002			8.7	8.14		0.0005
0.005		7.45		0.0024		0.0818		13.7		0.001					0.00079						0.0005
0.005		7.81		0.0043		0.109		11.8		0.001					0.0005			9.1	8.03		0.0005
0.005		7.12		0.001		0.125		12.4		0.001					0.0002				8		0.0005
0.005		8.21		0.001		0.137		12.3		0.001				159.1	0.0002			8.1	7.81		0.0005
0.005		8.72		0.0023		0.103		12.6		0.001				43.4	0.0002			8.23	7.89		0.0005
0.01		8.82		0.002		0.117		14.4		0.002		0.005	0.02		0.0004				8.02		0.001
0.005		9.34		0.006		0.132		12		0.001					0.0003			8.5			0.0005
0.005		5.58		0.001		0.0729		7.4		0.001					0.00033			8.2	8.02		0.0005
0.005		6.25		0.0029		0.115		10.1		0.0011					0.0002			8.6	7.78		0.0005
0.005		5.95		0.001		0.0945		8.93		0.001					0.0002			8.5	8.12		0.0005
0.0021		8.24		0.0011		0.0782		8.79		0.0005		0.001	0.005		0.000131			8.4	8.14		0.0001
0.01		6.68		0.0012		0.107		7.37		0.005		0.001	0.0382		0.0005			8.5	7.8		0.001
0.0015		5.61		0.00044		0.151		8.07		0.0005		0.001	0.005		0.00005			8.9	7.59		0.0001
0.001		5.81		0.00066		0.116		7.4		0.0005		0.001	0.005	119.3	0.00005			8.06	7.88		0.0001
0.0019		6.61		0.00019		0.0828		6.23		0.0005		0.001	0.005		0.00005			8.1	7.97		0.0001
0.0019		6.57		0.00267		0.112		7.1		0.0005		0.001	0.005		0.000052			8.2	8.09		0.0001
0.0018		6.47		0.00046		0.105		6.02		0.0005		0.001	0.005		0.000175				7.99		0.0001
0.0017		6.36		0.00047		0.0757		5.1		0.0005		0.001	0.0386		0.000057			8.6	7.79		0.0001
0.0022		9.64		0.00188		0.0777		6.82		0.0005		0.001	0.005		0.000053			8.5	8.21		0.0001
0.0019		5.7		0.0011		0.117		5.21		0.0005		0.001	0.005	127.2	0.00005			8.34	7.92		0.0001
0.0015		5.31		0.00023		0.111		5.11		0.0005		0.001	0.005	154.3	0.00005			8.71	8.31		0.0001
0.0018		7.06		0.00108		0.0455		3.76		0.0005					0.0001						0.0001
0.005		18.9		0.00479		0.183		9.5		0.0005		0.029	1.34	60.1	0.00005			7.77	8.29		0.00646

Li-D	Li-T	Mg-D	Mg-T	Mn-D	Mn-T	Mo-D	Mo-T	Na-D	Na-T	Ni-D	Ni-T	N-NO2	N-NO3	ORP	Pb-D	Pb-T	Column2	pH-F	pH-L	P-T	Sb-D
0.0017		6.66		0.00073		0.0645		3.32		0.00057		0.001	0.005	208	0.00005			8.36	8.1		0.00099
0.0018		9.16		0.0025		0.0488		4.11		0.0005		0.001	0.176	152.4	0.00005			7.58	8.03		0.00012
0.0025		9.05		0.00348		0.122		5.24		0.0005		0.001	0.0159	126.3	0.00005			7.96	8.07		0.00011
0.0018		6.53		0.00092		0.0709		3.29		0.0005		0.001	0.0185	184.9	0.00005			7.45	8.09		0.0001
0.001		3.8		0.00264		0.0333		1.44		0.0005		0.001	0.005		0.00005				7.5		0.00031
0.01	0.01	2	2	0.177	0.185	0.002	0.002	6	6	0.002	0.002				0.0002	0.0002			6.99		0.0033
	0.01		24		0.123		0.109		197		0.002					0.0003			8		
0.01	0.01	13	14	0.026	0.045	0.066	0.067	60	60	0.001	0.001	0.021	0.5		0.0002	0.0014			7.48		0.0005
0.01		21		0.02		0.092		82		0.001					0.0002				7.78		0.0005
0.01		27		0.028		0.109		101		0.001					0.0002				7.76		0.0005
0.01	0.01	25	25	0.014	0.018	0.128	0.121	104	107	0.001	0.001				0.0002	0.0002			7.68		0.0006
0.01	0.01	21	19	0.023	0.03	0.109	0.094	95	82	0.001	0.001	0.101	0.44		0.0002	0.0007			7.91		0.0005
0.01		19		0.017		0.108		80		0.001					0.0002						0.0005
0.01		18		0.016		0.105		88		0.001		0.422	0.41		0.0002				7.79		0.0005
0.01	0.01	18	20	0.01	0.018	0.074	0.082	59	63	0.001	0.001	0.9	0.28		0.0002	0.0005			7.91		0.0005
0.01		11		0.002		0.06		33		0.002					0.0002						0.0005
0.01		13		0.002		0.078		40		0.005					0.0002						0.0005
0.005		27.7		0.005		0.164		70		0.001					0.0002				7.69		0.0005
0.005		27.7		0.005		0.164		70		0.001					0.0002				7.69		0.0005
0.005		28.7		0.002		0.162		65.4		0.001					0.0002						0.0005
0.005	0.005	27.8	26.4	0.001	0.004	0.16	0.154	56.5	52.9	0.001	0.001				0.0002	0.0006			7.46	0.016	0.0005
0.012		25.4		0.002		0.15		48.1		0.001					0.0002				7.34		0.0005
0.005		25.6		0.001		0.153		45.5		0.001					0.0002				7.45		0.0005
0.005	0.0002	27.6	15	0.002	0.011	0.154	0.0005	47.8	1.7	0.001	0.0092	0.025	0.025		0.0002	2.57			7.52	0.005	0.0005
	0.005		17.4		0.176		0.0588		25		0.001					0.00849				0.453	
0.005		10.9		0.0016		0.0949		19		0.001					0.0002				7.5		0.0005
0.005		21.2		0.001		0.126		33.6		0.0015					0.0002				7.71		0.0005
0.005		22.4		0.001		0.118		31.8		0.001					0.0002				7.91		0.0005
0.005		18		0.0012		0.155		26		0.001					0.0002			8.3			0.0005
																		7.7			
0.005		12.2		0.0019		0.175		21		0.001					0.0002						0.0005
0.005		13.6		0.001		0.132		22.6		0.001		0.05	0.2	161.3	0.0002			7.83	7.81		0.0005
0.005		16.9		0.001		0.163		29.6		0.001					0.0002			7.9	7.77		0.0005
0.005		16.6		0.001		0.154		28.6		0.001					0.0002			8.3	7.74		0.0005
0.005		20.1		0.001		0.146		30.2		0.001					0.0002			8.1	7.77		0.0005
0.005		16.3		0.001		0.157		26.5		0.001					0.0002			5.9	7.42		0.0005
0.005		19.7		0.001		0.139		30.2		0.001					0.0002			7.8			0.0005
0.005		20.6		0.001		0.141		30.3		0.0012				125.9	0.0002			7.82	7.96		0.0005
0.005		25.9		0.0013		0.0744		24.8		0.001					0.0002			7.9	7.95		0.0005
0.005		22.6		0.0029		0.0977		22.2		0.001					0.0002				7.98		0.0005
0.005		22.4		0.001		0.113		22.5		0.001					0.0002						0.0005
0.005		20.1		0.0011		0.109		21.3		0.001					0.0002			8.1	7.86		0.0005
0.005		20.4		0.001		0.128		21.3		0.001					0.0002				7.78		0.0005
0.005		19.2		0.0018		0.149		19.4		0.001					0.0002			8.6	7.66		0.0005
0.005		18.9		0.001		0.158		22.4		0.001					0.0002				7.81		0.0005
0.005		20.8		0.001		0.146		23.1		0.001				182.2	0.0002			7.98	7.72		0.0005
0.005		25.5		0.001		0.106		22.4		0.001				68.3	0.0002			7.9	7.79		0.0005
0.005		21.9		0.001		0.118		22.5		0.001		0.005	0.02		0.0002				7.87		0.0005
0.005		21.6		0.001		0.169		21.3		0.001					0.0002						0.0005
0.005		14.4		0.001		0.132		16.2		0.001					0.0002			8.1	7.75		0.0005
0.005		14.8		0.0011		0.139		18.4		0.001					0.0002			8.3	7.33		0.0005
0.005		15.8		0.001		0.108		14.3		0.001					0.0002			8.5	7.83		0.0005
0.0021		9.85		0.0025		0.045		7.94		0.0005					0.00005						0.00012
0.01		14.4		0.0013		0.13		12.1		0.005					0.0005			7.5			0.001

Li-D	Li-T	Mg-D	Mg-T	Mn-D	Mn-T	Mo-D	Mo-T	Na-D	Na-T	Ni-D	Ni-T	N-NO2	N-NO3	ORP	Pb-D	Pb-T	Column2	pH-F	pH-L	P-T	Sb-D
0.0028		11.3		0.0002		0.14		9.45		0.0005		0.001	0.005		0.00005			8.7	7.36		0.0001
0.0021		10.8		0.00018		0.12		9.42		0.0005		0.001	0.005	138.1	0.00005			7.83	7.68		0.0001
0.0026		11.4		0.00015		0.0984		8.8		0.0005		0.001	0.005		0.00005			8.9	7.75		0.0001
0.0033		13.2		0.00038		0.122		10.4		0.0005		0.001	0.005		0.00005			8.6	7.71		0.0001
0.0031		10.7		0.00047		0.105		8.02		0.0005		0.001	0.005		0.00005				7.73		0.0001
0.0023		9.56		0.00045		0.0853		7.14		0.0005		0.001	0.0051		0.00005			8.1	7.8		0.0001
0.0025		14.4		0.0012		0.0593		7.26		0.0005		0.001	0.005		0.00005			8.4	8.03		0.0001
0.0023		8.5		0.00125		0.0803		5.29		0.0005		0.001	0.0469		0.00005			8.8	7.78		0.0001
0.0052		23.2		0.00039		0.177		13.9		0.0005		0.013	1.12	66	0.00005			7.35	8.01		0.00692
0.0027		11.7		0.00039		0.0908		7.32		0.0005		0.0011	0.647	211.8	0.00005			8.16	8		0.00039
0.0017		8.89		0.0024		0.0371		4.59		0.0005		0.001	0.0653	150.6	0.00005			7.64	7.92		0.00012
0.0034		13.2		0.00244		0.112		7.16		0.0005		0.001	0.0252	131.7	0.00005			7.99	7.98		0.0001
0.0022		7.93		0.00142		0.0843		4.69		0.0005		0.001	0.0472	203.3	0.00005			7.1	7.93		0.0001
0.0022		7.64		0.00061		0.0775		3.9		0.0005		0.001	0.0357	198.8	0.00005			7.28	7.92		0.0001
0.0012		4.89		0.00065		0.0379		2.28		0.0005		0.001	0.005	185.5	0.00005			8.16	7.67		0.0001
0.01	0.01	36	38	0.078	0.102	0.106	0.116	115	118	0.001	0.001	0.017	0.68		0.0005	0.0033			7.45		0.0005
0.01		50		0.109		0.157		169		0.001					0.0002				7.75		0.0005
0.011	0.01	45	44	0.08	0.081	0.186	0.187	160	166	0.001	0.001				0.0002	0.0002			7.75		0.0005
0.012	0.01	54	47	0.108	0.111	0.123	0.118	134	118	0.003	0.001	0.017	0.5		0.0004	0.0016			7.71		0.0005
0.011		46		0.1		0.121		124		0.001					0.0002						0.0005
0.011		42		0.102		0.156		87		0.001		0.023	0.43		0.0004				7.64		0.0005
0.01	0.01	43	46	0.054	0.066	0.097	0.106	87	91	0.001	0.001	0.171	0.21		0.0004	0.0012			7.77		0.0005
0.01		55.5		0.034		0.287		119		0.001					0.0004				7.28		0.0005
0.01		55.5		0.034		0.287		119		0.001					0.0004				7.28		0.0005
0.012		55.4		0.016		0.308		118		0.001					0.0002						0.0005
0.014	0.011	57.8	51.3	0.009	0.008	0.256	0.232	96.8	86.8	0.001	0.001				0.0002	0.0004			7.56	0.01	0.0005
0.018		48.4		0.006		0.21		73.5		0.001					0.0002				7.59		0.0005
0.01		49.2		0.004		0.213		70.7		0.001					0.0002				7.38		0.0005
0.01	0.0002	49.5	16	0.002	0.01	0.19	0.0005	71.5	1.2	0.001	0.0187	0.025	0.025		0.0002	2.78			7.53	0.005	0.0005
	0.005		13.7		0.0143		0.101		20.3		0.001					0.00132				0.049	
0.0084	0.0085	37	35	0.0045	0.0118	0.314	0.298	56.5	53.5	0.001	0.001	0.036	1.85		0.0002	0.00084			7.56	0.031	0.0005
0.01		48.8		0.0079		0.232		66.7		0.0042					0.0004				7.65		0.001
0.0095		50.7		0.0065		0.258		61.8		0.001				131.9	0.0002			7.9	7.75		0.0005
0.0099		48.9		0.0068		0.293		58.6		0.001					0.0002			8	7.51		0.0005
0.0077		34.4		0.014		0.239		37.4		0.001					0.0002						0.0005
0.011		43.7		0.0041		0.337		65		0.001		0.05	0.2	197.3	0.0002			7.75	7.67		0.0005
0.011		51.6		0.0033		0.232		47.7		0.001					0.0002			7.9	7.63		0.0005
0.0106		49.2		0.0027		0.224		46.2		0.001					0.0002			8	7.32		0.0005
0.011		50.6		0.0032		0.27		55.7		0.001					0.0002			8.1	7.59		0.0005
0.0106		48		0.0033		0.244		48.7		0.001					0.0002			5.9	7.45		0.0005
0.0103		51.4		0.0046		0.247		52.1		0.001					0.0002						0.0005
0.0109		55.2		0.0029		0.225		50.3		0.001				135.2	0.0002			7.67	7.79		0.0005
0.0081		45.5		0.0119		0.0889		23.5		0.001					0.0002			7.7	7.72		0.0005
0.0089		48.6		0.0063		0.119		25.7		0.001					0.0002				7.64		0.0005
0.0094		47.6		0.0084		0.122		24.8		0.001					0.0002						0.0005
0.0065		45.3		0.0055		0.156		25.6		0.001					0.0002			7.7	7.35		0.0005
0.0112		45.2		0.0199		0.256		27		0.001					0.0002			8.3	7.66		0.0005
0.0114		46		0.0112		0.279		30.8		0.001					0.0002				7.56		0.0005
0.0128		47.9		0.0057		0.347		41.9		0.001					0.0002				7.55		0.0005
0.0118		55.5		0.0155		0.164		30.7		0.001				79.9	0.0002			7.62	7.57		0.0005
0.0131		69.4		0.0104		0.205		39.7		0.001		0.005	0.02		0.0002				7.61		0.0005
0.0136		62.3		0.0423		0.296		32.6		0.001					0.0002						0.0005
0.0095		46.3		0.033		0.217		27		0.001					0.0002			7.6	7.47		0.0005

Li-D	Li-T	Mg-D	Mg-T	Mn-D	Mn-T	Mo-D	Mo-T	Na-D	Na-T	Ni-D	Ni-T	N-NO2	N-NO3	ORP	Pb-D	Pb-T	Column2	pH-F	pH-L	P-T	Sb-D
0.0108		47.7		0.0233		0.231		29.9		0.001					0.0002			7.9	7.63		0.0005
0.0082		46.8		0.029		0.166		21.5		0.001					0.0002			8.4	7.64		0.0005
0.01		52.4		0.023		0.136		22.8		0.001		0.006	0.025		0.0001				7.61		0.0002
0.014		46.2		0.0331		0.182		18.2		0.005					0.0005			7.5			0.001
0.0083		46.3		0.013		0.126		14.3		0.001		0.005	0.025		0.0001			8	7.19		0.0002
0.0095		43.6		0.0106		0.149		15.8		0.001		0.02	0.1	154	0.0001			7.57	7.47		0.0002
0.0086		44.1		0.00893		0.124		14.9		0.001		0.01	0.05		0.0001			8.2	7.64		0.0002
0.0109		48.5		0.0273		0.159		17		0.001		0.02	0.1		0.0001			7.7	7.62		0.0002
0.0099		41.9		0.0237		0.148		13.7		0.001		0.005	0.025		0.0001				7.7		0.0002
0.0076		39		0.0289		0.0669		9.4		0.001		0.02	0.1		0.0001			8.1	7.92		0.0002
0.0097		46		0.0357		0.12		11.7		0.0025					0.00025			7.4			0.0005
0.0105		42.2		0.024		0.128		11.3		0.001		0.005	0.025		0.0001				7.68		0.0002
0.0105		44.7		0.0083		0.183		9.44		0.001		0.023	0.41	90.7	0.0001			7.83	7.94		0.0002
0.007		27.5		0.0428		0.104		7.41		0.00094		0.017	0.069	219.9	0.00005			8.04	7.74		0.00012
0.0078		42.7		0.0401		0.106		9.44		0.001		0.01	0.184	168.1	0.0001			7.35	7.67		0.0002
0.0093		39.4		0.0457		0.116		7.43		0.001		0.01	0.05	145.9	0.0001			7.79	7.76		0.0002
0.0072		32.1		0.0393		0.0841		4.98		0.001		0.01	0.058	161.8	0.0001			7.68	7.74		0.0002
0.006		26.7		0.0373		0.0731		3.79		0.0005		0.01	0.05	212.9	0.00005			7.19	7.67		0.0001
0.0034		17.1		0.0405		0.0394		2.21		0.001		0.01	0.05	196.1	0.0001			7.92	7.4		0.0002
0.01	0.01	29	31	0.077	0.096	0.104	0.11	59	59	0.001	0.001	0.013	0.6		0.0002	0.0022			7.32		0.0005
0.011		56		0.142		0.218		121		0.001					0.0003				7.69		0.0006
0.01	0.011	40	39	0.088	0.096	0.171	0.227	98	99	0.001	0.001				0.0002	0.0004			7.67		0.0005
0.011	0.01	44	39	0.115	0.106	0.142	0.127	79	73	0.002	0.001	0.013	0.44		0.0003	0.0009			7.61		0.0005
0.011		48		0.146		0.172		92		0.003					0.0004						0.0005
0.012		50		0.078		0.132		130		0.001					0.0003						0.0005
0.01	0.01	33	33	0.069	0.074	0.113	0.125	57	57	0.001	0.001	0.309	0.23		0.0003	0.0006			7.64		0.0005
0.01		31		0.037		0.142		62		0.002					0.0002						0.0005
0.009		41.6		0.053		0.455		82.8		0.003					0.0002				7.31		0.0005
0.01		36.1		0.114		0.762		102		0.001					0.0003						0.0005
0.009		41.6		0.053		0.455		82.8		0.003					0.0002				7.31		0.0005
0.011		42.1		0.047		0.441		82.3		0.001					0.0003						0.0005
0.012	0.011	42.4	38.1	0.028	0.023	0.385	0.345	73	63	0.001	0.001				0.0003	0.0005			7.62	0.02	0.0005
0.017		33.5		0.014		0.301		53.9		0.001					0.0002				7.28		0.0005
0.009		34.5		0.01		0.306		53.2		0.001					0.0002				7.53		0.0005
0.009	0.0002	35.5	31	0.011	0.011	0.265	0.0005	56	2.6	0.001	0.0137	0.025	0.025		0.0002	2.76			7.57	0.005	0.0005
0.0072	0.0066	24	20.6	0.0176	0.02	0.475	0.396	39.9	34.7	0.001	0.001	0.0148	0.647		0.0002	0.00055		7.35	7.46	0.027	0.0005
0.0077		23.3		0.0159		0.373		36.8		0.0013					0.00025				7.52		0.00063
0.01		32.1		0.0172		0.414		46.1		0.0038					0.0004				7.73		0.001
0.0082		29.6		0.0221		0.637		45.4		0.001				123	0.0002			7.8	7.74		0.0005
0.0067		24.2		0.0126		0.533		36.7		0.001					0.0002			8			0.0005
0.0081		26.4		0.0183		0.523		40.9		0.001		0.005	0.02		0.0002				7.11		0.0005
0.0102		30.6		0.0085		0.657		48.5		0.001		0.05	0.2	199	0.0002			7.6	7.62		0.0005
0.0084		30.7		0.0057		0.411		35.9		0.001					0.0002			8	7.4		0.0005
0.0084		31.3		0.0029		0.546		41.6		0.001					0.0002			8	7.44		0.0005
0.0081		28		0.0049		0.405		33		0.001					0.0002			6.7	7.18		0.0005
0.0078		33.4		0.0038		0.416		36		0.0011				132.1	0.0002			7.73	7.7		0.0005
0.0056		22.1		0.0126		0.148		16.8		0.001					0.0002			8	7.67		0.0005
0.0066		25		0.0085		0.534		26.3		0.001					0.0002			7.7	7.62		0.0005
0.0094		25.8		0.0264		0.479		26.1		0.001					0.0002			8.3	7.6		0.0005
0.0093		27.9		0.0062		0.46		29.8		0.001					0.0002				7.54		0.0005
0.0085		29.6		0.0035		0.572		33.5		0.001					0.0002				7.57		0.0005
0.0092		33.2		0.0098		0.316		27.4		0.001				94.6	0.0002			7.75	7.6		0.0005
0.0117		30.2		0.0421		0.602		31.1		0.001					0.0002						0.0005

Li-D	Li-T	Mg-D	Mg-T	Mn-D	Mn-T	Mo-D	Mo-T	Na-D	Na-T	Ni-D	Ni-T	N-NO2	N-NO3	ORP	Pb-D	Pb-T	Column2	pH-F	pH-L	P-T	Sb-D
0.0064		22.8		0.0193		0.334		20.3		0.001					0.0002			7.8	7.38		0.0005
0.0084		26.3		0.014		0.423		27.1		0.0023					0.0002			7.8	7.33		0.0005
0.0066		23.2		0.0172		0.264		17.1		0.001					0.0002			8.3	7.63		0.0005
0.011		23.1		0.022		0.332		18.5		0.005		0.005	0.046		0.0005			7.7	7.29		0.001
0.0083		24.9		0.00344		0.326		15.9		0.001		0.005	0.025		0.0001			8.1	7.28		0.0002
0.0067		22.4		0.00466		0.263		16.6		0.001		0.02	0.1	151.3	0.0001			7.65	7.54		0.0002
0.0049		18.5		0.0122		0.197		11.6		0.001		0.01	0.05		0.0001			8	7.61		0.0002
0.008		24.8		0.0127		0.367		17.6		0.001		0.005	0.025		0.0001				7.62		0.0002
0.0062		23.9		0.0114		0.285		15.9		0.0005		0.01	0.05		0.00005			8	7.48		0.0001
0.006		23.6		0.0182		0.189		11.3		0.001		0.02	0.1		0.0001			8.3	7.84		0.0002
0.0081		23.3		0.0139		0.308		15.2		0.001		0.005	0.025	153.9	0.0001			7.56	7.62		0.0002
0.0121		33.1		0.00797		0.696		19.2		0.001		0.02	0.1	94	0.0001			7.98	7.84		0.00077
0.0058		17.4		0.0442		0.264		10.5		0.00051		0.014	0.244	219.2	0.00005			7.95	7.73		0.00013
0.0034		11.6		0.0389		0.118		4.1		0.001		0.01	0.0809	166.7	0.0001			7.45	7.54		0.0002
0.0074		22.8		0.0555		0.39		12.2		0.001		0.01	0.12	149.6	0.0001			7.73	7.7		0.0002
0.0056		18.7		0.0451		0.222		7.36		0.001		0.01	0.05	165.7	0.0001			7.73	7.66		0.0002
0.0051		16.6		0.0444		0.223		6.43		0.0005		0.01	0.05	214.9	0.00005			7.29	7.69		0.0001
0.01	0.01	1	1	0.005	0.007	0.001	0.001	1	1	0.001	0.001	0.005	0.26		0.0002	0.0002			6.61		0.0008
0.01		1		0.003		0.001		1		0.001					0.0002				6.51		0.0005
0.01	0.01	1	1	0.003	0.019	0.001	0.001	1	1	0.001	0.001				0.0002	0.0002			6.67		0.0005
0.01	0.01	1	1	0.002	0.002	0.001	0.001	1	1	0.001	0.001	0.005	0.02		0.0002	0.0002			6.23		0.0005
0.01		1		0.001		0.001		1		0.001					0.0002						0.0005
0.01		1		0.001		0.001		1		0.001		0.005	0.02		0.0002				6.05		0.0005
0.01	0.01	1	1	0.001	0.001	0.001	0.001	1	1	0.001	0.001	0.005	0.02		0.0002	0.0002			5.59		0.0005

Sb-T	S-D	Se-D	Se-T	Si-D	Si-T	Sn-D	Sn-T	SO4-D	Sr-D	Sr-T	S-T	TDS	Temp-F	Ti-D	Ti-T	Tl-D	Tl-T	TSS	U-D	U-T	V-D
	60	0.0008		2		0.005			0.036					0.01		0.00005			0.0001		0.005
	60	0.0008		2		0.005			0.022					0.01		0.00005			0.0001		0.005
0.0005			0.0187		2.85		0.005	63		2.94	60				0.01		0.00005			0.0127	
0.0005	60	0.0146	0.0242	2	5.66	0.005	0.005	36	1.19	1.25	60	190		0.01	0.031	0.00005	0.00005	20	0.0076	0.008	0.005
	60	0.0194		2.21		0.005		48	1.78			250		0.01		0.00005		18	0.0108		0.005
	60	0.0259		2.84		0.005		70	2.19			300		0.01		0.00005		9	0.0134		0.005
0.0005	60	0.0273	0.0266	2.76	2.91	0.005	0.005	57	2	1.97	60	270		0.01	0.01	0.00005	0.00005	6	0.0117	0.0115	0.005
0.0005	60	0.0178	0.0142	2.87	2.75	0.005	0.005	39	1.6	1.54	60	190		0.01	0.01	0.00005	0.00005	11	0.0113	0.0101	0.005
	60	0.0153		2.79		0.005			1.53					0.01		0.00005			0.0089		0.005
0.0005	60	0.0112	0.0112	2.3	2.62	0.005	0.005	45	1.29	1.26	60	180		0.01	0.01	0.00005	0.00005	15	0.0065	0.0067	0.005
	25	0.0155		3.19		0.005			2.2					0.005		0.00005			0.0067		0.005
	31	0.0204		3.09		0.005			3.9					0.005		0.00005			0.0129		0.005
	25	0.0155		3.19		0.005			2.2					0.005		0.00005			0.0067		0.005
	29	0.0074		3.09		0.005		66	1.97					0.005		0.00005			0.0063		0.005
0.0005	28	0.008	0.0071	3.74	3.29	0.005	0.005	71	1.64	1.47	24			0.005	0.005	0.00005	0.00005		0.0046	0.0042	0.005
	25	0.0035		3.41		0.005		53	1.45			160		0.005		0.00005		4	0.0027		0.005
	19	0.0071		2.63		0.005		59	1.14					0.005		0.00005			0.003		0.005
1.23			0.005		0.00005		0.0029			0.005	25	8.07			0.005		0.0005	68	0.0194		0.00405
0.0005			0.011		7.18		0.005			2.82	25.6	194			0.104		0.000063	18.3		0.0111	
0.0005	21.4	0.0136	0.0106	2.67	2.64	0.005	0.005	57.2	1.53	1.49	19.2	162	11.3	0.005	0.0111	0.00005	0.00005	11.2	0.00386	0.00399	0.005
	16.9	0.0113		2.7		0.005		47.3	1.53					0.005		0.00005			0.0036		0.005
	20.1	0.0151		2.32		0.005		57.2	1.72					0.005		0.00005			0.00543		0.005
	15.3	0.0137		2.54		0.005		45.7	1.88				7.4	0.005		0.00005			0.00784		0.005
	16.8	0.0117		3.43		0.005		50.6	1.87				18.9	0.005		0.00005			0.00482		0.005
	15.9	0.0117		3.19		0.005		46.2	1.42			146	16.4	0.005		0.00005		4.4	0.00167		0.005
	16.3	0.0132		2.97		0.005		43.4	1.43			128	20.1	0.005		0.00005		4	0.00247		0.005
	17.2	0.0126		3.07		0.005		44	1.37				16.6	0.005		0.00005			0.00218		0.005
	20.6	0.0165		2.69		0.005		61.9	1.82				9.9	0.005		0.00005			0.00444		0.005
	15.2	0.0126		2.4		0.005		43.7	1.55				10.7	0.005		0.00005			0.00384		0.005
	15.2	0.0133		2.1		0.005		47.2	1.81				2.7	0.005		0.00005			0.00552		0.005
	9.4	0.00998		2.26		0.005		32.9	1.85				3.7	0.005		0.00005			0.00626		0.005
	12	0.00887		2.59		0.005			1.97					0.005		0.00005			0.00621		0.005
	19.8	0.0134		3.08		0.005		54.3	2.11				17.7	0.005		0.00005			0.0042		0.005
	21	0.0176		2.7		0.005		53.6	1.9					0.005		0.00005			0.00307		0.005
	25.7	0.0212		2.47		0.005		80.3	2.23				3.8	0.005		0.00005			0.00455		0.005
	18.1	0.0131		2.5		0.005		52.4	2.05				5.6	0.005		0.00005			0.00545		0.005
	1800	0.0121		3.02		0.01		55.5	2.04			162		0.01		0.0001			0.00572		0.01
	25.7	0.0199		3.15		0.005		61.1	2.33				18.1	0.005		0.00005			0.0044		0.005
	9.9	0.00827		2.2		0.005		27.9	1.46				10.9	0.005		0.00005			0.0023		0.005
	14.9	0.014		2.86		0.0061		44.5	1.58				13.7	0.005		0.00005			0.00251		0.005
	11.6	0.01		2.12		0.005		32.8	1.38				7.3	0.005		0.00005			0.00299		0.005
	13.7	0.0113		2.45		0.0001		42.5	1.97			149	9.1	0.0003		0.00001		3	0.00496		0.00078
	16.6	0.0123		2.61		0.001		48.9	1.7				16.7	0.003		0.0001		8.7	0.00216		0.005
	16.5	0.0159		2.63		0.0001		47.5	1.36				12.5	0.0003		0.00001		3	0.0013		0.00221
	14.4	0.0117		1.87		0.0001		42.5	1.34			112	8.2	0.0003		0.00001		3	0.00211		0.00108
	11.1	0.00923		2.28		0.0001		33.5	1.61			122	13.8	0.0003		0.00001		11.1	0.00363		0.0009
	12.7	0.0131		2.41		0.0001		43.5	1.49			117	18.5	0.0003		0.00001		3	0.00137		0.00171
	14.2	0.013		2.37		0.0001		44.4	1.51			112		0.0003		0.00001		5	0.00189		0.0014
	11.4	0.0102		2.03		0.0001		35.5	1.59			117	10.6	0.0003		0.00001			0.00228		0.00089
	16.7	0.0112		1.99		0.0001		48.5	2.16			158	7.6	0.0003		0.00001		3	0.00488		0.00067
	14.2	0.0121		2.19		0.0001		43.6	1.43			112	14.8	0.00174		0.00001		3.3	0.00163		0.0015
	11	0.00972		1.89		0.0001		37.8	1.2			98.2	7.5	0.0003		0.00001		3	0.00188		0.00206
	6.69	0.00582		1.98		0.0001			1.6					0.0003		0.00001			0.0029		0.00056
	39.4	0.0309		4.49		0.00024		114	4.28			319	16.1	0.0003		0.00001		24.4	0.00733		0.00172

Sb-T	S-D	Se-D	Se-T	Si-D	Si-T	Sn-D	Sn-T	SO4-D	Sr-D	Sr-T	S-T	TDS	Temp-F	Ti-D	Ti-T	Tl-D	Tl-T	TSS	U-D	U-T	V-D
	11	0.00839		1.5		0.0001		34.4	1.74			115	11.5	0.0003		0.00001		3	0.0025		0.00057
	7.36	0.0059		1.91		0.0001		25	2.05				5.6	0.00065		0.00001		3	0.00317		0.00084
	16	0.0114		2.54		0.0001		47.8	2.34			153	16.7	0.0003		0.00001		3	0.00306		0.0016
	6.3	0.00487		1.97		0.0001		18.4	1.59			104	13.1	0.0003		0.00001		3	0.00229		0.00102
	2.96	0.00173		1.17		0.0001		8.68	0.774			58.6		0.00072		0.00001		55.4	0.00103		0.00066
0.0033	60	0.0008	0.0008	2	2	0.005	0.005		0.547	0.556	60			0.01	0.01	0.00005	0.00005		0.0007	0.0007	0.005
0.0579			0.0116		3.58		0.005	630		9.12	277				0.01		0.00005			0.0203	
0.0005	141	0.0097	0.0097	2	2.77	0.005	0.005	350	4.69	4.77	134	610		0.01	0.028	0.00005	0.00005	20	0.009	0.0096	0.005
	198	0.0159		2.05		0.005		580	7.51			1000		0.01		0.00005		58	0.0169		0.005
	272	0.0164		2.13		0.005		790	8.85			1200		0.01		0.00005		92	0.0219		0.005
0.0005	267	0.0234	0.0225	2.38	2.75	0.005	0.005	690	8.87	8.72	258	1200		0.01	0.01	0.00005	0.00005	12	0.0231	0.0221	0.005
0.0005	199	0.0119	0.011	2.5	2.84	0.005	0.005	500	6.34	5.98	164	840		0.01	0.015	0.00005	0.00005	11	0.0165	0.0137	0.005
	212	0.0123		2.79		0.005			6.48					0.01		0.00005			0.0157		0.005
	173	0.0106		2.75		0.005		440	5.13			810		0.01		0.00005		6	0.0121		0.005
0.0005	162	0.0075	0.0073	2.24	2.47	0.005	0.005	480	5.76	6.06	174	740		0.01	0.01	0.00005	0.00005	15	0.0091	0.0095	0.005
	121	0.0061		2		0.005			3.7					0.01		0.00005			0.0073		0.005
	144	0.0072		2		0.005			4.35					0.01		0.00005			0.0085		0.005
	234	0.0119		3.22		0.005			6.65					0.005		0.00005			0.01		0.005
	234	0.0119		3.22		0.005			6.65					0.005		0.00005			0.01		0.005
	237	0.0112		2.69		0.005		610	7.39					0.005		0.00005			0.0086		0.005
0.0005	246	0.0105	0.0095	3.04	2.93	0.005	0.005	680	7.81	7.65	231			0.005	0.005	0.00005	0.00005		0.0058	0.0056	0.005
	240	0.0092		2.47		0.005		630	7.35			1100		0.005		0.00005		4	0.0027		0.005
	226	0.0084		2.51		0.005		630	7.52					0.005		0.00005			0.0029		0.005
8.05	252	0.0092	0.005	2.57	0.00005	0.005	0.0038	740	8.05	0.005	45	1107.5		0.005	0.005	0.00005	0.0005	744	0.2098		0.0155
0.0005			0.00691		9.11		0.005			5.57	153				0.148		0.00005			0.00961	
	94.2	0.00868		2.04		0.005		300	3.09					0.005		0.00005			0.00381		0.005
	180	0.0143		2.19		0.005		514	6.4					0.005		0.00005			0.00822		0.005
	172	0.0122		2.43		0.005		544	6.23					0.005		0.00005			0.0125		0.005
	153	0.0122		2.95		0.005			5.4				17.9	0.005		0.00005			0.00515		0.005
													21.3								
	108	0.0136		3.09		0.005			4.08					0.005		0.00005			0.00251		0.005
	115	0.0138		2.86		0.005		318	4.06			536	20.5	0.005		0.00005		4	0.00394		0.005
	141	0.0124		2.89		0.005		351	4.74				16.7	0.005		0.00005			0.00375		0.005
	143	0.0125		3.38		0.005		392	4.52				19.2	0.005		0.00005			0.00435		0.005
	146	0.0151		2.5		0.005		455	5.33				9.6	0.005		0.00005			0.00634		0.005
	131	0.0121		2.45		0.005		367	4.5				10.6	0.005		0.00005			0.00571		0.005
	157	0.0131		2.79		0.005			4.87				9.9	0.005		0.00005			0.00542		0.005
	169	0.013		2.09		0.005		462	5.77				1.6	0.005		0.00005			0.00943		0.005
	203	0.00771		2.46		0.005		536	7.47				3.1	0.005		0.00005			0.0143		0.005
	180	0.00697		2.52		0.005		515	6.64					0.005		0.00005			0.0111		0.005
	185	0.0066		2.55		0.005			6.27					0.005		0.00005			0.0102		0.005
	148	0.0082		2.39		0.005		435	5.89				8.9	0.005		0.00005			0.00926		0.005
	155	0.00752		2.81		0.005		415	5.37					0.005		0.00005			0.00705		0.005
	150	0.0126		2.75		0.005			5.86				16.9	0.005		0.00005			0.00686		0.005
	154	0.0149		2.5		0.005		398	5.48					0.005		0.00005			0.00492		0.005
	160	0.0196		1.86		0.005		433	5.49				1.9	0.005		0.00005			0.00628		0.005
	208	0.0106		2.24		0.005		515	6.76				3.9	0.005		0.00005			0.00975		0.005
	168	0.0103		2.61		0.005		466	6.05			780		0.005		0.00005			0.00881		0.005
	166	0.0162		2.51		0.005		413	6.12					0.005		0.00005			0.0059		0.005
	105	0.0114		1.88		0.005		257	3.68				11.8	0.005		0.00005			0.00261		0.005
	115	0.0107		2.11		0.005		1480	4.02				13.1	0.005		0.00005			0.00271		0.005
	122	0.00659		1.79		0.005		298	4.1				6.6	0.005		0.00005			0.00373		0.005
	74.8	0.00421		1.28		0.0001			2.91					0.0003		0.00001			0.000531		0.0005
	97.2	0.0115		2.3		0.001			3.64				17	0.003		0.0001			0.00289		0.005

Sb-T	S-D	Se-D	Se-T	Si-D	Si-T	Sn-D	Sn-T	SO4-D	Sr-D	Sr-T	S-T	TDS	Temp-F	Ti-D	Ti-T	Tl-D	Tl-T	TSS	U-D	U-T	V-D
	74.6	0.00827		2.02		0.0001		213	2.71				10.8	0.0003		0.00001		3	0.00157		0.00091
	75.1	0.00789		1.36		0.0001		216	2.58			330	7.1	0.0003		0.00001		3	0.00163		0.00054
	74.8	0.00695		1.66		0.0001		229	2.82			356	13.6	0.0003		0.00001		14.1	0.00279		0.00059
	73.4	0.00796		1.87		0.0001		231	3.08			367	17.7	0.0003		0.00001		4	0.00136		0.00099
	67	0.00817		1.86		0.0001		200	2.58			319		0.00049		0.00001		3	0.00196		0.00075
	58.3	0.00767		1.53		0.0001		165	2.27			276	10.4	0.0003		0.00001			0.00151		0.00058
	84.7	0.00498		1.47		0.0001		242	3.52			402	5.8	0.0003		0.00001		9.2	0.00436		0.0005
	40	0.00347		1.43		0.0001		126	1.86			229	11.3	0.0003		0.00001		3	0.00153		0.00052
	140	0.0206		1.84		0.0001		397	5.16			627	15.2	0.0003		0.00001		28.2	0.00464		0.00091
	57.5	0.00822		0.753		0.0001		182	2.77			316	12.4	0.0006		0.00001		3	0.00229		0.00073
	23.8	0.00302		1.23		0.0001		77.4	1.76				5.2	0.00053		0.00001		3	0.00147		0.00062
	68.5	0.00602		1.76		0.0001		201	3.27			350	16.4	0.0003		0.00001		3	0.00255		0.00098
	34.2	0.00298		1.41		0.0001		100	1.78			201	12.4	0.0003		0.00001		3	0.00146		0.0007
	27.1	0.00232		1.3		0.0001		82.8	1.67			186	7.3	0.0003		0.00001		13.8	0.00147		0.00073
	16.2	0.00148		0.86		0.0001		49.2	0.966			110	3.1	0.00056		0.00001		3	0.000798		0.00077
0.0005	456	0.0189	0.0185	2	3.09	0.005	0.005	1300	7.61	8.34	475	2000		0.01	0.035	0.00005	0.00005	23	0.0141	0.0153	0.005
	584	0.0278		2.74		0.005		1500	9.48			2600		0.01		0.00005		32	0.0293		0.005
												2300						52			
0.0005	541	0.0317	0.0308	2.46	2.66	0.005	0.005	1400	8.51	9	546	2400		0.01	0.01	0.00005	0.00005	8	0.0283	0.0284	0.005
0.0005	627	0.0164	0.0148	2.59	3.7	0.005	0.005	1500	11	9.87	539	2500		0.01	0.028	0.00005	0.00005	35	0.0255	0.0209	0.005
	576	0.0156		3.1		0.005			9.48					0.01		0.00005			0.0195		0.005
	569	0.0153		2.69		0.005		1500	7.31			2500		0.01		0.00005		6	0.0269		0.005
0.0005	583	0.013	0.0132	2.51	2.97	0.005	0.005	1600	9.08	9.42	605	2300		0.01	0.011	0.00005	0.00005	23	0.0136	0.0143	0.005
	685	0.0267		3.06		0.005			8.92					0.005		0.00005			0.0153		0.005
	685	0.0267		3.06		0.005			8.92					0.005		0.00005			0.0153		0.005
	656	0.0286		3.15		0.005		1600	9.75					0.005		0.00005			0.0162		0.005
0.0005	655	0.0241	0.0219	3.47	3.2	0.005	0.005	1600	10.4	9.34	581			0.005	0.005	0.00005	0.00005		0.0147	0.0133	0.005
	567	0.0186		2.61		0.005		1500	9.4			2600		0.005		0.00005		6	0.0104		0.005
	561	0.0173		2.73		0.005		1500	9.54					0.005		0.00005			0.0087		0.005
9.86	585	0.0187	0.005	2.78	0.00005	0.005	0.0066	1600	9.86	0.005	34	2007.51		0.005	0.005	0.00005	0.0005	1604	0.5396		0.0168
0.0005			0.00774		2.08		0.005			4.07	224				0.0223		0.00005			0.00263	
0.0005	518	0.0304	0.027	2.7	2.59	0.005	0.005	1360	7.09	6.78	441	2200		0.005	0.009	0.00005	0.00005	18.7	0.0148	0.0142	0.005
	544	0.0268		2.06		0.01		1600	8.12					0.01		0.0001			0.0169		0.01
	519	0.0263		2.3		0.005		1560	6.61				8.4	0.005		0.00005			0.0207		0.005
	551	0.0309		2.83		0.005		1630	7.01				17.5	0.005		0.00005			0.00871		0.005
	538	0.0242		2.97		0.005			7.35					0.005		0.00005			0.00441		0.005
	553	0.0398		3.1		0.005		1640	6.93			2250	19.3	0.005		0.00005		5	0.0139		0.005
	607	0.021		2.95		0.005		1660	8.6				17.2	0.005		0.00005			0.00791		0.005
	620	0.0215		3.28		0.005		1650	7.72				19.2	0.005		0.00005			0.00758		0.005
	544	0.0281		2.64		0.005		1650	7.46				9.6	0.005		0.00005			0.0131		0.005
	515	0.0234		2.39		0.005		1580	6.97				10.6	0.005		0.00005			0.0135		0.005
	589	0.0249		2.69		0.005			7.59					0.005		0.00005			0.0112		0.005
	508	0.021		2.23		0.005		1510	7.16				1.9	0.005		0.00005			0.0201		0.005
	513	0.0112		2.32		0.005		1400	6.94				2.5	0.005		0.00005			0.0178		0.005
	563	0.0117		2.29		0.005		1630	7.74					0.005		0.00005			0.015		0.005
	540	0.0117		2.46		0.005			7.12					0.005		0.00005			0.0119		0.005
	514	0.0154		2.17		0.005		1480	7.03				9	0.005		0.00005			0.0127		0.005
	524	0.0236		2.88		0.005		1560	7.55				16.7	0.005		0.00005			0.0132		0.005
	533	0.0295		2.54		0.005		1470	7.49					0.005		0.00005			0.00942		0.005
	502	0.0503		2.08		0.005		1470	6.89					0.005		0.00005			0.0194		0.005
	534	0.0227		2.51		0.005		1360	6.46				4.5	0.005		0.00005			0.0191		0.005
	623	0.0258		3.1		0.005		1490	8.15			2250		0.005		0.00005			0.0188		0.005
	632	0.0335		2.9		0.005		1510	7.72					0.005		0.00005			0.0139		0.005
	503	0.0264		2.03		0.005		1420	6.49				11	0.005		0.00005			0.00601		0.005

Sb-T	S-D	Se-D	Se-T	Si-D	Si-T	Sn-D	Sn-T	SO4-D	Sr-D	Sr-T	S-T	TDS	Temp-F	Ti-D	Ti-T	Tl-D	Tl-T	TSS	U-D	U-T	V-D
	549	0.0248		2.36		0.005		292	6.71				13	0.005		0.00005			0.00627		0.005
	504	0.0154		2.07		0.005		1350	6.27				7.3	0.005		0.00005			0.00817		0.005
	475	0.02		2.11		0.0002		1440	6.24			2050		0.0006		0.00002		13.3	0.0117		0.001
	513	0.0221		2.51		0.001			6.62				16.9	0.003		0.0001			0.00755		0.005
	542	0.016		2.37		0.0002		1470	5.31				11.2	0.0006		0.00002		3	0.00357		0.0012
	596	0.0179		1.93		0.0002		1570	6.28			2190	7	0.0006		0.00002		3	0.00558		0.001
	566	0.0185		2.09		0.0002		1580	6.32			2210	13.5	0.0006		0.00002		36.1	0.0109		0.001
	582	0.0209		2.44		0.0002		1640	6.29			2300	17	0.0006		0.00002		7.8	0.0069		0.001
	575	0.0179		2.23		0.0002		1550	6.13			2170		0.0006		0.00002		6	0.00755		0.001
	484	0.0107		1.84		0.0002		1320	5.23			1900	6.4	0.0006		0.00002		4.2	0.0119		0.001
	498	0.0145		1.98		0.0005			5.83				14.3	0.0015		0.00005			0.0056		0.0025
	518	0.0155		1.86		0.0002		1500	5.61			2130		0.0006		0.00002		26	0.00669		0.001
	647	0.0213		2.34		0.0002		1660	7			2750	14.4	0.0006		0.00002		5.6	0.0102		0.001
	398	0.0169		1.37		0.0001		1220	4.77			1760	13	0.0006		0.00001		3	0.00517		0.0005
	493	0.0137		1.79		0.0002		1380	5.91				5.3	0.0006		0.00002		3	0.00902		0.001
	550	0.0116		1.94		0.0002		1570	6.15			2240	16.3	0.0006		0.00002		3	0.00656		0.001
	461	0.00509		1.82		0.0002		1290	4.77			1860	12.6	0.0006		0.00002		3	0.00537		0.001
	460	0.00385		1.68		0.0001		1260	4.53			1840	7.2	0.0003		0.00001		3.5	0.00501		0.00057
	353	0.00227		1		0.0002		985	3.06			1400	3.1	0.00062		0.00002		8.2	0.00287		0.001
0.0005	402	0.0137	0.013	2	2.05	0.005	0.005	1100	5.16	5.48	406	1700		0.01	0.031	0.00005	0.00005	19	0.018	0.0193	0.005
	594	0.0285		2.47		0.005		1500	8.44			2600		0.01		0.00005		160	0.0456		0.005
												2500						54			
0.0005	463	0.0252	0.0252	2	2.25	0.005	0.005	1200	6.1	8.44	469	2000		0.01	0.01	0.00005	0.00005	14	0.0343	0.0455	0.005
0.0005	597	0.0143	0.0129	2.27	2.43	0.005	0.005	1400	8.63	7.59	500	2400		0.01	0.01	0.00005	0.00005	6	0.0347	0.0275	0.005
	645	0.0166		2.79		0.005			8.37					0.01		0.00005			0.0352		0.005
	605	0.017		2.9		0.005			9.32					0.01		0.00005			0.0187		0.005
0.0005	562	0.0105	0.0111	2.16	2.26	0.005	0.005	1500	6.51	7.39	538	2300		0.01	0.01	0.00005	0.00005	5	0.0191	0.0208	0.005
	515	0.015		2		0.005			6.01					0.01		0.00005			0.0207		0.005
	655	0.0201		2.74		0.005			6.48					0.005		0.00005			0.0225		0.005
	570	0.0333		2.37		0.005			5.28					0.005		0.00005			0.0382		0.005
	655	0.0201		2.74		0.005			6.48					0.005		0.00005			0.0225		0.005
	629	0.0201		2.68		0.005		1500	7.13					0.005		0.00005			0.0213		0.005
0.0005	618	0.0176	0.0147	3.45	3.14	0.005	0.005	1600	7.51	7.29	556			0.005	0.005	0.00005	0.00005		0.0188	0.0206	0.005
	535	0.0144		2.74		0.005		1500	6.76			2500		0.005		0.00005		3	0.0161		0.005
	529	0.0129		2.72		0.005		1500	6.8					0.005		0.00005			0.0151		0.005
7.24	549	0.0137	0.005	2.76	0.00005	0.005	0.0126	1600	7.24	0.005	41	2407.55		0.005	0.005	0.00005	0.0005	1604	0.5526		0.01391
0.0005	513	0.0191	0.0136	2.3	1.95	0.005	0.005	1310	4.61	4.05	376	2070	11.5	0.005	0.0081	0.00005	0.00005	11.6	0.0167	0.0146	0.005
	526	0.0154		2.4		0.0063		1320	4.39					0.0063		0.000063			0.0146		0.0063
	522	0.0149		1.94		0.01		1540	5.44					0.01		0.0001			0.0209		0.01
	461	0.0191		2.02		0.005		1450	4.12				9.4	0.005		0.00005			0.0273		0.005
	532	0.0186		2.28		0.005			4.59				18.1	0.005		0.00005			0.00738		0.005
	501	0.0182		2.68		0.005		1570	4.81			2380		0.005		0.00005			0.00523		0.005
	549	0.0207		2.88		0.005		1570	5.11			2130	18.8	0.005		0.00005		4	0.0144		0.005
	589	0.0121		3		0.005		1590	5.74				17	0.005		0.00005			0.00945		0.005
	505	0.0161		2.49		0.005		1630	5.16				9.9	0.005		0.00005			0.0227		0.005
	505	0.0119		2.28		0.005		1440	4.39				10.6	0.005		0.00005			0.0181		0.005
	477	0.0124		2.05		0.005		1440	4.82				2.2	0.005		0.00005			0.0262		0.005
	485	0.00625		1.87		0.005		1320	4.18				2.5	0.005		0.00005			0.0196		0.005
	496	0.0173		2.26		0.005		1440	4.69				10.1	0.005		0.00005			0.0253		0.005
	487	0.0138		2.7		0.005		1480	5.25				16.9	0.005		0.00005			0.0136		0.005
	552	0.016		2.45		0.005		1440	4.9					0.005		0.00005			0.0115		0.005
	476	0.0201		1.77		0.005		1420	4.47					0.005		0.00005			0.0221		0.005
	532	0.0118		2.38		0.005		1350	4.46				4.7	0.005		0.00005			0.0256		0.005
	564	0.0189		2.76		0.005		1440	4.98					0.005		0.00005			0.0153		0.005

Sb-T	S-D	Se-D	Se-T	Si-D	Si-T	Sn-D	Sn-T	SO4-D	Sr-D	Sr-T	S-T	TDS	Temp-F	Ti-D	Ti-T	Tl-D	Tl-T	TSS	U-D	U-T	V-D
	475	0.0108		1.89		0.005		1350	3.92				9	0.005		0.00005			0.00762		0.005
	506	0.0129		2.15		0.005		1390	4.28				13.3	0.005		0.00005			0.0092		0.005
	468	0.00629		2.01		0.005		1340	4.03				7.4	0.005		0.00005			0.0124		0.005
	492	0.013		2.29		0.001		1380	4.34				17.1	0.003		0.0001		28.7	0.00709		0.005
	517	0.00975		2.57		0.0002		1460	4.56				11.2	0.0006		0.00002		3	0.00868		0.0016
	557	0.00937		2		0.0002		1490	4.17			2080	6.8	0.0006		0.00002		3	0.00941		0.001
	513	0.00729		1.98		0.0002		1400	3.82			1980	13.4	0.0006		0.00002		7.9	0.0118		0.001
	555	0.0119		2.25		0.0002		1520	3.99			2110		0.0006		0.000022		13.8	0.00944		0.0012
	560	0.0121		1.96		0.00019		1480	3.77			2090	10.1	0.0009		0.000016			0.00851		0.00092
	505	0.00707		1.83		0.0002		1400	3.63			2000	6.9	0.0006		0.00002		8.2	0.0156		0.001
	515	0.0101		2.1		0.0002		1440	4			2060	14.5	0.0006		0.00002		16.7	0.00783		0.001
	573	0.0256		3.11		0.0002		1850	4.8			2490	15.4	0.0006		0.00003		15.6	0.0156		0.0011
	391	0.00859		1.54		0.0001		1170	3.35			1710	11.6	0.0006		0.000015		6	0.00792		0.00056
	380	0.00377		1.18		0.0002		1120	2.56				5.2	0.0006		0.00002		3	0.00587		0.001
	521	0.00846		1.88		0.0002		1480	4.37			2130	14.8	0.0006		0.00002		3	0.00889		0.00107
	439	0.0033		1.79		0.0002		1300	3.41			1860	12.1	0.0006		0.00002		3	0.00733		0.001
	420	0.00344		1.74		0.0001		1270	3.46			1860	7.2	0.0003		0.00001		3	0.00658		0.00078
0.0007	60	0.0008	0.0008	2	2	0.005	0.005	0.7	0.007	0.008	60	18		0.01	0.01	0.00005	0.00005	2	0.0001	0.0001	0.005
	60	0.0008		2		0.005		1.7	0.004			10		0.01		0.00005		9	0.0001		0.005
												16						4			
0.0005	60	0.0008	0.0008	2	2	0.005	0.005	0.5	0.005	0.006	60	12		0.01	0.01	0.00005	0.00005	9	0.0001	0.0001	0.005
0.0005	60	0.0008	0.0008	2	2	0.005	0.005	0.7	0.002	0.002	60	10		0.01	0.01	0.00005	0.00005	2	0.0001	0.0001	0.005
	60	0.0008		2		0.005			0.002					0.01		0.00005			0.0001		0.005
	60	0.0008		2		0.005		0.9	0.002			10		0.01		0.00005		2	0.0001		0.005
0.0005	60	0.0008	0.0008	2	2	0.005	0.005	0.6	0.001	0.001	60	10		0.01	0.01	0.00005	0.00005	3	0.0001	0.0001	0.005

V-T	Zn-D	Zn-T	Zr-D	Zr-T	Alk-P	SO4-T	N-NH4	Chlord	Fluord	N-NH3	N-T	N-NO23	O-DO-%	O-DO	Sp-Cond	Anion	Cation
	0.037		0.002														
	0.01		0.002														
0.005		0.01		0.002				27									
0.007	0.01	0.01	0.002	0.002	0.5			10	1.14	0.05		0.68					
	0.01		0.002		0.5			15	1.24								
	0.01		0.002		0.5			22	1.3								
0.005	0.01	0.01	0.002	0.002	0.5			18	1.44								
0.005	0.01	0.01	0.002	0.002	0.5			8.1	1.62	0.2		0.57					
	0.01		0.002														
0.005	0.01	0.01	0.002	0.01	0.5			3.7	1.48	0.008		0.76					
	0.005		0.0005		0.5												
	0.006		0.0005														
	0.005		0.0005		0.5												
	0.005		0.0005					33	1.88								
0.005	0.005	0.005	0.0005	0.0005	0.5			18	2								
	0.005		0.0005		0.5			12	1.9								
	0.005		0.0005		0.5			12	1.9								
	0.00505		0.0261		0.5			11				0.005					
0.0122		0.018		0.0005	0.5												
0.005	0.005	0.005	0.0005	0.0005	0.5			4.9	1.2	0.0611		0.193			278		
	0.005		0.0005		0.5			3	1.1								
	0.005		0.0005		0.5			3.3	1.2								
	0.005		0.0005		0.5			2.3	1.2				72.2	8.57	272.8		
	0.005		0.0005		0.5			2	1.5								
	0.005		0.0005		0.5			1.5	1.4	0.012		0.02	67.7	6.56	213.9		
	0.005		0.0005		0.5			1.6	1.2	0.056		0.2	70.5	6.39	207		
	0.005		0.0005		0.5			1.3	1.6								
	0.005		0.0005		0.5			1.4	1.1								
	0.005		0.0005		0.5			1.1	1								
	0.005		0.0005		0.5			1.3	1				81.6	10.91	254		
	0.005		0.0005		0.5			0.66	1								
	0.005		0.0005														
	0.005		0.0005		0.5			0.94	1.3								
	0.005		0.0005		0.5			0.75	1.3								
	0.005		0.0005		0.5			1.2	1				93.7	12.27	335.9		
	0.005		0.0005		0.5			0.8	1.1				88.7	11.14	282		
	0.01		0.001		0.5			0.65	1.4	0.015		0.02					
	0.005		0.0005					1.6	1.3								
	0.0157		0.0005		0.5			0.5	1.1								
	0.005		0.0005		0.5			0.63	1.3								
	0.005		0.0005		0.5			0.6	1.2								
	0.0034		0.0003					0.56				0.0051				2.65	2.79
	0.01		0.003					0.9				0.0382				2.2	2.27
	0.001		0.0003					0.71				0.0051				1.97	1.94
	0.0014		0.0003					0.5		0.005		0.0051	98.1	11.55	226.4	1.97	1.93
	0.001		0.0003					0.56		0.005		0.0051				2.31	2.1
	0.0016		0.0003					0.71				0.0051				1.93	2.2
	0.0017		0.0003					0.65				0.0051				1.87	2.04
	0.0016		0.0003					0.5				0.0386				2.14	2.08
	0.0014		0.0003					0.58		0.005		0.0051				2.95	2.73
	0.001		0.0003					0.52		0.005		0.0051	87.3	8.81	261	1.96	1.89
	0.001		0.0003					0.5		0.005		0.0051	116.4	13.95	187.3	1.7	1.7
	0.0022		0.0003														
	0.0026		0.0003					2.43	1.74	0.127			79.2	7.96	487		

V-T	Zn-D	Zn-T	Zr-D	Zr-T	Alk-P	SO4-T	N-NH4	Chlord	Fluord	N-NH3	N-T	N-NO23	O-DO-%	O-DO	Sp-Cond	Anion	Cation
	0.0032		0.0003					0.61		0.0103		0.0051	86.9	9.47	233.3	2.11	2.07
	0.0034		0.0002		1			0.46		0.006			78.8	9.91	210.7		
	0.0062		0.0002		1			0.57		0.0134		0.05	62.3	6.01	253	2.52	2.76
	0.001		0.0002		1			0.18		0.0065		0.0187	73.8	7.66	216.3	1.85	1.9
	0.0013		0.0002		1			0.22				0.0051				1.04	1.1
0.005	0.045	0.043	0.002	0.002	0.5				0.08								
0.005		0.594		0.002				17									
0.005	0.013	0.01	0.002	0.002	0.5			8.3	0.78	0.13		0.52					
	0.01		0.002		0.5			15	0.95								
	0.01		0.002		0.5			20	0.95								
0.005	0.01	0.01	0.002	0.002	0.5			20	1.06								
0.005	0.01	0.01	0.002	0.002	0.5			7.4	1.51	0.54		0.54					
	0.01		0.002														
	0.01		0.002		0.5			6.3	1.33			0.84					
0.005	0.01	0.01	0.002	0.004	0.5			2.9	1.22	0.088		1.18					
	0.01		0.002														
	0.01		0.002														
	0.005		0.0005		0.5												
	0.005		0.0005		0.5												
	0.005		0.0005					27	1.45								
0.005	0.005	0.005	0.0005	0.0005	0.5			16	1.5								
	0.005		0.0005		0.5			12	1.5								
	0.005		0.0005		0.5			12	1.5								
	0.0326		0.0483		1			24		0.005		0.025					
0.0203		0.0249		0.0005													
	0.005		0.0005		0.5			4.8	1.1								
	0.005		0.0005		0.5			5.8	0.98								
	0.005		0.0005		0.5			3.2	0.95								
	0.005		0.0005														
	0.005		0.0005														
	0.005		0.0005		0.5			2.7	1.2	0.008		0.2	63.9	5.75	674		
	0.005		0.0005		0.5			2.1	1.3								
	0.005		0.0005		0.5			2.8	1.3								
	0.005		0.0005		0.5			2.4	1.1								
	0.005		0.0005		0.5			2	1.1								
	0.0088		0.0005														
	0.005		0.0005		0.5			1.8	1.1				84.8	11.63	929		
	0.005		0.0005		0.5			1.1	0.91								
	0.005		0.0005		0.5			0.5	1.1								
	0.005		0.0005														
	0.005		0.0005		0.5			0.65	1.1								
	0.005		0.0005		0.5			1.1	1.3								
	0.005		0.0005		0.5												
	0.005		0.0005		0.5			0.93	1.3								
	0.005		0.0005		0.5			1.4	1				90.8	12.47	858.6		
	0.005		0.0005		0.5			0.7	1				89.6	11.66	1005		
	0.005		0.0005		0.5			0.69	1.2	0.017		0.02					
	0.005		0.0005					1.3	1.4								
	0.005		0.0005		0.5			0.71	1.2								
	0.005		0.0005		0.5			1.5	1.2								
	0.005		0.0005		0.5			0.5	1.2								
	0.0073		0.0003														
	0.01		0.003														

V-T	Zn-D	Zn-T	Zr-D	Zr-T	Alk-P	SO4-T	N-NH4	Chlord	Fluord	N-NH3	N-T	N-NO23	O-DO-%	O-DO	Sp-Cond	Anion	Cation
	0.001		0.0003					0.5				0.0051				5.12	5.35
	0.001		0.0003					0.5		0.005		0.0051	100.5	12.14	505.6	5.13	4.93
	0.001		0.0003					0.5		0.005		0.0051				5.71	5.13
	0.0023		0.0003					0.5				0.0051				5.45	6.06
	0.0014		0.0003					0.45				0.0051				5.11	4.69
	0.0016		0.0003					0.5				0.0051				4.41	4.28
	0.0023		0.0003					0.5		0.0056		0.0051				6.44	6.18
	0.0017		0.0003					0.5				0.0469				3.76	3.6
	0.0026		0.0003					2.5	1.58	0.452			82.5	8.22	884		
	0.0037		0.0003					0.61		0.0099		0.648	86.8	9.25	515.9	5.05	4.96
	0.0022		0.0002		1			0.25		0.005			75.9	9.64	288.3		
	0.0038		0.0002		1			0.82		0.0066		0.05	59	5.76	524.1	5.36	5.66
	0.0016		0.0002		1			0.17		0.0058		0.0476	64.5	6.86	330.9	3.3	3.16
	0.0013		0.0002		1			0.81		0.005		0.0359	87.1	1.47	303.9	3.04	3.11
	0.0012		0.0002		1			0.18				0.0051	73.8	9.89	203.6	1.8	1.84
0.005	0.01	0.013	0.002	0.002	0.5			12	0.63	0.58		0.69					
	0.055		0.002		0.5			23	0.85								
0.005	0.038	0.04	0.002	0.002	0.5			24	0.84								
0.005	0.01	0.01	0.002	0.002	0.5			9.5	0.84	1.2		0.51					
	0.01		0.002														
	0.01		0.002		0.5			8.4	0.85			0.46					
0.005	0.01	0.01	0.002	0.002	0.5			4.2	0.8	0.65		0.38					
	0.005		0.0005		0.5												
	0.005		0.0005		0.5												
	0.011		0.0005					4.8	1.05								
0.005	0.005	0.005	0.0005	0.0005	0.5			3.4	1								
	0.005		0.0005		0.5			2.4	1.1								
	0.005		0.0005		0.5			2.1	1.1								
	0.0545		0.072		1			4.2		0.006		0.026					
0.005		0.0089		0.0005													
0.005	0.0058	0.0094	0.0005	0.0005	0.5			2.8	0.81	0.0164		1.88					
	0.012		0.001		0.5			2.7	0.84								
	0.005		0.0005		0.5			1.9	0.87				72.9	8.54	2237		
	0.0098		0.0005		0.5			2.9	1								
	0.0182		0.0005														
	0.0054		0.0005		0.5			3.1	1.1	0.014		0.2	70.1	6.39	2308		
	0.005		0.0005		0.5			1.5	1.1								
	0.005		0.0005		0.5			1.7	0.97								
	0.005		0.0005		0.5			1.8	1.1								
	0.0066		0.0005		0.5			1.8	1								
	0.0137		0.0005														
	0.0065		0.0005		0.5			1.2	1				77.6	10.53	2224		
	0.0102		0.0005		0.5			0.73	0.73								
	0.005		0.0005		0.5			0.57	0.85								
	0.0105		0.0005														
	0.0081		0.0005		0.5			0.52	0.95								
	0.0104		0.0005		0.5			1.8	1.1								
	0.005		0.0005		0.5			1.6	1.1								
	0.0071		0.0005		0.5			3.3	0.99								
	0.0099		0.0005		0.5			1.4	0.93				85.7	10.98	2318		
	0.0078		0.0005		0.5			1.4	1.2	0.032		0.022					
	0.0075		0.0005					2.5	1.3								
	0.0061		0.0005		0.5			1.9	1.2								

V-T	Zn-D	Zn-T	Zr-D	Zr-T	Alk-P	SO4-T	N-NH4	Chlord	Fluord	N-NH3	N-T	N-NO23	O-DO-%	O-DO	Sp-Cond	Anion	Cation
	0.005		0.0005		0.5			0.58	1.3								
	0.005		0.0005		0.5			0.67	1.1								
	0.0085		0.0006					2.5				0.025				30.6	30.8
	0.01		0.003														
	0.0028		0.0006					2.5				0.025				31.1	33.1
	0.0037		0.0006					10		0.005		0.1	97.1	11.68	2312	33.2	31.2
	0.0045		0.0003					5		0.005		0.051				33.9	31.1
	0.0065		0.0003					10				0.1				35	32.8
	0.0062		0.0003					1.16				0.025				33.1	30.6
	0.0123		0.0003					10		0.005		0.1				28.7	28.2
	0.0077		0.0003							0.005							
	0.0063		0.0003					2.5		0.005		0.025				32	31.1
	0.0122		0.0004					10	1.17	0.0059			80.6	8.09	2769		
	0.0075		0.0003					2.6		0.0067		0.086	91	9.5	1981	26.3	25.9
	0.0089		0.0004		1			1.73		0.0103			84.4	70.61	2167		
	0.0077		0.0004		1			1.47		0.0072		0.051	65.3	6.36	2364	33.6	32.5
	0.0039		0.0004		1			1		0.005		0.0582	67.4	7.13	2032	27.8	27.1
	0.0046		0.0002		1			1		0.0116		0.051	68.8	8.21	2029	27.2	27.6
	0.004		0.0004		1			1				0.051	78.1	10.35	1712	21.2	19.8
0.005	0.01	0.01	0.002	0.002	0.5			12	0.46	0.23		0.61					
	0.01		0.002		0.5			27	0.83								
0.005	0.01	0.01	0.002	0.002	0.5			22	0.66								
0.005	0.01	0.01	0.002	0.002	0.5			8.4	0.7	0.75		0.45					
	0.01		0.002														
	0.01		0.002														
0.005	0.01	0.01	0.002	0.002	0.5			4.9	0.67	0.14		0.54					
	0.01		0.002														
	0.005		0.0005		0.5												
	0.018		0.0005														
	0.005		0.0005		0.5												
	0.017		0.0005					5.5	0.89								
0.005	0.007	0.005	0.0005	0.0005	0.5			4.1	0.88								
	0.005		0.0005		0.5			2.9	0.9								
	0.005		0.0005		0.5			3.4	0.89								
	0.0405		0.0565		1			6.2		0.007		0.027					
0.005	0.0058	0.0105	0.0005	0.0005	0.5			3	0.61	0.02		0.661			2071		
	0.0063		0.00063		0.5			2.5	0.65								
	0.01		0.001		0.5			2.9	0.68								
	0.005		0.0005		0.5			2.4	0.68				70.6	8.1	2105		
	0.006		0.0005														
	0.0166		0.0005		0.5			2.5	0.75	0.017		0.02					
	0.0054		0.0005		0.5			3	0.87	0.014		0.2	68.7	6.19	2201		
	0.005		0.0005		0.5			1.3	0.84								
	0.005		0.0005		0.5			2	0.79								
	0.005		0.0005		0.5			1.6	0.73								
	0.005		0.0005		0.5			1.2	0.72				80.7	10.9	2061		
	0.0068		0.0005		0.5			0.7	0.51								
	0.0084		0.0005		0.5			2	0.71								
	0.0104		0.0005		0.5			2.1	0.83								
	0.005		0.0005		0.5			1.5	0.83								
	0.0064		0.0005		0.5			2.3	0.74								
	0.0083		0.0005		0.5			1.2	0.71				91	11.62	2207		
	0.0117		0.0005					2.5	0.91								

V-T	Zn-D	Zn-T	Zr-D	Zr-T	Alk-P	SO4-T	N-NH4	Chlord	Fluord	N-NH3	N-T	N-NO23	O-DO-%	O-DO	Sp-Cond	Anion	Cation
	0.0055		0.0005		0.5			1.4	0.78								
	0.005		0.0005		0.5			1.4	0.83								
	0.005		0.0005		0.5			0.5	0.77								
	0.01		0.003					2.5				0.046				29.3	31.2
	0.0021		0.0006					2.5				0.025				30.9	31.7
	0.0049		0.0006					10		0.005		0.1	95.9	11.52	2260	31.6	29.3
	0.005		0.0003					5		0.005		0.051				29.8	28.1
	0.0042		0.0003					1.09				0.025				32.3	28.8
	0.0072		0.0003					5				0.051				31.6	29.8
	0.0058		0.0003					10		0.005		0.1				30.1	28.9
	0.0081		0.0003					2.5		0.005		0.025	109.3	10.97	2313	30.7	30.3
	0.0054		0.0004					10	1.23	0.0148			103.5	10.33	2574		
	0.0157		0.0003					1.6		0.0124		0.258	84.8	9.14	1972	25.2	25.8
	0.0066		0.0004		1			1		0.0074			87.4	11.05	1859		
	0.0143		0.0004		1			2.07		0.0093		0.12	66.4	6.67	2250	31.6	31.7
	0.0041		0.0004		1			1		0.0123		0.051	68.4	7.26	2052	27.9	26.7
	0.004		0.0002		1			1		0.005		0.051	79.1	9.35	2044	27.2	28.6
0.005	0.01	0.01	0.002	0.002	0.5			0.8	0.01	0.05		0.26					
	0.01		0.002		0.5			0.5	0.01								
0.005	0.01	0.011	0.002	0.002	0.5			0.5	0.02								
0.005	0.01	0.01	0.002	0.002	0.5			0.6	0.04	0.15		0.02					
	0.01		0.002														
	0.01		0.002		0.5			0.5	0.01			0.02					
0.005	0.01	0.01	0.002	0.002	0.5			0.5	0.03	0.025		0.02					

Appendix F Phase VII Exploration Assay Statistics

Mine Area	Statistic	Total Cu	Au	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Fe	Ga	Hg	K	La	Mg
		%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	%	ppm	%
Minto North	Min	0.00008	0.0025	0.1	0.21	1.0	5.0	13	0.25	1.0	0.13	0.25	0.5	0.5	0.33	5	0.5	0.05	1,100	0.04
	P10	0.0006	0.0025	0.15	1.0	1.0	5.0	56	0.25	1.0	0.5	0.25	5.0	4.0	2.4	10	0.5	0.16	7,100	0.54
	P50	0.16	0.039	0.7	1.4	1.0	5.0	160	0.25	2.5	0.86	1.0	7.0	6.0	3.3	10	0.5	0.8	10,000	0.8
	Average	0.53	0.15	1.8	1.4	3.3	5.3	190	0.27	2.4	1.0	1.2	7.2	7.1	3.6	10	0.54	0.79	13,000	0.79
	P90	1.6	0.41	4.7	1.9	3.6	5.0	360	0.25	3.0	1.7	3.0	10	12	5.3	10	0.5	1.3	20,000	1.1
	Max	10	10	26	3.2	820	20	910	1.6	25	6.7	14	46	19	19	30	7.0	2.2	50,000	1.9
	Count	1,582	1,582	1,582	1,582	735	735	1,582	1,582	1,582	1,582	1,582	1,582	1,582	1,582	735	1,582	1,582	1,582	1,582
Minto East 2	Min	0.0004	0.0025	0.1	0.36	1.0	5.0	30	0.25	1.0	0.23	0.25	0.5	2.0	0.63	5.0	0.5	0.1	5,000	0.04
	P10	0.0059	0.0025	0.1	1.1	1.0	5.0	80	0.25	1.0	0.66	0.25	5.0	4.0	2.2	10	0.5	0.23	5,000	0.45
	P50	0.32	0.071	1	1.4	1.0	5.0	190	0.25	1.0	1.1	0.25	8.0	5.0	3.1	10	0.5	0.76	10,000	0.73
	Average	0.59	0.16	1.8	1.4	1.5	5.4	220	0.28	1.1	1.2	0.64	8.0	5.6	3.6	9.9	0.56	0.71	13,000	0.72
	P90	1.2	0.37	4.5	1.9	2.0	5.0	360	0.25	1.0	1.9	1.3	11	8.0	6.2	10	1.0	1.1	20,000	0.94
	Max	5.5	2	14	2.6	8.0	10	1,600	0.8	7.0	4.0	5.3	20	12	9.6	20	1.0	2.0	30,000	1.5
	Count	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170

Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Se	Sn	Sr	Th	Ti	Tl	U	V	W	Y	Zn	Zr
ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
84	0.5	0.01	0.5	30	1.0	0.005	1.0	0.25	0.5	5.0	14	10	0.005	5	5	4	5		7.0	0.25
430	0.5	0.04	1.0	630	1.0	0.005	1.0	2.3	0.5	5.0	32	10	0.02	5	5	46	5		54	0.25
590	2.0	0.07	3.0	970	2.0	0.15	2.5	4.0	5.0	5.0	58	10	0.15	5	5	67	5		90	1.0
630	4.9	0.069	2.7	980	3.6	0.51	1.9	4.3	4.8	5.1	70	10	0.14	5	5	69	5		120	1.1
930	7.0	0.1	4.0	1,300	7.0	1.5	2.5	6.0	10	5.0	110	10	0.22	5	5	96	5		180	2
2,000	470	0.21	10	10,000	98	9.2	11	13	70	26	680	20	0.4	10	5	280	17		2,300	4.5
1,582	1,582	1,582	1,582	1,582	1,582	1,582	1,582	1,582	1,582	851	1,582	735	1,582	735	735	1,582	1,582		1,582	851
250	0.5	0.03	0.5	40	1.0	0.005	1.0	1.0	-	-	20	10	0.005	5	5	7	5		32	-
390	0.5	0.04	1.0	510	1.0	0.005	1.0	2.0	-	-	38	10	0.04	5	5	45	5		63	-
660	1.0	0.07	2.0	950	3.0	0.19	1.0	4.0	-	-	60	10	0.13	5	5	69	5		100	-
730	8.9	0.072	1.7	920	5.1	0.46	1.2	4.1	-	-	68	10	0.12	5	5	71	5		120	-
1,200	12	0.1	2.0	1,200	11	1.2	2.0	6.0	-	-	110	10	0.19	5	5	100	5		190	-
2,200	660	0.12	5.0	3,600	40	3.3	4.0	8.0	-	-	200	20	0.37	10	5	220	5		600	-
170	170	170	170	170	170	170	170	170	0	0	170	170	170	170	170	170	170		170	0

Appendix G Phase VII Exploration ABA Statistics

SAMPLE	Data Set	Paste pH	FIZZ RATING	Total S-Leco	Sulphate S (HCl leach)	Sulphide-S Calc	Inorganic C	TIC	Modified NP	AP Calc	TIC/AP	NP/AP	Inorganic C	Total C	Ratio (NP:MPA)	MPA	NNP
DESCRIPTION		**Unity**	**Unity**	**%**	**%**	**%**	**%C**	**kgCaCO3 /t**	**tCaCO3/1Kt**				**%CO2**	**%**	**Unity**	**tCaCO3/1Kt**	**tCaCO3 /1Kt**
LOD		**0.1**		**0.01**	**0.01**	**0.01**	**0.05**	**4.2**	**1**								
K990792	MnE2	9	1	0.02	0.01	0.01	0.11	9.17	18	0.3125	29.33	57.60	0.4	0.13	28.8	0.6	17
K984008	MnE2	8.1	1	0.17	0.08	0.09	0.17	14.17	20	2.8125	5.04	7.11	0.6	0.18	3.76	5.3	15
K983845	MnE2	8.2	2	0.38	0.01	0.37	0.35	29.17	40	11.5625	2.52	3.46	1.3	0.38	3.37	11.9	28
K983874	MnE2	9.3	1	0.01	0.01	***0.01***	0.21	17.50	25	0.3125	56.00	80.00	0.8	0.23	80	0.3	25
K983943	MnE2	8.2	1	0.23	0.21	0.02	0.18	15.00	22	0.625	24.00	35.20	0.6	0.18	3.06	7.2	15
K982187	MnE2	8.4	1	0.13	***0.01***	0.13	0.1	8.33	13	4.0625	2.05	3.20	0.4	0.11	3.2	4.1	9
K982211	MnE2	8.9	2	0.04	***0.01***	0.04	0.52	43.33	37	1.25	34.67	29.60	1.9	0.53	29.6	1.3	36
K982230	MnE2	9.3	1	0.01	***0.01***	0.01	0.12	10.00	15	0.3125	32.00	48.00	0.5	0.13	48	0.3	15
K982262	MnE2	9.3	1	0.02	***0.01***	0.02	0.15	12.50	19	0.625	20.00	30.40	0.6	0.16	30.4	0.6	18
K990855	MnE2	9.6	1	0.04	***0.01***	0.04	***0.05***	4.17	12	1.25	3.33	9.60	0.2	0.05	9.6	1.3	11
K990902	MnE2	8.4	1	0.14	***0.01***	0.14	0.1	8.33	14	4.375	1.90	3.20	0.4	0.11	3.2	4.4	10
K990936	MnE2	8.2	2	0.22	0.16	0.06	0.25	20.83	27	1.875	11.11	14.40	0.9	0.26	3.93	6.9	20
K990968	MnE2	8.4	1	0.15	0.12	0.03	***0.05***	4.17	10	0.9375	4.44	10.67	0.2	0.05	2.13	4.7	5
K983188	MnE2	7.9	2	0.13	0.05	0.08	0.27	22.50	29	2.5	9.00	11.60	1	0.28	7.14	4.1	25
B0067132	MnN	9.2	1	0.01	***0.01***	0.01	0.2	16.67	23	0.3125	53.33	73.60	0.8	0.22	73.6	0.3	23
B0067357	MnN	8.9	1	0.02	***0.01***	0.02	0.25	20.83	28	0.625	33.33	44.80	0.9	0.27	44.8	0.6	27
B0067393	MnN	9	1	0.01	***0.01***	0.01	0.16	13.33	19	0.3125	42.67	60.80	0.6	0.17	60.8	0.3	19
B0067437	MnN	8.7	1	0.02	0.01	0.01	0.22	18.33	26	0.3125	58.67	83.20	0.8	0.22	41.6	0.6	25
B0061602	MnN	8.9	1	0.01	0.01	***0.01***	***0.05***	4.17	8	0.3125	13.33	25.60	-0.2	0.04	25.6	0.3	8
B0061637	MnN	8.7	2	0.03	***0.01***	0.03	0.27	22.50	28	0.9375	24.00	29.87	1	0.29	29.87	0.9	27
B0061677	MnN	7.8	1	0.2	0.01	0.19	***0.05***	4.17	8	5.9375	0.70	1.35	-0.2	0.09	1.28	6.3	2
B0061804	MnN	9.1	1	0.02	***0.01***	0.02	0.06	5.00	10	0.625	8.00	16.00	0.2	0.1	16	0.6	9
B0061805	MnN	8.7	1	0.01	***0.01***	0.01	0.18	15.00	18	0.3125	48.00	57.60	0.7	0.23	57.6	0.3	18
B0061852	MnN	9	1	0.01	***0.01***	0.01	0.05	4.17	9	0.3125	13.33	28.80	0.2	0.1	28.8	0.3	9
B0061894	MnN	7.6	1	0.2	0.02	0.18	***0.05***	4.17	7	5.625	0.74	1.24	-0.2	0.05	1.12	6.3	1
B0061974	MnN	9.4	1	0.01	***0.01***	0.01	0.06	5.00	8	0.3125	16.00	25.60	0.2	0.09	25.6	0.3	8
B0062036	MnN	7.9	2	0.4	0.01	0.39	0.35	29.17	30	12.1875	2.39	2.46	1.3	0.37	2.4	12.5	18
B0062050	MnN	8.6	1	0.02	***0.01***	0.02	0.12	10.00	6	0.625	16.00	9.60	0.5	0.16	9.6	0.6	5
B0062053	MnN	8.6	1	0.03	***0.01***	0.03	0.13	10.83	20	0.9375	11.56	21.33	0.5	0.15	21.33	0.9	19

APPENDIX 1-9

2021 Geotechnical Annual Review

2021 Geotechnical Annual Review

Minto Mine, Yukon
Minto Explorations Ltd.

SRK Consulting (Canada) Inc. ■ 1CM002.073 ■ October 2021

FINAL

2021 Geotechnical Annual Review

Minto Mine, Yukon

Prepared for:
Minto Explorations Ltd.
61 Wasson Place
Whitehorse, Yukon, Y1A 0H7
Canada

+1 604 759 4659
mintomine.com

Prepared by:
SRK Consulting (Canada) Inc.
1066 West Hastings Street, Suite 2200
Vancouver, BC, V6E 3X2
Canada

+1 604 681 4196
www.srk.com

Lead Author: Peter Mikes, P.Eng. **Initials:** PHM
Reviewer: Kisa Elmer, P.Eng. **Initials:** KAE

File Name:
2021GeotechInsp_Report_1CM002-073_20211031.docx

Suggested Citation:
SRK Consulting (Canada) Inc. 2021. 2021 Geotechnical Annual Review. . Prepared for Minto Explorations Ltd.: Whitehorse, Yukon. Project number: 1CM002.073. Issued October. 2021.

Contents

Tables

Appendices

Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

DSTSF	Dry Stack Tailings Storage Facility
MWD	Main Waste Dump
MVFE	Mill Valley Fill Extension
SWD	Southwest Dump
TDD	Tailings Diversion Ditch
WSP	Water Storage Pond

1 Introduction

1.1 Purpose of Review

On September 2-3, 2021, SRK Consulting (Canada) Inc. completed a geotechnical inspection of the Minto Mine site. The purpose of the inspection was to document the physical condition of the site based on visual observations and to provide geotechnical assessment, noting potential signs of physical instability such as erosion, differential settlement, sloughing or bulging of material, seepage, etc. The inspection is documented in the photographic compilation provided in Appendix A. This report summarizes the findings and recommendations.

This report is in partial fulfillment of the requirements of Minto Explorations Ltd.'s existing Water License QZ14-031 Clause 100 and Quartz Licence QML-001 Paragraph 13.2 that require the physical stability of all engineered structures, works and installations be inspected by an independent engineer after the spring thaw of each year (by June). In 2021, the June independent engineer inspection by SRK was unable to be completed due to COVID travel restrictions in the Yukon. As a result, the June inspection was completed internally by Minto as part of their routine quarterly inspections and SRK undertook the next scheduled quarterly visual inspection in September 2021.

1.2 Site Conditions

The Minto Mine was in production from July 2007 to late 2018 when the mine was placed in temporary care and maintenance. In 2019, the mine transitioned back into production with underground mining starting on September 2, 2019 and milling on October 10, 2019. Waste rock produced from underground is either disposed of underground or in the SAT Dump in the Main Pit.

The 2021 geotechnical inspection was completed by Peter Mikes, PEng (YK) and Kisa Elmer, PEng (YK), of SRK. SRK staff were accompanied by Klaus Gil, Senior Tailings Engineer with Minto, throughout the visit. Mr. Gil was SRK's primary contact for information while on-site about the activities during the past year and provided background and support during review of the instrumentation data. Weather during the site inspection was partly cloudy with estimated temperatures between 5°C and 20°C with dry ground conditions on site.

1.3 Scope

The following engineered structures, works, and installations were inspected during the site visit:

- Dry Stack Tailings Storage Facility (DSTSF) and Mill Valley Fill Extension (MVFE) (Stage 1 and 2)
- Tailings Diversion Ditch (TDD)
- Main Waste Dump (MWD), including Main Waste Dump Expansion, and Main Waste Dump Wrap
- Southwest Waste Dump (SWD)
- Reclamation Overburden Dump

- Ore stockpiles
- Mill and camp site
- Fuel containment facility
- Water Storage Pond (WSP) Dam
- Big Creek Bridge
- Main Pit Dump
- Main Pit including South Wall Buttress, In-Pit Dump, and SAT Dump
- Area 2 Pit
- Area 118 Pit and Backfill Dump
- Minto North Pit

As a part of the inspection, SRK reviewed, previous year’s reports, instrumentation data, design reports and monitoring guidance documents as required to guide the inspections. The instrumentation data was reviewed prior to the inspection to check for indications of unusual performance or change in trends. Section 4 of this report presents a list of data reviewed, including the last data collection date.

2 Site Inspection Observations

A summary of SRK's observations during the site inspection is provided in Table 1. Site observations are listed per each inspection area. A photographic record of the observations is provided in Appendix A.

Table 1: Site Inspection Observations

Area Number	Name	Inspection Observations
1	Dry Stack Tailings Storage Facility (DSTSF)	▪ No observations of global instability. ▪ No signs of further instability of the slump of the cover material observed in 2019 at the south end, near the grade transition point of the old TDD alignment (see Photo 1-2, Appendix A). Slump was observed in 2019 to be approx. 25 m wide with the cracks at the top of the slump appear to be self-healing. ▪ Variable vegetation establishment was observed across the areas of the covered and regraded WR Shell that were seeded in 2019. ▪ Settlement cracking noted in the 2020 inspection the in southern portion of the cover (orientated parallel to the southern crest) was not observed and was obscured by vegetation. ▪ Multiple erosion gullies observed on the north and east slopes of the cover (see Photo 1-7, Appendix A). ▪ The protective cover over Piezometer DSP-06 and Thermistor DST-11 was observed to be displaced during the inspection and the instrumentation exposed. The cover should be replaced following each reading to prevent damage and prevent rain entering the borehole and influencing the thermistor readings.
2	Mill Valley Fill Extension (MVFE)	▪ No observations of global instability. ▪ Multiple erosion gullies within the cover soil observed on the north and east slopes of the cover where runoff concentrates (see Photos 2-3, 2-4, and 2-5, Appendix A). ▪ The excavated slope to the south of the Minto Creek Seepage Collection System (MCSCS) that is excavated into permafrost soils has no observable changes compared to the previous years' inspection. The access road headed down to the MCSCS was upgraded in the past year with an armoured ditch constructed to direct surface runoff away from the MCSCS. ▪ No signs of seepage visible at the toe of the MVFE. The MCSCS appears to be functioning as per design, with no signs of seepage below the system.
3	Tailings Diversion Ditch (TDD)	▪ Construction of the TDD Intake Structure and Overflow Spillway into the Area 2 Stage 3 Pit remains incomplete with construction of the intake channel side-slopes and riprap placement remaining. ▪ Runoff from the Underground Access Road flows into the TDD Intake Structure and has deposited sediments in the basin (Photos 3-1 and 3-2, Appendix A). A berm is also present that prevents use of the overflow spillway into the Area 2 Pit. Any flow that overtops the TDD Intake Structure would be directed down the Underground Access Road to the north. Most of this flow would bypass the DSTSF to the west, but some flow would pass between gaps in the road berm and flow overtop the DSTSF cover. ▪ Conditions in the TDD remain the same as previous inspections with no major obstructions or signs of instability along the TDD were observed. ▪ Minor vegetation was observed in the upper portion of the unarmoured ditch (see Photos 3-3 and 3-4, Appendix A). The vegetation growth will be required to be removed within the next year and should continue to be monitored as part of routine inspections.

Area Number	Name	Inspection Observations
		▪ Remaining armoured portion of the ditch was generally free from vegetation (see Photo 3-5, Appendix A). ▪ TDD outlet showed no signs of instability or obstructions (see Photo 3-6, Appendix A).
4	Main Waste Dump (MWD)	▪ No observations of global instability. ▪ Erosion gullies observed in cover material. ▪ Trees have been planted in portions of the MWD Expansion area where resloping and cover placement have been completed. ▪ The longitudinal crack noted in the 2019 inspection in the resloped area above the former PAG Oxide stockpile (Photo 4-23, Appendix A) was not observed in the 2020 or 2021 inspection. The cracking was approx. 50 m long with the area below the cracks appearing with a concave slope due to potential differential settlement.
5	Main Waste Dump Wrap	▪ Differential settlement, cracking and small sinkholes are prevalent on the top bench, likely attributed to snow within the fill during winter construction (Photo 5-1, Appendix A). The condition of the area is consistent with the previous year's inspection. ▪ In 2020, the upper lift of the MWD Wrap was partially resloped. Since the 2020 inspection, waste rock has been excavated from the toe of the wrap resulting in an over-excavated slope and a risk of surficial slope failures/rockfall. Coarse rock is present at the base of the slope that acts as a small barrier to rockfall, but until the wrap has been regraded, traffic should be restricted near the toe. (Photo 5-2, Appendix A).
6	Southwest Waste Dump (SWD)	▪ A crack approx. 180 m long observed along the access road immediately west (upslope) of areas where overburden stockpiles are present. – The crack was first observed in the 2019 annual inspection. In the past year, the crack has grown in length by approximately 40 m to the south and is up to 40 cm wide (up from 35 cm wide in 2020 annual inspection) and has an approximate 20 cm vertical displacement (up from 10 cm in the 2020 inspection. See Photos 6-3, 6-4, and 6-5, Appendix A. – The crack is located above survey hub SWD12 and any large-scale slope deformation would be expected to be detected by SWD012 located downslope of the crack. The survey hub has shown a steady total displacement rate of 0.65 mm/day in the past year (See Section 3.4), which is a slight deceleration compared to the movement rate at the time of the inspection in 2020 (0.70 mm/day). – The crack should continue to be visually monitored as part of routine inspections for any change in condition.
7	Reclamation Overburden Dump (ROD)	▪ Conditions are the same as noted in previous years' inspections. ▪ Vegetation has established in many areas the dump area on suitable overburden piles (Photo 7-1 and 7-2, Appendix A). ▪ Previous notes include: – Slumping, settlement, and tension cracks are expected in the dump as it is constructed with frozen overburden and thawing is expected – Discontinuous tension cracks and differential settlement have been observed along the perimeter crest – Ground undulation is typically 0.3 m and is prevalent throughout the facility ▪ This area was not inspected on foot during the 2021 inspection
8	Ore Stockpiles	▪ The ore stockpiles were investigated briefly in passing and appeared to be in good condition. No obvious signs of instability were noted.

Area Number	Name	Inspection Observations
9	Mill Site	▪ No observations of global instability of the highwall north of the mill were observed Minor erosion and spalling of loose rocks is ongoing. A fence was installed at the base of the slope in 2019 as a mitigation with no evidence of fence damage observed due to falling materials
10	Camp Site	▪ Observations were consistent with previous years' inspection. ▪ No signs of instability were observed. ▪ The erosion gully noted in the 2020 inspection was repaired with fill and the camp pad graded to direct runoff to the north (Photo 10-1, Appendix A). ▪ No change was observed to the erosion gullies located between the camp and main access road (Photo 10-4, Appendix A).
11	Fuel Containment Facility	▪ The highwall to the north of the facility did not show signs of global instability. ▪ Significant new rutting that has exposed the base liner between the access ramp and the sump occurred within the past year (Photos 11-2 to 11-5, Appendix A. The rutting also has cause damage to the access ramp. ▪ Several areas of exposed geotextile were observed with one tear in the geotextile found with approximate dimensions of 5 cm x 8 cm (Photo 11-5, Appendix A). No damage to the liner beneath the liner could be felt, however liner damage cannot be ruled out. In addition, there could be other areas along the ruts where damage has occurred but could not be detected due to sloughing of the rut edges that may have covered up liner damage. ▪ An investigation is recommended to assess for potential damage to the liner. The damaged geosynthetics should be repaired and additional sand material should be placed within the facility to fill the ruts. The investigation should be completed carefully using hand shovels to expose the geotextile/liner along the ruts to allow for the condition of the materials to be carefully inspected. ▪ The equipment that caused the rutting appeared to have driven straight down the ramp to the sump, then backed up and turned around at the base of the ramp prior to traveling back up the ramp. Areas where the equipment tires turned over top of the liner would be most susceptible to damage and particular attention should be paid during the investigation in these areas. ▪ No change in condition of the exposed liner on the sides of the facility were observed.
12	Water Storage Pond (WSP) Dam	▪ The water level within the pond (~713.4 m) was approximately 4 m higher compared to the 2020 inspection. Otherwise, observations are consistent with previous years' inspection. ▪ No observations of global instability. ▪ Some deadfall/logs are accumulating on the upstream slope of the dam (Photos 12-5 and 12-6, Appendix A). ▪ Some of the rip rap used to armour the upstream and downstream slopes was observed to be weak and friable. ▪ No change in appearance was noted in the small potential sinkhole or animal burrow observed in 2019 at the downstream slope, near the southern edge and approximately 5 m NW of WDT-8 and approximately 50 m downstream of the crest. Dimensions are approximately 0.3 m diameter and was able to lower measuring tape to about 1.4m below ground surface (Photo 12-5, Appendix A). No action is required to address this feature. If it is an animal burrow, it does not appear to be active and at this location, would not develop deep enough though the embankment or abutment to be able to act as a preferential pathway. ▪ Seepage water downstream of the dam was clear and no accumulation of sediments was observed (Photo 12-8 to 12-10, Appendix A). ▪ Seepage flow at the weir outlet was estimated to be less than 1 L/s however a portion of the flow appeared to be by-passing the weir to the south (Photo 12-9,

Area Number	Name	Inspection Observations
		Appendix A). The seepage then reports to the collection sump at W17 and is pumped back to the WSP.
13	Big Creek Bridge	▪ Observations of the bridge are consistent with previous years' inspection ▪ The bridge abutments and road approaches are in good condition, with no signs of instability observed. ▪ The tree growing in western abutment should be removed as it impedes the inspections and could trap debris/impede flow during a larger flood event.
14	Main Pit Dump, SAT Dump, In-Pit Dumps, and W-15 Sump	▪ No observations of global instability. ▪ SAT dump showed no signs of cracking or movement (Photo 14-7, Appendix A). ▪ The longitudinal cracking on the crest of the In-Pit Dump above the SAT Dump is filling with sediment with no signs of additional movement (see Photo 14-8, Appendix A). ▪ The condition of the cracks in the MPD appear to be unchanged compared to the 2020 inspection. ▪ Top bench of the Main Pit Dump has an undulating surface with some differential settlement. ▪ During the inspection, waste rock material was being excavated from the south side of the top bench of the Main Pit Dump to be processed and used as road construction material. If significant volume of material is expected to be used is it recommended that the north end of the dump be used as the source material as it would reduce the driving force in the area of the dump that is currently moving. ▪ Evidence of overtopping of the W15 Sump and pooling on the access road north of the sump was observed. The water appears to have infiltrated through a sinkhole beneath haul road, which would infiltrate into the pit.
15	Area 2 Pit	▪ Observations were consistent with previous years' inspection. ▪ No observations of global instability. ▪ The cracks observed along the access road on the northeast side of the pit rim appears to have widened compared to the previous inspection. This road has been barricaded from use. No signs of instability were observed below the access road from across the pit. ▪ The erosion gully in the wall of the Stage 3 pit does not appear to have increased in size (Photo 15-6, Appendix A).
16	Area 118 Pit and Backfill Dump	▪ Observations were consistent with previous years' inspection. ▪ No observations of global instability.
17	Minto North Pit	▪ Observations were consistent with previous years' inspection. ▪ Mining at the pit was completed in October 2016. ▪ The failure of the south pit wall (Photo 17-1, Appendix A) occurred one day following completion of mining in the pit and removal of all equipment and personnel and was predicted based on pit wall monitoring. No additional pit slope failures have occurred since.

3 Monitoring and Instrumentation Data

Minto's Physical Monitoring Program (PMP) is a component of the Environmental Monitoring, Surveillance and Reporting Plan. The objective of the PMP is to monitor the performance of key mine infrastructure and workings. The PMP consists of two main components: regular geotechnical inspections, and instrumentation to measure ground conditions and deformations. The PMP was last updated in February 2021 and specifies the inspection and monitoring frequencies.

Table 2 lists instrumentation data reviewed as part of the inspection, with the date of the most recent data. Changes to the list of instrumentation compared to the last inspection are listed below the table in the notes. Instrumentation plots are provided in the appendices. Appendix B provides a site-wide summary of the survey hub data indicating the current movement rates and directions for each hub.

Table 2: Summary of Instrumentation Data

Facility	Instrumentation Type	List of Reviewed Instrumentation	Last Reading Date
Area 2 Pit	Survey Hubs	A210, A215, A216, A217, A218, DS01, DS02, DS03, DS04	August 2021
	Inclinometers	A2I-1	June 2021
	Ground Temperature Cables	A2T-1	June 2021
DSTSF and MVFE	Survey Hubs	DSSH06, DSSH10, DSSH12, DSSH14, DSSH15, DSSH18, DSSH19, DSSH20, DSSH24, DSSH26, DSSH27, DSSH28, DSSH29, DSSH31, DSSH32, MV1, MV2.	Varies between May 31 and July 30, 2021
	Inclinometer	DSI-24	June 2021
	Piezometers	**Active:** DSP-05B, DSP-06(A and B), DSP-07 Sensors #1 through 4 **Non-functional**[1]: DSP-05A, DSP-07 Sensors #5 and #6	June 2021
	Ground Temperature Cables	DST-10, DST-11, DST-13, DST-14, DST-15	June 2021
MWD	Survey Hubs	**Active**: MWDH01, MWDH02, MWDH03, MWDH04 **Non-functional**[2]: MWDH05, MWDH06	Varies between Feb. and May 2021
	Inclinometers	MDI-2	May 2021
SWD	Survey Hubs	SWD-01, SWD-06, SWD-07, SWD-08, SWD-09, SWD-10, SWD-11, SWD-12	Varies between June and August 2021
	Piezometers	**Active**: SDP-2 (A and B), SDP-3 (A and B)	June 2021
	Ground Temperature Cables	**Active**: SDT-1, SDT-2, SDT-3	June 2021
Main Pit	Survey Hubs	**Active**: M79, M80, M81, M82, M83, M84, M88, M89, M92, M93, M94, M95, M96, M97, M98 **In-active**[3]: M89, M96	Varies between March and August 2021
WSP	Survey Hubs	WSP-1, WSP-3, WSP-4, WSP-5	August 2021

Facility	Instrumentation Type	List of Reviewed Instrumentation	Last Reading Date
	Piezometers	WDP-2, WDP-3, WDP-3A, WDP-4, WDP-5, WDP-6, WDP-7, WDP-8, WDP-9, WDP-10, WDP-11, WDP-12, WDP-13	August 2021
	Ground Temperature Cables	WDT-1, WDT-2, WDT-3, WDT-4, WDT-5, WDT-6, WDT-7, WDT-8	August 2021

Notes:

[1] Piezometers DSP-7 Sensors 5 and 6 have not produced a successful reading since February 8, 2020. Piezometer DSP-05a has not produced a successful reading since November 11, 2018. Piezometer DSP-06b began to produce successful readings on November 22, 2020 after not producing a reading since November 11, 2018.

[2] Survey hubs MWDH05 and MWDH06 were destroyed in the fall of 2020 because of regrading of the Main Waste Dump Wrap. These two hubs showed some settlement but no significant movement since their installation.

[3] Main Waste Dump Survey hubs M89 and M96 were not monitored in the past year. Since installation, both hubs had not shown any movement and were removed from the monitoring program.

3.1 Area 2 Pit

Area 2 Pit instrumentation data is provided in Appendix C and includes a ground temperature cable (A2T-1) and an inclinometer (A2I-1) that were installed in 2013 in the southeast corner of the planned Area 2 Stage 3 Pit, as well as ten survey hubs installed at various locations around the perimeter of the pit.

The inclinometer data is shown in Figure 1 of Appendix C. The data shows a shear zone developing between depths of 36 m and 50 m starting in the fall of 2017, which corresponds to the mining of the Area 2 Stage 3 Pit. The observed shear zone includes multiple discrete zones between 36 and 50 m. The movement rate then slowed, and since 2019 shows a slight acceleration trend that has increased the movement rate from approximately 0.1 mm/day in 2019 to 0.15 mm/day in 2021.

The ground temperature data is sown in Figure 2 of Appendix C. A2T-1 is measured at the same location as the inclinometer and indicates permafrost conditions are present to an approximate depth of 60 m below ground surface.

Survey hub movement data are presented in Figure 3 of Appendix C. Four survey hubs (DS01 through DS04) are located near the Underground Shop along the east crest of the pit that are monitored weekly because of their proximity to the Underground Shop. Data from these hubs show steady and decreasing movement rates that range between 0.03 and 0.3 mm/day. No signs of additional cracking or deformation were noted in the area during the site inspection (Section 2). The movement is likely due to mining of the Area 2 Stage 3 Pit and changes to the thermal ground regime resulting in thawing of permafrost soils. The other survey hubs on the west and northern portion of the Area 2 Pit also show steady or decreasing movement rates ranging from 0.01 mm/day to 0.11 mm/day.

3.2 Dry Stack Tailings Storage Facility and Mill Valley Fill Extension

Instrumentation data for the DSTSF and MVFE are provided in Appendix D.

Movements in the DSTSF were first identified in early 2009. The MVFE Stage 1 was designed to mitigate the movement with construction of the facility occurring between January 2012 and 2013. The survey hubs used to monitor rates of the DSTSF showed a deceleration ranging from 20 to 60 percent since the start of the MVFE Stage 1 placement. Construction of a second extension (MVFE Stage 2) began in late 2015 and was completed in the summer of 2016. The MVFE Stage 2 doubled the size of the Stage 1 buttress and resulted in further decreases to the movement rates.

Survey Hubs

Survey hub movement data are presented in Figure 1 to 18 of Appendix D. Following construction of the MVFE Stage 2, the survey hubs were expected to slow with the movement rates asymptotically approaching zero. The timing for when no movement is expected is uncertain. The hubs have generally been performing as expected since the construction of the MVFE Stage 2. Rates of movement within the DSTSF are substantially lower compared to before the construction of the MVFE Stage 2 with most survey hubs continuing to show a decelerating trend with the rate of deceleration decreasing in the past year. Several hubs show steady movement, but additional time is needed to evaluate if deceleration has stopped. Two survey hubs show possible acceleration trends:

- DSSH12 (Figure 4) shows an apparent acceleration in the last reading on July 31, 2021, with the horizontal movement rate increasing from 0.13 mm/day to 0.4 mm/day. Additional readings are needed to confirm the trend. A seasonal increase in movement was also observed in 2019 with the hub subsequently continuing to decelerate.
- DSSH26 (Figure 11) shows an apparent acceleration in the last reading on May 31, 2021 with the horizontal movement rate increasing from 0.07 mm/day to 0.25 mm/day. Additional readings are needed to confirm the trend because the hub may have shifted because of the spring thaw and settlement of the cover beneath the hub. This hub has previous shown a deceleration trend since its installation in 2015.

Two additional hubs (ASH05 and ASH06) are located further to the south of the DSTSF on the airport access road (Appendix D, Figure 19). ASH05 shows no significant movement trend. ASH06 showed slight movement in the spring of 2017, which is believed to be the result of disturbance caused by a nearby pipeline installation. The hub showed no significant movement in the past year.

Piezometers

Piezometric data from the DSTSF are presented in Figures 20 to 22 in Appendix D.

DSP-05B (Figure 20, Appendix D) showed an increase in pore pressure that appears to have peaked near the beginning of 2018 and has since fluctuated between 793 m and 798 m. This sensor is located approximately 2 m below the tailings in the foundation. DSP-05A, located approximately 2 m above the base of the tailings continued to show a gradual increase in pore pressure until November 2018 when the sensor became unresponsive. Readings measured at DSP-05A were significantly less than those at DSP-05B. Temperatures at both sensors are approximately at the freezing point of water (less than 0.5°C) and the excess pore pressures are believed to be the result of an increase in the unfrozen water being unable to dissipate as a result of unfrozen conditions in the surrounding soils. As the survey hubs in the vicinity of the sensor show decelerating movement, no additional action is recommended.

DSP-06 (Figure 21, Appendix D) also includes two vibrating wire piezometers: DSP-06A is 2 m above the base of the tailings and DSP06B is 2 m below the base of the tailings. DSP-06A shows no pore pressure, while DSP-06B showed a gradual increasing pore pressure trend that peaked in February 2019 and has since decreased.

All sensors at DSP-07 (Figure 22, Appendix D) have shown continued increases in pore pressure since their installation in 2015. Readings in 2019 all showed steady pore pressures, but since 2020, the sensors resumed an increasing trend, except for DSP-07-03 that shows a decrease in pore pressures. All sensors are in zones with significant amounts of ground ice with ground temperatures ranging from -1° to -0.6°. Survey hubs in the vicinity of these sensors also show decelerating movement.

Ground Temperature Cables

Ground temperature profiles are provided in Figures 23 to 27 of Appendix D. The profiles indicate that warm permafrost is present at all locations, except in the lower portions of DST-11 and DST-13 that are below the depth of permafrost. DST-11 is located near the crest of the DSTSF, while DST-13 is located approximately 300 m east of the DSTSF in an undisturbed location.

Inclinometers

Inclinometer data from DSI-24 are presented in Figure 28 of Appendix D. The inclinometer is located between the MVFES2 and the DSTSF. The profile plot indicates a main shear zones at depths of 45 m and 53 m. The last reading collected on June 19, 2021 shows an increase in the movement rate (0.19 mm/day), which had previously shown a deceleration trend with an average movement rate of 0.055 mm/day in 2021. Additional readings are needed to confirm if the acceleration is real, or due to variability, or is an erroneous reading.

3.3 Main Waste Dump

The MWD instrumentation data are provided in Appendix E and includes an inclinometer and six survey hubs that were installed in the summer of 2018 following construction of the MWD Wrap.

Displacements in MDI-2 increased during the winter of 2017-18 (likely related to the construction of the MWD Wrap), with a movement rate of approximately 0.07 mm/day primarily occurring between the depths of 22 and 28 m below ground surface. The movement rate has slowed since completion of the dump, with a current rate of 0.01 mm/day over the past year.

Six survey hubs were installed on the MWD Wrap in August 2018. Hubs MWDH01, MWDH02, MWDH03 and MWDH04 show no current movement. Survey hubs MWDH05 and MWDH06 were destroyed in the fall of 2020 during regrading of the Main Waste Dump Wrap. These two hubs showed some settlement but no significant movement during their monitoring period.

3.4 Southwest Waste Dump

Instrumentation data for the SWD are provided in Appendix F.

Survey hub movement data are presented in Figure 1 to 9 of Appendix F. Survey Hub SWD07 shows a possible acceleration trend, SWD10 shows no significant movement, SWD12 shows a steady displacement rate, and the remainder show decreasing movement rates.

Survey hubs SWD12 and SWD09 are located downslope of the longitudinal crack observed during site inspection (See Figure A-4 and Photos 6-3, 6-4 and 6-5 in Appendix A for crack location and photographs). The movement of these hubs may be due creep or thawing of ice-rich soils present beneath the lower portions of the dump near the valley bottom (east side). In addition, the stockpiled cover material downslope of the crack likely contributes a driving force to the movement. The future spreading of the cover will likely reduce the driving force and movement rate. The foundation soils the upper (western) portion of the dump consists of colluvial soils with low ice content (EBA 2008). The survey hub movement direction is perpendicular to the dump crest with no indication of down valley movement (towards the Main Pit). The crack location was plotted overtop of an interpreted overburden isopach plan (Figure 14, Appendix F). The isopach indicates that the overburden is generally thin in the in the area of the crack and downslope; however, this is based on one drillhole in the vicinity of the crack and the accuracy of that borehole was unable to be confirmed at this time. The survey hubs are recommended to continue to be monitored at a quarterly basis.

Ground temperature data for the SWD are presented in Figures 10 to 12 of Appendix F, with the temperature cable locations shown in Figure 1. The profiles indicate that warm permafrost is present at all locations with time graphs generally indicating a warming trend.

Piezometric data for the SWD are presented in Figure 13 of Appendix F. The pore pressures for all piezometers show a decreasing trend.

3.5 Main Pit and Main Pit Dump

The initial indication of movement in the Main Pit south wall was observed in April 2009. A waste rock buttress was subsequently designed and constructed. Substantial completion of the buttress (South Wall Buttress) was completed in 2013. A detailed assessment and history of the physical stability associated with the Main Pit south wall is provided in the letter report “Detailed Review of Foundation Performance at Select Mine Waste Facilities and Main Pit South Wall” (SRK 2012b).

The Main Pit is a disposal location for waste rock with an NP:AP ratio less than 3 (referred to as “SAT” material at Minto) with the material to be placed below the final water elevation of the pit. In addition to the South Wall Buttress, several In-Pit Dumps have been constructed in the pit at various times that did not have the same stringent compaction requirements. The In-Pit Dump noted in Appendix A was end dumped into the pit water with a high dump height and significant cracking and settlement has been observed since. In April 2015, construction of a new dump (SAT Dump) began that will be constructed on top of the tailings and will also buttress the In-Pit Dump.

In February 2017, construction of the Main Pit Dump (MPD) began over areas of the south wall of the Main Pit that do not contain SAT. Placement of waste in the MPD occurred intermittently throughout the 2017 and 2018, with a large volume of material placed in the fall of 2017 and over the winter of 2017-18. MPD construction stopped following the completion of the Area 2 Stage 3 Pit in the Spring of 2018.

Survey hub movement data for the Main Pit Dump are presented in Figures 1 to 14 of Appendix G, with the footprints of the MPD are provided in Figure 1 of Appendix G. All hubs show either no significant changes in horizontal movement, or a decelerating movement trend. The highest movement rate of 1.3 mm/day occurs at hub M97, which is located at the top of the MPD, and has decreased from a rate of 1.6 mm/day in July 2020.

3.6 Water Storage Pond Dam

Instrumentation data for the WSP Dam are provided in Appendix H and consists of eight ground temperature cables, 13 vibrating wire piezometers, and five survey hubs.

Survey hub movement data are presented in Figure 1 and 2 of Appendix H. No significant movement was observed.

Ground temperature data are presented in Figures 3 to 10 of Appendix H. All temperature sensors are above zero and have shown an increasing trend since installation that appears to be stabilizing. Temperatures at depth are typically within the range of observed groundwater temperatures in nearby Westbay monitoring wells MW-12-05 and MW-12-06.

Piezometric data are presented in Figures 11 to 14 of Appendix H. In general, pressures continue to follow historical patterns and fluctuate with the pond water elevation.

4 Recommendations

A summary of the recommendations is provided in Table 4 with the priority rankings (1 to 4) defined by the descriptions in Table 3.

Table 3: General Description of Priority Rankings

Priority	Description
1	A high probability or actual safety issue considered immediately dangerous to life, health or the environment, or a significant regulatory concern.
2	If not corrected, could likely result in safety issues leading to injury, environmental impact or significant regulatory action; or, a repetitive deficiency that demonstrates a systematic breakdown of procedures.
3	Single occurrences of deficiencies or non-conformances that alone would not be expected to result in safety issues.
4	Best Management Practice as a suggestion for continuous improvement towards industry best practices that could further reduce potential risks. This typically includes ongoing construction items within the appropriate construction cycle.

Notes: Based on the Health, Safety and Reclamation Code (HSRC) for Mines in British Columbia.

Table 4: Summary of Recommendations

Area	ID No.	Recommendations	Priority (Table 3)	Recommended Deadline
General	2021-01	▪ The 2020 inspection recommended an InSAR satellite survey study to be completed to increase the understanding of movement of the various waste facilities at site (DSTSF, SWD, and Main Pit Dump). At this time of this inspection, Minto has proceeded with the study that is being undertaken by SRK and 3VGeomatics, but the study results are not yet available for consideration in this report.	4	End of 2021
	2021-02	▪ Several instrumentation cables and PVC pipes were observed to be exposed with no protective covers. Minto staff responsible for obtaining readings should be reminded to replace the cover following readings to prevent water ingress and damage due to freeze thaw.	3	End of 2021
DSTSF and MVFE	2021-03	▪ As part of the routine visual inspections, continue to monitor the following for any changes in condition: – 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.	4	n/a
TDD	2021-04	▪ Implement upgrades to the TDD Intake Structure to prevent future sedimentation accumulation within the channel next freshet. The upgrades should be completed in a manner that meets the design objectives documented in the SRK design memo and should consider the following: – Raising the elevation of the TDD intake pipes to prevent sediments from entering the pipes. – Regrading of the Underground Access Road to prevent sedimentation from entering the intake structure. Runoff from the road should be directed to the opposite side of the road and conveyed into the Area 2 Pit (via a sump/pipeline system, lined channel/slope, or equivalent). – Flows that exceeds the capacity of the TDD Intake Structure will flow down the Underground Access Road to the north. Either a berm should be constructed along the access road to prevent this water from flowing onto the DSTSF cover, or the Underground Access Road should be regraded to direct overtopping flows to the Area 2 Pit.	2	Construction should be implemented as soon as practical in 2022 (Frozen ground conditions make completion of the investigation in 2021 impractical).
MWD Wrap	2021-05	▪ Complete the regrading of MWD Wrap to grade over the over-steepened slope at the toe of the dump. In its current state, there is a higher risk of surficial slope failures and rockfall. Coarse rock is present at the base of the slope that acts as a small barrier to rockfall, but until the wrap has been regraded, traffic should be restricted near the toe.	3	Measures to ensure that equipment and personnel are kept away from dump toe should be implemented by the end of 2021. There is no recommended deadline for completion of the dump regrading.
SWD	2021-06	▪ Continue to monitor the cracking upslope of the cover soil stockpiles as part of the routine inspections specified in the PMP.	4	n/a

Area	ID No.	Recommendations	Priority (Table 3)	Recommended Deadline
Fuel Containment Facility	**2021-07**	▪ **An investigation is needed to inspect the condition of the geotextile and liner in the area along the new rutting in the facility.** The inspection should be completed using hand shovels to carefully expose the geosynthetics to allow for a thorough assessment of the condition of the geosynthetic materials. All areas of damaged geosynthetics should be repaired by a qualified professional and new sand material should be used to fill in the ruts after the repairs have been made.	**2**	Construction should be implemented as soon as practical in 2022. (Frozen ground conditions make completion of the investigation in 2021 impractical).
WSP	2021-08	▪ Continue to monitor the identified potential sinkhole located 5 m NW of WDT-08 as part of the routine visual inspections for any change in condition. Photographs records should be maintained to aid in monitoring.	4	n/a
	2021-09	▪ Deadfall/logs should be removed from the upstream face of the dam. Should any extreme precipitation event occur, the deadfall could plug/reduce the conveyance capacity of the spillway resulting in uncontrolled overtopping of the dam.	3	Prior to Freshet 2022.
Main Pit Dump, SAT Dump & In-Put Dumps	2021-10	▪ Waste rock materials being processed for construction material should be excavated from the northern edge of the top bench instead of the south end as observed during the inspection to assist in unloading of the dump in the area currently experiencing movement.	4	n/a
	2021-11	▪ The sinkhole north of the W15 Sump should be filled and the erosion channel graded to minimize infiltration into the pit in the event of any future overtopping of the sump.	3	**CLOSED** Sinkhole filled and area graded in October 2021.
Area 2 Pit	2021-12	▪ 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.	4	n/a

Closure

This report, 2021 Geotechnical Annual Review, was prepared by

PROFESSIONAL
YUKON
PETER H. MIKES
TERRITORY
Nov. 1/2021
ENGINEER

Peter Mikes, P.Eng.
Principal Consultant

and reviewed by

PROFESSIONAL
YUKON
KISA A. ELMER
TERRITORY
ENGINEER

Kisa Elmer, P.Eng
Consultant

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

References

EBA Engineering Consultants, Ltd., 1994. Geotechnical Evaluation for Mill & Camp site (0201-95-11509), Minto Project, Report to Minto Explorations Ltd.

EBA Engineering Consultants, Ltd., 2008. Geotechnical Design Proposed Southwest Waste Dump, Minto Mine, Yukon. EBA Project No. W14101068.005. September.

SRK Consulting (Canada) Inc., 2012a. 2012 Geotechnical Annual Review, Minto Mine, YT. Prepared for Minto Explorations Ltd. SRK Project Number: 1CM002.006.400. November.

SRK Consulting (Canada) Inc., 2012b. Letter Report: Detailed Review of Foundation Performance at the South Waste Dump and Stability of the Main Pit South Wall. Prepared for Minto Explorations, Ltd. SRK Project Number: 219500.050. November 19.

Appendix A Photographs

No.	Inspection Area Name
1	Dry Stack Tailings Storage Facility (DSTSF)
2	Mill Valley Fill Extension (MVFE) Stages 1 and 2
3	Tailings Diversion Ditch (TDD)
4	Main Waste Dump (MWD) and Expansion
5	Main Waste Dump (MWD) Wrap
6	Southwest Waste Dump (SWD)
7	Reclamation Overburden Dump
8	Ore Stockpiles
9	Mill Site
10	Camp Site
11	Fuel Containment Facility
12	Water Storage Pond (WSP) Dam
13	Big Creek Bridge
14	Main Pit, Main Pit Dump (MPD), South Wall Buttress, In-Pit Dumps
15	Area 2 Pit
16	Area 118 Pit and Backfill Dump
17	Minto North Pit

GlobalMapper File: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw

2021 Inspection GPS Track Log

srk consulting

MINTO

Site Inspection Photo Log

Inspection Areas and Photo Log

Job No: 1CM002.073

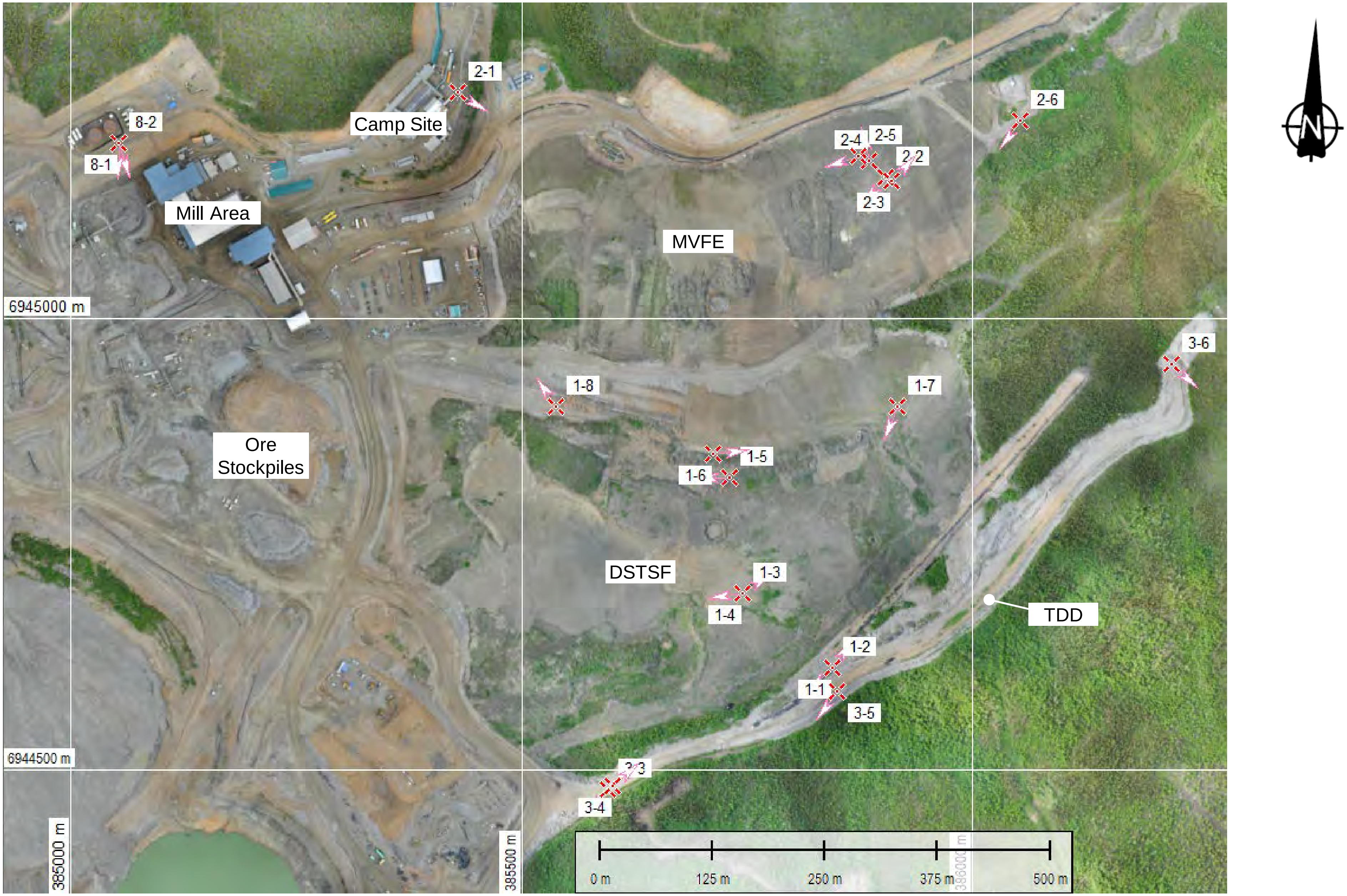
Filename: AppA-InspectionAreaTrackLog.pptx

Minto Mine

Date: October 2021

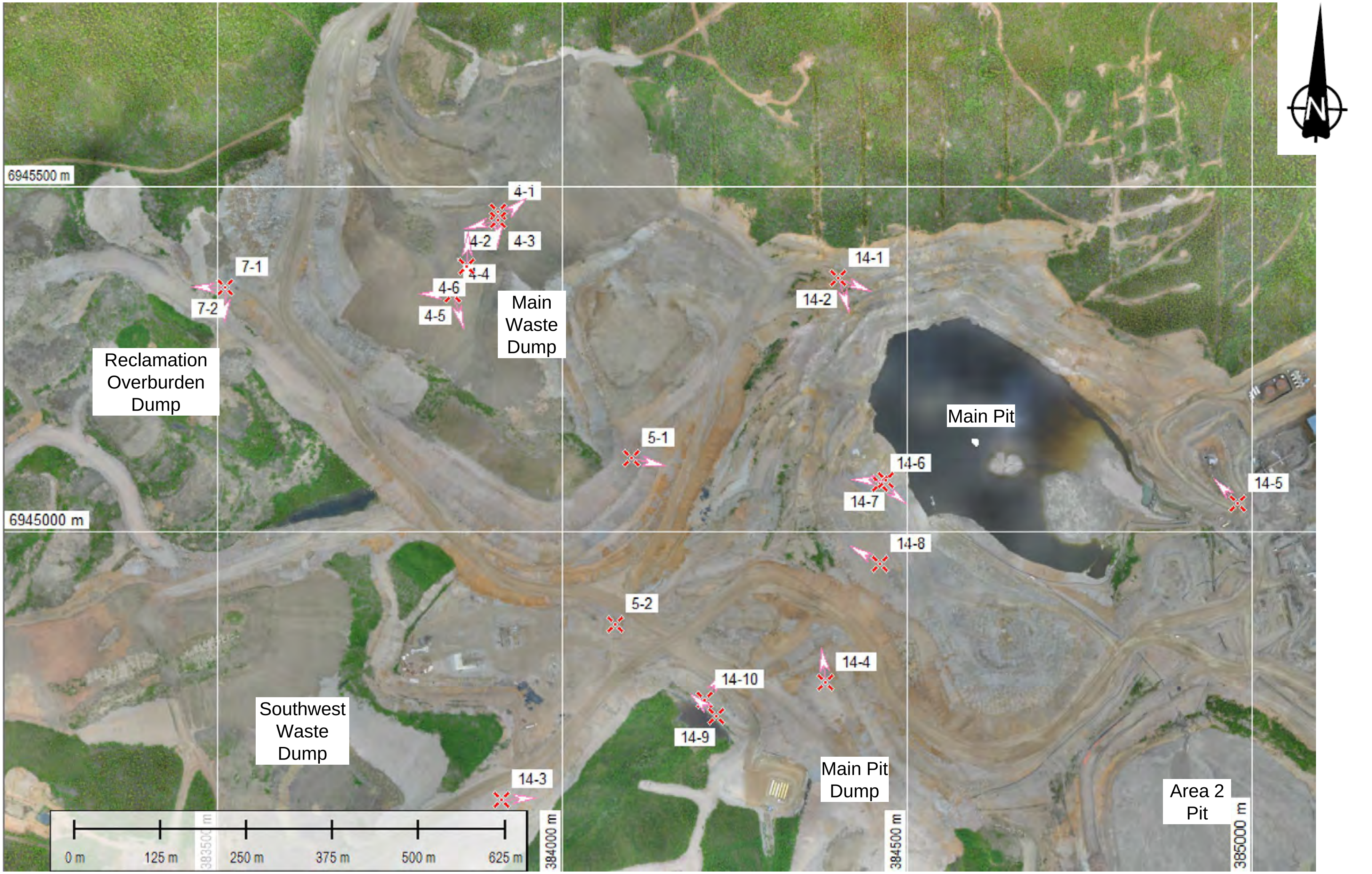
Approved: PHM

Figure: **A-P-1**



srk consulting	MINTO	Site Inspection Photolog
		DSTSF, MVFE TDD, and Ore Stockpile Photo Locations
Job No: 1CM002.073 Filename: AppA_PhotoLocations_Landscape.pptx	Minto Mine	Date: October 2021 / Approved: PHM / Figure: **A-P-2**

Source file:
\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw



Source file:
\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw

srk consulting

MINTO

Job No: 1CM002.073
Filename: AppA_PhotoLocations_Landscape.pptx

Minto Mine

Site Inspection Photolog

Main Waste Dump (MWD), Main Pit Dump (MPD), and Reclamation Overburden Dump (ROD)

Date:	Approved:	Figure:
October 2021	PHM	**A-P-3**

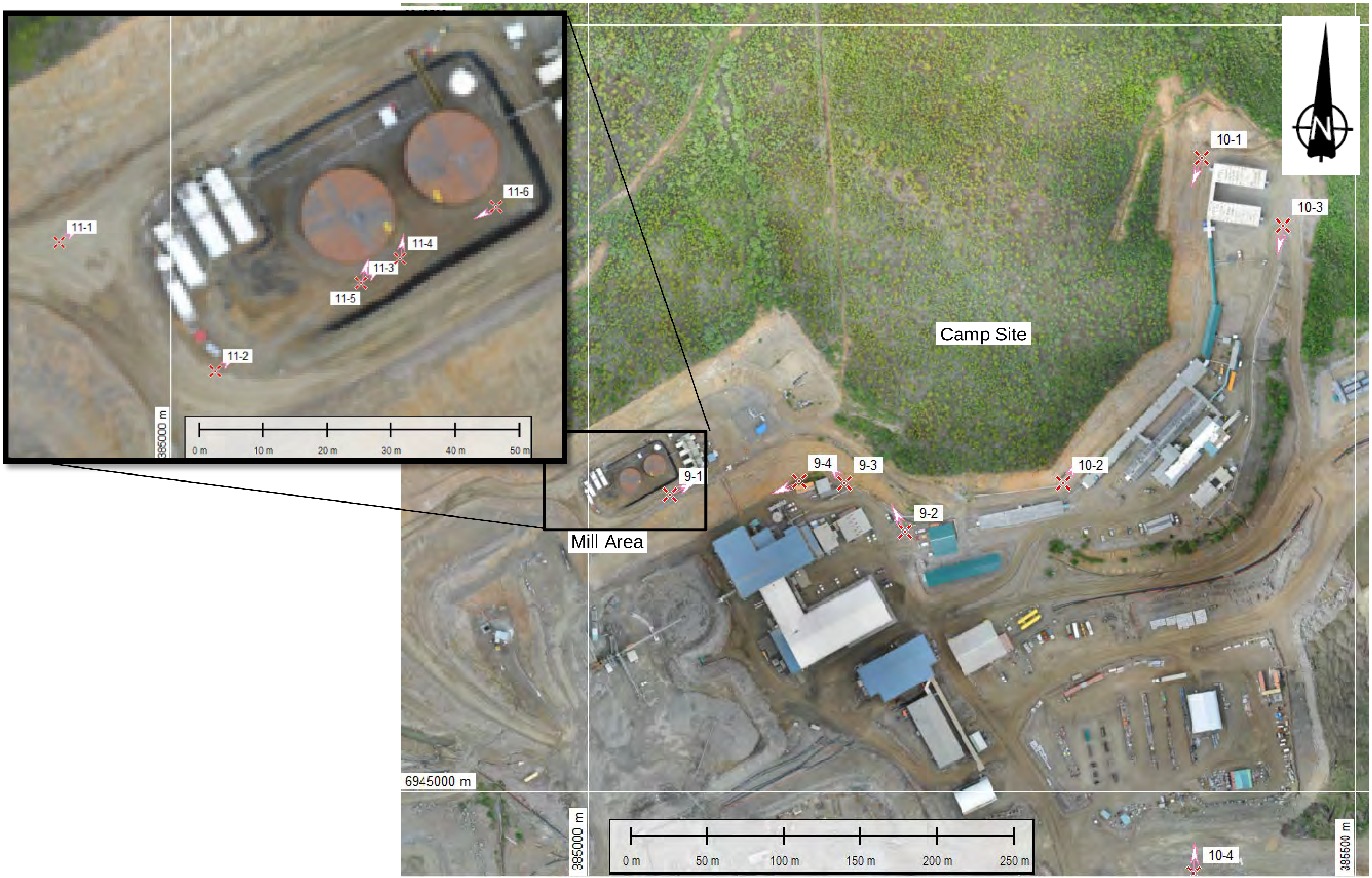
srk consulting

MINTO

Site Inspection Photo Log

Southwest Waste Dump Photo Locations

Job No: 1CM002.073 Filename: AppA_PhotoLocations_Portrait.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-P-4**



srk consulting	MINTO	Site Inspection Photolog
		Mill Area, Camp Area, and Fuel Containment Facility
Job No: 1CM002.073 Filename: AppA_PhotoLocations_Landscape.pptx	Minto Mine	Date: October 2021 / Approved: PHM / Figure: **A-P-5**

Source file:
\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw

srk consulting

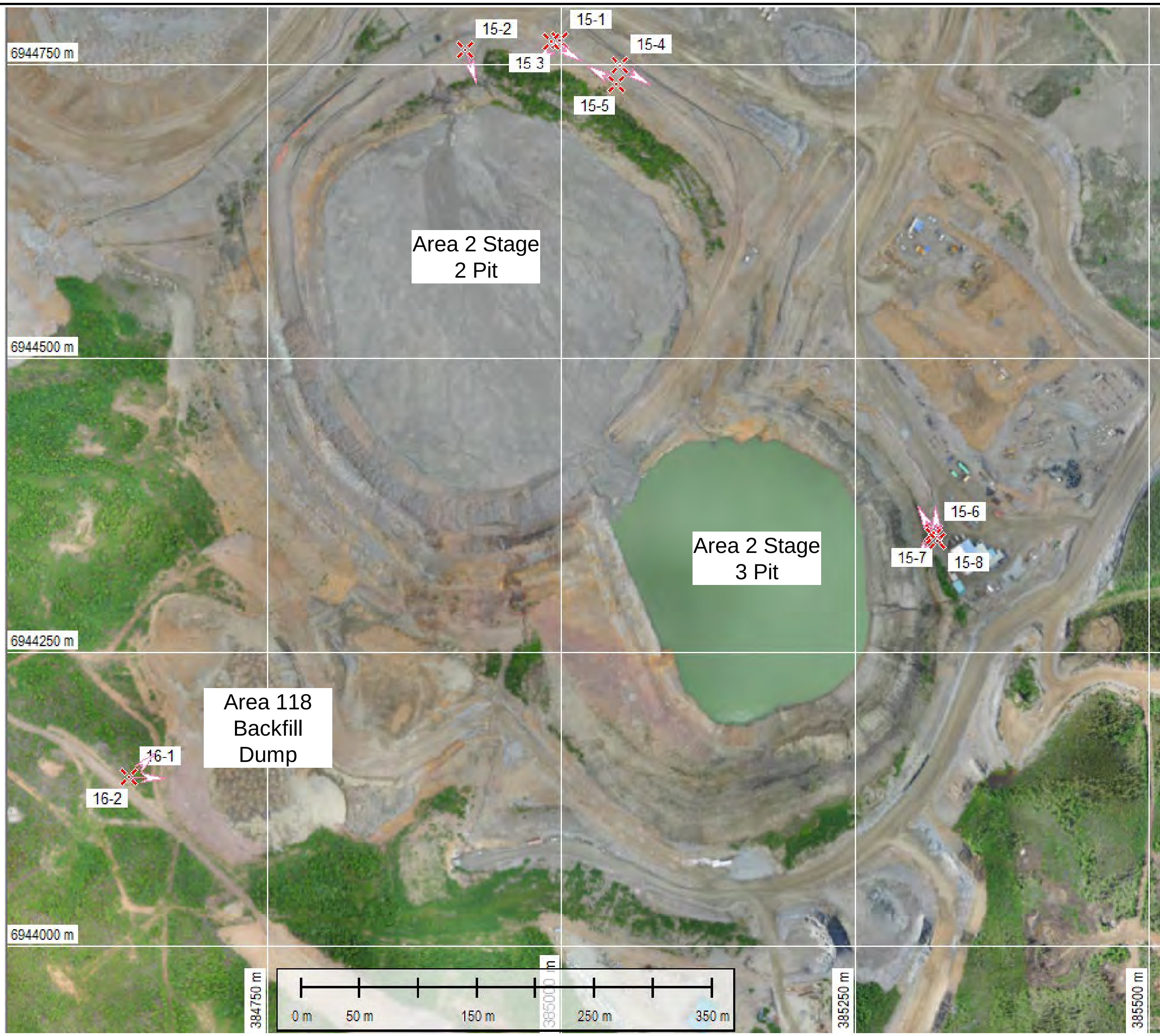
MINTO

Site Inspection Photolog

Water Storage Pond (WSP) Dam

Source file:
\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw

Job No: 1CM002.073	Minto Mine	Date: October 2021	Approved: PHM	Figure: **A-P-6**
Filename: AppA_PhotoLocations_Landscape.pptx				



srk consulting

MINTO

Site Inspection Photolog

Area 2 Pit, Area 118 Pit & Backfill Dump

Job No: 1CM002.073
Filename: AppA_PhotoLocations_Landscape.pptx

Minto Mine

Date:	Approved:	Figure:
October 2021	PHM	**A-P-7**

Source file:
\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw

srk consulting	MINTO	Site Inspection Photolog
		Minto North Pit
Job No: 1CM002.073 Filename: AppA_PhotoLocations_Landscape.pptx	Minto Mine	Date: October 2021 | Approved: PHM | Figure: **A-P-8**

Source file:
\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw

Photo 1-1: Southwest corner of DSTSF (looking west)

Photo 1-2: Southeast end of the DSTSF from TDD road (looking east)

srk consulting	MINTO	Site Inspection Photo Log **Dry Stack Tailings Storage Facility (DSTSF)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-01-01**

Photo 1-3: Covered DSTSF surface in a well naturally-vegetated area.

Photo 1-4: Covered DSTSF surface in an area with no vegetation.

srk consulting	MINTO	Site Inspection Photo Log **Dry Stack Tailings Storage Facility (DSTSF)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-01-02**

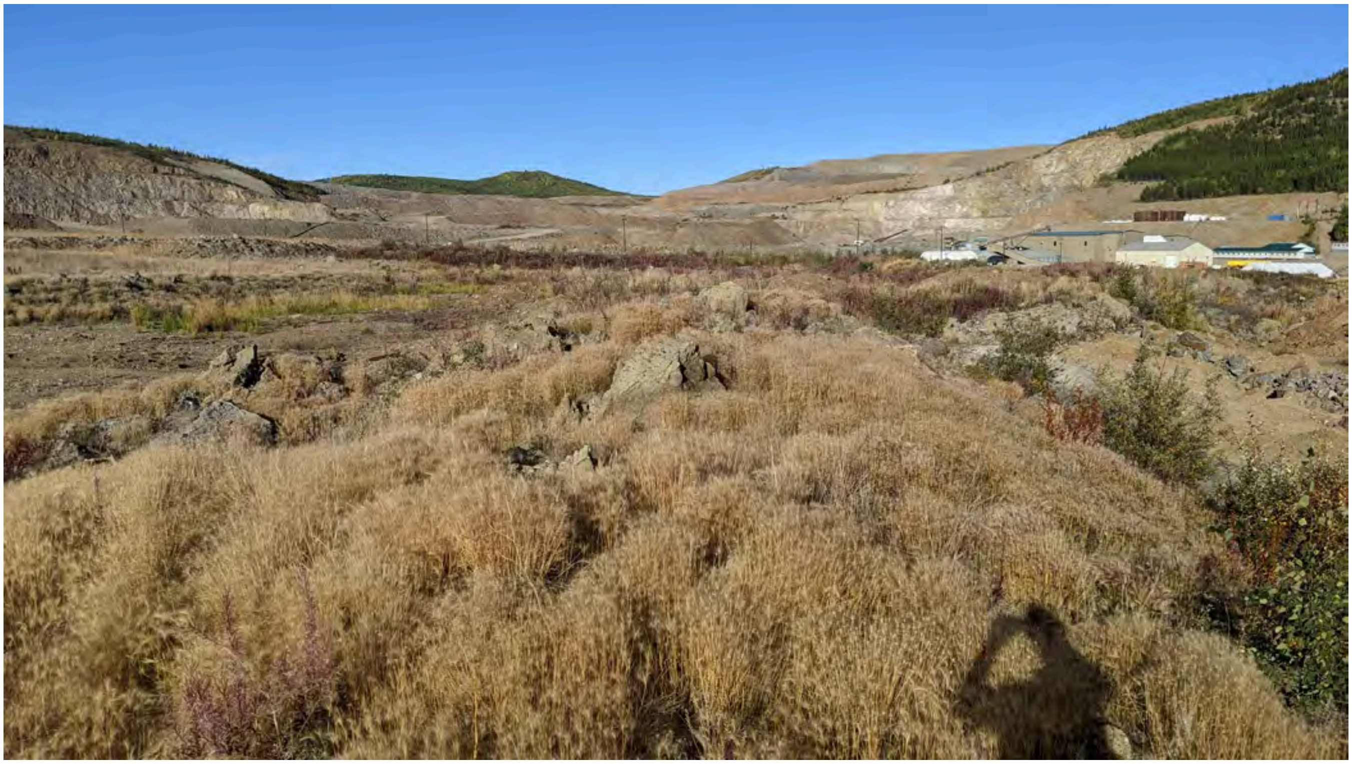


Photo 1-5: Area of stockpiled cover material south of the ungraded waste rock shell.

Photo 1-6: DSTSF crest along the northern end looking east. A 2m high overburden stockpile is on the right side of the picture.

srk consulting	MINTO	Site Inspection Photo Log **Dry Stack Tailings Storage Facility (DSTSF)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-01-03**

Photo 1-7: Erosion gully on regraded cover slope at the northeast corner of the DSTSF.

Photo 1-8: Piezometer DSP-06 and Thermistor DST-11 on the DSTSF waste rock crest. The instrumentation was found to be uncovered and exposed to the elements. Precipitation down the borehole could influence the instrumentation readings.

Photo 2-1: Overview of the MVFE from the camp site (looking southeast).

Photo 2-2: Looking west across Tier C, minor erosion gullies visible down Tier B of the MVFE.

Photo 2-3: Erosion gullies – looking east towards the WSP.

Photo 2-4: Erosion gullies, looking north towards the main access road.

Photo 2-5: View of the north regraded, covered, and vegetated slopes of the MVFE looking towards camp.

Photo 2-6: The road down to the MVFE Sump has been upgraded with an armored drainage channel constructed on the south side of the road to prevent sediment transport to the MVFE Sump area.

srk consulting	MINTO	Site Inspection Photo Log **Mill Valley Fill Extension (MVFE)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-02-03**

Photo 3-1: TDD Intake Channel. Photo taken from the Airport Access Road looking upstream. Grading of the Underground Access Road results in surface runoff being directed into TDD intake. The intake area was cleaned-out prior to the inspection.

Photo 3-2: TDD Intake Channel. View of the location where the Underground Access Road runoff enters the TDD area. The overflow spillway is non functional. Flows that exceed the TDD intake will continue down the Underground access road. Most of this flow would be directed west of the DSTSF.

srk consulting	MINTO	Site Inspection Photo Log
		Tailings Diversion Ditch (TDD)
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021 | Approved: PHM | Figure: **A-03-01**

Photo 3-3: Vegetation in the upper portion of the TDD looking upstream.

Photo 3-4: Vegetation in the upper portion of the TDD looking downstream.

Photo 3-5: Typical view of the lower portion of the TDD with riprap. Sparce vegetation growing in the channel.

Photo 3-6: TDD Outlet. No flow was observed at the time of the inspection.

srk consulting	MINTO	Site Inspection Photo Log **Tailings Diversion Ditch (TDD)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-03-03**

Photo 4-1: MWD regraded slope (looking southeast). A stockpile of cover soil is visible that is located above a portion of the dump that remains to be regraded.

Photo 4-2: MWD regraded slope (looking northeast). Photo is in the location of the cracking of the cover soil noted in the 2019 inspection. The crack was not observed in the 2020 or 2021 inspection. The cover surface in this area has a concave slope.

Photo 4-3: Upper portion of the MWD has been planted with trees in 2021.

Photo 4-4: Regraded MWD slope looking towards the Reclamation Overburden Dump.

Photo 4-5: View from the top of the MWD Expansion looking down to the top of the original MWD.

Photo 4-6: Stockpiled cover material at the top of the MWD Expansion.

srk consulting	MINTO	Site Inspection Photo Log **Main Waste Dump (MWD)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-04-03**

Photo 5-1: Cracking on the crest of the lower bench of the MWD Wrap.

Photo 5-2: Waste Rock excavated from the toe of the MWD Wrap (looking north) that has resulted in an over-steepened slope.

srk consulting	MINTO	Site Inspection Photo Log **Main Waste Dump Wrap**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-05-01**

Photo 6-1: Overview of the north end of the SWD and ROD from the Main Waste Dump.

Photo 6-2: Overview of the SWD from the Main Waste Dump.

srk consulting	MINTO	Site Inspection Photo Log
		Southwest Waste Dump (SWD)
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021 | Approved: PHM | Figure: **A-6-01**

Photo 6-3: Longitudinal cracking along the crest of the SWD first observed in 2019.

Photo 6-4: Longitudinal cracking along the crest of the SWD first observed in 2019..

srk consulting	MINTO	Site Inspection Photo Log **Southwest Waste Dump (SWD)**
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021 | Approved: PHM | Figure: **A-6-02**

Photo 6-5: Longitudinal cracking along the crest of the SWD first observed in 2019 at its widest point.

Photo 6-6: Regraded SWD slope below the longitudinal cracks.

srk consulting	MINTO	Site Inspection Photo Log **Southwest Waste Dump (SWD)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-6-03**

Photo 6-5: HGW Pad at the south end of the SWD

Photo 6-6: Overview of the SWD taken from the south end of the SWD..

srk consulting	MINTO	Site Inspection Photo Log **Southwest Waste Dump (SWD)**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-6-04**

Photo 7-1: Reclamation Overburden Dump looking south.

Photo 7-2: Reclamation Overburden Dump looking west.

srk consulting	MINTO	Site Inspection Photo Log **Reclamation Overburden Dump**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-07-01**

Photo 8-1: Crusher Stockpile west of the mill.

Photo 8-2: Ore Stockpiles south of the mill.

srk consulting	MINTO	Site Inspection Photo Log
		Ore Stockpiles
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021 | Approved: PHM | Figure: **A-08-01**

Photo 9-1: Highwall behind the mill area taken from the Fuel Tank Farm looking east.

Photo 9-2: Highwall behind the mill area looking northwest from near the south end of camp.

Photo 9-3: Historical seepage location located at the northeast corner of the mill area. No seepage was observed at the time of the inspection.

Photo 9-4: Minor slope erosion on the highwall.

Photo 10-1: Highwall behind Selkirk Manor looking south from the north end of camp.

Photo 10-2: Highwall behind camp looking northwest from near the south end of camp.

srk consulting	MINTO	Site Inspection Photo Log **Camp Site**
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021 · Approved: PHM · Figure: **A-10-01**

Photo 10-3: Repaired erosion gulley noted in the 2020 inspection at the north end of camp. (looking south).

Photo 10-4: Historical erosion gullies below the camp pad. The condition of the gullies is unchanged from previous inspections and the camp pad is graded to prevent runoff entering the top of the gullies.

Photo 11-1: Highwall behind Fuel Containment Facility.

Photo 11-2: Entrance ramp to the facility with a new large rut near the edge and new rutting between the ramp and sump (far end).

srk consulting	MINTO	Site Inspection Photo Log		
		Fuel Containment Facility		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-11-01**

Photo 11-3: Tire ruts between the ramp and sump has exposed the base geotextile and liner in areas.

Photo 11-4: Exposed geosynthetics in the rut. A thin plastic is present overtop of the geotextile (that overtops the liner) that appears to be a sacrificial warning layer to prevent liner damage.

Photo 11-5: A small geotextile tear was found in the rut that is approximately 5cm x 8 cm. Liner damage could not be detected within the tear.

Photo 11-6: View of the ruts and liner along the side wall of the facility.

Photo 12-1: Overview of the WSP from the MVFE looking northeast.

Photo 12-2: WSP Crest taken from the north abutment looking south.

Photo 12-3: WSP spillway looking downstream.

Photo 12-4: WSP spillway looking south from the dam crest.

Photo 12-5: Upstream north abutment. The water level in the pond is higher than the previous year, which has resulted in the accumulation of logs across the upstream face of the dam.

Photo 12-6: Accumulation of logs along the south abutment of the dam.

srk consulting	MINTO	Site Inspection Photo Log **Water Storage Pond**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-12-03**

Photo 12-7: Potential minor sinkhole or burrow on the downstream south abutment near ground temperature cable WDT-08. No apparent change in condition since first observed in the 2019 inspection.

Photo 12-8: Seepage at the toe of the dam immediately upstream of the seepage collection sump. Seepage was clear with no signs of sediment transport.

srk consulting	MINTO	Site Inspection Photo Log **Water Storage Pond**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-12-04**

Photo 12-9: View of the seepage weir downstream of the dam.

Photo 12-10: Ponding seepage downstream of the WDP Dam looking south. Seepage was clear with no signs of sediment transport.

Photo 13-1: Western bridge abutment.

Photo 13-2: Western abutment. A Tree is growing on the upstream side of the western abutment.

Photo 13-3: Big Creek looking upstream from the western abutment. An eddy is present upstream of the west abutment. The condition of the eddy and creek is the same as the 2020 inspection.

Photo 13-4: Downstream end of the eastern abutment. A rope is suspended from the bridge by the Minto Environmental department for environmental monitoring of the creek.

Photo 14-1: Main Pit and Main Pit Dump looking south.

Photo 14-2: Main Pit looking east.

srk consulting

MINTO

Site Inspection Photo Log

Main Pit, Main Pit Dump (MPD), South Wall Buttress & In-Pit Dumps

Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-14-01**

Photo 14-3: Veiw of the Main Pit Dump from the Southwest Dump.

Photo 14-4: West wall of the Main Pit.

Photo 14-5: Vent raise located west of the Main Pit.

Photo 14-6: Main Pit Reclaim Barge and In-Pit Dumps.

srk consulting	MINTO	Site Inspection Photo Log **Main Pit, Main Pit Dump (MPD), South Wall Buttress & In-Pit Dumps**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-14-03**

Photo 14-7: SAT Dump. An additional lift of SAT material has been placed on the SAT Dump in the past year. If the Main Dam does not proceed, this additional material will need to be relocated below the long-term water level.

Photo 14-8: Historical cracking of the In-Pit Dump above the SAT Dump. The cracks are filling-in and near-by survey hubs indicate no current movement.

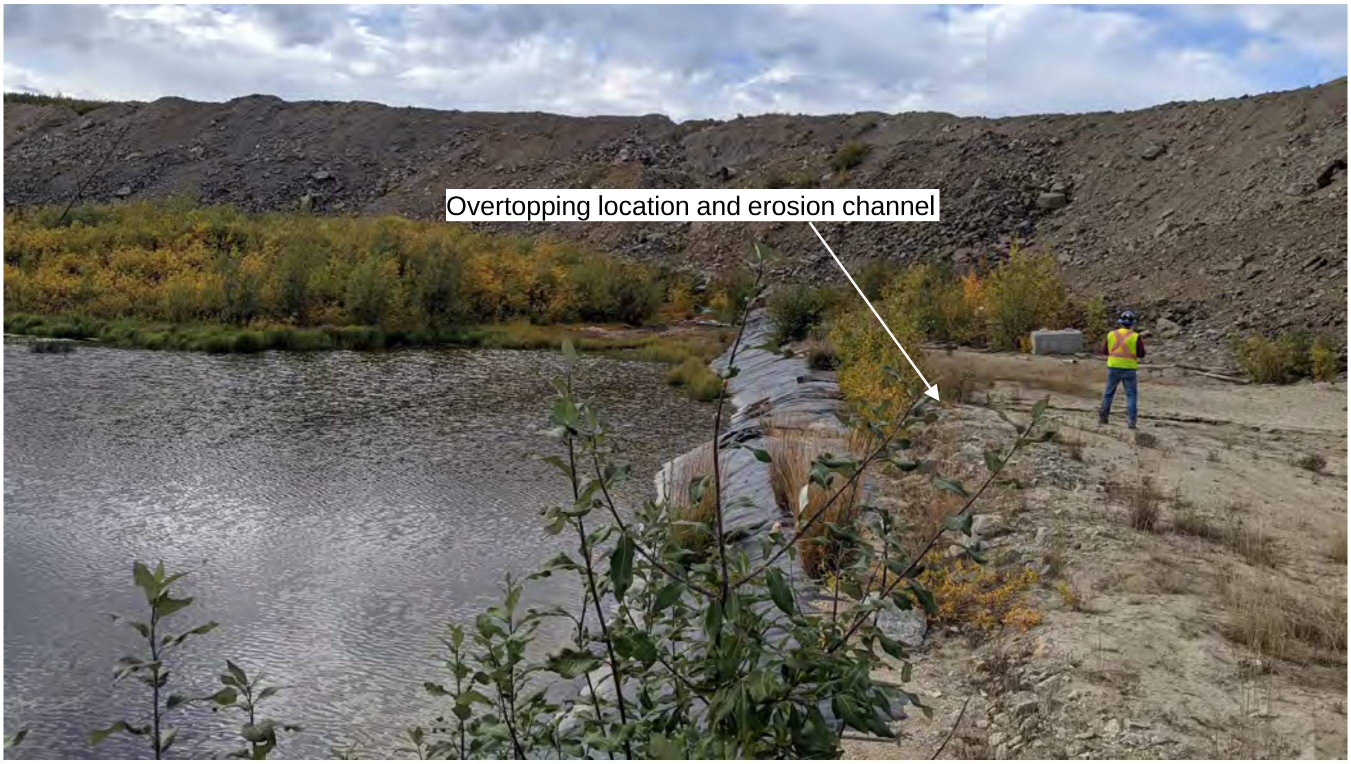


Photo 14-9: W15 Sump south of the Main Pit. The sump appears to have overtopped in the past year with water infiltrating through a sinkhole into the pit.

Photo 14-10: Lower end of the erosion channel and sinkhole beneath the haul road..

srk consulting	MINTO	Site Inspection Photo Log
		Main Pit, Main Pit Dump (MPD), South Wall Buttress & In-Pit Dumps
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021 / Approved: PHM / Figure: **A-14-05**


Photo 15-1: Area 2 Stage 2 Pit backfilled with tailings looking southwest


Photo 15-2: Area 2 Stage 2 Pit looking south.

Photo 15-3: Cracking along inactive access road along pit rim.

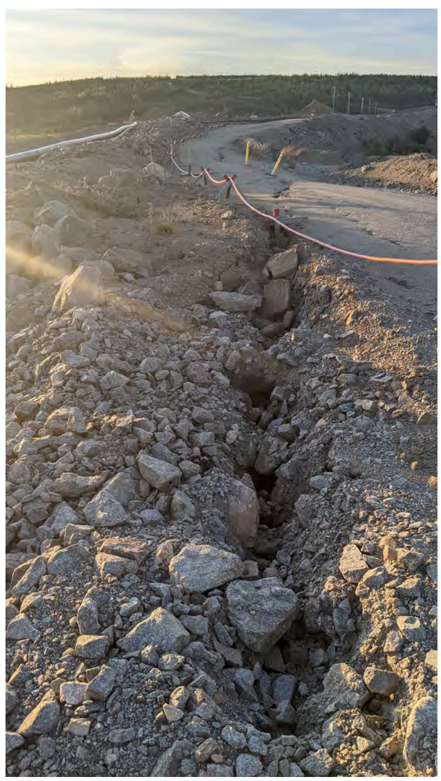


Photo 15-4: Cracking along inactive access road along pit rim.

srk consulting	MINTO	Site Inspection Photo Log **Area 2 Pit**		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-15-02**

Photo 15-5: Cracking along the pit rim.

Photo 15-6: Area 2 Stage 3 Pit looking south.

Photo 15-7: Cracking along the Area 2 Stage 3 Pit rim.

Photo 15-8: Cracking along the Area 2 Stage 3 Pit rim near the Underground Shop.

srk consulting	MINTO	Site Inspection Photo Log		
		Area 2 Pit		
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021	Approved: PHM	Figure: **A-15-04**

Photo 16-1: South end of the Area 118 Pit

Photo 16-2: North end of the Area 118 Pit

srk consulting	MINTO	Site Inspection Photo Log
		Area 118 and Backfill Dump
Job No: 1CM002.073 Filename: MintoAGI_Photolog.pptx	Minto Mine Geotechnical Annual Review	Date: October 2021 | Approved: PHM | Figure: A-16-01

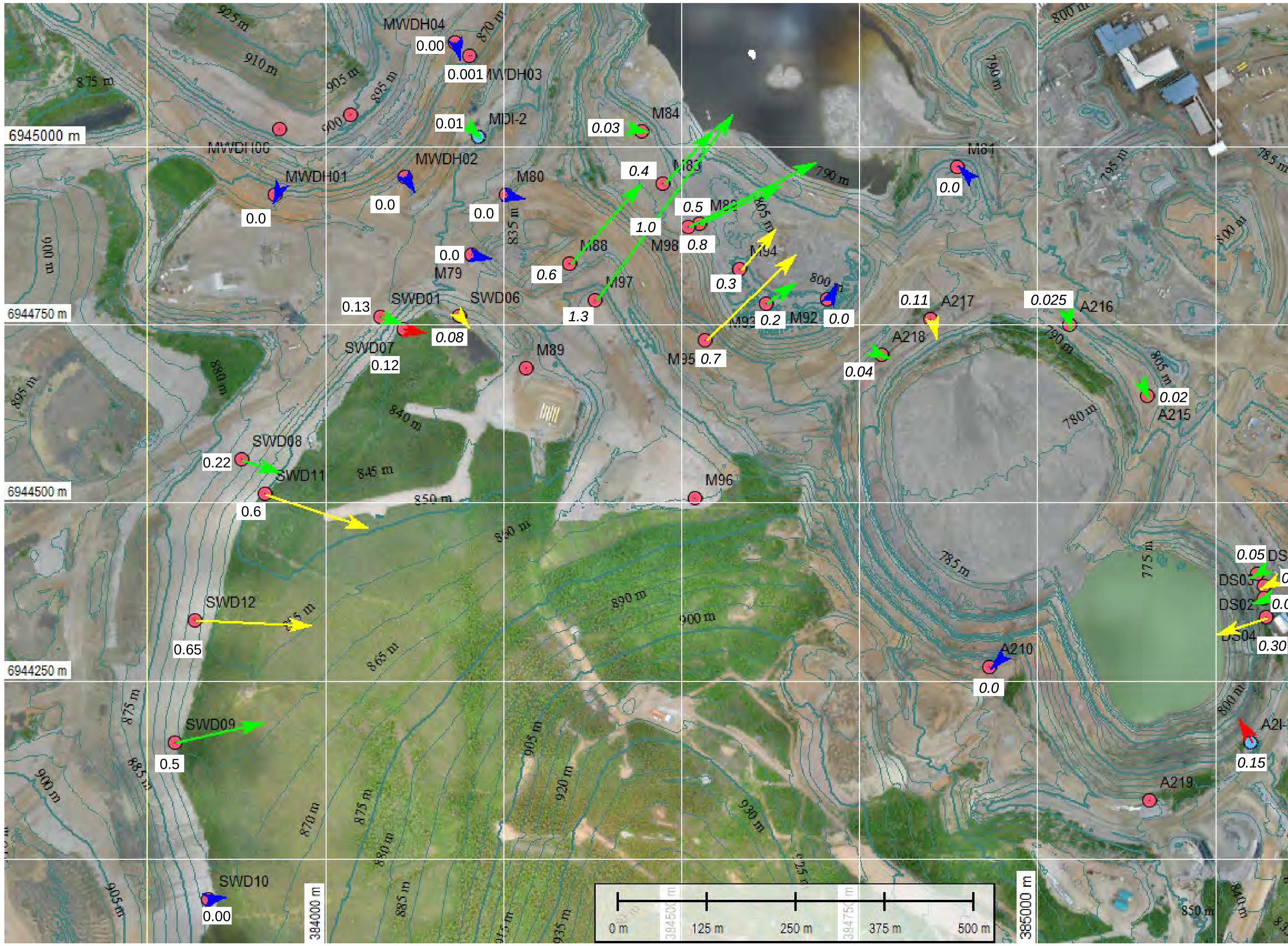
Photo 17-1: Previous pit wall failure in Minto North Pit (looking southwest).

Photo 17-2: North pit wall.

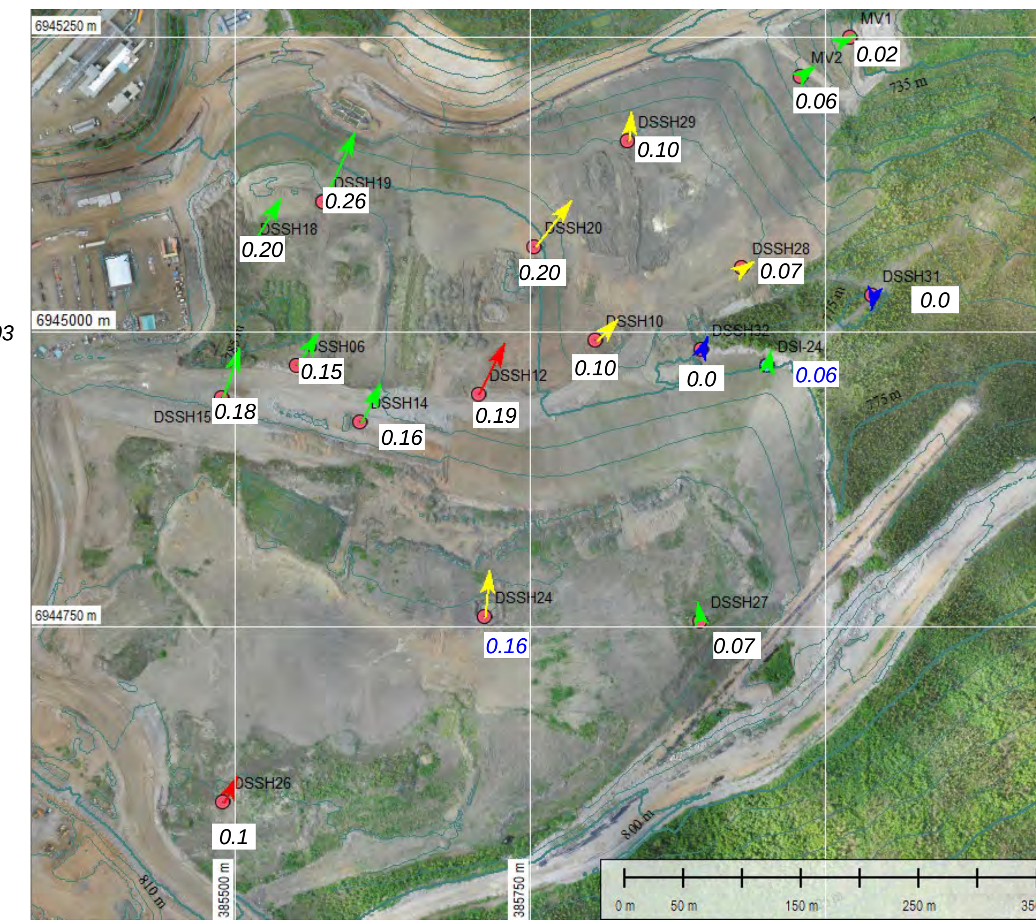
Appendix B Survey Hub Summary

LEGEND

- Survey Hubs - Active
- Survey Hubs - Destroyed
- 0.5 Total Movement Rate (mm/day)
- 0.5 Horizontal Movement Rate (mm/day)
- Movement Vector - No Current Movement
- Movement Vector - Decelerating Movement
- Movement Vector - Steady Movement
- Movement Vector - Accelerating Movement



a) Southwest Dump and Main Pit Areas



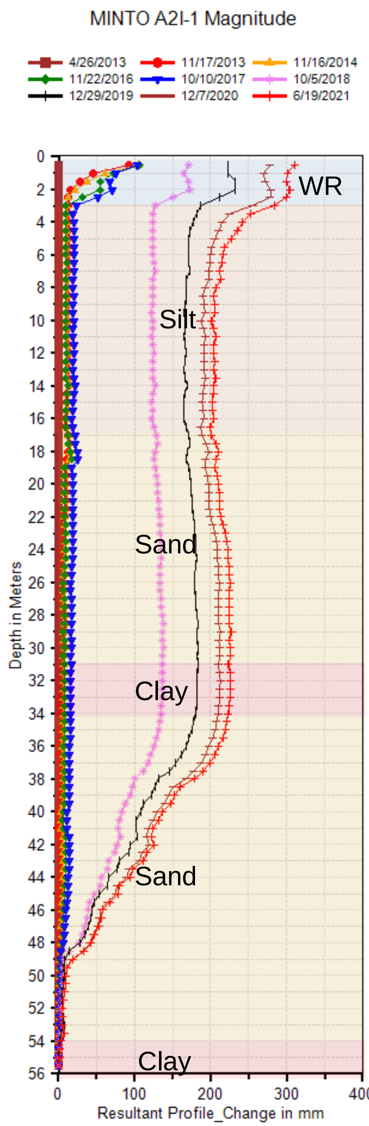
b) Dry Stack Tailings Storage Facility

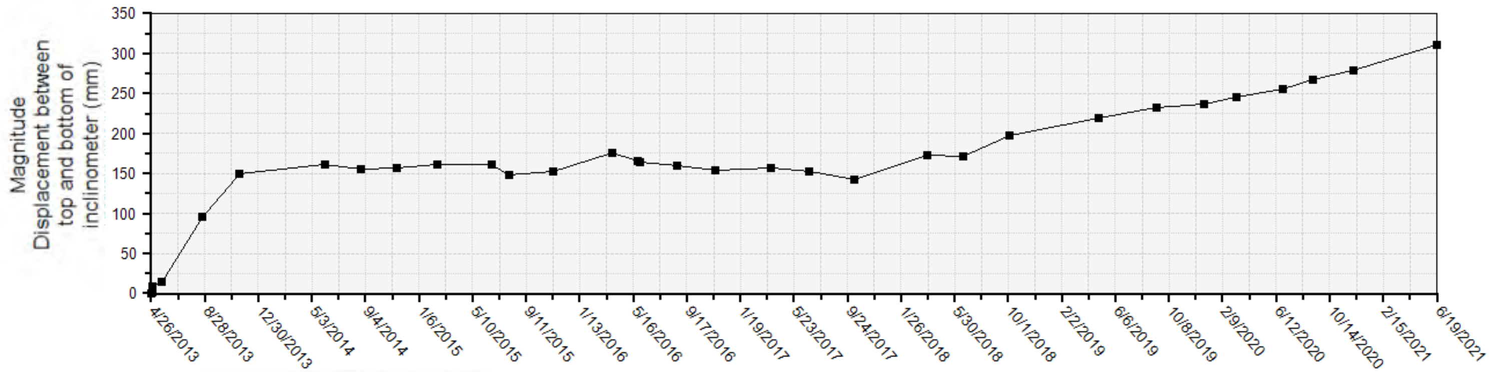
Notes:

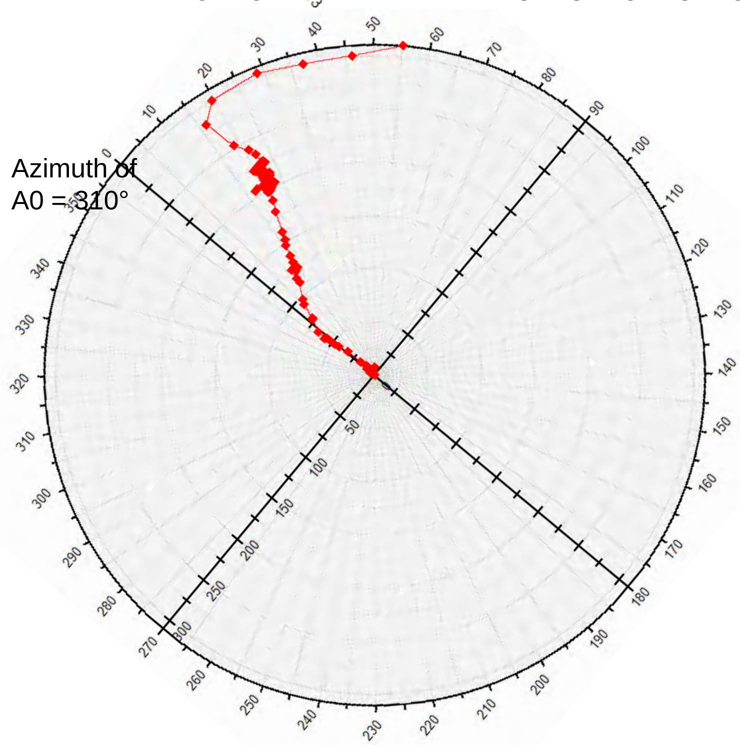
1. Movement vectors have been scaled by a factor of 250 (i.e. length equals 250 times the current velocity in mm/day) except for the blue vectors where no current movement is observed. The length of the blue vectors is arbitrary and is included to show the direction of past movement.

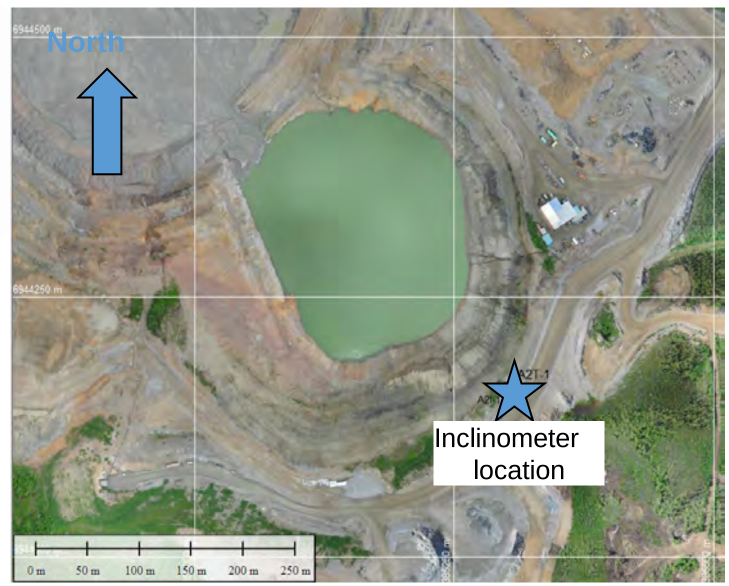
srk consulting	MINTO	2021 Survey Hub Data
		Survey Hub Summary
Job No: 1CM002.073 Filename: MintoSurveySummary11x17.pptx	Minto Mine	Date: October 2021 / Prepared by: PHM / Figure: 1

Appendix C Area 2 Pit Instrumentation Data









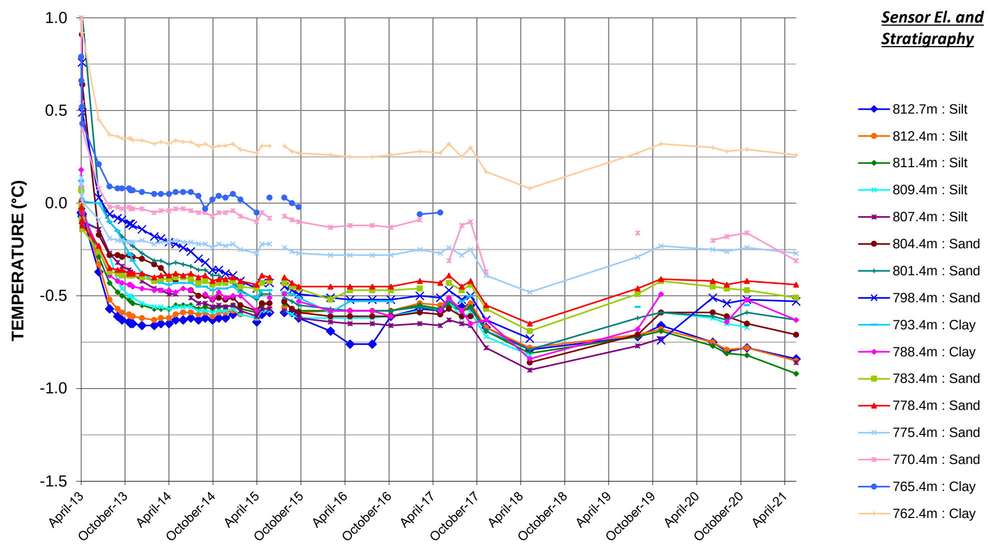
Notes

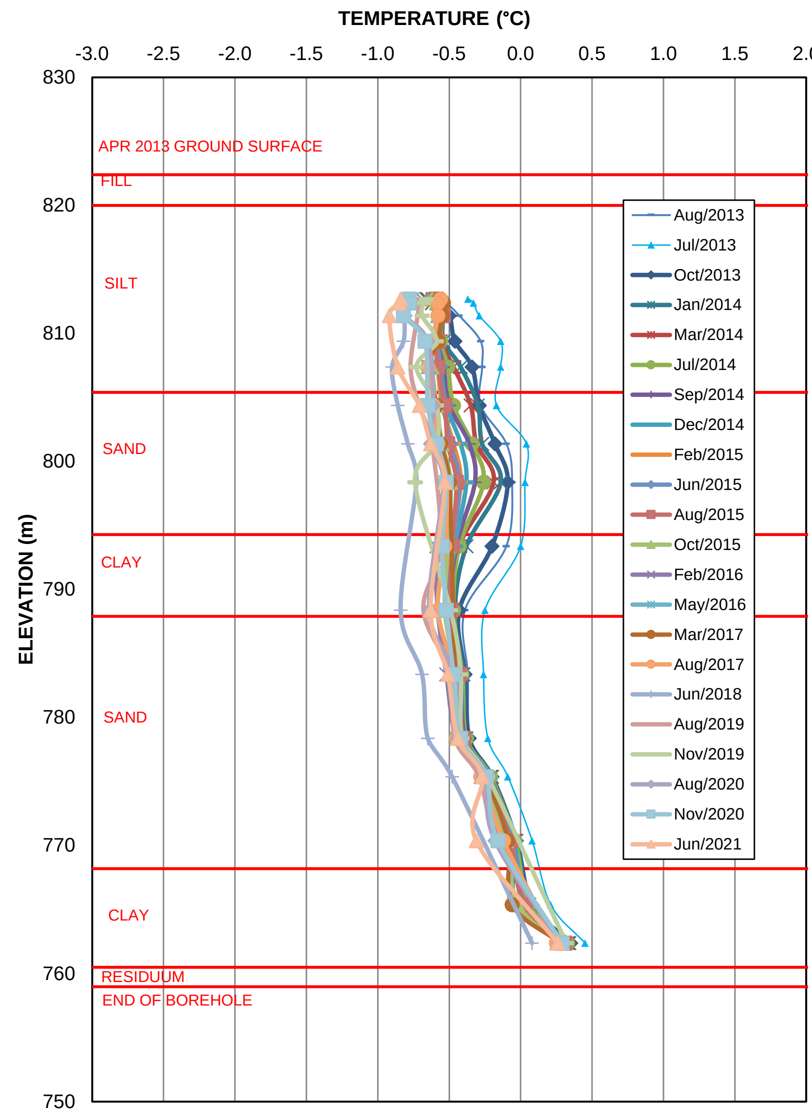
1. Inclinometer software (DigiPro2 v2.12.4) plots A0 as 0 degrees. The plot above has been rotated such that the orientation matches the plan (north is up).

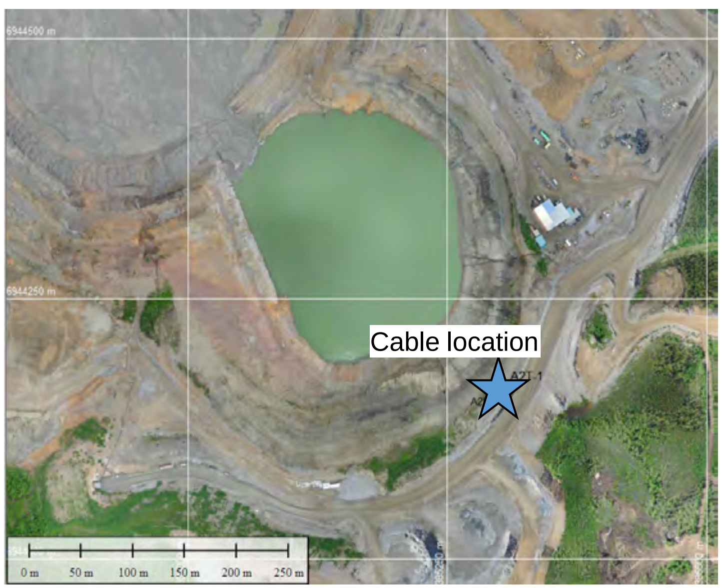
Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\Minto SI Instrumentation Database.dpw

srk consulting	MINTO	Area 2 Pit Instrumentation Data		
		Inclinometer A2I-1		
Job No: 1CM002.073 Filename: ApC_2021Area2Pit.pptx	Minto Mine	Date: October 2021	Prepared by PHM	Figure: 1







Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\GTC + Piezometer Instrumentation – Area 2 Pit_SRK_.xlsm

srk consulting

MINTO

Area 2 Pit Instrumentation Data

Ground Temperature Cable – A2T-1

Job No: 1CM002.073

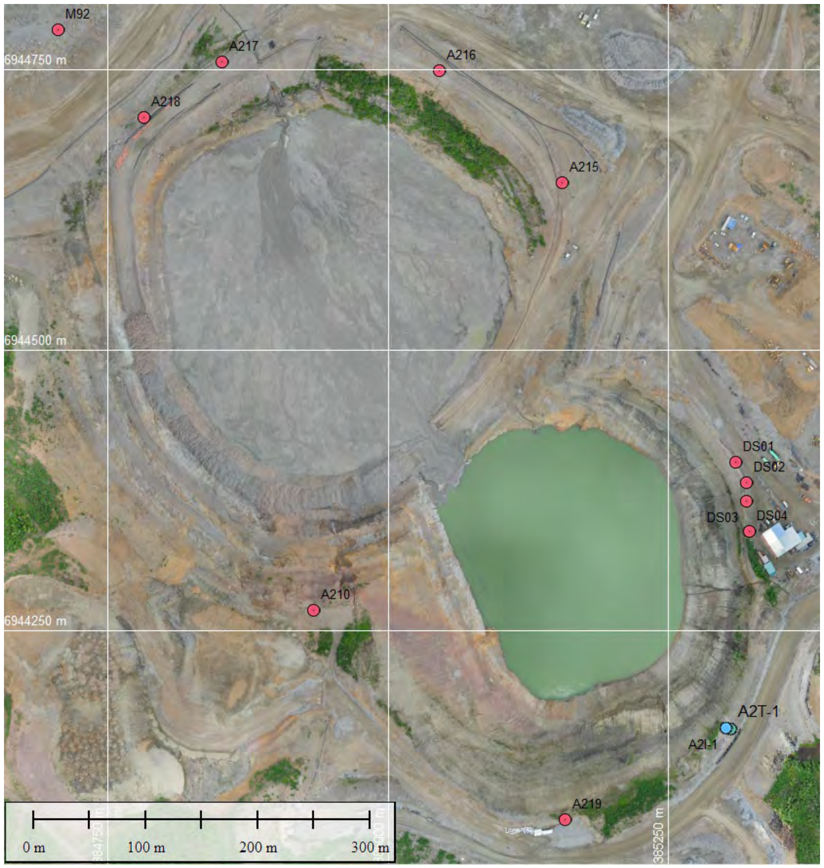
Filename: ApC_2021Area2Pit.pptx

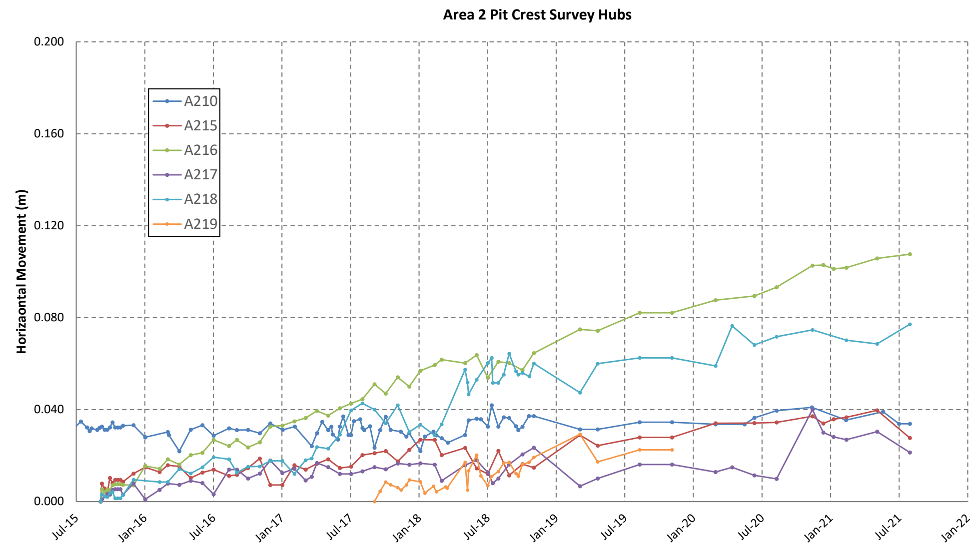
Minto Mine

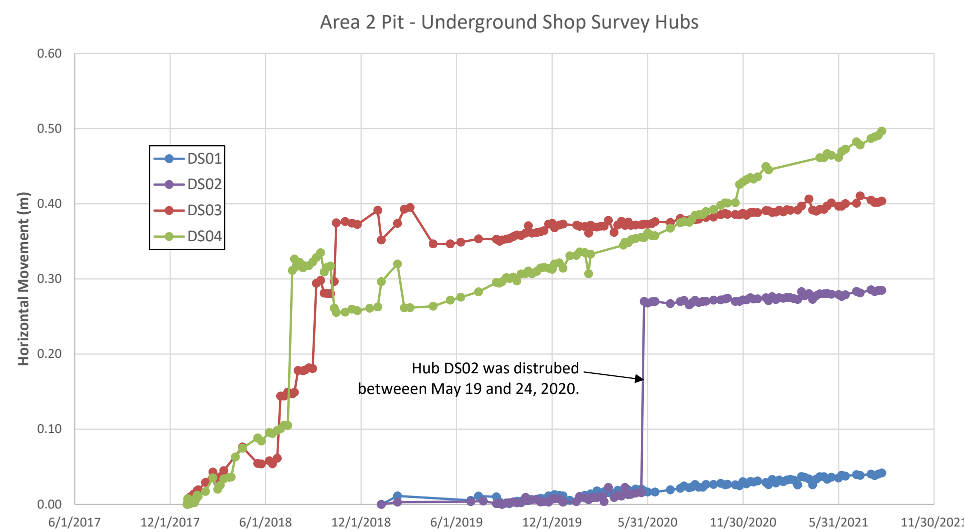
Date: October 2021

Prepared by PHM

Figure: 2







Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\Area2_SurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	Area 2 Pit Instrumentation Data		
		Survey Hubs		
Job No: 1CM002.073 Filename: ApC_2021Area2Pit.pptx	Minto Mine	Date: October 2021	Prepared by PHM	Figure: 3

Appendix D DSTSF Instrumentation Data

Active Survey Hubs					
Survey Hub	Last Reading	Movement Rate (mm/day)		Bearing (over past year)	Comments
		Current (as of last reading)	One year prior to last reading		
DSSH06	7/30/2021	0.15	0.24	30	Decelerating, movement direction shifting to the east.
DSSH10	5/31/2021	0.10	0.10	42	Steady movement rate for the past two years. No apparent vertical displacement.
DSSH12	7/30/2021	0.19	0.19	26	Possible acceleration trend. Additional readings needed to confirm. Vertical displacement rate continues to show deceleration.
DSSH14	5/31/2021	0.16	0.16	24	Slight deceleration trend observable in the horizontal displacement data. Movement direction shifted towards the east by 2 degrees in past year.
DSSH15	5/31/2021	0.18	0.19	18	Slight deceleration trend observable.
DSSH18	5/31/2021	0.20	0.20	32	Deceleration trend observable in the horizontal displacement graph.
DSSH19	5/31/2021	0.26	0.26	24	Slight deceleration trend observable.
DSSH20	5/31/2021	0.20	0.20	38	Total displacement graph shows an apparent acceleration trend due to an increase in settlement. Horizontal displacement graph shows a deceleration trend. Movement direction shifted towards the east by 6 degrees in past year (likely due to settlement).
DSSH24	5/31/2021	0.16	0.16	5	Steady movement rate in the past year. Less variability in the total displacement graph due to the reduction in the reading frequency in 2019. Rate of settlement is decreasing.
DSSH26	5/31/2021	0.25	0.07	27	Possible acceleration trend in the horizontal displacement graph. Additional readings needed to confirm.
DSSH27	2/2/2021	0.07	0.16	180	Decelerating.
DSSH28	7/30/2021	0.07	0.07	32	Steady movement rate.
DSSH29	5/31/2021	0.10	0.10	6	Vertical settlement has increased in past year, while the horizontal displacement is steady, with the last reading indicating no significant movement.
DSSH31	5/31/2021	0.00	0.00	277	No significant horizontal movement trend
DSSH32	5/31/2021	0.00	0.00	24	No significant horizontal movement trend
MV1	5/31/2021	0.02	0.05	61	Decelerating
MV2	5/31/2021	0.06	0.09	51	Slight deceleration trend observable in the horizontal displacement data.

Notes:
1. See subsequent figures for each survey hub for the interpretations of the movement rates with time.
2. Blue text indicates horizontal movement rates, while the black text are total movement rates.
3. Bearing direction is measured from true north.

srk consulting

MINTO

DSTSF Instrumentation Data

DSTSF Survey Hub Summary

Job No: 1CM002.073

Filename: ApD_DSTSFPort.pptx

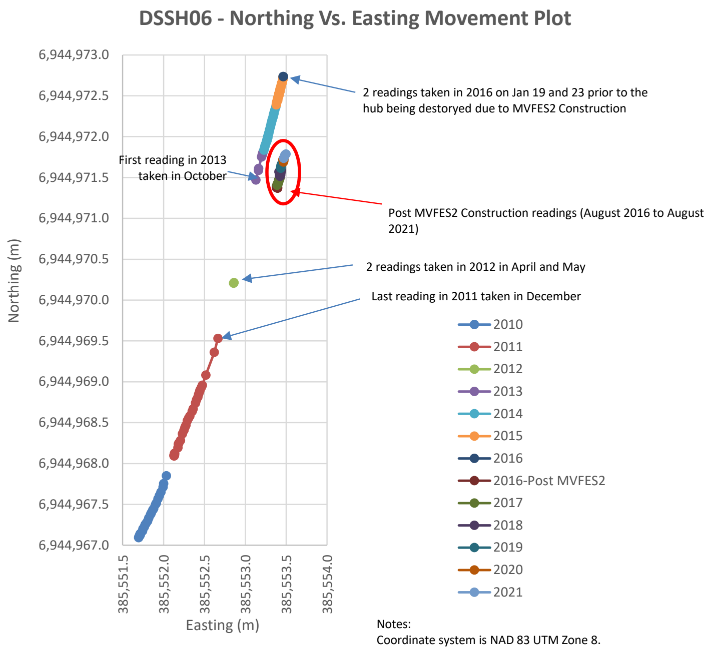
Minto Mine

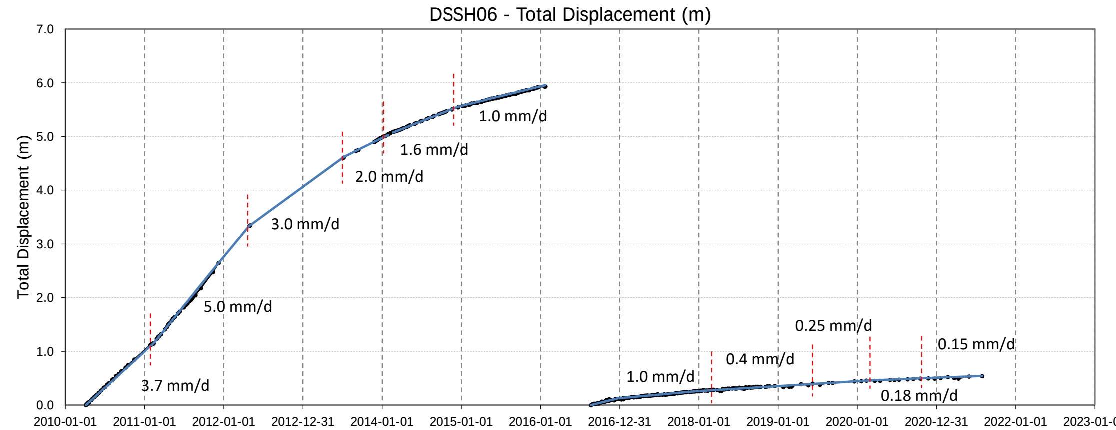
Date: October 2021

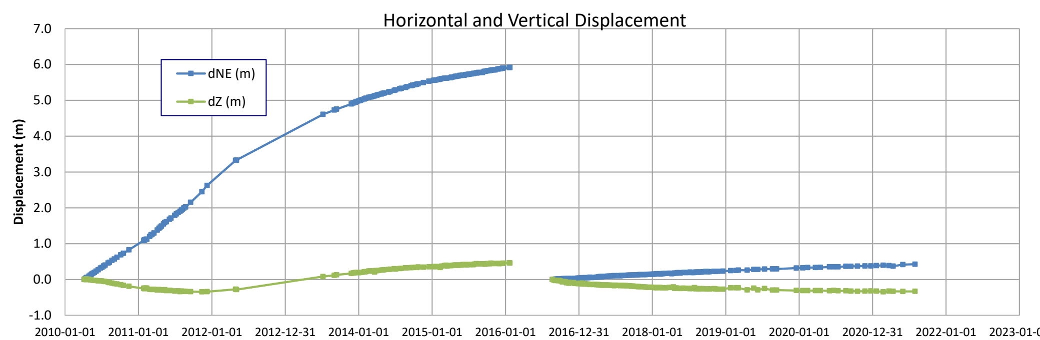
Prepared by: PHM

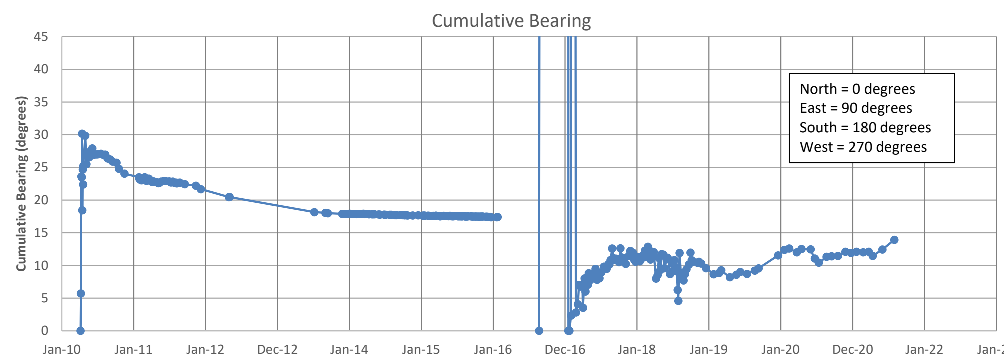
Figure: 1

Source file:
Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm



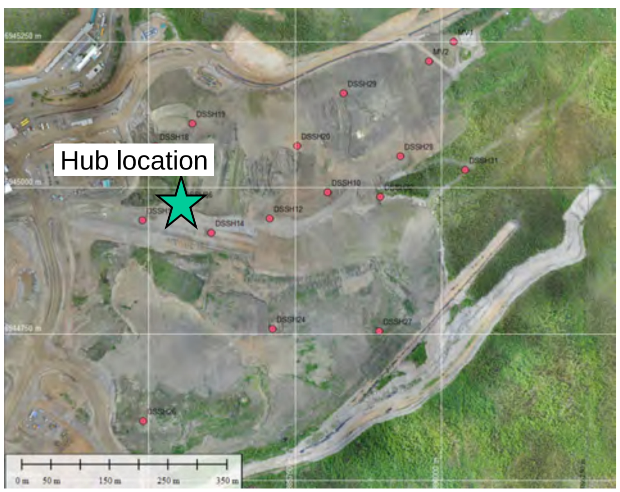






Note:

1. The survey hub was removed in January 2016 prior to MVFES2 construction. The hub was reinstalled in August 2016 following completion of construction.



Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

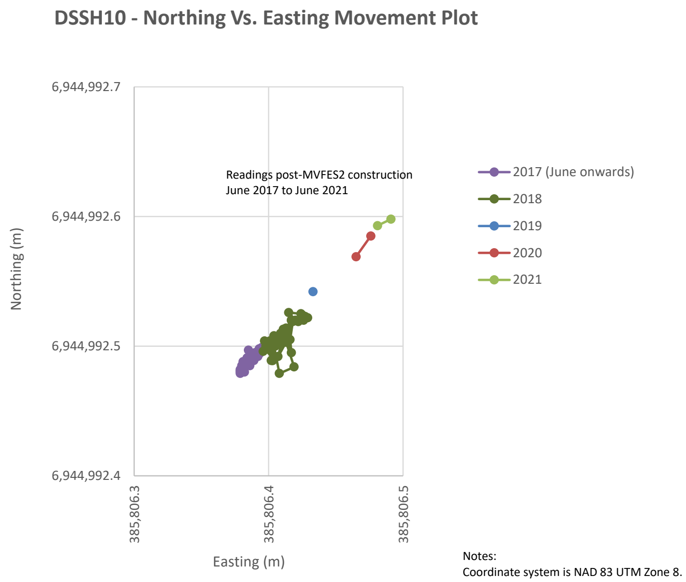
srk consulting | MINTO | DSTSF Instrumentation Data

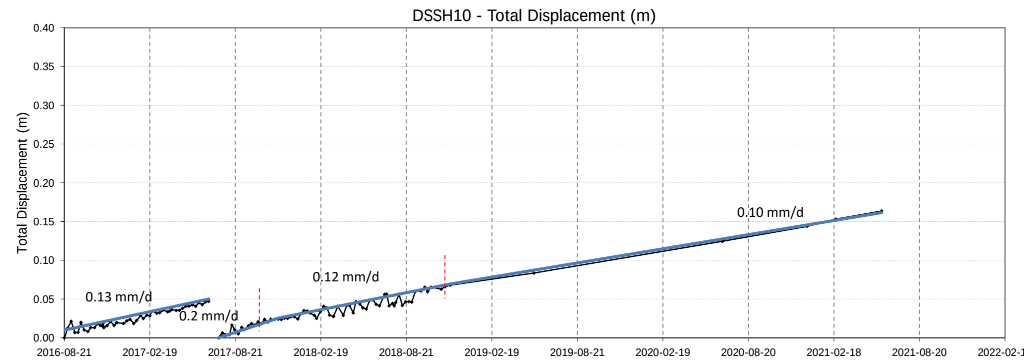
DSTSF – DSSH06

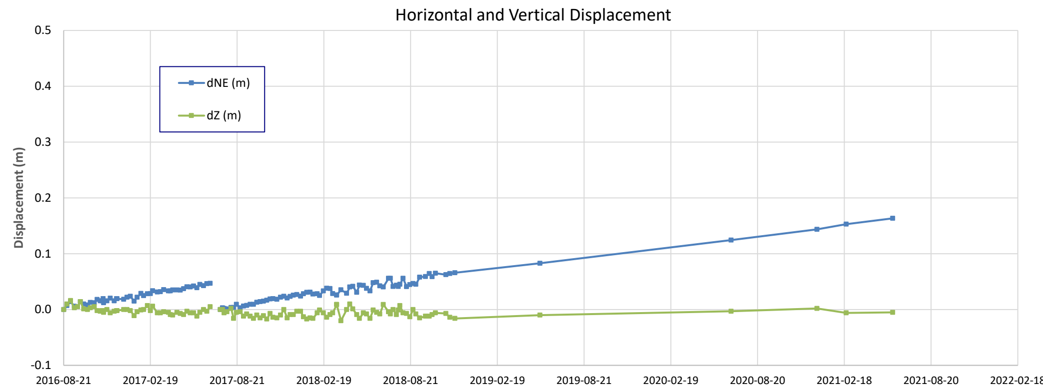
Job No: 1CM002.073
Filename: ApD_2021DSTSFLandscape.pptx

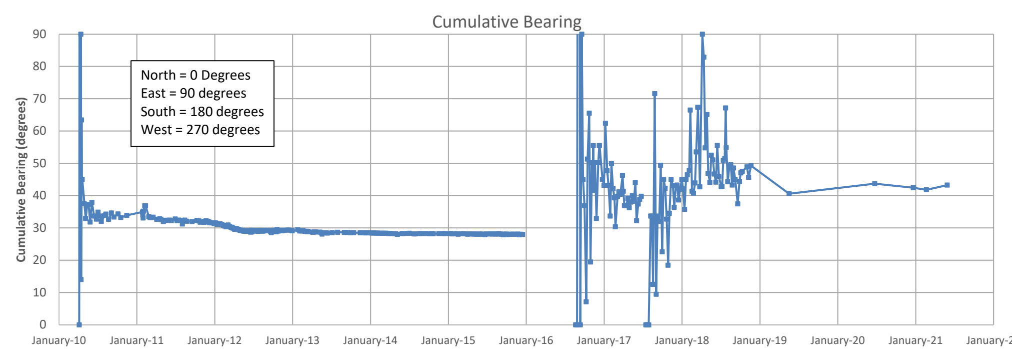
Minto Mine

Date:	Prepared by	Figure:
October 2021	PHM	2



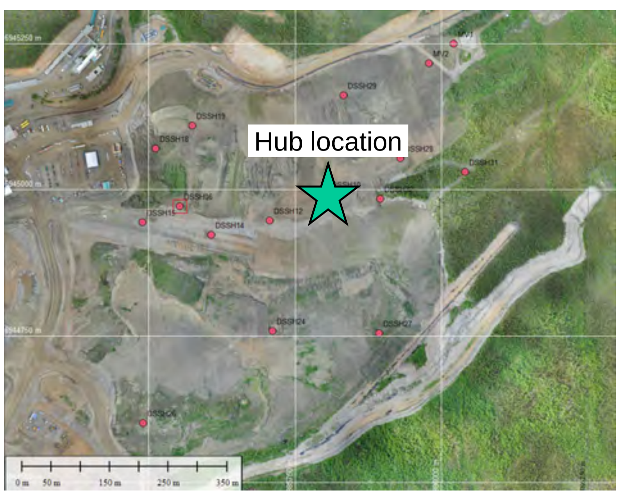






Note:

1. The survey hub was removed in December 2016 prior to MVFES2 construction. The hub was reinstalled in August 2016 following completion of construction and was repositioned in June 2017.



Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting

MINTO

DSTSF Instrumentation Data

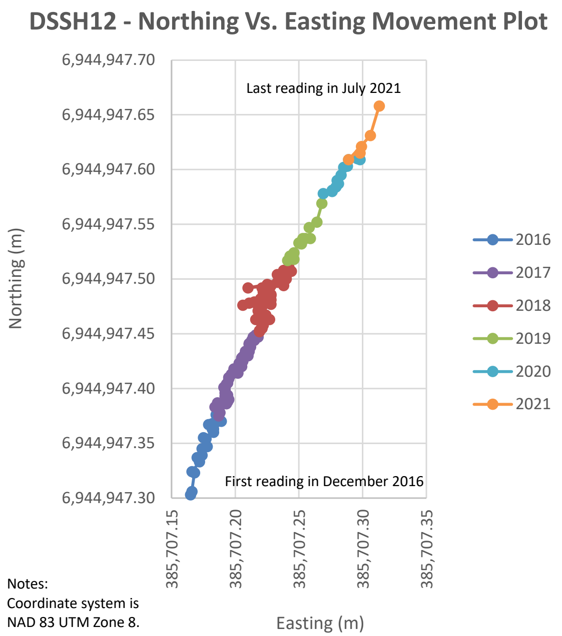
Survey Hub – DSSH10

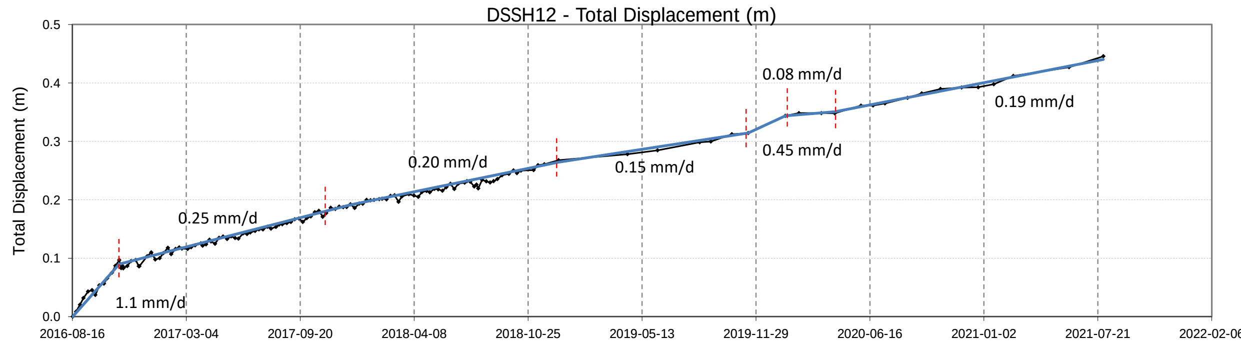
Job No: 1CM002.073

Filename: ApD_2021DSTSFLandscape.pptx

Minto Mine

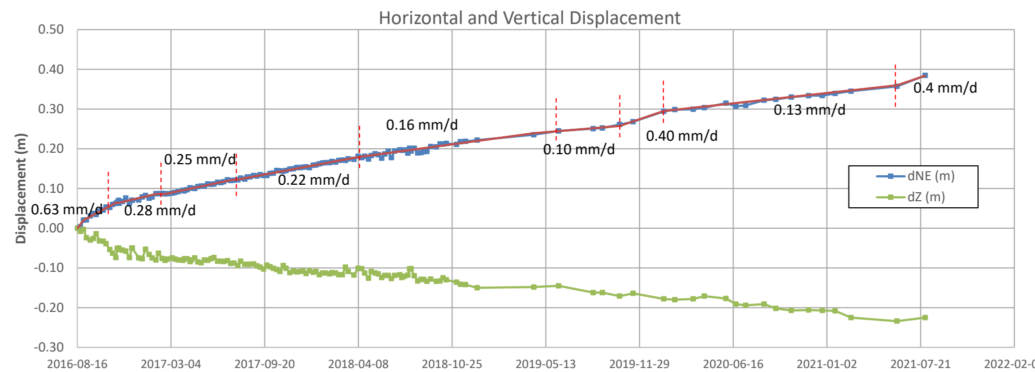
Date:	Prepared by	Figure:
October 2021	PHM	3

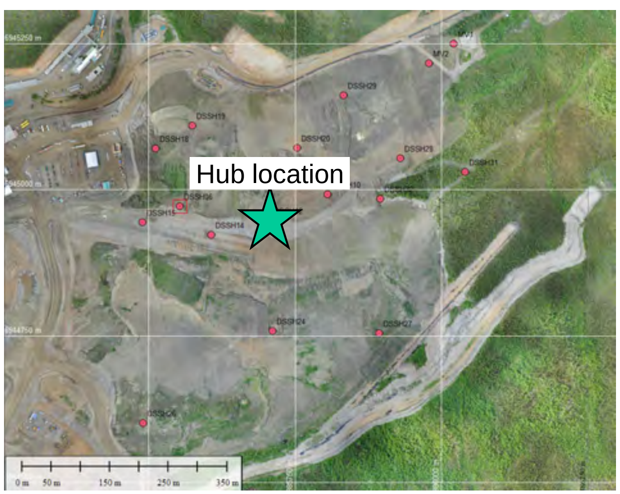


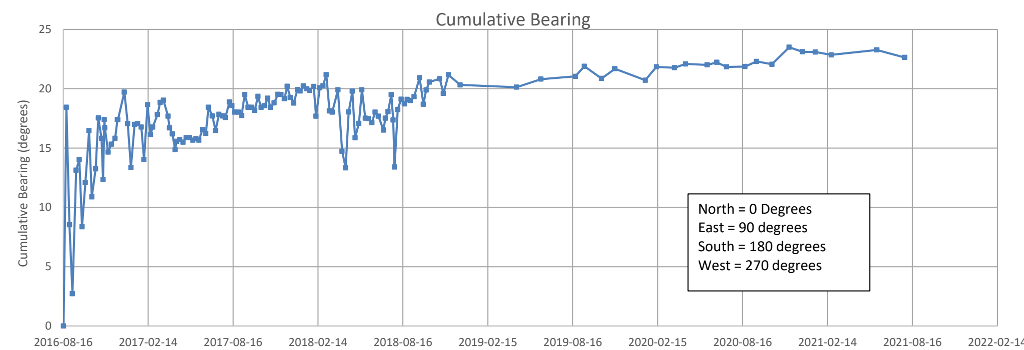


Note:

1. The survey hub was removed in January 2016 prior to MVFES2 construction. The hub was reinstalled in December 2016 following completion of construction.





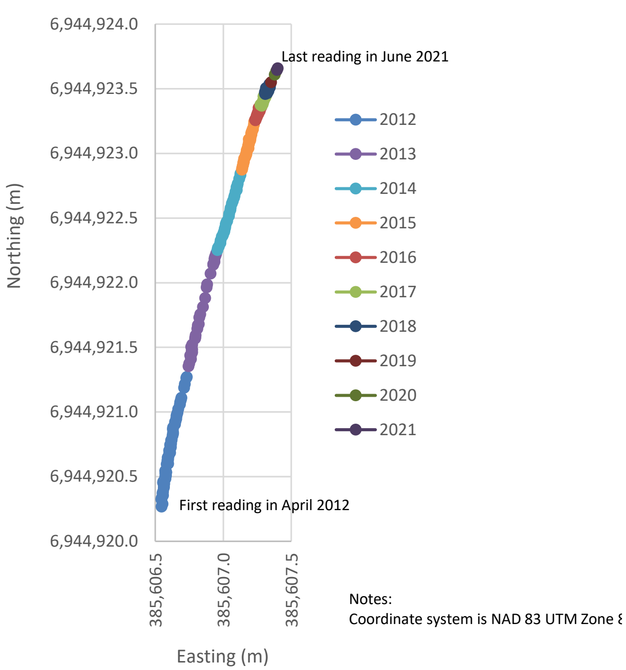


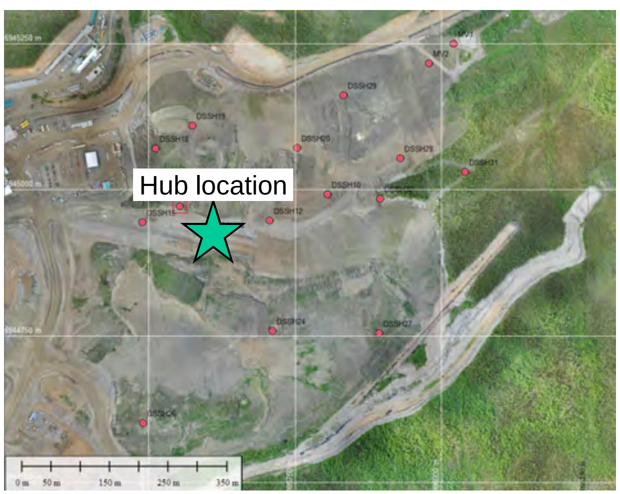
Source files:

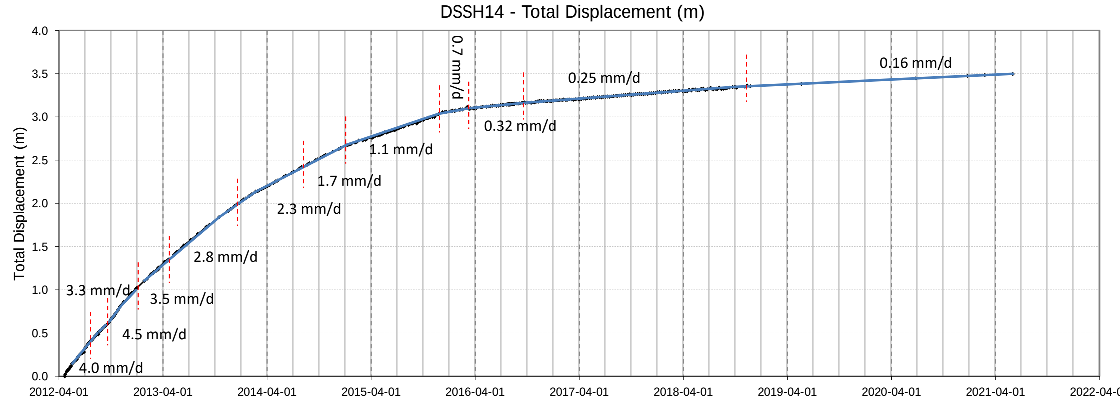
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

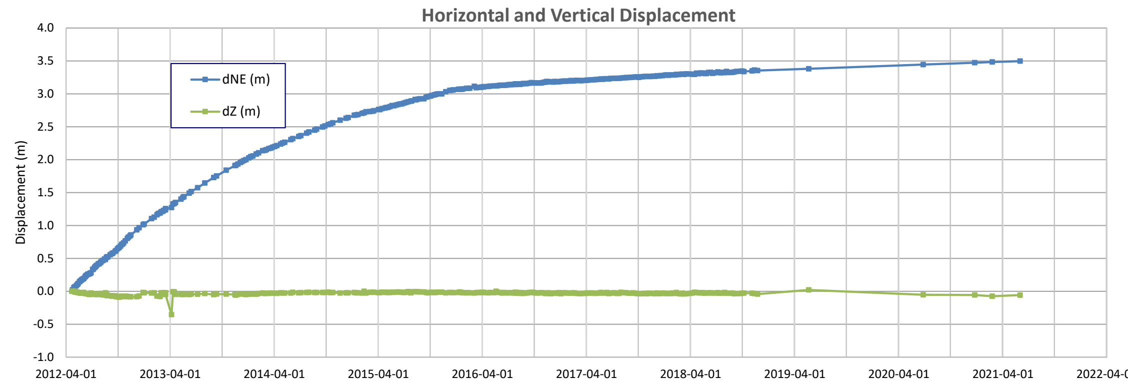
srk consulting	MINTO	DSTSF Instrumentation Data **Survey Hub – DSSH12**
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 4

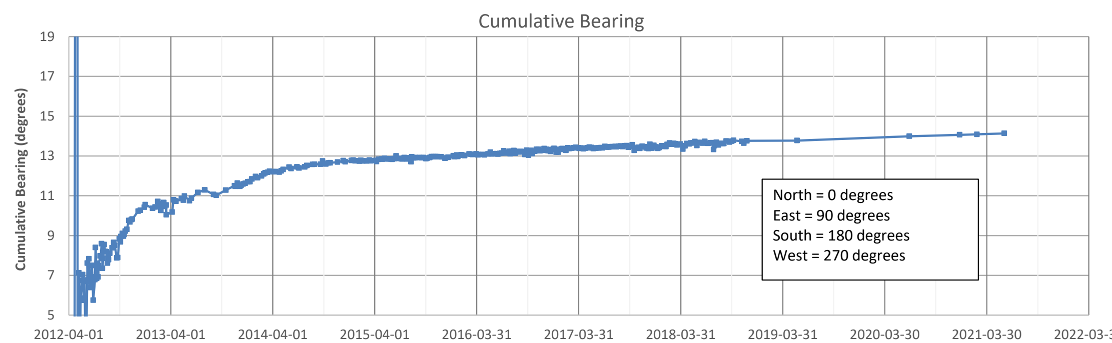
DSSH14 - Northing Vs. Easting Movement Plot







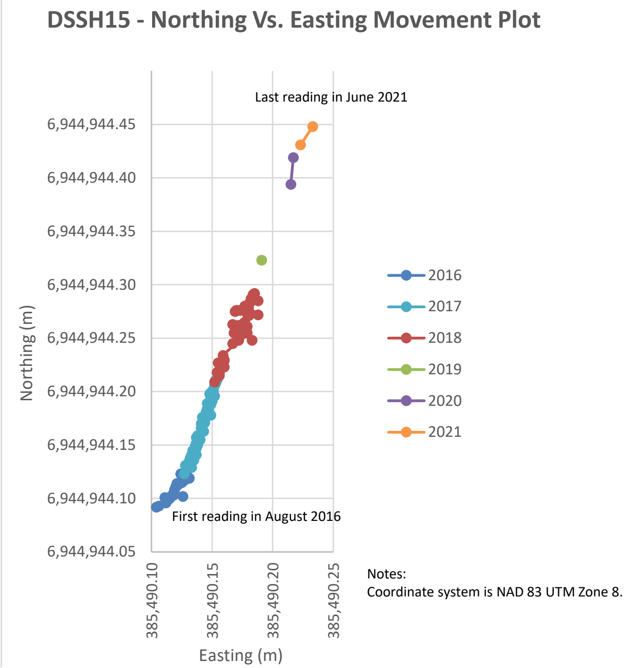


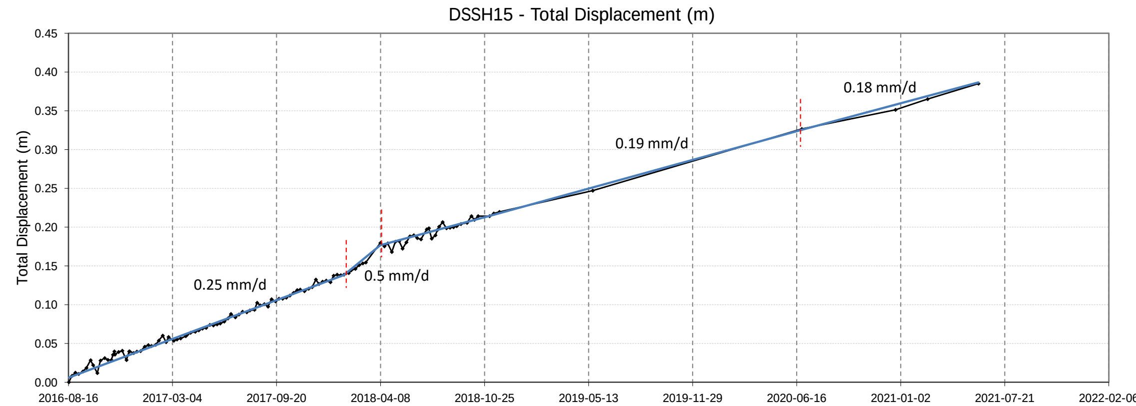


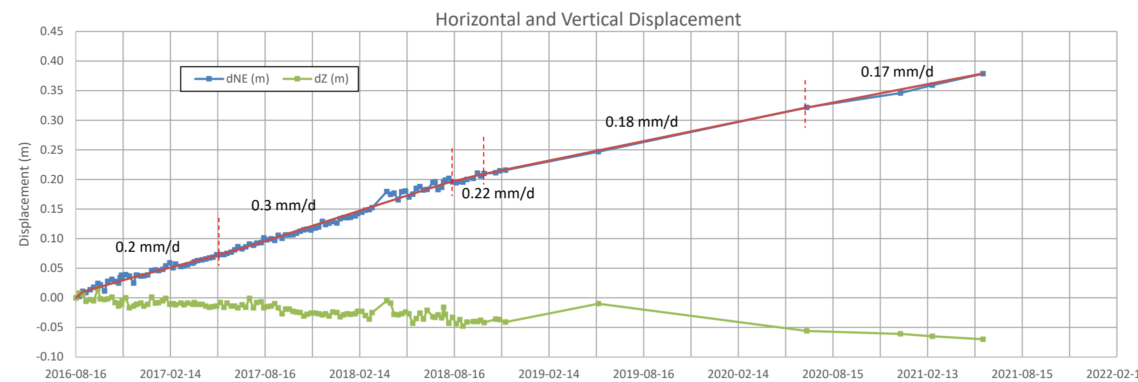
Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH14
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 5

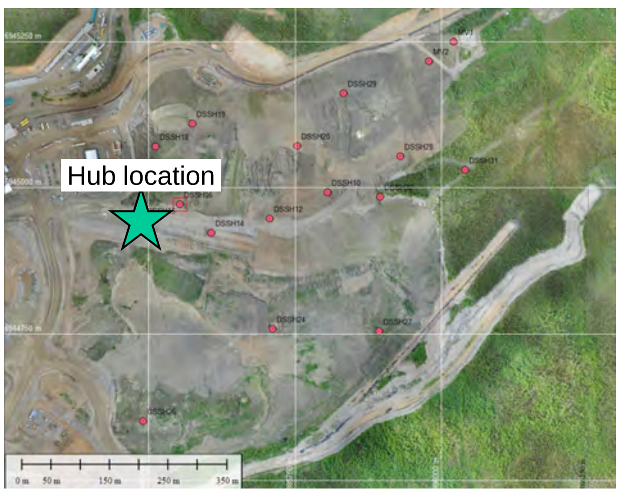


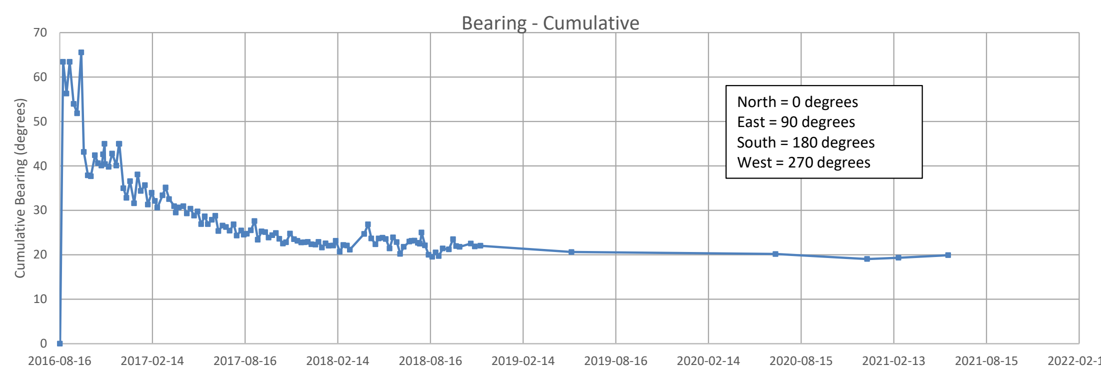




Note:

1. The survey hub was removed in February 2016 prior to MVFES2 construction. The hub was reinstalled in August 2016 following completion of construction.

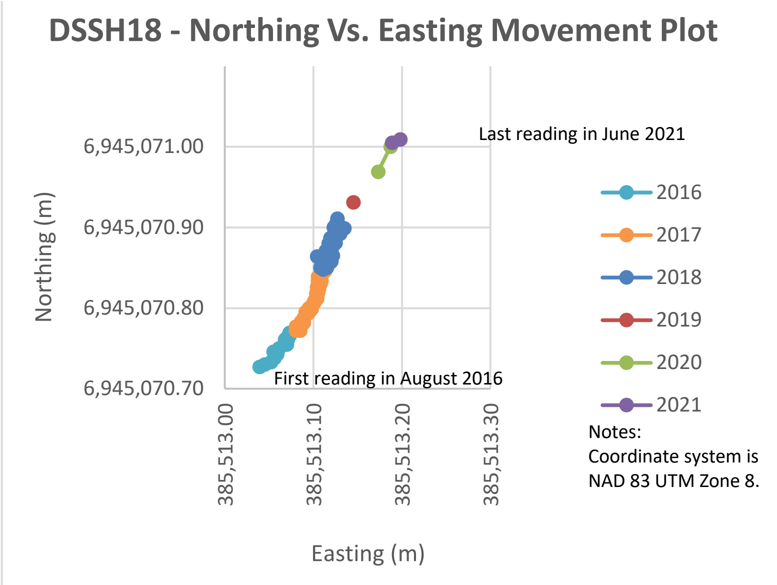


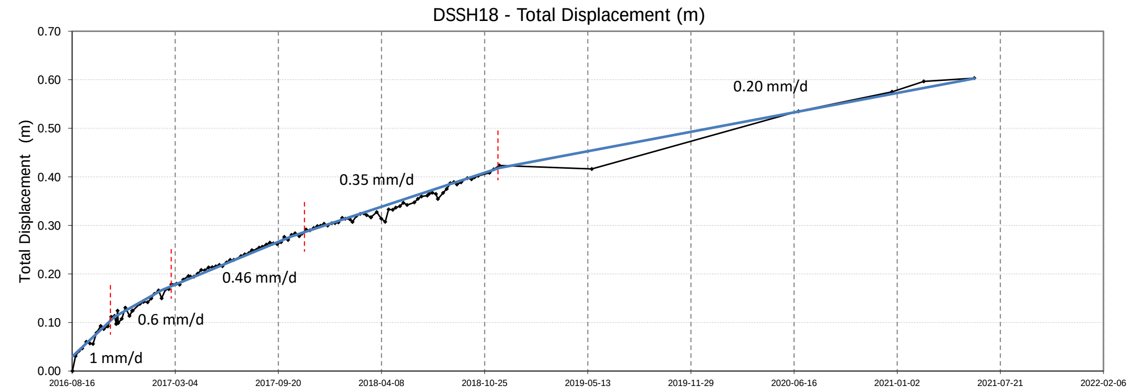


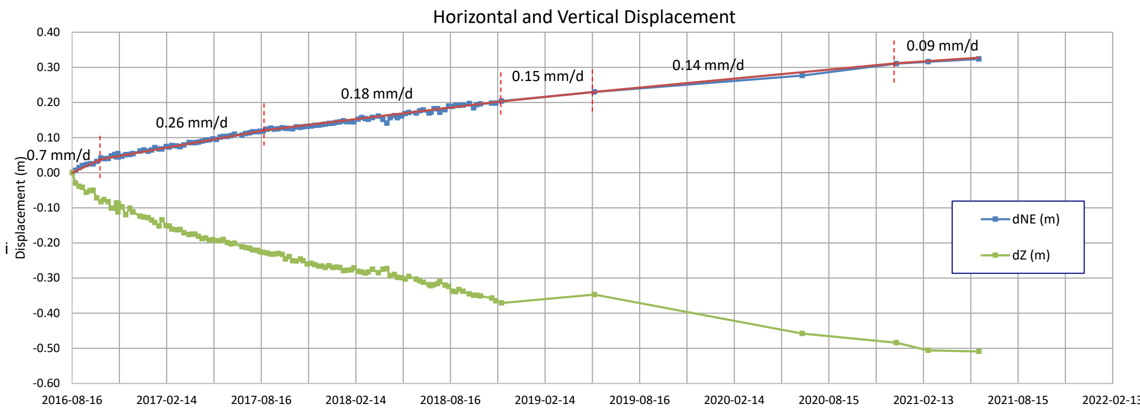
Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH15
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 6

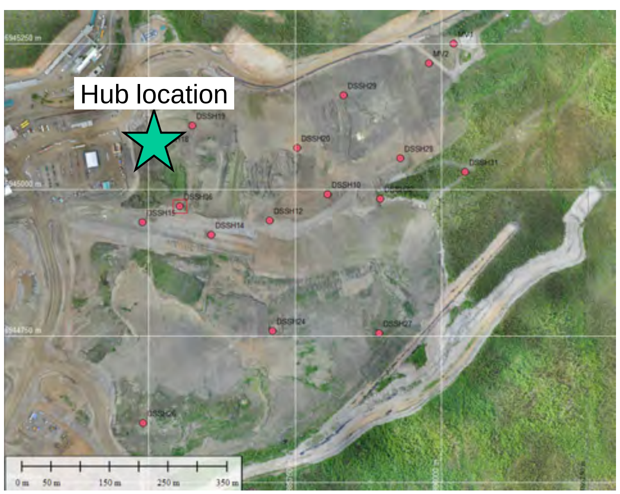


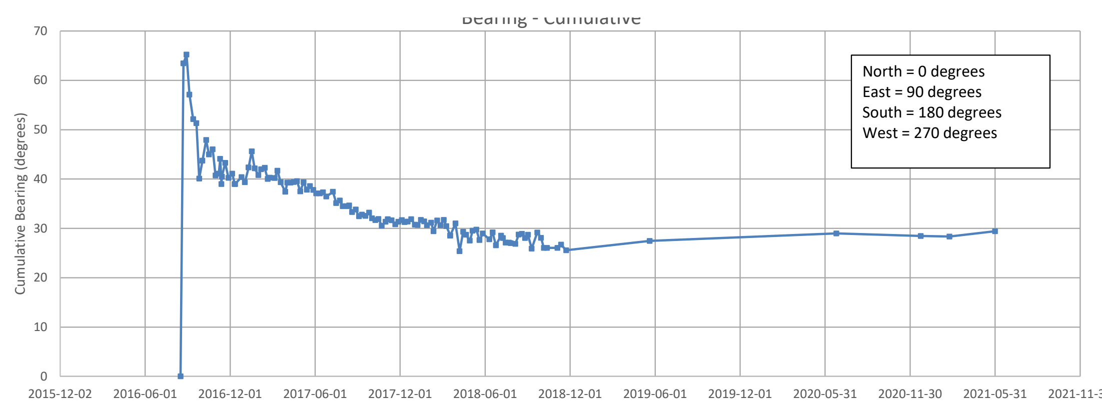




Note:

1. The survey hub was removed in December 2015 prior to MVFES2 construction. The hub was reinstalled i August 2016 following completion of construction.





Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

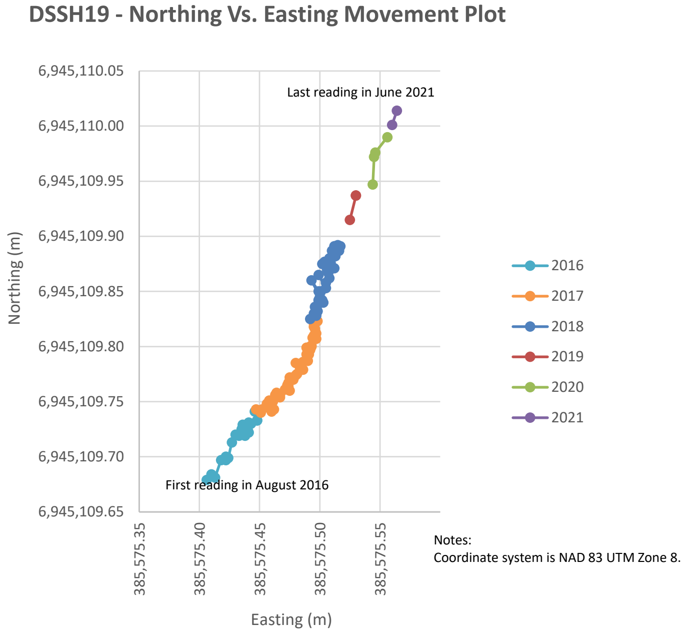
srk consulting | MINTO | DSTSF Instrumentation Data

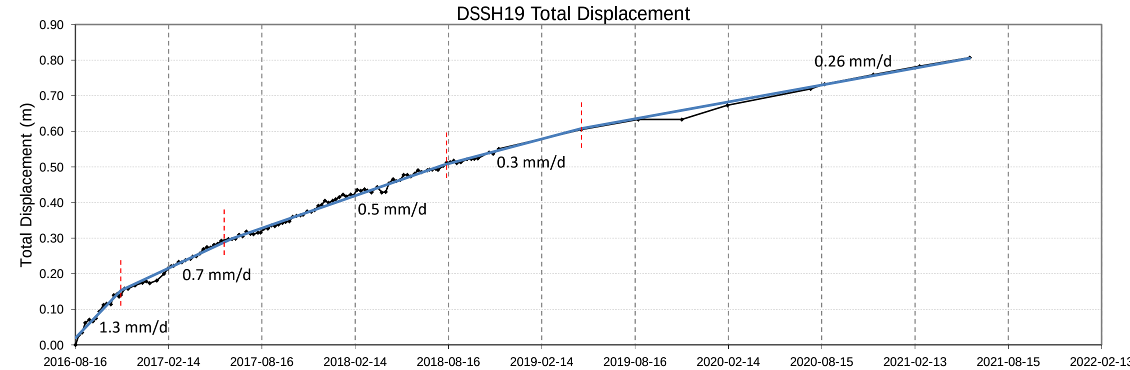
Survey Hub – DSSH18

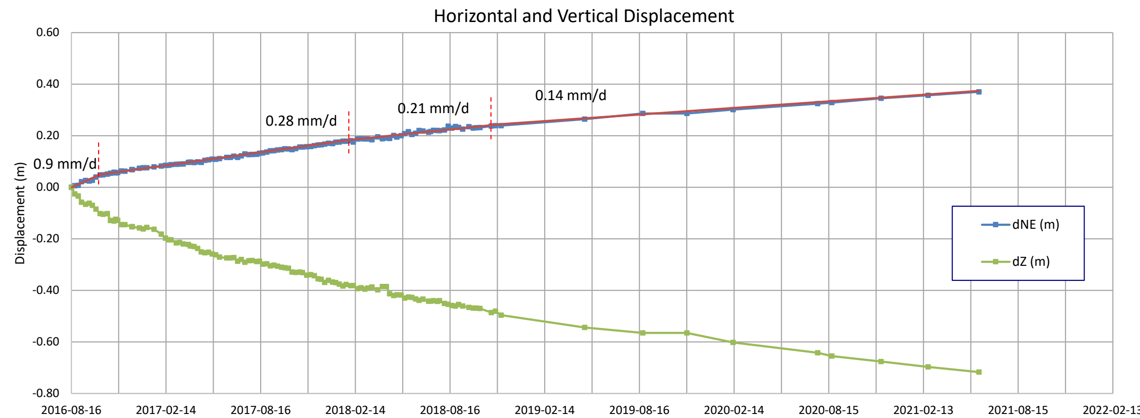
Job No: 1CM002.073
Filename: ApD_2021DSTSFLandscape.pptx

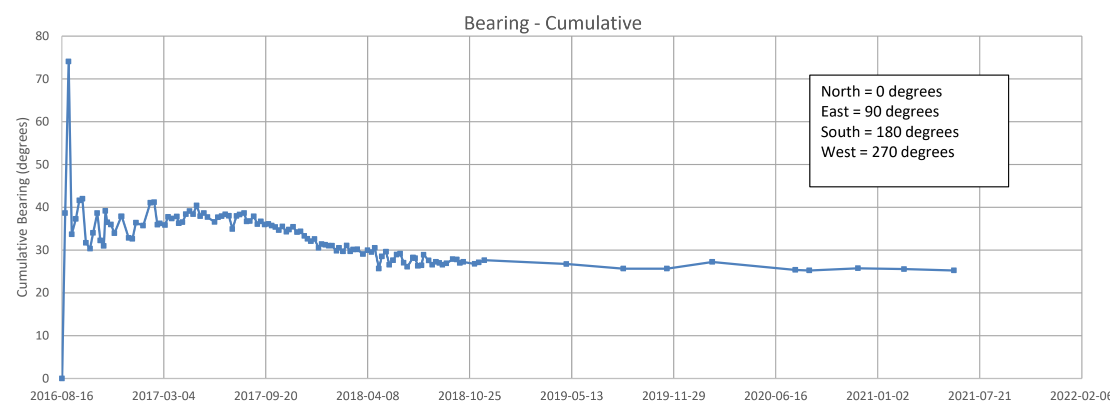
Minto Mine

Date:	Prepared by	Figure:
October 2021	PHM	7



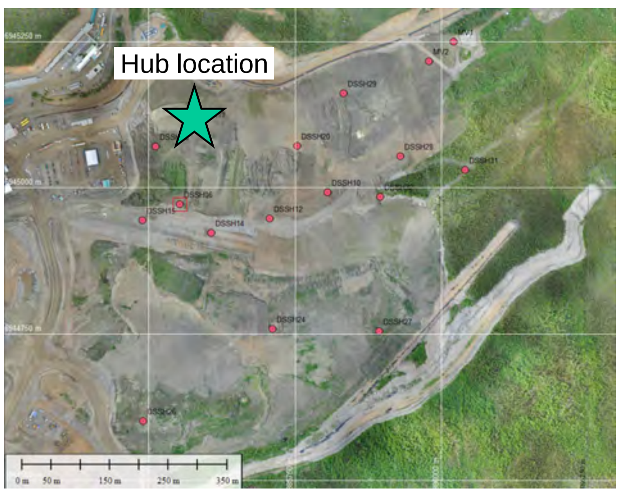






Note:

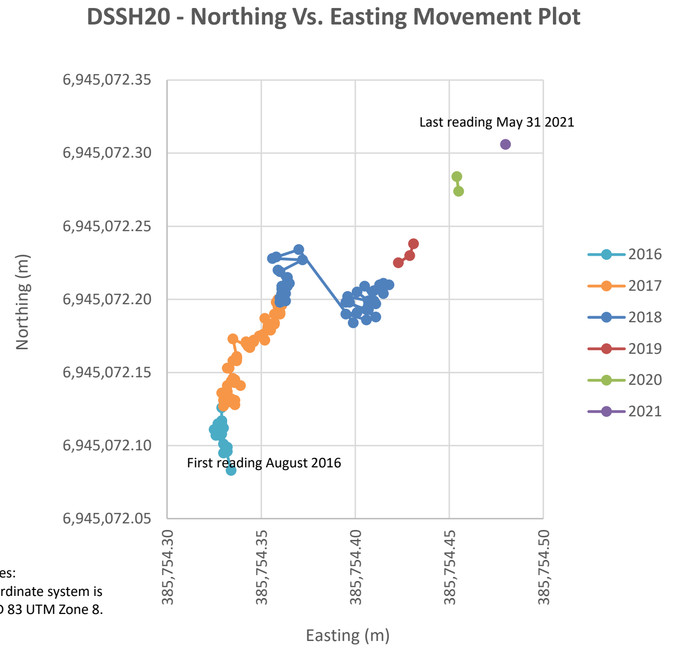
1. The survey hub was removed in December 2015 prior to MVFES2 construction. The hub was reinstalled in August 2016 following completion of construction.



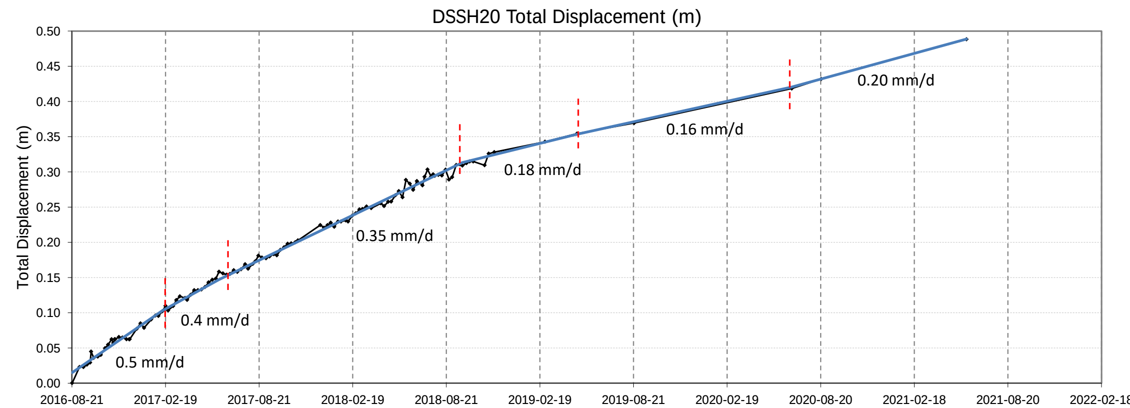
Source files:

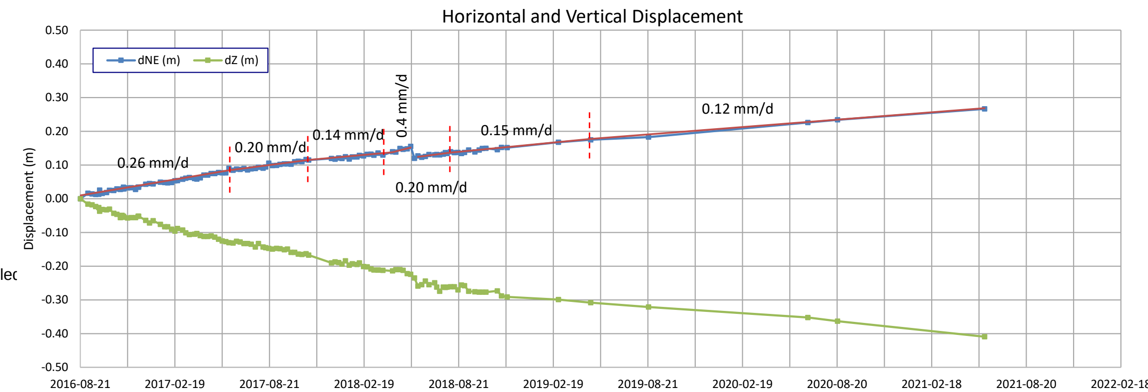
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	DSTSF Instrumentation Data **Survey Hub – DSSH19**
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by: PHM / Figure: 8



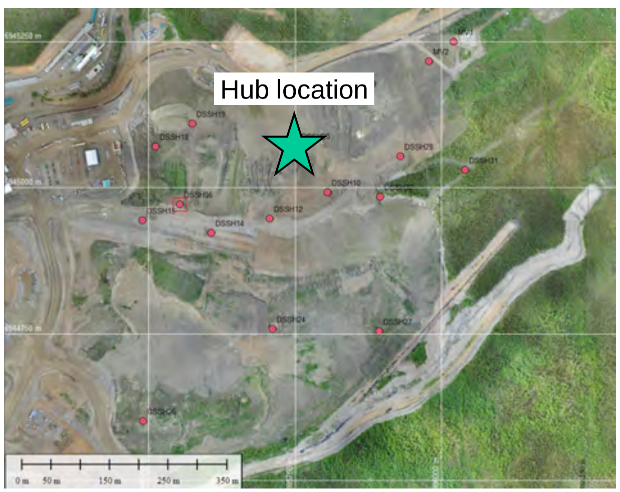
Notes:
Coordinate system is NAD 83 UTM Zone 8.

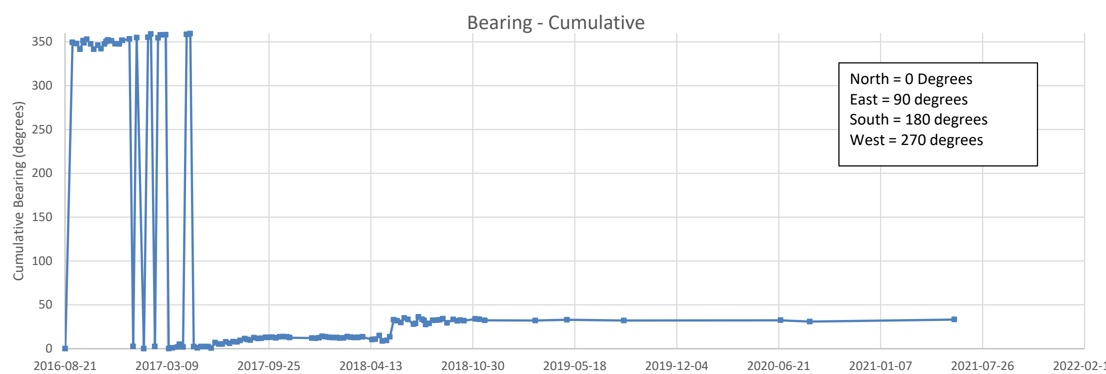




Note:

1. The survey hub was removed in December 2015 prior to MVFES2 construction. The hub was reinstalled August 2016 following completion of construction.

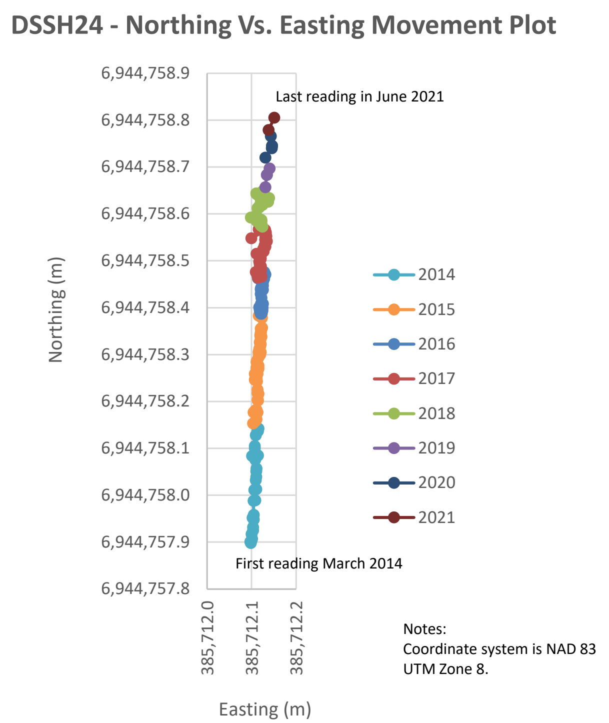


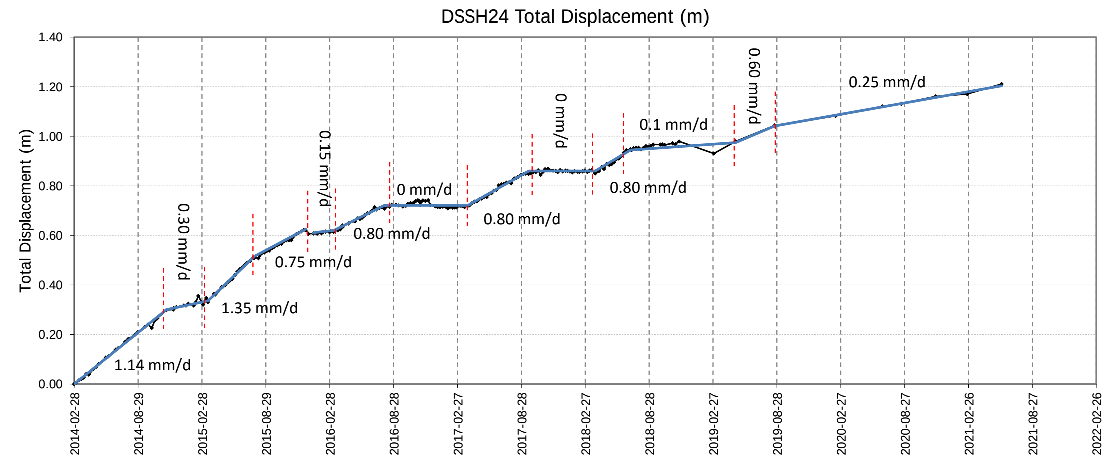


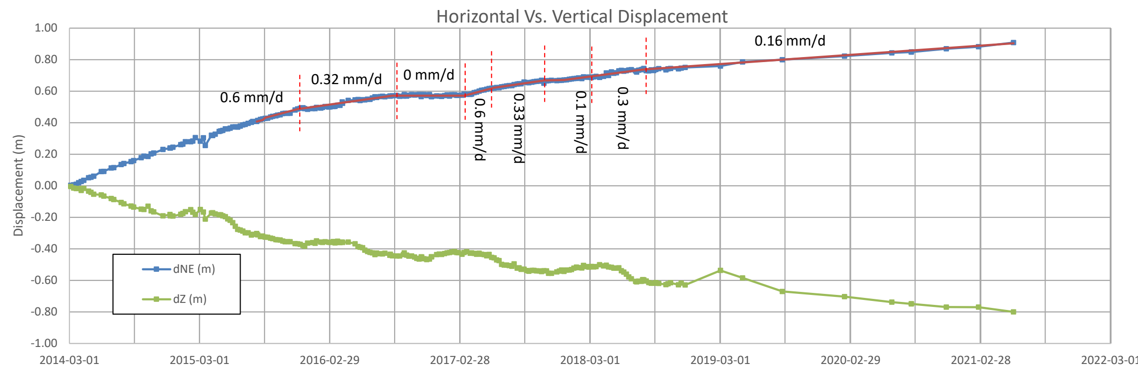
Source files:

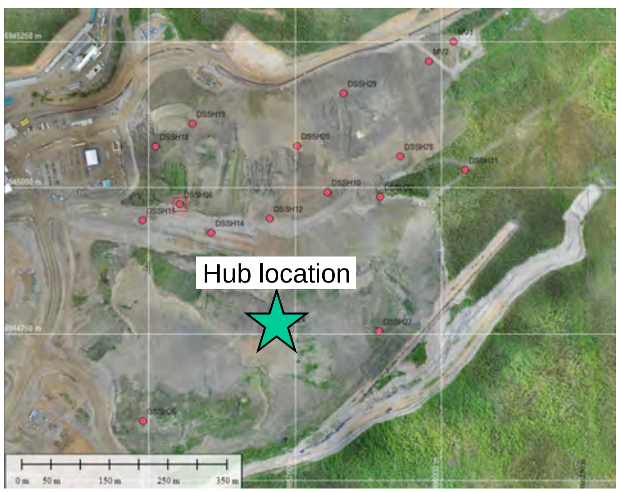
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

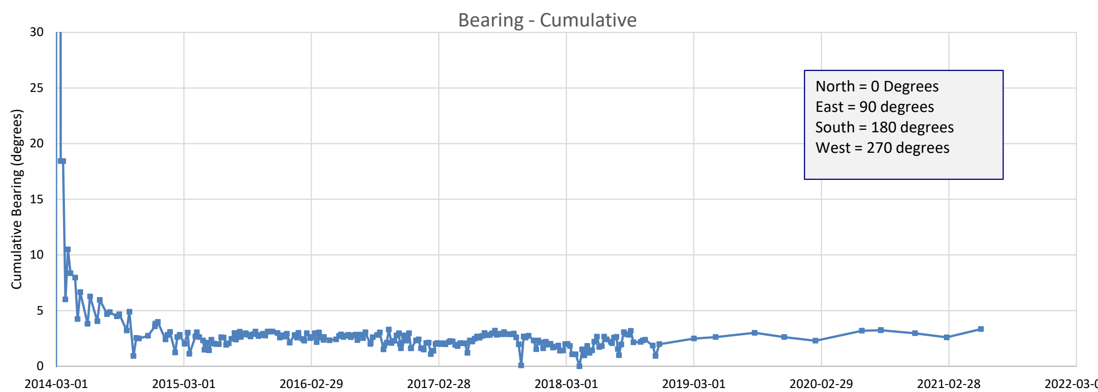
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH20
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 9









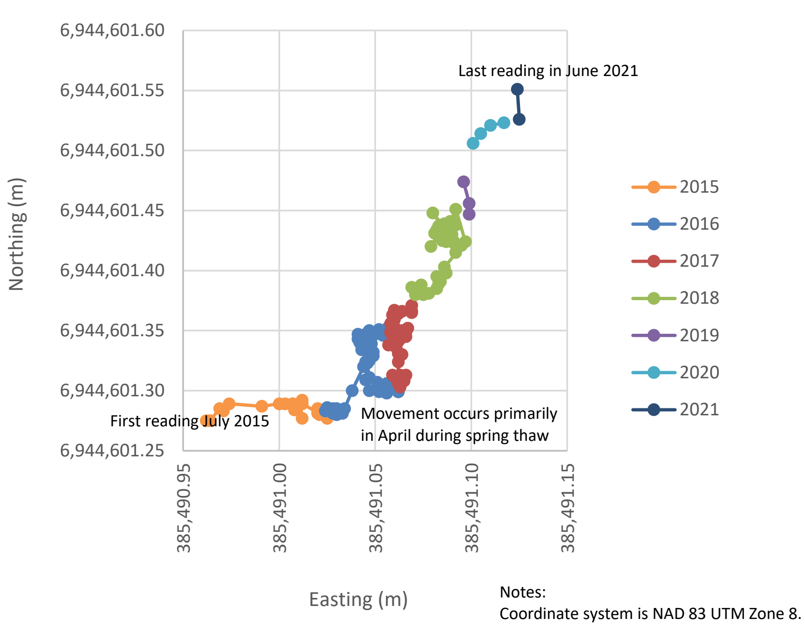


Source files:

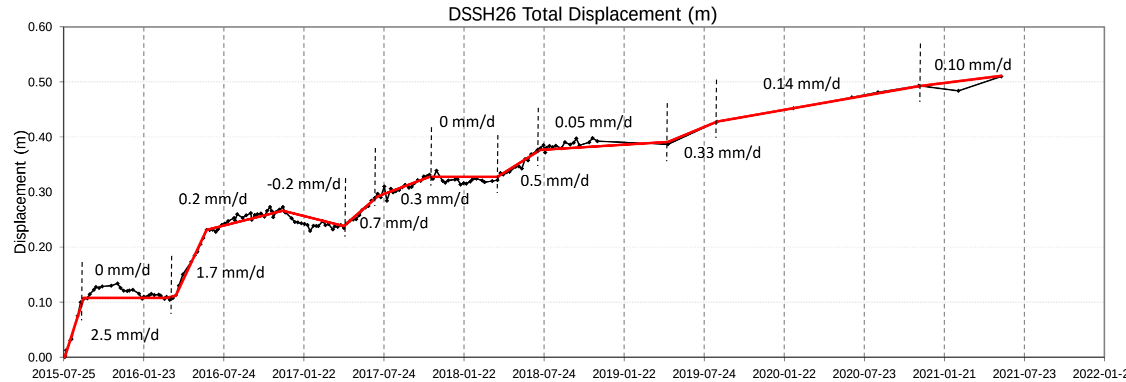
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

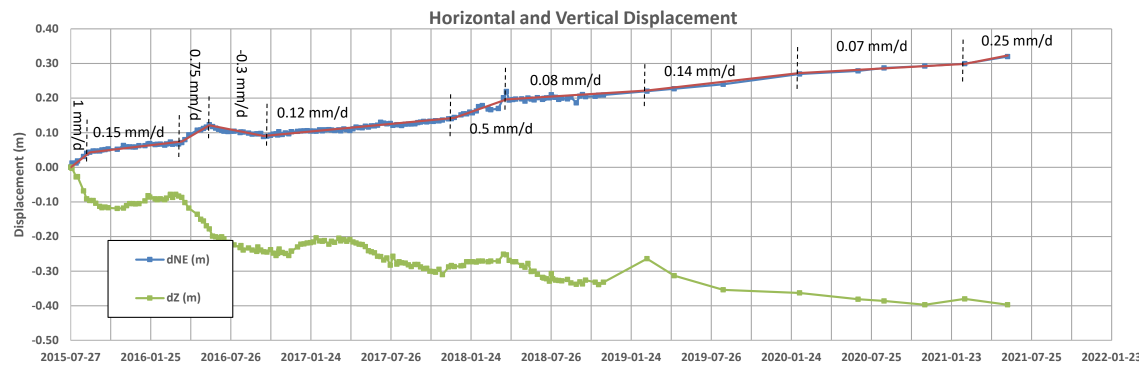
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH24
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 10

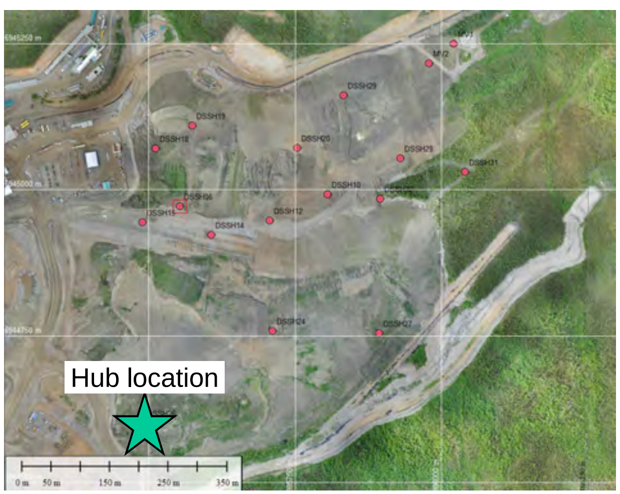
DSSH26 - Northing Vs. Easting Movement Plot

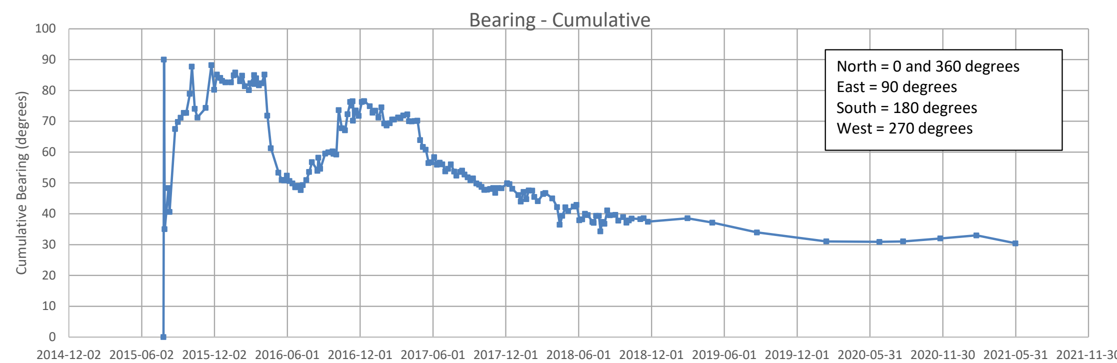


Notes:
Coordinate system is NAD 83 UTM Zone 8.





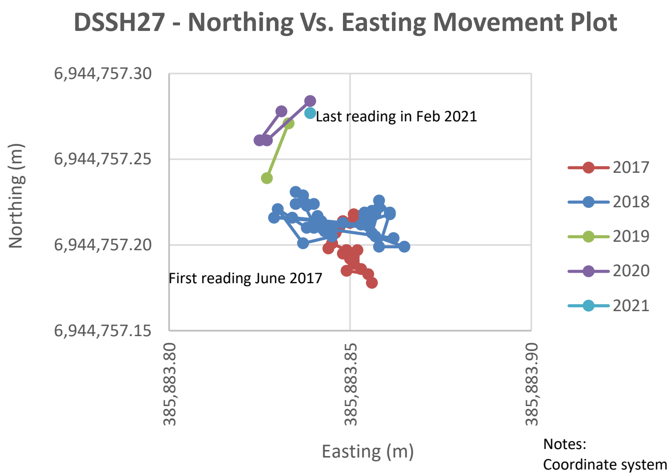




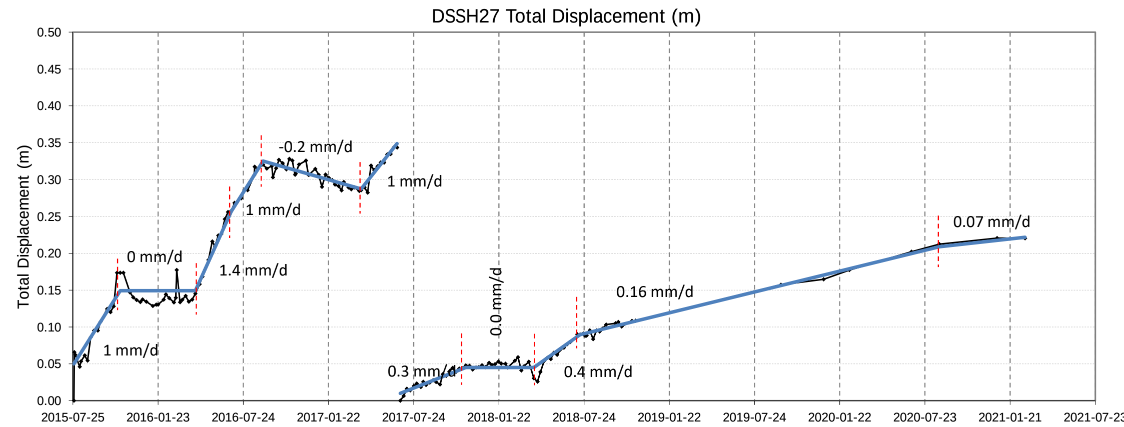
Source files:

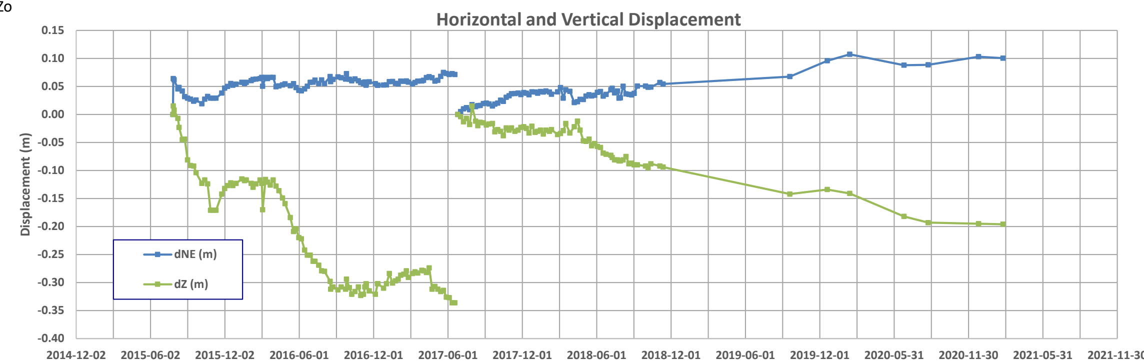
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

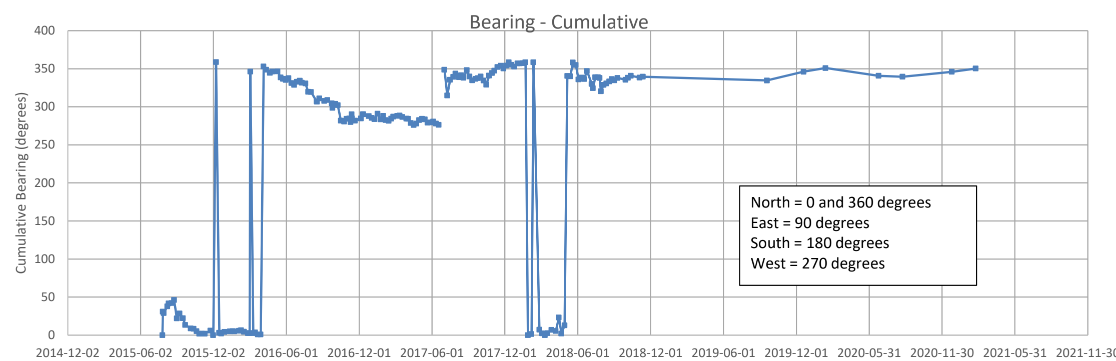
srk consulting	MINTO	DSTSF Instrumentation Data **Survey Hub – DSSH26**
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 · Prepared by: PHM · Figure: **11**



Notes:
Coordinate system is NAD 83 UTM Zo

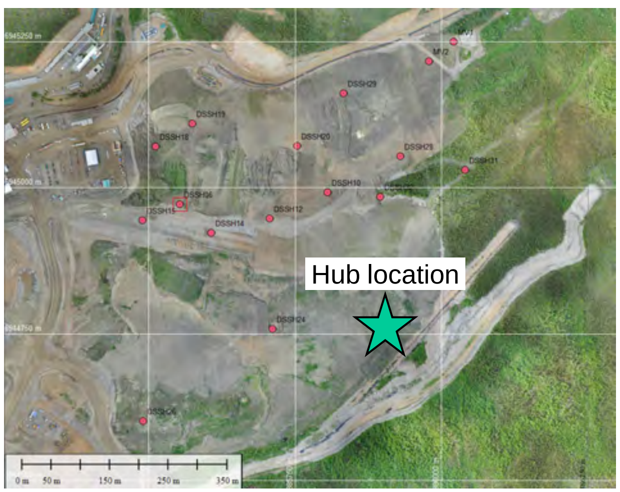






Note:

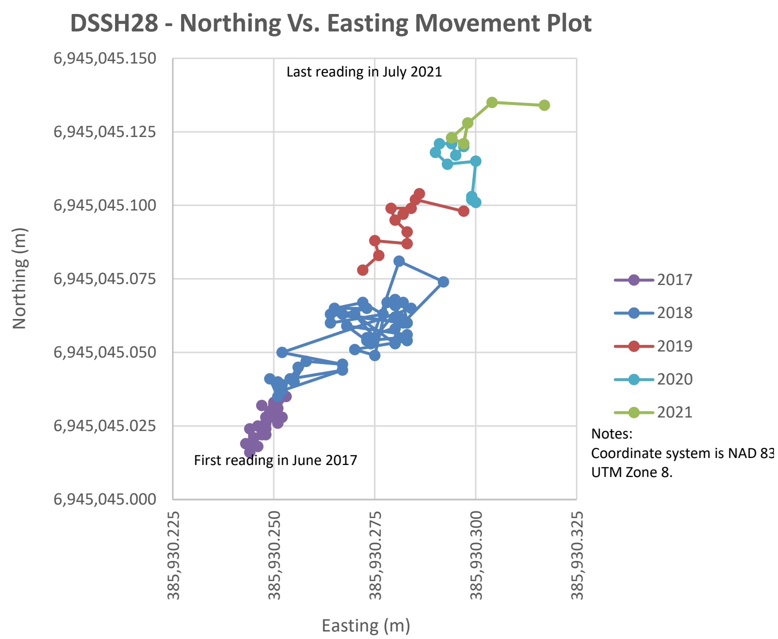
1. The survey hub was repositioned in June 2017.

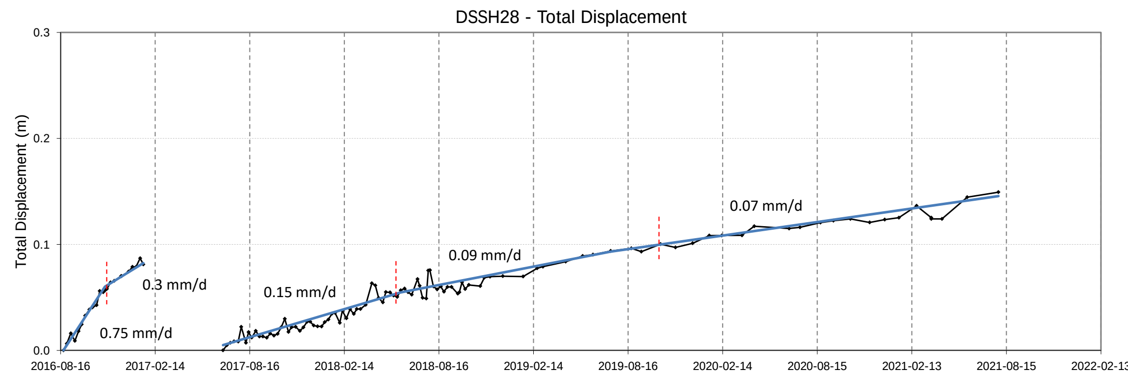


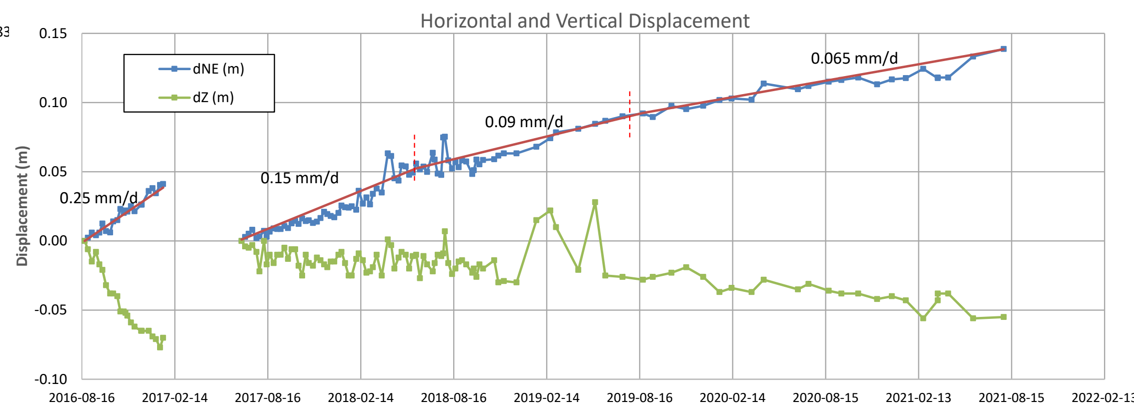
Source files:

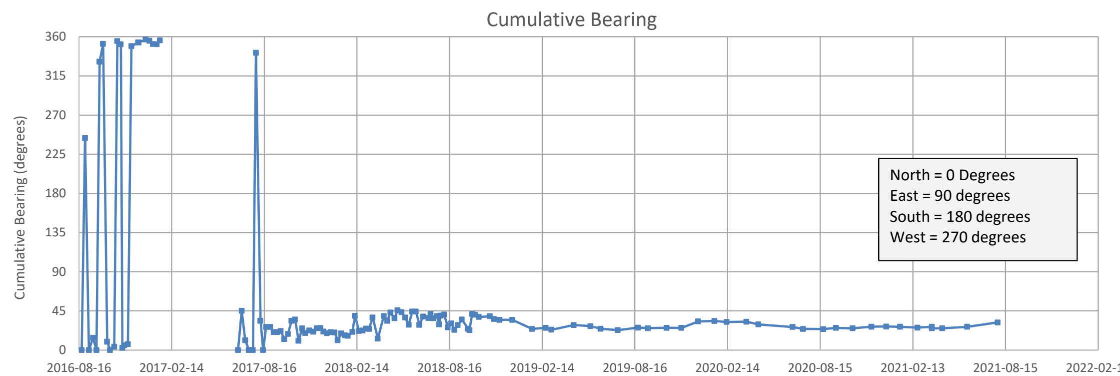
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

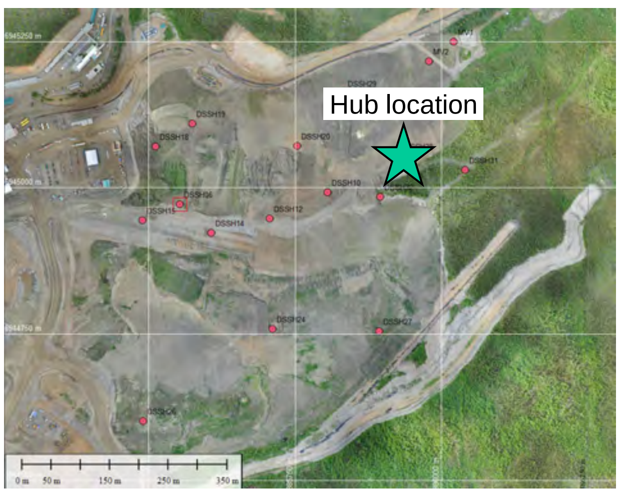
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH27
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 12









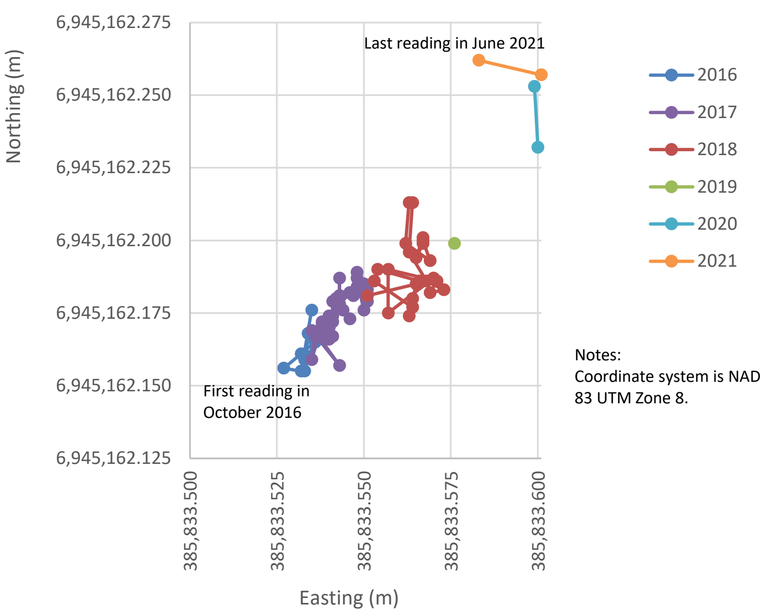


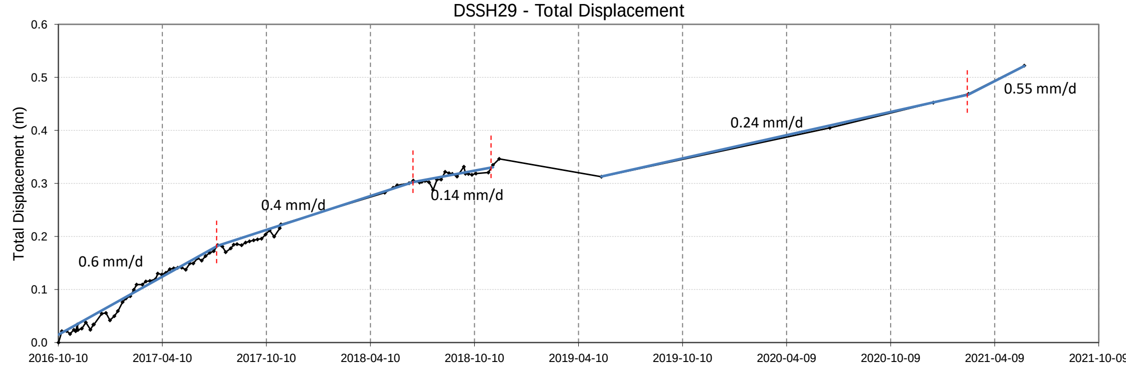
Source files:

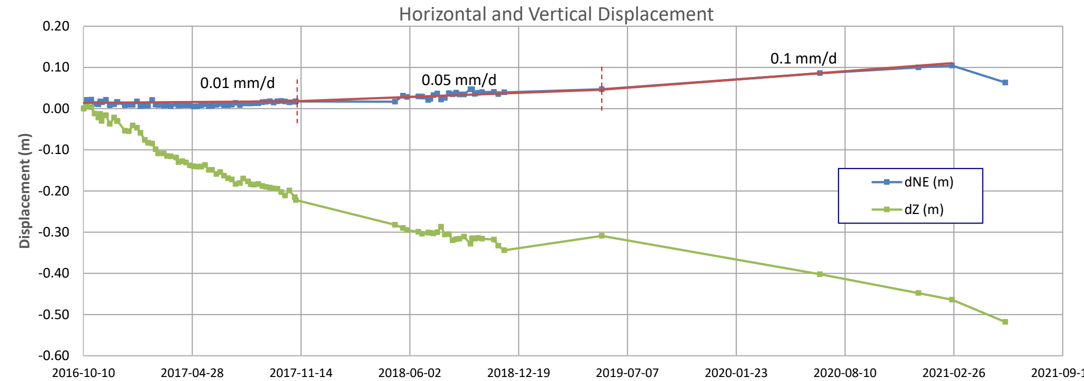
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

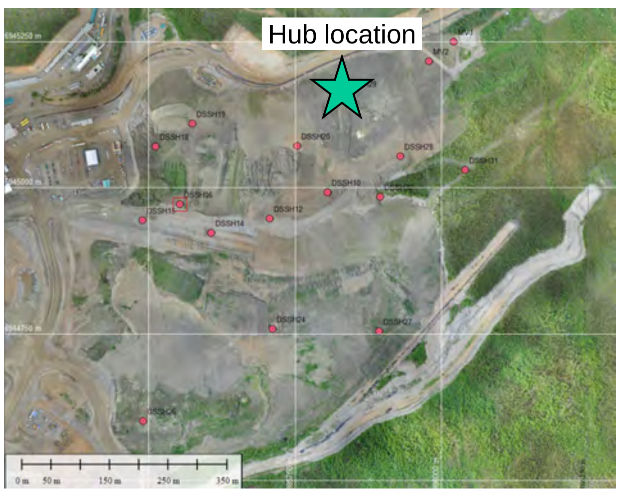
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH28
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 13

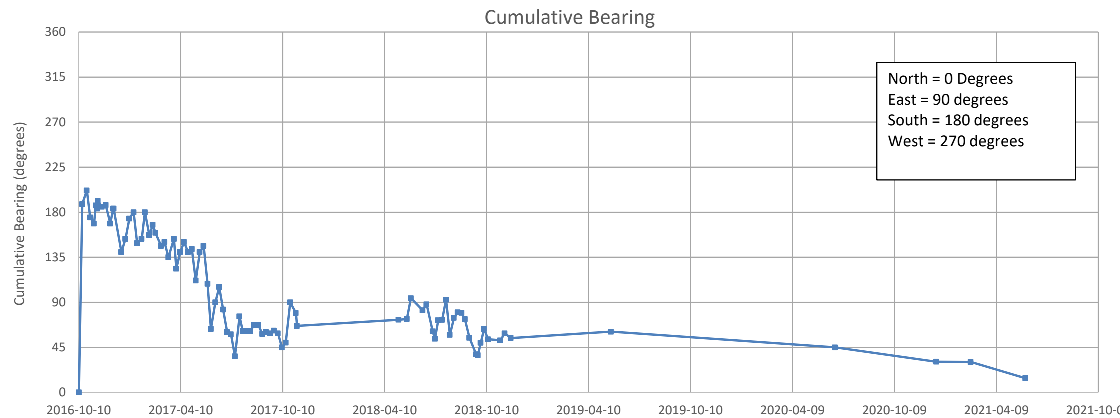
DSSH29 - Northing Vs. Easting Movement Plot







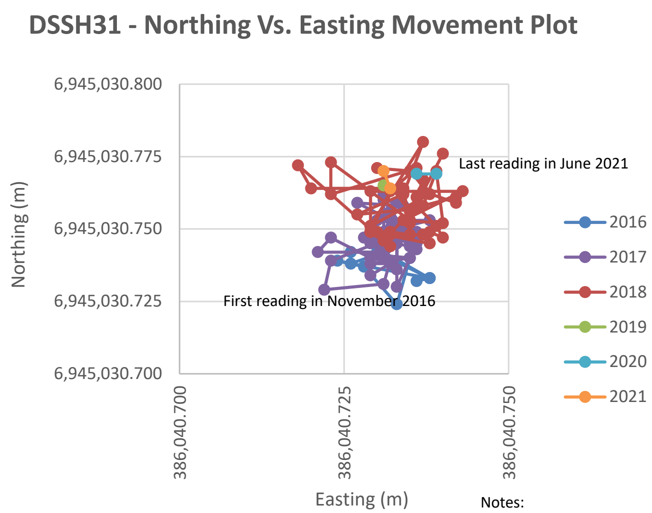




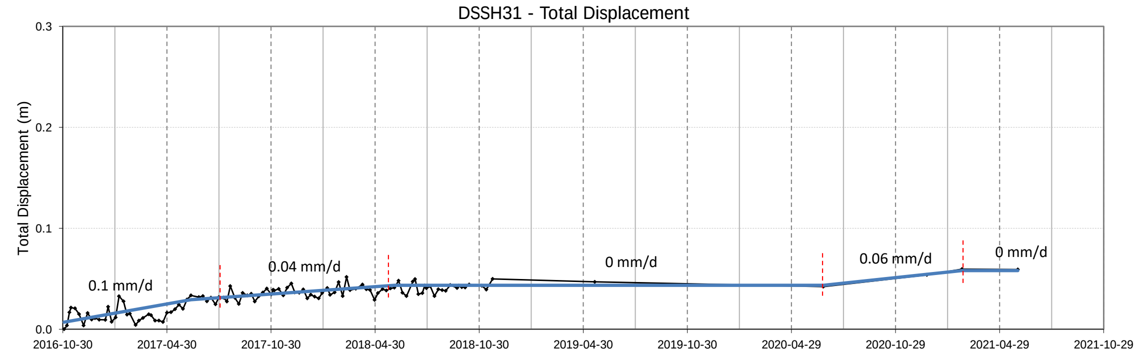
Source files:

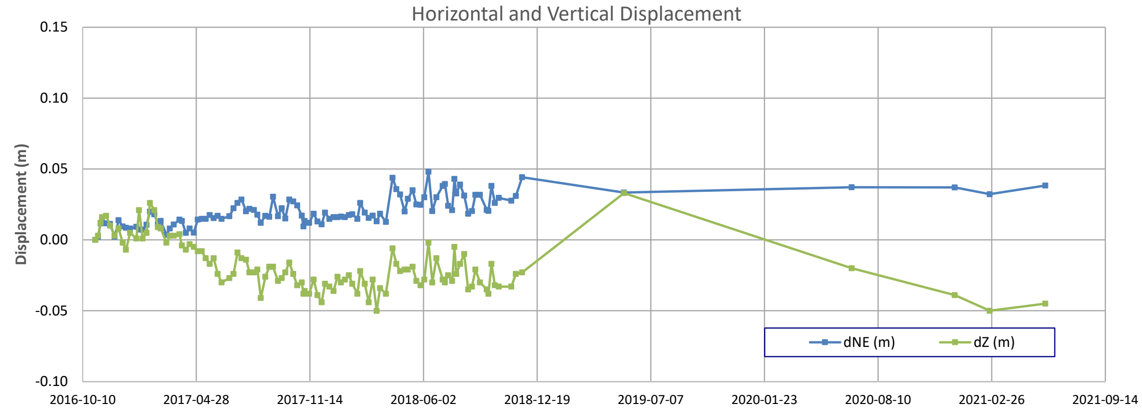
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

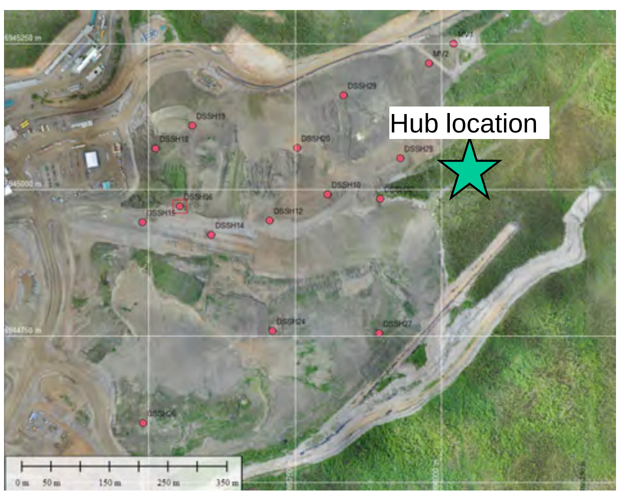
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH29
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: **14**

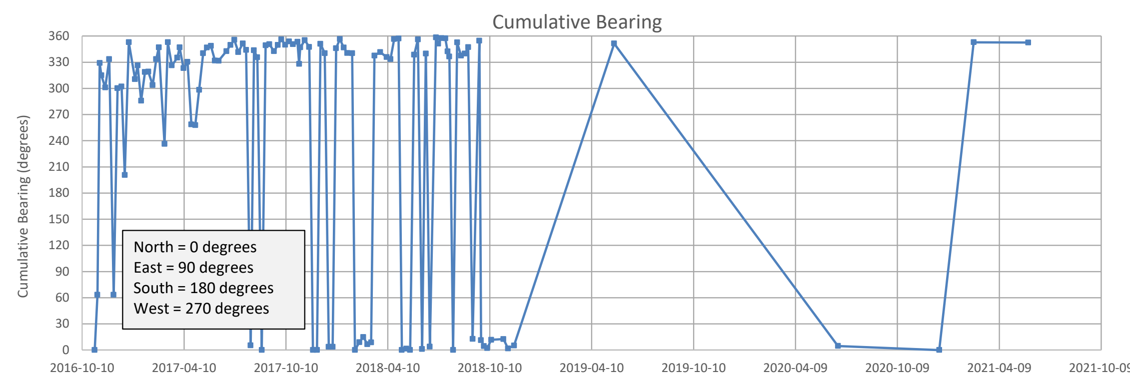


Notes:
Coordinate system is NAD 83 UTM Zone 8.







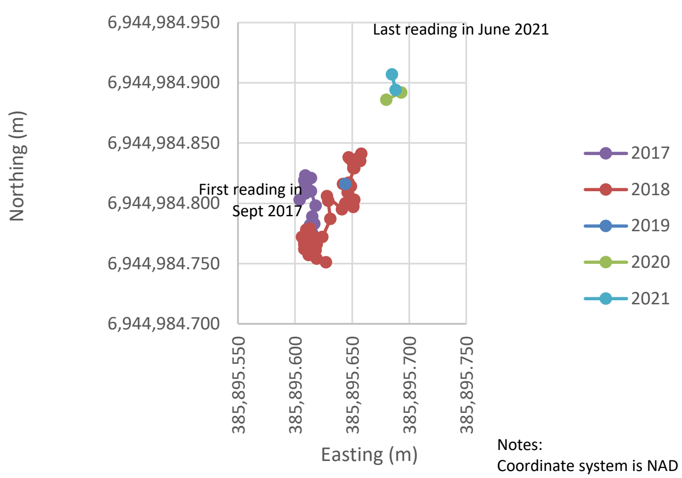


Source files:

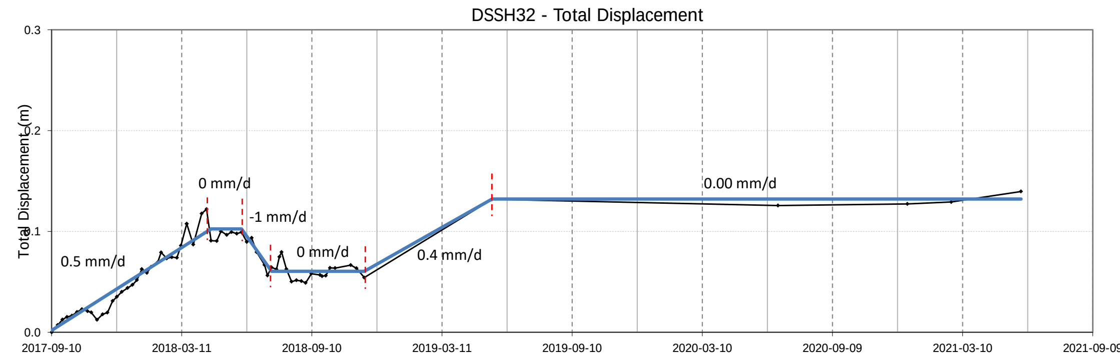
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

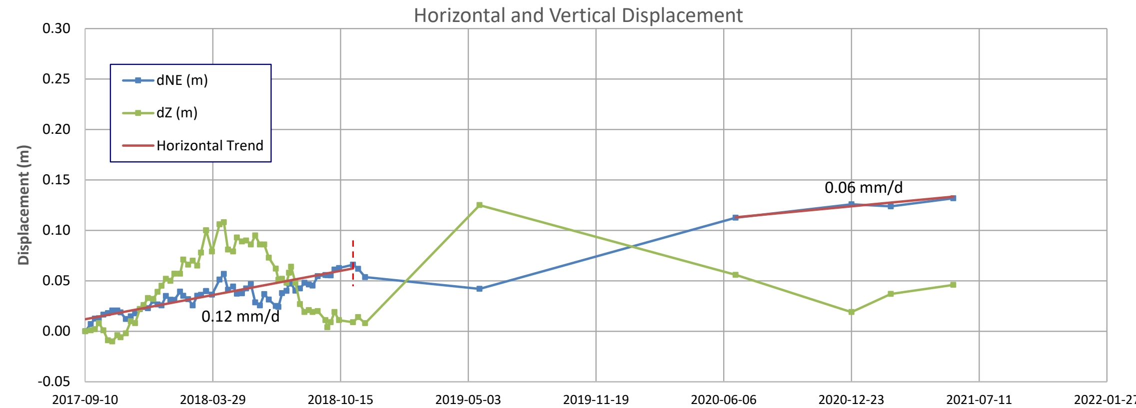
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH31
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: **15**

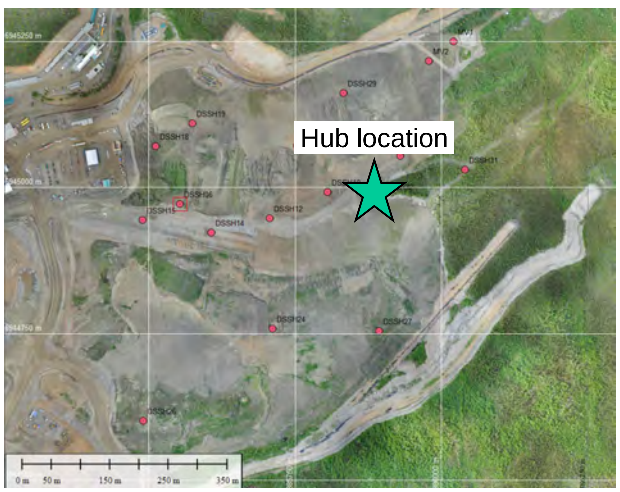
DSSH32 - Northing Vs. Easting Movement Plot

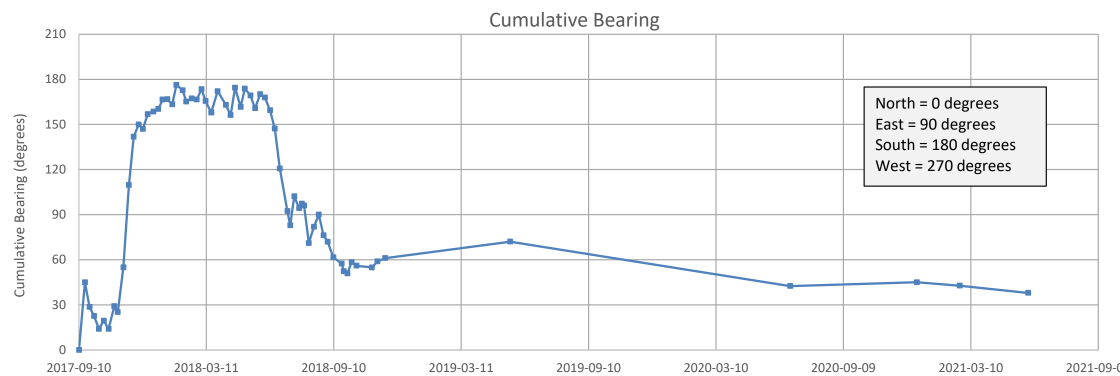


Notes:
Coordinate system is NAD 83 UTM Zone 8.





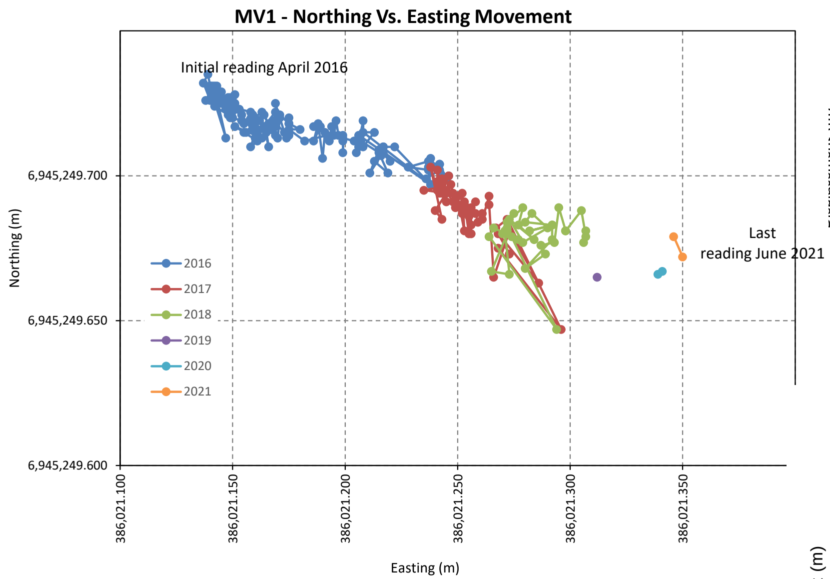


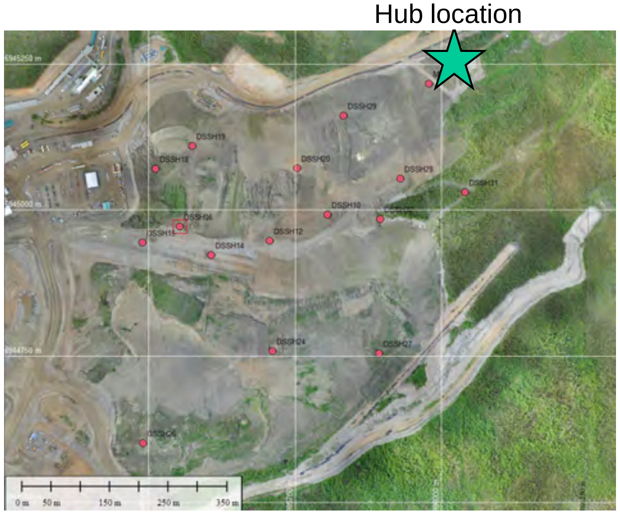


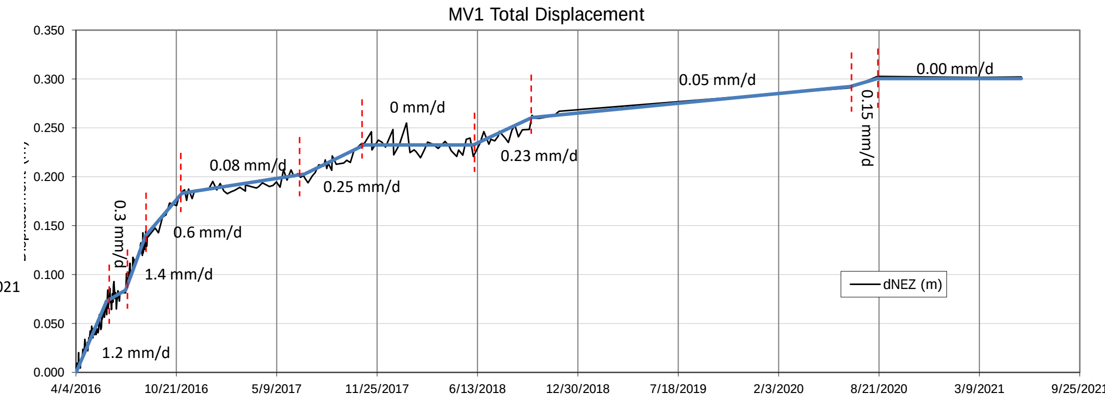
Source files:

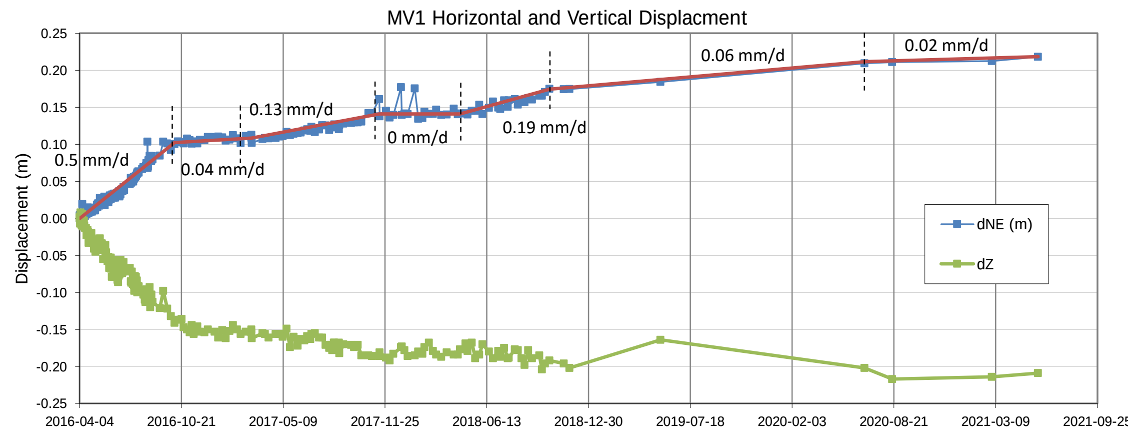
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

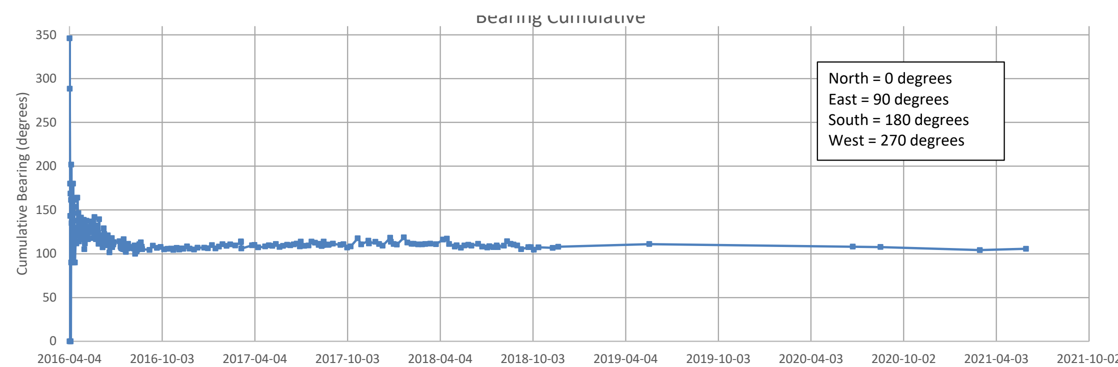
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hub – DSSH32
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 | Prepared by PHM | Figure: **16**











Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting

MINTO

DSTSF Instrumentation Data

Survey Hub – MV1

Job No: 1CM002.073

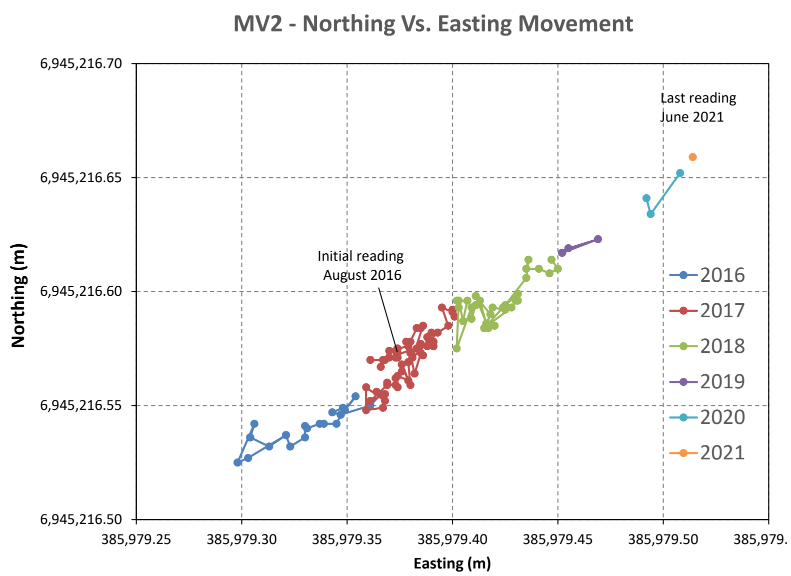
Filename: ApD_2021DSTSFLandscape.pptx

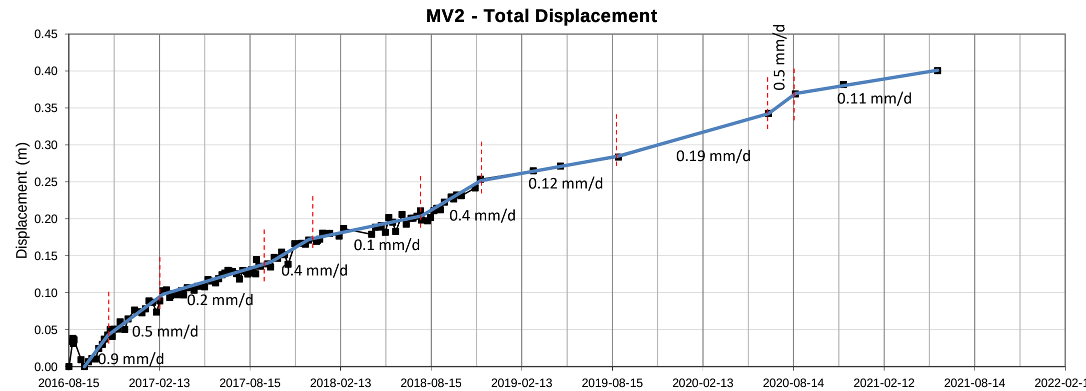
Minto Mine

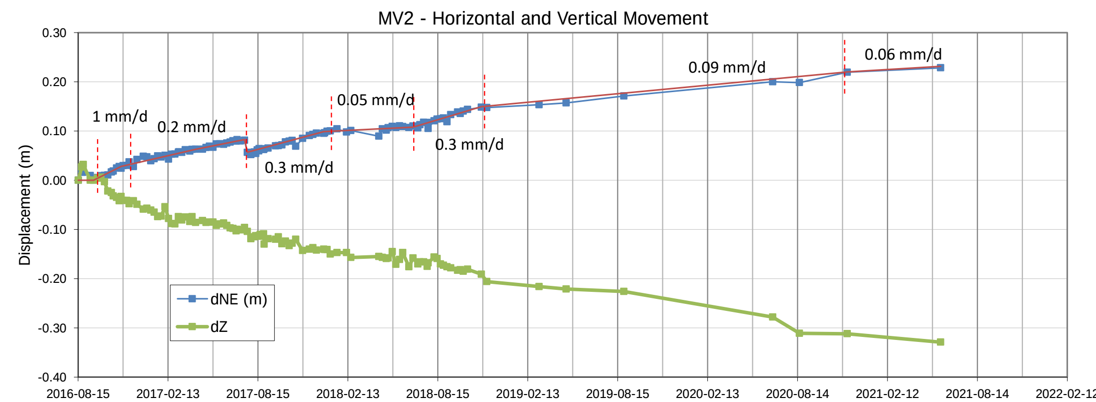
Date: October 2021

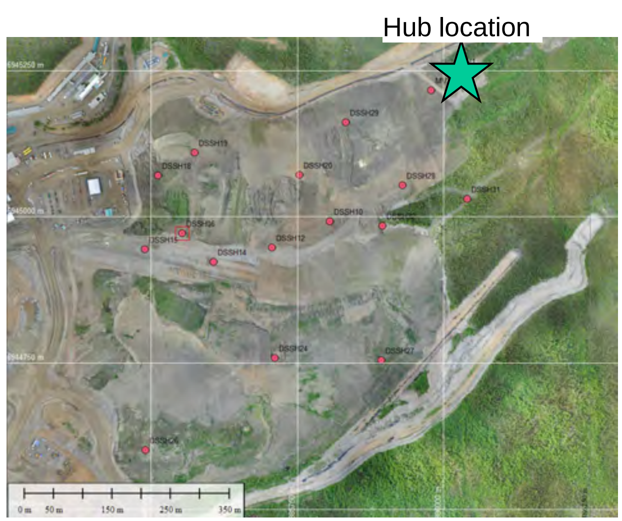
Prepared by PHM

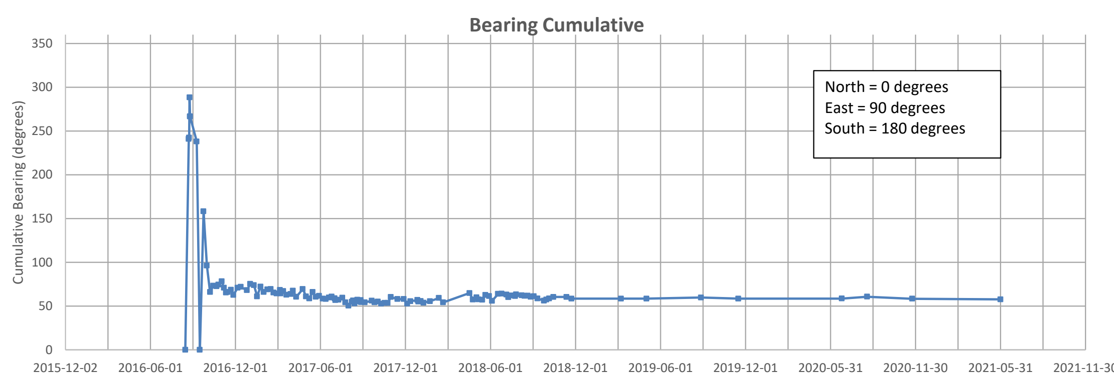
Figure: 17











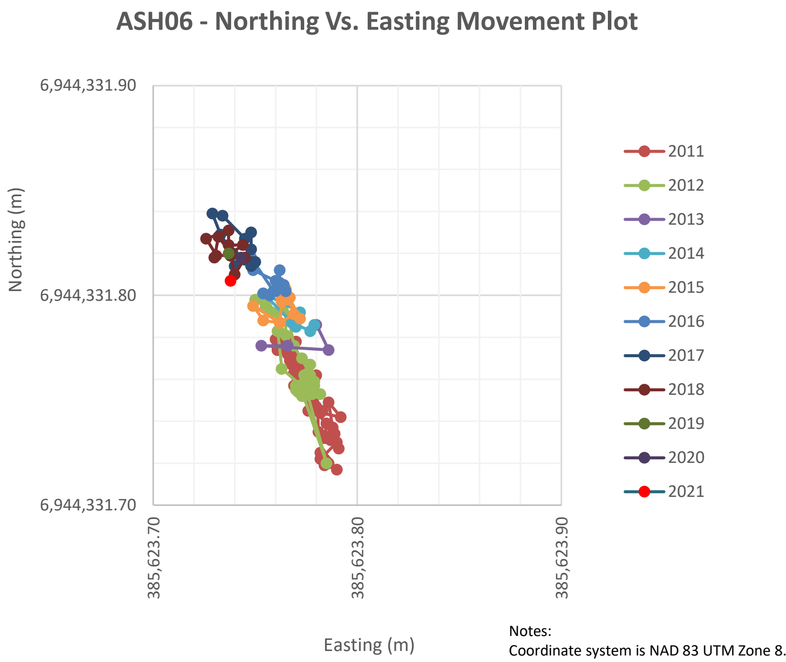
Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

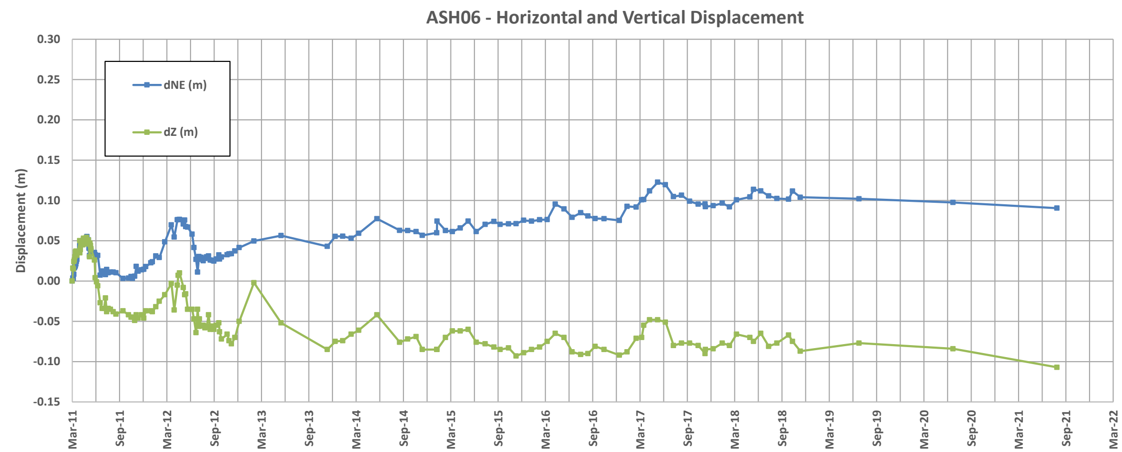
srk consulting

MINTO

Job No: 1CM002.073	Minto Mine	DSTSF Instrumentation Data
Filename: ApD_2021DSTSFLandscape.pptx		**Survey Hub – MV2**
		Date: October 2021 / Prepared by PHM / Figure: **18**

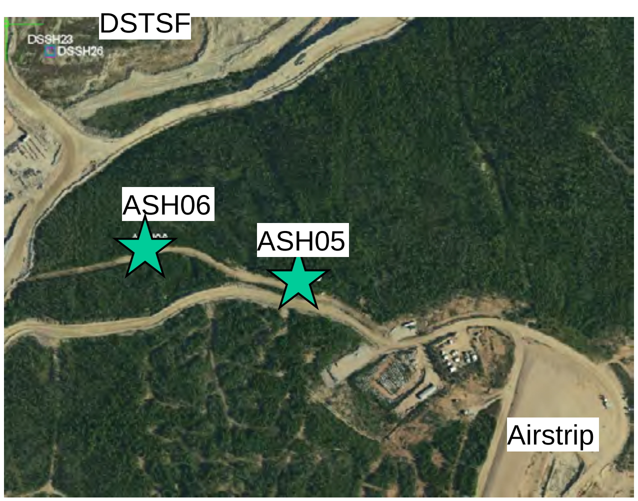


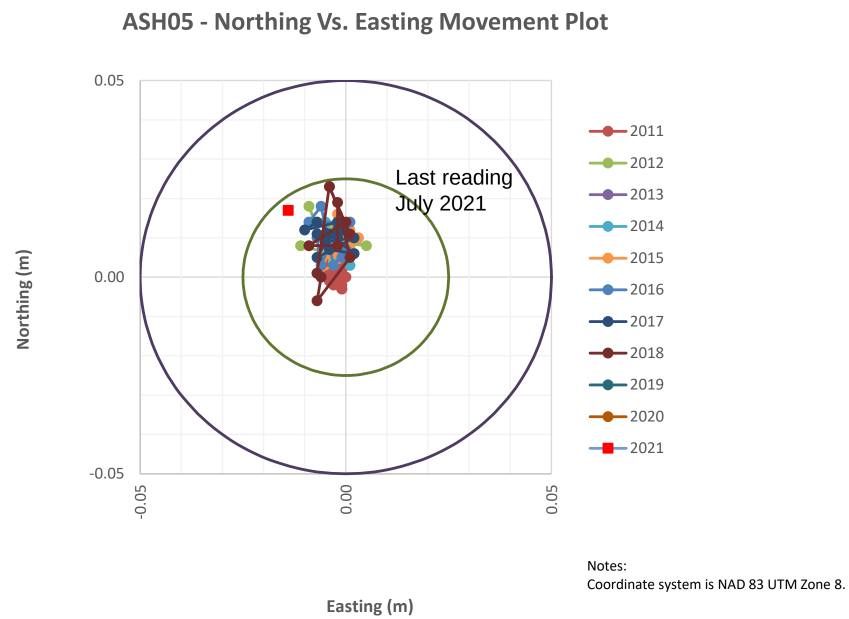
Notes:
Coordinate system is NAD 83 UTM Zone 8.



Notes:

1. Minto's survey reading comments on January 14, 2017 notes ASH06 may have been disturbed as a result of a pipeline installation.



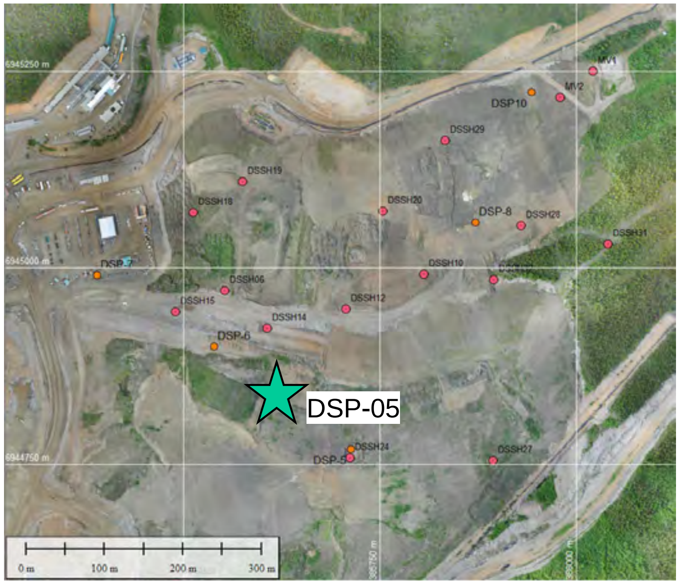


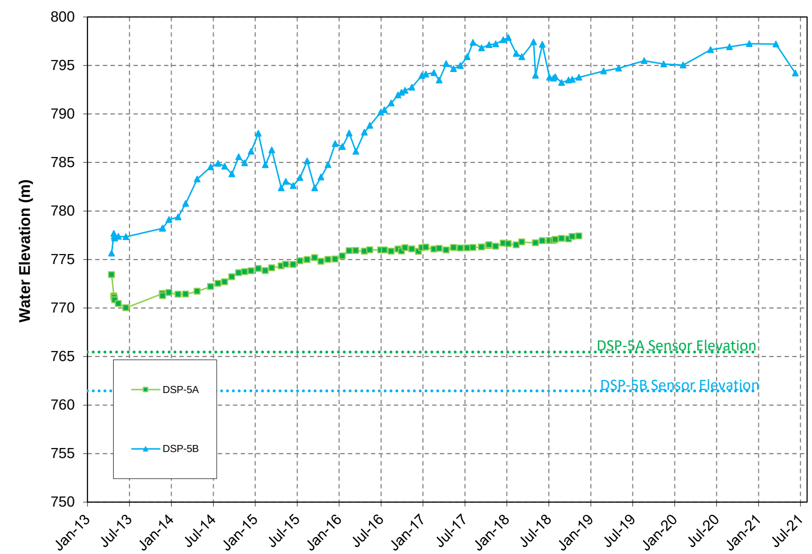
Notes:
Coordinate system is NAD 83 UTM Zone 8.

Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

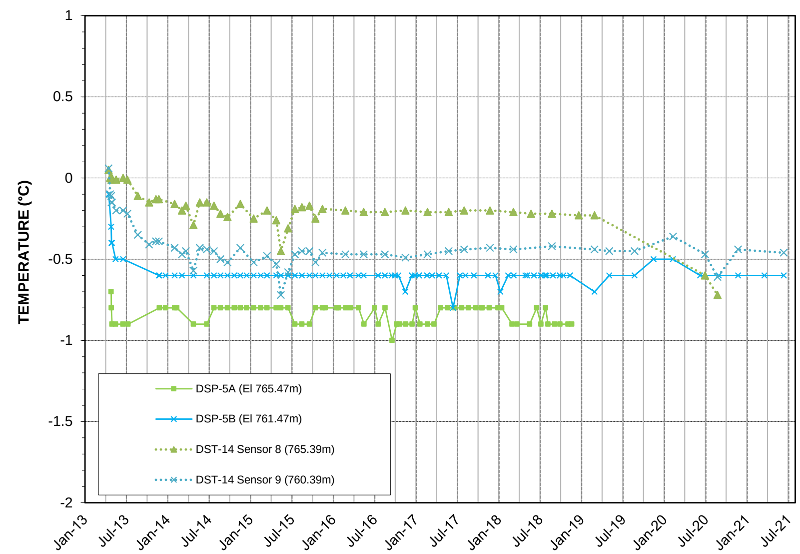
srk consulting	MINTO	DSTSF Instrumentation Data
		Survey Hubs – ASH05 and ASH06
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 19





Notes:

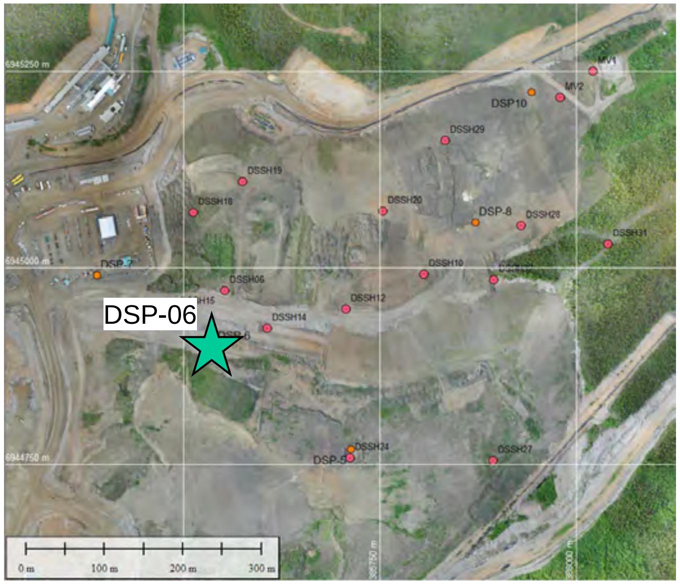
1. The pore pressure sensors at DSP-05 are located approximately 2 m above original ground in tailings (A) and 2 m below original ground.
2. The bottom sensor at DSP-05 (B) shows an increase in pore pressure that peaked in 2018, and is since fluctuating between 793 and 797 m. The sensor is located in an area of silt with stratified ice lenses and the temperature at the sensor is near the freezing point of water -0.6°. The temperature plot also shows thermistor data from nearby ground temperature cable DST-14 for sensors at similar elevations.
3. Sensors at DSP-05A also shows gradual increasing pore pressure trend, with the sensor becoming malfunctional in February 2019.



Source files:

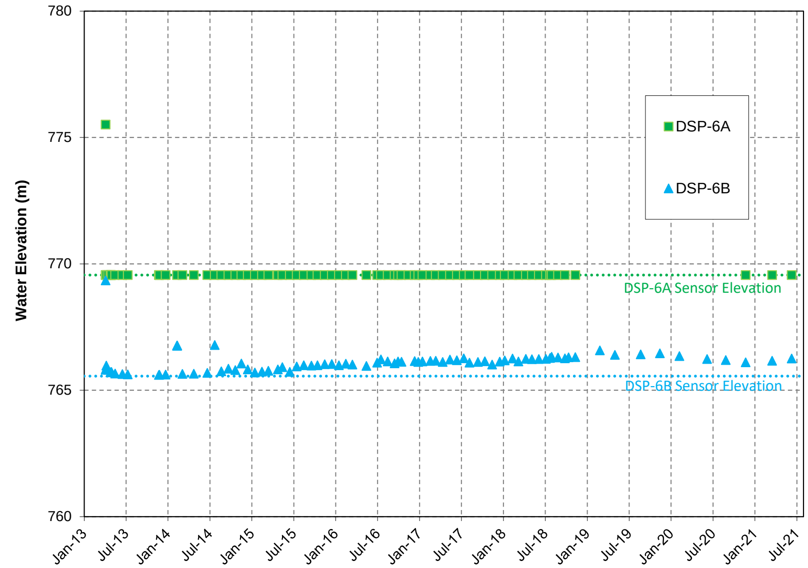
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

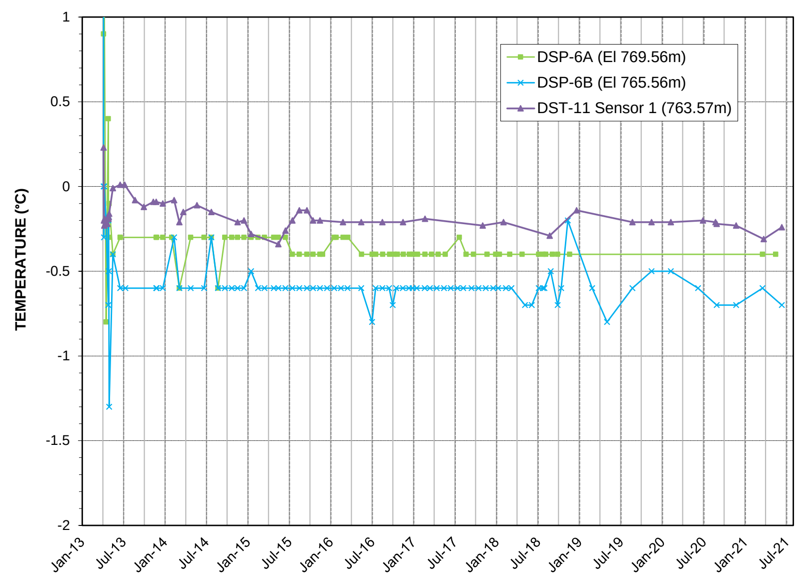
srk consulting	MINTO	DSTSF Instrumentation Data
		Piezometer – DSP-05
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 20



Notes:

1. The pore pressure sensors at DSP-06 are located approximately 2 m above original ground in tailings (A) and 2 m below original ground (B).
2. DSP-06A shows no pore pressure (pore pressure equal to the sensor elevation).
3. The bottom sensor at DSP-06B showed a gradual increasing pore pressure trend that peaked in February 2019 and has since decreased.

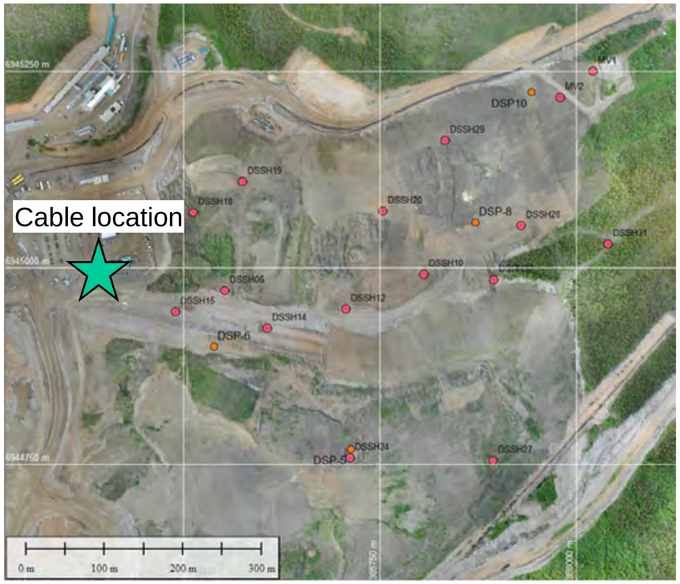




Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

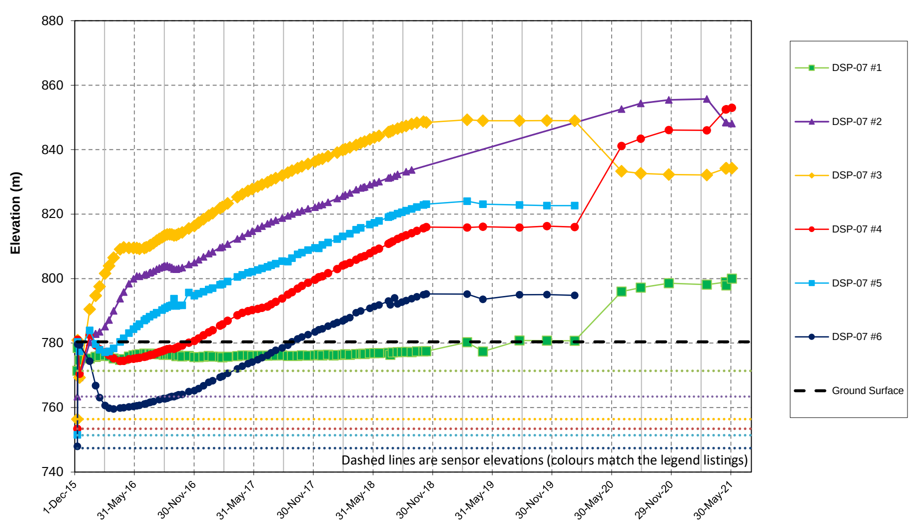
srk consulting	MINTO	DSTSF Instrumentation Data
		Piezometer – DSP-06
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: **21**

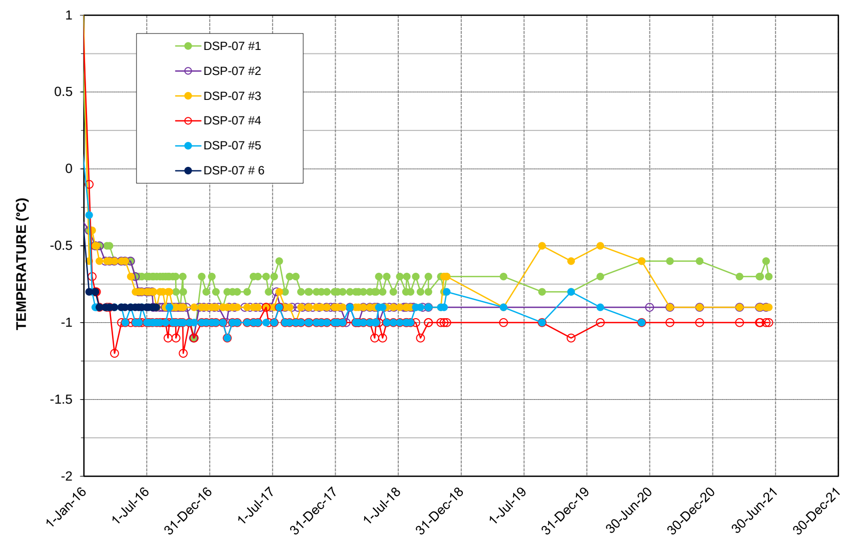


Sensor #	Stratigraphy, Ice Description	Ice Description
1	Silt. Some clay, little sand, trace gravel, soft, wet, medium plastic, varved.	Vr, Ice/moisture content up to 50%.
2	Sand, few gravel, loose, unrounded, no fines.	Vr. Mostly no visible ice, some small random ice lenses up to 1.5 cm thick.
3 4 5	Clay, some silt, trace gravel and sand, wet, high plastic. (MC=50%)	Vr; Approx. 50% ice, lenses between 2 and 20 mm thick, parallel and nearly horizontal, interbedded with clay.
6	Weathered Bedrock; Highly weathered granite. Rust staining. Friable.	Nbn. No excess ice.

Notes:

1. Sensors #5 and #6 are no longer operational.





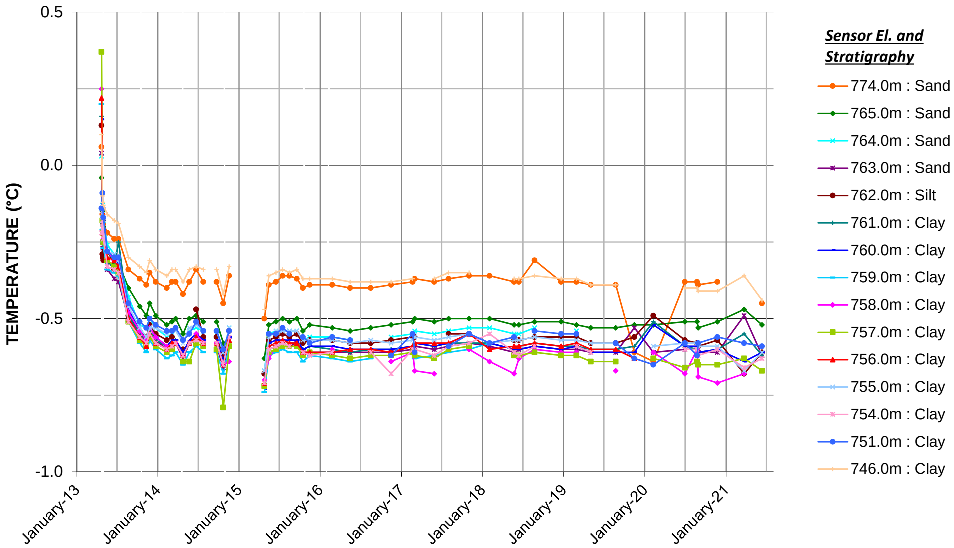
Source files:

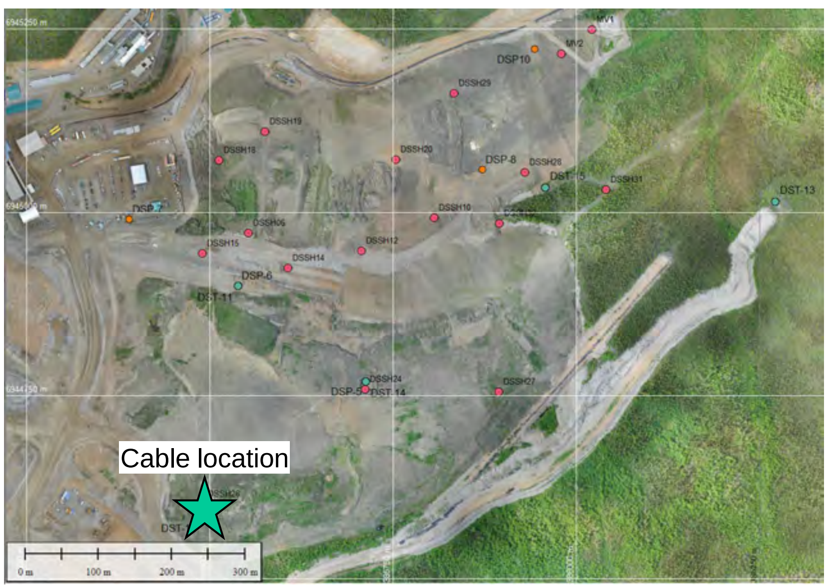
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

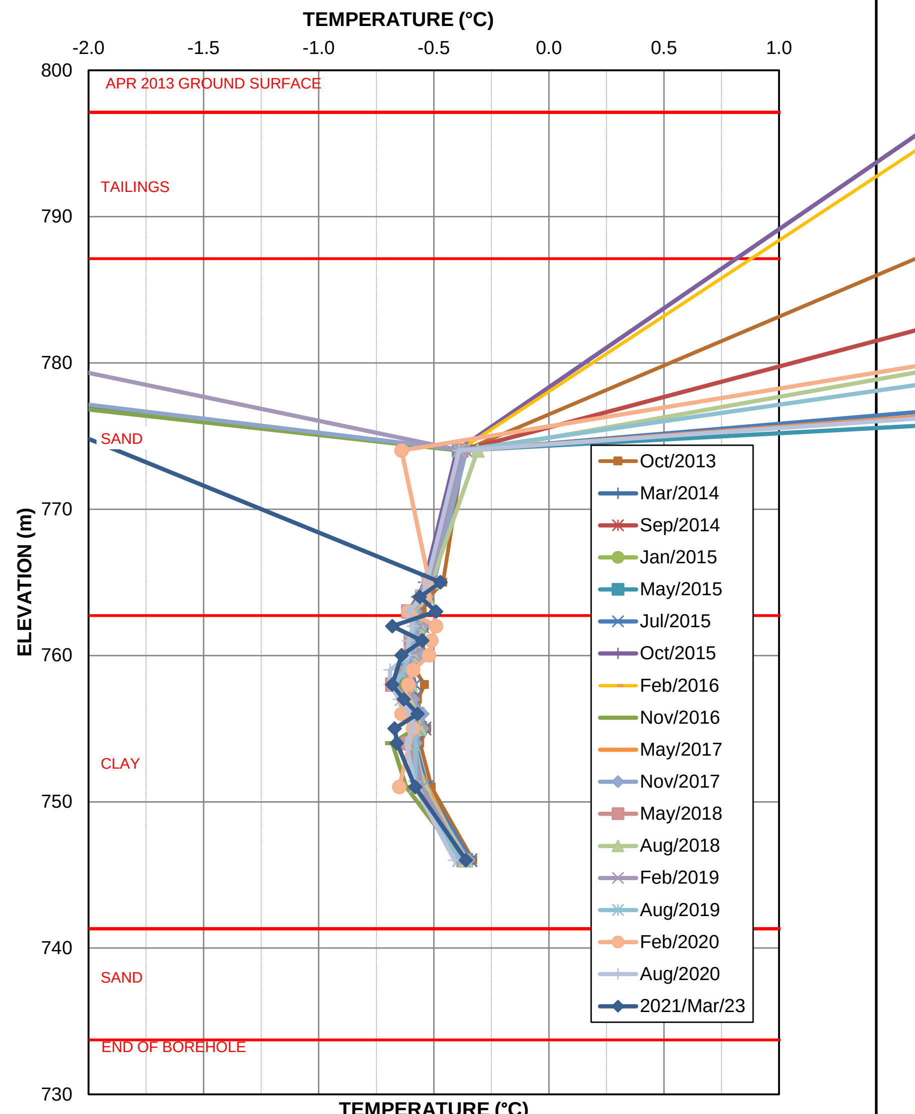
srk consulting

MINTO

Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	DSTSF Instrumentation Data **Piezometer – DSP-07** Date: October 2021 · Prepared by: PHM · Figure: 22



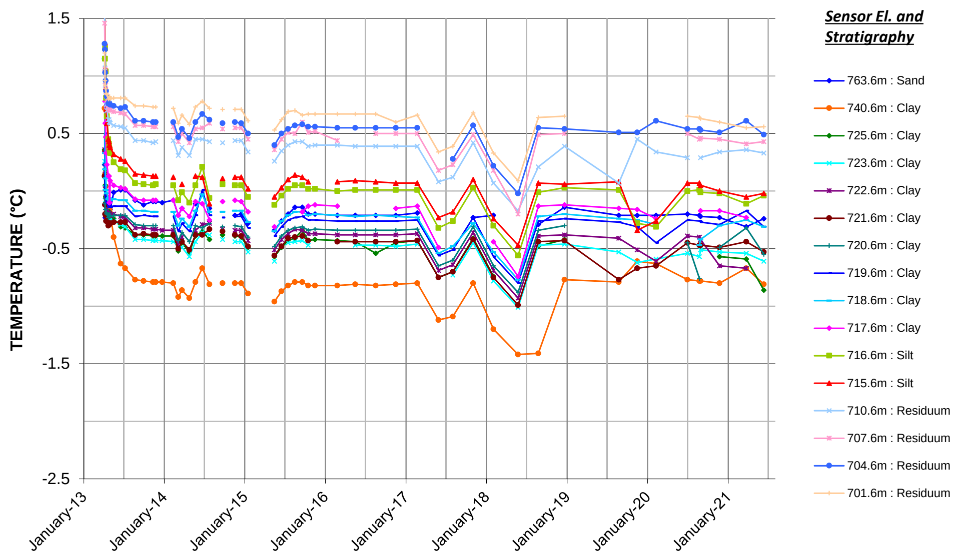


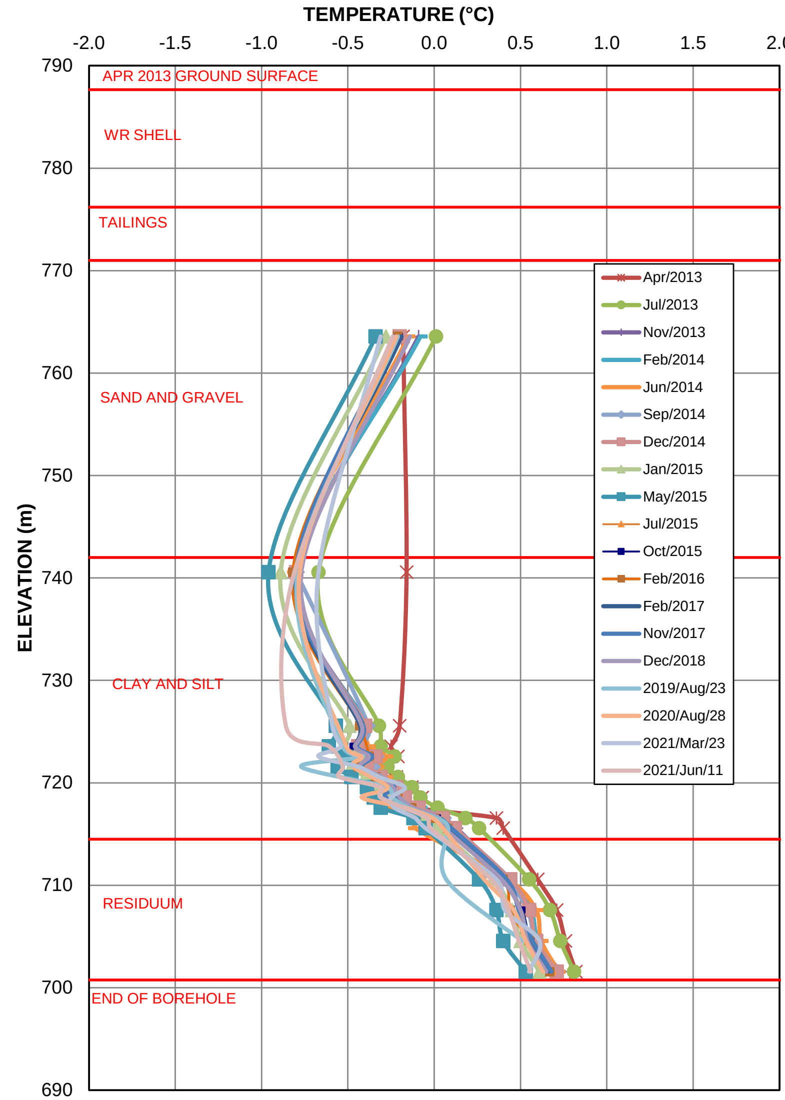


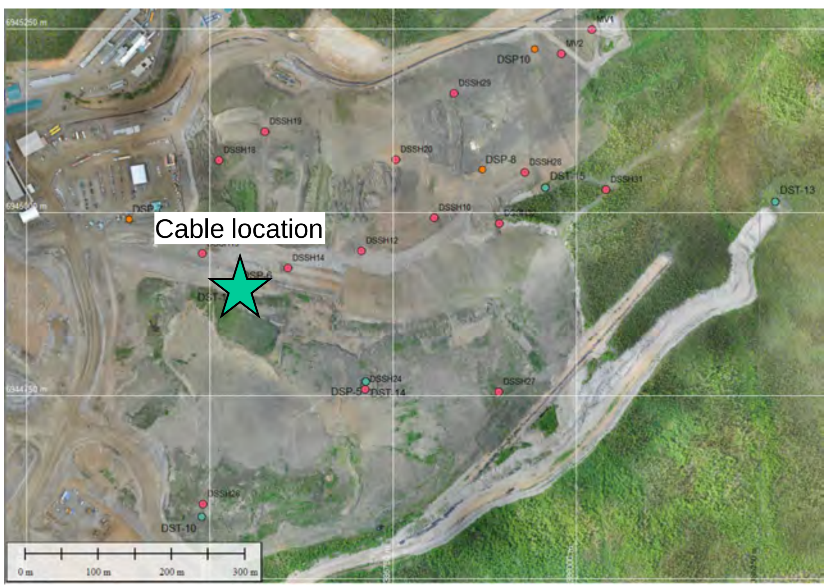
Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	DSTSF Instrumentation Data
		Temperature Cable – DST-10
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by: PHM / Figure: **23**







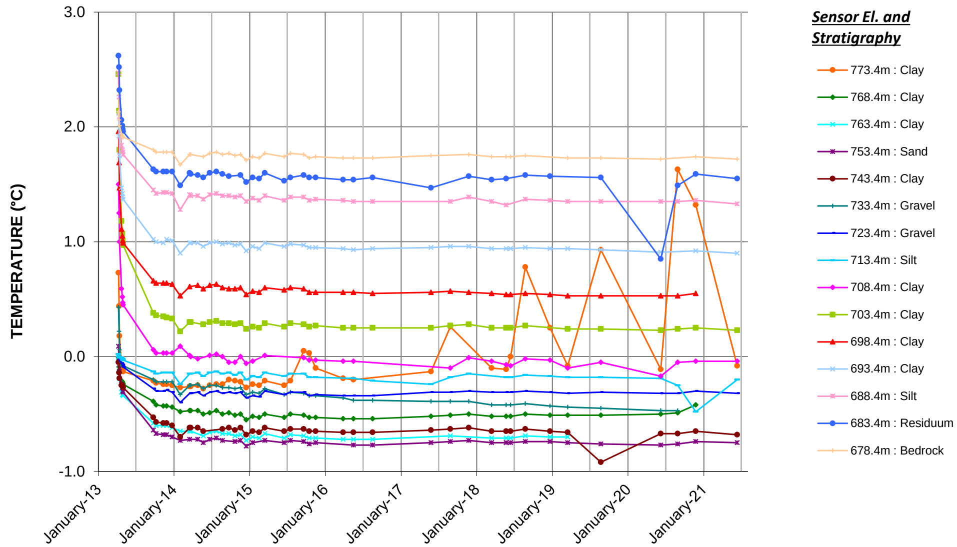
Source files:

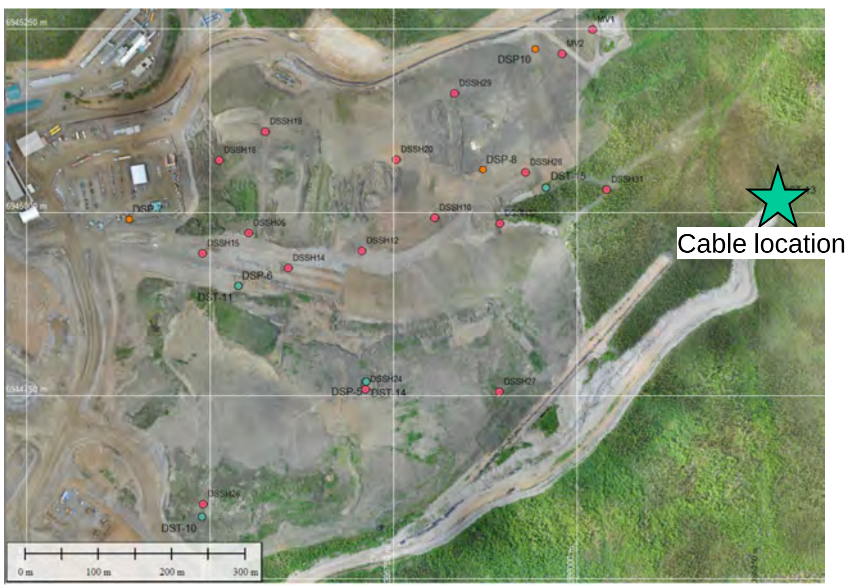
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

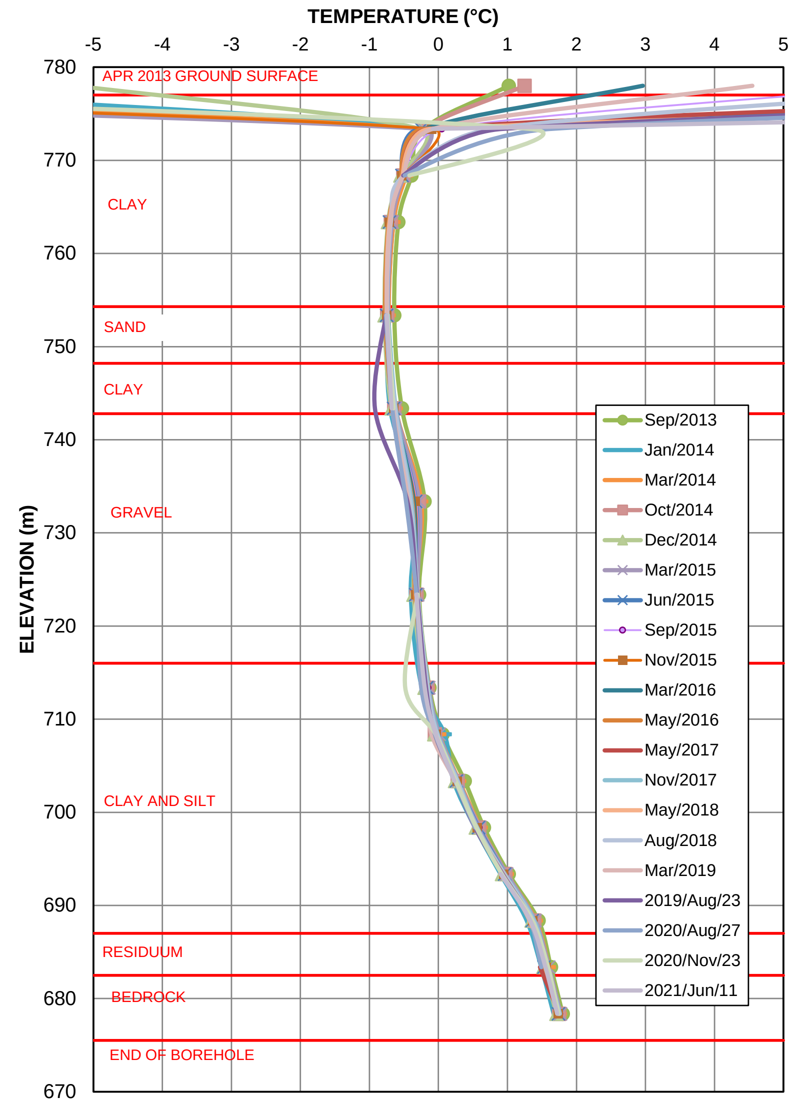
srk consulting

MINTO

Job No: 1CM002.073	Minto Mine	DSTSF Instrumentation Data
Filename: ApD_2021DSTSFLandscape.pptx		**Temperature Cable – DST-11**
		Date: October 2021 · Prepared by: PHM · Figure: 24







Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting

MINTO

DSTSF Instrumentation Data

Temperature Cable – DST-13

Job No: 1CM002.073

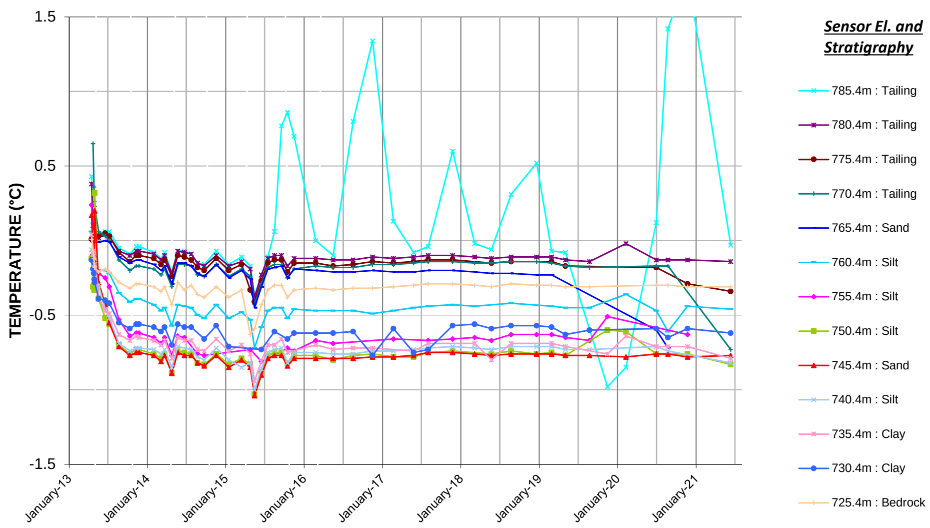
Filename: ApD_2021DSTSFLandscape.pptx

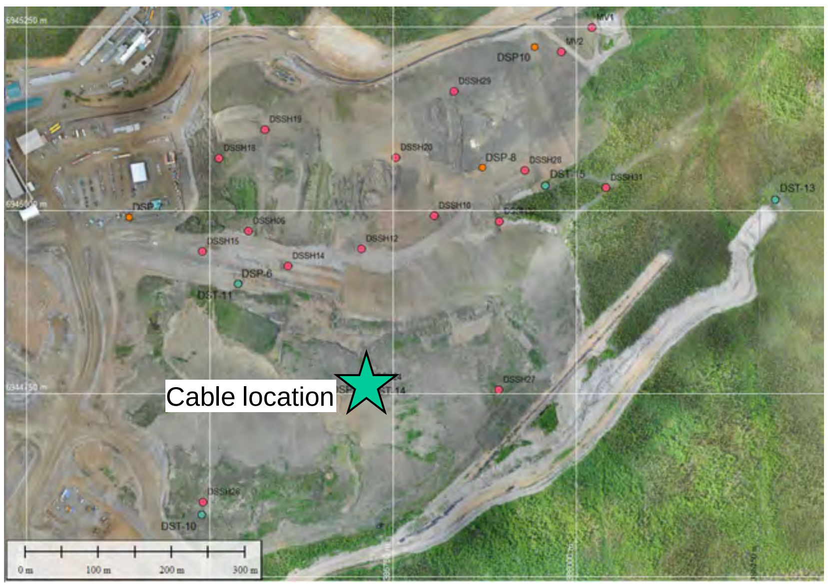
Minto Mine

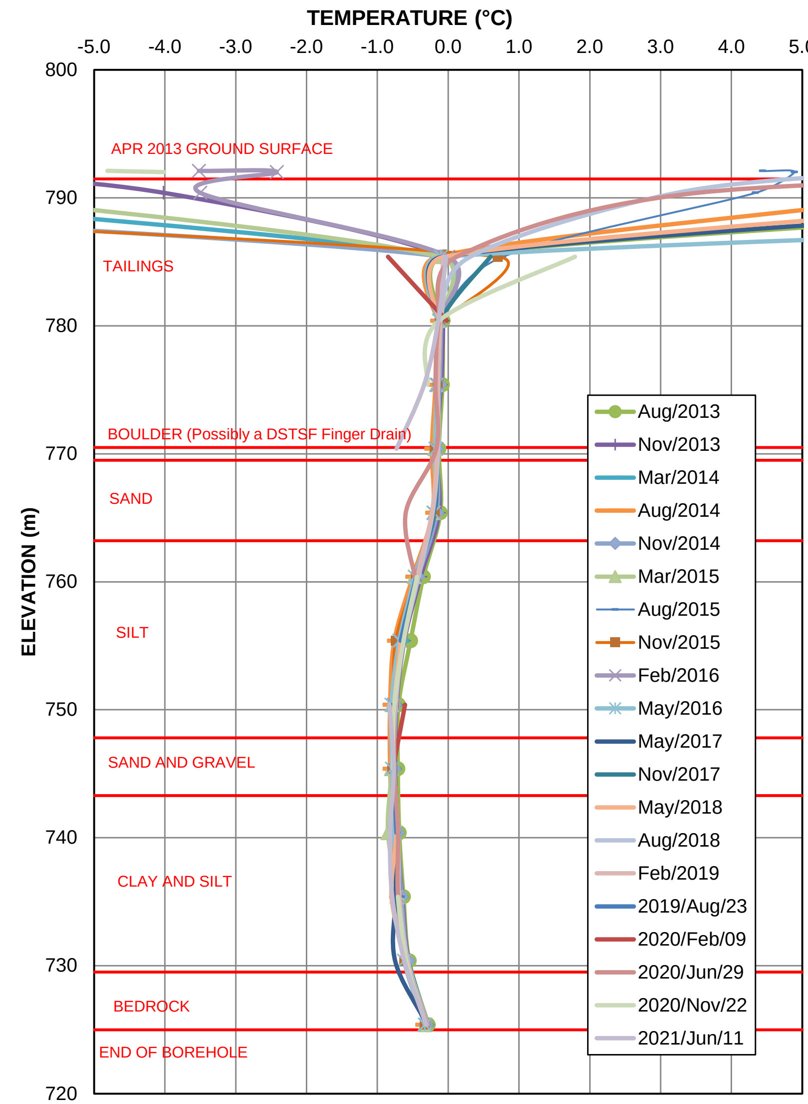
Date: October 2021

Prepared by: PHM

Figure: 25



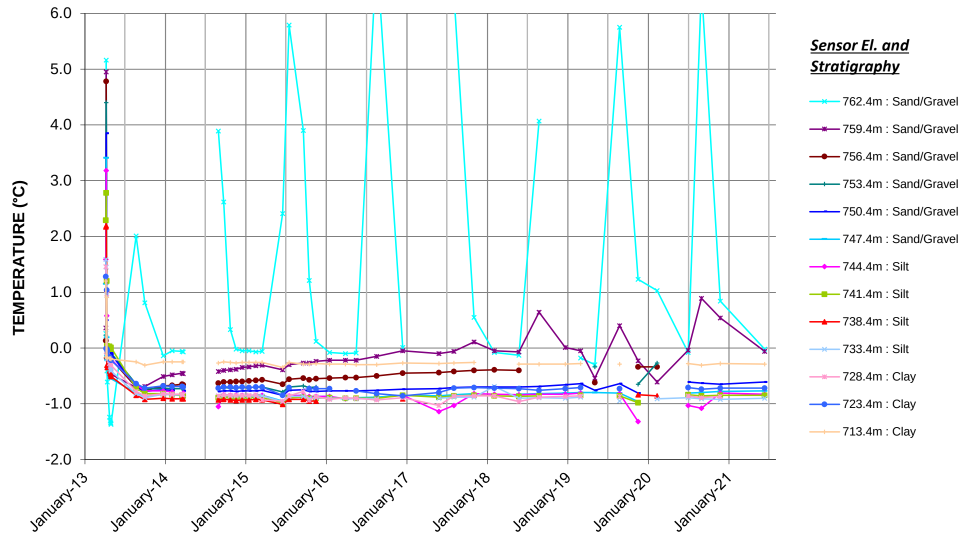


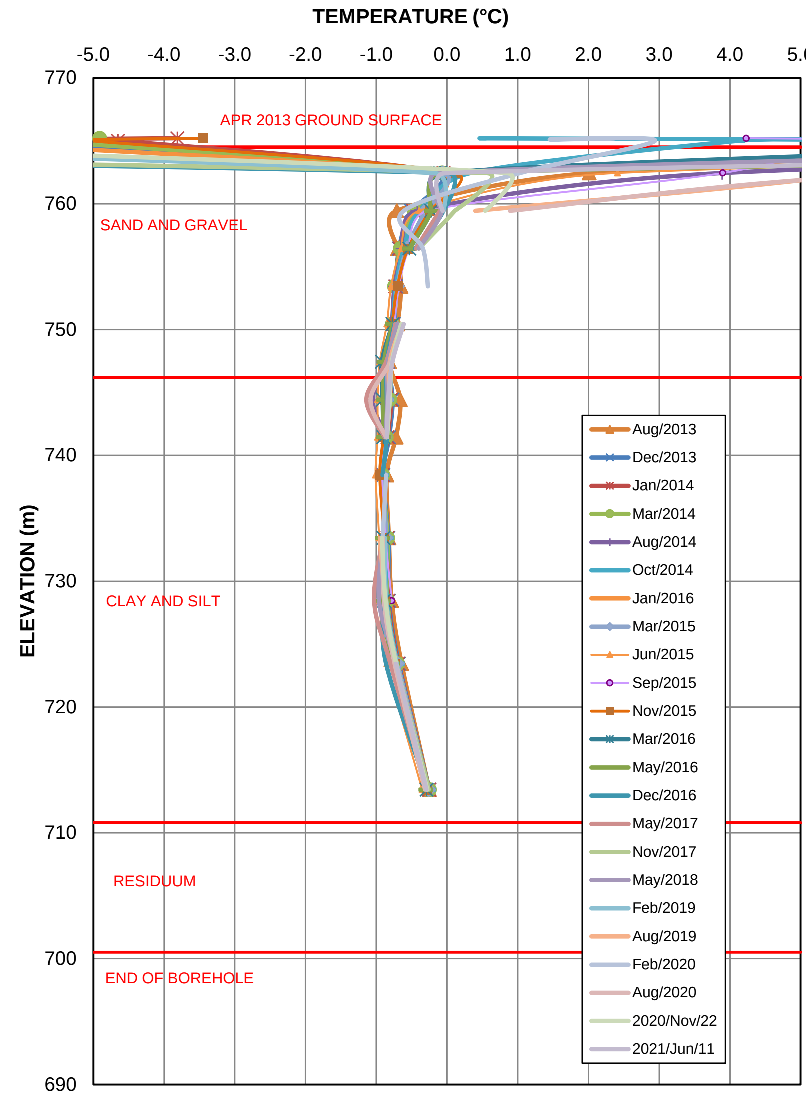


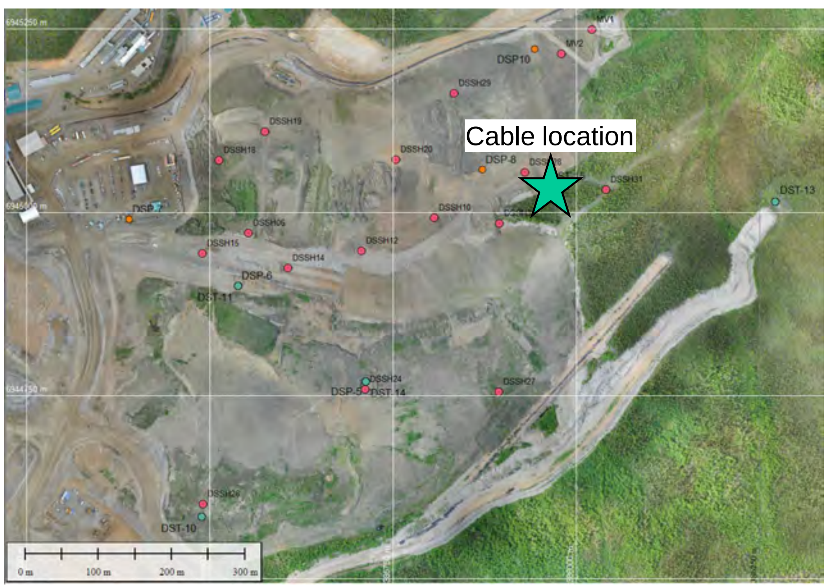
Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	DSTSF Instrumentation Data
		Temperature Cable– DST-14
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: **26**



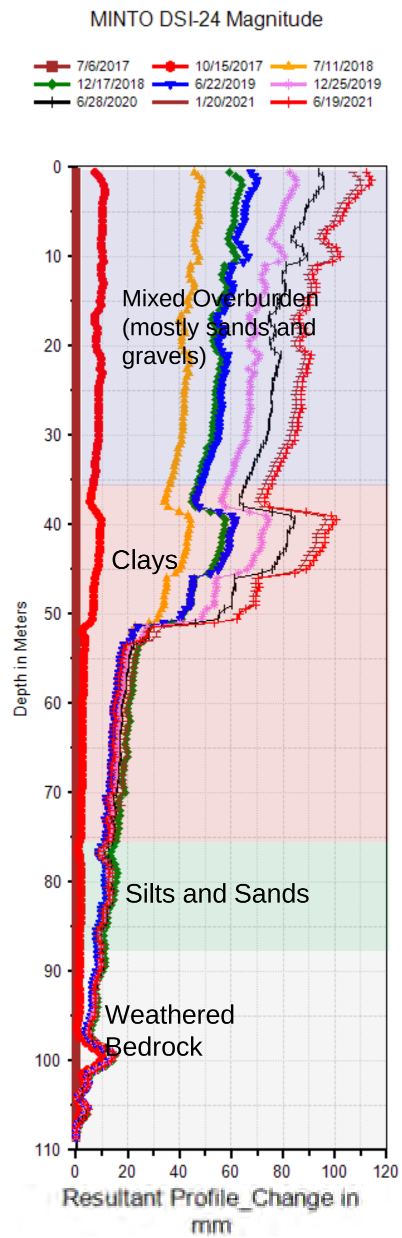


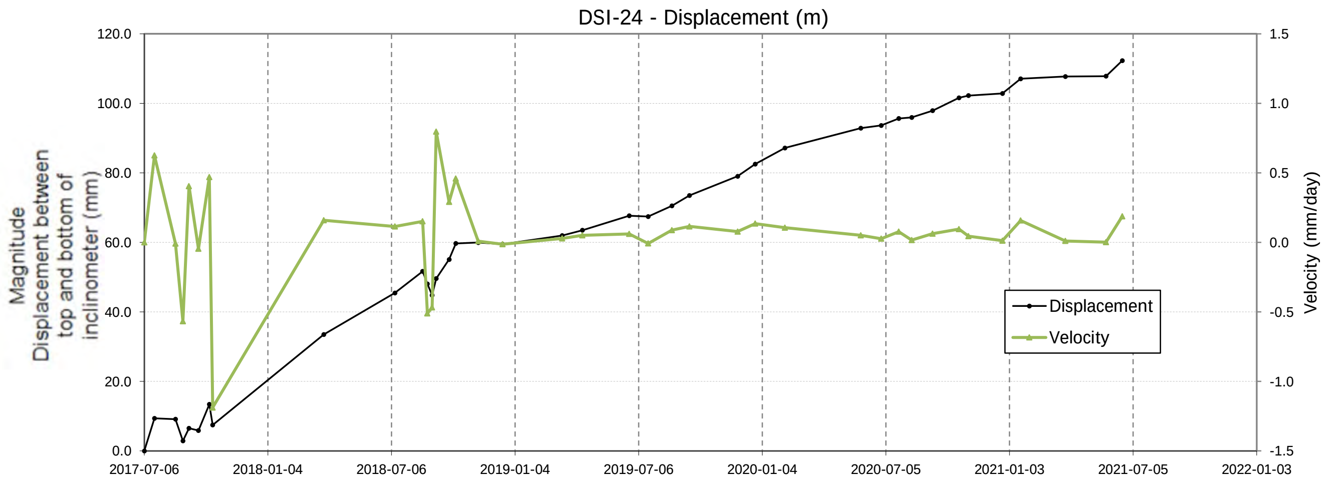


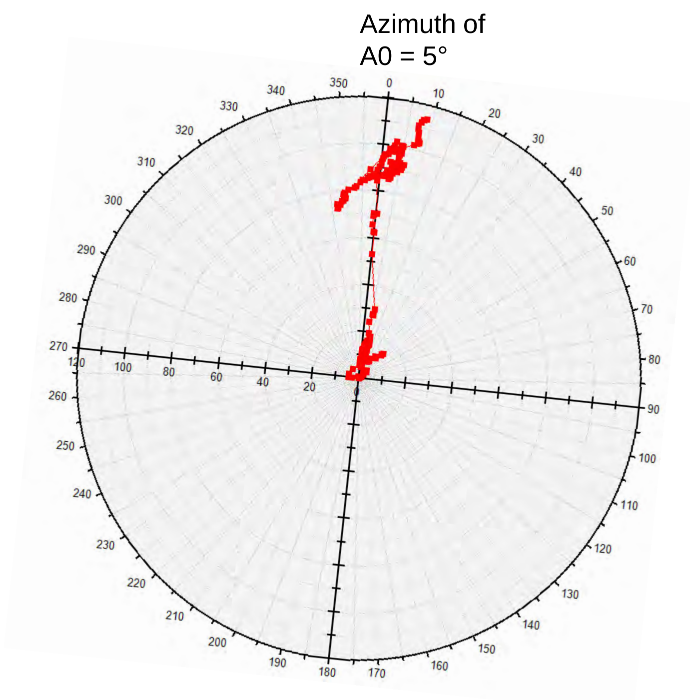
Source files:

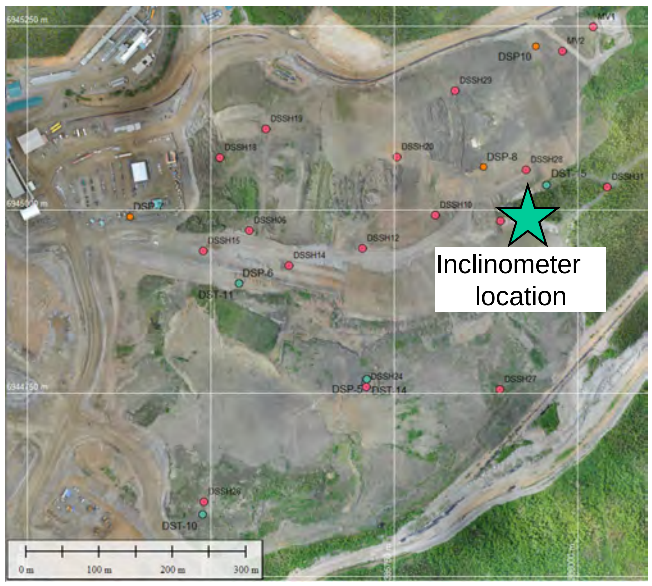
1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\DSTFSurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	DSTSF Instrumentation Data
		Temperature Cable – DST-15
Job No: 1CM002.073 Filename: ApD_2021DSTSFLandscape.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 27









Source files:

1. GlobalMapper: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\2020Instrumentation.gmp
2. Instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\Minto SI Instrumentation Database.dpw

srk consulting

MINTO

DSTSF Instrumentation Data

Inclinometer – DSI-24

Job No: 1CM002.073

Filename: ApD_2021DSTSFLandscape.pptx

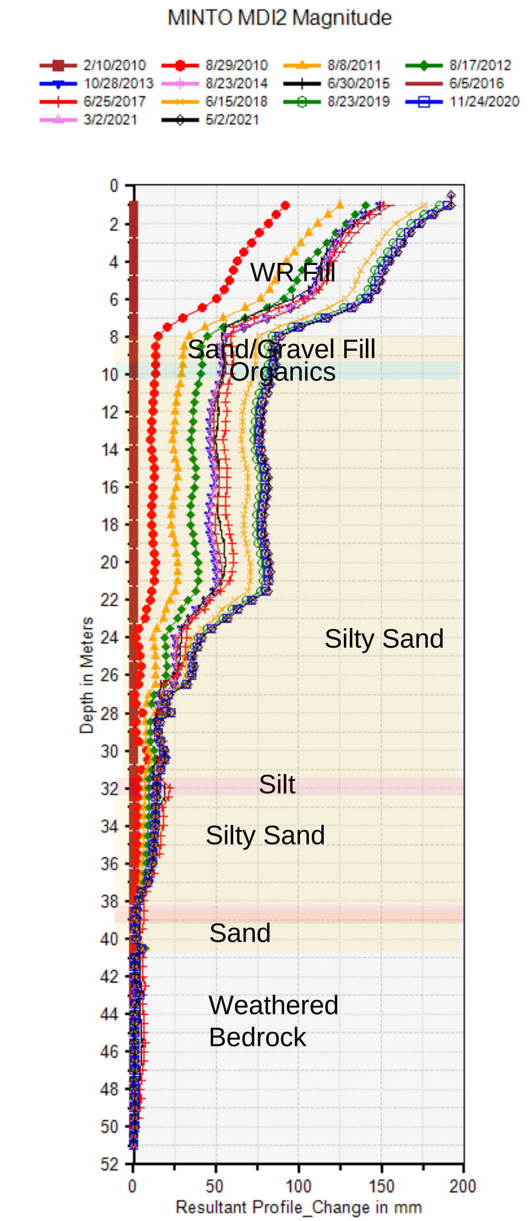
Minto Mine

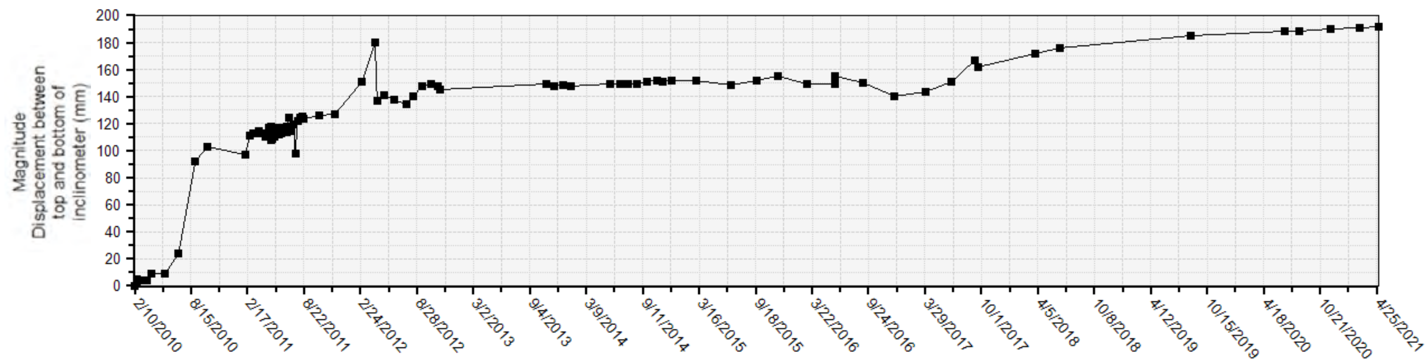
Date: October 2021

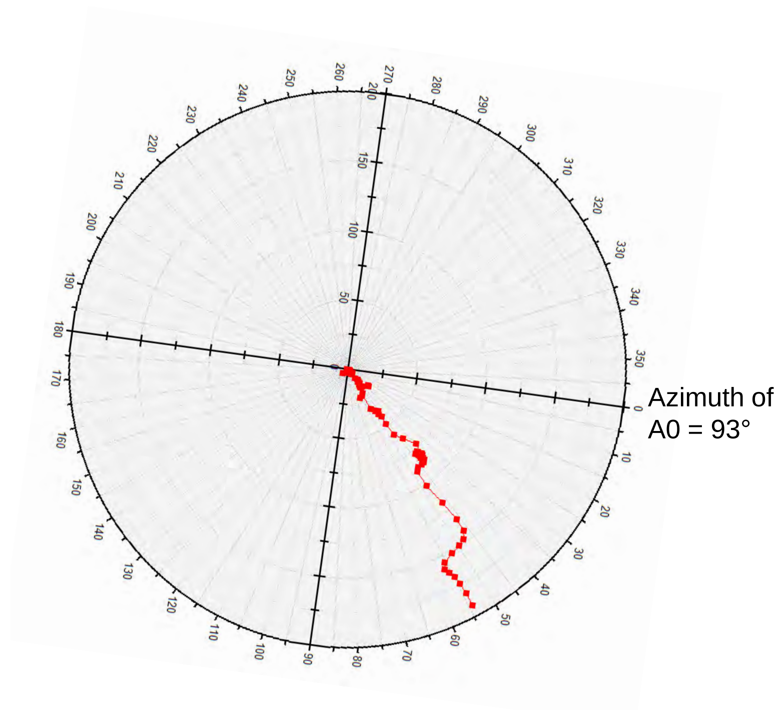
Prepared by PHM

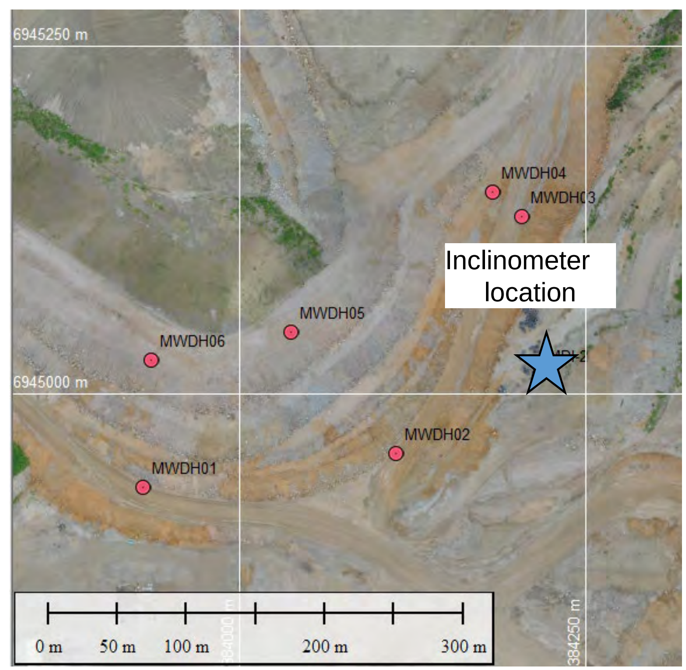
Figure: 28

Appendix E MWD Instrumentation Data







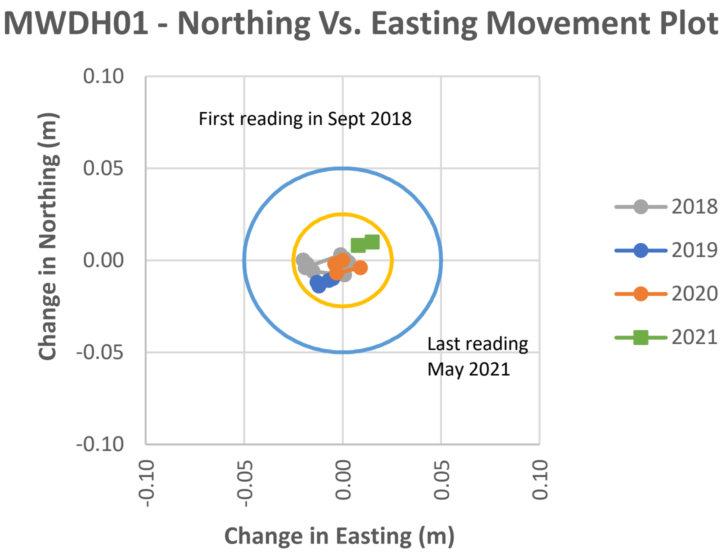


Note: Inclinometer software (DigiPro2 v2.12.4) plots A0 as 0 degrees. The plot above has been rotated such that the orientation matches the plan (north is up).

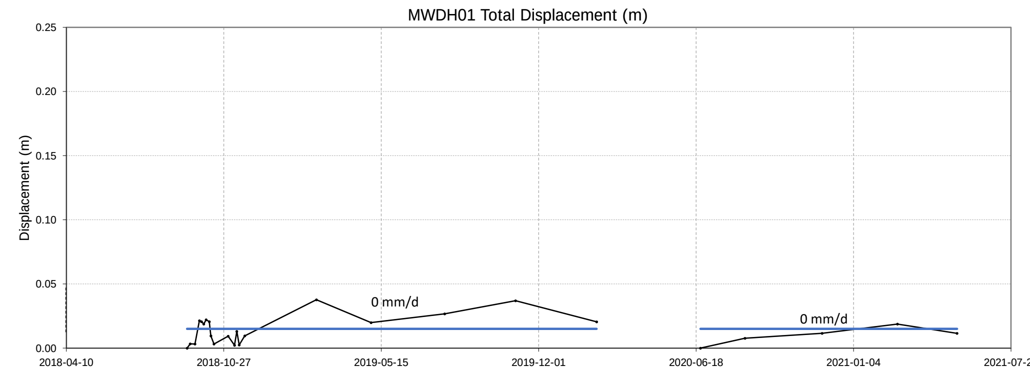
Source files:

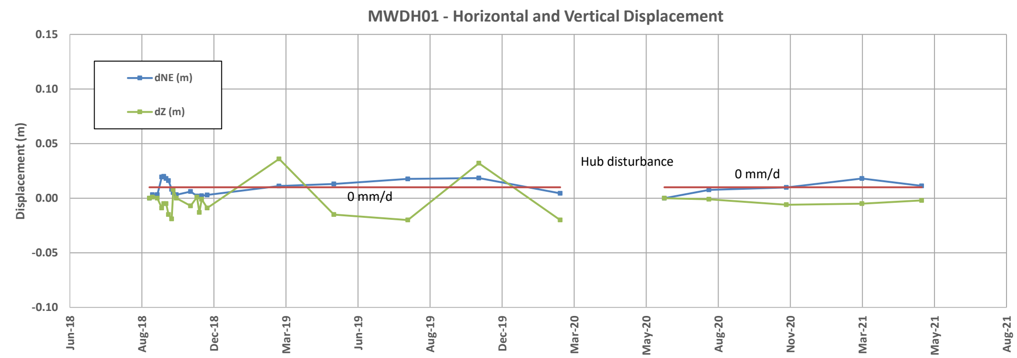
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\Minto SI Instrumentation Database.dpw

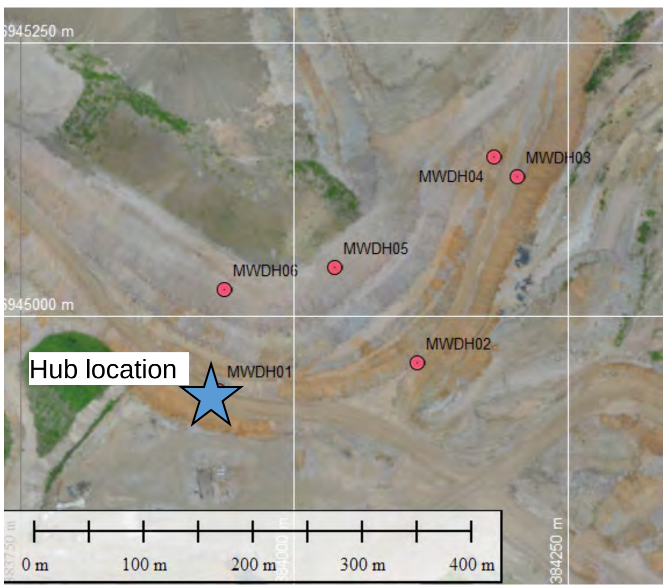
srk consulting	MINTO	MWD Instrumentation Data
		Inclinometer – MDI-2
Job No: 1CM002.073 Filename: ApE_2021MWDInstrumentation.pptx	Minto Mine	Date: October 2021 | Prepared by PHM | Figure: 1

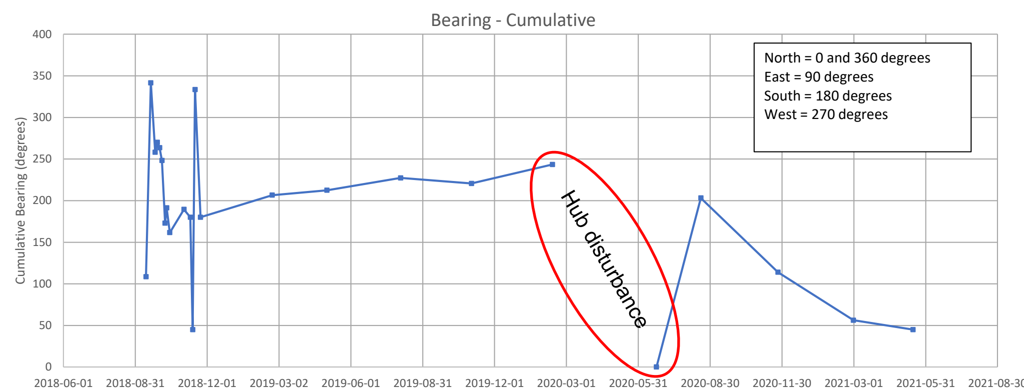


Note: Survey hub was disturbed sometime between February and June 2020. Plot above resets the change in displacement to 0 on June 2020.









Source files:

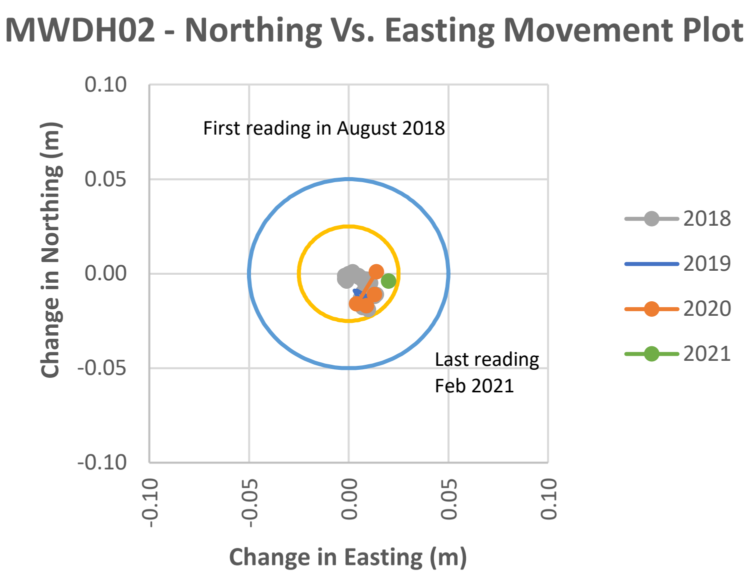
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MWD_Hub_Monitoring_SRK.xlsm

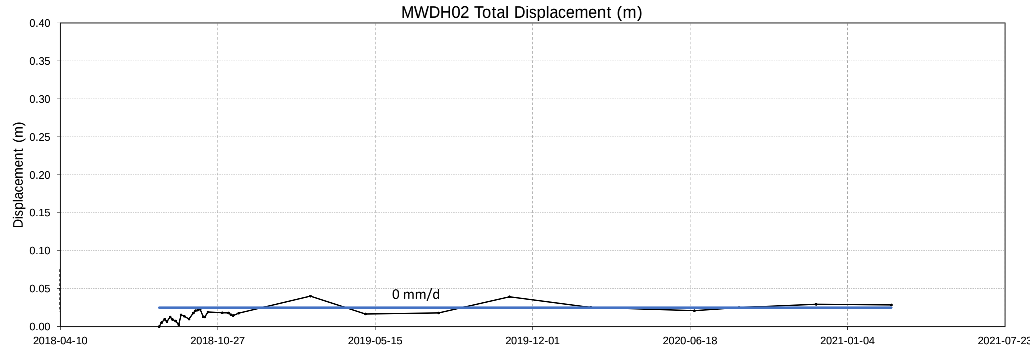
srk consulting

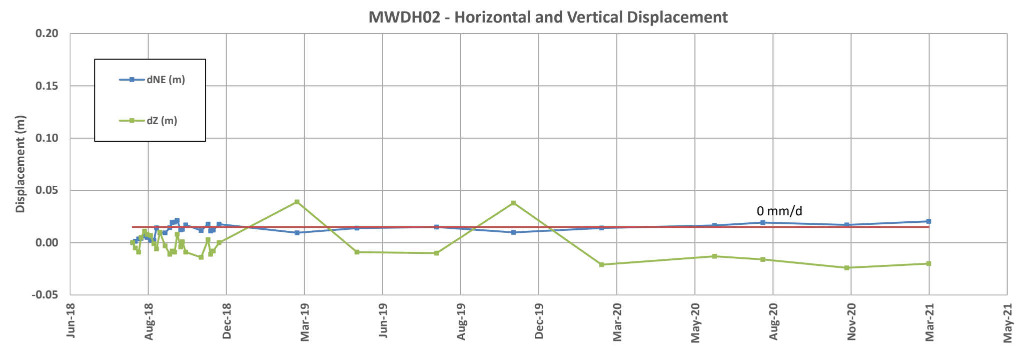
MINTO

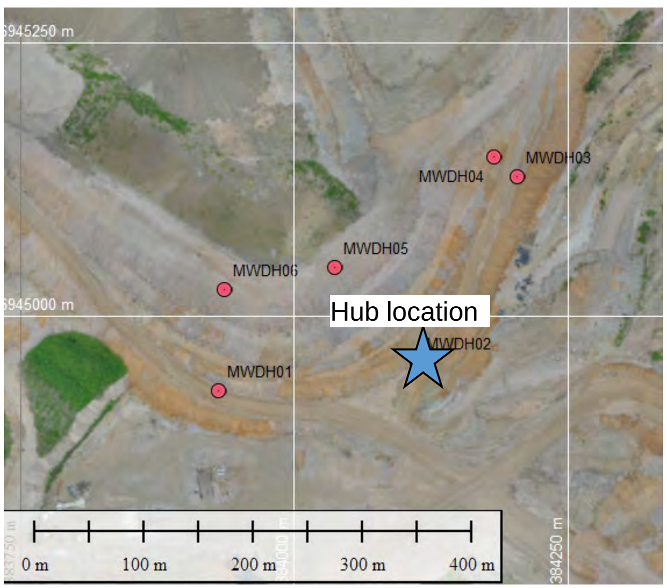
Job No: 1CM002.073 Filename: ApE_2021MWDInstrumentation.pptx	Minto Mine	MWD Instrumentation Data **Survey Hub – MWDH01**

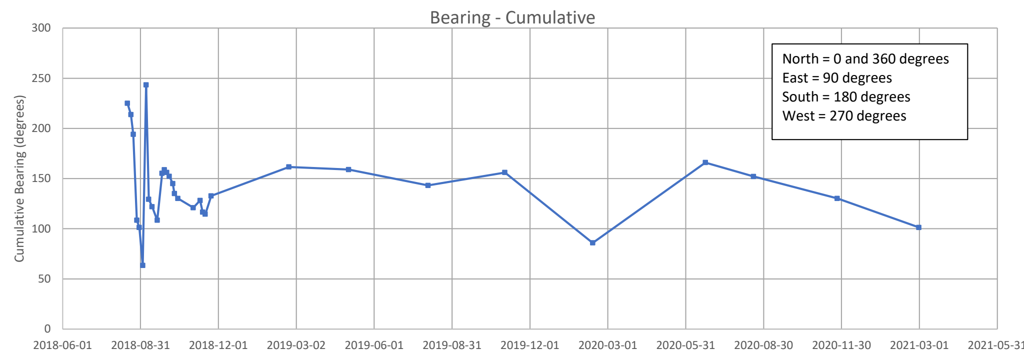
Date:	Prepared by	Figure:
October 2021	PHM	2







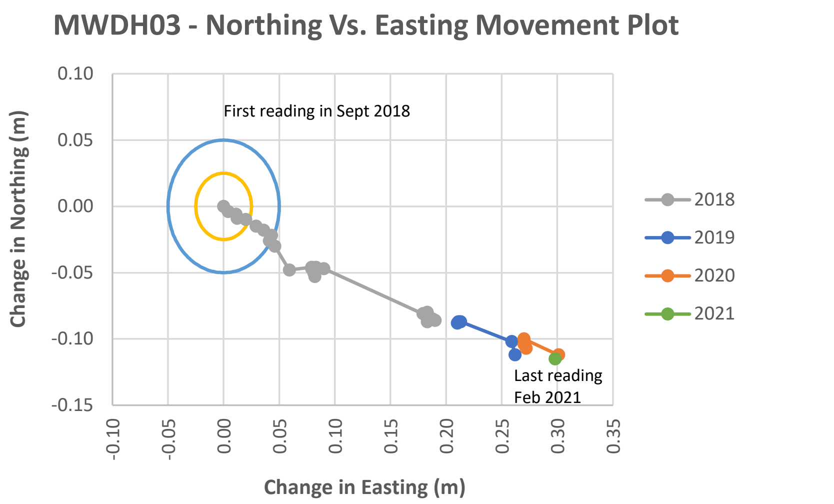


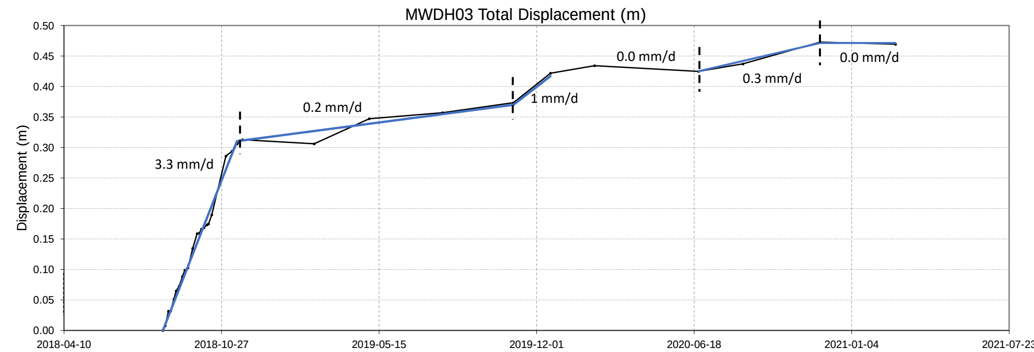


Source files:

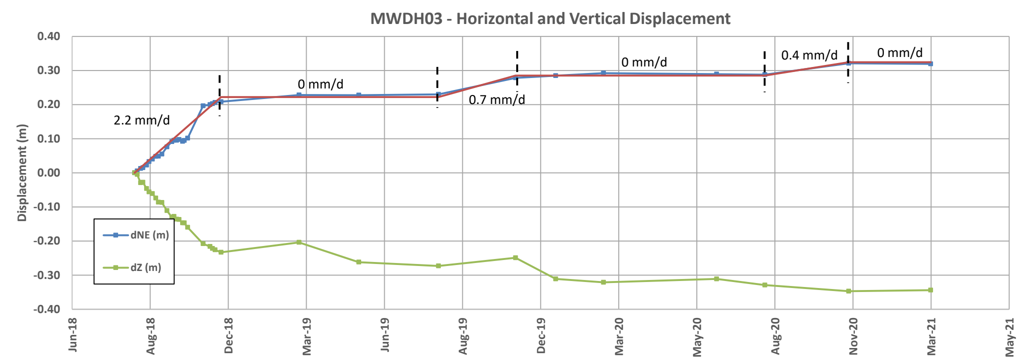
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MWD_Hub_Monitoring_SRK.xlsm

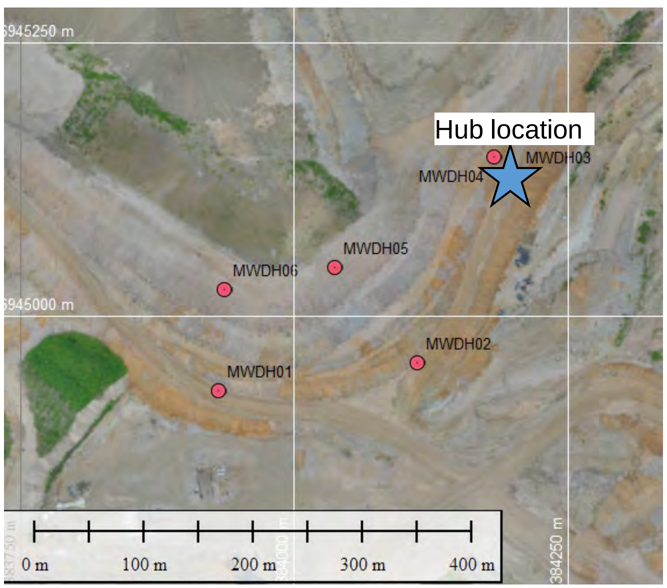
srk consulting	MINTO	MWD Instrumentation Data **Survey Hub – MWDH02**
Job No: 1CM002.073 Filename: ApE_2021MWDInstrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 3

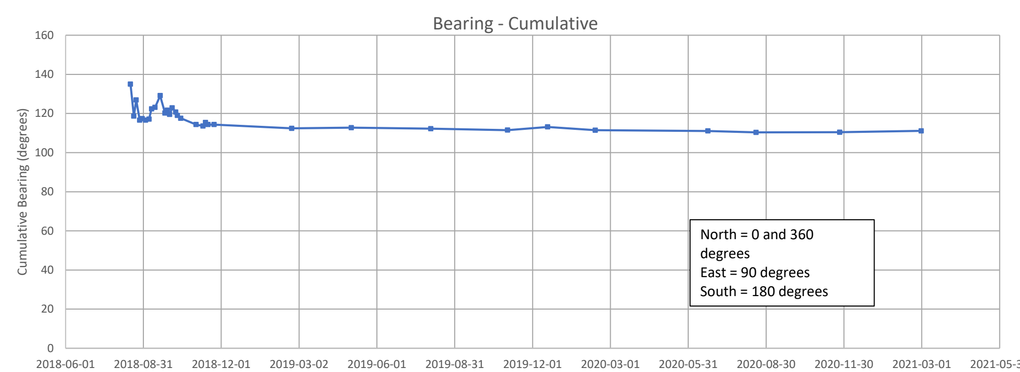




Hub movement occurs primarily in the fall and is likely due to frost heave.







Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MWD_Hub_Monitoring_SRK.xlsm

srk consulting

MINTO

MWD Instrumentation Data

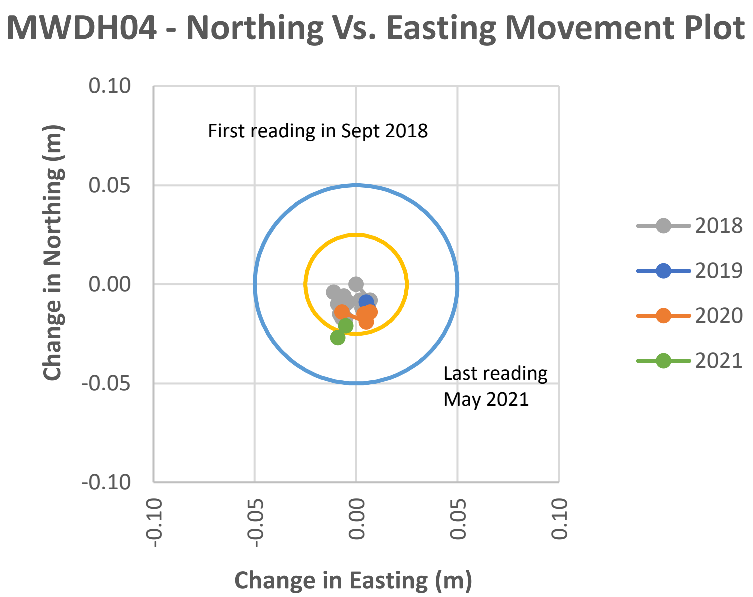
Survey Hub – MWDH03

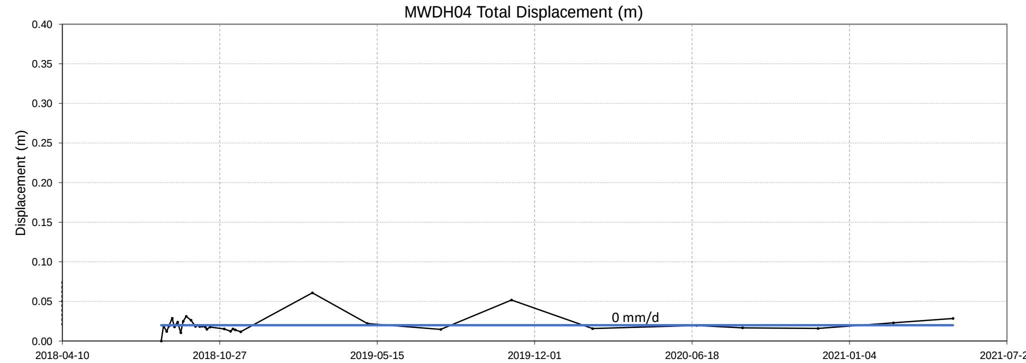
Job No: 1CM002.073

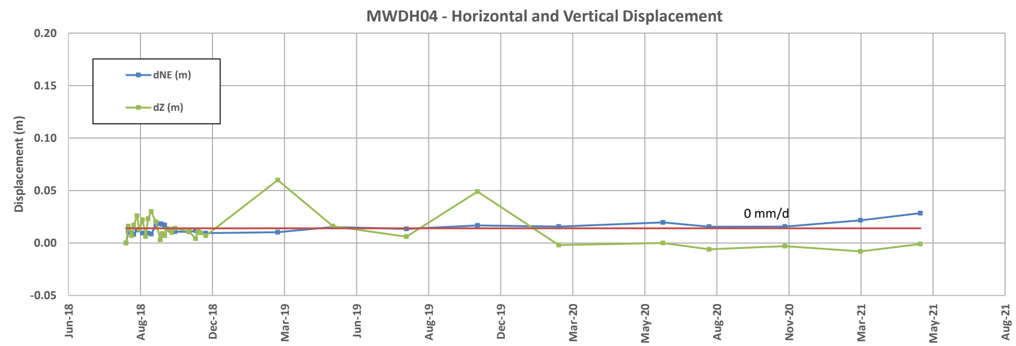
Filename: ApE_2021MWDInstrumentation.pptx

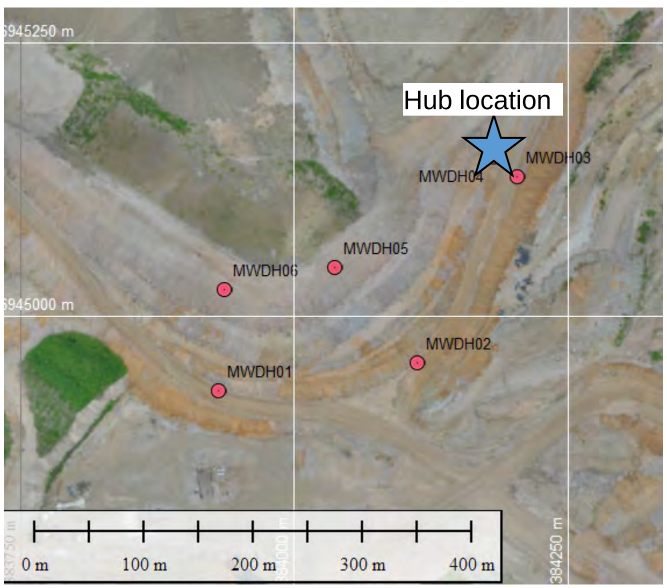
Minto Mine

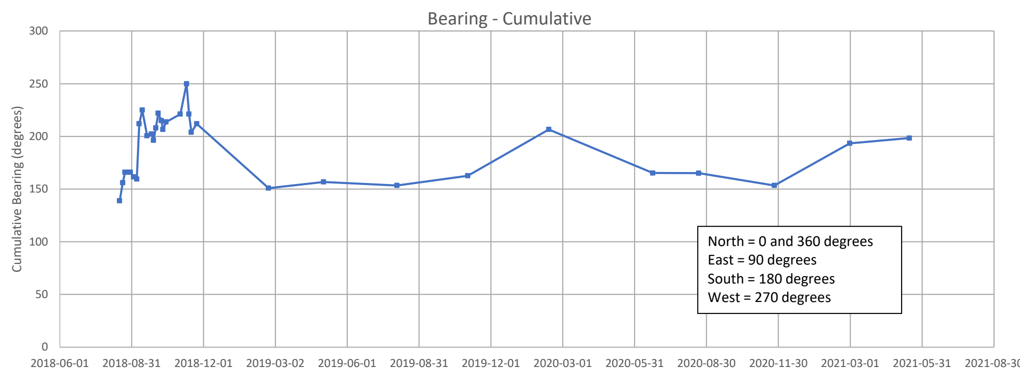
Date:	Prepared by	Figure:
October 2021	PHM	4











Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MWD_Hub_Monitoring_SRK.xlsm

srk consulting | MINTO | MWD Instrumentation Data

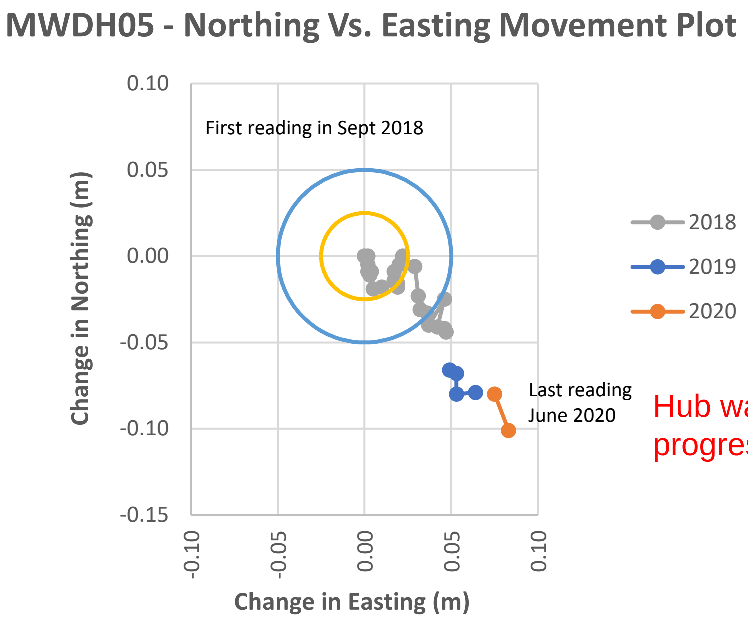
Survey Hub – MWDH04

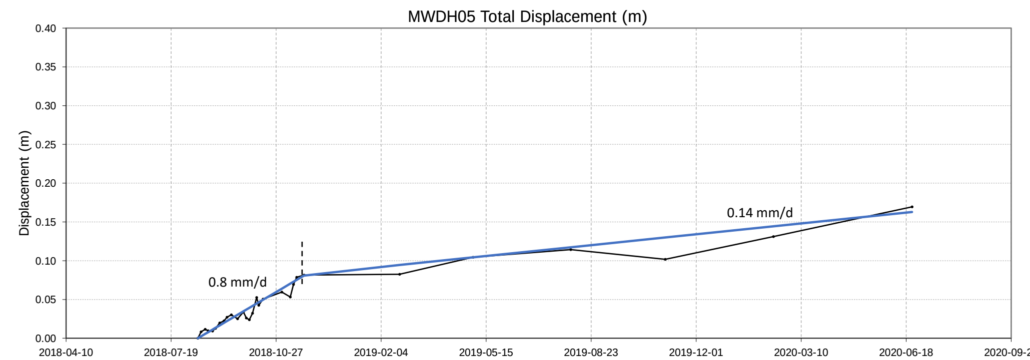
Job No: 1CM002.073

Filename: ApE_2021MWDInstrumentation.pptx

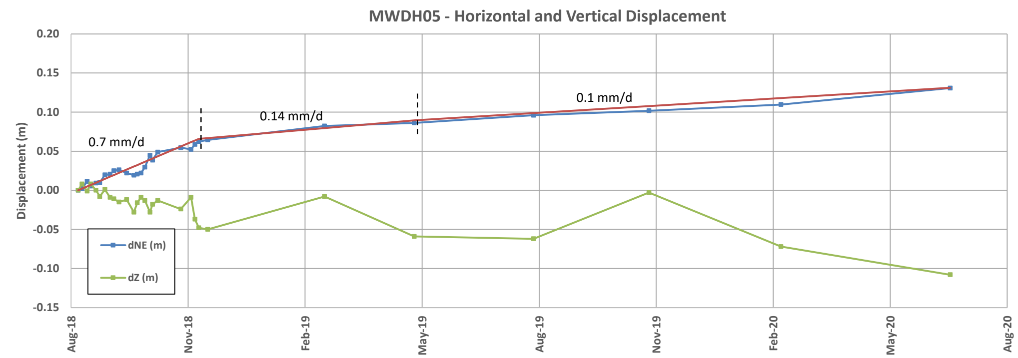
Minto Mine

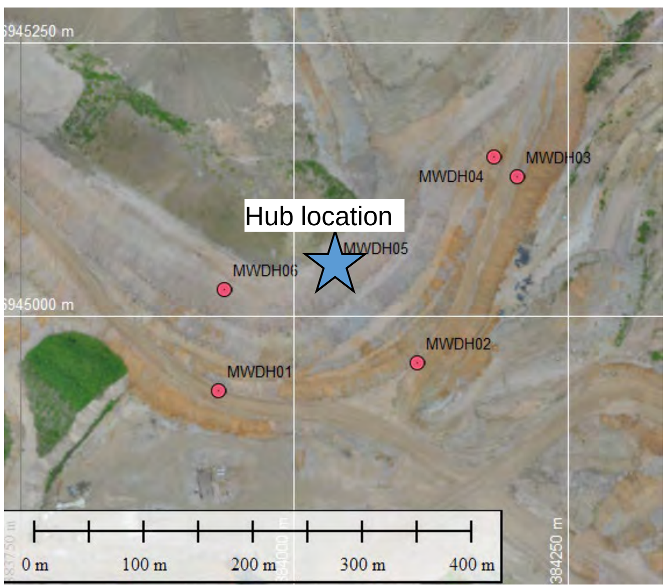
Date:	Prepared by	Figure:
October 2021	PHM	5

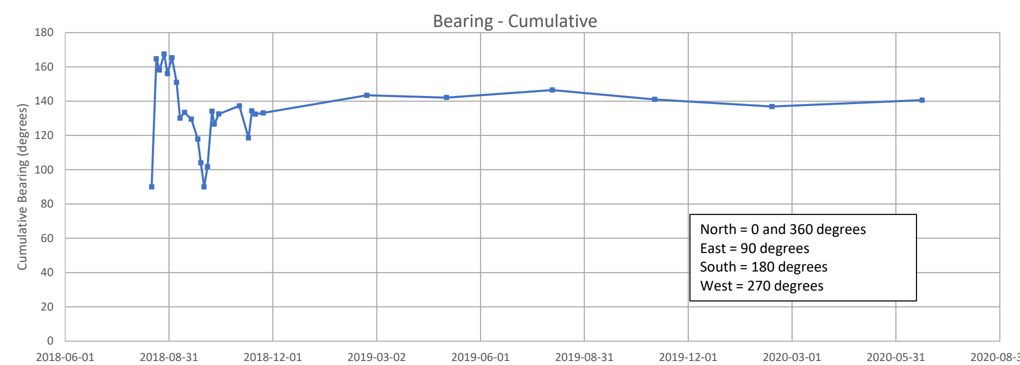




Hub was destroyed in the summer of 2020 due to progressive reclamation and resloping of the MWD Wrap.







Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MWD_Hub_Monitoring_SRK.xlsm

srk consulting | MINTO

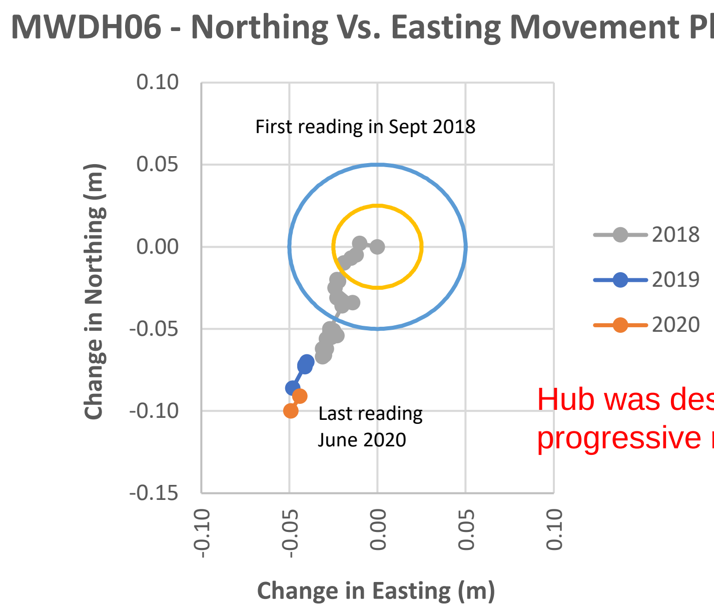
MWD Instrumentation Data

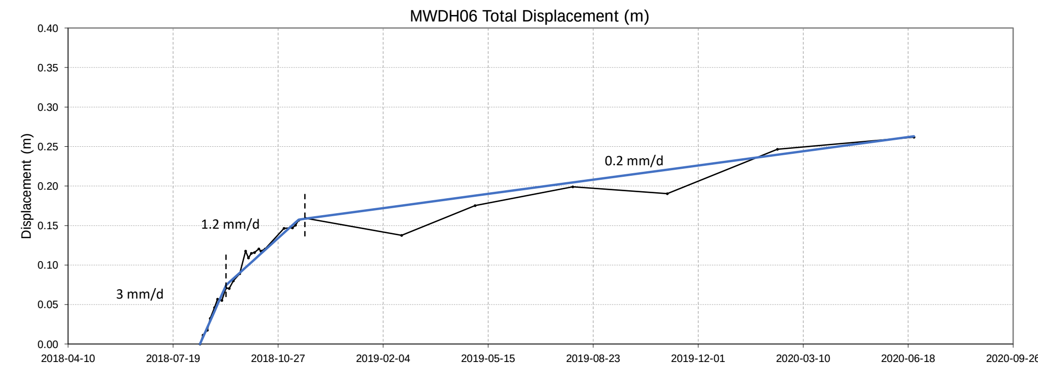
Survey Hub – MWDH05

Job No: 1CM002.073
Filename: ApE_2021MWDInstrumentation.pptx

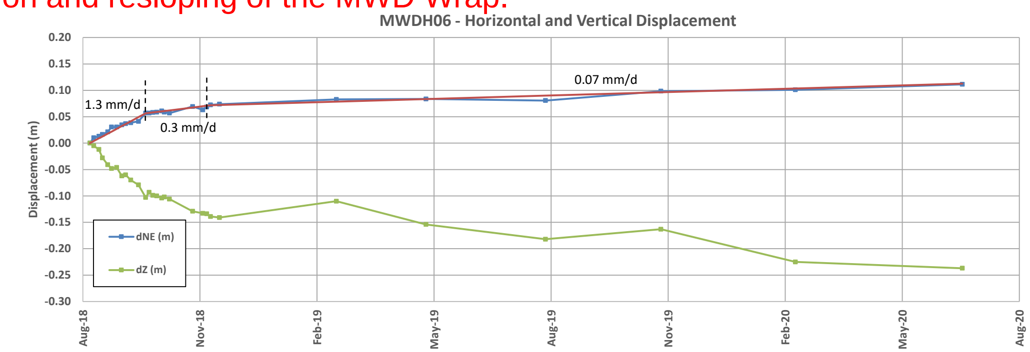
Minto Mine

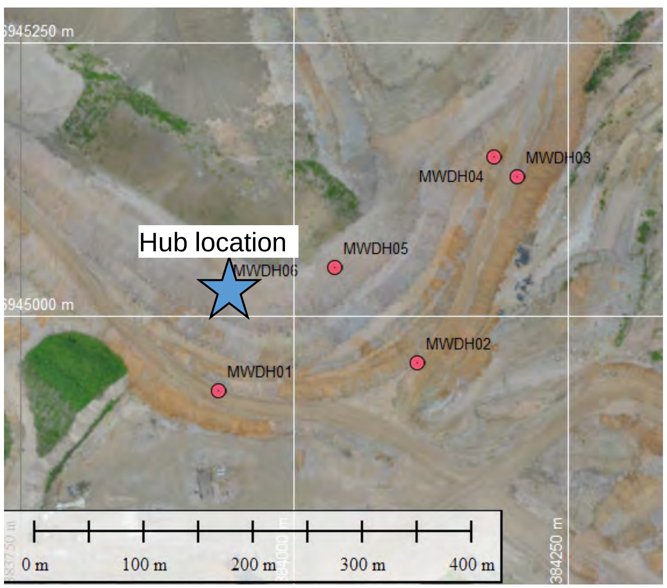
Date: October 2021 | Prepared by PHM | Figure: 6

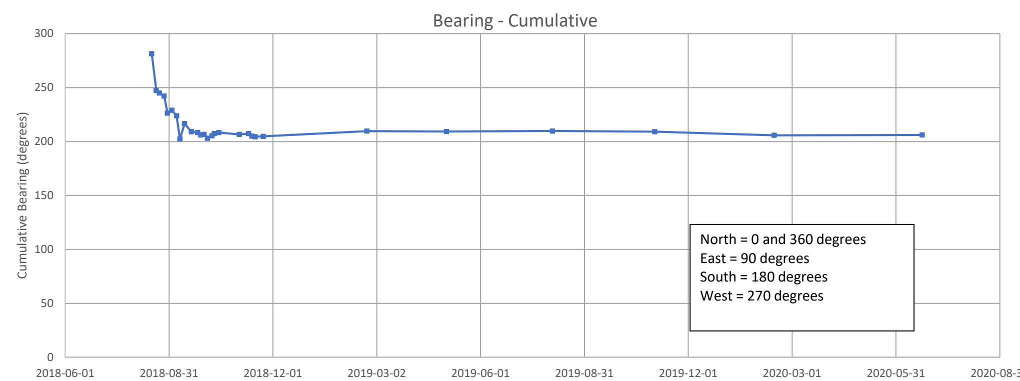




Hub was destroyed in the summer of 2020 due to progressive reclamation and resloping of the MWD Wrap.





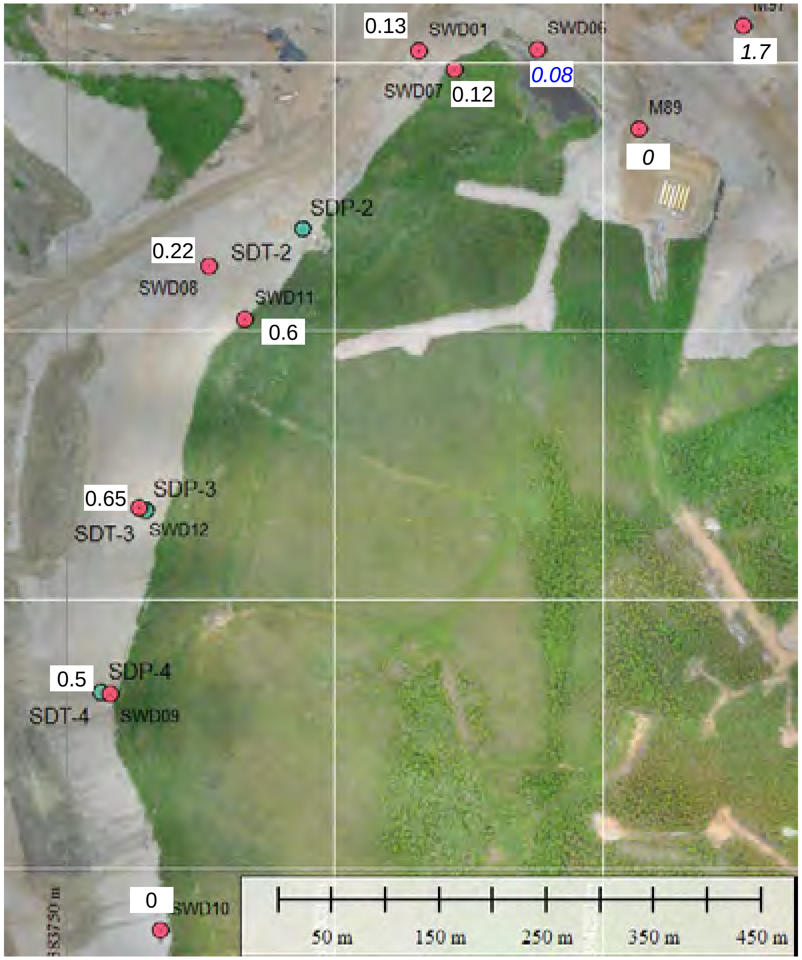


Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MWD_Hub_Monitoring_SRK.xlsm

srk consulting	MINTO	MWD Instrumentation Data
		Survey Hub – MWDH06
Job No: 1CM002.073 Filename: ApE_2021MWDInstrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 7

Appendix F SWD Instrumentation Data



Legend/Notes

1. *Values in black are total movement rates in units of mm/day*
2. *Values in blue are horizontal movement rates in mm/day.*
3. *Survey hubs with no movement rates listed have been inactive for over one year.*

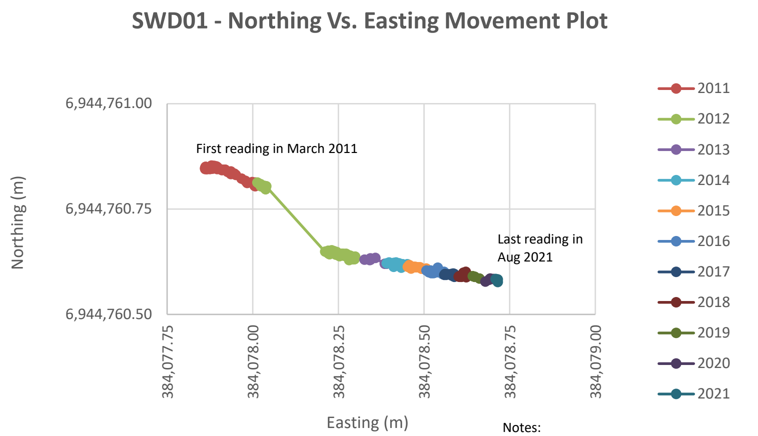
South West Dump Active Survey Hubs

Survey Hub	Last Reading	Movement Rate (mm/day)		Bearing (over past year)	Comments
		Current (as of last reading)	One year prior to last reading		
SWD-01	8/11/2021	0.13	0.13	110	Slight decelleration trend observable (horizontal rate reduced from 0.1mm/day to 0.06 mm/day).
SWD-06	8/11/2021	0.08	0.08	143	Horizontal movement rate listed. Similar pattern of seasonal fluctuation due to freeze/thaw of survey hub.
SWD-07	8/11/2021	0.12	0.07	102	Possible acceleration trend. Difficult to determine due to seasonal freeze/thaw fluctuations.
SWD-08	8/11/2021	0.22	0.26	108	Slight decelleration trend observable.
SWD-09	8/11/2021	0.50	0.80	77	Slight decelleration trend observable.
SWD-10	8/11/2021	-	-	-	No significant movement
SWD-11	8/11/2021	0.60	0.60	108	Similar pattern of seasonal fluctuation due to freeze/thaw of survey hub.
SWD-12	6/23/2020	0.65	0.70	93	Steady displacement since installation in Fall 2018

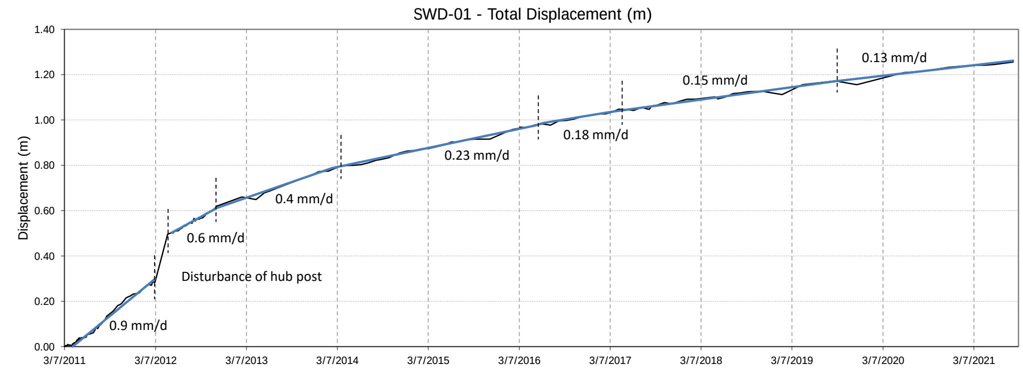
Source files:

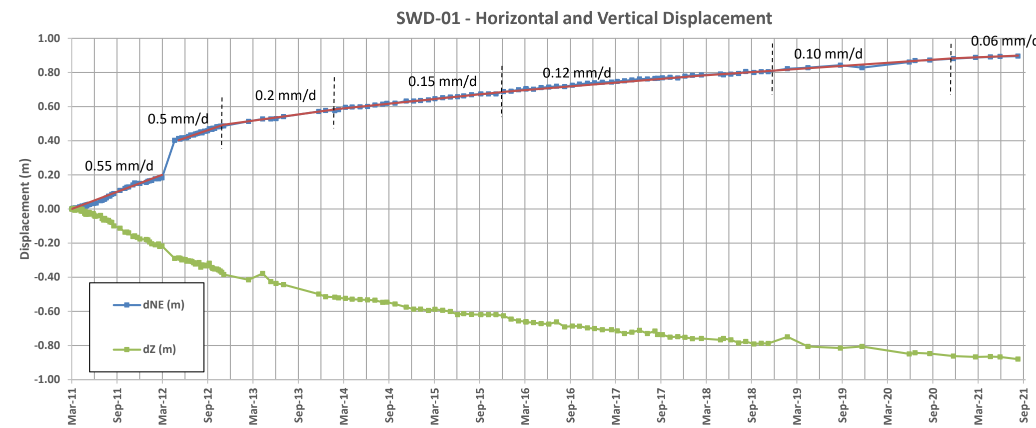
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

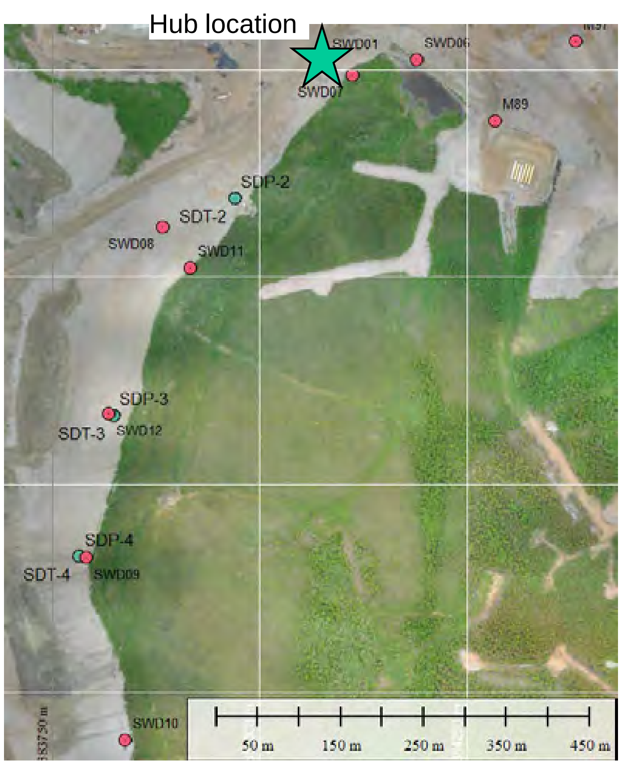
srk consulting	MINTO	SWD Instrumentation Data **Southwest Dump Survey Hub Summary**
Job No: 1CM002.073 Filename: ApF_2021SWD Instrumentation.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 1

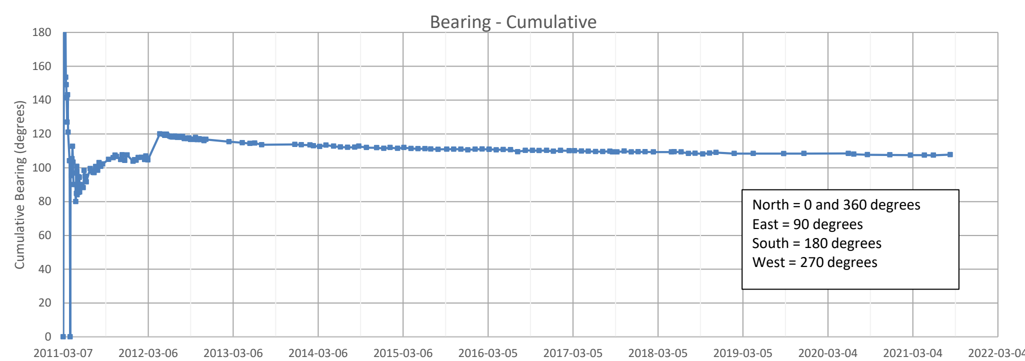


Notes:
Coordinate system is NAD 83 UTM Zone 8.









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting

MINTO

SWD Instrumentation Data

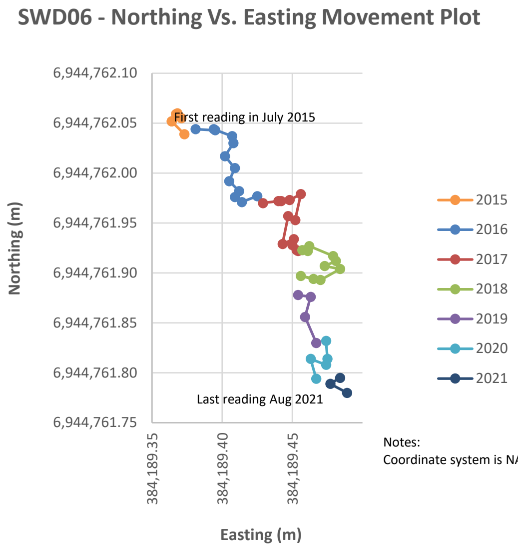
Survey Hub – SWD-01

Job No: 1CM002.073

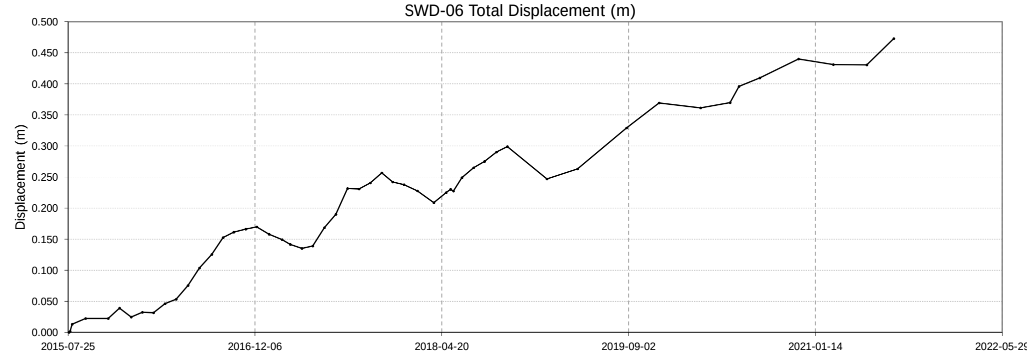
Filename: ApF_2021SWD Instrumentation.pptx

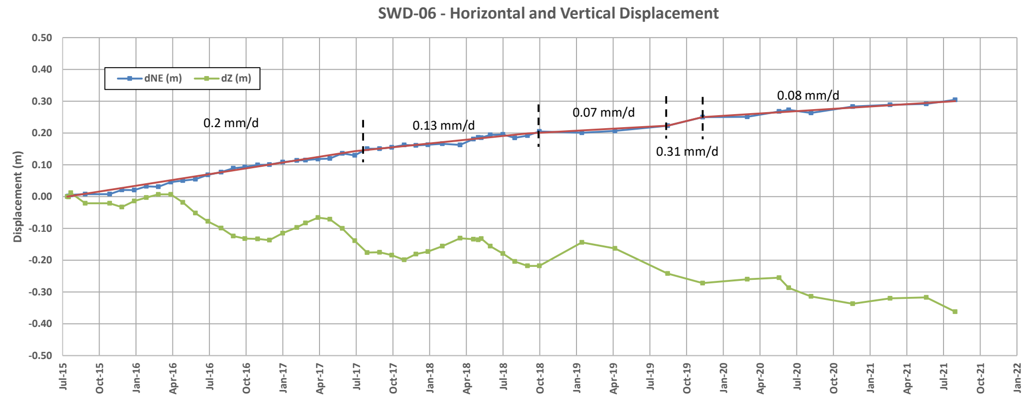
Minto Mine

Date:	Prepared by	Figure:
October 2021	PHM	2



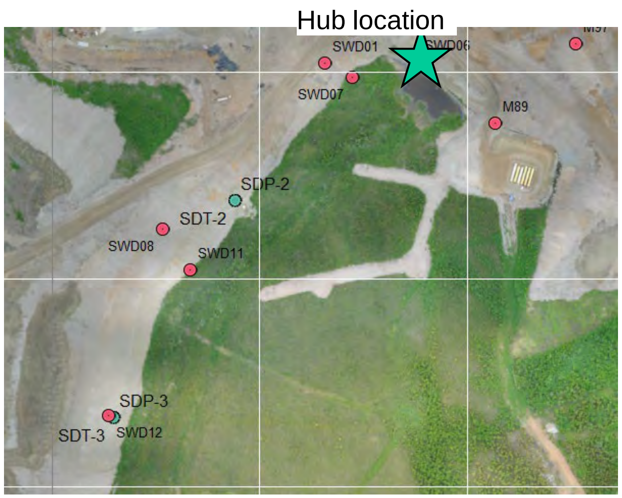
Notes:
Coordinate system is NAD 83 UTM Zone 8.

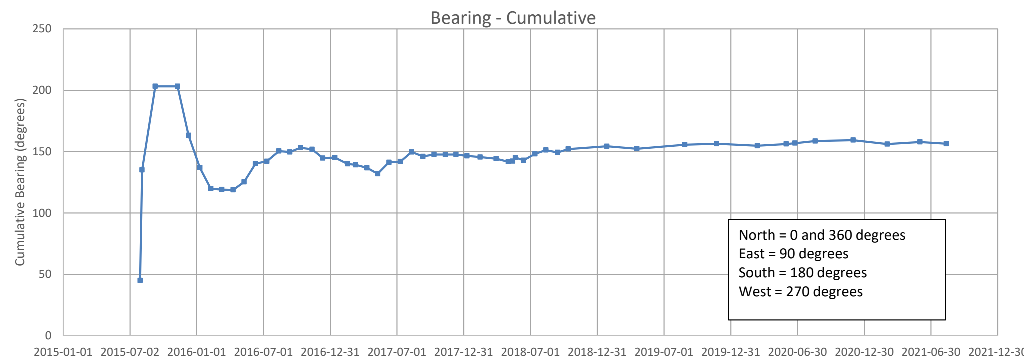




Notes

1. *Hub is a replacement for SWD-01A that was disturbed by frost heave.*
2. *The hub consists of a lock-block on surface, and as a result, seasonal ground movement as a result freeze/thaw cycles may occur that is not indicative of large-scale ground movement. As a result, the horizontal displacement plot is likely to be the most useful plot for monitoring movement.*

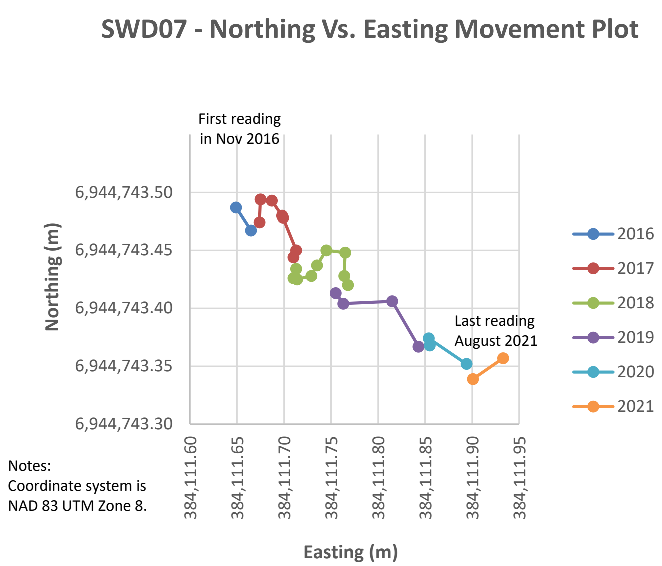


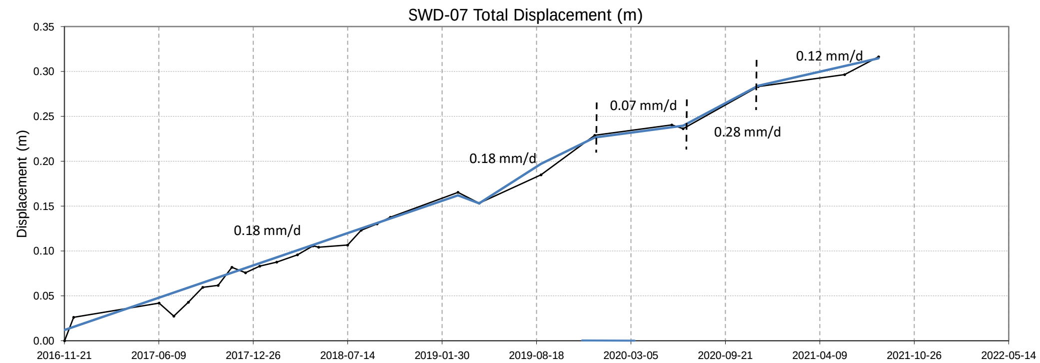


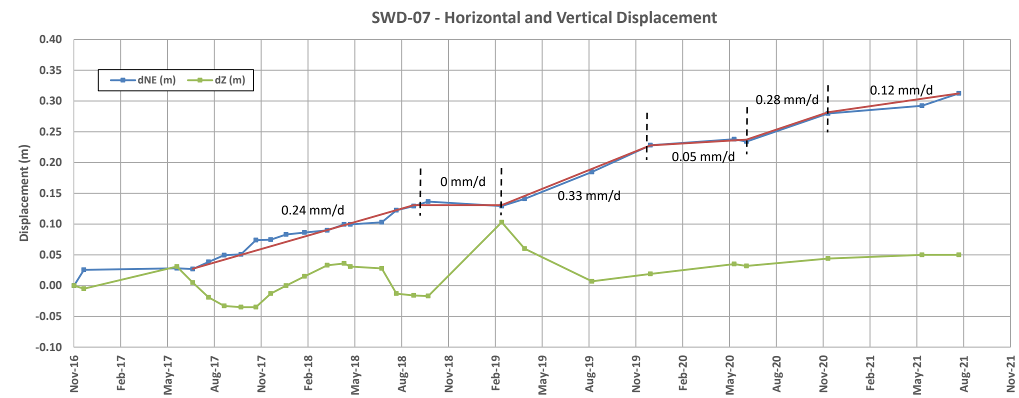
Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	SWD Instrumentation Data
		Survey Hub – SWD-06
Job No: 1CM002.073 Filename: ApF_2021SWD Instrumentation.pptx	Minto Mine	Date: October 2021 | Prepared by PHM | Figure: 3

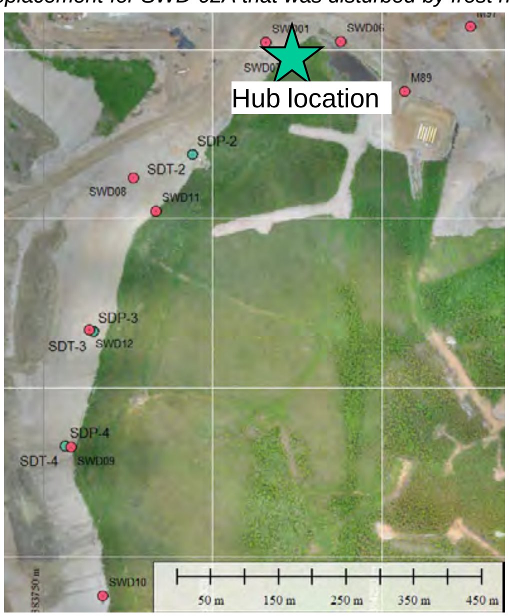


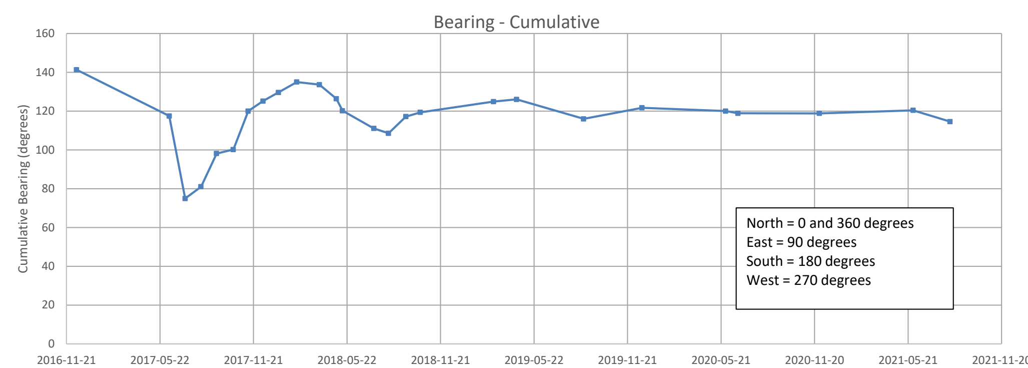




Notes

1. *Hub is a replacement for SWD-02A that was disturbed by frost heave.*





Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting | MINTO

SWD Instrumentation Data

Survey Hub – SWD-07

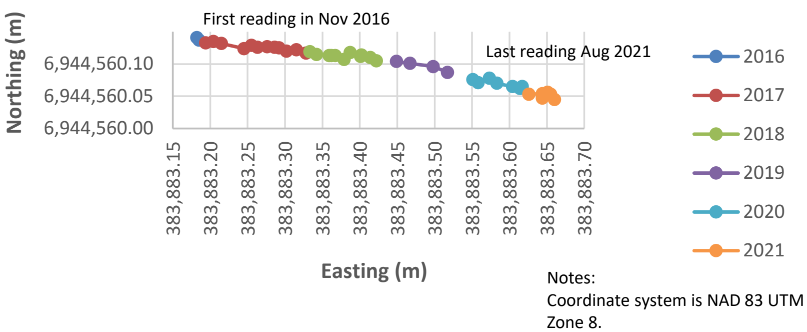
Job No: 1CM002.073

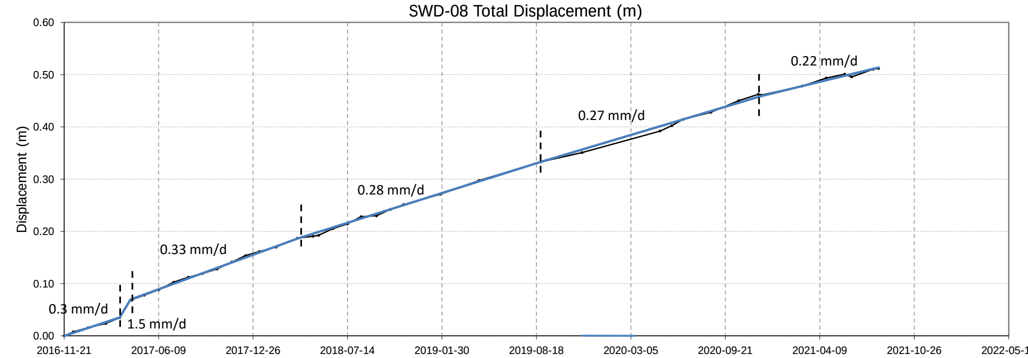
Filename: ApF_2021SWD Instrumentation.pptx

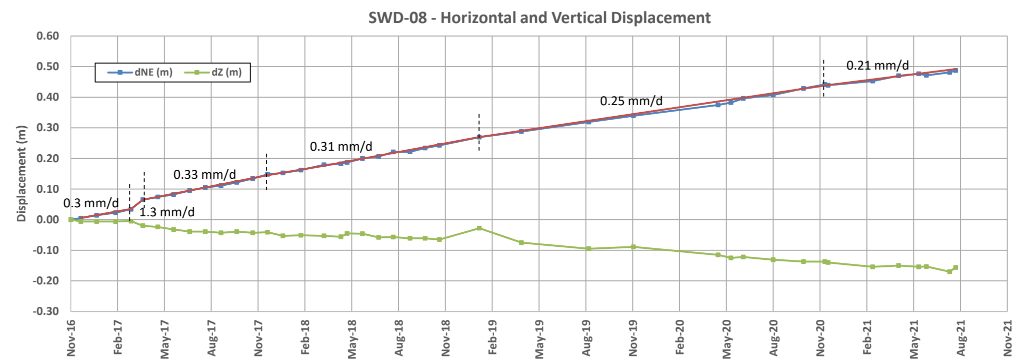
Minto Mine

Date: October 2021 | Prepared by PHM | Figure: 4

SWD08 - Northing Vs. Easting Movement Plot

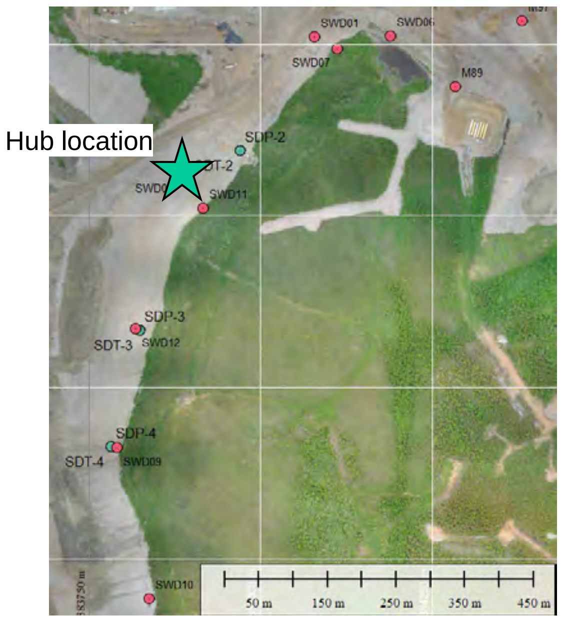


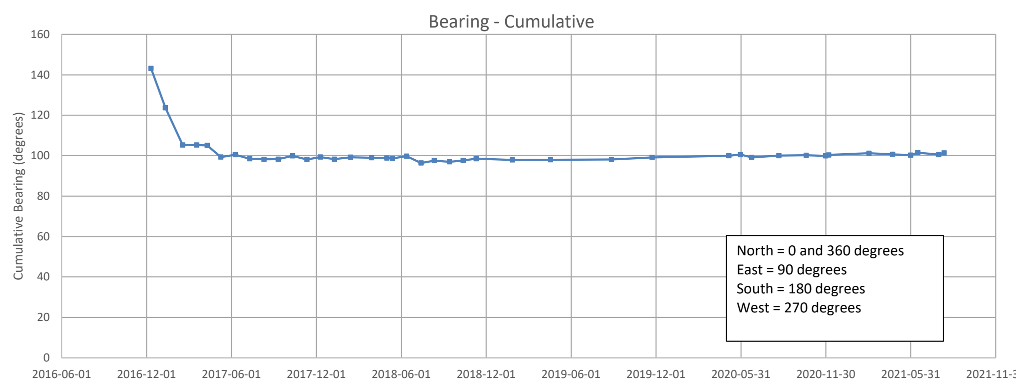




Notes

1. *Hub is a replacement for SWD-02 that was disturbed as a result of regrading of the SWD.*





Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting

MINTO

SWD Instrumentation Data

Survey Hub – SWD-08

Job No: 1CM002.073

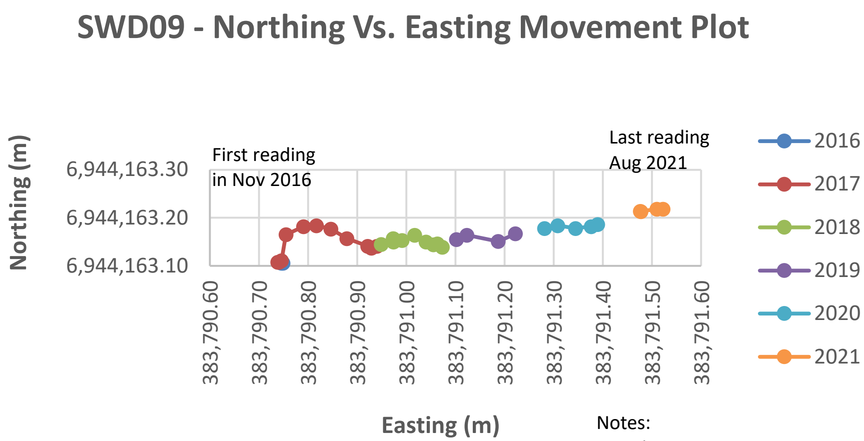
Filename: ApF_2021SWD Instrumentation.pptx

Minto Mine

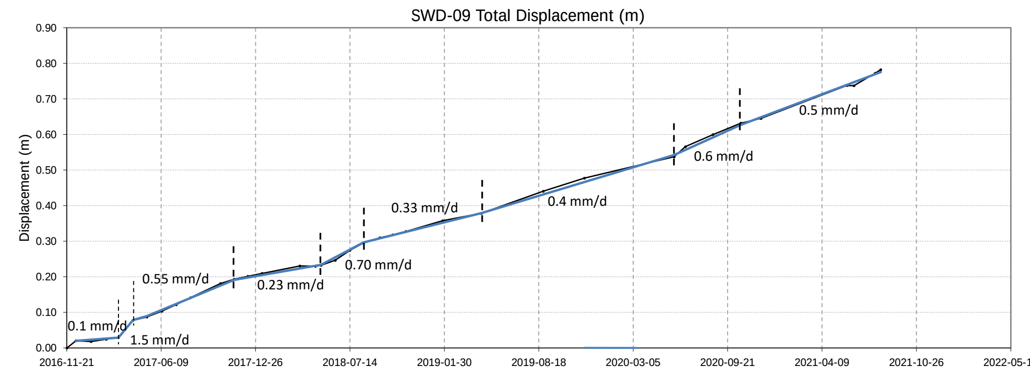
Date: October 2021

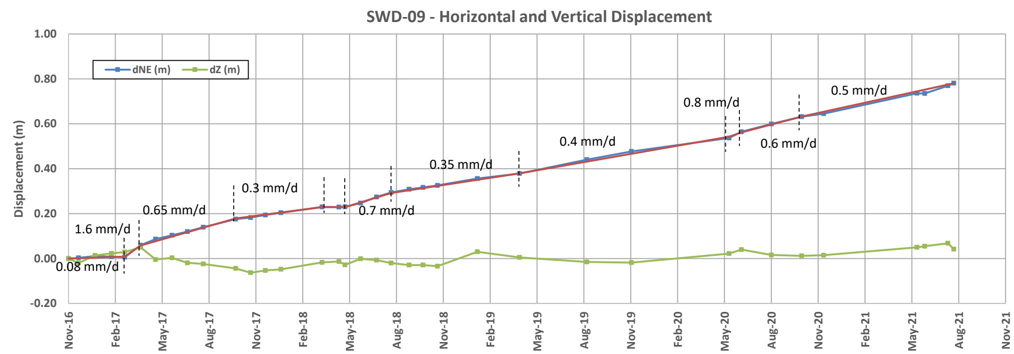
Prepared by PHM

Figure: 5



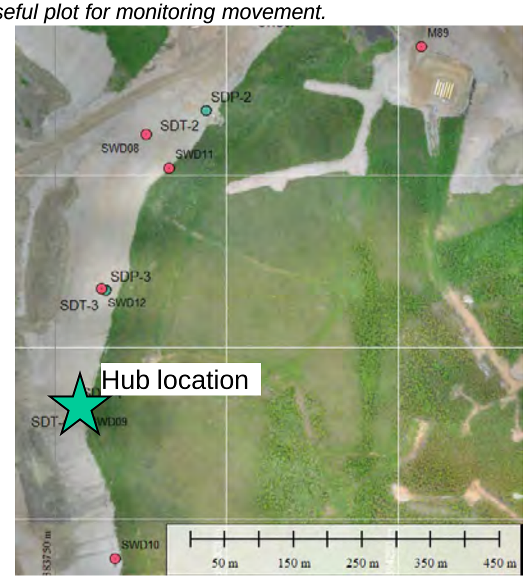
Notes:
Coordinate system is NAD 83 UTM Zone 8.

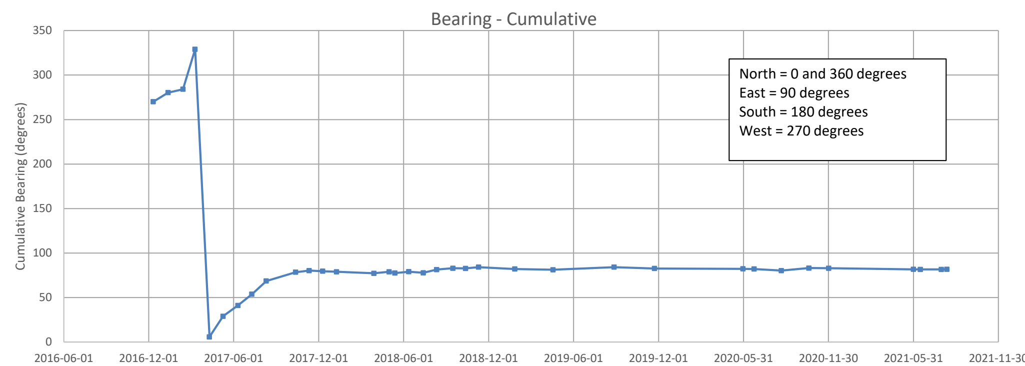




Notes

1. *Hub is a replacement for SWD-04A that was disturbed by frost heave.*
2. *The hub consists of a large boulder on surface, and as a result, seasonal ground movement as a result freeze/thaw cycles may occur that is not indicative of large-scale ground movement. As a result, the horizontal displacement plot is likely to be the most useful plot for monitoring movement.*





Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

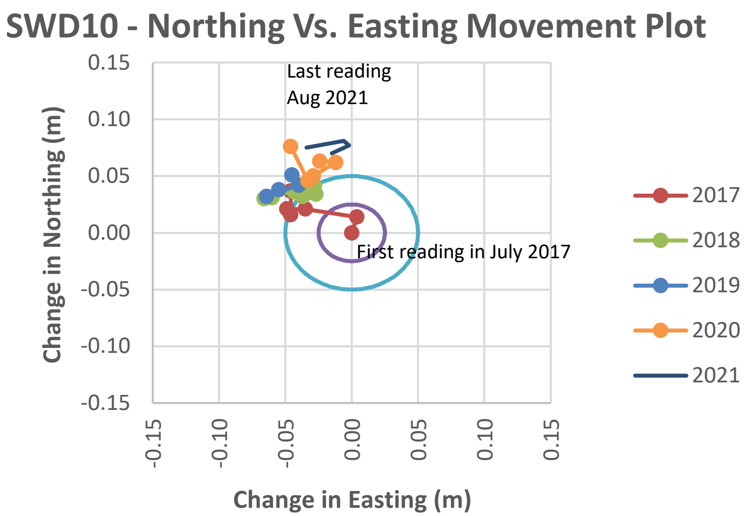
srk consulting | MINTO | SWD Instrumentation Data

Survey Hub – SWD-09

Job No: 1CM002.073
Filename: ApF_2021SWD Instrumentation.pptx

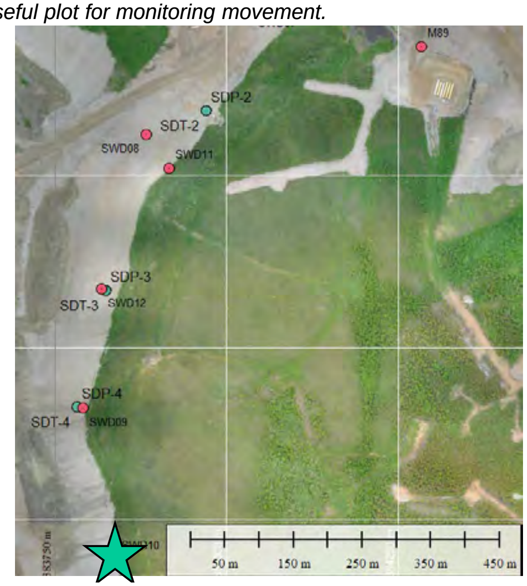
Minto Mine

Date:	Prepared by	Figure:
October 2021	PHM	6

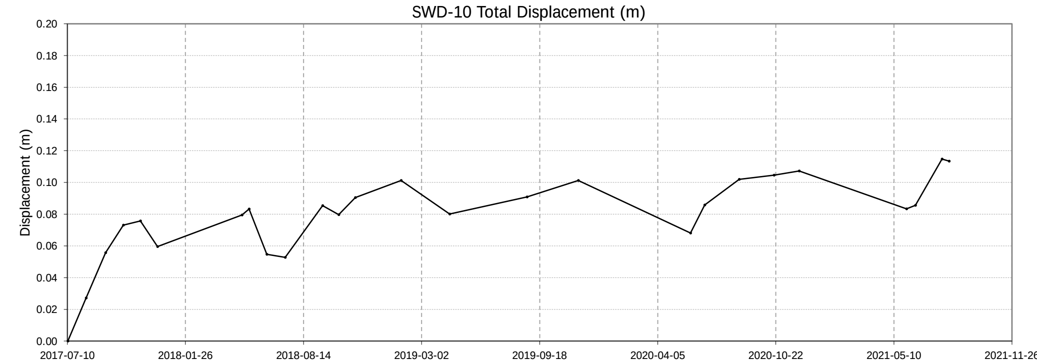


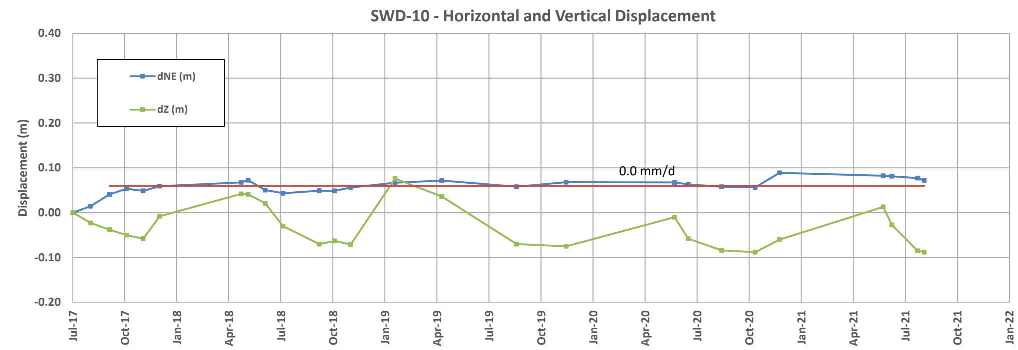
Notes

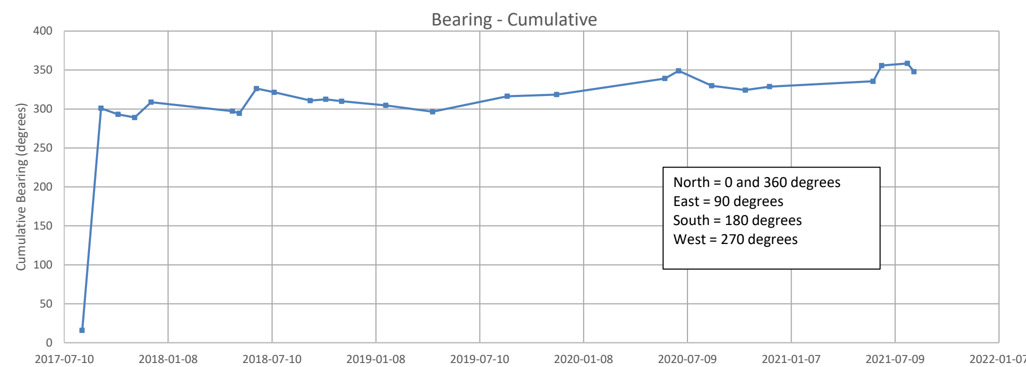
1. *Hub is a replacement for SWD-05A that was disturbed by frost heave.*
2. *The hub consists of a large boulder on surface, and as a result, seasonal ground movement as a result freeze/thaw cycles may occur that is not indicative of large-scale ground movement. As a result, the horizontal displacement plot is likely to be the most useful plot for monitoring movement.*



Hub location



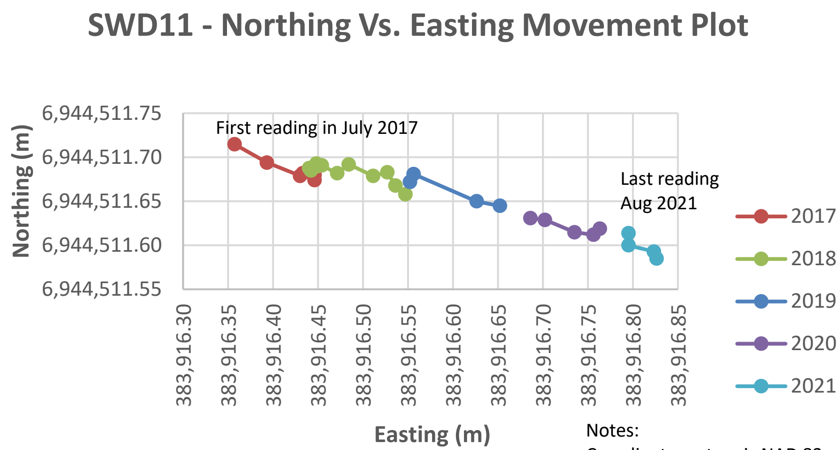




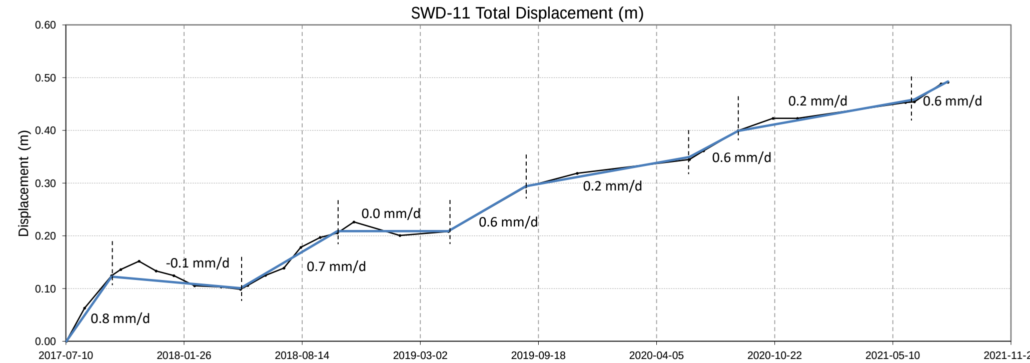
Source files:

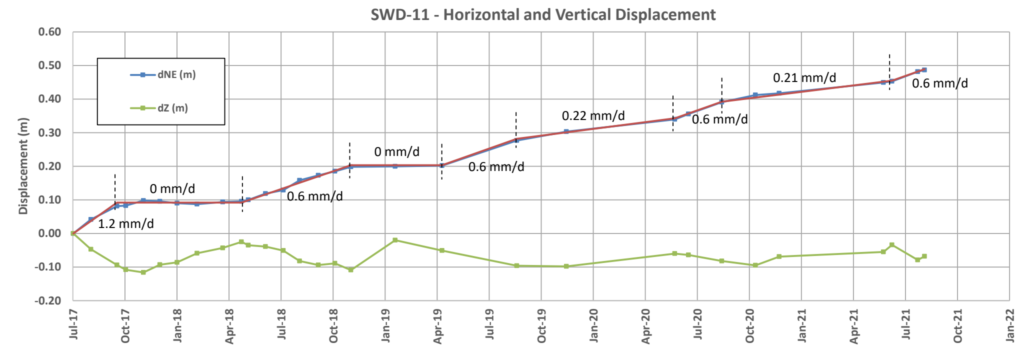
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	SWD Instrumentation Data
		Survey Hub – SWD-10
Job No: 1CM002.073 Filename: ApF_2021SWD Instrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 7



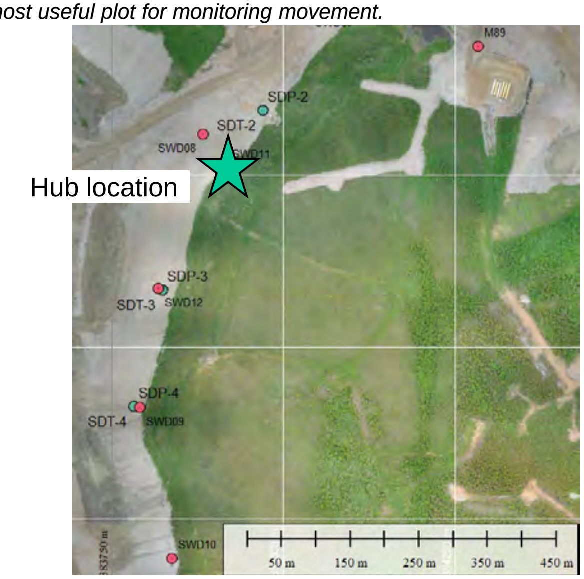
Notes:
Coordinate system is NAD 83 UTM Zone 8.

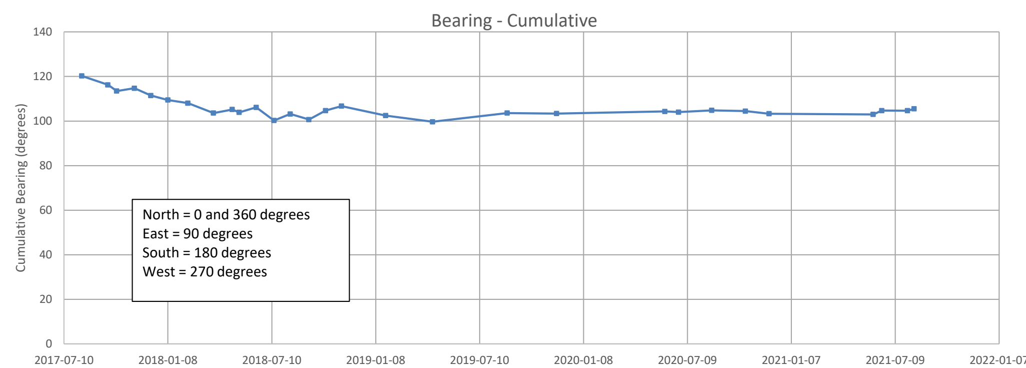




Notes

1. *Hub is a replacement for SWD-03A that was disturbed by frost heave.*
2. *The hub consists of a large boulder on surface, and as a result, seasonal ground movement as a result freeze/thaw cycles may occur that is not indicative of large-scale ground movement. As a result, the horizontal displacement plot is likely to be the most useful plot for monitoring movement.*

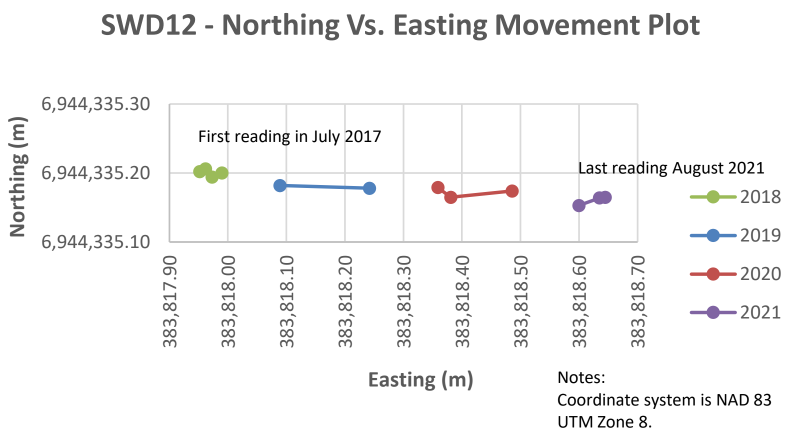


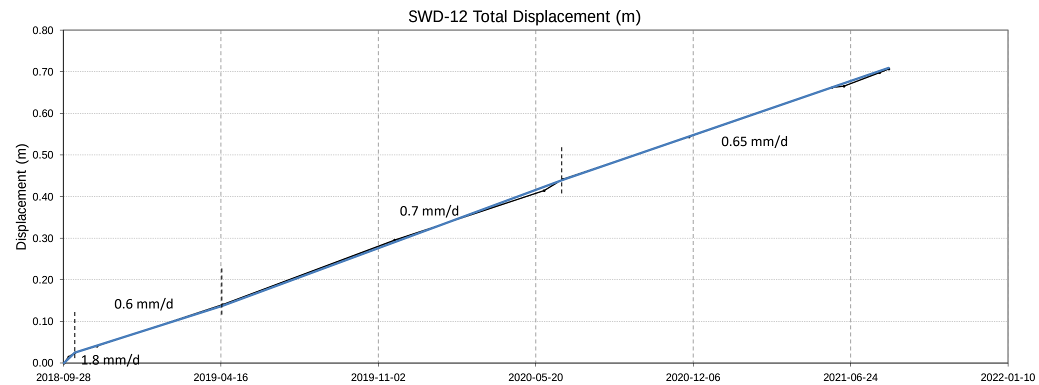


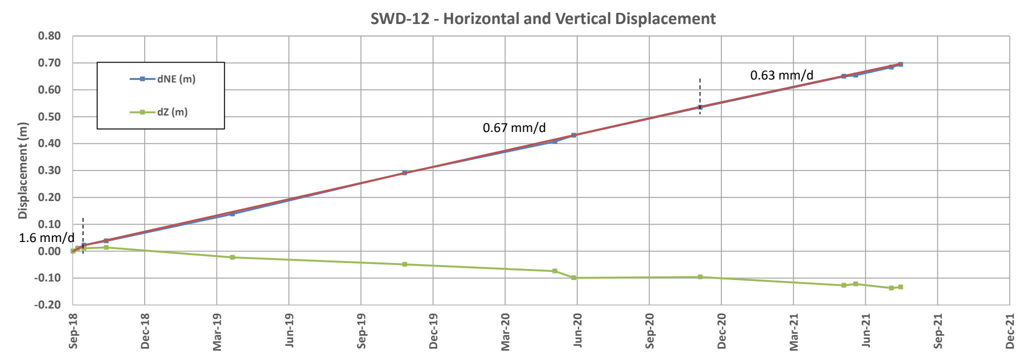
Source files:

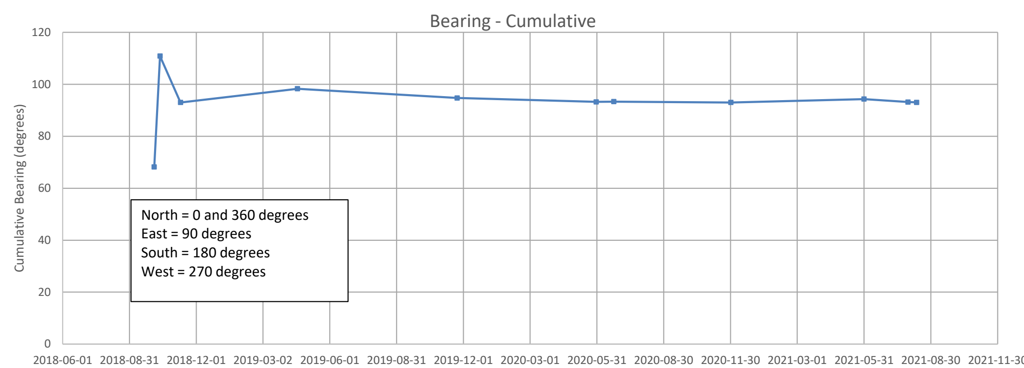
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting	MINTO	SWD Instrumentation Data
		Survey Hub – SWD-11
Job No: 1CM002.073 Filename: ApF_2021SWD Instrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by: PHM / Figure: 8



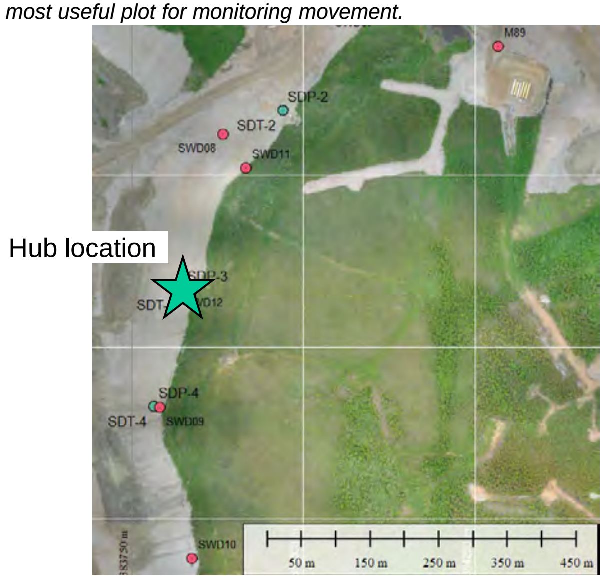






Notes

1. *Hub is a replacement for inclinometer SDI-3 that sheared off in August 2017.*
2. *The hub consists of a large boulder on surface, and as a result, seasonal ground movement as a result freeze/thaw cycles may occur that is not indicative of large-scale ground movement. As a result, the horizontal displacement plot is likely to be the most useful plot for monitoring movement.*



Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting

MINTO

Job No: 1CM002.073

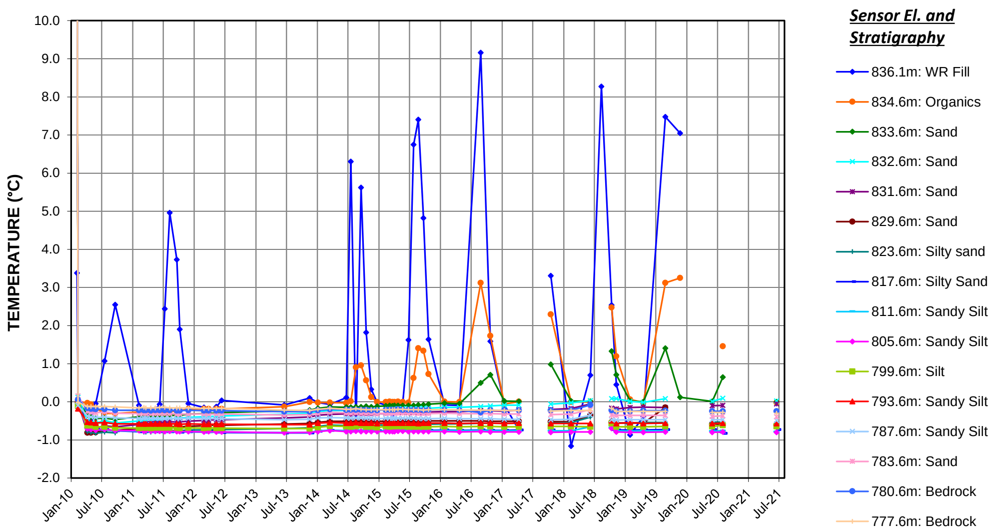
Filename: ApF_2021SWD Instrumentation.pptx

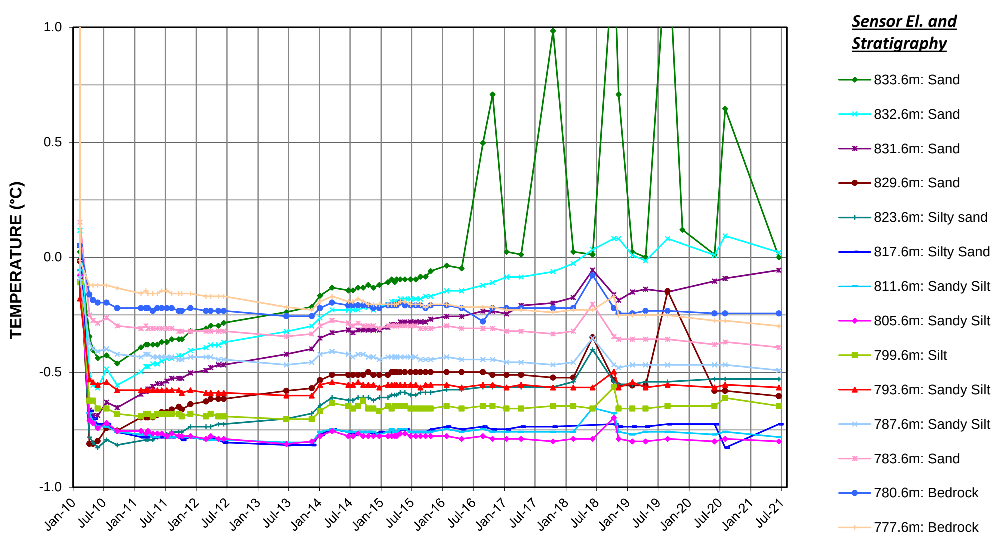
Minto Mine

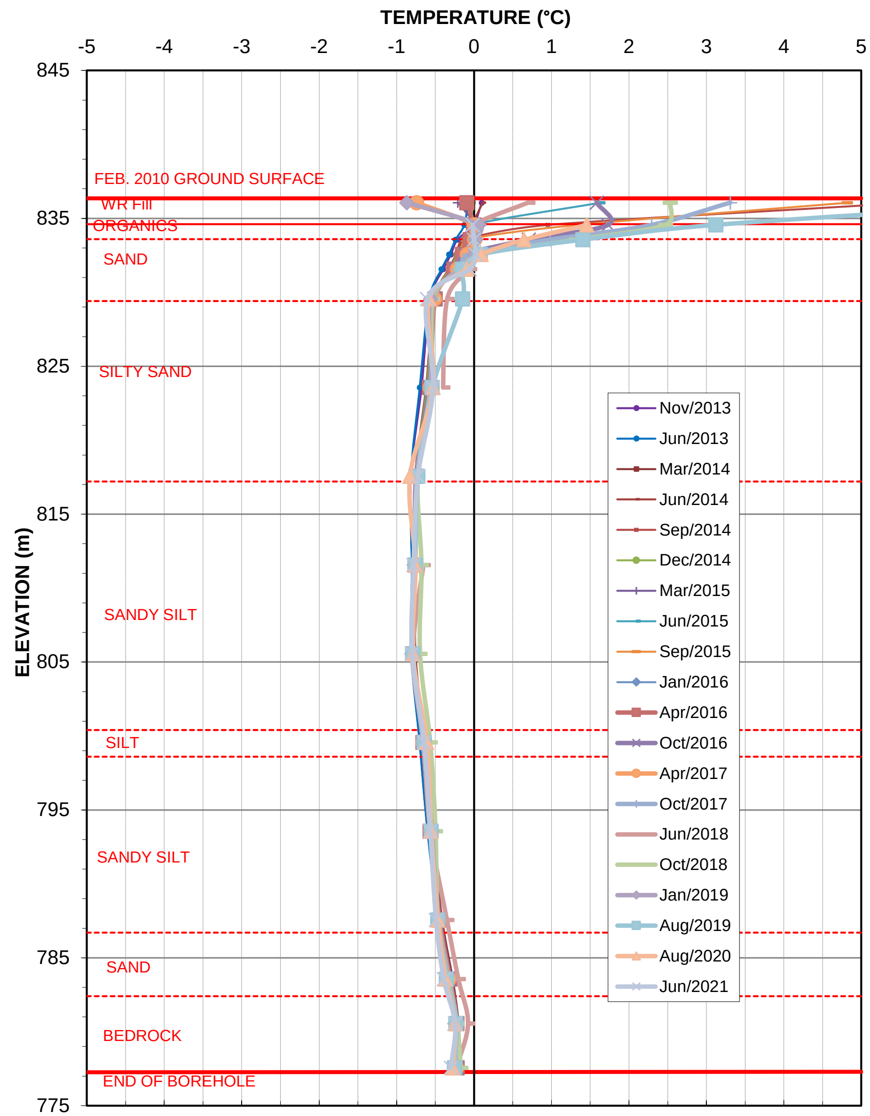
SWD Instrumentation Data

Survey Hub – SWD-12

Date:	Prepared by	Figure:
October 2021	PHM	9







Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMasterSWDInstrumentation_SRK.xlsm

srk consulting

MINTO

SWD Instrumentation Data

Temperature Cable – SDT-1

Job No: 1CM002.073

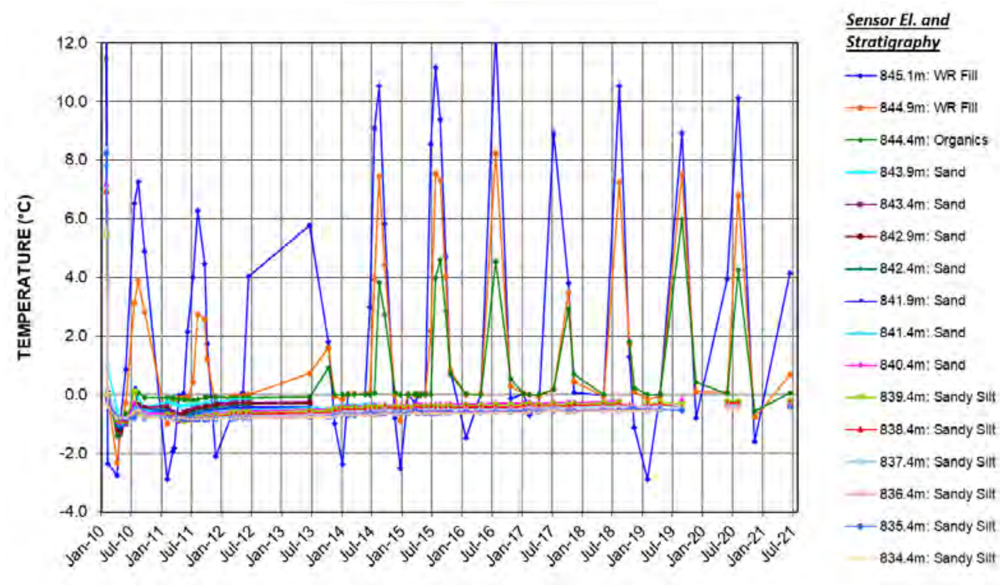
Filename: ApF_2021SWD Instrumentation.pptx

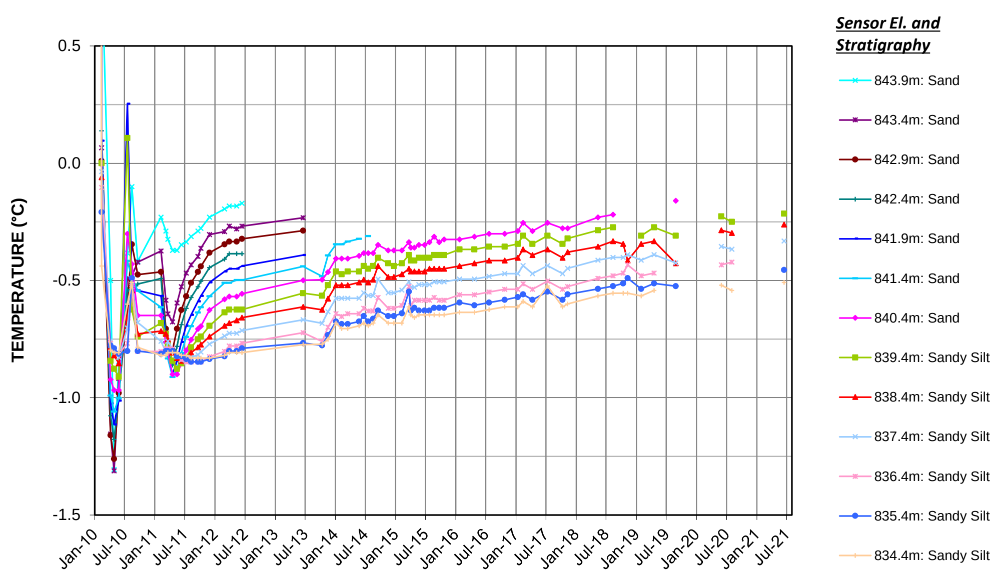
Minto Mine

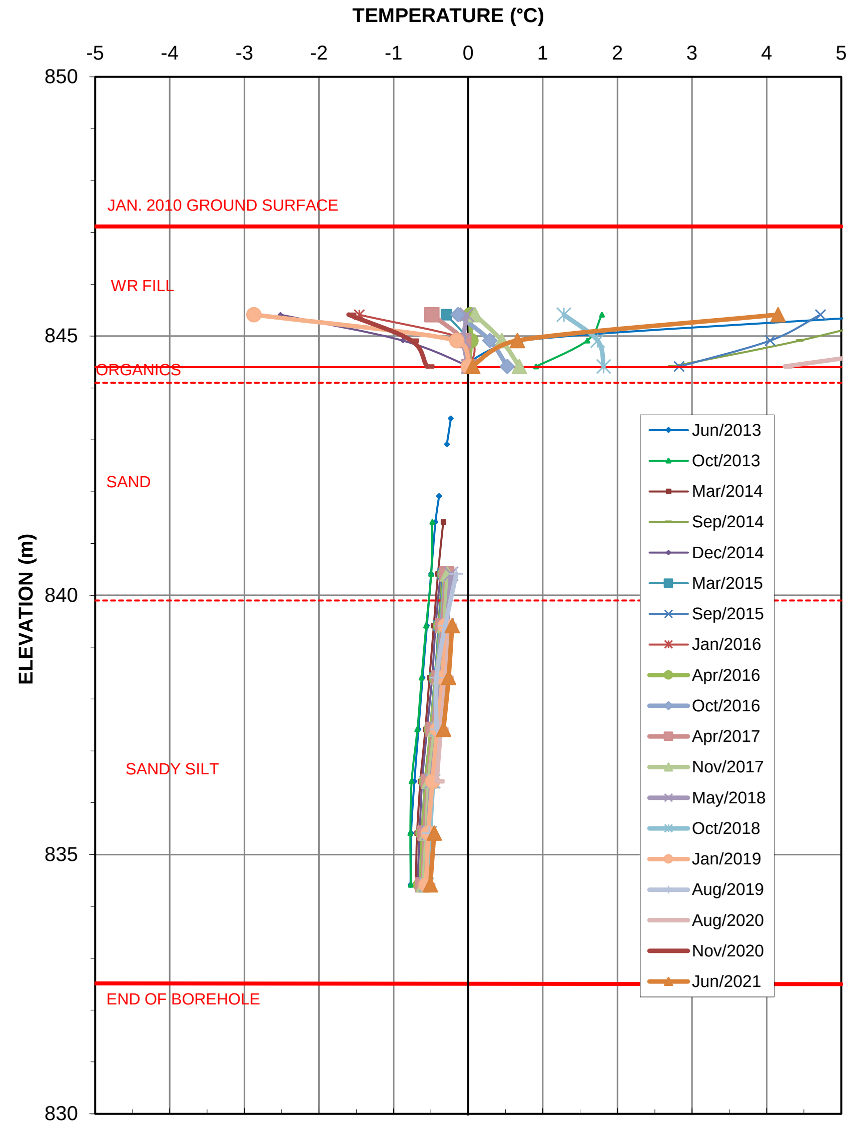
Date: October 2021

Prepared by PHM

Figure: 10



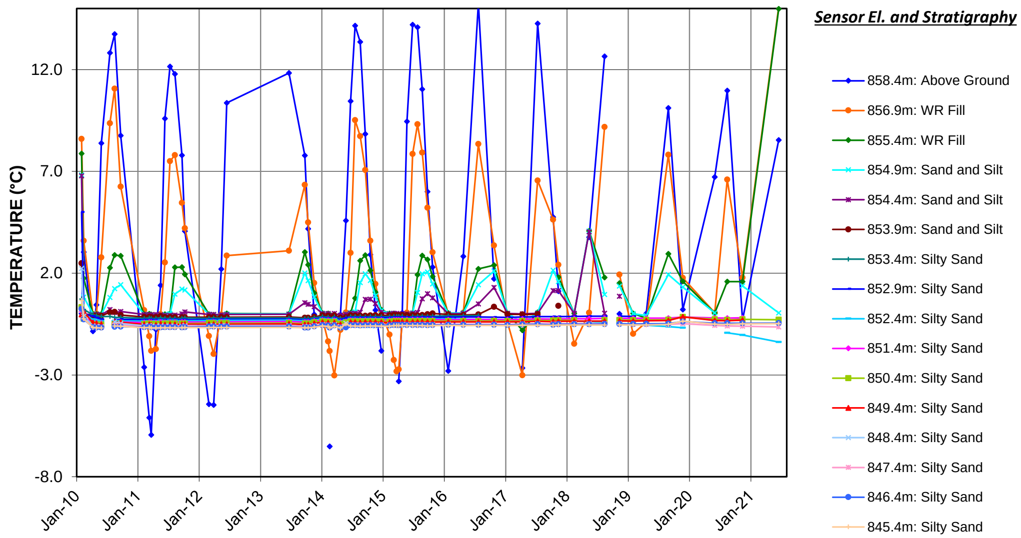


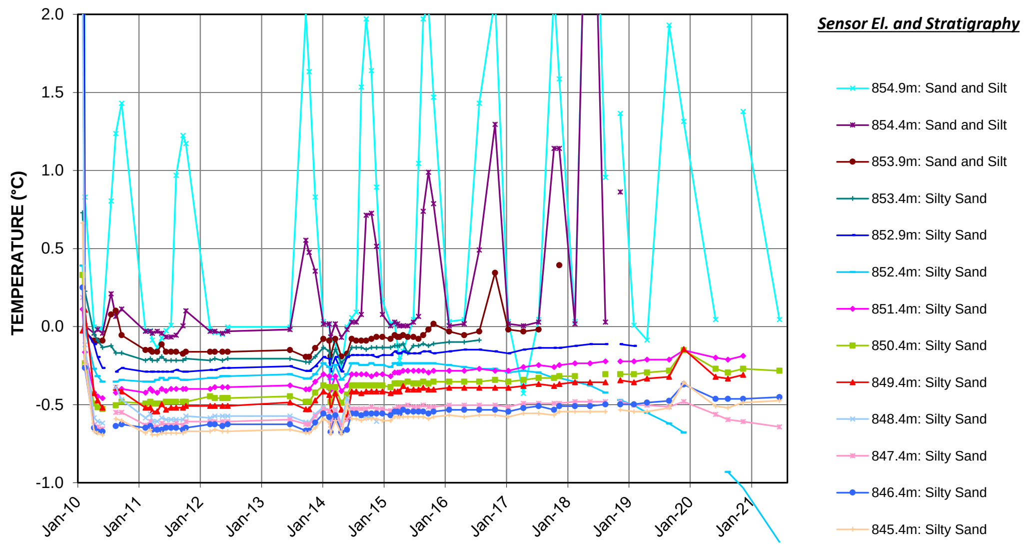


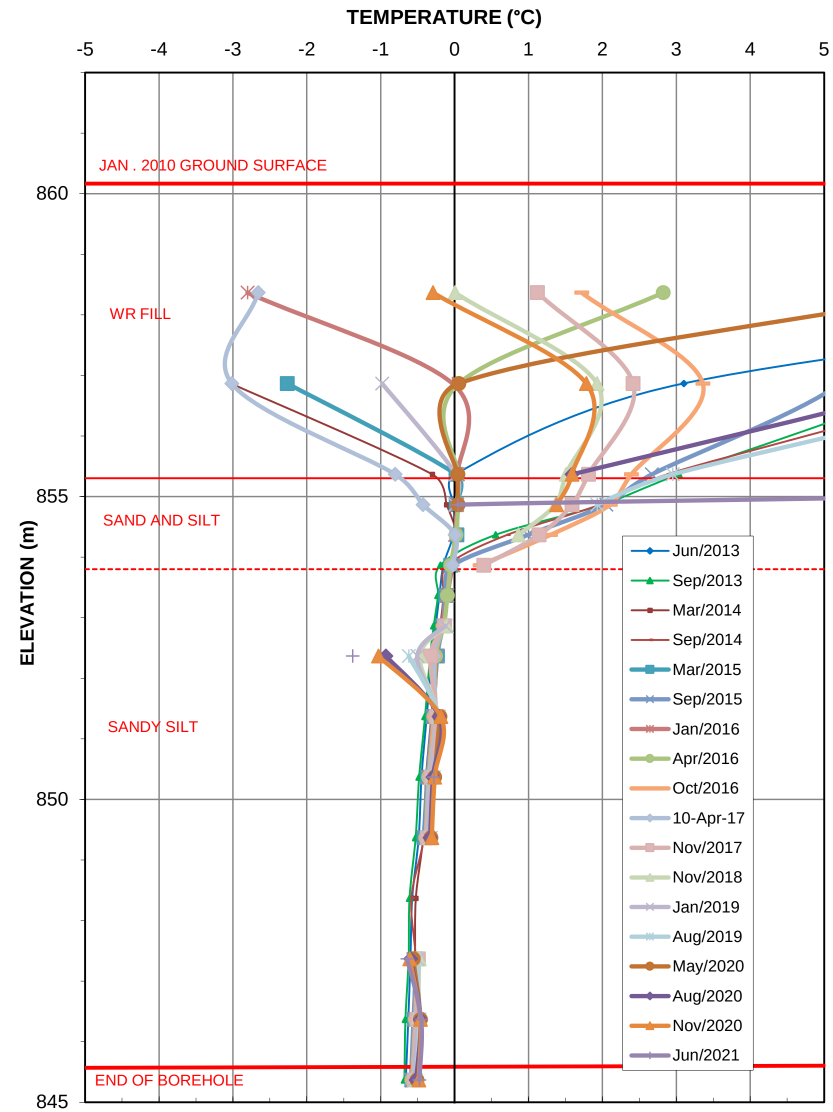
Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMasterSWDInstrumentation_SRK.xlsm

srk consulting	MINTO	SWD Instrumentation Data
		Temperature Cable – SDT-2
Job No: 1CM002.073 Filename: ApF_2021SWD Instrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 11



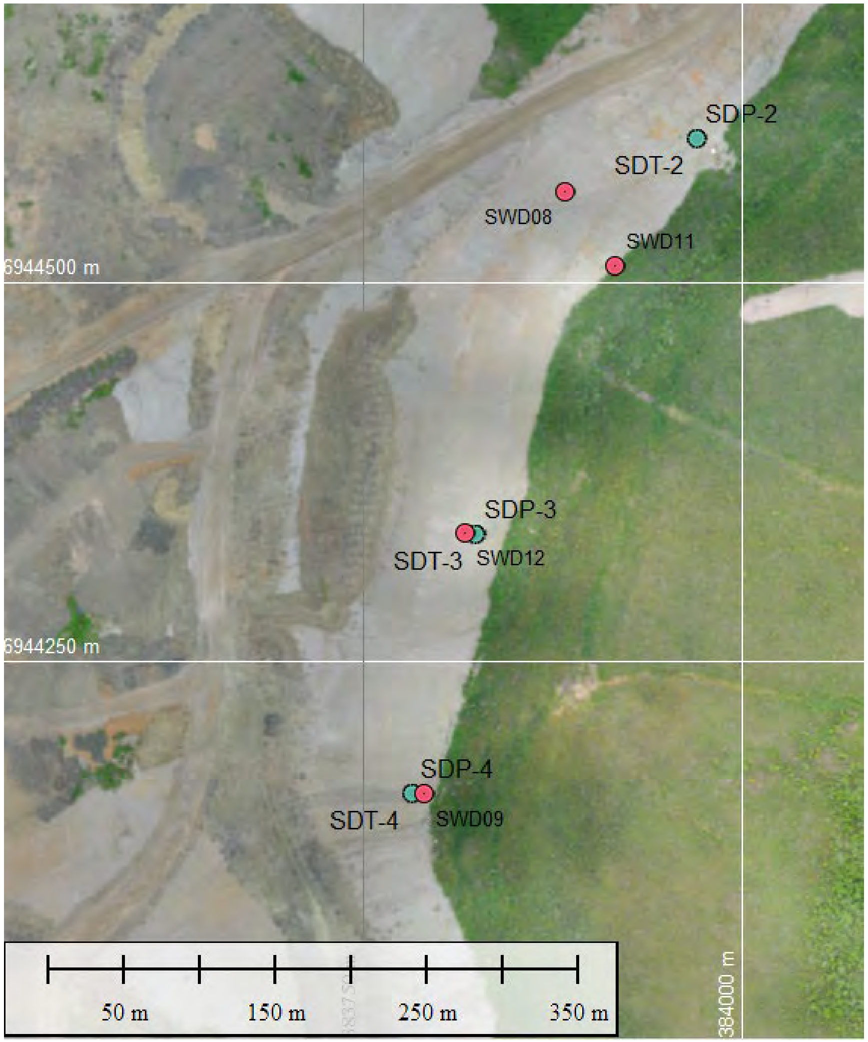




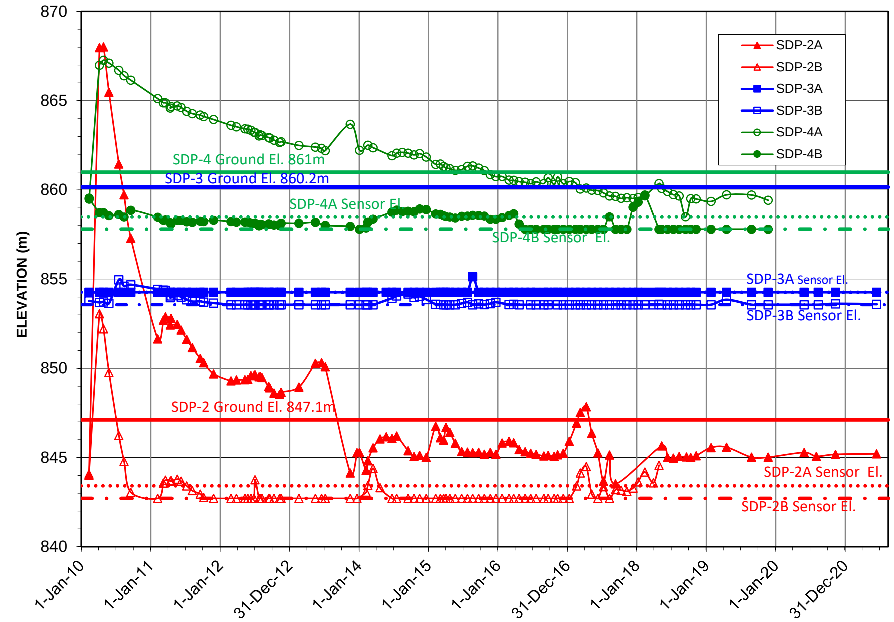
Source files:

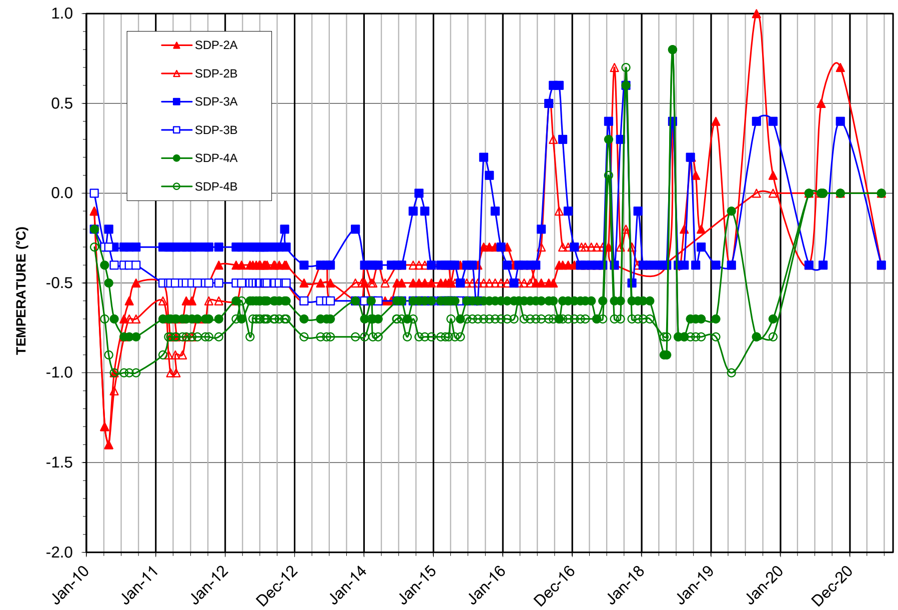
1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMasterSWDInstrumentation_SRK.xlsm

srk consulting	MINTO	SWD Instrumentation Data
		Temperature Cable – SDT-3
Job No: 1CM002.073 Filename: ApF_2021SWD Instrumentation.pptx	Minto Mine	Date: October 2021 · Prepared by: PHM · Figure: **12**



Southwest Dump Piezometers and Ground Temperature Cables





Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMasterSWDInstrumentation_SRK.xlsm

srk consulting

MINTO

SWD Instrumentation Data

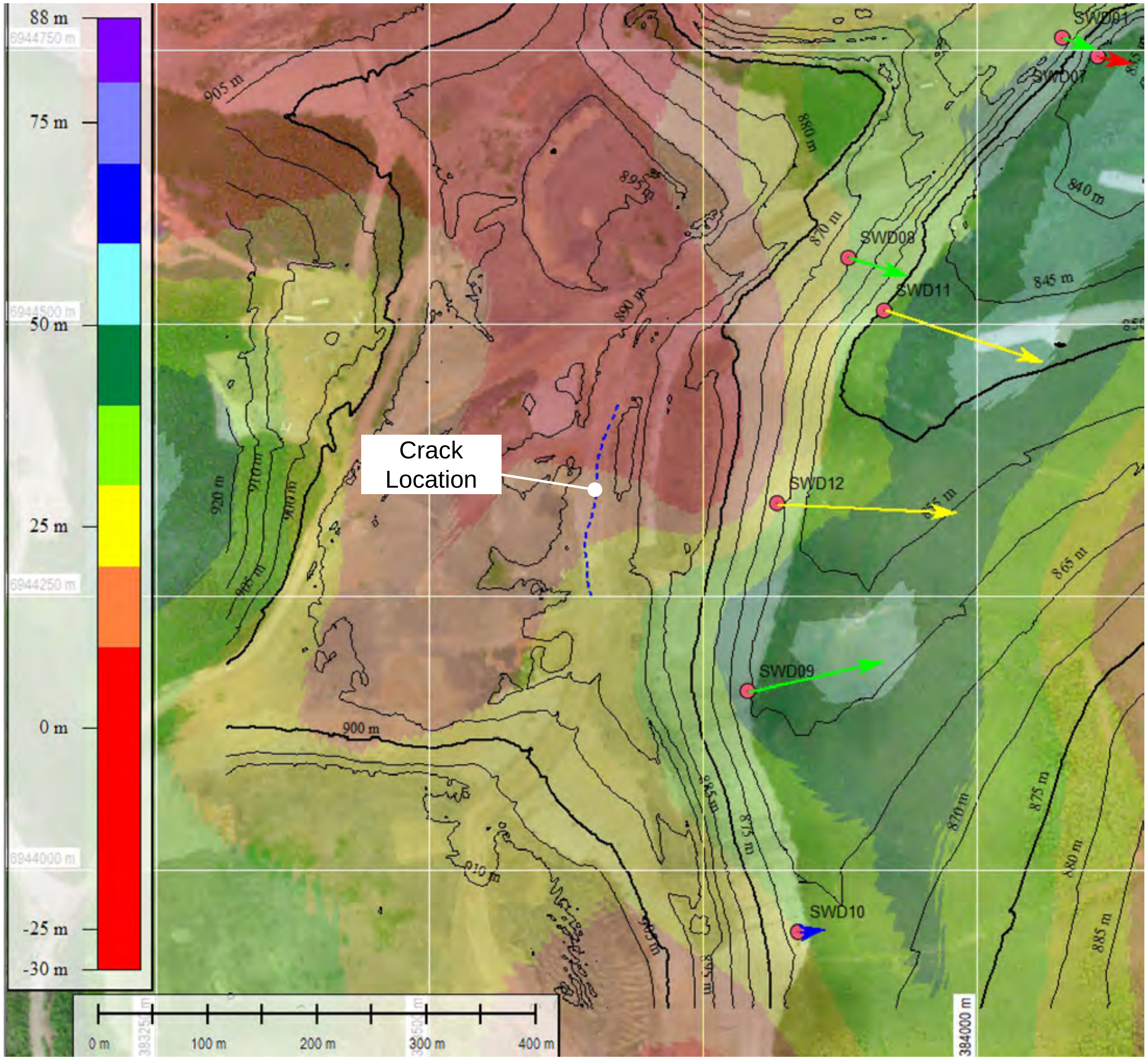
Southwest Dump Piezometers

Job No: 1CM002.073

Filename: ApF_2021SWD Instrumentation.pptx

Minto Mine

Date:	Prepared by	Figure:
October 2021	PHM	13



Movement Vector - No Current Movement
Movement Vector - Decelerating Movement
Movement Vector - Steady Movement
Movement Vector - Accelerating Movement

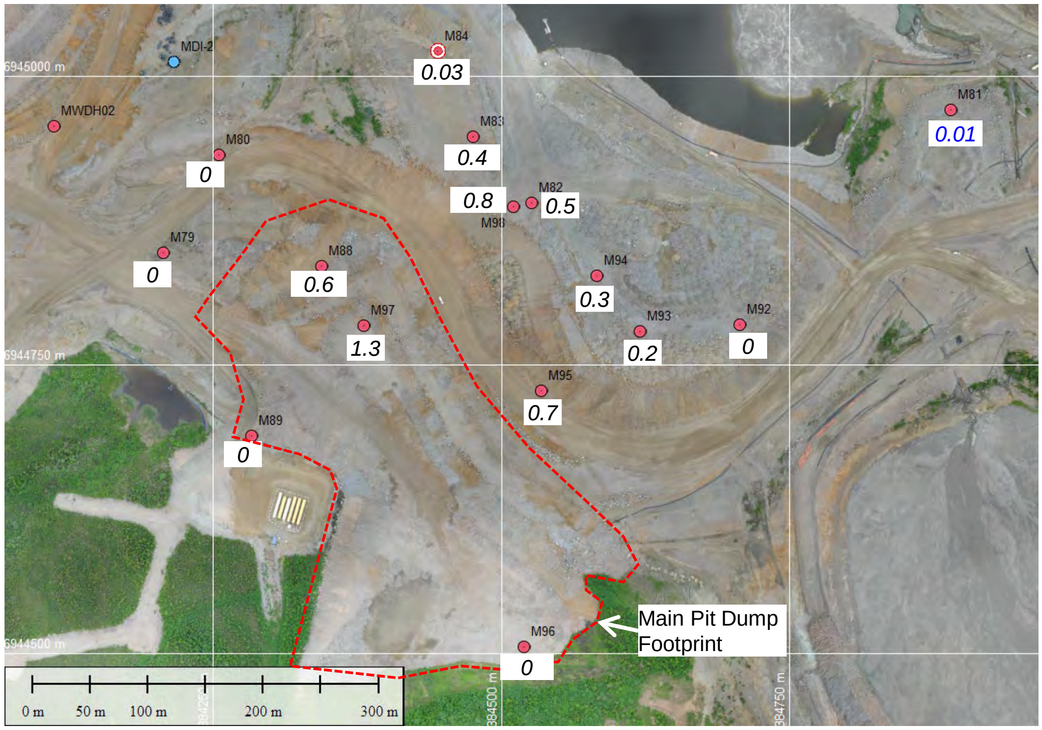
srk consulting	MINTO	SWD Instrumentation Data
		Southwest Dump Crack Location Compared to Overburden Isopach
Job No: 1CM002.073 Filename: ApF_2021SWD Instrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 14

Source file:
\\srk.ad\dfs\na\van\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\Minto2020.gmw

Appendix G Main Pit Instrumentation Data

Legend/Notes

1. *Values in black are total movement rates in units of mm/day*
2. *Values in blue are horizontal movement rates in mm/day.*



Source files:

1. GlobalMapper: C:\Users\pmikes.SRK\OneDrive - SRK Consulting\Projects\Minto\GlobalMapper\Minto2020.gmw
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

Main Pit Active Survey Hubs					
Survey Hub	Last Reading	Movement Rate (mm/day)		Bearing (over past year)	Comments
		Current (as of last reading)	One year prior to last reading		
M79	8/10/2021	0	0	n/a	No significant movement.
M80	8/10/2021	0	0	n/a	No significant movement.
M81	8/9/2021	0.01	0.01	345	No significant horizontal movement (horizontal rates listed).
M82	8/9/2021	0.5	0.8	64	Decelerating since completion of MPD.
M83	8/9/2021	0.4	0.6	43	Decelerating since completion of MPD.
M84	5/15/2021	0.03	0.1	98	Decelerating.
M88	8/9/2021	0.6	0.8	42	Slight deceleration trend observable.
M92	8/10/2021	0	0	n/a	No significant movement.
M93	8/10/2021	0.2	0.3	52	Decelerating.
M94	8/10/2021	0.3	0.3	41	Steady movement, vertical deplacement rate is decellerating, movement direction is turning north.
M95	8/10/2021	0.7	0.7	46	Steady movement.
M97	3/17/2021	1.3	1.6	36	Decelerating.
M98	7/12/2020	0.8	1.2	63	Decelerating.

srk consulting

MINTO

Main Pit Instrumentation Data

Survey Hub Summary

Job No: 1CM002.073

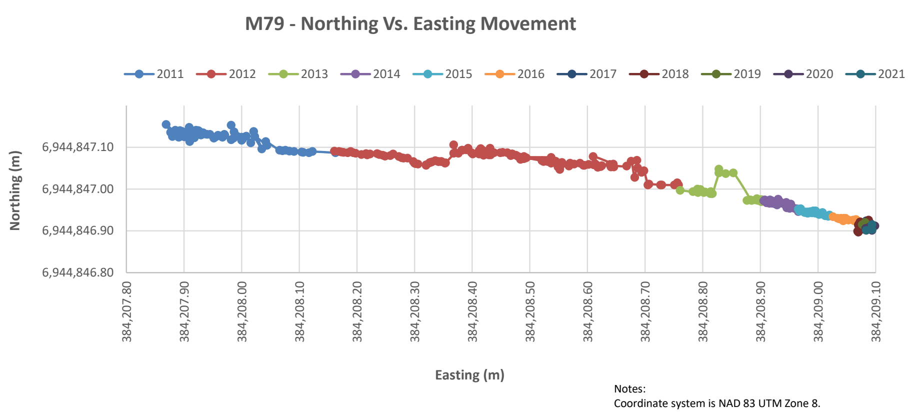
Filename: ApG_MainPitPort.pptx

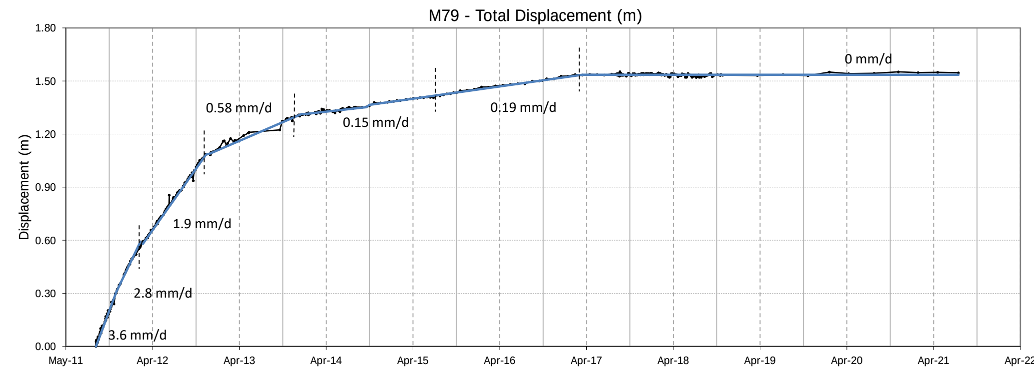
Minto Mine

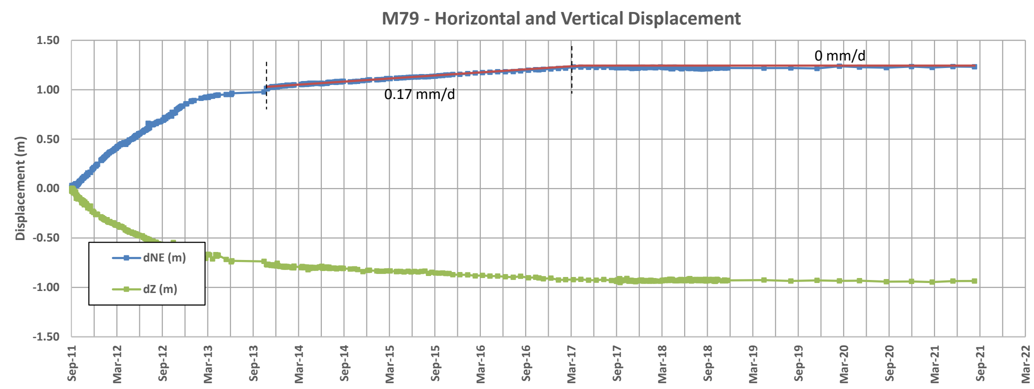
Date: October 2021

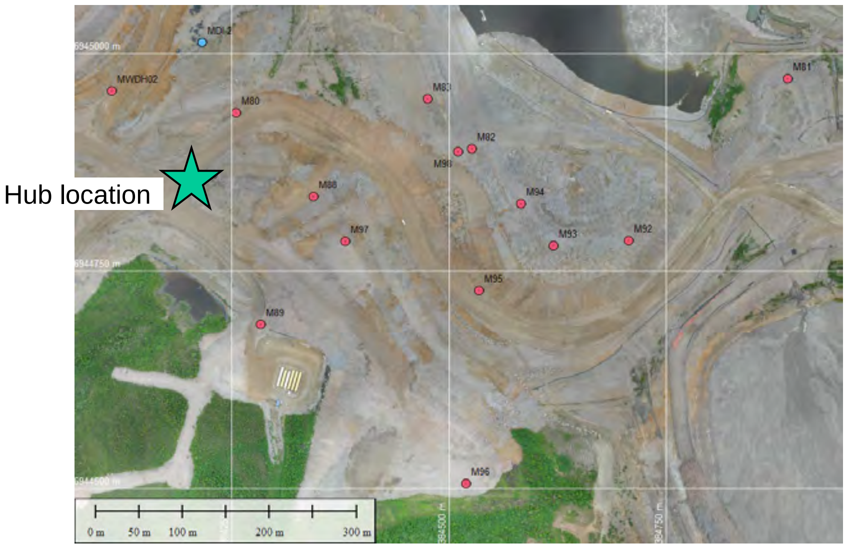
Prepared by: PHM

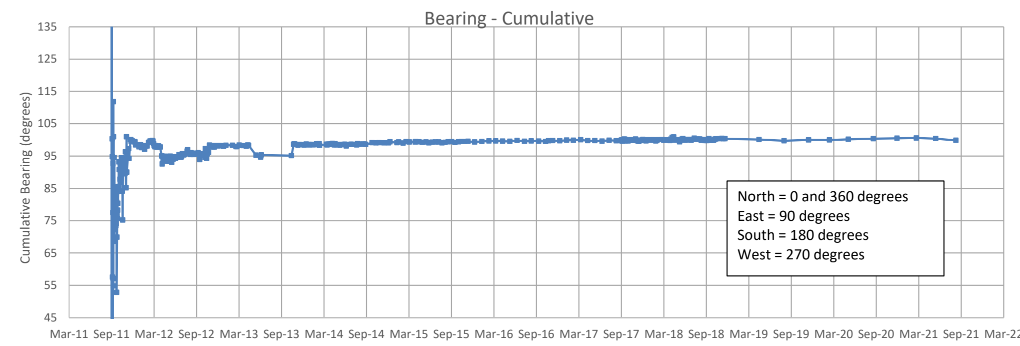
Figure: 1











Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

srk consulting

MINTO

Main Pit Instrumentation Data

Survey Hub – M79

Job No: 1CM002.073

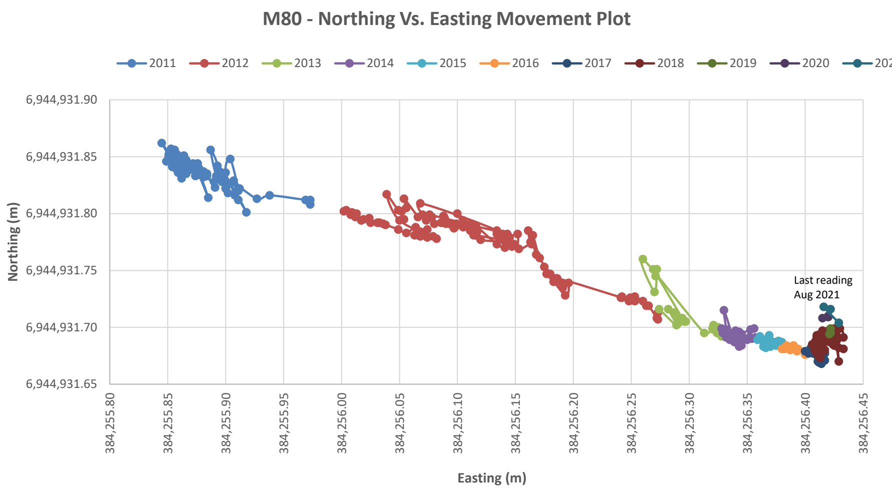
Filename: ApG_2021MainPitInstrumentation.pptx

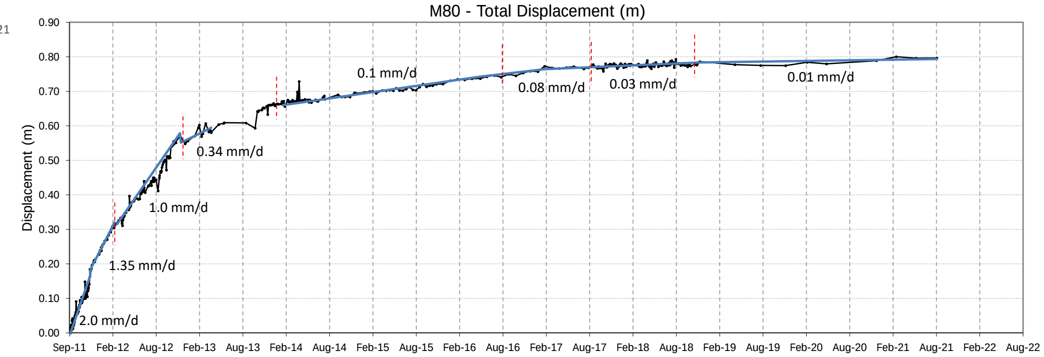
Minto Mine

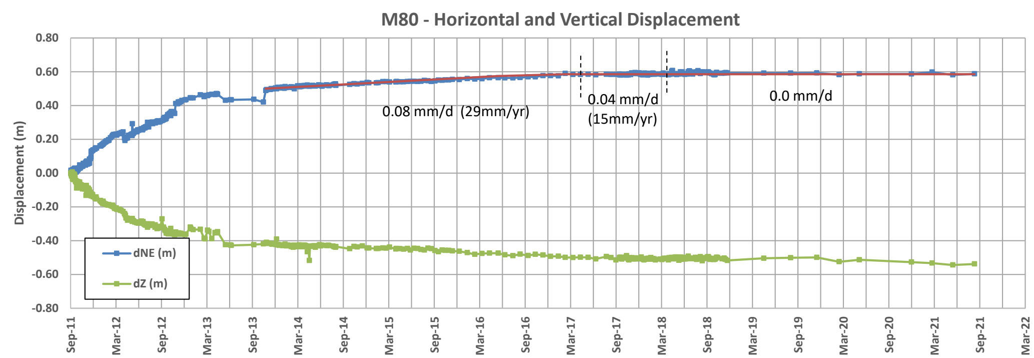
Date: October 2021

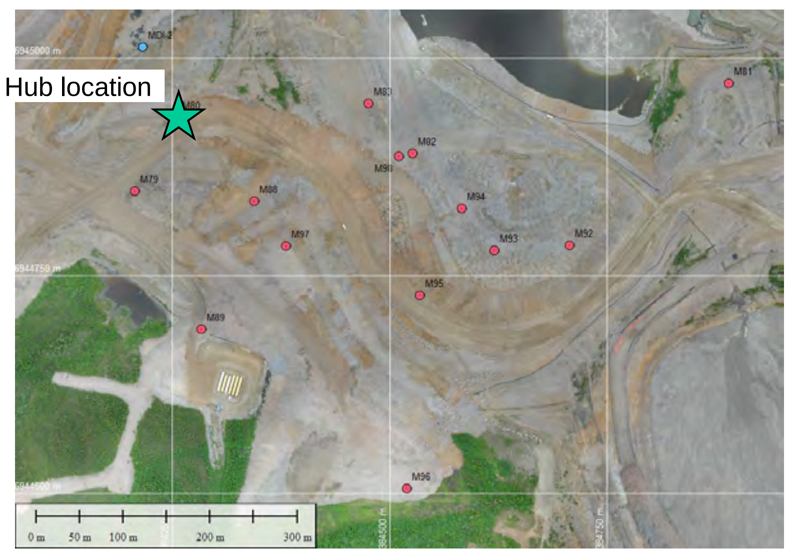
Prepared by: PHM

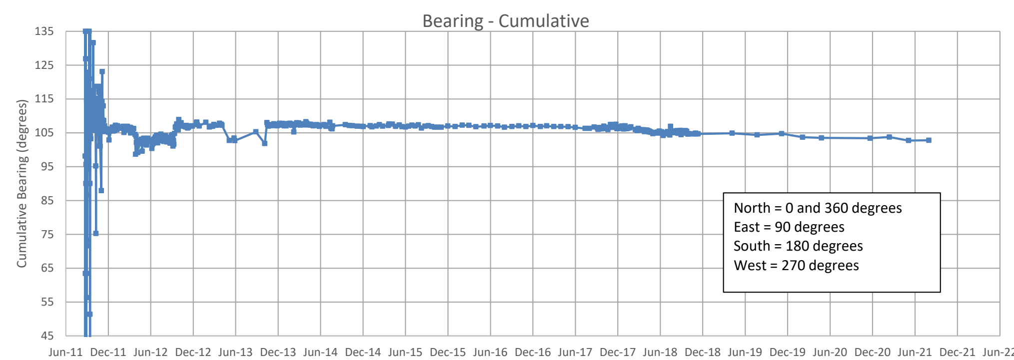
Figure: 2







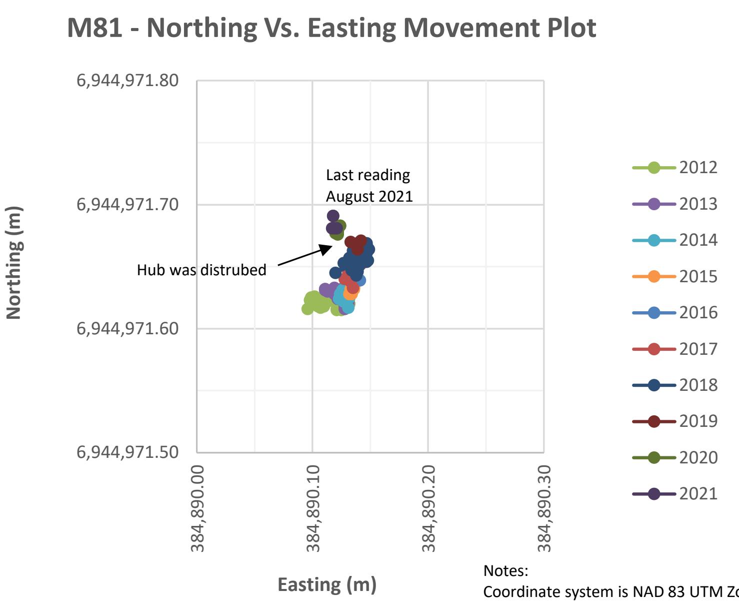




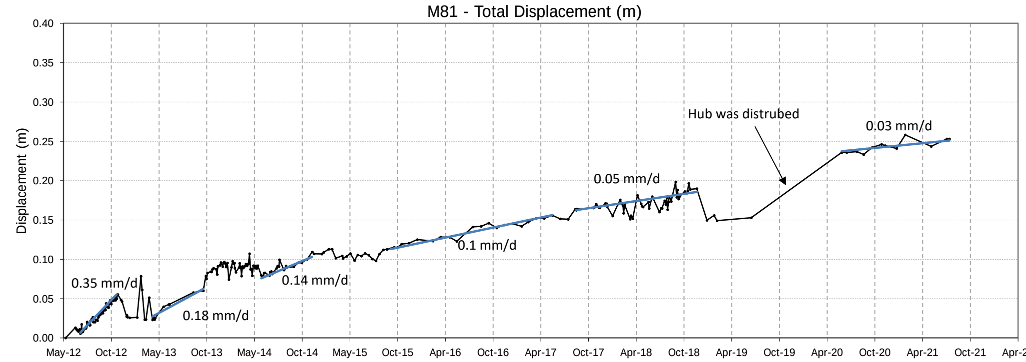
Source files:

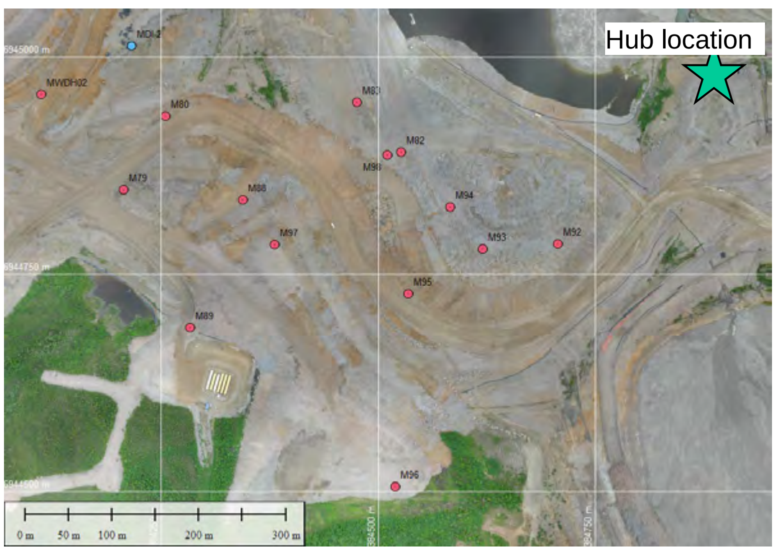
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

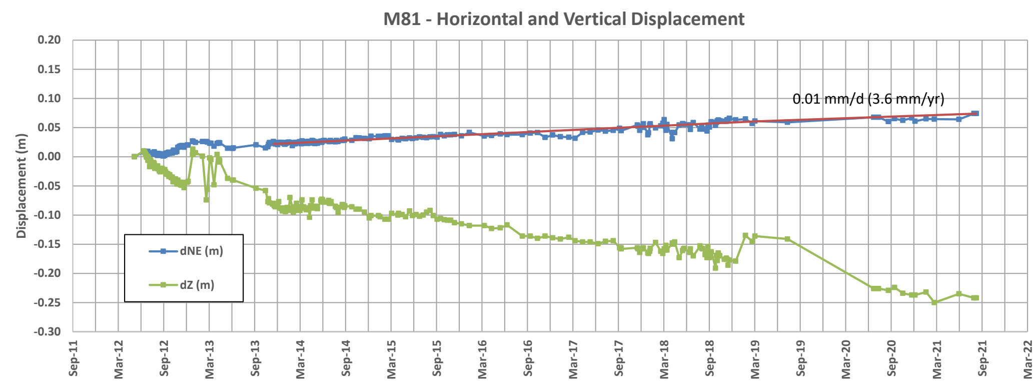
srk consulting	MINTO	Main Pit Instrumentation Data
		Survey Hub – M80
Job No: 1CM002.073 Filename: ApG_2021MainPitInstrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 3

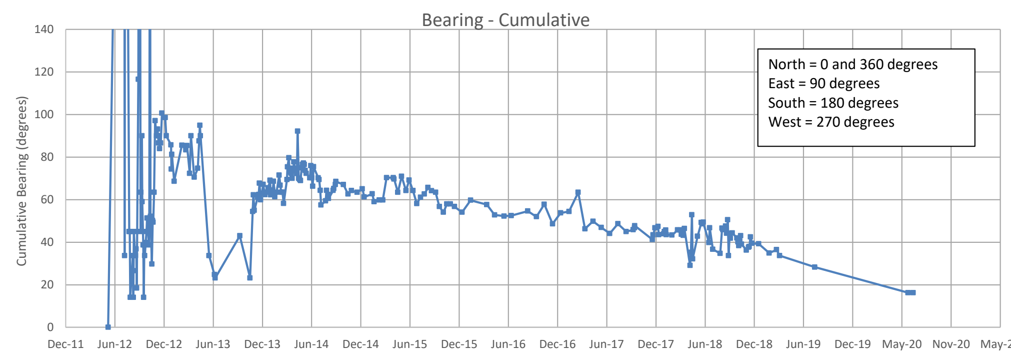


Notes:
Coordinate system is NAD 83 UTM Zone 8.





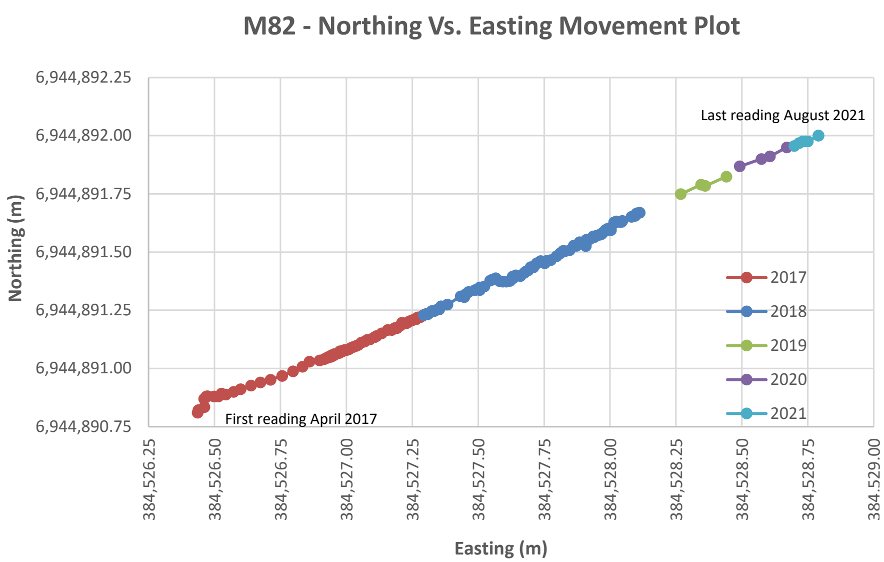




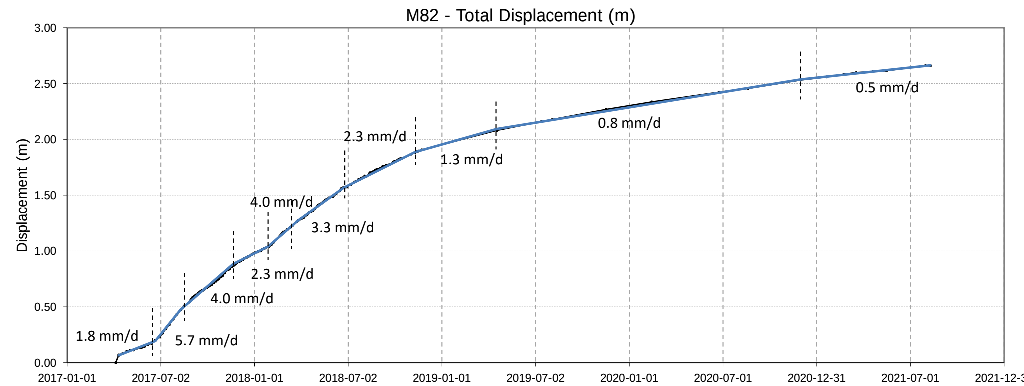
Source files:

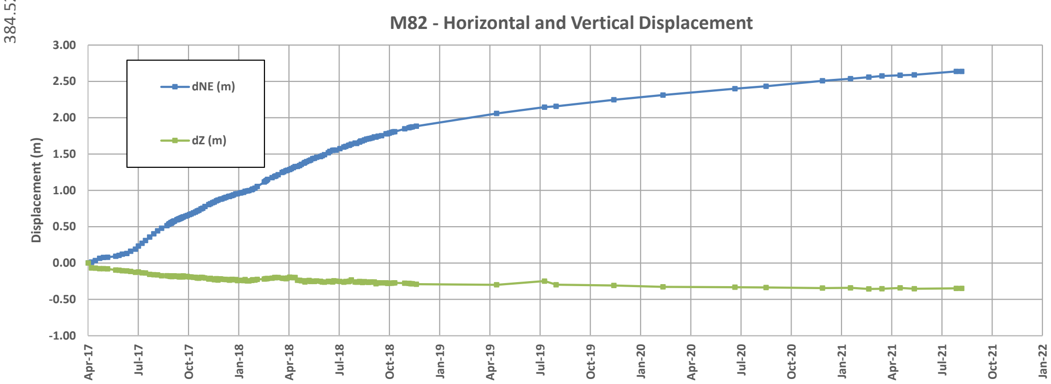
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

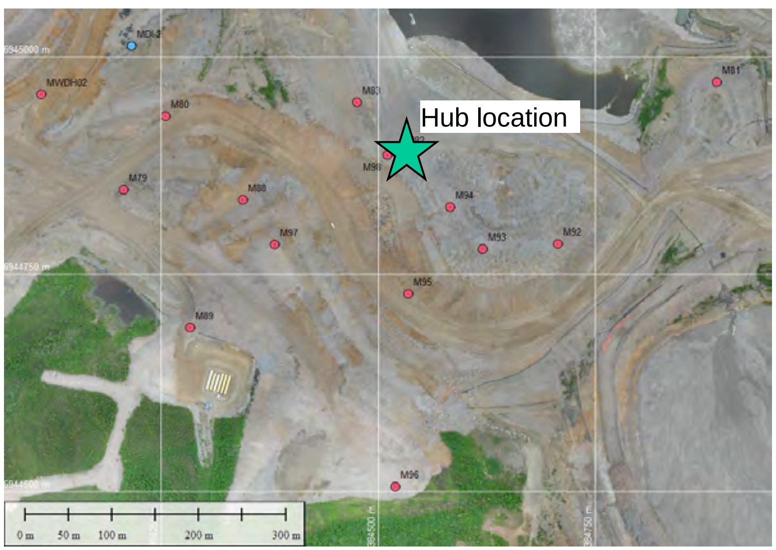
srk consulting	MINTO	Main Pit Instrumentation Data
		Survey Hub – M81
Job No: 1CM002.073 Filename: ApG_2021MainPitInstrumentation.pptx	Minto Mine	Date: October 2021 | Prepared by PHM | Figure: 4

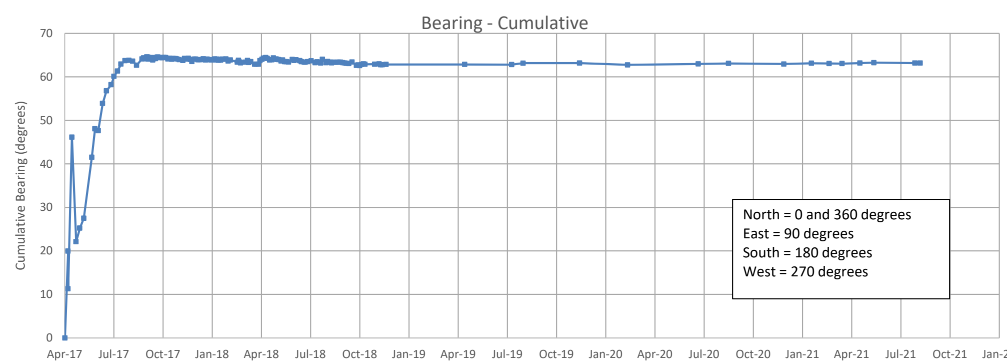


Notes:
Coordinate system is NAD 83 UTM Zone 8.









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

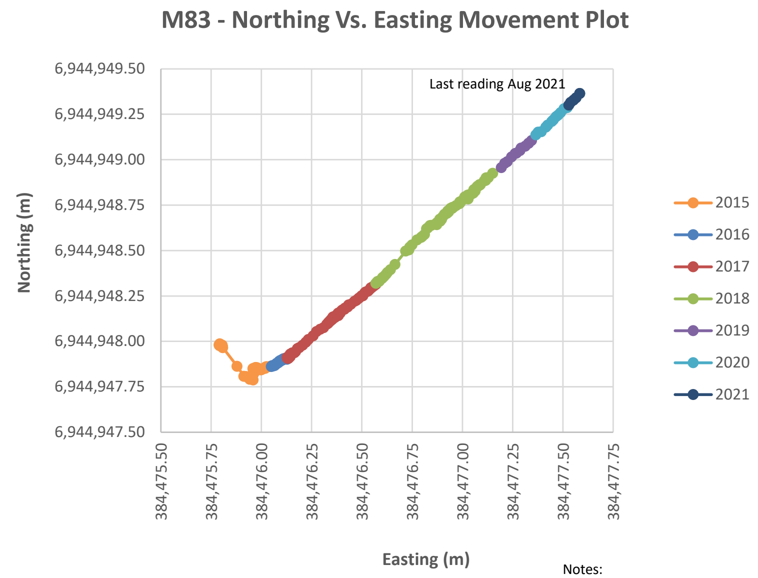
srk consulting

MINTO

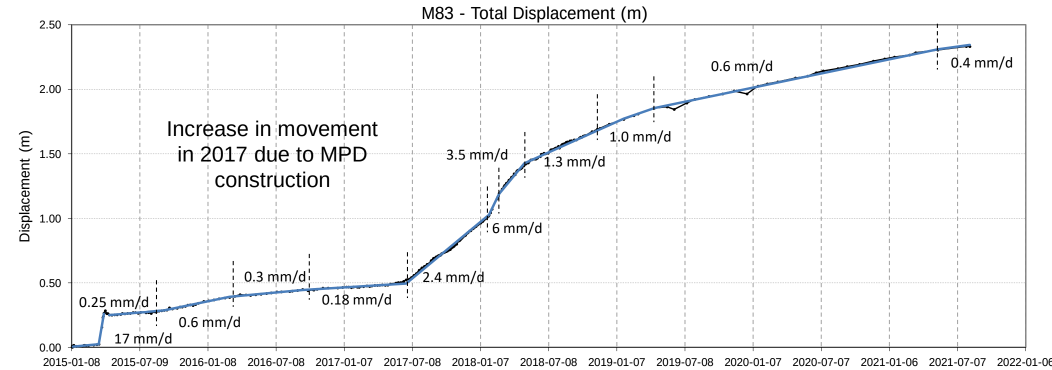
Main Pit Instrumentation Data

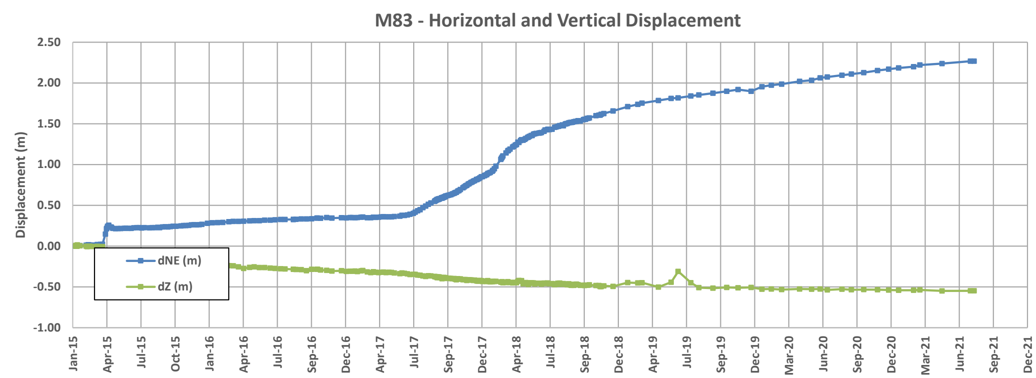
Survey Hub – M82

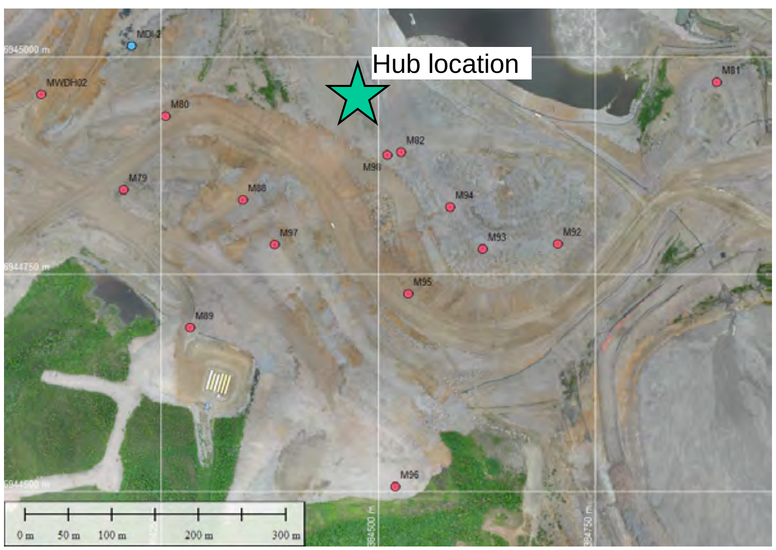
Job No: 1CM002.073	Minto Mine	Date: October 2021	Prepared by PHM	Figure: 5
Filename: ApG_2021MainPitInstrumentation.pptx				

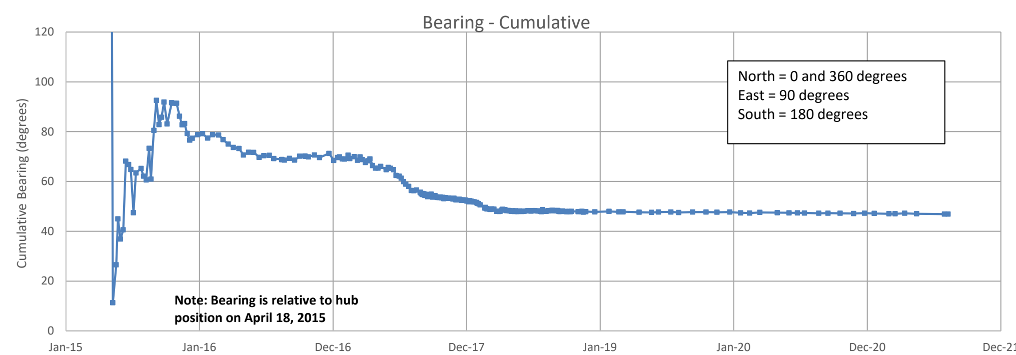


Notes:
Coordinate system is NAD 83 UTM Zone 8.









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

srk consulting

MINTO

Main Pit Instrumentation Data

Survey Hub – M83

Job No: 1CM002.073

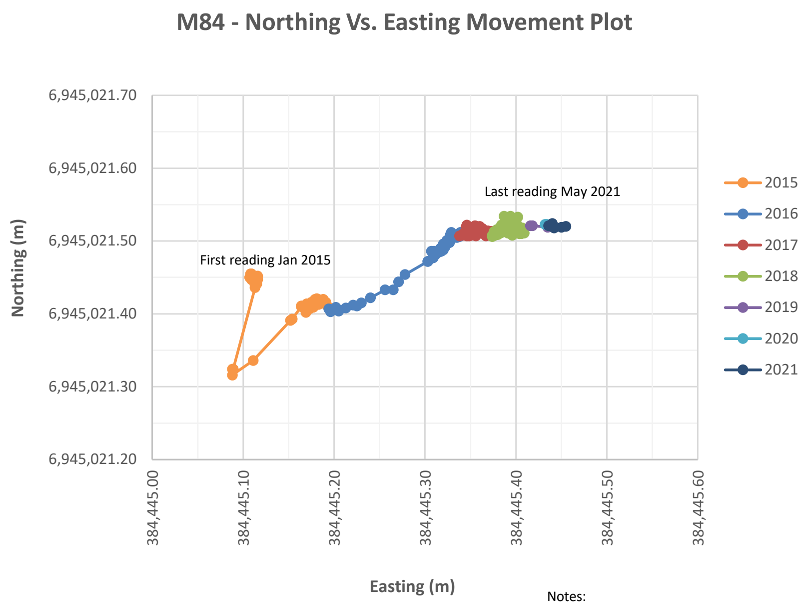
Filename: ApG_2021MainPitInstrumentation.pptx

Minto Mine

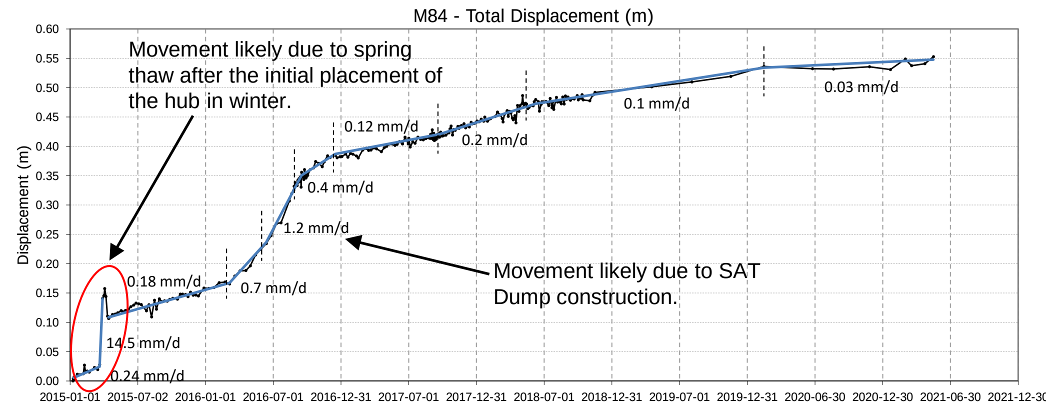
Date: October 2021

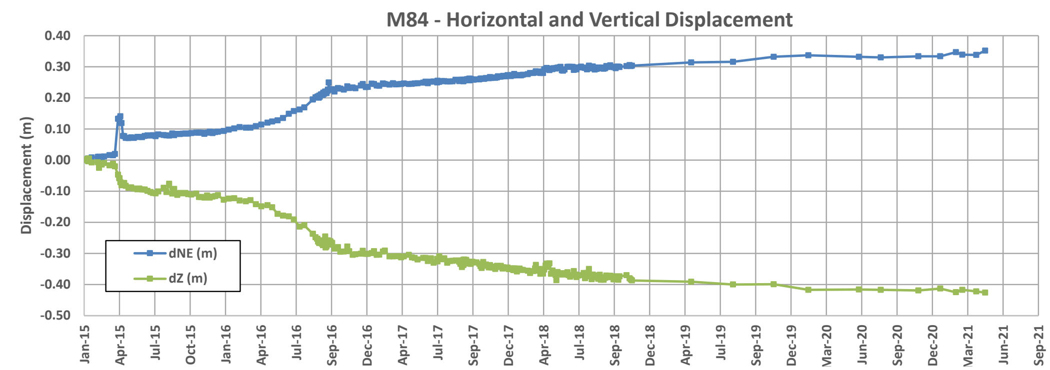
Prepared by PHM

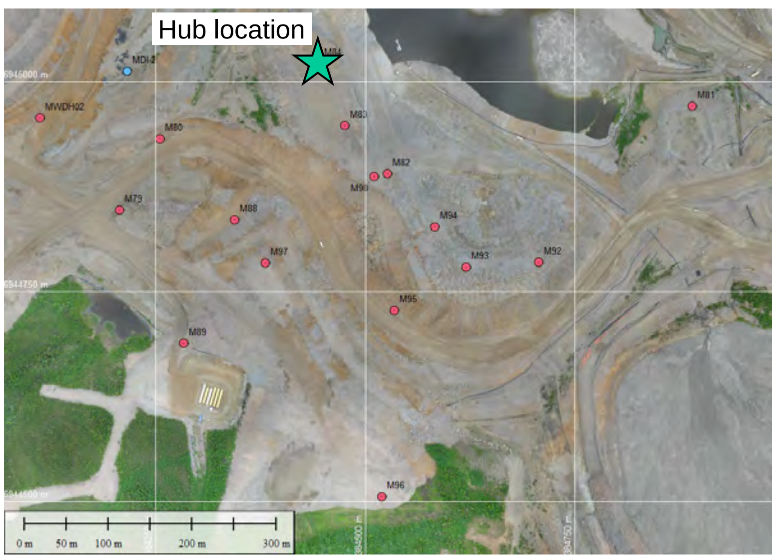
Figure: 6

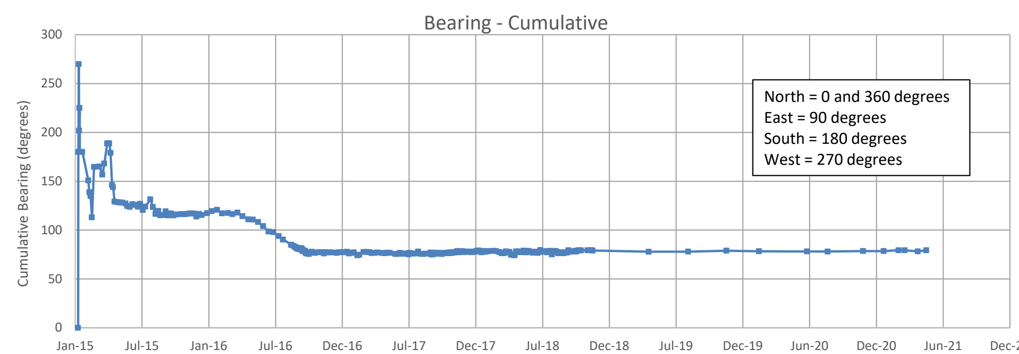


Notes:
Coordinate system is NAD 83 UTM Zone 8.









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

srk consulting | MINTO | Main Pit Instrumentation Data

Survey Hub – M84

Job No: 1CM002.073

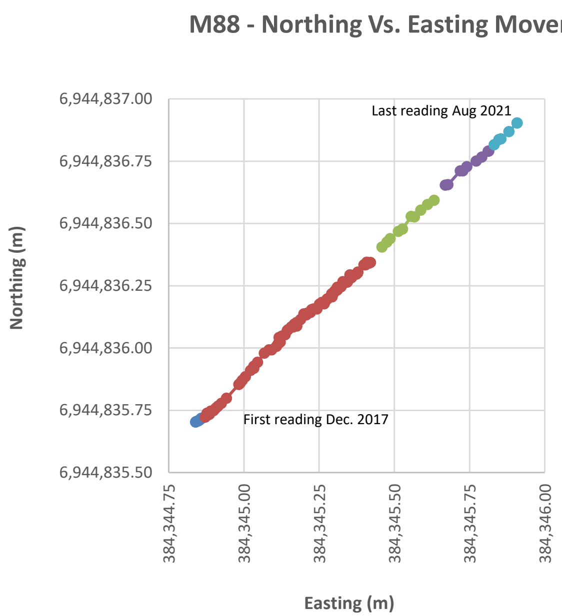
Filename: ApG_2021MainPitInstrumentation.pptx

Minto Mine

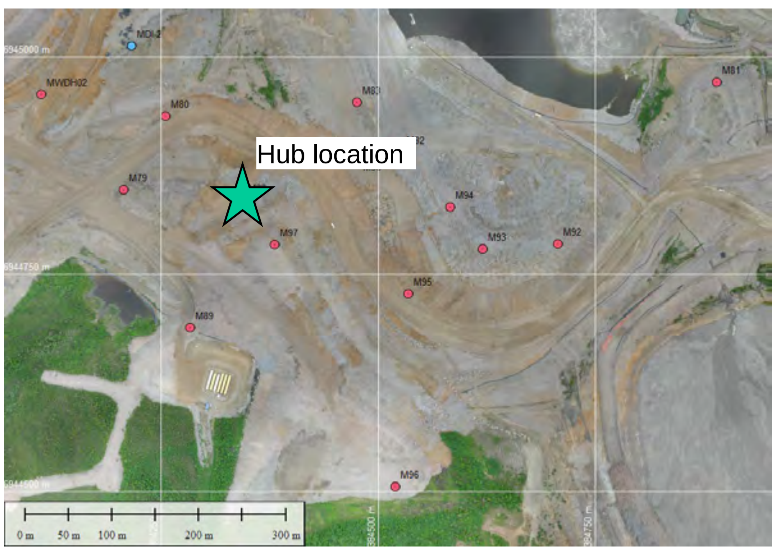
Date: October 2021

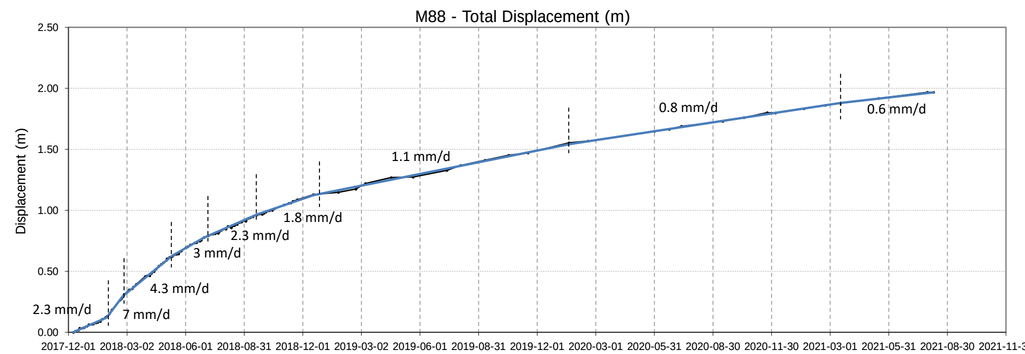
Prepared by: PHM

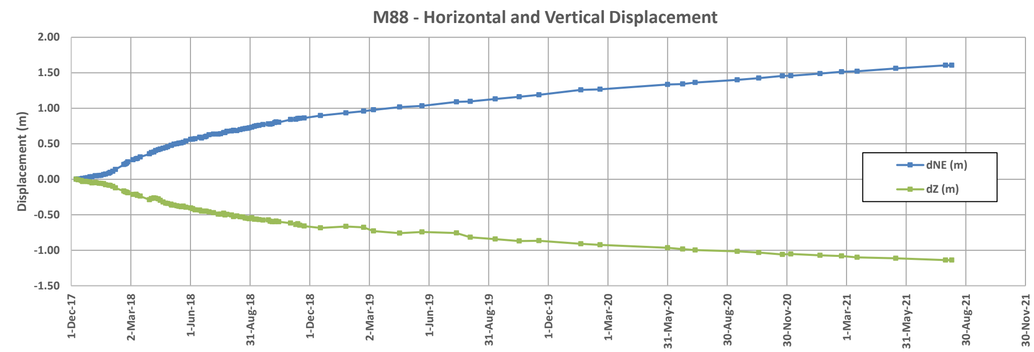
Figure: 7

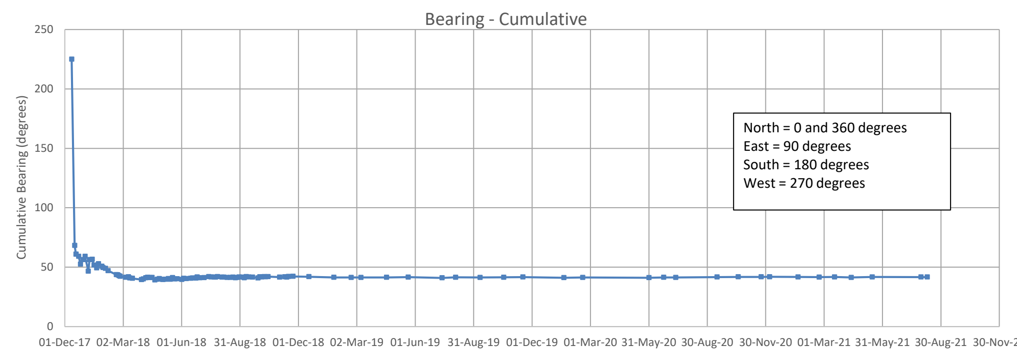


Notes:
Coordinate system is NAD 83 UTM Zone 8.









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

Main Pit Instrumentation Data

Survey Hub – M88

Job No: 1CM002.073

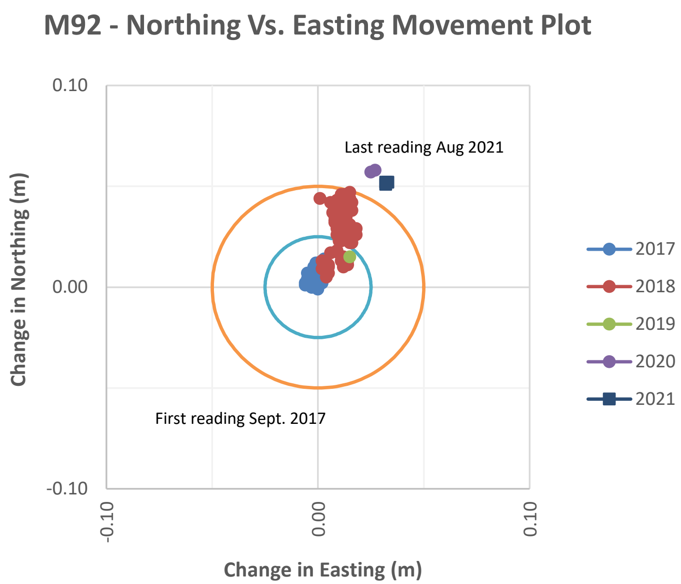
Filename: ApG_2021MainPitInstrumentation.pptx

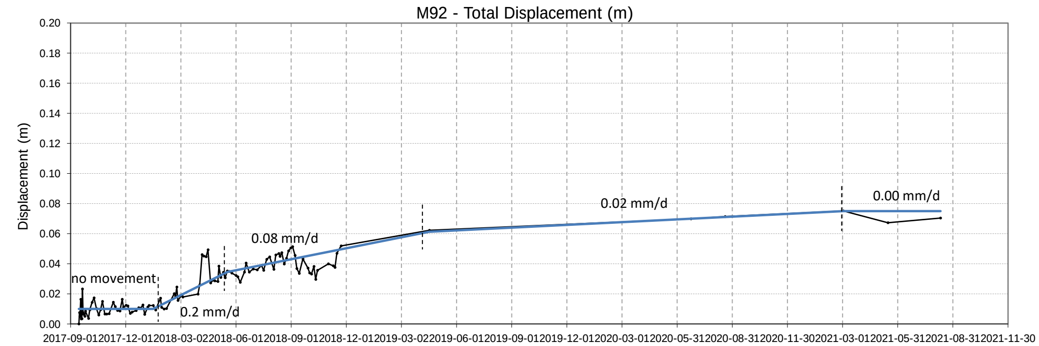
Minto Mine

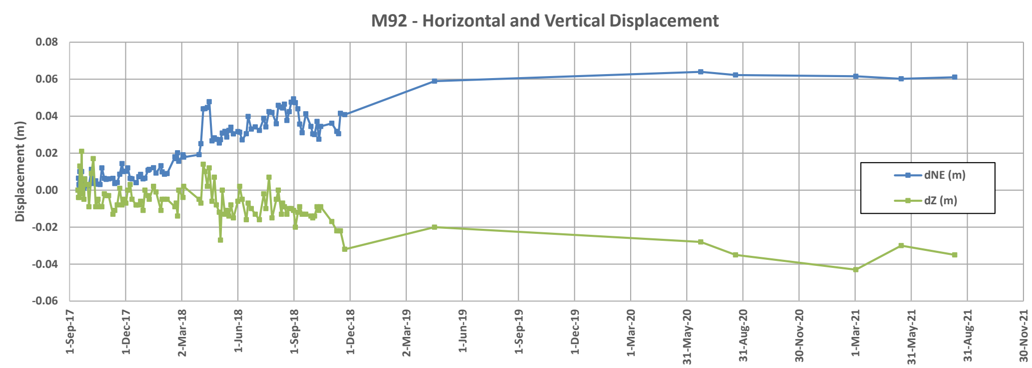
Date: October 2021

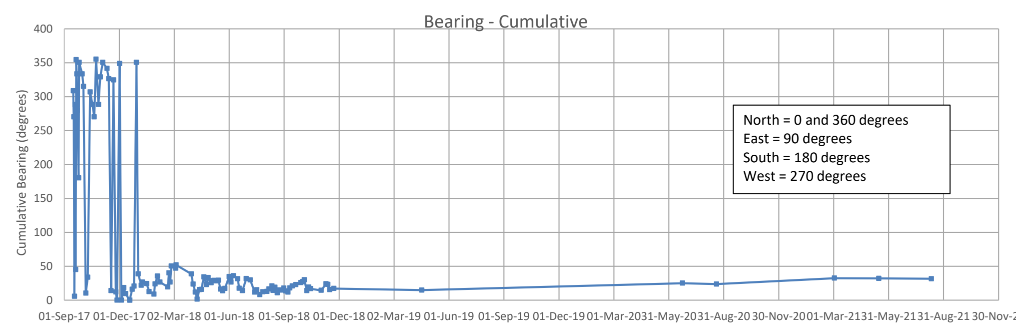
Prepared by PHM

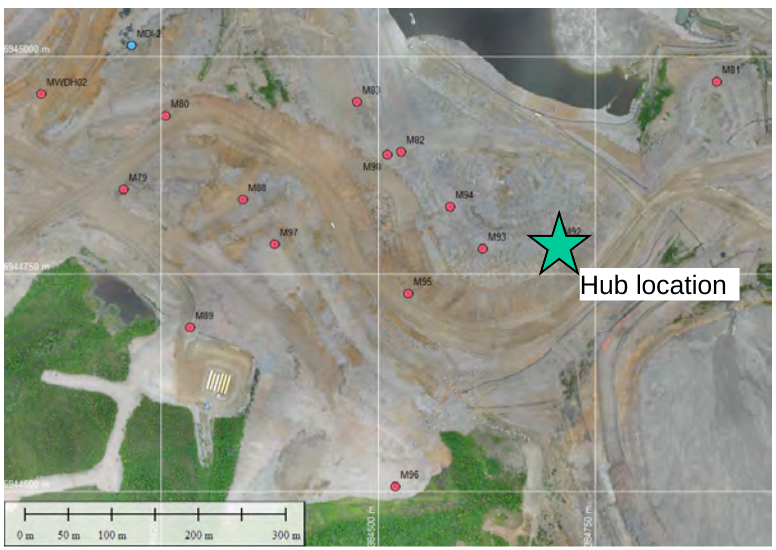
Figure: 8







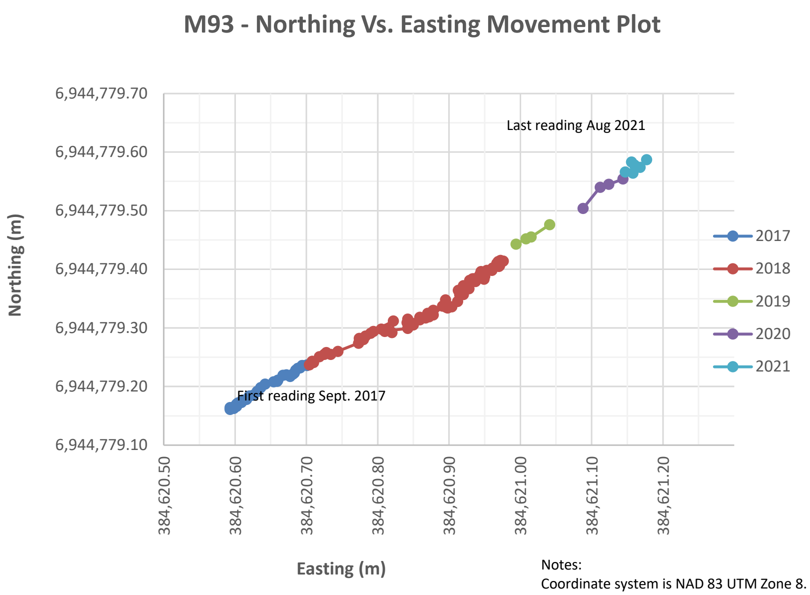




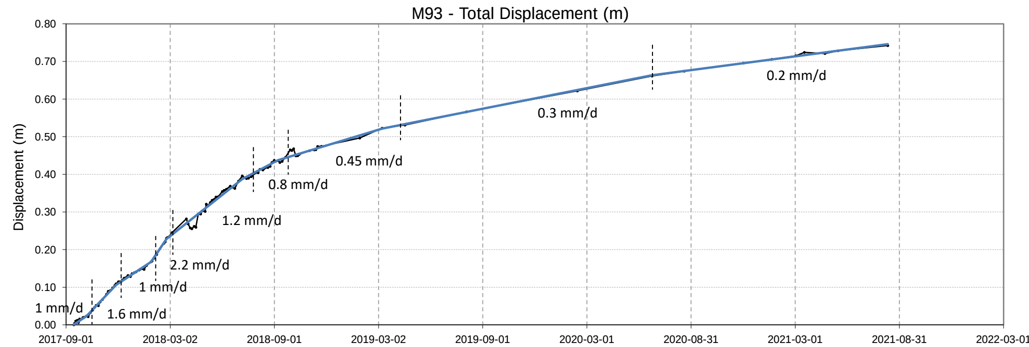
Source files:

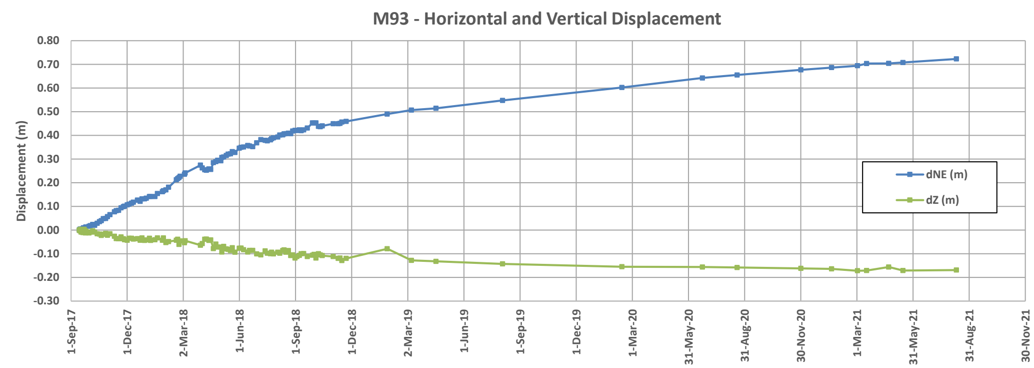
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

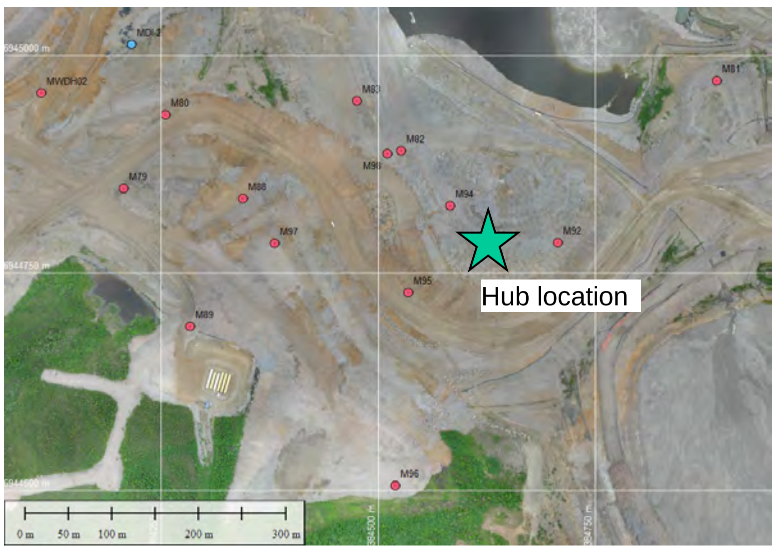
srk consulting	MINTO	Main Pit Instrumentation Data
		Survey Hub– M92
Job No: 1CM002.073 Filename: ApG_2021MainPitInstrumentation.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 9

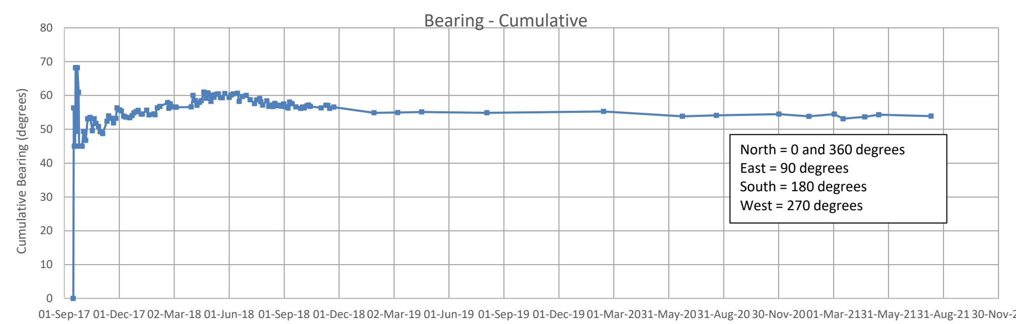


Notes:
Coordinate system is NAD 83 UTM Zone 8.









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

srk consulting

MINTO

Main Pit Instrumentation Data

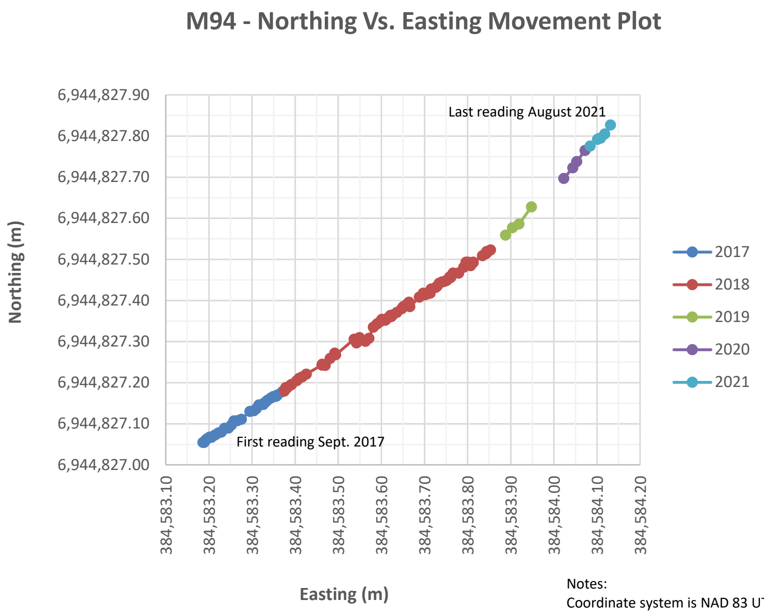
Survey Hub – M93

Job No: 1CM002.073

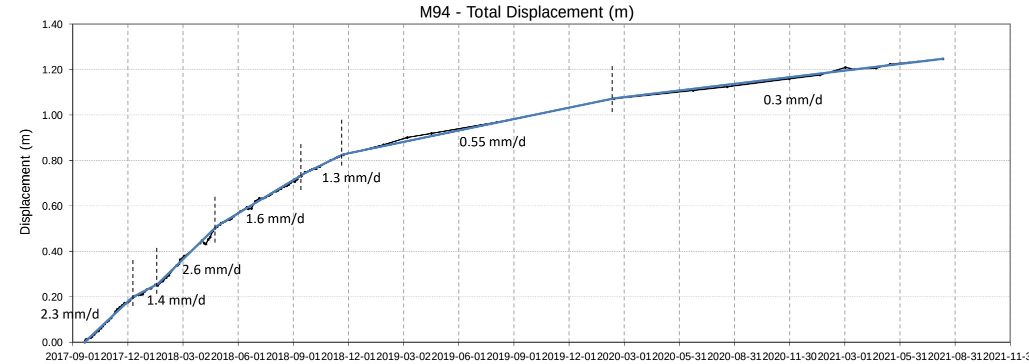
Filename: ApG_2021MainPitInstrumentation.pptx

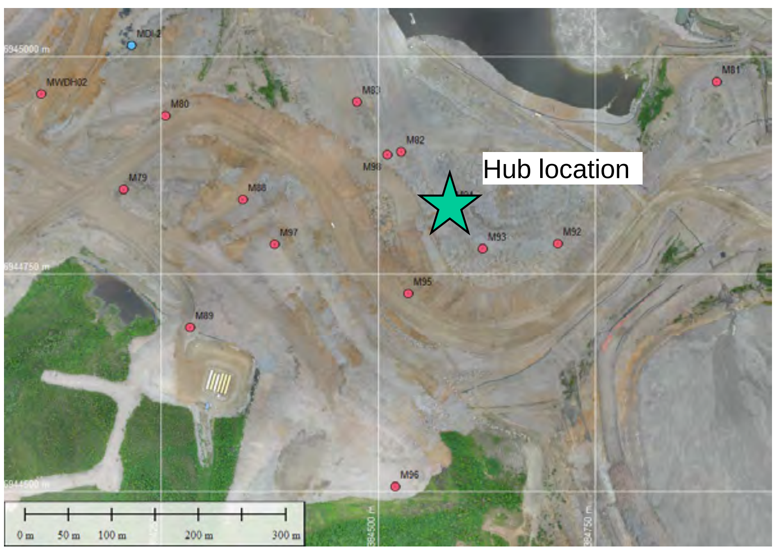
Minto Mine

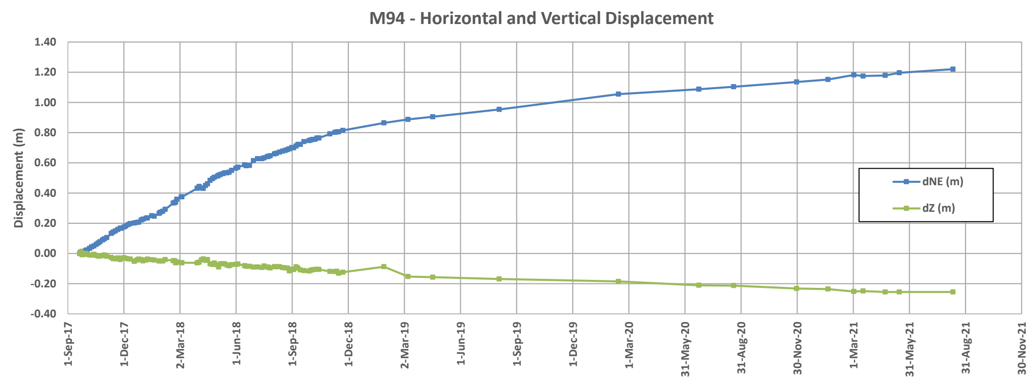
Date:	Prepared by	Figure:
October 2021	PHM	10

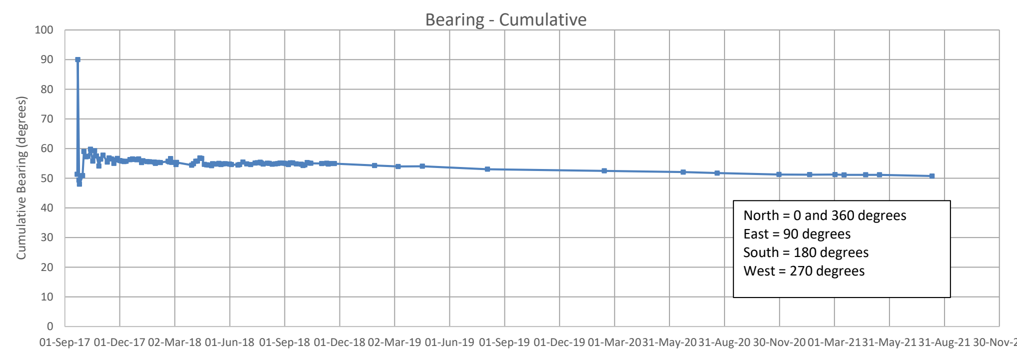


Notes:
Coordinate system is NAD 83 UTM Zone 8.









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

srk consulting

MINTO

Main Pit Instrumentation Data

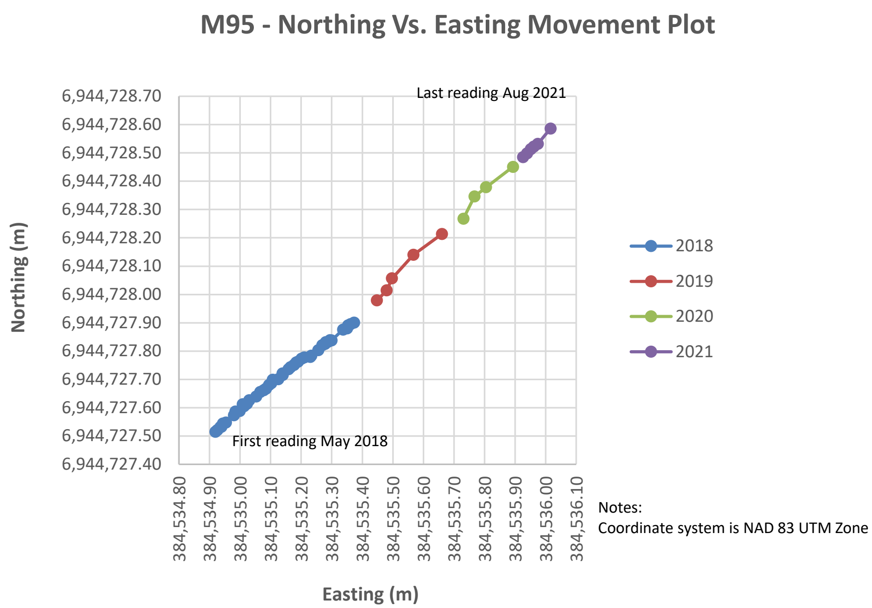
Survey Hub – M94

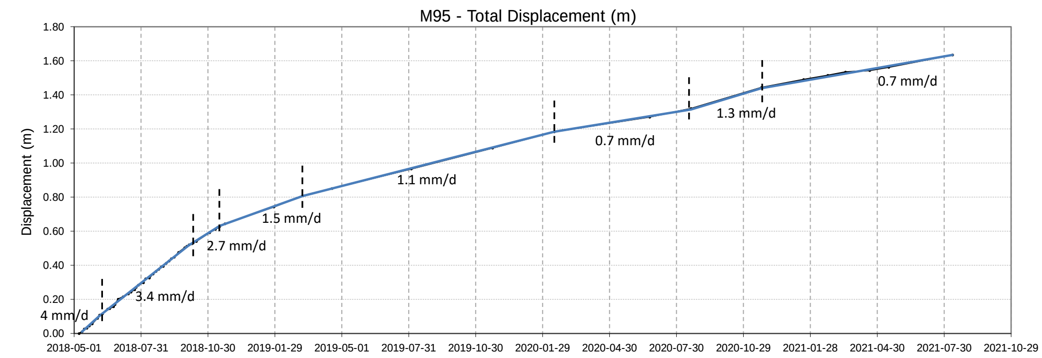
Job No: 1CM002.073

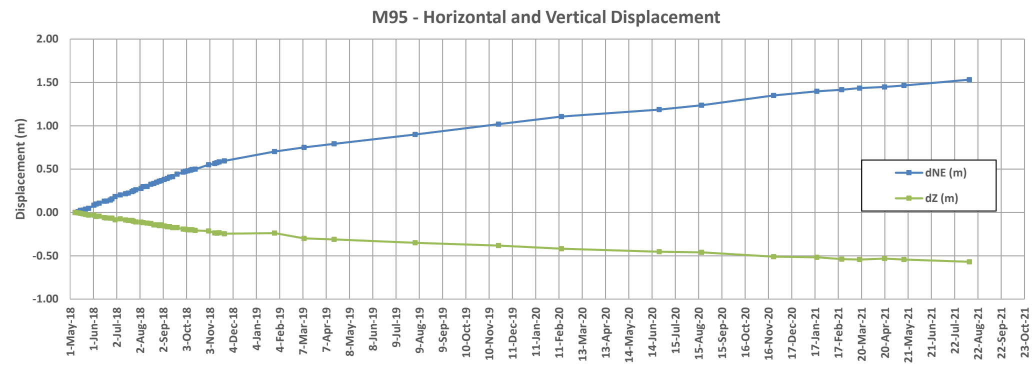
Filename: ApG_2021MainPitInstrumentation.pptx

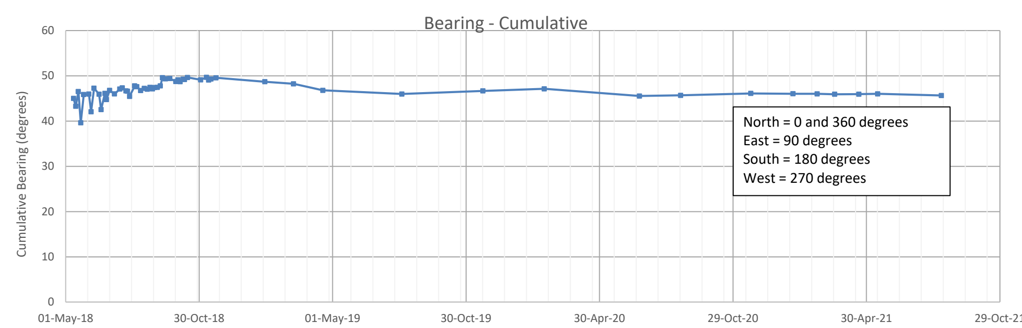
Minto Mine

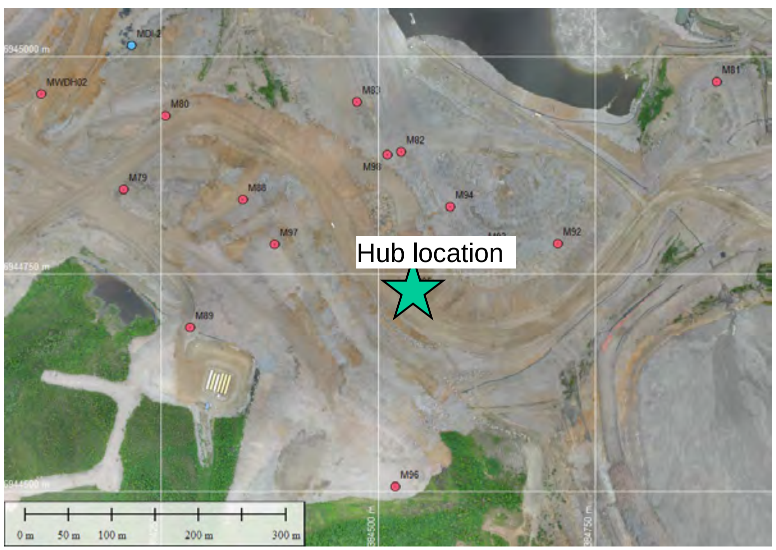
Date:	Prepared by	Figure:
October 2021	PHM	11











Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

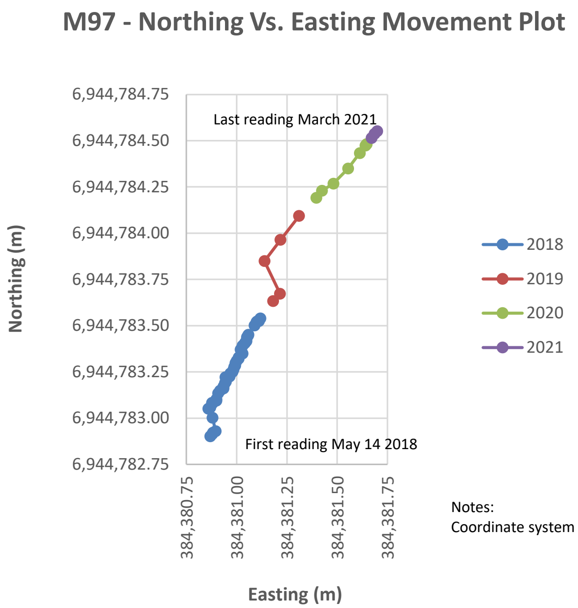
srk consulting

MINTO

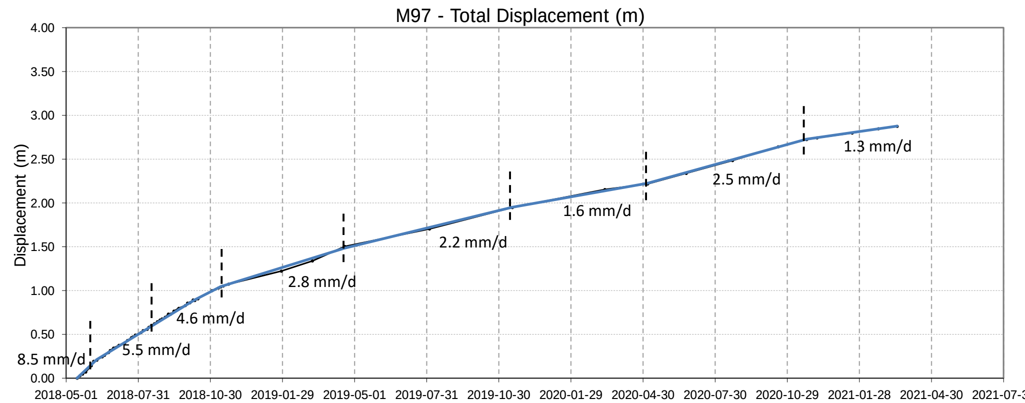
Main Pit Instrumentation Data

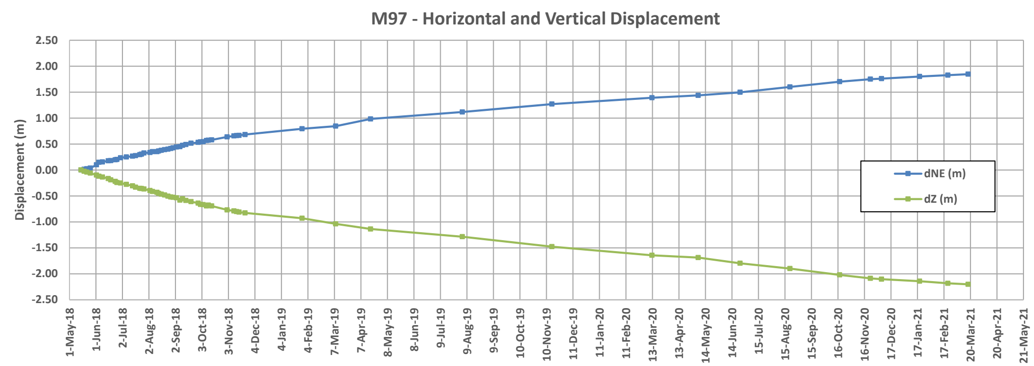
Survey Hub – M95

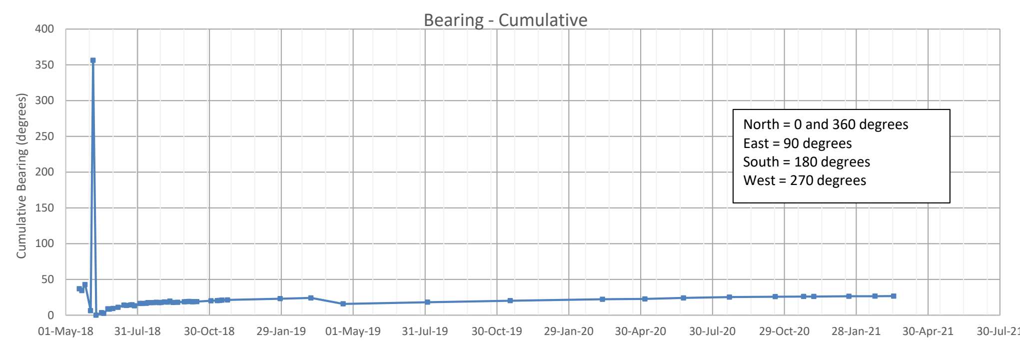
Job No: 1CM002.073	Minto Mine	Date: October 2021	Prepared by PHM	Figure: 12
Filename: ApG_2021MainPitInstrumentation.pptx				

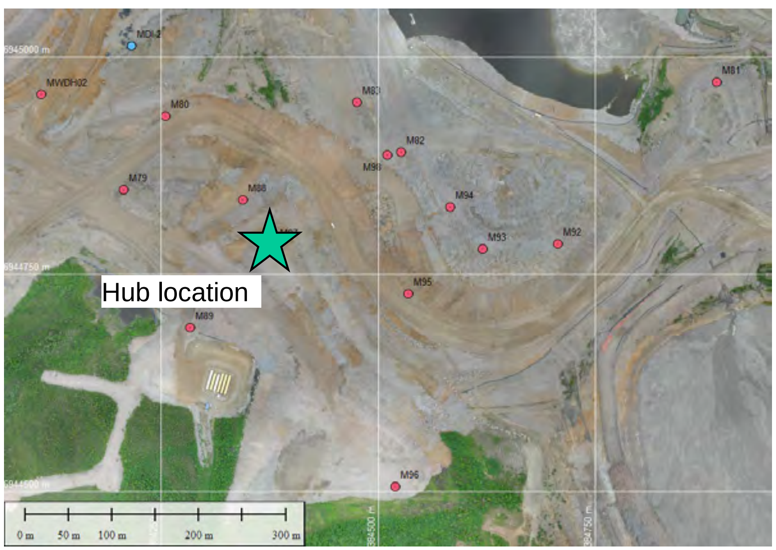


Notes:
Coordinate system is NAD 83 UTM Zone 8.







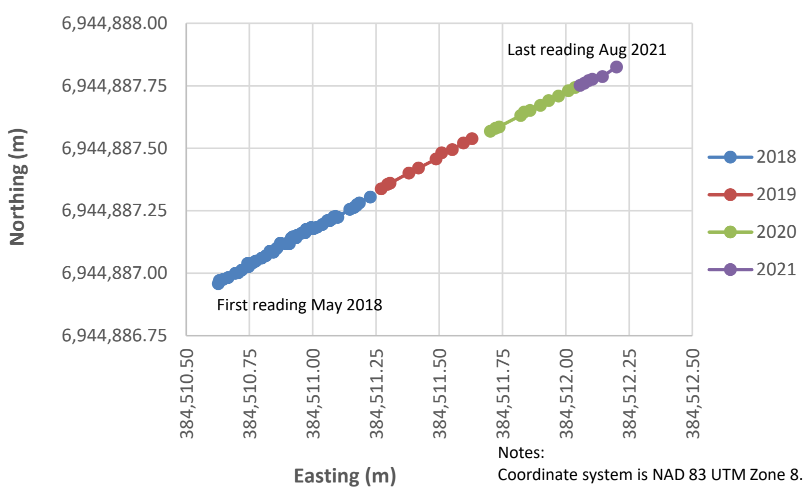


Source files:

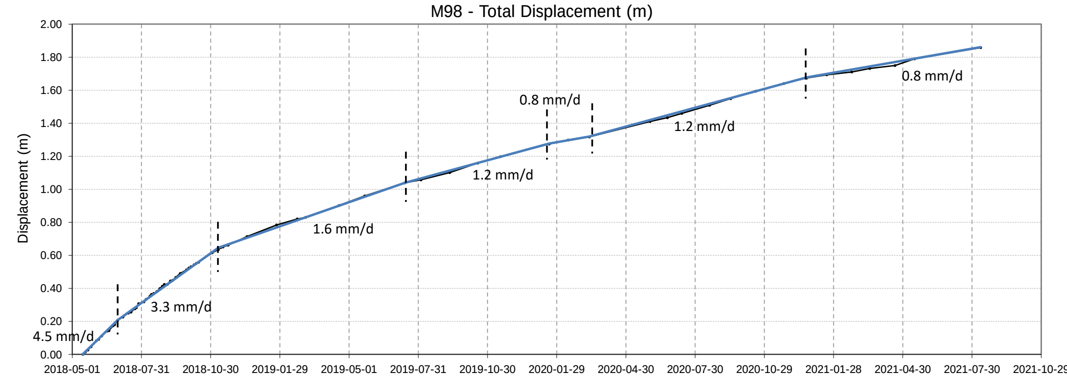
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

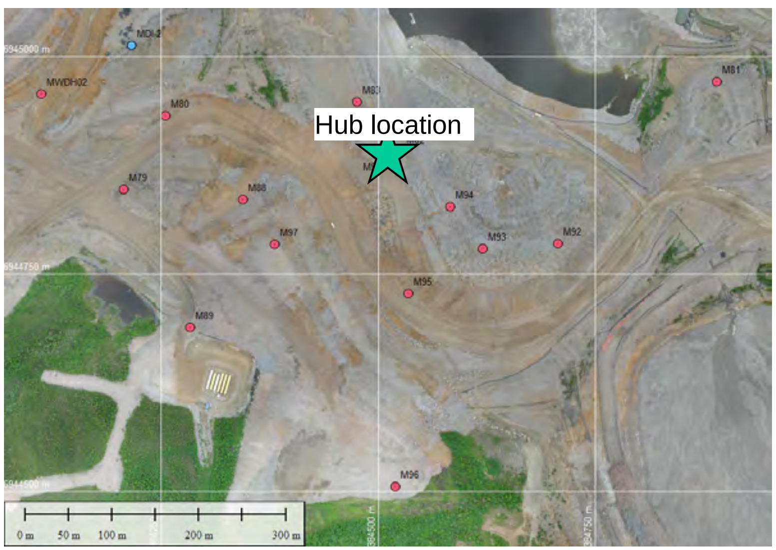
srk consulting	MINTO	Main Pit Instrumentation Data
		Survey Hub – M97
Job No: 1CM002.073 Filename: ApG_2021MainPitInstrumentation.pptx	Minto Mine	Date: October 2021 | Prepared by PHM | Figure: **13**

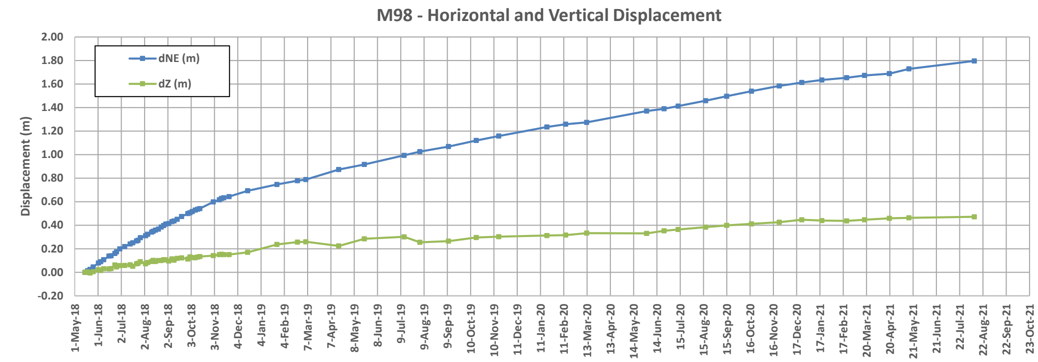
M98 - Northing Vs. Easting Movement Plot

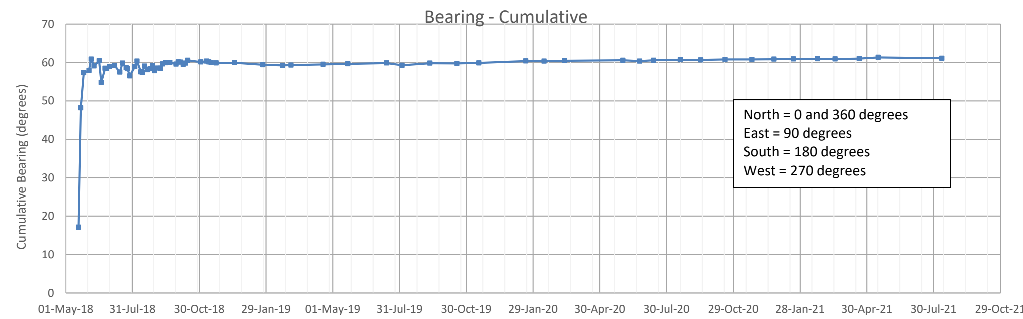


Notes:
Coordinate system is NAD 83 UTM Zone 8.







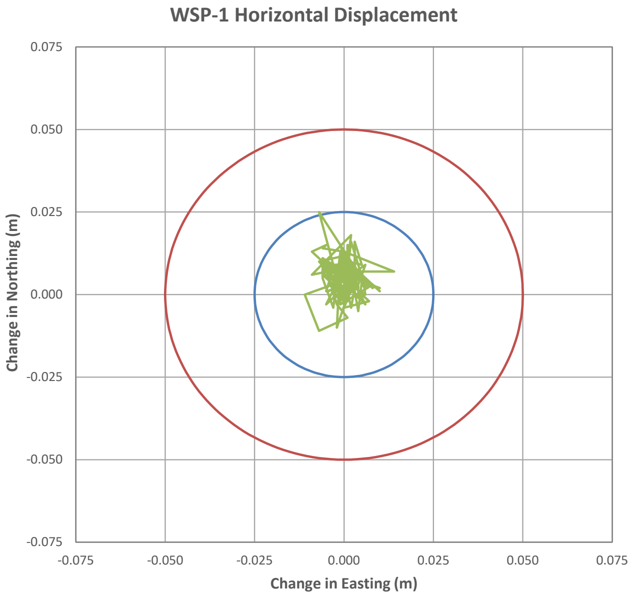


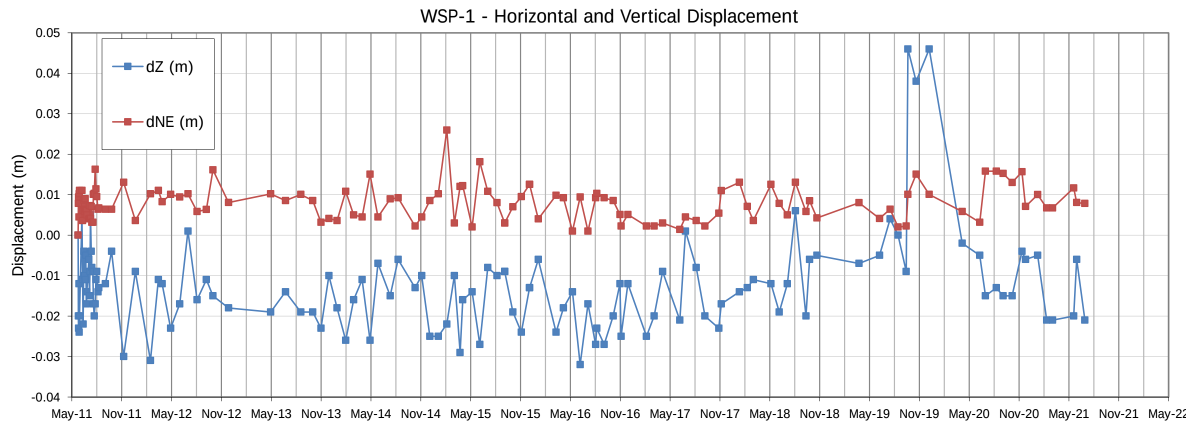
Source files:

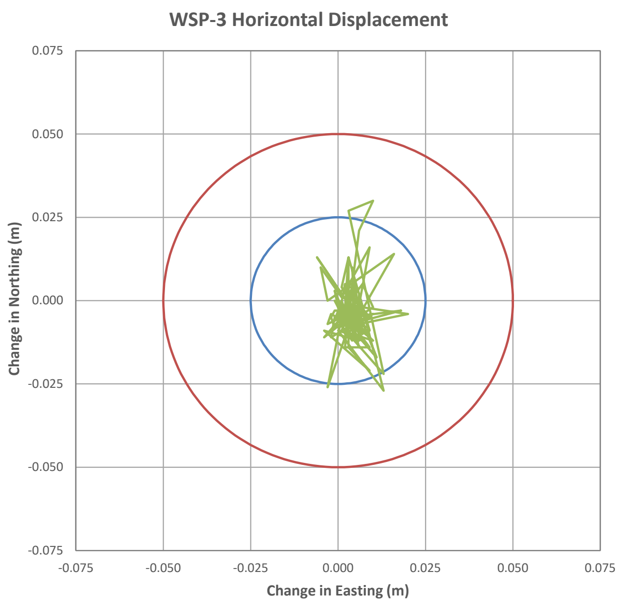
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\!040_AutoCAD\GeotechInstrumentation\GeotechInstrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMainPitSurveyHubs_SRK.xlsm

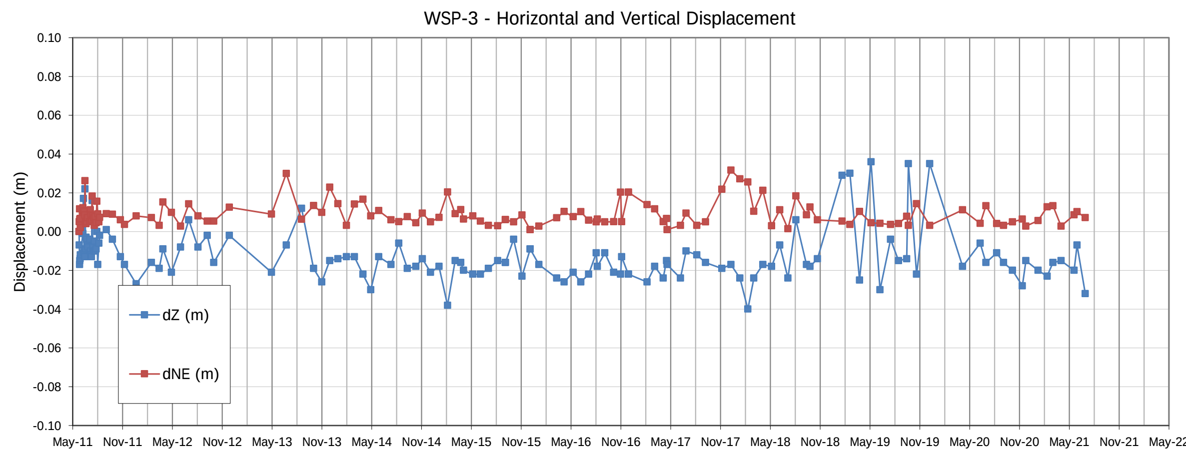
srk consulting	MINTO	Main Pit Instrumentation Data
		Survey Hub – M98
Job No: 1CM002.073 Filename: ApG_2021MainPitInstrumentation.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 14

Appendix H WSP Instrumentation Data









Source file: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

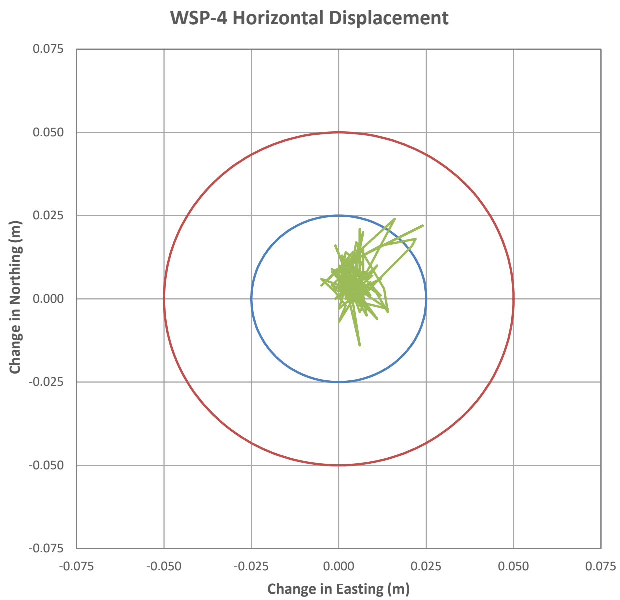
srk consulting | MINTO | Water Storage Pond Data

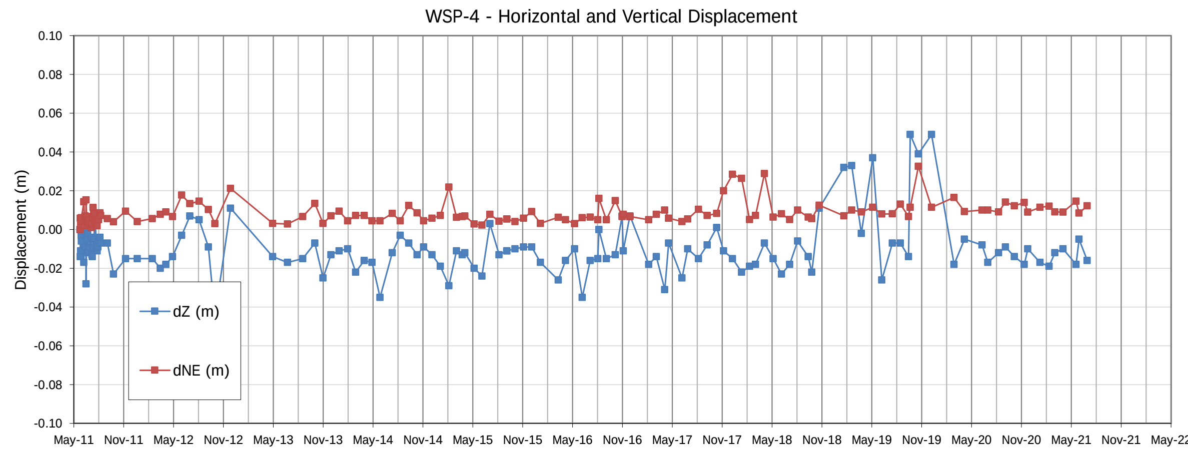
Survey Hubs – WSP-1 and WSP-3

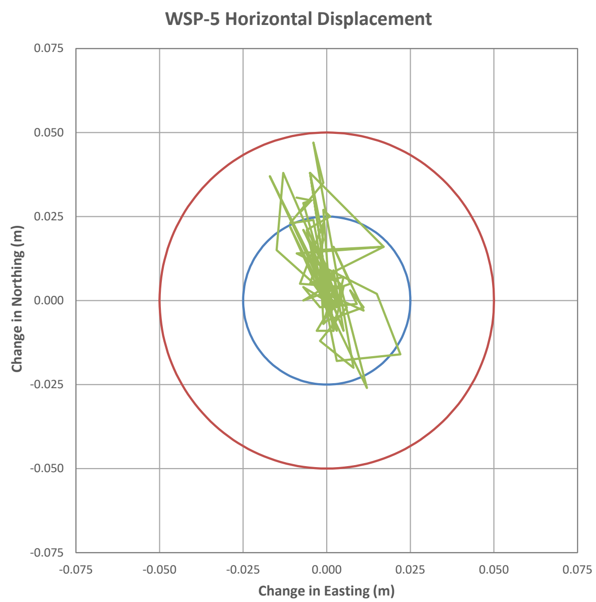
Job No: 1CM002.073
Filename: ApH_WaerStoragePond2021.pptx

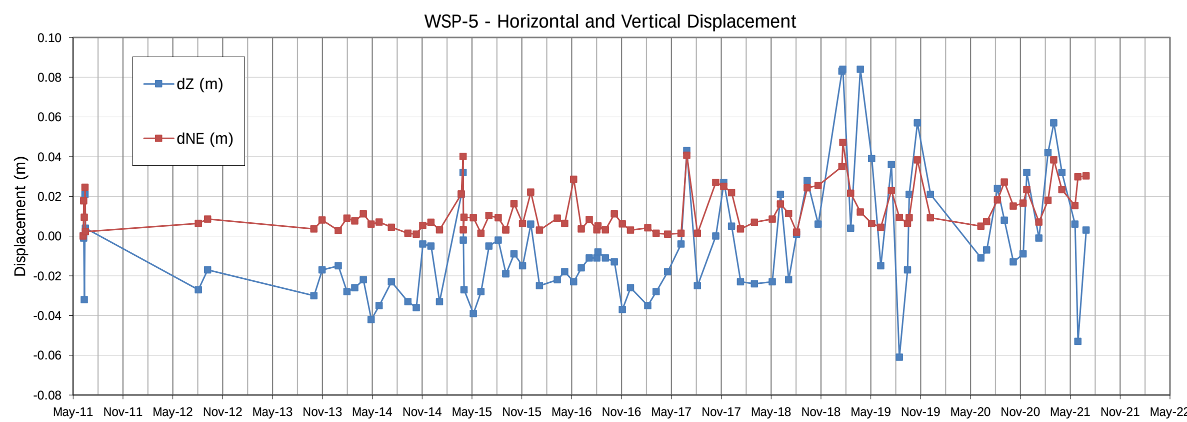
Minto Mine

Date: October 2021 | Prepared by PHM | Figure: 1









Source file: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRK Data Set\SWD_ASH_WSP_SurveyHubMonitoring_SRK.xlsm

srk consulting

MINTO

Water Storage Pond Data

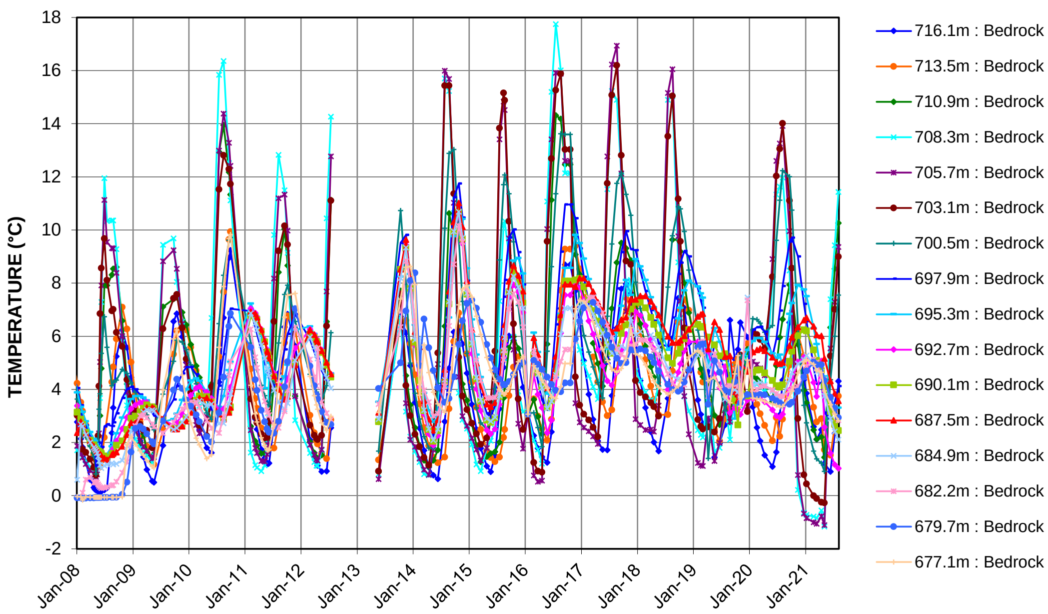
Survey Hubs – WSP-4 and WSP-5

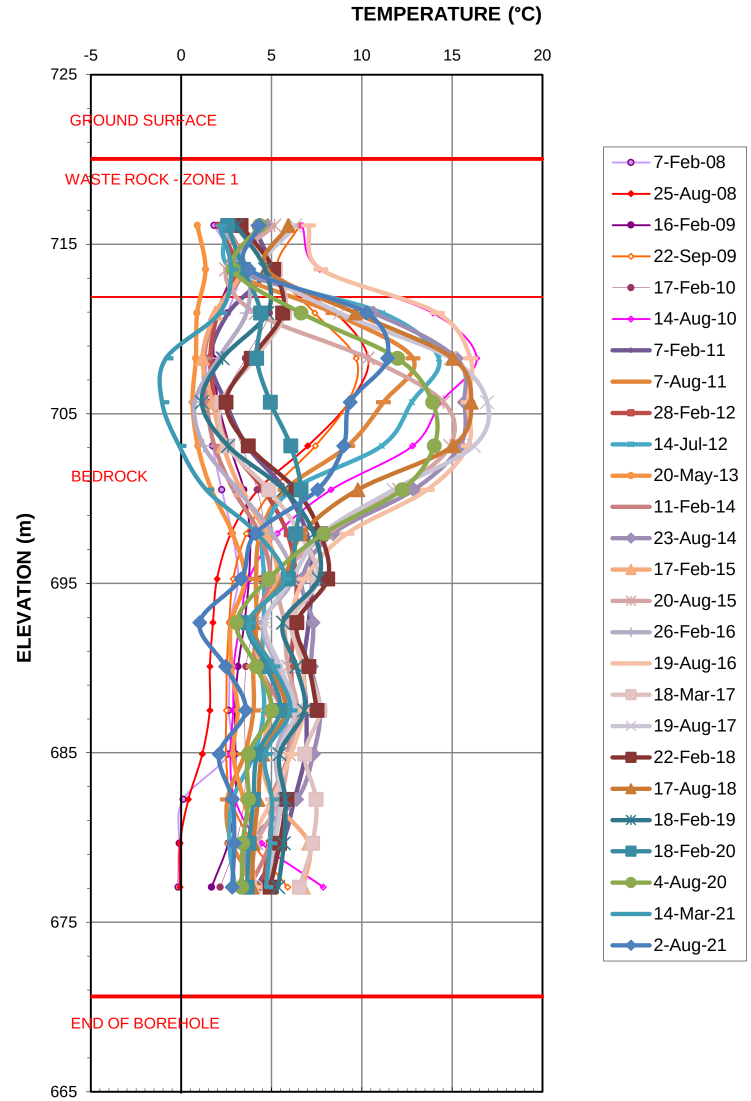
Job No: 1CM002.073

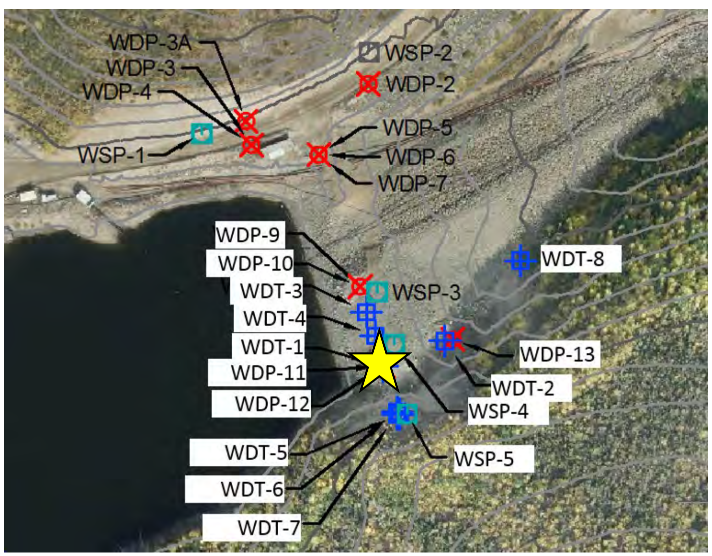
Filename: ApH_WaerStoragePond2021.pptx

Minto Mine

Date:	Prepared by	Figure:
October 2021	PHM	2







Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting

MINTO

Job No: 1CM002.073

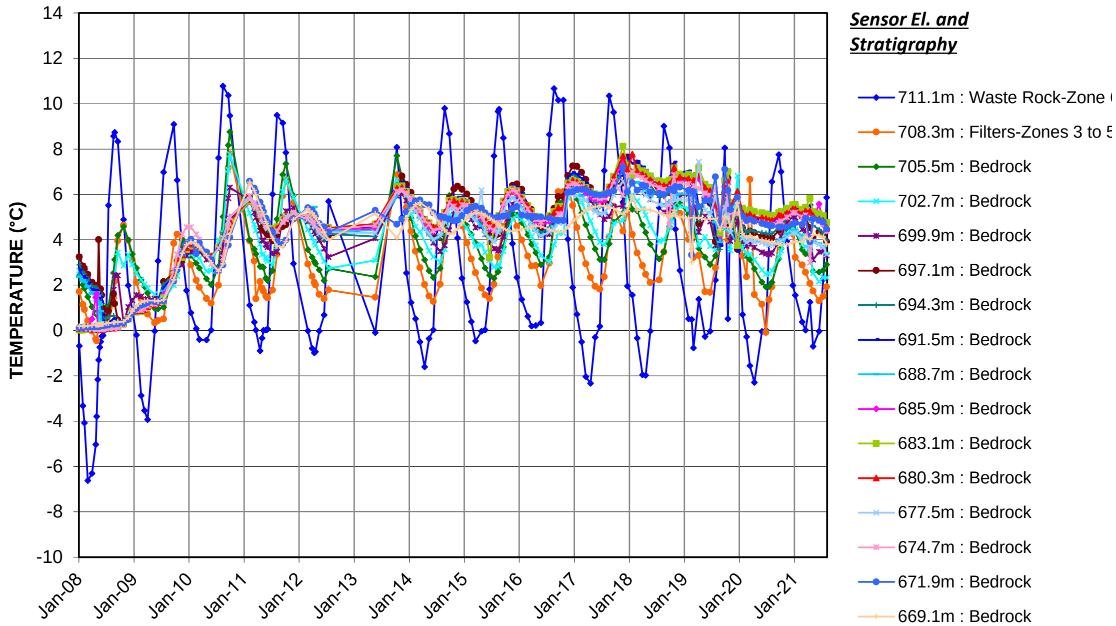
Filename: ApH_WaerStoragePond2021.pptx

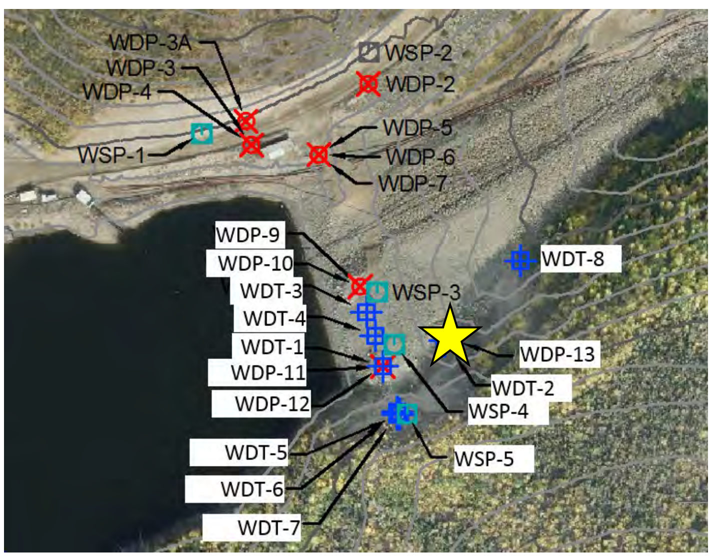
Minto Mine

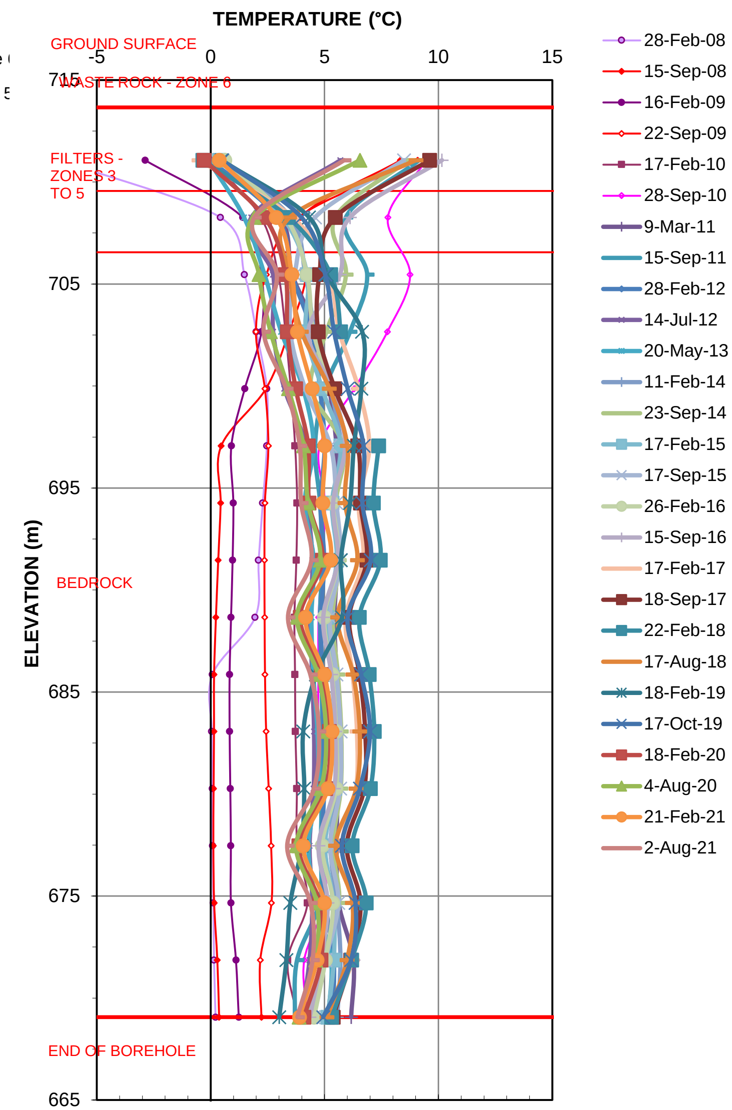
Water Storage Pond Data

Temperature Cable – WDT-1

Date:	Prepared by	Figure:
October 2021	PHM	3







Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting

MINTO

Job No: 1CM002.073

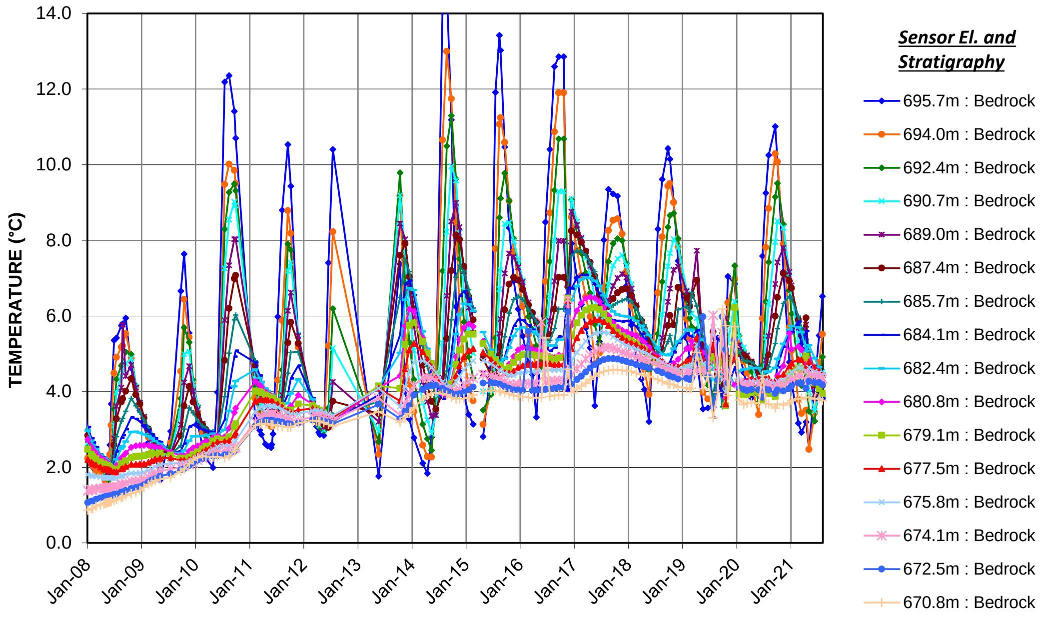
Filename: ApH_WaerStoragePond2021.pptx

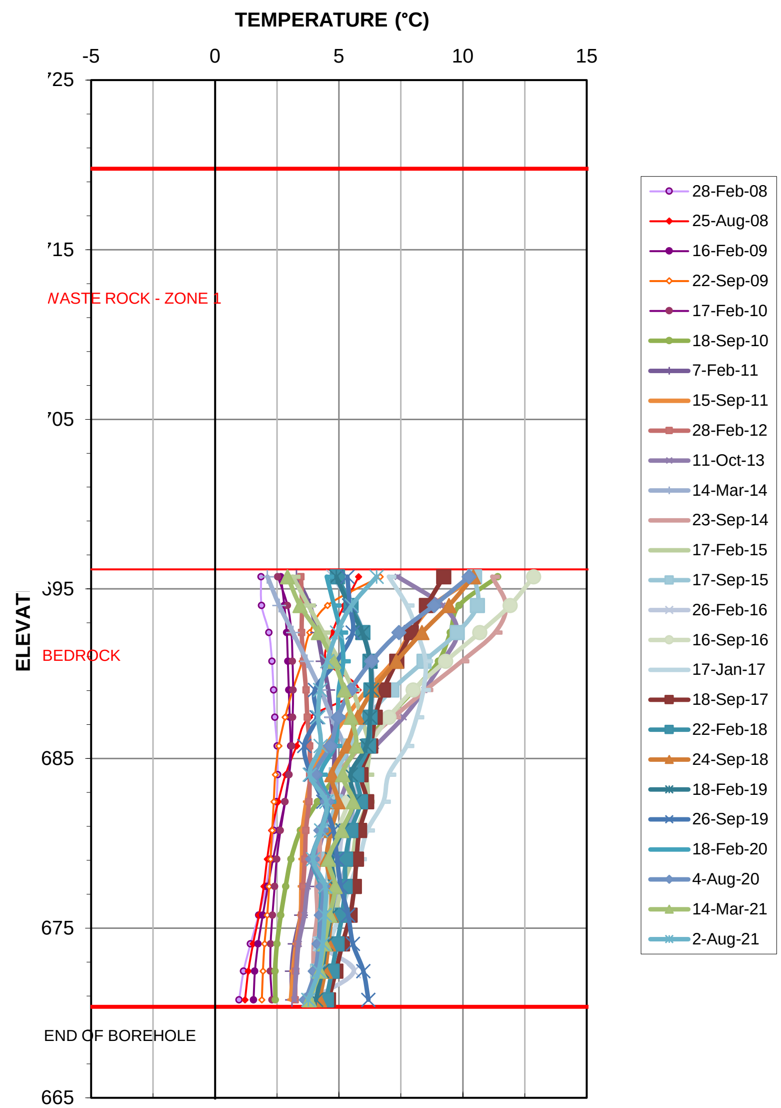
Minto Mine

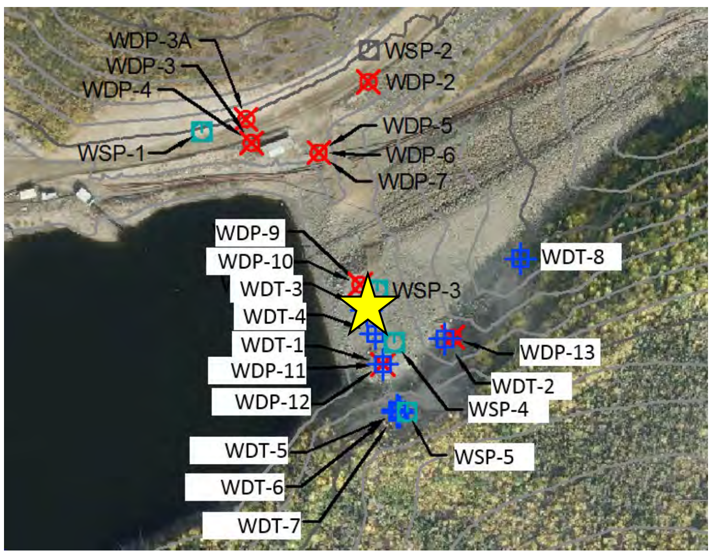
Water Storage Pond Data

Temperature Cable – WDT-2

Date:	Prepared by	Figure:
October 2021	PHM	4



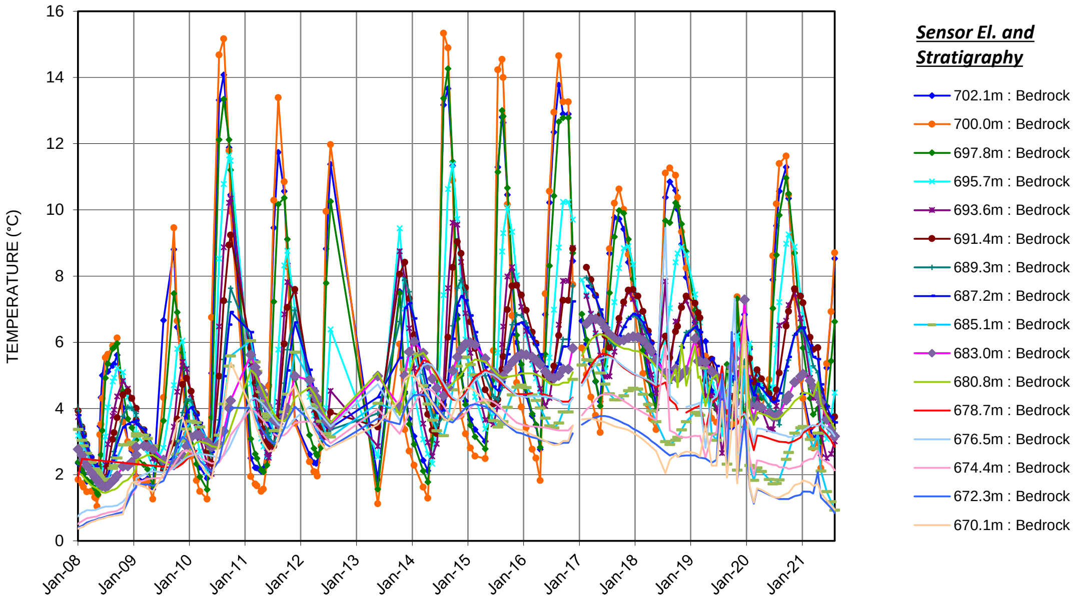


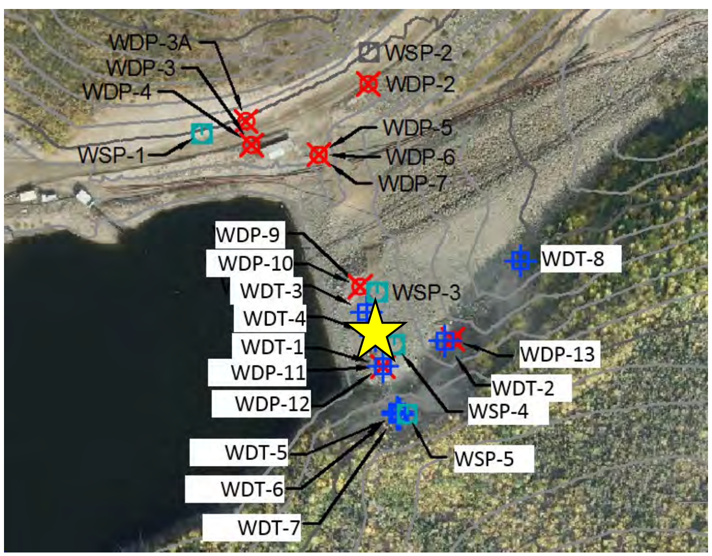


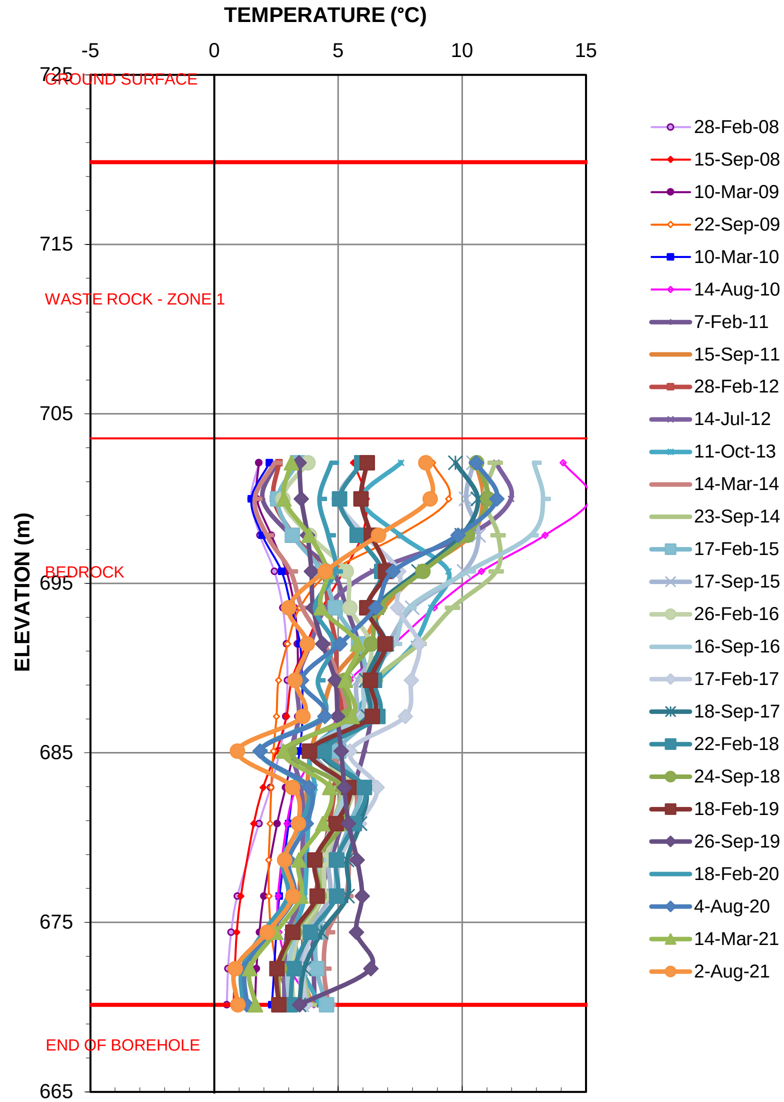
Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting	MINTO	Water Storage Pond Data
		Temperature Cable – WDT-3
Job No: 1CM002.073 Filename: ApH_WaerStoragePond2021.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 5







Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting

MINTO

Water Storage Pond Data

Temperature Cable – WDT-4

Job No: 1CM002.073

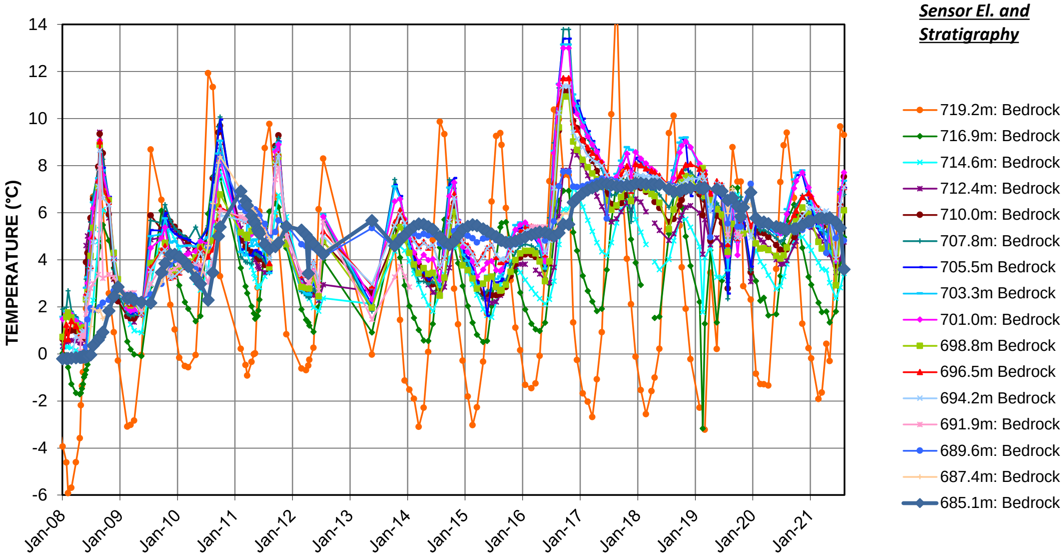
Filename: ApH_WaerStoragePond2021.pptx

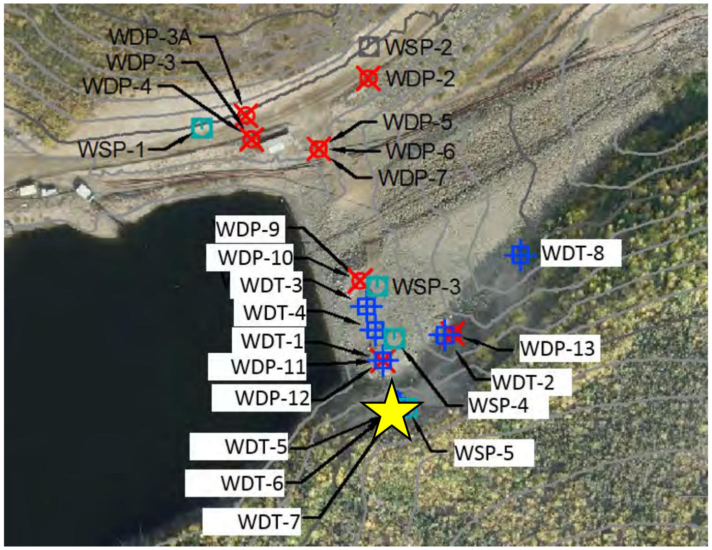
Minto Mine

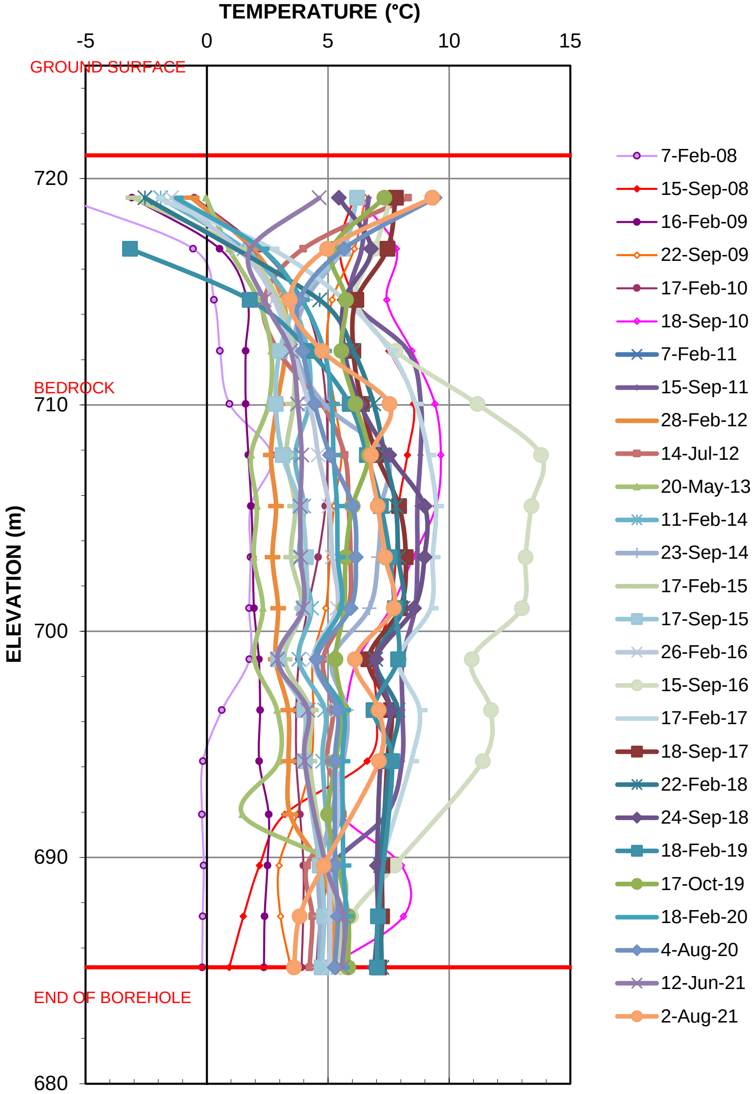
Date: October 2021

Prepared by PHM

Figure: 6



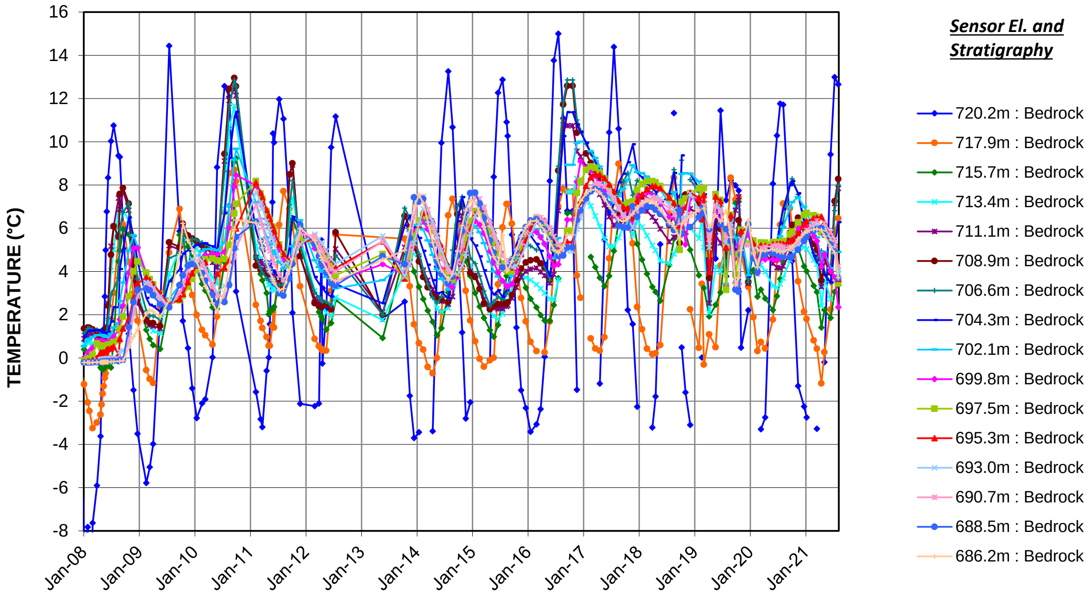


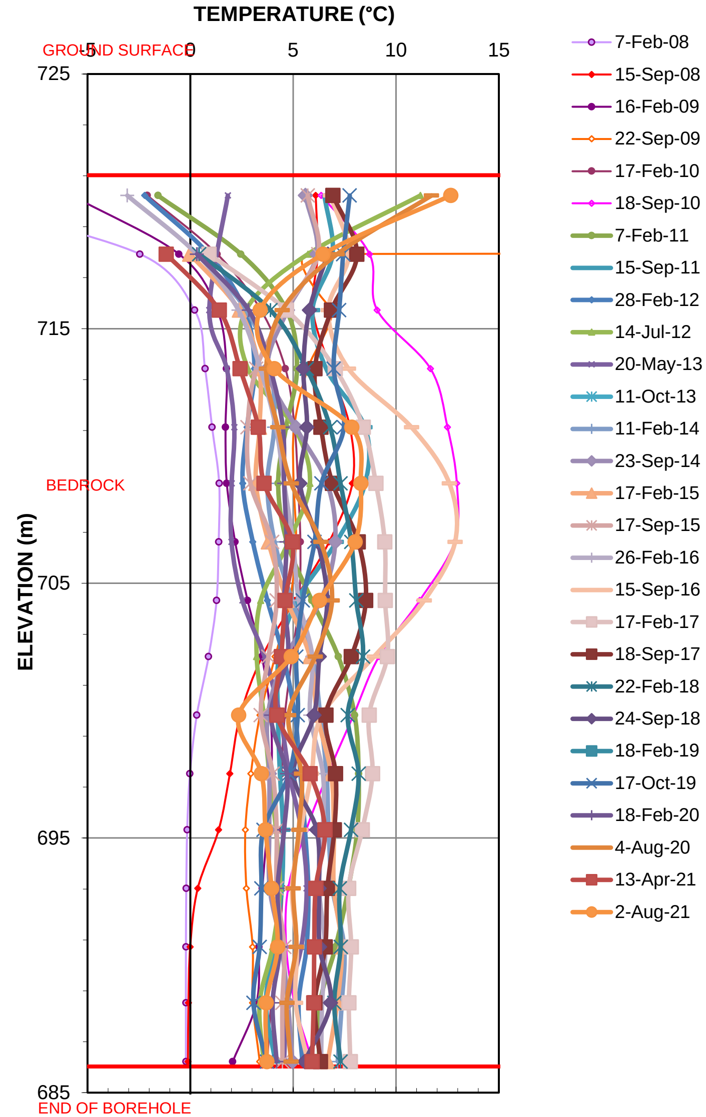


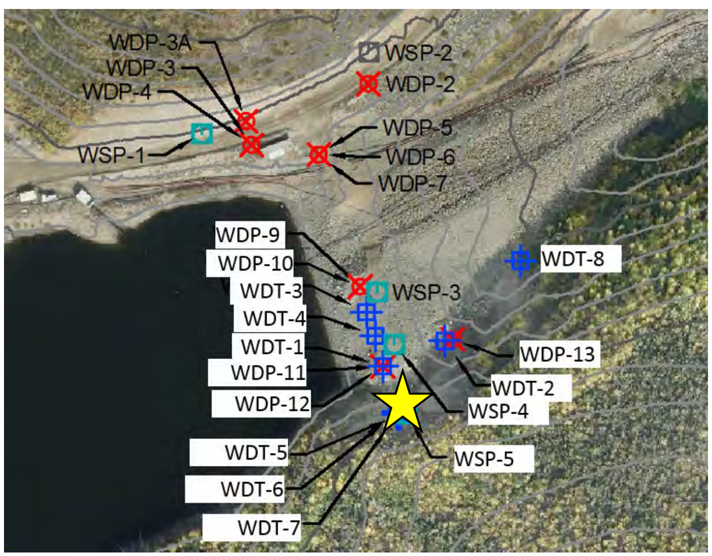
Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting	MINTO	Water Storage Pond Data **Temperature Cable – WDT-5**
Job No: 1CM002.073 Filename: ApH_WaerStoragePond2021.pptx	Minto Mine	Date: October 2021 · Prepared by PHM · Figure: 7



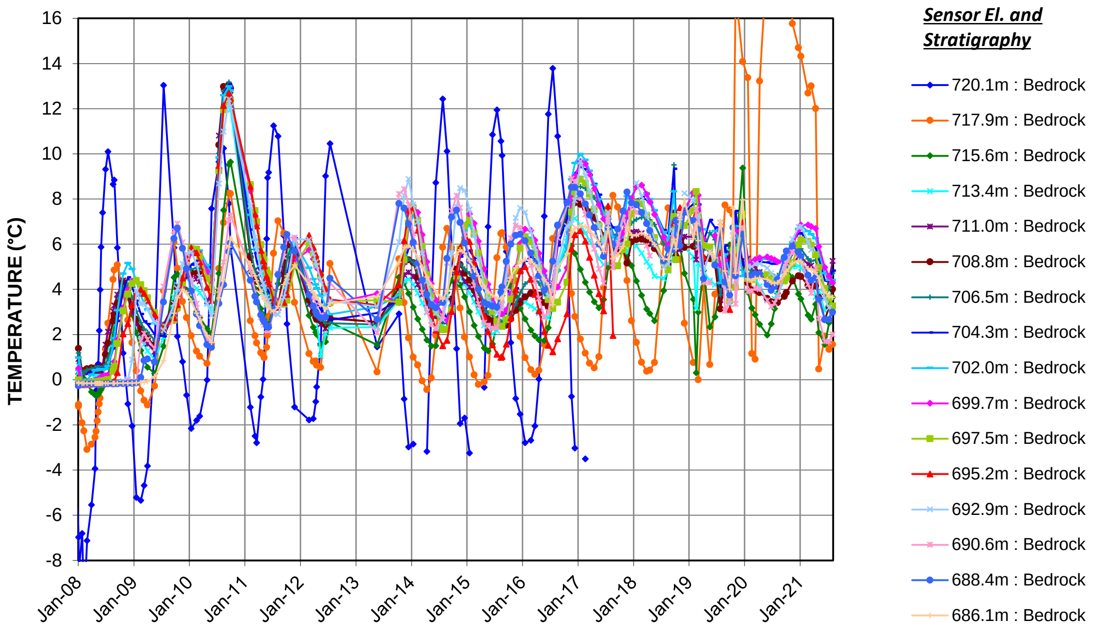


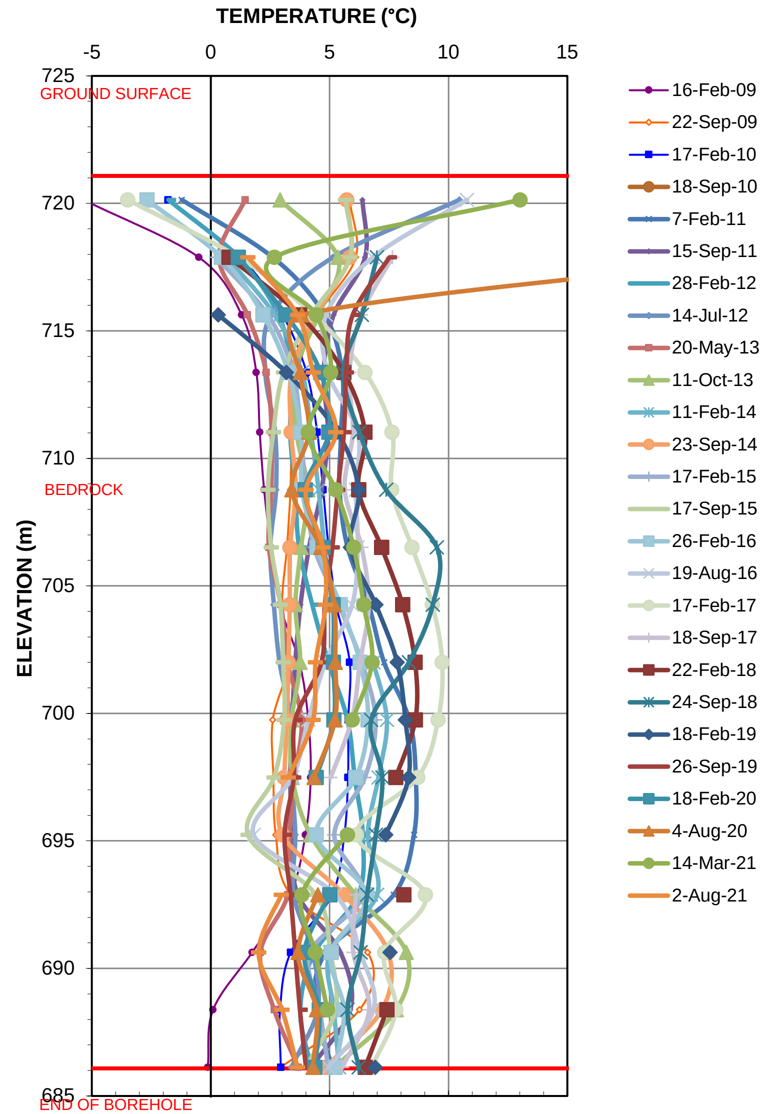


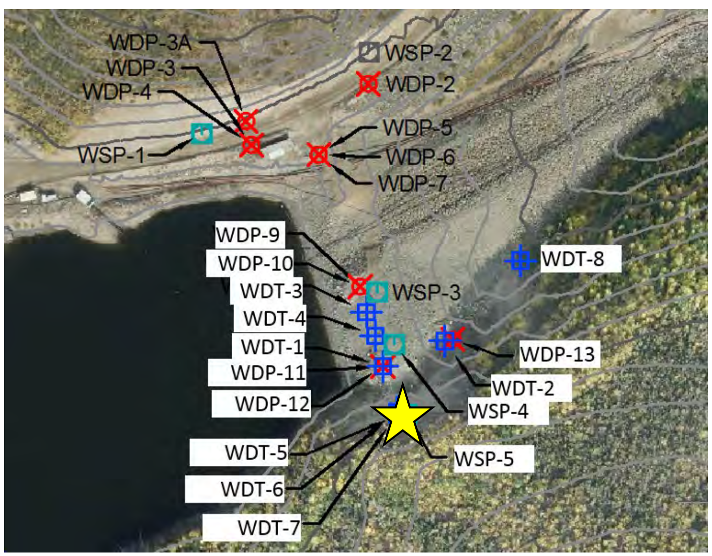
Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting	MINTO	Water Storage Pond Data
		Temperature Cable – WDT-6
Job No: 1CM002.073 Filename: ApH_WaerStoragePond2021.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 8



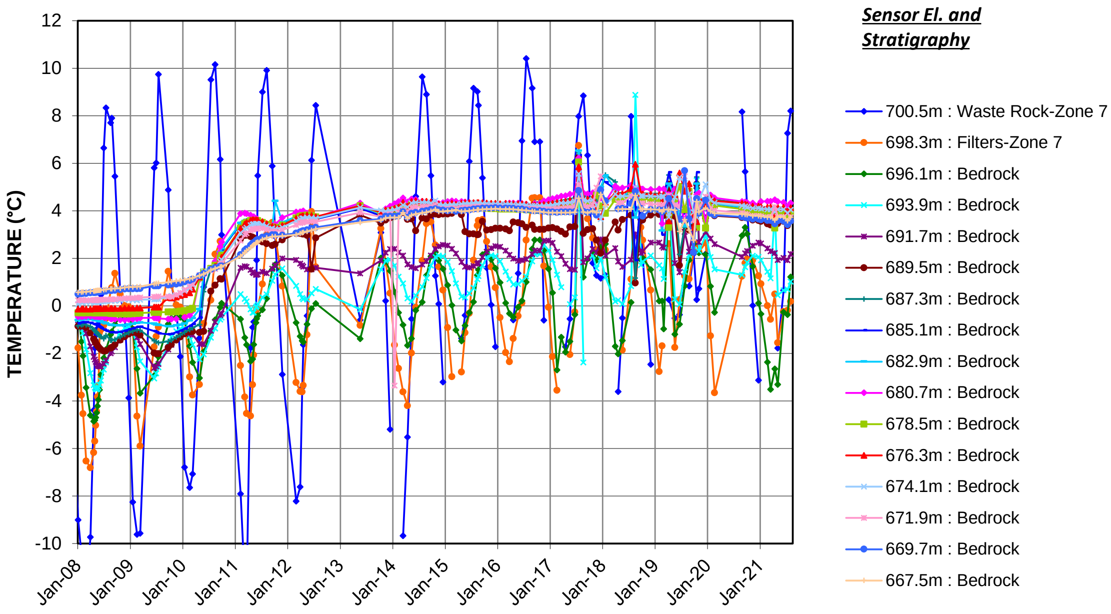


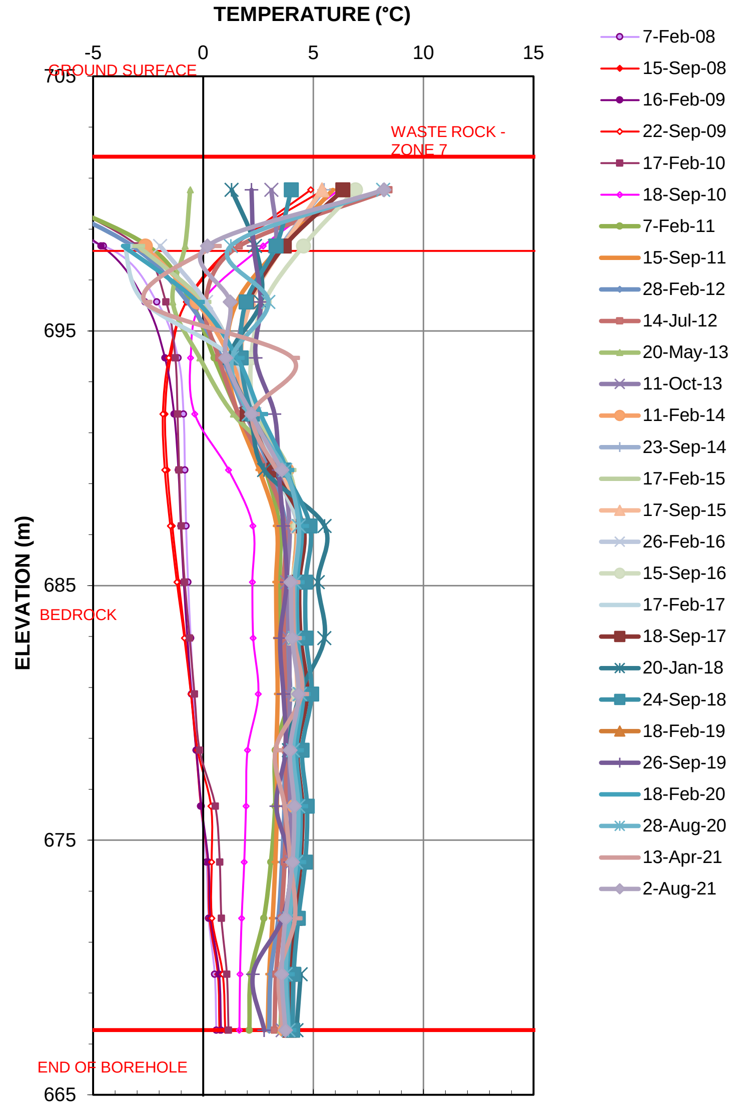


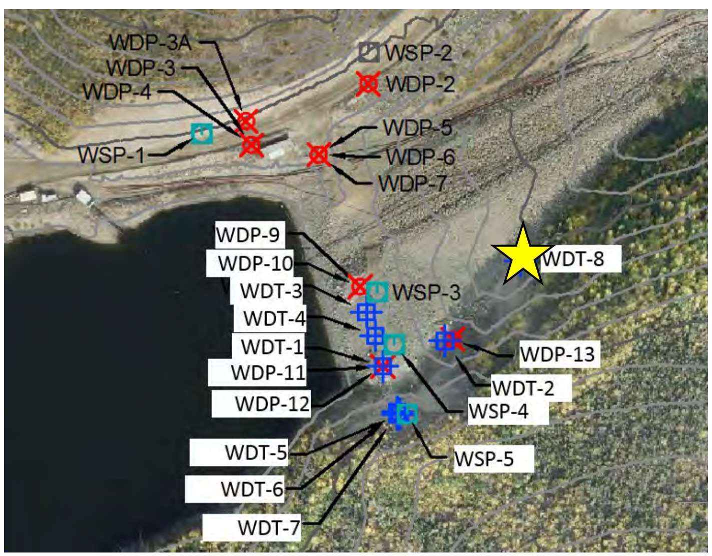
Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting	MINTO	Water Storage Pond Data
		Temperature Cable – WDT-7
Job No: 1CM002.073 Filename: ApH_WaerStoragePond2021.pptx	Minto Mine	Date: October 2021 / Prepared by PHM / Figure: 9







Source files:

1. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKDataSet\MintoWSPDInstrumentation_SRKSet.xlsm

srk consulting

MINTO

Water Storage Pond Data

Temperature Cable – WDT-8

Job No: 1CM002.073

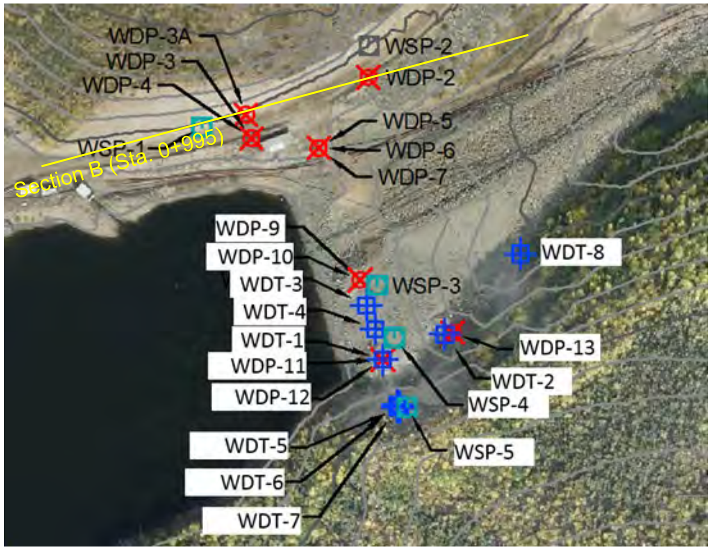
Filename: ApH_WaerStoragePond2021.pptx

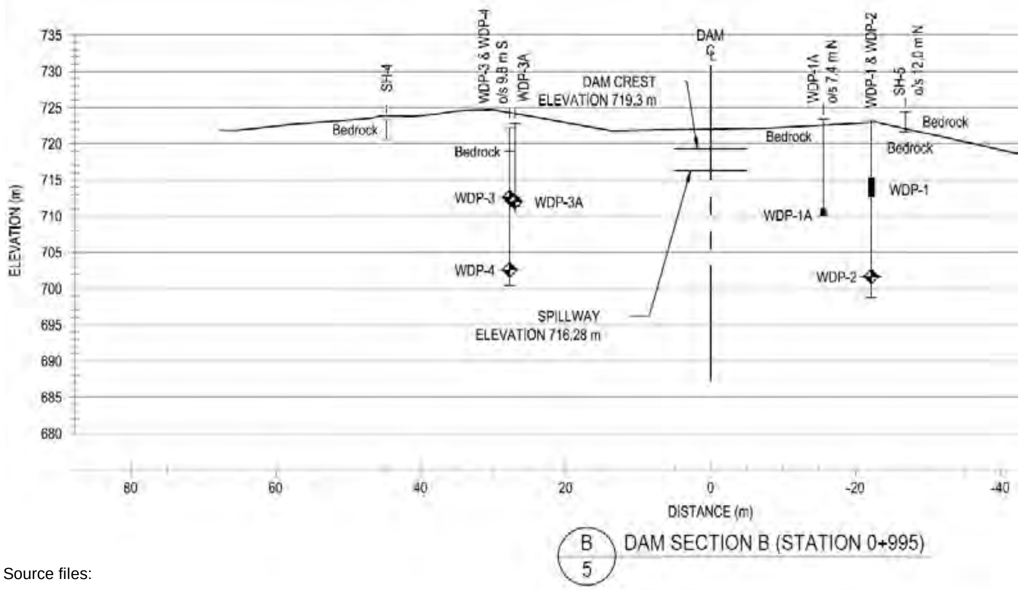
Minto Mine

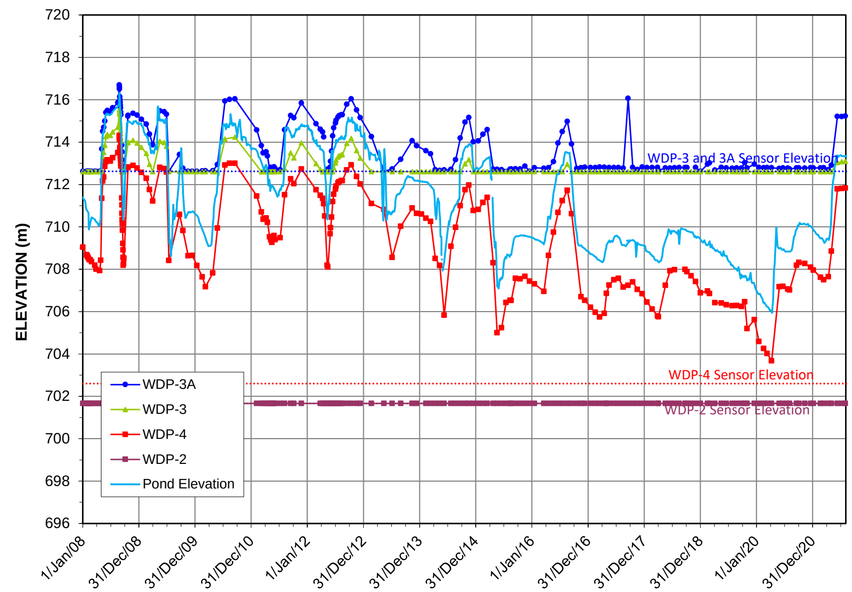
Date: October 2021

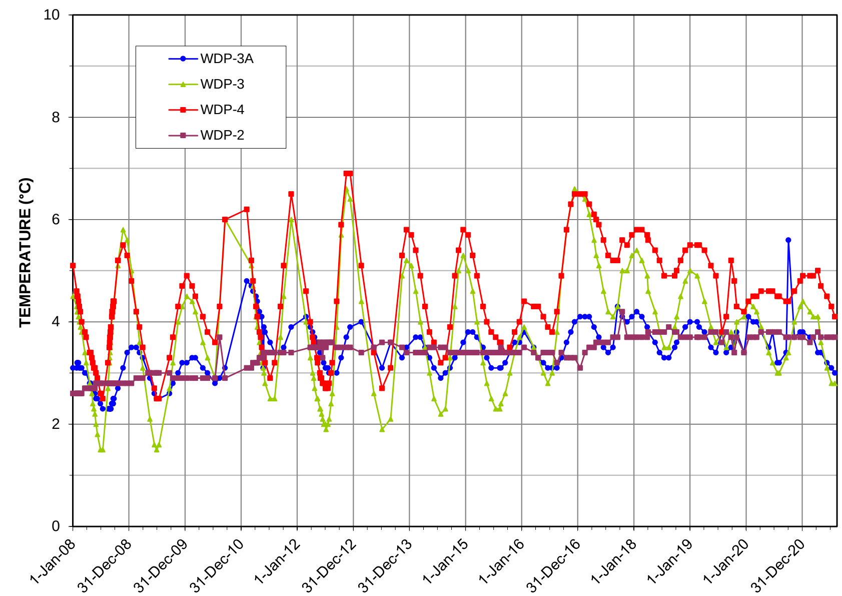
Prepared by PHM

Figure: 10









Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\1CM002.050_2016 Geotech Op Support\!040_AutoCAD\1CM002.050-Site Plan Showing Instrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\SRKSet\MintoSWDInstrumentation_SRKSet.xlsm
3. Cross Section B from EBA (2011) report: Water Storage Pond Dam Geotechnical Instrumentation and Seepage Data Review" dated December 23, 2011.

srk consulting | MINTO | Water Storage Pond Data

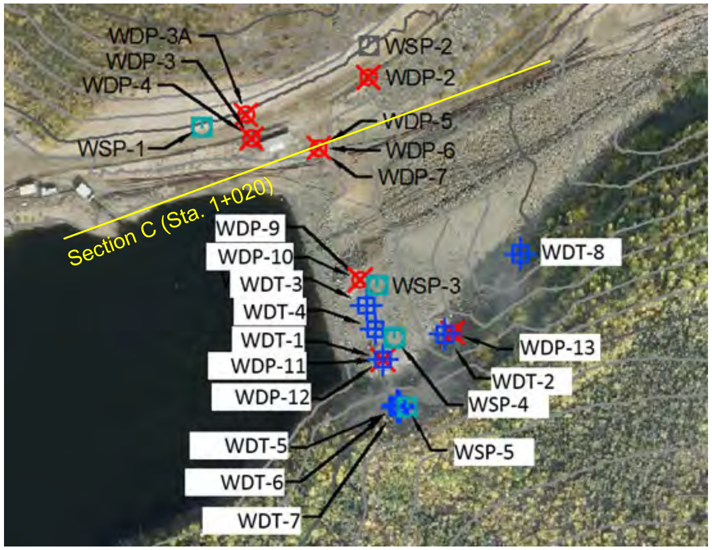
Piezometers – Left Abutment

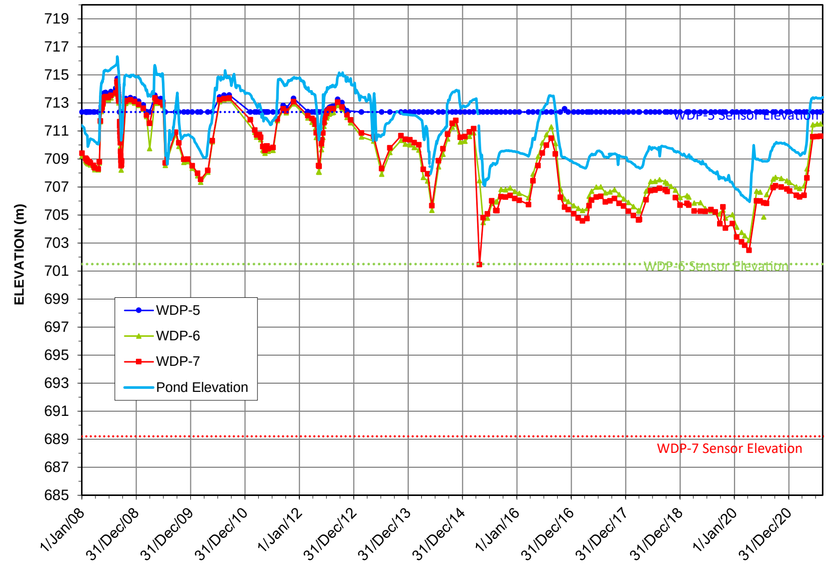
Job No: 1CM002.073

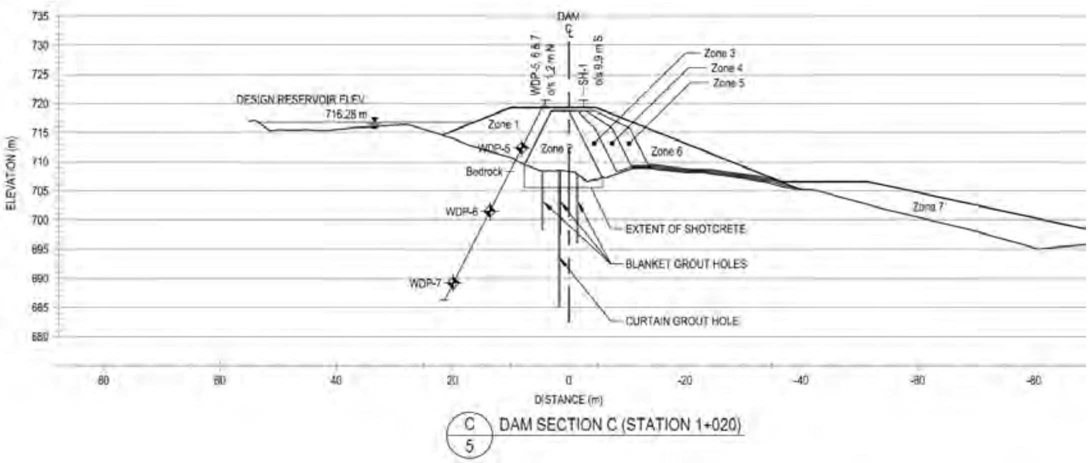
Filename: ApH_WaerStoragePond2021.pptx

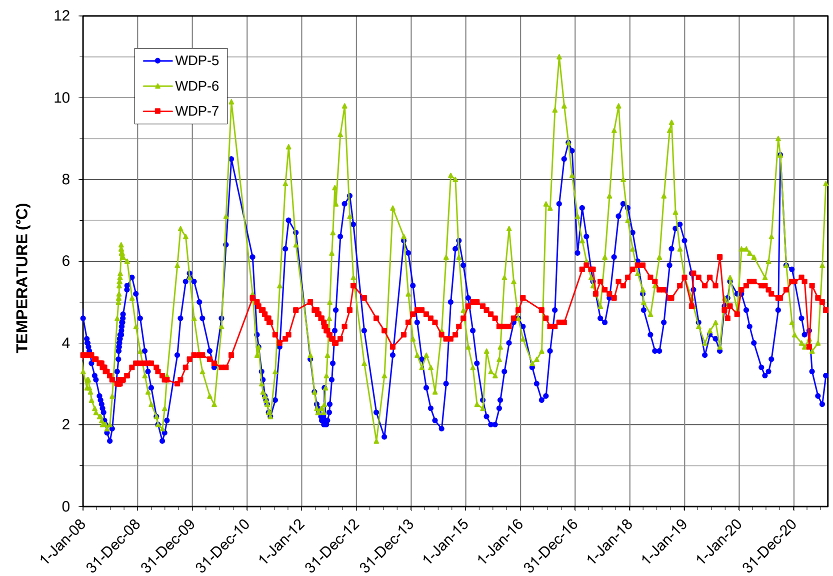
Minto Mine

Date:	Prepared by	Figure:
October 2021	PHM	11





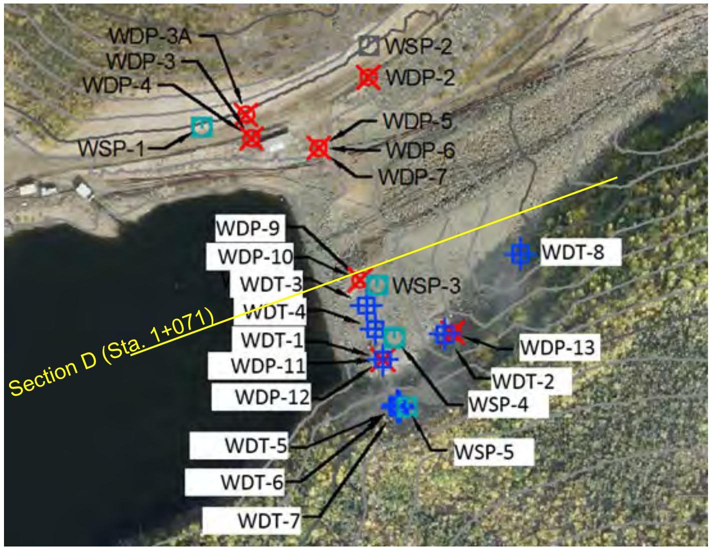


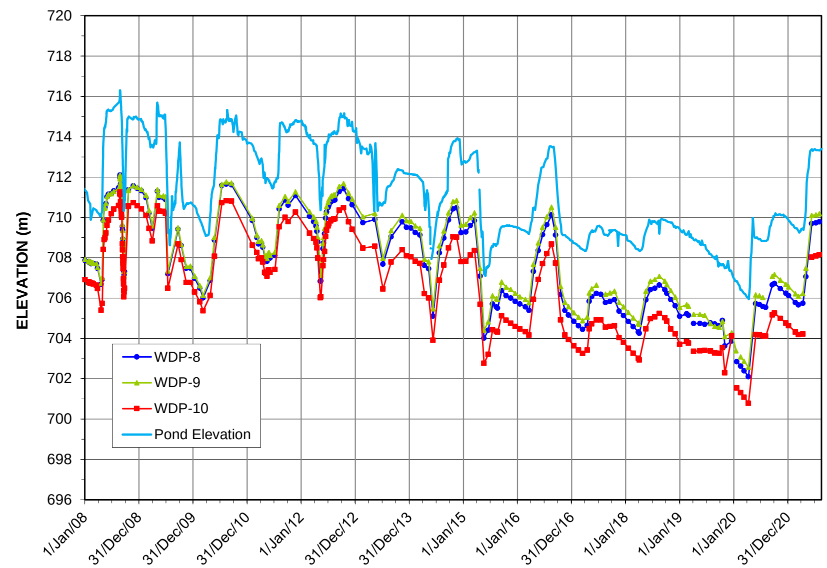


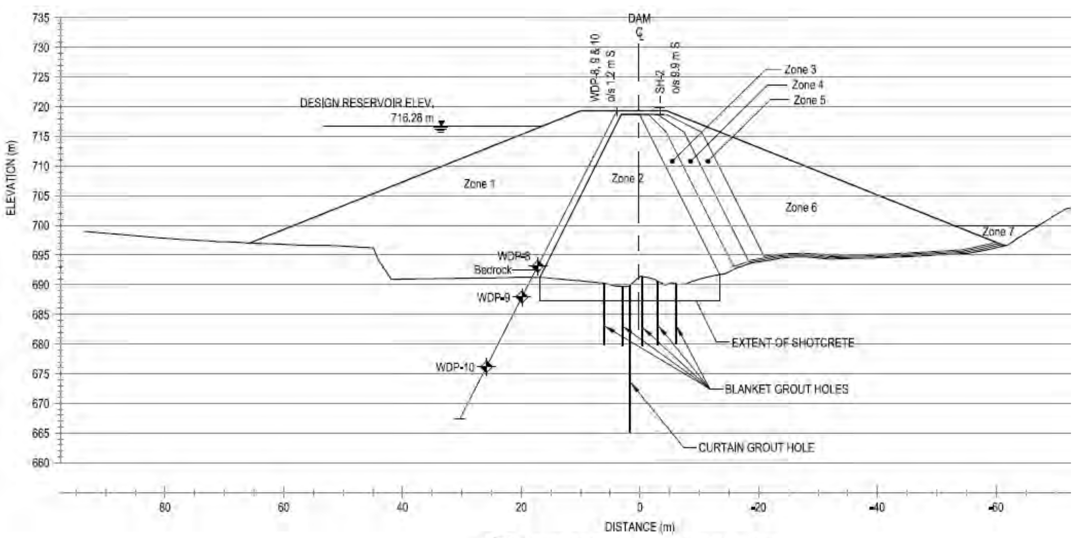
Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\1CM002.050_2016 Geotech Op Support\!040_AutoCAD\1CM002.050-Site Plan Showing Instrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMasterSWDInstrumentation_2016Geotech.xlsm
3. Dam section from EBA (2011) report: Water Storage Pond Dam Geotechnical Instrumentation and Seepage Data Review" dated December 23, 2011.

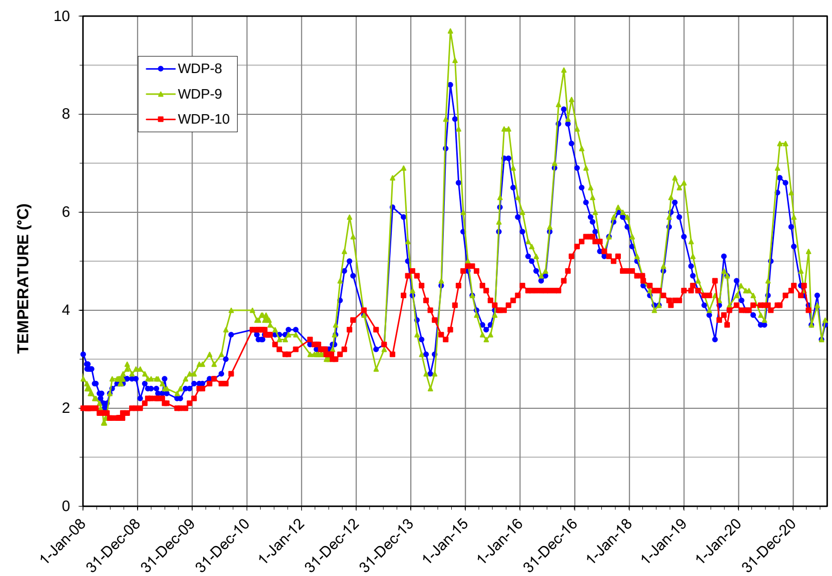
srk consulting	MINTO	Water Storage Pond Data
		Piezometers – Section C (Station 1+020)
Job No: 1CM002.073 Filename: ApH_WaerStoragePond2021.pptx	Minto Mine	Date: October 2021 | Prepared by PHM | Figure: **12**







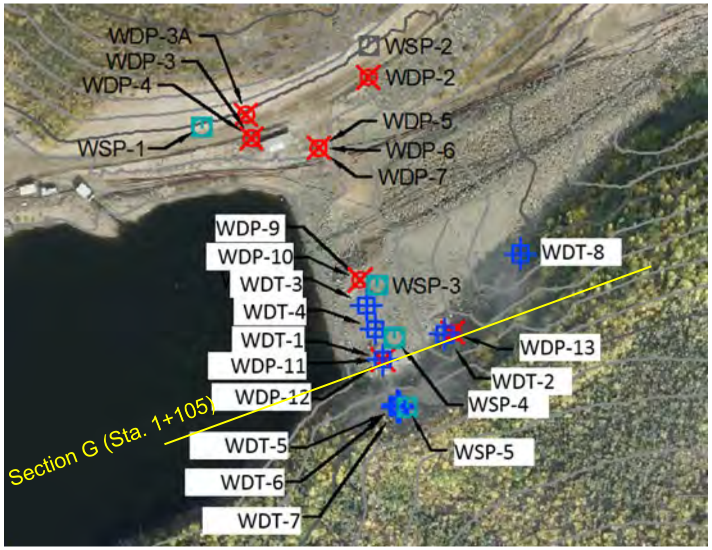
D
5
DAM SECTION D (STATION 1+071)

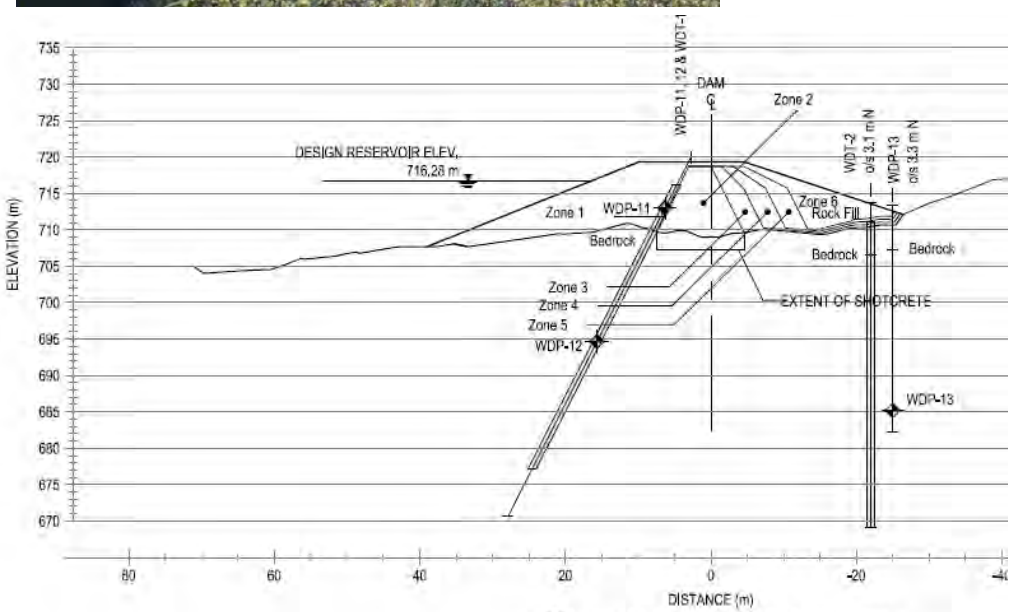


Source files:

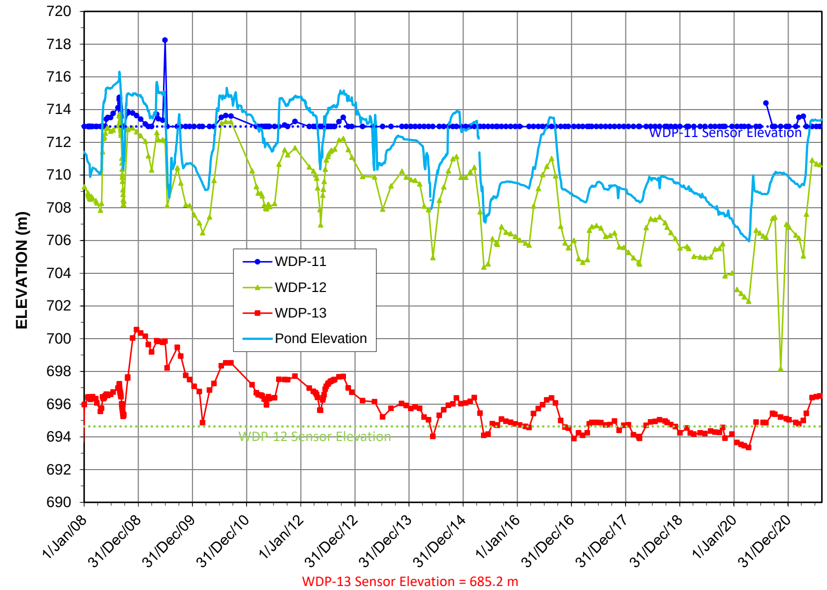
1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\1CM002.050_2016 Geotech Op Support\!040_AutoCAD\1CM002.050-Site Plan Showing Instrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMasterSWDInstrumentation_2016Geotech.xlsm
3. Dam section from EBA (2011) report: Water Storage Pond Dam Geotechnical Instrumentation and Seepage Data Review" dated December 23, 2011.

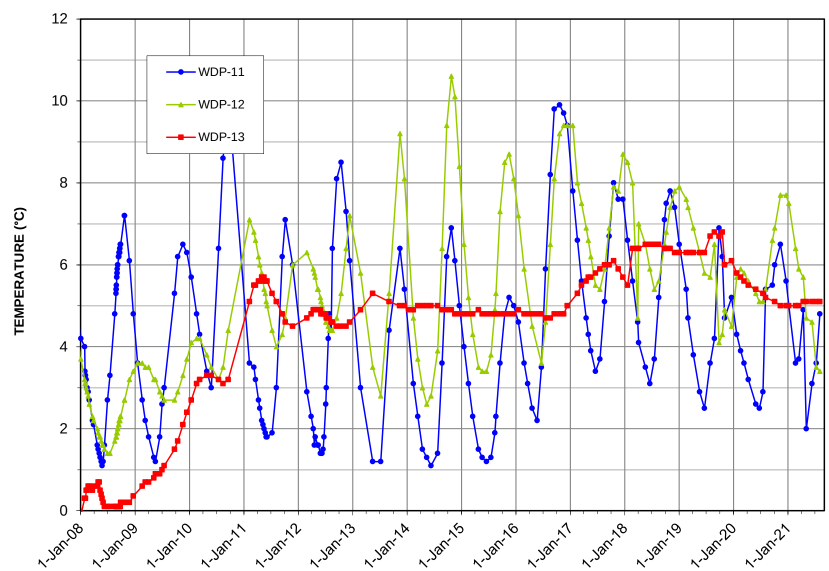
srk consulting	MINTO	Water Storage Pond Data **Piezometers – Section D (Station 1+071)**
Job No: 1CM002.073 Filename: ApH_WaerStoragePond2021.pptx	Minto Mine	Date: October 2021 / Prepared by: PHM / Figure: **13**





G 5 DAM SECTION G (STATION 1+105)





Source files:

1. AutoCAD: \\VAN-SVR0\Projects\01_SITES\Minto\1CM002.050_2016 Geotech Op Support\!040_AutoCAD\1CM002.050-Site Plan Showing Instrumentation.dwg
2. Excel instrumentation data: \\VAN-SVR0\Projects\01_SITES\Minto\!020_Site_Wide_Data\Geotechnical\Geotech Monitoring Data\MintoMasterSWDInstrumentation_2016Geotech.xlsm
3. Dam section from EBA (2011) report: Water Storage Pond Dam Geotechnical Instrumentation and Seepage Data Review" dated December 23, 2011.

srk consulting

MINTO

Job No: 1CM002.073

Filename: ApH_WaerStoragePond2021.pptx

Minto Mine

Water Storage Pond Data

Piezometers – Section G (Station 1+105)

Date:	Prepared by	Figure:
October 2021	PHM	14