Lupin Mines Incorporated

A wholly owned indirect subsidiary of Mandalay Resources Corporation

Lupin Mine Site

Nunavut, Canada

Post Closure Monitoring Plan

Lupin Mines Incorporated

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Lupin Mines Incorporated
Mandalay Resources Corporation
76 Richmond Street East, Suite 330
Toronto, Ontario M5C 1P1

Document Control

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1.0	9/04/2021	Post Closure Monitoring Plan for Lupin Gold Mine prepared to meet the requirements of the Type A Water Licence 2AM-LUP2032.	Golder/ Stantec/LMI	K. Lewis

Executive Summary

A Post Closure Monitoring Plan (PCMP) for Lupin Gold Mine (Lupin) has been prepared by Lupin Mines Incorporated (LMI), a wholly owned indirect subsidiary of Mandalay Resources Corporation (Mandalay), to meet the requirements of the Type A Water Licence 2AM-LUP2032. Lupin is located approximately 285 km southeast of Kugluktuk, in the Kitikmeot Region of Nunavut, and was in operation from 1982 to 2005. Preparatory work and reclamation of Lupin Mine began in 2019 and will be complete by the end of 2021. The PCMP covers the 2.5-year time period during reclamation (Active Closure; Phase 1) and the following 5-year period from 2022 to 2026 (Passive Closure; Phase 2). The PMCP is a living document that will be updated on a regular basis to reflect changes in monitoring program design as the project moves from the active to passive closure. Monitoring will continue after this time period per the Water Licence requirements and adaptive monitoring framework for the project, as applicable. Post closure monitoring through active and passive closure will be conducted to meet the global objectives of Physical Stability, Chemical Stability, and Future Use and Aesthetics.

Consultation on the PCMP, per Part B, Item 20 of the Water Licence, has occurred via online calls and presentations with stakeholders on 9 and 25 March 2021. A consultation session with community members and organizations in the community of Kugluktuk was also facilitated by LMI on 8 April 2021 prior to submission of the PCMP.

Phase 1 (Active Closure) monitoring includes bi-weekly inspections during freshet per Part J, Item 11 of the Water Licence. Inspections include seepage from the dams, water levels in ponds/cells, and general surface erosion, tension cracks, and/or anomalies on dams. Monitoring at the TCA includes inspections, instrumentation downloads, and water quality sampling for verification monitoring and to meet the requirements of the Water Licence and Metal and Diamond Mining Effluent Regulations (MDMER). The final year of discharge from the TCA is scheduled for 2021, after which time Lupin is expected to attain Recognized Closed Mine Status under the MDMER. Geotechnical monitoring will continue at the TCA and all locations where waste has been deposited. Confirmatory monitoring of soil quality will be conducted in areas where contaminated soils are excavated as part of remediation efforts.

Phase 2 (Passive Closure) monitoring includes monthly inspections from June to September each year. In addition, an annual inspection of the TCA will be completed by a geotechnical engineer during ice-free open water conditions per Part J, Item 12 of the Water Licence. Coincident with the annual TCA inspections, the geotechnical engineer will also carry out a visual inspection of the condition of the esker covers over the dome, the landfill, and the adit. For the TCA, passive discharge from the remediated (covered) ponds is proposed to proceed if pH is demonstrated to have achieved a stable site-specific trigger of 5.5. For all other areas (Mine Site and receiving environment), water quality sampling will be conducted per the requirements of the Water Licence. Geotechnical monitoring will continue, but the program will be adapted for the final (reclaimed) site configuration. Monitoring of contaminated soils during the Passive Closure Period will not be required given that the contaminated soils will be disposed in the underground mine workings.

Reporting for the Phase 1 and Phase 2 monitoring programs will consist of an annual monitoring report per the Water Licence (Part J Item 10) submitted by 31 March each year, a final MDMER report for 2021, Phase 1 and 2 geotechnical monitoring reports, and a final soils remediation report.

Executive Summary Inuktitut

Awaiting translation – to be provided as soon as possible

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List of Acronyms and Abbreviations

List of Acronyms

Acronym	Definition
ALS	ALS Environmental Laboratories
ANFO	Ammonium Nitrate/Fuel Oil
APEC	area of potential environmental concern
ARD	acid rock drainage
BP	before present
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCME	Canadian Council of Ministers of the Environment
CGI	combustible gas instrument
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
CoC	Chain of Custody
COPC	Constituent of Potential Concern
DL	detection limit
DMS	Discovery Mining Services
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
ESA	Environmental Site Assessment
FCRP	Final Closure and Reclamation Plan
GPS	Global Positioning System
HHERA	Human Health and Ecological Risk Assessment
ID	identification
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
LMI	Lupin Mines Incorporated
Lupin or Lupin Mine or the Site	Lupin Gold Mine
MDMER	Metal and Diamond Mining Effluent Regulations
NWB	Nunavut Water Board
NWNSRTA	*Nunavut Waters and Nunavut Surface Rights Tribunal Act*
NWR	*Nunavut Water Regulations*
PAG	Potentially Acid Generating
PAH	polycyclic aromatic hydrocarbon
PCMP	Post Closure Monitoring Plan
PHC	petroleum hydrocarbon
QA	quality assurance
QC	quality control
RCM	Recognized Closed Mine

List of Acronyms and Abbreviations

Acronym	Definition
SWIM	Single Window Information Management
TC	Technical Comment
TCA	Tailings Containment Area
TM/PHC	Technical Meeting and Pre-hearing Conference
VOR	very high frequency omni-directional range
WQG-PAL	Canadian Water Quality Guidelines for the Protection of Aquatic Life
XRF	x-ray fluorescence

List of Units

Unit	Definition
%	percent
<	less than
>	more than
°C	degrees Celsius
ha	hectare
km	kilometre
km^2	square kilometre
m	metre
m^2	square metre
m^3	cubic metre
mbgs	metres below ground surface
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mL	millilitre
mm	millimetre
ppm	parts per million

1.0 Introduction

The Lupin Mine (Lupin / Lupin Mine or the Site) is located approximately 285 km southeast of Kugluktuk, in the Kitikmeot Region of Nunavut (Figure 1). The Site is owned by Lupin Mines Incorporated (LMI), a wholly owned indirect subsidiary of Mandalay Resources Corporation.

Lupin Mine is an underground gold mine that was in operation from 1982 to 2005 with temporary suspensions of activities between January 1998 and April 2000, and again between August 2003 and March 2004. The mine resumed production in March 2004 until February 2005. The Site remained in Care and Maintenance from 2005 until 2019. In July 2018, LMI initiated a water licence amendment and renewal process that culminated in the issuance of amended Type A Water Licence 2AM-LUP2032 on 29 February 2020 by the Nunavut Water Board (NWB) and approval by the Minister of Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) on 9 April 2020. LMI continued active preparatory work and initiated year one of the Active Closure phase in first quarter of 2020.

An important objective for closure of Lupin Mine is to return the Site to a condition that protects the health and safety of Nunavut residents and the environment around Lupin Mine. LMI is committed to meeting this objective through the implementation of the NWB approved Final Closure and Reclamation Plan (FCRP) for remediation of Lupin Mine.

A fundamental component of final closure is implementation of post closure management and monitoring. During post closure management and monitoring, LMI will provide a project management team to oversee remediation activities. Upon completion of active remediation, post closure management of the Site will be handled remotely by Discovery Mining Services (DMS) out of Yellowknife, Northwest Territories consistent with approach taken by LMI and DMS during the Care and Maintenance Phase.

1.1 Scope of Monitoring Plan

During the Technical Meeting associated with the Licence renewal and amendment, LMI committed to submitting a Post Closure Monitoring Plan (PCMP) within one year of approval of the renewed/amended licence, following discussion with all stakeholders (TM/PHC Commitment No. 14). It was agreed that the PCMP would incorporate, where appropriate, regulatory review comments, ongoing fieldwork, results from the Human Health and Ecological Risk Assessment (HHERA), and any other direction from the NWB (CIRNAC TC No. 29). The requirements of the PCMP were subsequently confirmed by the NWB as a requirement of Water Licence 2AM-LUP2032 (Part J, Item 13 and Schedule J, Items 1 & 2).

Post closure monitoring of the Site will be conducted to meet the global objectives of Physical Stability, Chemical Stability, and Future Use and Aesthetics described in Section 1.2. A high-level conceptual PCMP was developed and incorporated in the FCRP (refer to Section 5.0 of the FCRP). It is anticipated that active monitoring will occur for 2.5 years and passive monitoring will occur for approximately 5 years following completion of the reclamation work, or until the global objectives for the Site can be confirmed.

Figure 2 provides an overview of the mine area and spatial extent of the PCMP.

1.2 Objectives of Monitoring Plan

The overarching objective of Final Closure is to return the Site and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities. The overall closure goal is supported by the three closure principles of Physical Stability, Chemical Stability, and Future Use and Aesthetics for each component of the Project. The overall closure goal is consistent with the Mine Site Reclamation Guidelines for the Northwest Territories (INAC 2007)

and the Mine Site Reclamation Policy (INAC 2002). The intent of the PCMP is to collect sufficient information to assess the effectiveness of the remediation measures in achieving the overall closure goals and principles.

Closure principles for Lupin Mine are described as follows:

- **Physical Stability:** The components of the reclaimed Site should be constructed or modified at closure so that they do not erode, subside or move under extreme design events, and therefore do not pose a threat to humans, wildlife, or environmental health and safety.
- **Chemical Stability:** The components of the reclaimed Site should be chemically stable so as to prevent adverse soil, water and air quality effects that might pose a risk to humans, wildlife or environmental health and safety.
- **Future Use and Aesthetics:** The reclaimed Site should be compatible with the surrounding lands at the completion of the reclamation activities.

1.3 Structure

The PCMP is divided into the following components:

- Project Description (Section 2.0)
- Environmental Setting (Section 3.0)
- Summary of Final Closure: A summary of final closure implementation for key Site components (Section 4.0)
- Regulatory Requirements or Context (Section 5.0)
- Monitoring Plan (Section 6.0)
  - Phase 1 – Active Closure Monitoring
  - Phase 2 – Passive Closure Monitoring
- Data Storage, Analysis and Reporting (Section 7.0)
- Consultation (Section 8.0)

Supporting appendices include:

- Figures (Appendix A)
- Index of Applicable Regulations (Appendix B)
- Quality Assurance/Quality Control (Appendix C)
- Water Licence, Part J (Appendix D)

1.4 Terminology and Background Documents

The following terminology is used for monitoring components in the PCMP:

- **Active Closure Monitoring** refers to the 2.5-year period during which active on-site reclamation work is completed. LMI projects the manpower presence at the Site will increase marginally during Care and Maintenance phase. The increased presence of personnel on-site is anticipated for the reclamation period. Monitoring programs will be carried out by on-site personnel under the supervision and direction of DMS.

- **Passive Closure Monitoring** refers to the 5-year period following the completion of active reclamation work. Environmental monitoring will be conducted to determine the success of the reclamation measures and confirm that objectives have been achieved. Consistent with the Care and Maintenance phase, LMI does not project continuous manpower presence on-site during this passive closure monitoring. Monitoring programs will be carried out during site visits under the supervision and direction of DMS.

Monitoring is further classified into regulated discharge monitoring and general monitoring as follows:

- **Regulated Discharge Monitoring** refers to monitoring at regulatory compliance locations. Discharge limits must be achieved at these locations to maintain compliance with the Type A Water Licence and/or federal regulations, i.e., Metal and Diamond Mining Effluent Regulations (MDMER) Enforcement action may be taken if discharge limits are not met. Refer to Section 5.0 for further details.
- **General Monitoring** is commonly included in a water licence to specify additional monitoring requirements and a schedule for these activities. General monitoring covers a wide range of activities, such as geotechnical, soils, and water quality monitoring. These monitoring programs may be subject to regulatory compliance assessments to confirm that sampling was carried out using established methods and protocols, including quality assurance/quality control (QA/QC). General monitoring is subject to change, as directed by an Inspector or by the Licensee, and is also subject to approval by the NWB. Refer to Section 5.0 and Appendix D.
- **Verification Monitoring** is additional monitoring undertaken is internal operation management monitoring to verify previous assumptions, model results, or projections. Verification monitoring could include a number of activities, but at the Lupin Mine, will be focused primarily around water quality (e.g., seepage).

Related plans or studies that support this plan include the following:

- Updated Final Closure and Reclamation Plan (FCRP) Rev1, September 2020
- Spill Contingency Plan, March 2016
- Care and Maintenance Plan, March 2016
- Waste Management Plan (Solid and Hazardous), March 2016 (included the Incinerator Operation and Maintenance Procedure, Landfill Management Plan, and Landfarm Management Plan)
- Liquid Waste Management Plan, March 2016
- Monitoring and Inspection Schedule, March 2016
- Water Quality Monitoring Plan and Quality Assurance/Quality Control Plan, August 2020
- Fuel Containment Management Strategy, February 2012
- Closure Plan for Tailing Containment Area, January 2005
- Human Health Ecological Risk Assessment, December 2019
- Phase 1 and 2 Contaminated Site Assessments, October 2017

2.0 Project Description

Figure 2 shows the general layout of Lupin Mine. Other than the transportation requirements for materials and supplies necessary to sustain the workforce and industrial operations, the Site is completely self-contained and relatively compact.

Figure 3 shows the current mine, mill, and camp complex. There are two main areas: the residential complex consisting of accommodation, the kitchen, and the recreation center; the industrial complex comprised of ore processing facilities, as well as maintenance areas, the head frame, hoist room, powerhouse, and warehouse and office facilities. The freshwater pump house is situated approximately 1.6 km northwest of the camp, on the shore of Contwoyto Lake.

In association with the above, there are a number of support areas consisting of shops and yards (maintenance, surface, backfill, and carpentry), storage/laydown areas (cold storage buildings), the main fuel tank farm, camp sewage facilities, mill tailings line, a recently constructed landfarm, and a weather/aircraft control office with exploration shack. Only the main tank farm is currently being used for the storage of bulk fuel.

The Tailings Containment Area (TCA), shown in Figure 4, is situated approximately 3 km south of the mine site. As shown on Figure 3, the only physical connections between the TCA and the mine site are a road and the 8-inch diameter insulated tailings line, used to transport the tailings slurry from the mill to the deposition point in the tailings cells. The explosives magazine is located approximately 2 km west of the TCA and is accessible by road from the TCA road network.

3.0 Environmental Setting

For a comprehensive summary of the environmental setting, refer to the updated FCRP (LMI 2020a).

3.1 Topography

The Site is located in the tundra zone of the Canadian Shield, an area of continuous permafrost. It was glaciated multiple times during the Pleistocene age (Golder 2018). The most recent glaciation was the late Wisconsin glacial stage, which reached a maximum extent about 14,000 years before present (BP) and disappeared about 6,000 years BP.

Terrain in the vicinity of the Site is generally low and undulating, ranging between 470 to 505 m in elevation. The Site is located on a hill, with the height augmented by development/waste rock used to form the foundation of the Site buildings (Golder 2017a).

Much of the Site exhibits bedrock at surface, and it is typified by “tombstone” topography over some of its area (LMI 2020a). These “tombstone” features resemble grave markers and occur as a result of ice-jacking action in heavily jointed rocks where joints tend to be pseudo-vertical and near-horizontal. The frost heave blocks are of various sizes and are scattered in a chaotic fashion. Removal of a block raised by this action would reveal an underlying mass of permanent ice.

3.2 Hydrology

Contwoyto Lake is the major waterbody in the region, with a surface area of approximately 95,900 ha and a drainage area of 800,000 ha (Morrow 2006). Contwoyto Lake has two outlets in the Burnside River, which flows from the northwest end of the lake towards Bathurst Inlet, and the Back River at the southeast end of the lake, which flows into Pellatt Lake (Golder 2020). The main body of Contwoyto Lake lies approximately 1.5 km to the east and south of the mine site. To the north of the mine, a portion of Contwoyto Lake extends to the west and south, terminating in a narrow bay (Sun Bay) which lies directly west of the Site (Golder 2020; Morrow 2006).

The aquatic habitat in the receiving environment, immediately downstream of the TCA is comprised of three shallow lakes (Dam 2 Lake, Dam 1a Lake, and Unnamed Lake), two streams (Seep Creek and Concession Creek), two shallow ponds, and two embayment areas of Contwoyto Lake (Inner and Outer Sun Bay; Figure 5; Golder 2018). Due to low winter flows, both Seep Creek and Concession Creek freeze to the bottom in winter, as do the small lakes and ponds around the Site (Morrow 2006). Consequently, overwintering habitat for fish is limited primarily to Outer Sun Bay and the main body of Contwoyto Lake.

Concession Creek drains Concession Lake via Unnamed Lake and flows into Inner Sun Bay. Lower Concession Creek (i.e., that section between Unnamed Lake and Inner Sun Bay) varies in width between 25 m and 75 m, depending on seasonal discharge. Side channels are active during spring freshet. Stream depth generally is less than 1 m, except during spring freshet when depths approach 1.5 m. The substrate is primarily large boulders with large and small cobbles occupying the interstices.

Seep Creek enters the Sun Bay drainage system along the east side of Unnamed Lake. Seep Creek is approximately 6.5 km in length, flowing from its source in Dam 2 Lake and Dam 1a Lake (via separate branches which join about 2 km downstream) to Unnamed Lake. The stream channel in upper Seep Creek is poorly defined, often flowing through marshy areas, between large boulders, or through bedrock fractures. This section of the creek is generally less than 0.5 m in depth and less than 2 m wide. The dominant substrate type is boulders, although localized areas of cobble and gravel are present. Lower Seep Creek (i.e., the 400 m section upstream of Unnamed Lake) is characterized by a well-developed channel varying in width from 1 to 4 m, although during freshet, the maximum wetted width can reach about 20 m. The substrate is dominated by boulders, with localized areas of cobble and gravel.

Inner Sun Bay (approximate area of 150 ha) is primarily shallow (mean depth of 1.7 m), with a maximum depth of about 6.5 m. Over 91% of the surface area is shallower than 3 m, and much of the bay freezes to the bottom in winter. Outer Sun Bay is deeper (greater than 10 m).

As illustrated in Figure 4, and discussed further in Section 4.4, the waste rock dome proposed in the FCRP is located at a watershed divide, with cover runoff and seepage reporting to the following watersheds: Upper Sewage Lake, Lower Sewage Lake, Boot Lake, Unnamed Lake, and Contwoyto Lake. All watersheds report to Contwoyto Lake.

3.3 Geology

The Lupin Deposit is situated in an Archean metaturbidite sequence of the Contwoyto Formation, part of the Yellowknife Supergroup of supracrustal metasedimentary and metavolcanic rocks of the Slave Geologic Province. The rocks have been subjected to both regional and contact metamorphism and to several phases of deformation and intrusion. The bedrock at the Site consists of a mixture of low-grade metamorphosed argillite, siltstone, slate, greywacke, and quartzite, generally phyllite (Golder 2018).

Where bedrock is not present at surface, the ground surface typically consists of glacial till which is occasionally overlain by glacio-fluvial and glacio-lacustrine sand and gravel deposits (in the form of eskers and lake shore deposits) (Golder 2018). The glacial till is characterized as a silty sand with gravel and boulder content and is underlain by weathered and competent low grade clastic metamorphosed bedrock of the Yellowknife Supergroup.

The subsurface conditions recorded during the 2017 Phase I and II Environmental Site Assessment (ESA) Update (Golder 2017a) were generally consistent with those documented in the 2006 Phase 1 and 2 ESA (Morrow 2006). The subsurface conditions consist of upper development mine rock fill materials, underlain by native silty sand/sand and gravel glacial till and bedrock. The following paragraphs describe these two stratigraphic units.

- Fill Materials - The fill materials typically range from 0.5 to 2.0 m in thickness, with an average thickness of 1.0 m across the Site. Upper fill/surface materials typically consist of angular sand, gravel, cobbles, and boulders (Unit 1; Morrow 2006). Development/waste rock was placed during Site development and construction. This upper fill material typically ranges in thickness from 0.5 to 1.5 m. Lower fill materials consist of sand and gravel materials, likely sourced from the nearby esker (Unit 2; Morrow 2006). The granular fill material is typically 0.5 m in thickness and frequently directly overlies the native ground conditions. The fill materials are typically dry, within variable quantities of cobbles and boulders. Minimal evidence of debris was observed within the fill materials.
- Native Soil - The native soil underlies the fill materials and typically extends from about 0.5 to about 3.0 metres below ground surface (mbgs). The upper stratum of native soil typically consists of silt/sand glacial till (Unit 3; Morrow 2006). Discontinuous ground ice was noted in the several samples of this unit. The lower stratum of native soil consists of sand and gravel materials, which extend to a depth of approximately 3.0 mbgs (Unit 4; Morrow 2006).

These fill and native soil strata are underlain by bedrock. The typical depth to bedrock ranges from 1.0 to 3.0 mbgs. Permafrost was recorded at an average depth of approximately 1.3 mbgs.

3.4 Hydrogeology

Depth to groundwater at the Site ranged from near surface to 1.75 mbgs (Golder 2017a). As indicated previously, the Site is located at the top of a small hill and is augmented by the development of a waste rock pad. As a result, the shallow groundwater is “mounded” in a similar pattern as the topographic contours with radial groundwater flow to the north, east, south, and west. Figure 6 presents show the shallow groundwater flow direction map, based on the findings of the Phase I and II ESA Update (Golder 2017a).

Discharge of deep groundwater to Contwoyto Lake may occur because the lake is a very large waterbody and would have a talik (thaw zone) beneath it. Shallow groundwater would not interact with Contwoyto Lake due to the permafrost conditions. The observation in June 2019 that the water level in the partially flooded mine workings is more than 50 m below the water level in Contwoyto Lake is evidence that there is not a strong hydraulic connection between the mine workings and the deep groundwater flow system.

Discharge of groundwater to other surrounding lakes (e.g., Boot Lake, Unnamed Lake, and Lower Sewage Lake) would not occur due to the permafrost conditions. As these lakes are too small to have taliks beneath them, deep groundwater would also not interact with these lakes.

3.5 Vegetation

The Site is located within an area of sparse vegetation, in the barren land tundra of Nunavut. It is typified as having sparse low-lying vegetation which is extremely tolerant and well adapted to the climatic conditions. Some of the more prevalent types of habitat that can be found throughout the area include upland and lowland tundra, wet meadows, and gentle slopes.

Vegetation across the Site is diverse, consisting of grasses and sedges, and ground cover such as mosses, Labrador tea, cranberry, bilberry, bearberry, and arctic white heather. In wet areas, predominant species include cotton grass, bog rush, and other aquatic grasses. Dwarf birch and willows populate trenches, and examples of colourful flowering plant species include fireweed, Lapland rosebay, azalea, and saxifrage (Golder 2018).

3.6 Climate

Climate in this region is classed as semi-arid subarctic, with an average annual precipitation of approximately 300 mm. August is the wettest month with average rainfall of 59.8 mm. The annual average temperature is −10.9°C); July is the warmest month with average temperature of 11.7°C, whereas January is the coldest month with a monthly average of −29.7°C (LMI 2020a).

3.7 Background Concentrations

The 2006 Phase I and II ESA (Morrow 2006) and 2017 Phase I and II ESA Update (Golder 2017a) identified elevated natural background concentrations for soil as an area of potential environmental concern (APEC). This was based on the interpretation of geology maps for the area of the Lupin Mine. The maps showed the setting of the mine site in the region and showed mineralized (i.e., iron sulphide) veins that extended beyond the area that was mined. Naturally, elevated metals concentrations would be expected to be associated with those veins. To investigate this APEC, a surface soil sample (soil sample ID SS76) was collected in July 2005 by Morrow (2006). In addition, 20 transect surface soil samples (soil sample IDs 51171 through 51190) were collected by Kinross Gold Corporation (i.e., LMI personnel) in September 2005 to the north, south, east, and west of the mill site. Background soil samples were analyzed for total metals, sulphide, and pH. No background samples were collected in 2017 by Golder. Background concentrations for metals were calculated using all soil data from all depths from the 2006 Morrow and 2005 Kinross investigations.

Background concentrations for groundwater are not available for the Site. For seepage surface water, one sample from a creek north of the Site (considered to be unimpacted by the historical mine operations) was collected as a background sample. For lake surface water, the background water quality from Fingers Lake, as used in the water quality model and the HHERA (Golder 2019a).

Background concentrations were used in the HHERA as part of the identification of Constituents of Potential Concern (COPCs) for further assessment. Parameters with concentrations in soil and seepage surface water that were lower than background concentrations were not retained for further evaluation in the HHERA (Golder 2019a). Similarly, for parameters without guidelines/standards, background concentrations were used as a site-specific point of comparison.

3.7.1 Soil, Groundwater, and Seepage Surface Water Quality Data

The previous environmental investigations completed at the Site (Section 1.4) have identified exceedances of the federal guidelines/standards (based on industrial land use) for metals and petroleum hydrocarbons (PHCs) in soil, groundwater, and seepage surface water at the Site. Data are also available for routine physical and chemical parameters (e.g., pH, major ions, etc.) in groundwater and seepage surface water. The datasets relied upon in the are briefly described for each environmental medium below:

- Soil quality data from all environmental investigations (from 2006 and 2017) and all depths were used in support of the HHERA. Soil data are available for PHCs, metals, polycyclic aromatic hydrocarbons (PAHs), and glycols.

- Groundwater quality data are available for 2006 and 2017. Groundwater quality data from 2017 were used in support of the HHERA, as these concentrations were considered to be most representative of current conditions. Groundwater data from shallow groundwater monitoring wells are available for PHCs, metals, PAHs, and glycols. Deep groundwater was not evaluated.
- Seepage surface water data are available for 2017 and 2019. Seepage surface water quality data from 2019 were used in support of the HHERA, where available, as these concentrations were considered to be most representative of current conditions.

The approximate locations of soil, groundwater and seepage surface water sampling stations are shown in Figures 6, 7, and 8, respectively.

3.7.2 Water Quality Predictions for Lakes

As noted previously, surface water quality modeling of receiving water bodies was completed to evaluate the performance of the proposed granular esker cover of the waste rock dome with respect to limiting generation of acid rock drainage (ARD) impacted waters from the waste rock dome (Golder 2019b). After closure, the waste rock dome is expected to be roughly circular and to cover an area of about 30 ha. It will contain about 820,000 m^3 of waste rock and it will have a surface slope of about 1.6%. The resulting predictions of loading to surface water were evaluated in the HHERA for potential risks to human and ecological receptors.

The proposed waste rock dome is planned to be constructed over historic mine infrastructure including the mill, camp, crown pillar, and tank farm. As illustrated in Figure 4, the dome is located at an area of watershed divides, with cover runoff and seepage reporting to multiple watersheds as follows:

- Upper Sewage Lake
- Lower Sewage Lake
- Boot Lake
- Unnamed Lake
- Contwoyto Lake

Water quality predictions were completed for the following prediction nodes in the receiving environment:

- Unnamed Lake Outlet
- Boot Lake Outlet
- Lower Sewage Lake Outlet

All watersheds report to Contwoyto Lake. Given the large size of Contwoyto Lake (greater than 500 km^2), it was assumed that mine related effects in the majority of the lake will be negligible and that observable effects (if any) would be limited to the immediate vicinity of stream confluences with Contwoyto Lake. It was anticipated that mixing of mine impacted water with Contwoyto Lake at these confluences would result in concentrations at or below background conditions or applicable water quality criteria due to the relatively low flow rates of mine impacted streams. Predictive modelling of water chemistry values for Contwoyto Lake in the vicinity of these confluences has not been completed to date.

The predicted composition of water at each receiving node was expected to vary on a monthly basis during the open-water season depending on the proportion of precipitation and snowmelt that report as cover runoff versus infiltration. Higher metal concentrations were generally anticipated in the relatively small watersheds of Lower Sewage Lake and Unnamed Lake compared with Boot Lake, where the larger watershed results in a greater proportion of natural runoff relative to contact water. No channels have been observed to transport flow from existing waste rock piles to receiving water bodies. It was considered probable that a portion of waste rock seepage flows travelling overland from the toe of the proposed waste rock dome to the receiving water body would either evaporate or infiltrate prior to reaching a receiving water body.

The model was constructed based on the conceptualization of sources and release mechanisms, combined with data interpretation, to describe water quality conditions at the Site. Where uncertainty existed in model input values, conservative inputs and assumptions were applied. Climatic controls were not modelled, except for those which were captured in thermal-seepage modelling of the waste rock dome. Therefore, the model may overestimate the predicted concentrations in the modelled catchments (Golder 2019b).

The water quality model provided predictions for the four months of the open-water season (June, July, August, and September). The model included two scenarios to represent uncertainty in geochemical source terms: 50th percentile of source data concentrations, to represent expected conditions; and 75th percentile of source data concentrations, to represent upset conditions (i.e., worst-case). Given that the model is considered to be conservative, the water quality model results for the 50th percentile source terms scenario were used in support of the HHERA.

Background concentrations used in the model were data from 2006 through 2016 for Fingers Lake (approximately 6 km southeast of the mill site). Fingers Lake is also used as a background water quality monitoring location in Environmental Effects Monitoring (EEM) studies for Lupin Mine. The 50th percentile background concentration was used to be consistent with the predicted surface water concentrations used in the HHERA.

4.0 Summary of Final Closure

The approved FCRP has been prepared on the assumption that all facilities and installations that comprise the Lupin Mine Operations will ultimately be decommissioned, removed, or reclaimed under the terms of the land lease and in accordance with the reclamation requirements set out in the Water Licence (LMI 2020a).

For complete and comprehensive details associated with final remediation and closure refer to the FCRP.

4.1 Mine Workings (Underground)

The Lupin underground workings are shown on Figure 9, and include a 1,210 m vertical shaft and a decline drift, or ramp, to a depth of 1,560 m. A secondary hoist system (Winze) was installed in 2001 allowing hoist access to 1,340 m. The current mine depth is 1,550 m. There are also two other shafts open to surface: a fresh air raise and an exhaust raise. Incorporated into the underground facility were maintenance shops, an electrical shop, and a primary crushing station. The winze and underground mine equipment were removed from site when the mine entered care and maintenance in 2006. All hazardous materials were removed from the underground workings. Any equipment left (disposed of) in the underground workings was drained of fluids.

Shafts will be backfilled to prevent animal or human entrance. The West Zone crown pillars will be blasted down where required for stability or disposal. Contaminated soil and waste rock will be disposed of into the shafts and the open crown pillars. The combined volume available for underground disposal for the West Zone stope, the fresh air raise, and exhaust raise totals approximately 75,066 m^3 of underground storage volume. Crown pillars will be backfilled with rock fill (up to 1.5 m above surface to allow for settlement plus additional waste rock to suit the grading of the dome), then capped with 1.0 m of esker material.

The Lupin Mine was also serviced by an access ramp, which has already been sealed with a soil and rock plug and a locked fence installed to prevent access during the phase of care and maintenance.

The permanent closure of the access ramp (also known as the portal) will be established by the following: "To prevent future access to people and wildlife, a 10 m long plug of rock fill will be placed in the adit and portal area. The areas above the shaft and raises, and all remaining surface expressions of the underground workings (including the portal area depression if additional backfill material is needed), will be backfilled to above grade with waste rock from surface and then capped with esker material." (CIRNAC TC No. 1).

4.2 Borrows and Quarries

The sand and gravel used for road and dam construction as well for covering the TCA cells since 1995 was obtained from the Fingers Lake esker. The Fingers Lake esker will continue to provide the cover material for the remaining TCA cells and will also be used for the reclamation of the other components of the Lupin Mine (Figure 1). During closure implementation, the Finger Lakes esker area will be contoured, and esker material will be used in the placement of erosion protection in drainage paths.

The two existing bedrock quarry areas; one within the TCA area and the other one near the Fingers Lake esker, are small and inactive and there are no plans to use these areas further during closure implementation.

4.3 Waste Rock

Waste rock was generally used throughout the Site as pads, roadbed materials, in dam construction, airstrip stabilization, underground backfill, and laydown yards or for other purposes such as building foundation preparation. The estimated volume of waste rock on surface is about 1,000,000 m^3. Mine operations did not produce any stockpiles of overburden or unprocessed low-grade ore.

Environmental site assessments in 2006 and 2017 indicated that up to 67% of the waste rock can be classified as Potentially Acid Generating (PAG) and that PAG samples were distributed across the Site. Accordingly, the main objective of the reclamation of the waste rock is to limit the contact between the waste rock and surface water.

During closure implementation, waste rock containing high levels of arsenic, cyanide, or lead nitrate will be disposed of into the open shafts or crown pillars. Waste rock from perimeter areas will be disposed of into shafts or open crown pillars, into the landfill, or it will be consolidated into the central waste rock area. GPS coordinates of the disposal locations will be collected in degrees, minutes and seconds of latitude and longitude as part of the waste rock disposal. The waste rock remaining on surface will be contoured to shed water and then it will be capped with 1.0 m of esker material.

4.4 Tailings Containment Area

As described in the FCRP, the tailings from Lupin milling and ore processing operations were deposited within a number of cells in the Lupin TCA. In accordance with the approved TCA 2004 Final Abandonment and Restoration Plan (Final TCA ARP) (Kinross 2004), as of the end of the 2017 construction season, a 1.0 m esker material cover had been completed over approximately 1,311,500 m^2 of the exposed tailings. As of the end of 2017, there remained approximately 123,500 m^2 of exposed tailings in Cell 5 and 86,000 m^2 in Cell 3. LMI intends to complete the placement of the cover by the end of the summer of 2021 as part of the approved reclamation activities.

The tailings pipeline will be removed and buried in the landfill. The treatment plant will be demolished, and rubble will be disposed of in the landfill. Permanent monitoring instrumentation will be installed for the continued monitoring of site conditions.

The arsenic treatment facility is a steel frame/metal clad building located at the TCA between Ponds 1 and 2 at the south end of J-Dam (Figure 4). It is used during operations to treat the water in Pond 1 prior to discharge into Pond 2. It has also been used during closure activities to pre-dose Pond 1 water with soda ash during transfer to Pond 2. Pond 2 is the last point of control prior to discharge into the receiving environment. The treatment plant or facility was used for mixing of reagents (ferric sulphate and lime) for water treatment operations during the early 1990's and has been inactive since 1996. The facility has been partially decommissioned. All remaining components were flushed after use. LMI proposes to demolish the treatment plant and dispose of the debris in the landfill after water treatment activities are completed at site (FCRP, Section 4.3.2.8; LMI 2020a).

During closure implementation, the water inventory in the TCA ponds will be treated with lime or soda ash and then released to maintain the pond water levels within operating range. If any tailings are exposed when the ponds are lowered, the tailings will be covered in place with 1.0 m of esker material.

Several other actions are required to complete the permanent closure of the TCA at the end of the Active Closure period (if monitoring data supports this approach). Constructing permanent open channel spillways through Dam 1A and J Dam is required to re-establish natural drainage through the TCA watershed. Once it has been documented that ongoing treatment is no longer required, the TCA will be made passive by constructing engineered spillways to re-establish natural drainage through the TCA watershed. Permanent closure spillways will be constructed through Dam 1A and J Dam and lined with geotextile and rip rap. For additional details on the permanent closure spillways to be constructed through Dam 1A and J Dam refer to Section 4.3.2.8 and Section 4.3.2.13 of the FCRP (LMI 2020a).

LMI will provide final spillway designs as directed by the NWB at least 60 days prior to proposed start of construction, in accordance with Part G, Item 1 of the current Licence.

4.5 Mill Complex

All metallurgical reagents used during operation in the Mill Complex, with the exception of lime and soda ash, have been shipped off site during the care and maintenance phase. The mill was given a complete wash down with the intent of gold recovery (visible gold that settles within the system) and any residual contaminants (from chemical use) were removed to the tailings impoundment prior to the care and maintenance phase.

Mill buildings will be demolished, and rubble will be disposed of in the landfill. Materials that can be economically salvaged will be consolidated and shipped off-site. Any concrete foundation slabs will be hoe rammed and, left in place. If otherwise exposed, they will be covered with 0.3 m of granular fill. Any asbestos containing materials will be safely disposed of in the landfill.

4.6 Landfill and Other Waste Disposal

The waste management facilities used at the Site are an incinerator, a temporary "boneyard" (for decommissioned tanks, buildings, and equipment), a solid non-hazardous waste landfill, a landfarm, two burn pits (annual applications to CIRNAC are required for open burning), and waste oil storage. Waste materials that cannot be disposed of in a management facility on site are appropriately segregated, stored such that they are inaccessible to wildlife and later shipped to a third-party waste receiver in Yellowknife, Northwest Territories.

Recyclable containers, primarily food and beverage containers, will be segregated and shipped off-site for management by a third-party waste receiver.

All non-hazardous wastes will be disposed of in the existing landfill, including ash which will be removed from burn pits. Waste rock will be used to infill voids and create a stable contoured surface which drains freely. All non-hazardous and non-burnable waste (scrap metal, plastics, residue from burning) historically will be disposed at the Site landfill and buried with waste rock on a regular basis. The waste in the landfill will be covered progressively during use.

All hazardous materials that cannot be disposed at the landfill, such as paints, batteries, solvents, chemicals, and glycols will be assembled in a staging area and then shipped off site for disposal.

The mine currently uses a small landfill adjacent to the Lower Sewage Lagoon. The approximate compacted volume of debris (non-hazardous, inert materials) to be generated during closure activities, by demolition of all of the buildings, the contents suitable for disposal, tanks, pipelines, etc., is estimated to be approximately 55,290 m^3. Barring salvage opportunities, landfill disposal will also be required for the approximately 20,000 m^3 of materials stored on surface laydowns. No hazardous waste will be disposed of in the landfill. LMI completed a Phase I and II ESA in 2017 (Golder 2017a) and a HHERA in 2019 to establish project-specific standards (Golder 2019a). LMI will use a combination of field screening and confirmatory lab analysis techniques to ensure that the PHC soil remediation program meets Nunavut guidelines (Government of Nunavut 2009). For additional information related post remediation risks to human and environmental health, refer to the HHERA (Golder 2019a).

4.7 Support Infrastructure

4.7.1 Accommodation Facilities

Accommodation facilities will be demolished; rubble will be disposed the landfill.

4.7.2 Freshwater Supply

The freshwater for the Site is obtained from Contwoyto Lake approximately 1.5 km from the complex. A causeway/breakwater extending out into the lake supports a pump house building and docking facilities.

The freshwater supply pumps were decommissioned in 2006 as a care and maintenance requirement. Currently, freshwater is trucked from the breakwater on Contwoyto Lake to a water storage tank at the accommodation buildings. The water supply system will be removed for final closure; however, the breakwater will be left in place for future use.

4.7.3 Arsenic Treatment Facility

This facility, a steel frame/metal clad building, is located at the TCA between Ponds 1 and 2, at the south end of J Dam. It was used for mixing of reagents (ferric sulphate and lime) for water treatment operations during the early 1990's and has been inactive since 1996. The facility has been partially decommissioned.

All remaining components were flushed after use. The facility will be demolished after water treatment activities are complete, and the rubble will be disposed in the landfill.

4.7.4 Explosives Magazine

The explosives storage magazine is located 2 km west of the TCA and consists of 2 steel-frame/metal clad buildings for Ammonium Nitrate/Fuel Oil (ANFO) storage, and historically numerous Sea-Containers for the storage of stick powder and other blasting products. The storage facility will be used temporarily for the blasting of the West Zone crown pillar and then it will be demolished, and the rubble will be disposed of in the landfill.

4.7.5 Roads and Airstrips

Roadways were constructed in part with mine development waste rock. Roads will be rehabilitated for closure (scarified and graded, cut through access roads and removal of culverts).

The old airstrip that was used during construction had been used as a laydown area after the new airstrip was operational. This area was slowly phased out as a storage location and, in 1998, the gravel/esker fill strip was graded to conform to the natural landscape with cuts and backsloping applied where necessary to promote natural drainage and reduce erosion. The surface was scarified utilizing a grader with a ripping attachment.

The main airstrip is 1,950 m (6,400 ft.) in length and was constructed of crushed waste rock produced from development underground. The drainage in the area has been altered slightly in a lateral direction; however, all runoff from both the east and west sides of the strip report in a northerly direction, eventually to Contwoyto Lake. The airstrip fueling facility has been removed and the fuelling area has been reclaimed. The airstrip will be left in place for public use after closure.

4.7.6 Sewage and Refuse Facilities

The sewage facilities consist of several lift stations within the camp and an 800 m long 6-inch diameter insulated steel pipeline to the first of two sewage lakes. Alternatively, when, during Care and Maintenance, camp capacity requirements do not warrant its use; sewage and grey water are collected in a sewage tank at the accommodation buildings. The tank is then hauled to the Upper Sewage Lake wherein waste is deposited. A sewage line to convey camp sewage directly to the Upper Sewage Lake may be utilized.

Grey water originating from log cabin (guesthouse or office cabin or manager's house) use may be deposited in an adjacent leach pit. All sewage is to be discharged to the Sewage Lakes Disposal Facilities.

A 'permeable' type dam with an emergency overflow and a syphon exists between the first and second lake. Discharge from the second lake is controlled by syphons. Water accumulating in the Lower Sewage Lake is tested prior to discharge to the environment. Discharge procedures are described in the Liquid Waste Management Plan.

For closure, the upper and lower dams will be breached with engineered spillway that will be lined with geotextile and rip rap. The invert of the spillway will be set to the original ground and it is anticipated that a small residual pond will remain in the former Upper Sewage Lake in order to reduce the possible transport of suspended solids.

4.7.7 Tailings Pipeline

The tailings line has been flushed thoroughly with clean water, and then partially dismantled but left in place. For closure, the piping will be disposed of in the landfill. The tailings line foundation will be generally left intact with the exception of areas where drainage is controlled by culverts. The removal of culverts and the backsloping of the openings will ensure that minimal erosion takes place and proper drainage is achieved. Any other areas of water pooling along the tailings lines during spring melt will be opened up to provide unlimited drainage. The management of PAG material in the tailings line foundation and elevated metal concentrations in the adjacent soil will be as described in Section 4.3.2.3 of the FCRP.

4.7.8 Fuel Storage

The fuel storage facilities at Lupin included a main tank farm (including a system of 14 diesel tanks, 1 jet A tank and 9 individual tanks), a satellite tank farm (including a system of 10 diesel tanks and 2 gasoline tanks and a waste oil tank farm which included 2 waste oil tanks). In addition, there were 5 glycol tanks on site and various individual tanks. Geomembrane liners were used for containment purposes.

At the end of 2017, there was an ample inventory of diesel fuel in storage at the Site and it had been tested and verified as still useable. Most of this fuel will be consumed in undertaking the closure measures; diesel fuel that remains after closure is completed will be burnt on site. After the tanks are emptied, they will be purged according to regulations and then cut up and disposed of in the landfill.

In 2014 buried pipes were removed between the main tank farm and satellite tank farm. The fuel remaining in the satellite tank farm was used up in 2015. In 2017, a portion (approximately 500 m^3) of petroleum contaminated soils associated with the satellite tank farm were removed and relocated to the landfarm for bioremediation. After treatment, the bioremediated soil will be used for site grading. It is planned that the remaining volume of contaminated soil will be relocated to underground locations for disposal, and that the tanks will be cleaned, and transported to the boneyard in 2018 for salvage or landfill disposal.

An updated Phase I and II ESA carried out in 2017 indicated that there was a total of about 34,700 m^3 of PHC contaminated soils present in a number of locations on the Site. The PHC soils will be cleaned up and disposed of in the underground mine workings. GPS coordinates of the disposal locations will be collected in degrees, minutes and seconds of latitude and longitude as part of the PHC soil remediation.

4.7.9 Chemical Storage

During operations, the mine had an inventory of chemicals which included: cyanide, lime, lead nitrate, zinc dust, flocculants, and ferric sulphate in major quantities and miscellaneous refinery reagents in much lesser quantities. Of the chemicals listed, only lime is held on-site during care and maintenance.

During closure implementation, any remaining paints, solvents, chemicals, glycols and hazardous materials will be drummed and shipped to off-site disposal; waste oil will be burned in the incinerators; diesel fuel will mostly be consumed during closure operations, with any remaining fuel being burned in incinerators; fuel tanks will be purged and disposed in accordance with the Canadian Environmental Protection Act Regulation; hydrocarbon contaminated soils will be buried in the underground workings (i.e., in shafts or open crown pillar voids); soil currently in landfarm will be disposed of in the shafts and crown pillar. Fluids drained from on-site equipment will be burned in the incinerators or shipped off-site for disposal.

5.0 Regulatory Requirements or Context

The regulatory requirements for decommissioning, reclamation, and closure of the Lupin Mine are outlined primarily in the Water Licence and federal land leases. It should also be noted that additional regulatory requirements related to the Fisheries Act, Inuit Water Rights under the Nunavut Agreement, and land use planning and environmental assessment requirements are also mandated.

For a full listing of applicable acts, regulation, guidelines, or policies that govern the Site refer to Appendix B.

5.1 Nunavut Waters and Nunavut Surface Rights Tribunal Act and Nunavut Waters Regulations

The original Water Licence for mining and milling at Lupin was issued by the Northwest Territories Water Board on 1 June 1981. Several Amendments and renewals have occurred since that time.

The Lupin Mine is currently licenced in accordance with the legislative requirement of the Nunavut Waters and Nunavut Surface Rights Tribunal Act (NWNSRTA) and Nunavut Waters Regulations by the NWB under a Type A Water Licence 2AM-LUP2032 (Water Licence). The current Water Licence was issued by the Board on 28 February 2020, approved by the Minister of Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC or Minister) on 9 April 2020. The Licence expires on 27 February 2032. LMI has maintained the Water Licence in good standing and is in compliance with terms and conditions set out therein.

5.1.1 Water Licence Monitoring Requirements

The Water Licence (2AM-LUP2032) establishes water quality limits at regulated discharge locations as outlined below, and general monitoring requirements for other compliance stations in Part J (see Appendix D). It is noted that per Section 73 of the NWNSRTA, conditions related to discharge limits must be at least as stringent as the federal MDMER regulations.

Regulated discharge monitoring requirements apply to effluent discharged from the TCA (final discharge scheduled for 2021), Sewage Lakes Disposal Facility, and Bulk Fuel Storage Facility. Water quality limits for discharge from each of these areas are specified in Part E of the Water Licence (Conditions Applying to Waste Disposal and Management) and are summarized below in Tables 1 to 5.

Water quality limits in Table 1 apply to all discharge from the TCA, with additional limits in Table 2 specified for total arsenic, total cyanide, and un-ionized ammonia that apply to discharge between June 2021 and the date that Lupin Mine attains Recognized Closed Mine status.

Table 1: Water Quality Limits for Discharge from the TCA (LUP-10) as per Water Licence 2AM-LUP2032

Parameter	Unit	Maximum Average Concentration	Maximum Concentration of Any Grab Sample
Total Arsenic	mg/L	0.50	1.00
Total Copper	mg/L	0.15	0.30
Total Cyanide	mg/L	0.80	1.60
Total Lead	mg/L	0.10	0.20
Total Nickel	mg/L	0.20	0.40
Total Zinc	mg/L	0.40	0.80
Total Suspended Solids	mg/L	15	30
Oil and Grease	-	No Visible Sheen	
pH	-	The Effluent discharged shall have a pH between 6.0 and 9.5	

- = no unit.

Table 2: Additional Water Quality Limits for Discharge from the TCA from June 2021 until Lupin Attains Closed Mine Status as per Water Licence 2AM-LUP2032

Parameter	Unit	Maximum Average Concentration	Maximum Concentration of Any Grab Sample
Total Arsenic	mg/L	0.30	0.60
Total Cyanide	mg/L	0.50	1.00
Un-ionized Ammonia (as N)	mg-N/L	0.50	1.00

mg-N/L = milligrams as nitrogen per litre.

Table 3: Water Quality Limits for Discharge from the Sewage Lakes Disposal Facility (LUP-14) as per Water Licence 2AM-LUP2032

Parameter	Unit	Maximum Concentration of Any Grab Sample
Total Arsenic	mg/L	0.05
Total Copper	mg/L	0.20
Total Lead	mg/L	0.05
Total Nickel	mg/L	0.30
Total Zinc	mg/L	0.50
Total Suspended Solids	mg/L	35
BOD_5	mg/L	30
Fecal Coliforms	CFU/100 mL	1000
Oil and Grease	-	No Visible Sheen
pH	-	6.0 – 9.5

CFU/100 mL = colony forming units/100 mL; - = no unit.

Table 4: Water Quality Limits for Discharge from the Bulk Fuel Storage and Landfarm Facilities (LUP-27 and LUP-28) as per Water Licence 2AM-LUP2032

Parameter	Unit	Maximum Concentration of Any Grab Sample
pH	-	6.0 – 9.5
Total Suspended Solids	mg/L	15
Total Oil and Grease	mg/L	5.0 and No Visible Sheen
Total Ammonia	mg/L	2.0
Total Lead	mg/L	0.01
Benzene	mg/L	0.37
Toluene	mg/L	0.002
Ethyl Benzene	mg/L	0.09

- = no unit.

Table 5: Water Quality Limits for Discharge from the Landfill Facility (LUP-31 and LUP-35) as per Water Licence 2AM-LUP2032

Parameter	Unit	Maximum Concentration of Any Grab Sample
Total Arsenic	mg/L	0.50
Total Copper	mg/L	0.30
Total Lead	mg/L	0.20
Total Nickel	mg/L	0.50
Total Zinc	mg/L	0.50
Total Suspended Solids	mg/L	15
Oil and Grease	-	No Visible Sheen
pH	-	6.0 – 9.5

- = no unit.

5.2 Territorial Land Act and Regulations

LMI holds five surface leases under the *Territorial Land Act* for mining on crown lands administered by CIRNAC. A list of the surface land leases pertaining to the Lupin Mine is presented in Table 6 and shown on Figure 2.

Table 6: Surface Leases, Lupin

Name	Type	Description	Expiry	Area (ha)
76E/14-1-12	Surface Lease	Minesite, Tailings Containment Area	31-Mar-2042	1,048.52
76E/14-2-13	Surface Lease	Airstrip	31-Mar-2042	52.99
76E/11-2-7	Surface Lease	Fingers Lake Quarry, access road	31-Mar-2042	191.90
76E/11-3-7	Surface Lease	Fingers Lake Waterlot - dock	31-Mar-2042	0.61
76E/14-10-6	Surface Lease	VOR Navigation aid site	31-Mar-2042	0.09

5.3 Federal Regulations

Environment and Climate Change Canada (ECCC) is responsible for the *Canadian Environmental Protection Act* and the *Fisheries Act*, including the pollution prevention measures and MDMER. Note: LMI does not hold any stand-alone Fisheries Authorizations for the mine.

5.3.1 MDMER Monitoring Requirements

The MDMER under the *Fisheries Act* came into force on 1 June 2018 (Government of Canada 2002) and stipulates the conditions under which deleterious substances may be discharged to the aquatic environment by metal and diamond mines (Environment Canada 2012). Specifically, these regulations impose limits on the release of deleterious substances, which include: total cyanide, arsenic, copper, lead, nickel, and zinc, radium-226, total suspended solids, and un-ionized ammonia (Table 7), as well as prohibiting the discharge of effluent that is acutely lethal to fish. Monitoring requirements for the MDMER under Phase 1 are described in Section 6.1.2.2.

The MDMER also requires mines to conduct an EEM program every three years. The objective of the EEM program, as defined in the Metal Mining Technical Guidance for EEM document (Environment Canada 2012), is to evaluate the effects of mine effluent on fish, fish habitat, and use of fisheries resources by humans. Six phases of EEM have been conducted at Lupin Mine, with the final Phase 6 EEM conducted in August 2019. The Final Interpretative Report from the Phase 6 EEM was submitted to ECCC in June 2020 (Golder 2020). Receipt of the Final Interpretative Report was acknowledged by ECCC on 8 June 2020; comments from the Technical Advisory Panel were received on 2 February 2021 and are in the process of being addressed.

Table 7: MDMER Authorized Limits of Deleterious Substances in Treated Effluent (In Effect From 1 June 2021)

Parameter[a]	Unit	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Grab Sample
Total Arsenic	mg/L	0.30	0.60
Total Copper	mg/L	0.30	0.60
Total Cyanide	mg/L	0.50	1.00
Total Lead	mg/L	0.10	0.20
Total Nickel	mg/L	0.50	1.00
Total Zinc	mg/L	0.50	1.00
Total Suspended Solids	mg/L	15.00	30.00
Radium-226	Bq/L	0.37	1.11
Un-ionized ammonia (as N)	mg/L	0.50	1.00
pH	-	The Effluent discharged shall have a pH between 6.0 and 9.5	

a) Field pH and temperature must be recorded at the time of sample collection.

b) Methods for calculation of un-ionized ammonia are as per Section 12(3) of the MDMER.

- = no unit.

5.3.2 MDMER Closed Mine Status

While operations at the Lupin Mine ceased in 2005, it has not been officially designated as having “closed mine status” under the MDMER. Therefore, the regulatory requirements outlined by the MDMER are applicable to the Mine.

On 30 January 2019, LMI provided notification under Part 4, Section 32 of the MDMER of its intent to close the Lupin Mine and achieve “Recognized Closed Mine” (RCM) status, and confirmed that all records, books of account, or other documents required by the MDMER shall be kept at the offices of Mandalay Resources Corporation. ECCC confirmed receipt of the notice of intent on 5 February 2019 and confirmed the mine would become an RCM starting on **30 January 2022**, provided that the requirements of Part 4, Section 32 of the MDMER have been met. ECCC further noted that all requirements of the MDMER for operating mines, including effluent and water quality monitoring and reporting, remain in effect until the mine becomes an RCM. The requirements for Lupin to become an RCM per the requirements of the MDMER and the steps undertaken by LMI to meet these requirements are summarized in Table 8.

Table 8: Requirements for Recognized Closed Mine Status Under the MDMER and Compliance Steps Undertaken by Lupin Mines Incorporated

Section	Requirement	Compliance/Note
31(1)	An owner or operator who intends to close a mine shall:	n/a
31(1)(a)	provide written notice of that intention to the Minister of the Environment;	Notice was provided on 30 January 2019 and confirmed by ECCC on 5 February 2019.
31(1)(b)	maintain the mine's rate of production at less than 10% of its design-rated capacity for a continuous period of three years starting on the day on which the written notice is received by the Minister of the Environment; and	Mine production ceased in 2005. No further production is planned.
31(1)(c)	conduct a biological monitoring study during the three-year period referred to in paragraph (b) in accordance with Division 3 of Part 2 of Schedule 5.	The Phase 6 EEM was conducted in August 2019
31(2)	If the owner or operator has complied with all of the requirements set out in paragraphs (1)(a) to (c), the mine becomes a recognized closed mine after the expiry of the three-year period referred to in subsection (1).	Projected date to receive closure mine status as provided by ECCC is **30 January 2022**
31(3)	The owner or operator shall notify the Minister of the Environment in writing at least 60 days before reopening the recognized closed mine.	Not applicable
31(4)	The owner or operator referred to in this section shall keep at any place in Canada all records, books of account or other documents required by these Regulations for a period of not less than five years beginning on the day they are made, and shall notify the Minister of the Environment in writing of their location.	Records, books of account and other documents will be maintained at: the offices of Mandalay Resources Corporation and notice will be filed within 60 days following completion of active remediation.

6.0 Monitoring Plan

Monitoring of the Site post closure will progress in two distinct phases:

- Phase 1 – Active Closure Period
- Phase 2 – Passive Closure Period

The Active Closure Period (Phase 1) refers to the 2.5-year period during which active on-site reclamation work is being completed. Monitoring programs during Phase 1 will be carried out by on-site personnel under the supervision and direction of DMS. Phase 1 monitoring began in the summer of 2019 and LMI forecasts that reclamation will be completed in summer of 2021.

The Passive Closure Period (Phase 2) refers to the 5-year period following the completion of active reclamation work (2022 to 2026). Environmental monitoring will be conducted through Phase 2 to determine the success of the reclamation measures and confirm that the closure objectives have been achieved. Phase 2 monitoring programs will be carried out during site visits under the supervision and direction of DMS.

The following sections describe the Phase 1 and Phase 2 monitoring plans for each component, including water quality, soils, and geotechnical requirements. It is noted that LMI will implement all Water Licence monitoring requirements. It is anticipated that active monitoring will occur for 2.5 years and passive monitoring will take approximately 5 years following completion of the reclamation work, or until the global objectives for the mine site can be confirmed (as outlined in Section 1.2).

6.1 Phase 1 - Active Closure Monitoring

6.1.1 Site Inspections

Monitoring inspections during the Active Closure period shall be carried out per Part J, Item 11 of the Water Licence on a bi-weekly basis during freshet (approximately May and June), and monthly during the remainder of the open water period (approximately July to October) of the following:

- seepage from dams
- water levels in ponds/cells
- general surface erosion, tension cracks, and/or anomalies on dams

LMI will provide 30 days written notice of each monitoring inspection event to the Inspector. Records of these inspections shall be kept for review upon the request of an Inspector, or as otherwise approved by the Board. More frequent inspections shall be performed at the request of an Inspector, and LMI will schedule the Site inspections to coincide where possible with any regulatory site inspections designated under federal legislation.

In addition, an annual inspection of the TCA will be completed by a geotechnical engineer during ice-free open water conditions per Part J, Item 12 of the Water Licence. This inspection will occur, and an engineer's report will be submitted to the Board within sixty (60) days following the inspection and shall include a cover letter from the Licensee outlining an implementation plan to respond to the Engineer's recommendations.

6.1.2 Tailings Containment Area

LMI has been implementing final remediation of the TCA following NWB approval of the Final Closure Plan for the TCA at the last licence renewal under 2AM-LUP1520. The final active discharge from the TCA is scheduled for 2021, after which passive drainage will be established via a series of engineered spillways (Section 4.4). Post closure monitoring of the TCA is required to confirm that the completed reclamation measures return the TCA to a viable and, wherever practicable, self-sustaining ecosystem that is compatible with a healthy environment and with human activities. More specifically, the TCA will be monitored for chemical and physical stability through a series of field visits for TCA inspections, instrumentation downloads, and water quality sampling. This monitoring is proposed in addition to the TCA monitoring already required by the Water Licence. This additional field work will have both Active Closure (Phase 1) and Passive Closure (Phase 2) components, with Phase 2 TCA monitoring described in Section 6.2.

In addition to Water License monitoring requirements for Active Closure, LMI proposes to sample (i.e., verification monitoring) at Pond 2, Pond 1, and Cell 4 monthly for the same parameter list as the Water Licence (see Section 6.1.2). During sampling, the field staff will walk the perimeter of the ponds, looking for areas of active oxidation or seepage. Photos will be taken of any changes from the previous inspection. The inspections will focus on areas that have recently become exposed from lowered water levels. Seep flows will also be quantified and sampled when possible.

6.1.3 Water Quality and Toxicity

6.1.3.1 Water Licence Regulated and General Monitoring

Details of the regulated discharge monitoring and general monitoring requirements of the Water Licence are summarized Section 5.1.1 and Appendix D.

Water monitoring at the Site will be conducted following the procedures outlined in the in the Lupin Mine Site Water Quality Monitoring Plan and Quality Assurance/Quality Control Plan (LMI 2020b; Appendix C) per Water Licence 2AM-LUP2032 Part J, Item 6. The locations, frequencies, and analytical requirements for monitoring are summarized in Table 9, with further details on parameter groups provide in Table 10.

Field measurements will be collected using a calibrated multi-meter. Samples will be collected following standard sampling protocols by qualified personnel using clean laboratory-supplied bottles. Water samples for laboratory analysis will be filtered and preserved (as required) and stored in a cool environment before shipping to the laboratory. Analysis will only be conducted by accredited laboratories using detection limits (DLs) specified in the laboratory quote for the project. For water quality programs, QC samples will represent a minimum of 10% of the total sample count (field samples plus QC samples) for each program (Environment Canada 2012).

Table 9: Water Quality Monitoring Requirements for Active and Passive Closure at Lupin Mine

Station Name[a]	Station Description	Phase 1 – Active Closure			Phase 2 – Passive Closure					Parameters and Sampling Frequency[b]
		2019	2020	2021	2022	2023	2024	2025	2026	
		Preparatory Work	Active Monitoring		Passive Monitoring					
LUP-01	Freshwater Intake from Contwoyto Lake	Yes	Yes	Yes	Only if still active					Volume: Monthly totals Field, conventional, total metals, and biological: Annually
LUP-10	Pond 2 discharge at Dam 1A	Yes	Yes	Yes	No – Recognized Closured Mine Status anticipated 30 January 2022					Volume: Quantity of treated effluent discharged, measured, and recorded in cubic metres Field, conventional, total metals, and cyanide, no visible sheen oil & grease: Daily during periods of discharge Nutrients, radium: Weekly during discharge Cyanide and bioassay: Monthly (no less than one-month intervals) commencing with the first day of decant
LUP-10a (LUP-102)	Internal station in TCA Pond 2, approximately 100 m upstream from siphon intake	Yes	Yes	Yes	No					Field, conventional, nutrients, total metals, cyanide, radium, and bioassay: Once prior to initiation of decant and once prior to termination of decant
LUP-10b	Pond 2 TCA spillway	Not active	Not active	Not active	Yes – new monitoring station installed at Dam 1A spillway. See Section 6.2.1 for TCA pH triggers and adaptive monitoring requirements.					Field, conventional, nutrients, total metals, cyanide, radium, and bioassay: Twice-yearly, once in freshet and once in late open-water season (aligned with seepage sampling program at TCA and Waste Rock Dome)
LUP-11	Mine-water discharge at automatic sample in the mill	Not active	Not active	Not active	Not active					2AM-LUP2032 confirms station as “Inactive”. Refer to Schedule J, Table 1.
LUP-12	Mill tailings taken at the mill	Not active	Not active	Not active	Not active					2AM-LUP2032 confirms station as “Inactive”. Refer to Schedule J, Table 1
LUP-14	Decant structure from the Sewage Lakes Disposal Facilities	Yes	Yes	Yes	No – decant structure will be decommissioned during Phase 1					Volume: Monthly quantity of treated effluent discharged in cubic meters Field, conventional, nutrients, total metals, biological Other (biochemical oxygen demand), total phosphorus, total orthophosphorus, total Kjeldahl nitrogen: First day of discharge and then monthly thereafter during periods of flow
LUP-15	Discharge from TCA Pond 1 (east pond) not TCA Pond 2 (west pond)	Not active	Not active	Not active	Not active					2AM-LUP2032 confirms station as “Inactive”. Refer to Schedule J, Table 1.
LUP-16	TCA Pond 2 at Centre	Not active	Not active	Not active	Not active					2AM-LUP2032 confirms station as “Inactive”. Refer to Schedule J, Table 1.
LUP-17	TCA Pond 2 upstream of LUP-10	Not active	Not active	Not active	Not active					2AM-LUP2032 confirms station as “Inactive”. Refer to Schedule J, Table 1.
LUP-19	East End of Seep Creek in Dam 2 Lake	Not active	Not active	Not active	Not active					2AM-LUP2032 confirms station as “Inactive”. Refer to Schedule J, Table 1.
LUP-20	West end of Seep Creek before discharge into Unnamed Lake	Yes	Yes	Yes	No – Lupin anticipated to have ceased discharge from TCA in 2021; no further monitoring required in Seep Creek or Sun Bay					Field, conventional, nutrients, total metals, cyanide, and radium: Weekly during discharge from the TCA, commencing with the fist day of decant
LUP-21	North end of Concession Creek before discharge into Unnamed Lake. MDMER Reference Area.	Yes	Yes	Yes	No – Lupin anticipated to have ceased discharge from TCA in 2021; no further monitoring required in Seep Creek or Sun Bay					Field, conventional, nutrients, total metals, cyanide, and radium: Weekly during discharge from the TCA, commencing with the fist day of decant
LUP-22	Inner Sun Bay near center and midway between end of peninsula and west shore	Yes	Yes	Yes	No – Lupin anticipated to have ceased discharge from TCA in 2021; no further monitoring required in Seep Creek or Sun Bay					Field, conventional, nutrients, total metals, cyanide, and radium: Weekly at mid-depth commencing one week prior to discharge from the TCA and concluding two weeks after cessation of the discharge
LUP-24	Inner Sun Bay at mid-way point in narrows. MDMER Exposure Area.	Yes	Yes	Yes	No – Lupin anticipated to have ceased discharge from TCA in 2021; no further monitoring required in Seep Creek or Sun Bay					Field, conventional, nutrients, total metals, cyanide, and radium: Weekly at mid-depth commencing one week prior to discharge from the TCA and concluding two weeks after cessation of the discharge and when bioassay sample is collected at LUP-10 just prior to termination of decant
LUP-25	Outer Sun Bay	Yes	Yes	Yes	No – Lupin anticipated to have ceased discharge from TCA in 2021; no further monitoring required in Seep Creek or Sun Bay					Field, conventional, nutrients, total metals, cyanide, and radium: Weekly at mid-depth commencing one week prior to discharge from the TCA and concluding two weeks after cessation of the discharge
LUP-26	Contwoyto Lake in bay east of water intake	Not active	Not active	Not active	Not active					2AM-LUP2032 confirms station “Inactive”. Refer to Schedule J, Table 1
LUP-27	Bulk Fuel Storage Facility	Yes	Yes	Yes	No – will be remediated by the end of Phase 1					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Once prior to discharge and weekly during periods of discharge
LUP-28	Discharge from the Landfarm Facility	No	No	Yes	Only if not yet remediated					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Once prior to discharge and weekly during periods of discharge

Table 9: Water Quality Monitoring Requirements for Active and Passive Closure at Lupin Mine

Station Name[a]	Station Description	Phase 1 – Active Closure			Phase 2 – Passive Closure					Parameters and Sampling Frequency[b]
		2019	2020	2021	2022	2023	2024	2025	2026	
		Preparatory Work	Active Monitoring		Passive Monitoring					
LUP-29[c]	Landfarm Facility Monitoring Well – Upgradient	Not required	Not required	Not required	Not required, assuming wells remain inactive					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-30a[c]	Landfarm Facility Monitoring Well – Downgradient	Not required	Not required	Not required	Not required, assuming wells remain inactive					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-30b[c]	Landfarm Facility Monitoring Well – Downgradient	Not required	Not required	Not required	Not required, assuming wells remain inactive					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-31	Seepage from the Landfill Facility	No	No	Yes	Yes – continue confirmatory sampling to check for any residual contaminated soils and inputs into seepage.					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-32	Landfill Facility Monitoring Well – Upgradient	Well locations will be confirmed after footprint of landfill is confirmed								Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-33a	Landfill Facility Monitoring Well – Downgradient	Well locations will be confirmed after footprint of landfill is confirmed								Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-34b	Landfill Facility Monitoring Well – Downgradient	Well locations will be confirmed after footprint of landfill is confirmed								Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-35	Seepage from the Landfill Facility	No	No	Yes	Yes – continue confirmatory sampling to check for any residual contaminated soils and inputs into seepage.					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-36	Demolition Landfill Facility Monitoring Well – Upgradient	No	No	No	Demolition landfill is not planned for construction					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-37a	Demolition Landfill Facility Monitoring Well – Downgradient	No	No	No	Demolition landfill is not planned for construction					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-37b	Demolition Landfill Facility Monitoring Well – Downgradient	No	No	No	Demolition landfill is not planned for construction					Field, conventional, nutrients, total metals, total oil and grease, and BTEX: Monthly during periods of observed flow (June to September)
LUP-EL-01	Unnamed Lake (also known as East Lake) shoreline near potential seepage inputs	Yes	Yes	Yes	Yes – confirmatory sampling for model predictions					Field, conventional, total metals: Twice-yearly; once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.
LUP-BL-01	Boot Lake near shoreline near the potential seepage inputs	Yes	Yes	Yes	Yes – confirmatory sampling for model predictions					Field, conventional, total metals: Twice-yearly; once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.
LUP-LSL-01	Lower Sewage Lake near shoreline near the potential seepage inputs	Yes	Yes	Yes	Yes – confirmatory sampling for model predictions					Field, conventional, total metals: Twice-yearly; once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.
LUP-SP-01 to LUP-SP-XX[d]	Seeps from the Waste Rock Dome, locations of observed seepage or flow from the waste rock pile	Yes	No	Yes, if flowing	Yes, if flowing – continue confirmatory sampling to check for any residual contaminated soils and inputs into seepage. Combine sampling programs with landfill seepage monitoring (LUP-31 and LUP-35).					Field, conventional, total metals: Twice-yearly; once in freshet and once in late open-water season. [Add oil and grease and BTEX as additional parameters not required by Water Licence due to hydrological connectivity with landfill – see parameter list for LUP-31 and LUP-35]
LUP-TCA-01 to LUP-TCA-XX[d]	Seeps from the TCA, locations of observed seepage	No	No	Yes, if flowing	Yes, if flowing					Field, conventional, total metals: Twice-yearly; once in freshet and once in late open-water season.

a) Previous EEM sampling locations are not included unless they are also Water Licence monitoring locations.

b) Parameter list provided in Table 10.

c) Landfarm wells are inactive and monitoring is not required per letter from Nunavut Water Board to LMI (dated 17 April 2017)

d) Seep sampling locations will be added to the post closure monitoring program as new seeps are documented.

MDMER = Metal Diamond Mining Effluent Regulations; EL = East Lake; BL = Boot Lake; LSL = Lower Sewage Lake; SP = seep; TCA = Tailings Containment Area; BTEX = Benzene, toluene, ethylbenzene, and xylenes.

Table 10: Water Quality Monitoring Parameter Groups (Schedule J, Table 2 of Water Licence 2AM-LUP2032)

Parameter Group Code	Specific Parameters
Volume	Volume per day (discharged to the environment or withdrawn from the environment for use)
Field	pH, temperature, conductivity, and dissolved oxygen[(a)]
Conventional	pH, total suspended solids, alkalinity, and hardness
Nutrients	Total ammonia, nitrate, and nitrite
Total Metals	Aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, selenium, uranium, and zinc
Cyanide	Total cyanide
Radium	Radium-226
Biological	Fecal coliforms
Bioassay	Acute toxicity tests (Rainbow Trout and *Daphnia magna*)
BTEX	Benzene, toluene, ethylbenzene, and xylenes
Other	Specified by station in Schedule J

a) Dissolved oxygen only measured at receiving environment stations

6.1.3.2 MDMER Monitoring

MDMER water quality monitoring requirements for the discharge of treated effluent are summarized in Table 11, and include:

- Treated effluent monitoring weekly during discharge – Part 2, Division 2; Schedules 3 and 4
- Treated effluent characterization once per quarter and at least one month (i.e., 30 days) apart – Part 2, Division 1; Schedule 5, Section 4
- Water quality monitoring four times per year and at least one month (i.e., 30 days) apart – Part 2, Division 1; Schedule 5, Section 7

Table 11: MDMER Effluent Quality Testing Requirements

Sampling Location	Frequency of Sampling	Parameters
TCA Discharge: LUP-10	Weekly during discharge[(a)]	Deleterious substances (including field pH)
	Once per quarter, at least 30 days apart[(b)]	Expanded effluent characterization parameter list per Schedule 5, Section 4(1)
Reference and Exposure Areas: LUP-21 and LUP-24	Four times per year	Expanded water quality monitoring parameter list per Schedule 5, Section 4(1) plus dissolved oxygen and temperature

a) Under the MDMER, a week is defined as the period from Sunday to Saturday; if discharge starts on a Friday, for example, a sample must be collected on Friday or Saturday to meet the weekly sampling requirement.

b) In cases where the MDMER effluent characterization and water quality monitoring samples cannot be collected 30 days apart due to discharge ending mid-month, then samples should still be collected at least once in each calendar month.

Additional toxicity testing requirements during discharge of treatment effluent are summarized in Table 12, and include:

- Monthly (pass/fail) acute toxicity testing of treated effluent with Rainbow Trout and *D. magna.*[1]
- Quarterly sublethal testing (at least one month apart) with the most sensitive species, defined as the species with the lowest geometric mean IC_{25} calculated from the previous three years of data[2] – Section 39(b) and Schedule 5, Section 6(3).

Table 12: MDMER Effluent Toxicity Testing Requirements

Sampling Location	Frequency of Sampling	Toxicity Tests Conducted
LUP-10	Monthly during discharge	Acute testing (multi-concentration) with *D. magna* and Rainbow Trout
	Once per calendar quarter during discharge	Sublethal testing (multi-concentration) with *C. dubia*, Fathead Minnow, *L. minor*, and *P. subcapitata*[(a)]

a) Schedule 5, Section 6 of the MDMER requires testing on all four species once per quarter (at least one month apart) for three years. After three years, testing shall be conducted once per calendar quarter on the most sensitive species.

Analyses of MDMER compliance samples and toxicity testing will be completed by accredited laboratories. For water quality, samples analyzed for deleterious substances shall comply, at a minimum, with the analytical requirements set out in the MDMER Schedule 3 (Government of Canada 2002), as summarized in the Water Quality QA/QC Plan (Appendix C).

6.1.4 Geotechnical Monitoring (Temperature/Thermistor)

Geotechnical verification monitoring will continue at the TCA and at all Site locations where waste has been deposited. Instrumentation locations are shown in Figure 4. A summary of existing and future geotechnical instrumentation monitoring is provided in Table 13.

Some perimeters dams can be declassified as dam structure in Phase 2, as they will no longer contain water when the ponds are passively managed at a much lower post closure water levels. The thermistors in these declassified structures would be obsolete for frozen core performance monitoring. They will continue to be monitored for site record keeping, but upkeep of these particular instruments is not required.

[1] Pass/fail toxicity testing is conducted with 100% effluent and laboratory control (i.e., toxicity testing is not conducted on a dilution series).

[2] IC_{25} = effluent concentration that causes a 25% inhibitory effect in the sublethal endpoint being measured.

Table 13: Existing and Future Instrumentation Monitoring

Station	Location	Instrument Type	Approved Final Reclamation Work	Phase 1 (Active Closure Period)	Phase 2 (Passive Closure Period)
D1A-00-01S	Dam 1A	Thermistors	Monthly from 2000 through 2006, annually in the summer from 2009 through 2019	Damaged in 2020 – attempting to repair. If possible, annually concurrent with site inspection (i.e., June–September)	If possible, annually concurrent with site inspection (i.e., June–September)
D2-00-2N	Dam 2		Monthly from 2000 through 2006, annually in the summer from 2010 through 2019	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site inspection (i.e., June – September)
D3D-1	Dam 3D		Monthly from 2004 through 2006, once in the Summer of 2009 and annually in the summer from 2014 through 2019	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site inspection (i.e., June – September)
D4-1	Dam 4		Monthly from 1995 through 2006, annually between 2009 and 2019	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site inspection (i.e., June – September)
D4-3			Monthly from 1995 through 2006, annually between 2009 and 2019	Damaged in 2020 – attempting to repair. If possible, annually concurrent with site inspection (i.e., June – September)	If possible, annually with site inspection (i.e., June – September)
D4-4			Monthly from 1995 through 2006, annually between 2009 and 2019	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site inspection (i.e., June – September)
DK-3	Dam K	Thermistors	Monthly from 2004 through 2006, once in the Summer of 2009 and annually in the summer from 2014 through 2019	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site Annually concurrent (i.e., June – September)
TC1-3	Cell 1 Cover		Monthly from 1995 through 2006, once in the Summer of 2009 and twice in 2015	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site inspection (i.e., June – September)
TC1-6			Monthly from 2003 through 2006, once in the Summer of 2015	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site inspection (i.e., June – September)
TC1-7			Monthly from 2004 through 2006, once in the Summer of 2009 and thrice in summer of 2015	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement concurrent with site inspection (i.e., June – September)
TC3-1	Cell 3 Cover		Monthly from 2004 through 2006, thrice in summer of 2015	Annual single point measurement concurrent with site inspection (i.e., June – September)	Annual single point measurement Concurrent with site inspection (i.e., June – September)

Table 13: Existing and Future Instrumentation Monitoring

Station	Location	Instrument Type	Approved Final Reclamation Work	Phase 1 (Active Closure Period)	Phase 2 (Passive Closure Period)
C1VWC	Cell 1 Cover	Soil Moisture and Temperature Probes (TEROS-12 VWC sensors)	Every 12 hours throughout the closure period via datalogger (downloaded during site inspections)	Every 12 hours throughout the closure period via datalogger (downloaded during site inspections)	Weekly throughout the closure period via datalogger (downloaded during site inspections)
C3VWC	Cell 3 Cover			Every 12 hours throughout the closure period via datalogger (downloaded during site inspections)	Weekly throughout the closure period via datalogger (downloaded during site inspections)
WRD-1	Waste Rock Dome Cover	Thermistor string	To be installed in 2021	-	Weekly via datalogger (downloaded during site inspections)
WRD-2	Waste Rock Dome Cover	Thermistor string	To be installed in 2021	-	Weekly via datalogger (downloaded during site inspections)
WRD-3	Waste Rock Dome Cover	Thermistor string	To be installed in 2021	-	Weekly via datalogger (downloaded during site inspections)
WRD-4	Waste Rock Dome Cover	Thermistor string	To be installed in 2021	-	Weekly via datalogger (downloaded during site inspections)

6.1.5 Soils Monitoring

Confirmatory monitoring of soil quality will be conducted in areas where contaminated soils are to be excavated as part of remediation efforts. This monitoring program will be designed to confirm that the soil quality remediation objectives have been achieved. The monitoring program will consist of two primary components:

- field screening
- confirmation sampling

A detailed discussion of the proposed techniques and their application throughout the stages of remediation are described below. Further details on the Contaminated Soils QA/QC program are provided in Appendix C.

6.1.5.1 Field Screening

Soil samples will be screened to obtain "real-time" field data to guide the remedial activities and to enable the collection of a subset of confirmatory samples for laboratory analysis. Field screening techniques such as portable combustible gas instruments (CGIs) and x-ray fluorescence (XRF) instruments are widely used during remediation activities. Although these field tools do not replace the collection of confirmation laboratory analysis, they provide complimentary data to support field decisions with respect to soil excavation and will be used to verify soil quality compliance. The following sections summarize the field screening instruments and methodologies for the primary contaminants of concern: PHCs and total arsenic.

Petroleum Hydrocarbons (PHCs)

Field screening of PHCs will consist of a combination of visual assessment of staining and the use of a portable CGI. The presence of residual volatile hydrocarbons within soil affected by weathered diesel and fuel oil is likely low and it is therefore expected that field screening for PHCs may not be highly effective. The portable CGI measures concentrations of volatile hydrocarbons from soil in either the parts per million (ppm) or percentage Lower Explosive Limit ranges. The unit will be calibrated to a reference gas, typically operated in methane elimination mode.

Discrete soil samples will be collected from the walls and base of the remedial excavations following the definition of the potential limits. The frequency of discrete field screening will be determined based on an excavation-by-excavation basis. If bedrock or permafrost is encountered below PHC contaminated soil, discrete soil samples will be collected if possible. However, if ex-situ screening can not be completed due to terrain limitations, a visual assessment of the bedrock or permafrost surface will be completed and documented.

Discrete soil samples will be collected in the field from the excavation or the excavator bucket depending on the depth of the excavation and applicable health and safety requirements. Samples will be stored in re-sealable plastic bags and allowed to acclimatise to room temperature for approximately 15 minutes. The CGI probe is then inserted into the bag for measurement of combustible vapours. It is anticipated that field screening results using the CGI will generally fall into two categories:

- Field screening data indicates a high likelihood of a below applicable criteria confirmation laboratory result. Field screening data should include CGI readings less than 50 ppm and no staining or olfactory indications of contamination observed.

- Field screening data characterized by elevated CGI readings exceeding 50 ppm and/or significant staining or olfactory indications of contamination observed indicates a low likelihood of a below applicable criteria confirmation laboratory result.

It is recognized that the interpretation of field screening data will evolve as correlations between laboratory and field screening results become established. The results of the field screening program will be used to identify sample stations designated for confirmatory sampling.

Total Arsenic

Field screening of total arsenic will be completed using a portable XRF instrument, which allows for the detection of mg/kg concentrations of a wide spectrum of metals within soil. The XRF instrument will be used to estimate total arsenic concentrations in the field and the results will be used to determine whether additional excavation is required or if confirmatory soil sampling may be initiated.

Upon completion of the remedial excavations, it is assumed that residual soil will be present along the base and walls of the excavations. As a result, once the potential limits of the remedial excavations are encountered, detailed field screening of the walls and bases will be completed using discrete samples collected on a grid pattern. Discrete soil samples (approximately 250 mL in size) will be collected directly from the excavation or bucket of the excavator depending on the depth of the excavation and applicable health and safety requirements. Samples will be collected such that minimal organic material and/or gravel-sized fragments are present in order to minimize interference with the XRF. Three methods will be used to complete the XRF field screening:

i) Unprocessed ex-situ method. This method involves sample placement in thin-walled plastic bags. No sample processing (i.e., drying, sieving, or blending) will occur. Measurements are taken in a trailer located on-site with the instrument mounted to a stand.

ii) Processed ex-situ method. This method requires sample preparation (i.e., drying, sieving, and blending) and compaction/placement in XRF sample cups. Measurements are also taken in an on-site trailer with instrument mounted to stand.

iii) In-Situ “point and shoot” method. This method involves collecting in-field readings of total arsenic concentrations from soil remaining on bedrock terrain or permafrost exposed during remedial activities. Although this method is generally not considered to provide as accurate of results as the ex-situ methods, it will be used to assess soil quality in bedrock terrain or permafrost where sample collection for ex-situ screening methods is not considered feasible.

The majority of the discrete soil samples will be field screened using the unprocessed ex-situ method in order to reduce the time and effort required to prepare each sample. If a discrete sample is observed to be frozen or have excessive moisture, that sample will need to be field screened using the processed ex-situ method as moisture content will interfere with the XRF readings. For each of the methods, a minimum of three readings will be taken per sample using the XRF. These three readings will be collected sequentially and averaged to produce a single screening value. The frequency of discrete field screening will be determined on an excavation-by-excavation basis and will be based on the final extents of the excavation.

The results of the field screening program will be used to either: (i) temporarily suspend excavation activities and proceed with confirmatory sampling; or (ii) continue remedial excavation activities. The field screening results will be used to predict expected compliance with the applicable criteria, whereas the confirmatory sampling analytical data will be used to verify compliance with the applicable criteria. It is

recognized that the interpretation of field screening data will evolve as correlations between laboratory and field screening results become established. It is anticipated that field screening results using the XRF will generally fall into three categories:

- Field screening data indicates a high likelihood of a below applicable criteria confirmation laboratory result.
- Field screening result is marginally below the applicable criteria, suggesting the confirmation laboratory result may be just below or above the applicable criteria.
- Field screening data indicates a low likelihood of a below applicable criteria confirmation laboratory result.

Table 14 summarizes the planned strategy for the interpretation of the XRF field screening results.

Table 14: Strategy for Interpretation of XRF Field Screening Results

XRF Screening Result	Strategy
Less than 50% of arsenic "hotspot" value (<2,000 mg/kg total arsenic)	Proceed with confirmatory sample collection
Between 50% to 100% of arsenic "hotspot" value (2,000 mg/kg to 4,000 mg/kg total arsenic)	Proceed with limited additional remedial work and field screening
Greater than 100% of arsenic "hotspot" value (>4,000 mg/kg total arsenic)	Continue with remedial work and field screening

6.1.5.2 Confirmation Sampling

Confirmatory sampling will be completed throughout the remedial works for the purposes of verifying the contaminant concentrations prior to proceeding with backfilling activities. It is expected that the field screening results for both the CGI and XRF will correlate with the laboratory results. However, this correlation will be assessed following the collection of approximately 100 sample pairs.

The analytical testing program will focus on verifying contaminant concentrations at the limits of remedial excavations and thereby confirming compliance with the remedial objectives. Discrete soil samples, selected based on field screening results, will be submitted to an accredited analytical laboratory for chemical analysis. Discrete confirmatory soil samples will be collected within a grid pattern from the walls and bases of the excavations. The frequency of confirmatory soil sample submission will be determined on an excavation-by-excavation basis and will consider the lateral extents of the excavation. However, the generally frequency for confirmatory soil sampling will consist of a maximum confirmatory soil sampling grid pattern of 10 m by 10 m (CCME 2016).

Should results of the laboratory analysis confirm contaminant concentrations below the applicable remedial objectives, the limits of the remedial excavations will be documented, and backfilling activities will commence. However, should the results identify contaminant concentrations exceeding the applicable remedial objectives, additional excavation will be required, and new samples will be collected from the revised excavation limits for field screening and confirmatory sampling. This process will continue until the analytical results from all soil samples confirm the contaminant concentrations are below the applicable remedial objectives.

6.2 Phase 2 - Passive Closure Monitoring

The following sections outline the proposed frequency of site inspections and monitoring during the Passive Closure period. Monitoring programs will, in general, continue as per the Active Closure period with any exceptions noted in the following sections. This section also outlines the adaptive monitoring framework for passive closure, whereby monitoring may be enhanced or reduced in response to an observed change in monitoring data or site conditions. The proposed monitoring programs for each component are also outlined (the TCA, water quality, geotechnical, and soils), including applicable triggers that may result in a request to amend the monitoring parameters, locations, or frequencies.

6.2.1 Site Inspections

Monitoring during the closure period will be undertaken monthly as a series of brief site inspections expected to last 3-4 days each from June to September each year. LMI will schedule the Site inspections to coincide where possible with any regulatory site inspections completed by an Inspector designated under federal legislation. LMI will provide 30 days written notice of each monitoring inspection event to the Inspector.

In addition, an annual inspection of the TCA will be completed by a geotechnical engineer during ice-free open water conditions per Part J, Item 12 of the Water Licence. This inspection will occur, and an engineer's report will be submitted to the Board within sixty (60) days following the inspection and shall include a cover letter from the Licensee outlining an implementation plan to respond to the Engineer's recommendations. This annual inspection and its format will continue during the Phase 1 Active Closure Period. Phase 3 Passive Closure Period will have a variable inspection frequency with time and equilibrium of the Site established.

A separate visual inspection will be done to monitor the condition of the esker covers over the dome, the landfill, and the adit. Any evidence of surficial settlement or erosion or settlement above the crown pillar or shafts will be documented with photographs and reported.

6.2.2 Tailings Containment Area

The last year of active discharge from the TCA is 2021, with remediation and construction of the TCA cover described in the FCRP for Lupin Mine. The following section therefore describes a monitoring framework for passive discharge from the TCA during Phase 2, assuming the TCA will achieve physical and chemical stability over this five-year monitoring period.

A baseline assessment for water around the TCA was described in the 1984 Interim Abandonment and Reclamation Plan for Lupin Mine. Seven waterbodies were identified in this assessment with pH values below 6.0 prior to the operation of the Lupin Mine TCA:

- Dam 2 Lake (pH 5.1)
- Sun Bay (pH 5.4)
- Seep Creek (pH 5.6)
- Concession Creek (pH 5.7)
- Tributary Creek (pH 5.8)
- Shallow Bay (pH 5.8)
- Test Lake (pH 5.9)

As discussed in Section 6.2.4.1, a minimum pH of 5.9 was also documented during the recent (2019) Phase 6 EEM program at the Fingers Lake reference area (Golder 2020), which confirms the previous baseline results above. These results are consistent with the expected conditions in tundra landscapes in the Canadian north, which typically exhibit slightly acidic conditions related to lack of mineral soils and natural buffering capacity. Natural baseline conditions in the area (i.e., low pH) should therefore be considered when planning for long-term chemical stability of the Site.

LMI proposes a site-specific TCA pH trigger limit of 5.5 for post closure monitoring because the natural environment surrounding the TCA has historically demonstrated pH values below 5.5. It is proposed that at the end of Phase 1 monitoring (i.e., starting in Phase 2; 2022), if pH remains above 5.5 and is not actively decreasing, then LMI would passively discharge Pond 2 to the environment and move to a reduced Phase 2 monitoring frequency. The proposed Phase 2 reduced monitoring frequency is:

- Sample Pond 2, Pond 1, and Cell 4 twice per year (instead of monthly in Phase 1) once in spring freshet after melt and once in late summer (late August or September) before freeze up.

If pH is below 5.5 and actively decreasing, LMI would continue monitoring at the same frequency as for Phase 1 and would not commence passive discharge.

In the other two scenarios, where pH remains above 5.5 but is actively deceasing or pH is below 5.5 but stable, further evaluation would be required before a revised monitoring plan could be developed. If TCA water quality does not meet the criteria for moving from active to passive closure (i.e., pH values in Pond 2, Pond 1, or Cell 4 are less than 5.5 and are shown to decrease through Phase 1), then LMI will not discharge without treatment and will not propose moving to the reduced Phase 2 monitoring frequency. In this case, the TCA cannot be opened to passively drain to the environment. A forensic program will be initiated to attempt to understand the source of non-compliance. LMI will also conduct whatever water treatment is required to discharge the TCA within the terms of the Water License, as necessary, in the non-compliant scenario. To that end, LMI is going to leave infrastructure required onsite for further water treatment after the active closure phase. Further details on the adaptive monitoring framework for the Mine are provided in Section 6.2.6.

6.2.3 Water Quality and Toxicity

6.2.3.1 Water Licence Regulated and General Monitoring

Water quality and toxicity monitoring requirements for Phase 2 are presented in Table 9 (Section 6.1.3) alongside the Phase 1 requirements. The Phase 2 monitoring requirements apply for a minimum of 5 years, but LMI will continue monitoring beyond this timeframe, as applicable, to meet all Water Licence or adaptive monitoring requirements (see Section 6.2.6 for a description of the adaptive monitoring framework for Phase 2).

The final discharge season from the TCA is scheduled for 2021, and the Water Licence and MDMER requirements for water quality and toxicity monitoring at the following TCA and receiving environment stations will therefore not apply through the post closure period:

- LUP-10: Pond 2 discharge at Dam 1A
- LUP-10a (LUP-102): Internal station in TCA Pond 2, approximately 100 m upstream from siphon intake
- LUP-20: West end of Seep Creek before discharge into Unnamed Lake

- LUP-21: North end of Concession Creek before discharge into Unnamed Lake; MDMER Reference Area
- LUP-22: Inner Sun Bay near center and midway between end of peninsula and west shore
- LUP-24: Inner Sun Bay at mid-way point in narrows; MDMER Exposure Area
- LUP-25: Outer Sun Bay (Total Rather than specific metals)

Monitoring at the following Water Licence stations is not anticipated to be required as the associated infrastructure will have been completed by the end of 2021:

- LUP-14: Decant structure from the Sewage Lakes Disposal Facilities
- LUP-27: Bulk Fuel Storage Facility
- LUP-28: Discharge from the Landfarm Facility

Seeps from the Landfill, Waste Rock Dome and TCA

Per Water Licence requirements, seepage surveys and applicable sampling will be conducted twice yearly at the landfill facility (LUP-31 and LUP-35) and Waste Rock Dome (LUP-SP-01 to LUP-SP-XX) through the Phase 2 Passive Monitoring, as for Phase 1 Active Monitoring (Table 9). Surveys will be conducted once in spring freshet after complete melt and once in late summer (late August or September) before freeze-up. This monitoring requirement is consistent with response to CIRNAC TC No. 17 during the Water Licence review process, whereby LMI committed to monitor and sample seeps from the domed covered waste rock area.

Seepage surveys will be timed to coincide with the proposed reduced monitoring frequency for sampling at Pond 2, Pond 1, and Cell 4 described in Section 6.2.3, assuming that the pH requirements for Passive Monitoring are met for this area. As new seeps are identified, they will be documented via photographs and field notes and locations will be recorded using a hand-held GPS. The seep locations will be named with a unique station identifier per the Water Licence (LUP-SP-01, LUP-SP-01, etc.).

Further, although not required by the Water Licence, LMI proposes to sample for oil and grease and BTEX at the waste rock dome seepage stations for consistency with the parameter list at the landfill seepage locations, and also as confirmatory sampling for removal of contaminated soil from this area.

East Lake, Boot Lake, and Lower Sewage Lake

Water quality modelling has been undertaken to predict the impacts that the seeps from the Waste Rock Dome will have on surface water receptors, with results provided in the HHERA (Golder 2019a). The HHERA concluded that there could remain a moderate risk to aquatic life from low pH in Boot Lake and Unnamed Lake (East Lake) after remediation based on predicted concentrations of:

- Boot Lake – 5.6 to 6.6
- East Lake – 5.0 to 6.6

At both lakes, the lowest predicted concentrations are below the Canadian Council of Minister of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Aquatic Life (WQG-PAL) of 6.5 to 9.0 (CCME 1999). However, results from the recent Phase 6 EEM program confirm that pH is typically lower than the CCME WQG-PAL in the area around Lupin Mine (Section 6.2.3). Field-measured pH at the Fingers Lake reference location during the Phase 6 EEM program ranged from 5.9 to 6.5

(Golder 2020). These results are comparable with model predictions for Boot Lake, but higher than model predictions for East Lake (5.9 compared with 5.0), suggesting that East Lake water may be more acidic than reference conditions during Passive Closure.

Field pH was also measured at Boot Lake, East Lake, and Lower Sewage lake in June/July and September in 2020 (Table 15. Results from Boot Lake and Lower Sewage Lake were variable between the two sampling seasons, with higher pH in spring and lower pH in fall likely due to increased dilution from surface water inputs during spring freshet. For Boot Lake, minimum pH (5.4) was below the modelled range of 5.6 to 6.6, but maximum pH (7.0) was higher than the model predictions. For East Lake, spring and fall results were more consistent, ranging from 4.6 to 5.2. The spring result at this location (5.2) was within the range of model predictions (5.0 to 6.6).

Table 15: 2020 Field pH Results from Boot Lake, East Lake, and Lower Sewage Lake

Location	Boot Lake		East Lake		Lower Sewage Lake	
Sample Name	LUP-BL-01		LUP-EL-01		LUP-LSL-01	
Sample Date	21-Jul-20	05-Sep-20	22-Jul-20	05-Sep-20	21-Jun-20	05-Sep-20
Field pH	7.0	5.4	5.2	4.6	8.6	6.3

Based on the results of the surface water model and recommendations provided in the HHERA, ongoing monitoring will occur at East Lake, Boot Lake, and Lower Sewage Lake (LUP-EL-01, LUP-BL-01, and LUP-LSL-01) through Phase 1 and Phase 2 active monitoring period to confirm model predictions and evaluate the risk to receptor environments, i.e., once in freshet and once in late-summer for field, conventional, and total metals (Table 9).

6.2.3.2 MDMER Monitoring

It is anticipated that Lupin will attain RCM status under the MDMER in January 2022 (Section 5.3.2). MDMER monitoring requirements will therefore not apply during the passive monitoring phase.

6.2.4 Geotechnical Monitoring (Temperature/Thermistor)

Geotechnical instrumentation locations are shown in Figure 4.

Once Phase 1 is completed, a modified geotechnical monitoring plan will need to accommodate the final closure configuration. The monitoring requirements must be modified accordingly as some of the dams will no longer require monitoring as they will no longer be containing water. This modification would declassify Dam 1A, 1B, 1C, Dam 3, Dam 4, Divider Dyke, and Dam J from monitoring requirements. In their place, inspection of the two new spillways at Dam 1A and Dam J will be added to the visual monitoring requirements. No new thermistors are planned for the TCA.

New volumetric water content probes might be installed within the new Cell 3, 5 and N cover to monitor their performance and will be report as part of the annual TCA report. The number, locations and details of these probes will be determined based on site conditions and reported at end of closure construction.

6.2.5 Soils Monitoring

The PHC contaminated soils will be remediated to the CCME Canada-Wide Standards for PHCs in Soil (2008) and the Guidelines for Contaminated Site Remediation (Government of Nunavut 2009) and will be disposed of in the underground mine workings. In addition, arsenic “hotspot” soils (total arsenic >4,000 mg/kg) will also be remediated and disposed in the underground mine workings. GPS coordinates of the disposal locations will be collected in degrees, minutes and seconds of latitude and longitude as

part of the soils remediation. Given that the contaminated soils will be disposed in the underground mine workings, the contaminated soils will be stable. As a result, monitoring of contaminated soils during the Passive Closure Period will not be required.

6.2.6 Adaptive Monitoring

Phase 2 monitoring will proceed as outlined in Sections 6.2.1 to 6.2.5 unless a change is observed in the monitoring dataset or site conditions that suggests that monitoring requirements should either be scaled up (enhanced) or reduced. The need for enhanced monitoring could be linked to factors such as a deterioration in water quality at a specific station that may indicate a change in source area conditions (e.g., seepage). A detailed monitoring plan will be developed for any areas of concern depending on the geographic extent of the observed concern and/or a source, pathway, and receptor analysis for potential contaminant release to the environment.

Although the adaptive monitoring framework for the Mine considers the possible need for enhanced monitoring, it is more likely that Lupin Mine will scale back monitoring requirements through Phase 2 and beyond as the Mine attains the closure principles of Physical Stability, Chemical Stability, and Future Use and Aesthetics (Section 1.2). The following section therefore focuses on the process whereby LMI may apply to scale back monitoring requirements at the Mine, notwithstanding the primary objectives of meeting closure goals and regulatory requirements per the Water Licence.

6.2.6.1 Framework for Reduction in Monitoring Requirements

The purpose of this section is to outline a process whereby LMI may submit a request for reduction in monitoring requirements during the Passive Closure phase. The primary requirement for a reduction in monitoring requirements is that the three closure principles of Physical Stability, Chemical Stability, and Future Use and Aesthetics are met for each component.

LMI proposes gradually decreasing the frequency of site inspections and or specific monitoring requirements as testing results (verification monitoring) confirm predictions of chemical and physical stability. If results are not as predicted, additional monitoring, and/or remediation works will be undertaken by LMI as part of the adaptive monitoring framework for the project. Any additional information associated with an expanded monitoring program will be incorporated into the next Annual Report required under the Type A Water Licence. Monitoring results will also be submitted to other regulatory agencies (i.e., ECCC, CIRNAC, and Kitikmeot Inuit Association), as required.

Requests for reduction in monitoring requirements in Passive Closure will be evidence based, and submitted to the NWB and regulatory authorities under Part B, Item 17 of the Type A Water Licence that allows:

> *The Schedules attached to this Licence provide details regarding the requirements associated with specific items in the main body of the Licence and included in the Schedule to provide greater clarity and as an aid to interpretation for the Licensee. If the Board subsequently determines that an item in any of the Schedules requires revision in order to better reflect the intent and objectives of the Licence, the Board may at its discretion, and upon consulting and providing written notice to the Licensee and interested parties, revise the Schedule accordingly. Unless the Board directs otherwise, such revision may not necessarily be considered as an "Amendment" to the Licence.*

In this context, a reduction in monitoring may include:

- Removal of a monitoring parameter.
- Removal of a monitoring station or specific area from the monitoring program (a reduction in the spatial coverage of the monitoring program).
- Reduction in the required frequency of monitoring at one or more stations or areas (a reduction in the temporal coverage of the monitoring program).

These potential changes to the monitoring requirements are discussed in the following sections. For any reduction in monitoring requirements, LMI would file written request to the NWB for consideration by the Board and any other interested parties. This request would be filed as part of the Annual Report or in a stand-alone submission and would include rationale and evidence for any proposed changes or revisions. It is anticipated that reduction in monitoring would no be made until there is sufficient evidence to evaluate the request (Golder 2017b).

6.2.6.2 Removal of a Monitoring Parameter

A parameter will be considered for removal from the monitoring program under the following circumstances:

1) The parameter was not associated with processing or operations at the mine and is also not linked to remediation activities.
2) Results for the parameter are consistently, e.g., in four or more consecutive samples (NWTWB 1992) or in 12 or more consecutive samples less than the analytical detection limit (Government of Canada 2002).
3) Results for the parameter are below the predefined triggers for the removal or reduction of a parameter (see Section 6.2.3).

6.2.6.3 Removal of a Monitoring Station or Area

A monitoring station will be considered for removal from the monitoring program under the following circumstances:

1) Results from the station are consistently less than the analytical detection limits (using detection limits appropriate for the station), and it has been determined that the station is appropriately placed for the designated purpose.
2) Results are consistently at less than 10% of the model predictions.
3) The station is not required under other regulations (e.g., MDMER).

6.2.6.4 Reduction in Monitoring Frequency at a Station or Area

The monitoring frequency may be reduced under the following circumstances:

1) The station location is confirmed has being appropriate for the intended purpose in the monitoring program.
2) Analysis of data collected to date from the particular station or area show no increasing trends (decreasing trends for pH, dissolved oxygen, and alkalinity).

3) Data are consistently within model predictions (i.e., the quality of the environmental component is better than predicted).

4) Data collected to date consistently meet all applicable guidelines.

6.2.6.5 Application for a Reduction in Monitoring Requirements

The Water Licence (Part B, Item 15) requires LMI approved to review Plans and modify these documents to reflect changes in operations and/or technology. LMI will review the PCMP on an annual basis and will submit proposed revisions to the PCMP in the form of an Addendum to be included with the Annual Report (required by Part B, Item 2 to be submitted by 31 March for the previous reporting year). This addendum will include a list of revisions detailing where significant changes in content have been made to the PCMP.

A change in operation will occur when LMI completes active remediation (Phase 1) and moves to implementation of Passive Closure (Phase 2) monitoring on site. It is therefore anticipated that the next major updated to the PCMP will occur as part of the submission of the 2021 Annual Report (i.e., submitted in early 2022).

Once the objectives of final closure are achieved as per the approved FCRP, and confirmed through supporting evidence, it is anticipated that the application for a reduction in monitoring requirements would not constitute an amendment to the Water Licence. In this case, a revision to the Water Licence schedules would be made at the discretion of the Board consistent with Part B, Item 17 of the Water Licence.

7.0 Data Storage, Analysis and Reporting

7.1 Tailings Containment Area

LMI proposes compilation and summary of water quality monitoring and observational results. Reporting will be completed if the either of the following applies:

1) trigger limits are exceeded in the TCA

2) a request is being made for reduced monitoring frequency or TCA discharge

7.2 Water Licence

The Water Licence (Part J Item 10) requires LMI to submit an annual monitoring report by 31 March for the proceeding year of monitoring, including:

- a description of the sample activities undertaken
- description of the existing conditions at each sampling station
- tabular summary of analytical results, including the results of the quality control samples (travel blank, field blank, duplicate samples)
- interpretation of the analytical lab results including comparison of the results with Water Licence criteria and assessment of the reliability of the results

In addition, the Nunavut Waters Regulations, Section 13 states that a licensee must:

a) maintain accurate and detailed books and records of

   i) the quantity of water, in cubic metres, used each day,

   ii) the quantity of waste, in cubic metres, deposited each day,

   iii) the type of waste deposited each day,

   iv) the concentration of the substance, or substances, in the deposited solid or liquid that has the effect of making the deposit waste, and

   v) the methodology used to calculate or determine the information referred to in subparagraphs (i) to (iv).

b) keep the books and records on the Site of the appurtenant undertaking during the period of its operation or until the expiry or cancellation of the licence; and

c) keep the books and records for a period of at least five years after the expiry or cancellation of the licence.

7.3 Metal and Diamond Mining Effluent Regulations

Under the MDMER, the reporting of treated effluent characterization and surface water quality monitoring results will be carried out as required under Part 2, Division 1 and Schedule 5 of the MDMER as follows:

- Quarterly reporting of treated effluent and water quality data in the electronic Single Window Information Management (SWIM) system of ECCC within 45 days after the end of each calendar quarter.

- Annual reporting of treated effluent and water quality monitoring for the previous calendar year, submitted to the ECCC Authorization Officer via the electronic SWIM system by 31 March of the following year.

Until Lupin attains RCM status under the MDMER, quarterly and annual submissions are required, even if there was no discharge from the TCA. In these cases, the ECCC submissions will be completed for 'no discharge'.

7.4 Geotechnical

The Site inspections will photo-document conditions using an app that records GPS location and the direction of the photo taken. Similar photos will be taken at each critical location of each dam over the inspection period to observe and compare any physical changes. The data from the instruments will be compiled with previous readings and reviewed by a qualified professional. It is also anticipated that any new instruments would require a few seasons to establish equilibrium after installation.

It is assumed that the Phase 1 annual reporting will be completed in a format that is similar to the existing Dam Safety Inspection. For Phase 2, reporting is assumed annually for the first 3 years, then every 5 years for the next 15 years, then every decade as deemed necessary. The format for the Phase 2 report will be adjusted to suit post closure conditions as described above.

7.5 Soils

At the conclusion of the contaminated soils remedial works, a closure report will be produced for LMI. This report will document the results of the remedial excavation activities and will include a description and summary of the remedial works, a summary of the field screening concentrations, a comparison of the results of the confirmatory soil sample analyses to the applicable criteria, and a discussion of the results. The report will also include tables summarizing the analytical results and figures outlining the Site features, excavation extents, confirmatory sampling locations, and analytical results. The report will also include appendices with select photographs of the daily work and copies of the laboratory certificates of analysis.

8.0 Consultation

Part B, Item 20 of the Water Licence requires LMI to conduct consultation during development of the PCMP. Consultation sessions were scheduled for March 2021 as part of the development of the PCMP prior to final submission in April 2021.

Part B, Item 20 of the Water Licence also requires LMI to conduct consultation with community members and organizations in the community of Kugluktuk during the implementation of the updated FCRP. These consultation sessions will be facilitated by LMI and will provide information regarding the status of reclamation and closure activities, communicate the results of monitoring conducted under the Licence, and to consider and address any relevant questions and concerns raised by community members and organizations.

9.0 References

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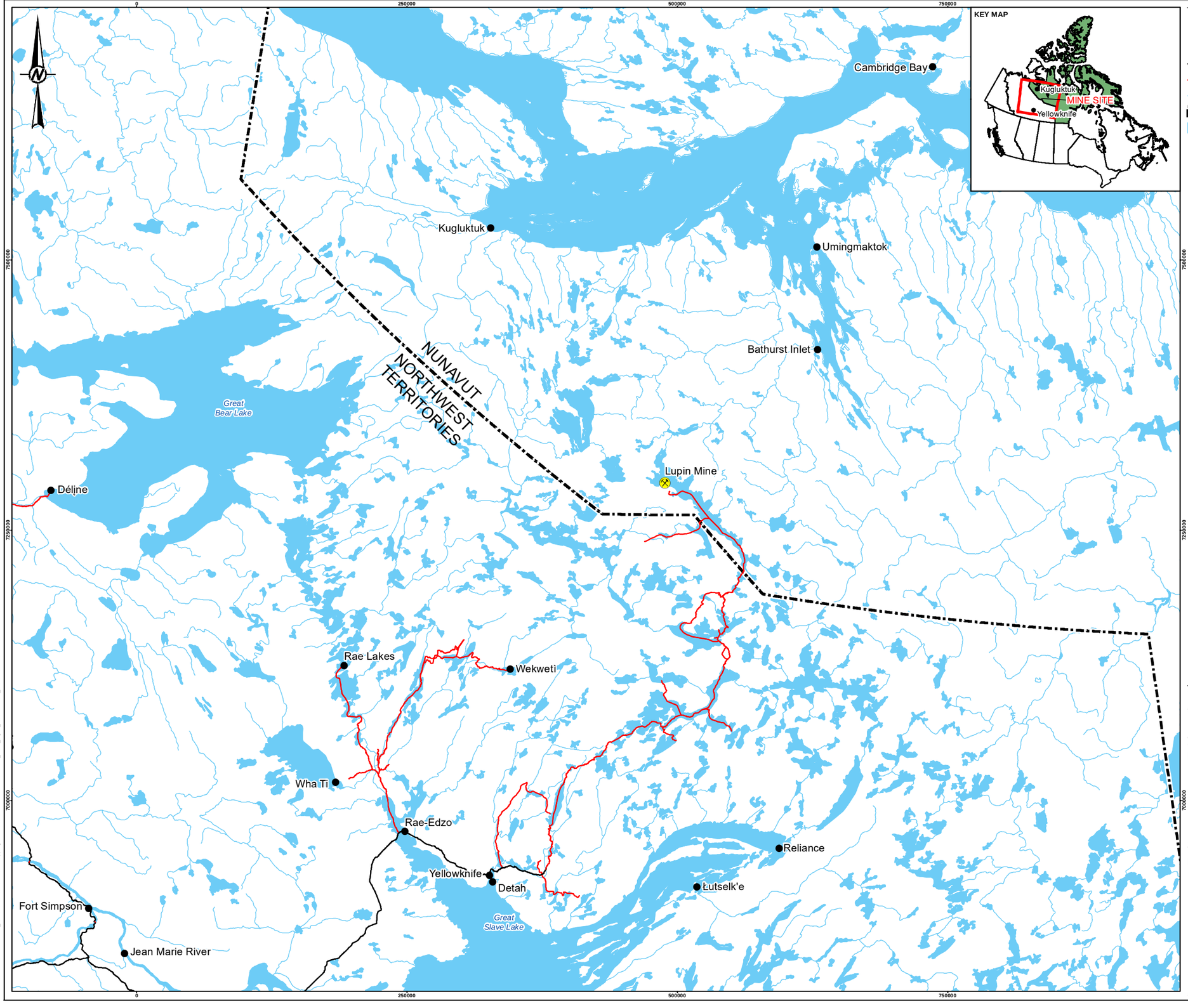
NWTWB (Northwest Territories Water Board). 1992. Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories, 24 p.

Appendix A: Figures



LEGEND

- LUPIN MINE
- POPULATED PLACE
- HIGHWAY
- WINTER ROAD
- WATERCOURSE
- TERRITORIAL/PROVINCIAL BOUNDARY
- WATERBODY

0 75 150

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REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
LOCATION PLAN

LUPIN MINES INCORPORATED

YYYY-MM-DD	2021-04-08
DESIGNED	NC
PREPARED	AA/PT
REVIEWED	KS
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
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7295000 7292500 7290000 7287500 7285000

Contwoyto Lake
White Lake
Boot Lake
East Lake
Upper Sewage Lake
Punkin Lake
Seep Creek
Dam 2 Lake
Boomerang Lake
Den Lake
Dam 1A Lake
Fox Lake
Lori Lake
End Lake
Long Lake (Decant Lake)
Norma Lake
Black Lake
Fingers Lake
Sep Lake
Post Lake
Esker Lake

Dock
Mine Site
Airstrip
2428
Sewage Dam
Lower Sewage Lake
Dump Pond
Explosives Storage
Cell 5
Cell 2
Cell 1
Tailings Pond 2
Tailings Pond 1
Cell 4
Cell 3
3278
3276
3275
Quarry
Esker Borrow Area
Borrow Area
3277

LEGEND

- ROAD
- WATERCOURSE
- APPROXIMATE 2017 RECLAMATION WORK
- DISTURBANCE FOOTPRINT
- INFRASTUCTURE FOOTPRINT
- MINERAL LEASE BOUNDARY
- WATERBODY

0 2 4

1:50,000 KILOMETRES

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
GENERAL SITE LAYOUT, 2021 CONDITIONS

LUPIN MINES INCORPORATED

YYYY-MM-DD	2021-04-08
DESIGNED	NC
PREPARED	PT/LS
REVIEWED	KS
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
20446521	1030	0	2

LEGEND

- CONTOUR
- WATERCOURSE
- ROAD
- DISTURBANCE FOOTPRINT
- INFRASTUCTURE FOOTPRINT
- REHABILITATED DISTURBED AREA
- WATERBODY

0 250 500

1:15,000 METRES

NOTE(S)

MOST BUILDINGS IN THE MINE AND MILL SITE AREA WERE REMOVED IN 2020. THE CAMP FACILITIES AND MACHINE SHOP WILL REMAIN IN PLACE UNTIL THE END OF 2021 TO SUPPORT RECLAMATION ACTIVITIES. THE LOG CABIN WILL REMAIN IN PLACE PERMANENTLY.

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
MINE AND MILL SITE AREA, 2021 CONDITIONS

LUPIN MINES INCORPORATED

YYYY-MM-DD	2021-04-08
DESIGNED	NC
PREPARED	PT/LS
REVIEWED	KS
APPROVED	KB

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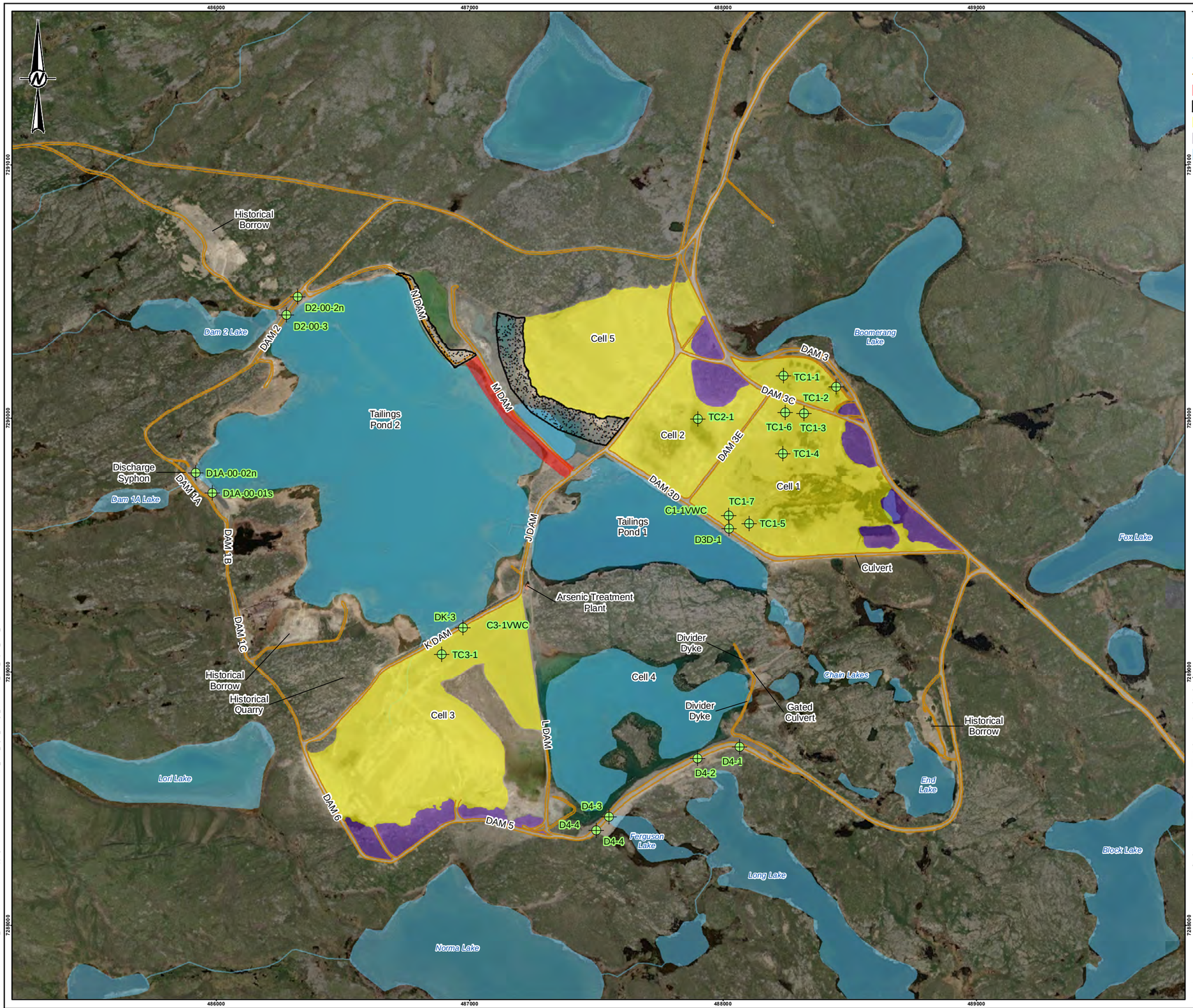

LEGEND

- ACTIVELY MONITORED THERMISTOR
- WATERCOURSE
- ROAD
- APPROXIMATE 2017 DAM REPAIR AND MAINTENANCE WORK
- APPROXIMATE 2017 RECLAMATION WORK
- PREVIOUSLY COMPLETED COVER
- TUNDRA
- WATERBODY

0 250 500

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REFERENCE(S)

THERMISTOR LOCATIONS AND 2017 RECLAMATION WORKS OBTAINED FROM NORWEST CORP., JANUARY 26, 2018. HYDROGRAPHY AND TOPOGRAPHY DATA OBTAINED FROM GEOGRATIS © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. FOOTPRINT OBTAINED FROM CLIENT. IMAGERY COPYRIGHT © 20160706/20160630 ESRI AND ITS LICENSORS. SOURCE: VIVID, MAXAR. USED UNDER LICENSE, ALL RIGHTS RESERVED.
DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
TAILINGS CONTAINMENT AREA LAYOUT – PRE-2020

LUPIN MINES INCORPORATED

YYYY-MM-DD	2021-04-08
DESIGNED	NORWEST CORP.
PREPARED	PT/LS
REVIEWED	KS
APPROVED	KB

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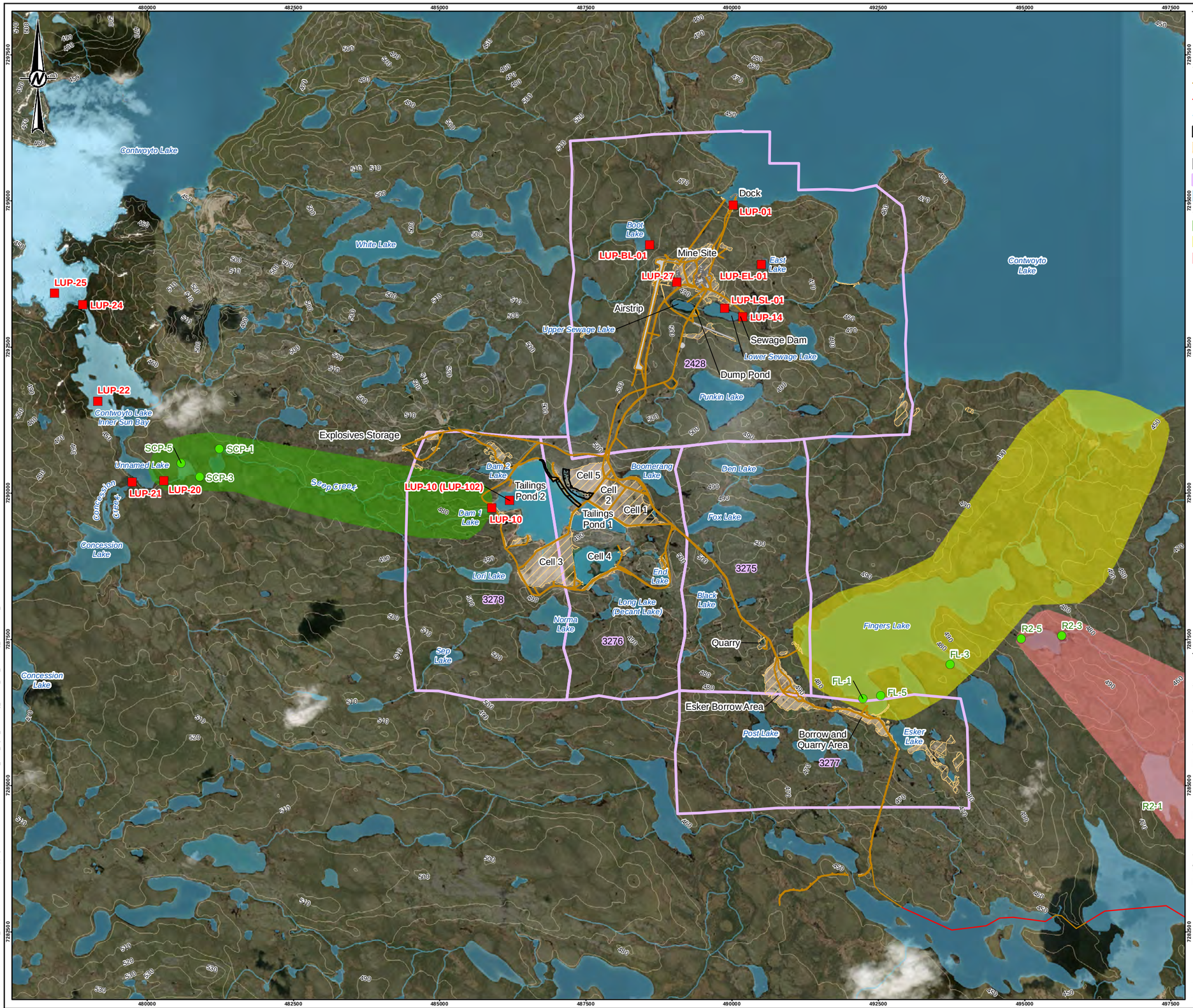

LEGEND

- EEM MONITORING LOCATION
- WATER QUALITY SAMPLING LOCATION
- CONTOUR
- ROAD
- WINTER ROAD
- WATERCOURSE
- APPROXIMATE 2017 RECLAMATION WORK
- DISTURBANCE FOOTPRINT
- INFRASTUCTURE FOOTPRINT
- MINERAL LEASE BOUNDARY
- WATERBODY

SAMPLING AREAS

- EXPOSURE AREA
- REFERENCE AREA 1
- REFERENCE AREA 2

0 2 4

1:65,000 KILOMETRES

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
WATER QUALITY MONITORING STATIONS FOR ACTIVE AND PASSIVE CLOSURE

LUPIN MINES INCORPORATED

YYYY-MM-DD	2021-04-08
DESIGNED	NC
PREPARED	PT/LS
REVIEWED	KS
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
20446521	1030	0	5

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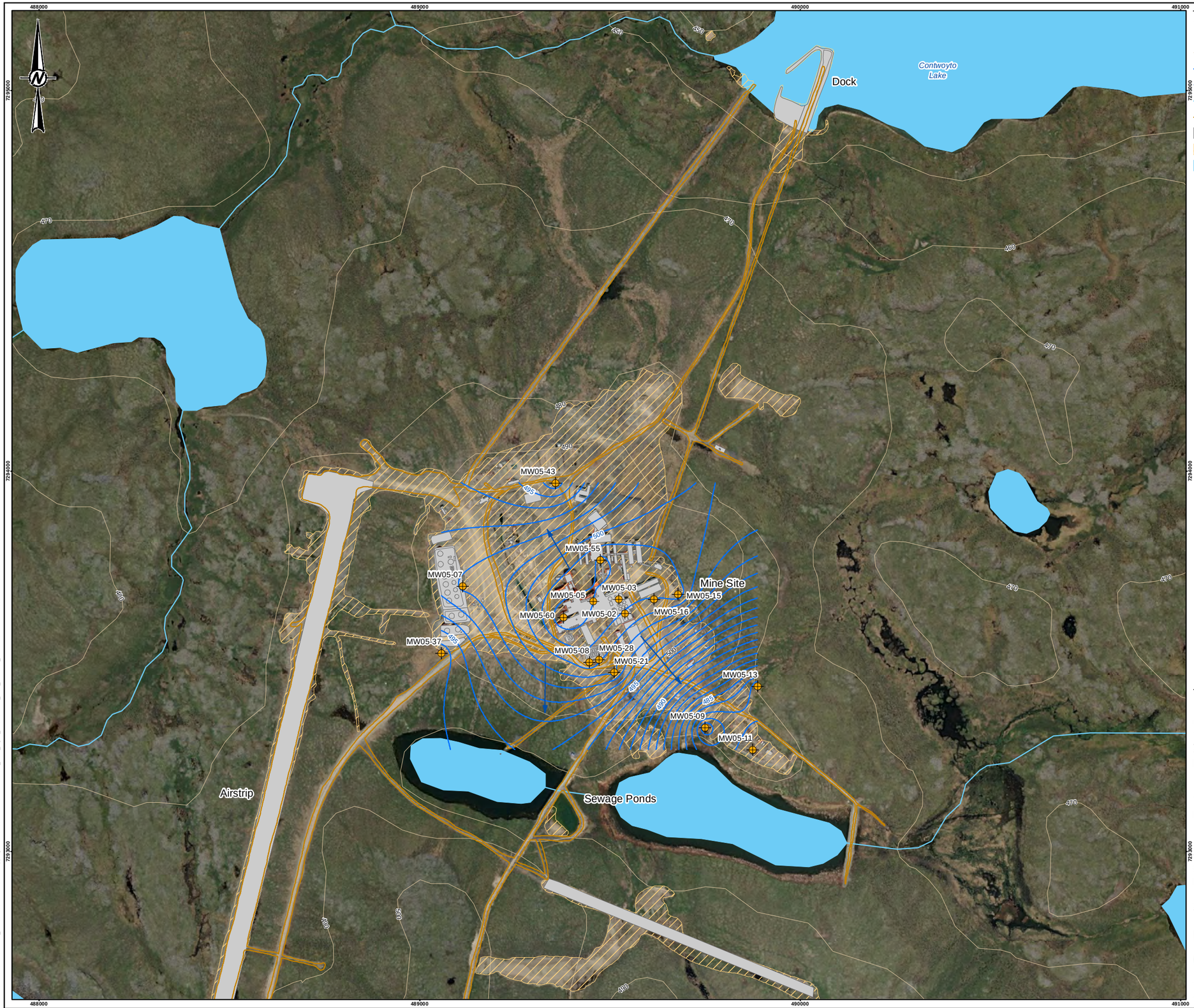

LEGEND

- MONITORING WELL
- CONTOUR
- EQUIPOTENTIAL LINE
- GROUNDWATER FLOW DIRECTION
- WATERCOURSE
- ROAD
- INFRASTUCTURE FOOTPRINT
- DISTURBANCE FOOTPRINT
- WATERBODY

0 250 500

1:10,000 METRES

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
GROUNDWATER FLOW DIRECTION AND MONITORING WELL LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2021-04-08
DESIGNED	DY
PREPARED	JT/LS
REVIEWED	KS
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
20446521	1030	0	6

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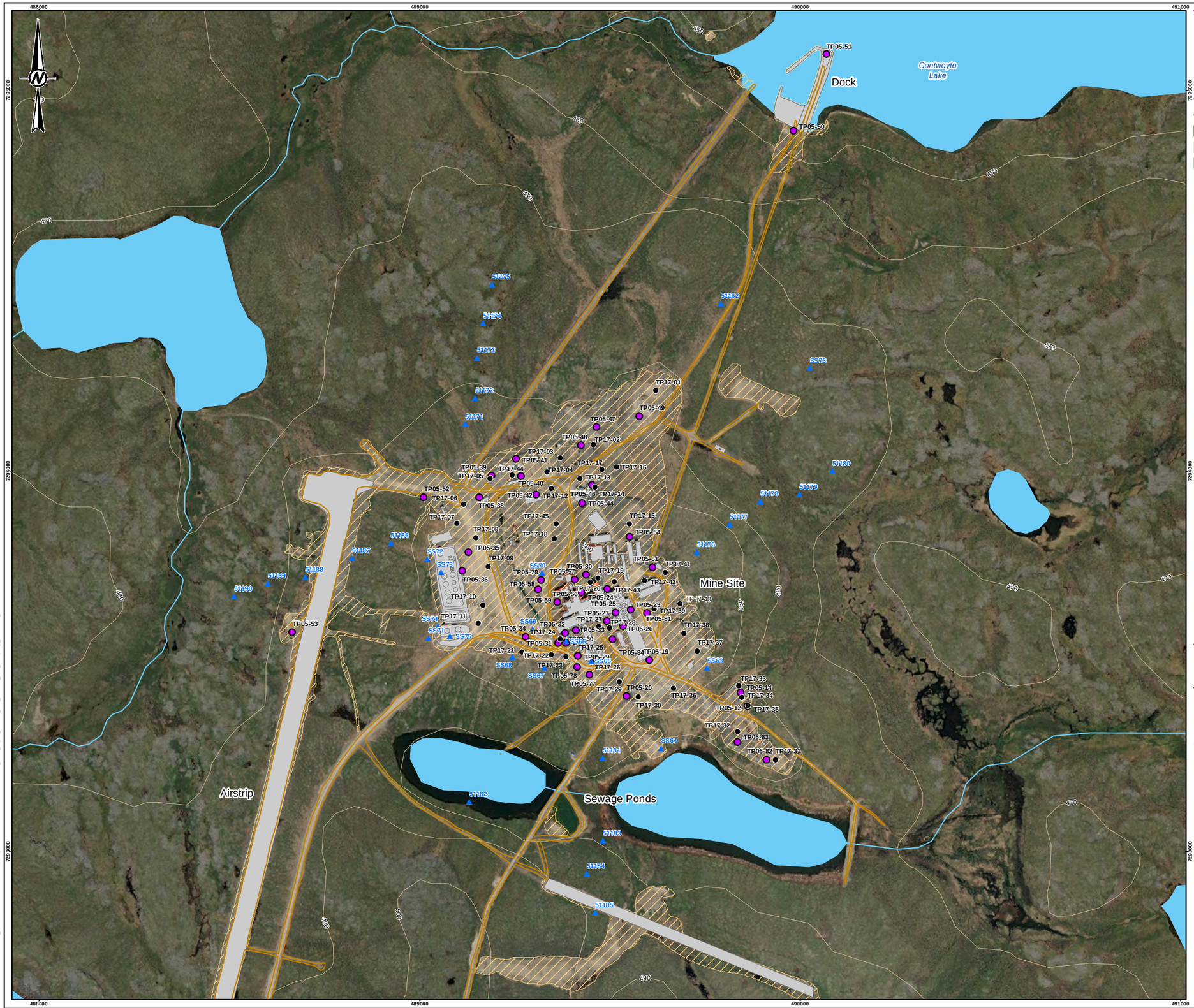

LEGEND

- 2017 TEST PIT LOCATION
- HISTORICAL SOIL SAMPLE LOCATION
- 2006 TEST PIT LOCATION
- CONTOUR
- WATERCOURSE
- ROAD
- INFRASTUCTURE FOOTPRINT
- DISTURBANCE FOOTPRINT
- WATERBODY

NOTE(S)

MOST BUILDINGS IN THE MINE AND MILL SITE AREA WERE REMOVED IN 2020. THE CAMP FACILITIES AND MACHINE SHOP WILL REMAIN IN PLACE UNTIL THE END OF 2021 TO SUPPORT RECLAMATION ACTIVITIES. THE LOG CABIN WILL REMAIN IN PLACE PERMANENTLY.

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
CURRENT AND HISTORIC SOIL SAMPLING LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2021-04-08
DESIGNED	DY
PREPARED	JT
REVIEWED	KS
APPROVED	KS

PROJECT NO.	CONTROL	REV.	FIGURE
20446521	1030	0	7

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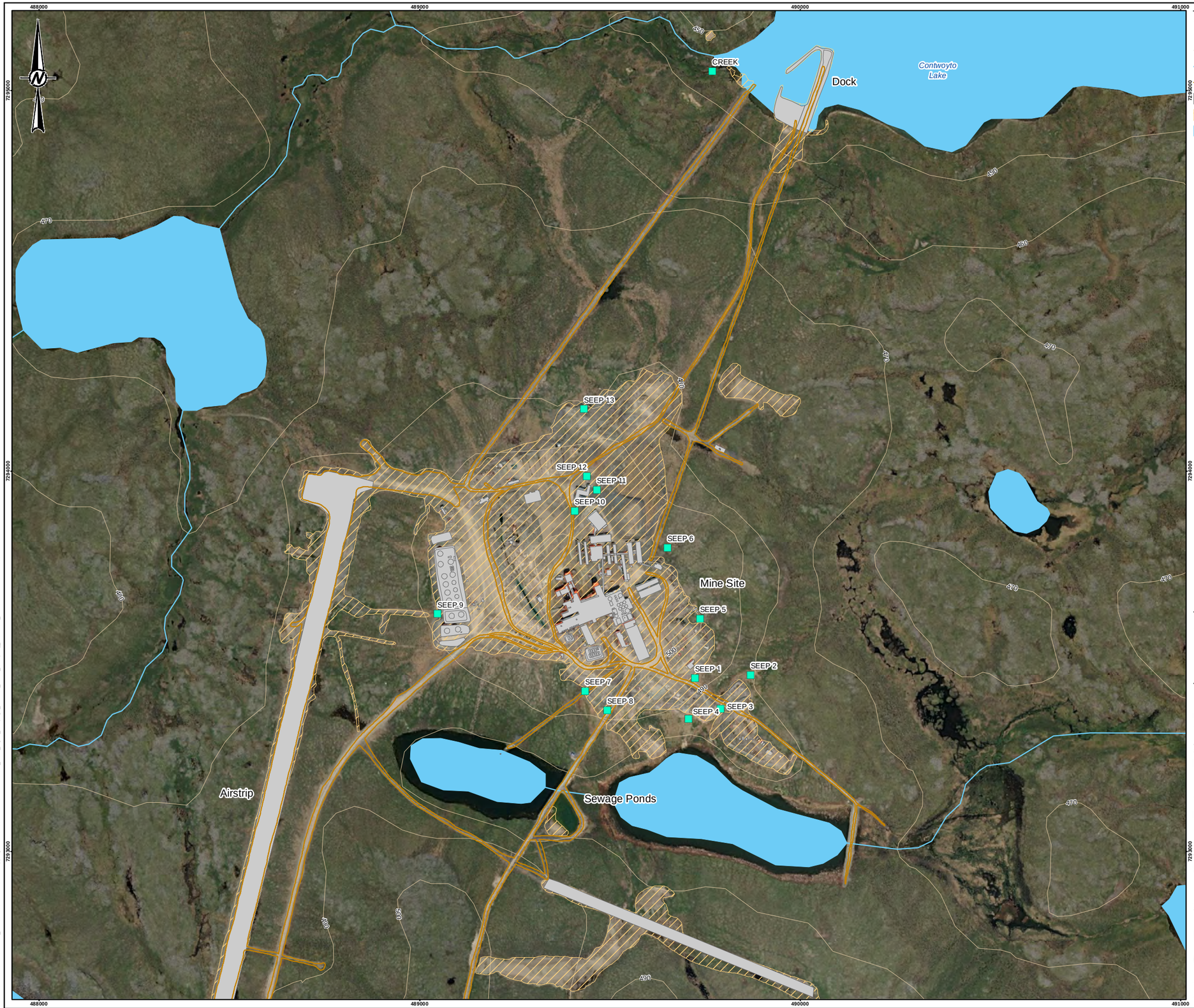

LEGEND

- SURFACE WATER SEEP SAMPLE LOCATIONS
- CONTOUR
- WATERCOURSE
- ROAD
- INFRASTUCTURE FOOTPRINT
- DISTURBANCE FOOTPRINT
- WATERBODY

0 250 500

1:10,000 METRES

NOTE(S)

SEEPS SAMPLED IN AUGUST 2019 PRIOR TO RECLAMATION OF THE MILL SITE. AFTER REMEDIATION, SEEP MONITORING WILL BE AT THE TOES OF THE COVERS ON THE ROCK DOME, THE ADIT, AND THE LANDFILL

MOST BUILDINGS IN THE MINE AND MILL SITE AREA WERE REMOVED IN 2020. THE CAMP FACILITIES AND MACHINE SHOP WILL REMAIN IN PLACE UNTIL THE END OF 2021 TO SUPPORT RECLAMATION ACTIVITIES. THE LOG CABIN WILL REMAIN IN PLACE PERMANENTLY.

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
SEEPAGE SURFACE WATER SAMPLING LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2021-04-08
DESIGNED	DY
PREPARED	JT
REVIEWED	KS
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
20446521	1030	0	8

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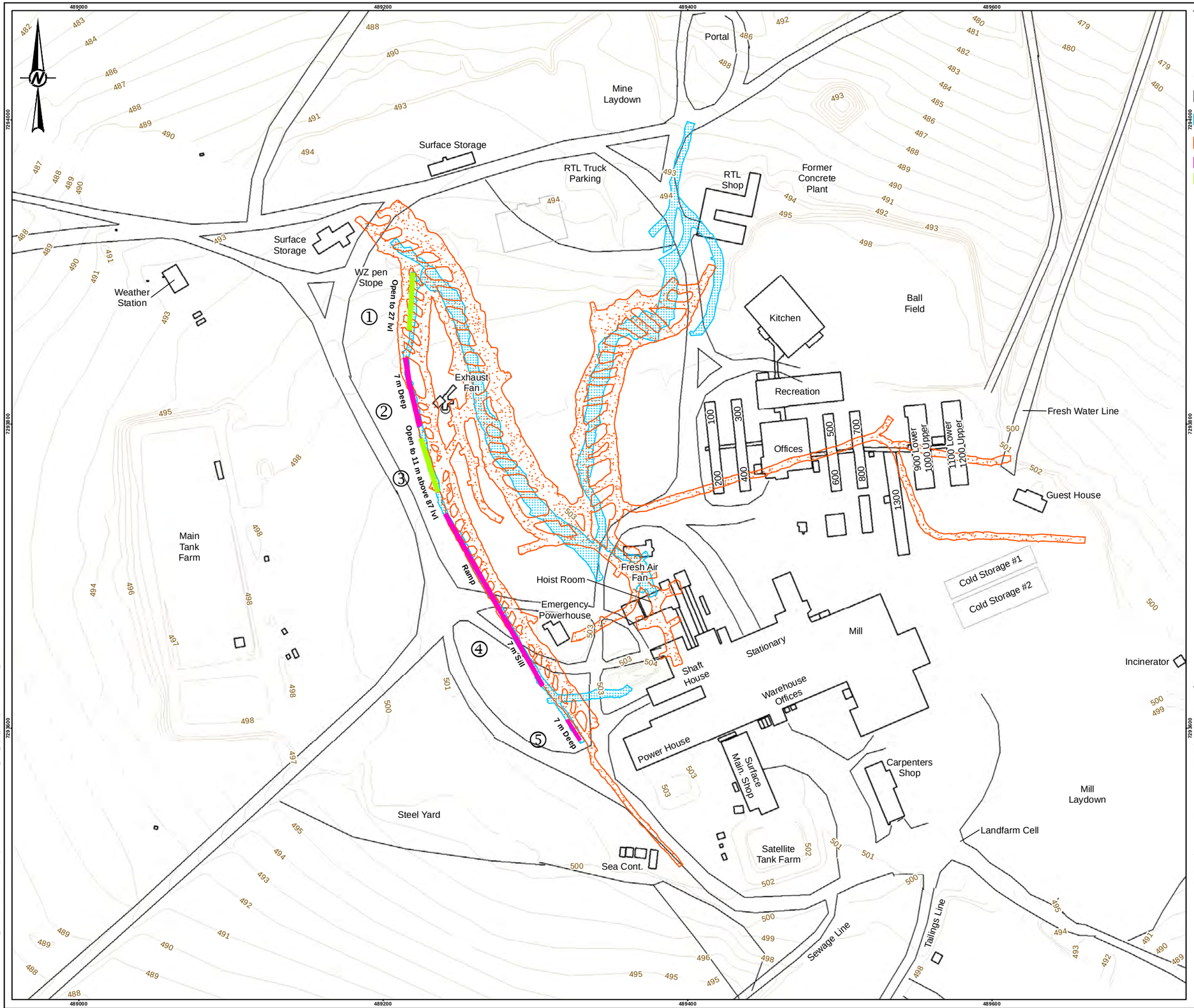

LEGEND

① WZ UNDERGROUND DISPOSAL KEY CROSS-SECTION LOCATION

CONTOUR

INFRASTUCTURE FOOTPRINT

27 LEVEL ORE DRIFT PROJECTION

87 LEVEL ACCESS DRIFT PROJECTION

WZ CROWN PILLAR PIT

WZ OPEN STOPE

0 50 100

1:2,500 METRES

REFERENCE(S)

UNDERGROUND DISPOSAL AND FACILITY DATA OBTAINED FROM NORWEST CORP., JANUARY 26, 2018. HYDROGRAPHY AND TOPOGRAPHY DATA OBTAINED FROM GEOGRATIS © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. FOOTPRINT OBTAINED FROM CLIENT.
DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
SURFACE PROJECTION OF SHALLOW MINE WORKINGS AND OPENINGS TO SURFACE

LUPIN MINES INCORPORATED

YYYY-MM-DD	2021-04-08
DESIGNED	NORWEST CORP.
PREPARED	AA/LS
REVIEWED	KS
APPROVED	KS

PROJECT NO.	CONTROL	REV.	FIGURE
20446521	1030	0	9

490000
492000
494000
7288000
7286000
7284000

Quarry
Esker Borrow Area
Borrow Area
Fingers Lake
Post Lake
Esker Lake

LEGEND

- CONTOUR
- WINTER ROAD
- WATERCOURSE
- ROAD
- DISTURBANCE FOOTPRINT
- WATERBODY

0 250 500
1:15,000 METRES

REFERENCE(S)

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DATUM: NAD83 PROJECTION: UTM ZONE 12

CLIENT
MANDALAY RESOURCES CORPORATION

PROJECT
LUPIN MINE CLOSURE

TITLE
LOCATION OF BORROW PIT AND QUARRIES

LUPIN MINES INCORPORATED

YYYY-MM-DD	2018-01-25
DESIGNED	NC
PREPARED	AA
REVIEWED	KS
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
20446521	1030	0	10

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Appendix B: Index of Applicable Regulatory Requirements

Responsible Authority	Legislation	Authorization	Project Activity	Permitting Strategy/Timeline
Nunavut Impact Review Board	Nunavut Agreement Article 12 Nunavut Planning and Project Assessment Act (S.C. 2013, c. 14, s. 2)	Project Certificate – not applicable	Required to obtain requisite permits and approvals to proceed with Project	NIRB Screening Decision (NIRB 99WR053) issued 16 November 1999.
Kitikmeot Inuit Association	Nunavut Agreement Article 26	Inuit Impact and Benefits Agreement	Required to proceed with Project	Not Applicable – project entirely on Crown Lands
	Nunavut Agreement Article 20	Inuit Water Rights Compensation Agreement	May be required	
	Nunavut Agreement Article 6	Wildlife Compensation Agreement		
	Nunavut Agreement	Inuit Owned Lands – Commercial Land Use Lease	Access surface IOL to develop mine	
		Inuit Owned Lands – Quarry Concession Licences	Extract aggregate on IOL	
Nunavut Water Board	Nunavut Agreement Article 13 *Nunavut Waters and Nunavut Surface Rights Tribunal Act* Nunavut Waters Regulations	Type A and B Water Licences; Approval without a Licence	Required for water use and waste disposal	Type A -2AM-LUP2032 issued on 28 February 2020 and approved on 9 April 2020.
Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)	*Territorial Lands Act* Canadian Mining Regulations- Territorial Land Use Regulations	Crown Land – Land lease and Water lot lease	Access surface Crown lands for the Project life	Refer to Section 1.3.2, Table 1
	Territorial Quarrying Regulations	Crown Land – Quarry Lease/Permit	Extract aggregate on Crown Land	
Fisheries and Oceans Canada	*Fisheries Act* (Section 35(2))	Authorization under Paragraph 35(2)(b) of the *Fisheries Act*; required if serious harm to fish cannot be avoided. In instances in which serious harm to fish can be avoided, DFO may provide a letter of authorization in addition to compliance with Measures to Avoid Causing Harm to Fish and Fish Habitat.	Project activities directly removing or altering fish habitat: full lake dewatering, culvert installations, dam construction in watercourses, stream flow reductions and potential water and sediment quality changes.	General Application of DFO environmental protection measures No Authorization for the Project.
Environment Canada	*Fisheries Act (Section 36)* Metal Mining Effluent Regulations	Notice of Closed Mine Status	Notice to be provided; Final Study design required not less than 6 months following notice.	Notice of Closure filed 30 January 2019. ECCC confirmed closed mine status on 30 January 2022.
		Environmental Effects Monitoring	Implement EEM program	EEM Final Study design implemented August 2019. (See Sections 1.3.3 and 2.1.6)
Natural Resources Canada	*Explosives Act* and Regulations Blasting Permits Explosive Magazine Permits Radio Licensing	Licence for a Factory and Magazine	Required for construction of explosives factories and magazines and storage of explosives	–
GN Culture and Heritage	Nunavut Archaeological and Palaeontological Sites Regulations (Nunavut) *Nunavut Historical Resources Act*	Archaeology Permit	Required to conduct archaeology surveys and to mitigate cultural/heritage resources	Not required at this time.
Nunavut Research Institute	*Scientist Act* (Nunavut)	Scientific Licences: Land and Water Social and Traditional Knowledge	Undertake non-biological and non-cultural heritage baseline and monitoring studies	Required for Final Study Design
GN Environment	*Environmental Protection Act* (Nunavut) Spill Contingency Planning and Reporting Regulations (Nunavut)	Approval of Spill Contingency Plan	–	–
	Environmental Protection Act (Nunavut)	Hazardous Waste Generator	–	Generator No. NUG10047
	Wildlife Act (Nunavut)		–	–
GN Health and Social Services	*Public Health Act* (Nunavut) Camp Sanitation Regulations (Nunavut)	Approval of camp facilities	Construction and operation of camp, medical facilities, buildings and propane storage	–
	Emergency Medical Aid Act (Nunavut)	Medical facilities approval		
GN Community and Government Services	Building Codes (Nunavut)	Building Permits	Construction and operation of camp, medical facilities, buildings and propane storage	–
	Fire Prevention Act (Nunavut) Fire Prevention Regulations (Nunavut) Propane Cylinder Storage Regulations	Approval of camp facilities and propane storage		
Worker's Safety and Compensation Commission of Nunavut - Mine Health and Safety	*Explosives Use Act* (Nunavut) Explosive Use Regulations (Nunavut)	Authorization to store and use explosives	Required to store detonators in a magazine	–
	Mine Health and Safety Act (Nunavut) Mine Health and Safety Regulations (Nunavut)	Authorization to store and use explosives	Required to store detonators in a magazine	
	Worker's Compensation Act (Nunavut) Workers Compensation Regulations (Nunavut)	Authorization for Activities	Required to proceed with Project activities	Letter on File

IOL = Inuit Owned Land; - = not applicable.

Appendix C: Quality Assurance/Quality Control (QA/QC)

Lupin Mines Incorporated

A wholly owned indirect subsidiary of Mandalay Resources Corporation

Lupin Mine Site

Nunavut, Canada

Water Quality Monitoring Plan and Water and Soil Quality Assurance/ Quality Control Plan

(Care and Maintenance)

February 2021

Lupin Mines Incorporated
Mandalay Resources Corporation
76 Richmond Street East, Suite 330
Toronto, Ontario M5C 1P1

Document Control

Revision No.	Date	Details	Author	Approver
1.0	30/03/2013	Replaces Care and Maintenance Plan – *Sampling Procedure: Tailings Containment Area and Sewage Lakes Disposal Facility*, March 2012 Replaces the *Environmental Laboratory Quality Assurance / Control Plan*, Prepared: March 1993, Revised: December 1995 Update contact and general information Revised to include bioassay sample requirements	D. Vokey	W. Osborne
2.0	18/03/2016	Updated to reflect new water licence Added Landfill and Landfarm facility requirements Updated parameters and frequency of testing for all stations Added provisions for the annual sampling of the interior ponds of the TCA Updated contact and general information Updated UTM coordinates for sample stations to agree with those shown on the figures. Corrected reference to ammonia as NH_3 not NH_4 (NH_4 is ammonium) Updated laboratory accreditations Provided additional direction for the discharge from the sewage and TCA added	SRK	K. Lewis
3.0	14/08/2020	Updated to reflect new water licence Updated parameters and frequency of testing for all stations Updated laboratory accreditations Added QA/QC for Soils	Golder	K. Lewis
4.0	26/02/2021	Updated contact information and distribution list Update Plan Title	Golder	K. Lewis

Executive Summary

Lupin Mines Incorporated (LMI), a wholly owned indirect subsidiary of Mandalay Resources Corporation (Mandalay), has prepared this Monitoring Plan.

A review of the Plan takes place and revisions are submitted as necessary with the annual report. The current Type A Water Licence 2AM-LUP2032 (Water Licence) for the Lupin Gold Mine (Lupin or the Lupin Mine or the Site) is valid until February 27, 2032.

Executive Summary Inuktitut

Awaiting translation – to be provided as soon as possible

Executive Summary Inuinnaqtun

Awaiting translation – to be provided as soon as possible

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Figures

Tables

Appendices

1 Introduction

Lupin Mines Incorporated (LMI), a wholly owned indirect subsidiary of Mandalay Resources Corporation (Mandalay), has prepared this Water Quality Monitoring Plan and Quality Assurance / Quality Control Plan (the Plan).

An annual review of the Plan takes place and revisions are submitted as necessary with the Annual Report to the Nunavut Water Board (NWB). The current Type A Water Licence 2AM-LUP2032 (Water Licence) for the Lupin Gold Mine (Lupin or the Lupin Mine or the Site) is valid until February 27, 2032.

1.1 Project and Company Information

Mandalay is a Canadian based company focused on producing assets in Australia, Chile and Sweden, a development project in Chile and the exploration and development of the past-producing Lupin Gold Mine and the Ulu gold project, both located in Nunavut, Canada.

Mandalay purchased Elgin Mining Inc., which owns LMI and the Lupin Mine, in September 2014. Lupin was in operation from 1982 to 2005 with temporary suspensions of activities between January 1998 and April 2000, and again between August 2003 and March 2004. The mine resumed production in March 2004 until February 2005.

Lupin Mine is currently in Closure and Reclamation with final reclamation and closure of on-site facilities being conducted in accordance with the *Final Closure and Reclamation Plan* and the *Closure and Reclamation Plan for the Tailings Containment Area.* Progressive reclamation will be implemented during the Closure and Post Closure Phase in accordance with *Care and Maintenance Plan* for the Project. Surface exploration is conducted under Water Licence 2BE-LEP1217. All camp infrastructure required for the surface exploration program currently exists at the Lupin Mine

Company:	LMI
Project:	Lupin Mine, Nunavut
Company Address:	Suite 330, 76 Richmond Street East, Toronto, ON M5C 1P1 Telephone: 778-386-7340
Email:	k.lewis@mandalayresources.com
Attention:	Karyn Lewis, General Administration
Effective date:	26 Feb 2021
Distribution List:	
Karyn Lewis	General Administration
Discovery Mining Services	Site Contractor
Golder Associates	Site Consultant
Stantec Consulting	Site Consultant

Additional copies of this Plan are available from General Administration. This Plan will be posted in key locations at the Site, and all employees and contractors will be made aware of its contents.

1.2 Site Location

The Lupin Mine is located in the Kitikmeot Region, Nunavut, 400 km north of Yellowknife, Northwest Territories and 285 km southeast of Kugluktuk, Nunavut. The airport serving this Site is at 65°46'00" N and 111 14'41" W. The Site is on the western shore of Contwoyto Lake, approximately 60 km south of the Arctic Circle (Figure 1).

1.3 Environmental and Sustainable Development Policy

Lupin Mine Incorporated (LMI) is committed to maintaining a safe, clean, compliant and respectful work environment. LMI looks to our employees, contractors and managers to adopt and grow a culture of social responsibility and environmental excellence. Together we achieve this by:

- Promoting environmental stewardship in all tasks. Nothing is too important that it cannot be done in a clean and responsible manner. We strive towards maintaining a zero-incident work place.
- Recognizing that we have a shared responsibility as stewards of the environment in which we operate. We will not walk away from a non-compliant act.
- Identifying, managing and mitigating environmental, business and social risks in an open, honest and transparent manner.
- Planning our work so it is done in the cleanest possible manner and executing work according to plan.
- Continually improving environmental and operational performance by setting and reviewing achievable targets.
- Providing appropriate and necessary resources in the form of training, personnel and capital, including that required for closure planning and reclamation.
- Managing our materials and waste streams, maintaining a high degree of emergency response preparedness and minimizing our operational footprint to maintain environmental protection at all stages of project development.
- Procuring goods and services locally, where available, and favouring suppliers with environmentally and socially responsible business practices.
- Seeking to understand, learn from and mitigate the root causes of environmental incidents and near misses when they do occur.
- Employing systems and technology to achieve compliance, increase efficiency and promote industry best practices in development, operations and environmental stewardship.
- Working with stakeholders to identify and pursue opportunities for sustainable social and economic development and capacity building.
- Conducting early and ongoing stakeholder engagement relevant to the stage of project and mine development and operation.
- Recognizing diversity in the workplace and building meaningful relationships with all stakeholders in a timely, collaborative and transparent manner.

Through implementation of this policy, LMI seeks to earn the public's trust and be recognized as a respectful and conscientious employer, neighbor, and environmental steward.

1.4 Purpose and Scope

The purpose of this Plan is to identify water quality and soils monitoring requirements for the Site and minimize the impacts of potential sampling and analytical errors by providing a set of standardized procedures for sampling, analysis and reporting. These procedures are to be implemented by any personnel involved in monitoring for the purpose of regulatory compliance or internal environmental management.

The Plan documents Quality Assurance (QA) and Quality Control (QC) procedures for the Lupin Mine Monitoring Program as required by Type A Water Licence 2AM-LUP2032 Part J, Items 5, 6 and 7. The Plan also documents QA/QC procedures for the Lupin Mine Monitoring Program as required by the *Metal and Diamond Mine Effluent Regulations* (MDMER) under the *Fisheries* Act Part 2 Division 1 Item 11 and Part 2 Division 2 Items 12(1) and (2), 14(1), (2), and (3), 17(1) and (2), and 19(3) as well as Schedule 4 and 5.

QA/QC planning has been developed in accordance with the Crown-Indigenous Relations and Northern Affairs Canada (CCIRNAC), *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class 'A' Licensees in meeting SNP Requirements and for Submission of a QA/QC Plan*, July 1996 which defines QA and QC as follows:

Quality Assurance: is the system of activities designed to better ensure that quality control is done effectively.

Quality Control: is the use of established procedures to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability.

This Plan outlines field sample collection procedures including sampling requirements and methods; field sample identification, preservation and transport procedures; field sampling quality control measures; analytical laboratory information; and reporting requirements.

2 Field Sampling

2.1 Sample Collection

2.1.1 Sampling Station Locations, Requirements and Parameters

Sampling station locations, requirements, and parameter analyses are set out in the Type A Water Licence 2AM-LUP2032 Table 1 of Schedule J and in the MDMER Part 2 Division 2 Items 12 thru 18 and Schedules 4 and 5. In addition, LMI's site monitoring program includes the collection of additional samples to assess the progression of water quality and the performance of or need for treatment measures.

Generally, samples are required from the following locations:

- Freshwater intake at Contwoyto Lake,
- Tailings Containment Area (TCA):
    - Annual characterization samples;
    - Prior to discharge;
    - During discharge;
    - Reference areas; and
    - Downstream exposure areas,
- Sewage Lakes Disposal Facility,
- Bulk Fuel Storage Facility
- Landfarm Facility, and
- Landfill Facility.

The monitoring requirements outlined in the Water Licence and MDMER effluent monitoring requirements are outlined in Table 2.1. Water sampling under the Environmental Effects Monitoring Program of the MDMER will accompany any planned discharges from the TCA. Monitoring guided by LMI's initiative are also outlined.

A sample event schedule is also provided in Table 2.2 which outlines the Water Licence and MDMER effluent monitoring requirements as well as field monitoring and QC sample requirements (see Section 3 of this Plan for more details about QC monitoring). LMI's routine sampling initiatives are also listed. This table is intended to serve as a guide to on-site personnel with sampling responsibilities.

Regulatory authorities are to be notified of planned discharge events. Table 2.3 provides the notification schedule.

Table 2.1: Sample collection requirements

Station ID	Location Description	Parameters												Frequency
		Field[a]	Conventional[b]	Metals and Mercury	Nutrients[c]	Cyanide	Ra-226	Anions and TP[d]	Fecal Coliform	BOD, TKN and ortho-phosphorus[e]	BTEX and O&G[f]	Bioassay		
												Acute[g]	Sublethal[h]	
LUP-01	Freshwater Intake from Contwoyto Lake	X	X	X	-	-	-	-	X	-	-	-	-	Annually
LUP-10	Pond 2 discharge at Dam 1A	X	X	X	-	X	-	-	-	-	-	-	-	Daily during periods of discharge
		X	X	X	X	X	X	-	-	-	-	-	-	Weekly
		X	X	X	X	X	X	X	-	-	-	X	-	Monthly (no less than one month Intervals) commencing with the first day of decant
		X	X	X	X	X	X	X	-	-	-	X	X	Once per calendar quarter
LUP10a (LUP-102)	Internal station in TCA Pond 2, approximately 100 m upstream from siphon intake	X	X	X	X	X	X	-	-	-	-	X	-	Once prior to initiation of decant and once prior to termination of decant
LUP-11	Mine-water discharge at automatic sampler in the mill	-	-	-	-	-	-	-	-	-	-	-	-	Not Active
LUP-12	Mill tailings taken at the mill	-	-	-	-	-	-	-	-	-	-	-	-	Not Active
LUP-14	Decant structure from the Sewage Lakes Disposal Facilities	X	X	X	X	-	-	-	X	X	-	-	-	First day of discharge and then monthly thereafter during periods of flow
LUP-15	Discharge from TCA Pond 1 (east pond) into TCA Pond 2 (west pond)	-	-	-	-	-	-	-	-	-	-	-	-	Not Active

Table 2.1: Sample collection requirements

Station ID	Location Description	Parameters												Frequency
		Field[a]	Conventional[b]	Metals and Mercury	Nutrients[c]	Cyanide	Ra-226	Anions and TP[d]	Fecal Coliform	BOD, TKN and ortho-phosphorus[e]	BTEX and O&G[f]	Bioassay		
												Acute[g]	Sublethal[h]	
LUP-16	TCA Pond 2 at center	-	-	-	-	-	-	-	-	-	-	-	-	Not Active
LUP-17	TCA Pond 2 upstream of Station LUP-10	-	-	-	-	-	-	-	-	-	-	-	-	Not Active
LUP-19	East end of Seep Creek in Dam 2 Lake	-	-	-	-	-	-	-	-	-	-	-	-	Not Active
LUP-20	West end of Seep Creek before discharge into Unnamed Lake	X	X	X	X	X	X	-	-	-	-	-	-	Weekly during discharge from the Tailings Containment Area, commencing with the first day of decant
LUP-21	North end of Concession Creek before discharge into Unnamed Lake	X	X	X	X	X	X	-	-	-	-	-	-	Weekly during discharge from the Tailings Containment Area, commencing with the first day of decant
		X	X	X	X	X	X	X	-	-	-	-	-	Four times per year
LUP-22	Inner Sun Bay near center and midway between end of peninsula and west shore	X	X	X	X	X	X	-	-	-	-	-	-	Weekly at mid-depth, commencing one (1) week prior to discharge from the Tailings Containment Area and concluding two (2) weeks after cessation of the discharge

Table 2.1: Sample collection requirements

Station ID	Location Description	Parameters												Frequency
		Field[a]	Conventional[b]	Metals and Mercury	Nutrients[c]	Cyanide	Ra-226	Anions and TP[d]	Fecal Coliform	BOD, TKN and ortho-phosphorus[e]	BTEX and O&G[f]	Bioassay		
												Acute[g]	Sublethal[h]	
LUP-24	Inner Sun Bay at mid-way point in narrows	X	X	X	X	X	X	-	-	-	-	-	-	Weekly at mid-depth, commencing one (1) week prior to discharge from the Tailings Containment Area, and concluding two (2) weeks after cessation of the discharge and when bioassay sample is collected at LUP-10 just prior to termination of decant
		X	X	X	X	X	X	X	-	-	-	-	-	Four times per year
LUP-25	Outer Sun Bay (Total Rather than specific metals)	X	X	X	X	X	X	-	-	-	-	-	-	Weekly at mid-depth, commencing one (1) week prior to discharge from the Tailings Containment Area, and concluding two (2) weeks after cessation of the discharge
LUP-26	Contwoyto Lake in bay east of water intake	-	-	-	-	-	-	-	-	-	-	-	-	Inactive
LUP-27	Bulk Fuel Storage Facility	X	X	X	X	-	-	-	-	-	X	-	-	Once prior to discharge and weekly during periods of discharge
LUP-28	Discharge from the Landfarm Facility.	X	X	X	X	-	-	-	-	-	X	-	-	Once prior to discharge and weekly during periods of discharge

Table 2.1: Sample collection requirements

Station ID	Location Description	Parameters												Frequency
		Field[a]	Conventional[b]	Metals and Mercury	Nutrients[c]	Cyanide	Ra-226	Anions and TP[d]	Fecal Coliform	BOD, TKN and ortho-phosphorus[e]	BTEX and O&G[f]	Bioassay		
												Acute[g]	Sublethal[h]	
LUP-29	Landfarm Facility Monitoring Well – Up gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-30a	Landfarm Facility Monitoring Well – Down gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-30b	Landfarm Facility Monitoring Well – Down gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-31	Seepage from the Landfill Facility	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow
LUP-32	Landfill Facility Monitoring Well – Up gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-33a	Landfill Facility Monitoring Well – Down gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-34b	Landfill Facility Monitoring Well – Down gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-35	Seepage from the Landfill Facility	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September

Table 2.1: Sample collection requirements

Station ID	Location Description	Parameters												Frequency
		Field[a]	Conventional[b]	Metals and Mercury	Nutrients[c]	Cyanide	Ra-226	Anions and TP[d]	Fecal Coliform	BOD, TKN and ortho-phosphorus[e]	BTEX and O&G[f]	Bioassay		
												Acute[g]	Sublethal[h]	
LUP-36[i]	Demolition Landfill Facility Monitoring Well – Up gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-37a[i]	Demolition Landfill Facility Monitoring Well – Down gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-37b[i]	Demolition Landfill Facility Monitoring Well – Down gradient	X	X	X	X	-	-	-	-	-	X	-	-	Monthly during periods of observed flow – June through September
LUP-EL-01	East Lake near shoreline near the potential seepage inputs	X	X	X	-	-	-	-	-	-	-	-	-	Twice-yearly: Once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.
LUP-BL-01	Boot Lake near shoreline near the potential seepage inputs	X	X	X	-	-	-	-	-	-	-	-	-	Twice-yearly: Once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.
LUP-LSL-01	Lower Sewage Lake near shoreline near the potential seepage inputs	X	X	X	-	-	-	-	-	-	-	-	-	Twice-yearly: Once in freshet and once in late open-water season, ensuring that baseline samples are collected prior to construction of the waste rock dome.

Table 2.1: Sample collection requirements

Station ID	Location Description	Parameters												Frequency
		Field[a]	Conventional[b]	Metals and Mercury	Nutrients[c]	Cyanide	Ra-226	Anions and TP[d]	Fecal Coliform	BOD, TKN and ortho-phosphorus[e]	BTEX and O&G[f]	Bioassay		
												Acute[g]	Sublethal[h]	
LUP-SP-01 to LUP-SP-XX[j]	Seeps from the Waste Rock Dome, Locations of observed seepage or flow from waste rock pile	X	X	X	-	-	-	-	-	-	-	-	-	Twice-yearly: Once in freshet and once in late open-water season
LUP-TCA-01 to LUP-TCA-XX[j]	Seeps from the Tailings Containment Area (TCA), Locations of observed seepage or flow from waste rock pile	X	X	X	-	-	-	-	-	-	-	-	-	Twice-yearly: Once in freshet and once in late open-water season

Notes:

(a) pH, conductivity, temperature and dissolved oxygen (receiving environment only).

(b) pH, conductivity, total suspended solids, alkalinity, hardness.

(c) Total ammonia, nitrate, and nitrite.

(d) Chloride and sulphate. TP = Total Phosphorus.

(e) Biochemical Oxygen Demand, Total Kjedahl Nitrogen and ortho-phosphorus.

(f) Benzene, toluene, ethyl benzene, xylene, and Oil and Grease.

(g) Acute Toxicity Testing: Rainbow Trout and *Daphnia Magna*.

(h) Sublethal Toxicity Testing for Fathead Minnows, *Ceriodaphnia dubia*, *Lemna minor* and *P. subcapitata*.

(i) Monitoring requirements are as per Water Licence, but are not applicable because the Demolition Landfill is not planned for construction.

(j) Seep sampling locations will be added to the post-closure monitoring program as new seeps are documented.

Table 2.2: Sampling event schedule.

Sampling Events	Station	Samples and Parameters	Quality Control[(1)]
TAILINGS CONTAINMENT FACILITY			
Annually	LUP-10a (LUP-102) LUP-POND1 LUP-CELL4 LUP-CELL5	Field pH, temperature, conductivity	1 field duplicate
		pH, TSS, hardness	
		Total Metals	
		Dissolved Metals	
One month prior to discharge	LUP-10a (LUP-102)	Field pH, temperature, conductivity	-
		pH, conductivity, TSS, alkalinity, hardness,	
		NO_2, NO_3, NH_3	
		Total Metals and Hg	
		CN (total cyanide)	
		^{226}Ra	
Upon receipt of results meeting discharge criteria (expect pH) and not less than two weeks prior to discharge	LUP-10a (LUP-102)	Field pH, temperature and conductivity	-
		Static pass/ fail Bioassay with pH adjustment[(2)]	
One week prior to discharge	Pond 2 (various locations and depths)	Field pH, temperature conductivity	1 field duplicate or field blank
		Field pH, temperature, and conductivity (Daily)	
	LUP-22, 24, 25 (at mid-depth)	pH, conductivity, TSS, alkalinity, hardness	
		Total Metals and Hg	
		NO_2, NO_3, NH_3	
		CN	
Daily during discharge	LUP-10	Field pH, temperature, and conductivity	1 field duplicate or field blank per week
		Field observation of visual sheen	
		flow rate m^3	
		pH, conductivity, TSS, alkalinity, hardness	
		CN	
		Total Metals and Hg	

Table 2.2: Sampling event schedule.

Sampling Events	Station	Samples and Parameters	Quality Control[1]
First day of discharge (in addition to daily sampling)	LUP-10	NO_2, NO_3, NH_3	1 field duplicate or field blank
		Total Metals and Hg	
		MDMER Bioassays: LC50	
		^{226}Ra	
	LUP-20, 21 (surface), LUP-22, 24, 25 (at mid-depth)	Field pH, temperature, conductivity, dissolved oxygen	
		pH, conductivity, TSS, alkalinity, hardness	
		Total Metals and Hg	
		NO_2, NO_3, NH_3	
		CN	
	LUP-21 (surface), LUP-24 (at mid-depth)	Anions and Total Phosphorus	
Weekly during discharge (in addition to daily sampling)	LUP-10	NO_2, NO_3, NH_3	1 field duplicate or field blank
		^{226}Ra	
	LUP-20, 21 (surface), LUP-22, 24, 25 (at mid-depth)	pH, conductivity, TSS, alkalinity, hardness	
		Total Metals and Hg	
		NO_2, NO_3, NH_3	
		CN	
		^{226}Ra	
Monthly during discharge (in addition to daily and weekly sampling	LUP-10	MDMER Bioassay LC50 and sublethal[3]	1 field duplicate or field blank
	LUP-21 (surface), LUP-24 (at mid-depth)	Total Hg	
		Field dissolved oxygen	
		Anions and Total Phosphorus	

Table 2.2: Sampling event schedule.

Sampling Events	Station	Samples and Parameters	Quality Control[(1)]
Just before the bioassay sample at LUP- 102 prior to termination of decant	LUP-21 (surface), LUP-24 (at mid- depth)	pH, conductivity, TSS, alkalinity, hardness	1 field duplicate or field blank
		Total Metals and Hg	
		NO_2, NO_3, NH_3	
		CN	
		^{226}Ra	
Last day of discharge	LUP-10a (LUP-102)	Static Pass/ Fail Bioassay	-
		Field pH, temperature, conductivity and dissolved oxygen	
		pH, TSS, alkalinity, hardness	
		Total Metals and Hg	
		CN	
		NO_2, NO_3, NH_3	
		^{226}Ra	
Weekly for two weeks following termination of discharge	LUP-22, 24, 25 (at mid-depth)	pH, TSS, alkalinity, hardness	1 field duplicate or field blank
		Total Metals	
		NO_2, NO_3, NH_3	
		CN	
SEWAGE LAKES DISPOSAL FACILITY			
Three weeks prior to discharge	LUP-14	Field pH, temperature, conductivity	1 field duplicate
		Field observation for visual sheen	
		pH, conductivity, TSS, alkalinity, hardness	
		Total Metals and Hg	
		NO_2, NO_3, NH_3, TKN, TP, OPO4	
		BOD5	
		Fecal Coliforms	
Daily during discharge		Field flow rate in m^3	-
		Field pH, temperature, conductivity	
		Field observation for visual sheen	

Table 2.2: Sampling event schedule.

Sampling Events	Station	Samples and Parameters	Quality Control[(1)]
First day of discharge and Monthly thereafter [(2)] (in addition to daily sampling)		pH, TSS, alkalinity, hardness	1 field duplicate or field blank
		Total Metals and Hg	
		BOD5	
		Fecal Coliforms	
		NO_2, NO_3, NH_3, TKN, TP, OPO4	
FRESHWATER INTAKE FACILITY			
Daily during intake	LUP-01	Field flow rate in m^3	-
Annually		Field pH, temperature, conductivity	
		pH, conductivity, TSS, conductivity	
		Total Metals and Hg	
		Fecal Coliforms	
BULK FUEL STORAGE FACILITY			
One week prior to discharge (RUSH 48 hour turnaround for sample results are to be requested of the laboratory)	LUP-27	Field pH, temperature, conductivity	1 field duplicate
		Field observation for visual sheen	
		pH, conductivity, TSS, hardness, alkalinity	
		Total Metals and Hg	
		Total Oil and Grease	
		BTEX	
		NO_2, NO_3, NH_3	
Daily during discharge		Field flow rate in m^3	-
		Field pH, temperature, conductivity	
		Field observation for visual sheen	
Weekly during discharge (in addition to daily testing)		pH, conductivity, TSS, hardness, alkalinity	1 field duplicate or field blank
		Total Metals and Hg	
		Total Oil and Grease	
		BTEX	
		NO_2, NO_3, NH_3	

Table 2.2: Sampling event schedule.

Sampling Events	Station	Samples and Parameters	Quality Control[(1)]
LANDFARM			
Monthly during discharge during periods of observed flow – June through September	LUP-28, LUP-29, LUP- 30a, LUP-30b	pH, conductivity, TSS, hardness, alkalinity	1 field duplicate or field blank
		Total Metals and Hg	
		Total Oil and Grease	
		BTEX	
		NO_2, NO_3, NH_3	
LANDFILL FACILITY			
Monthly during discharge during periods of observed flow – June through September	LUP-31, LUP-32, LUP- 33a, LUP-33b	pH, conductivity, TSS, hardness, alkalinity	1 field duplicate or field blank
		Total Metals and Hg	
		NO_2, NO_3, NH_3	

Notes:

(1) Duplicate and Blank samples must be collected for approximately every ten (10) field samples collected across the range of parameters. At least one duplicate must be submitted per sample shipment.

(2) Samples are to be collected on the morning of the next plane departure after discharge commences where hold time restraints apply.

(3) Twice per year. Nautilus Environmental should be advised that the dilution series for *Ceriodaphnia* and *Lemna* should be adjusted prior to sublethal testing.

Table 2.3: Discharge notification schedule.

Discharge Event	Schedule	Action Required
TAILINGS CONTAINMENT AREA	30 days prior to MDMER Bioassay	Provide notice to Environment and Climate Change Canada (ECCC) of planned sample date.
	10 days prior to discharge	Provide notice to the CIRNAC inspector, include analytical results and estimated volume of discharge.
LOWER SEWAGE LAKE	10 days prior to discharge	Provide notice to the CIRNAC inspector, include analytical results and estimated volume of discharge.
BULK FUEL STORAGE FACILITY	10 days prior to discharge	Provide notice to the CIRNAC inspector and estimated volume of discharge (1). Analytical results will be provided upon receipt and no discharge to occur prior to CIRNAC acknowledgment of receipt.

Note:

(1) Discharge from the bulk fuel storage facilities needs to commence as soon as possible when water starts accumulating in the spring.

Active monitoring (sampling) station locations as shown in Figure 2.1 are clearly identified in the field with permanent stakes and appropriate signage.

Samples must always be collected from the same locations, unless the sampling locations are relocated at the request of the designated CIRNAC Inspector or sampling location modifications are approved in writing by the NWB. The following Table 2.4 summarizes the current UTM coordinates of the active sampling locations:

Table 2.4: Lupin Mine sampling locations using the UTM NAD85, Zone 12N coordinates

Monitoring Station No.	Description	UTM Northing	UTM Easting
LUP-01	Freshwater intake from Contwoyto Lake	7294933	490030
LUP-10	TCA Pond 2 discharge at Dam 1A	7289689	485843
LUP-102 (Station 102)	Approximately 100 m upstream from the siphon intake in TCA Pond 2	7289875	486196
LUP-14	Decant structure from the Sewage Lakes Disposal Facilities	7293013	490187
LUP-20	West end of Seep Creek before discharge into Unnamed Lake	7290197	480149
LUP-21	North end of Concession Creek before discharge into Unnamed Lake	7290217	479841
LUP-22	Inner Sun Bay near centre midway between end of peninsula and west shore	7291715	479160
LUP-24	Inner Sun Bay near narrows	7293125	478989
LUP-25	Outer Sun Bay	7293770	478330
LUP-27	Bulk Fuel Storage Facility	7293609	489072
LUP-28	Discharge from the Landfarm Facility	TBD	TBD
LUP-29	Landfarm Facility monitoring well – upgradient	TBD	TBD
LUP-30a	Landfarm Facility monitoring well – downgradient	TBD	TBD

Table 2.4: Lupin Mine sampling locations using the UTM NAD85, Zone 12N coordinates

Monitoring Station No.	Description	UTM Northing	UTM Easting
LUP-30b	Landfarm Facility monitoring well – downgradient	TBD	TBD
LUP-31	Seepage from the Landfill Facility	TBD	TBD
LUP-32	Landfill Facility monitoring well – upgradient	TBD	TBD
LUP-33a	Landfill Facility monitoring well – downgradient	TBD	TBD
LUP-33b	Landfill Facility monitoring well – downgradient	TBD	TBD
LUP-EL-01	East Lake near shoreline near the potential seepage inputs	7293910	490496
LUP-BL-01	Boot Lake near shoreline near the potential seepage inputs	7294246	488593
LUP-LSL-01	Lower Sewage Lake near shoreline near the potential seepage inputs	7293164	489874

2.1.2 Field Measurements and Field Log Book

Where required by the monitoring program, pH, temperature, conductivity and dissolved oxygen of water is measured and recorded in the field directly from the water body being sampled wherever possible. Where it is not possible to take field measurements directly from the water body, the measurements can be taken from the sample bottle.

The pH and conductivity meters must be calibrated in advance of each day's sampling activities according to the manufacturer's instructions, using fresh standard calibration solutions. Any discrepancies must be recorded in the Field Log Book along with the sampling data; however recorded field measurements must not be altered due to calibration issues. Refer to the pH and conductivity meter manuals for instructions regarding how to calibrate and take measurements with the particular devices.

Details of all sampling activities are recorded in the Field Log Book including:

- Date and time of each sample collected,
- Sampling location visited,
- Weather conditions and air temperature,
- Flow rates where applicable,
- Integrity of sample location and water observations,
- Samples collected at each location including identification number (see Section 2.2), whether the sample will be submitted for analysis, and type of analysis as well and sample preservation measures,
- Sample depth where applicable, and
- Field measurements (i.e. pH, conductivity, temperature, dissolved oxygen) as well as any calibration discrepancies with the field meters.

Immediately following field activities, an electronic copy of the Field Log data must be made. Field log entries in the Field Log Book must not be altered; pages must not be removed; space or pages left blank must be labeled as such and crossed with a diagonal line; and errors must be crossed out, not erased.

2.1.3 Sample Containers

Sample container sizes and materials of construction depend upon the parameter(s) to be analyzed. A summary of sample container requirements for various parameters is provided in Table 2.5 (Section 2.3 of this Plan).

All water quality sample containers will be prepared and supplied by the contracted laboratory. Only clean, unused containers should be used to limit contamination and preservation errors. Samples analyzed for fecal coliform tests must be contained in bottles provided by the laboratory to ensure that the bottle is sterilized prior to use. Toxicity samples are to be collected in food grade containers, such as water jugs or buckets. The food grade containers must be thoroughly cleaned and rinsed and then triple rinsed with the sample water prior to being filled.

2.1.4 Sampling Methods

Water quality sampling methods are as follows:

- Record details of the sampling activity and field measurements in the Field Log Book (see Section 2.1.2 for details).
- In the field, disposable nitrile sampling gloves must be worn during handling of all the bottles and equipment.
- Triple rinse sample bottles with the source water prior to sample collection, except for those bottles with preservative already added by the laboratory (i.e., BTEX), as well as those bottles for Oil and Grease or Fecal Coliform analysis.
- Collect samples off-shore as much as possible without disturbing bottom sediments.
- When collecting samples from flowing bodies of waters (i.e. stream, creeks):
    - The sample must be collected as close as possible to the middle of the flowing water body. To prevent the stirring up of sediment, use a container attached to a pole extension. Otherwise, if wading into the stream is unavoidable, wait for the sediment to settle or flow away before collecting the sample.
    - When rinsing, plunge the sample bottle into the flowing water toward the current allowing it to fill at a depth of approximately half the stream depth. If the stream depth is too shallow to collect a clean sample without disturbing sediment or too shallow to fill the bottle completely, use a smaller bottle and transfer the water to the larger sample bottle.
    - Empty rinse water downstream of the sample locations so as not to disturb sediments.
- When collecting samples from surface water bodies (ponds, lakes) follow the same procedures as above for flowing bodies of water, ensuring that subsequent samples are collected at the same location, and by plunging the sample bottle into the water to a depth of about six (6) inches below the water surface.

- Sample bottles must be filled with room left for preservative addition and mixing. Add preservatives after filling as directed by the laboratory (unless the bottle was provided pre- loaded with preservatives by the laboratory).
- Record field measurements (pH, temperature, conductivity, dissolved oxygen) and any deviations from the sample collection method in the Field Log Book.

2.2 Sample Identification

All water samples must be provided with a unique sample identification number based on the following example:

Example: LUP-22-200801-50

LUP-22 Refers to the monitoring station.

130801 Refers to the date that the sample was collected (yy/mm/dd). In this example the date the sample was collected was August 1, 2020.

50 Refers to the depth in centimeters from surface which the same was collected. If the depth of the sample is not applicable do not include the suffix.

Sample labels including at a minimum: sample identification number, location, date, and parameters for analyses should be prepared as much as possible before entering the field for the sampling event with a waterproof, non-smear pen. Then, sample labels, bottles and preservatives should be packed, preferably in a cooler to maintain constant temperature, for transport to the field.

Sample bottle labels must be clearly and consistently labeled prior to being sent to the external laboratory with the following information:

- Company name,
- Site name,
- Sample Station Number,
- Sample Number,
- Sample Date and Time, and
- Analysis required.

Quality Control (QC) samples (i.e., field blanks, trip blanks, duplicates) are provided with unique sample identification numbers and note of the sample as a QC sample is recorded in the Field Log Book.

2.3 Sample Preservation

Water quality samples must be preserved, either by laboratory issued chemical preservative or temperature control, immediately following sample collection to ensure that the quality of the water sample remains similar to the source water. The following Table 2.5 summarizes the required containers, preservatives, and holding times for each parameter as outlined in ALS Sample Collection pocket Guide, Version 2 and additional information provided directly by ALS staff.

Table 2.5: Required sample containers, preservation, holding times, and sample volumes for analysis of specific parameters.

Parameter	Container Type	Preservative	Holding Time
pH [1,5]	500 mL plastic	4° C	0.25 hours
TSS [1]	500 mL plastic	4° C	7 days
Conductivity [1,5]	500 mL plastic	4° C	28 days
Total Metals and Hardness [4]	80 mL plastic	3 mL 1:3 Nitric Acid	6 months
Mercury	40 mL glass vial	2 mL Hydrochloric acid	28 days
Radium226	0.5 – 1 L plastic	6 mL 1:3 Nitric Acid	6 months
Cyanide (Total or WAD (low level))	60 mL plastic	3 mL 6N Sodium Hydroxide	14 days
Alkalinity [1]	500 mL plastic	4° C	14 days
Total Ammonia	100 mL amber glass with septa cap	1 mL 1:1 Sulphuric Acid	28 days
Nitrogen, Nitrate and Nitrite	500 mL plastic	4° C	28 days
Kjeldahl or Organic Nitrogen	100 mL amber glass with septa cap	1 mL 1:1 Sulphuric Acid	28 days
Total Phosphorus	100 mL amber glass with septa cap	1 mL 1:1 Sulphuric Acid	28 days
Ortho Phosphate[1]	500 mL plastic	4° C	2 days
BOD5 [1]	500 mL plastic	500 mL plastic	2 days
Fecal Coliforms	250 mL sterilized plastic	Sodium Thiosulphate	30 hours
Oil and Grease	2 x 250 mL amber glass	2 mL 1:1 H2SO4	28 days
BTEX [2,3]	2 x 40 mL glass vials	Sodium Bisulphate or Thiosulphate	14 days
Daphnia magna (pass/fail, LC50) [6]	2 x 20 L carboy	4° C	5 days
Rainbow Trout (pass/ fail, LC50) [7]		4° C	5 days
Fathead Minnows (sublethal)	3 x 20 L carboy	4° C	5 days
C. dubia (sublethal)		4° C	5 days
L. minor (sublethal)		4° C	5 days
P. subcapitata (sublethal)		4° C	5 days

Notes:

(1) Parameters may be analyzed from a single unpreserved bottle.

(2) 40 mL glass vials must be filled with no headspace. May contain preservative. Do not pre-rinse with sample. If sample is chlorinated use thiosulphate preservative.

(3) All volatile organics in water (chlorinated aromatics, BTEX, volatile organics, THMs and halogenated aliphatics) can be analyzed from the same set of vials. Consult ALS whether 2 or 3 vials are required.

(4) If field filtering is not possible, or poses unacceptable risks for sample contamination, then send the samples unfiltered to and unpreserved to the laboratory as soon as possible.

(5) Testing in the field is recommended.

(6) For Daphnia Magna (LC50), require 2 L minimum volume. For Daphnia Magna (Pass/Fail), require 1 L minimum volume.

(7) For Rainbow Trout (LC50), 2 x 20 L bladder and 40 L minimum volume required. For Rainbow Trout (Pass/Fail), 1 x 20 L bladder and 20 L minimum volume required.

2.4 Sample Transportation

Sample integrity will be preserved from the time of sample collection to completion of delivery to the laboratory by limiting exposure of samples to heat, light, and agitation.

Sample bottles will be packed standing upright and immobile in a new or laboratory issued portable cooler. Samples suspected of elevated contaminant levels, such as a sewage sample, will be shipped separately from clean samples. All samples will be stored and transported at 10°C to 1°C in the coolers with ice packs and the cooler will be securely closed prior to shipping. Samples will be shipped as soon as possible following sample collection with appropriate transportation instructions such as "refrigerate" and "do not freeze".

2.5 Chain of Custody Forms

A Chain of Custody Form containing the following information is completed by the sampler for every cooler shipment of samples:

- Company name and contact information,
- Analytical laboratory name, address , and contact person,
- Invoicing instructions,
- Report format requested,
- Project information,
- Sampler's name,
- Sample identification number, time and date of sampling, sample type, and analyses requested,
- Any special instructions, and
- Name of person releasing the shipment as well as date and time of release. Each person relinquishing and receiving the samples, including the courier, must sign the Chain of Custody form.

Each cooler shipped must have a Chain of Custody form indicating those samples contained in the particular cooler. Chain of Custody forms should be enclosed in a Ziploc bag to protect them from possible water damage during shipment.

One copy of the Chain of Custody form is included with the shipment and one copy must remain at the mine site for recording keeping. An example of the Chain of Custody Form is provided in Appendix A.

3 Water Field Quality Control

3.1 Trip or Travel Blanks

Travel blanks are supplied and shipped by the laboratory to test for possible contamination that might arise during the handling, transport, or storage of the samples. The identity of these samples must be recorded in the Field Log Book.

One travel blank must be submitted per sample shipment.

3.2 Duplicates or Replicates

Duplicate or replicate sampling is the collection of more than one sample for a given analysis at a given location to test the validity of sampling procedures and laboratory methodology. Duplicates are collected, handled, and analysed using the same procedures applied to routine samples. Duplicates are submitted to the laboratory with a unique (fictitious) identifier to prevent association of the paired samples. The identity of these samples must be recorded in the Field Log Book.

Duplicate samples must be collected for approximately every ten (10) field samples collected across the range of parameters. At least one duplicate must be submitted per sample shipment.

4 Laboratory Analyses

ALS Environmental laboratories (ALS) located in Yellowknife, NWT performs the required environmental analyses for the Lupin Mine, with the exception of MDMER toxicity testing which is completed by Nautilus Environmental in Calgary, AB.

ALS is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) and conforms to the requirements of ISO/IEC Standard 17025. Attached in Appendix B is a copy of the ALS Yellowknife laboratory scope of accreditation. The scope of accreditation of all ALS laboratories is available from their website at:

https://www.alsglobal.com/en/myals/downloads

Nautilus Environmental is accredited by the CALA to conduct acute lethality and Daphnia magna monitoring tests and conforms to the requirements of ISO/IEC Standard 17025. Nautilus Environmental should be advised that the dilution series for *Ceridodaphnia* and *Lemna* should be adjusted prior to sublethal testing. Attached in Appendix B is a copy of the Nautilus Environmental Burnaby laboratory scope of accreditation.

All analyses are conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater including regular QA/QC during the analysis of field samples including a program of method blanks, laboratory control samples, instrument calibration samples, matrix spikes, and duplicates.

5 Reporting

All analytical results will be forwarded in electronic format from ALS to LMI for data collection and management. Upon receipt, LMI will review the results to identify any anomalies. Anomalous results will be either re-analyzed by the laboratory or new samples will be collected to confirm the analytical results.

Any analytical results that indicate exceedance of regulatory criteria will be reported to the appropriate agencies including the NWB and the CIRNAC inspector.

Part J Item 10 of the Lupin Mine Water Licence requires LMI to include in its Annual Report (due March 31st), all data, monitoring results and information required by Part J of the Water Licence. Under the MDMER effluent monitoring reporting of all tests and monitoring conducted during each quarter is to be reported not later than 45 days after the end of a quarter. A report summarizing the previous calendar year is also required under the MDMER to Environment and Climate Change Canada (due March 31st).

To facilitate the required annual reporting, LMI prepares written monthly reports supported by laboratory analyses results table summaries and quality assurance review. Each monthly report includes the following:

- A description of the sample activities undertaken,
- Description of the existing conditions at each sampling station,
- Tabular summary of analytical lab result including the results of the quality control samples (travel blank, field blank, duplicate samples), and
- Interpretation of the analytical lab results including comparison of the results with water licence criteria and assessment of the reliability of the results.
- Within the annual report, the acceptability of samples will be evaluated qualitatively by examination of the trip blanks and field duplicate sample data. Reproducibility of samples will be expressed as relative percent difference (RPD):

$$RPD = 100 * ((X_1 – X_2) / (X_1 + X_2) / 2)$$

Where X_1 is the original sample concentration, X_2 is the duplicate sample concentration, and X_1-X_2 denotes the absolute value of the difference between these two concentrations.

Quality Assurance/Quality Control Plan for Soils at the Lupin Mine

The purpose of this document is to provide a quality assurance (QA) / quality control (QC) plan for the remediation of contaminated soils at Lupin Mine (the Site). This QA/QC plan for contaminated soils outlines the field screening and confirmatory sampling program for the remediation of contaminated soils that will be required as part of Site closure. The objective of this QA/QC plan is to confirm that the contractor successfully remediates the areas of contaminated soils and meets the intent of the design.

The remediation of contaminated soils will require a field QA/QC plan to confirm compliance with the established remedial criteria. The QA/QC program will include four primary components:

- Field layout and remedial excavation.
- Field screening.
- Confirmation sampling.
- Reporting.

6. Field Layout and Remedial Excavations

The excavation of contaminated soils will be initially defined in the field based on the locations of test pits where contaminated soils were identified as part of the 2006 Phase I and II ESA (Morrow 2006) and the 2017 Phase I and II ESA Update (Golder 2017a). The layout of the locations of the planned remedial excavations will be surveyed in the field and the locations will be verified prior to remedial work commencing.

The remedial excavations of contaminated soils will be monitored, and the type and quantity of excavated material will be documented as remedial activities advance. Visual observations will initially be used to identify the limits of contaminated materials and a photographic log of remedial activities will be maintained. The advancement of remedial activities will be tracked and compared with the design estimates of remedial volumes and excavation limits.

7. Field Screening

Soil samples will be screened to obtain "real-time" field data to guide the remedial activities and to enable the collection of a subset of confirmatory samples for laboratory analysis. Field screening techniques such as portable combustible gas instruments (CGIs) and x-ray fluorescence (XRF) instruments are widely used during remediation activities. Although these field tools do not replace the collection of confirmation laboratory analysis, they provide complimentary data to support field decisions with respect to soil excavation and will be used to verify soil quality compliance.

The CGI and XRF instruments must be calibrated by the equipment supplier prior to shipment to the Site. Afterwards, regular "bump" tests of the CGI instrument should be completed according to the manufacture's instructions. As part of the daily field screening, field notes should be collected which include the following information:

- Date of field screening.
- Weather conditions.
- Excavation and field screening sample identifications.
- Field screening sample depths.
- Field screening concentrations.

The following sections summarize the field screening instruments and methodologies for the primary contaminants of concern: PHCs and total arsenic.

7.1. Petroleum Hydrocarbons (PHCs)

Field screening of PHCs will consist of a combination of visual assessment of staining and the use of a portable CGI. The presence of residual volatile hydrocarbons within soil affected by weathered diesel and fuel oil is likely low and it is therefore expected that field screening for PHCs may not be highly effective. The portable CGI measures concentrations of volatile hydrocarbons from soil in either the parts per million (ppm) or percentage Lower Explosive Limit ranges. The unit will be calibrated to a reference gas, typically operated in methane elimination mode.

Discrete soil samples will be collected from the walls and base of the remedial excavations following the definition of the potential limits. The frequency of discrete field screening will be determined on an excavation by excavation basis based upon the lateral and vertical extents. If bedrock or permafrost is encountered below PHC contaminated soil, discrete soil samples will be collected if possible. However, if ex-situ screening can not be completed due to terrain limitations, a visual assessment of the bedrock or permafrost surface will be completed and documented.

Discrete soil samples will be collected in the field from the excavation or the excavator bucket depending on the depth of the excavation and applicable health and safety requirements. Samples will be stored in re-sealable plastic bags and allowed to acclimatise to room temperature for approximately 15 minutes. The CGI probe is then inserted into the bag for measurement of combustible vapours. It is anticipated that field screening results using the CGI will generally fall into two categories:

- Field screening data indicates a high likelihood of a below applicable criteria confirmation laboratory result. Field screening data should include CGI readings less than 50 ppm and no staining or olfactory indications of contamination observed.
- Field screening data characterized by elevated CGI readings exceeding 50 ppm and/or significant staining or olfactory indications of contamination observed indicates a low likelihood of a below applicable criteria confirmation laboratory result.

It is recognized that the interpretation of field screening data will evolve as correlations between laboratory and field screening results become established. The results of the field screening program will be used to identify sample locations designated for confirmatory sampling.

7.2. Total Arsenic

Field screening of total arsenic will be completed using a portable XRF instrument, which allows for the detection of mg/kg concentrations of a wide spectrum of metals within soil. The XRF instrument will be used to estimate total arsenic concentrations in the field and the results will be used to determine whether additional excavation is required or if confirmatory soil sampling may be initiated. The XRF is a radiation source and requires health and safety training for use as well as specific Transport Canada documentation associated with land and air transport.

Upon completion of the remedial excavations, it is assumed that residual soil will be present along the base and walls of the excavations. As a result, once the potential limits of the remedial excavations are encountered, detailed field screening of the walls and bases will be completed using discrete samples collected on a grid pattern. Discrete soil samples (approximately 250 ml in size) will be collected directly from the excavation or bucket of the excavator depending on the depth of the excavation and applicable health and safety requirements. Samples will be collected such that minimal organic material and/or gravel-sized fragments are present in order to minimize interference with the XRF. Three methods will be used to complete the XRF field screening:

- Unprocessed ex-situ method. This method involves sample placement in thin walled plastic bags. No sample processing (i.e., drying, sieving, or blending) will occur. Measurements are taken in a trailer located on-site with the instrument mounted to a stand.
- Processed ex-situ method. This method requires sample preparation (i.e., drying, sieving, and blending) and compaction/placement in XRF sample cups. Measurements are also taken in an on-site trailer with instrument mounted to stand.
- In-Situ “point and shoot” method. This method involves collecting in-field readings of total arsenic concentrations from soil remaining on bedrock terrain or permafrost exposed during remedial activities. Although this method is generally not considered to provide as accurate of results as the ex-situ methods, it will be used to assess soil quality in bedrock terrain or permafrost where sample collection for ex-situ screening methods is not considered feasible.

The majority of the discrete soil samples will be field screened using the unprocessed ex-situ method in order to reduce the time and effort required to prepare each sample. If a discrete sample is observed to be frozen or have excessive moisture, that sample will need to be field screened using the processed ex-situ method as moisture content will interfere with the XRF readings. For each of the methods, a minimum of three readings will be taken per sample using the XRF. These three readings will be collected sequentially and averaged to produce a single screening value. The frequency of discrete field screening will be determined on an excavation by excavation basis and will be based on the final extents of the excavation.

The results of the field screening program will be used to either: (i) temporarily suspend excavation activities and proceed with confirmatory sampling; or (ii) continue remedial excavation activities. The field screening results will be used to predict expected compliance with the applicable criteria, whereas the confirmatory sampling analytical data will be used to verify compliance with the applicable criteria. It is recognized that the interpretation of field screening data will evolve as correlations between laboratory and field screening results become established. It is anticipated that field screening results using the XRF will generally fall into three categories:

- Field screening data indicates a high likelihood of a below applicable criteria confirmation laboratory result.
- Field screening result is marginally below the applicable criteria, suggesting the confirmation laboratory result may be just below or above the applicable criteria.
- Field screening data indicates a low likelihood of a below applicable criteria confirmation laboratory result.

Table 7.1 summarizes the planned strategy for the interpretation of the XRF field screening results.

Table 7.1: Strategy for Interpretation of XRF Field Screening Results

XRF Screening Result	Strategy
Less than 50% of arsenic “hotspot” value (<2,000 mg/kg total arsenic)	Proceed with confirmatory sample collection
Between 50% to 100% of arsenic “hotspot” value (2,000 mg/kg to 4,000 mg/kg total arsenic)	Proceed with limited additional remedial work and field screening
Greater than 100% of arsenic “hotspot” value (>4,000 mg/kg total arsenic)	Continue with remedial work and field screening

7.3. Confirmation Sampling

Confirmatory sampling will be completed throughout the remedial works for the purposes of verifying the contaminant concentrations prior to proceeding with backfilling activities. It is expected that the field screening results for both the CGI and XRF will correlate with the laboratory results. However, this correlation will be assessed following the collection of approximately 100 sample pairs.

The analytical testing program will focus on verifying contaminant concentrations at the limits of remedial excavations and thereby confirming compliance with the remedial objectives. Discrete soil samples,

selected based on field screening results, will be submitted to an accredited analytical laboratory for chemical analysis. Discrete confirmatory soil samples will be collected within a grid pattern from the walls and bases of the excavations. The frequency of confirmatory soil sample submission will be determined on an excavation by excavation basis and will consider the lateral extents of the excavation. However, the generally frequency for confirmatory soil sampling will consist of a maximum confirmatory soil sampling grid pattern of 10 m by 10 m (CCME 2016).

7.4. Sample Collection and Handling

Confirmatory samples will be collected for laboratory analysis of either benzene, toluene, ethylbenzene, xylenes (BTEX), and PHC Fractions F1 through F4 or total arsenic. All samples will be collected directly from the excavator bucket and will be gathered using dedicated Terracore samplers and/or a putty knife. All samples will be handled using dedicated nitrile gloves and sampling equipment will be decontaminated using Liquinox and distilled water between sample locations. The confirmatory samples will be placed within laboratory supplied sample containers. Samples for analysis of BTEX and PHC Fractions F1 through F4 will be placed into two 40 mL vials pre-charged with methanol for field preservation and one 125 mL jar, while samples for analysis of total arsenic will be placed in sealable plastic bags. Afterwards the samples will be placed in coolers with ice packs in order to limit the loss of volatile compounds.

7.5. Sample Labelling

Samples must be clearly and consistently labeled using a waterproof, non-smear pen prior to being sent to the laboratory with the following information:

- Company name.
- Site name.
- Sample identification.
- Sample date and time.
- Analysis required.

7.6. Sample Transportation

Sample integrity will be preserved from the time of sample collection to completion of delivery to the laboratory by limiting exposure of samples to heat, light, and agitation. The sample containers will be packed standing upright and immobile in a new or laboratory issued portable cooler. Samples suspected of elevated contaminant levels will be shipped separately from clean samples. All samples will be stored and transported at 10°C to 1°C in the coolers with ice packs and the cooler will be securely closed prior to shipping. Samples will be shipped as soon as possible following sample collection with appropriate transportation instructions such as “refrigerate” and “do not freeze”.

7.7. Chain of Custody Forms

A Chain of Custody (CoC) form containing the following information must be completed by the sampler for every cooler shipment of samples:

- Company name and contact information.
- Analytical laboratory name, address, and contact person.
- Invoicing instructions.
- Report format requested.
- Project information.
- Sampler's name.
- Sample identification number, time and date of sampling, sample type, and analyses requested.
- Any special instructions.
- Name of person releasing the shipment as well as date and time of release.

Each person relinquishing and receiving the samples, including the courier, must sign the CoC form. Each cooler shipped must have a CoC form indicating those samples contained in the particular cooler. CoC forms should be enclosed in a Ziploc bag to protect them from possible water damage during shipment. One copy of the CoC form is included with the shipment and one copy must remain at the Site for recording keeping.

8. Duplicate Samples

Duplicate or replicate sampling is the collection of more than one sample for a given analysis at a given location to test the validity of sampling procedures and laboratory methodology. Duplicates are collected, handled, and analyzed using the same procedures applied to the parent samples. Duplicate soil samples will be collected at an approximate 10% frequency. The location of the duplicate soil samples will be recorded in the field notebook. The duplicate soil samples will be submitted to the laboratory with a unique (fictitious) identifier to prevent association of the paired samples and should be stored and handled the same as the parent samples. At least one duplicate soil sample should be submitted per sample shipment.

9. Laboratory Analysis

ALS Environmental Laboratories (ALS) located in Yellowknife, Northwest Territories will perform the required environmental analyses for the confirmatory samples. ALS is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) and conforms to the requirements of ISO/IEC Standard 17025. The scope of accreditation of all ALS laboratories is available from their website at: https://www.alsglobal.com/en/myals/downloads

Should results of the laboratory analysis confirm contaminant concentrations below the applicable remedial objectives, the limits of the remedial excavations will be documented, and backfilling activities will commence. However, should the results identify contaminant concentrations exceeding the applicable remedial objectives, additional excavation will be required, and new samples will be collected

from the revised excavation limits for field screening and confirmatory sampling. This process will continue until the analytical results from all soil samples confirm the contaminant concentrations are below the applicable remedial objectives.

10. Reporting

Throughout the remedial works, daily reports will be produced which will include the following information:

- Date and hours worked.
- Weather and other notable site conditions.
- Daily construction activities completed.
- Daily monitoring activities completed.
- Drawings showing excavation extents and sample locations.
- Field screening concentrations.
- Samples submitted for confirmation sampling.
- Select photographs of the daily work.

In addition, on a weekly basis, field data, field notes, and photographs will be scanned and uploaded to an electronic server for ease of retrieval. As analytical results are received from the laboratory, the results will be communicated by e-mail to the contractor, client, and any other relevant parties.

At the conclusion of the contaminated soils remedial works, a closure report will be produced for LMI. This report will document the results of the remedial excavation activities and will include a description and summary of the remedial works, a summary of the field screening concentrations, a comparison of the results of the confirmatory soil sample analyses to the applicable criteria, and a discussion of the results. The report will also include tables summarizing the analytical results and figures outlining the Site features, excavation extents, confirmatory sampling locations, and analytical results. The report will also include appendices with select photographs of the daily work and copies of the laboratory certificates of analysis.

Legend

Project Location

Coordinate System: NAD_1983_UTM_Zone_12N

Map Sources/Notes:
Various Canadian Government Websites - Feb 2012

0 60 120 240 360 480 600 Km

1:15,000,000

Approved By: SH
Project No.: LUP
Prepared By: PW
Date Revised: 21 Mar 2012

File Name: Lup-12-10-01-LocationMap-A.mxd

Project: **Lupin Project**
Location: Kitikmeot Region, Nunavut, Canada

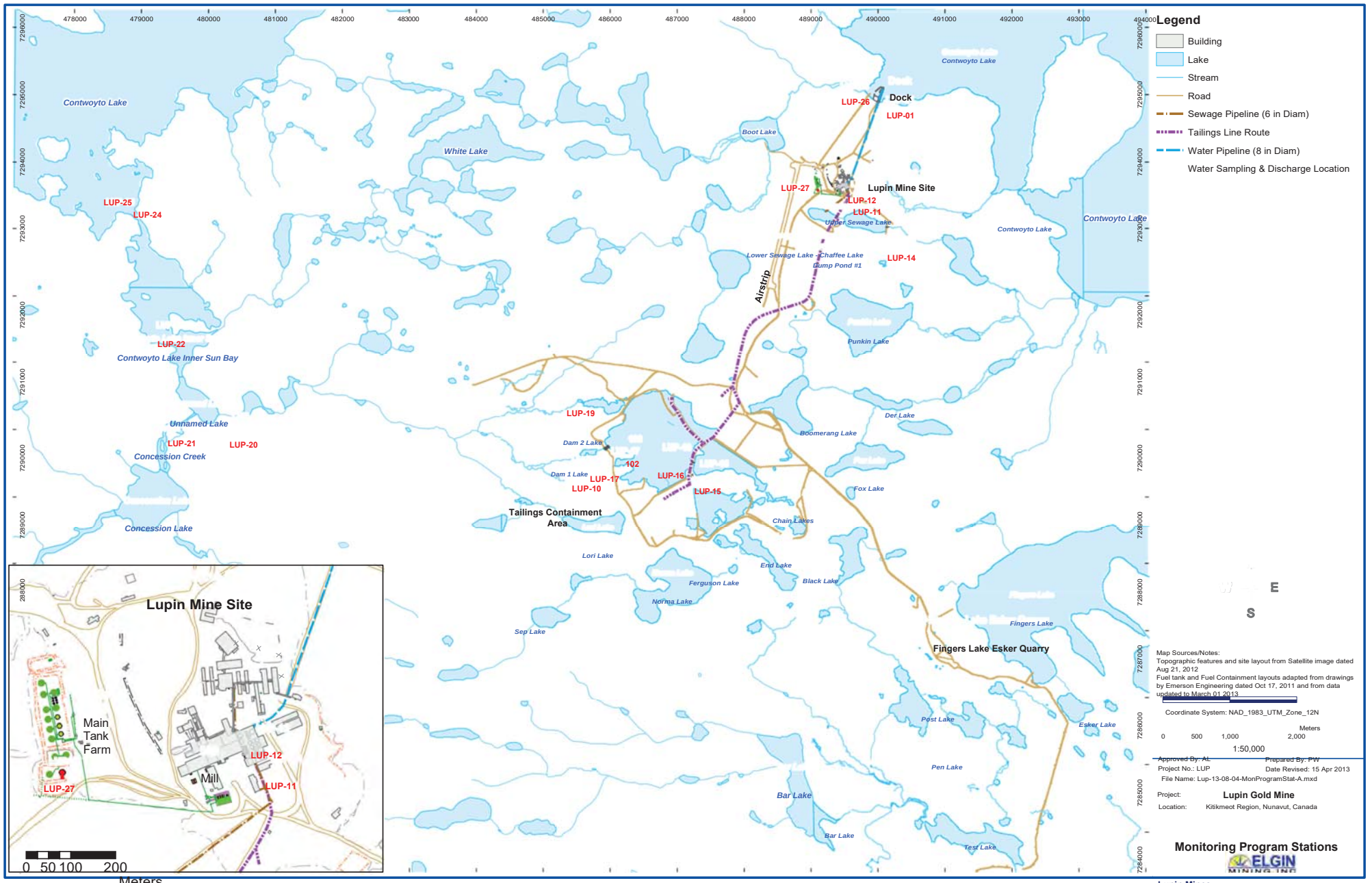
Lupin Mine Annual Report - Water Licence 2AM-LUP0914

Location Map - Lupin Mine

Lupin Mines Incorporated

ELGIN MINING INC.

Figure: 1
Rev: 120321


Legend
Building
Lake
Stream
Road
Sewage Pipeline (6 in Diam)
Tailings Line Route
Water Pipeline (8 in Diam)
Water Sampling & Discharge Location
Lupin Mine Site
Dock
LUP-01
LUP-26
LUP-27
LUP-12
LUP-11
LUP-14
LUP-25
LUP-24
LUP-22
LUP-21
LUP-20
LUP-19
LUP-17
LUP-16
LUP-15
LUP-10
102
Tailings Containment Area
Airstrip
Contwoyto Lake
Boot Lake
White Lake
Upper Sewage Lake
Lower Sewage Lake
Chaffee Lake
Dump Pond #1
Punkin Lake
Contwoyto Lake Inner Sun Bay
Unnamed Lake
Concession Creek
Concession Lake
Dam 2 Lake
Dam 1 Lake
Der Lake
Boomerang Lake
Fox Lake
Chain Lakes
Lori Lake
End Lake
Ferguson Lake
Black Lake
Norma Lake
Sep Lake
Fingers Lake
Fingers Lake Esker Quarry
Esker Lake
Post Lake
Pen Lake
Bar Lake
Test Lake
Lupin Mine Site
Main Tank Farm
Mill
0 50 100 200
Meters
Map Sources/Notes:
Topographic features and site layout from Satellite image dated Aug 21, 2012
Fuel tank and Fuel Containment layouts adapted from drawings by Emerson Engineering dated Oct 17, 2011 and from data updated to March 01 2013
Coordinate System: NAD_1983_UTM_Zone_12N
0 500 1,000 2,000
Meters
1:50,000
Approved By: AL
Prepared By: PW
Project No.: LUP
Date Revised: 15 Apr 2013
File Name: Lup-13-08-04-MonProgramStat-A.mxd
Project: Lupin Gold Mine
Location: Kitikmeot Region, Nunavut, Canada
Monitoring Program Stations
ELGIN MINING INC.
Lupin Mines Incorporated
Figure:
Rev:
130415

Appendix A: Chain of Custody

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number:

Page of

Report To	Contact and company name below will appear on the final report
Company:	Lupin Mines Inc.
Contact:	Karyn Lewis
Phone:	
	Company address below will appear on the final report
Street:	76 Richmond Street, Suite 330
City/Province:	Toronto ON
Postal Code:	M5C 1P1

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	k.lewis@mandalayresources.com
Email 2	erichard@golder.com
Email 3	jim.mckinley@stantec.com

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 [E - 100%]** ☐
- **Same Day, Weekend or Statutory holiday [E2 -200%** ☐
  (Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	k.lewis@mandalayresources.com

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☑ MAIL ☐ FAX
Email 1 or Fax
Email 2

Project Information

ALS Account # / Quote #: Q80133
Job #:
PO / AFE:
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: Oliver Gregg **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	NUMBER OF CONTAINERS	Conventional (pH, EC, Alk-Tot, hardness, TS	Nutrients (Nitrate, Nitrite and total ammonia)	Total Metals + Hg	Cyanide	Radium-226	Acute Toxicity Daphnia magna	Acute Toxicity Rainbowm Trout	Major Ions	Phosphorus (colorimetric)	Sublethal Toxicity - Fathead Minnows	Sublethal Toxicity - Ceridaphinia dubia	Sublethal Toxicity - Lemna minor	Sublethal Toxicity - P. subcapitata		SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	LUP-10			Effluent		R	R	R	R	R	R	R	R	R	R	R	R	R			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☑ NO

Are samples for human consumption/ use?
☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)		
Released by:	Date:	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCT 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Appendix B: Scope of Accreditations

Canadian Association for Laboratory Accreditation Inc.

Certificate of Accreditation

ALS Environmental (Vancouver)
ALS Canada Ltd.
8081 Lougheed Highway
Suite 100
Burnaby, British Columbia

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Accreditation No.:	A1719
Issued On:	December 12, 2018
Accreditation Date:	January 3, 2005
Expiry Date:	June 11, 2021

President & CEO

CALA
Canadian Association for
Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 1719
Laboratory Name: ALS Environmental (Vancouver)
Parent Institution: ALS Canada Ltd.
Address: 8081 Lougheed Highway Suite 100 Burnaby BC V5A 1W9
Contact: Ms. Helenita Franco
Phone: (604) 253-4188
Fax: (604) 253-6700
Email: quality.vancouver@alsglobal.com

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: June 18, 2020
Valid To: June 11, 2021

Scope of Accreditation

Air (Inorganic)
Dustfall - Air [Dustfall] (227)
VA-TM-1039; ASTM D1739-98 and BC MOE LABORATORY MANUAL
GRAVIMETRIC
Fixed Dustfall
Total Dustfall
Total Insoluble Dustfall
Total Soluble Dustfall

Air (Inorganic)
Mercury - Air [Dustfall] (271)
NA-TM-1005, NA-TP-2012, VA-TP-2063; modified from BC MOE LABORATORY MANUAL and EPA 1631E
COLD VAPOUR AAS - DIGESTION
Mercury

Air (Inorganic)
Metals - Air [Dustfall] (224)
NA-TM-1002, NA-TP-2007, VA-TP-2063; modified from BC MOE LABORATORY MANUAL and EPA 6020B
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

Calcium
Chromium
Cobalt
Copper
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Strontium
Thallium
Tin
Uranium
Vanadium
Zinc

Air (Inorganic)
Total Particulates - Air [Filter, Particulate] (035)
VA-TM-1041; modified from ASTM D2009-65 and BC WORKERS COMPENSATION BOARD STANDARDS (BCWCB) 1150
GRAVIMETRIC
Respirable Dust
Total Particulate Matter

Air (Organic)
Volatile Organic Compounds (VOC) - Air (206)
VA-TM-1109; modified from EPA TO-17
GC/MS
1,1-Dichloroethane
1,1-Dichloroethylene
1,1-Dichloropropene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2-Trichlorotrifluoroethane
1,1,2,2-Tetrachloroethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (Ethylene dibromide)
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

The list of tests and measurement capabilities for which a laboratory is accredited can change at any time due to circumstances such as scope extensions, voluntary withdrawal of tests by the laboratory and suspension. Scopes are published by the CALA via the Internet at http://www.cala.ca/cala_directories.html

1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3-Butadiene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
2-Butanone (Methyl ethyl ketone, MEK)
2-Chlorophenol
2-Chlorotoluene
2-Hexanone (Methyl butyl ketone, MBK)
2-Propanol (Isopropyl alcohol)
2,2-Dichloropropane
4-Chlorotoluene (p-Chlorotoluene)
4-isopropyltoluene (p-Cymene)
4-Methyl-2-pentanone (MIBK)
Acetone (2-Propanone)
Benzene
Biphenyl (1,1-Biphenyl)
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane (Ethyl Chloride)
Chloroethene (Vinyl chloride)
Chloroform
Chloromethane (Methyl chloride)
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Cyclohexane
Decane
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane
Dichloromethane (Methylene Chloride)
Ethyl acetate
Ethylbenzene
Hexachlorobutadiene
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl tert-butyl ether (MTBE)
Methylcyclohexane

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n-Butylbenzene
n-Heptane
n-Hexane
n-Octane
n-Propylbenzene
Naphthalene
o-Xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane

Air (Organic)
Volatile Organic Compounds (VOC) - Air (207)
VA-TM-1109; modified from EPA TO-17
GC/FID
F1: C6-C10
F2: C10-C16
Total Volatile Organic Compounds (TVOC): >C10-C12
Total Volatile Organic Compounds (TVOC): >C12-C16
Total Volatile Organic Compounds (TVOC): >C6-C8
Total Volatile Organic Compounds (TVOC): >C8-C10
Volatile Hydrocarbons (VH): C6-C13

Dust (Inorganic)
Soluble Anions - Dustfall (255)
NA-TM-1001, VA-TM-1039; modified from BC MOE LABORATORY MANUAL and EPA 300.0 and SM 4110
ION CHROMATOGRAPHY
Chloride
Nitrate

Food
Arsenic Speciation - Food [Egg, Fresh Fruit, Meat, Processed Food, Vegetables] (236)
NA-TM-1002, NA-TP-2007, VA-TM-1082; modified from CFIA SOM-DAR-CHE-053-04 and EPA 6020A
HPLC - ICP/MS
Arsenate (As(V))
Arsenite (As(III))
Arsenobetaine (AsB)
Arsenocholine (AsC)
Dimethylarsinic acid (DMA)
Monomethyl arsenate (MMA)

Food (Inorganic)
Methyl mercury - Seafood (272)
NA-TM-1002, VA-TM-1088; modified from FDA METHOD 4.8
HPLC - ICP/MS
Methyl mercury

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Oil (Organic)
Total Polychlorinated Biphenyls (PCB) - Oil (080)
VA-TM-1118, VA-TP-2116; modified from EPA 3620C and EPA 3660B and EPA 3665A and EPA 600/4-81-045 and EPA 8082A
GC/ECD
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Paint (Inorganic)
Lead - Paint (261)
NA-TM-1002, NA-TP-2004; modified from EPA 200.2 and EPA 6020B
ICP/MS - DIGESTION
Lead

Soil (Inorganic)
Acidity - Solids [Soil] (257)
VA-TM-1053, VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 2320 B
TITRIMETRIC - SHAKEFLASK EXTRACTION
Acidity

Soil (Inorganic)
Alkalinity - Solids [Soil] (258)
VA-TM-1053, VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 2320 B
TITRIMETRIC - SHAKEFLASK EXTRACTION
Alkalinity

Soil (Inorganic)
Anions - Solids [Leachate] (256)
NA-TM-1001, VA-TM-1078; modified from BC MOE LABORATORY MANUAL and EPA 300.0 and SM 4110
ION CHROMATOGRAPHY (IC) - FIXED RATIO EXTRACTION
Chloride
Chloride
Sulphate
Sulphate (Sulfate)

Soil (Inorganic)
Leachable Anions - Solids [Soil] (244)
NA-TM-1001, VM-TM-1074; modified from EPA 300.1 and MEND REPORT 1.20.1
IC - SHAKEFLASK EXTRACTION
Bromide
Chloride
Fluoride
Nitrate as Nitrogen
Nitrite as Nitrogen
Sulphate (Sulfate)

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Soil (Inorganic)
Leachable Metals - Solids [Soil] (247)
NA-TM-1002, NA-TP-2007, VA-TM-1074; modified from EPA 6020B and MEND REPORT 1.20.1
ICP/MS - SHAKEFLASK EXTRACTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Uranium
Vanadium
Zinc

Soil (Inorganic)
pH - Solids [Soil] (250)
VA-TM-1074; modified from MEND REPORT 1.20.1 and SM 4500-H
pH METER-Shake flask Extraction
pH

Soil (Microbiology)
Fecal (Thermotolerant) Coliforms - Solids [Soil] (245)
VA-TM-1200; modified from EPA 1680
MOST PROBABLE NUMBER
Fecal (Thermotolerant) Coliforms

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Solids (Inorganic)
Acid Volatile Sulphide (AVS) - Solids [Soil] (230)
VA-TM-1021; modified from EPA 821-R-91-100
COLORIMETRIC - EXTRACTION
Acid Volatile Sulfides

Solids (Inorganic)
Anions - Solids [Soil] (148)
NA-TM-1001, VA-TP-2066; modified from EPA 300.1 and SM 4110 B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
IC-SATURATED EXTRACTION
Bromide
Chloride
Fluoride
Nitrate-N
Nitrite
Sulphate

Solids (Inorganic)
Conductivity - Solids [Soil] (147)
VA-TM-1053, VA-TP-2066; modified from SM 2510 B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
METER - SATURATION EXTRACTION
Conductivity

Solids (Inorganic)
Cyanide - Solids [Soil] (213)
NA-TM-1003, VA-WI-3019; modified from BC MOE LABORATORY MANUAL and ISO 14403 and ON MOECC E3015 and SM 4500-CN- I
AUTO COLOR - DISTILLATION-EXTRACTION
Cyanide (SAD)
Cyanide (WAD)

Solids (Inorganic)
Cyanide - Solids [Soil] (214)
NA-TM-1003, VA-WI-3019; modified from ASTM 7237 and BC MOE LABORATORY MANUAL and ON MOECC E3015
AUTO COLOR/GAS DIFFUSION-EXTRACTION
Cyanide, Free

Solids (Inorganic)
Flashpoint - Solids [Ash] (264)
VA-TM-1090; modified from ASTM D93-15
PENSKE-MARTEN CLOSED CUP
Flashpoint

Solids (Inorganic)
Leachable Mercury - Solids [Soil] (270)
NA-TM-1005, NA-TP-2012, VA-TM-1074; modified from MEND REPORT 1.20.1
COLD VAPOUR AA - SPECTROMETRIC SHAKE FLASK EXTRACTION
Mercury

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Solids (Inorganic)
Leachable Mercury - Solids [Waste] (267)
NA-TM-1005, NA-TP-2012, VA-TM-1071; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) and EPA 1631E
CVAAS-MELP EXTRACTION
Mercury

Solids (Inorganic)
Leachable Mercury - Solids [Waste] (268)
NA-TM-1005, NA-TM-1700, NA-TP-2012; modified from EPA 1311 (PREPARATION) and EPA 1631E (ANALYSIS)
COLD VAPOUR AA - TCLP EXTRACTION
Mercury

Solids (Inorganic)
Leachable Metals - Solids (121)
VA-TM-1066, VA-TM-1071, VA-TP-2072; modified from BC MOE ENVIRONMENTAL MANAGEMENT ACT HAZARDOUS WASTE REGULATION (EMA/HWR) and EPA 6010D
ICP/OES- MLEP EXTRACTION
Arsenic
Barium
Boron
Cadmium
Chromium
Copper
Lead
Selenium
Silver
Uranium
Zinc

Solids (Inorganic)
Leachable Metals - Solids (122)
NA-TM-1700, VA-TM-1066, VA-TP-2072; modified from EPA 1311 (PREPARATION) and EPA 6010D (ANALYSIS)
ICP/OES - EXTRACTION - TCLP
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Nickel
Selenium

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Silver
Thallium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Leachable Metals - Solids [Soil] (235)
NA-TM-1002, NA-TM-1700, NA-TP-2007; modified from BC PROTOCOL 13 (ANALYSIS) and EPA 1311 (PREPARATION) and EPA 6020B (ANALYSIS)
ICP/MS - Extraction - TCLP
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Nickel
Selenium
Silver
Thallium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Mercury - Solids [Soil] (269)
NA-TM-1005, NA-TP-2004, NA-TP-2012; modified from BC MOE LABORATORY MANUAL, SALM (PREPARATION) and EPA 1631E (ANALYSIS) and EPA 200.2 (ANALYSIS)
COLD VAPOUR AAS - DIGESTION
Mercury

Solids (Inorganic)
Metals - Solids [Soil] (152)
NA-TM-1002, NA-TP-2004, NA-TP-2007; modified from BC MOE LABORATORY MANUAL, SALM (PREPARATION) and EPA 200.2 (ANALYSIS) and EPA 6020B (ANALYSIS)
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth

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Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Solids (Inorganic)
Metals - Solids [Soil] (153)
VA-TM-1066, VA-TP-2066, VA-TP-2072; modified from EPA 6010D and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
ICP/OES - SATURATION EXTRACTION
Calcium
Magnesium
Potassium
Sodium

Solids (Inorganic)
Methyl Mercury - Solids [Soil] (173)
VA-TM-1062; modified from EPA 1630
P&T - GC - CVAFS - EXTRACTION
Methyl mercury

Solids (Inorganic)
Moisture - Solids [Soil] (089)
NA-TM-1200; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GRAVIMETRIC
Percent Moisture

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Solids (Inorganic)
Oil and Grease - Solids [Soil] (239)
VA-TM-1125; modified from BC MOE LABORATORY MANUAL
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease

Solids (Inorganic)
Paint Filter - Solids [Paint] (262)
VA-TM-1055; modified from EPA 9095B
FILTRATION
Paint Filter (Free Liquid)

Solids (Inorganic)
Percent Saturation - Solids [Saturated Paste] (149)
VA-TP-2066; modified from SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
GRAVIMETRIC - SATURATED PASTE
Percent Saturation

Solids (Inorganic)
pH - Solids [Soil] (120)
VA-TM-1078, VA-TP-2066; modified from SM 4500-H+ B and SOIL SAMPLING & METHODS OF ANALYSIS CHAPTER 15
METER - SATURATION EXTRACTION
pH

Solids (Inorganic)
pH - Solids [Soil] (169)
VA-TM-1078; modified from BC MOE LABORATORY MANUAL and SM 4500-H+ B
METER - FIXED RATIO EXTRACTION
pH

Solids (Inorganic)
Simultaneously Extracted Metals (SEM) - Solids [Soil] (228)
NA-TM-1005, NA-TP-2011, NA-TP-2012, VA-TM-1021; modified from EPA 1631E and EPA 821-R-91-100
CVAFS - SEM EXTRACTION
Mercury

Solids (Inorganic)
Simultaneously Extracted Metals (SEM) - Solids [Soil] (229)
VA-TM-1021, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and EPA 821-R-91-100
ICP/OES - SEM EXTRACTION
Arsenic
Cadmium
Copper
Lead
Nickel
Zinc

Solids (Inorganic)
Waste Oil - Solids (123)
VA-TM-1111; BC MOE LABORATORY MANUAL
GRAVIMETRIC - EXTRACTION
Waste Oil Content

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Solids (Organic)
Extractable Hydrocarbons - Solids [Soil] (184)
NA-TM-1106, NA-TP-2106; modified from BC MOE LABORATORY MANUAL and EPA 3570
GC/FID - EXTRACTION (COLD SHAKE)
EPH C10-C19 (sg)
EPH C19-C32 (sg)
Extractable Petroleum Hydrocarbons (EPH): C10-C19
Extractable Petroleum Hydrocarbons (EPH): C19-C32

Solids (Organic)
Glycols - Solids [Soil] (156)
VA-TM-1113; modified from EPA 8015B
GC/FID - EXTRACTION
Diethylene glycol
Ethylene glycol
Propylene glycol
Triethylene glycol

Solids (Organic)
Organochlorine (OC) Pesticides - Solids [Soil] (079)
VA-TM-1121, VA-TP-2117; modified from EPA 3540C and EPA 3630C and EPA 3660B and EPA 8081B
GC/ECD - EXTRACTION
2,4'-DDD (o,p'-DDD)
2,4'-DDE (o,p'-DDE)
2,4'-DDT (o,p'-DDT)
4,4'-DDD (p,p'-DDD)
4,4'-DDE (p,p'-DDE)
4,4'-DDT (p,p'-DDT)
4,4'-Methoxychlor (p,p'-Methoxychlor)
Aldrin
alpha-BHC
alpha-Chlordane
beta-BHC
beta-HCH (beta-Hexachlorocyclohexane (b-HCH, b-BHC, beta-BHC, beta-Hexachlorocyclohexane)
cis-Nonachlor
Dieldrin
Endosulfan I (a-Endosulfan)
Endosulfan II (b-Endosulfan)
Endosulfan Sulfate
Endrin
gamma-Chlordane
Heptachlor
Heptachlor epoxide
Lindane (gamma-BHC)
Mirex
Oxychlordane
trans-Nonachlor

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Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (189)
NA-TM-1100, NA-TP-2100; modified from ALBERTA ENVIRONMENT INTERPRETATION, SEPT 2003 and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD (DEC 2000 NO. 1310)
GC/FID - TUMBLER EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50

Solids (Organic)
Petroleum Hydrocarbons (PHC) - Solids [Soil] (190)
NA-TM-1100; modified from ALBERTA ENVIRONMENT INTERPRETATION, SEPT 2003 and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD (DEC 2000 NO. 1310)
GRAVIMETRIC - TUMBLER EXTRACTION
F4: Gravimetric
F4G-SG: Gravimetric Heavy Hydrocarbons - Silica

Solids (Organic)
Phenols - Solids [Soil] (071)
VA-TM-1122, VA-TP-2113; modified from EPA 3570 and EPA 8270D and KNAPP 1979
GC/MS - EXTRACTION
2-Chlorophenol
2-Methylphenol (o-Cresol)
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4-Dichlorophenol + 2,5-Dichlorophenol
2,4-Dimethylphenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dichlorophenol
3-Chlorophenol
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methylphenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
m-Cresol
Pentachlorophenol
Phenol

Solids (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Solids [Soil] (185)
NA-TM-1106, NA-TP-2103; modified from EPA 3570 and EPA 8270D
GC/MS - EXTRACTION (COLD SHAKE)
2-Methylnaphthalene

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Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b,j)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3 - cd)pyrene
Naphthalene
Phenanthrene
Pyrene
Quinoline

Solids (Organic)
Total Polychlorinated Biphenyls (PCB) - Solids [Soil] (112)
VA-TM-1119, VA-TP-2116; modified from EPA 3570 and EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Solids (Organic)
Volatile Hydrocarbons (VH) - Solids [Soil] (202)
NA-TM-1102, NA-TP-2102; modified from BC MOE LABORATORY MANUAL and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 5021A
GC/FID - HEADSPACE
F1: C6-C10
VH: C6-C10

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids (263)
NA-TM-1102, VA-TM-1126; modified from EPA 1311 (PREPARATION) and EPA 8260C (ANALYSIS)
GC/MS - HEADSPACE - TCLP
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,4-Dichlorobenzene
Benzene

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Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethene (Vinyl chloride)
Chloroform
Dichloromethane (Methylene Chloride)
Ethylbenzene
m,p-Xylene
Methyl ethyl ketone
o-Xylene
Tetrachloroethylene
Toluene
Trichloroethylene

Solids (Organic)
Volatile Organic Compounds (VOC) - Solids [Soil] (201)
NA-TM-1102, NA-TP-2102; modified from EPA 5021A and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-Dichloroethylene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
4-Isopropylbenzene
Benzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane (Ethyl Chloride)
Chloroethene (Vinyl chloride)
Chloroform
Chloromethane (Methyl chloride)
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dichloromethane

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Ethylbenzene
Ethylene Dibromide
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl t-butyl ether
n-Propylbenzene
Naphthalene
o-Xylene
Styrene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane

Swab (Organic)
Total Polychlorinated Biphenyls (PCB) - Solids [Swab] (249)
VA-TM-1120, VA-TP-2116; modified from EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268

Tissue (Inorganic)
Ashfree - Tissue (259)
VM-TM-1051; modified from SM 10300
GRAVIMETRIC
Ash-free weight

Tissue (Inorganic)
Lipid Content - Tissue (241)
VA-TM-1112; modified from EPA 3570 and EPA 8290A
GRAVIMETRIC
Lipid Content

Tissue (Inorganic)
Methyl Mercury - Tissue (172)
VA-TM-1062; modified from EPA 1630
P&T - GC - CVAFS - DIGESTION
Methyl mercury

Tissue (Inorganic)
Moisture - Tissue (090)
VA-TM-1087; modified from PUGET SOUND PROTOCOLS
GRAVIMETRIC
Percent Moisture

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Tissue (Inorganic)
Selenium Speciation - Tissue (253)
NA-TM-1002, NA-TP-2007, VA-TM-1085; CFIA METHOD SOM-DAR CHE-053-04
HPLC - ICP/MS
Selenium (IV)
Selenium (VI)
SelenoMethionine

Tissue (Inorganic)
Total Mercury - Tissue (266)
NA-TM-1005, NA-TP-2006, NA-TP-2012; modified from EPA 1631E and EPA 200.3
COLD VAPOUR AA - SPECTROMETRIC
Mercury

Tissue (Inorganic)
Total Metals - Tissue (100)
NA-TM-1002, NA-TP-2006, NA-TP-2007; modified from EPA 200.3 and EPA 6020A
ICP/MS - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Rubidium
Selenium
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tellurium
Thallium
Tin

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Titanium
Uranium
Vanadium
Zinc
Zirconium

Urine (Inorganic)
Creatinine - Biomaterials [Urine] (234)
VA-TM-1052; THERMO DRI CREATININE-DETECT SPECIMEN VALIDITY TEST
COLORIMETRIC
Creatinine

Urine (Organic)
Arsenic Speciation - Biomaterials [Urine] (233)
NA-TM-1002, NA-TP-2007, VA-TM-1081; modified from CDC METHOD ID ITU003B, 2004 and EPA 6020A
HPLC-ICPMS
Arsenate (As(V))
Arsenite (As(III))
Arsenobetaine (AsB)
Dimethylarsinic acid (DMA)
Monomethyl arsenate (MMA)
Total Arsenic Species
Total Inorganic Arsenic
Total Inorganic Arsenic and Methylated Metabolites

Water (Inorganic)
Acidity - Water (219)
VA-TM-1053; modified from SM 2310
TITRIMETRIC
Acidity

Water (Inorganic)
Alkalinity - Water (001)
VA-TM-1053; modified from SM 2320 B
TITRIMETRIC
Alkalinity (pH 4.5)
Alkalinity-Bicarbonate
Alkalinity-Carbonate
Alkalinity-Hydroxide
Phenolphthalein Alkalinity

Water (Inorganic)
Ammonia - Water (208)
VA-TM-1024; JOURNAL OF ENVIRONMENTAL MONITORING (2005) SECTION 7, P. 37-42
AUTO-FLUORESCENCE
Ammonia

Water (Inorganic)
Anions - Water (026)
NA-TM-1001; modified from EPA 300.1
IC
Bromide
Chloride
Fluoride

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Nitrate

Nitrate plus Nitrite

Nitrite

Sulfate

Water (Inorganic)
Arsenic - Water (232)
NA-TM-1002, NA-TP-2007, VA-TM-1086; modified from USGS Water Resources Investigation Report 02-4144
HPLC - ICPMS

Arsenate (AsV)

Arsenite (ASIII)

Arsenobetaine (AsB)

Dimethylarsinic acid (DMA)

Monomethyl arsenate (MMA)

Total Arsenic Species

Total Inorganic Arsenic

Total Inorganic Arsenic and Methylated Metabolites

Water (Inorganic)
Biochemical Oxygen Demand (BOD) - Water (027)
VA-TM-1032; modified from SM 5210 B
D.O. METER

BOD (5 day)

CBOD (5 day)

Soluble Biological Oxygen Demand (SBOD)

Water (Inorganic)
Carbon - Water (091)
VA-TM-1037; modified from SM 5310 B
IR - COMBUSTION

Inorganic Carbon

Organic Carbon

Total Carbon (TC)

Water (Inorganic)
Chemical Oxygen Demand (COD) - Water (028)
VA-TM-1033; modified from SM 5220 D
COLOR - DIGESTION

COD

Water (Inorganic)
Chlorophyll A - Water (220)
VA-TM-1038, VA-TP-2011; modified from EPA 445.0
FLUORIMETRY

Chlorophyll a

Water (Inorganic)
Colour - Water (015)
VA-TM-1004; modified from BC MOE Laboratory Manual and SM 2120 C
COLORIMETRIC

Apparent Colour

True Colour

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Water (Inorganic)
Conductivity - Water (004)
VA-TM-1053; modified from SM 2510 B
CONDUCTIVITY METER
Conductivity (25˚C)

Water (Inorganic)
Cyanide - Water (209)
NA-TM-1003; modified from ISO 14403 and SM 4500-CN- I
AUTO COLOR - DISTILLATION
Cyanide (SAD)
Cyanide (WAD)

Water (Inorganic)
Cyanide - Water (210)
NA-TM-1003; modified from ASTM D7237
AUTO COLOR (GAS DIFFUSION)
Cyanide, Free

Water (Inorganic)
Dissolved Ferrous Iron - Water (242)
VA-TM-1046, VA-TP-2009; modified from SM 3500-FE
COLORIMETRIC - FILTRATION
Ferrous Iron

Water (Inorganic)
Dissolved Metals - Water (032)
NA-TM-1002, NA-TP-2002, NA-TP-2007; modified from EPA 6020B and SM 3030 B
ICP/MS - FILTRATION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cesium
Chromium
Cobalt
Copper
Gallium
Gold
Indium
Iron
Lanthanum
Lead
Lithium
Magnesium
Manganese
Molybdenum

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Nickel
Niobium
Phosphorus
Potassium
Rhenium
Rubidium
Selenium
Silicon
Silver
Sodium
Strontium
Sulphur (Sulfur)
Tantalum
Tellurium
Thallium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium

Water (Inorganic)
Dissolved Metals - Water (036)
NA-TP-2002, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and SM 3030 B
ICP/OES
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum

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Nickel
Phosphorus
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Vanadium
Zinc

Water (Inorganic)
Mercury - Water (136)
NA-TM-1005, NA-TP-2002, VA-TP-2068; modified from EPA 1631E
CVAFS - BrCl DIGESTION
Mercury

Water (Inorganic)
Mercury - Water (265)
NA-TM-1005, NA-TP-2002, NA-TP-2012; modified from EPA 1631E
COLD VAPOUR AA - SPECTROMETRIC
Mercury

Water (Inorganic)
Methyl Mercury - Water (192)
VA-TM-1062; modified from EPA 1630
P&T GC-CVAFS-DISTILLATION
Methyl mercury

Water (Inorganic)
Nitrogen - Water (217)
VA-TM-1047, VA-WI-3046; modified from SM 4500-P J
AUTO COLOR - DIGESTION
Total Dissolved Nitrogen
Total Nitrogen

Water (Inorganic)
Oil and Grease - Water (061)
NA-TM-1107; modified from EPA 1664
GRAVIMETRIC - EXTRACTION
Mineral Oil and Grease
Total Oil and Grease

Water (Inorganic)
pH - Water (018)
VA-TM-1053; modified from SM 4500-H+ B
pH METER
pH

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Water (Inorganic)
Phosphorus - Water (179)
VA-TM-1025, VA-TP-2009, VA-WI-3046; modified from SM 4500-P B and SM 4500-P E
COLOR - DIGESTION (AUTOCLAVE)
Phosphate
Total Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Reactive Silica - Water (008)
VA-TM-1018; modified from SM 4500-SIO2 D
COLORIMETRIC
Reactive Silica

Water (Inorganic)
Selenium Speciation - Water (252)
NA-TM-1002, NA-TP-2007, VA-TM-1084; Spectrochimica Acta Part B60 (2005) 633-641
HPLC - ICP/MS
Selenium (IV)
Selenium (VI)
SelenoMethionine

Water (Inorganic)
Solids - Water (016)
NA-TM-1004, VA-TM-1009, VA-TM-1050; modified from SM 2540 B and SM 2540 C and SM 2540 D and SM 2540 E
GRAVIMETRIC
Fixed Suspended Solids
Total Dissolved Solids
Total Solids (TS)
Total Suspended Solids
Volatile Suspended Solids

Water (Inorganic)
Sulphide - Water (010)
VA-TM-1020; modified from SM 4500-S2- D
COLOR
Sulphide

Water (Inorganic)
Thiocyanate - Water (014)
VA-TM-1029; modified from SM 4500-CN- M
COLOR
Thiocyanate

Water (Inorganic)
Total Kjeldahl Nitrogen (TKN) - Water (211)
VA-TM-1044; modified from SM 4500-NORG D
AUTO FLUORESCENCE - DIGESTION
Dissolved Kjeldahl Nitrogen
Total Kjeldahl Nitrogen

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Water (Inorganic)

Total Metals - Water (031)

NA-TM-1002, NA-TP-2001, NA-TP-2007; modified from EPA 200.2 and EPA 6020B

ICP/MS - DIGESTION

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Calcium
- Cesium
- Chromium
- Cobalt
- Copper
- Gallium
- Gold
- Indium
- Iron
- Lanthanum
- Lead
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Niobium
- Phosphorus
- Potassium
- Rhenium
- Rubidium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Sulphur (Sulfur)
- Tantalum
- Tellurium
- Thallium
- Thorium
- Tin
- Titanium
- Tungsten

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Uranium
Vanadium
Yttrium
Zinc
Zirconium

Water (Inorganic)
Total Metals - Water (041)
NA-TP-2001, VA-TM-1066, VA-TP-2072; modified from EPA 6010D and SM 3030 E
ICP/OES - DIGESTION
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Vanadium
Zinc

Water (Inorganic)
Turbidity - Water (020)
VA-TM-1011; modified from SM 2130 B
TURBIDIMETRIC
Turbidity

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Water (Inorganic)
UV Absorbance and Transmittance - Water (254)
VA-TM-1042, VA-TP-2011; modified from SM 5910 B
SPECTROPHOTOMETRIC
UV Absorbance
UV Transmittance

Water (Microbiology)
Coliforms - Water (145)
NA-TM-1300; modified from SM 9223 B
MOST PROBABLE NUMBER (ENZYME SUBSTRATE)
Escherichia coli
Fecal (Thermotolerant) Coliforms
Total Coliforms

Water (Microbiology)
Enterococci - Water (186)
VA-TM-1203; modified from SM 9230 C
MEMBRANE FILTRATION (mENTEROCOCCUS)
Enterococci

Water (Microbiology)
Escherichia coli (E. coli) - Water (240)
VA-TM-1201; modified from SM 9222 G
MEMBRANE FILTRATION (mFC/NA-MUG)
Escherichia coli

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (029)
VA-TM-1200; modified from SM 9221 E
MOST PROBABLE NUMBER
Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (030)
VA-TM-1201; modified from SM 9222 D
MEMBRANE FILTRATION (mFC)
Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Heterotrophic Plate Count (HPC) - Water (126)
NA-TM-1301; modified from SM 9215 B
POUR PLATE (PLATE COUNT AGAR)
Heterotrophic Plate Count (HPC)

Water (Microbiology)
Pseudomonas aeruginosa - Water (187)
VA-TM-1204; modified from SM 9213 E
MEMBRANE FILTRATION (mPAC)
Pseudomonas aeruginosa

Water (Microbiology)
Total Coliforms - Water (142)
VA-TM-1200; modified from SM 9221 B
MOST PROBABLE NUMBER
Total Coliforms

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Water (Microbiology)
Total Coliforms - Water (143)
VA-TM-1201; modified from SM 9222 B
MEMBRANE FILTRATION (mENDO)
Total Coliforms

Water (Organic)
Extractable Petroleum Hydrocarbons (EPH) - Water (251)
NA-TM-1112, VA-TP-2127, VA-TP-2129; BC MOE LABORATORY MANUAL
GC/FID - EXTRACTION
EPH C10-C19 (sg)
EPH C19-C32 (sg)
Extractable Petroleum Hydrocarbons (EPH): C10-C19
Extractable Petroleum Hydrocarbons (EPH): C19-C32
Total Extractable Hydrocarbons (TEH): C10-C30

Water (Organic)
Glycols - Water (155)
VA-TM-1113; modified from EPA 8015C
GC/FID - EXTRACTION
Diethylene glycol
Ethylene glycol
Propylene glycol
Triethylene glycol

Water (Organic)
Petroleum Hydrocarbons (PHC) - Water (238)
NA-TM-1112, NA-TP-2100; modified from CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 3511
GC/FID - EXTRACTION
F2: C10-C16
F3: C16-C34
F4: C34-C50

Water (Organic)
Phenols - Water (059)
VA-TM-1101, VA-TP-2113; modified from BC MOE LABORATORY MANUAL and EPA 3510C and EPA 8270D
GC/MS - EXTRACTION
2-Chlorophenol
2-Methylphenol (o-Cresol)
2,3-Dichlorophenol
2,3,4-Trichlorophenol
2,3,4,5-Tetrachlorophenol
2,3,4,6-tetrachlorophenol
2,3,5-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4,5-Trichlorophenol
2,4,6-trichlorophenol
2,6-Dichlorophenol

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3-Chlorophenol
3,4-Dichlorophenol
3,4,5-Trichlorophenol
3,5-Dichlorophenol
4-Chloro-3-methylphenol
4-Chlorophenol
4-Methylphenol (p-Cresol)
m-Cresol
Pentachlorophenol
Phenol

Water (Organic)
Polycyclic Aromatic Hydrocarbons (PAH) - Water (237)
NA-TM-1112, VA-TP-2128; modified from EPA 3511 and EPA 8270D
GC/MS - EXTRACTION
1-Methylnaphthalene
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b,j)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3 - cd)pyrene
Naphthalene
Phenanthrene
Pyrene
Quinoline

Water (Organic)
Resin and Fatty Acids - Water (212)
VA-TM-1105, VA-TP-2114; modified from EPA 3510C and EPA 8270D
GC/MS/LIQUID-LIQUID EXTRACTION
12-Chlorodehydroabietic acid
14-Chlorodehydroabietic acid
Abietic acid
Arachidic acid
Behenic acid
Dehydroabietic acid
Dichlorodehydroabietic acid
Dodecanoic acid (Lauric acid)
Hexadecanoic acid (Palmitic acid)

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Isopimaric acid + Palustric acid
Levopimaric acid
Lignoceric acid
Linoleic acid
Linolenic acid (Octadecadienoic acid)
Myristic acid (Tetradecanoic Acid)
Neoabietic acid
Oleic acid
Pimaric acid
Sandaracopimaric acid
Stearic acid (Octadecanoic acid)

Water (Organic)
Total Polychlorinated Biphenyls (PCB) - Water (115)
VA-TM-1115, VA-TP-2116; modified from EPA 3510C and EPA 3620C and EPA 3660B and EPA 3665A and EPA 8082A
GC/ECD - EXTRACTION
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Total PCB

Water (Organic)
Volatile Hydrocarbons (VH) - Water (197)
NA-TM-1102; modified from BC MOE LABORATORY MANUAL and CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD and EPA 5021A
GC/FID - HEADSPACE
F1: C6-C10
Volatile Hydrocarbons (VH): C6-C10

Water (Organic)
Volatile Organic Compounds (VOC) - Water (196)
NA-TM-1102, NA-TP-2102; modified from EPA 5021A and EPA 8260C
GC/MS - HEADSPACE
1,1-Dichloroethane
1,1-Dichloroethylene
1,1,1-Trichloroethane
1,1,1,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene

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1,3,5-Trimethylbenzene
1,4-Dichlorobenzene
4-isopropyltoluene (p-Cymene)
Acetone (2-Propanone)
Benzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane (Ethyl Chloride)
Chloroform
Chloromethane (Methyl chloride)
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dichloromethane
Ethylbenzene
Ethylene Dibromide
Isopropylbenzene (Cumene)
m,p-Xylene
Methyl ethyl ketone
Methyl isobutyl ketone (MIBK)
Methyl t-butyl ether
n-Propylbenzene
Naphthalene
o-Xylene
Styrene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl chloride

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CALA
Canadian Association for
Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 2800
Laboratory Name: Nautilus Environmental-Calgary
Parent Institution: Nautilus Environmental Company Inc.
Address: #4, 6125 12th St. S.E. Calgary AB T2H 2K1
Contact: Ms. Tamara Pomeroy
Phone: (403) 253-7121
Fax: (403) 252-9363
Email: tamara@nautilusenvironmental.ca; tanya@nautilusenvironmental.ca

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: September 12, 2019
Valid To: November 25, 2021

Scope of Accreditation

Solids (Toxicology)
Chironomids - Solids [Sediment] (013)
WTR-ME-026; EPS 1/RM/32
SURVIVAL AND GROWTH
Freshwater midge Chironomus dilutus (formerly Chironomus tentans) (10d)

Solids (Toxicology)
Hyalella azteca - Solids [Sediment] (014)
WTR-ME-021; EPS 1/RM/33
SURVIVAL AND GROWTH
Freshwater Amphipod Hyalella Azteca (14d)

Water (Microbiology)
Microcystins - Water (058)
WTRQ-ME-016; ENZYME-LINKED IMMUNOSORBENT ASSAY FOR THE CONGENER-INDEPENDENT DETERMINATION OF MICROCYSTINS & NODULARINS IN WATER SAMPLES
ELISA
Microcystins

Water (Toxicology)
Ceriodaphnia dubia - Water (006)
WTR-ME-018; EPS 1/RM/21
SURVIVAL AND REPRODUCTION
Ceriodaphnia dubia

Water (Toxicology)
Daphnia magna - Water (002)
WTR-ME-015; EPS 1/RM/11 and EPS 1/RM/14
ACUTE LETHALITY (SURVIVAL)
Daphnia LC50 (48 h)

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Daphnia Single Concentration (48h)

Water (Toxicology)
Fathead Minnow - Water (007)
WTR-ME-046; EPS 1/RM/22
GROWTH AND SURVIVAL
Fathead minnow (Pimephales promelas)

Water (Toxicology)
Hyalella azteca - Water (059)
WTR-ME-065; EPS 1/RM/33
SURVIVAL AND GROWTH
Hyalella azteca

Water (Toxicology)
Lemna minor - Water (017)
WTR-ME-030; EPS 1/RM/37
GROWTH INHIBITION
Freshwater macrophyte (Lemna minor)

Water (Toxicology)
Microtox - Water (003)
SOIL-ME-001; EPS 1/RM/24
BIOLUMINESCENCE
Microtox IC50 (15 min)

Water (Toxicology)
Pseudokirchneriella subcapitata - Water (008)
WTR-ME-034; EPS 1/RM/25
GROWTH INHIBITION
Freshwater alga (Pseudokirchneriella subcapitata)

Water (Toxicology)
Rainbow Trout - Water (001)
WTR-ME-041; EPS 1/RM/13 and EPS 1/RM/9
ACUTE LETHALITY (SURVIVAL)
Single Concentration (96h)
Trout LC50 (96 h)

Water (Toxicology)
Rainbow Trout [pH Stabilization] - Water (057)
WTR-ME-062; EPS 1/RM/13 and EPS 1/RM/50
ACUTE LETHALITY (pH STABILIZATION)
Single Concentration (96h)
Trout LC50 (96h)

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Canadian Association for
Laboratory Accreditation Inc.

CALA Directory of Laboratories

Membership Number: 2635
Laboratory Name: Taiga Environmental Laboratory
Parent Institution: Government of Northwest Territories (GNWT)
Address: P.O. Box 1320 4601 - 52nd Avenue Yellowknife NT X1A 2L9
Contact: Mr. Bruce Stuart
Phone: (867) 767-9235
Fax: (867) 920-8740
Email: bruce_stuart@gov.nt.ca; taiga@gov.nt.ca; Glen_hudy@gov.nt.ca

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: All Interested Parties
Revised On: December 11, 2019
Valid To: March 5, 2022

Scope of Accreditation

Solids (Inorganic)
Moisture - Solids [Soil] (030)
TEL007; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GRAVIMETRIC
Percent Moisture

Solids (Organic)
BTEX - Solids [Soil] (072)
TEL038; modified from EPA 502.2 and EPA 5030B and EPA 602
GC/MS - PURGE AND TRAP
Benzene
Ethylbenzene
m,p-Xylene
o-Xylene
Toluene

Solids (Organic)
Purgeable Hydrocarbons - Solids [Soil] (074)
TEL056; CCME CWS PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD
GC/FID - PURGE AND TRAP
F1: C6-C10

Water (Inorganic)
Alkalinity - Water (066)
TEL060:PC TITRATE; modified from SM 2320 A and SM 2320 B
AUTO TITRIMETRIC
Alkalinity (pH 4.5)

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Water (Inorganic)
Ammonia Nitrogen - Water (089)
TEL068; modified from SM 4500-NH3 G
COLORIMETRIC - DISCRETE
Ammonia

Water (Inorganic)
Anions - Water (059)
TEL055; modified from SM 4110 B
ION CHROMATOGRAPHY
Chloride
Fluoride
Nitrate
Nitrite
Sulfate

Water (Inorganic)
Biochemical Oxygen Demand (BOD) - Water (004)
TEL019; modified from SM 5210 A and SM 5210 B
D.O. METER
BOD (5 day)
CBOD (5 day)

Water (Inorganic)
Carbon - Water (029)
TEL033; modified from SM 5310 B
INFRARED
Organic Carbon

Water (Inorganic)
Cations - Water (042)
TEL055; modified from SM 4110 B
ION CHROMATOGRAPHY
Calcium
Magnesium
Potassium
Sodium

Water (Inorganic)
Chemical Oxygen Demand (COD) - Water (061)
TEL016; modified from SM 5220 D
REFLUX - COLORIMETRIC
COD

Water (Inorganic)
Colour - Water (063)
TEL051; modified from SM 2120 C
SPECTROPHOTOMETRIC
Apparent Colour
True Colour

Water (Inorganic)
Conductivity - Water (068)
TEL059:PC TITRATE; modified from SM 2510 B
AUTO CONDUCTIVITY METER
Conductivity (25˚C)

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Water (Inorganic)
Dissolved Metals - Water (013)
TEL035; modified from EPA 200.8
ICP/MS
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Cesium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Manganese
Molybdenum
Nickel
Rubidium
Selenium
Silver
Strontium
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc

Water (Inorganic)
Mercury - Water (080)
TEL062; modified from EPA 245.7
ATOMIC FLUORESCENCE
Mercury

Water (Inorganic)
Oil and Grease - Water (060)
TEL024: HEM; modified from EPA 1664A (REVISION A)
GRAVIMETRIC - EXTRACTION
Total Oil and Grease

Water (Inorganic)
pH - Water (067)
TEL058:PC TITRATE; modified from SM 4500-H+ A and SM 4500-H+ B
AUTO - pH METER
pH

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Water (Inorganic)
Phosphate - Water (087)
TEL069; modified from SM 4500-P F
COLORIMETRIC - DISCRETE
Phosphate

Water (Inorganic)
Reactive Silica - Water (090)
TEL070; modified from SM 4500-SI F
COLORIMETRIC - DISCRETE
Reactive Silica

Water (Inorganic)
Solids - Water (011)
TEL008, TEL009; modified from SM 2540 C and SM 2540 D
GRAVIMETRIC
Total Dissolved Solids
Total Suspended Solids

Water (Inorganic)
Total and Dissolved Nitrogen - Water (086)
TEL066; modified from ASTM D5176-91 and ISO 11905
PYROLYSIS - CHEMILUMINESCENCE
Dissolved Nitrogen
Total Nitrogen

Water (Inorganic)
Total and Dissolved Phosphorus - Water (088)
TEL069; modified from SM 4500-P F
COLORIMETRIC - DISCRETE
Dissolved Phosphorus
Total Phosphorus

Water (Inorganic)
Total Metals - Water (054)
TEL035; modified from EPA 200.8
ICP/MS
Aluminum
Arsenic
Barium
Beryllium
Boron
Cadmium
Cesium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Manganese
Mercury
Molybdenum

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Nickel
Rubidium
Selenium
Silver
Strontium
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc

Water (Inorganic)
Turbidity - Water (028)
TEL006; modified from SM 2130 B
NEPHELOMETRY
Turbidity

Water (Microbiology)
Coliforms - Water (045)
TEL053; modified from IDEXX QUANTI-TRAY
MOST PROBABLE NUMBER (QUANTI-TRAY)
Escherichia coli
Total Coliforms

Water (Microbiology)
Fecal (Thermotolerant) Coliforms - Water (041)
TEL017; modified from SM 9222 D
MEMBRANE FILTRATION (mFC)
Fecal (Thermotolerant) Coliforms

Water (Microbiology)
Fecal Streptococci - Water (055)
TEL053; modified from IDEXX QUANTI-TRAY
MOST PROBABLE NUMBER (QUANTI-TRAY)
Fecal streptococci

Water (Organic)
BTEX - Water (070)
TEL037:BTEX; modified from EPA 502.2 and EPA 5030B and EPA 602
GC/MS - PURGE AND TRAP
Benzene
Ethylbenzene
m,p-Xylene
o-Xylene
Toluene

Water (Organic)
Extractable Hydrocarbons - Water (085)
TEL067; modified from EPA 3510C and EPA 3630C and SM 6010
GC/FID - SOLID PHASE EXTRACTION
C10-C50

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Water (Organic)
Purgeable Hydrocarbons - Water (084)
TEL044; modified from EPA 5030 and EPA 8000 and EPA 8015 and EPA 8260B
GC/FID - PURGE AND TRAP
C6-C10

Water (Organic)
Trihalomethanes (THM) - Water (077)
TEL039:THM; modified from EPA 502.2 and EPA 5030B and EPA 602
GC/MS - PURGE AND TRAP
Bromodichloromethane
Bromoform
Chlorodibromomethane
Chloroform

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Appendix D: Licence Part J, Schedule Excerpt

Part J: Conditions Applying to Monitoring

1) The Licensee shall undertake the Monitoring Program as per Tables 1 and 2 of Schedule J.

2) The Licensee shall provide the GPS co-ordinates, in degrees, minutes and seconds of latitude and longitude, of all locations where sources of Water are utilized for all purposes.

3) The Licensee shall determine the GPS co-ordinates, in degrees, minutes and seconds of latitude and longitude, of all locations where Wastes associated with the Project are deposited.

4) All sampling, sample preservation and analyses shall be conducted in accordance with the most recent edition of Standard Methods for the Examination of Water and Wastewater, or by such other methods approved by an Analyst.

5) All compliance analyses shall be performed in an accredited laboratory according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.

6) The Licensee shall implement the Water Quality Monitoring Plan and Quality Assurance/Quality Control Plan (March 2016) and Monitoring and Inspection Schedule (March 2016), previously approved by the Board.

7) The Licensee shall, within ninety (90) days following the approval of the Licence, submit to the Board for review updated Plan(s) referred to in Part J, Item 6 to reflect changes in operations. Where applicable (i.e., QA/QC measures), proposed changes shall be submitted to an accredited laboratory for approval.

8) Additional monitoring requirements may be requested by the Inspector.

9) The Licensee shall include in the Annual Report required under Part B, Item 2, all data, monitoring results and information required by this Part and the associated Schedule.

10) The Licensee shall submit to the Board for approval any requests for change(s) to the Monitoring Program as outlined in Part J and Schedule J, including justification for the change(s). The NWB may modify the Monitoring Program under Schedule J without an Amendment to the Licence.

11) The Licensee shall undertake inspections of the Tailings Containment Area, to include at a minimum:

    a. During active Closure Phase and Care and Maintenance Phase, inspections shall be carried out on a bi weekly basis during freshet (approx. May and June), and monthly during the remainder of the open water period (approx. July to October) of the following:

        i. Seepage from Dams.

        ii. Water levels in ponds/cells.

        iii. General surface erosion, tension cracks, and/or anomalies on dams; and

        iv. Records of these inspections shall be kept for review upon the request of an Inspector, or as otherwise approved by the Board. More frequent inspections shall be performed at the request of an Inspector.

    b. More frequent inspections shall be performed at the request of an Inspector

12) The Licensee shall, during active Closure Phase and prior to Post Closure, undertake annual inspection of the Tailings Containment Area, during ice free, open-water conditions by a Geotechnical Engineer. The Engineer's report shall be submitted to the Board within sixty (60) days following the inspection and shall include a cover letter from the Licensee outlining an implementation plan to respond to the Engineer's recommendations.

13) The Licensee shall, within one (1) year following the approval of the Licence, submit to the Board for approval a Post Closure Monitoring Plan in accordance with requirements in Schedule J.

14) The Licensee shall undertake the Post Closure Monitoring Program as per the Post Closure Monitoring Plan referred to in Part J, Item 13.

Schedule J: Conditions Applying to Monitoring

1) As set out in Part B, Item 20 during the development of the Post Closure Monitoring Plan and subsequently during post closure monitoring, the Licensee will consult with community members and organizations in Kugluktuk, and will include in the Annual Report referred to in Part B, Item 2, and provided to the Board, a summary of these community consultations.

2) The Post Closure Monitoring Plan referred to in Part J, Item 13, shall include:

   a. An updated framework for annual reporting requirements as required by Schedule B, Item 2.

   b. A review of historical data and estimate of waste rock quantities use across the Site for construction of dams and other permanent structures.

   c. Existing and Future Instrumentation Monitoring.

   d. Monitoring Program Table 1 and 2 applicable to Post Closure Phase.

   e. Dam stability monitoring.

   f. TCA monitoring.

   g. Thresholds for water quality and tailings cover performance that would trigger moving to reduced monitoring frequency or intensity.

   h. Monitoring of the TCA cover and water quality over a period that is sufficient to demonstrate physical and chemical stability and acceptable quality for the long term.